



## MET Laboratories, Inc.

*Safety Certification - EMI - Telecom Environmental Simulation*

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December 5, 2012

Murata Wireless  
4441 Sigma Road  
Dallas, TX 75244

Dear Bob Nelson,

Enclosed is the EMC Wireless test report for compliance testing of the Murata Wireless, DR-WLS1271L-102 as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15, Subpart B, ICES-003, Issue 4 February 2004 for a Class B Digital Device and FCC Part 15 Subpart C, RSS-210, Issue 8, Dec. 2010 for Intentional Radiators.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,  
MET LABORATORIES, INC.

Jennifer Warnell  
Documentation Department

Reference: (Murata Wireless\EMCS36587D-FCC247)

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## Electromagnetic Compatibility Criteria Test Report

for the

**Murata Wireless**  
**DR-WLS1271L-102**

**Tested under**  
the FCC Certification Rules  
contained in  
Title 47 of the CFR, Parts 15 Subpart B & ICES-003  
for Class B Digital Devices  
&  
15.247 Subpart C & RSS-210, Issue 8, Dec. 2010  
for Intentional Radiators

**MET Report: EMCS36587D-FCC247**

December 5, 2012

**Prepared For:**

**Murata Wireless**  
**4441 Sigma Road**  
**Dallas, TX 75244**

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

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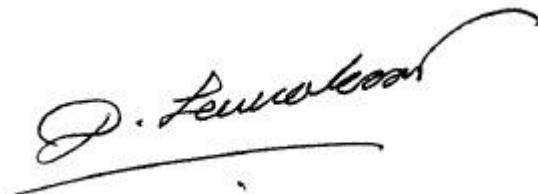


Anderson Soungpanya, Project Engineer  
Electromagnetic Compatibility Lab



Jennifer Warnell  
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Parts 15B, 15.247 and Industry Canada standards ICES-003, Issue 4 February 2004, RSS-210, Issue 8, Dec. 2010 under normal use and maintenance.



Dusmantha Tennakoon,  
Wireless Manager, Electromagnetic Compatibility Lab

## Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	December 5, 2012	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
<i>d</i>	Measurement Distance
<b>dB</b>	Decibels
<b>dB<sub>μ</sub>A</b>	Decibels above one <b>microamp</b>
<b>dB<sub>μ</sub>V</b>	Decibels above one <b>microvolt</b>
<b>dB<sub>μ</sub>A/m</b>	Decibels above one <b>microamp per meter</b>
<b>dB<sub>μ</sub>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
<i>f</i>	Frequency
<b>FCC</b>	Federal Communications Commission
<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>μH</b>	<b>microhenry</b>
<b>μ</b>	<b>microfarad</b>
<b>μs</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>	Volts <b>per meter</b>
<b>VCP</b>	Vertical Coupling Plane

# I. Executive Summary

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Murata Wireless DR-WLS1271L-102, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the DR-WLS1271L-102. Murata Wireless should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the DR-WLS1271L-102, 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, §15.247, in accordance with Murata Wireless, purchase order number 30835. All tests were conducted using measurement procedure ANSI C63.4-2003.

FCC Reference 47 CFR Part 15.247:2005	IC Reference RSS-210 Issue 8: 2010; RSS-GEN Issues 3: 2010	Description	Compliance
47 CFR Part 15.107 (a)	ICES-003 Issue 4 February 2004	Conducted Emission Limits for a Class B Digital Device	Compliant
47 CFR Part 15.109 (a)	ICES-003 Issue 4 February 2004	Radiated Emission Limits for a Class B Digital Device	Compliant
Title 47 of the CFR, Part 15 §15.203	N/A	Antenna Requirement	Compliant
Title 47 of the CFR, Part 15 §15.207(a)	RSS-GEN (7.2.4)	Conducted Emission Limits	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RSS-Gen(4.6)	20 dB Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)		99% Occupied Bandwidth	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RSS-210(A8.1)	Average Time of Occupancy (Dwell Time)	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RSS-210(A8.1)	Number of RF Channels	Compliant
Title 47 of the CFR, Part 15 §15.247(a)(1)	RSS-210(A8.1)	RF Channel Separation	Compliant
Title 47 of the CFR, Part 15 §15.247(b)	RSS-210(A8.4)	Peak Power Output	Compliant
Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205	RSS-210(A8.5)	Radiated Spurious Emissions	Compliant
Title 47 of the CFR, Part 15 §15.247(d)	RSS-210(A8.5)	Spurious Conducted Emissions	Compliant
Title 47 of the CFR, Part 15 §15.247(g) & (h)	RSS-210(A8.1)	Declaration Statements for FHSS	Compliant
Title 47 of the CFR, Part 15 §15.247(i)	RSS-GEN (5.6)	Maximum Permissible Exposure (MPE)	Compliant
N/A	RSS-GEN (4.10)	Receiver Spurious Emissions	Compliant

Table 1. Executive Summary of EMC Part 15.247 Compliance Testing

## II. Equipment Configuration

## A. Overview

MET Laboratories, Inc. was contracted by Murata Wireless to perform testing on the DR-WLS1271L-102, under Murata Wireless's purchase order number 30835.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Murata Wireless, DR-WLS1271L-102.

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

<b>Model(s) Tested:</b>	DR-WLS1271L-102
<b>Model(s) Covered:</b>	DR-WLS1271L-102
<b>EUT Specifications:</b>	Primary Power: 5VDC (Supplied from USB Laptop)
	FCC ID: TE6-DRWLS1273L
	IC: 10748A-DRWLS1273L
	Type of Modulations: EDR, GFSK
	Equipment Code: DSS
	Peak RF Output Power: 8.50 dBm
<b>Analysis:</b>	EUT Frequency Ranges: 2402-2480MHz
	The results obtained relate only to the item(s) tested.
	Temperature: 15-35° C
	Relative Humidity: 30-60%
	Barometric Pressure: 860-1060 mbar
	Anderson Soungpanya
<b>Report Date(s):</b>	December 5, 2012

**Table 2. EUT Summary Table**

## 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>RSS-210, Issue 8, Dec. 2010</b>	Low-power Licence-exempt Radiocommunications Devices (All Frequency Bands): Category I Equipment
<b>RSS-GEN, Issue 3, Dec. 2010</b>	General Requirements and Information for the Certification of Radio Apparatus
<b>ICES-003, Issue 4 February 2004</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>ISO/IEC 17025:2005</b>	General Requirements for the Competence of Testing and Calibration Laboratories
<b>ANSI C63.10-2009</b>	American National Standard for Testing Unlicensed Wireless Devices

**Table 3. References**

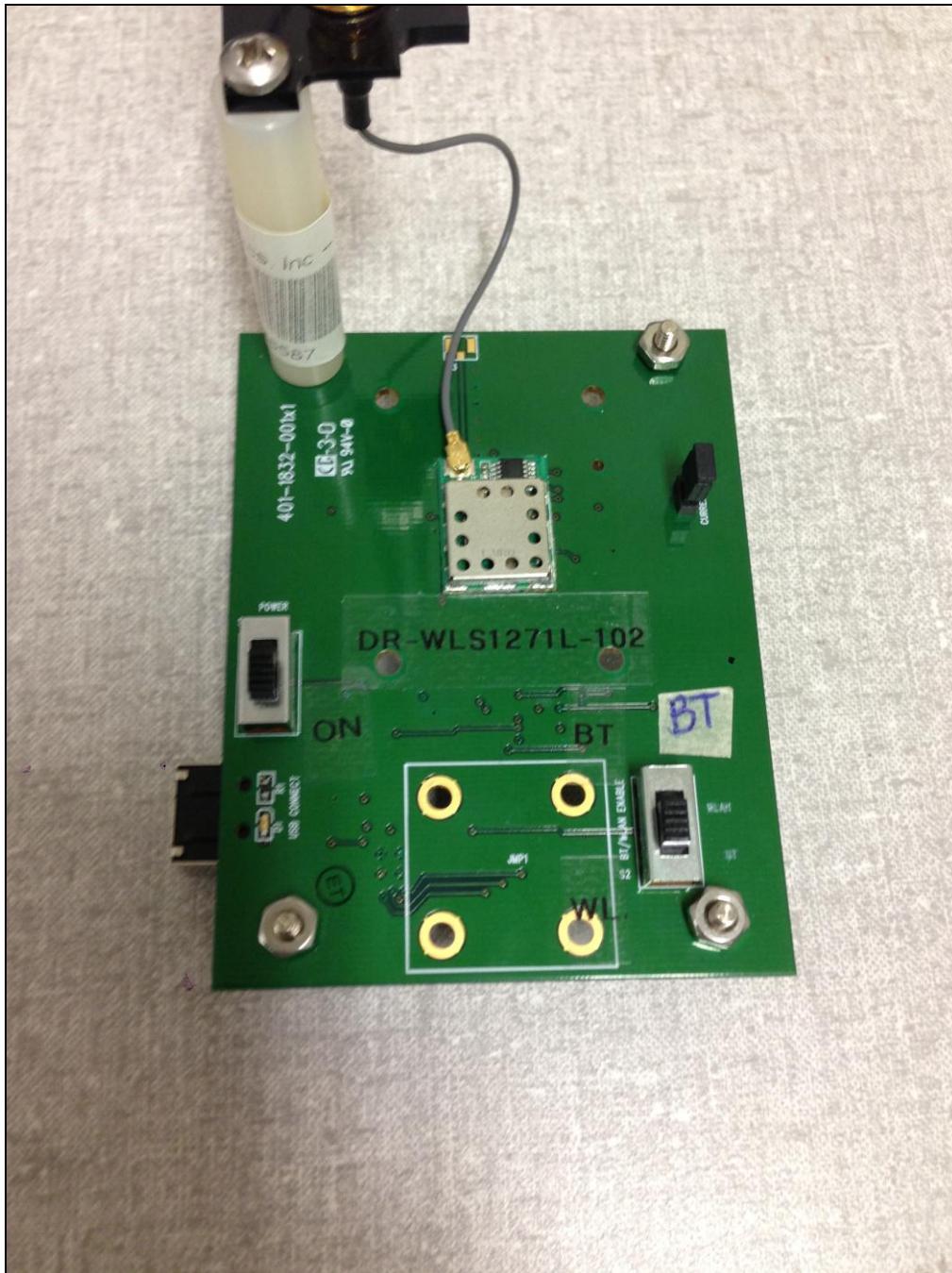
## C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick St., Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

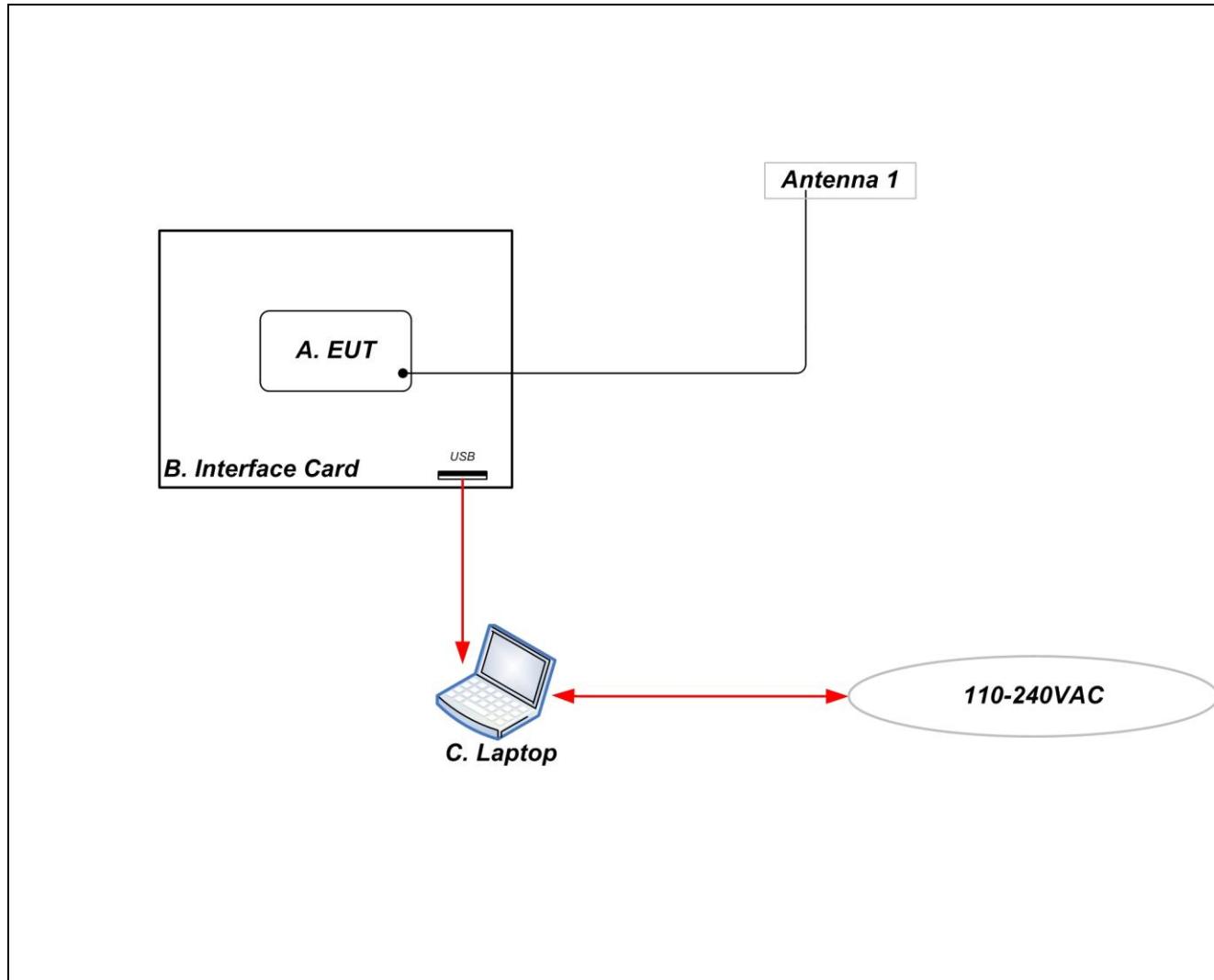
Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Description of Test Sample

The Murata Wireless DR-WLS1271L-102, Equipment Under Test (EUT), is a WiFi Bluetooth combo module - WiFi 802.11b/g/n - Bluetooth core 4.0.



Photograph 1. Murata Wireless DR-WLS1271L-102



**Figure 1. Block Diagram of 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	Serial Number
A	802.11b/g/n & Bluetooth Module	1271	001

**Table 4. Equipment Configuration**

## F. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number
C	Laptop	Dell	Latitude D600

**Table 5. Support Equipment**

## G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
1	USB	Com Port/Power Supply	1	1.5	Y	USB, Laptop

**Table 6. Ports and Cabling Information**

## H. Mode of Operation

Both modules are a WiFi/Bluetooth combo module.

The WiFi I/O interface is 4 bit SDIO.

The Bluetooth I/O interface is Uart.

Module does not transmit WIFI and Bluetooth simultaneously. Only one modulation/Band can transmit at a time.

## I. Method of Monitoring EUT Operation

None.

## 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 Murata Wireless upon completion of testing.

### III. Electromagnetic Compatibility Criteria for Unintentional Radiators

## Electromagnetic Compatibility Criteria

### § 15.107 Conducted Emissions Limits

**Test Requirement(s):** **15.107 (a)** Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

**15.107 (b)** For a Class A digital device that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in Table 7. Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals. The lower limit applies at the band edges.

**15.207(a)**, Except as shown in paragraphs (b) and (c) of this section\*, charging, AC adapters or battery eliminators the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the Table 7, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency range (MHz)	Class A Conducted Limits (dB $\mu$ V)		*Class B Conducted Limits (dB $\mu$ V)	
	Quasi-Peak	Average	Quasi-Peak	Average
* 0.15- 0.45	79	66	66 - 56	56 - 46
0.45 - 0.5	79	66	56	46
0.5 - 30	73	60	60	50

Note 1 — The lower limit shall apply at the transition frequencies.  
 Note 2 — The limit decreases linearly with the logarithm if the frequency in the range 0.15 MHz to 0.5 MHz.  
 \* -- Limits per Subsection 15.207(a).

**Table 7. Conducted Limits for Radio Frequency Devices calculated from FCC Part 15 Subsections 15.107(a) (b) and 15.207(a)**

**Test Procedures:**

The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing, test conditions, and test procedures of ANSI C63.4 were used. The EUT was powered through a 50 $\Omega$ /50 $\mu$ H LISN. An EMI receiver, connected to the measurement port of the LISN, scanned the frequency range from 150 kHz to 30 MHz in order to find the peak conducted emissions. All peak emissions within 6 dB of the limit were re-measured using a quasi-peak and/or average detector as appropriate.

**Test Results:**

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

**Test Engineer(s):**

Jonathan Chao

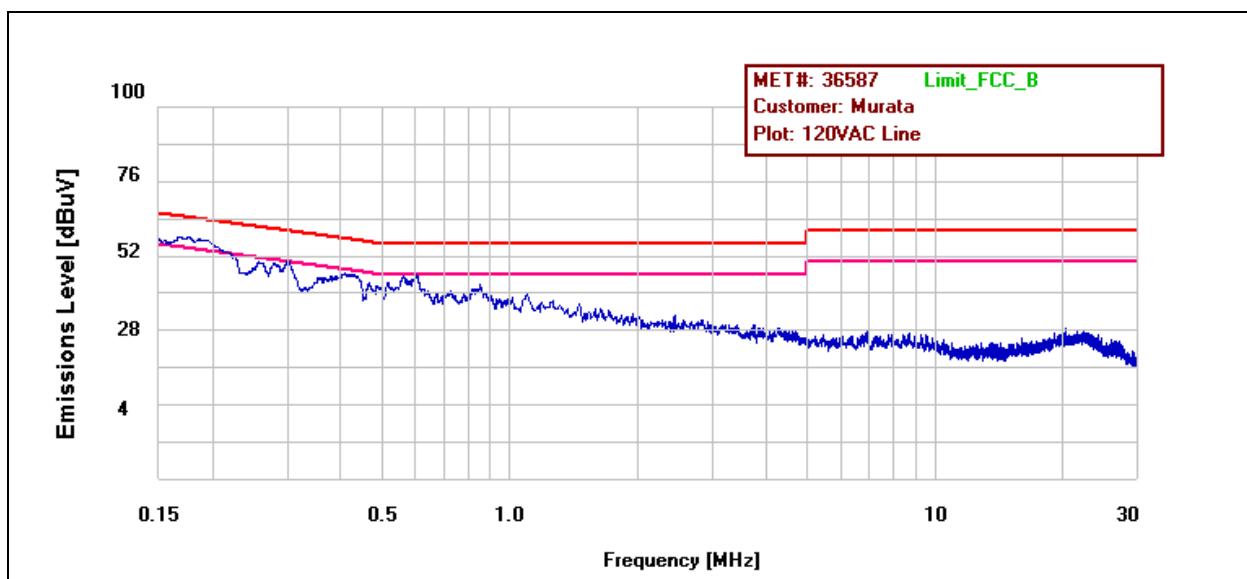
**Test Date(s):**

10/31/12

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

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120 VAC Line	.152	52.33	65.89	-13.56	Pass	39.87	55.89	-16.02	Pass
120 VAC Line	.280	45.29	60.83	-15.54	Pass	39.64	50.83	-11.19	Pass
120 VAC Line	.422	39	57.432	-18.432	Pass	25.1	47.432	-22.332	Pass

Table 8. Conducted Emissions - Voltage, AC Power, Phase Line

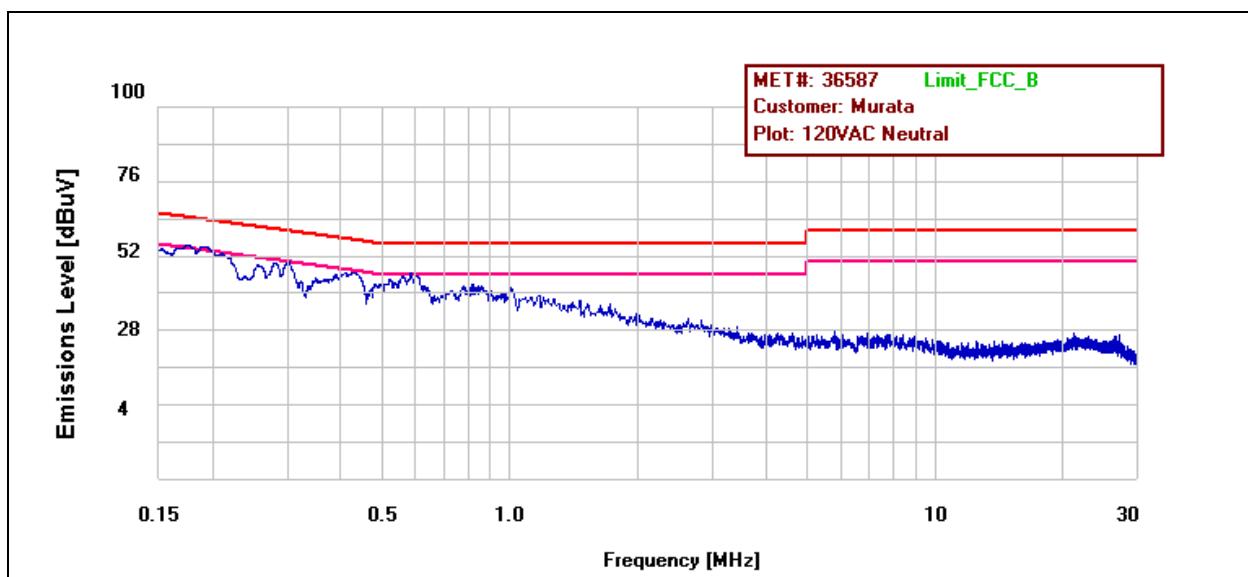


Plot 1. Conducted Emission, Phase Line Plot

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

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Neutral	.188	48.96	64.13	-15.17	Pass	40.12	54.13	-14.01	Pass
120VAC Neutral	.256	45.61	61.572	-15.962	Pass	42.34	51.572	-9.232	Pass
120VAC Neutral	.423	50.31	57.413	-7.103	Pass	36.43	47.413	-10.983	Pass

Table 9. Conducted Emissions - Voltage, AC Power, Neutral Line



Plot 2. Conducted Emission, Neutral Line Plot

## Conducted Emission Limits Test Setup



Photograph 2. Conducted Emissions, Test Setup



Photograph 3. Conducted Emissions, Test Setup, Side View

## Radiated Emission Limits

### § 15.109 Radiated Emissions Limits

**Test Requirement(s):**

**15.109 (a)** Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the Class B limits expressed in Table 10.

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

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

**Table 10. Radiated Emissions Limits calculated from FCC Part 15, §15.109 (a) (b)**

**Test Procedures:**

The EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4 were used. An antenna was located 3 m from the EUT on an adjustable mast. A pre-scan was first performed in order to find prominent radiated emissions. For final emissions measurements at each frequency of interest, the EUT was rotated and the antenna height was varied between 1 m and 4 m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. Unless otherwise specified, measurements were made using a quasi-peak detector with a 120 kHz bandwidth.

**Test Results:**

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

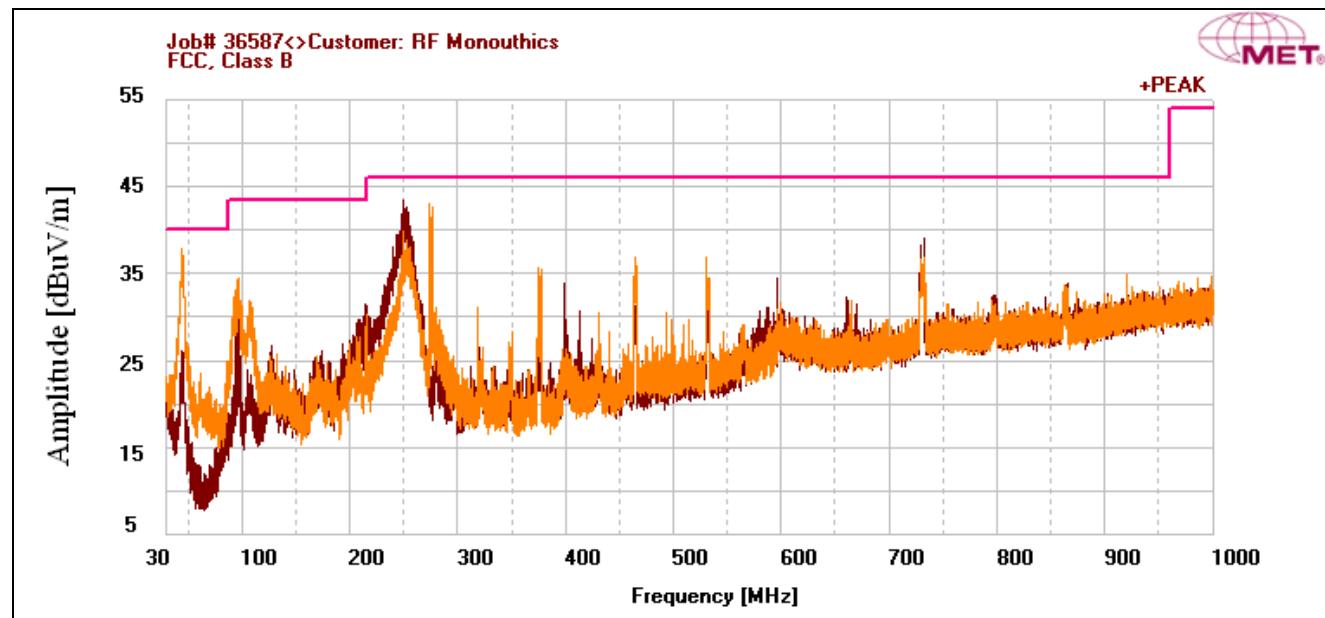
**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 10/29/12

## Radiated Emissions Limits Test Results, Class B

Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
250	H	90	100	26.55	12.9	0	2.39	0	41.84	46	-4.16
730.19	H	143	100	10.89	22.004	0	4.146	0	37.04	46	-8.96
276.4	V	118	100	13.22	13	0	2.514	0	28.734	46	-17.266
44.35	V	155	100	25.45	9.895	0	0.925	0	36.27	40	-3.73
96.1	V	75	105	21.64	10.91	0	1.41	0	33.96	43.5	-9.54
250	V	122	100	23.45	12.5	0	2.39	0	38.34	46	-7.66

Table 11. Radiated Emissions Limits, Test Results, 30 MHz – 1 GHz, FCC Limits

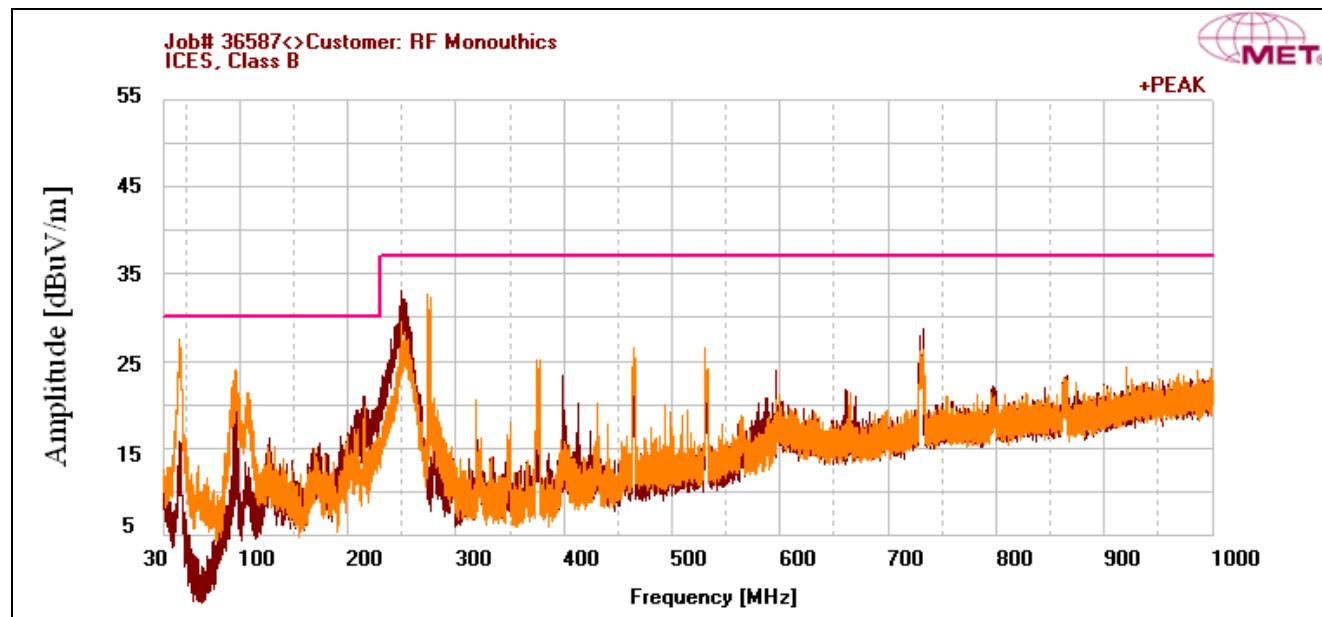


Plot 3. Radiated Emissions, 30 MHz - 1 GHz, FCC Limits

## Radiated Emissions Limits Test Results, Class B

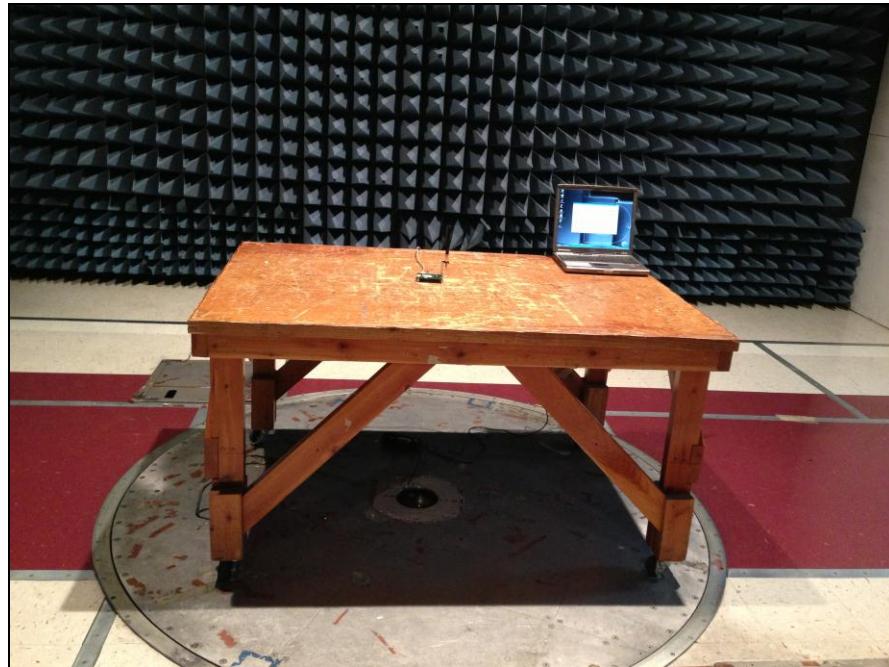
Frequency (MHz)	Antenna Polarity	EUT Azimuth (Degrees)	Antenna Height (cm)	Uncorrected Amplitude (dBuV)	ACF (dB/m)	Pre Amp Gain (dB)	CBL (dB)	DCF (dB)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
250	H	90	100	26.55	12.9	0	2.39	-10.46	31.38	37	-5.62
730.19	H	143	100	10.89	22.004	0	4.146	-10.46	26.58	37	-10.42
276.4	V	118	100	13.22	13	0	2.514	-10.46	18.274	37	-18.726
44.35	V	155	100	25.45	9.895	0	0.925	-10.46	25.81	30	-4.19
96.1	V	75	105	21.64	10.91	0	1.41	-10.46	23.5	30	-6.5
250	V	122	100	23.45	12.5	0	2.39	-10.46	27.88	37	-9.12

Table 12. Radiated Emissions Limits, Test Results, ICES-003 Limits

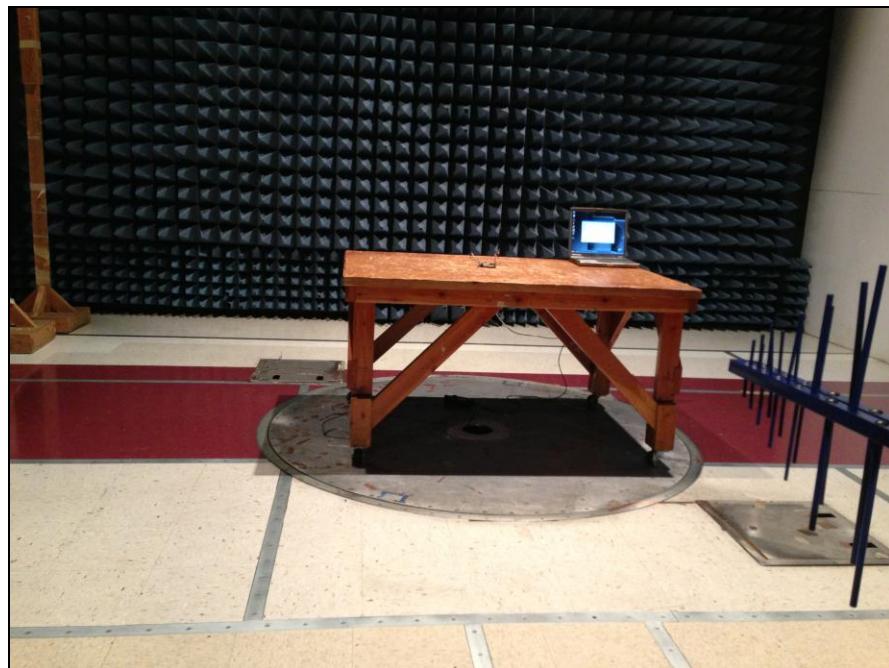


Plot 4. Radiated Emissions, ICES-003 Limits

## Radiated Emissions Limits Test Setup



Photograph 4. Radiated Emissions, Test Setup



Photograph 5. Radiated Emissions, Test Setup, 30 MHz – 1 GHz



Photograph 6. Radiated Emissions, Test Setup, Rear View

## IV. 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 is compliant the criteria of §15.203. There is an U.FL connector on module which is a unique type of connector.

**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 10/23/12

Gain	Type
3dBi	Omni

**Table 13. Antenna List**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Emissions Limits

**Test Requirement(s):**

**§ 15.207 (a):** For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50  $\Omega$  line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

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

**Table 14. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)**

**Test Procedure:**

The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50  $\Omega$ /50  $\mu$ H Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with ANSI C63.4-2003 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz". The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50  $\Omega$ /50  $\mu$ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

**Test Results:** The EUT was compliant with this requirement.

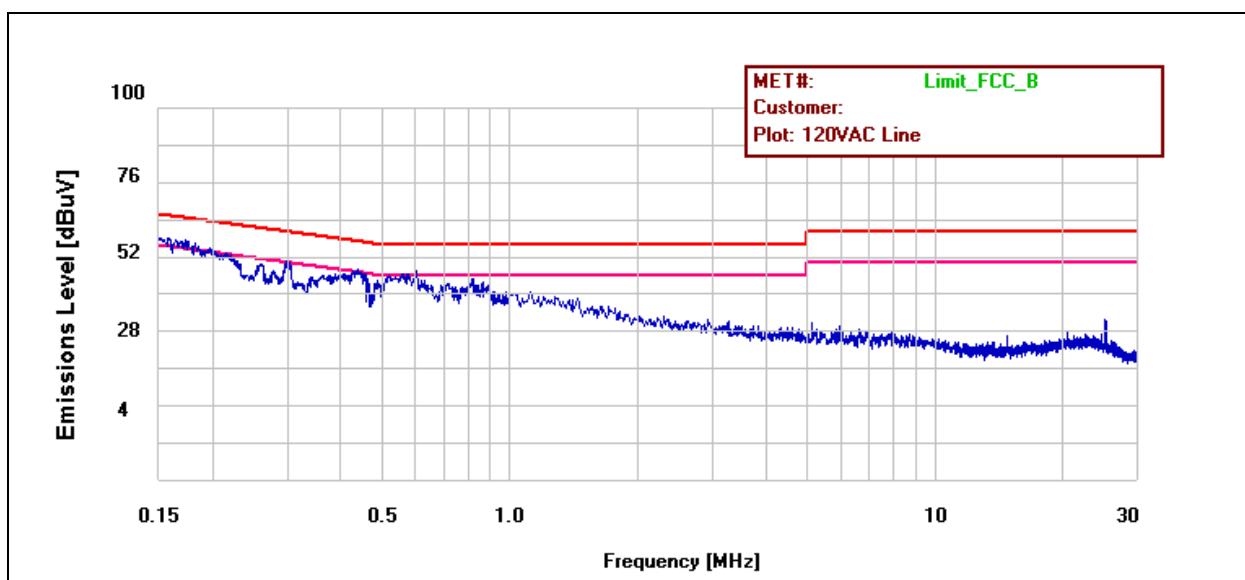
**Test Engineer(s):** Jonathan Chao

**Test Date(s):** 11/07/12

### 15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Line	.153	53.6	65.836	-12.236	Pass	43.54	55.836	-12.296	Pass
120VAC Line	.301	48.28	60.231	-11.951	Pass	47.44	50.231	-2.791	Pass
120VAC Line	.406	42.84	57.752	-14.912	Pass	29.19	47.752	-18.562	Pass

Table 15. Conducted Emissions, 15.207(a), Phase Line, Test Results

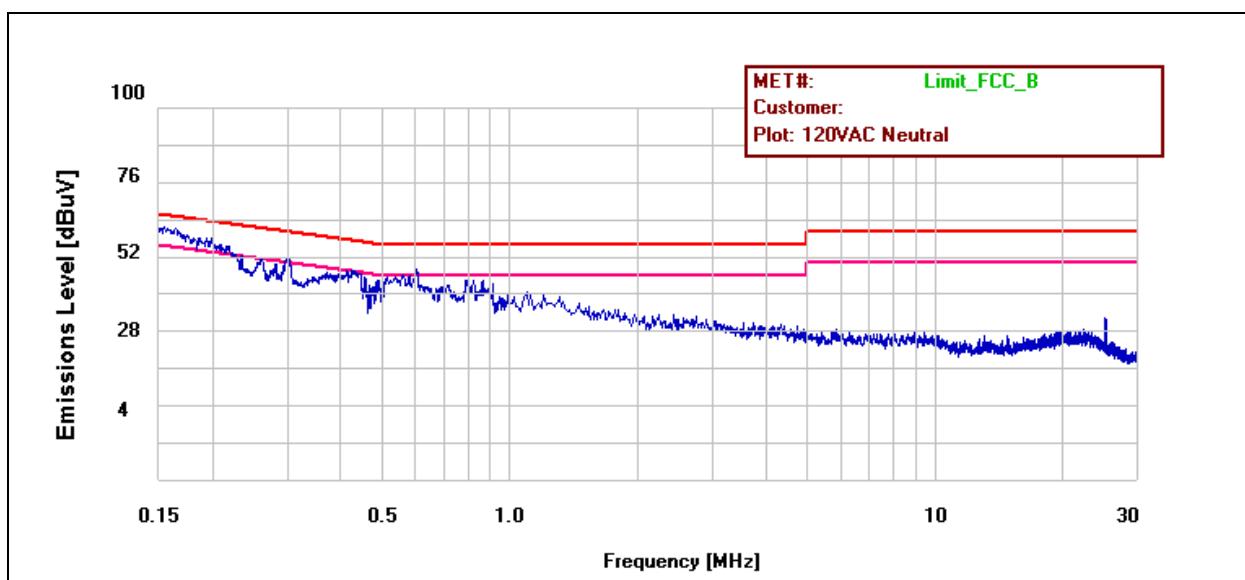


Plot 5. Conducted Emissions, 15.207(a), Phase Line

## 15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
120VAC Neutral	.155	57.89	65.728	-7.83799	Pass	44.85	55.728	-10.878	Pass
120VAC Neutral	.298	48.05	60.314	-12.264	Pass	47.29	50.314	-3.024	Pass
120VAC Neutral	.432	44.23	57.238	-13.008	Pass	28.7	47.238	-18.538	Pass

Table 16. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 6. Conducted Emissions, 15.207(a), Neutral Line

### 15.207(a) Conducted Emissions Test Setup Photo



Photograph 7. Conducted Emissions, 15.207(a), Test Setup



Photograph 8. Conducted Emissions, 15.207(a), Test Setup, Side View

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a)(1) 20 dB Occupied Bandwidth

**Test Requirements:** **§ 15.247(a):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

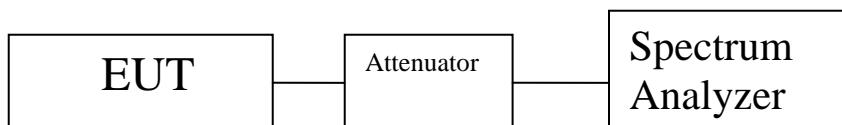
For systems using digital modulation techniques, the EUT may operate in the 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz bands. For DTS, the minimum 6 dB bandwidth shall be at least 500 kHz. For frequency hopping systems, the EUT shall have hopping channel carrier frequencies separated by a minimum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

**Test Procedure:** The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW approximately equal to 1% of the total emission bandwidth. The 20 dB bandwidth was measured and recorded.

**Test Results** The EUT was compliant with § 15.247 (a)(2).

**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 10/29/12



**Figure 2. Block Diagram, Occupied Bandwidth Test Setup**

## Occupied Bandwidth Test Results

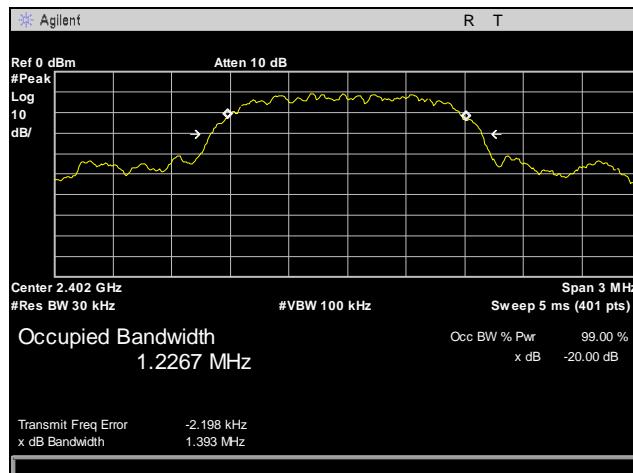
Occupied Bandwidth			
Mode	Carrier Channel	Frequency (MHz)	Measured 20 dB Bandwidth (MHz)
EDR	Low	2402	1.393
	Mid	2441	1.393
	High	2480	1.392
GFSK	Low	2402	0.922
	Mid	2441	0.886
	High	2480	0.927

Table 17. 20 dB Occupied Bandwidth, Test Results

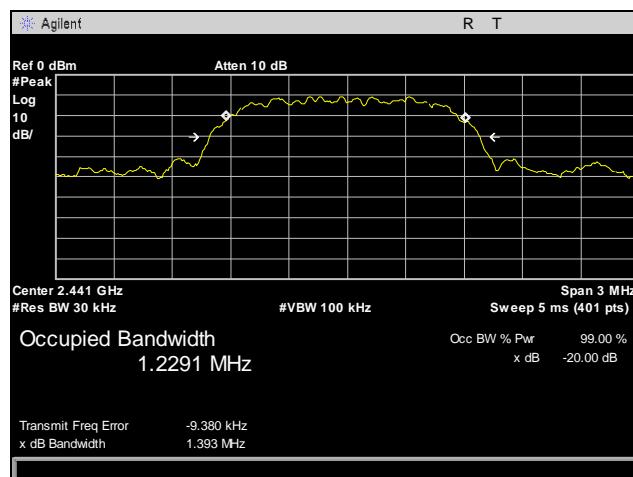
Occupied Bandwidth			
Mode	Carrier Channel	Frequency (MHz)	Measured 99% Bandwidth (MHz)
EDR	Low	2402	1.2436
	Mid	2441	1.2302
	High	2480	1.2404
GFSK	Low	2402	0.8411
	Mid	2441	0.8243
	High	2480	0.8457

Table 18. 99% Occupied Bandwidth, Test Results

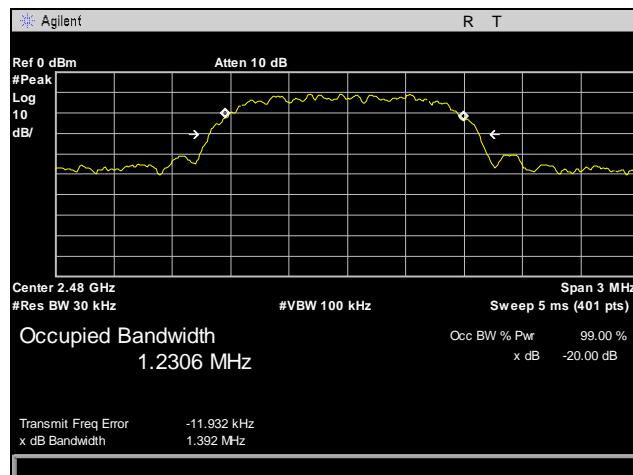
## Occupied Bandwidth Test Results, EDR



Plot 7. 20 dB Occupied Bandwidth, Low Channel, EDR

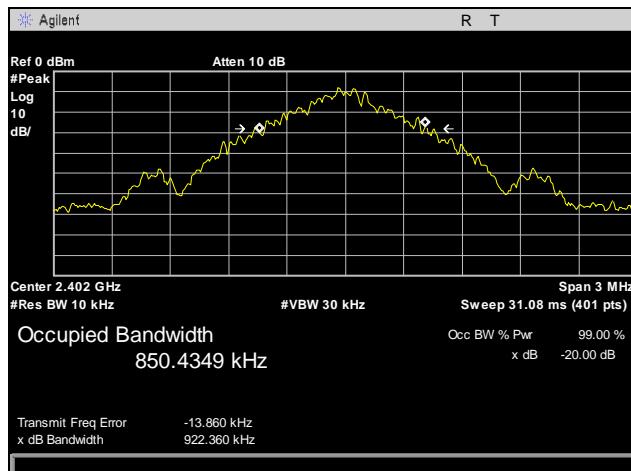


Plot 8. 20 dB Occupied Bandwidth, Mid Channel, EDR

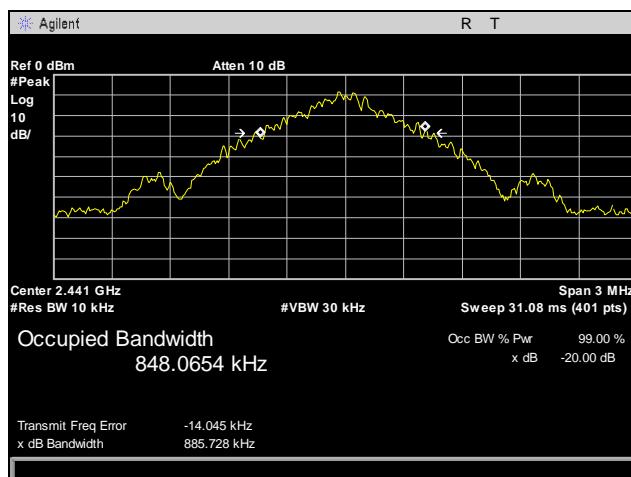


Plot 9. 20 dB Occupied Bandwidth, High Channel, EDR

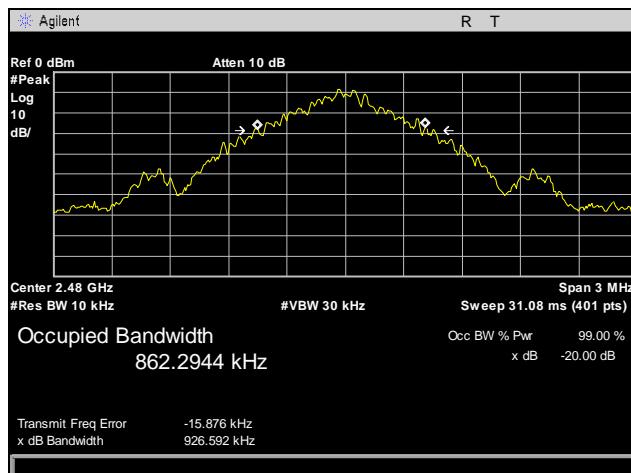
## Occupied Bandwidth Test Results, GFSK



Plot 10. 20 dB Occupied Bandwidth, Low Channel, GFSK

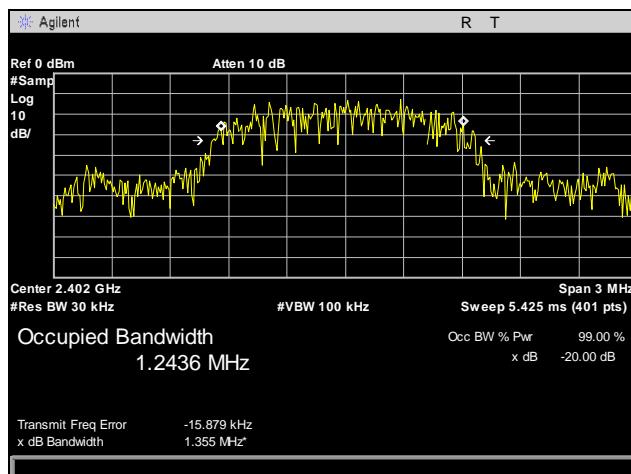


Plot 11. 20 dB Occupied Bandwidth, Mid Channel, GFSK

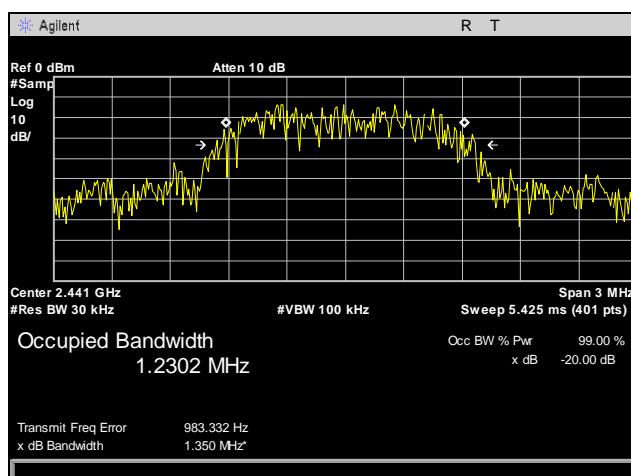


Plot 12. 20 dB Occupied Bandwidth, High Channel, GFSK

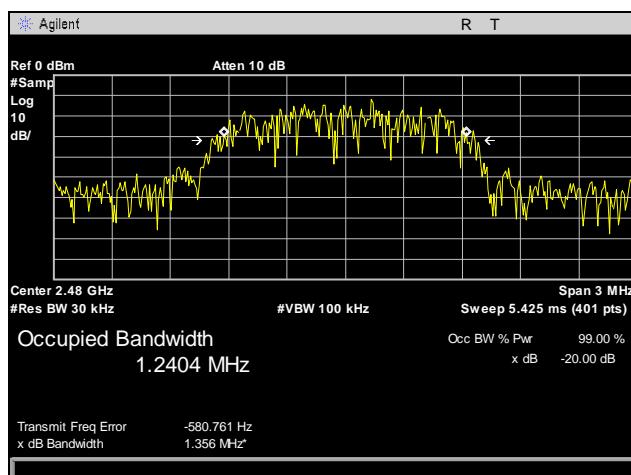
## Occupied Bandwidth Test Results, EDR



Plot 13. 99% Occupied Bandwidth, Low Channel, EDR

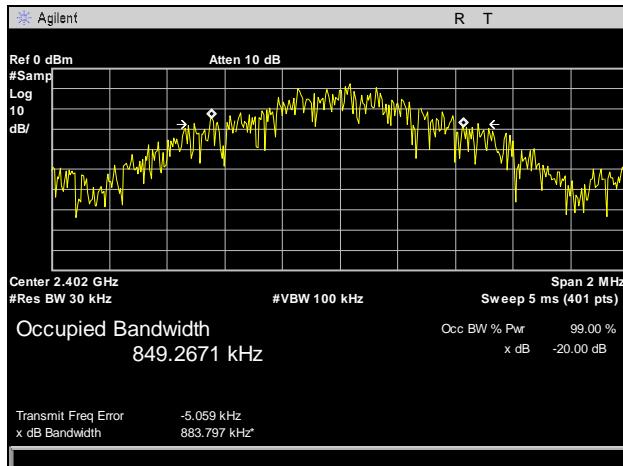


Plot 14. 99% Occupied Bandwidth, Mid Channel, EDR

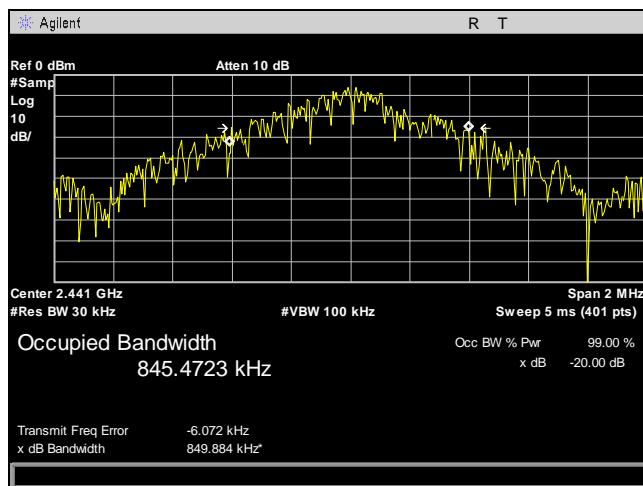


Plot 15. 99% Occupied Bandwidth, High Channel, EDR

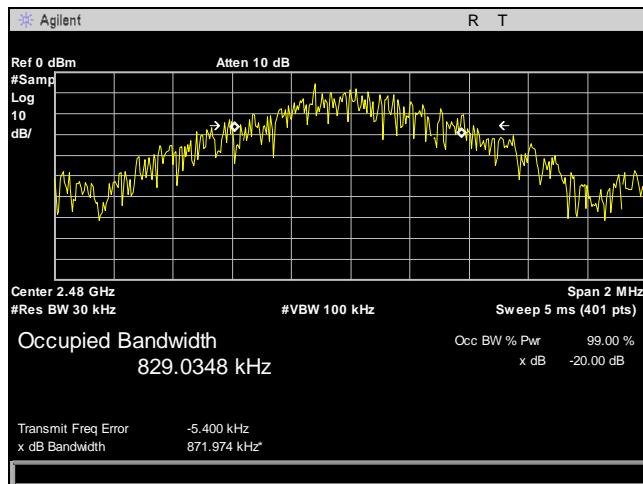
## Occupied Bandwidth Test Results, GFSK



Plot 16. 99% Occupied Bandwidth, Low Channel, GFSK



Plot 17. 99% Occupied Bandwidth, Mid Channel, GFSK



Plot 18. 99% Occupied Bandwidth, High Channel, GFSK

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a)(1)      Average Time of Occupancy (Dwell Time)

**Remarks:** The Average time of occupancy on any channel shall not be greater than 400ms within a period of 400ms multiplied by the number of hopping channels.

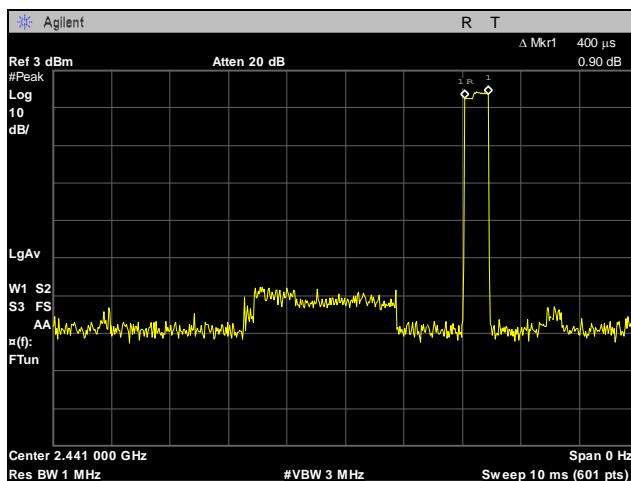
Total hopping channels is 79 for EDR and GFSK Modulation. The EUT meets the specifications of Section 15.247(a) (1) (iii) for Number of Hopping Channels.

Modulation	Packet Type	# of Channels	Dwell Time	# of pulses in 31.6 Seconds (Pulses*10)	Average Time of Occupancy in 31.6 Seconds	Limit	Margin
					ms		
GFSK	DM1	79	0.380	190	72.20	400	-327.80
	DM3	79	1.640	180	295.20	400	-104.80
	DM5	79	2.850	120	342.00	400	-58.00
	DH1	79	0.390	210	81.90	400	-318.10
	DH3	79	1.640	180	295.20	400	-104.80
	DH5	79	2.900	110	319.00	400	-81.00
2-EDR	2-DH1	79	0.410	210	86.10	400	-313.90
	2-DH3	79	1.533	180	275.94	400	-124.06
	2-DH5	79	1.533	190	291.27	400	-108.73

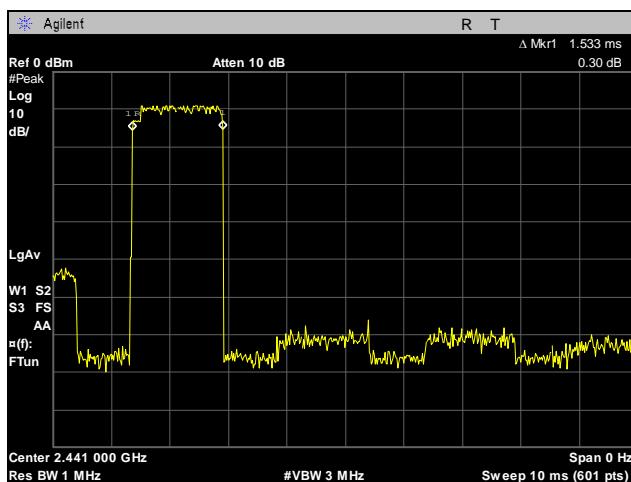
**Table 19. Average Time of Occupancy**

The Average time of occupancy in the specified 31.6 seconds (79\*0.400) is equal to # of pulses in (3.16\*10\*Dwell Time).

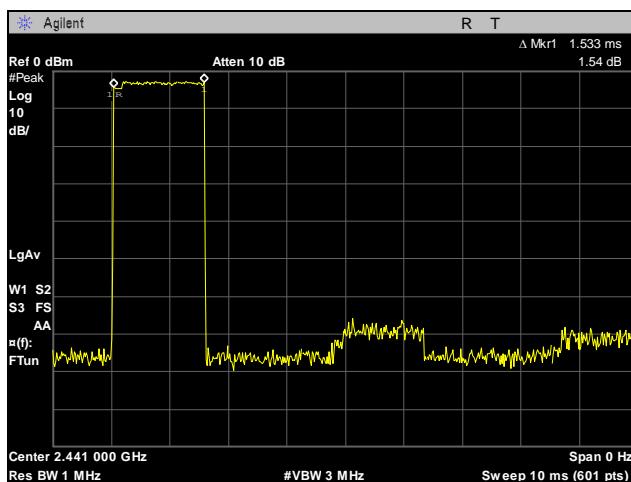
## Dwell Time, EDR



Plot 19. Dwell Time, EDR, DH1

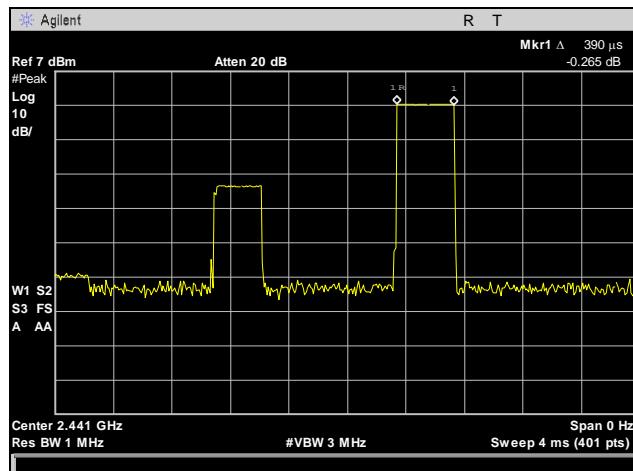


Plot 20. Dwell Time, EDR, DH3

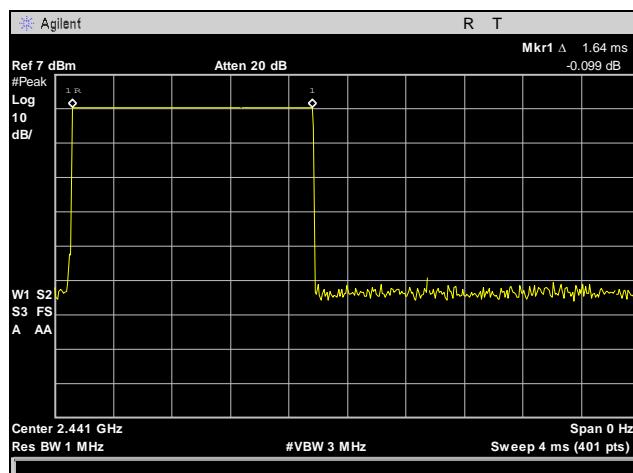


Plot 21. Dwell Time, EDR, DH5

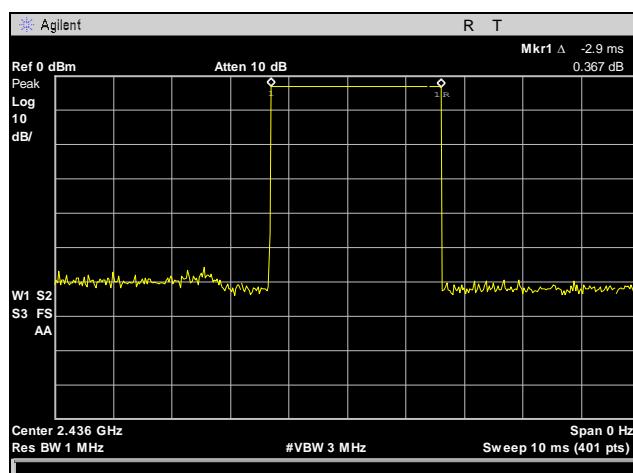
## Dwell Time, GFSK



Plot 22. Dwell Time, GFSK, DH1

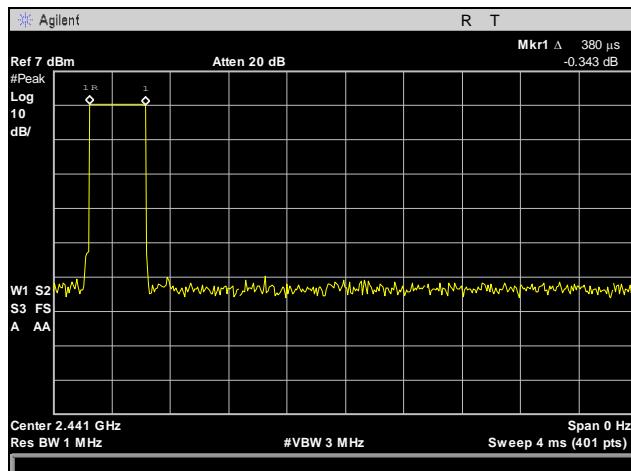


Plot 23. Dwell Time, GFSK, DH3

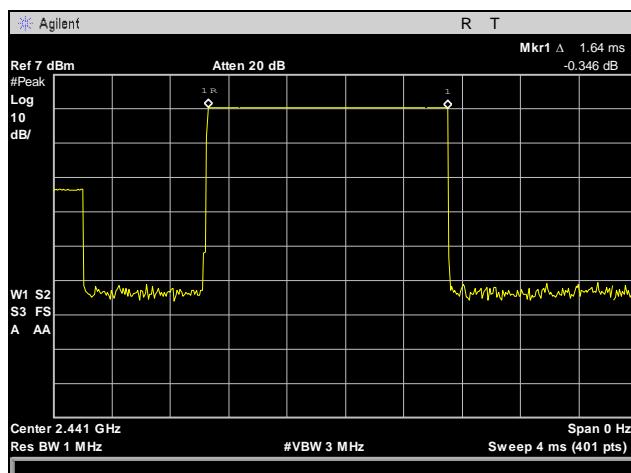


Plot 24. Dwell Time, GFSK, DH5

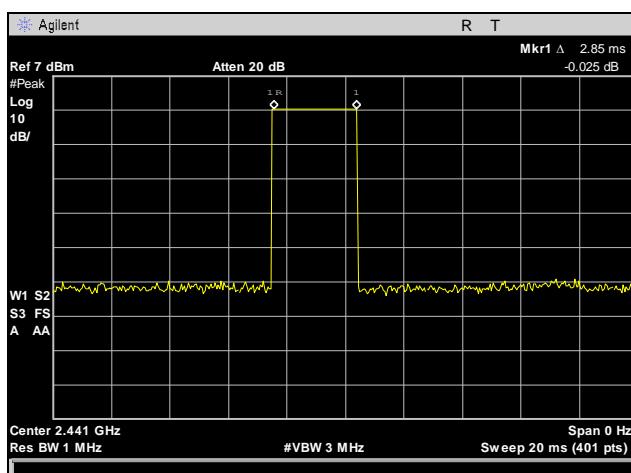
## Dwell Time, GFSK



Plot 25. Dwell Time, GFSK, DM1

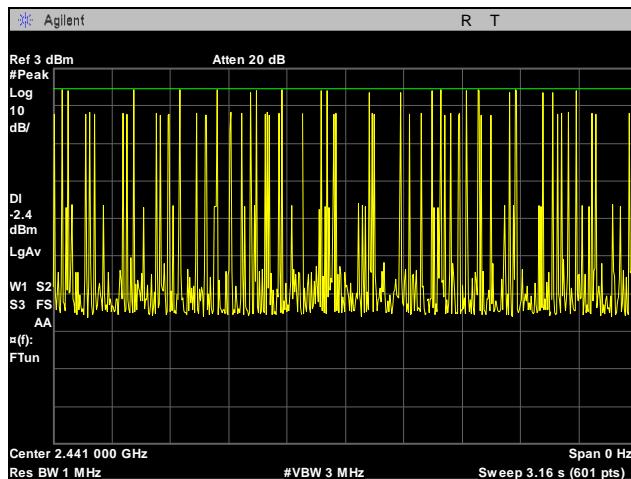


Plot 26. Dwell Time, GFSK, DM3

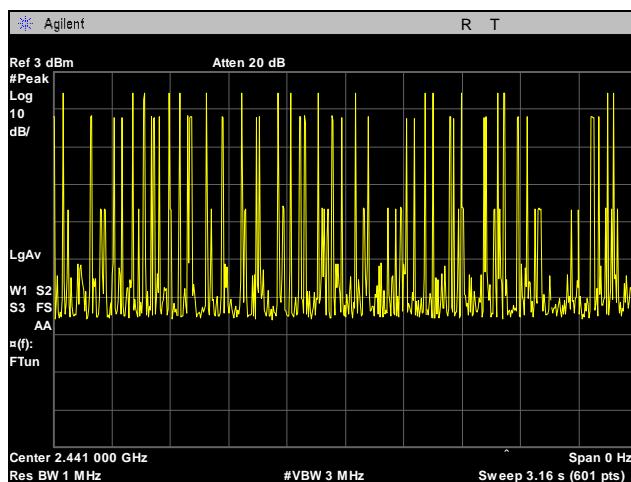


Plot 27. Dwell Time, GFSK, DM5

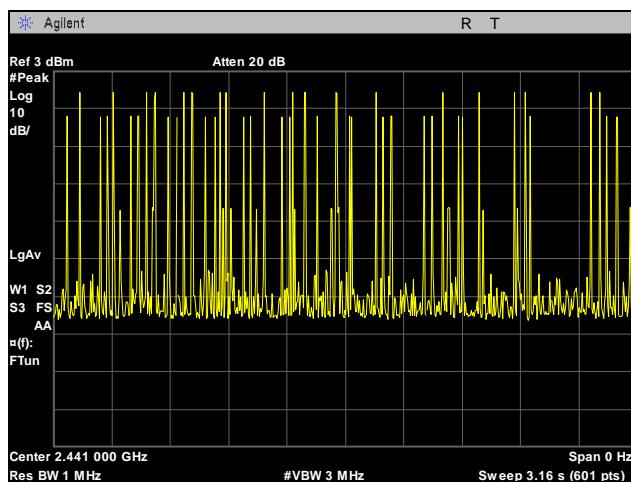
## Number of Pulses, EDR



Plot 28. Number of Pulses, EDR, DH1 (21 Pulses)

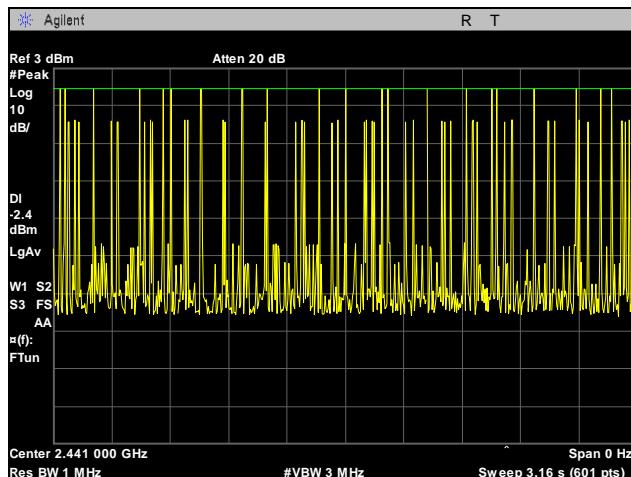


Plot 29. Number of Pulses, EDR, DH3 (18 Pulses)

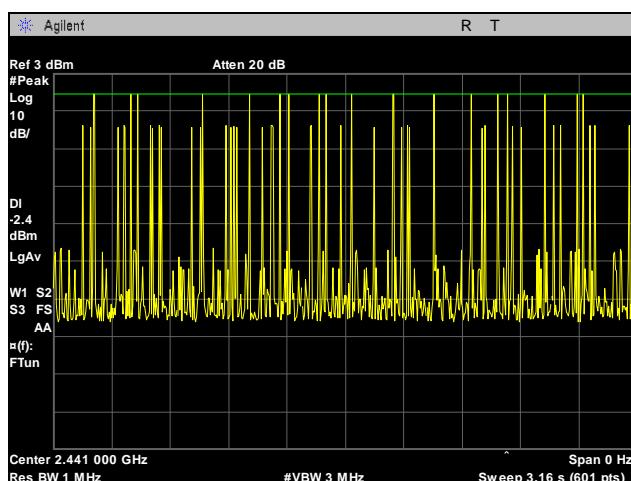


Plot 30. Number of Pulses, EDR, DH5 (19 Pulses)

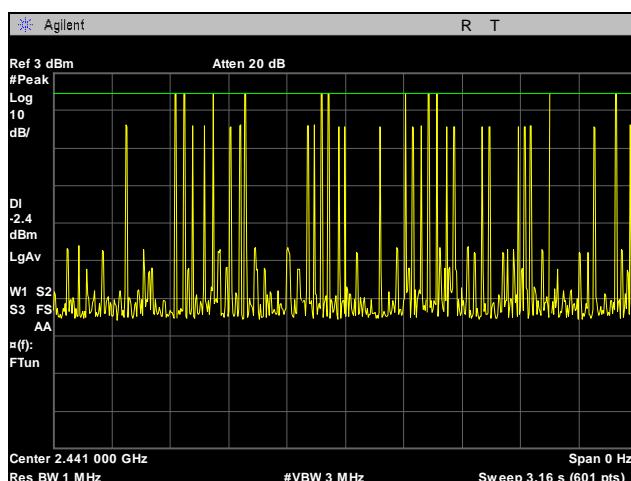
## Number of Pulses, GFSK



Plot 31. Number of Pulses, GFSK, DH1 (21 Pulses)

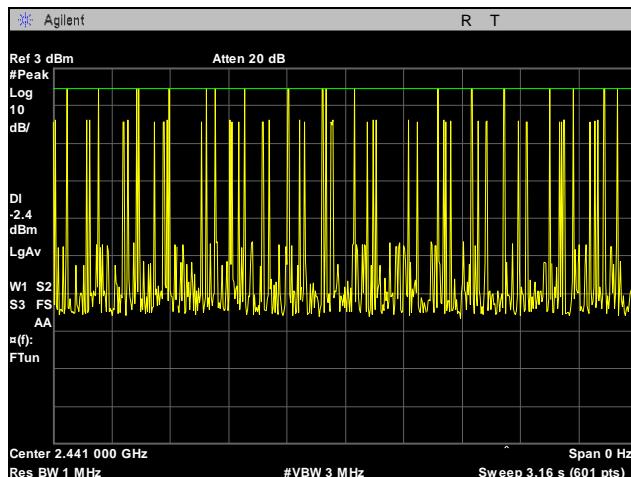


Plot 32. Number of Pulses, GFSK, DH3 (18 Pulses)



Plot 33. Number of Pulses, GFSK, DH5 (11 Pulses)

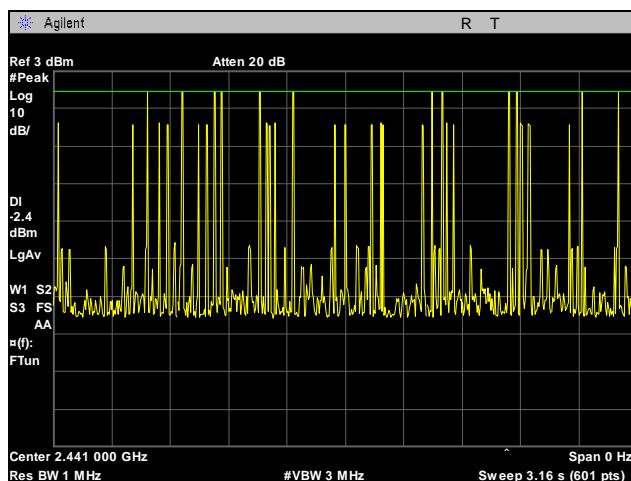
## Number of Pulses, GFSK



Plot 34. Number of Pulses, GFSK, DM1 (19 Pulses)



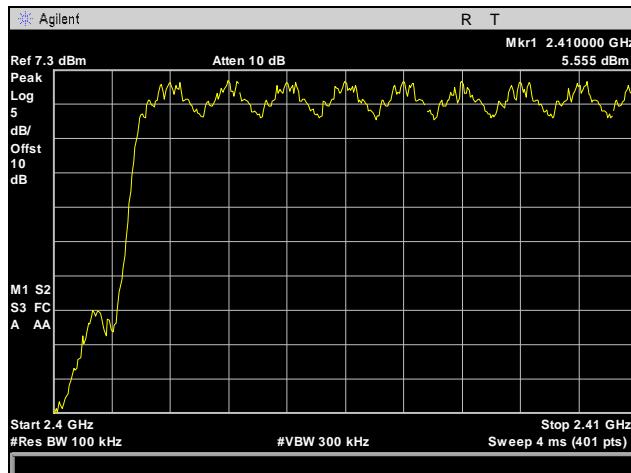
Plot 35. Number of Pulses, GFSK, DM3 (18 Pulses)



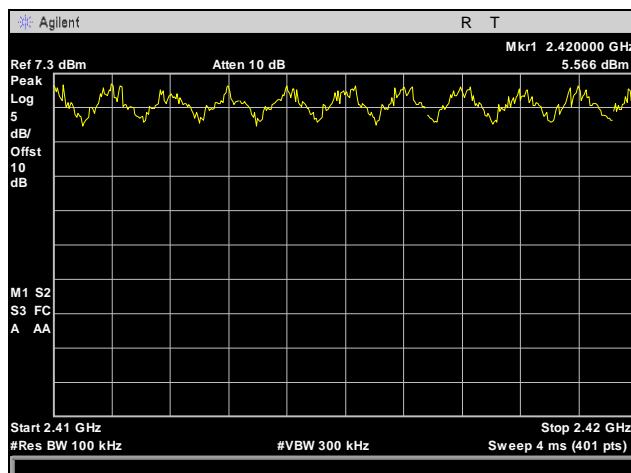
Plot 36. Number of Pulses, GFSK, DM5 (12 Pulses)

§ 15.247(a)(1)

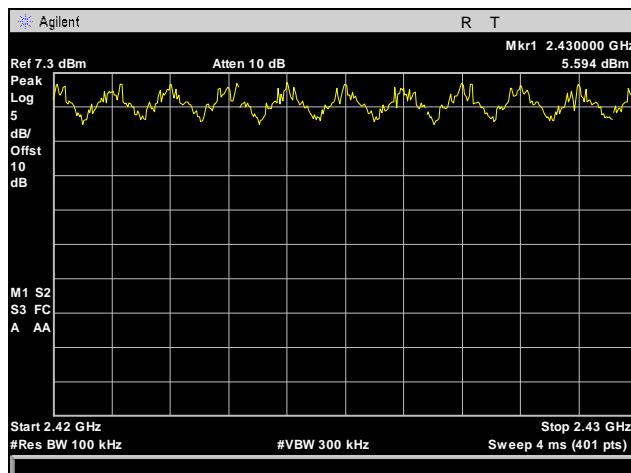
**Number of RF Channels**



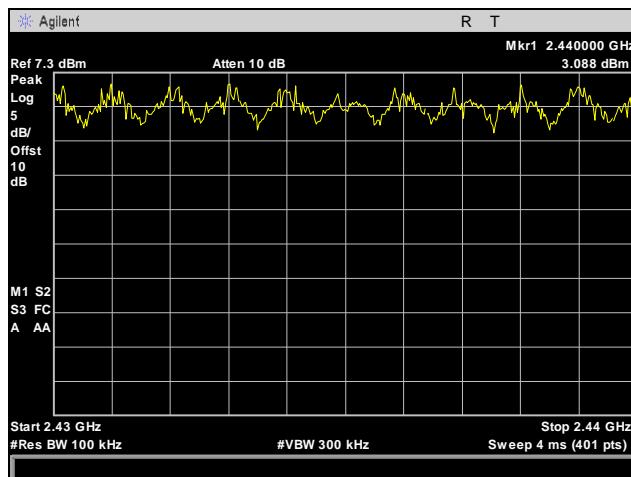
**Plot 37. Number of Channels, 2400 – 2410 MHz, EDR (9 Channels)**



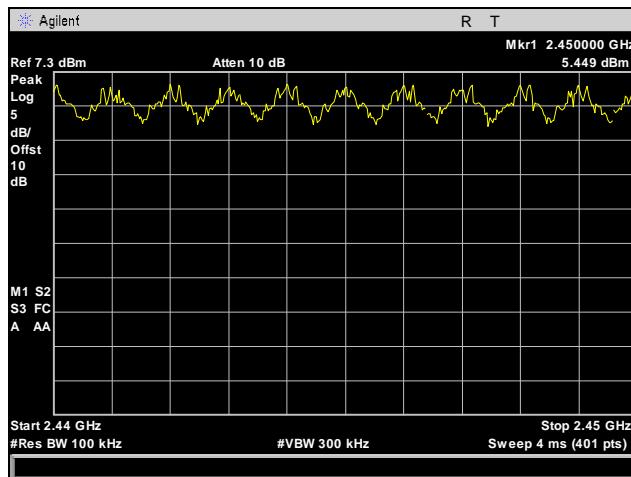
**Plot 38. Number of Channels, 2410 – 2420 MHz, EDR (10 Channels)**



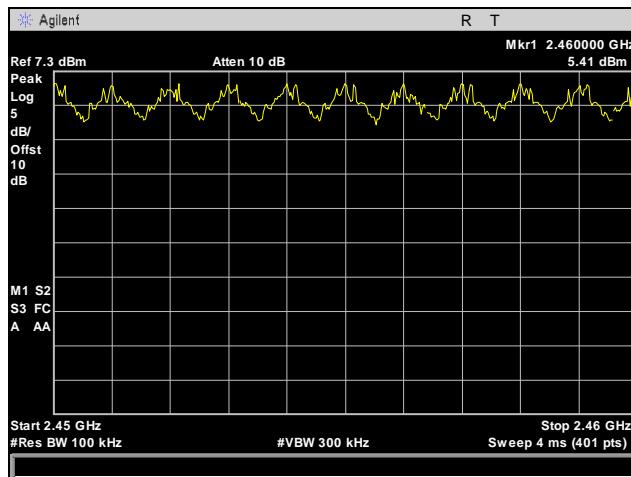
**Plot 39. Number of Channels, 2420 – 2430 MHz, EDR (10 Channels)**



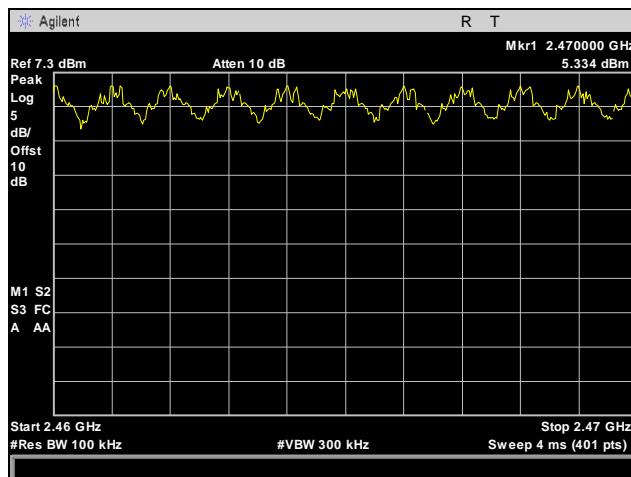
Plot 40. Number of Channels, 2430 – 2440 MHz, EDR (10 Channels)



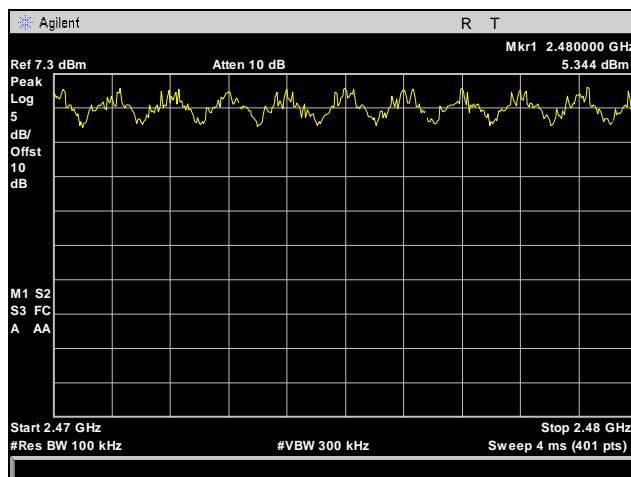
Plot 41. Number of Channels, 2440 – 2450 MHz, EDR (10 Channels)



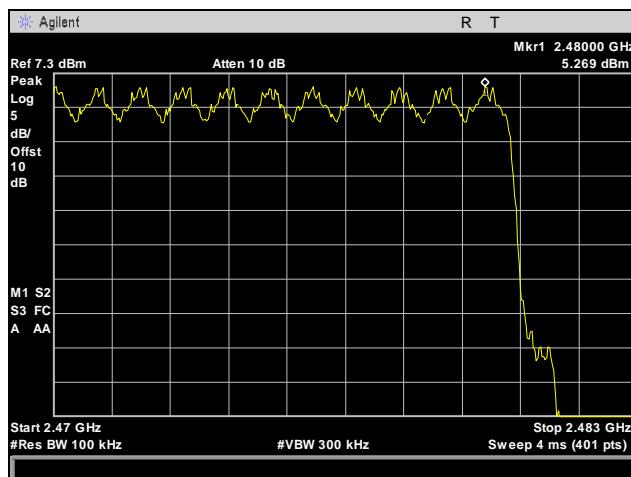
Plot 42. Number of Channels, 2450 – 2460 MHz, EDR (10 Channels)



Plot 43. Number of Channels, 2460 – 2470 MHz, EDR (10 Channels)

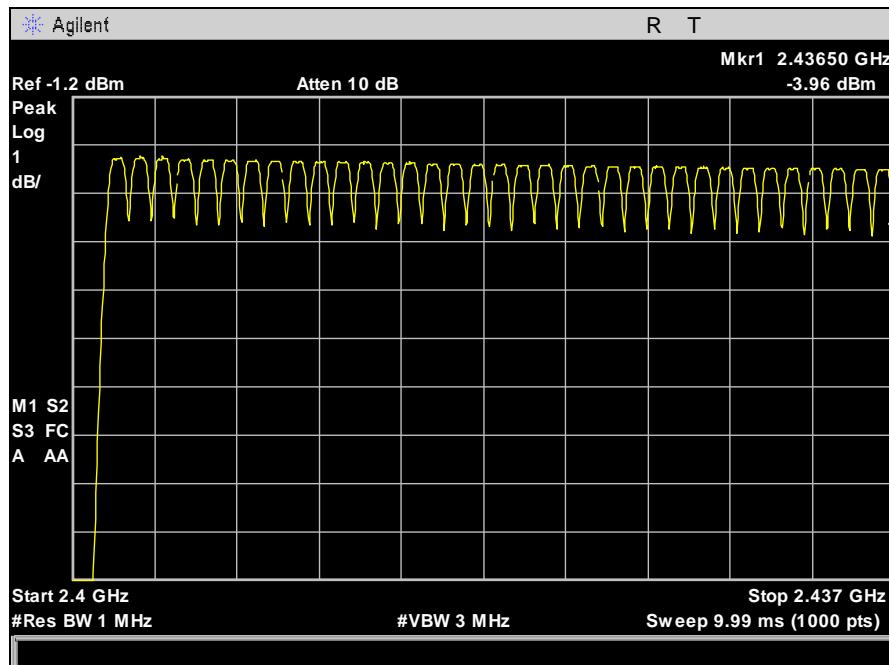


Plot 44. Number of Channels, 2470 – 2480 MHz, EDR (10 Channels)

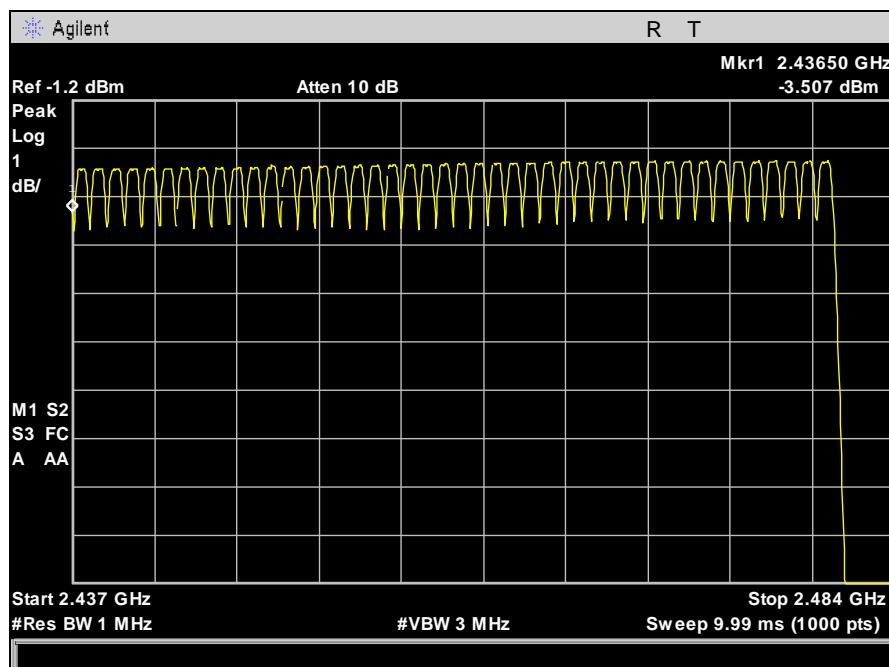


Plot 45. Number of Channels, 2470 – 2483.5 MHz, EDR (10 Channels)

## Number of Channels, GFSK



Plot 46. Number of Channels, 2400 – 2436.5 MHz, GFSK (35 Channels)



Plot 47. Number of Channels, 2436.5 – 2484 MHz, GFSK (44 Channels)

## Electromagnetic Compatibility Criteria for Intentional Radiators

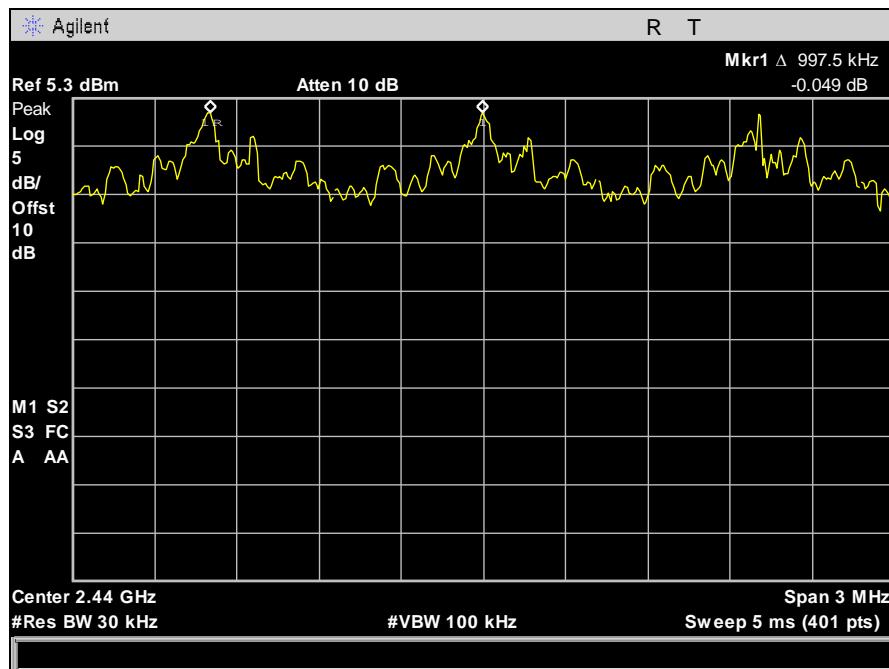
### § 15.247(a)(1) RF Channel Separation

**Requirement:** Frequency hopping systems 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. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

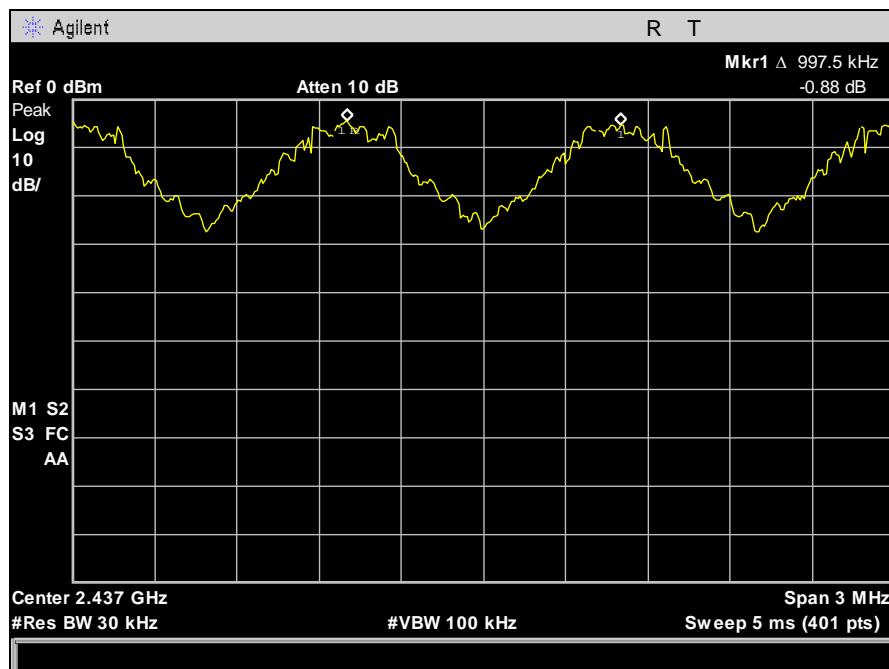
**Remarks:** EUT operates below 125mW (20dBm). Channels are separated by more than two thirds of the -20dB Bandwidth.

EDR –  $2/3 * 1.393 \text{ MHz (20dB Bandwidth)} = 929 \text{ kHz Minimum Separation Distance}$

GFSK –  $2/3 * 0.927 \text{ MHz (20dB Bandwidth)} = 618 \text{ kHz Minimum Separation Distance}$



Plot 48. Channel Separation, EDR



Plot 49. Channel Separation, GFSK

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(b) Peak Power Output

**Test Requirements:** **§15.247(b)(1):** The maximum peak output power of the intentional radiator shall not exceed 0.125 Watts for frequency hopping systems operating in the 2400-2483.5 MHz band. .

**§15.247(c):** if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values, 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 and using a point to point application may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

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

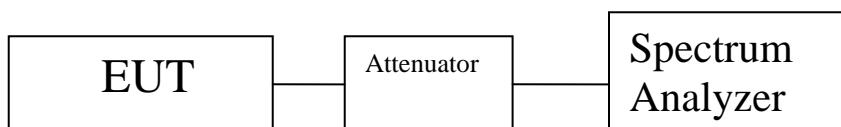
Fixed, point-to-point operation excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the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

**Test Procedure:** The transmitter was connected to a calibrated spectrum analyzer. The EUT was measured at the low, mid and high channels of each band. The EUT was utilizes a 3dBi Omni Antenna, so the maximum power allowed is 30dBm.

**Test Results:** The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 11/05/12



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

## Peak Power Output Test Results

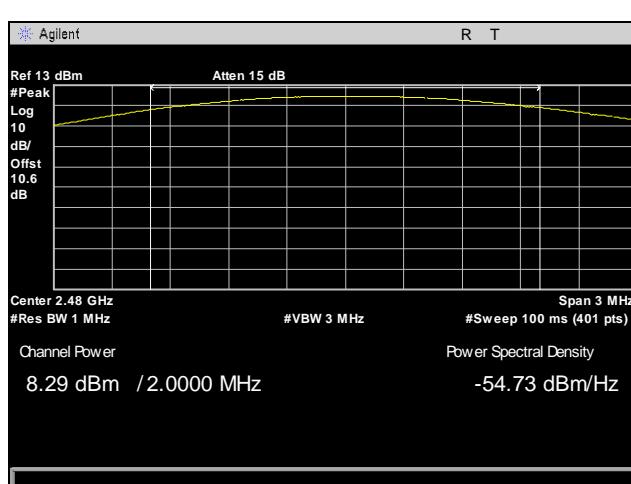
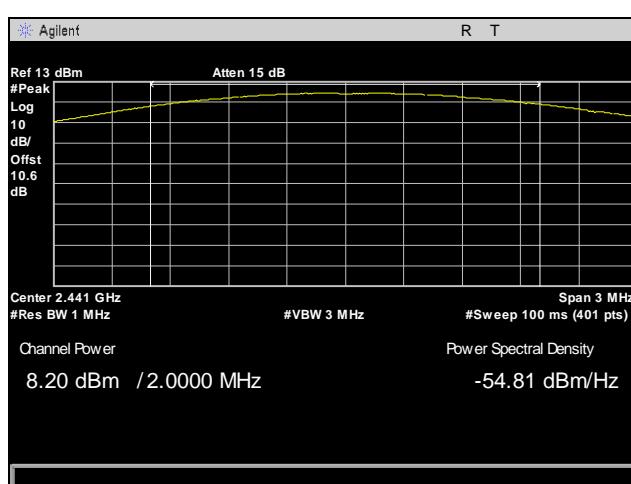
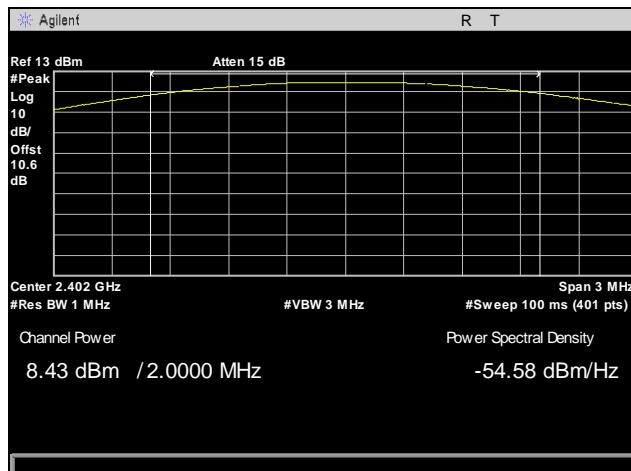
Peak Conducted Output Power		
Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
Low	2402	8.43
Mid	2441	8.20
High	2480	8.29

Table 20. Peak Power Output, Test Results, EDR

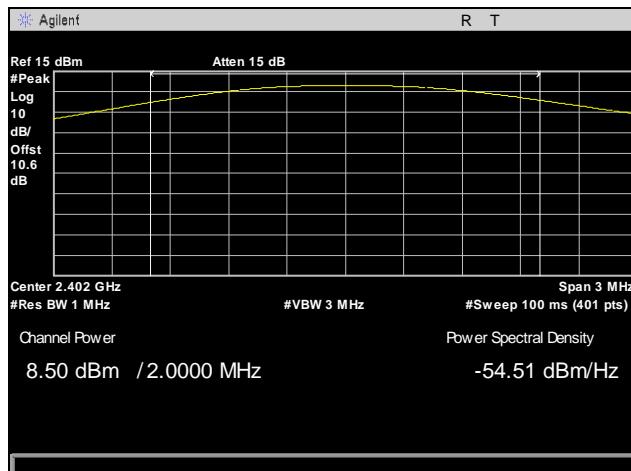
Peak Conducted Output Power		
Carrier Channel	Frequency (MHz)	Measured Peak Output Power dBm
Low	2402	8.50
Mid	2441	8.35
High	2480	8.37

Table 21. Peak Power Output, Test Results, GFSK

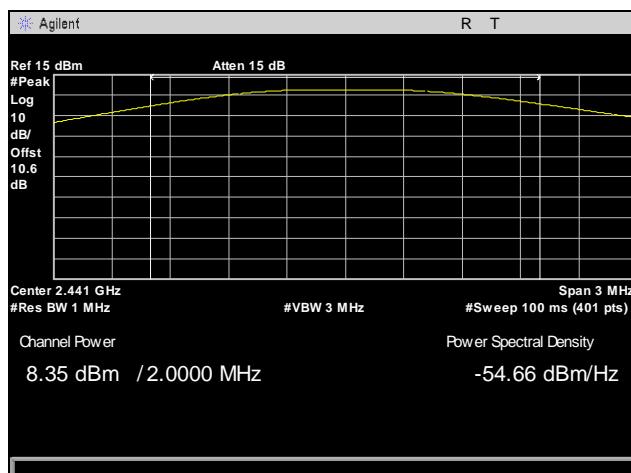
## Peak Power Output Test Results, EDR



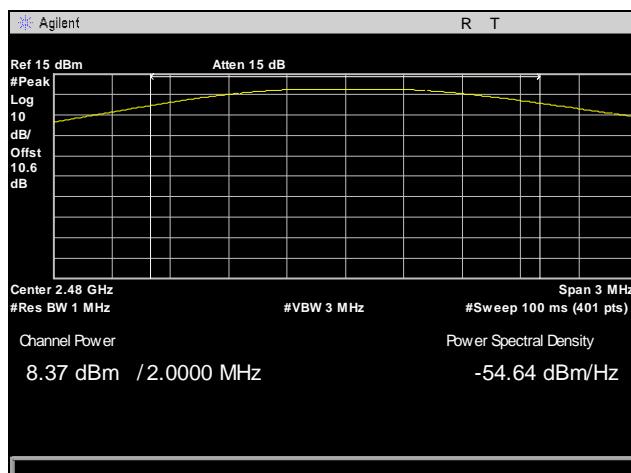
## Peak Power Output Test Results, GFSK



**Plot 53. Peak Power Output, Low Channel, GFSK**



**Plot 54. Peak Power Output, Mid Channel, GFSK**



**Plot 55. Peak Power Output, High Channel, GFSK**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(d) Radiated Spurious Emissions Requirements and Band Edge

**Test Requirements:** §15.247(d); §15.205: Emissions outside the frequency band.

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

**§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 22. Restricted Bands of Operation**

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

<sup>2</sup> Above 38.6

**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 23.

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

**Table 23. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)**

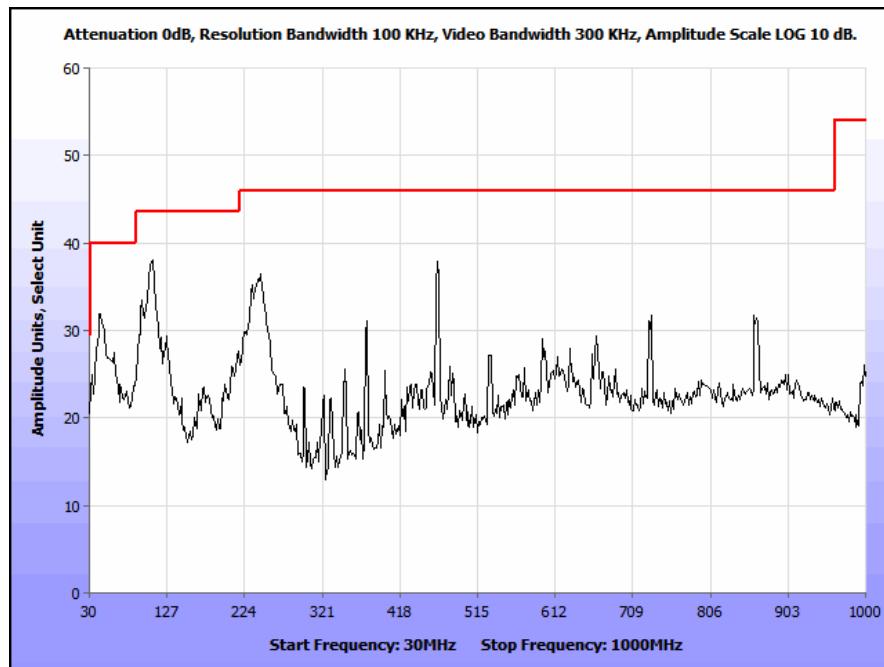
**Test Procedures:** The transmitter was turned on. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes. A filter was used to notch out the 2.4GHz carrier. Peak measurements were made using a Peak Detector, 1 MHz RBW and 3 MHz VBW and compared to the average limit. Plots shown are corrected for antenna correction factor, preamplifier, cable loss and distance and compared to a 3 m limit line. Only noise floor was measured above 18 GHz.

**Test Results:** The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d)**.

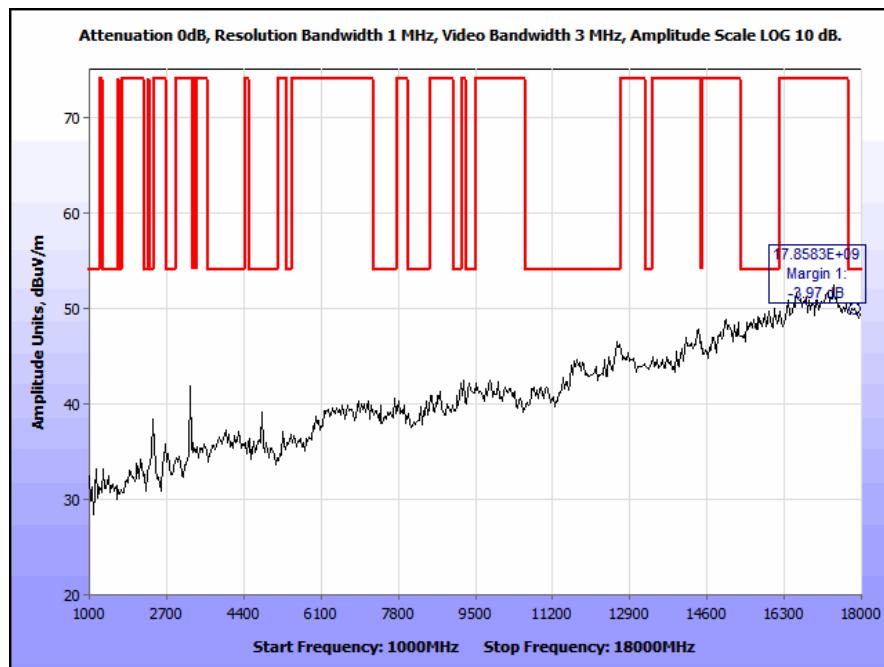
**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 11/05/12 – 11/06/12

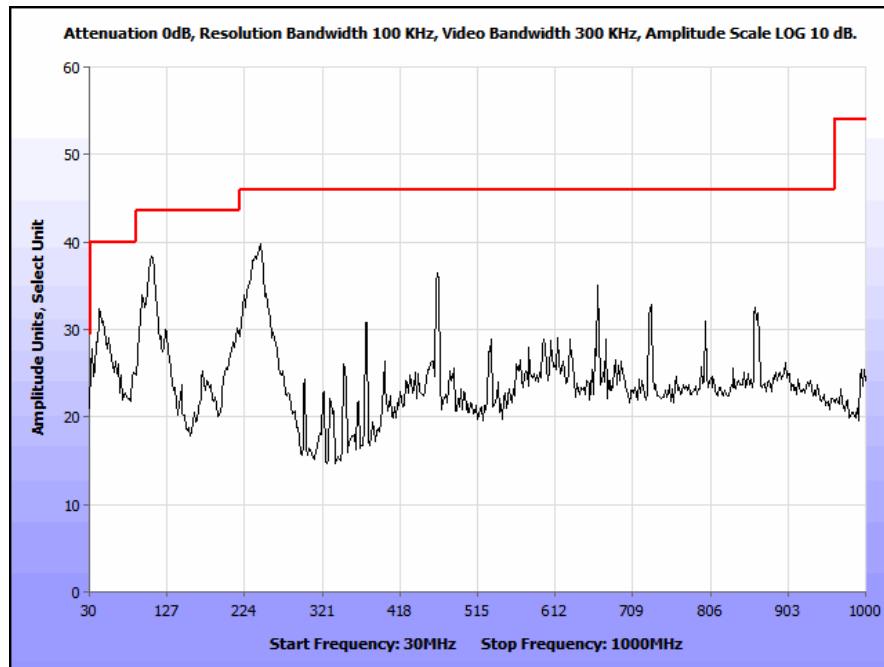
## Radiated Spurious Emissions Test Results, EDR



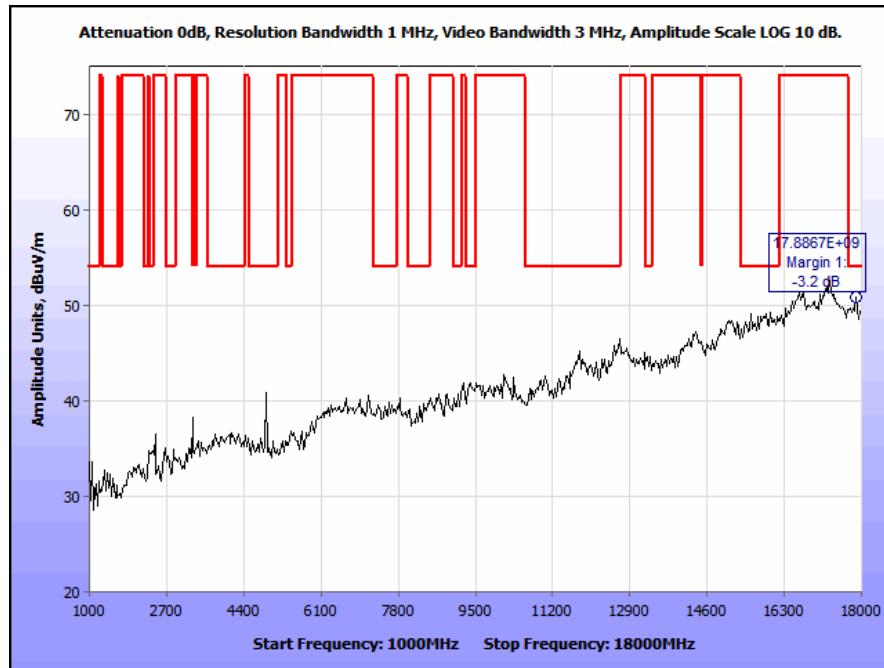
Plot 56. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, EDR



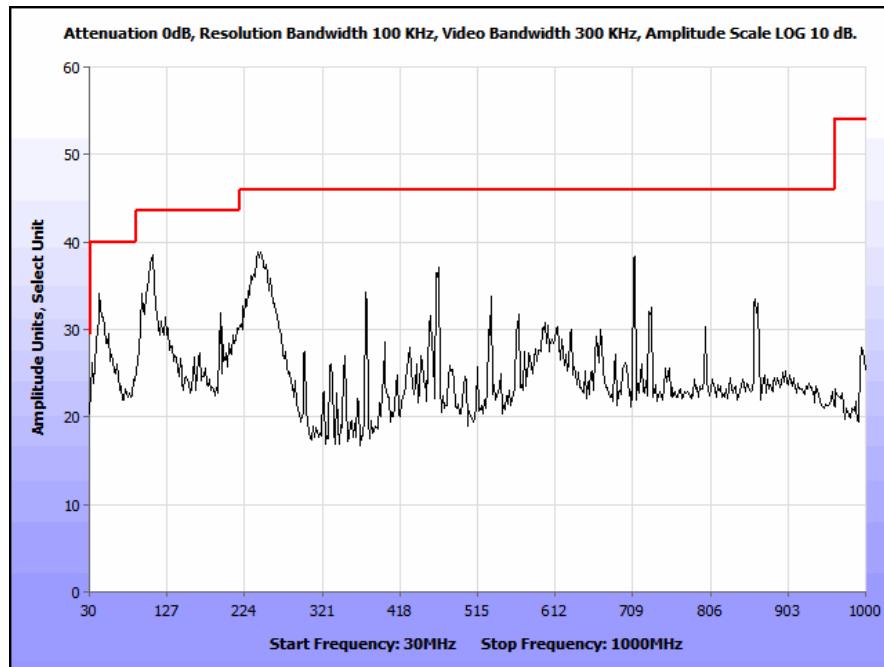
Plot 57. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, EDR



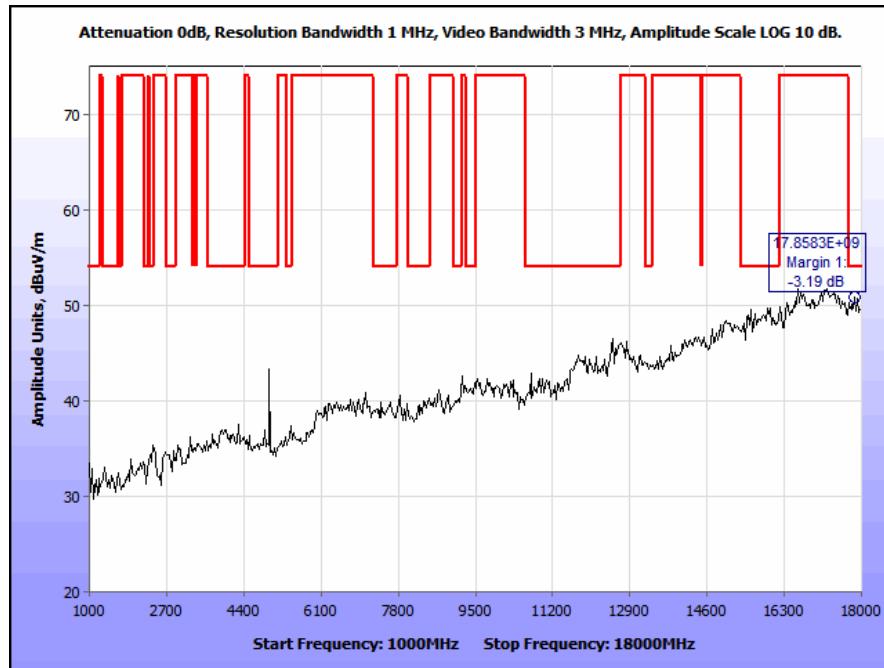
**Plot 58. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, EDR**



**Plot 59. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, EDR**

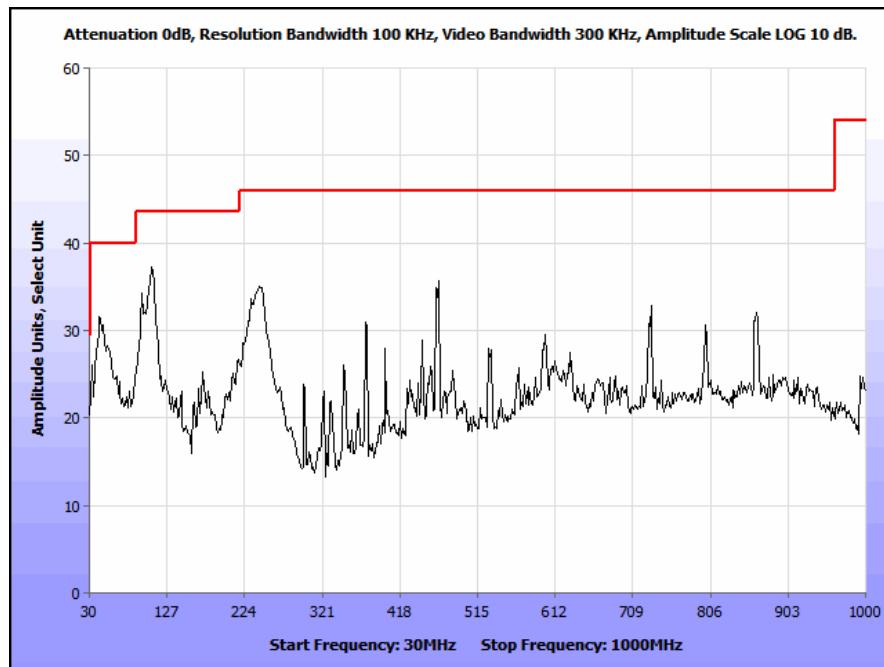


**Plot 60. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, EDR**

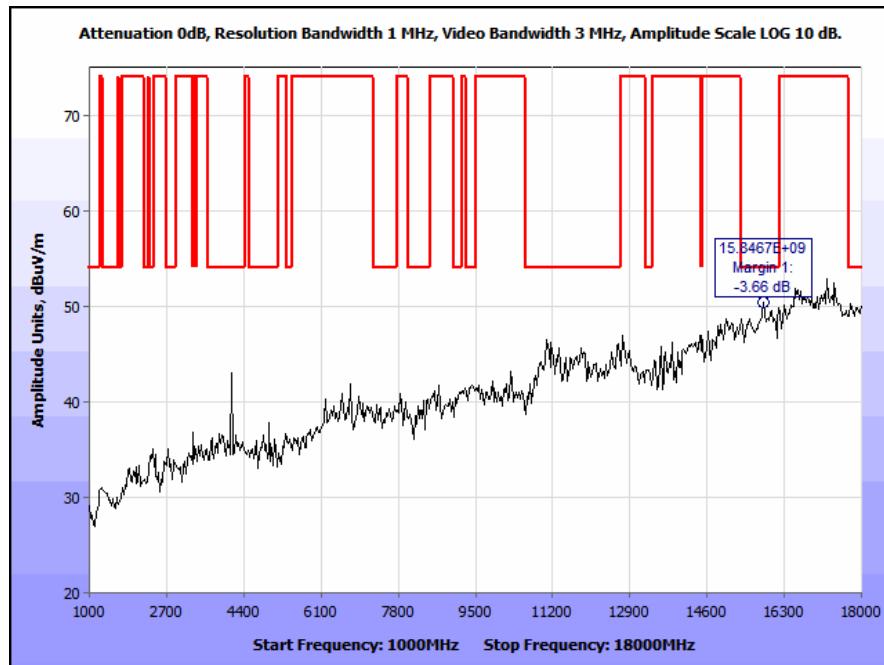


**Plot 61. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, EDR**

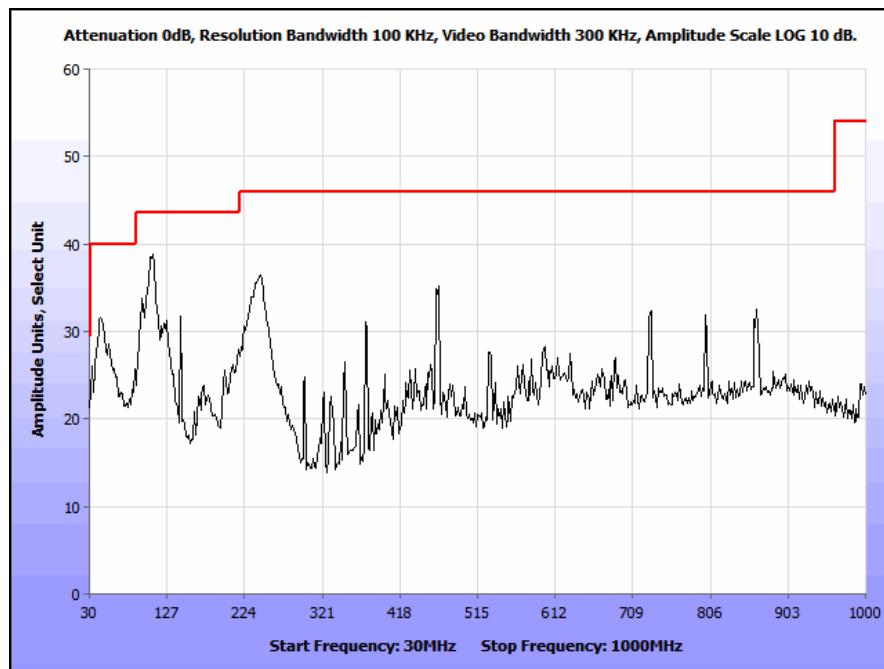
## Radiated Spurious Emissions Test Results, GFSK



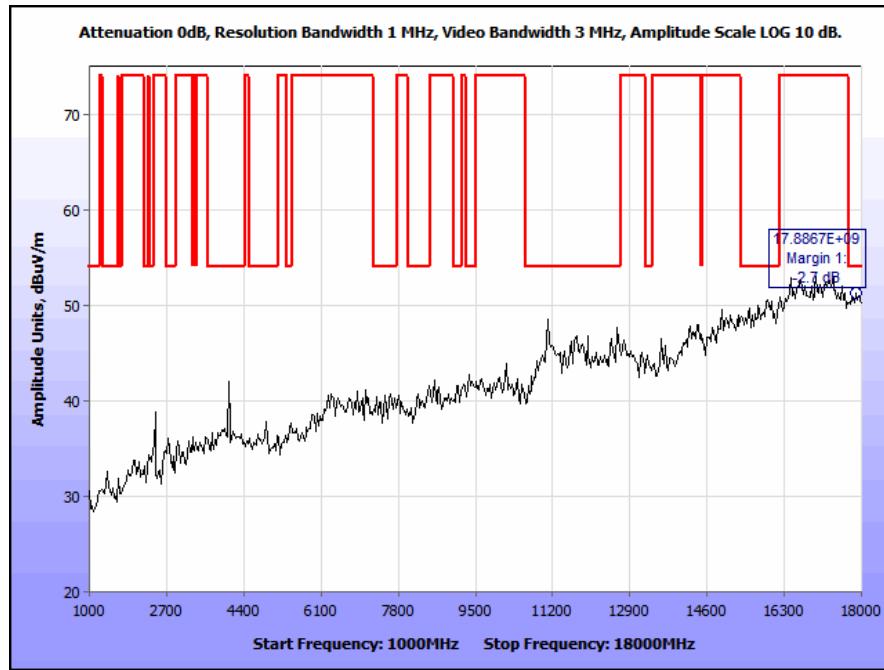
Plot 62. Radiated Spurious Emissions, Low Channel, 30 MHz – 1 GHz, GFSK



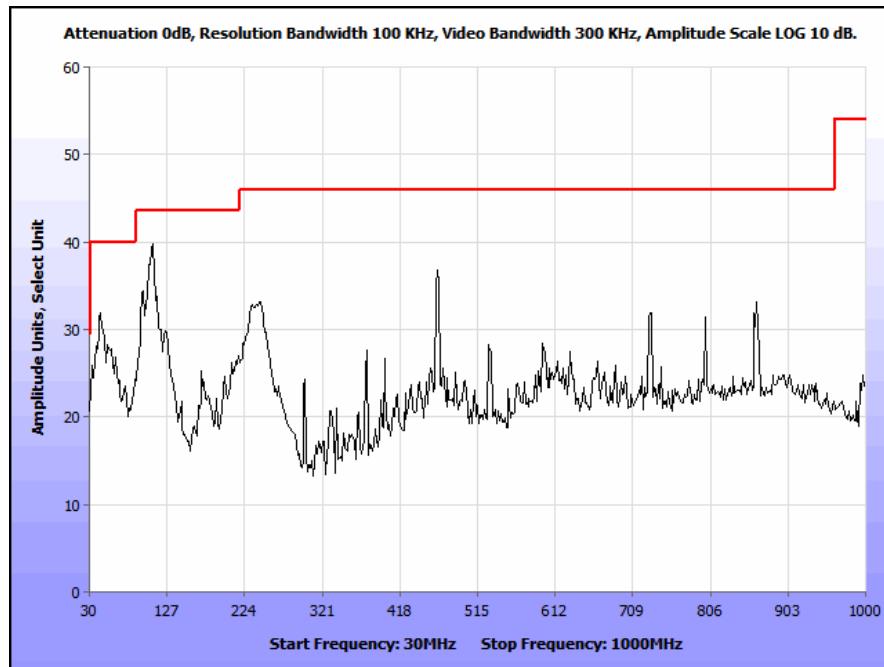
Plot 63. Radiated Spurious Emissions, Low Channel, 1 GHz – 18 GHz, GFSK



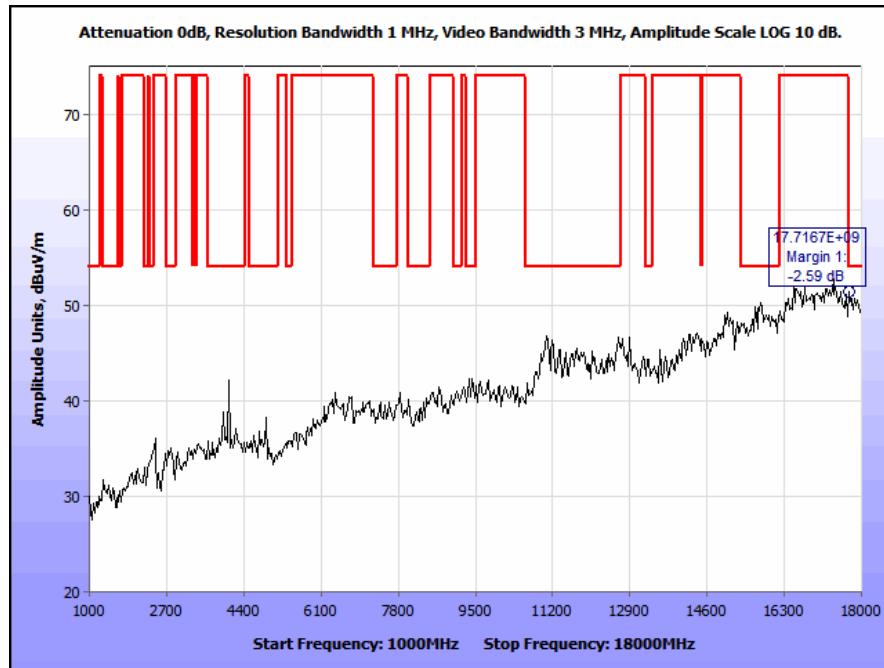
**Plot 64. Radiated Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, GFSK**



**Plot 65. Radiated Spurious Emissions, Mid Channel, 1 GHz – 18 GHz, GFSK**



Plot 66. Radiated Spurious Emissions, High Channel, 30 MHz – 1 GHz, GFSK

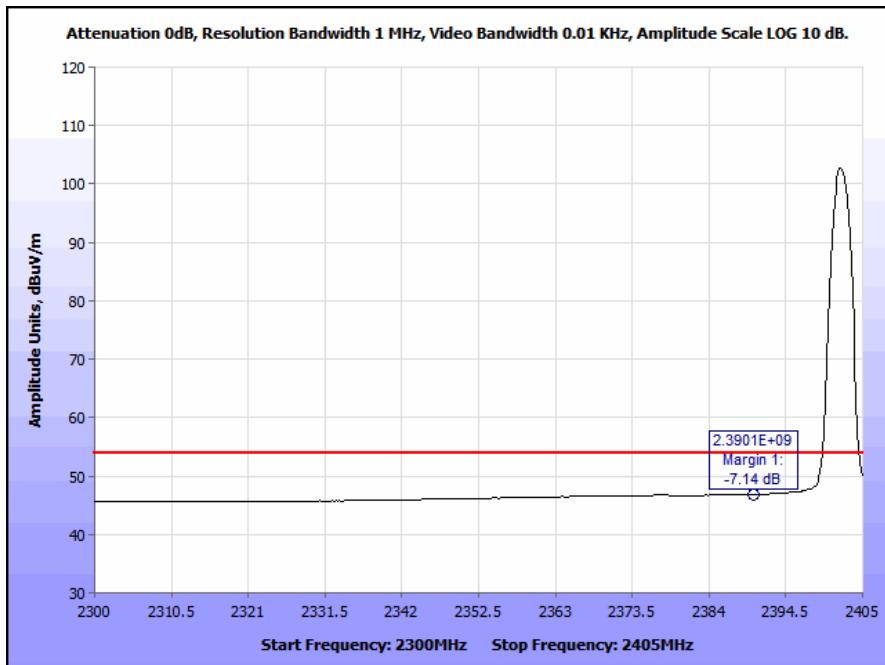


Plot 67. Radiated Spurious Emissions, High Channel, 1 GHz – 18 GHz, GFSK

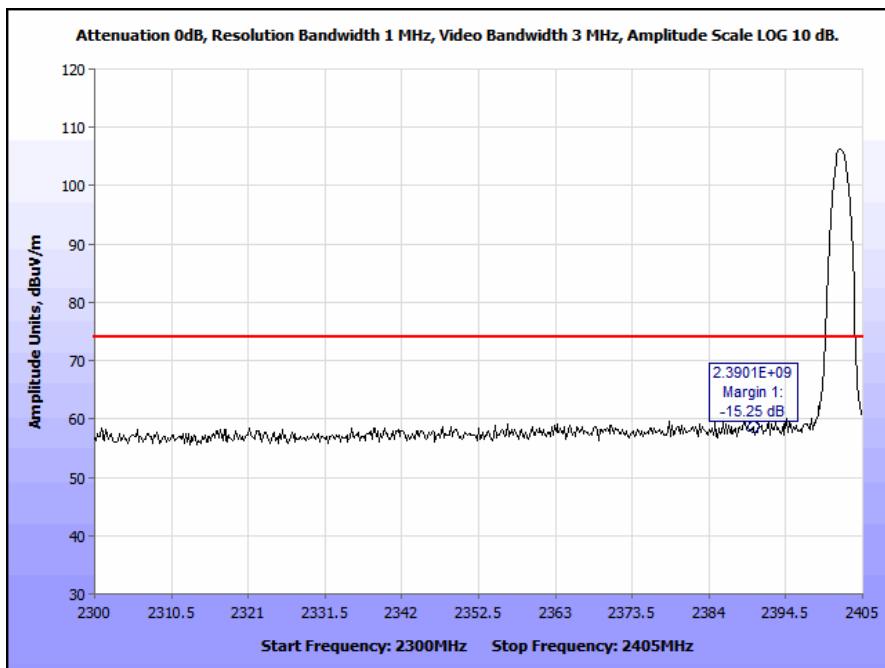
## Radiated Band Edge Measurements, EDR

### Test Procedures:

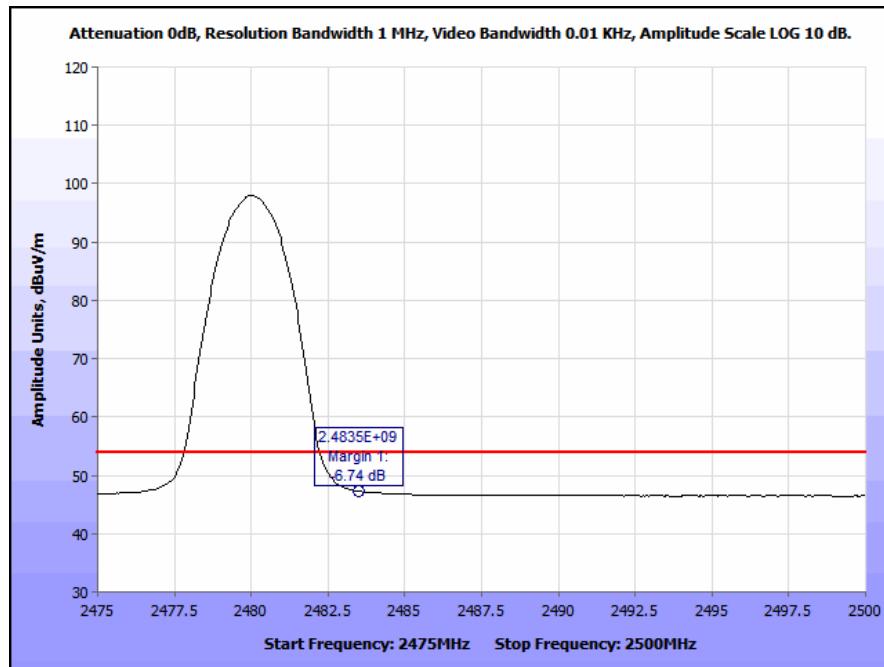
The transmitter was turned. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes. Plots shown are corrected for both antenna correction factor and distance.



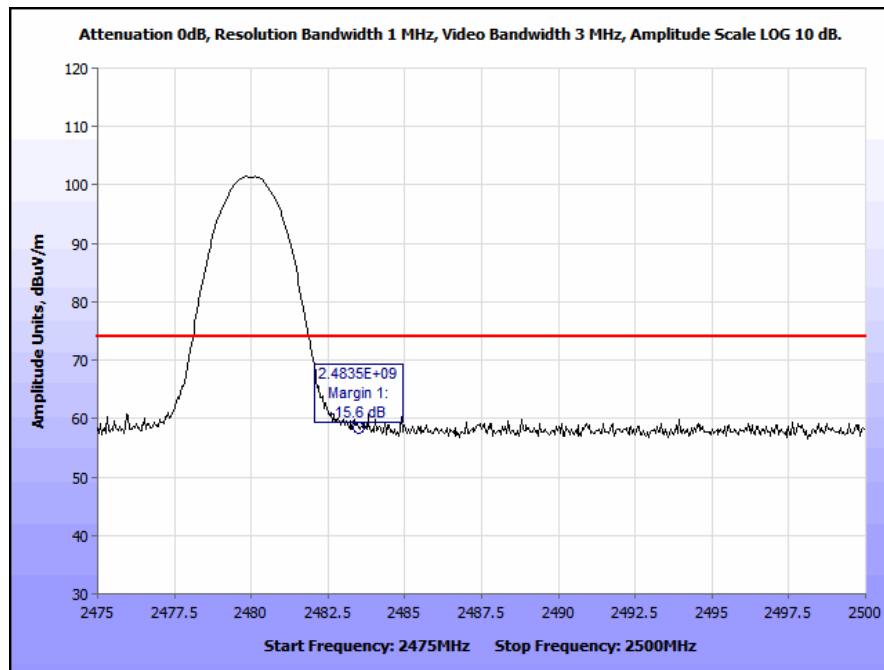
Plot 68. Radiated Band Edge, Low Channel, Average, EDR



Plot 69. Radiated Band Edge, Low Channel, Peak, EDR

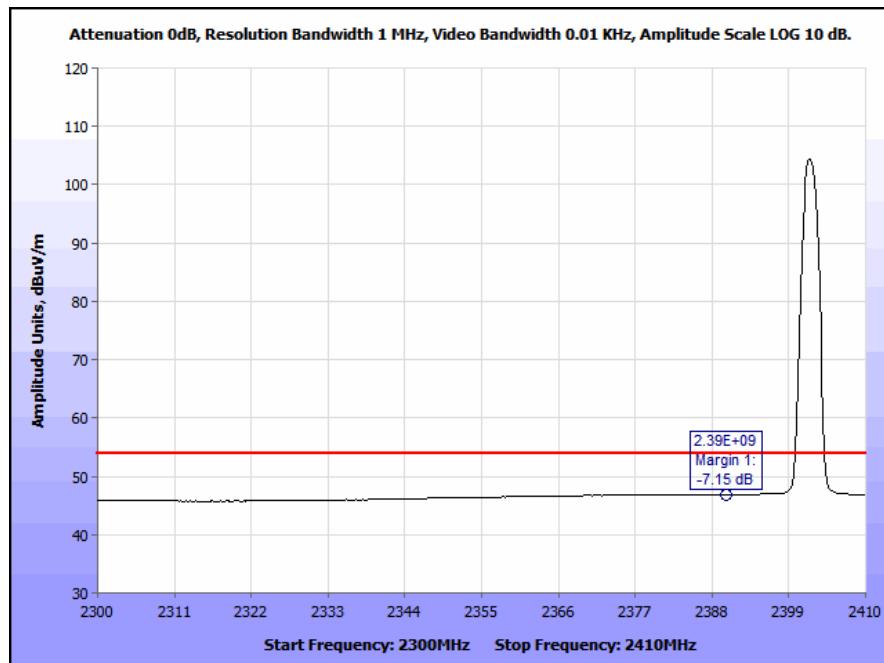


**Plot 70. Radiated Band Edge, High Channel, Average, EDR**

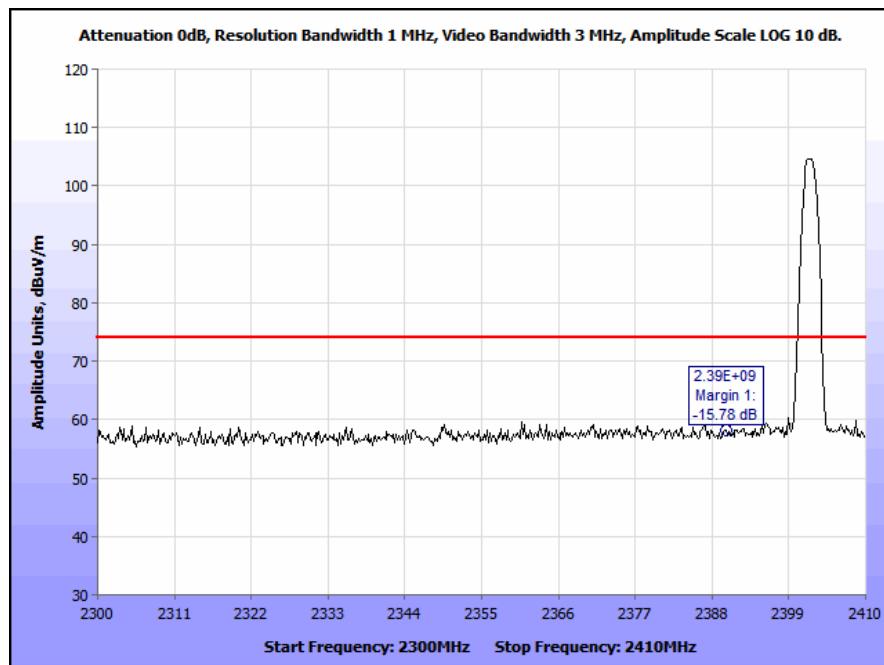


**Plot 71. Radiated Band Edge, High Channel, Peak, EDR**

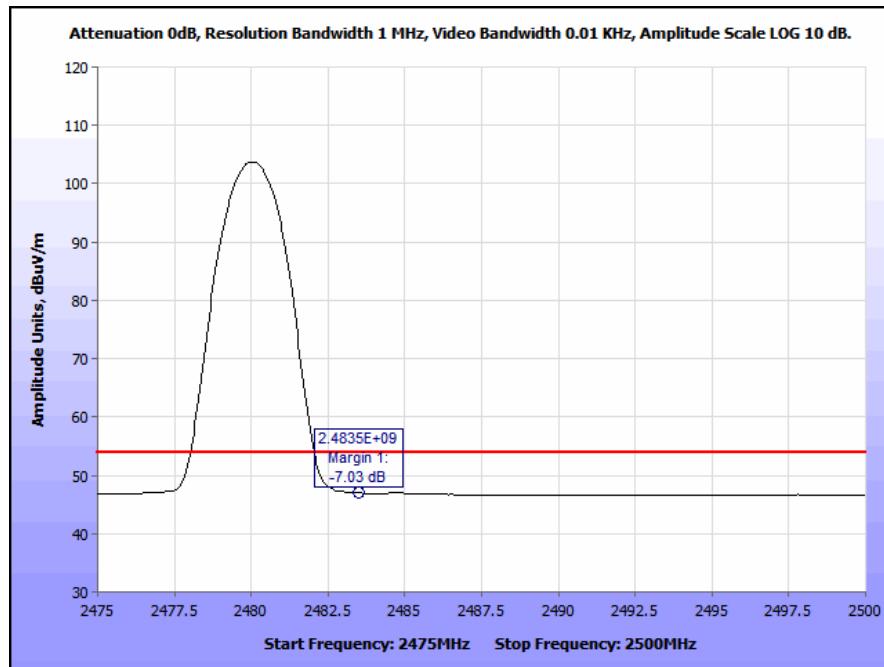
## Radiated Band Edge Measurements, GFSK



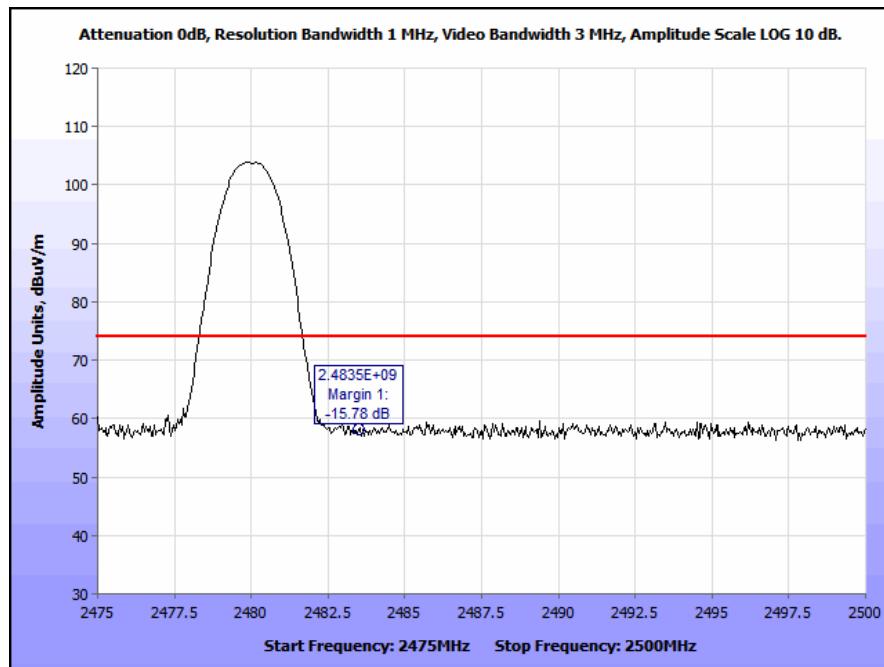
Plot 72. Radiated Band Edge, Low Channel, Average, GFSK



Plot 73. Radiated Band Edge, Low Channel, Peak, GFSK

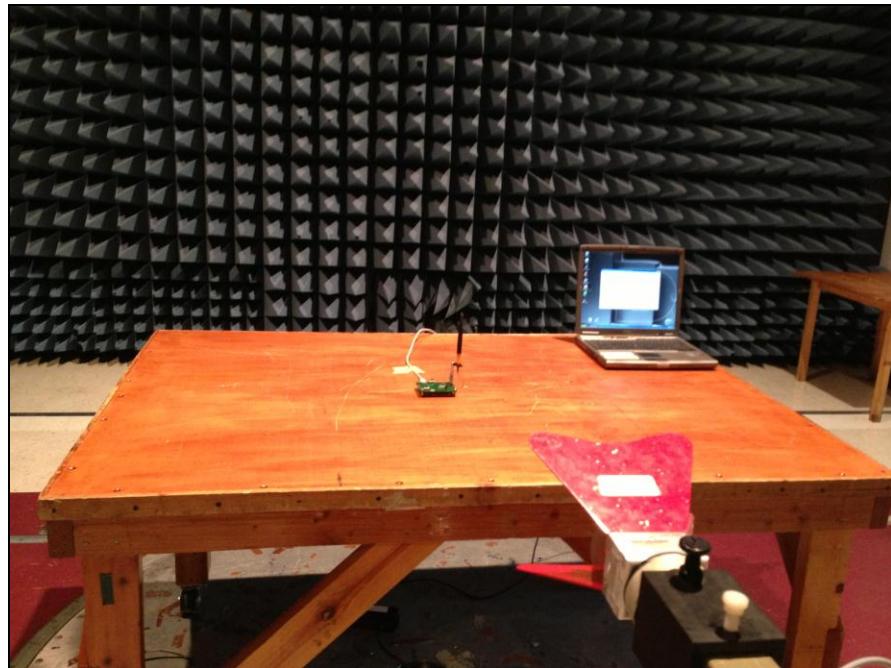


**Plot 74. Radiated Band Edge, High Channel, Average, GFSK**

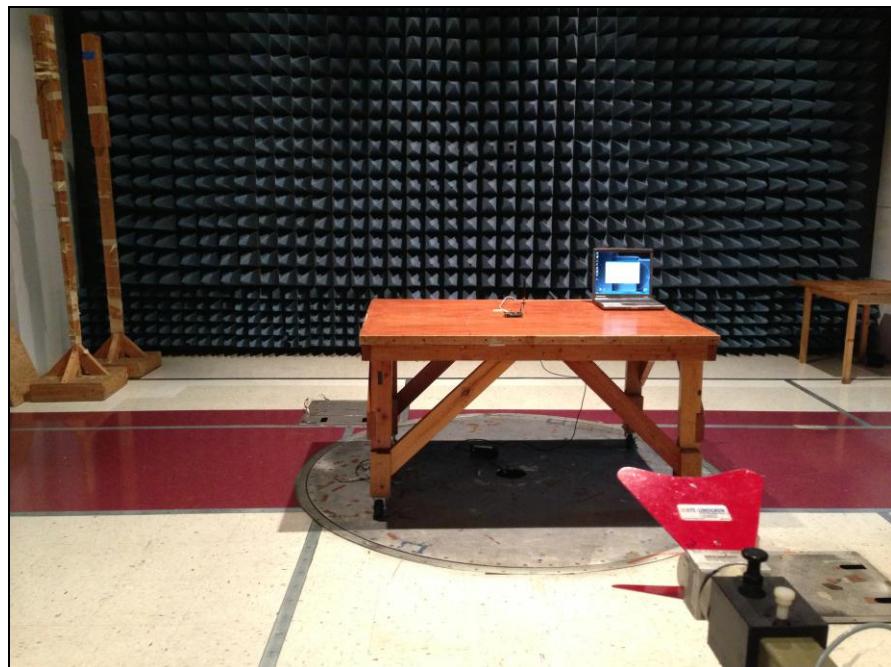


**Plot 75. Radiated Band Edge, High Channel, Peak, GFSK**

## Radiated Spurious Emissions Test Setup



Photograph 9. Radiated Spurious Emissions, Test Setup, 1 m



Photograph 10. Radiated Spurious Emissions, Test Setup, 3 m



**Photograph 11. Radiated Spurious Emissions, Test Setup, 30 MHz – 1 GHz**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(d) RF Conducted Spurious Emissions Requirements and Band Edge

**Test Requirement:**

**15.247(d)** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

**Test Procedure:**

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

A sample was provided fitted with a SMA connector. The EUT was connected from the SMA connector to a spectrum analyzer using a 10 dB Attenuator. Testing was performed on Low, Mid and High Channels. A resolution bandwidth of 100kHz and video bandwidth of 300kHz were utilized.

For conducted band edge, a delta measurement was taken from the peak of the fundamental to the Band edge then compared to the limit. The plots were corrected for both attenuator and cable loss.

See following pages for detailed test results with RF Conducted Spurious Emissions.

**Test Results:**

The EUT was compliant with the Conducted Spurious Emission limits of **§15.247(d)**.

**Test Engineer(s):**

Anderson Soungpanya

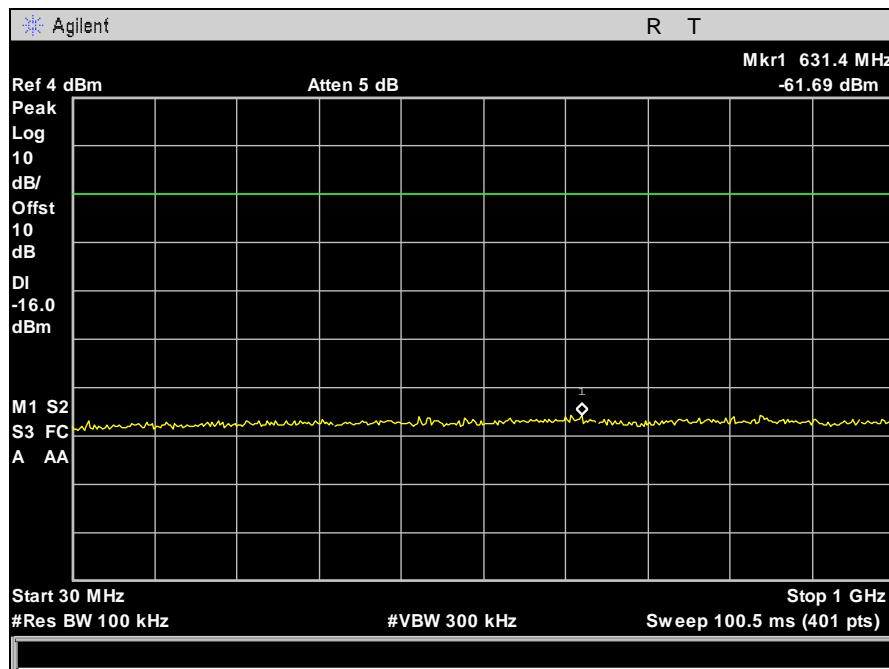
**Test Date(s):**

11/05/12

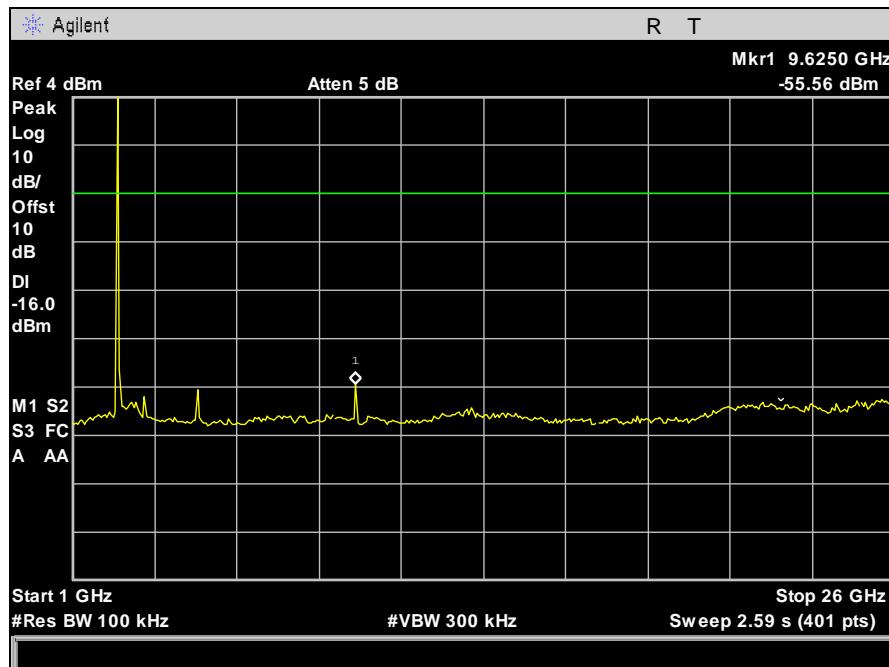


**Figure 4. Block Diagram, Conducted Spurious Emissions Test Setup**

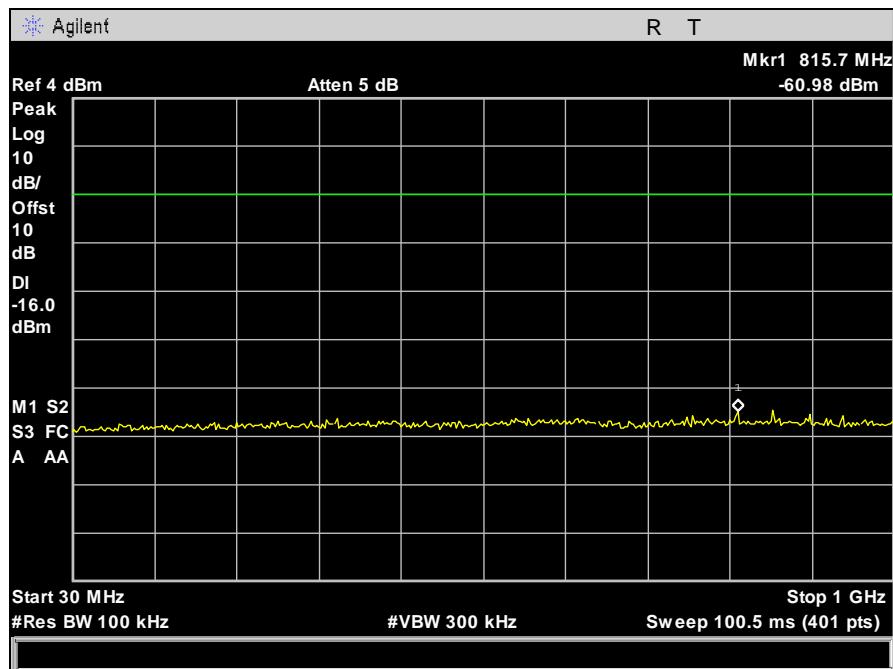
## Conducted Spurious Emissions Test Results, EDR



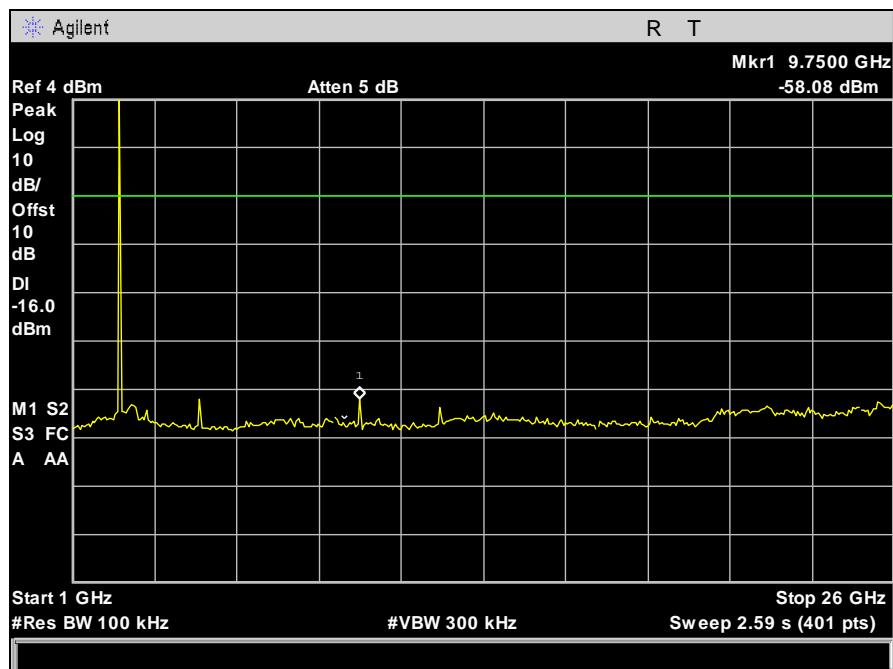
Plot 76. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, EDR



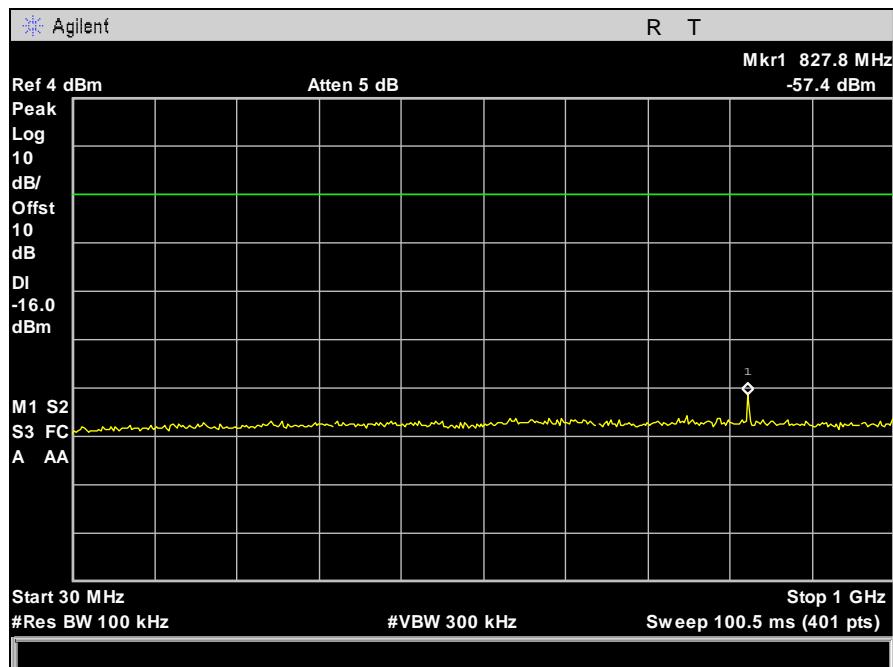
Plot 77. Conducted Spurious Emissions, Low Channel, 1 GHz – 26 GHz, EDR



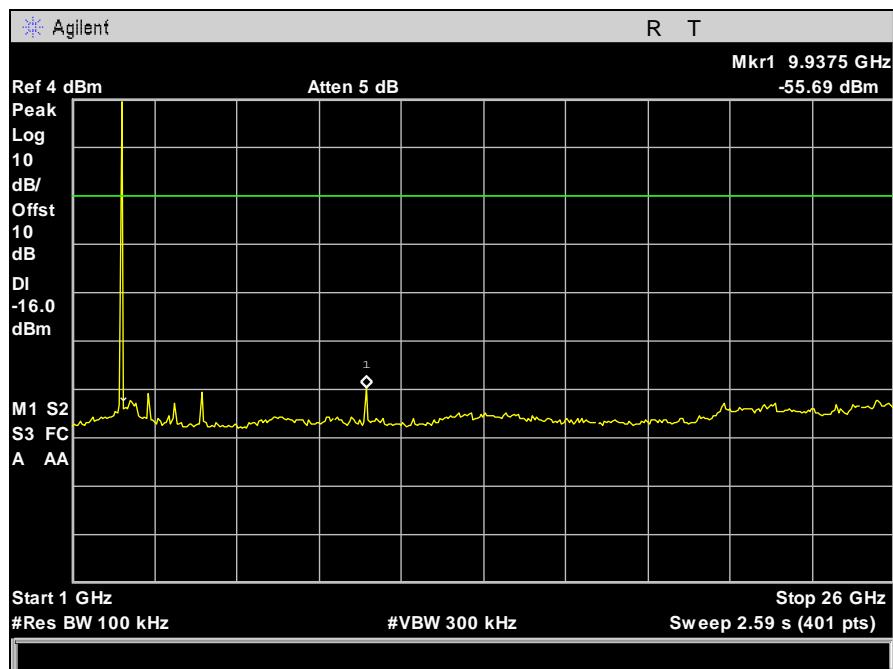
Plot 78. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, EDR



Plot 79. Conducted Spurious Emissions, Mid Channel, 1 GHz – 26 GHz, EDR

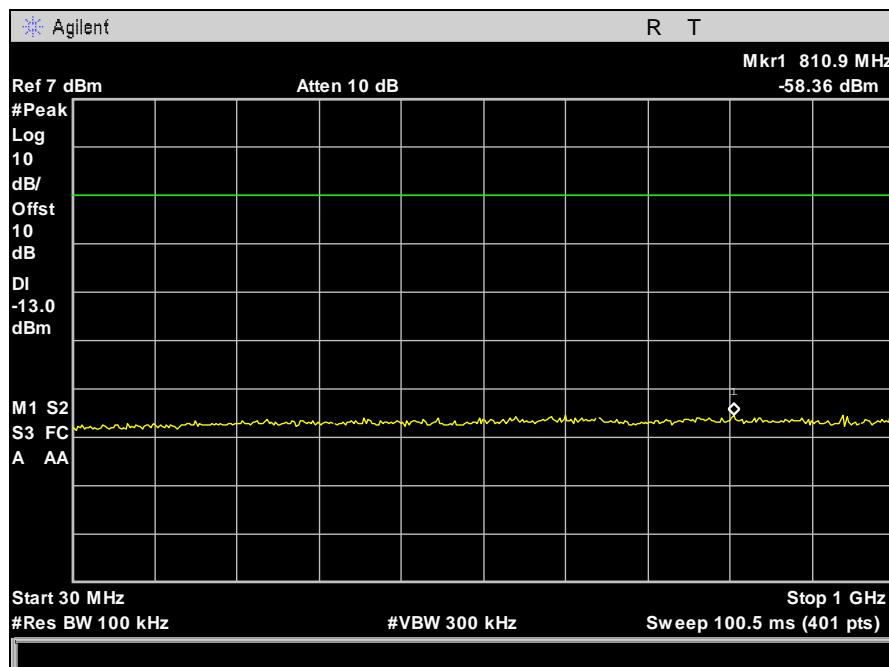


Plot 80. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, EDR

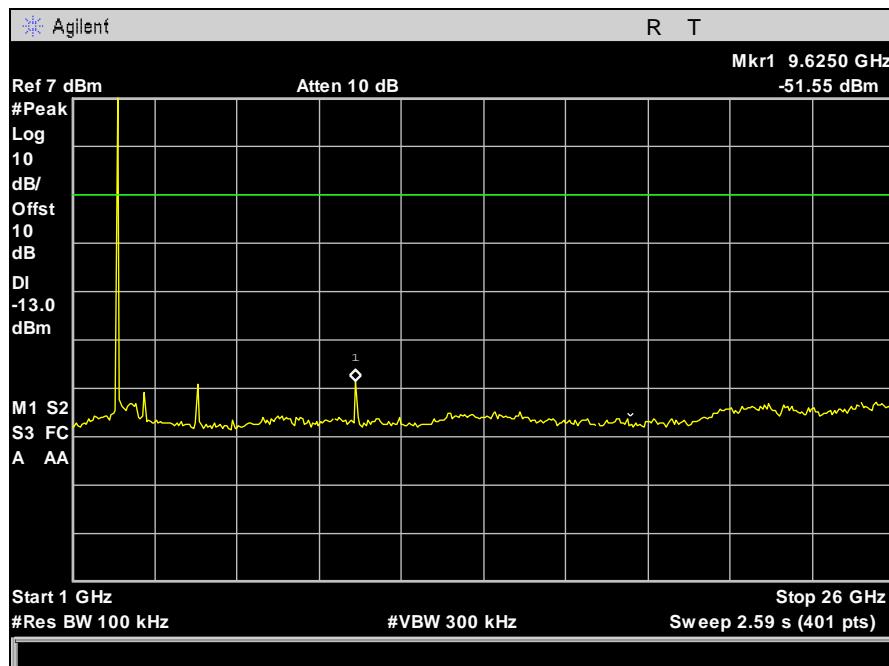


Plot 81. Conducted Spurious Emissions, High Channel, 1 GHz – 26 GHz, EDR

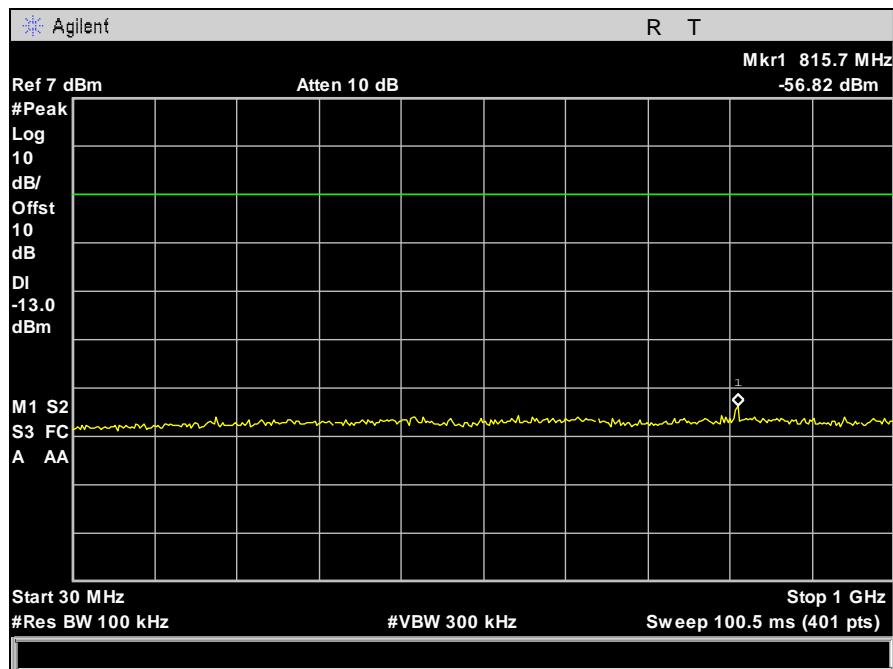
## Conducted Spurious Emissions Test Results, GFSK



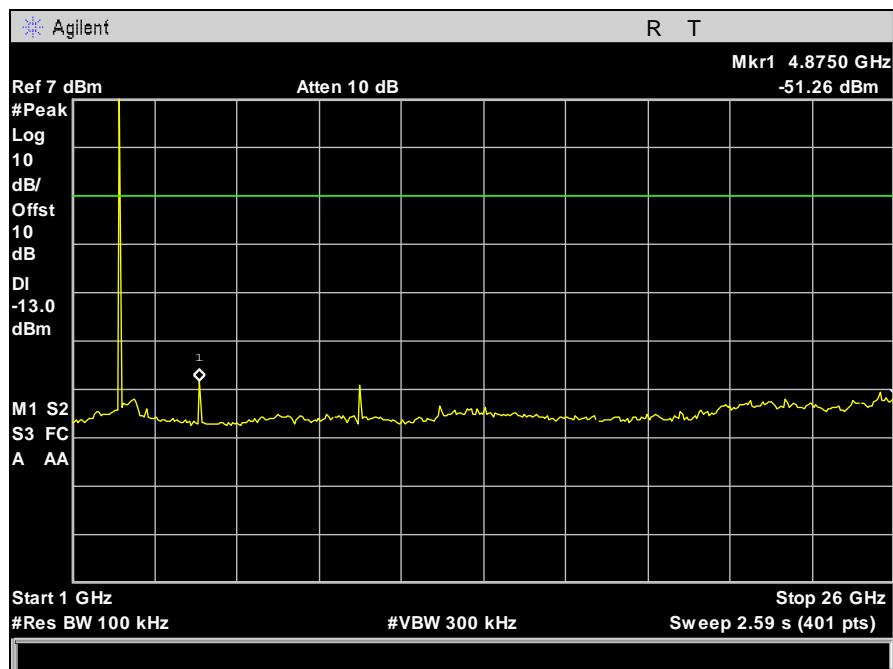
Plot 82. Conducted Spurious Emissions, Low Channel, 30 MHz – 1 GHz, GFSK



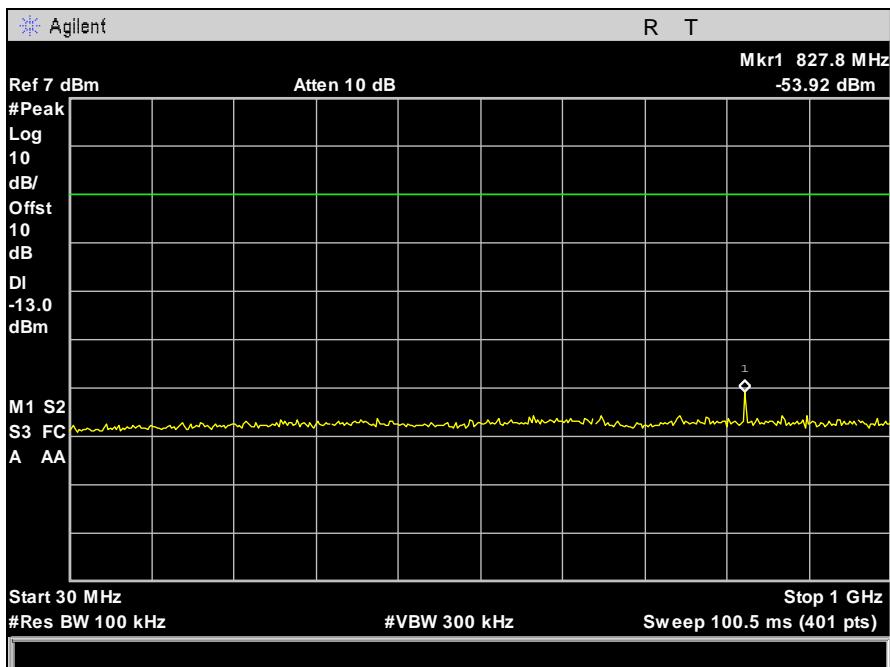
Plot 83. Conducted Spurious Emissions, Low Channel, 1 GHz – 26 GHz, GFSK



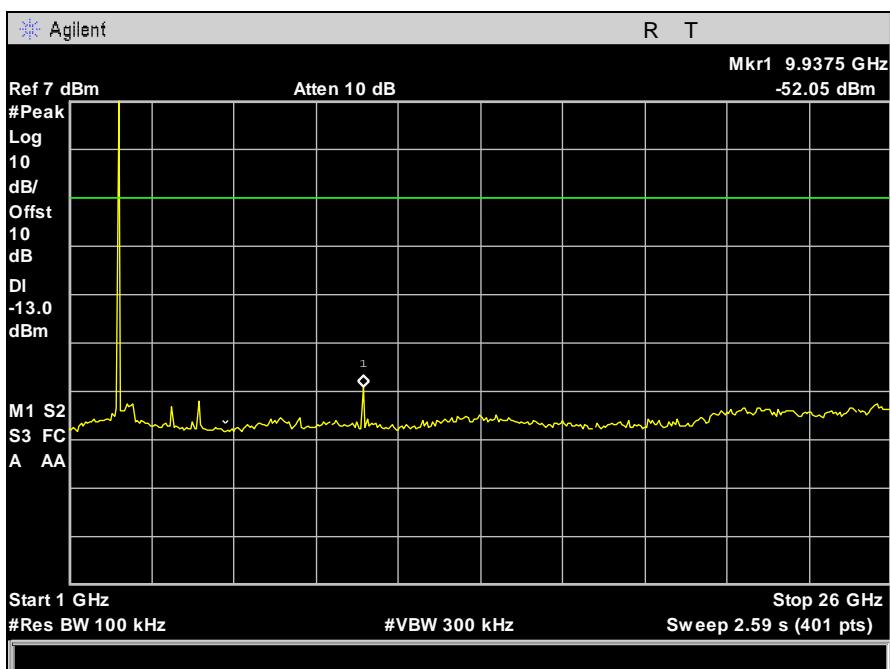
Plot 84. Conducted Spurious Emissions, Mid Channel, 30 MHz – 1 GHz, GFSK



Plot 85. Conducted Spurious Emissions, Mid Channel, 1 GHz – 26 GHz, GFSK



Plot 86. Conducted Spurious Emissions, High Channel, 30 MHz – 1 GHz, GFSK



Plot 87. Conducted Spurious Emissions, High Channel, 1 GHz – 26 GHz, GFSK

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(g)(h) Declaration Statements for FHSS



#### Declaration Letter

11/14/2012

To Whom It May Concern:

- i. The hopping sequence is pseudorandom, all channels are used equally on average, the receiver input bandwidth is approximately equal to the transmit bandwidth and the receiver hops in sequence with the transmitted signal.
- ii. The system is designed to comply with all of the regulations in 15.247 when the transmitter is presented with continuous data.
- iii. The system does not coordinate its channel selection / hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

Product Engineer / FAE

Bob Nelson



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\*\*\*\*\* Delivering M2M

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(i) Maximum Permissible Exposure

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

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

MPE Limit Calculation: EUT's operating frequencies @ 2400-2483.5 MHz; highest conducted power = 8.50 dBm (peak) therefore, **Limit for Uncontrolled exposure: 1 mW/cm<sup>2</sup> or 10 W/m<sup>2</sup>**

EUT maximum antenna gain = 3 dBi.

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

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

where,  $S$  = Power Density ( $1 \text{ mW/cm}^2$ )  
 $P$  = Power Input to antenna ( $7.08 \text{ mW}$ )  
 $G$  = Antenna Gain (2.00 numeric)

$$S = (7.08 * 2.00 / 4 * 3.14 * 20.0^2) = (14.13 / 5024) = \mathbf{0.0028 \text{ mW/cm}^2} @ 20\text{cm separation}$$

## Electromagnetic Compatibility Criteria for Intentional Radiators

### RSS-GEN      Receiver Spurious Emissions Requirements

**Test Requirements:** The following receiver spurious emission limits shall be complied with:

- (a) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table 24.

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

**Table 24. Spurious Emission Limits for Receivers**

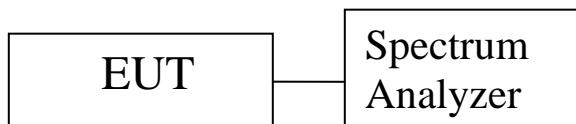
- (b) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2 nanowatts per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5 nanowatts above 1 GHz.

**Test Procedures:** The EUT was programmed for receive mode only. Conducted measurements were taken at the antenna port of the EUT. 300 kHz resolution bandwidth was used from 30 MHz - 1 GHz and 1MHz resolution was used for measurements done above 1 GHz. All plots are corrected for cable loss.

**Test Results:** Equipment is compliant with the Receiver Spurious Emissions Requirements of RSS-GEN.

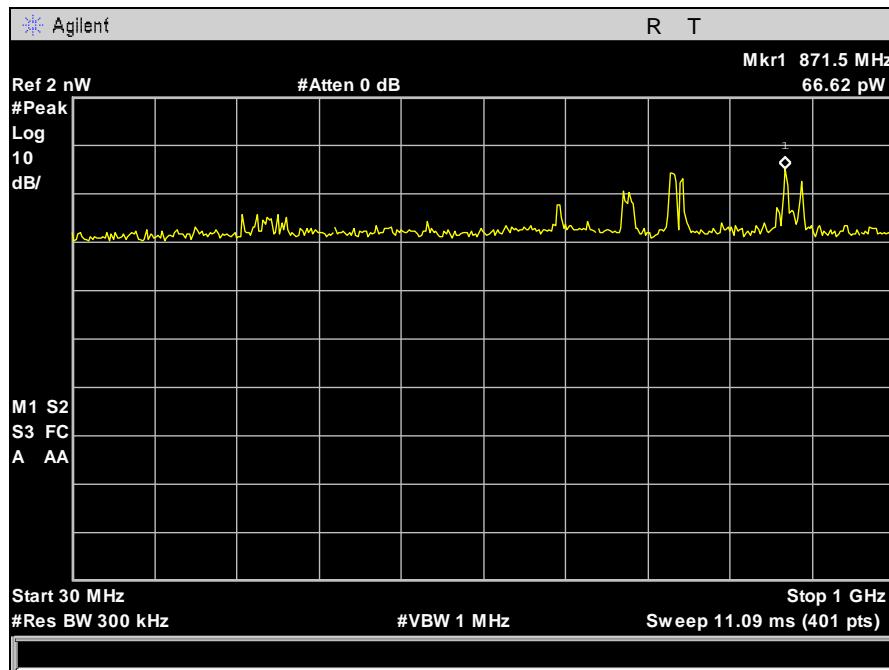
**Test Engineer(s):** Anderson Soungpanya

**Test Date(s):** 11/05/12

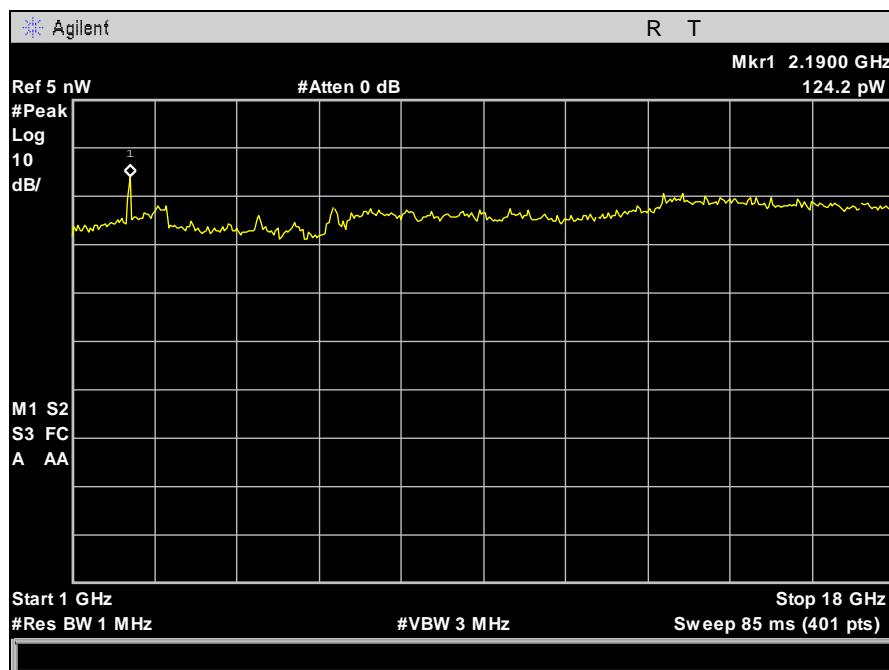


**Figure 5. Block Diagram, Conducted Receiver Spurious Emissions Test Setup**

## Conducted Receiver Spurious Emissions



Plot 88. Receiver Spurious Emission, 30 MHz – 1 GHz



Plot 89. Receiver Spurious Emission, 1 GHz – 18 GHz

## IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	4/14/2010	4/14/2013
1S2482	5 METER CHAMBER (NSA)	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	11/22/2011	5/22/2013
1S2583	SPECTRUM ANALYZER	AGILENT/HP	E4447A	3/27/2012	9/27/2013
1S2460	1-26GHZ SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4407B	7/27/2012	1/27/2014
1S2202	HORN ANTENNA (1 METER)	EMCO	3116	4/23/2010	4/23/2013
1S2523	PREAMPLIFIER	AGILENT TECHNOLOGIES	8449B	SEE NOTE	
1S2603	DOUBLE RIDGED WAVEGUIDE HORN	ETS-LINDGREN	3117	4/15/2011	4/15/2013
1S2729	SONOMA AMPLIFIER	SONOMA INSTRUMENT	310N	4/18/2012	10/18/2013
1S2229	TEMPERATURE CHAMBER	TENNY ENGINEERING	T63C	2/18/2012	8/18/2013
1S2710	DRG HORN ANTENNA	AH SYSTEMS, INC	SAS-574	11/30/2011	11/30/2012
NA	NOTCH FILTER	MICRO-TRONICS	BRM50702	SEE NOTE	

**Table 25. Test Equipment List**

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 stages; 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

### 1. Label and User's Manual Information

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

#### § 15.19 Labeling requirements.

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

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

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

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

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

(3) All other devices shall bear the following statement in a conspicuous location on the device:

*This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

#### § 15.21 Information to user.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Verification & User's Manual Information

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

### § 15.105 Information to the user.

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

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial 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. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) 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.

## ICES-003 Procedural & Labeling Requirements

From the Industry Canada Electromagnetic Compatibility Advisory Bulletin entitled, "Implementation and Interpretation of the Interference-Causing Equipment Standard for Digital Apparatus, ICES-003" (EMCAB-3, Issue 2, July 1995):

"At present, CISPR 22: 2002 and ICES technical requirements are essentially equivalent. Therefore, if you have CISPR 22: 2002 approval by meeting CISPR Publication 22, the only additional requirements are: to attach a note to the report of the test results for compliance, indicating that these results are deemed satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations; to maintain these records on file for the requisite five year period; and to provide the device with a notice of compliance in accordance with ICES-003."

### Procedural Requirements:

According to Industry Canada's Interference Causing Equipment Standard for Digital Apparatus ICES-003 Issue 4, February 2004:

Section 6.1: A record of the measurements and results, showing the date that the measurements were completed, shall be retained by the manufacturer or importer for a period of at least five years from the date shown in the record and made available for examination on the request of the Minister.

Section 6.2: A written notice indicating compliance must accompany each unit of digital apparatus to the end user. The notice shall be in the form of a label that is affixed to the apparatus. Where because of insufficient space or other constraints it is not feasible to affix a label to the apparatus, the notice may be in the form of a statement in the user's manual.

### Labeling Requirements:

The suggested text for the notice, in English and in French, is provided below, from the Annex of ICES-003:

This Class <sup>[2]</sup> digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe <sup>[1]</sup> est conforme à la norme NMB-003 du Canada.

<sup>2</sup> Insert either A or B but not both as appropriate for the equipment requirements.

# End of Report