4.3.2.6 Radiated Emissions - FM Direct Adapter

4.3.2.6.1 Test Setup – FM Direct Adapter

In the FM Direct Adaptor setup, the EUT was placed in the SkyFi3 car cradle, with an XM FM Direct Adapter, XM car antenna and XM 5V cigarette adaptor (ITE) power supply. The FM Direct Adapter FM OUT cable was terminated with 75 ohms to simulate an FM radio's FM input jack. The FM Direct Adaptor FM IN cable was attached to an FM aerial antenna on a ground plane to simulate a vehicle's FM antenna. The ground plane is connected to the negative supply of the vehicle battery.

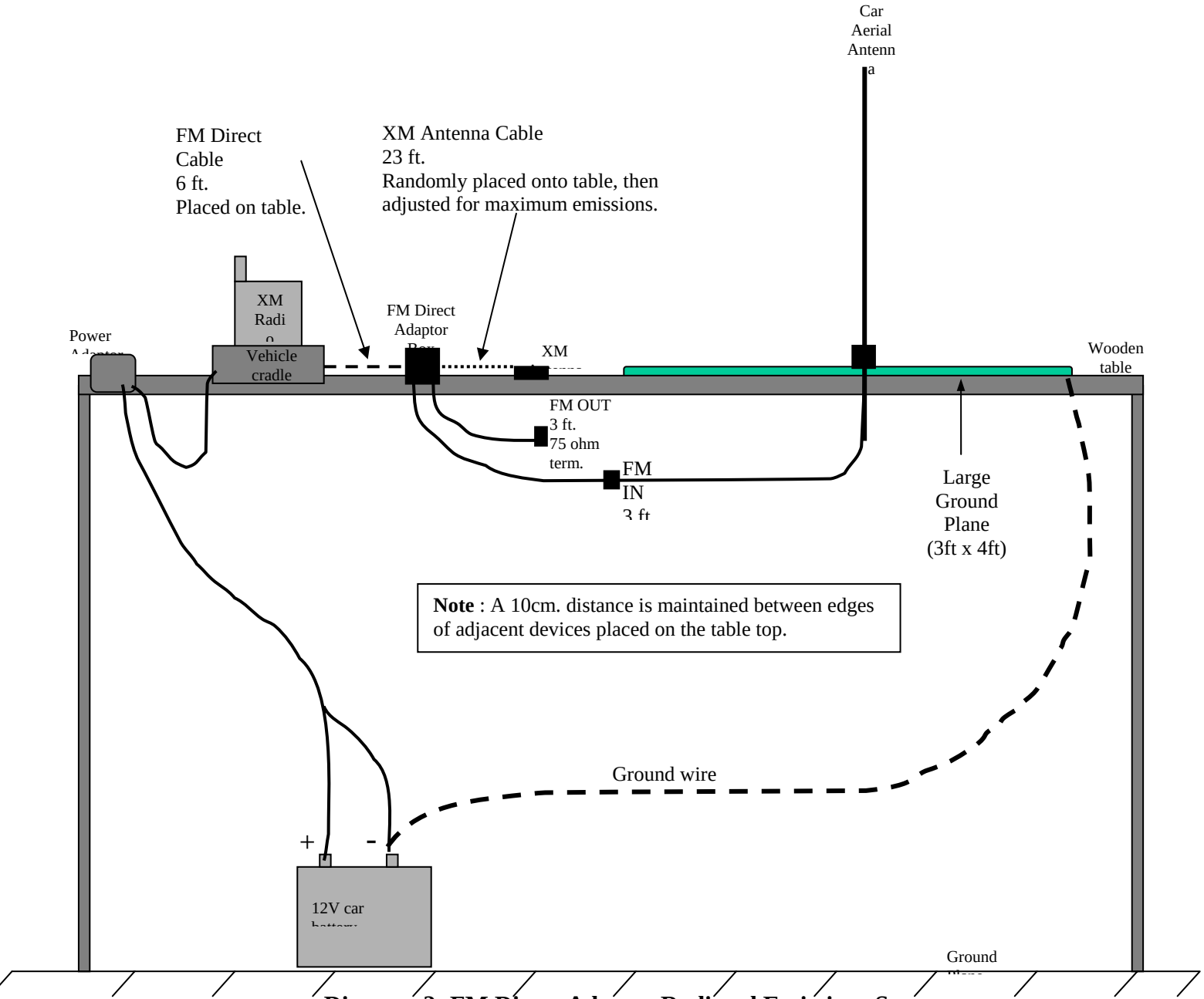


Diagram 2: FM Direct Adapter Radiated Emissions Setup

4.3.2.6.2 Test Data – FM Direct Adapter

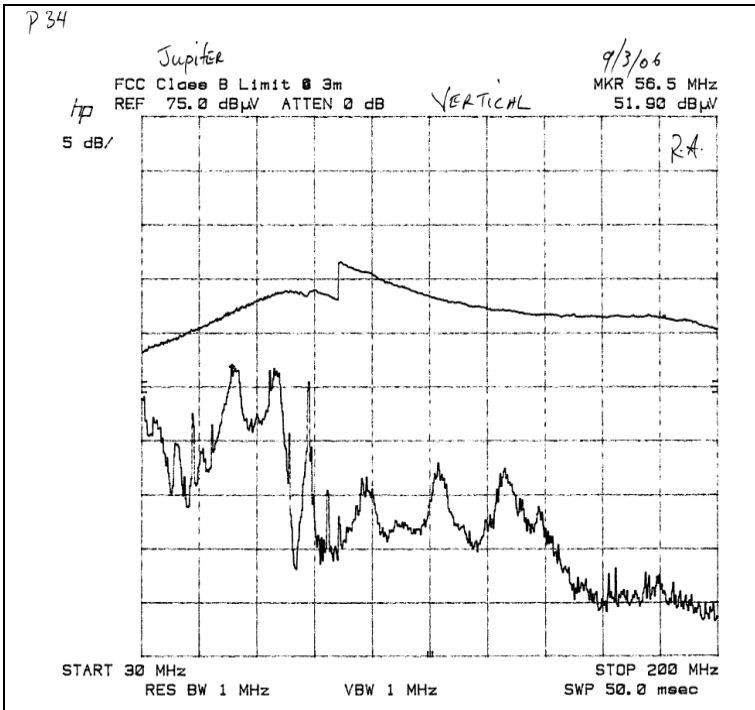


Figure 46 30MHz to 200MHz Vertical (FM programmed to 88.1MHz)

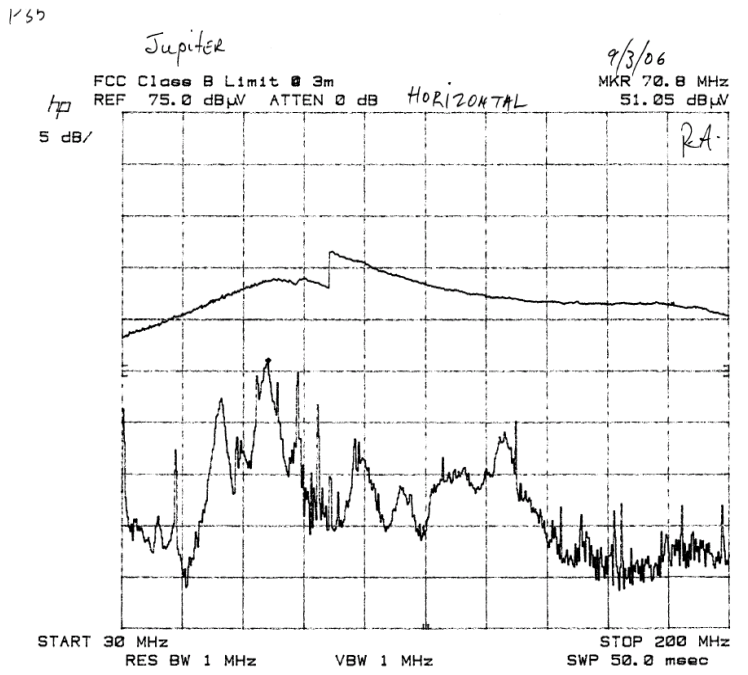


Figure 47 30MHz to 200MHz Horizontal (FM programmed to 88.1MHz

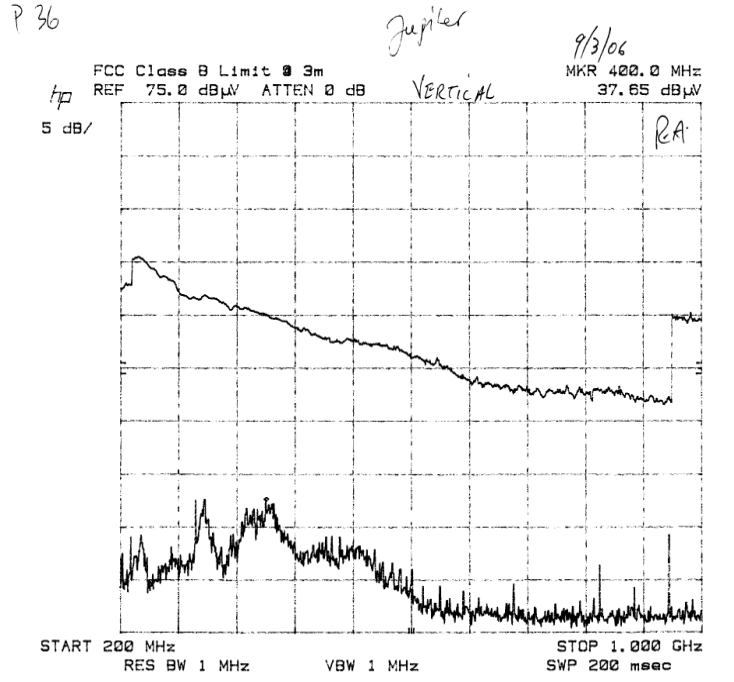


Figure 48 200MHz to 1GHz Vertical (FM programmed to 88.1MHz)

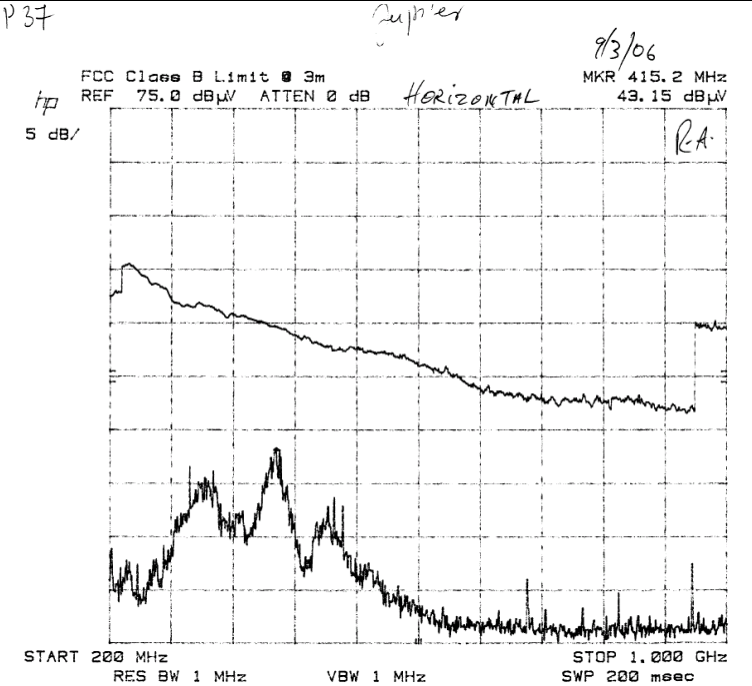


Figure 49 200MHz to 1GHz Horizontal (FM programmed to 88.1MHz)

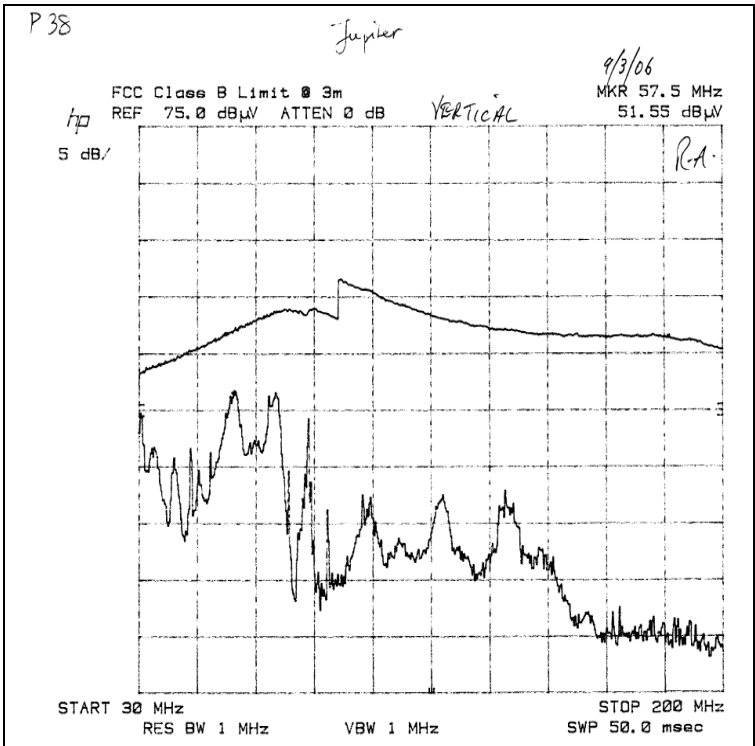


Figure 50 30MHz to 200MHz Vertical (FM programmed to 96.9MHz)

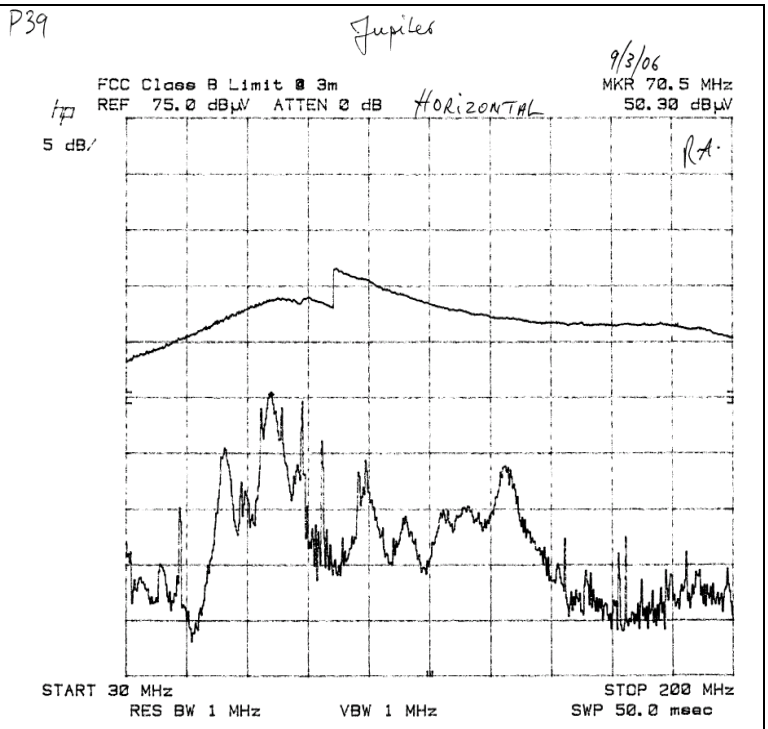


Figure 51 30MHz to 200MHz Horizontal (FM programmed to 96.9MHz

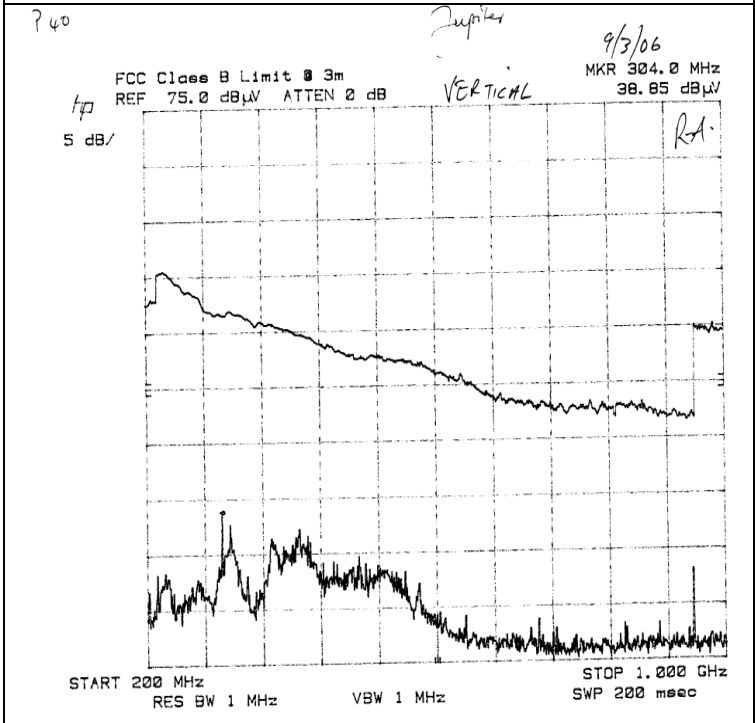


Figure 52 200MHz to 1GHz Vertical (FM programmed to 96.9MHz)

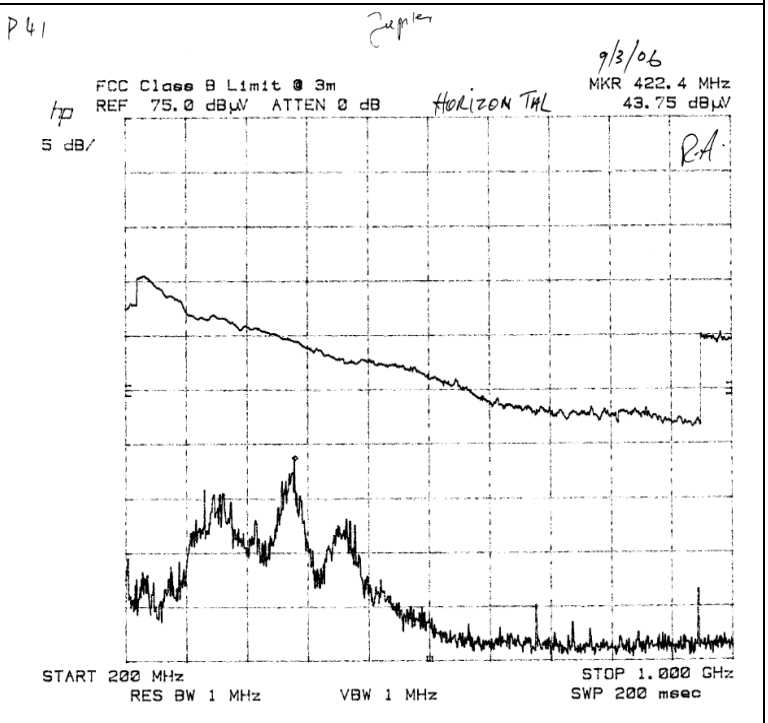


Figure 53 200MHz to 1GHz Horizontal (FM programmed to 96.9MHz)

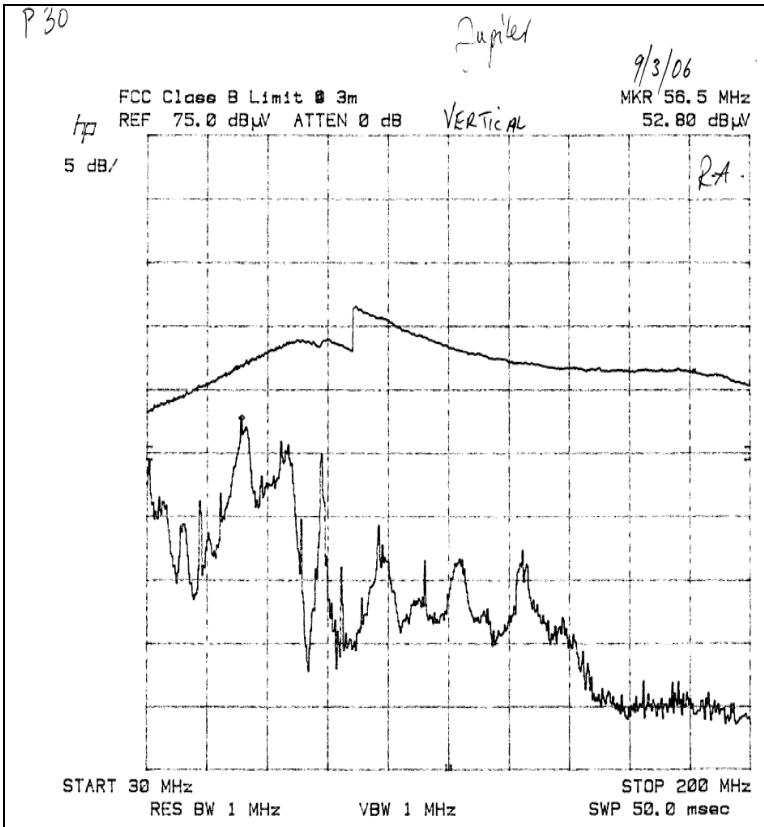


Figure 54 30MHz to 200MHz Vertical (FM programmed to 107.9MHz)

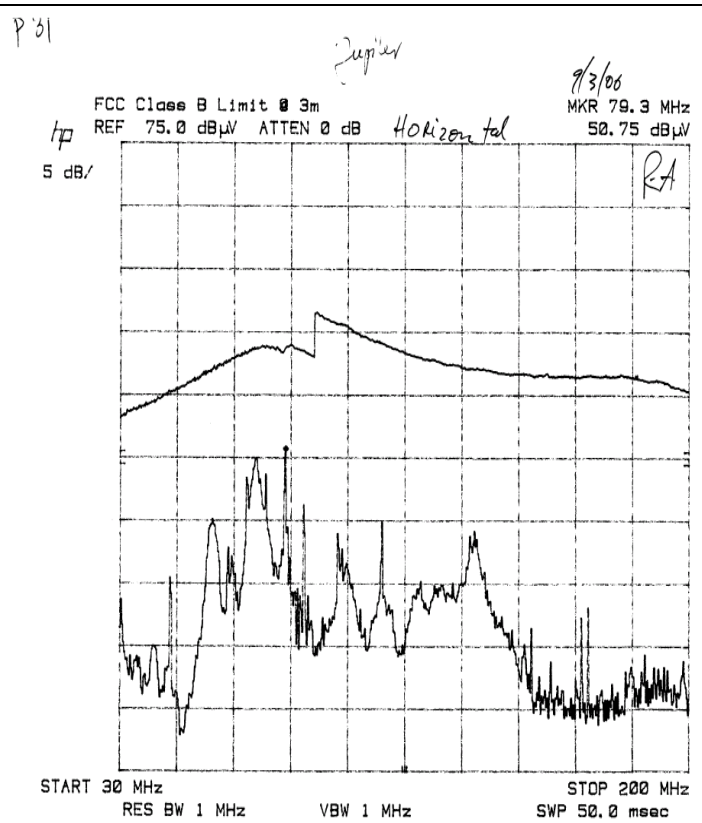


Figure 55 30MHz to 200MHz Horizontal (FM programmed to 107.9MHz)

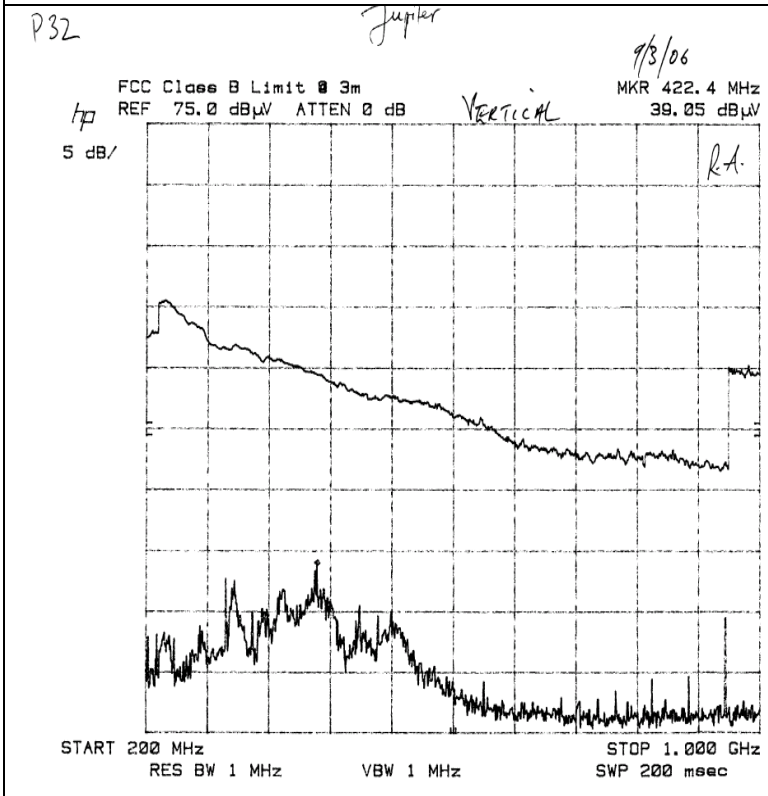


Figure 56 200MHz to 1GHz Vertical (FM programmed to 107.9MHz

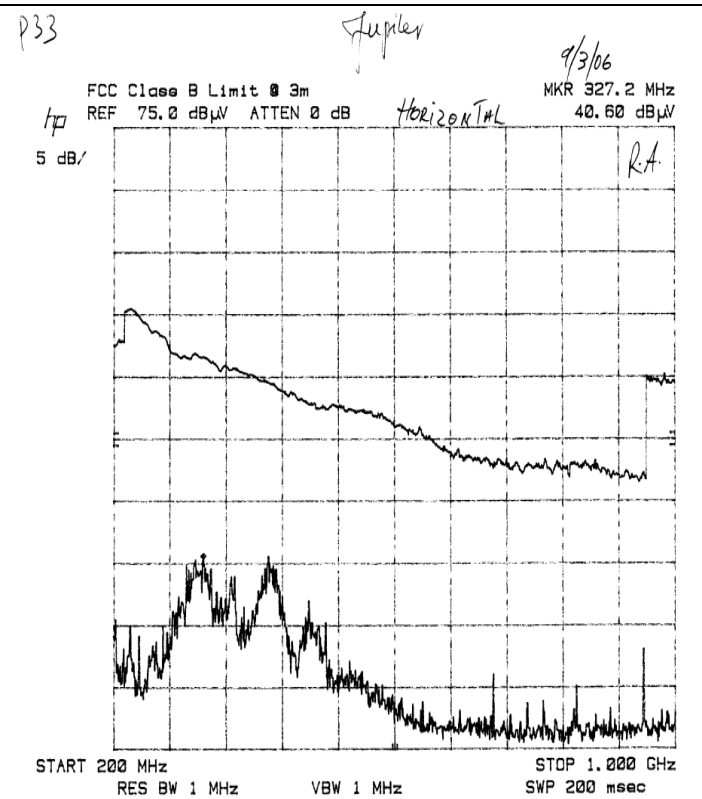


Figure 57 200MHz to 1GHz Horizontal (FM programmed to 107.9MHz)

4.3.2.7 Radiated Emissions – Car Cradle and XM Antenna only

4.3.2.7.1 Test Setup – Car Cradle and XM Antenna only

In this test setup, the EUT was placed into a SkyFi3 car cradle with an XM antenna and 5V Cigarette adaptor (CLA) power supply connected to the radio.

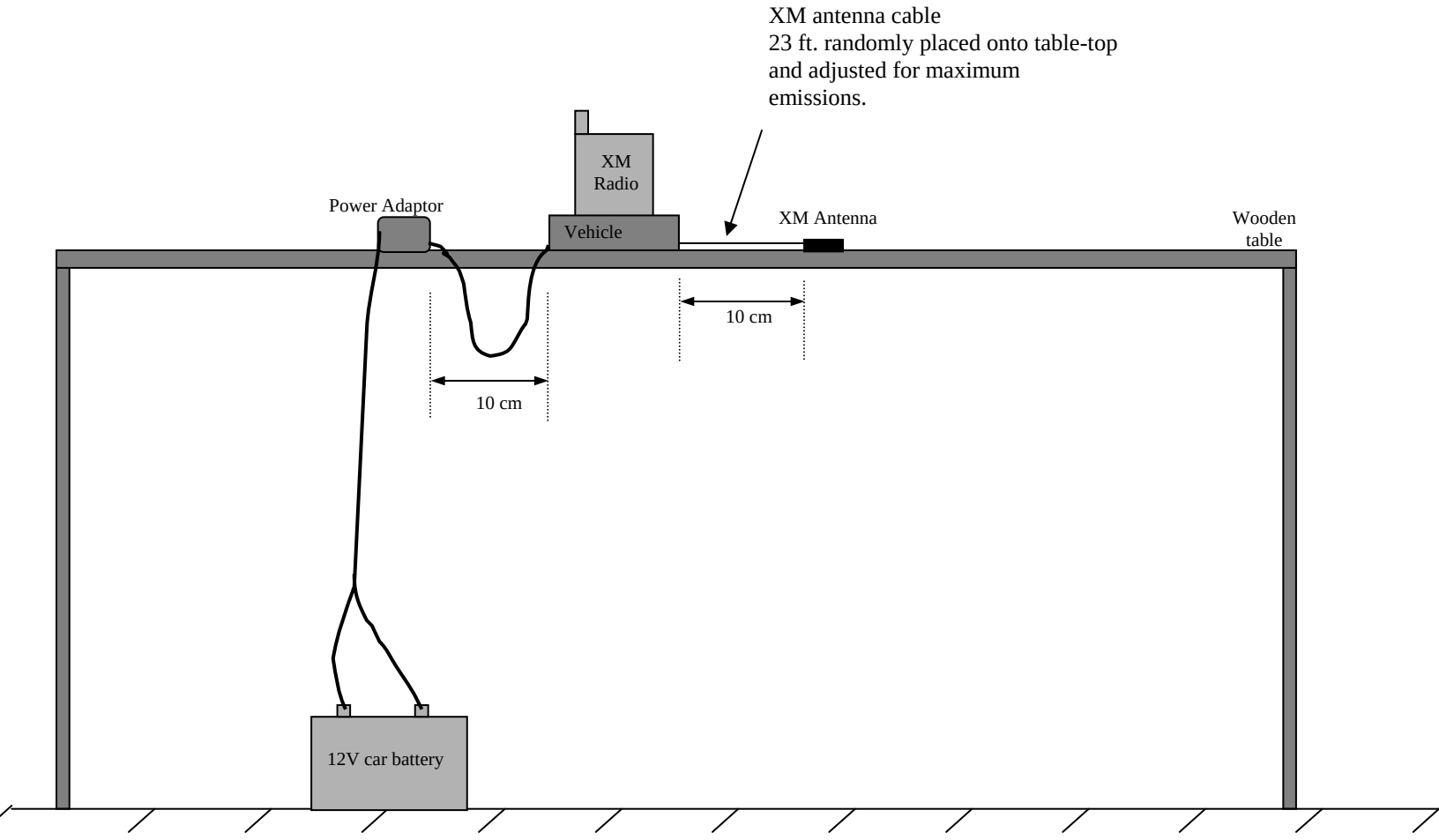


Diagram 3: XM Antenna Only - Radiated Emissions Setup

4.3.2.7.2 Test Data – Car Cradle and XM antenna

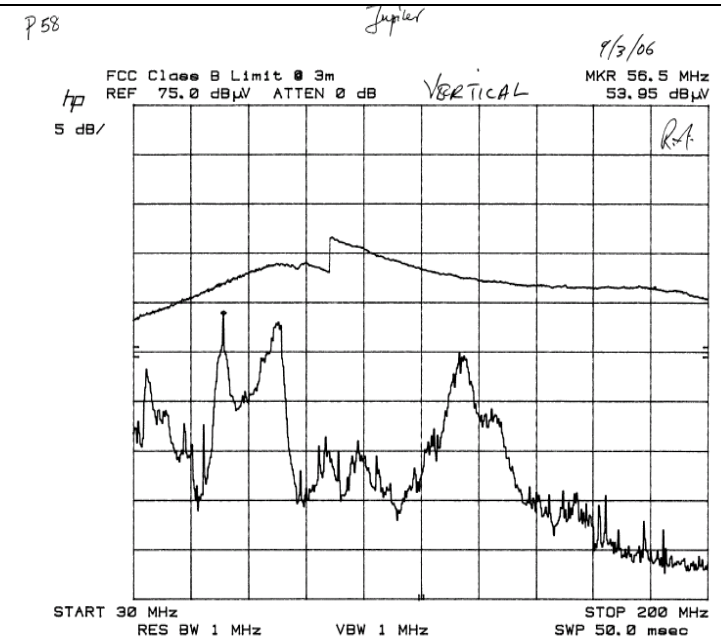


Figure 58 30MHz to 200MHz Vertical

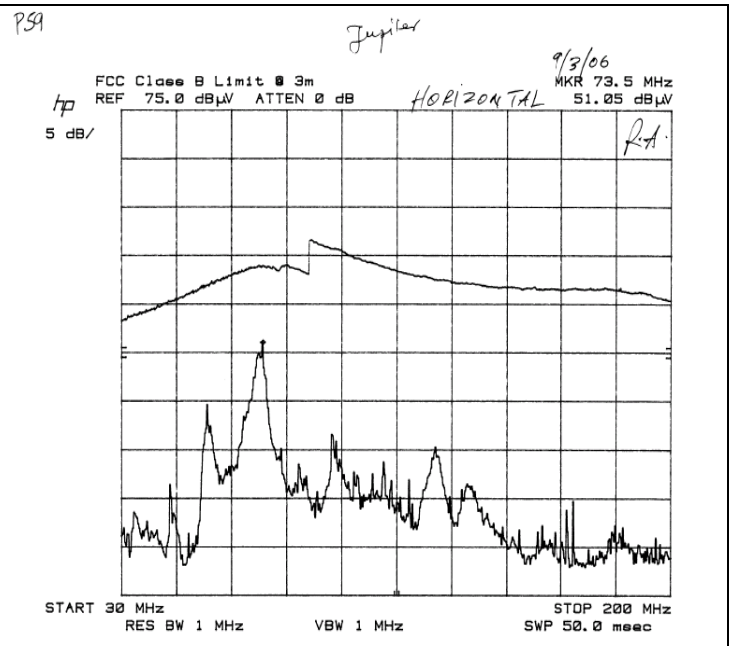


Figure 59 30MHz to 200MHz Horizontal

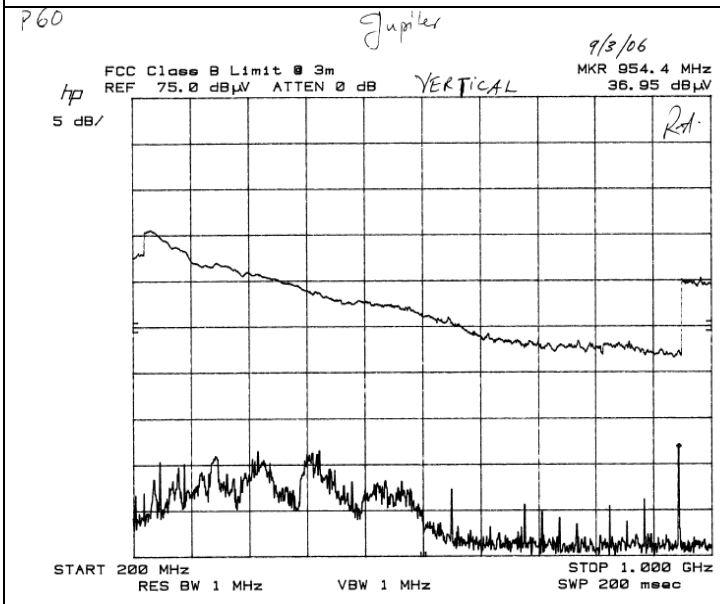


Figure 60 200MHz to 1GHz Vertical

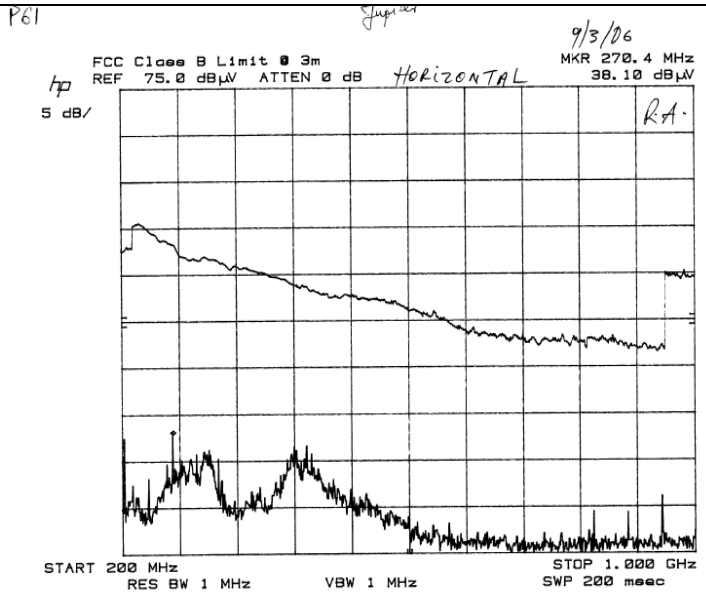


Figure 61 200MHz to 1GHz Horizontal

4.4 INTENTIONAL RADIATOR – Section 15.239 Operation in the Band 88 MHz to 108 MHz

4.4.1 Test Setup – Using FM Aerial antenna

The XM Satellite Radio, Inc SkyFi3 Model SA10101 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 (dBµV/m) = SA reading (dBµV) + Antenna Factor (dB/m) + Cable Loss (dB) - Amp Gain (dB)

It should be noted that the limit line indicated in Figures 62-73 was for FCC Class B unintentional limit. However, the allowable field strength for Intentional radiation as per Section 15.239 was 250 µV/m or 47.96 dBµV/m, which is 4.45 dB higher than unintentional FCC Class B (43.5 dBµV/m) at this frequency range. As example, the measured value at 108 MHz on Figure70 was 1 dB (44.5 dBµV/m) above the FCC Class B unintentional limit, but it was 3.46 dB below the intentional Class B limit of 47.96 dBµV/m.

4.4.2 Test Data – FM Aerial Antenna

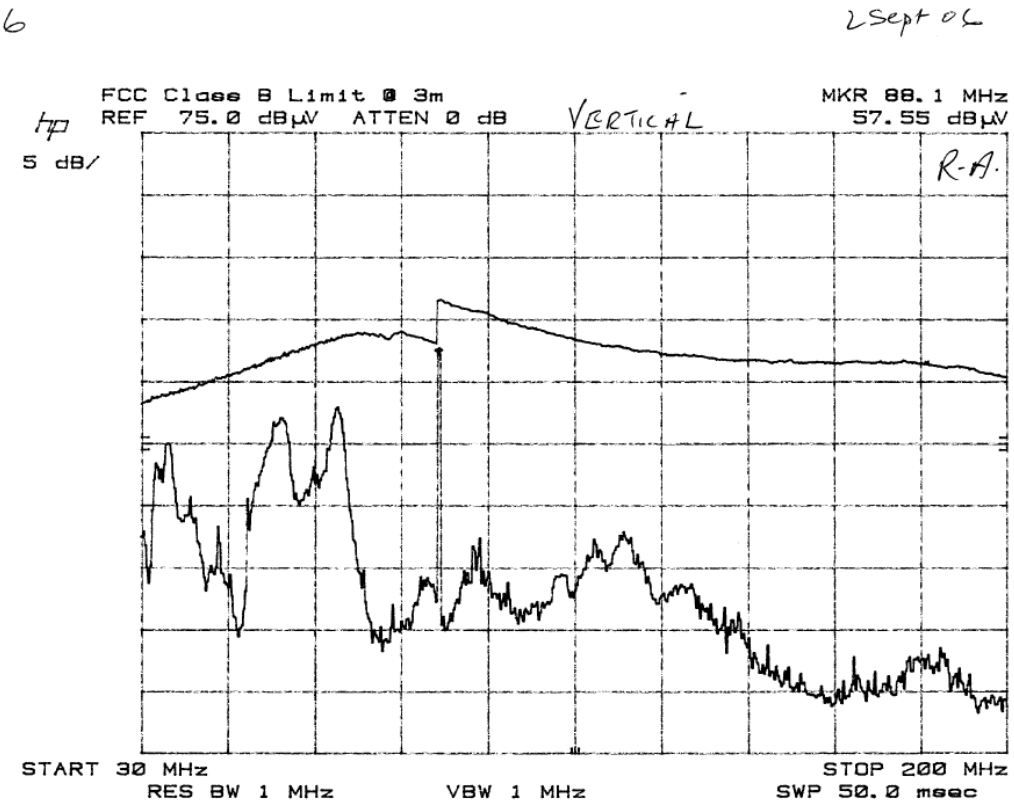


Figure 62 30MHz to 200MHz Vertical
(FM programmed to 88.1MHz)

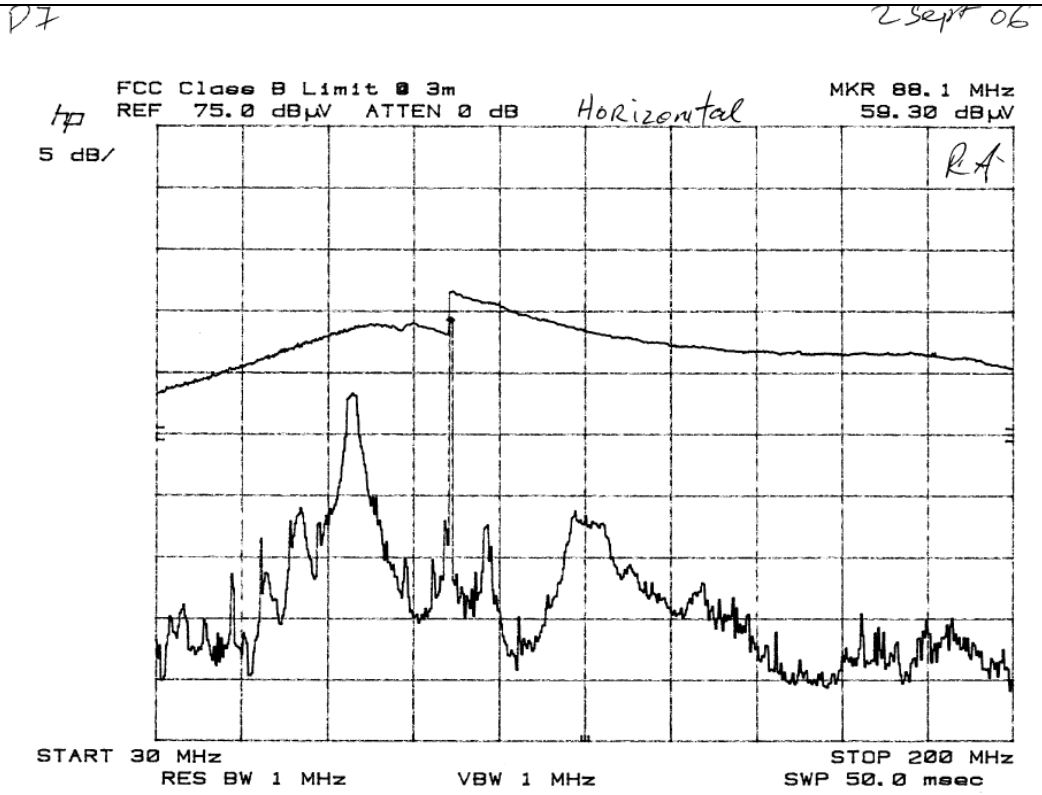


Figure 63 30MHz to 200MHz Horizontal
(FM programmed to 88.1MHz)

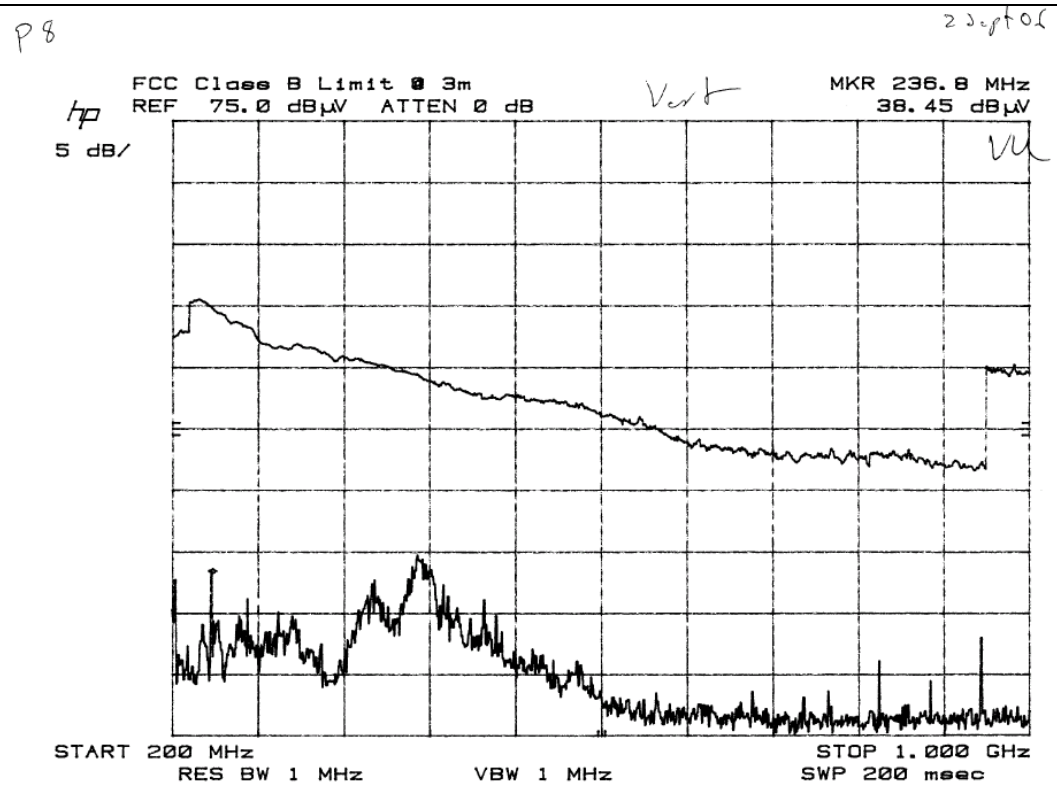


Figure 64 200MHz to 1GHZ Vertical
(FM programmed to 88.1MHz)

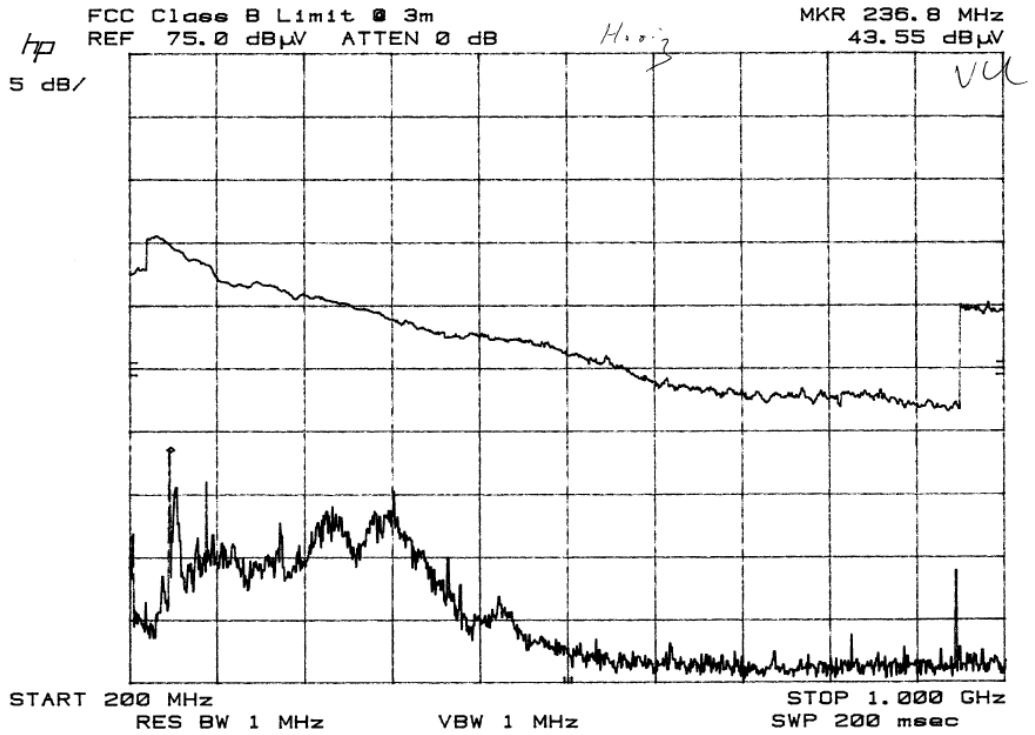


Figure 65 200MHz to 1GHz Horizontal
(FM programmed to 88.1MHz)

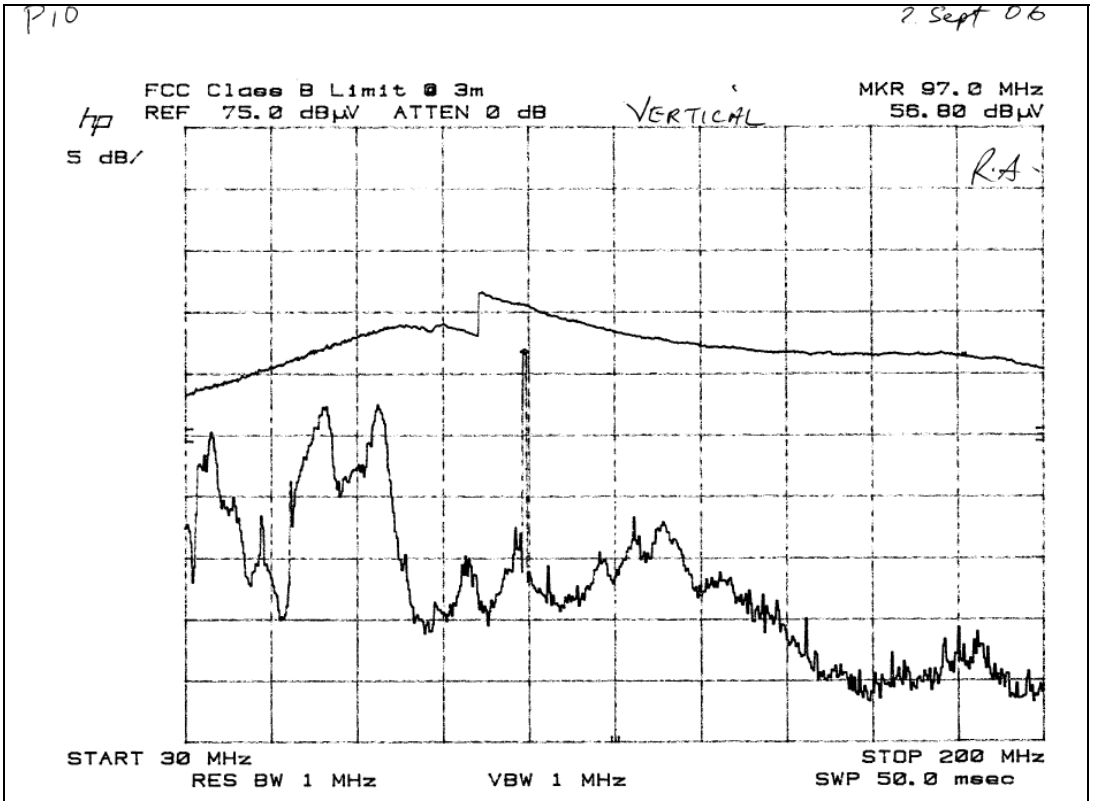


Figure 66 30MHz to 200MHz Vertical
(FM programmed to 96.9MHz)

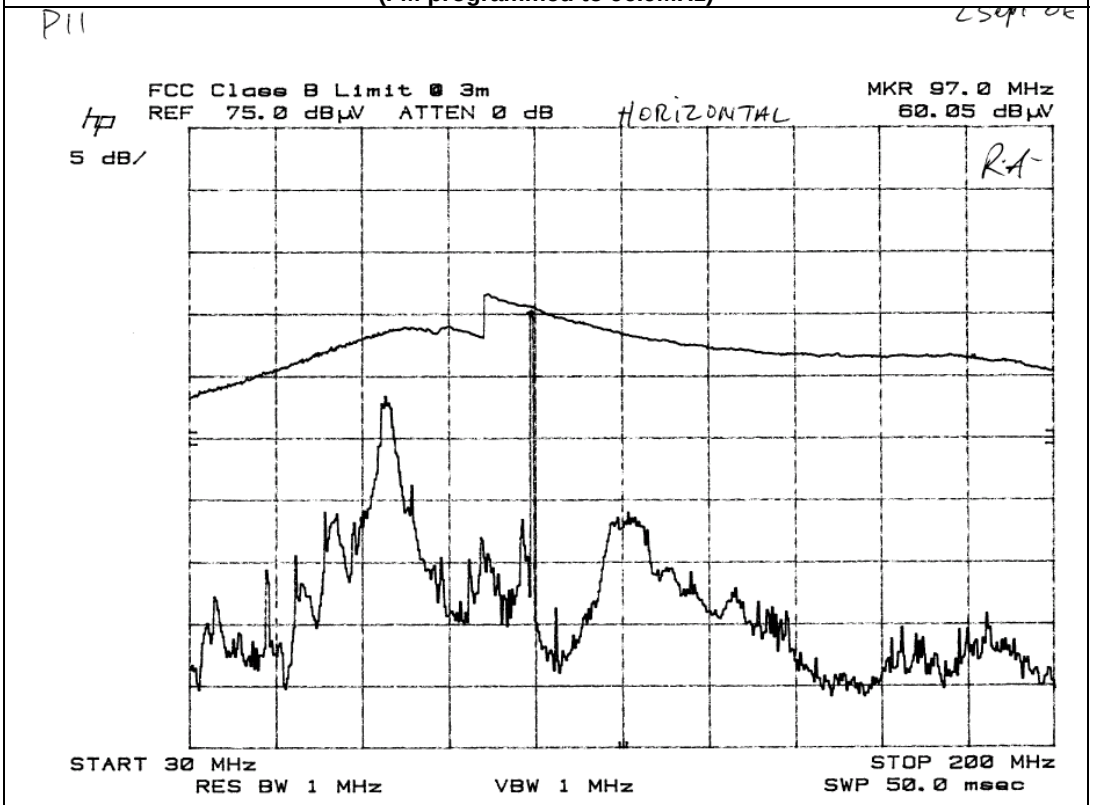


Figure 67 30MHz to 200MHz Horizontal
(FM programmed to 96.9MHz)

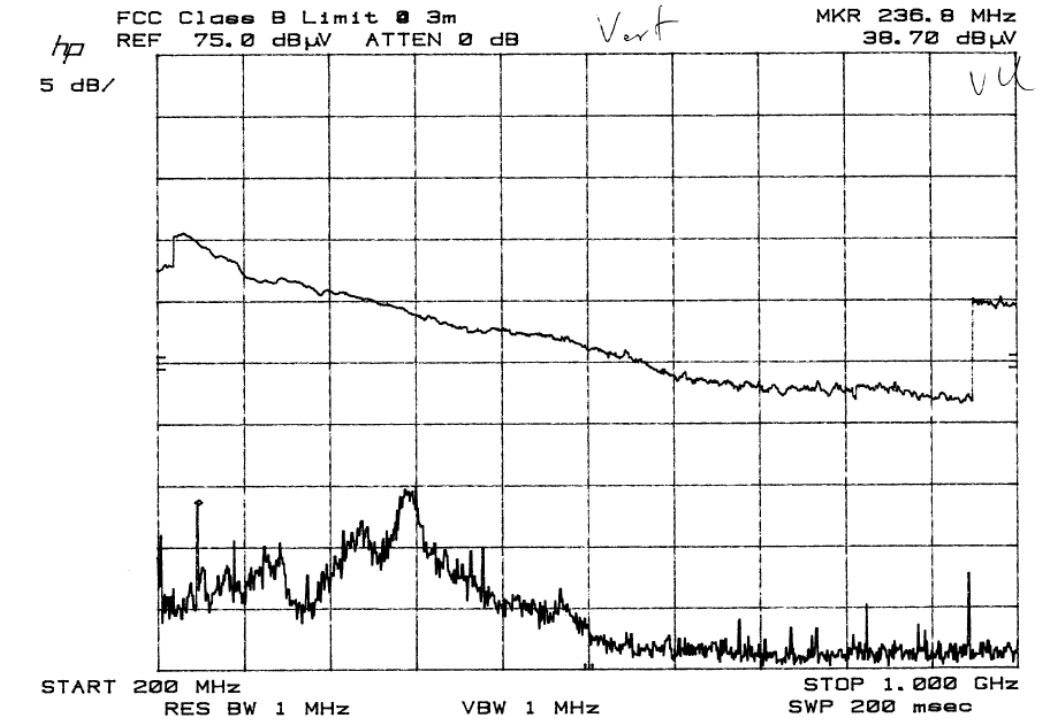


Figure 68 200MHz to 1GHZ Vertical
(FM programmed to 96.9MHz)

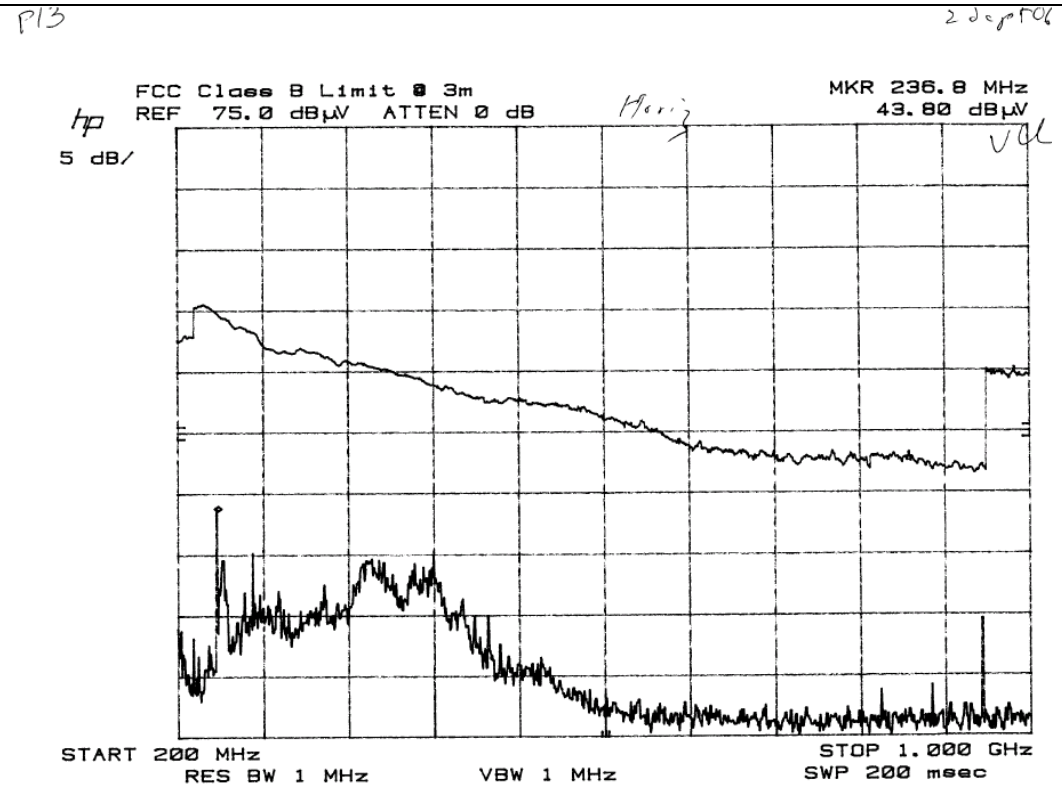


Figure 69 200MHz to 1GHz Horizontal
(FM programmed to 96.9MHz)

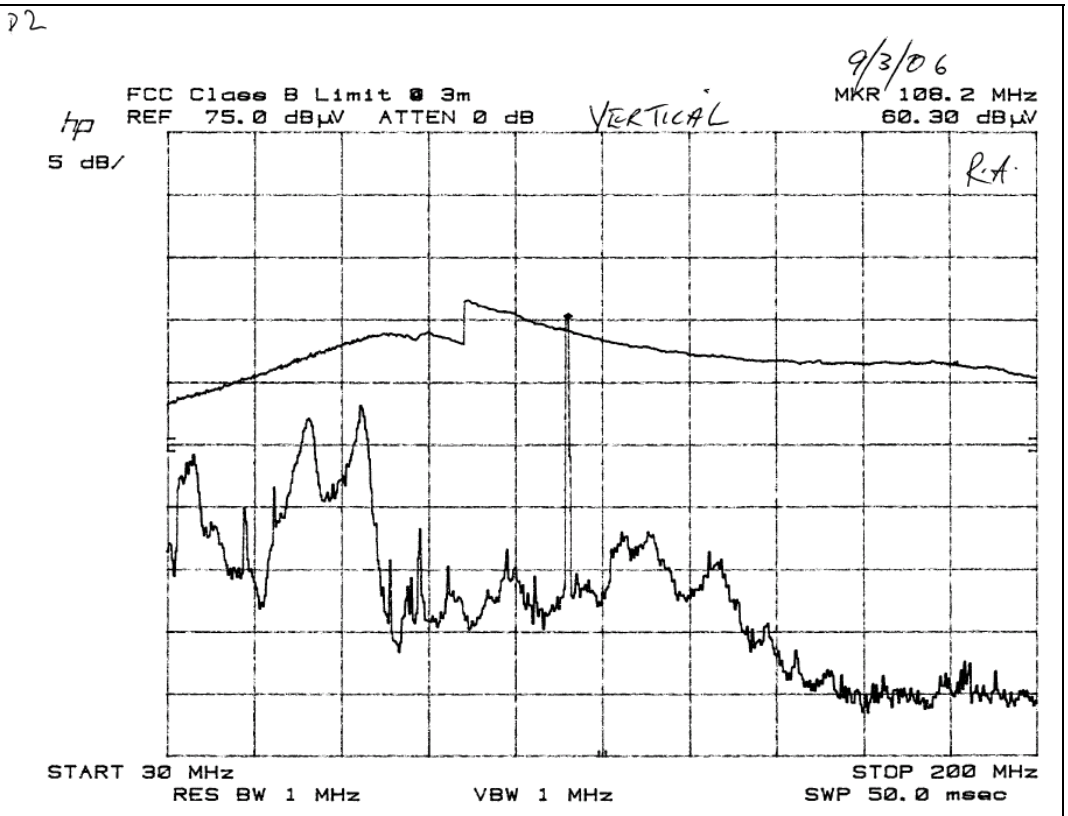


Figure 70 30MHz to 200MHz Vertical
(FM programmed to 107.9MHz)

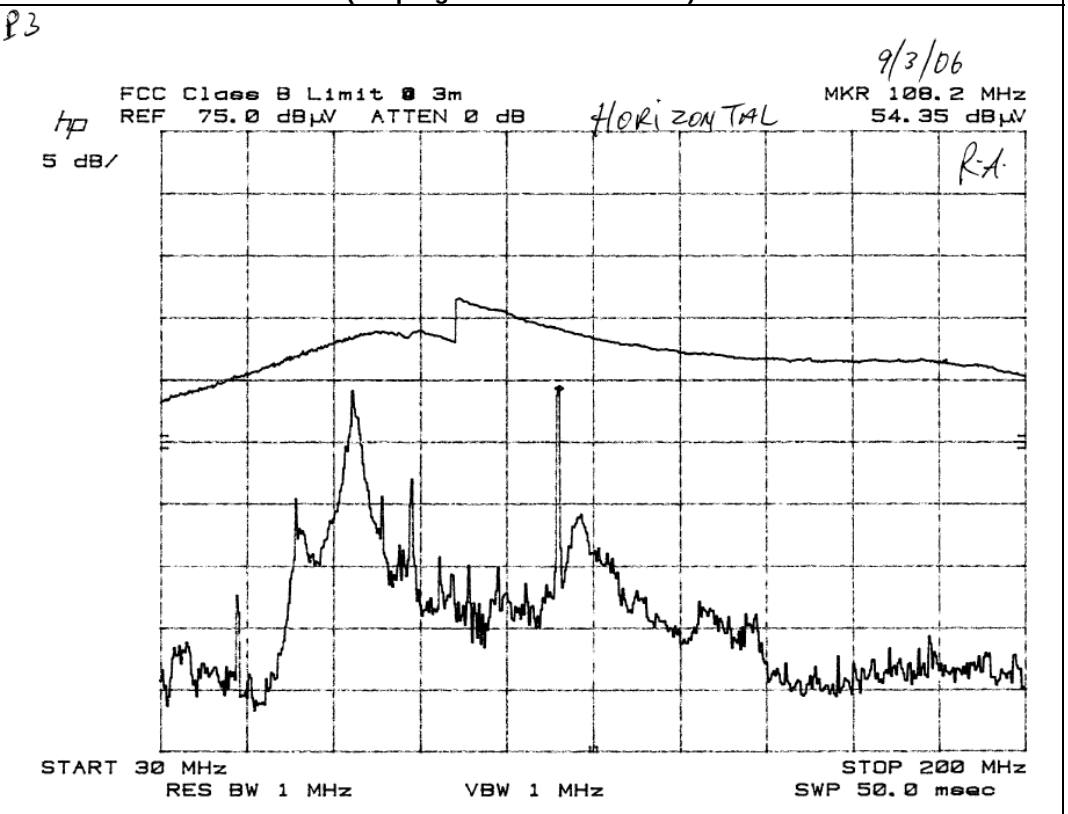


Figure 71 30MHz to 200MHz Horizontal
(FM programmed to 107.9MHz)

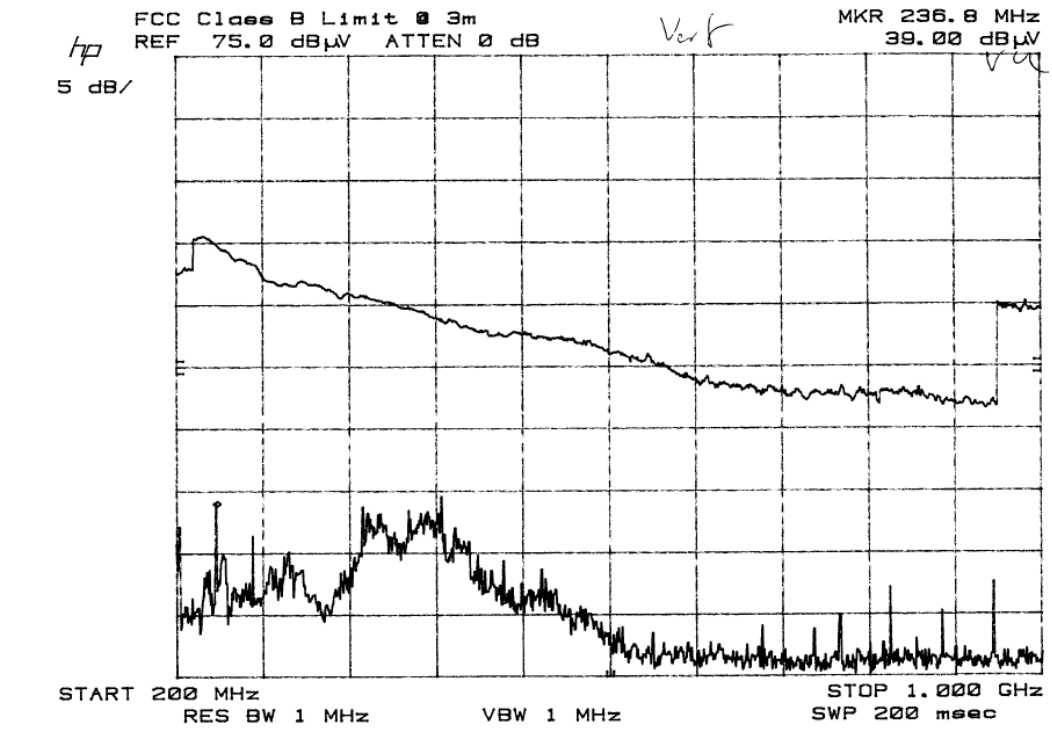


Figure 72 200MHz to 1GHz Vertical
(FM programmed to 107.9MHz)

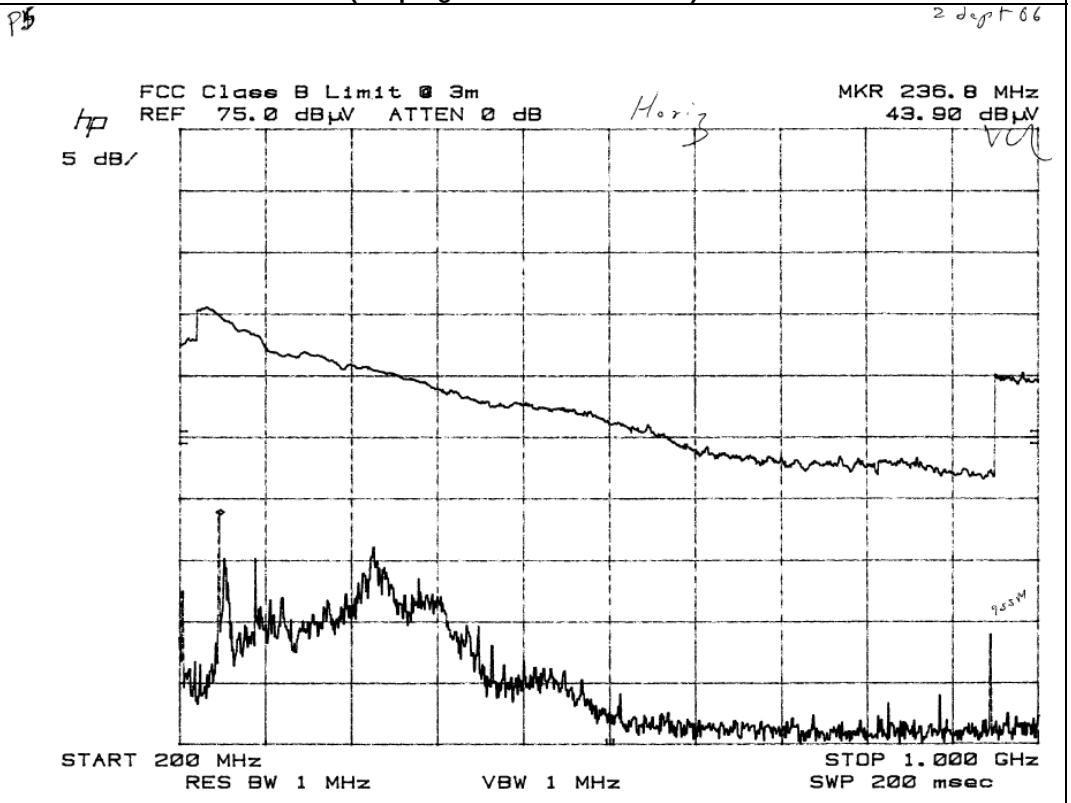


Figure 73 200MHz to 1GHz Horizontal
(FM programmed to 107.9MHz)

4.5 Tabular Data of Peak Voltage Measurements

The following table shows maximum voltage measurements for any emissions that were within 10 dB of the limit for all figures that were taken in the 3 meter semi-anechoic chamber. Where noted, the QP value or the intentional radiator limit is used.

	Peak	Peak	Correction	Corrected	FCC	
Figure No.	Frequency	Voltage	Factor	Peak Voltage	Limit	Margin
	MHz	dBµV	dB/m	dBµV/m	dBµV/m	dB
2	31	46.6[1]	-13.7	32.9[1]	40	7.1
6	81.7	52.5	-18.7	33.8	40	6.2
10	31	46.6[1]	-13.7	32.9	40	7.1
10	83	55.1	-18.7	36.4	40	3.6
14	31	45.9[1]	-13.7	32.2[1]	40	7.8
14	83	54	-18.7	35.3	40	4.7
19	70.8	49.5	-19.2	30.3	40	9.7
22	73.5	54.05	-19	35.05	40	5.0
23	73.5	50.65	-19	31.65	40	8.4
26	72.5	54.05	-19.1	34.95	40	5.1
27	73.5	50.8	-19.1	31.7	40	8.3
30	101.7	55.15	-16.9	38.25	43.5	5.3
31	101.7	53.44[1]	-16.9	36.54[1]	43.5	6.96
34	62.3	54.11[1]	-18.5	35.61[1]	40	4.4
35	56.5	50.55	-17.7	32.85	40	7.2
39	30	45.15	-13.7	31.45	40	8.6
44	239.2	52.2	-13.9	38.3	46	7.7
45	239.2	53.9	-13.9	40	46	6.0
46	56.5	51.9	-18.1	33.8	40	6.2
47	70	51.05	-19.2	31.85	40	8.2
50	57.5	51.55	-17.9	33.65	40	6.4
51	70.5	50.33	-19.2	31.13	40	8.9
54	56.5	52.8	-17.6	35.2	40	4.8
55	79.3	50.75	-18.8	31.95	40	8.1
58	56.5	53.95	-17.5	36.25	40	3.55
59	73.5	51.05	-19.1	31.95	40	8.05
62	88.1	57.55	-18.5	39.05	48[2]	9.0
63	88.1	59.3	-18.5	40.8	48[2]	7.2
66	97	56.8	-17.5	39.3	48[2]	8.7
67	97	60.05	-17.5	42.55	48[2]	5.45
70	108.2[3]	60.3	-16.4	43.9	48[2]	4.1
71	108.2[3]	54.35	-16.4	37.95	48[2]	10.05

Note 1: A quasi-peak detector measurement is used for these data points, and the QP value is shown in the table.
Note 2: The intentional radiator limit is used for these frequency points.
Note 3: Due to the resolution of the spectrum analyzer, the frequency report is within the receiver uncertainty.

Table 1: Measurements from FAU 3-m chamber

4.6 Radiated Emissions – Section 15.239 – Measured On-Vehicle

Per customer instructions, the FM fundamental power measurements using the FM coupling device were measured on three different vehicles which utilize embedded FM antennas in the vehicle's glass.

The test vehicles that were used during the test include:

- Pontiac G6
- Toyota Camry
- Nissan Maxima

4.6.1 Test Setup – In Vehicle Measurements

TEST PROCEDURE

1. The satellite radio receiver and FM Coupler were installed in each vehicle per the installation guidelines provided to the user and tuned to one of the two-test FM frequencies.
2. The RBW and VBW of the spectrum analyzer were set to 120 kHz and 300 kHz, respectively. An R&S Spectrum, Model FSIQ7, set for peak detector was utilized.
3. For tests where the receiving antenna is in Vertical polarization, the receive antenna is initially placed at one meter from the ground. For Horizontal polarization, the receive antenna is initially placed at 3 meters from the ground.
4. While monitoring the power of the fundamental FM emission, the receive antenna base is moved horizontally along one of the vehicles sides, at 3 meters from the vehicle. The position that produces the highest emission is found.
5. At the position found in step (4) above, the antenna is moved vertically through the range from 1 meter to 4 meters. The highest FM emission is found and recorded.
6. The above procedure is repeated for each of the four sides of the vehicle.
7. The above procedure is repeated for each of two FM frequencies (88.7 MHz and 107.1 MHz).
8. The cable loss, amplifier gain, and antenna factors are used to determine the absolute field strength from each peak power measurement as shown in the table below.
9. The absolute field strength is obtained by adding the vertical or horizontal polarization factor to the SA measurement in dBµV.

Test Frequency (MHz)	Vertical Polarization V-Factor	Horizontal Polarization H-Factor
88.7	-19.2 dB/m	-18.8 dB/m
96.9	-20.0 dB/m	-18.2 dB/m
107.1	-21.0 dB/m	-18.7 dB/m

Table 2: Calibration Factors for In-Vehicle Measurements

Diagram 5: In-Vehicle Measurement Method

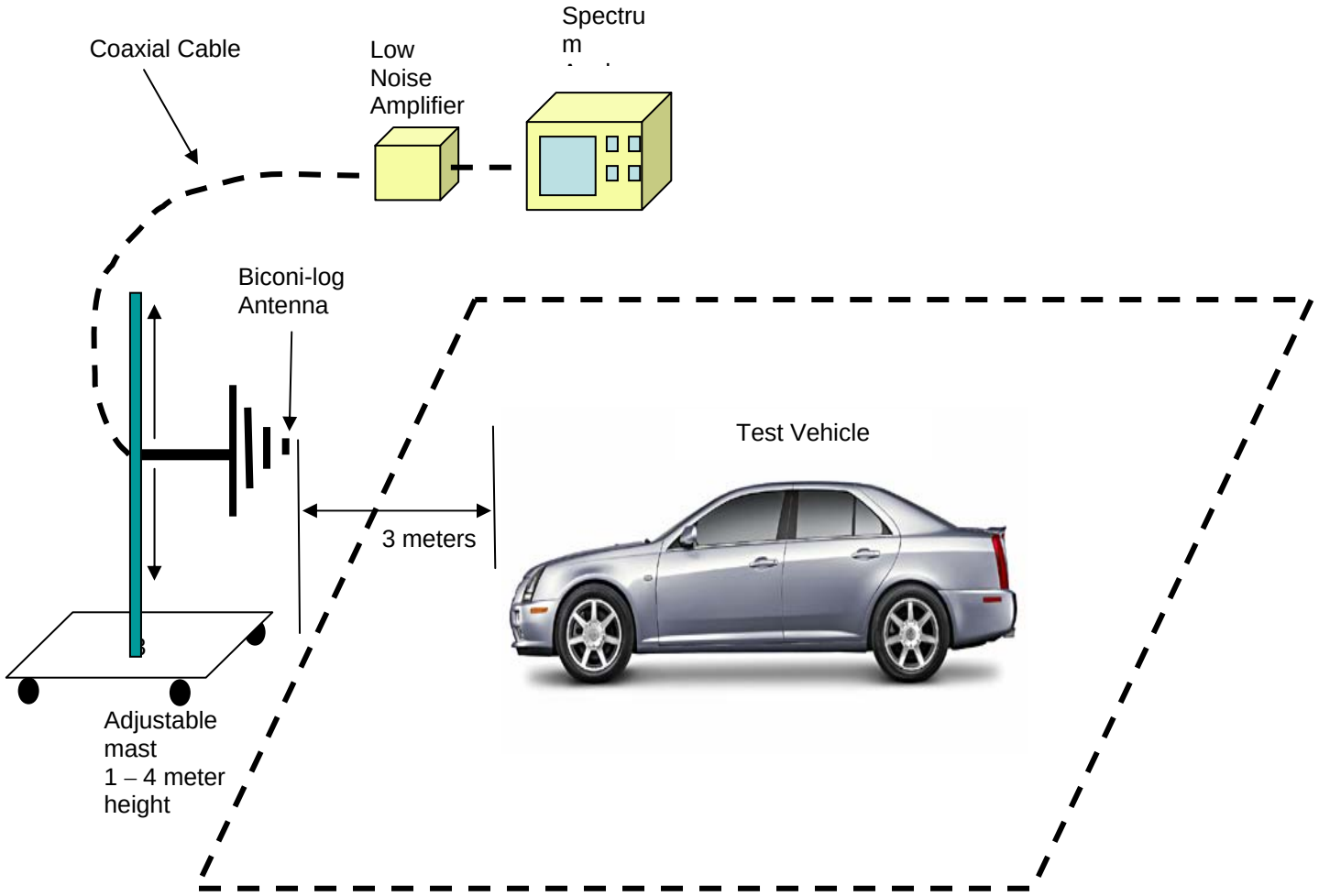
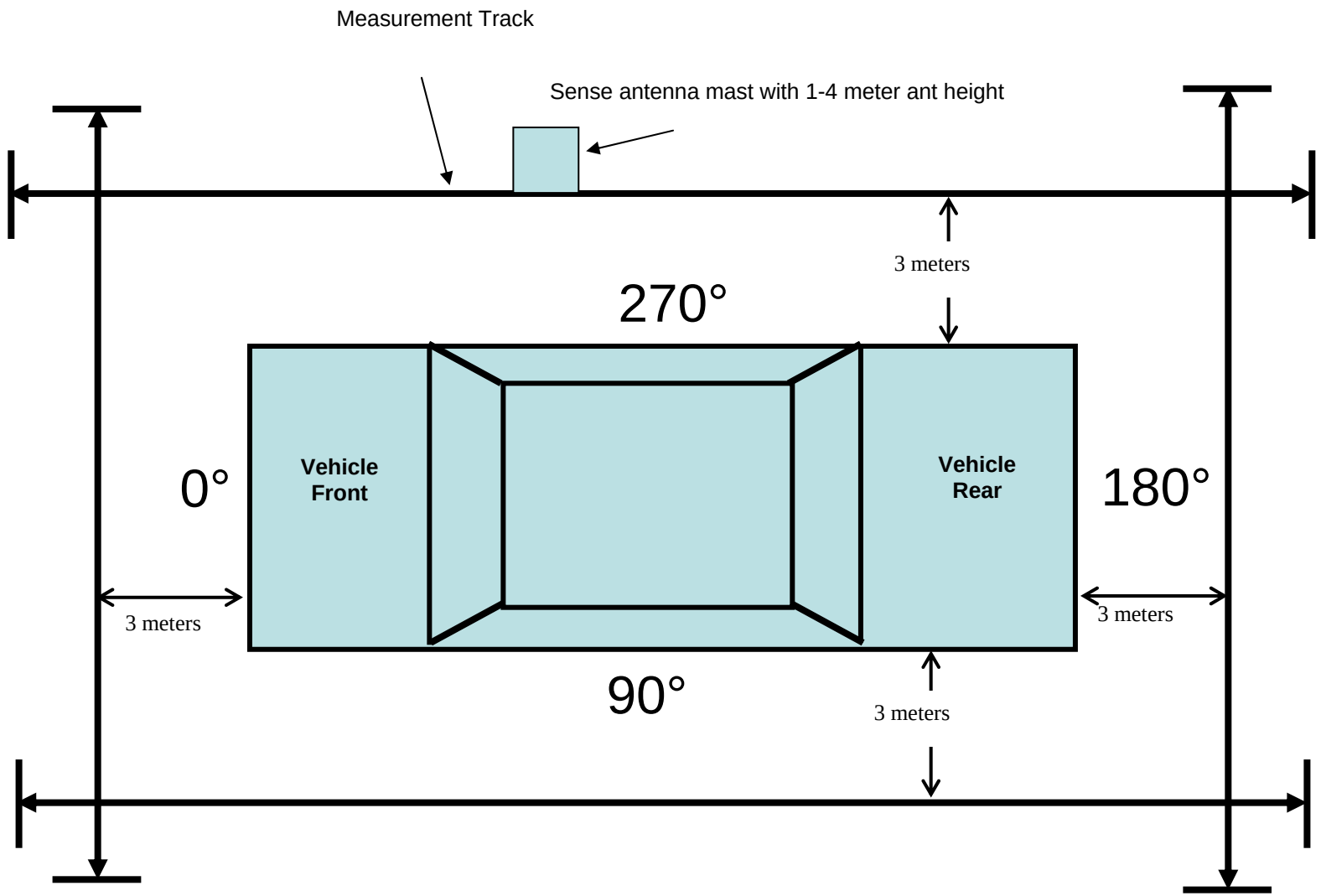


Diagram 6: In Vehicle Measurement Method



4.6.2 Test Data – In-Vehicle Measurements

Product Description	Freq (MHz)	V-factor (dB/m)	FAU OATS reading VERTICAL (dBµV)				Meas. Peak	Peak field strength	Limit	Margin
			0 deg	90 deg	180 deg	270 deg	(dBµV)	(dBµV /m)	(dBµV /m)	(dB)
Pontiac G6	88.7	-19.20	57.0	55.84	60.5	51.4	60.5	41.3	48	**-6.7**
	96.9	-20.00	60.7	54.19	62.5	53.9	62.5	42.5	48	**-5.5**
	107.1	-21.00	53.1	48.74	56.5	45.9	56.5	35.5	48	**-12.5**
Camry	88.7	-19.20	52.3	51.2	56.7	51.1	56.7	37.5	48	**-10.5**
	96.9	-20.00	53.0	54.3	61.2	51.1	61.2	41.2	48	**-6.8**
	107.1	-21.00	51.3	50.8	58.1	50.7	58.1	37.1	48	**-10.9**
Nissan Maxima	88.7	-19.20	45.6	40.2	43.3	38.1	45.6	26.4	48	**-21.6**
	96.9	-20.00	45.1	39.8	41.0	37.6	45.1	25.1	48	**-22.9**
	107.1	-21.00	47.2	42.1	46.1	41.6	47.2	26.2	48	**-21.8**

Table 3: Vertical Polarization results from In-Vehicle Measurements

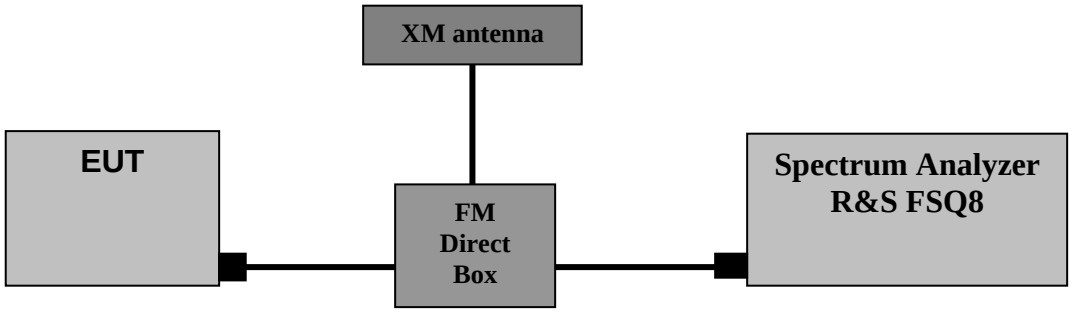
Product Description	Freq (MHz)	H-Factor (dB/m)	FAU OATS reading HORIZONTAL (dBµV)				Meas. Peak	Peak field strength	Limit	Margin
			0 deg	90 deg	180 deg	270 deg	(dBµV)	(dBµV /m)	(dBµV /m)	(dB)
Pontiac G6	88.7	-18.8	52.5	60.79	46.7	59.0	60.8	42	48	**-6.0**
	96.9	-18.2	54.3	61.49	46.8	60.3	61.5	43.3	48	**-4.7**
	107.1	-18.7	50.8	43.99	47.4	54.6	54.6	35.9	48	**-12.1**
Camry	88.7	-18.8	46.6	54.6	41.1	56.3	56.3	37.5	48	**-10.5**
	96.9	-18.2	50.8	58.3	45.3	58.2	58.3	40.1	48	**-7.9**
	107.1	-18.7	46.3	54.6	45.6	55.5	55.5	36.8	48	**-11.2**
Nissan Maxima	88.7	-18.8	40.8	43.8	39.3	44.5	44.5	25.7	48	**-22.3**
	96.9	-18.2	41.1	41.5	41.6	42.7	42.7	24.5	48	**-23.5**
	107.1	-18.7	43.4	43.8	43.8	42.8	43.8	25.1	48	**-22.9**

Table 4: Horizontal Polarization results from In-Vehicle Measurements

4.7 Occupied Bandwidth – Section 15.239(a)

4.7.1 Test Setup – Occupied Bandwidth

The occupied bandwidth test was performed using an FM direct adaptor to maximize the power into the spectrum analyzer. The unit was programmed to the minimum, mid and maximum FM frequencies (88.1 MHz, 96.9 MHz and 107.9 MHz) while receiving live over-the-air signal. *It was verified that the unit could not be program outside of this frequency range.* The FM audio level was maximized to find the highest occupied bandwidth. Audio was also generated from stored information in the EUT and then broadcast at the same three frequencies.



4.7.2 Test Data – Occupied Bandwidth

4.7.2.1 88.1 MHz

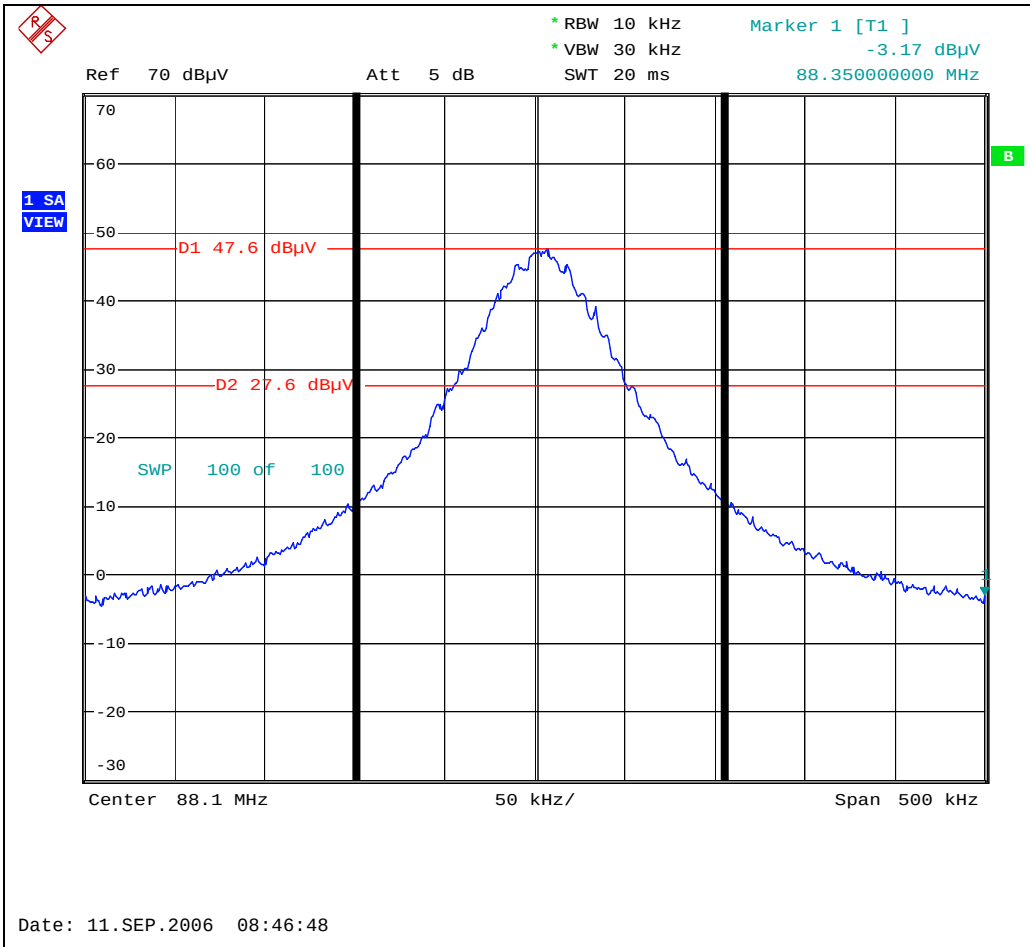


Figure 82 Live XM 88.1MHz With Modulation

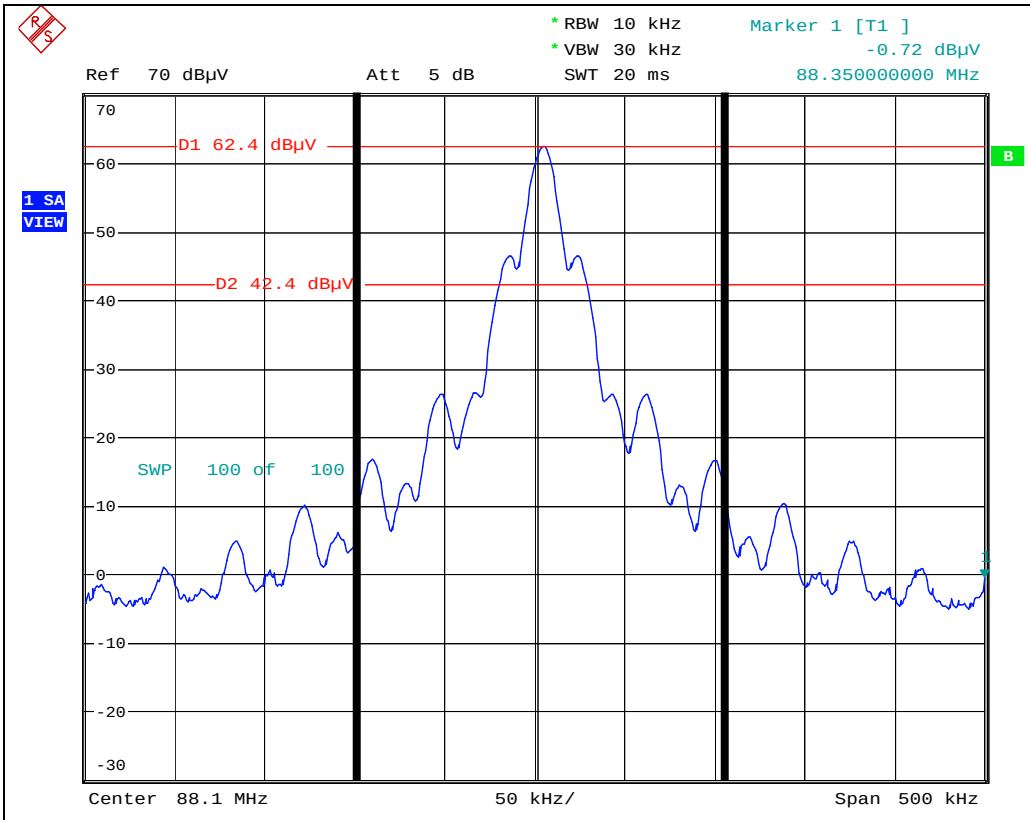


Figure 83 88.1MHz No Modulation

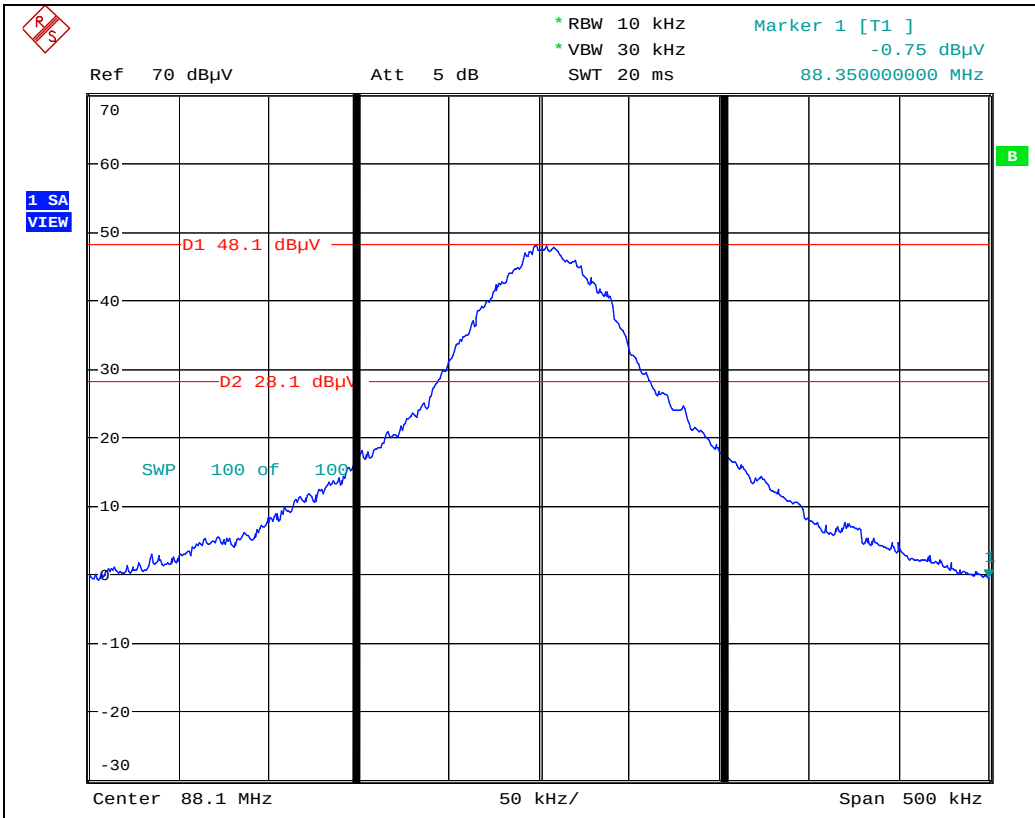


Figure 84 My Music 88.1 MHz With Modulation

4.7.2.2 96.9 MHz

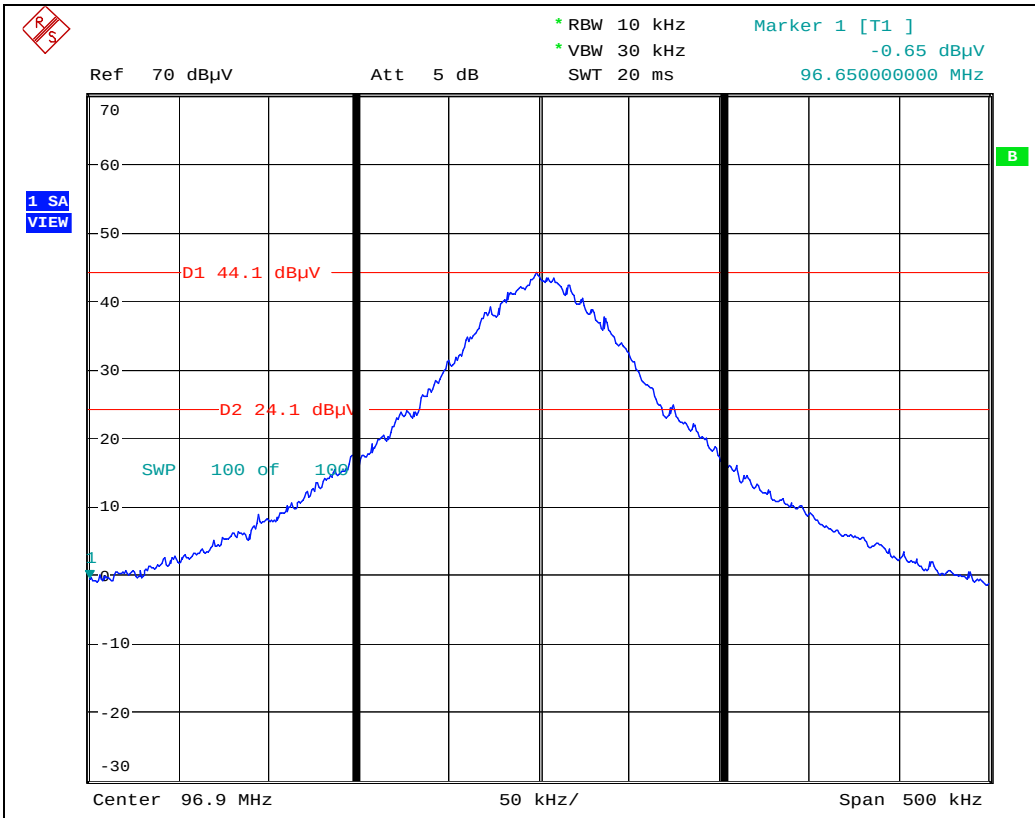


Figure 85 Live XM 96.9 MHz with Modulation

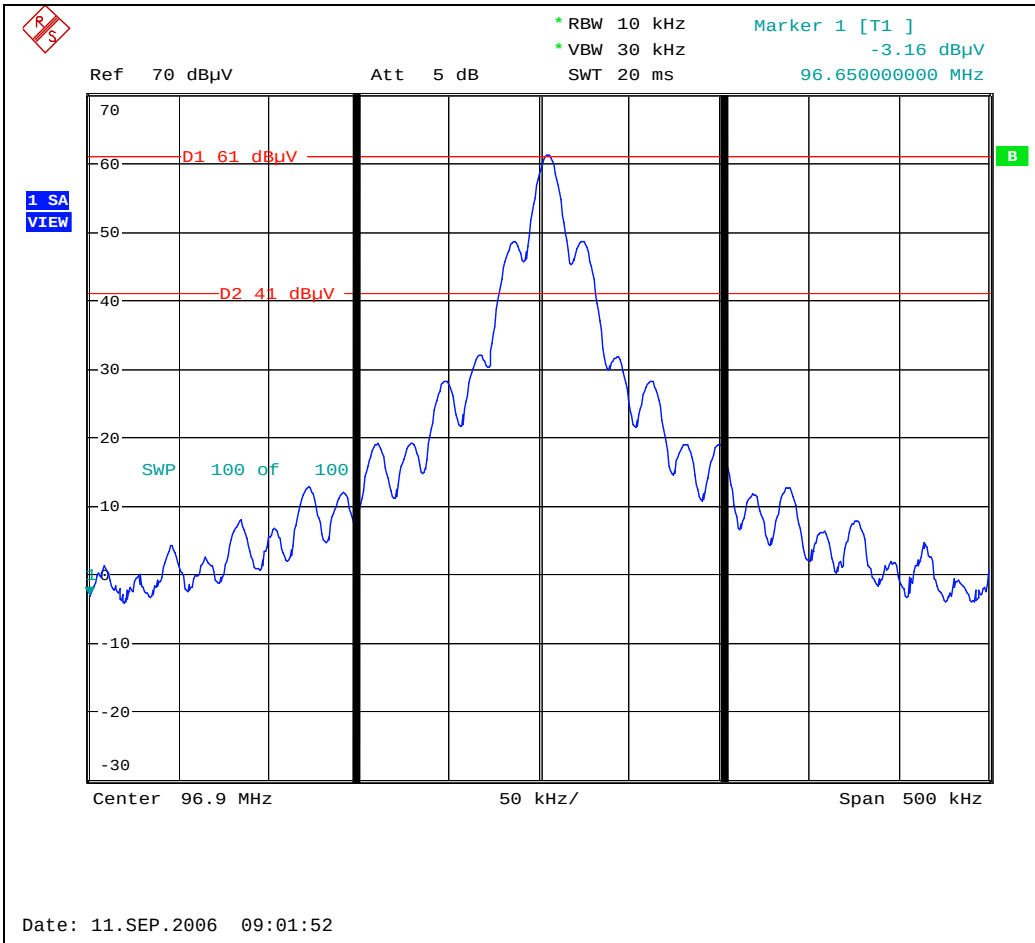


Figure 86 96.9 MHz with no Modulation

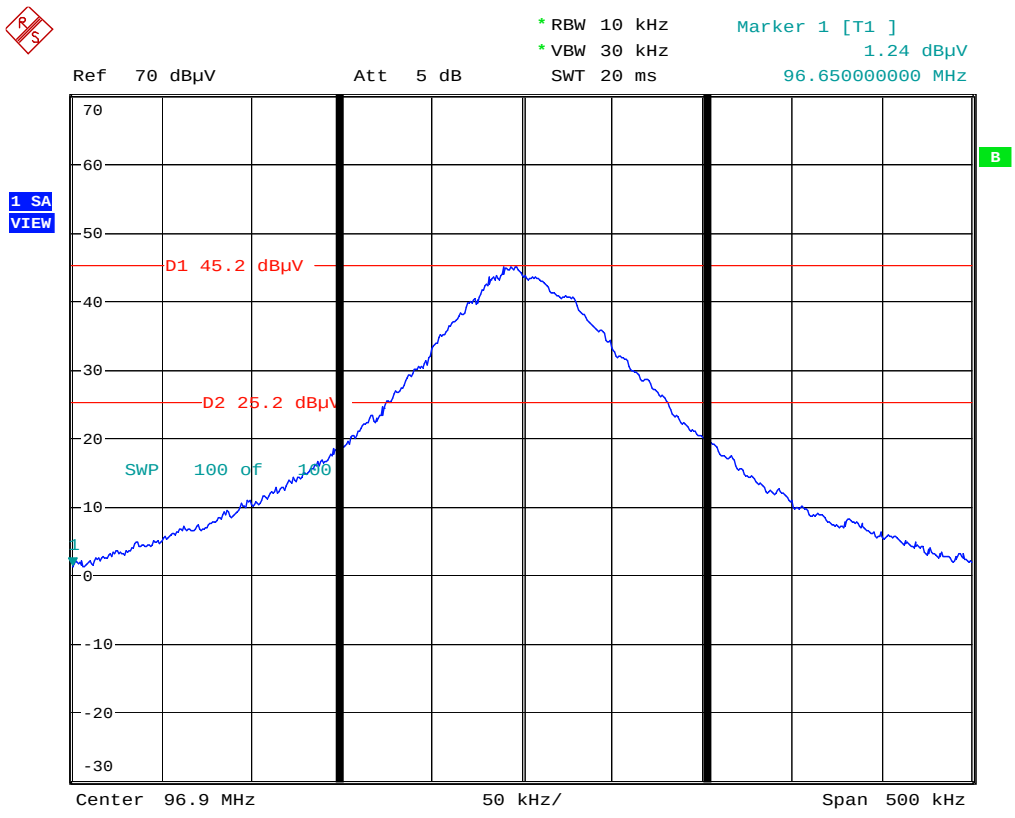


Figure 87 96.9 MHz My Music with Modulation

4.7.2.3 107.9 MHz

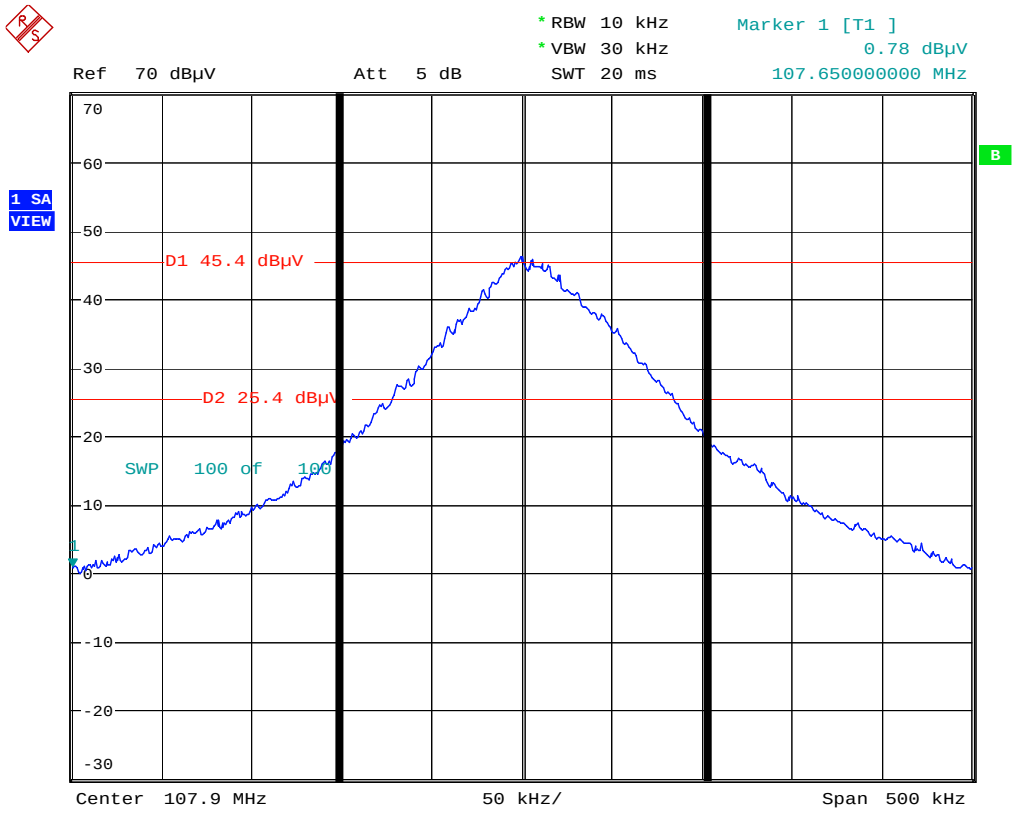


Figure 88 Live XM 107.9 MHz with Modulation

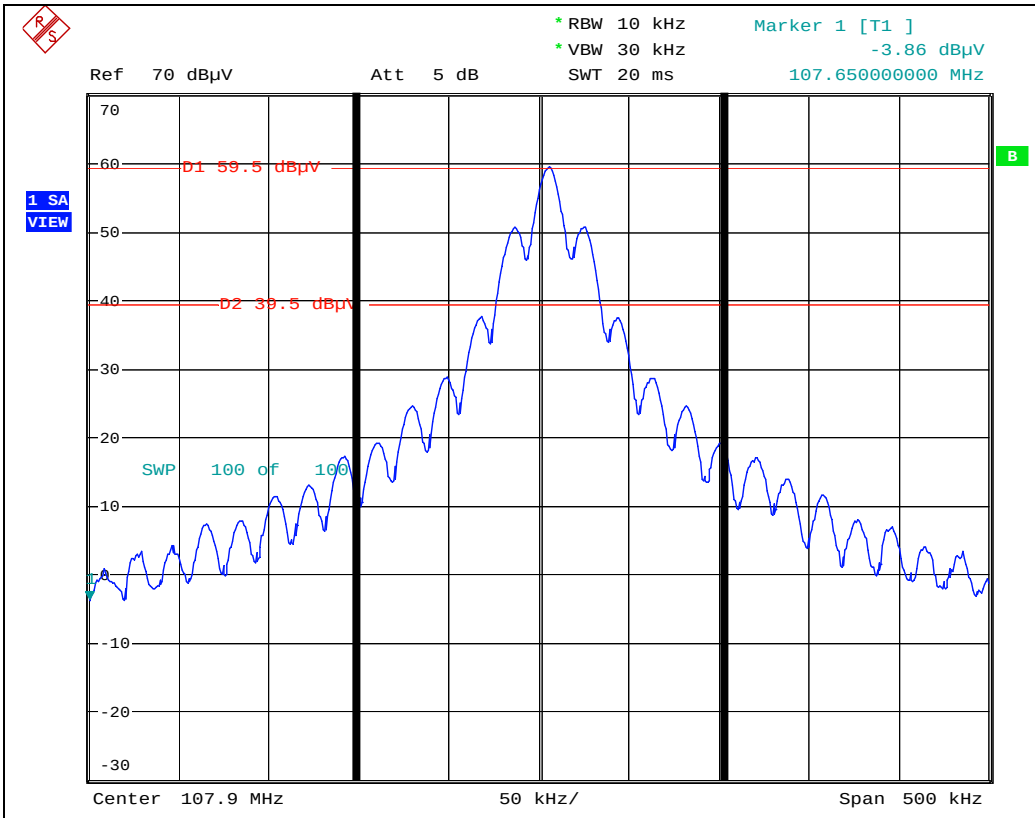


Figure 89 107.9MHz No Modulation

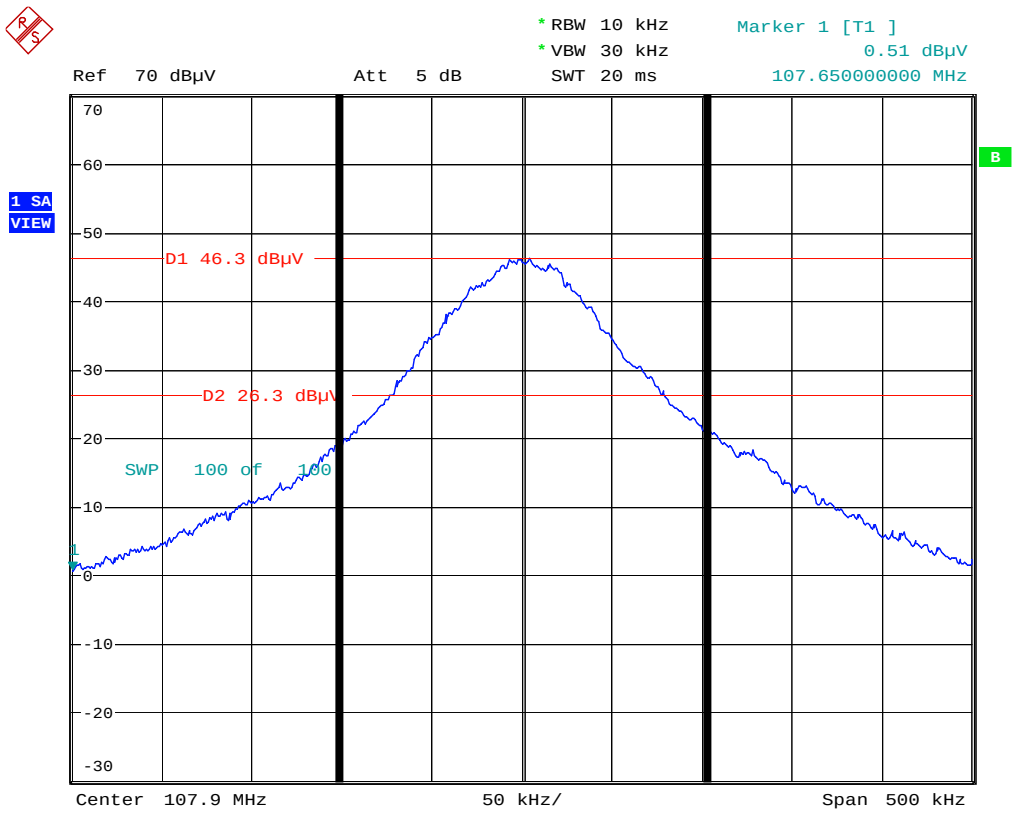


Figure 90 My Music107.9MHz with Modulation

4.8 TEST EQUIPMENT

FAU EMI LAB

FAU EMI R&D LABORATORY TEST EQUIPMENT						
Equipment Type	**Manufacturer**	**Description**	**Model**	**Serial No.**	**Calibration Date**	**Calibration Interval (Years)**
Spectrum Analyzer	Hewlett Packard	RF Section	8566B	2403A06381	Aug-22-06	2
Spectrum Analyzer	Hewlett Packard	Display	85662A	2407A06381	Aug-22-06	2
Quasi Peak Adapter	Hewlett Packard	Quasi Peak Adapter	85650A	2430A00559	Aug-22-06	2
RF Preselector	Hewlett Packard	RF Preselector	85685A	2510A00151	Feb-8-06	2

IN-VEHICLE TEST SETUP

Equipment Type	**Manufacturer**	**Model**	**Cal Date**	**Due Date**
Spectrum Analyzer	R&S	FSIQ7	3/28/2006	3/28/2007
Low Noise Amplifier	Sonoma	Inst310	6/9/2006	6/9/2007
Biconilog Antenna	ETS-Lindgren	3142C	6/5/2006	6/5/2007

OCCUPIED BANDWIDTH TEST SETUP

Equipment Type	**Manufacturer**	**Model**	**Cal Date**	**Due Date**
Spectrum Analyzer	R&S	FSQ8	3/28/2006	3/28/2007

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

Description:	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.
Site Filing:	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.
Instrument Tolerance:	All measuring equipment is in accordance with ANSI C63.4 and CISPR 22 requirements.

End Report