

**TEST REPORT FOR  
FCC PART 15 COMPLIANCE  
FOR PHONIC EAR INC.**

Prepared by  
Daniel C. Swann  
August 9, 1999

Phonic Ear Inc.  
Part Number PE 560T

FCC Part 15.237  
Intentional Radiator

FCC ID BRG560T

GEL Report File PE9901

**GLEN ELLEN LABORATORIES**  
1876 London Ranch Road  
Glen Ellen, CA 95442

**MEASUREMENT/TECHNICAL REPORT**

**PHONIC EAR**

**FCC ID BRG560T**

This report concerns: An Original Grant

Equipment type: Part 15.237 Intentional Radiator

Deferred grant requested: no

Transition rules per 15.37: no

Report prepared by: Daniel C. Swann  
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Report Certified By: Daniel C. Swann \_\_\_\_\_

Date \_\_\_\_\_

GEL Report File: PE9901

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## **1 GENERAL INFORMATION**

### **1.1 Product Description**

The Phonic Ear Part Number PE 560T is a frequency modulated transmitter which utilizes the FCC Part 15.237 frequency bands for auditory assistance devices.

The transmitter uses either a short flexible plastic covered broadband antenna, or a 6 foot Large Area tuned antenna (two differently tuned antennas are required to cover the frequency range). The short antenna was tested attached to the rear RF connector of the unit, and also tested connected with a coax cable to a small groundplane placed remotely from the transmitter.

The coaxial antenna connections are made to the transmitter unit and to the antennas with a unique coupling, insuring that no other antenna than that furnished by Phonic Ear inc. will be used. Specifically, the connector used is a left hand thread TNC coaxial connector, denoted LH-TNC.

The transmitter uses a standard audio input from a microphone, as used for the testing detailed in this report, or another audio source.

See the User Instructions for a description of the available controls on the EUT.

The product is powered by a wall-mount transformer.

The internal construction is a single multi layer PC board, a front panel keyboard PC board, and a display module.

The product is housed in a metal box.

### **1.2 Related Submittal or Grant**

There are no related submittals or grants.

### 1.3 Tested System Details

EUT

Phonic Ear Part Number PE 560T transmitter, PC Board Fab 900-7285-401.

Power Supply Calrad Model 45-764, 120VAC input, 16 VAC output at 1.1 amp, with 1.9 meter unshielded cable.

With the following accessories:

Note: LH-TNC is a abbreviation for “Left Hand Thread TNC coaxial connector”

Accessory	PE Part Number	Description
Short Antenna	AT0777	Broadband antenna with LH-TNC connector
Groundplane	AT0775	Antenna Groundplane, LH-TNC with connector kit
Groundplane	AT0776	Antenna Groundplane, LH-TNC, with LH-TNC 50 foot cable
Large Area Antenna, Low Band	AT0773	Large Area Antenna, LH-TNC, Low Band, with connector kit
Large Area Antenna, High Band	AT0774	Large Area Antenna, High Band, LH-TNC with connector kit
Connector kit	AT0778	LH-TNC cable connector kit
Coax Cable	AT0779	LH-TNC cable, 50 feet long

Made by:

Phonic Ear Inc.  
3880 Cypress Drive  
Petaluma, CA 94954-7600

The circuit uses various oscillators. See the Block Diagram for more information.

#### **1.4 Test Methodology**

The emissions tests were performed in accordance with the ANSI C63.4-1992 standard.

#### **1.5 Test Facility**

The Glen Ellen Laboratories open area test site and conducted measurement facility is located in Glen Ellen, California, at the street address of 1876 London Ranch Road. This site has been fully described in a report dated September 16, 1996, submitted to the FCC, and accepted in a letter dated December 4, 1996 (31040/SIT/1300F2.)

Test equipment used included:

1. Hewlett Packard 8560A opt 002 spectrum analyzer, cal due 6-20-00.
2. Sonoma Instruments 317 preamplifier, 10 kHz to 2.5 GHz, cal due 3-5-00.
3. GEL BIC9414 biconical antenna, 30 MHz to 300 MHz, cal due 6-22-00.
4. GEL LPA-3 log periodic antenna, 275 MHz to 2 GHz, cal due 6-22-00.
5. Two Solar LISN's model number 8028-50-TS-24-BNC, cal due 5-09-00.
6. EMCO LISN, model number 3825/2, cal due 5-09-00.

## **2 PRODUCT MANUAL STATEMENT**

### **2.1 FCC Statement in User Manual**

The following statement appears in a prominent location in the text of the user manual:

*NOTE: 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.*

*Any changes or modifications made to any government approved element of this FM system, without the expressed approval of Phonic Ear Inc., in writing, could void the user's authority to operate those elements of the system.*

*If any antenna or cordage, other than those specifically approved for use with this FM system by Phonic Ear Inc. is used, the antenna or cord must be installed by a professional and the operation of the system must be verified by the installer of the antenna or cord to comply with applicable government regulations.*

*IMPORTANT: This product was tested for FCC compliance under conditions that included the use of shielded cables and connectors between System components.*

### **3 SYSTEM TEST CONFIGURATION**

#### **3.1 Justification**

The EUT was tested in accordance with the standard ANSI C63.4-1992, and 47 CFR Part 15. Measurements were made at 10 meter measurement distance. Part 15.237 Intentional Radiator test limits were scaled from 3 meter test distance to 10 meter test distance using the scale factor  $20 \cdot \text{LOG}(3/10)$ , or  $-10.5$  dB. The field strength limit in the specified 200 kHz transmitter bandwidth is 80 millivolts/meter at 3 meters, or 98.1 dBuV/meter at 3 meters, or 87.6 dBuV/meter at 10 meters. The out of band emissions limit is 1500 microvolts/meter at 3 meters, or 63.5 dBuV/meter at 3 meters, or 53.0 dBuV/meter at 10 meters. To prevent preamplifier overload, a notch filter at the transmit frequency was used to allow measurement of out of band measurements, and an attenuation of 20 dB was used for measuring power in band. Measurements were made using an average detector. Peak levels were less than 3 dB above average levels, compliant with FCC Part 15.35

Measurements were made in each of the three Part 15.237 frequency bands, Channel A in the 72.0 MHz to 73.0 MHz band, Channel I in the 74.6 MHz to 74.8 MHz band, and Channel H in the 75.2 MHz to 76.0 MHz band.

#### **3.2 EUT Exercise Equipment and Software**

The transmitter was tested without modulation for the radiated emissions test, and tested with modulation for the occupied bandwidth test. See the plots in Appendix 6.1 for details of the occupied bandwidth tests.

#### **3.3 Special Accessories**

No special accessories were used.

#### **3.4 Equipment Modifications**

No equipment modifications were made.



### **3.5 Configuration of Tested System**

The system was configured with the transmitter and the microphone placed 10 cm apart on the radiated test tabletop. The antenna was attached to the RF connector on the back of the unit. For the groundplane measurements, the antenna was connected to the Antenna Groundplane with a 10 foot coax cable.

For tests with the Large Area Antennas, the antenna was placed in a tripod stand next to the turntable. Power output of the transmitter was adjusted to compensate for the greater gain of the long antenna. See note below.

This condition put the EUT in the highest emissions state.

For the occupied bandwidth test the auxiliary microphone input connector was connected to an audio function generator through a 50 meter RG-58 cable. Modulation was set at the maximum.

See the photographs for the configuration of the tested system.

#### **Note:**

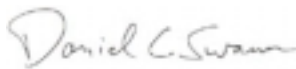
The conducted power was measured on a spectrum analyzer with a 50 ohm termination and recorded for both antenna configurations. These measurements will be used to set the output power on the units when tested in manufacturing.

#### 4 CONDUCTED EMISSIONS DATA

Conducted measurements were made using 10 kHz RBW, in quasi-peak detection mode. These measurements were made on July 23, 1999, August 4, 1999, and August 5, 1999, by Daniel Swann, Roger Davis and Lee Henderson. See the photographs for the configuration of the test setup.

Channel A Frequency MHz	72.1000 Measured Amplitude dBuV	Corrected Measured Amplitude dBuV	FCC B Limit dBuV	FCC B Margin dB
Line				
0.450	26.2	36.9	48.0	-11.1
12.288	15.6	29.1	48.0	-18.9
15.360	15.4	29.4	48.0	-18.6
18.432	14.6	28.9	48.0	-19.1
21.504	16.8	31.5	48.0	-16.5
24.576	24.5	39.4	48.0	-8.6
27.649	16.7	32.0	48.0	-16.0
Neutral				
0.458	30.9	41.6	48.0	-6.4
12.289	15.8	29.3	48.0	-18.8
15.359	16.0	30.0	48.0	-18.0
18.432	14.8	29.1	48.0	-18.9
21.504	16.5	31.1	48.0	-16.9
24.576	23.1	38.1	48.0	-9.9
27.649	14.1	29.4	48.0	-18.6

Test Personnel:




Tester Name: Daniel C. Swann

Channel H Frequency MHz	75.9000 Measured Amplitude dBuV	Corrected Measured Amplitude dBuV	FCC B Limit dBuV	FCC B Margin dB
Line				
0.451	27.3	37.9	48.0	-10.1
12.289	17.9	31.4	48.0	-16.6
15.361	17.1	31.0	48.0	-17.0
21.504	19.1	33.8	48.0	-14.2
24.577	23.8	38.8	48.0	-9.2
27.649	18.6	33.9	48.0	-14.1
Neutral				
0.500	28.5	39.2	48.0	-8.8
9.217	16.5	29.5	48.0	-18.5
12.289	15.4	28.9	48.0	-19.1
15.361	16.3	30.2	48.0	-17.8
18.433	14.6	28.8	48.0	-19.2
21.505	16.9	31.6	48.0	-16.4
24.577	22.0	37.0	48.0	-11.0
27.649	14.4	29.8	48.0	-18.2

Channel I	74.7000			
Line				
0.500	27.7	38.4	48.0	-9.6
9.214	19.0	32.0	48.0	-16.0
12.286	19.3	32.8	48.0	-15.2
15.358	17.9	31.8	48.0	-16.2
18.430	18.3	32.6	48.0	-15.4
21.502	18.8	33.5	48.0	-14.5
24.576	23.4	38.4	48.0	-9.6
27.648	18.5	33.8	48.0	-14.2
Neutral				
0.500	27.9	38.6	48.0	-9.4
12.288	16.1	29.6	48.0	-18.4
15.360	16.9	30.8	48.0	-17.2
18.432	16.1	30.4	48.0	-17.6
21.504	17.3	32.0	48.0	-16.0
24.576	23.9	38.9	48.0	-9.1
27.648	17.9	33.2	48.0	-14.8

Test Personnel:



Tester Name: Daniel C. Swann

## 5 RADIATED EMISSIONS DATA

### 5.1 Data

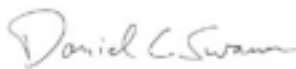
The following data lists the significant emissions frequencies, measured levels and FCC Part 15.237 limits for measurements made on July 23, 1999, August 4, 1999 and August 5, 1999 by Daniel Swann, Roger Davis and Lee Henderson. Measurements are average readings, with an IF bandwidth of 10 KHz for in band measurements, and 100 KHz for out of band measurements. A video filter was not used. Peak levels were less than 3 dB above average levels, compliant with FCC Part 15.35. The plots of Occupied Bandwidth for the three bands are presented in Appendix 6.1. See Section 3.1, Justification, for the calculation of the emission limits at 10 meter measurement distance.

#### In Band Measurements

##### Broadband Antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Channel A							
Vertical Polarization							
72.110	96.6	6.5	2.3	18.6	86.9	87.6	-0.7
Horizontal Polarization							
72.113	71.1	6.5	2.3	18.6	61.5	87.6	-26.1
Channel I							
Vertical Polarization							
74.710	94.2	6.6	2.4	18.6	84.6	87.6	-3.0
Horizontal Polarization							
74.716	82.1	6.6	2.4	18.6	72.4	87.6	-15.2
Channel H							
Vertical Polarization							
75.912	93.2	6.5	2.4	18.6	83.5	87.6	-4.1
Horizontal Polarization							
75.910	81.8	6.5	2.4	18.6	72.1	87.6	-15.5

Test Personnel:



Tester Name: Daniel C. Swann

**5.1 Data (continued) (in band measurements continued)****Measurements with groundplane**

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength DBuV/m	Part 15.237 Average dBuV/m	10 meter limit Average Margin
<b>Channel A</b>							
Vertical Polarization							
72.110	96.6	6.5	2.3	18.6	86.9	87.6	-0.7
Horizontal Polarization							
72.113	71.1	6.5	2.3	18.6	61.5	87.6	-26.1
<b>Channel I</b>							
Vertical Polarization							
74.713	95.7	6.6	2.4	18.6	86.1	87.6	-1.5
Horizontal Polarization							
74.708	68.6	6.6	2.4	18.6	58.9	87.6	-28.7
<b>Channel H</b>							
Vertical Polarization							
75.911	95.0	6.5	2.4	18.6	85.4	87.6	-2.2 channel H
Horizontal Polarization							
75.911	85.0	6.5	2.4	18.6	75.4	87.6	-12.2 channel H

Test Personnel:



Tester Name: Daniel C. Swann

**5.1 Data (continued) (in band measurements continued)****Measurements with Large Area Antenna**

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
<b>Channel A</b>							
Vertical Polarization							
72.108	95.5	6.5	2.3	18.6	85.8	87.6	-1.8
Horizontal Polarization							
72.108	72.5	6.5	2.3	18.6	62.8	87.6	-24.8
<b>Channel I</b>							
Vertical Polarization							
74.713	96.5	6.6	2.4	18.6	86.8	87.6	-0.8
Horizontal Polarization							
74.719	74.0	6.6	2.4	18.6	64.3	87.6	-23.3
<b>Channel H</b>							
Vertical Polarization							
75.900	96.3	6.5	2.4	18.6	86.7	87.6	-0.9
Horizontal Polarization							
75.899	71.7	6.5	2.4	18.6	62.0	87.6	-25.6

Test Personnel:



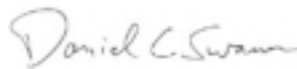
Tester Name: Daniel C. Swann

**5.1 Data (continued)****Out of Band Measurements**

Channel A, broadband antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	10 meter limit Average Margin
Vertical Polarization							
36.860	43.0	15.7	1.7	38.5	21.9	53.0	-31.1
40.000	47.3	14.4	1.8	38.5	24.9	53.0	-28.1
55.290	50.4	9.2	2.1	38.5	23.2	53.0	-29.8
62.100	40.1	7.8	2.2	38.5	11.6	53.0	-41.4
73.720	30.7	6.6	2.4	38.6	1.1	53.0	-51.9
110.580	44.6	11.4	2.9	38.6	20.4	53.0	-32.6
120.000	50.0	12.9	3.0	38.5	27.4	53.0	-25.6
124.200	39.0	13.2	3.1	38.5	16.7	53.0	-36.3
129.010	41.7	13.7	3.1	38.5	19.9	53.0	-33.1
144.220	45.8	14.5	3.3	38.5	25.1	53.0	-27.9
160.000	65.4	15.2	3.5	38.5	45.6	53.0	-7.4
184.300	41.2	16.5	3.7	38.6	22.9	53.0	-30.1
186.300	34.7	16.5	3.7	38.6	16.4	53.0	-36.6
200.000	53.1	17.0	3.9	38.6	35.3	53.0	-17.7
216.330	39.1	17.3	4.0	38.6	21.8	53.0	-31.2
239.620	36.2	17.0	4.3	38.7	18.8	53.0	-34.2
240.000	55.1	17.0	4.3	38.7	37.7	53.0	-15.3
248.400	31.4	17.2	4.4	38.7	14.3	53.0	-38.7
288.440	36.9	18.4	4.7	38.6	21.5	53.0	-31.5
320.000	43.0	15.1	5.0	38.5	24.6	53.0	-28.4
400.000	44.5	17.0	5.6	38.6	28.5	53.0	-24.5
480.000	47.0	18.4	6.2	38.5	33.1	53.0	-19.9
560.000	46.1	19.7	6.7	38.6	33.9	53.0	-19.1

Test Personnel:



Tester Name: Daniel C. Swann

**5.1 Data (continued)****Out of Band Measurements**

Channel A, broadband  
antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Horizontal Polarization							
40.000	32.0	14.4	1.8	38.5	9.6	53.0	-43.4
40.000	32.0	14.4	1.8	38.5	9.6	53.0	-43.4
120.000	45.7	12.9	3.0	38.5	23.1	53.0	-29.9
120.000	45.7	12.9	3.0	38.5	23.1	53.0	-29.9
124.200	36.3	13.2	3.1	38.5	14.0	53.0	-39.0
124.200	36.3	13.2	3.1	38.5	14.0	53.0	-39.0
144.223	42.1	14.5	3.3	38.5	21.4	53.0	-31.6
144.223	42.1	14.5	3.3	38.5	21.4	53.0	-31.6
160.000	61.4	15.2	3.5	38.5	41.6	53.0	-11.4
160.000	61.4	15.2	3.5	38.5	41.6	53.0	-11.4
184.300	41.8	16.5	3.7	38.6	23.4	53.0	-29.6
184.300	41.8	16.5	3.7	38.6	23.4	53.0	-29.6
200.000	51.6	17.0	3.9	38.6	33.9	53.0	-19.1
200.000	51.6	17.0	3.9	38.6	33.9	53.0	-19.1
216.333	35.4	17.3	4.0	38.6	18.2	53.0	-34.8
216.333	35.4	17.3	4.0	38.6	18.2	53.0	-34.8
240.000	49.5	17.0	4.3	38.7	32.2	53.0	-20.8
240.000	49.5	17.0	4.3	38.7	32.2	53.0	-20.8
320.000	48.3	15.1	5.0	38.5	29.8	53.0	-23.2
400.000	47.0	17.0	5.6	38.6	31.0	53.0	-22.0
480.000	49.4	18.4	6.2	38.5	35.5	53.0	-17.5
560.000	52.9	19.7	6.7	38.6	40.6	53.0	-12.4

Test Personnel:



Tester Name: Daniel C. Swann

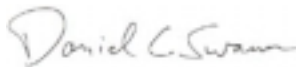


**5.1 Data (continued) (out of band measurements continued)**

Channel I, broadband antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Vertical Polarization							
36.860	41.4	15.7	1.7	38.5	20.4	53.0	-32.6
40.000	48.4	14.4	1.8	38.5	26.1	53.0	-26.9
55.277	49.7	9.2	2.1	38.5	22.4	53.0	-30.6
110.580	42.8	11.4	2.9	38.6	18.5	53.0	-34.5
120.000	51.7	12.9	3.0	38.5	29.1	53.0	-23.9
147.419	42.1	14.6	3.3	38.5	21.4	53.0	-31.6
149.420	42.3	14.8	3.3	38.5	21.9	53.0	-31.1
160.000	62.5	15.2	3.5	38.5	42.7	53.0	-10.3
184.279	38.2	16.5	3.7	38.6	19.9	53.0	-33.1
200.000	50.1	17.0	3.9	38.6	32.3	53.0	-20.7
224.120	42.3	17.2	4.1	38.6	25.0	53.0	-28.0
239.569	35.4	17.0	4.3	38.7	18.0	53.0	-35.0
240.000	56.3	17.0	4.3	38.7	38.9	53.0	-14.1
298.830	33.3	19.1	4.8	38.6	18.6	53.0	-34.4
320.000	45.1	15.1	5.0	38.5	26.6	53.0	-26.4
400.000	46.0	17.0	5.6	38.6	30.0	53.0	-23.0
560.000	47.7	19.7	6.7	38.6	35.4	53.0	-17.6
Horizontal Polarization							
120.000	49.0	12.9	3.0	38.5	26.4	53.0	-26.6
149.395	42.2	14.8	3.3	38.5	21.8	53.0	-31.2
160.000	58.1	15.2	3.5	38.5	38.2	53.0	-14.8
160.000	57.7	15.2	3.5	38.5	37.8	53.0	-15.2
184.300	40.3	16.5	3.7	38.6	22.0	53.0	-31.0
200.000	51.9	17.0	3.9	38.6	34.1	53.0	-18.9
240.000	52.6	17.0	4.3	38.7	35.3	53.0	-17.7
298.825	34.7	19.1	4.8	38.6	20.0	53.0	-33.0
320.000	48.1	15.1	5.0	38.5	29.6	53.0	-23.4
400.000	48.1	17.0	5.6	38.6	38.6	53.0	38.6
440.000	52.5	17.4	5.9	38.5	37.3	53.0	-15.7
480.000	51.3	18.4	6.2	38.5	37.4	53.0	-15.6

Test Personnel:




Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**

Channel H, broadband antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Vertical Polarization							
36.860	41.7	15.7	1.7	38.5	20.7	53.0	-32.3
40.000	48.8	14.4	1.8	38.5	26.5	53.0	-26.5
55.292	49.7	9.2	2.1	38.5	22.5	53.0	-30.5
62.100	38.4	7.8	2.2	38.5	9.9	53.0	-43.1
110.582	46.3	11.4	2.9	38.6	22.1	53.0	-30.9
120.000	53.5	12.9	3.0	38.5	30.9	53.0	-22.1
124.200	33.2	13.2	3.1	38.5	10.9	53.0	-42.1
151.801	41.5	15.0	3.3	38.5	21.3	53.0	-31.7
160.000	62.3	15.2	3.5	38.5	42.4	53.0	-10.6
184.302	40.5	16.5	3.7	38.6	22.2	53.0	-30.8
200.000	49.9	17.0	3.9	38.6	32.2	53.0	-20.8
227.713	36.6	17.0	4.1	38.6	19.1	53.0	-33.9
239.590	36.1	17.0	4.3	38.7	18.7	53.0	-34.3
240.000	56.2	17.0	4.3	38.7	38.8	53.0	-14.2
320.000	43.8	15.1	5.0	38.5	25.4	53.0	-27.6
400.000	45.7	17.0	5.6	38.6	29.7	53.0	-23.3
480.000	48.1	18.4	6.2	38.5	34.2	53.0	-18.8
560.000	48.3	19.7	6.7	38.6	36.0	53.0	-17.0
Horizontal Polarization							
120.000	46.7	12.9	3.0	38.5	24.1	53.0	-28.9
151.800	38.9	15.0	3.3	38.5	18.7	53.0	-34.3
160.000	58.2	15.2	3.5	38.5	38.4	53.0	-14.6
184.300	41.9	16.5	3.7	38.6	23.6	53.0	-29.4
200.000	51.8	17.0	3.9	38.6	34.0	53.0	-19.0
227.700	36.9	17.0	4.1	38.6	19.4	53.0	-33.6
240.000	52.6	17.0	4.3	38.7	35.2	53.0	-17.8
280.000	49.1	18.3	4.7	38.6	33.5	53.0	-19.5
320.000	50.2	15.1	5.0	38.5	31.7	53.0	-21.3
400.000	47.9	17.0	5.6	38.6	31.9	53.0	-21.1
480.000	50.6	18.4	6.2	38.5	36.8	53.0	-16.2
560.000	53.2	19.7	6.7	38.6	40.9	53.0	-12.1

Test Personnel:




Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**Channel A, groundplane  
configuration

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	10 meter limit Average Margin
Vertical Polarization							
40.000	44.4	14.4	1.8	38.5	22.1	53.0	-30.9
62.100	47.2	7.8	2.2	38.5	18.7	53.0	-34.3
120.000	48.6	12.9	3.0	38.5	25.9	53.0	-27.1
144.220	48.4	14.5	3.3	38.5	27.7	53.0	-25.3
160.000	61.6	15.2	3.5	38.5	41.7	53.0	-11.3
184.300	38.5	16.5	3.7	38.6	20.2	53.0	-32.8
200.000	56.1	17.0	3.9	38.6	38.4	53.0	-14.6
240.000	48.9	17.0	4.3	38.7	31.6	53.0	-21.4
280.000	39.2	18.3	4.7	38.6	23.6	53.0	-29.4
320.000	41.4	15.1	5.0	38.5	23.0	53.0	-30.0
360.000	46.2	16.3	5.3	38.6	29.2	53.0	-23.8
400.000	46.2	17.0	5.6	38.6	30.2	53.0	-22.8
440.000	44.3	17.4	5.9	38.5	29.1	53.0	-23.9
480.000	42.1	18.4	6.2	38.5	28.2	53.0	-24.8
520.000	51.8	18.6	6.4	38.5	38.3	53.0	-14.7
560.000	45.4	19.7	6.7	38.6	33.2	53.0	-19.8
600.000	44.3	19.8	6.9	38.4	32.5	53.0	-20.5
720.000	37.6	21.5	7.5	38.6	28.0	53.0	-25.0
Horizontal Polarization							
120.000	52.3	12.9	3.0	38.5	29.6	53.0	-23.4
144.200	45.4	14.5	3.3	38.5	24.7	53.0	-28.3
160.000	56.8	15.2	3.5	38.5	36.9	53.0	-16.1
200.000	45.4	17.0	3.9	38.6	27.6	53.0	-25.4
240.000	50.9	17.0	4.3	38.7	33.5	53.0	-19.5
280.000	35.1	18.3	4.7	38.6	19.5	53.0	-33.5
320.000	39.5	15.1	5.0	38.5	21.0	53.0	-32.0
360.000	44.1	16.3	5.3	38.6	27.1	53.0	-25.9
400.000	44.8	17.0	5.6	38.6	28.8	53.0	-24.2
440.000	39.6	17.4	5.9	38.5	24.4	53.0	-28.6
480.000	36.0	18.4	6.2	38.5	22.1	53.0	-30.9
560.000	36.2	19.7	6.7	38.6	24.0	53.0	-29.0

Test Personnel:




Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**

Channel I, groundplane  
configuration

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Vertical Polarization							
36.860	38.1	15.7	1.7	38.5	17.1	53.0	-35.9
40.000	49.6	14.4	1.8	38.5	27.3	53.0	-25.7
73.720	34.4	6.6	2.4	38.6	4.8	53.0	-48.2
80.000	35.0	6.8	2.4	38.6	5.7	53.0	-47.3
92.150	46.8	8.6	2.6	38.6	19.5	53.0	-33.5
110.580	38.1	11.4	2.9	38.6	13.9	53.0	-39.1
120.000	54.2	12.9	3.0	38.5	31.6	53.0	-21.4
129.010	33.6	13.7	3.1	38.5	11.8	53.0	-41.2
147.440	37.0	14.6	3.3	38.5	16.4	53.0	-36.6
149.426	45.6	14.8	3.3	38.5	25.1	53.0	-27.9
160.000	58.6	15.2	3.5	38.5	38.8	53.0	-14.2
165.870	38.7	15.7	3.5	38.5	19.4	53.0	-33.6
184.300	41.1	16.5	3.7	38.6	22.8	53.0	-30.2
200.000	52.4	17.0	3.9	38.6	34.7	53.0	-18.3
202.730	35.5	17.1	3.9	38.6	17.9	53.0	-35.1
221.160	34.1	17.0	4.1	38.6	16.5	53.0	-36.5
224.139	42.8	17.2	4.1	38.6	25.4	53.0	-27.6
239.590	33.5	17.0	4.3	38.7	16.1	53.0	-36.9
240.000	54.1	17.0	4.3	38.7	36.8	53.0	-16.2
258.020	32.3	17.5	4.5	38.7	15.6	53.0	-37.4
280.000	39.0	18.3	4.7	38.6	23.4	53.0	-29.6
298.852	32.1	19.1	4.8	38.6	17.4	53.0	-35.6
320.000	40.8	15.1	5.0	38.5	22.4	53.0	-30.6
320.000	41.5	15.1	5.0	38.5	23.0	53.0	-30.0
360.000	46.3	16.3	5.3	38.6	29.3	53.0	-23.7
360.000	46.4	16.3	5.3	38.6	29.4	53.0	-23.6
400.000	47.6	17.0	5.6	38.6	31.6	53.0	-21.4
440.000	45.9	17.4	5.9	38.5	30.7	53.0	-22.3
480.000	42.5	18.4	6.2	38.5	28.6	53.0	-24.4
560.000	45.4	19.7	6.7	38.6	33.1	53.0	-19.9
600.000	44.5	19.8	6.9	38.4	32.7	53.0	-20.3
680.000	39.7	21.5	7.3	38.6	29.9	53.0	-23.1
720.000	38.9	21.5	7.5	38.6	29.3	53.0	-23.7
760.000	34.3	21.8	7.7	38.4	25.4	53.0	-27.6

Test Personnel:



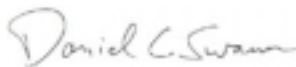
Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**

Channel I, groundplane  
configuration

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Horizontal Polarization							
40.000	36.4	14.4	1.8	38.5	14.1	53.0	-38.9
62.100	35.3	7.8	2.2	38.5	6.8	53.0	-46.2
80.000	32.8	6.8	2.4	38.6	3.5	53.0	-49.5
110.580	35.6	11.4	2.9	38.6	11.4	53.0	-41.6
120.000	54.8	12.9	3.0	38.5	32.1	53.0	-20.9
124.200	36.5	13.2	3.1	38.5	14.2	53.0	-38.8
129.010	37.3	13.7	3.1	38.5	15.5	53.0	-37.5
147.440	38.8	14.6	3.3	38.5	18.2	53.0	-34.8
149.392	40.8	14.8	3.3	38.5	20.3	53.0	-32.7
160.000	53.4	15.2	3.5	38.5	33.6	53.0	-19.4
184.300	33.3	16.5	3.7	38.6	15.0	53.0	-38.0
186.300	34.7	16.5	3.7	38.6	16.3	53.0	-36.7
200.000	43.5	17.0	3.9	38.6	25.7	53.0	-27.3
224.100	34.1	17.2	4.1	38.6	16.7	53.0	-36.3
240.000	52.4	17.0	4.3	38.7	35.1	53.0	-17.9
248.400	33.5	17.2	4.4	38.7	16.3	53.0	-36.7
280.000	33.9	18.3	4.7	38.6	18.3	53.0	-34.7
298.808	32.6	19.1	4.8	38.6	17.9	53.0	-35.1
320.000	39.2	15.1	5.0	38.5	20.8	53.0	-32.2
360.000	43.2	16.3	5.3	38.6	26.2	53.0	-26.8
400.000	45.2	17.0	5.6	38.6	29.2	53.0	-23.8
440.000	40.2	17.4	5.9	38.5	25.0	53.0	-28.0
480.000	36.5	18.4	6.2	38.5	22.6	53.0	-30.4
560.000	35.9	19.7	6.7	38.6	23.6	53.0	-29.4
600.000	38.0	19.8	6.9	38.4	26.2	53.0	-26.8
760.000	35.0	21.8	7.7	38.4	26.0	53.0	-27.0

Test Personnel:



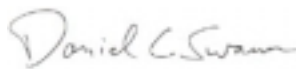
Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**

Channel H, groundplane configuration

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Vertical Polarization							
36.860	36.1	15.7	1.7	38.5	15.1	53.0	-37.9
36.860	35.3	15.7	1.7	38.5	14.3	53.0	-38.7
40.000	44.9	14.4	1.8	38.5	22.5	53.0	-30.5
55.290	60.5	9.2	2.1	38.5	33.2	53.0	-19.8
62.100	48.2	7.8	2.2	38.5	19.7	53.0	-33.3
73.720	33.7	6.6	2.4	38.6	4.0	53.0	-49.0
80.000	34.6	6.8	2.4	38.6	5.3	53.0	-47.7
110.580	39.1	11.4	2.9	38.6	14.9	53.0	-38.1
120.000	54.8	12.9	3.0	38.5	32.2	53.0	-20.8
147.440	31.3	14.6	3.3	38.5	10.7	53.0	-42.3
151.820	41.8	15.0	3.3	38.5	21.6	53.0	-31.4
160.000	58.8	15.2	3.5	38.5	39.0	53.0	-14.0
184.300	38.2	16.5	3.7	38.6	19.9	53.0	-33.1
186.300	41.1	16.5	3.7	38.6	22.8	53.0	-30.2
200.000	53.0	17.0	3.9	38.6	35.3	53.0	-17.7
221.160	33.8	17.0	4.1	38.6	16.2	53.0	-36.8
227.730	38.5	17.0	4.1	38.6	21.0	53.0	-32.0
240.000	54.1	17.0	4.3	38.7	36.8	53.0	-16.2
258.020	31.7	17.5	4.5	38.7	15.0	53.0	-38.0
280.000	40.3	18.3	4.7	38.6	24.7	53.0	-28.3
320.000	41.4	15.1	5.0	38.5	22.9	53.0	-30.1
360.000	46.4	16.3	5.3	38.6	29.4	53.0	-23.6
400.000	47.2	17.0	5.6	38.6	31.2	53.0	-21.8
440.000	44.0	17.4	5.9	38.5	28.8	53.0	-24.2
480.000	42.4	18.4	6.2	38.5	28.5	53.0	-24.5
520.000	51.1	18.6	6.4	38.5	37.7	53.0	-15.3
560.000	44.8	19.7	6.7	38.6	32.6	53.0	-20.4
600.000	44.4	19.8	6.9	38.4	32.6	53.0	-20.4
720.000	39.6	21.5	7.5	38.6	30.0	53.0	-23.0

Test Personnel:



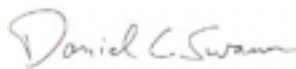
Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**

Channel H, groundplane configuration

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	10 meter limit Average Margin
Horizontal Polarization							
120.000	54.7	12.9	3.0	38.5	32.0	53.0	-21.0
129.010	38.4	13.7	3.1	38.5	16.6	53.0	-36.4
151.800	38.8	15.0	3.3	38.5	18.5	53.0	-34.5
160.000	53.6	15.2	3.5	38.5	33.7	53.0	-19.3
184.300	33.1	16.5	3.7	38.6	14.8	53.0	-38.2
200.000	44.1	17.0	3.9	38.6	26.4	53.0	-26.6
227.700	29.5	17.0	4.1	38.6	11.9	53.0	-41.1
240.000	51.5	17.0	4.3	38.7	34.1	53.0	-18.9
280.000	33.3	18.3	4.7	38.6	17.7	53.0	-35.3
320.000	40.5	15.1	5.0	38.5	22.1	53.0	-30.9
360.000	43.7	16.3	5.3	38.6	26.7	53.0	-26.3
400.000	45.4	17.0	5.6	38.6	29.4	53.0	-23.6
440.000	41.2	17.4	5.9	38.5	26.0	53.0	-27.0
480.000	34.8	18.4	6.2	38.5	20.9	53.0	-32.1
560.000	36.4	19.7	6.7	38.6	24.2	53.0	-28.8
600.000	39.3	19.8	6.9	38.4	27.5	53.0	-25.5

Test Personnel:



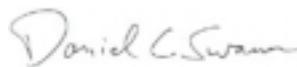
Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**

## Channel A, Large Area Antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 Average dBuV/m	10 meter limit Average Margin
Vertical Polarization							
40.012	52.4	14.4	1.8	38.5	30.1	53.0	-22.9
62.100	48.7	7.8	2.2	38.5	20.2	53.0	-32.8
120.012	53.6	12.9	3.0	38.5	31.0	53.0	-22.0
144.200	42.7	14.5	3.3	38.5	21.9	53.0	-31.1
160.012	65.2	15.2	3.5	38.5	45.3	53.0	-7.7
200.012	57.3	17.0	3.9	38.6	39.6	53.0	-13.4
240.012	51.4	17.0	4.3	38.7	34.1	53.0	-18.9
280.012	52.7	18.3	4.7	38.6	37.1	53.0	-15.9
320.000	46.3	15.1	5.0	38.5	27.9	53.0	-25.1
360.000	48.0	16.3	5.3	38.6	31.0	53.0	-22.0
Horizontal Polarization							
62.100	48.1	7.8	2.2	38.5	19.6	53.0	-33.4
120.000	48.8	12.9	3.0	38.5	26.2	53.0	-26.8
147.072	47.5	14.6	3.3	38.5	26.8	53.0	-26.2
160.000	66.1	15.2	3.5	38.5	46.3	53.0	-6.7
200.000	57.7	17.0	3.9	38.6	39.9	53.0	-13.1
240.012	47.6	17.0	4.3	38.7	30.3	53.0	-22.7
280.012	51.6	18.3	4.7	38.6	36.0	53.0	-17.0
320.000	47.6	15.1	5.0	38.5	29.2	53.0	-23.8
360.000	45.8	16.3	5.3	38.6	28.8	53.0	-24.2

Test Personnel:



Tester Name: Daniel C. Swann



**5.1 Data (continued) (out of band measurements continued)**

## Channel I, Large Area Antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 Average dBuV/m	10 meter limit Average Margin
Vertical Polarization							
36.864	40.0	15.7	1.7	38.5	19.0	53.0	-34.0
40.000	45.6	14.4	1.8	38.5	23.3	53.0	-29.7
62.100	47.3	7.8	2.2	38.5	18.8	53.0	-34.2
110.592	41.3	11.4	2.9	38.6	17.1	53.0	-35.9
120.000	57.5	12.9	3.0	38.5	34.9	53.0	-18.1
124.200	43.8	13.2	3.1	38.5	21.5	53.0	-31.5
147.426	48.9	14.6	3.3	38.5	28.2	53.0	-24.8
149.426	45.4	14.8	3.3	38.5	25.0	53.0	-28.0
160.000	61.8	15.2	3.5	38.5	42.0	53.0	-11.0
224.115	35.1	17.2	4.1	38.6	17.8	53.0	-35.2
240.000	49.6	17.0	4.3	38.7	32.3	53.0	-20.7
298.828	32.0	19.1	4.8	38.6	17.3	53.0	-35.7
320.000	45.6	15.1	5.0	38.5	27.1	53.0	-25.9
360.000	46.9	16.3	5.3	38.6	29.9	53.0	-23.1
Horizontal Polarization							
40.000	37.1	14.4	1.8	38.5	14.7	53.0	-38.3
62.100	33.6	7.8	2.2	38.5	5.1	53.0	-47.9
120.000	50.1	12.9	3.0	38.5	27.4	53.0	-25.6
149.439	42.4	14.8	3.3	38.5	21.9	53.0	-31.1
160.000	62.3	15.2	3.5	38.5	42.4	53.0	-10.6
320.000	44.5	15.1	5.0	38.5	26.1	53.0	-26.9
360.000	49.6	16.3	5.3	38.6	32.6	53.0	-20.4

Test Personnel:



Tester Name: Daniel C. Swann

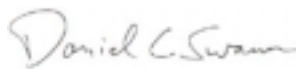
**5.1 Data (continued) (out of band measurements continued)**

Channel H, Large Area Antenna

Out of Band Measurements

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Vertical Polarization							
36.864	38.2	15.7	1.7	38.5	17.2	53.0	-35.8
40.000	45.8	14.4	1.8	38.5	23.4	53.0	-29.6
55.296	44.8	9.2	2.1	38.5	17.5	53.0	-35.5
80.000	27.9	6.8	2.4	38.6	-1.4	53.0	-54.4
110.592	38.6	11.4	2.9	38.6	14.4	53.0	-38.6
120.000	51.2	12.9	3.0	38.5	28.6	53.0	-24.4
129.024	27.1	13.7	3.1	38.5	5.3	53.0	-47.7
147.456	36.7	14.6	3.3	38.5	16.1	53.0	-36.9
151.802	44.2	15.0	3.3	38.5	23.9	53.0	-29.1
160.000	63.9	15.2	3.5	38.5	44.1	53.0	-8.9
184.320	36.4	16.5	3.7	38.6	18.1	53.0	-34.9
200.000	50.2	17.0	3.9	38.6	32.4	53.0	-20.6
227.704	34.4	17.0	4.1	38.6	16.9	53.0	-36.1
240.001	50.8	17.0	4.3	38.7	33.4	53.0	-19.6
280.000	44.6	18.3	4.7	38.6	29.0	53.0	-24.0
319.989	47.7	15.0	5.0	38.5	29.2	53.0	-23.8
359.989	39.0	16.1	5.3	38.6	21.8	53.0	-31.2

Test Personnel:




Tester Name: Daniel C. Swann

**5.1 Data (continued) (out of band measurements continued)**

Channel H, Large Area Antenna

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	10 meter limit Average Margin
Horizontal Polarization							
120.000	44.7	12.9	3.0	38.5	22.1	53.0	-30.9
151.799	42.9	15.0	3.3	38.5	22.6	53.0	-30.4
151.800	42.9	15.0	3.3	38.5	22.6	53.0	-30.4
160.000	59.3	15.2	3.5	38.5	39.4	53.0	-13.6
184.320	36.0	16.5	3.7	38.6	17.7	53.0	-35.3
184.320	39.9	16.5	3.7	38.6	21.6	53.0	-31.4
200.000	51.7	17.0	3.9	38.6	33.9	53.0	-19.1
202.752	31.5	17.1	3.9	38.6	14.0	53.0	-39.0
227.699	34.0	17.0	4.1	38.6	16.5	53.0	-36.5
240.000	41.7	17.0	4.3	38.7	24.4	53.0	-28.6
280.000	42.7	18.3	4.7	38.6	27.1	53.0	-25.9
320.000	46.2	15.1	5.0	38.5	27.8	53.0	-25.2
359.989	49.0	16.1	5.3	38.6	31.9	53.0	-21.1

Test Personnel:



Tester Name: Daniel C. Swann

## 5.2 Field Strength Calculations

The field strength was calculated from the following formula:

$$\text{FIELD STRENGTH} = \text{MEASURED SIGNAL} + \text{CORRECTION FACTOR}$$

Where             $\text{MEASURED SIGNAL} = \text{Spectrum Analyzer amplitude, in dBuV}$

$\text{CORRECTION FACTOR} = \text{AF} + \text{CF} - \text{GAIN, in dB/m}$

$\text{AF} = \text{antenna factor, in dB/m}$

$\text{CF} = \text{cable attenuation factor, in dB}$

$\text{GAIN} = \text{pre-amplifier gain, in dB, minus any attenuation used}$

For example, at 160.000 MHz in vertical polarization, broadband antenna, out of band measurement, Channel A, an average reading of 65.4 dBuV was measured, and the antenna factor is 15.2 dB/m, the cable loss is 3.5 dB, and the pre-amplifier gain is 38.5 dB.

$$\text{FS (dBuV/m)} = 65.4 + 15.2 + 3.5 - 38.5$$

$$\text{FS (dBuV/m)} = 45.6 \text{ dBuV/m}$$

FCC Part 15.237 Limit, out of band, = 53.0 dBuV/m  
at 10 meters measurement distance.

## 6 APPENDIX

### 6.1 Plots of Occupied Bandwidth

Following are the plots of the Plots of Occupied Bandwidth of Part 15.237 limits for measurements made on July 23, 1999, August 4, 1999 and August 5, 1999 by Daniel Swann, Roger Davis and Lee Henderson.

Measurements were made at 10 meter measurement distance. Part 15.237 Intentional Radiator test limits were scaled from 3 meter test distance to 10 meter test distance using the scale factor  $20 \cdot \log(3/10)$ , or  $-10.5$  dB. The out of band emissions limit is 1500 microvolts/meter at 3 meters, or 63.5 dBuV/meter at 3 meters, or 53.0 dBuV/meter at 10 meters. An attenuation of 20 dB was used, as reflected in the amplifier gain of 18.6 dB. Measurements were made in vertical polarization based on earlier measurements showing that vertical polarization is about 20 dB higher than horizontal polarization.

The out of band measurement limit was calculated from the following:

Frequency MHz	Measured Amplitude dBuV	Antenna Factor dB/m	Cable Loss dB	Amplifier Gain dB	Field Strength dBuV/m	Part 15.237 10 meter limit Average dBuV/m	Average Margin
Channel I							

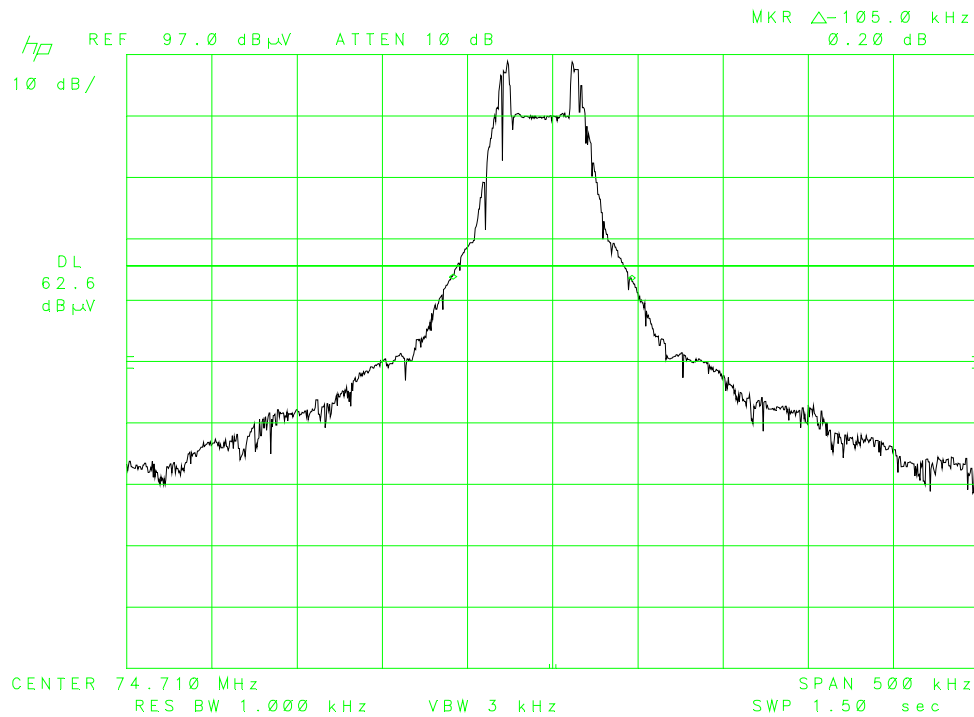
for zero dB margin, i.e. the maximum signal for part 15.237 out of band limit, the calculation is:

74.710	62.6	6.6	2.4	18.6	53.0	53.0	0.0
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Thus, the receiver input level for a signal at the part 15.237 out of band limit is 62.6 dBuV

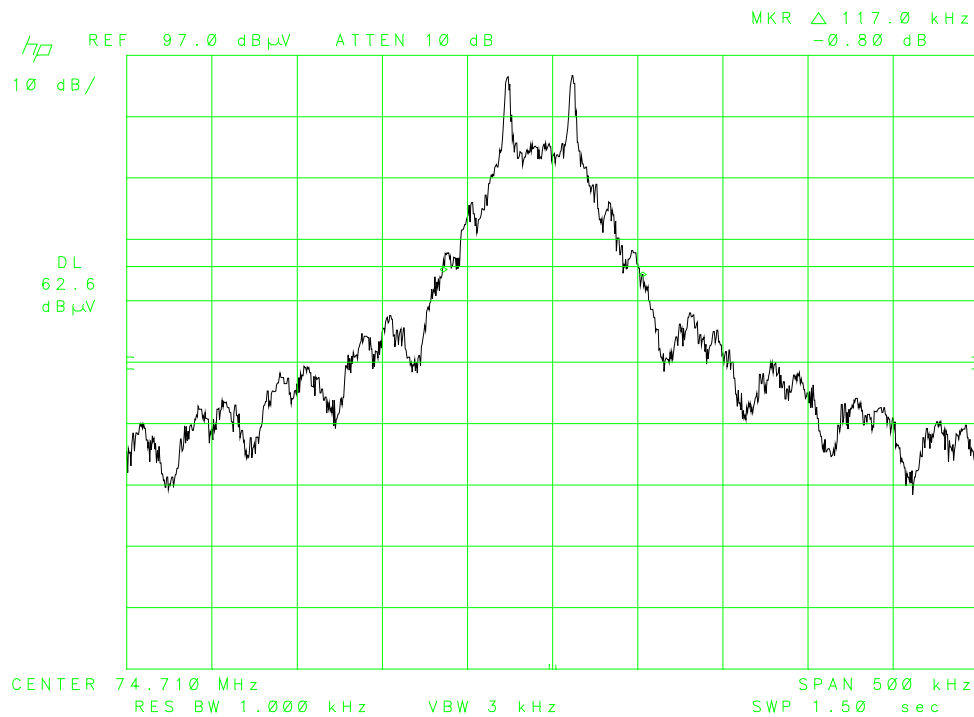
## 6.1 Plots of Occupied Bandwidth

Plot of occupied bandwidth at 100 Hz modulation. Display line, set at 62.6 dBuV denotes the out of band emission limit of 1500 uV/meter at 3 meter measurement distance. The emission bandwidth at 62.6 dBuV limit is 98.8 kHz, under the limit of 200 kHz.



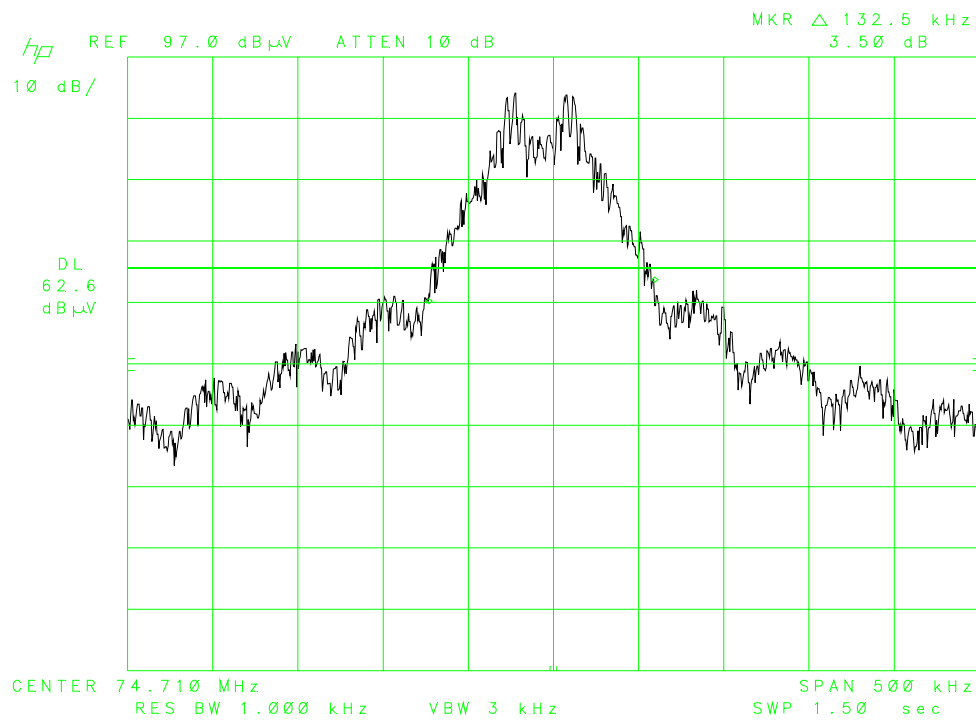
## 6.1 Plots of Occupied Bandwidth (continued)

Plot of occupied bandwidth at 1 kHz modulation. Display line, set at 62.6 dBuV denotes the out of band emission limit of 1500 uV/meter at 3 meter measurement distance. The emission bandwidth at 62.6 dBuV limit is 117.0 kHz, under the limit of 200 kHz.



## 6.1 Plots of Occupied Bandwidth (continued)

Plot of occupied bandwidth at 5 kHz modulation. Display line, set at 62.6 dBuV denotes the out of band emission limit of 1500 uV/meter at 3 meter measurement distance. The emission bandwidth at 62.6 dBuV limit is 132.5 kHz, under the limit of 200 kHz.





### **6.3 List of Exhibits**

Internal photographs. See file "Internal Photos.doc"  
External photographs. See file "External Photos.doc"  
Test set up photographs. See file "Test Setup Photos.doc"  
Block Diagram. See file "Block Diagram.doc"  
Schematic Diagram. See file "Schematic.doc"  
Theory of Operation. See file "Operational Description.doc"  
User Guide. See file "User Guide.doc"  
FCC Label. See file "FCC ID label and label location.doc"  
LH-TNC Printed Circuit Board Connector. See file "RT-1208.pdf"  
LH-TNC Bulkhead Connector. See file "RT-1211-1.pdf"  
LH-TNC Cable Connector. See file "RT-1200-C.pdf"  
LH-TNC Right Angle Adapter. See file "RT-1227.pdf"  
Whip Antenna w/ LH-TNC Connector. See file "CAF25862.pdf"  
Antenna Ground Plane with Connector Kit. See file "AT0775.pdf"  
Antenna Ground Plane with 50' Cable. See file "AT0776.pdf"  
LH-TNC Cable Connector Kit. See file "AT0778.pdf"  
LH-TNC Cable, 50ft. See file "AT0779.pdf"