



Measurement of RF Interference from a
Model M110 Transmitter

For : Touchtronics, Inc.
Elkhart, IN


P.O. No. : 8532

Date Received: August 3, 2006

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Test Personnel: Daniel E. Crowder

Specification : FCC "Code of Federal Regulations" Title 47
Part 15, Subpart C

Test Report By : 
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Approved By : 
Raymond J. Klouda
Registered Professional Engineer of
Illinois - 44894



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THIS REPORT SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF
ELITE ELECTRONIC ENGINEERING INCORPORATED.

Measurement of RF Emissions from the M110 transmitter

1.0 INTRODUCTION:

1.1 Description of Test Item - This document represents the results of the series of radio interference measurements performed on a model M110 transmitter, (hereinafter referred to as the test item). The test item was designed to transmit at approximately 135 kHz using an internal antenna. The test item was manufactured and submitted for testing by Touchtronics, Inc. located in Elkhart, IN.

1.2 Purpose - The test series was performed to determine if the test item meets the radiated RF emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Sections for Intentional Radiators. Testing was performed in accordance with ANSI C63.4-2003.

1.3 Deviations, Additions and Exclusions - There were no deviations, additions to, or exclusions from the test specification during this test series.

1.4 Applicable Documents - The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 15, Subpart C, dated 1 October 2005
- ANSI C63.4-2003, "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz"

1.5 Subcontractor Identification - This series of tests was performed by Elite Electronic Engineering Incorporated of Downers Grove, Illinois. The laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). NVLAP Lab Code: 100278-0.

1.6 Laboratory Conditions - The temperature at the time of the test was 25°C and the relative humidity was 55%.

2.0 TEST ITEM SETUP AND OPERATION:

The test item is an M110. A block diagram of the test item setup is shown as Figure 1.

2.1 Power Input - The test item received 13.6VDC power via power supply.

2.2 Grounding - Since the test item is typically used in a vehicle, it was ungrounded during the tests.

2.3 Support Equipment - No support equipment was required for the test.

2.4 Interconnect Cables - A 1.5 meter cable harness with provided. The harness was un-terminated for the test.

2.5 Operational Mode - The test item was powered and placed on an 80cm high non-conductive table. When the test item was powered, it was in its normal operating mode, transmitting at 135kHz. Operation of the test item could be verified by placing a proximity card near the test item and monitoring LEDs.

3.0 TEST EQUIPMENT:

3.1 Test Equipment List - A list of the test equipment used can be found on Table I. All equipment was calibrated per the instruction manuals supplied by the manufacturer.

The fundamental, harmonics and spurious emissions were measured with a spectrum analyzer. All measurements were taken with the resolution and video bandwidth of the measuring instrument adjusted to 300Hz below 150kHz and 10kHz above 150kHz.

3.2 Calibration Traceability Test equipment is maintained and calibrated on a regular basis. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

4.0 REQUIREMENTS, PROCEDURES AND RESULTS:

4.1 Powerline Conducted Emissions

4.1.1 Requirements – Since the test item is typically powered by an automotive battery and not connected to the AC network, no conducted emissions tests were performed.

4.2 Radiated Emissions

4.2.1 Requirements - The test item must comply with the requirements of FCC "Code of Federal Regulations Title 47", Part 15, Subpart C, Section 15.205 et seq.

Paragraph 15.209(a) has the following radiated emission limits:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100**	3
88 – 216	150**	3
216 – 960	200**	3
Above 960	500	3

** - Except as provided in paragraph (g), fundamental emissions from intentional radiators operating



under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470 MHz-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§ 15.231 and 15.241.

In addition, emissions appearing in the Restricted Bands of Operation listed in paragraph 15.205(a) shall not exceed the general requirements shown in paragraph 15.209.

4.2.2 Procedures -

4.2.2.1 Preliminary Radiated Measurements -

All preliminary tests were performed in a 32ft. x 20ft. x 14ft. high absorber lined shielded enclosure. All powerlines and signal lines entering the enclosure pass through filters on the enclosure wall.

The loop antenna was positioned at a 3 meter distance from the test item. The entire frequency range from 10kHz to 30MHz was investigated using a peak detector function.

4.2.2.2 Final Radiated Measurements - Measurements were performed at a test distance of 3 meters using a peak detector. The final open field emission tests were performed over the frequency range of 135kHz to 2MHz. For all measurements, a loop antenna was used as the pick-up device. All significant broadband and narrowband signals were measured and recorded. Final measurements were performed in a 32ft. x 20ft. x 14ft. high absorber lined shielded enclosure.

4.2.3 Results - A preliminary plot with the test item transmitting at 135kHz is presented on data page 10. This plot is presented for a reference only, and is not used to determine compliance.

The final open area radiated levels are presented on data page 11. As can be seen from the data, the test items measured level was within the specification limits. The level closest to the limit (worst case) occurred at 135kHz. The signal level at this frequency was 17.9 dB within the limit. See data page 11 for details. Photographs of the test configuration which yielded the highest or worst case, radiated levels are shown on Figure 2.

5.0 CONCLUSIONS:

It was determined that the Touchtronics Inc. M110, did fully meet the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.205 et seq. for Intentional Radiators, when tested per ANSI C63.4-2003.



6.0 CERTIFICATION:

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the test item at the test date. Any electrical or mechanical modification made to the test item subsequent to the specified test date will serve to invalidate the data and void this certification.

7.0 ENDORSEMENT DISCLAIMER:

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.



TABLE I: TEST EQUIPMENT LIST

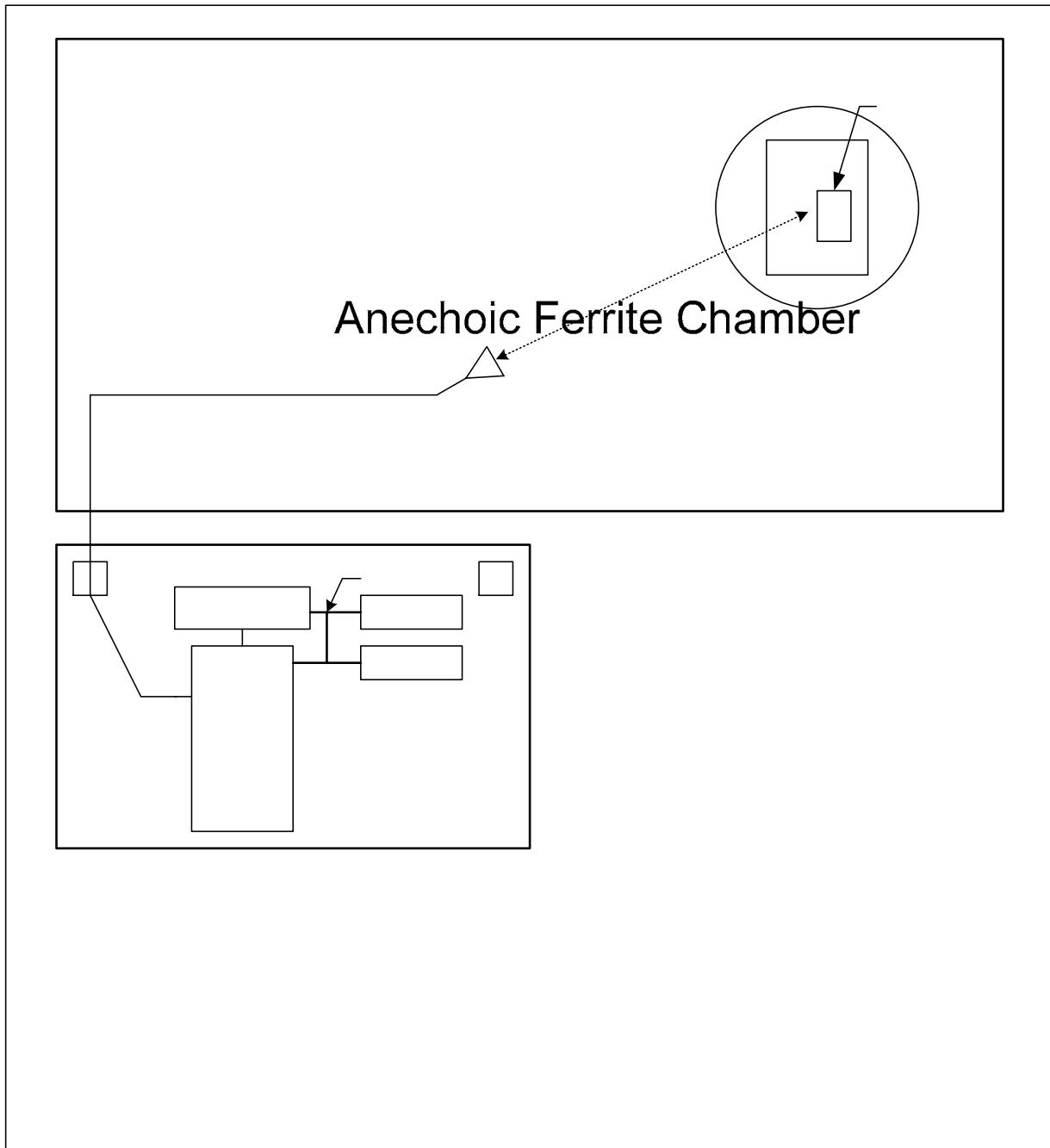
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Page: 1

Eq ID	Equipment Description	Manufacturer	Model No.	Serial No.	Frequency Range	Cal Date	Cal Inv	Due Date
Equipment Type: ACCESSORIES, MISCELLANEOUS								
XZG3	ATTENUATOR/SWITCH DRIVER	HEWLETT PACKARD	11713A	2421A03059	---		N/A	
Equipment Type: AMPLIFIERS								
APK3	PREAMPLIFIER	AGILENT TECHNOL	8449B	3008A01593	1-26.5GHZ	05/09/06	12	05/09/07
Equipment Type: ANTENNAS								
NLS1	24" ACTIVE LOOP ANTENNA	EMCO	6502	8903-2329	0.01-30MHZ	01/23/06	12	01/23/07
Equipment Type: CONTROLLERS								
CDD2	COMPUTER	HEWLETT PACKARD	D4171A#ABA	US61654645	---		N/A	
CMA0	MULTI-DEVICE CONTROLLER	EMCO	2090	9701-1213	---		N/A	
Equipment Type: PRINTERS AND PLOTTERS								
HRE1	LASER JET 5P	HEWLETT PACKARD	C3150A	USHB061052	---		N/A	
Equipment Type: RECEIVERS								
RAC2	SPECTRUM ANALYZER	HEWLETT PACKARD	85660B	3638A08770	100HZ-22GHZ	02/10/06	12	02/10/07
RACD	RF PRESELECTOR	HEWLETT PACKARD	85685A	3010A01205	20HZ-2GHZ	02/10/06	12	02/10/07
RAF4	QUASIPeAK ADAPTER	HEWLETT PACKARD	85650A	2043A00320	0.01-1000MHZ	02/10/06	12	02/10/07

Cal. Interval: Listed in Months I/O: Initial Only N/A: Not Applicable

Note 1: For the purpose of this test, the equipment was calibrated over the specified frequency range, pulse rate, or modulation prior to the test or monitored by a calibrated instrument.



Rec

Hpib cbl

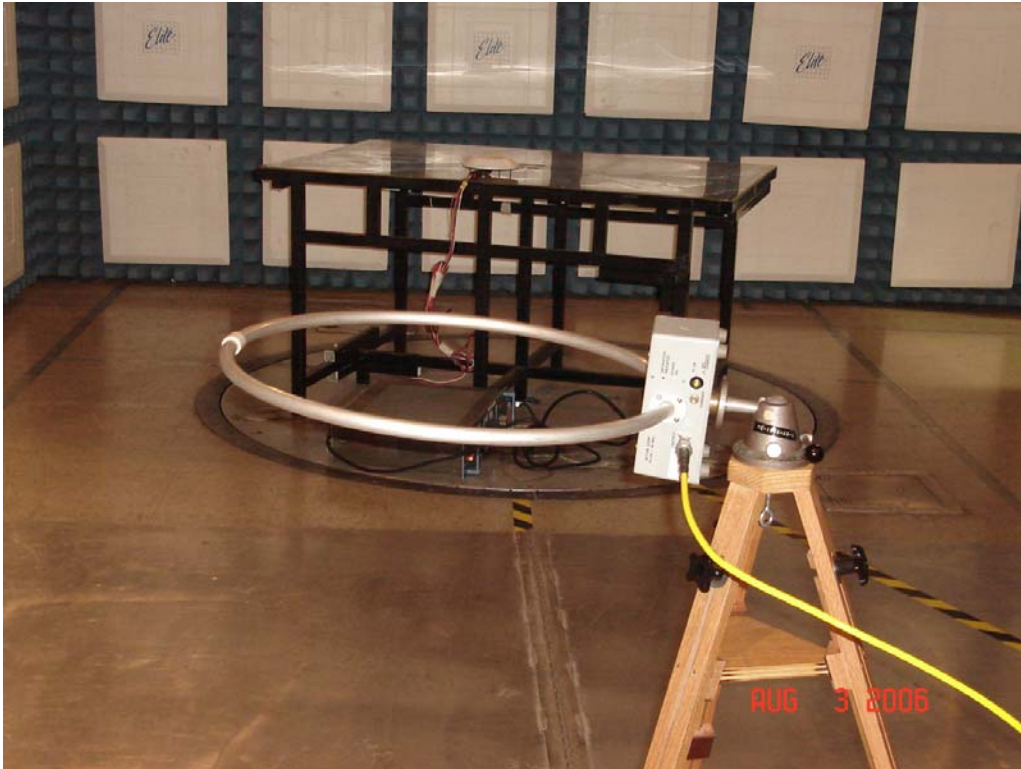
Turn Table & Mast
Controller

Computer

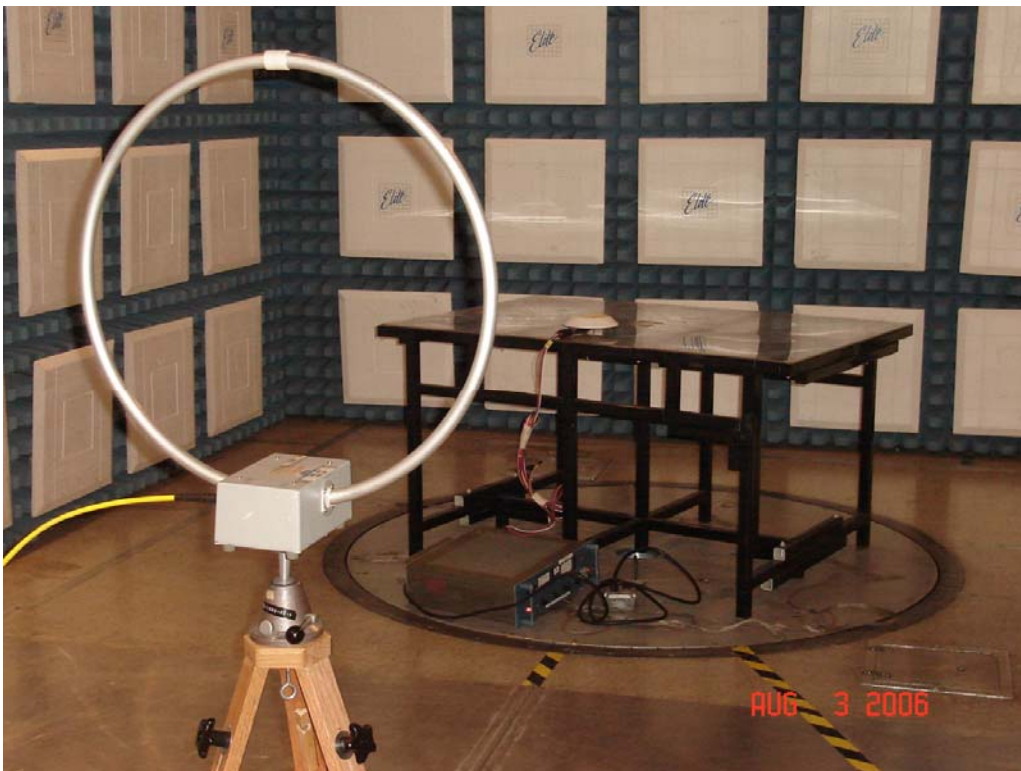
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Printer

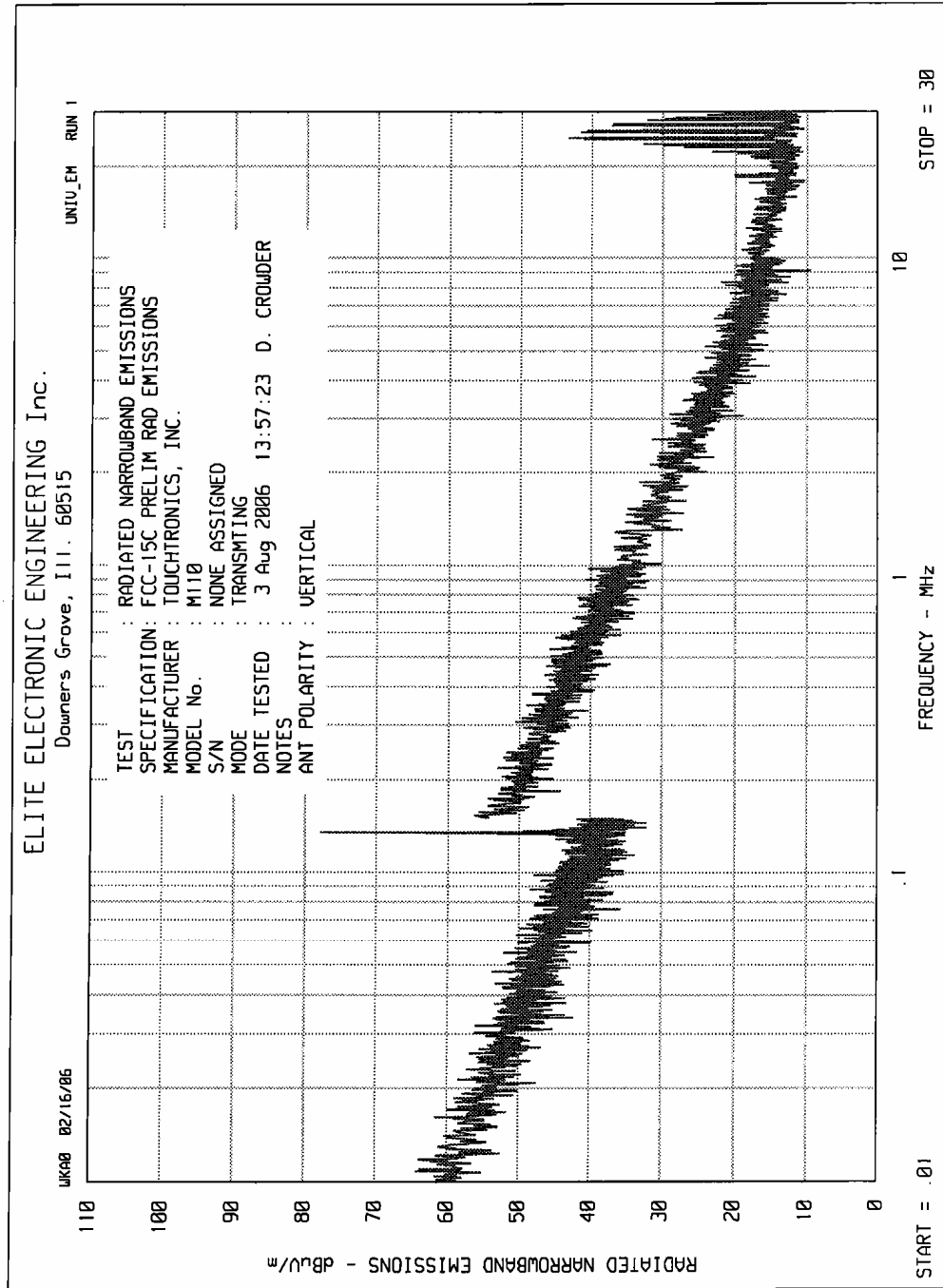
Figure 2



Radiated Emissions Worst Case Horizontal Polarization



Radiated Emissions Worst Case Vertical Polarization





MANUFACTURER : Touchtronics, Inc.
 MODEL : M110
 S/N : None Assigned
 SPECIFICATION : FCC-15C Radiated Emissions
 DATE : August 3, 2006
 NOTES : See below.

FREQ. (kHz)	BW	DET.	ANT POL.	METER		ANT. FAC.	CBL. FAC.	DIST. CORR. FAC.	TOTAL dBuV/m	LIMIT 300M dBuV/m	LIMIT 30M dBuV/m
				READING dBuV	AMB						
135	1KHz	Peak	V	70.9		11.0	0	-80	1.9	25.0	
135	1KHz	Peak	H	76.1		11.0	0	-80	7.1	25.0	
270	10KHz	Peak	V	42.4	*	10.8	0	-80	-26.8	19.0	
270	10KHz	Peak	H	42.5	*	10.8	0	-80	-26.7	19.0	
405	10kHz	Peak	V	39.0	*	10.7	0	-80	-30.3	15.5	
405	10kHz	Peak	H	39.5	*	10.7	0	-80	-29.8	15.5	
540	10kHz	Peak	V	36.3	*	10.3	0	-40	6.6		33.0
540	10kHz	Peak	H	36.1	*	10.3	0	-40	6.4		33.0
675	10kHz	Peak	V	33.8	*	10.4	0	-40	4.2		31.0
675	10kHz	Peak	H	34.4	*	10.4	0	-40	4.8		31.0
810	10kHz	Peak	V	34.2	*	10.4	0	-40	4.6		29.4
810	10kHz	Peak	H	32.0	*	10.4	0	-40	2.4		29.4
945	10kHz	Peak	V	30.3	*	10.4	0	-40	0.7		28.1
945	10kHz	Peak	H	33.5	*	10.4	0	-40	3.9		28.1
1080	10kHz	Peak	V	30.1	*	10.4	0	-40	0.5		26.9
1080	10kHz	Peak	H	29.2	*	10.4	0	-40	-0.4		26.9
1215	10kHz	Peak	V	28.0	*	10.4	0	-40	-1.6		25.9
1215	10kHz	Peak	H	28.0	*	10.4	0	-40	-1.6		25.9
1350	10kHz	Peak	V	27.2	*	10.3	0	-40	-2.5		25.0
1350	10kHz	Peak	H	27.0	*	10.3	0	-40	-2.7		25.0

Test Distance = 3 Meters
 Site = 3M Anechoic Chamber

Distance Correction Factor: Per CFR 15.31(f)(2), At frequencies below 30MHz measurements may be performed at a distance closer than that specified in the regulations. The results may be extrapolated to the specified distance by using the square of an inverse linear distance extrapolation factor (40dB/decade).
 Distance correction factor (300 meters to 3 meters) = 80dB (2 decades @ 40dB per decade)
 Distance correction factor (30 meters to 3 meters) = 40dB (1 decade @ 40dB per decade)

CHECKED BY: