H.B. Compliance Solutions

Intentional Radiator Test Report

For the

Raveon Technologies

Daisy ISM-NA Wireless Modem RV-M50-EC

Tested under

The FCC Rules contained in Title 47 of the CFR, Part 15.247 for

Digitally Transmitting Sequence / Hybrid

Prepared for:

Raveon Technologies Corp.

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Vista, CA 92081

Prepared By:

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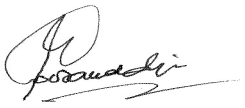
Reviewed By:



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 15 of the FCC Rules under normal use and maintenance.

Report Status Sheet

Revision #	Report Date	Reason for Revision
Ø	January 19, 2016	Initial Issue

Table of Contents

EXECUTIVE SUMMARY

1. Testing Summary

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15.247. All tests were conducted using measurement procedure from ANSI C63.10-2009, FCC Public Notice 558074 DTS Guide April 09, 2013 as appropriate.

Test Name	Test Method/Standard	Result	Comments
Unintentional Radiated Emissions	15.109	Pass	
A/C Powerline Conducted Emissions	15.207	Pass	
Occupied Bandwidth	15.247(a)(2)	Pass	
Peak Output Power	15.247(b)	Pass	
Conducted Spurious Emissions	15.247(d)	Pass	
Radiated Spurious Emissions & Restricted Band	15.247(d), 15.209(a), 15.205	Pass	
Emissions At Band Edges	15.247(d), 15.209(a), 15.205	Pass	
Power Spectral Density	15.247(e)	Pass	
Time of Occupancy (Dwell Time)	15.247(a)	Pass	
Carrier Frequency Separation	15.247(a)	Pass	

EQUIPMENT CONFIGURATION

1. Overview

H.B Compliance Solutions was contracted by Raveon Technologies to perform testing on the RV-M50-EC Radio modem under the purchase order number 7467.

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, RV-M50-EC radio modem.

The tests were based on FCC Part 15 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 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:	Daisy ISM-NA Wireless Modem
Model(s) Tested:	RV-M50-EC
FCC ID:	SRS-M50-EC
Supply Voltage Input:	Primary Power : 5 Vdc
Frequency Range:	902.3 - 927.8MHz
No. of Channels:	2
Necessary Bandwidth	N/A
Type(s) of Modulation:	FSK
Range of Operation Power:	0.307 W
Emission Designator:	N/A
Channel Spacing(s)	None
Test Item:	Pre-Production
Type of Equipment :	Fixed
Antenna Requirement (§15.203) :	Type of Antenna Connector: MMCX Gain of Antenna: N/A
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):	02/14/15 till 01/12/16

2. Test Facility

Radiated Emissions testing was performed at Artesyn Embedded Technologies. This facility is located at 2900 S. Diablo Way, Suite 190, 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 Technologies 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 Emerson Network Power.

3. Description of Test Sample

The Raveon Technologies, RV-M50-EC is a wireless modem used for high-performance, long range wireless access card and GPS transponder. It runs off battery powered. This model transmit data in a in the 902 to 927MHz range.

4. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number
# 1	Daisy ISM-NA Wireless Modem	RV-M50-E	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	Wireless Module Evaluation Kit	Raveon	OP688 Rev D	-
# 3	Laptop Computer	Dell Inspiron	PP41L	88LSZJ1

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
#3	Power	2 wire	1	2	N	DC Power
# 4	Serial	dB9	1	2	N	Laptop Computer

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. Customer provide a Test software on a computer which communicated with the module via a serial port which sent all the required test commands. Test command allowed to cycle through test various test modes which allowed to select the lower, middle and upper band of the device. These commands allowed the selection of the channel bandwidth, Random Data and CW mode for all three channels. 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 upon completion of testing & certification

Criteria for Un-Intentional Radiators

1. Radiated Emissions

Test Requirement(s):	§15.109	**Test Engineer(s):**	Frank Farrone
Test Results:	Pass	**Test Date(s):**	01/12/2016

Test Procedures:

The final radiated emissions test was performed using the parameters described above as worst case. That final test was conducted at a facility that meets the ANSI C63.4 NSA requirements. The frequency range noted in the data sheets was scanned/tested at that facility. Emissions were maximized as specified, by varying table azimuth, antenna height, and manipulating cables.

Using the mode of operation and configuration noted within this report, a final radiated emissions test was performed. The frequency range investigated (scanned), is also noted in this report. Radiated emissions measurements were made at the EUT azimuth and antenna height such that the maximum radiated emissions level will be detected. This requires the use of a turntable and an antenna positioner. The preferred method of a continuous azimuth search is utilized for frequency scans of the EUT field strength with both polarities of the measuring antenna. A calibrated, linearly polarized antenna was positioned at the specified distance from the periphery of the EUT.

> *Note: The specified distance is the horizontal separation between the closest periphery of the EUT and the center of the axis of the elements of the receiving antenna. However, if the receiving antenna is a log-periodic array, the specified distance shall be the distance between the closest periphery of the EUT and the front-to-back center of the array of elements.*

Tests were made with the antenna positioned in both the horizontal and vertical polarization planes. The measurement was varied in height above the conducting ground plane to obtain the maximum signal strength. Though specified in the report, the measurement distance shall be 3 meters. At any measurement distance, the antenna height was varied from 1 meter to 4 meters. These height scans apply for both horizontal and vertical polarization, except that for vertical polarization the minimum height of the center of the antenna shall be increased so that the lowest point of the bottom of the antenna clears the ground surface by at least 25 cm.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
30 MHz to 1 GHz	120 kHz	120 kHz	N/A
1 GHz to 11 GHz	1MHz	N/A	1MHz
Measurements were made using the bandwidths and detectors specified. The video filter was at least as wide as the IF bandwidth of the measuring receiver.			

Table 4. Radiated Emissions – Measurement Bandwidth

Emissions Tests Calculations

In the case of indoor measurements, radiated emissions measurements are made by the manipulation of correction factors using Rohde and Schwarz ES-K1 software. This is done automatically by the software during the final measurement process.

In both cases, the level of the Field Strength of the interfering signal is calculated by adding the Antenna Factor, Cable Factor and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + (CF –AG)

Where: FS = Field Strength

RA = Receiver (indicated) Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

This laboratory uses an approach of combining the CF and AG using an end-to-end measurement of the entire cabling system, including the test cable, any in-line amplifiers, attenuators, or transient protection networks, all measured in-situ.

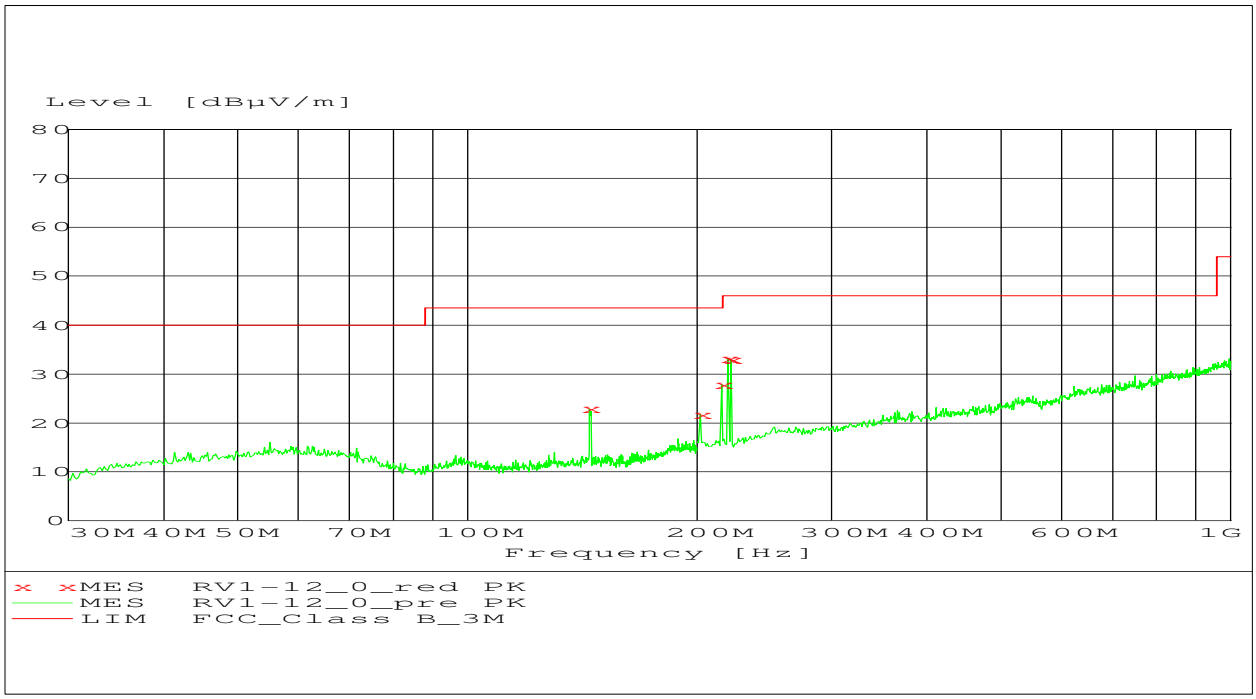
For a sample calculation, assume a receiver reading of 52.5 dBuV is obtained. With an antenna factor of 7.4 and a combined cable factor (CF + AG) of -27.9:

FS = 52.5 + 7.4 + (-27.9) = 32 dBuV/m

FS = 32 dBuV/m

If desired, this can be converted into its corresponding level in uV/m:

FS = 10^((32 dBuV/m)/20) = 39.8 uV/m



Plot 1 – Radiated Emissions – 30MHz to 1GHz

Frequency (MHz)	Measured Level	Height (cm)	Azimuth (deg)	Polarization
144.57	22.89	200	90	Horizontal
201.77	21.72	300	315	Horizontal
215.11	27.93	300	315	Horizontal
219.55	33.18	300	315	Horizontal
221.33	32.93	300	315	Horizontal

Table 5. Final Measurement Results for Radiated Emissions

2. Conducted Emissions

Test Requirement(s):	§15.207	Test Engineer(s):	Jerry Mejak
Test Results:	Pass	Test Date(s):	01/12/2016

Test Procedures: The EUT was placed on a non-metallic table, 80cm above the ground plane inside a shielded enclosure. The EUT was powered through a 50Ω/50µH LISN. The conducted emissions tests were performed using the mode of operation and configuration noted within this report. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Equipment is tested with power cords that are the same as those cords normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network). All 50 Ohm measuring ports of the LISN are terminated by 50 Ohms, either by the 50 Ohm EMI receiver or a 50 Ohm resistive load.

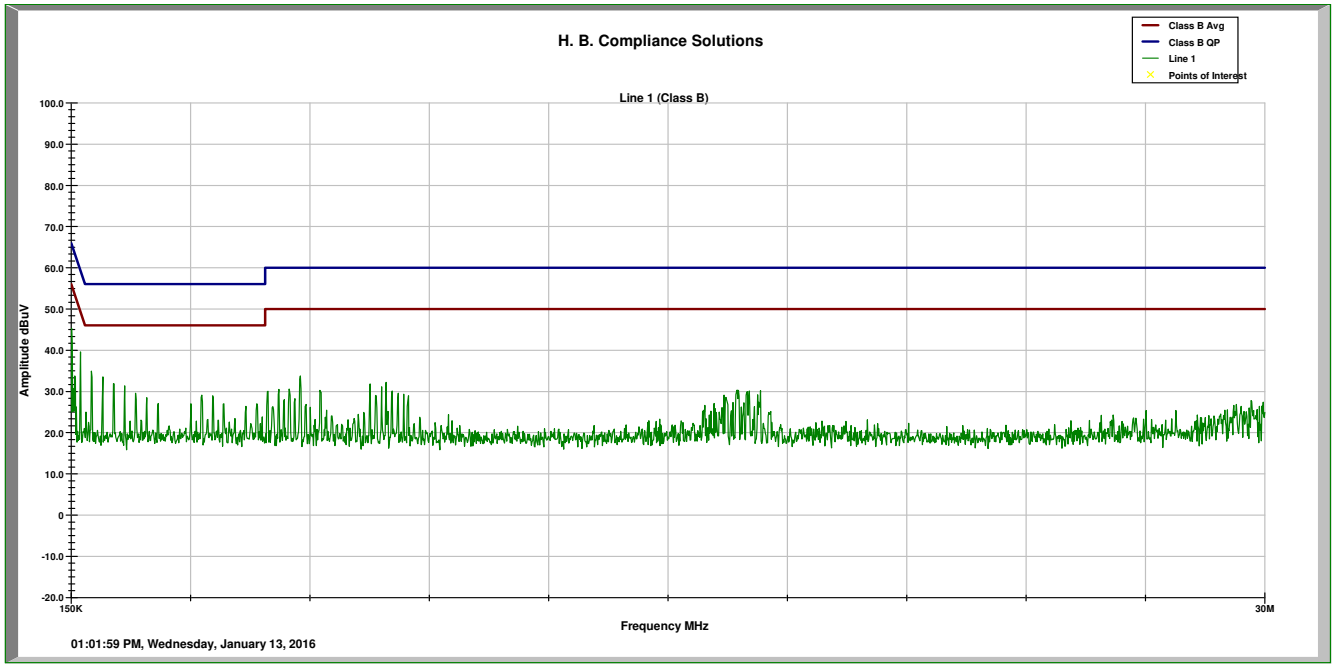
Refer to the Emissions Tests Calculations section in the Radiated Emissions section for sample calculations. For the purposes of the conducted emissions test, the Antenna Factor (AF) is replaced by the LISN correction factor.

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.150 - 30	9.0	9.0	9.0
Measurements were made using the bandwidths and detectors specified. No video filter was used.			

Table 1.Conducted Emissions – Measurement Bandwidth

Frequency Range (MHz)	15.107(b), Class A Limits (dBuV)		15.107(a), Class B Limits (dBuV)	
	Quasi-Peak	Average	Quasi Peak	Average
0.15 – 0.5	79	66	66 - 56	56 - 46
0.5 – 5.0	73	60	56	46
5.0 – 30	73	60	60	50
Note 1 – The lower limit shall apply at the transition frequencies.				

Table 2. Conducted Emissions Limits – FCC Limits from Section 15.107(a)(b)



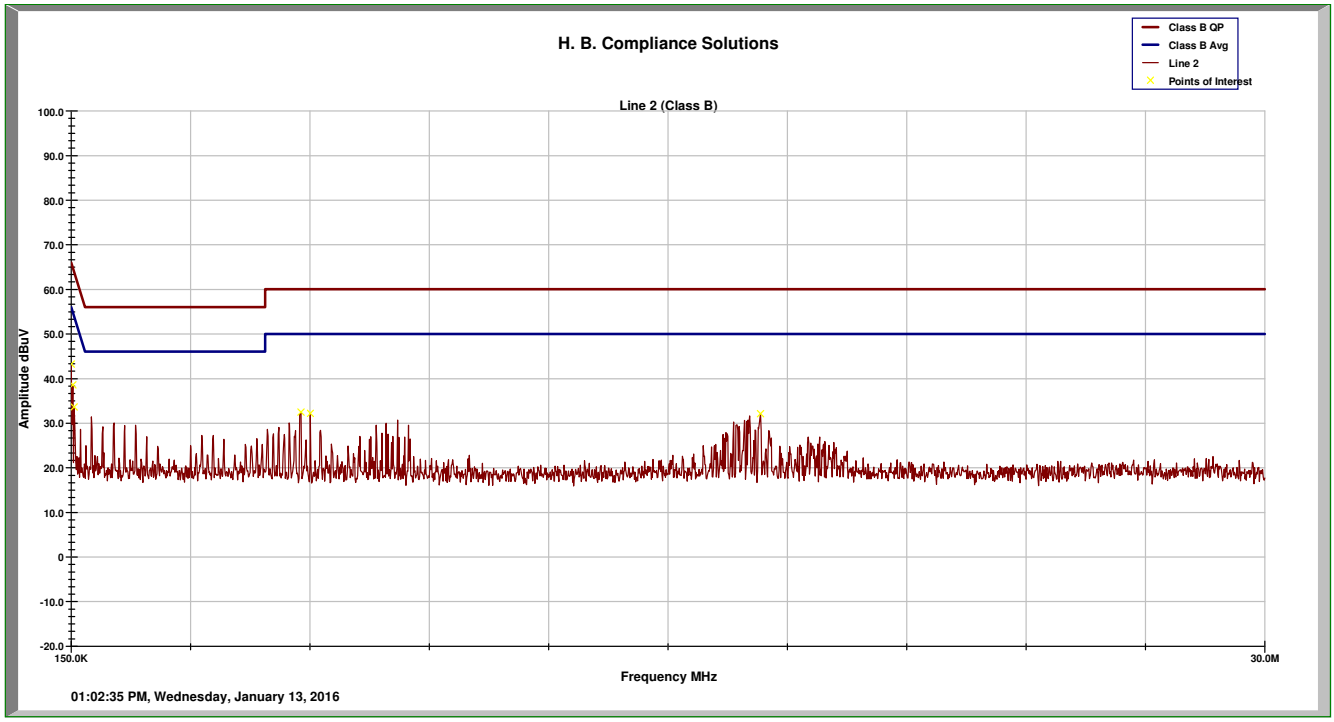
Plot 2 – Conducted Emission Plot – Line Side

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.161	47.68	65.682	-18.00
0.176	41.87	65.252	-23.38
0.407	29.31	58.656	-29.34
0.618	16.02	56	-39.98
0.691	37.01	56	-18.99
1.089	21.73	56	-34.27

Table 3. Measurement Results for QP

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.161	21.778	55.682	-33.90
0.176	13.733	55.252	-41.52
0.407	29.775	48.656	-18.88
0.618	10.602	46	-35.39
0.691	36.365	46	-9.635
1.089	9.707	46	-36.29

Table 4. Measurement Results for Average



Plot 3 – Conducted Emissions – Neutral Side

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.152	49.5	65.943	-16.44
0.194	41.99	64.719	-22.72
5.940	34.07	60	-25.93
6.19	29.86	60	-30.14
27.70	33.55	60	-26.45
28.29	28.27	60	-31.73

Table 5. Measurement Results for Quasi Peak

Frequency (MHz)	Measured Level (dBuV)	Limit (dBuV)	Margin (dB)
0.152	27.988	55.943	-27.95
0.194	20.585	54.719	-34.13
5.940	23.422	50	-26.57
6.19	23.815	50	-26.18
27.70	29.888	50	-20.11
28.29	27.88	50	-22.11

Table 6. Measurement Results for Average

1. Occupied Bandwidth

Test Requirement(s):	15.247(a)(2), ANSI C63.10	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	12/10/15

Test Procedure: As required by 47 CFR 15.247(a): System using digital modulation techniques may operate in the 902-928MHz, 2400 – 2483.5MHz, and 5725 – 5850MHz bands. The minimum 6dB bandwidth shall be at least 500 kHz.

Customer provided a test mode to control the EUT 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 100kHz and VBW>RBW. Measurements were carried out at the low, mid and high channels of the TX band at the output terminals of the EUT.

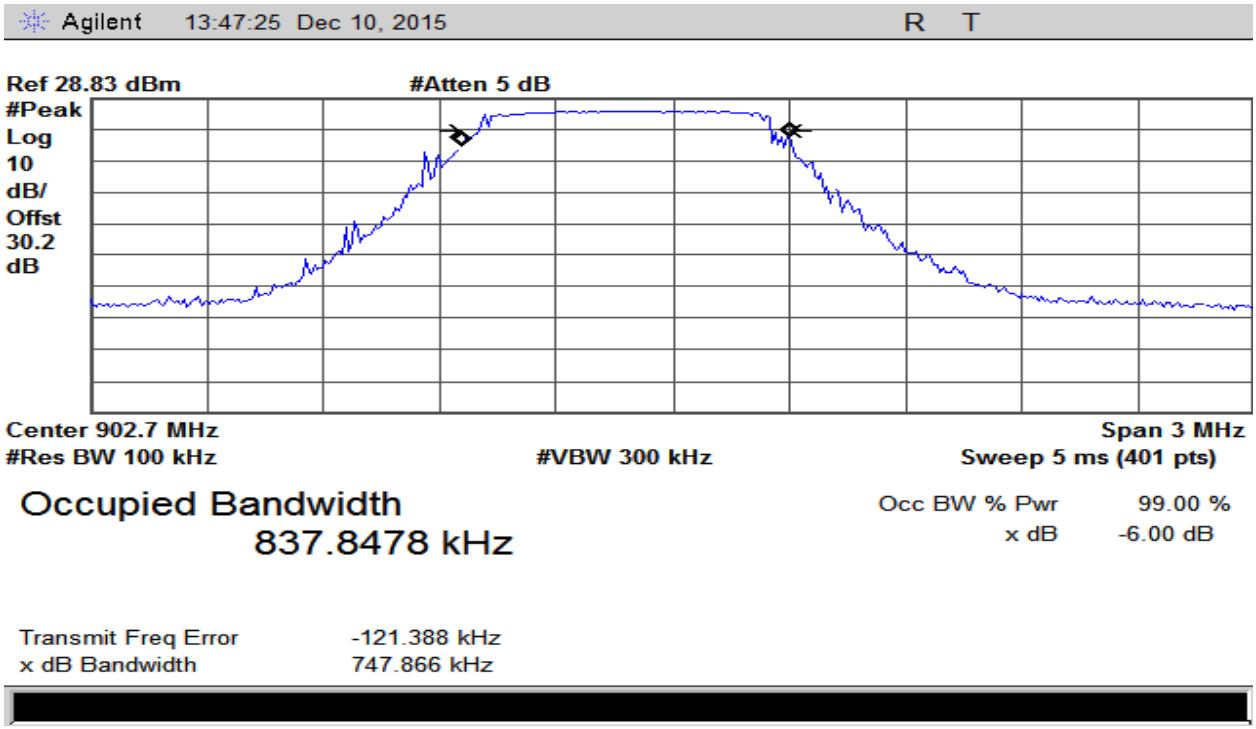
Frequency (MHz)	Recorded Measurement	Specification Limit
902.7	747.866 kHz	≥ 500 KHz
914.6	813.473 kHz	≥ 500 KHz
927.5	834.428 kHz	≥ 500 KHz

Table 7. Occupied Bandwidth Summary, Test Results

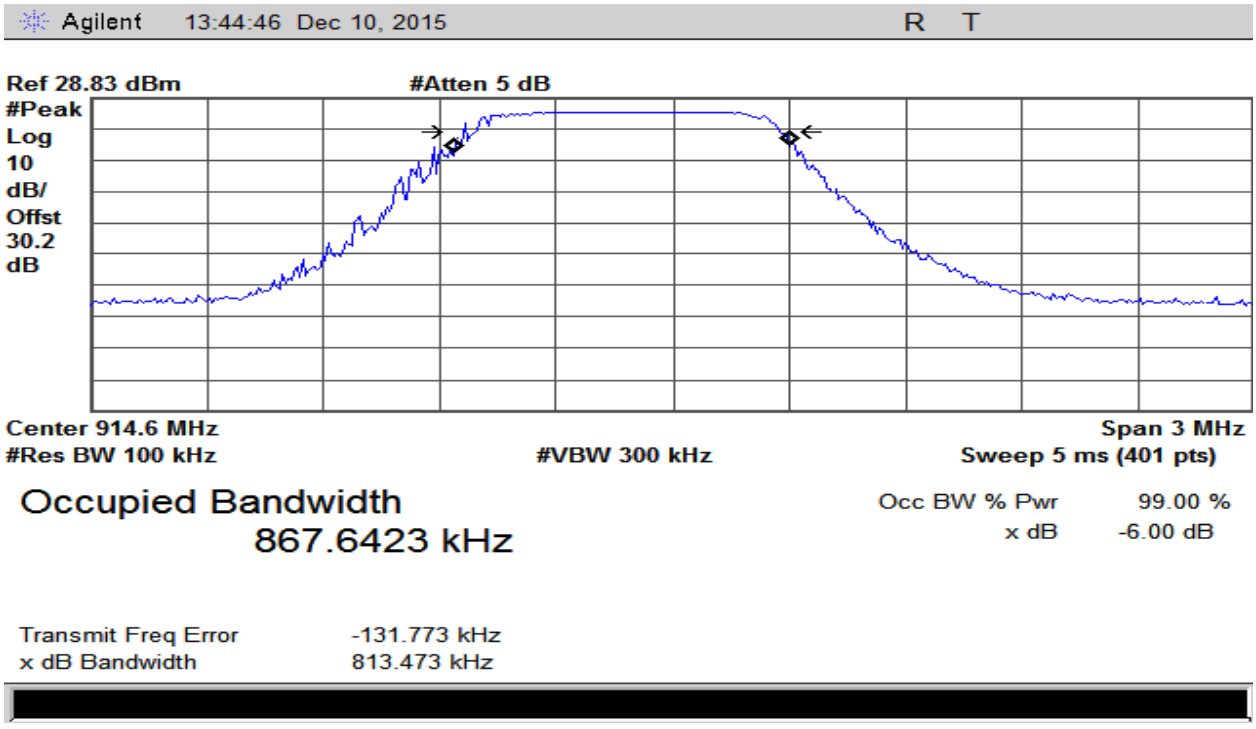
Frequency (MHz)	Recorded Measurement	Comment
902.7	847.84 kHz	DTS Mode
914.6	867.64 kHz	DTS Mode
927.5	881.85 kHz	DTS Mode
902.3	391.02 kHz	Hybrid Mode
914.6	387.69 kHz	Hybrid Mode
927.8	410.485 kHz	Hybrid Mode

Table 8. 99% Bandwidth, Test Results

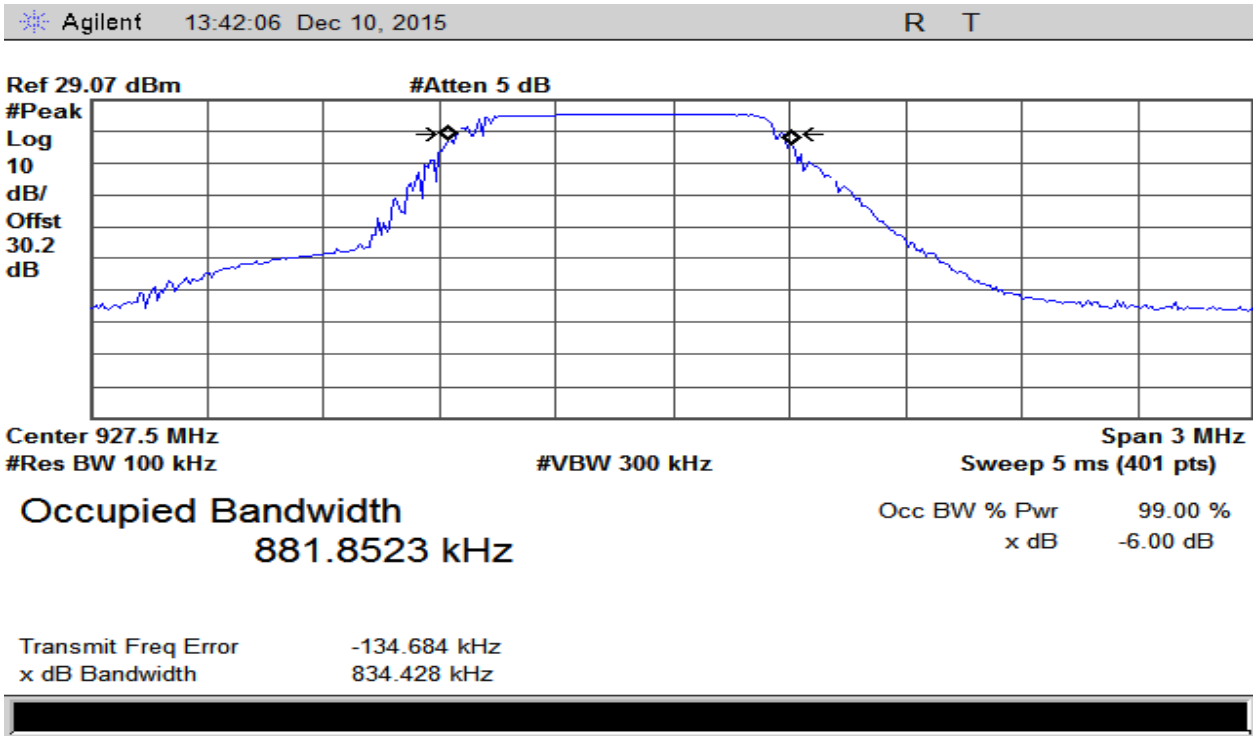
The following pages show measurements of Occupied Bandwidth plots:



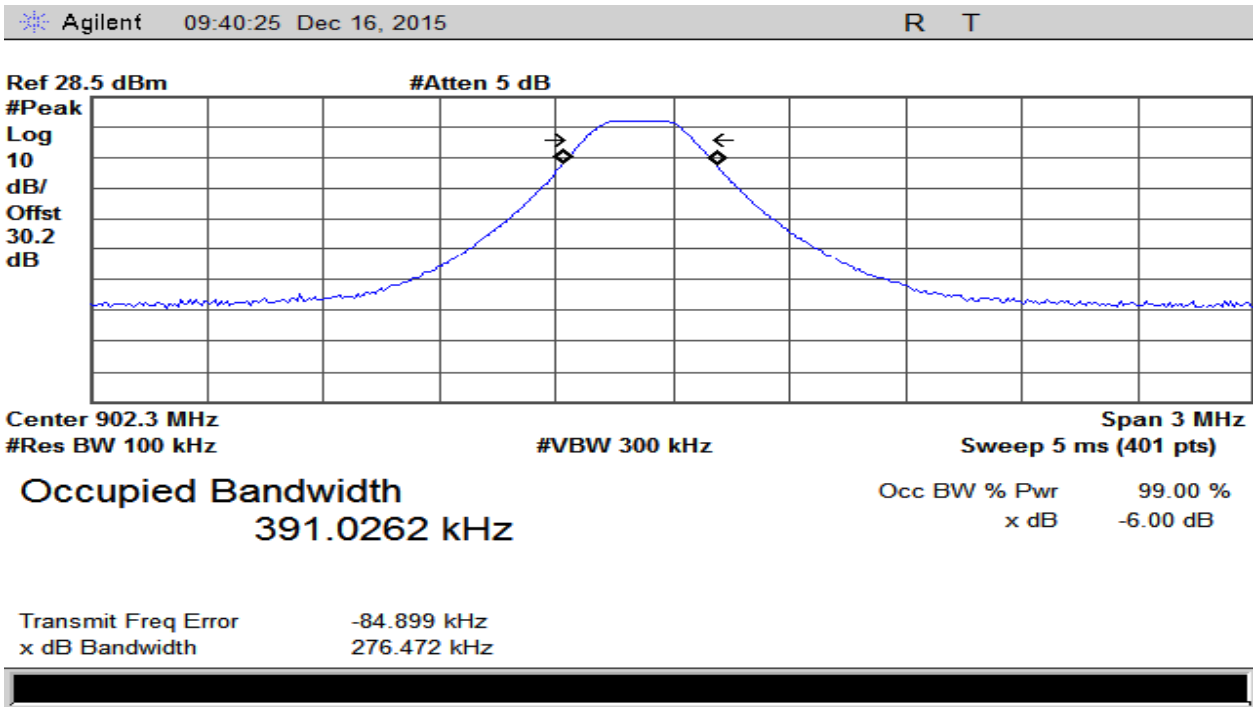
Plot 4 – Lowest Channel – 6dB BW – DTS Mode



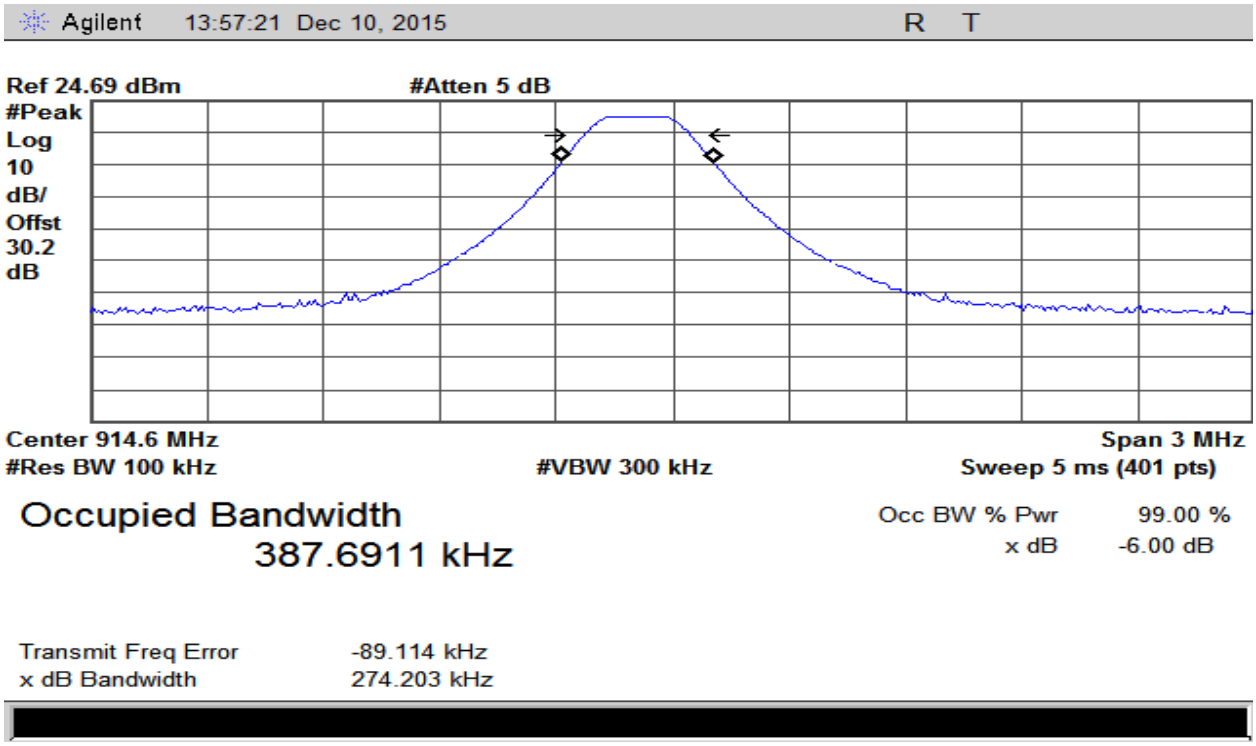
Plot 5 – Middle Channel – 6dB BW – DTS Mode



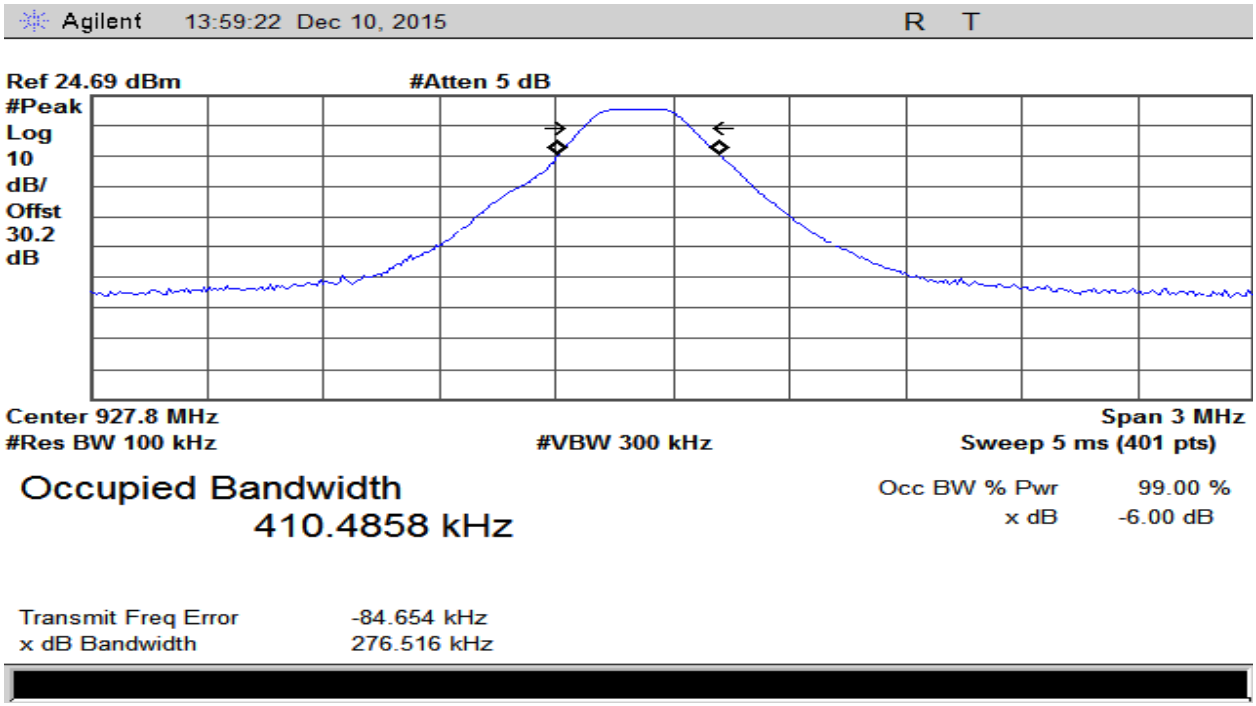
Plot 6 – Highest Channel – 6dB BW – DTS Mode



Plot 7 – Lowest Channel – Hybrid Mode



Plot 8 – Middle Channel – Hybrid Mode



Plot 9 – Highest Channel – Hybrid Mode

2. RF Power Output

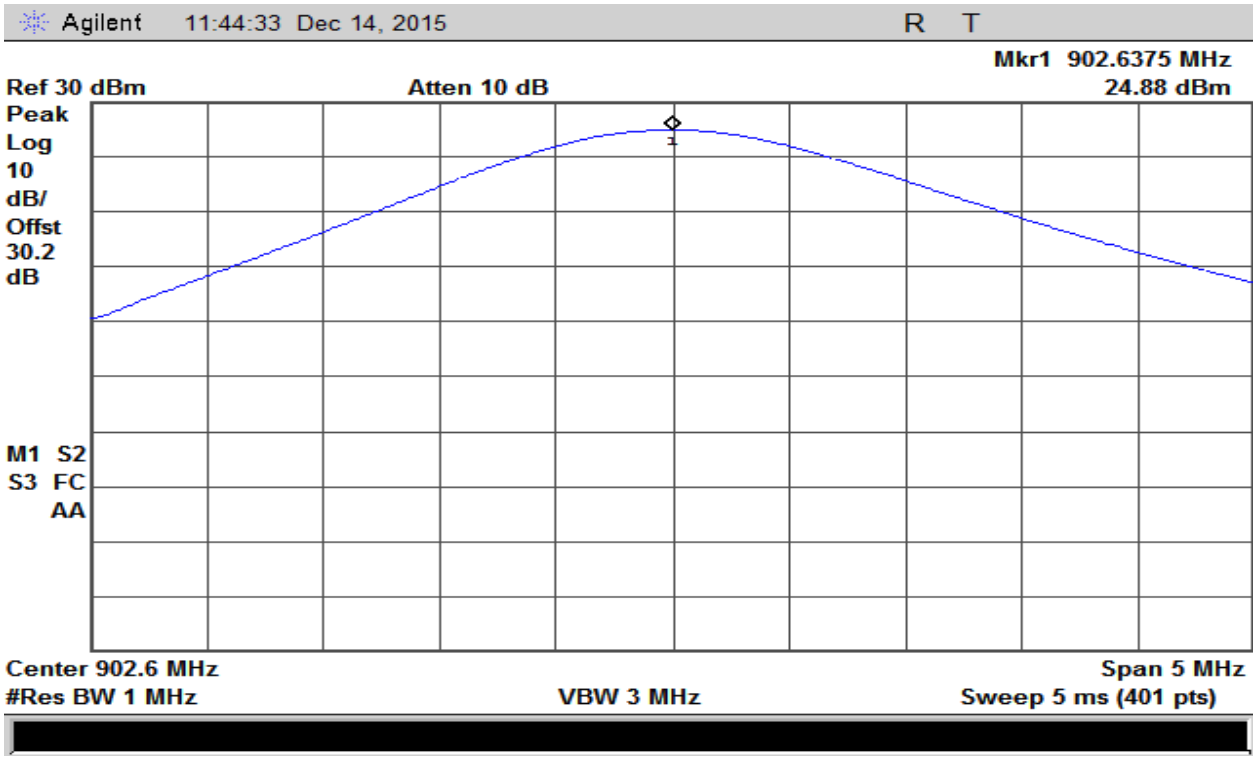
Test Requirement(s):	§15.247(b)(3)	Test Engineer(s):	Keith T.
Test Results:	Pass	Test Date(s):	12/14/15

Test Procedures: As required by 47 CFR 15.247(b)(3), RF Power output measurements were made at the RF output terminals of the EUT. DTS Procedure 9.2.2.2 was used for Average measurements

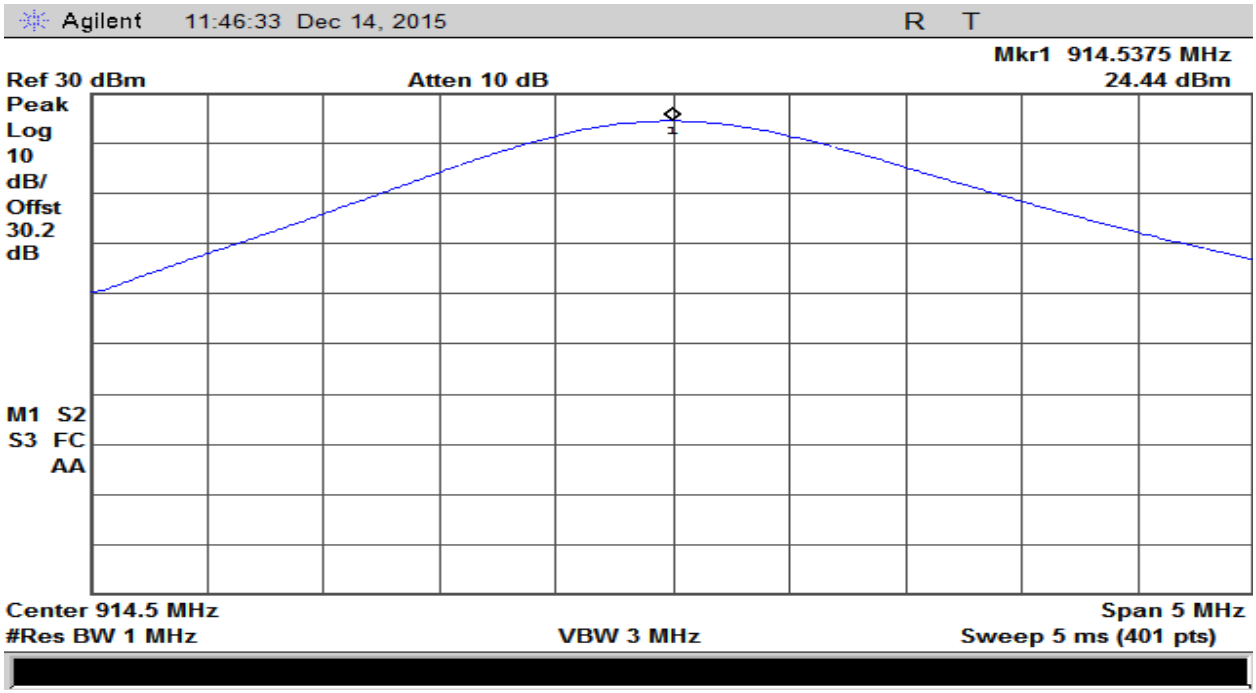
Customer provided a test mode to control the EUT RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer capable of making power measurements. Measurements were made at the low, mid, and high channels of the entire frequency band.

Frequency (MHz)	Conducted Power (dBm)	Conducted Power (W)	Specification Limit	Mode
902.6	24.88	0.307	1W	DTS
914.5	24.44	0.277	1W	DTS
927.4	24.4	0.275	1W	DTS
902.2	20.72	0.118	1W	Hybrid
914.6	19.75	0.094	1W	Hybrid
927.7	19.94	0.098	1W	Hybrid

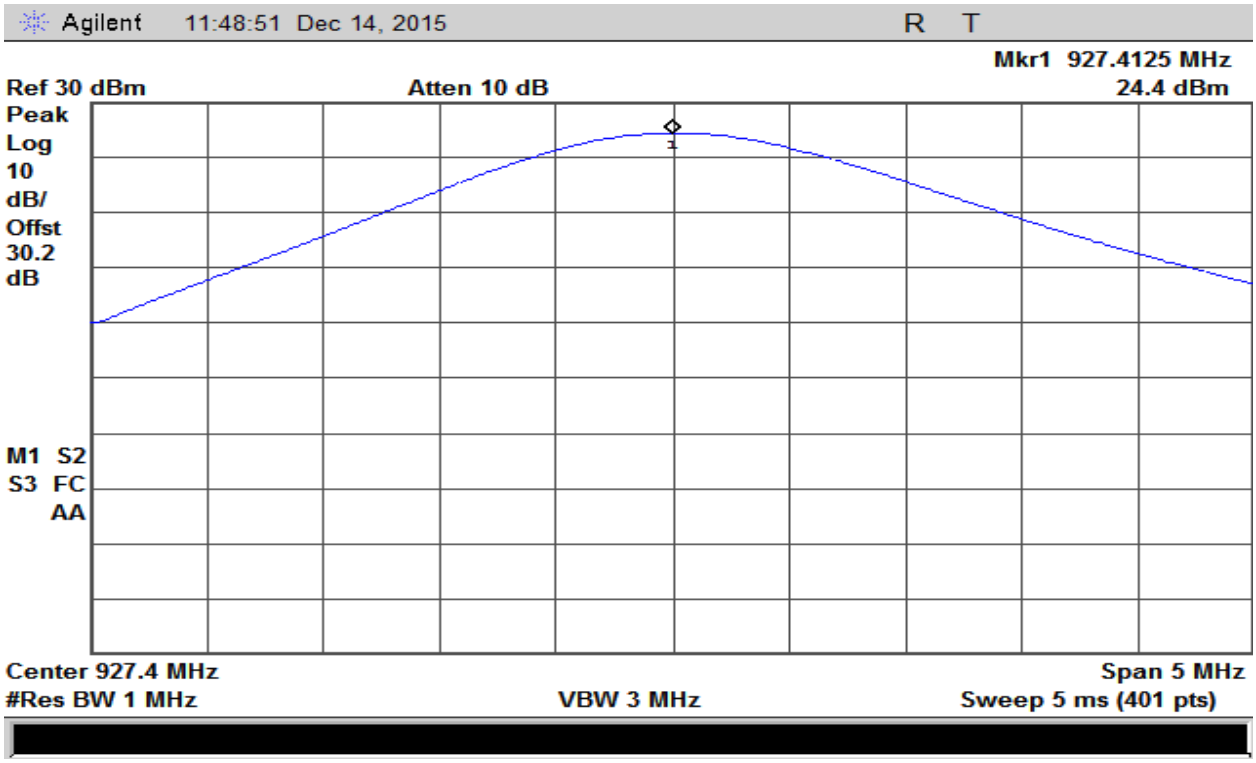
Table 9. RF Power Output, Test Results



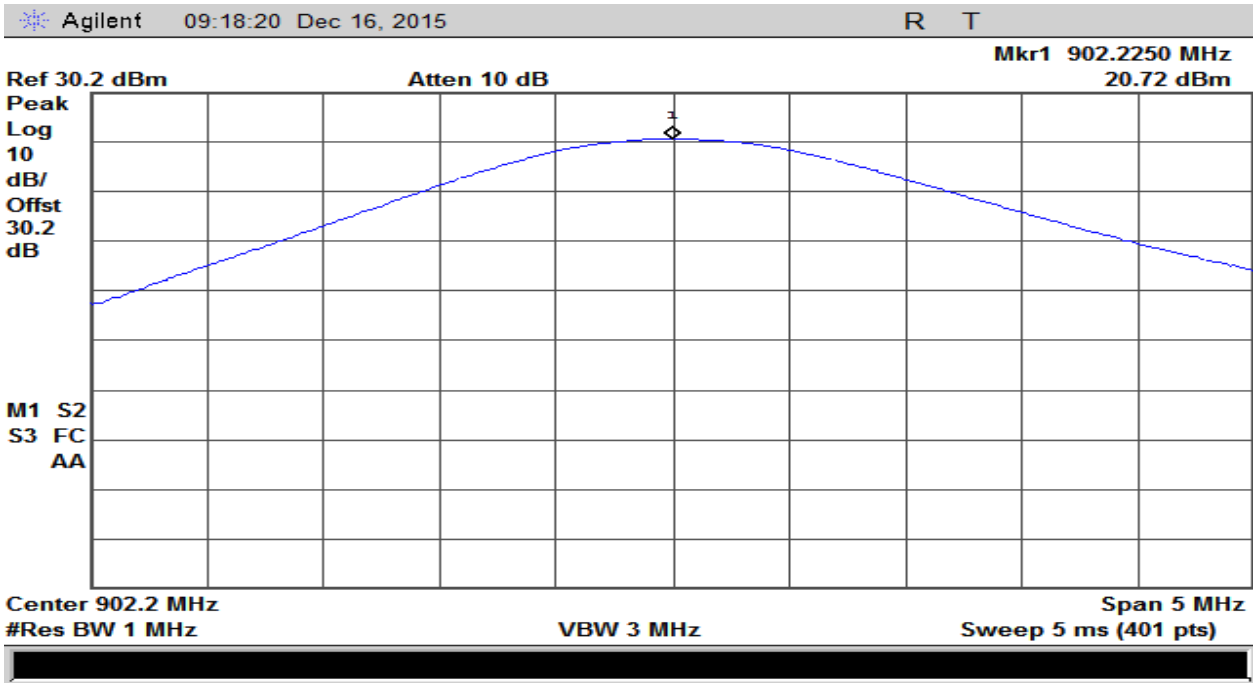
Plot 10 – Output Power – Low – DTS Mode



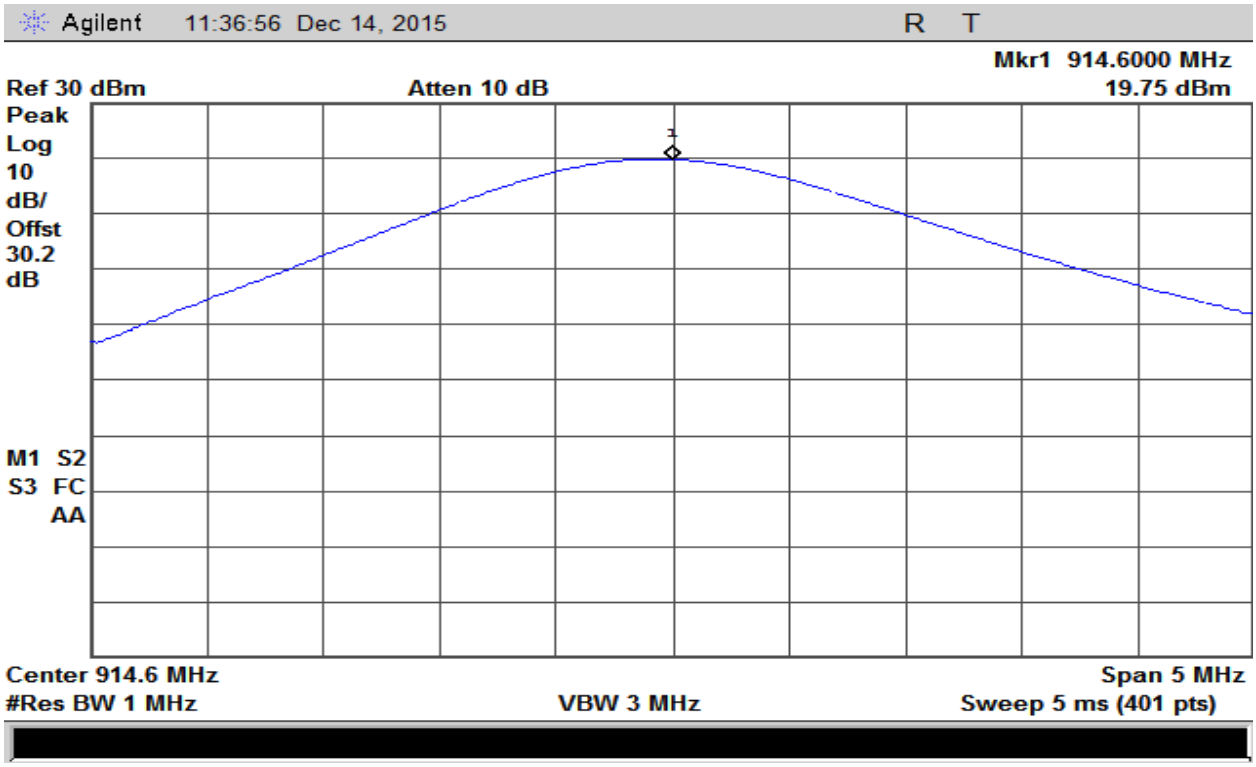
Plot 11– Output Power – Mid – DTS Mode



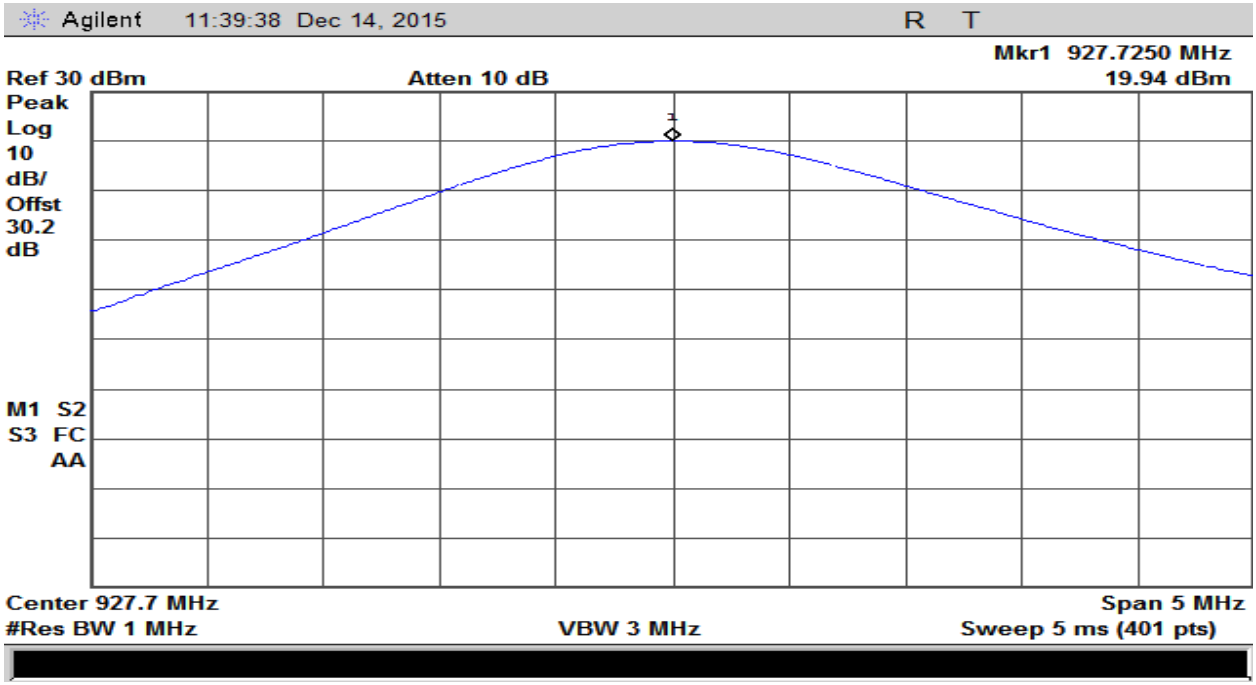
Plot 12 – Output Power – High – DTS mode



Plot 13 – Output Power – Low – Hybrid mode



Plot 14 – Output Power – Mid – Hybrid mode



Plot 15 – Output Power – High – Hybrid mode

3. Conducted Spurious Emissions

Test Requirement(s):	§15.247(c)	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	02/19/15

Test Procedures:

As required by 47 CFR 15.247(c): In any 100kHz bandwidth the frequency band in which the spread spectrum or digitally modulation intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either and RF conducted or a radiated measurement. Conducted spurious emissions at antenna terminal measurements were made at the RF output antenna terminal of the EUT.

Customer provided a test mode to control the EUT RF modulation, and frequency channel. The EUT was connected through an attenuator to a Spectrum Analyzer with RBW set to 100KHz and VBW ≥ RBW. 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 Data:

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)
7445.00	-37.47	-0.59

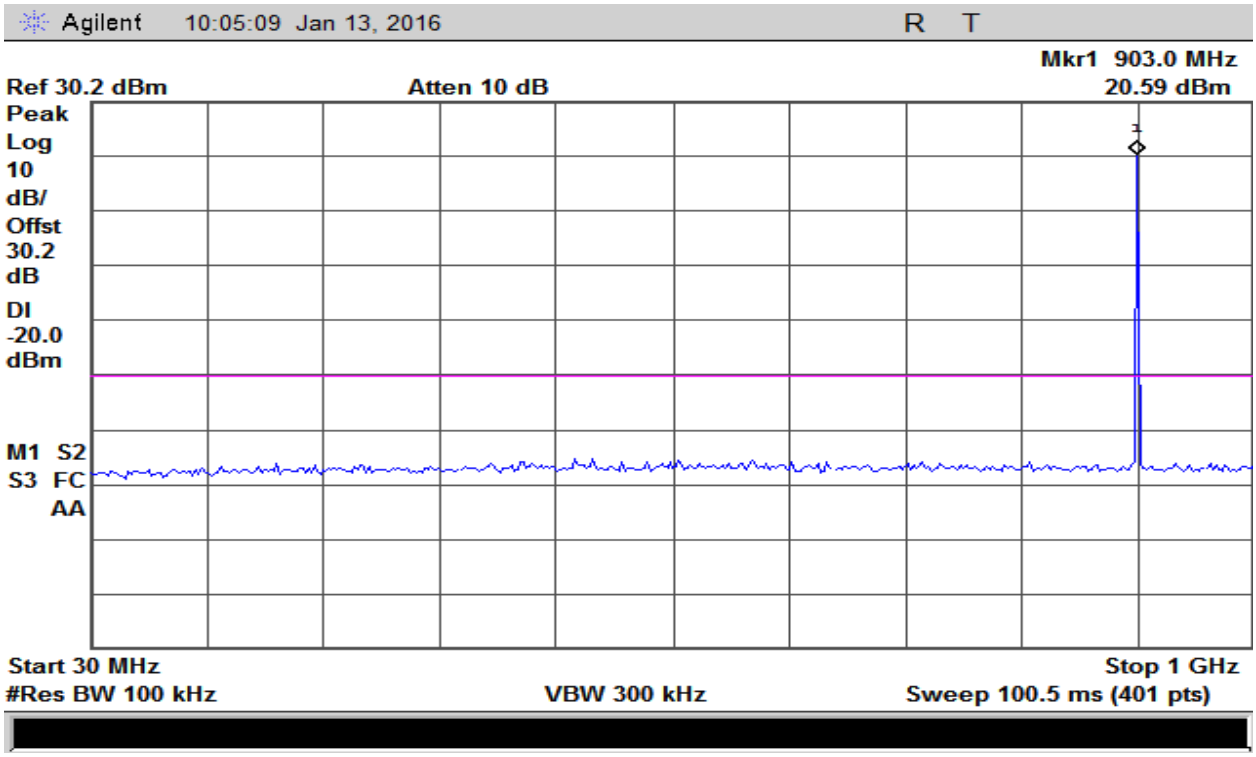
Table 10. Lowest Channel – Conducted Spurious Emissions, Test Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)
6465.00	-36.63	-0.59

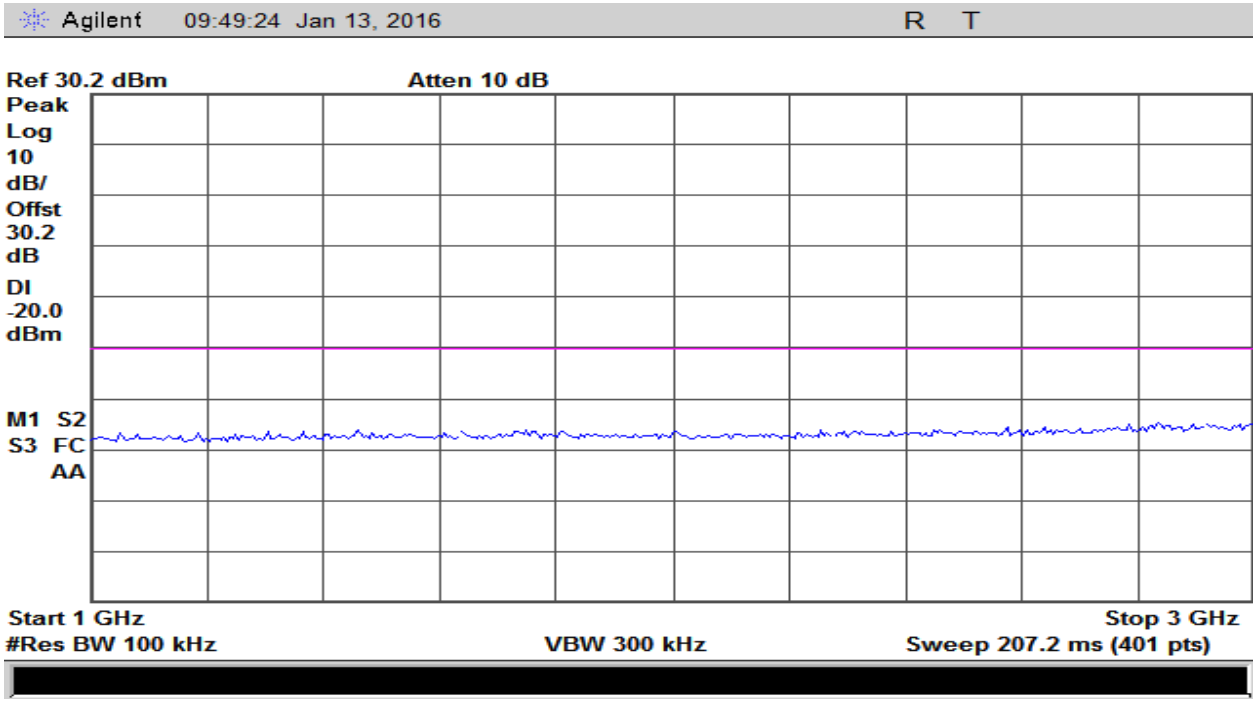
Table 11. Middle Channel – Conducted Spurious Emissions, Test Results

Frequency (MHz)	Measured Level (dBm)	Limit (dBm)
6827	-36.97	-0.59

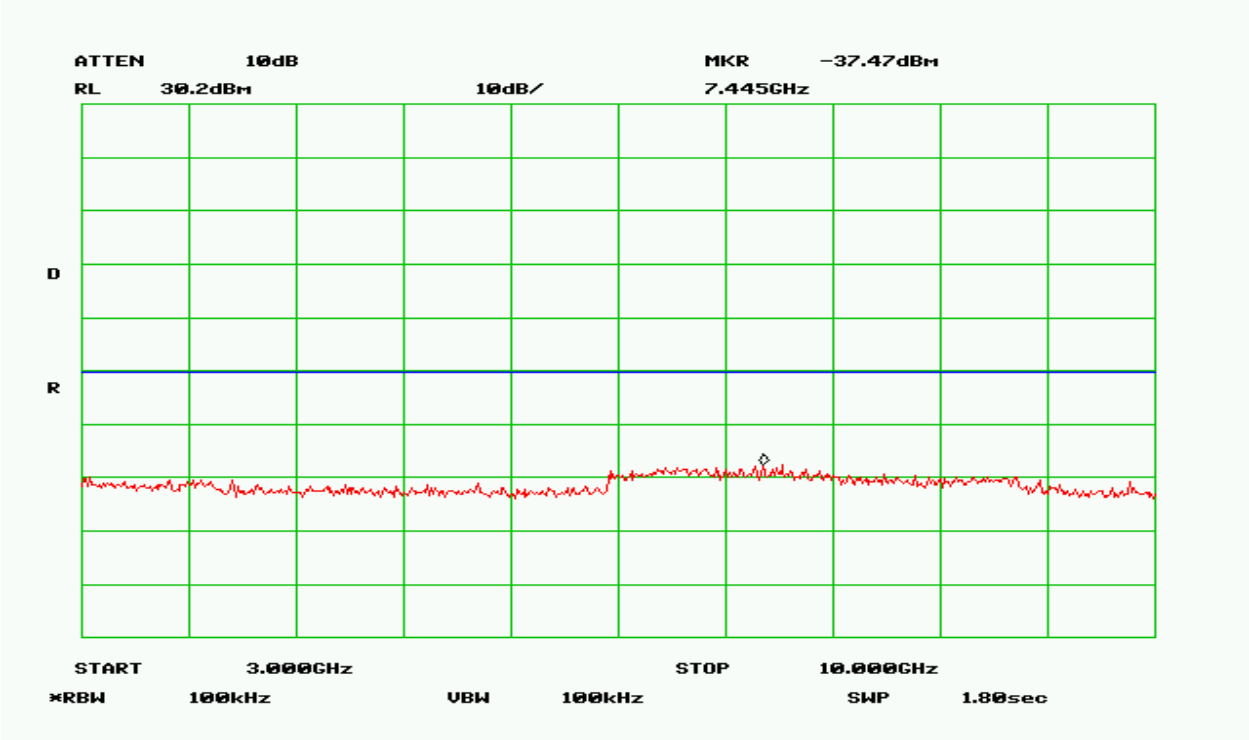
Table 12. Highest Channel – Conducted Spurious Emissions, Test Results



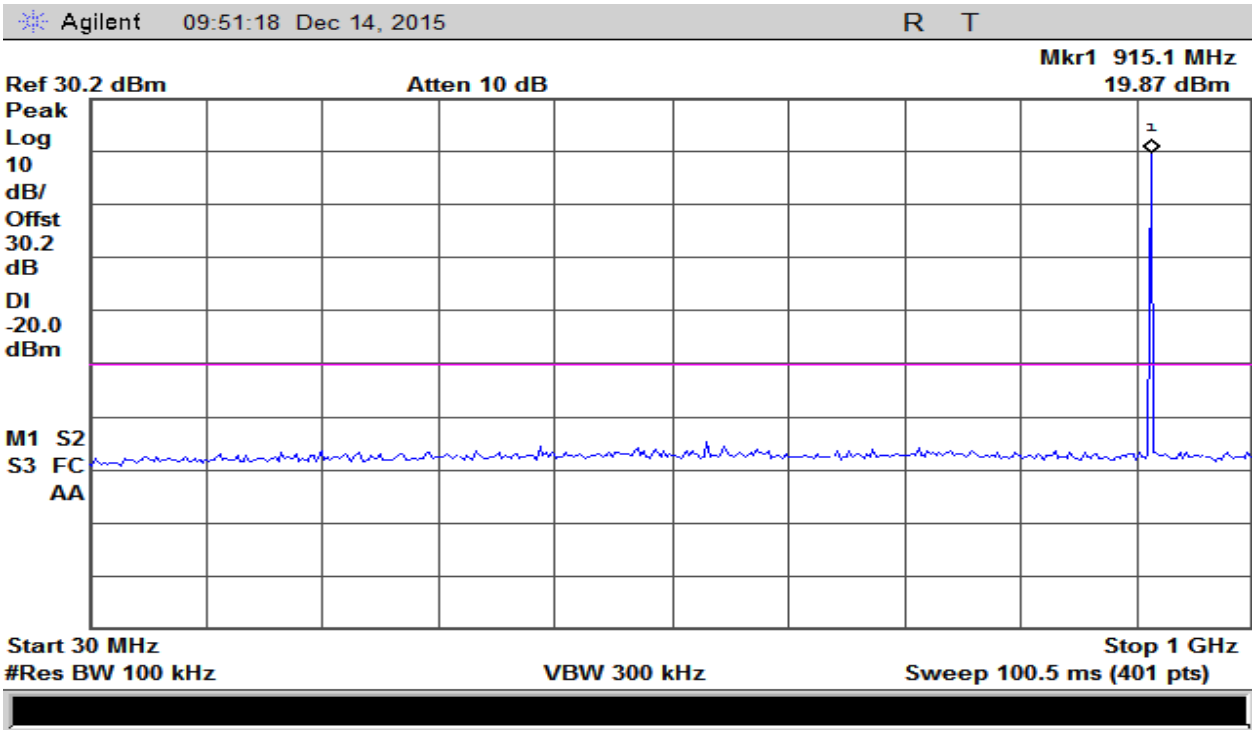
Plot 16 – Low Band – 30MHz to 1GHz



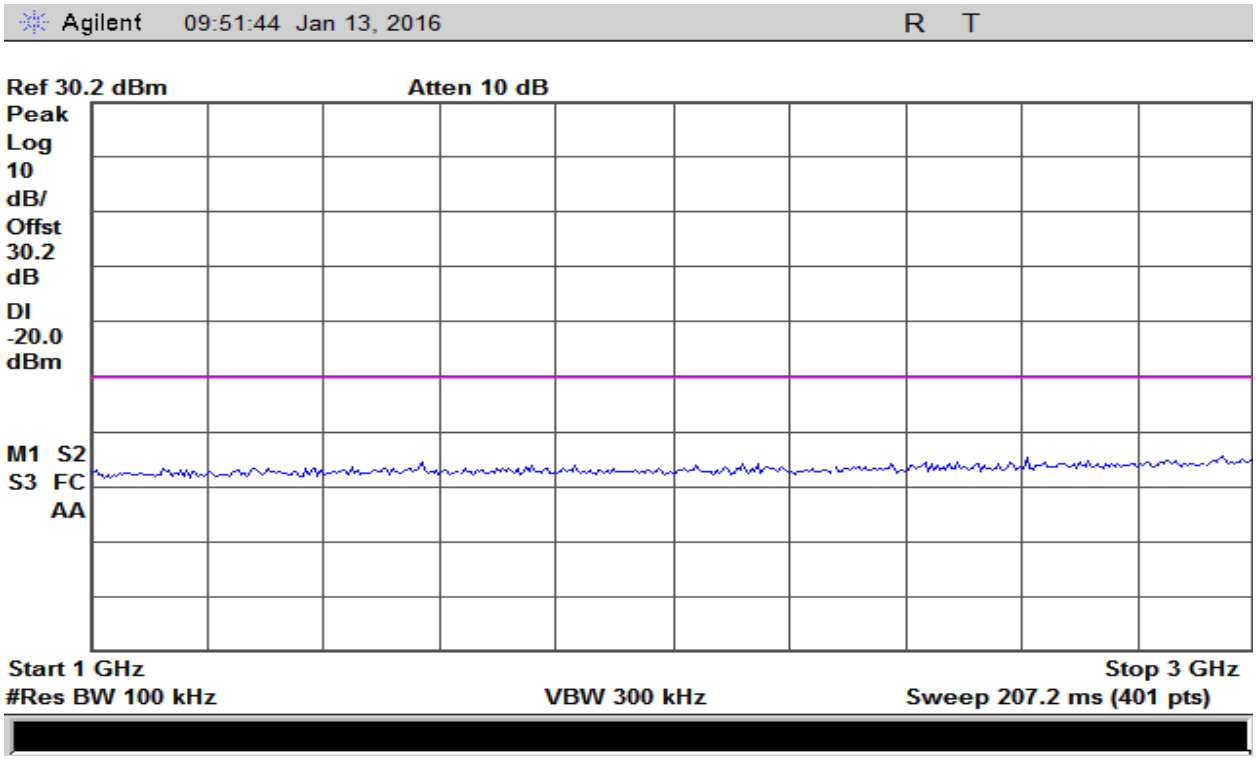
Plot 17 – Low Band – 1GHz to 3GHz



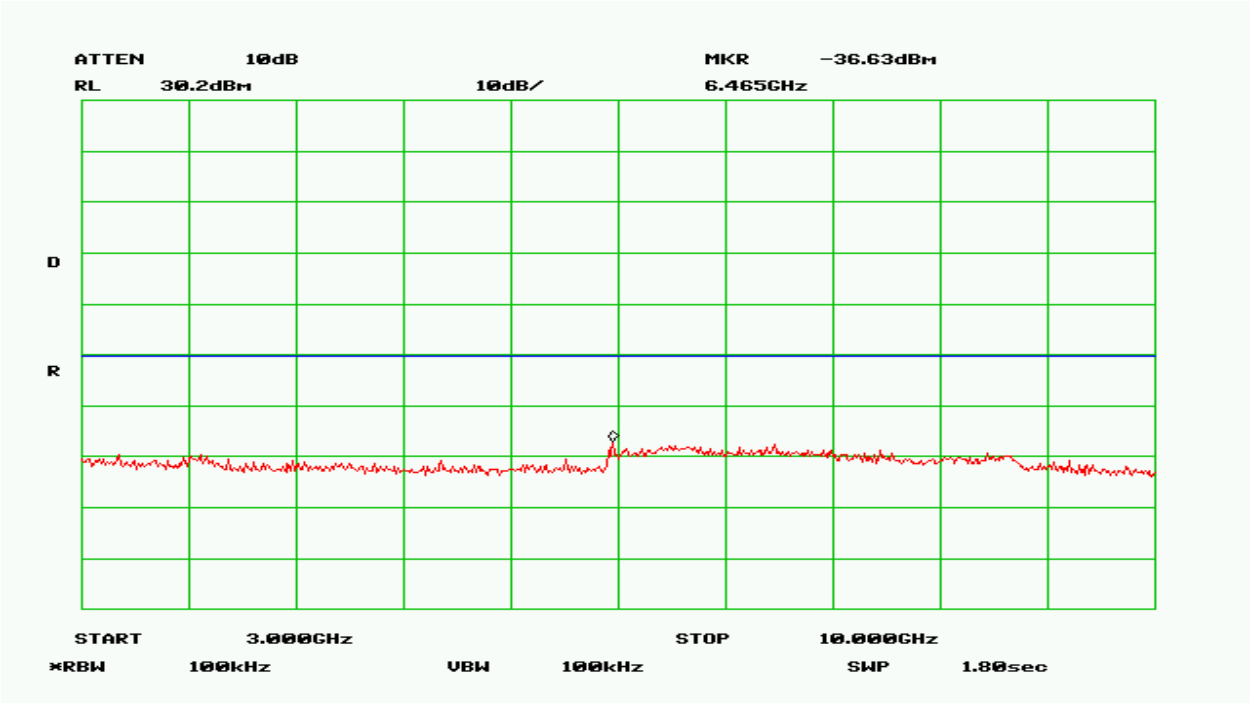
Plot 18 – Low Band – 3GHz to 10GHz



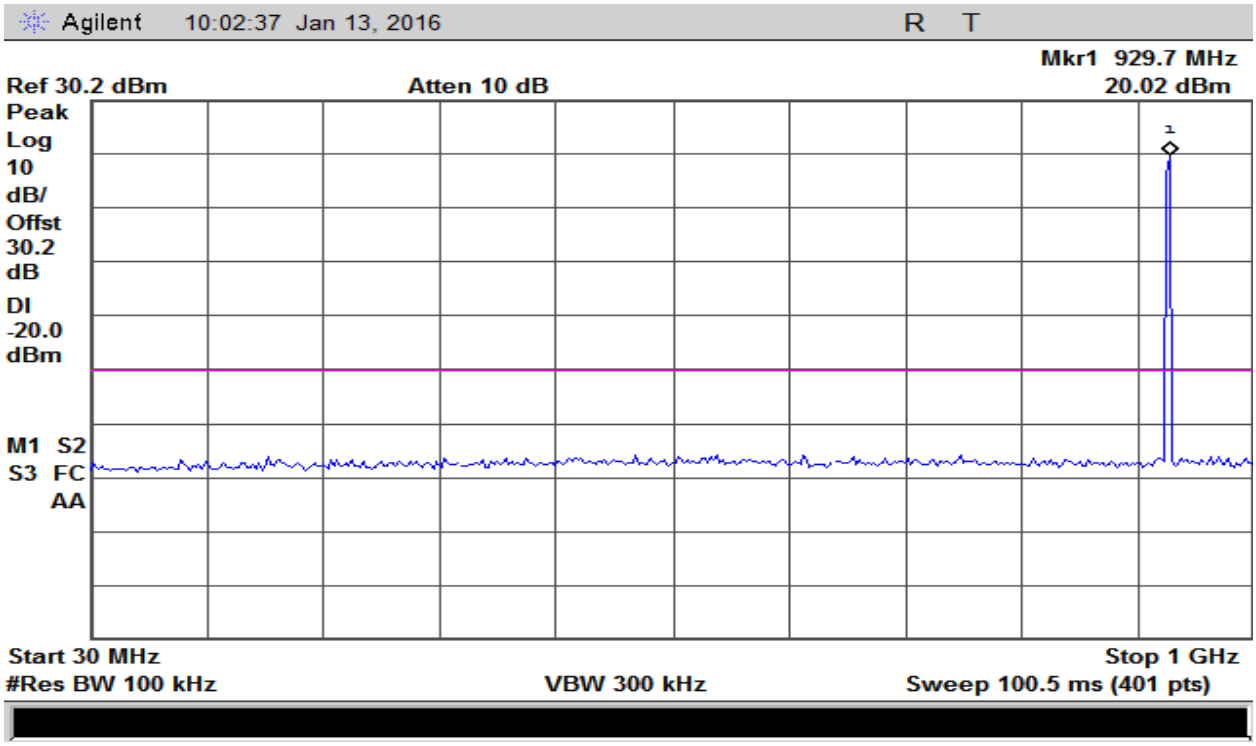
Plot 19 – Mid Band - 30MHz to 1GHz



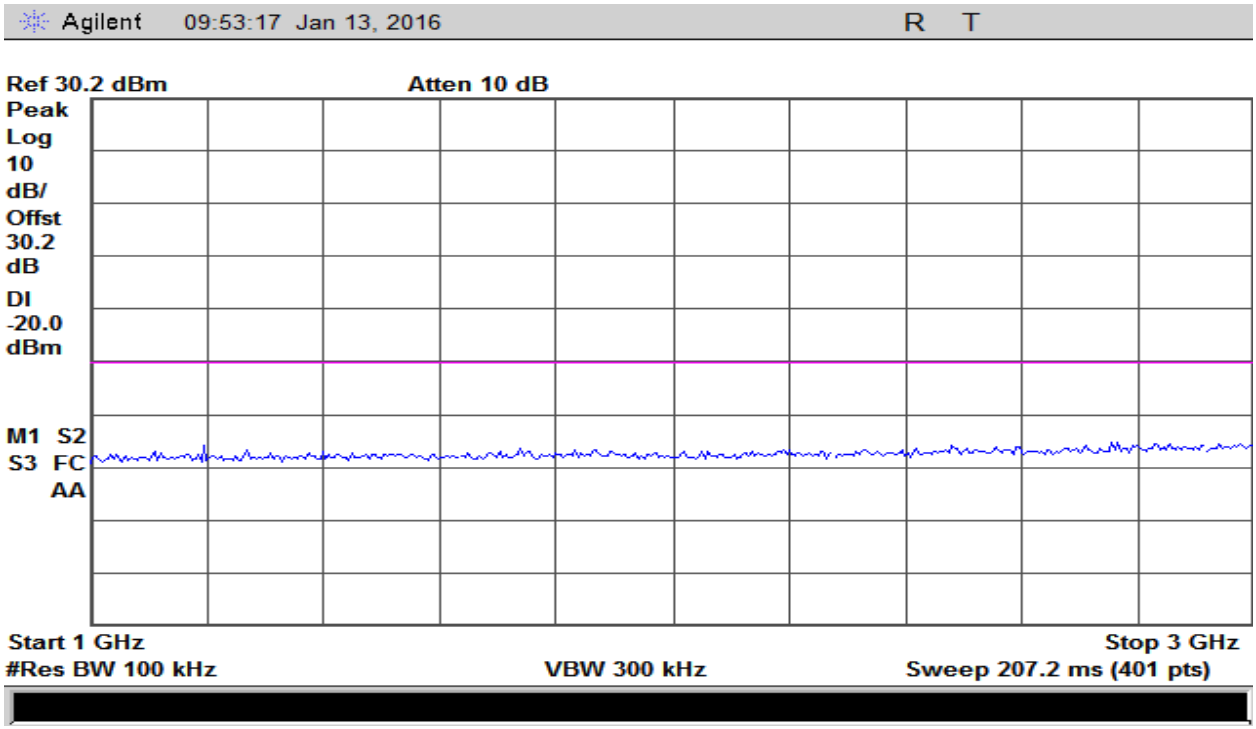
Plot 20 – Mid Band – 1GHz to 3GHz



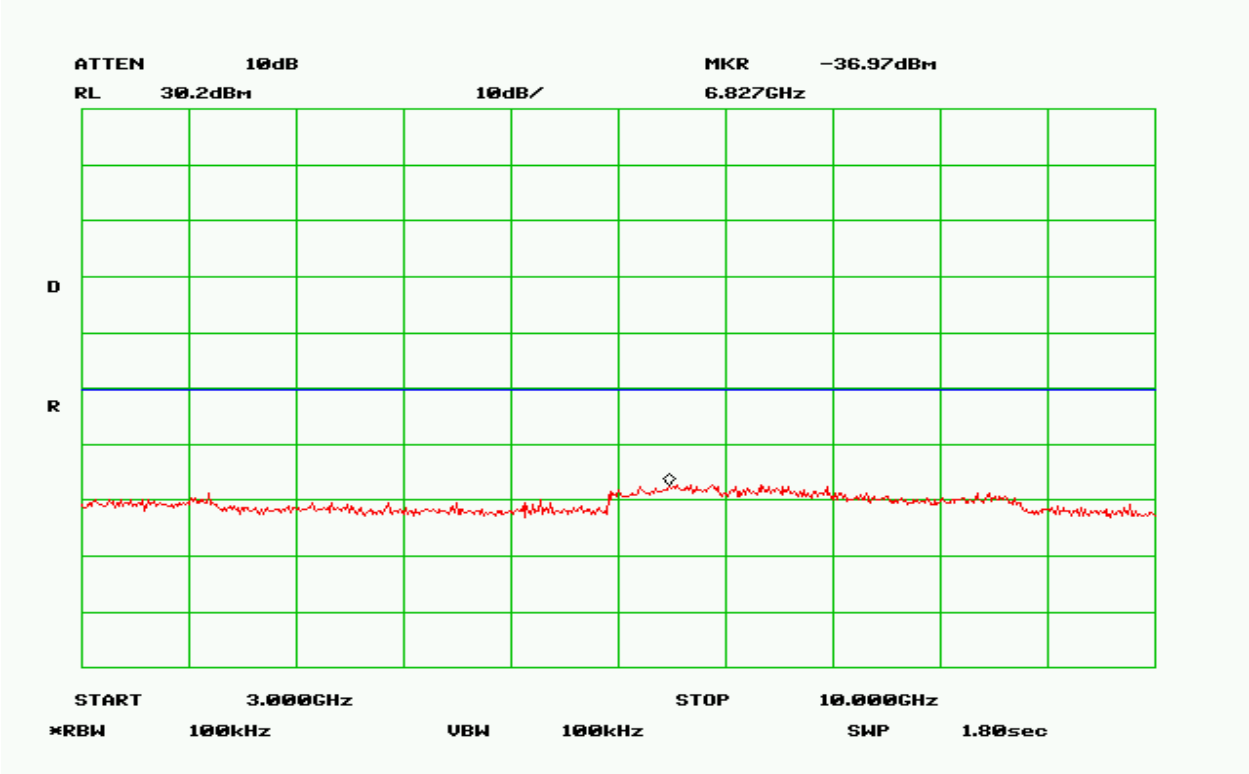
Plot 21 – Mid Band – 3GHz to 10GHz



Plot 22 – High Band – 30MHz to 1GHz



Plot 23 – High Band – 1GHz to 3GHz



Plot 24 – High Band – 3GHz to 10GHz

4. Radiated Spurious Emissions and Restricted Band

Test Requirement(s):	§15.247(d), 15.209(a), 15.205	**Test Engineer(s):**	Jerry Mejak
Test Results:	Pass	**Test Date(s):**	02/24/15

Test Procedures: As required by 47 CFR 15.247, Radiated spurious measurements were made in accordance with the procedures of the ANSI C63.10-2009.

The EUT was placed on a non-reflective table inside a 3 meter semi-anechoic room. The EUT was set on continuous transmit.

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 frequency range up to the 10th harmonic was investigated.

Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
Peak	1MHz	1MHz	As necessary
Average	1MHz	10Hz	0 Hz

Table 13. Analyzer Settings

Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m))	Average Limit (dBuV/m)
1804.6	53.2	115.5	-	95.5
2706.9	48.78	115.5	-	95.5

Table 14 - Spurious Radiated Emission Data – Low Band –Chip Antenna

Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m)	Average Limit (dBuV/m)
1829.2	53.97	115.5	-	95.5
2743.8	50.26	115.5	-	95.5

Table 15 – Spurious Radiated Emission Data – Mid Band - Chip Antenna

Frequency (MHz)	Peak Amplitude (dbuV/m)	Peak Limit (dBuV/m)	Average Amplitude (dBuV/m)	Average Limit (dBuV/m)
1855.6	56.64	115.5	-	95.5
2783.4	51.42	115.5	-	95.5

Table 16 – Spurious Radiated Emission Data – High Band - Chip Antenna

NOTE 1: There were no detectable emissions above the 3th harmonic.

6. Emissions At Band Edges

Test Requirement(s):	§15.247(d)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	12/16/15

Test Procedures: As required by 47 CFR 15.247, Band edge radiated emissions measurements were made at the RF antenna output terminals of the EUT using the marker-delta method.

The EUT was placed on a wooden table inside a 3 meter semi-anechoic chamber. The EUT was set on continuous transmit.

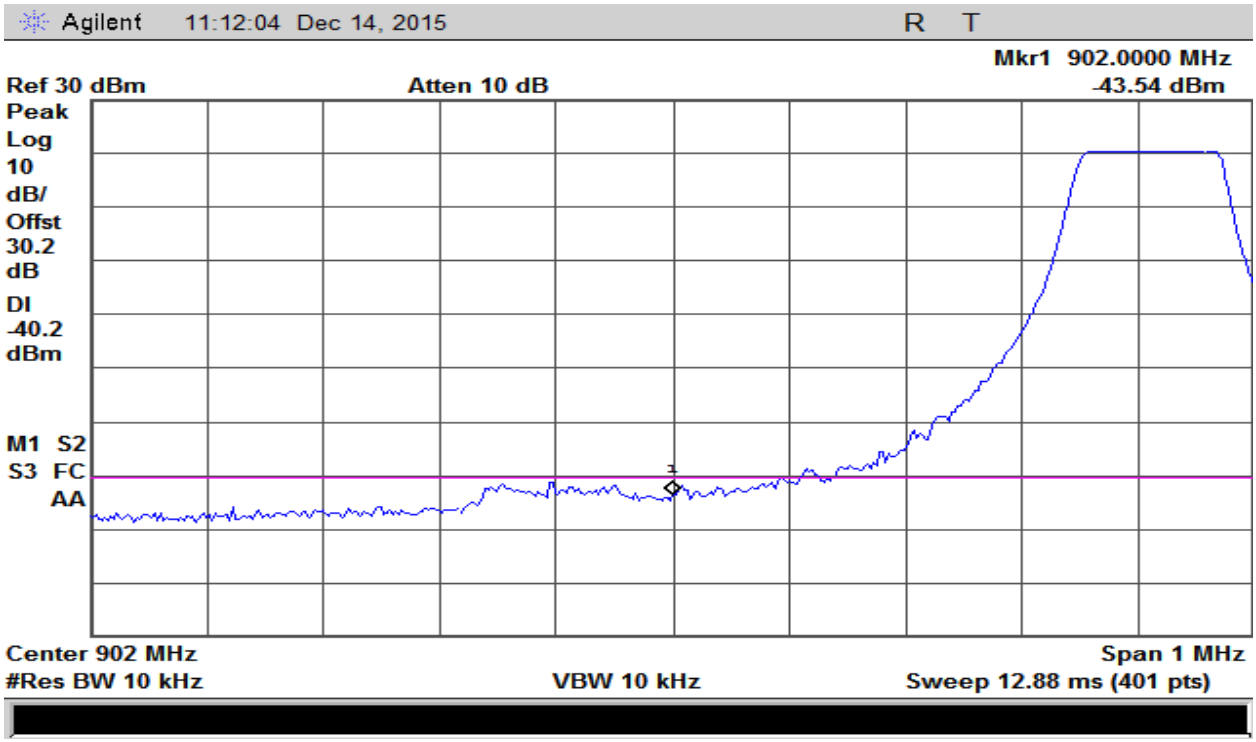
The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The EUT was set up at maximum power, first on the lowest operating channel, then on the highest operating channel of the transmit band.

Frequency (MHz)	Measured Level	Detector	Limit
902	-43.54dB	Peak	-20dBc
928	-31.84dB	Peak	-20dBc

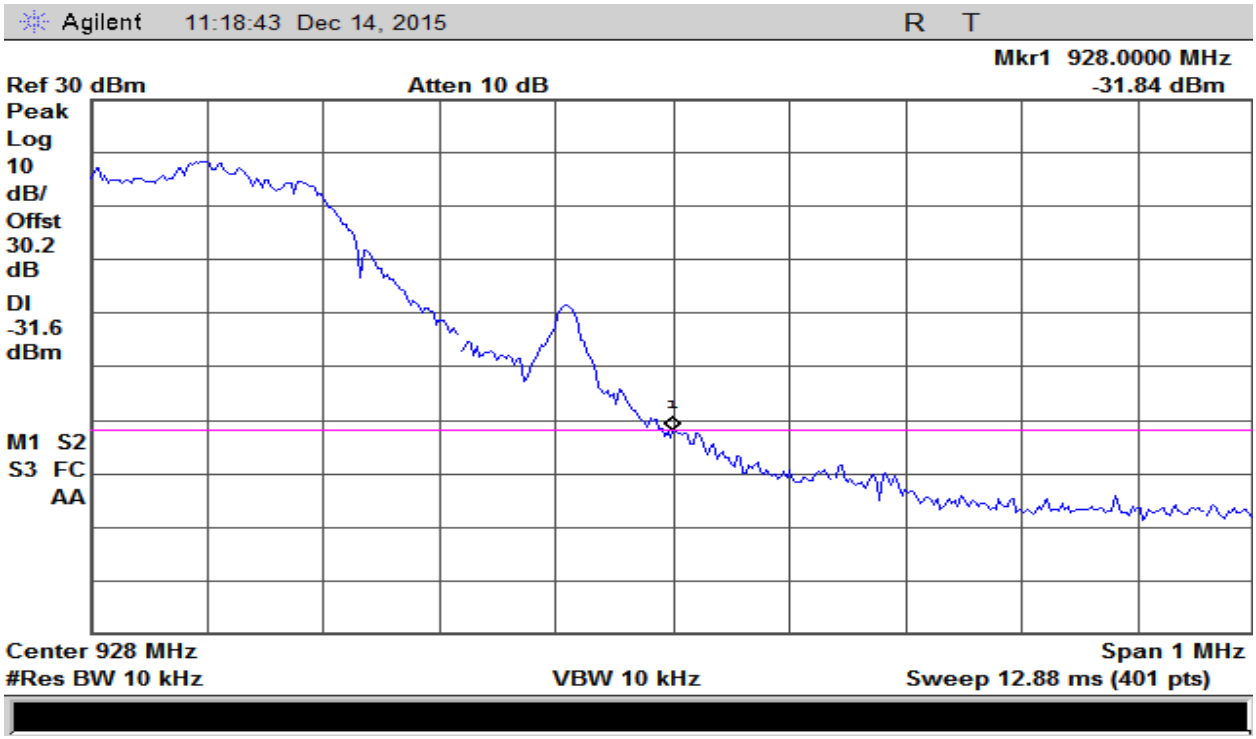
Table 17 – Band Edge Emissions Summary – DTS Mode

Frequency (MHz)	Measured Level	Detector	Limit
902	-29.12B	Peak	-20dBc
928	-41.9dB	Peak	-20dBc

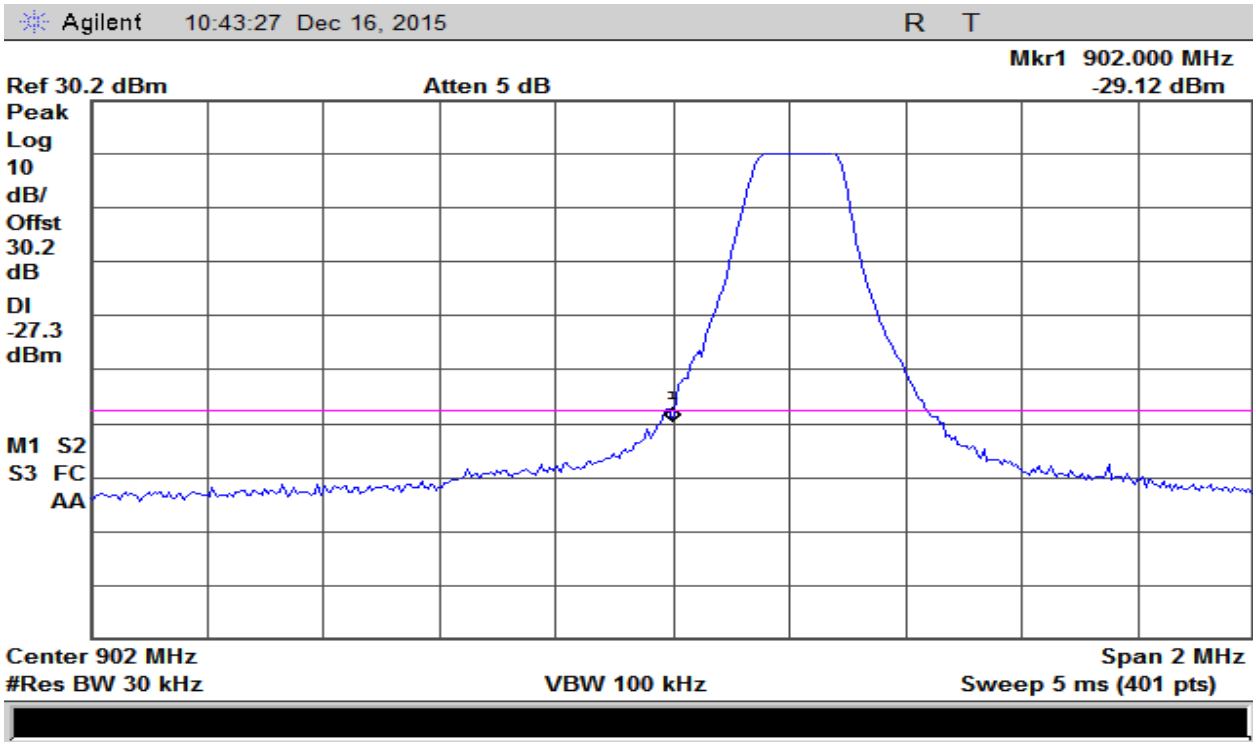
Table 18 – Band Edge Emissions Summary – Hybrid Mode



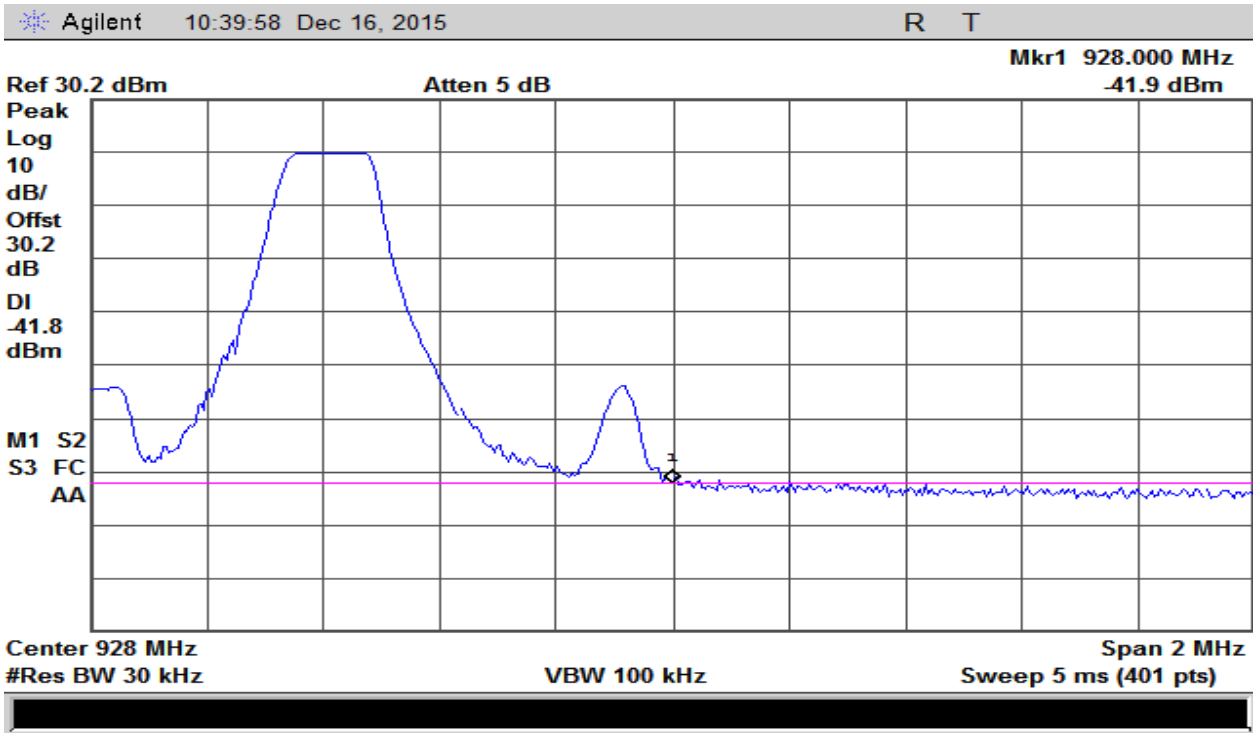
Plot 25 - Band Edge – Low Channel – DTS Mode



Plot 26 – Band Edge - High Channel – DTS Mode



Plot 27 - Band Edge – Low Channel – Hybrid Mode



Plot 28 – Band Edge - High Channel – Hybrid Mode

7. Power Spectral Density

Test Requirement(s):	§15.247(d)	Test Engineer(s):	Hoosam B.
Test Results:	Pass	Test Date(s):	08/06/14

Test Procedures: As required by 47 CFR 15.247(d), For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3kHz band during any time interval of continuous transmission. Power spectral density measurements were made at the RF antenna output terminals of the EUT using the DTS methods section 10.2 was used for DTS mode and section 10.3 was used for Hybrid mode.

The EUT output was connected directly to the spectrum analyzer through an attenuator. The measurements were made at the RF antenna output terminals of the EUT.

Detector Setting	Resolution Bandwidth	Sweep Time	Span
Peak	3KHz	500 seconds	2 MHz

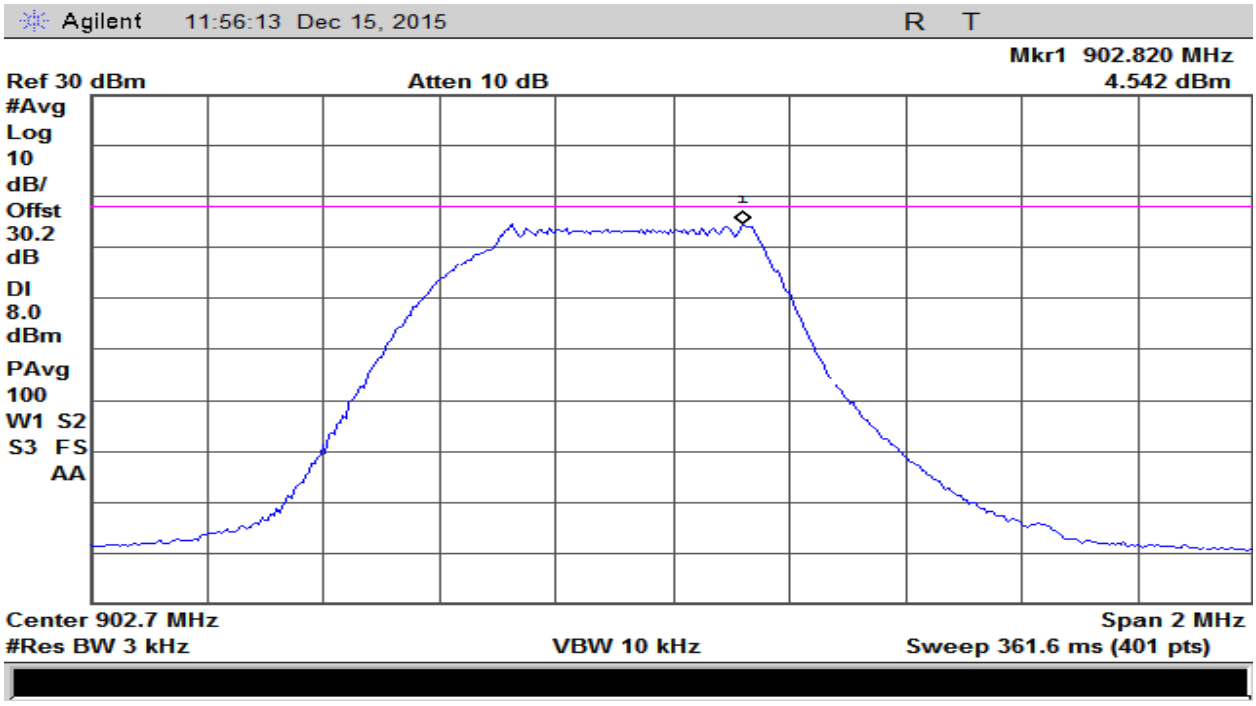
Table 19 – Analyzer settings

Frequency (MHz)	Measured Level	Limit
902.7	4.54 dBm	8 dBm
914.6	4.25 dBm	8 dBm
927.5	4.14 dBm	8 dBm

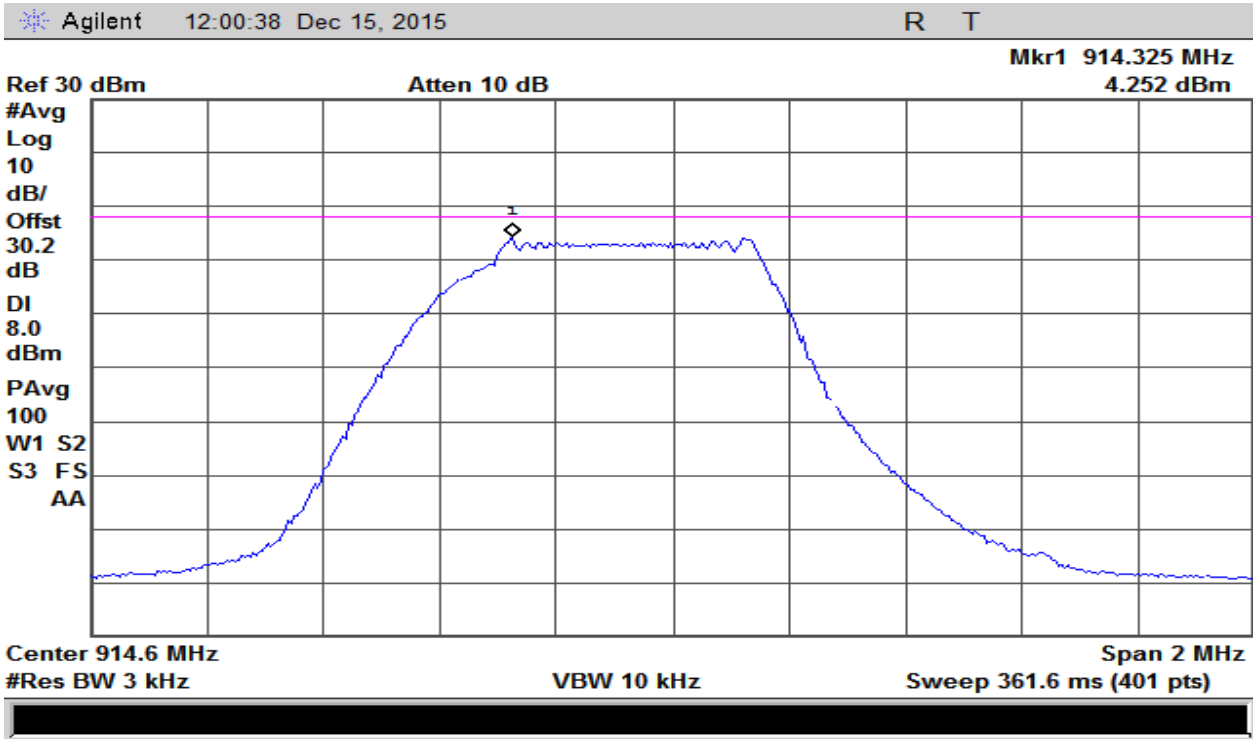
Table 20 - PSD Summary Test Result-DTS Mode

Frequency (MHz)	Measured Level	Limit
902.5	5.48 dBm	8 dBm
914.6	5.22 dBm	8 dBm
927.8	5.76 dBm	8 dBm

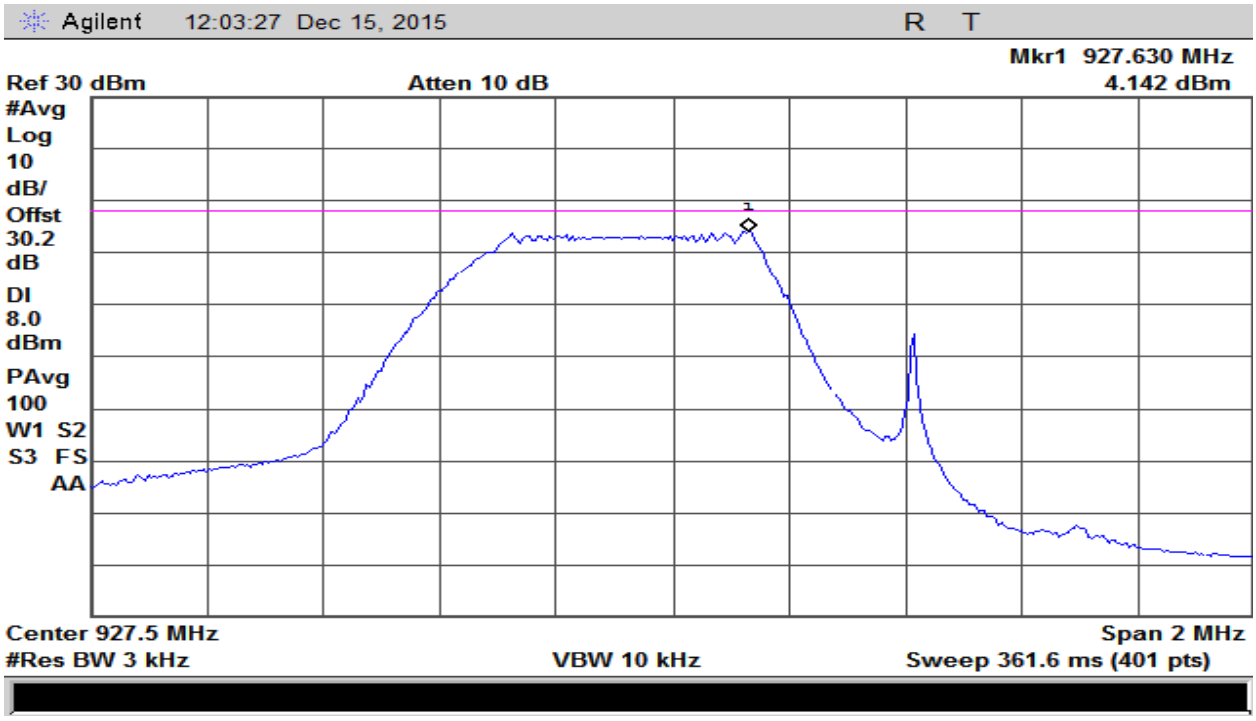
Table 21 - PSD Summary Test Result- Hybrid Mode



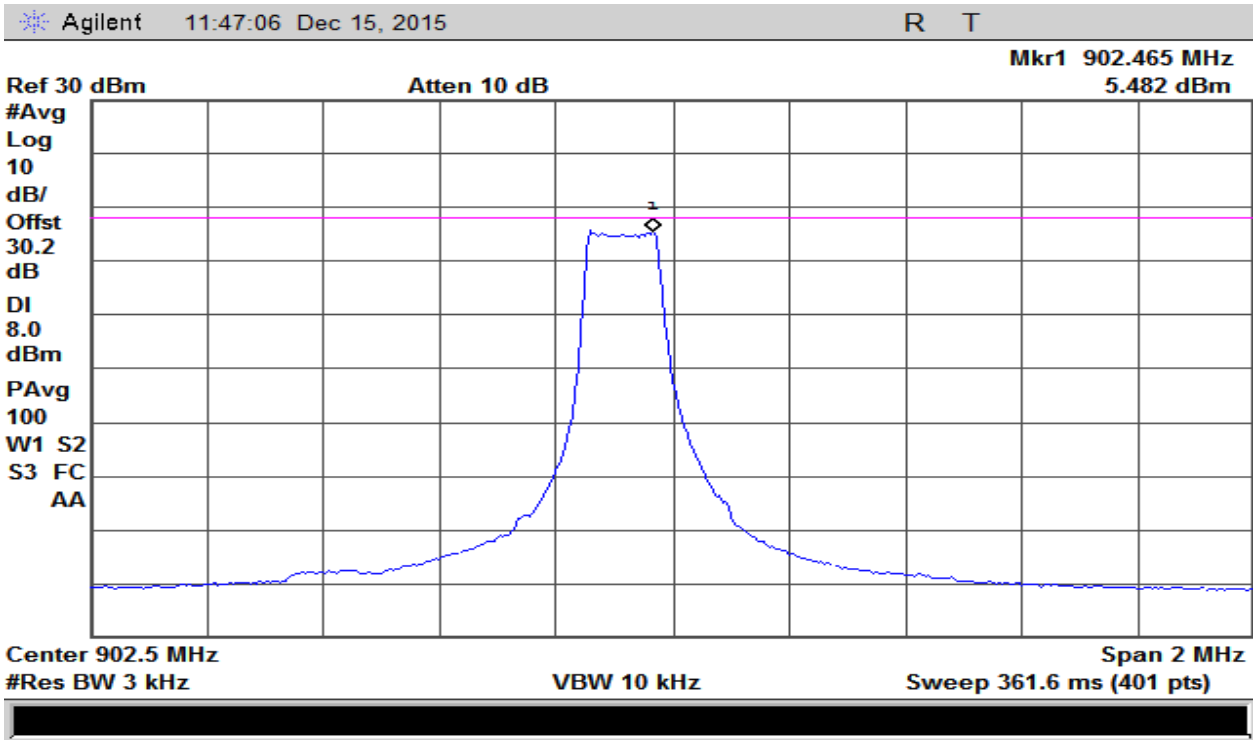
Plot 29 – Power Spectral Density – Lowest Channel - DTS Mode



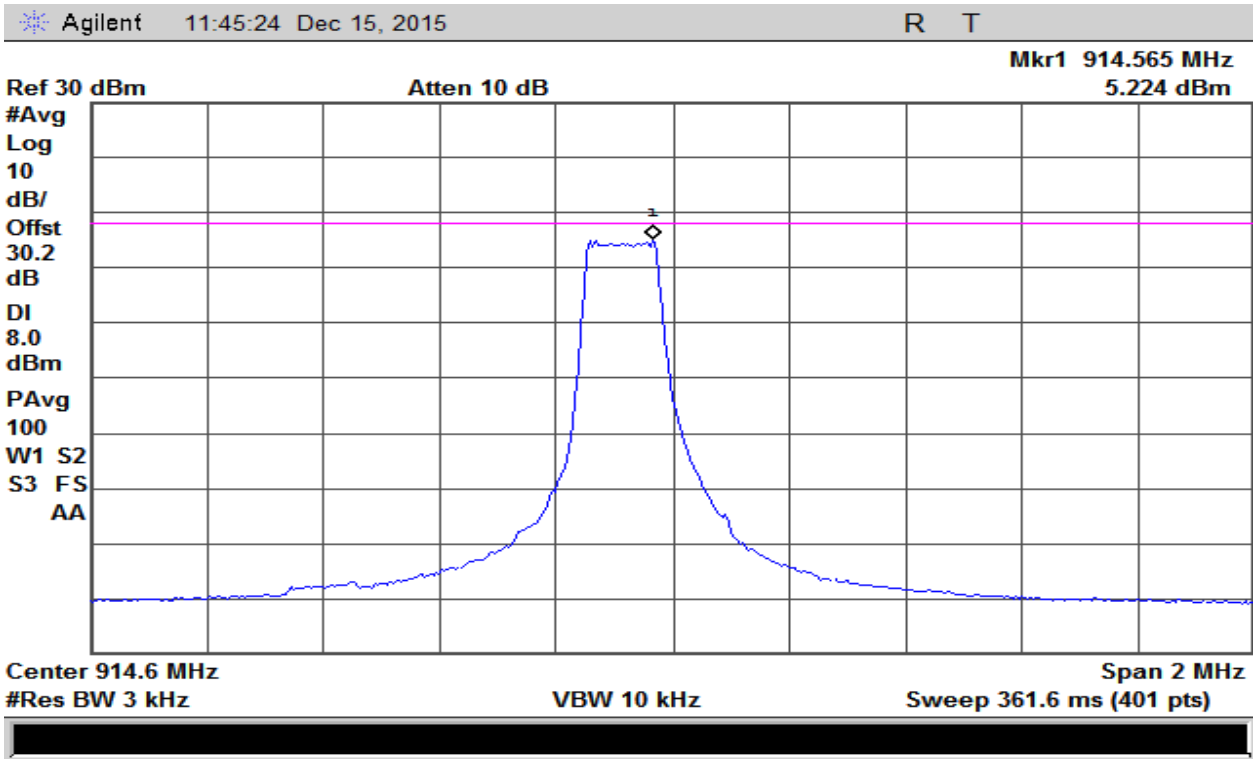
Plot 30 – Power Spectral Density – Middle Channel - DTS Mode



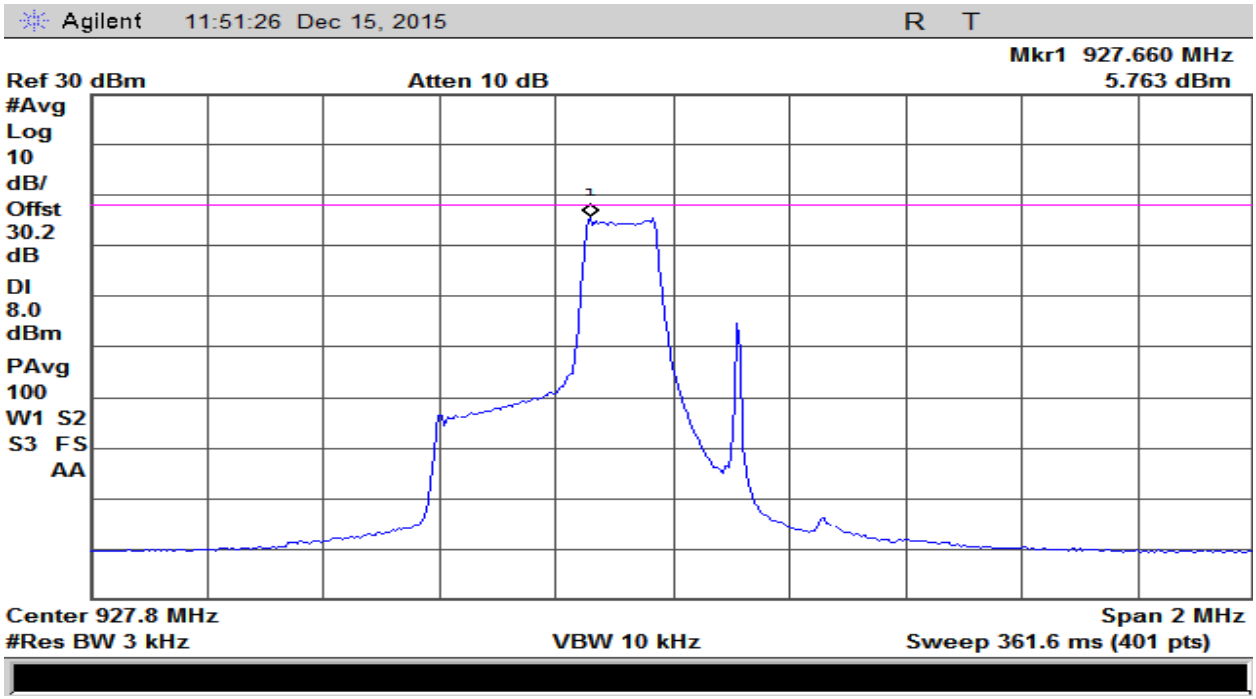
Plot 31 – Power Spectral Density – Highest Channel – DTS Mode



Plot 32 – Power Spectral Density – Lowest Channel – Hybrid Mode



Plot 33 – Power Spectral Density – Middle Channel – Hybrid Mode



Plot 34 – Power Spectral Density – Highest Channel – Hybrid Mode

8. Time of Occupancy (Dwell Time)

Test Requirement(s):	§15.247(f)	**Test Engineer(s):**	Keith T.
Test Results:	Pass	**Test Date(s):**	12/18/15

Test Procedures: As required by 47 CFR 15.247(f), for hybrid systems, the average time of occupancy on any frequency shall not exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. Measurements were made with device hopping function enabled and direct sequence or digital modulation operation turned off.

The EUT output was connected directly to the spectrum analyzer through an attenuator. The measurements were made at the RF antenna output terminals of the EUT.

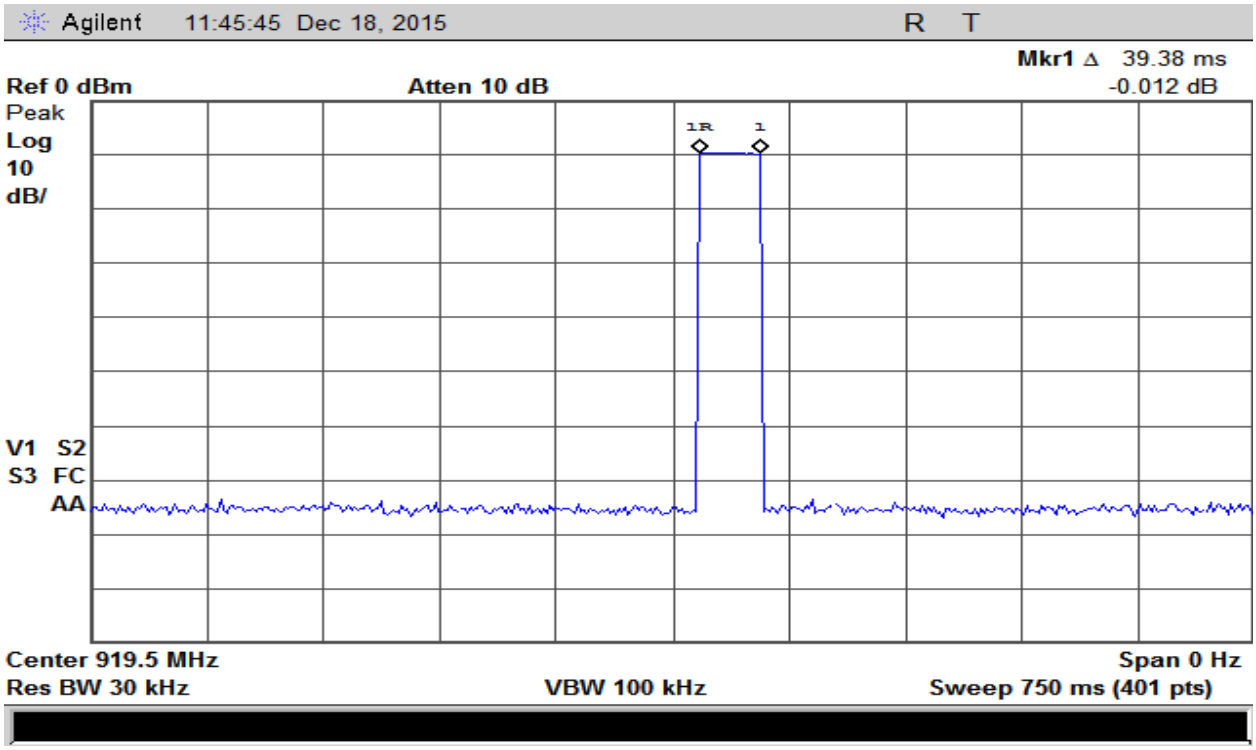
Detector Setting	Resolution Bandwidth	Video Bandwidth	Span
Peak	1MHz	1MHz	0

Table 22 – Analyzer settings

Calculation: Device has one hopping set mode with 2 hops with 200kHz channel separation. At channel 919.5MHz, Burst period is 39.38msec. There are total of 2 channels.

Time Period = 0.4 * 2 channels = 800 ms.

Device operates within the time period requirements



Plot 35 – Dwell Time – Hybrid Mode

9. Carrier Frequency Separation

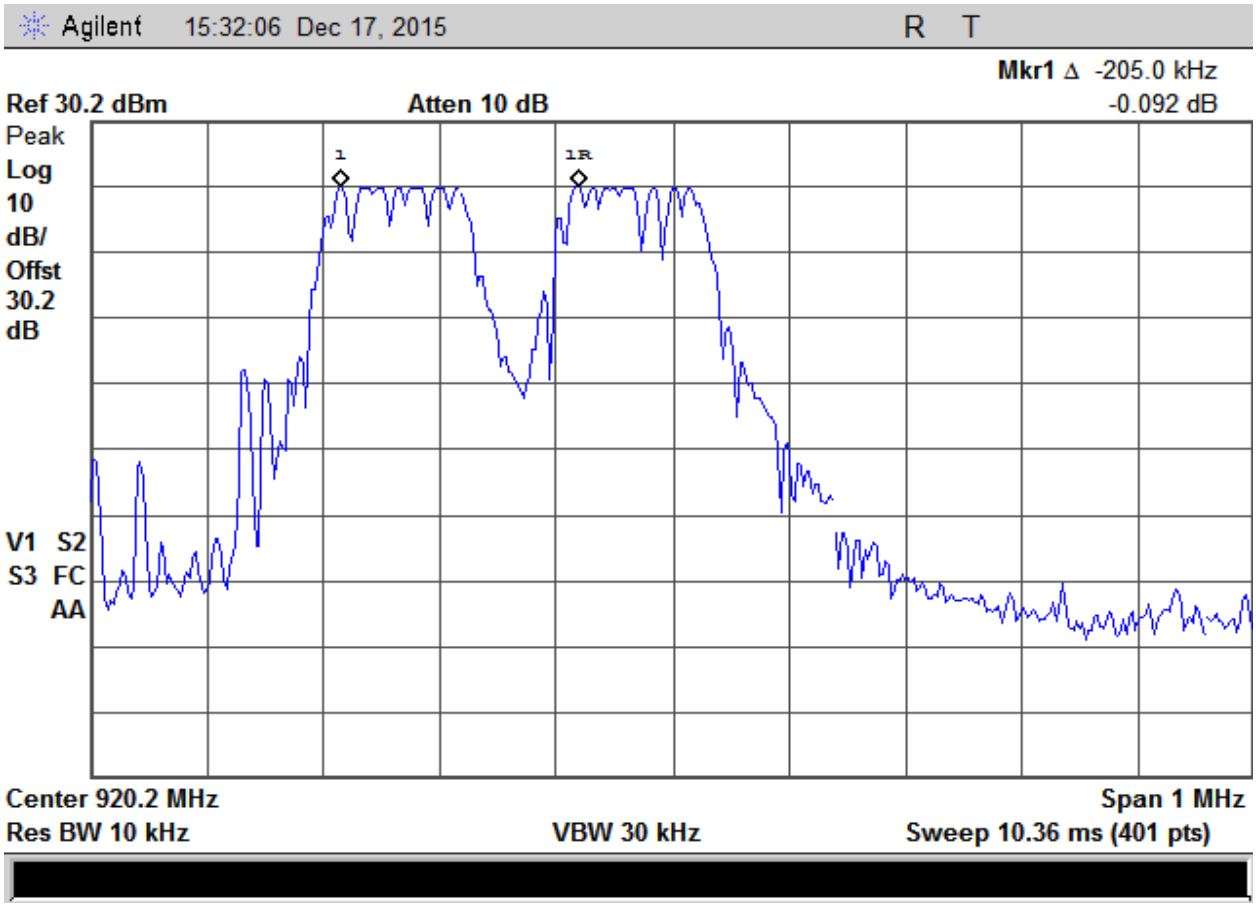
Test Requirement(s):	§15.247(a)(1)	**Test Engineer(s):**	Hoosam B.
Test Results:	Pass	**Test Date(s):**	02/19/15

Test Procedures: As required by 47 CFR 15.247(a), for frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Measurements were made with device hopping function enabled.

The EUT output was connected directly to the spectrum analyzer through an attenuator. The measurements were made at the RF antenna output terminals of the EUT. Peak detector was used and trace was set to max hold.

Frequency Measured (MHz)	Frequency Separation (kHz)	Detector	Limit (20dB BW)
920.2	205 kHz	Peak	480.9 kHz

Table 23 – Carrier Frequency Separation - Summary



Plot 36 – Carrier Frequency Separation (Using Delta Marker Method)

I. Test Equipment

Equipment	Manufacturer	Model	Serial #	Last Cal Date	Cal Due Date
Spectrum Analyzer	Agilent	E4402B	US41192757	Jan/27/15	Jan/27/16
Temperature Meter	Control Company	6066N53	140536623	Aug/08/14	Aug/08/16
Spectrum Analyzer	Hewlett Packard	8563E	3821A09316	Oct/03/15	Oct/03/16
High Pass Filter	Mini-Circuits	VHF-3100+	1023	Verified	
EMI Receiver	R&S	ESCS-30	828985/007	Jun/23/15	Jun/23/16
High Pass Filter	Mini-Circuits	VHF-1320+	1034	Verified	
Signal Generator	R&S	SMY02	1062.5502.12	NCR	None
Attenuator 10dB	Huber+Suhner	6810.17.A	747300	Verified	
Horn Antenna	Com-Power	AHA-118	711150	Feb/10/15	Feb/10/16
Bilog Antenna	Chase	CBL6140	1040	Mar/30/15	Mar/30/16

Table 24 – 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