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Emissions
Test Report

EUT Name: Subpac Audio Device

Model No.: M2X

CFR 47 Part 15.247:2016 and RSS-247:2017

Prepared for:

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Revisions

Revision No.	Date MM/DD/YYYY	Reason for Change	Author
0	01/31/2017	Original Document	N/A

Note: Latest revision report will replace all previous reports.

Statement of Compliance

Manufacturer:	Subpac 380 Portage Avenue Palo Alto, CA 94306
Requester / Applicant:	Sarosh Khwaja
Name of Equipment:	Subpac Audio Device
Model No.	M2X
Type of Equipment:	Intentional Radiator
Application of Regulations:	CFR 47 Part 15.247:2016 and RSS-247:2017
Test Dates:	13 December 2016 to 30 January 2017

Guidance Documents:

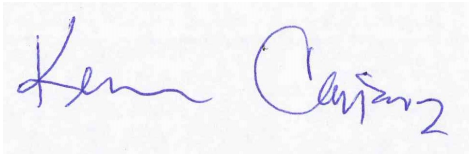
Emissions: ANSI C63.10:2013

Test Methods:

Emissions: ANSI C63.10:2013

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that the equipment described above has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government. This report contains data that are not covered by A2LA accreditation. This report shall not be reproduced except in full, without the written authorization of TUV Rheinland of North America.



Kerwinn Corpuz	January 31, 2017
Test Engineer	Date

David Spencer	January 31, 2017
Laboratory Signature	Date

Testing Cert #3331.02 **US1131** **2932M**

1 Executive Summary

1.1 Scope

This report is intended to document the status of conformance with the requirements of the CFR 47 Part 15.247:2016 and RSS-247:2017 based on the results of testing performed on 13 December 2016 to 30 January 2017 on the Subpac Audio Device Model M2X manufactured by Subpac This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

1.2 Purpose

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

The report documents the 2.4GHz radio characteristics for the Subpac Audio Device.

1.3 Summary of Test Results

Table 1: Summary of Test Results

Test	Test Method ANSI C63.4:2014/ ANSI C63.10:2013	Test Parameters	Measured Value	Result
2402 MHz to 2480 MHz Band				
Spurious Emission in Transmitted Mode	CFR47 15.209, RSS-GEN Sect.8.9	Class B	-4.04 dB (Margin)	**Complied**
Restricted Bands of Operation	CFR47 15.205, RSS GEN Sect. 8.10	Class B		**Complied**
AC Power Conducted Emission	CFR47 15.207, RSS-GEN Sect.8.8	Class B	-21.87 dB (QP Margin)	**Complied**
Occupied Bandwidth	CFR 47 15.247(a1), RSS Gen Sect. 6.6	N/A	20dB BW = 1.25 MHz 99% BW = 1.18 MHz	**Complied**
Channel Separation	CFR47 15.247 (a1), RSS 247 Sect. 5.1(b)	> 591 kHz	1005 kHz	**Complied**
Number of Hopping Channels	CFR47 15.247 (a1), RSS 247 Sect. 5.1(d)	>15	79 Channels	**Complied**
Average time occupancy of Channel	CFR47 15.247 (a1), RSS 247 Sect. 5.1(d)	< 0.4 sec	0.265 sec	**Complied**
Maximum Transmitted Power	CFR47 15.247 (b1), RSS 247 Sect. 5.4(b)	< 1Watt	2.046 mW	**Complied**
Out of Band Emission	CFR47 15.247 (d), RSS 247 Sect. 5.5	< -30 dBr	- 22.62 dBr (-43.08 dBm at 7.4397 GHz)	**Complied**
Maximum Permissible Exposure	CFR47 15.247 (i), 2.1093 / KDB 447498 D01	≤ 3.0 for 1-g	0.448 for 1-g (SAR Exempted)	**Complied**

Note: 1. Met restricted band emission requirements.
2. This report is only documented for 2402 – 2480MHz.

1.4 Special Accessories

No special accessories were necessary in order to achieve compliance.

1.5 Equipment Modifications

The PIFA was trimmed down to 3mm to comply with radiated emissions.

2 Laboratory Information

2.1 Accreditations & Endorsements

2.1.1 US Federal Communications Commission

TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 is recognized by the commission for performing testing services for the general public on a fee basis. These laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (US1131). The laboratory scope of accreditation includes: Title 47 CFR Parts 15, 18, and 90. The accreditation is updated every 3 years.

2.1.2 NIST / A2LA

TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 17025:2005 and ISO 9002 (Lab Code Testing Cert #3331.02). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

2.1.3 Canada – Industry Canada

TUV Rheinland of North America at the 1279 Quarry Ln, Pleasanton, CA 94566 address is accredited by Industry Canada for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by Industry Canada (File Number 2932M). This reference number is the indication to the Industry Canada Certification Officers that the site meets the requirements of RSS 212, Issue 1 (Provisional). The accreditation is updated every 3 years.

2.1.4 Japan – VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America at 1279 Quarry Ln, Pleasanton, CA 94566 has been assessed and approved in accordance with the Regulations for Voluntary Control Measures.

VCCI Registration No. for Pleasanton: A-0261

2.1.5 Acceptance by Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland at 1279 Quarry Ln, Pleasanton, CA 94566 test results and test reports within the scope of the laboratory NIST / A2LA accreditation will be accepted by each member country.

2.2 Test Facilities

All of the test facilities are located at 1279 Quarry Lane, Pleasanton, California 94566, USA. The 2305 Mission College, Santa Clara, 95054, USA location is considered a Pleasanton annex.

2.2.1 Emission Test Facility

The Semi-Anechoic chamber and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 and 5 meters. The site is listed with the FCC and accredited by A2LA (Lab Code 3331.02). The 3/5-meter semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4-2014, at a test distance of 3 meter and 5 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7 m x 4.8 m x 3.175 mm thick aluminum floor connected to PE ground.

For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of 10^9 Ohms/square on a 1.6 m x 0.8 m x 0.8 m high non-conductive table with a 3.175 mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50 cm x 50 cm x 3.175 mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470-kΩ resistors.

For EFT, Surge, PQF, the HCP and VCP are removed.

RF Field Immunity testing is performed in a 7.3m x 4.3m x 4.1m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.8m x 3.7m x 3.175mm thick aluminum ground plane.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st Edition, 1995.

The Combined Standard Uncertainty is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities; it is equal to the positive square root of the sum of the variances or co-variances of these other quantities, weighted according to how the measurement result varies with changes in these quantities. The term *standard uncertainty* is the result of a measurement expressed as a standard deviation.

2.3.1 Sample Calculation – radiated & conducted emissions

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

2.3.2 Measurement Uncertainty Emissions

Per CISPR 16-4-2	**U_{lab}**	**U_{cispr}**
Radiated Disturbance @ 10 meters		
30 – 1,000 MHz	2.25 dB	4.51 dB
Radiated Disturbance @ 3 meters		
30 – 1,000 MHz	2.26 dB	4.52 dB
1 – 6 GHz	2.12 dB	4.25 dB
6 – 18 GHz	2.47 dB	4.93 dB
Conducted Disturbance @ Mains Terminals		
150 kHz – 30 MHz	1.09 dB	2.18 dB
Disturbance Power		
30 MHz – 300 MHz	3.92 dB	4.3 dB

Voltech PM6000A

The estimated combined standard uncertainty for harmonic current and flicker measurements is ± 5.0%.	Per CISPR 16-4-2 Methods

2.3.3 Measurement Uncertainty Immunity

The estimated combined standard uncertainty for ESD immunity measurements is ± 8.2%.	Per IEC 61000-4-2
The estimated combined standard uncertainty for radiated immunity measurements is ± 4.10 dB.	Per IEC 61000-4-3
The estimated combined standard uncertainty for conducted immunity measurements with CDN is ± 3.66 dB	Per IEC 61000-4-6
The estimated combined standard uncertainty for power frequency magnetic field immunity is ± 11.6%.	Per IEC 61000-4-8

Thermo KeyTek EMC Pro

The estimated combined standard uncertainty for EFT fast transient immunity measurements is ± 5.84%.
The estimated combined standard uncertainty for surge immunity measurements is ± 5.84 %.
The estimated combined standard uncertainty for voltage variation and interruption measurements is ± 3.48%.

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

Measurement Uncertainty – Radio Testing

The estimated combined standard uncertainty for frequency error measurements is ± 3.88 Hz
The estimated combined standard uncertainty for carrier power measurements is ± 1.59 dB.
The estimated combined standard uncertainty for adjacent channel power measurements is ± 1.47 dB.
The estimated combined standard uncertainty for modulation frequency response measurements is ± 0.46 dB.
The estimated combined standard uncertainty for transmitter conducted emission measurements is ± 4.01 dB

The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Standard 17025:2005.

3 Product Information

3.1 Product Description

The Model M2X, Subpac Audio Device, is a wearable form factor, vibrotactile membrances to enable full experiential sound for music, gaming and virtual reality entertainment. The M2X operates in the 2.4 GHz, Bluetooth.

3.2 Equipment Configuration

A description of the equipment configuration is given in the Test Plan Section. The EUT was tested as called for in the test standard and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to reach intended operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of a EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.3 Operating Mode

A description of the operation mode is given in the Test Plan Section. In the case of a EUT that can operate in more than one state, preliminary testing was performed to determine the operating mode that produced maximum radiation.

The final operating mode was selected to produce the worst case radiation for emissions testing and to place the EUT in the most susceptible state for immunity testing.

3.4 Unique Antenna Connector

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of CFR47 Parts 15.211, 15.213, 15.217, 15.219, or 15.221.

3.4.1 Results

The Subpac Audio Device uses 2.4 GHz PIFA and has a maximum antenna gain of 0 dBi. No additional antenna available.

4 Emission Requirements – 2400 MHz to 2483.5 MHz Band

Testing was performed in accordance with CFR 47 Part 15.247: 2016 and RSS 247: 2017. These test methods are listed under the laboratory's A2LA Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices. Procedures described in Section 8 of the standard were used.

4.1 Output Power Requirements

The maximum output power requirement is the maximum equivalent isotropic radiated power delivering at the transmitting antenna under specified conditions of measurements in the presence of modulation.

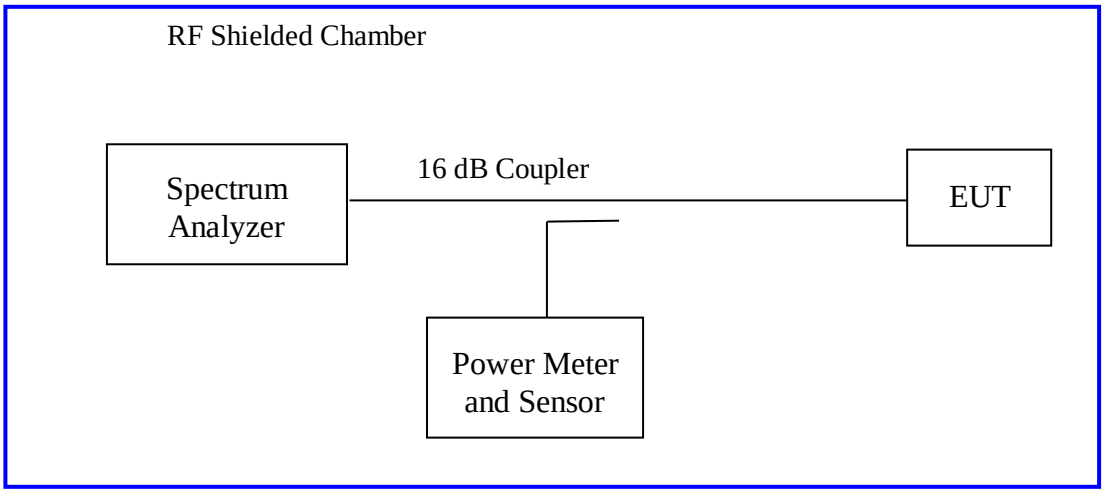
The maximum output power and harmonics shall not exceed CFR47 Part 15.247 (b1) and RSS 247 Sect. 5.4(b): 2017

Frequency hopping systems in the 2400-2483.5 MHz band: 1 watts.

4.1.1 Test Method

The conducted method was used to measure the channel power output according to ANSI C63.10:2013 Section 11.9.2.2.2. The measurement was performed with modulation per CFR47 Part 15.247 (b 1):2016 and RSS 247 Sect. 5.4(b). This test was conducted on 3 channels on M2X. The worst mode result indicated below.

Test Setup:



4.1.2 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 2: RF Output Power at the Antenna Port – Test Results

Test Conditions: Conducted Measurement, Normal Temperature				
Antenna Type: PIFA		**Power Setting:** See test plan		
Max. Directional Gain: 0 dBi				
Signal State: Modulated at 100%.				
Ambient Temp.: 22° C		**Relative Humidity:**40%		
802.15.1 Mode				
Package	**Operating Channel**	**Limit [dBm]**	**Power [dBm]**	**Margin [dB]**
DH1 (BDR)	2402 MHz	+30.00	-3.00	-33.00
	2441 MHz	+30.00	-1.80	-31.80
	2480 MHz	+30.00	-1.37	-31.37
DH3 (EDR)	2402 MHz	+30.00	0.27	-29.73
	2441 MHz	+30.00	2.42	-27.58
	2480 MHz	+30.00	1.87	-28.13
DH5 (EDR)	2402 MHz	+30.00	0.84	-29.16
	2441 MHz	+30.00	3.11	-26.89
	2480 MHz	+30.00	2.32	-27.68
2-DH1 (BDR)	2402 MHz	+30.00	-5.10	-35.10
	2441 MHz	+30.00	-2.90	-32.90
	2480 MHz	+30.00	-3.30	-33.30
2-DH3 (EDR)	2402 MHz	+30.00	-2.87	-32.87
	2441 MHz	+30.00	-0.18	-30.18
	2480 MHz	+30.00	-1.03	-31.03
2-DH5 (EDR)	2402 MHz	+30.00	-1.98	-31.98
	2441 MHz	+30.00	0.34	-29.66
	2480 MHz	+30.00	-0.22	-30.22
Note: Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.				

Table 3: RF Output Power at the Antenna Port – Test Results Continues

Test Conditions: Conducted Measurement, Normal Temperature				
Antenna Type: Custom Integrated			**Power Setting:** See test plan	
Max. Directional Gain: 0 dBi				
Signal State: Modulated at 100%.				
Ambient Temp.: 21° C			**Relative Humidity:**32%	
802.15.1 Mode				
Package	**Operating Channel**	**Limit [dBm]**	**Power [dBm]**	**Margin [dB]**
3-DH1 (BDR)	2402 MHz	+30.00	-5.22	-35.22
	2441 MHz	+30.00	-3.05	-33.05
	2480 MHz	+30.00	-3.08	-33.08
3-DH3 (EDR)	2402 MHz	+30.00	-2.60	-32.60
	2441 MHz	+30.00	-0.38	-30.38
	2480 MHz	+30.00	-0.59	-30.59
3-DH5 (EDR)	2402 MHz	+30.00	-1.94	-31.94
	2441 MHz	+30.00	0.53	-29.47
	2480 MHz	+30.00	-0.23	-30.23
Note: Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.				

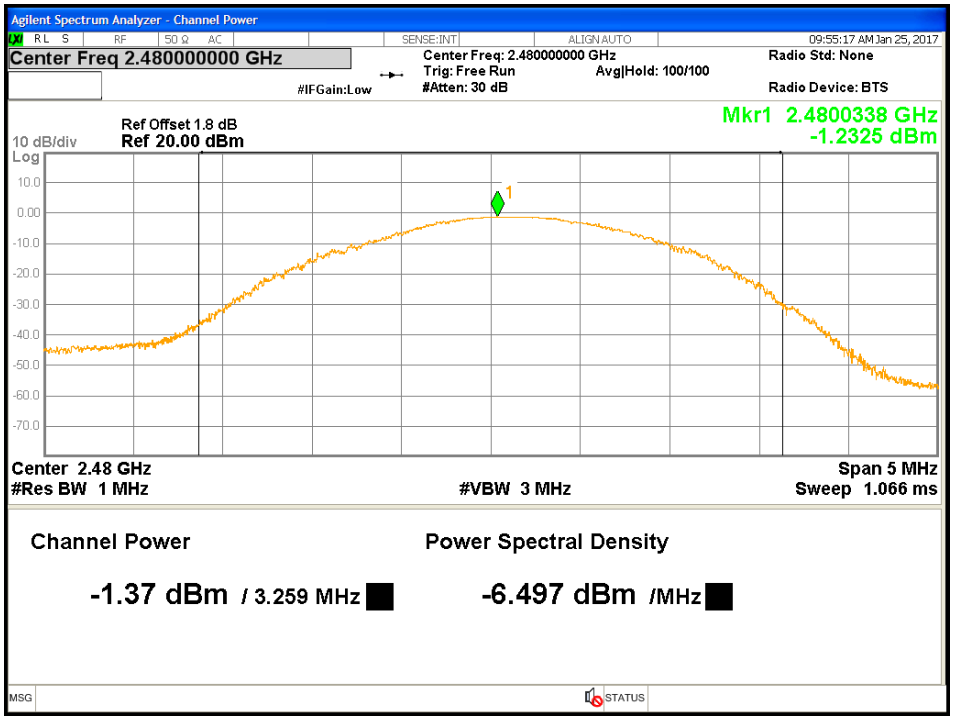


Figure 1: Maximum Transmitted Power, 2480 MHz (DH1)

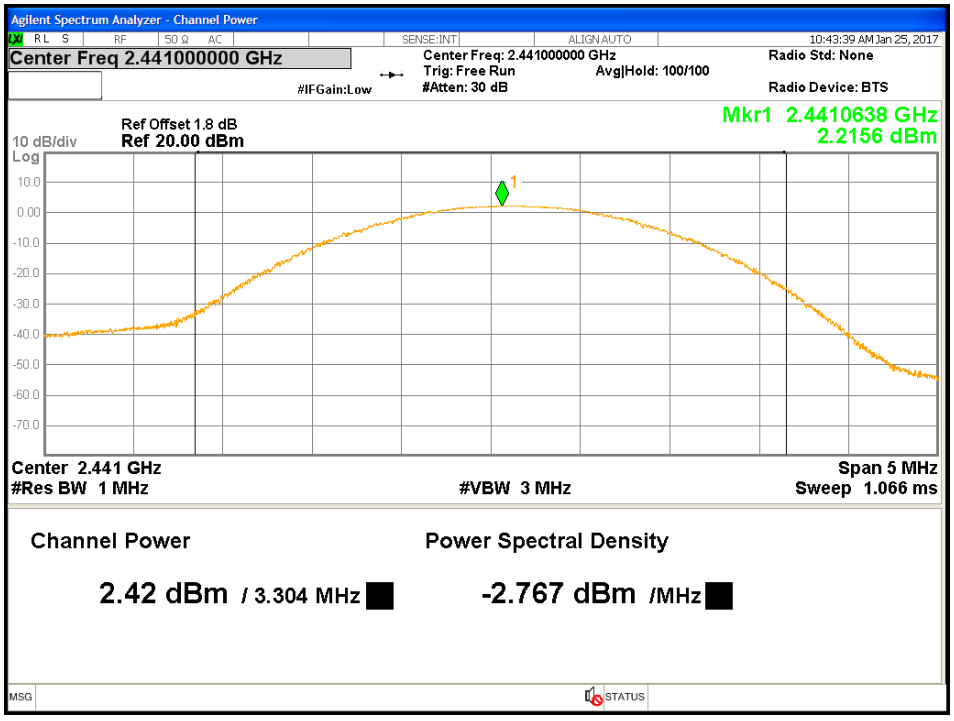


Figure 2: Maximum Transmitted Power, 2441 MHz (DH3)

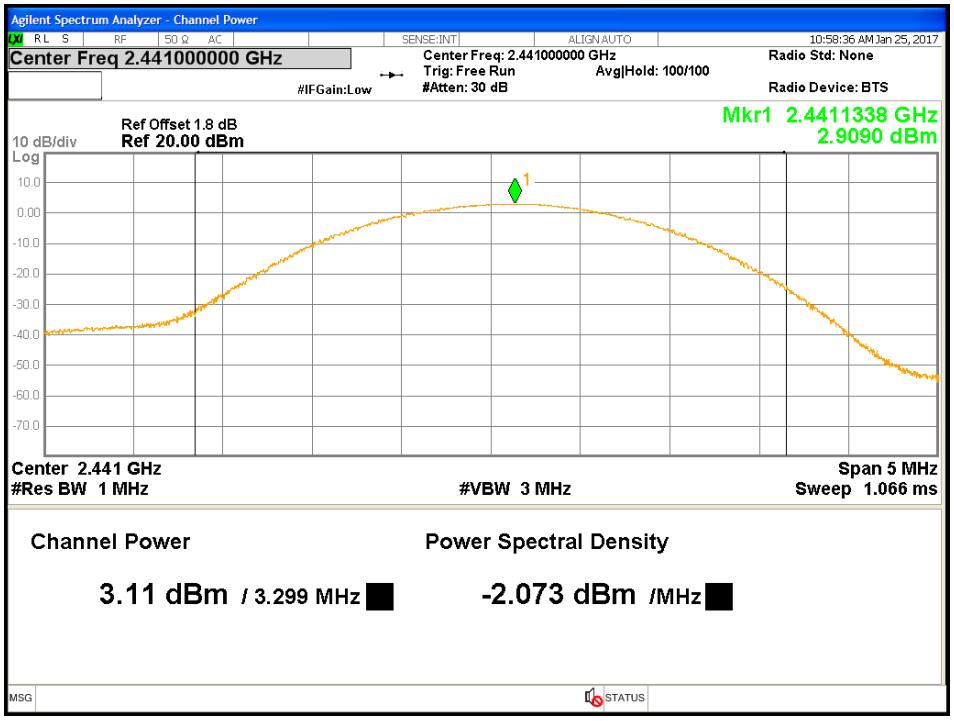


Figure 3: Maximum Transmitted Power, 2441 MHz (DH5)

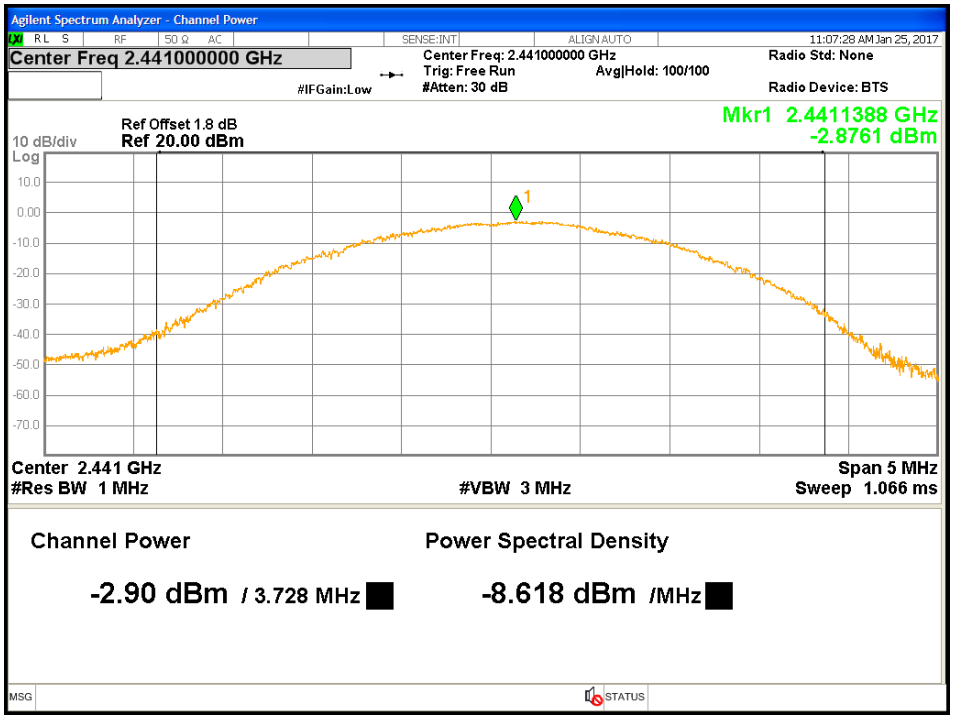


Figure 4: Maximum Transmitted Power, 2441 MHz (2-DH1)

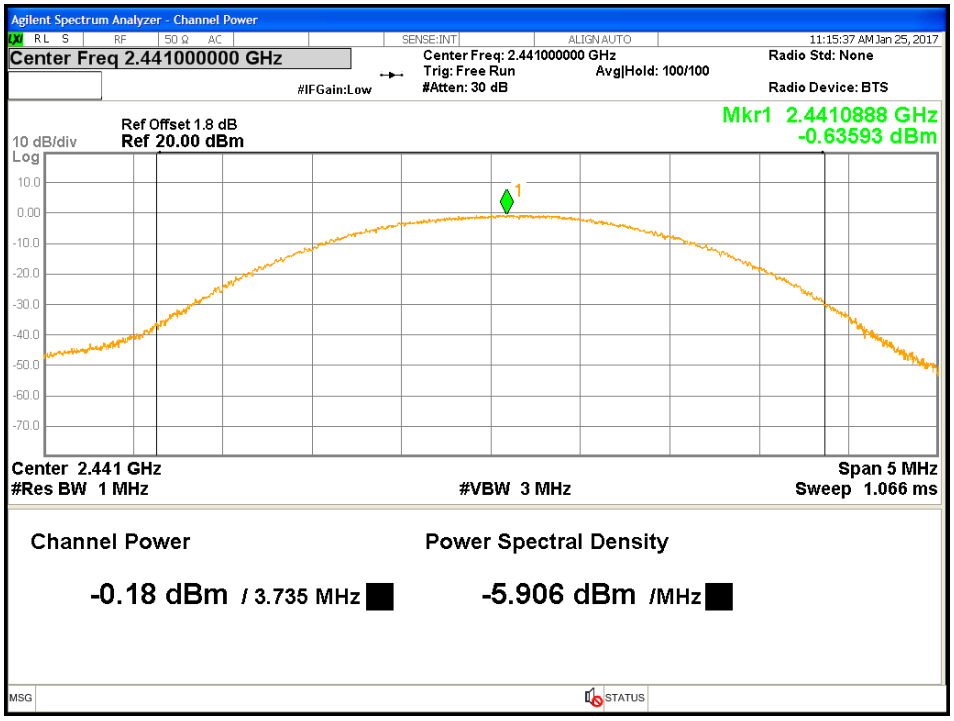


Figure 5: Maximum Transmitted Power, 2441 MHz (2-DH3)

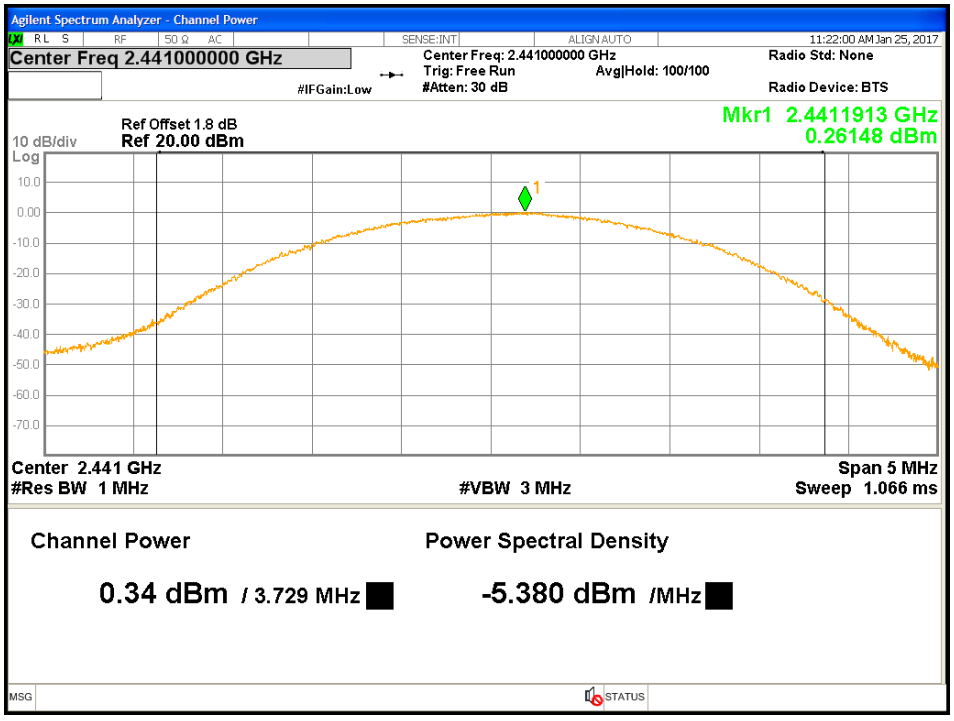


Figure 6: Maximum Transmitted Power, 2441 MHz (2-DH5)

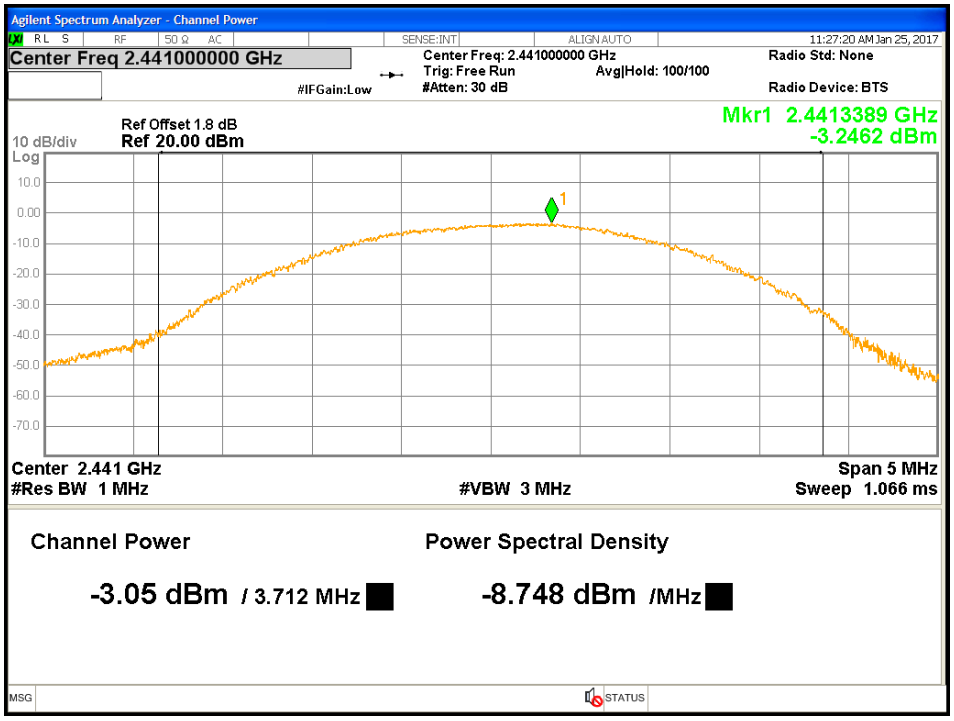


Figure 7: Maximum Transmitted Power, 2441 MHz (3-DH1)

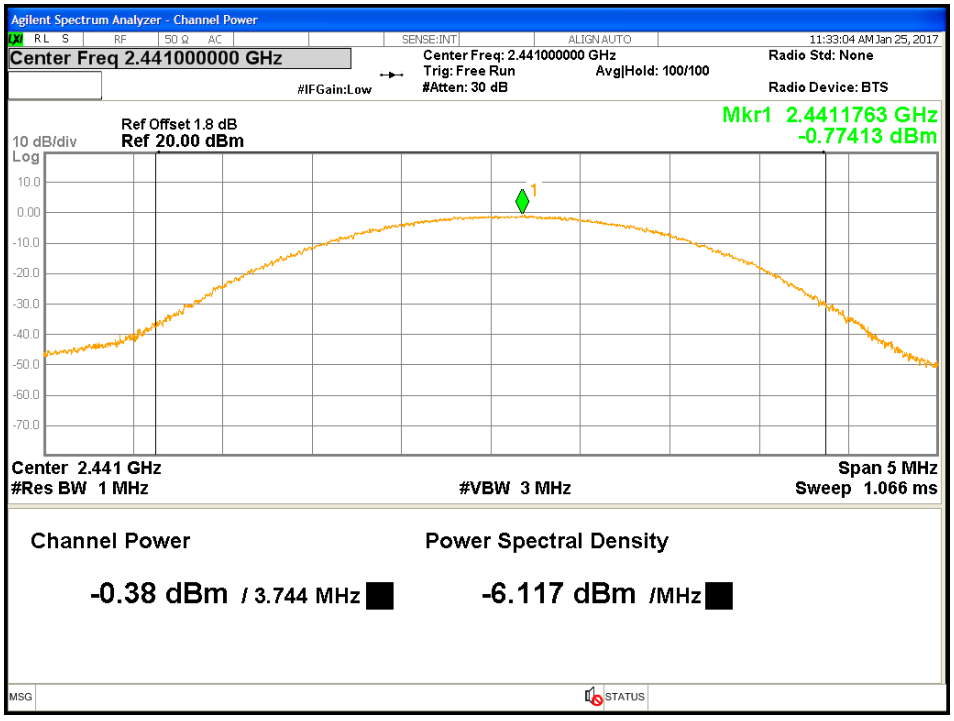


Figure 8: Maximum Transmitted Power, 2441 MHz (3-DH3)

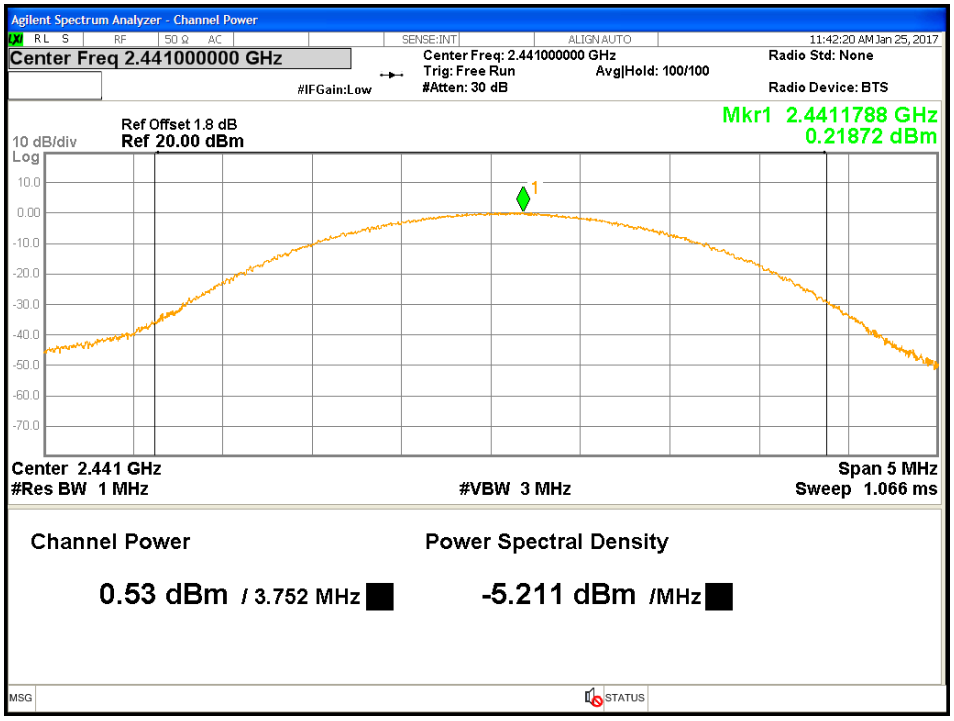


Figure 9: Maximum Transmitted Power, 2480 MHz (3-DH5)

4.2 Occupied Bandwidth

The occupied bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at the fundamental frequency.

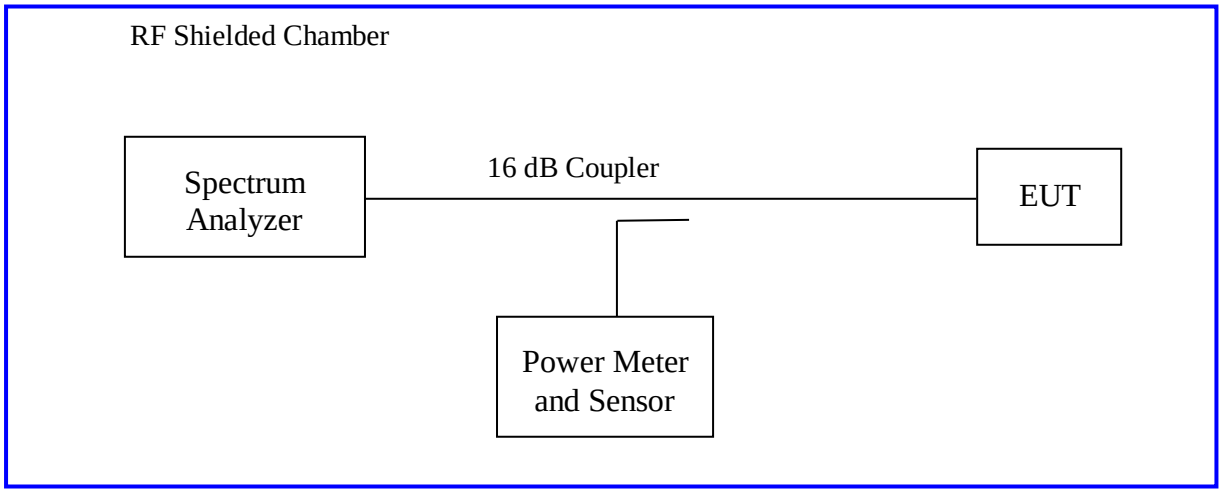
The 99% bandwidth is the bandwidth in which 99% of the transmitted power occupied.

20 dB bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

4.2.1 Test Method

The conducted method was used to measure the occupied bandwidth. The measurement was performed with modulation per CFR47 15.247(a) (1) 2016 and RSS Gen Sect. 6.6: 2014. This test was conducted on 3 channels on M2X. The worst sample result indicated below.

Test Setup:



4.2.2 Results

These measurements were used for information only

Table 4: Occupied Bandwidth – Test Results

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: PIFA		**Power Setting:** See test plan	
Max. Directional Gain: 0 dBi			
Signal State: Modulated at 100%.			
Ambient Temp.: 22° C		**Relative Humidity:**42%	
Bandwidth (MHz)			
Package	**Freq. (MHz)**	**20dB Bandwidth MHz**	**99% Bandwidth MHz**
DH1 (BDR)	2402	0.933	0.853
	2441	0.926	0.849
	2480	0.931	0.851
DH3 (EDR)	2402	0.930	0.845
	2441	0.930	0.849
	2480	0.932	0.851
DH5 (EDR)	2402	0.942	0.866
	2441	0.927	0.848
	2480	0.930	0.850
2-DH1 (BDR)	2402	1.195	1.160
	2441	1.214	1.166
	2480	1.216	1.167
2-DH3 (EDR)	2402	1.234	1.178
	2441	1.240	1.174
	2480	1.245	1.174

Table 5: Occupied Bandwidth – Test Results Continues

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: PIFA		**Power Setting:** See test plan	
Max. Directional Gain: 0 dBi			
Signal State: Modulated at 100%.			
Ambient Temp.: 22° C		**Relative Humidity:**42%	
Bandwidth (MHz)			
Package	**Freq. (MHz)**	**20dB Bandwidth MHz**	**99% Bandwidth MHz**
2-DH5 (EDR)	2402	1.228	1.176
	2441	1.231	1.173
	2480	1.231	1.173
3-DH1 (BDR)	2402	1.196	1.147
	2441	1.197	1.143
	2480	1.195	1.144
3-DH3 (EDR)	2402	1.254	1.174
	2441	1.255	1.183
	2480	1.256	1.183
3-DH5 (EDR)	2402	1.254	1.166
	2441	1.255	1.175
	2480	1.254	1.174
Note: Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.			

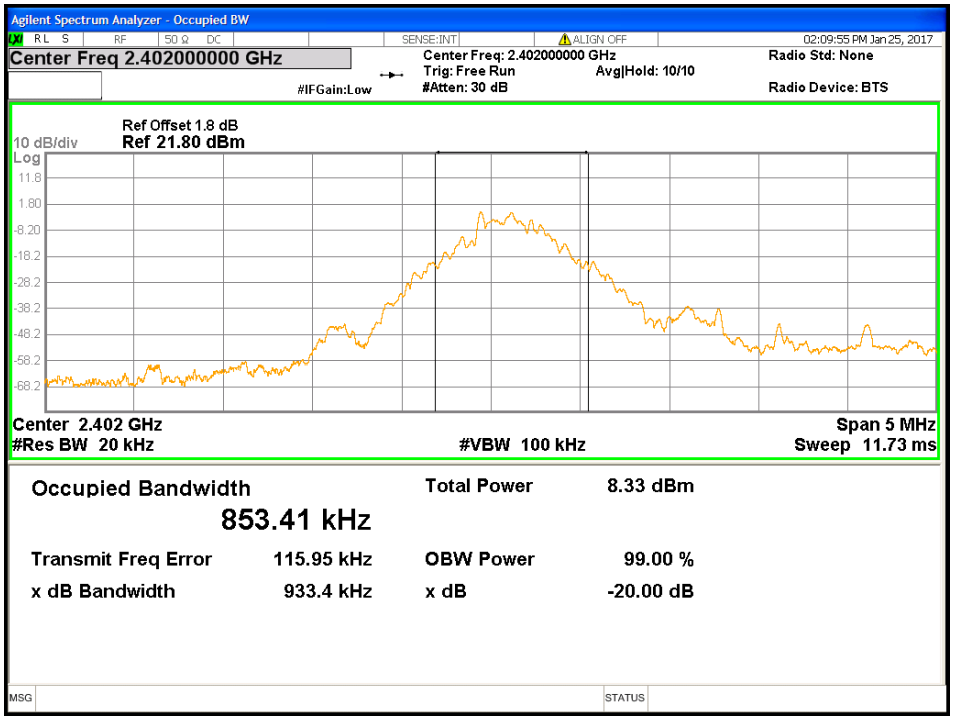


Figure 10: Occupied Bandwidth at 2402 MHz (DH1)

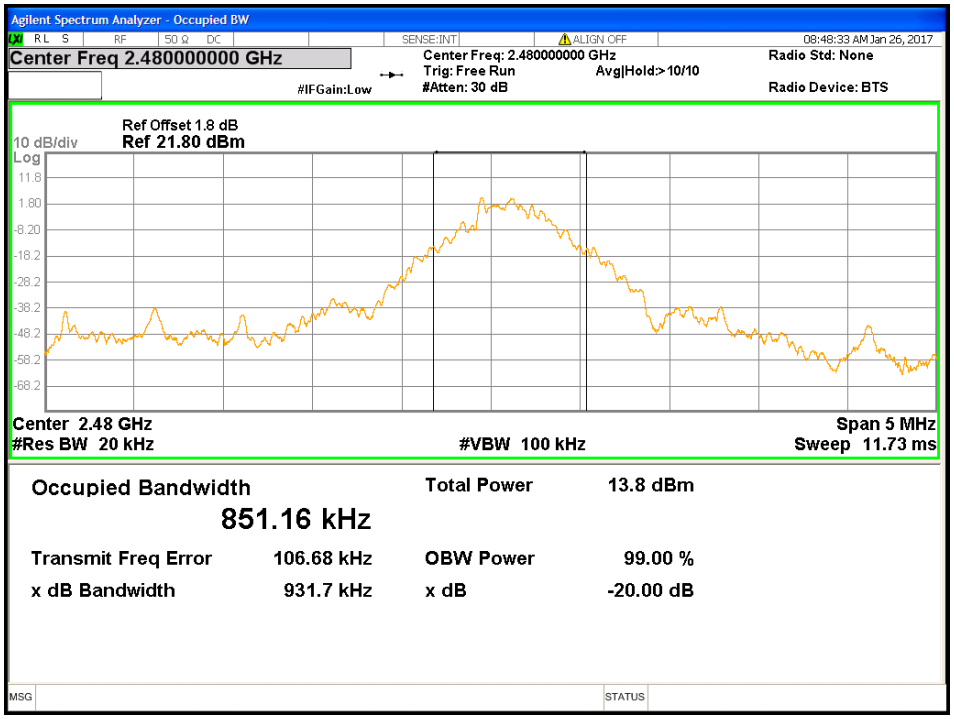


Figure 11: Occupied Bandwidth at 2480 MHz (DH3)

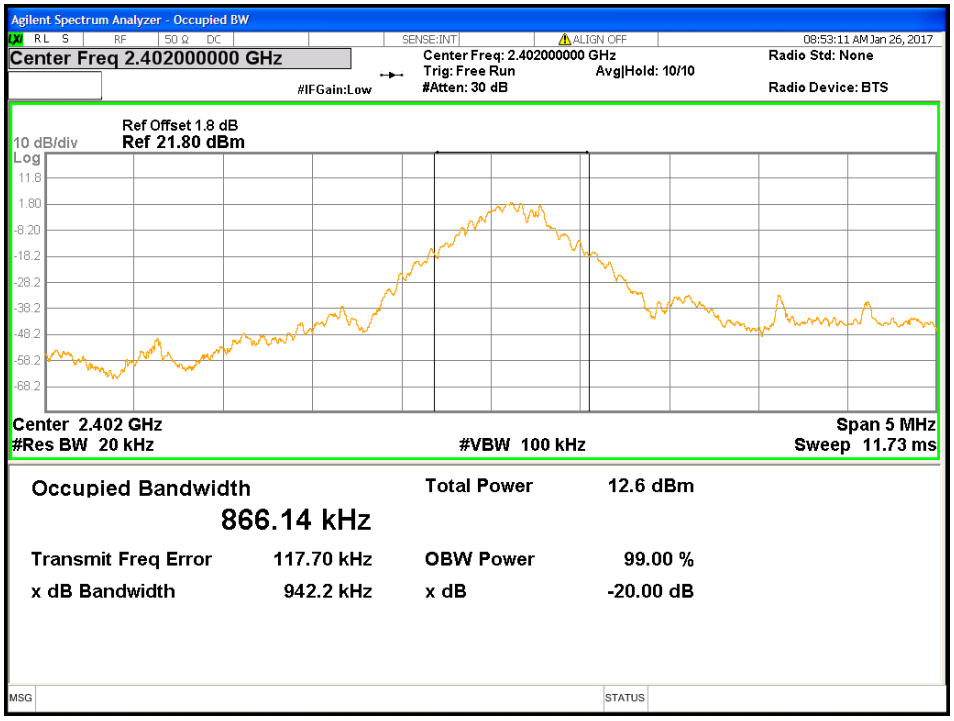


Figure 12: Occupied Bandwidth at 2402 MHz (DH5)

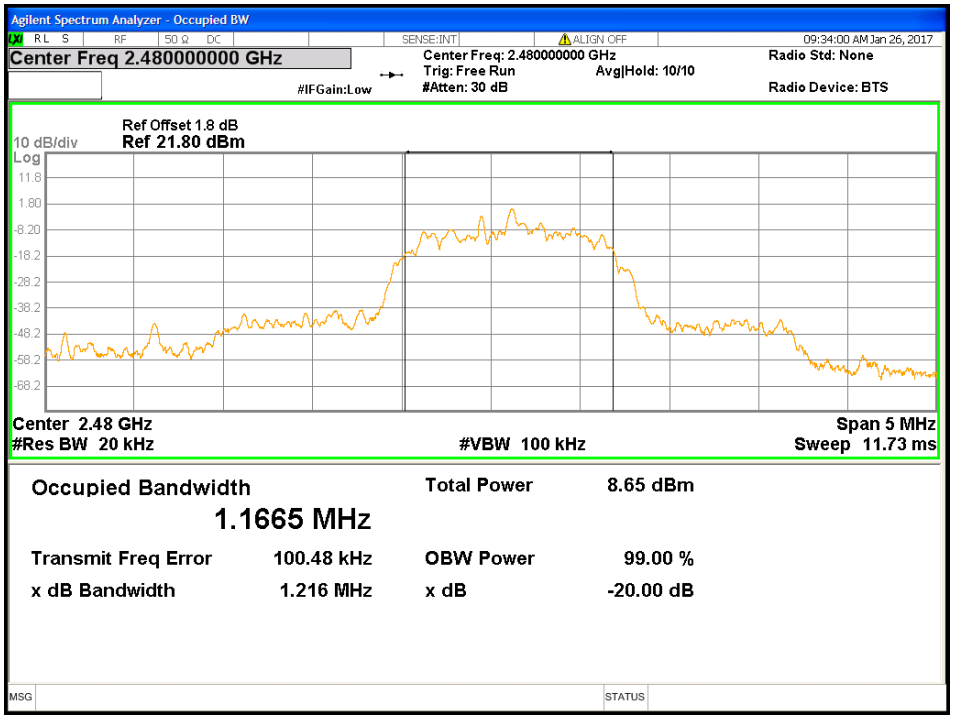


Figure 13: Occupied Bandwidth at 2480 MHz (2-DH1)

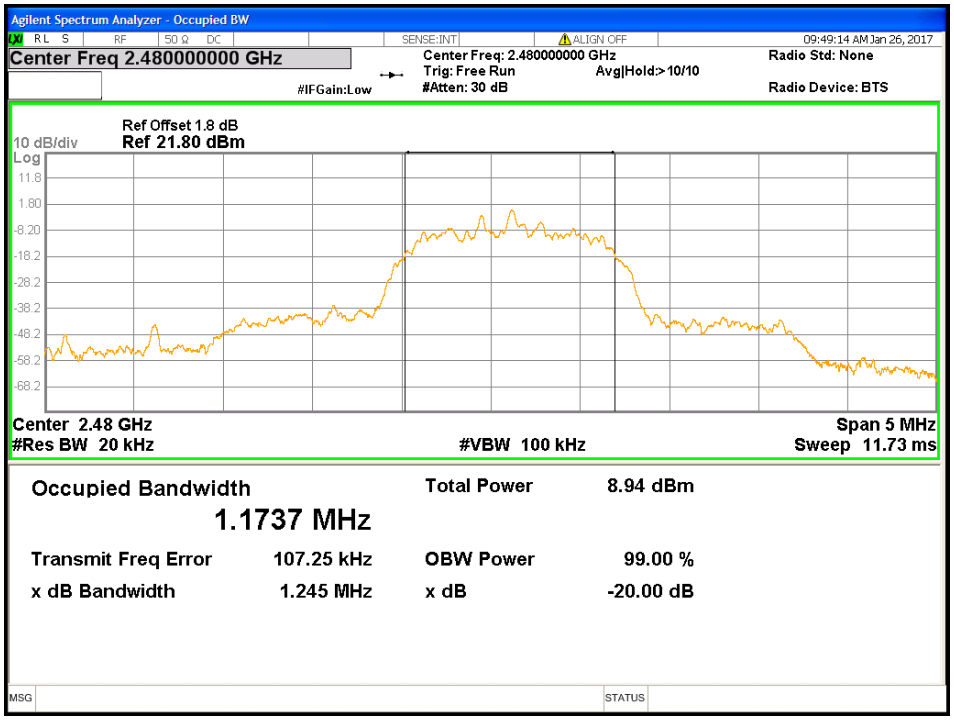


Figure 14: Occupied Bandwidth at 2480 MHz (2-DH3)

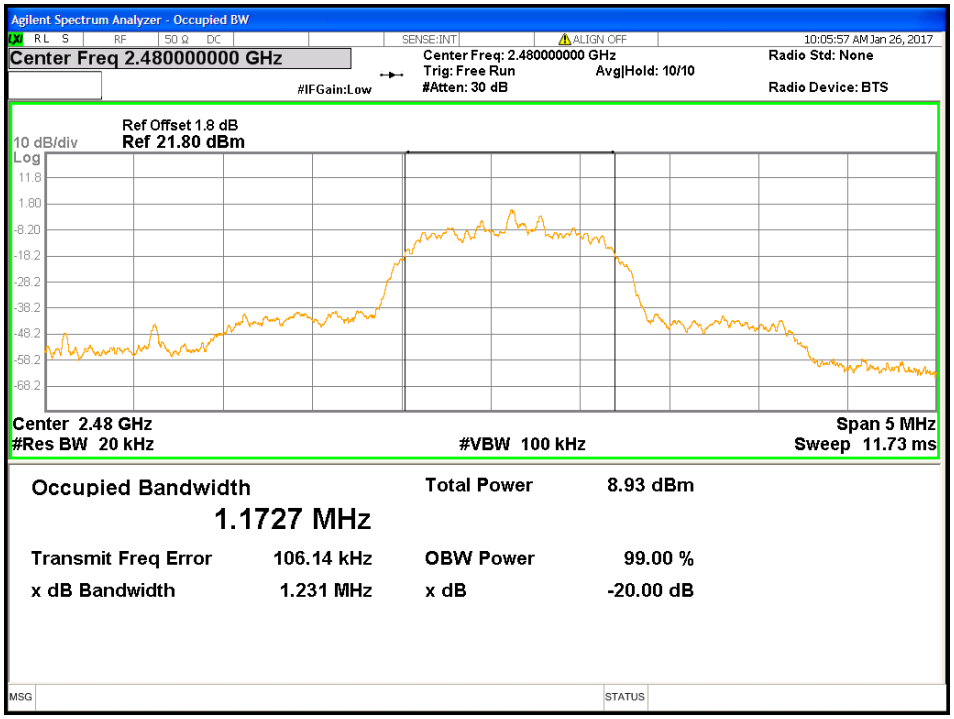


Figure 15: Occupied Bandwidth at 2480 MHz (2-DH5)

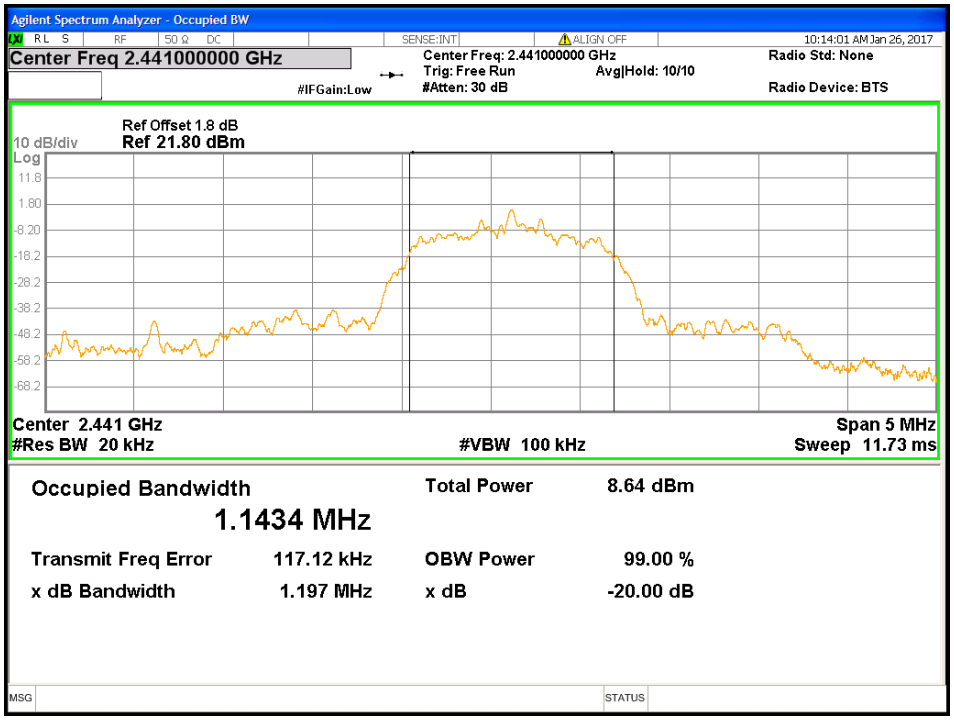


Figure 16: Occupied Bandwidth at 2441 MHz (3-DH1)

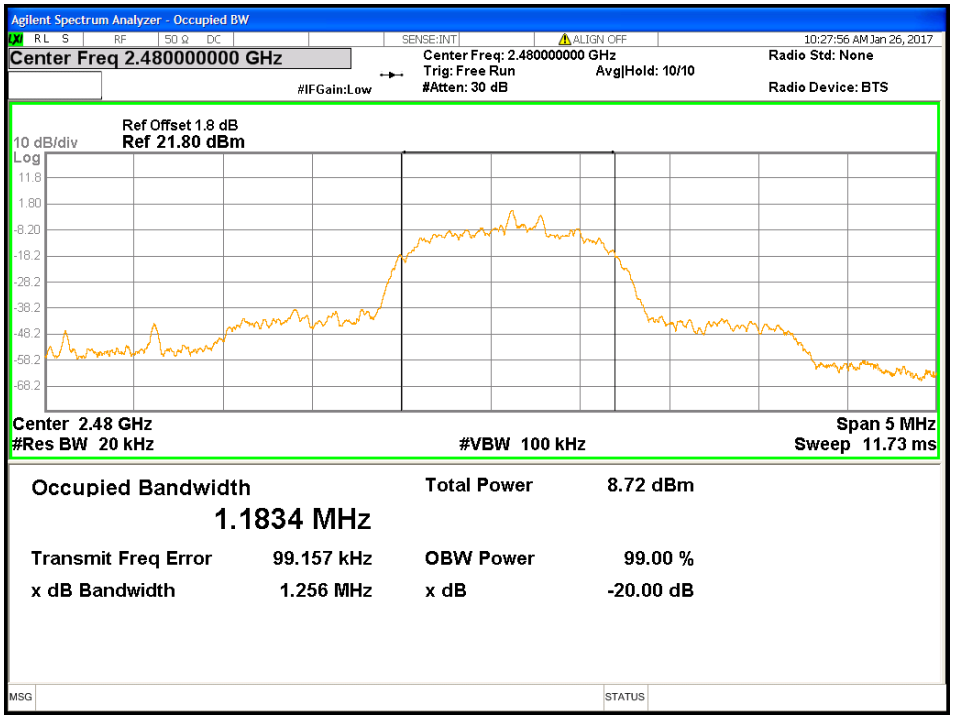


Figure 17: Occupied Bandwidth at 2480 MHz (3-DH3)

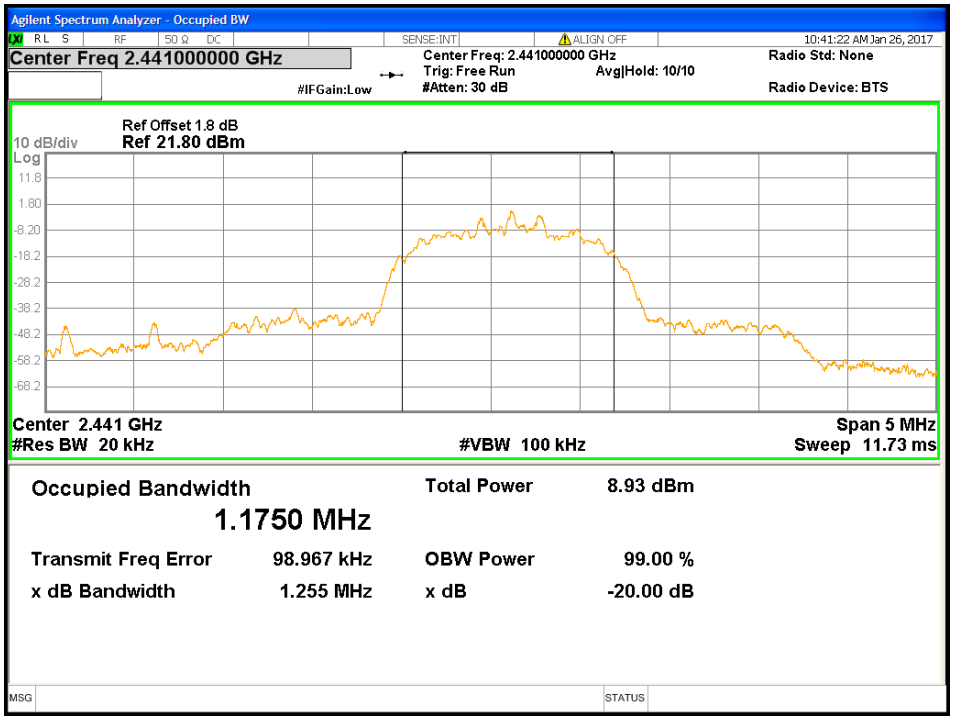


Figure 18: Occupied Bandwidth at 2441 MHz (3-DH5)

4.3 Hopping Frequency Requirements

The Frequency Hopping Requirements are applicable to the equipment using Frequency Hopping Spread Spectrum (FHSS) modulation.

Per CFR47 15.247 (a1), RSS 247 Sect. 5.1(b) and Sect. 5.1(d), frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

The setup was identical to RF output power measurement.

4.3.1 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 6: Frequency Hopping Requirements

Test Conditions: Conducted Measurement, Normal Temperature					
Antenna Type: PIFA			**Power Setting:** See test plan		
Max. Directional Gain: 0 dBi					
Signal State: Modulated at 100%.					
Ambient Temp.: 22° C			**Relative Humidity:**42%		
Average Occupancy Time					
Package	**Pulse Width (ms)**	**# of Pulses (3.16s)**	**Ave. Time (ms)**	**Limit (s)**	**Result**
DH1 (BDR)	0.4112	32	131.584	< 0.4	Pass
DH5 (EDR)	1.6540	16	264.640	< 0.4	Pass
Note: 1. Since the dwell time in each channel must be less than 0.4 seconds. The total time for dwell all 79 channels is 31.6 seconds. To determine the average dwell time, the frequency 2441MHz was sample in 3.2 second, 1/10th of the total 79 channel dwell time. 2. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.					

Table 7: Frequency Hopping Requirements Continues

Test Conditions: Conducted Measurement, Normal Temperature			
Antenna Type: PIFA		**Power Setting**: See test plan	
Max. Directional Gain: 0 dBi			
Signal State: Modulated at 100%.			
Ambient Temp.: 22° C		**Relative Humidity:** 42%	
Minimum Channel Separation			
Package	**Hopping Separation (kHz)**	**Two-Third of 20dB Bandwidth Limit (kHz)**	**Result**
DH1 (BDR)	1005	> 616.04	Pass
DH5 (EDR)	999	> 621.85	Pass
Note: The EUT was hopping randomly all 79 operating channels. The channel separation was measured at the middle channel, 2441 MHz. Two-Third of the highest 20dB bandwidth was used.			
Minimum Number of Channels			
Range (2402MHz -2480MHz)	**Min. Channel Limit**	**Result**	
79	15	Pass	
Note: N/A			

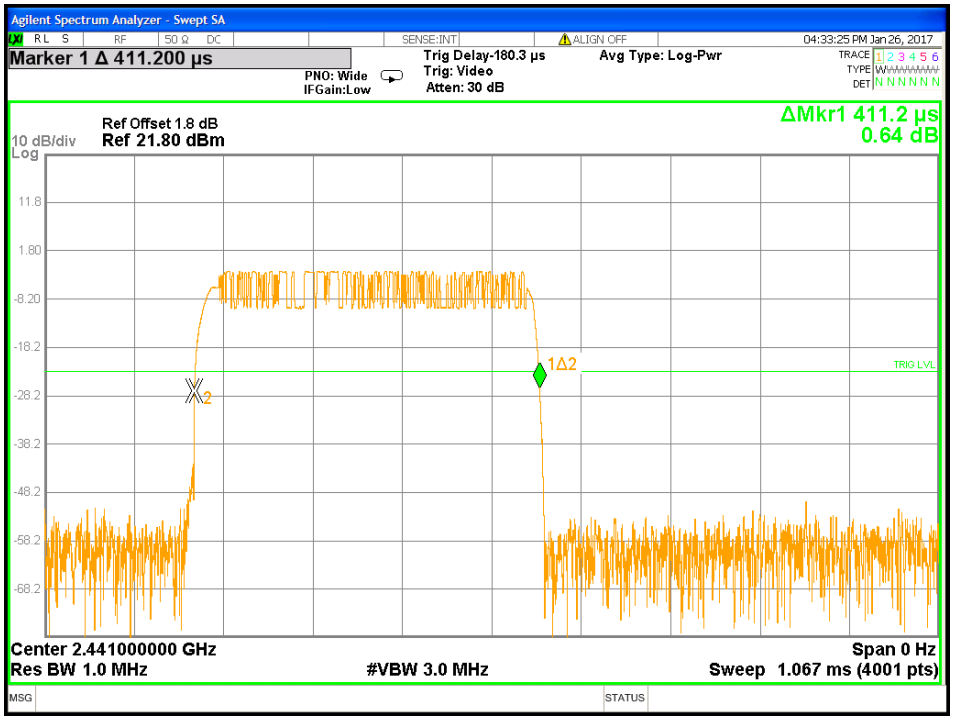


Figure 19: Pulse Width at 2441MHz for DH1

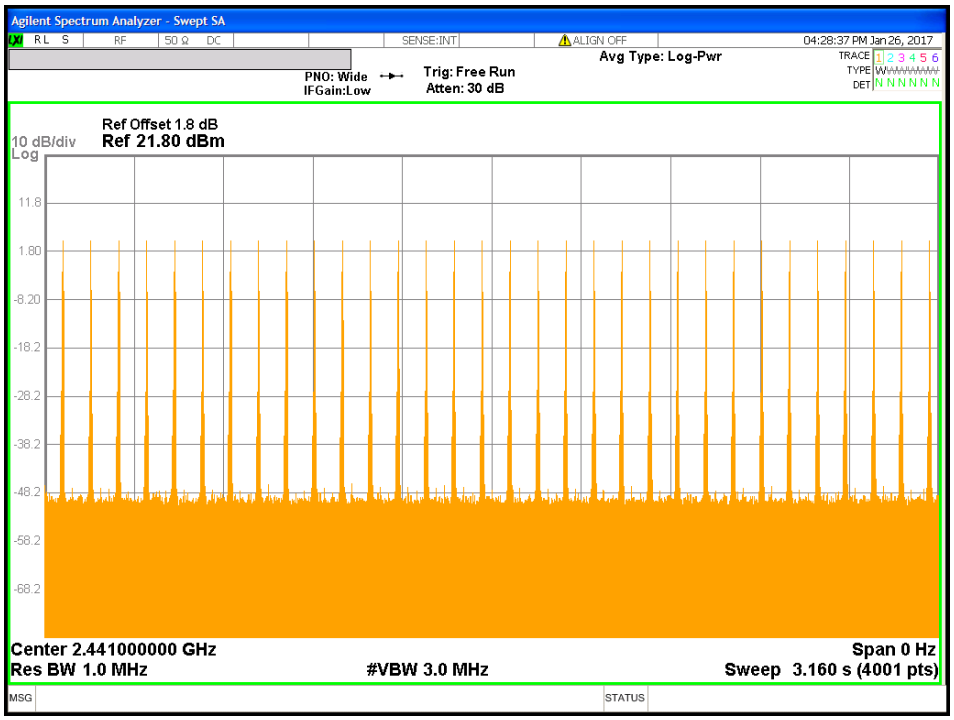


Figure 20: Average Dwell Time at Channel 2441MHz for DH1 – 32 Pulses

Note: There are 32 pulses in 3.16 seconds.

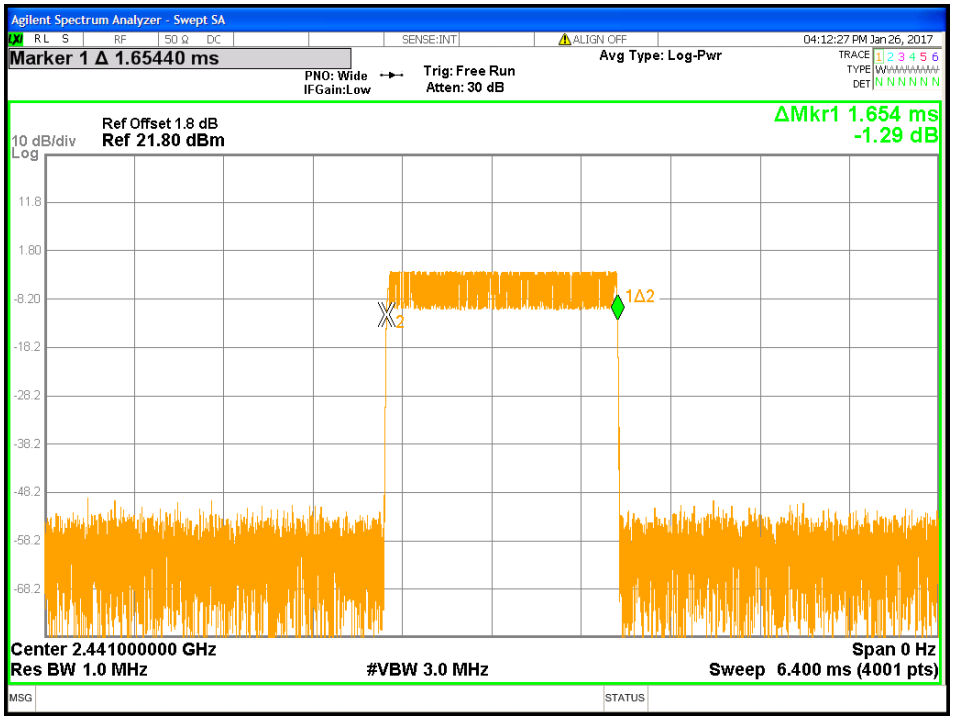


Figure 21: Pulse Width at 2441MHz for DH5

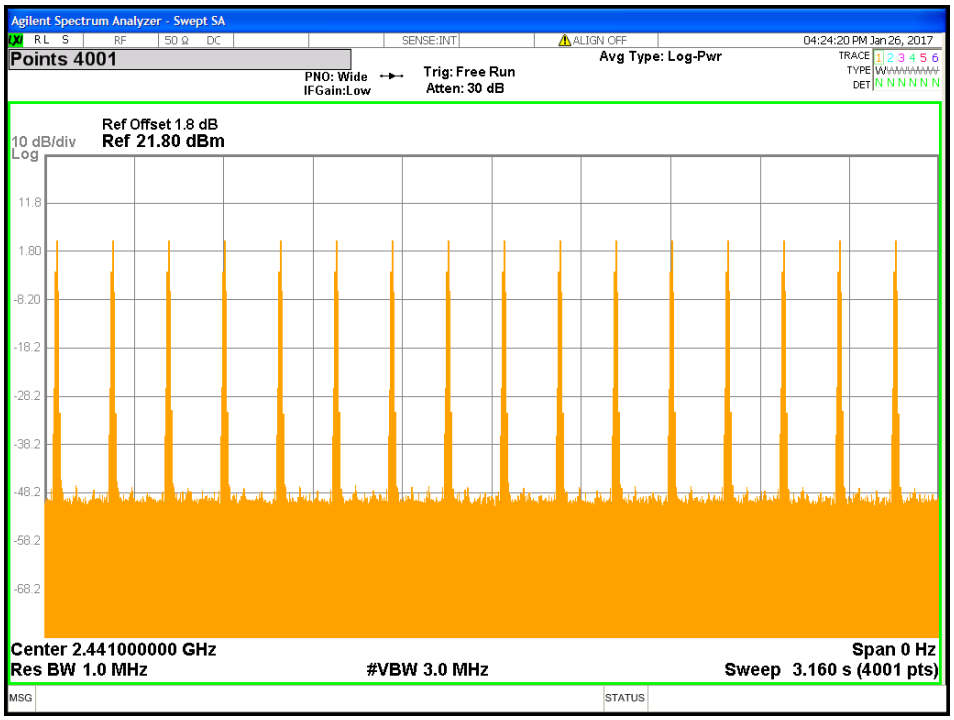


Figure 22: Average Dwell Time at Channel 2441MHz for DH5 – 16 Pulses

Note: There are 16 pulses in 3.16 seconds.

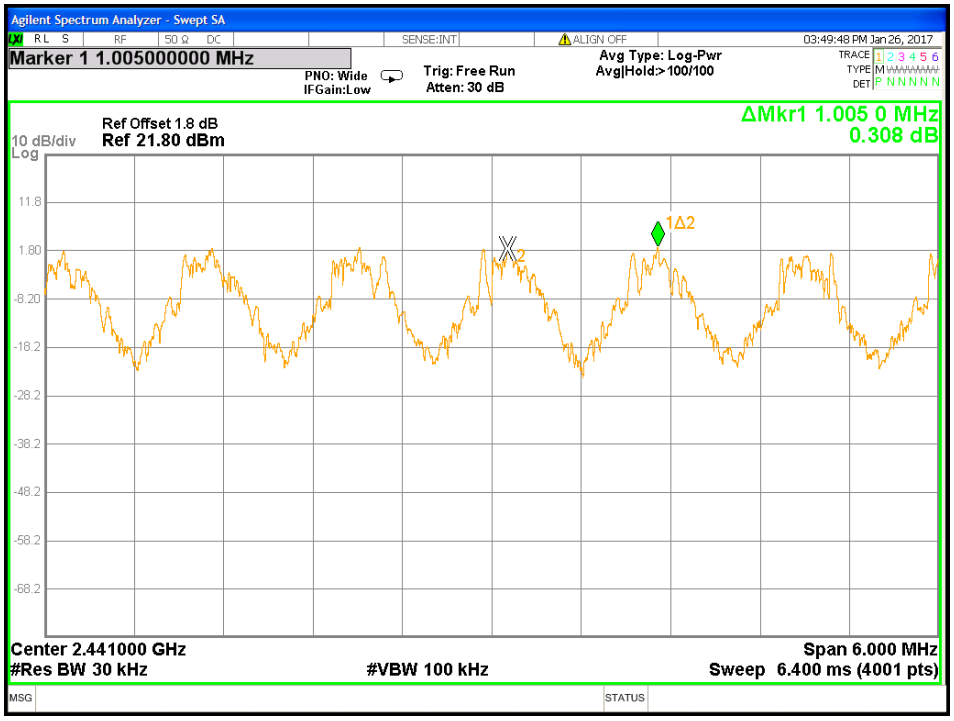


Figure 23: Hopping Separation for DH1

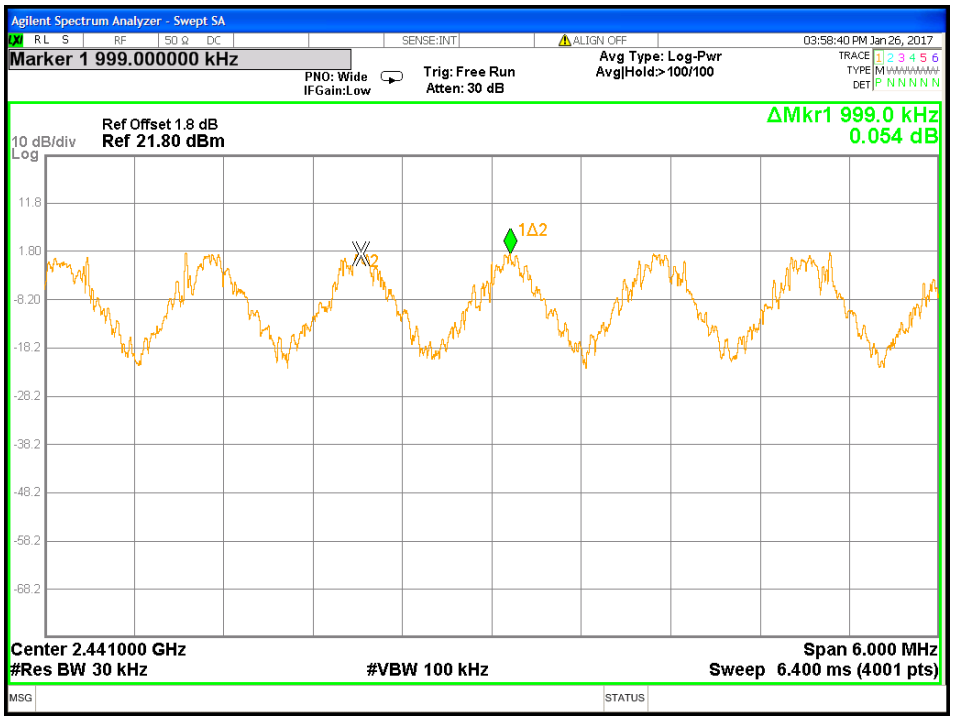


Figure 24: Hopping Separation for DH1

Figure 25: Number of Operating Channels (79)

4.4 Out of Band Emission requirements

The setup was identical to RF output power measurement. Intentional radiators operating under the alternative provisions to the general emission limits, must be designed to ensure that the 30 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If the frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

Any frequency outside the band of 2400 MHz to 2483.5 MHz, the power output level must be below 30 dB from the in-band transmitting signal; CFR 47 Part 15.215, 15.247(d) and RSS 247 Sect.5.5.

The setup was identical to RF output power measurement.

This test was conducted on 3 channels on M2X.

4.1.1 Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 8: Band Edge Requirements

Test Conditions: Conducted Measurement, Normal Temperature				
Antenna Type: PIFA		**Power Setting:** See test plan		
Max. Directional Gain: 0 dBi				
Signal State: Modulated at 100%.				
Ambient Temp.: 22° C		**Relative Humidity:**42%		
-30 dBr Band Edge Results				
Package	**Operating Freq. (MHz)**	**Limit (dBm)**	**Measured Value (dBm)**	**Result**
DH1 (BDR)	2402	-28.26	-58.040	Pass
	2441	-26.07	-59.965	Pass
	2480	-26.36	-60.151	Pass
DH3 (EDR)	2402	-28.42	-58.707	Pass
	2441	-22.71	-61.293	Pass
	2480	-22.69	-58.283	Pass

DH5 (EDR)	2402	-24.68	-50.239	Pass
	2441	-22.67	-61.389	Pass
	2480	-22.62	-60.349	Pass
2-DH1 (BDR)	2402	-27.65	-51.374	Pass
	2441	-27.76	-61.022	Pass
	2480	-28.27	-59.161	Pass
2-DH3 (EDR)	2402	-30.30	-58.480	Pass
	2441	-27.97	-59.861	Pass
	2480	-27.94	-58.920	Pass
2-DH5 (EDR)	2402	-30.42	-57.062	Pass
	2441	-28.16	-60.805	Pass
	2480	-28.04	-59.261	Pass
3-DH1 (BDR)	2402	-30.10	-59.246	Pass
	2441	-27.98	-60.291	Pass
	2480	-28.22	-60.863	Pass
3-DH3 (EDR)	2402	-30.45	-58.355	Pass
	2441	-28.49	-61.492	Pass
	2480	-28.34	-59.942	Pass
3-DH5 (EDR)	2402	-30.72	-58.128	Pass
	2441	-28.23	-61.328	Pass
	2480	-28.38	-59.795	Pass

Note: 1. The stated limits for 30 dBr are relative to each individual output per ANSI C63.10 Method. The worst case of each data rate is recorded.

2. Plots for all the measurements stated above were taken, to reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

Table 9: Out of Band Emissions Requirements

Test Conditions: Conducted Measurement, Normal Temperature				
Antenna Type: PIFA		**Power Setting:** See test plan		
Max. Directional Gain: 0 dBi				
Signal State: Modulated at 100%.				
Ambient Temp.: 22° C		**Relative Humidity:**42%		
Out of Band Emission				
Package	**Operating Freq. (MHz)**	**Limit (dBm)**	**Measured Value (dBm)**	**Result**
DH1 (BDR)	2402	-28.26	-46.96 (2.5063 GHz)	Pass
	2441	-26.07	-46.48 (2.5970 GHz)	Pass
	2480	-26.36	-44.51 (2.6361 GHz)	Pass
DH3 (EDR)	2402	-28.42	-46.72 (2.5579 GHz)	Pass
	2441	-22.71	-45.97 (7.3240 GHz)	Pass
	2480	-22.69	-43.77 (7.4405 GHz)	Pass
DH5 (EDR)	2402	-24.68	-46.27 (2.5579 GHz)	Pass
	2441	-22.67	-45.67 (7.3231 GHz)	Pass
	2480	-22.62	-43.08 (7.4397 GHz)	Pass
2-DH1 (BDR)	2402	-27.65	-49.15 (23.7798 GHz)	Pass
	2441	-27.76	-48.54 (24.0062 GHz)	Pass
	2480	-28.27	-48.00 (2.6361 GHz)	Pass
2-DH3 (EDR)	2402	-30.3	-49.03 (23.7723 GHz)	Pass
	2441	-27.97	-49.05 (24.8319 GHz)	Pass
	2480	-27.94	-48.04 (2.5845 GHz)	Pass

2-DH5 (EDR)	2402	-30.42	-48.99 (24.0669 GHz)	Pass
	2441	-28.16	-48.97 (23.7831 GHz)	Pass
	2480	-28.04	-48.73 (23.8955 GHz)	Pass
3-DH1 (BDR)	2402	-30.1	-48.67 (23.7498 GHz)	Pass
	2441	-27.98	-48.18 (24.1976 GHz)	Pass
	2480	-28.22	-48.88 (23.8896 GHz)	Pass
3-DH3 (EDR)	2402	-30.45	-48.70 (23.8946 GHz)	Pass
	2441	-28.49	-49.26 (23.9895 GHz)	Pass
	2480	-28.34	-48.94 (24.8402 GHz)	Pass
3-DH5 (EDR)	2402	-30.72	-48.32 (23.7332 GHz)	Pass
	2441	-28.23	-48.71 (23.7465 GHz)	Pass
	2480	-28.38	-48.67 (24.8000 GHz)	Pass

Note: 1. The stated limits for 30dBr are relative to each individual output per ANSI C63.10 Method.
2. Plots for all the measurements stated above were taken including other modes. To reduce complexity and bulkiness of the report Highlighted Plots are placed in the report.

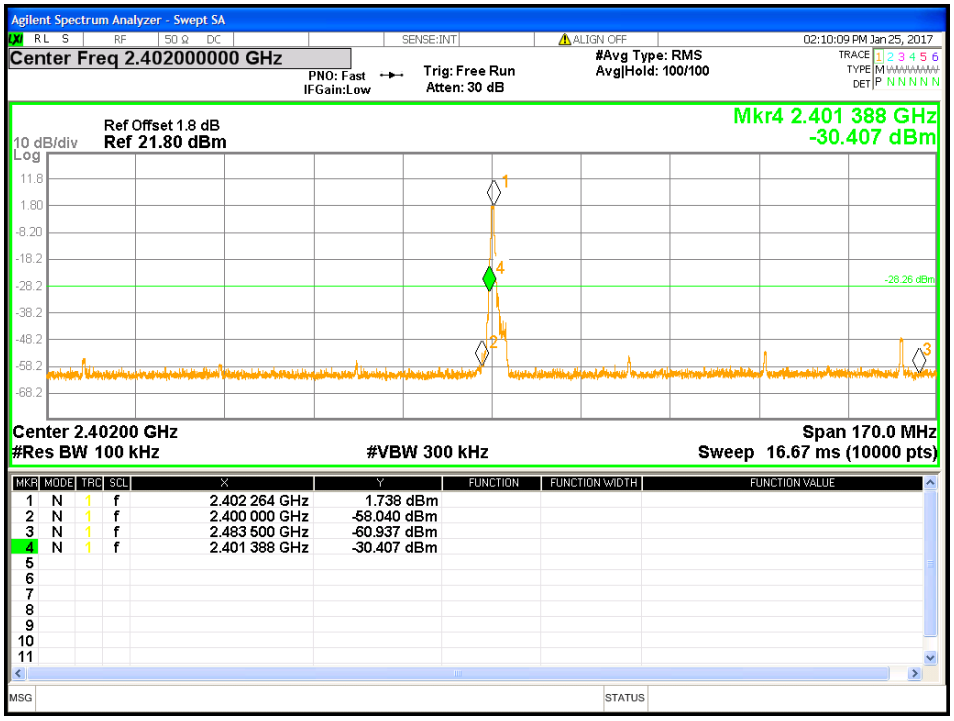


Figure 26: Band Edge Requirements at 2402 MHz – DH1

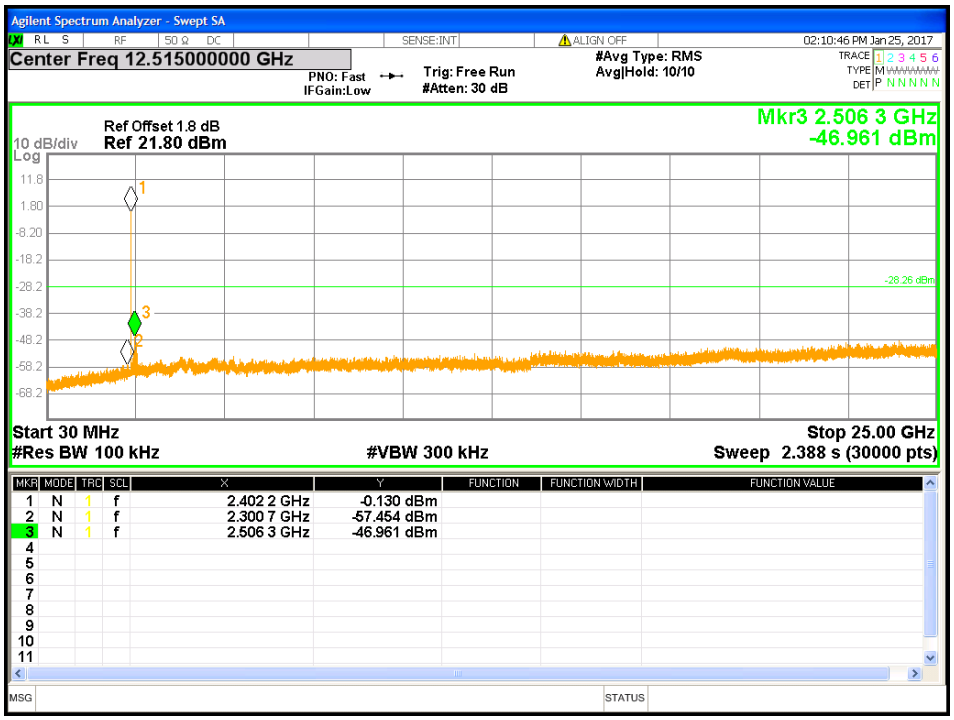


Figure 27: Out of Band Emission Requirements at 2402 MHz – DH1

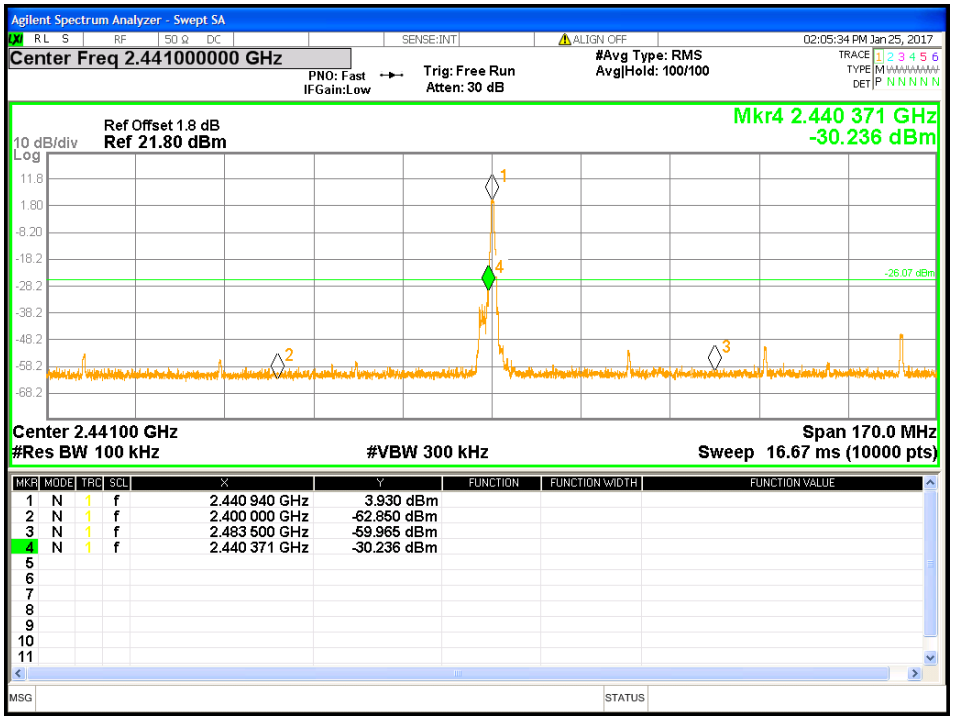


Figure 28: Band Edge Requirements at 2441 MHz – DH1

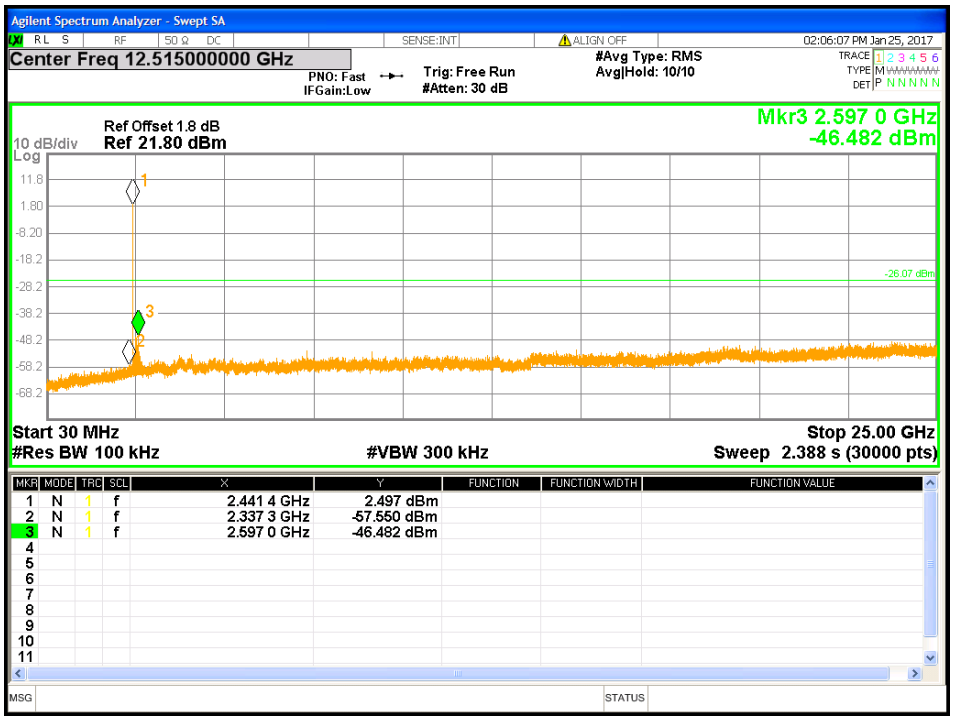


Figure 29: Out of Band Emission Requirements at 2441 MHz – DH1

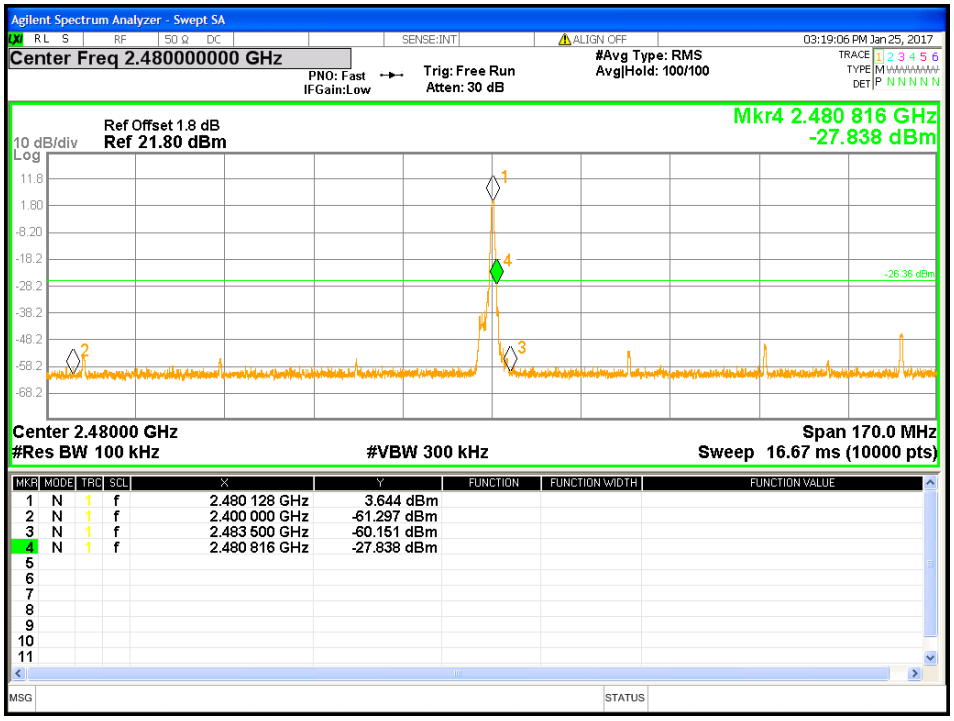


Figure 30: Band Edge Requirements at 2480 MHz – DH1

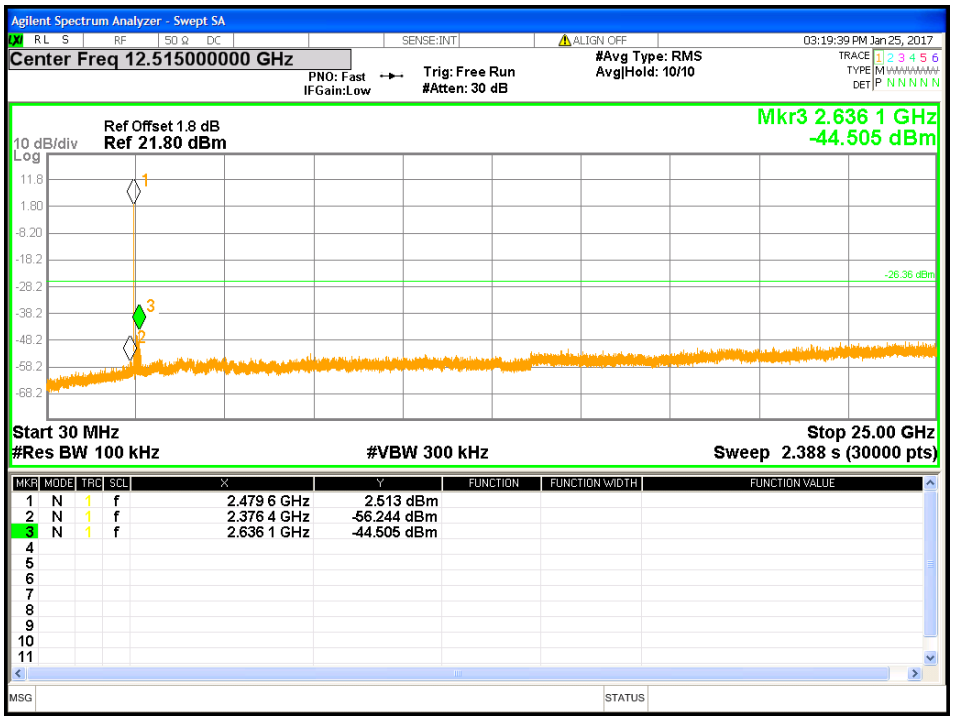


Figure 31: Out of Band Emission Requirements at 2480 MHz – DH1

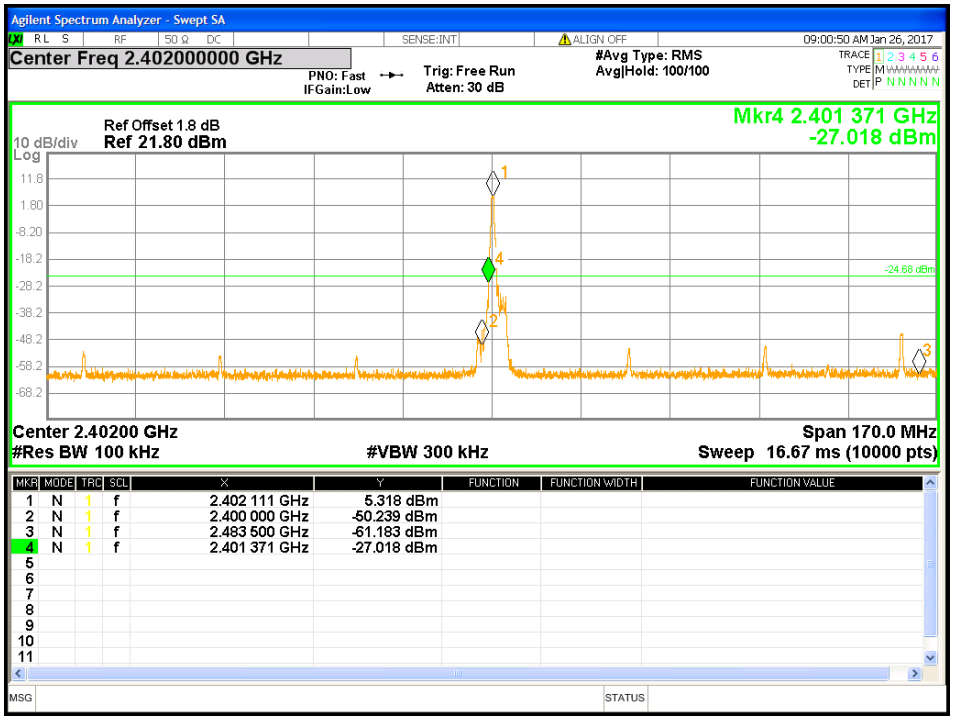


Figure 32: Band Edge Requirements at 2402 MHz – DH5

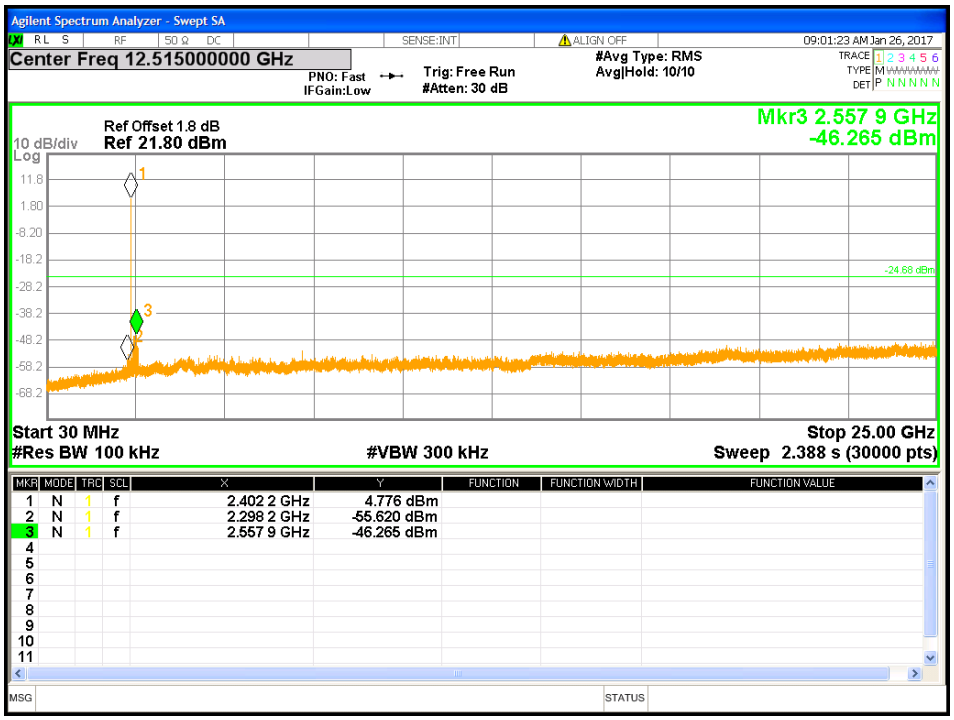


Figure 33: Out of Band Emission Requirements at 2402 MHz – DH5

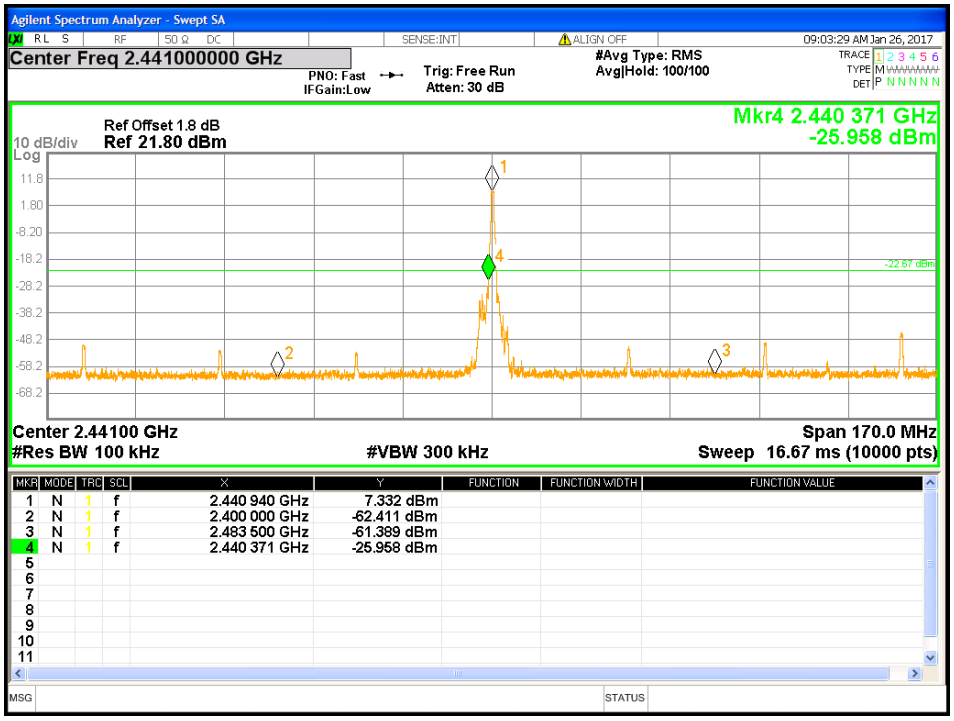


Figure 34: Band Edge Requirements at 2441 MHz – DH5

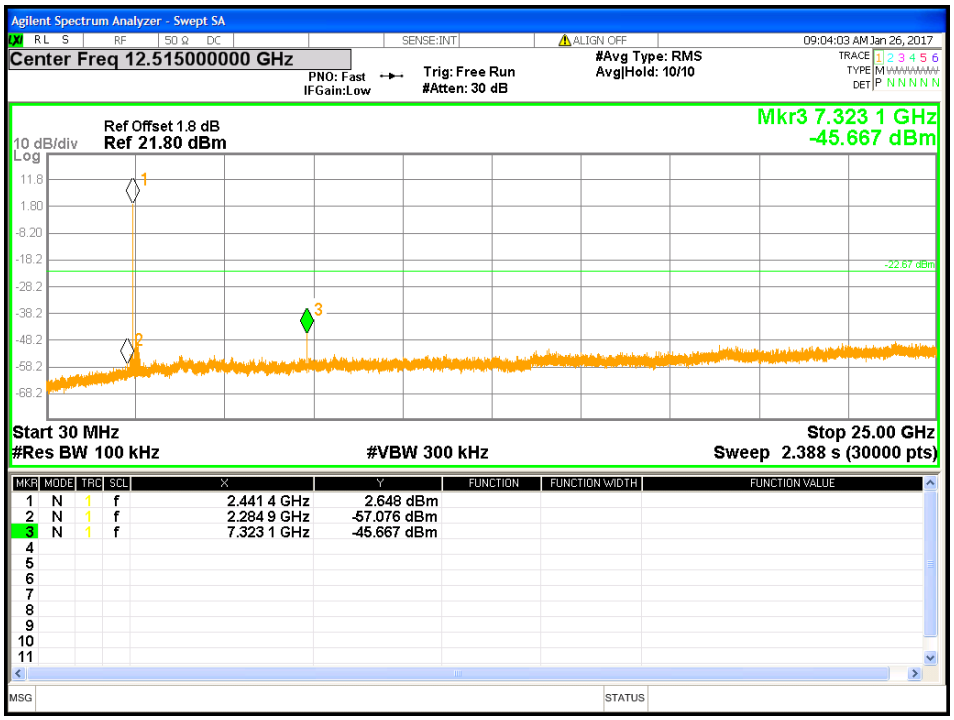


Figure 35: Out of Band Emission Requirements at 2441 MHz – DH5

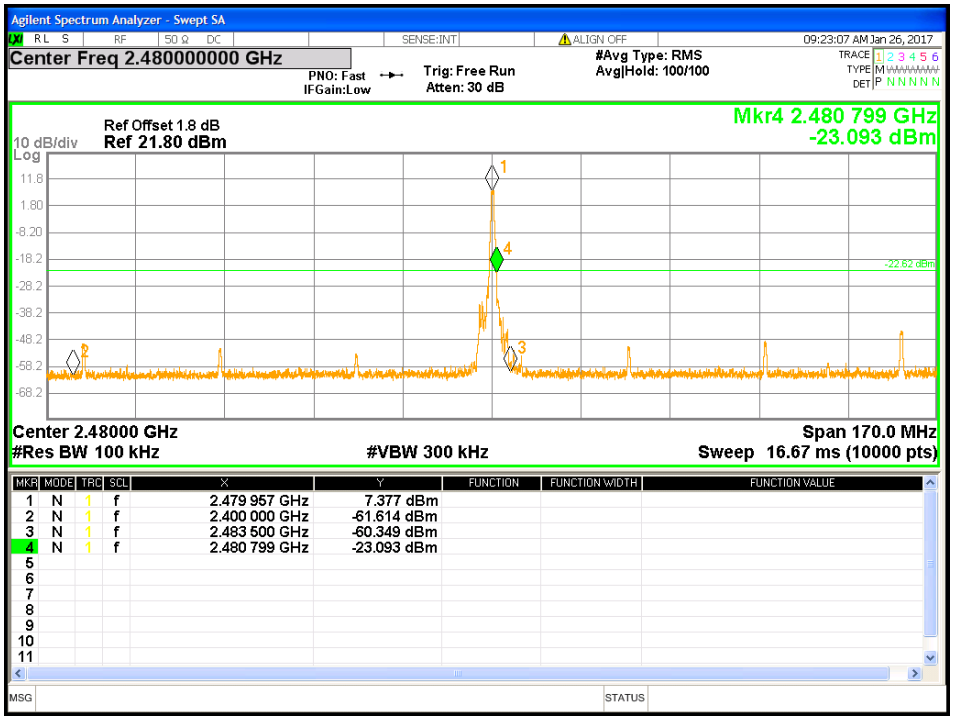


Figure 36: Band Edge Requirements at 2480 MHz – DH5

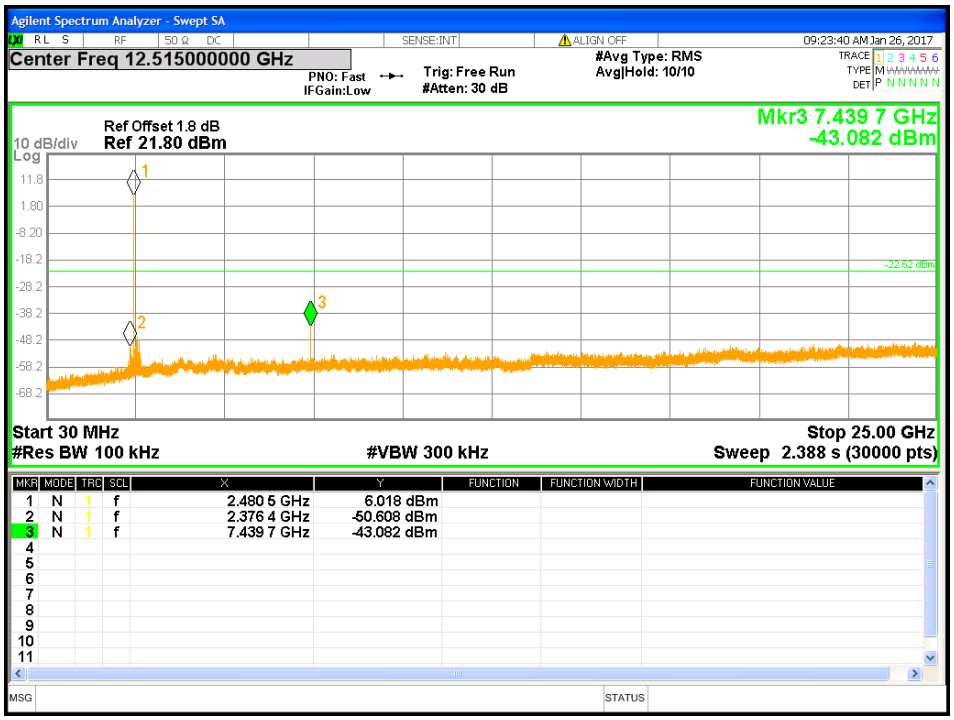


Figure 37: Out of Band Emission Requirements at 2480 MHz – DH5

4.5 Transmitter Spurious Emissions

Transmitter spurious emissions are emissions outside the frequency range of the equipment when the equipment is in transmitting mode; per requirement of CFR47 15.205, 15.209, 15.247(d), RSS 247 Sect. 5.5

4.6.1 Test Methodology

4.6.1.1 Preliminary Test

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 120 kHz and provide a reading at each frequency for no more than 12° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

4.6.1.2 Final Test

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

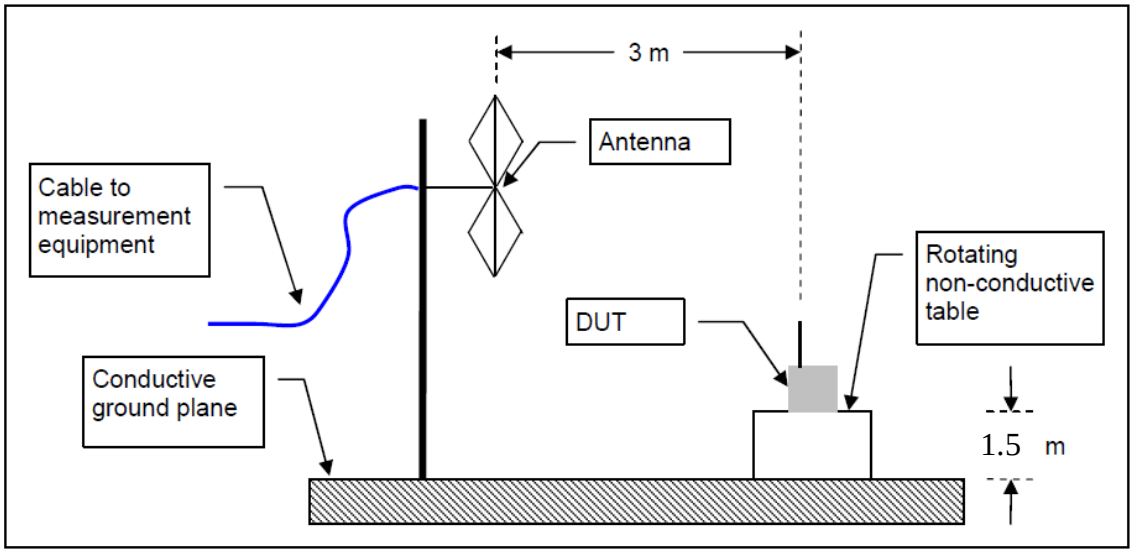
Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm (<1 GHz) and 150cm (>1 GHz) above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

The final scans performed on the worst case for three operating channels: 2402 MHz, 2441 MHz, and 2480 MHz at DH1 (BDR) and DH5 (EDR).

4.6.1.3 Deviations

None.

Test Setup:



4.6.2 Transmitter Spurious Emission Limit

The spurious emissions of the transmitter shall not exceed the values in CFR47 Part 15.205, 15.209: 2016 and RSS Gen. Sect. 8.9: 2014.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490.....	2400/F(kHz)	300
0.490-1.705.....	24000/F (kHz)	30
1.705-30.0.....	30	30
30-88.....	100 **	3
88-216.....	150 **	3
216-960.....	200 **	3
Above 960.....	500	3

All harmonics and spurious emission which are outside of the restricted band shall be 20 dB below the in-band emission.

4.6.3 Test Results

The final measurement data was taken under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and Test Plan.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 10: Transmit Spurious Emission at Restricted Band Edge Requirements

Test Conditions: Radiated Measurement, Normal Temperature								
Antenna Type: PIFA			**Power Setting:** See test plan					
Max. Directional Gain: 0 dBi								
Signal State: Modulated at 100%.								
Ambient Temp.: 21° C			**Relative Humidity:**45%					
Band-Edge Results								
Freq. (MHz)	Level (dBuV/m)	Pol. (H/V)	Limit (dBuV/m)	Margin (dB)	Det.	Table Deg.	Tower (cm)	Note
2345.94	55.15	V	74.00	-18.85	Pk	231	118	Figure 38: DH1-2402MHz
2390.00	42.92	V	54.00	-11.08	Avg	231	118	Figure 39: DH1-2402MHz
2336.34	56.27	H	74.00	-17.73	Pk	216	256	Figure 40: DH1-2402MHz
2390.00	42.94	H	54.00	-11.06	Avg	216	256	Figure 41: DH1-2402MHz
2484.74	56.14	H	74.00	-17.86	Pk	213	218	Figure 42: DH1-2480MHz
2483.50	43.14	H	54.00	-10.86	Avg	213	218	Figure 43: DH1-2480MHz
2488.51	55.93	V	74.00	-18.07	Pk	200	133	Figure 44: DH1-2480MHz
2483.50	43.13	V	54.00	-10.87	Avg	200	133	Figure 45: DH1-2480MHz
2369.16	55.26	H	74.00	-18.74	Pk	220	231	Figure 46: DH5-2402MHz
2390.00	42.91	H	54.00	-11.09	Avg	220	231	Figure 47: DH5-2402MHz
2378.75	56.82	V	74.00	-17.18	Pk	207	125	Figure 48: DH5-2402MHz
2390.00	42.87	V	54.00	-11.13	Avg	207	125	Figure 49: DH5-2402MHz
2489.91	56.45	V	74.00	-17.55	Pk	197	161	Figure 50: DH5-2480MHz
2483.50	43.23	V	54.00	-10.77	Avg	197	161	Figure 51: DH5-2480MHz
2484.76	56.62	H	74.00	-17.38	Pk	221	216	Figure 52: DH5-2480MHz
2483.50	43.23	H	54.00	-10.77	Avg	221	216	Figure 53: DH5-2480MHz
Note: 1. The emissions were measured at the adjacent restricted band of the fundamental signal. 2. All the band-edge measurements met the restricted band requirements of CFR47 15.205. 3. EUT was set to transmit at single channel.								

Table 11: Transmit Spurious Emission at Restricted Band Edge Requirements continues

Test Conditions: Radiated Measurement, Normal Temperature								
Antenna Type: PIFA			**Power Setting:** See test plan					
Max. Directional Gain: 0 dBi								
Signal State: Modulated at 100%.								
Ambient Temp.: 21° C			**Relative Humidity:**45%					
Band-Edge Results								
Freq. (MHz)	Level (dBuV/m)	Pol. (H/V)	Limit (dBuV/m)	Margin (dB)	Det.	Table Deg.	Tower (cm)	Note
2387.07	56.05	V	74.00	-17.95	Pk	207	125	Figure 54: DH1-2402MHz
2390.00	42.83	V	54.00	-11.17	Avg	207	125	Figure 55: DH1-2402MHz
2382.99	55.87	H	74.00	-18.13	Pk	220	231	Figure 56: DH1-2402MHz
2390.00	42.79	H	54.00	-11.21	Avg	220	231	Figure 57: DH1-2402MHz
2499.12	56.75	V	74.00	-17.25	Pk	197	161	Figure 58: DH1-2480MHz
2483.50	43.01	V	54.00	-10.99	Avg	197	161	Figure 59: DH1-2480MHz
2485.02	55.85	H	74.00	-18.15	Pk	221	216	Figure 60: DH1-2480MHz
2483.50	43.05	H	54.00	-10.95	Avg	221	216	Figure 61: DH1-2480MHz
2384.65	55.71	V	74.00	-18.29	Pk	207	125	Figure 62: DH5-2402MHz
2390.00	42.87	V	54.00	-11.13	Avg	207	125	Figure 63: DH5-2402MHz
2370.09	55.84	H	74.00	-18.16	Pk	220	231	Figure 64: DH5-2402MHz
2390.00	42.88	H	54.00	-11.12	Avg	220	231	Figure 65: DH5-2402MHz
2486.21	57.47	V	74.00	-16.53	Pk	197	161	Figure 66: DH5-2480MHz
2483.50	43.13	V	54.00	-10.87	Avg	197	161	Figure 67: DH5-2480MHz
2498.33	57.28	H	74.00	-16.72	Pk	221	216	Figure 68: DH5-2480MHz
2483.50	43.10	H	54.00	-10.90	Avg	221	216	Figure 69: DH5-2480MHz
Note: 1. The emissions were measured at the adjacent restricted band of the fundamental signal. 2. All the band-edge measurements met the restricted band requirements of CFR47 15.205. 3. EUT was set to transmit at hopping mode.								

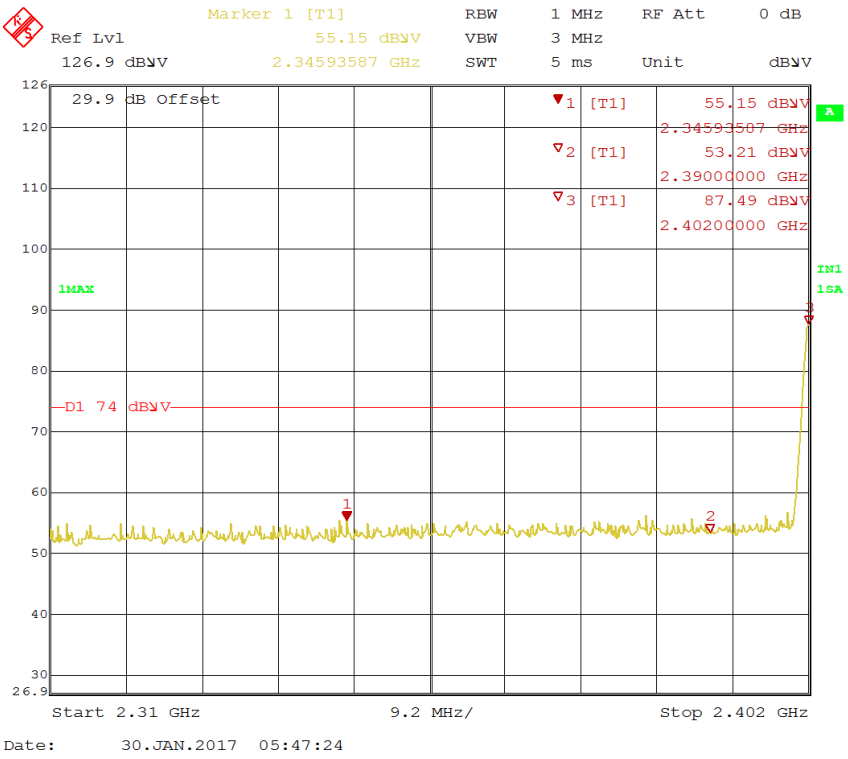


Figure 38: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH1 – Vertical (Pk)

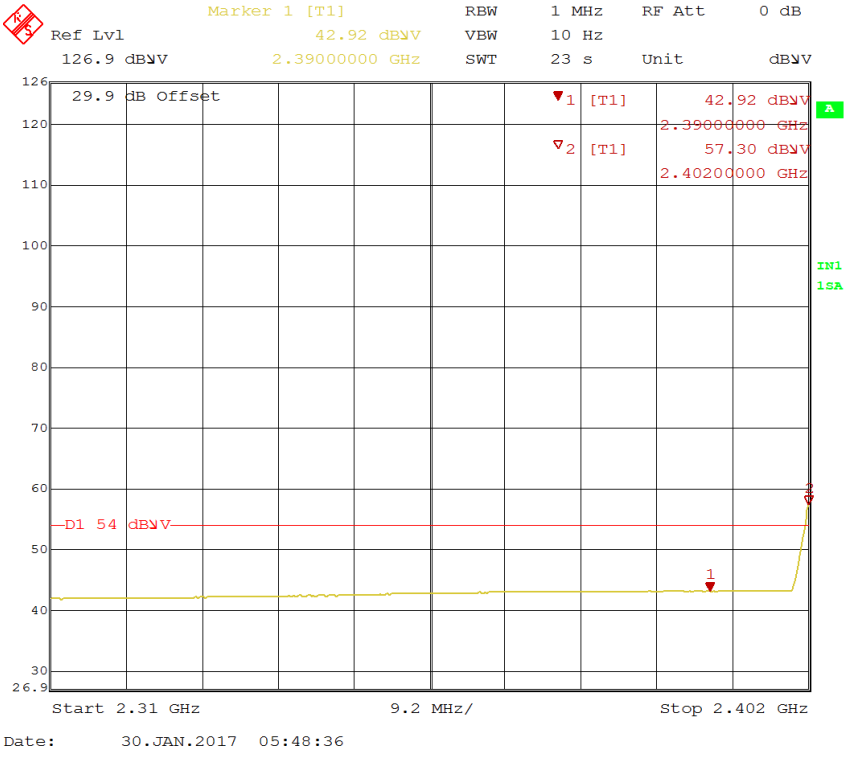


Figure 39: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH1 – Vertical (Avg)

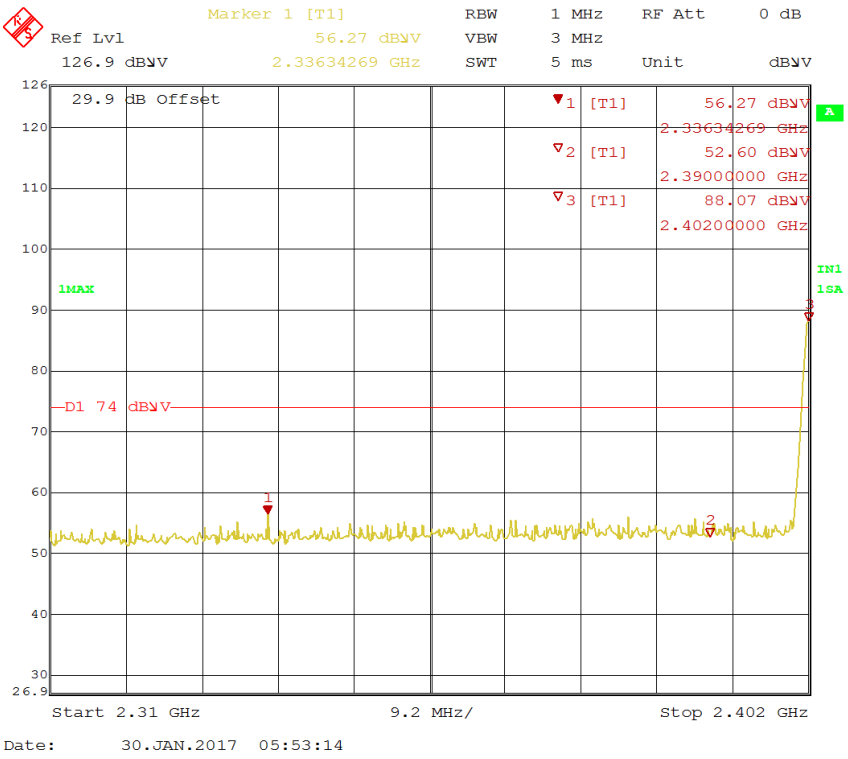


Figure 40: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH1 – Horizontal (Pk)

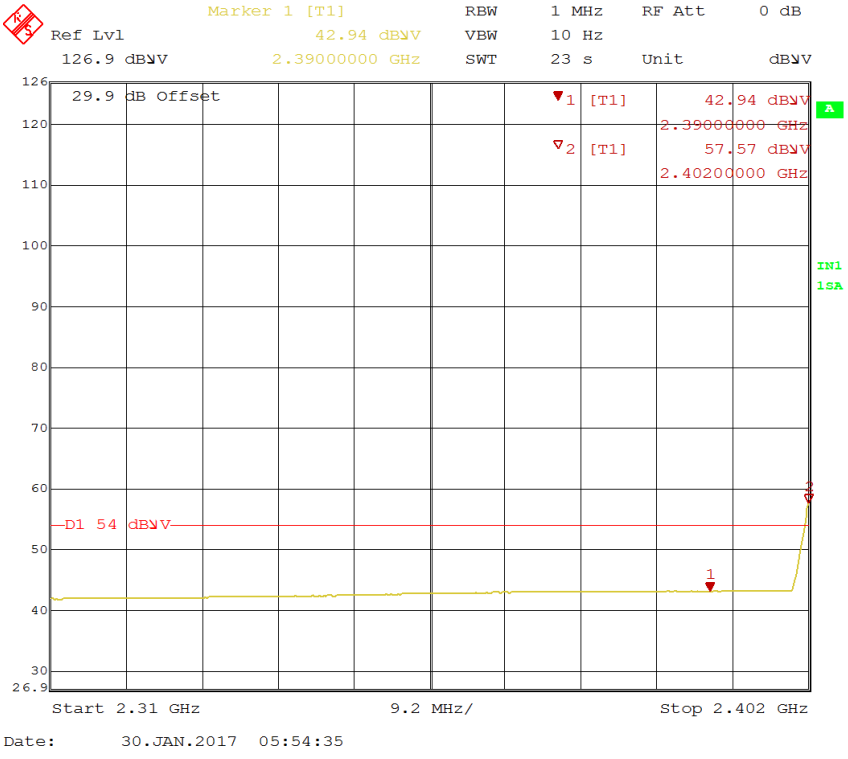


Figure 41: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH1 – Horizontal (Avg)

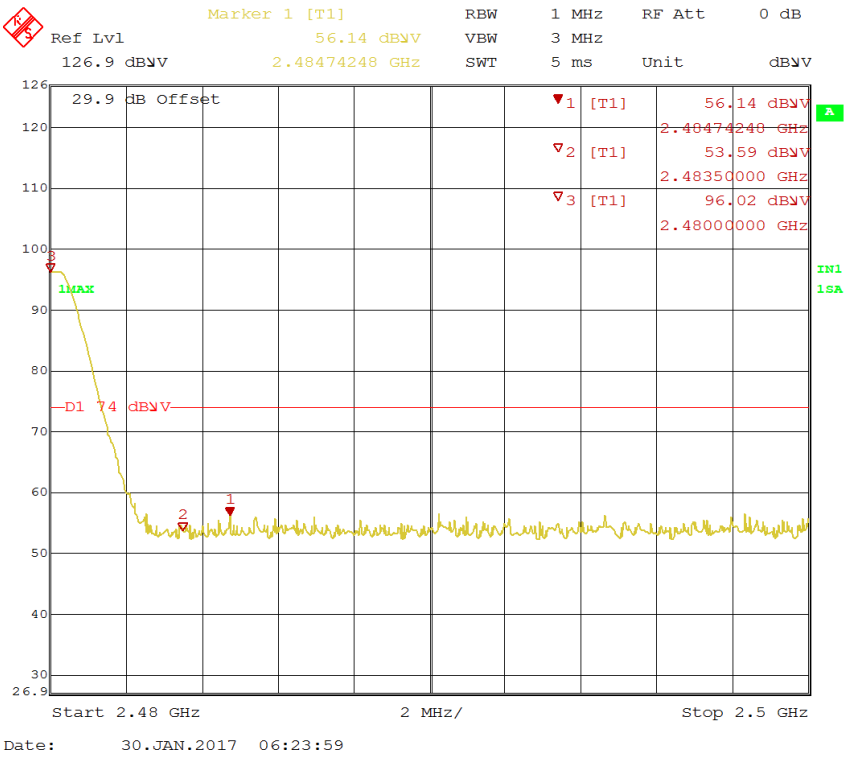


Figure 42: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH1 – Horizontal (Pk)

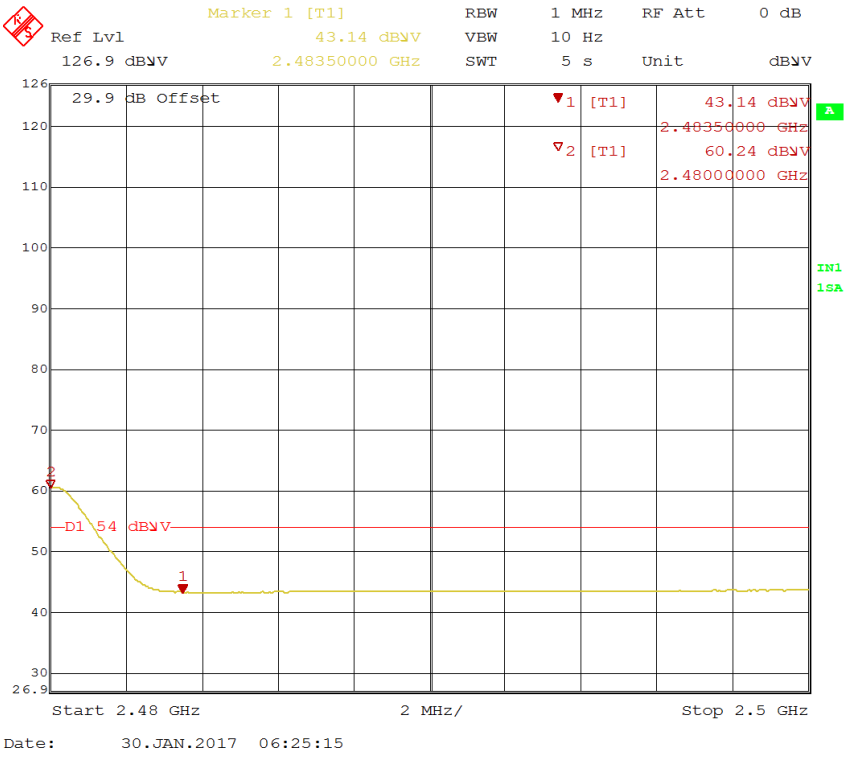


Figure 43: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH1 – Horizontal (Avg)

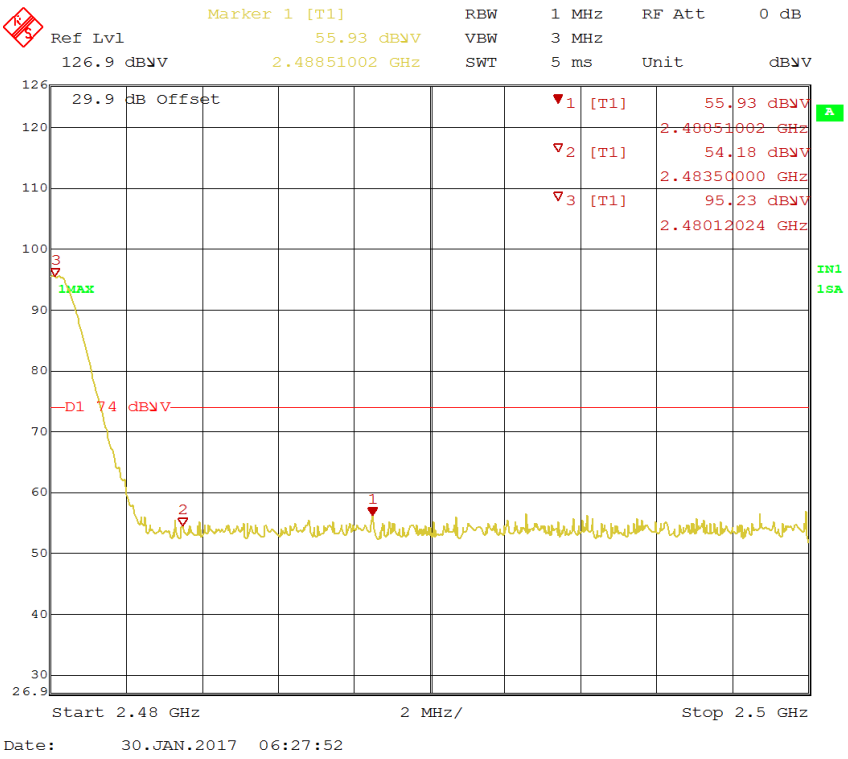


Figure 44: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH1 – Vertical (Pk)

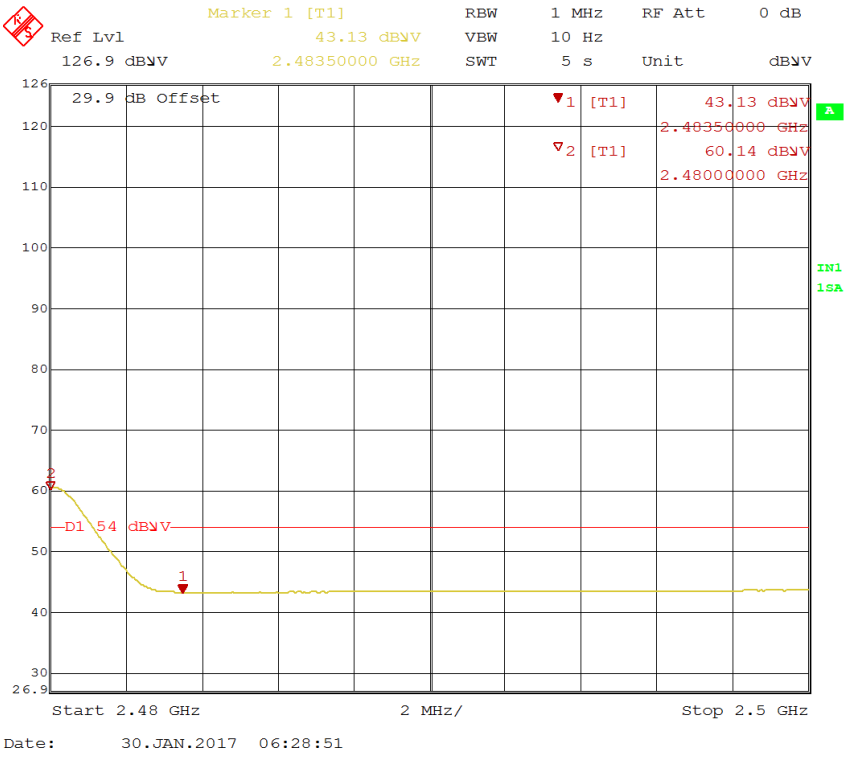


Figure 45: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH1 – Vertical (Avg)

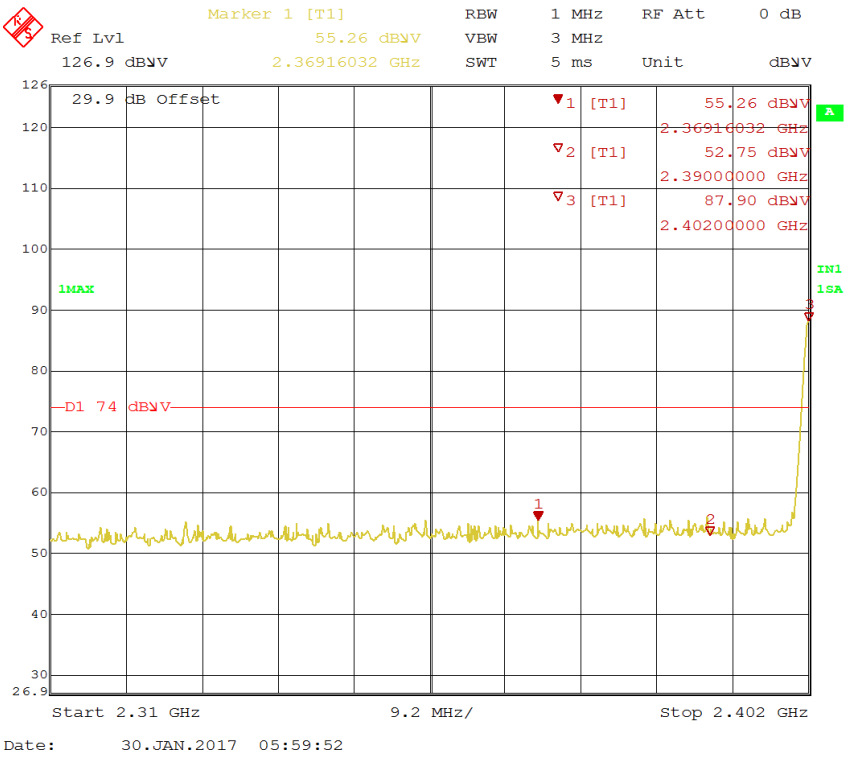


Figure 46: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH5 – Horizontal (Pk)

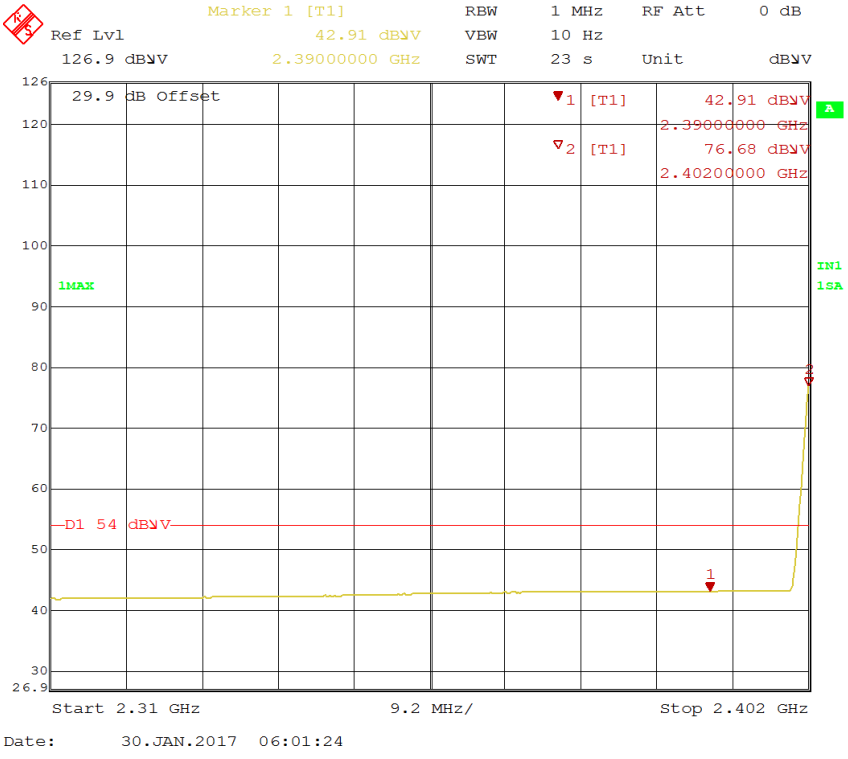


Figure 47: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH5 – Horizontal (Avg)

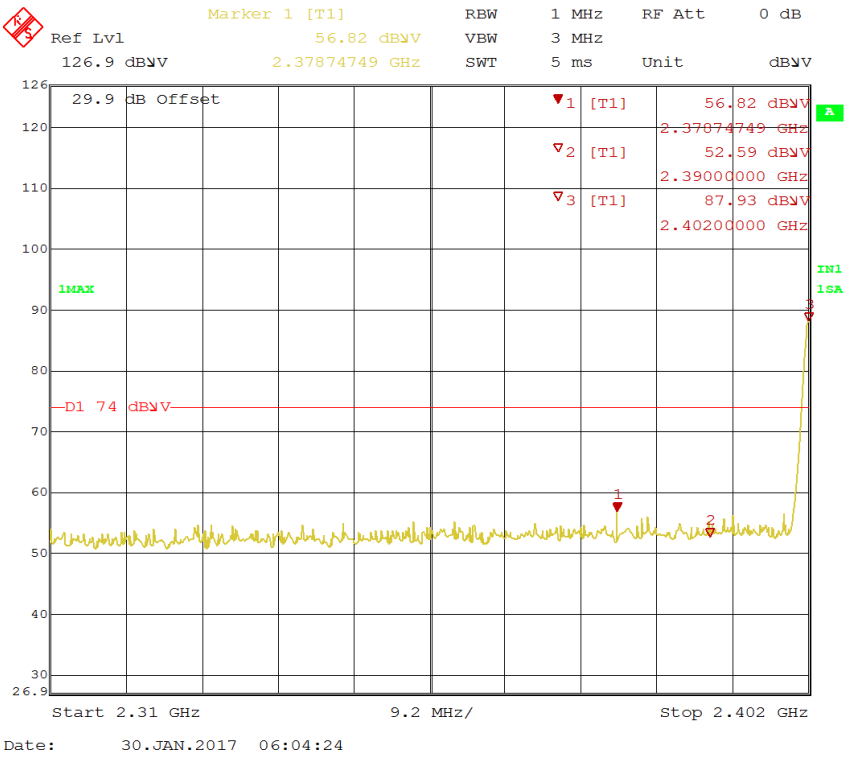


Figure 48: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH5 – Vertical (Pk)

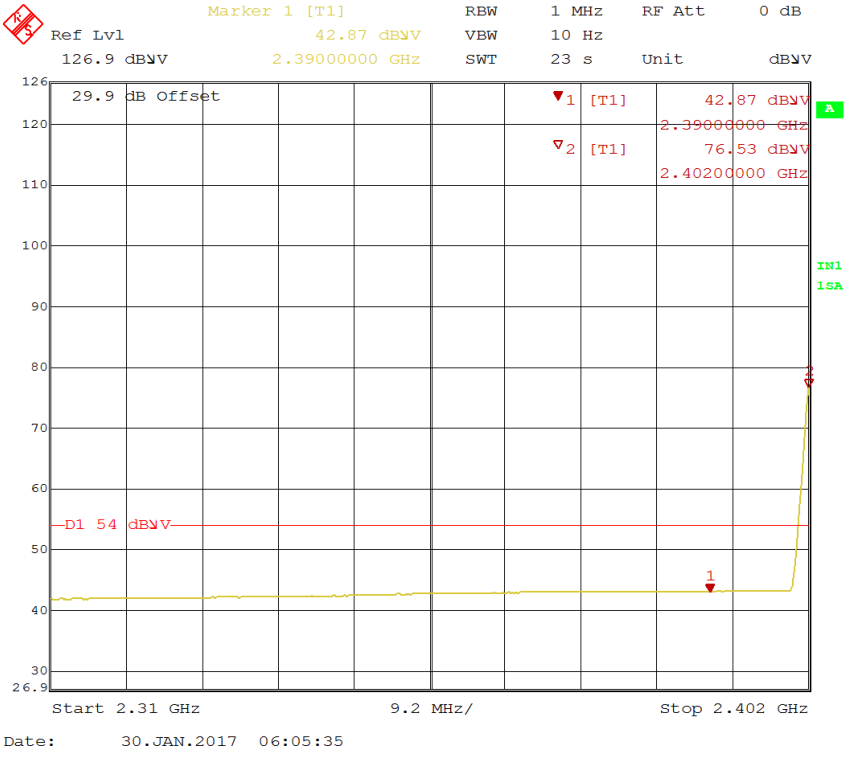


Figure 49: Radiated Emission at the 2390MHz Edge for Channel 2402MHz at DH5 – Vertical (Avg)

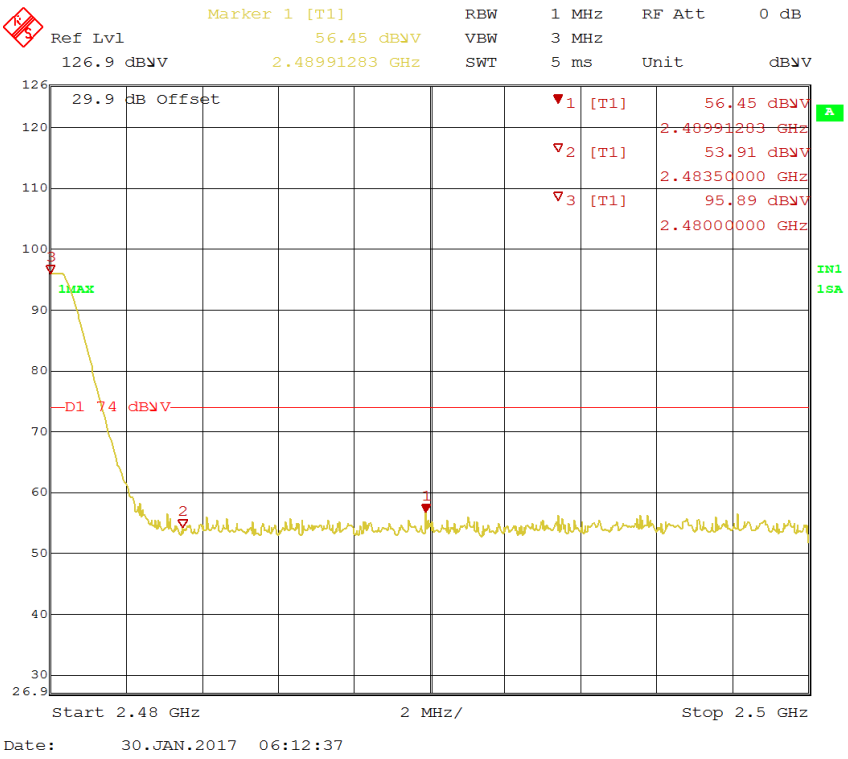


Figure 50: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH5 – Vertical (Pk)

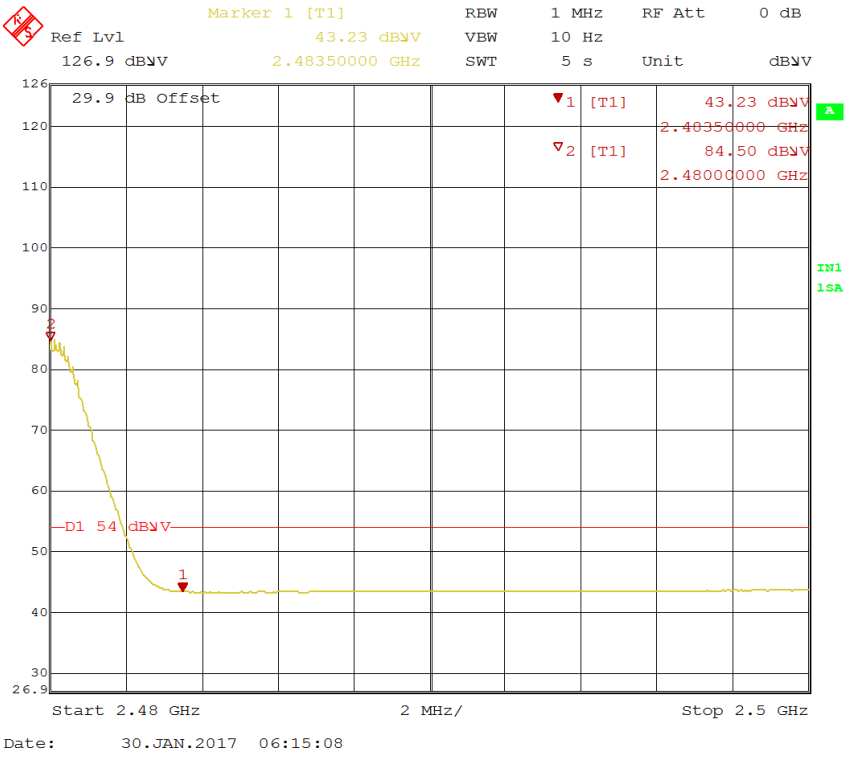


Figure 51: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH5 – Vertical (Avg)

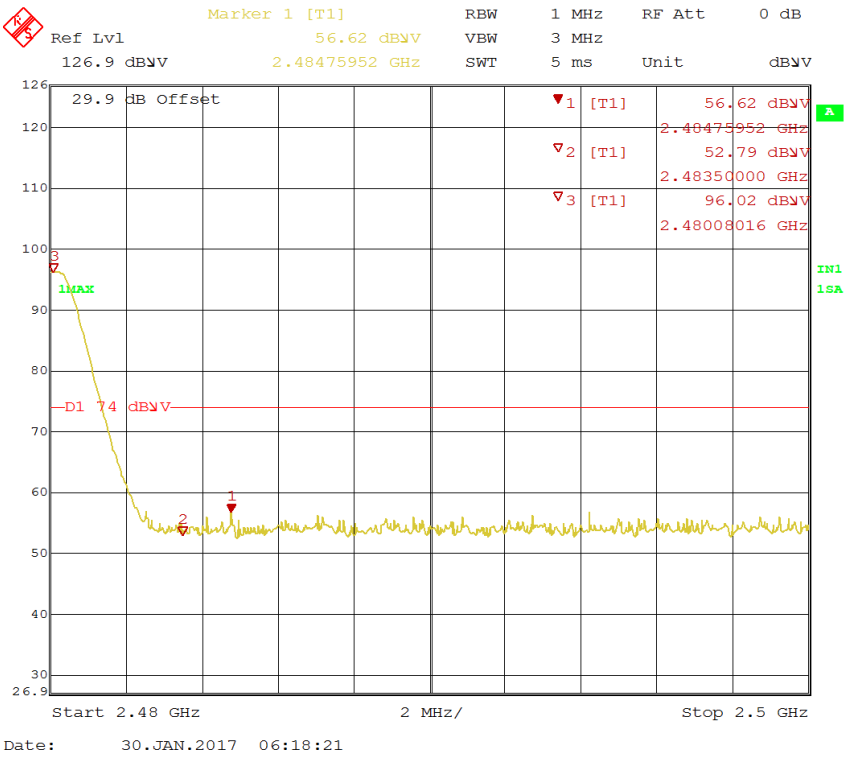


Figure 52: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH5 – Horizontal (Pk)

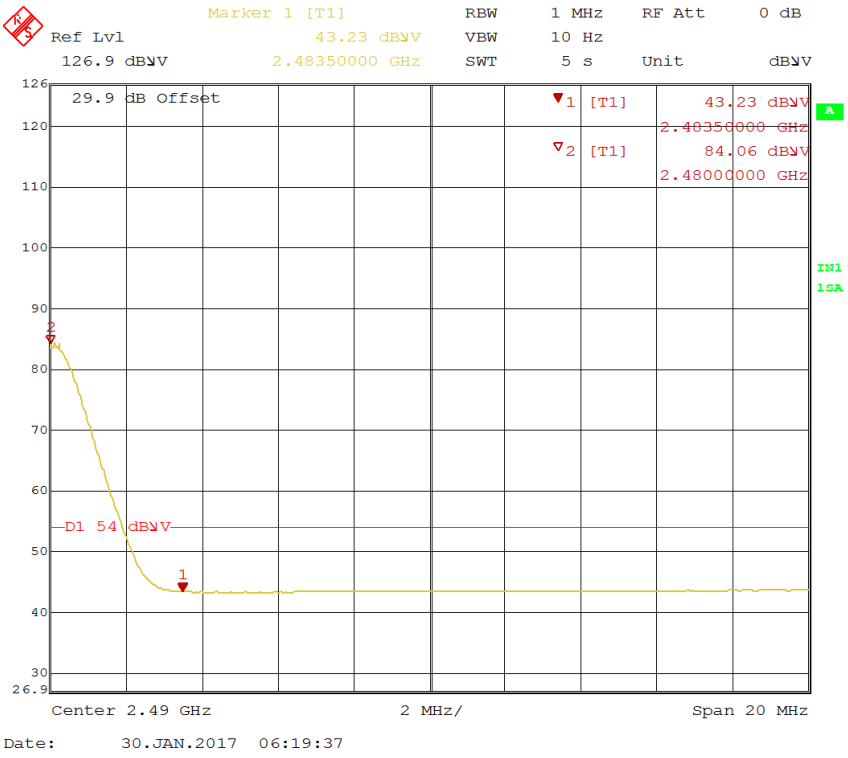


Figure 53: Radiated Emission at the 2483.5MHz Edge for Channel 2480MHz at DH5 – Horizontal (Avg)

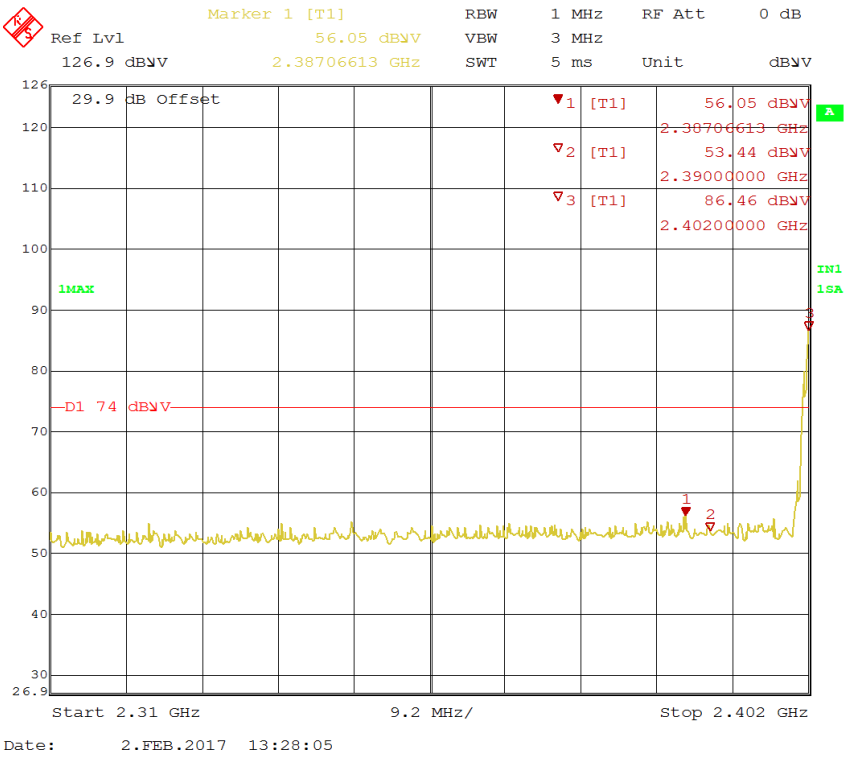


Figure 54: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH1 Hopping – Vertical (Pk)

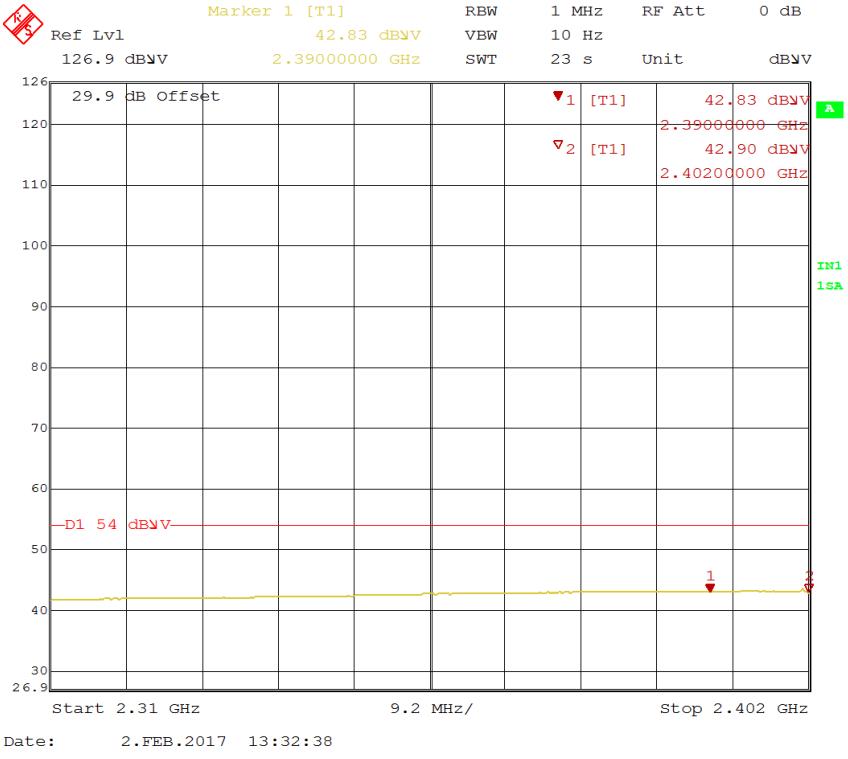


Figure 55: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH1 Hopping – Vertical (Avg)

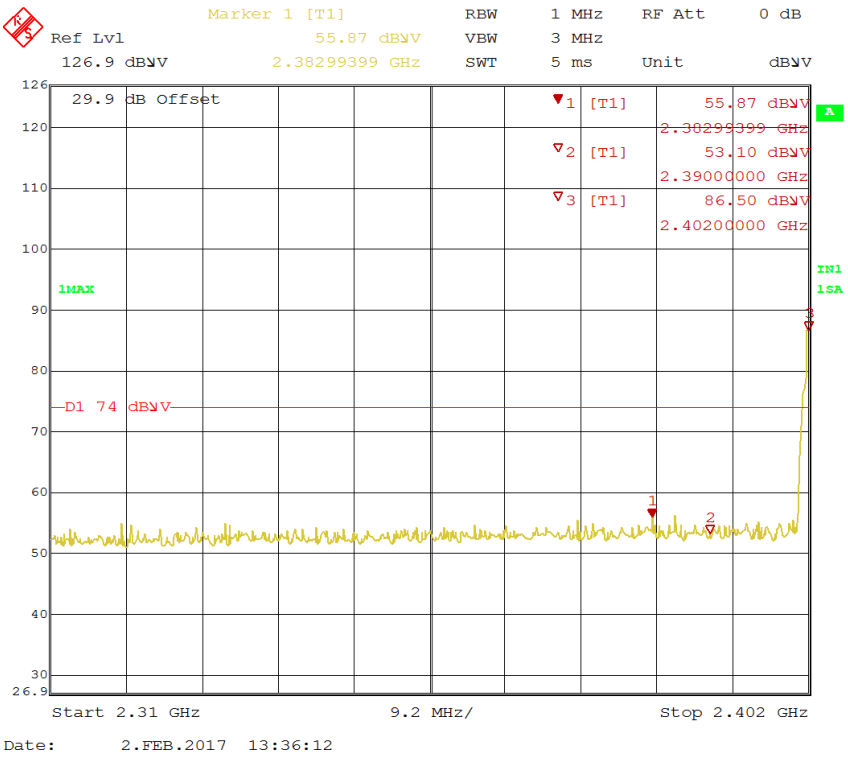


Figure 56: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH1 Hopping – Horizontal (Pk)

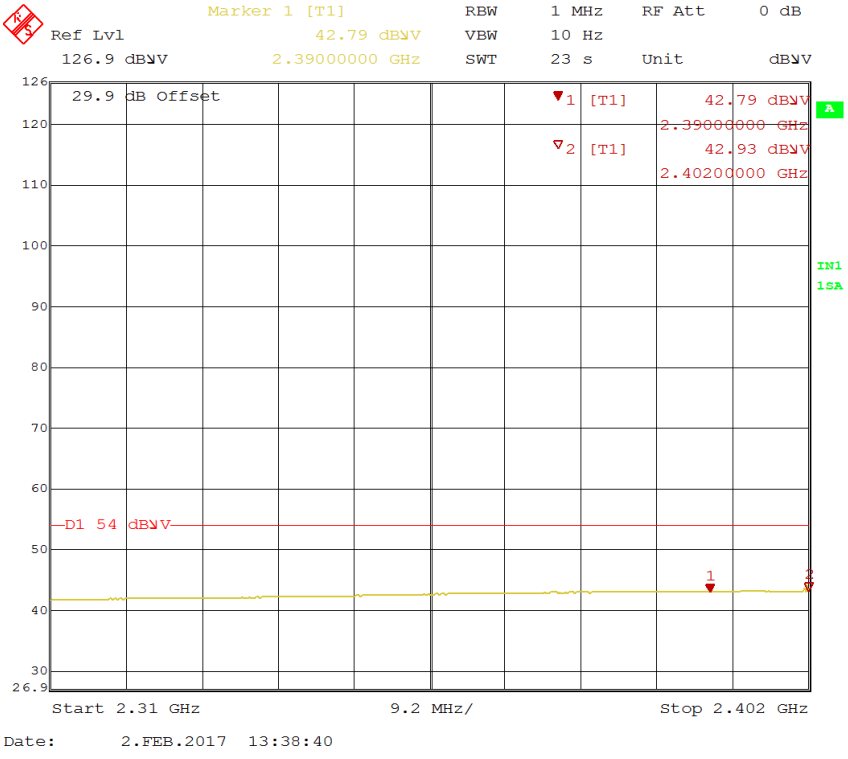


Figure 57: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH1 Hopping – Horizontal (Avg)

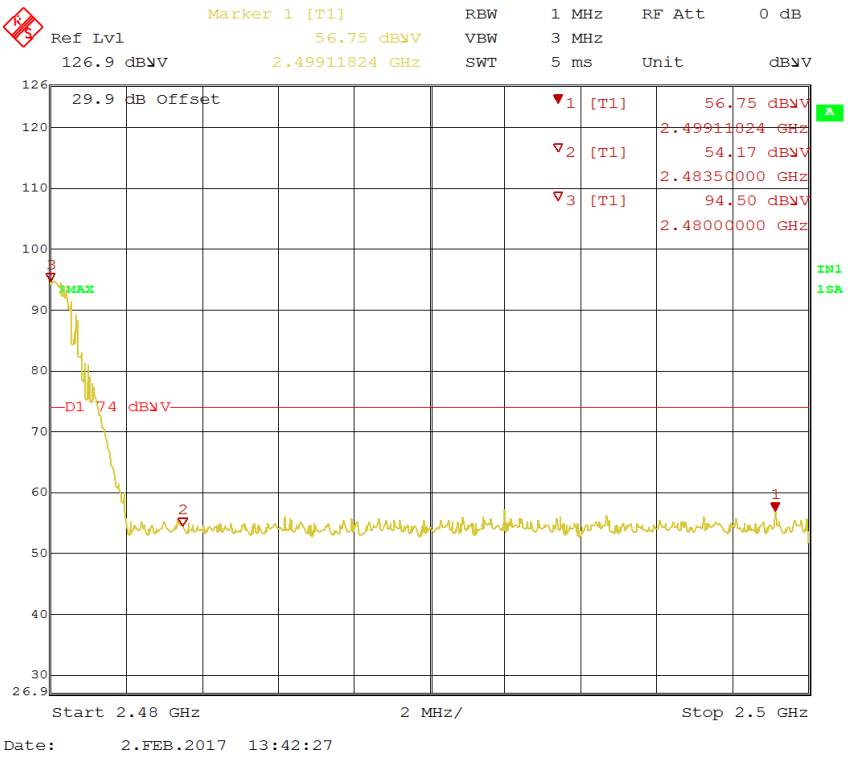


Figure 58: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH1 Hopping – Vertical (Pk)

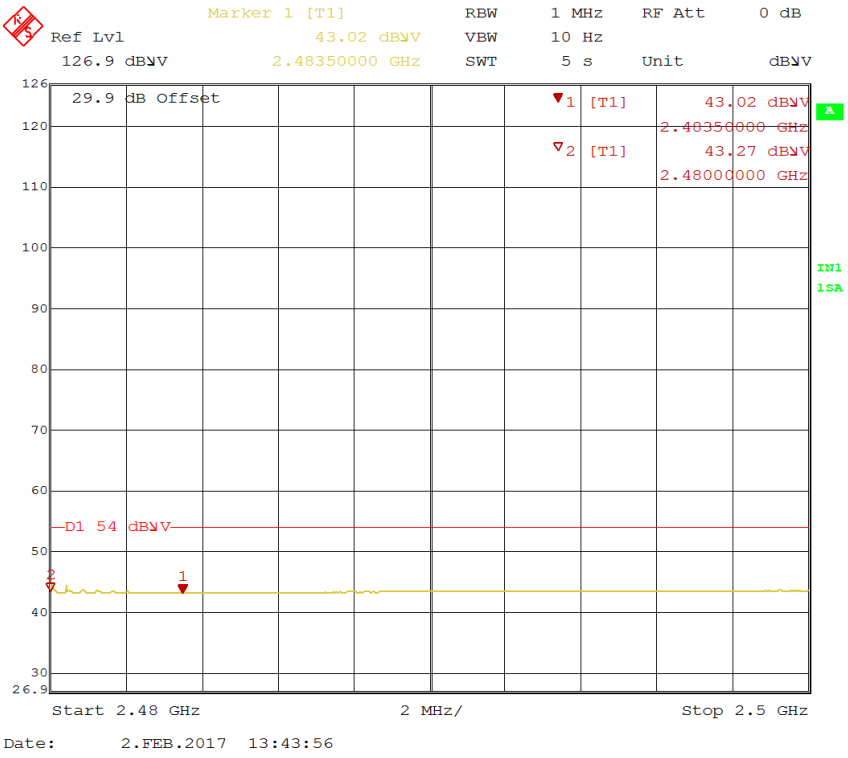


Figure 59: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH1 Hopping – Vertical (Avg)

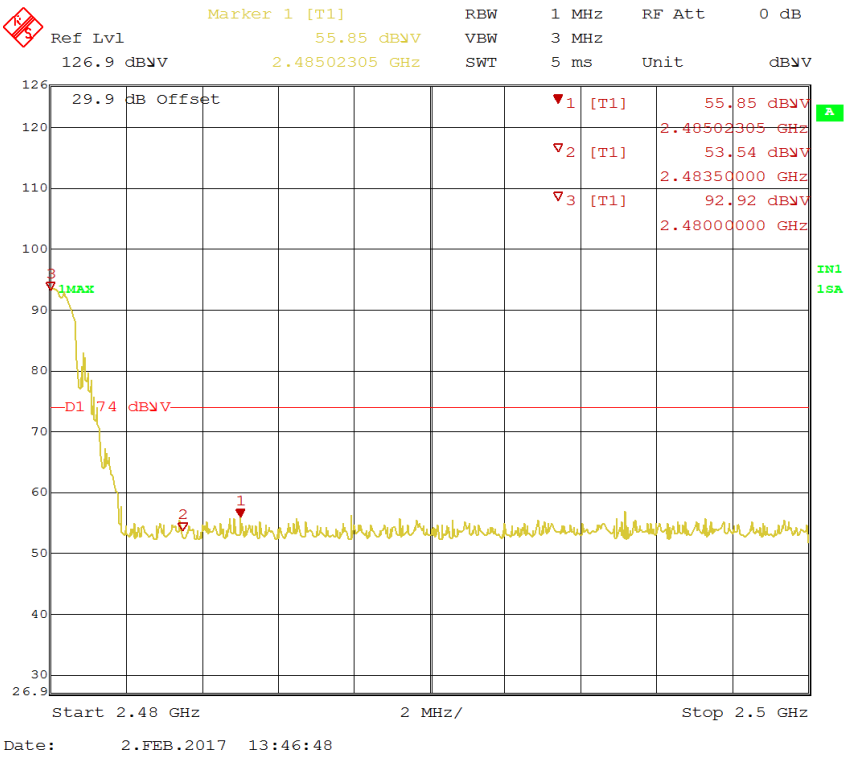


Figure 60: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH1 Hopping – Horizontal (Pk)

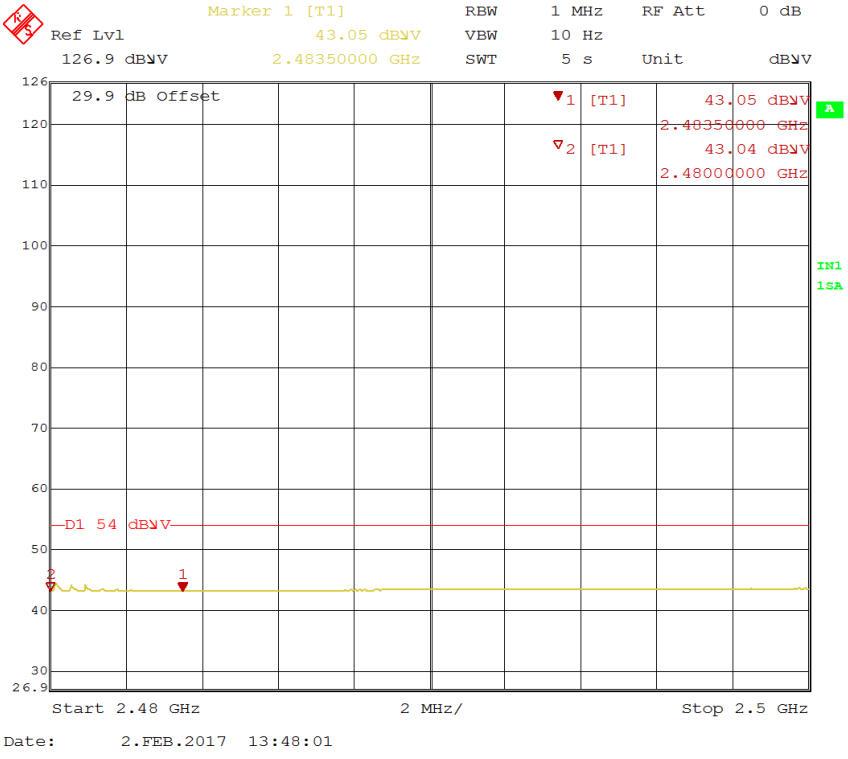


Figure 61: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH1 Hopping – Horizontal (Avg)

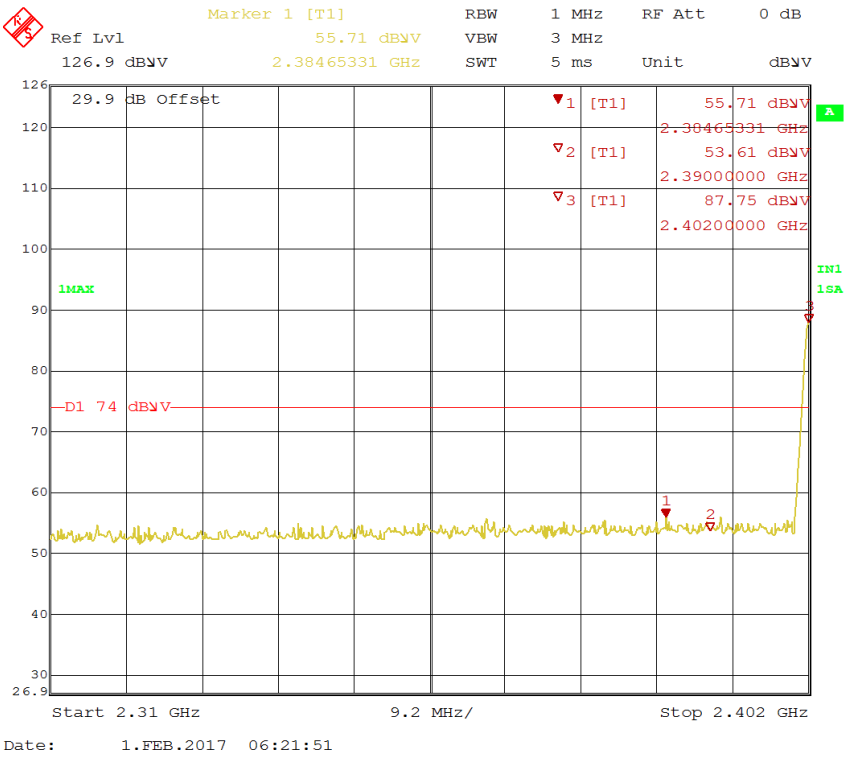


Figure 62: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH5 Hopping – Vertical (Pk)

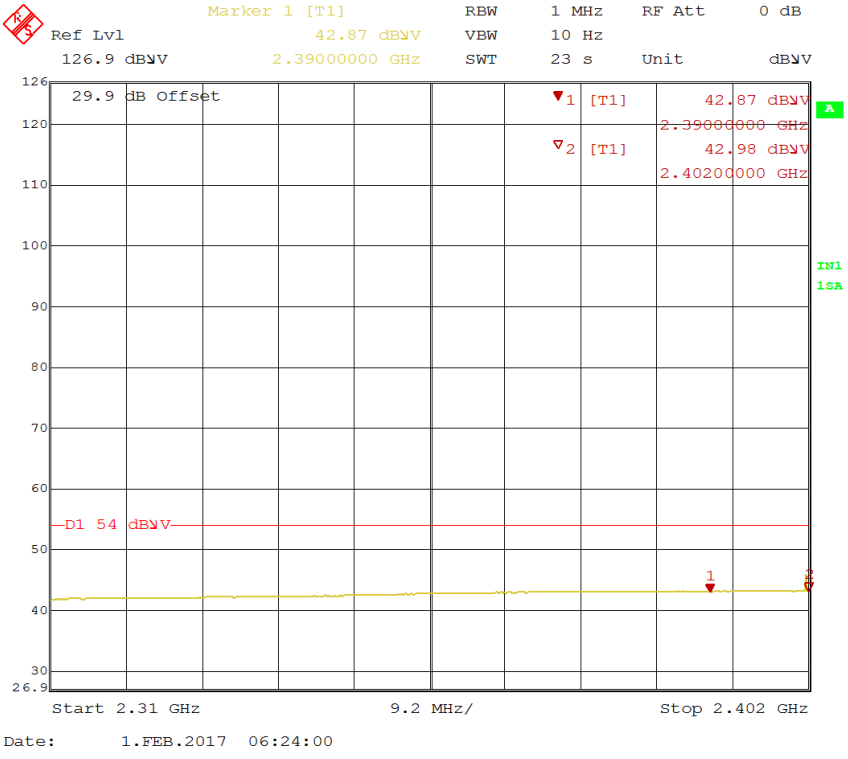


Figure 63: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH5 Hopping – Vertical (Avg)

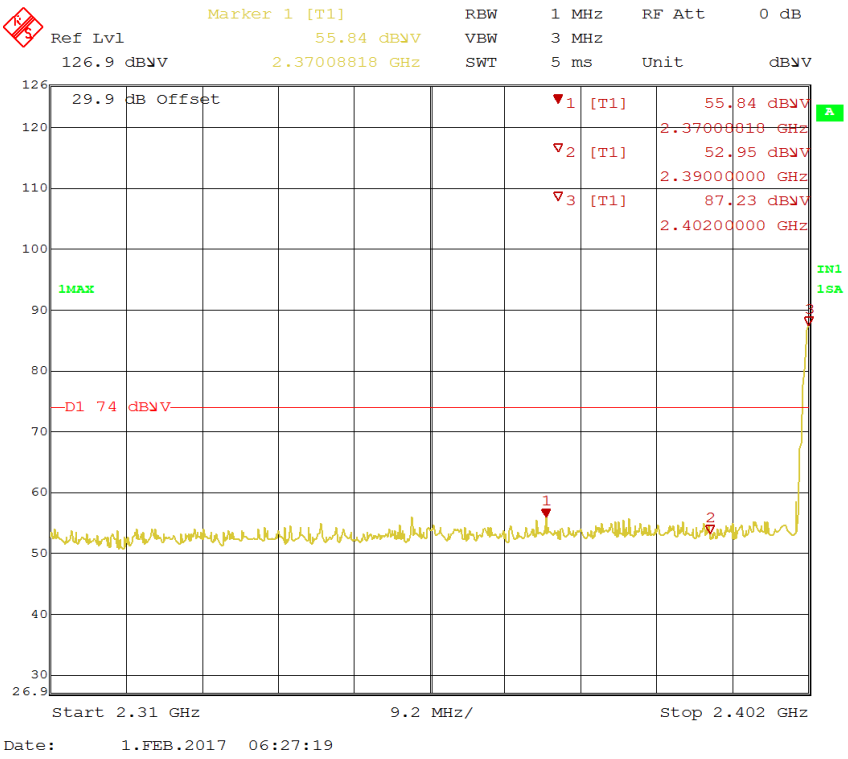


Figure 64: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH5 Hopping – Horizontal (Pk)

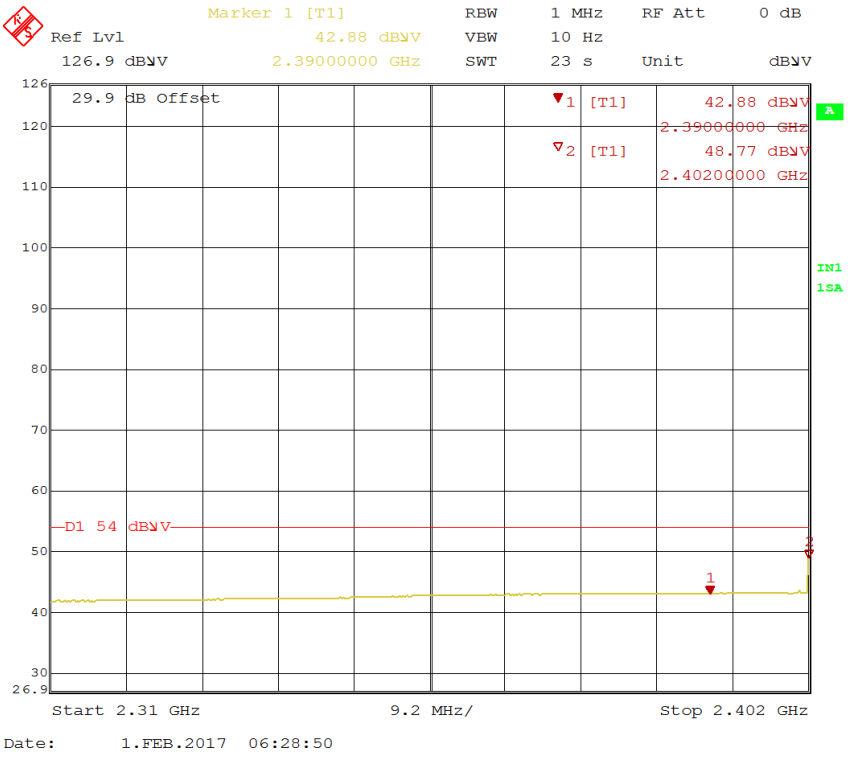


Figure 65: Rad Emission at the 2390MHz Edge for Ch 2402MHz at DH5 Hopping – Horizontal (Avg)

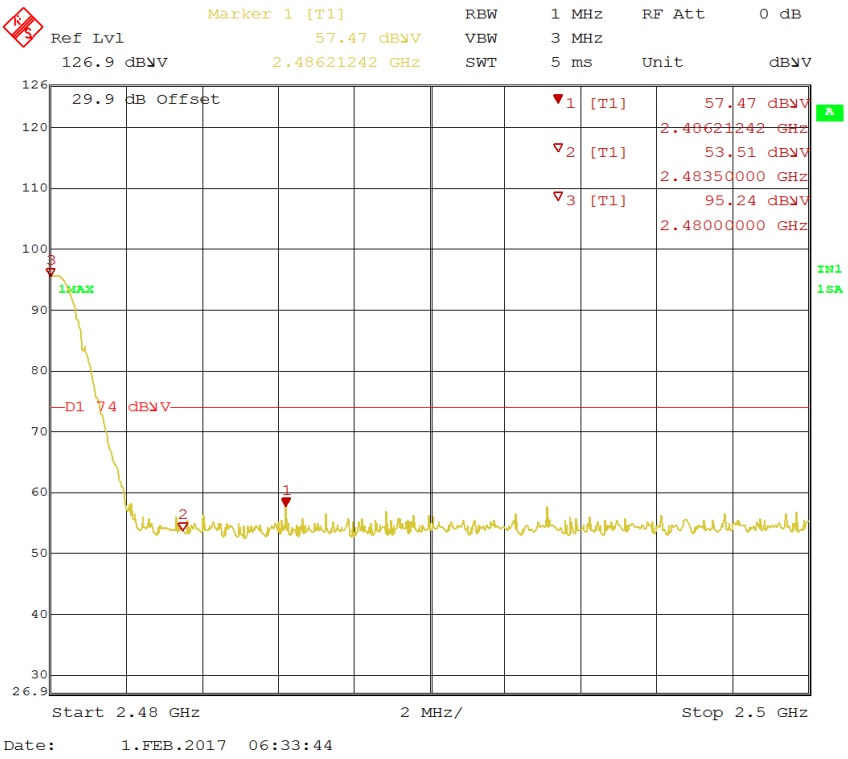


Figure 66: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH5 Hopping – Vertical (Pk)

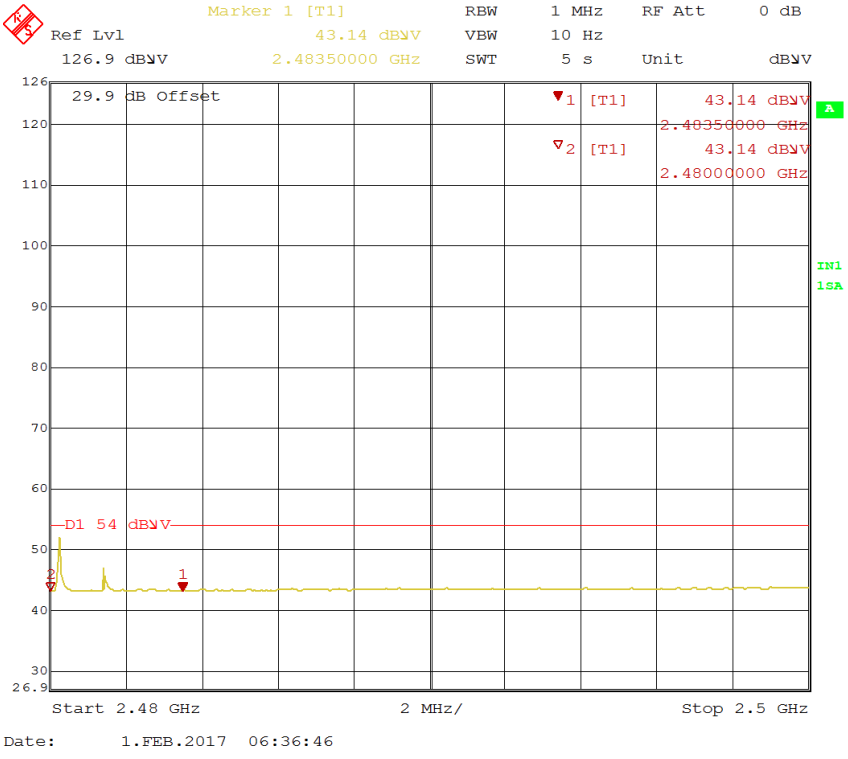


Figure 67: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH5 Hopping – Vertical (Avg)

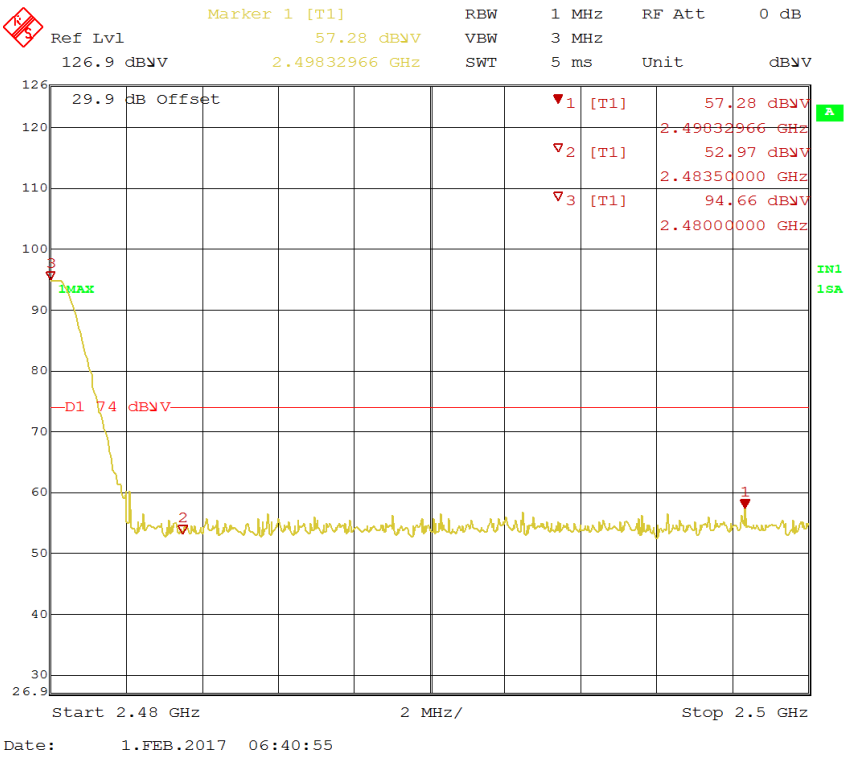


Figure 68: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH5 Hopping – Horizontal (Pk)

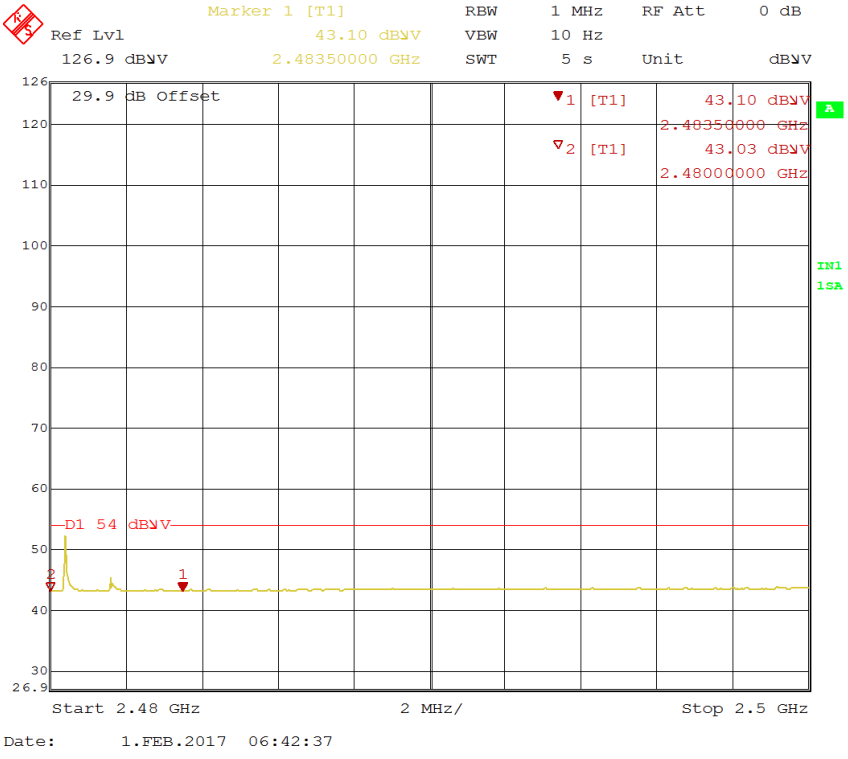


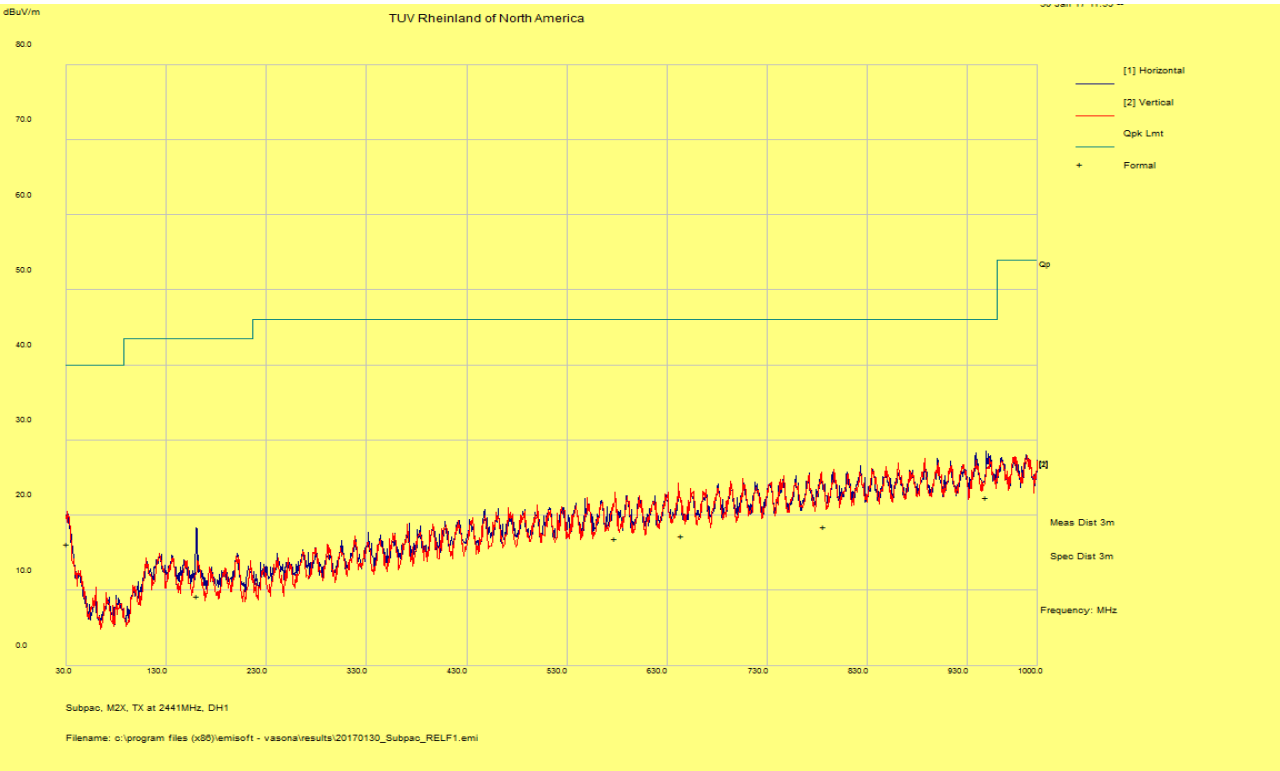
Figure 69: Rad Emission at the 2483.5MHz Edge for Ch 2480MHz at DH5 Hopping – Horizontal (Avg)

SOP 1 Radiated Emissions — Tracking # 31663775.001 Page 1 of 14

EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Kerwinn Corpuz

30 MHz – 1 GHz Transmit at 2441 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
161.12	22.59	2.23	-15.60	9.22	QP	H	350	82	43.50	-34.28
949.31	21.52	4.10	-3.23	22.39	QP	H	181	358	46.00	-23.61
31.44	22.89	1.57	-8.24	16.23	QP	V	106	308	40.00	-23.77
578.91	22.10	3.38	-8.54	16.94	QP	V	116	154	46.00	-29.06
644.61	21.52	3.52	-7.71	17.33	QP	V	380	22	46.00	-28.67
787.41	20.54	3.82	-5.83	18.52	QP	V	117	358	46.00	-27.48



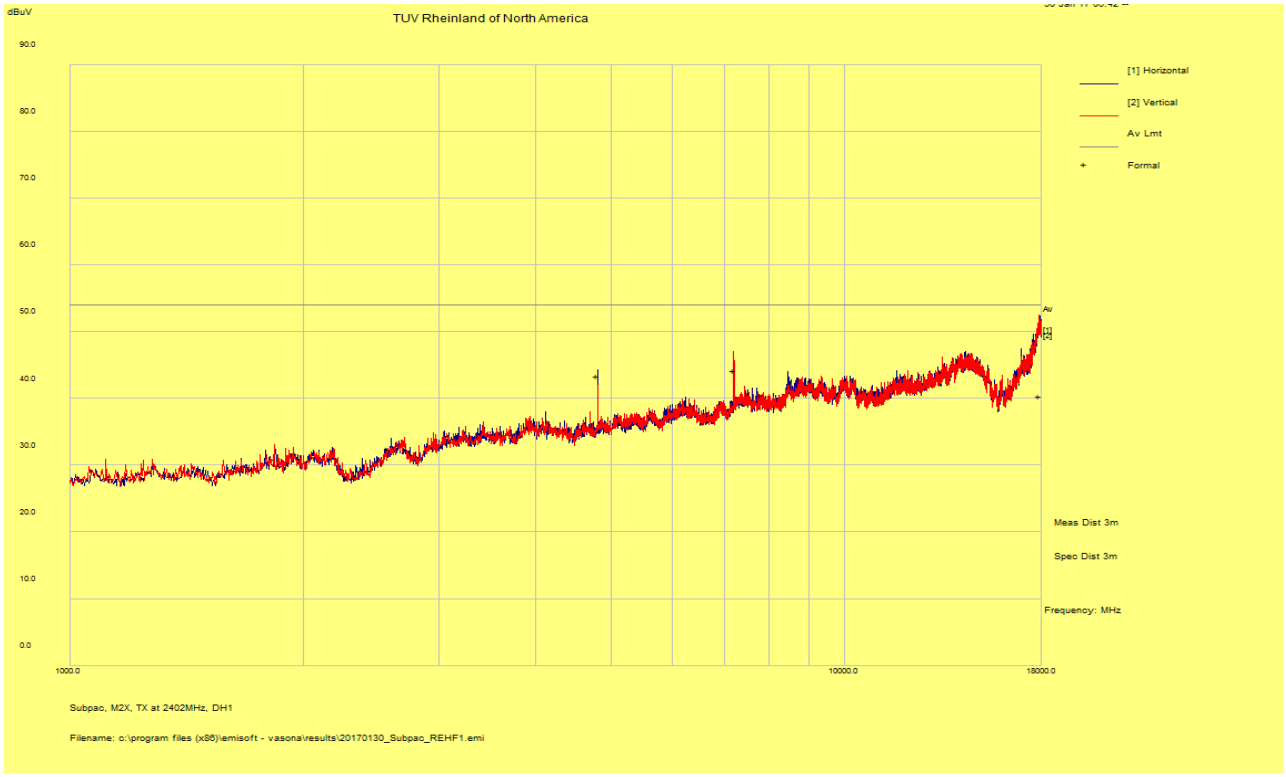
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: 1. Worst case was observed on Mid channel of DH1 mode.
2. No significant emission was observed below 30MHz.
3. To reduce complexity and bulkiness of the report Worst case Plots is placed in the report.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 2 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

1 – 18 GHz Transmit at 2402 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
4804.16	61.72	1.75	-20.11	43.36	Average	H	140	164	54.00	-10.64
7206.32	58.53	2.20	-16.51	44.22	Average	V	170	184	54.00	-9.78
17884.64	40.14	3.71	-3.45	40.40	Average	V	215	56	54.00	-13.60



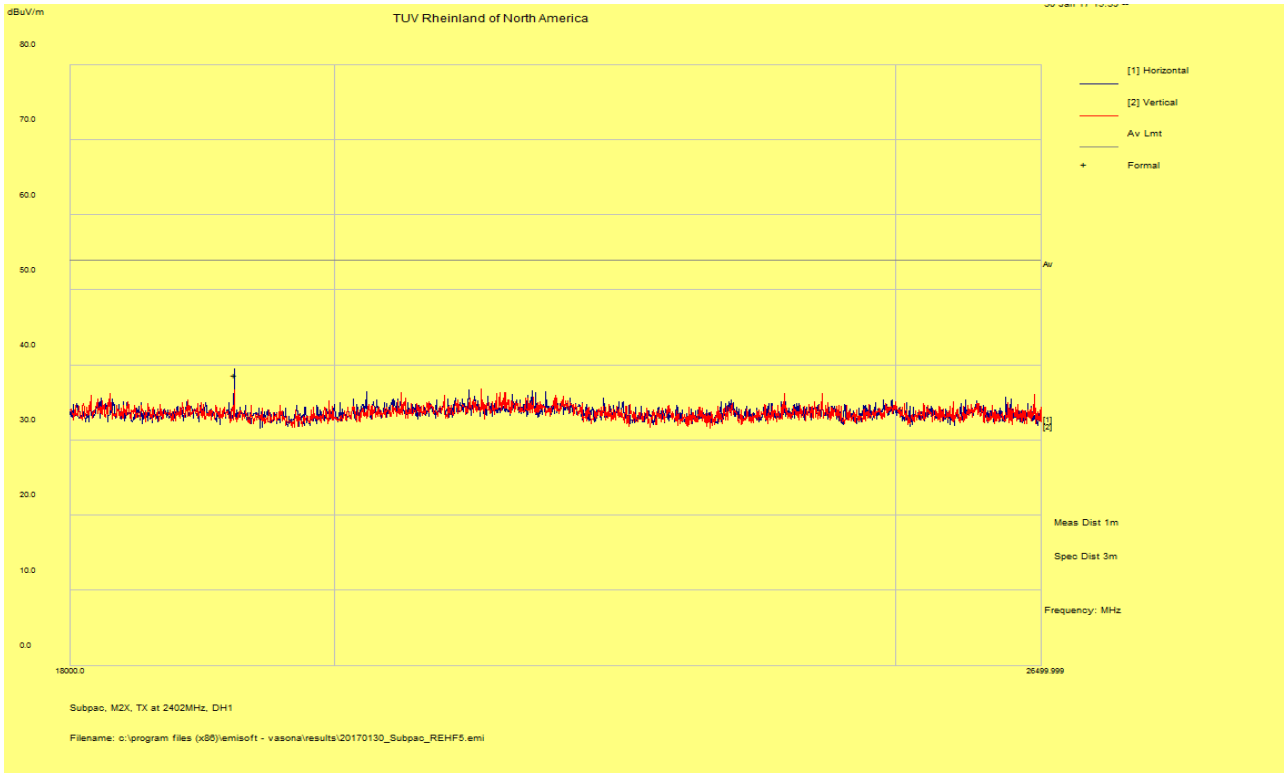
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH1

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 3 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

18 – 26 GHz Transmit at 2402 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19216.85	40.57	7.12	-8.96	38.74	Average	H	150	134	54.00	-15.27



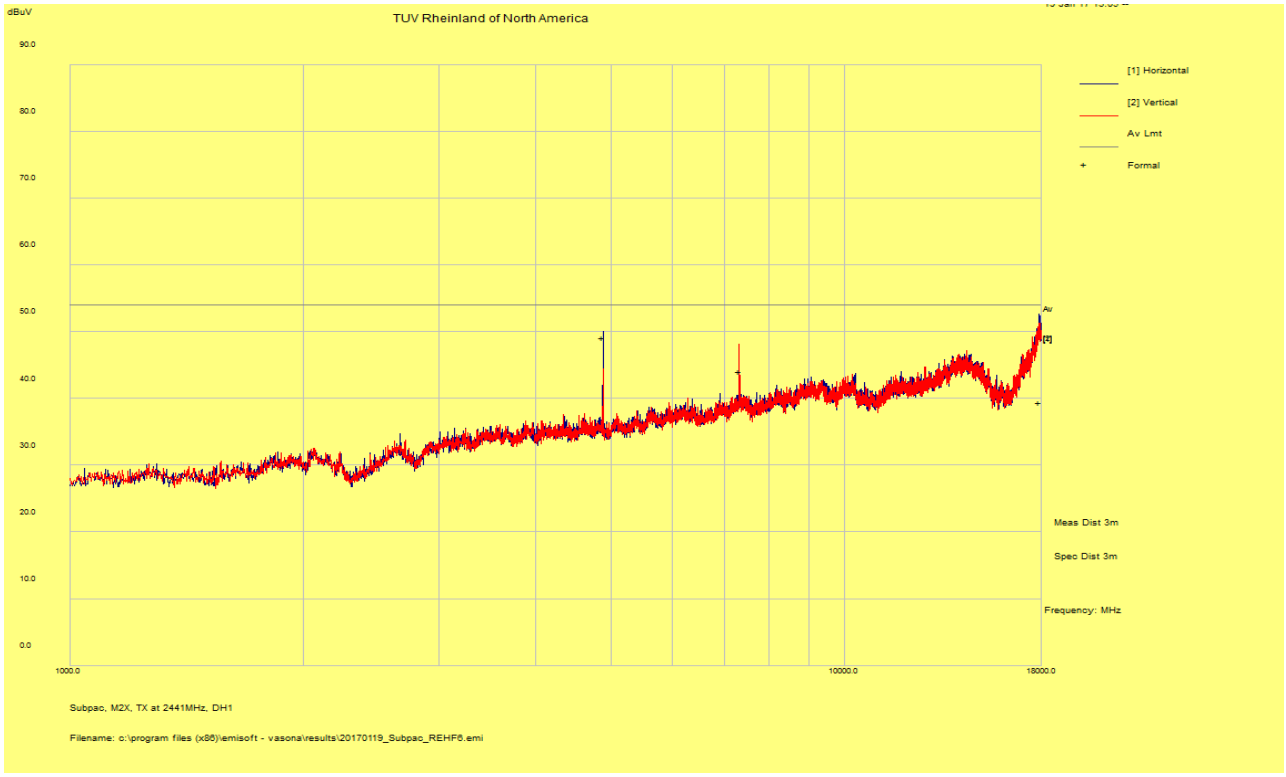
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH1.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 4 of 14	
EUT Name	Subpac Audio Device	**Date**	January 19, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 43%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

1 – 18 GHz Transmit at 2441 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
4882.22	67.44	1.77	-20.14	49.07	Average	H	167	222	54.00	-4.93
17853.59	39.28	3.72	-3.63	39.36	Average	H	177	286	54.00	-14.64
7323.29	57.48	2.21	-15.64	44.06	Average	V	141	282	54.00	-9.94



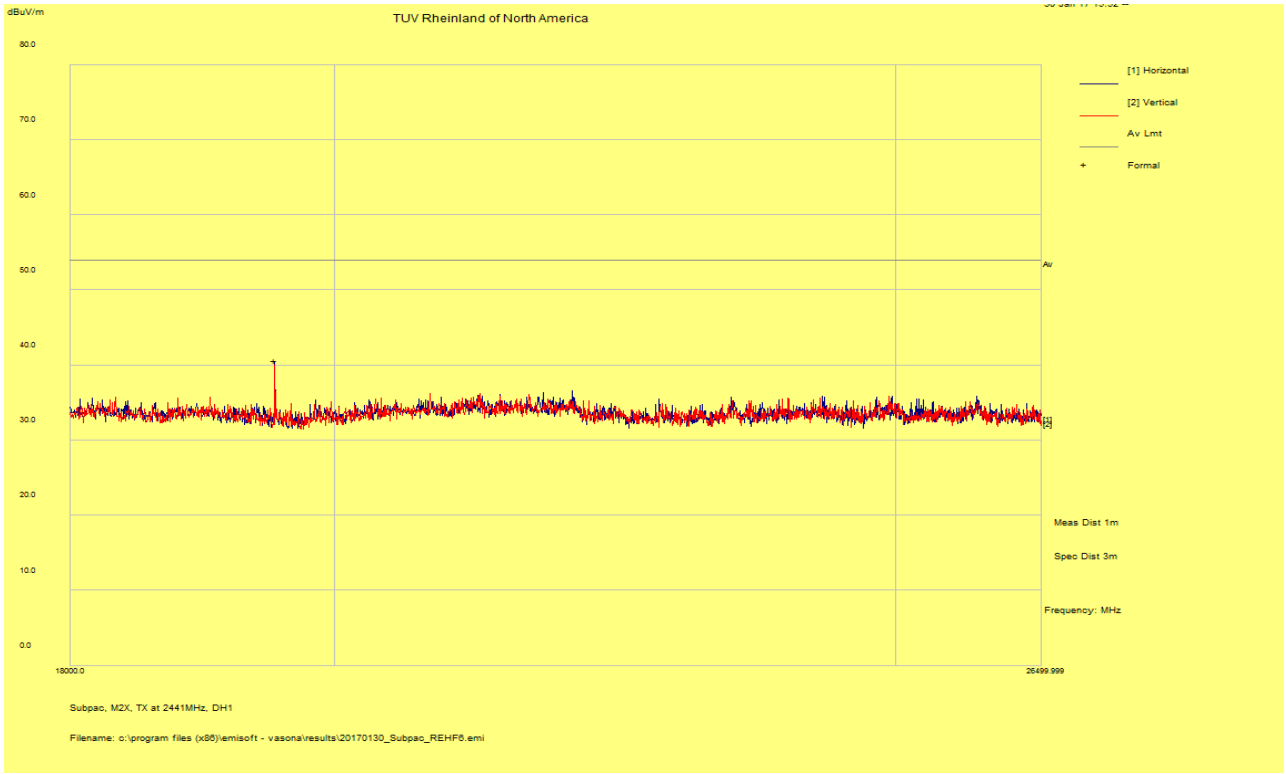
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH1.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 5 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

18 – 26 GHz Transmit at 2441 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19528.80	42.72	7.14	-9.21	40.65	Average	H	163	248	54.00	-13.35



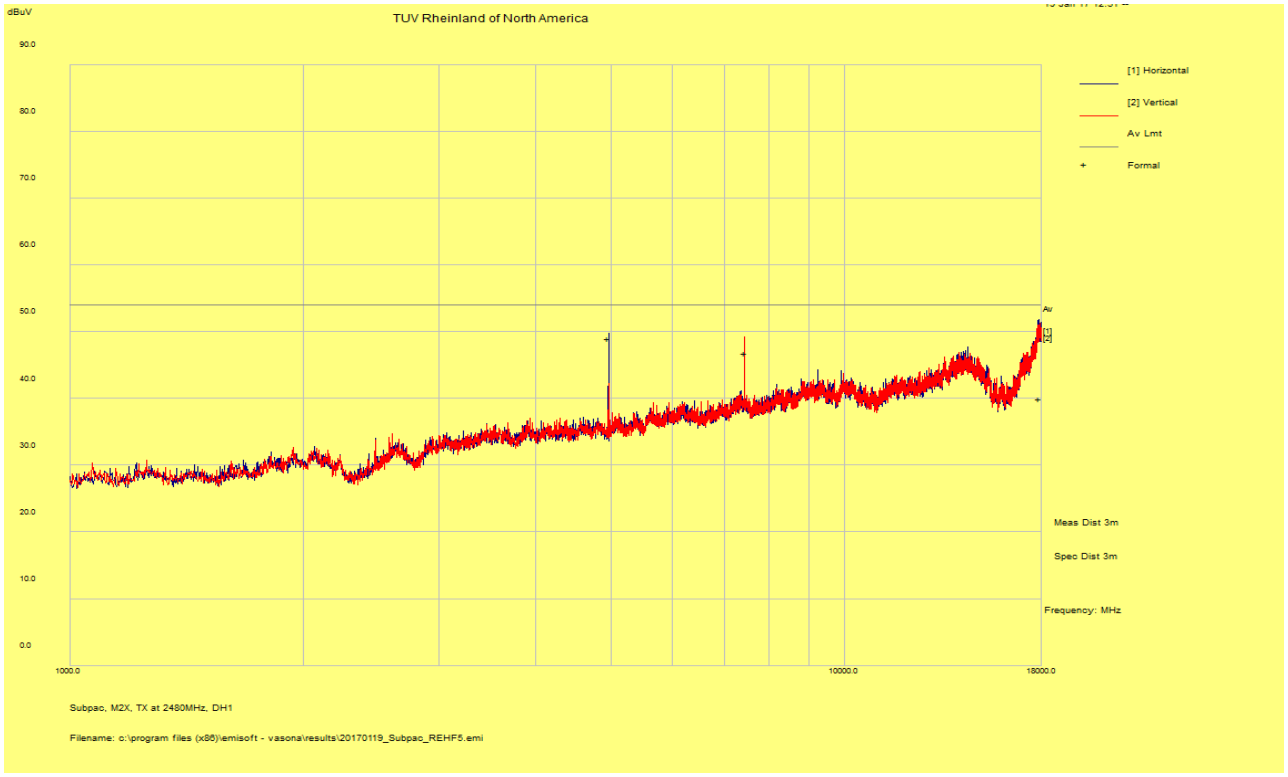
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH1.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 6 of 14	
EUT Name	Subpac Audio Device	**Date**	January 19, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 43%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

1 – 18 GHz Transmit at 2480 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
4960.21	67.41	1.79	-20.16	49.03	Average	H	253	224	54.00	-4.97
17882.31	39.66	3.71	-3.47	39.91	Average	H	121	250	54.00	-14.09
7440.20	60.17	2.23	-15.59	46.81	Average	V	100	270	54.00	-7.19



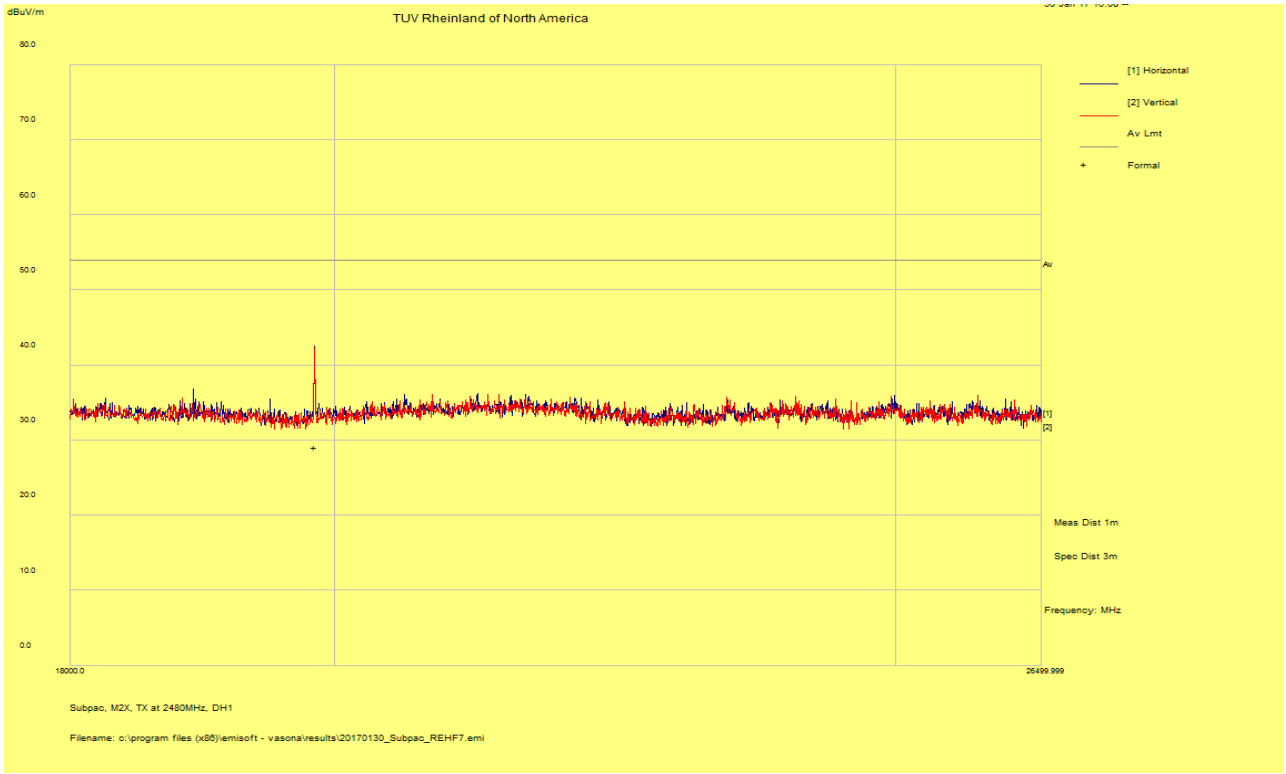
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH1.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 7 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH1	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

18 – 26 GHz Transmit at 2480 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19841.44	31.15	7.21	-9.23	29.12	Average	H	150	156	54.00	-24.88



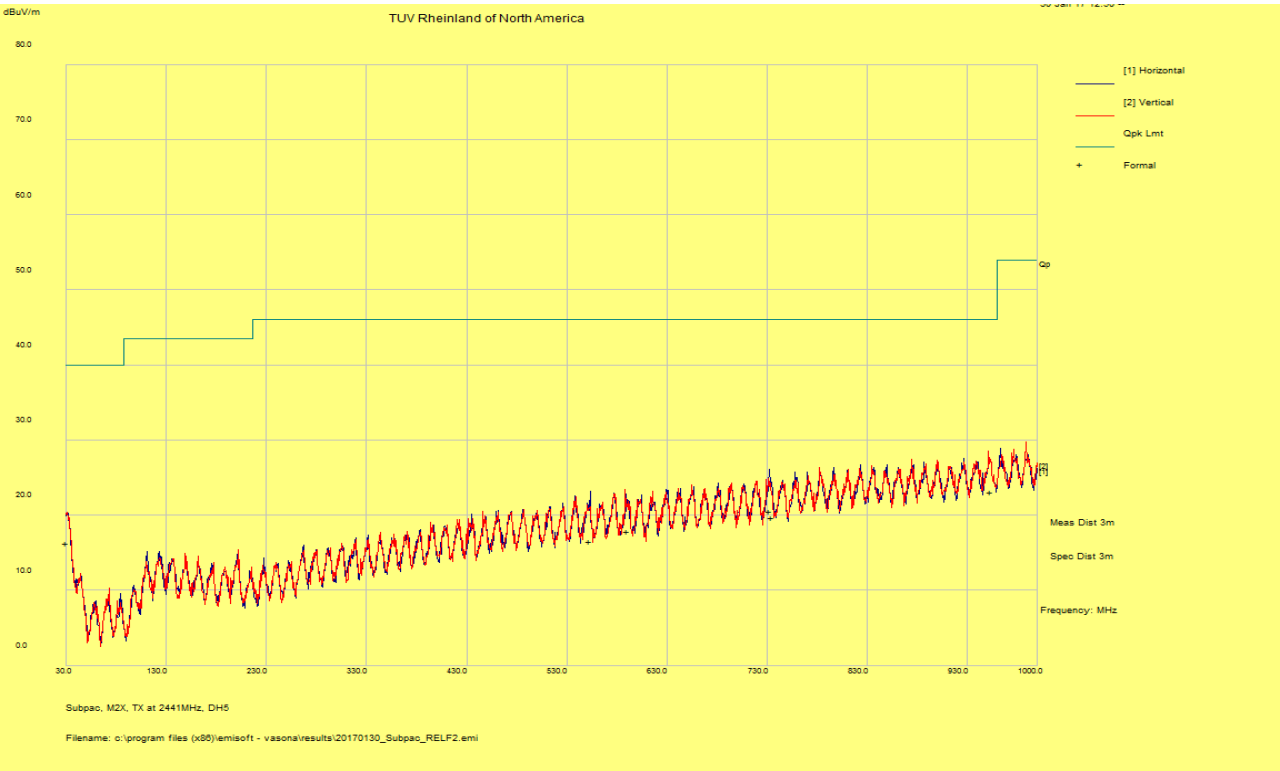
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH1.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 8 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH5	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	120 kHz/ 300 kHz
Dist/Ant Used	3m / JB3	**Performed by**	Kerwinn Corpuz

30 MHz – 1 GHz Transmit at 2441 MHz

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
553.02	22.55	3.32	-9.27	16.60	QP	H	160	334	46.00	-29.40
732.80	23.45	3.70	-6.57	20.58	QP	H	122	298	46.00	-25.42
734.37	22.55	3.70	-6.53	19.71	QP	H	314	46	46.00	-26.29
30.73	22.55	1.57	-7.76	16.36	QP	V	204	12	40.00	-23.64
590.18	23.27	3.41	-8.76	17.92	QP	V	116	80	46.00	-28.08
952.84	22.08	4.12	-3.11	23.08	QP	V	310	34	46.00	-22.92



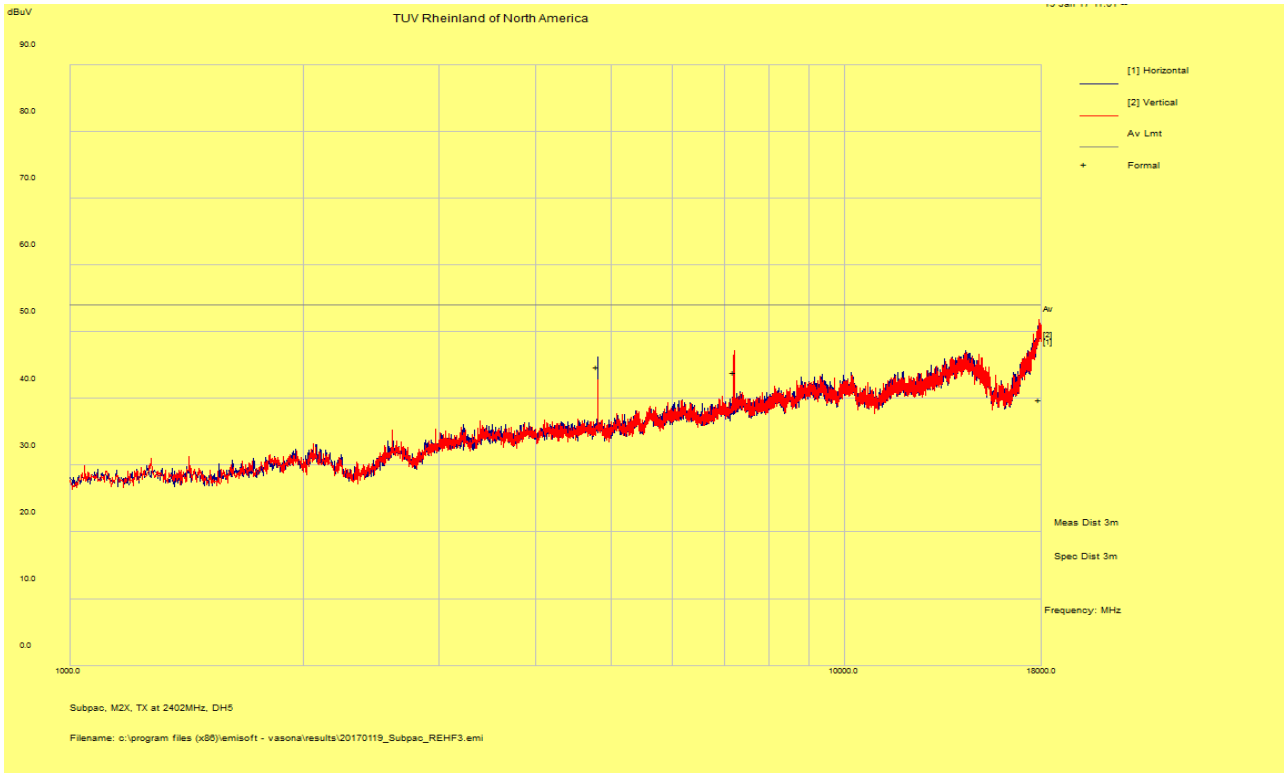
Spec Margin = E-Field QP - Limit, E-Field QP = FIM QP+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: 1. Worst case was observed on Mid channel of DH5 mode.
2. No significant emission was observed below 30MHz.
3. To reduce complexity and bulkiness of the report Worst case Plots is placed in the report.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 9 of 14	
EUT Name	Subpac Audio Device	**Date**	January 19, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 43%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH5	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

1 – 18 GHz Transmit at 2402 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
4804.23	63.16	1.75	-20.11	44.80	Average	H	115	174	54.00	-9.20
7206.30	58.25	2.20	-16.51	43.94	Average	V	139	238	54.00	-10.06
17859.73	39.69	3.72	-3.60	39.81	Average	V	157	66	54.00	-14.19



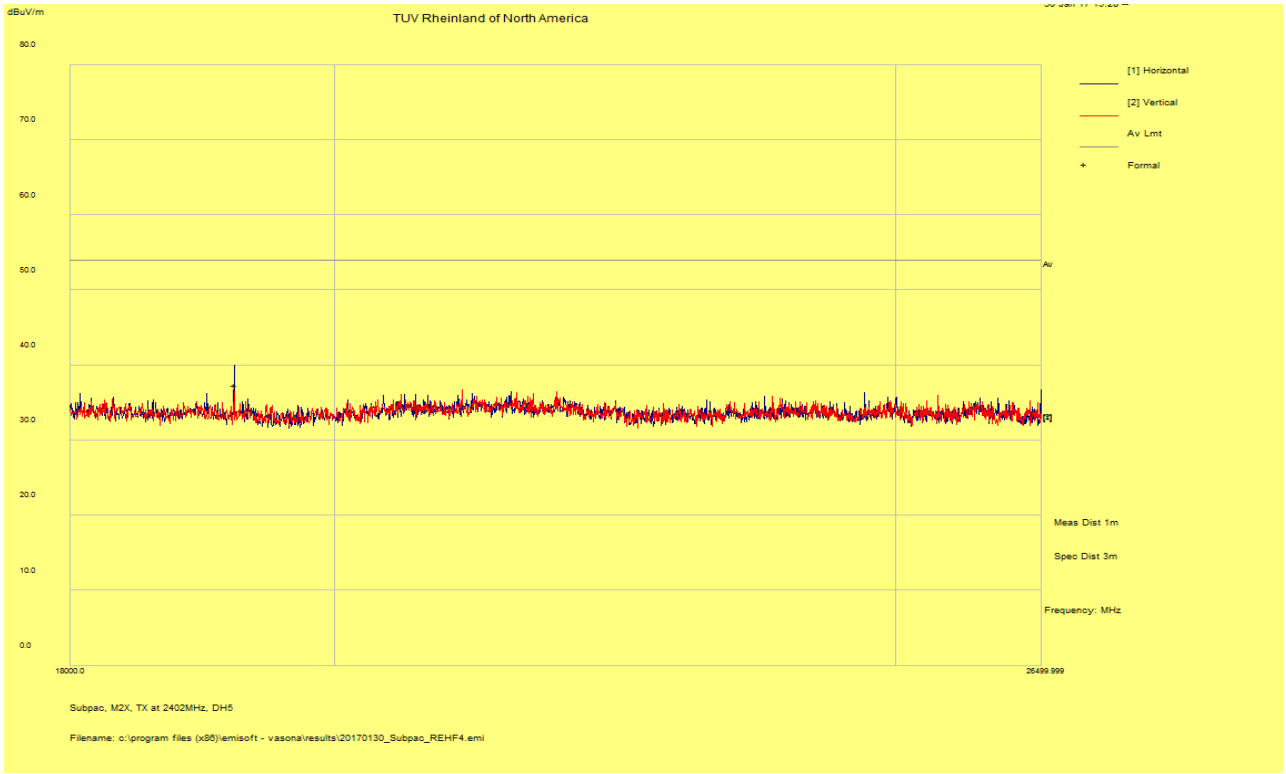
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH5

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 10 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH5	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

18 – 26 GHz Transmit at 2402 MHz (Low Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19216.76	39.20	7.12	-8.96	37.36	Average	H	148	130	54.00	-16.64



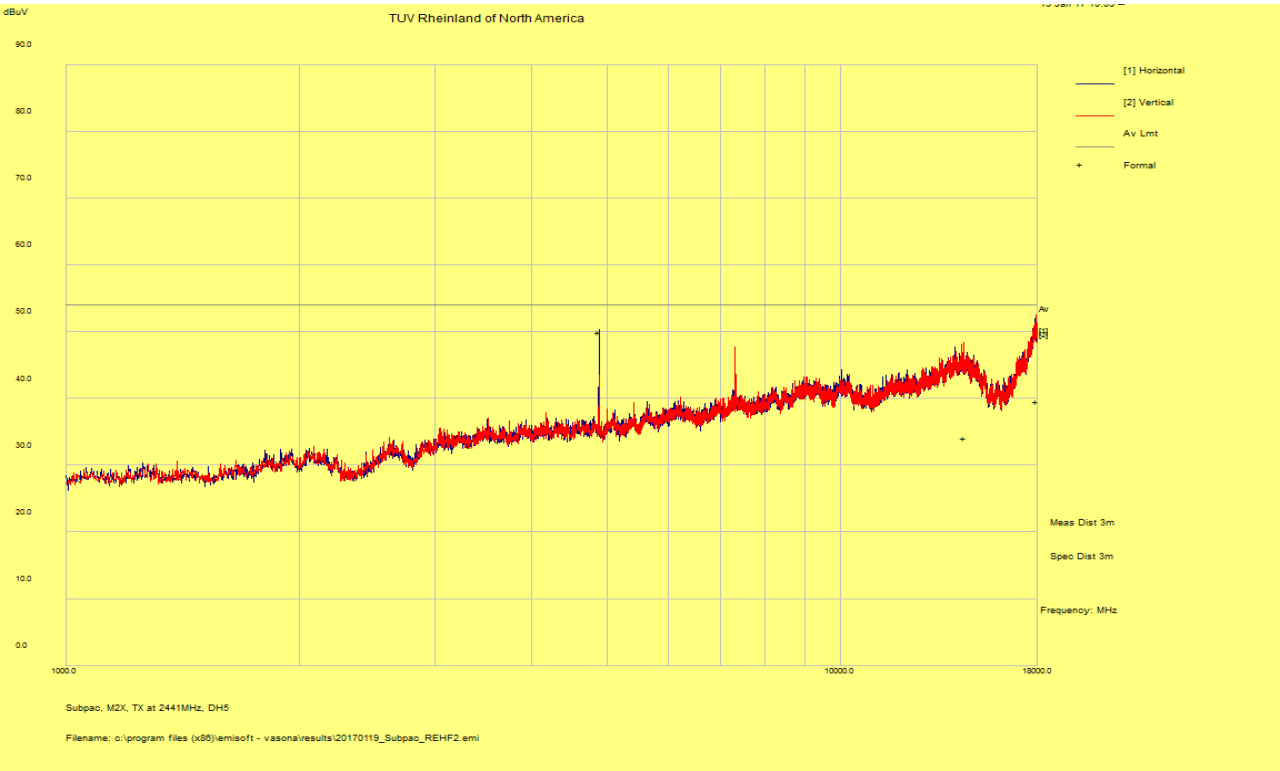
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH5.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 11 of 14	
EUT Name	Subpac Audio Device	**Date**	January 19, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 43%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH5	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

1 – 18 GHz Transmit at 2441 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
4882.21	68.33	1.77	-20.14	49.96	Average	H	163	216	54.00	-4.04
14473.41	39.48	3.20	-8.57	34.10	Average	V	172	32	54.00	-19.90
17936.15	38.98	3.74	-3.18	39.54	Average	V	202	-2	54.00	-14.46
7323.2275	58.04	2.21	-15.6	44.61	Average	V	130	216	54.00	-9.39



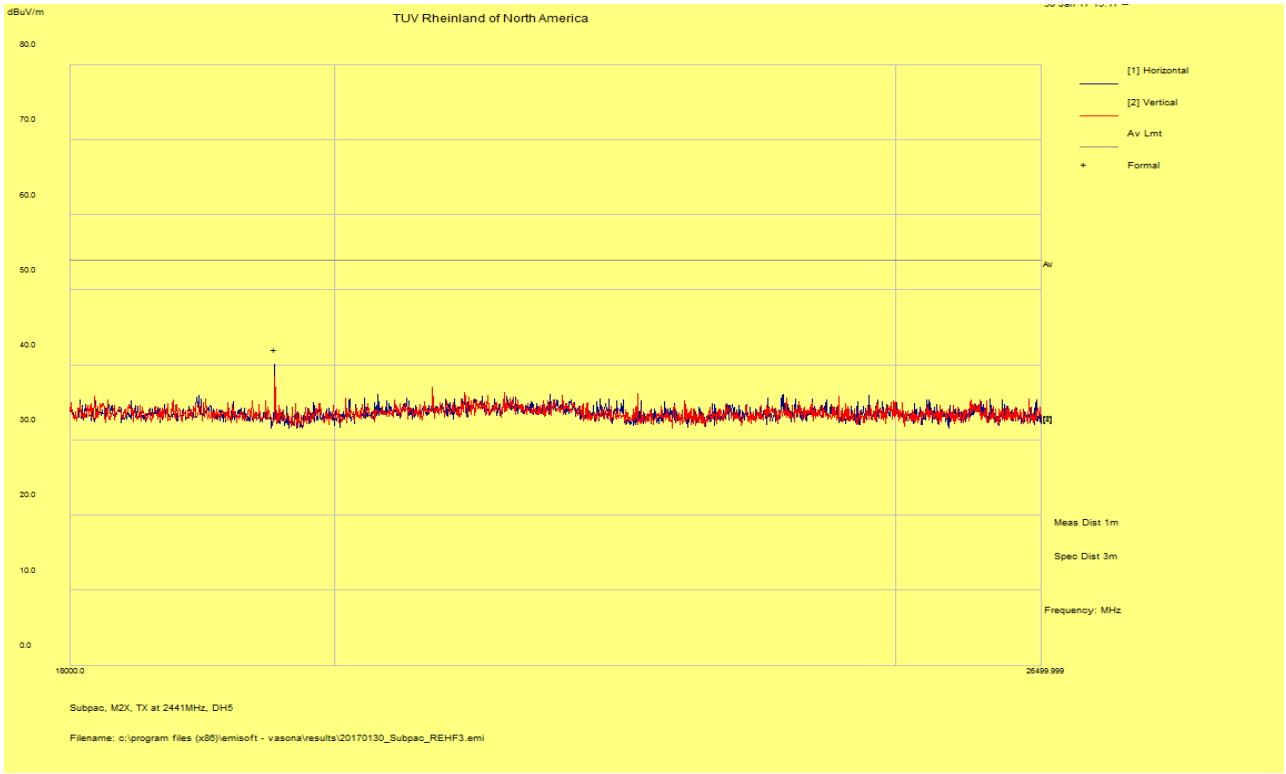
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH5

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 12 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH5	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

18 – 26 GHz Transmit at 2441 MHz (Mid Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19528.72	44.22	7.14	-9.21	42.15	Average	H	157	238	54.00	-11.85



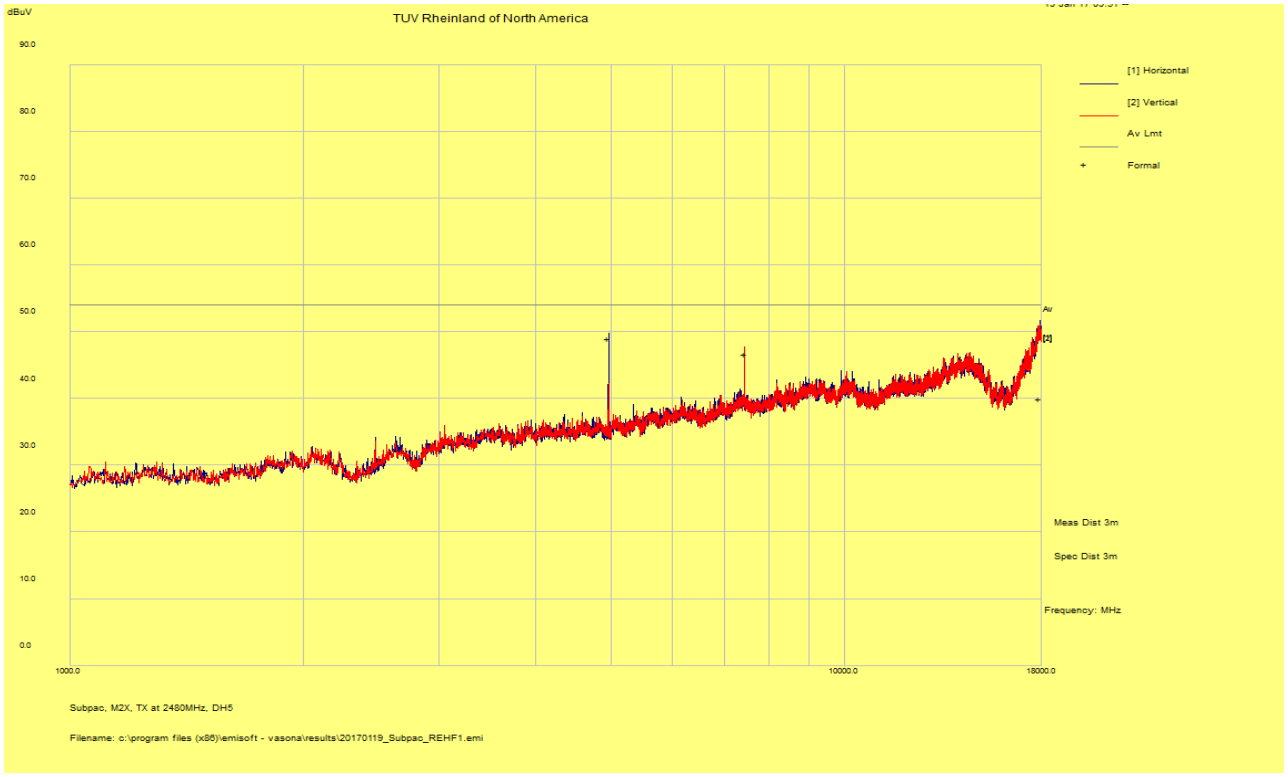
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH5.

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 13 of 14	
EUT Name	Subpac Audio Device	**Date**	January 19, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 43%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH5	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

1 – 18 GHz Transmit at 2480 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
4960.17	67.40	1.79	-20.16	49.02	Average	H	253	222	54.00	-4.98
17908.45	39.52	3.72	-3.32	39.92	Average	H	203	82	54.00	-14.08
7440.22	59.97	2.23	-15.59	46.61	Average	V	126	266	54.00	-7.39



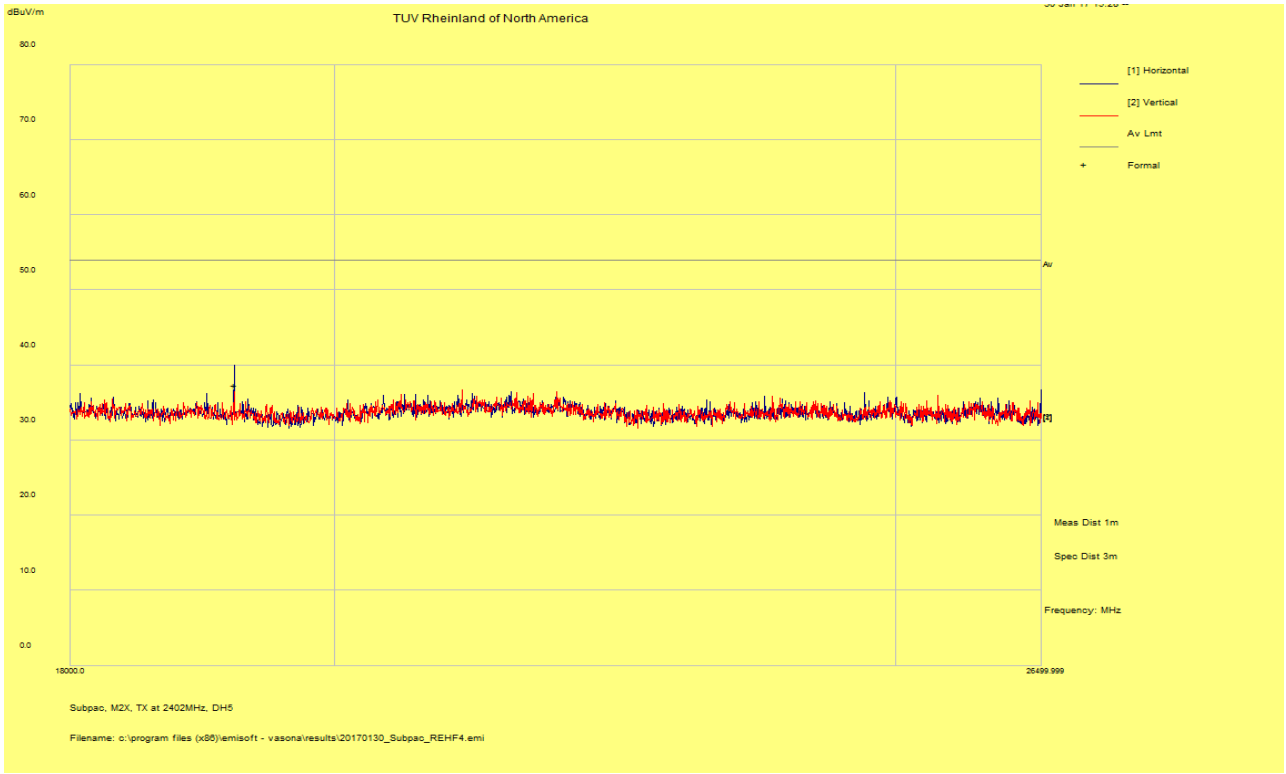
Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH5

SOP 1 Radiated Emissions		Tracking # 31663775.001 Page 14 of 14	
EUT Name	Subpac Audio Device	**Date**	January 30, 2017
EUT Model	M2X	**Temp / Hum in**	21° C / 45%rh
EUT Serial	M2X16002700	**Temp / Hum out**	N/A
EUT Config.	802.15.1 at DH5	**Line AC / Freq**	120 Vac / 60 Hz
Standard	CFR47 Part 15 Subpart C, RSS-247, RSS-GEN	**RBW / VBW**	1 MHz/ 3 MHz
Dist/Ant Used	3m – EMCO3115 / 1m – AHA-840	**Performed by**	Kerwinn Corpuz

18 – 26 GHz Transmit at 2480 MHz (High Channel)

Frequency	Raw	Cable Loss	AF	Level	Detector	Polarity	Height	Azimuth	Limit	Margin
MHz	dBuV/m	dB	dB	dBuV/m		H/V	cm	deg	dBuV/m	dB
19216.76	39.20	7.12	-8.96	37.36	Average	H	148	130	54.00	-16.64



Spec Margin = E-Field AVG - Limit, E-Field AVG = FIM AVG+ Total CF ± Uncertainty
Total CF= AF+ Cable Loss AF= Antenna factor + Preamp

Note: Worst case was observed on DH5.

4.6.4 Sample Calculation

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = FIM - AMP + CBL + ACF

Where:

FIM = Field Intensity Meter (dBμV)
AMP = Amplifier Gain (dB)
CBL = Cable Loss (dB)
ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

4.2 AC Conducted Emissions

Testing was performed in accordance with ANSI C63.4: 2014. These test methods are listed under the laboratory's A2LA Scope of Accreditation.

This test measures the levels emanating from the EUT's AC input port, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

The AC conducted emissions of equipment under test shall not exceed the values in CFR47 Part 15.207: 2016 and RSS-Gen. Sect. 8.8: 2014.

4.2.1 Test Methodology

A test program that controls instrumentation and data logging was used to automate the AC Power Line Conducted emission test procedure. The frequency range of interest was divided into sub-ranges such as to yield a frequency resolution of 9 kHz. Each phase and neutral of the AC power line were measured with respect to ground. Measurements were performed using a set of 50μH / 50Ω LISNs.

Testing is performed in Lab 5. The setup photographs clearly identify which site was used. The vertical ground plane used in the semi-anechoic chamber is a 2m x 2m solid aluminum frame and panel, and it is bonded to the horizontal ground plane.

In the case of tabletop equipment, the EUT is placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane and 40cm from a vertical ground reference plane. The rear of the EUT was positioned flush with the backside of the table and directly over the LISNs. The power and I/O cables were routed over the edge of the table and bundled approximately 40cm from the ground plane. Support equipment was powered from a separate LISN.

4.2.1.1 Deviations

There were no deviations from this test methodology.

4.2.2 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

Table 12: AC Conducted Emissions – Test Results

Test Conditions: Conducted Measurement at Normal Conditions only		
Antenna Type: Custom Integrated	**Power Level:** See Test Plan	
AC Power: 110 Vac/60 Hz	**Configuration:** Tabletop	
Ambient Temperature: 22° C	**Relative Humidity:** 47% RH	
Configuration	**Frequency Range**	**Test Result**
Line 1 (Hot)	0.15 to 30 MHz	Pass
Line 2 (Neutral)	0.15 to 30 MHz	Pass

SOP 2 Conducted Emissions — Tracking # 31663775.001 Page 1 of 4

EUT Name	Subpac Audio Device	**Date**	January 27, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 39% rh
EUT Serial	M2X16000350 / PSU = 11-16100094-00345	**Temp / Hum out**	N/A
EUT Config.	TX DH5 Hopping Mode	**Line AC / Freq**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 1	**Performed by**	Kerwinn Corpuz

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV		Line	dBuV	dB	
0.159	33.46	9.98	0.23	43.67	QP	Live	65.54	-21.87	Pass
0.159	8.79	9.98	0.23	19.00	Ave	Live	55.54	-36.54	Pass
0.207	27.30	9.99	0.18	37.48	QP	Live	63.33	-25.85	Pass
0.207	2.42	9.99	0.18	12.60	Ave	Live	53.33	-40.73	Pass
0.265	19.29	9.99	0.14	29.43	QP	Live	61.27	-31.84	Pass
0.265	-1.43	9.99	0.14	8.71	Ave	Live	51.27	-42.56	Pass
0.309	17.19	10.00	0.13	27.31	QP	Live	60.00	-32.69	Pass
0.309	-7.45	10.00	0.13	2.67	Ave	Live	50.00	-47.33	Pass
0.478	16.81	10.01	0.10	26.92	QP	Live	56.37	-29.45	Pass
0.478	7.03	10.01	0.10	17.14	Ave	Live	46.37	-29.23	Pass
0.484	16.82	10.01	0.10	26.93	QP	Live	56.27	-29.34	Pass
0.484	7.72	10.01	0.10	17.83	Ave	Live	46.27	-28.44	Pass

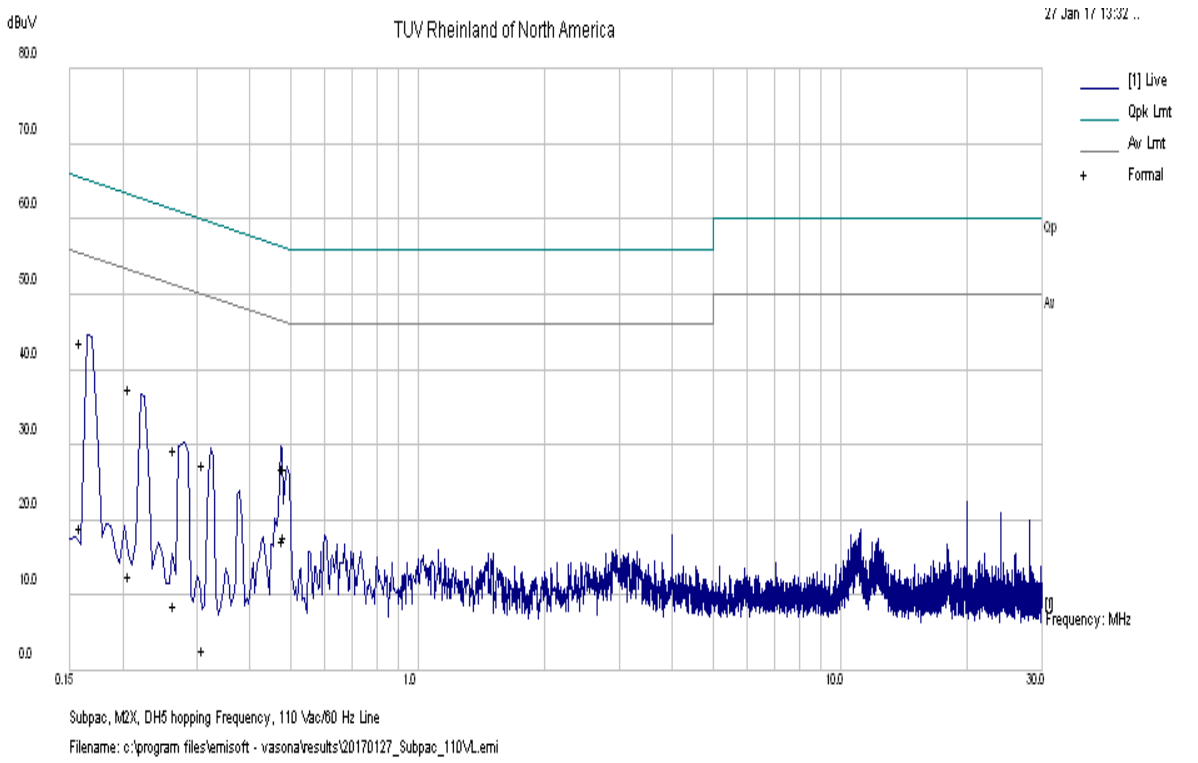
Spec Margin = QP./Ave. - Limit, ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: EUT was setup as table top equipment and transmitted in 802.15.1 at DH5 Hopping Mode.

SOP 2 Conducted Emissions		Tracking # 31663775.001 Page 2 of 4	
EUT Name	Subpac Audio Device	**Date**	January 27, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 39% rh
EUT Serial	M2X16000350 / PSU = 11-16100094-00345	**Temp / Hum out**	N/A
EUT Config.	TX DH5 Hopping Mode	**Line AC**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 1	**Performed by**	Kerwinn Corpuz

150 kHz to 30 MHz Plot for Line 1 (Hot)



Note: Met FCC Class B limit.

SOP 2 Conducted Emissions

Tracking # 31663775.001 Page 3 of 4

EUT Name	Subpac Audio Device	**Date**	January 27, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 39% rh
EUT Serial	M2X16000350 / PSU = 11-16100094-00345	**Temp / Hum out**	N/A
EUT Config.	TX DH5 Hopping Mode	**Line AC / Freq**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 2	**Performed by**	Kerwinn Corpuz

Frequency	Raw	Limiter	Ins. Loss	Level	Detector	Line	Limit	Margin	Result
MHz	dBuV	dB	dB	dBuV		Line	dBuV	dB	
0.150	32.39	9.98	0.25	42.62	QP	Neutral	66.00	-23.38	Pass
0.150	6.02	9.98	0.25	16.25	Ave	Neutral	56.00	-39.75	Pass
0.169	31.11	9.98	0.22	41.31	QP	Neutral	65.02	-23.71	Pass
0.169	2.24	9.98	0.22	12.44	Ave	Neutral	55.02	-42.58	Pass
0.239	24.03	9.99	0.16	34.18	QP	Neutral	62.14	-27.96	Pass
0.239	-3.45	9.99	0.16	6.70	Ave	Neutral	52.14	-45.44	Pass
0.284	19.95	9.99	0.14	30.08	QP	Neutral	60.71	-30.63	Pass
0.284	-3.31	9.99	0.14	6.82	Ave	Neutral	50.71	-43.89	Pass
0.399	12.89	10.01	0.11	23.01	QP	Neutral	57.86	-34.85	Pass
0.399	-9.79	10.01	0.11	0.33	Ave	Neutral	47.86	-47.53	Pass
0.498	14.94	10.01	0.10	25.05	QP	Neutral	56.03	-30.98	Pass
0.498	6.18	10.01	0.10	16.29	Ave	Neutral	46.03	-29.74	Pass

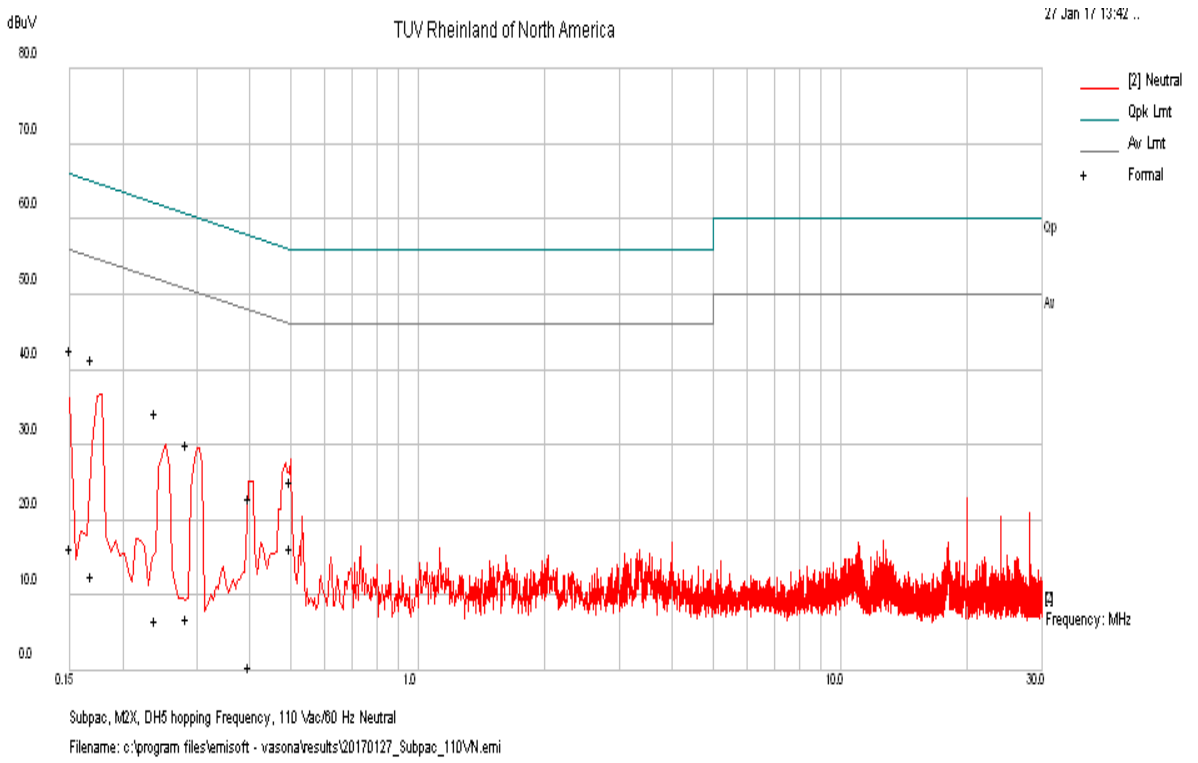
Spec Margin = QP./Ave. - Limit, ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.2 dB Expanded Uncertainty $U = ku_c(y)$ k = 2 for 95% confidence

Notes: EUT was setup as table top equipment and transmitted in 802.15.1 at DH5 Hopping Mode.

SOP 2 Conducted Emissions		Tracking # 31663775.001 Page 4 of 4	
EUT Name	Subpac Audio Device	**Date**	January 27, 2017
EUT Model	M2X	**Temp / Hum in**	22° C / 39% rh
EUT Serial	M2X16000350 / PSU = 11-16100094-00345	**Temp / Hum out**	N/A
EUT Config.	TX DH5 Hopping Mode	**Line AC**	120Vac / 60Hz
Standard	CFR47 Part 15.207 and RSS Gen	**RBW / VBW**	9 kHz / 30 kHz
Lab/LISN	Lab #5 /Com-Power, Line 2	**Performed by**	Kerwinn Corpuz

150 kHz to 30 MHz Plot for Line 2 (Neutral)



Note: Met FCC Class B Limit.

4.3 Maximum Permissible Exposure

4.3.1 Test Methodology

In this section, we try to prove the safety of radiation harmfulness to the human body for our product. The KDB 447498 D01 General RF Exposure Guidance is followed. The Gain of the antenna used in this calculation is declared by the manufacturer, and the maximum average power input to the antenna is measured. Using the general SAR test exclusion guidance in Section 4.3 of KDB 447498, we show the device meeting the SAR exclusion threshold.

4.3.2 FCC KDB 447498 D01 – General SAR Test Exclusion Guidance

The SAR exclusion threshold conditions are listed:
1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR,16 where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation17
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:18
a) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
b) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz

3) At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:19
a) The threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by [1 + log(100/f(MHz))] for test separation distances > 50 mm and < 200 mm

b) The threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by ½ for test separation distances ≤ 50 mm

c) SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

4.3.3 EUT Operating Condition

The software provided by Manufacturer enabled the EUT to transmit data at lowest, middle and highest channel individually.

4.3.4 Classification

The antenna of the product, under normal use condition, is at least 6mm away from the body of the user. Warning statement to the user for keeping at least 6mm or more separation distance with the antenna is included in user's manual. This device is classified as a **Portable Device**. It is intended to be with body (waist) worn device; extremity SAR limit is applied.

4.3.5 Test Results

4.3.5.1 Antenna Gain

The 2.4 GHz transmitting antenna is integrated and has a maximum gain of 0 dBi or 1 (numeric).

4.3.5.2 SAR Test Exclusion

Mode	Max. Power (dBm)	EIRP (dBm)	Min. Separation Distance (mm)	Cal. Excl. Threshold	1-g SAR Limit	10-g extremity SAR Limit	Result
Bluetooth (2.4GHz)	3.11	3.11	6	0.537503	≤3.0	≤7.5	Exempted *

Note:
1. Per manufacture the separation between the transmitter antenna and user is greater than 6mm. This separation distance was used for calculation per condition #1 of SAR Exclusion Threshold.
2. The maximum output power was taken from Table 2.
3. (*) The calculated threshold is less than 3.0; therefore, EUT is SAR exempted for head and body usage.

6 Test Equipment Use List

6.1 Equipment List

Equipment	Manufacturer	Model #	Serial/Inst #	Last Cal mm/dd/yyyy	Next Cal mm/dd/yyyy
Bilog Antenna	Sunol Sciences	JB3	A102606	06/15/2016	06/15/2018
Horn Antenna	EMCO	3115	9710-5301	10/08/2015	10/08/2017
Antenna (18-40 GHz)	Com-Power	AHA-840	105005	03/26/2015	03/26/2017
Loop Antenna	EMCO	6502	9110-2683	06/13/2016	06/13/2017
Spectrum Analyzer	Agilent	N9038A	MY52260210	01/06/2017	01/06/2018
Spectrum Analyzer	Agilent	N9030A	MY51380291	01/17/2017	01/17/2018
Spectrum Analyzer	Rohde Schwarz	ESIB	832427/002	01/16/2017	01/16/2018
Spectrum Analyzer	Rohde Schwarz	FSV40	1321.3008K40	08/30/2016	08/30/2017
Amplifier	Sonoma Instruments	310	165516	01/19/2017	01/19/2018
Amplifier	Miteq	TTA1800-30-HG	2020728	11/12/2016	11/12/2017
Power Meter	Agilent	E4418B	MY45103859	01/19/2017	01/19/2018
Power Sensor	Hewlett Packard	8482A	US37295801	01/19/2017	01/19/2018
Thermometer	Fluke	52II	96480032	09/07/2016	09/07/2017
Thermo Chamber	Espec	BTZ-133	0613436	NCR	NCR
Notch Filter	Micro-Tronics	BRM50702	037	07/29/2016	07/29/2017
Notch Filter	Micro-Tronics	BRM50716	003	01/18/2017	01/18/2018
Signal Generator	Rohde & Schwarz	SMF100A	1167.0000K02	09/06/2016	09/06/2017
Signal Generator	Rohde & Schwarz	SMBV100A	1407.6004K02	09/06/2016	09/06/2017
Power Sensors	Rohde & Schwarz	OSP120	1520.9010.02	09/06/2016	09/06/2017

* Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.

NCR = No Calibration Required

7 EMC Test Plan

7.1 Introduction

This section provides a description of the Equipment Under Test (EUT), configurations, operating conditions, and performance acceptance criteria. It is an overview of information provided by the manufacturer so that the test laboratory may perform the requested testing.

7.2 Customer

Table 13: Customer Information

Company Name	Subpac
Address	380 Portage Avenue
City, State, Zip	Palo Alto, CA 94306
Country	U.S.A.

Table 14: Technical Contact Information

Name	Sarosh Khwaja
E-mail	sarosh@subpac.com
Phone	(415) 936-4133

7.3 Equipment Under Test (EUT)

Table 15: EUT Specifications

EUT Specifications	
Dimensions	W: 11.8 in (300mm) x D: 1.6 in (40mm) x H: 16.9 in (40mm)
AC Input	100-240V AC, 50 – 60 Hz
Environment	Indoor
Operating Temperature Range:	0 to 35 degrees C
Multiple Feeds:	☐ Yes and how many ☒ No
Product Marketing Name (PMN)	SUBPAC M2X
Hardware Version Identification Number (HVIN)	M2X
Firmware Version Identification Number (FVIN)	2.5
802.11-radio modules	
Operating Mode	Bluetooth V2.1
Transmitter Frequency Band	2.4 GHz – 2.4835 GHz
Max. Rated Power Output	See Channel Planning Table.
Power Setting @ Operating Channel	See Channel Planning Table.
Antenna Type	PIFA
Antenna Gain	0 dBi
Modulation Type	☐ AM ☐ FM ☐ DSSS ☐ OFDM ☒ Other describe: GFSK / π/4-DQPSK / 8DPSK
Data Rate	GFSK: 1 Mbps π/4-DQPSK: 2 Mbps 8DPSK: 3 Mbps
TX/RX Chain (s)	Single
Directional Gain Type	☐ Correlated ☐ Beam-Forming ☐ Other describe:
Type of Equipment	☐ Table Top ☐ Wall-mount ☐ Floor standing cabinet ☒ Other: Wearable
Note: None	

Table 16: EUT Channel Power Specifications

Max Power

Frequency (MHz)	Target Power Value (dBm)									
	DH1	DH3	DH5	2-DH1	2-DH3	2-DH5	3-DH1	3-DH3	3-DH5	BLE
2402	-3.00	0.27	0.84	-5.10	-2.87	-1.98	-5.22	-2.60	-1.94	N/A
2441	-1.80	2.42	3.11	-2.90	-0.18	0.34	-3.05	-0.38	0.53	N/A
2480	-1.37	1.87	2.32	-3.30	-1.03	-0.22	-3.08	-0.59	-0.23	N/A

Note: 1. The adjusted power target values are updated at the evaluated frequencies.
2. TP setting = 4 (for all channels).

Table 17: Interface Specifications

Interface Type	Cabled with what type of cable?	Is the cable shielded?	Maximum potential length of the cable?	Metallic (M), Coax (C), Fiber (F), or Not Applicable?
N/A	N/A	☐ No	☐ Metric: N/A	☐ N/A

Table 18: Supported Equipment

Equipment	Manufacturer	Model	Serial	Used for
Laptop	ASUS	X200M	F3N0CX339281138	Setup EUT operating channel
Note: None.				

Table 19: Description of Sample used for Testing

Device	Serial	RF Connection	CFR47 Part 15.247
BT module / Digital board	M2X16000350	PIFA	TX Radiated Emission, AC Conducted Emission
	M2X16002700	Direct Connection	Peak Transmit Power, Peak Power Spectral Density, Occupied Bandwidth, Band-Edge, Out-of-Band Emission

Table 20: Description of Test Configuration used for Radiated Measurement.

Device	Antenna	Mode	Setup Photo (X-Axis)	Setup Photo (Y-Axis)	Setup Photo (Z-Axis)
BT module / Digital board	PIFA	Transmit	N/A	EUT upright	N/A
Note: The EUT is positioned Y-axis during normal operation.					

7.4 Test Specifications

Table 21: Test Specifications

Emissions and Immunity	
Standard	Requirement
CFR 47 Part 15.247: 2016	All
RSS-247 Issue 2, 2017	All

END OF REPORT