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BoxLock, Inc.

TEST REPORT

SCOPE OF WORK

EMC TESTING – BOXLOCK 2

REPORT NUMBER

104350997LEX-006.2

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EMC TEST REPORT (FULL COMPLIANCE)

Report Number: 104350997LEX-006.2

Project Number: G104350997

Report Issue Date: 9/4/2020

Report Revised Date: 2/9/2021

Model(s) Tested: BoxLock 2

Standards: Title 47 CFR Part 15.247

RSS-247 Issue 2

RSS-Gen Issue 5

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Dr.
Lexington, KY 40510
USA

Client:
BoxLock, Inc.
692 Kirkwood Ave, Suite C1
Atlanta, GA 30316
USA

Report prepared by



Brian Lackey, Staff Engineer

Report reviewed by



Bryan Taylor, Team Leader

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1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
6	Receiver Spurious Emissions (ANSI C63.4: 2014)	Pass
7	Transmitter Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
8	Output Power (FCC Part 15.247(b)(3), RSS-247 Issue 2 § 5.4(d))	Pass
9	Occupied Bandwidth (FCC Part 15.247, RSS-247 Issue 2 § 5.2(a))	Pass
10	Power Spectral Density (FCC Part 15.247(e), RSS-247 Issue 2 § 5.2(b))	Pass
11	Conducted Spurious Emissions (FCC Part 15.247(d), RSS-247 Issue 2 § 5.5)	Pass
12	Number of Hopping Channels, Channel Separation, and Time of Occupancy (FCC Part 15.247(a), RSS-247 Issue 2 § 5.1)	Pass
13	Antenna Requirement (FCC Part 15.203, RSS-Gen Issue 5 § 6.8)	Pass
-	Conducted Emissions (ANSI C63.4: 2014)	NA ¹

¹ Test is not applicable. The device does not connect to AC mains.



3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	BoxLock, Inc.
Address:	692 Kirkwood Ave, Suite C1 Atlanta, GA 30316 USA
Contact:	Brad Ruffkess
Email:	bar@getboxlock.com
Manufacturer Information	
Manufacturer Name:	BoxLock, Inc.
Manufacturer Address:	692 Kirkwood Ave, Suite C1 Atlanta, GA 30316 USA



4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	BoxLock 2
Model Numbers	BoxLock-003
Serial Number	SN31
Receive Date	7/30/2020
Test Start Date	7/30/2020
Test End Date	2/9/2021
Device Received Condition	Good
Test Sample Type	Production
Input Rating	3.7V, 0.5A Battery: 3.7V, 2.5AH
Software Used By EUT	boxlock2_00_90_00.bin, version 0.9.0
Frequency Band(s)	2400-2483.5MHz
Transmission Mode(s)	Bluetooth (FHSS) Bluetooth Low Energy (BLE, DTS) Wi-Fi: 802.11b, 802.11g, 802.11n, 802.11nHT40 (DTS)
Test Channel(s)	Bluetooth: 0 (2402MHz), 38 (2440MHz), 78 (2480MHz) BLE: 37 (2402MHz), 17 (2440MHz), 39 (2480MHz) 802.11b, 802.11g, 802.11n: 1 (2412MHz), 6 (2437MHz), 11 (2462MHz) 802.11nHT40: 3 (2422MHz), 7 (2442MHz), 11 (2462MHz)
Antenna(s) Used by EUT	Johanson 2450AT18A100E
Maximum Antenna Gain (dBi)	0.5dBi
Description of Equipment Under Test (provided by client)	
An internet connected padlock. Uses Wi-Fi / cellular for secure access to allow authorized unlocking of device.	

4.1 Variant Models:

There were no variants covered by this evaluation.



5 System Setup and Method

5.1 Method:

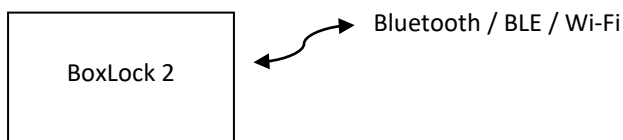
Configuration as required by ANSI C63.4: 2014 and ANSI C63.10:2013

No.	Descriptions of EUT Exercising
1	Transmitting a Bluetooth signal or low, middle, or high channel
2	Transmitting a Bluetooth Low Energy (BLE) signal or low, middle, or high channel
3	Transmitting an 802.11b signal or low, middle, or high channel
4	Transmitting an 802.11g signal or low, middle, or high channel
5	Transmitting an 802.11n signal or low, middle, or high channel
6	Transmitting an 802.11nHT40 signal or low, middle, or high channel
7	Idle, not transmitting.

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
	None used				

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	HP	-	-

5.2 EUT Block Diagram:





6 Receiver Spurious Emissions

6.1 Test Method

Tests are performed in accordance with ANSI C63.4: 2014

TEST SITE: 10m ALSE

Site Designation: 10m Chamber

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	U _{CISPR}
Radiated Emissions, 10m	30-1000 MHz	3.9dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.0dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.7dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required.



6.2 Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength in dB μ V/m
- RA = Receiver Amplitude (including preamplifier) in dB μ V
- CF = Cable Attenuation Factor in dB
- AF = Antenna Factor in dB
- AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dB μ V is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dB μ V/m. This value in dB μ V/m was converted to its corresponding level in μ V/m.

RA = 52.0 dB μ V
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dB μ V/m

To convert from dB μ V to μ V or mV the following was used:

$$UF = 10^{(NF / 20)} \text{ where } UF = \text{Net Reading in } \mu\text{V}$$

NF = Net Reading in dB μ V

Example:

$$FS = RA + AF + CF - AG = 52.0 + 7.4 + 1.6 - 29.0 = 32.0$$
$$UF = 10^{(32 \text{ dB}\mu\text{V} / 20)} = 39.8 \mu\text{V/m}$$

**6.3 Test Equipment Used**

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde&Schwarz	ESU40	9/18/2019	9/18/2020
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	8/8/2019	9/8/2020*
Horn Antenna (1-18GHz)	3780	ETS	3117	6/18/2020	6/18/2021
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
Coaxial Cable	3074			12/6/2019	12/6/2020
Preamplifier	3918	TS-PR18	122005	12/6/2019	12/6/2020
Coaxial Cable	2588			12/6/2019	12/6/2020
Coaxial Cable	2593			12/6/2019	12/6/2020
Coaxial Cable	2592			12/6/2019	12/6/2020
Coaxial Cable	3339			12/6/2019	12/6/2020

* The equipment was operating under a calibration extension at the time of testing.

6.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

6.5 Test Results

The sample tested was found to be **compliant**.

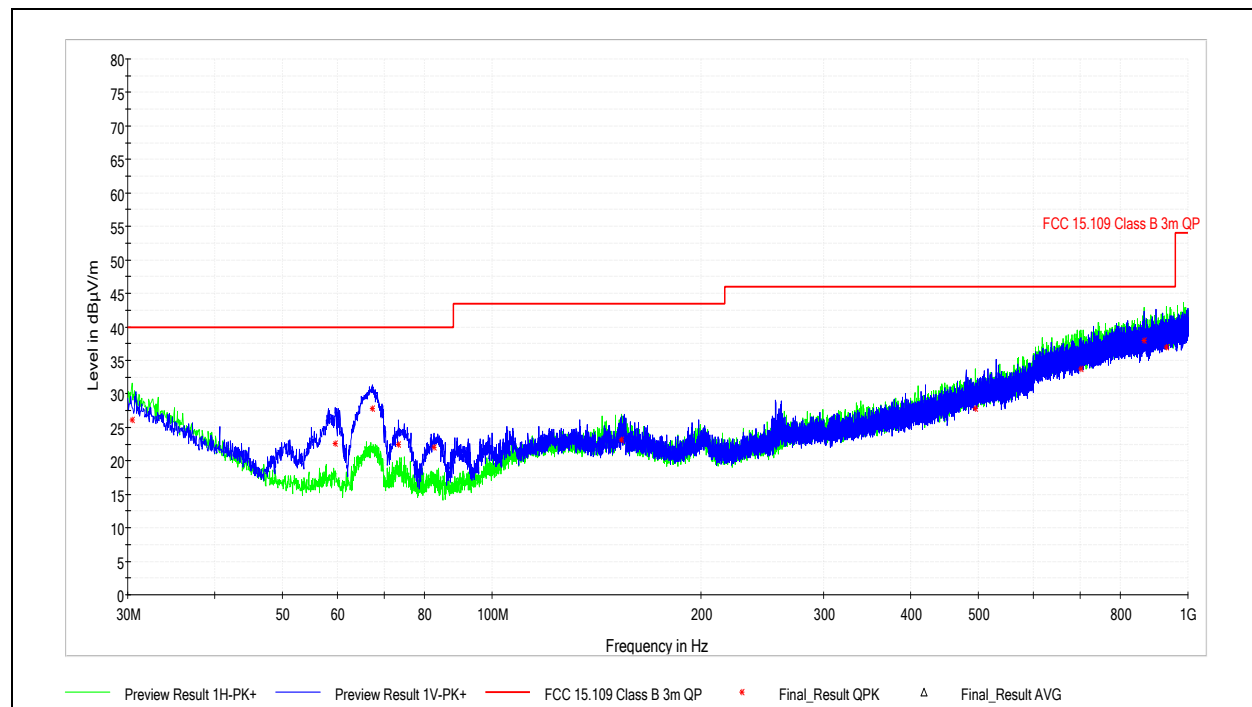
6.6 Test Conditions

Test Personnel: Brian Lackey
 Supervising/Reviewing Engineer: NA
 (Where Applicable) FCC Part 15.247
 Product Standard: RSS-247 Issue 2
 Input Voltage: Battery
 Pretest Verification w / Ambient Signals or BB Source: Yes

Test Date: 8/14/2020
 Limit Applied: FCC Part 15.209 / FCC Part 15.109 Class B
 Ambient Temperature: 22.6C
 Relative Humidity: 63.0%
 Atmospheric Pressure: 983.0mbar



6.7 Test Data: 30MHz – 1GHz

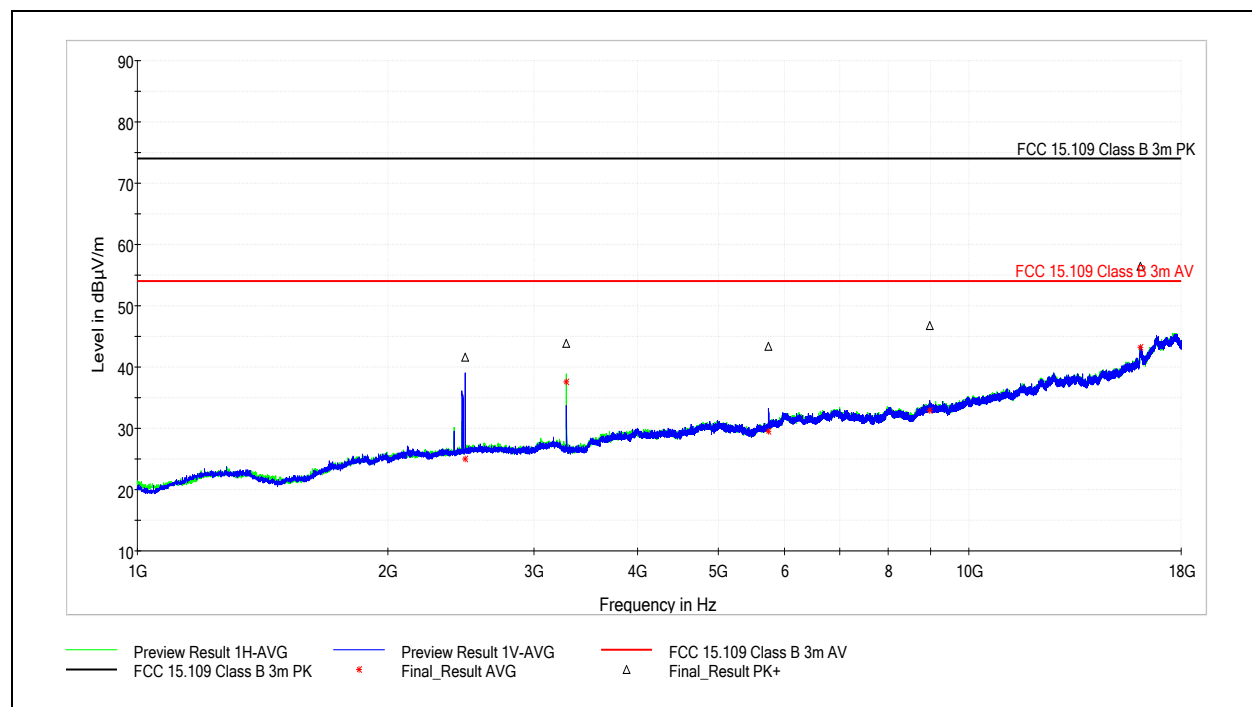


Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.431111	26.10	40.00	13.90	120.000	297.5	H	146.0	28.5
59.585000	22.53	40.00	17.47	120.000	105.0	V	0.0	14.3
67.345000	27.86	40.00	12.14	120.000	105.3	V	16.0	14.6
73.488333	22.45	40.00	17.55	120.000	100.2	V	321.0	14.9
82.541667	22.08	40.00	17.92	120.000	102.2	V	219.0	15.9
153.513333	23.15	43.52	20.37	120.000	165.9	H	254.0	21.6
494.845556	27.83	46.02	18.19	120.000	213.6	H	184.0	29.5
701.994444	33.79	46.02	12.23	120.000	166.0	H	182.0	34.1
865.277778	38.01	46.02	8.01	120.000	154.3	H	267.0	36.4
932.046111	37.00	46.02	9.02	120.000	332.4	H	230.0	37.2

Deviations, Additions, or Exclusions: None



6.8 Test Data: 1GHz – 18GHz



Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2480.000000	41.63	73.98	32.35	1000.000	241.0	V	81.0	4.1
3282.500000	43.90	73.98	30.08	1000.000	193.0	H	129.0	5.5
5745.500000	43.32	73.98	30.66	1000.000	153.0	V	330.0	9.6
8966.500000	46.79	73.98	27.19	1000.000	410.0	V	303.0	13.7
16096.000000	56.48	73.98	17.50	1000.000	410.0	V	157.0	25.5

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2480.000000	25.08	53.98	28.90	1000.000	241.0	V	81.0	4.1
3282.500000	37.66	53.98	16.32	1000.000	193.0	H	129.0	5.5
5745.500000	29.54	53.98	24.44	1000.000	153.0	V	330.0	9.6
8966.500000	32.94	53.98	21.04	1000.000	410.0	V	303.0	13.7
16096.000000	43.30	53.98	10.68	1000.000	410.0	V	157.0	25.5

Deviations, Additions, or Exclusions: None



7 Transmitter Spurious Emissions

7.1 Test Limits

FCC Part 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 Issue 2 § 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

7.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.12.1 Radiated emission measurements.



7.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde&Schwarz	ESU40	9/18/2019	9/18/2020
Bilog Antenna (30MHz-1GHz)	7085	SunAR	JB6	8/8/2019	9/8/2020*
Horn Antenna (1-18GHz)	3780	ETS	3117	6/18/2020	6/18/2021
Horn Antenna (18-40GHz)	3779	ETS	3116c	7/23/2020	7/23/2021
System Controller	4096	ETS Lindgren	2090	Verify at Time of Use	Verify at Time of Use
System Controller	3957	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
Coaxial Cable	3074			12/6/2019	12/6/2020
Preamplifier	3918	TS-PR18	122005	12/6/2019	12/6/2020
Coaxial Cable	2588			12/6/2019	12/6/2020
Coaxial Cable	2593			12/6/2019	12/6/2020
Coaxial Cable	2592			12/6/2019	12/6/2020
Coaxial Cable	3339			12/6/2019	12/6/2020
Preamplifier (18-40GHz)	3921	Rohde & Schwarz	TS-PR40	12/4/2019	12/4/2020
Coaxial Cable (40GHz)	7020			12/4/2019	12/4/2020
Coaxial Cable (40GHz)	7021			12/4/2019	12/4/2020

* The equipment was operating under a calibration extension at the time of testing.

7.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

7.5 Test Results

The sample tested was found to be **compliant**. The data presented represents the worst case emissions with the device positioned in three orthogonal positions. All observed emissions outside of the band of operation were attenuated by at least 20dB.

7.6 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	8/14/2020-8/19/2020
Supervising/Reviewing Engineer:			FCC Part 15.209 in Restricted Bands
(Where Applicable)	NA	Limit Applied:	from FCC Part 15.205
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	24.3C
Input Voltage:	Battery	Relative Humidity:	45.7%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	982.7mbar

**7.7 Spurious Emissions (9kHz – 30MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB)
0.496787	48.67	73.68	25.01	9.000	315.0	12.0
2.178044	33.51	69.54	36.03	9.000	0.0	11.7
4.127074	27.97	69.54	41.57	9.000	73.0	11.5
6.216574	24.61	69.54	44.93	9.000	0.0	11.4
8.292904	22.96	69.54	46.58	9.000	331.0	11.3
8.363140	22.05	69.54	47.49	9.000	46.0	11.3
8.385088	22.79	69.54	46.75	9.000	126.0	11.3
12.520191	19.19	69.54	50.35	9.000	170.0	11.2
13.393743	19.61	69.54	49.93	9.000	0.0	11.2
16.422640	19.44	69.54	50.10	9.000	26.0	11.2

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Azimuth (deg)	Corr. (dB)
0.496787	36.25	73.68	37.43	9.000	315.0	12.0
2.178044	21.71	69.54	47.83	9.000	0.0	11.7
4.127074	16.39	69.54	53.15	9.000	73.0	11.5
6.216574	13.24	69.54	56.30	9.000	0.0	11.4
8.292904	11.16	69.54	58.38	9.000	331.0	11.3
8.363140	10.79	69.54	58.75	9.000	46.0	11.3
8.385088	10.82	69.54	58.72	9.000	126.0	11.3
12.520191	8.23	69.54	61.31	9.000	170.0	11.2
13.393743	8.23	69.54	61.31	9.000	0.0	11.2
16.422640	7.15	69.54	62.39	9.000	26.0	11.2

Test Personnel:	Brian Lackey	Test Date:	1/8/2021
Supervising/Reviewing Engineer:		FCC Part 15.209 in Restricted Bands	
(Where Applicable)	NA	Limit Applied:	from FCC Part 15.205
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	22.8C
Input Voltage:	Battery	Relative Humidity:	24.8%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Note: testing represents the worst case emissions from all modes of operation.

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/5/2020	10/5/2021
Magnetic Loop Antenna	2366	ETS	6502	7/17/2020	7/17/2021
Coaxial Cable	3339			12/21/2020	12/21/2021
Coaxial Cable	2593			12/21/2020	12/21/2021
Coaxial Cable	2592			12/21/2020	12/21/2021

**7.8 Bluetooth Low Energy****7.8.1 Channel 37 (2402MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1583.500000	33.19	73.98	40.79	1000.000	127.0	V	0.0	-1.3
2268.000000	37.59	73.98	36.39	1000.000	410.0	H	110.0	3.3
3967.500000	41.17	73.98	32.81	1000.000	100.0	H	313.0	7.1
4804.000000	52.03	73.98	21.95	1000.000	392.0	H	314.0	8.2
7600.500000	44.50	73.98	29.48	1000.000	410.0	V	0.0	11.8
12615.500000	51.51	73.98	22.47	1000.000	410.0	V	0.0	19.2
16094.000000	56.25	73.98	17.73	1000.000	410.0	V	200.0	25.5

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1583.500000	20.11	53.98	33.87	1000.000	127.0	V	0.0	-1.3
2268.000000	24.55	53.98	29.43	1000.000	410.0	H	110.0	3.3
3967.500000	27.95	53.98	26.03	1000.000	100.0	H	313.0	7.1
4804.000000	45.84	53.98	8.14	1000.000	392.0	H	314.0	8.2
7600.500000	31.17	53.98	22.81	1000.000	410.0	V	0.0	11.8
12615.500000	37.80	53.98	16.18	1000.000	410.0	V	0.0	19.2
16094.000000	43.18	53.98	10.80	1000.000	410.0	V	200.0	25.5

7.8.2 Channel 17 (2440MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
38.137222	24.87	40.00	15.13	120.000	100.0	V	314.0	22.0
128.185556	19.60	43.52	23.92	120.000	261.1	V	0.0	22.4
163.752222	20.45	43.52	23.07	120.000	100.0	V	0.0	21.7
168.494445	20.71	43.52	22.81	120.000	108.9	V	0.0	21.6
245.340000	21.68	46.02	24.34	120.000	105.0	H	94.0	21.7
273.308333	24.65	46.02	21.37	120.000	103.9	H	221.0	23.5
329.676111	22.95	46.02	23.07	120.000	202.8	H	5.0	25.0
409.000556	25.06	46.02	20.96	120.000	334.8	H	257.0	27.3
611.838333	32.26	46.02	13.76	120.000	371.7	H	0.0	32.3
970.037778	37.53	53.98	16.45	120.000	118.5	H	283.0	37.5

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2222.500000	38.62	73.98	35.36	1000.000	206.0	H	47.0	3.4
2804.000000	38.02	73.98	35.96	1000.000	100.0	H	178.0	4.6
4066.500000	41.81	73.98	32.17	1000.000	100.0	V	191.0	7.2
4880.000000	51.67	73.98	22.31	1000.000	100.0	H	316.0	8.3
8413.000000	44.85	73.98	29.13	1000.000	410.0	V	287.0	12.6
12629.500000	51.01	73.98	22.97	1000.000	410.0	H	158.0	19.2
16097.500000	57.01	73.98	16.97	1000.000	410.0	H	279.0	25.6
17740.500000	58.04	73.98	15.94	1000.000	410.0	H	180.0	26.4
19566.500000	55.10	73.98	18.88	1000.000	100.0	V	79.0	15.9
22682.000000	53.90	73.98	20.08	1000.000	258.0	H	311.0	6.9
23946.000000	53.06	73.98	20.92	1000.000	100.0	H	9.0	6.3



Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2222.500000	24.61	53.98	29.37	1000.000	206.0	H	47.0	3.4
2804.000000	25.02	53.98	28.96	1000.000	100.0	H	178.0	4.6
4066.500000	28.65	53.98	25.33	1000.000	100.0	V	191.0	7.2
4880.000000	45.75	53.98	8.23	1000.000	100.0	H	316.0	8.3
8413.000000	31.60	53.98	22.38	1000.000	410.0	V	287.0	12.6
12629.500000	37.95	53.98	16.03	1000.000	410.0	H	158.0	19.2
16097.500000	43.27	53.98	10.71	1000.000	410.0	H	279.0	25.6
17740.500000	44.67	53.98	9.31	1000.000	410.0	H	180.0	26.4
19566.500000	41.73	53.98	12.25	1000.000	100.0	V	79.0	15.9
22682.000000	40.67	53.98	13.31	1000.000	258.0	H	311.0	6.9
23946.000000	39.94	53.98	14.04	1000.000	100.0	H	9.0	6.3

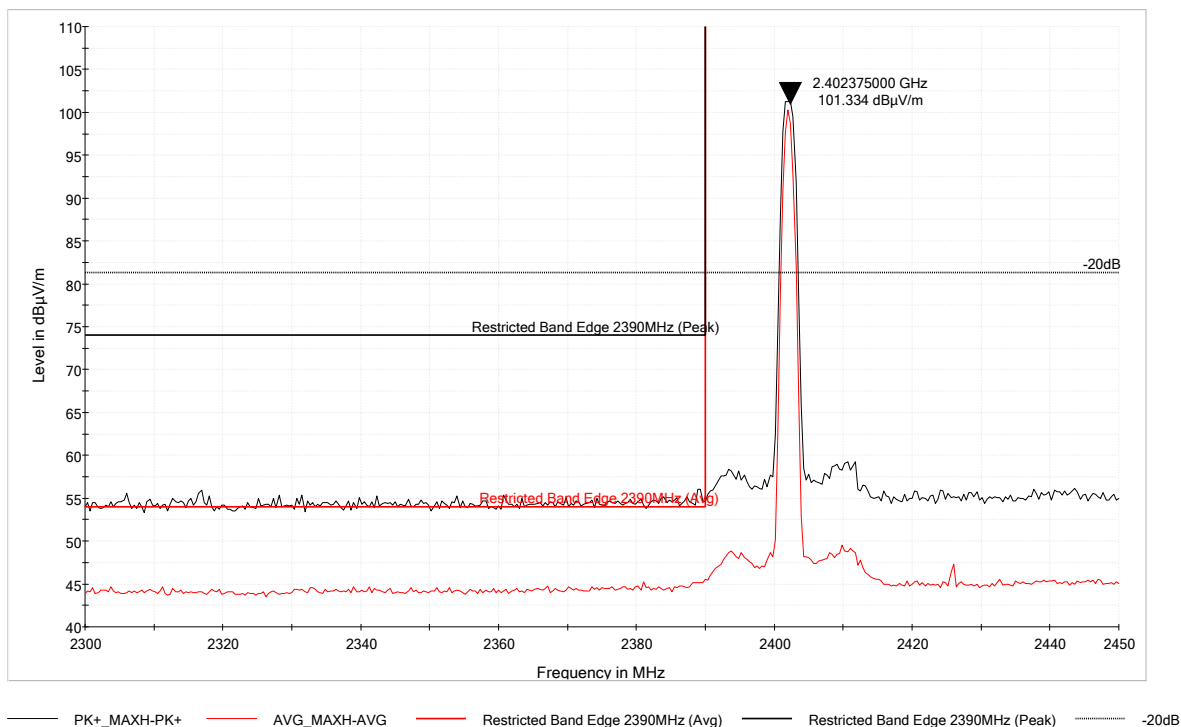
7.8.3 Channel 39 (2480MHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1504.500000	33.59	73.98	40.39	1000.000	199.0	V	319.0	-1.6
2782.000000	37.81	73.98	36.17	1000.000	152.0	H	0.0	4.4
3980.500000	41.63	73.98	32.35	1000.000	100.0	V	322.0	7.2
4960.000000	49.86	73.98	24.12	1000.000	100.0	H	310.0	8.2
12635.500000	51.19	73.98	22.79	1000.000	410.0	H	254.0	19.2
16103.000000	56.49	73.98	17.49	1000.000	410.0	H	272.0	25.6

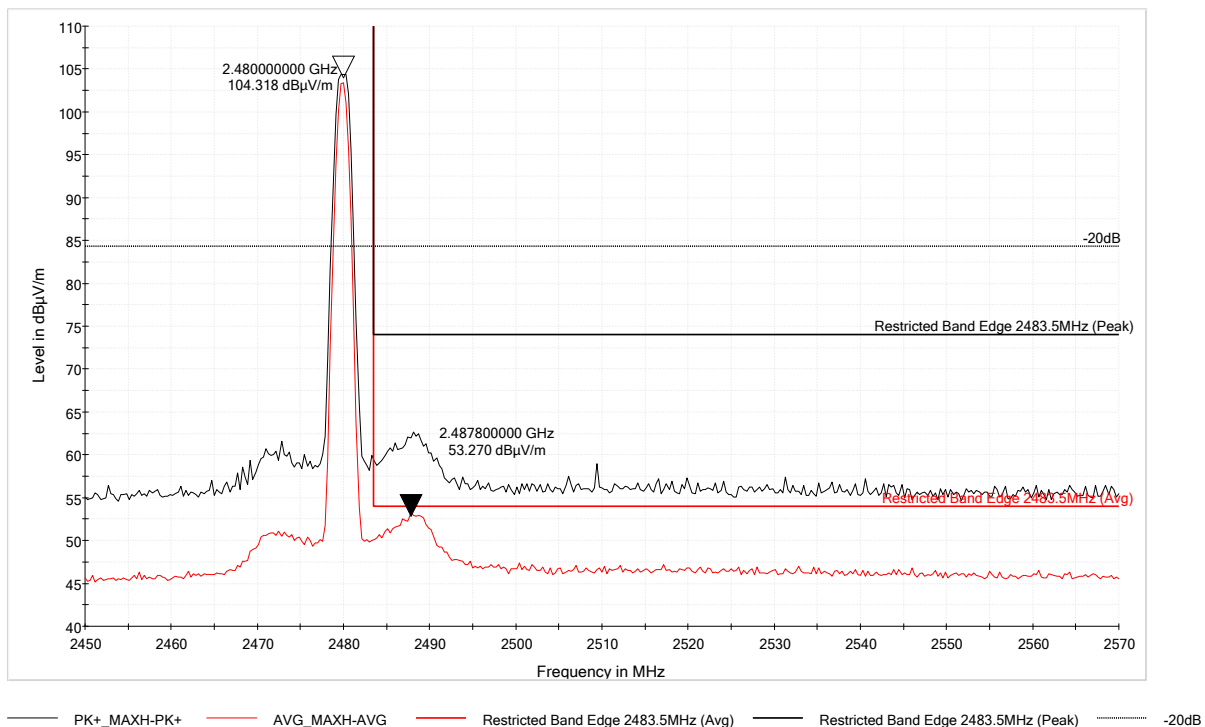
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1504.500000	19.98	53.98	34.00	1000.000	199.0	V	319.0	-1.6
2782.000000	24.98	53.98	29.00	1000.000	152.0	H	0.0	4.4
3980.500000	28.19	53.98	25.79	1000.000	100.0	V	322.0	7.2
4960.000000	43.11	53.98	10.87	1000.000	100.0	H	310.0	8.2
12635.500000	37.95	53.98	16.03	1000.000	410.0	H	254.0	19.2
16103.000000	43.23	53.98	10.75	1000.000	410.0	H	272.0	25.6



7.8.4 Emissions at the low band edge



7.8.5 Emissions at the high band edge



**7.9 Bluetooth****7.9.1 DH1, Channel 0 (2402MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1514.000000	32.55	73.98	41.43	1000.000	410.0	H	210.0	-1.7
2262.500000	38.18	73.98	35.80	1000.000	410.0	V	254.0	3.2
3979.500000	41.49	73.98	32.49	1000.000	410.0	H	307.0	7.1
4804.000000	51.72	73.98	22.26	1000.000	294.0	V	184.0	8.2
12169.000000	50.38	73.98	23.60	1000.000	410.0	H	0.0	18.5
16101.500000	56.77	73.98	17.21	1000.000	410.0	H	338.0	25.6

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1514.000000	20.02	53.98	33.96	1000.000	410.0	H	210.0	-1.7
2262.500000	24.10	53.98	29.88	1000.000	410.0	V	254.0	3.2
3979.500000	28.21	53.98	25.77	1000.000	410.0	H	307.0	7.1
4804.000000	34.21	53.98	19.77	1000.000	294.0	V	184.0	8.2
12169.000000	37.11	53.98	16.87	1000.000	410.0	H	0.0	18.5
16101.500000	43.29	53.98	10.69	1000.000	410.0	H	338.0	25.6

7.9.2 DH1, Channel 38 (2440MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.867778	24.58	40.00	15.42	120.000	100.0	V	285.0	22.2
119.455556	19.45	43.52	24.07	120.000	237.2	H	8.0	21.8
167.039445	21.46	43.52	22.06	120.000	100.0	V	0.0	21.6
283.062222	23.25	46.02	22.77	120.000	105.1	H	212.0	23.7
328.760000	23.20	46.02	22.82	120.000	100.2	H	193.0	25.0
402.857222	24.52	46.02	21.50	120.000	368.5	V	109.0	26.8
608.389444	32.27	46.02	13.75	120.000	100.0	H	154.0	32.3
990.353889	38.11	53.98	15.87	120.000	363.7	H	0.0	38.0

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2262.500000	37.52	73.98	36.46	1000.000	410.0	H	64.0	3.3
4082.000000	42.02	73.98	31.96	1000.000	100.0	H	170.0	7.4
4880.000000	54.37	73.98	19.61	1000.000	100.0	H	0.0	8.3
12429.000000	50.41	73.98	23.57	1000.000	100.0	V	301.0	18.8
16101.500000	57.62	73.98	16.36	1000.000	410.0	H	314.0	25.6
18848.000000	55.95	73.98	18.03	1000.000	100.0	V	136.0	18.3
22858.000000	53.67	73.98	20.31	1000.000	100.0	H	46.0	6.4
23923.500000	53.35	73.98	20.63	1000.000	410.0	V	199.0	6.1



Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2262.500000	24.27	53.98	29.71	1000.000	410.0	H	64.0	3.3
4082.000000	28.28	53.98	25.70	1000.000	100.0	H	170.0	7.4
4880.000000	36.18	53.98	17.80	1000.000	100.0	H	0.0	8.3
12429.000000	37.19	53.98	16.79	1000.000	100.0	V	301.0	18.8
16101.500000	43.31	53.98	10.67	1000.000	410.0	H	314.0	25.6
18848.000000	42.13	53.98	11.85	1000.000	100.0	V	136.0	18.3
22858.000000	40.43	53.98	13.55	1000.000	100.0	H	46.0	6.4
23923.500000	40.08	53.98	13.90	1000.000	410.0	V	199.0	6.1

7.9.3 DH1, Channel 78 (2480MHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1507.500000	33.20	73.98	40.78	1000.000	410.0	V	335.0	-1.6
2793.500000	38.23	73.98	35.75	1000.000	410.0	H	208.0	4.5
4133.000000	41.87	73.98	32.11	1000.000	100.0	H	150.0	7.5
4960.000000	51.31	73.98	22.67	1000.000	100.0	H	0.0	8.2
12326.500000	50.73	73.98	23.25	1000.000	410.0	V	0.0	18.5
16098.500000	56.22	73.98	17.76	1000.000	410.0	H	232.0	25.6

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1507.500000	20.06	53.98	33.92	1000.000	410.0	V	335.0	-1.6
2793.500000	25.07	53.98	28.91	1000.000	410.0	H	208.0	4.5
4133.000000	28.52	53.98	25.46	1000.000	100.0	H	150.0	7.5
4960.000000	33.81	53.98	20.17	1000.000	100.0	H	0.0	8.2
12326.500000	37.23	53.98	16.75	1000.000	410.0	V	0.0	18.5
16098.500000	43.31	53.98	10.67	1000.000	410.0	H	232.0	25.6

**7.9.4 DH3, Channel 0 (2402MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.000000	53.63	73.98	20.35	1000.000	100.0	H	319.0	8.2
12104.000000	50.80	73.98	23.18	1000.000	100.0	H	199.0	18.4
12587.500000	51.07	73.98	22.91	1000.000	100.0	H	100.0	19.1
16096.500000	56.11	73.98	17.87	1000.000	410.0	V	284.0	25.6
17743.000000	58.69	73.98	15.29	1000.000	410.0	H	323.0	26.4

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.000000	44.23	53.98	9.75	1000.000	100.0	H	319.0	8.2
12104.000000	36.97	53.98	17.01	1000.000	100.0	H	199.0	18.4
12587.500000	37.74	53.98	16.24	1000.000	100.0	H	100.0	19.1
16096.500000	43.23	53.98	10.75	1000.000	410.0	V	284.0	25.6
17743.000000	44.78	53.98	9.20	1000.000	410.0	H	323.0	26.4

7.9.5 DH3, Channel 38 (2440MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.975556	24.72	40.00	15.28	120.000	100.1	V	320.0	22.1
119.455556	19.16	43.52	24.36	120.000	129.7	H	349.0	21.8
166.823889	21.35	43.52	22.17	120.000	99.9	V	0.0	21.6
283.062222	22.76	46.02	23.26	120.000	104.9	H	256.0	23.7
328.760000	23.03	46.02	22.99	120.000	105.1	H	220.0	25.0
609.575000	32.34	46.02	13.68	120.000	237.6	H	201.0	32.3
990.353889	38.13	53.98	15.85	120.000	100.0	H	155.0	38.0

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2821.000000	38.75	73.98	35.23	1000.000	410.0	V	247.0	4.6
3980.500000	41.06	73.98	32.92	1000.000	100.0	V	295.0	7.2
4880.000000	50.92	73.98	23.06	1000.000	171.0	H	156.0	8.3
16096.000000	56.37	73.98	17.61	1000.000	410.0	H	142.0	25.6
19177.000000	55.04	73.98	18.94	1000.000	329.0	H	182.0	17.2
22840.000000	53.07	73.98	20.91	1000.000	100.0	H	170.0	6.3
23898.500000	53.26	73.98	20.72	1000.000	339.0	H	0.0	5.9



Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2821.000000	25.28	53.98	28.70	1000.000	410.0	V	247.0	4.6
3980.500000	28.28	53.98	25.70	1000.000	100.0	V	295.0	7.2
4880.000000	40.88	53.98	13.10	1000.000	171.0	H	156.0	8.3
16096.000000	43.24	53.98	10.74	1000.000	410.0	H	142.0	25.6
19177.000000	42.05	53.98	11.93	1000.000	329.0	H	182.0	17.2
22840.000000	40.01	53.98	13.97	1000.000	100.0	H	170.0	6.3
23898.500000	39.68	53.98	14.30	1000.000	339.0	H	0.0	5.9

7.9.6 DH3, Channel 78 (2480MHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2260.500000	37.87	73.98	36.11	1000.000	293.0	H	138.0	3.3
2741.000000	38.58	73.98	35.40	1000.000	241.0	H	184.0	4.4
4133.000000	42.51	73.98	31.47	1000.000	287.0	H	155.0	7.5
4960.000000	49.71	73.98	24.27	1000.000	267.0	H	325.0	8.2
11616.000000	48.95	73.98	25.03	1000.000	410.0	V	262.0	17.4
16142.500000	55.86	73.98	18.12	1000.000	410.0	H	120.0	24.6

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2260.500000	24.55	53.98	29.43	1000.000	293.0	H	138.0	3.3
2741.000000	24.61	53.98	29.37	1000.000	241.0	H	184.0	4.4
4133.000000	28.92	53.98	25.06	1000.000	287.0	H	155.0	7.5
4960.000000	39.74	53.98	14.24	1000.000	267.0	H	325.0	8.2
11616.000000	35.77	53.98	18.21	1000.000	410.0	V	262.0	17.4
16142.500000	42.51	53.98	11.47	1000.000	410.0	H	120.0	24.6

**7.9.7 DH5, Channel 0 (2402MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2784.000000	38.76	73.98	35.22	1000.000	410.0	H	340.0	4.5
3993.000000	41.14	73.98	32.84	1000.000	410.0	H	102.0	7.1
4804.000000	54.26	73.98	19.72	1000.000	100.0	V	182.0	8.2
12172.000000	50.24	73.98	23.74	1000.000	410.0	V	329.0	18.5
16099.500000	56.83	73.98	17.15	1000.000	410.0	V	232.0	25.6

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2784.000000	25.19	53.98	28.79	1000.000	410.0	H	340.0	4.5
3993.000000	28.00	53.98	25.98	1000.000	410.0	H	102.0	7.1
4804.000000	36.43	53.98	17.55	1000.000	100.0	V	182.0	8.2
12172.000000	37.10	53.98	16.88	1000.000	410.0	V	329.0	18.5
16099.500000	43.28	53.98	10.70	1000.000	410.0	V	232.0	25.6

7.9.8 DH5, Channel 38 (2440MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.975556	24.45	40.00	15.55	120.000	110.1	V	304.0	22.1
120.587222	19.23	43.52	24.29	120.000	105.4	H	182.0	21.9
126.838333	19.37	43.52	24.15	120.000	177.6	H	8.0	22.1
164.668333	20.84	43.52	22.68	120.000	97.1	V	7.0	21.6
168.602222	20.65	43.52	22.87	120.000	101.9	V	0.0	21.6
274.871111	23.57	46.02	22.45	120.000	104.7	H	112.0	23.6
324.125556	22.80	46.02	23.22	120.000	309.3	H	46.0	24.8
404.797222	24.86	46.02	21.16	120.000	296.7	H	119.0	27.1
613.562778	32.34	46.02	13.68	120.000	296.9	H	36.0	32.3
967.289444	37.61	53.98	16.37	120.000	240.1	H	314.0	37.6

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1576.500000	33.73	73.98	40.25	1000.000	410.0	V	80.0	-1.2
2763.500000	38.46	73.98	35.52	1000.000	410.0	H	300.0	4.4
3984.500000	41.51	73.98	32.47	1000.000	410.0	V	330.0	7.2
4880.000000	53.20	73.98	20.78	1000.000	232.0	H	0.0	8.3
8333.500000	44.46	73.98	29.52	1000.000	410.0	V	234.0	12.6
12600.500000	51.30	73.98	22.68	1000.000	410.0	H	248.0	19.2
16099.000000	56.28	73.98	17.70	1000.000	410.0	H	288.0	25.6
17765.500000	58.01	73.98	15.97	1000.000	333.0	V	154.0	26.3
18648.000000	56.42	73.98	17.56	1000.000	410.0	V	242.0	18.6
22877.000000	53.55	73.98	20.43	1000.000	100.0	V	338.0	6.6
23808.000000	52.98	73.98	21.00	1000.000	100.0	V	296.0	6.4



Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1576.500000	20.23	53.98	33.75	1000.000	410.0	V	80.0	-1.2
2763.500000	25.01	53.98	28.97	1000.000	410.0	H	300.0	4.4
3984.500000	28.35	53.98	25.63	1000.000	410.0	V	330.0	7.2
4880.000000	35.63	53.98	18.35	1000.000	232.0	H	0.0	8.3
8333.500000	31.45	53.98	22.53	1000.000	410.0	V	234.0	12.6
12600.500000	37.81	53.98	16.17	1000.000	410.0	H	248.0	19.2
16099.000000	43.31	53.98	10.67	1000.000	410.0	H	288.0	25.6
17765.500000	44.70	53.98	9.28	1000.000	333.0	V	154.0	26.3
18648.000000	43.08	53.98	10.90	1000.000	410.0	V	242.0	18.6
22877.000000	40.29	53.98	13.69	1000.000	100.0	V	338.0	6.6
23808.000000	39.63	53.98	14.35	1000.000	100.0	V	296.0	6.4

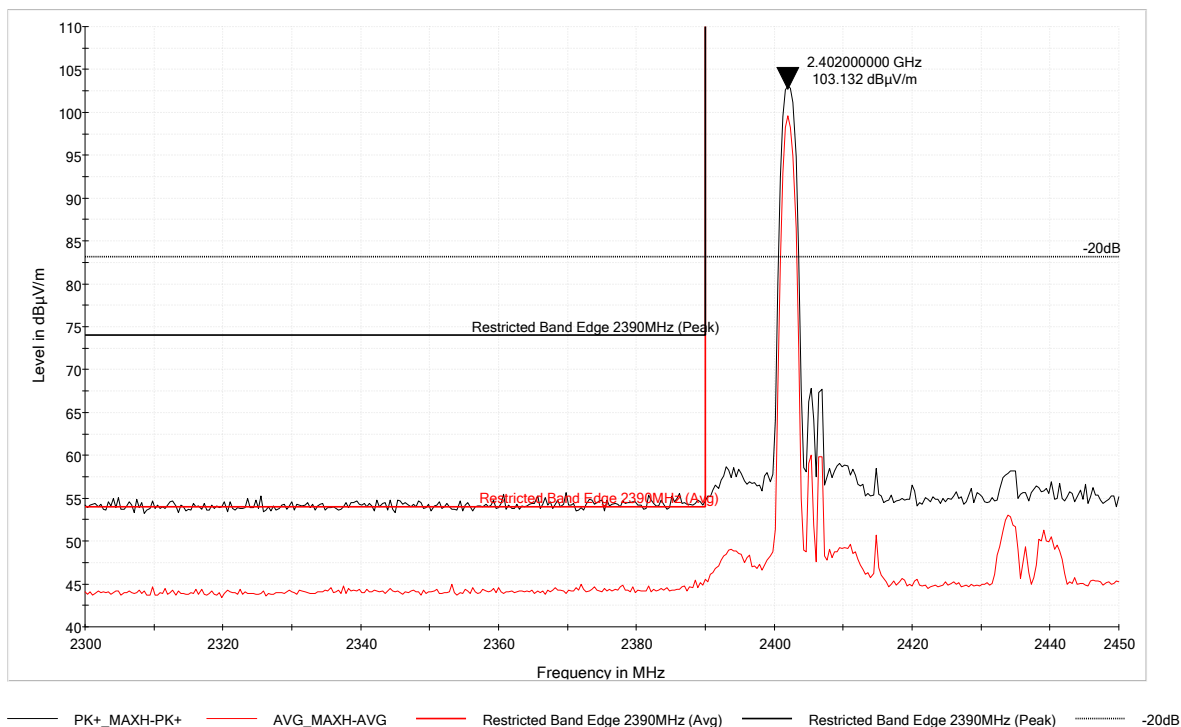
7.9.9 DH5, Channel 78 (2480MHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2336.000000	36.77	73.98	37.21	1000.000	410.0	V	312.0	3.6
2796.500000	38.57	73.98	35.41	1000.000	100.0	V	282.0	4.5
4133.000000	41.43	73.98	32.55	1000.000	100.0	V	191.0	7.2
4960.000000	49.62	73.98	24.36	1000.000	395.0	V	342.0	8.1
7400.500000	44.16	73.98	29.82	1000.000	410.0	H	262.0	11.7
12668.500000	51.51	73.98	22.47	1000.000	410.0	H	242.0	19.3
16080.000000	56.29	73.98	17.69	1000.000	410.0	H	185.0	25.2

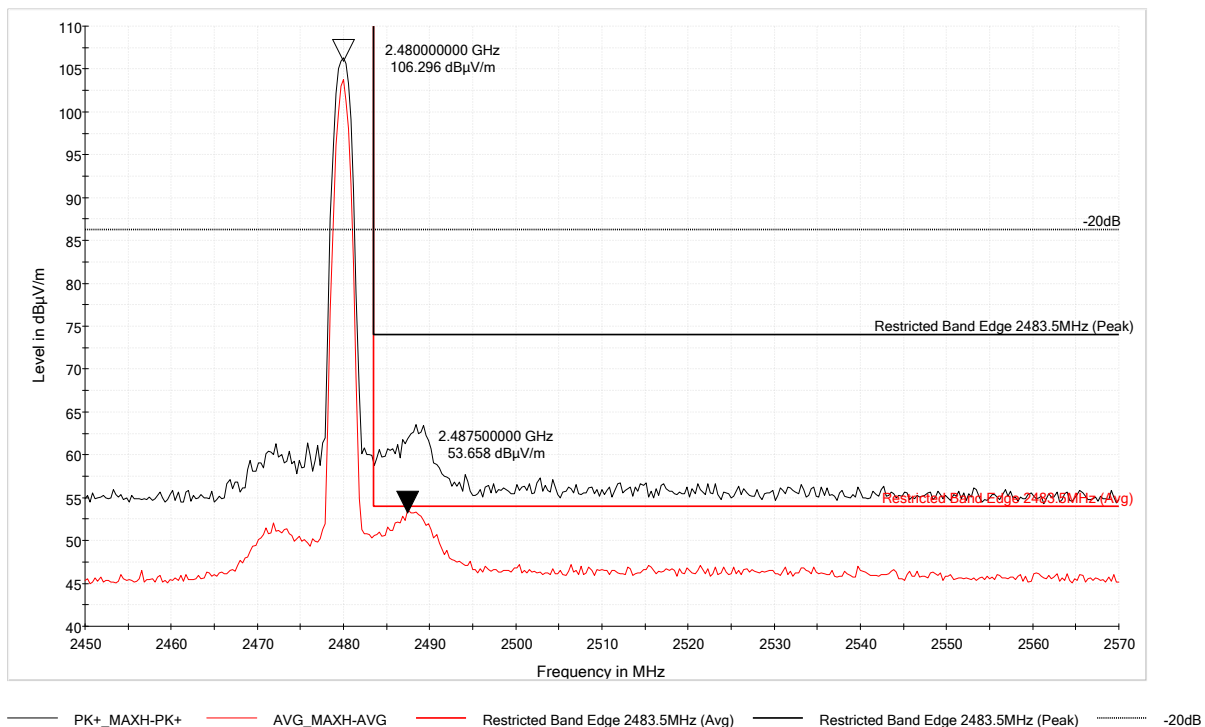
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2336.000000	23.78	53.98	30.20	1000.000	410.0	V	312.0	3.6
2796.500000	25.11	53.98	28.87	1000.000	100.0	V	282.0	4.5
4133.000000	28.07	53.98	25.91	1000.000	100.0	V	191.0	7.2
4960.000000	33.32	53.98	20.66	1000.000	395.0	V	342.0	8.1
7400.500000	31.13	53.98	22.85	1000.000	410.0	H	262.0	11.7
12668.500000	37.98	53.98	16.00	1000.000	410.0	H	242.0	19.3
16080.000000	42.87	53.98	11.11	1000.000	410.0	H	185.0	25.2



7.9.10 Emissions at the low band edge



7.9.11 Emissions at the high band edge



**7.10 Wi-Fi, 802.11b****7.10.1 Channel 1 (2412MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2856.500000	38.01	73.98	35.97	1000.000	100.0	V	248.0	4.6
4003.500000	41.60	73.98	32.38	1000.000	100.0	V	289.0	7.3
4960.000000	49.47	73.98	24.51	1000.000	100.0	H	306.0	8.2
8259.000000	45.12	73.98	28.86	1000.000	410.0	H	280.0	12.6
12195.500000	51.20	73.98	22.78	1000.000	410.0	H	186.0	18.6
16099.000000	57.09	73.98	16.89	1000.000	410.0	V	192.0	25.6

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2856.500000	24.84	53.98	29.14	1000.000	100.0	V	248.0	4.6
4003.500000	28.11	53.98	25.87	1000.000	100.0	V	289.0	7.3
4960.000000	42.49	53.98	11.49	1000.000	100.0	H	306.0	8.2
8259.000000	31.69	53.98	22.29	1000.000	410.0	H	280.0	12.6
12195.500000	37.11	53.98	16.87	1000.000	410.0	H	186.0	18.6
16099.000000	43.25	53.98	10.73	1000.000	410.0	V	192.0	25.6

7.10.2 Channel 6 (2437MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
116.545556	18.84	43.52	24.68	120.000	320.0	V	127.0	21.8
165.153333	20.70	43.52	22.82	120.000	99.9	V	6.0	21.6
275.895000	23.67	46.02	22.35	120.000	105.1	H	229.0	23.6
329.460556	22.44	46.02	23.58	120.000	165.7	V	207.0	24.5
409.808889	24.73	46.02	21.29	120.000	383.0	V	9.0	27.0
996.281667	37.32	53.98	16.66	120.000	99.9	V	138.0	37.2

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2817.500000	38.28	73.98	35.70	1000.000	163.0	H	190.0	4.6
4873.000000	60.08	73.98	13.90	1000.000	142.0	V	328.0	8.2
8372.000000	44.67	73.98	29.31	1000.000	410.0	V	0.0	12.6
16106.500000	56.55	73.98	17.43	1000.000	410.0	H	334.0	25.5
19691.500000	55.45	73.98	18.53	1000.000	274.0	V	130.0	15.8
22717.000000	53.56	73.98	20.42	1000.000	100.0	H	254.0	6.7
23886.500000	52.97	73.98	21.01	1000.000	100.0	V	321.0	6.0

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2817.500000	25.00	53.98	28.98	1000.000	163.0	H	190.0	4.6
4873.000000	52.15	53.98	1.83	1000.000	142.0	V	328.0	8.2
8372.000000	31.49	53.98	22.49	1000.000	410.0	V	0.0	12.6
16106.500000	43.11	53.98	10.87	1000.000	410.0	H	334.0	25.5
19691.500000	42.08	53.98	11.90	1000.000	274.0	V	130.0	15.8
22717.000000	40.40	53.98	13.58	1000.000	100.0	H	254.0	6.7
23886.500000	39.67	53.98	14.31	1000.000	100.0	V	321.0	6.0

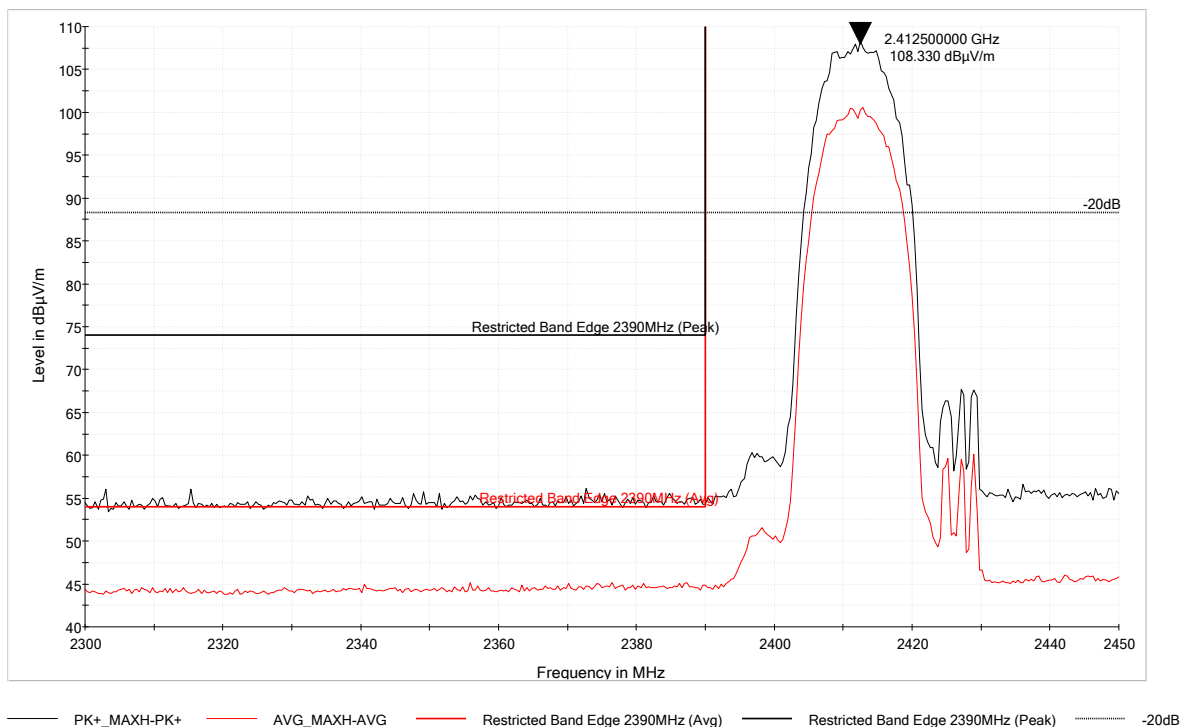
**7.10.3 Channel 11 (2462MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1541.000000	34.33	73.98	39.65	1000.000	410.0	V	320.0	-1.2
2238.000000	38.24	73.98	35.74	1000.000	296.0	H	140.0	3.2
2863.500000	37.76	73.98	36.22	1000.000	100.0	V	197.0	4.6
3998.000000	41.32	73.98	32.66	1000.000	100.0	V	0.0	7.3
4923.000000	59.27	73.98	14.71	1000.000	153.0	V	1.0	8.3
12490.000000	51.91	73.98	22.07	1000.000	410.0	H	305.0	19.1
16097.500000	56.72	73.98	17.26	1000.000	410.0	H	287.0	25.6

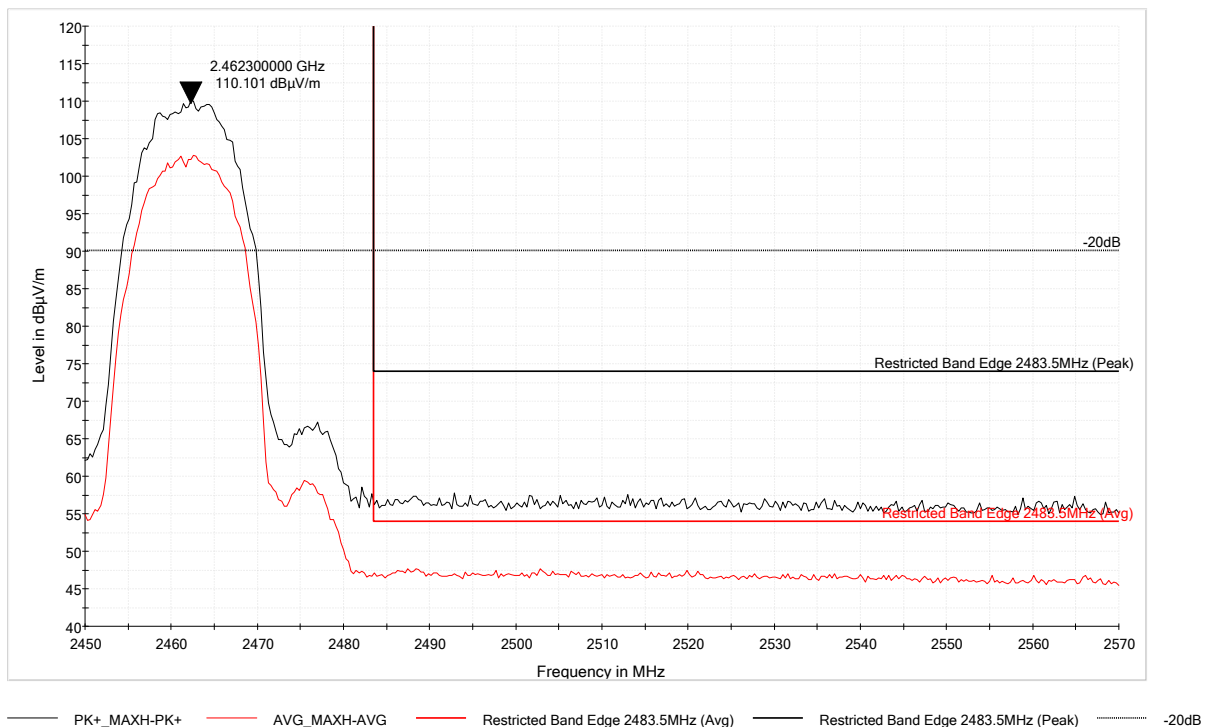
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1541.000000	20.21	53.98	33.77	1000.000	410.0	V	320.0	-1.2
2238.000000	25.12	53.98	28.86	1000.000	296.0	H	140.0	3.2
2863.500000	24.72	53.98	29.26	1000.000	100.0	V	197.0	4.6
3998.000000	28.17	53.98	25.81	1000.000	100.0	V	0.0	7.3
4923.000000	51.33	53.98	2.65	1000.000	153.0	V	1.0	8.3
12490.000000	37.54	53.98	16.44	1000.000	410.0	H	305.0	19.1
16097.500000	43.26	53.98	10.72	1000.000	410.0	H	287.0	25.6



7.10.4 Emissions at the low band edge



7.10.5 Emissions at the high band edge



**7.11 Wi-Fi, 802.11g****7.11.1 Channel 1 (2412MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2259.500000	39.20	73.98	34.78	1000.000	297.0	H	140.0	3.3
3994.000000	41.54	73.98	32.44	1000.000	100.0	V	0.0	7.3
4826.000000	56.78	73.98	17.20	1000.000	351.0	V	338.0	8.2
12650.500000	51.16	73.98	22.82	1000.000	410.0	H	234.0	19.3
16093.000000	56.62	73.98	17.36	1000.000	410.0	V	274.0	25.5

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2259.500000	25.38	53.98	28.60	1000.000	297.0	H	140.0	3.3
3994.000000	28.08	53.98	25.90	1000.000	100.0	V	0.0	7.3
4826.000000	46.19	53.98	7.79	1000.000	351.0	V	338.0	8.2
12650.500000	37.88	53.98	16.10	1000.000	410.0	H	234.0	19.3
16093.000000	43.15	53.98	10.83	1000.000	410.0	V	274.0	25.5

7.11.2 Channel 6 (2437MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.867778	24.27	40.00	15.73	120.000	104.7	V	294.0	22.2
114.228333	19.09	43.52	24.43	120.000	275.8	H	0.0	21.4
124.467222	19.54	43.52	23.98	120.000	228.0	V	264.0	22.4
163.644445	19.90	43.52	23.62	120.000	100.0	V	331.0	21.7
273.577778	24.61	46.02	21.41	120.000	100.0	H	219.0	23.5
612.107778	32.28	46.02	13.74	120.000	400.0	H	316.0	32.3
977.474444	37.66	53.98	16.32	120.000	299.3	H	163.0	37.6

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2240.000000	38.69	73.98	35.29	1000.000	216.0	H	47.0	3.2
3974.000000	40.88	73.98	33.10	1000.000	100.0	V	294.0	7.2
4873.500000	55.58	73.98	18.40	1000.000	100.0	V	194.0	8.2
7382.000000	44.89	73.98	29.09	1000.000	410.0	H	0.0	11.6
12646.500000	51.20	73.98	22.78	1000.000	410.0	H	119.0	19.3
16100.500000	57.79	73.98	16.19	1000.000	410.0	H	269.0	25.7

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2240.000000	25.59	53.98	28.39	1000.000	216.0	H	47.0	3.2
3974.000000	27.86	53.98	26.12	1000.000	100.0	V	294.0	7.2
4873.500000	44.87	53.98	9.11	1000.000	100.0	V	194.0	8.2
7382.000000	30.96	53.98	23.02	1000.000	410.0	H	0.0	11.6
12646.500000	37.90	53.98	16.08	1000.000	410.0	H	119.0	19.3
16100.500000	43.31	53.98	10.67	1000.000	410.0	H	269.0	25.7

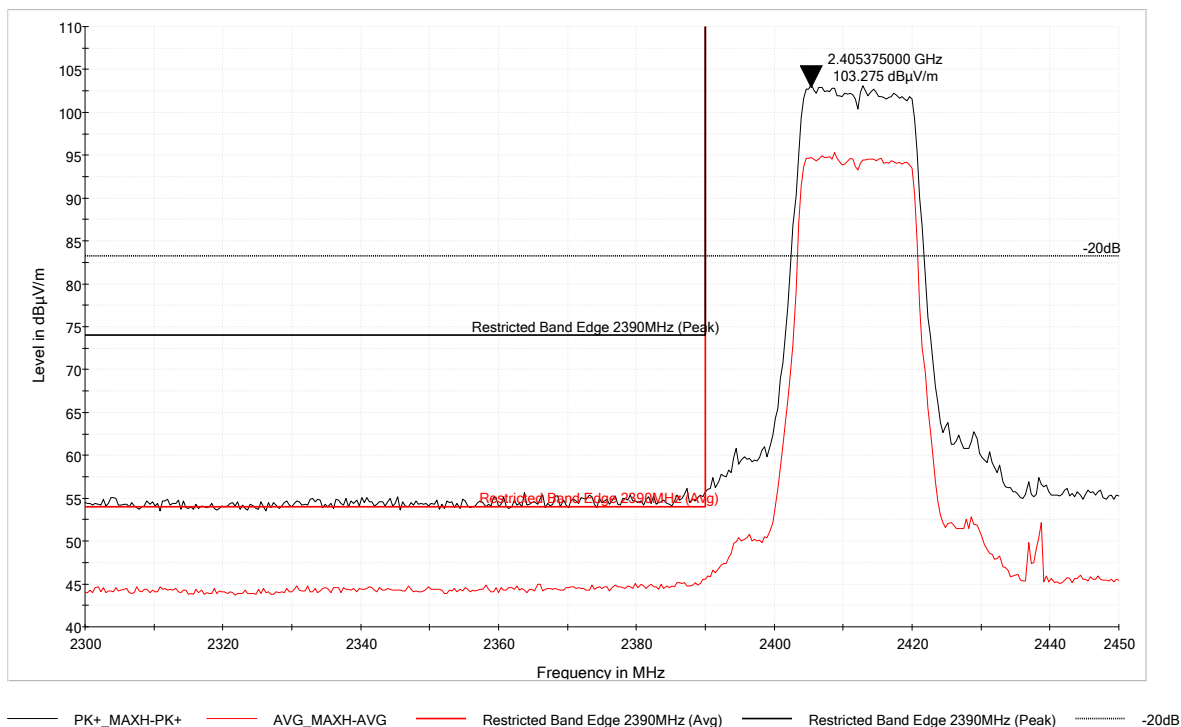
**7.11.3 Channel 11 (2462MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2240.000000	39.25	73.98	34.73	1000.000	296.0	H	139.0	3.2
4102.000000	41.53	73.98	32.45	1000.000	100.0	H	147.0	7.6
4924.000000	52.93	73.98	21.05	1000.000	100.0	H	310.0	8.3
12624.500000	51.47	73.98	22.51	1000.000	410.0	V	155.0	19.2
16094.000000	56.57	73.98	17.41	1000.000	410.0	H	276.0	25.5

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2240.000000	25.96	53.98	28.02	1000.000	296.0	H	139.0	3.2
4102.000000	28.27	53.98	25.71	1000.000	100.0	H	147.0	7.6
4924.000000	42.05	53.98	11.93	1000.000	100.0	H	310.0	8.3
12624.500000	37.87	53.98	16.11	1000.000	410.0	V	155.0	19.2
16094.000000	43.19	53.98	10.79	1000.000	410.0	H	276.0	25.5



7.11.4 Emissions at the low band edge



7.11.5 Emissions at the high band edge



**7.12 Wi-Fi, 802.11n****7.12.1 Channel 1 (2412MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1339.000000	34.23	73.98	39.75	1000.000	134.0	H	0.0	-0.7
4824.000000	54.72	73.98	19.26	1000.000	100.0	H	312.0	8.2
7498.000000	44.15	73.98	29.83	1000.000	100.0	H	287.0	11.7
12610.000000	50.83	73.98	23.15	1000.000	100.0	H	359.0	19.2
15917.000000	54.17	73.98	19.81	1000.000	100.0	H	282.0	22.9

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1339.000000	21.32	53.98	32.66	1000.000	134.0	H	0.0	-0.7
4824.000000	42.39	53.98	11.59	1000.000	100.0	H	312.0	8.2
7498.000000	31.10	53.98	22.88	1000.000	100.0	H	287.0	11.7
12610.000000	37.89	53.98	16.09	1000.000	100.0	H	359.0	19.2
15917.000000	40.76	53.98	13.22	1000.000	100.0	H	282.0	22.9

7.12.2 Channel 6 (2437MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
38.191111	24.64	40.00	15.36	120.000	105.0	V	284.0	21.9
119.671111	19.18	43.52	24.34	120.000	400.1	V	91.0	22.0
130.772222	19.70	43.52	23.82	120.000	249.3	V	301.0	22.5
325.580556	22.90	46.02	23.12	120.000	284.7	H	146.0	24.8
406.629445	24.90	46.02	21.12	120.000	400.0	H	9.0	27.2
979.683889	37.93	53.98	16.05	120.000	99.7	H	146.0	37.7

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1179.000000	34.65	73.98	39.33	1000.000	218.0	V	280.0	-1.6
4876.500000	61.48	73.98	12.50	1000.000	100.0	V	187.0	8.2
12124.000000	50.19	73.98	23.79	1000.000	100.0	V	324.0	18.4
16063.500000	55.57	73.98	18.41	1000.000	410.0	H	46.0	24.9
17777.500000	57.67	73.98	16.31	1000.000	100.0	V	0.0	26.4
18107.000000	56.68	73.98	17.30	1000.000	336.0	V	202.0	20.8
22679.000000	54.09	73.98	19.89	1000.000	100.0	H	248.0	6.9
23862.500000	53.35	73.98	20.63	1000.000	311.0	H	159.0	6.1



Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1179.000000	20.93	53.98	33.05	1000.000	218.0	V	280.0	-1.6
4876.500000	50.83	53.98	3.15	1000.000	100.0	V	187.0	8.2
12124.000000	36.94	53.98	17.04	1000.000	100.0	V	324.0	18.4
16063.500000	42.38	53.98	11.60	1000.000	410.0	H	46.0	24.9
17777.500000	44.66	53.98	9.32	1000.000	100.0	V	0.0	26.4
18107.000000	43.62	53.98	10.36	1000.000	336.0	V	202.0	20.8
22679.000000	40.87	53.98	13.11	1000.000	100.0	H	248.0	6.9
23862.500000	39.92	53.98	14.06	1000.000	311.0	H	159.0	6.1

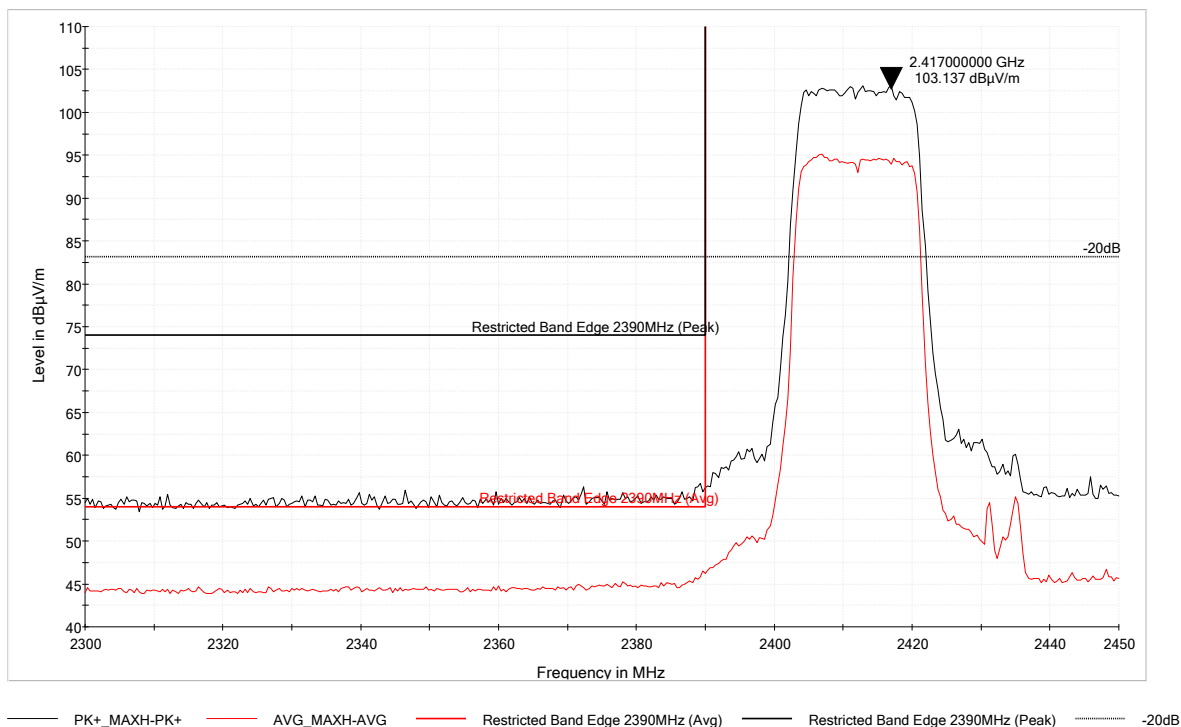
7.12.3 Channel 11 (2462MHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4923.500000	57.53	73.98	16.45	1000.000	324.0	H	336.0	8.3
7273.500000	45.94	73.98	28.04	1000.000	100.0	H	306.0	11.6
11102.500000	49.05	73.98	24.93	1000.000	100.0	H	262.0	17.3
12151.000000	50.71	73.98	23.27	1000.000	410.0	H	280.0	18.5
16096.000000	56.53	73.98	17.45	1000.000	410.0	V	217.0	25.5

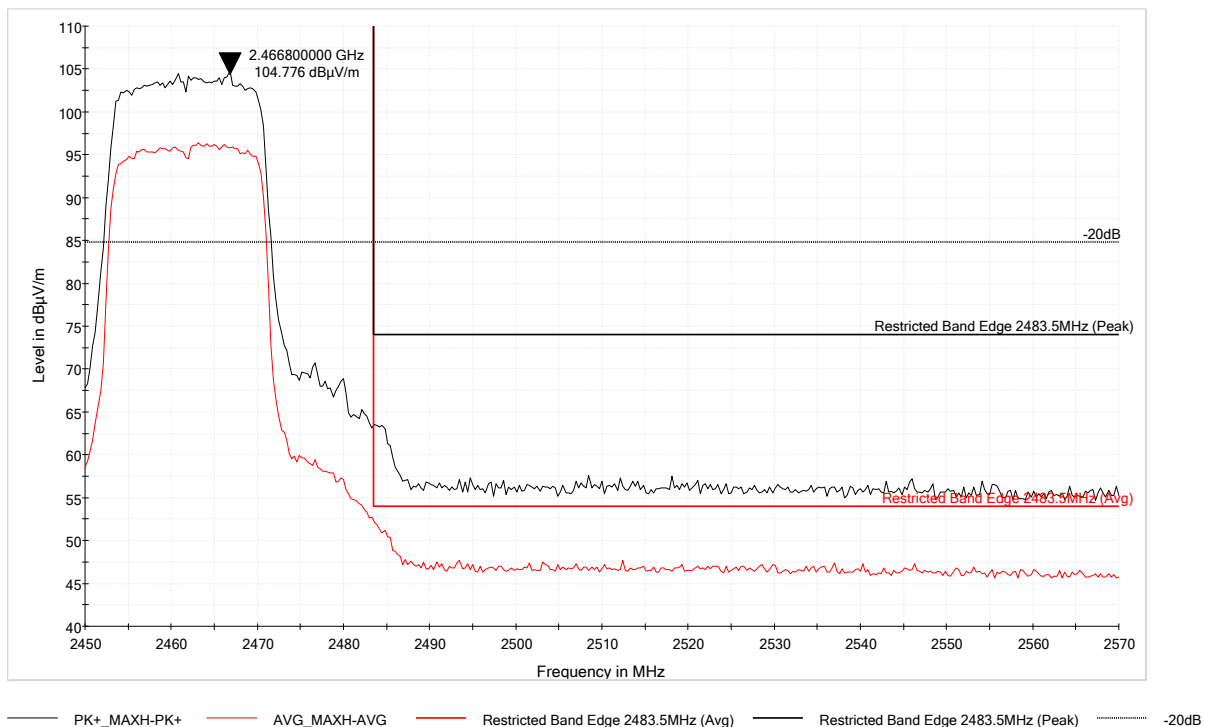
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4923.500000	47.24	53.98	6.74	1000.000	324.0	H	336.0	8.3
7273.500000	31.30	53.98	22.68	1000.000	100.0	H	306.0	11.6
11102.500000	35.82	53.98	18.16	1000.000	100.0	H	262.0	17.3
12151.000000	37.14	53.98	16.84	1000.000	410.0	H	280.0	18.5
16096.000000	43.21	53.98	10.77	1000.000	410.0	V	217.0	25.5



7.12.4 Emissions at the low band edge



7.12.5 Emissions at the high band edge



**7.13 Wi-Fi, 802.11nHT40****7.13.1 Channel 3 (2422MHz)**

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4840.000000	51.64	73.98	22.34	1000.000	100.0	V	195.0	8.4
11132.500000	49.10	73.98	24.88	1000.000	100.0	H	109.0	17.3
12606.000000	51.76	73.98	22.22	1000.000	100.0	H	260.0	19.2
16098.500000	56.33	73.98	17.65	1000.000	100.0	V	90.0	25.6
17779.500000	58.59	73.98	15.39	1000.000	410.0	H	330.0	26.5

Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4840.000000	40.49	53.98	13.49	1000.000	100.0	V	195.0	8.4
11132.500000	35.40	53.98	18.58	1000.000	100.0	H	109.0	17.3
12606.000000	37.89	53.98	16.09	1000.000	100.0	H	260.0	19.2
16098.500000	43.25	53.98	10.73	1000.000	100.0	V	90.0	25.6
17779.500000	44.94	53.98	9.04	1000.000	410.0	H	330.0	26.5

7.13.2 Channel 7 (2442MHz)

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
119.994445	19.52	43.52	24.00	120.000	102.1	V	5.0	22.0
132.927778	19.15	43.52	24.37	120.000	308.6	H	166.0	22.0
248.627222	21.94	46.02	24.08	120.000	99.8	V	10.0	21.9
267.111111	22.27	46.02	23.75	120.000	189.8	V	174.0	23.2
278.697222	22.46	46.02	23.56	120.000	100.4	H	94.0	23.7

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4184.500000	41.48	73.98	32.50	1000.000	100.0	H	0.0	7.5
4873.000000	53.23	73.98	20.75	1000.000	100.0	H	318.0	8.3
12102.500000	51.55	73.98	22.43	1000.000	410.0	V	44.0	18.3
16084.000000	55.81	73.98	18.17	1000.000	410.0	H	110.0	25.3
17769.500000	58.34	73.98	15.64	1000.000	410.0	H	0.0	26.5
18659.000000	56.14	73.98	17.84	1000.000	410.0	V	301.0	18.5
22645.000000	53.74	73.98	20.24	1000.000	100.0	H	175.0	6.8
23851.500000	52.95	73.98	21.03	1000.000	100.0	H	100.0	6.2



Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4184.500000	28.22	53.98	25.76	1000.000	100.0	H	0.0	7.5
4873.000000	40.75	53.98	13.23	1000.000	100.0	H	318.0	8.3
12102.500000	36.95	53.98	17.03	1000.000	410.0	V	44.0	18.3
16084.000000	42.94	53.98	11.04	1000.000	410.0	H	110.0	25.3
17769.500000	44.86	53.98	9.12	1000.000	410.0	H	0.0	26.5
18659.000000	42.96	53.98	11.02	1000.000	410.0	V	301.0	18.5
22645.000000	40.37	53.98	13.61	1000.000	100.0	H	175.0	6.8
23851.500000	39.66	53.98	14.32	1000.000	100.0	H	100.0	6.2

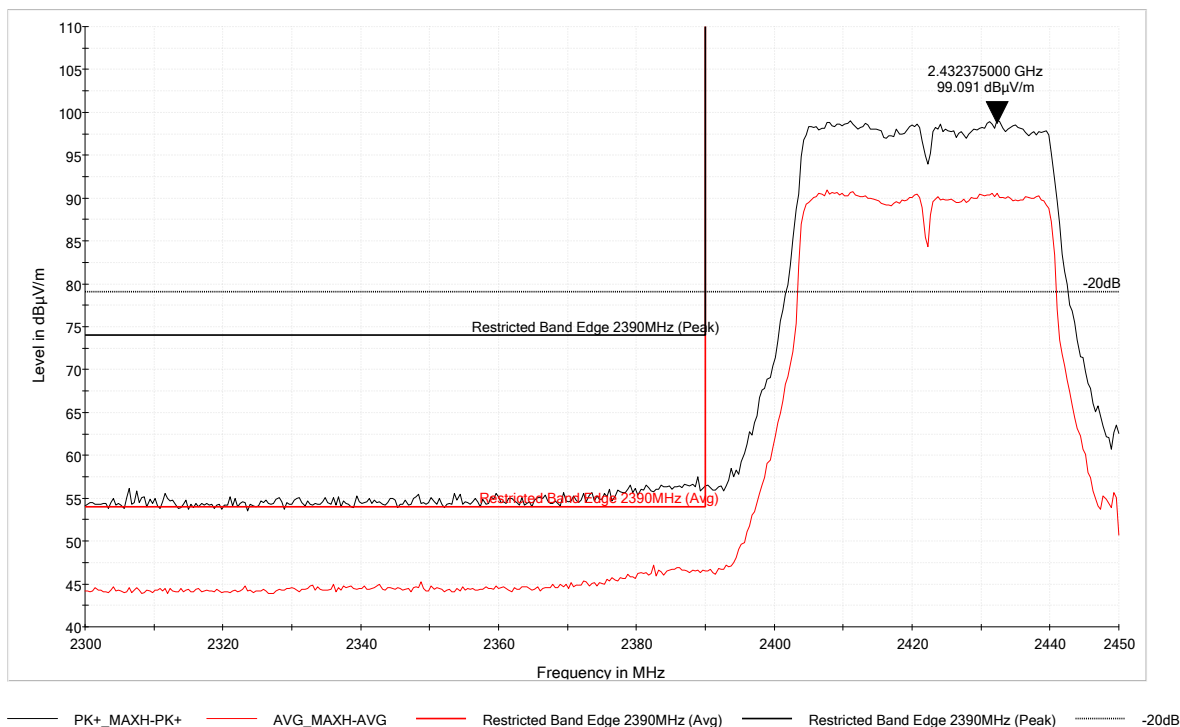
7.13.3 Channel 11 (2462MHz)

Frequency (MHz)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4902.500000	46.85	73.98	27.13	1000.000	293.0	H	294.0	8.2
7589.500000	44.17	73.98	29.81	1000.000	100.0	H	199.0	11.9
12630.000000	51.27	73.98	22.71	1000.000	410.0	H	196.0	19.2
16083.500000	56.44	73.98	17.54	1000.000	410.0	H	316.0	25.3

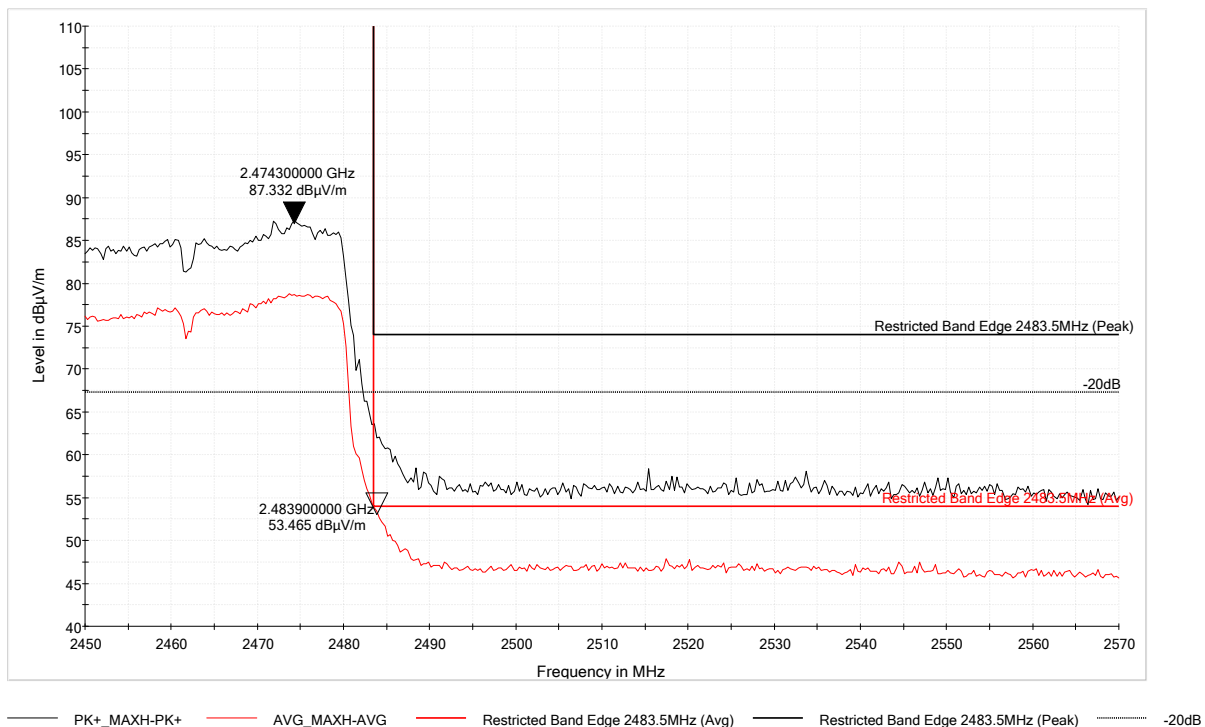
Frequency (MHz)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4902.500000	34.16	53.98	19.82	1000.000	293.0	H	294.0	8.2
7589.500000	31.20	53.98	22.78	1000.000	100.0	H	199.0	11.9
12630.000000	38.04	53.98	15.94	1000.000	410.0	H	196.0	19.2
16083.500000	42.94	53.98	11.04	1000.000	410.0	H	316.0	25.3



7.13.4 Emissions at the low band edge



7.13.5 Emissions at the high band edge





8 Output Power

8.1 Test Limits

FCC Part 15.247(b)(1):

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

FCC Part 15.247(b)(3):

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

RSS-247 Issue 2 § 5.4(b):

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

RSS-247 Issue 2 § 5.4(d):

For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

8.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 7.8.5, 11.9.1.1, and 11.9.1.2.



8.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESi26	9/30/2019	9/30/2020

8.4 Test Results

The device was found to be **compliant**. The peak output power was less than 1W.

8.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	7/30/2020
Supervising/Reviewing Engineer:			15.247(b)(1), (3)
(Where Applicable)	NA	Limit Applied:	RSS-247 § 5.4(b), (d)
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	25.6C
Input Voltage:	Battery	Relative Humidity:	52.2%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

8.6 Test Data

Mode	Channel (Frequency)	Peak Output Power (dBm)	Limit (dBm)	Result
Bluetooth	0 (2402MHz)	1.98	30	Pass
	38 (2440MHz)	2.07	30	Pass
	78 (2480MHz)	2.01	30	Pass
Bluetooth Low Energy	37 (2402MHz)	-2.02	30	Pass
	17 (2440MHz)	-1.38	30	Pass
	39 (2480MHz)	-1.13	30	Pass
802.11b	1 (2412MHz)	15.17	30	Pass
	6 (2437MHz)	15.07	30	Pass
	11 (2462MHz)	15.62	30	Pass
802.11g ²	1 (2412MHz)	14.77	30	Pass
	6 (2437MHz)	15.16	30	Pass
	11 (2462MHz)	14.48	30	Pass
802.11n ²	1 (2412MHz)	14.33	30	Pass
	6 (2437MHz)	14.62	30	Pass
	11 (2462MHz)	14.12	30	Pass
802.11nHT40 ³	3 (2422MHz)	14.03	30	Pass
	7 (2442MHz)	14.24	30	Pass
	11 (2462MHz)	13.77	30	Pass

Deviations, Additions, or Exclusions: None

² 802.11g and 802.11n modes were tested with an output attenuation setting of 8 (2dB)

³ 802.11nHT40 mode was tested with an output attenuation setting of 12 (3dB)



9 Occupied Bandwidth

9.1 Test Limits

FCC Part 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

RSS-247 Issue 2 § 5.2(a):

The minimum 6 dB bandwidth shall be 500 kHz.

9.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 6.9.2 and 11.8.1.

9.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESi26	9/30/2019	9/30/2020

9.4 Test Results

The device was found to be **compliant**. The 6dB bandwidth was at least 500kHz.

9.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	7/30/2020
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	25.6C
Product Standard:	FCC Part 15.247	Relative Humidity:	52.2%
Input Voltage:	Battery	Atmospheric Pressure:	985.4mbar
Pretest Verification w / Ambient			
Signals or BB Source:	Yes		

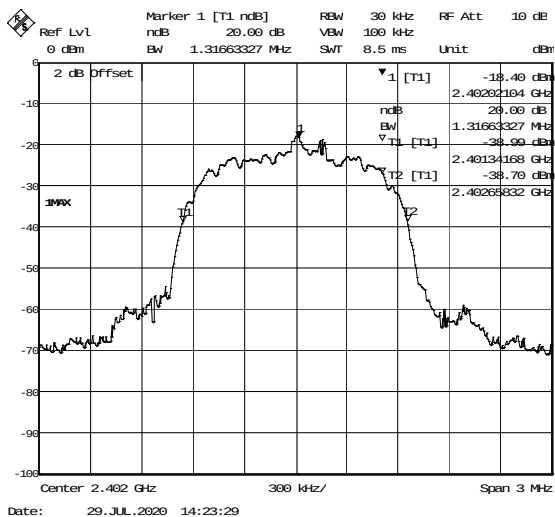
**9.6 Test Data**

Mode	Channel (Frequency)	6dB BW (MHz)	20dB BW (MHz)	99% BW (MHz)
Bluetooth	0 (2402MHz)	-	1.317	1.184
	38 (2440MHz)	-	1.329	1.184
	78 (2480MHz)	-	1.317	1.184
Bluetooth Low Energy	37 (2402MHz)	0.6914	1.226	1.052
	17 (2440MHz)	0.6974	1.220	1.046
	39 (2480MHz)	0.6974	1.214	1.040
802.11b	1 (2412MHz)	8.838	15.21	13.95
	6 (2437MHz)	8.838	15.15	13.89
	11 (2462MHz)	8.838	14.97	13.71
802.11g	1 (2412MHz)	16.75	17.56	16.51
	6 (2437MHz)	16.67	17.56	16.43
	11 (2462MHz)	16.75	17.56	16.51
802.11n	1 (2412MHz)	17.88	18.36	17.56
	6 (2437MHz)	17.88	18.36	17.56
	11 (2462MHz)	17.88	18.36	17.56
802.11nHT40	3 (2422MHz)	36.71	37.68	36.39
	7 (2442MHz)	36.71	37.68	36.23
	11 (2462MHz)	36.71	37.68	36.39

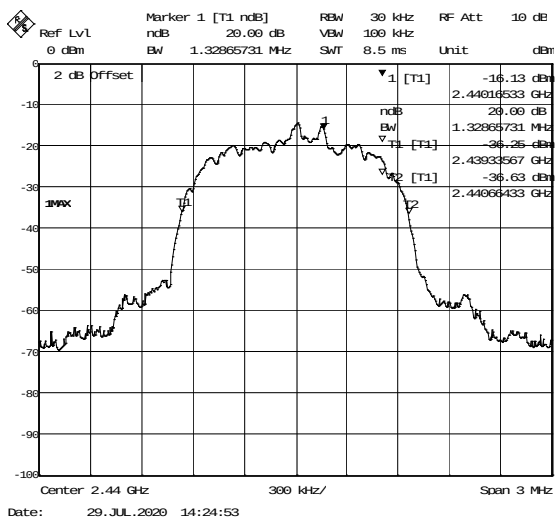
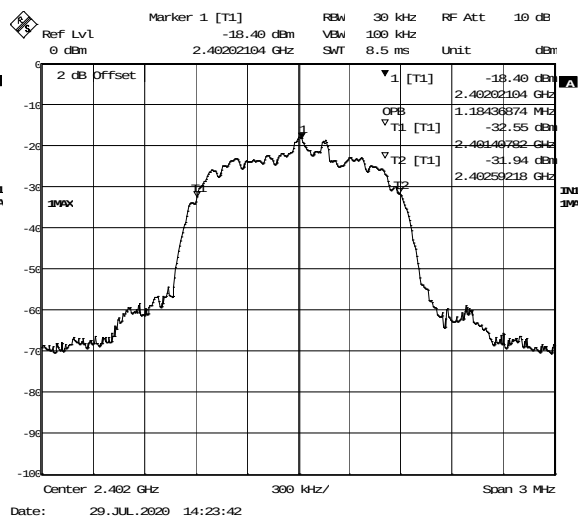
Deviations, Additions, or Exclusions: None.



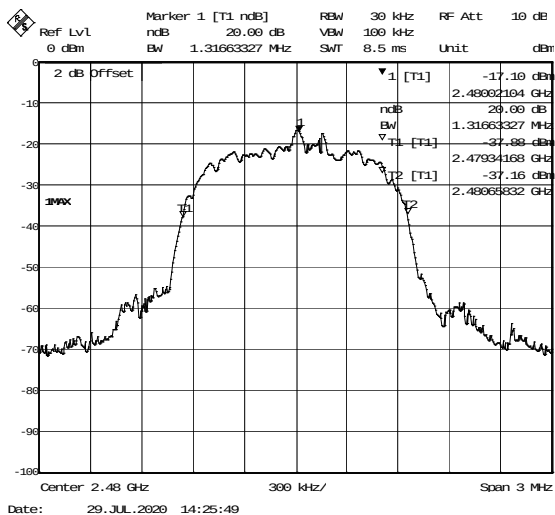
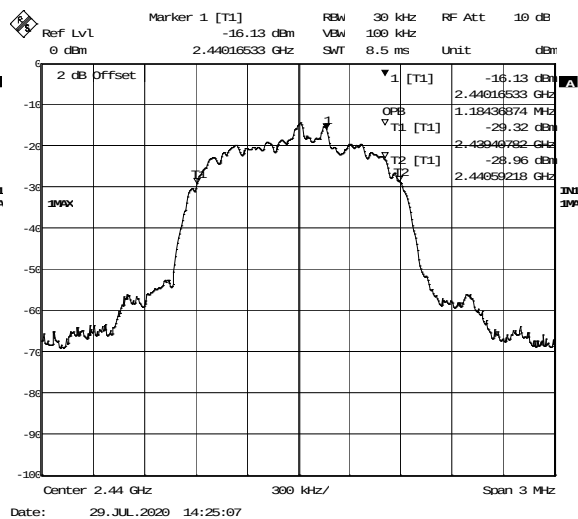
9.6.1 Bluetooth



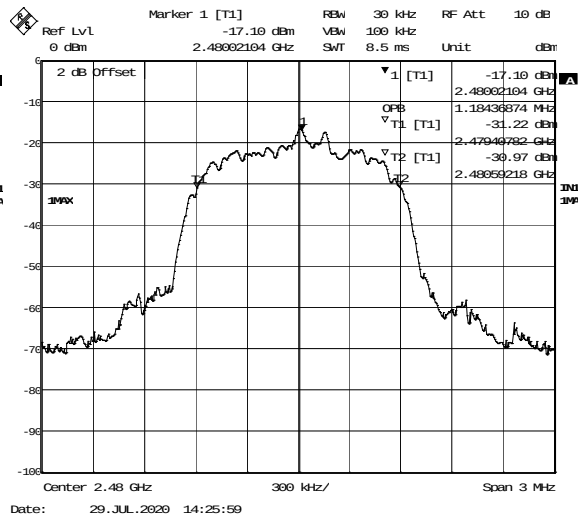
Channel 0 (2402MHz) 20dB (left) and 99% (right)



Channel 38 (2440MHz) 20dB (left) and 99% (right)

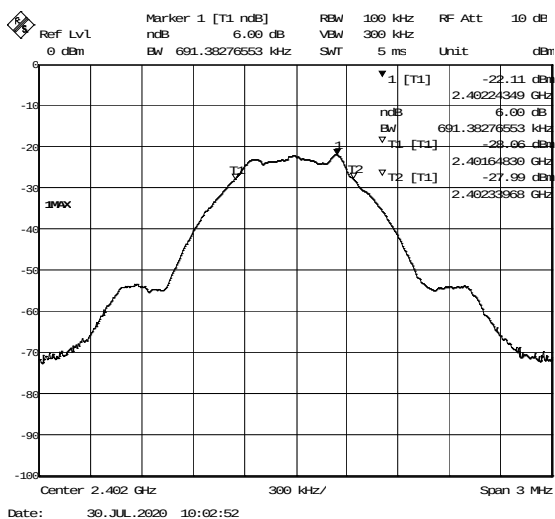


Channel 78 (2480MHz) 20dB (left) and 99% (right)

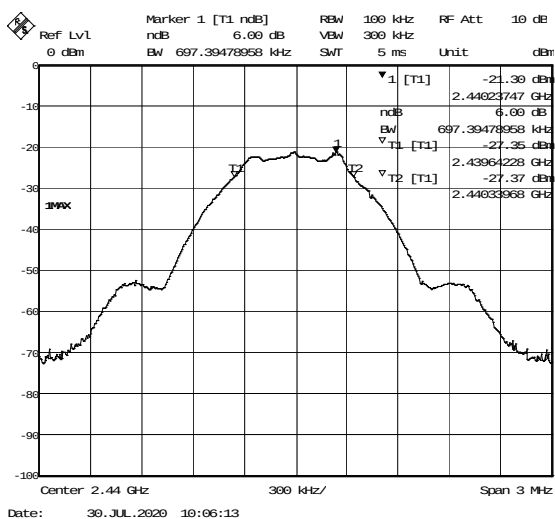
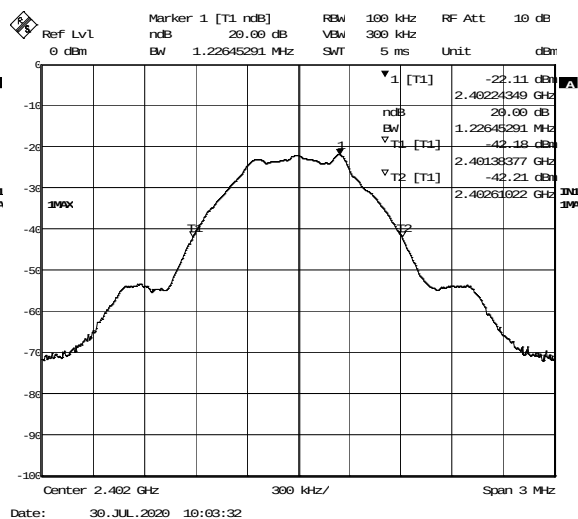




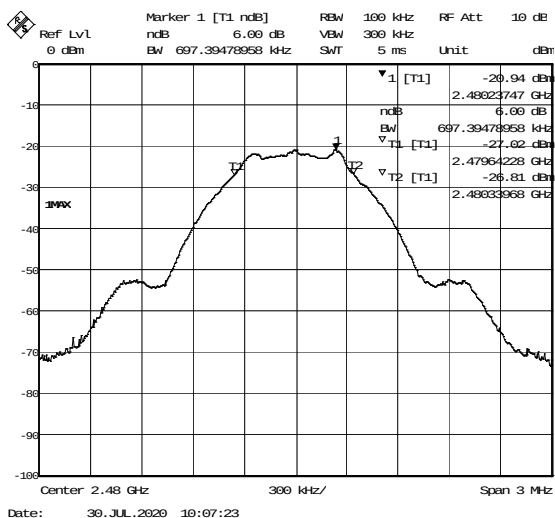
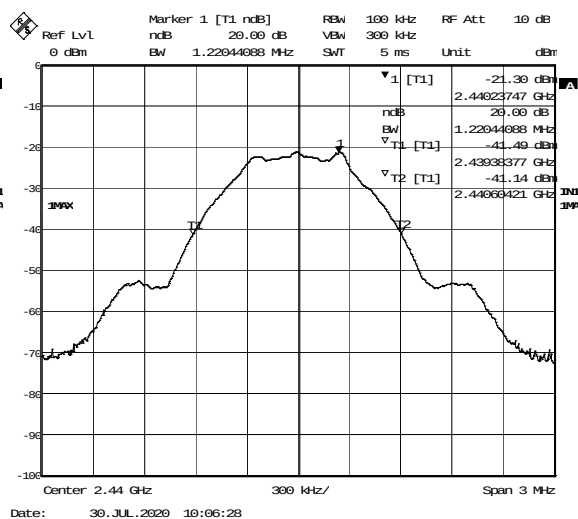
9.6.2 Bluetooth Low Energy



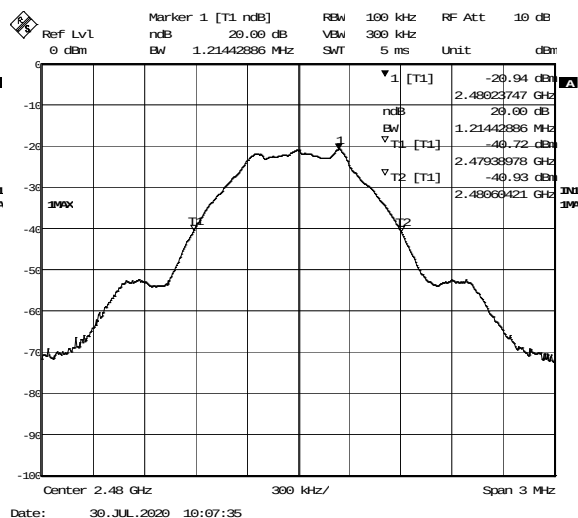
Channel 37 (2402MHz) 6dB (left) and 20dB (right)

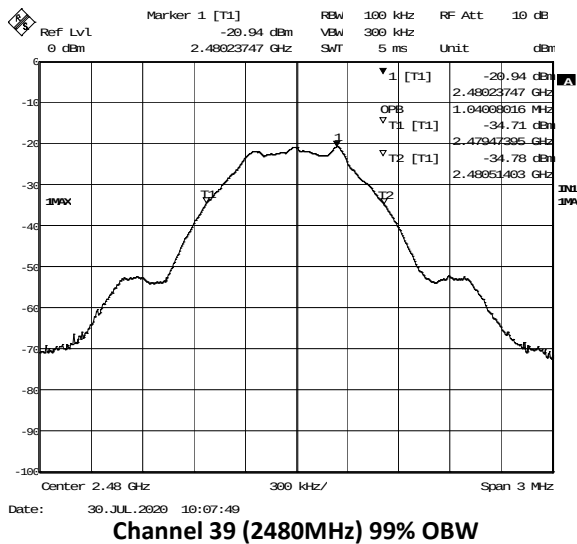
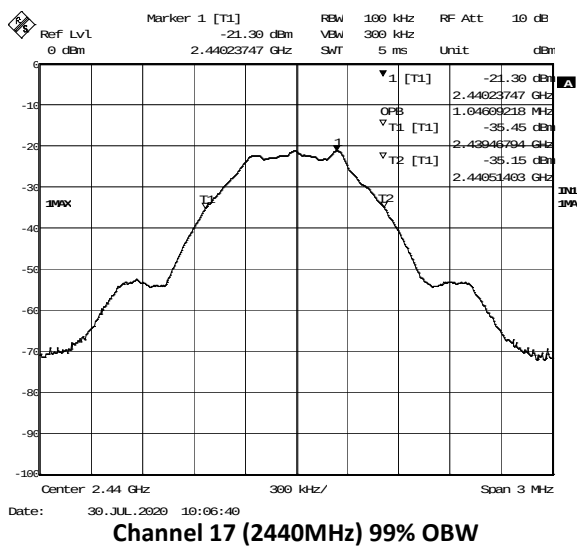
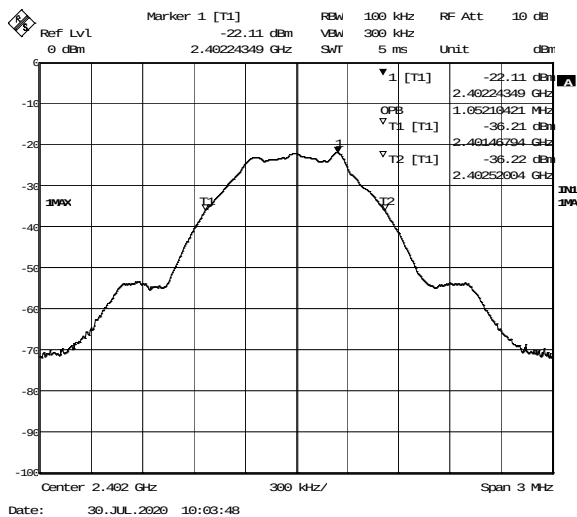


Channel 17 (2440MHz) 6dB (left) and 20dB (right)



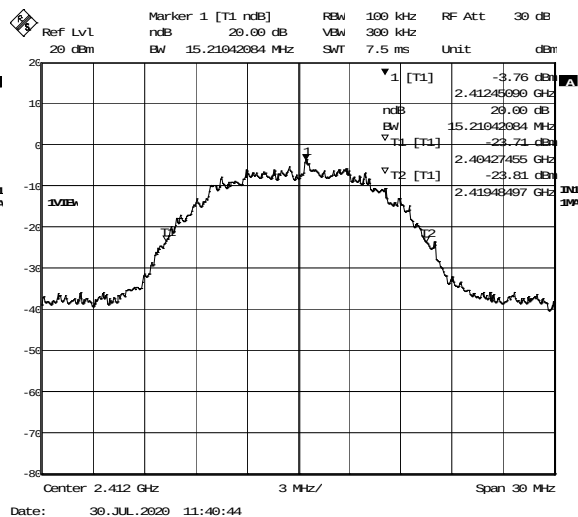
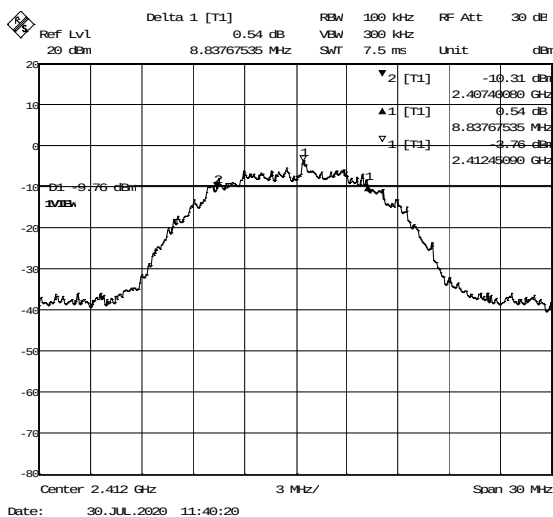
Channel 39 (2480MHz) 6dB (left) and 20dB (right)



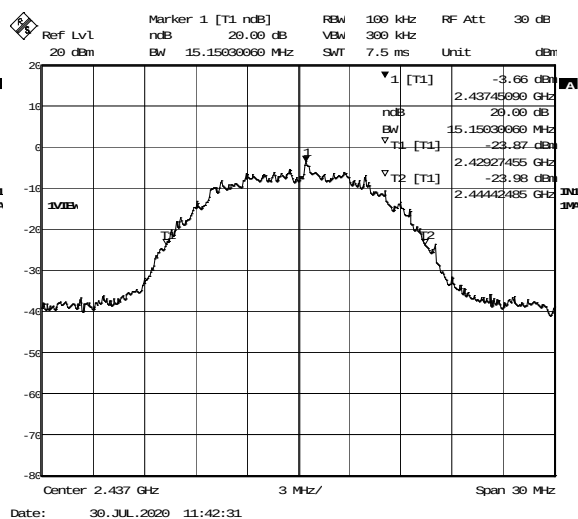
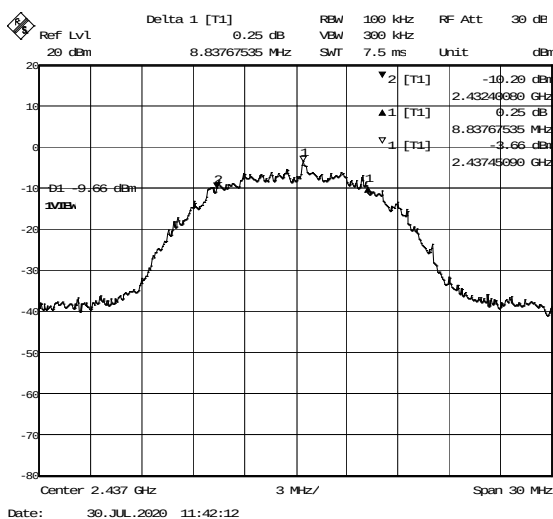




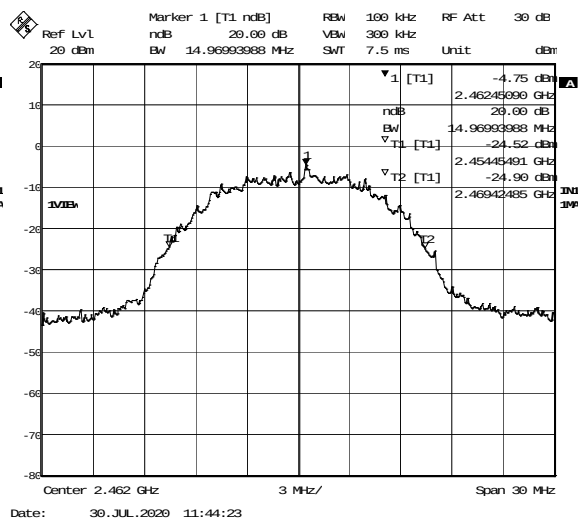
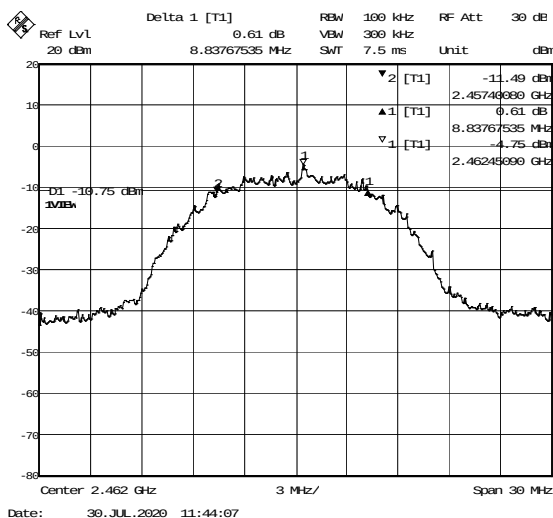
9.6.3 Wi-Fi, 802.11b



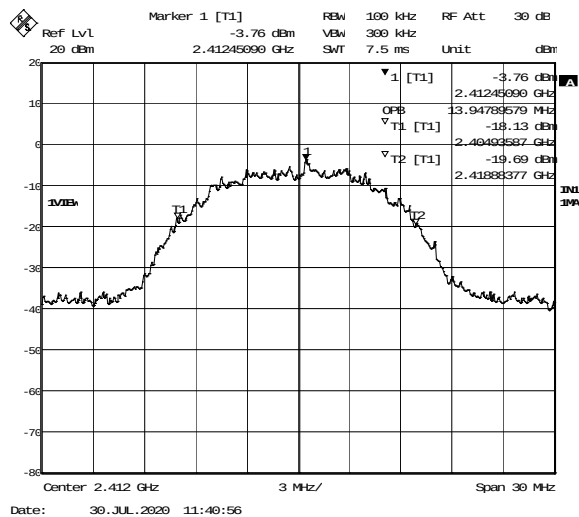
Channel 1 (2412MHz) 6dB (left) and 20dB (right)



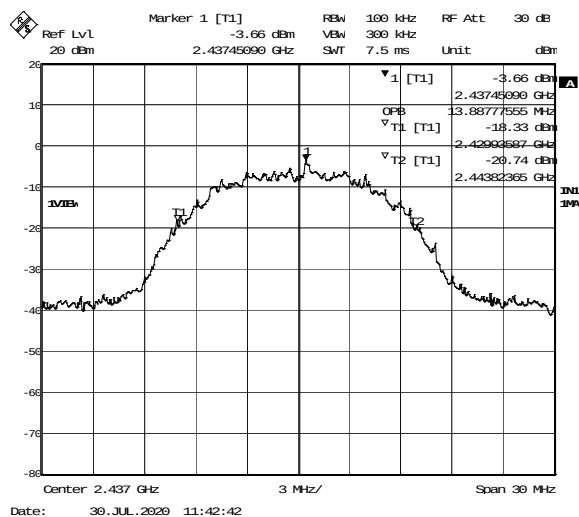
Channel 6 (2437MHz) 6dB (left) and 20dB (right)



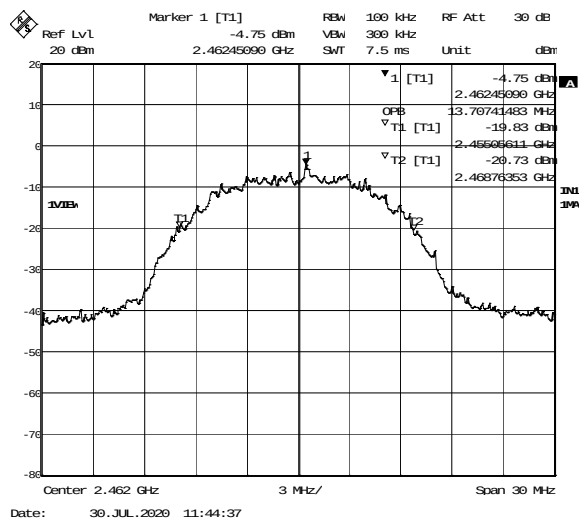
Channel 11 (2462MHz) 6dB (left) and 20dB (right)



Channel 1 (2412MHz) 99% OBW



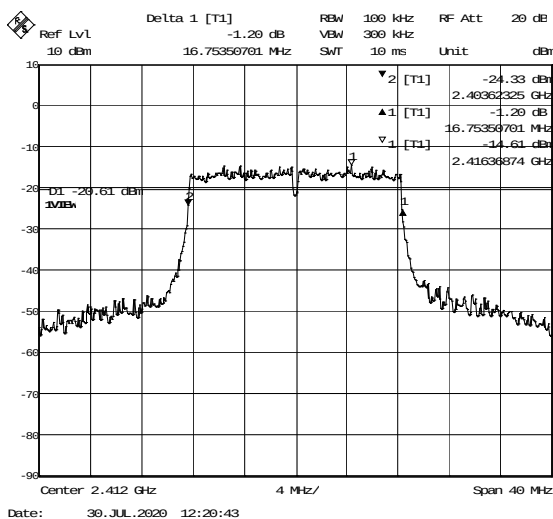
Channel 6 (2437MHz) 99% OBW



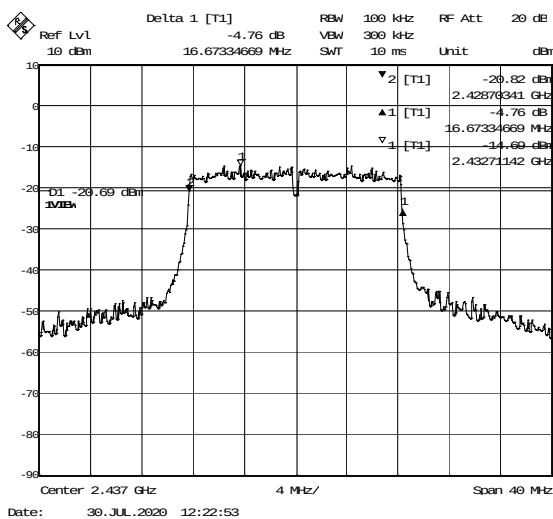
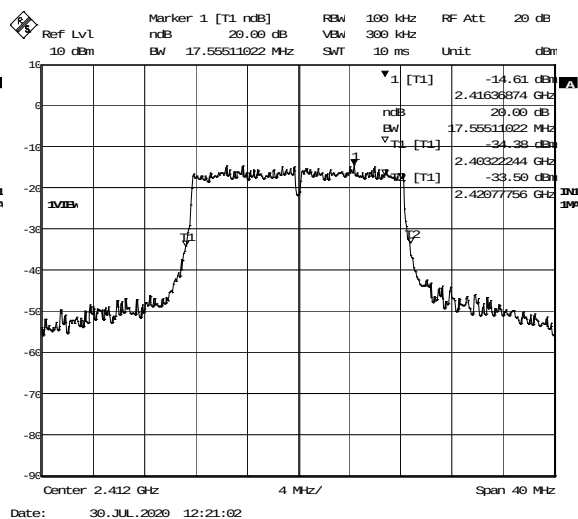
Channel 11 (2462MHz) 99% OBW



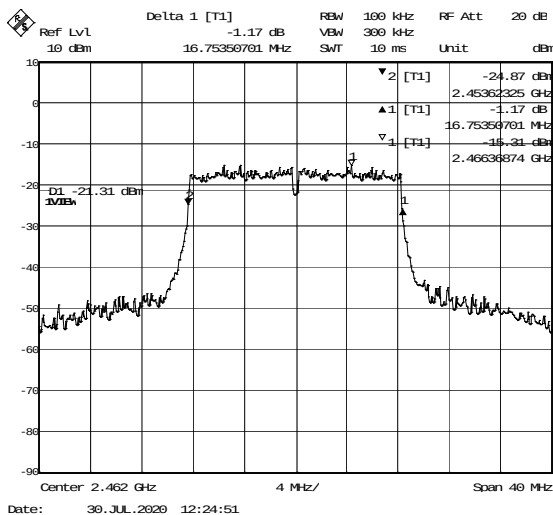
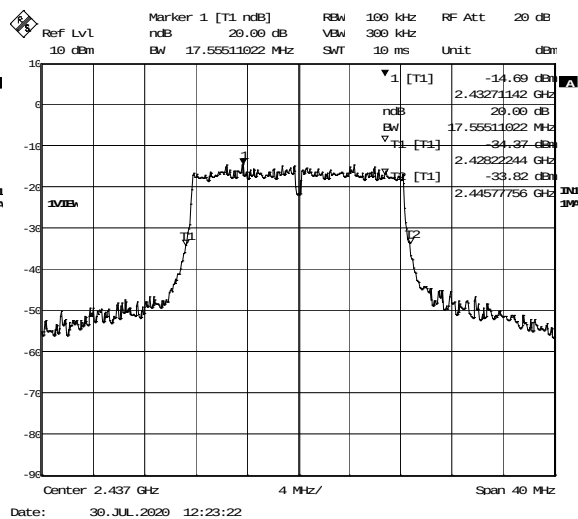
9.6.4 Wi-Fi, 802.11g



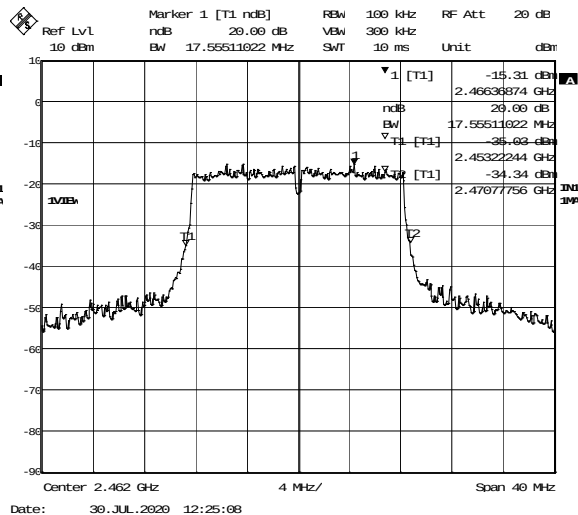
Channel 1 (2412MHz) 6dB (left) and 20dB (right)

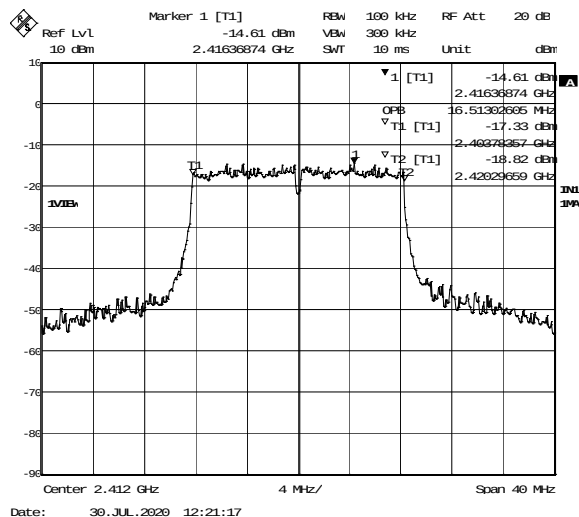


Channel 6 (2437MHz) 6dB (left) and 20dB (right)

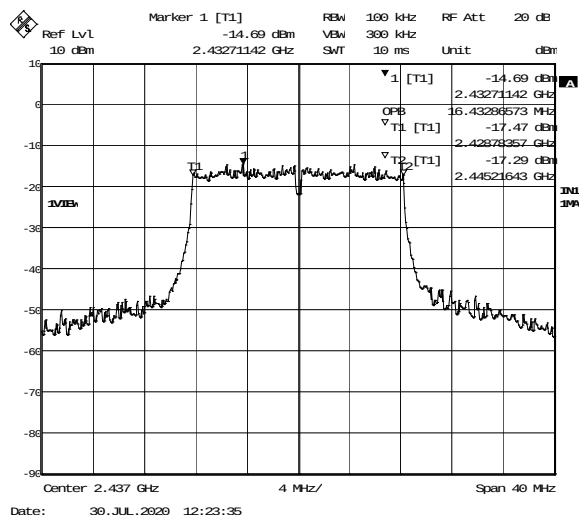


Channel 11 (2462MHz) 6dB (left) and 20dB (right)

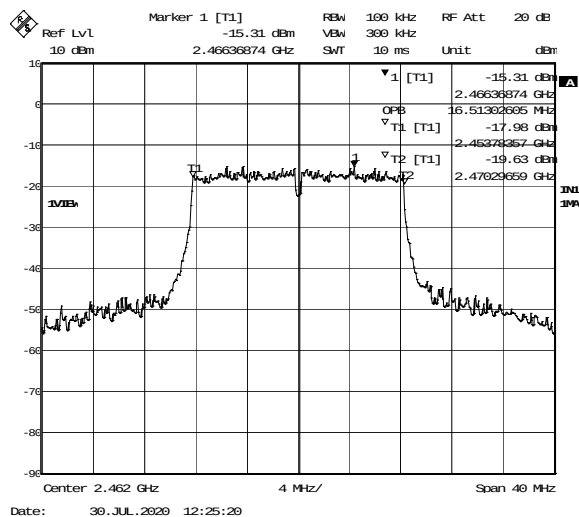




Channel 1 (2412MHz) 99% OBW



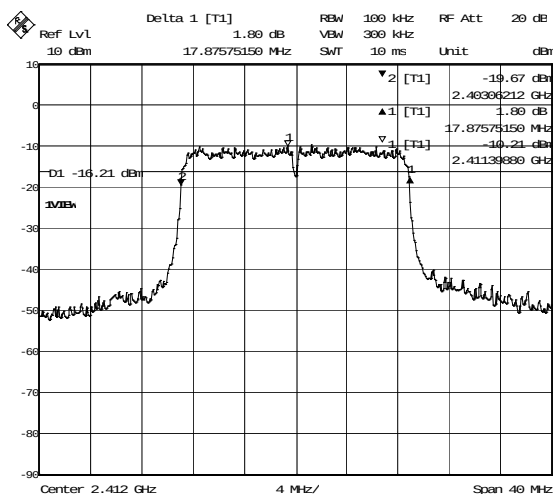
Channel 6 (2437MHz) 99% OBW



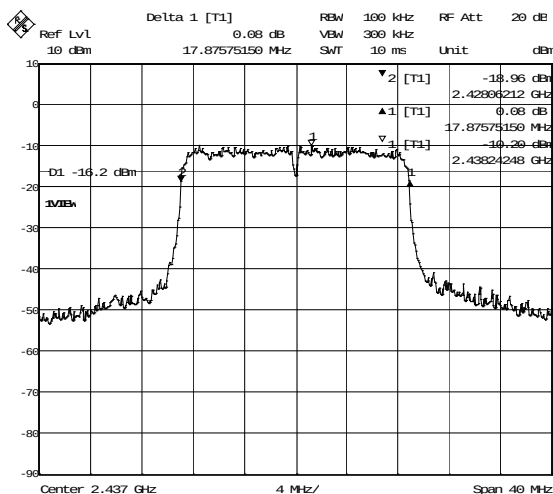
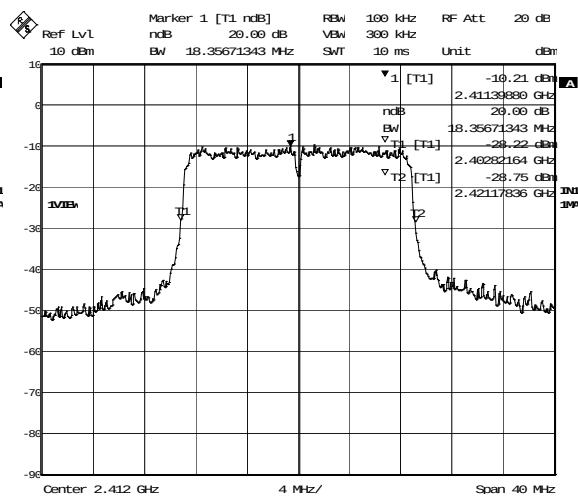
Channel 11 (2462MHz) 99% OBW



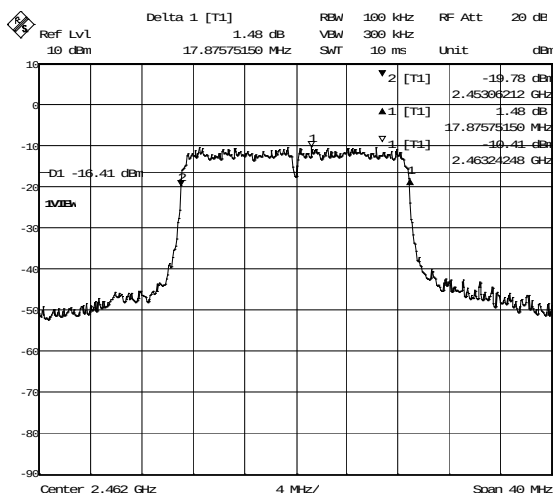
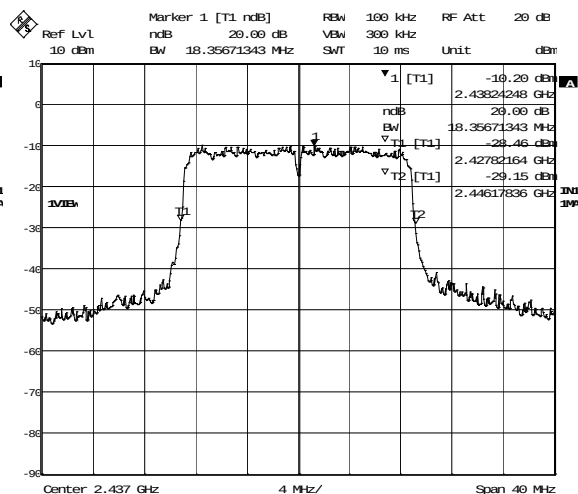
9.6.5 Wi-Fi, 802.11n



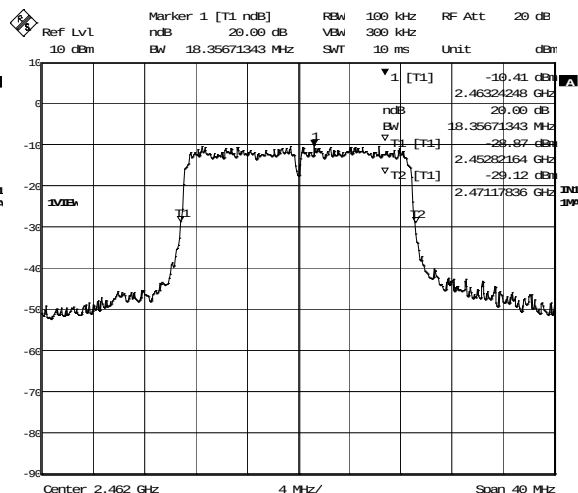
Channel 1 (2412MHz) 6dB (left) and 20dB (right)

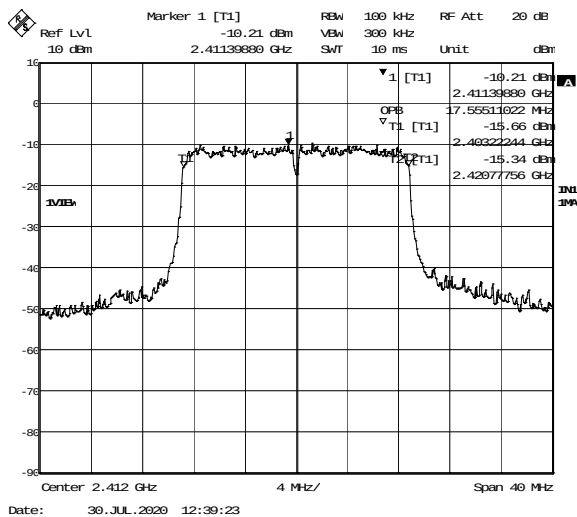


Channel 6 (2437MHz) 6dB (left) and 20dB (right)

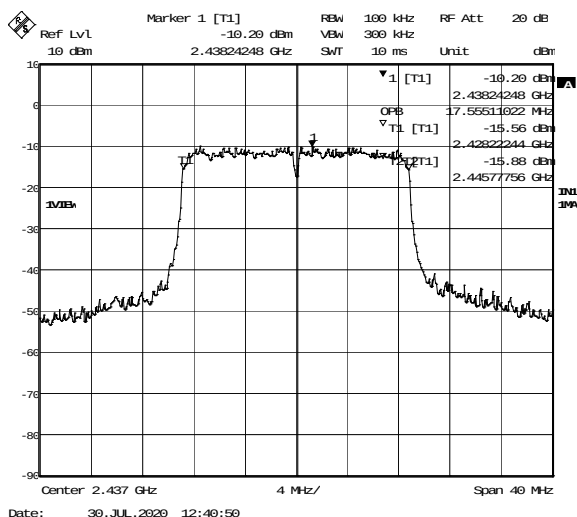


Channel 11 (2462MHz) 6dB (left) and 20dB (right)

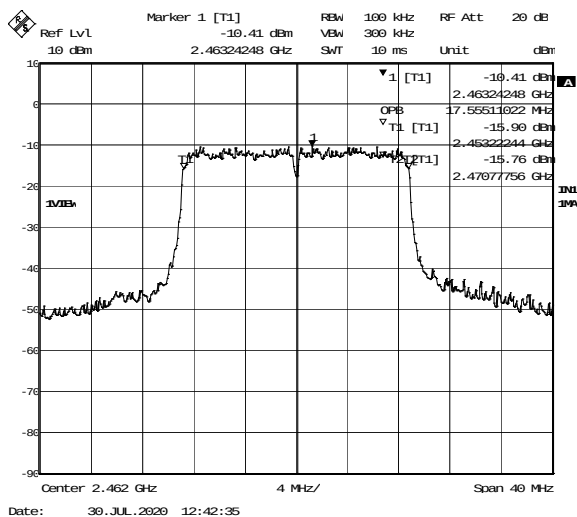




Channel 1 (2412MHz) 99% OBW



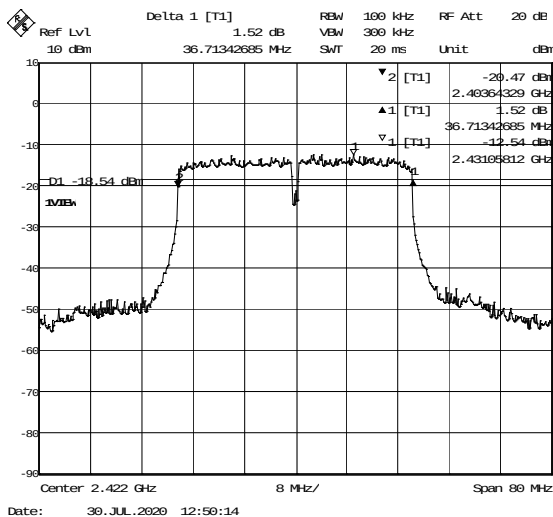
Channel 6 (2437MHz) 99% OBW



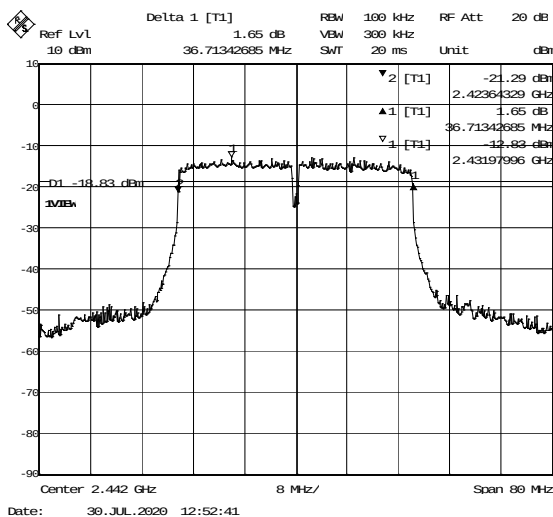
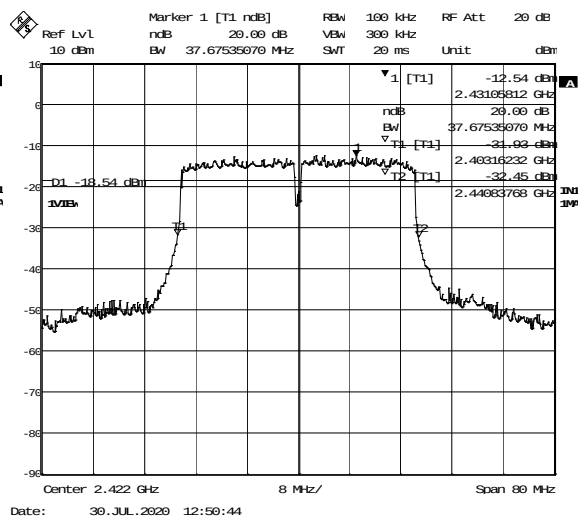
Channel 11 (2462MHz) 99% OBW



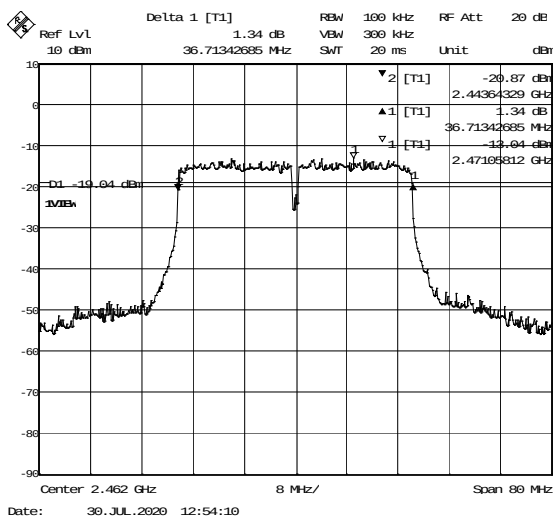
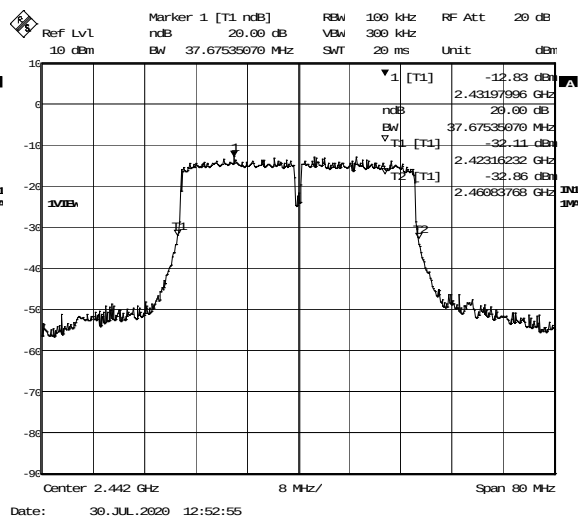
9.6.6 Wi-Fi, 802.11nHT40



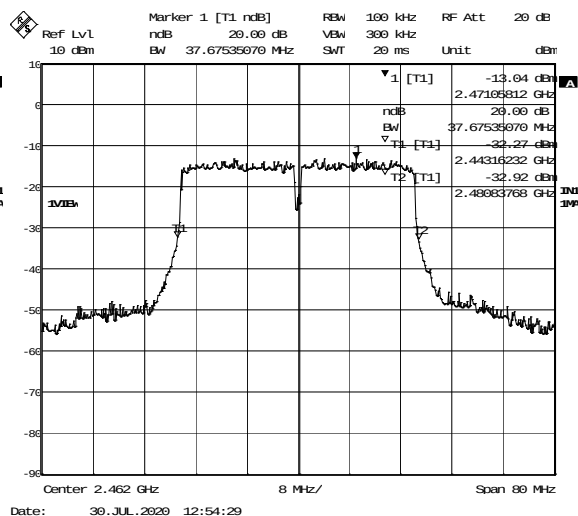
Channel 3 (2422MHz) 6dB (left) and 20dB (right)

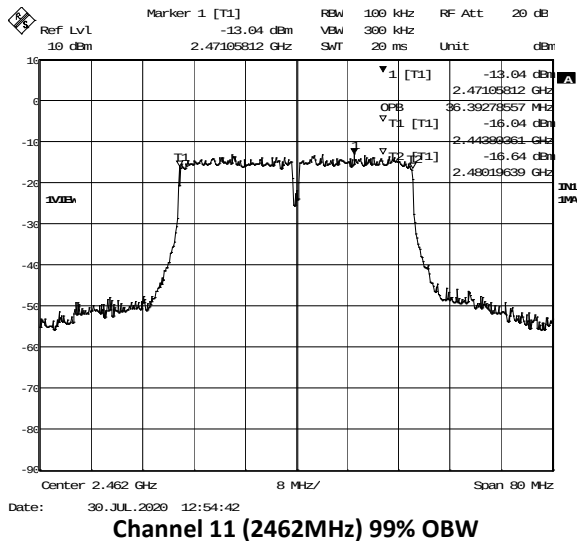
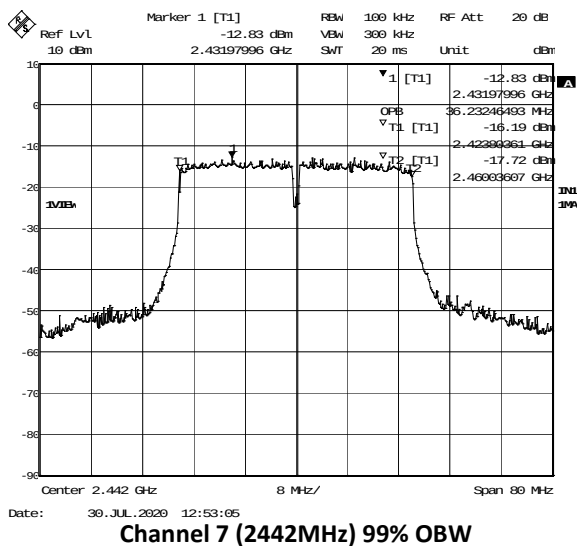
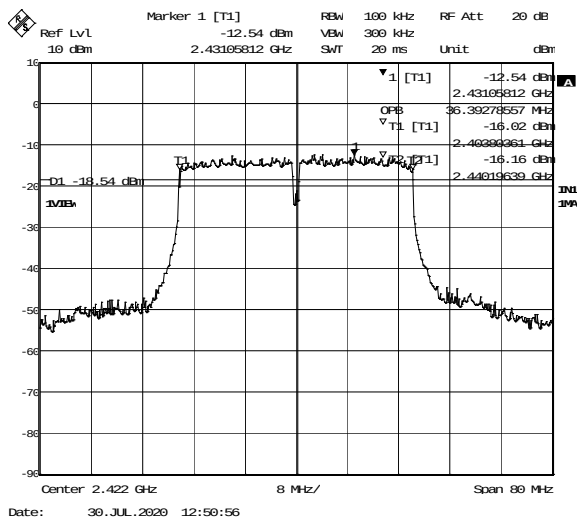


Channel 7 (2442MHz) 6dB (left) and 20dB (right)



Channel 11 (2462MHz) 6dB (left) and 20dB (right)







10 Power Spectral Density

10.1 Test Limits

FCC Part 15.247(e):

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

RSS-247 Issue 2 § 5.2(b):

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

10.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 11.10.2 Method PKPSD (peak PSD).

10.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESi26	9/30/2019	9/30/2020

10.4 Test Results

The device was found to be **compliant**. The peak power spectral density was less than 8dBm.

10.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	8/26/2020
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	25.6C
Product Standard:	FCC Part 15.247	Relative Humidity:	52.2%
Input Voltage:	RSS-247 Issue 2	Atmospheric Pressure:	985.4mbar
Pretest Verification w / Ambient	Battery		
Signals or BB Source:	Yes		

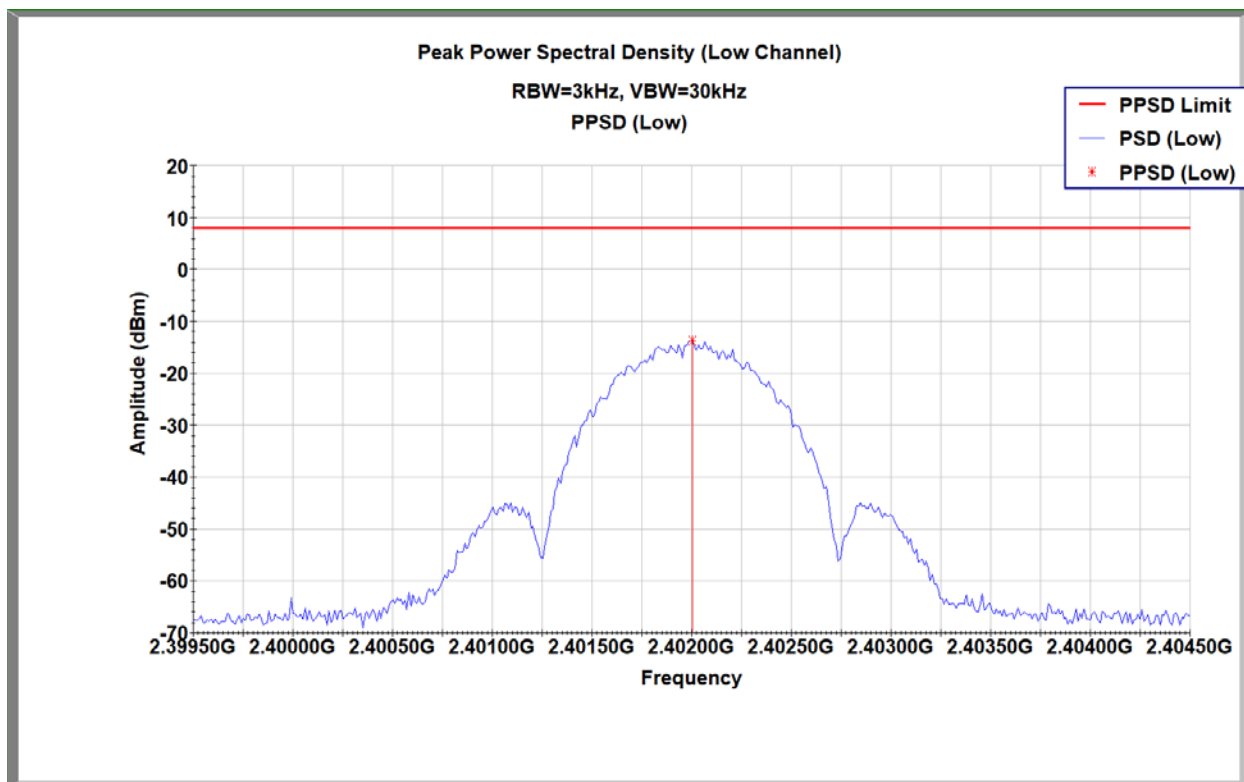
**10.6 Test Data**

Mode	Channel (Frequency)	PPSD (dBm)	Limit (dBm)	Result
Bluetooth Low Energy	37 (2402MHz)	-13.723	8	Pass
	17 (2440MHz)	-12.675	8	Pass
	39 (2480MHz)	-12.447	8	Pass
802.11b	1 (2412MHz)	-16.930	8	Pass
	6 (2437MHz)	-16.698	8	Pass
	11 (2462MHz)	-17.467	8	Pass
802.11g	1 (2412MHz)	-17.775	8	Pass
	6 (2437MHz)	-17.257	8	Pass
	11 (2462MHz)	-17.821	8	Pass
802.11n	1 (2412MHz)	-18.039	8	Pass
	6 (2437MHz)	-17.444	8	Pass
	11 (2462MHz)	-17.866	8	Pass
802.11nHT40	3 (2422MHz)	-20.767	8	Pass
	7 (2442MHz)	-20.389	8	Pass
	11 (2462MHz)	-20.192	8	Pass

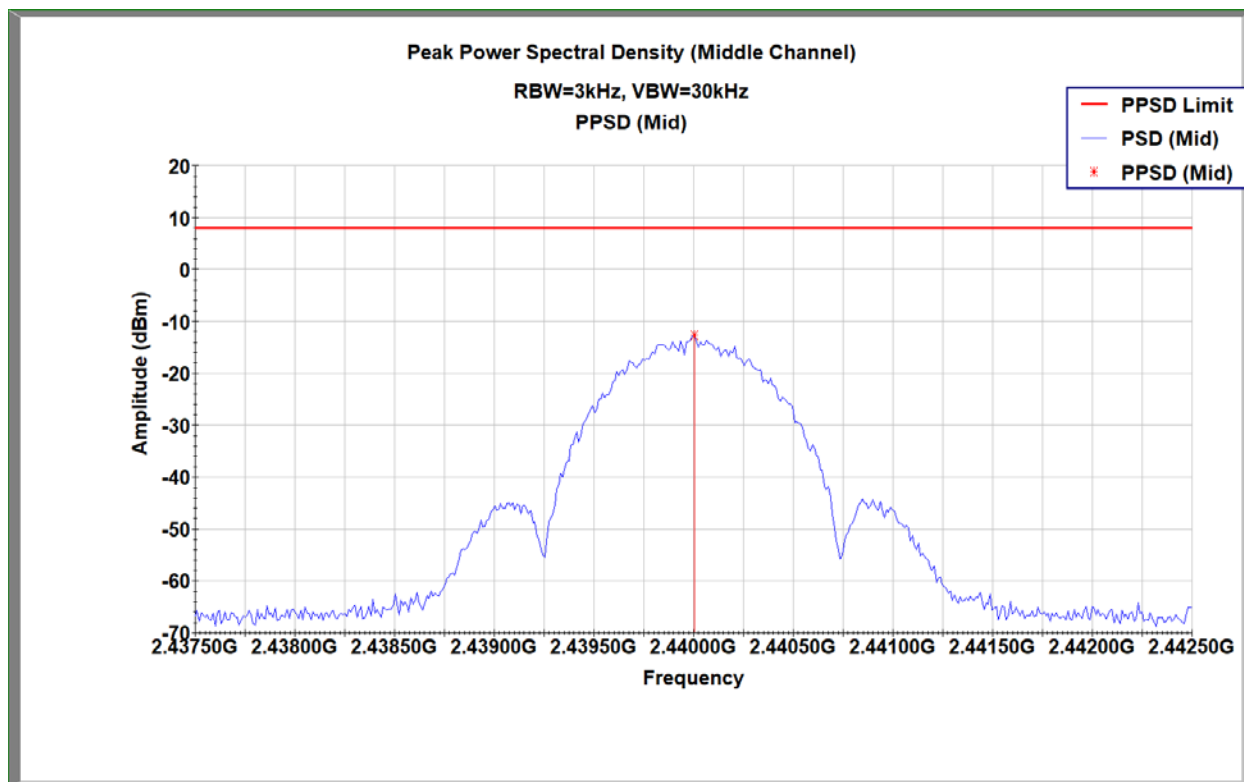
Deviations, Additions, or Exclusions: None.



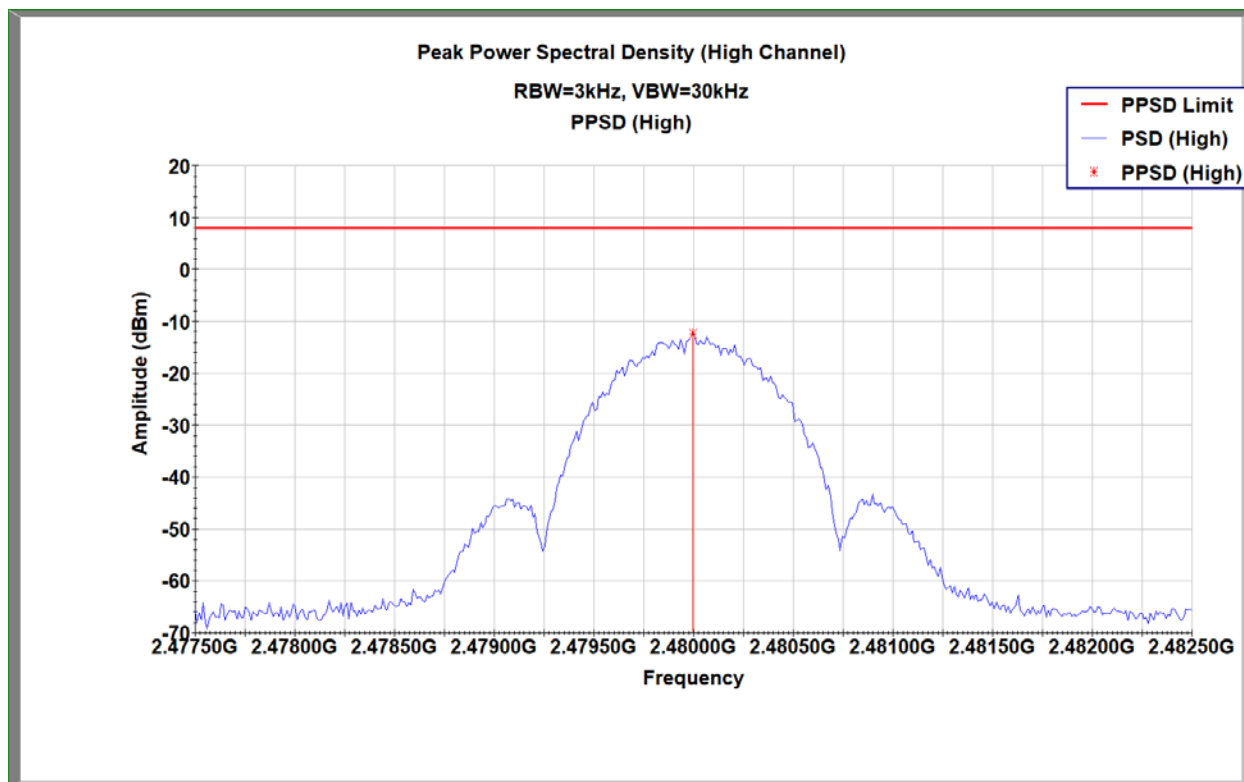
10.6.1 Bluetooth Low Energy



Channel 37 (2402MHz) PPSS



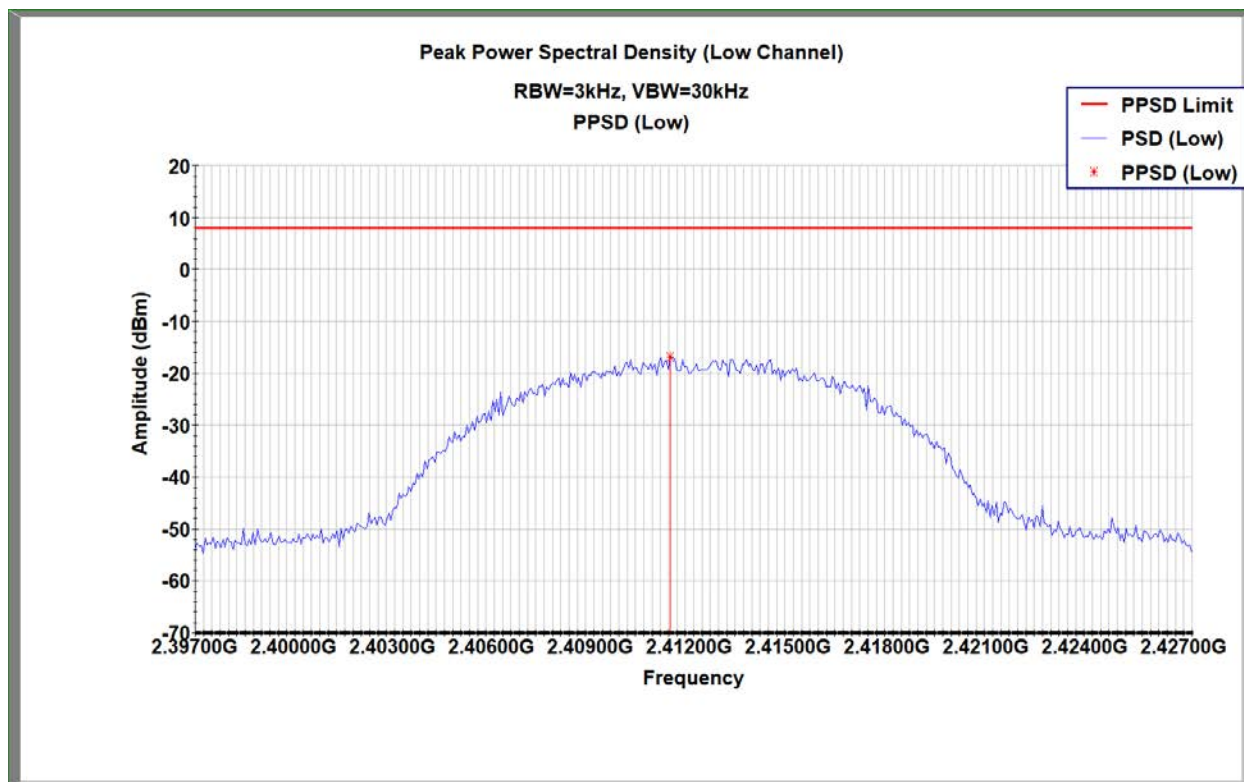
Channel 17 (2440MHz) PPSS



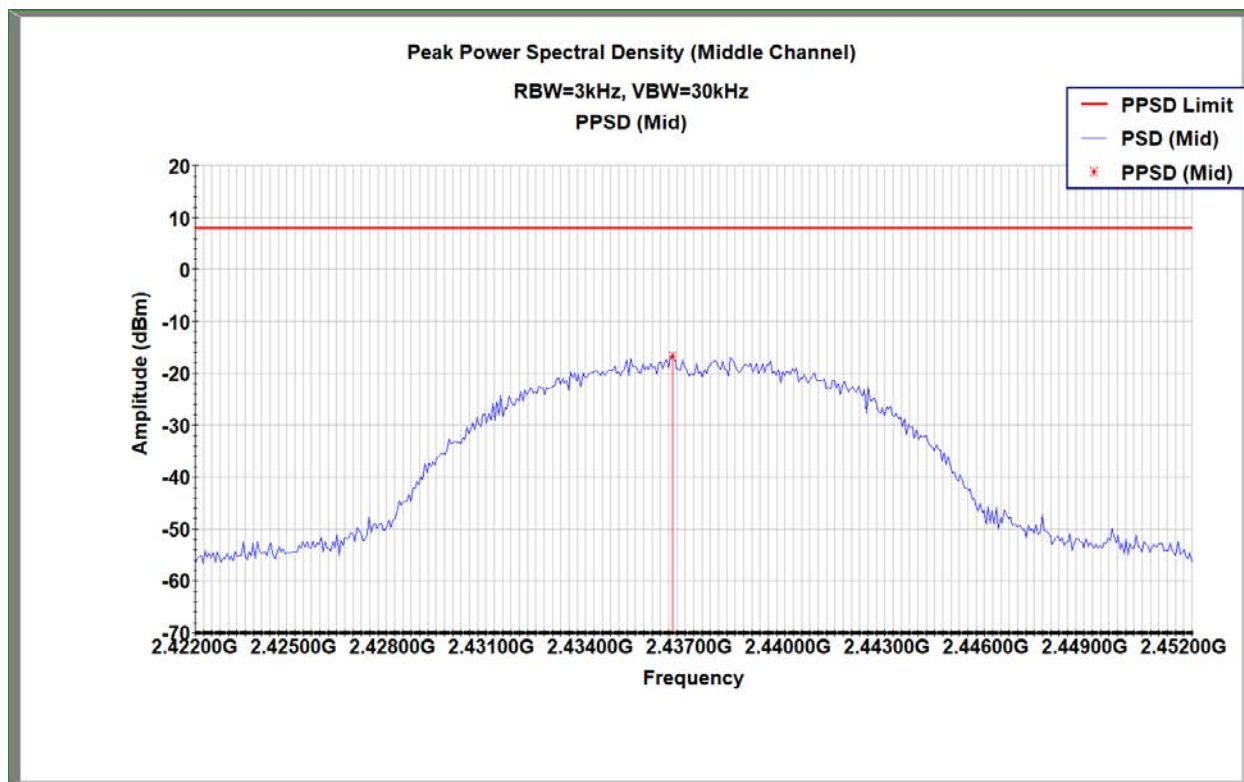
Channel 39 (2480MHz) PPSS



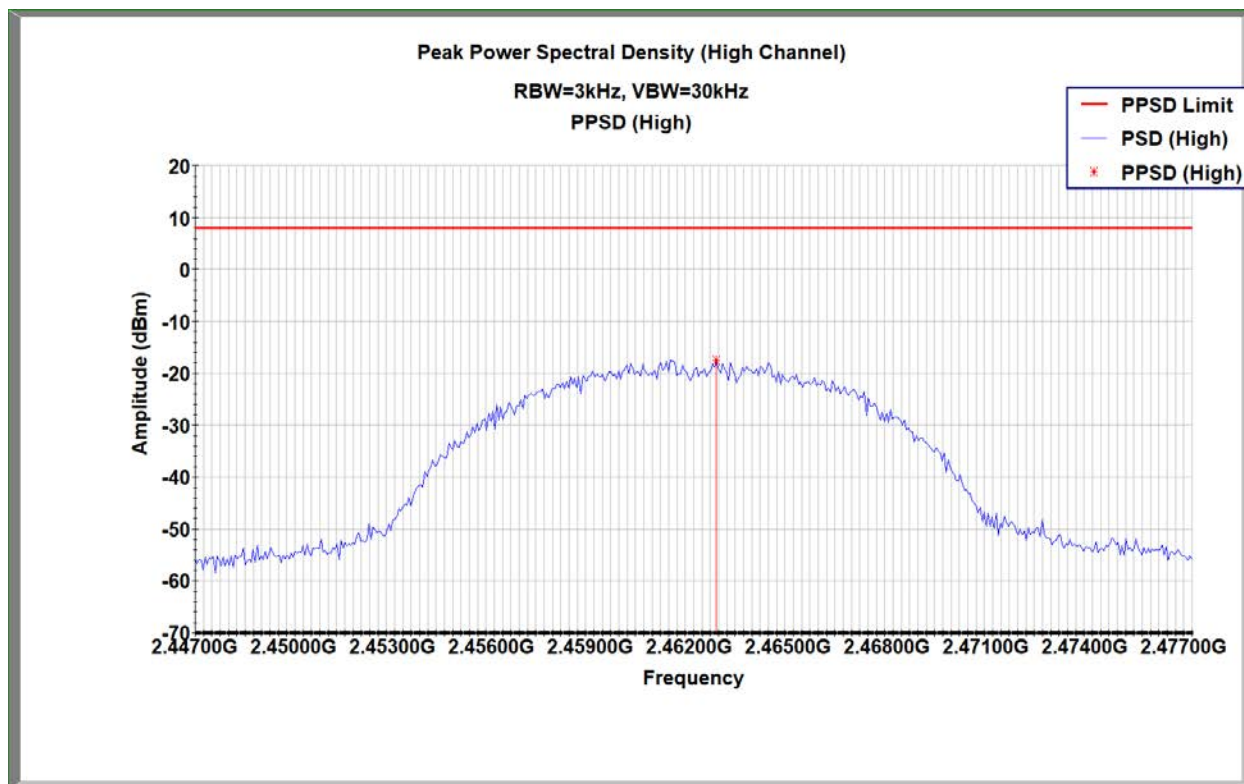
10.6.2 Wi-Fi, 802.11b



Channel 1 (2412MHz) PPSP



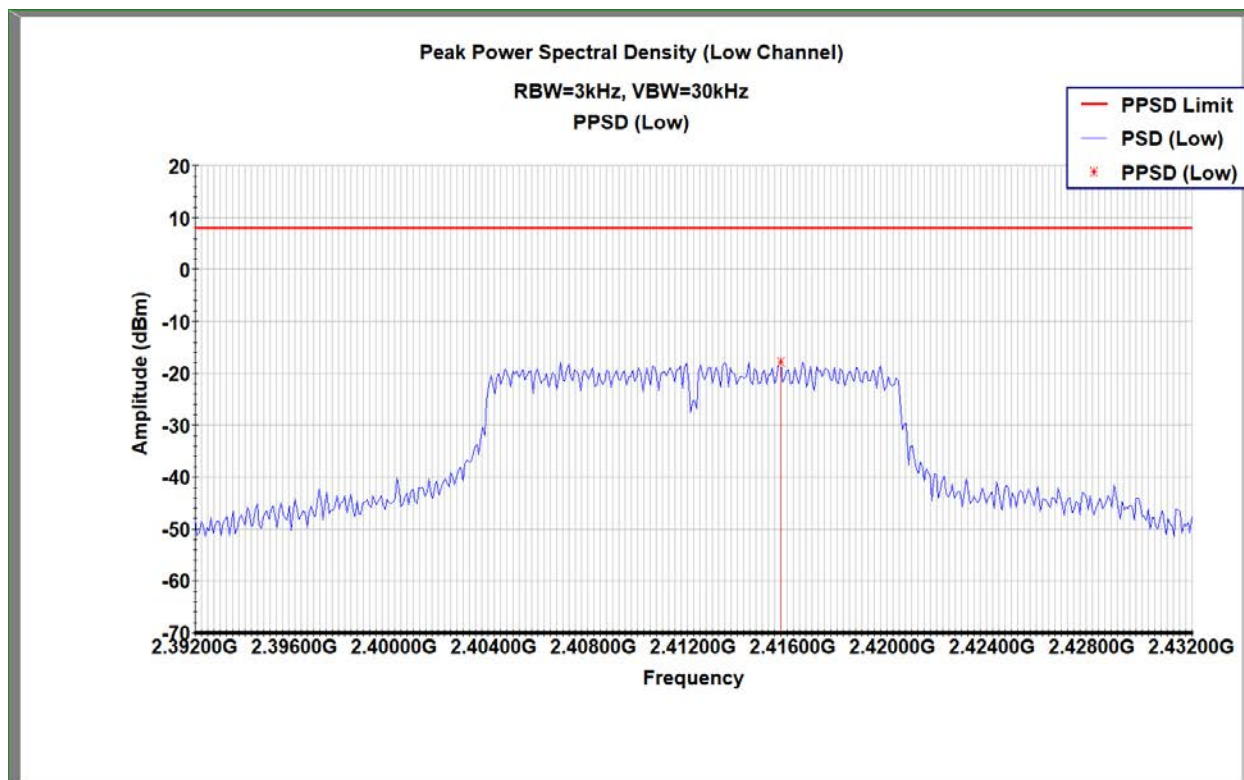
Channel 6 (2437MHz) PPSP



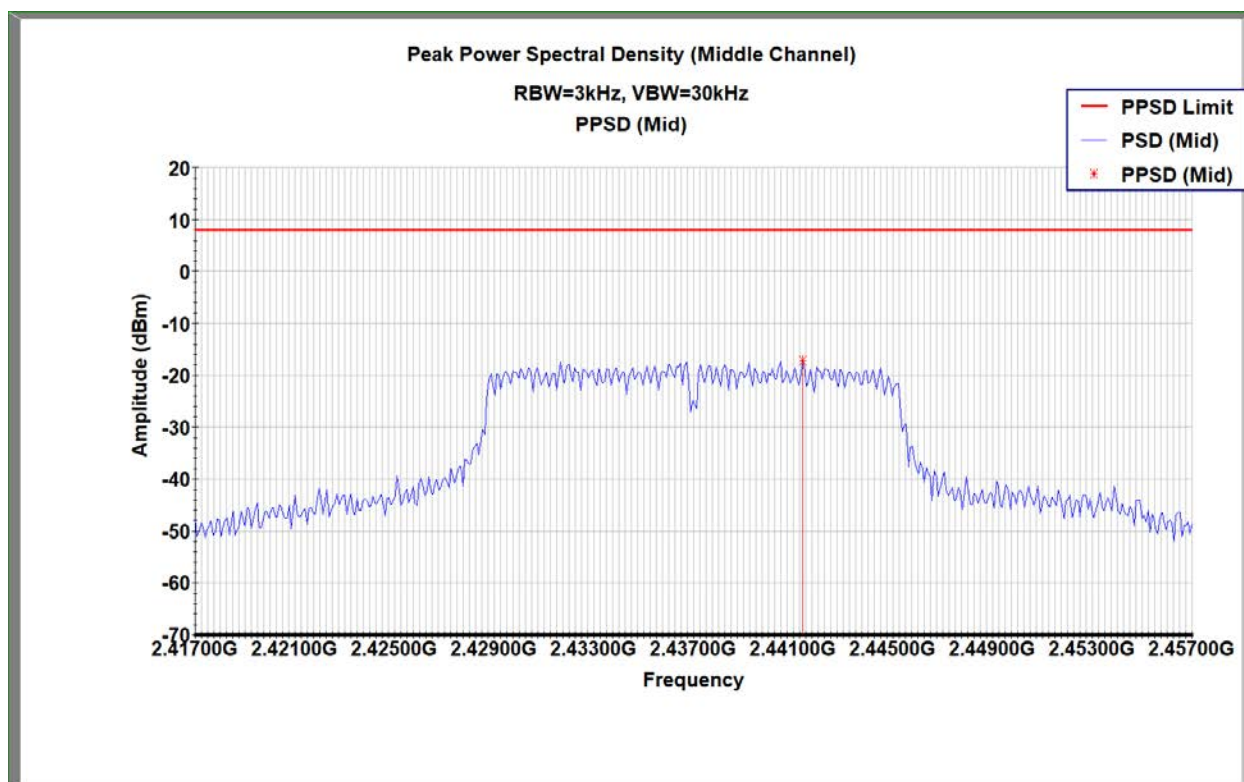
Channel 11 (2462MHz) PPSS



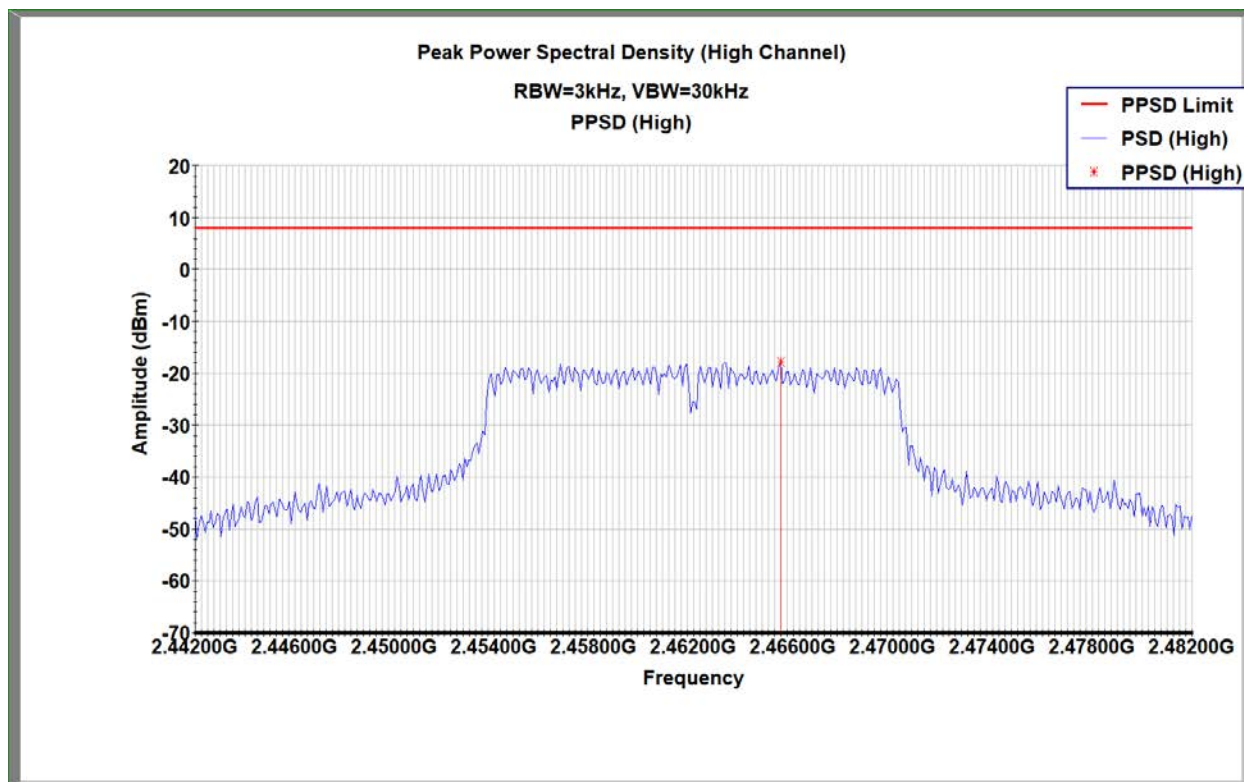
10.6.3 Wi-Fi, 802.11g



Channel 1 (2412MHz) PPSS



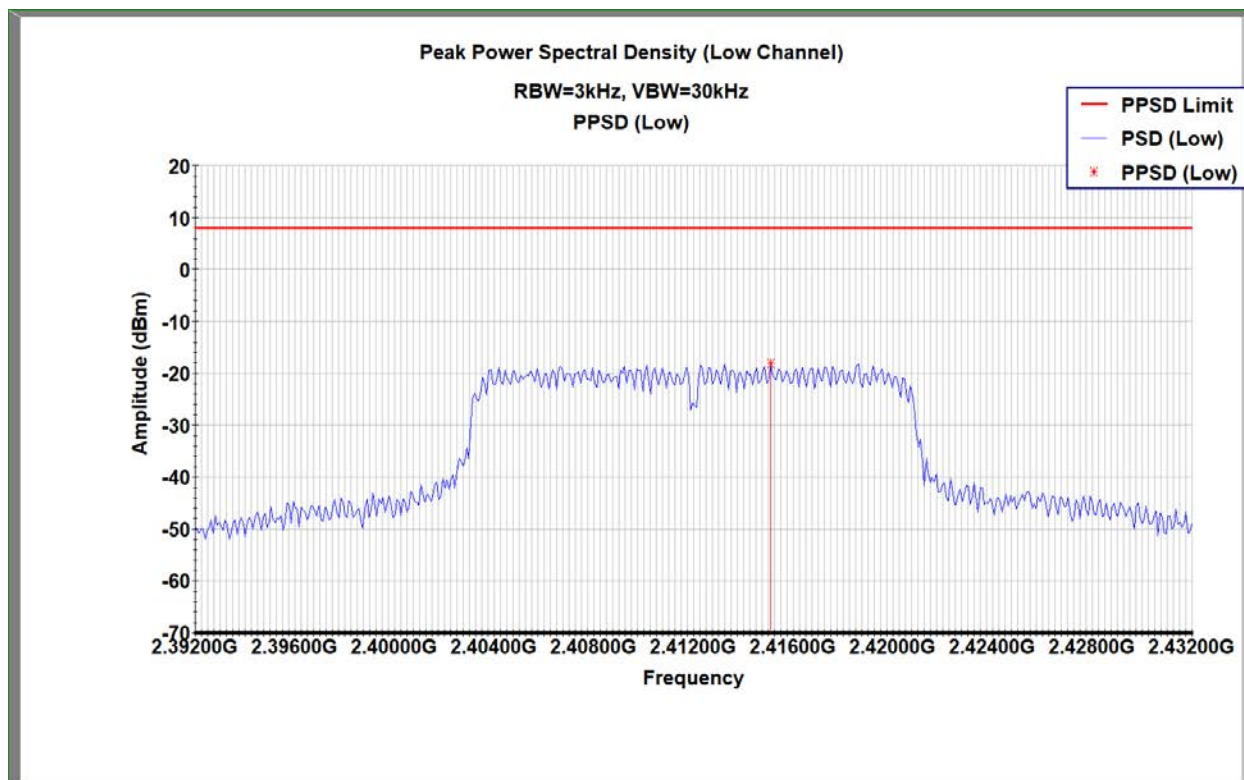
Channel 6 (2437MHz) PPSS



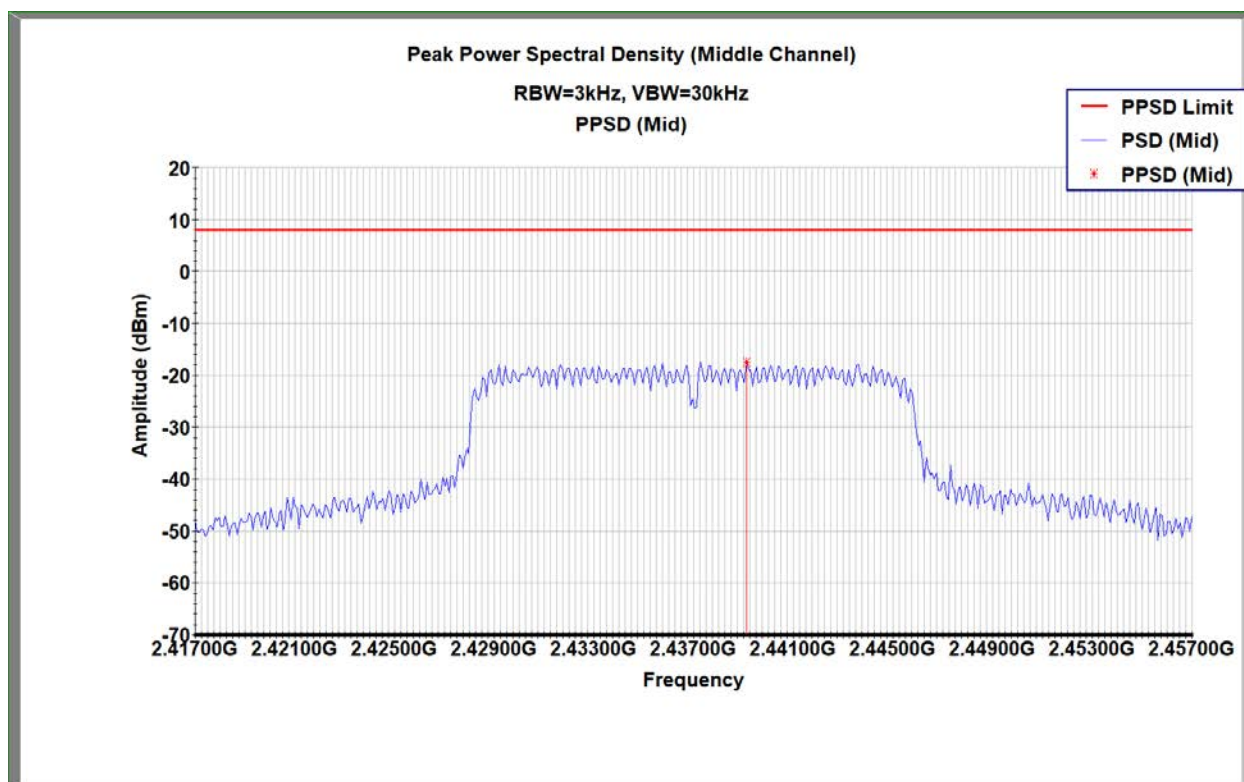
Channel 11 (2462MHz) PSD



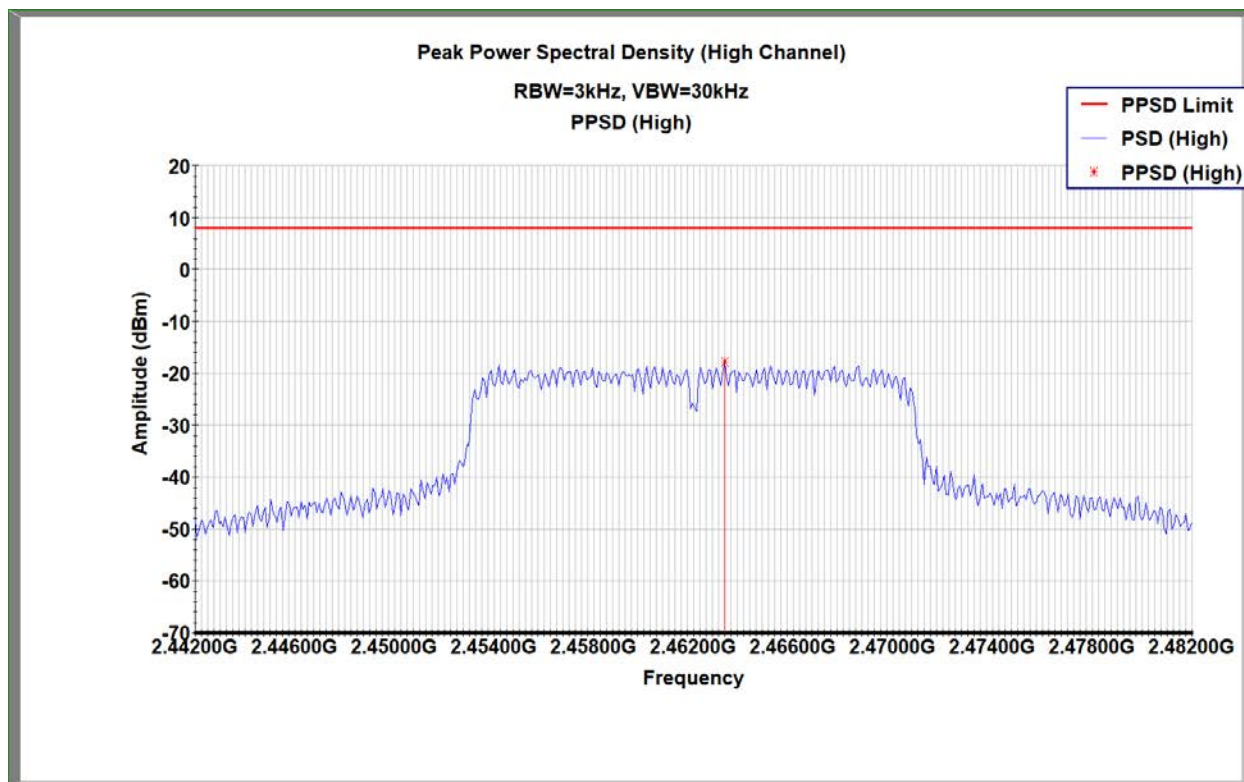
10.6.4 Wi-Fi, 802.11n



Channel 1 (2412MHz) PPSD



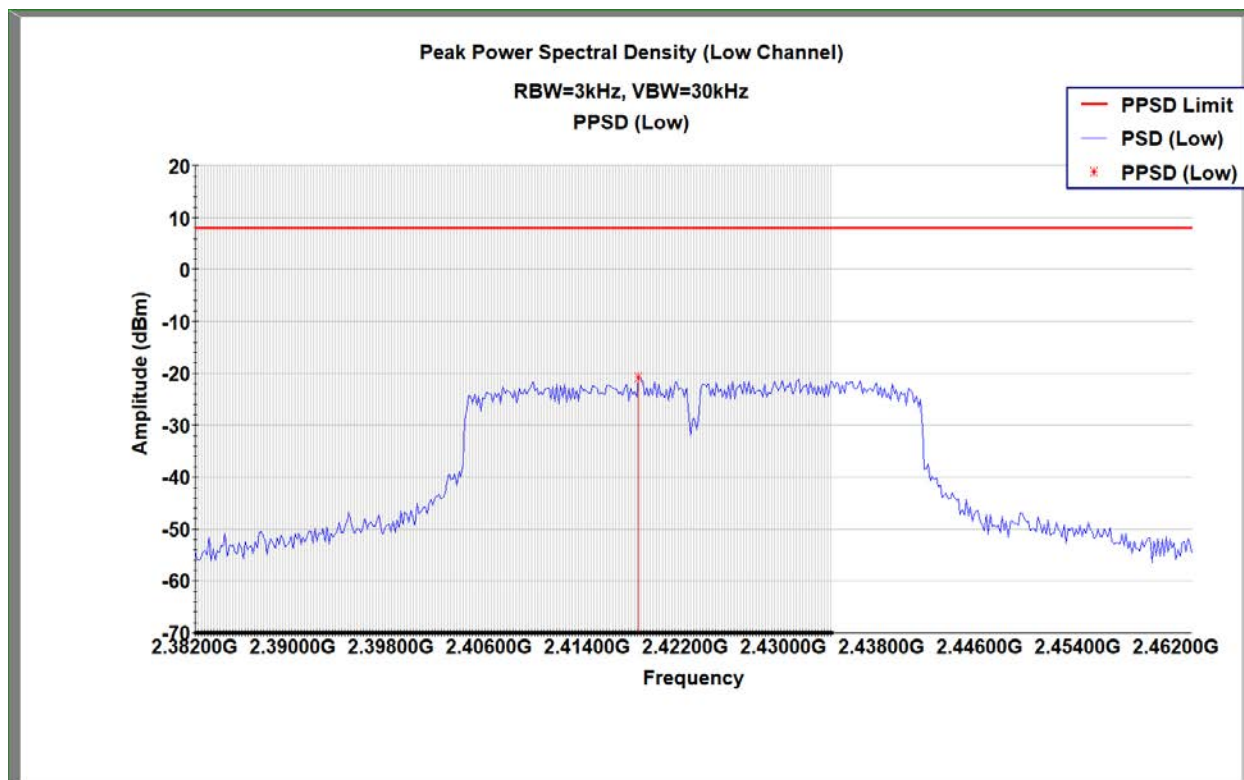
Channel 6 (2437MHz) PPSD



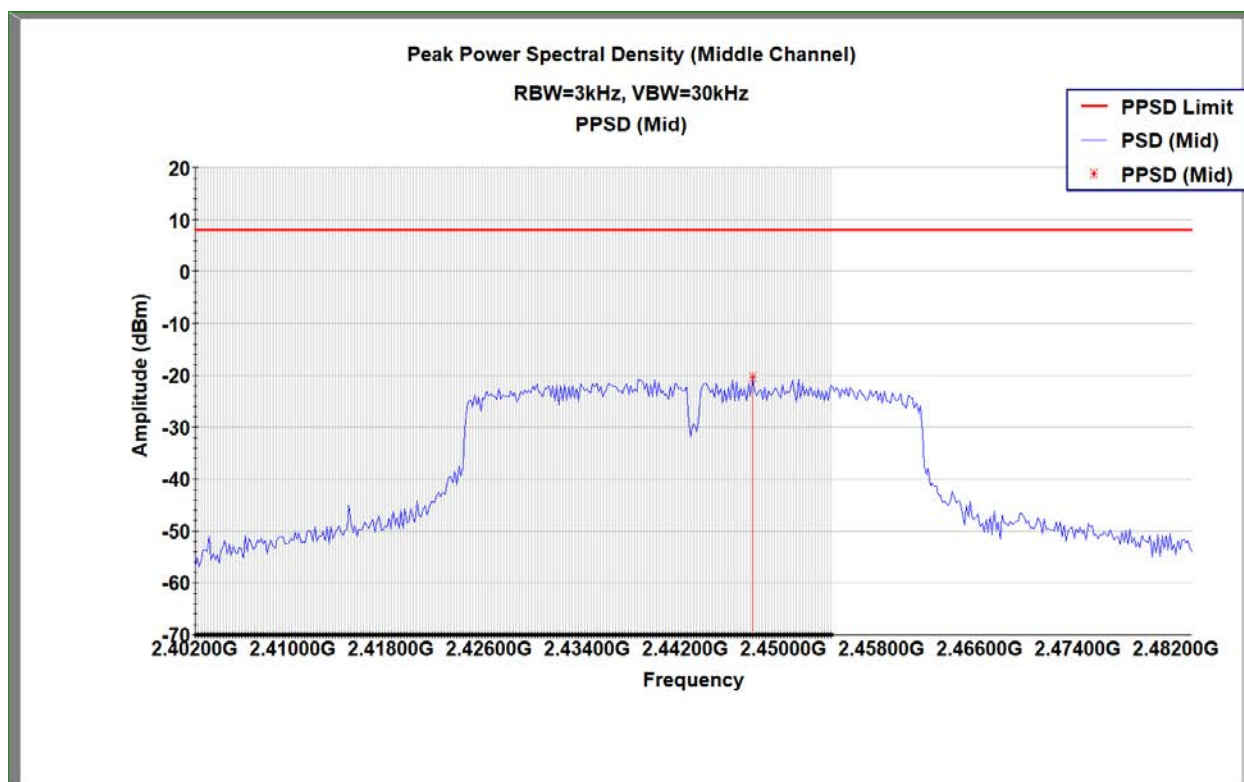
Channel 11 (2462MHz) PPSP



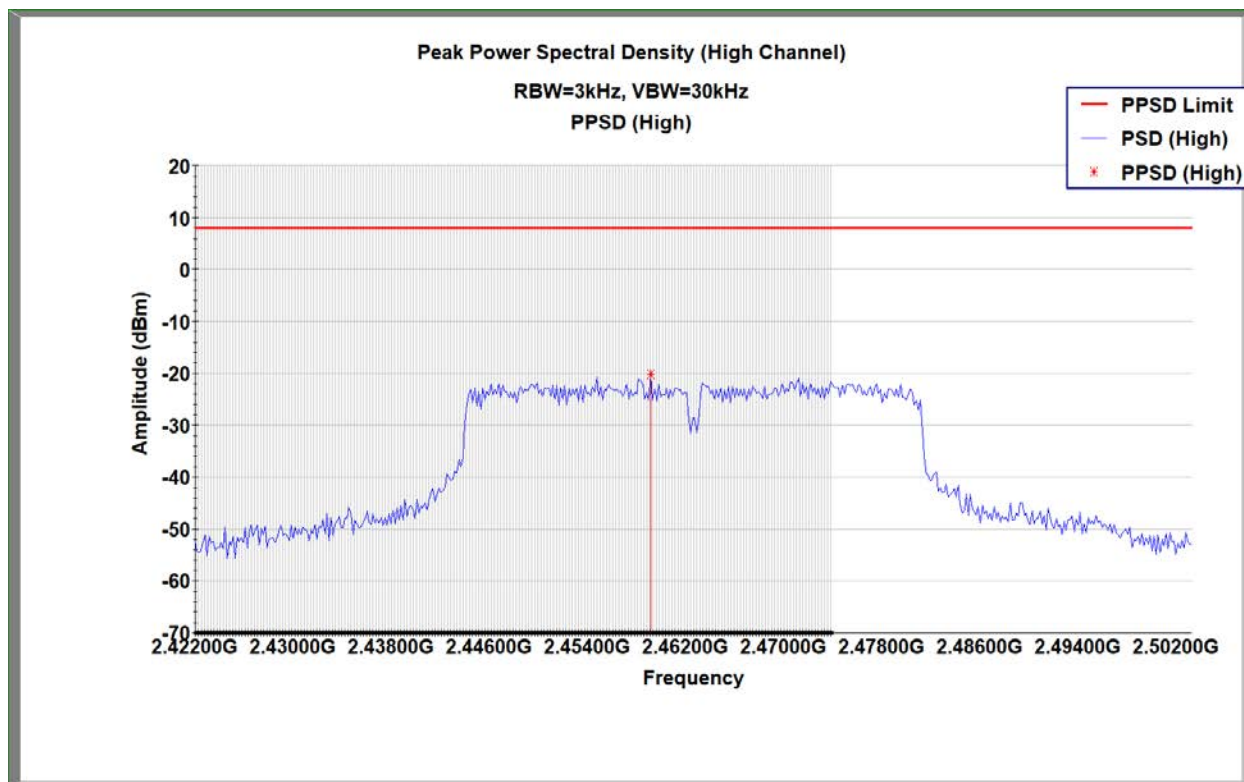
10.6.5 Wi-Fi, 802.11nHT40



Channel 1 (2412MHz) PPSS



Channel 6 (2437MHz) PPSS



Channel 11 (2462MHz) PSD



11 Conducted Spurious Emissions

11.1 Test Limits

FCC Part 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247 Issue 2 § 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

11.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 7.8.8 and 11.11.

11.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESi26	9/30/2019	9/30/2020

11.4 Test Results

The device was found to be **compliant**. All spurious emissions were found to be attenuated more than 20dB below the level of the fundamental.

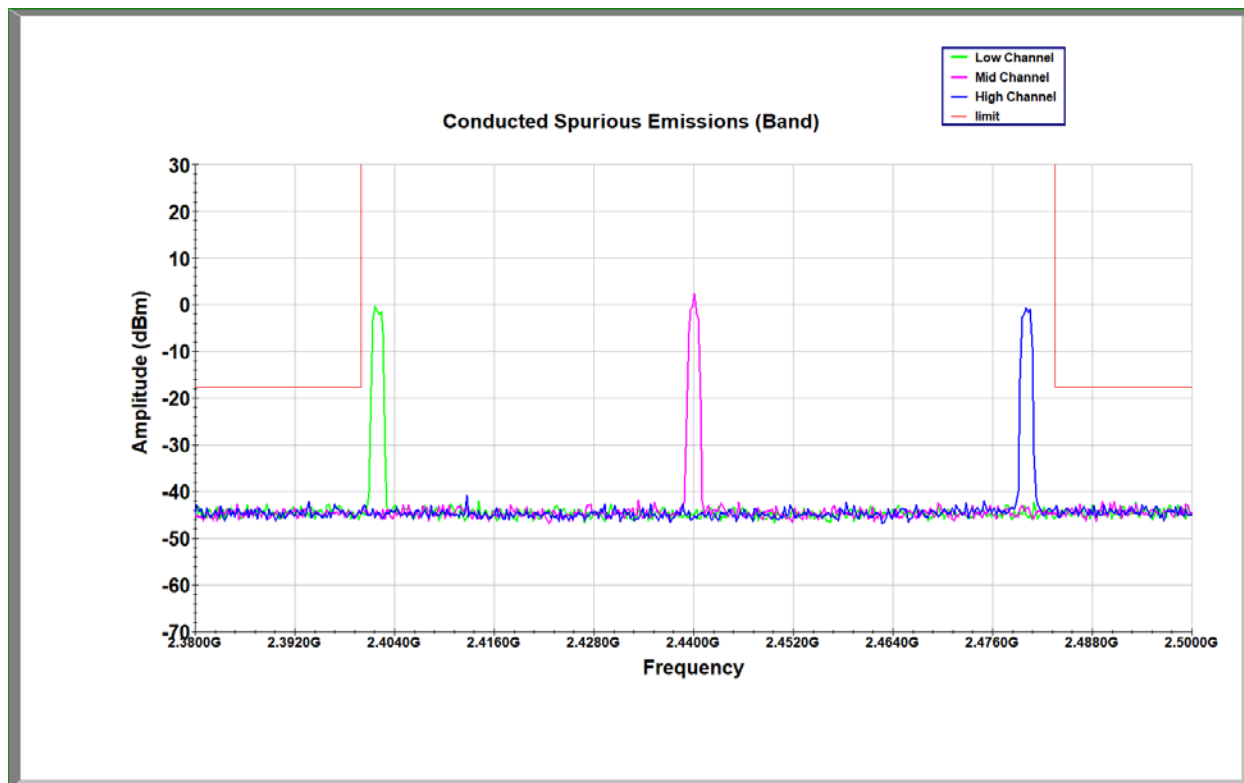
11.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	8/26/2020
Supervising/Reviewing Engineer:		Limit Applied:	See Above
(Where Applicable)	NA	Ambient Temperature:	25.6C
Product Standard:	FCC Part 15.247	Relative Humidity:	52.2%
Input Voltage:	RSS-247 Issue 2	Atmospheric Pressure:	985.4mbar
Pretest Verification w / Ambient	Battery		
Signals or BB Source:	Yes		

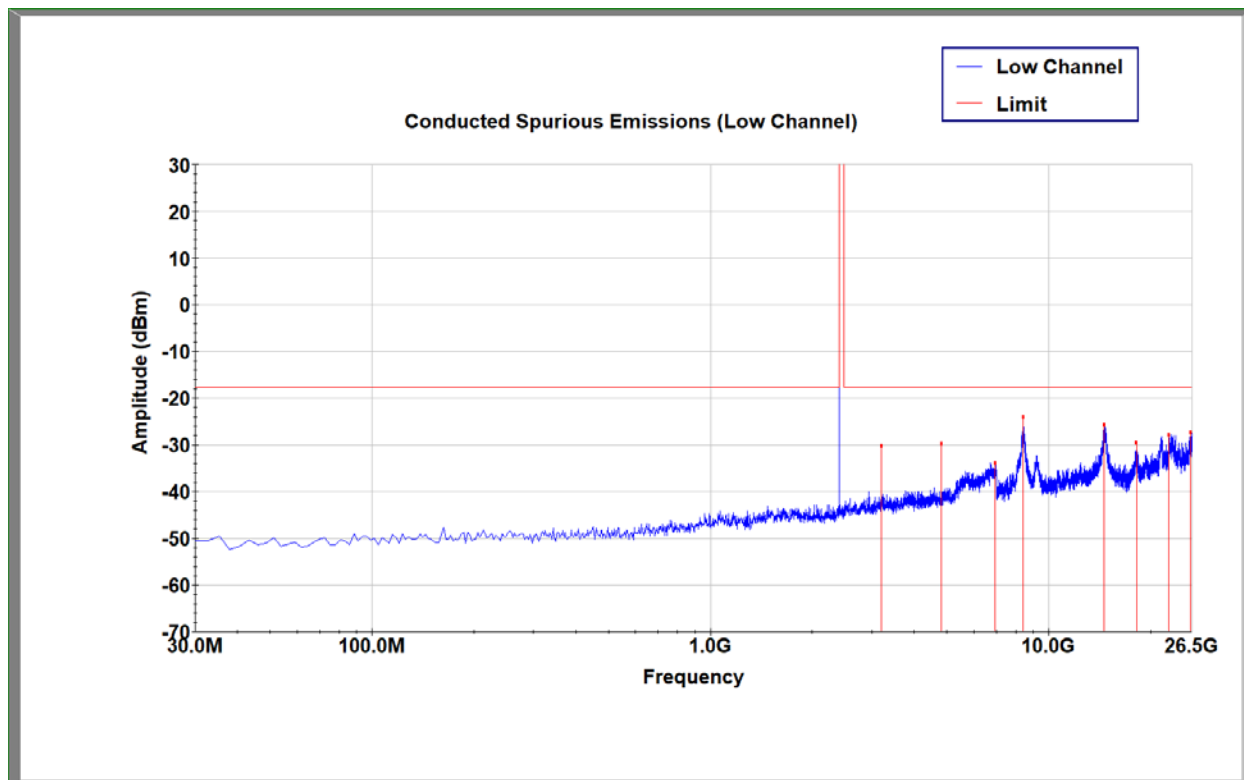


11.6 Test Data

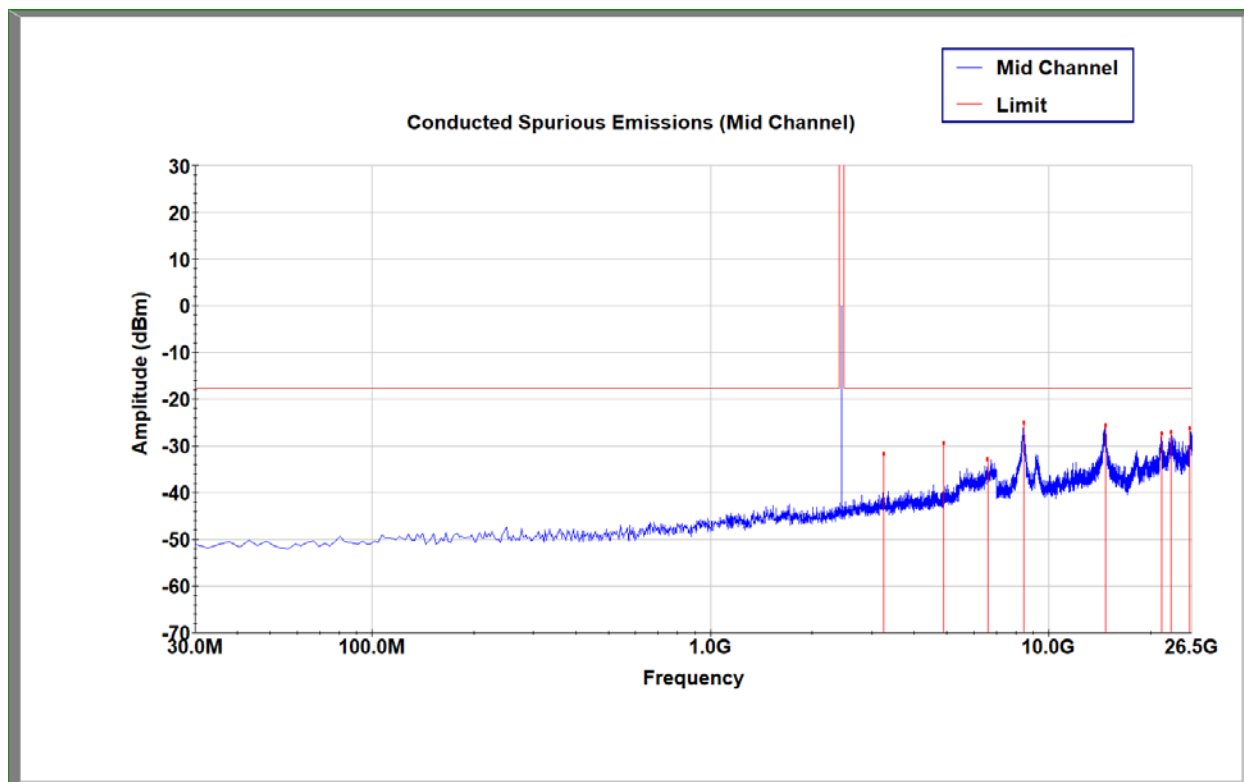
11.6.1 Bluetooth



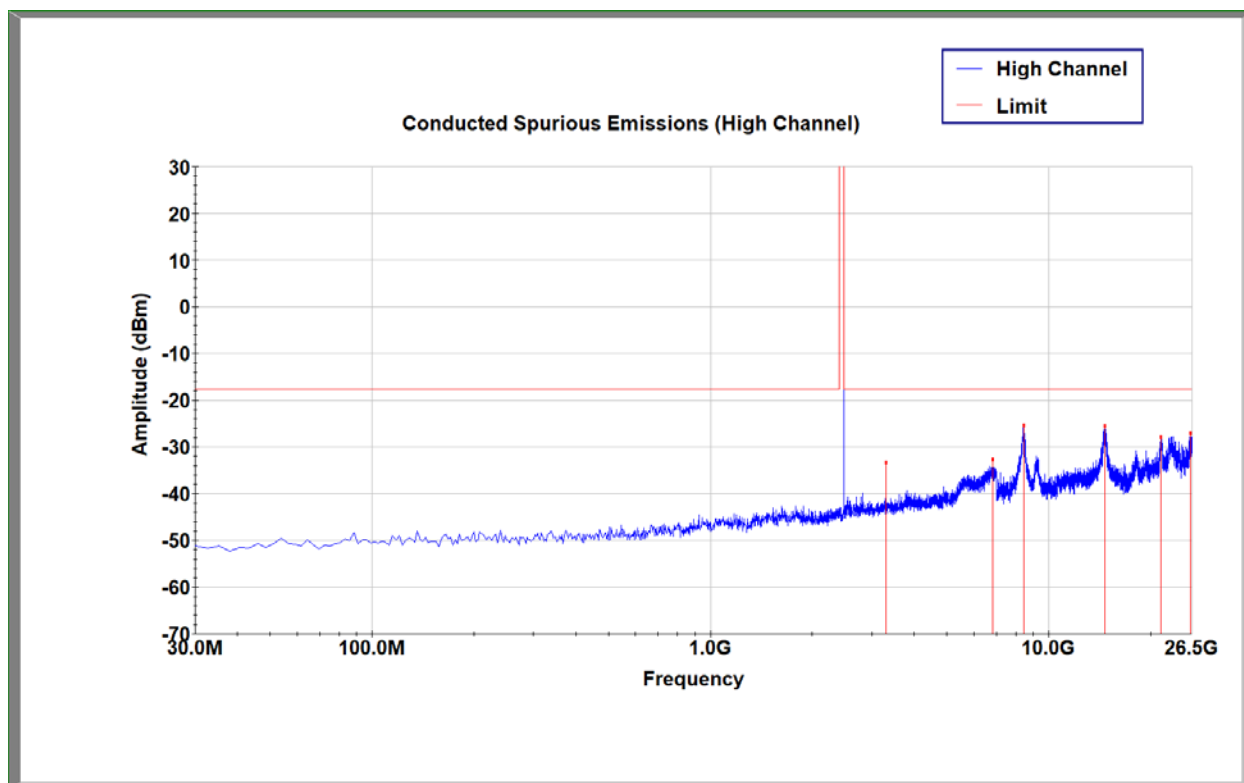
Conducted Spurious Emissions (Band)



Channel 0 (2402MHz) Conducted Spurious Emissions



Channel 38 (2440MHz) Conducted Spurious Emissions

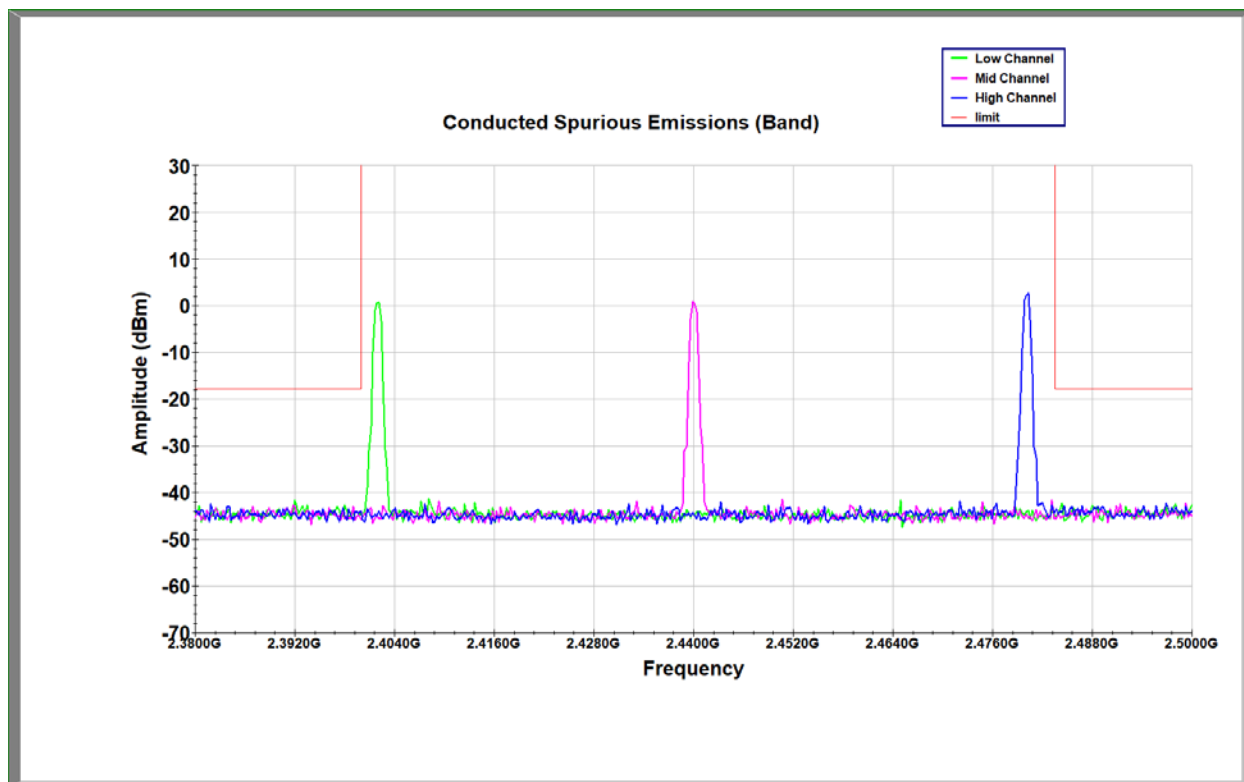


Channel 78 (2480MHz) Conducted Spurious Emissions

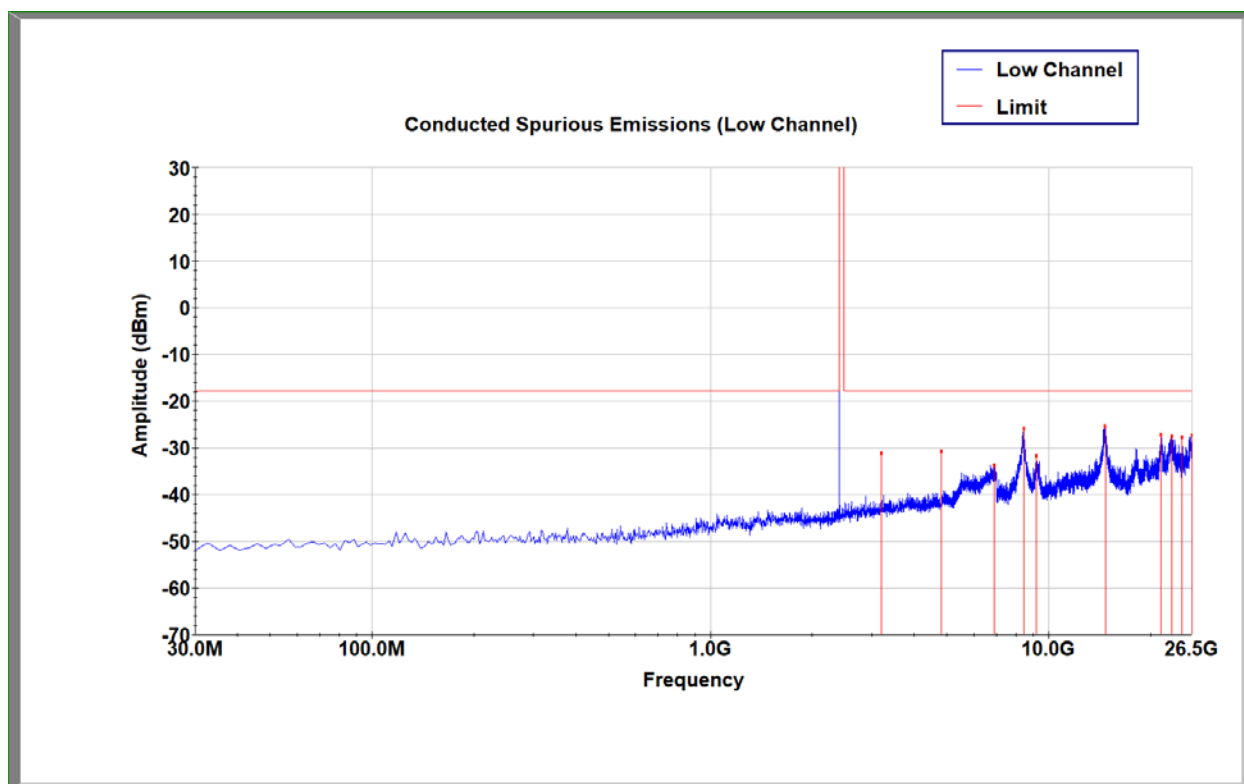
Deviations, Additions, or Exclusions: None.



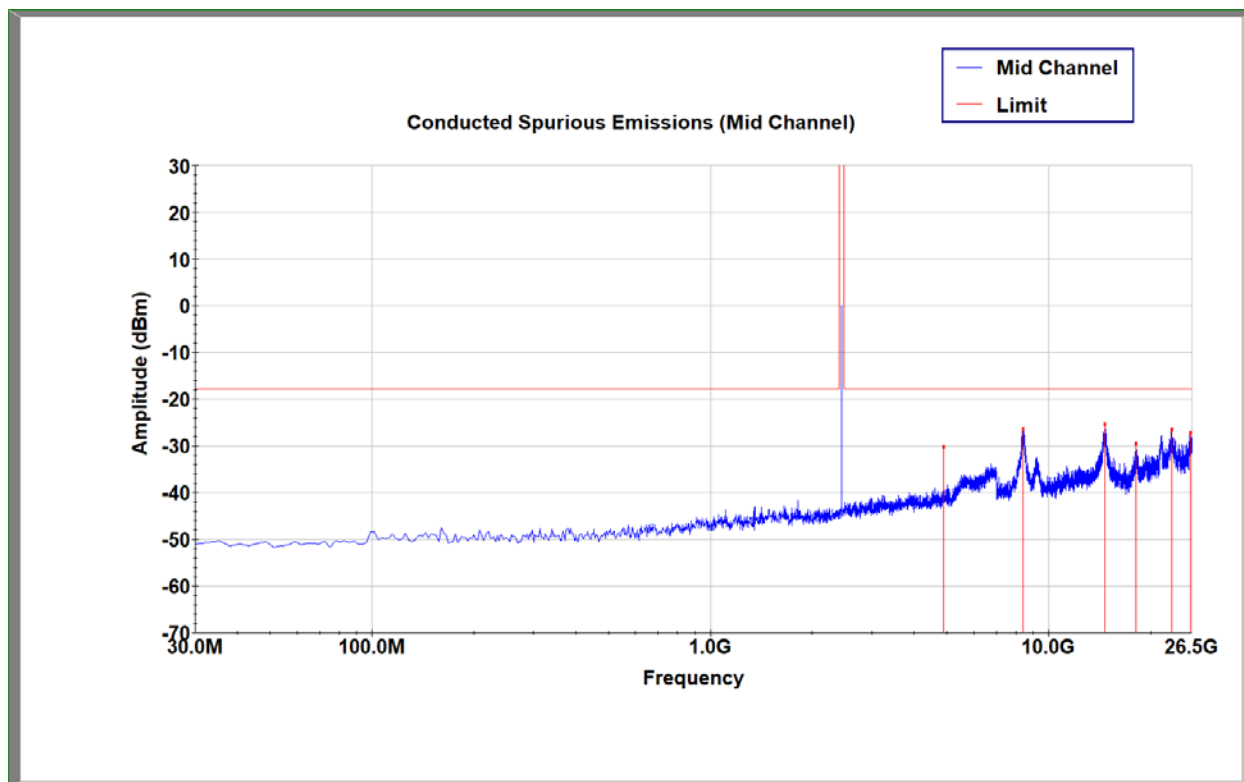
11.6.2 Bluetooth Low Energy



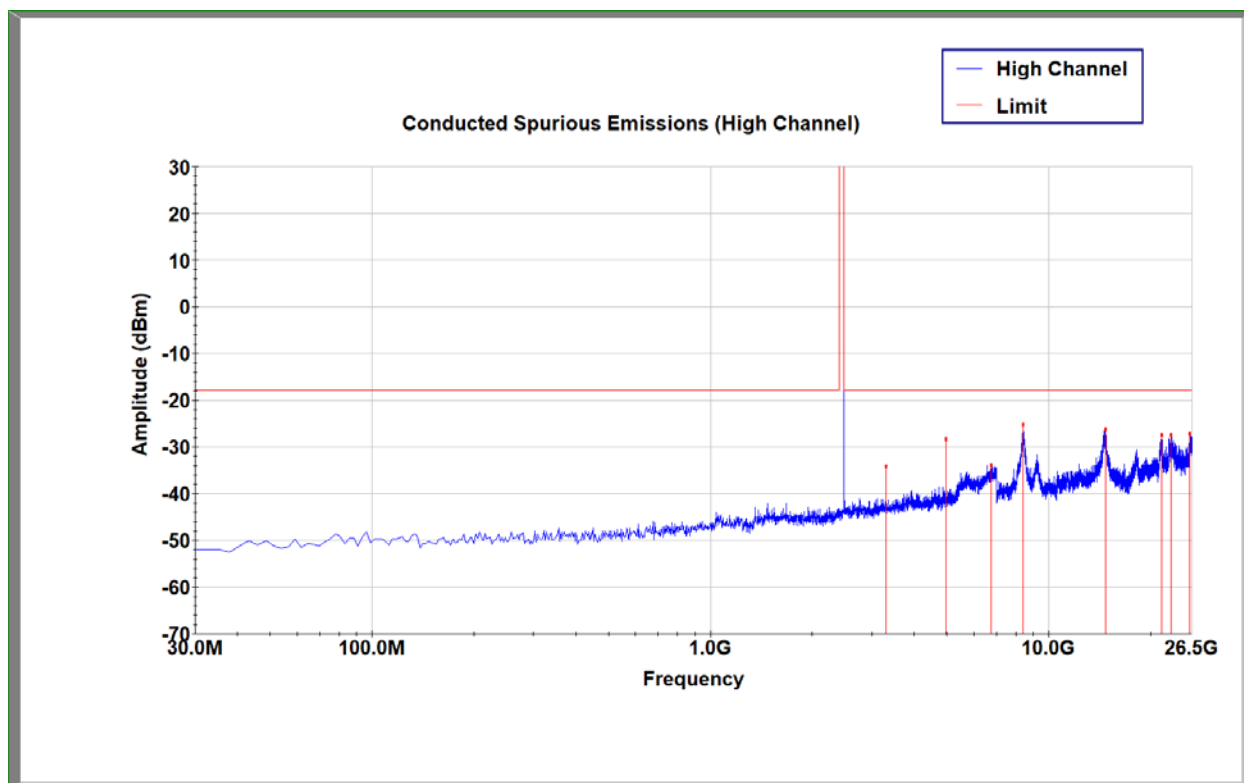
Conducted Spurious Emissions (Band)



Channel 37 (2402MHz) Conducted Spurious Emissions



Channel 17 (2440MHz) Conducted Spurious Emissions

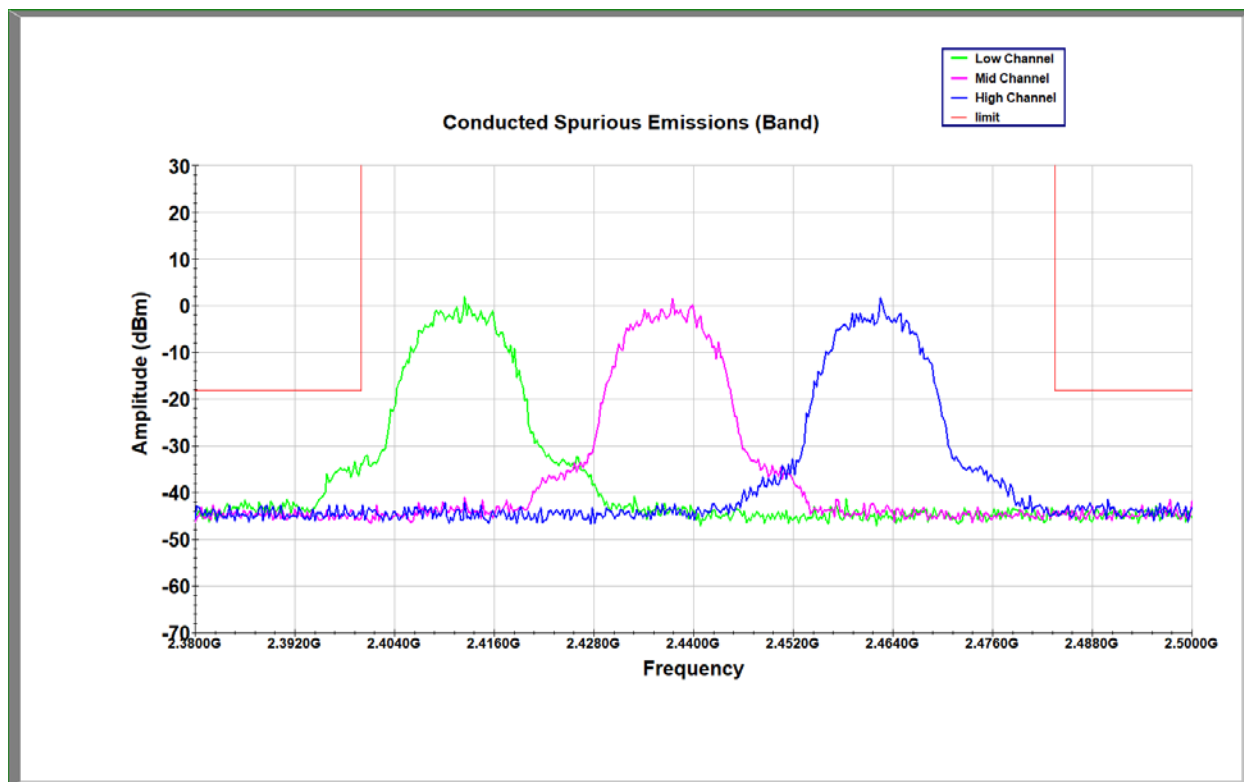


Channel 39 (2480MHz) Conducted Spurious Emissions

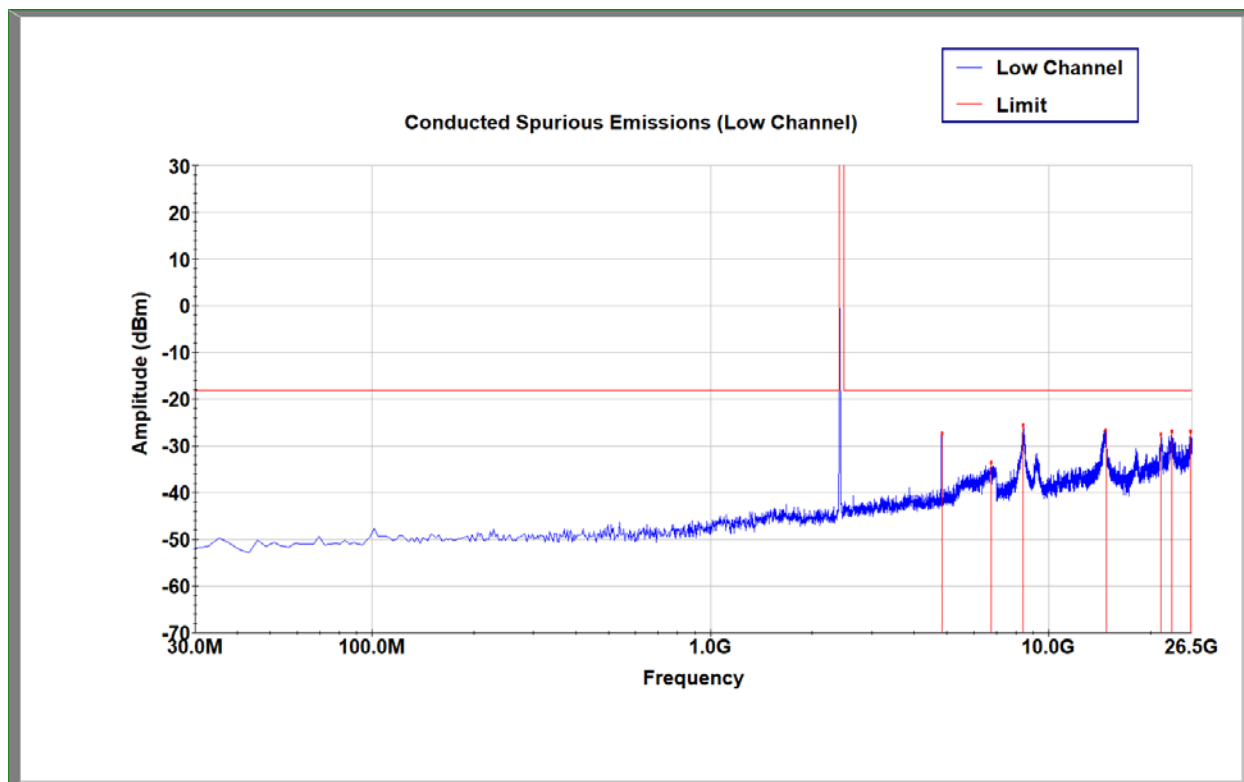
Deviations, Additions, or Exclusions: None.



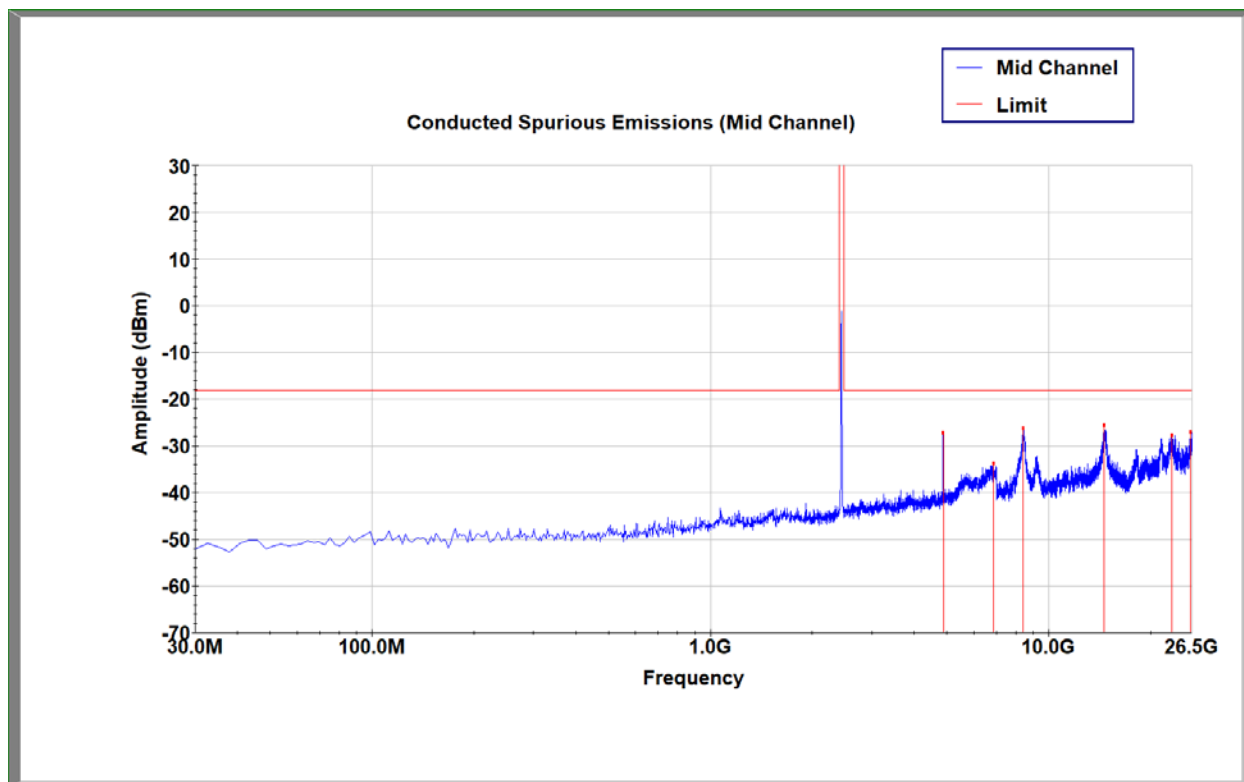
11.6.3 Wi-Fi, 802.11b



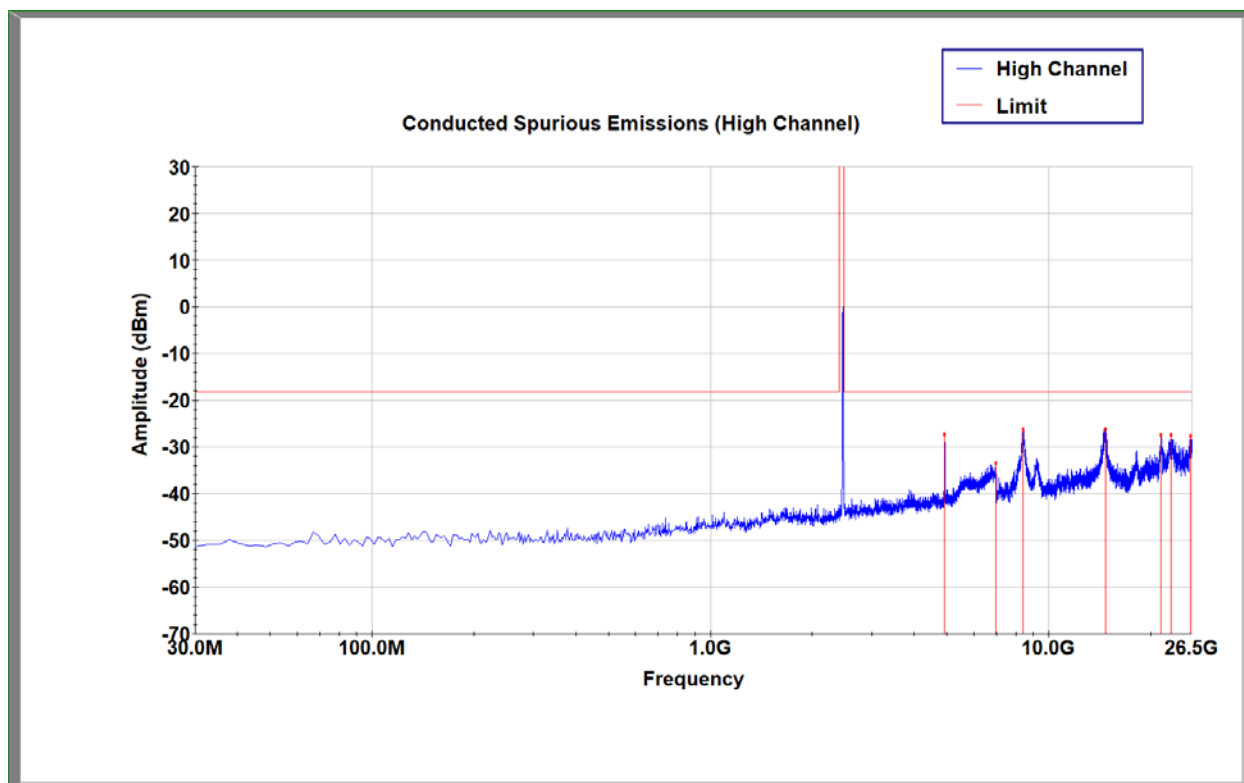
Conducted Spurious Emissions (Band)



Channel 1 (2412MHz) Conducted Spurious Emissions



Channel 6 (2437MHz) Conducted Spurious Emissions

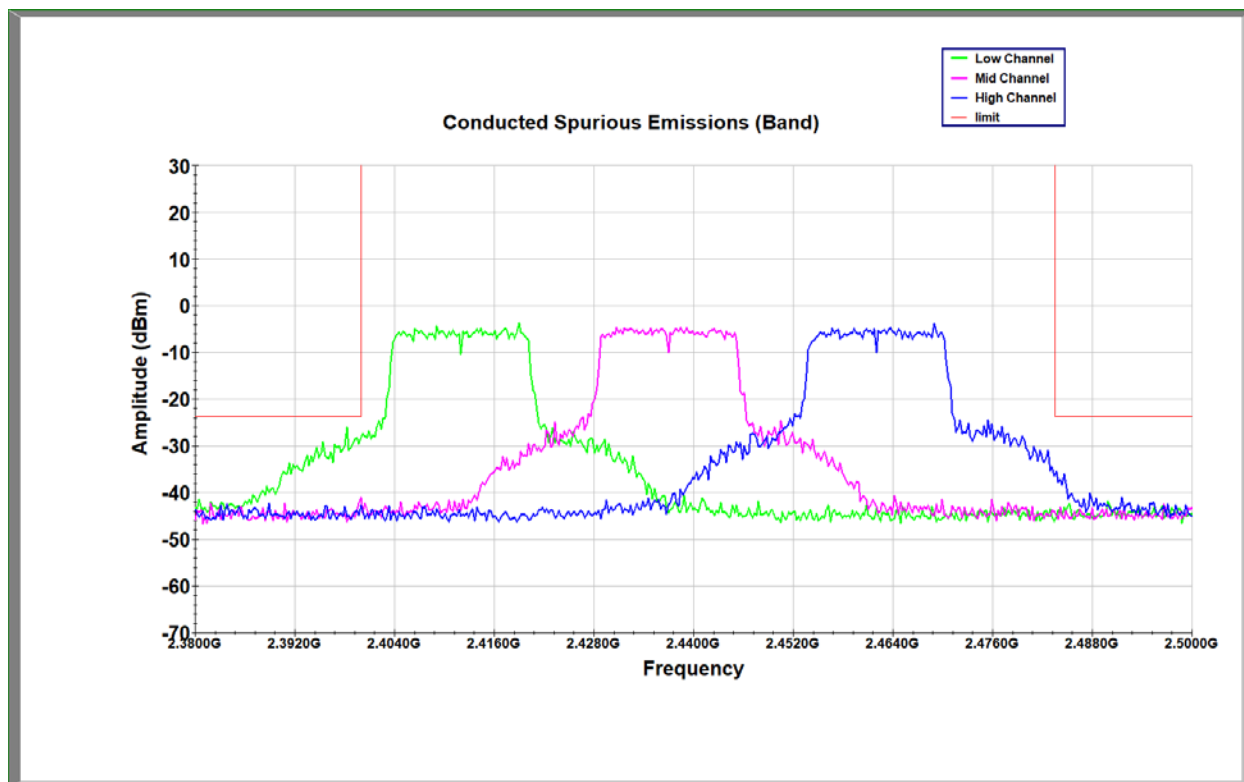


Channel 11 (2462MHz) Conducted Spurious Emissions

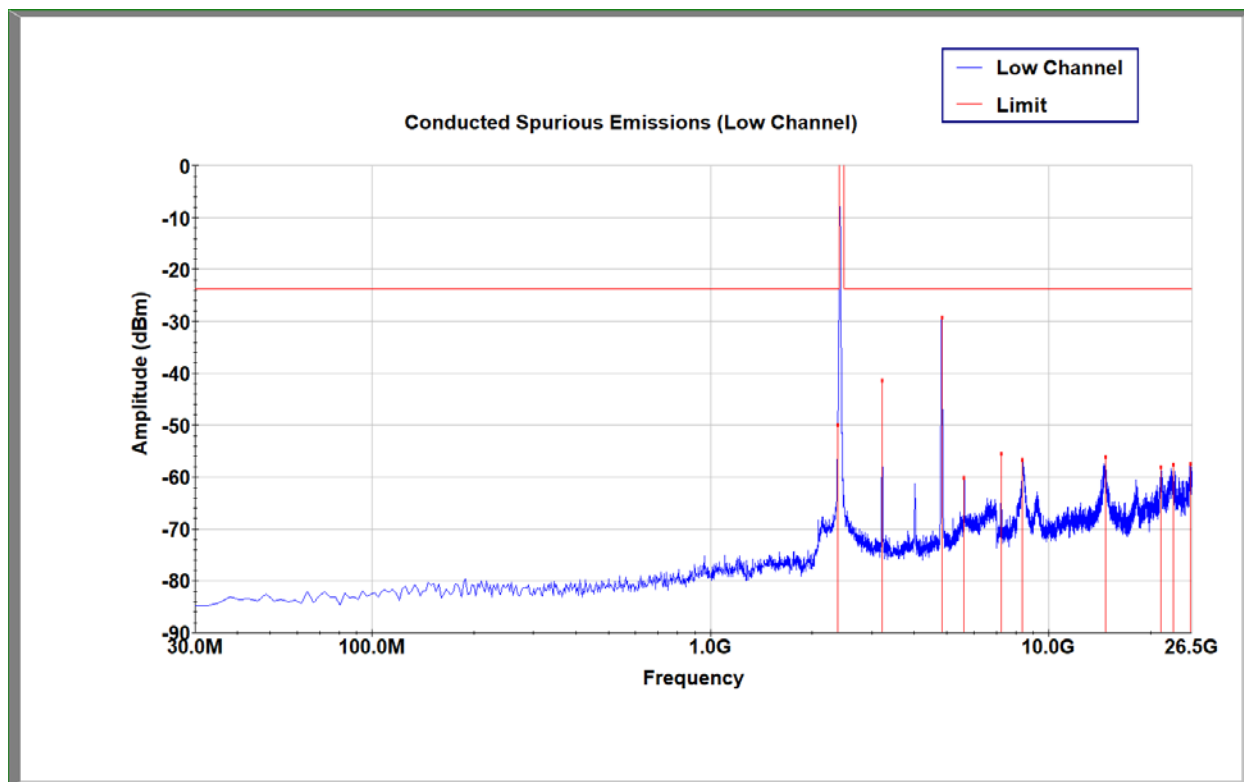
Deviations, Additions, or Exclusions: None.



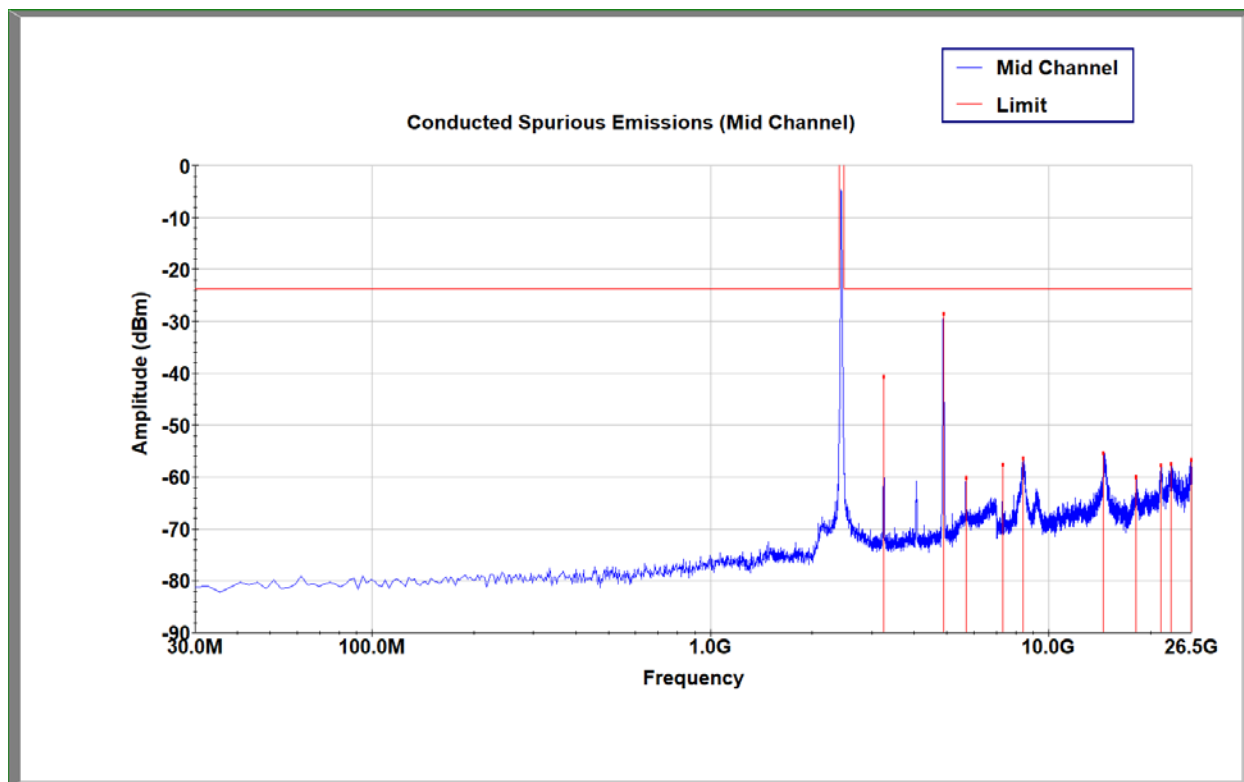
11.6.4 Wi-Fi, 802.11g



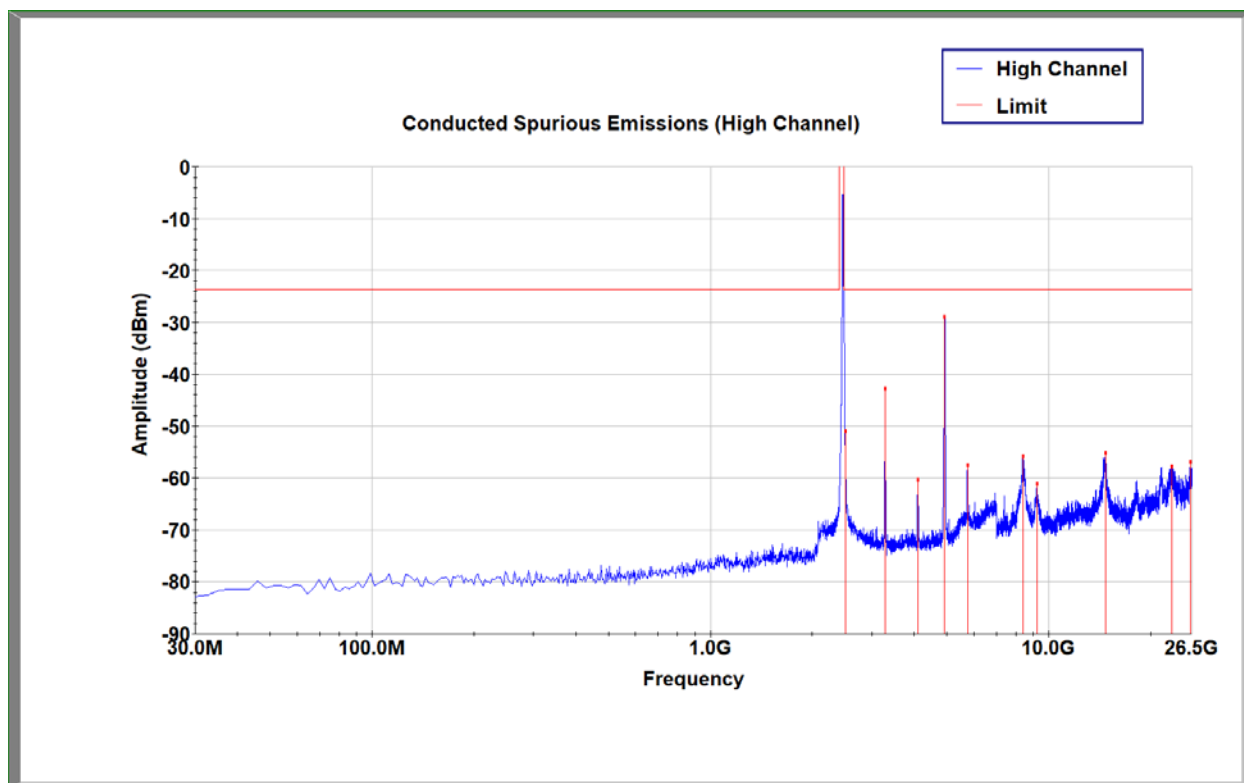
Conducted Spurious Emissions (Band)



Channel 1 (2412MHz) Conducted Spurious Emissions



Channel 6 (2437MHz) Conducted Spurious Emissions

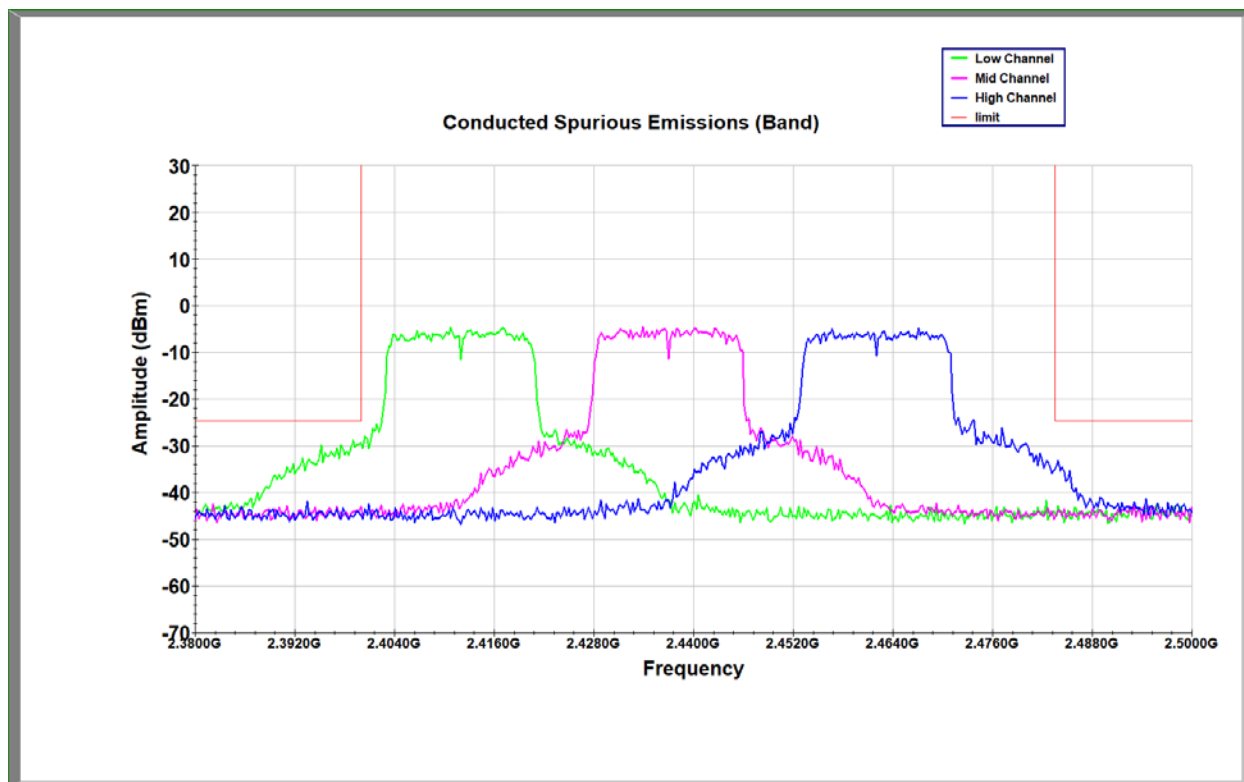


Channel 11 (2462MHz) Conducted Spurious Emissions

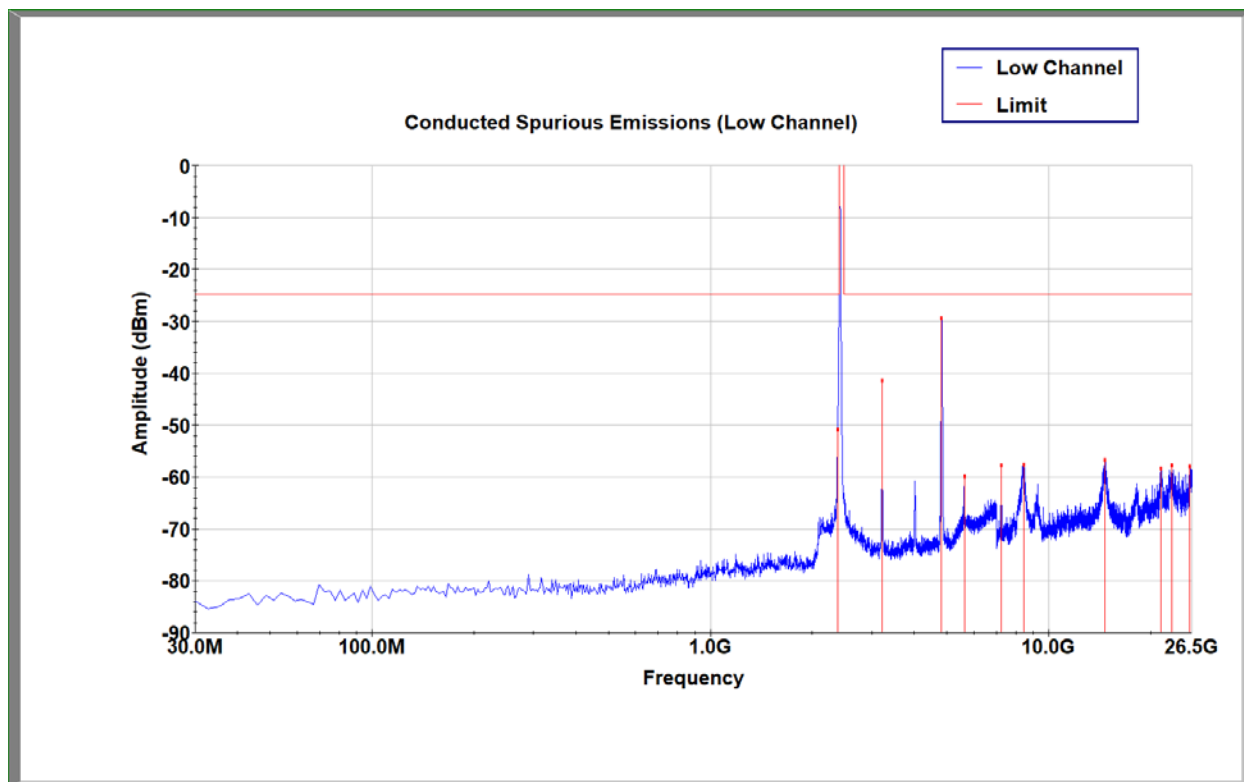
Deviations, Additions, or Exclusions: The output attenuation setting was set to 8 (2dB) for this test.



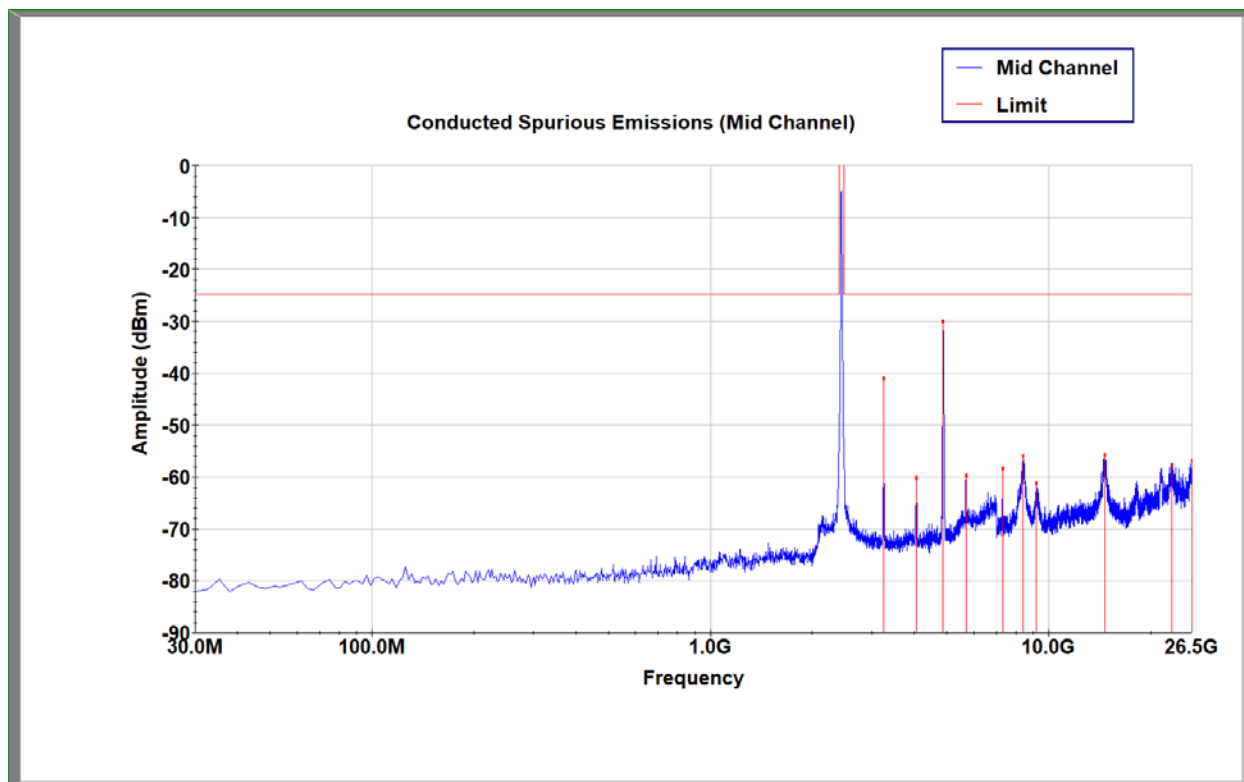
11.6.5 Wi-Fi, 802.11n



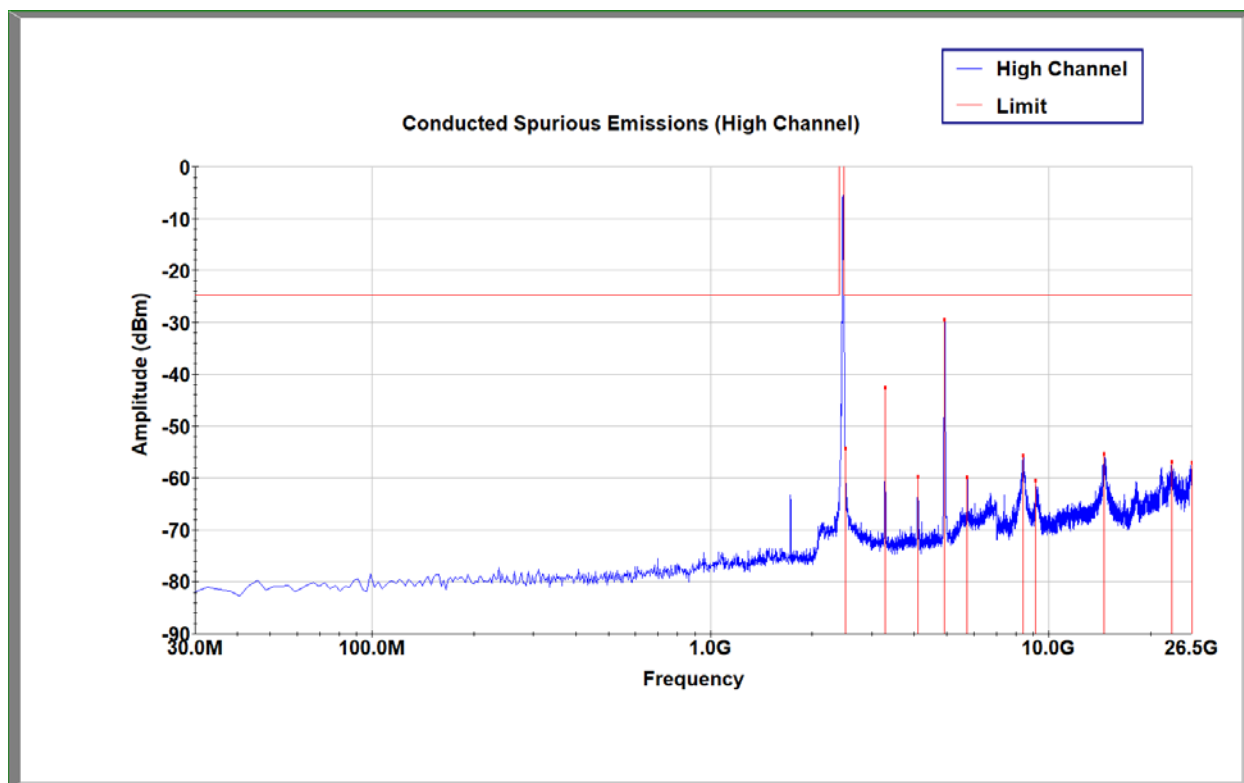
Conducted Spurious Emissions (Band)



Channel 1 (2412MHz) Conducted Spurious Emissions



Channel 6 (2437MHz) Conducted Spurious Emissions

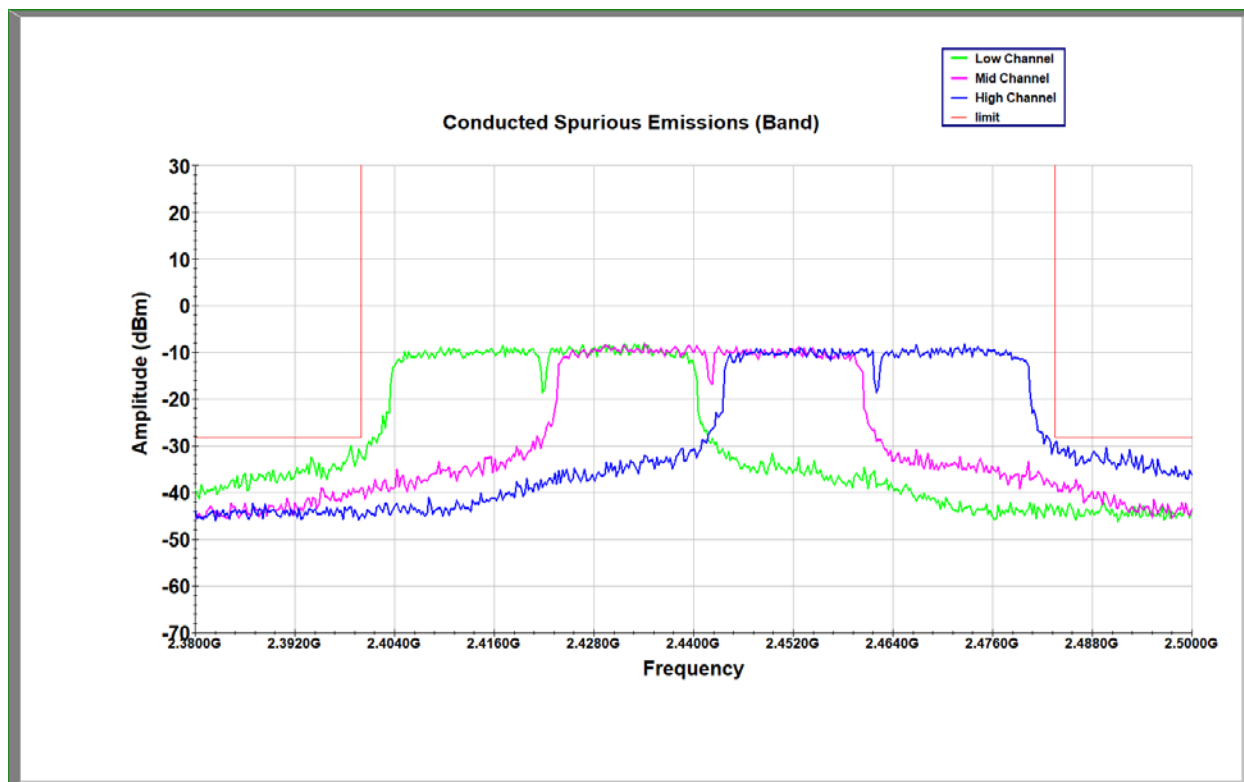


Channel 11 (2462MHz) Conducted Spurious Emissions

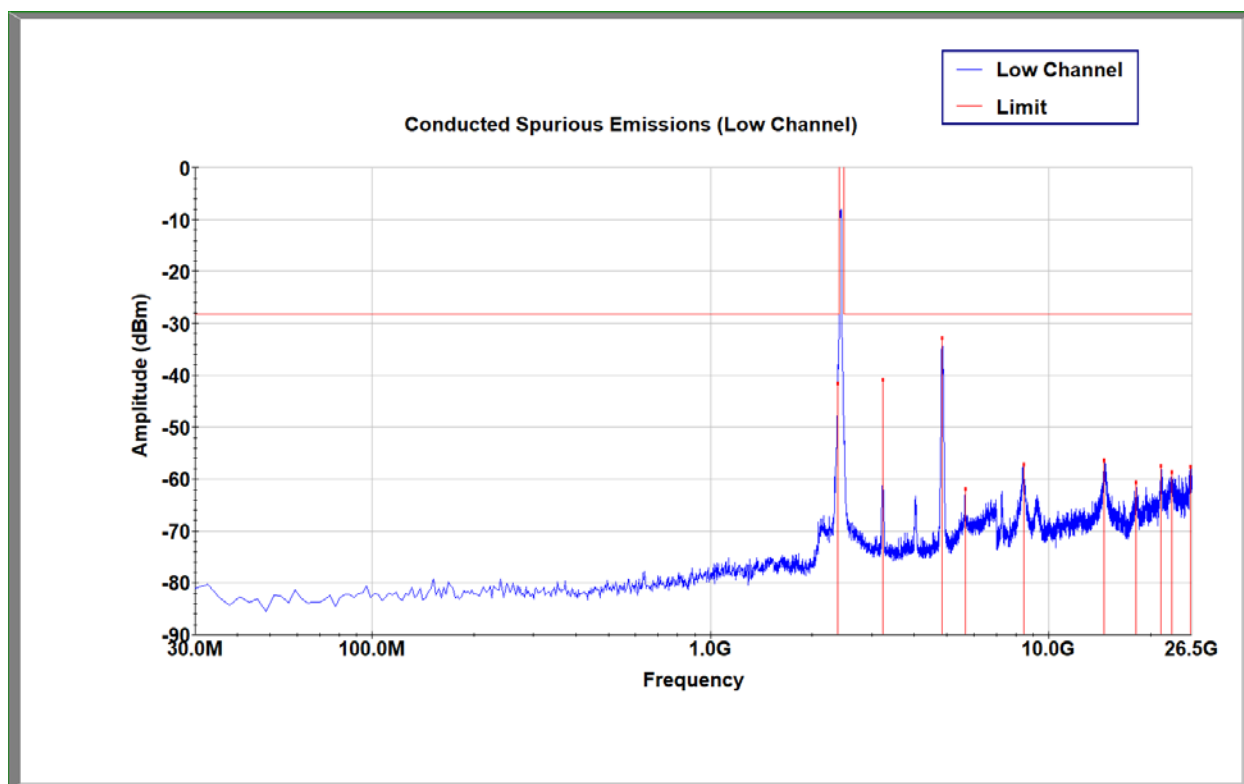
Deviations, Additions, or Exclusions: The output attenuation setting was set to 8 (2dB) for this test.



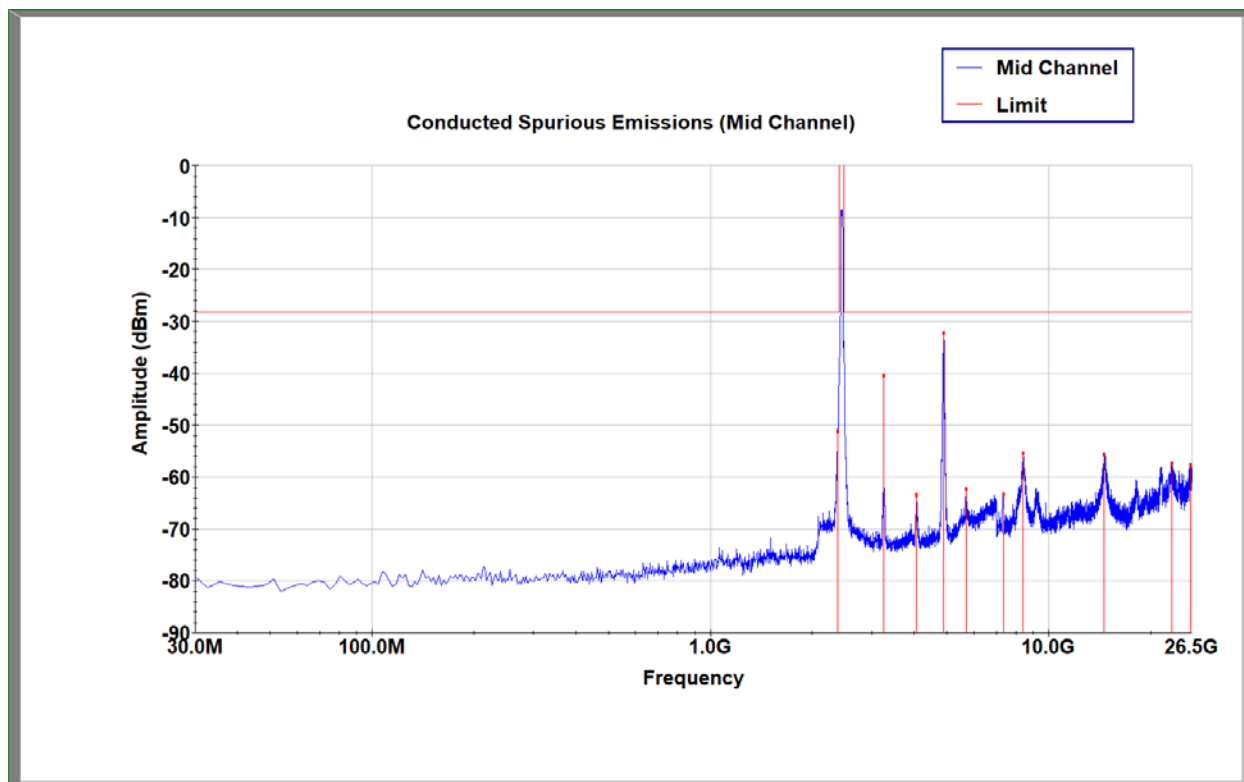
11.6.6 Wi-Fi, 802.11nHT40



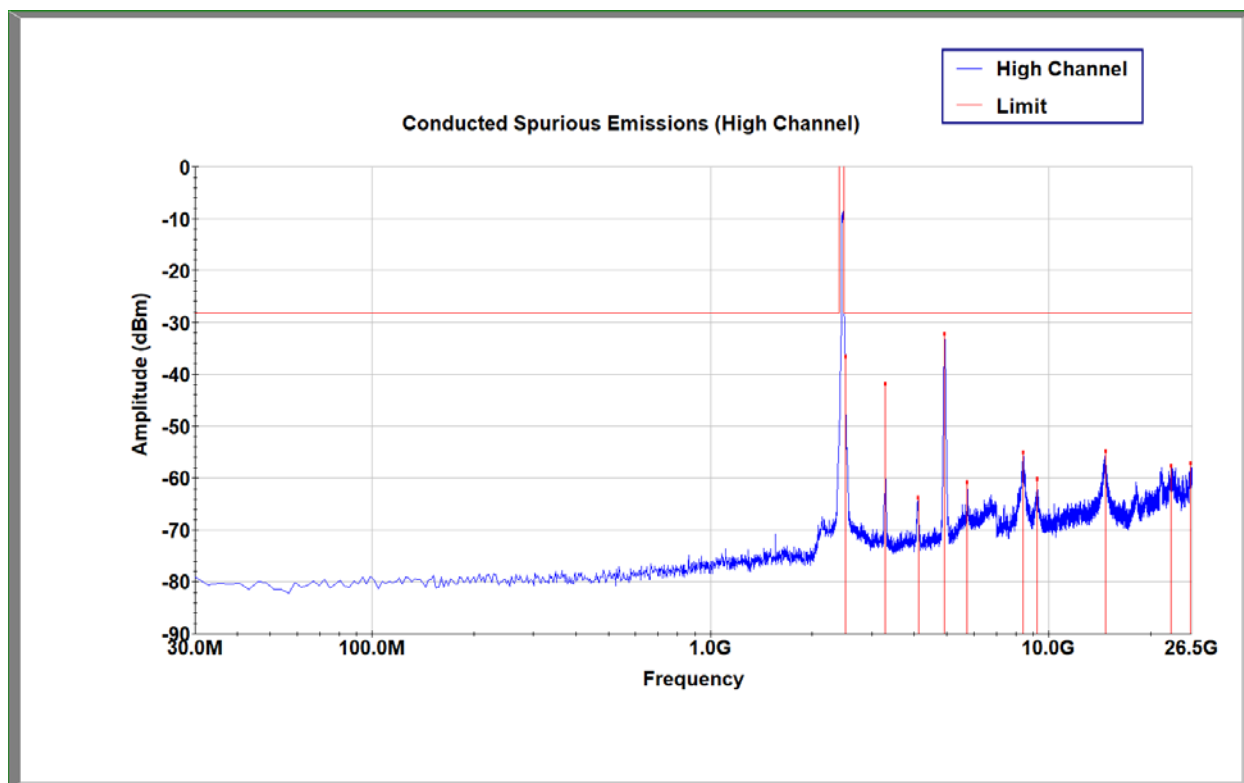
Conducted Spurious Emissions (Band)



Channel 3 (2422MHz) Conducted Spurious Emissions



Channel 7 (2442MHz) Conducted Spurious Emissions



Channel 11 (2462MHz) Conducted Spurious Emissions

Deviations, Additions, or Exclusions: The output attenuation setting was set to 12 (3dB) for this test.



12 Number of Hopping Channels, Channel Separation, and Time of Occupancy

12.1 Test Limits

FCC Part 15.247(a)(1):

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 system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

FCC Part 15.247(a)(1)(iii):

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 may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

RSS-247 Issue 2 § 5.1(b):

FHSs 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, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

RSS-247 Issue 2 § 5.1(d):

FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping 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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

12.2 Test Method

Tests are performed in accordance with ANSI C63.10:2013 § 7.8.2, 7.8.3, 7.8.4



12.3 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde & Schwarz	ESi26	9/30/2019	9/30/2020

12.4 Test Results

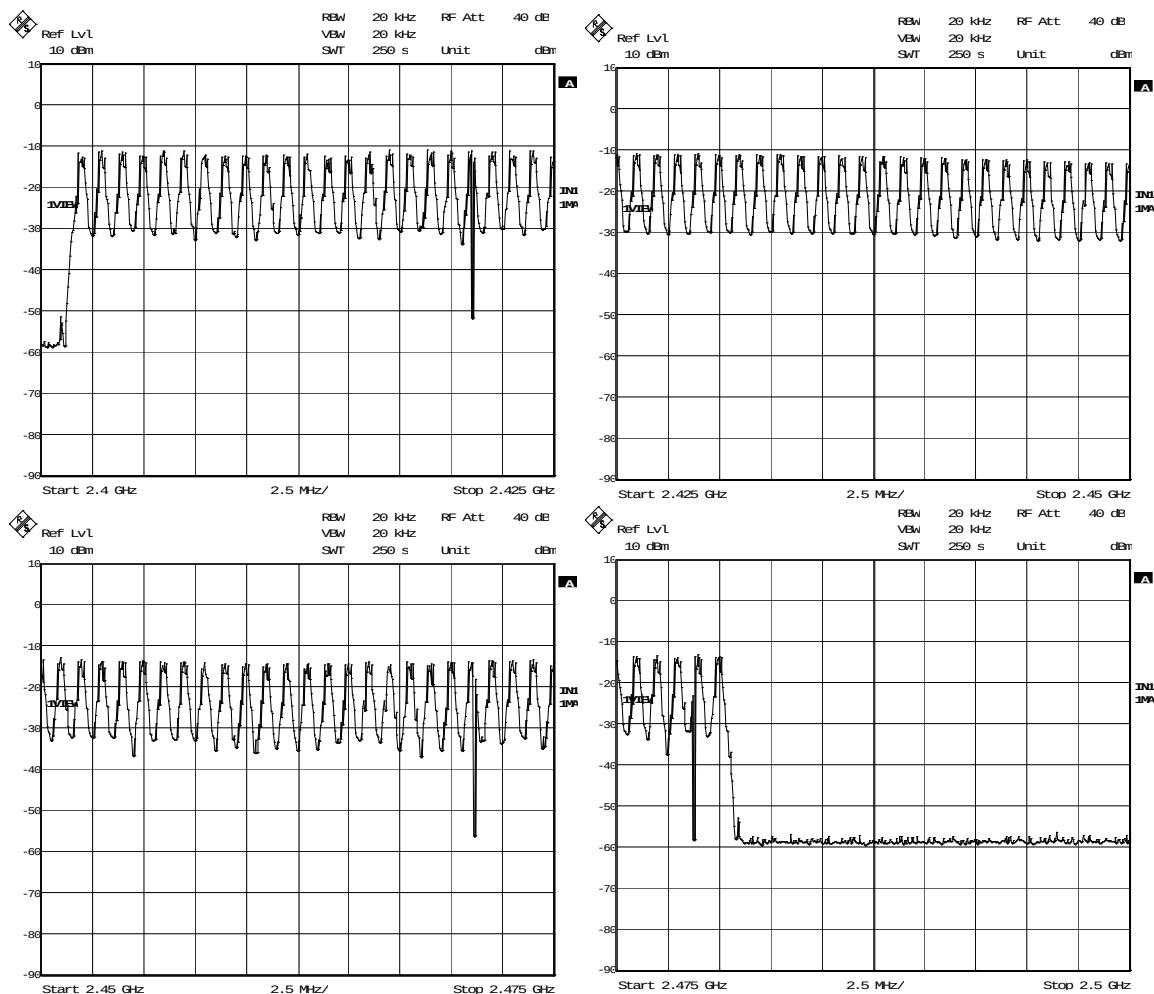
The device was found to be **compliant**. The Bluetooth radio used 79 hopping channels separated by 1MHz, greater than 2/3 of the measured 20dB bandwidth of 1.329MHz (see section 9 of this report). The total time of occupancy was 0.198s in a 31.6s period.

12.5 Test Conditions

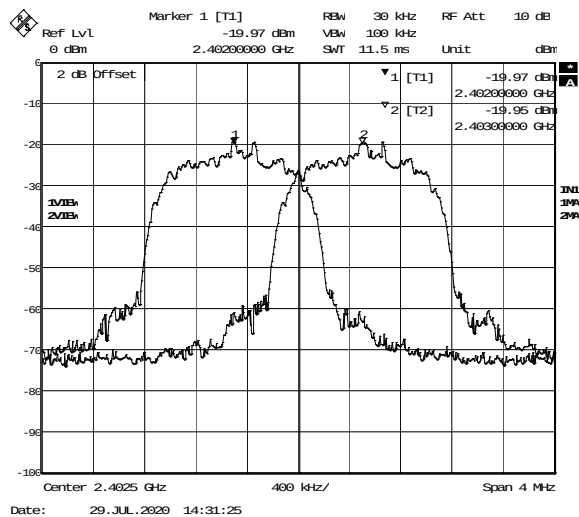
Test Personnel:	Brian Lackey	Test Date:	7/29/2020
Supervising/Reviewing Engineer:			15.247(a)(1), (1)(iii)
(Where Applicable)	NA	Limit Applied:	RSS-247 Issue 2 § 5.1(b), (d)
	FCC Part 15.247		
Product Standard:	RSS-247 Issue 2	Ambient Temperature:	25.6C
Input Voltage:	Battery	Relative Humidity:	52.2%
Pretest Verification w / Ambient			
Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar



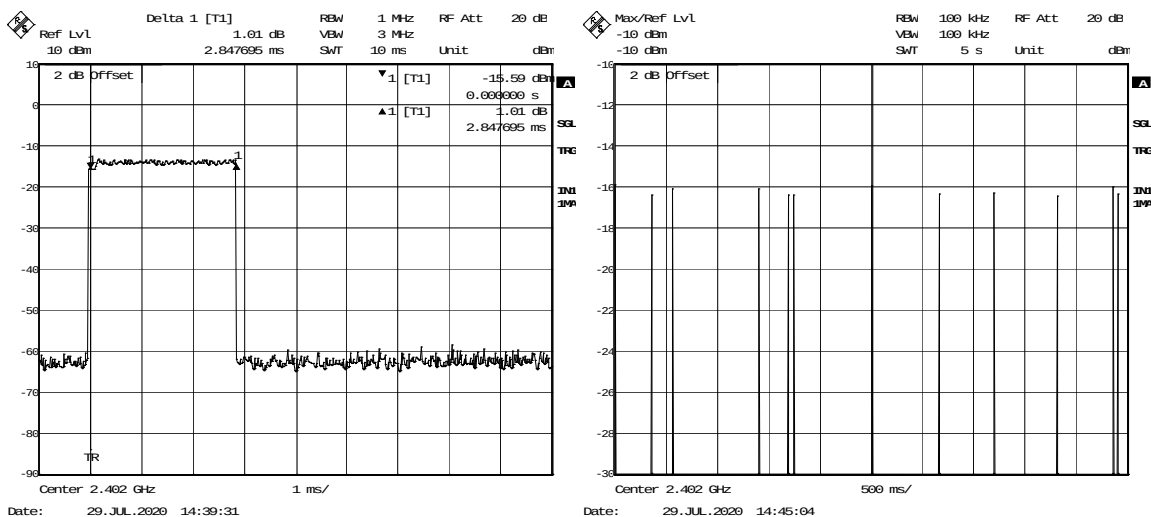
12.6 Test Data



Total Number of Hopping Channels Observed = 79



Channel Separation



Time of single occupancy of 2.848ms (left) and 11 occupancies observed in 5s (right)

Period of observation = $0.4s \times 79 = 31.6s$

Total time of occupancy = $0.002848s \times 11 \times (31.6s / 5s) = 0.198s$

Deviations, Additions, or Exclusions: None



13 Antenna Requirement

13.1 Test Limits

FCC Part 15.203:

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 §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

RSS-Gen Issue 5 § 6.8:

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

13.2 Test Results

The device was found to be **compliant**. The device has an internal, permanently affixed antenna.

**14 Revision History**

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	9/4/2020	104350997LEX-006	BZ	BCT	Original Issue
1	1/8/2021	104350997LEX-006.1	BZ	BCT	Updated spurious emissions data
2	2/9/2021	104350997LEX-006.2	BZ	BCT	Updated radiated band edge data