H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Globalstar, Inc.

STINGR

Tested under

The FCC Rules contained in Title 47 of the CFR, Part 25 for

Satellite Communications

June 29, 2015

Prepared for:

Globalstar, Inc.

300 Holiday Square Blvd.

Covington, LA 70433

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 25 of the FCC Rules under normal use and maintenance.

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Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	June 29, 2015	Initial Issue
1	August 4, 2015	TCB Comments

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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 25. 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; 25.204	Pass	
Occupied Bandwidth	2.1049	Pass	
Unwanted Emissions at Antenna Terminals	2.1051; 25.202(f)	Pass	
Radiated Spurious Emissions	2.1053; 25.202(f)	Pass	
Protection of Aeronautical Radio Navigation Satellite Service	25.216(c)(f)(g)(i)	Pass	
Frequency Stability over Temperature Variations	2.1055(a)(1); 25.202(d)	Pass	
Frequency Stability over Voltage Variations	2.1055(d); 25.202(d)	Pass	

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Globalstar to perform testing on the STINGR under the purchase order number 15251.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Globalstar, STINGR.

The tests were based on FCC Part 25 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. Globalstar 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:	Globalstar STINGR
Model(s) Tested:	STINGR
FCC ID:	L2V-STGR
Supply Voltage Input:	Primary Power : 3.7 Vdc
Frequency Range:	1611.25MHz to 1618.75MHz
No. of Channels:	Four Channels
Necessary Bandwidth	N/A
Type(s) of Modulation:	BPSK
Range of Operation Power:	0.415W
Voltage into final Transistor	3.3V
Current into final Transistor	475mA
Emission Designator:	2M00G1D
Channel Spacing(s)	2.5MHz
Test Item:	Pre-Production
Type of Equipment :	Mobile
Antenna:	Integrated Patch Antenna
Environmental Test Conditions:	Temperature: 15-35°C Humidity: 30-60% Barometric Pressure: 860-1060 mbar
Modification to the EUT:	None
Evaluated By:	Staff at Artesyn Embedded & H.B. Compliance Solutions
Test Date(s):	03/05/15 till 03/23/15

2. Test Facility

Radiated testing was performed at Artesyn Embedded Computing. This facility is located at 2900 S. Diablo Way, Suite 190, Tempe, AZ 85282. All conducted tests 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.

Test facility at Artesyn Embedded Computer is an A2LA accredited test site. The A2LA certificate number is 2716.01. The scope of accreditation covers the FCC Method - 47 CFR Part 15, ICES-003, CISPR 22, AS/NZS 3548 and VCCI

Conducted testing was performed at H.B. Compliance Solutions. This facility is located at 5005 S. Ash Avenue, Suite # A-10, Tempe AZ 85282

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

3. Description of Test Sample

The Globalstar, STINGR (**S**atellite **T**ransmitter with **IN**tegrated **G**PS **R**eceiver) is a satellite communication device which obtains GPS derived locations and reports its position along with other rudimentary status information over the Globalstar satellite network. All transmissions are one way from the unit to the satellite, and subsequently from the satellite down to a network of ground stations located around the globe. It is marketed towards OEMs who wish to develop custom devices to track and/or monitor assets such as trailers, rail-cars, cargo containers, equipment, etc. Users are able to receive the messages from the STINGR via an FTP or HTTP connection. The STINGR provides a serial interface where a host processor can provide information to be sent over the satellite network as well as control the mode of operation of the STINGR. The STINGR is a satellite transmitter radio module which contains a satellite transmitter, GPS receiver, motion sensor, and a dual band patch antenna. The STINGR is a surface mount module designed to attach to a user defined host PCB which must provide power and communications with a host processor which will control the operation of the STINGR. All electrical connections are provided via the castellated pads on the perimeter of the PCB.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	Globalstar (Sample # 1 with temporary SMA connector) – For Conducted test only	STINGR	F0047525
# 2	Globalstar (Sample # 2) – For Radiated test only	STINGR	F0047529

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 #
#3	DC Power Supply	Hewlett Packard	E3610A	KR83021468
#4	Test Host Board	Globalstar	-	-

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
-	-	-	-	-	-	-

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 its normal operating power level. Test mode was provided to switch between channels of the transmitter by using the test host board supplied by the manufacturer. The host board allowed switching between various frequencies and continuous and un-continuous mode for specific test requirements. 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 Globalstar upon completion of testing & certification

1. RF Power Output

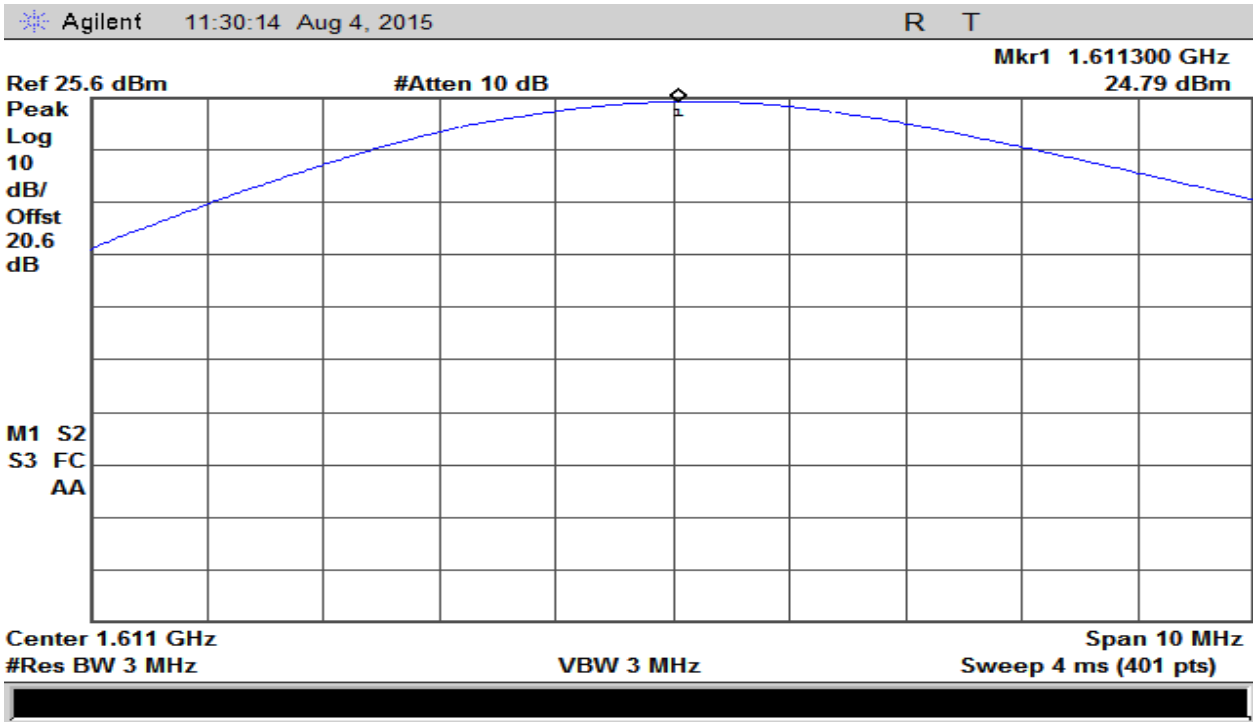
Test Requirement(s):	§2.1046 and §25.204	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	03/05/15

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

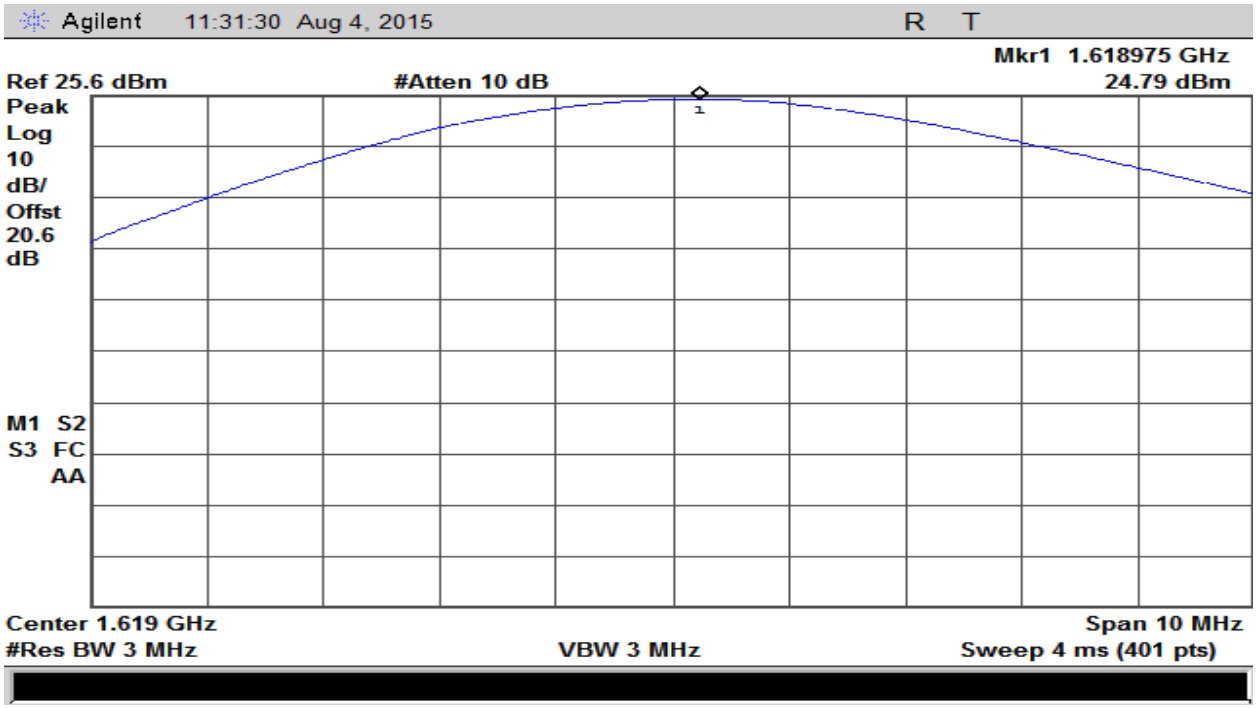
Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer capable of making power measurements. Measurements were made at the low and high channels of the entire frequency band.

Frequency (MHz)	Channel	Conducted Power (dBm)	Transmit Antenna Gain (dBi)	Carrier Power Peak EIRP (dBm)	Specification Limit (dBW)
1611.25	Lowest	24.79	1.4	26.19	40
1618.75	Highest	24.79	1.4	26.19	40

Table 4. RF Power Output, Test Results



Plot 1 – Output Power – Low



Plot 2 – Output Power – High

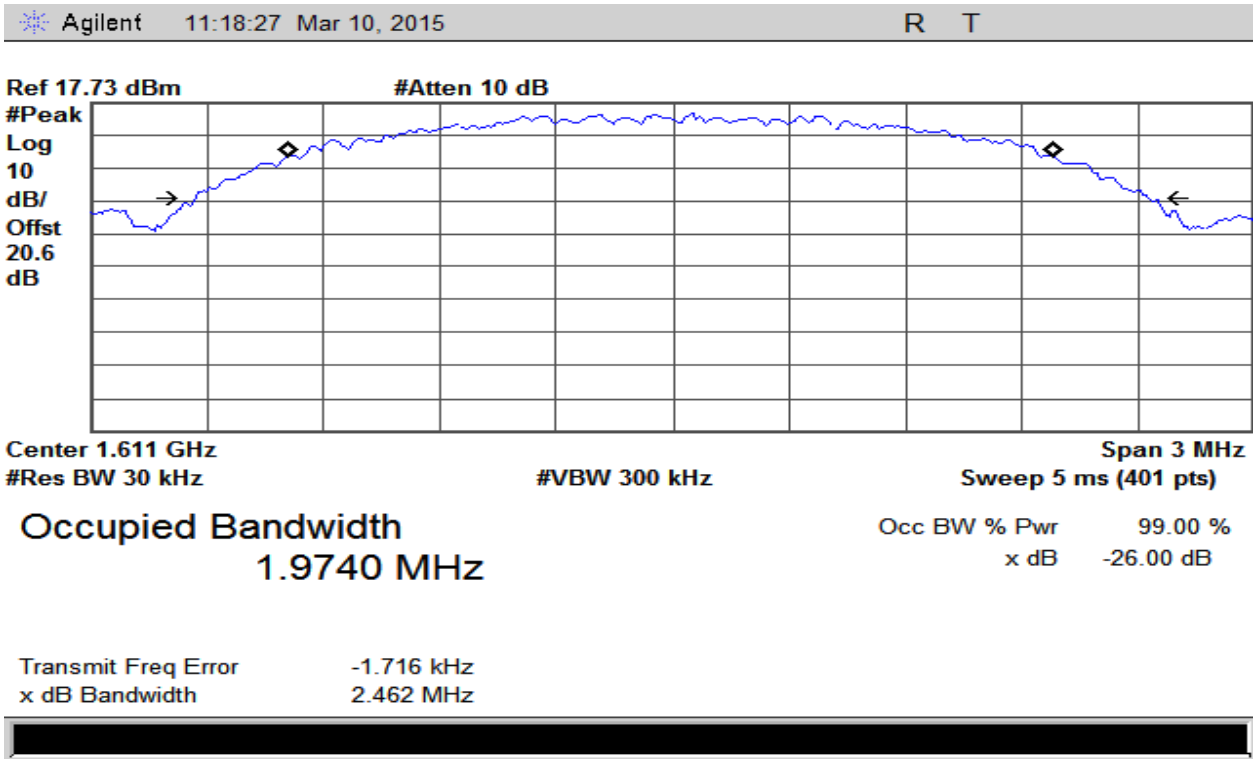
2. Occupied Bandwidth

Test Requirement(s):	2.1049	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	03/10/15

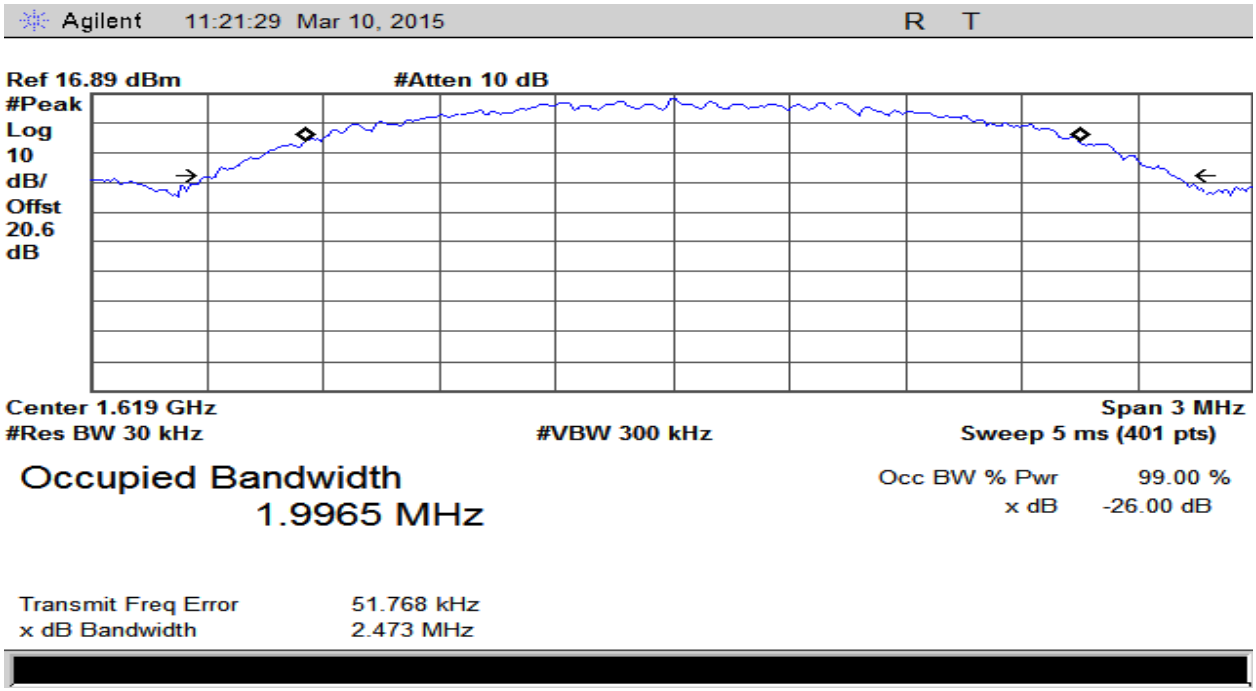
Test Procedure: As required by 47 CFR 2.1049, occupied bandwidth measurements were made at the output terminals of the EUT.

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 and video bandwidth was set to 3 times the resolution bandwidth. Measurements were carried out at the low and high channels of the TX band.

The following pages show measurements of Occupied Bandwidth plots:



Plot 3 – Low Channel – 26dB Bandwidth



Plot 4 – High Channel – 26dB Bandwidth

3. Unwanted Emissions at Antenna Terminals

Test Requirement(s):	§2.1051 and 25.202(f)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	03/10/15

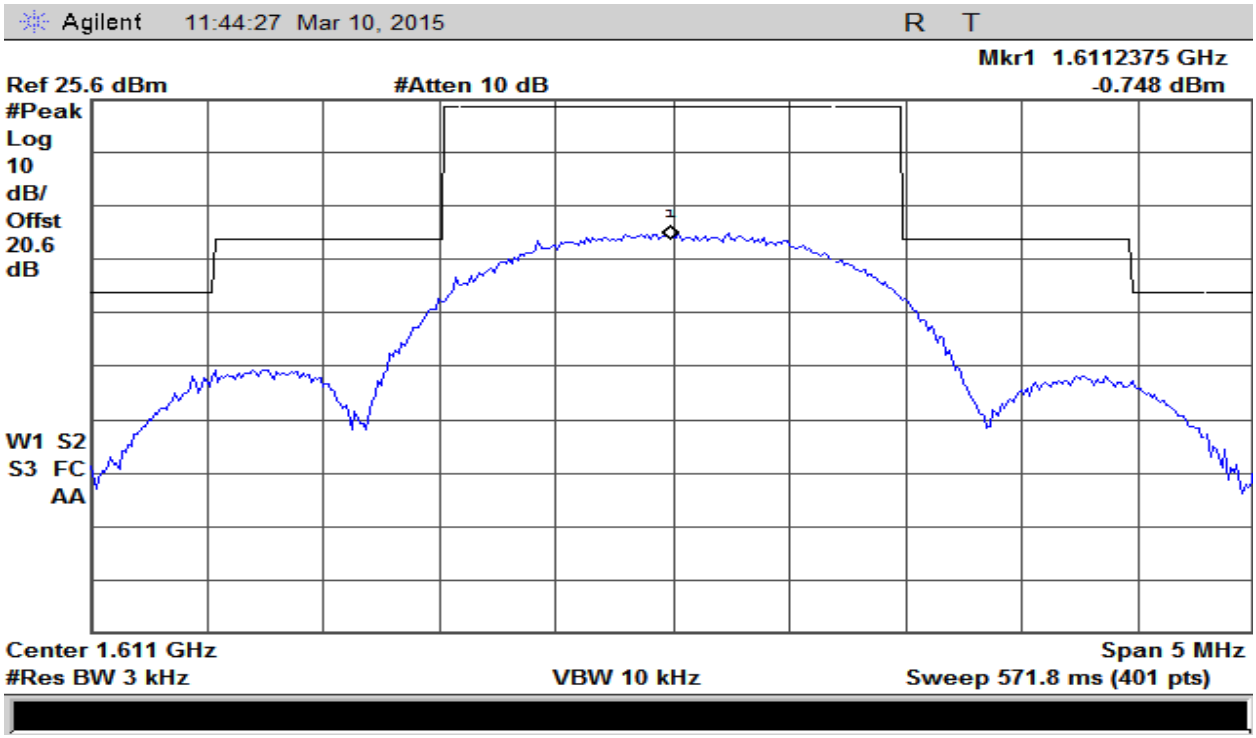
Test Procedures:

As required by 47 CFR 25.202(f), unwanted emissions at antenna terminal measurements were made at the RF output antenna terminal of the EUT.

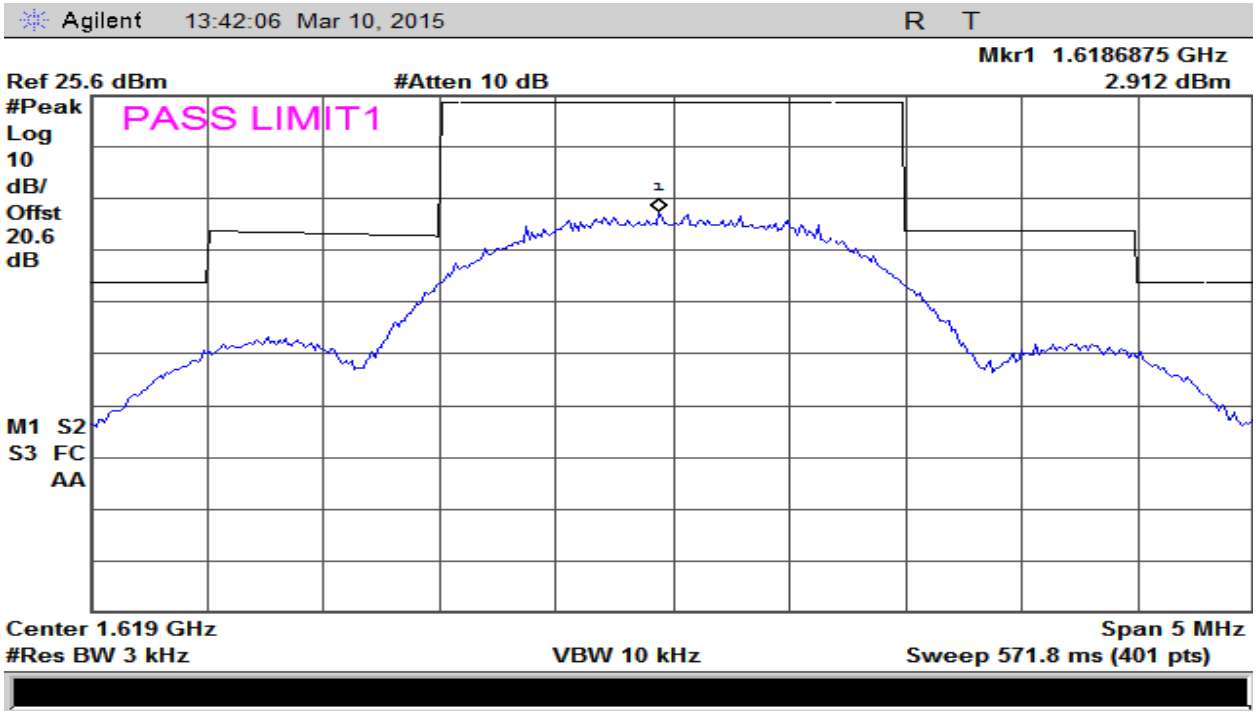
Customer provided a test mode internal to the EUT to control the RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer to verify the EUT met the requirements as specified in §25.202(f). Measurements were made at the lowest and highest frequency of the transmit band.

Frequency removed from channel center by	Minimum signal reduction
0 to 50%	In Channel
50 to 100%	-25dBc
100 to 250%	-35dBc
More than 250%	-13dBm

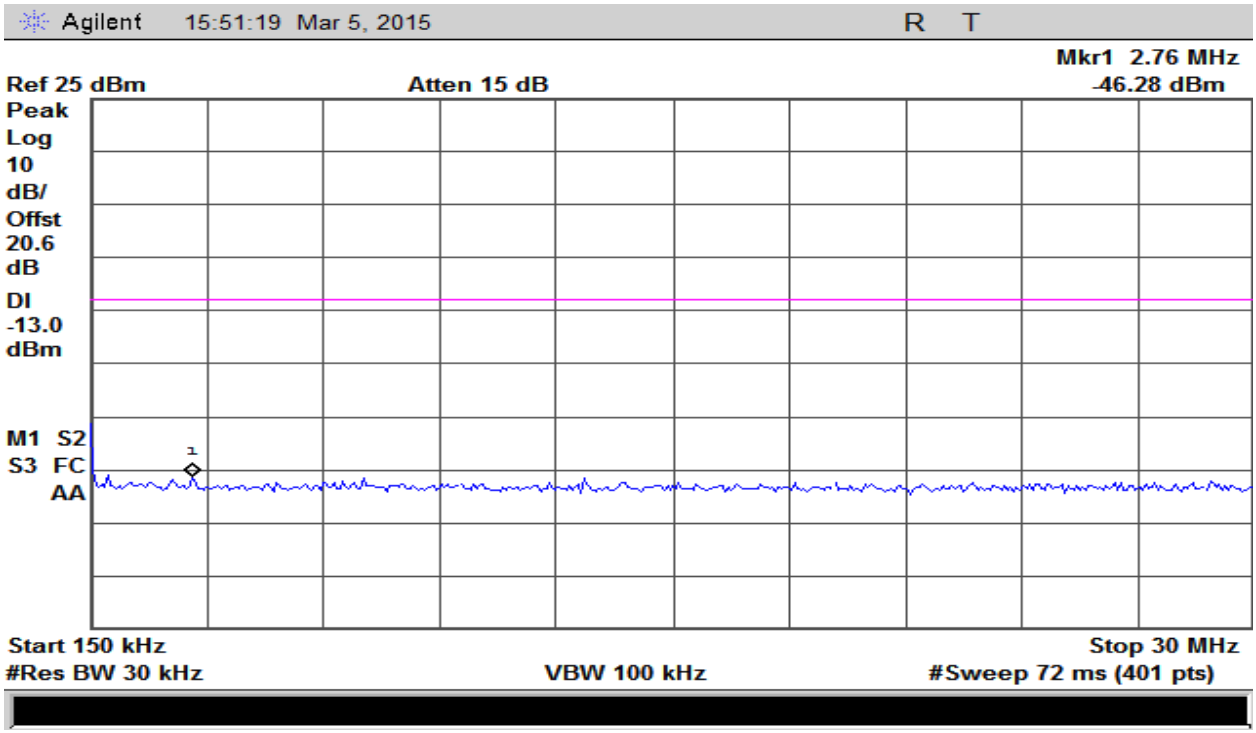
Table 5 – Test Limit per section 25.202(f)



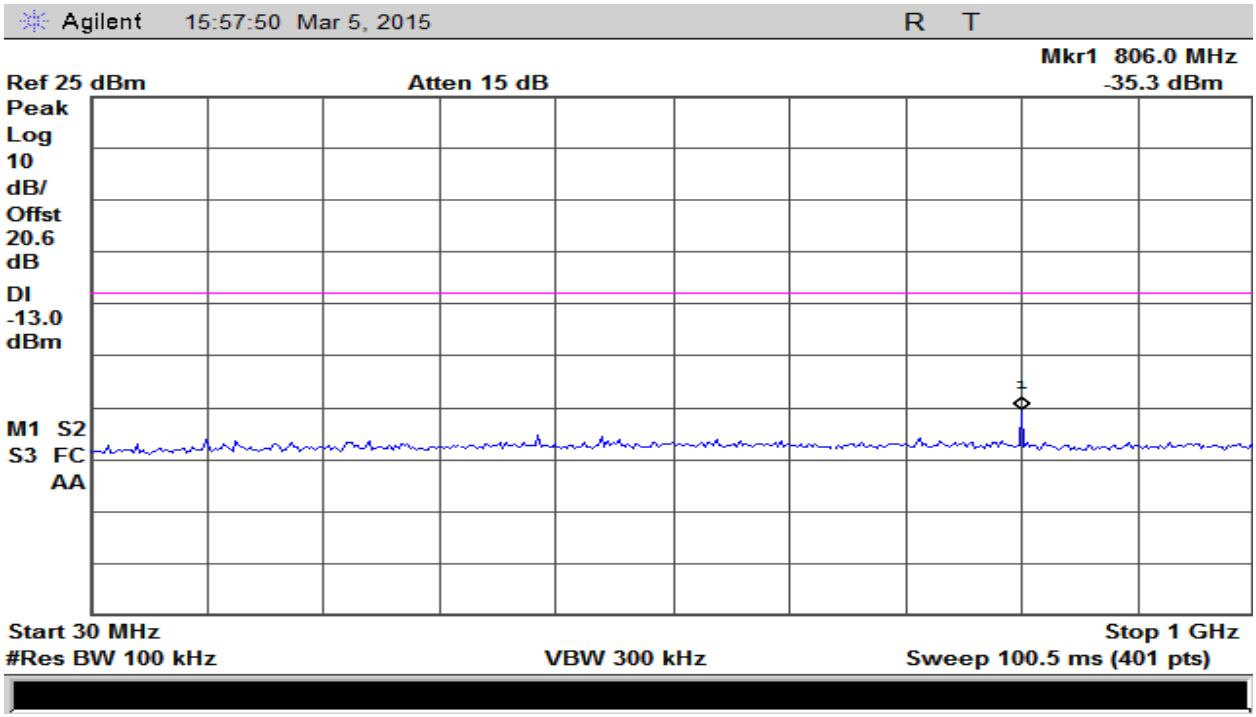
Plot 5 – Low Channel



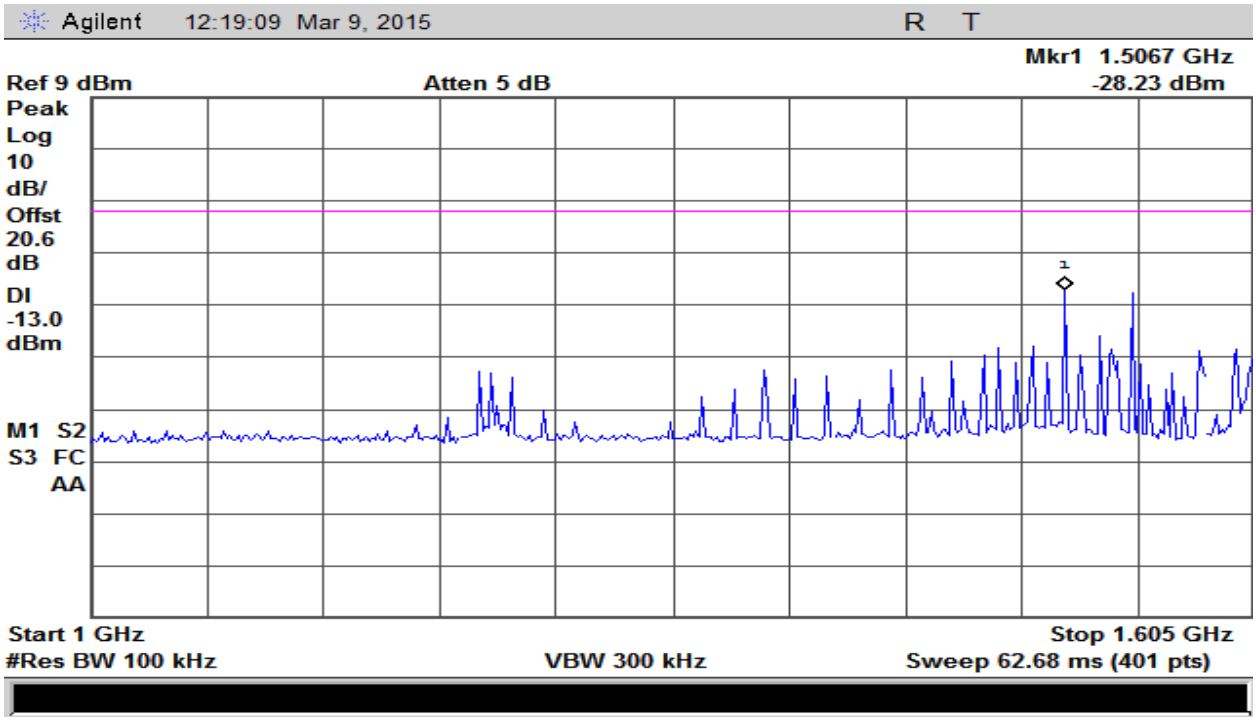
Plot 6 – High Channel



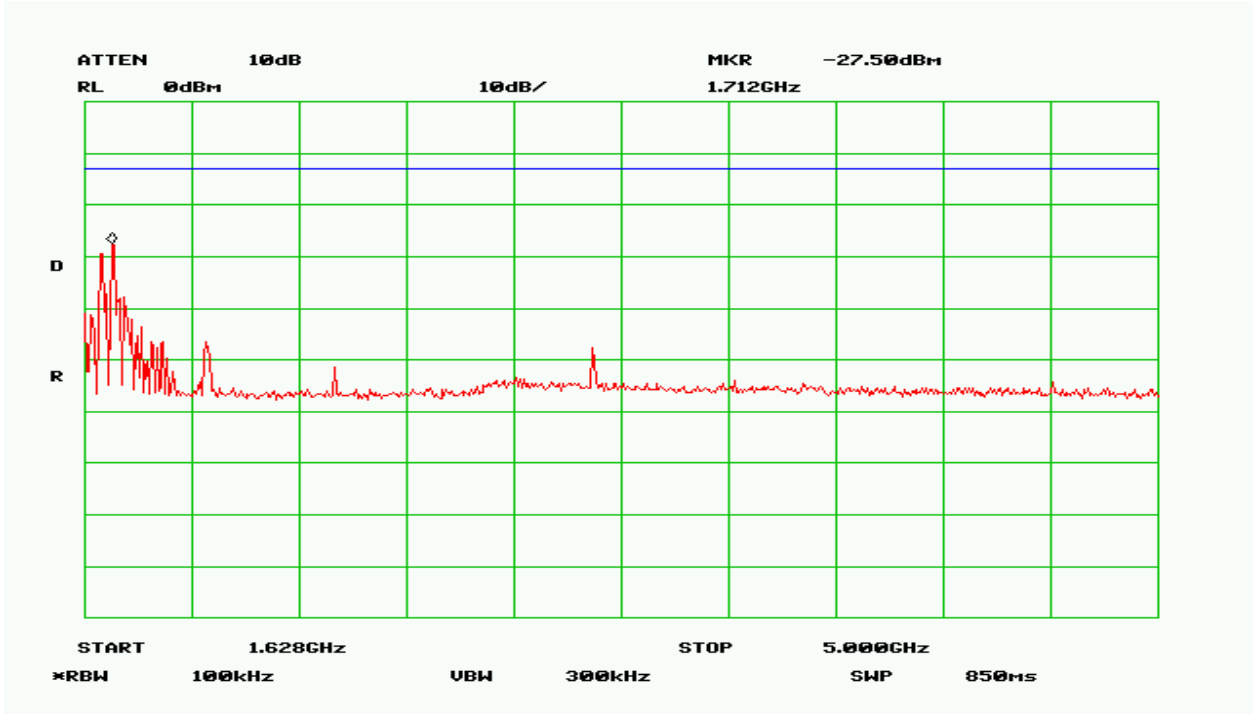
Plot 7 – Low Channel – 150kHz to 30MHz



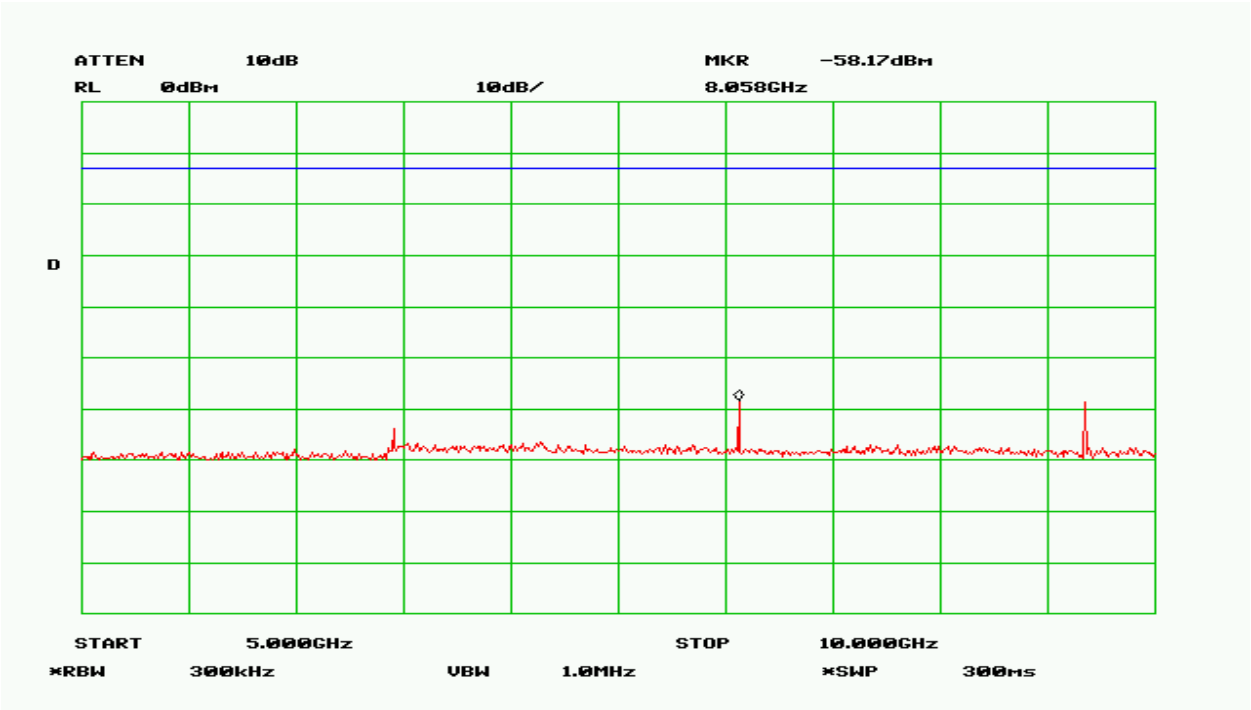
Plot 8 – Low Channel – 30MHz to 1GHz



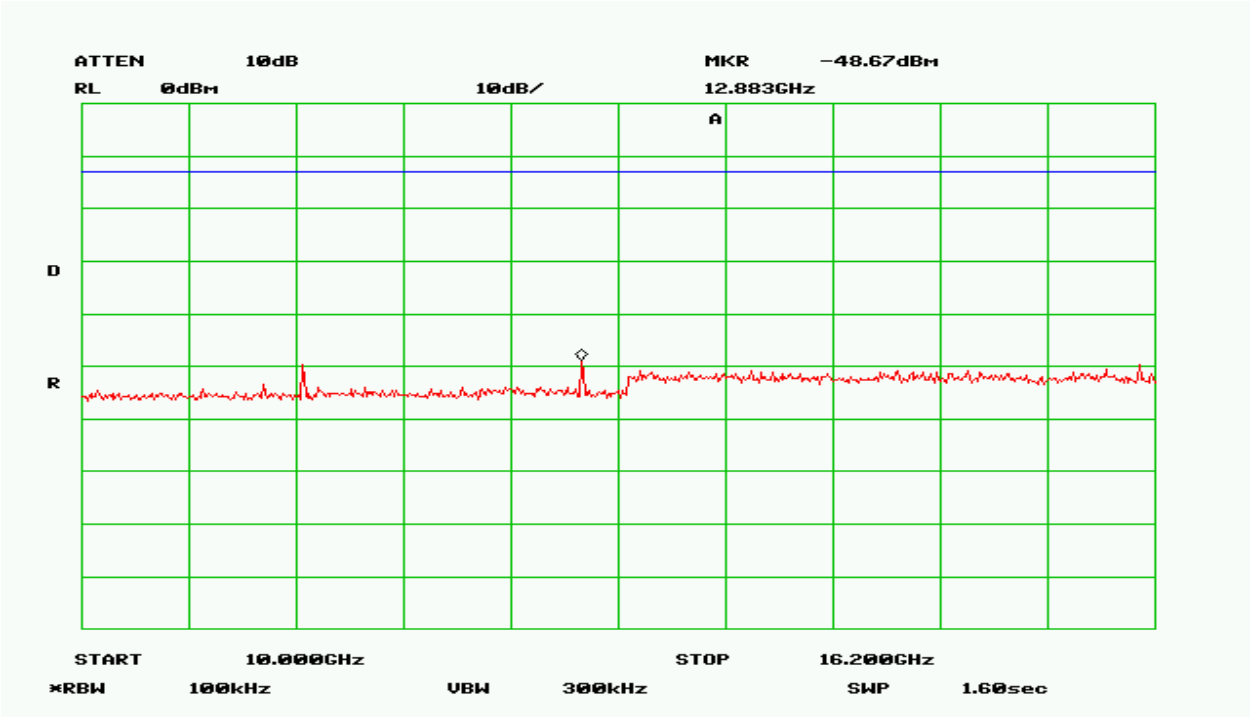
Plot 9 – Low Channel – 1 to 1.605GHz



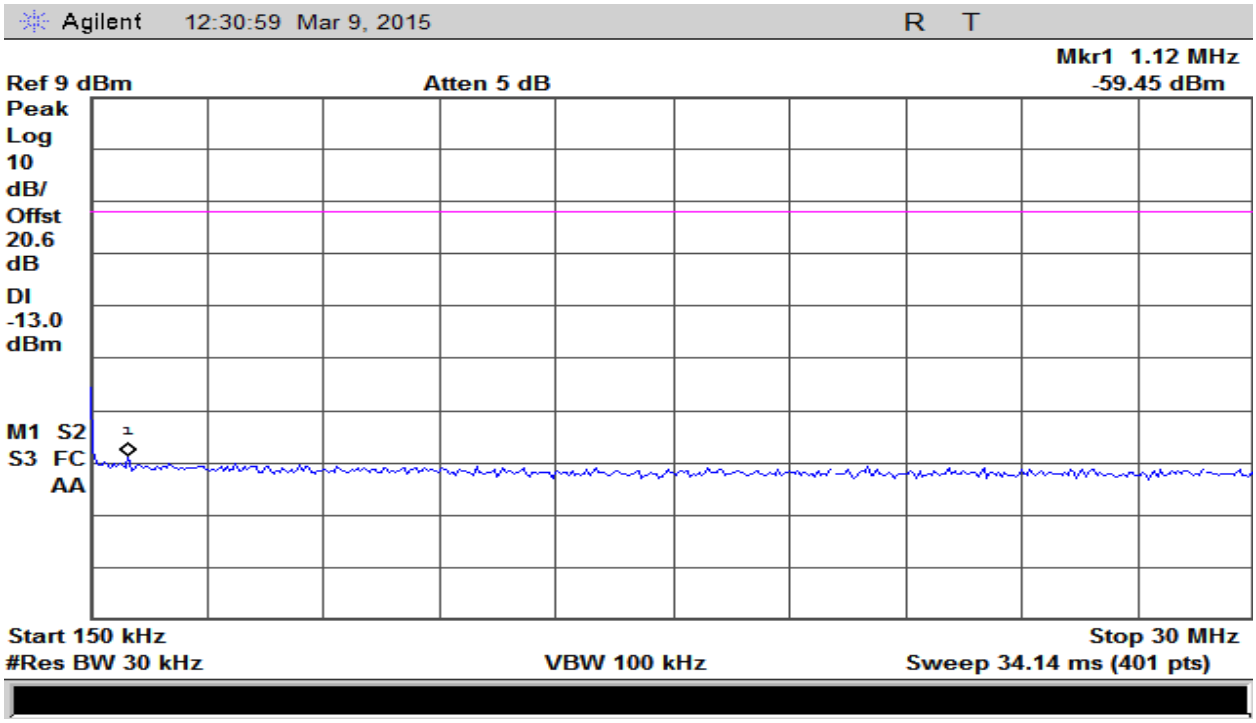
Plot 10 – Low Channel - 1.628 – 5 GHz



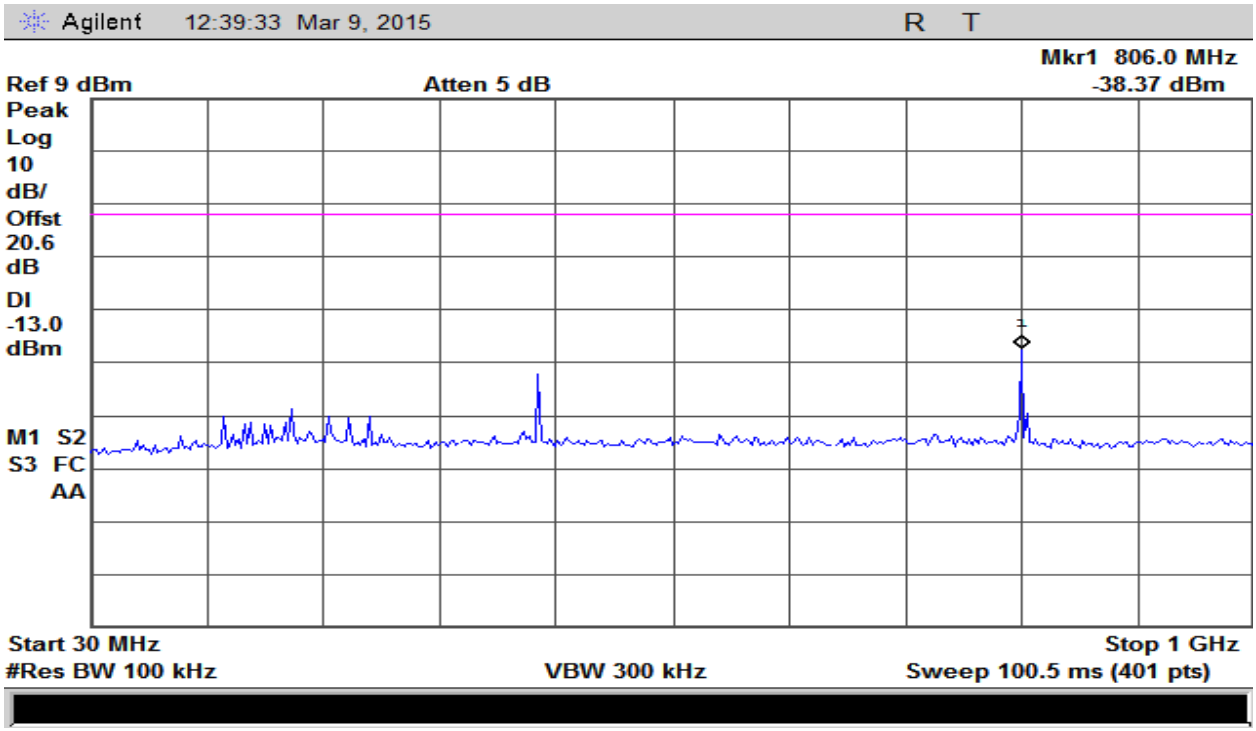
Plot 11 – Low Channel - 5 to 10GHz



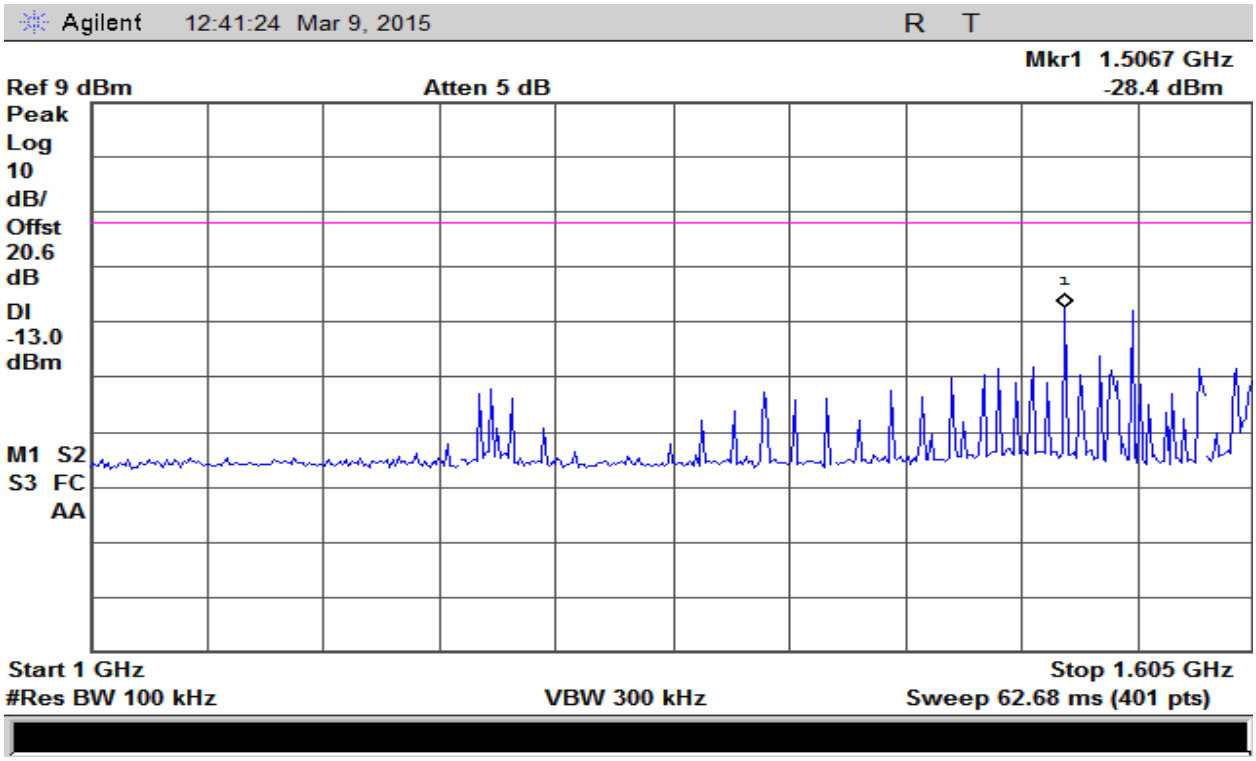
Plot 12 – Low Channel – 10 to 16.2GHz



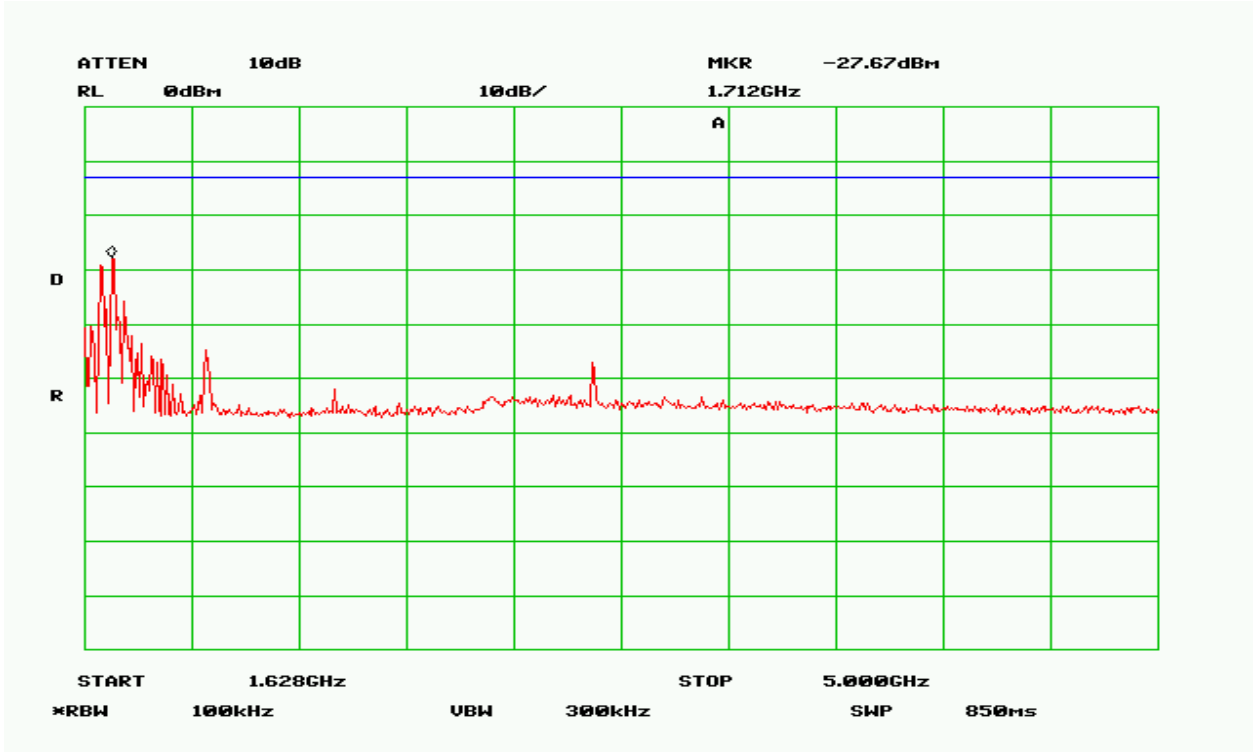
Plot 13 – High Band – 150kHz to 30MHz



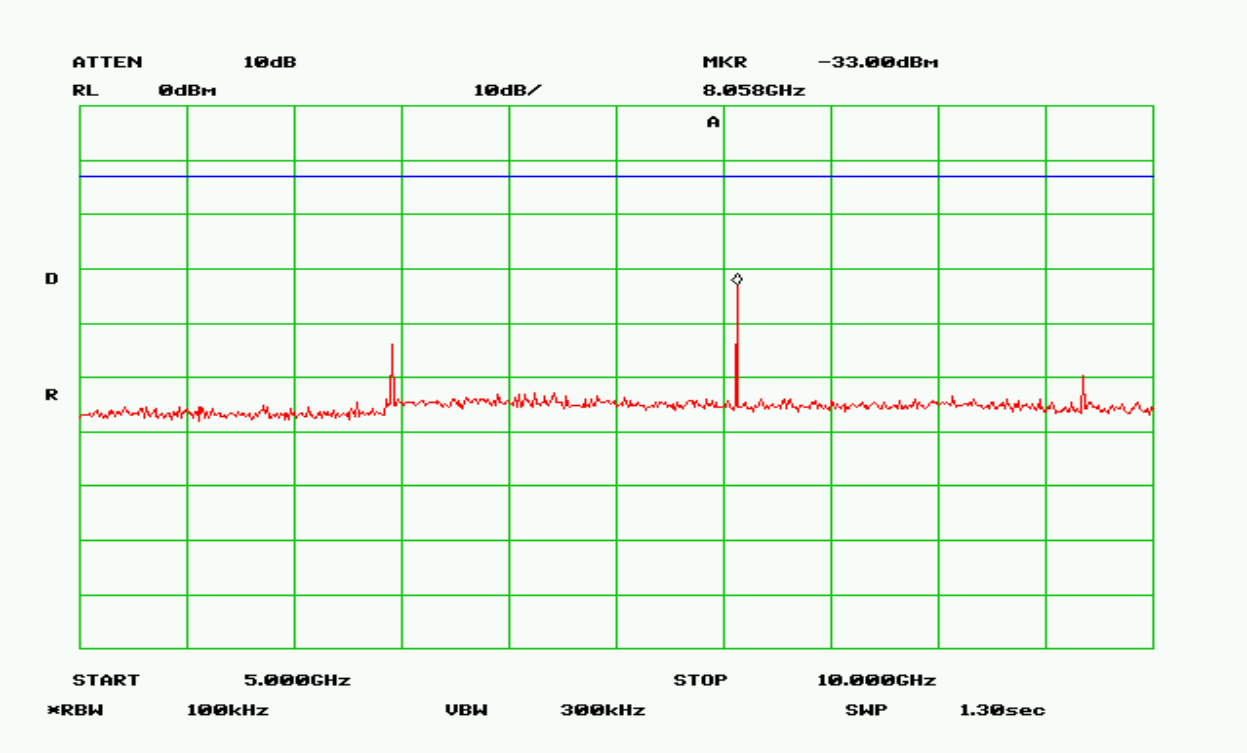
Plot 14 – High Band – 30MHz to 1GHz



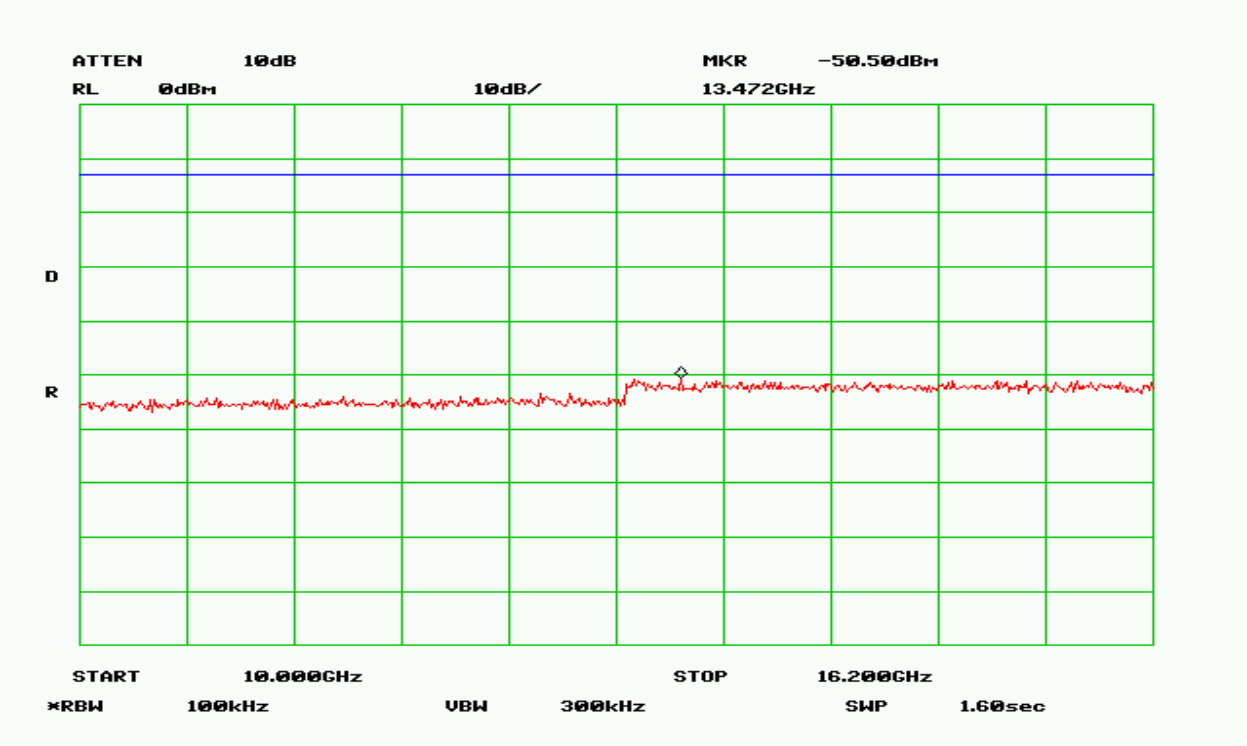
Plot 15 – High Band – 1GHz to 1.605GHz



Plot 16 – High Band – 1.628GHz to 5GHz



Plot 17 – High Band – 5 to 10GHz



Plot 18 – High Band – 10GHz to 16.2GHz

4. Radiated Spurious Emissions

Test Requirement(s):	§2.1053 and 25.202(f)	**Test Engineer(s):**	Jerry Mejak
Test Results:	Pass	**Test Date(s):**	03/23/15

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-A-2004.

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.

Frequency (MHz)	Measured Amplitude (dBuV/m)	Equivalent Radiated Power (dBm)	Antenna Polarity	Spurious Limit (dBm)	Margin	Comment
1611.25	114.17	18.97	Vertical	-	-	Fundamental
3222.5	71.5	-23.7	Vertical	-13	-10.7	
4833.75	59.17	-36.03	Horizontal	-13	-23.03	
6445.0	44.3	-50.90	Horizontal	-13	-31.3	
8056.25	40.33	-54.87	Horizontal	-13	-27.33	

Table 6 - Spurious Radiated Emission Data – Low Band

Frequency (MHz)	Measured Amplitude (dBuV/m)	Equivalent Radiated Power (dBm)	Antenna Polarity (V/H)	Spurious Limit (dBm)	Margin (dB)	Comment
1618.75	115.67	20.47	Vertical	-	-	Fundamental
3237.5	75.67	-19.53	Vertical	-13	-6.53	
4856.25	63.83	-31.37	Horizontal	-13	-18.37	
6475.0	52.5	-42.7	Horizontal	-13	-29.7	
8093.75	40.67	-54.53	Horizontal	-13	-41.53	

Table 7– Spurious Radiated Emission Data – High Band

NOTE: There were no detectable emissions above the 5th harmonic. Measurement was made at the 10th harmonic.

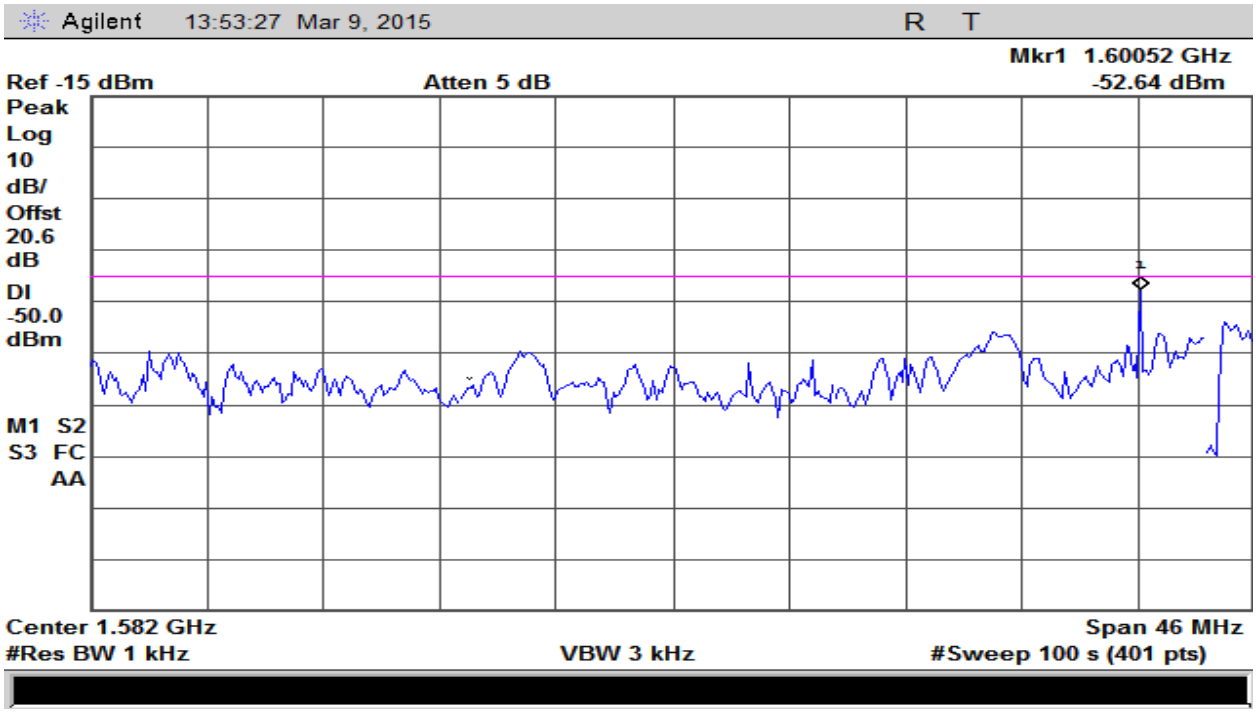
5. Protection of Aeronautical Radio Navigation Satellite Service

Test Requirement(s):	§25.216	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	03/09/15

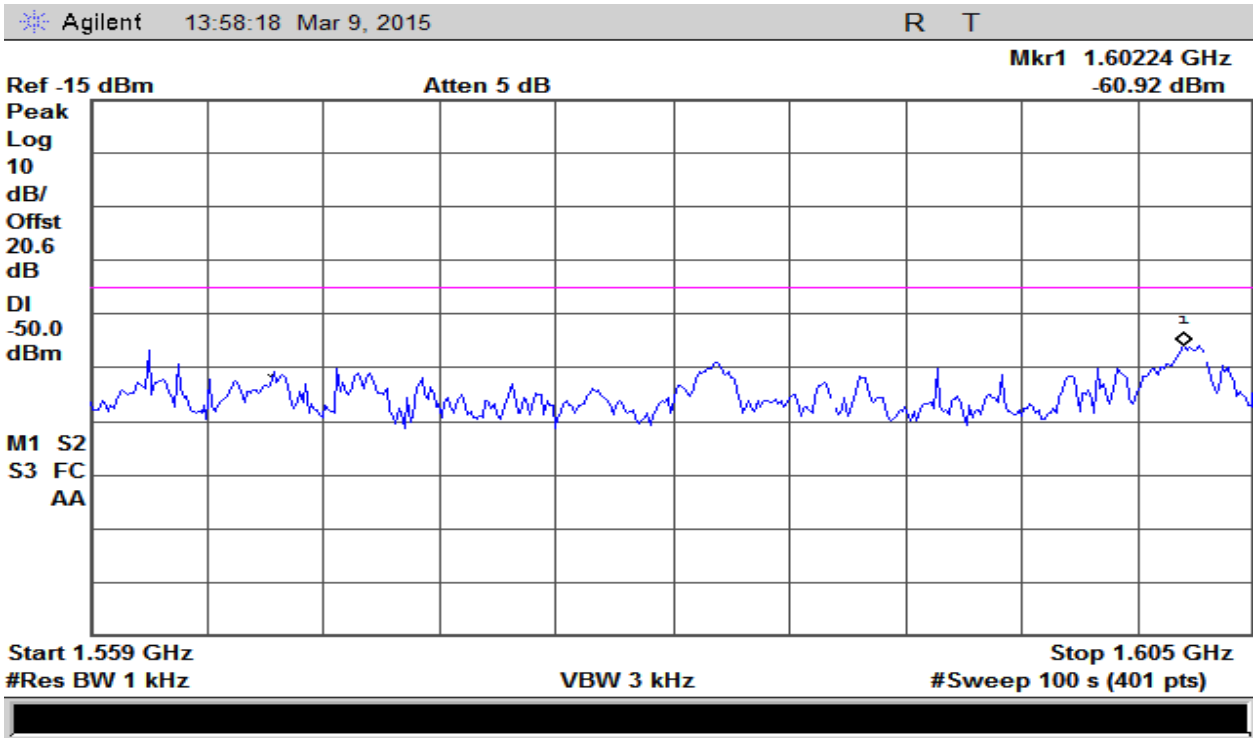
Test Procedures: As required by 47 CFR 25.216(h), measurement were made at the RF output antenna terminal of the EUT.

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 to verify the EUT met the requirements as specified in in §25.202(f). Measurements were made at the lowest and highest frequency of the transmit band

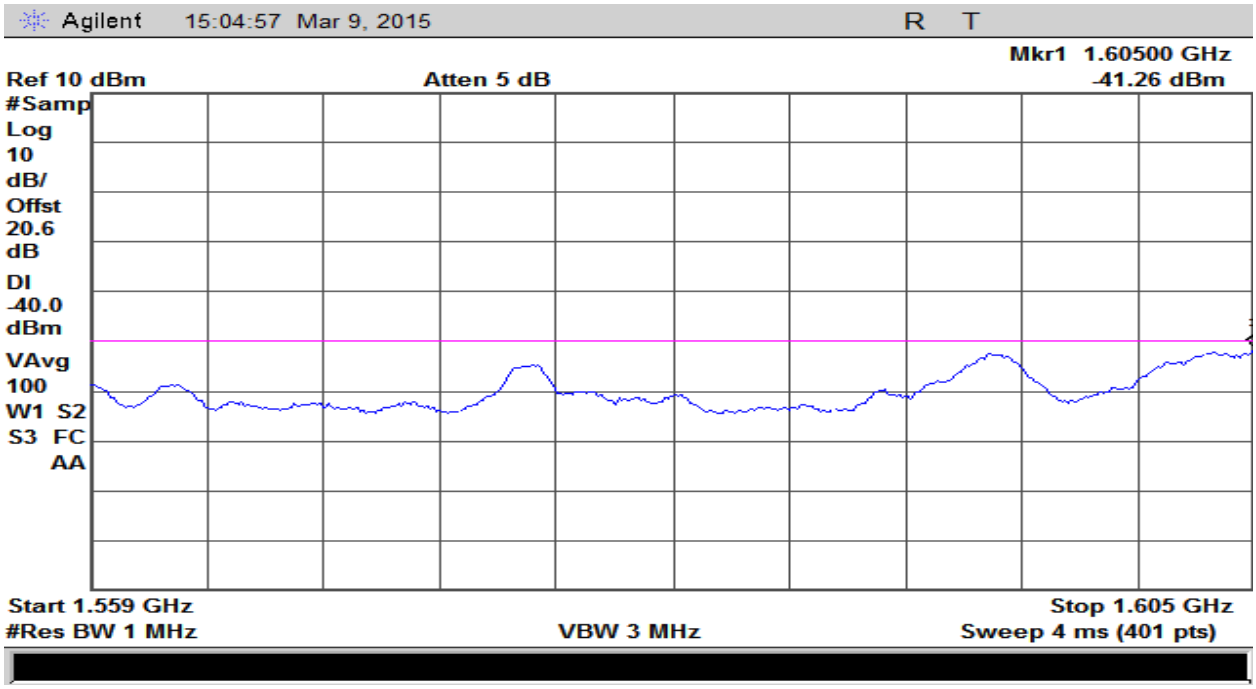
25.216 Section	Description	Result	Comments
25.216 (c)	Limits for MES Protect Radionavigation-Satellite Service	Pass	See Plot # 19 -22
25.216 (f) (g)	Limits for MES Protect Radionavigation-Satellite Service	Pass	See Plots 23 - 26
25.216 (i)	Limits for MES e.i.r.p density of carrier-off	Pass	See Plots 27 & 28



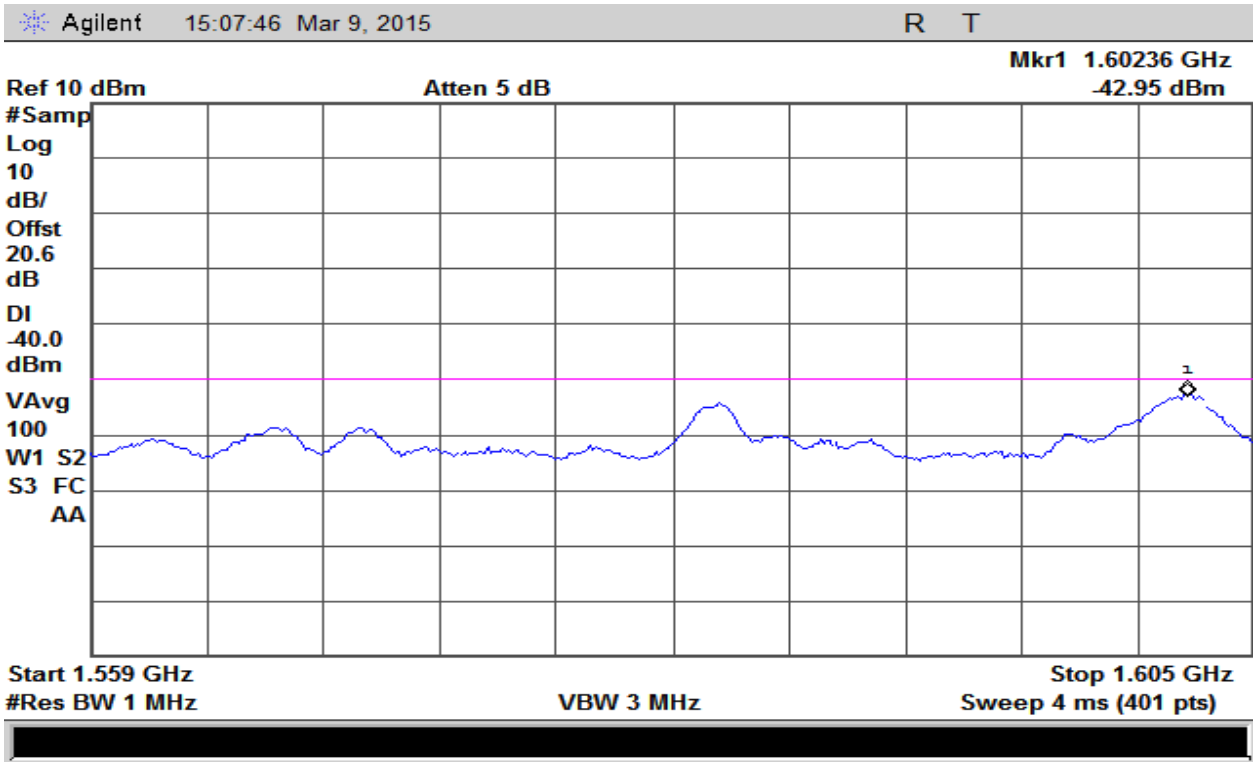
Plot 19 – Low Channel – Test Limit 25.216 (c) – Discrete Emissions



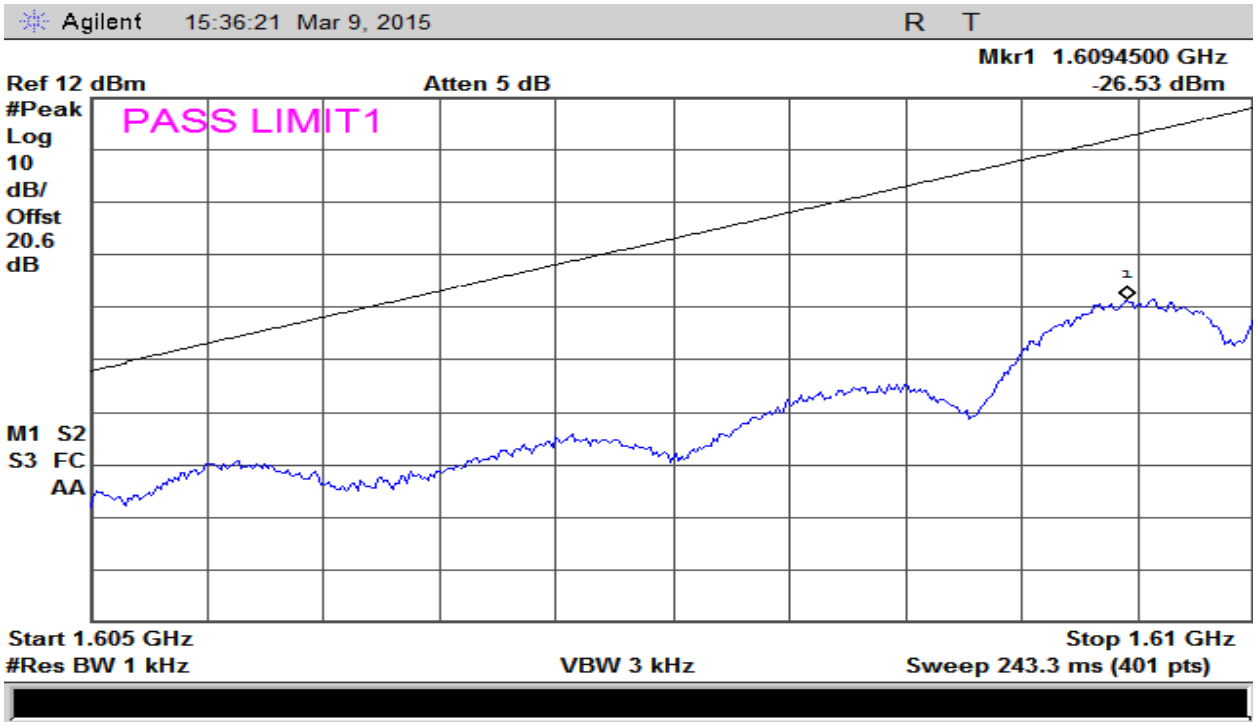
Plot 20 – High Channel – Test Limit 25.216 (c) – Discrete Emissions



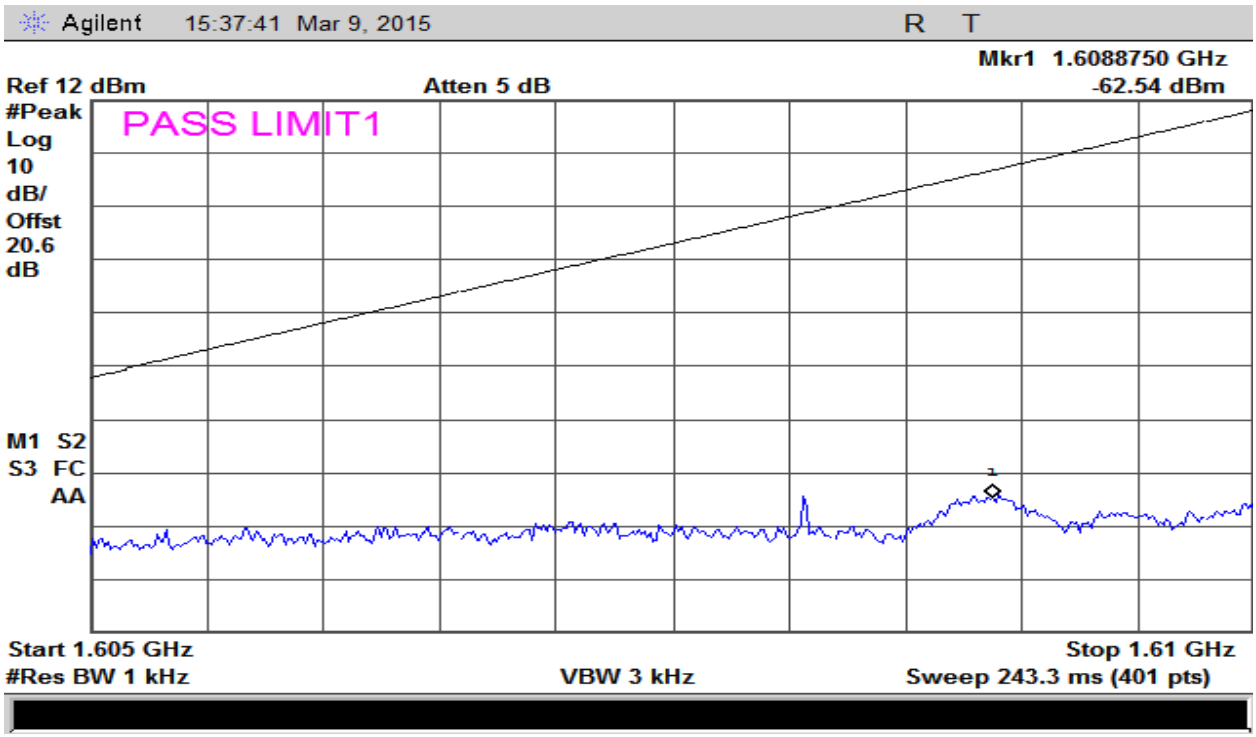
Plot 21 – Low Channel – Test Limit 25.216 (c)



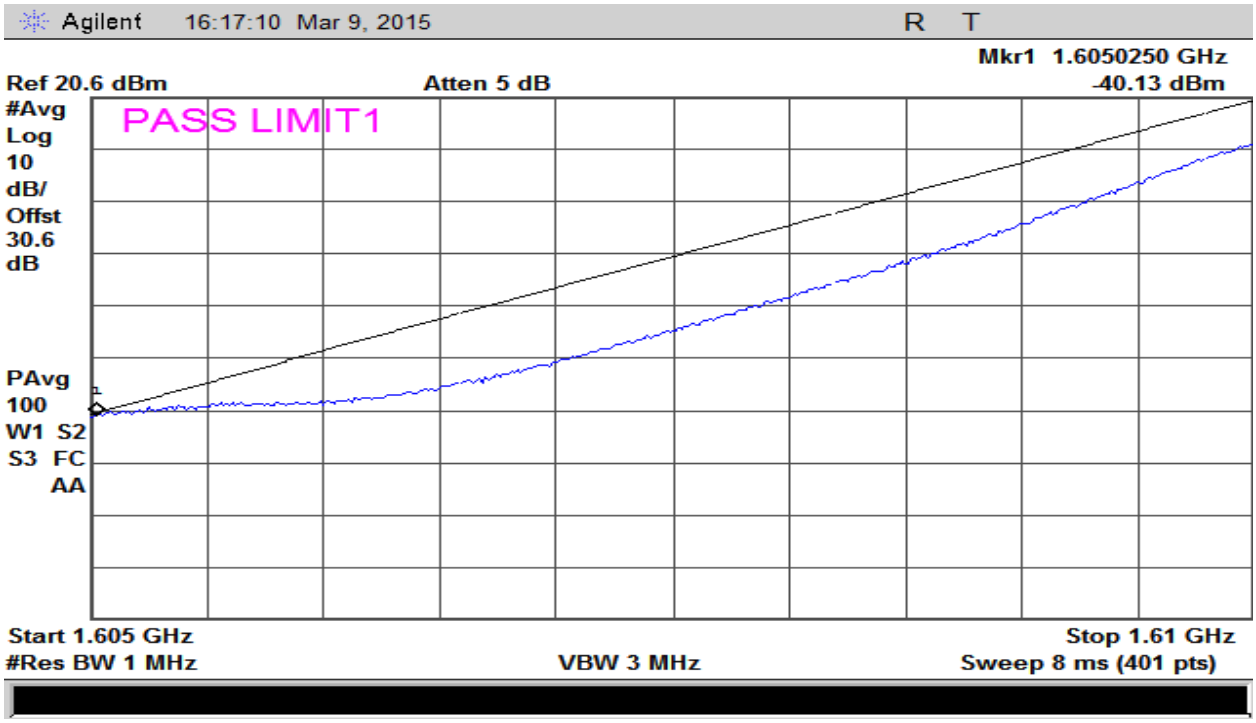
Plot 22 – High Channel – Test Limit 25.216 (c)



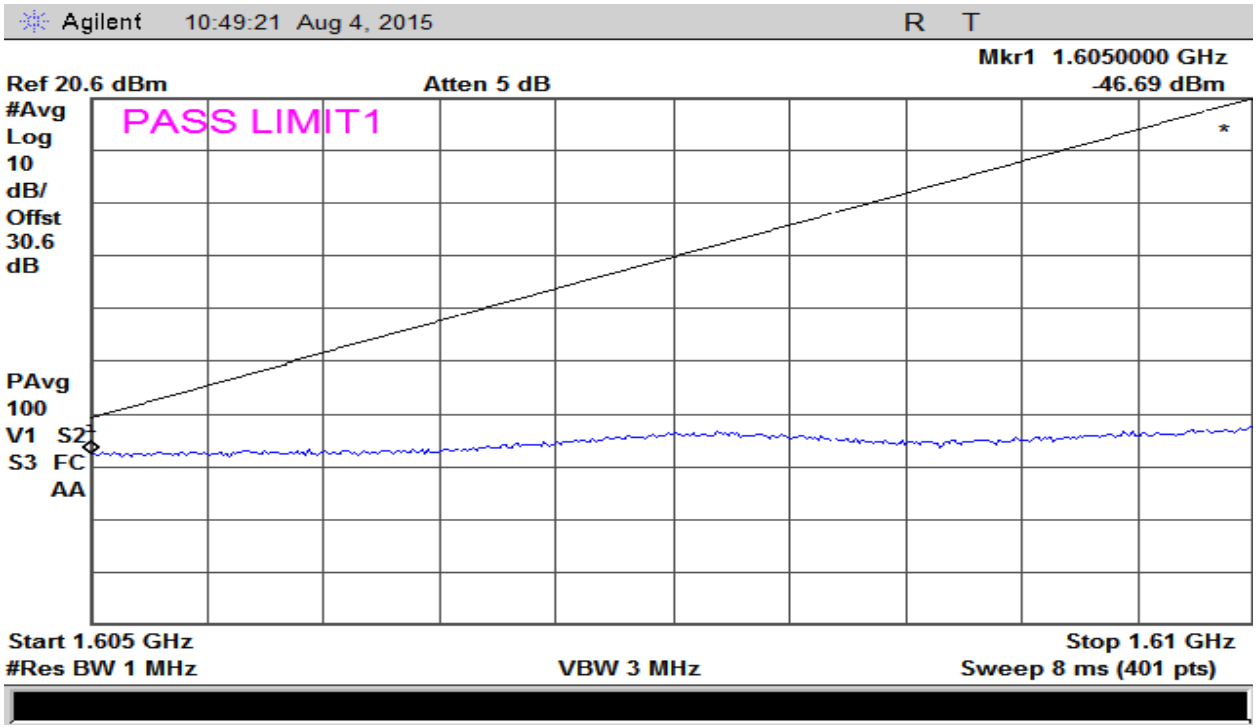
Plot 23- Low Channel – Test Limit 25.216 (f)(g) – Discrete Emissions



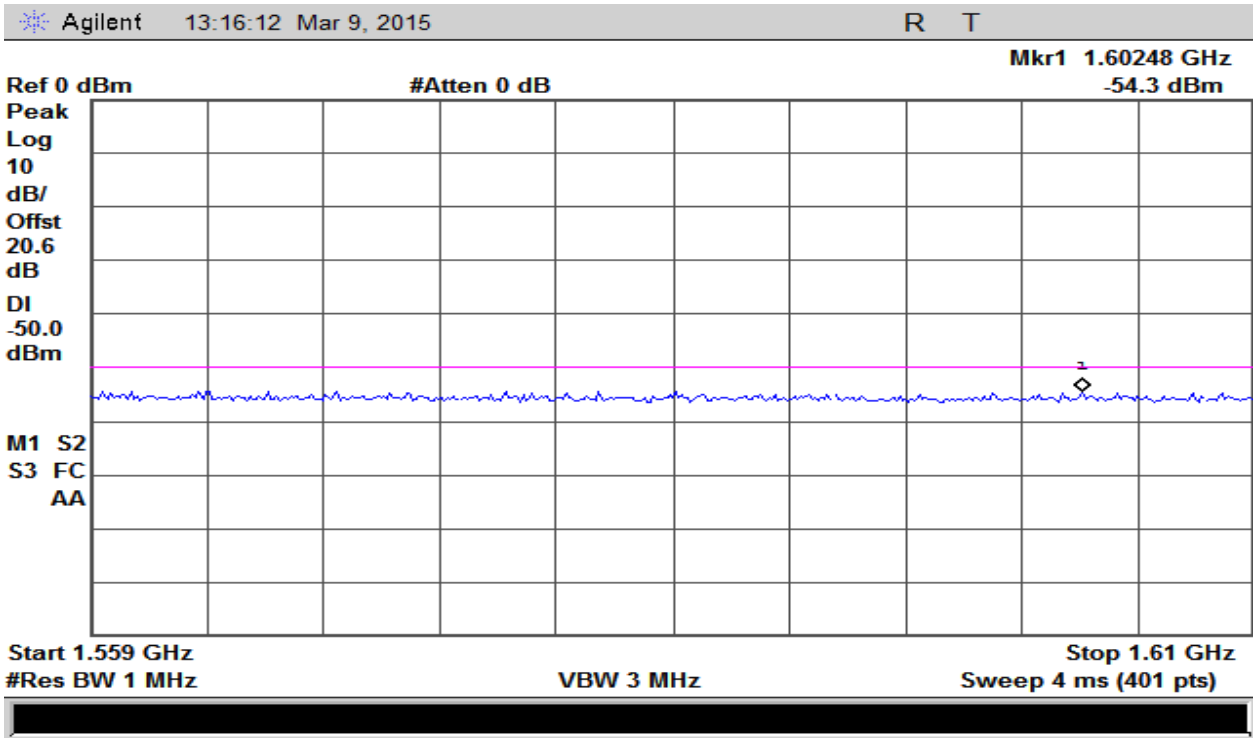
Plot 24-High Channel – Test Limit 25.216 (f)(g) – Discrete Emissions



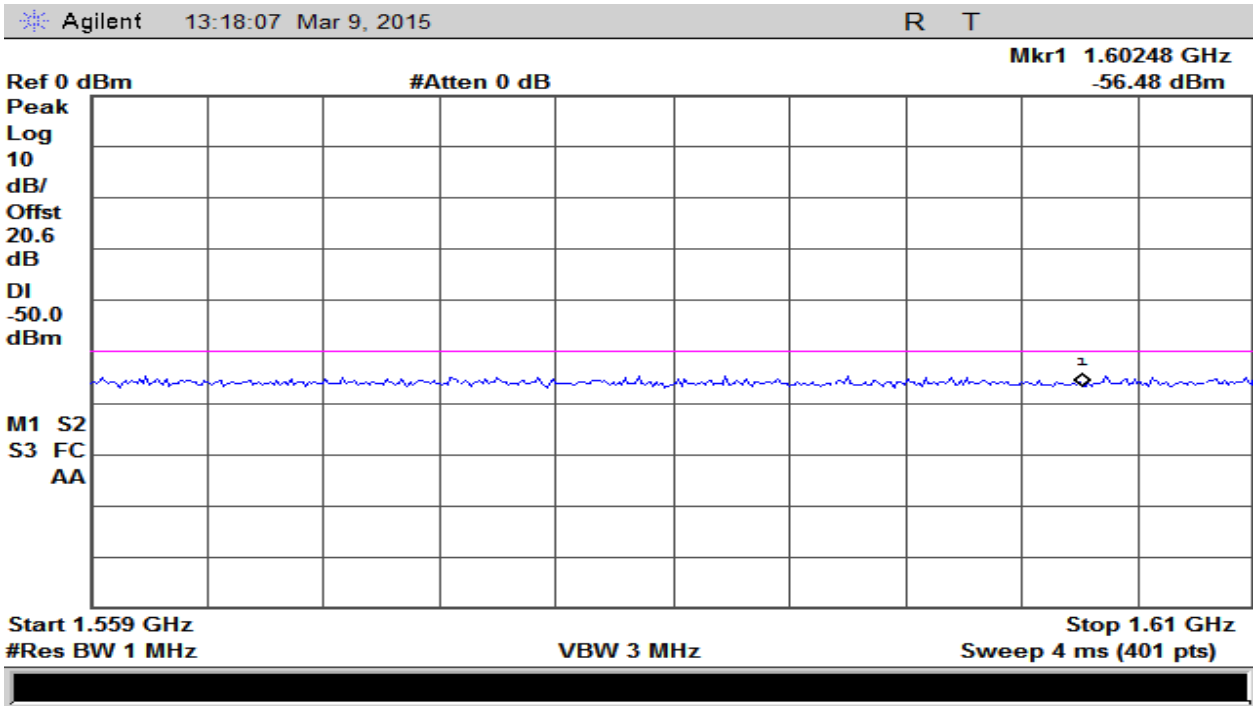
Plot 25- Low Channel – Test Limit 25.216 (f)(g)



Plot 26-High Channel – Test Limit 25.216 (f)(g)



Plot 27- Low Channel - Carrier Off



Plot 28 – High Channel – Carrier Off

6. Frequency Stability vs Temperature

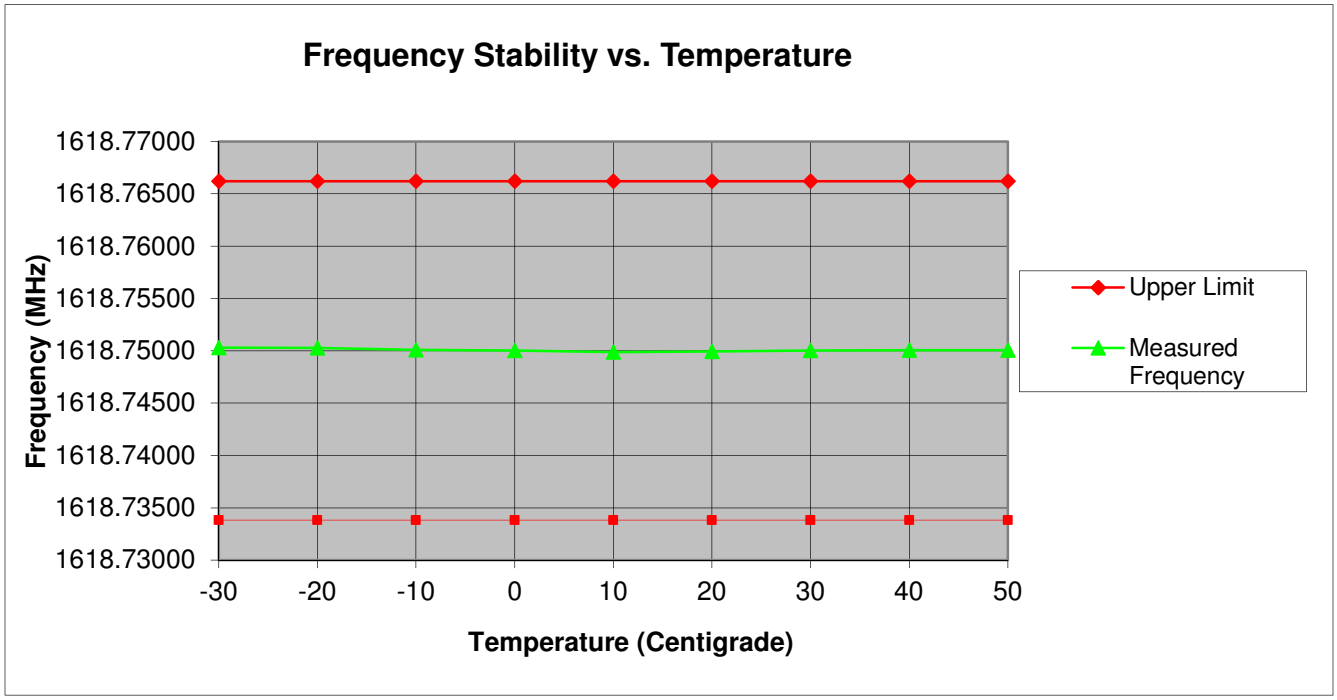
Test Requirement(s):	§2.1055	**Test Engineer(s):**	Jerry M.
Test Results:	Pass	**Test Date(s):**	03/12/15

Test Procedures: As required by 47 CFR 2.1055, 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.

Temperature centigrade	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
-30	1618.75031	-0.01588	0.01650
-20	1618.75026	-0.01593	0.01645
-10	1618.75009	-0.01610	0.01628
0	1618.75003	-0.01616	0.01622
10	1618.74986	-0.01633	0.01605
20	1618.74992	-0.01627	0.01611
30	1618.75004	-0.01615	0.01623
40	1618.75006	-0.01613	0.01625
50	1618.75005	-0.01614	0.01624

Table 8 – Temperature vs Frequency Test Result



Plot 29 – Temperature vs Frequency

7. Frequency Stability vs Voltage

Test Requirement(s):	§2.1055	**Test Engineer(s):**	Jerry M.
Test Results:	Pass	**Test Date(s):**	03/12/15

Test Procedures: As required by 47 CFR 2.1055, Frequency Stability measurements were made at the RF antenna output terminals of the EUT.

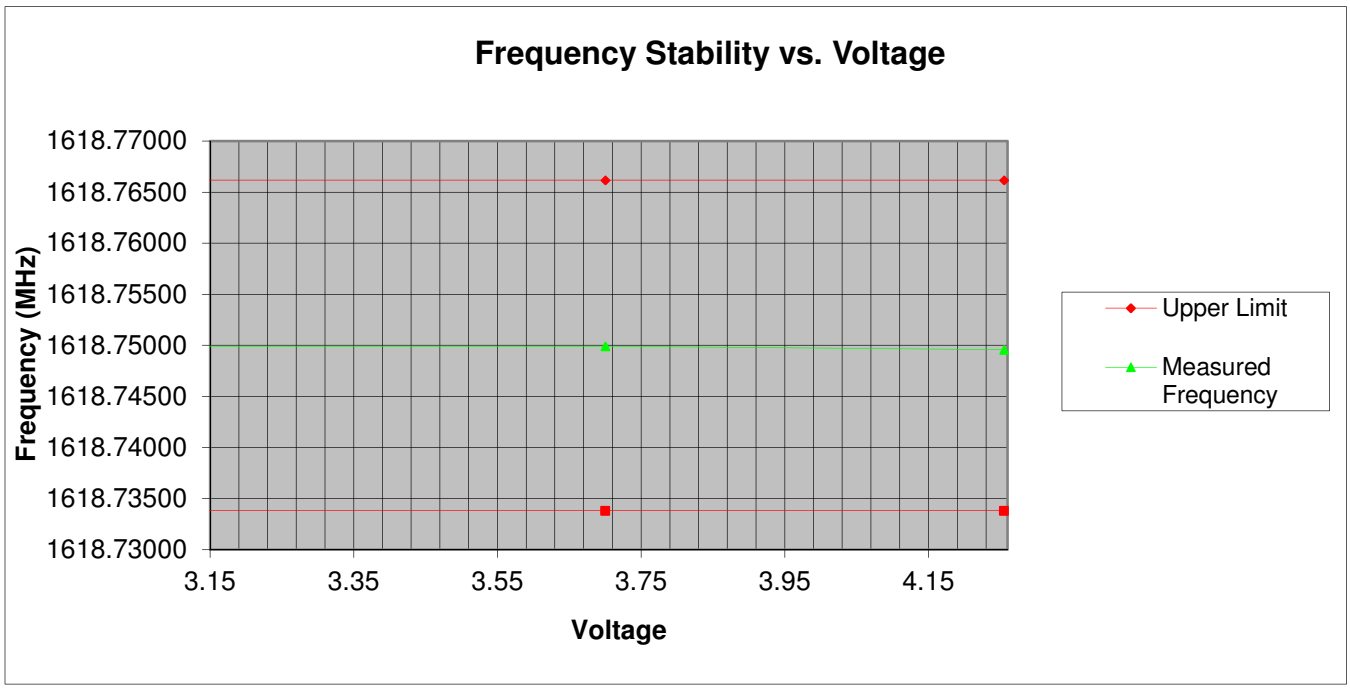
The EUT was connected to a variable DC source. The frequency was measured at both the nominal 3.7 Vdc of the EUT and at the extreme ±15% of nominal which is 85% level or 3.15Vdc and at the 115% level or 4.26Vdc

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 6.

Reference Frequency: 1618.75 at 3.7VdC at 25°C

Input Voltage (Vdc)	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
3.15	1618.74991	-0.01628	0.01610
3.70	1618.74992	-0.01627	0.01611
4.26	1618.74958	-0.01661	0.01577

Table 9. Temperature vs. Voltage Test Result



Plot 30 – Temperature vs Voltage

I. Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Power Supply	Hewlett Packard	E3610A	KR83021468	NCR	None
Digital Multimeter	Fluke	77III	72550270	Sep/26/13	Sep/26/15
Spectrum Analyzer	Hewlett Packard	E4402B	US41192757	Jan/27/15	Jan/27/16
Notch Filter	K & L	3TNF-00008	634	Verified	
Spectrum Analyzer	Hewlett Packard	8563E	3821A09316	Sep/19/14	Sep/19/15
Temp Chamber	Thermotron	SM-3.5S mini Max	12817	Sep/22/14	Sep/24/15
Attenuator 10dB	Huber+Suhner	6810.17.A	747300	Verified	
Signal Generator	Agilent	E4432B	US38220446	Aug/25/14	Aug/25/15
Attenuator 20dB	Mini Circuits	CAT-20	10012	Verified	
Horn Antenna	Com-Power	AHA-118	071150	Sep/13/13	Sep/13/15
Bilog Antenna	Chase	CBL6140	1040	Nov/09/14	Nov/09/15

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