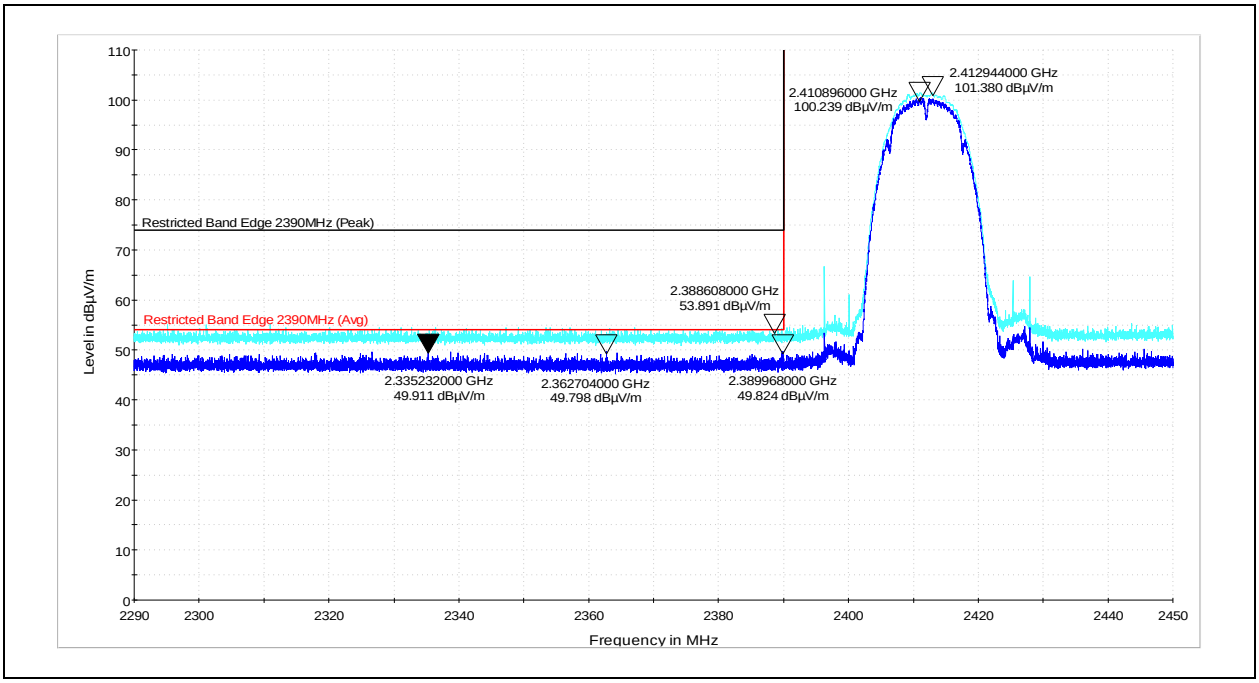
9.8 Test Data (Restricted Band Edge):

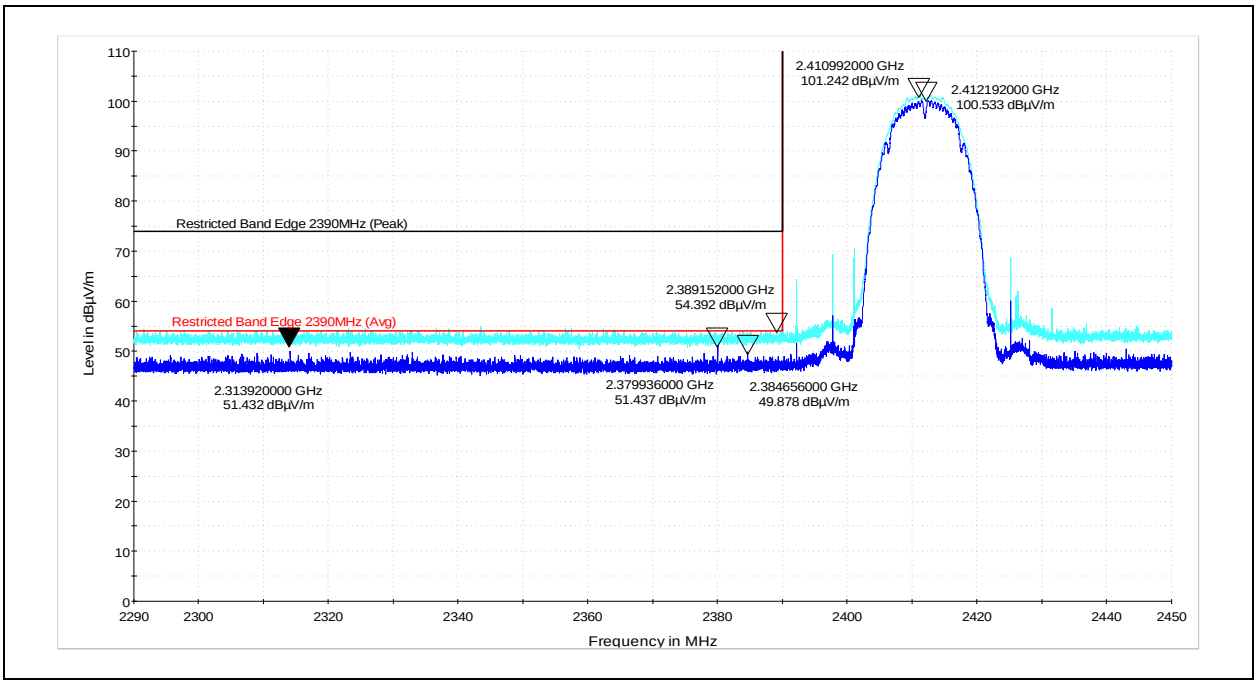
In the plots that follow, the turquoise color is a max-hold peak detector and the blue is a max-hold average detector. The measurement antenna was positioned in vertical and horizontal polarities while the test sample was maximized and positioned in three orthogonal axis in order to arrive at a worst case measurement. Markers were then placed on the plots at the highest points within the restricted band.

All testing was performed with a 17dBm setting on the test tool except where noted.

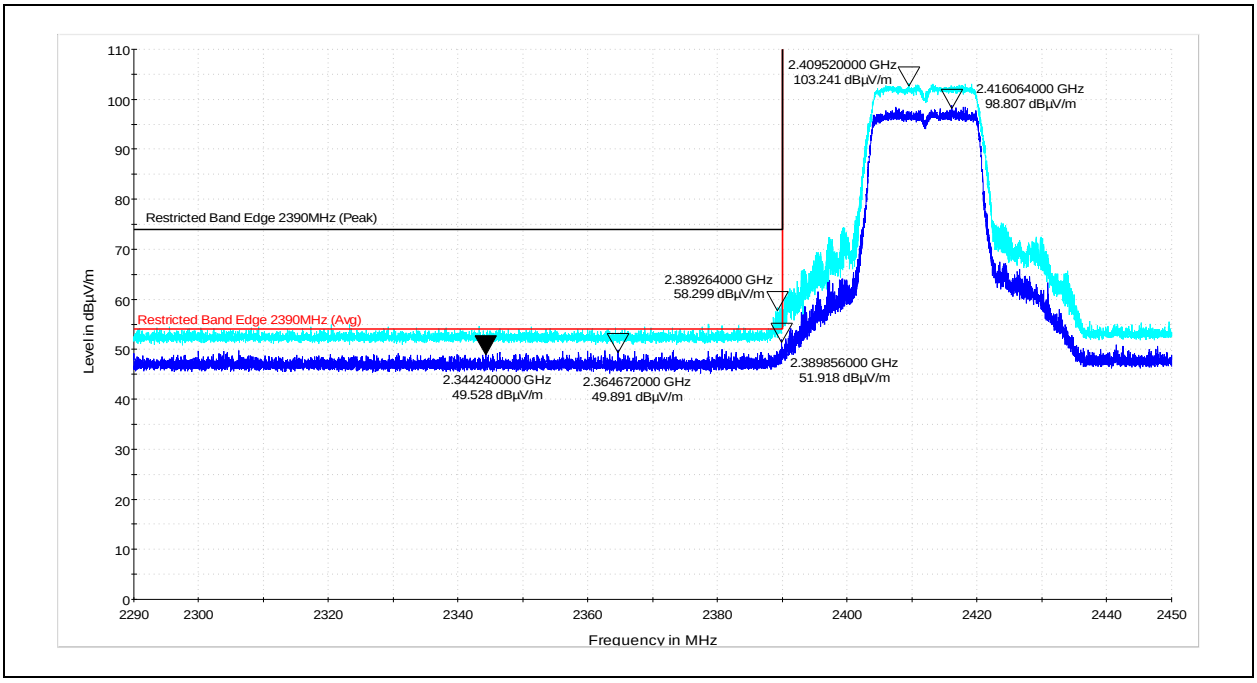
Restricted Band Edge; Internal Antenna; 802.11b (Horizontal and Vertical Worst Case)



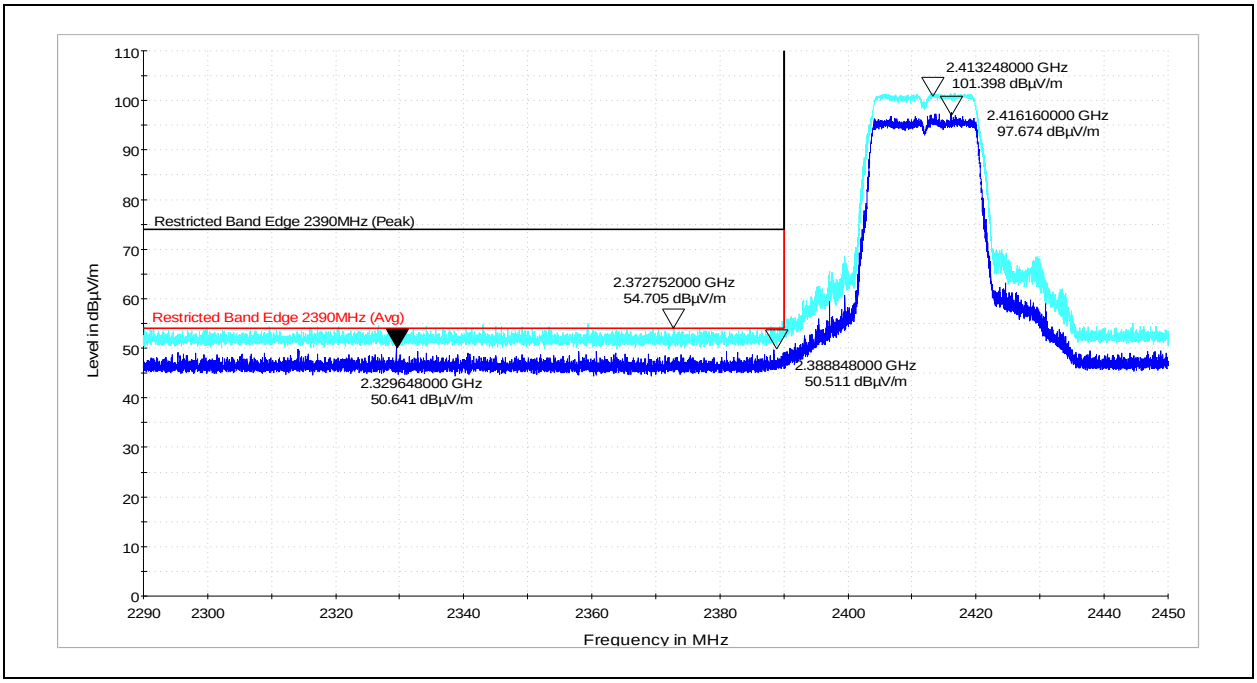
Restricted Band Edge; External Antenna; 802.11b (Horizontal and Vertical Worst Case)



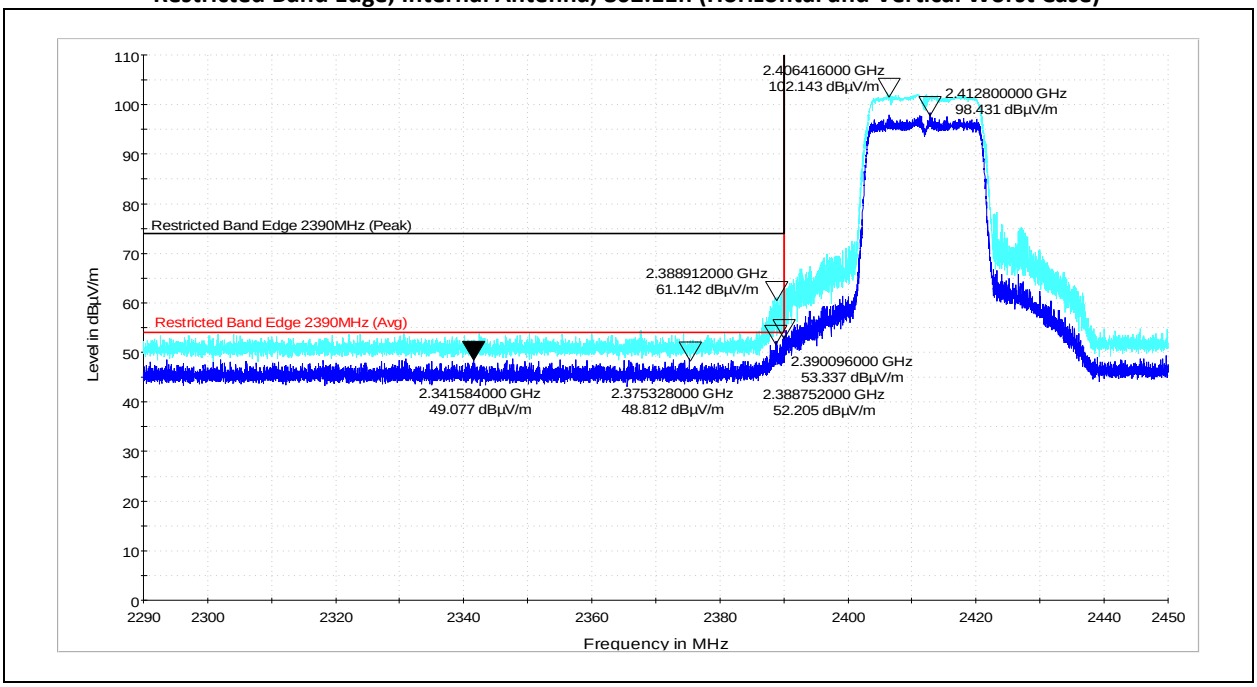
Restricted Band Edge; Internal Antenna; 802.11g (Horizontal and Vertical Worst Case)



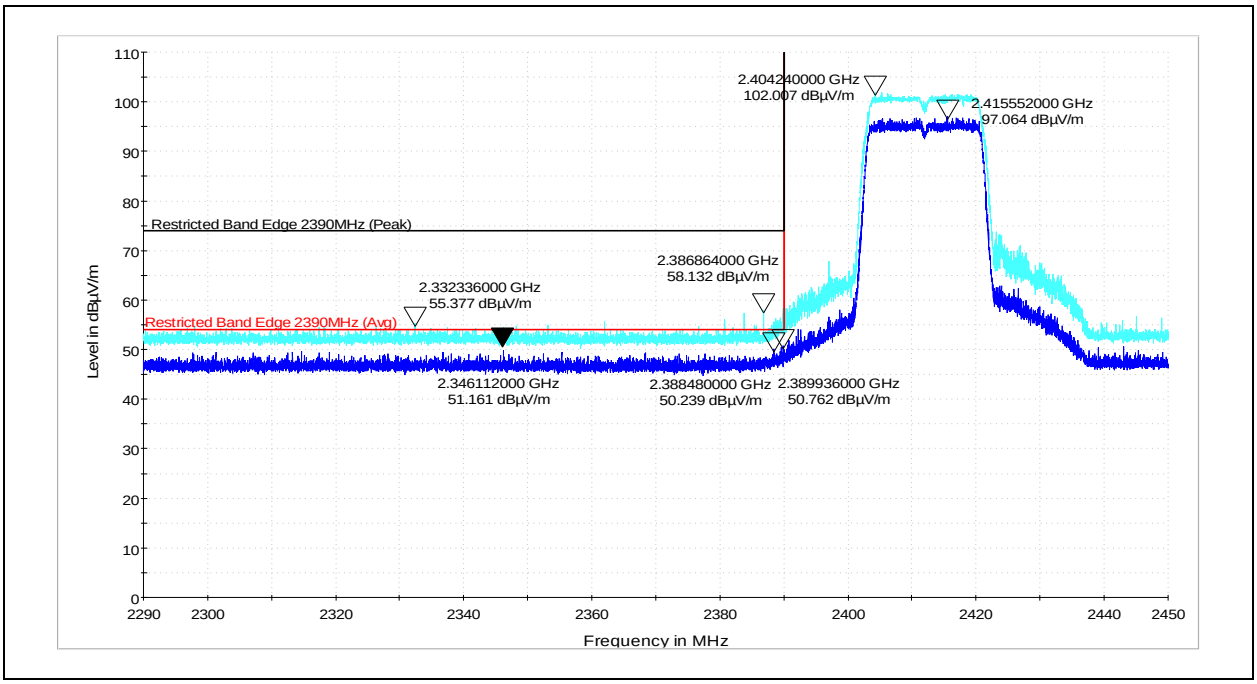
Restricted Band Edge; External Antenna; 802.11g (Horizontal and Vertical Worst Case)



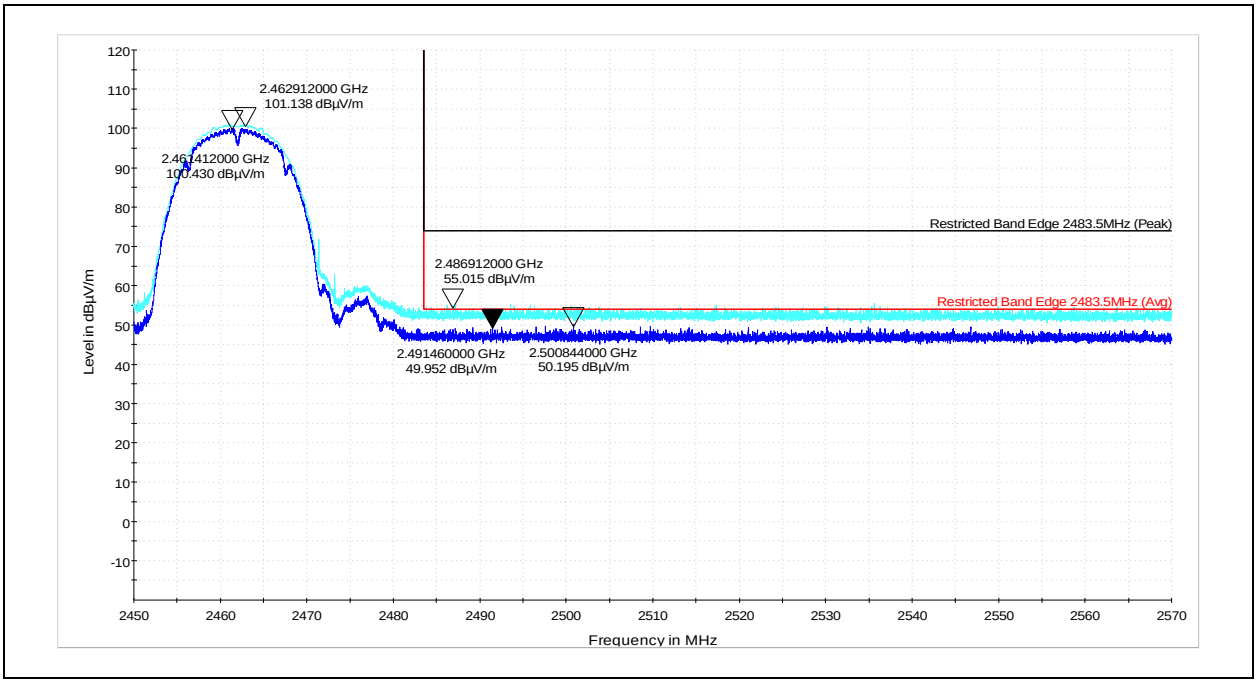
Restricted Band Edge; Internal Antenna; 802.11n (Horizontal and Vertical Worst Case)



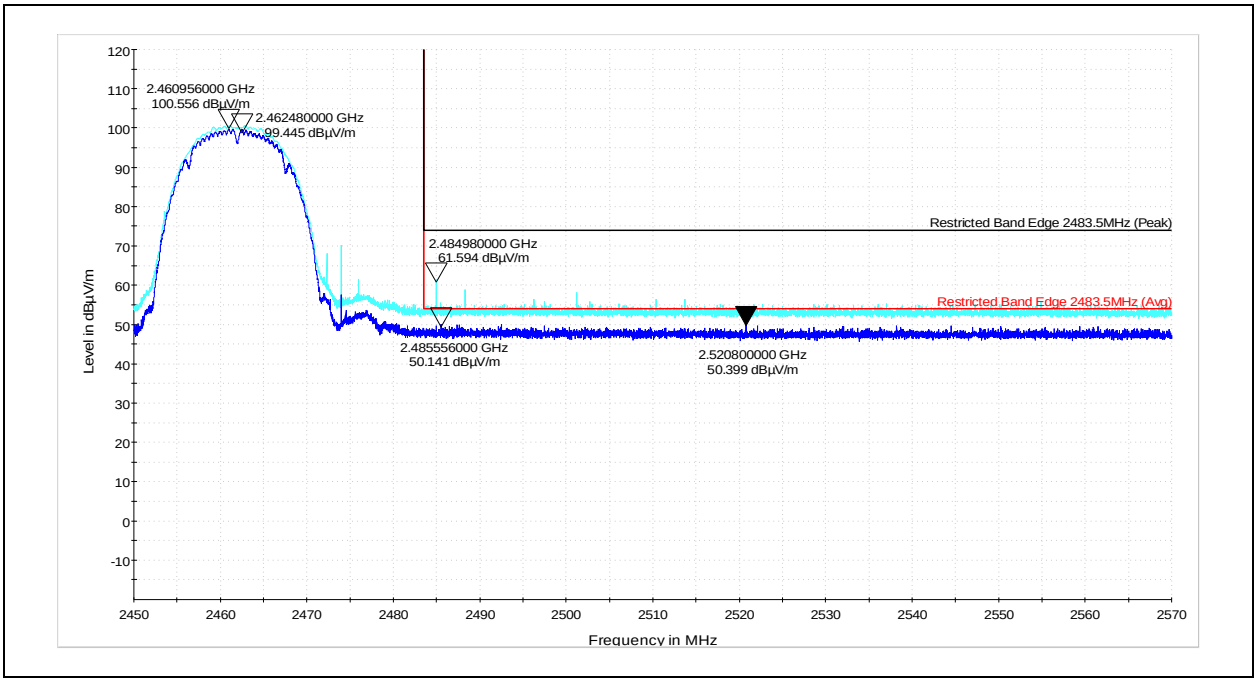
Restricted Band Edge; External Antenna; 802.11n (Horizontal and Vertical Worst Case)



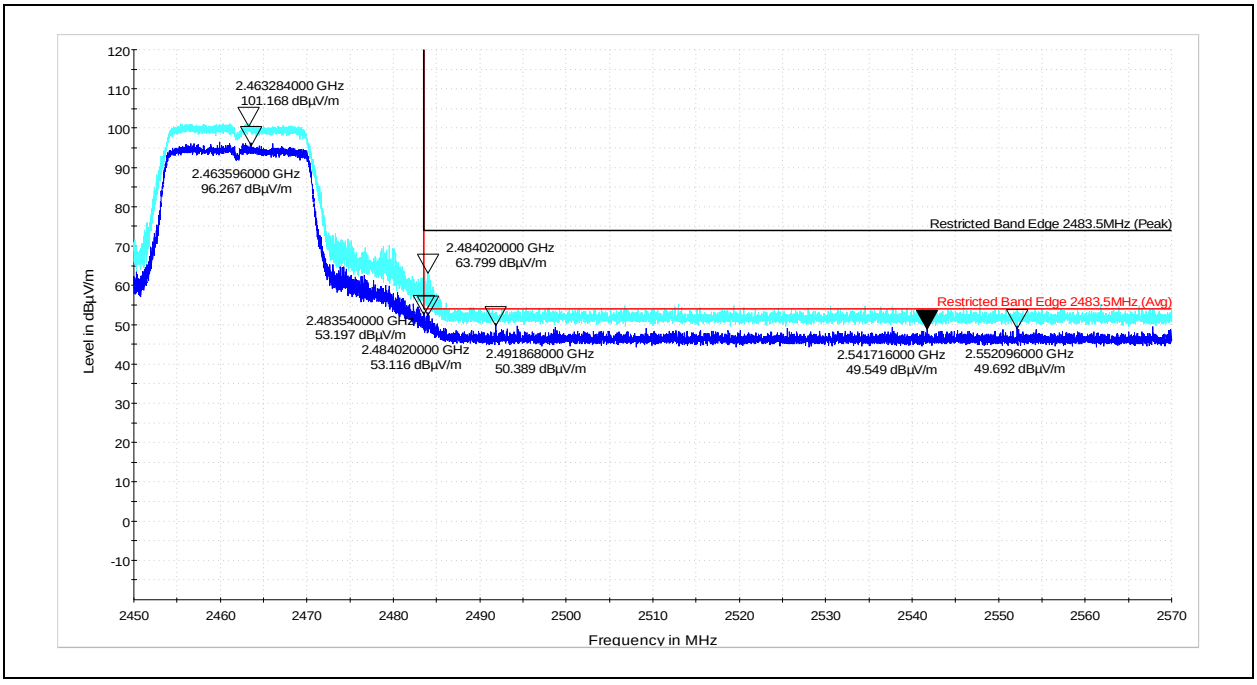
Restricted Band Edge; Internal Antenna; 802.11b Channel 11 (Horizontal and Vertical Worst Case)



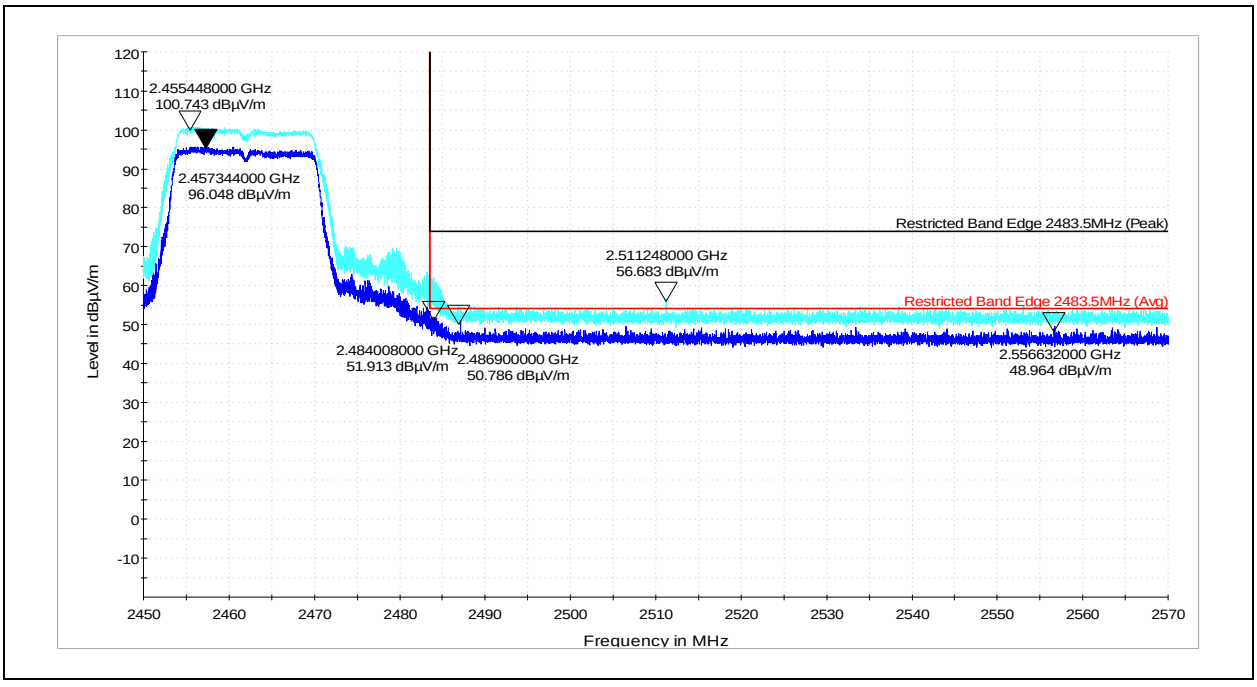
Restricted Band Edge; External Antenna; 802.11b Channel 11 (Horizontal and Vertical Worst Case)



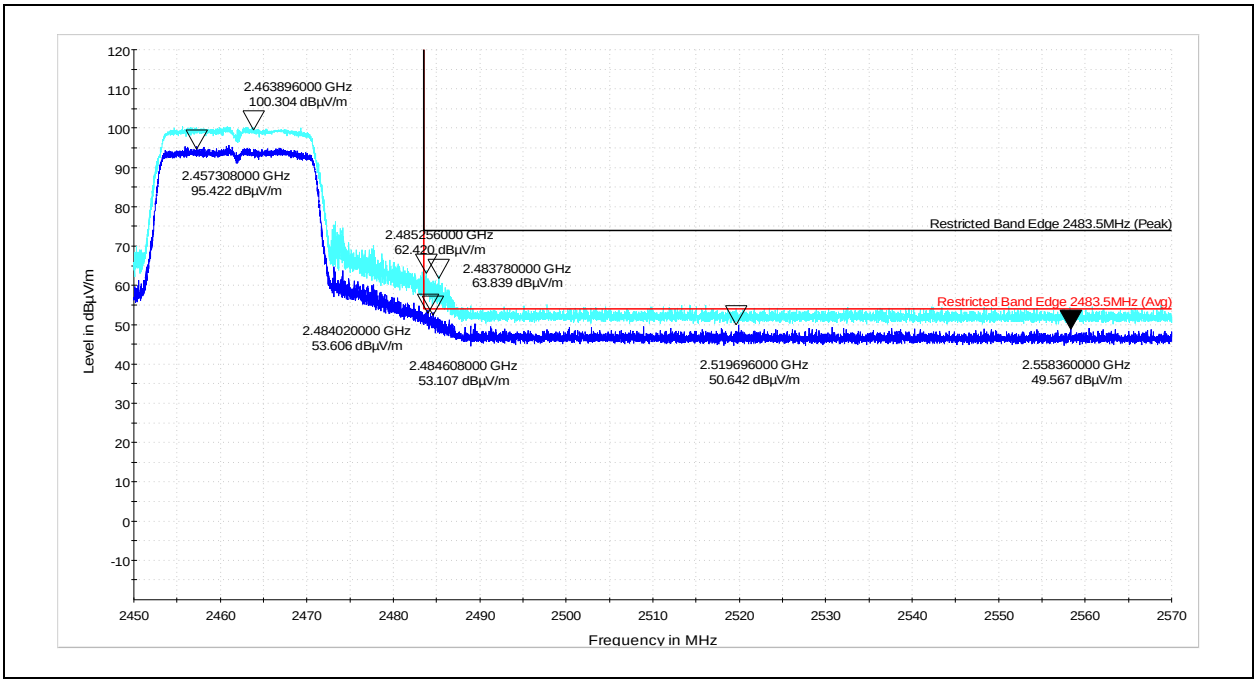
Restricted Band Edge; Internal Antenna; 802.11g Channel 11 (Horizontal and Vertical Worst Case)



Restricted Band Edge; External Antenna; 802.11g Channel 11 (Horizontal and Vertical Worst Case)

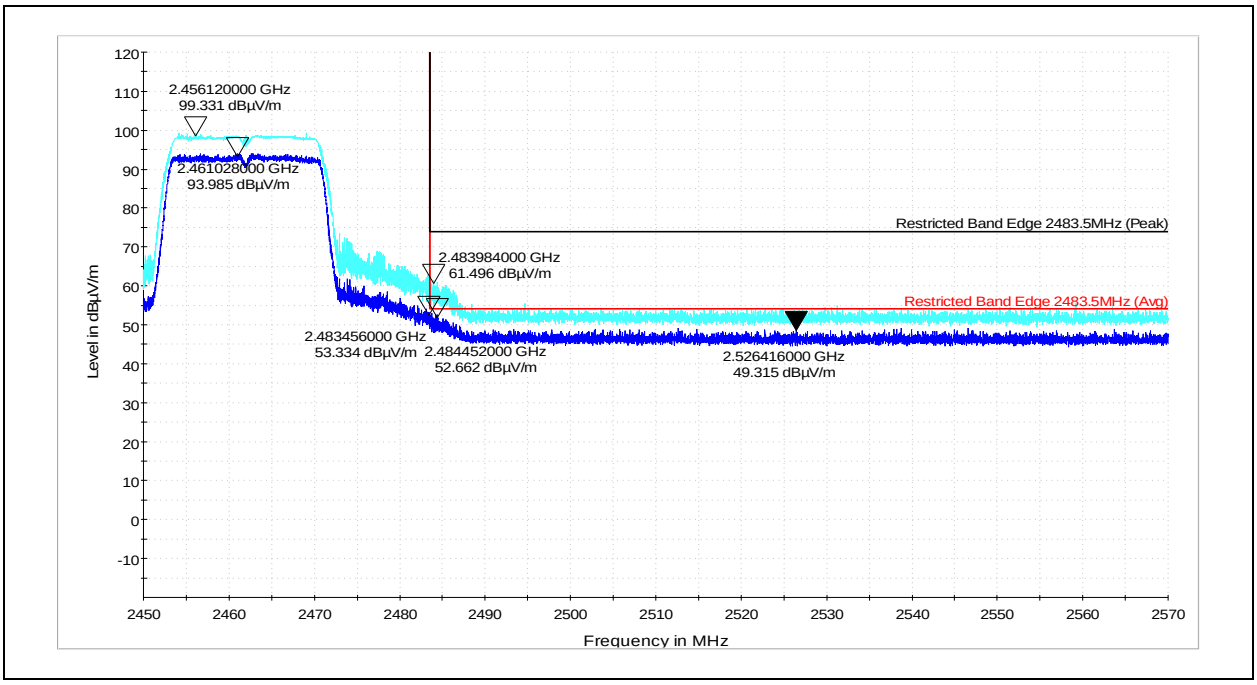


Restricted Band Edge; External Antenna; 802.11n Channel 11 (Horizontal and Vertical Worst Case)



Power Setting = 16dbm

Restricted Band Edge; External Antenna; 802.11n Channel 11 (Horizontal and Vertical Worst Case)



Power Setting = 16dbm

10 Radiated Spurious Emissions (Receiver)

10.1 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:

RSS-Gen (7.1.2): Radiated emission measurements shall be performed with the receiver antenna connected to the receiver antenna terminals. The search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is higher, to at least 5x the highest tunable or local oscillator frequency, whichever is higher, without exceeding 40 GHz. Spurious emissions from receivers shall not exceed the radiated limits shown below:

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

10.2 Test Procedure:

ANSI C63.4: 2014

10.3 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

10.4 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 - 40GHz)	3779	ETS	3116c	6/5/2017	6/5/2018
Preamplifier	3921	Rohde&Schwarz	TS-PR40	12/1/2018	12/1/2019
Preamplifier	3918	Rohde&Schwarz	TS-PR18	12/1/2018	12/1/2019
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 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

10.5 Test Results:

The device was found to be **compliant**. 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.

10.6 Test Conditions:

Test Personnel:	Carmen Davis	Test Date:	5/7/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	22.6C
Input Voltage:	5VDC via USB	Relative Humidity:	44.7%
		Atmospheric Pressure:	994.8mbar

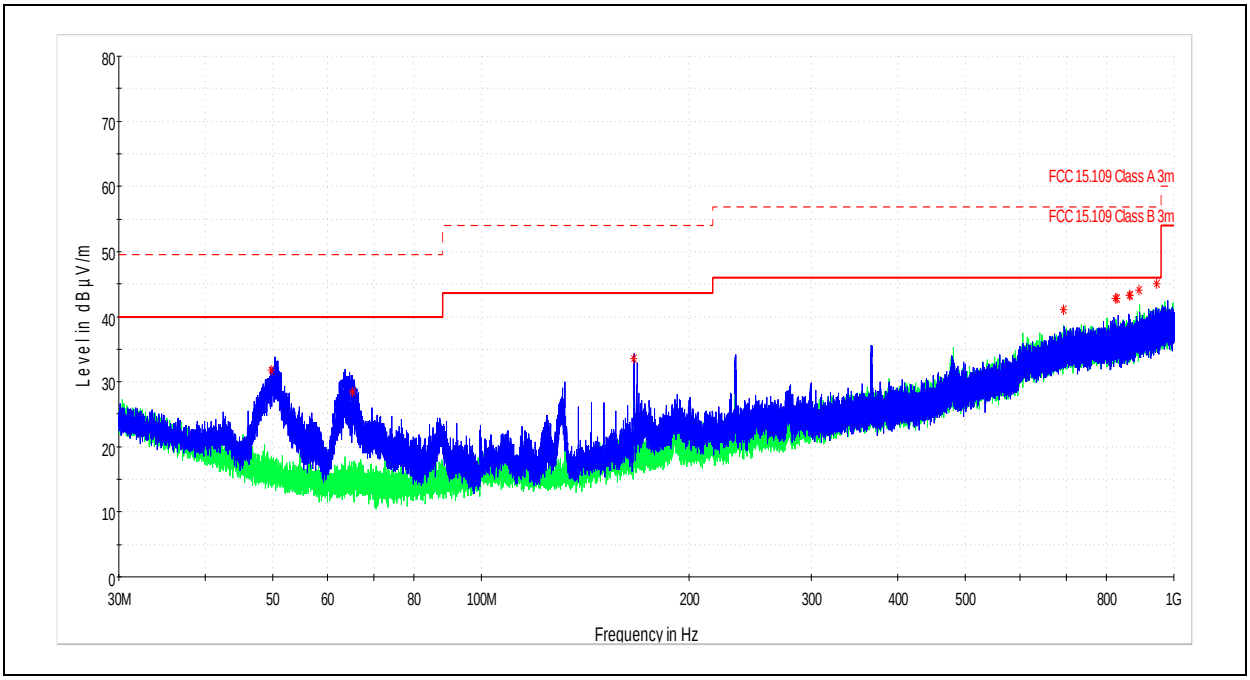
10.7 Test Data:

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.

10.7.1 Receive / Idle Mode, Bilog:

EUT Information

EUT Name:	LEX-M08-001 WiFi Module
Manufacturer:	Lexmark
Test Engineer:	Carmen Davis
Date:	05/07/2018
Temp/Humidity/Pressure:	23.2/43.8/985.4
Comment:	External Antenna_Rx mode

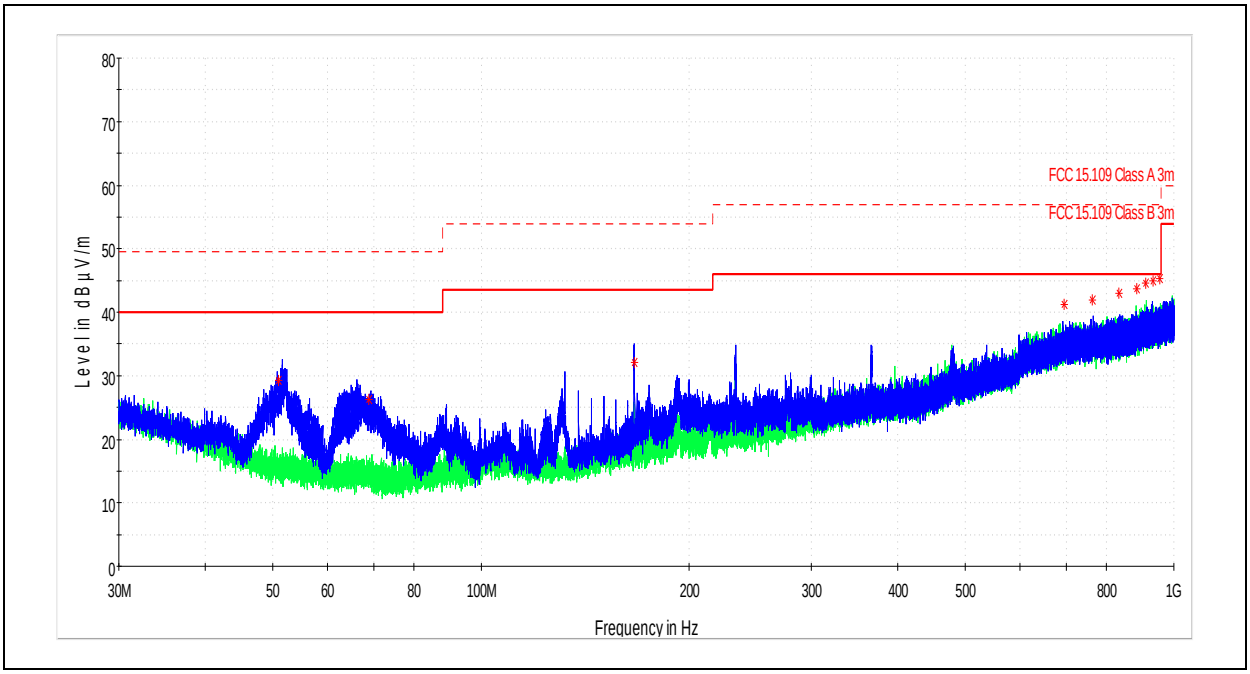


Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.845000	31.70	40.00	8.30	120.000	97.3	V	340.0	16.4
65.312000	28.42	40.00	11.58	120.000	98.1	V	1.0	15.0
166.140000	33.56	43.52	9.96	120.000	98.5	V	248.0	18.3
692.820000	41.03	46.02	4.99	120.000	397.1	H	194.0	33.4
824.000000	42.75	46.02	3.27	120.000	317.1	V	310.0	34.7
826.740000	42.86	46.02	3.16	120.000	397.0	V	148.0	34.8
863.460000	43.24	46.02	2.78	120.000	291.1	V	0.0	35.1
865.460000	43.29	46.02	2.73	120.000	397.1	V	26.0	35.1
891.680000	44.10	46.02	1.92	120.000	397.1	H	64.0	35.7
945.260000	45.07	46.02	0.95	120.000	104.7	V	302.0	36.3

EUT Information

EUT Name:	LEX-M08-001 WiFi Module
Manufacturer:	Lexmark
Test Engineer:	Carmen Davis
Date:	05/07/2018
Temp/Humidity/Pressure:	23.2/43.8/985.4
Comment:	Internal antenna_Rx mode



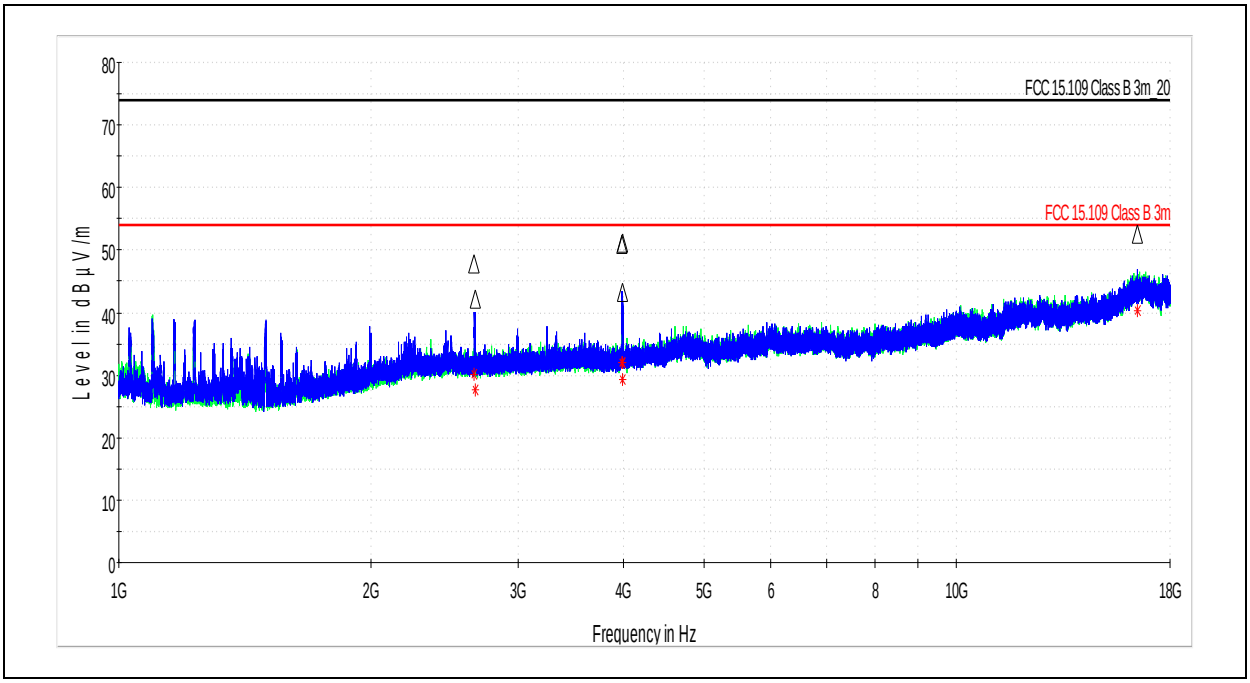
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
51.034000	29.26	40.00	10.74	120.000	100.4	V	0.0	16.2
68.910000	26.24	40.00	13.76	120.000	97.8	V	10.0	15.0
166.560000	32.09	43.52	11.43	120.000	99.6	V	256.0	18.3
694.140000	41.18	46.02	4.84	120.000	267.2	V	36.0	33.4
763.700000	41.92	46.02	4.10	120.000	397.0	V	82.0	33.7
834.580000	42.94	46.02	3.08	120.000	235.0	V	136.0	34.8
885.140000	43.77	46.02	2.25	120.000	136.9	H	341.0	35.5
911.700000	44.52	46.02	1.50	120.000	267.8	H	145.0	36.1
933.120000	44.91	46.02	1.11	120.000	397.0	V	8.0	36.3
955.520000	45.23	46.02	0.79	120.000	302.4	H	128.0	36.4

10.7.2 Receive / Idle Mode, Horn:

EUT Information

EUT Name:	LEX-M08-001 WiFi Module
Manufacturer:	Lexmark
Test Engineer:	Carmen Davis
Date:	05/07/2018
Temp/Humidity/Pressure:	23.2/43.8/985.4
Comment:	External Antenna_Rx mode



Final_Result_PK+

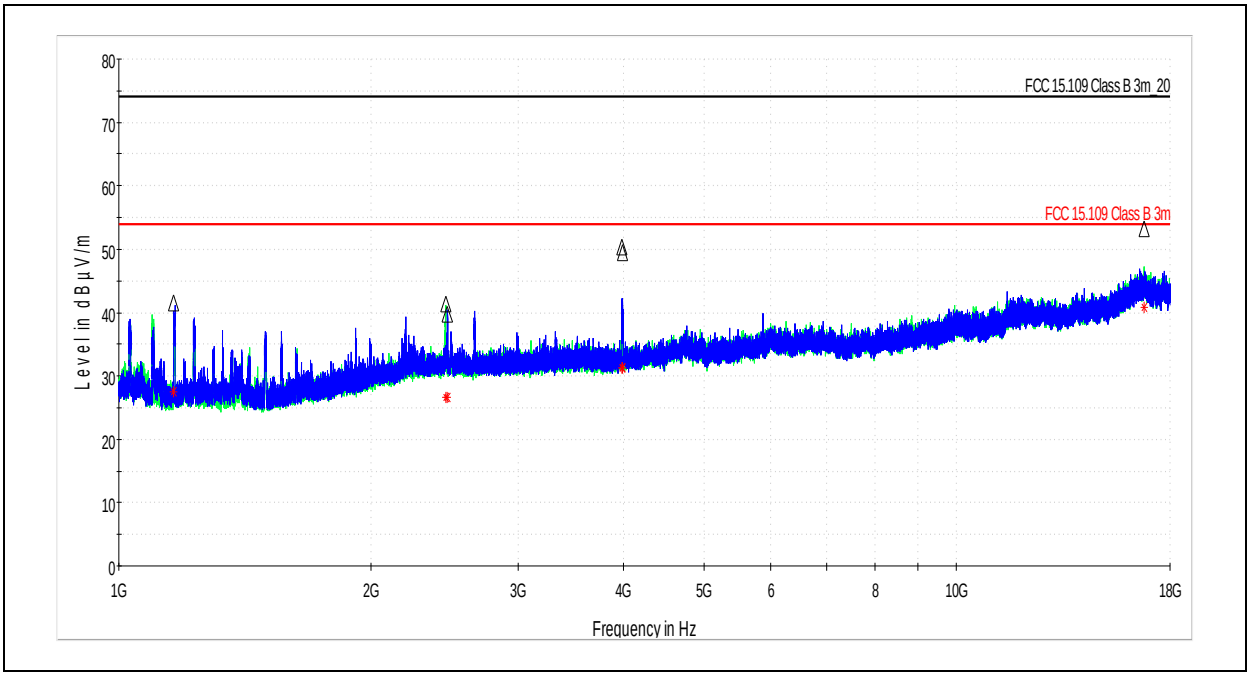
Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2657.212500	47.88	74.00	26.12	1000.000	100.0	V	0.0	4.0
2665.852000	42.21	74.00	31.79	1000.000	100.0	V	30.0	4.0
3985.575500	50.81	74.00	23.19	1000.000	188.0	V	222.0	6.5
3998.877060	51.13	74.00	22.87	1000.000	185.0	V	215.0	6.5
3999.205420	43.26	74.00	30.74	1000.000	400.0	V	197.0	6.5
16460.959500	52.61	74.00	21.39	1000.000	245.0	V	357.0	21.3

Final_Result_AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2657.212500	30.05	54.00	23.95	1000.000	100.0	V	0.0	4.0
2665.852000	27.59	54.00	26.41	1000.000	100.0	V	30.0	4.0
3985.575500	32.08	54.00	21.92	1000.000	188.0	V	222.0	6.5
3998.877060	31.93	54.00	22.07	1000.000	185.0	V	215.0	6.5
3999.205420	29.32	54.00	24.68	1000.000	400.0	V	197.0	6.5
16460.959500	40.32	54.00	13.68	1000.000	245.0	V	357.0	21.3

EUT Information

EUT Name:	LEX-M08-001 WiFi Module
Manufacturer:	Lexmark
Test Engineer:	Carmen Davis
Date:	05/07/2018
Temp/Humidity/Pressure:	23.2/43.8/985.4
Comment:	Internal Antenna Rx mode



Final_Result_PK+

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1162.625500	41.44	74.00	32.56	1000.000	255.0	V	226.0	-1.6
2458.301500	41.34	74.00	32.66	1000.000	300.0	H	240.0	3.9
2468.616000	39.78	74.00	34.22	1000.000	300.0	V	288.0	3.9
3985.078500	50.37	74.00	23.63	1000.000	200.0	V	224.0	6.5
3999.391000	49.36	74.00	24.64	1000.000	174.0	V	230.0	6.5
16746.835500	53.25	74.00	20.75	1000.000	300.0	H	22.0	21.7

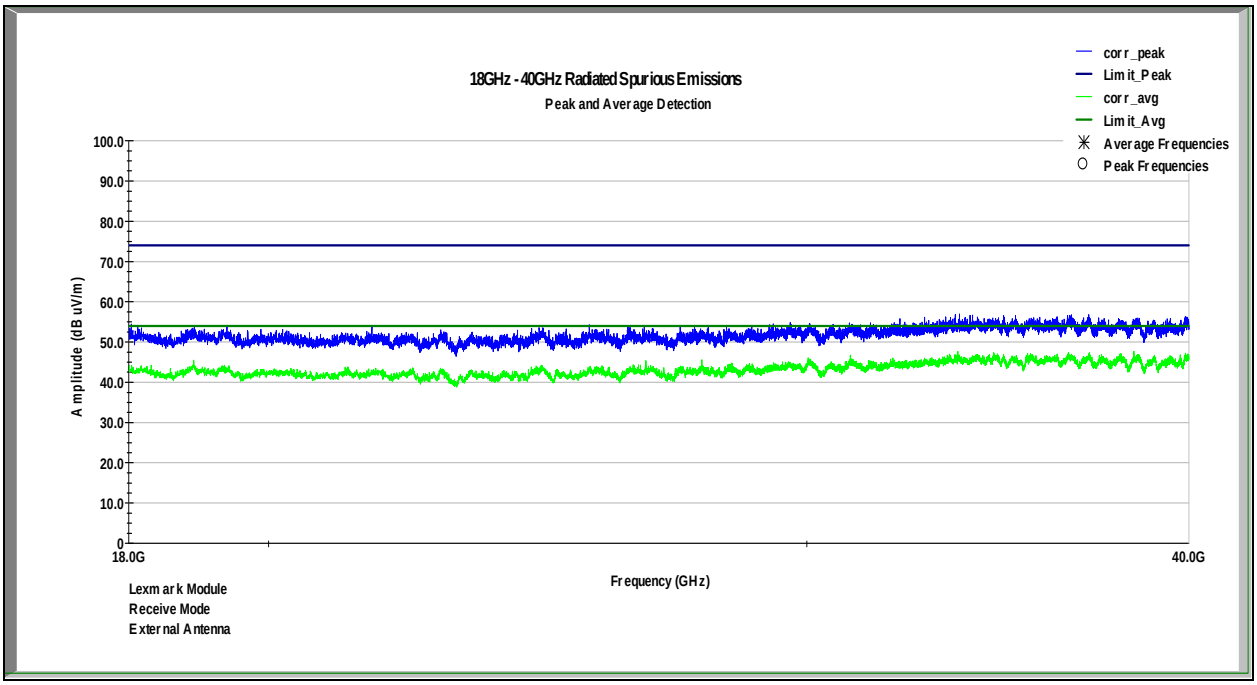
Final_Result_AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1162.625500	27.51	54.00	26.49	1000.000	255.0	V	226.0	-1.6
2458.301500	26.69	54.00	27.31	1000.000	300.0	H	240.0	3.9
2468.616000	26.52	54.00	27.48	1000.000	300.0	V	288.0	3.9
3985.078500	31.35	54.00	22.65	1000.000	200.0	V	224.0	6.5
3999.391000	31.34	54.00	22.66	1000.000	174.0	V	230.0	6.5
16746.835500	40.79	54.00	13.21	1000.000	300.0	H	22.0	21.7

802.11b Radiated Emission Results

EUT Information

EUT Name:	LEX-M08-001 WiFi Module
Manufacturer:	Lexmark
Test Engineer:	Bryan Taylor
Date:	05/14/2018
Temp/Humidity/Pressure:	22.3C/35.8%/982.0mbar
Comment:	External Antenna Receive Mode

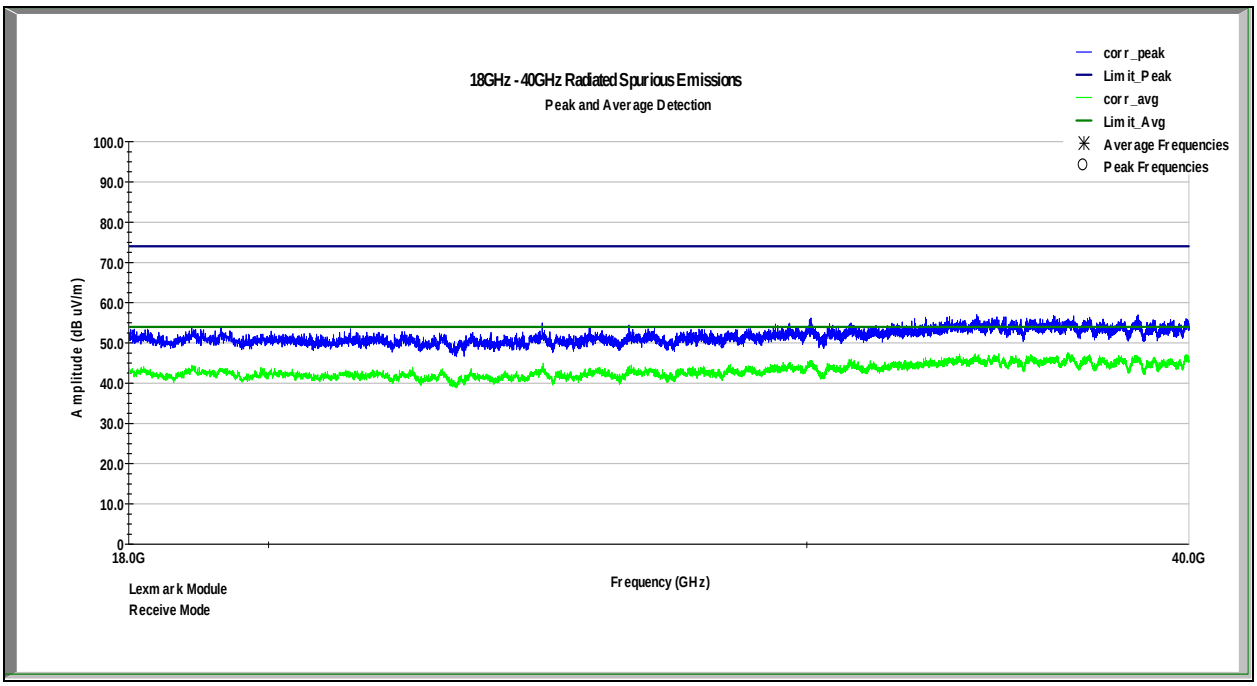


*Worst case vertical and horizontal scan performed at 1m. No significant emissions were found.

802.11b Radiated Emission Results

EUT Information

EUT Name:	LEX-M08-001 WiFi Module
Manufacturer:	Lexmark
Test Engineer:	Bryan Taylor
Date:	05/14/2018
Temp/Humidity/Pressure:	22.3C/35.8%/982.0mbar
Comment:	Internal Antenna Receive Mode



*Worst case vertical and horizontal scan performed at 1m. No significant emissions were found.

11 AC Powerline Conducted Emissions

11.1 Test Limits:

§ 15.107(e): Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

RSS-Gen (8.8): A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3. Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The more stringent limit applies at the frequency range boundaries.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

*Decreases with the logarithm of the frequency.

11.2 Test Procedure:

ANSI C63.4: 2014

11.3 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
LISN	3333	Teseq	NNB52	6/15/2017	6/15/2018
Measurement Cable (COND2)	5025			12/1/2017	12/1/2018

11.4 Test Results:

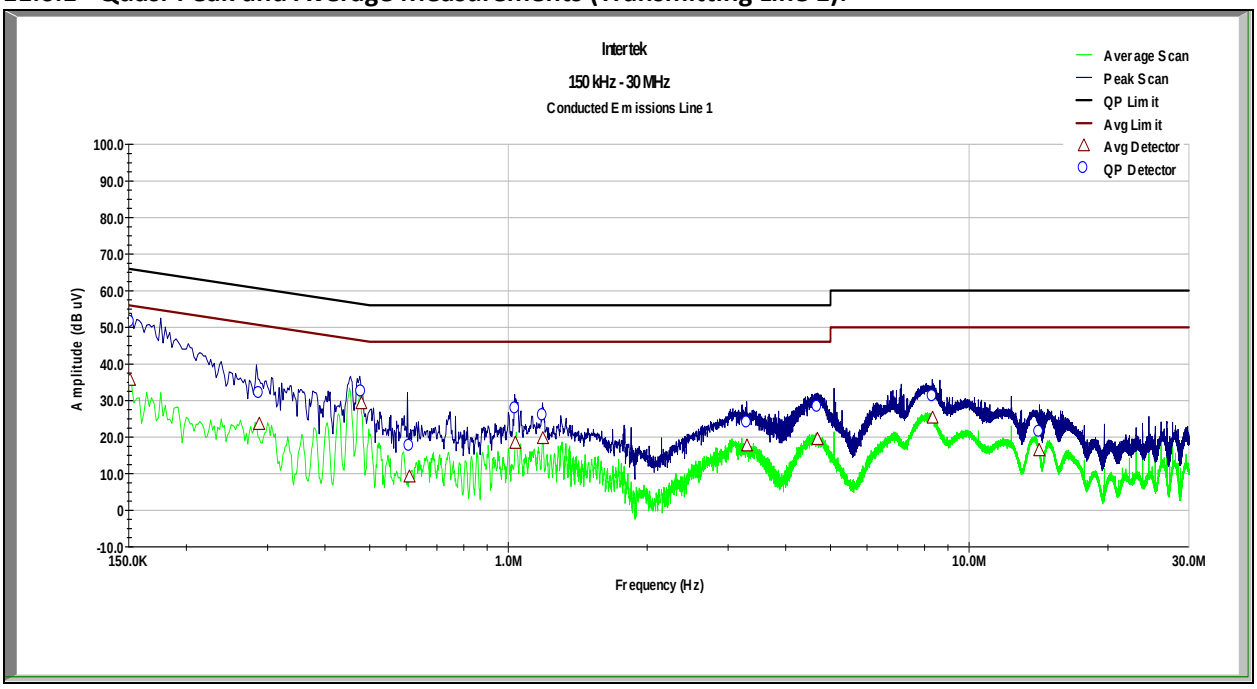
The device was found to be **compliant**.

11.5 Test Conditions:

Test Personnel:	Carmen Davis	Test Date:	5/11/2018
Supervising/Reviewing Engineer: (Where Applicable)	NA	Ambient Temperature:	22.2C
Input Voltage:	120VAC Input to Laptop	Relative Humidity:	42.8%
		Atmospheric Pressure:	997.8mbar

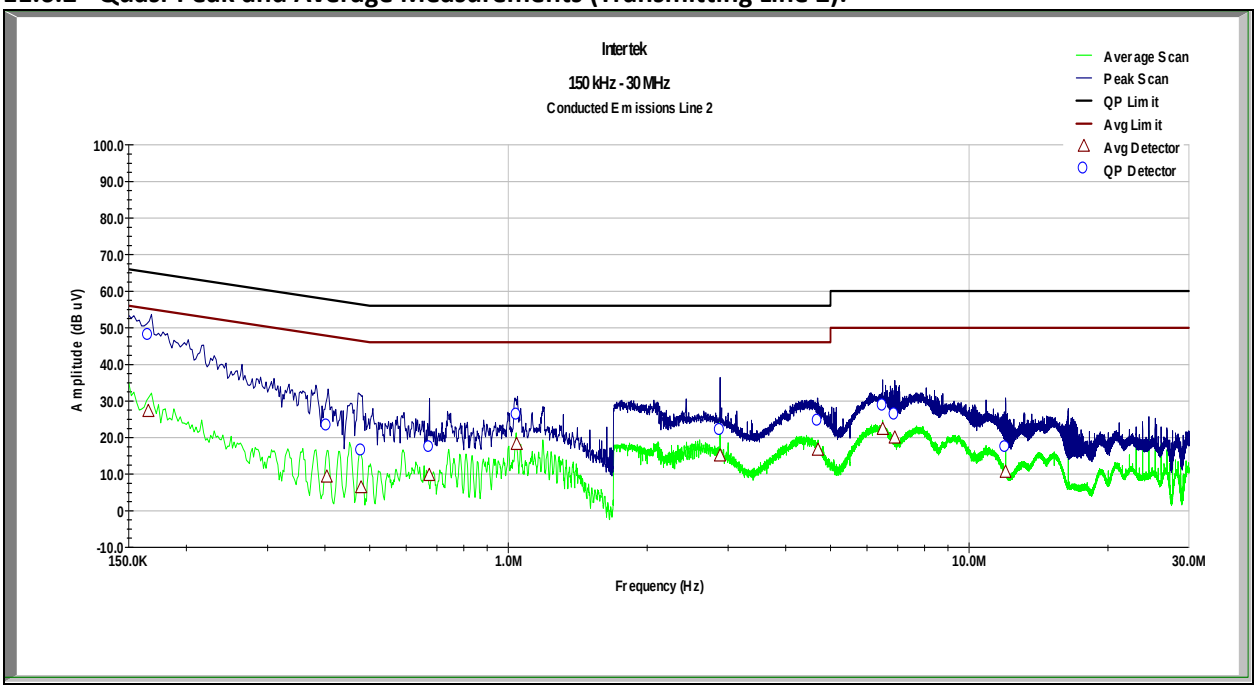
11.6 Test Data:

11.6.1 Quasi-Peak and Average Measurements (Transmitting Line 1):



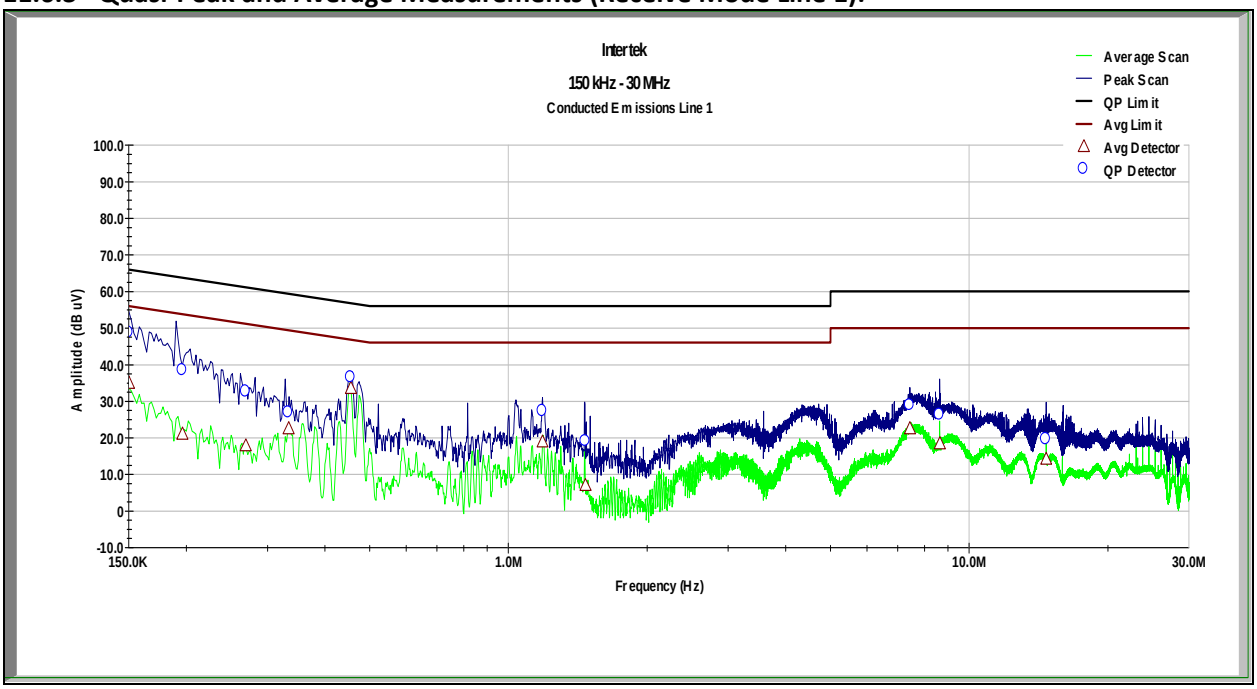
Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.151	51.326	65.977	14.651	35.545	55.977	20.432
0.288	31.936	62.063	30.127	23.439	52.063	28.623
0.480	32.328	56.577	24.249	29.152	46.577	17.425
0.610	17.472	56.000	38.528	9.097	46.000	36.903
1.035	27.694	56.000	28.306	18.328	46.000	27.672
1.189	25.815	56.000	30.185	19.559	46.000	26.441
3.296	23.886	56.000	32.114	17.559	46.000	28.441
4.688	28.105	56.000	27.895	19.342	46.000	26.658
8.332	31.057	60.000	28.943	25.203	50.000	24.797
14.203	21.303	60.000	38.697	16.285	50.000	33.715

11.6.2 Quasi-Peak and Average Measurements (Transmitting Line 2):



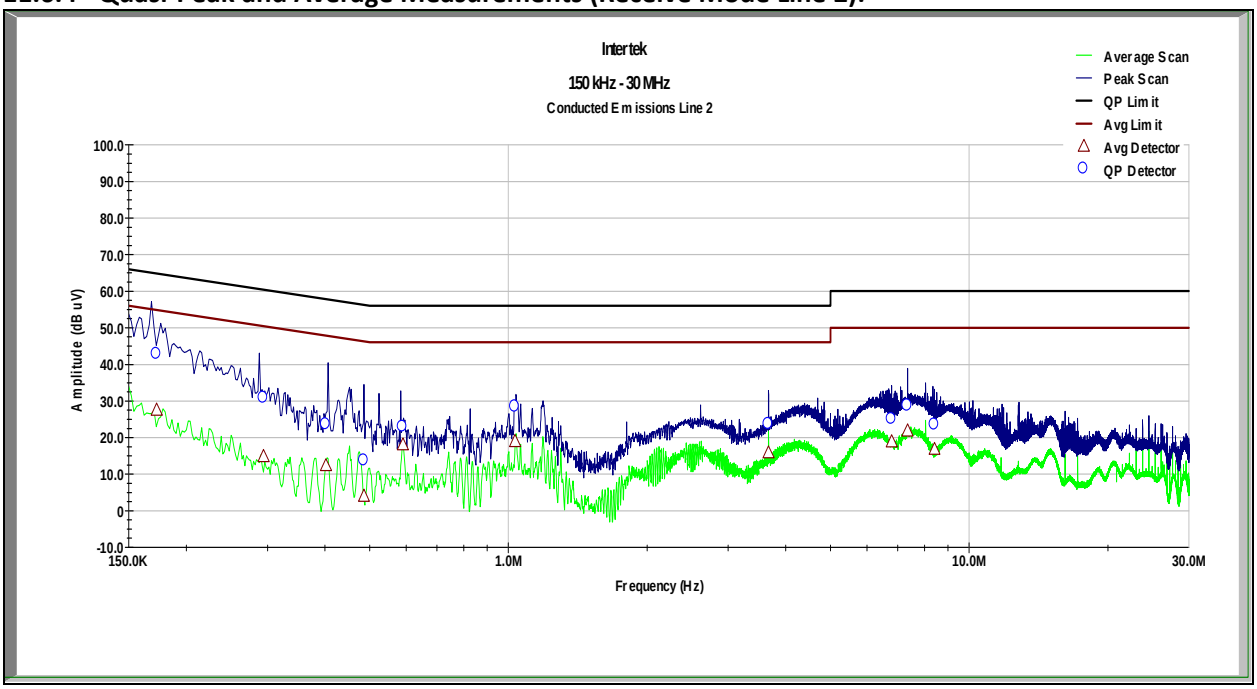
Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.165	47.862	65.560	17.698	27.121	55.560	28.439
0.404	23.148	58.751	35.603	9.218	48.751	39.533
0.479	16.295	56.594	40.299	6.292	46.594	40.302
0.673	17.248	56.000	38.752	9.644	46.000	36.356
1.043	26.105	56.000	29.895	18.111	46.000	27.889
2.880	21.886	56.000	34.114	14.953	46.000	31.047
4.696	24.457	56.000	31.543	16.561	46.000	29.439
6.494	28.612	60.000	31.388	22.277	50.000	27.723
6.895	26.148	60.000	33.852	19.890	50.000	30.110
11.998	17.240	60.000	42.760	10.535	50.000	39.465

11.6.3 Quasi-Peak and Average Measurements (Receive Mode Line 1):



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.150	48.662	65.997	17.335	34.971	55.997	21.026
0.196	38.360	64.680	26.320	21.014	54.680	33.666
0.269	32.512	62.594	30.083	17.831	52.594	34.763
0.334	26.834	60.757	33.923	22.507	50.757	28.250
0.455	36.404	57.280	20.876	33.533	47.280	13.747
1.186	27.225	56.000	28.775	18.887	46.000	27.113
1.470	19.019	56.000	36.981	6.978	46.000	39.022
7.441	28.777	60.000	31.223	22.489	50.000	27.511
8.637	26.181	60.000	33.819	18.403	50.000	31.597
14.700	19.540	60.000	40.460	14.152	50.000	35.848

11.6.4 Quasi-Peak and Average Measurements (Receive Mode Line 2):



Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
0.172	42.764	65.360	22.596	27.498	55.360	27.862
0.294	30.771	61.883	31.112	14.803	51.883	37.080
0.402	23.501	58.803	35.302	12.353	48.803	36.450
0.486	13.628	56.400	42.772	3.963	46.400	42.437
0.590	22.873	56.000	33.127	18.001	46.000	27.999
1.034	28.308	56.000	27.692	18.900	46.000	27.100
3.671	23.592	56.000	32.408	15.830	46.000	30.170
6.792	24.959	60.000	35.041	18.817	50.000	31.183
7.349	28.600	60.000	31.400	21.824	50.000	28.176
8.413	23.449	60.000	36.551	16.788	50.000	33.212

12 Antenna Requirement per FCC Part 15.203

12.1 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.

RSS-Gen (8.3): 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. 8 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.

12.2 Test Results:

The device was found to be **compliant**. The sample tested met the antenna requirement. The antennas used were permanently attached to the unit.

12.3 Test Conditions:

Test Personnel:	Bryan Taylor	Test Date:	5/11/2018
Supervising/Reviewing Engineer:			
(Where Applicable)	NA	Ambient Temperature:	21.4
Input Voltage:	5VDC via USB	Relative Humidity:	42.9%
		Atmospheric Pressure:	991.7mBar

13 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	

14 Revision History

Revision Level	Date	Report Number	Notes
0	5/16/2018	103509456LEX-004	Original Issue
1	7/1/2018	103509456LEX-004.1	Updated the 99% Bandwidth measurements to use a RBW between 1% and 5% of the measured OBW.