



**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*  
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## **Electromagnetic Compatibility Criteria Test Report**

For the

**Carlson Wireless Technologies, Inc.  
TB 4.9**

Tested under

**The FCC Verification Rules  
Contained in Title 47 of the CFR, Part 90, Subpart Y  
for Private Land Mobile Radio Services**

**MET Report: EMCS18723-FCC90**

December 21, 2005

**Prepared For:  
Carlson Wireless Technologies, Inc.  
1180 Evergreen Rd., Suite B  
Redway, CA 95560**

**Prepared By:  
MET Laboratories, Inc.  
33439 Western Ave.  
Union City, California 94587**



Carlson Wireless Technologies, Inc.  
TB 4.9

Electromagnetic Compatibility  
CFR Title 47, Part 90, Subpart Y

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A handwritten signature in black ink, appearing to read "Shawn McMillen".

Shawn McMillen  
Electromagnetic Compatibility Lab

A handwritten signature in blue ink, appearing to read "Cheryl Anicete".

Cheryl Anicete  
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 / is not capable of operation in accordance with the requirements of Part 90, Subpart Y of the FCC Rules under normal use and maintenance.

A handwritten signature in blue ink, appearing to read "Tony Permsombut".

Tony Permsombut, Manager  
Electromagnetic Compatibility Lab



Carlson Wireless Technologies, Inc.  
TB 4.9

Electromagnetic Compatibility  
Report Status Sheet  
CFR Title 47, Part 90, Subpart Y

## Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	December 21, 2005	Initial Issue.



## Table of Contents

<b>1. Testing Summary .....</b>	<b>1</b>
<b>2. Equipment Configuration.....</b>	<b>2</b>
<b>2.1. Overview .....</b>	<b>2</b>
<b>2.2. Test Site .....</b>	<b>2</b>
<b>2.3. Description of Test Sample .....</b>	<b>2</b>
<b>2.4. Equipment Configuration.....</b>	<b>3</b>
<b>2.5. Support Equipment .....</b>	<b>3</b>
<b>2.6. Ports and Cabling Information .....</b>	<b>3</b>
<b>2.7. Mode of Operation .....</b>	<b>5</b>
<b>2.8. Method of Monitoring EUT Operation .....</b>	<b>5</b>
<b>2.9. Modifications .....</b>	<b>5</b>
<b>2.9.1. Modifications to EUT .....</b>	<b>5</b>
<b>2.9.2. Modifications to Test Standard .....</b>	<b>5</b>
<b>2.10. Disposition of EUT .....</b>	<b>5</b>
<b>3. Electromagnetic Compatibility RF Power Output Requirements.....</b>	<b>6</b>
<b>3.1. Peak Power Output.....</b>	<b>7</b>
<b>4. Electromagnetic Compatibility Modulation Characteristics Requirements.....</b>	<b>10</b>
<b>4.1. Modulation Characteristics .....</b>	<b>10</b>
<b>5. Electromagnetic Compatibility Occupied Bandwidth Requirements.....</b>	<b>11</b>
<b>5.1. Occupied Bandwidth (Emission Masks) .....</b>	<b>11</b>
<b>6. Electromagnetic Compatibility Spurious Emissions at Antenna Terminal Requirements .....</b>	<b>14</b>
<b>6.1. Spurious Emissions at Antenna Terminals.....</b>	<b>14</b>
<b>7. Electromagnetic Compatibility Radiated Emissions Requirements .....</b>	<b>22</b>
<b>7.1. Radiated Emissions (Substitution Method) .....</b>	<b>22</b>
<b>8. Electromagnetic Compatibility Frequency Stability Requirements .....</b>	<b>25</b>
<b>8.1. Frequency Stability .....</b>	<b>25</b>
<b>9. Electromagnetic Compatibility Transient Frequency Behavior Requirements .....</b>	<b>27</b>
<b>9.1. Transient Frequency Behavior .....</b>	<b>27</b>
<b>10. Electromagnetic Compatibility Criteria for Unintentional Radiators .....</b>	<b>28</b>
<b>10.1. Conducted Emissions Limits.....</b>	<b>28</b>
<b>10.2. Radiated Emissions Limits.....</b>	<b>32</b>
<b>11. Test Equipment .....</b>	<b>35</b>
<b>12. RF Exposure Requirements .....</b>	<b>36</b>
<b>13. Certification Label &amp; User's Manual Information .....</b>	<b>37</b>
<b>13.1. Verification Information .....</b>	<b>37</b>
<b>13.2. Label and User's Manual Information .....</b>	<b>41</b>

All references to section numbers are taken directly from the standard/specification used. Only sections requiring testing or evaluation are included.



## List of Tables

Table 1. Equipment Configuration.....	3
Table 2. Support Equipment.....	3
Table 3. Ports and Cabling Information .....	3
Table 4. Temperature Vs. Frequency Test Results.....	26
Table 5. Frequency vs. Voltage Test Results .....	26
Table 6. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.107(a) (b).....	28
Table 7. Conducted Emissions - Voltage, AC Power, Phase Line (110 VAC, 60 Hz).....	29
Table 8. Conducted Emissions - Voltage, AC Power, Neutral Line (110 VAC, 60 Hz).....	29
Table 9. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b) .....	32
Table 10. Radiated Emissions Limits Test Results .....	33

## List of Figures

Figure 1. Block Diagram of Test Configuration (Radiated Emissions).....	4
Figure 2. Block Diagram of Test Configuration (RF) .....	4
Figure 3. RF Power Output Test Setup .....	6
Figure 4. PPSD Test Setup .....	9
Figure 5. Occupied Bandwidth (Emission Mask) Test Setup.....	13
Figure 6. Spurious Emissions at Antenna Terminals Test Setup.....	21

## List of Photographs

Photograph 1. Radiated Emission Spurious Test Setup.....	24
Photograph 2. Conducted Emissions Test Setup .....	31
Photograph 3. Radiated Emission Limits Test Setup .....	34



## List of Terms and Abbreviations

<b>AC</b>	Alternating Current
<b>ACF</b>	Antenna Correction Factor
<b>Cal</b>	Calibration
<b>d</b>	Measurement Distance
<b>dB</b>	Decibels
<b>dB<math>\mu</math>A</b>	Decibels above one microamp
<b>dB<math>\mu</math>V</b>	Decibels above one microvolt
<b>dB<math>\mu</math>A/m</b>	Decibels above one microamp per meter
<b>dB<math>\mu</math>V/m</b>	Decibels above one microvolt per meter
<b>DC</b>	Direct Current $\mu$
<b>E</b>	Electric Field
<b>DSL</b>	Digital Subscriber Line
<b>ESD</b>	Electrostatic Discharge
<b>EUT</b>	Equipment Under Test
<b>f</b>	Frequency
<b>FCC</b>	Federal Communications Commission
<b>GR-1089-CORE</b>	( <b>GR</b> ) General Requirement(s) imposed by the NEBS standard, ( <b>CORE</b> ) Central Office Recovery Express (AT&T), ( <b>I089</b> ) specifies various parts of the General Requirements under Bellcore Technical Standard, Requirements for Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment
<b>GRP</b>	Ground Reference Plane
<b>H</b>	Magnetic Field
<b>HCP</b>	Horizontal Coupling Plane
<b>Hz</b>	Hertz
<b>IEC</b>	International Electrotechnical Commission
<b>kHz</b>	kilohertz
<b>kPa</b>	kilopascal
<b>kV</b>	kilovolt
<b>LISN</b>	Line Impedance Stabilization Network
<b>MHz</b>	Megahertz
<b><math>\mu</math>H</b>	microhenry
<b><math>\mu</math></b>	microfarad
<b><math>\mu</math>s</b>	microseconds
<b>NEBS</b>	Network Equipment-Building System
<b>PRF</b>	Pulse Repetition Frequency
<b>RF</b>	Radio Frequency
<b>RMS</b>	Root-Mean-Square
<b>TWT</b>	Traveling Wave Tube
<b>V/m</b>	Volts per meter
<b>VCP</b>	Vertical Coupling Plane



## 1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 90, Subpart Y. All tests were conducted using measurement procedure ANSI TIA/EIA-603-A-2004.

Type of Submission/Rule Part:	Certification / Part 90 Subpart Y		
EUT:	TB 4.9		
FCC ID:	OPA-TB49		
Equipment Code:	TNB		
Type of Modulation:	QPSK		
Emission Designator:	16M6D7D		
Power Limit:	For High Power Device only		
RF Power Output:	Highest Conducted Output Power: Peak 16.42dBm (43.8mW) Avg 13.97dBm (24.9mW)		
EUT Operating Frequency range(MHz):	4950 - 4980		

Title 47 of the CFR, Part 90, Subpart Y, and FCC 04-265 Reference and Test Description	Conformance			Comments
	Yes	No	N/A	
<i>Yes - Equipment complies with the Requirement No - Equipment does not comply with the Requirement N/A - Not applicable to the equipment under tests</i>				
2.1046; 90.1215(a) Peak Power Output	✓			Measured emissions below applicable limits.
2.1046; 90.1215(a) Peak Power Spectral Density	✓			Measured emissions below applicable limits.
2.1047(a) Modulation Characteristics			✓	EUT is non-voice, data only.
2.1049; 90.210(L) Occupied Bandwidth (Emission Mask)	✓			Measured emissions below applicable limits.
2.1051; 90.210(L) Spurious Emissions at Antenna Terminals	✓			Measured emissions below applicable limits.
2.1053; 90.210(L) Radiated Spurious Emissions	✓			Measured emissions below applicable limits.
2.1055(a) (1); 90.213 Frequency Stability over Temperature Variations	✓			Measured emissions below applicable limits.
2.1055(d) (2) Frequency Stability over Voltage Variations	✓			Measured emissions below applicable limits.
90.214 Transient Frequency Behavior			✓	EUT operating frequency is at 4.9 GHz.



## 2. Equipment Configuration

### 2.1. Overview

MET Laboratories, Inc. was contracted by Carlson Wireless Technologies, Inc. to perform testing on the TB 4.9 under purchase order number 10611 and 10610.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Carlson Wireless Technologies, Inc., TB 4.9.

An EMC evaluation to determine compliance of the TB 4.9 with the requirements of Part 90, Subpart Y, was conducted. (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 TB4.9. Carlson Wireless Technologies, Inc. should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been **permanently** discontinued.

The results obtained relate only to the item(s) tested.

<b>Model(s) Tested:</b>	TB 4.9
<b>Model(s) Covered:</b>	TB, TL, TB Star series all equate to TB 4.9. The RC 4.9 is a TB radio module concatenated in a card cage.
<b>EUT Specifications:</b>	Primary Power: 120 VAC, 60 Hz
	Secondary Power: N/A
	Highest Clock Frequency: 4980 MHz
<b>Evaluated by:</b>	Shawn McMillen
<b>Date(s):</b>	December 21, 2005

### 2.2. Test Site

All testing was performed at MET Laboratories, Inc., 4855 Patrick Henry Drive, Building 6, Santa Clara, California 95054. 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 in a 10 meter semi-anechoic chamber (equivalent to an Open Area Test Site). 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 Carlson Wireless Technologies, Inc., TB 4.9 is a licensed radio module that operates in the 4940-4990 MHz band. The EUT operates as an up-link in a point to point or point to multipoint topology providing a DS1 or multiple DS0s.



## 2.4. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Part Number	Serial Number	Rev. #
A	TB radio modules	J1210HPL	N/A	100332	N/A
B	Gabriel Antenna 4.90-5.2 GHz	EPD1-49	N/A	N/A	N/A

Table 1. Equipment Configuration

## 2.5. Support Equipment

Carlson Wireless Technologies, Inc. supplied support equipment necessary for the operation and testing of the TB 4.9. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
C	Laptop	Dell	Inspiration 600m	N/A
D	Spectrum Analyzer	Agilent	E4407B (1S2460)	N/A
E	Power Meter	Anritsu	ML2488A (1S2430)	N/A
F	Attenuator	Weinschel	N/A	N/A
G	50ohms Terminator	N/A	N/A	N/A

Table 2. Support Equipment

\* - The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.

## 2.6. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded (Yes/No)	Termination Box ID & Port ID
Conducted Measurement						
1	A, PWR Input	AC PWR cord	1	1.5	No	AC PWR Source
2	A, Console	DB9, RS232	1	1	Yes	C
Unintentional						
1	A, PWR Input	AC PWR cord	1	1.5	No	AC PWR Source
2	A, GND	10 AWG cable	1	2	No	GND

Table 3. Ports and Cabling Information

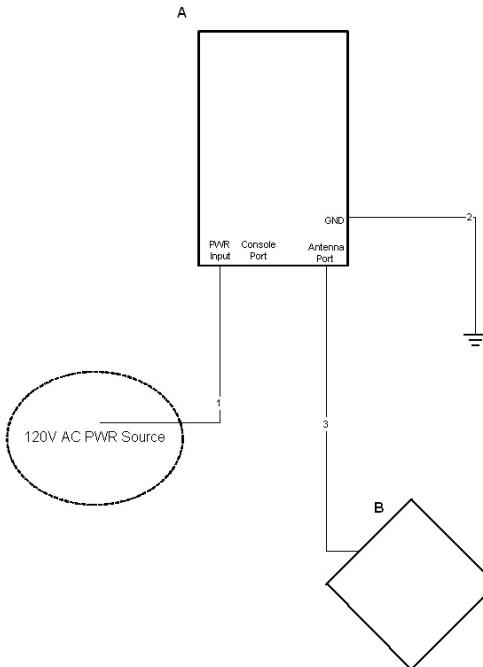


Figure 1. Block Diagram of Test Configuration (Radiated Emissions)

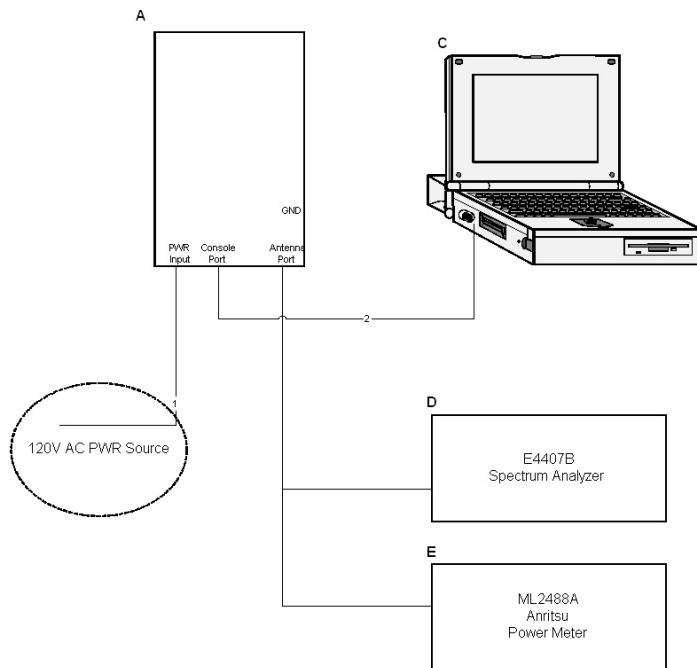


Figure 2. Block Diagram of Test Configuration (RF)



## 2.7. Mode of Operation

The EUT was operated in the following manner:  
Units link up in a point-to-point or point-to-multipoint topology providing a DS1 or multiple DS0s.

## 2.8. Method of Monitoring EUT Operation

Performance of the EUT was monitored in the following manner:  
System has two red LEDs that will not extinguish if a fault condition exists and a serial/ip port providing alarms indications.

## 2.9. Modifications

### 2.9.1. Modifications to EUT

No modifications were made to the EUT.

### 2.9.2. Modifications to Test Standard

No modifications were made to the test standard.

## 2.10. Disposition of EUT

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



### 3. Electromagnetic Compatibility RF Power Output Requirements

#### 3.1. Peak Power Output

**Test Requirement(s):** §2.1046 and §90.1215(a) with FCC 04-265 (High Power Devices)

**Test Procedures:** As required by 47 CFR 2.1046, *RF power output measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected through a Directional Coupler to a Spectrum Analyzer to monitor the frequency and to a Power Meter to measure the Peak and Average power. The EUT power was adjusted enough to produce maximum output power as specified in the owner's manual. The output power was then recorded with peak and average reading. Measurements were made at the low, mid and high channels.

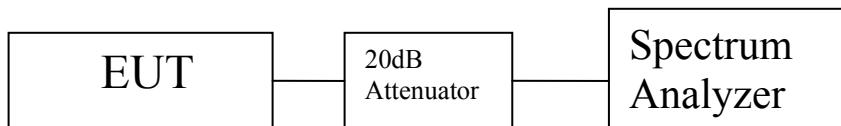
**Test Results:** Equipment complies with 47CFR 2.1046 and 90.1215(a) with FCC 04-265 (Low Power Devices). The EUT does not exceed 20dBm peak power at the carrier frequency.

All RF Power output measurements were direct connection to RF output Terminal of EUT from a Power Meter.

RF Power Output		
Frequency (MHz)	Measured Peak Power (dBm)	Measured Average Power (dBm)
4950	16.00	13.90
4960	16.12	13.85
4980	16.42	13.97

**Test Engineer(s):** Shawn McMillen

**Test Date(s):** November 22, 2005



**Figure 3. RF Power Output Test Setup**



### 3.2. Peak Power Spectral Density

**Test Requirement(s):** §90.1215(a) with FCC 04-265 (Low Power Devices)

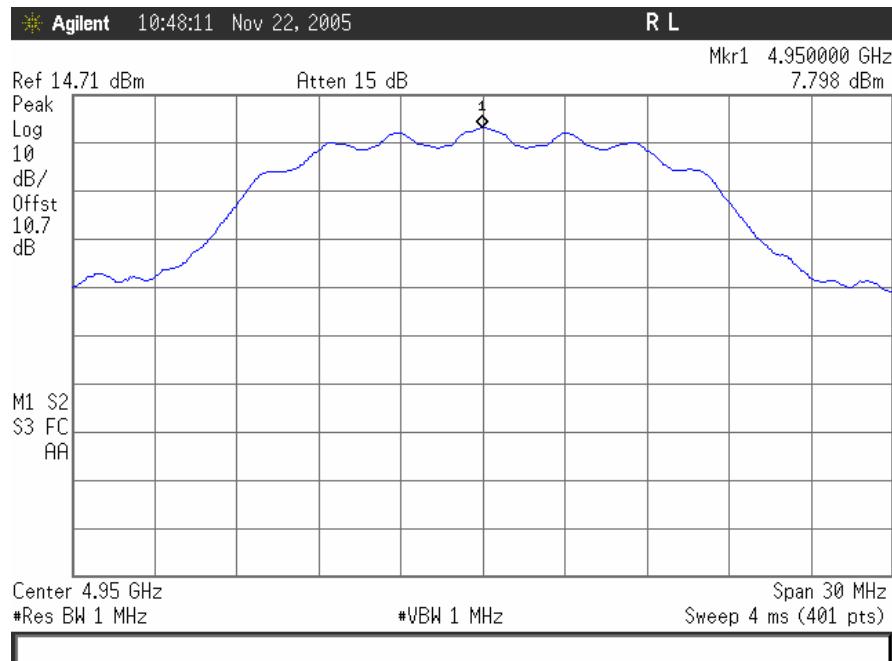
**Test Procedures:** As required by 47 CFR 2.1046, *RF power output measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer in order to measure the power level. The Spectrum Analyzer was set to a RBW = VBW = 1 MHz. The EUT power was adjusted at the maximum output power level. The max hold key from the Spectrum Analyzer was activated capturing the modulated envelope of the EUT. The Peak Power Spectral Density was then recorded. Measurements were made at the low, mid and high channels.

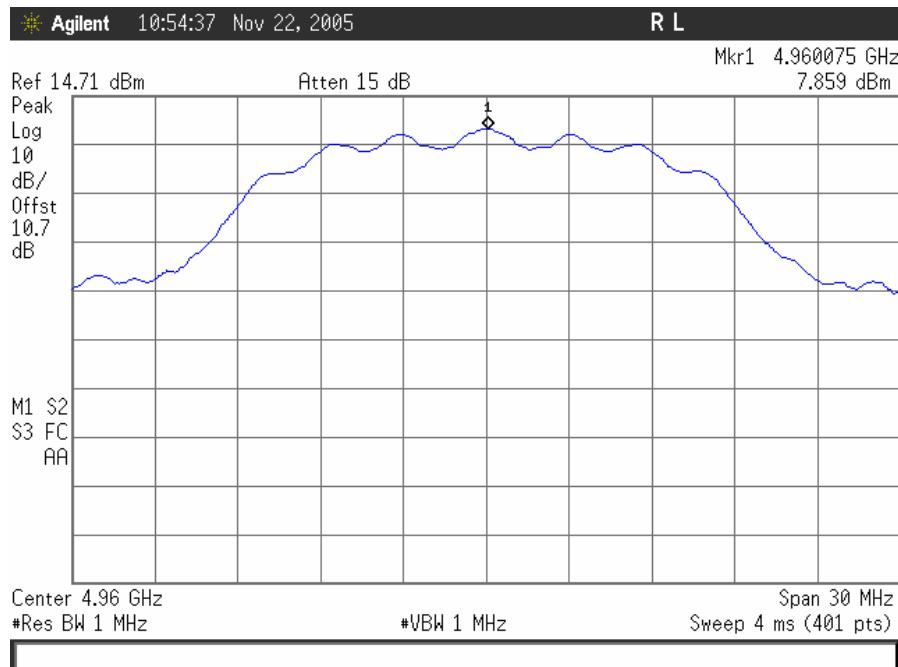
**Test Results:** Equipment complies with 47 CFR 2.1046 and 90.1215(a) with FCC 04-265 (Low Power devices). The EUT does not exceed 8dBm/MHz peak power spectral density at the carrier frequency.

The following pages show measurements of Peak Power Spectral Density plots which is recorded below:

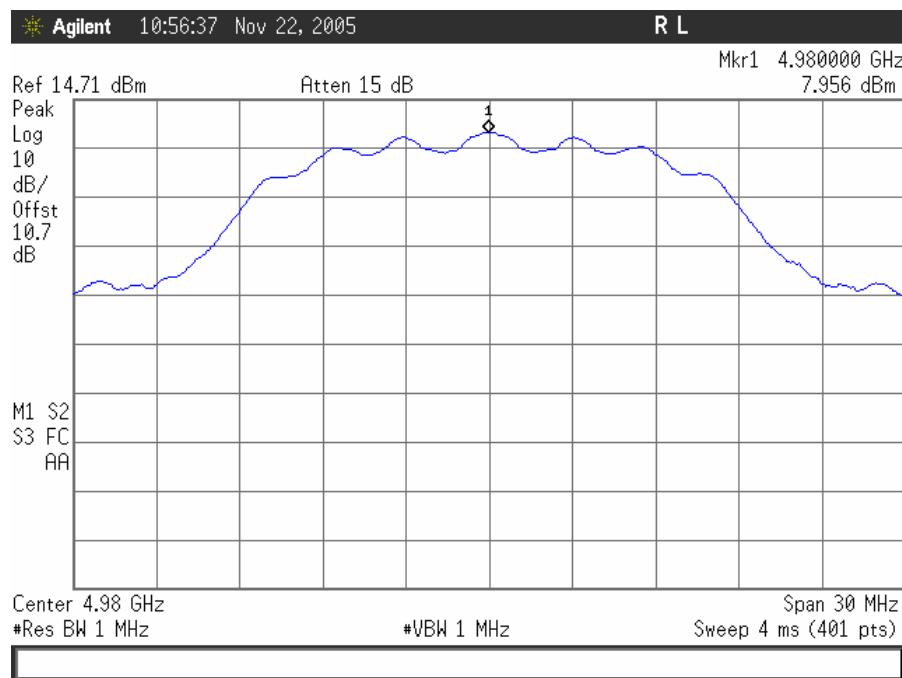
Peak Power Spectral Density				
Plot #	Frequency (MHz)	EUT Channel Bandwidth (MHz)	Measured Power Spectral Density (dBm)	Limit (dBm)
1	4950	20	7.798	8
2	4960	20	7.859	8
3	4980	20	7.956	8



**Plot 1. PPSD Low Ch**



**Plot 2. PPSD Mid Ch BW**



Plot 3. PPSD High Ch

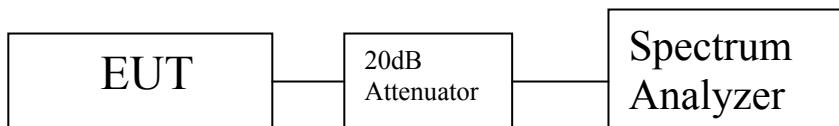


Figure 4. PPSD Test Setup



## 4. Electromagnetic Compatibility Modulation Characteristics Requirements

### 4.1. Modulation Characteristics

**Test Requirement(s):** §2.1047

**Test Procedures:** As required by 47 CFR 2.1047, *Modulation Characteristics measurements* were made at the RF output terminals.

**Test Results:** EUT is not required for this test.  
The EUT contain no analog voice circuitry.



## 5. Electromagnetic Compatibility Occupied Bandwidth Requirements

### 5.1. Occupied Bandwidth (Emission Mask)

**Test Requirement(s):** §2.1049 and §90.210 (L) with FCC 04-265 (Emissions Mask L)

**Test Procedures:** As required by 47 CFR 2.1049, *occupied bandwidth measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter monitoring the power output level.

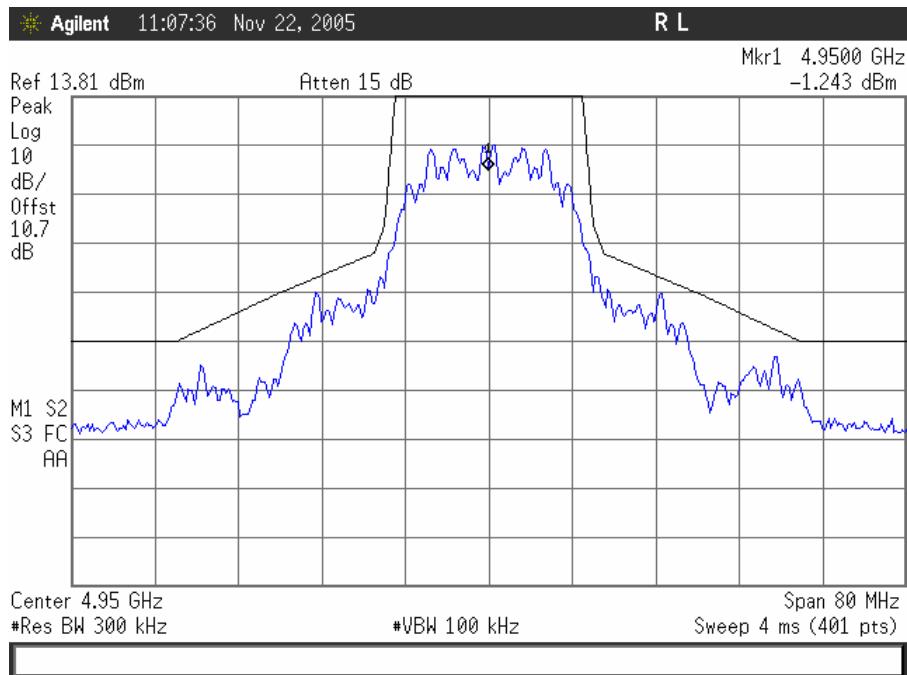
A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer and a Power Meter to monitor the output power level. The measured highest Average Power was set relative to zero dB reference. The RBW of the Spectrum Analyzer was set to at least 1% of the channel bandwidth which is 20MHz. The EUT power was adjusted at the maximum output power level. Measurements were carried out at the low, mid and high channels of the TX band.

**Test Results:** Equipment complies with Section 2.1049 and 90.210(L) with FCC 04-265 (Emission Mask L). The EUT does not exceed the Emission Masks limit.

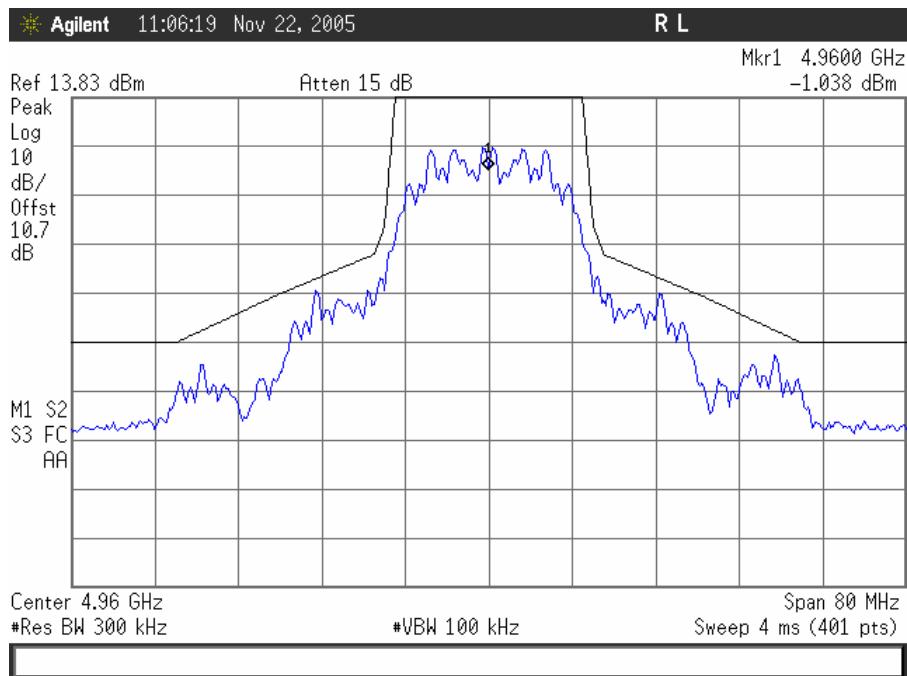
The following pages show measurements of Emission Mask plots:

**Test Engineer(s):** Shawn McMillen

**Test Date(s):** November 22, 2005



Plot 4. Emission Mask Low Ch



Plot 5. Emission Mask Mid Ch



Plot 6. Emission Mask High Ch

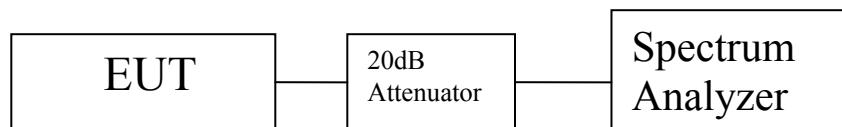


Figure 5. Occupied Bandwidth (Emission Mask) Test Setup



## 6. Electromagnetic Compatibility Spurious Emissions at Antenna Terminal Requirements

### 6.1. Spurious Emissions at Antenna Terminals

**Test Requirement(s):** §2.1051 and §90.210(L) with FCC 04-265 (Emission Mask M)

**Test Procedures:** As required by 47 CFR 2.1051, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

A laptop was connected to EUT to control the RF power output and frequency channel. The EUT was connected to a Spectrum Analyzer and a Power Meter to monitor the output power level. The Spectrum Analyzer was set to sweep 30 MHz and up to 10<sup>th</sup> harmonic of the fundamental or 40GHz which ever is the lesser. Measurements were made at the low, mid and high channels.

For frequencies 1-18GHz, measurements were made at coupler port of a 20dB directional coupler. The output of the coupler was terminated by a 50Ω load. For frequencies 18-40GHz a HP11970A and HP11970K harmonic mixer was used. Each harmonic mixer was fed with a SMA to wave guide adapter.

The Conducted Spurious Emissions *Limit* is obtained by the following:

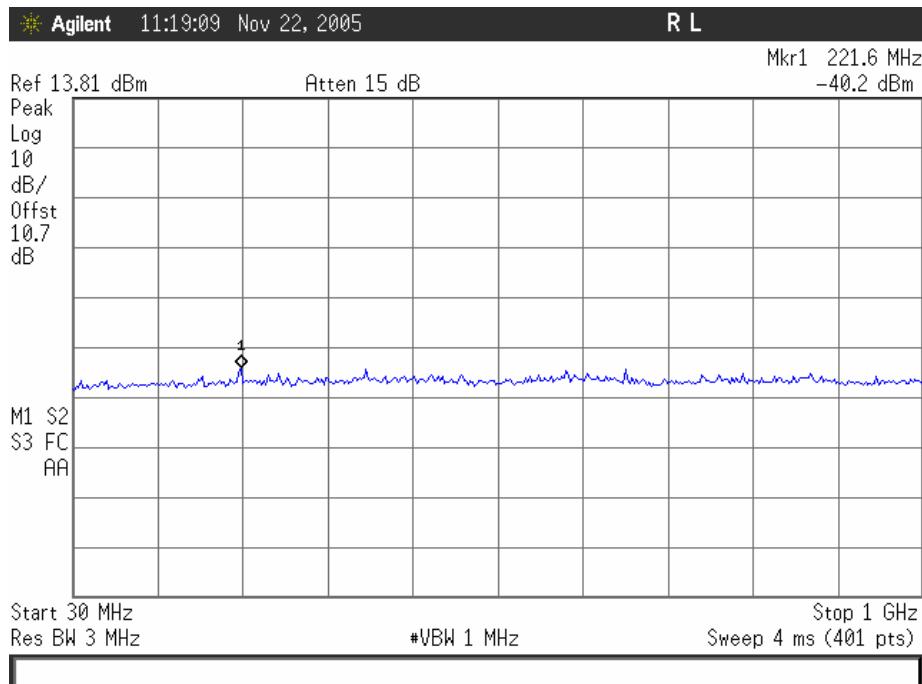
Measured Average Power Output of EUT: 13.97dBm

Spurious limit = 13.97dBm – 50 dB = – 36.03dBm

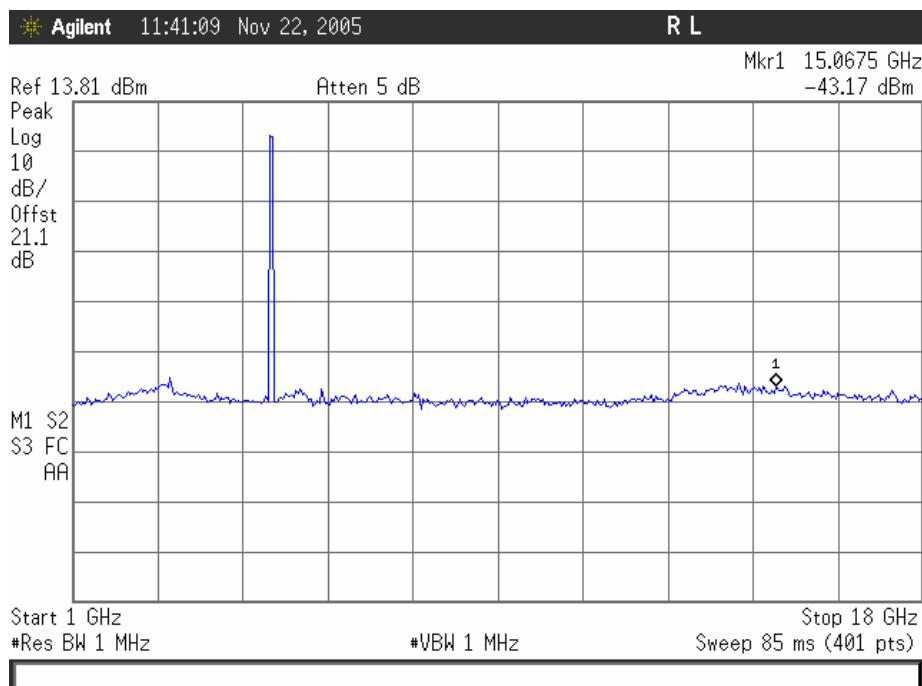
**Test Results:** Equipment complies with Section 2.1051 and 90.210(L) with FCC 04-265 (Emission Mask L).

**Test Engineer(s):** Shawn McMillen

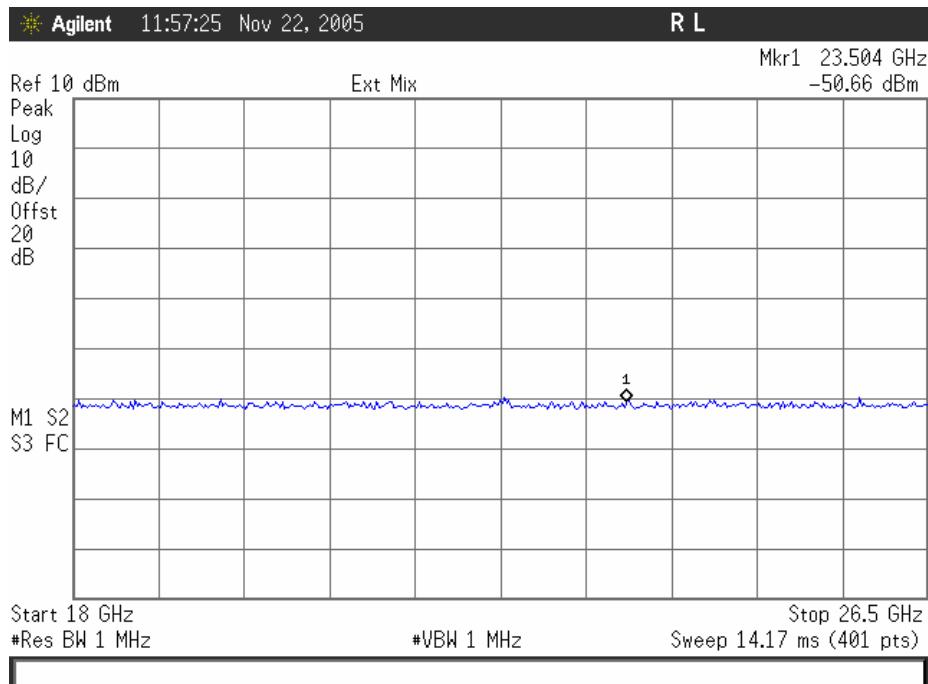
**Test Date(s):** November 22, 2005



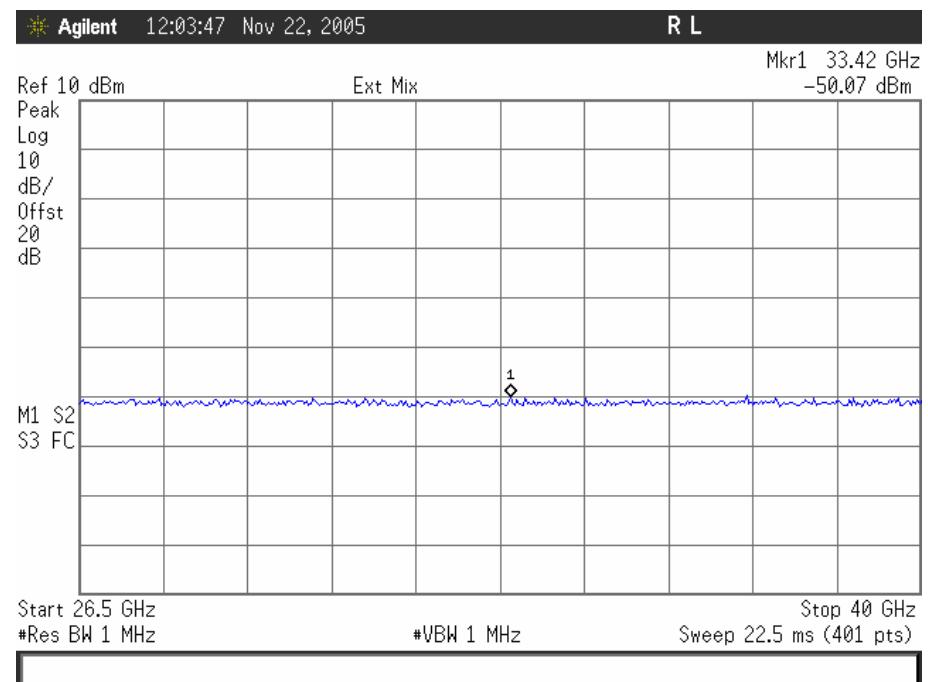
Plot 7. Conducted Spurious Emissions low Ch (30MHz – 1GHz)



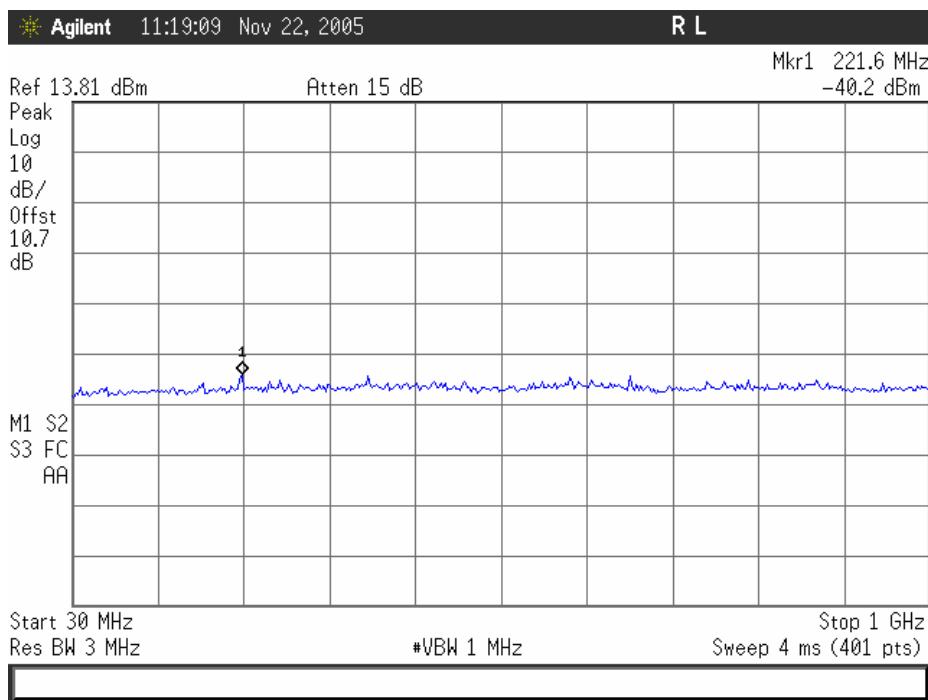
Plot 8. Conducted Spurious Emissions Low Ch (1GHz – 18GHz)



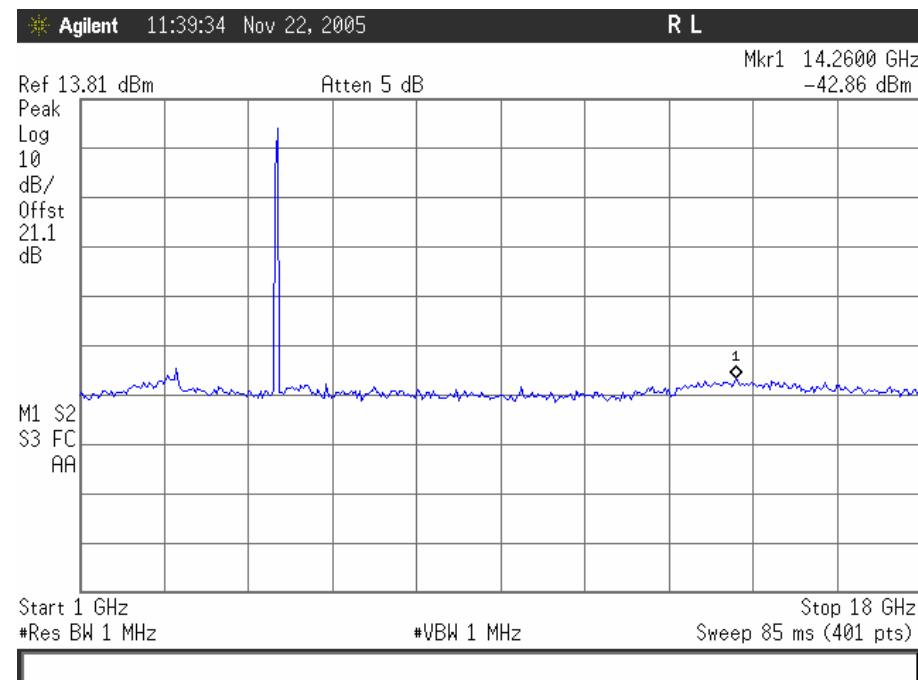
**Plot 9. Conducted Spurious Emissions Low Ch (18GHz - 26.5GHz)**



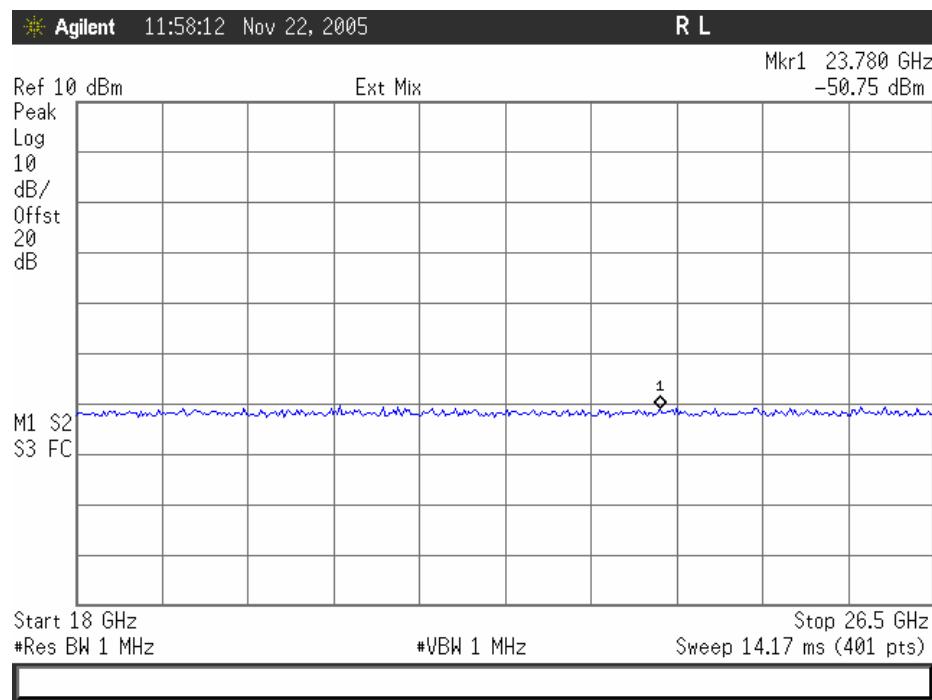
**Plot 10. Conducted Spurious Emissions Low Ch (26.5 – 40GHz)**



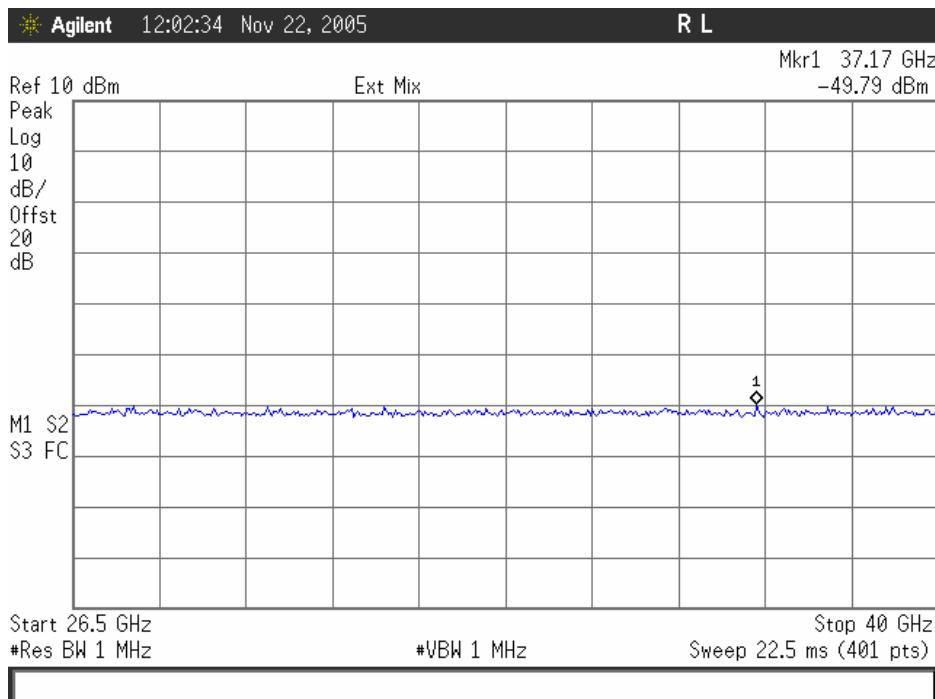
Plot 11. Conducted Spurious Emissions Mid Ch (30MHz – 1GHz)



Plot 12. Conducted Spurious Emissions Mid Ch (1GHz – 18GHz)



Plot 13. Conducted Spurious Emissions Mid Ch (18MHz – 26.5GHz)

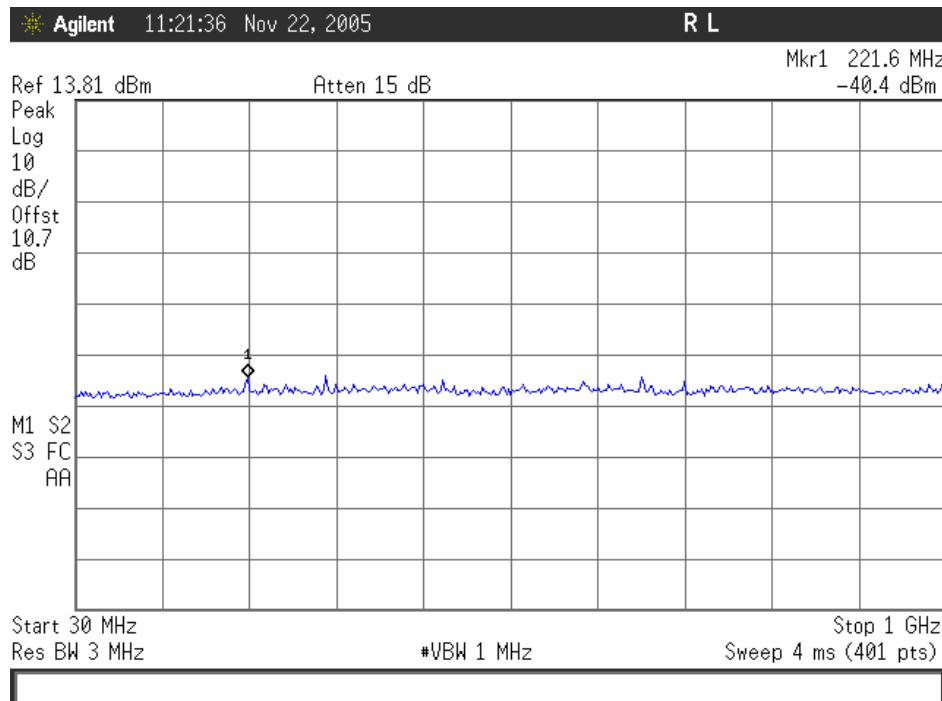


Plot 14. Conducted Spurious Emissions Mid Ch (26.5GHz – 40GHz)

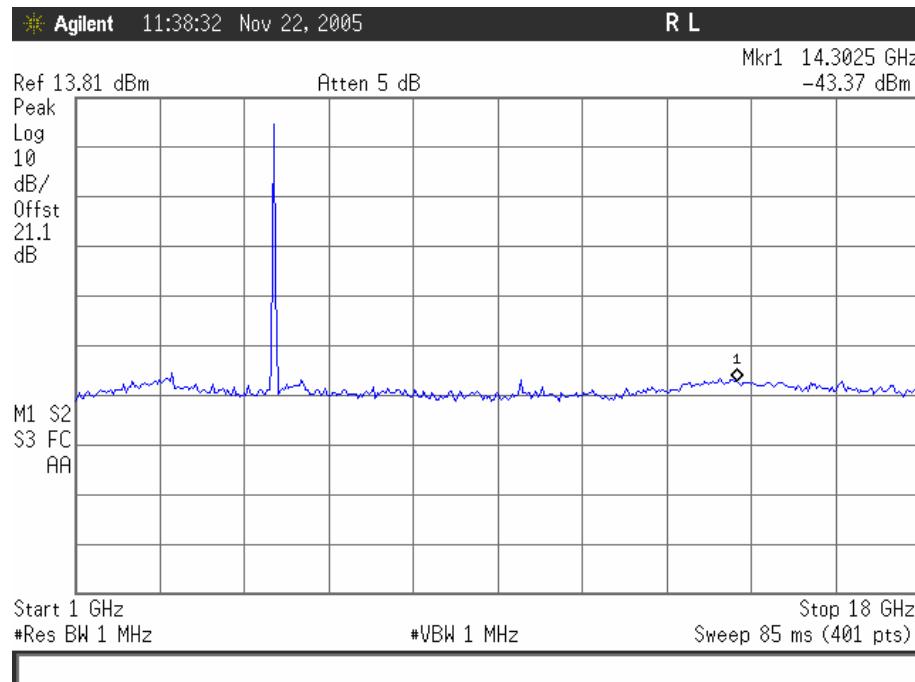


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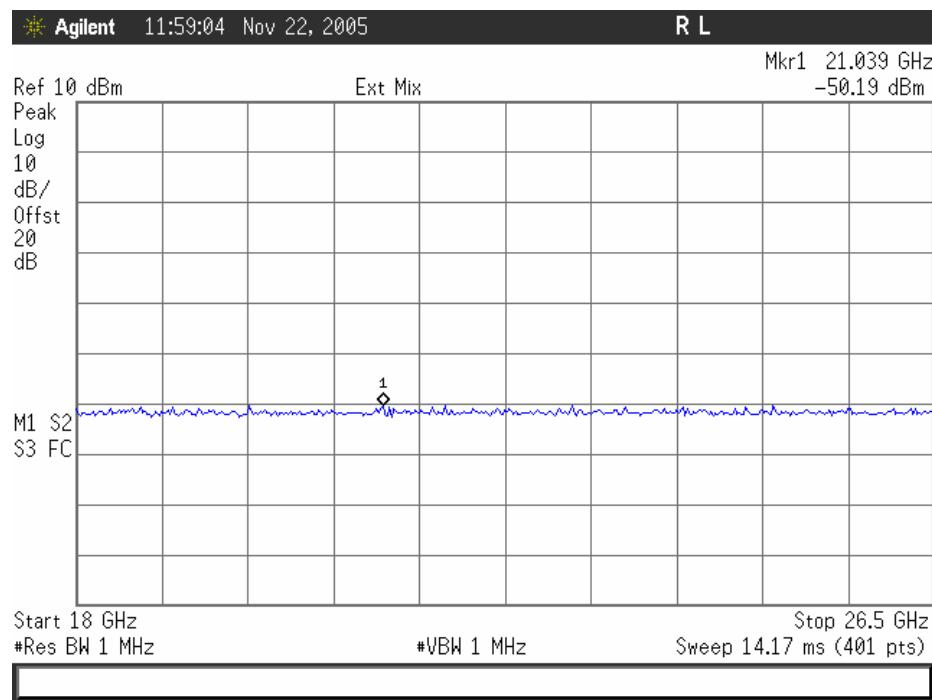
Electromagnetic Compatibility  
Spurious Emissions at Antenna Terminal Requirements  
CFR Title 47, Part 90, Subpart Y



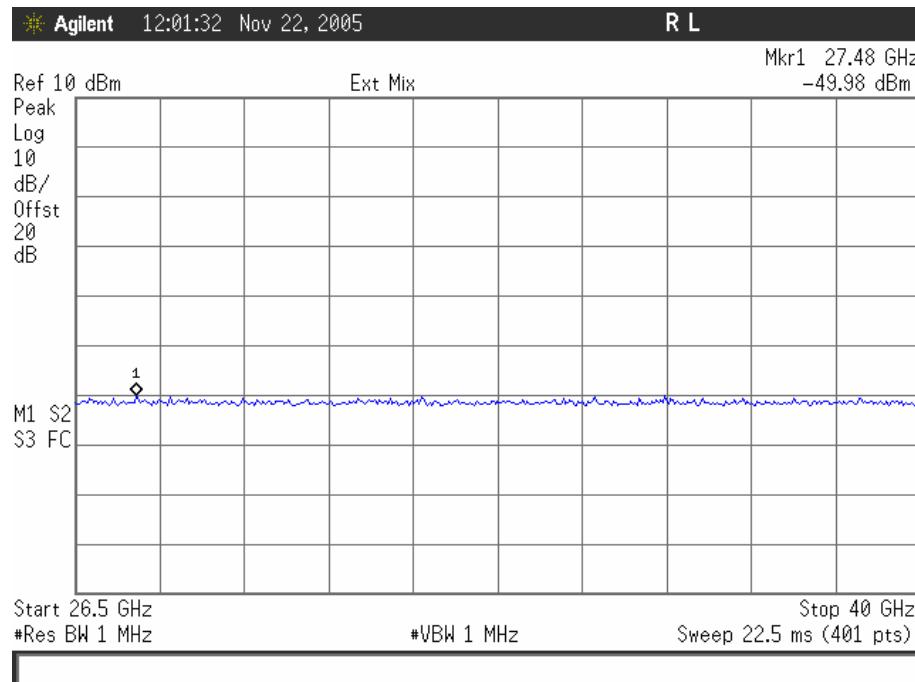
**Plot 15. Conducted Spurious Emissions High Ch (30MHz – 1GHz)**



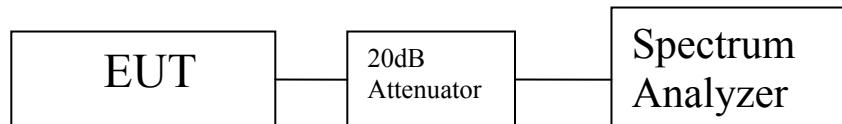
**Plot 16. Conducted Spurious Emissions High Ch (1GHz – 18GHz)**



**Plot 17. Conducted Spurious Emissions High Ch (18GHz – 26.5GHz)**



**Plot 18. Conducted Spurious Emissions High Ch (26.5GHz – 40GHz)**



**Figure 6. Spurious Emissions at Antenna Terminals Test Setup**



## 7. Electromagnetic Compatibility Radiated Emissions Requirements

### 7.1. Radiated Emissions (Substitution Method)

**Test Requirement(s):** §2.1053 and §90.210(L) with FCC 04-265 (Emission Mask L)

**Test Procedures:** As required by 47 CFR 2.1053, *field strength of radiated spurious measurements* were made in accordance with the procedures of TIA/EIA-603-A-2001 "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards".

Radiated emission measurements were performed inside a 10 meter semi-anechoic chamber. The EUT was set at a distance of 3m from the receiving antenna. The EUT's RF ports were terminated to 50ohm load. The EUT was set to transmit at the low, mid and high channels of the transmitter frequency range at its maximum power level. The EUT was rotated about 360° and the receiving antenna scanned from 1-4m in order to capture the maximum emission. A calibrated antenna source was positioned in place of the EUT and the previously recorded signal was duplicated. The maximum EIRP of the emission was calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps were carried out with the receiving antenna in both vertical and horizontal polarization. Harmonic emissions up to the 10<sup>th</sup> or 40GHz, whichever was the lesser, were investigated.

**Test Results:** Equipment complies with Section 2.1053 and 90.210(L) with FCC 04-265 (Emission Mask L).

**Test Engineer(s):** Shawn McMillen

**Test Date(s):** November 22, 2005



## Radiated Emissions (Substitution Method) Test Results

Frequency (MHz)	Polarization V/H	Spectrum Analyzer Reading (dBm)	Substitution antenna power input (dBm)	Tx Ant. Gain (dBi)	EIRP (dBm)
9900	H	-67.3	-49.0	11.9	-37.1
14850	H	-76.5	-55.3	11.8	-43.5

*fo = 4950 MHz*

Frequency (MHz)	Polarization V/H	Spectrum Analyzer Reading (dBm)	Substitution antenna power input (dBm)	Tx Ant. Gain (dBi)	EIRP (dBm)
9920	H	-70.3	-53.1	11.9	-41.2
14880	H	-75.3	-58.2	11.8	-46.4

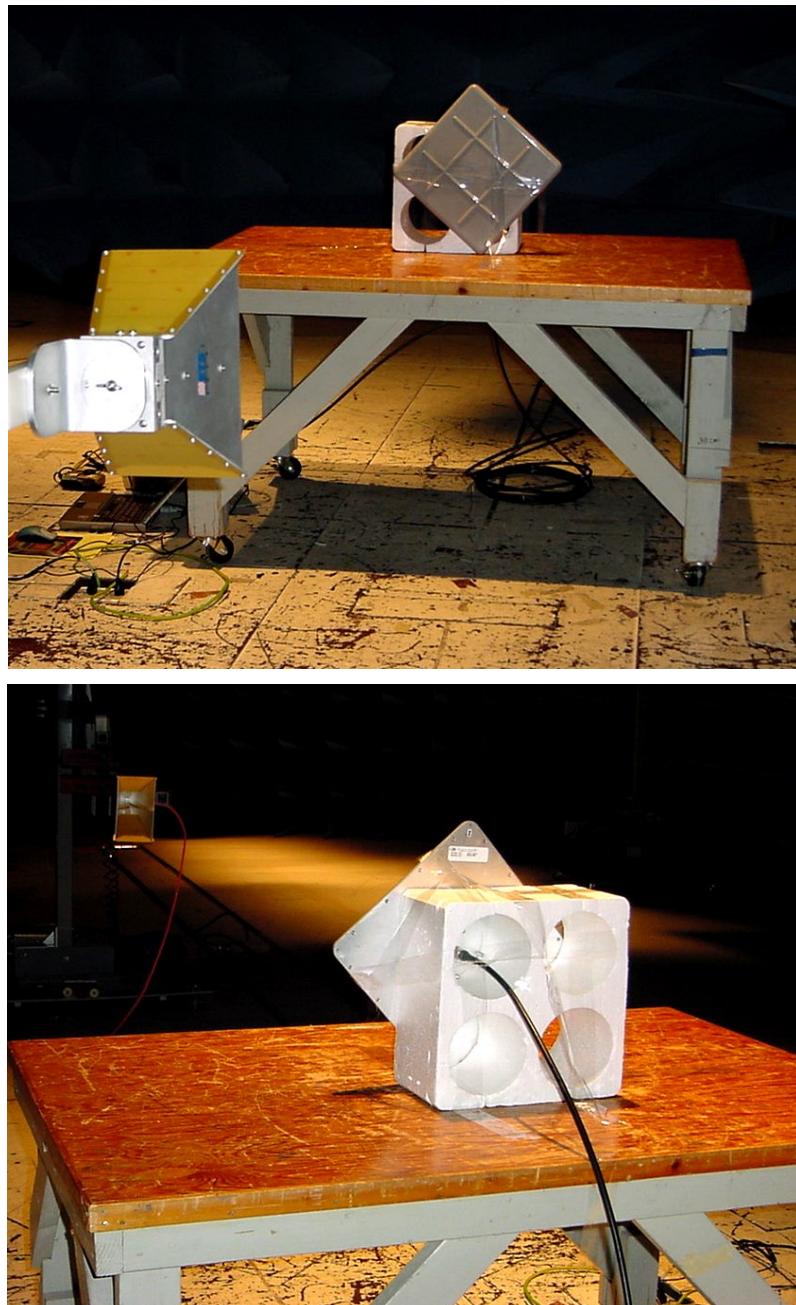
*fo = 4960 MHz*

Frequency (MHz)	Polarization V/H	Spectrum Analyzer Reading (dBm)	Substitution antenna power input (dBm)	Tx Ant. Gain (dBi)	EIRP (dBm)
9960	H	-69.9	-51.6	11.9	-39.7
14940	H	-75.2	-58.4	11.8	-46.6

*fo = 4980 MHz*

Notes: All other emissions were measured at the noise floor of the spectrum analyzer.

## Radiated Emissions Spurious Test Setup



Photograph 1. Radiated Emission Spurious Test Setup



## 8. Electromagnetic Compatibility Frequency Stability Requirements

### 8.1. Frequency Stability

**Test Requirement(s):** §2.1055 and §90.213

**Test Procedures:** As required by 47 CFR 2.1055, *Frequency Stability measurements* were made at the RF output terminals using a Directional Coupler through a Spectrum Analyzer and Power Meter.

The EUT was placed in the Environmental Chamber and support equipments are outside the chamber on a table. The EUT was set to transmitter at a data rate corresponding to 20MHz BW. The frequency counter option on the Spectrum Analyzer was used to measure frequency deviations. The frequency drift was investigated for every  $10^{\circ}\text{C}$  increment until the unit is stabilized then recorded the reading in tabular format with the temperature range of -30 to  $50^{\circ}\text{C}$ .

Voltage supplied to EUT is 120 VAC reference temperature was done at  $20^{\circ}\text{C}$ . The voltage was varied by  $\pm 15\%$  of nominal

**Test Results:** Equipment complies with Section 2.1055 and 90.213

**Test Engineer(s):** Shawn McMillen

**Test Date(s):** November 22, 2005



## Frequency Stability Test Results

Reference Freq.: 4973.770010 MHz at 20°C

Temperature (Celsius)	Measured Freq (MHz)	Drift ppm
50	4973.772635	0.53
40	4973.777273	1.46
30	4973.772601	0.52
20	Reference	
10	4973.775118	1.03
0	4973.771145	0.23
-10	4973.774187	0.84
-20	4973.772190	0.44
-30	4973.770881	0.18

Table 4. Temperature Vs. Frequency Test Results

Reference: 120Vac at 20°C Freq. = 4973.770010 MHz at 20°C

Measured Voltage(dc) +/-15% of nominal	Measured Freq (MHz)	Drift (Hz)
102	4973.770209	0.04
138	4973.776155	1.24

Table 5. Frequency vs. Voltage Test Results



## 9. Electromagnetic Compatibility Transient Frequency Behavior Requirements

### 9.1. Transient Frequency Behavior

**Test Requirement(s):** §90.214

**Test Procedures:** As required by 47 CFR 90.214, *Transient Frequency Behavior measurements* were made at the ON/OFF switch terminal.

**Test Results:** EUT is not required for this test.  
The EUT operating frequency is at 4.9 GHz.



## 10. Electromagnetic Compatibility Criteria for Unintentional Radiators

### 10.1. Conducted Emissions Limits

**Test Requirement(s):** **15.107 (a)** “Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, 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 Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.”

**15.107 (b)** “For a Class A digital device that is designed to be connected to the public utility (AC) power line, 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 Table 6. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.”

Frequency range (MHz)	15.107(b), Class A Limits (dB $\mu$ V)		15.107(a), Class B Limits (dB $\mu$ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
0.15- 0.5	79	66	66 - 56	56 - 46
0.5 - 5.0	73	60	56	46
5.0 - 30	73	60	60	50

Note — The lower limit shall apply at the transition frequencies.

**Table 6. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Section 15.107(a) (b)**

**Test Procedures:**

The EUT was placed on a 0.8m-high wooden table 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 50 $\Omega$ /50 $\mu$ H 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.

**Test Results:**

The EUT was found compliant with the Class A requirement(s) of this section. Measured emissions below applicable limits.

**Test Engineer(s):** Billy Kwan

**Test Date(s):** 12/8/2005



## Conducted Emissions - Voltage, AC Power

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Pass/Fail AVG	Margin (dB) AVG
0.16	44.92	79	PASS	-34.08	35.22	66	PASS	-30.78
10.65	36.82	73	PASS	-36.18	31.98	60	PASS	-28.02
17.06	34.07	73	PASS	-38.93	28.05	60	PASS	-31.95

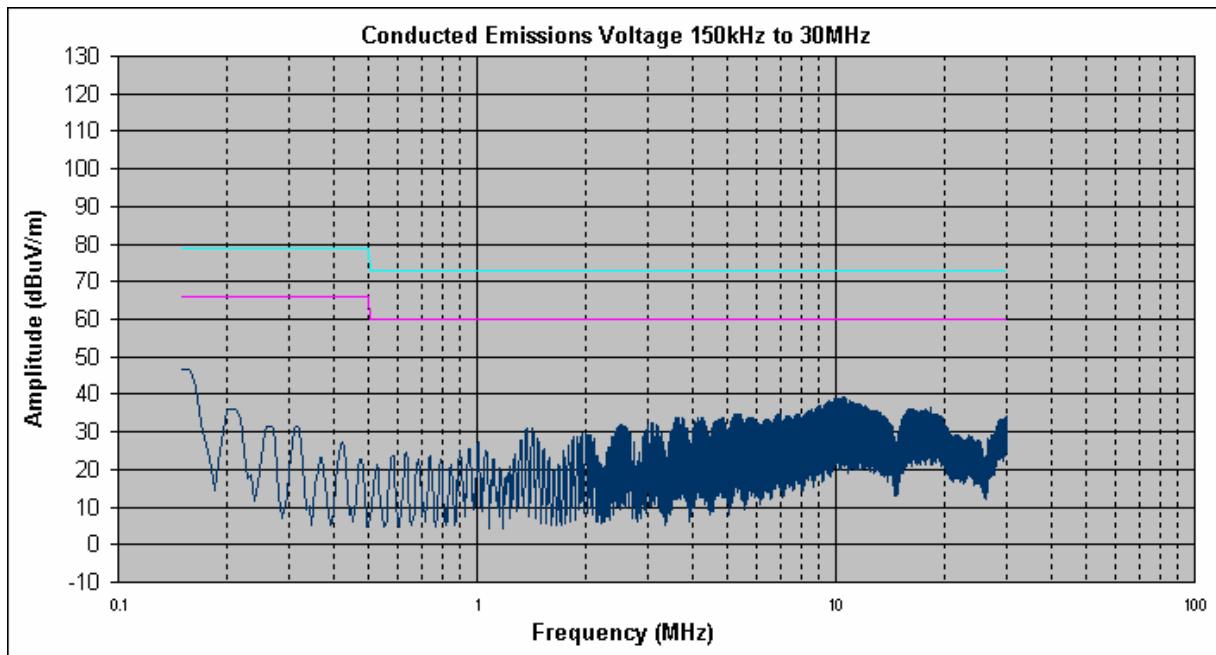
Table 7. Conducted Emissions - Voltage, AC Power, Phase Line (110 VAC, 60 Hz)

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Pass/Fail AVG	Margin (dB) AVG
0.16	45.61	79	PASS	-33.39	38.43	66	PASS	-27.57
9.31	36.07	73	PASS	-36.93	33.1	60	PASS	-26.9
15.152	38.15	73	PASS	-34.85	34.84	60	PASS	-25.16

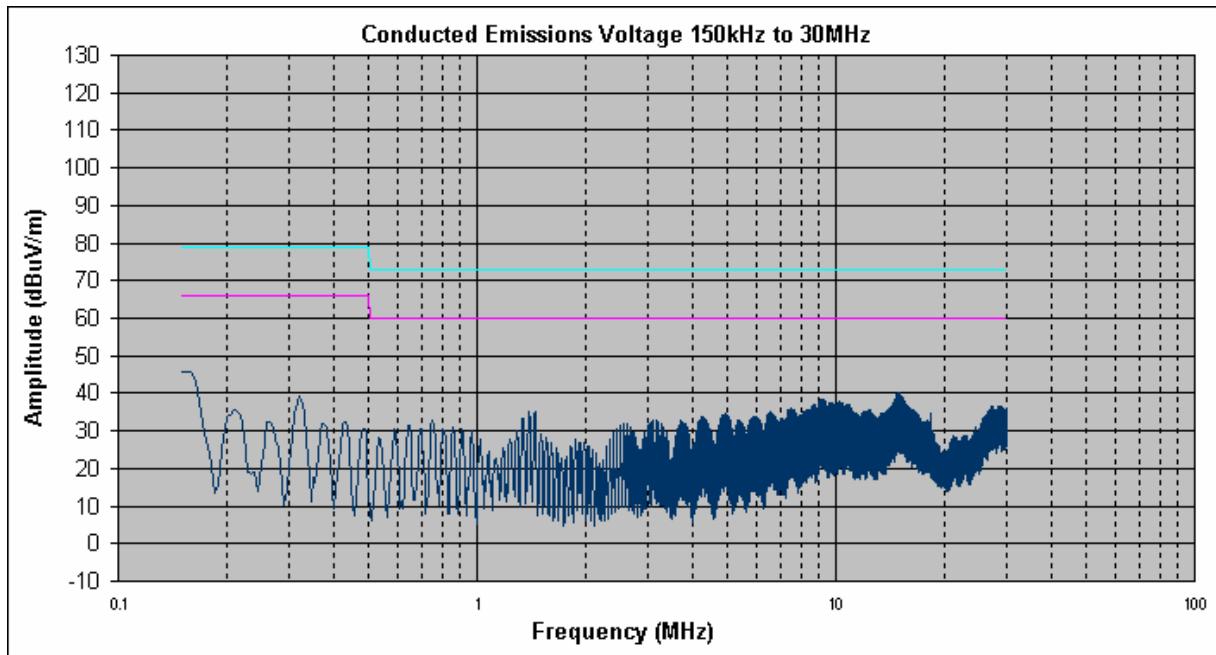
Table 8. Conducted Emissions - Voltage, AC Power, Neutral Line (110 VAC, 60 Hz)



## Conducted Emissions - Voltage, Worst Case Emissions, AC Power

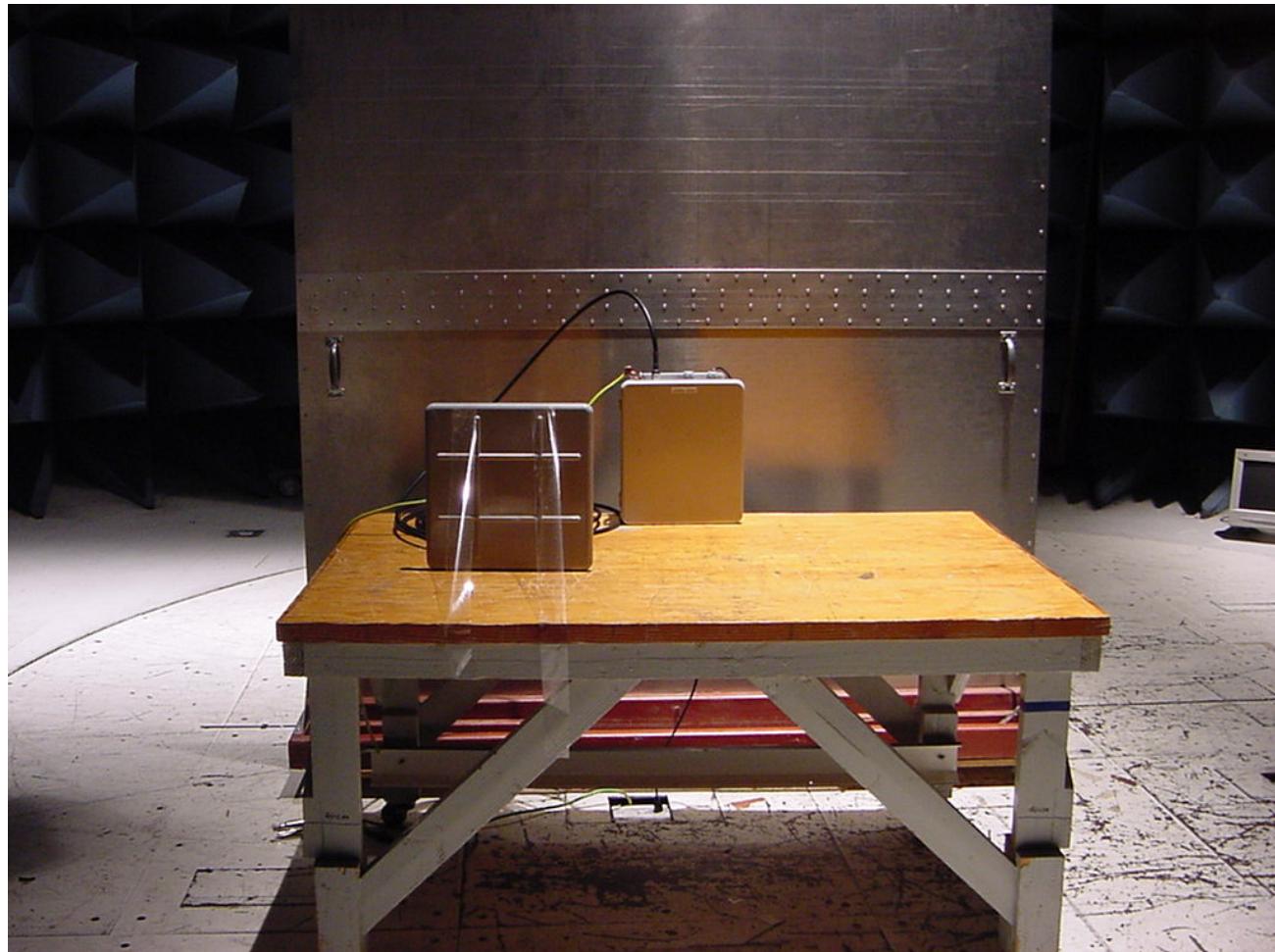


Conducted Emission, Phase Line Plots



Conducted Emission, Neutral Line Plots

## Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions Test Setup



## 10.2. Radiated Emissions Limits

**Test Requirement(s):**

**15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 9.

**15.109 (b)** The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the Class A limits expressed in Table 9.

Frequency (MHz)	Field Strength (dB $\mu$ V/m)	
	§15.109 (b), Class A Limit (dB $\mu$ V) @ 10m	§15.109 (a), Class B Limit (dB $\mu$ V) @ 3m
30 - 88	39.00	40.00
88 - 216	43.50	43.50
216 - 960	46.40	46.00
Above 960	49.50	54.00

**Table 9. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)**

**Test Procedures:**

The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 10 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

**Test Results:**

The EUT was found compliant with the Class A requirement(s) of this section. Measured emissions below applicable limits.

**Test Engineer(s):** Billy Kwan

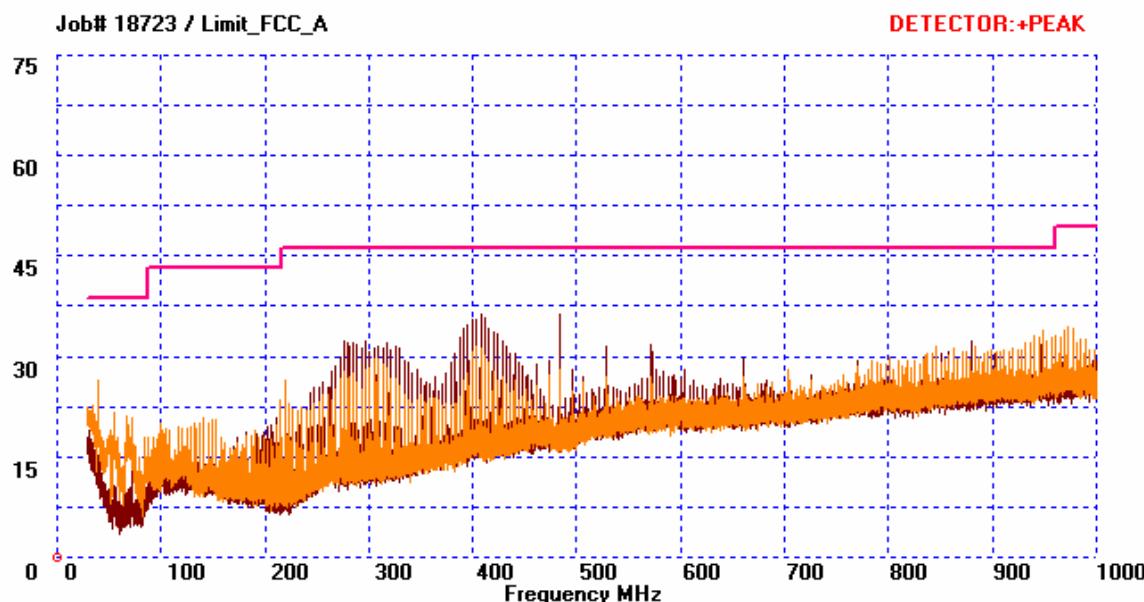
**Test Date(s):** 12/08/2005



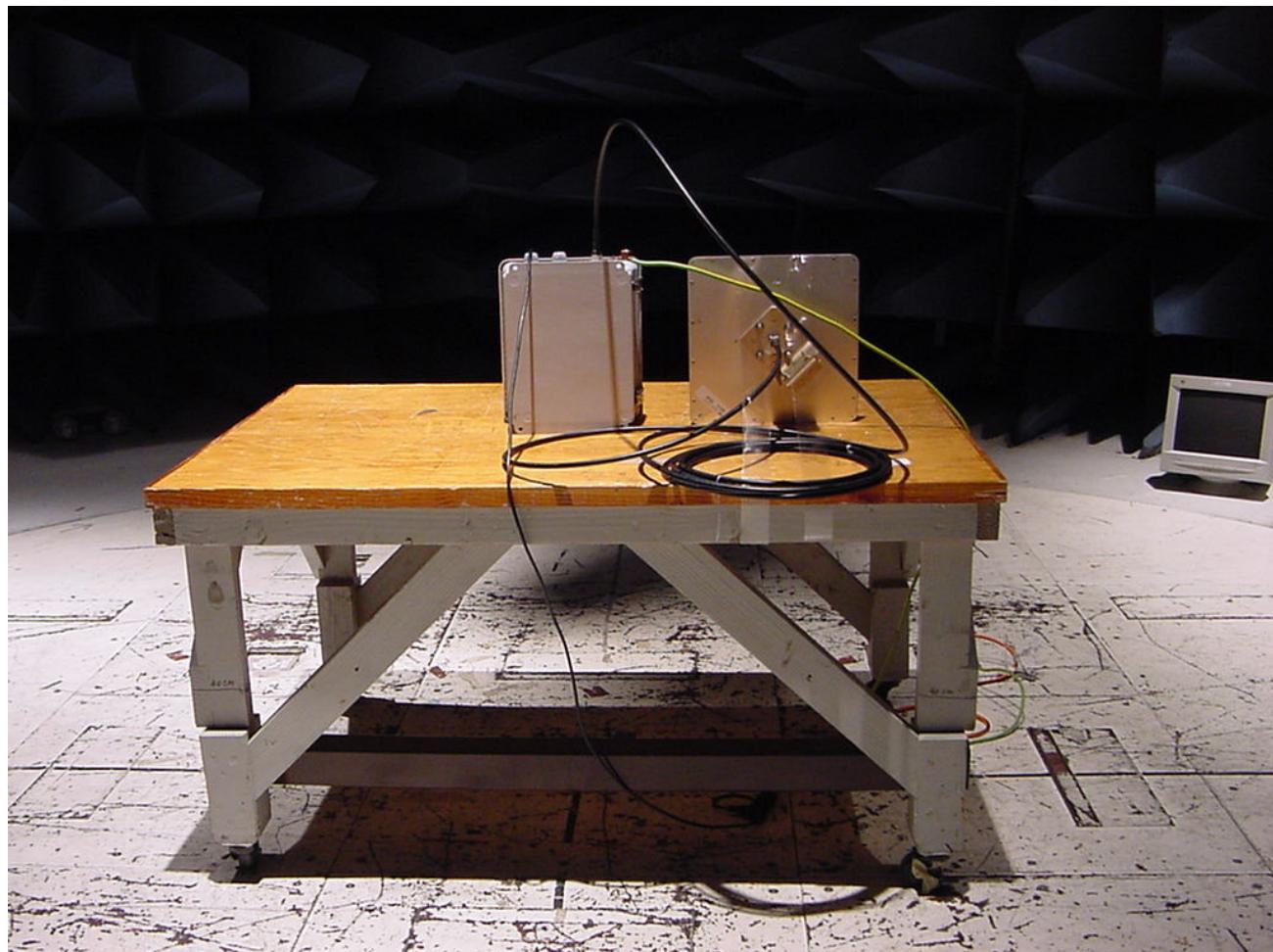
## Radiated Emissions Limits Test Results, Class A

Frequency (MHz)	Antenna Polarity (H/V)	EUT Azimuth (Degrees)	Antenna Height (m)	Uncorrected Amplitude (dBuV)	Antenna Correction Factor (dB/m) (+)	Pre Amp Gain (dB) (-)	Cable Loss (dB) (+)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
38.92	V	116	1	9.67	12.72	0.00	1.01	23.40	39.00	-15.61
284.68	H	327	2.48	17.47	13.17	0.00	2.83	33.47	46.40	-12.93
407.56	H	25	1.76	16.83	15.70	0.00	3.54	36.07	46.40	-10.33
484	H	39	143	17.80	17.05	0.00	3.94	38.79	46.40	-7.61
572	H	234	2.79	10.75	19.08	0.00	4.43	34.26	46.40	-12.14
948.2	V	0	1.4	8.11	21.26	0.00	6.14	35.51	46.40	-10.89

**Table 10. Radiated Emissions Limits Test Results**



## Radiated Emission Limits Test Setup



Photograph 3. Radiated Emission Limits Test Setup



## 11. 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 #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	2/9/2005	2/9/2006
1S2184	BILOG ANTENNA	CHASE	CBL6112A	1/12/2005	1/12/2006
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	10/14/2005	10/14/2006
1S2198	ANTENNA, HORN	EMCO	3115	7/14/2005	7/14/2006
1S2202	ANTENNA, HORN, 1 METER	EMCO	3116	3/23/2005	3/23/2007
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2263	CHAMBER, 10 METER	RANTEC	N2-14	7/25/2005	7/25/2006
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2006
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2006
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2460	Analyzer, Spectrum 9 kHz-40GHz	Agilent	E4407B	07/06/2005	07/06/2008
1S2430	WIDEBAND POWER METER	ANRITSU COMPANY	ML2488A	1/12/2005	1/12/2006
1S2432	WIDEBAND POWER SENSOR	ANRITSU COMPANY	MA2491A	1/12/2005	1/12/2006
1S2034	COUPLER, DIRECTIONAL 1-20 GHz	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2128	Harmonic Mixer	Hewlett Packard	11970A	N/A	3/10/2006
1S2129	Harmonic Mixer	Hewlett Packard	11970K	N/A	3/10/2006

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



## 12. RF Exposure Requirements

**RF Exposure Requirements:** **§90.1217, §1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

**RF Radiation Exposure Limit:** **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit Calculation: EUT's operating frequencies @ 2400-2483.5 MHz; highest conducted power = 16.4dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm<sup>2</sup> or 10 W/m<sup>2</sup>**

EUT maximum antenna gain = 18 dBi.

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

where,  $S$  = Power Density (1 mW/cm<sup>2</sup>)  
 $P$  = Power Input to antenna (43.6mW)  
 $G$  = Antenna Gain (63.1 numeric)

$$R = (43.6 * 63.1 / 4 * 3.14 * 1.0)^{1/2} = (2751.1 / 12.56)^{1/2} = 14.7\text{cm}$$



## 13. Certification Label & User's Manual Information

### 13.1. 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 provision 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 Y — 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.<sup>1</sup> *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, whichever is applicable.

**§ 2.902 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.

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<sup>1</sup> 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.



## 13.2. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

### § 15.19 Labeling requirements.

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

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

*This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.*

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

*This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.*

(3) All other devices shall bear the following statement 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.*

(4) 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.

(5) 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.

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.

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

#### § 15.105 Information to the user.

(a) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.



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Electromagnetic Compatibility  
Certification Label & User's Manual Information  
CFR Title 47, Part 90, Subpart Y

## End of Report