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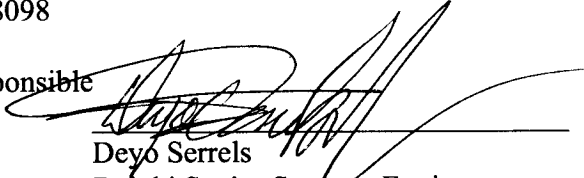
Technical Report No. 06-065

**“EMI Evaluation of the Delphi
XM Satellite Radio SkyFi3 Model SA10225 to FCC Class B
Conducted and Radiated Emission Requirements
And Intentional Radiator Requirements”**


Date Performed: 30 Aug 2006 –13 Sep 2006

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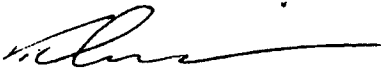
Company Official responsible
for product(s) tested:


Deyo Serrels
Delphi Senior Systems Engineer

Test Performed and
Reported By:


Raymond Aina, Test Engineer
FAU EMI R&D Laboratory

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Director, FAU EMI R&D Laboratory

Date of Test Report: 07 September 2006



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Table of Contents

1. Introduction	3
2. Objective	3
3. Conclusion	4
4. Test Procedure and Result	
4.1 General Test Procedures	5
4.2 Conducted Emissions 15.107(a)	5
4.3 Radiated Emissions 15.109(a)	8
4.4 Operation from 88 MHz to 107 MHz 15.239	21
4.5 Tabular Data (all plots)	28
4.6 Radiated Emissions on vehicle 15.239	30
4.7 Occupied Bandwidth 15.239(a)	35
4.8 Test Equipment	38

1. INTRODUCTION

The Delphi XM Satellite Radio, SkyFi3 Model SA10225 was evaluated for compliance to the FCC Part 15, Sections 15.107(a), 15.109(a) and 15.239(a), (b), (c) 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 Delphi and XM Satellite Radio, Inc., as reported in this document.

2. OBJECTIVE

Test Specifications

This evaluation was performed to verify conformance of the Delphi XM Satellite Radio, Inc. SkyFi3 receiver to U.S. Federal Communications Commission (FCC) Code of Federal Regulations (CFR), Title 47 - Telecommunication, Part 15 - Radio Frequency Devices,

- Subpart B - Unintentional Radiators, Section 15.107(a) Conducted limits, and Section 15.109(a) Radiated Class B Emission limits.
- Subpart C – Paragraph 15.239 (a), (b), (c) – Operation in the band 88 MHz to 108 MHz

Mode of Operation

- During FCC Part 15 Subpart B, Paragraph 15.107(a) conducted emission test, the EUT was configured to receive an XM Satellite Radio signal, with the EUT in the SkyFi3 home cradle with the XM home AC adaptor.
- During FCC Part 15 Subpart C, Paragraphs 15.239 (b), (c) radiated emissions tests, the EUT was configured to transmit a continuous FM signal with normal modulation at 88.1 MHz, 96.9 MHz and 107.1 MHz using the XM Satellite Radio's FM Coupler attached to a standard FM aerial antenna attached to a large ground plane.
- During FCC Part 15 Subpart B, Paragraph 15.109(a), the EUT was configured to receive an XM Satellite Radio signal, with the EUT in three different modes:
 - In a SkyFi3 car cradle, using only an XM Satellite Radio car antenna.
 - In a SkyFi3 car cradle, using an FM Direct Adaptor and car antenna.
 - In a SkyFi3 home cradle, using only an XM Satellite Radio home antenna.
- During FCC Part 15 Subpart B, Paragraph 15.109(a), the EUT was operated as a playback device in the following configurations:
 - In a SkyFi3 Car Cradle, the product was operating as a 'playback' device utilizing musical data stored on external (micro SD) memory.
 - In a SkyFi3 Car Cradle, the product was operating as a 'playback' device utilizing musical data stored on internal flash memory.
 - In a SkyFi3 Home Cradle, the product was operating as a 'playback' device utilizing musical data stored on external (micro SD) memory.
 - In a SkyFi3 Home Cradle, the product was operating as a 'playback' device utilizing musical data stored on internal flash memory.

- Receiver as a stand alone playback device operating from internal battery.
- During FCC Part 15 Subpart B, Paragraph 15.109(a), the EUT was tested for performance while in these data transfer configurations:
 - As a stand alone product uploading/downloading data thru the USB port using the internal battery
- During FCC Part 15 Subpart B, Paragraph 15.109(a), the EUT was tested for performance in these other configurations:
 - In a SkyFi3 Car Cradle, the product was operating in AUX mode
 - In a SkyFi3 Home Cradle, the product was operating in AUX mode
- During FCC Part 15 Subpart B, Paragraph 15.109(a), the EUT was tested for performance in these other configurations:
 - In a ‘semi-portable mode’ Car Cradle, the product was operating in playback mode.
- During FCC Part 15 Subpart C, Paragraphs 15.239(b), (c), the EUT was also configured to transmit a continuous FM signal with normal modulation at 88.7 MHz, 96.9 MHz and 107.1 MHz in three representative vehicles, using the XM Satellite Radio’s FM Coupler attached to the vehicle’s in-glass FM antennas, in accordance with the intentional radiator limits described in 15.239(b).

3. CONCLUSION

The Delphi XM Satellite Radio SkyFi3 Model SA10255 met the FCC Class B conducted and radiated emission requirements, as well as the intentional radiation limits, as described in the following pages.

4. TEST PROCEDURES AND RESULTS

4.1 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.

4.2 CONDUCTED EMISSIONS – Section 15.107(a)

4.2.1 Test Setup – Conducted Emissions

The Delphi XM Satellite Radio SkyFi3, Model SA10255, was powered by an I.T.E Power Supply, Model No. SMPS5V2A-XMRT. The 120 VAC/ 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 Ω , 50 μ 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. HP 85864B software was utilized with two sweeps in conjunction with HP 85685A preselector during the measurements.

4.2.2 Test Data – Conducted Emissions

The EUT was tested for the peak-detected emissions on phase and neutral lines while the SkyFi3 unit was in the home cradle and receiving a live XM broadcast.

PLOT 2

Delphi XM SkyFi3

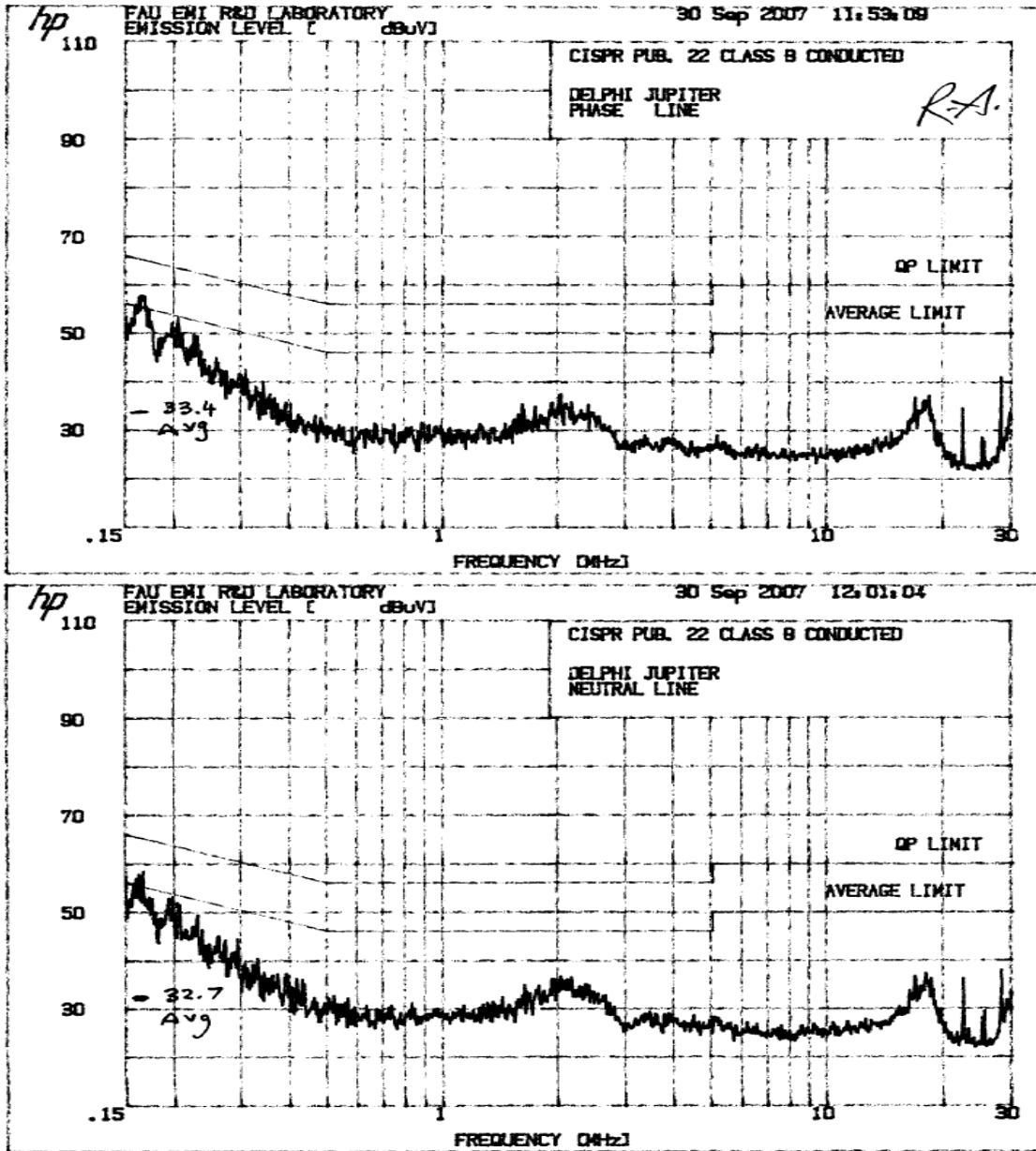


FIGURE 1: Phase and Neutral Conducted Emissions 150 kHz-30 MHz

The average measurement technique was applied at 162 kHz and the results were 33.4 dBμV and 32.7 dBμV for phase and neutral emissions, which were below the average limits.

4.3 RADIATED EMISSIONS – Section 15.109(a)

4.3.1 General Test Setup

The Delphi XM Satellite Radio SkyFi3 Model SA10255 was set up on a wooden table 80 centimeters above the ground plane turntable of the FAU Semi-Anechoic test room.

An EMCO 3104 Broadband bi-conical 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 SkyFi3 unit was tested in multiple configurations under Section 15.109(a). SkyFi3 was configured in home/car cradle with battery powered speakers, line-in was terminated with an un-powered iPod device, stand alone utilizing internal battery and in a semi-stand alone mode with powered using a cigarette lighter adapter (CLA) adapter and with headphones plugged into the receiver .

- Home Cradle using home antenna
 - Live XM signal
- Home Cradle receiver in pass thru (AUX)
 - Aux Input
- Home Cradle receiver in playback
 - Playback External Memory
 - Playback Internal Memory
- Car Cradle using XM antenna only (FM OFF)
- Car Cradle receiver in playback
 - Playback Internal Memory
 - Playback External Memory
- Stand alone (Portable mode- play back mode) internal battery
- Semi portable mode with CLA power
- Stand alone receiving data via USB powered with internal battery
- Stand alone transmitting data via USB powered with internal battery
- Car Cradle using XM car antenna coupling to FM aerial antenna

4.3.2 Radiated Emissions - Home Cradle

4.3.2.1 Test Setup – Home Cradle

In the home cradle setup, the EUT was placed in the SkyFi3 home cradle, with an XM home antenna and XM 5V AC (ITE) power adaptor. External speakers were connected to the audio output connector on the home cradle with the unit receiving a live XM broadcast signal.

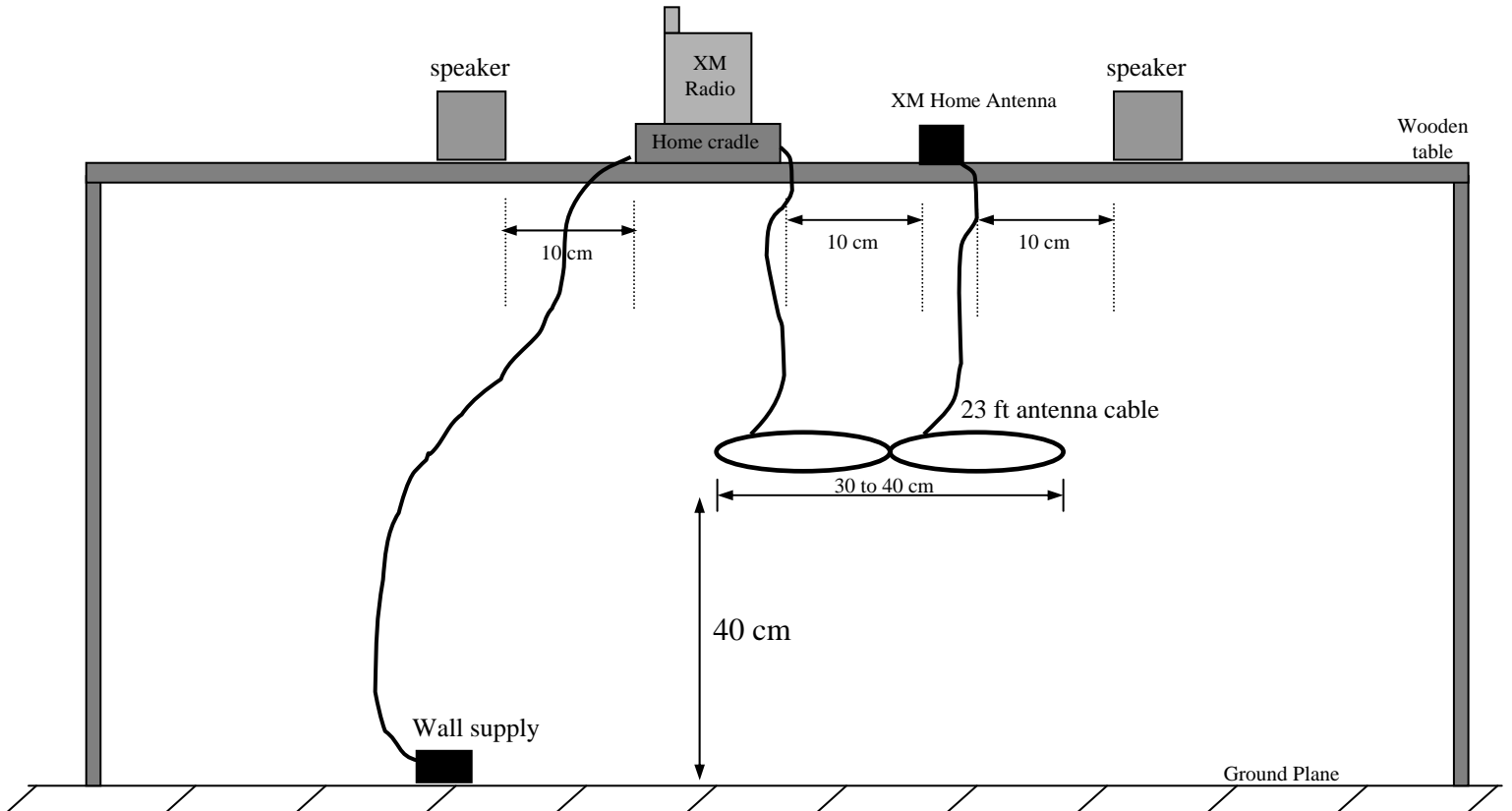
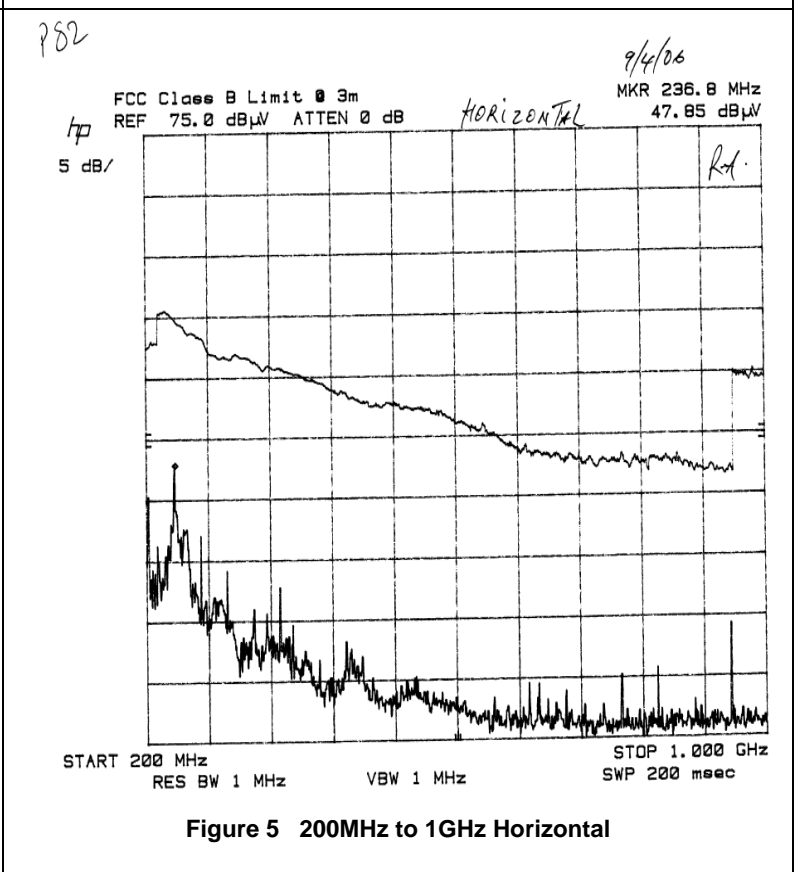
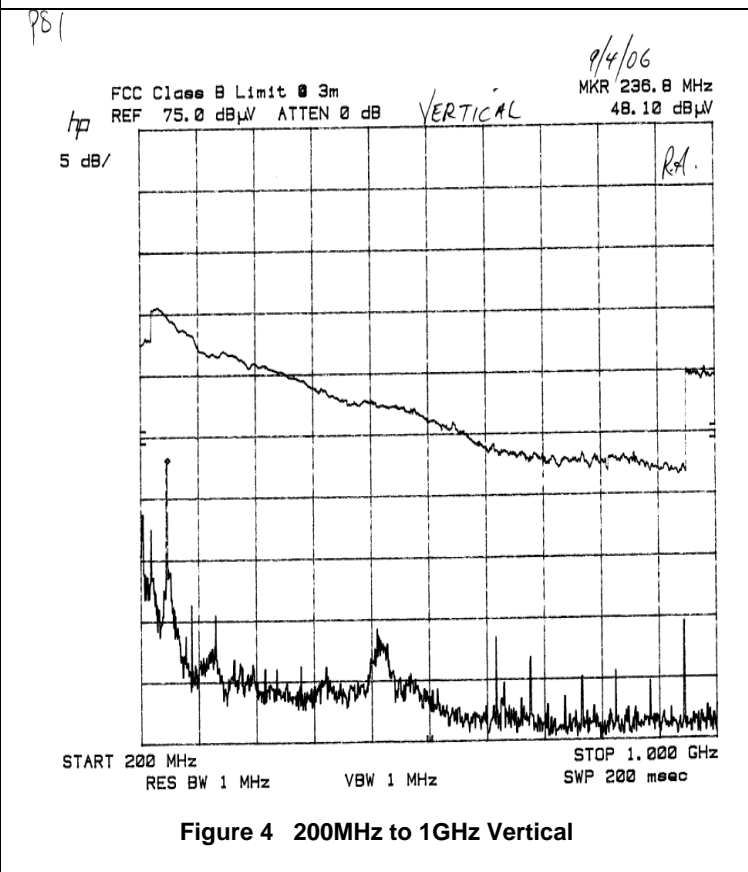
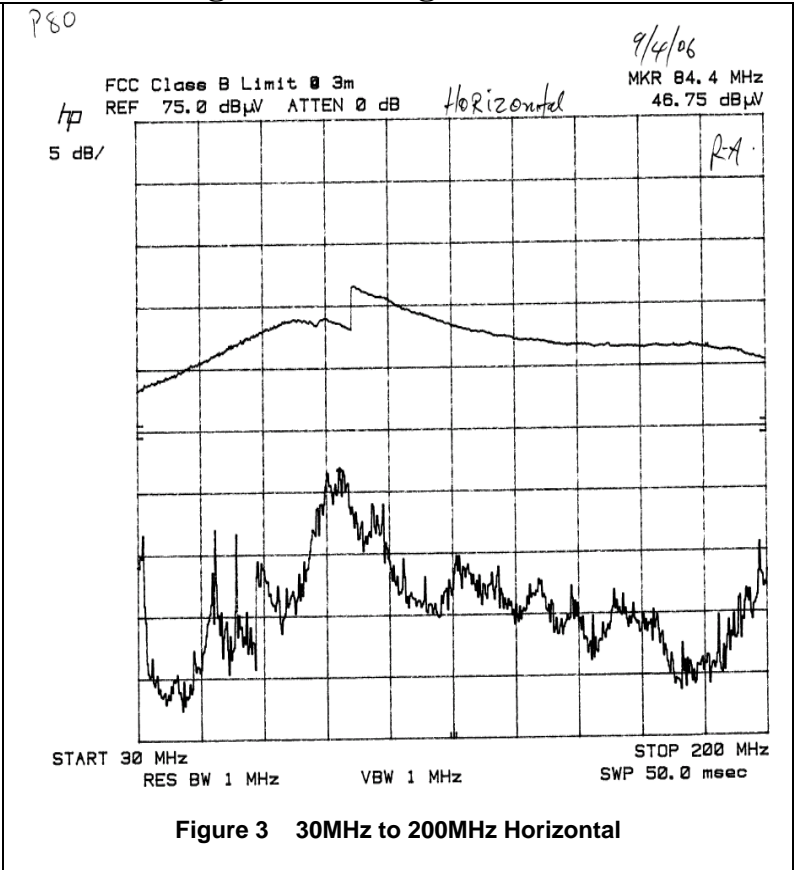
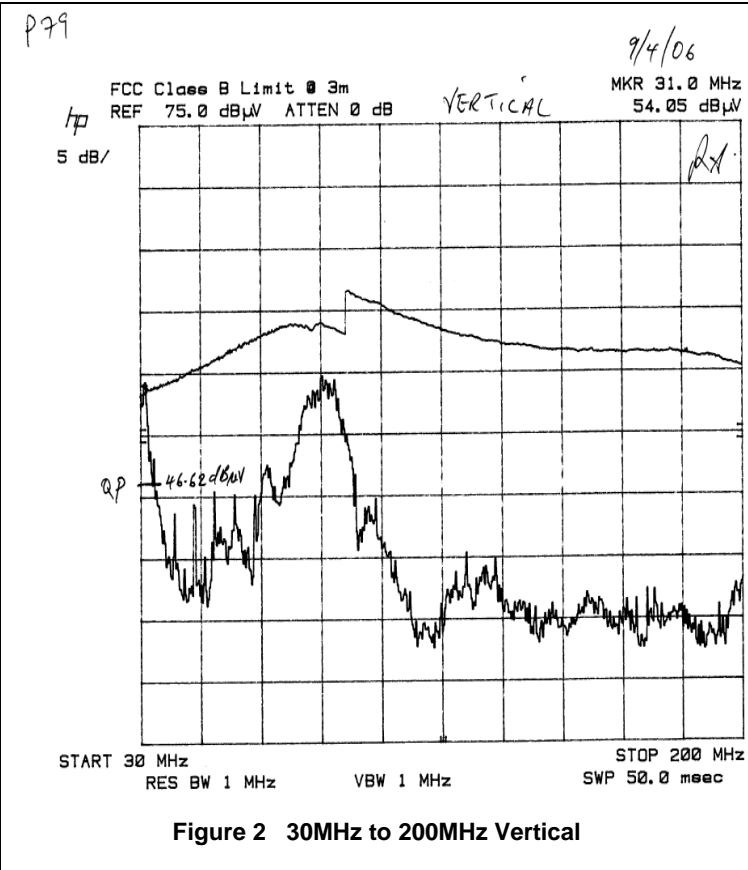


Diagram 1: Home Cradle Radiated Emissions Setup

4.3.2.2 Test Data – Home Cradle

4.3.2.2.1 Receiver Home Cradle and Receiving Live XM Signal



4.3.2.2.2 Receiver Home Cradle Aux In

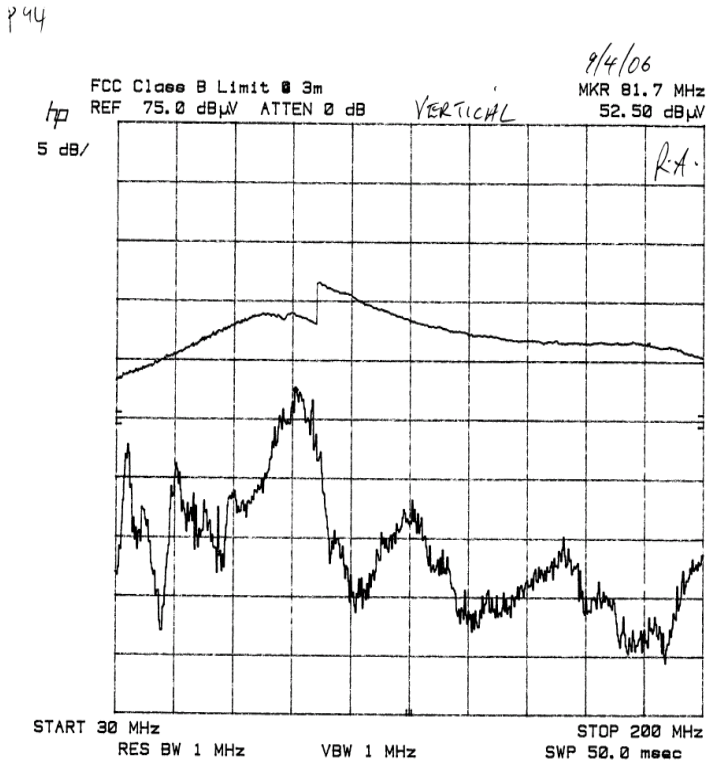


Figure6 30MHz to 200MHz Vertical

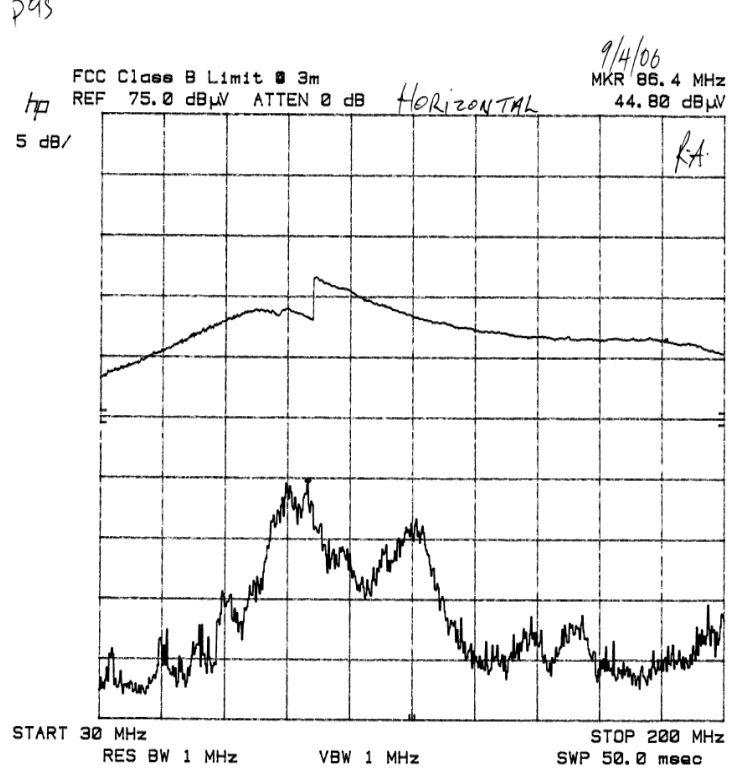


Figure 7 30MHz to 200MHz Horizontal

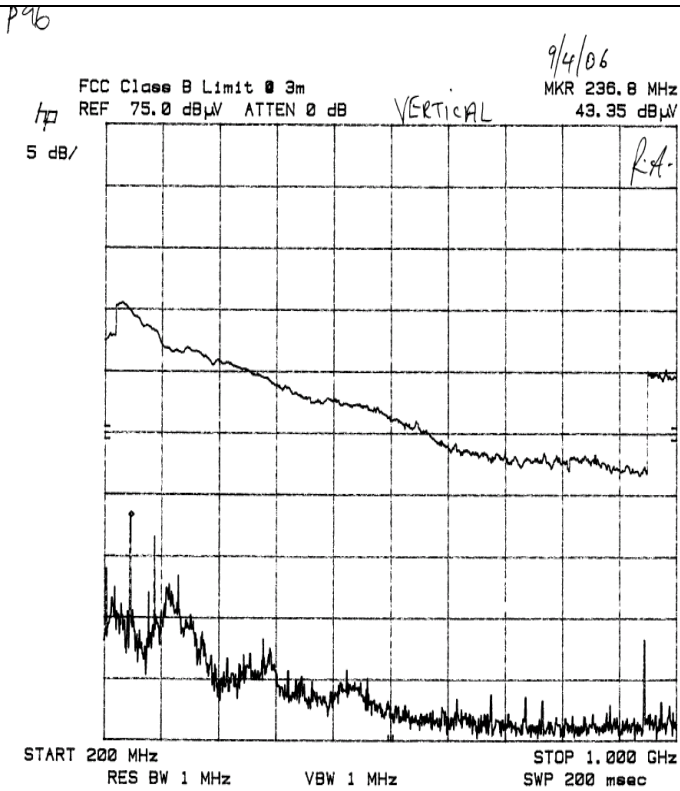


Figure 8 200MHz to 1GHz Vertical

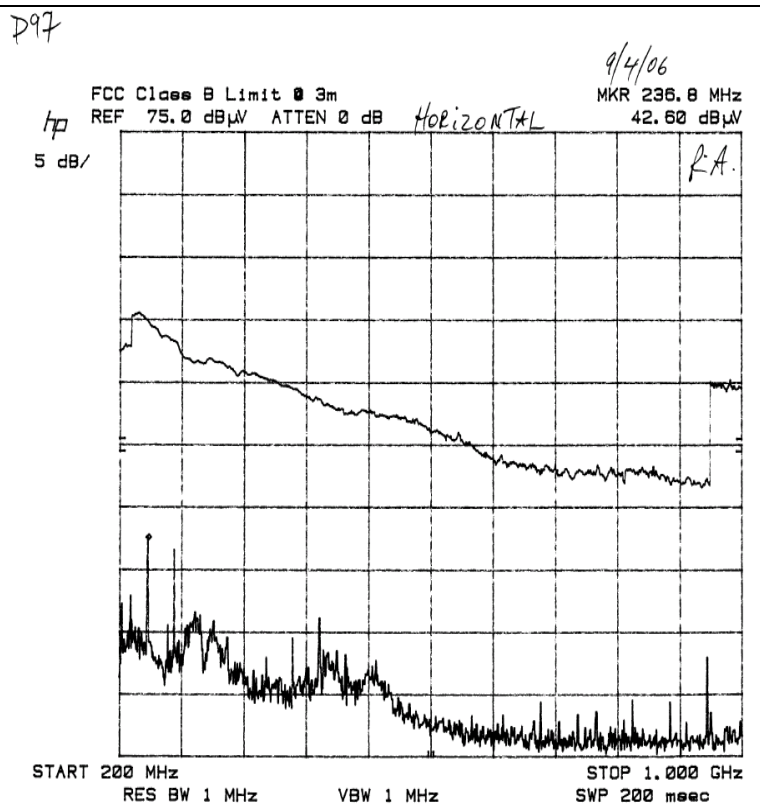
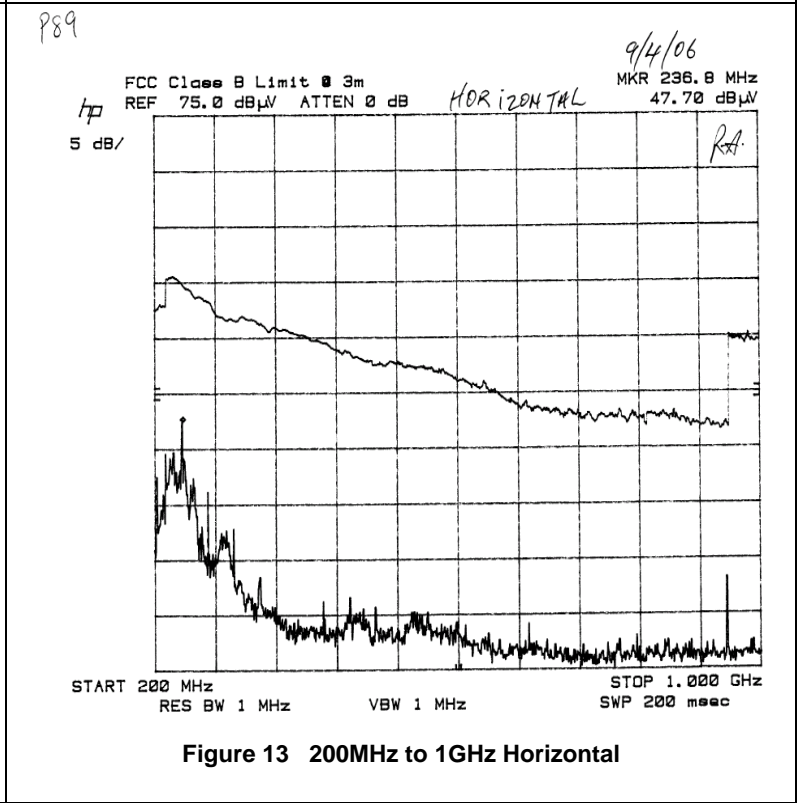
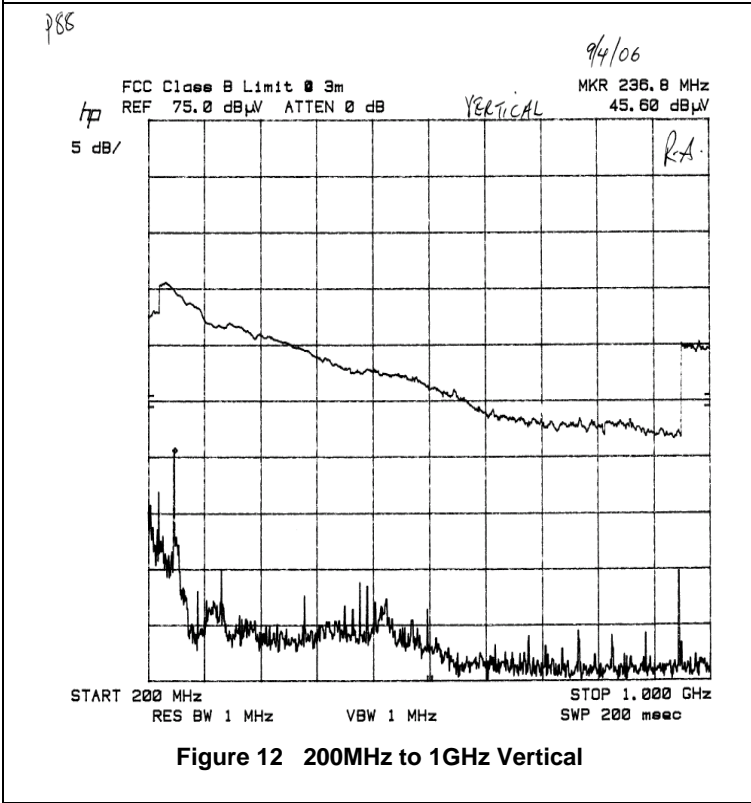
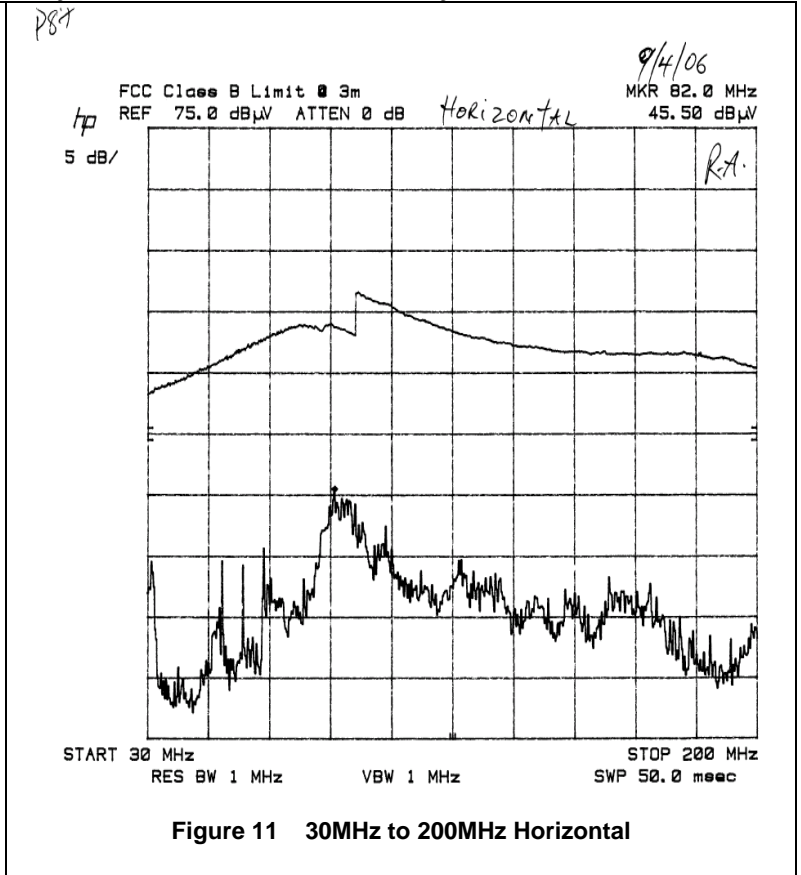
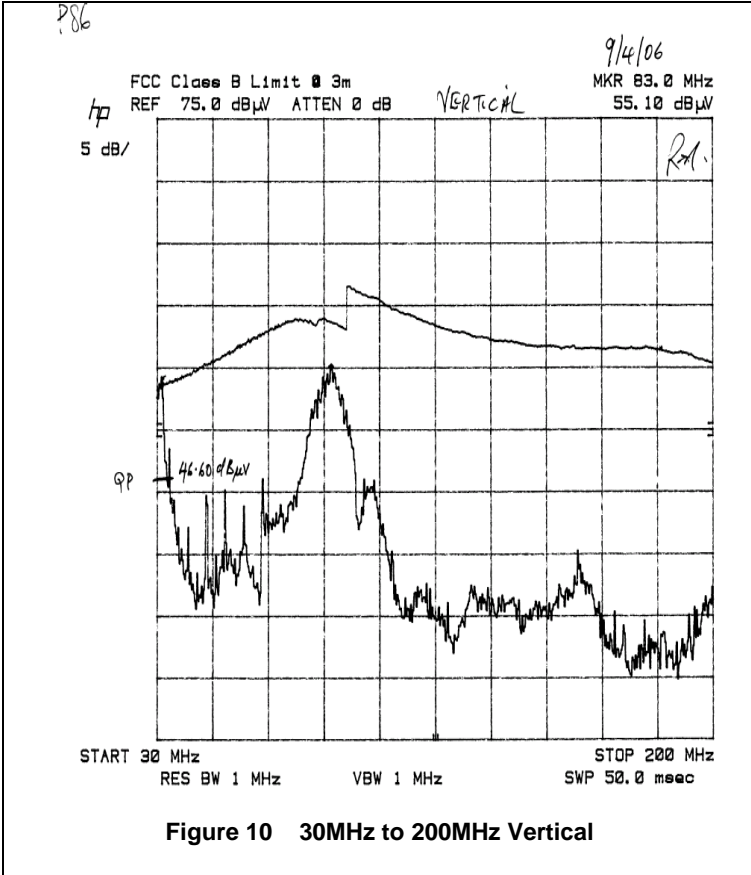


Figure 9 200MHz to 1GHz Horizontal

4.3.2.2.3 Receiver Home Cradle Playback (External Memory)



4.3.2.2.4 Receiver Home Cradle Playback (Internal Memory)

P90

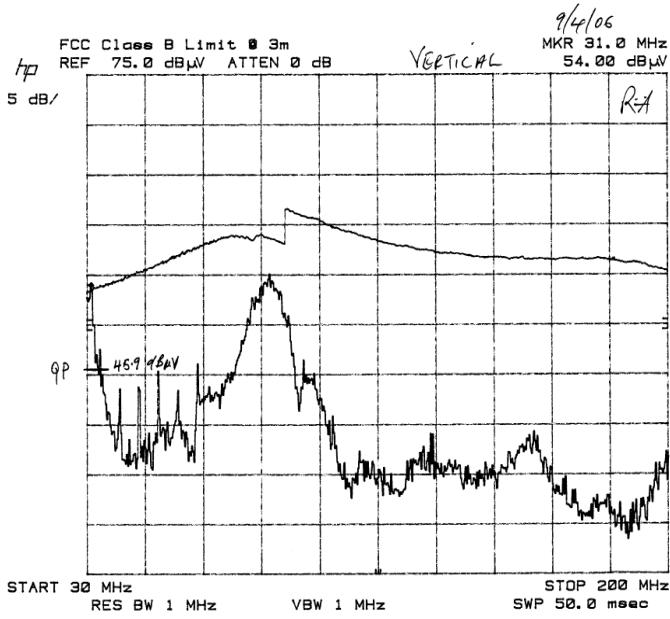


Figure 14 30MHz to 200MHz Vertical

P91

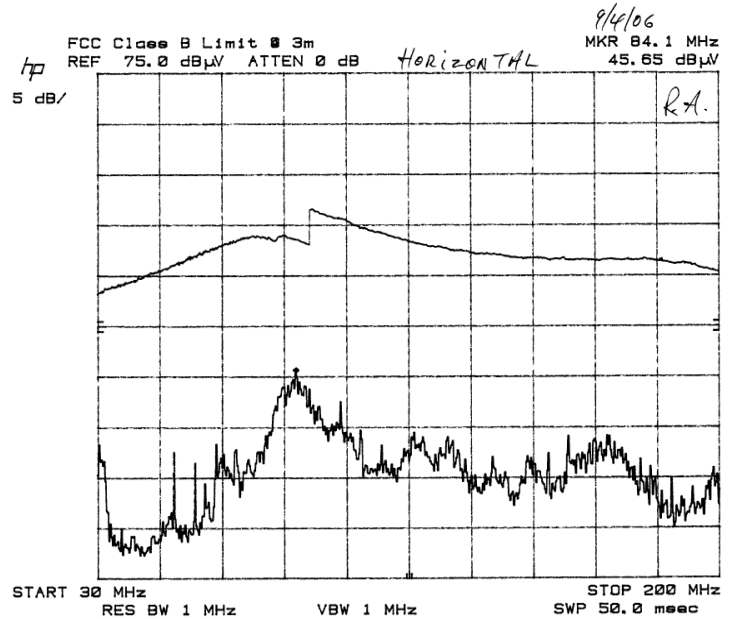


Figure 15 30MHz to 200MHz Horizontal

P92

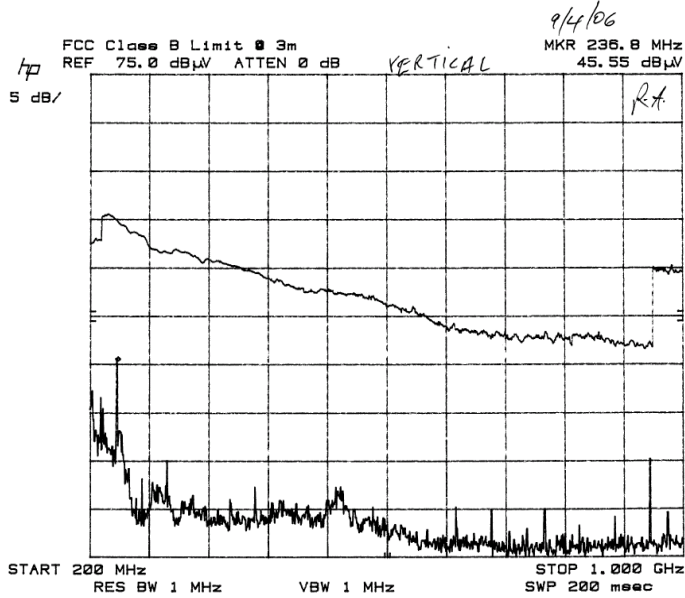


Figure 16 200MHz to 1GHz Vertical

P93

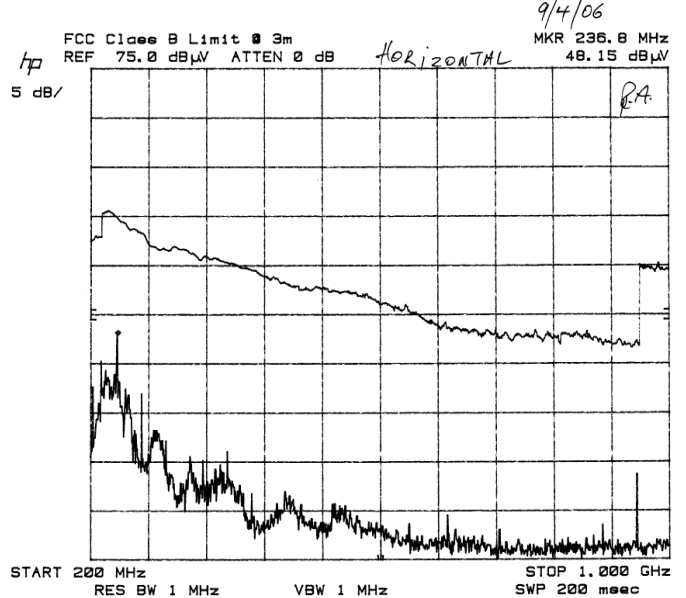


Figure 17 200MHz to 1GHz Horizontal

4.3.2.3 Test Data – Car Cradle

4.3.2.3.1 Car Cradle FM Off

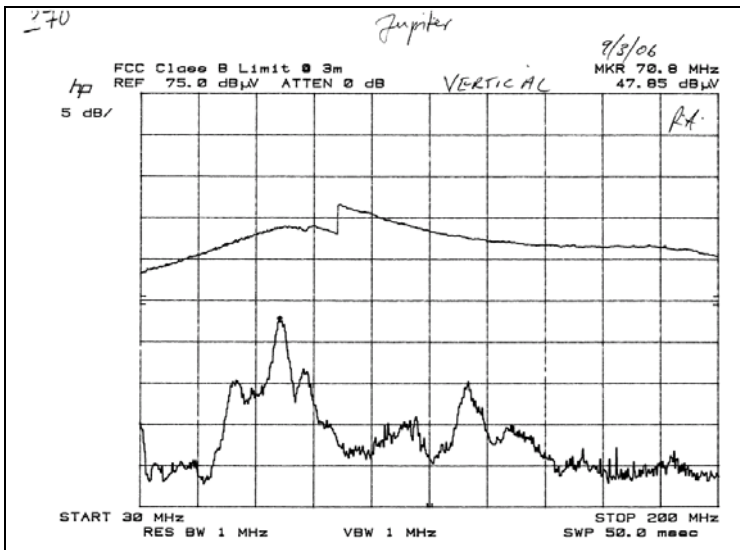


Figure 18 30MHz to 200MHz Vertical

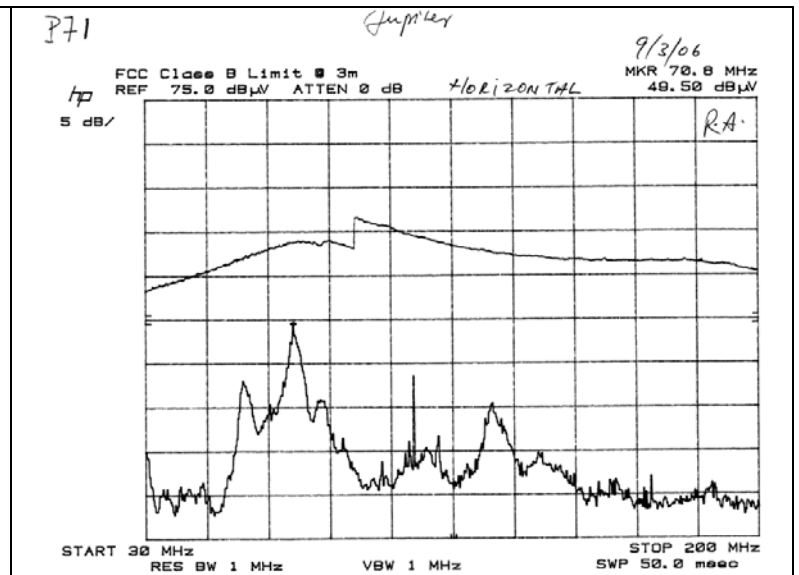


Figure 19 30MHz to 200MHz Horizontal

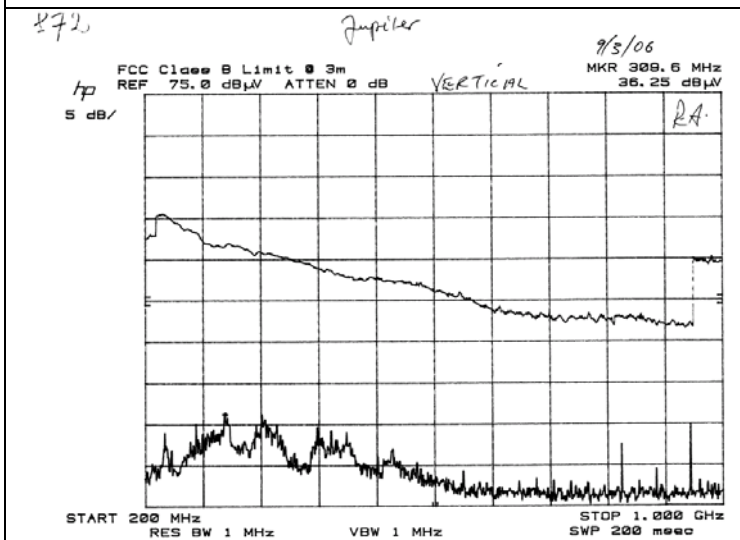


Figure 20 200MHz to 1GHz Vertical

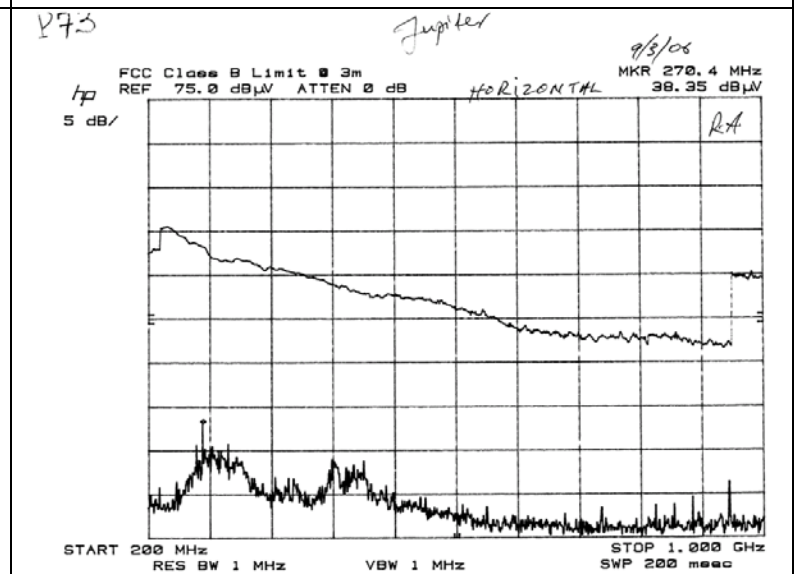


Figure 21 200MHz to 1GHz Horizontal

4.3.2.3.2 Car Cradle Playback (Internal Memory)

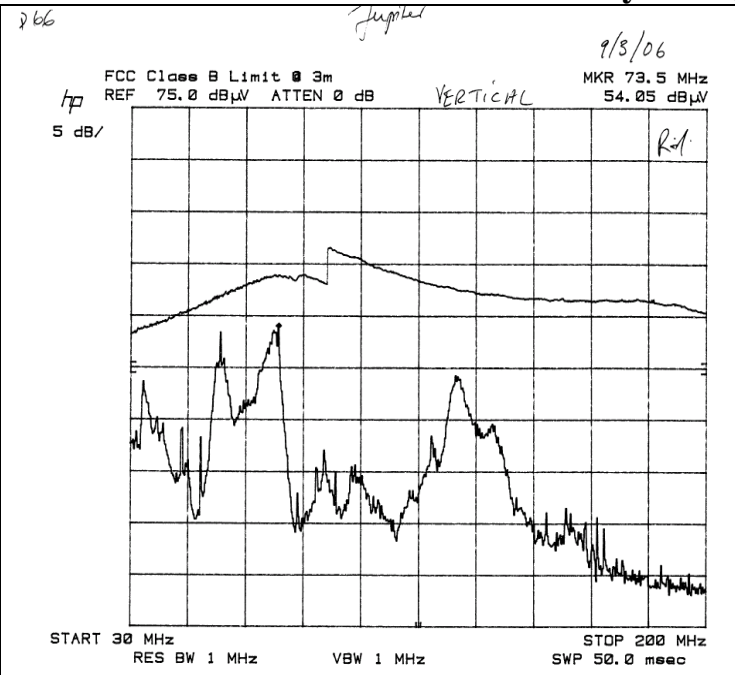


Figure 22 30MHz to 200MHz Vertical

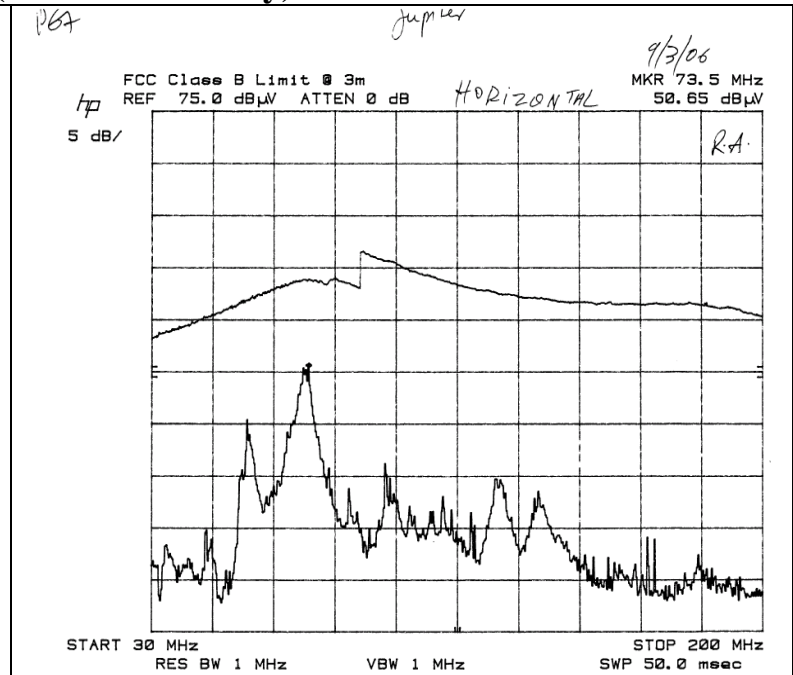


Figure 23 30MHz to 200MHz Horizontal

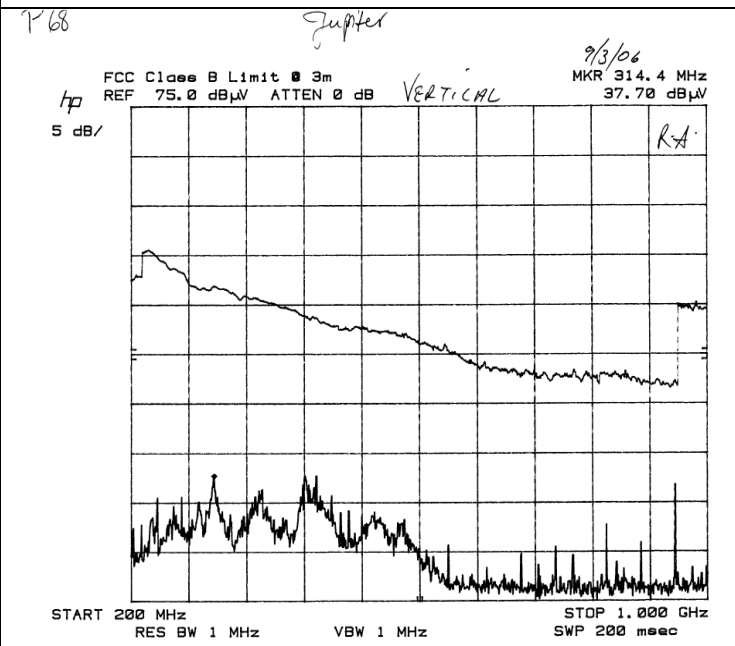


Figure 24 200MHz to 1GHz Vertical

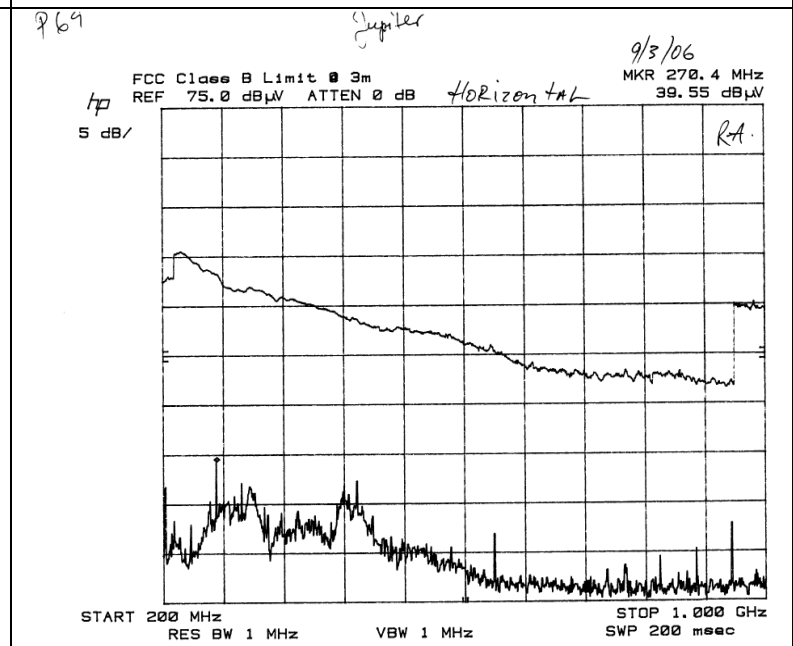


Figure 25 200MHz to 1GHz Horizontal

4.3.2.3.3 Car Cradle Playback (External Memory)

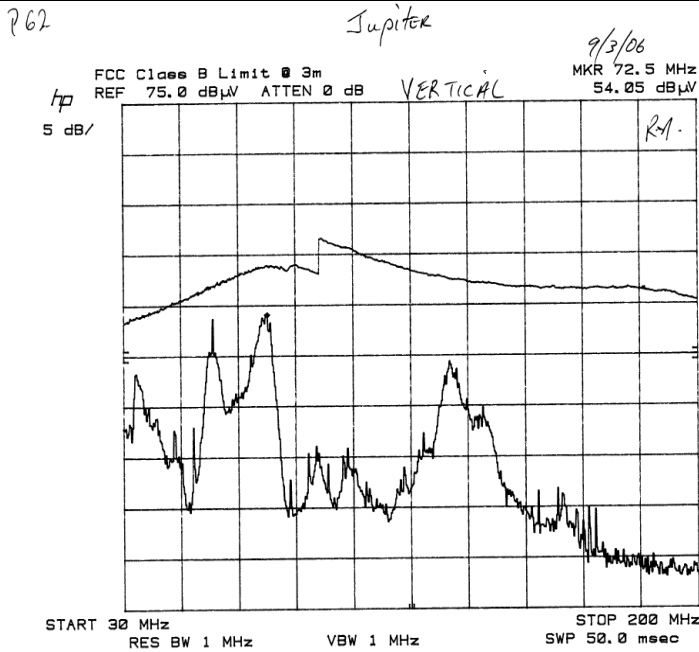


Figure 26 30MHz to 200MHz Vertical

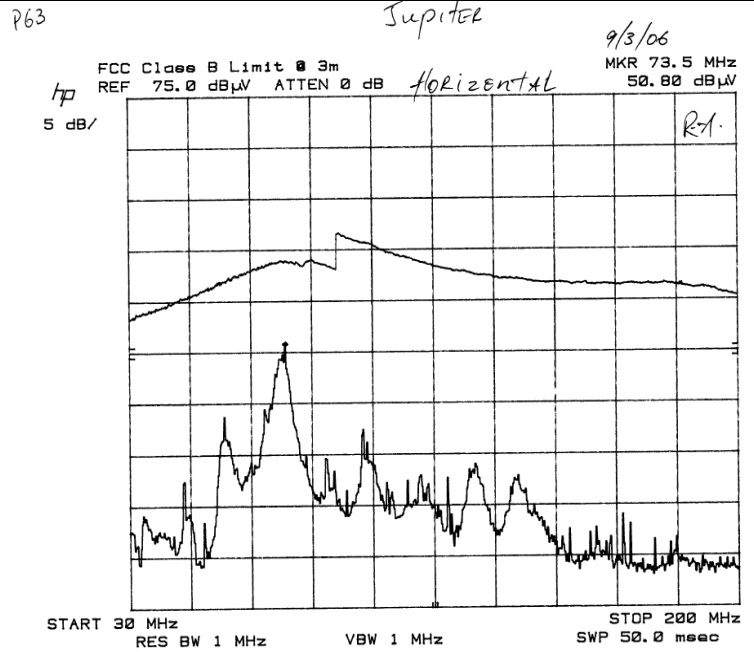


Figure 27 30MHz to 200MHz Horizontal

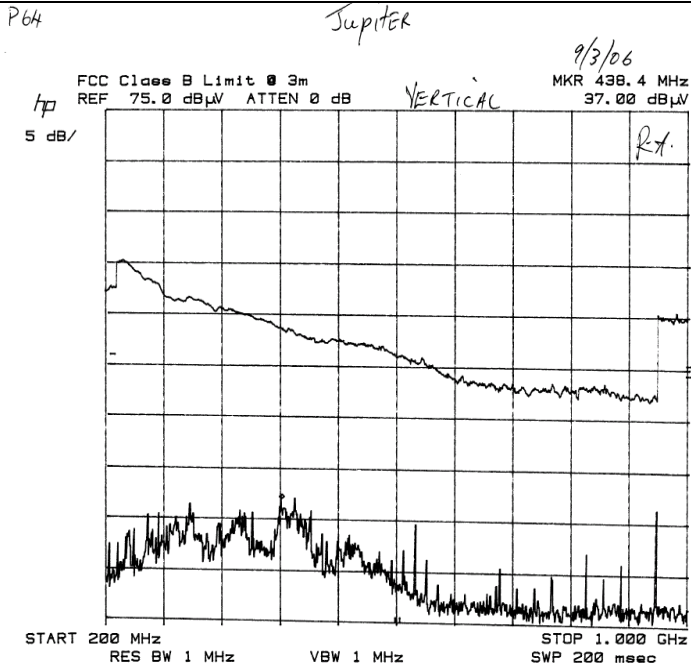


Figure 28 200MHz to 1GHz Vertical

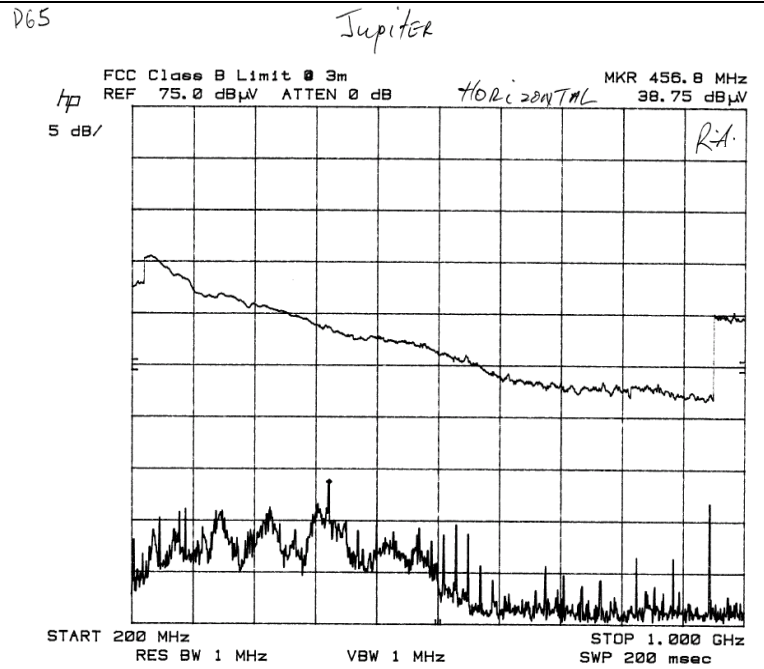


Figure 29 200MHz to 1GHz Horizontal