Diehl Metering GmbH
TEST REPORT

SCOPE OF WORK
FCC PART 15C / RSS-247 ISSUE 2 - IZAR OH BT 2

REPORT NUMBER
103477146LEX-002.1

ISSUE DATE	**[REVISED DATE]**
6/5/2018	6/5/2018

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

BLUETOOTH TEST REPORT

Report Number:	**103477146LEX-002.1**
Project Number:	**G103477146**
Report Issue Date:	**6/5/2018**
Product Name:	**IZAR OH BT 2**
Standards:	**Title 47 CFR Part 15 Subpart C** **RSS-247 Issue 2**

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

Client:
Diehl Metering GmbH
Industriestr. 13
91522 Ansbach
Germany

Report prepared by

Brian Lackey, Project Engineer

Report reviewed by

Bryan Taylor, Team Leader

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1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. 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 complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1 and ANSI C63.4. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters. The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2042M-1.

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
7	Peak Output Power	§ 15.247(b)(1)	RSS-247 § 5.4(b)	Pass
9	Occupied Bandwidth	§ 15.247(a)(1)	RSS-247 § 5.2(a)	Pass
14	Number of Hopping Channels	§ 15.247(a)(1)(iii)	RSS-247 § 5.1(d)	Pass
16	Channel Separation	§ 15.247(a)(1)	RSS-247 § 5.1(b)	Pass
18	Time of Occupancy	§ 15.247(a)(1)(iii)	RSS-247 § 5.1(d)	Pass
20	Conducted Spurious Emissions	§ 15.247(d)	RSS-Gen § 7.1.3	Pass
25	Power Spectral Density	§ 15.247(e)	RSS-247 § 5.2(b)	Pass
30	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-247 § 5.5	Pass
47	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen § 7.1.2	Pass
51	AC Mains Conducted Emissions	§ 15.107, § 15.207	RSS-Gen § 8.8	Pass
59	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen § 8.3	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Diehl Metering GmbH
Model Number	3094452
Serial Number	00802543B240
Receive Date	5/14/2018
Test Start Date	5/14/2018
Test End Date	5/25/2018
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2402 – 2480MHz
Mode(s) of Operation	Bluetooth BDR and EDR
Modulation Type	FHSS
Transmission Control	Test Commands
Maximum Output Power	1.21mW
Maximum Antenna Gain[1]	0.9 dBi
Test Channels	0 (2402MHz), 39 (2440MHz), 79 (2480MHz)
Antenna Type (15.203)	Internal
Operating Voltage	Battery

Description of Equipment Under Test
The IZAR OPTO HEAD BT 2 (IZAR OH BT 2) is an optical reading head that can be connected to static or mobile computers via a Bluetooth interface. Laptops or PCs can be retrofitted with this interface if necessary using a Bluetooth USB adapter. The optical interface offers the two standards IrDA and ZVEI, which means all Diehl Metering Group meters with an optical interface can be read and configured. The IZAR OH BT 2 is switched between ZVEI and IrDA by Diehl Metering programs either automatically or must be set in the software according to the interface of the meter to be read. The IZAR OH BT 2 is equipped with a lithium ion battery for approx. 14 hours of continuous operation. Charging a completely flat battery takes about 3.5 hours. The operating statuses are indicated by four coloured LEDs. An on/off switch is built into the device for easy operation. The IZAR OH BT also has a metal ring to fasten a carrying strap.

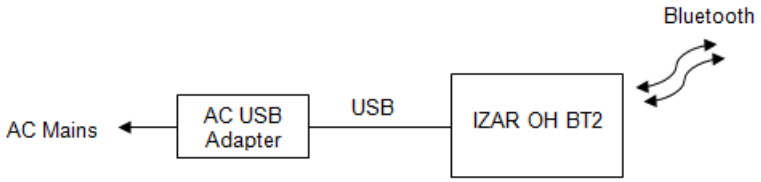
Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting Bluetooth BDR signal on low (2402), middle (2440), or high (2480) channel
2	Transmitting Bluetooth BDR in hopping mode
3	Transmitting Bluetooth EDR signal on low (2402), middle (2440), or high (2480) channel
4	Transmitting Bluetooth EDR in hopping mode
5	Receive / idle mode

[1] From antenna datasheet

4 System setup including cable interconnection details, support equipment and simplified block diagram

4.1 EUT Block Diagram:



4.2 Cables:

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	USB A-micro B	1	No	No	USB

4.3 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
AC Power Adapter	Phihong	PSM03A-050Q-3	PH12047385

5 Peak Output Power

5.1 Test Limits

§ 15.247(b): The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(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.

5.2 Test Procedure

ANSI C63.10: 2013. The peak output power was measured using a wideband power sensor in burst average mode.

5.3 Test Equipment Used

Description	Asset Number	Manufacturer	Model	Cal. Date	Cal. Due
Wideband Power Sensor	4022	Rohde & Schwarz	NRP-Z81	9/20/2017	9/20/2018

5.4 Test Results

The device was found to be **compliant**. The output power was less than the limit.

5.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	120V/60Hz to 5V USB	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

5.6 Test Data

Mode	Channel	Frequency (MHz)	Output Power (mW)	Limit (mW)	Pass / Fail
BDR	0	2402	1.21	125	Pass
BDR	39	2440	1.20	125	Pass
BDR	79	2480	1.16	125	Pass
EDR	0	2402	0.664	125	Pass
EDR	39	2440	0.637	125	Pass
EDR	79	2480	0.581	125	Pass

6 Occupied Bandwidth

6.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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.

6.2 Test Procedure

ANSI C63.10: 2013.

6.3 Test Equipment Used

Description	Asset Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/20/2017	9/20/2018

6.4 Test Results

The 20dB bandwidth measurements are shown below. A 99% bandwidth measurement was also performed.

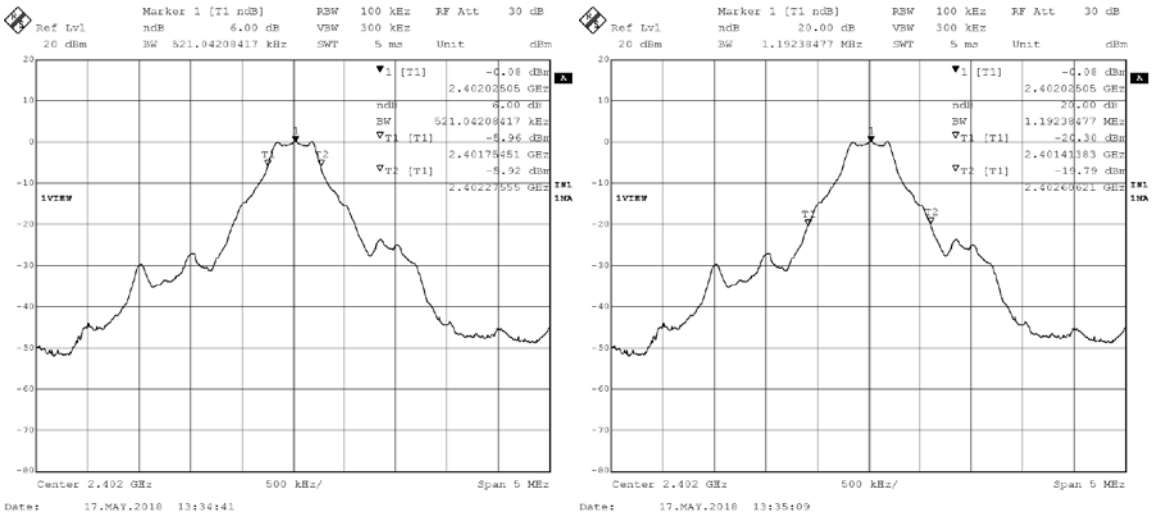
Mode	Channel	Frequency (MHz)	6dB Bandwidth (MHz)	20dB Bandwidth (MHz)	99% Power Bandwidth (MHz)
BDR	0	2402	0.521	1.192	1.082
BDR	39	2440	0.521	1.172	1.052
BDR	79	2480	0.521	1.162	1.032
EDR	0	2402	0.902	1.393	1.222
EDR	39	2440	0.912	1.393	1.222
EDR	79	2480	0.891	1.403	1.222

6.5 Test Conditions

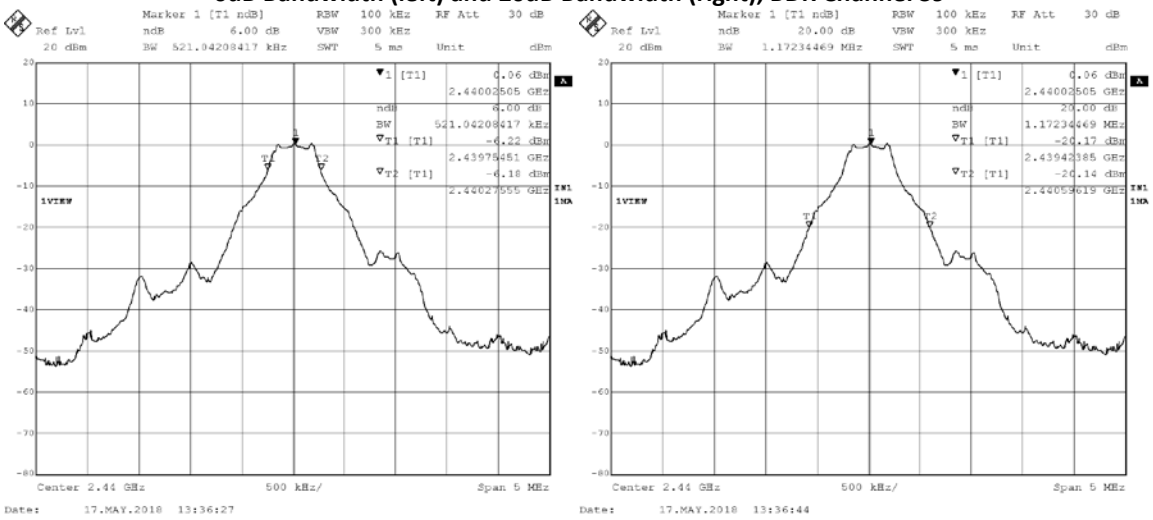
Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	Battery	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

6.6 Test Data

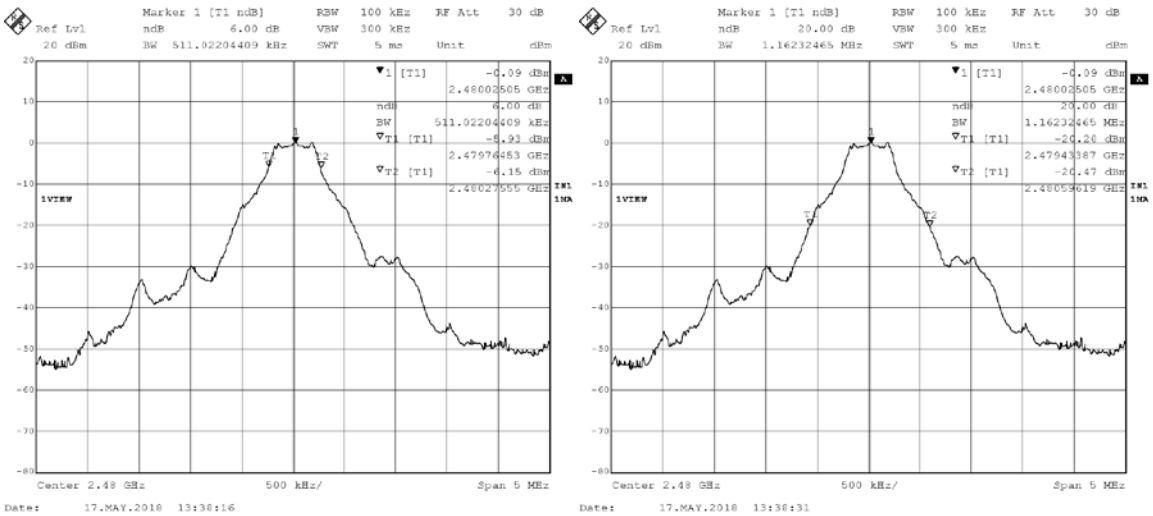
6dB Bandwidth (left) and 20dB Bandwidth (right), BDR Channel 0



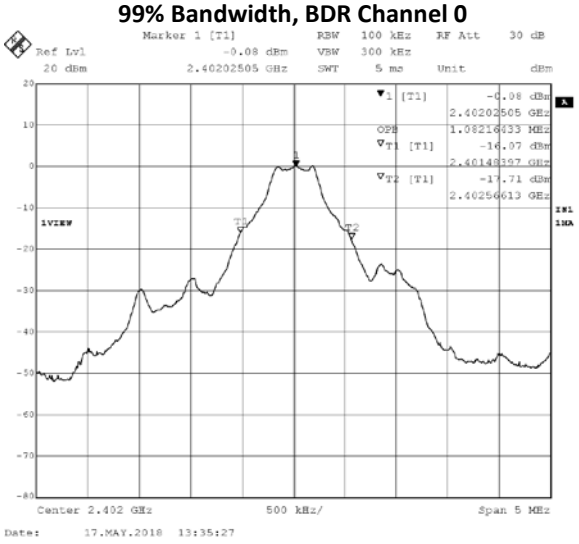
6dB Bandwidth (left) and 20dB Bandwidth (right), BDR Channel 39



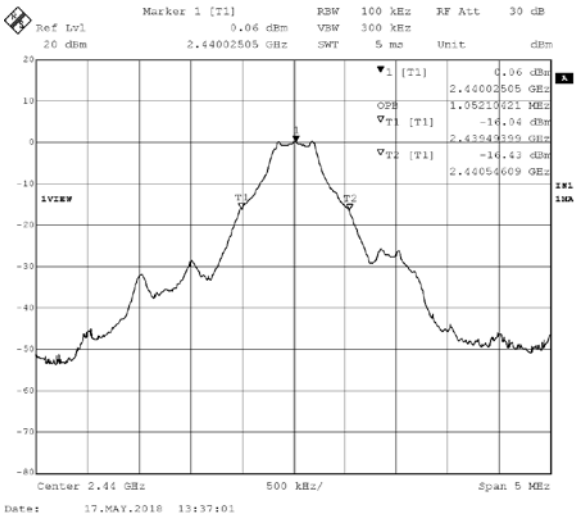
6dB Bandwidth (left) and 20dB Bandwidth (right), BDR Channel 79



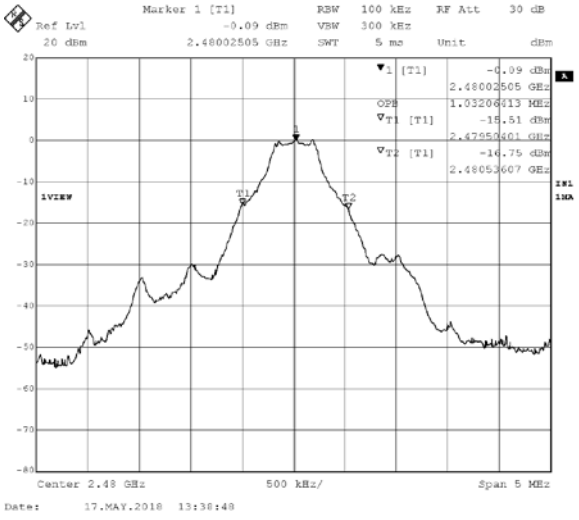
99% Bandwidth, BDR Channel 0



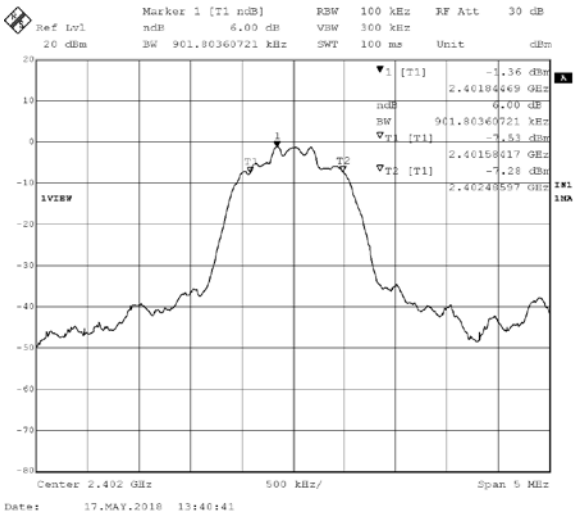
99% Bandwidth, BDR Channel 39

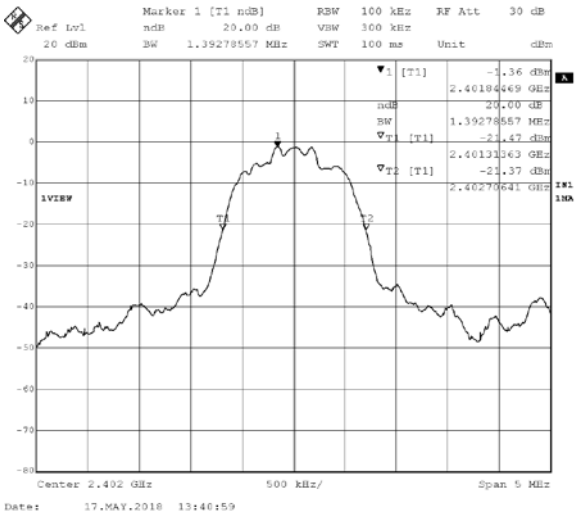


99% Bandwidth, BDR Channel 79

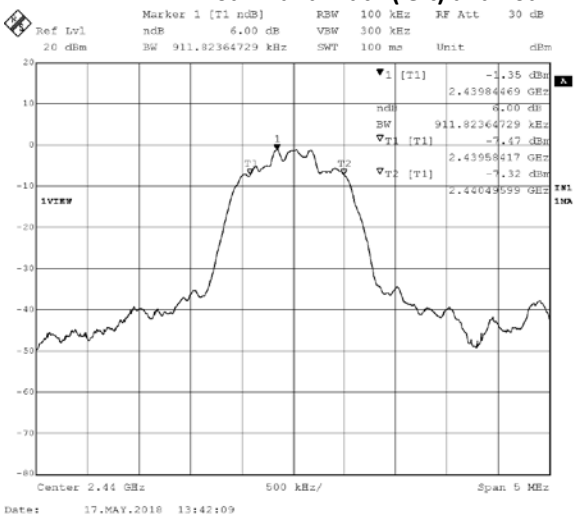


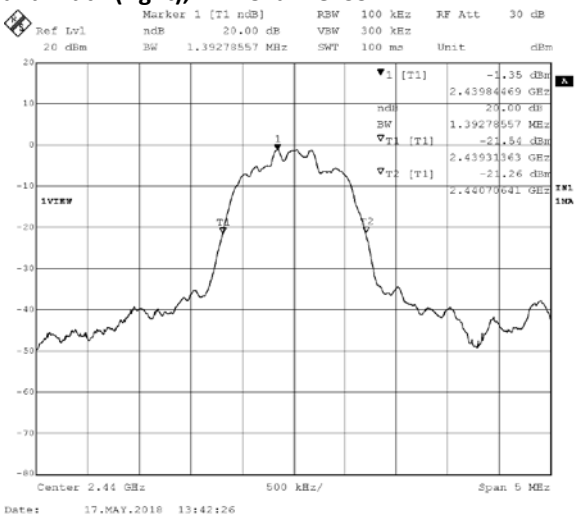
6dB Bandwidth (left) and 20dB Bandwidth (right), EDR Channel 0



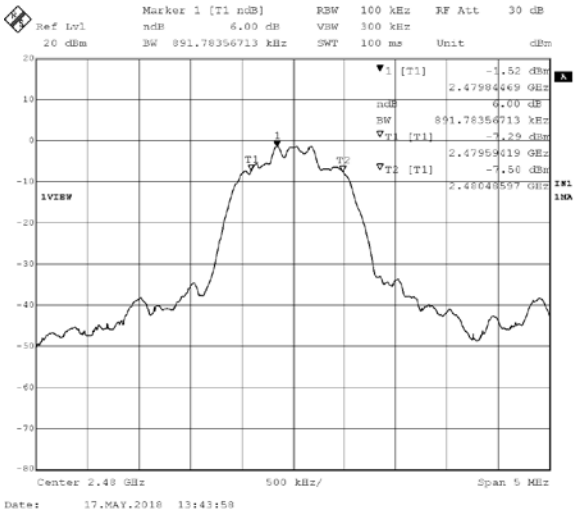


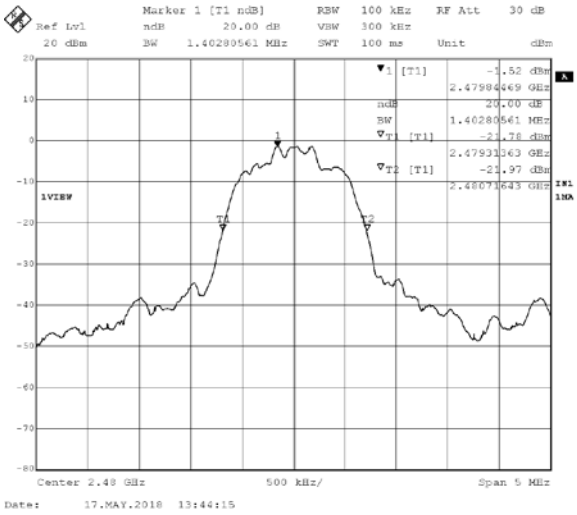
6dB Bandwidth (left) and 20dB Bandwidth (right), EDR Channel 39



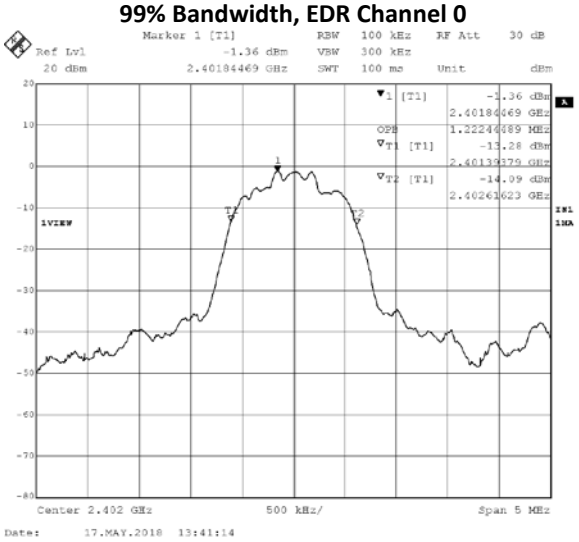


6dB Bandwidth (left) and 20dB Bandwidth (right), EDR Channel 79

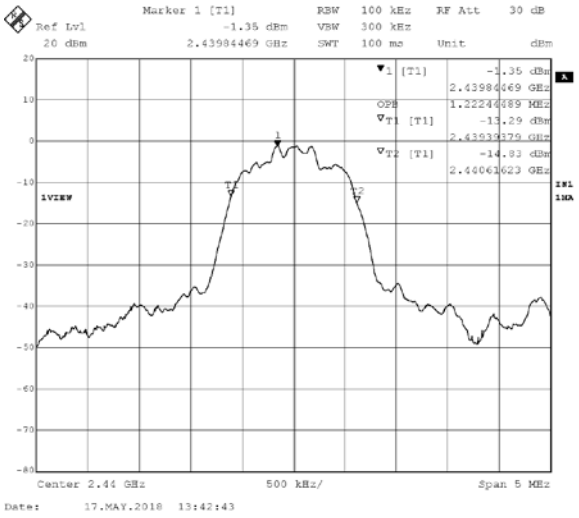




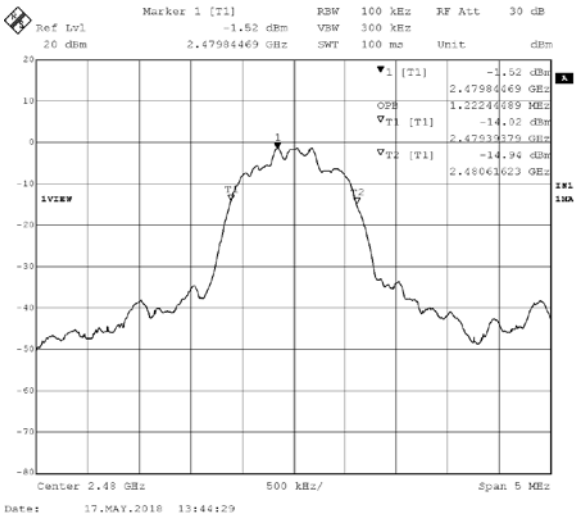
99% Bandwidth, EDR Channel 0



99% Bandwidth, EDR Channel 39



99% Bandwidth, EDR Channel 79



7 Number of Hopping Channels

7.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(1)(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

7.2 Test Procedure

ANSI C63.10: 2013 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

7.3 Test Equipment Used:

Description	Asset Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/20/2017	9/20/2018

7.4 Test Results

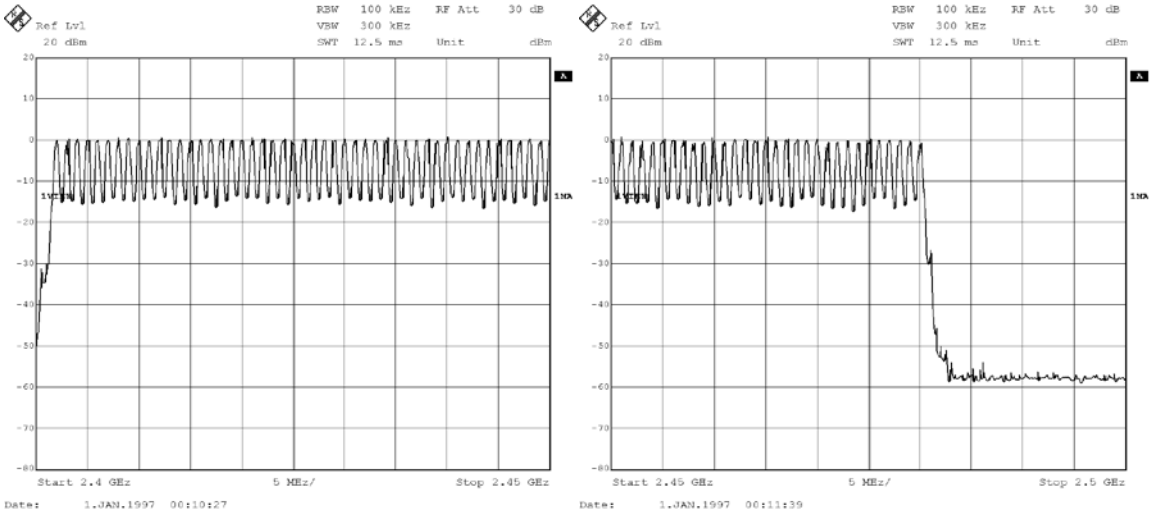
The device was found to be **compliant**. The device used 79 hopping channels in each mode.

7.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	Battery	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

7.6 Test Data

BDR and EDR Mode hopping channels – 48 channels (left) and 31 channels (right) for a total of 79 channels



8 Channel Separation

8.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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.

8.2 Test Procedure

ANSI C63.10: 2013 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

8.3 Test Equipment Used:

Description	Asset Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/20/2017	9/20/2018

8.4 Test Results

The device was found to be **compliant**. The channel separation was measured to be 1MHz.

8.5 Test Conditions

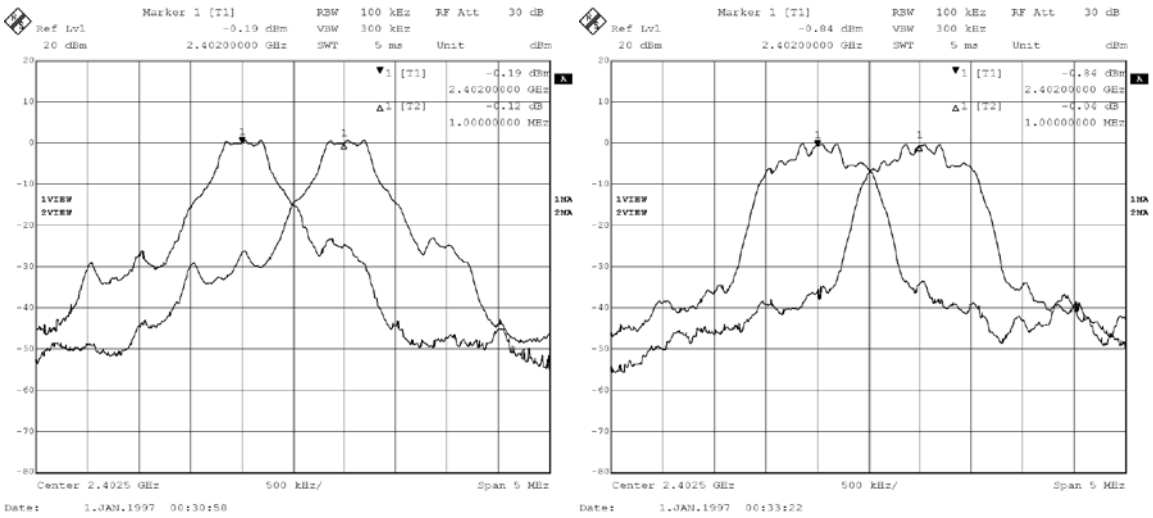
Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	Battery	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

8.6 Test Data

Mode	Channel	Frequency (MHz)	Adjacent Channel Separation (kHz)	Minimum Limit (kHz)*	Result
BDR	0	2402	1000	795	Pass
EDR	0	2402	1000	929	Pass

* Limit derived from 2/3 of measured 20dB bandwidth

Adjacent Channel Separation – BDR (left) and EDR (right)



9 Time of Occupancy

9.1 Test Limits

§ 15.247(a): Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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

9.2 Test Procedure

ANSI C63.10: 2013.

9.3 Test Equipment Used

Description	Asset Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/20/2017	9/20/2018

9.4 Test Results

The device was found to be **compliant**. The time of occupancy was less than the limit.

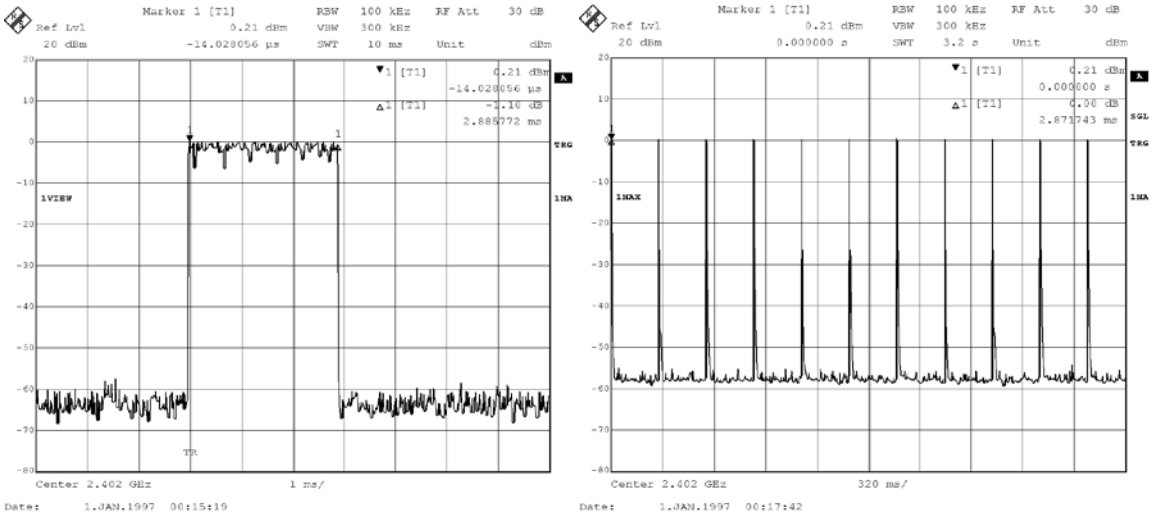
9.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	Battery	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

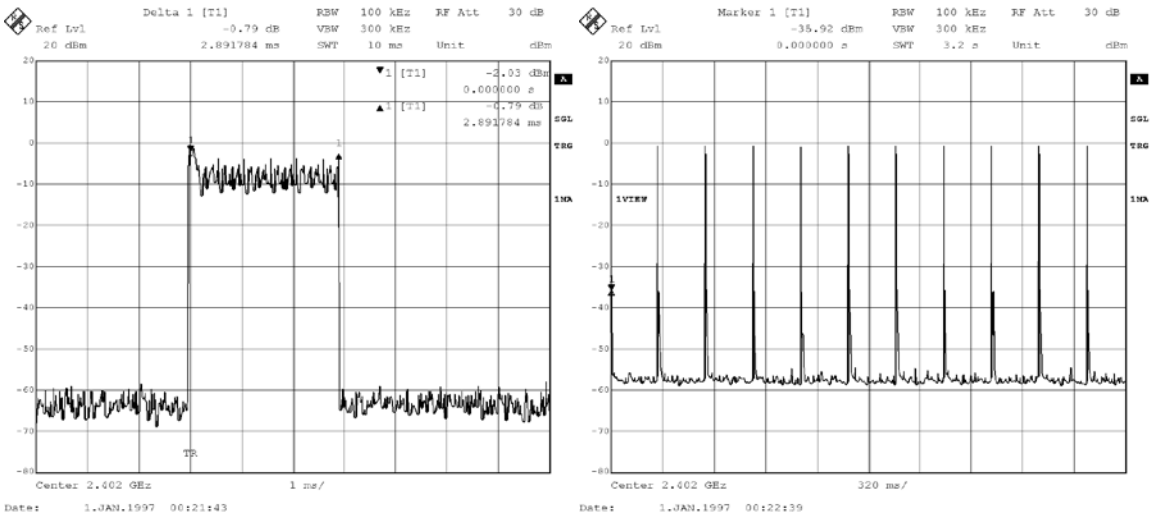
9.6 Test Data

Mode	Number of Transmissions in a 32s Frame (80 Hopping Ch x 0.4s)	Single Transmission Time (ms)	Total Transmission Time (ms)	Limit (ms)	Result
BDR	11 (times in 3.2sec) * (32sec / 3.2sec) = 110	2.886	317.46	400	Pass
EDR	11 (times in 3.2sec) * (32sec / 3.2sec) = 110	2.892	318.12	400	Pass

Dwell Time (left) and Number of Pulses in a 3.2s Frame (right), BDR



Dwell Time (left) and Number of Pulses in a 3.2s Frame (right), EDR



10 Conducted Spurious Emissions

10.1 Test Limits

§ 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.

10.2 Test Procedure

ANSI C63.10: 2013.

10.3 Test Equipment Used

Description	Asset Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/20/2017	9/20/2018

10.4 Test Results

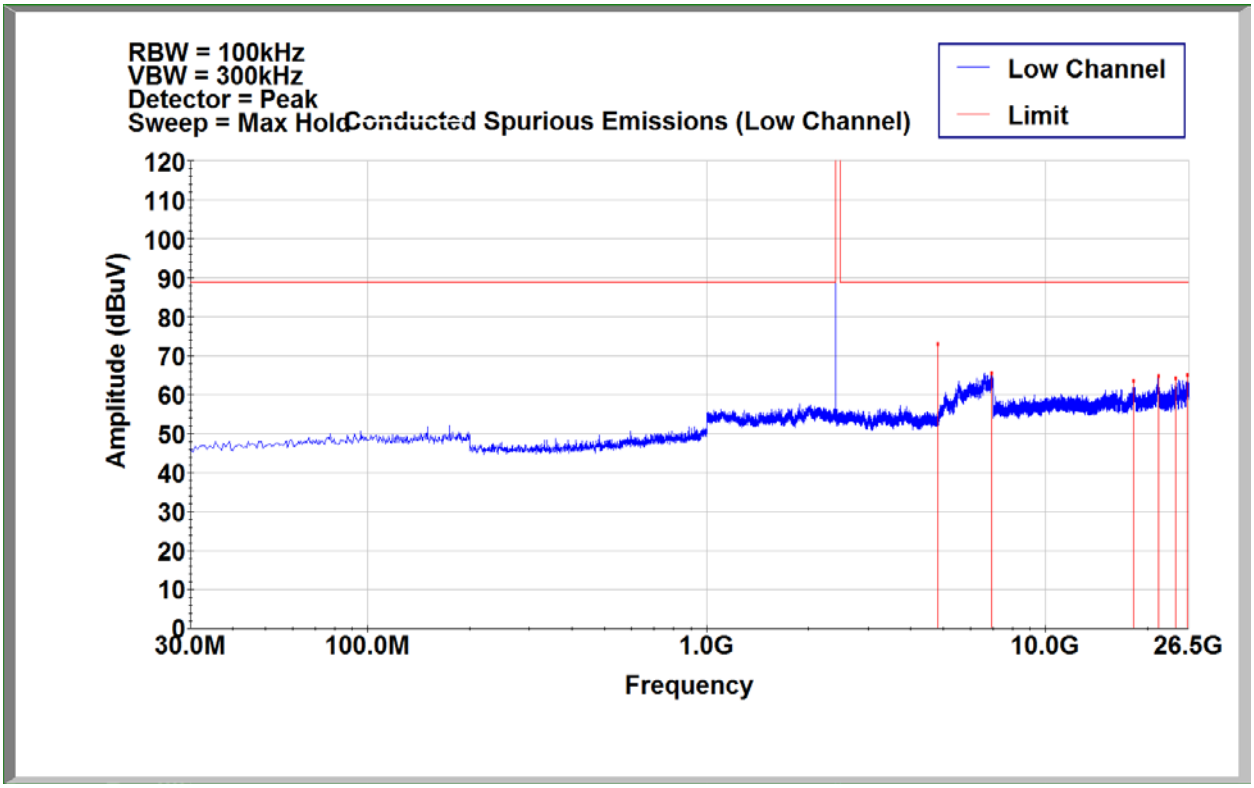
The device was found to be **compliant**. The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria. Plots are also presented showing the band edge compliance.

10.5 Test Conditions

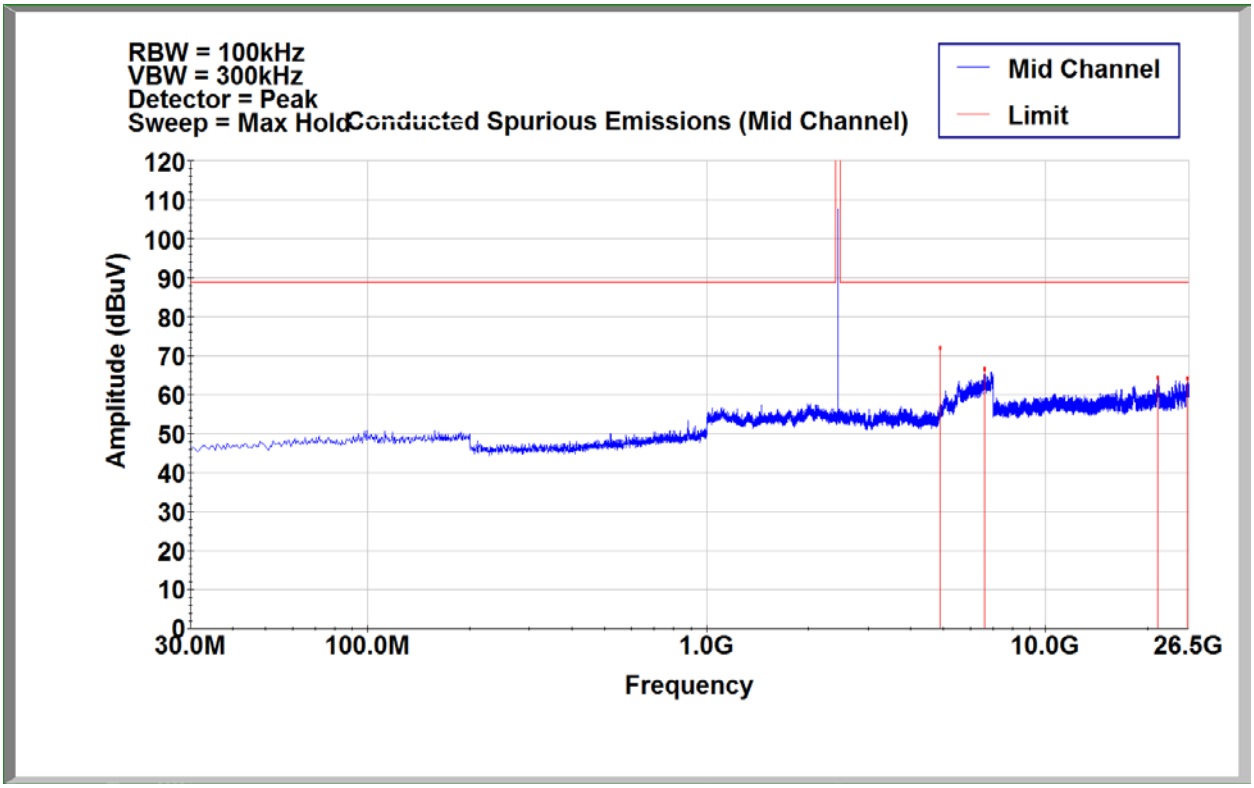
Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	Battery	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

10.6 Test Data

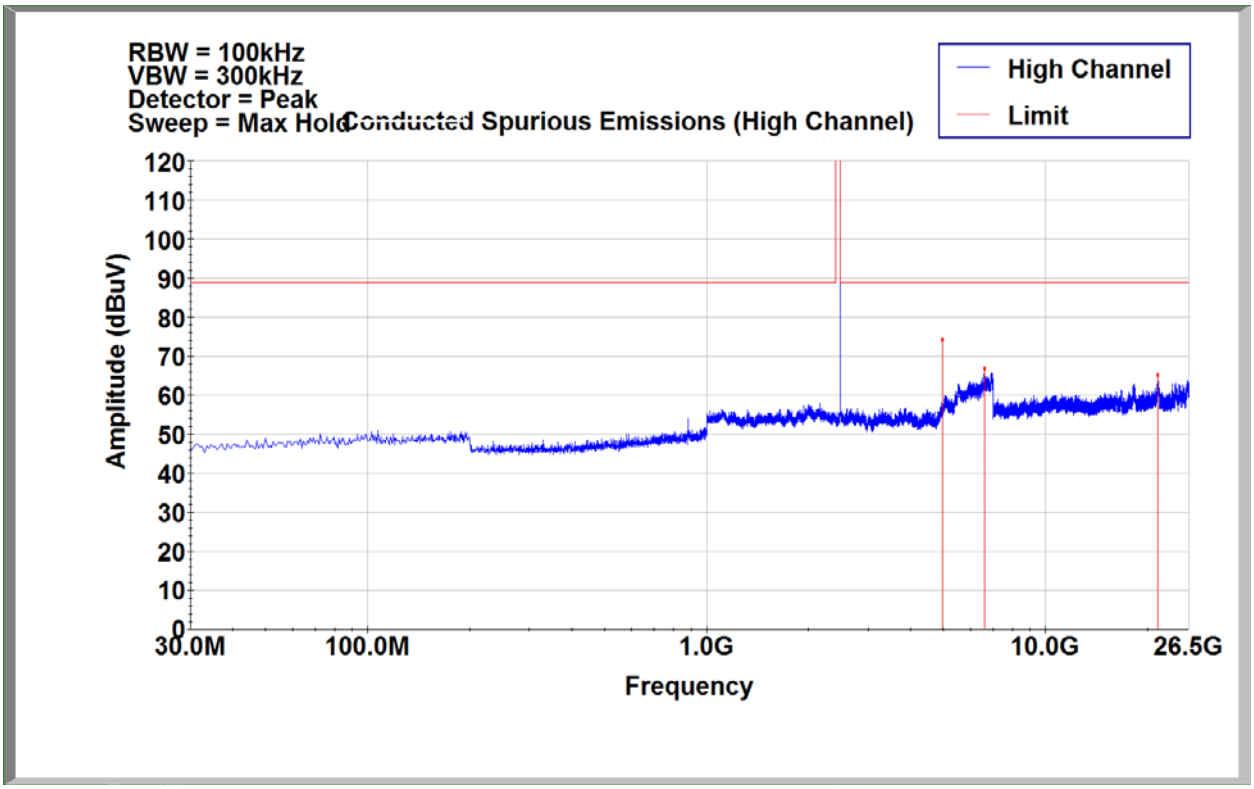
Conducted Spurious Emissions at Antenna Port BDR Channel 0



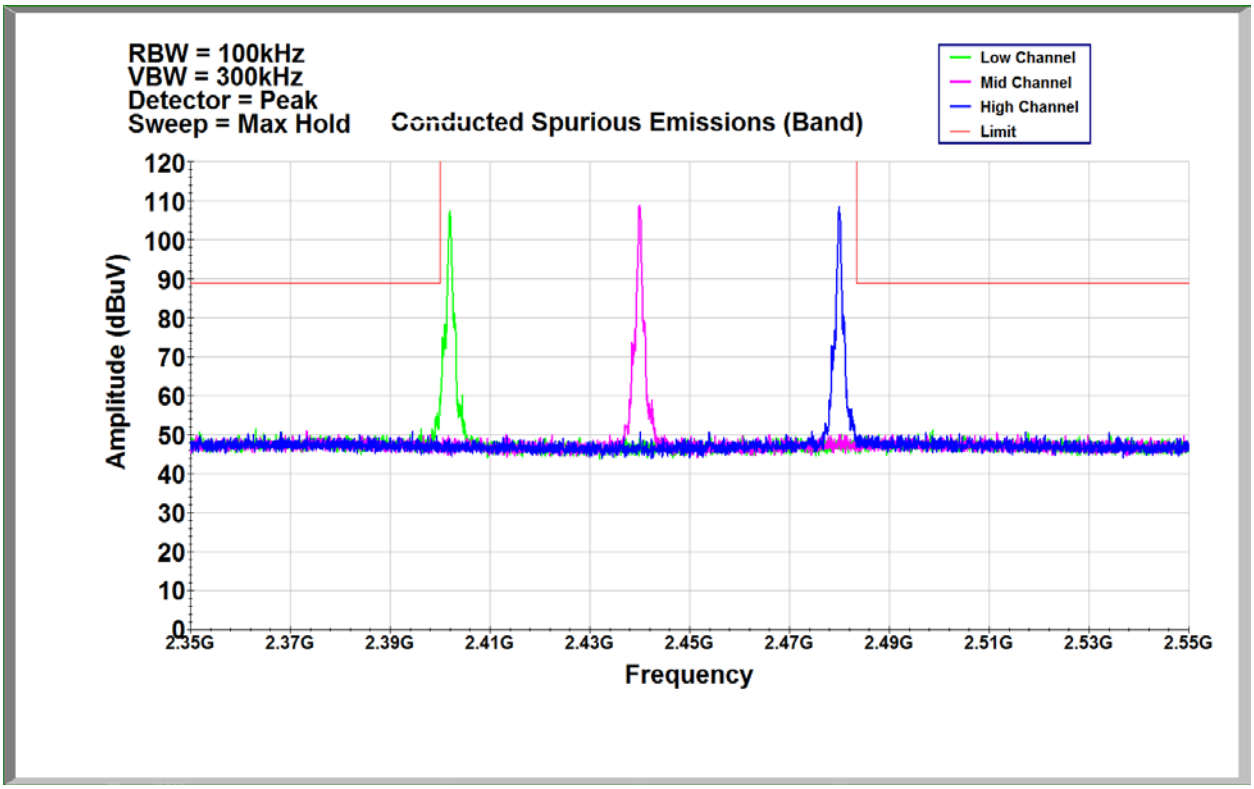
Conducted Spurious Emissions at Antenna Port BDR Channel 39



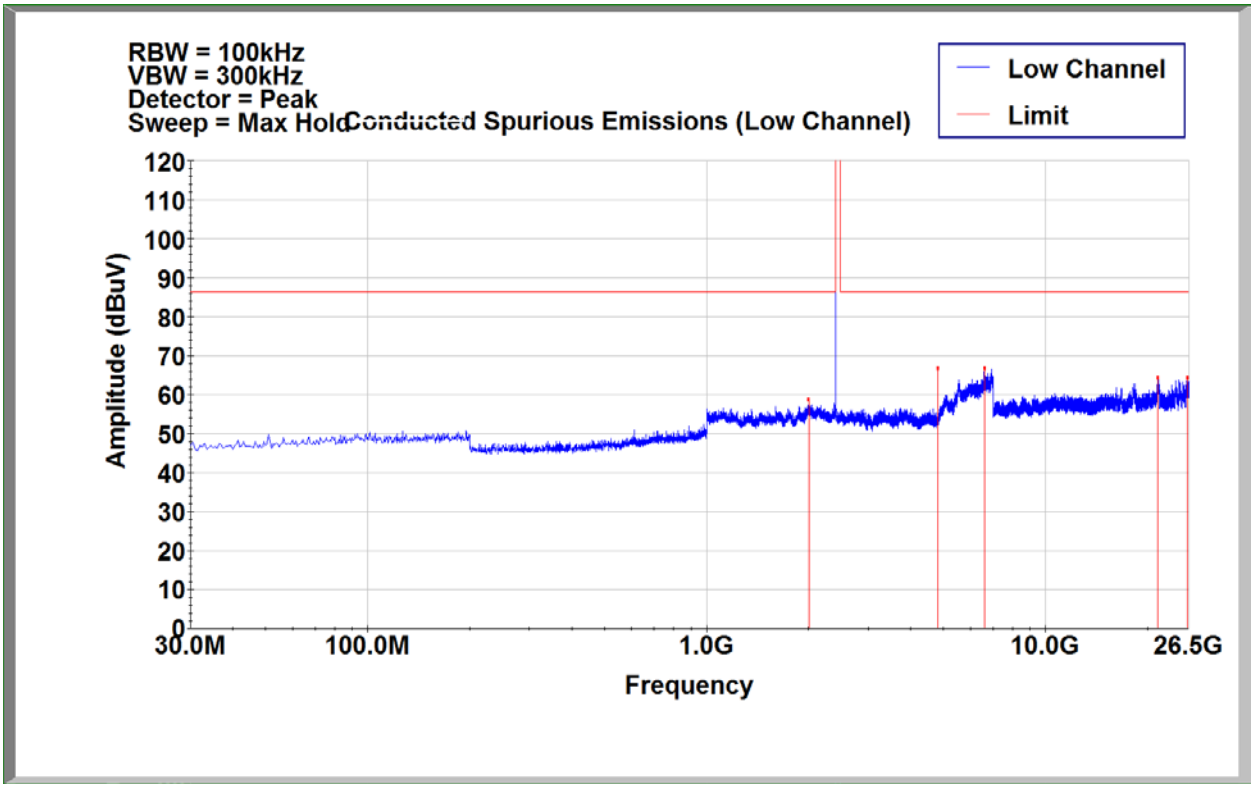
Conducted Spurious Emissions at Antenna Port BDR Channel 79



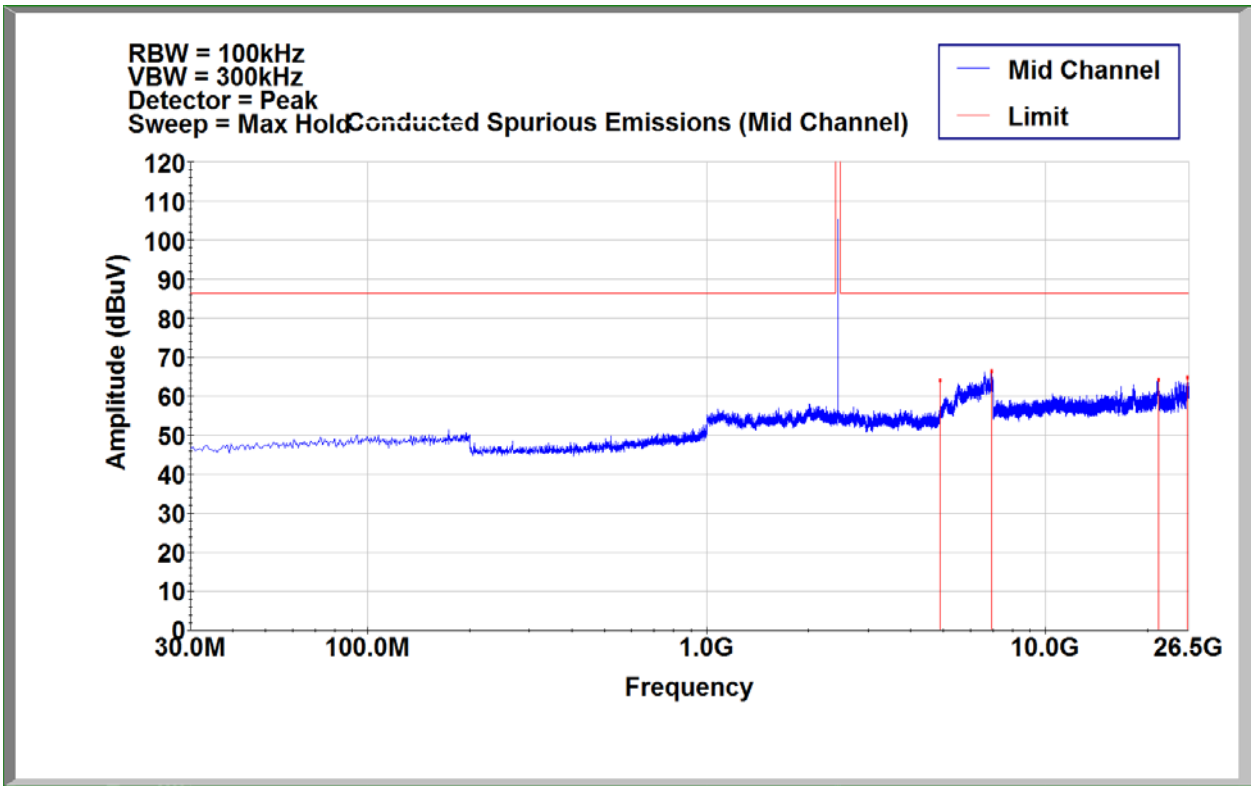
BDR Band Edge Plot



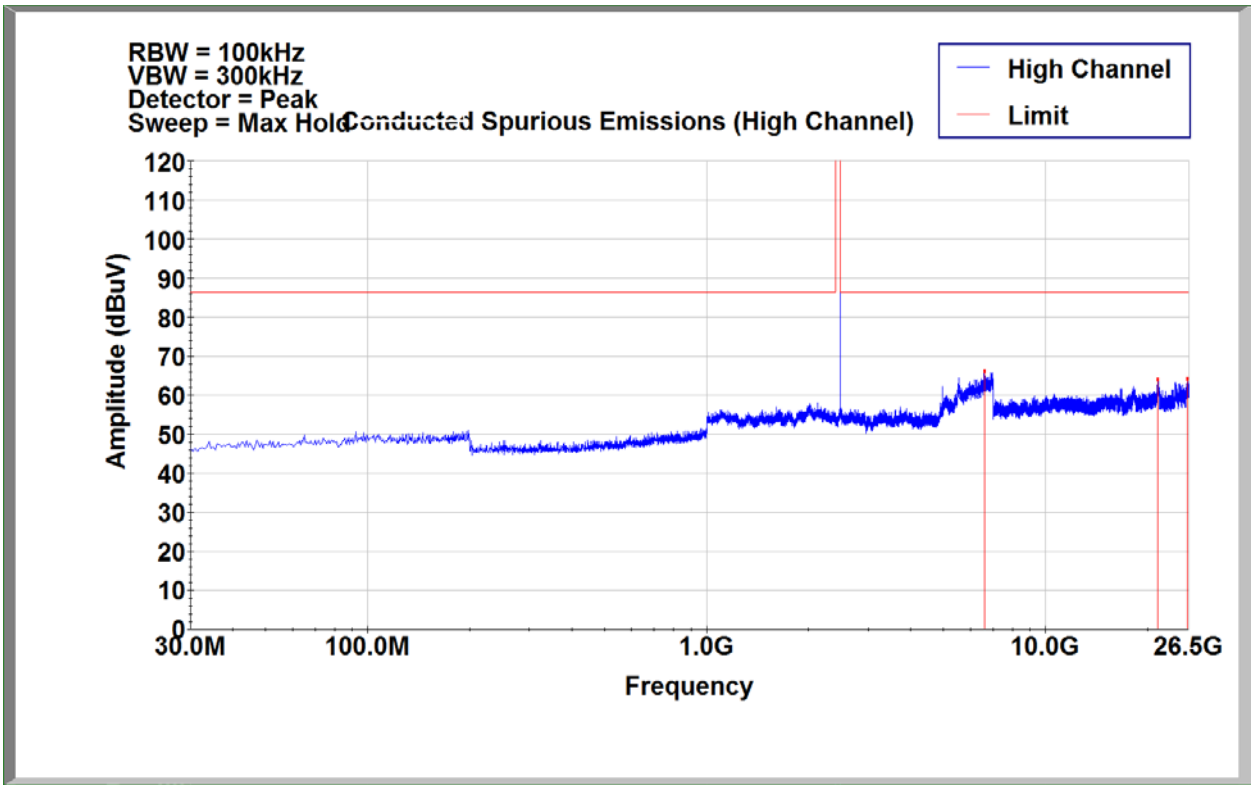
Conducted Spurious Emissions at Antenna Port EDR Channel 0



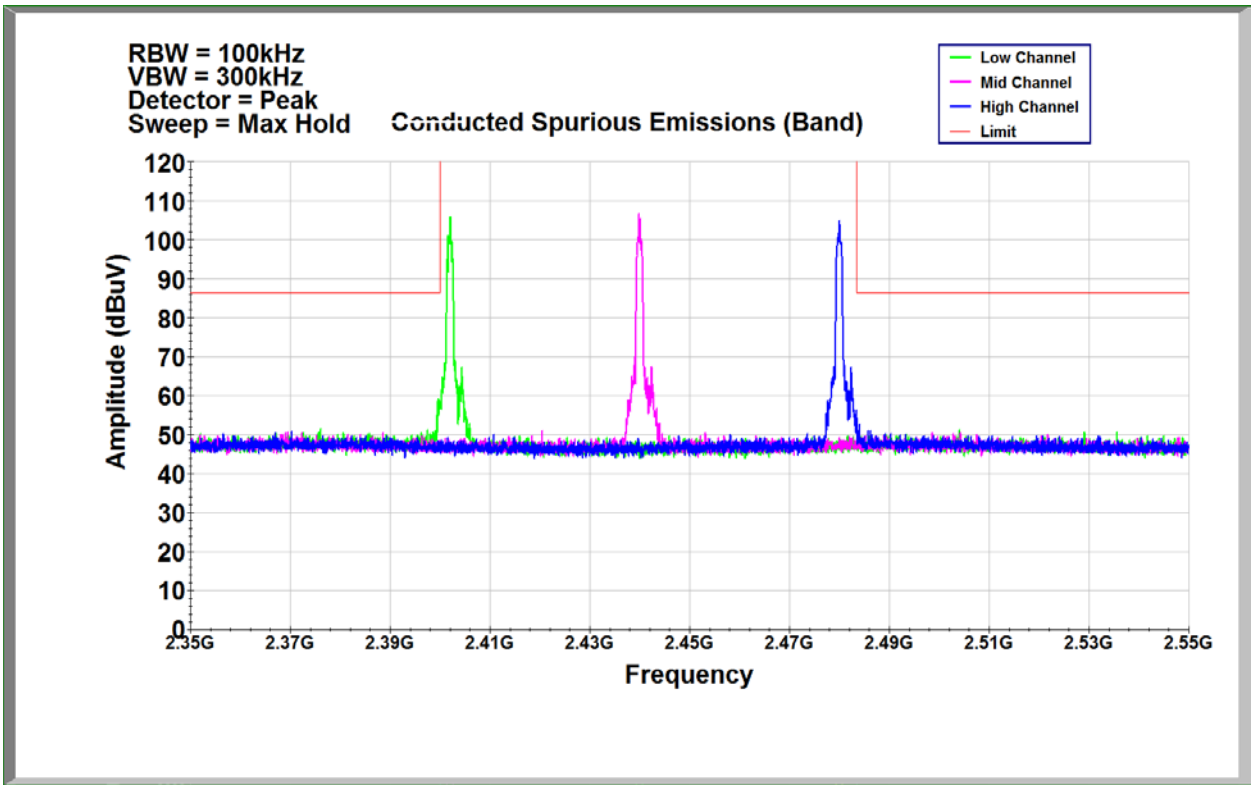
Conducted Spurious Emissions at Antenna Port EDR Channel 39



Conducted Spurious Emissions at Antenna Port EDR Channel 79



EDR Band Edge Plot



11 Power Spectral Density

11.1 Test Limits

§ 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.

11.2 Test Procedure

ANSI C63.10: 2013.

11.3 Test Equipment Used

Description	Asset Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	2327	Rohde & Schwarz	ESI26	9/20/2017	9/20/2018

11.4 Test Results

The device was found to be **compliant**. The peak power spectral density was less than the limit.

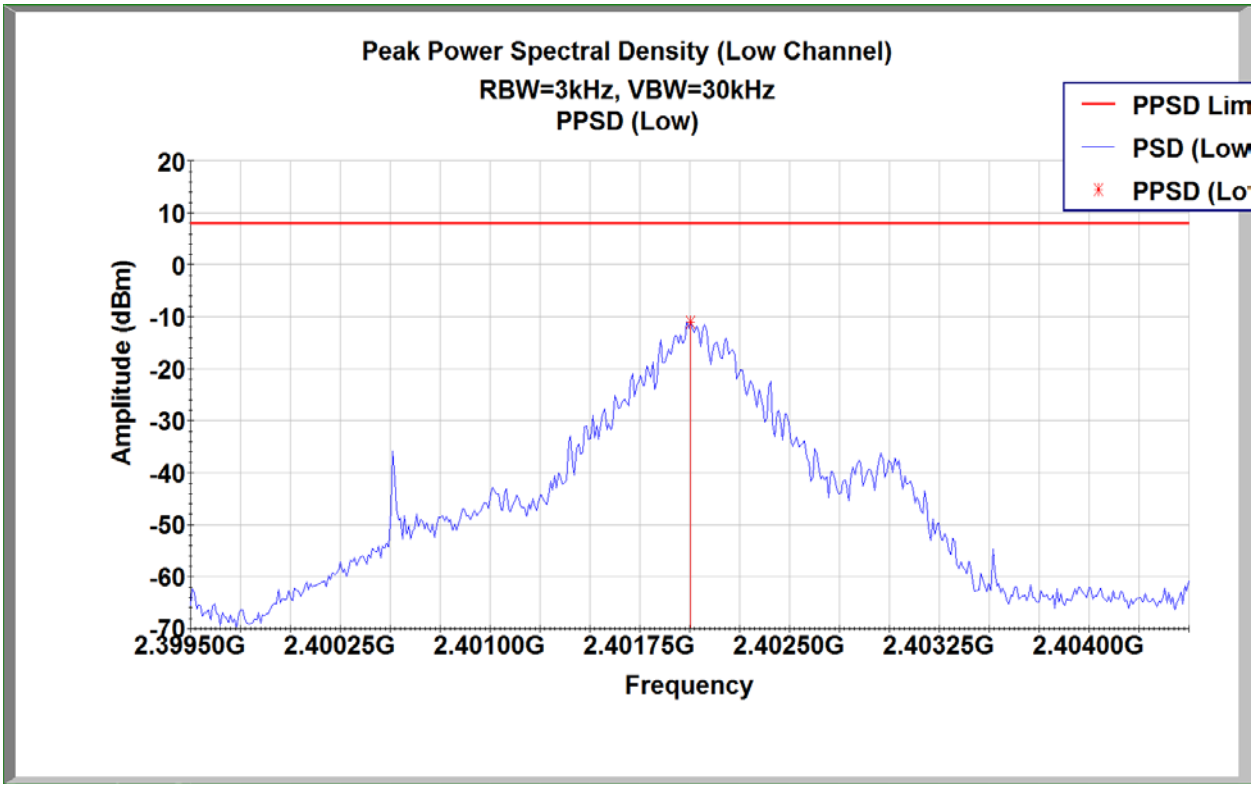
11.5 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	Battery	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

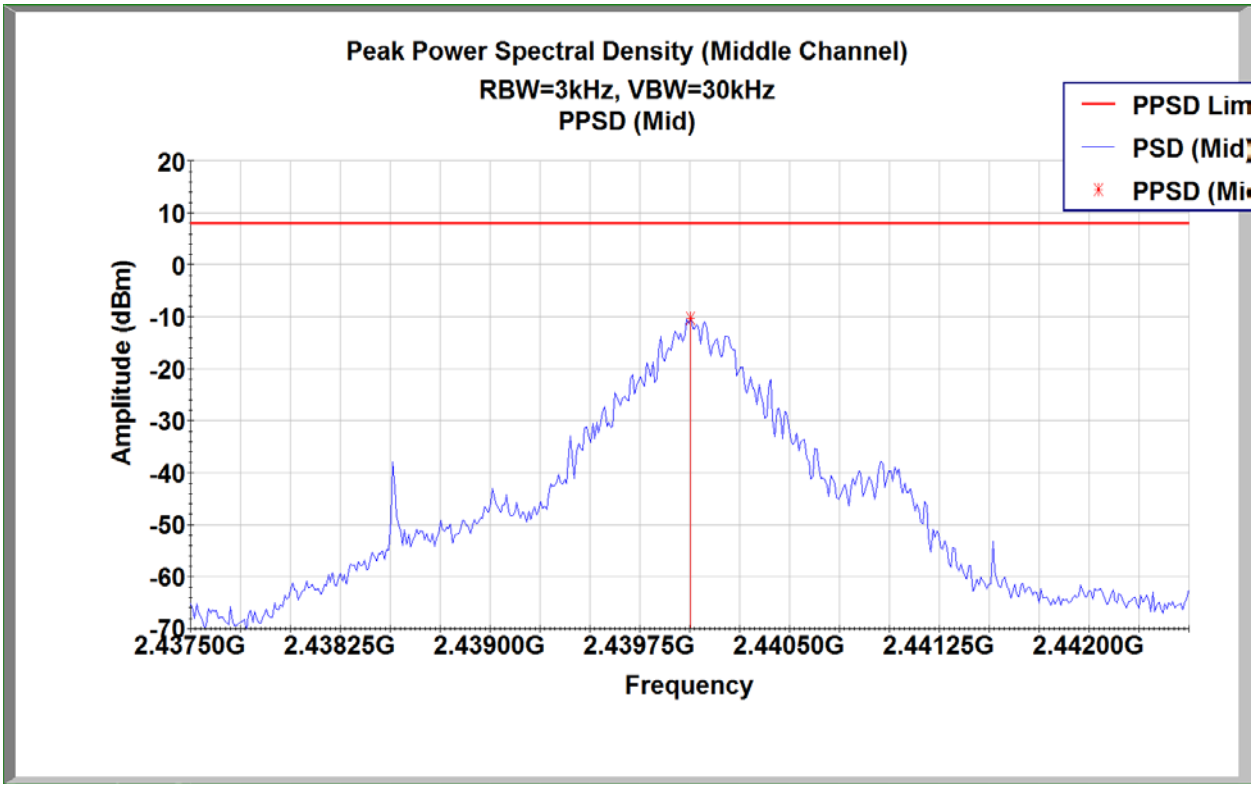
11.6 Test Data

Mode	Channel Number	Frequency (MHz)	PSD in 3kHz BW (dBm)	Limit (dBm)	Margin (dBm)	Result
BDR	0	2402	-11.045	8	19.045	Pass
BDR	39	2440	-10.319	8	18.319	Pass
BDR	79	2480	-10.622	8	18.622	Pass
EDR	0	2402	-14.220	8	22.220	Pass
EDR	39	2440	-14.126	8	22.126	Pass
EDR	79	2480	-13.878	8	21.878	Pass

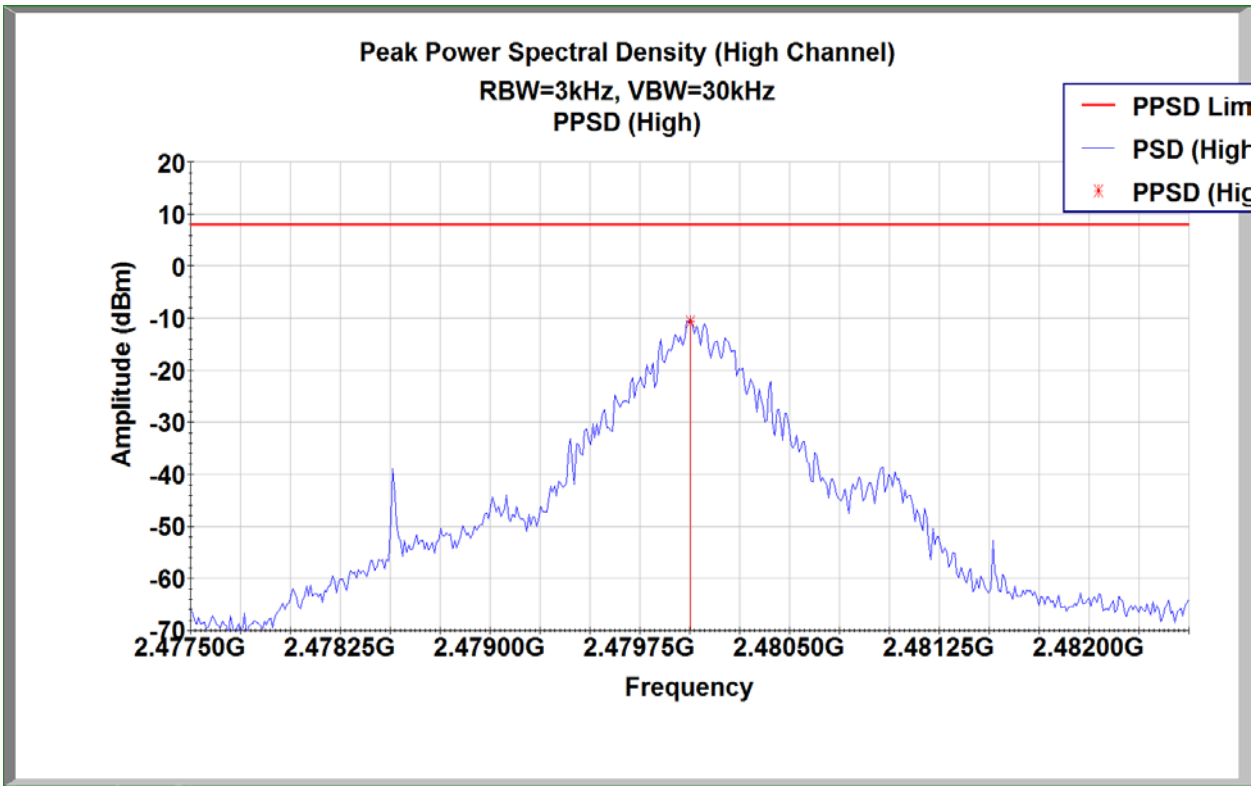
Power Spectral Density – BDR Channel 0



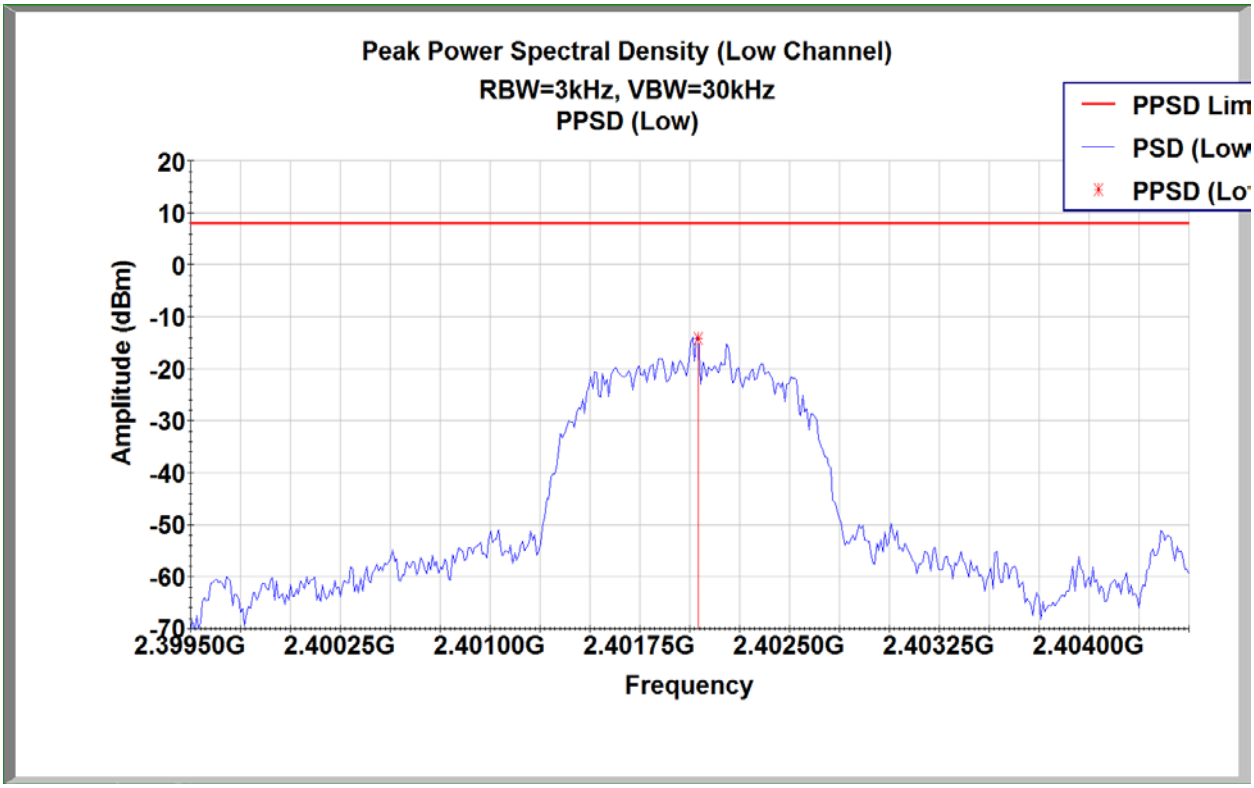
Power Spectral Density – BDR Channel 39



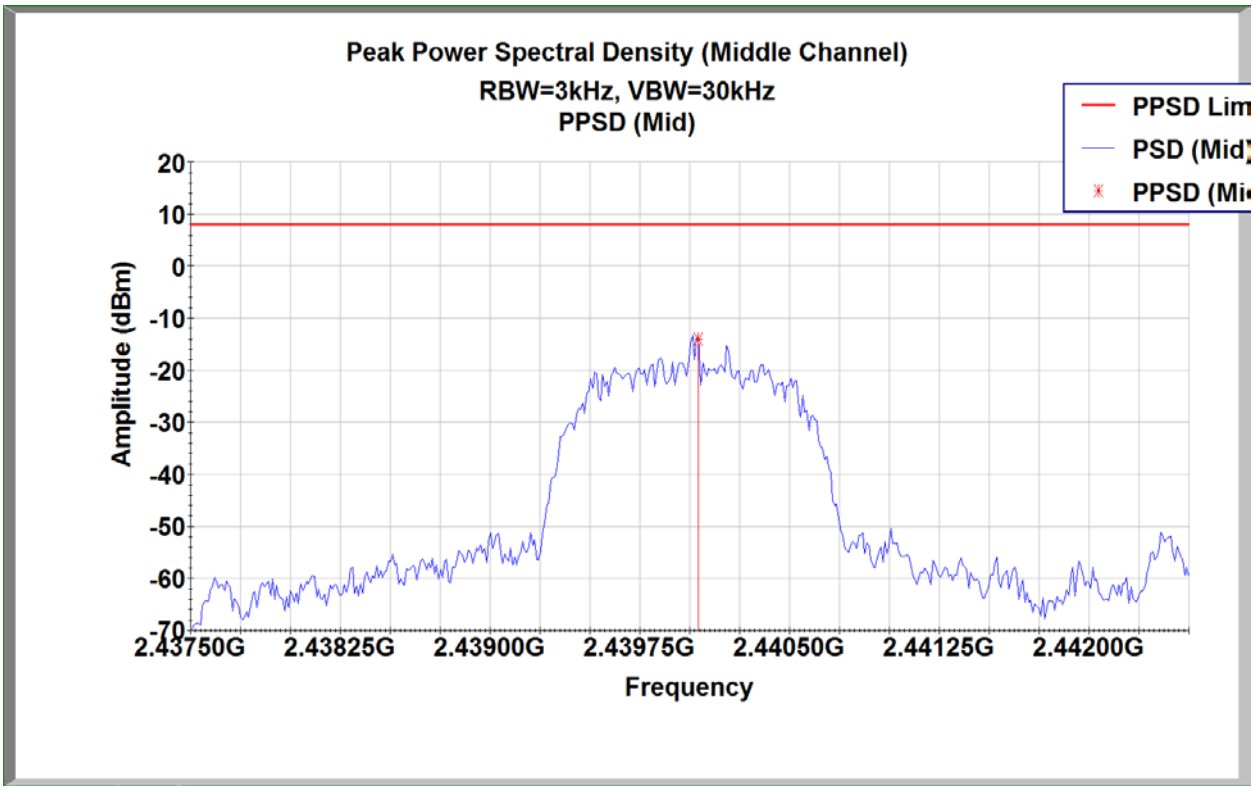
Power Spectral Density – BDR Channel 79



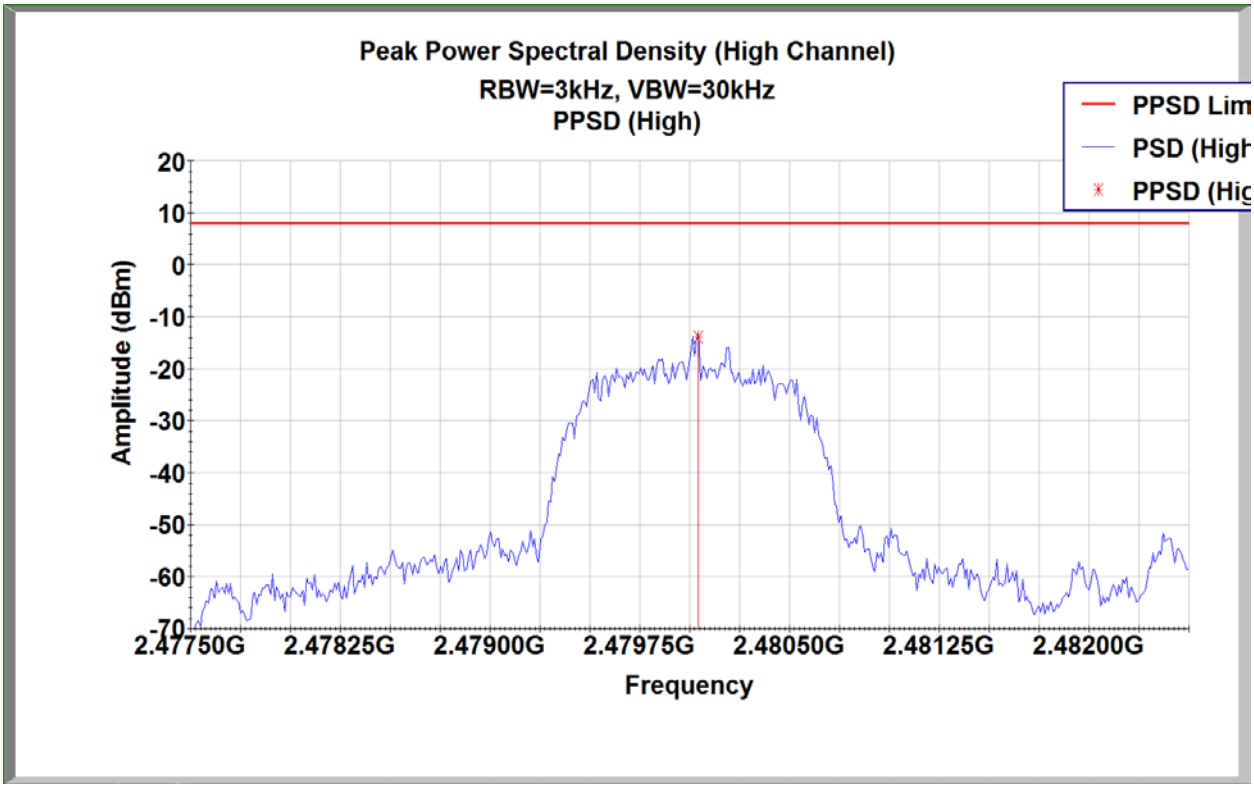
Power Spectral Density – EDR Channel 0



Power Spectral Density – EDR Channel 39



Power Spectral Density – EDR Channel 79



12 Radiated Spurious Emissions (Transmitter)

12.1 Test Limits

§ 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)).

Part 15.205(a): Restricted Bands of Operations

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	[2]
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

Part 15.209(a): Field Strength Limits for Restricted Bands of Operation

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / F (kHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

12.2 Test Procedure

ANSI C63.10: 2013.

12.3 Example of Field Strength Calculation Method

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

12.4 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/20/2017	9/20/2018
Bilog Antenna	3133	ETS Lindgren	3142C	4/6/2017	10/6/2018
Horn Antenna	3780	ETS Lindgren	3117	6/1/2017	6/1/2018
Horn Antenna (18 GHz – 40GHz)	3779	ETS	3116c	6/5/2017	6/5/2018
Preamplifier	3921	Rohde & Schwarz	TS-PR40	12/1/2017	12/1/2018
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
3m Cable Antenna→Preamp	3074			11/29/2017	11/29/2018
3m Cable Preamplifier	3918	TS-PR18	122005	11/29/2017	11/29/2018
3m Cable Preamp→Chamber	2588			11/29/2017	11/29/2018
3m Cable Chamber→Control Room	2593			11/29/2017	11/29/2018
3m Cable Control Room→Receiver	2592			11/29/2017	11/29/2018
10m Cable Antenna→Preamp	3339			11/29/2017	11/29/2018
10m Cable Preamplifier	7019	ZX60-3018G-S+	SUU63801252	11/29/2017	11/29/2018
10m Cable Preamp→Chamber	3172			11/29/2017	11/29/2018
10m Cable Chamber→Control Room	2590			11/29/2017	11/29/2018
10m Cable Control Room→Receiver	2589			11/29/2017	11/29/2018

12.5 Test Results

The device was found to be **compliant**. All spurious emissions were attenuated by at least 20dB below the level of the fundamental as required by Part 15.247(d). Additionally, all emissions falling within restricted bands of operation and at the band edges were found to be below the limit specified in Part 15.209(a). The spurious emissions listed in the following table are the worst case emissions.

12.6 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/17/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	24.2C
Input Voltage:	Battery	Relative Humidity:	45.4%
		Atmospheric Pressure:	982.0mbar

12.7 Test Data

Worst Case Spurious Measurements

*Emissions were investigated with the test sample in its worst operating position across 3 orthogonal axes.

Bluetooth BDR Channel 0 (2402MHz) Spurious Emissions

Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4803.678000	54.45	74.00	19.55	1000.000	400.0	H	80.0	7.8
7205.862500	45.24	74.00	28.76	1000.000	300.0	V	34.0	10.2
9604.044500	45.63	74.00	28.37	1000.000	400.0	V	173.0	13.5
12004.218000	49.01	74.00	24.99	1000.000	278.0	V	60.0	17.2
14401.642500	49.64	74.00	24.36	1000.000	400.0	H	202.0	17.3
16831.936500	53.25	74.00	20.75	1000.000	343.0	H	10.0	21.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4803.678000	46.56	54.00	7.44	1000.000	400.0	H	80.0	7.8
7205.862500	33.07	54.00	20.93	1000.000	300.0	V	34.0	10.2
9604.044500	33.31	54.00	20.69	1000.000	400.0	V	173.0	13.5
12004.218000	36.68	54.00	17.32	1000.000	278.0	V	60.0	17.2
14401.642500	36.61	54.00	17.39	1000.000	400.0	H	202.0	17.3
16831.936500	40.72	54.00	13.28	1000.000	343.0	H	10.0	21.8

Bluetooth BDR Channel 39 (2440MHz) Spurious Emissions

Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.703500	59.33	74.00	14.67	1000.000	220.0	H	32.0	7.4
7321.862000	44.15	74.00	29.85	1000.000	284.0	H	330.0	10.5
9774.752500	46.92	74.00	27.08	1000.000	243.0	V	110.0	13.8
12187.147500	49.43	74.00	24.57	1000.000	300.0	V	297.0	17.0
14646.796500	49.82	74.00	24.18	1000.000	207.0	V	294.0	17.4
17093.143500	53.38	74.00	20.62	1000.000	335.0	H	63.0	21.3

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.703500	52.23	54.00	1.77	1000.000	220.0	H	32.0	7.4
7321.862000	31.37	54.00	22.63	1000.000	284.0	H	330.0	10.5
9774.752500	33.57	54.00	20.43	1000.000	243.0	V	110.0	13.8
12187.147500	36.52	54.00	17.48	1000.000	300.0	V	297.0	17.0
14646.796500	36.85	54.00	17.15	1000.000	207.0	V	294.0	17.4
17093.143500	40.04	54.00	13.96	1000.000	335.0	H	63.0	21.3

Bluetooth BDR Channel 79 (2480MHz) Spurious Emissions

Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4960.247500	59.25	74.00	14.75	1000.000	300.0	H	262.0	7.2
7447.028500	43.77	74.00	30.23	1000.000	300.0	V	8.0	10.8
9919.483000	48.35	74.00	25.65	1000.000	300.0	H	240.0	14.0
12397.948500	48.79	74.00	25.21	1000.000	300.0	V	142.0	16.5
14934.283500	50.13	74.00	23.87	1000.000	184.0	H	269.0	18.7
17359.635000	51.63	74.00	22.37	1000.000	181.0	V	193.0	20.6

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4960.247500	47.16	54.00	6.84	1000.000	300.0	H	262.0	7.2
7447.028500	31.02	54.00	22.98	1000.000	300.0	V	8.0	10.8
9919.483000	36.09	54.00	17.91	1000.000	300.0	H	240.0	14.0
12397.948500	36.13	54.00	17.87	1000.000	300.0	V	142.0	16.5
14934.283500	37.70	54.00	16.30	1000.000	184.0	H	269.0	18.7
17359.635000	39.45	54.00	14.55	1000.000	181.0	V	193.0	20.6

Bluetooth EDR Channel 0 (2402MHz) Spurious Emissions

Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.878500	42.97	74.00	31.03	1000.000	217.0	H	57.0	7.8
7198.653000	43.70	74.00	30.30	1000.000	179.0	V	8.0	10.2
9607.781000	46.30	74.00	27.70	1000.000	286.0	H	190.0	13.5
12008.095500	49.02	74.00	24.98	1000.000	400.0	H	163.0	17.2
14426.160000	48.96	74.00	25.04	1000.000	400.0	H	7.0	17.0
16836.603000	53.35	74.00	20.65	1000.000	400.0	V	108.0	21.9

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.878500	30.23	54.00	23.77	1000.000	217.0	H	57.0	7.8
7198.653000	31.04	54.00	22.96	1000.000	179.0	V	8.0	10.2
9607.781000	33.34	54.00	20.66	1000.000	286.0	H	190.0	13.5
12008.095500	36.75	54.00	17.25	1000.000	400.0	H	163.0	17.2
14426.160000	36.35	54.00	17.65	1000.000	400.0	H	7.0	17.0
16836.603000	40.78	54.00	13.22	1000.000	400.0	V	108.0	21.9

Bluetooth EDR Channel 39 (2440MHz) Spurious Emissions

Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4882.635000	42.81	74.00	31.19	1000.000	175.0	H	342.0	7.4
7319.011500	45.57	74.00	28.43	1000.000	170.0	H	130.0	10.5
9764.442000	46.05	74.00	27.95	1000.000	361.0	V	2.0	13.7
12200.821500	49.48	74.00	24.52	1000.000	400.0	V	41.0	17.0
14439.435000	48.98	74.00	25.02	1000.000	300.0	V	223.0	17.0
17067.052500	52.40	74.00	21.60	1000.000	400.0	H	50.0	21.3

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4882.635000	30.19	54.00	23.81	1000.000	175.0	H	342.0	7.4
7319.011500	31.23	54.00	22.77	1000.000	170.0	H	130.0	10.5
9764.442000	33.57	54.00	20.43	1000.000	361.0	V	2.0	13.7
12200.821500	36.62	54.00	17.38	1000.000	400.0	V	41.0	17.0
14439.435000	36.37	54.00	17.63	1000.000	300.0	V	223.0	17.0
17067.052500	39.90	54.00	14.10	1000.000	400.0	H	50.0	21.3

Bluetooth EDR Channel 79 (2480MHz) Spurious Emissions

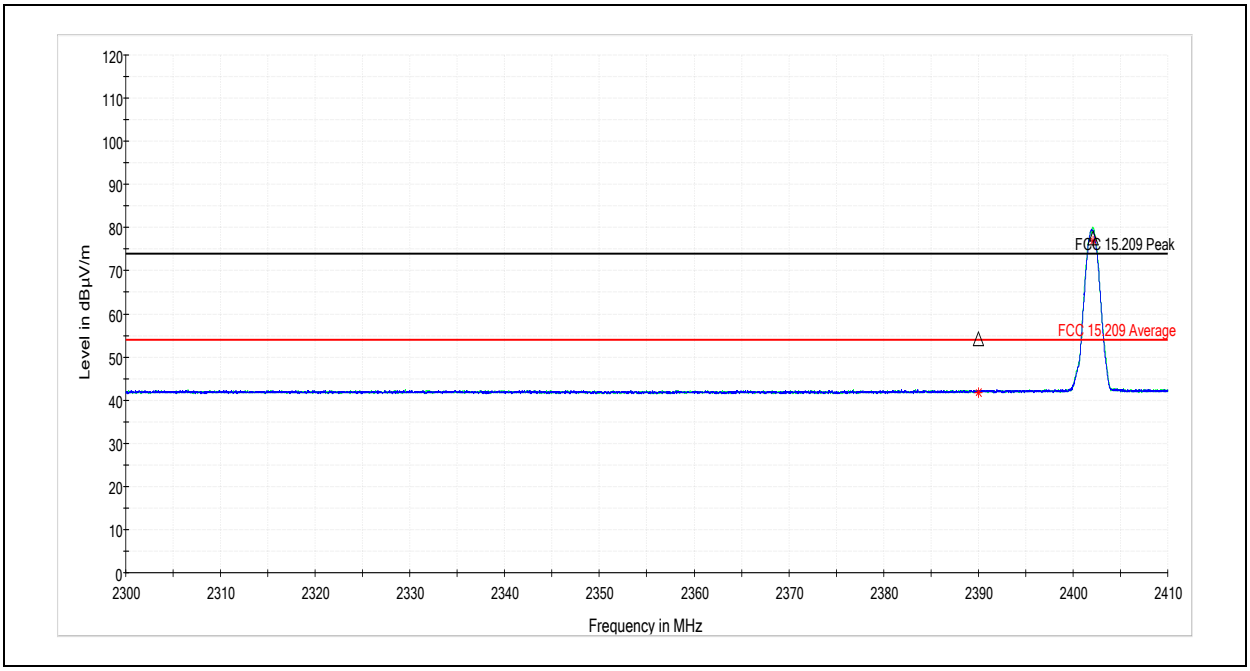
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4954.311000	42.89	74.00	31.11	1000.000	272.0	V	156.0	7.2
7446.475500	44.08	74.00	29.92	1000.000	300.0	V	10.0	10.8
9918.516000	46.57	74.00	27.43	1000.000	300.0	V	86.0	14.0
12402.831000	48.74	74.00	25.26	1000.000	300.0	V	308.0	16.5
14875.258500	50.33	74.00	23.67	1000.000	300.0	H	221.0	18.3
17365.524000	51.87	74.00	22.13	1000.000	225.0	V	50.0	20.6

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4954.311000	29.49	54.00	24.51	1000.000	272.0	V	156.0	7.2
7446.475500	31.34	54.00	22.66	1000.000	300.0	V	10.0	10.8
9918.516000	33.82	54.00	20.18	1000.000	300.0	V	86.0	14.0
12402.831000	35.95	54.00	18.05	1000.000	300.0	V	308.0	16.5
14875.258500	37.11	54.00	16.89	1000.000	300.0	H	221.0	18.3
17365.524000	39.52	54.00	14.48	1000.000	225.0	V	50.0	20.6

Bluetooth Low Band Edge, Transmitting on BDR Channel 0 (2402MHz)



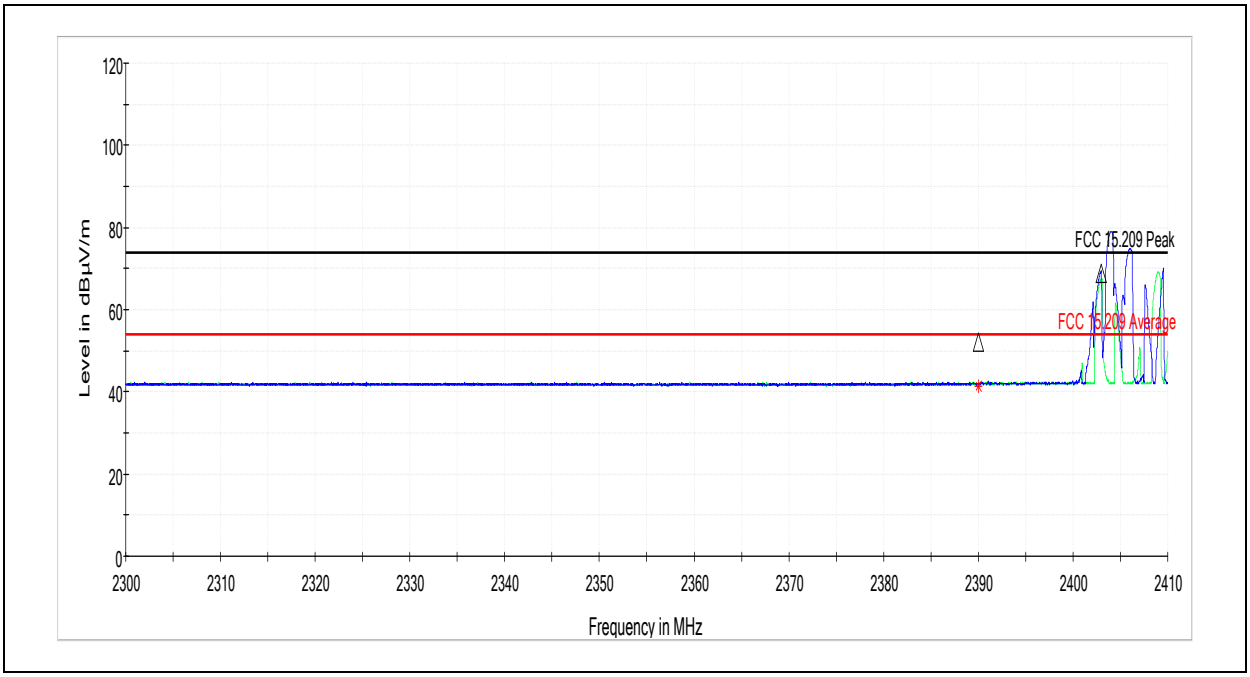
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.002000	54.13	74.00	19.87	1000.000	410.0	H	274.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.002000	41.70	54.00	12.30	1000.000	410.0	H	274.0	37.8

Bluetooth Low Band Edge, BDR Frequency Hopping Enabled



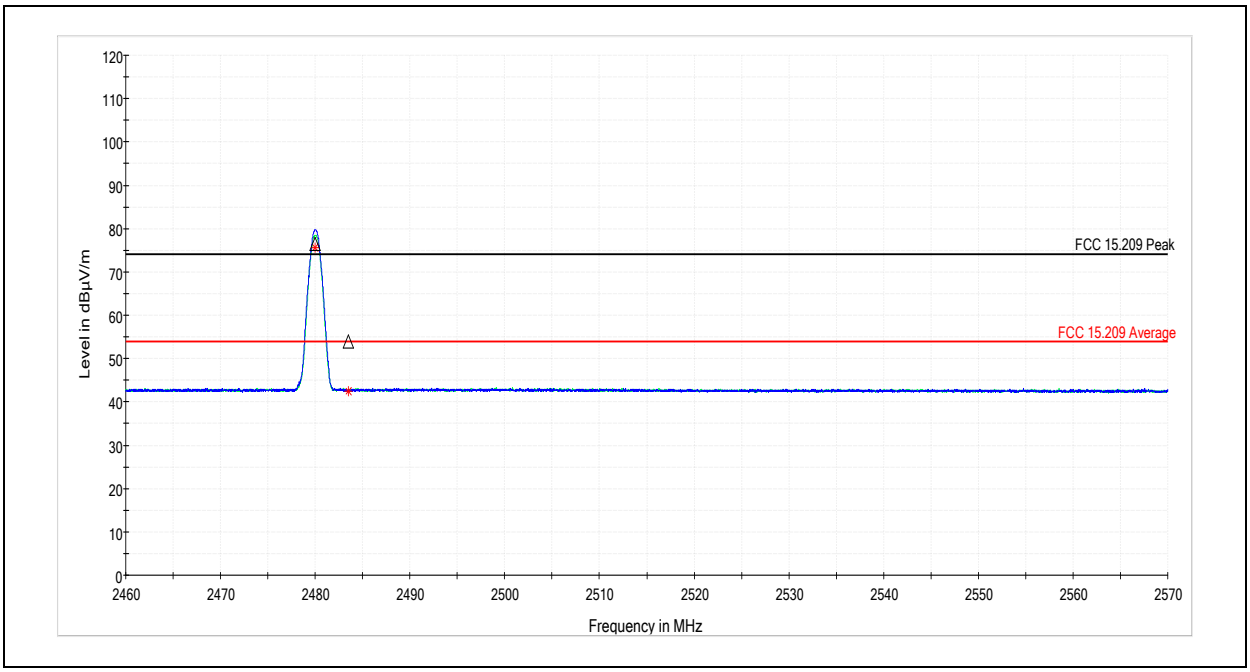
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.013000	52.19	74.00	21.81	1000.000	189.0	H	348.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.013000	41.51	54.00	12.49	1000.000	189.0	H	348.0	37.8

Bluetooth High Band Edge, Transmitting on BDR Channel 79 (2480MHz)



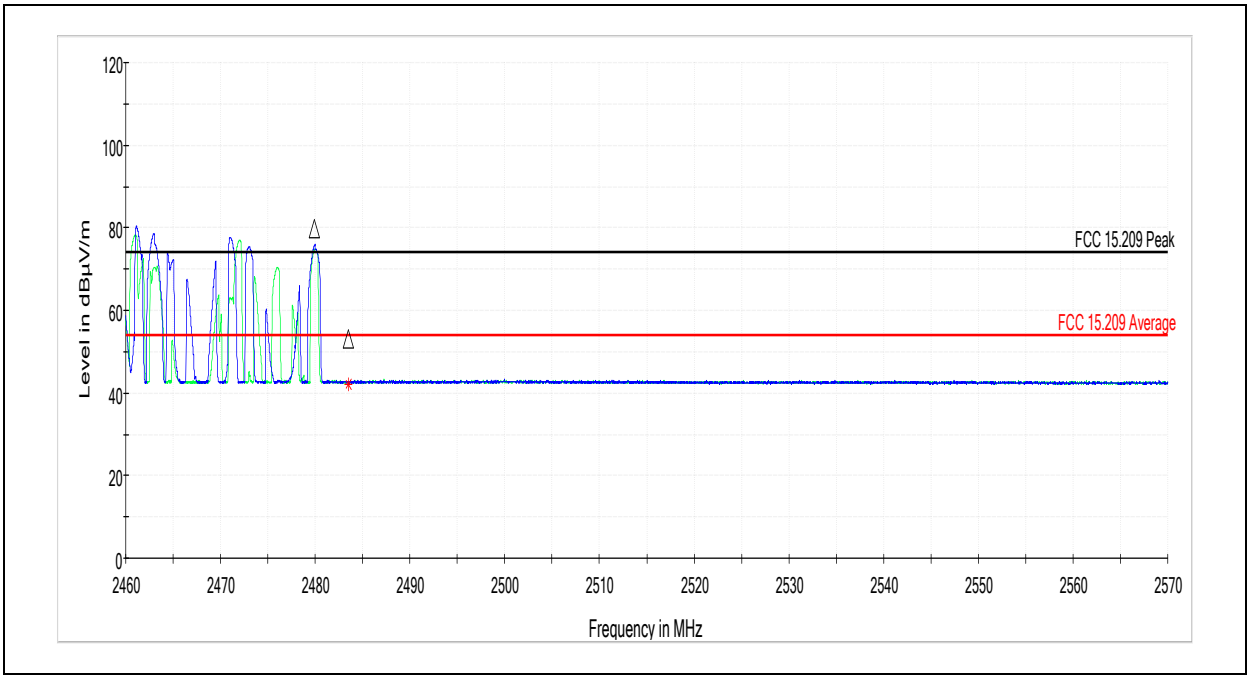
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.485000	53.90	74.00	20.10	1000.000	206.0	V	219.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.485000	42.35	54.00	11.65	1000.000	206.0	V	219.0	37.8

Bluetooth High Band Edge, BDR Frequency Hopping Enabled



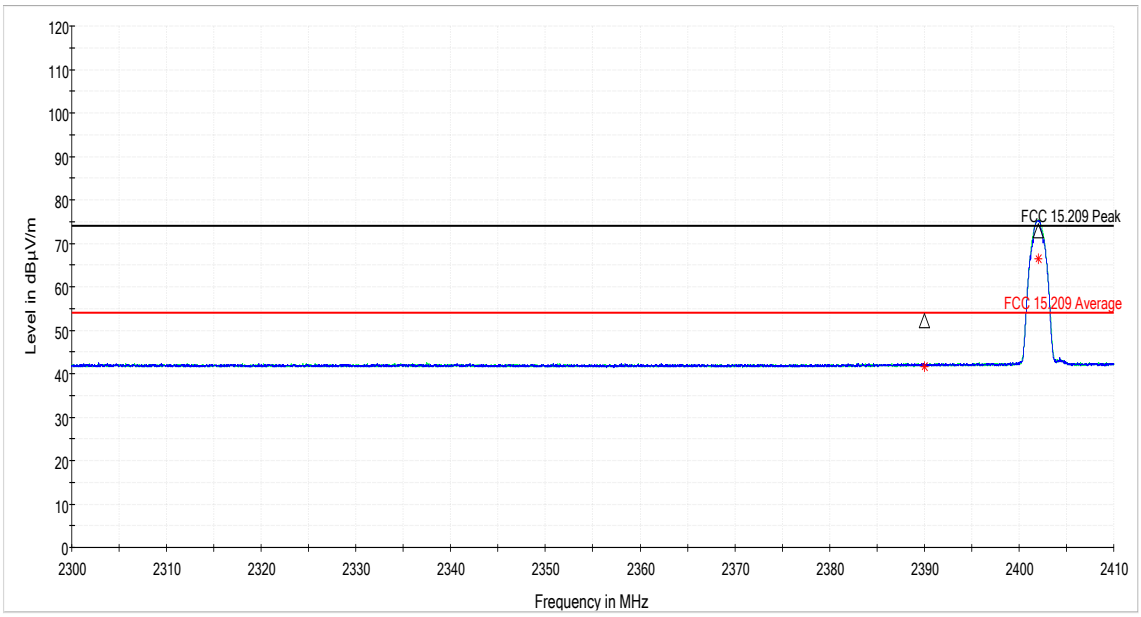
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.507000	52.95	74.00	21.05	1000.000	410.0	H	166.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.507000	42.16	54.00	11.84	1000.000	410.0	H	166.0	37.8

Bluetooth Low Band Edge, Transmitting on EDR Channel 0 (2402MHz)



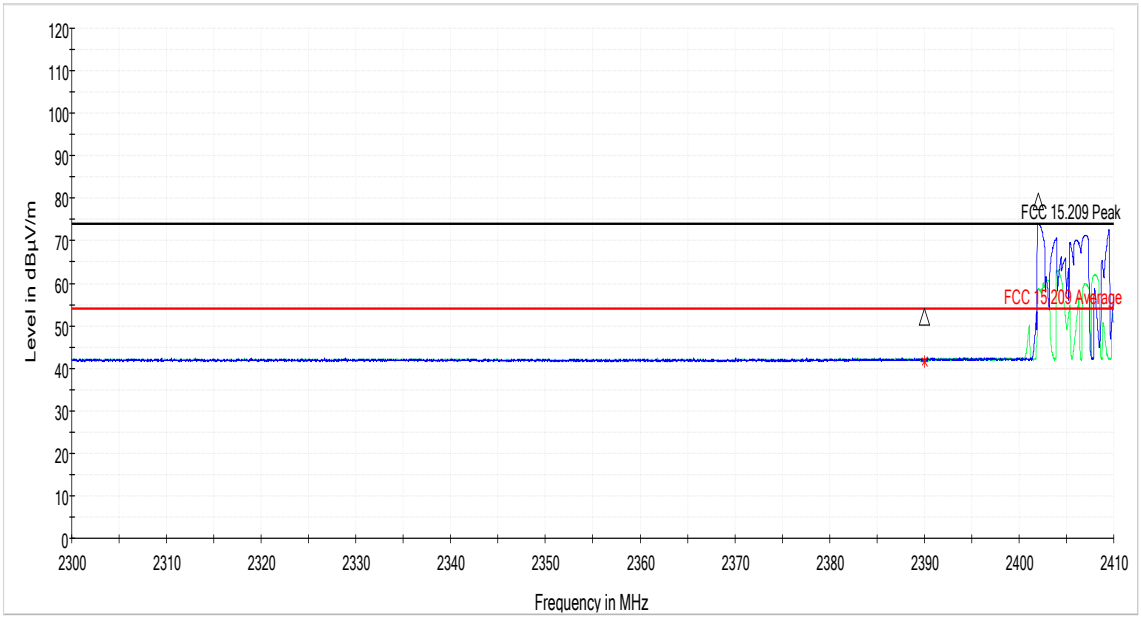
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2389.991000	52.27	74.00	21.73	1000.000	302.0	H	162.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2389.991000	41.57	54.00	12.43	1000.000	302.0	H	162.0	37.8

Bluetooth Low Band Edge, EDR Frequency Hopping Enabled



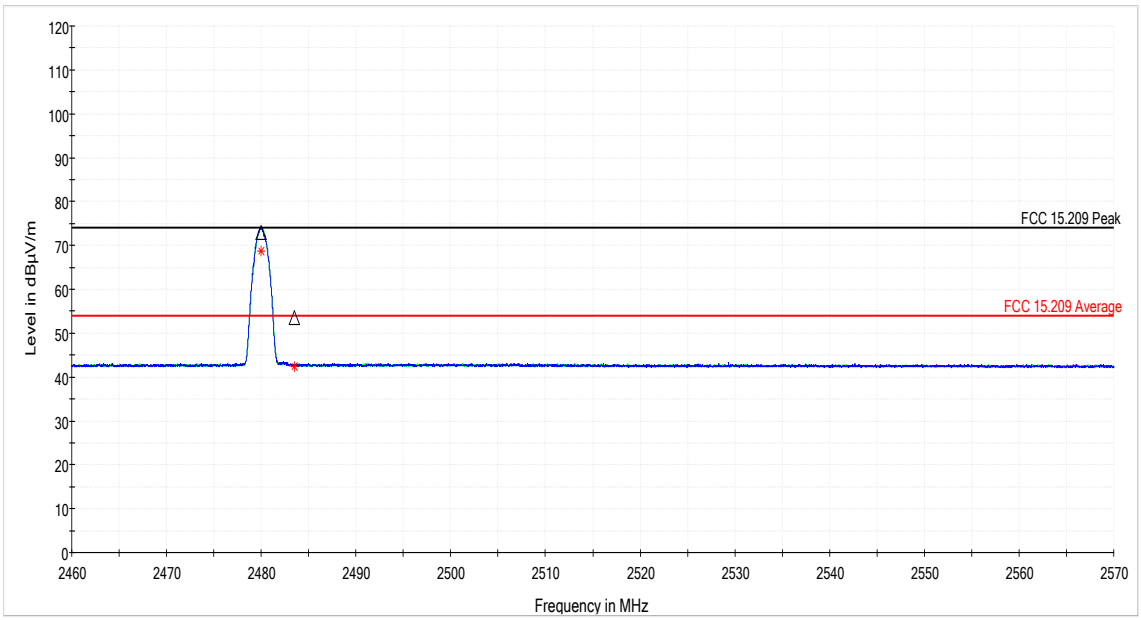
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.002000	52.04	74.00	21.96	1000.000	410.0	H	0.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.002000	41.60	54.00	12.40	1000.000	410.0	H	0.0	37.8

Bluetooth High Band Edge, Transmitting on EDR Channel 79 (2480MHz)



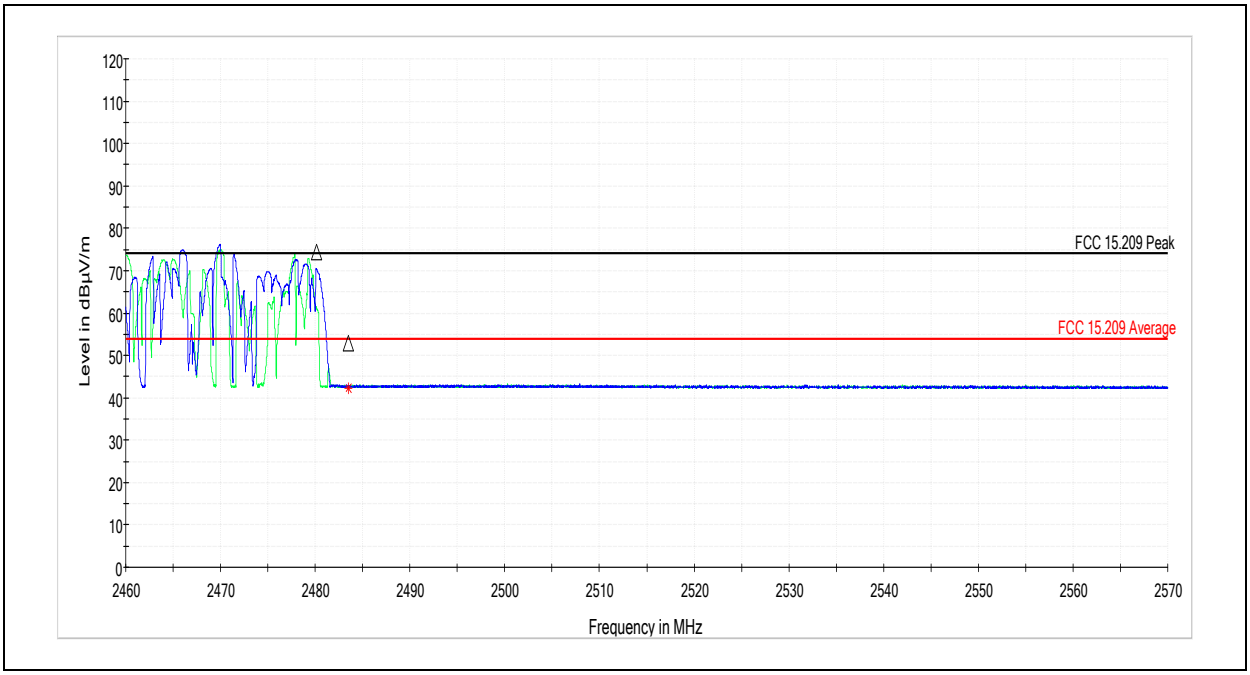
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.485000	53.61	74.00	20.39	1000.000	347.0	H	176.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.485000	42.33	54.00	11.67	1000.000	347.0	H	176.0	37.8

Bluetooth High Band Edge, BDR Frequency Hopping Enabled



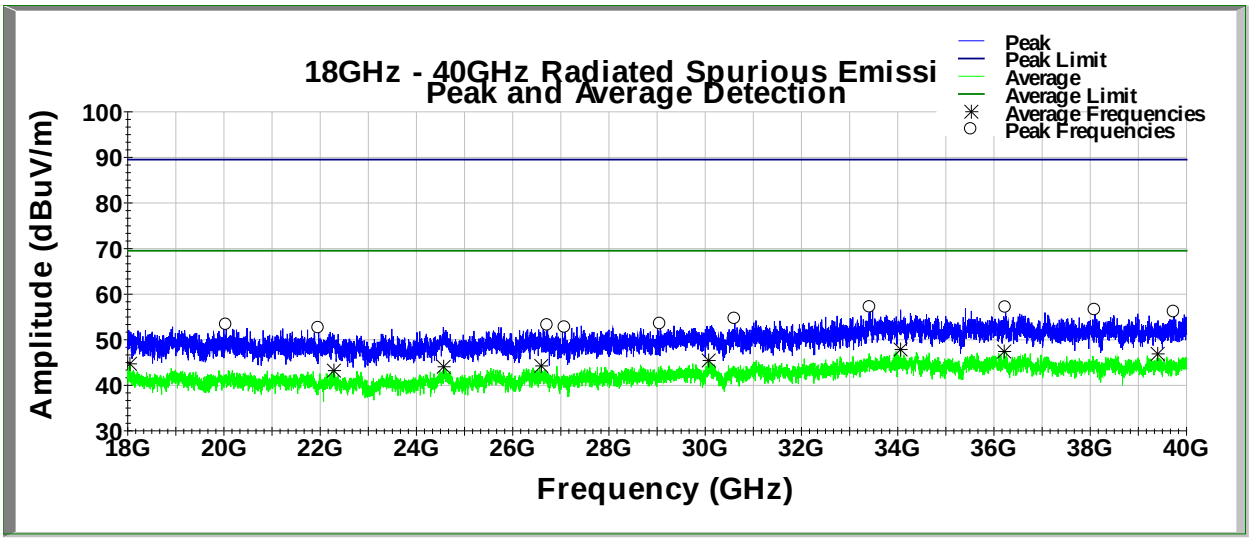
Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.496000	52.87	74.00	21.13	1000.000	410.0	V	236.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.496000	42.32	54.00	11.68	1000.000	410.0	V	236.0	37.8

Bluetooth BDR 18-40GHz spurious emissions data, representative of the worst case of all transmission modes measured in 3 orthogonal axes.



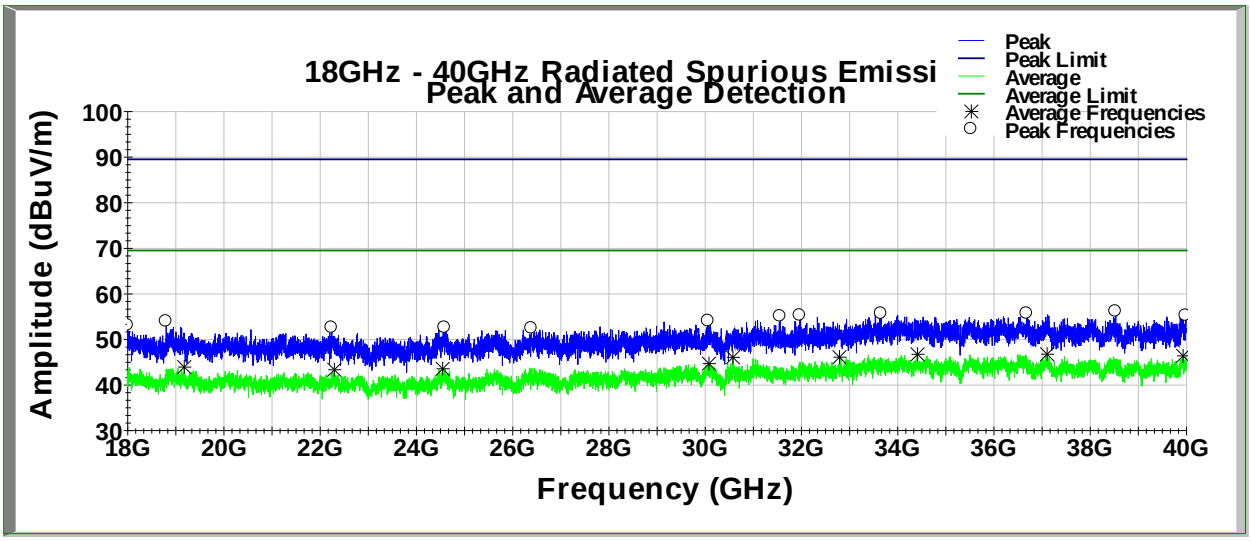
Peak

Frequency (GHz)	Peak (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
20.048	53.26	89.50	36.24
21.969	52.49	89.50	37.01
26.725	53.09	89.50	36.41
27.088	52.64	89.50	36.86
29.066	53.40	89.50	36.10
30.615	54.53	89.50	34.97
33.426	57.08	89.50	32.42
36.242	57.03	89.50	32.47
38.099	56.48	89.50	33.02
39.740	56.03	89.50	33.47

Average

Frequency (GHz)	Average (dBuV/m)	Limit (dBuV/m)	Average Margin (dB)
18.046	44.70	69.50	24.80
22.286	43.22	69.50	26.28
24.565	44.06	69.50	25.44
26.593	44.23	69.50	25.27
30.071	45.43	69.50	24.07
34.060	47.84	69.50	21.66
36.212	47.39	69.50	22.11
39.402	46.87	69.50	22.63

Bluetooth EDR 18-40GHz spurious emissions data, representative of the worst case of all transmission modes measured in 3 orthogonal axes.



Peak

Frequency (GHz)	Peak (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
18.000	53.07	89.50	36.43
18.801	53.92	89.50	35.58
22.242	52.55	89.50	36.95
24.589	52.56	89.50	36.94
26.391	52.42	89.50	37.08
30.065	54.01	89.50	35.49
31.559	55.03	89.50	34.47
31.970	55.23	89.50	34.27
33.655	55.63	89.50	33.87
36.685	55.64	89.50	33.86
38.530	56.10	89.50	33.40
39.987	55.17	89.50	34.33

Average

Frequency (GHz)	Average (dBuV/m)	Limit (dBuV/m)	Average Margin (dB)
19.175	43.92	69.50	25.58
22.294	43.34	69.50	26.16
24.545	43.55	69.50	25.95
30.078	44.67	69.50	24.83
30.575	46.05	69.50	23.45
32.791	46.10	69.50	23.40
34.412	46.72	69.50	22.78
37.105	46.74	69.50	22.76
39.930	46.39	69.50	23.11

13 Radiated Spurious Emissions (Receiver)

13.1 Test Limits

§ 15.109: Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency of emission (MHz)	Field strength (microvolts/meter)	Field strength (dBuV/m)
30–88	100	40
88–216	150	43.5
216–960	200	46
Above 960	500	54

These limits are identical to those in RSS-GEN

13.2 Test Procedure

ANSI C63.4: 2014

13.3 Example of Field Strength Calculation Method

The measured field strength was calculated by summing the readings taken from the spectrum analyzer with the appropriate correction factors associated with the antenna losses and cable losses. The calculation formula and sample calculations are listed below:

Formula:
FS = RA + AF + CF

FS = Field Strength in dBμV/m
RA = Receiver Amplitude in dBμV
AF = Antenna Factor in dB
CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

FS = 19.48 + 18.52 + 0.78 = 38.78 dBμV/m
Level in μV/m = Common Antilogarithm [(38.78 dBμV/m)/20] = 86.89 μV/m

13.4 Test Equipment Used

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	3900	Rohde & Schwarz	ESU40	9/20/2017	9/20/2018
Bilog Antenna	3133	ETS Lindgren	3142C	4/6/2017	4/6/2018
Horn Antenna	3780	ETS Lindgren	3117	6/1/2017	6/1/2018
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
3m Cable Antenna→Preamp	3074			11/29/2017	11/29/2018
3m Cable Preamplifier	3918	TS-PR18	122005	11/29/2017	11/29/2018
3m Cable Preamp→Chamber	2588			11/29/2017	11/29/2018
3m Cable Chamber→Control Room	2593			11/29/2017	11/29/2018
3m Cable Control Room→Receiver	2592			11/29/2017	11/29/2018
10m Cable Antenna→Preamp	3339			11/29/2017	11/29/2018
10m Cable Preamplifier	7019	ZX60-3018G-S+	SUU63801252	11/29/2017	11/29/2018
10m Cable Preamp→Chamber	3172			11/29/2017	11/29/2018
10m Cable Chamber→Control Room	2590			11/29/2017	11/29/2018
10m Cable Control Room→Receiver	2589			11/29/2017	11/29/2018

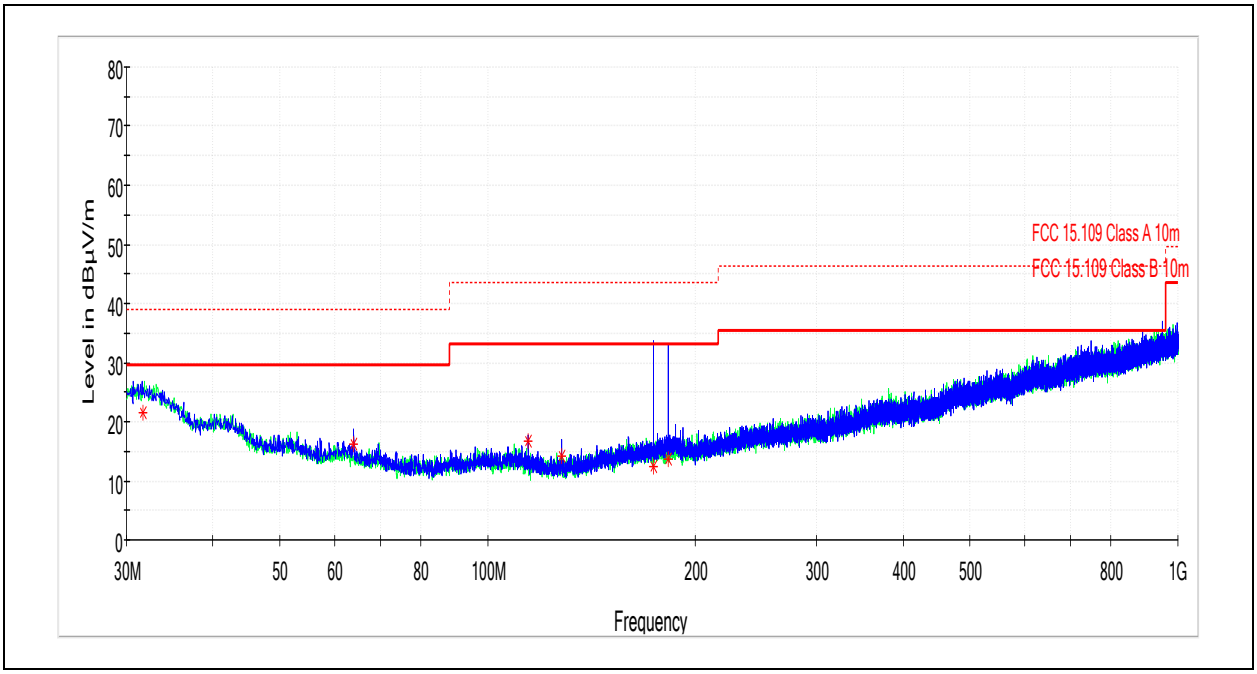
13.5 Test Results

All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device and RSS-GEN Section 6.1. All peak detected emissions were at least 15dB below the limit.

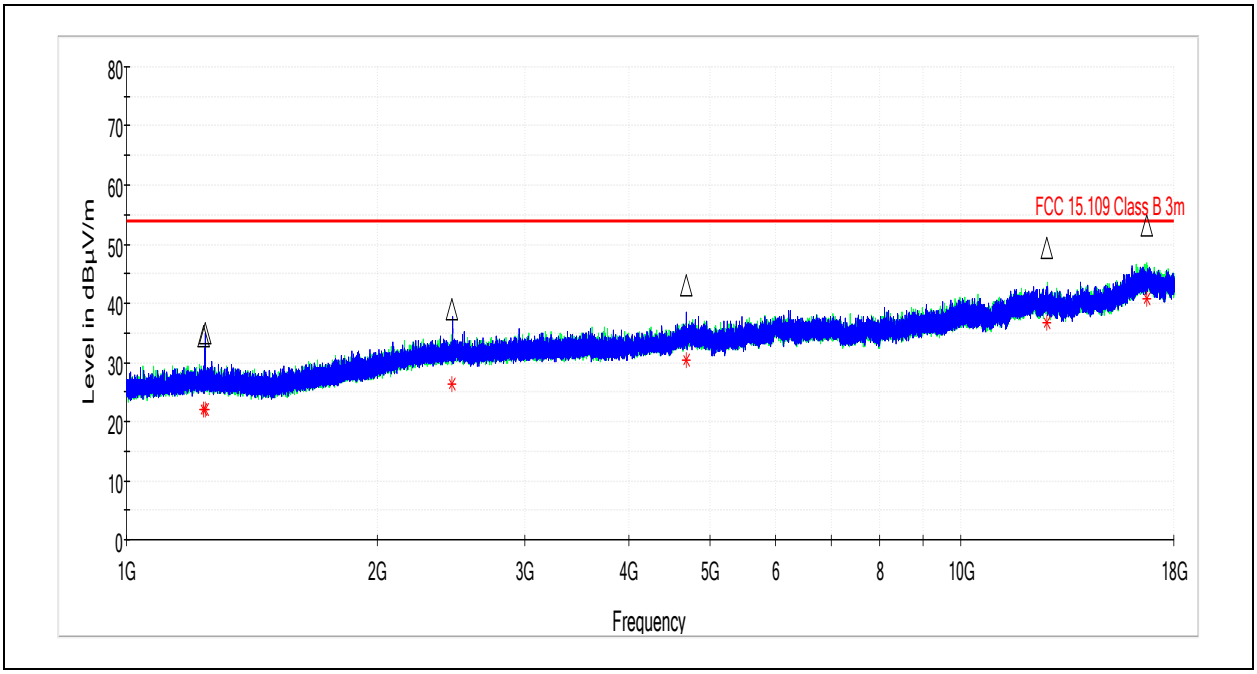
13.6 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/16/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	25.3C
Input Voltage:	Battery	Relative Humidity:	44.2%
		Atmospheric Pressure:	982.0mbar

13.7 Test Data



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
31.678222	21.58	29.00	7.42	120.000	400.3	H	102.0	0.2
64.024000	16.30	29.00	12.70	120.000	176.8	V	136.0	-8.5
114.545778	16.67	33.50	16.83	120.000	357.7	V	147.0	-8.0
127.968000	14.13	33.50	19.37	120.000	100.2	V	263.0	-8.3
173.696444	12.35	33.50	21.15	120.000	100.4	V	35.0	-4.9
182.711889	13.78	33.50	19.72	120.000	104.5	V	145.0	-4.5



Peak

Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1236.823500	34.55	74.00	39.45	1000.000	184.0	V	220.0	-1.1
1242.417000	34.96	74.00	39.04	1000.000	300.0	V	237.0	-1.0
2454.443000	39.08	74.00	34.92	1000.000	300.0	V	183.0	3.9
4682.581000	42.98	74.00	31.02	1000.000	300.0	V	5.0	8.4
12690.958500	49.29	74.00	24.71	1000.000	400.0	H	95.0	16.9
16717.426500	53.08	74.00	20.92	1000.000	170.0	H	247.0	21.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1236.823500	21.96	54.00	32.04	1000.000	184.0	V	220.0	-1.1
1242.417000	22.02	54.00	31.98	1000.000	300.0	V	237.0	-1.0
2454.443000	26.45	54.00	27.55	1000.000	300.0	V	183.0	3.9
4682.581000	30.45	54.00	23.55	1000.000	300.0	V	5.0	8.4
12690.958500	36.64	54.00	17.36	1000.000	400.0	H	95.0	16.9
16717.426500	40.67	54.00	13.33	1000.000	170.0	H	247.0	21.8

14 Conducted Emissions

14.1 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
AC 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.

14.2 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

14.3 Test Equipment Used:

Description	Asset	Manufacturer	Model	Cal Date	Cal Due
EMI Test Receiver	2327	Rohde&Schwarz	ESI26	9/20/2017	9/20/2018
LISN	3333	Teseq	NNB52	6/15/2017	6/15/2018
COND3	7024			12/1/2017	12/1/2018

14.4 Software Utilized:

Name	Manufacturer	Version
TILE	ETS Lindgren	V7.0.6.545

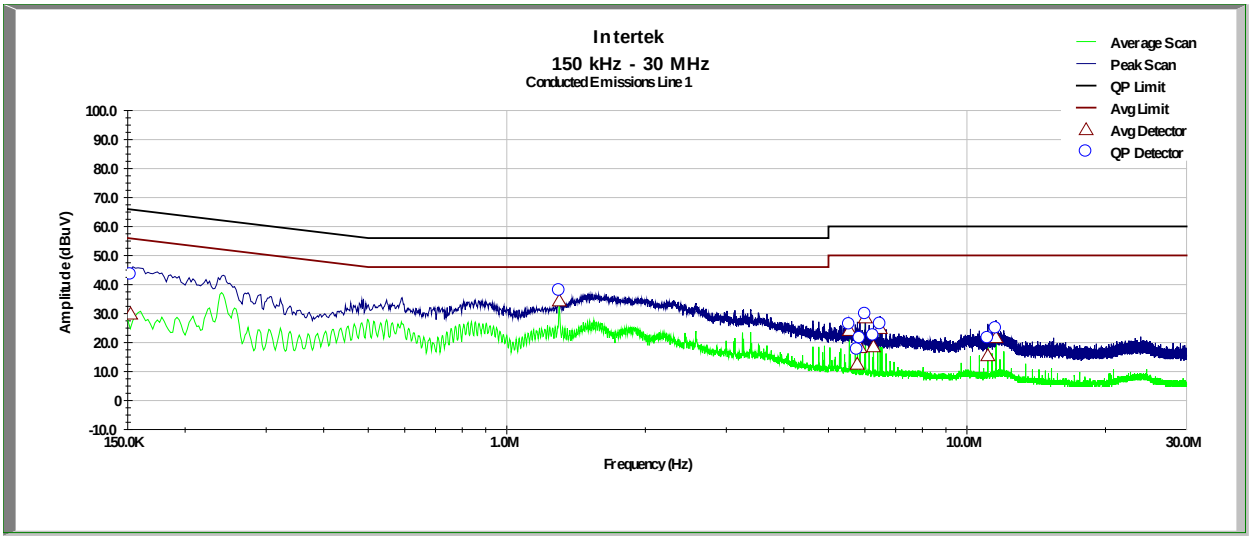
14.5 Test Results

All conducted emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device and RSS-GEN Section 6.1. All peak detected emissions were at least 15dB below the limit.

14.6 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/25/2018
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Ambient Temperature:	22.6C
Input Voltage:	120V/60Hz to 5V USB	Relative Humidity:	54.6%
		Atmospheric Pressure:	982.0mbar

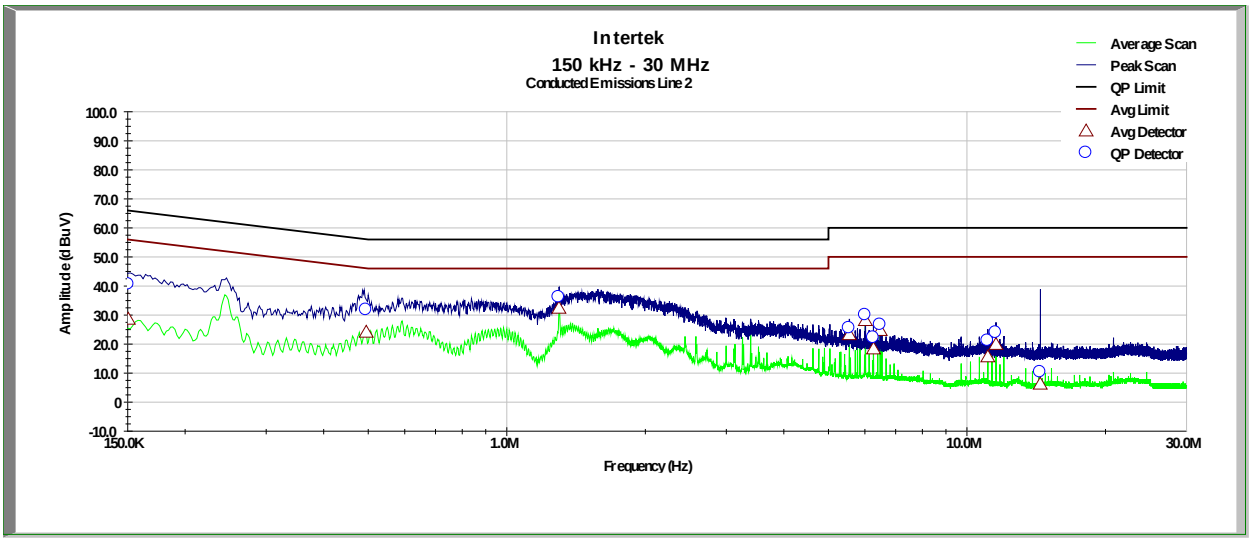
14.7 Plots/Data: Conducted Emissions (Idle)



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.152	43.391	65.937	22.546	29.790	55.937	26.148
1.300	37.873	56.000	18.839	34.339	46.000	12.372
5.551	26.260	60.000	29.828	24.139	50.000	21.949
5.775	17.541	60.000	38.583	12.514	50.000	33.610
5.853	21.450	60.000	34.686	18.222	50.000	27.914
6.014	29.779	60.000	26.383	28.490	50.000	17.673
6.263	22.364	60.000	33.838	18.512	50.000	27.690
6.477	26.348	60.000	29.888	24.821	50.000	21.415
11.099	21.460	60.000	35.515	15.419	50.000	31.557
11.564	24.855	60.000	32.195	21.688	50.000	25.362

Line

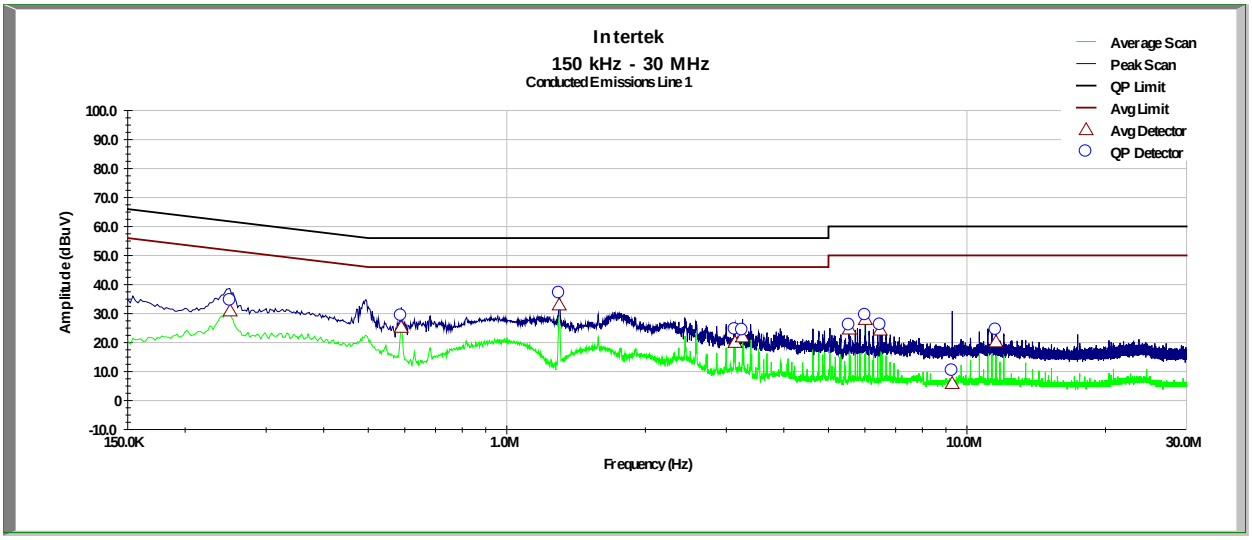


Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.150	40.536	65.986	25.450	28.545	55.986	27.441
0.495	31.699	56.146	24.447	24.072	46.146	22.074
1.298	36.074	56.000	20.636	32.339	46.000	14.370
5.549	25.425	60.000	30.663	23.231	50.000	22.857
6.015	29.923	60.000	26.240	28.084	50.000	18.079
6.265	22.136	60.000	34.067	18.319	50.000	27.883
6.478	26.559	60.000	29.677	24.657	50.000	21.580
11.099	21.075	60.000	35.901	15.586	50.000	31.389
11.562	23.870	60.000	33.180	19.870	50.000	27.180
14.432	10.300	60.000	47.209	6.187	50.000	41.322

Neutral

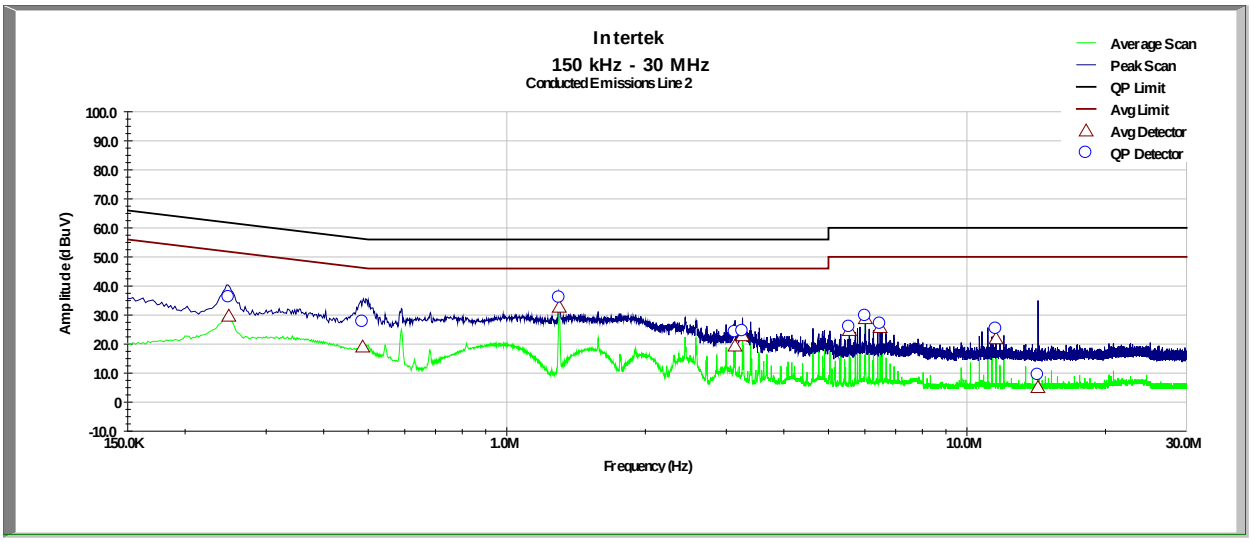
14.8 Plots/Data: Conducted Emissions (BDR Transmitting)



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.251	34.449	63.129	28.679	30.896	53.129	22.233
0.589	29.213	56.000	26.866	25.231	46.000	20.848
1.300	37.009	56.000	19.702	32.939	46.000	13.772
3.133	24.509	56.000	33.832	20.026	46.000	28.315
3.251	24.242	56.000	34.203	21.913	46.000	26.533
5.550	25.966	60.000	30.122	24.618	50.000	21.470
6.015	29.435	60.000	26.728	27.946	50.000	18.216
6.478	26.058	60.000	30.178	24.274	50.000	21.963
9.289	10.237	60.000	46.450	5.875	50.000	40.811
11.561	24.329	60.000	32.721	20.198	50.000	26.852

Line

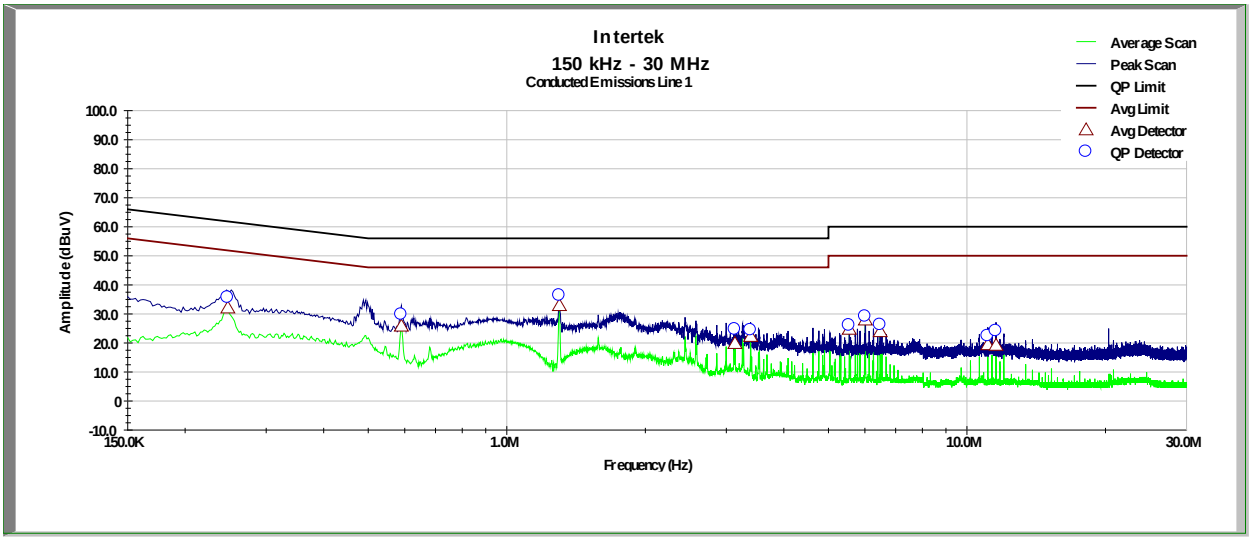


Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.249	36.060	63.177	27.117	29.591	53.177	23.586
0.486	27.607	56.397	28.790	18.972	46.397	27.425
1.300	35.958	56.000	20.753	32.694	46.000	14.017
3.131	24.059	56.000	34.280	19.298	46.000	29.041
3.253	24.421	56.000	34.026	22.856	46.000	25.592
5.551	25.890	60.000	30.198	24.662	50.000	21.426
6.013	29.633	60.000	26.529	28.743	50.000	17.419
6.476	26.966	60.000	29.270	25.676	50.000	20.560
11.567	25.195	60.000	31.855	21.816	50.000	25.235
14.267	9.330	60.000	48.152	5.006	50.000	42.477

Neutral

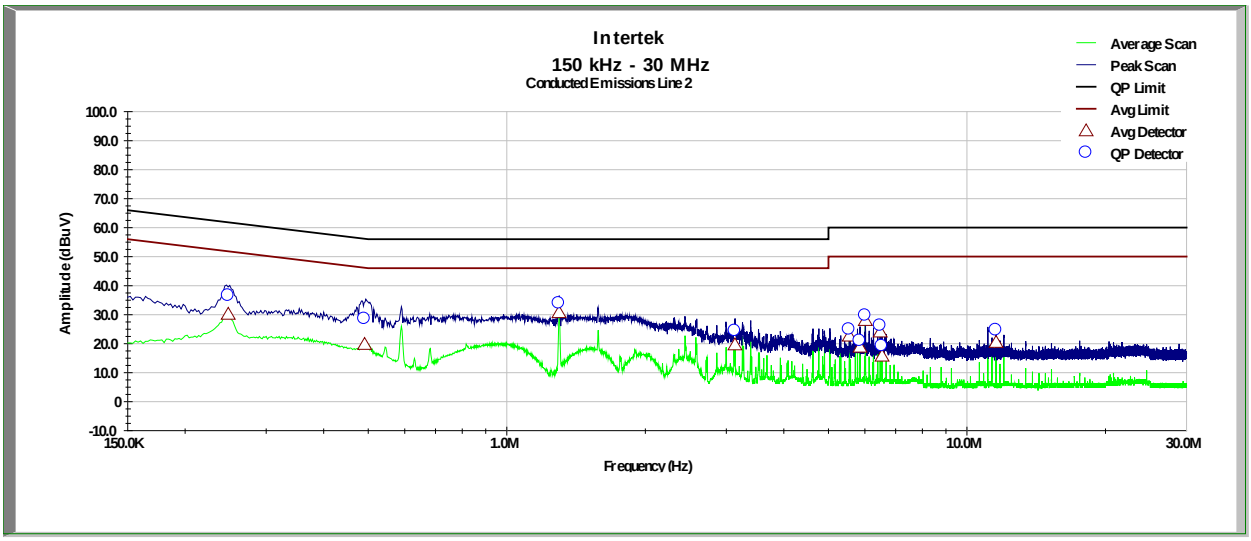
14.9 Plots/Data: Conducted Emissions (EDR Transmitting)



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.248	35.539	63.211	27.673	32.047	53.211	21.165
0.590	29.704	56.000	26.376	25.785	46.000	20.295
1.301	36.278	56.000	20.434	32.848	46.000	13.864
3.132	24.596	56.000	33.744	19.790	46.000	28.550
3.388	24.340	56.000	34.227	22.231	46.000	26.337
5.550	25.966	60.000	30.122	24.684	50.000	21.404
6.014	29.024	60.000	27.139	27.876	50.000	18.286
6.478	26.132	60.000	30.105	23.889	50.000	22.348
11.100	22.300	60.000	34.676	19.385	50.000	27.591
11.570	24.053	60.000	32.998	19.169	50.000	27.882

Line



Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.248	36.486	63.197	26.711	30.131	53.197	23.067
0.491	28.475	56.263	27.788	19.745	46.263	26.518
1.299	33.831	56.000	22.879	30.688	46.000	16.022
3.132	24.332	56.000	34.008	19.586	46.000	28.753
5.548	24.849	60.000	31.239	22.602	50.000	23.486
5.856	20.931	60.000	35.206	18.782	50.000	27.355
6.014	29.633	60.000	26.529	28.000	50.000	18.162
6.478	26.132	60.000	30.105	23.998	50.000	22.238
6.539	19.107	60.000	37.140	15.707	50.000	30.539
11.570	24.602	60.000	32.449	20.419	50.000	26.632

Neutral

15 Antenna Requirement per FCC Part 15.203

15.1 Test Limits

§ 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, or §15.221. 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.

15.2 Test Results

The sample tested met the antenna requirement. The antenna used was internal to the sample and permanently attached to the PCB.

15.3 Test Conditions

Test Personnel:	Brian Lackey	Test Date:	5/16/2018
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Ambient Temperature:	25.3C
Input Voltage:	Battery	Relative Humidity:	44.2%
		Atmospheric Pressure:	982.0mbar

16 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

Parameter	Uncertainty	Notes
Radiated emissions, 30 to 1000 MHz	±3.9dB	
Radiated emissions, 1 to 18 GHz	±4.2dB	
Radiated emissions, 18 to 40 GHz	±4.3dB	
Power Port Conducted emissions, 150kHz to 30 MHz	±2.8dB	

17 Revision History

Revision Level	Date	Report Number	Notes
0	5/31/2018	103477146LEX-002	Original Issue
0	6/5/2018	103477146LEX-002.1	Updated model number and contact information