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Test Report

Prepared for: Taser International, Inc.

Model: AX1006

Description: Body Worn POV Camera System

Serial Number: DVR FCC TEST1, DVR FCC TEST4, Controller FCC TEST1

FCC ID: X4G-S00146

IC: 8803A-S00146

To

FCC Part 15.407

Date of Issue: January 9, 2017

On the behalf of the applicant:

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Attention of:

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Alex Macon
Project Test Engineer

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Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	November 28, 2016	Alex Macon	Original Document
2.0	December 8, 2016	Alex Macon	Included example of duty cycle measurement. Corrected typo on page 12 Added harmonic mixer to test equipment list. Removed 2.4 GHz plot from Annex C Updated conducted emissions language for clarification on procedure. Also Annex A was clarified. Included RSS mask in Annex A
3.0	December 12, 2016	Alex Macon	Updated test equipment list with RF filters. Clarified Duty Cycle correction plots and language. Updated page 7 output power. Updated Annex A mask plots Updated antenna gain
4.0	December 14, 2016	Alex Macon	Removed 15.207 test data. Updated the equipment utilized list.
5.0	December 15, 2016	Alex Macon	Removed LISN's from Test Equipment Utilized table Added 15.207 testing to 'Test Results Summary'
6.0	December 16, 2016	Amanda Reed	Changed model name
7.0	December 29, 2016	Amanda Reed	Updated zip code
8.0	December 30, 2016	Alex Macon	Updated standards reference dates on page 9 Added language for 1.5 meters in the test procedure on page 14
9.0	January 9, 2017	Alex Macon	Added nomenclature to Annex B Updated additional information on page 6



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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**



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 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 marked 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.



Standard Test Conditions Engineering Practices

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

In accordance with C63.10-2013 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 specified testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

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

Environmental Conditions		
Temperature (°C)	Humidity (%)	Pressure (mbar)
22.7 – 24.3	25.1 – 35.6	967.8 – 972.5

EUT Description

Model: AX1006

Description: Body Worn POV Camera System

Firmware: DVR (radio test mode): skytest-0.71.2-0.10.43

DVR (operation mode): TASER 1.7.6

Controller: TASER 0.1.37

Software: N/A

Serial Number: DVR FCC TEST1, DVR FCC TEST4, Controller FCC TEST1

Additional Information:

The EUT is a wireless POV camera utilizing UNII-3 WiFi. It is designed to be used by police officers.

EUT incorporated a chip antenna

EUT Operation during Tests

The EUT was placed into a test mode by the manufacturer. The manufacturer was present during all testing



EUT Specifications

Equipment Code	NII
Model(s) Tested	AX1006
Model(s) covered	AX1006
Maximum Output Power	18.96 dBm
Frequency Range	5725 - 5850
Bandwidths	20 MHz
Data Rates	6, 9, 12, 18, 24, 36, 48, 54, MCS0, MCS1, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7, MCS8, MCS9
Modulations	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM

Antenna List

No.	Manufacturer	Part #	Antenna Type	Peak Gain
1	Taser	VGAP-CLB-AS-A1	Chip	-3.0 dBi Typ.

15.203: Antenna Requirement:

- ☒ The antenna is permanently attached to the EUT
- ☐ The antenna uses a unique coupling
- ☐ The EUT must be professionally installed
- ☐ The antenna requirement does not apply



Accessories:

Qty	Description	Manufacturer	Model	S/N
1	Controller	Taser	N/A	N/A

Cables:

Qty	Description	Length (M)	Shielding Y/N	Shielded Hood Y/N	Ferrite Y/N
1	UFL to SMA	<.2	Y	Y	N

Modifications: None



Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
§15.203	Antenna Requirements	Pass	
§15.207 §15.407(b)(6)	Line Conducted Emissions	Pass	
§15.407(a)(3)	Conducted Output Power	Pass	
§15.407(a)(3),(5)	Power Spectral Density	Pass	
§15.403(i) §15.407(e)	6dB Occupied Bandwidth	Pass	
	99% Occupied Bandwidth		
§15.407(b)(4)	Undesirable Emissions	Pass	
§15.205 §15.407(b)(4),(5),(6)	General Field Strength Limits (Restricted Bands and Radiated Emission limits)	Pass	
§15.407(g)	Frequency Stability	Pass	
§15.407(f)	RF Exposure	Pass	
15.207	A/C Powerline Conducted Emissions	N/A	EUT is DC powered

References	Description
CFR47, Part 15, Subpart B	Unintentional Radiators
CFR47, Part 15, Subpart C	Intentional Radiators
CFR47, Part 15, Subpart E	Unlicensed Nation Information Infrastructure Devices (U-NII)
ANSI C63.10-2013	American National standard for testing Unlicensed Wireless Devices
ANSI C63.4-2014	Method and Measurements of Radio-Noise Emissions from low-Voltage Electrical and Electronic Equipment in the range 9kHz to 40GHz.
ISO/IEC 17025:2005	General requirements for the Competence of Testing and Calibrations Laboratories
KDB 644545 D03 v01	Guidance for IEEE 802 11ac New Rules
KDB 789033 D02 v01r03	General U-NII Test Procedures New Rules V01
KDB 926956 D01 v02	U-NII Transition Plan



Peak Output Power

Engineer: Alex Macon

Test Date: 10/18/16

Test Requirements

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

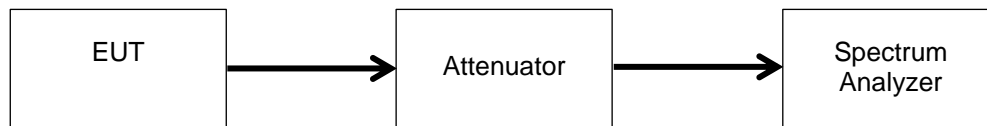
Test Procedure

The RF power was calculated using the spectrum analyzers' band power function per Method SA-2 from KDB 789033 D02 General U-NII Test Procedures New Rules v01. Measurements were made at the low, mid and high channels of the band. SA-2 was chosen due to overheating of the device when a higher duty cycle was initiated.

The Spectrum analyzer was set to the following:

- RBW = 1 MHz
- VBW \geq 3 MHz
- Sweep time = auto
- Detector = RMS
- 100 traces in power averaging mode
- Duty cycle correction: $10 \log (1/0.34) = 4.68$ dB

Test Setup



Test Results

A Mode

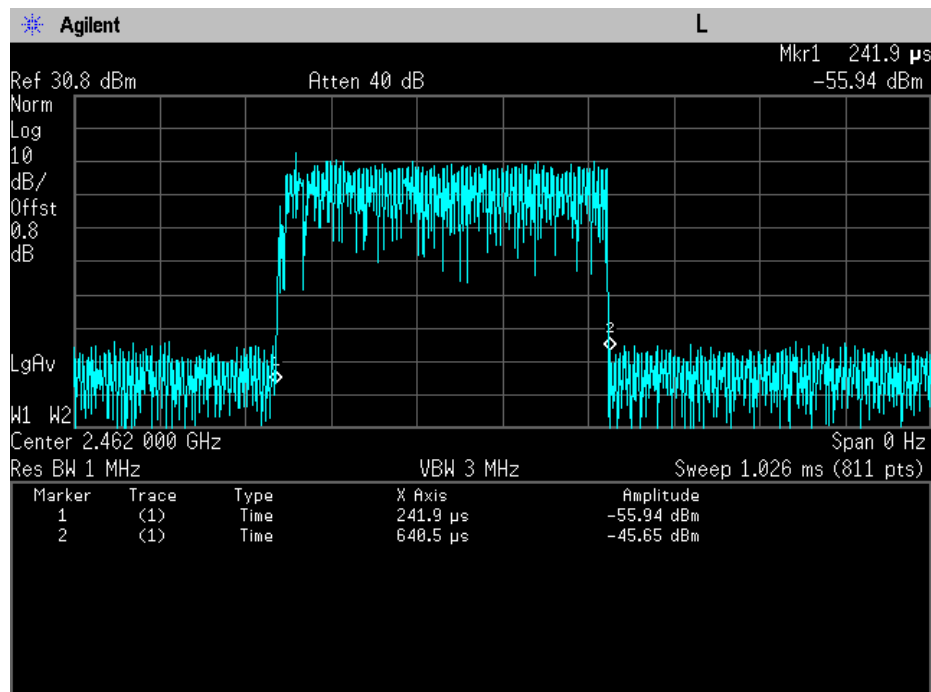
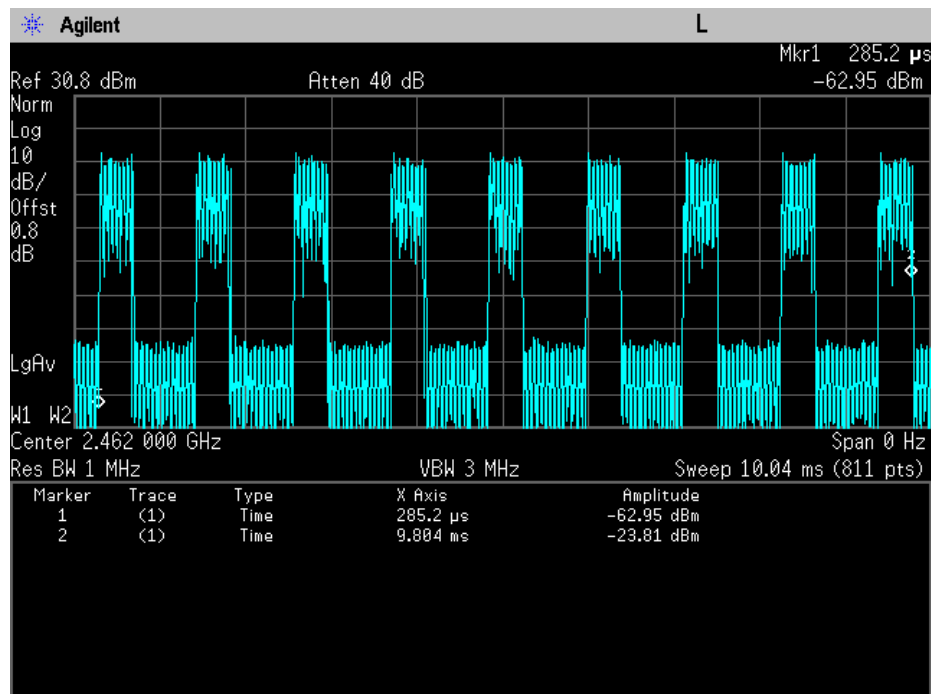
Tuned Frequency (MHz)	Measured Value (dBm)	Duty Cycle Correction (dB)	Corrected Value (dBm)	Specification Limit	Result
5745	13.46	4.68	18.14	1 W (30 dBm)	Pass
5785	13.61	4.68	18.29	1 W (30 dBm)	Pass
5825	14.28	4.68	18.96	1 W (30 dBm)	Pass

N Mode

Tuned Frequency (MHz)	Measured Value (dBm)	Duty Cycle Correction (dB)	Corrected Value (dBm)	Specification Limit	Result
5745	13.38	4.68	18.06	1 W (30 dBm)	Pass
5785	13.45	4.68	18.13	1 W (30 dBm)	Pass
5825	13.98	4.68	18.66	1 W (30 dBm)	Pass



Example of Duty Cycle Measurement:



The above plots are examples of the radio transmitting in the 2.4 GHz spectrum. The duty cycle was investigated during all applicable modulation schemes and was confirmed to be within 2% variation throughout its operating range.



Transmitter Power Spectral Density

Engineer: Alex Macon

Test Date: 10/19/16

Test Requirements

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in power spectral density.

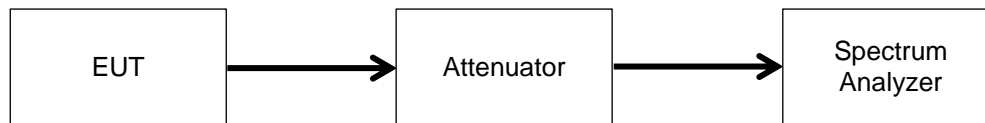
Test Procedure

The Power Spectral Density was measured using the method per SA-1 from KDB 789033 D02 General U-NII Test Procedures New Rules v01. Measurements were made at the low, mid and high channels of the band. The maximum PSD was determine by finding the peak value across the carrier bandwidth. SA-1 was used for this test because the overheating of the unit was not an issue given the measurement time for PSD is less than the measurement time for output power. The EUT was capable of transmitting at >98% for short durations without reduction in power.

The Spectrum Analyzer was set to the following:

- RBW = 500 KHz.
- VBW \geq 1500 MHz
- Span $1.5 * BW$
- Sweep time = auto
- Detector = RMS
- 100 traces in power averaging mode

Test Setup



Test Results

A Mode

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
5745	11.47	1 W (30 dBm)	Pass
5785	12.34	1 W (30 dBm)	Pass
5825	11.63	1 W (30 dBm)	Pass

N Mode

Tuned Frequency (MHz)	Measured Value (dBm)	Specification Limit	Result
5745	11.58	1 W (30 dBm)	Pass
5785	11.86	1 W (30 dBm)	Pass
5825	10.59	1 W (30 dBm)	Pass



Undesirable Emissions Conducted

Engineer: Alex Macon

Test Date: 11/2/16

Test Requirements

Unwanted Emissions that fall Outside Restricted Bands

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

The provisions of §15.205 apply to intentional radiators operating under this section.

Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209.

For Conducted Unwanted Emissions in the Restricted Bands

For conducted measurements above 1000 MHz, EIRP was determined and then the field strength computed by the following:

$E[\text{dB}\mu\text{V/m}] = \text{EIRP}[\text{dBm}] - 20 \log(d[\text{meters}]) + 104.77$, where E = field strength and $d = 3\text{m}$

$E[\text{dB}\mu\text{V/m}] = \text{EIRP}[\text{dBm}] + 95.2$, for $d = 3\text{ meters}$.

Test Procedure

Per KDB 789033 D02 General U-NII Test Procedures New Rules v01 conducted RF port measurements were made in lieu of radiated. In addition, Cabinet Emissions measurements were performed in a semi-anechoic chamber with the antenna port terminated by a matching load. See additional section for Radiated Emissions.

Emissions were observed first with no filter present, and then a band reject filter was incorporated to determine if any emissions close to the fundamental were erroneous. The band reject filter was replaced with a high pass filter to determine if the higher frequency spurs (including the 2nd harmonic) were accurate.

The following criteria were addressed:

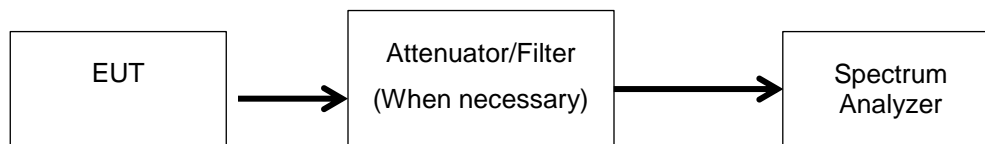
The Spectrum Analyzer was set to the following for emissions > 1000MHz:

- RBW = 1 MHz
- VBW \geq 3 MHz
- Detector = Peak.
- Sweep time = auto.
- Trace mode = max hold.
 - Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
- RBW = 1 MHz
- VBW \leq RBW/100 (i.e., 10 kHz) but not less than 10 Hz.

For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

- RBW = 100 kHz
- VBW \geq 300 kHz
- Detector = Peak.
- Sweep time = auto.
- Trace mode = max hold.

Test Setup



Test Results: See Annex A: Undesirable Emissions Conducted



Undesirable Emissions Radiated

Engineer: Alex Macon

Test Date: 11/2/16

Test Requirements

The provision of §15.209 were applied. In addition the requirements of §15.205 were also applied.

FCC Part 15 Subpart C Paragraph 15.209(a) Limits

Frequency (MHz)	Frequency (microvolts/meter)	Frequency (meter)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remarks: E field strength (dBμV/m) = 20 log E field strength (uV/m)

Test Procedure

The EUT was setup in accordance with ANSI C63.10. 2013 and tested per KDB 789033. The antenna was replaced with non-radiating matched load. The EUT is placed on non-conductive platform at a height of 0.8 meters above the ground plane for frequencies less than 1GHz and at a height of 1.5 meters above the ground plane for frequencies greater than 1GHz. The EUT was rotated 360 degrees and the receive antenna raised and lowered to find the maximum emissions from 30MHz to the 10th harmonic of the fundamental. The EUT was set to the maximum power level allowed and the low, mid, and high channels were investigated for emissions.

The Spectrum Analyzer was set to the following for emissions > 1000MHz:

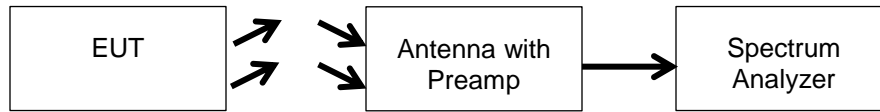
- a. (RBW = 1 MHz
- b. VBW ≥ 3 MHz
- c. Detector = Peak.
- d. Sweep time = auto.
- e. Trace mode = max hold.
 - 1. Note: For emissions where the peak exceeded that of the average 15.209 emission limit the following was performed.
- f. RBW = 1 MHz
- g. VBW ≤ RBW/100 (i.e., 10 kHz) but not less than 10Hz

For emissions below 1000MHz the Spectrum Analyzer settings were as follows:

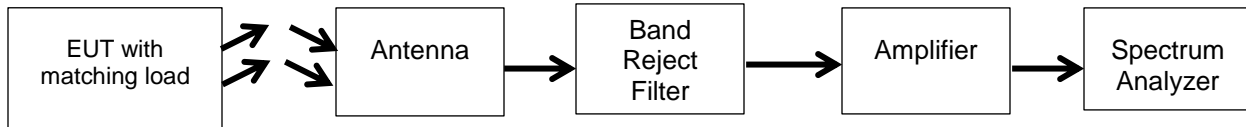
- a. RBW = 100 kHz
- b. VBW ≥ 300 kHz
- c. Detector = Peak.
- d. Sweep time = auto.
- e. Trace mode = max hold.
 - 1. Note: A quasi peak detector was used for emissions where the peak exceeded that of the average 15.209 emission limits



Test Setup below 1000MHz



Test Setup above 1000MHz



Test Results: **See Annex B: Undesirable Emission Radiated**



Occupied Bandwidth

Engineer: Alex Macon

Test Date: 10/18/16

Test Requirement

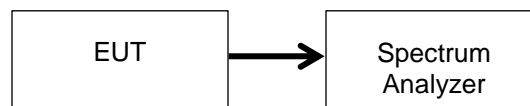
Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz. For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 6 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement

Test Procedure

The Spectrum analyzer was set to the following parameters

- a. RBW = 100 – 470 kHz.
- b. VBW \geq 300 kHz
- c. Detector = Peak.
- d. Trace mode = max hold.

Test Setup



Test Results: **See Annex C: Occupied Bandwidth**



Frequency Stability

Engineer: Alex Macon

Test Date: 10/19/16

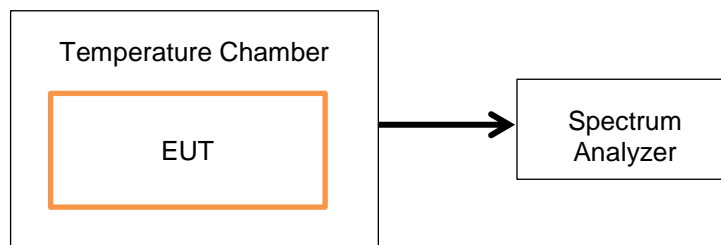
Test Requirement

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

Test Procedure

- The EUT was placed into a temperature chamber and the temperature ranges were set to the manufacturers' specifications.
- The RF output of the EUT was connected to a spectrum analyzer
- The lowest and highest channels of the band were set to transmit
- The carrier plots were measured to insure that the 6dB band width remained within the band over the prescribed temperature extremes.

Test Setup



Test Results: See Annex D: Frequency Stability



Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Temperature Chamber	Tenney	Tenney Jr	i00027	NCR	NCR
Harmonic Mixer	HP	11970A	i00193	6/4/15	6/4/18
Horn Antenna	ARA	DRG-118/A	i00271	6/16/16	6/16/18
Horn Antenna, Amplified	ARA	MWH-1826/B	i00273	4/22/15	4/22/18
Humidity / Temp Meter	Newport	IBTHX-W-5	i00282	5/26/16	5/26/17
Voltmeter	Fluke	87III	i00319	4/11/16	4/11/17
Spectrum Analyzer	Agilent	E4407B	i00331	10/19/16	10/19/17
Data Logger	Fluke	Hydra Data Bucket	i00343	4/5/16	4/5/17
Vector Signal Generator	Agilent	E4438C	i00348	2/16/16	2/16/18
Bi-Log Antenna	Schaffner	CBL 6111D	i00349	8/3/16	8/3/18
EMI Analyzer	Agilent	E7405A	i00379	2/11/16	2/11/17
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/16	8/15/19
Signal Generator	Agilent	E4438C	i00457	10/19/16	10/19/18
Tunable Notch Filter	Wainwright	WTRCJV8-5150-5900-40-160-50SSK	i00462	NCR	
PSA Spectrum Analyzer	Agilent	E4445A	i00471	8/30/16	8/30/17
Signal Generator	Agilent	E4437B	i00489	3/18/16	3/18/17
High-Pass Filter	Micro-Tronics	HPM50106	S/N: 013	NCR	

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