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## **Electromagnetic Compatibility Criteria Test Report**

for the

**Power Monitors, Inc.  
Eagle Class PQ Wireless Recorder, Model 440**

**Verified under**  
the FCC Certification Rules  
contained in  
Title 47 of the CFR, Part 15, Subpart C  
for Intentional Radiators

**MET Report: EMCS14669-FCC247**

December 18, 2003

### **Prepared For:**

**Power Monitors, Inc.  
1661 Virginia Avenue  
Harrisonburg, Virginia 22802**

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



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Title 47 of the CFR, Part 15, Subpart C  
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A handwritten signature in blue ink that appears to read "Alvin Ilarina".

Alvin Ilarina  
Electromagnetic Compatibility Lab

A handwritten signature in blue ink that appears 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 capable of operation in accordance with the requirements of Part 15, Section 15.247 of the FCC Rules under normal use and maintenance.

A handwritten signature in blue ink that appears to read "Kerwinn Corpuz".

Kerwinn Corpuz  
Electromagnetic Compatibility Lab



## Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	December 18, 2003	Initial Issue.



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## 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 <b>microamp</b>
<b>dB<math>\mu</math>V</b>	Decibels above one <b>microvolt</b>
<b>dB<math>\mu</math>A/m</b>	Decibels above one <b>microamp per meter</b>
<b>dB<math>\mu</math>V/m</b>	Decibels above one <b>microvolt per meter</b>
<b>DC</b>	Direct Current
<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>1089</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>	<b>microhenry</b>
<b><math>\mu</math>F</b>	<b>microfarad</b>
<b><math>\mu</math>s</b>	<b>microseconds</b>
<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>	<b>Volts per meter</b>
<b>VCP</b>	Vertical Coupling Plane



## I. Executive Summary



## A. Purpose of Test

An EMC evaluation to determine compliance of the Power Monitors, Inc., Eagle Class PQ Wireless Recorder, Model 440 with the requirements of Part 15, Subpart C, §15.247 was performed. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Power Monitors, Inc., Eagle Class PQ Wireless Recorder, Model 440. Power Monitors, Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Eagle Class PQ Wireless Recorder, Model 440 has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, §15.247, in accordance with Power Monitors, Inc., purchase order number P0000440. All tests were conducted using measurement procedure ANSI C63.4-2001.

Reference	Description	IR Type (Requirement)			Compliance
		FHSS	DSS	Hybrid	
Title 47 of the CFR, Part 15, Subpart C, §15.205	Restricted Bands of Operation	T	T	T	Complies
Title 47 of the CFR, Part 15, Subpart C, §15.207	Conducted Limits	T	T	T	Complies
Title 47 of the CFR, Part 15, Subpart C, §15.209	Radiated Emissions Limits; General Requirements	✓	✓	✓	Complies
Title 47 of the CFR, Part 15, Subpart C, §15.247(a)	Bandwidth & Channelization	✓	✓	✓	Complies
Title 47 of the CFR, Part 15, Subpart C, §15.247(b)	Peak Output Power	✓	✓	✓	Complies
Title 47 of the CFR, Part 15, Subpart C, §15.247(c)	Spurious Emissions - Radiated and RF Conducted	✓	✓	✓	Complies
Title 47 of the CFR, Part 15, Subpart C, §15.247(d)	Power Spectral Density	N/A	✓	N/A	N/A-EUT is a FHSS (Bluetooth)
Title 47 of the CFR, Part 15, Subpart C, §15.247(f)	Hybrid Requirements	N/A	N/A	✓	N/A

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

NOTE: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 2400 - 2483.5 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.



Power Monitors, Inc.  
Eagle Class PQ Wireless Recorder, Model 440

Electromagnetic Compatibility  
Equipment Configuration  
CFR Title 47, Part 15, Subpart C

## II. Equipment Configuration



<b>Model(s) Tested:</b>	Eagle440
<b>Model(s) Covered:</b>	Eagle330 and Eagle220
<b>EUT Specifications:</b>	Primary Power: See note below
	Secondary Power: 12V AC/DC Adapter; 2 - AAA NiMH Battery
	FCC ID: RO9E2003 Equipment Code: DSS
	RF Power Output: ERP = 2.64 mW; EIRP = 3.48 mW
	Equipment Frequency Range: 2402 – 2480 MHz
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.
<b>Environmental Test Conditions:</b>	Temperature (15-35° C): 21° C
	Relative Humidity (30-60%): 47%
	Barometric Pressure (860-1060 mbar): 1020 mbar
<b>Evaluated by:</b>	Kerwinn Corpuz
<b>Date(s):</b>	December 4 - 12, 2003

**Note:** The unit is normally powered from the Channel 1 voltage input (banana jack input). The 12V adapter is for powering during data downloading to a PC (if not "plugged in" to an AC source), and the batteries provide temporary "ride-through" power in the even of a power outage (on CH1 voltage input).



## A. Overview

The purpose of this series of tests was to verify compliance of the Power Monitors, Inc., Eagle Class PQ Wireless Recorder, Model 440 with the limits of CFR 47, §15.247 for Intentional Radiators.

## B. 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: 1992</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

## C. Test Site

All testing was performed at MET Laboratories, Inc., 4855 Patrick Henry Drive, 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 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).

## D. Description of Test Sample

The Eagle Class PQ Wireless Recorder, Model 440 (referred to as EUT hereafter), is used for power quality and analysis utility systems and other industrial/commercial applications.

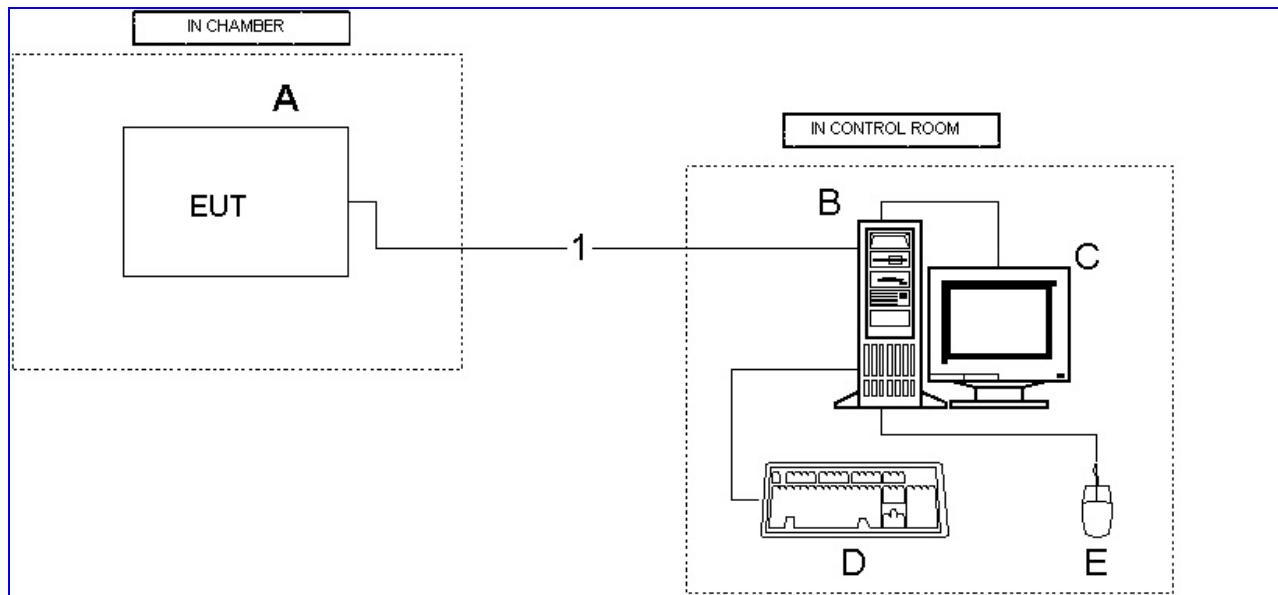


Figure 1. Block Diagram of CEV and REE Test Configuration

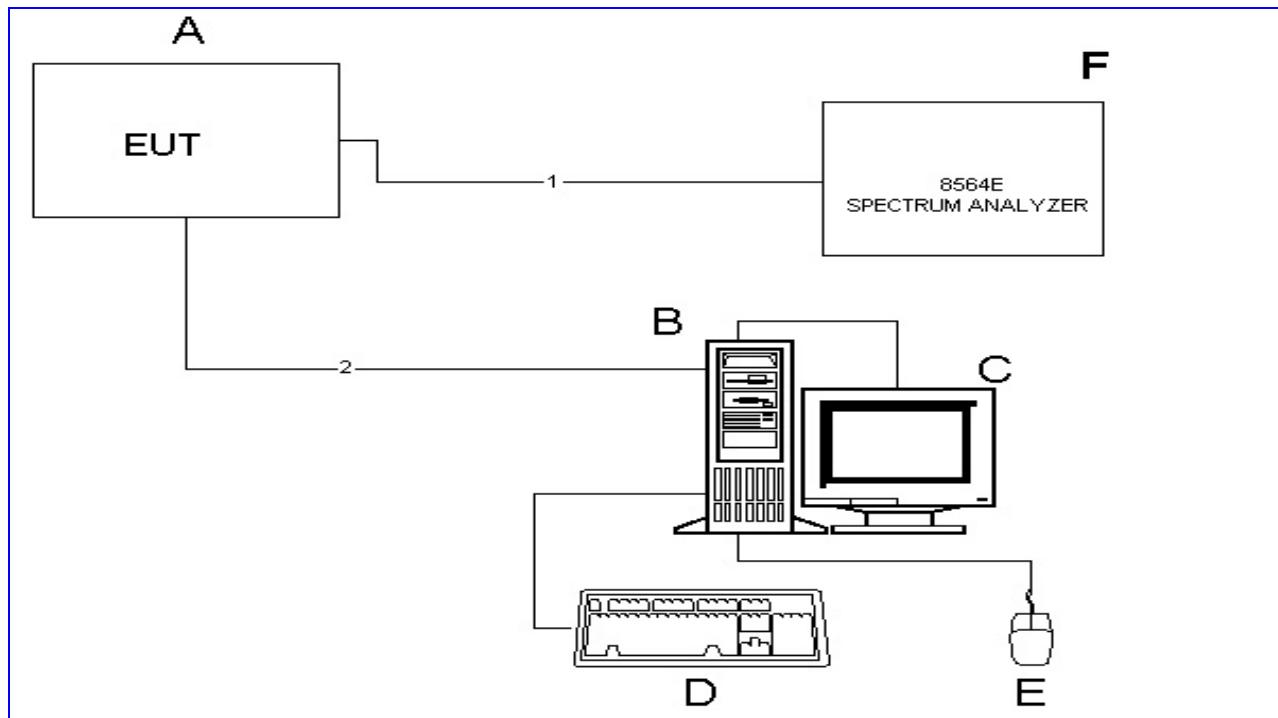


Figure 2. RF Antenna Conducted Test Configuration



## E. 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	Eagle Class PQ Wireless Recorder	Eagle 440	N/A	8031	--

**Table 2. Equipment Configuration**

## F. Support Equipment

Power Monitors, Inc. supplied support equipment necessary for the operation and testing of the Eagle Class PQ Wireless Recorder, Model 440. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
B	PC	Dell Corp.	OptiPlex G1	N/A
C	Monitor	Sony Corp.	Multiscan 15sfII	N/A
D	Keyboard	Dell Corp.	SK-1000Rew	N/A
E	Mouse	Dell Corp.	M-S34	N/A

**Table 3. CEV and REE Support Equipment**

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
B	PC	Dell Corp.	OptiPlex G1	N/A
C	Monitor	Sony Corp.	Multiscan 15sfII	N/A
D	Keyboard	Dell Corp.	SK-1000Rew	N/A
E	Mouse	Dell Corp.	M-S34	N/A
F	Spectrum Analyzer	Hewlett Packard	8564E	N/A

**Table 4. RF Antenna Conducted 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.



## G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Box ID & Port ID
1	DB9	DB9, RS232	1	15	No	B, Back

Table 5. Ports and Cabling Information (CEV and REE Test Configuration)

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Box ID & Port ID
1	N/A (moderified)	SMA	1	0.4	No	F, Input Front
2	RS232	RS232	1	4	No	B, Back

Table 6. Ports and Cabling Information (RF Antenna Conducted Test Configuration)

## H. Mode of Operation

The EUT was set to transmit maximum power at Low, Middle and High channel. In some other tests, the EUT was set to hop on all channels.

RF and Digital device circuitry were removed from EUT plastic enclosure to facilitate testing. This enclosure is not used for RF shielding purposes. The configuration as tested represents all RF and Digital device circuitry in the EUT.

## I. Method of Monitoring EUT Operation

A software was use to control the EUTs transmission to change channel location and turning the RF on or off.

## J. Modifications

### a) Modifications to EUT

No modifications were made to the EUT.

### b) Modifications to Test Standard

No modifications were made to the Test Standard.

## K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Power Monitors, 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 EUT as tested meets the criteria of this rule by virtue of having a permanently attached internal antenna soldered onto the EUT and is not accessible by the user. The EUT is therefore compliant with §15.203.

Type of Antenna: Small ceramic PC board mounted antenna

Gain of Antenna: 1.2 dBi

**Test Engineer(s):** Kerwinn Corpuz

**Test Date(s):** 12/11/03



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted 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- 0.5	66 – 56*	56 – 46*
0.5 - 0.5	56	46
0.5 - 30	60	50

\*Decreases with the logarithm of the frequency

**Table 7 Conducted Limits for Intentional Radiators from FCC Part § 15.207(a)**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Limits

**Test Procedure:** The transmitter was set to the middle channel and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber (See Photograph 1). The EUT was situated such that the back of the EUT was 0.4 m from the vertical conducting 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 Ω/50 µH 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 9 kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 µH LISN as the input transducer to an EMC/field intensity meter.

**Results:** Equipment meets the specifications of **Section 15.207 (a)** for Intentional Radiators. Test result details appear on following pages.

**Test Engineer(s):** Kerwinn Corpuz

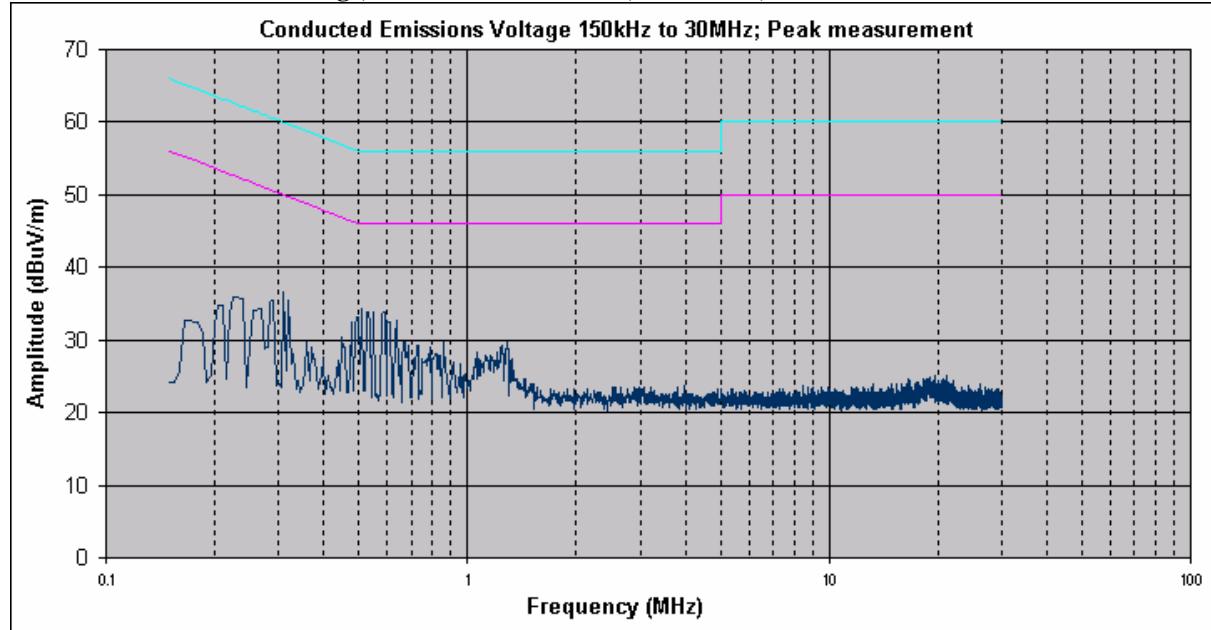
**Test Date(s):** 12/08/03



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Limits

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



#### Conducted Emission Limits, Phase Line Plot

FREQ. (MHz)	Corrected Amplitude (dBuV) PK	Limit (dBuV) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dBuV) PK	Limit (dBuV) AVG	Pass/Fail AVG	Margin (dB) AVG
0.31	37.9	59.97	PASS	-22.07	37.9	49.97	PASS	-12.07
0.53	35.1	56	PASS	-20.9	35.1	46	PASS	-10.9
0.59	35	56	PASS	-21	35	46	PASS	-11

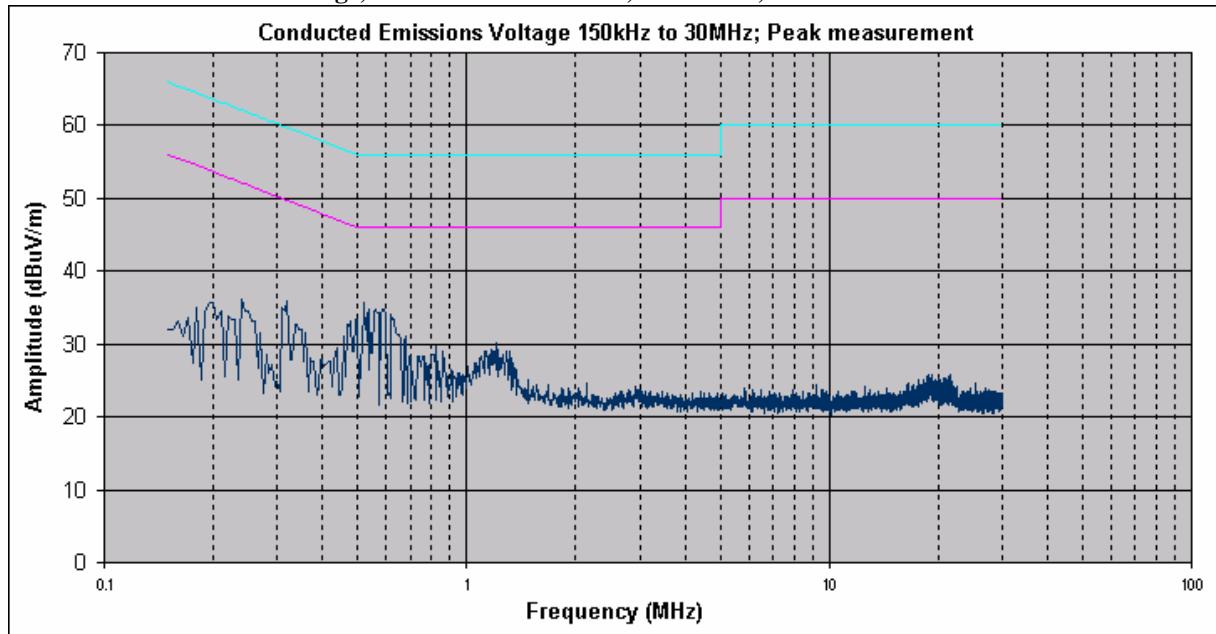
**Remarks:** EUT meets the specifications of **Section 15.207(a)** for Intentional Radiators.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Limits

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



#### Conducted Emission Limits, Neutral Line Plot

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dBuV) PK	Limit (dBuV) AVG	Pass/Fail AVG	Margin (dB) AVG
0.31	37.1	59.97	PASS	-22.87	37.1	49.97	PASS	-12.87
0.53	36.8	56	PASS	-19.2	36.8	46	PASS	-9.2
0.59	36	56	PASS	-20	36	46	PASS	-10

#### Remarks:

EUT meets the specifications of **Section 15.207(a)** for Intentional Radiators.



Power Monitors, Inc.  
Eagle Class PQ Wireless Recorder, Model 440

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

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Limits



**Photograph 1. Conducted Limits, Test Setup**



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

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

Frequency (MHz)	§ 15.209(a), Radiated Emission Limits (dB $\mu$ V/m) @ 3m
30 - 88	40.00
88 - 216	43.50
216 - 960	46.00
Above 960	54.00

**Table 8. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)**

**Test Procedure:**

The transmitter was set to the lowest channel and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Various antennas were located between 3 m and 0.5 m from an adjustable antenna mast near the EUT. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst case orientation for maximum emissions. Repeated the measurement with middle and highest channel.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. For frequencies above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1MHz and average measurements were made with RBW = 1MHz and VBW = 10 Hz.

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 10th 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.

**Test Results:**

The EUT was found compliant with the Radiated Emission limits of **§15.209** for Intentional Radiators. See following pages for detailed test results.

**Test Engineer(s):**

Kerwinn Corpuz

**Test Date(s):**

12/11/03



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

#### Radiated Emissions Limits, Low Channel Test Results

Freq. (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Height (m)	Detector (Pk) or (Avg)	Raw Amp (dBuV)	Pre- Amp (dB)	Ant. Cor. Factor (dB)	Cable Loss (dB)	Dist. Cor. Factor (dB)	EUT Field Strength Final Amp (dBuV/ m)	Limit @ 3 m (dBu V/m)	Delta (dBu V/m)	Remark
4.804	135	H	1.2	Avg	30	34.72	34.11	3.60	9.54	23.46	54	-30.54	A, E & F
4.804	270	V	1	Avg	30.4	34.72	34.27	3.60	9.54	24.02	54	-29.98	A, E & F
4.804	135	H	1.2	Pk	40.1	34.72	34.11	3.60	9.54	33.56	74	-40.44	A, E & F
4.804	270	V	1	Pk	41.10	34.72	34.27	3.60	9.54	34.72	74	-39.28	A, E & F
7.206	135	H	1.2	Avg	34.40	34.97	36.46	4.54	9.54	30.89	54	-23.11	A & E
7.206	270	V	1	Avg	34.70	34.97	36.54	4.54	9.54	31.26	54	-22.74	A & E
7.206	135	H	1.2	Pk	45.00	34.97	36.46	4.54	9.54	41.49	74	-32.51	A & E
7.206	270	V	1	Pk	45.30	34.97	36.54	4.54	9.54	41.86	74	-32.14	A & E
9.608	135	H	1.2	Avg	33.50	35.47	38.37	5.44	9.54	32.30	54	-21.70	A & E
9.608	270	V	1	Avg	33.50	35.47	38.39	5.44	9.54	32.32	54	-21.68	A & E
9.608	135	H	1.2	Pk	44.40	35.47	38.37	5.44	9.54	43.20	74	-30.80	A & E
9.608	270	V	1	Pk	45.10	35.47	38.39	5.44	9.54	43.92	74	-30.08	A & E
12.01	135	H	1.2	Avg	33.80	34.92	40.58	6.49	9.54	36.42	54	-17.58	A, E & F
12.01	270	V	1	Avg	33.90	34.92	40.58	6.49	9.54	36.51	54	-17.49	A, E & F
12.01	135	H	1.2	Pk	44.20	34.92	40.58	6.49	9.54	46.82	74	-27.18	A, E & F
12.01	270	V	1	Pk	44.50	34.92	40.58	6.49	9.54	47.11	74	-26.89	A, E & F
14.412	135	H	1.2	Avg	38.10	33.66	41.46	7.13	9.54	43.49	54	-10.51	A & E
14.412	270	V	1	Avg	38.10	33.66	41.46	7.13	9.54	43.49	54	-10.51	A & E
14.412	135	H	1.2	Pk	49.50	33.66	41.46	7.13	9.54	54.89	74	-19.11	A & E
14.412	270	V	1	Pk	49.60	33.66	41.46	7.13	9.54	54.99	74	-19.01	A & E
16.814	135	H	1.2	Avg	38.70	34.07	41.57	7.84	15.56	38.48	54	-15.52	B & E
16.814	270	V	1	Avg	38.80	34.07	41.75	7.84	15.56	38.76	54	-15.24	B & E
16.814	135	H	1.2	Pk	50.00	34.07	41.57	7.84	15.56	49.78	74	-24.22	B & E
16.814	270	V	1	Pk	50.40	34.07	41.75	7.84	15.56	50.36	74	-23.64	B & E
19.216	135	H	1.2	Avg	39.10	33.74	44.72	8.89	15.56	43.40	54	-10.60	B, E & F
19.216	270	V	1	Avg	39.20	33.74	44.72	8.89	15.56	43.50	54	-10.50	B, E & F
19.216	135	H	1.2	Pk	50.10	33.74	44.72	8.89	15.56	54.40	74	-19.60	B, E & F
19.216	270	V	1	Pk	50.20	33.74	44.72	8.89	15.56	54.50	74	-19.50	B, E & F
21.618	135	H	1.2	Avg	44.20	34.22	45.38	9.39	20	44.75	54	-9.25	C & E
21.618	270	V	1	Avg	44.30	34.22	45.38	9.39	20	44.85	54	-9.15	C & E
21.618	135	H	1.2	Pk	54.80	34.22	45.38	9.39	20	55.35	74	-18.65	C & E
21.618	270	V	1	Pk	55.30	34.22	45.38	9.39	20	55.85	74	-18.15	C & E
24.02	135	H	1.2	Avg	44.60	34.27	45.80	10.15	20	46.28	54	-7.72	C & E
24.02	270	V	1	Avg	44.70	34.27	45.80	10.15	20	46.38	54	-7.62	C & E
24.02	135	H	1.2	Pk	54.70	34.27	45.80	10.15	20	56.38	74	-17.62	C & E
24.02	270	V	1	Pk	55.80	34.27	45.80	10.15	20	57.48	74	-16.52	C & E



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

#### Radiated Emissions Limits, Low Channel Test Results, cont.

- Note A: Measuring distance @ 1 meter away.
- Note B: Measuring distance @ 0.5 meter away.
- Note C: Measuring distance @ 0.3 meter away.
- Note D: Emissions are 20 dB below the specified limit.
- Note E: Measured emissions are noise floor.
- Note F: Restricted Band.

**Remarks:** The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

#### Radiated Emissions Limits, Mid Channel Test Results

Freq. (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Height (m)	Detector (Pk) or (Avg)	Raw Amp (dBuV)	Pre- Amp (dB)	Ant. Cor. Factor (dB)	Cable Loss (dB)	Dist. Cor. Factor (dB)	EUT Field Strength Final Amp (dBuV/ m)	Limit @ 3 m (dBu V/m)	Delta (dBu V/m)	Remark
4.882	135	H	1.2	Avg	30	34.71	34.35	3.63	9.54	23.72	54	-30.28	A & E
4.882	270	V	1	Avg	30.3	34.71	34.52	3.63	9.54	24.20	54	-29.80	A & E
4.882	135	H	1.2	Pk	40.3	34.71	34.35	3.63	9.54	34.02	74	-39.98	A & E
4.882	270	V	1	Pk	41.00	34.71	34.52	3.63	9.54	34.90	74	-39.10	A & E
7.323	135	H	1.2	Avg	34.40	34.99	36.44	4.58	9.54	30.88	54	-23.12	A & E
7.323	270	V	1	Avg	34.70	34.99	36.44	4.58	9.54	31.19	54	-22.81	A & E
7.323	135	H	1.2	Pk	45.20	34.99	36.44	4.58	9.54	41.68	74	-32.32	A & E
7.323	270	V	1	Pk	45.40	34.99	36.44	4.58	9.54	41.89	74	-32.11	A & E
9.764	135	H	1.2	Avg	33.60	35.41	38.62	5.49	9.54	32.76	54	-21.24	A & E
9.764	270	V	1	Avg	33.60	35.41	38.68	5.49	9.54	32.82	54	-21.18	A & E
9.764	135	H	1.2	Pk	44.40	35.41	38.62	5.49	9.54	43.56	74	-30.44	A & E
9.764	270	V	1	Pk	45.10	35.41	38.68	5.49	9.54	44.32	74	-29.68	A & E
12.205	135	H	1.2	Avg	33.80	34.78	40.23	6.54	9.54	36.25	54	-17.75	A & E
12.205	270	V	1	Avg	33.80	34.78	40.15	6.54	9.54	36.17	54	-17.83	A & E
12.205	135	H	1.2	Pk	44.00	34.78	40.23	6.54	9.54	46.45	74	-27.55	A & E
12.205	270	V	1	Pk	44.40	34.78	40.15	6.54	9.54	46.77	74	-27.23	A & E
14.646	135	H	1.2	Avg	38.00	33.91	41.18	7.17	9.54	42.91	54	-11.09	A & E
14.646	270	V	1	Avg	38.00	33.91	41.15	7.17	9.54	42.88	54	-11.12	A & E
14.646	135	H	1.2	Pk	49.40	33.91	41.18	7.17	9.54	54.31	74	-19.69	A & E
14.646	270	V	1	Pk	49.60	33.91	41.15	7.17	9.54	54.48	74	-19.52	A & E
17.087	135	H	1.2	Avg	38.70	33.79	43.00	7.90	15.56	40.26	54	-13.74	B & E
17.087	270	V	1	Avg	38.80	33.79	43.32	7.90	15.56	40.67	54	-13.33	B & E
17.087	135	H	1.2	Pk	50.00	33.79	43.00	7.90	15.56	51.56	74	-22.44	B & E
17.087	270	V	1	Pk	50.30	33.79	43.32	7.90	15.56	52.17	74	-21.83	B & E
19.528	135	H	1.2	Avg	39.10	33.91	45.03	9.05	15.56	43.71	54	-10.29	B & E
19.528	270	V	1	Avg	39.20	33.91	45.03	9.05	15.56	43.81	54	-10.19	B & E
19.528	135	H	1.2	Pk	50.10	33.91	45.03	9.05	15.56	54.71	74	-19.29	B & E
19.528	270	V	1	Pk	50.10	33.91	45.03	9.05	15.56	54.71	74	-19.29	B & E
21.969	135	H	1.2	Avg	44.20	34.33	45.31	9.49	20	44.67	54	-9.33	C & E
21.969	270	V	1	Avg	44.20	34.33	45.31	9.49	20	44.67	54	-9.33	C & E
21.969	135	H	1.2	Pk	54.80	34.33	45.31	9.49	20	55.27	74	-18.73	C & E
21.969	270	V	1	Pk	55.30	34.33	45.31	9.49	20	55.77	74	-18.23	C & E
24.41	135	H	1.2	Avg	44.60	34.09	45.72	10.35	20	46.58	54	-7.42	C & E
24.41	270	V	1	Avg	44.70	34.09	45.72	10.35	20	46.68	54	-7.32	C & E
24.41	135	H	1.2	Pk	54.70	34.09	45.72	10.35	20	56.68	74	-17.32	C & E
24.41	270	V	1	Pk	55.80	34.09	45.72	10.35	20	57.78	74	-16.22	C & E



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

#### Radiated Emissions Limits, Mid Channel Test Results, cont.

- Note A: Measuring distance @ 1 meter away.
- Note B: Measuring distance @ 0.5 meter away.
- Note C: Measuring distance @ 0.3 meter away.
- Note D: Emissions are 20 dB below the specified limit.
- Note E: Measured emissions are noise floor.
- Note F: Restricted Band.

**Remarks:** The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

#### Radiated Emissions Limits, Hi Channel Test Results

Freq. (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Height (m)	Detector (Pk) or (Avg)	Raw Amp (dBuV)	Pre- Amp (dB)	Ant. Cor. Factor (dB)	Cable Loss (dB)	Dist. Cor. Factor (dB)	EUT Field Strength Final Amp (dBuV/ m)	Limit @ 3 m (dBu V/m)	Delta (dBu V/m)	Remark
4.96	135	H	1.2	Avg	30	34.70	34.58	3.66	9.54	23.99	54	-30.01	A, E & F
4.96	270	V	1	Avg	30.4	34.70	34.77	3.66	9.54	24.59	54	-29.41	A, E & F
4.96	135	H	1.2	Pk	40.1	34.70	34.58	3.66	9.54	34.09	74	-39.91	A, E & F
4.96	270	V	1	Pk	41.00	34.70	34.77	3.66	9.54	35.19	74	-38.81	A, E & F
7.44	135	H	1.2	Avg	34.40	35.02	36.41	4.63	9.54	30.88	54	-23.12	A, E & F
7.44	270	V	1	Avg	34.60	35.02	36.35	4.63	9.54	31.02	54	-22.98	A, E & F
7.44	135	H	1.2	Pk	45.10	35.02	36.41	4.63	9.54	41.58	74	-32.42	A, E & F
7.44	270	V	1	Pk	45.40	35.02	36.35	4.63	9.54	41.82	74	-32.18	A, E & F
9.92	135	H	1.2	Avg	33.50	35.34	38.87	5.54	9.54	33.03	54	-20.97	A & E
9.92	270	V	1	Avg	33.60	35.34	38.96	5.54	9.54	33.21	54	-20.79	A & E
9.92	135	H	1.2	Pk	44.40	35.34	38.87	5.54	9.54	43.93	74	-30.07	A & E
9.92	270	V	1	Pk	45.20	35.34	38.96	5.54	9.54	44.81	74	-29.19	A & E
12.4	135	H	1.2	Avg	33.80	34.64	39.88	6.58	9.54	36.08	54	-17.92	A, E & F
12.4	270	V	1	Avg	33.80	34.64	39.72	6.58	9.54	35.92	54	-18.08	A, E & F
12.4	135	H	1.2	Pk	44.30	34.64	39.88	6.58	9.54	46.58	74	-27.42	A, E & F
12.4	270	V	1	Pk	44.40	34.64	39.72	6.58	9.54	46.52	74	-27.48	A, E & F
14.88	135	H	1.2	Avg	38.10	34.11	41.00	7.22	9.54	42.67	54	-11.33	A & E
14.88	270	V	1	Avg	38.10	34.11	40.92	7.22	9.54	42.59	54	-11.41	A & E
14.88	135	H	1.2	Pk	49.50	34.11	41.00	7.22	9.54	54.07	74	-19.93	A & E
14.88	270	V	1	Pk	49.50	34.11	40.92	7.22	9.54	53.99	74	-20.01	A & E
17.36	135	H	1.2	Avg	38.70	33.76	44.59	7.97	15.56	41.93	54	-12.07	B & E
17.36	270	V	1	Avg	38.80	33.76	44.63	7.97	15.56	42.07	54	-11.93	B & E
17.36	135	H	1.2	Pk	50.00	33.76	44.59	7.97	15.56	53.23	74	-20.77	B & E
17.36	270	V	1	Pk	50.30	33.76	44.63	7.97	15.56	53.57	74	-20.43	B & E
19.84	135	H	1.2	Avg	39.10	34.11	45.41	9.12	15.56	43.96	54	-10.04	B, E & F
19.84	270	V	1	Avg	39.20	34.11	45.41	9.12	15.56	44.06	54	-9.94	B, E & F
19.84	135	H	1.2	Pk	50.20	34.11	45.41	9.12	15.56	55.06	74	-18.94	B, E & F
19.84	270	V	1	Pk	50.20	34.11	45.41	9.12	15.56	55.06	74	-18.94	B, E & F
22.32	135	H	1.2	Avg	44.20	34.06	45.56	9.58	20	45.28	54	-8.72	C, E & F
22.32	270	V	1	Avg	44.30	34.06	45.56	9.58	20	45.38	54	-8.62	C, E & F
22.32	135	H	1.2	Pk	54.80	34.06	45.56	9.58	20	55.88	74	-18.12	C, E & F
22.32	270	V	1	Pk	55.40	34.06	45.56	9.58	20	56.48	74	-17.52	C, E & F
24.8	135	H	1.2	Avg	44.60	33.92	45.52	10.55	20	46.74	54	-7.26	C & E
24.8	270	V	1	Avg	44.60	33.92	45.52	10.55	20	46.74	54	-7.26	C & E
24.8	135	H	1.2	Pk	54.70	33.92	45.52	10.55	20	56.84	74	-17.16	C & E
24.8	270	V	1	Pk	55.80	33.92	45.52	10.55	20	57.94	74	-16.06	C & E



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

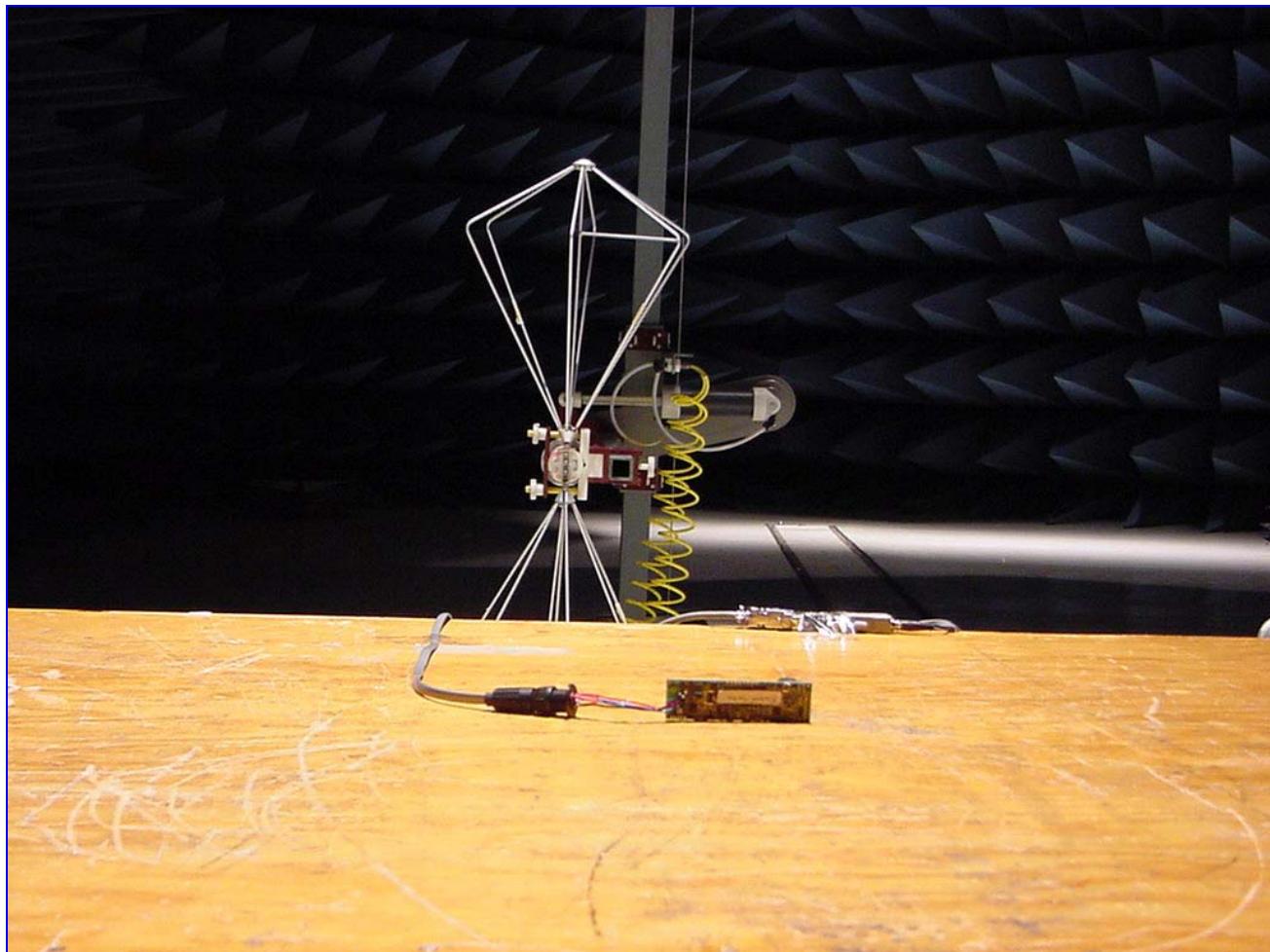
#### Radiated Emissions Limits, Hi Channel Test Results, cont.

- Note A: Measuring distance @ 1 meter away.
- Note B: Measuring distance @ 0.5 meter away.
- Note C: Measuring distance @ 0.3 meter away.
- Note D: Emissions are 20 dB below the specified limit.
- Note E: Measured emissions are noise floor.
- Note F: Restricted Band

**Remarks:** The EUT meets the specifications of **Section 15.209(a)** for Radiated Emissions of Intentional Radiators.

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission Limits

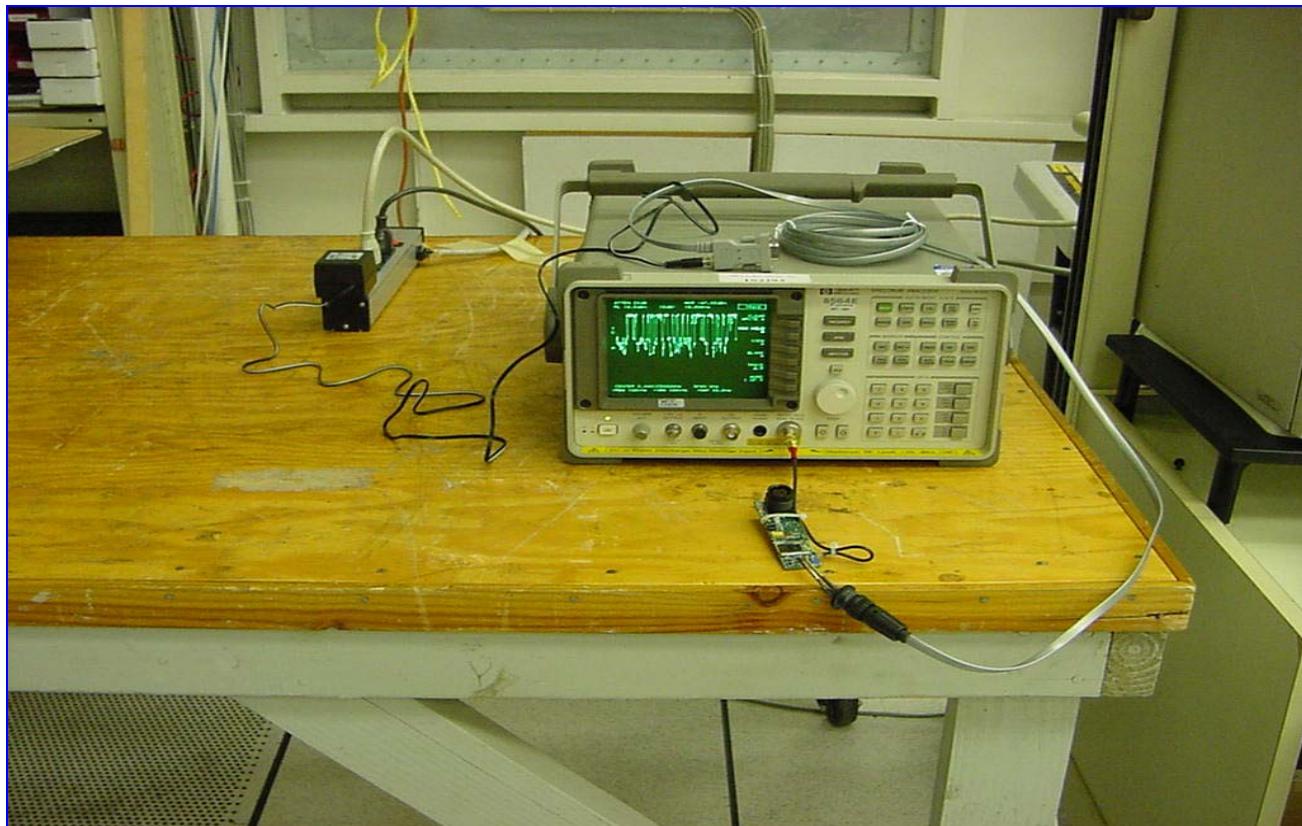


Photograph 2. Radiated Emission Limits, Test Setup



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(c) RF Antenna Conducted Limits



Photograph 3. RF Antenna Conducted, Test Setup



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a) Bandwidth & Channelization Requirements

**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:

For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. For DTS, the minimum 6 dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

**Test Procedure:** The transmitter was set to the lowest channel and the output was connected to the spectrum analyzer. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth,  $VBW > RBW$ . The 20 dB bandwidth was measured and recorded. Repeated the measurement with middle and highest channel.

Frequency hopping was set when channelization requirements were measured.

**Test Results** This device has the following technical specifications:

1. The carrier frequency separation is 1000 kHz.
2. The radio hops through 79 frequencies.
3. The dwell time of each frequency is 1.275 milli-seconds.
4. The time between each pulse of a channel is 178.13 milli-seconds.
5. The average time of occupancy within a period of 31.6 seconds is 0.2262 seconds.

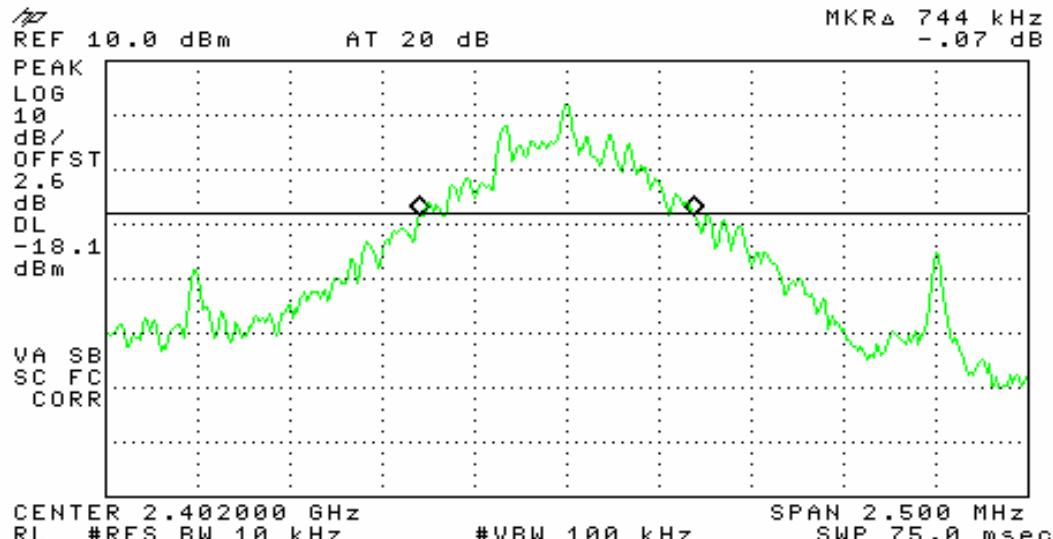
Equipment complies with § 15.247 (a). The 20 dB bandwidth and channelization requirements were determined from the plots on the following pages.

**Test Engineer:** Kerwinn Corpuz

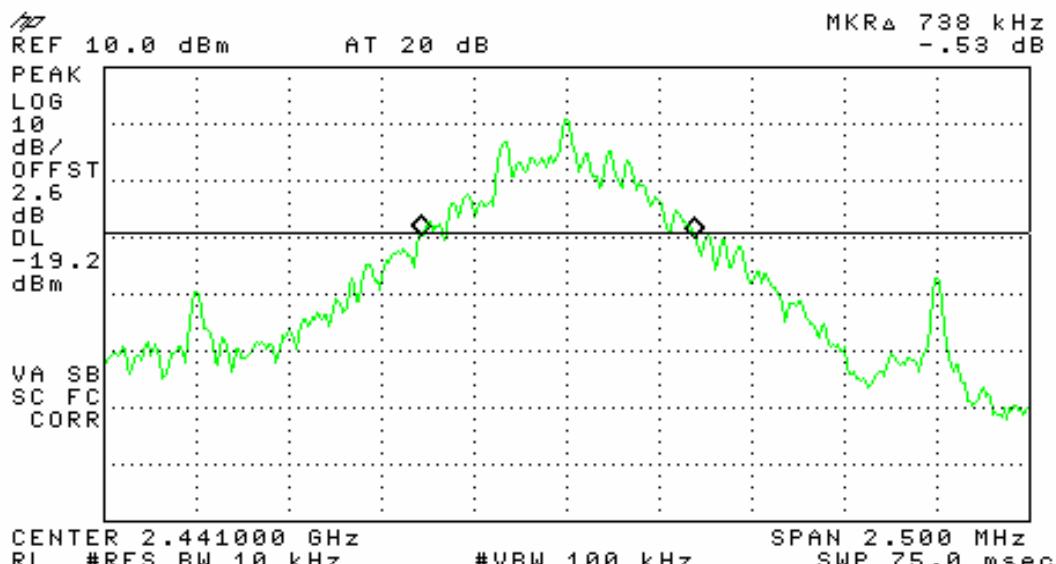
**Test Date:** 12/09/03

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 20 dB Bandwidth



Plot #1: LOW Occupied BW = Low Channel



Plot #2: MID Occupied BW = Middle Channel

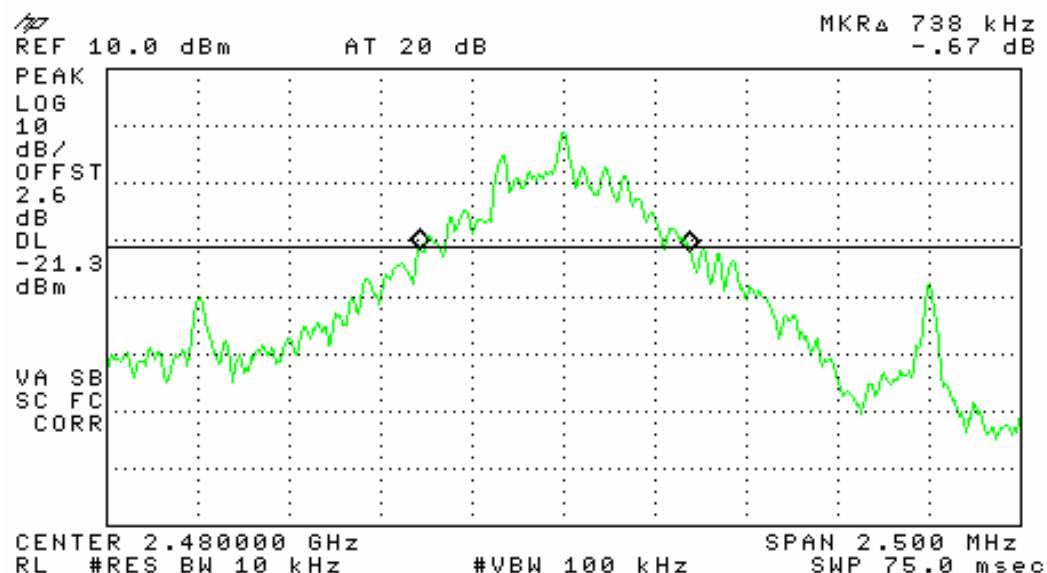
**Remarks:**

The EUT meets the specifications of **Section 15.247(a)** for 20 dB Bandwidth.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 20 dB Bandwidth

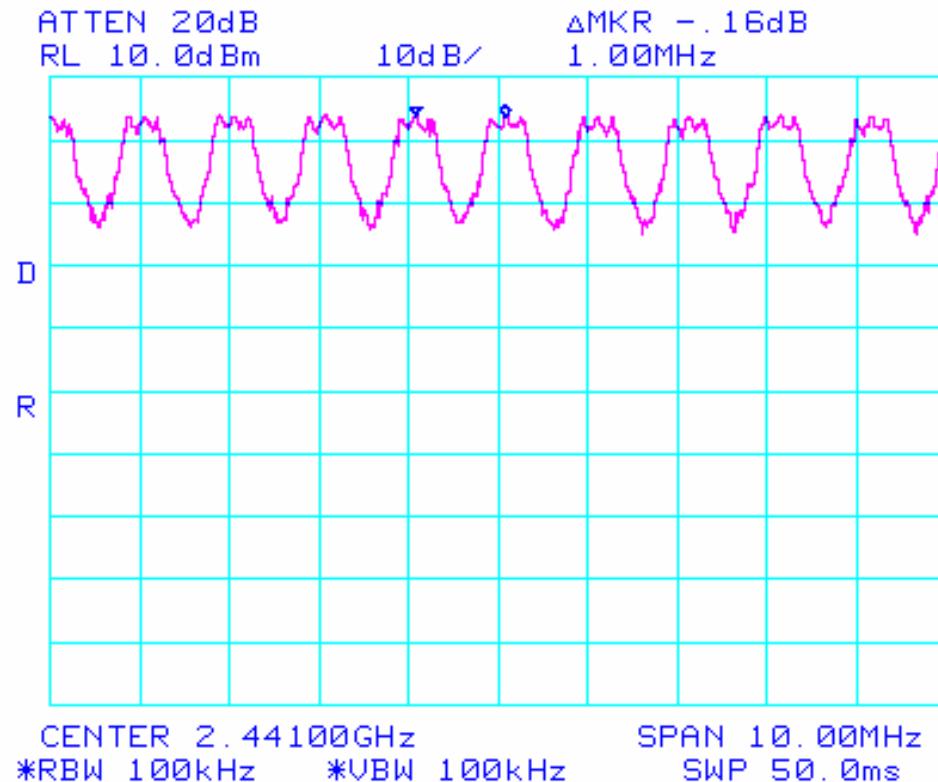


Plot #3: HI occupied BW = High Channel



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 Carrier Frequency Separation

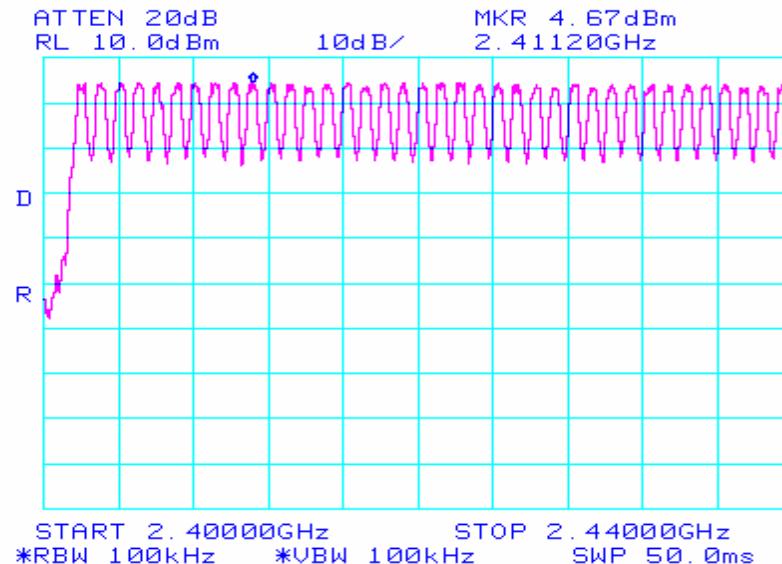


#### Remarks:

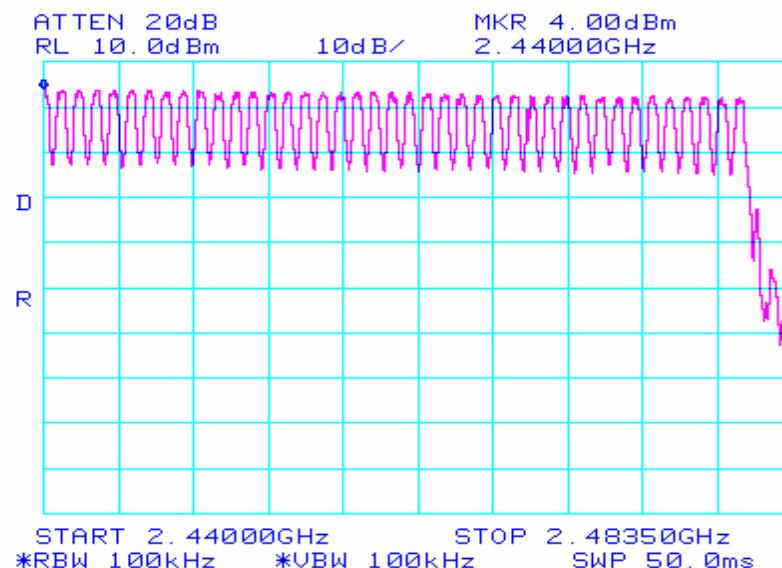
The measured 20 dB bandwidth is 744 kHz. Therefore, the frequency separation shall be greater than 744 kHz. The measurement of hopping channel carrier frequencies separation is 1 MHz. The EUT meets the specifications of **Section 15.247(a)(1)** for hopping channel carrier frequencies separation.

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 Number of Hopping Channels



Plot #1: 1<sup>st</sup> half = Bottom half of Frequency Range



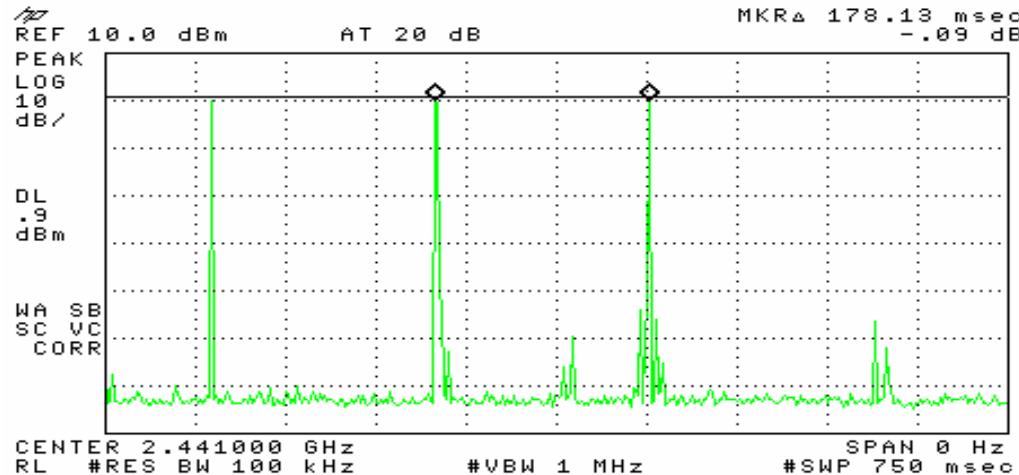
Plot #2: 2<sup>nd</sup> half = Top half of Frequency Range

**Remarks:**

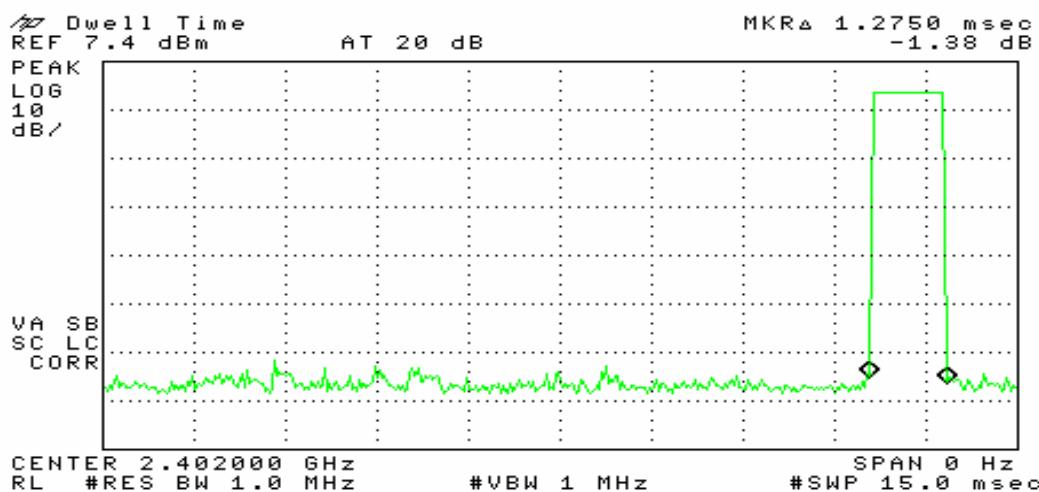
Total hopping channels = 38 + 41 = 79. The EUT meets the specifications of **Section 15.247(a)(1)(iii)** for Number of Hopping Channels.

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 Time of Occupancy



Plot #1: Time Between Pulses



Plot #2: Dwell Time

**Remarks:**

The average time of occupancy shall be less than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels.

$$0.4 \text{ seconds} * 79 \text{ channels} = 31.6 \text{ seconds period}$$

$$\text{Therefore, time of occupancy} = 31.6 \text{ seconds period} / \text{time between pulses} * \text{dwell time.}$$

$$0.2262 \text{ seconds} = 31.6 / 0.17813 \text{ sec} * 0.001275 \text{ sec}$$

The EUT meets the specifications of **Section 15.247(a)(1)(iii)** for the Average Time of Occupancy on any channel.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Output Power and RF Exposure

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

Frequency Hopping Systems Band (MHz)	Output Limit for systems with 25 to <50 Channels (Watts)	Output Limit for systems with $\geq$ 50 Channels (Watts)
902-928	0.250	1.000
2400-2483.5	0.125	1.000
5725- 5850	1.000	1.000

**Table 9. Output Power Requirements from §15.247**

Except for:

Systems operating in the 2400- 2483.5 MHz band, and

5725- 5850 MHz band that are used exclusively for fixed, point-to-point operations,

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 9, 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, omni-directional 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.

**RF Exposure Requirements - §15.247(b)(5); §1.1307(b)(1):** 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.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Output Power and RF Exposure

**Test Procedure:** The transmitter was set to the lowest channel and the output was connected to the spectrum analyzer. The RBW was set at least 3 times larger than the bandwidth of the emission,  $VBW \geq RBW$ . The output power was measured and recorded. Repeated the measurement with middle and highest channel.

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

Peak Output Power = 2.64 mW.

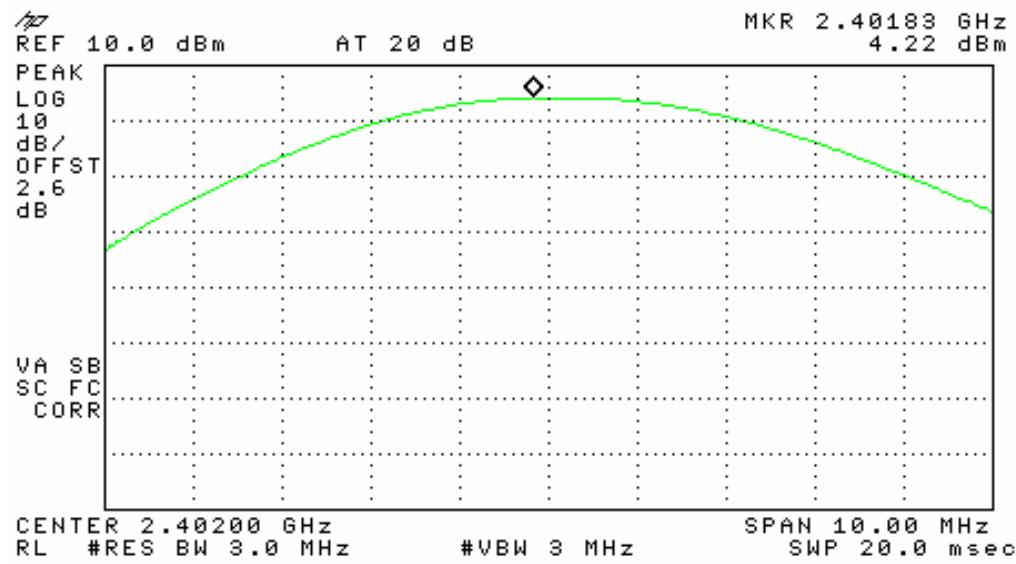
The peak output power was determined from the plots on the following page(s).

**Test Engineer:** Kerwinn Corpuz

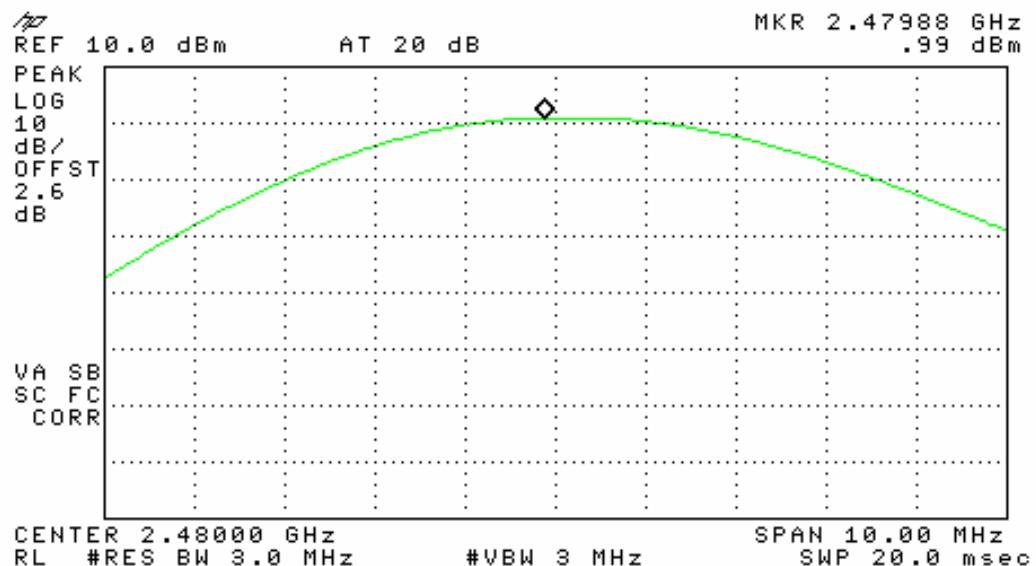
**Test Date:** 12/09/03

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Output Power and RF Exposure



Plot #1: LOW Channel (2402 MHz) Power Output

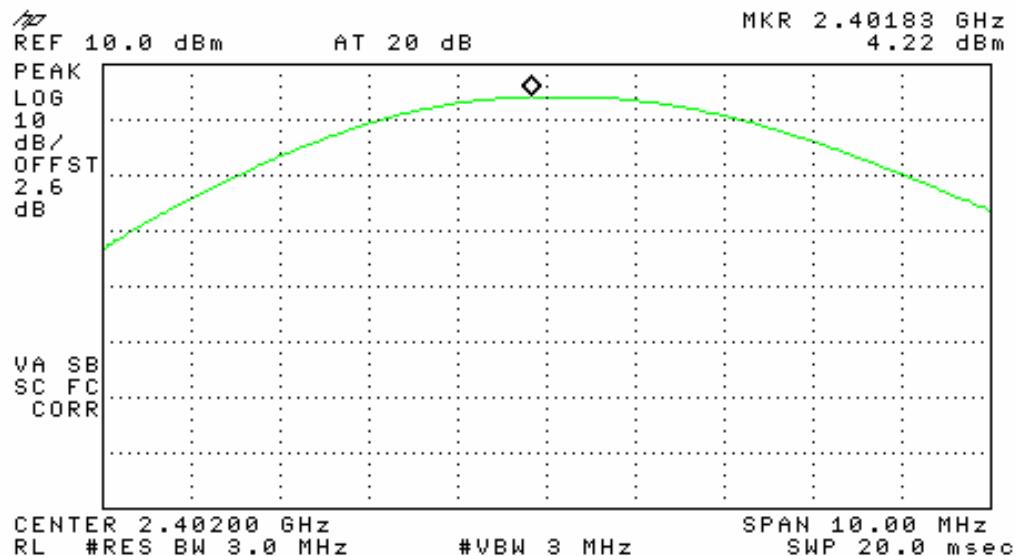


Plot #2: MIDDLE Channel (2441 MHz) Power Output



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Output Power and RF Exposure, cont.



Plot #3: HIGH Channel (2480 MHz) Power Output

**Remarks:** Equipment complies with the Output Power and RF Exposure limits of § 15.247 (b).

Peak Output Power: LOW channel = 2.64 mW; MIDDLE channel = 2.01 mW; HIGH channel = 1.26 mW.

### RF Exposure Requirements – 1.1307(b)(2); 1.1310

**Specification:** 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.

MPE Limit Calculation: EUT's operating frequencies @ 2402 - 2480 MHz; ERP = 4.22 dBm therefore, **Limit for Uncontrolled exposure: 1 mW/cm<sup>2</sup> or 10 W/m<sup>2</sup>**

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

$$S = PG / 4\pi R^2 \quad \text{where, } S = \text{Power Density}$$

P = Power Input to antenna (0.0026 Watts)

G = Antenna Gain (1.2 dBi)

R = distance to the center of radiation of the antenna (20 cm or 0.2 m)

$$S = 0.0026W * 1.2\text{dBi} / 4 * 3.14 * (0.2\text{m})^2 = 0.0032W / 0.5024\text{m}^2 = 0.0063 \text{ W/m}^2$$

EUT comply with 20cm distance exposure.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(c) Spurious Emissions Requirements – Radiated and RF Conducted

**Test Requirements:** §15.247(c); § 15.209 (a); §15.205:

**§15.247(c):** 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).

**§15.205(a):** Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110-----	16.42–16.423	399.9–410	4.5–5.15
<sup>1</sup> 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	( <sup>2</sup> )

**Table 10. Restricted Bands of Operation from §15.205**

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490 – 0.510 MHz.

<sup>2</sup> Above 38.6



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(c) Spurious Emissions Requirements – Radiated and RF Conducted

#### Test Procedure:

The transmitter was set to the lowest channel and placed on a 0.8 m high wooden table inside in a semi-anechoic chamber. Various antennas were located between 3 m and 0.5 m from an adjustable antenna mast near the EUT. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst case orientation for maximum emissions. Repeated the measurement with middle and highest channel.

For frequencies from 30 MHz to 1 GHz, measurements were made using a quasi-peak detector with a 120 kHz bandwidth. For frequencies above 1 GHz, peak measurements were made with a resolution bandwidth of 1 MHz and a video bandwidth of 1 MHz and average measurements were made with RBW = 1 MHz and VBW = 10 Hz. Repeated the measurement with middle and highest channel.

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 Emissions Bandedge measurement, set the transmitter to the lowest channel with maximum output power and record the reading at 2390 MHz. Repeat step by setting the transmitter to the highest channel and record the reading at 2483.5 MHz.

For RF Conducted Emissions, the transmitter was set to the lowest channel and the output was connected to the spectrum analyzer. Set the Display Line 20 dB below the operating frequency. RBW = 100 kHz, VBW  $\geq$  RBW. Scan through 10<sup>th</sup> harmonic of the highest fundamental frequency. Repeated the measurement with middle and highest channel.

#### Test Results:

Equipment complies with the Spurious Emissions Requirements – Radiated and RF Conducted limits of **§ 15.247 (c)**. For Radiated Emissions result, refer to section “§15.209: Radiated Emission Limits”. See following pages for detailed test results with RF Conducted Spurious Emissions and §15.205.

#### Test Engineer:

Kerwinn Corpuz

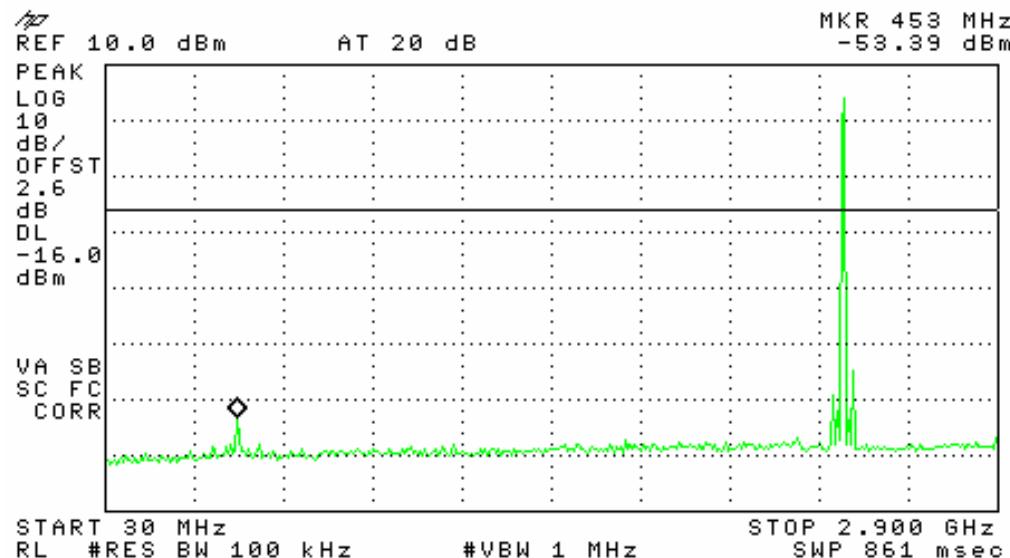
#### Test Date:

12/12/03

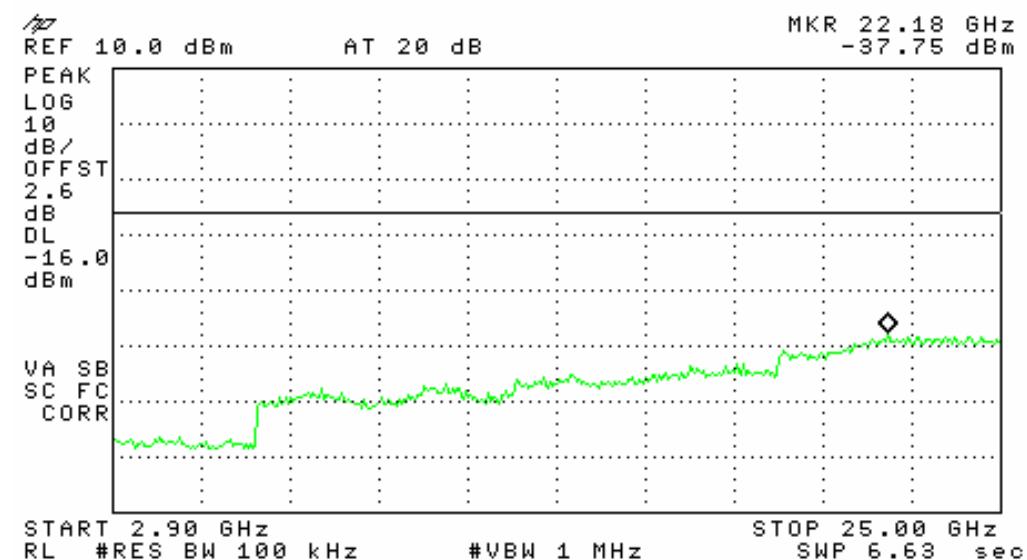


## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(c) Spurious Emissions Requirements – RF Conducted



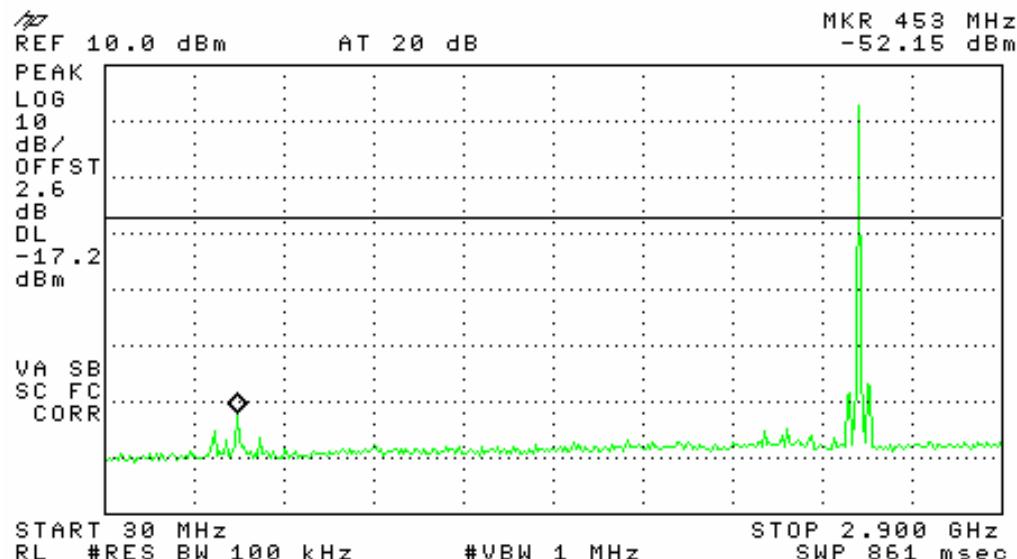
Plot #1: LOW channel (2402 MHz) Spurious Emission 30 MHz - 2.9 GHz



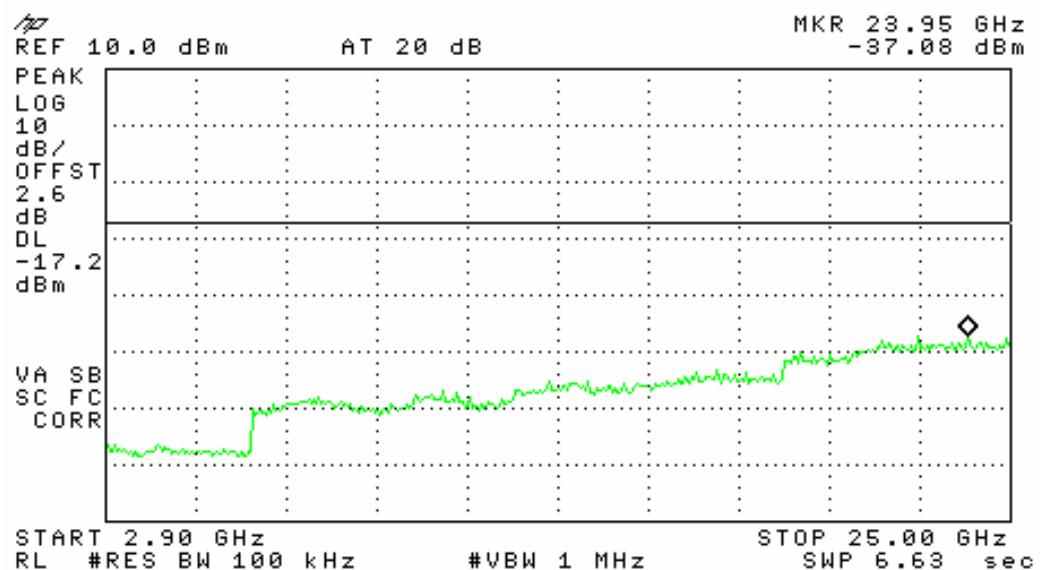
Plot #2: LOW Channel (2402 MHz) Spurious Emission 2.9 – 25 GHz

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(c) Spurious Emissions Requirements – RF Conducted, cont.



Plot #3: MIDDLE Channel (2441 MHz) Spurious Emission 30 MHz - 2.9 GHz

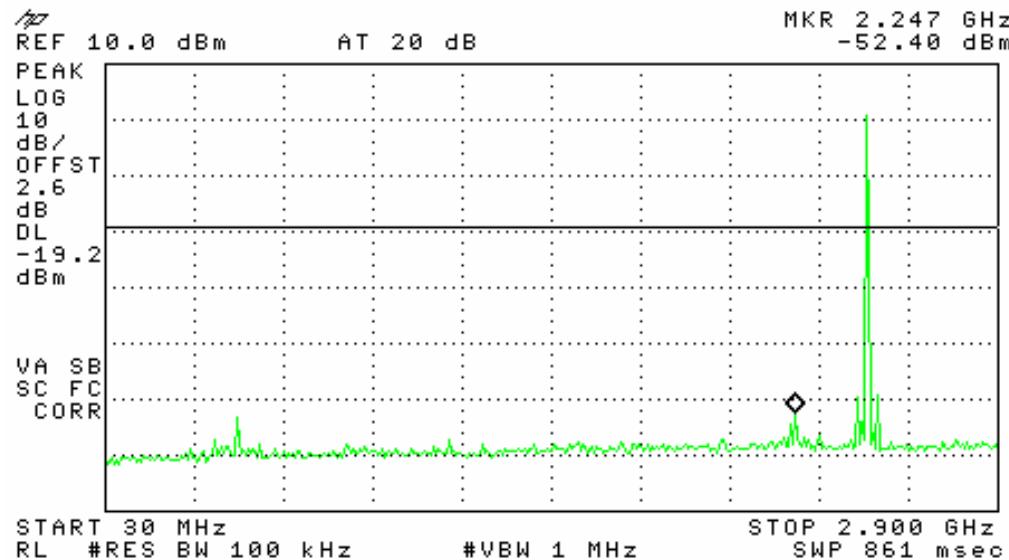


Plot #4: MIDDLE Channel (2441 MHz) Spurious Emission 2.9 – 25 GHz



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(c) Spurious Emissions Requirements – RF Conducted, cont.



**Remarks:** Equipment complies with the Spurious Emissions Requirements – RF Conducted limits of § 15.247(c). The Display Line was set 20 dB below the operating frequency.



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.205 Spurious Emissions Requirements – Restricted Bandedge

Freq. (GHz)	EUT Azimuth (Degrees)	Antenna Polarity (H/V)	Height (m)	Detector (Pk) or (Avg)	Raw Amp. @ 3 m (dBuV)	Ant. Cor. Factor (dB)	Cable Loss (dB)	EUT Field Strength corrected (dBuV/m)	Delta (-dBc)	Signal Level (dBuV/ m)	Limit @ 3 m (dBuV/ m)	Delta (dBuV/ m)	Remark
2.39	135	H	1.2	Avg	63.3	28.85	2.38	94.53	51.39	43.14	54	-10.86	A & C
2.39	270	V	1	Avg	71.2	28.85	2.38	102.43	51.39	51.04	54	-2.96	A & C
2.39	135	H	1.2	Pk	63.7	28.85	2.38	94.93	51.39	43.54	74	-30.46	A & C
2.39	270	V	1	Pk	71.30	28.85	2.38	102.53	51.39	51.14	74	-22.86	A & C
2.4835	135	H	1.2	Avg	59.00	28.98	2.44	90.42	46.86	43.56	54	-10.44	B & C
2.4835	270	V	1	Avg	66.00	28.98	2.44	97.42	46.86	50.56	54	-3.44	B & C
2.4835	135	H	1.2	Pk	59.40	28.98	2.44	90.82	46.86	43.96	74	-30.04	B & C
2.4835	270	V	1	Pk	66.40	28.98	2.44	97.82	46.86	50.96	74	-23.04	B & C

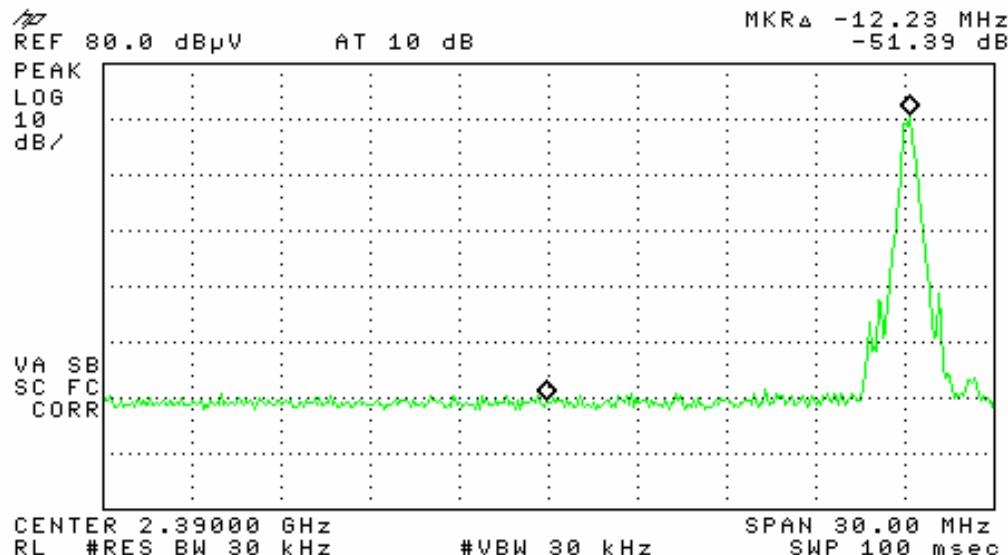
Note A: EUT was transmitting @ Lowest channel; 2.402 GHz.

Note B: EUT was transmitting @ Highest channel; 2.480 GHz.

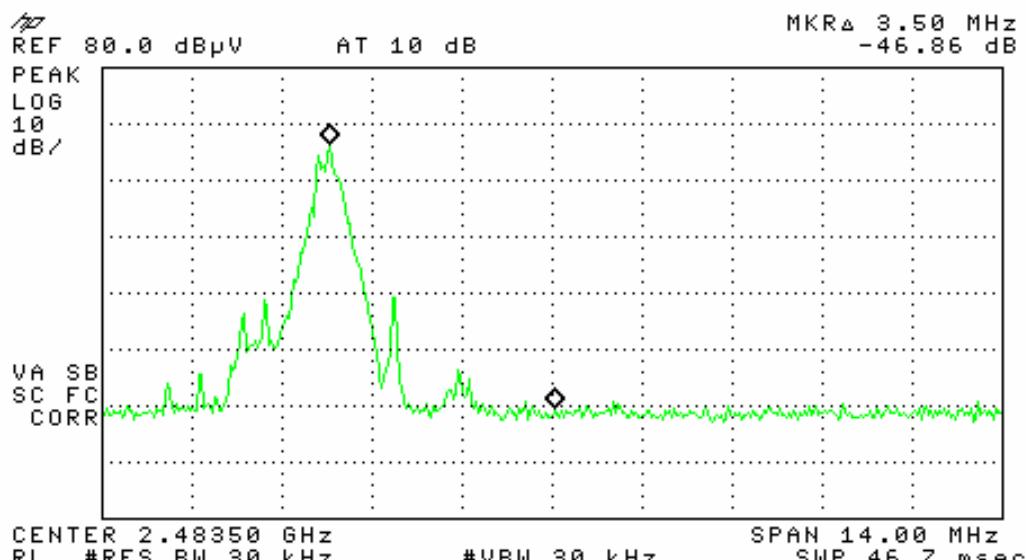
Note C: Delta, -dBc, was measured from fundamental of EUT to the Restricted Bandedge. See plot for delta.

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.205 Spurious Emissions Requirements – Restricted Bandedge, cont.



Plot #1: Delta between 2402 MHz (LOW channel) and 2390 MHz



Plot #2: Delta between 2480 MHz (HIGH channel) and 2483.5 MHz

**Remarks:** Equipment complies with the Spurious Emissions Requirements – Restricted Bandedge of § 15.247 (c); § 15.205.



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## 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			Test Date(s): 12/08/03 & 12/09/03		
MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2122	SPECTRUM ANALYZER	HEWLETT PACKARD	8566A	10/20/03	10/20/04
1S2265	SPECTRUM ANALYZER DISPLAY UNIT	HEWLETT PACKARD	85662A	10/20/03	10/20/04
1S2120	QUASI-PEAK ADAPTER	HEWLETT PACKARD	85650A	10/20/03	10/20/04
1S2118	RF PRE-SELECTOR	HEWLETT PACKARD	85685A	10/20/03	10/20/04
1S2372	CUSTOM LISN	FCC	50A AC	01/10/03	01/10/04
1S2263	10 METER CHAMBER	RANTEC	N2-14	07/23/03	07/23/04
1S2293	SPECTRUM ANALYZER, 9kHz-40GHz	HEWLETT PACKARD	8564E	09/09/03	09/09/04
1S2198	HORN ANTENNA	EMCO	3115	06/04/03	06/04/04
1U2	SPECTRUM ANALYZER	HEWLETT PACKARD	8593EM	02/19/03	02/19/04
Test Name: Radiated Emissions			Test Date(s): 12/11/03 & 12/12/03		
MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1U2	SPECTRUM ANALYZER	HEWLETT PACKARD	8593EM	02/19/03	02/19/04
1S2198	HORN ANTENNA	EMCO	3115	06/04/03	06/04/04
1S2263	10 METER CHAMBER	RANTEC	N2-14	07/23/03	07/23/04
1S2109	EMI RECIEVER SECTION	HEWLETT PACKARD	85462A	05/19/03	05/19/04
1S2108	EMI RF FILTER SECTION	HEWLETT PACKARD	85460A	05/19/03	05/19/04
1S2205	BICONICAL ANTENNA	EMCO	3108	03/18/03	03/18/04
1S2207	LOG PERIODIC ANTENNA	EMCO	3146	03/17/03	03/17/04
1S2405	PRE-AMPLIFIER	HEWLETT PACKARD	8447D	08/06/03	08/06/04
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	10/08/03	10/08/04
1S2202	1 METER HORN ANTENNA	EMCO	3116	03/12/03	03/12/04
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	

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



Power Monitors, Inc.  
Eagle Class PQ Wireless Recorder, Model 440

Electromagnetic Compatibility  
Certification & User's Manual Information  
CFR Title 47, Part 15, Subpart C

## V. Certification & User's Manual Information



## Certification & User's Manual Information

### A. 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

### B. 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 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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## VI. Exhibits



Power Monitors, Inc.  
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## Exhibit A, Hopping Capability Requirements



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## Exhibit B, Non-Coordination Requirements



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# End of Report