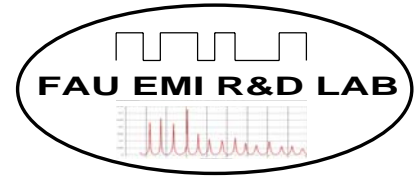




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Technical Report No. 06-074

“EMI Evaluation of the XM Satellite Radio, Inc.  
 XM2go XM Satellite Radio Receiver to FCC Class B  
 Conducted and Radiated Emission Requirements for a  
 PC Peripheral Device – Model No. X2G-100”


Date Performed: 9/28/2006-9/29/2006

Customer: XM Satellite Radio, Inc.  
 Attn: Terry Helstrom  
 3161 S.W. 10<sup>th</sup> street  
 Deerfield Beach, FL 33442

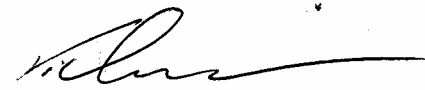
Company Official responsible  
 for product(s) tested:

  
 \_\_\_\_\_  
 Terry Helstrom, Engineer

Test Performed and  
 Reported By:

  
 \_\_\_\_\_  
 Raymond Aina, Test Engineer  
 FAU EMI R&D Laboratory

Approved by:

  
 \_\_\_\_\_  
 Vichate Ungvichian, Ph.D., P.E.  
 Director, FAU EMI R&D Laboratory

Date of Test Report: 2 October 2006



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## **1. INTRODUCTION**

The XM Satellite Radio, Inc., XM2go Model X2G-100 was evaluated for compliance to the FCC Class B requirements and the results apply only to the specific items of equipment, configurations and procedures supplied to the Florida Atlantic University EMI Research Lab by XM Satellite Radio, Inc., as reported in this document.

## **2. OBJECTIVE**

### **Test Specifications**

This evaluation was performed to verify conformance of the XM Satellite Radio, Inc., XM2go XM Satellite Radio receiver to U.S. Federal Communications Commission (FCC) Code of Federal Regulations (CFR), Title 47 - Telecommunication, Part 15 - Radio Frequency Devices,

- Section 15.107(a) Conducted limits, and
- Section 15.109(a) Radiated Class B Emission limits.

### **Modes of Operation Tested**

Per ANSI C63.4 Section 11, Measurement of Information Technology Equipment (ITE), the device under test was configured to be continuously receiving data from a host PC via a USB connection.

The Minimum System Requirements of ANSI C63.4, Section 11.2, were met by using a host PC (laptop computer), and an additional external peripheral device which utilized the Serial Port of the laptop with continuous data traffic on the cable.

Host PC : Laptop Model Compaq nc6000, Serial # CNU41228G9

External Peripheral : Earthmate GPS Receiver, Model Delorme

EUT : XM2go Hardware ID : BCWRJQMB

- During FCC Part 15 Subpart B, Paragraph 15.107(a) conducted emissions tests, the EUT was configured with the EUT in the XM2go home cradle with the XM Home AC adaptor.
- During FCC Part 15 Subpart B, Paragraph 15.109(a), radiated emissions, the EUT was configured and tested in two different operating modes:
  - In a XM2go home cradle powered by a 5V AC wall adapter.
  - In Portable Mode, under battery power.

## **3. CONCLUSION**

The XM Satellite Radio, Inc., XM2go Model X2G-100, met the FCC Class B conducted and radiated emission requirements as a PC Peripheral Device as described in the following report.

## 4. TEST PROCEDURES AND RESULTS

### 4.1 TABLE OF DATA PLOTS

Figure #	Test	Mode of Operation	Frequency Range	Polarization
1	Conducted	Home Cradle	150KHz - 30MHz	N/A
2	Radiated	Home Cradle	30MHz - 200MHz	Vertical
3	Radiated	Home Cradle	30MHz - 200MHz	Horizontal
4	Radiated	Home Cradle	200MHz - 1GHz	Vertical
5	Radiated	Home Cradle	200MHz - 1GHz	Horizontal
6	Radiated	Portable	30MHz - 200MHz	Vertical
7	Radiated	Portable	30MHz - 200MHz	Horizontal
8	Radiated	Portable	200MHz - 1GHz	Vertical
9	Radiated	Portable	200MHz - 1GHz	Horizontal

### 4.2 GENERAL TEST PROCEDURES

The measurement techniques identified in the measurement procedure of ANSI C63.4-2003 *"American National Standard of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"* were followed as close as practical during this evaluation. Complete details and specific procedures used are discussed in the respective test result sections.

## **4.3 CONDUCTED EMISSIONS – Section 15.107(a)**

### **4.3.1 Test Setup – Conducted Emissions**

The XM Satellite Radio, Inc., XM2go50 Model X2G-100B; was powered by a I.T.I Power Supply Model No. SMPS5V2A-XMRT. The 120VAC/ DC 5V switching power supply was then installed in the FAU EMI Research facilities conducted emissions shielded enclosure on a wooden test table 80 centimeters above the ground plane floor and 40 centimeters from the rear wall. The I.T.E Power Supply was then plugged into an EMCO Model No.3825/2R Serial No. 1095, 50  $\Omega$ , 50  $\mu$ H Line Impedance Stabilization Network (LISN).

Conducted power line emissions were measured on both the phase and neutral lines with reference to earth ground, over the specified 150 kHz to 30 MHz range on a Hewlett Packard HP 8566B Spectrum Analyzer operated in the peak detection mode with a bandwidth of 9 kHz obtained through the HP 85650A Quasi Peak Adapter and in conjunction with HP85685A preselector. Photograph 1 and 2 depict the conducted setup.

### 4.3.2 Test Data – Conducted Emissions

The EUT was tested for the peak-detected emissions on phase and neutral lines while the XM2go50 unit was receiving data over the USB link connected to the host PC.

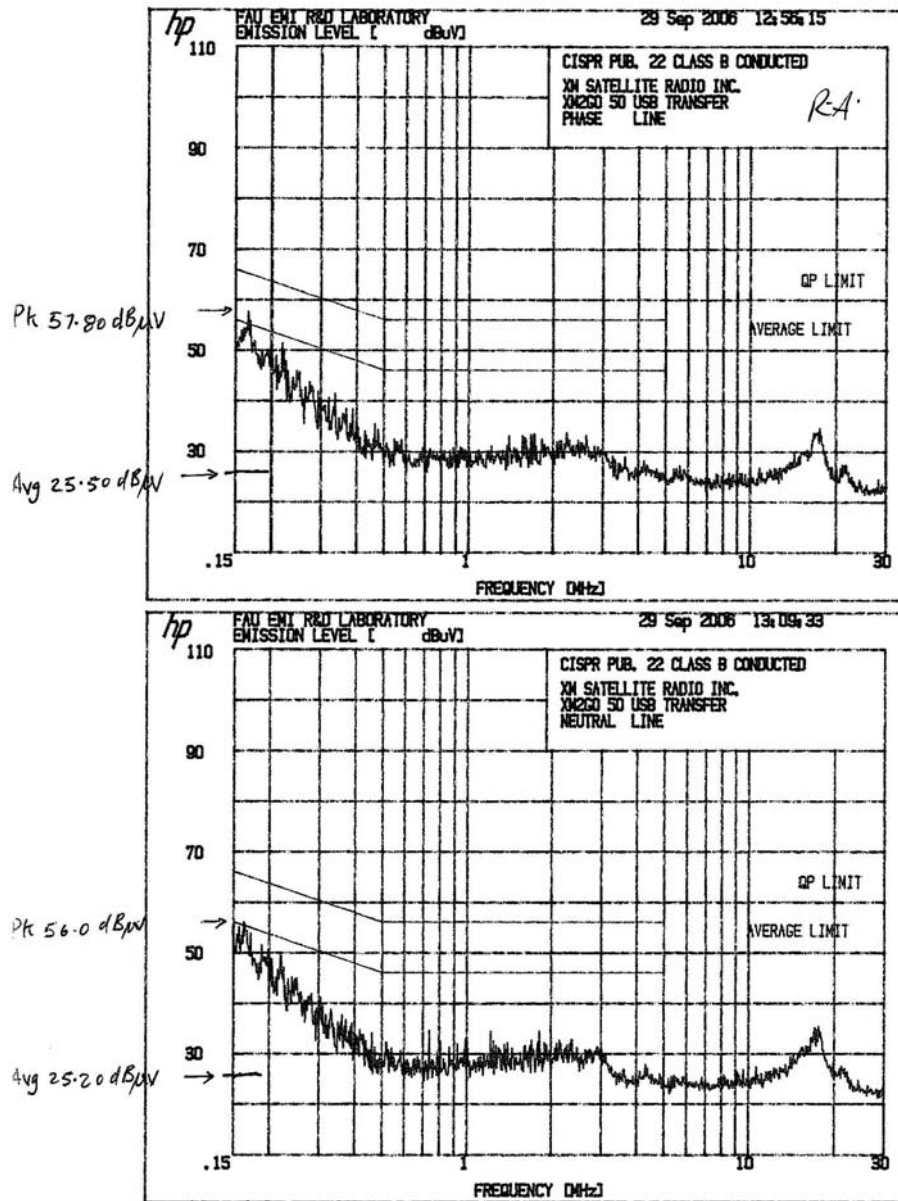


Figure 1: Phase and Neutral Conducted Emissions 150 kHz-30 MHz

Line Tested	Frequency (kHz)	Peak Value (dBµV)	Average Value (dBµV)	QP Value (dBµV)	Limit (dBµV)	Margin (dB)
Phase	150.12	57.8	25.5	-	55.5	30
Neutral	150.12	56.0	25.2	-	55.5	30.3

Table 1 : Peak Measurement Results – Conducted Emissions

## **4.4 RADIATED EMISSIONS – Section 15.109(a)**

### **4.4.1 General Test Setup – Radiated Emissions**

The XM Satellite Radio, Inc., XM2go Model X2G-100 was set up on a wooden table 80 centimeters above the ground plane turntable of the FCC listed Semi-Anechoic test site.

An EMCO 3104 Broadband Biconical antenna was installed on an EMCO pneumatically controlled Antenna Mast at a distance of 3 meters from the system. The 30 to 200 MHz frequency range was automatically scanned on the HP 8566B Spectrum Analyzer operated in the peak detector mode with a bandwidth of 120 kHz obtained through the HP 85650A Quasi Peak Adapter. It should be noted that the RES BW and VBW of the spectrum analyzer must be set to 1 MHz for the Quasi Peak Adaptor to provide 120 kHz bandwidth correctly. Hence, in the figures RES BW and VBW are still indicated as 1 MHz. The turntable was incrementally rotated through 360 degrees and at the same time the receiving antenna was scanned in height from 1 to 4 meters in both the horizontal and vertical polarizations. An EMCO 3146 Log Periodic antenna was then installed and the above procedure was repeated for the 200 to 1000 MHz ranges.

The FCC Class B limit lines have been corrected for the appropriate antenna factors, cable loss, and amplifier gain based on the following equation:

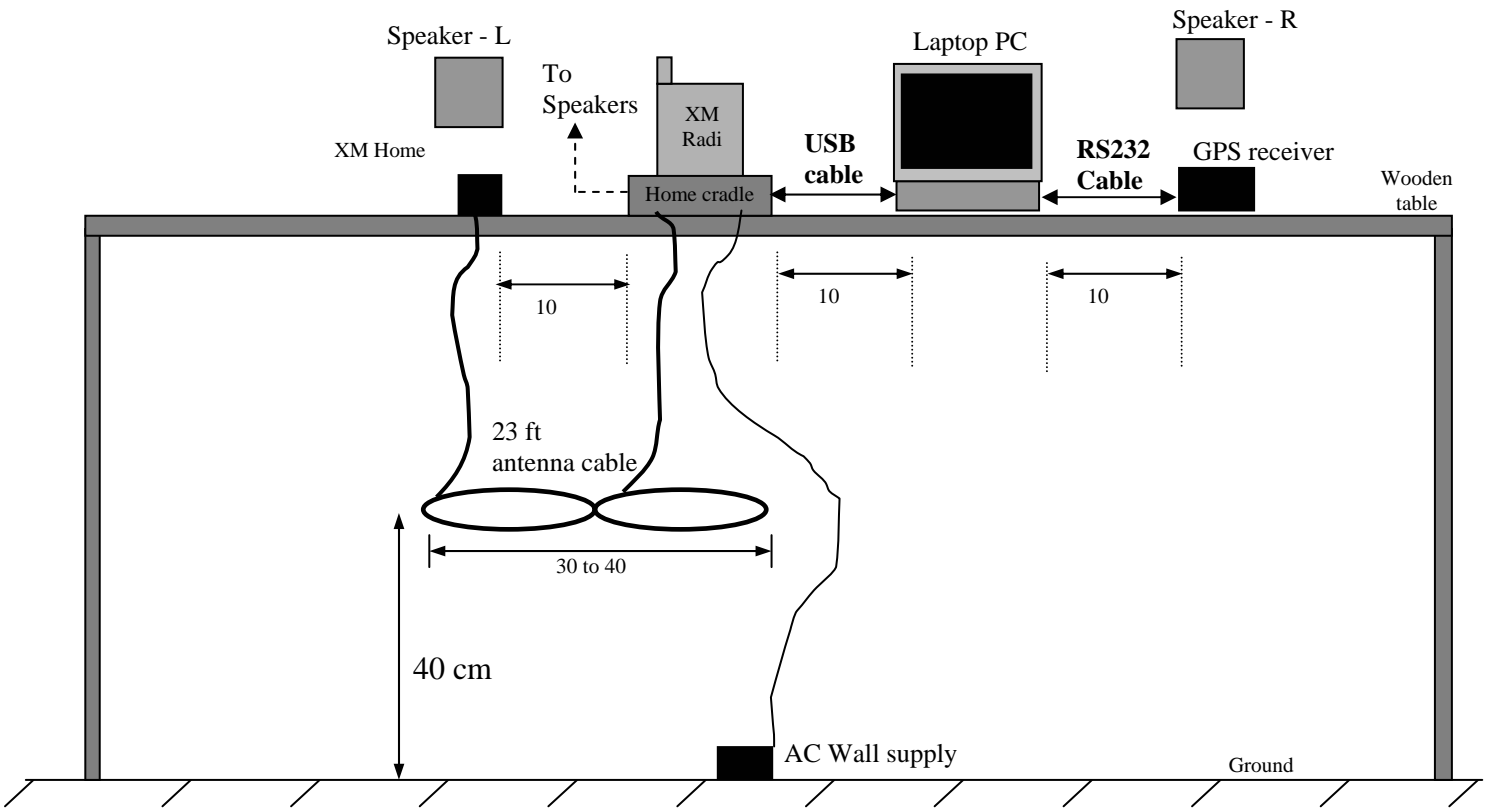
$$E \text{ (dB}\mu\text{V/m)} = \text{SA reading (dB}\mu\text{V)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Amp Gain (dB)}$$

The EUT was tested in TWO configurations under Section 15.109(a)

- Home Cradle with Speaker attached
- Portable Mode under battery power

## 4.4.2 Radiated Emissions – Home Cradle (with USB transfer)

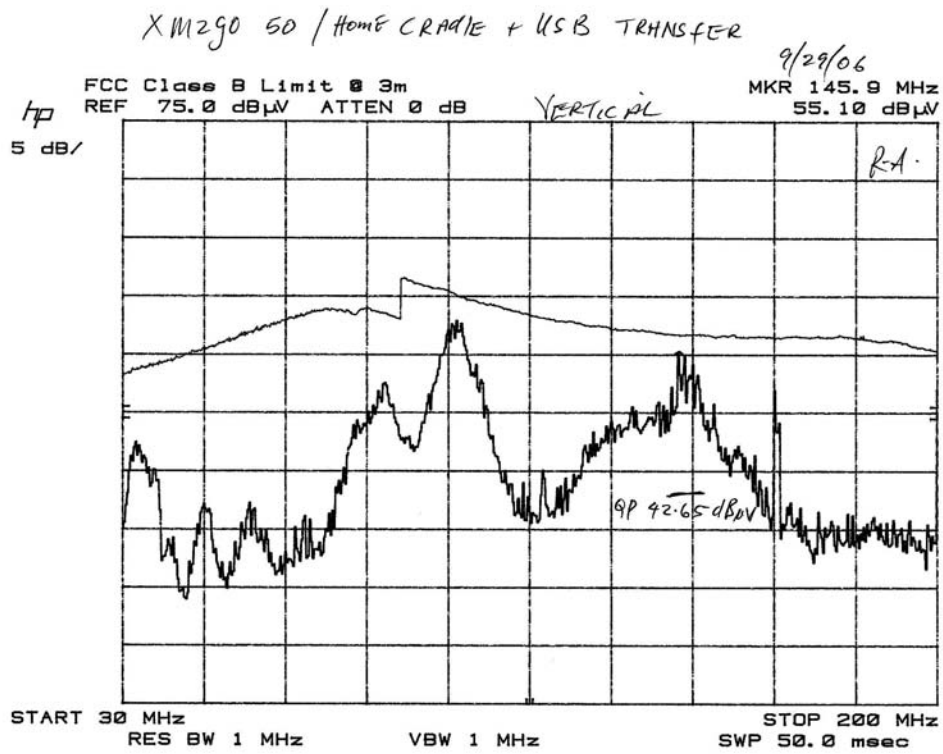
### 4.4.2.1 Test Setup – Home Cradle



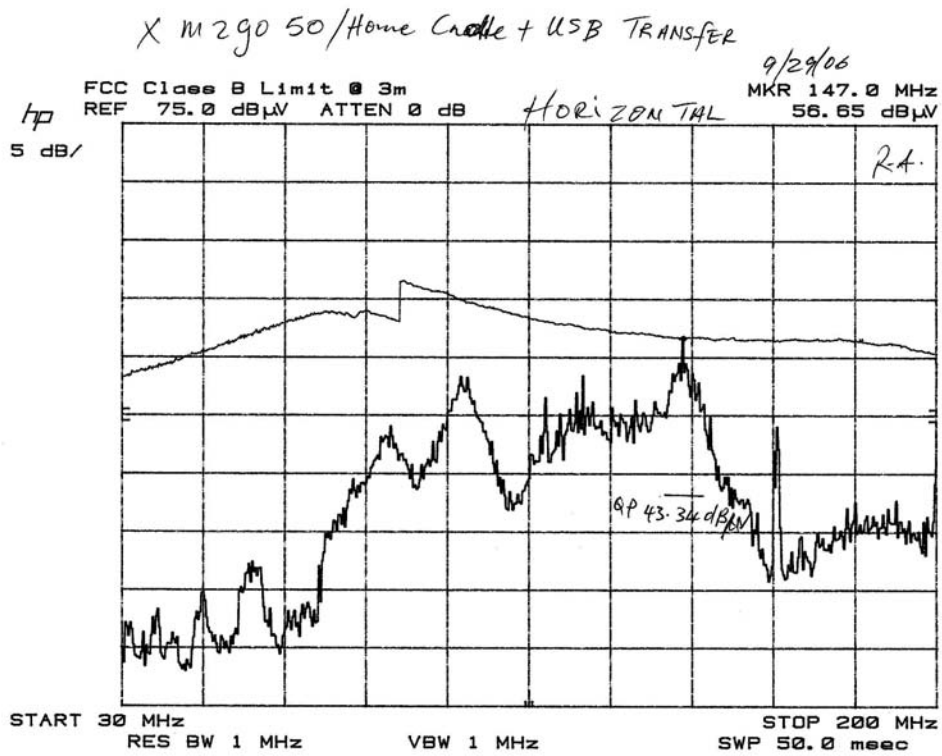
**Diagram 1 : Radiated Emissions – Home Cradle – Test Setup**



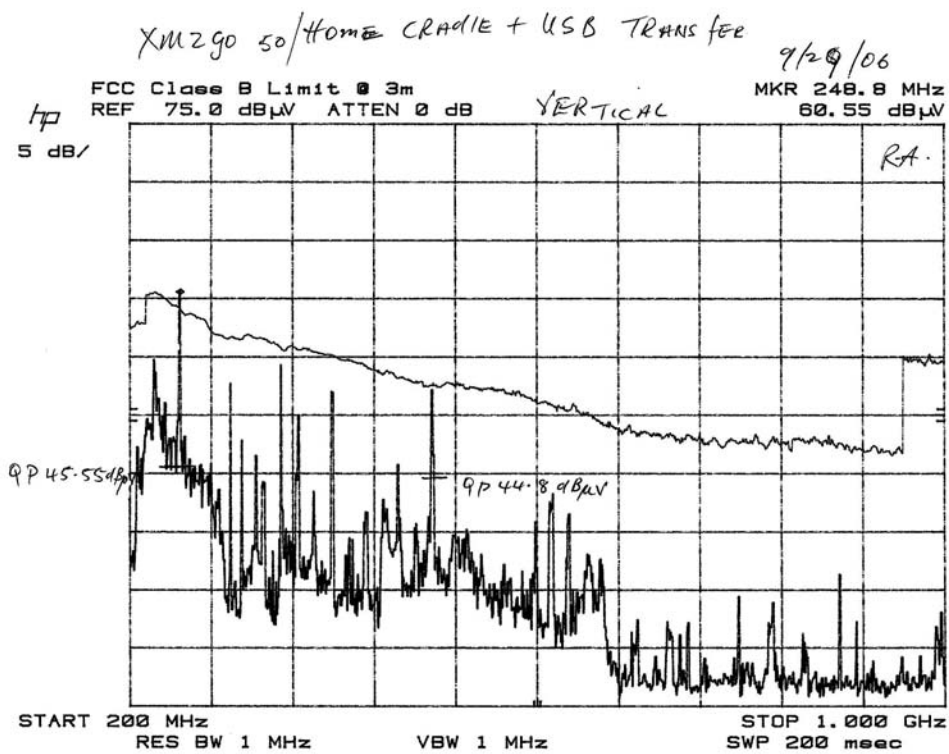
### 4.4.2.2 Test Data – Home Cradle



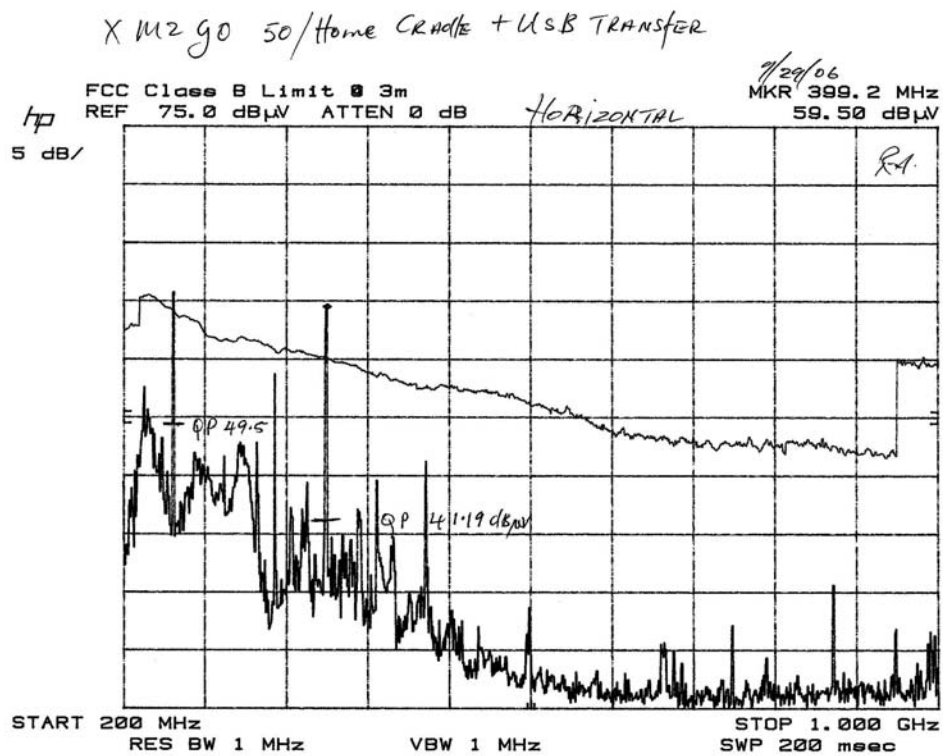
**Figure 2 : Radiated Emissions – Home Cradle – 30MHz to 200MHz - Vertical**



**Figure 3 : Radiated Emissions – Home Cradle – 30MHz to 200MHz - Horizontal**



**Figure 4 : Radiated Emissions – Home Cradle – 200MHz to 1GHz - Vertical**



**Figure 5 : Radiated Emissions – Home Cradle – 200MHz to 1GHz - Horizontal**

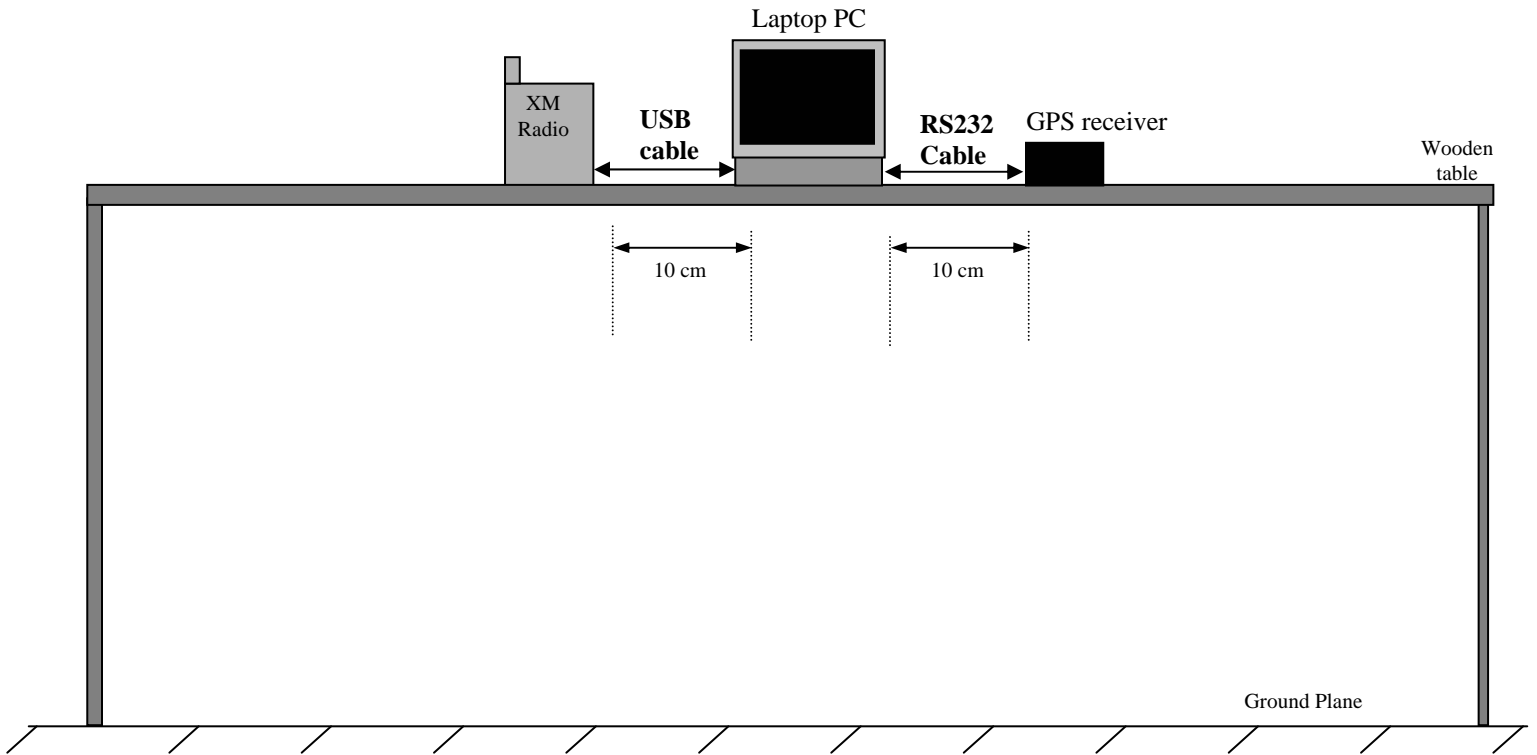
Figure No.	Frequency (MHz)	Measured Peak (dB $\mu$ V)	Quasi Peak (dB $\mu$ V)	Correction Factor (dB)	Corrected Peak (dB $\mu$ V/m)	FCC Limit (dB $\mu$ V/m)	Margin (dB)
2	145.9	55.1	42.7	-14.0	28.7	43.5	14.9
3	147.0	56.6	43.3	-14.0	29.3	43.5	14.2
4	248.8	60.6	45.6	-13.7	31.9	46.0	14.2
4	500.0	52.3	44.8	-7.0	37.8	46.0	8.2
5	248.8	60.4	49.5	-13.7	35.8	46.0	10.2
5	399.2	59.5	41.2	-9.6	31.6	46.0	14.4

**Table 2 : Peak Measurement Results – Home Cradle Radiated Emissions**

### 4.4.3 Radiated Emissions - Portable Mode (USB Transfer)

*Note : For each portable mode test setup, the radio was placed in each of three possible axis. The reported data is from axis which results in overall highest emissions.*

#### 4.4.3.1 Test Setup – Portable Mode



**Diagram 2 : Radiated Emissions – Portable Mode – Test Setup**

### 4.4.3.2 Test Data – Portable Mode

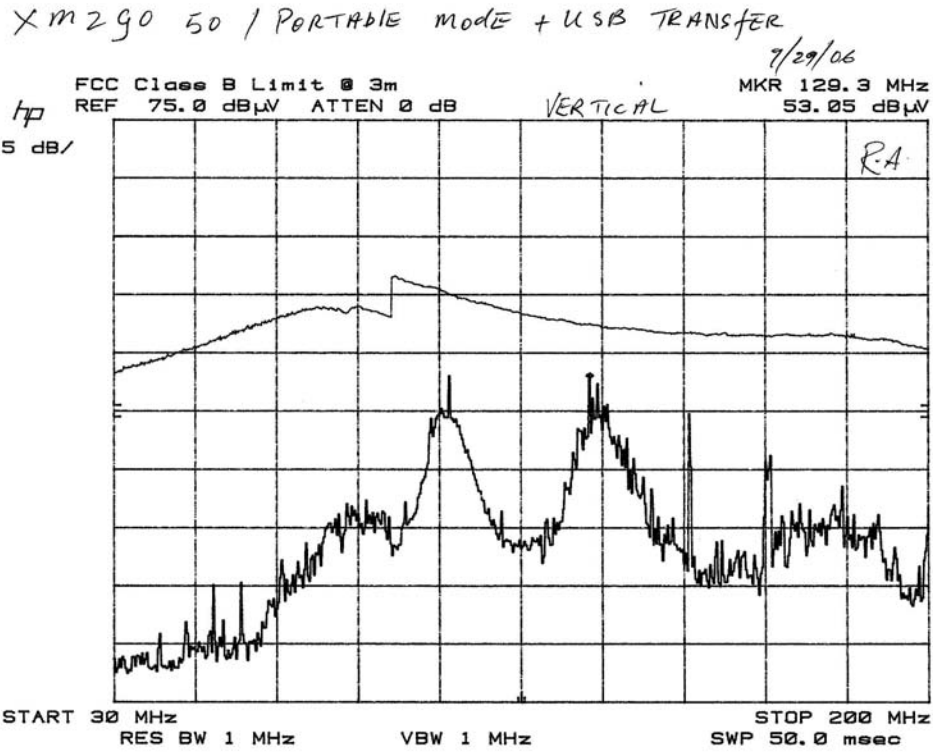


Figure 6 : Radiated Emissions – Portable Mode – 30MHz to 200MHz - Vertical

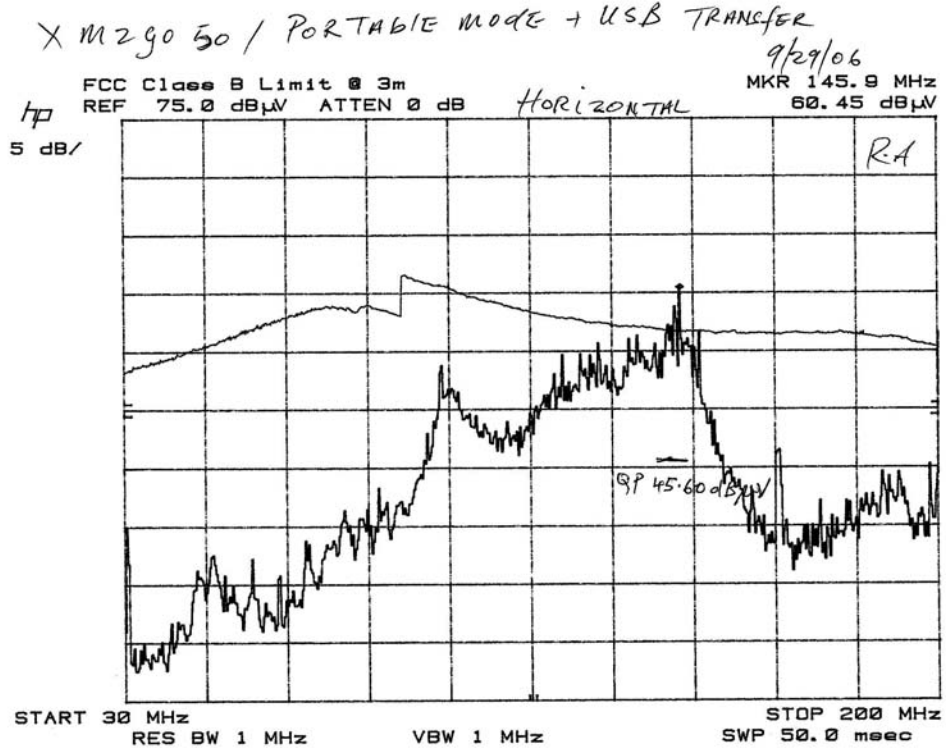


Figure7 : Radiated Emissions – Portable Mode – 30MHz to 200MHz - Horizontal

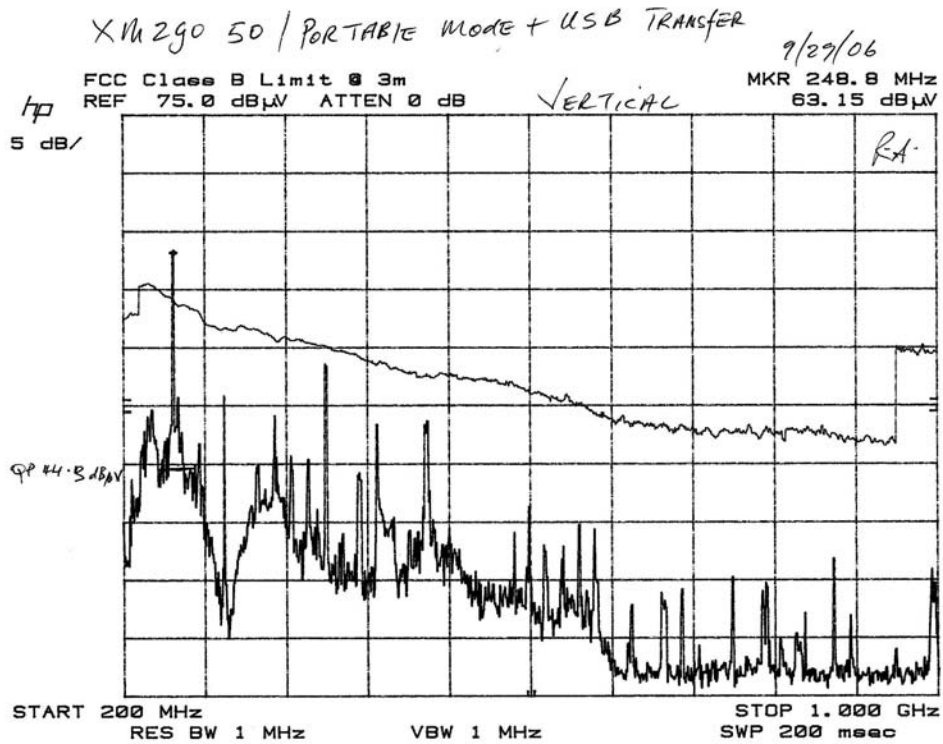


Figure 8 : Radiated Emissions – Portable Mode – 200MHz to 1GHz - Vertical

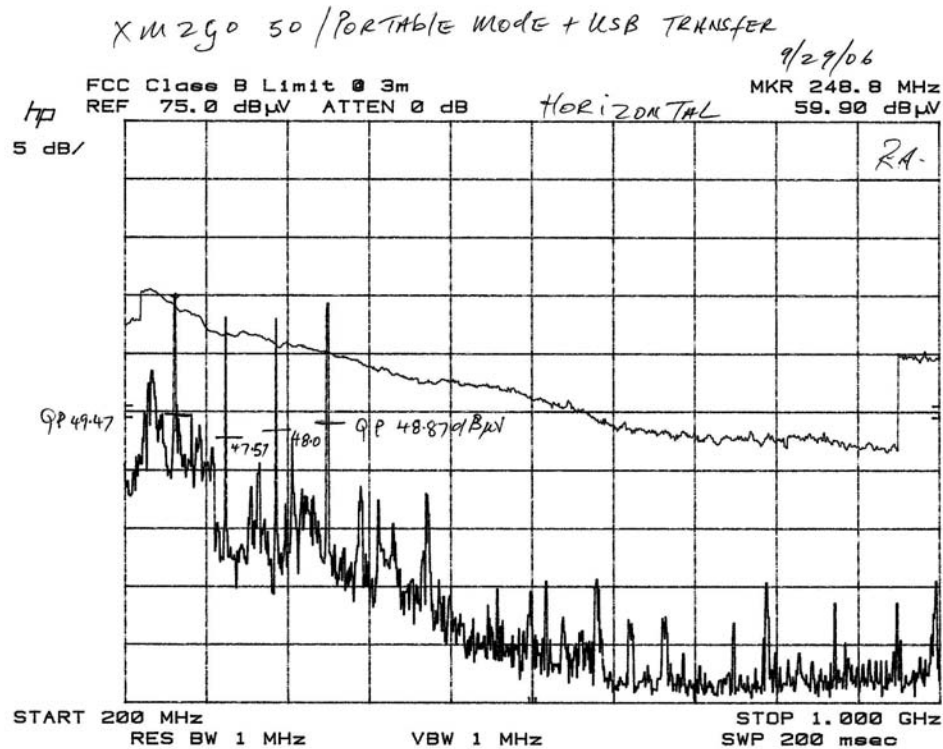


Figure 9 : Radiated Emissions – Portable Mode – 200MHz to 1GHz - Horizontal

Figure No.	Frequency (MHz)	Measured Peak (dB $\mu$ V)	Quasi Peak (dB $\mu$ V)	Correction Factor (dB)	Corrected Peak (dB $\mu$ V/m)	FCC Limit (dB $\mu$ V/m)	Margin (dB)
7	145.9	60.5	45.6	-14.0	31.6	43.5	11.9
8	248.8	63.2	44.3	-13.7	30.6	46.0	15.4
9	248.8	59.9	49.5	-13.7	35.8	46.0	10.2
9	324.1	57.5	47.6	-10.5	37.1	46.0	8.9
9	362.0	58.0	48.0	-9.9	38.1	46.0	7.9
9	400.0	59.3	48.9	-9.6	39.3	46.0	6.7

**Table 3 : Peak Measurement Results – Portable Mode Radiated Emissions**

## 4.5 TEST EQUIPMENT

### FAU EMI LAB – Equipment used for Radiated and Conducted Emissions

<b>FAU EMI R&amp;D LABORATORY TEST EQUIPMENT</b>						
<b>Equipment Type</b>	<b>Manufacturer</b>	<b>Description</b>	<b>Model</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Interval (Years)</b>
Spectrum Analyzer	Hewlett Packard	RF Section	8566B	2403A06381	Aug-22-06	2
Spectrum Analyzer	Hewlett Packard	Display	85662A	2407A06381	Aug-22-06	2
Spectrum Analyzer	Hewlett Packard	Quasi Peak Adapter	85650A	2430A00559	Aug-22-06	2
RF Preselector	Hewlett Packard	Preselector	85685A	2510A00151	Feb-8-06	2
LISN	EMCO	Line Impedance Stabilization Network	3825/2R	1095	Mar-10-06	2



## TEST FACILITY

FAU EMI Research and Development Laboratory  
Department of Electrical Engineering  
Florida Atlantic University  
Boca Raton, Florida 33431  
(561) 361-4390

A2LA Certificate Number: 2129.01  
FCC Registration: 90599  
Industry of Canada: IC46405-4076

<b>Description:</b>	The 3-m semi-anechoic chamber and Power Line Conducted Spurious Voltage test setup is constructed and calibrated to meet the FCC requirements of Section 2.948, as well as Industry Canada RSS 212 Issue 1.
<b>Site Filing:</b>	A site description is on file with the Federal Communications Commission, 7435 Oakland Mills Road, Columbia, MD 21046, and with the Industry Canada, Certification and Engineering Bureau, 3701 Carling Ave., Building 94, P.O. Box 11490, Station "H", Ottawa Ontario, K2H 8S2.
<b>Instrument Tolerance:</b>	All measuring equipment is in accordance with ANSI C63.4 and CISPR 22 requirements.

## End Report