

BLUETOOTH (LE) TEST REPORT

Report Number: 103264009LEX-004a

Project Number: G103264009

Report Issue Date: 12/11/2017

Product Name: Wireless Print Server

Model Number: LEX-M07-001

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:
Lexmark International, Inc.
740 W New Circle Road, F61/004-2
Lexington, KY 40511

Report prepared by



Bryan Taylor, Team Leader

Report reviewed by



Brian Lackey, Project Engineer

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

TABLE OF CONTENTS

1	<i>Introduction and Conclusion</i>	3
2	<i>Test Summary</i>	3
3	<i>Description of Equipment Under Test</i>	4
4	<i>System setup including cable interconnection details, support equipment and simplified block diagram</i>	5
5	<i>Peak Output Power</i>	6
6	<i>6dB Bandwidth.....</i>	9
7	<i>Power Spectral Density</i>	14
8	<i>Radiated Spurious Emissions (Transmitter).....</i>	18
9	<i>Radiated Spurious Emissions (Receiver).....</i>	29
10	<i>Antenna Requirement per FCC Part 15.203.....</i>	33
11	<i>Measurement Uncertainty.....</i>	34
12	<i>Revision History</i>	35

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
6	Peak Output Power	§ 15.247(b)(3)	RSS-247 § 5.4(b)	Pass
9	6dB Bandwidth	§ 15.247(a)(2)	RSS-247 § 5.2(a)	Pass
14	Power Spectral Density	§ 15.247(e)	RSS-247 § 5.2(b)	Pass
14	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-247 § 5.5	Pass
29	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen § 7.1.2	Pass
-	AC Mains Conducted Emissions	§ 15.107, § 15.207	RSS-Gen § 8.8	Pass
33	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen § 8.3	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	Lexmark International, Inc.
Model Number	LEX-M07-001
Serial Number	Test Sample 3
Receive Date	10/9/2017
Test Start Date	10/24/2017
Test End Date	12/11/2017
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2402 – 2480MHz
Mode(s) of Operation	Bluetooth Low Energy
Modulation Type	DTS
Transmission Control	Test Commands
Maximum Output Power	4.39dBm
Test Channels	0, 19, 39
Antenna Type (15.203)	Internal
Operating Voltage	5V Via USB Cable
Antenna Gain	2402MHz: -0.7dBi 2440MHz: 0.2dBi 2480MHz: 0.3dBi

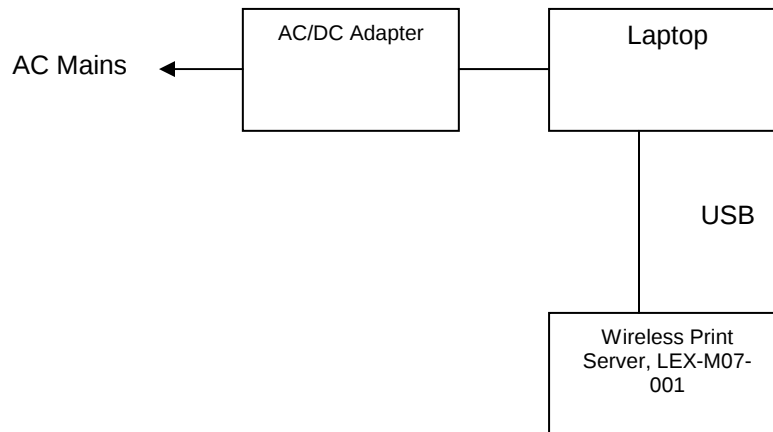
Description of Equipment Under Test
The LEX-M07-001 is a 2.4GHz/5GHz dual band Wi-Fi module supporting 802.11b/g/a/n/ac standards. WiFi function supports 2x2 MU-MIMO. Module hardware also supports Bluetooth 4.2/Bluetooth Low Energy.

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Bluetooth low energy (BTLE) transmitting on low, mid, and high channels
2	Bluetooth low energy (BTLE) normal hopping enabled
2	Receive / idle mode

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 Cable	2m	Yes	None	Laptop Computer

4.3 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Laptop	HP	ProBook 455 G4	5CD7212NG5

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:

(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

5.2 Test Procedure

ANSI C63.10: 2013. The peak output power was measured using the marker to peak function of the spectrum analyzer.

5.3 Test Equipment Used

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	10/12/2017	10/12/2018
Horn Antenna	154521	ETS	3117	6/1/2017	6/1/2018
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use

5.4 Test Results

The device was found to be **compliant**. The peak output power was less than the limit. Note that the sample did not have an antenna connector so the measurements were performed via radiated methods and the field strength converted from dBuV/m to dBm per the guidance in ANSI C63.10: 2013.

5.5 Test Conditions

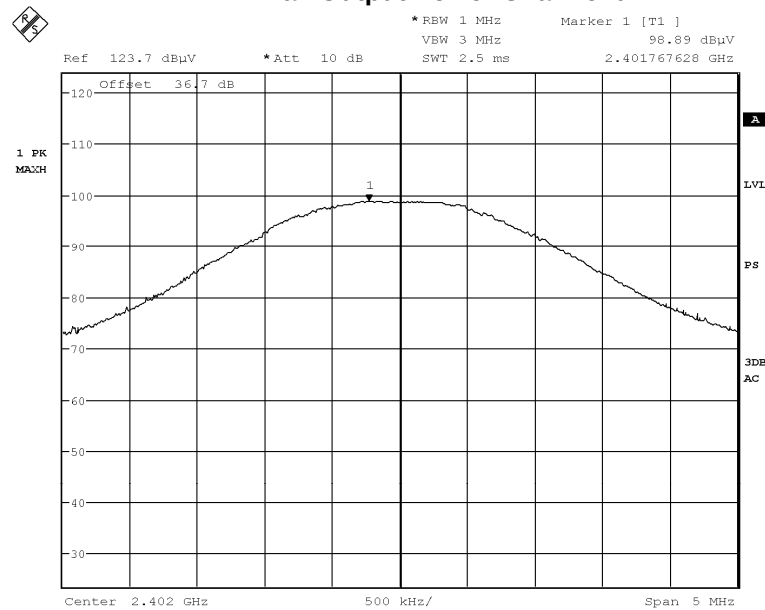
Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer:
(Where Applicable) NA
Product Standard: FCC Part 15C, RSS-247
Input Voltage: DC Powered via USB
Pretest Verification w/ Ambient Signals or BB Source: Yes

Test Date: 11/29/2017
Limit Applied: 30dBm (1 Watt)
Ambient Temperature: 22.4C
Relative Humidity: 44.9%

5.6 Test Data

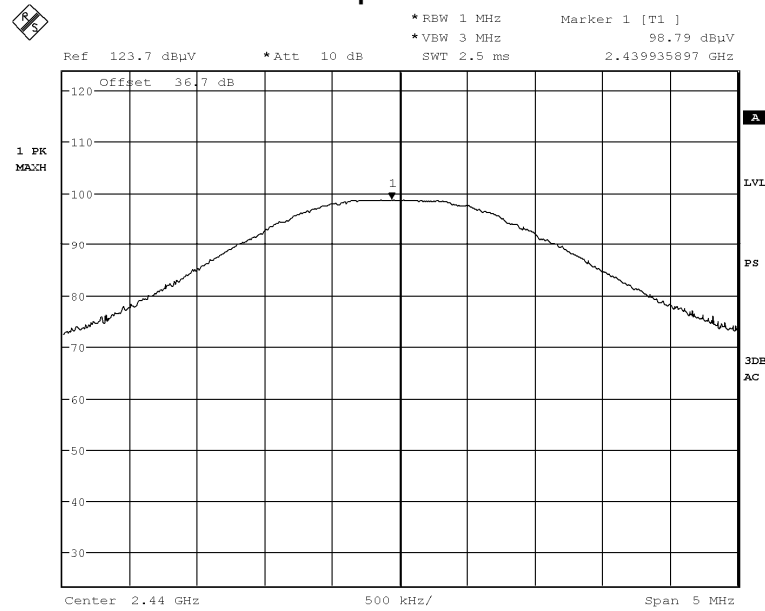
Mode	Freq. (MHz)	Field Strength (dBuV/m)	EIRP (dBm)	Antenna Gain (dBi)	Cond. Output Power (dBm)	Limit (dBm)	Margin (dB)	Result
BLE	2402	98.89	3.69	-0.7	4.39	30	25.61	Pass
BLE	2440	98.79	3.59	0.2	3.39	30	26.61	Pass
BLE	2480	98.34	3.14	0.3	2.84	30	27.16	Pass

Max Output Power Channel 0



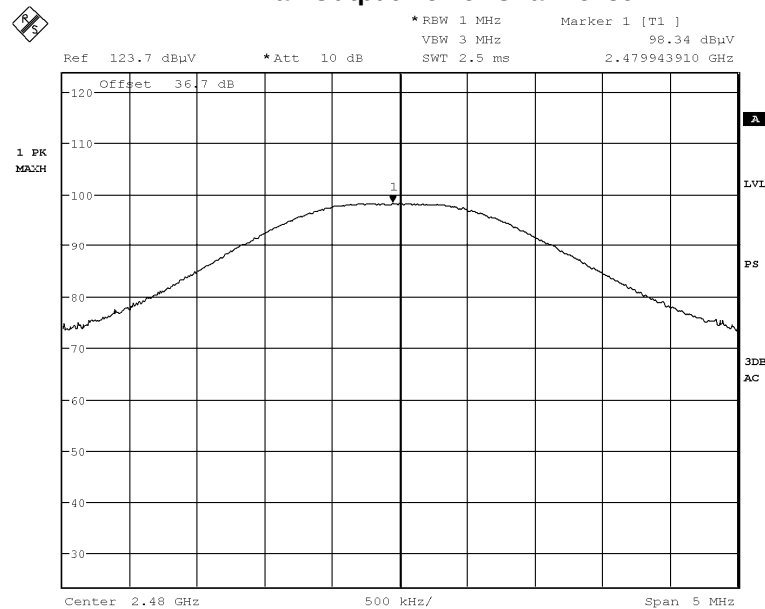
Date: 29.NOV.2017 12:28:59

Max Output Power Channel 19



Date: 29.NOV.2017 12:59:49

Max Output Power Channel 39



Date: 29.NOV.2017 12:36:51

6 6dB 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:

(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.

6.2 Test Procedure

ANSI C63.10: 2013.

6.3 Test Equipment Used

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde&Schwarz	FSP7	10/18/2017	10/18/2018

6.4 Test Results

The 6dB bandwidth measurements are shown below. A 99% bandwidth measurement was also performed. The 6dB bandwidth measurements are all greater than the 500kHz minimum requirement.

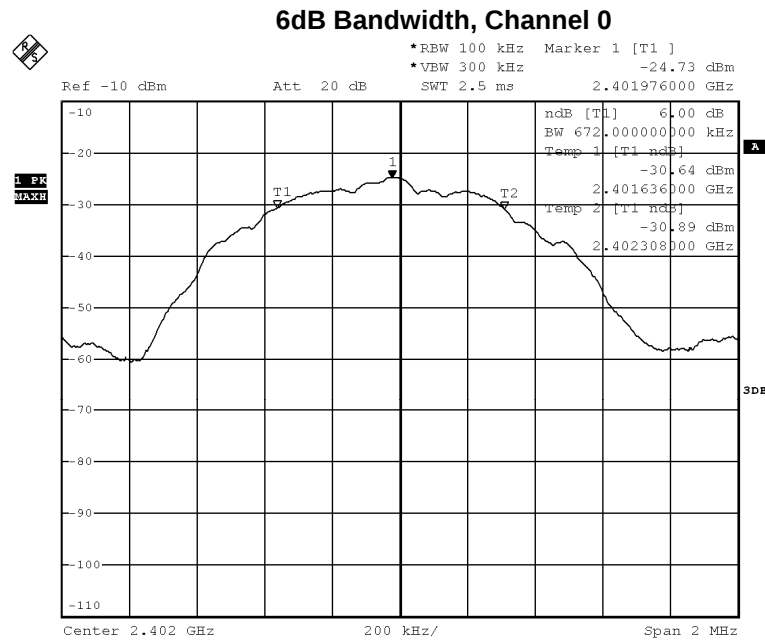
Channel	Frequency (MHz)	6dB Bandwidth (kHz)	99% Bandwidth (MHz)	Limit (kHz)	Result
0	2402	672kHz	1.06MHz	500kHz	Pass
19	2440	672kHz	1.06MHz	500kHz	Pass
39	2480	676kHz	1.06MHz	500kHz	Pass

6.5 Test Conditions

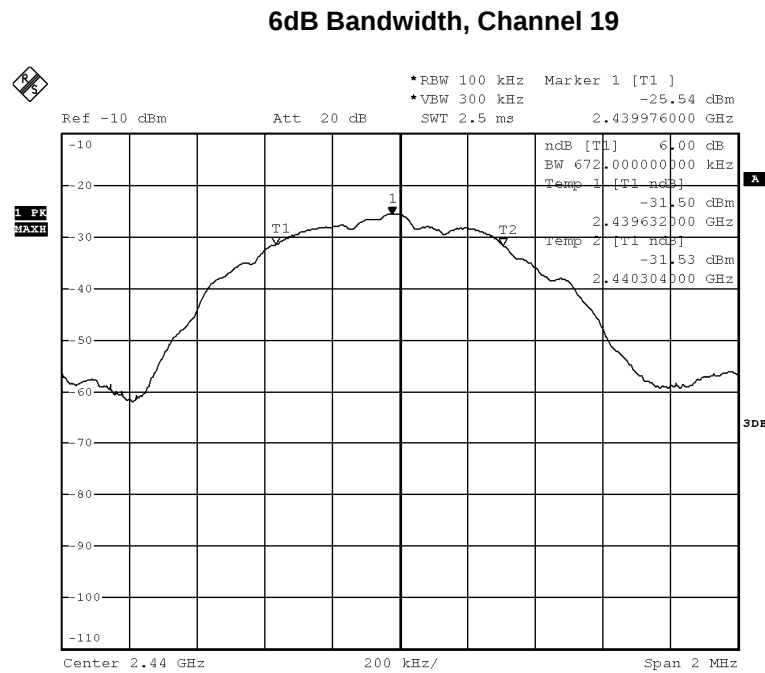
Test Personnel: Bryan Taylor
Supervising/Reviewing Engineer: NA
(Where Applicable) NA
Product Standard: FCC Part 15C, RSS-247
Input Voltage: DC Powered via USB
Pretest Verification w/ Ambient Signals or BB Source: Yes

Test Date: 12/11/2017
Limit Applied: DTS Limit for 2400 – 2483.5MHz Band (>500kHz)
Ambient Temperature: 22.7C
Relative Humidity: 33.5%

6.6 Test Data

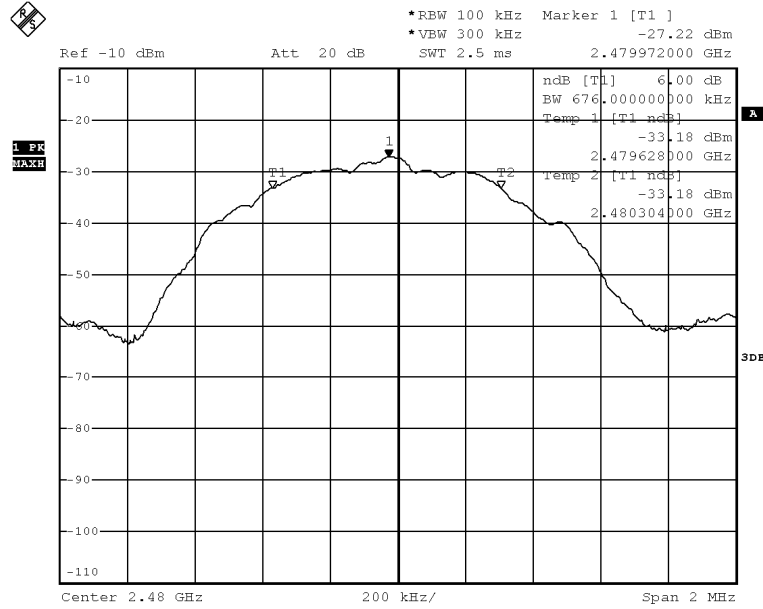


Date: 11.DEC.2017 09:41:14



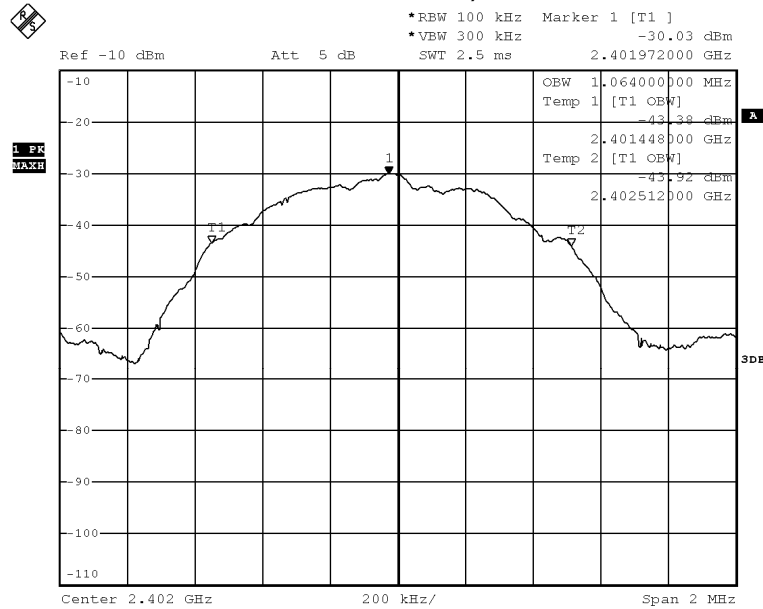
Date: 11.DEC.2017 09:42:47

6dB Bandwidth, Channel 39



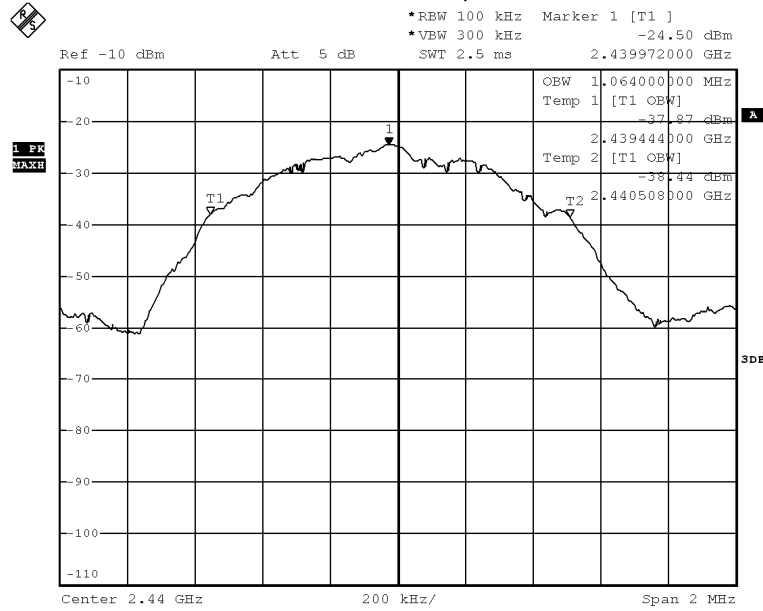
Date: 11.DEC.2017 09:43:58

99% Bandwidth, Channel 0



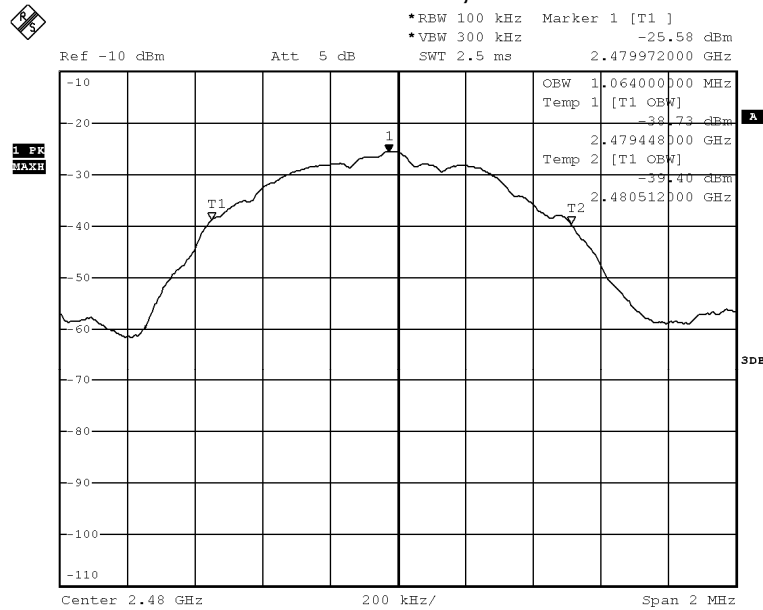
Date: 11.DEC.2017 09:48:24

99% Bandwidth, Channel 19



Date: 11.DEC.2017 09:47:35

99% Bandwidth, Channel 39



Date: 11.DEC.2017 09:46:44

7 Power Spectral Density

7.1 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.

7.2 Test Procedure

ANSI C63.10: 2013.

7.3 Test Equipment Used

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	10/12/2017	10/12/2018
Horn Antenna	154521	ETS	3117	6/1/2017	6/1/2018
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use

7.4 Test Results

The device was found to be **compliant**. The peak power spectral density was less than the limit. Note that the sample did not have an antenna connector so the measurements were performed via radiated methods and the field strength converted from dBuV/m to dBm per the guidance in ANSI C63.10: 2013.

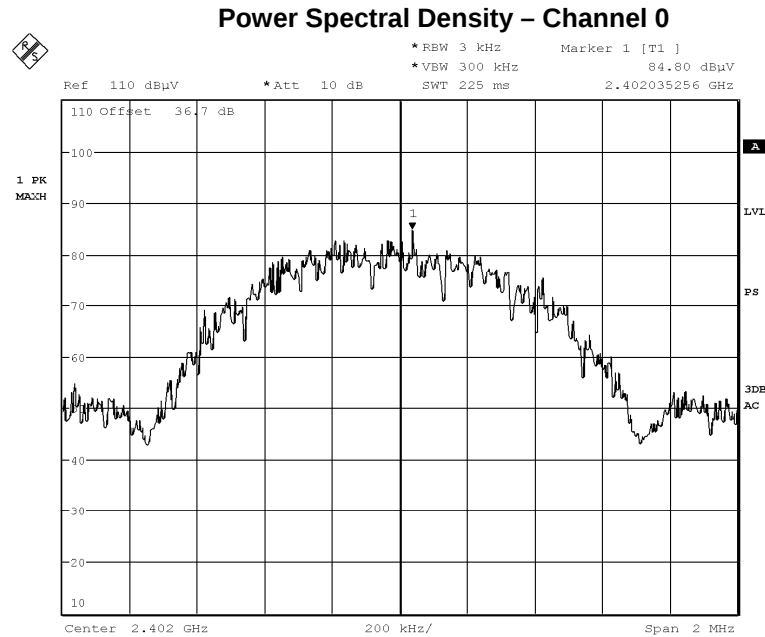
7.5 Test Conditions

Test Personnel: Bryan Taylor
Supervising/Reviewing
Engineer:
(Where Applicable) NA
Product Standard: FCC Part 15C, RSS-247
Input Voltage: DC Powered via USB
Pretest Verification w/
Ambient Signals or
BB Source: Yes

Test Date: 11/29/2017
Limit Applied: 8dBm
Ambient Temperature: 22.4C
Relative Humidity: 44.9%
Atmospheric Pressure: 995.6mbar

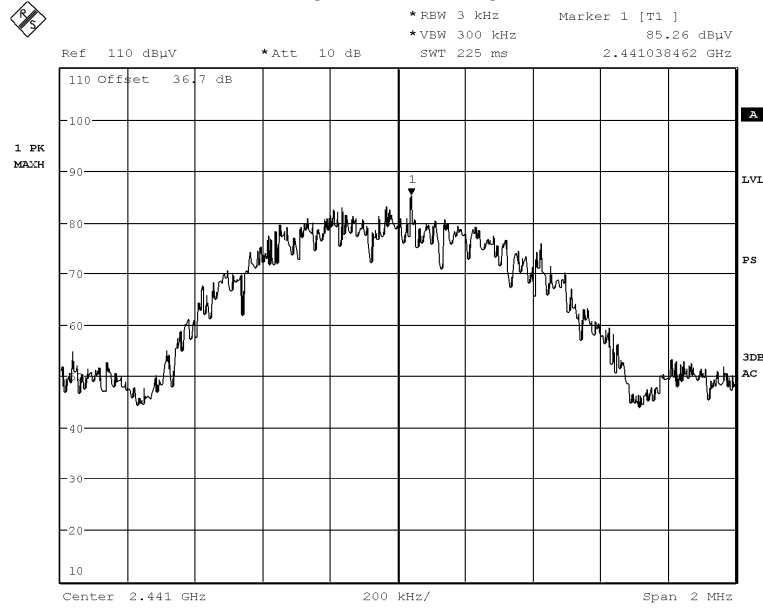
7.6 Test Data

Mode	Freq. (MHz)	Field Strength (dBuV/m)	EIRP (dBm)	Antenna Gain (dBi)	PPSD (dBm)	Limit (dBm)	Margin (dB)	Result
BLE	2402	84.8	-10.4	-0.7	-9.7	8	17.7	Pass
BLE	2441	85.26	-9.94	0.2	-10.14	8	18.14	Pass
BLE	2480	84.69	-10.51	0.3	-10.81	8	18.81	Pass



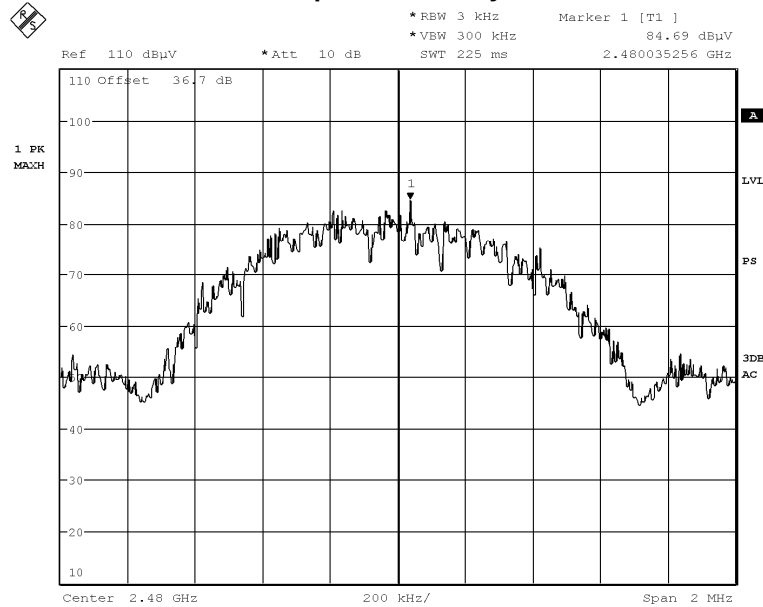
Date: 29.NOV.2017 12:55:21

Power Spectral Density – Channel 19



Date: 29.NOV.2017 12:53:30

Power Spectral Density – Channel 39



Date: 29.NOV.2017 12:50:36

8 Radiated Spurious Emissions (Transmitter)

8.1 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
10.495–0.505	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

8.2 Test Procedure

ANSI C63.10: 2013.

8.3 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 dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

$$RA = 19.48 \text{ dB}\mu\text{V}$$

$$AF = 18.52 \text{ dB}$$

$$CF = 0.78 \text{ dB}$$

$$FS = 19.48 + 18.52 + 0.78 = 38.78 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

8.4 Test Equipment Used

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	10/12/2017	10/12/2018
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/17/2016	11/17/2017
Biconnilog Antenna	9610-1102	ETS	3142	2/25/2016	2/25/2018
Horn Antenna	154521	ETS	3117	6/1/2017	6/1/2018
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/17/2016	11/17/2017
3m Cable Preamp→Chamber	2588			11/17/2016	11/17/2017
3m Cable Chamber→Control Room	2593			11/17/2016	11/17/2017
3m Cable Control Room→Receiver	2592			11/17/2016	11/17/2017
10m Cable Antenna→Preamp	3339			11/17/2016	11/17/2017
10m Cable Preamp→Chamber	3172			11/17/2016	11/17/2017
10m Cable Chamber→Control Room	2590			11/17/2016	11/17/2017
10m Cable Control Room→Receiver	2589			11/17/2016	11/17/2017

8.5 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. Plots are also presented showing compliance with the restricted bands immediately adjacent to the transmit band.

8.6 Test Conditions

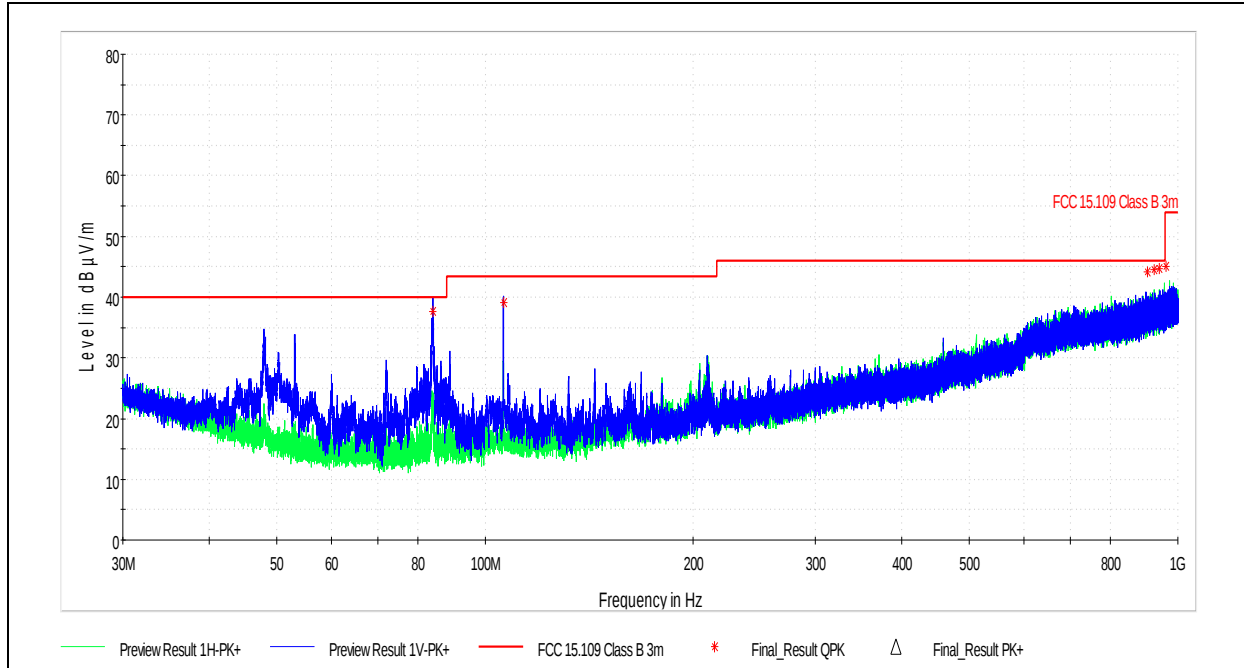
Test Personnel:	Bryan Taylor
Supervising/Reviewing Engineer:	
(Where Applicable)	NA
Product Standard:	FCC Part 15C, RSS-247
Input Voltage:	DC Powered via USB
Pretest Verification w/ Ambient Signals or BB Source:	Yes

Test Date:	10/24/2017
	20dB down from fundamental (non-restricted bands)
Limit Applied:	15.209 (restricted bands)
Ambient Temperature:	22.4C
Relative Humidity:	44.9%
Atmospheric Pressure:	995.6mbar

8.7 Test Data

The worst case test data is shown below. Note that emissions were investigated with the test sample in its worst operating position across 3 orthogonal axes.

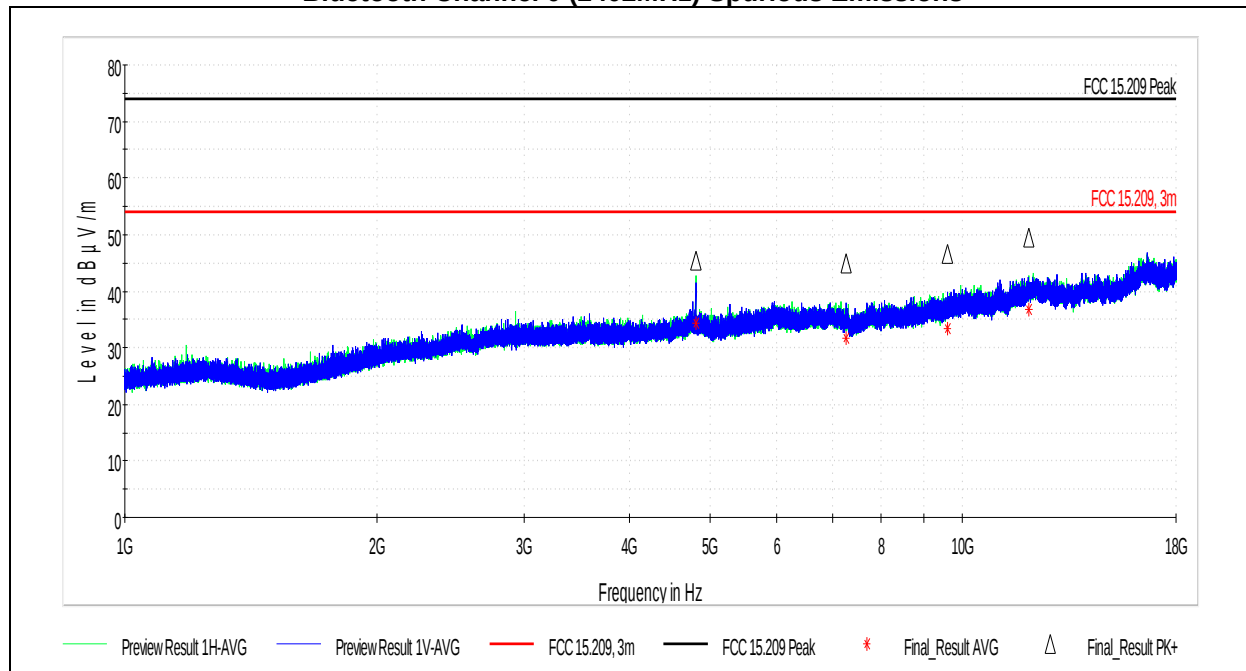
Bluetooth 30MHz – 1GHz Data (Worst case is shown and is representative of all channels)



Final_Result

Frequency (MHz)	QuasiPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
83.965000	37.67	40.00	2.33	120.000	104.6	V	7.0	16.1
106.320000	39.08	43.52	4.44	120.000	109.7	V	0.0	16.8
903.460000	44.15	46.02	1.87	120.000	248.3	V	165.0	35.8
924.780000	44.46	46.02	1.56	120.000	329.8	H	218.0	36.0
939.660000	44.76	46.02	1.26	120.000	331.7	H	184.0	36.0
960.920000	45.00	54.00	9.00	120.000	405.0	H	72.0	36.2

Bluetooth Channel 0 (2402MHz) Spurious Emissions



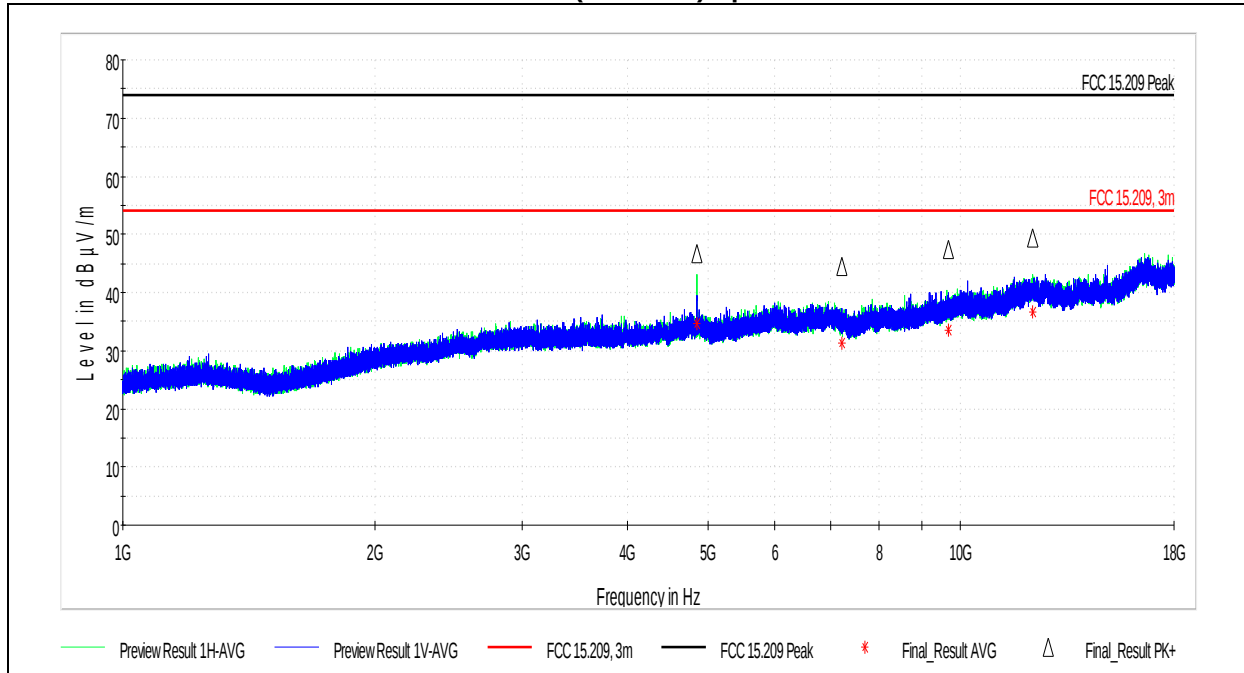
Final Result PK+

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4803.927000	45.47	74.00	28.53	1000.000	166.0	V	10.0	7.5
7268.508500	44.93	74.00	29.07	1000.000	148.0	V	50.0	10.4
9592.259500	46.61	74.00	27.39	1000.000	128.0	V	50.0	13.5
12011.301979	49.40	74.00	24.60	1000.000	165.0	H	50.0	17.4

Final Result AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4803.927000	34.28	54.00	19.72	1000.000	166.0	V	10.0	7.5
7268.508500	31.73	54.00	22.27	1000.000	148.0	V	50.0	10.4
9592.259500	33.49	54.00	20.51	1000.000	128.0	V	50.0	13.5
12011.301979	36.84	54.00	17.16	1000.000	165.0	H	50.0	17.4

Bluetooth Channel 19 (2440MHz) Spurious Emissions



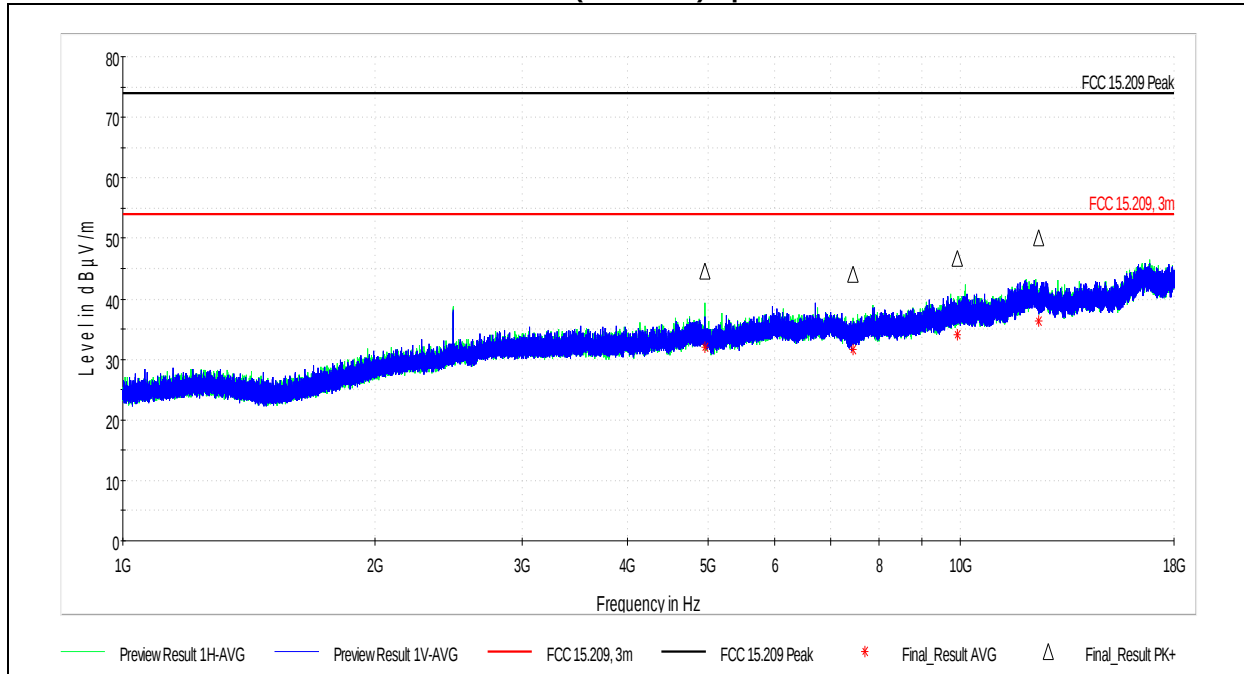
Final Result PK+

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4844.286500	46.79	74.00	27.21	1000.000	200.0	V	0.0	7.4
7225.932500	44.58	74.00	29.42	1000.000	159.0	V	50.0	10.4
9689.029000	47.40	74.00	26.60	1000.000	145.0	V	50.0	13.6
12210.530500	49.29	74.00	24.71	1000.000	170.0	H	27.0	17.2

Final Result AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4844.286500	34.69	54.00	19.31	1000.000	200.0	V	0.0	7.4
7225.932500	31.39	54.00	22.61	1000.000	159.0	V	50.0	10.4
9689.029000	33.63	54.00	20.37	1000.000	145.0	V	50.0	13.6
12210.530500	36.61	54.00	17.39	1000.000	170.0	H	27.0	17.2

Bluetooth Channel 39 (2480MHz) Spurious Emissions



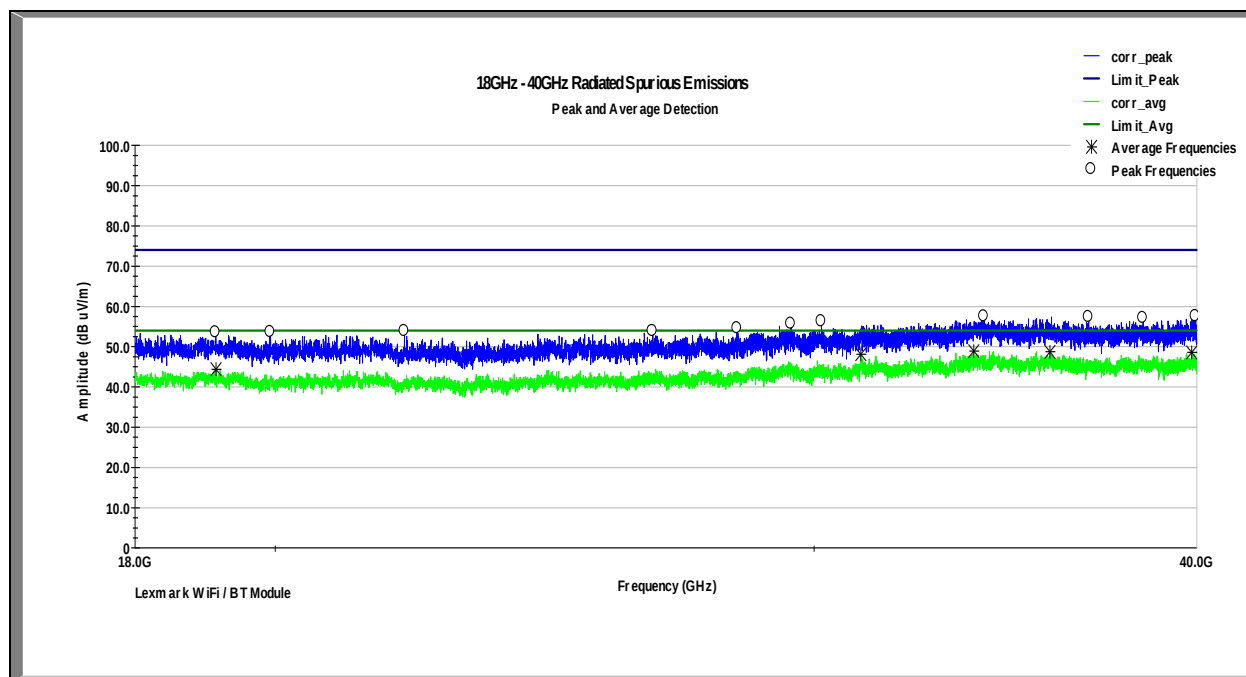
Final_Result_PK+

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4959.997000	44.57	74.00	29.43	1000.000	200.0	V	23.0	7.2
7446.099000	44.04	74.00	29.96	1000.000	145.0	H	0.0	10.9
9919.149500	46.69	74.00	27.31	1000.000	158.0	V	50.0	14.0
12402.883500	50.05	74.00	23.95	1000.000	176.0	V	50.0	16.9

Final_Result_AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4959.997000	31.94	54.00	22.06	1000.000	200.0	V	23.0	7.2
7446.099000	31.66	54.00	22.34	1000.000	145.0	H	0.0	10.9
9919.149500	34.01	54.00	19.99	1000.000	158.0	V	50.0	14.0
12402.883500	36.28	54.00	17.72	1000.000	176.0	V	50.0	16.9

Bluetooth 18 – 40GHz Data
(Worst case is shown and is representative of all channels)

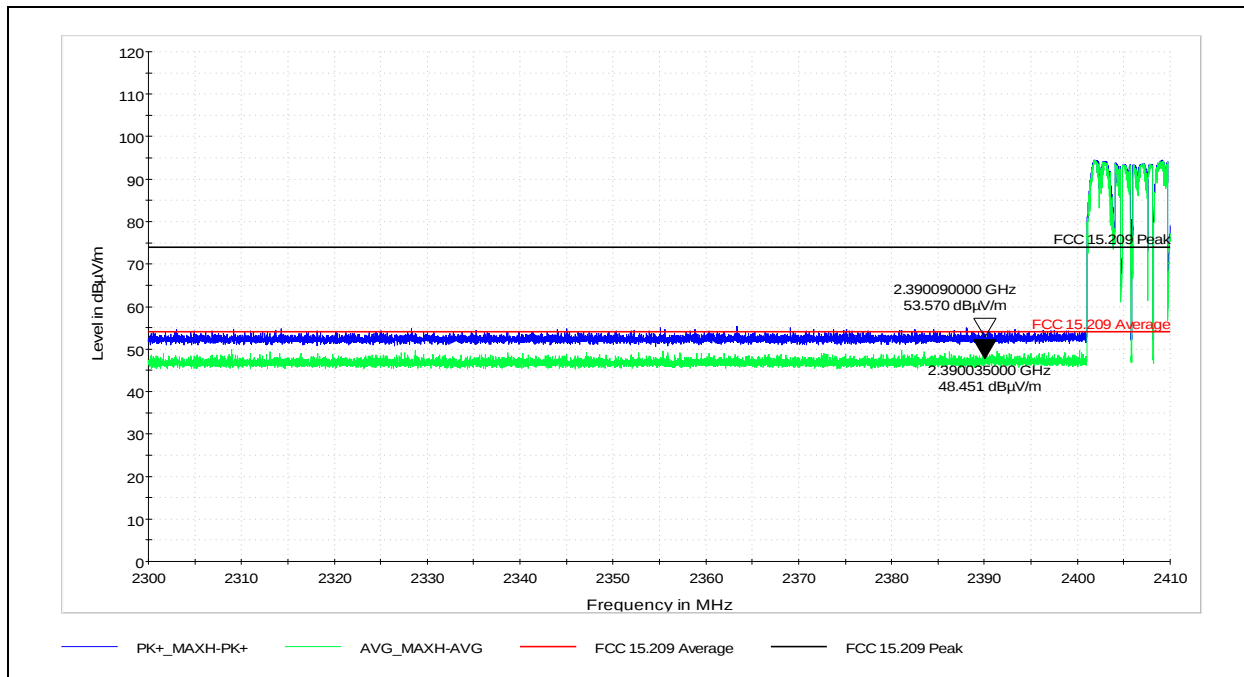
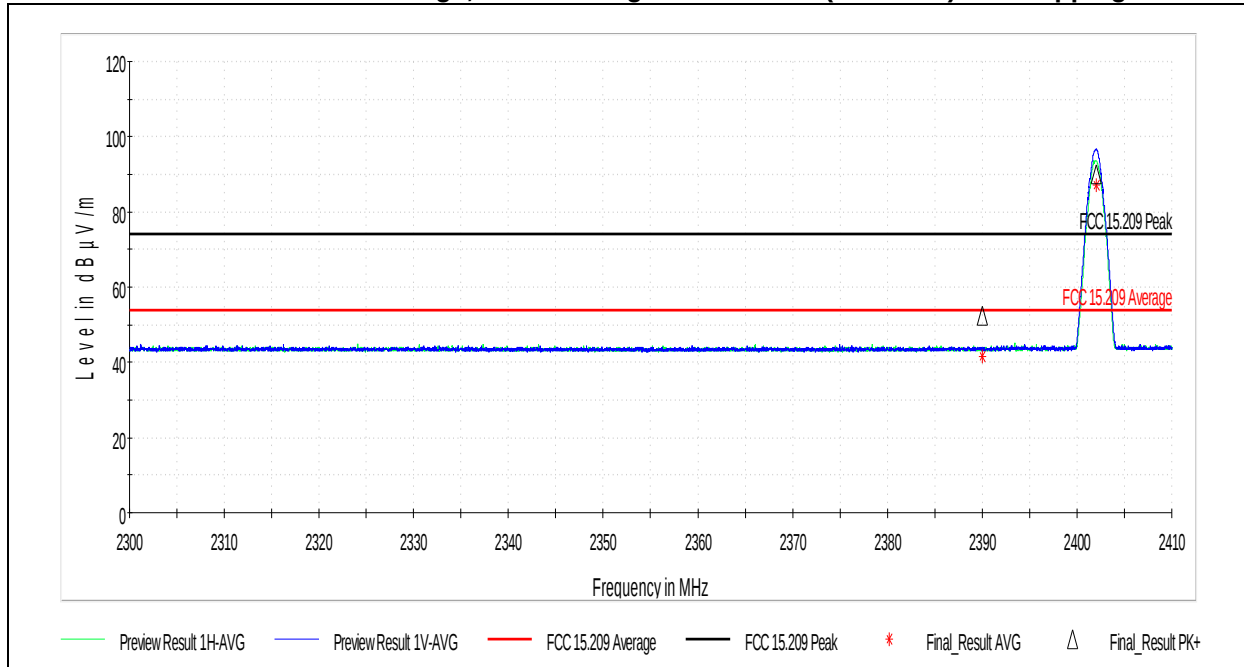
**Scan_Result_PK+**

Frequency (GHz)	Peak (dBuV/m)	Peak Limit (dBuV/m)	Peak Margin (dB)
19.129 GHz	53.44	74.00	20.56
19.932 GHz	53.53	74.00	20.47
22.044 GHz	53.82	74.00	20.18
26.571 GHz	53.79	74.00	20.21
28.316 GHz	54.45	74.00	19.55
29.484 GHz	55.61	74.00	18.39
30.166 GHz	56.20	74.00	17.80
34.089 GHz	57.42	74.00	16.58
36.880 GHz	57.24	74.00	16.76
38.420 GHz	57.04	74.00	16.96
39.971 GHz	57.47	74.00	16.53

Scan_Result_AVG

Frequency (GHz)	Average (dBuV/m)	Limit (dBuV/m)	Average Margin (dB)
19.131 GHz	44.40	54.00	29.60
31.070 GHz	48.09	54.00	25.91
33.825 GHz	48.89	54.00	25.11
35.820 GHz	48.71	54.00	25.29
39.853 GHz	48.55	54.00	25.45

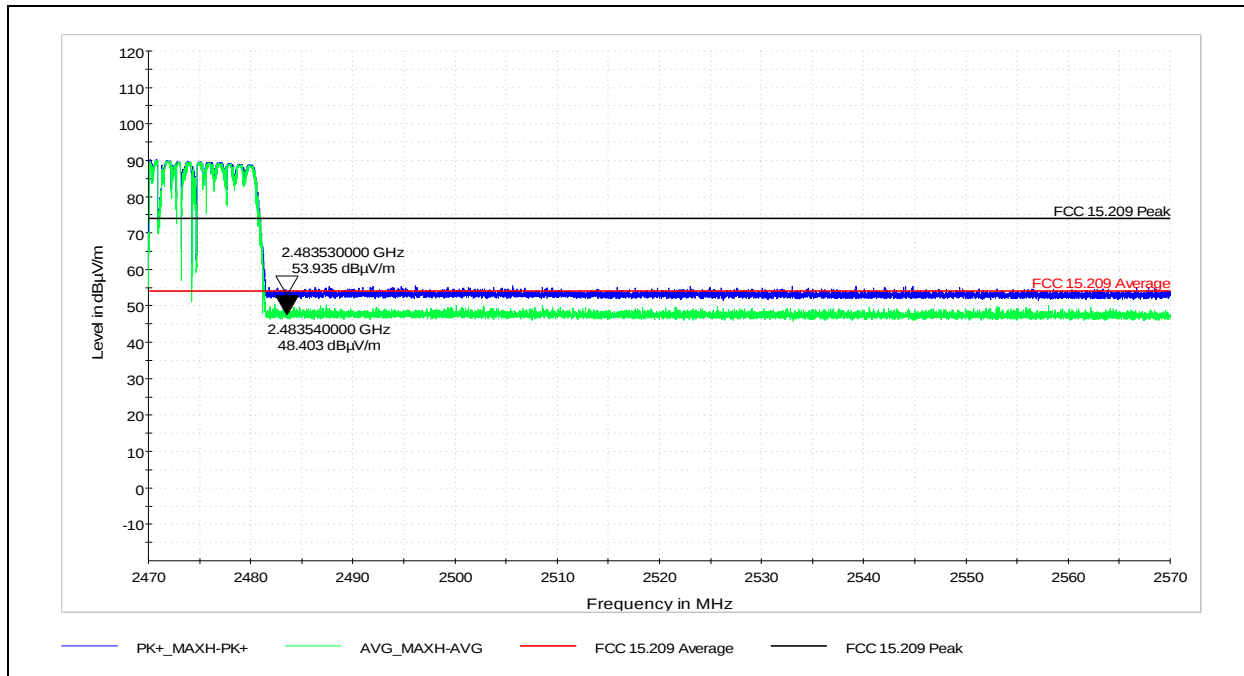
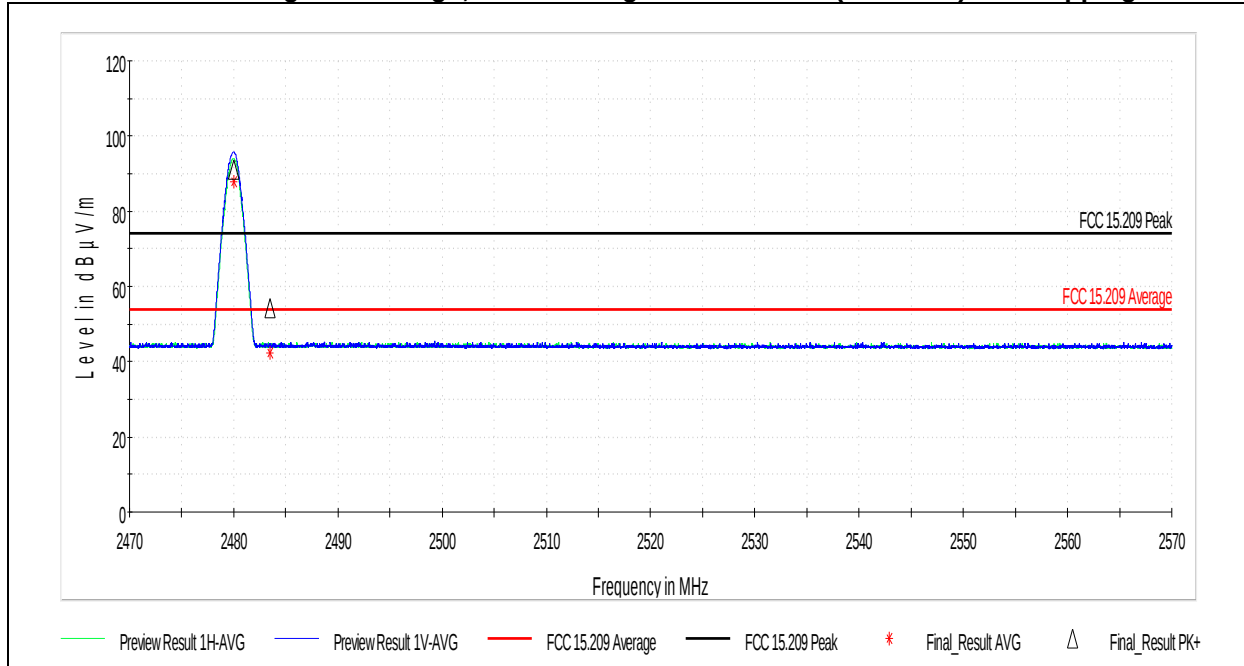
Bluetooth Low Band Edge, Transmitting on Channel 0 (2402MHz) and Hopping



Final Result

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	---	52.24	74.00	21.76	1000.000	243.0	V	0.0	37.7
2390.000000	41.49	---	54.00	12.51	1000.000	243.0	V	0.0	37.7
2402.014000	---	89.98	Fund	Fund	1000.000	205.0	V	171.0	37.8
2402.014000	87.11	---	Fund	Fund	1000.000	205.0	V	171.0	37.8

Bluetooth High Band Edge, Transmitting on Channel 39 (2480MHz) and Hopping



Final Result

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2480.020000	---	91.07	Fund	Fund	1000.000	410.0	H	341.0	37.8
2480.020000	87.84	---	Fund	Fund	1000.000	410.0	H	341.0	37.8
2483.500000	---	54.14	74.00	19.86	1000.000	215.0	V	334.0	37.8
2483.500000	42.16	---	54.00	11.84	1000.000	215.0	V	334.0	37.8

9 Radiated Spurious Emissions (Receiver)

9.1 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

9.2 Test Procedure

ANSI C63.4: 2014

9.3 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 dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB

CF = Cable Attenuation Factor in dB (Including preamplifier and filter attenuation)

Example Calculation:

RA = 19.48 dB μ V

AF = 18.52 dB

CF = 0.78 dB

$$FS = 19.48 + 18.52 + 0.78 = 38.78 \text{ dB}\mu\text{V/m}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(38.78 \text{ dB}\mu\text{V/m})/20] = 86.89 \mu\text{V/m}$$

9.4 Test Equipment Used

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde & Schwarz	ESU40	10/12/2017	10/12/2018
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/17/2016	11/17/2017
Biconnilog Antenna	9610-1102	ETS	3142	2/25/2016	2/25/2018
Horn Antenna	154521	ETS	3117	6/1/2017	6/1/2018
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/17/2016	11/17/2017
3m Cable Preamp→Chamber	2588			11/17/2016	11/17/2017
3m Cable Chamber→Control Room	2593			11/17/2016	11/17/2017
3m Cable Control Room→Receiver	2592			11/17/2016	11/17/2017
10m Cable Antenna→Preamp	3339			11/17/2016	11/17/2017
10m Cable Preamp→Chamber	3172			11/17/2016	11/17/2017
10m Cable Chamber→Control Room	2590			11/17/2016	11/17/2017
10m Cable Control Room→Receiver	2589			11/17/2016	11/17/2017

9.5 Test Results

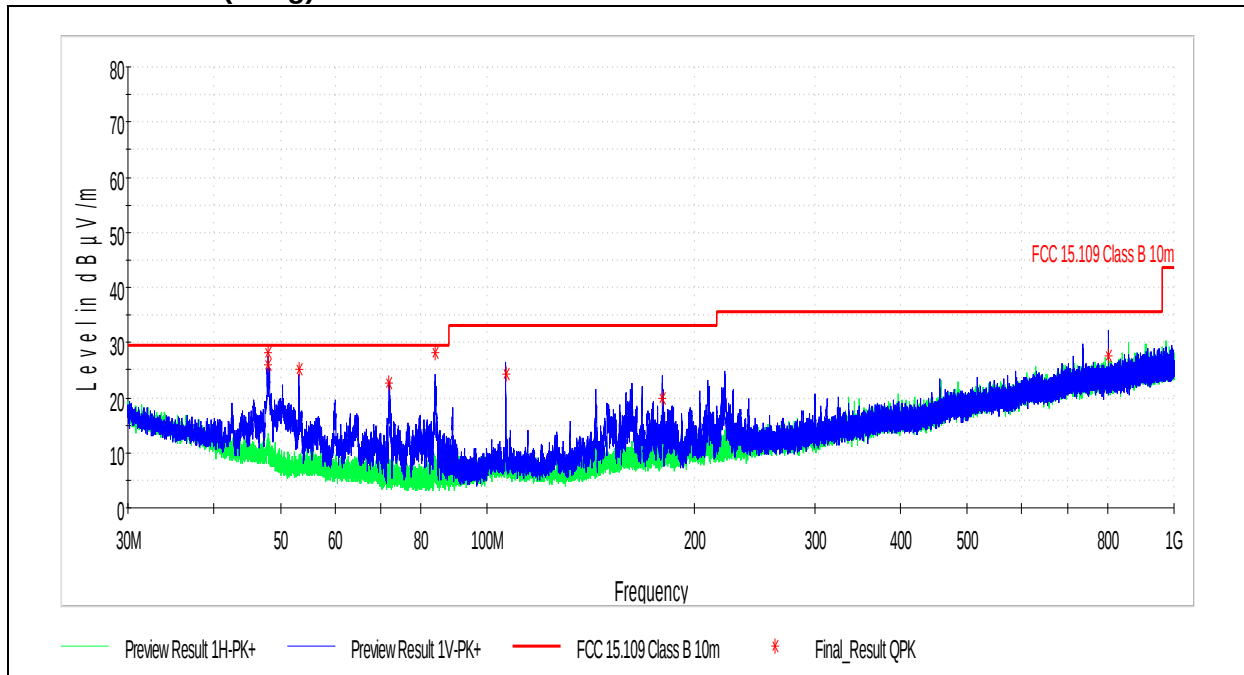
All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device and RSS-GEN Section 6.1. All peak detected emissions were at least 15dB below the limit.

9.6 Test Conditions

Test Personnel: Bryan Taylor
 Supervising/Reviewing Engineer:
 (Where Applicable) NA
 Product Standard: FCC Part 15C, RSS-247
 Input Voltage: DC Powered via USB
 Pretest Verification w/ Ambient Signals or BB Source: Yes

Test Date: 10/24/2017
 Limit Applied: Class B
 Ambient Temperature: 22.4C
 Relative Humidity: 44.9%
 Atmospheric Pressure: 995.6mbar

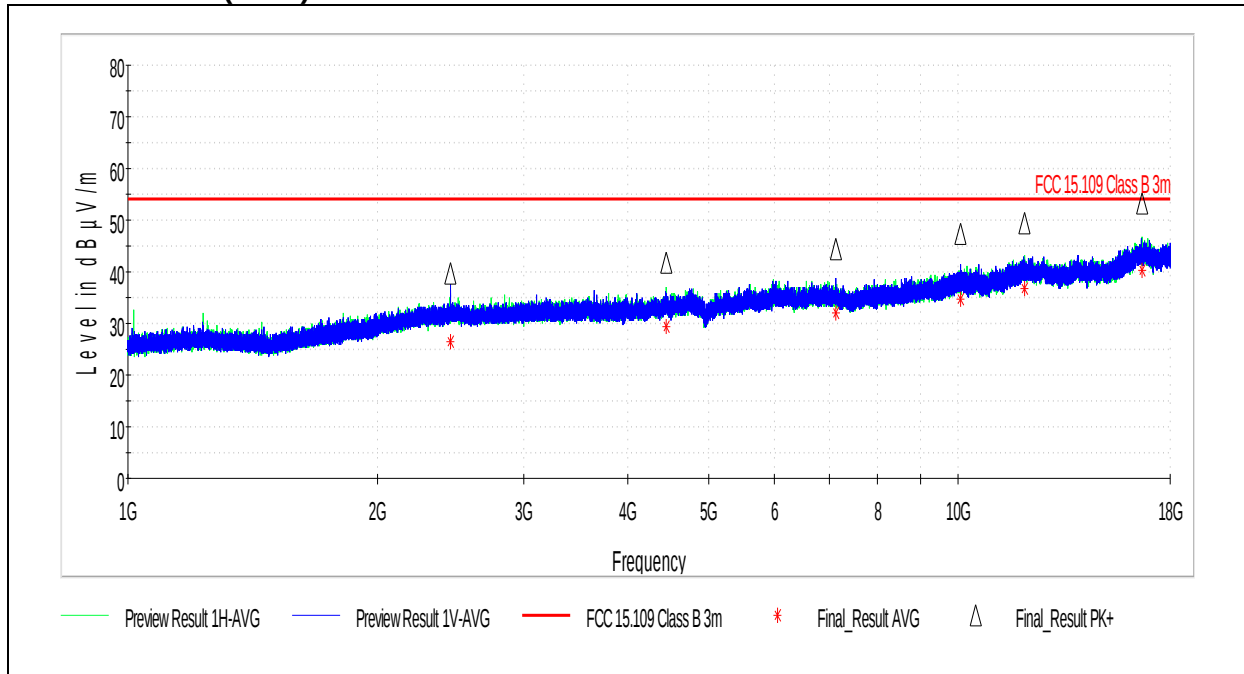
9.7 Test Data (Bilog)



Final Results

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
48.001600	28.26	29.55	1.29	120.000	343.8	V	0.0	-10.8
48.012300	26.03	29.55	3.52	120.000	337.0	V	94.0	-10.8
53.193700	25.01	29.55	4.54	120.000	100.5	V	244.0	-11.8
71.986100	22.64	29.55	6.91	120.000	181.9	V	0.0	-13.0
83.989200	28.16	29.55	1.39	120.000	139.4	V	0.0	-13.1
106.533600	24.34	33.10	8.76	120.000	99.6	V	0.0	-11.9
179.994000	19.99	33.10	13.11	120.000	104.9	V	60.0	-9.1
801.822000	27.71	35.55	7.84	120.000	110.2	V	274.0	6.5

9.8 Test Data (Horn)



Final_Result_PK+

Frequency (MHz)	MaxPeak (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2447.233000	39.66	70.00	30.34	1000.000	166.0	V	50.0	3.9
4450.298000	41.86	74.00	32.14	1000.000	200.0	V	50.0	7.2
7122.561500	44.46	74.00	29.54	1000.000	177.0	V	19.0	10.2
10067.851000	47.45	74.00	26.55	1000.000	165.0	V	20.0	14.4
12028.892500	49.42	74.00	24.58	1000.000	135.0	V	50.0	17.4
16650.824000	53.21	74.00	20.79	1000.000	200.0	H	50.0	21.5

Final_Result_AVG

Frequency (MHz)	Average (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2447.233000	26.48	54.00	27.52	1000.000	166.0	V	50.0	3.9
4450.298000	29.32	54.00	24.68	1000.000	200.0	V	50.0	7.2
7122.561500	32.02	54.00	21.98	1000.000	177.0	V	19.0	10.2
10067.851000	34.56	54.00	19.44	1000.000	165.0	V	20.0	14.4
12028.892500	36.89	54.00	17.11	1000.000	135.0	V	50.0	17.4
16650.824000	40.36	54.00	13.64	1000.000	200.0	H	50.0	21.5

10 Antenna Requirement per FCC Part 15.203

10.1 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.

10.2 Test Results

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

10.3 Test Conditions

Test Personnel: Brian Lackey
Supervising/Reviewing
Engineer:
(Where Applicable) NA
Input Voltage: USB

Test Date: 10/27/2017
Ambient Temperature: 22.6C
Relative Humidity: 41.1%
Atmospheric Pressure: 990.8mbar

11 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	$\pm 3.9\text{dB}$	
Radiated emissions, 1 to 18 GHz	$\pm 4.2\text{dB}$	
Radiated emissions, 18 to 40 GHz	$\pm 4.3\text{dB}$	
Power Port Conducted emissions, 150kHz to 30 MHz	$\pm 2.8\text{dB}$	

12 Revision History

Revision Level	Date	Report Number	Notes
0	12/11/2017	103264009LEX-004b	Original Issue