Compliance Testing, LLC
Previously Flom Test Lab
EMI, EMC, RF Testing Experts Since 1963

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Test Report

Prepared for: Garmin International

Model: O4AHNM00

Description: Wireless Dog Training Collar

FCC ID: IPH-O4AHNM00

To

FCC Part 95

Date of Issue: March 24, 2014

On the behalf of the applicant:	**Garmin International** **1200 East 151st Street** **Olathe, KS 66062**
Attention of:	**Paul Phrommany, Compliance Engineer** **Ph: (913) 397-8200** **E-Mail: paul.phrommany@garmin.com**

Prepared By
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Project No: p1420003

Mike Graffeo
Project Test Engineer

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All results contained herein relate only to the sample tested.

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	February 17, 2014	Mike Graffeo	Original Document
2.0	March 17, 2014	Mike Graffeo	Removed reference to RSS-Gen
3.0	March 24, 2014	Mike Graffeo	1) Specified rules and showed how limits were determined for Spurious Radiation, 2) Showed where limits were derived from for Emissions mask. 3) Clarified Bandwidth section. 4) Update model name

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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

Testing Certificate Number: **2152.01**

ACCREDITED
TESTING CERT
#2152.01

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

The Applicant has been cautioned as to the following:

15.21: **Information to the User**

The user's manual or instruction manual for an intentional 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.

15.27(a): **Special Accessories**

Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without an additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.

Test and Measurement Data

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II, Part 2, Subpart J, Sections 2.947, 2.1033(c), 2.1041, 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, and the following individual Parts 95.

Standard Test Conditions and Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing.

In accordance with ANSI/TIA 603C, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104°F) unless the particular equipment requirements specify testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Environmental Conditions		
Temp (ºC)	**Humidity (%)**	**Pressure (mbar)**
19.6 – 22.5	29.4 – 32.2	962.5 – 968.3

Measurement results, unless otherwise noted, are worst-case measurements.

EUT Description
Model: O4AHNM00
Description: Wireless Dog Training Collar
Additional Information:
The EUT is a wireless handheld transmitter. The EUT is a device transmitting in the MURS band to a wireless dog training collar. High, medium and low MURS band frequencies were tested as appropriate.

EUT Operation during Tests

EUT was in continuous transmit mode during all tests and receiver collar was turned on except as noted.

Accessories: Normally supplied antenna and extended range antenna

Cables: None

Modifications: None

Test Result Summary

Specification	Test Name	Pass, Fail, N/A	Comments
2.1046 95.639(h)	Carrier Output Power (Conducted)	Pass	
2.1053 95.635	Field Strength of Spurious Radiation	Pass	
95.635(e) 2.1049	Emission Masks (Occupied Bandwidth)	Pass	
95.632	Frequency Stability (Temperature Variation)	Pass	
95.632	Frequency Stability (Voltage Variation)	Pass	
2.202	Necessary Bandwidth Calculation	Pass	

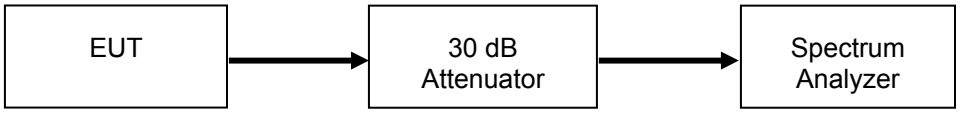
Carrier Output Power (Conducted)

Name of Test:	Carrier Output Power (Conducted)	**Engineer:**	
Test Equipment Utilized:	i00379	**Test Date:**	2/13/14

Measurement Procedure

The Equipment Under Test (EUT) was connected to a spectrum analyzer through a 30 dB Power attenuator. All cable and attenuator losses were input into the spectrum analyzer as a reference level offset to ensure accurate readings were obtained.

Test Setup



High Power Transmitter Peak Output Power

Tuned Frequency (MHz)	Recorded Measurement (dBm)	Result
151.82	32.94	Pass

Tuned Frequency (MHz)	Recorded Measurement (dBm)	Result
151.94	32.20	Pass

Tuned Frequency (MHz)	Recorded Measurement (dBm)	Result
154.60	32.60	Pass

All power levels were below MURS band limit of 2 Watts (33dBm)

Field Strength of Spurious Radiation

Name of Test:	Field Strength of Spurious Radiation	**Engineer:**	Mike Graffeo
Test Equipment Utilized:	i00349, i00379	**Test Date:**	2/6/14

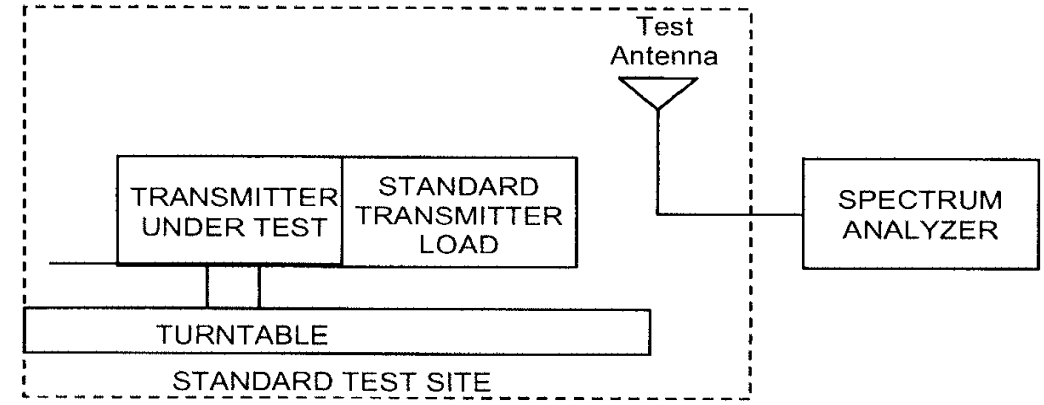
Test Procedure

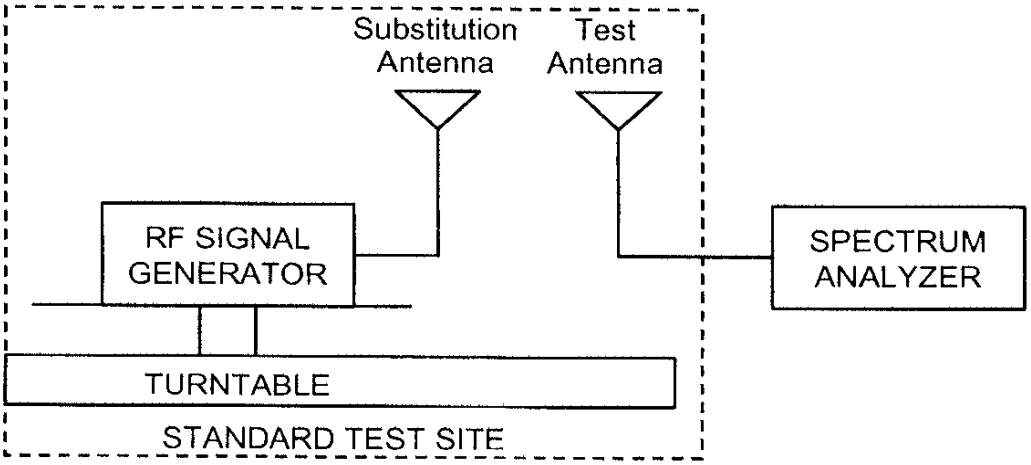
A) Connect the equipment as illustrated below.
B) Adjust the spectrum analyzer to the following settings:
    1) Resolution Bandwidth 100 kHz (< 1 GHZ), 1 MHZ (> 1GHz)
    2) Video Bandwidth ≥ 3 times Resolution Bandwidth, or 30 kHz
    3) Sweep Speed ≤2000 Hz/second
    4) Detector Mode = Mean or Average Power
C) Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non- radiating load that is placed on the turntable. The RF cable to this load should be of minimum length.
D) For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to ± the test bandwidth (see Section 1.3.4.4).
E) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
F) Repeat Step E) for each spurious frequency with the test antenna polarized vertically.
G) Reconnect the equipment as illustrated.
H) Keep the spectrum analyzer adjusted as in Step B).
I) Remove the transmitter and replace it with a substitution antenna (the antenna should be half wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.
J) Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
K) Repeat Step J) with both antennas vertically polarized for each spurious frequency.
L) Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in Steps J) and K) by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.
M) The levels recorded in Step L) are absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

Radiated spurious emissions dB = $10\log_{10}$ (TX power in watts/0.001) – the levels in Step I)

NOTE: Both normal supplied antenna and an extended range antenna were tested

Test Setup


Test
Antenna
TRANSMITTER
UNDER TEST
STANDARD
TRANSMITTER
LOAD
SPECTRUM
ANALYZER
TURNTABLE
STANDARD TEST SITE


Substitution
Antenna
Test
Antenna
RF SIGNAL
GENERATOR
SPECTRUM
ANALYZER
TURNTABLE
STANDARD TEST SITE

Test Results

151.82 MHz (Normal Antenna)

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
303.64	-48.76	-20
455.46	-49.42	-20
607.28	-59.70	-20
759.10	-63.73	-20
910.92	-83.19	-20

Mask #1, rule section 95.635(e)(1): Frequency (fd in kHz) of more than 12.5 kHz: **Limit=** 33 – [50 + 10 log (P) dB],

151.94 MHz (Normal Antenna)

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
303.88	-50.91	-20
455.82	-51.00	-20
607.76	-59.43	-20
759.70	-61.55	-20
911.64	-73.52	-20

Mask #1, rule section 95.635(e)(1): Frequency (fd in kHz) of more than 12.5 kHz: **Limit=** 33 – [50 + 10 log (P) dB],

154.6 MHz (Normal Antenna)

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
309.20	-52.13	-13
463.80	-53.33	-13
618.40	-58.76	-13
773.00	-66,79	-13
927.60	-72.19	-13

Mask #3, rule section 95.635(e)(3): Any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: **Limit =** 33 – [43 + 10 log (P) dB],

No other emissions were detected.

151.82 MHz (Extended Range Antenna)

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
303.64	-22.49	-20
455.46	-37.33	-20
607.28	-31.12	-20
759.10	-39.61	-20
910.92	-45.31	-20

Mask #1, rule section 95.635(e)(1): Frequency (fd in kHz) of more than 12.5 kHz: **Limit=** 33 – [50 + 10 log (P) dB],

151.94 MHz (Extended Range Antenna)

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
303.88	-27.17	-20
455.82	-30.78	-20
607.76	-31.21	-20
759.70	-40.73	-20
911.64	-44.94	-20

Mask #1, rule section 95.635(e)(1): Frequency (fd in kHz) of more than 12.5 kHz: **Limit=** 33 – [50 + 10 log (P) dB],

154.6 MHz (Extended Range Antenna)

Measured Frequency (MHz)	Measured Value (dBm)	Limit (dBm)
309.20	-23.28	-13
463.80	-46.23	-13
618.40	-33.14	-13
773.00	-42.42	-13
927.60	-72.19	-13

Mask #3, rule section 95.635(e)(3): Any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: **Limit =** 33 – [43 + 10 log (P) dB],

No other emissions were detected.

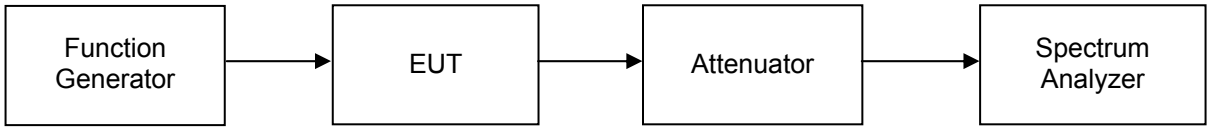
Emission Masks (Occupied Bandwidth)

Name of Test:	Emission Masks (Occupied Bandwidth)	**Engineer:** Mike Graffeo
Test Equipment Utilized	i00379	**Test Date:** 2/14/14

Measurement Procedure

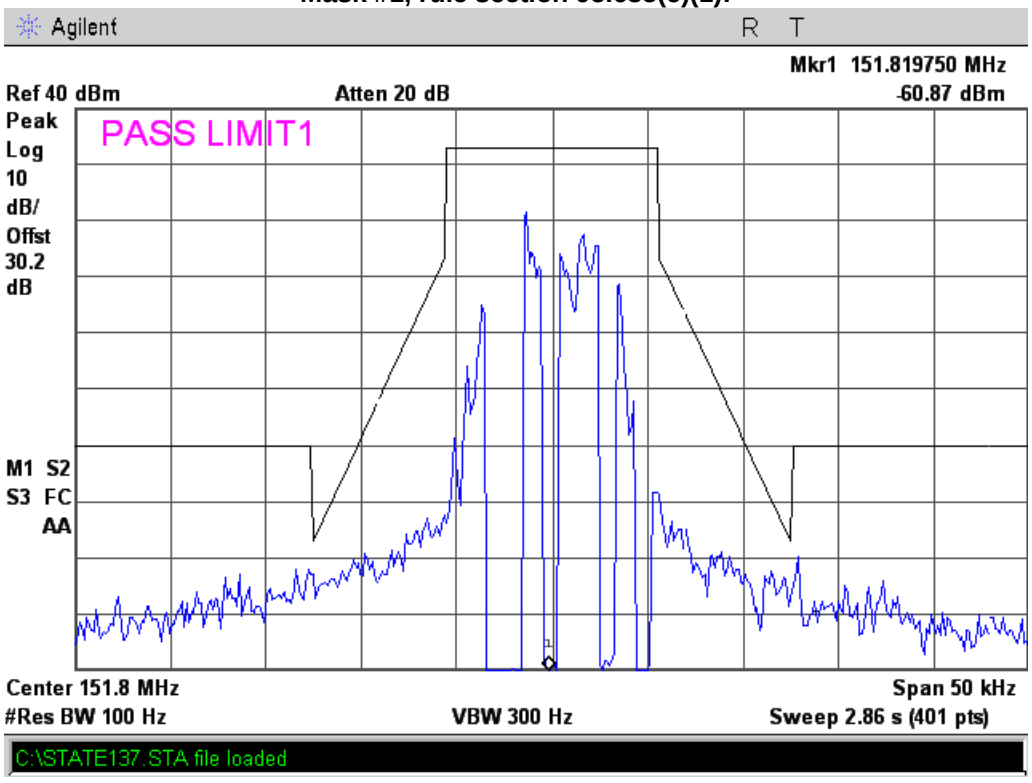
The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask. A reference level plot is provided to verify that the peak power was established prior to testing the mask. This is an RC device.

Test Setup



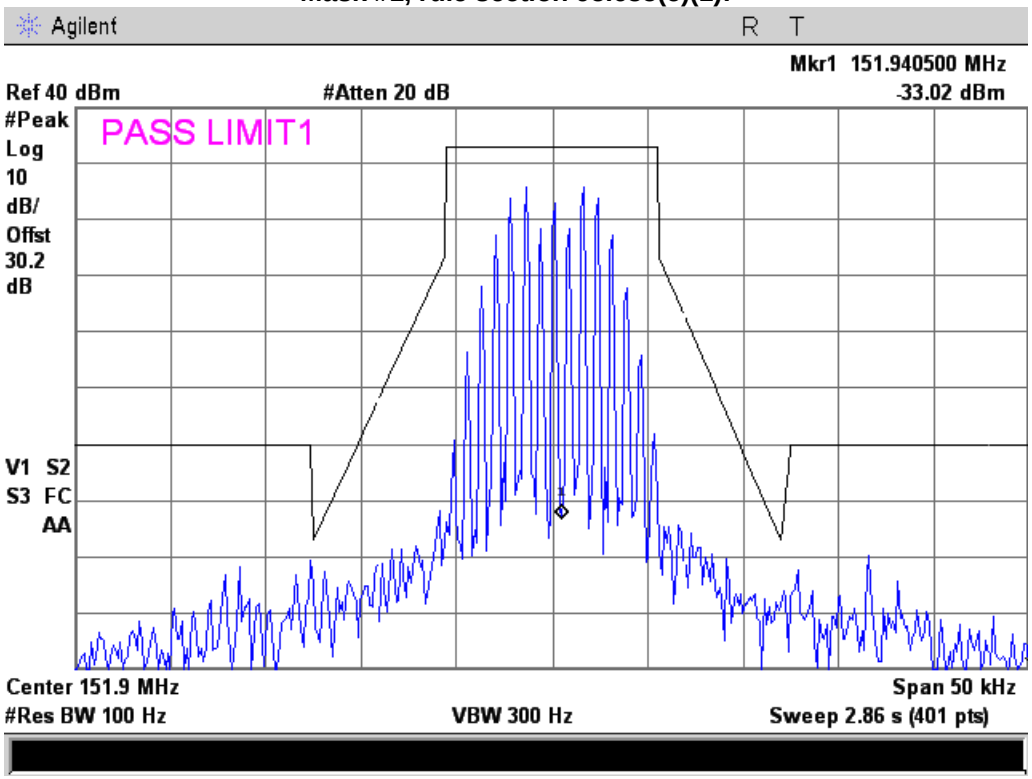
Occupied Bandwidth Plots

151.82 MHz (MURS without audio LP filter)
Mask #1, rule section 95.635(e)(1):

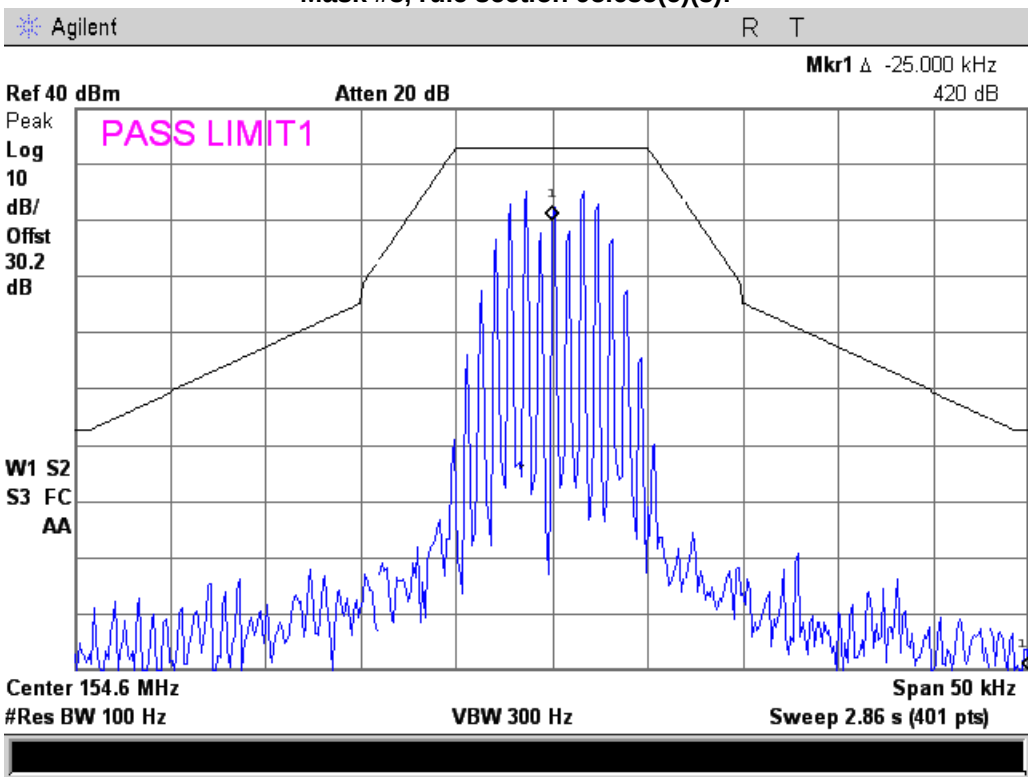


Occupied Bandwidth Plots (continued)

151.94 MHz (MURS without audio LP filter)
Mask #1, rule section 95.635(e)(1):



154.6 MHz (MURS without audio LP filter)
Mask #3, rule section 95.635(e)(3):



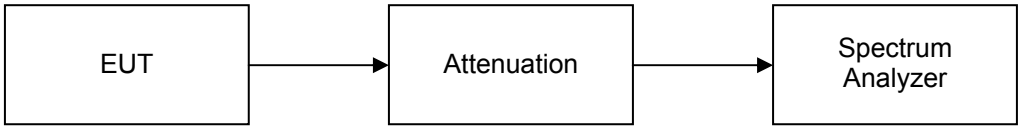
Frequency Stability (Temperature and Voltage Variation)

Name of Test:	Frequency Stability (Temperature and Voltage Variation)	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00027, i00320, i00343	**Test Date:** 2/14/14

Measurement Procedure

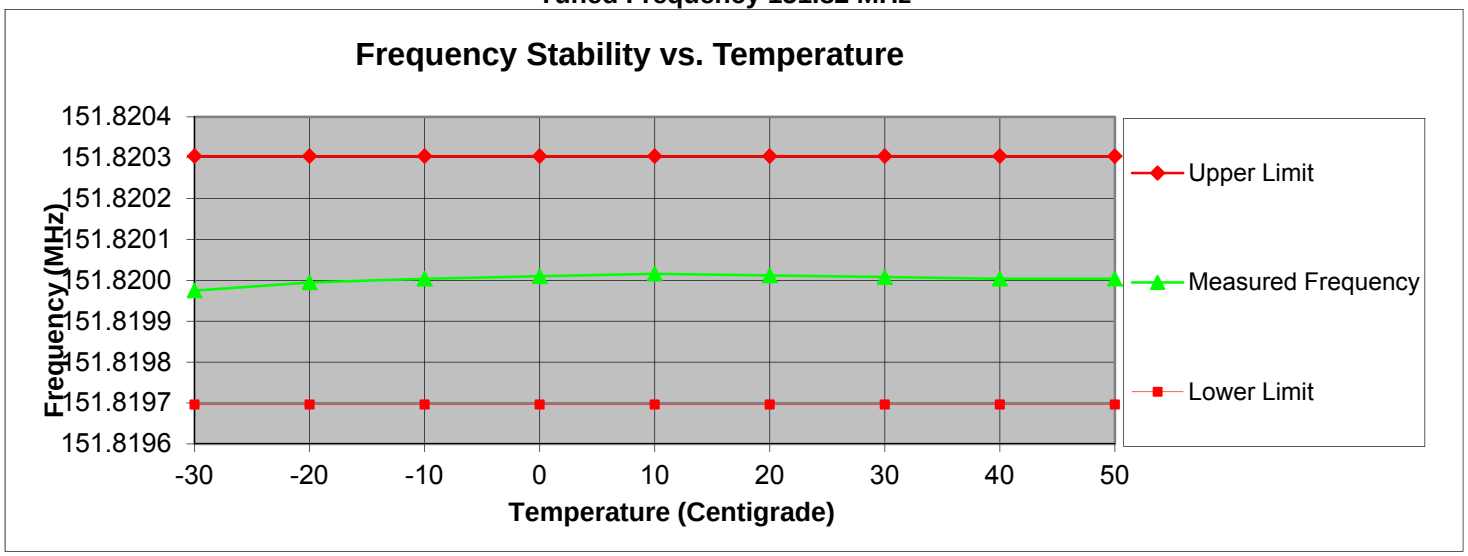
The EUT was placed in an environmental test chamber and the RF output was connected directly to a spectrum analyzer. The temperature was varied from -30°C to 50°C in 10°C increments. After a sufficient time for temperature stabilization the RF output frequency was measured. At 20°C the power supply voltage to the EUT was varied from 85% to 115% of the nominal value and the RF output was measured.

Measurement Setup



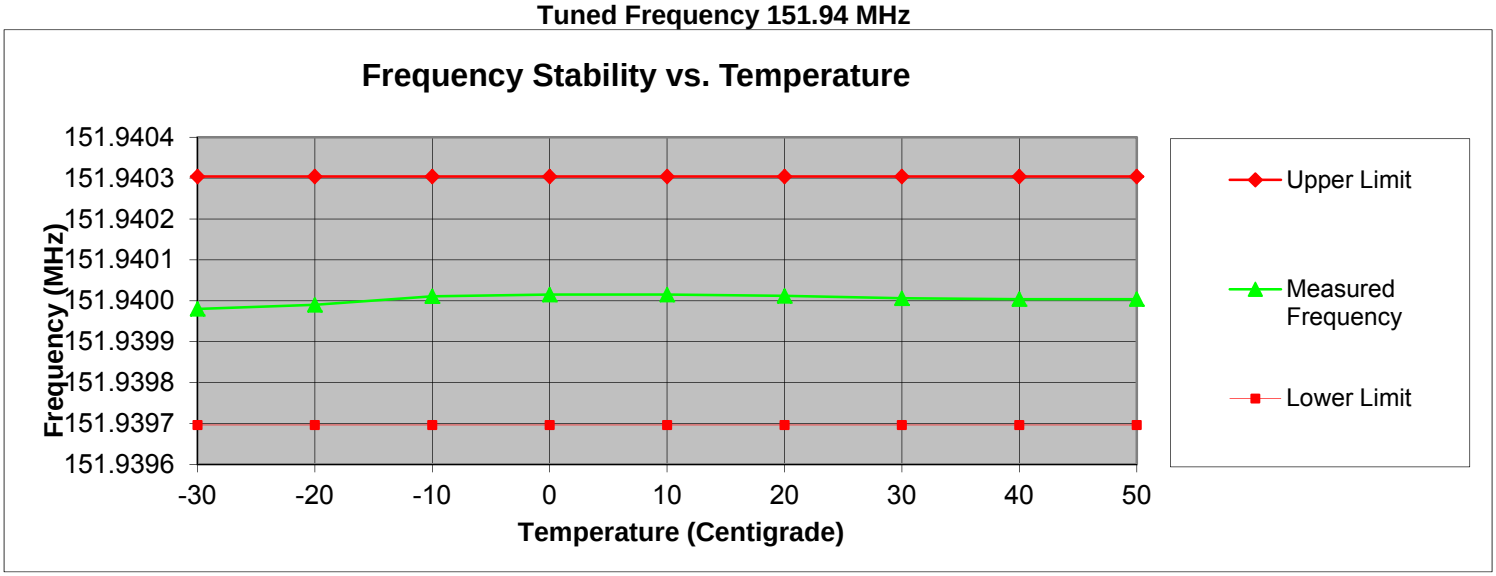
Measurement Results

Tuned Frequency 151.82 MHz



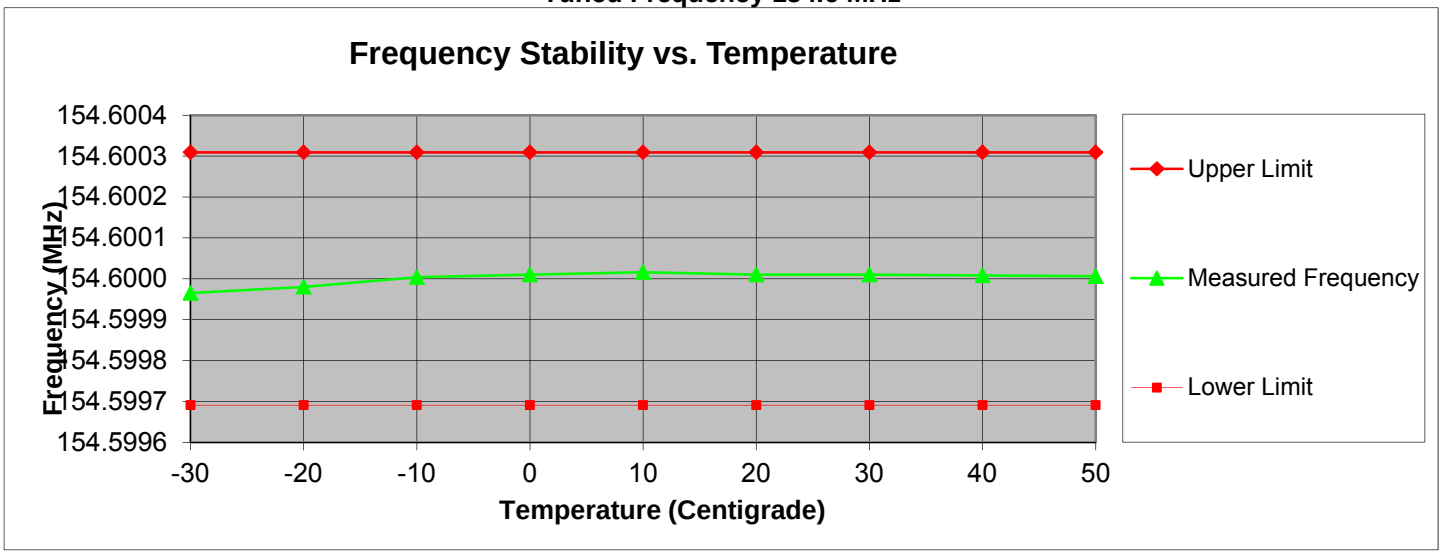
Tuned Frequency 151.82 MHz
Tolerance – 2.0 ppm
Upper Limit – 151.820304
Lower Limit – 151.819696

Tuned Frequency 151.94 MHz



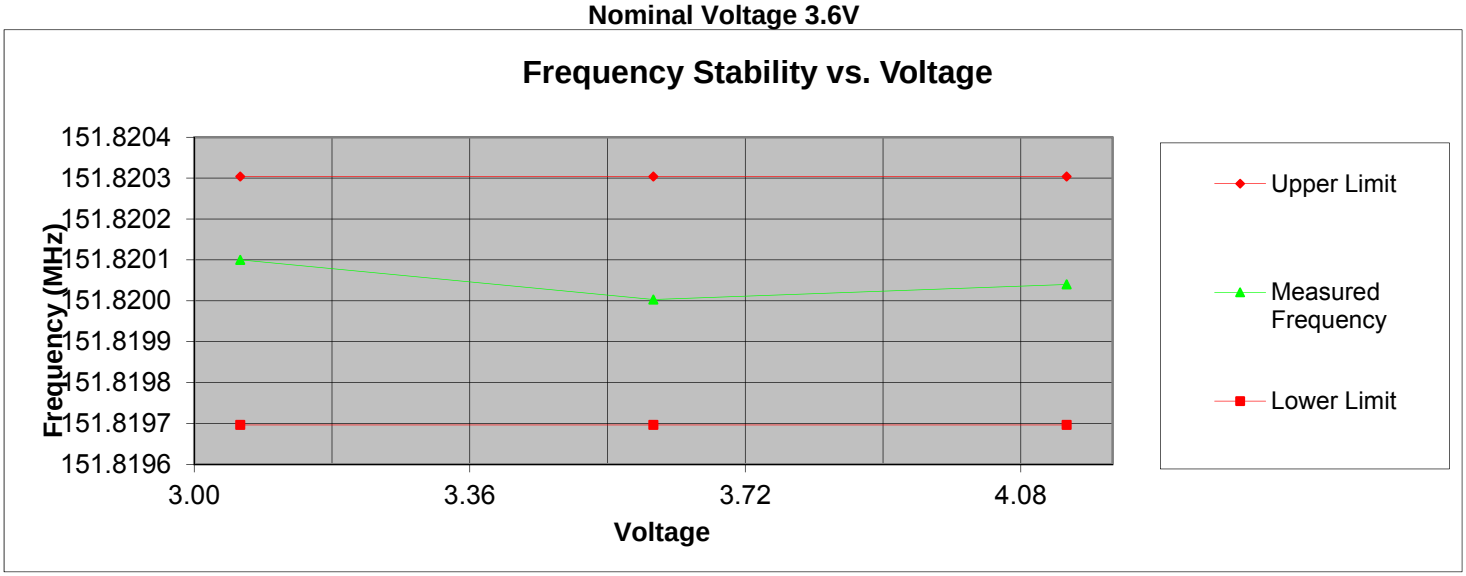
Tuned Frequency 151.94 MHz
Tolerance – 2.0 ppm
Upper Limit – 151.940304
Lower Limit – 151.939696

Tuned Frequency 154.6 MHz



Tuned Frequency 154.6 MHz
Tolerance – 2.0 ppm
Upper Limit – 154.600309
Lower Limit – 154.599691

Nominal Voltage 3.6V



Tuned Frequency 151.82 MHz
Tolerance – 2.0 ppm
Upper Limit – 151.820304
Lower Limit – 151.819696

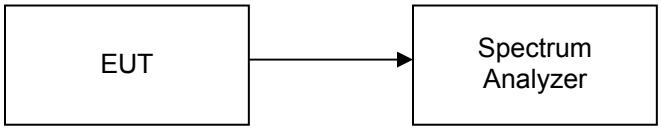
Receiver Spurious Emissions

Name of Test:	Receiver Spurious Emissions	**Engineer:** Mike Graffeo
Test Equipment Utilized:	i00379	**Test Date:** 2/13/14

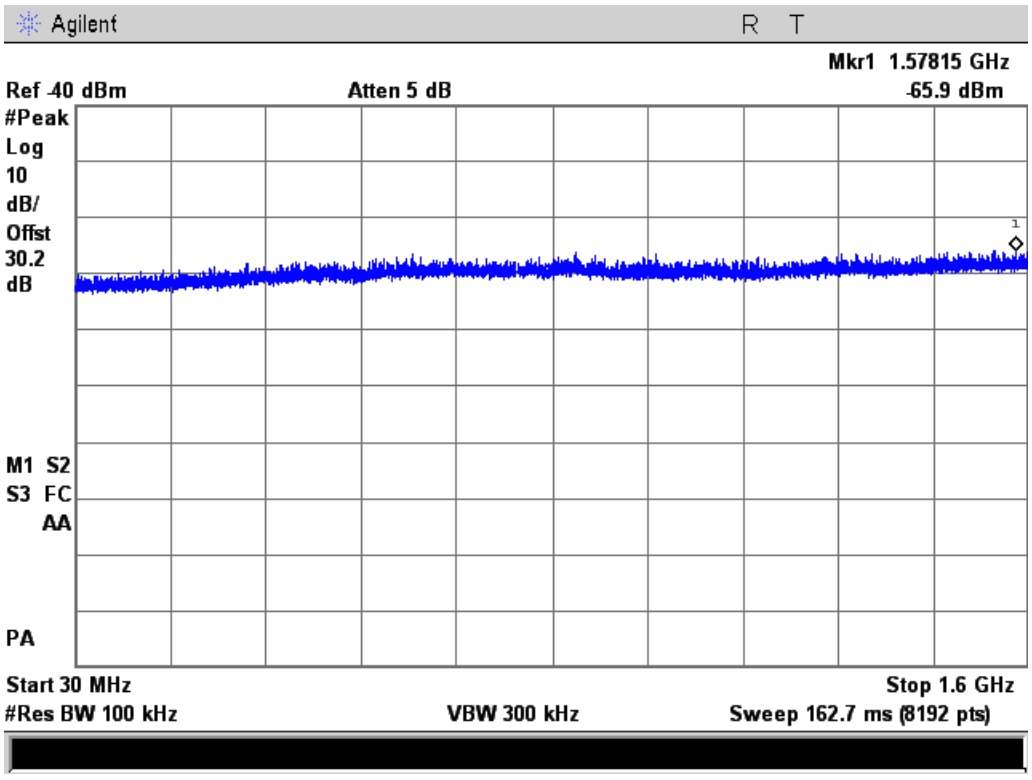
Test Procedure

The EUT was connected directly to a spectrum analyzer. The cable loss was input into the analyzer as a reference level offset to ensure accurate readings.

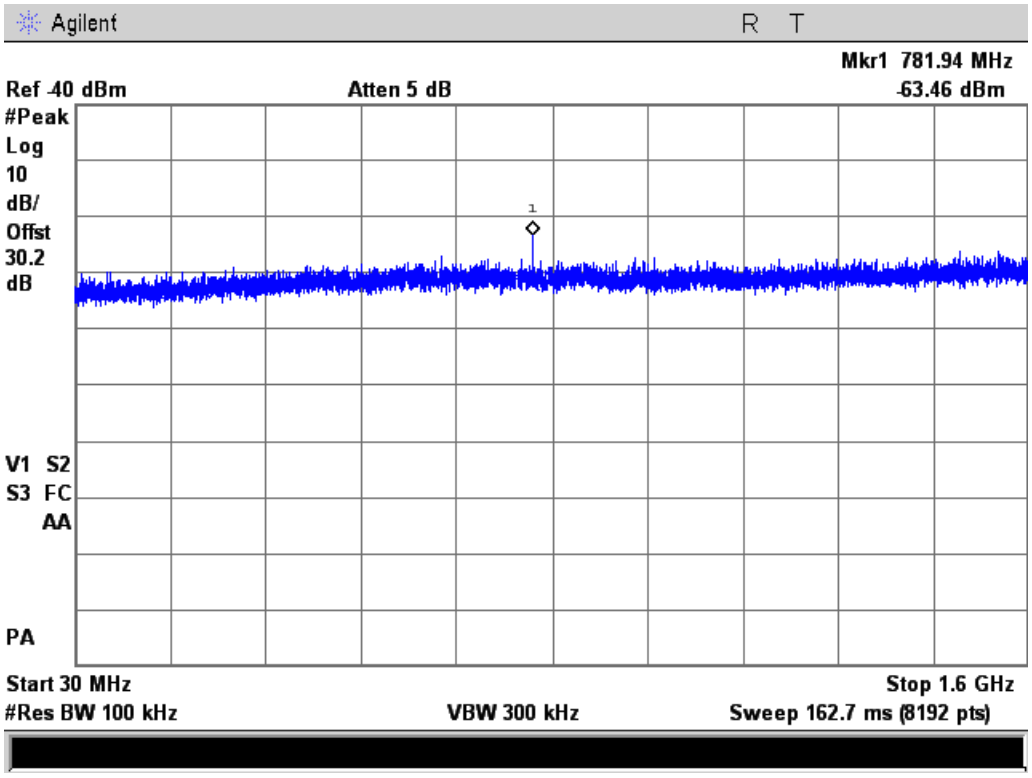
Test Setup



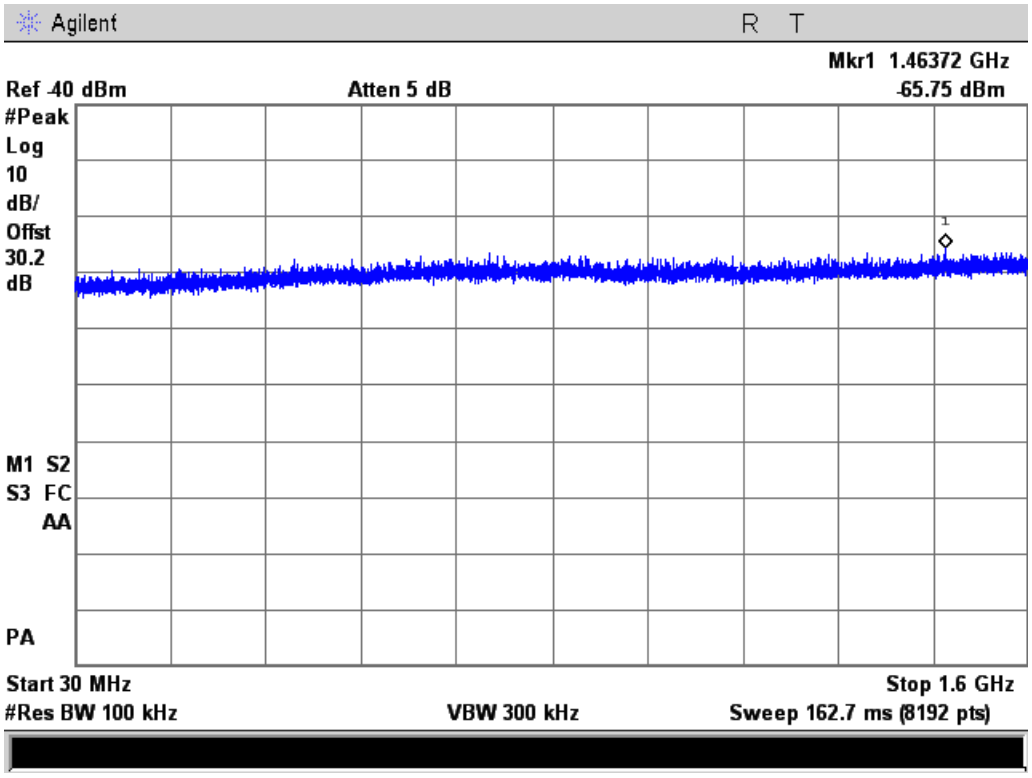
Tuned Frequency 151.82 MHz



Tuned Frequency 151.94 MHz



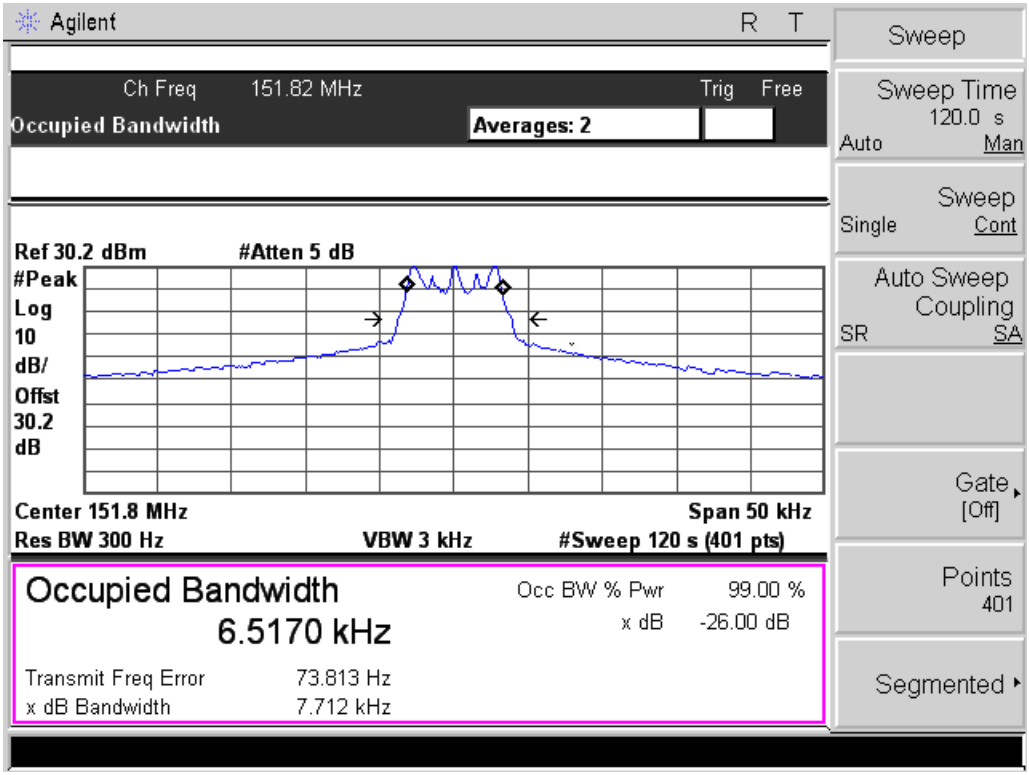
Tuned Frequency 154.6 MHz



Necessary Bandwidth Calculations

Name of Test:	Necessary Bandwidth Calculations	**Engineer:** Mike Graffeo
Test Specification:	2.202	**Test Date:** 2/14/14

EUT was designed to be 6.5 kHz and to be utilized in a 12.5 kHz bandwidth application.
Below is measured bandwidth:



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Temperature Chamber	Tenney	Tenney Jr	i00027	Verified on: 2/7/14	
Power Supply	HP	6286A	i00054	Verified on:2/7/14	
*Voltmeter	Fluke	75III	i00320	2/1/13	2/1/14
**Data Logger	Fluke	Hydra Data Bucket	i00343	12/19/12	12/19/13
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	10/8/13	10/8/15
EMI Analyzer	Agilent	E7405A	i00379	1/14/14	1/14/15
Thermo Hygrometer	Omega	RH81	i00408	4/15/13	4/15/15
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	11/14/13	11/14/15

*Note: Equipment is under a 30 day calibration extension per Lab Manager
**Note: Equipment is under a 60 day calibration extension per Lab Manager

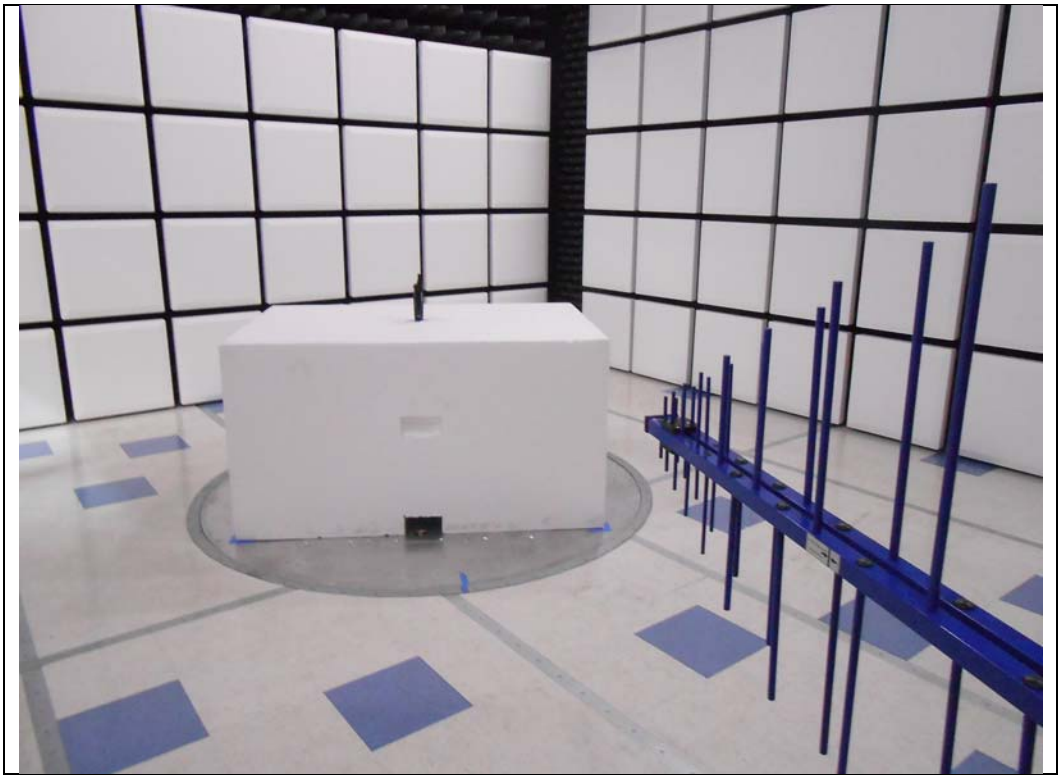
In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT

Test Setup Photos
FCC ID: IPH-O4AHNM00

RF Conducted

RF Radiated #1



RF Radiated #2