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July 11, 2016

Carbon3D  
312 Chestnut St.  
Redwood City, CA 94063

Dear Brenda Cucci,

Enclosed is the EMC test report for compliance testing of the Carbon3D, NFC Driver/Antenna, tested to the requirements of Title 47 of the CFR, Part 15.225, Subpart C and RSS-210, Issue 8, Dec. 2010 for Certification as an Intentional Radiator.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,  
MET LABORATORIES, INC.

Jennifer Warnell  
Documentation Department

Reference: (\Carbon3D\EMCS89495-FCC225 REV 1)

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## **Electromagnetic Compatibility Criteria Test Report**

for the

**Carbon3D  
NFC Driver/Antenna**

**Tested under**  
the FCC Certification Rules  
contained in  
15.225 Subpart C & RSS-210, Issue 8, Dec. 2010  
for Intentional Radiators

**MET Report: EMCS89495-FCC225 REV 1**

July 11, 2016

**Prepared For:**

**Carbon3D  
312 Chestnut St.  
Redwood City, CA 94063**

**Prepared By:**  
**MET Laboratories, Inc.**  
914 West Patapsco Avenue  
Baltimore, MD 21230

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15.225 Subpart C & RSS-210, Issue 8, Dec. 2010  
for Intentional Radiators



Ajaz Khan, Project Engineer  
Electromagnetic Compatibility Lab



Jennifer Warnell  
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.225 and Industry Canada standard RSS-210, Issue 8, Dec. 2010 under normal use and maintenance.



Asad Bajwa,  
Director, Electromagnetic Compatibility Lab

## Report Status Sheet

Revision	Report Date	Reason for Revision
Ø	June 24, 2016	Initial Issue.
1	July 11, 2016	TCB Engineering Corrections.

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## List of Terms and Abbreviations

<b>AC</b>	<b>Alternating Current</b>
<b>ACF</b>	<b>Antenna Correction Factor</b>
<b>Cal</b>	<b>Calibration</b>
<b><i>d</i></b>	<b>Measurement Distance</b>
<b>dB</b>	<b>Decibels</b>
<b>dB<math>\mu</math>A</b>	<b>Decibels above one microamp</b>
<b>dB<math>\mu</math>V</b>	<b>Decibels above one microvolt</b>
<b>dB<math>\mu</math>A/m</b>	<b>Decibels above one microamp per meter</b>
<b>dB<math>\mu</math>V/m</b>	<b>Decibels above one microvolt per meter</b>
<b>DC</b>	<b>Direct Current</b>
<b>E</b>	<b>Electric Field</b>
<b>DSL</b>	<b>Digital Subscriber Line</b>
<b>ESD</b>	<b>Electrostatic Discharge</b>
<b>EUT</b>	<b>Equipment Under Test</b>
<b><i>f</i></b>	<b>Frequency</b>
<b>FCC</b>	<b>Federal Communications Commission</b>
<b>GRP</b>	<b>Ground Reference Plane</b>
<b>H</b>	<b>Magnetic Field</b>
<b>HCP</b>	<b>Horizontal Coupling Plane</b>
<b>Hz</b>	<b>Hertz</b>
<b>IEC</b>	<b>International Electrotechnical Commission</b>
<b>kHz</b>	<b>kilohertz</b>
<b>kPa</b>	<b>kilopascal</b>
<b>kV</b>	<b>kilovolt</b>
<b>LISN</b>	<b>Line Impedance Stabilization Network</b>
<b>MHz</b>	<b>Megahertz</b>
<b><math>\mu</math>H</b>	<b>microhenry</b>
<b><math>\mu</math></b>	<b>microfarad</b>
<b><math>\mu</math>s</b>	<b>microseconds</b>
<b>NEBS</b>	<b>Network Equipment-Building System</b>
<b>PRF</b>	<b>Pulse Repetition Frequency</b>
<b>RF</b>	<b>Radio Frequency</b>
<b>RMS</b>	<b>Root-Mean-Square</b>
<b>TWT</b>	<b>Traveling Wave Tube</b>
<b>V/m</b>	<b>Volts per meter</b>
<b>VCP</b>	<b>Vertical Coupling Plane</b>

# **I. Executive Summary**

## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Carbon3D NFC Driver/Antenna, with the requirements of Part 15, §15.225. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the NFC Driver/Antenna. Carbon3D should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the NFC Driver/Antenna, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.225, in accordance with Carbon3D, purchase order number PO02279. All tests were conducted using measurement procedure ANSI C63.4-2014.

FCC Reference 47 CFR Part 15.225	IC Reference RSS-210 Issue 8: 2010; RSS-GEN Issues 4: 2011	Description	Compliance
Part 15 §15.203	N/A	Antenna Requirement	Compliant
Part 15 §15.207(a)	RSS-GEN	Conducted Emission Limits	Compliant
Part 15 §15.215	RSS-210 (A6.1.3)	20dB Occupied Bandwidth	
Part 15 §15.225(a)	RSS-210 (2.5)	Field Strength emissions within the band 13.553 – 13.567 MHz	Compliant
Part 15 §15.225(b)	RSS-210 (2.5)	Field Strength emissions within the band 13.410 – 13.553 MHz and 13.567 – 13.710 MHz	Compliant
Part 15 §15.225(c)	RSS-210 (2.5)	Field Strength emissions within the band 13.110 – 13.410 MHz and 13.710 – 14.010 MHz	Compliant
Part 15 §15.225(d)	RSS-210 (2.5)	Outside-Band Field Strength emissions per 15.209 - 13.110 – 14.010 MHz	Compliant
Part 15 §15.225(e)		Frequency Tolerance of the Carrier	Compliant

**Table 1. Executive Summary of EMC Part 15.225 Compliance Testing**

## II. Equipment Configuration

## A. Overview

MET Laboratories, Inc. was contracted by Carbon3D to perform testing on the NFC Driver/Antenna, under Carbon3D's purchase order number PO02279.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Carbon3D, NFC Driver/Antenna.

The results obtained relate only to the item(s) tested.

<b>Model(s) Tested:</b>	NFC Driver/Antenna		
<b>Model(s) Covered:</b>	NFC Driver/Antenna		
<b>EUT Specifications:</b>	Primary Power: 5 VDC		
	FCC ID: 2AITLNFC		
	Type of Modulations:	ASK	
	Equipment Code:	DTS	
	Peak RF Output Power:	31.1 dBuV/m @ 30m	
	EUT Frequency Ranges:	13.56 MHz	
<b>Analysis:</b>	The results obtained relate only to the item(s) tested.		
<b>Environmental Test Conditions:</b>	Temperature: 15-35° C		
	Relative Humidity: 30-60%		
	Barometric Pressure: 860-1060 mbar		
<b>Evaluated by:</b>	Ajaz Khan		
<b>Report Date(s):</b>	June 16, 2008		

**Table 2. EUT Summary Table**

## B. References

<b>CFR 47, Part 15, Subpart C</b>	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies
<b>ANSI C63.4:2014</b>	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
<b>ISO/IEC 17025:2005</b>	General Requirements for the Competence of Testing and Calibration Laboratories
<b>ANSI C63.10-2013</b>	American National Standard for Testing Unlicensed Wireless Devices

**Table 3. References**

## C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick Street, Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

Correlation between semi-anechoic chamber and OATS:

Two calibrated Loop antennas were used on an OATS. One antenna was driven by a signal generator with a known power. The receive antenna was initially placed 1m away from the transmit antenna. The two antennas were placed parallel to each other. The receive antenna was in turn connected to a calibrated spectrum analyzer. The emissions were swept from 9 kHz to 30 MHz. The receive antenna was then rotated 90 degrees and measurements re-taken. Additional measurements were taken when the receive antenna was placed at 3meters. This same setup was taken to inside the semi-anechoic chamber and the measurements repeated.

The data was used to correlate the semi-anechoic chamber and OATS.

## D. Description of Test Sample

The NFC Driver/Antenna, Equipment Under Test (EUT), is a Near Field Communications (NFC) transmitter used to detect tags within 20mm of the antenna. It is a slave I2C device that reports the presence of an NFC tag every second. It is intended to be used within an industrial manufacturing machine for detecting unique installed components.

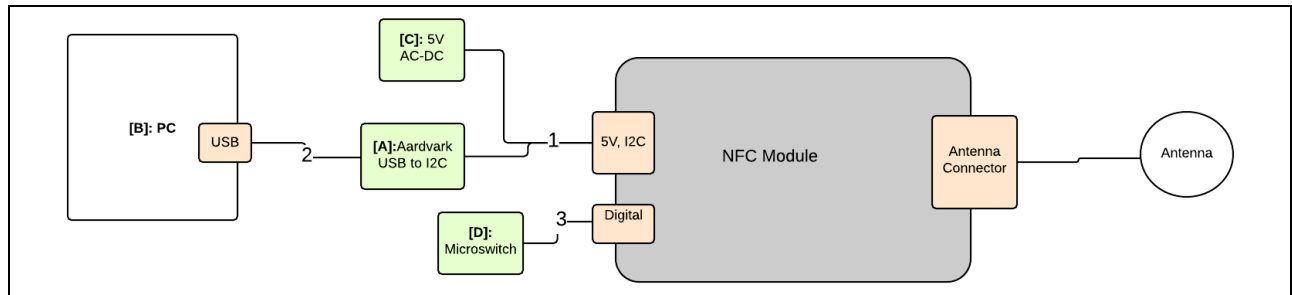


Figure 1. Block Diagram of Test Configuration

## E. Support Equipment

Support equipment necessary for the operation and testing of the EUT is included in the following list.

Ref. ID	Name / Description	Manufacturer	Model Number
A	Aardvark I2C/SPI Host Adapter	Total Phase	TP240141
B	Laptop with USB port	Dell	XPS
C	120VAC-5VDC	Phihong	PSM03A-50
A	Aardvark I2C/SPI Host Adapter	Total Phase	TP240141

Table 4. Support Equipment

## F. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
1	Main Board input	I2C, DC power	1	1	No	--
2	USB	Computer to aardvark USB	1	2	No	--
3	Switch input	Digital input	1	3	--	--

**Table 5. Ports and Cabling Information**

## G. Mode of Operation

The EUT is put in test mode for EMC emissions testing by setting the “RFRegulationTest” register via an I2C to USB converter connected to an external computer. The test mode will constantly transmit random RF data at 106kbps using Mifare modulation. The device can be disconnected from the computer and will still continually transmit.

## H. Method of Monitoring EUT Operation

The device will be continuously monitored for immunity testing via I2C. When the device responds with an error or communication with the device fails a red LED in the harness will illuminate.

## I. Modifications

### a) Modifications to EUT

No modifications were made to the EUT.

### b) Modifications to Test Standard

No modifications were made to the test standard.

## J. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Carbon3D upon completion of testing.

### **III. Electromagnetic Compatibility Criteria for Intentional Radiators**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.203 Antenna Requirement

**Test Requirement:** § 15.203: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

- a.) Antenna must be permanently attached to the unit.
- b.) Antenna must use a unique type of connector to attach to the EUT.
- c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

**Results:** The EUT as tested is compliant the criteria of §15.203. The antenna is professionally installed and has a unique connector.

**Test Engineer(s):** Ajaz Khan

**Test Date(s):** 05/20/16

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.207(a) Conducted Emissions Limits

**Test Requirement(s):** § 15.207 (a): For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50  $\Sigma$  line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency range (MHz)	§ 15.207(a), Conducted Limit (dB $\mu$ V)	
	Quasi-Peak	Average
* 0.15- 0.45	66 - 56	56 - 46
0.45 - 0.5	56	46
0.5 - 30	60	50

**Table 6. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)**

**Test Procedure:** The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50  $\Omega$ /50  $\mu$ H Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.4-2014 "Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz"*. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50  $\Omega$ /50  $\mu$ H LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

**Test Results:** The EUT was compliant with this requirement.

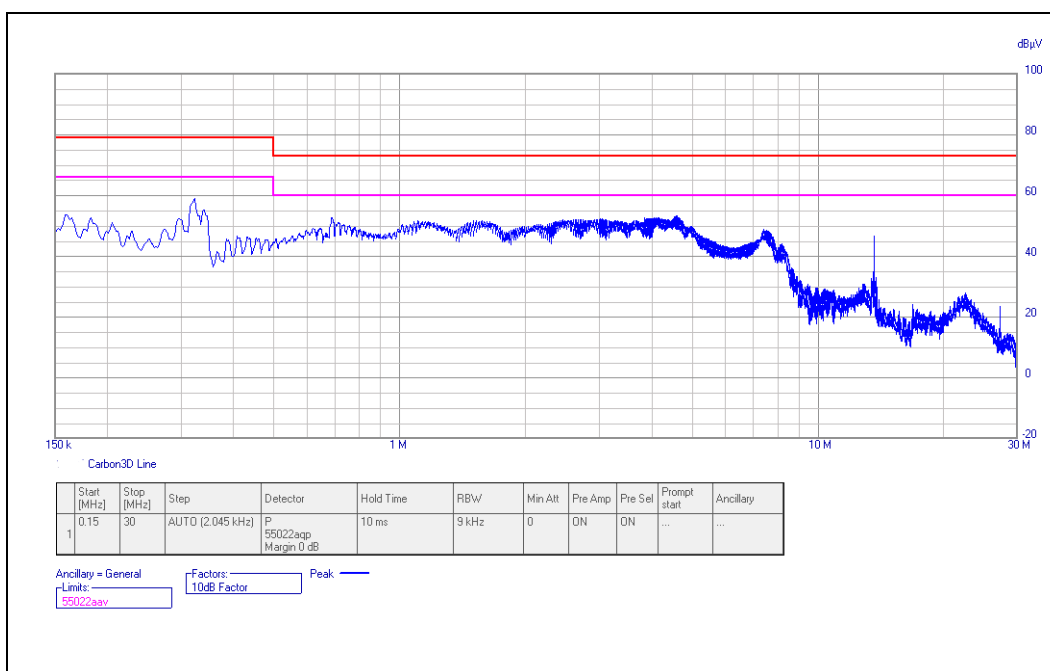
**Test Engineer(s):** Arsalan Hasan

**Test Date(s):** 05/19/16

## 15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	0.15818	49.14	79	-29.86	Pass	39.28	66	-26.72	Pass
Line	0.18272	48.93	79	-30.07	Pass	39.88	66	-26.12	Pass
Line	0.29519	50.95	79	-28.05	Pass	44.92	66	-21.08	Pass
Line	0.32587	56.11	79	-22.89	Pass	49.23	66	-16.77	Pass
Line	0.68988	49.99	73	-23.01	Pass	43.29	60	-16.71	Pass
Line	4.55697	50.21	73	-22.79	Pass	40.87	60	-19.13	Pass

Table 7. Conducted Emissions, 15.207(a), Phase Line, Test Results

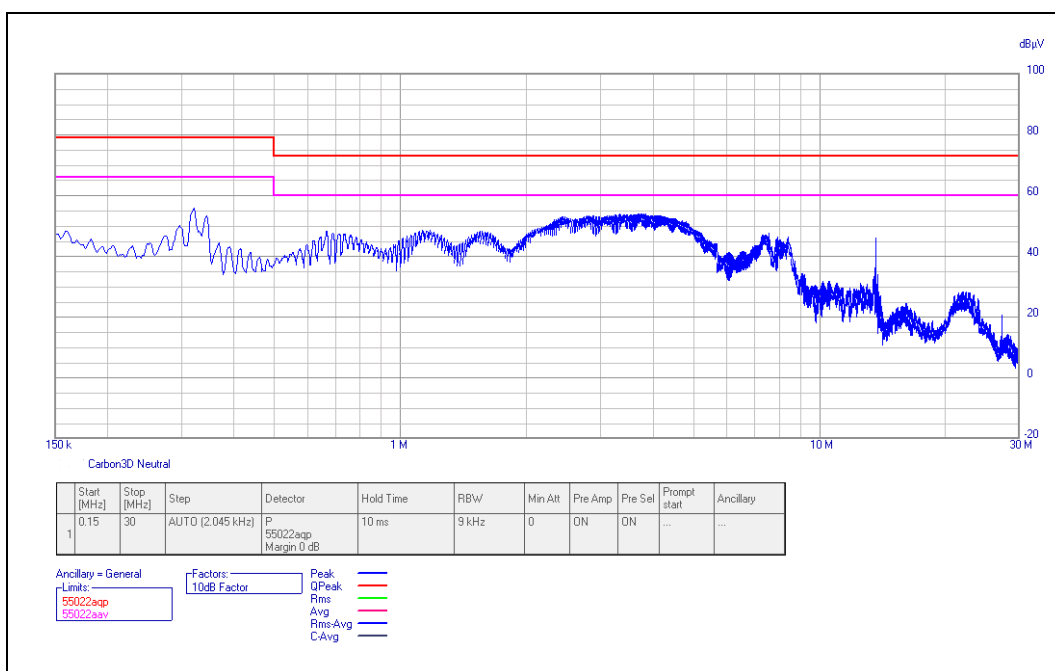


Plot 1. Conducted Emissions, 15.207(a), Phase Line

## 15.207(a) Conducted Emissions Test Results

Line	Freq. (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	0.29724	47.08	79	-31.92	Pass	36.06	66	-29.94	Pass
Neutral	0.323825	52.57	79	-26.43	Pass	41.16	66	-24.84	Pass
Neutral	0.34632	48.73	79	-30.27	Pass	36.85	66	-29.15	Pass
Neutral	1.17863	44.32	73	-28.68	Pass	31.77	60	-28.23	Pass
Neutral	2.13160	42.71	73	-30.29	Pass	29.66	60	-30.34	Pass
Neutral	3.77374	47.01	73	-25.99	Pass	35.42	60	-24.58	Pass

Table 8. Conducted Emissions, 15.207(a), Neutral Line, Test Results



Plot 2. Conducted Emissions, 15.207(a), Neutral Line

### 15.207(a) Conducted Emissions Test Setup Photo



Photograph 1. Conducted Emissions, 15.207(a), Test Setup

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.225(a) Spurious Emission Limits, within the band 13.553 – 13.567 MHz

**Test Requirement(s):** **15.225 (a)** The field strength of any emissions within the band 13.553 – 13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

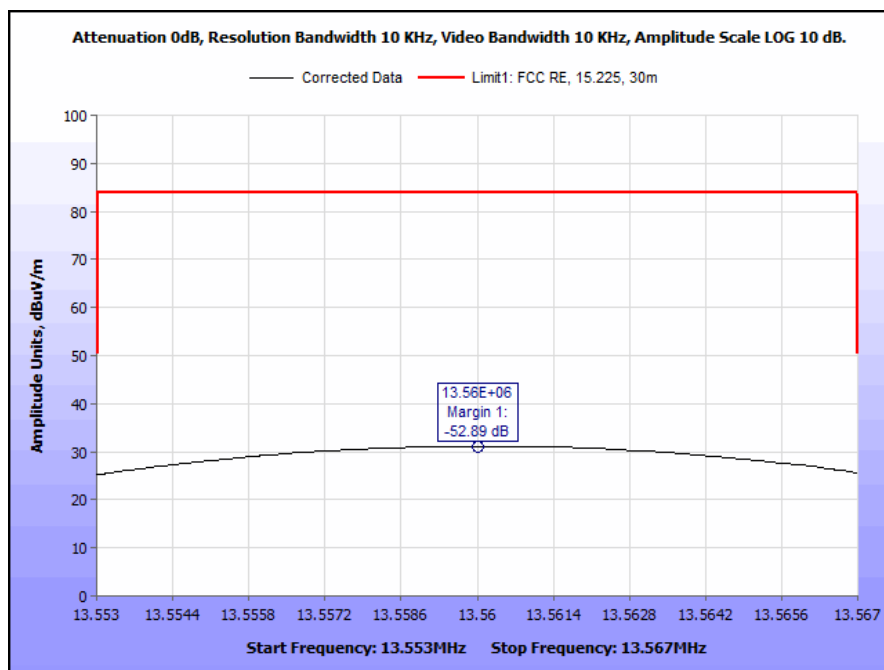
**Test Procedure:** The EUT was set to transmit and placed on a 0.8m-high wooden stand inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4: 2014 were used. The loop antenna was located 1 m from the EUT. Measurements were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used. The measurements were made at 1m and then extrapolated to 30m using the following correction factor.

$$40\log(1/30) = -59.1 \text{ dB}$$

**Test Results:** The EUT was compliant with the requirements of §15.225(a).

**Test Engineer(s):** Ajaz Khan

**Test Date(s):** 05/11/16



Plot 3. Spurious Emissions Within the Band 13.553 – 13.567 MHz, 10 kHz

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.225(b) Spurious Emission Limits, within the bands 13.410 – 13.553 MHz and 13.567 – 13.710 MHz

**Test Requirement(s):** **15.225 (b)** Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

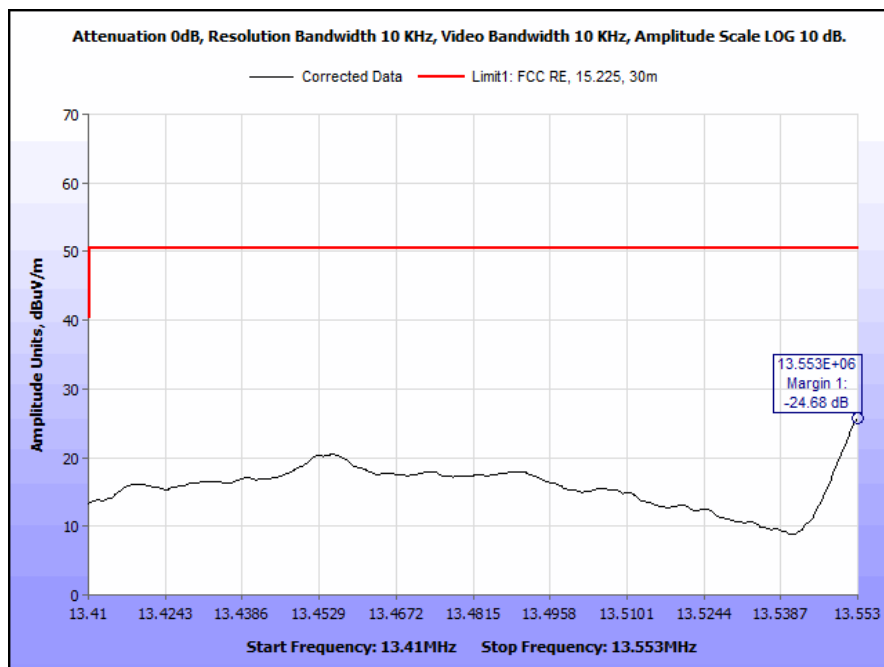
**Test Procedures:** The EUT was set to transmit and placed on a 0.8m-high wooden stand inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4: 2014 were used. The loop antenna was located 1 m from the EUT. Measurements were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used.  
The measurements were made at 1m and then extrapolated to 30m using the following correction factor.

$$40\log(1/30) = -59.1 \text{ dB}$$

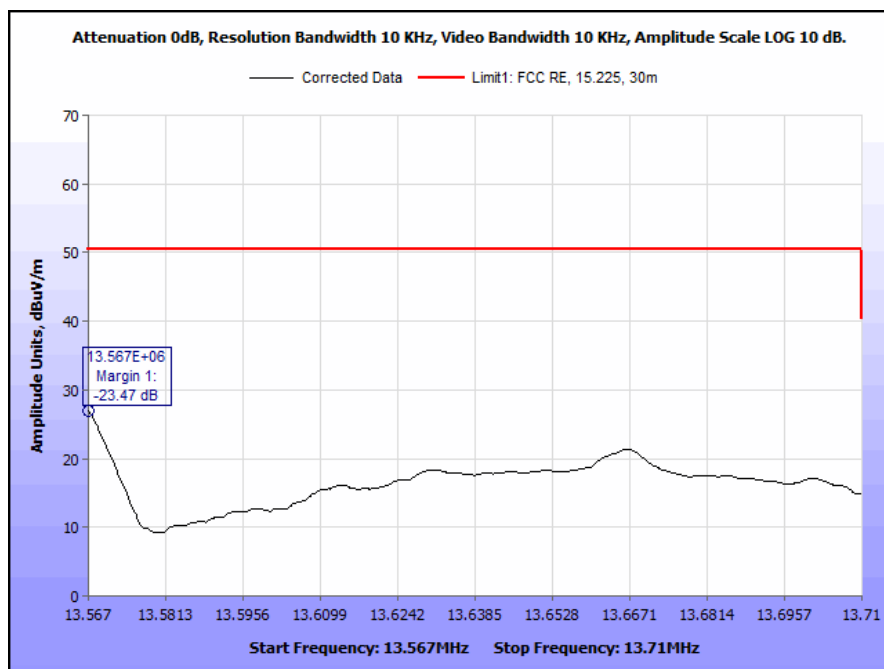
**Test Results:** The EUT was compliant with the requirements of § 15.225(b).

**Test Engineer(s):** Ajaz Khan

**Test Date(s):** 05/11/16



**Plot 4. Spurious Emissions Within the Band 13.410 – 13.553 MHz**



**Plot 5. Spurious Emissions Within the Band 13.567 – 13.710 MHz**

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.225(c) Spurious Emission Limits, within the bands 13.110 – 13.410 MHz and 13.710 – 14.010 MHz

**Test Requirement(s):** **15.225 (c)** Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

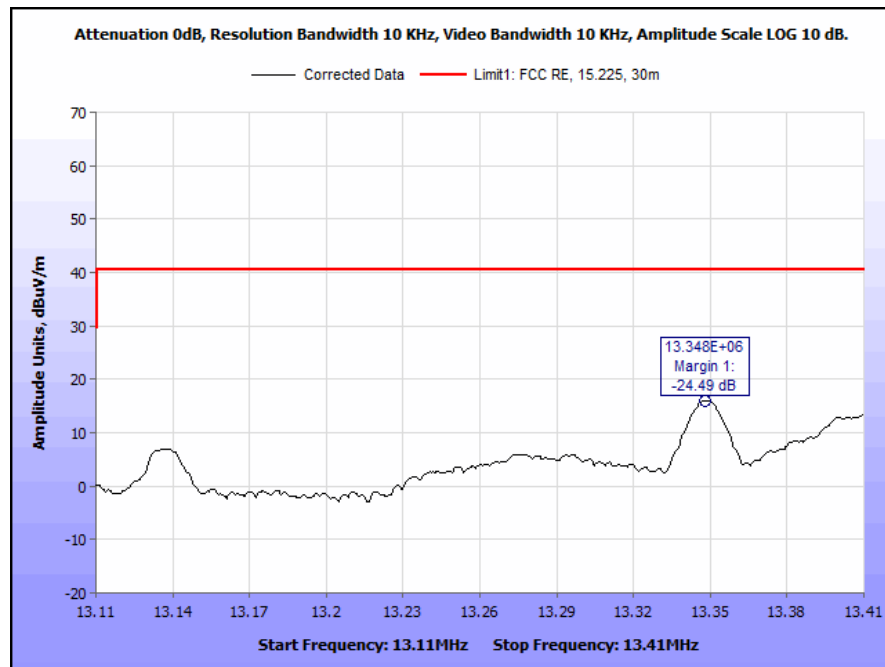
**Test Procedures:** The EUT was set to transmit and placed on a 0.8m-high wooden stand inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4: 2014 were used. The loop antenna was located 1 m from the EUT. Measurements were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used. The measurements were made at 1m and then extrapolated to 30m using the following correction factor.

$$40\log(1/30) = -59.1 \text{ dB}$$

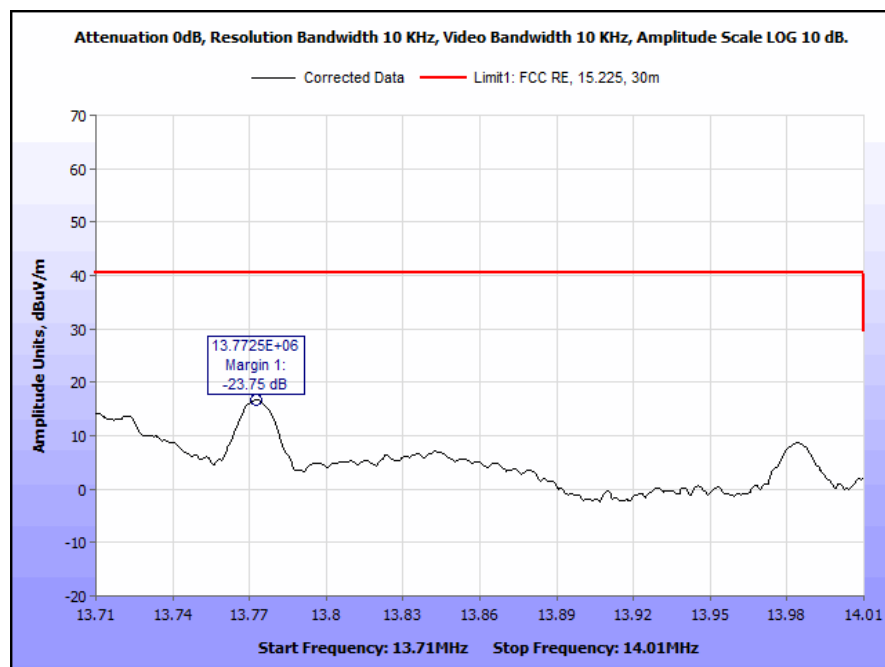
**Test Results:** The EUT was compliant with the requirements of §15.225(c).

**Test Engineer(s):** Ajaz Khan

**Test Date(s):** 05/11/16



Plot 6. Spurious Emissions Within the Band 13.110 – 13.410 MHz



Plot 7. Spurious Emissions Within the Band 13.710 – 14.010 MHz

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.225(d) Spurious Emission Limits, outside the bands 13.110 – 14.010 MHz

**Test Requirement(s):** 15.225 (d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

**Test Procedures:** The EUT was set to transmit and placed on a 0.8m-high wooden stand inside a semi-anechoic chamber. The method of testing and test conditions of ANSI C63.4: 2014 were used. For measurements below 30 MHz a loop antenna placed 1m away from the unit was used. For measurements above 30 MHz a biconalog antenna placed 3m away from the unit was used. Measurements were conducted with the loop antenna at coaxial (parallel) and planar (perpendicular) orientations. The Spectrum analyzer RBW was set to 10 kHz and VBW was set to 30 kHz. A peak detector was used below 30 MHz and a Quasi-peak detector was used for measurements for above 30 MHz.  
The measurements made at 1m with the loop antenna were then extrapolated to 30m using the following correction factor.

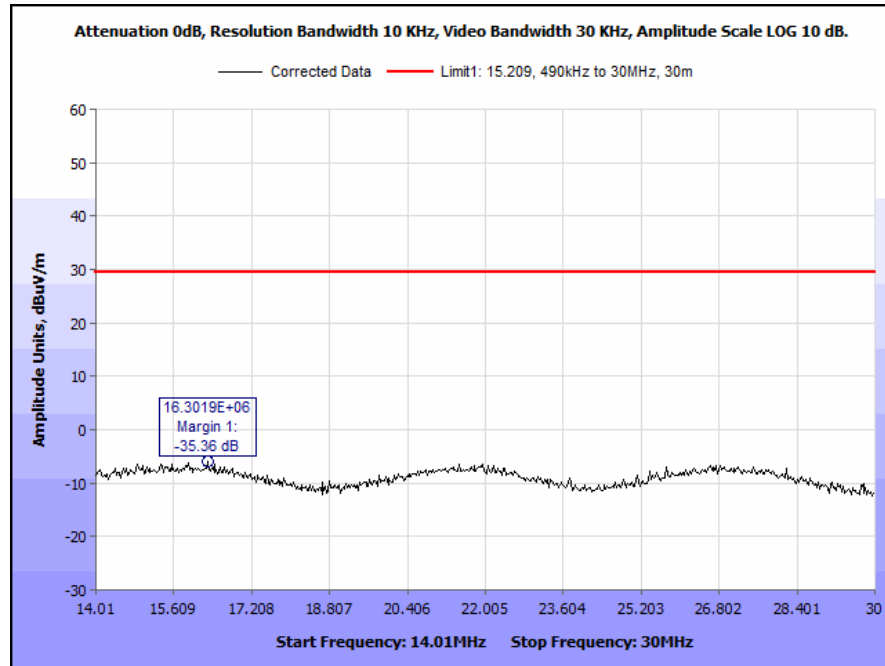
$$40\log(1/30) = -59.1 \text{ dB}$$

**Test Results:** The EUT was compliant with requirements of § 15.225 (d).

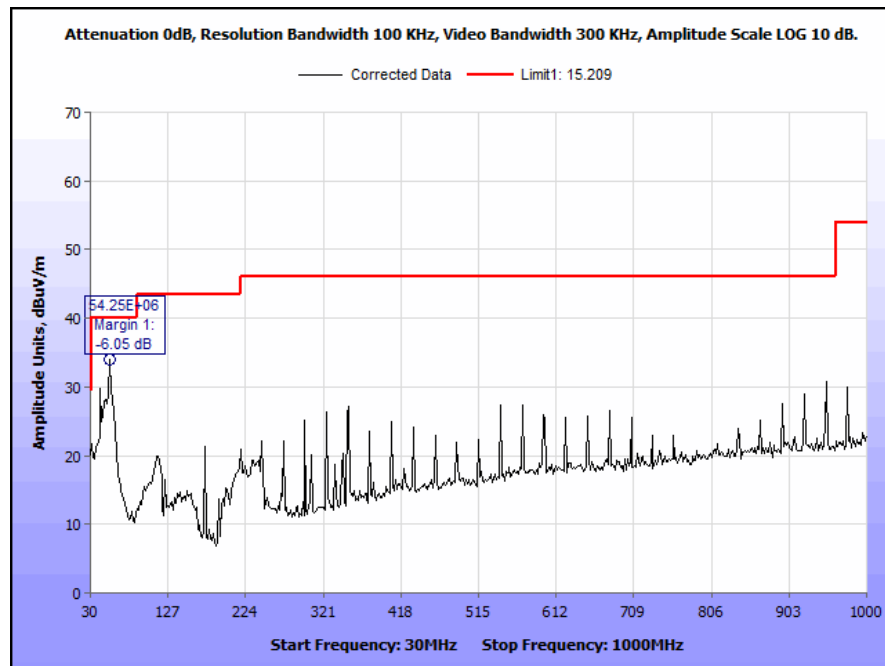
The peak power spectral density was determined from plots on the following page(s).

**Test Engineer:** Ajaz Khan

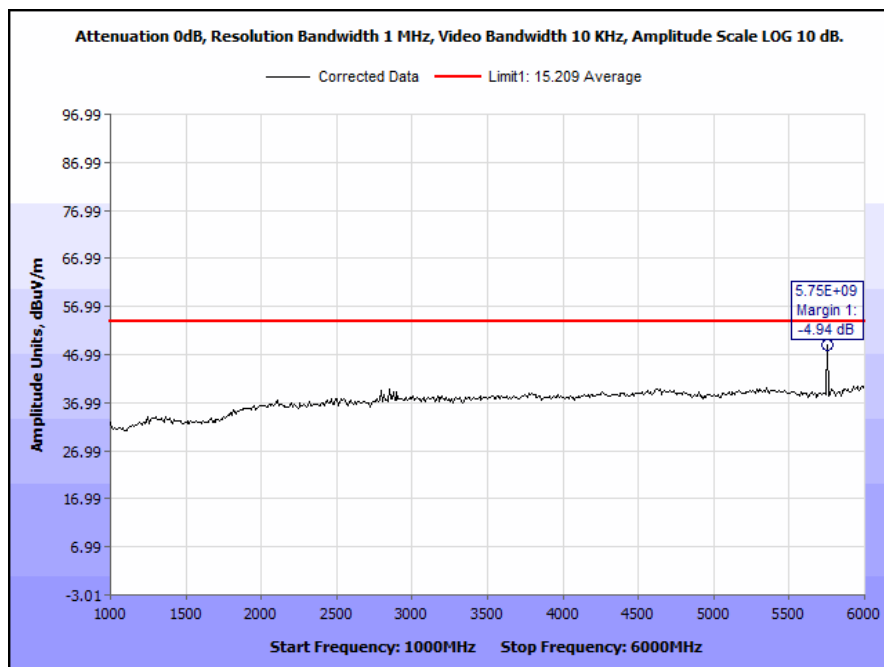
**Test Date:** 05/11/16



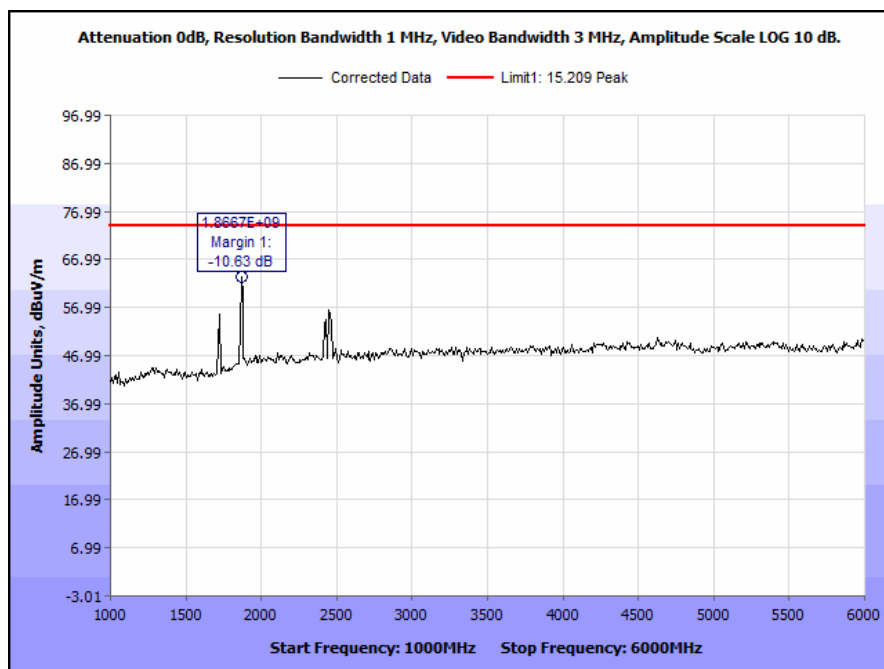
**Plot 8. Spurious Emissions Outside the Band 14.010 – 30 MHz**



**Plot 9. Spurious Emissions Outside the Band 30 MHz – 1 GHz**



Plot 10. Spurious Emissions Outside the Band 1 GHz – 6 GHz, Average



Plot 11. Spurious Emissions Outside the Band 1 GHz – 6 GHz, Peak

## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.225(e) Frequency Stability

**Test Requirement(s):** **15.225(e)** The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

**Test Procedure:** Measurements are in accordance with Part 2.1055. The EUT was placed in the Environmental Chamber and allowed to reach desired temperature. A spectrum analyzer was used to measure the frequency drift. The EUT was set to transmit in the operating frequency range. Frequency drift was investigated for the extreme temperatures and nominal temperature, until the unit is stabilized then recorded the reading in tabular format with the temperature range of  $-20^{\circ}$  to  $50^{\circ}\text{C}$ .

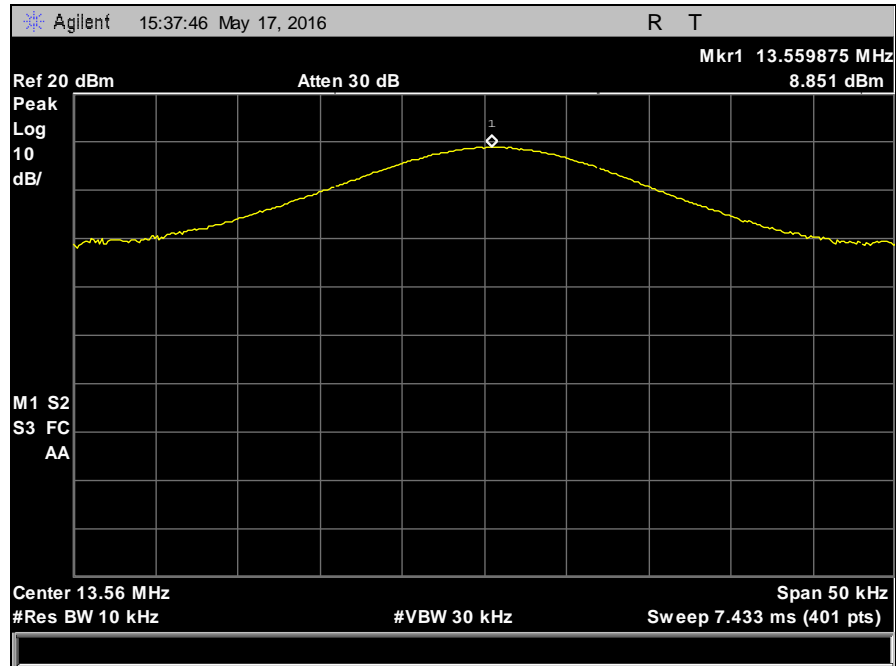
**Test Results:** The EUT was found compliant with Part 15.225 (e) requirement(s) of this section.

**Test Engineer(s):** Ajaz Khan

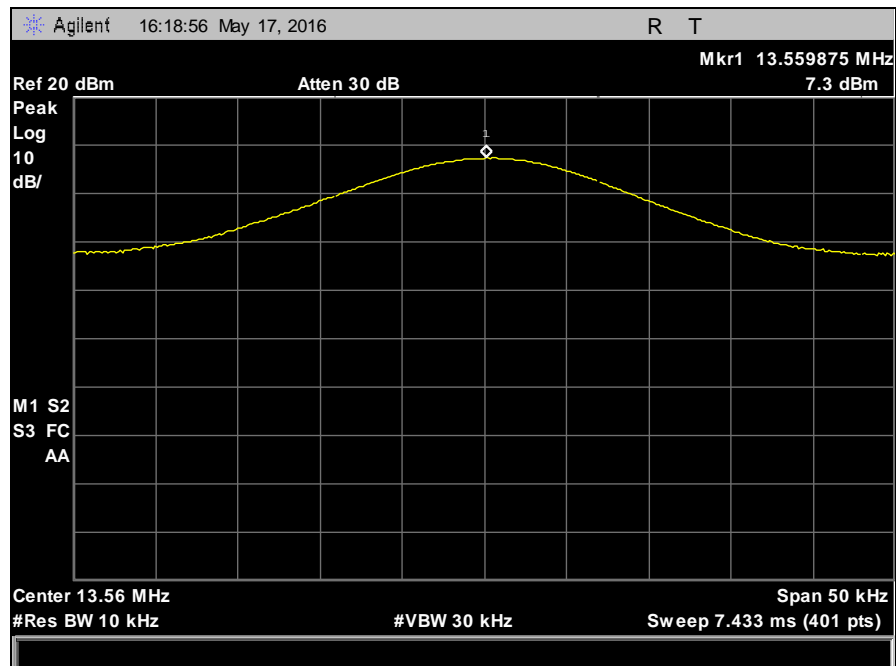
**Test Date(s):** 05/18/16

Voltages (V)	Temperatures ( $^{\circ}\text{C}$ )	Frequency (MHz)	Variation (%)
4.25	-20	13.559875	0.000922
	22	13.559875	0.000922
	50	13.560000	0.001844
5	-20	13.560250	0.003687
	22	13.559750	0.000000
	50	13.560125	0.002766
5.75	-20	13.559500	-0.001844
	22	13.560000	0.001844
	50	13.560500	0.005531

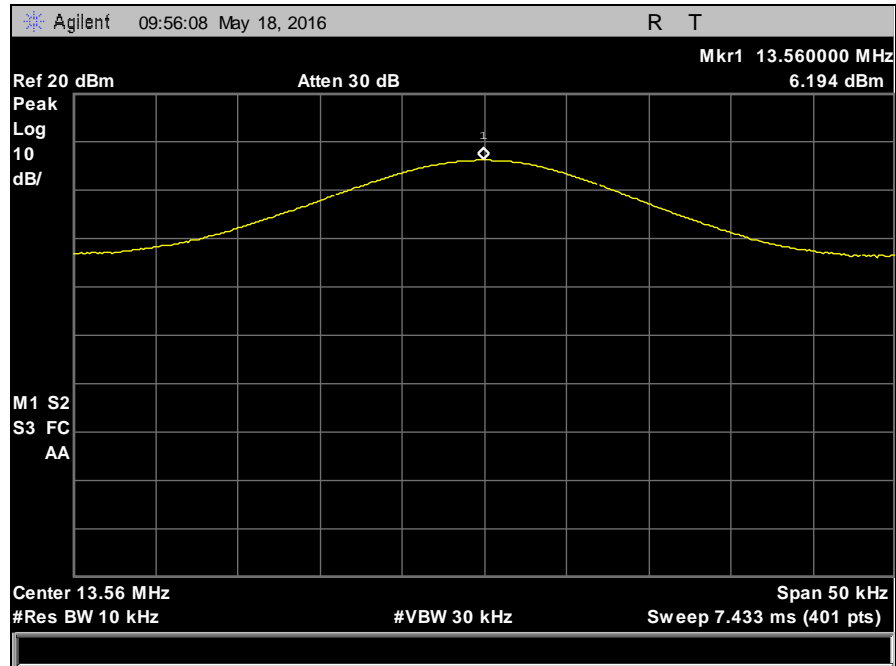
**Table 9. Frequency Stability, Test Results**



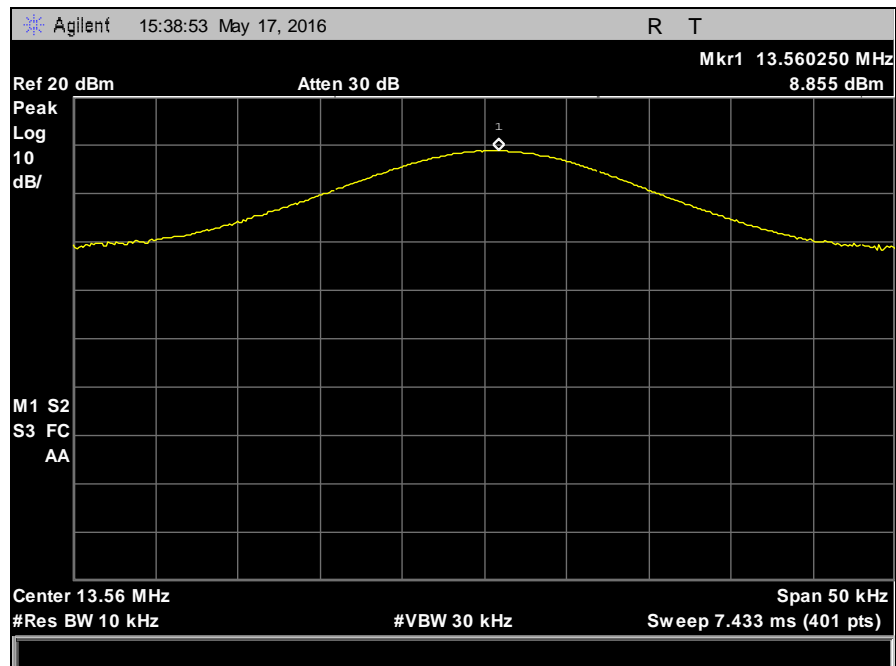
Plot 12. Frequency Stability, 4.25V at -20°C



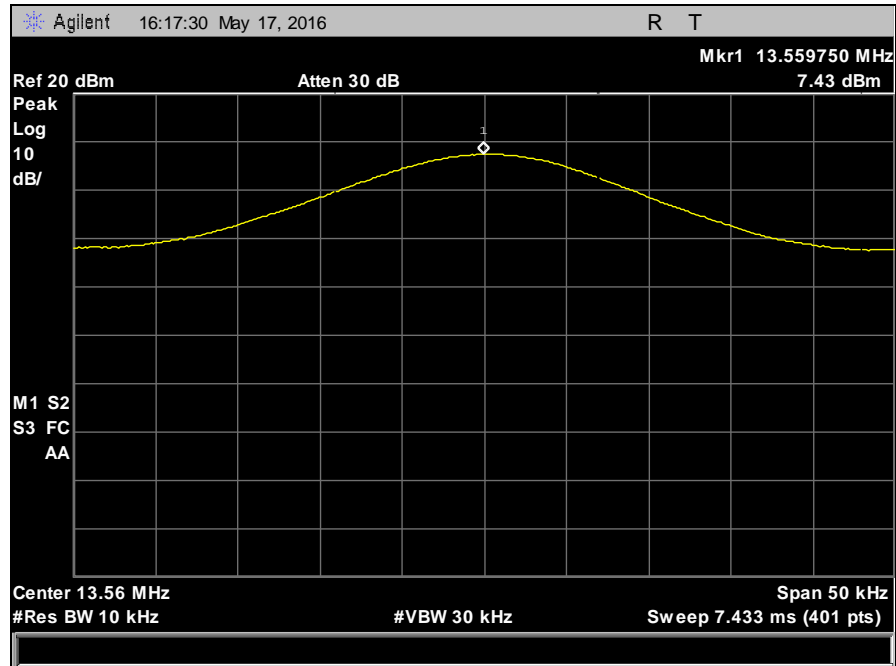
Plot 13. Frequency Stability, 4.25V at 22°C



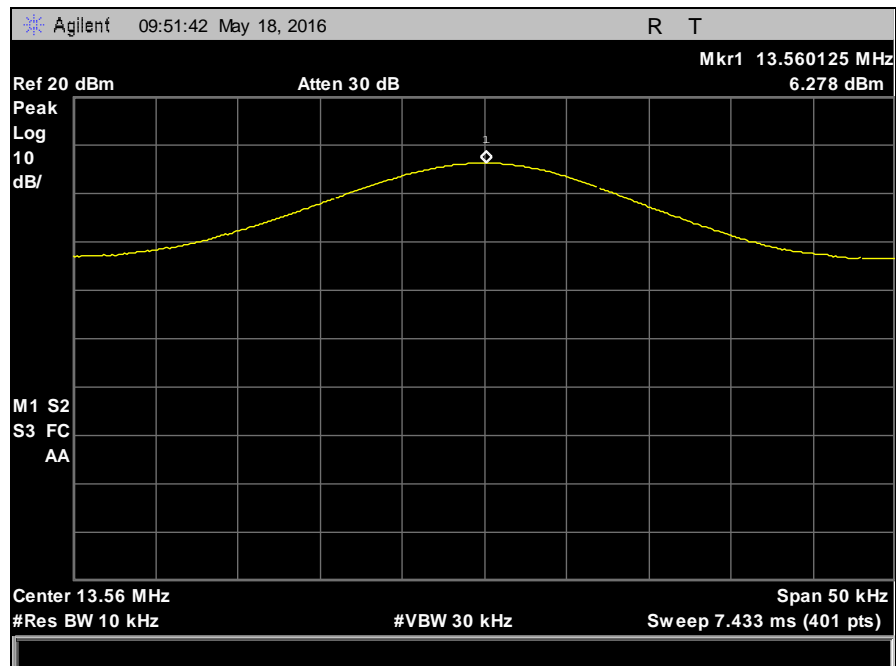
Plot 14. Frequency Stability, 4.25V at 55°C



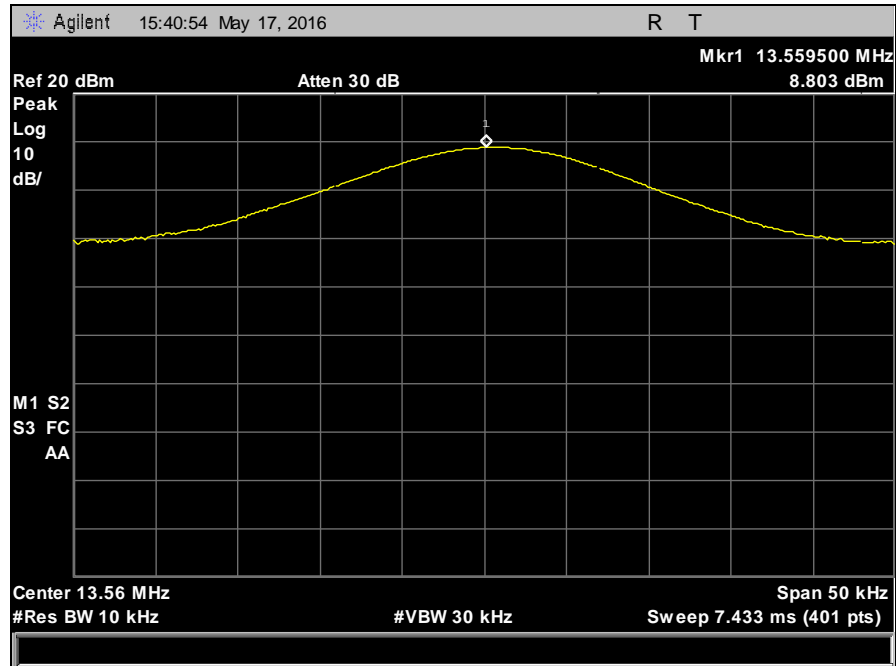
Plot 15. Frequency Stability, 5.0V at -20°C



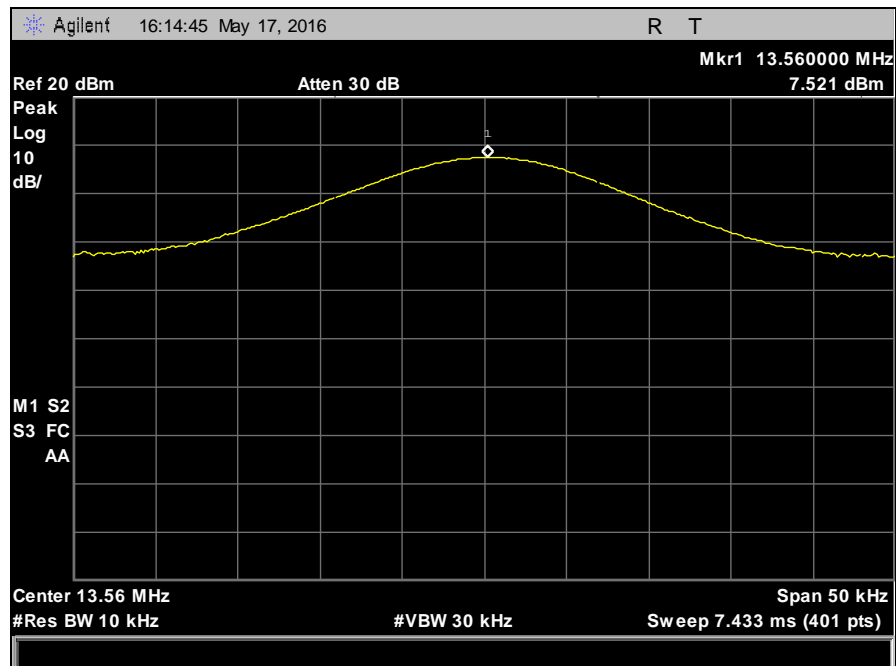
Plot 16. Frequency Stability, 5.0V at 22°C



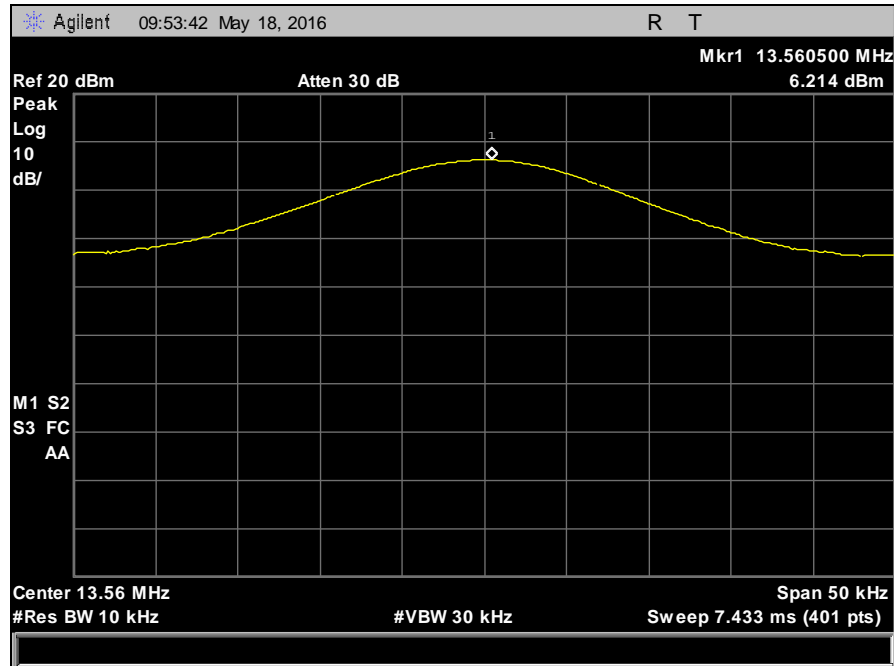
Plot 17. Frequency Stability, 5.0V at 50°C



Plot 18. Frequency Stability, 5.75V at -20°C



Plot 19. Frequency Stability, 5.75V at 22°C



Plot 20. Frequency Stability, 5.75V at 50°C

## IV. Test Equipment

## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

Asset	Equipment	Manufacturer	Model	Calibration Date	Calibration Due Date
1S2399	TURNTABLE CONTROLLER	SUNOL SCIENCE	SC99V	NOT REQUIRED	
1S2421	EMI TEST RECEIVER	ROHDE & SCHWARZ	ESIB7	12/31/2015	12/31/2016
1S2482	5 METER CHAMBER (NSA)	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	3/12/2015	9/12/2016
1S3826	DRG HORN ANTENNA	ETS-LINDGREN	3117	4/22/2015	4/22/2017
1S2600	BILOG ANTENNA	TESEQ	CBL6112D	10/5/2015	10/5/2016
1S3835	PSA SPECTRUM ANALYZER	AGILENT TECHNOLOGIES	E4448A	11/20/2015	11/20/2017
1T4800	ANTENNA, LOOP	EMCO	6512	10/1/2015	4/1/2017
1S2653	AMPLIFIER	SONOMA INSTRUMENTS	310N	SEE NOTE	
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	SEE NOTE	
1S2229	TEMPERATURE CHAMBER	TENNY ENGINEERING	T63C	5/4/2015	11/4/2016

**Table 10. Test Equipment List**

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

## **V. Certification & User's Manual Information**

## Certification & User's Manual Information

### A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

#### § 2.801 Radio-frequency device defined.

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

- (a) The various types of radio communication transmitting devices described throughout this chapter.
- (b) *The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*
- (c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.
- (d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

#### § 2.803 Marketing of radio frequency devices prior to equipment authorization.

- (a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:
  - (1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or
  - (2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.
- (d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

- (e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:
- (i) *Compliance testing;*
  - (ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;
  - (iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;
  - (iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or
  - (v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.
- (e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.
- (f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

## Certification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:

### § 2.901 Basis and Purpose

- (a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.<sup>1</sup> *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.*
- (b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

### § 2.907 Certification.

- (a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.
- (b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

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<sup>1</sup> In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

## Certification & User's Manual Information

### § 2.948 Description of measurement facilities.

- (a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.
  - (1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.
    - (i) *If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*
    - (ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.
  - (2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

## Certification & User's Manual Information

### 1. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

#### § 15.19 Labeling requirements.

(a) *In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:*

- (1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

- (2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

- (3) All other devices shall bear the following statement in a conspicuous location on the device:

*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.*

- (4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.
- (5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

#### § 15.21 Information to user.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

### § 15.105 Information to the user.

- (a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

- (b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

# End of Report