H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Raveon Technologies Corporation

Data Radio Modem Model # RV-M6S-VM

Tested under

The FCC Rules contained in Title 47 of the CFR, Part 95 Subpart J for

Personal Radio Services - MURS

January 17, 2019

Prepared for:

Raveon Technologies, Corp

2320 Cousteau Court

Vista, CA 92081

Prepared By:

H.B. Compliance Solutions

5005 S. Ash Avenue, Suite A-10

Tempe, Arizona 85282

Reviewed By:

Hoosamuddin Bandukwala

Cert # ATL-0062-E

Engineering Statement: The measurements shown in this report were made in accordance with the procedure 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 measurement made, the equipment tested is capable of operation in accordance with the requirements of Part 95 of the FCC Rules under normal use and maintenance. All results contained herein relate only to the sample tested.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	January 17, 2019	Initial Issue
1	January 31, 2019	Updated Frequency and add radiated plot

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EXECUTIVE SUMMARY

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 95 Subpart J. All tests were conducted using measurement procedure from ANSI TIA/EIA-603-D-2010 as appropriate.

Test Name	Test Method/Standard	Result	Comments
RF Output Power	2.1046; 95.639(h)	Pass	
Modulation Characteristics	2.1047(a)	Pass	The EUT does not transmit voice. The device transmit data signal only
Occupied Bandwidth	2.1049; 95.635(e)	Pass	
Spurious Emissions at Antenna Terminals	2.1051; 95.635(e)	Pass	
Radiated Spurious Emissions	2.1053; 95.635(e)	Pass	
Frequency Stability over Temperature Variations	2.1055(a)(1); 95.632	Pass	
Frequency Stability over Voltage Variations	2.1055(d)	Pass	

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Raveon Technologies Corporation to perform testing on the Data Radio Modem under the quotation number Q18091008.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Raveon Technologies Corporation, Data Radio Modem.

The tests were based on FCC Part 95 Rules. The tests described in this document were formal tests as described with the objective of the testing was to evaluate compliance of the Equipment Under Test (EUT) to the requirements of the aforementioned specifications. Raveon Technologies Corporation should retain a copy of this document and it should be kept on file for at least five years after the manufacturing of the EUT has been permanently discontinued. The results obtained relate only to the item(s) tested.

Product Name:	Data Radio Modem
Model(s) Tested:	RV-M6S-VM
FCC ID:	SRS-M6S-VM
Supply Voltage Input:	Primary Power : 6 Vdc
Frequency Range:	151.820, 151.880, 151.940, 154.570 & 154.600
No. of Channels:	Five Channels
Necessary Bandwidth	20kHz
Type(s) of Modulation:	DTMF
Range of Operation Power:	1.936 W
Voltage into final Transistor	6 volts
Current into final Transistor	2.5 amps
Emission Designator:	8K20F1D & 11K0F1D
Channel Spacing(s)	None
Test Item:	Pre-Production
Type of Equipment :	Fixed
Antenna:	O
Environmental Test Conditions:	Temperature: 15-35°C Humidity: 30-60% Barometric Pressure: 860-1060 mbar
Modification to the EUT:	None
Evaluated By:	H.B. Compliance Solutions
Test Date(s):	Oct/24/2018 till 01/04/2019

2. Test Facility

All testing was performed at H.B. Compliance Solutions. This facility is located at 5005 S. Ash Avenue, Suite # A-10, Tempe AZ-85282. All equipment used in making physical determination is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements from 30MHz to 1GHz were performed in a GTEM chamber (equivalent to an Open Area Test Site). Radiated Emission above 1GHz were performed on an Open Area Test Site (OATS). In accordance with §2.948(a)(3), a complete site description is contained at H.B. Compliance Solutions.

Test facility H.B. Compliance Solutions is an ANAB accredited test site. The ANAB certificate number is L2458. The scope of accreditation can be found on ANAB website www.anab.org

3. Description of Test Sample

The Raveon Technologies, RV-M6S-VM Data radio modem module, is capable of high-speed narrow-band data communications device. It contains a transmitter and a modem, creating an easy to use transparent data radio link. The built in DTMF protocol is compatible with many legacy systems. The components are contained in a metal enclosure. It runs off 6-34 Vdc via a 2-wire cord.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	Data Radio Modem	RV-M6S-VM	N/A

Table 1. Equipment Configuration

5. Support Equipment

All support equipment supplied is listed in the following Support Equipment List.

Ref ID	Name / Description	Manufacturer	Model #	Serial #
#2	DC Power Supply	Lambda	LA-200	LA2-AA20-1433535
#3	Laptop	Dell	Inspiron 1545	17934612445

Table 2. Support Equipment

6. Ports and Cabling Information

Ref ID	Port name on the EUT	Cable Description	Qty.	Length (m)	Shielded? (Y/N)	Termination Box ID & Port ID
#4	Power	2 wire	1	2	N	DC Power Supply

Table 3. Ports and Cabling Information

7. Method of Monitoring EUT Operation

A test receiver will be used to monitor the data transmission from the EUT.

8. Mode of Operation

The EUT will be configured to transmit at maximum power level. Test mode was provided to select the lower, middle and upper band of the transmitter by customer provided software. This software programmed the transmitter from three frequencies modulated and the other three in CW mode. These settings were created for testing purpose only.

9. Modifications

9.1 Modifications to EUT

No modifications were made to the EUT

9.2 Modifications to Test Standard

No Modifications were made to the test standard.

10. Disposition of EUT

The test sample including all support equipment submitted to H.B Compliance Solutions for testing will be returned to Raveon Technologies Corporation upon completion of testing & certification

1. RF Power Output

Test Requirement(s):	§2.1046 and §95.639(h)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Dec/19/2018

Test Procedures: As required by 47 CFR 2.1046, RF Power output measurements were made at the RF output terminals of the EUT.

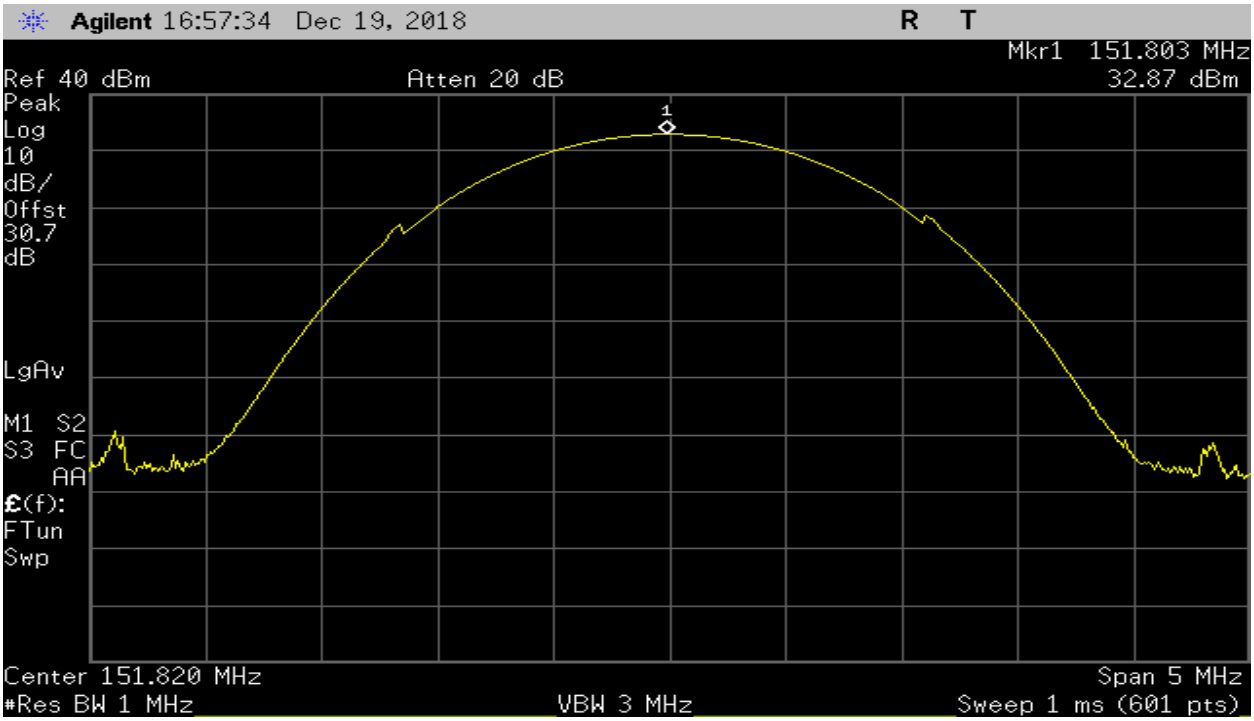
Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer capable of making power measurements. Measurements were made at the maximum output power.

Frequency (MHz)	Conducted Power (dBm)	Conducted Power (W)	Limit (W)
151.820	32.87	1.936	2.0
154.60	32.47	1.766	2.0

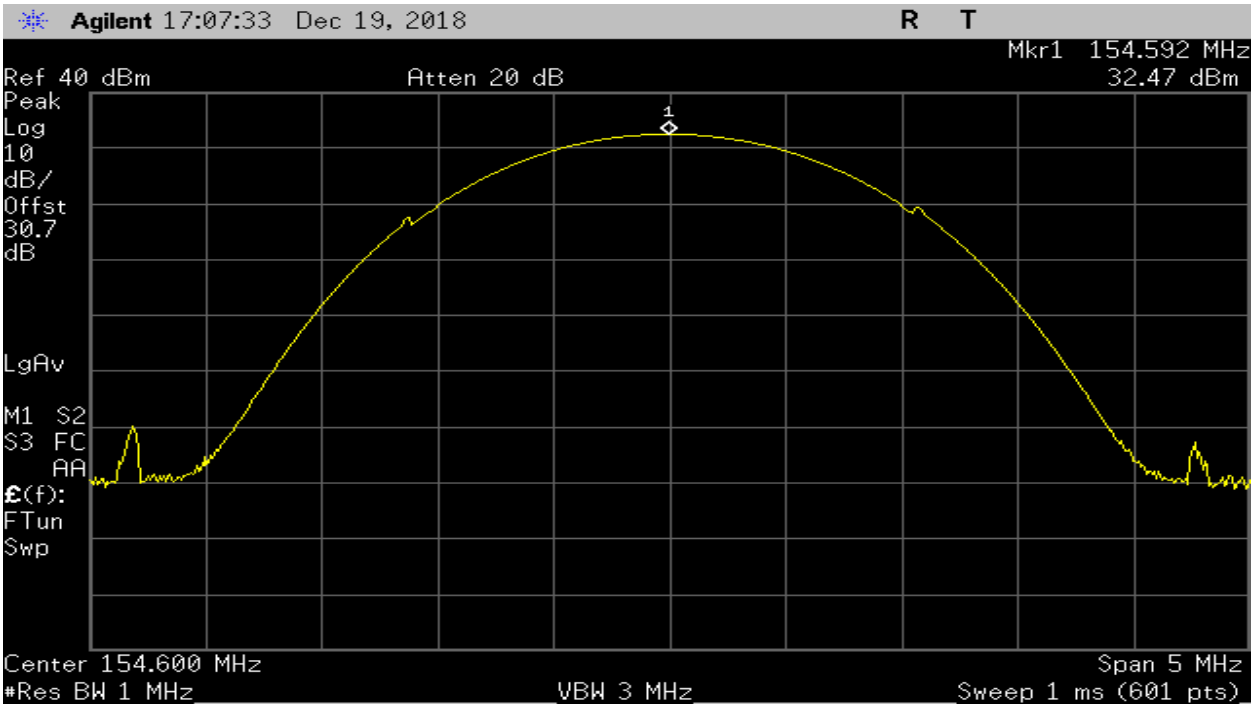
Table 4. RF Power Output, Test Results

Test Setup:

Figure 1 Output RF power Test Setup



Plot 1 – Output Power – Lowest Channel



Plot 2 – Output Power – Highest Channel

2. Modulation Characteristics

Test Requirement(s):	2.1047	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Dec/26/2018

Test Procedure: As required by 47 CFR 2.1047, Modulation characteristics measurements were made at the RF output terminals of the EUT.

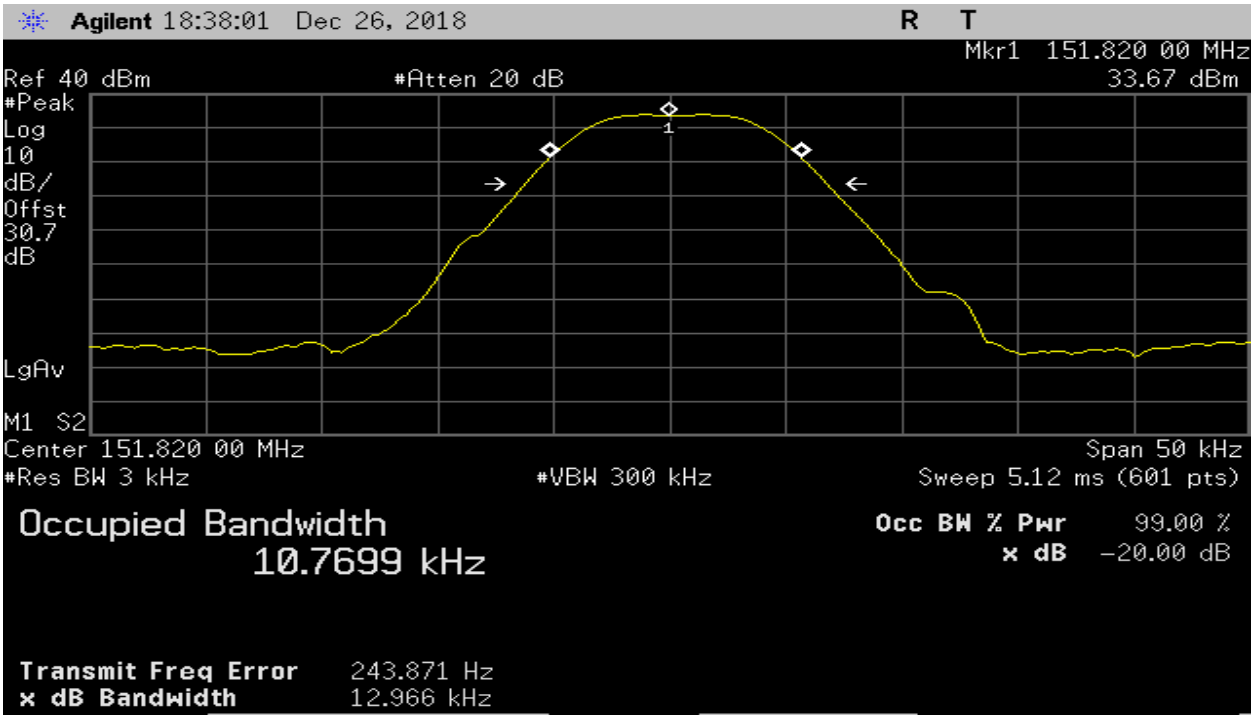
Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer.

As per standard a curve or equivalent data of the EUT is shown

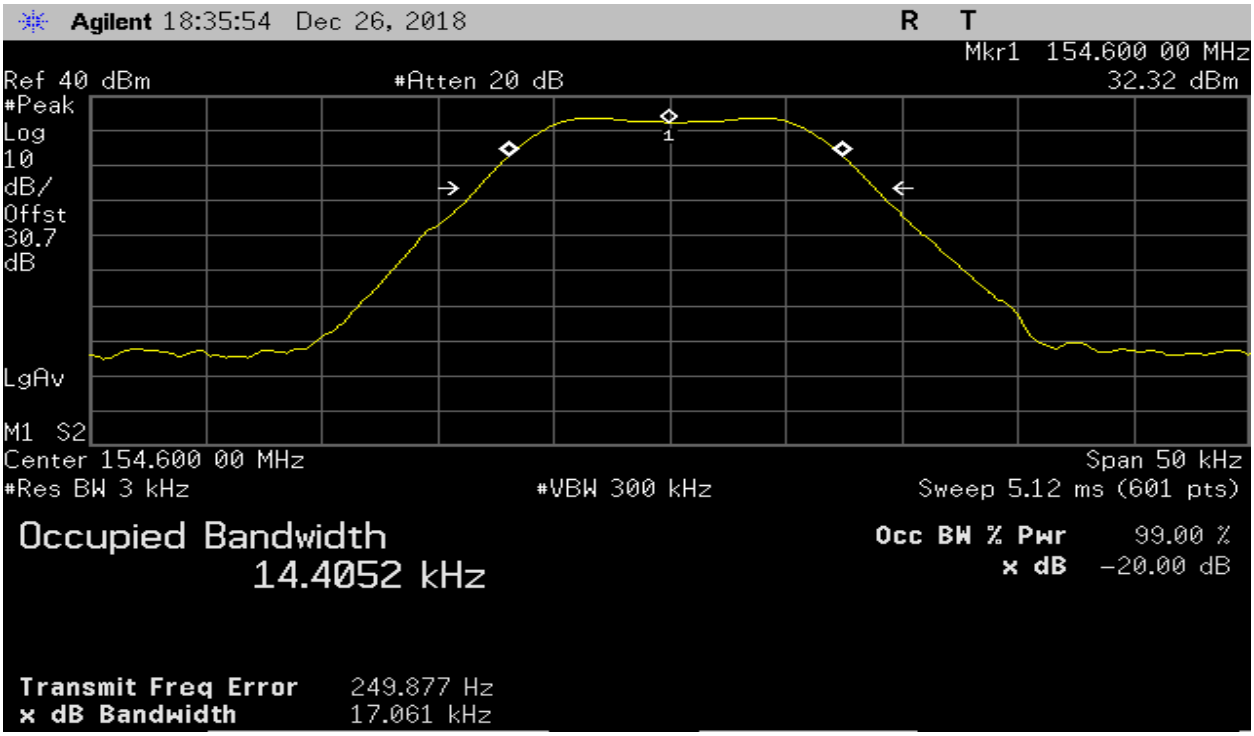
The plot(s) of the modulation characteristic is presented hereinafter as reference.

Test Setup:

Figure 2: Modulation Characteristics Bandwidth Test Setup



Plot 3 – Modulation Characteristics – Lowest Channel



Plot 4 – Modulation Characteristics – Highest Channel

3. Occupied Bandwidth (Emission Mask)

Test Requirement(s):	2.1049 and §95.635(e)(3) with FCC (Emission Mask 3)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Dec/27/2018

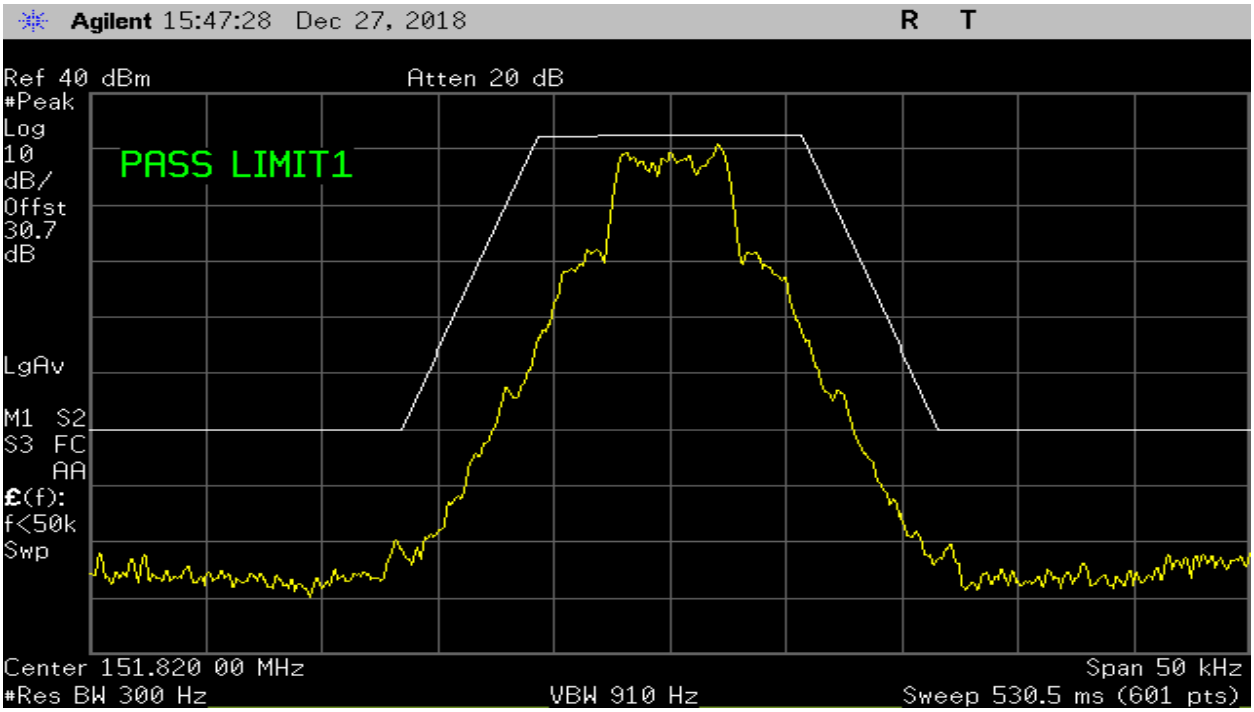
Test Procedure: As required by 47 CFR 2.1049, occupied bandwidth measurements were made at the output terminals of the EUT.

Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer. The measured highest peak power was set relative to zero dB reference. The RBW of the Spectrum Analyzer was set to at least 1% of the channel bandwidth. Measurements were carried out at the low, mid and high channels of the TX band.

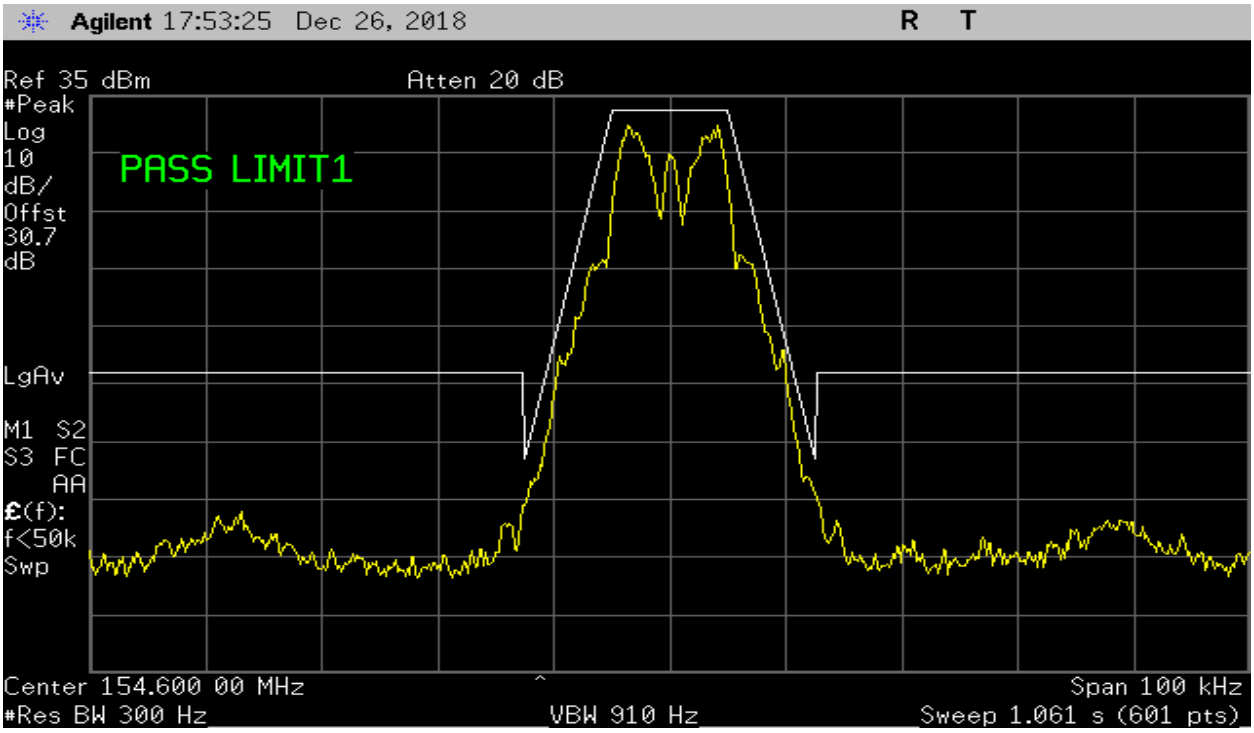
Test Setup:

Figure 3: Occupied Bandwidth Test Setup

The following pages show measurements of Emission Mask plots:



Plot 5 – 11.25 kHz Spacing – Mask 1 (Lowest Channel)



Plot 6 – 20 kHz Spacing – Mask 3 (Highest Channel)

4. Spurious Emissions at Antenna Terminals

Test Requirement(s):	§2.1051 and 95.635(e)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Dec/27/2018

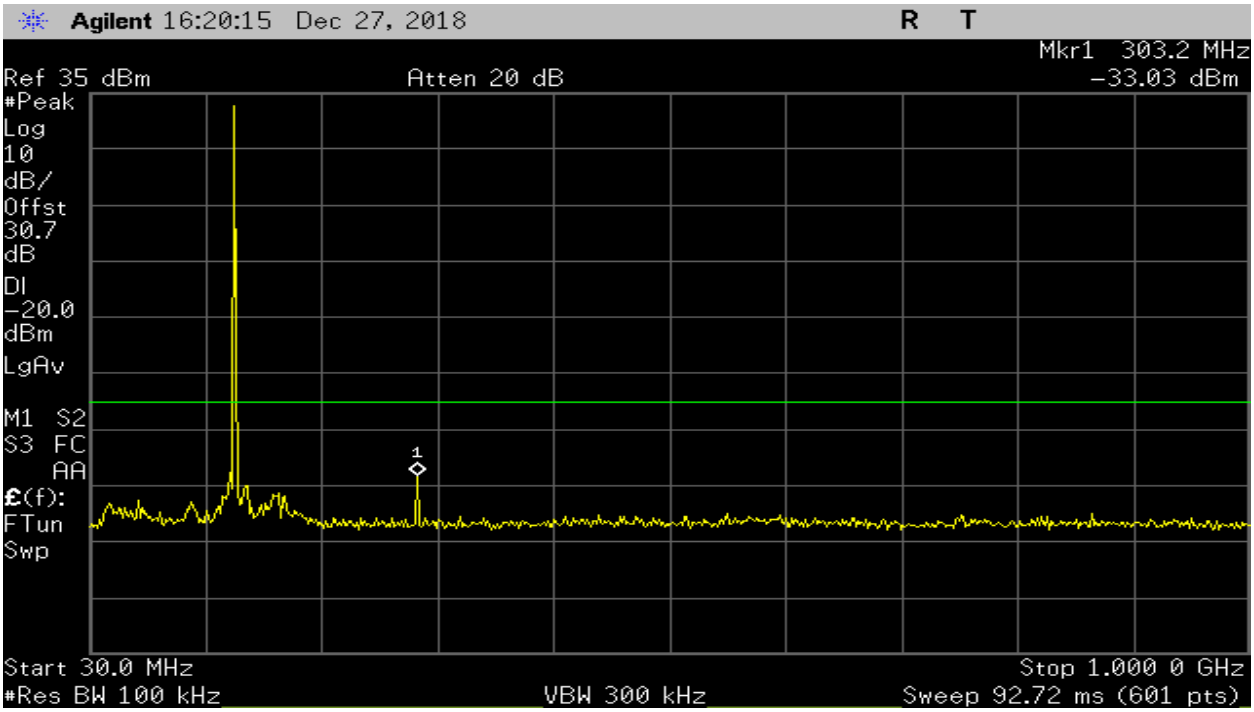
Test Procedures:

As required by 47 CFR 2.1051, spurious emissions at antenna terminal measurements were made at the RF output antenna terminal of the EUT.

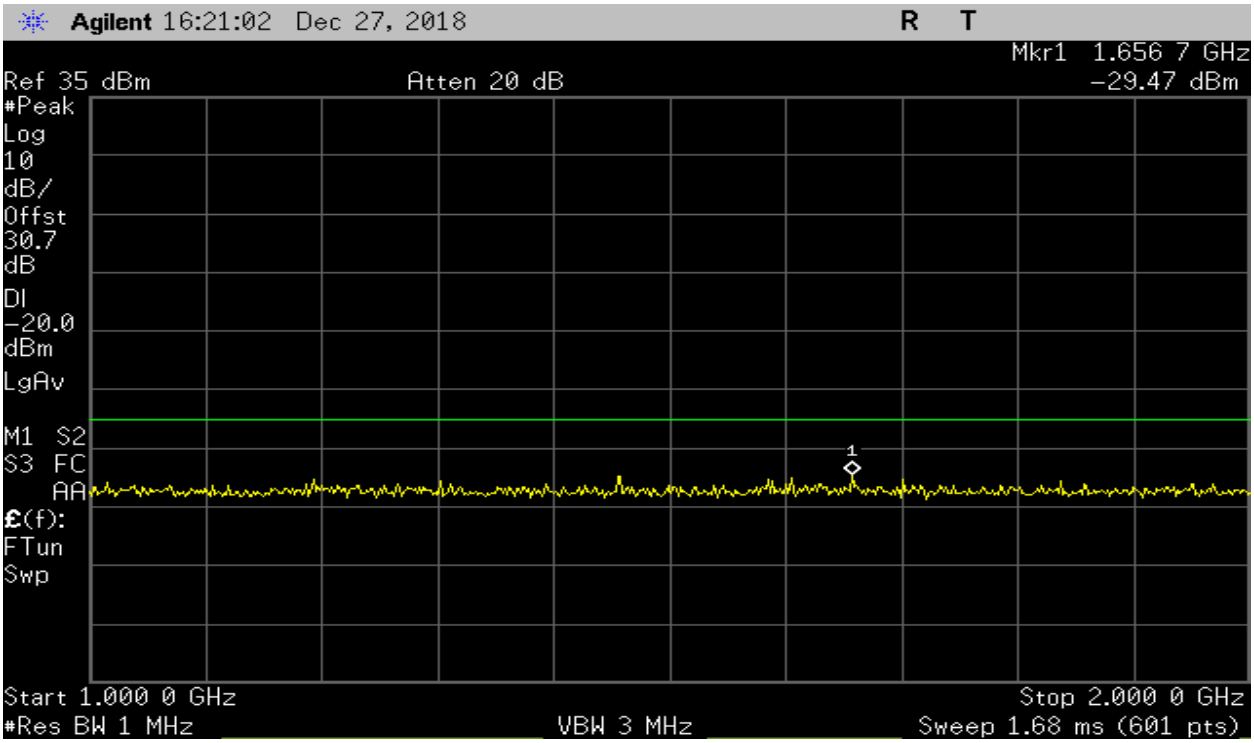
Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer. The Spectrum Analyzer was set to sweep from 30MHz up to 10th harmonic of the fundamental or 40GHz whichever is the lesser. Measurements were made at the low, mid and high frequency of the transmit band.

Test Setup:

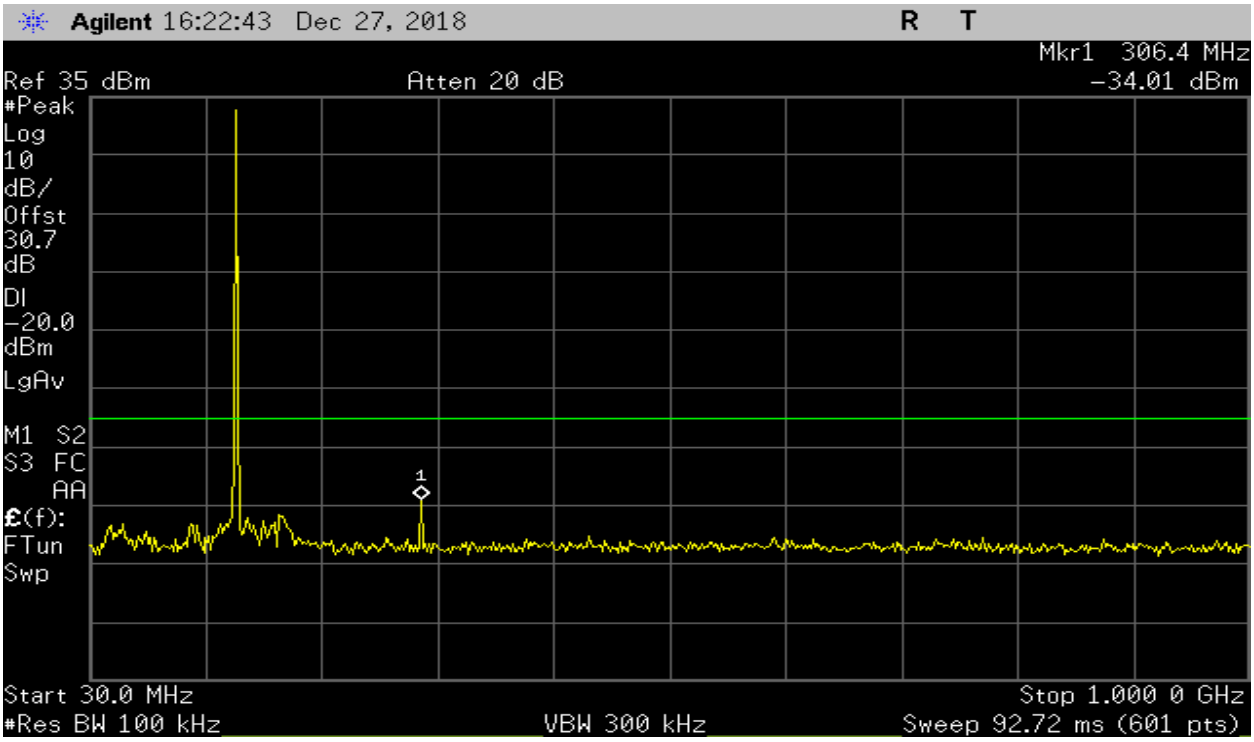
Figure 4: Spurious Emission at Antenna Terminal Test setup



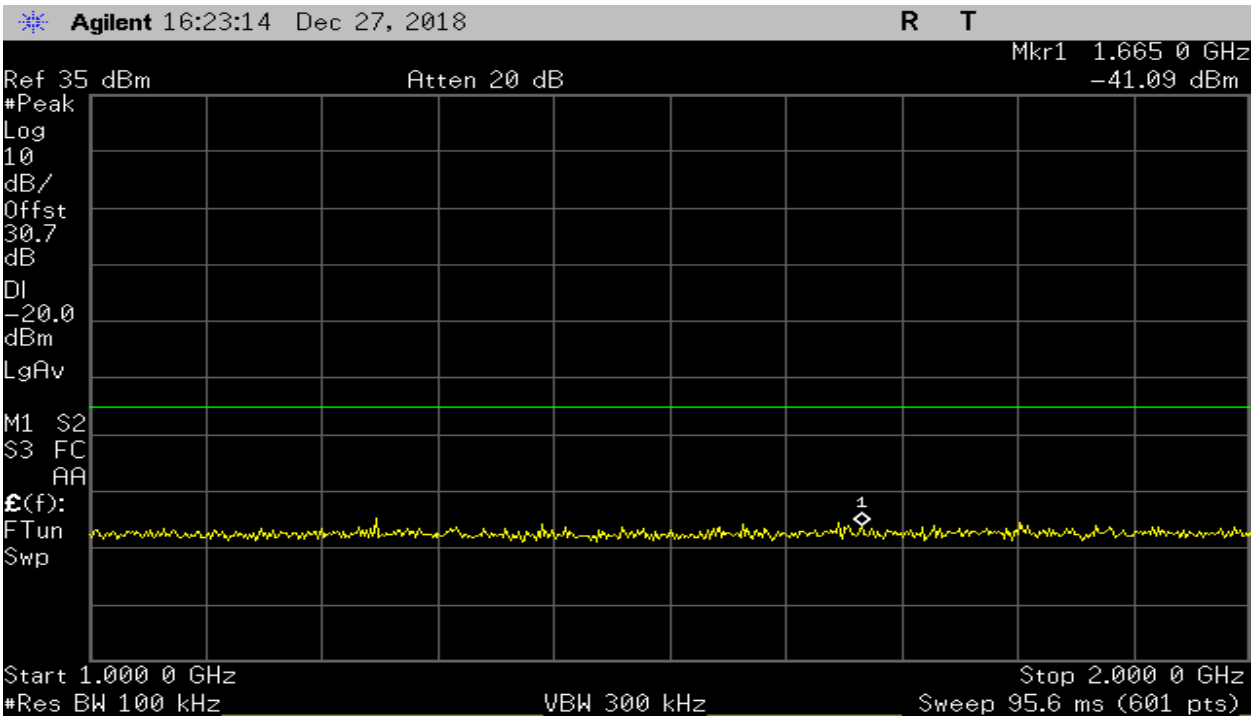
Plot 7 – Conducted Spurious – 30MHz to 1GHz – Lowest Channel



Plot 8 – Conducted Spurious – 1GHz to 2GHz – Lowest Channel



Plot 9 – Conducted Spurious – 30MHz to 1GHz – Highest Channel



Plot 10 – Conducted Spurious – 1GHz to 2GHz – Highest Channel

5. Radiated Spurious Emissions

Test Requirement(s):	§2.1053 and 90.210(j)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	Jan/042019

Test Procedures:

As required by 47 CFR 2.1053, field strength of radiated spurious measurements were made in accordance with the procedures of the TIA/EIA-603-D-2010.

The EUT was placed on a wooden table inside a 3 meter semi-anechoic chamber. The EUT was transmitting into a non-radiating load which was directly connected to the EUT antenna port.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3 orthogonal axis. The frequency range up to the 10^{th} harmonic was investigated.

The EUT is removed and replaced with a substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 log (Txpwr in Watts/0.001)-the absolute level

Spurious attenuation limit in dB = 50 + 10 $\log_{10}$ (P) dB or 70dB whichever is the lesser attenuation

Test Setup:

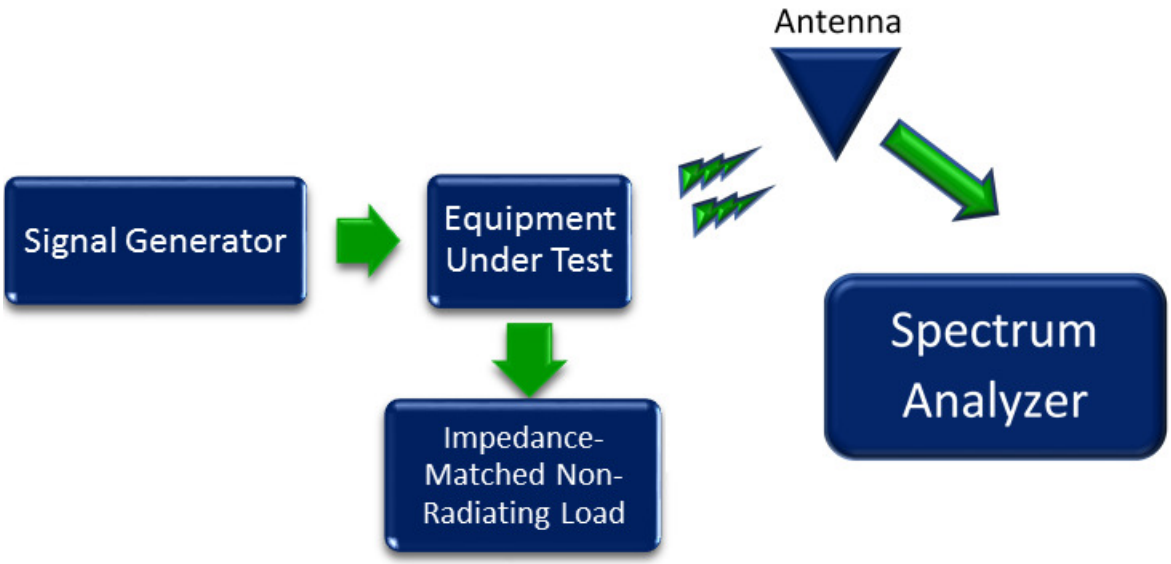
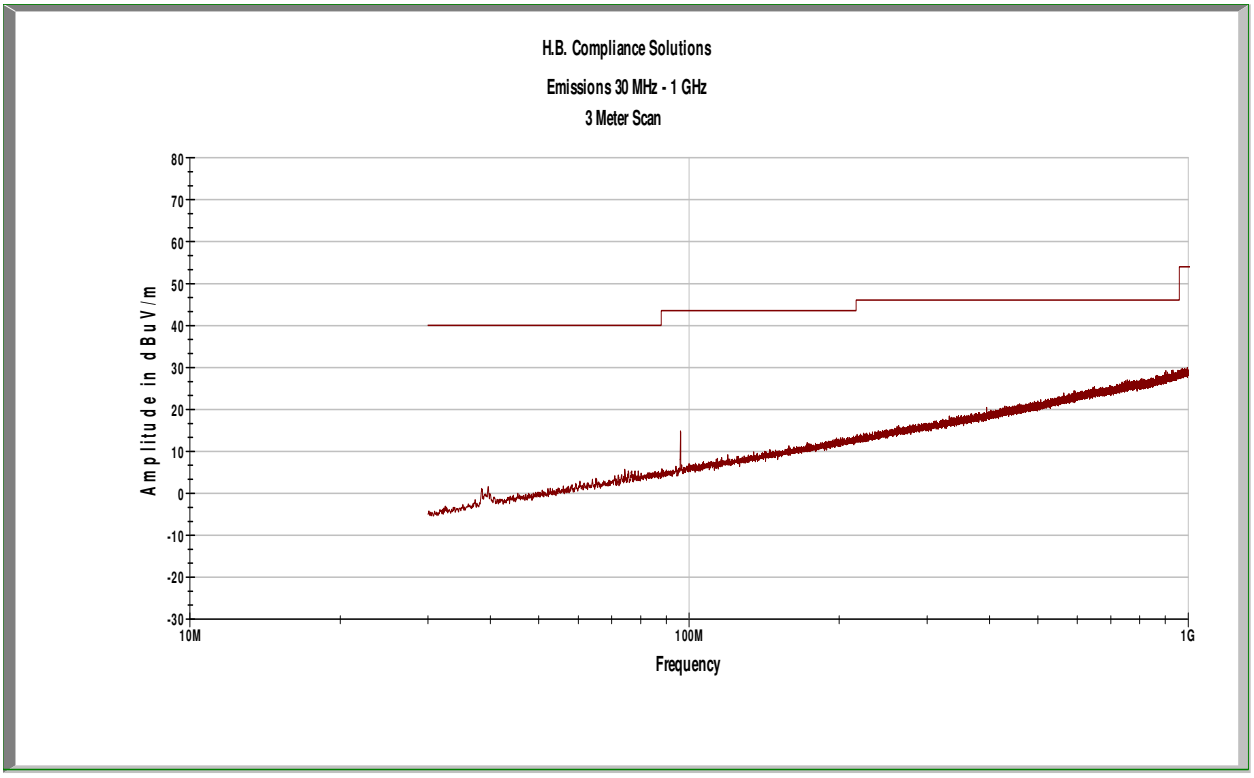


Figure 5 – Radiated Spurious Emission



Plot 11 – Radiated Emissions – 30MHz to 1GHz

Frequency (MHZ)	Amplitude (dbm)	Antenna Polarity	Cable Loss	Substitution Generator Level (dbm)	Transmit Antenna Gain	Corrected Amplitude (dBm)	Limit (dBm)
303.64	-55.0	Vert	0.1	-34.0	4.6	-29.3	-20
455.46	-67.0	Horz	0.3	-46.0	4.6	-41.1	-20
607.28	-74.0	Horz	0.4	-46.0	5.2	-40.4	-20

Table 5 - Spurious Radiated Emission Data – Lowest Channel

Frequency (MHZ)	Amplitude (dbm)	Antenna Polarity	Cable Loss	Substitution Generator Level (dbm)	Transmit Antenna Gain	Corrected Amplitude (dBm)	Limit (dBm)
309.2	-63.0	Vert	0.1	-38.0	4.6	-33.3	-20
463.8	-57.6	Horz	0.3	-35.0	4.6	-30.1	-20
618.4	-66.0	Horz	0.4	-43.0	5.2	-37.4	-20

Table 5 - Spurious Radiated Emission Data – Highest Channel

6. Frequency Stability vs Temperature

Test Requirement(s):	§2.1055 and 95.632	**Test Engineer(s):**	Jerry M.
Test Results:	Pass	**Test Date(s):**	Oct/24/2018

Test Procedures: As required by 47 CFR 2.0155, Frequency Stability measurements were made at the RF antenna output terminals of the EUT.

The EUT was placed in an Environmental Chamber with all the support equipment outside the chamber. The EUT was set to transmit a modulated carrier. The reference frequency at 20°C was observed and noted down. The frequency drift was investigated for every 10°C increment until the unit was stabilized then recorded the reading in tabular format with the temperature range of -30°C to 50°C.

Test Setup:

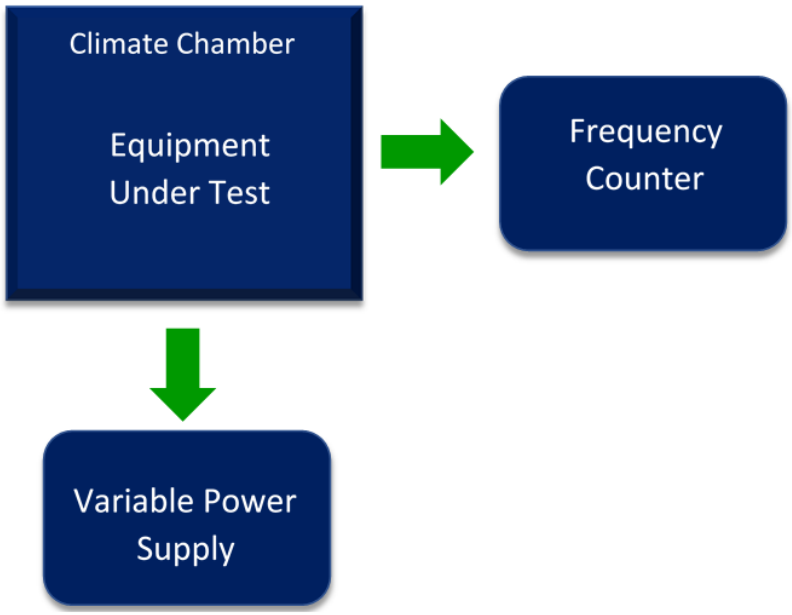
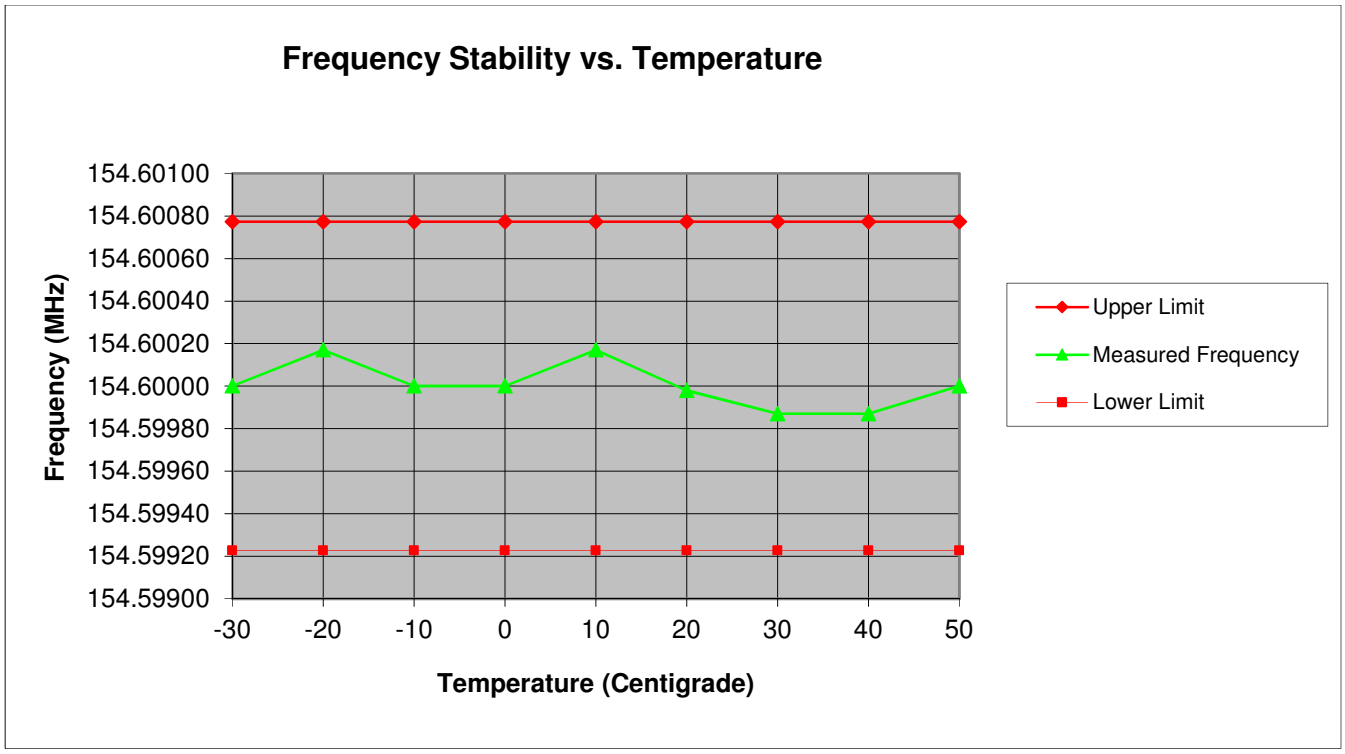


Figure 6 – Frequency Stability Test Setup

Temperature centigrade	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
-30	154.60000	-0.00077	0.00077
-20	154.60017	-0.00060	0.00094
-10	154.60000	-0.00077	0.00077
0	154.60000	-0.00077	0.00077
10	154.60017	-0.00060	0.00094
20	154.59998	-0.00079	0.00075
30	154.59987	-0.00090	0.00064
40	154.59987	-0.00090	0.00064
50	154.60000	-0.00077	0.00077

Table 8 – Temperature vs Frequency Test Result



Plot 12 – Temperature vs Frequency

7. Frequency Stability vs Voltage

Test Requirement(s):	§2.1055	**Test Engineer(s):**	Jerry M.
Test Results:	Pass	**Test Date(s):**	Oct/24/2018

Test Procedures: As required by 47 CFR 2.0155, Frequency Stability measurements were made at the RF antenna output terminals of the EUT.

The EUT was connected to a variable DC source. The frequency was measured at both the nominal 12 Vdc of the EUT and at the extreme lower and upper voltages.

With the voltage set to a measurement point, the transmitted signal was captured by the spectrum analyzer and the frequency value determined. The frequencies are compared to the tuned frequency. All data for these measurements are found in the table 9.

Reference Frequency: 151.82MHz at 12VdC at 20°C

Test Setup:

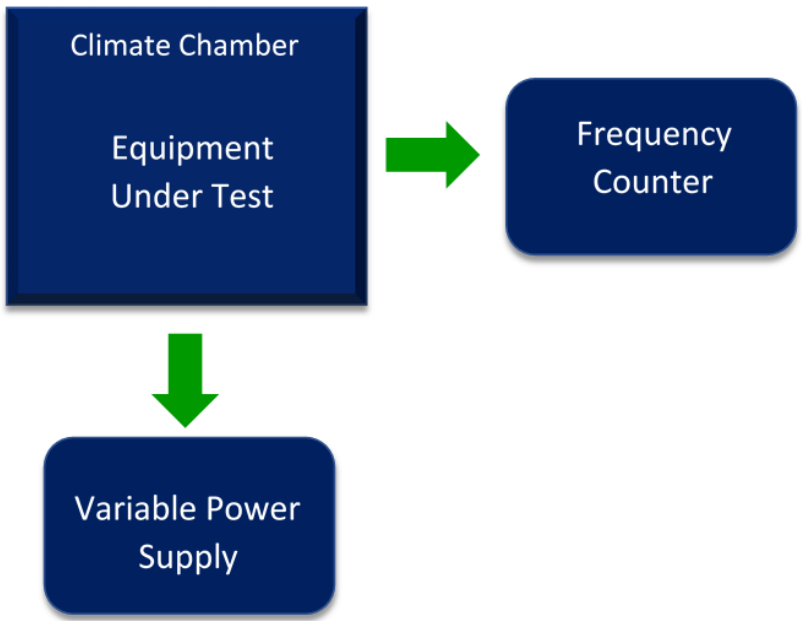
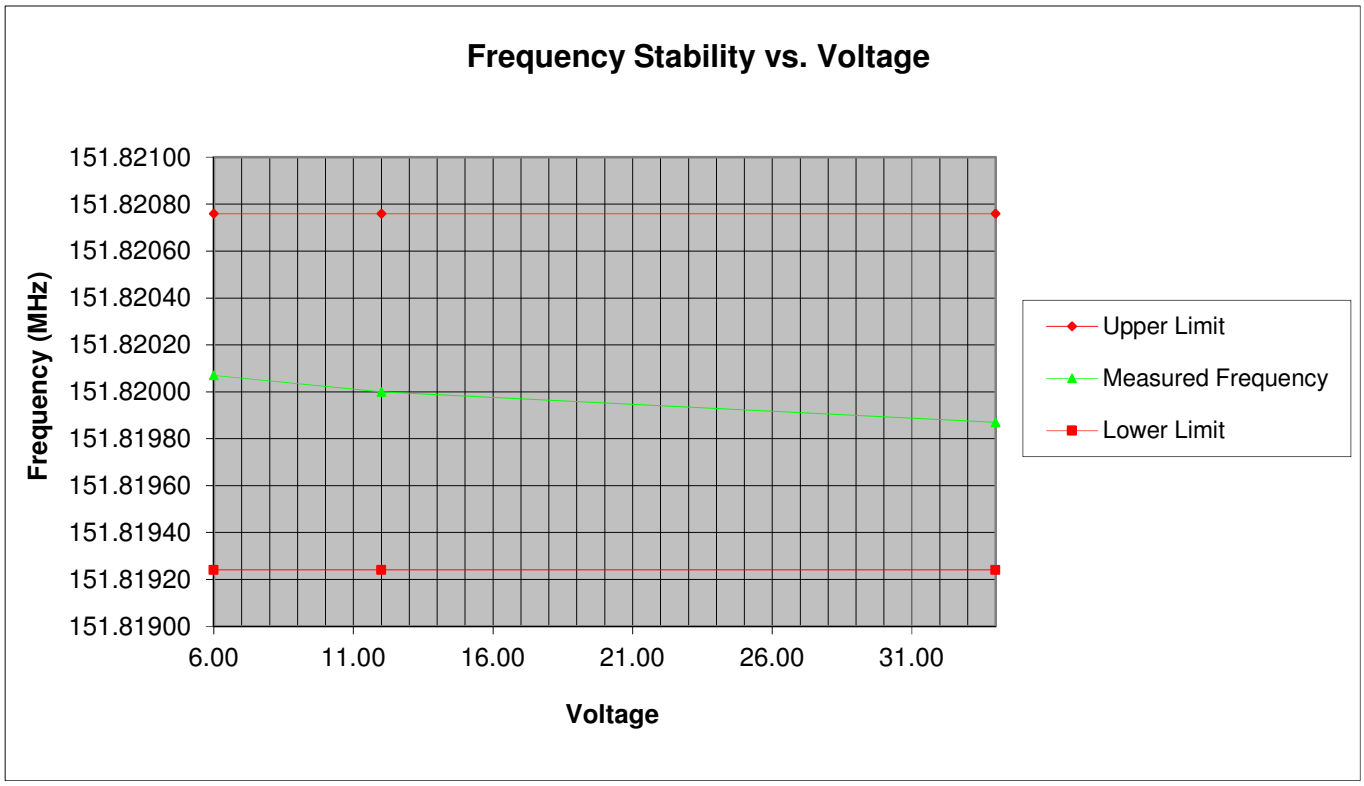


Figure 7 – Frequency Stability Test Setup

Input Voltage (Vdc)	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
6.00	151.82007	-0.00069	0.00083
12.00	151.82000	-0.00076	0.00076
34.00	151.81987	-0.00089	0.00063

Table 9. Temperature vs. Voltage Test Result



Plot 13 – Temperature vs Voltage

8. Necessary Bandwidth

Referencing Part 2.202 of the FCC Rules and Regulation and using the following formula for calculating the Necessary Bandwidth

B = 2M + 2DK

Where M = Baud Rate, D = Deviation and K= Constant

Digital Data: 2 level FSK; 4800 bps; Narrow Band; 12.5 KHz Channel Spacing

Calculation

Data Rate in bps (R) = 4800

Peak Deviation of Carrier (D) = +-1.8KHz

Number of States in Each Symbol = 2

Bn = 3.86 + 0.27R

BN = [3.86*(1800) + 0.27*4800]=8.24 KHz

Emission Designator: 8K20F1D

Digital Data: 2 level FSK; 9600 bps; Wide Band; 25 KHz Channel Spacing

Calculation

Data Rate in bps (R) = 9600

Peak Deviation of Carrier (D) = +-2.2KHz

Number of States in Each Symbol = 2

Bn = 3.86 +0.27R

BN = [3.86*(2200) + 0.27*9600] = 11.0 KHz

Emission Designator: 11K0F1D

I. Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Spectrum Analyzer	Agilent	E4402B	US41192757	Mar/19/18	Mar/19/19
Spectrum Analyzer	Hewlett Packard	8563E	3821A09316	Jan/30/18	Jan/30/19
Directional Coupler	Andrew	C-10-CPUS-N	150503142544	NCR	None
Attenuator 20dB	Weinschel	41-20-12	86332	NCR	None
Variable Attenuator	JFW	50R-320-SMA	7054221439	NCR	None
Signal Generator	Agilent	E4432B	US40053021	NCR	None
Signal Generator	Agilent	E4432B	US38220446	NCR	
Horn Antenna	Com-Power	AHA-118	071150	Nov/12/18	Nov/12/20
Horn Antenna	Com-Power	AH-118	71350	NCR	None
Antenna	EMCO	GTEM 5417	1063	Verified	None
Attenuator 10dB	Huber+Suhner	6810.17.A	747300	NCR	None
Digital Multimeter	Fluke	77 III	72550270	Jan/30/18	
Power Supply	Hewlett Packard	6236B	2735A-19608	NCR	None

Table 10 – Test Equipment List

***Statement of Traceability:** Test equipment is maintained and calibrated on a regular basis. All calibrations have been performed by a 17025 accredited test facility, traceable to National Institute of Standards and Technology (NIST)

END OF TEST REPORT