



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

for the

### **Broadcom Corporation, USB Bluetooth Module**

**MODEL NUMBER: BCN92045NMD  
FCC ID: QDS-BRCM1018  
IC ID: 4324A-BRCM1018**

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

**MET Report: EMCS17273-FCC247**

April 21, 2005

**Prepared For:**

**Broadcom Corporation**  
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**Prepared By:**  
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The FCC Certification Rules contained in  
Title 47 of the CFR, Part 15, Subpart C  
for Intentional Radiators

**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.

Shawn McMillen  
Electromagnetic Compatibility Lab



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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
DSL	Digital Subscriber Line
ESD	Electrostatic Discharge
EUT	Equipment Under Test
<i>f</i>	Frequency
FCC	Federal Communications Commission
GR-1089-CORE	( <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
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	microhenry
$\mu$ F	microfarad
$\mu$ s	microseconds
NEBS	Network Equipment-Building System
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



### A. Purpose of Test

An EMC evaluation to determine compliance of the Broadcom Corporation USB Bluetooth Module Model: BCN92045NMD 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 Broadcom Corporation USB Bluetooth Module. Broadcom Corporation should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the USB Bluetooth Module Model: BCN92045NMD 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. All tests were conducted using measurement procedure ANSI C63.4-2001.

Reference	Description	Compliance
Title 47 of the CFR, Part 15, Subpart C, §15.203	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.205	Emissions at Restricted Band	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.207(a);	Electromagnetic Compatibility - Conducted Emissions for Intentional Radiators	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.209(a); §15.247(a) and (b)	Electromagnetic Compatibility - Radiated Emissions for Intentional Radiators	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(a)	Bandwidth & Channelization	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(b)	Output Power and RF Exposure	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(c)	Spurious Emissions - Radiated and RF Conducted	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(d)	Power Spectral Density	N/A – EUT uses FHSS
Title 47 of the CFR, Part 15, Subpart C, §15.247(f)	Hybrid Requirements	N/A
Title 47 of the CFR, Part 15, Subpart C, §15.247(g)	Hopping Capability	Compliant
Title 47 of the CFR, Part 15, Subpart C, §15.247(h)	Non-Coordination Requirements	Compliant

**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.



## II. Equipment Configuration





<b>Type of Submission/Rule:</b>	Modular Approval Part 15.247 Original Filing
<b>Model(s) Tested:</b>	USB Bluetooth Module
<b>Model(s) Number:</b>	BCN92045NMD
<b>EUT Specifications:</b>	Primary Power from laptop: 120 VAC, 60 Hz
	Secondary Power: 5V DC from USB
	RF Power Output (conducted): 3.1 mW (8PSK) & 1.78 mW (GFSK)
	Equipment Frequency Range: 2402 – 2480 MHz
	Equipment Code: DSS
<b>Lab Ambient (Normal) Test Conditions:</b>	Temperature: 15-35° C
	Relative Humidity: 30-60%
	Atmospheric Pressure: 860-1060 mbar
<b>Evaluated by:</b>	Shawn McMillen
<b>Date(s):</b>	March 28 - April 15, 2005



## A. Overview

The purpose of this series of tests was to verify compliance of the Broadcom Corporation USB Bluetooth Module Model: BCN92045NMD 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 C63.4-2003</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

## 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 Broadcom Corporation USB Bluetooth Module, Equipment Under Test (EUT), is powered from a 120 VAC 60 Hz supply laptop. The EUT is equipped with a integral antenna with 2.2dBi gain.

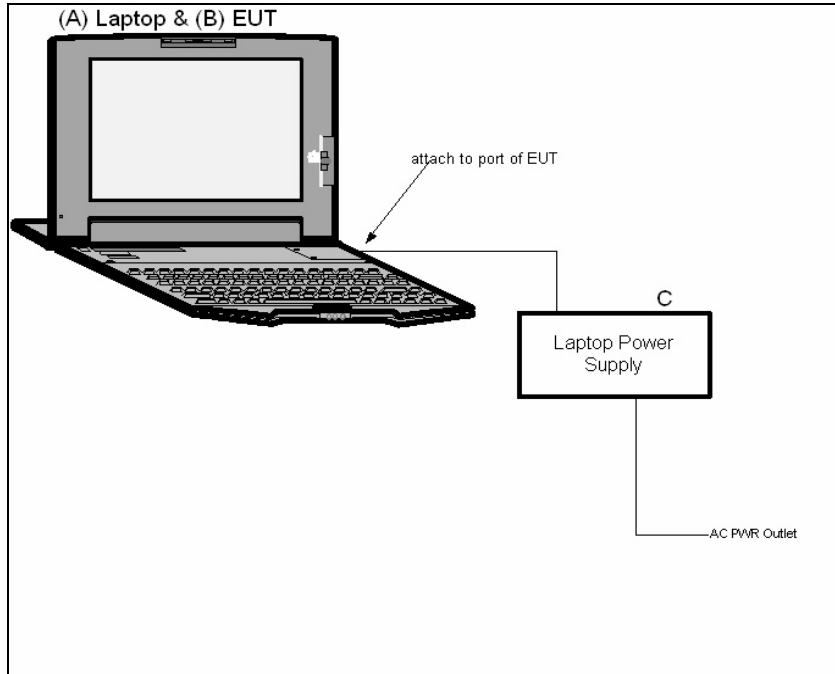


Figure 1. Block Diagram of CEV and REE Test Configuration

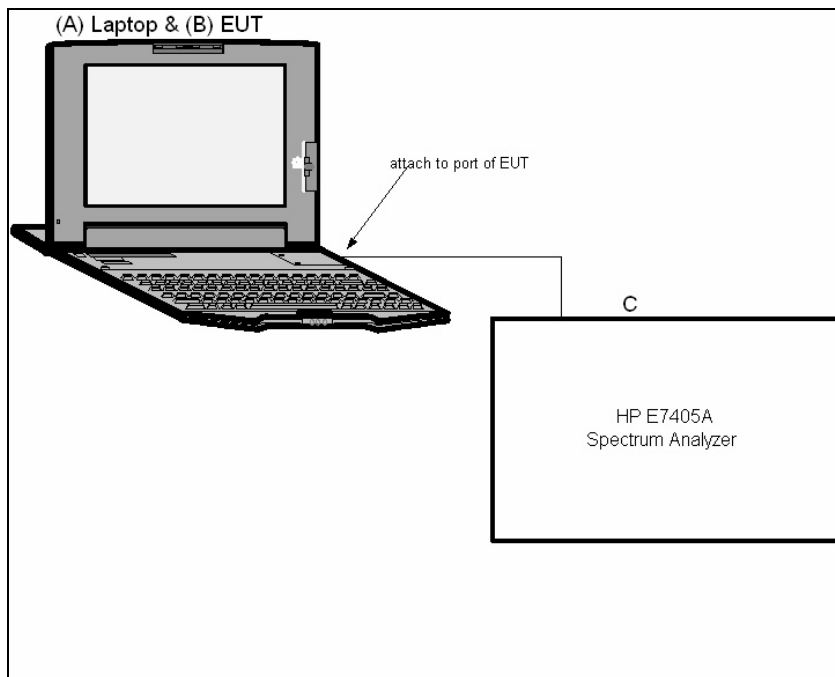


Figure 2. RF Antenna Conducted Test Configuration



### 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	USB Bluetooth Module	BCN92045NMD	N/A	8031	--

Table 2. Equipment Configuration

### F. Support Equipment

Broadcom Corporation supplied support equipment necessary for the operation and testing of the USB Bluetooth Module Model: BCN92045NMD. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
B	Laptop	Dell Corp.	Inspiron   4100	N/A
C	Power Supply	Dell Corp.	N/A	N/A

Table 3. CEV and REE Support Equipment

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
B	Laptop	Dell Corp.	Inspiron   4100	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	N/A (modified)	SMA	1	0.4	No	C, Input Front

Table 5. Ports and Cabling Information (RF Antenna Conducted Test Configuration)

## H. Mode of Operation

The EUT was connected to a USB port of a laptop computer. The EUT is capable of transmitting in GFSK@1Mbps and 8PSK@3Mbps modes using a PRBS9 pattern and a DH5/3-DH5 packet type.

## I. Method of Monitoring EUT Operation

A software was use to control the EUT's transmission to change channel location, packet size, modulation 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 Broadcom Corporation 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: PC board mounted antenna

Gain of Antenna: 2.2 dBi

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

**Test Date(s):** March 28 - April 15, 2005



## 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 6 Conducted Limits for Intentional Radiators from FCC Part § 15.207(a)**

**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  $\Omega$ /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 9 kHz 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.

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

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

**Test Date(s):** March 28 - April 15, 2005





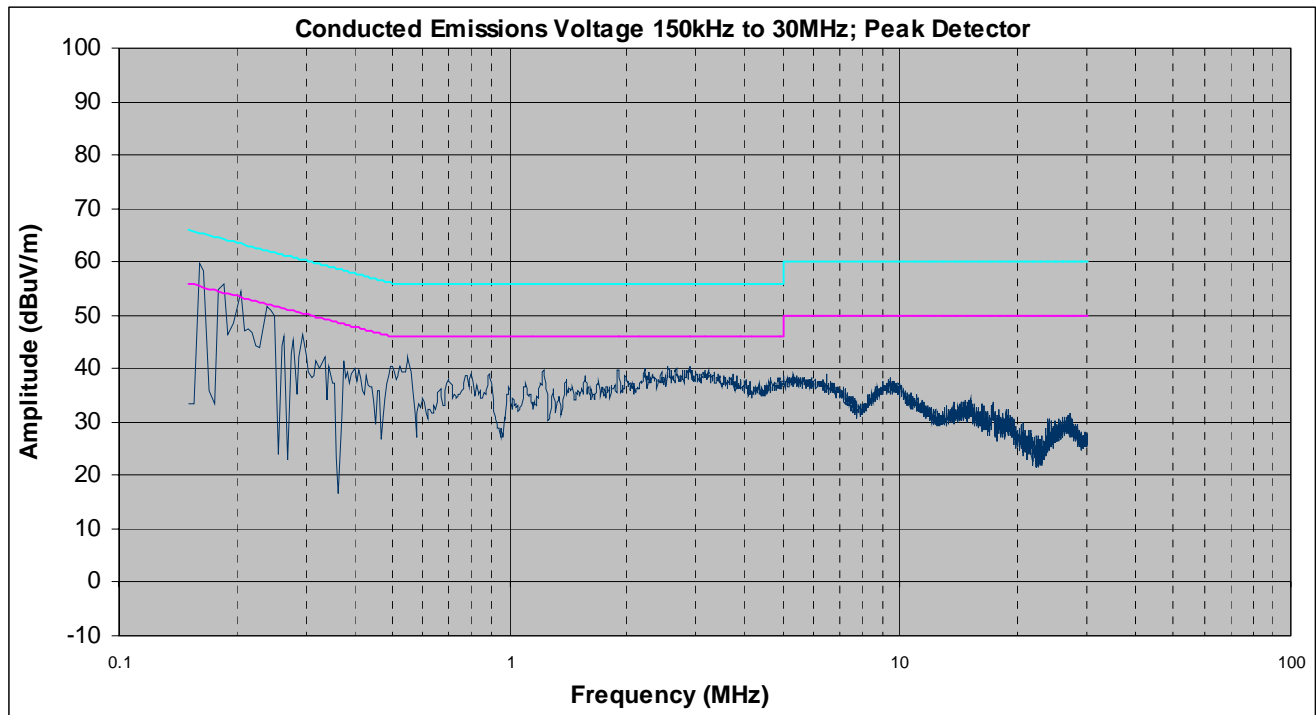
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Emissions

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

Line Under Test	FREQ. (MHz)	Corrected Amplitude (dBμV) QP	Limit (dBμV) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dBμV) AVG	Limit (dBμV) AVG	Pass/Fail AVG	Margin (dB) AVG
Phase A	0.16	51.9	65.46	PASS	-13.56	24.4	55.46	PASS	-31.06
Phase A	0.175	49.1	64.72	PASS	-15.62	21.1	54.72	PASS	-33.62
Phase A	0.205	46.3	63.41	PASS	-17.11	36.2	53.41	PASS	-17.21
Phase A	0.25	41.3	61.76	PASS	-20.46	13.2	51.76	PASS	-38.56

#### Conducted Emission Limits, Phase Line Plot



**Note:** Preliminary test was done with 8PSK and GFSK mode, worse case was 8PSK mode.

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



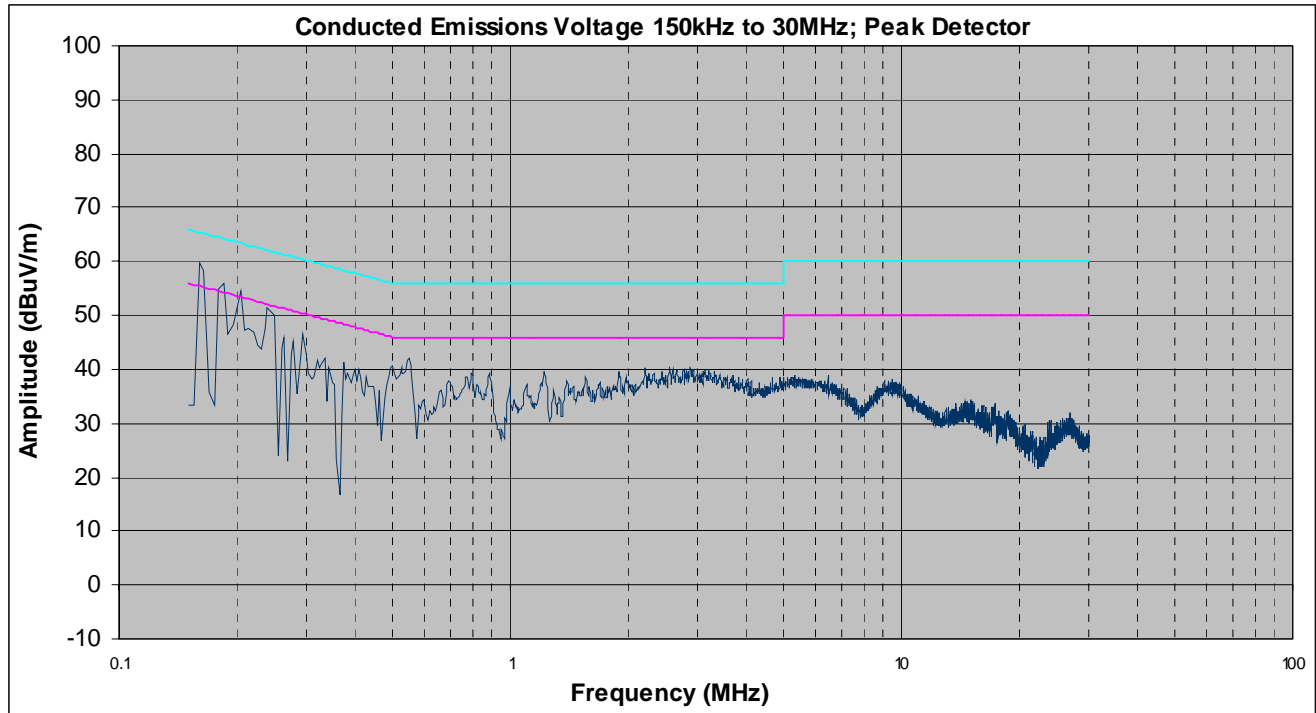
## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Emissions

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

Line Under Test	FREQ. (MHz)	Corrected Amplitude (dB $\mu$ V) QP	Limit (dB $\mu$ V) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dB $\mu$ V) AVG	Limit (dB $\mu$ V) AVG	Pass/Fail AVG	Margin (dB) AVG
Neutral	0.165	52.8	65.21	PASS	-12.41	25.1	55.21	PASS	-30.11
Neutral	0.175	48.6	64.72	PASS	-16.12	20.3	54.72	PASS	-34.42
Neutral	0.2	47.3	63.61	PASS	-16.31	35.6	53.61	PASS	-18.01
Neutral	0.24	42.2	62.1	PASS	-19.9	17.4	52.1	PASS	-34.7
Neutral	0.26	41.4	61.43	PASS	-20.03	12.15	51.43	PASS	-39.28
Neutral	0.28	39.4	60.82	PASS	-21.42	15.81	50.82	PASS	-35.01

#### Conducted Emission Limits, Neutral Line Plot



**Note:** Preliminary test was done with 8PSK and GFSK mode, worse case was 8PSK mode.

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



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Emissions



**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 Table 7.

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

**Table 7. 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):** Shawn McMillen

**Test Date(s):** March 28 - April 15, 2005

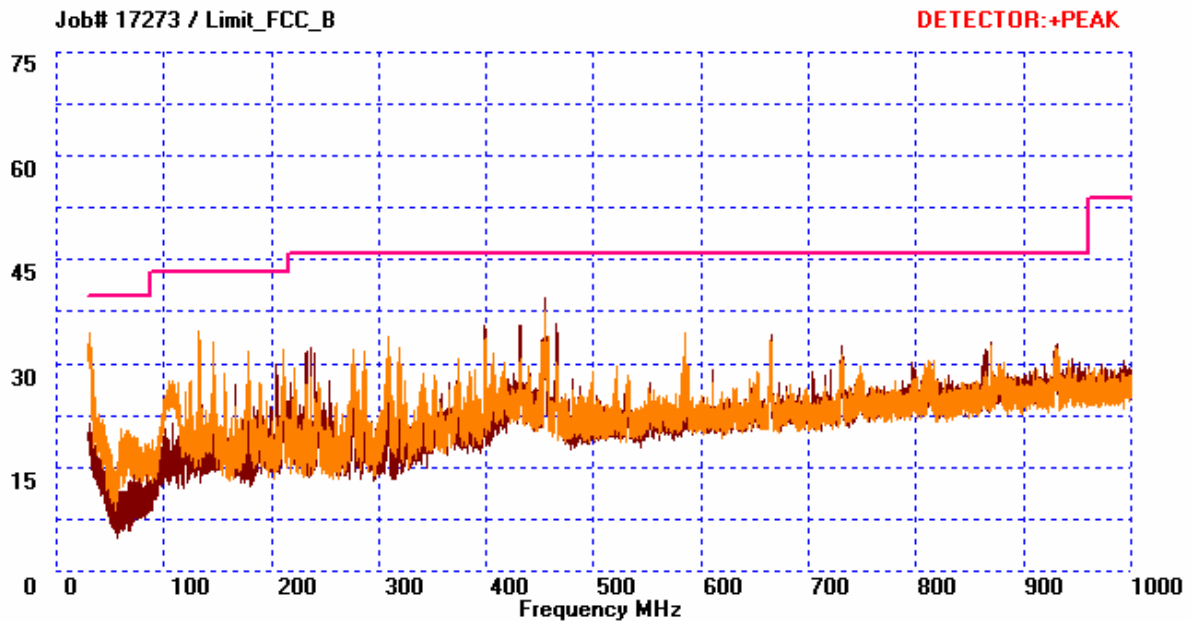


## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.209(a) Radiated Emission

#### Radiated Emissions Limits worst case 30 – 1000 MHz Vertical and Horizontal

Frequency (MHz)	Antenna Polarity (H/V)	EUT Azimuth (Degrees)	Antenna Height (m)	Uncorrected Amplitude (dBμV)	Antenna Correction Factor (dB/m) (+)	Pre Amp Gain (dB) (-)	Cable Loss (dB) (+)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
431.32	H	159	2.17	14.00	17.31	0.00	3.66	34.97	46.00	-11.03
454.76	H	185	1.21	20.00	17.64	0.00	3.78	41.42	46.00	-4.58
464.52	H	235	1.98	13.70	17.90	0.00	3.83	35.43	46.00	-10.57
31.68	V	97	1	14.50	17.23	0.00	0.94	32.67	40.00	-7.33
133.08	V	106	1	18.90	13.30	0.00	2.07	34.27	43.50	-9.23
146.2	V	30	1	15.90	12.60	0.00	2.20	30.70	43.50	-12.80



**Note:** Preliminary test was done with 8PSK and GFSK mode, worse case was 8PSK mode.

**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**

Frequency (GHz)	Antenna Polarity (H/V)	Height (m)	Raw Amp. @ 1m	P.Amp (dB)	Ant. Cor. Factor (dB)	Cable Loss (dB)	Dist. Cor Factor (dB)	EUT Field Strength Final Amp. (dBµV/m)	Limit @ 3m (dBµV/m)	Delta (dB)	Remark
4.804	H	1	45	34.591	33.958	5.220	9.54	40.047	74	-33.953	pk
4.804	H	1	33	34.591	33.958	5.220	9.54	28.047	54	-25.953	avg
7.206	H	1	54	34.783	36.730	6.580	9.54	52.987	74	-21.013	pk
7.206	H	1	41	34.783	36.730	6.580	9.54	39.987	54	-14.013	avg
4.804	V	1	45.1	34.591	33.888	5.220	9.54	40.077	74	-33.923	pk
4.804	V	1	32.8	34.591	33.888	5.220	9.54	27.777	54	-26.223	avg
7.206	V	1	56	34.783	36.730	6.580	9.54	54.987	74	-19.013	pk
7.206	V	1	43.5	34.783	36.730	6.580	9.54	42.487	54	-11.513	avg

**Radiated Harmonic Emissions**

**Note:** Preliminary test was done with 8PSK and GFSK mode, worse case was 8PSK mode.

**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



**Photograph 2. Radiated Emission Test Setup 30-1000MHz**



**Photograph 3. Radiated Emission Test Setup 1-26GHz**



## 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:** The EUT was found compliant with the Radiated Emission limits of §15.247(a) for Intentional Radiators. See following pages for detailed test results.

**Test Engineer:** Shawn McMillen

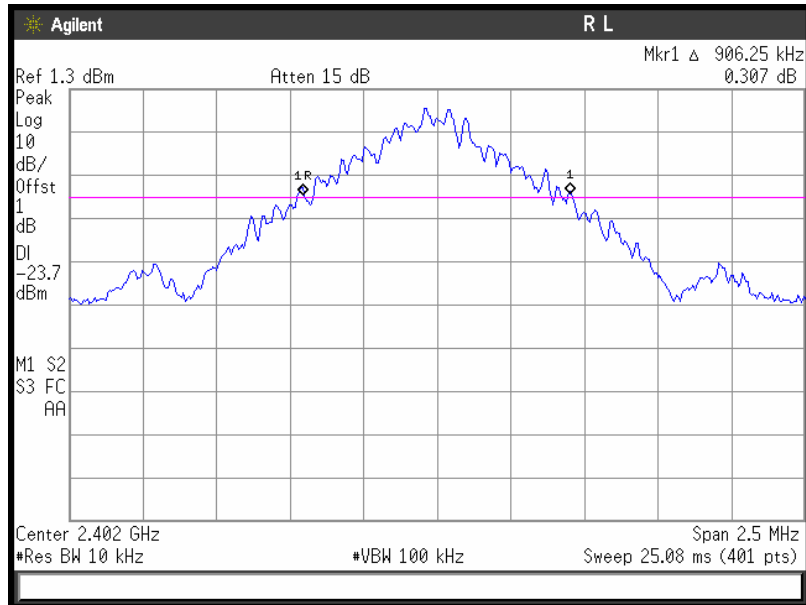
**Test Date(s):** March 28 - April 15, 2005



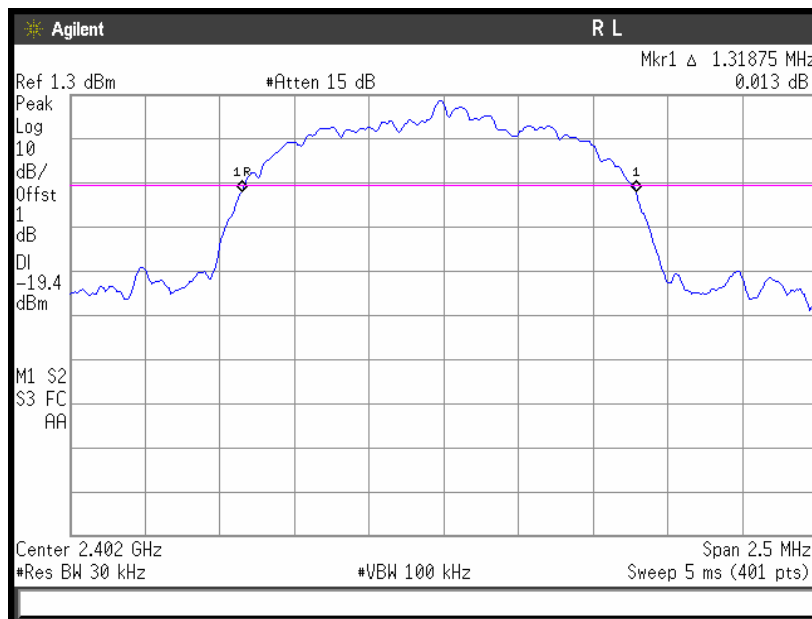


## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 20 dB Bandwidth



Low Ch. Occupied BW GFSK Mode

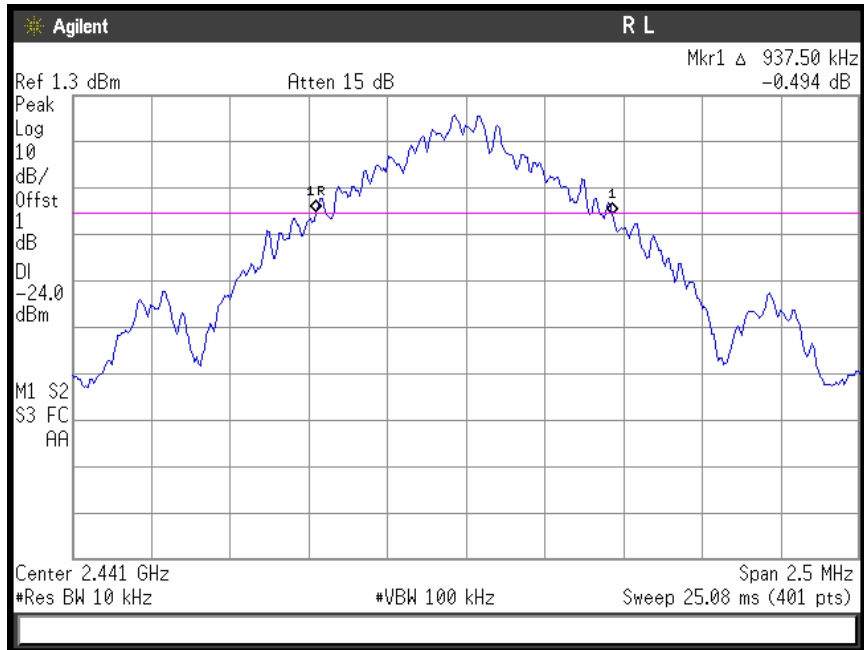


Low Ch. Occupied BW 8PSK Mode

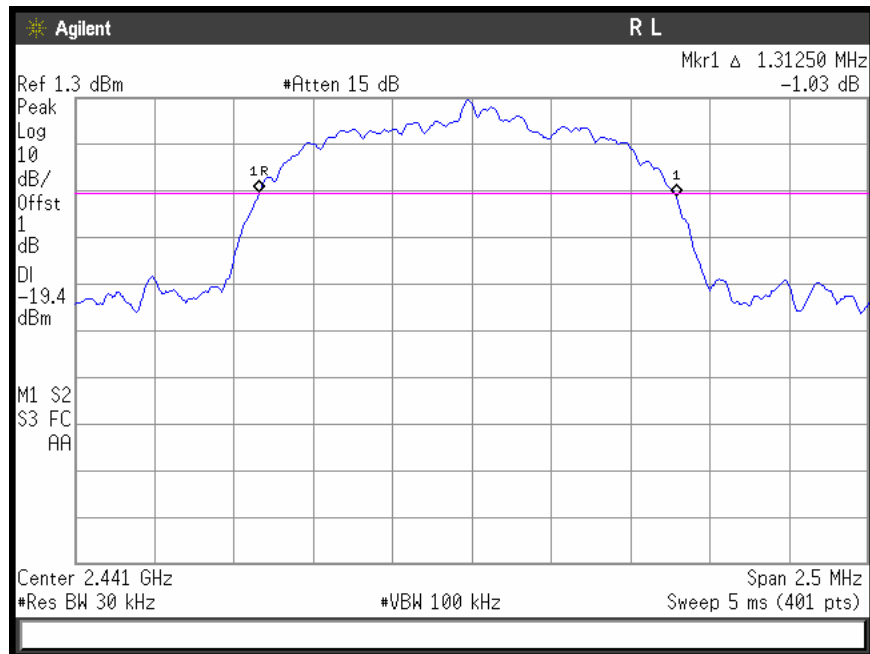


## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 20 dB Bandwidth



Mid Ch. Occupied BW GFSK Mode

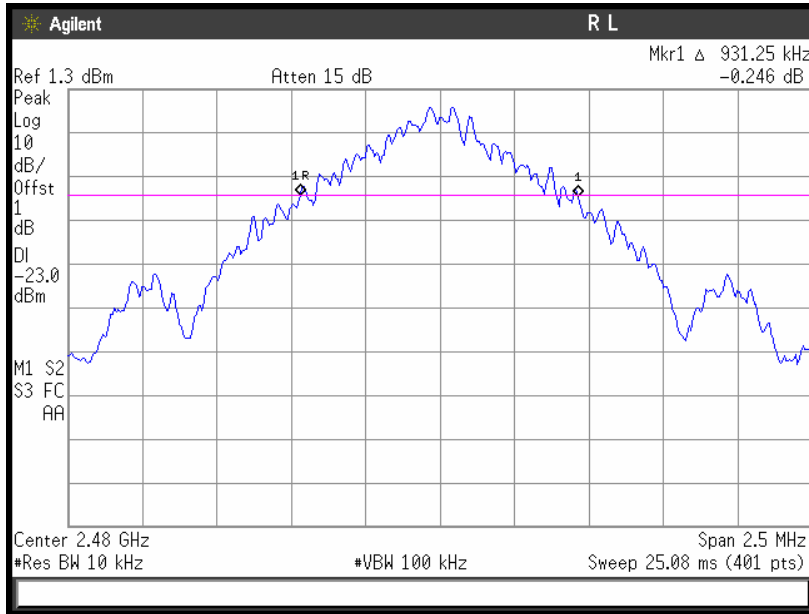


Mid Ch. Occupied BW 8PSK Mode

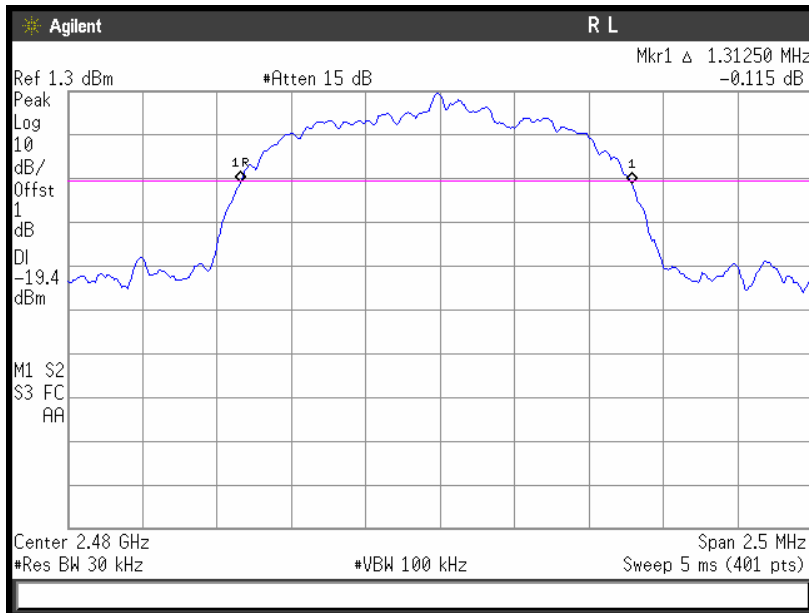


## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 20 dB Bandwidth



High Ch. Occupied BW GFSK Mode

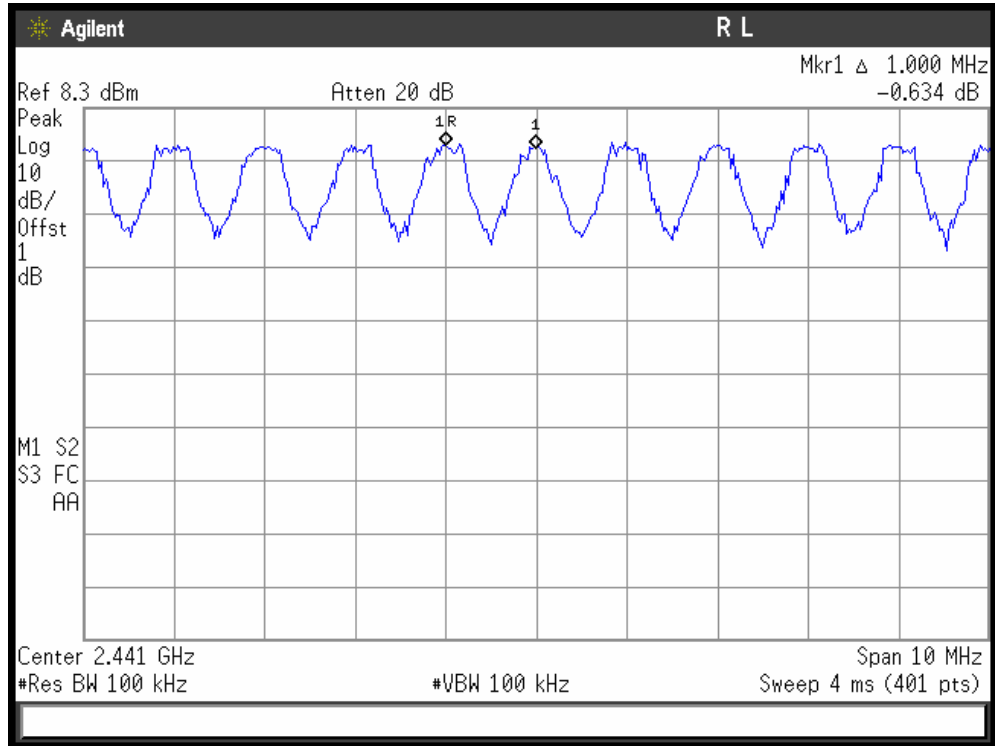


High Ch. Occupied BW 8PSK Mode



## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 Carrier Frequency Separation

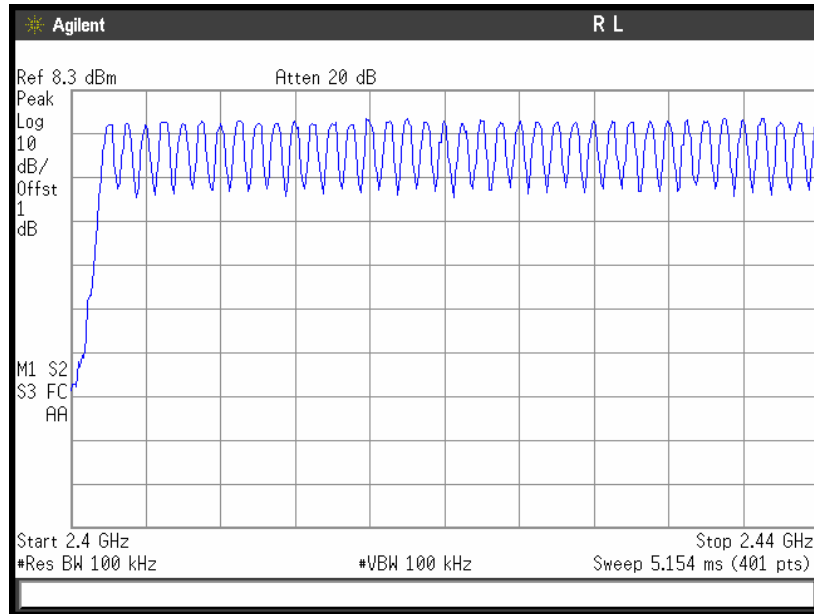


**Remarks:** The measured 20 dB bandwidth is 937.5 kHz in GFSK Mode and 1.31MHz in 8PSK Mode. Therefore, the frequency separation shall be greater than 937.5 kHz. The measurement of hopping channel carrier frequencies separation is 1 MHz. The EUT meets the specifications of **Section 15.247(a)(1)** for hopping channel carrier frequencies separation.

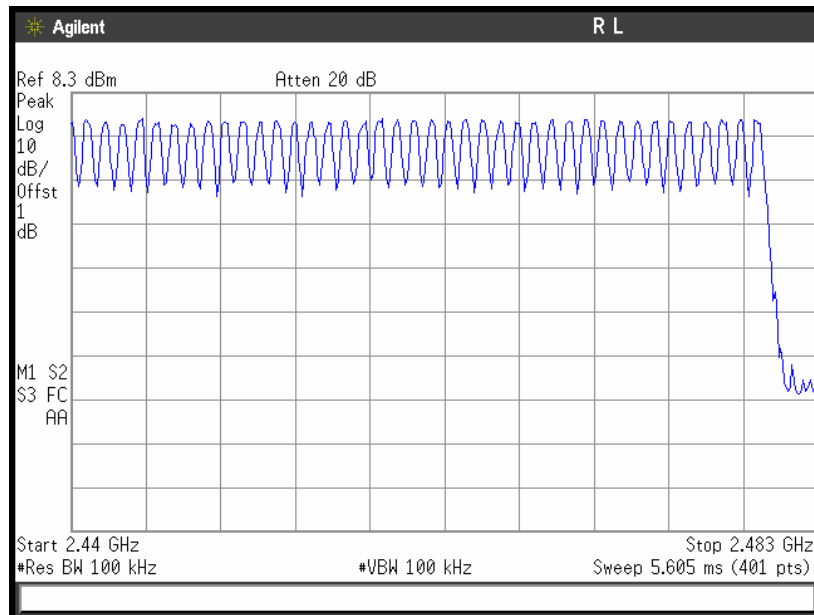


## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 Number of Hopping Channels



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



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

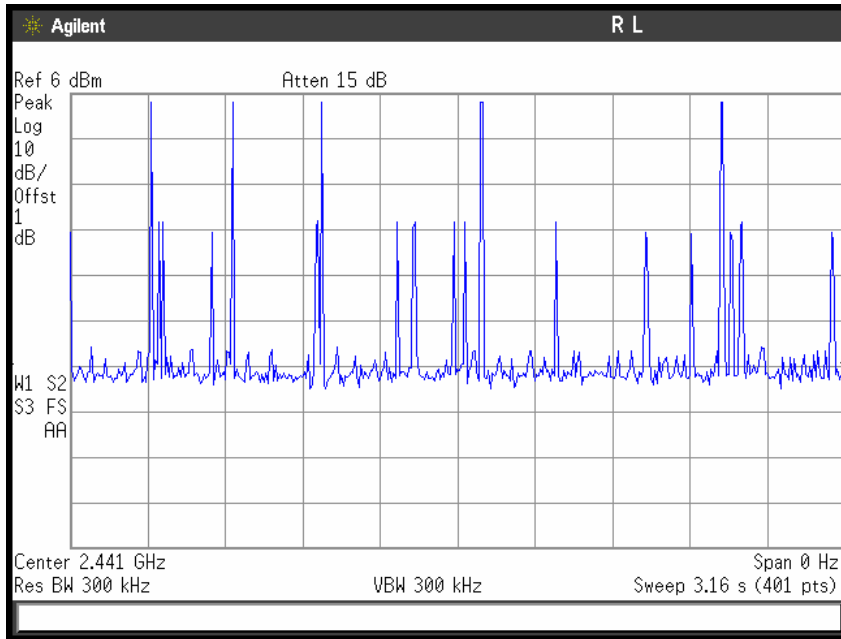
**Remarks:**

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

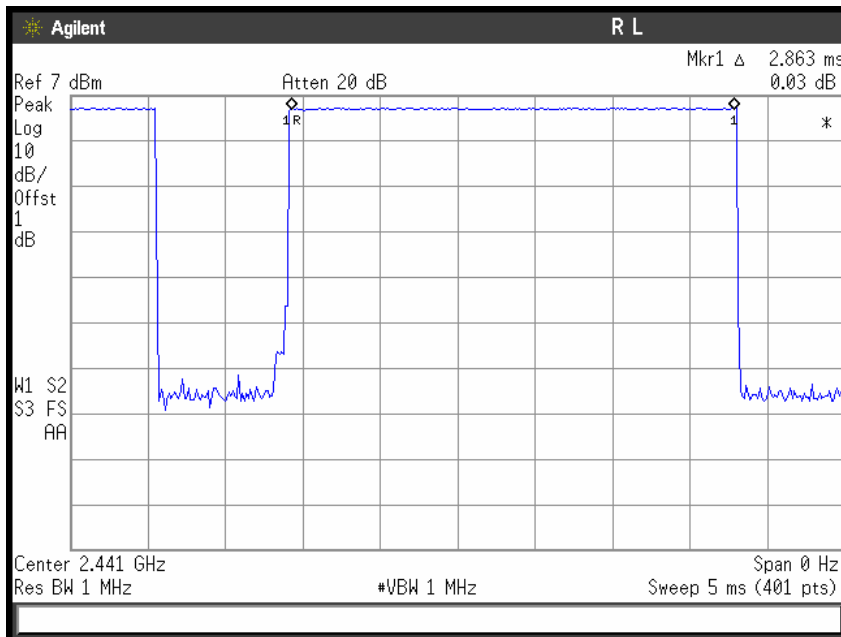


## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247 Time of Occupancy



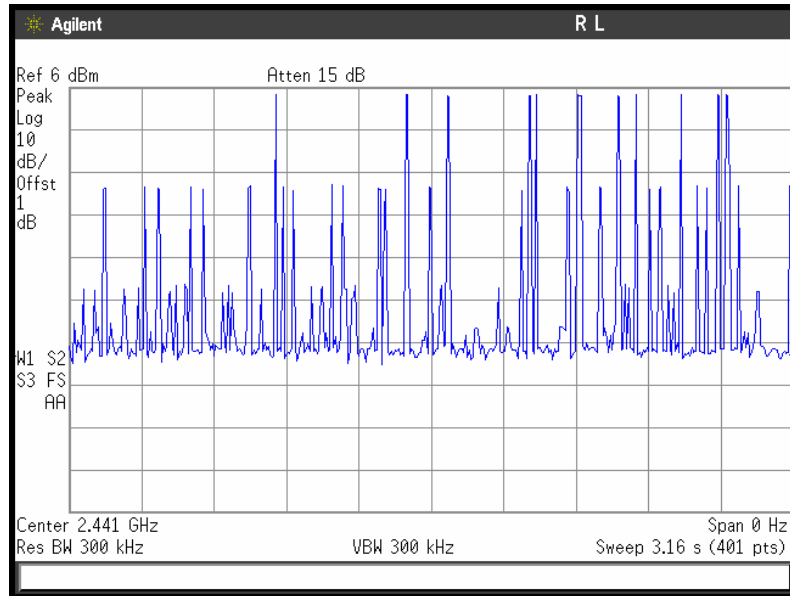
Number of Pulses in GFSK Mode



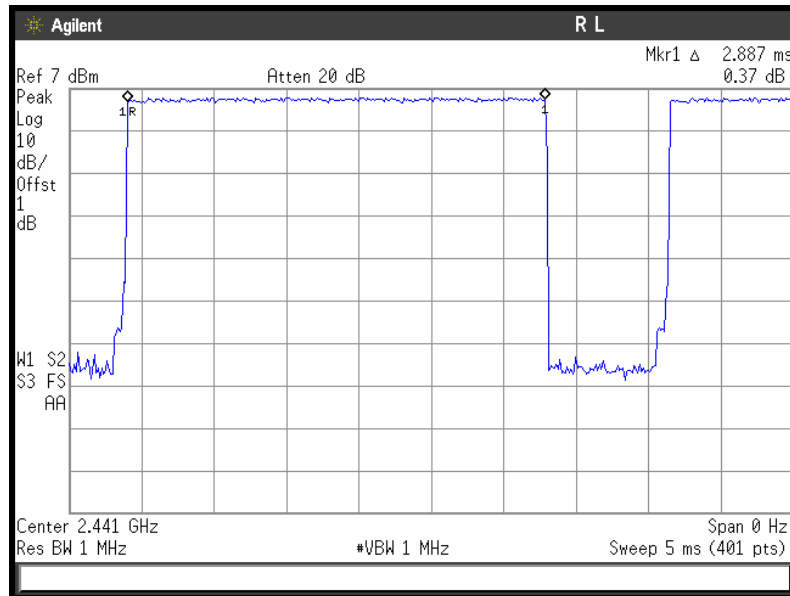
Dwell Time GFSK Mode



### Electromagnetic Compatibility Criteria for Intentional Radiators



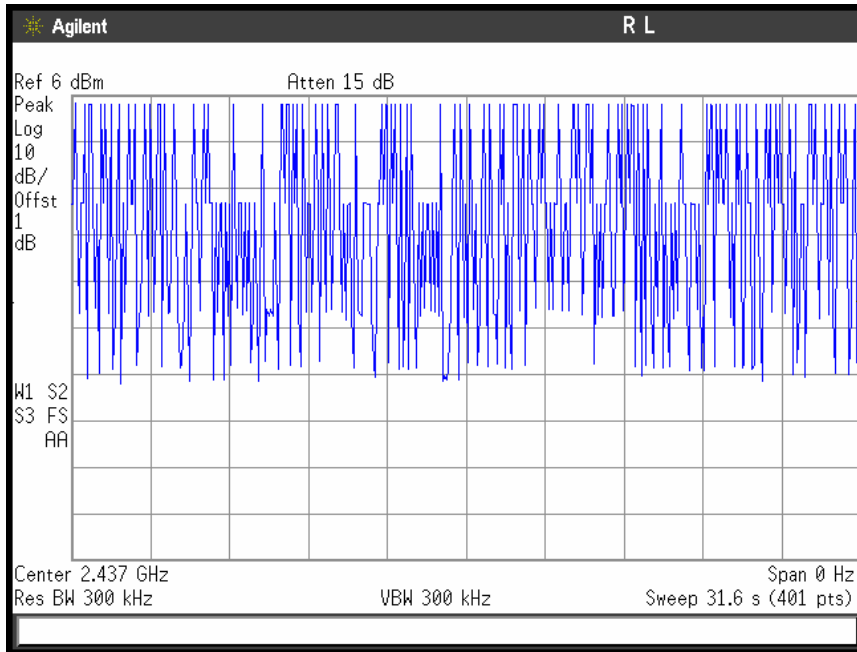
Number of Pulses in 8PSK Mode



Dwell Time 8PSK Mode



### Electromagnetic Compatibility Criteria for Intentional Radiators



Observed number of pulses in a 31.6s sweep





## Electromagnetic Compatibility Criteria for Intentional Radiators

**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.

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

The average time of occupancy in the specified 331.6 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{the pulse width}$ .

### Test Results:

Mode	Pulse Width (msec)	Humber of Pulses in 3.16 Seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK	2.863	5	0.143	0.4	0.257
8PSK	2.887	12	0.346	0.4	0.054



## 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 ≥ 50 Channels (Watts)
902-928	0.250	1.000
2400-2483.5	0.125	1.000
5725- 5850	1.000	1.000

**Table 8. 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 8, 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).

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

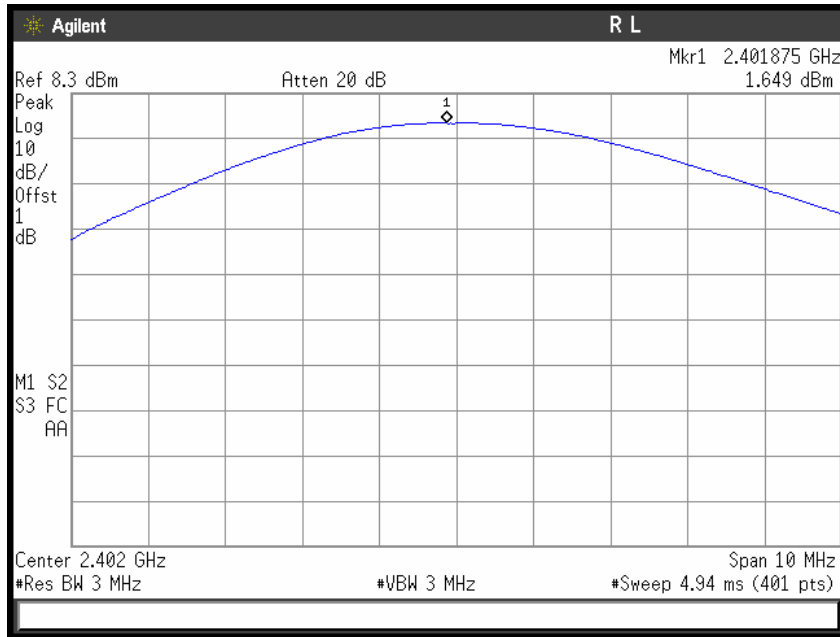
**Test Engineer:** Shawn McMillen

**Test Date(s):** March 28 - April 15, 2005

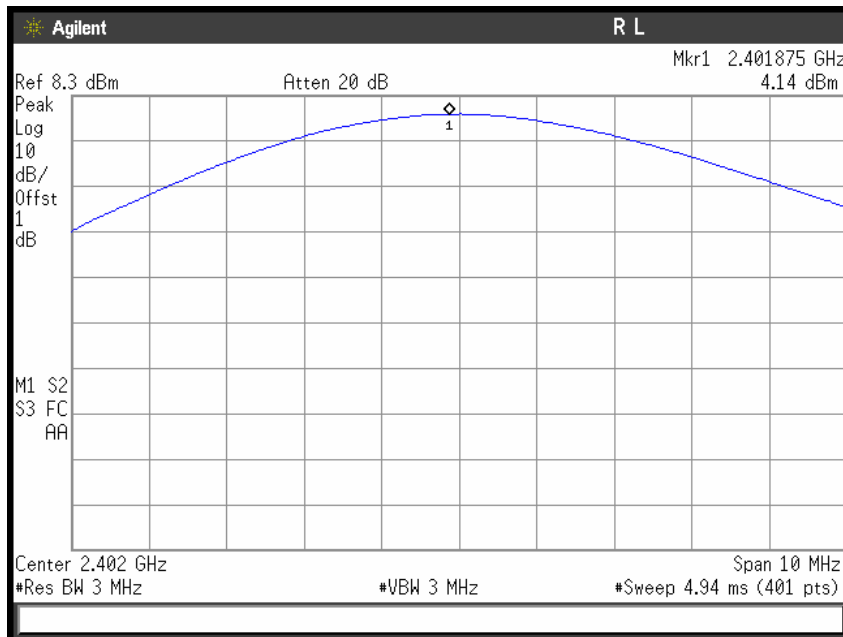


## Electromagnetic Compatibility Criteria for Intentional Radiators

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



Low Channel (2402 MHz) Power Output GFSK Mode

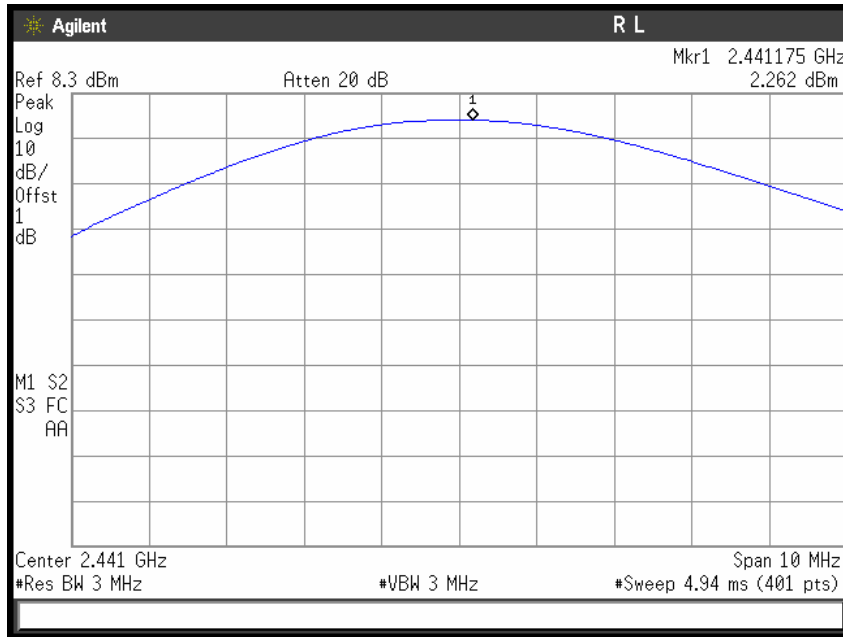


Low Channel (2402 MHz) Power Output 8PSK Mode

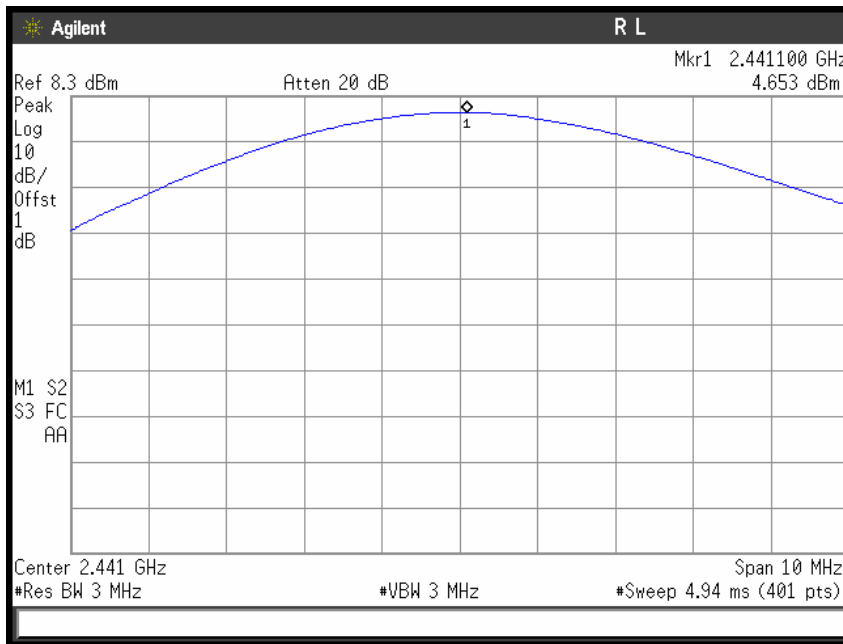


### Electromagnetic Compatibility Criteria for Intentional Radiators

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



Mid Channel (2441 MHz) Power Output GFSK Mode

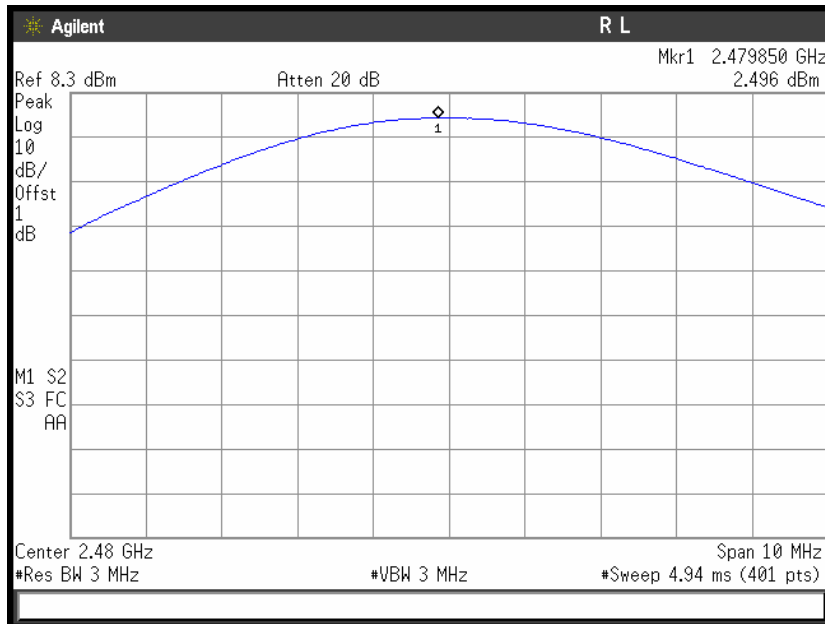


Mid Channel (2441 MHz) Power Output 8PSK Mode

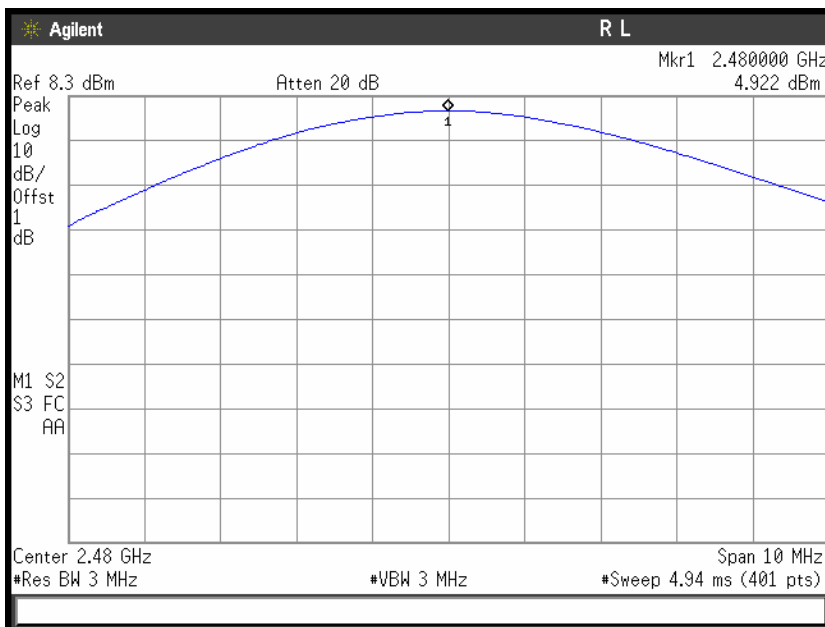


## Electromagnetic Compatibility Criteria for Intentional Radiators

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



High Channel (2480 MHz) Power Output GFSK Mode



High Channel (2480 MHz) Power Output 8PSK Mode



## Electromagnetic Compatibility Criteria for Intentional Radiators

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

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

**Test Results:**

Mode	Channel (MHz)	Max Conducted Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP(mW)
GFSK	2402	1.65	2.2	3.85	2.43
GFSK	2441	2.26	2.2	4.46	2.79
GFSK	2480	2.50	2.2	4.70	2.95
8PSK	2402	4.14	2.2	6.34	4.30
8PSK	2441	4.65	2.2	6.85	4.84
8PSK	2480	4.92	2.2	7.12	5.15

**Table 9. 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; EIRP = 7.12 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 (0.0031 Watts)  
 G = Antenna Gain (2.2 dBi) – numeric gain (1.65)  
 R = distance to the center of radiation of the antenna (20 cm or 0.2 m)

$$S = 0.0031W * 1.65 / 4 * 3.14 * (0.2m)^2 = 0.0135W / 0.5024m^2 = 0.0102W/m^2$$

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 an offset of 22.9 dB to the Spectrum Analyzer to compensate the antenna factor, cable loss and distance correction factor. 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 ≥ RBW. Scan through 10<sup>th</sup> harmonic of the highest fundamental frequency. Repeated the measurement with middle and highest channel.

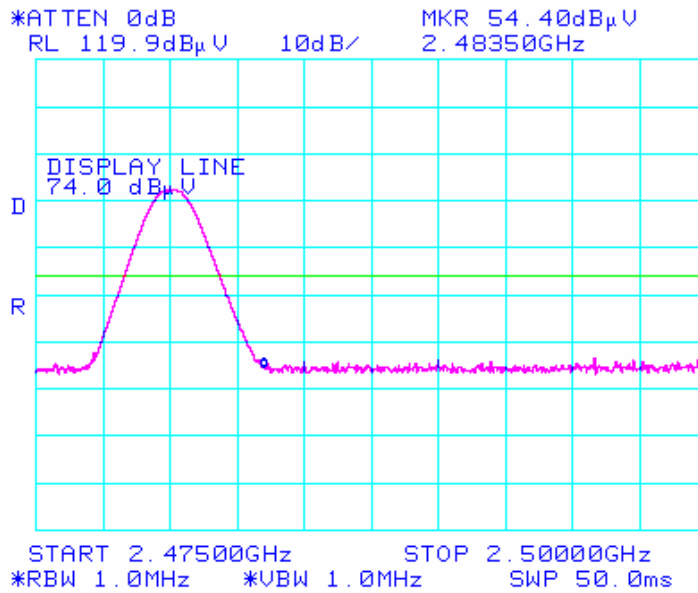
**Test Results:** Equipment complies with the Spurious Emissions Requirements – Radiated and RF Conducted limits of § 15.247 (c). For Radiated Emissions result, refer to section “§15.209: Radiated Emission Limits”. See following pages for detailed test results with RF Conducted Spurious Emissions and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

**Test Engineer:** Shawn McMillen

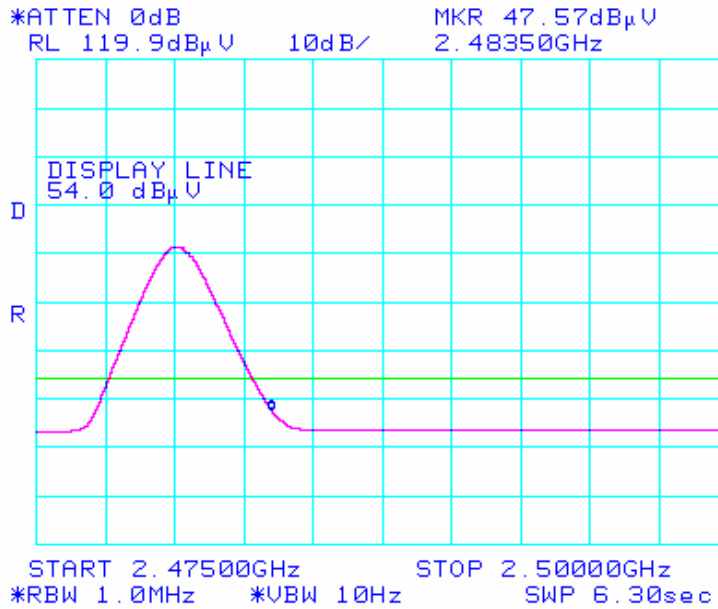
**Test Date:** March 28 - April 15, 2005





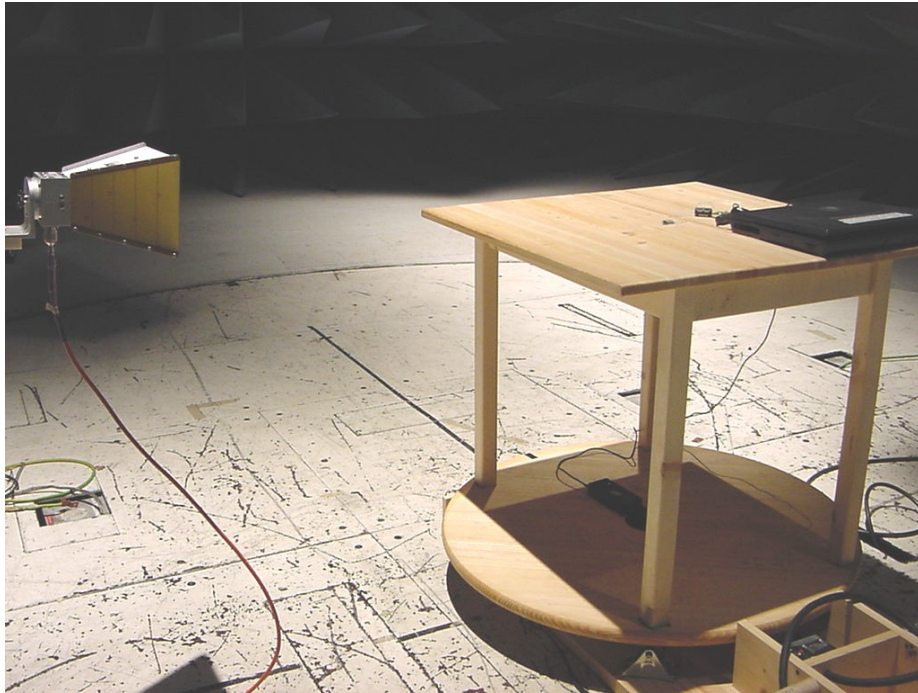


Restricted band 2483.5 – 2500MHz GFSK Mode Vertical Polarization (Peak)



Restricted band 2483.5 – 2500MHz GFSK Mode Vertical Polarization (Avg)





**Photograph 4. Restricted Band Edge Measurement Setup**

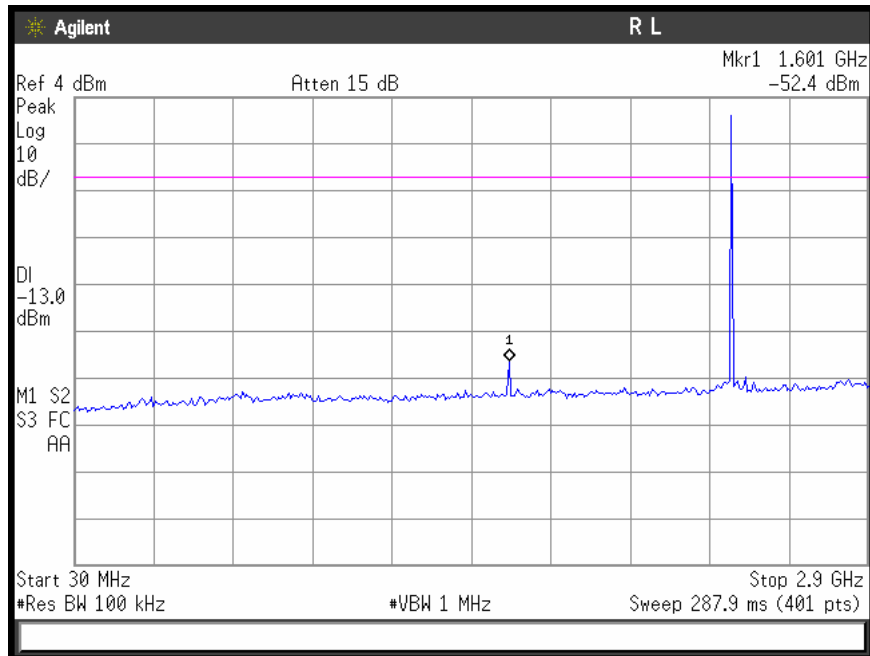


**Photograph 5. Restricted Band Edge Measurement Close-up of EUT**

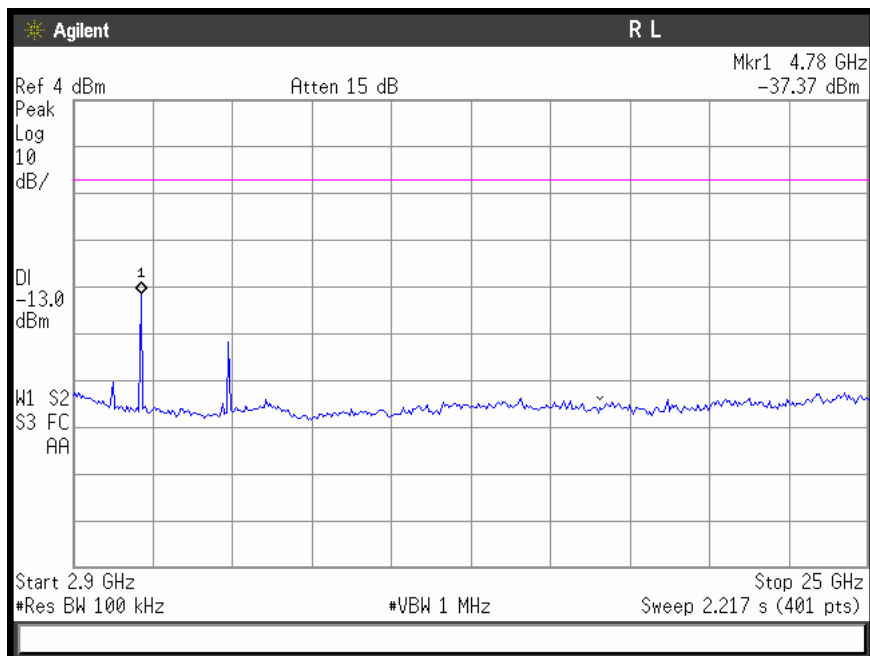


## Electromagnetic Compatibility Criteria for Intentional Radiators

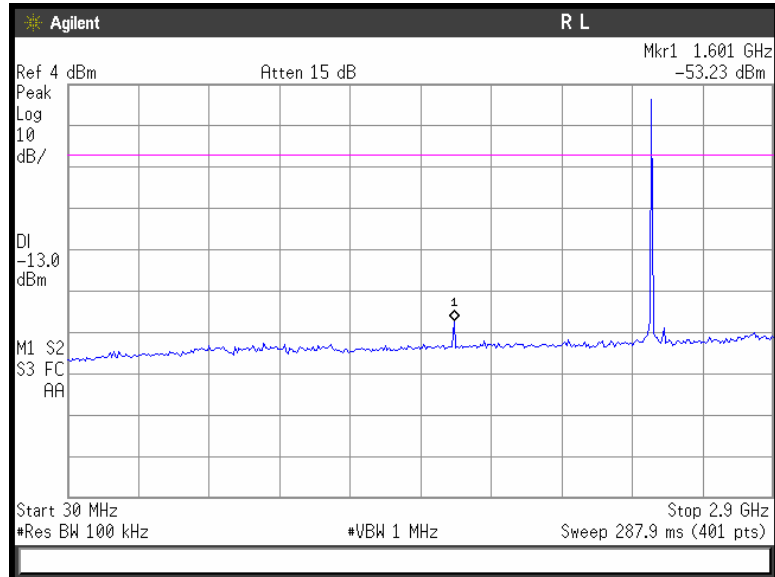
### § 15.247(c) Spurious Conducted Emissions Requirements



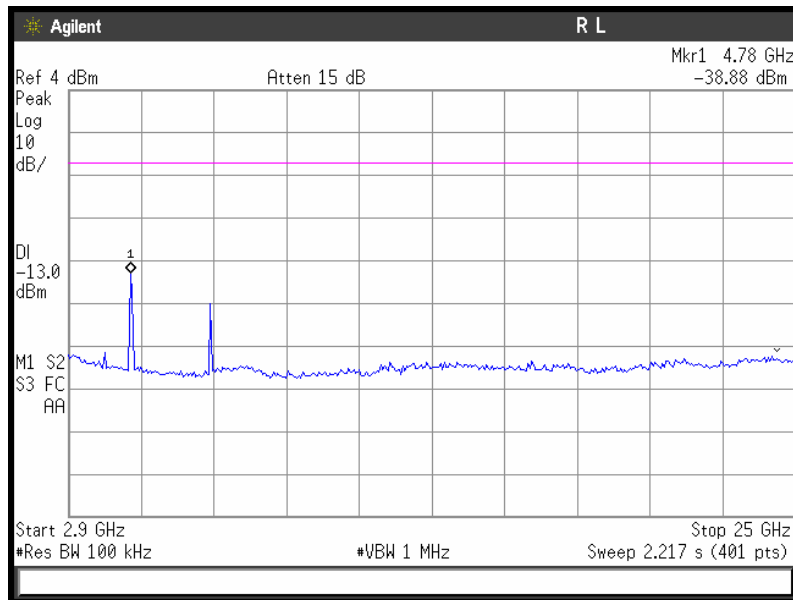
Low channel (2402 MHz) Spurious Emission 30 MHz - 2.9 GHz GFSK Mode



Low Channel (2402 MHz) Spurious Emission 2.9 – 25 GHz GMK Mode

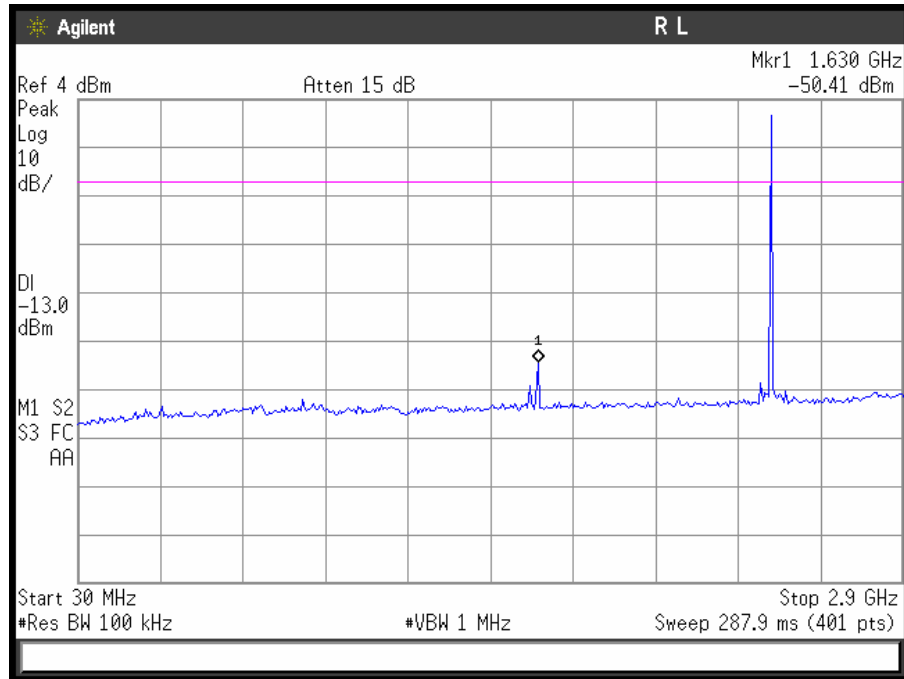


Low channel (2402 MHz) Spurious Emission 30 MHz - 2.9 GHz 8PSK Mode

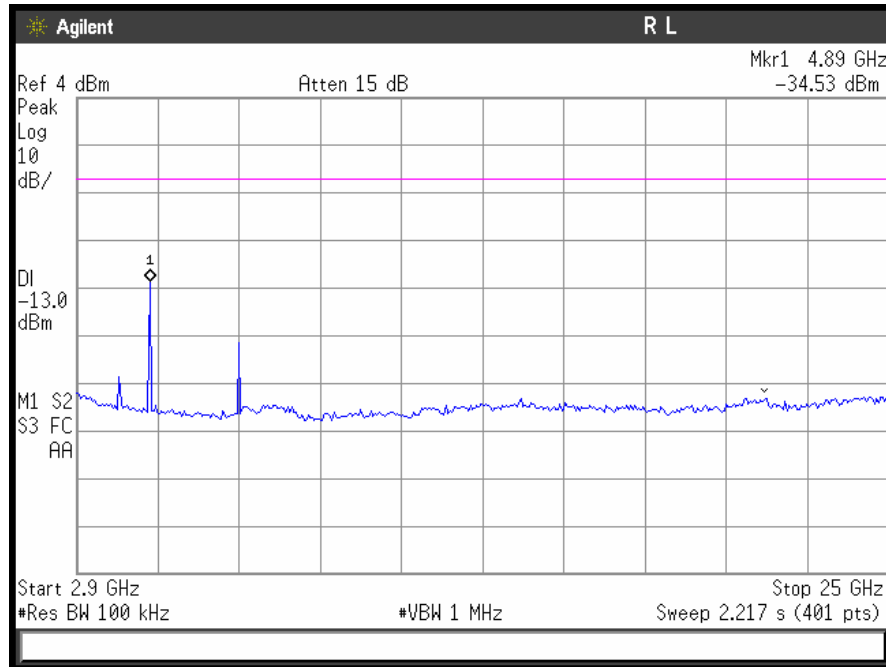


Low channel (2402 MHz) Spurious Emission 2.9 GHz - 25 GHz 8PSK Mode

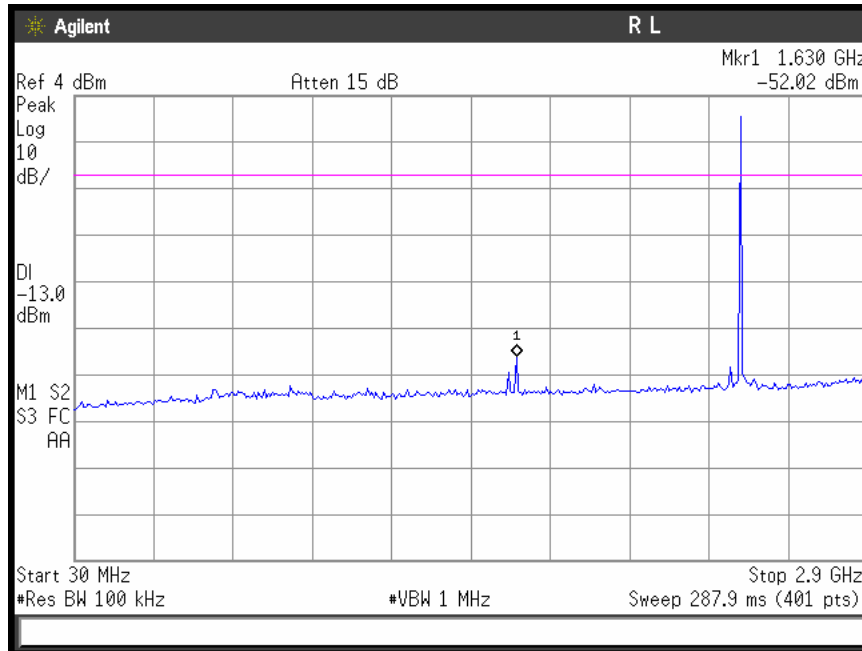




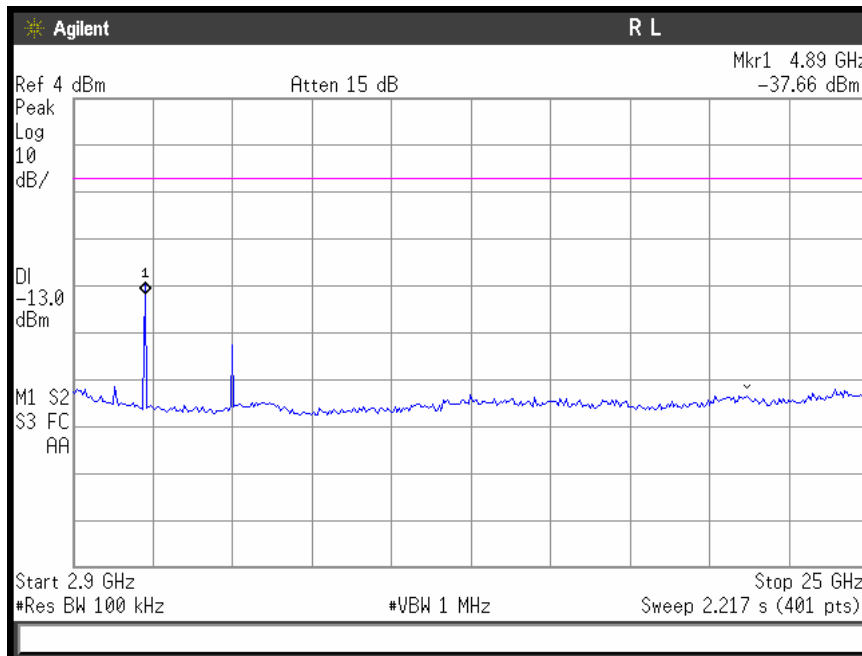
**Mid channel (2441 MHz) Spurious Emission 30 MHz - 2.9 GHz GFSK Mode**



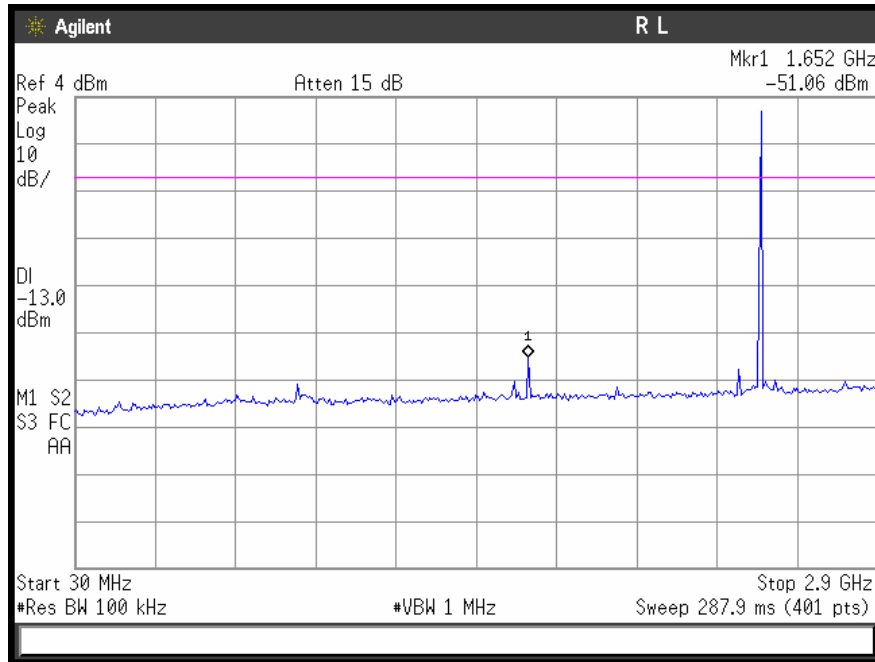
**Mid channel (2441 MHz) Spurious Emission 2.9 GHz - 25 GHz GFSK Mode**



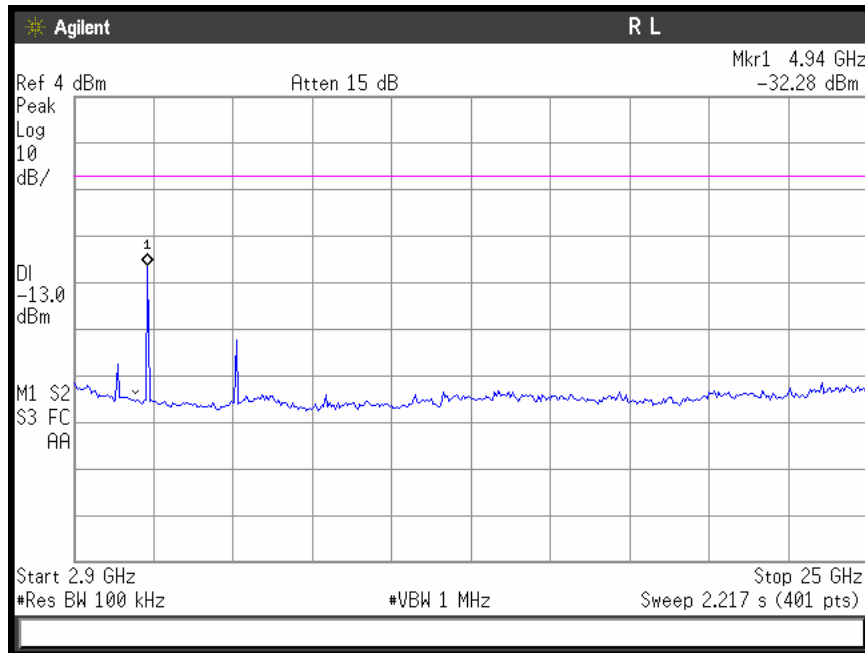
Mid channel (2441 MHz) Spurious Emission 30 MHz - 2.9 GHz 8PSK Mode



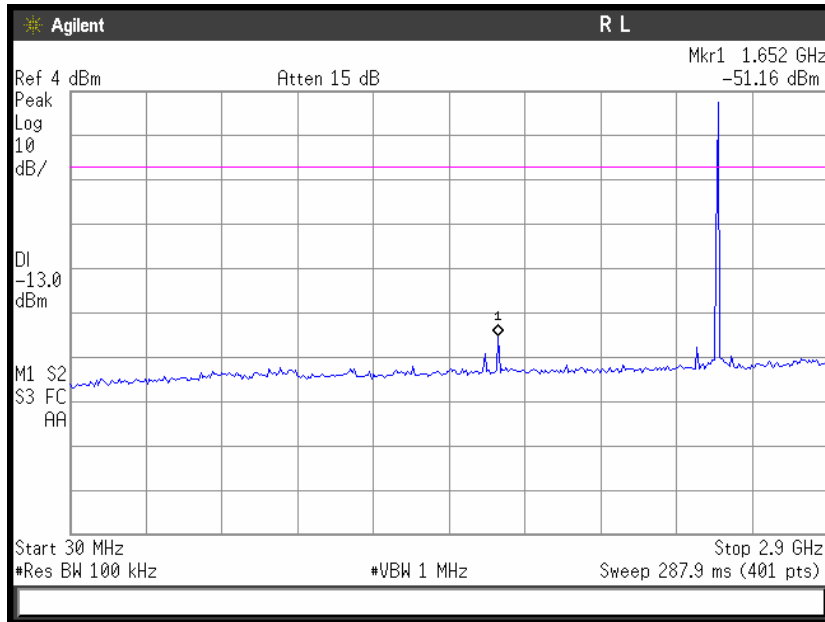
Mid channel (2441 MHz) Spurious Emission 2.9 GHz - 25 GHz 8PSK Mode



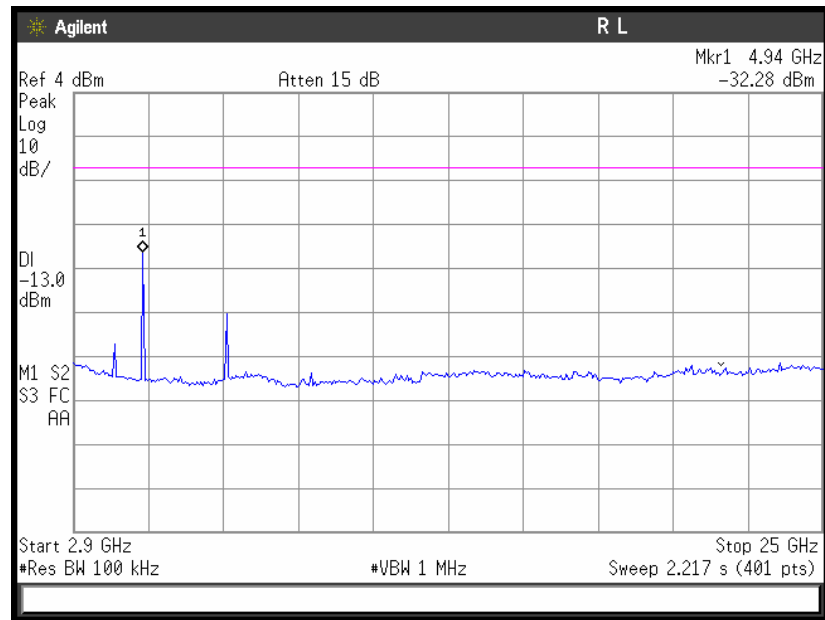
High channel (2480 MHz) Spurious Emission 30 MHz - 2.9 GHz GFSK Mode



High channel (2480 MHz) Spurious Emission 2.9 GHz - 25 GHz GFSK Mode

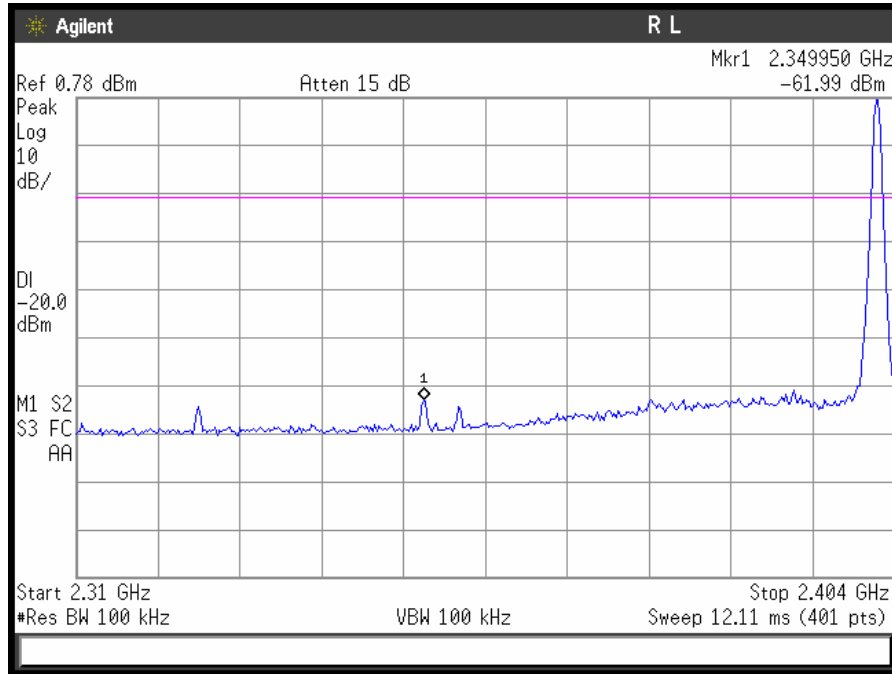


High channel (2480 MHz) Spurious Emission 30 MHz - 2.9 GHz 8PSK Mode

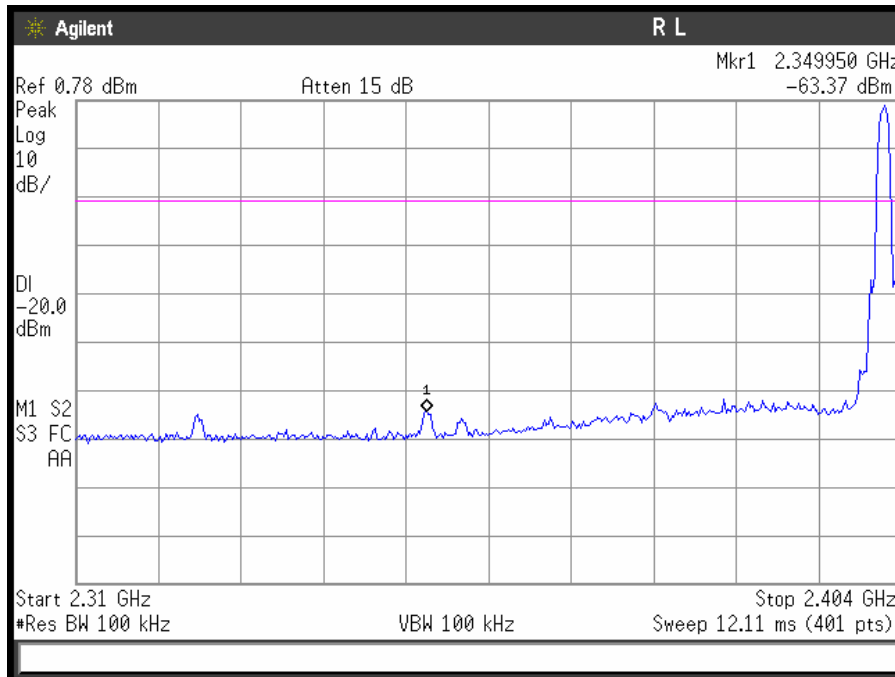


High channel (2480 MHz) Spurious Emission 2.9 GHz - 25 GHz 8PSK Mode

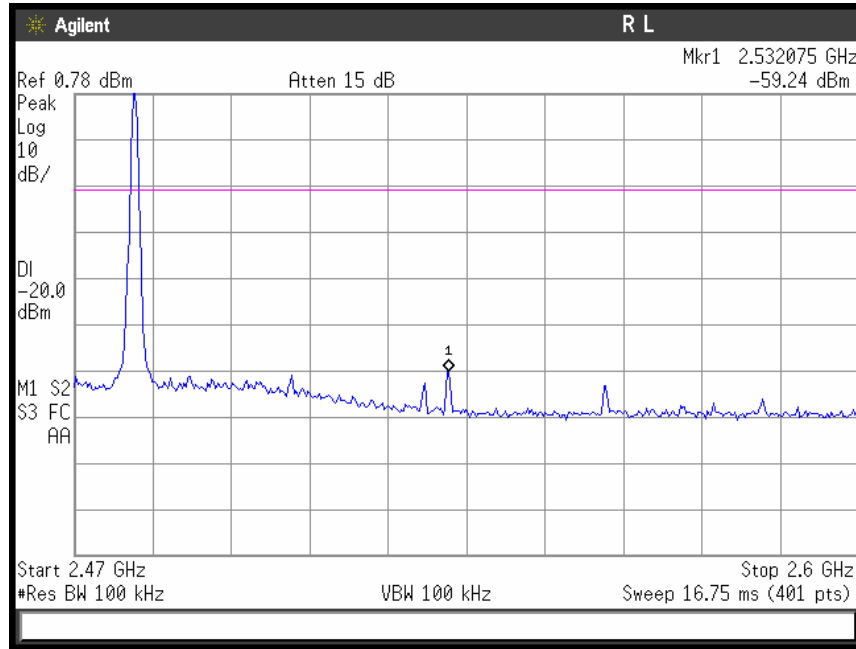
**Remarks:** Equipment complies with the Spurious Emissions Requirements – RF Conducted limits of § 15.247(c).



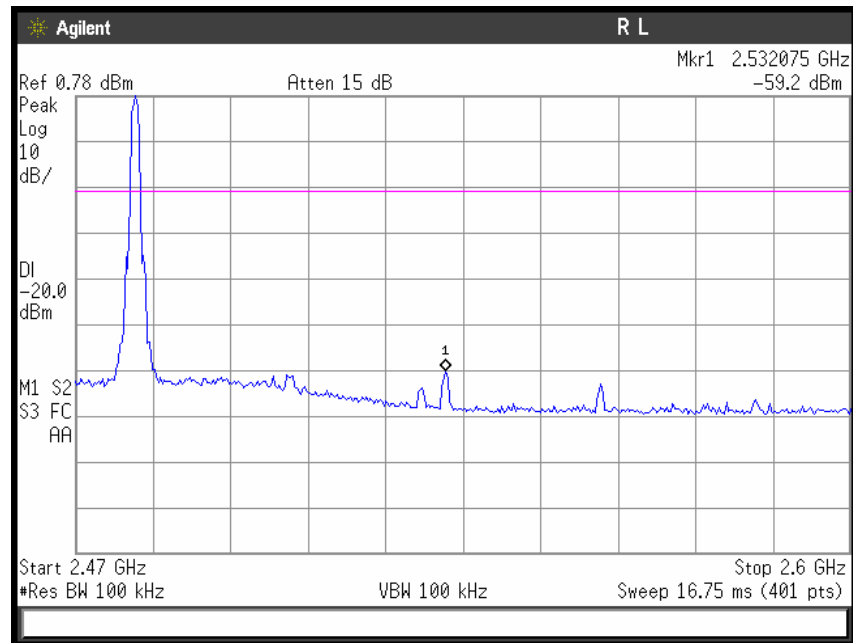
Low Channel Band Edge GSMK Mode



Low Channel Band Edge 8PSK Mode



High Channel Band Edge GSMK Mode



High Channel Band Edge 8PSK Mode

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



**Photograph 6. Conducted Measurements 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 Sections: FCC Subpart C - 15.247			Test Date(s): March 28 - April 15, 2005		
MET Asset #	Nomenclature	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2430	WCDMA Sensor	Anritsu Company	ML2488A	1/12/2005	1/12/2006
1S2432	WCDMA Power Monitor Sensor	Anritsu Company	MA2491A	1/12/2005	1/12/2006
1S2293	Analyzer, Spectrum, 9 kHz-40 GHz	Hewlett Packard	8564E	9/30/2004	9/30/2005
1S2421	EMI Test Receiver	Rhode & Schwarz	ESIB 7	2/9/2005	2/9/2006
1S2229	Chamber, Temperature	Tenny Engineering	T63C	10/21/2005	10/21/2006
1S2041	Coupler, Bi Directional Coaxial	Narda	N/A	See Note	
1S2034	Coupler, Directional 1-20 GHz	Krytar	101020020	See Note	
1S2263	Chamber, 10 Meter	Rantec	N2-14	7/26/2004	7/26/2005
Rental	EMI Analyzer	Hewlett Packard	E7405A	6/2/2004	6/2/2005
1S2278	Generator, Swept Signal	Hewlett Packard	83650B	6/04/2004	6/04/2005
1U7	Antenna, Horn	EMCO	3115	2/23/2005	2/23/2006
1S2198	Antenna, Horn	EMCO	3115	6/22/2004	6/22/2005
1S2121	Pre-Amplifier	Hewlett Packard	8449B	10/17/2004	10/17/2005
N/A	4.5 GHz High Pass Filter	Micro-Tronics	HPM13146	See Note	
1S2184	Bilog Antenna	Chase	CLB6112A	01/12/2005	01/12/2006
1S2109	EMI Analyzer	HP	8546A	06/29/2004	06/29/2005
1S2108	RF Filter Section	HP	85460A	06/29/2004	06/29/2005
1S2372	LISN	FCC	N/A	02/09/2005	02/09/2006
4U1566	AC Power Source	ELGAR	SWS250A	See Note	
Client	Laptop	Dell	INSPIRON 4100	N/A	

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

### 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.





## VI. Exhibits



## Exhibit A, Hopping Capability Requirements



## Exhibit B, Non-Coordination Requirements



**End of Report**