Intertek
731 Enterprise Drive
Lexington, KY 40510

Tel 859 226 1000
Fax 859 226 1040

www.intertek.com

Dormakaba USA, Inc.
TEST REPORT

SCOPE OF WORK
EMC TESTING – KEYPAD MODEL 705, LOCK MODEL 732

REPORT NUMBER
104364418LEX-001.2

ISSUE DATE	**REVISED DATE**
7/31/2020	2/16/2021

PAGES
39

DOCUMENT CONTROL NUMBER
Non-Specific EMC Report Shell Rev. December 2017

EMC TEST REPORT

(FULL COMPLIANCE)

Report Number:	104364418LEX-001.2
Project Number:	G104364418
Report Issue Date:	7/31/2020
Report Revised Date:	2/16/2021
Model(s) Tested:	Keypad Model 705 Lock Model 732
Variant Model(s) not Tested but Declared Electrically Identical by Manufacturer:	Keypad Models 703, 704 Lock Models 731, 733
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:
Dormakaba USA, Inc.
749 West Short Street
Lexington, KY 40508-1200
USA

Report prepared by

Brian Lackey, Staff Engineer

Report reviewed by

Bryan Taylor, Team Leader

Table of Contents

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	Antenna Requirement (FCC Part 15.203, RSS-Gen Issue 5 § 6.8)	Pass
13	Conducted Emissions (ANSI C63.4: 2014)	Pass

3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Dormakaba USA, Inc.
Address:	749 West Short Street Lexington, KY 40508-1200 USA
Contact:	James Adams
Email:	James.adams@dormakaba.com
Manufacturer Information	
Manufacturer Name:	Dormakaba USA, Inc.
Manufacturer Address:	749 West Short Street Lexington, KY 40508-1200 USA

4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Electronic Safe Lock
Model Numbers	Keypad Model 705 Lock Model 732
Serial Number	Lock 1
Receive Date	7/13/2020
Test Start Date	7/13/2020
Test End Date	2/15/2021
Device Received Condition	Good
Test Sample Type	Production
Rated Voltage	Battery: 9.4VDC Max
Software Used By EUT	BLE: 07-13-20 Entry: 00.00.98.05 Lock: 00.00.08.05
Frequency Band(s)	2400-2483.5MHz
Modulation Type(s)	GFSK
Test Channel(s)	2402MHz, 2440MHz, 2480MHz
Maximum Antenna Gain (dBi)	0.5 dBi
Description of Equipment Under Test (provided by client)	
User interface to communicate with bolt locking mechanism. Keypad may be programmed directly or with compatible software and connected PC.	

4.1 Variant Models:

The following variant models were partially tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models, depopulated models, or with reasonable similarity to the model(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

- Keypad models 703, 704
- Lock models 731, 733

5 System Setup and Method

5.1 Method:

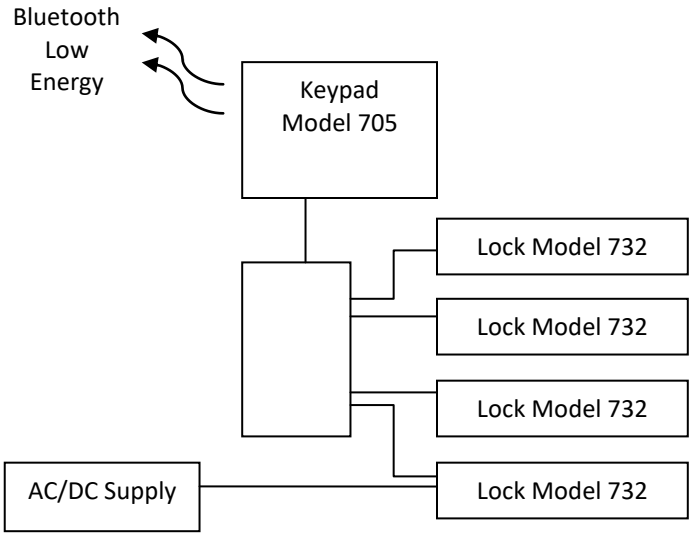
Configuration as required by ANSI C63.4: 2014 and ANSI C63.10:2013

No.	Descriptions of EUT Exercising
1	Transmitting a Bluetooth Low Energy (BLE) signal or low, middle, or high channel
2	Idle, not transmitting. External AC/DC supply used in lieu of battery for testing.

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	AC/DC Supply	2	No	No	Plug

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
AC/DC Supply	-	-	-

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)	Ucispr
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 dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
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 dBμV 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 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

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

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/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	8/8/2020
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

6.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

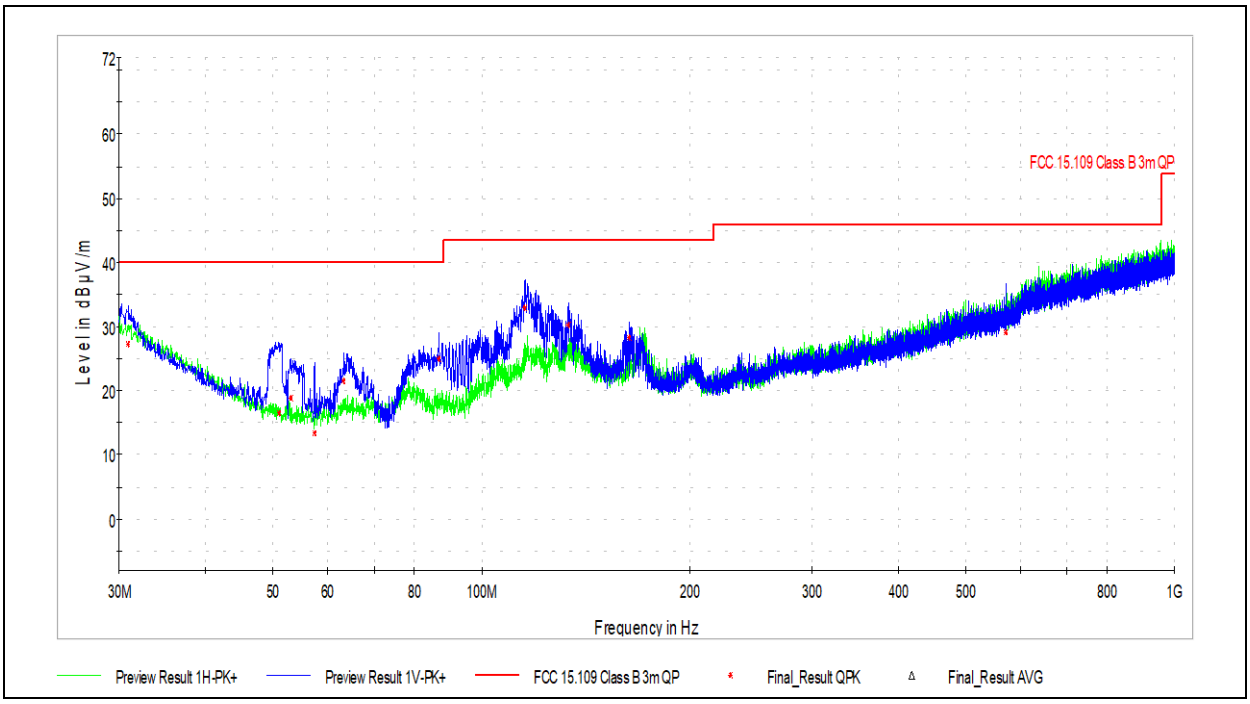
6.5 Test Results

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

6.6 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	7/13/2020
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	FCC Part 15.209 / FCC Part 15.109 Class B
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	26.7C
Input Voltage:	120V/60Hz to AC/DC supply	Relative Humidity:	44.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	982.7mbar

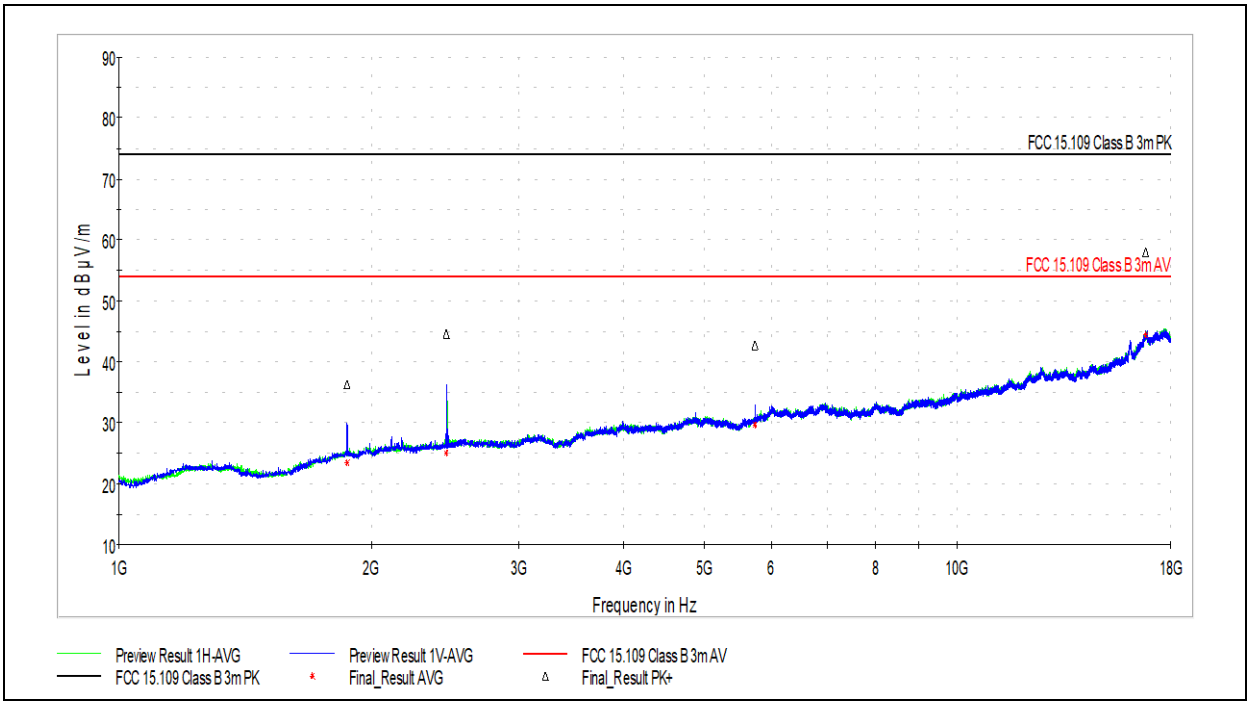
6.7 Test Data: 30MHz – 1GHz



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.916111	27.36	40.00	12.64	120.000	100.1	V	26.0	26.9
51.016667	16.44	40.00	23.56	120.000	130.6	V	74.0	15.2
53.118333	18.83	40.00	21.17	120.000	131.1	V	0.0	15.0
57.375556	13.44	40.00	26.56	120.000	273.3	V	36.0	14.6
63.249445	21.51	40.00	18.49	120.000	106.6	V	54.0	14.6
86.798889	24.94	40.00	15.06	120.000	130.4	V	199.0	16.5
115.521667	32.83	43.52	10.69	120.000	104.9	V	62.0	21.6
133.305000	30.18	43.52	13.34	120.000	100.0	V	111.0	22.4
163.375000	28.20	43.52	15.32	120.000	105.0	V	108.0	21.7
571.206111	29.12	46.02	16.90	120.000	371.5	V	228.0	30.6

Deviations, Additions, or Exclusions: None

6.8 Test Data: 1GHz – 18GHz



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1872.500000	36.25	73.98	37.73	1000.000	100.0	V	1.0	1.9
2458.500000	44.59	73.98	29.39	1000.000	223.0	V	282.0	3.9
5743.500000	42.81	73.98	31.17	1000.000	100.0	V	0.0	9.6
16805.000000	58.03	73.98	15.95	1000.000	100.0	V	292.0	26.1

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1872.500000	23.38	53.98	30.60	1000.000	100.0	V	1.0	1.9
2458.500000	25.02	53.98	28.96	1000.000	223.0	V	282.0	3.9
5743.500000	29.66	53.98	24.32	1000.000	100.0	V	0.0	9.6
16805.000000	44.38	53.98	9.60	1000.000	100.0	V	292.0	26.1

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	8/8/2020
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

7.4 Software Utilized

Name	Manufacturer	Version
EMC32	Rohde & Schwarz	Version 9.15.02

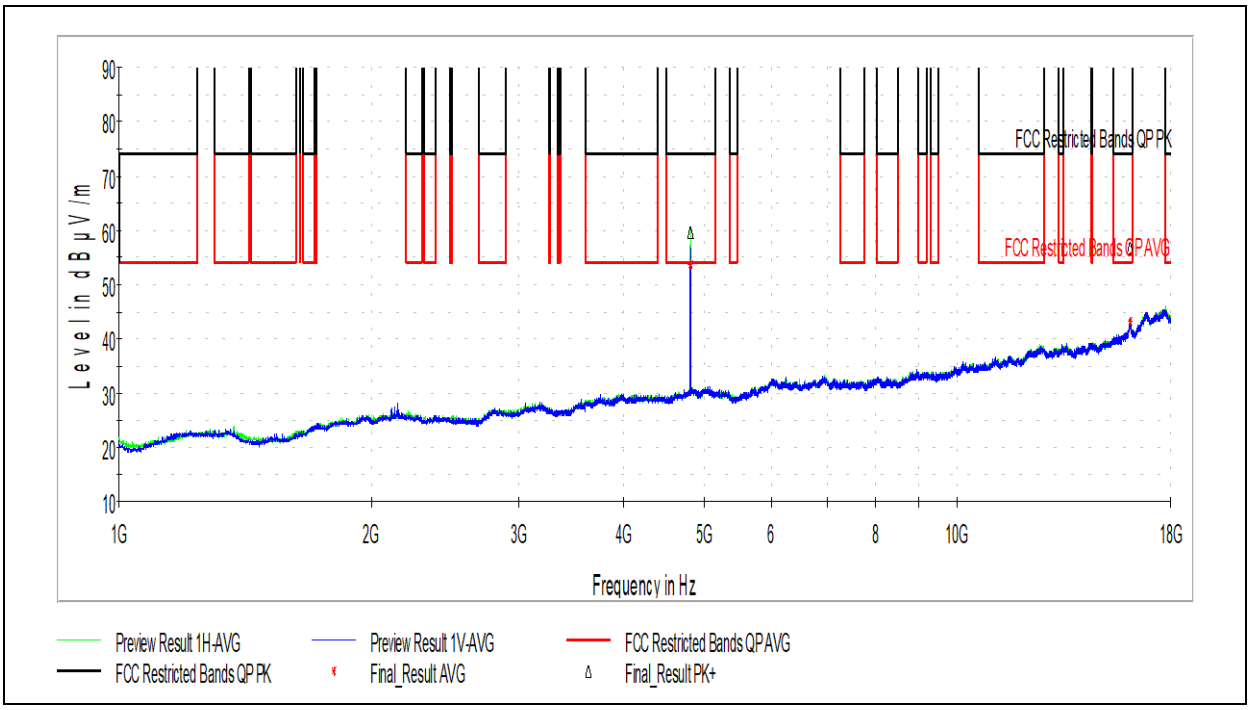
7.5 Test Results

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:	7/13/2020-7/15/2020
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	FCC Part 15.209 in Restricted Bands from FCC Part 15.205
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	23.0C
Input Voltage:	120V/60Hz to AC/DC supply	Relative Humidity:	47.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	988.8mbar

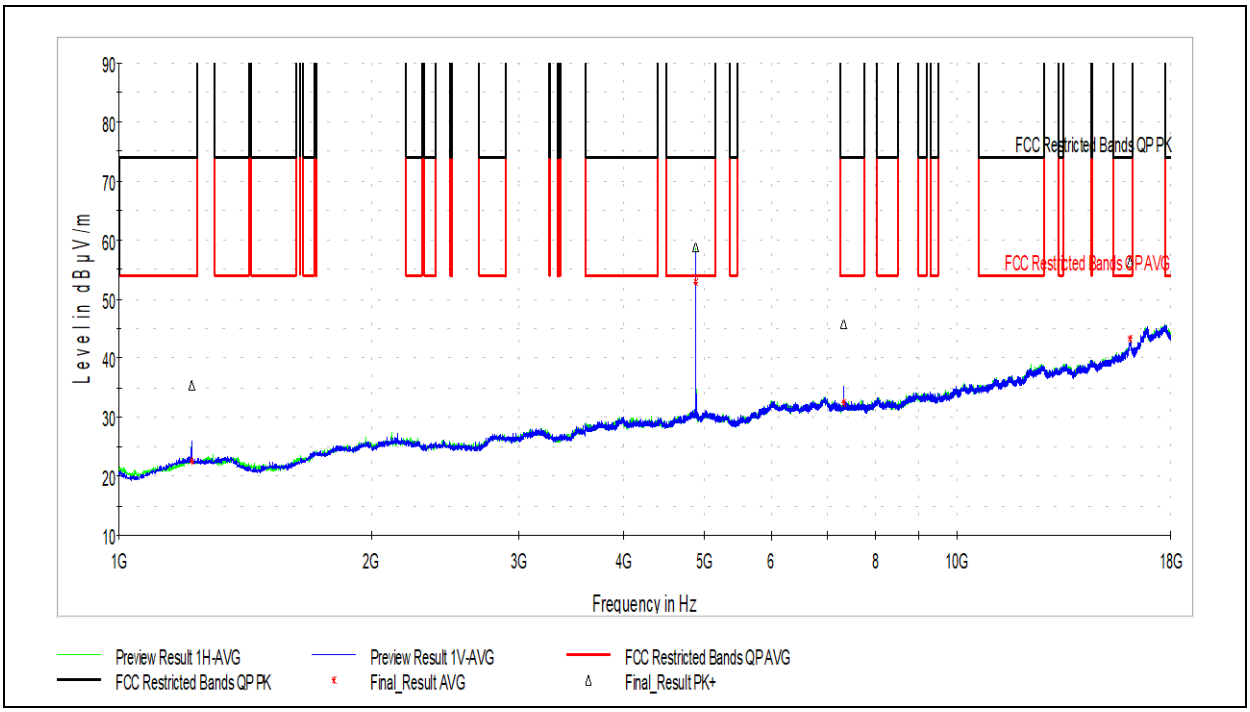
7.7 BLE 2402MHz Spurious Emissions:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.000000	59.58	73.98	14.40	1000.000	143.0	H	290.0	8.2
16096.500000	56.80	73.98	17.18	1000.000	109.0	V	216.0	25.6

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.000000	53.75	53.98	0.23	1000.000	143.0	H	290.0	8.2
16096.500000	43.25	53.98	10.73	1000.000	109.0	V	216.0	25.6

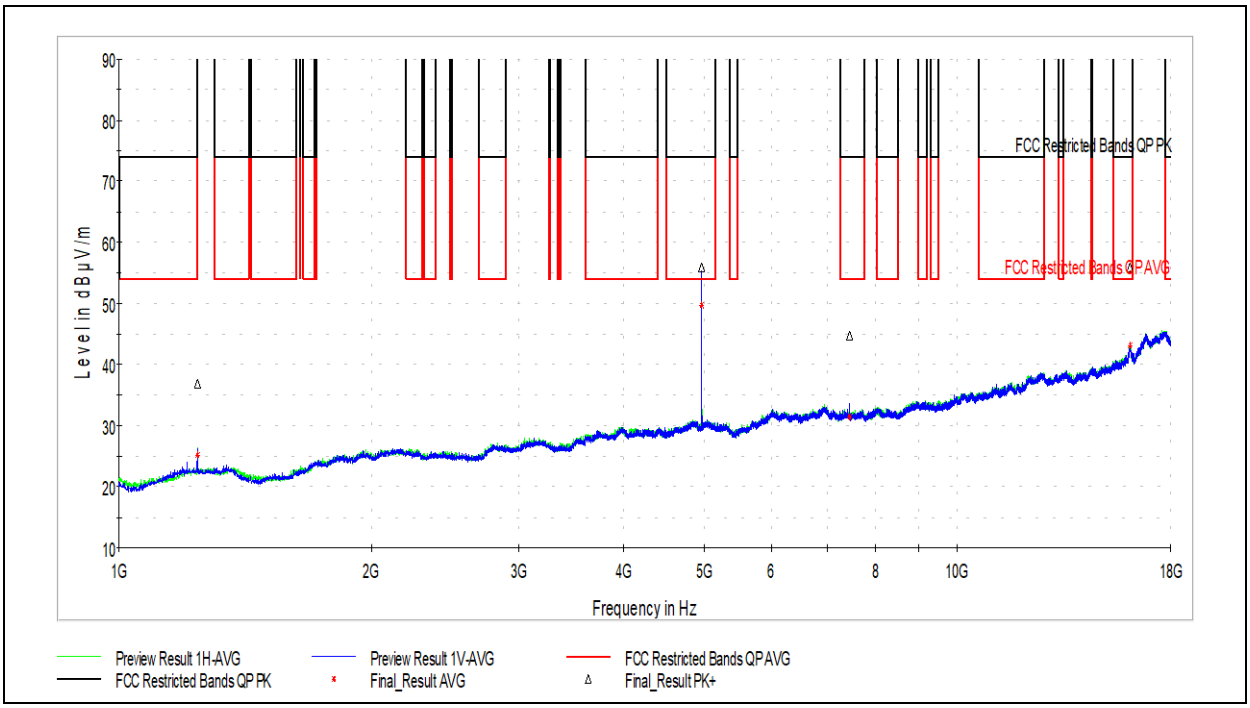
7.8 BLE 2440MHz Spurious Emissions:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1219.500000	35.37	73.98	38.61	1000.000	196.0	H	336.0	-1.4
4880.000000	58.92	73.98	15.06	1000.000	197.0	H	65.0	8.3
7320.000000	45.81	73.98	28.17	1000.000	100.0	V	35.0	11.5
16098.000000	56.31	73.98	17.67	1000.000	100.0	H	123.0	25.6

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1219.500000	22.55	53.98	31.43	1000.000	196.0	H	336.0	-1.4
4880.000000	52.88	53.98	1.10	1000.000	197.0	H	65.0	8.3
7320.000000	32.34	53.98	21.64	1000.000	100.0	V	35.0	11.5
16098.000000	43.30	53.98	10.68	1000.000	100.0	H	123.0	25.6

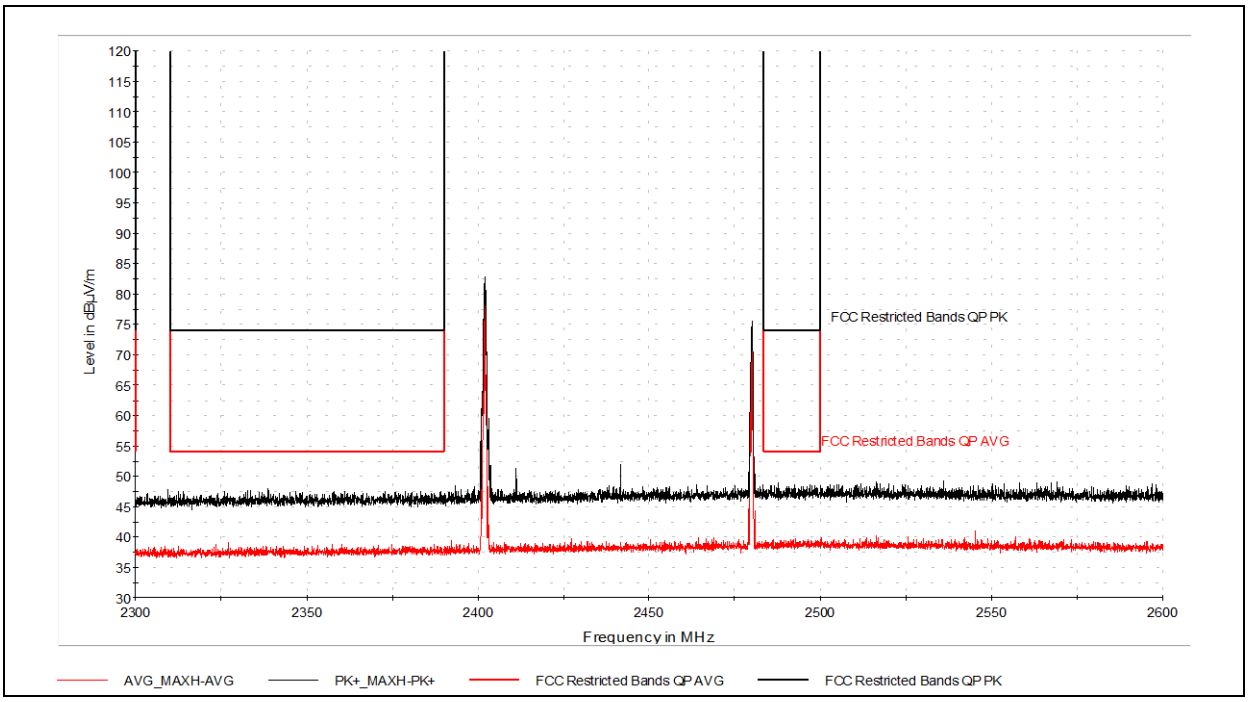
7.9 BLE 2480MHz Spurious Emissions:

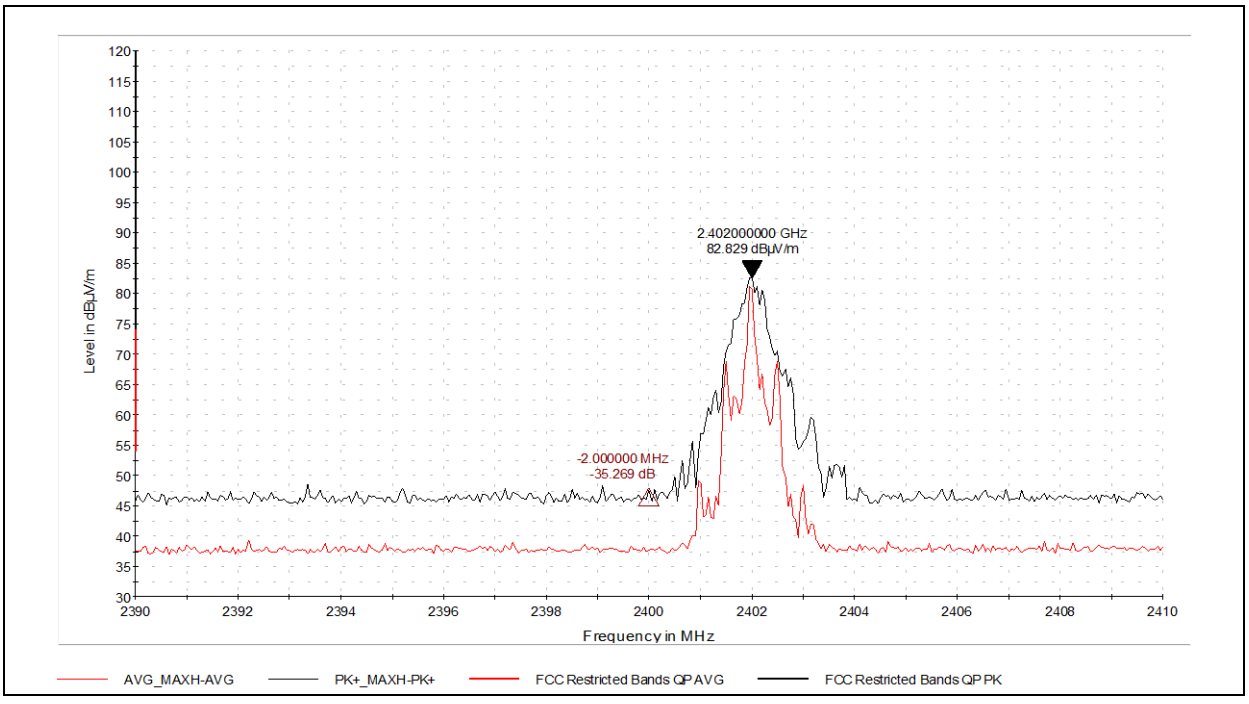


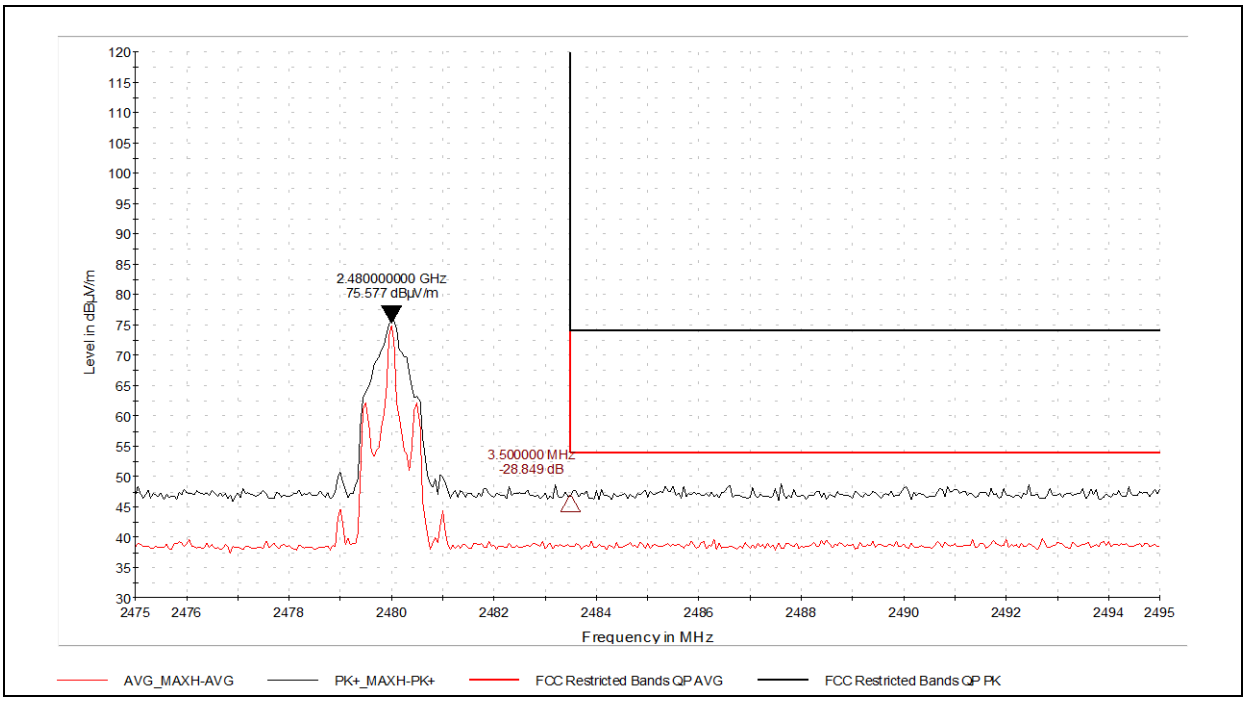
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1240.000000	36.89	73.98	37.09	1000.000	188.0	H	333.0	-0.9
4960.000000	56.02	73.98	17.96	1000.000	132.0	V	319.0	8.1
7440.500000	44.75	73.98	29.23	1000.000	100.0	V	8.0	11.6
16106.500000	56.00	73.98	17.98	1000.000	162.0	V	68.0	25.5

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1240.000000	25.26	53.98	28.72	1000.000	188.0	H	333.0	-0.9
4960.000000	49.67	53.98	4.31	1000.000	132.0	V	319.0	8.1
7440.500000	31.48	53.98	22.50	1000.000	100.0	V	8.0	11.6
16106.500000	43.05	53.98	10.93	1000.000	162.0	V	68.0	25.5

7.10 Emissions at the band edge:

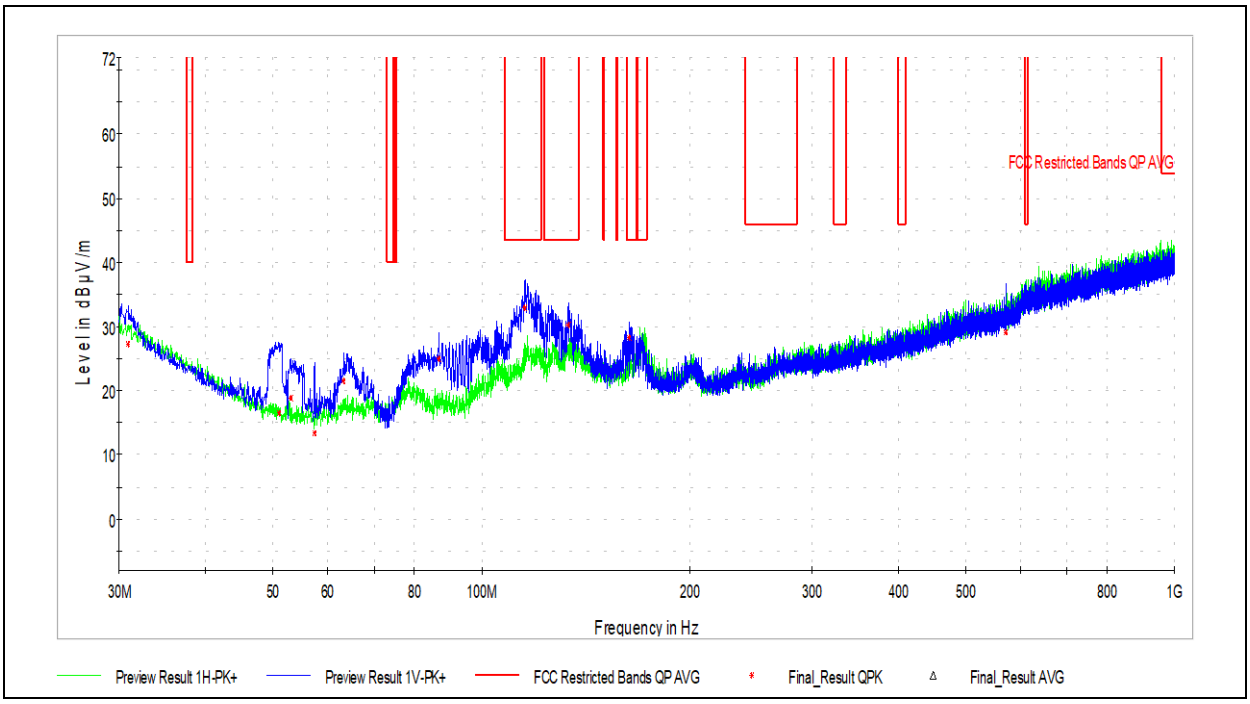






Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2483.5	46.73	74.00	27.27

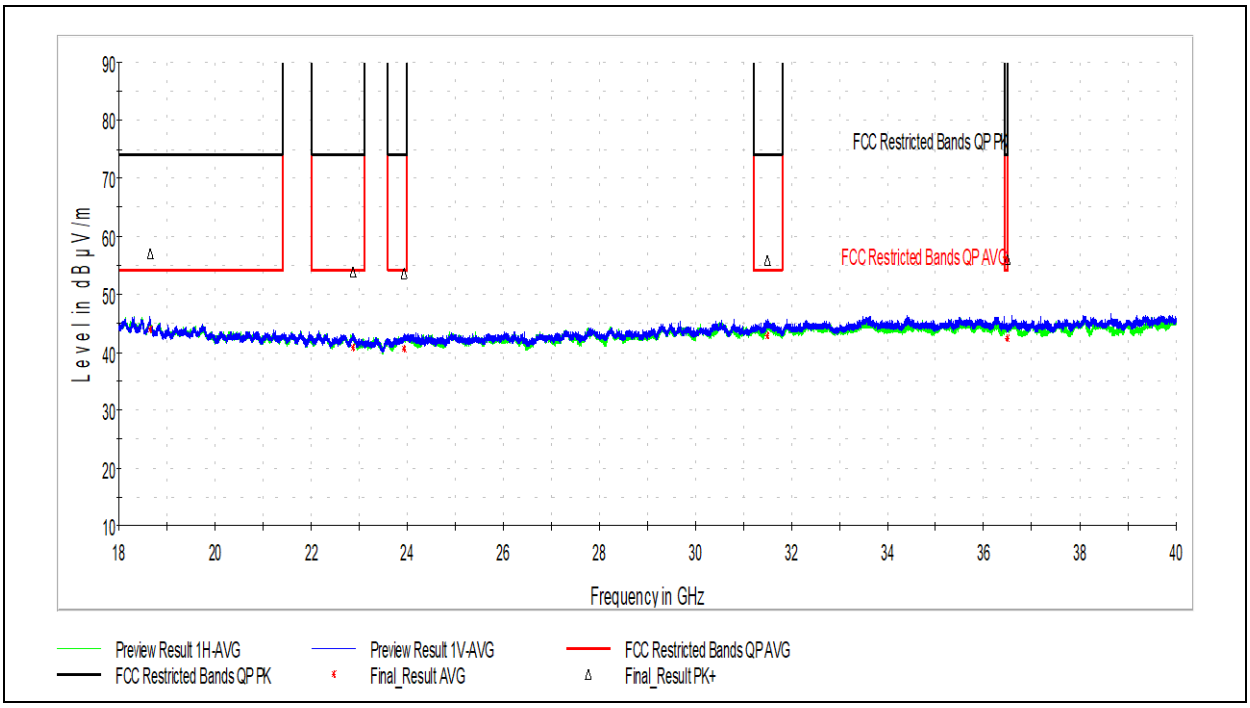
7.11 Spurious Emissions, 30MHz-1GHz:



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
115.521667	32.83	43.52	10.69	120.000	104.9	V	62.0	21.6
133.305000	30.18	43.52	13.34	120.000	100.0	V	111.0	22.4
163.375000	28.20	43.52	15.32	120.000	105.0	V	108.0	21.7

Note: results shown represent the worst case of three channels under test

7.12 Spurious Emissions, 18GHz-40GHz:



Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18645.500000	57.06	73.98	16.92	1000.000	410.0	V	0.0	18.6
22872.000000	53.82	73.98	20.16	1000.000	410.0	V	246.0	6.5
23930.500000	53.56	73.98	20.42	1000.000	410.0	V	112.0	6.1
31502.500000	55.80	73.98	18.18	1000.000	100.0	V	308.0	11.3
36480.000000	56.03	73.98	17.95	1000.000	116.0	V	40.0	11.2

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
18645.500000	43.89	53.98	10.09	1000.000	410.0	V	0.0	18.6
22872.000000	40.86	53.98	13.12	1000.000	410.0	V	246.0	6.5
23930.500000	40.57	53.98	13.41	1000.000	410.0	V	112.0	6.1
31502.500000	42.78	53.98	11.20	1000.000	100.0	V	308.0	11.3
36480.000000	42.43	53.98	11.55	1000.000	116.0	V	40.0	11.2

Note: results shown represent the worst case of three channels under test.

8 Output Power

8.1 Test Limits

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(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 § 11.9.1.1

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.

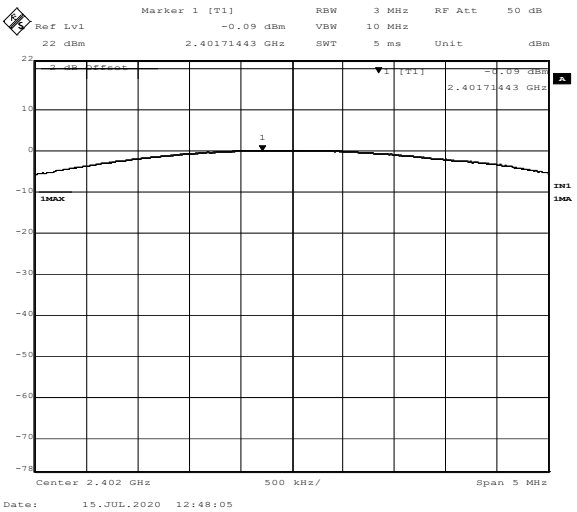
8.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	7/15/2020
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	25.6C
Input Voltage:	120V/60Hz to AC/DC supply	Relative Humidity:	52.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

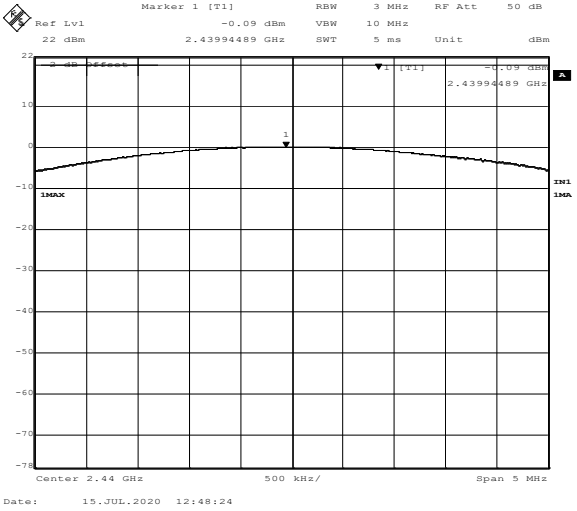
8.6 Test Data

Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	Result
2402	-0.09	30	Pass
2440	-0.09	30	Pass
2480	-0.44	30	Pass

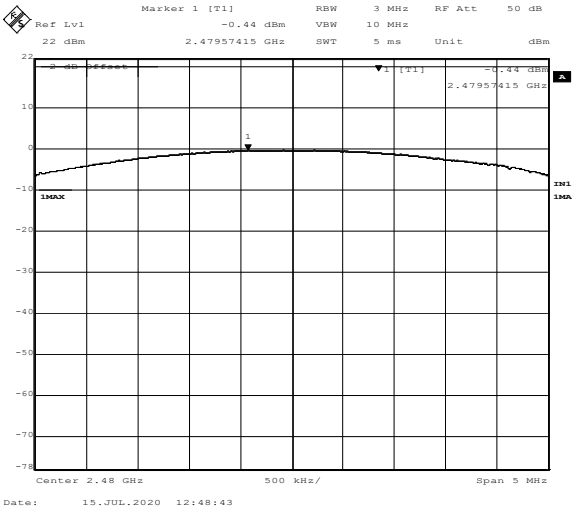
Deviations, Additions, or Exclusions: None



2402MHz Output Power



2440MHz Output Power



2480MHz Output Power

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 § 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
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	10/5/2020	10/5/2021

9.4 Test Results

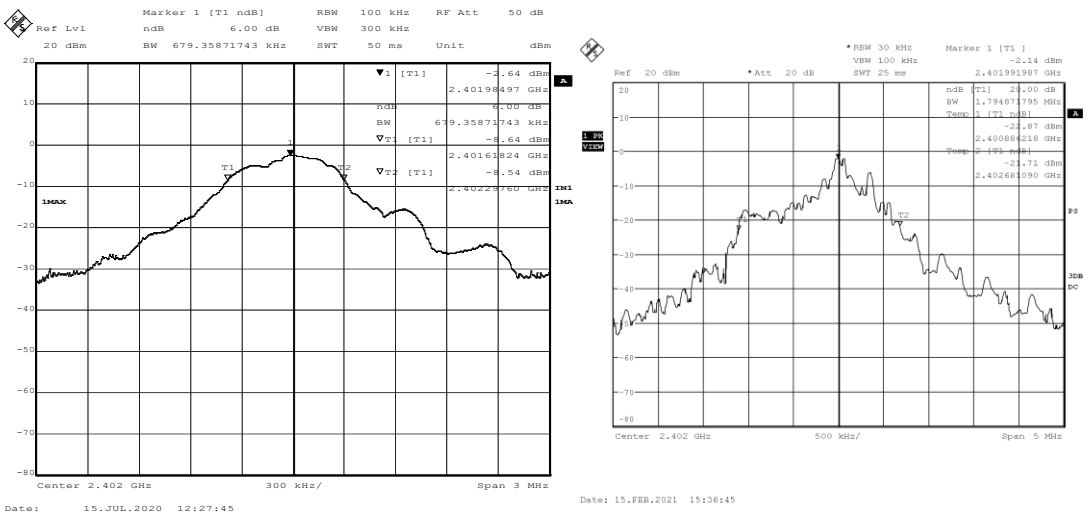
The device was found to be **compliant**. The 6dB bandwidth was at least 500kHz.

9.5 Test Conditions

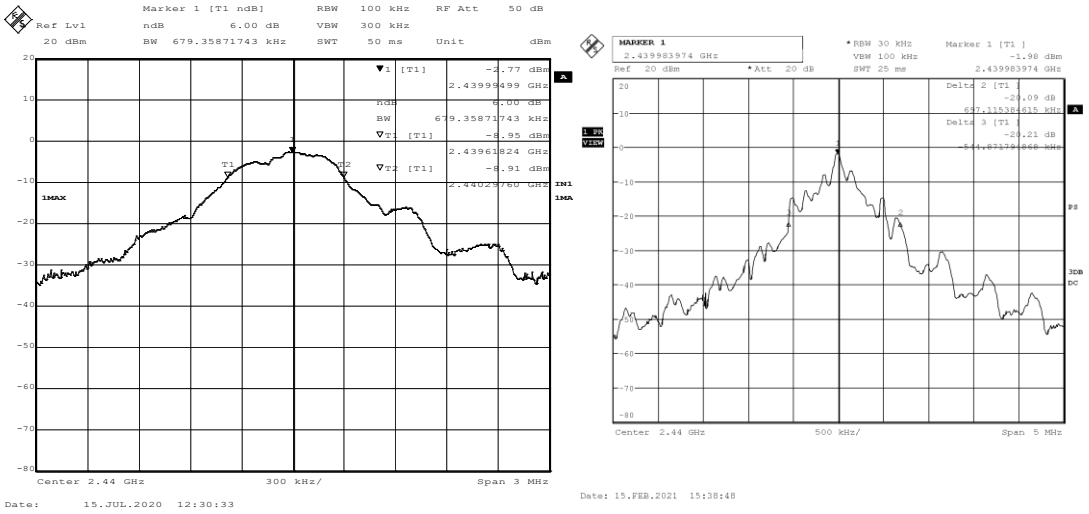
Test Personnel:	Brian Lackey	Test Date:	7/15/2020, 2/15/2021
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 RSS-247 Issue 2	Ambient Temperature:	25.6C
Input Voltage:	120V/60Hz to AC/DC supply	Relative Humidity:	52.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

9.6 Test Data

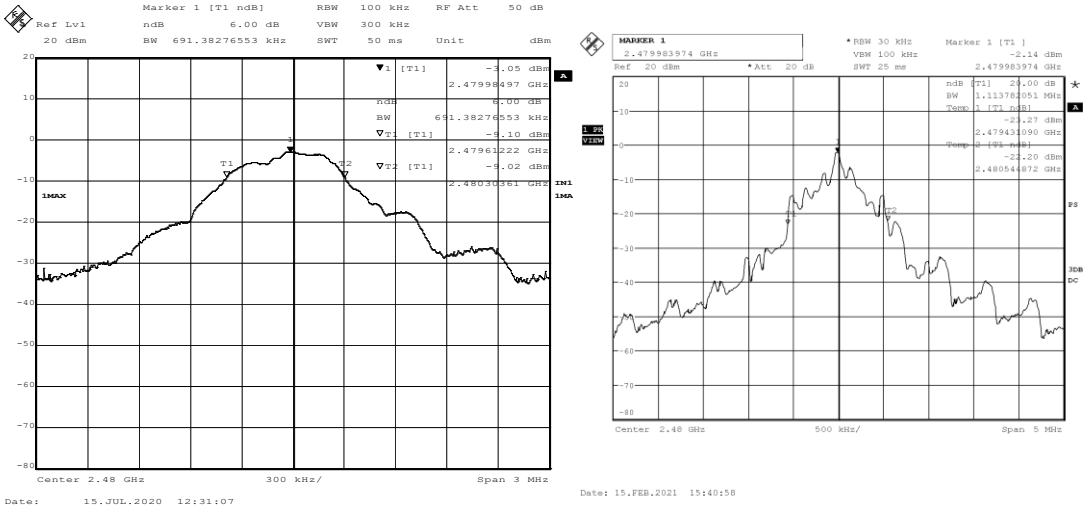
Frequency (MHz)	6dB BW (kHz)	20dB BW (kHz)	99% BW (kHz)
2402	679.4	1795	1787
2440	679.4	1242	1258
2480	691.4	1114	1186



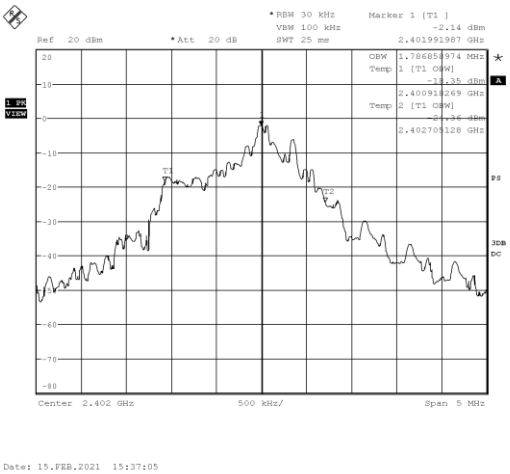
2402MHz 6dB BW (left) and 20dB BW (right)



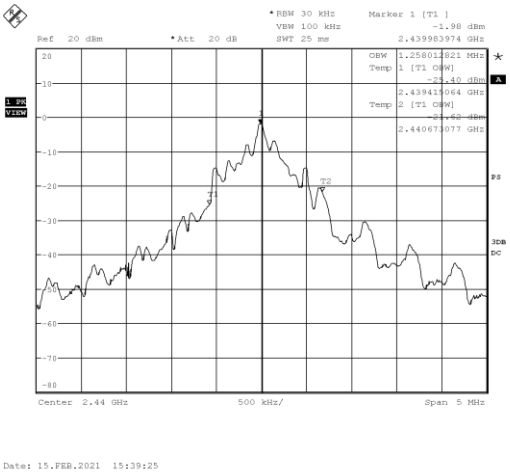
2440MHz 6dB BW (left) and 20dB BW (right)



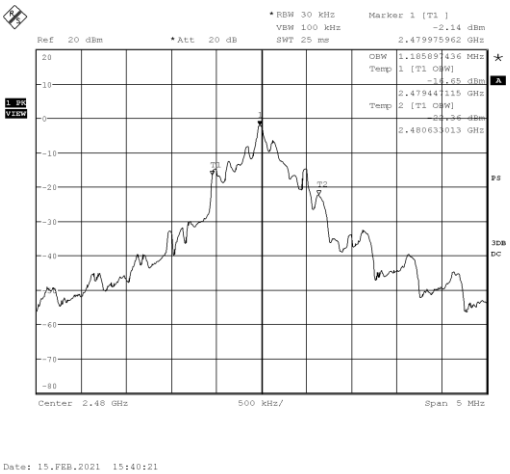
2480MHz 6dB BW (left) and 20dB BW (right)



2402MHz 99% BW



2440MHz 99% BW



2480MHz 99% BW

Deviations, Additions, or Exclusions: None

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.

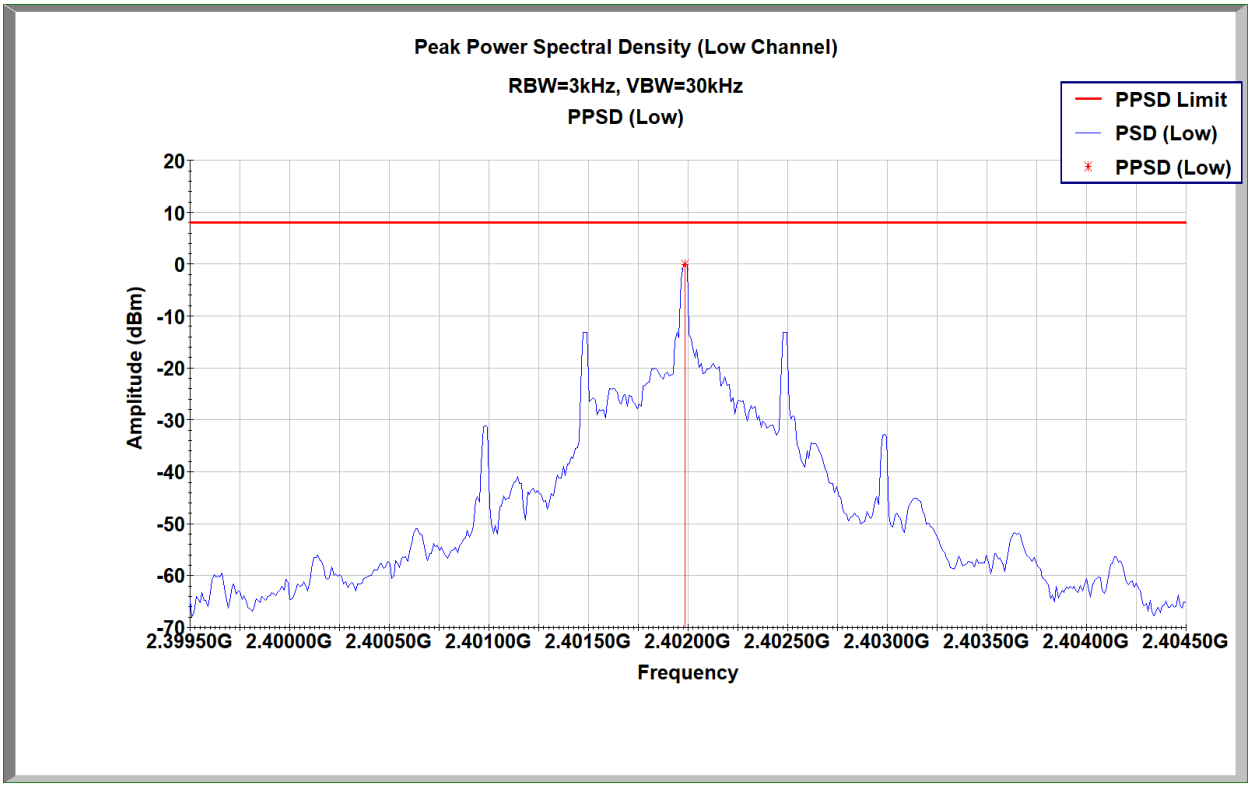
10.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	7/15/2020
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 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

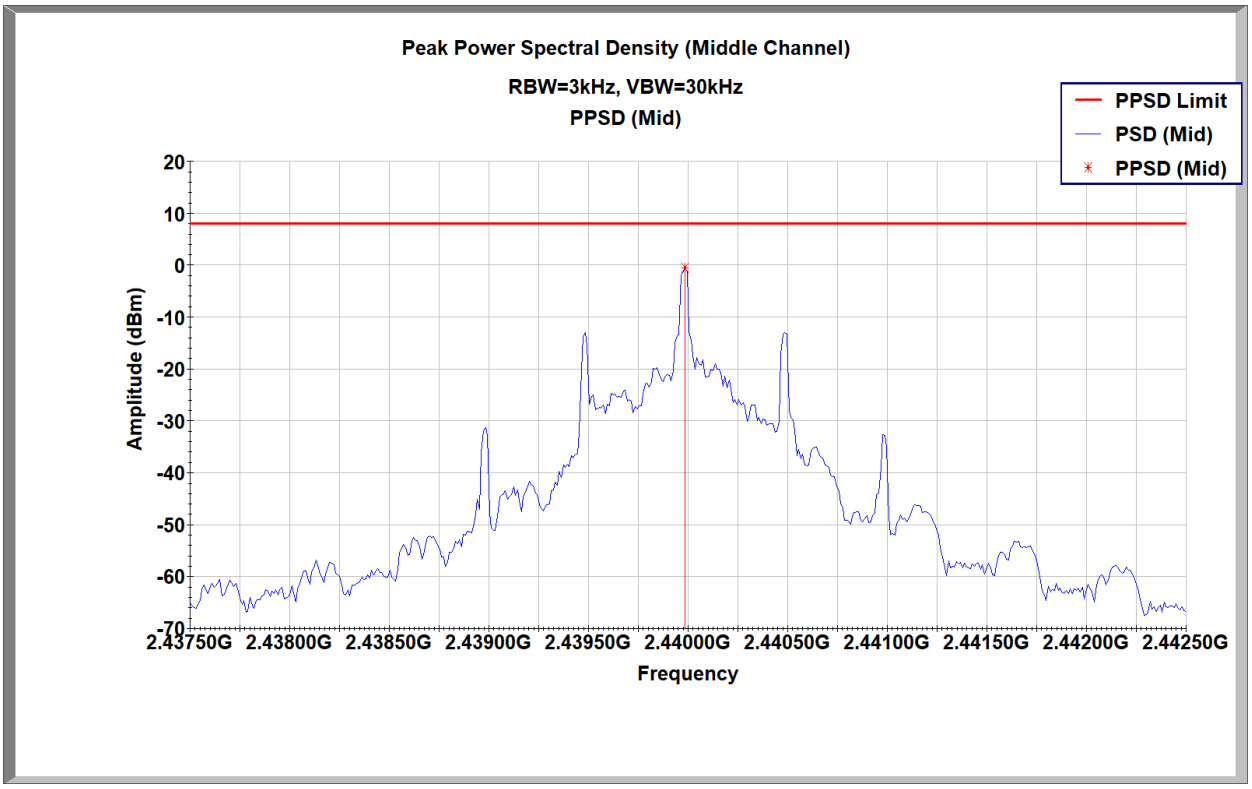
10.6 Test Data

Frequency (MHz)	RBW (kHz)	PPSD (dBm)	Limit (dBm EIRP)	Result
2402	3	-0.115	8	Pass
2440	3	-0.603	8	Pass
2480	3	-0.657	8	Pass

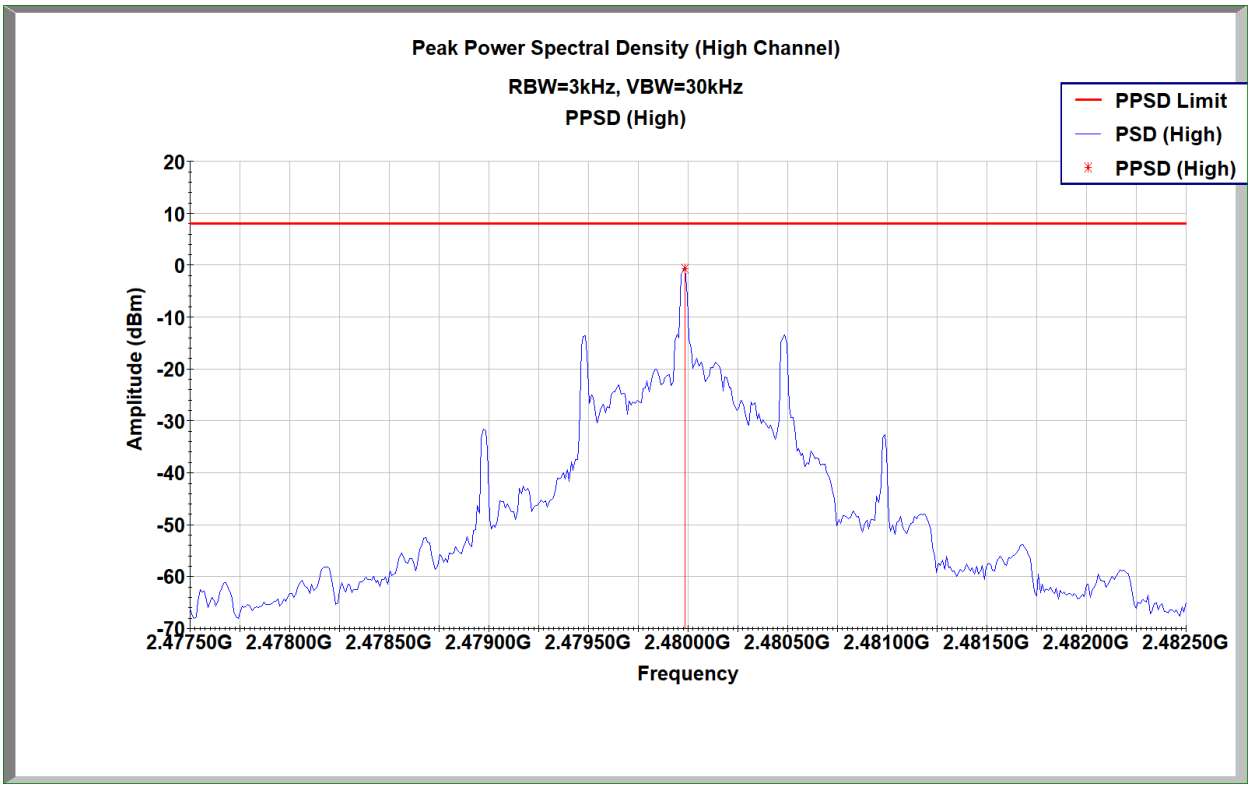
Deviations, Additions, or Exclusions: None.



2402MHz PPSD



2440MHz PPSD



2480MHz PPSD

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 § 11.11 Emissions in nonrestricted frequency bands.

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

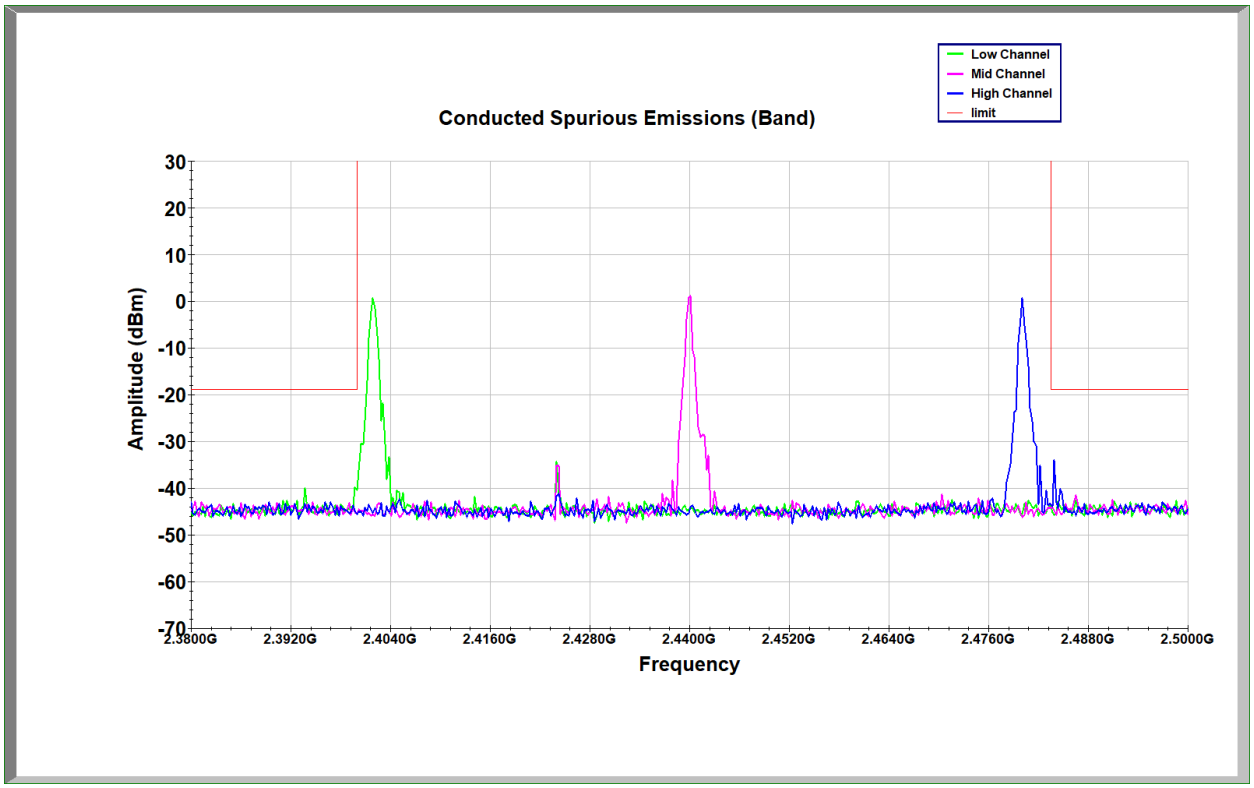
11.4 Test Results

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

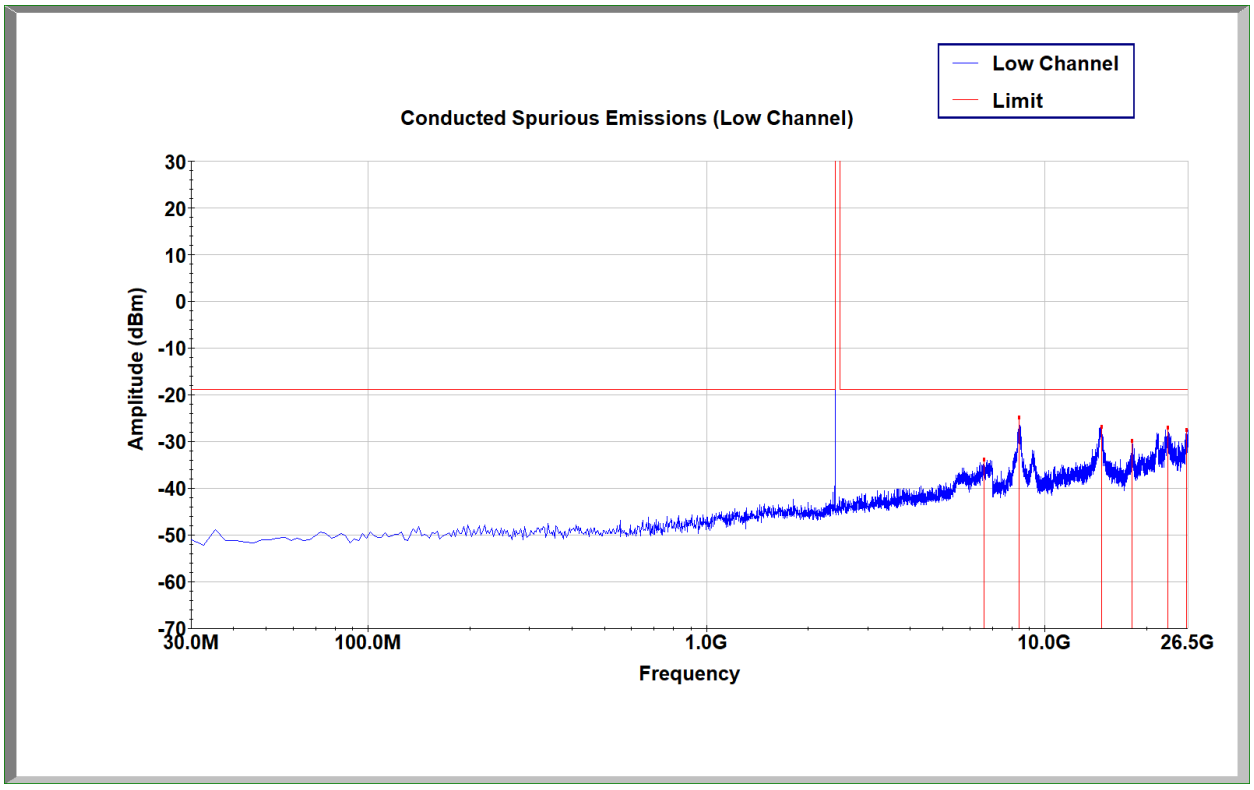
11.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	7/15/2020
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	See Above
Product Standard:	FCC Part 15.247 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

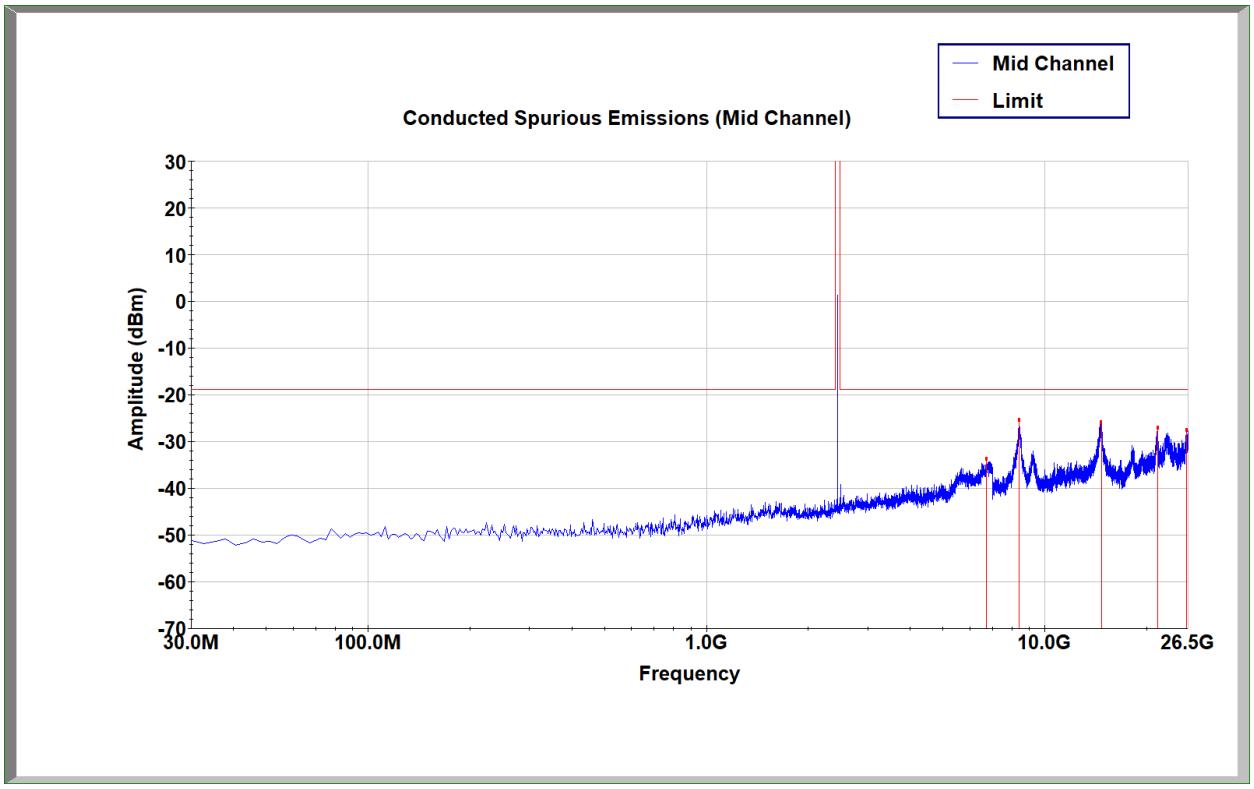
11.6 Test Data



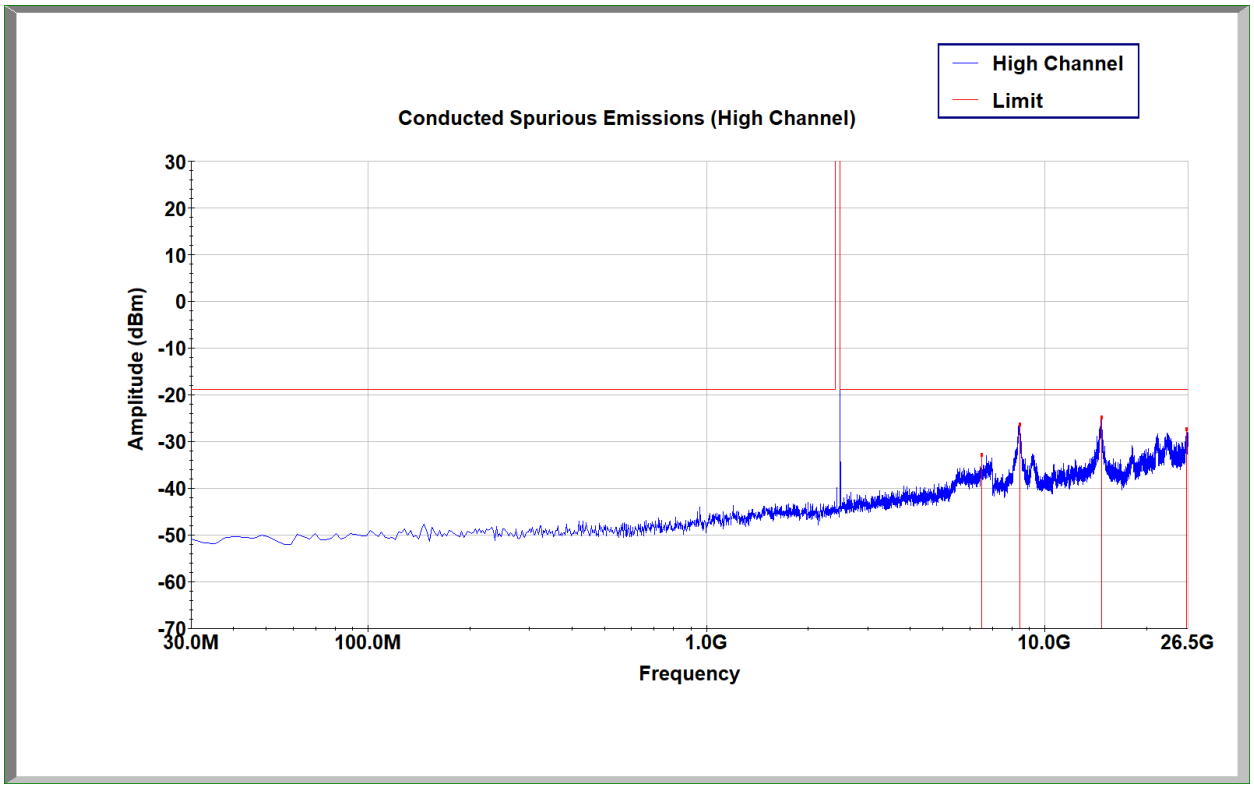
Conducted Spurious Emissions (Band)



2402MHz Conducted Spurious Emissions



2440MHz Conducted Spurious Emissions



2480MHz Conducted Spurious Emissions

12 Antenna Requirement

12.1 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).

12.2 Test Results

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

13 Conducted Emissions

13.1 Method

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

TEST SITE: Ground Plane

Site Designation: Ground Plane

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Power Line Conducted Emissions	150 kHz - 30 MHz	3.1dB	3.4dB
Telco Port Emissions	150 kHz - 30 MHz	3.2dB	5.0dB

As shown in the table above our conducted 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, based on CISPR 32 and CISPR 11 (for 2006 and later revisions) Clause 9.

Sample Calculations

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN or ISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(49.1\ dB\mu V / 20)}$ = 285.1 μV/m

13.2 Test Equipment Used:

Description	Asset Number	Manufacturer	Model	Calibration Date	Calibration Due Date
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/30/2019	9/30/2020
LISN	3333	Teseq	NNB52	4/29/2020	4/29/2021
Coaxial Cable	8066			12/6/2019	12/6/2020

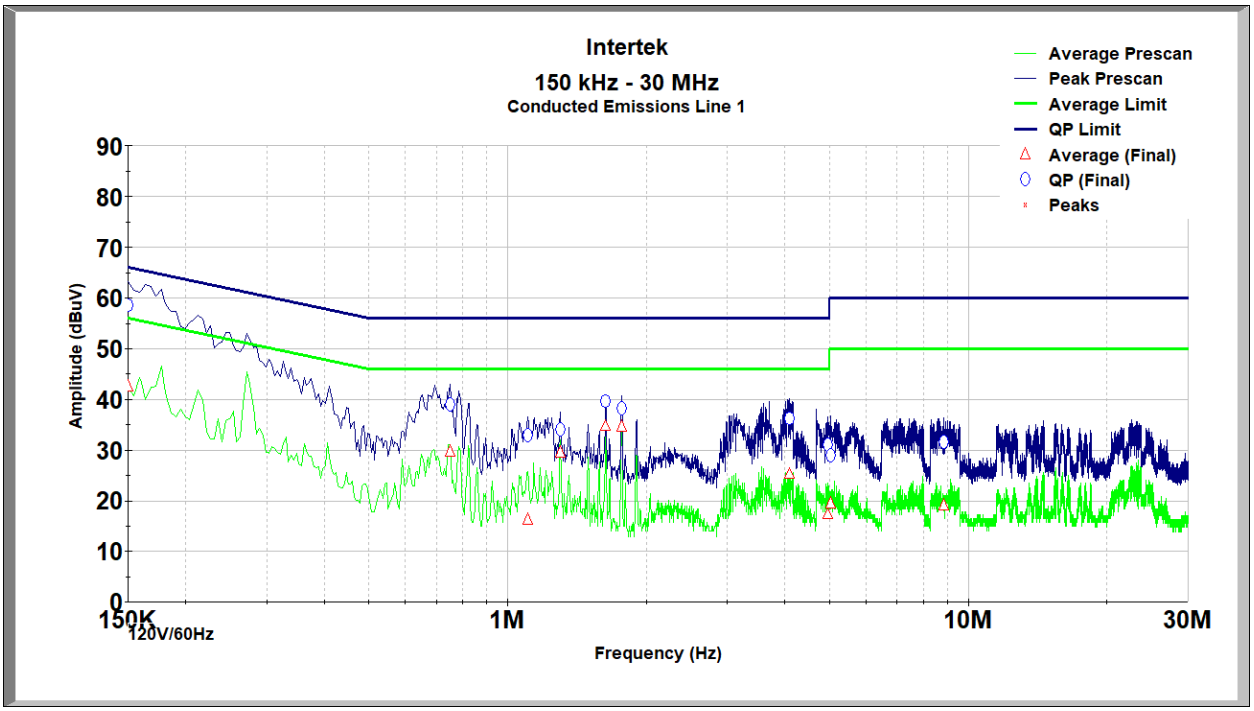
13.3 Software Utilized:

Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

13.4 Results:

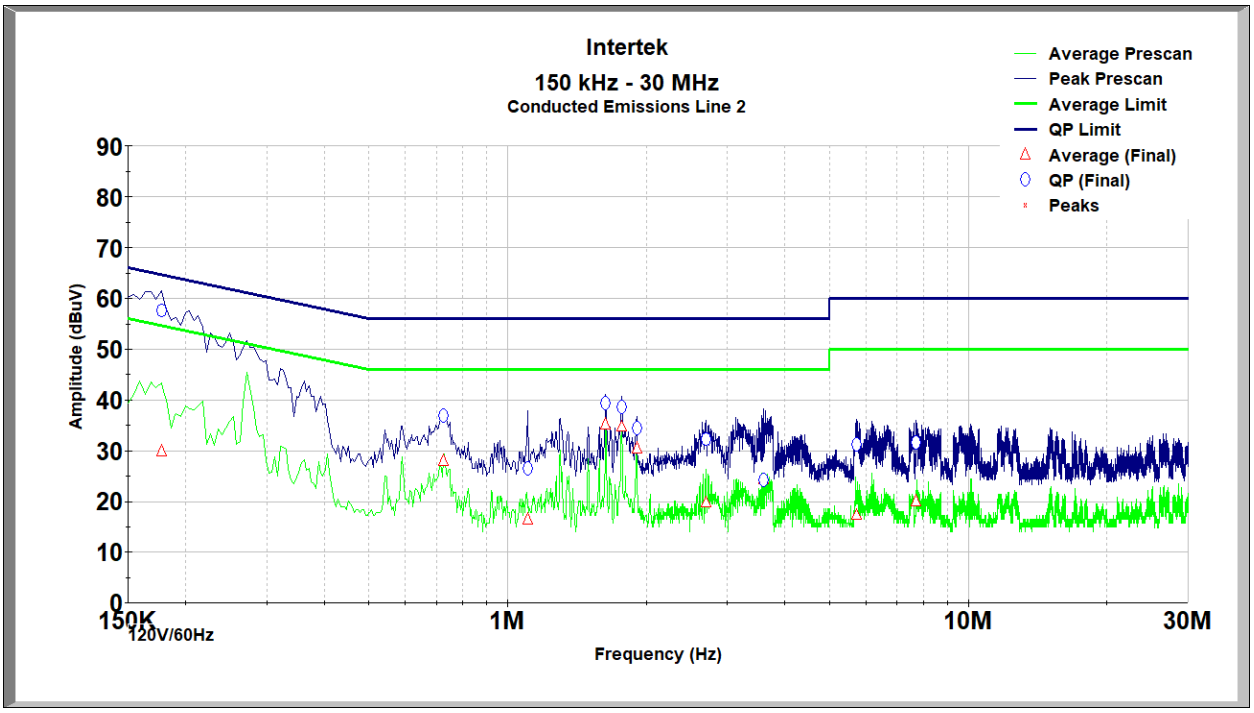
The sample tested was found to Comply.

13.5 Test Data



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.150	58.763	66.000	7.237	42.520	56.000	13.480
0.749	38.929	56.000	17.071	29.670	46.000	16.330
1.104	32.963	56.000	23.037	16.356	46.000	29.644
1.302	34.091	56.000	21.909	29.516	46.000	16.484
1.631	39.771	56.000	16.229	34.888	46.000	11.112
1.766	38.198	56.000	17.802	34.719	46.000	11.281
4.083	36.442	56.000	19.558	25.377	46.000	20.623
4.942	31.054	56.000	24.946	17.455	46.000	28.545
5.024	28.911	60.000	31.089	19.571	50.000	30.429
8.845	31.591	60.000	28.409	19.060	50.000	30.940



Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.177	57.760	65.229	7.469	30.004	55.229	25.224
0.726	36.874	56.000	19.126	28.036	46.000	17.964
1.104	26.536	56.000	29.464	16.516	46.000	29.484
1.631	39.457	56.000	16.543	35.264	46.000	10.736
1.766	38.588	56.000	17.412	34.737	46.000	11.263
1.905	34.505	56.000	21.495	30.537	46.000	15.463
2.692	32.345	56.000	23.655	19.859	46.000	26.141
3.588	24.210	56.000	31.790	24.474	46.000	21.526
5.721	31.229	60.000	28.771	17.485	50.000	32.515
7.702	31.631	60.000	28.369	20.004	50.000	29.996

Test Personnel:	Brian Lackey	Test Date:	7/15/2020
Supervising/Reviewing Engineer: (Where Applicable)	NA	Limit Applied:	FCC Part 15.207 / FCC Part 15.107 Class B
Product Standard:	FCC Part 15B ICES-003 Issue 6	Ambient Temperature:	25.6C
Input Voltage:	120V/60Hz to AC/DC supply	Relative Humidity:	52.2%
Pretest Verification w / Ambient Signals or BB Source:	Yes	Atmospheric Pressure:	985.4mbar

Deviations, Additions, or Exclusions: None

14 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	7/31/2020	104364418LEX-001	BL	BCT	Original Issue
1	2/15/2021	104364418LEX-001.1	BL	BCT	Updated bandwidth plots and added power plots
2	2/16/2021	104364418LEX-001.2	BL	BCT	Updated antenna gain