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TEST REPORT

Report Number: **102063374LEX-001**
Project Number: **G102063374**

Report Issue Date: **7/7/2015**

Model Number: **265D1664G008**

Standards: **CFR Title 47 Part 15 Subpart C**

Radios Under Test: **Low Energy Bluetooth (BTLE)**

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

Client:
GE Digital Energy
AP2-315, AP6-1NW Appliance Park
Louisville, KY 40225

Report prepared by
Toby Carrier, Technician

Report reviewed by
Bryan Taylor, Team Leader – EMC

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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
6	Peak Conducted Power	§ 15.247(b)(3)(4)	RSS-210 (A8.4)	Pass
9	Occupied Bandwidth	§ 15.247(a)(2)	RSS-210 (A8.2), RSS-GEN (4.6.1)	Pass
12	Conducted Spurious Emissions	§ 15.247(d)	RSS-210 (A8.5)	Pass
14	Power Spectral Density	§ 15.247(e)	RSS-210 (A8.2b)	Pass
17	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-210 (2.2) (A8.5)	Pass
22	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen (6.1)	Pass
26	Conducted Voltage Emissions on the AC Mains Terminals	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
31	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	GE Digital Energy
Model Number	265D1664G008
Serial Number	DC0001
Receive Date	4/12/2015
Test Start Date	4/12/22015
Test End Date	4/20/2015
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2402MHz – 2480MHz
Mode(s) of Operation	BTLE
Modulation Type	GFSK
Number of Hopping Channels	40
Transmission Control	Test Commands
Test Channels	0, 19, 39 (2402, 2440, 2480 MHz)
Antenna Type (15.203)	Internal
Power Supply	5-12Vdc

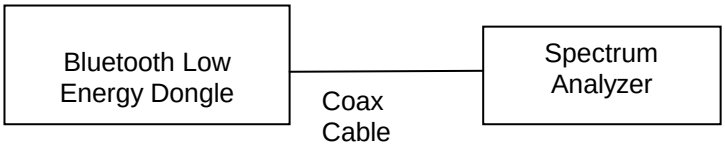
Description of Equipment Under Test
The Bluetooth Low Energy dongle provides BLE to serial UART communication for connected appliances. The Bluetooth Low Energy dongle communicates with the host appliance using a proprietary single-wire serial bus and with a mobile device using BLE. This module has 2 operational modes, Off Mode and Networking Mode: Networking Mode is the normal operating mode where the device is transmitting or receiving data via BLE. In Off Mode, only the Serial interface is powered, and BLE dongle monitors the Serial Bus for a command to wake the radio.

Operating modes of the EUT:

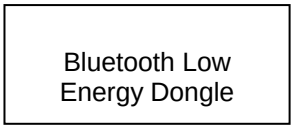
No.	**Descriptions of EUT Exercising**
1	Transmiting Bluetooth Low Energy on Low, Mid and High Channels
2	Receive mode / Idle Mode

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

3.2 EUT Block Diagram:



Conducted Output Measurements



Radiated Measurements

3.3 Cables:

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
Power / Communication Cable	5ft	No	No	EUT	Laptop

3.4 Support Equipment:

No support equipment was used during this evaluation.

4 Peak Conducted Power

4.1 Test Limits

§ 15.247(b)(3): For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247). The peak output power was measured using the channel power function of the spectrum analyzer.

4.3 Test Equipment Used:

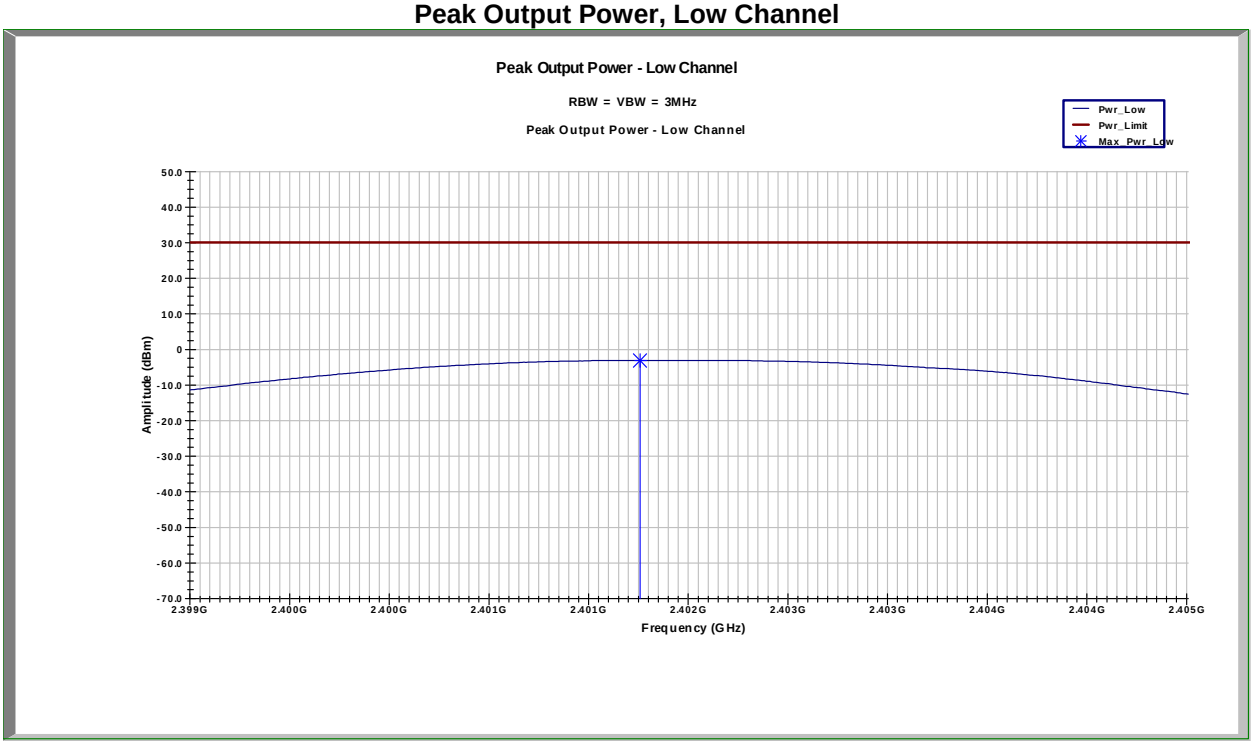
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/15/2014	9/15/2015

4.4 Results:

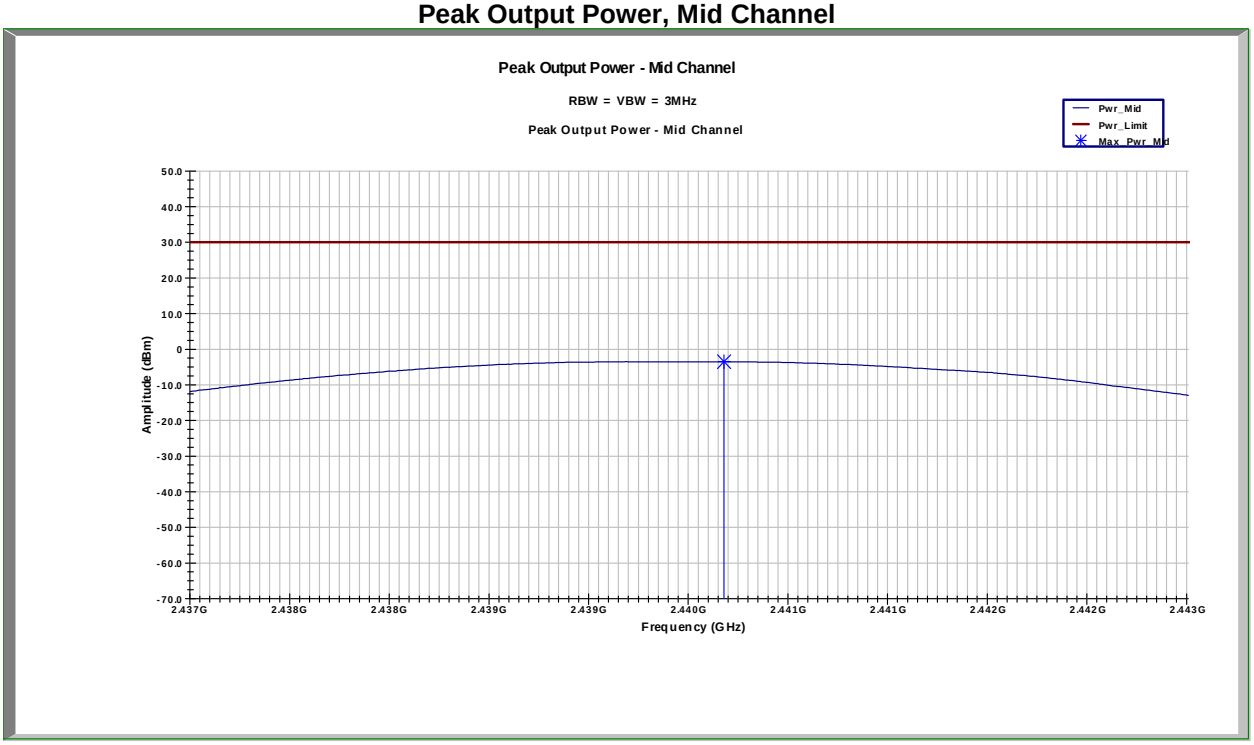
The peak output power measurements were all below the 30dBm limit.

Mode	Channel Number	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	Result
BTLE	0	2402	-3.110	30	Pass
BTLE	19	2440	-3.519	30	Pass
BTLE	39	2480	-4.078	30	Pass

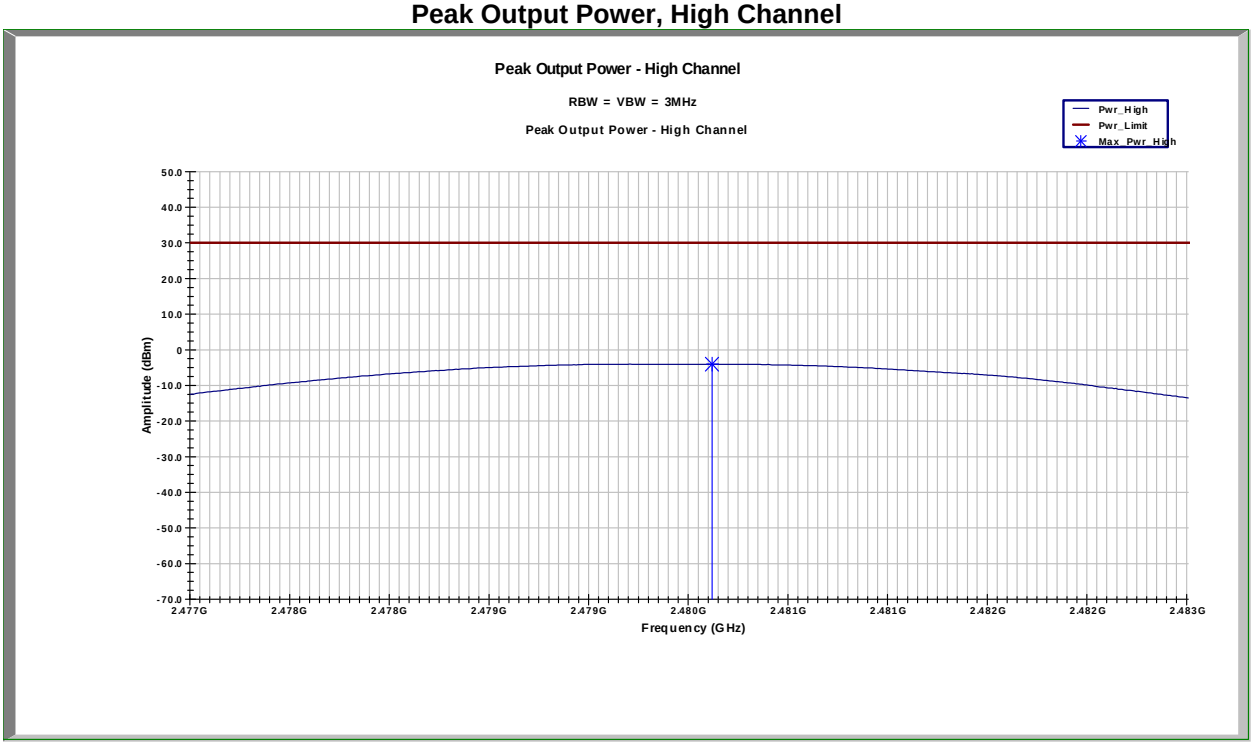
Peak Output Power, Low Channel



Peak Output Power, Mid Channel



Peak Output Power, High Channel



5 Occupied Bandwidth

5.1 Test Limits

§ 15.247(a)(2): For digital modulation systems, the minimum 6dB bandwidth shall be at least 500kHz.

5.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

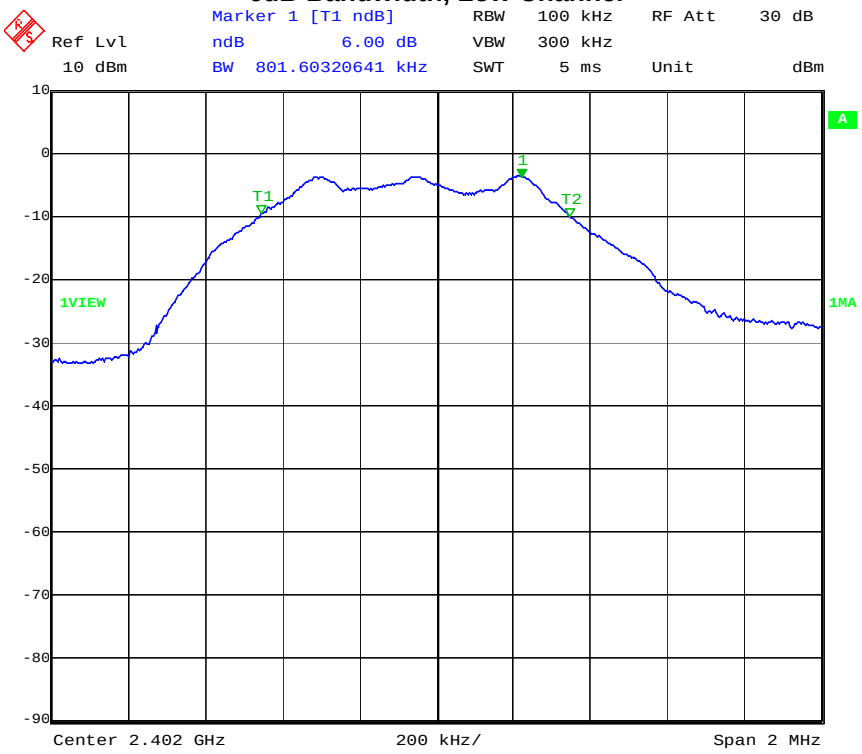
5.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/15/2014	9/15/2015

5.4 Results:

Mode	Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
BTLE	0	2402	801.60kHz	---	Pass
BTLE	19	2440	789.58kHz	1.09MHz	Pass
BTLE	39	2480	785.57kHz	---	Pass

6dB Bandwidth, Low Channel



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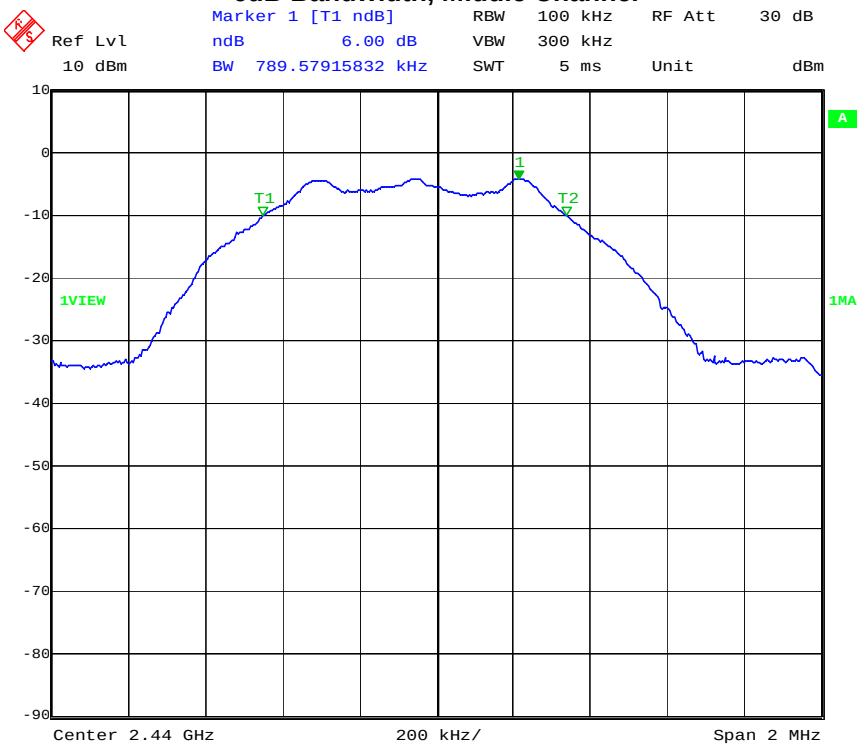
6dB Bandwidth, Middle Channel



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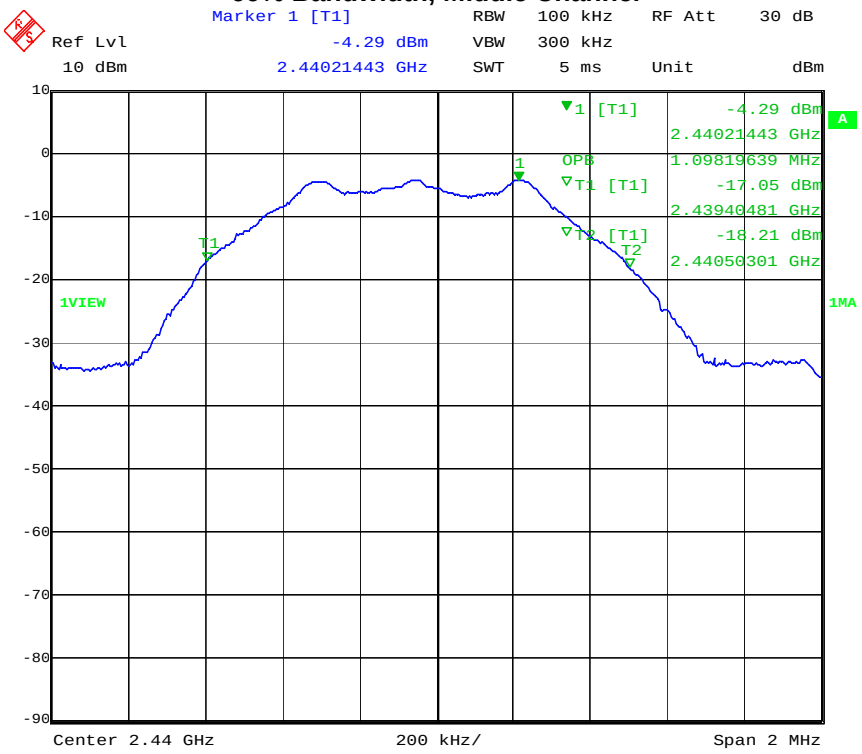
99% Bandwidth, Middle Channel



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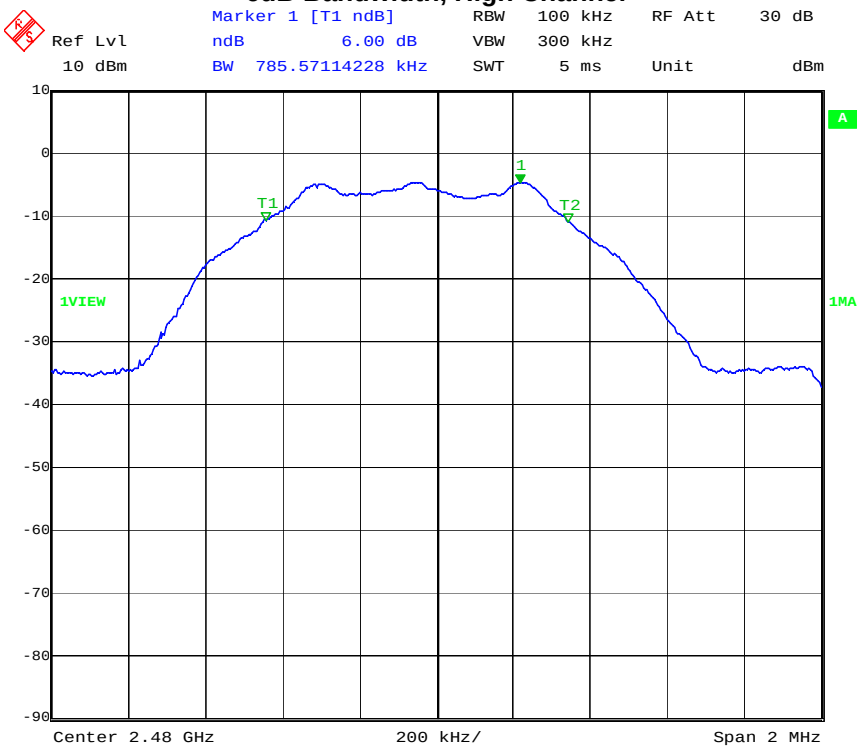
6dB Bandwidth, High Channel



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6 Conducted Spurious Emissions

6.1 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.

6.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

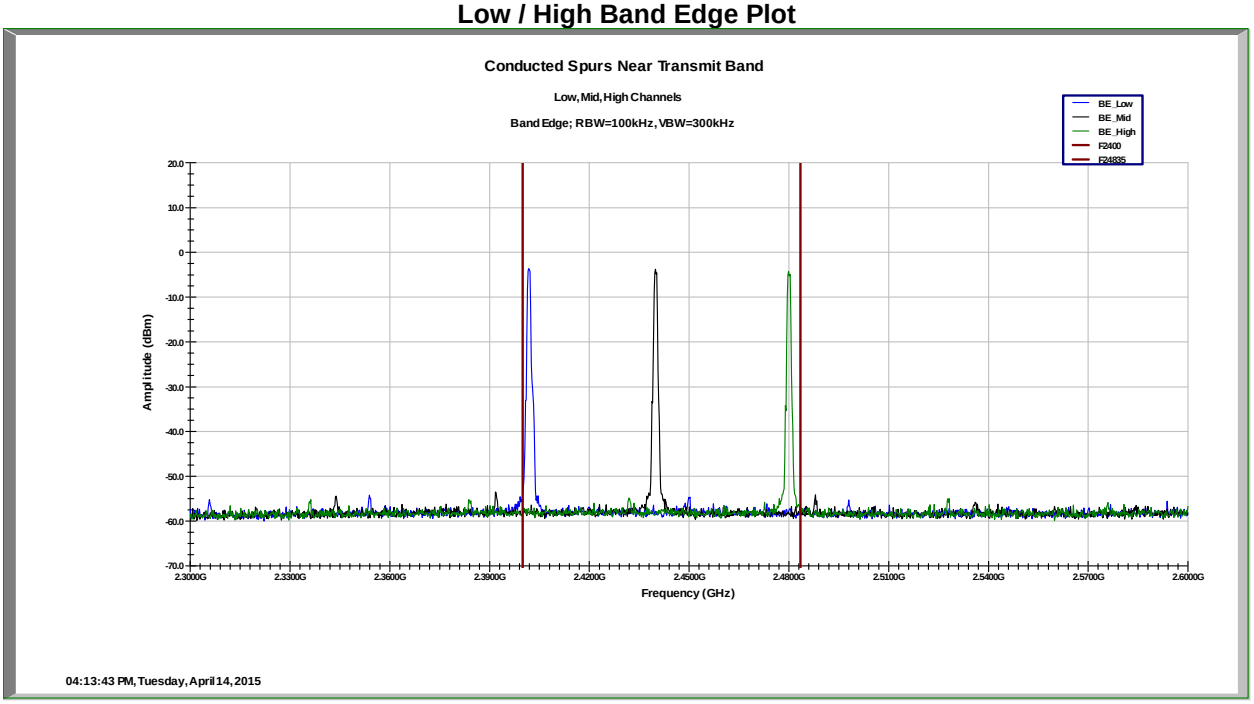
6.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/15/2014	9/15/2015

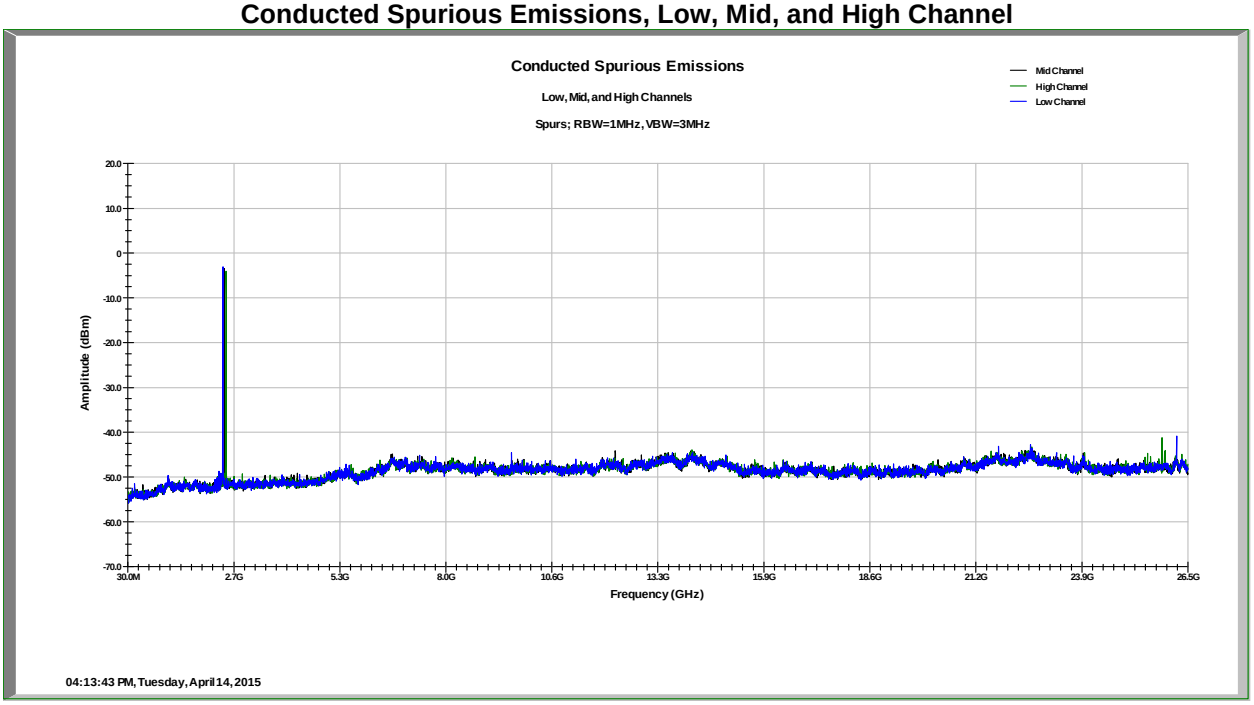
6.4 Results:

The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria.

Low / High Band Edge Plot



Conducted Spurious Emissions, Low, Mid, and High Channel



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 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

7.3 Test Equipment Used:

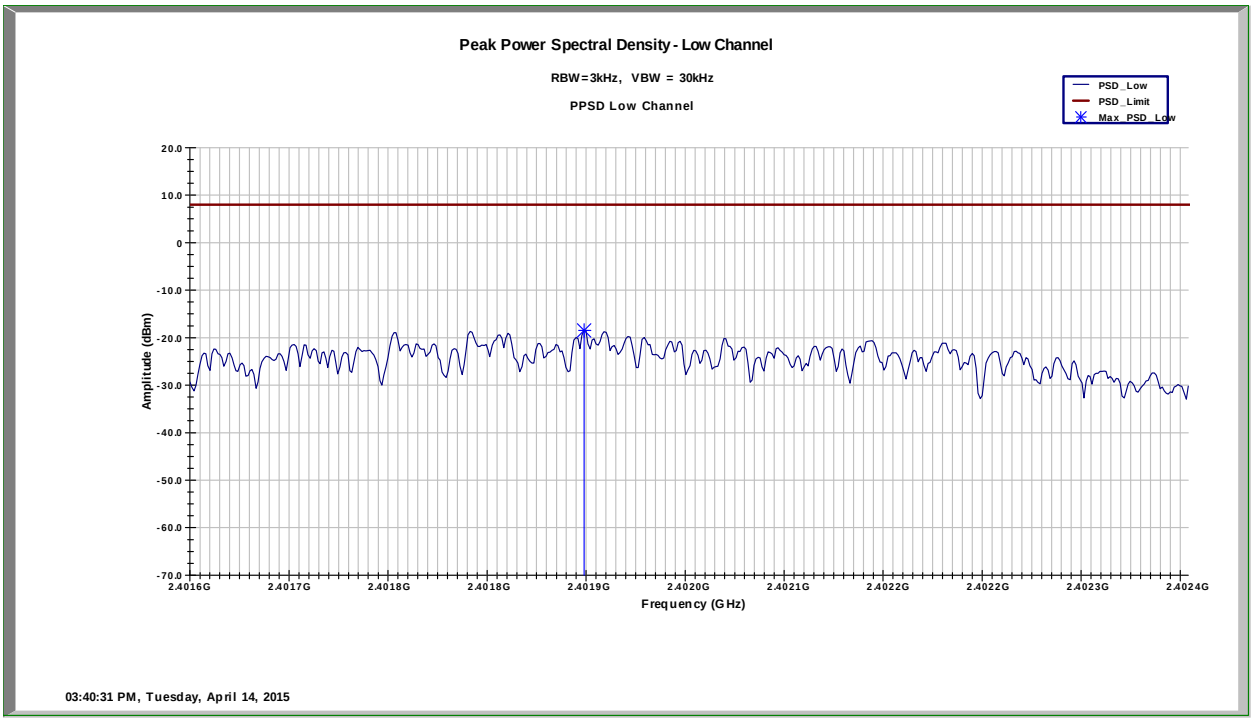
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/15/2014	9/15/2015

7.4 Results:

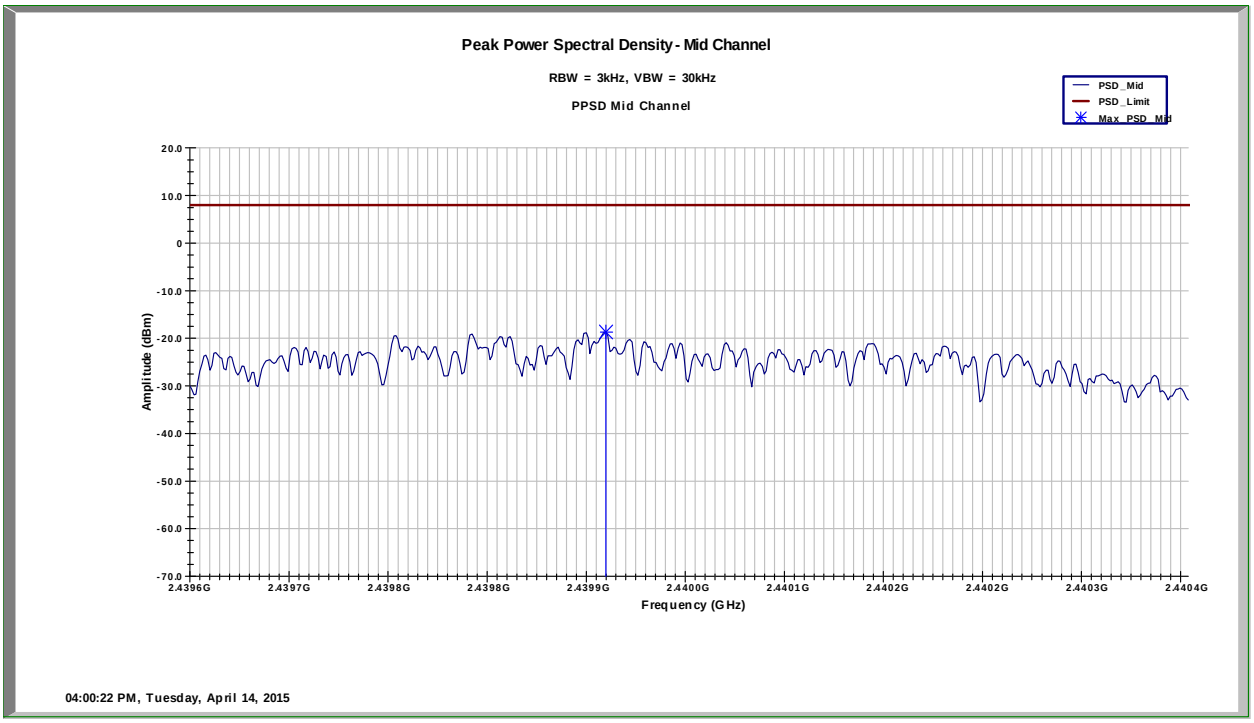
*PSD Option 1 Method

Mode	Channel Number	Frequency (MHz)	PSD in 3kHz BW (dBm)	Limit (dBm)	Result
BTLE	0	2402	-18.487	8.0	Pass
BTLE	19	2440	-18.694	8.0	Pass
BTLE	39	2480	-18.922	8.0	Pass

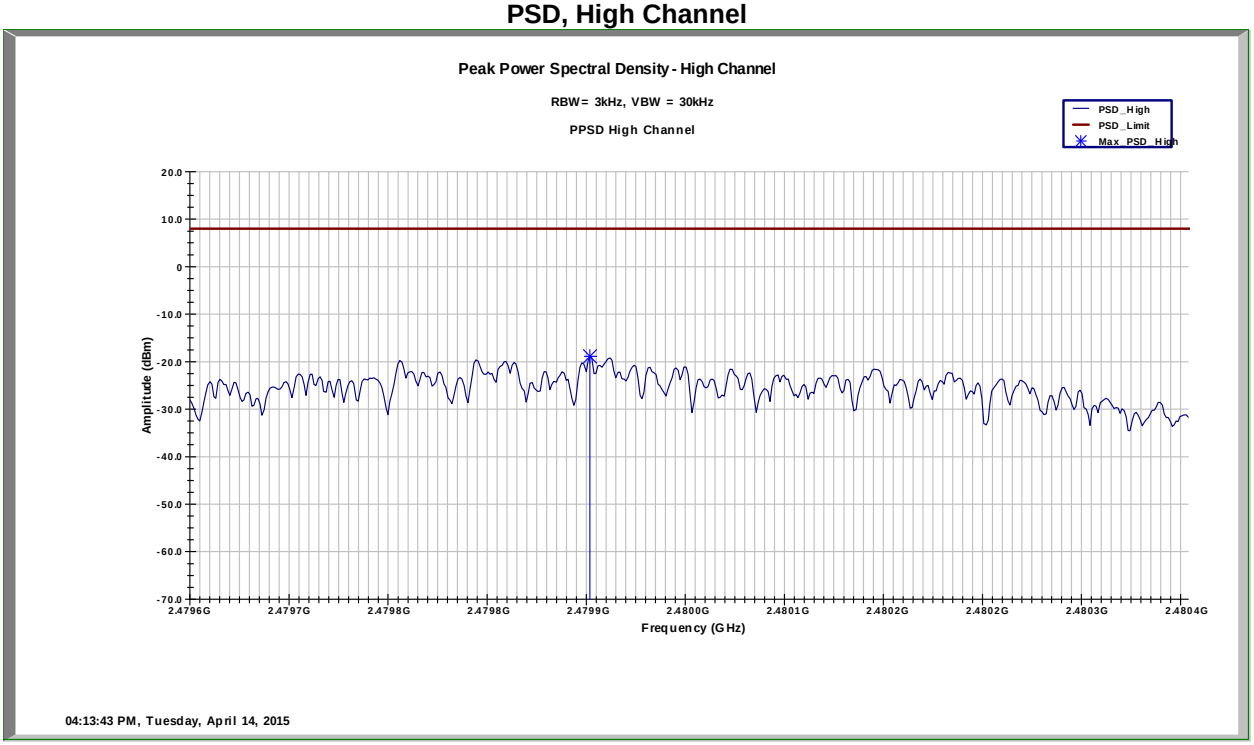
PSD Low Channel



PSD Middle Channel



PSD, High Channel



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
[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

8.2 Test Procedure

ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

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 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

8.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde&Schwarz	ESU40	9/17/2014	9/17/2015
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/26/2014	11/26/2015
Preamplifier	100050	Rohde&Schwarz	TS-PR26	11/26/2014	11/26/2015
Horn Antenna (18 – 40GHz)	00117798	ETS	3116c	5/13/2014	5/13/2015
Horn Antenna	00156319	ETS	3117	5/2/2014	5/2/2015
Bilog Antenna	00051864	ETS	3142C	1/20/2015	1/20/2016
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use
High Pass Filter	1	Wainwright	WHKX12-2533.85-2710-18000-40SS	Time of Use	Time of Use
EMC Software	Version 9.15.02	Rohde&Schwarz	EMC32	Time of Use	Time of Use

8.5 Results:

The radiated spurious testing was conducted up to 10 times the fundamental frequency. 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 tables are the worst case emissions. Emissions not reported were at or below the measurement noise floor. The test sample was evaluated on three orthogonal axes since it could be used in any orientation.

Worst Case Spurious Emissions (Channel 2402, GFSK)

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4803.800000	---	44.90	74.00	29.10	1000.000	393.0	H	186.0	7.5
4803.800000	33.28	---	54.00	20.72	1000.000	393.0	H	186.0	7.5
7205.400000	31.95	---	54.00	22.05	1000.000	323.0	V	163.0	10.4
7205.400000	---	44.43	74.00	29.57	1000.000	323.0	V	163.0	10.4
9607.000000	46.14	---	54.00	7.86	1000.000	372.0	V	134.0	13.6
9607.000000	---	58.38	74.00	15.62	1000.000	372.0	V	134.0	13.6
12011.000000	47.97	---	54.00	6.03	1000.000	100.0	V	312.0	17.4
12011.000000	---	60.51	74.00	13.49	1000.000	100.0	V	312.0	17.4
14413.000000	---	50.04	74.00	23.96	1000.000	395.0	H	137.0	17.0
14413.000000	37.15	---	54.00	16.85	1000.000	395.0	H	137.0	17.0
16815.000000	---	53.23	74.00	20.77	1000.000	360.0	H	214.0	21.5
16815.000000	40.74	---	54.00	13.26	1000.000	360.0	H	214.0	21.5

Worst Case Spurious Emissions (Channel 2402, GFSK, Band Edge)

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	---	52.51	74.00	21.49	1000.000	312.0	V	286.0	37.7
2390.000000	41.53	---	54.00	12.47	1000.000	312.0	V	286.0	37.7

Worst Case Spurious Emissions (Channel 2440, GFSK)

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.800000	33.83	---	54.00	20.17	1000.000	372.0	V	150.0	7.4
4879.800000	---	45.30	74.00	28.70	1000.000	372.0	V	150.0	7.4
7319.400000	32.48	---	54.00	21.52	1000.000	383.0	H	156.0	10.5
7319.400000	---	45.27	74.00	28.73	1000.000	383.0	H	156.0	10.5
9759.000000	48.29	---	54.00	5.71	1000.000	272.0	V	113.0	13.7
9759.000000	---	61.99	74.00	12.01	1000.000	272.0	V	113.0	13.7
12201.000000	40.56	---	54.00	13.44	1000.000	371.0	H	151.0	17.2
12201.000000	---	53.51	74.00	20.49	1000.000	371.0	H	151.0	17.2
14641.000000	---	51.06	74.00	22.94	1000.000	391.0	H	244.0	17.3
14641.000000	37.83	---	54.00	16.17	1000.000	391.0	H	244.0	17.3
17081.000000	---	52.53	74.00	21.47	1000.000	367.0	H	208.0	21.3
17081.000000	39.90	---	54.00	14.10	1000.000	367.0	H	208.0	21.3

Worst Case Spurious Emissions (Channel 2480, GFSK)

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4959.800000	---	44.60	74.00	29.40	1000.000	256.0	V	292.0	7.2
4959.800000	33.74	---	54.00	20.26	1000.000	256.0	V	292.0	7.2
7439.400000	34.49	---	54.00	19.51	1000.000	225.0	H	128.0	10.9
7439.400000	---	46.54	74.00	27.46	1000.000	225.0	H	128.0	10.9
9919.000000	46.62	---	54.00	7.38	1000.000	314.0	V	124.0	14.0
9919.000000	---	62.52	74.00	11.48	1000.000	314.0	V	124.0	14.0
12401.000000	40.10	---	54.00	13.90	1000.000	261.0	H	0.0	16.9
12401.000000	---	53.46	74.00	20.54	1000.000	261.0	H	0.0	16.9
14881.000000	---	51.54	74.00	22.46	1000.000	381.0	V	155.0	18.2
14881.000000	37.91	---	54.00	16.09	1000.000	381.0	V	155.0	18.2
17361.000000	39.28	---	54.00	14.72	1000.000	276.0	H	115.0	20.6
17361.000000	---	52.22	74.00	21.78	1000.000	276.0	H	115.0	20.6

Worst Case Spurious Emissions (Channel 2480, GFSK, Band Edge)

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.500000	---	53.09	74.00	20.91	1000.000	332.0	V	300.0	37.8
2483.500000	42.29	---	54.00	11.71	1000.000	332.0	V	300.0	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 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

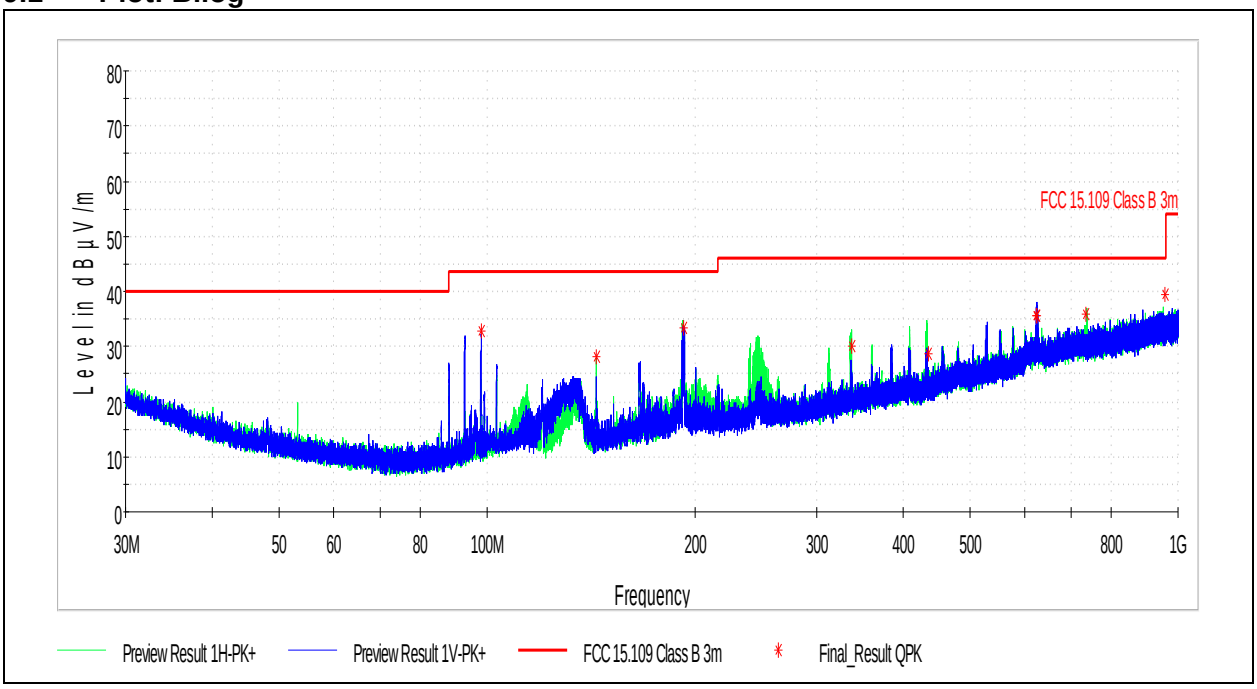
9.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde&Schwarz	ESU40	9/17/2014	9/17/2015
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/26/2014	11/26/2015
Preamplifier	100050	Rohde&Schwarz	TS-PR26	11/26/2014	11/26/2015
Horn Antenna (18 – 40GHz)	00117798	ETS	3116c	5/13/2014	5/13/2015
Horn Antenna	00156319	ETS	3117	5/2/2014	5/2/2015
Bilog Antenna	00051864	ETS	3142C	1/20/2015	1/20/2016
System Controller	121701-1	Sunol Sciences	SC99V	Time of Use	Time of Use
EMC Software	Version 9.15.02	Rohde&Schwarz	EMC32	Time of Use	Time of Use

9.5 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.

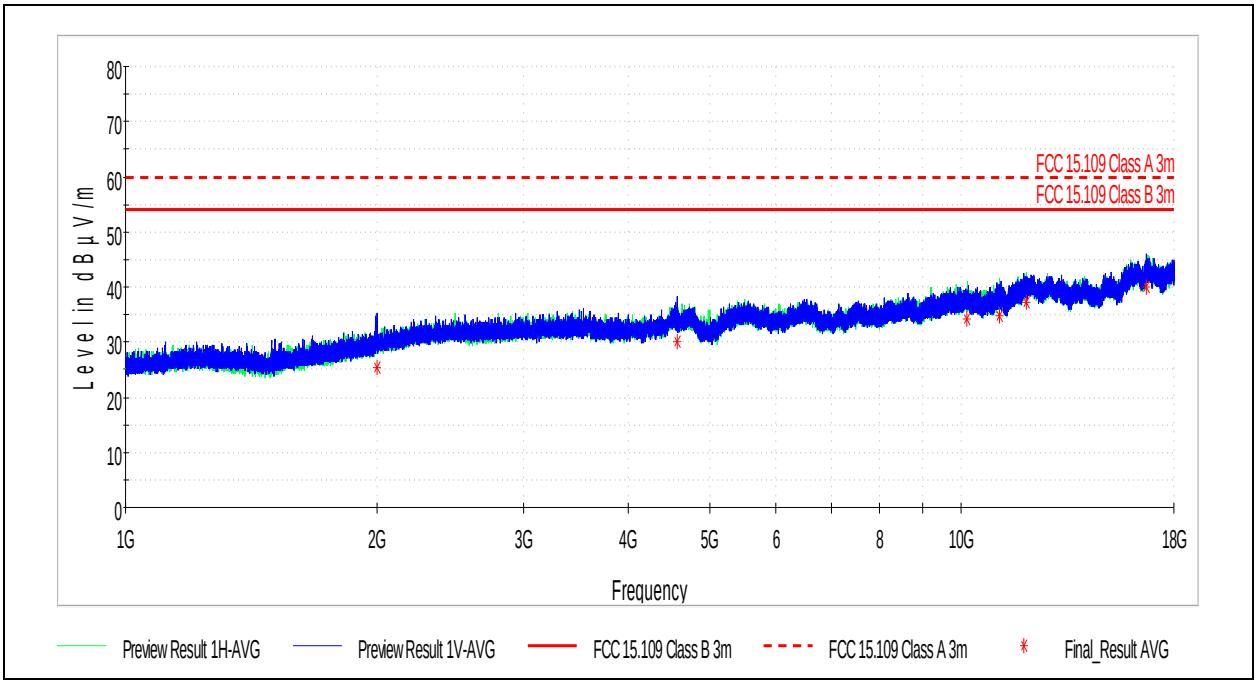
9.1 Plot: Bilog



9.2 Test Data: Bilog

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
98.096000	32.72	43.52	10.80	120.000	109.8	V	112.0	10.5
144.000000	28.10	43.52	15.42	120.000	217.3	H	328.0	10.8
192.380000	33.45	43.52	10.07	120.000	195.9	H	269.0	13.8
336.940000	30.18	46.02	15.84	120.000	110.1	H	278.0	18.5
435.040000	28.82	46.02	17.20	120.000	235.2	H	280.0	21.4
623.700000	35.71	46.02	10.31	120.000	171.1	V	158.0	26.1
625.260000	35.52	46.02	10.50	120.000	105.0	V	332.0	26.1
735.160000	35.90	46.02	10.12	120.000	117.6	H	0.0	27.2
957.080000	39.33	46.02	6.69	120.000	279.3	H	0.0	30.2

9.1 Plot: Horn



9.2 Test Data: Horn

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1998.717133	25.42	54.00	28.58	1000.000	200.0	V	10.0	1.8
4571.676400	30.17	54.00	23.83	1000.000	138.0	V	320.0	7.7
10177.255900	34.25	54.00	19.75	1000.000	100.0	H	206.0	14.6
11120.371100	34.70	54.00	19.30	1000.000	200.0	H	181.0	15.5
11989.125300	37.18	54.00	16.82	1000.000	158.0	H	306.0	17.5
16688.810200	39.94	54.00	14.06	1000.000	100.0	V	294.0	21.5

10 AC Powerline Conducted Emissions

10.1 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.

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.

10.2 Test Procedure

ANSI C63.4: 2014

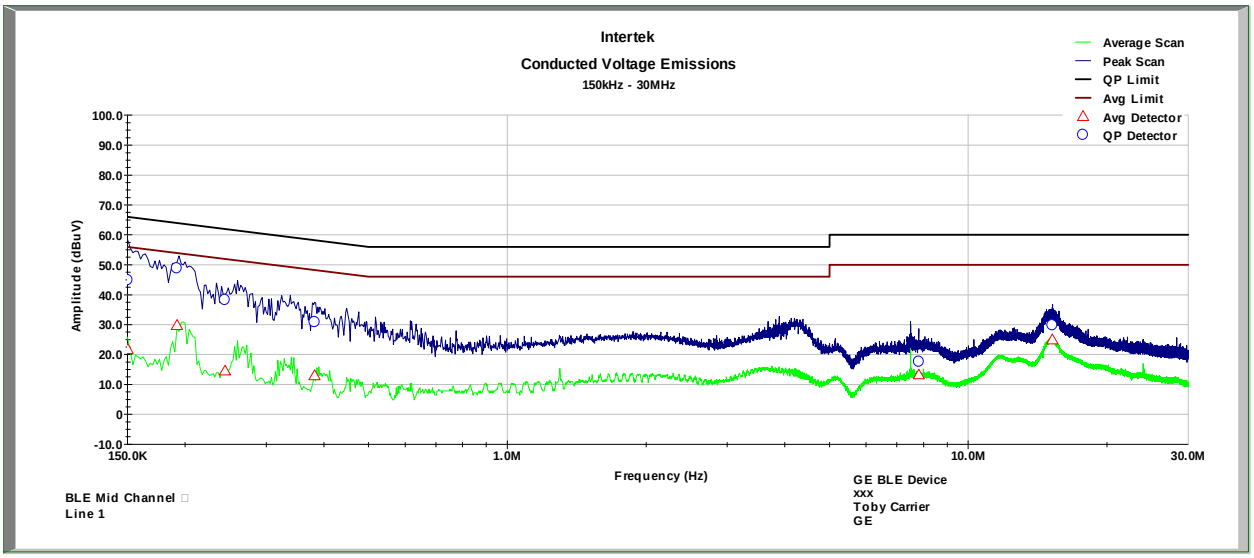
10.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	8/22/2014	8/22/2015
LISN	3333	Teseq	NNB52	3/12/2015	3/12/2016

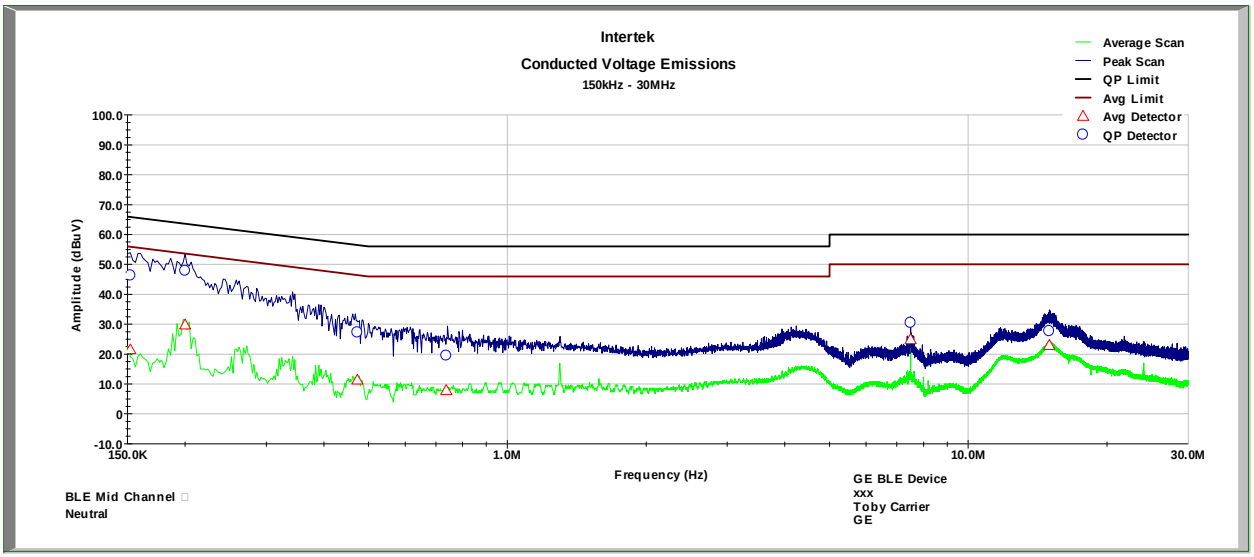
10.4 Results:

Conducted Voltage Emissions on Power Lines								
Test Engineer:	Toby Carrier	**Start Date:**	4/17/2015		**End Date:**	4/17/2015		
Temperature:	22.0℃	**Humidity:**	48.90%		**Pressure:**	968.39 mbars		
Specification:	FCC Part 15B	**Test Limit:**	Class B		**RBW:**	9kHz		
Notes:	Bluetooth Mid Channel							
Line	**Frequency (MHz)**	**Quasi-Peak (dBuV)**	**Quasi-Peak Limit (dBuV)**	**Quasi-Peak Delta (dB)**	**Average (dBuV)**	**Average Limit (dBuV)**	**Average Delta (dB)**	**Results**
Line 1	150.100 KHz	44.772	65.997	-21.225	21.739	55.997	-34.258	**Compliant**
	192.000 KHz	48.844	64.8	-15.956	29.754	54.8	-25.046	**Compliant**
	244.000 KHz	38.201	63.314	-25.113	14.501	53.314	-38.813	**Compliant**
	381.800 KHz	30.8	59.377	-28.577	12.964	49.377	-36.413	**Compliant**
	7.813 MHz	17.491	60	-42.509	13.223	50	-36.777	**Compliant**
	15.227 MHz	29.754	60	-30.246	24.97	50	-25.03	**Compliant**
Neutral	152.100 KHz	46.303	65.94	-19.637	21.496	55.94	-34.444	**Compliant**
	200.000 KHz	47.839	64.571	-16.732	29.789	54.571	-24.782	**Compliant**
	472.900 KHz	27.277	56.774	-29.497	11.317	46.774	-35.458	**Compliant**
	737.000 KHz	19.483	56	-36.517	7.86	46	-38.14	**Compliant**
	7.500 MHz	30.424	60	-29.576	24.884	50	-25.116	**Compliant**
	14.992 MHz	27.667	60	-32.333	22.963	50	-27.037	**Compliant**

Test Data – Bluetooth Low Energy Mid Channel



Line 1 – Bluetooth Low Energy Mid Channel

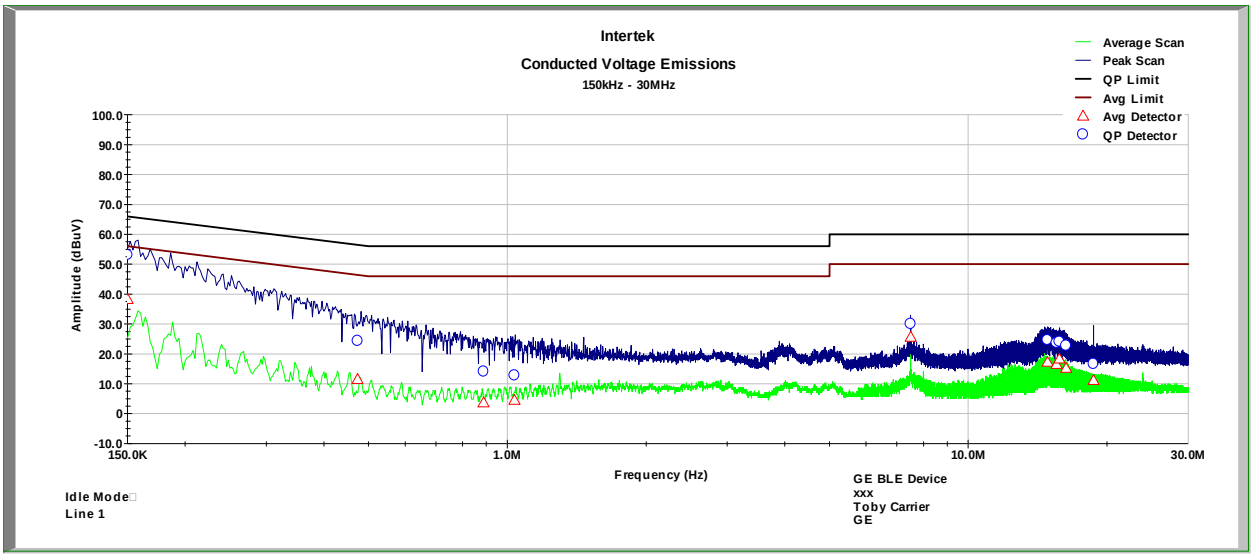


Neutral – Bluetooth Low Energy Mid Channel

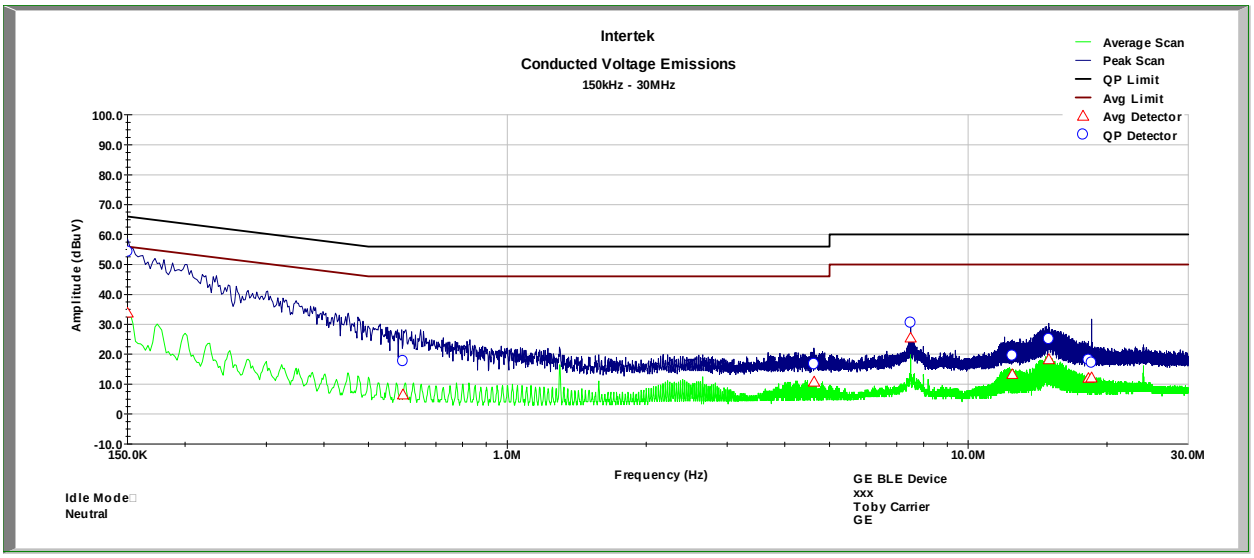
Conducted Voltage Emissions on Power Lines								
Test Engineer:	Toby Carrier	**Start Date:**	4/17/2015	**End Date:**	4/17/2015			
Temperature:	22℃	**Humidity:**	48.90%	**Pressure:**	963.25 mbars			
Specification:	FCC Part 15B	**Test Limit:**	Class B	**RBW:**	9kHz			
Notes:	Bluetooth RX Mode							

Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
Line 1	150.100 KHz	53.092	65.997	-12.905	38.197	55.997	-17.8	**Compliant**
	473.400 KHz	24.29	56.76	-32.47	11.451	46.76	-35.309	**Compliant**
	888.100 KHz	14.106	56	-41.894	3.698	46	-42.302	**Compliant**
	1.036 MHz	12.831	56	-43.169	4.503	46	-41.497	**Compliant**
	7.501 MHz	29.951	60	-30.049	25.582	50	-24.418	**Compliant**
	14.862 MHz	24.613	60	-35.387	17.22	50	-32.78	**Compliant**
	15.552 MHz	23.633	60	-36.367	16.476	50	-33.524	**Compliant**
	15.778 MHz	24.084	60	-35.916	18.289	50	-31.711	**Compliant**
	16.312 MHz	22.758	60	-37.242	15.154	50	-34.846	**Compliant**
Neutral	150.000 KHz	54.272	66	-11.728	33.784	56	-22.216	**Compliant**
	593.800 KHz	17.662	56	-38.338	6.376	46	-39.624	**Compliant**
	4.630 MHz	16.662	56	-39.338	10.682	46	-35.318	**Compliant**
	7.500 MHz	30.478	60	-29.522	25.423	50	-24.577	**Compliant**
	12.459 MHz	19.529	60	-40.471	13.221	50	-36.779	**Compliant**
	14.961 MHz	25.039	60	-34.961	18.234	50	-31.766	**Compliant**
	18.241 MHz	18.105	60	-41.895	11.931	50	-38.069	**Compliant**
	18.515 MHz	17.161	60	-42.839	12.106	50	-37.894	**Compliant**

Test Data – Bluetooth Low Energy Rx Mode



Line 1 – Bluetooth Rx Mode



Neutral – Bluetooth Rx Mode

11 Antenna Requirement per FCC Part 15.203

11.1 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.

11.2 Results:

The sample tested met the antenna requirement. The antenna was a PCB circuit board that was permanently soldered to the main board.

12 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	

13 Revision History

Revision Level	Date	Report Number	Notes
0	7/7/2015	102063374LEX-001	Original Issue