



**MET Laboratories, Inc.** *Safety Certification - EMI - Telecom Environmental Simulation*  
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November 2, 2007

Motorola, Inc.  
1064 Greenwood Blvd. Suite 400  
Lake Mary, FL 32746

Dear Bob Greenway,

Enclosed is the EMC test report for compliance testing of the Motorola, Inc., MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a) as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-03 ed.), Part 15, Subpart C.

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.

Jennifer Warnell  
Documentation Department

Reference: (\Motorola, Inc.\EMC22876-FCC247 Rev. 1)

DOC EMC702 9/13/2007

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*The Nation's First Licensed Nationally Recognized Testing Laboratory*





## **Electromagnetic Compatibility Test Report**

for the

**Motorola, Inc.**  
**MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a)**

**Verified under**  
the FCC Certification Rules  
contained in  
Title 47 of the CFR, Part 15.247, Subpart C  
for Intentional Radiators

**MET Report: EMC22876-FCC247 Rev. 1**

November 2, 2007

**Prepared For:**

**Motorola, Inc.**  
**1064 Greenwood Blvd. Suite 400**  
**Lake Mary, FL 32746**

**Prepared By:**  
**MET Laboratories, Inc.**  
914 W. Patapsco Avenue  
Baltimore, Maryland 21230



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the FCC Certification Rules  
contained in  
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for Intentional Radiators

Dusmantha Tennakoon  
Project Engineer, Electromagnetic Compatibility Lab

Jennifer Warnell  
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 15.407, of the FCC Rules under normal use and maintenance.

Shawn McMillen,  
Wireless Coordinator, Electromagnetic Compatibility Lab



## Report Status Sheet

Revision	Report Date	Reason for Revision
∅	November 1, 2007	Initial Issue.
1	November 2, 2007	Corrected 5.8 Radio operating frequency.



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## List of Terms and Abbreviations

AC	Alternating Current
ACF	Antenna Correction Factor
Cal	Calibration
<i>d</i>	Measurement Distance
dB	Decibels
dB $\mu$ A	Decibels above one <b>microamp</b>
dB $\mu$ V	Decibels above one <b>microvolt</b>
dB $\mu$ A/m	Decibels above one <b>microamp per meter</b>
dB $\mu$ V/m	Decibels above one <b>microvolt per meter</b>
DC	Direct Current
E	Electric Field
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GRP	Ground Reference Plane
H	Magnetic Field
HCP	Horizontal Coupling Plane
Hz	Hertz
IEC	International Electrotechnical Commission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	Line Impedance Stabilization Network
MHz	Megahertz
$\mu$ H	<b>microhenry</b>
$\mu$	<b>microfarad</b>
$\mu$ s	<b>microseconds</b>
PRF	Pulse Repetition Frequency
RF	Radio Frequency
RMS	Root-Mean-Square
TWT	Traveling Wave Tube
V/m	Volts <b>per meter</b>
VCP	Vertical Coupling Plane



# I. Executive Summary





## 1.1 Purpose of Test

An EMC evaluation was performed to determine compliance of the Motorola, Inc., MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a), with the requirements of Part 15, §15.247. 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 MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a). Motorola, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a), has been **permanently** discontinued

## 1.2 Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Motorola, Inc., purchase order number NP3529237. All tests were conducted using measurement procedure ANSI C63.4-2003.

Reference	Description	Results
Title 47 of the CFR, Part 15, Subpart C, §15.207	AC Power Line Conducted Emissions	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.203/15.247(b)(c)	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.205(d)	Band Edge Emissions	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(a)(2)	6dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(b)(3)	Maximum Peak Conducted Output Power	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(d)	Spurious Radiated Emissions	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(e)	Peak Power Spectral Density	Compliant

**Table 1 Executive Summary of EMC Part 15.247 Compliance Testing**



## II. Equipment Configuration



## 2.1 Overview

MET Laboratories, Inc. was contracted by Motorola, Inc. to perform testing on the MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a), under Motorola, Inc.'s purchase order number NP3529237.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Motorola, Inc., MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a).

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

<b>Model(s) Tested:</b>	MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a)	
<b>Model(s) Covered:</b>	MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a)	
<b>EUT Specifications:</b>	Primary Power: 120 VAC Secondary Power: 12 VDC	
	FCC ID: QJE-MM4300-5800	
	Type of Modulations:	CCK/OFDM – 2.4 GHz OFDM, 5.8 GHz
	Equipment Code:	DTS
	Peak RF Conducted Output Power:	802.11b: 26.66 dBm 802.11g: 26.62 dBm 802.11a: 25.88 dBm
	EUT TX Frequency Ranges:	2412 MHz – 2462 MHz 5745 MHz – 5825 MHz
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.	
<b>Evaluated by:</b>	Dusmantha Tennakoon	
<b>Date(s):</b>	November 1, 2007	



## 2.2 References

<b>CFR 47, Part 15, Subpart C</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
<b>CFR 47, Part 15, Subpart B</b>	Electromagnetic Compatibility: Criteria for Radio Frequency Devices
<b>ANSI C63.4:2003</b>	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>ANSI/NCSL Z540-1-1994</b>	Calibration Laboratories and Measuring and Test Equipment - General Requirements
<b>ANSI/ISO/IEC 17025:2000</b>	General Requirements for the Competence of Testing and Calibration Laboratories

## 2.3 Test Site

All testing was performed at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, MD 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 in 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).

## 2.4 Description of Test Sample

The MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a), Equipment Under Test (EUT), are radio units. The system operates at 2.4 GHz (ISM band 802.11 b/g) and 5.8 GHz using an Atheros AP30 chipset.

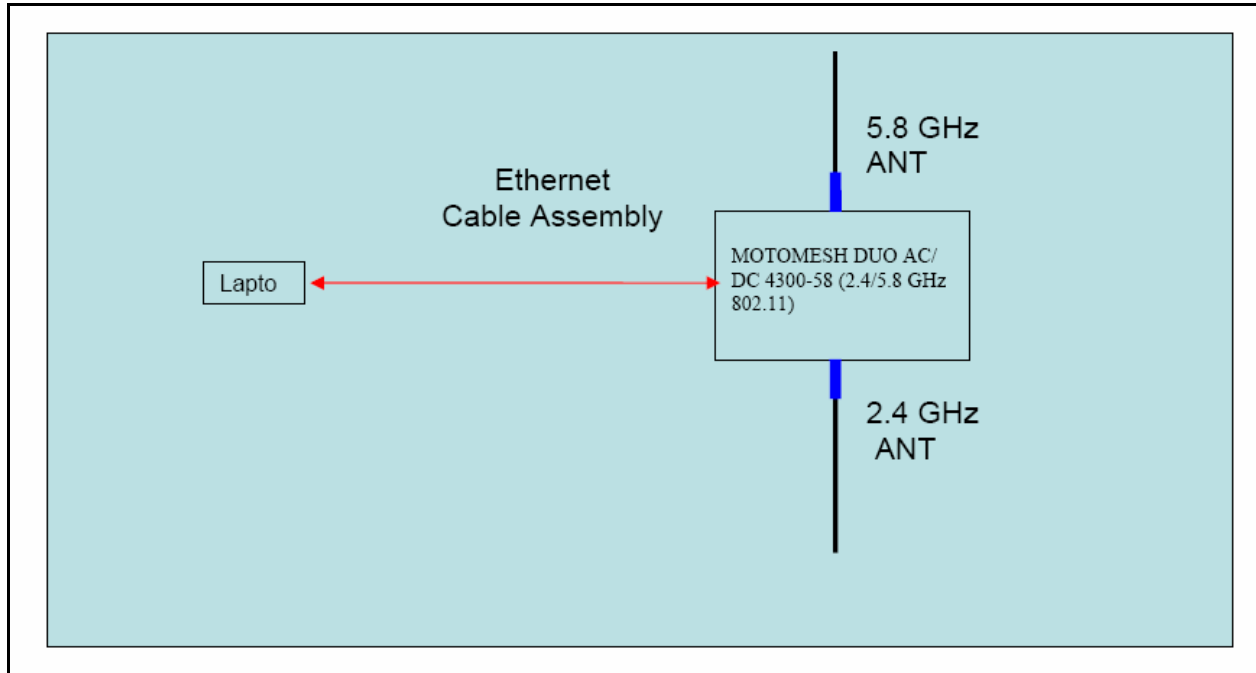


Figure 1. Block Diagram of Test Configuration (Radiated Emissions)

## 2.5 Equipment Configuration

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

Name / Description	Model Number
MOTOMESH DUO AC/DC (2.4/5.8 GHZ 802.11)	4300-58 AC/DC

Table 2. Equipment Configuration



## 2.6 Support Equipment

Motorola, Inc. supplied support equipment necessary for the operation and testing of the MOTOMESH DUO 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a). All support equipment supplied is listed in the following Support Equipment List.

Name / Description	Manufacturer	Model Number
LAPTOP COMPUTER	TOSHIBA	SATELLITE PRO M10-5405

Table 3. Support Equipment

## 2.7 Ports and Cabling Information

Ref. ID	Cable Description	Qty.	Length (m)	Shielded (Y/N)
1	8-PIN / RJ45 ETH CAT5 CABLE ASSEMBLY	1	3	Y
2	4-PIN / PWR PLUG POWER CORD CABLE ASSEMBLY	1	2	N
3	2.4 GHZ 8 DBI ANTENNA	1	-	N/A
4	5.X GHZ 10 DBI ANTENNA	1	-	N/A

Table 4. Ports and Cabling Information

## 2.8 Mode of Operation

The EUT was transmitting at max power continuously during testing.



## 2.9 Modifications

### a) Modifications to EUT

In order to meet the restricted band levels, the output power levels for the 802.11 b/g radio must be software controlled by the ART Software per channel as follows:

Mode	Channel #	Power (dBm)
802.11b	1	28
	2	28
	3	28
	4	28
	5	28
	6	28
	7	28
	8	28
	9	28
	10	28
	11	28
802.11g	1	25
	2	26
	3	27
	4	28
	5	28
	6	28
	7	28
	8	28
	9	27
	10	26
	11	25

For the 5.8 GHz band, the power setting can be set to 26 dBm for all channels

### b) 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 Motorola, Inc. upon completion of testing.





### **III. Electromagnetic Compatibility Criteria for Intentional Radiators**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.203 Antenna Requirement

**Test Requirement:** § 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

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

- a.) Antenna must be permanently attached to the unit.
- b.) Antenna must use a unique type of connector to attach to the EUT.
- c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

**Results:** The antennas are professionally installed. The EUT is therefore compliant with §15.203. The following antennas will be used:

Name/Description	Gain	Manufacturer	Model Number
2.4 – 2.5 GHz Antenna	8 dBi	MaxRad	Z3260
5.725 – 5.875 GHz Antenna	10 dBi	Radial Larsen	R380700212

**Test Engineer(s):** Dusmantha Tennakoon

**Test Date(s):** 10/23/2007 for 2.4 GHz and 10/19/2007 for 5.8 GHz.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.205 Band Edge Emissions

**Test Requirement(s):** § 15.205 (a): Except as shown in paragraph (d) of 15.205 **Restricted bands of operation**, only spurious emissions are permitted in any of the frequency bands specified in Table 5:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Note
13.36–13.41.			
Note : Above 38.6			

**Table 5. Restricted Bands of Operation from FCC Part 15, § 15.205**

**Test Procedure:** The EUT was set up at maximum power. It was verified that the channels tested were within the band 2400-2480 MHz and not infringing upon the restricted bands. The 5.8 GHz band does not have any immediate neighboring restricted bands.

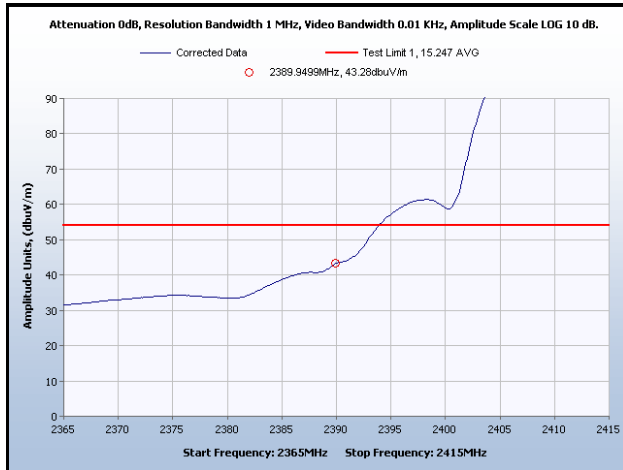
**Test Results:** The EUT was compliant with the requirements of this section.

**Test Engineer(s):** Dusmantha Tennakoon

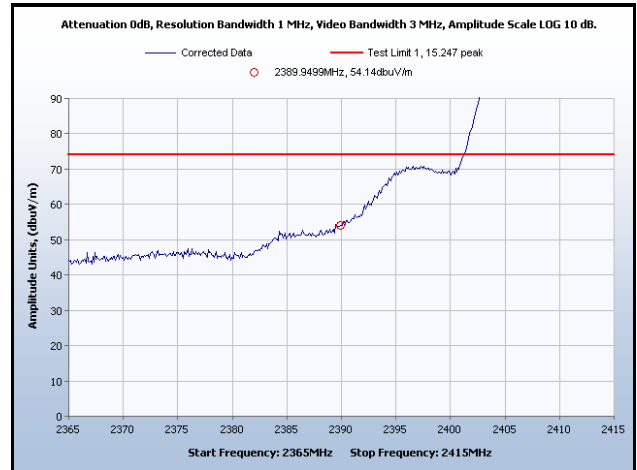
**Test Date(s):** 10/16/2007



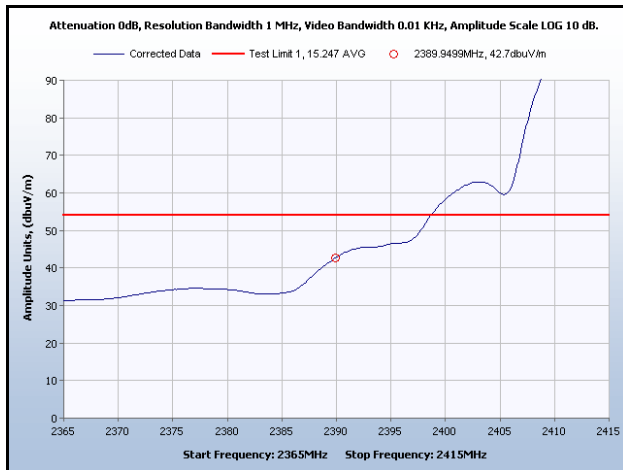
### 802.11b



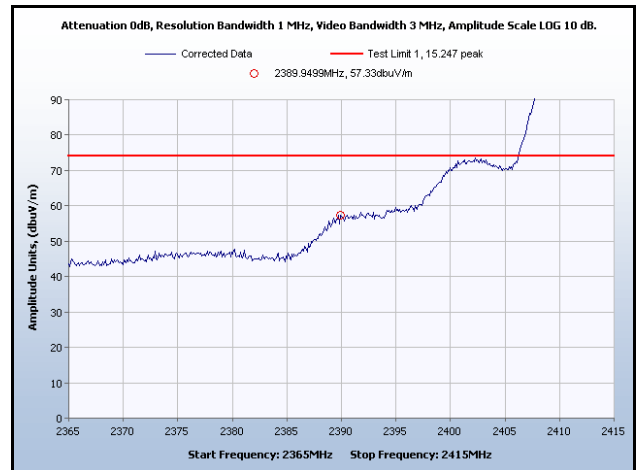
Restricted Band Edge, Channel 1, 28 dBm, Average



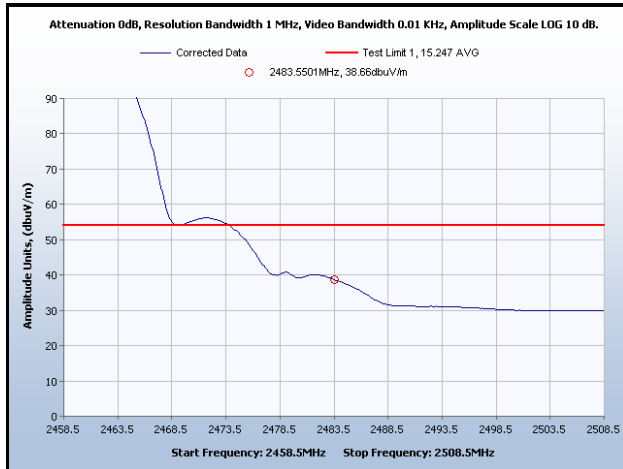
Restricted Band Edge, Channel 1, 28 dBm, Peak



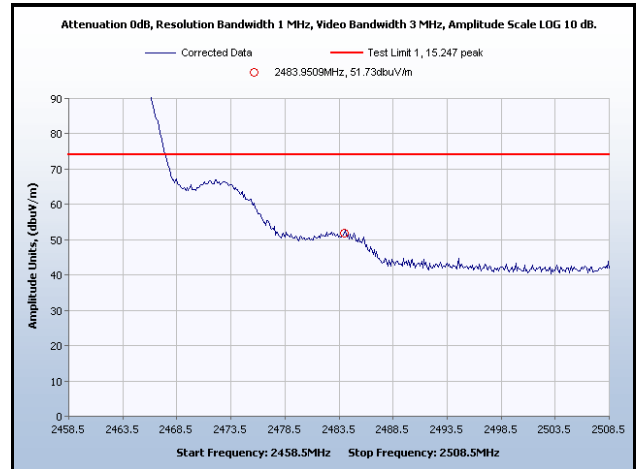
Restricted Band Edge, Channel 2, 28 dBm, Average



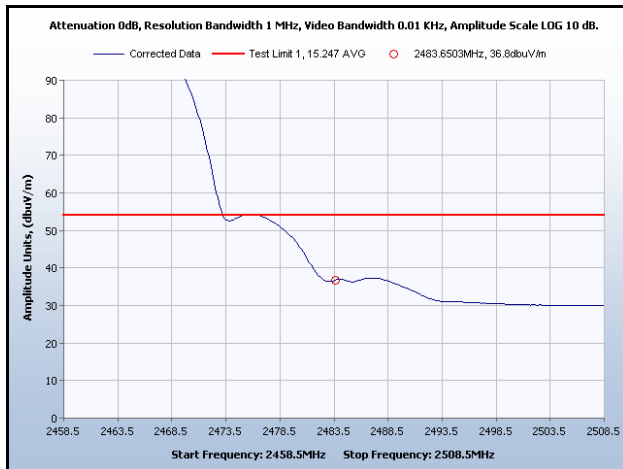
Restricted Band Edge, Channel 2, 28 dBm, Peak



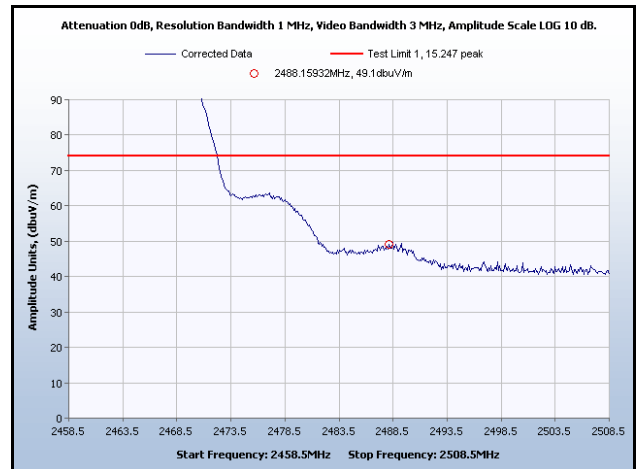
Restricted Band Edge, Channel 10, 28 dBm, Average



Restricted Band Edge, Channel 10, 28 dBm, Peak



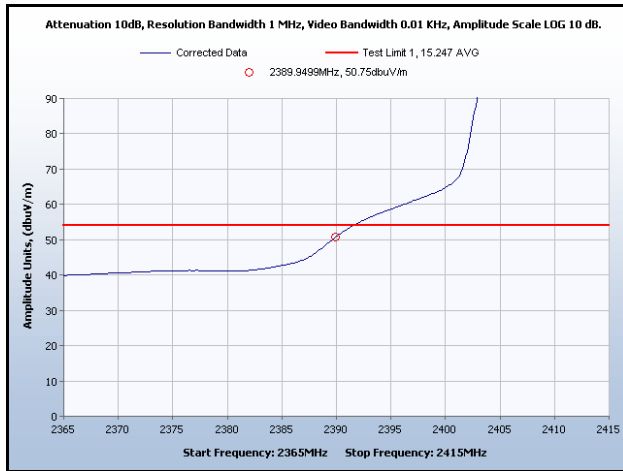
Restricted Band Edge, Channel 11, 28 dBm, Average



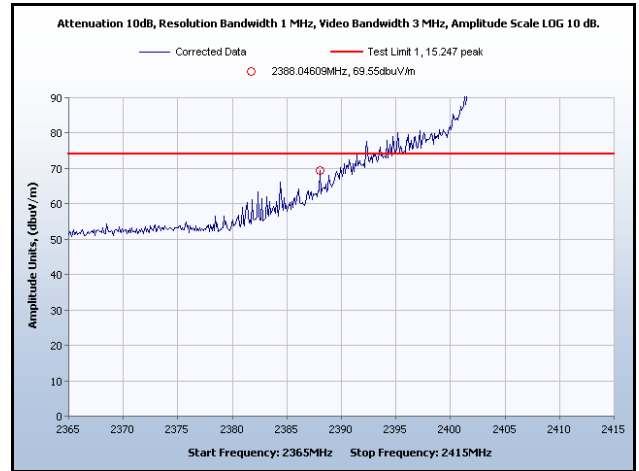
Restricted Band Edge, Channel 11, 28 dBm, Peak



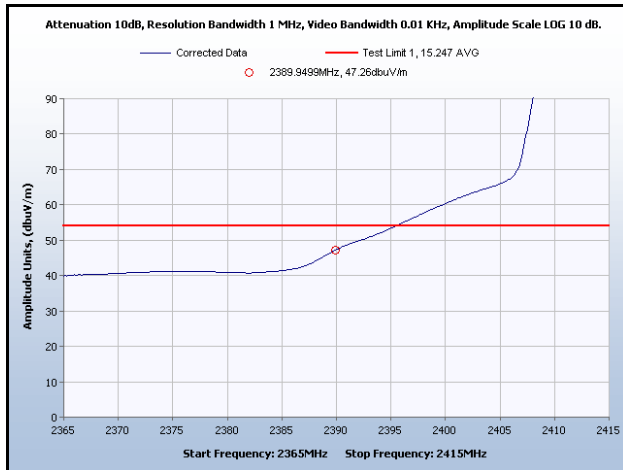
### 802.11g



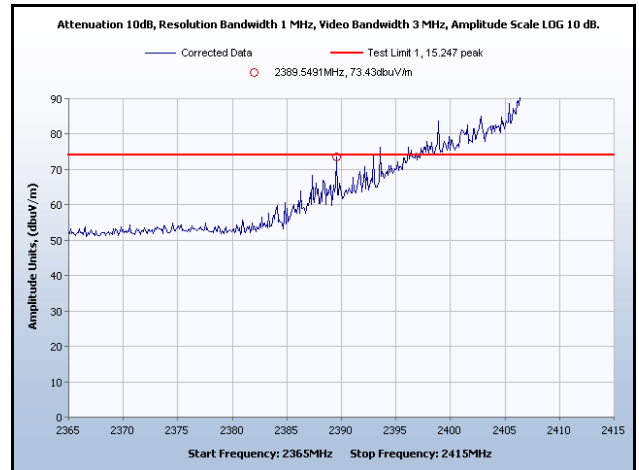
Restricted Band Edge, Channel 1, 25 dBm, Average



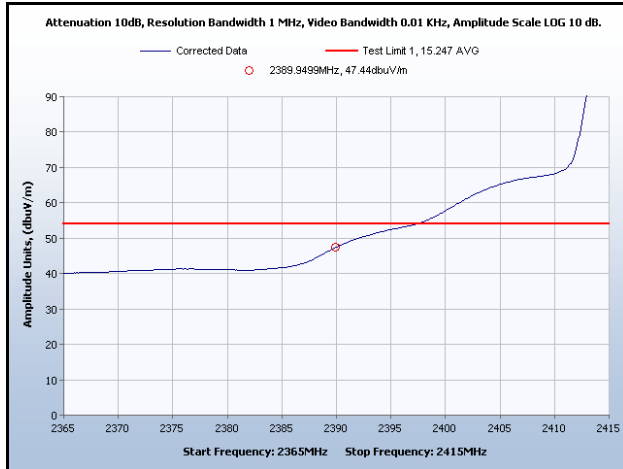
Restricted Band Edge, Channel 1, 25 dBm, Peak



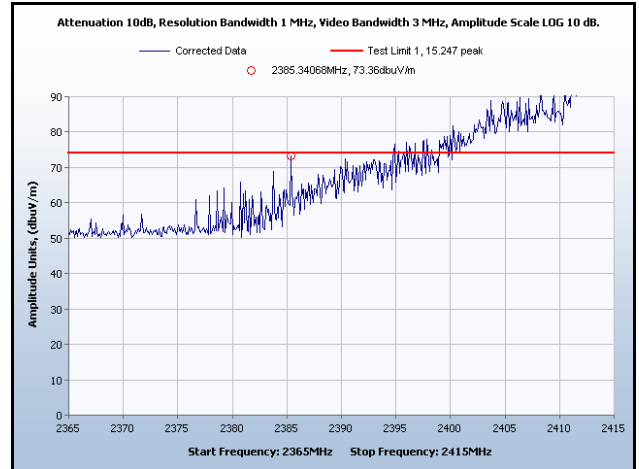
Restricted Band Edge, Channel 2, 26 dBm, Average



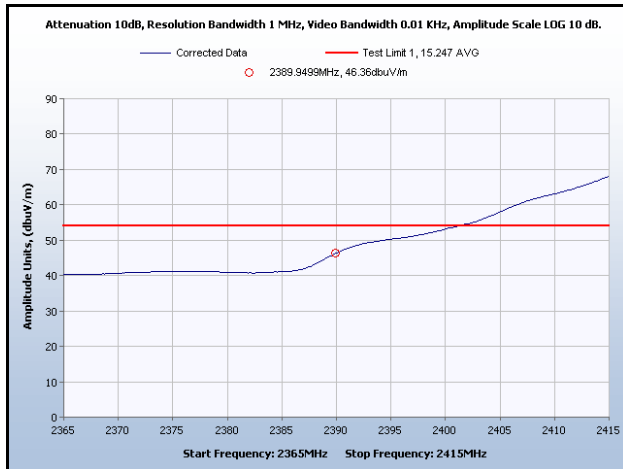
Restricted Band Edge, Channel 2, 26 dBm, Peak



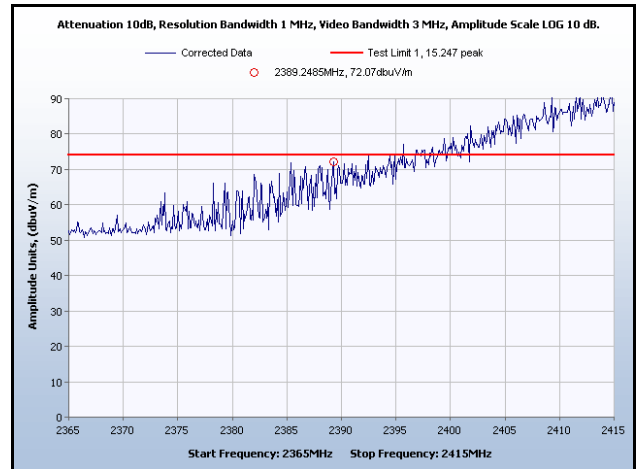
Restricted Band Edge, Channel 3, 27 dBm, Average



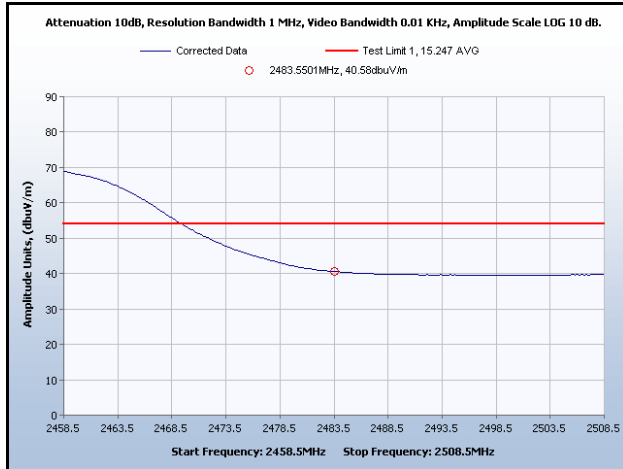
Restricted Band Edge, Channel 3, 27 dBm, Peak



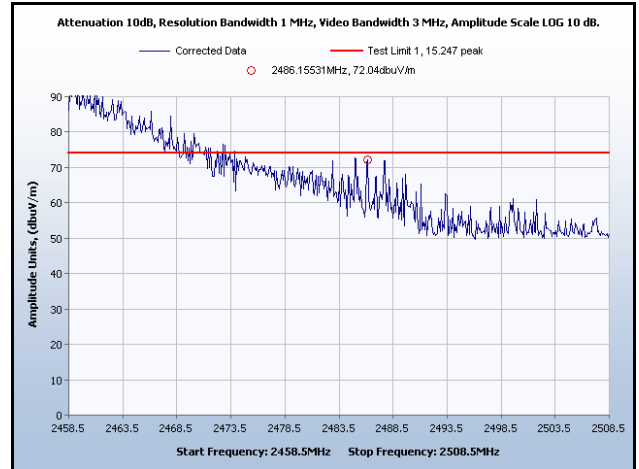
Restricted Band Edge, Channel 4, 28 dBm, Average



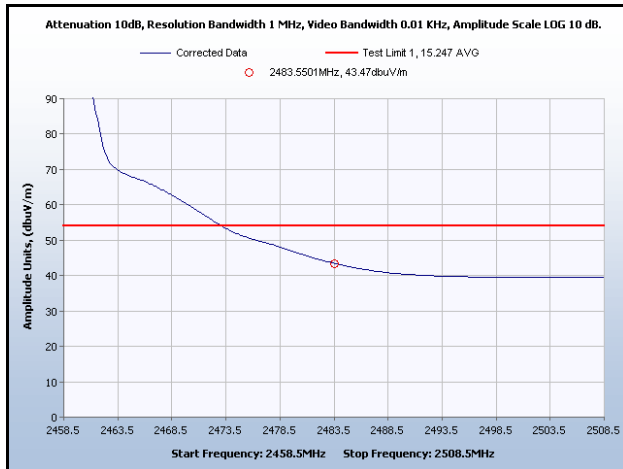
Restricted Band Edge, Channel 4, 28 dBm, Peak



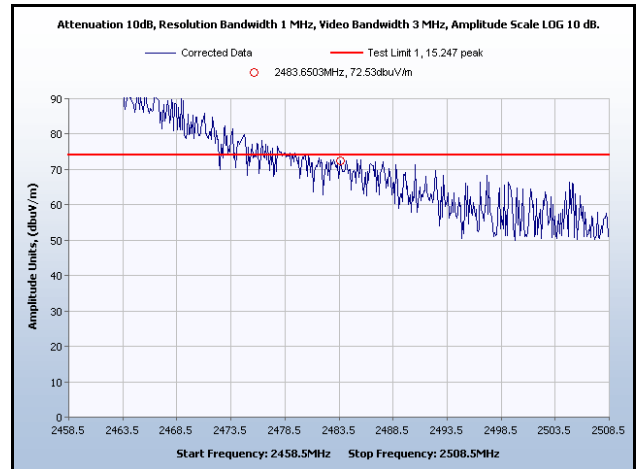
Restricted Band Edge, Channel 8, 28 dBm, Average



Restricted Band Edge, Channel 8, 28 dBm, Peak

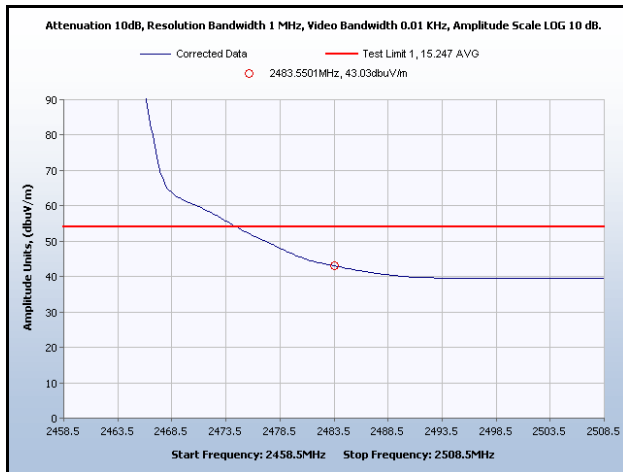


Restricted Band Edge, Channel 9, 27 dBm, Average

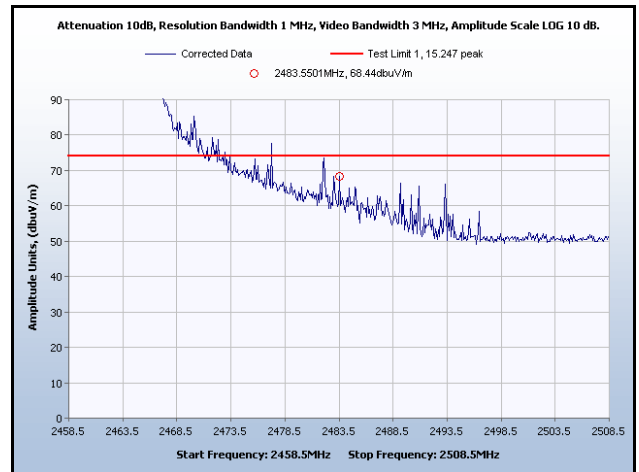


Restricted Band Edge, Channel 9, 27 dBm, Peak

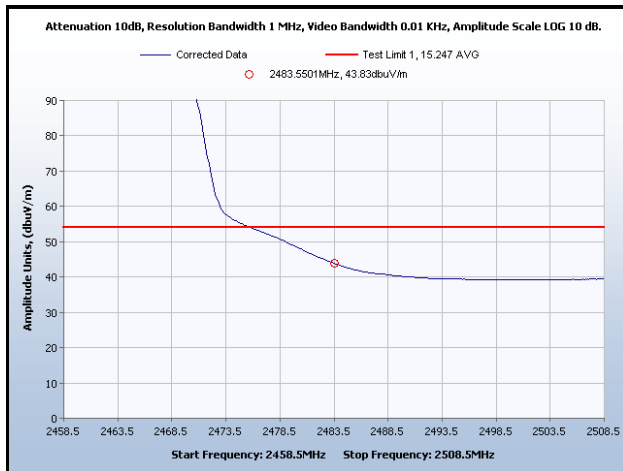




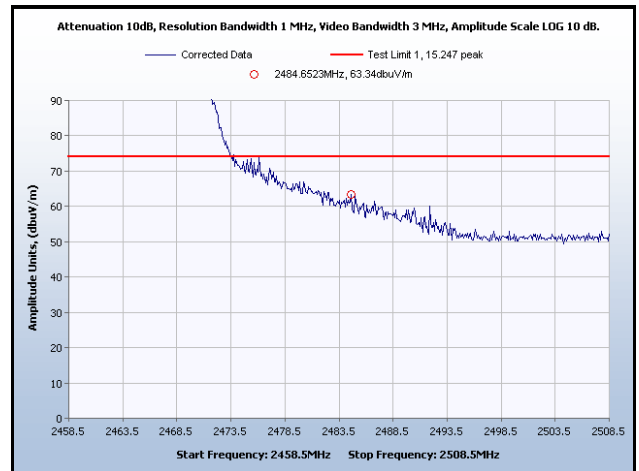
Restricted Band Edge, Channel 10, 26 dBm, Average



Restricted Band Edge, Channel 10, 26 dBm, Peak



Restricted Band Edge, Channel 11, 25 dBm, Average

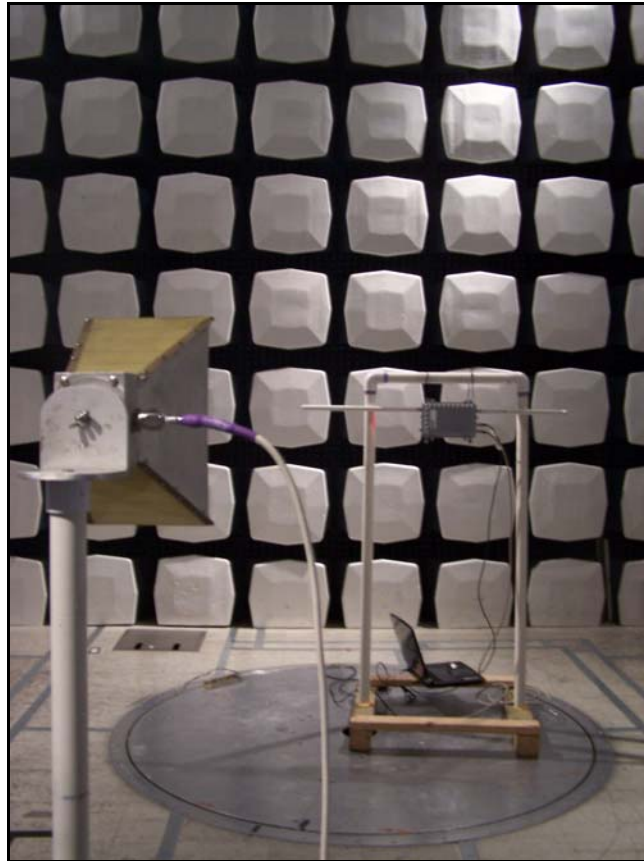


Restricted Band Edge, Channel 11, 25 dBm, Peak



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.205 Band Edge Emissions



Photograph 1. Band Edge Test Setup



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

**Test Requirement(s):** § 15.207 (a): For an intentional radiator 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 30MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50  $\Omega$  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 frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dB $\mu$ V)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

**Table 6. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)**

**Test Procedure:** The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50  $\Omega$ /50  $\mu$ H Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with ANSI C63.4-1992 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz". The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50  $\Omega$ /50  $\mu$ H LISN as the input transducer to an EMC/field intensity meter. The tests were conducted in a RF-shielded enclosure.

**Test Results:** The EUT was compliant with the Conducted Emission limits of §15.207(a) for Intentional Radiators. See following pages for detailed test results.

**Test Engineer(s):** Dusmantha Tennakoon

**Test Date(s):** October 19-23, 2007



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207 Conducted Emissions Limits

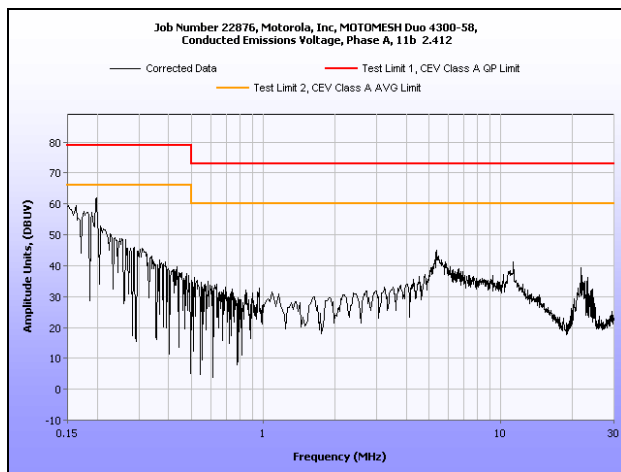
#### 2.4 GHz Radio – 802.11b

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
5.436	41.6	0.17	41.77	60	-18.23	28.6	0.17	28.77	50	-21.23
11.254	40.6	0.190064	40.790064	60	-19.2099	39	0.190064	39.190064	50	-10.8099
21.664	38.4	0.275088	38.675088	60	-21.3249	35.8	0.275088	36.075088	50	-13.9249
23.13	35.6	0.22671	35.82671	60	-24.1733	32.3	0.22671	32.52671	50	-17.4733
4.24	34	0.17	34.17	56	-21.83	29.3	0.17	29.47	46	-16.53
4.499	32.8	0.17	32.97	56	-23.03	23	0.17	23.17	46	-22.83

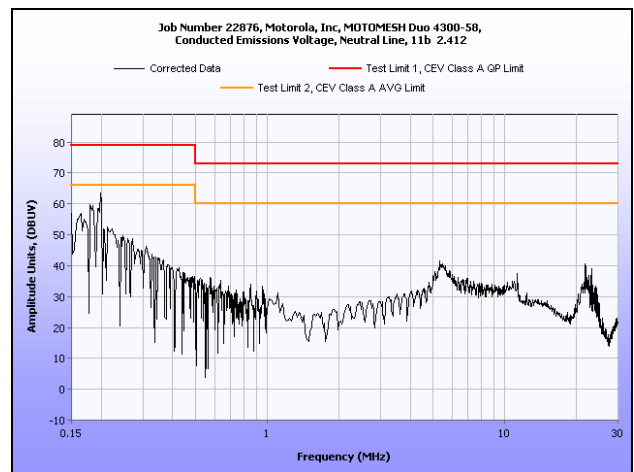
Table 7. Conducted Emissions - Voltage, Phase (120 VAC 60 Hz), 2.4 GHz, 802.11b, 2412

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
21.666	39	0.275022	39.275022	60	-20.725	37	0.275022	37.275022	50	-12.725
23.13	38	0.22671	38.22671	60	-21.7733	34.8	0.22671	35.02671	50	-14.9733
11.252	36.5	0.190032	36.690032	60	-23.31	34.7	0.190032	34.890032	50	-15.11
5.638	33.1	0.17	33.27	60	-26.73	22.1	0.17	22.27	50	-27.73
10.231	32.7	0.173696	32.873696	60	-27.1263	29.6	0.173696	29.773696	50	-20.2263
4.985	31.8	0.17	31.97	56	-24.03	24.9	0.17	25.07	46	-20.93

Table 8. Conducted Emissions - Voltage, Neutral (120 VAC 60 Hz), 2.4 GHz, 802.11b, 2412



2.4 GHz, 802.11b, 2412, Phase Line Plot



2.4 GHz, 802.11b, 2412, Neutral Line Plot

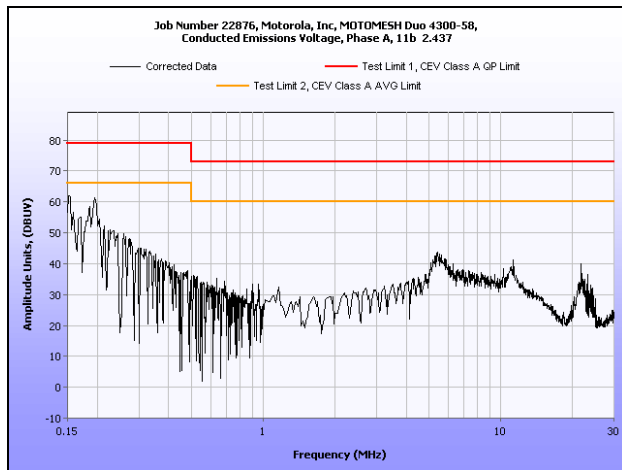


Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
11.253	40.1	0.190048	40.290048	60	-19.71	39.2	0.190048	39.390048	50	-10.61
5.516	39.6	0.17	39.77	60	-20.23	28.5	0.17	28.67	50	-21.33
21.666	38.4	0.275022	38.675022	60	-21.325	36.3	0.275022	36.575022	50	-13.425
5.343	38.1	0.17	38.27	60	-21.73	29	0.17	29.17	50	-20.83
23.13	35.7	0.22671	35.92671	60	-24.0733	32.3	0.22671	32.52671	50	-17.4733
2.699	31.4	0.17	31.57	56	-24.43	24.9	0.17	25.07	46	-20.93
24.352	30.6	0.186384	30.786384	60	-29.2136	27.7	0.186384	27.886384	50	-22.1136

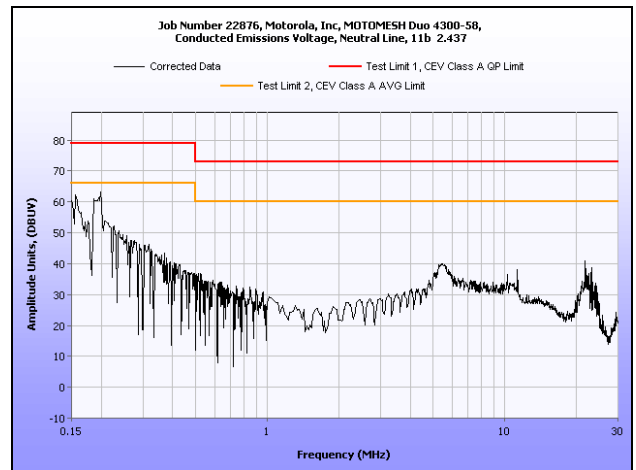
Table 9. Conducted Emissions - Voltage, Phase (120 VAC 60 Hz), 2.4 GHz, 802.11b, 2437

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
21.665	39	0.275055	39.275055	60	-20.7249	36.5	0.275055	36.775055	50	-13.2249
23.13	38.1	0.22671	38.32671	60	-21.6733	34.8	0.22671	35.02671	50	-14.9733
11.253	36.9	0.190048	37.090048	60	-22.91	35.3	0.190048	35.490048	50	-14.51
5.3	35.8	0.17	35.97	60	-24.03	27.6	0.17	27.77	50	-22.23
24.057	31.2	0.196119	31.396119	60	-28.6039	27.5	0.196119	27.696119	50	-22.3039
24.351	31	0.186417	31.186417	60	-28.8136	28.1	0.186417	28.286417	50	-21.7136

Table 10. Conducted Emissions - Voltage, Neutral (120 VAC 60 Hz), 2.4 GHz, 802.11b, 2437



2.4 GHz, 802.11b, 2437, Phase Line Plot



2.4 GHz, 802.11b, 2437, Neutral Line Plot

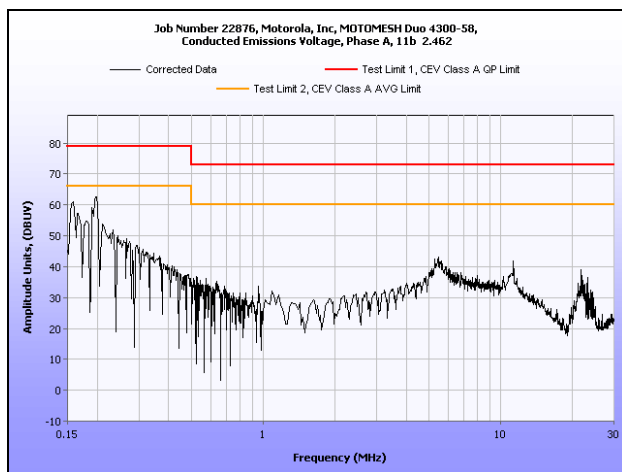


Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
11.253	40.3	0.190048	40.490048	60	-19.51	39	0.190048	39.190048	50	-10.81
5.571	39.9	0.17	40.07	60	-19.93	32.2	0.17	32.37	50	-17.63
21.663	37.9	0.275121	38.175121	60	-21.8249	34.9	0.275121	35.175121	50	-14.8249
5.119	36.7	0.17	36.87	60	-23.13	29.4	0.17	29.57	50	-20.43
23.131	35.3	0.226677	35.526677	60	-24.4733	32.4	0.226677	32.626677	50	-17.3733
3.973	33.8	0.17	33.97	56	-22.03	27.6	0.17	27.77	46	-18.23

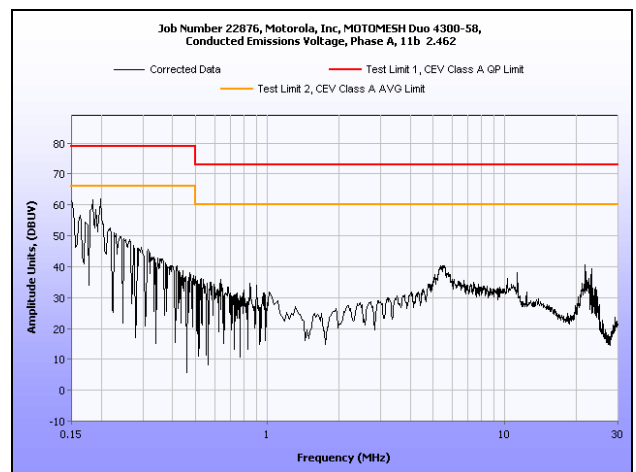
Table 11. Conducted Emissions - Voltage, Phase (120 VAC 60 Hz), 2.4 GHz, 802.11b, 2462

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
21.664	38.9	0.275088	39.175088	60	-20.8249	36	0.275088	36.275088	50	-13.7249
23.13	38.1	0.22671	38.32671	60	-21.6733	34.8	0.22671	35.02671	50	-14.9733
5.381	37.3	0.17	37.47	60	-22.53	28	0.17	28.17	50	-21.83
11.254	36.7	0.190064	36.890064	60	-23.1099	35	0.190064	35.190064	50	-14.8099
5.489	33.3	0.17	33.47	60	-26.53	20.3	0.17	20.47	50	-29.53
24.045	31.1	0.196515	31.296515	60	-28.7035	27.3	0.196515	27.496515	50	-22.5035

Table 12. Conducted Emissions - Voltage, Neutral (120 VAC 60 Hz), 2.4 GHz, 802.11b, 2462



2.4 GHz, 802.11b, 2462, Phase Line Plot



2.4 GHz, 802.11b, 2462, Neutral Line Plot



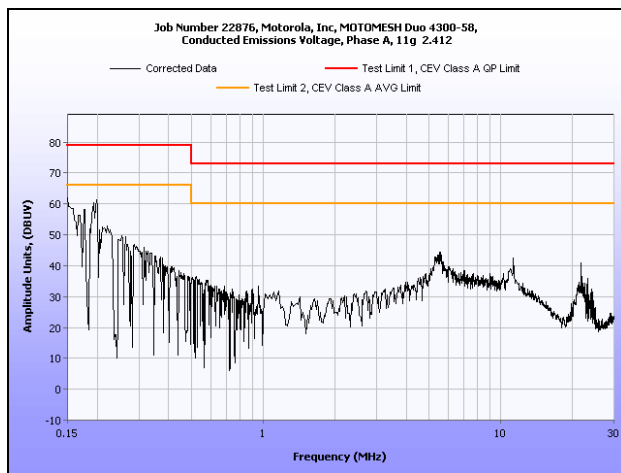
802.11g

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
11.254	41.1	0.190064	41.290064	60	-18.7099	39.2	0.190064	39.390064	50	-10.6099
5.305	40.8	0.17	40.97	60	-19.03	32.5	0.17	32.67	50	-17.33
21.666	38.2	0.275022	38.475022	60	-21.525	36	0.275022	36.275022	50	-13.725
23.13	35.1	0.22671	35.32671	60	-24.6733	31.9	0.22671	32.12671	50	-17.8733
4.465	34.3	0.17	34.47	56	-21.53	27.2	0.17	27.37	46	-18.63
3.45	32.4	0.17	32.57	56	-23.43	28.6	0.17	28.77	46	-17.23

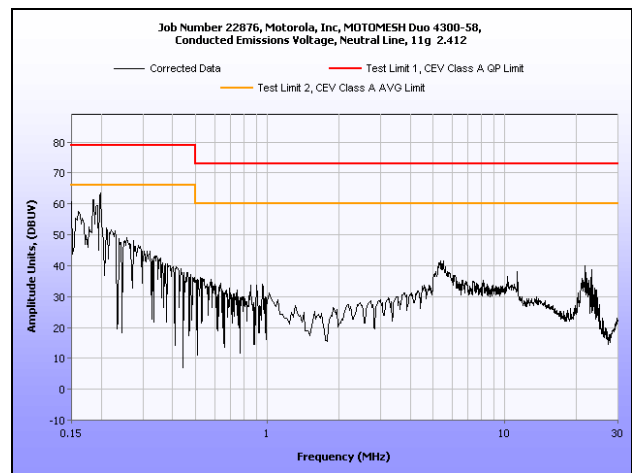
Table 13. Conducted Emissions - Voltage, Phase (120 VAC 60 Hz), 2.4 GHz, 802.11g, 2412

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
0.293	39.4	0.1581	39.5581	60.44	-20.8819	39.3	0.1581	39.4581	50.44	-10.9819
21.666	38.9	0.275022	39.175022	60	-20.825	36.2	0.275022	36.475022	50	-13.525
23.129	37.5	0.226743	37.726743	60	-22.2733	34.1	0.226743	34.326743	50	-15.6733
11.256	36.9	0.190096	37.090096	60	-22.9099	35	0.190096	35.190096	50	-14.8099
5.315	36.7	0.17	36.87	60	-23.13	28.5	0.17	28.67	50	-21.33
24.352	31	0.186384	31.186384	60	-28.8136	27.8	0.186384	27.986384	50	-22.0136

Table 14. Conducted Emissions - Voltage, Neutral (120 VAC 60 Hz), 2.4 GHz, 802.11g, 2412



2.4 GHz, 802.11g, 2412, Phase Line Plot



2.4 GHz, 802.11g, 2412, Neutral Line Plot

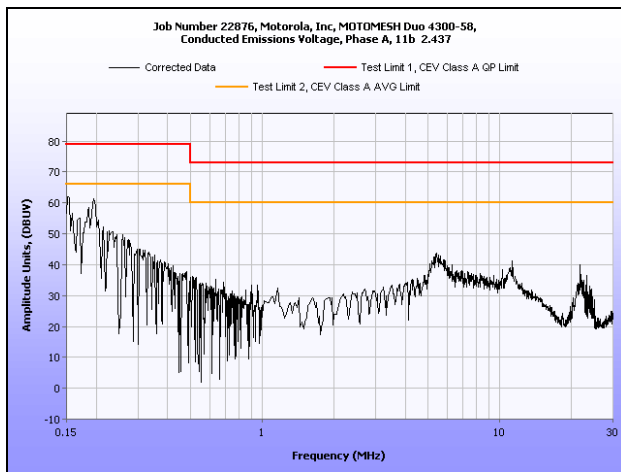


Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
5.422	42	0.17	42.17	60	-17.83	31	0.17	31.17	50	-18.83
11.255	41.6	0.19008	41.79008	60	-18.2099	39.4	0.19008	39.59008	50	-10.4099
5.258	40	0.17	40.17	60	-19.83	31.8	0.17	31.97	50	-18.03
21.665	38.5	0.275055	38.775055	60	-21.2249	36	0.275055	36.275055	50	-13.7249
23.13	35.2	0.22671	35.42671	60	-24.5733	32.1	0.22671	32.32671	50	-17.6733
4.252	32.4	0.17	32.57	56	-23.43	26.3	0.17	26.47	46	-19.53

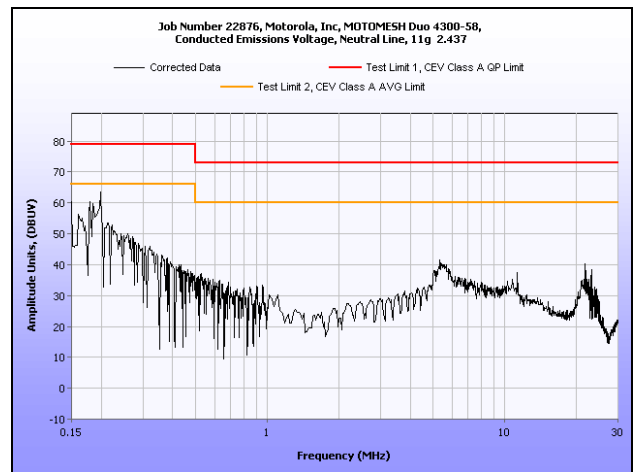
Table 15. Conducted Emissions - Voltage, Phase (120 VAC 60 Hz), 2.4 GHz, 802.11g, 2437

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
5.43	38.8	0.17	38.97	60	-21.03	34.4	0.17	34.57	50	-15.43
21.664	38.7	0.275088	38.975088	60	-21.0249	36	0.275088	36.275088	50	-13.7249
23.13	37.7	0.22671	37.92671	60	-22.0733	34.5	0.22671	34.72671	50	-15.2733
11.254	36.8	0.190064	36.990064	60	-23.0099	35.3	0.190064	35.490064	50	-14.5099
0.337813	35.1	0.17	35.27	59.26	-23.99	28.1	0.17	28.27	49.26	-20.99
23.74	30.5	0.20658	30.70658	60	-29.2934	26.6	0.20658	26.80658	50	-23.1934

Table 16. Conducted Emissions - Voltage, Neutral (120 VAC 60 Hz), 2.4 GHz, 802.11g, 2437



2.4 GHz, 802.11g, 2437, Phase Line Plot



2.4 GHz, 802.11g, 2437, Neutral Line Plot



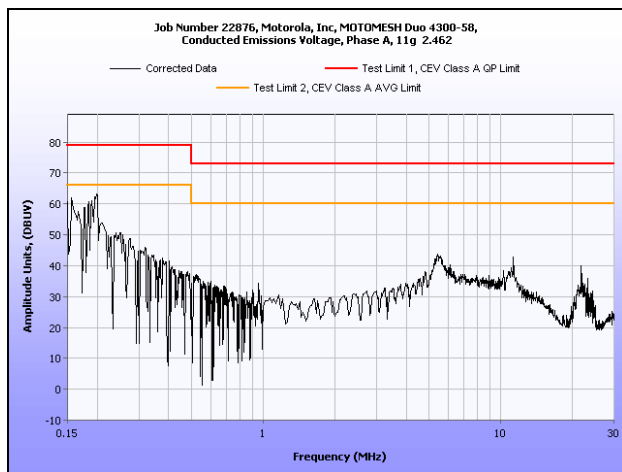


Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
11.253	41.2	0.190048	41.390048	60	-18.61	38.8	0.190048	38.990048	50	-11.01
5.364	40.6	0.17	40.77	60	-19.23	33.1	0.17	33.27	50	-16.73
21.665	38.6	0.275055	38.875055	60	-21.1249	36.5	0.275055	36.775055	50	-13.2249
21.911	35.6	0.266937	35.866937	60	-24.1331	33.2	0.266937	33.466937	50	-16.5331
23.13	35.4	0.22671	35.62671	60	-24.3733	32	0.22671	32.22671	50	-17.7733
5.03	33.4	0.17	33.57	60	-26.43	20.4	0.17	20.57	50	-29.43
2.44	30.8	0.17	30.97	56	-25.03	26.1	0.17	26.27	46	-19.73

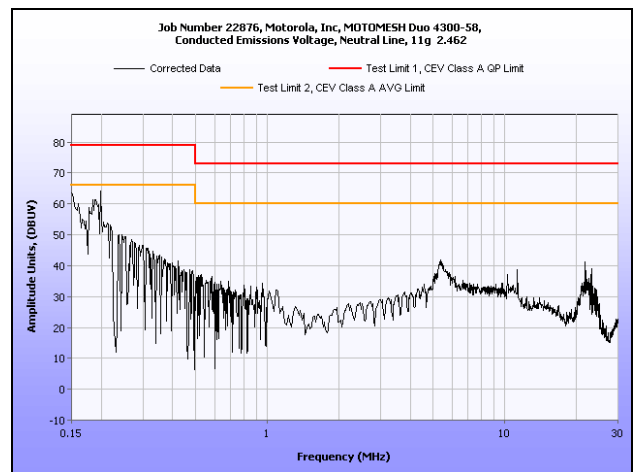
Table 17. Conducted Emissions - Voltage, Phase (120 VAC 60 Hz), 2.4 GHz, 802.11g, 2462

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
21.664	39	0.275088	39.275088	60	-20.7249	36.2	0.275088	36.475088	50	-13.5249
5.357	37.9	0.17	38.07	60	-21.93	30	0.17	30.17	50	-19.83
23.13	37.8	0.22671	38.02671	60	-21.9733	34.6	0.22671	34.82671	50	-15.1733
11.254	36.5	0.190064	36.690064	60	-23.3099	35.2	0.190064	35.390064	50	-14.6099
23.741	31.1	0.206547	31.306547	60	-28.6935	27.2	0.206547	27.406547	50	-22.5935
3.765	30.5	0.17	30.67	56	-25.33	23.2	0.17	23.37	46	-22.63

Table 18. Conducted Emissions - Voltage, Neutral (120 VAC 60 Hz), 2.4 GHz, 802.11g, 2462



2.4 GHz, 802.11g, 2462, Phase Line Plot



2.4 GHz, 802.11g, 2462, Neutral Line Plot



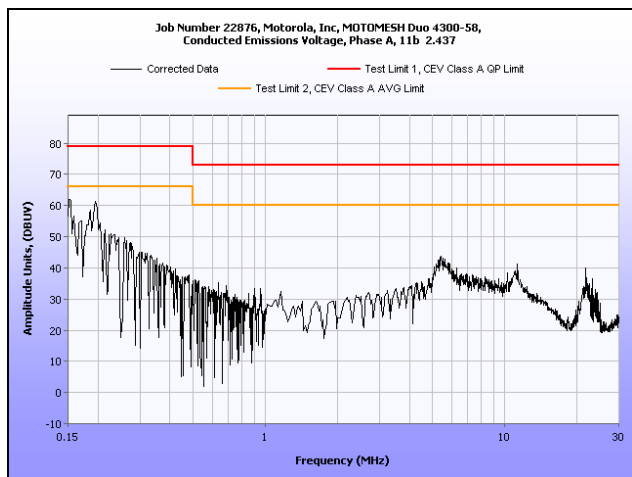
**5.8 GHz Radio**

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
5.422	42	0.17	42.17	60	-17.83	31	0.17	31.17	50	-18.83
11.255	41.6	0.19008	41.79008	60	-18.2099	39.4	0.19008	39.59008	50	-10.4099
5.258	40	0.17	40.17	60	-19.83	31.8	0.17	31.97	50	-18.03
21.665	38.5	0.275055	38.775055	60	-21.2249	36	0.275055	36.275055	50	-13.7249
23.13	35.2	0.22671	35.42671	60	-24.5733	32.1	0.22671	32.32671	50	-17.6733
4.252	32.4	0.17	32.57	56	-23.43	26.3	0.17	26.47	46	-19.53

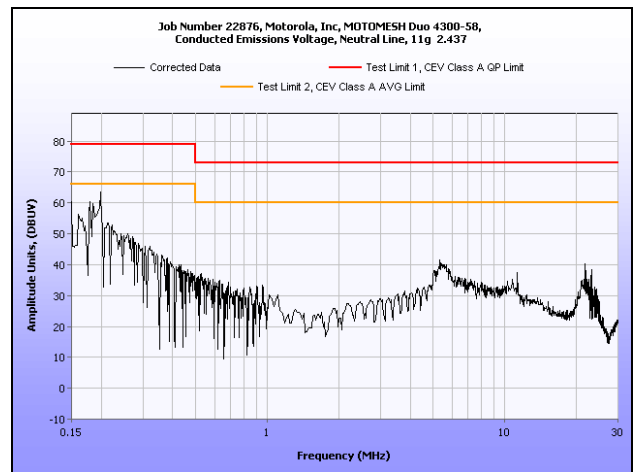
**Table 19. Conducted Emissions - Voltage, Phase (120 VAC 60 Hz), 5.8 GHz, 5785**

Frequency (MHz)	Uncorrected Meter Reading (dBuV) QP	Cable Loss (dB)	Corrected Measurement (dBuV) QP	Limit (dBuV) QP	Margin (dB) QP	Uncorrected Meter Reading (dBuV) Avg.	Cable Loss (dB)	Corrected Measurement (dBuV) AVG	Limit (dBuV) AVG	Margin (dB) AVG
5.43	38.8	0.17	38.97	60	-21.03	34.4	0.17	34.57	50	-15.43
21.664	38.7	0.275088	38.975088	60	-21.0249	36	0.275088	36.275088	50	-13.7249
23.13	37.7	0.22671	37.92671	60	-22.0733	34.5	0.22671	34.72671	50	-15.2733
11.254	36.8	0.190064	36.990064	60	-23.0099	35.3	0.190064	35.490064	50	-14.5099
0.337813	35.1	0.17	35.27	59.26	-23.99	28.1	0.17	28.27	49.26	-20.99
23.74	30.5	0.20658	30.70658	60	-29.2934	26.6	0.20658	26.80658	50	-23.1934

**Table 20. Conducted Emissions - Voltage, Neutral (120 VAC 60 Hz), 5.8 GHz, 5785**



**5.8 GHz, 5785, Phase Line Plot**



**5.8 GHz, 5785, Phase Line Plot**



**Photograph 2. Conducted Emission Test Setup**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209 Radiated Emissions - Spurious

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Note
13.36–13.41.			
Note: Above 38.6			

**Table 21. Restricted Bands of Operation from FCC Part 15, § 15.205**

**§ 15.205 (b):** (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**§ 15.35 (b):** ...When average radiated emission measurements are specified in this part, including emission measurements below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules...



Frequency (MHz)	Field Strength (Microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F (kHz)	300
0.490 – 1.705	24000/F (kHz)	30
1.705 – 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

\*\* Except as provided in 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 Part, e.g., Sections 15.231 and 15.241.

**Table 22. Radiated Emissions Limits from § 15.209 (a)**

**Test Procedure:**

For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10<sup>th</sup> harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

In accordance with §15.35 (b) the limit on the radio frequency emissions as measured using instrumentation with a peak detector function shall be 20 dB above the maximum permitted average limit for the frequency being investigated unless a different peak emission limit is otherwise specified in the rules.

For radiated Spurious emissions, the EUT was scanned from 1 GHz to 18 GHz for the 2.4 GHz radio, excluding the band 2.39 GHz to 2.4835 GHz, which was covered under Band Edge Emissions. For the 5.8 GHz band, the spectrum was investigated up to 40 GHz. In order to demonstrate compliance, measurements were taken in the form of peak plots shown with a peak and an average limit line. The plots were made at a 3m measurement distance and corrected for cable loss, and antenna correction factors, by the capture software. At each channel of interest, the EUT was rotated to maximize emissions.

Peak measurements, which exceeded the average limit line were re-measured using video averaging and plotted against an average limit line.

**Test Results:**

The EUT was compliant with the requirements of this section.

**Test Engineer(s):**

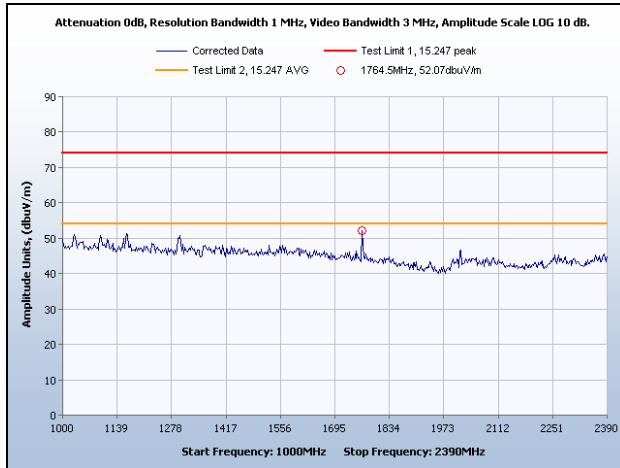
Dusmantha Tennakoon

**Test Date(s):**

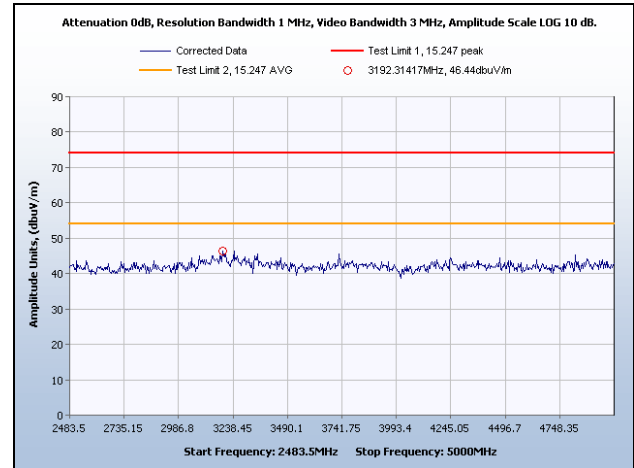
October 16-23, 2007



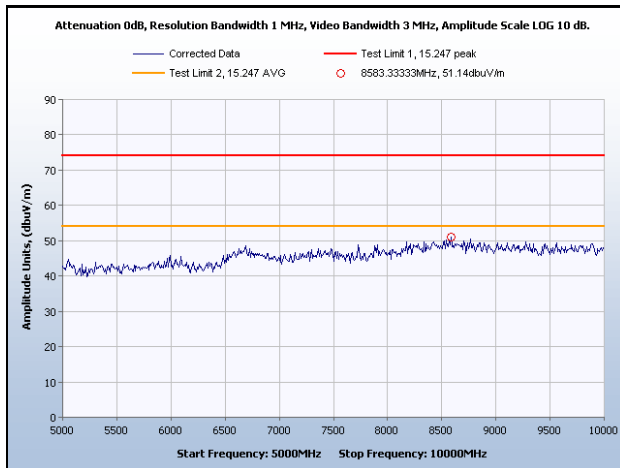
## 2.4 GHz Radio – 802.11b



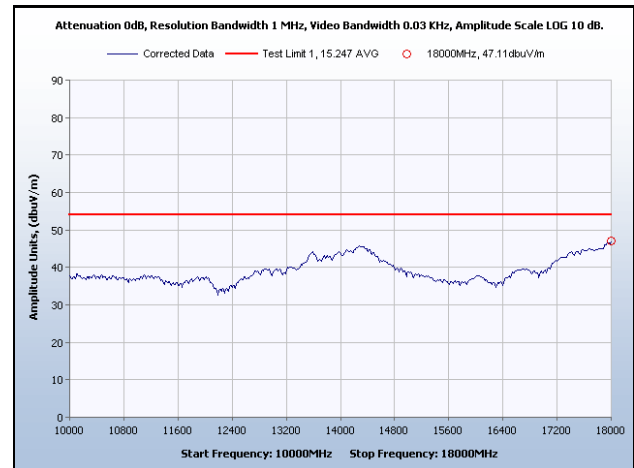
Spurious Radiated Emissions, 1 GHz to 2.39 GHz



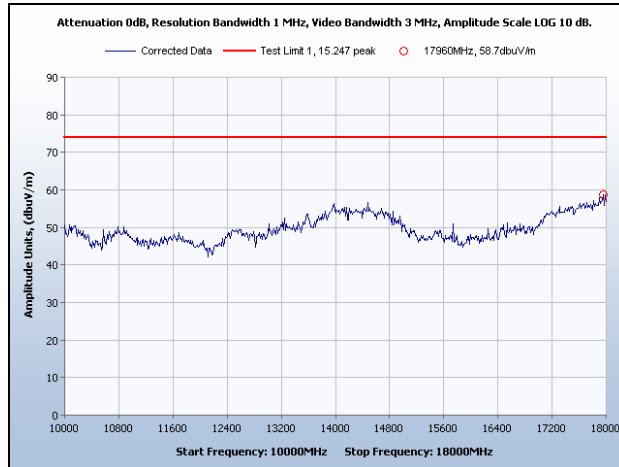
Spurious Radiated Emissions, 2.4835 GHz to 5 GHz



Spurious Radiated Emissions, 5 GHz to 10 GHz

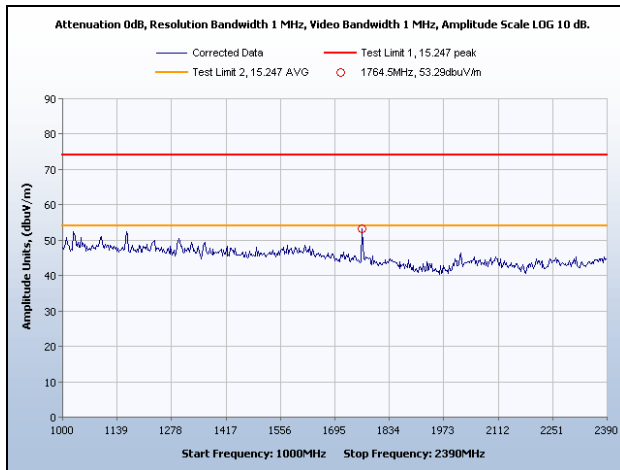


Spurious Radiated Emissions, 10 GHz to 18 GHz, Average

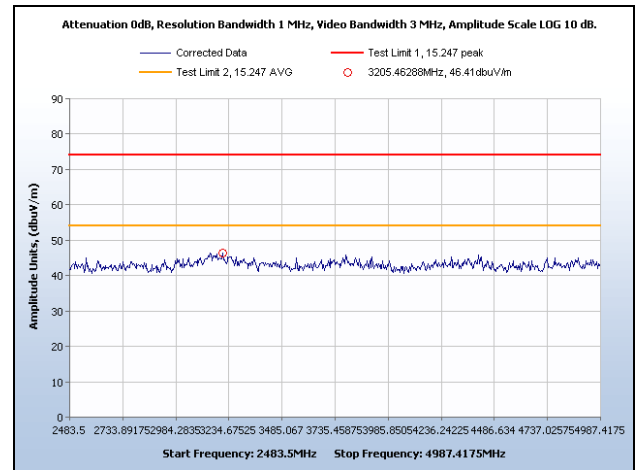


Spurious Radiated Emissions, 10 GHz to 18 GHz, Peak

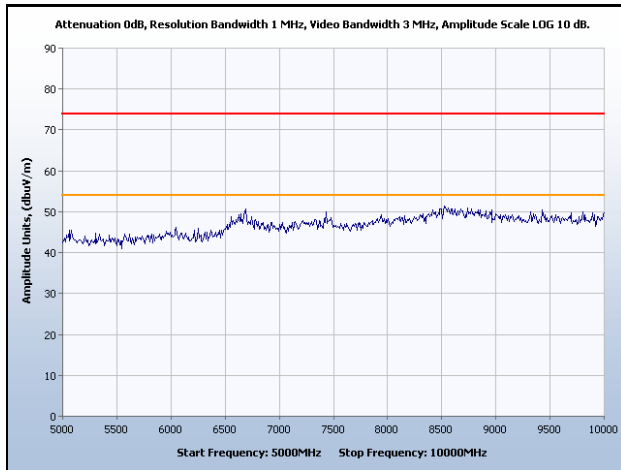
## 2.4 GHz Radio – 802.11g



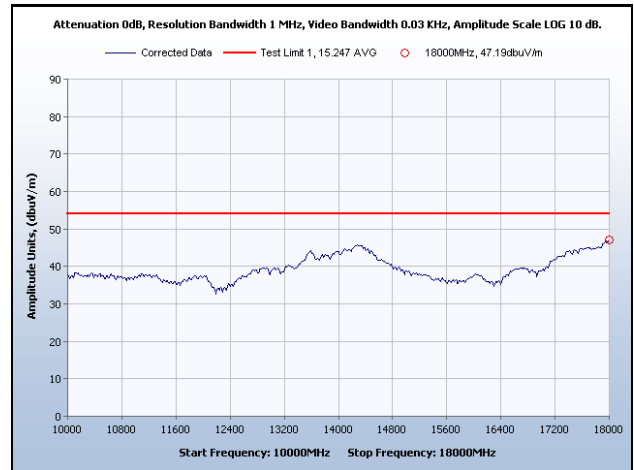
Spurious Radiated Emissions, 1 GHz to 2.39 GHz



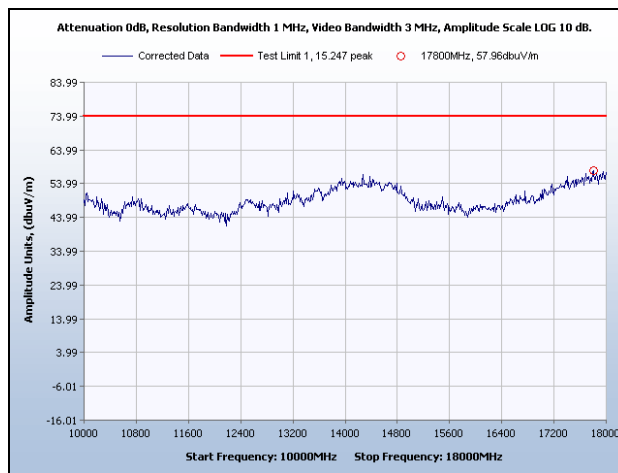
Spurious Radiated Emissions, 2.4835 GHz to 5 GHz



Spurious Radiated Emissions, 5 GHz to 10 GHz



Spurious Radiated Emissions, 10 GHz to 18 GHz, Average

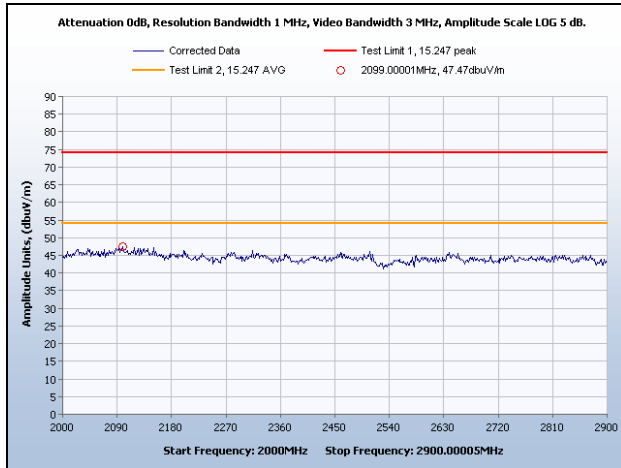


Spurious Radiated Emissions, 10 GHz to 18 GHz, Peak

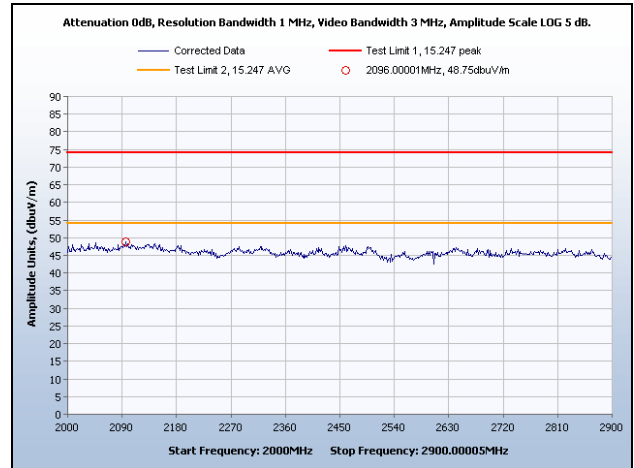




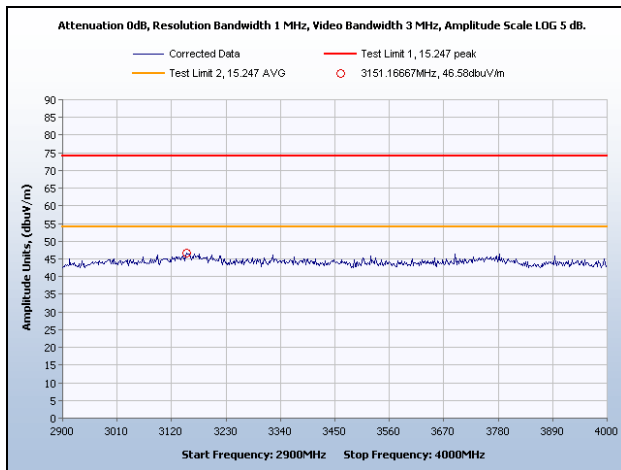
### 5.8 GHz Radio



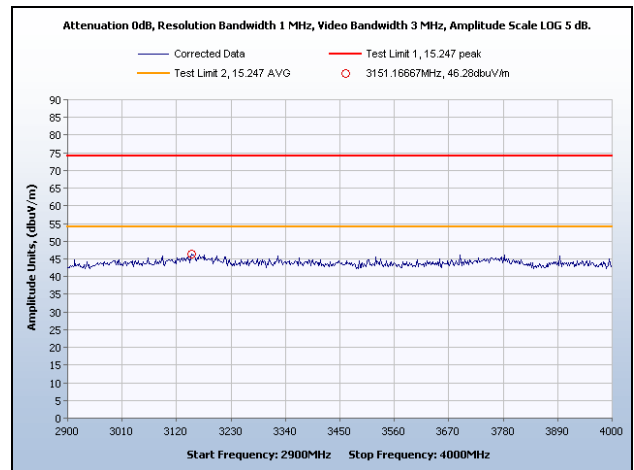
Spurious Radiated Emissions, 2 GHz to 2.9 GHz, Horizontal



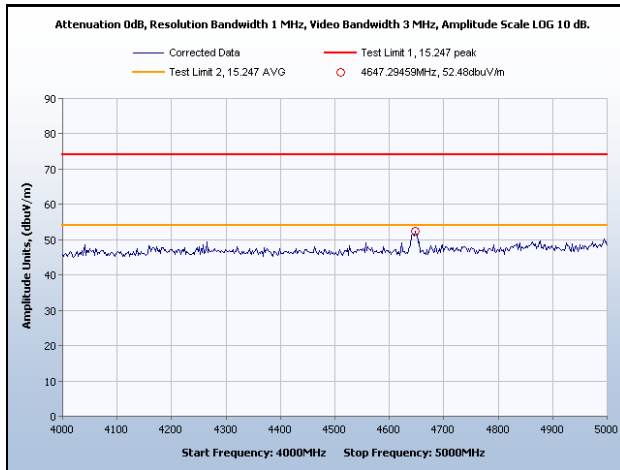
Spurious Radiated Emissions, 2 GHz to 2.9 GHz, Vertical



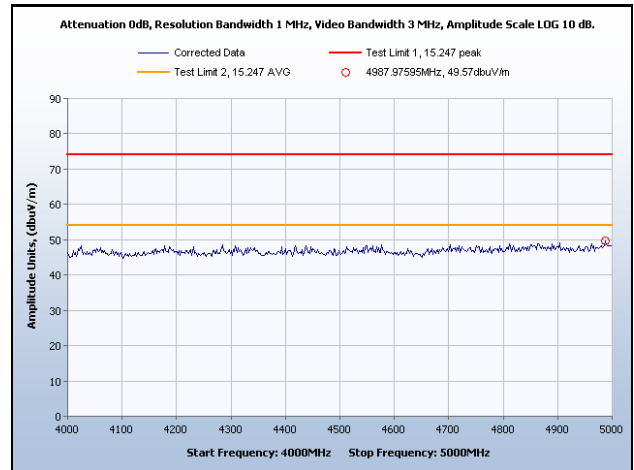
Spurious Radiated Emissions, 2.9 GHz to 4 GHz, Horizontal



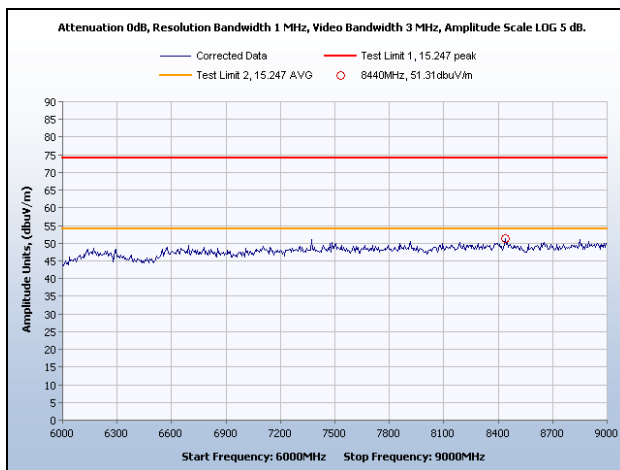
Spurious Radiated Emissions, 2.9 GHz to 4 GHz, Vertical



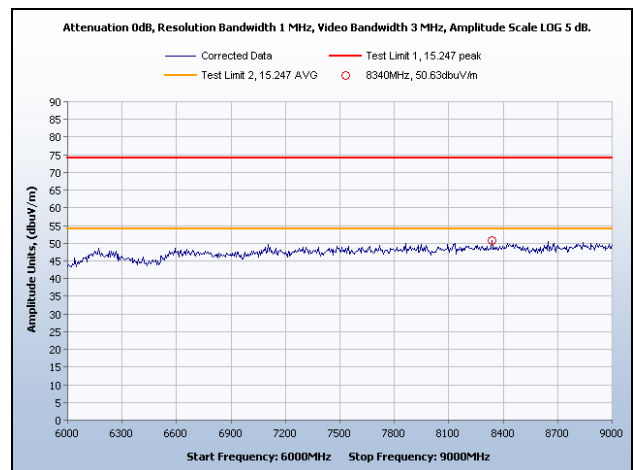
Spurious Radiated Emissions, 4 GHz to 5 GHz, Horizontal



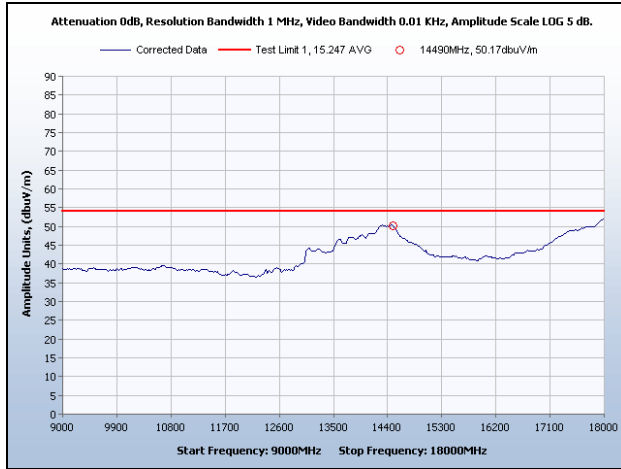
Spurious Radiated Emissions, 4 GHz to 5 GHz, Vertical



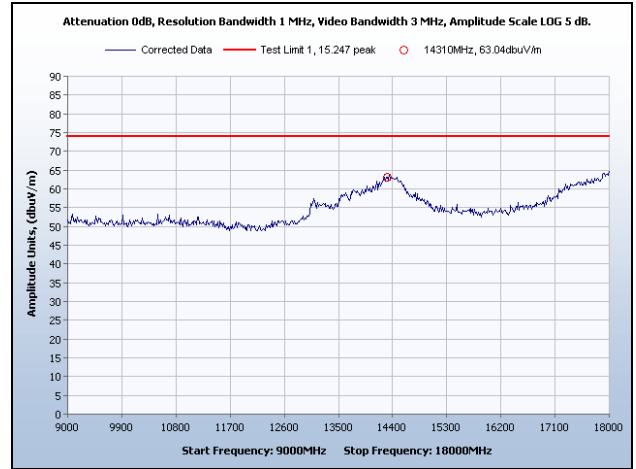
Spurious Radiated Emissions, 6 GHz to 9 GHz, Horizontal



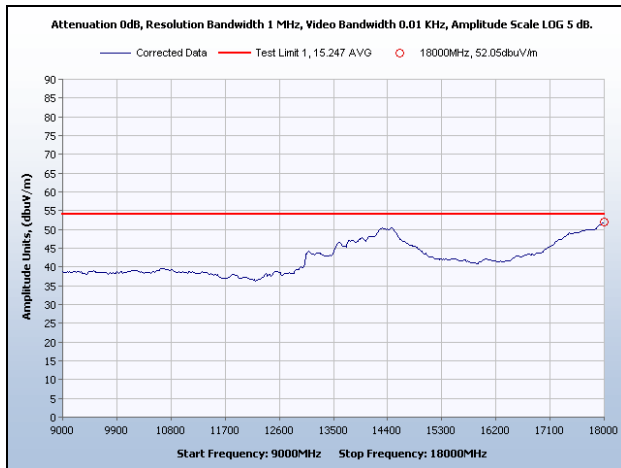
Spurious Radiated Emissions, 6 GHz to 9 GHz, Vertical



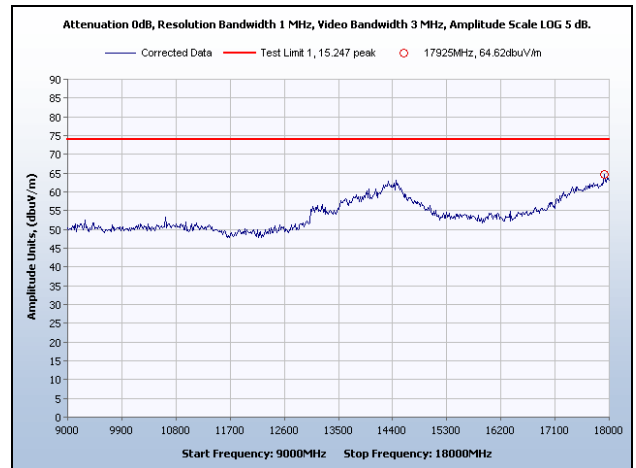
Spurious Radiated Emissions, 9 GHz to 18 GHz, Horizontal, Avg.



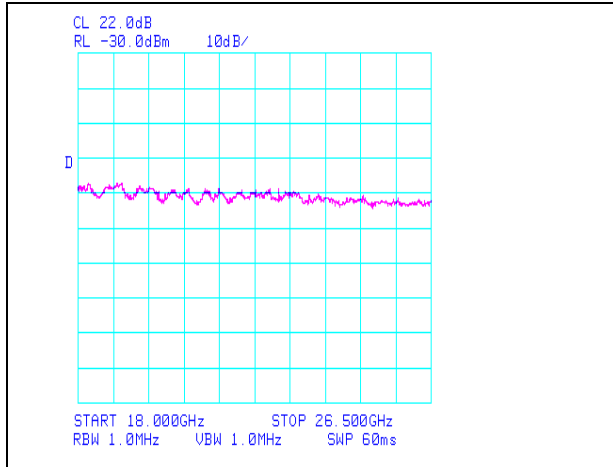
Spurious Radiated Emissions, 9 GHz to 18 GHz, Horizontal, Peak



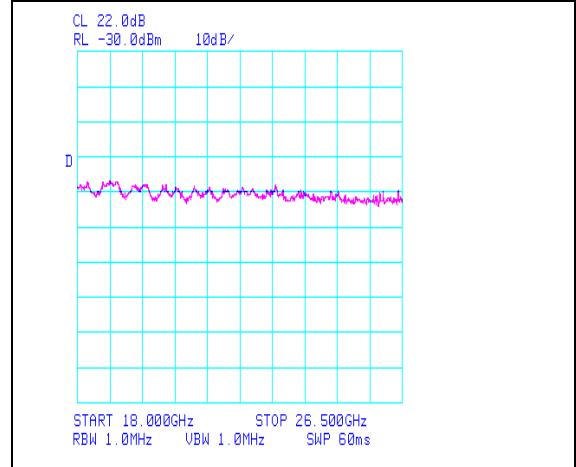
Spurious Radiated Emissions, 9 GHz to 18 GHz, Vertical, Avg.



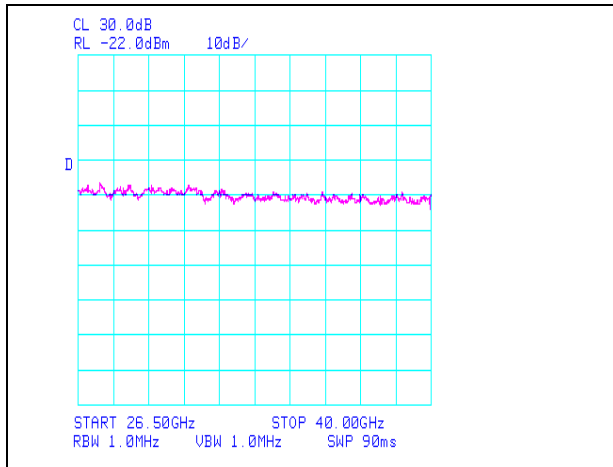
Spurious Radiated Emissions, 9 GHz to 18 GHz, Vertical, Peak



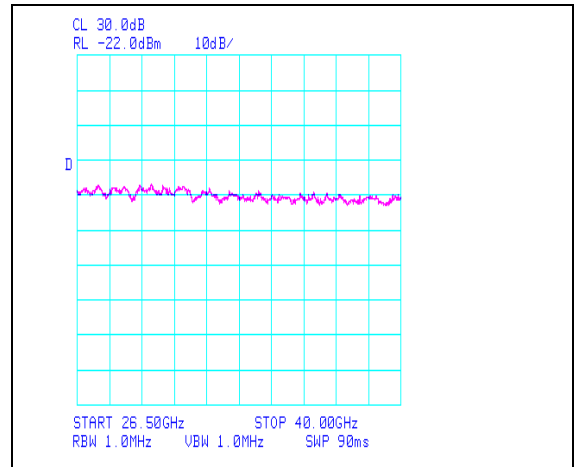
Spurious Radiated Emissions, 18 GHz to 26.5 GHz, Horizontal



Spurious Radiated Emissions, 18 GHz to 26.5 GHz, Vertical

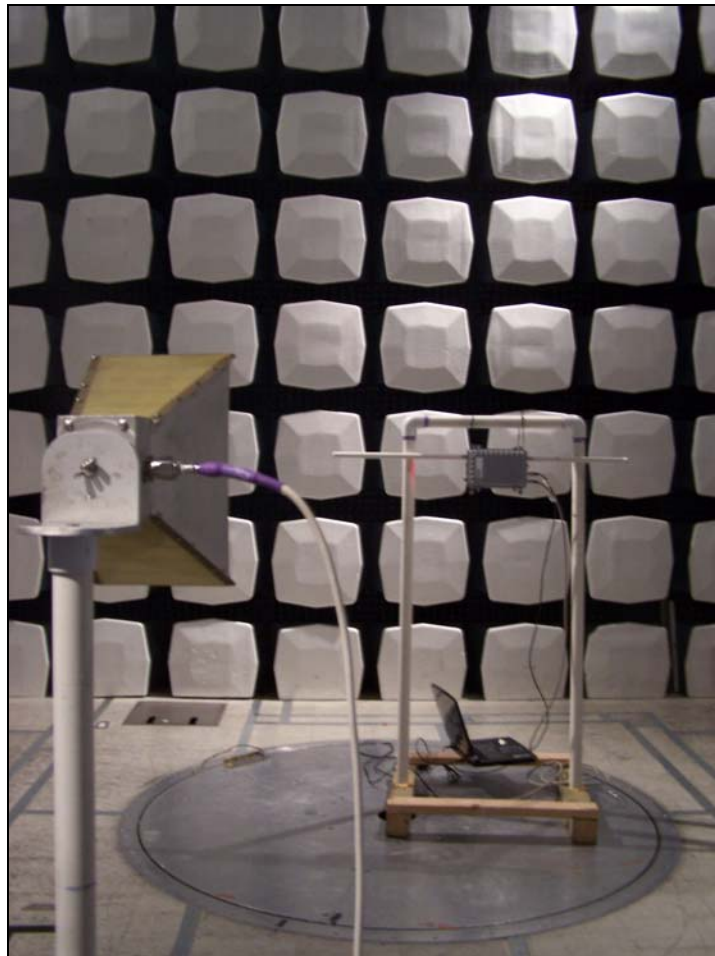


Spurious Radiated Emissions, 26.5 GHz to 40 GHz, Horizontal



Spurious Radiated Emissions, 26.5 GHz to 40 GHz, Vertical

Note: Only noise floor observed in the above four plots.



**Photograph 3. Radiated Emission Test Setup**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a) 6 dB a Bandwidth

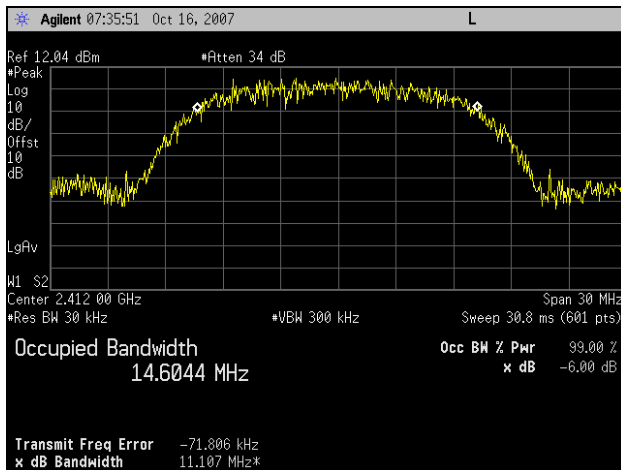
- Test Requirements:** § 15.247(a): Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:  
§ 15.247(a)(2): For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.
- Test Procedure:** The transmitter was set to the appropriate channels at the highest output power and connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured with the spectrum analyzer. The 6 dB Bandwidth was measured and recorded.
- Test Results:** Equipment complies with § 15.247 (a). The 6 dB Bandwidth was determined from the plots on the following pages.
- Test Engineer(s):** Dusmantha Tennakoon
- Test Date(s):** October 16-19, 2007



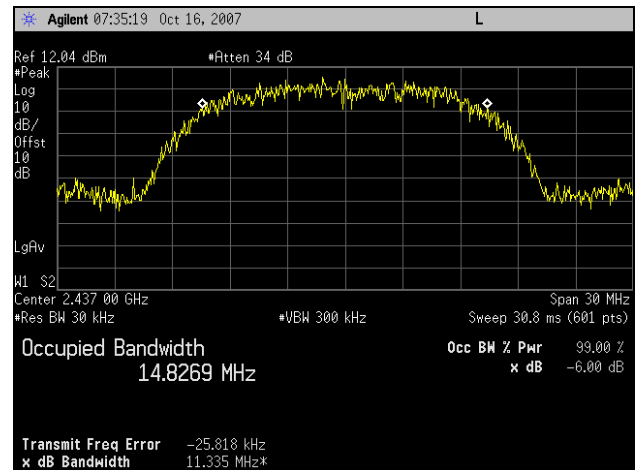
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a) 6 dB Bandwidth

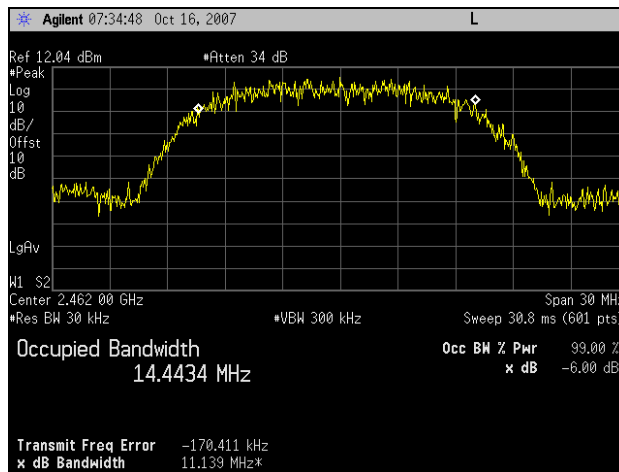
#### 2.4 GHz Radio – 802.11b



6 dB Occupied Bandwidth, 802.11b, 2412



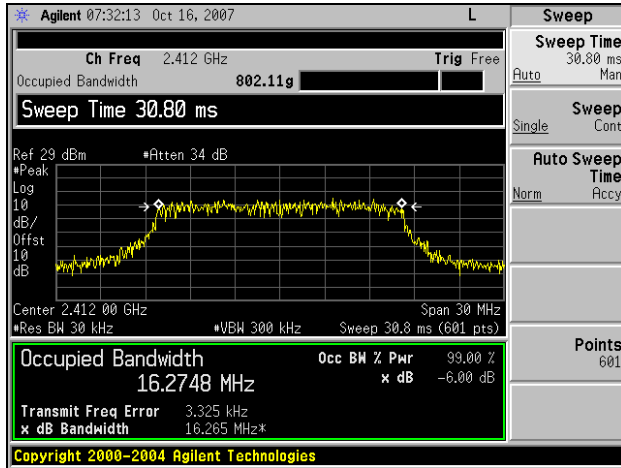
6 dB Occupied Bandwidth, 802.11b, 2437



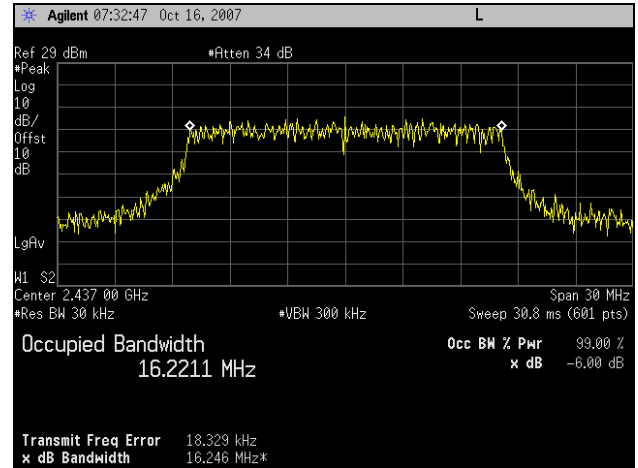
6 dB Occupied Bandwidth, 802.11b, 2462



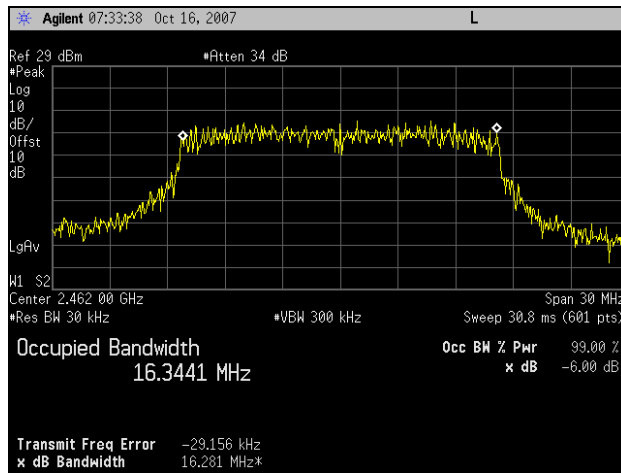
## 2.4 GHz Radio – 802.11g



6 dB Occupied Bandwidth, 802.11g, 2412



6 dB Occupied Bandwidth, 802.11g, 2437

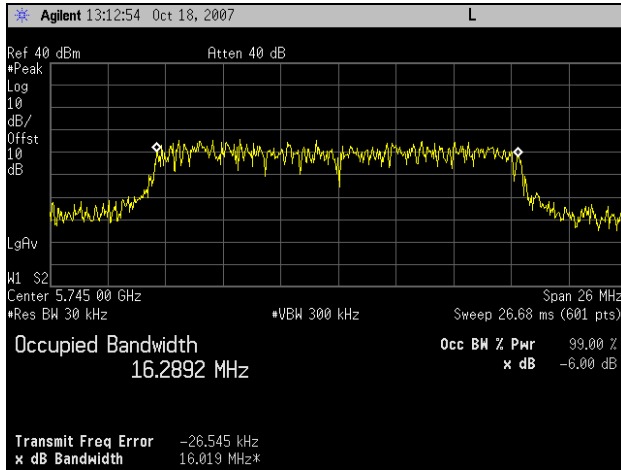


6 dB Occupied Bandwidth, 802.11g, 2462

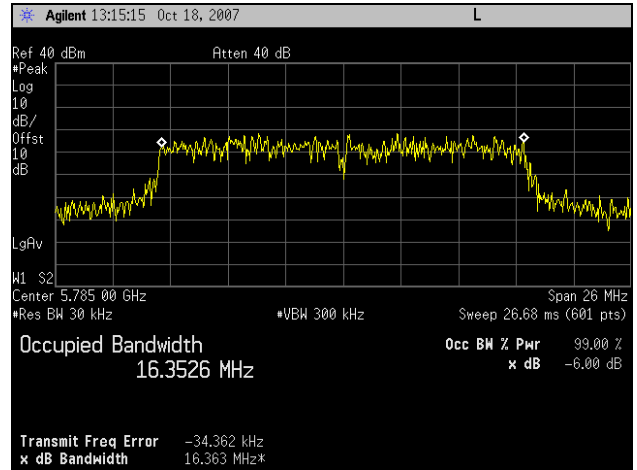




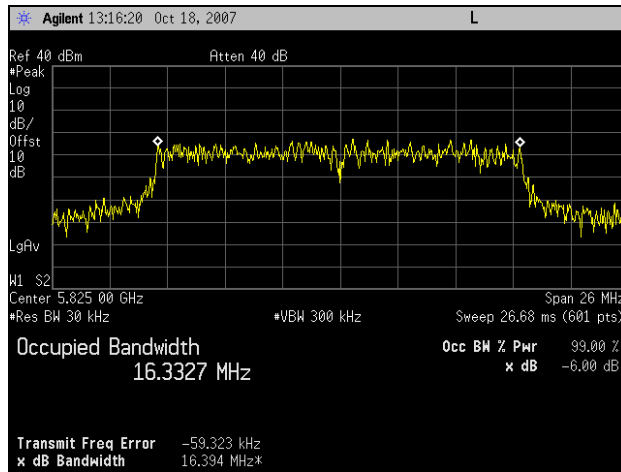
### 5.8 GHz Radio



6 dB Occupied Bandwidth, 5745



6 dB Occupied Bandwidth, 5785

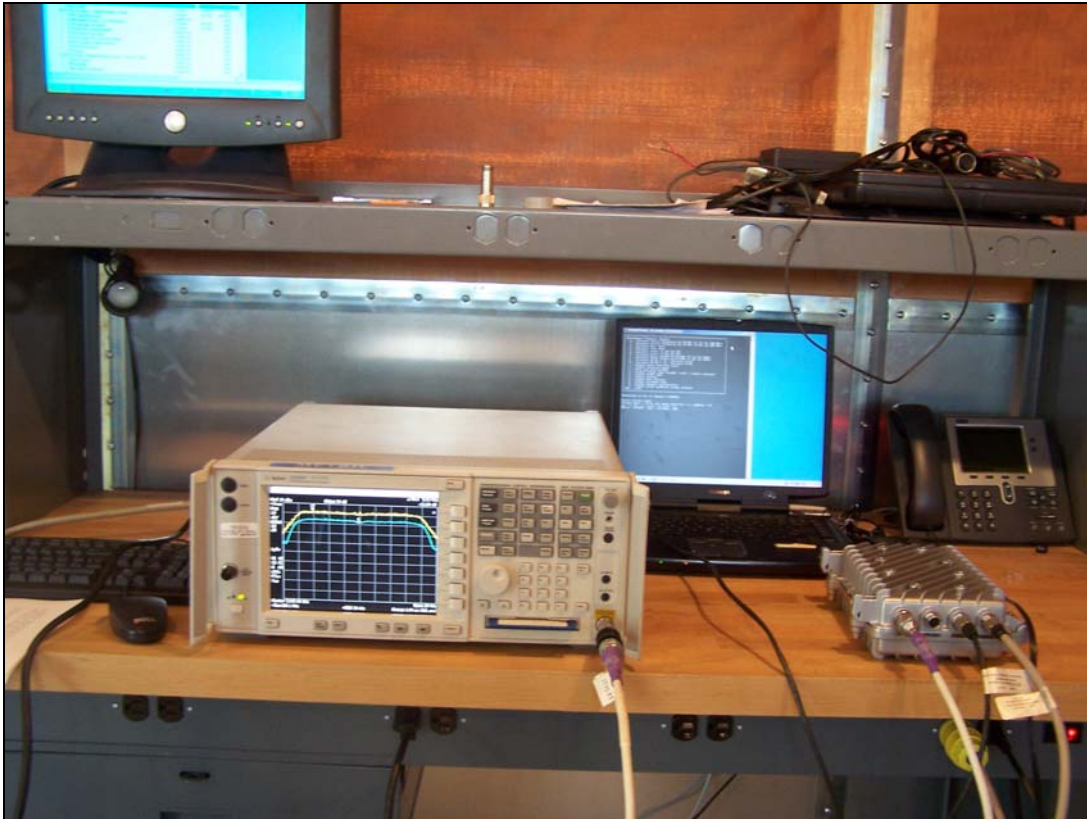


6 dB Occupied Bandwidth, 5825



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a) 6 dB Bandwidth



**Photograph 4. 6 dB Bandwidth Test Setup**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Peak Power Output

**Test Requirements:** §15.247(b): The maximum peak output power of the intentional radiator shall not exceed the following:

Digital Transmission Systems (MHz)	Output Limit (Watts)
902-928	1.000
2400-2483.5	1.000
5725- 5850	1.000

**Table 23. Output Power Requirements from §15.247**

§15.247(c): if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in the Table 23, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400 – 2483.5 MHz band may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Peak Power Output

**Test Procedure:** The transmitter was connected to a calibrated PSA Spectrum Analyzer. The EUT was measured at each channel.

**Test Results:** Equipment complies with the Peak Power Output limits of § 15.247(b).

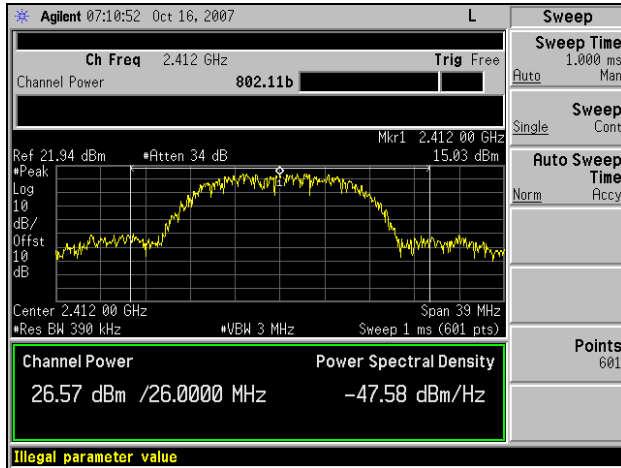
Mode	Frequency (GHz)	Max Antenna Gain (dBi)	Conducted Power (dBm)	Limit (dBm)
802.11b	2.412	8	26.57	28
	2.437	8	26.62	28
	2.462	8	26.66	28
802.11g	2.412	8	24.23	28
	2.437	8	26.62	28
	2.462	8	24.63	28
802.11a	5.745	10	25.88	26
	5.785	10	25.76	26
	5.825	10	25.85	26

**Test Engineer(s):** Dusmantha Tennakoon

**Test Date(s):** October 16-19, 2007



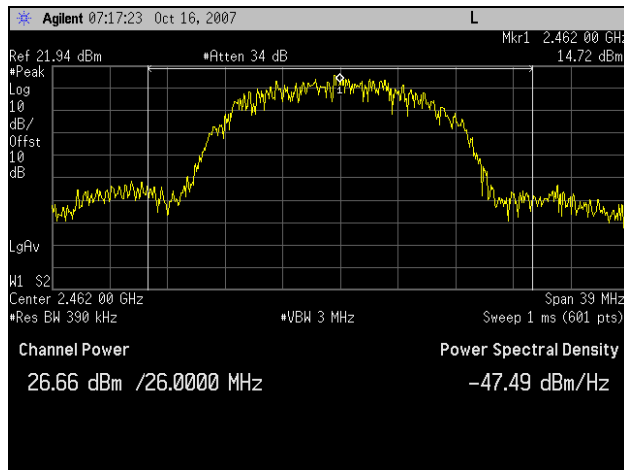
### 2.4 GHz Radio – 802.11b



Output Power, 802.11b, 2412



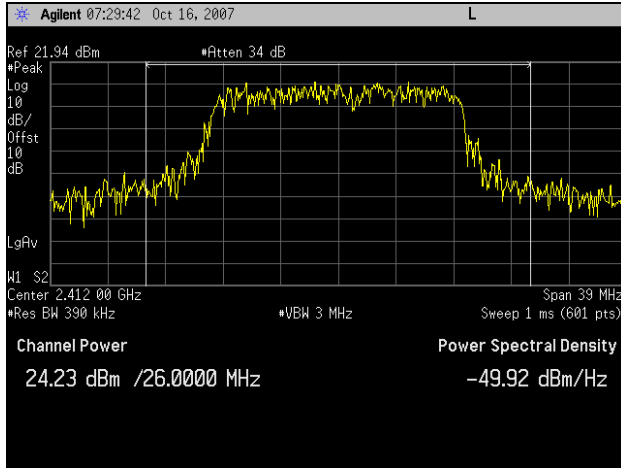
Output Power, 802.11b, 2437



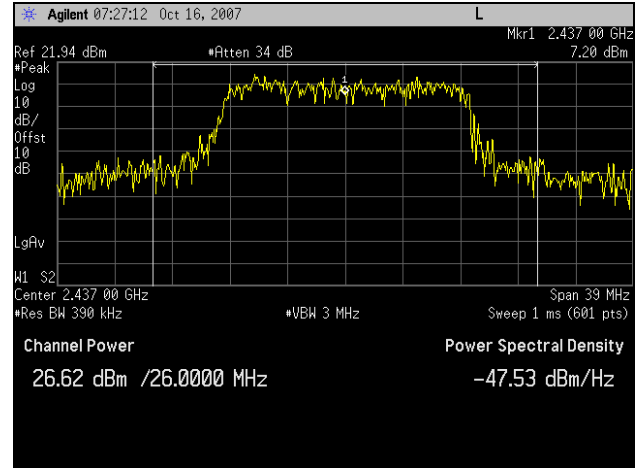
Output Power, 802.11b, 2462



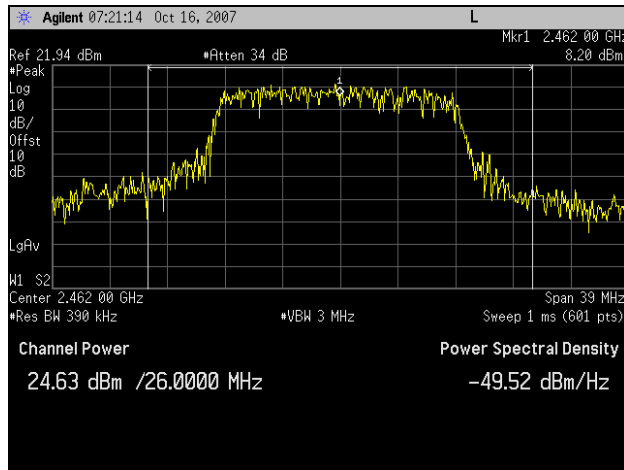
## 2.4 GHz Radio – 802.11g



Output Power, 802.11g, 2412



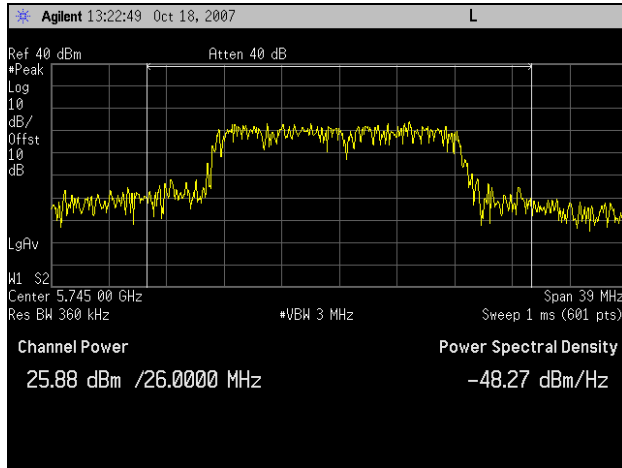
Output Power, 802.11g, 2437



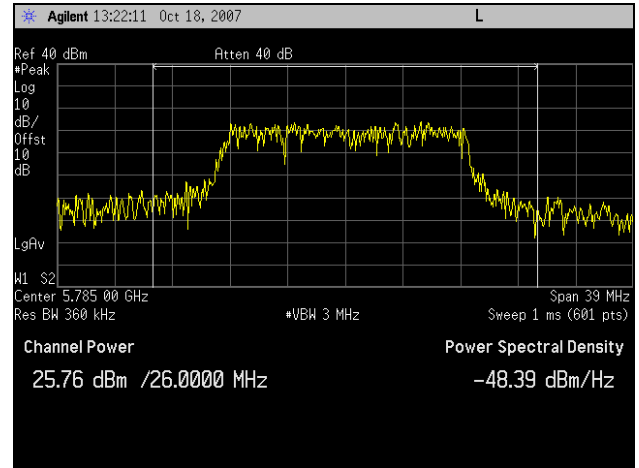
Output Power, 802.11g, 2462



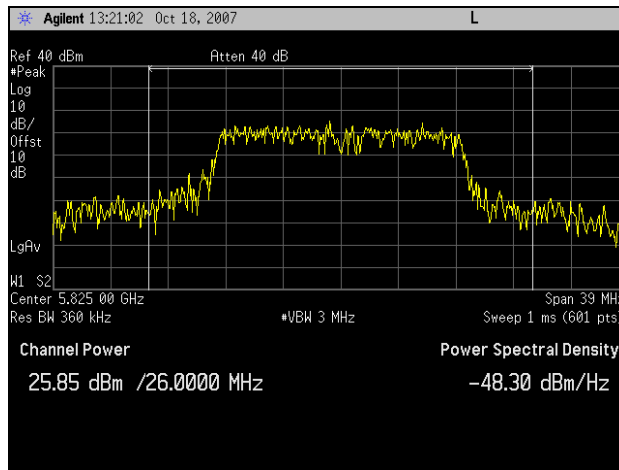
### 5.8 GHz Radio



Output Power, 5745



Output Power, 5785

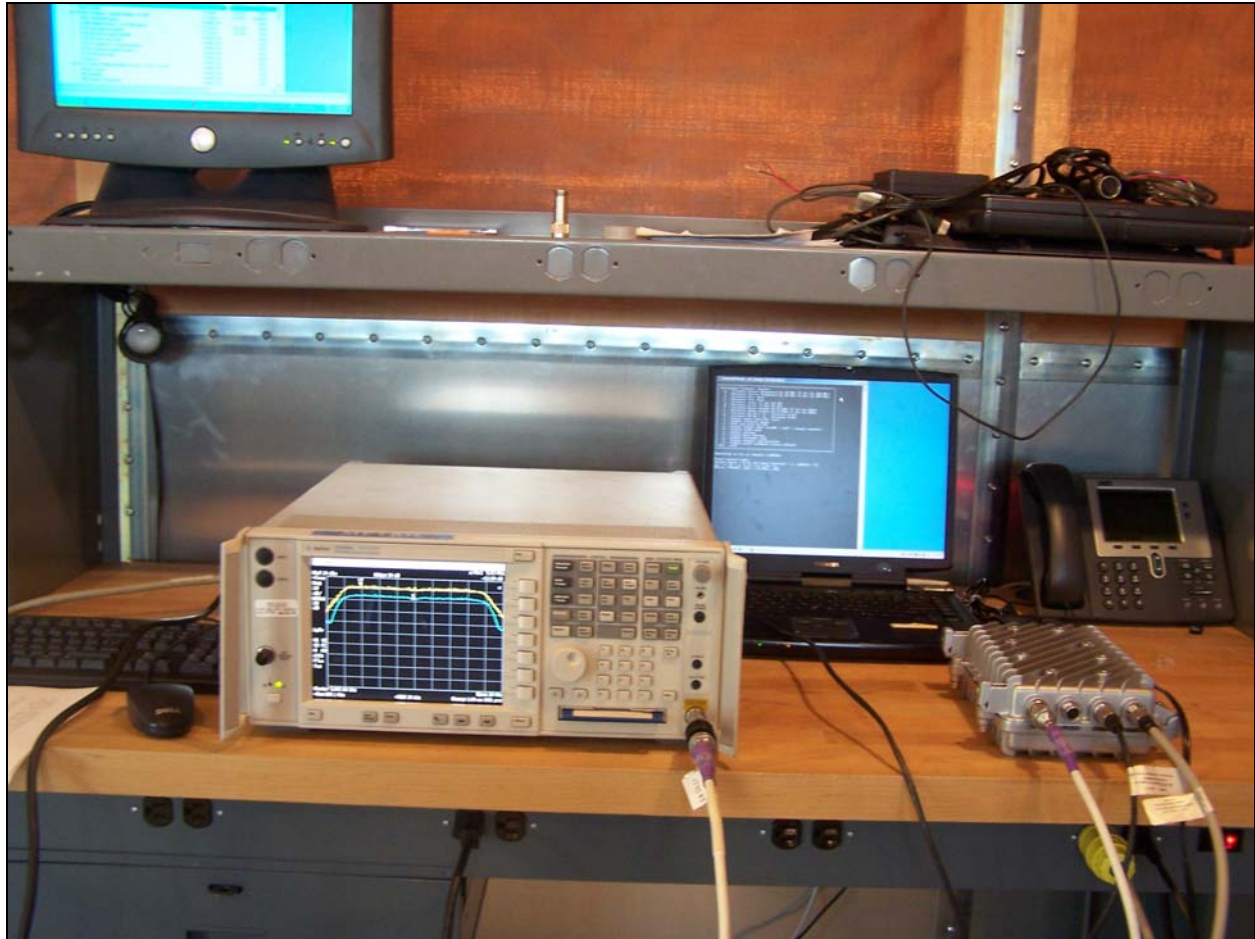


Output Power, 5825



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Peak Power Output



Photograph 5. Peak Power Output, Test Setup





## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) RF Exposure

**RF Exposure Requirements:** §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.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (minutes)
<b>(A) Limits for Occupational/Control Exposures</b>				
30-300	61.4	0.163	1.0	6
300-1,500	--	--	F/300	6
1,500-100,000	--	--	5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
30-300	27.5	0.073	0.2	30
300-1,500	--	--	F/1,500	30
1,500-100,000	--	--	1.0	30

**Table 24. Limits for Maximum Permissible Exposure**

Note: F=Frequency in MHz

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

$$S = PG / 4\pi R^2$$

where,

S = Power Density mW/m<sup>2</sup>

P = Power Input to antenna mili Watts

G = Numeric Antenna Gain

R = Distance to the center of radiation of the antenna (20 cm for Mobile minimum

distance)



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) RF Exposure

**Test Procedures:** Antenna substitution was used, in order to find the maximum EIRP. The methods of TIA/EIA 603 were used. From the EIRP, the power density was calculated.

**Test Results:**

**For 2.4 Unit:**

MPE Limit Calculation: EUT's operating frequencies @ 2412-2462 MHz; highest conducted power = 26.66 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm<sup>2</sup>**.

EUT maximum antenna gain = 8 dBi.

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

$$S = PG / 4\pi R^2$$

where, S = Power Density mW/m<sup>2</sup>  
P = Power Input to antenna mili Watts  
G = Numeric Antenna Gain  
R = Distance to the center of radiation of the antenna (20 cm for Mobile minimum distance)

$$\text{Antenna Numeric Gain} = 10^{\text{dBi}/10}$$

$$\text{Power at antenna port} = 464.5 \text{ mW}$$

$$\text{Antenna Gain} = 8 \text{ dBi}$$

$$\text{Numeric antenna gain} = 10^{8/10} = 6.31$$

$$S = (464.5)(6.31) / 4(3.1416)(20)^2$$

$$S = 0.583 \text{ mW/cm}^2$$

Therefore, EUT meets the Uncontrolled Exposure limit.



**For 5.8 Unit:**

MPE Limit Calculation: EUT's operating frequencies @ 5745-5825 MHz; highest conducted power = 25.88 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm<sup>2</sup>**.

EUT maximum antenna gain = 10 dBi.

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

$$S = PG / 4\pi R^2$$

where, S = Power Density mW/m<sup>2</sup>  
P = Power Input to antenna mili Watts  
G = Numeric Antenna Gain  
R = Distance to the center of radiation of the antenna (20 cm for Mobile minimum distance)

$$\text{Antenna Numeric Gain} = 10^{\text{dBi}/10}$$

Power at antenna port = 388.2 mW

Antenna Gain = 10dBi

$$\text{Numeric antenna gain} = 10^{10/10} = 10$$

$$S = (388.2)(10) / 4(3.1416)(20)^2$$

$$S = 0.772 \text{ mW/cm}^2$$

Therefore, EUT meets the Uncontrolled Exposure limit.

**Test Engineer(s):** Dusmantha Tennakoon

**Test Date(s):** October 19, 2007



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(d) Spurious Emissions – RF Conducted

**Test Requirements:** §15.247(d): In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

**Test Procedure:** The EUT was configured with the control software to transmit at maximum power. The transmit output was connected to the analyzer through an attenuator.  $RBW = 100 \text{ kHz}$ ,  $VBW \geq RBW$ .

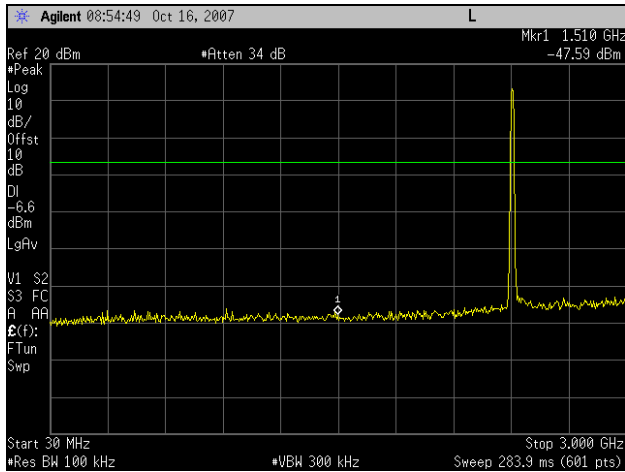
**Test Results:** The EUT was compliant with the requirements of this section.

**Test Engineer(s):** Dusmantha Tennakoon

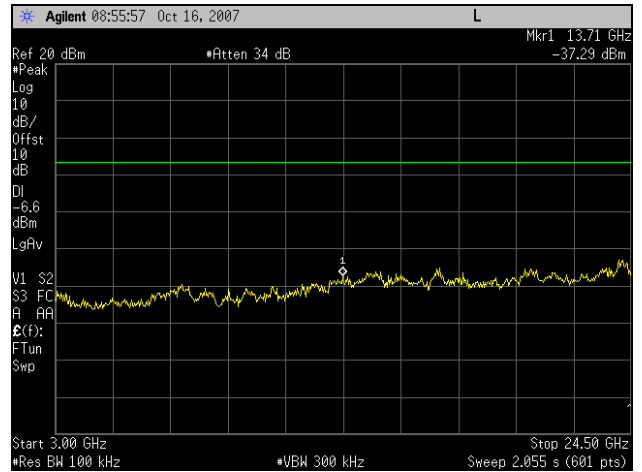
**Test Date(s):** October 16-19, 2007



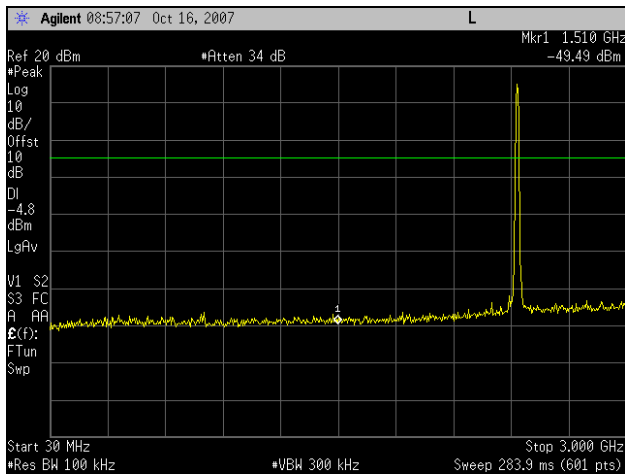
## 2.4 GHz Radio – 802.11b



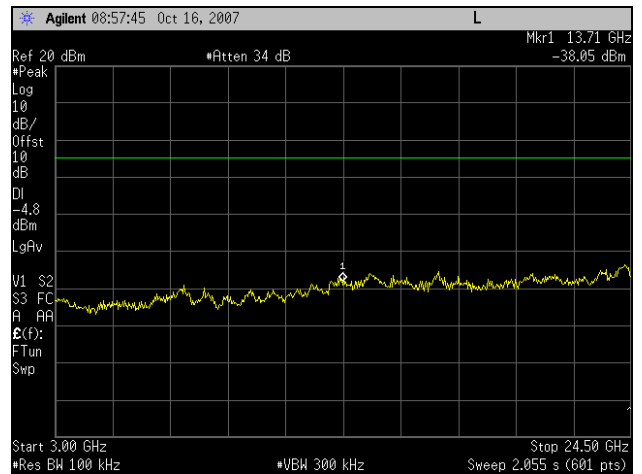
RF Conducted Spurious Emissions, 2412, 30 MHz to 3 GHz



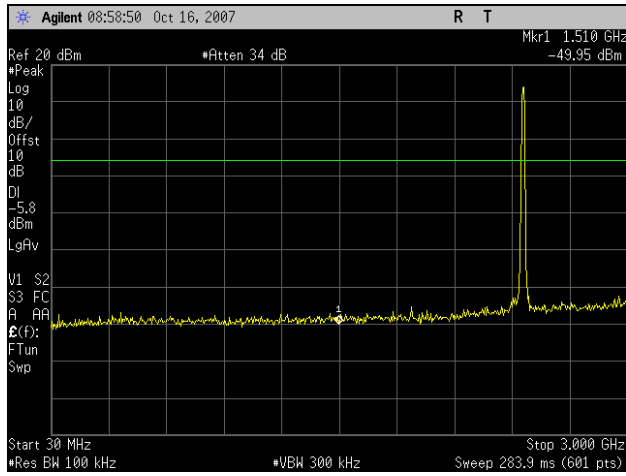
RF Conducted Spurious Emissions, 2412, 3 GHz to 24.5 GHz



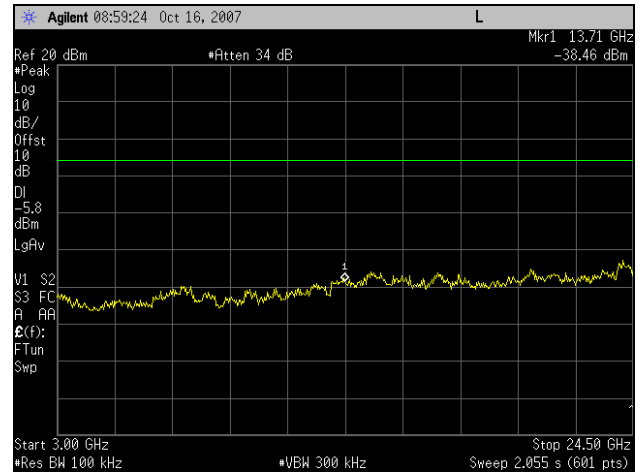
RF Conducted Spurious Emissions, 2437, 30 MHz to 3 GHz



RF Conducted Spurious Emissions, 2437, 3 GHz to 24.5 GHz



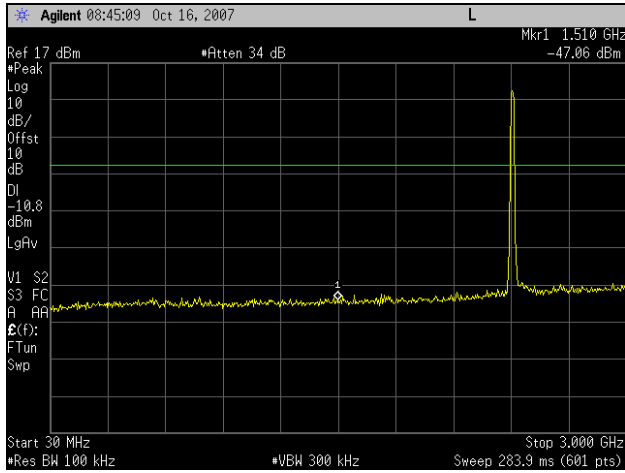
RF Conducted Spurious Emissions, 2462, 30 MHz to 3 GHz



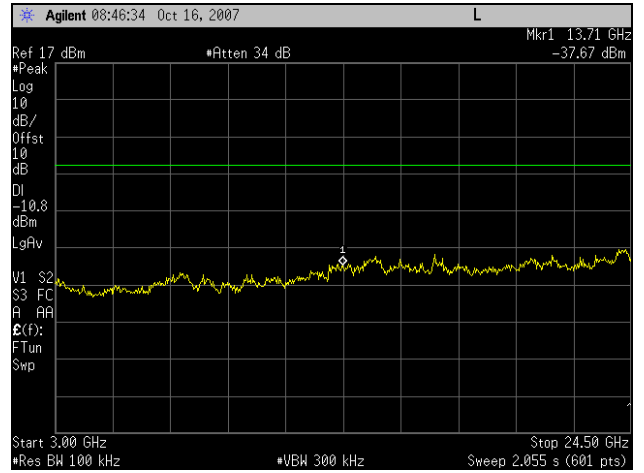
RF Conducted Spurious Emissions, 2462, 3 GHz to 24.5 GHz



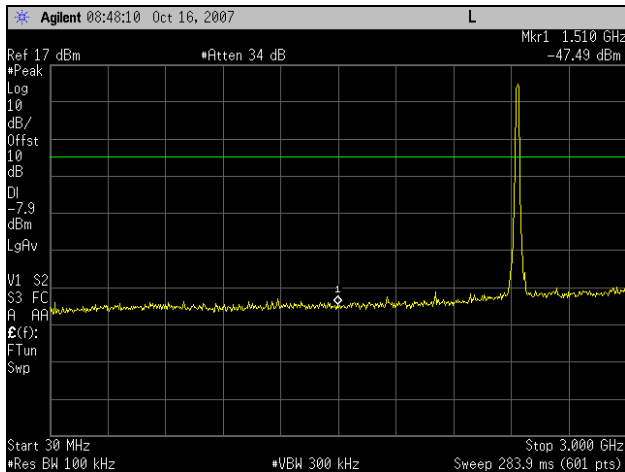
### 2.4 GHz Radio – 802.11g



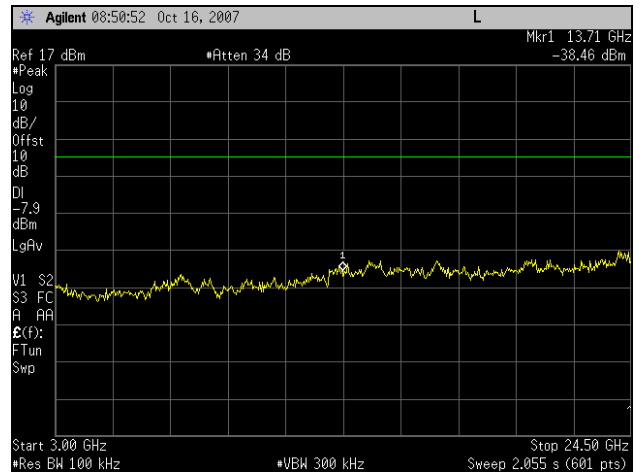
RF Conducted Spurious Emissions, 2412, 30 MHz to 3 GHz



RF Conducted Spurious Emissions, 2412, 3 GHz to 24.5 GHz



RF Conducted Spurious Emissions, 2437, 30 MHz to 3 GHz

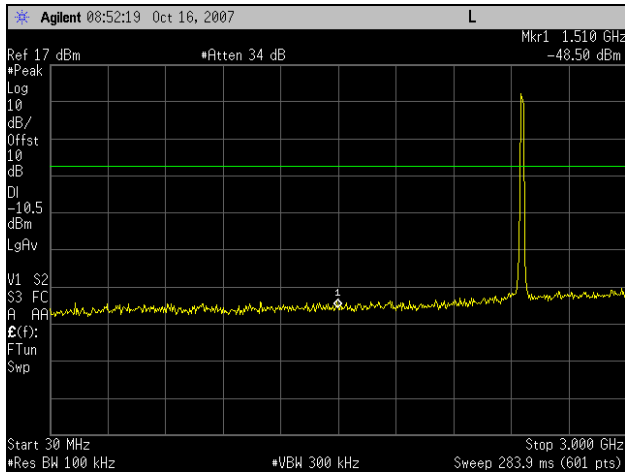


RF Conducted Spurious Emissions, 2437, 3 GHz to 24.5 GHz

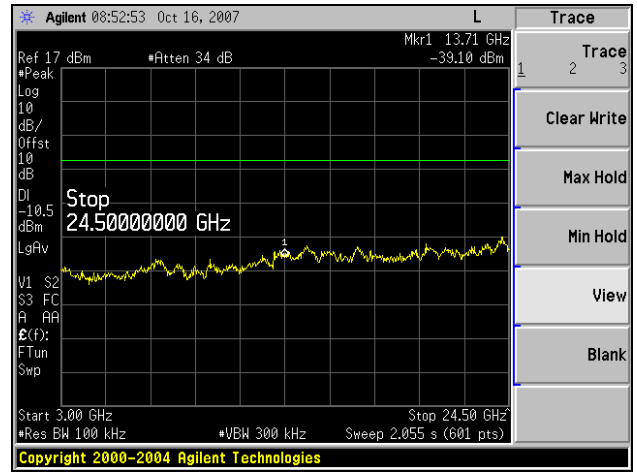


Motorola, Inc.  
MOTOMESH DUE 4300-58 AC/DC (2.4/5.8 GHz 802.11b/g/a)

Electromagnetic Compatibility  
Criteria for Intentional Radiators  
CFR Title 47, Part 15, Subpart C



RF Conducted Spurious Emissions, 2462, 30 MHz to 3 GHz

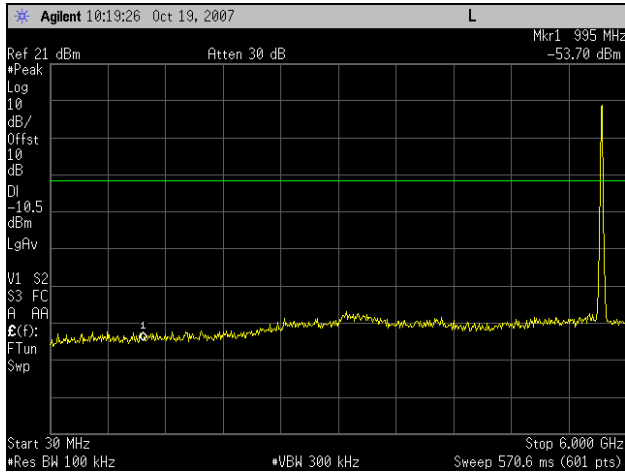


RF Conducted Spurious Emissions, 2462, 3 GHz to 24.5 GHz

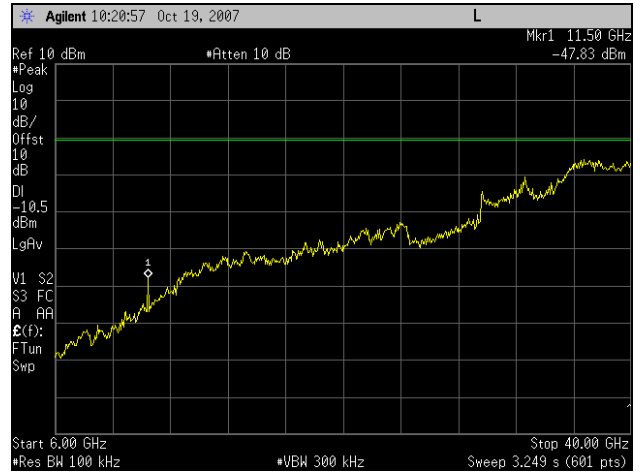




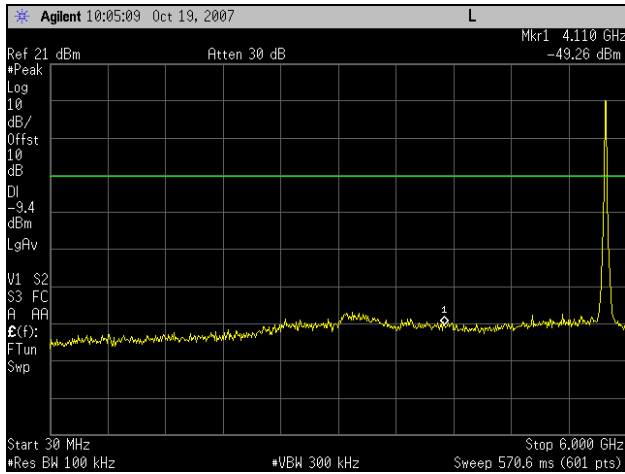
### 5.8 GHz Radio



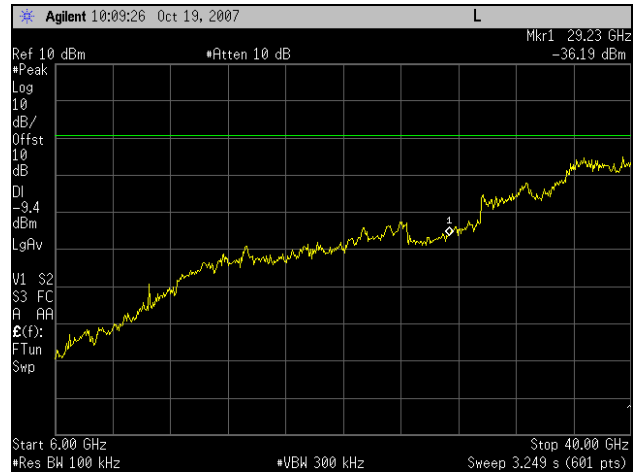
RF Conducted Spurious Emissions, 5745, 30 MHz to 6 GHz



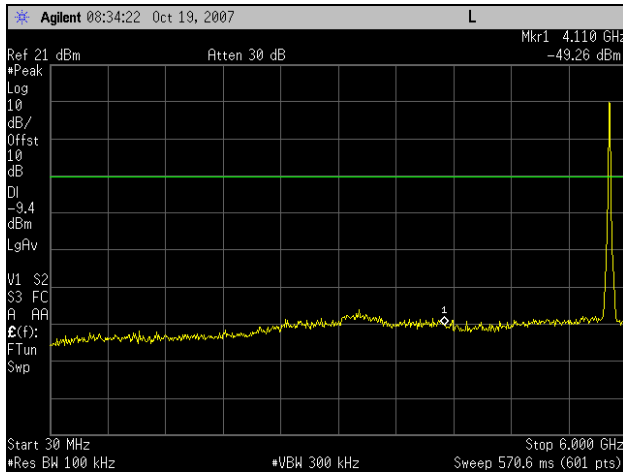
RF Conducted Spurious Emissions, 5745, 6 GHz to 40 GHz



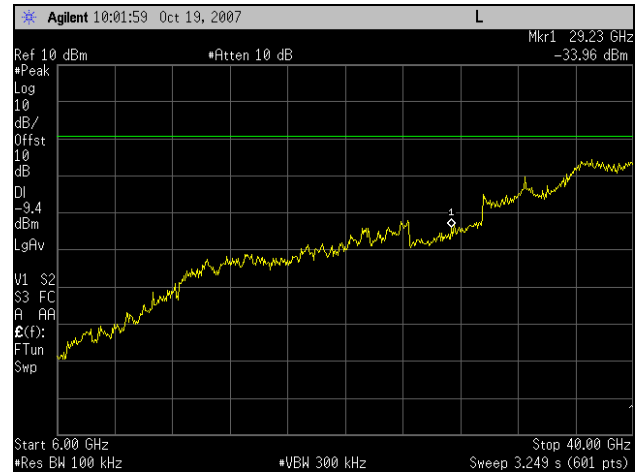
RF Conducted Spurious Emissions, 5785, 30 MHz to 6 GHz



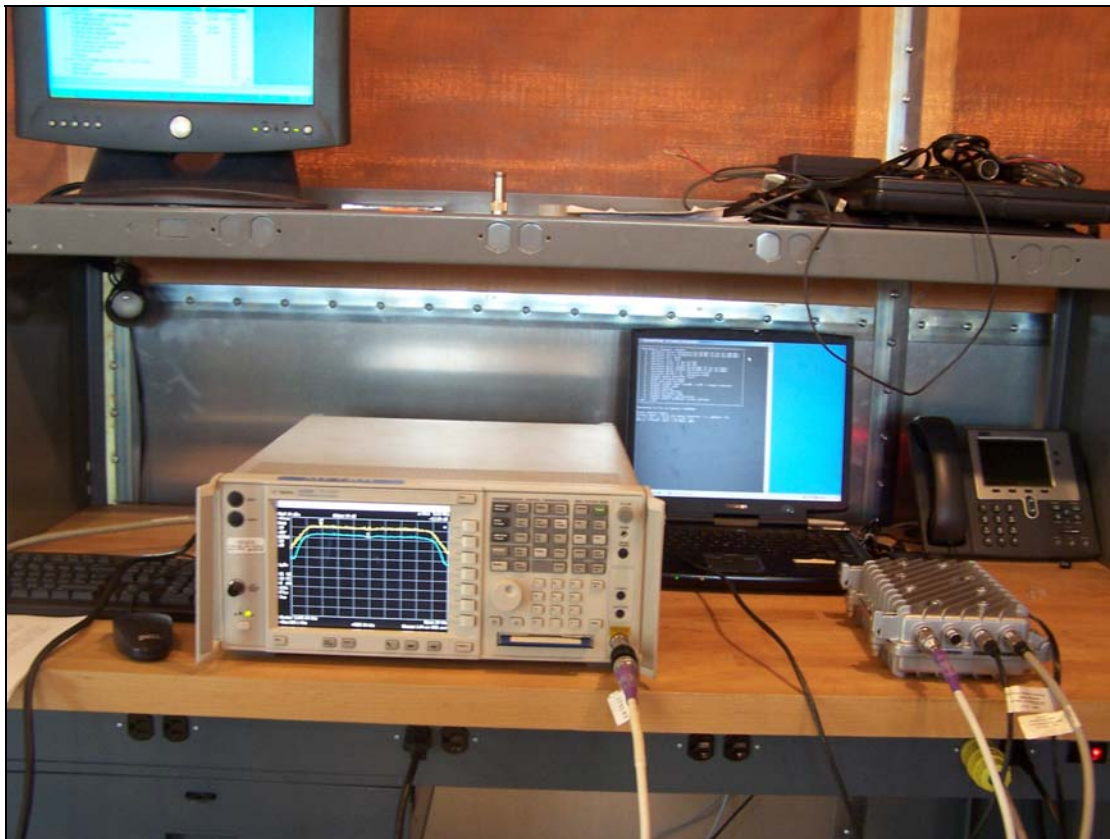
RF Conducted Spurious Emissions, 5785, 6 GHz to 40 GHz



RF Conducted Spurious Emissions, 5825, 30 MHz to 6 GHz



RF Conducted Spurious Emissions, 5825, 6 GHz to 40 GHz



Photograph 6. Spurious Conducted Emissions, Test Setup



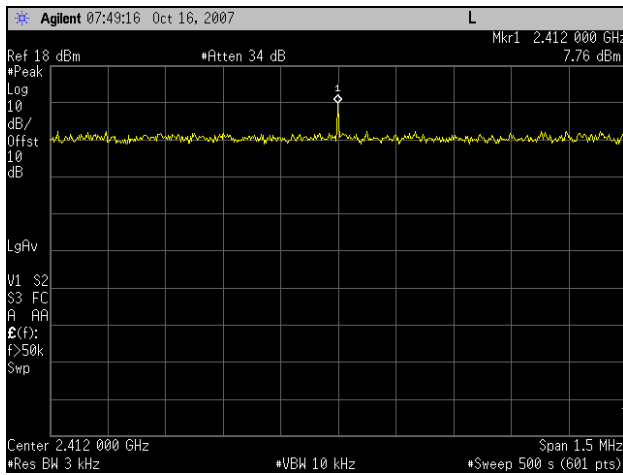
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(e) Peak Power Spectral Density

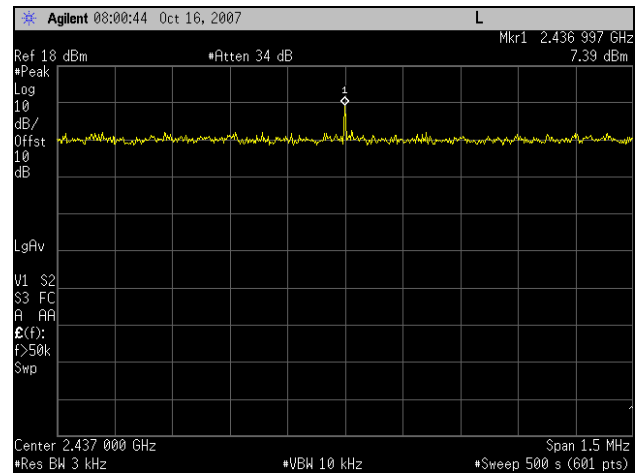
- Test Requirements:** §15.247(e): For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.
- Test Procedure:** The transmitter was connected directly to a Spectrum Analyzer. The power level was set to the maximum level.  
RBW = 3 kHz, VBW>RBW  
Sweep = Span/ 3 kHz
- Test Results:** Equipment complies with the peak power spectral density limits of § 15.247 (e). The peak power spectral density was determined from plots on the following page(s).
- Test Engineer(s):** Dusmantha Tennakoon
- Test Date(s):** October 16-19, 2007



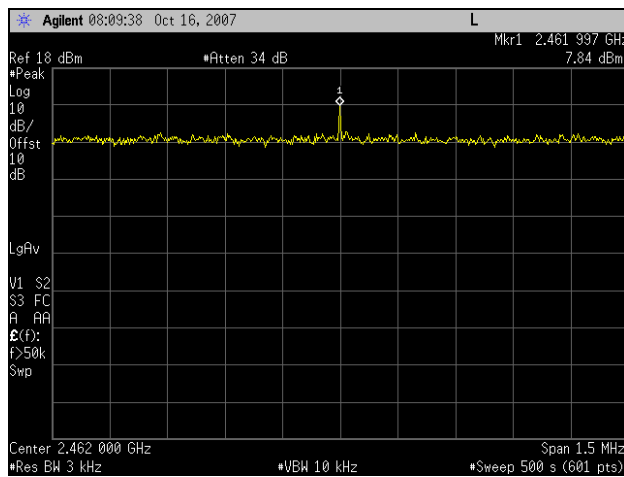
### 2.4 GHz Radio – 802.11b



Peak Power Spectral Density, 802.11b, 2412



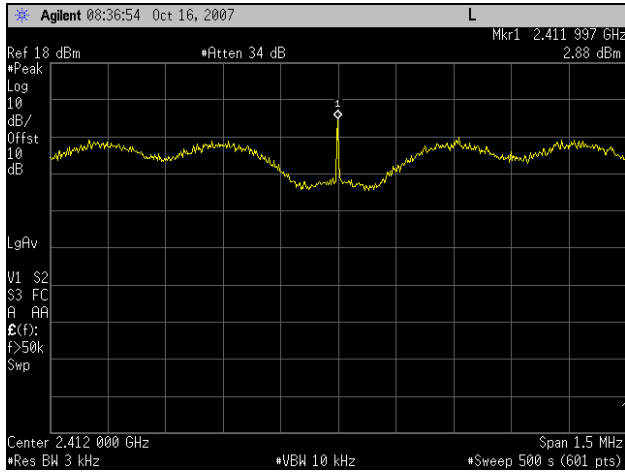
Peak Power Spectral Density, 802.11b, 2437



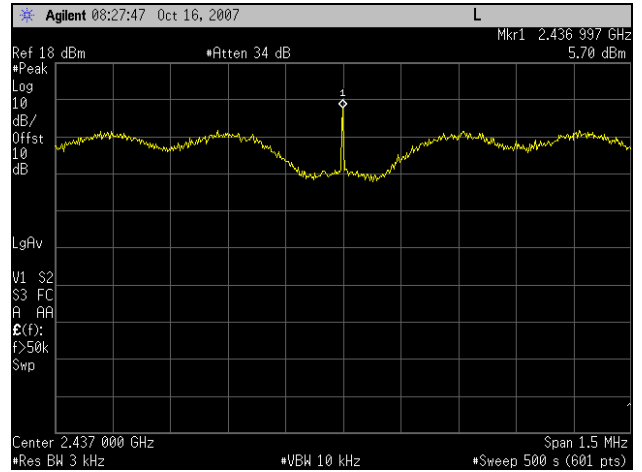
Peak Power Spectral Density, 802.11b, 2462



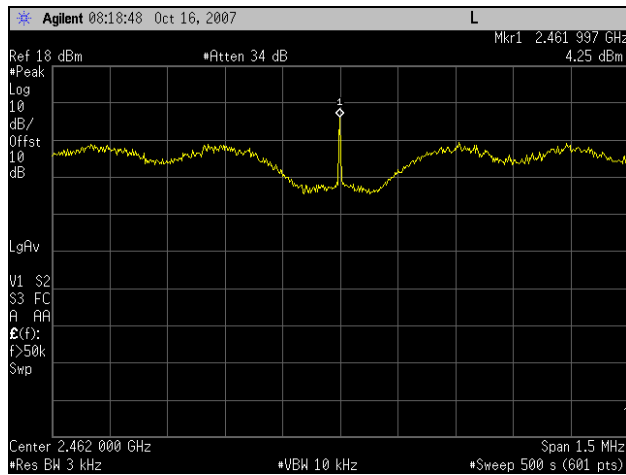
## 2.4 GHz Radio – 802.11g



Peak Power Spectral Density, 802.11g, 2412



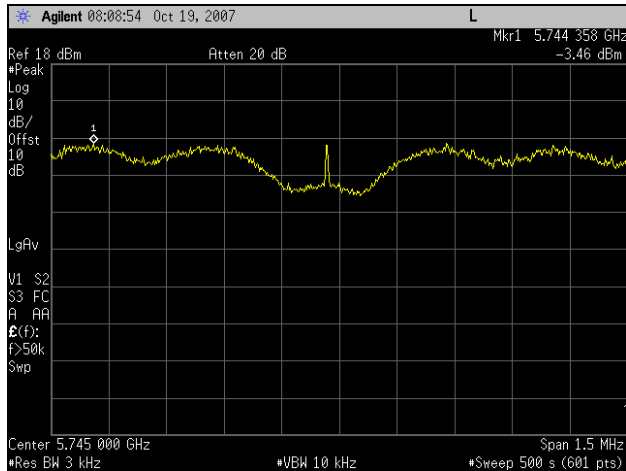
Peak Power Spectral Density, 802.11g, 2437



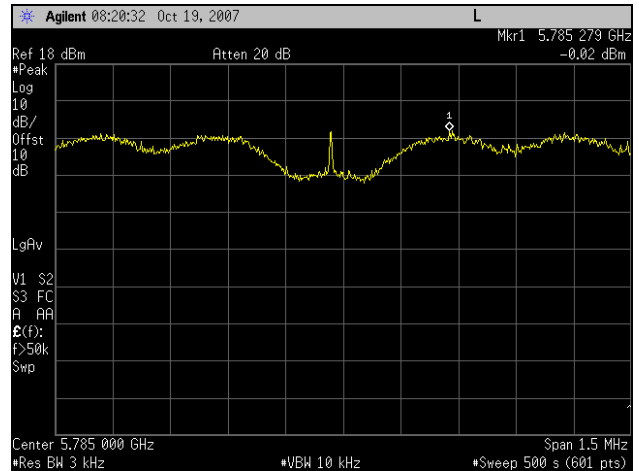
Peak Power Spectral Density, 802.11g, 2462



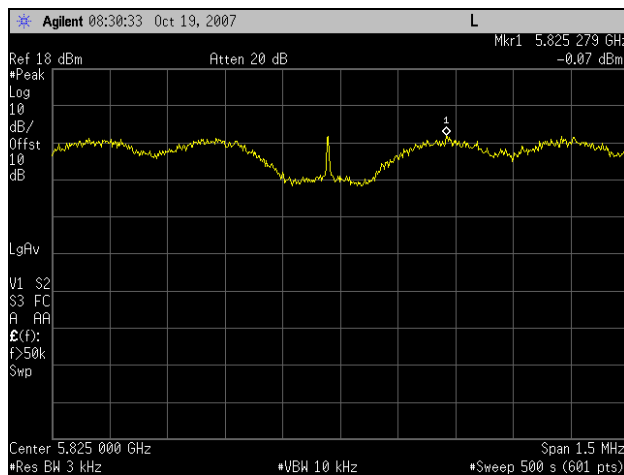
### 5.8 GHz Radio



**Peak Power Spectral Density, 5745**



**Peak Power Spectral Density, 5785**

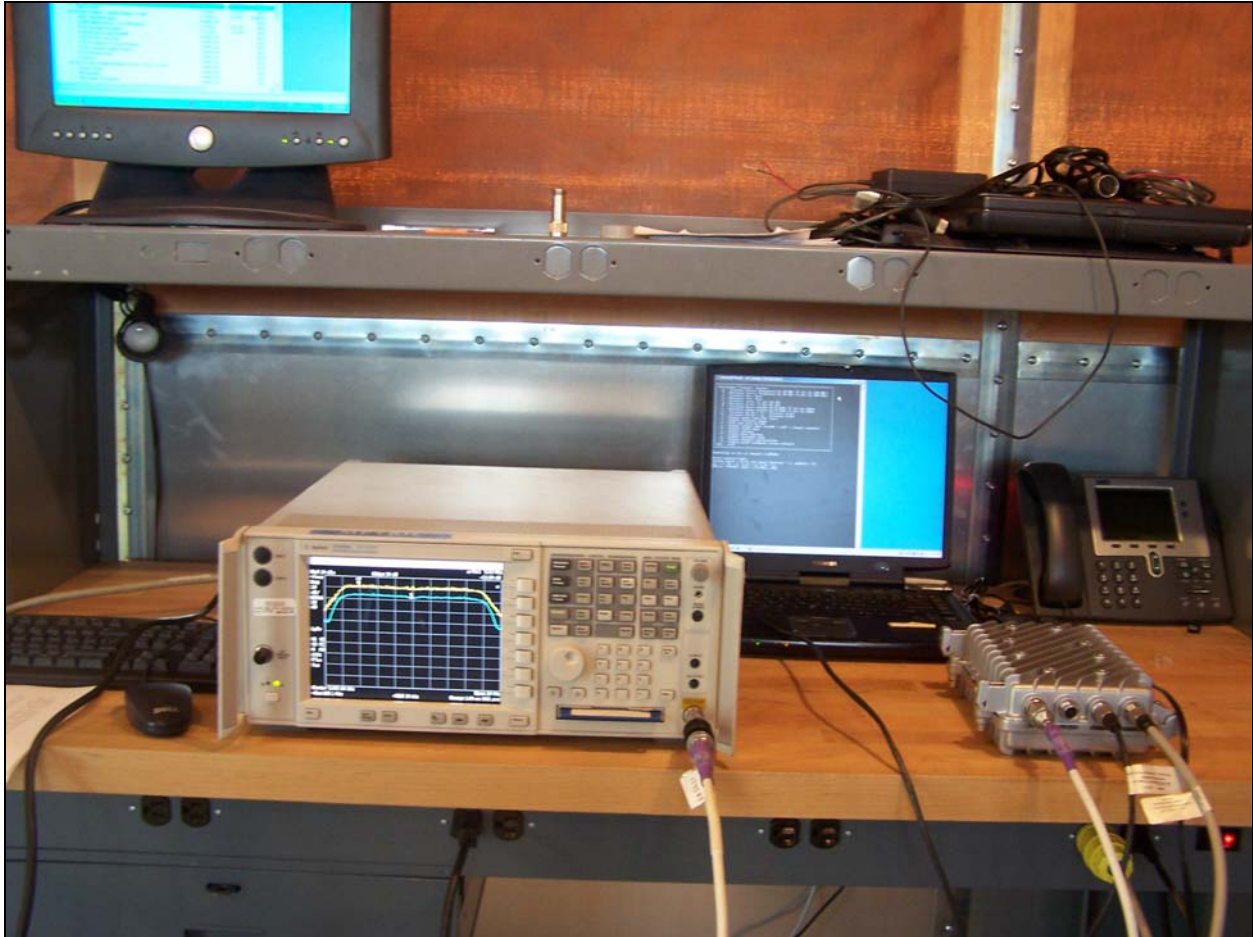


**Peak Power Spectral Density, 5825**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(e) Peak Power Spectral Density



Photograph 7. Peak Power Spectral Density Test Setup



## IV. Test Equipment





## 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.

Test Name: Conducted Emissions					
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4382	SHIELD ROOM 6	FIL-SHIELD	N/A	01/29/2007	01/29/2008
1T4302	EMI RECEIVER	HEWLETT PACKARD	85462A	11/20/2006	11/20/2007
1T4565	LISN (24 AMP)	SOLAR ELECTRONICS	9252-50-R-24-BNC	09/10/2007	09/10/2008
1T4554	THERMO-HYGROMETER	CONTROL COMPANY	56-627-9	04/11/2006	04/11/2008
Test Name: Radiated Emissions					
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T2665	ANTENNA; HORN	EMCO	3115	04/17/2007	04/17/2008
1T4300	SEMI-ANECHOIC CHAMBER # 1	EMC TEST SYSTEMS	NONE	02/17/2006	01/17/2009
1T4414	MICROWAVE PRE-AMPLIFIER	AH SYSTEMS	PAM-0118	SEE NOTE	
S/N:US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008
1T4155	HARMONIC MIXER 26.5 TO 40 GHZ	HEWLETT PACKARD	11970A	SEE NOTE	
1T4323	HARMONIC MIXER 18 TO 26.5 GHZ	HEWLETT PACKARD	11970K	SEE NOTE	
1T4288	SPECTRUM ANALYZER	HP	8563A	07/05/2007	07/05/2008
1T4409	EMI RECEIVER	ROHDE & SCHWARTZ	ESIB7	04/24/2007	04/24/2008
1T4592	RF FILTER KIT	VARIOUS	N/A	SEE NOTE	
Test Name: 6 dB Bandwidth					
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
S/N:US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008
Test Name: Peak Power Output					
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4583	10 DB ATTENUATOR	INMET	18N10W-10	SEE NOTE	
S/N:US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008
Test Name: Conducted Spurious Emissions					
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
S/N:US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008
1T4583	10 DB ATTENUATOR	INMET	18N10W-10	SEE NOTE	
Test Name: Peak Power Spectral Density					
MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T4583	10 DB ATTENUATOR	INMET	18N10W-10	SEE NOTE	
S/N:US42070103	PSA	AGILENT	E4448A	02/20/2007	02/20/2008

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



## **V. Certification & User's Manual Information**



## Certification & User's Manual 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.



## Certification & User's Manual Information

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.<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.

### § 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.

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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.



## Certification & User's Manual Information

### § 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.



## Certification & User's Manual Information

### 5.2 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.



## Verification & User's Manual Information

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 A 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 A 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.