

BTLE TEST REPORT

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Model Number: RC15 Range Control

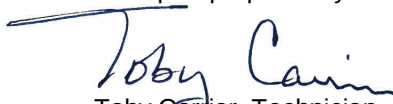
FCC Standards: Title 47 CFR 15 Subpart B and C

Industry Canada Standards: RSS-210 Issue 8 & RSS-GEN Issue 4

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Lexington, KY 40510

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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
21	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen (6.1)	Pass
24	Conducted Voltage Emissions on the AC Mains Terminals	§ 15.107, § 15.207	RSS-Gen (7.2.4)	Pass
29	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen (7.1.2)	Pass

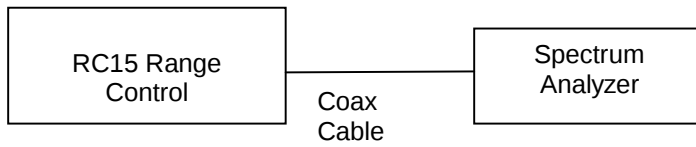
3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	GE Digital Energy
Model Number	RC15 Range Control
Serial Number	Test Sample #1
Receive Date	4/1/2015
Test Start Date	4/1/2015
Test End Date	5/15/2015
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	120Vac 60Hz

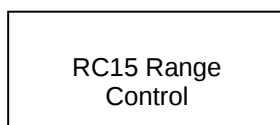
Description of Equipment Under Test
Bluetooth Low Energy Appliance Control Module

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Transmitting Bluetooth Low Energy on low, mid or 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 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 wide resolution bandwidth setting of the spectrum analyzer.

4.3 Test Equipment Used:

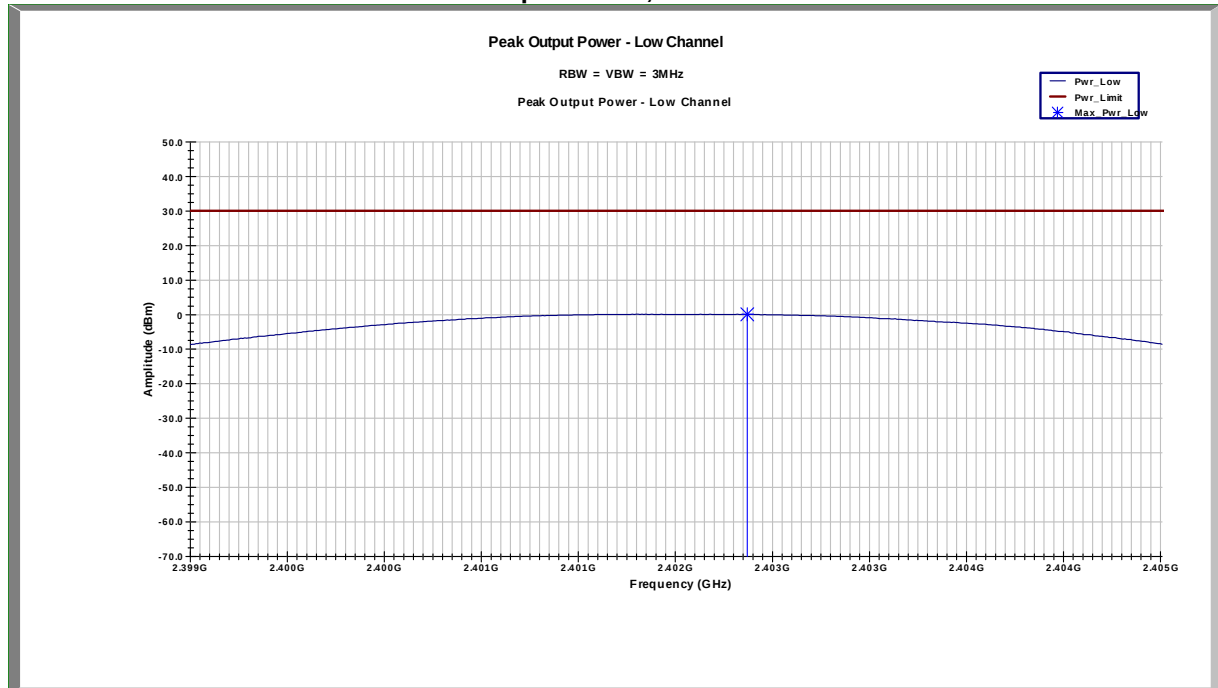
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde & Schwarz	FSEK30	9/15/2014	9/15/2015

4.4 Results:

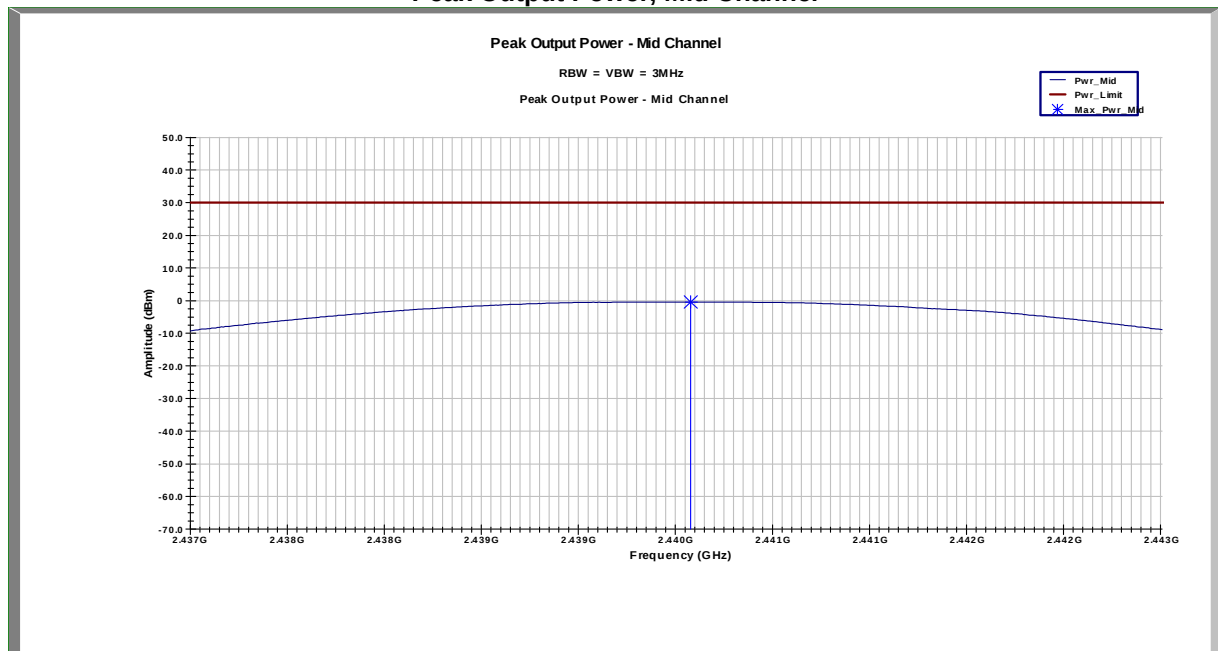
The peak output power measurements were all below the 30dBm limit.

Mode	Channel Number	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	Result
BTLE	0	2402	0.085	30	Pass
BTLE	19	2440	-0.430	30	Pass
BTLE	39	2480	-1.145	30	Pass

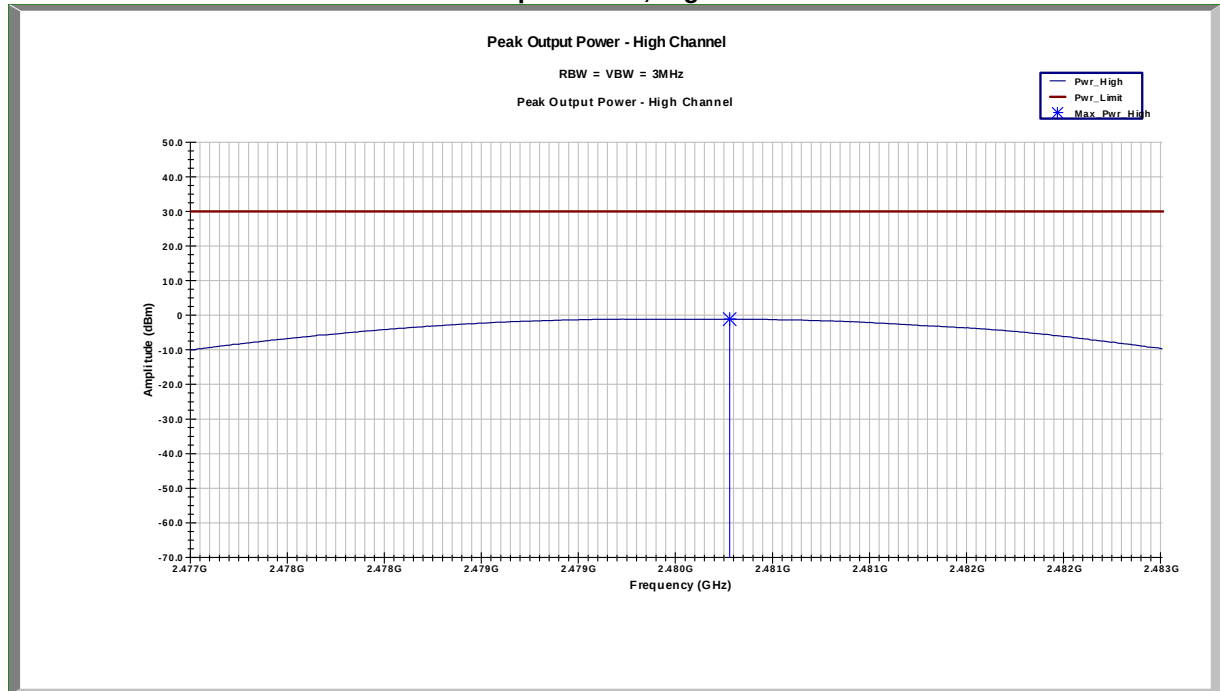
Peak Output Power, Low Channel



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)

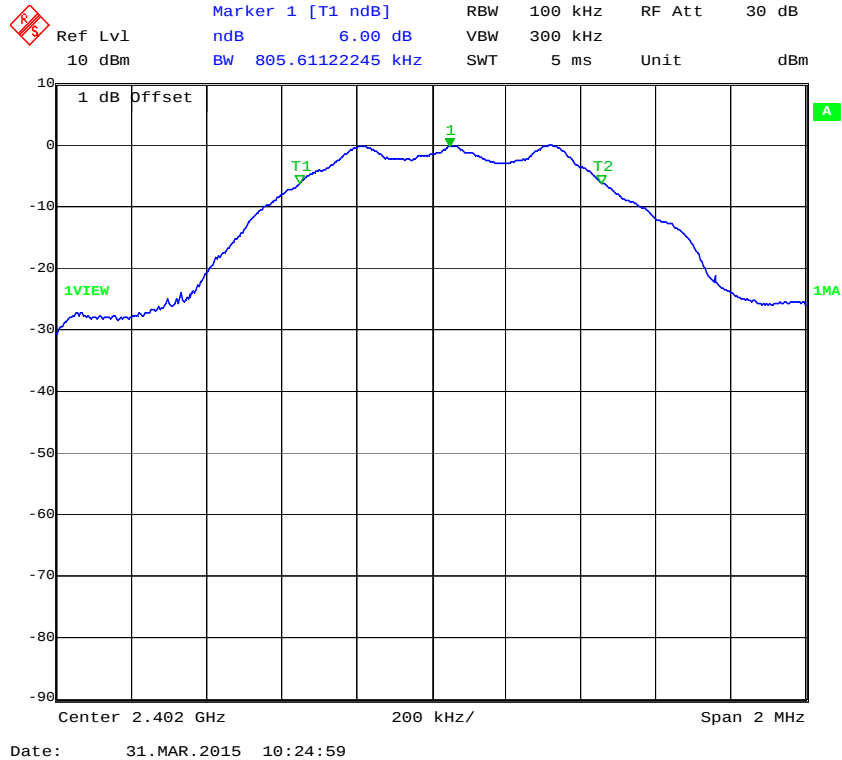
5.3 Test Equipment Used:

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

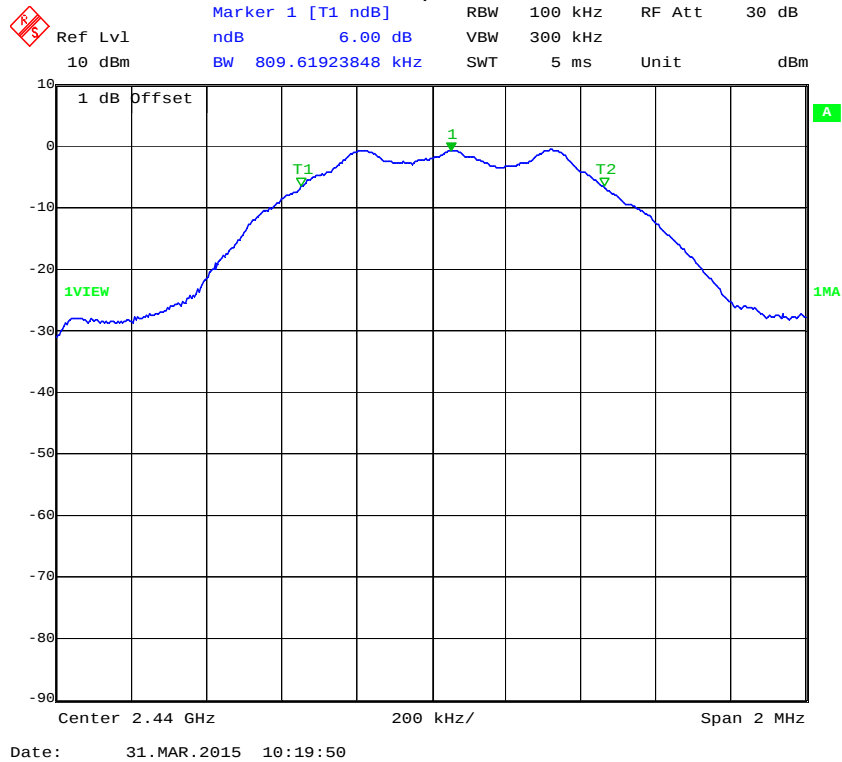
5.4 Results:

Mode	Channel Number	Frequency (MHz)	6dB Bandwidth	99% Power Bandwidth	Result
BTLE	0	2402	806kHz	---	Pass
BTLE	19	2440	810kHz	1.14MHz	Pass
BTLE	39	2480	806kHz	---	Pass

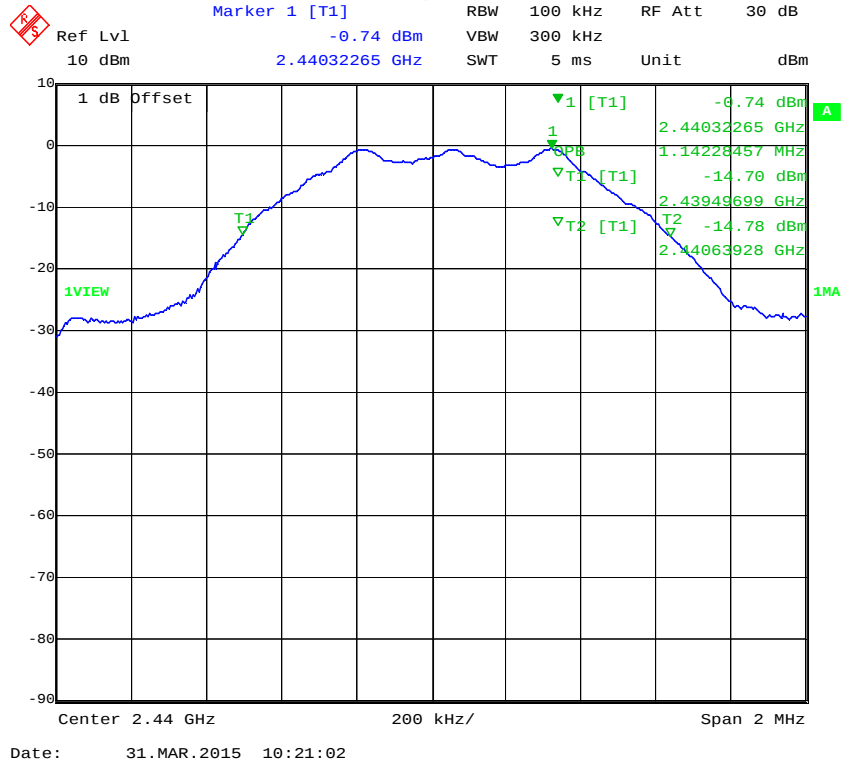
6dB Bandwidth, Low Channel



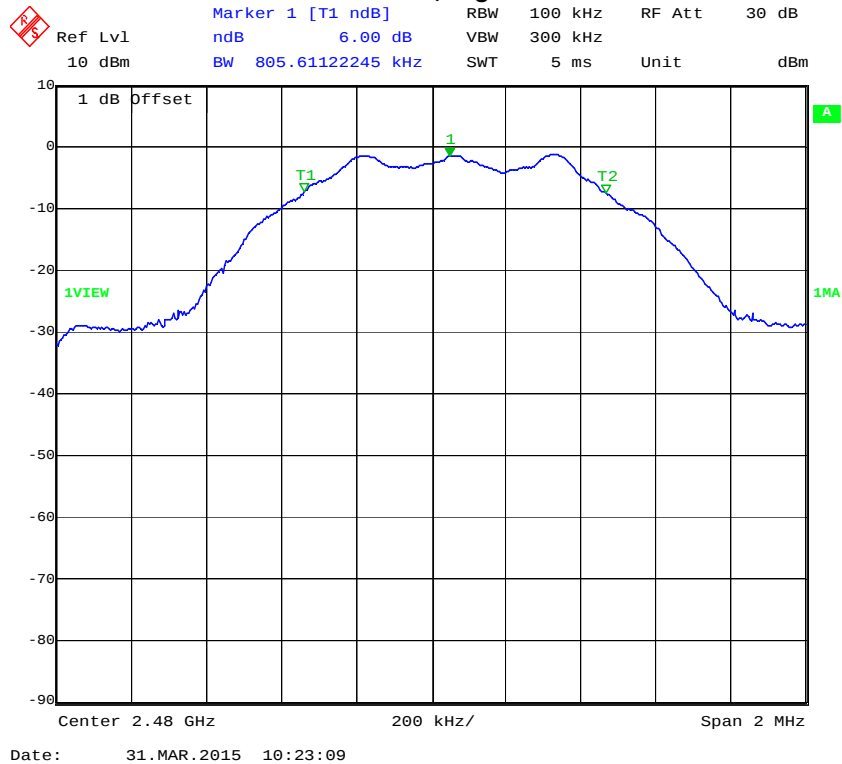
6dB Bandwidth, Middle Channel



99% Bandwidth, Middle Channel



6dB Bandwidth, High Channel



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)

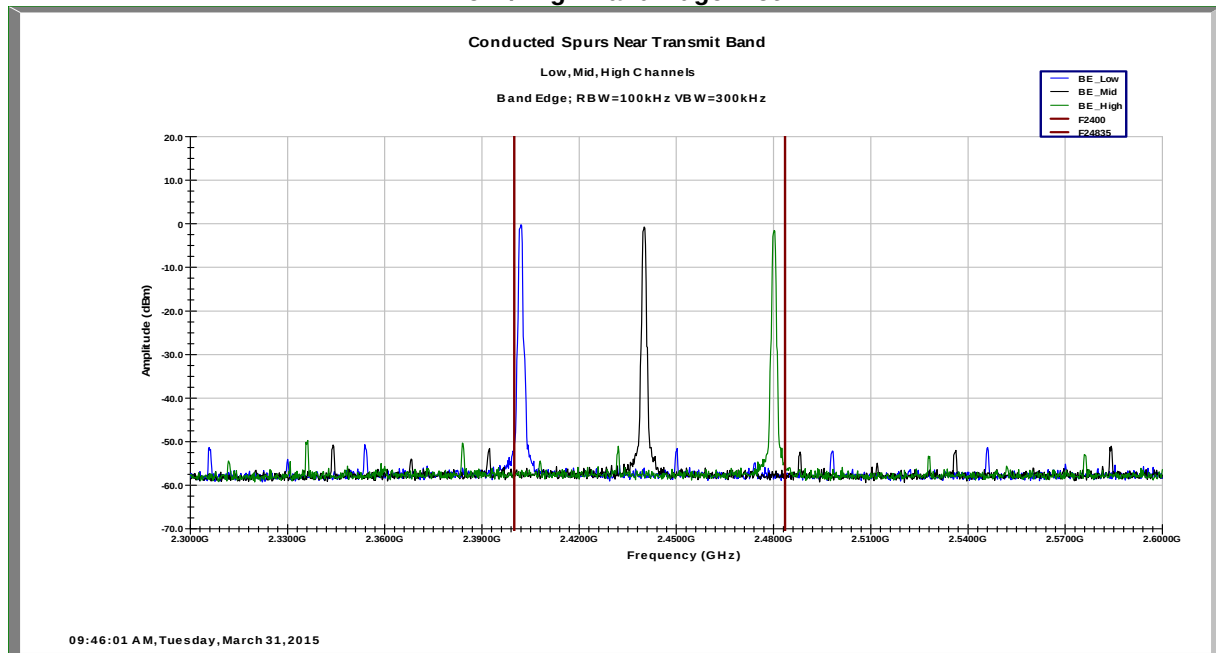
6.3 Test Equipment Used:

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

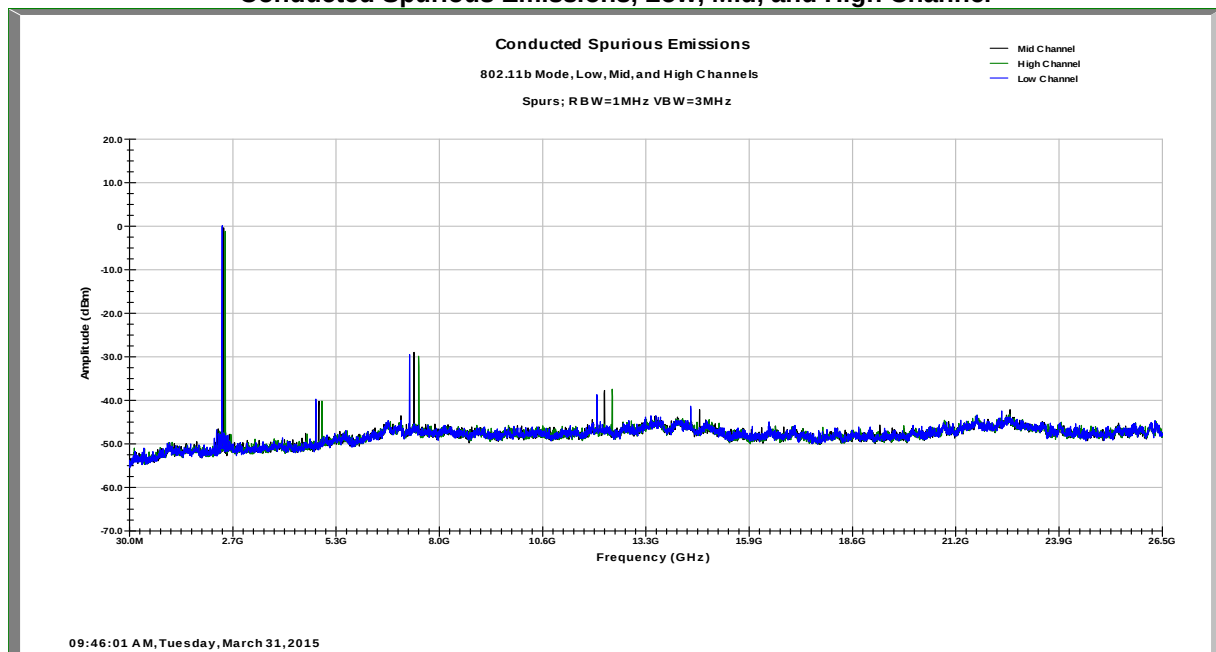
6.4 Results:

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:

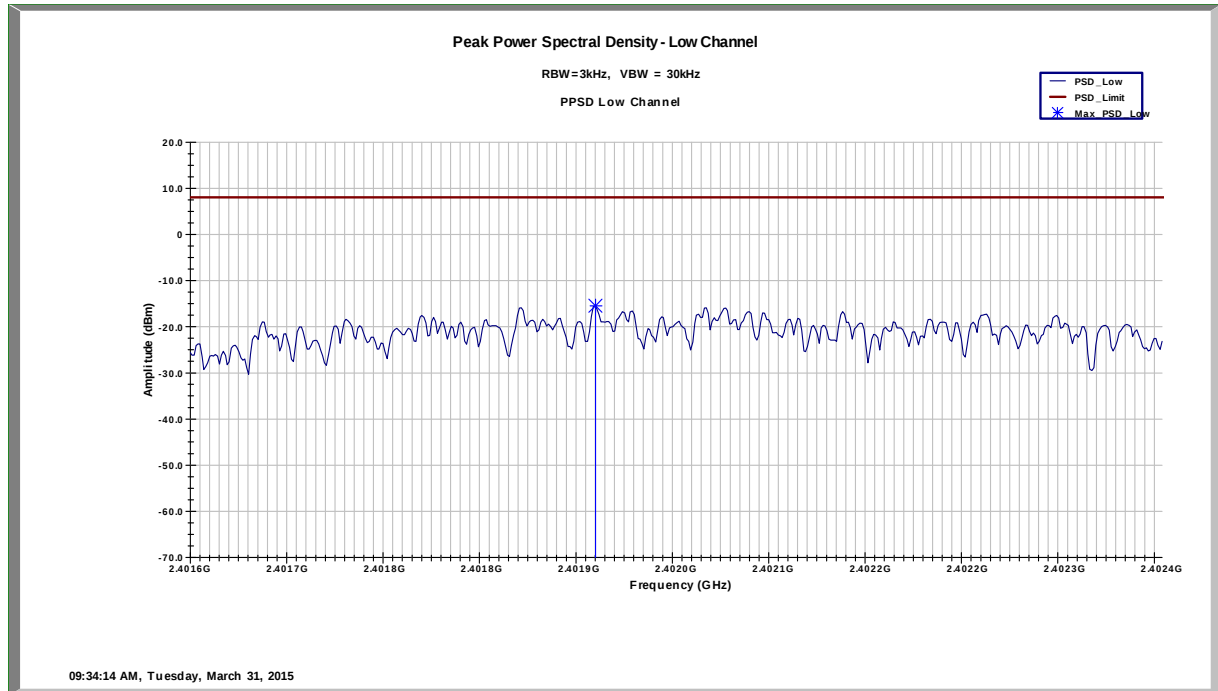
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3720	Rohde&Schwarz	FSEK30	9/15/2014	9/15/2015

7.4 Results:

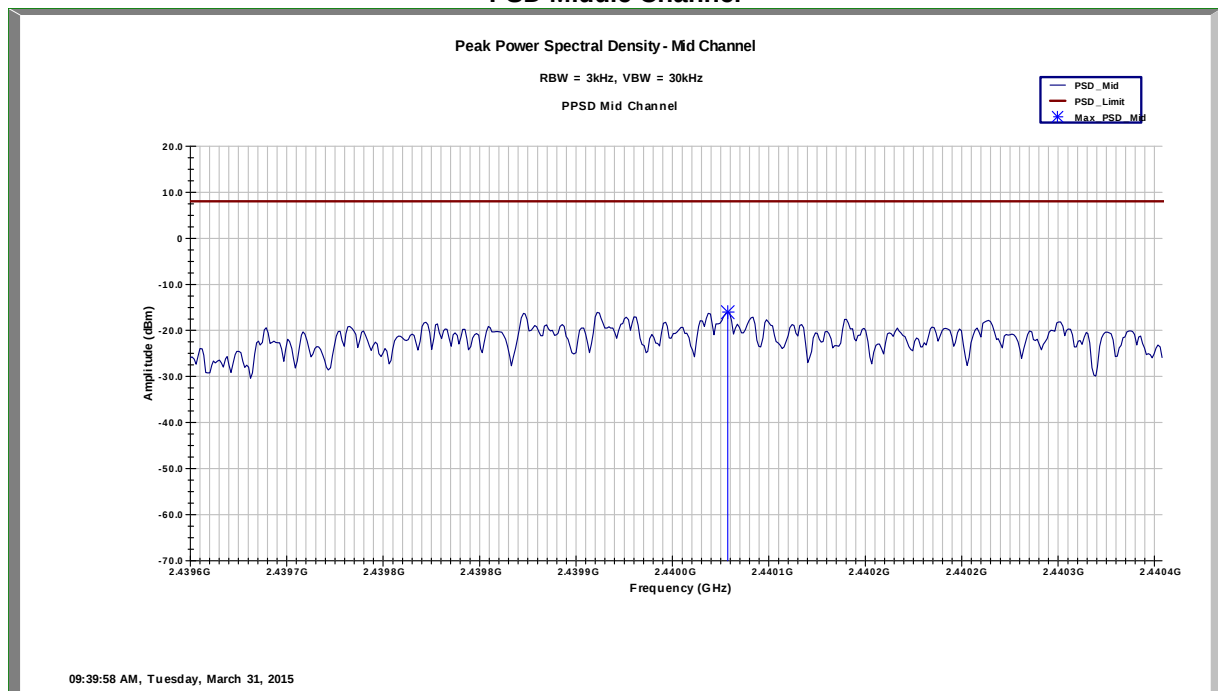
*PSD Option 1 Method

Mode	Channel Number	Frequency (MHz)	PSD in 3kHz BW (dBm)	Limit (dBm)	Result
BTLE	0	2402	-15.489	8.0	Pass
BTLE	19	2440	-16.030	8.0	Pass
BTLE	39	2480	-16.657	8.0	Pass

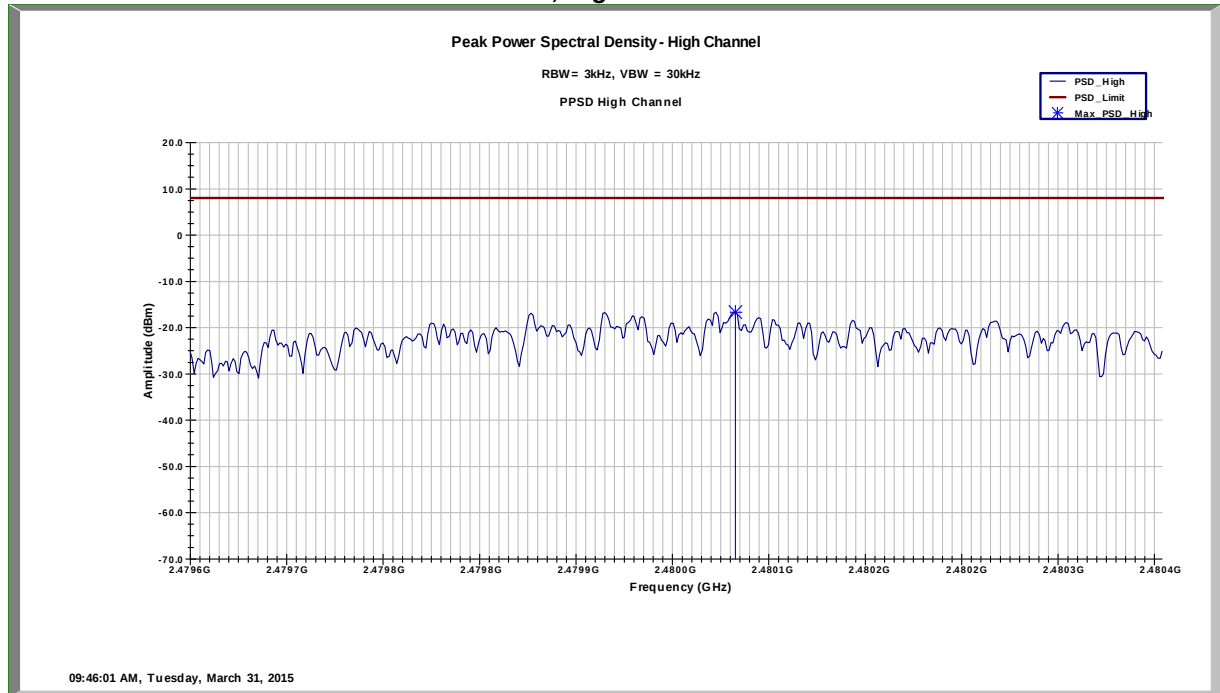
PSD Low Channel



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
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	1650–1710	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 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

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

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

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.

In the tables that follow, the average readings in parentheses “()” were adjusted by a duty cycle correction factor of -44.1dB, 20log(dwell time/100mS).

Worst Case Spurious Emissions (BTLE, Low Channel)

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.200000	---	56.39	74.00	17.61	1000.000	410.0	H	129.0	7.5
4804.200000	50.10	---	54.00	3.90	1000.000	410.0	H	129.0	7.5
7205.400000	---	70.02	74.00	3.98	1000.000	261.0	H	346.0	10.4
7205.400000	(6.29)	---	54.00	47.71	1000.000	261.0	H	346.0	10.4
9607.400000	---	47.45	74.00	26.55	1000.000	247.0	V	337.0	13.6
9607.400000	36.35	---	54.00	17.65	1000.000	247.0	V	337.0	13.6
12009.000000	---	53.17	74.00	20.83	1000.000	211.0	V	337.0	17.5
12009.000000	42.78	---	54.00	11.22	1000.000	211.0	V	337.0	17.5
14411.000000	---	54.44	74.00	19.56	1000.000	243.0	H	0.0	17.0
14411.000000	43.11	---	54.00	10.89	1000.000	243.0	H	0.0	17.0
16815.000000	---	52.40	74.00	21.60	1000.000	324.0	H	148.0	21.5
16815.000000	40.78	---	54.00	13.22	1000.000	324.0	H	148.0	21.5

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)
2390.000000	---	52.70	74.00	21.30	1000.000	410.0	H	214.0	37.7
2390.000000	41.58	---	54.00	12.42	1000.000	410.0	H	214.0	37.7

Channel 2402, GFSK, Band Edge

Worst Case Spurious Emissions (BTLE, Middle Channel)

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4879.800000	---	52.50	74.00	21.50	1000.000	379.0	H	227.0	7.4
4879.800000	44.10	---	54.00	9.90	1000.000	379.0	H	227.0	7.4
7319.600000	---	66.84	74.00	7.16	1000.000	230.0	H	342.0	10.5
7319.600000	(3.12)	---	54.00	50.88	1000.000	230.0	H	342.0	10.5
9759.000000	35.87	---	54.00	18.13	1000.000	208.0	V	333.0	13.7
9759.000000	---	46.53	74.00	27.47	1000.000	208.0	V	333.0	13.7
12199.000000	42.17	---	54.00	11.83	1000.000	202.0	H	309.0	17.2
12199.000000	---	53.32	74.00	20.68	1000.000	202.0	H	309.0	17.2
14639.000000	41.79	---	54.00	12.21	1000.000	238.0	H	0.0	17.3
14639.000000	---	53.11	74.00	20.89	1000.000	238.0	H	0.0	17.3
17081.000000	39.99	---	54.00	14.01	1000.000	215.0	H	174.0	21.3
17081.000000	---	51.25	74.00	22.75	1000.000	215.0	H	174.0	21.3

Channel 2440, GFSK

Worst Case Spurious Emissions (BTLE, High Channel)

Frequency (MHz)	Average (dBμV/m)	MaxPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4960.200000	---	50.06	74.00	23.94	1000.000	266.0	H	230.0	7.2
4960.200000	42.30	---	54.00	11.70	1000.000	266.0	H	230.0	7.2
7439.600000	(1.08)	---	54.00	52.92	1000.000	252.0	H	340.0	10.9
7439.600000	---	64.15	74.00	9.85	1000.000	252.0	H	340.0	10.9
9919.400000	35.37	---	54.00	18.63	1000.000	410.0	V	332.0	14.0
9919.400000	---	46.40	74.00	27.60	1000.000	410.0	V	332.0	14.0
12399.000000	44.06	---	54.00	9.94	1000.000	100.0	H	308.0	16.9
12399.000000	---	54.70	74.00	19.30	1000.000	100.0	H	308.0	16.9
14879.000000	37.81	---	54.00	16.19	1000.000	410.0	H	192.0	18.2
14879.000000	---	48.74	74.00	25.26	1000.000	410.0	H	192.0	18.2
17359.400000	39.59	---	54.00	14.41	1000.000	274.0	H	288.0	20.6
17359.400000	---	49.74	74.00	24.26	1000.000	274.0	H	288.0	20.6

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)
2483.500000	---	53.34	74.00	20.66	1000.000	242.0	V	348.0	37.8
2483.500000	42.18	---	54.00	11.82	1000.000	242.0	V	348.0	37.8

Channel 2480, GFSK, Band Edge

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

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

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

9.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	1302.6005.40	Rohde&Schwarz	ESU40	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. A ferrite was needed to pass emissions. Below are the tables for each ferrite used.

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
36.615000	31.80	40.00	8.20	120.000	109.6	V	318.0	15.2
50.053000	23.57	40.00	16.43	120.000	109.6	V	170.0	10.7
78.713000	24.30	40.00	15.70	120.000	105.0	V	0.0	8.3
116.260000	24.89	43.52	18.63	120.000	259.9	H	63.0	9.8
118.640000	25.30	43.52	18.22	120.000	259.4	H	62.0	9.7
458.180000	33.37	46.02	12.65	120.000	109.8	H	254.0	22.2
595.430000	33.38	46.02	12.64	120.000	371.3	H	200.0	25.2
868.440000	37.61	46.02	8.41	120.000	201.6	V	237.0	29.0
887.460000	38.08	46.02	7.94	120.000	141.7	H	74.0	29.4
922.360000	38.79	46.02	7.23	120.000	129.9	H	27.0	29.9

802.11rx Channel 1 Radiated Spurs with Laird 28A2029-0A2 Ferrite

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
30.360000	27.13	40.00	12.87	120.000	109.8	V	0.0	18.8
33.739000	27.09	40.00	12.91	120.000	110.1	V	0.0	16.8
50.048000	24.61	40.00	15.39	120.000	110.1	V	202.0	10.7
76.869000	23.92	40.00	16.08	120.000	104.8	V	0.0	8.3
79.738000	23.60	40.00	16.40	120.000	111.1	V	174.0	8.4
81.166000	21.60	40.00	18.40	120.000	109.8	V	0.0	8.5
457.580000	29.68	46.02	16.34	120.000	377.8	H	217.0	22.2
663.110000	34.20	46.02	11.82	120.000	152.0	V	0.0	26.1
835.240000	37.56	46.02	8.46	120.000	401.5	V	26.0	29.0
925.440000	38.81	46.02	7.21	120.000	239.6	H	54.0	30.0

802.11rx Channel 1 Radiated Spurs with Fair-rite 0444164181 Ferrite

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Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
41.574000	20.43	40.00	19.57	120.000	105.1	V	264.0	12.9
41.774000	20.51	40.00	19.49	120.000	104.9	V	263.0	12.9
76.826000	22.01	40.00	17.99	120.000	104.7	V	266.0	8.3
77.601000	22.96	40.00	17.04	120.000	104.9	V	263.0	8.3
78.038000	22.68	40.00	17.32	120.000	122.8	V	264.0	8.3
79.204000	23.71	40.00	16.29	120.000	105.0	V	266.0	8.4
81.002000	22.91	40.00	17.09	120.000	105.2	V	266.0	8.5
114.980000	29.00	43.52	14.52	120.000	105.2	V	166.0	9.9
137.320000	26.93	43.52	16.59	120.000	105.0	V	145.0	9.9
689.610000	35.14	46.02	10.88	120.000	311.0	V	146.0	27.1
943.280000	39.27	46.02	6.75	120.000	377.9	H	26.0	30.2

802.11rx Channel 1 Radiated Spurs with Laird 28A5776-0A2 Ferrite

Frequency (MHz)	QuasiPeak (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
37.412000	32.74	40.00	7.26	120.000	100.0	V	172.0	14.8
37.460000	32.38	40.00	7.62	120.000	99.7	V	174.0	14.8
37.481000	33.13	40.00	6.87	120.000	100.1	V	172.0	14.8
38.059000	32.30	40.00	7.70	120.000	100.3	V	182.0	14.5
78.936000	26.70	40.00	13.30	120.000	113.1	V	0.0	8.3
79.160000	25.50	40.00	14.50	120.000	104.6	V	0.0	8.4
80.894000	24.98	40.00	15.02	120.000	109.4	V	0.0	8.5
81.214000	24.87	40.00	15.13	120.000	110.8	V	0.0	8.6
81.853000	24.48	40.00	15.52	120.000	105.6	V	0.0	8.6
110.840000	24.73	43.52	18.79	120.000	100.3	V	0.0	10.3
123.720000	26.33	43.52	17.19	120.000	100.1	V	311.0	9.6
932.640000	39.23	46.02	6.79	120.000	401.6	V	54.0	30.3

802.11rx Channel 1 Radiated Spurs with Laird 28B0734-000 Ferrite

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 μ H/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 (dB μ V)	
	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	3/12/2014	3/12/2015

Intertek

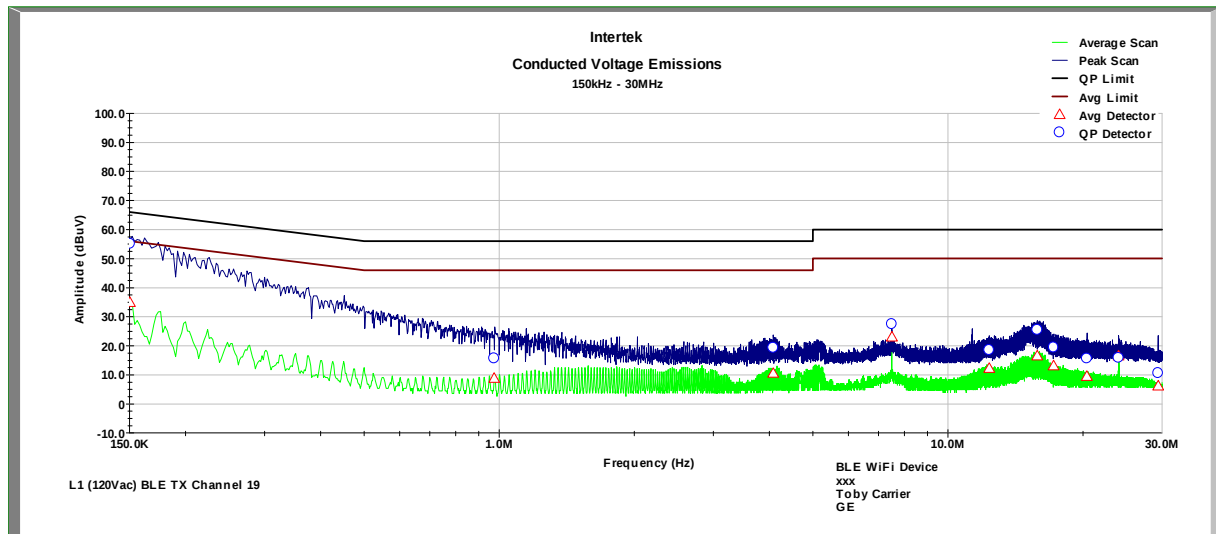
Report Number: 102052915LEX-002

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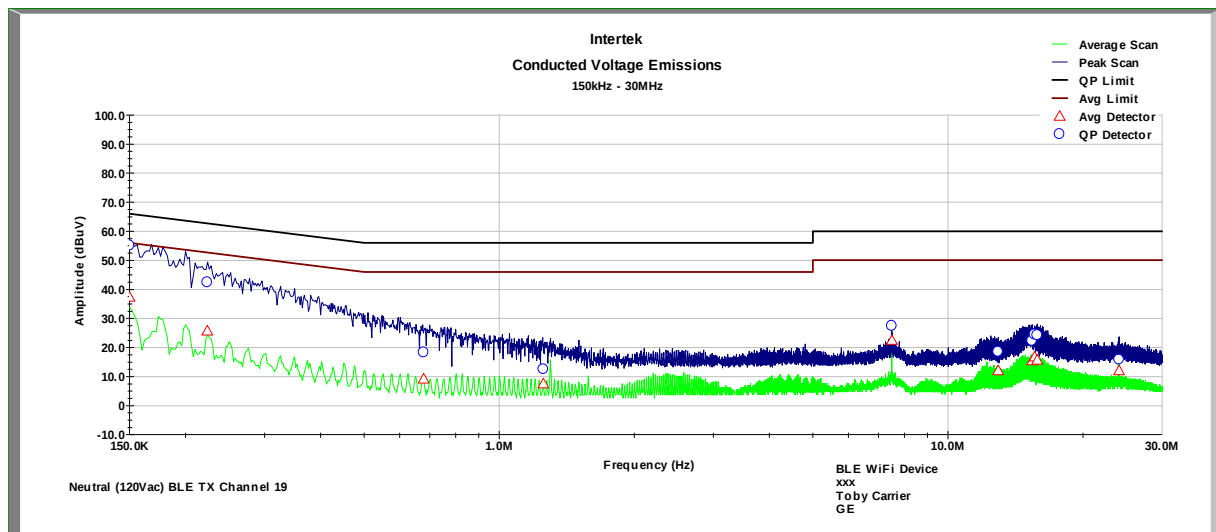
10.4 Results:

Conducted Voltage Emissions on Power Lines								
Test Engineer:	Toby Carrier		Start Date:	4/7/2015		End Date:	4/7/2015	
Temperature:	24.4°C		Humidity:	50.40%		Pressure:	985.3 mbar	
Specification:	FCC Part 15B		Test Limit:	Class B		RBW:	9kHz	
Notes:	Bluetooth Low Energy Channel 19 (Round 2)							
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	150.400 KHz	55.142	65.989	-10.847	34.88	55.989	-21.108	Compliant
	975.000 KHz	15.667	56	-40.333	8.846	46	-37.154	Compliant
	4.083 MHz	19.328	56	-36.672	10.518	46	-35.482	Compliant
	7.499 MHz	27.486	60	-32.514	23.039	50	-26.961	Compliant
	12.374 MHz	18.52	60	-41.48	12.286	50	-37.714	Compliant
	15.828 MHz	25.433	60	-34.567	16.56	50	-33.44	Compliant
	17.209 MHz	19.408	60	-40.592	13.166	50	-36.834	Compliant
	20.417 MHz	15.587	60	-44.413	9.524	50	-40.476	Compliant
	24.011 MHz	15.86	60	-44.14	16.498	50	-33.502	Compliant
29.402 MHz	10.569	60	-49.431	6.144	50	-43.856	Compliant	
Neutral	150.100 KHz	55.039	65.997	-10.958	37.281	55.997	-18.716	Compliant
	223.700 KHz	42.389	63.894	-21.505	25.644	53.894	-28.25	Compliant
	678.700 KHz	18.325	56	-37.675	9.172	46	-36.828	Compliant
	1.255 MHz	12.508	56	-43.492	7.523	46	-38.477	Compliant
	7.500 MHz	27.422	60	-32.578	22.422	50	-27.578	Compliant
	12.948 MHz	18.527	60	-41.473	12.042	50	-37.958	Compliant
	15.401 MHz	22.312	60	-37.688	15.45	50	-34.55	Compliant
	15.602 MHz	24.482	60	-35.518	16.73	50	-33.27	Compliant
	15.826 MHz	24.202	60	-35.798	15.662	50	-34.338	Compliant
24.072 MHz	15.86	60	-44.14	12.055	50	-37.945	Compliant	

Test Data – Bluetooth Low Energy Mid Channel



Line 1 – Bluetooth Low Energy Mid Channel



Neutral – Bluetooth Low Energy Mid Channel

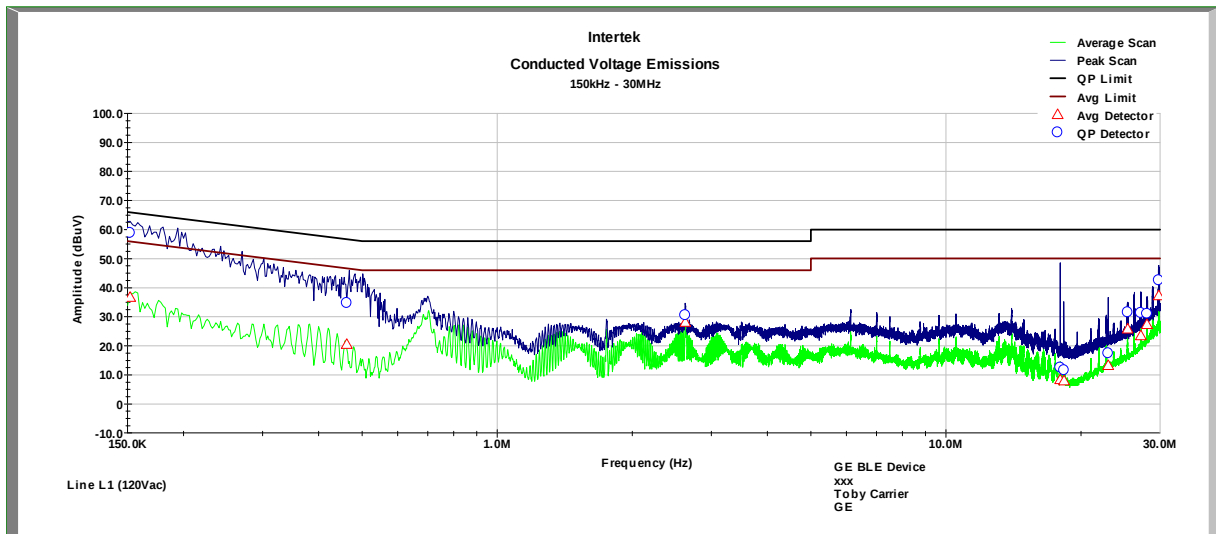
Intertek

Report Number: 102052915LEX-002

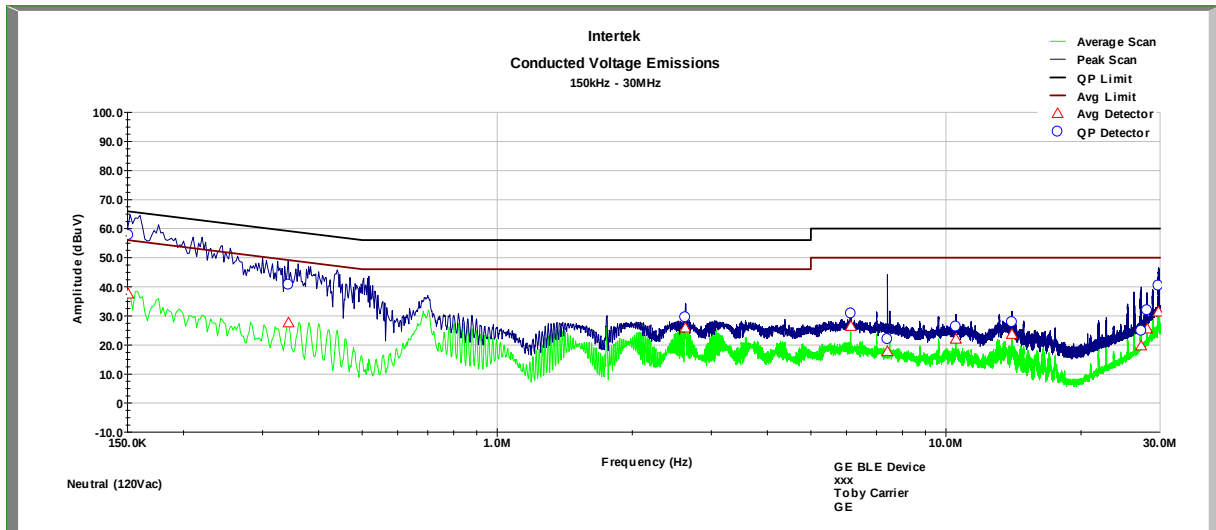
Issued: 5/26/2015

Conducted Voltage Emissions on Power Lines								
Test Engineer:	Toby Carrier		Start Date:	4/7/2015		End Date:	4/7/2015	
Temperature:	24.4°C		Humidity:	50.40%		Pressure:	985.3 mbar	
Specification:	FCC Part 15B		Test Limit:	Class B		RBW:	9kHz	
Notes:	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	151.900 KHz	58.809	65.946	-7.137	36.707	55.946	-19.239	Compliant
	462.200 KHz	34.752	57.08	-22.328	20.449	47.08	-26.631	Compliant
	2.625 MHz	30.493	56	-25.507	28.062	46	-17.938	Compliant
	17.983 MHz	12.515	60	-47.485	8.316	50	-41.684	Compliant
	18.332 MHz	11.621	60	-48.379	7.916	50	-42.084	Compliant
	22.999 MHz	17.404	60	-42.596	13.219	50	-36.781	Compliant
	25.404 MHz	31.513	60	-28.487	25.827	50	-24.173	Compliant
	27.199 MHz	31.274	60	-28.726	23.477	50	-26.523	Compliant
	28.069 MHz	31.005	60	-28.995	27.344	50	-22.656	Compliant
	29.807 MHz	42.563	60	-17.437	37.261	50	-12.739	Compliant
Neutral	150.600 KHz	57.777	65.983	-8.206	37.495	55.983	-18.488	Compliant
	342.600 KHz	40.716	60.497	-19.781	27.607	50.497	-22.89	Compliant
	2.625 MHz	29.547	56	-26.453	25.838	46	-20.162	Compliant
	6.139 MHz	30.838	60	-29.162	26.421	50	-23.579	Compliant
	7.406 MHz	21.982	60	-38.018	17.662	50	-32.338	Compliant
	10.529 MHz	26.309	60	-33.691	22.02	50	-27.98	Compliant
	14.036 MHz	27.891	60	-32.109	23.657	50	-26.343	Compliant
	27.249 MHz	24.821	60	-35.179	19.632	50	-30.368	Compliant
	28.079 MHz	31.893	60	-28.107	25.535	50	-24.465	Compliant
	29.756 MHz	40.411	60	-19.589	31.295	50	-18.705	Compliant

Test Data – Bluetooth Low Energy Rx Mode



Line 1 – Bluetooth Low Energy Rx Mode



Neutral – Bluetooth Low Energy 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	<u>+3.9dB</u>	
Radiated emissions, 1 to 18 GHz	<u>+4.2dB</u>	
Radiated emissions, 18 to 40 GHz	<u>+4.3dB</u>	
Power Port Conducted emissions, 150kHz to 30 MHz	<u>+2.8dB</u>	

13 Revision History

Revision Level	Date	Report Number	Notes
0	5/26/2015	102052915LEX-002	Original Issue