731 Enterprise Drive
Lexington, KY 40510

Telephone: 859-226-1000
Facsimile: 859-226-1040
www.intertek-etlsemko.com

BLUETOOTH TEST REPORT

Report Number: **102945895LEX-001a**
Project Number: **G102945895**

Report Issue Date: **5/4/2017**

Product Name: **P14W**

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:
PDI Communication Systems, Icn.
40 Greenwood Ln
Springboro, OH 45006-3033

Report prepared by

Brian Lackey, Project Engineer

Report reviewed by

Bryan Taylor, Team Leader

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1 Introduction and Conclusion

The tests indicated in section 2 were performed on the product constructed as described in section 3. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test method, a list of the actual test equipment used, documentation photos, results and raw data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested complied with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested.

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

2 Test Summary

Page	Test full name	FCC Reference	IC Reference	Result
6	Peak Output Power	§ 15.247(b)(1)	RSS-247 § 5.4(b)	Pass
9	20dB Bandwidth	§ 15.247(a)(1)	RSS-247 § 5.2(a)	Pass
13	Channel Separation	§ 15.247(a)(1)	RSS-247 § 5.1(b)	Pass
15	Number of Hopping Channels	§ 15.247(a)(1)(iii)	RSS-247 § 5.1(d)	Pass
17	Time of Occupancy	§ 15.247(a)(1)(iii)	RSS-247 § 5.1(d)	Pass
19	Conducted Spurious Emissions	§ 15.247(d)	RSS-Gen § 7.1.3	Pass
22	Power Spectral Density	§ 15.247(e)	RSS-247 § 5.2(b)	Pass
22	Radiated Spurious Emissions (Transmitter)	§ 15.247(d), § 15.209, and § 15.205	RSS-247 § 5.5	Pass
30	Radiated Spurious Emissions (Receiver)	§ 15.109	RSS-Gen § 7.1.2	Pass
33	AC Powerline Conducted Emissions	§ 15.107, § 15.207	RSS-Gen § 8.8	Pass
38	Antenna Requirement per FCC Part 15.203	§ 15.203	RSS-Gen § 8.3	Pass

3 Description of Equipment Under Test

Equipment Under Test	
Manufacturer	PDI Communication Systems, Icn.
Model Number	P14W
Serial Number	Unit 1
Receive Date	4/20/2017
Test Start Date	4/20/2017
Test End Date	4/24/2017
Device Received Condition	Good
Test Sample Type	Production
Frequency Band	2402 – 2480MHz
Mode(s) of Operation	Bluetooth Low Energy (BTLE)
Modulation Type	FHSS
Transmission Control	Test Commands
Maximum Output Power	7.06dBm
Test Channels	0, 19, 39
Antenna Type (15.203)	Internal
Operating Voltage	120Vac, 60Hz

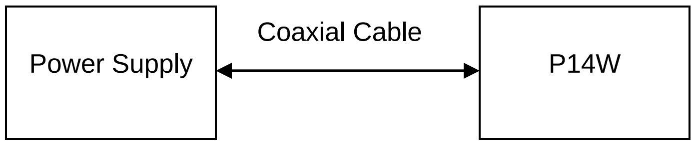
Description of Equipment Under Test
The P14W is a healthcare grade LCD widescreen HDTV.

Operating modes of the EUT:

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

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

3.2 EUT Block Diagram:



3.3 Cables:

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
1	Coaxial / Power	1	Yes	No	F Connector
2	AC Mains	1	No	No	Plug

3.4 Support Equipment:

Support Equipment			
Description	Manufacturer	Model Number	Serial Number
Power Supply	PDi Communication Systems	PDI-750A-C	999062

4 Peak Output Power

4.1 Test Limits

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

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

4.2 Test Procedure

ANSI C63.10: 2013 and FCC Public Notice DA 00-705 Released March 30, 2000: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems. The peak output power was measured using the marker to peak function of the spectrum analyzer.

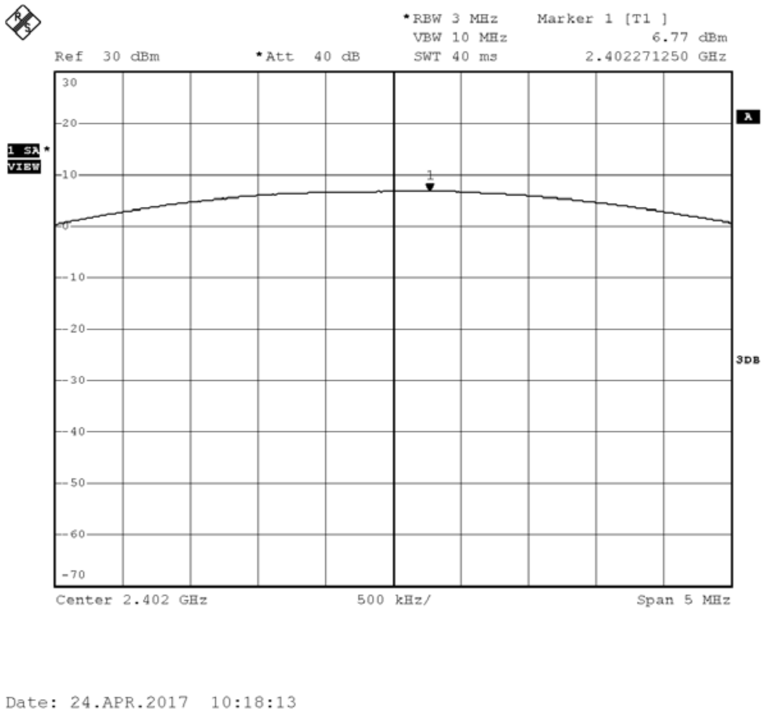
4.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/20/2016	9/20/2017

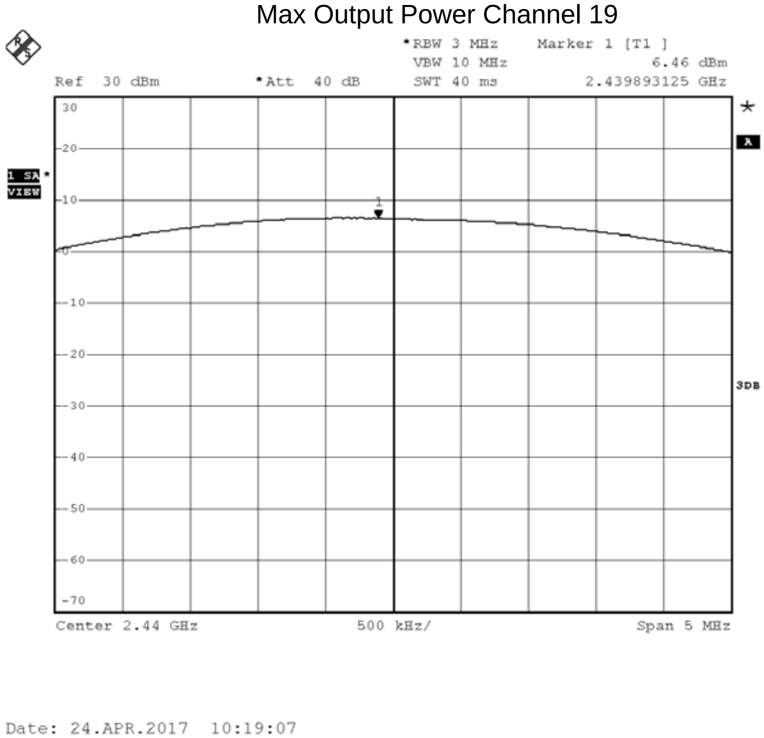
4.4 Results:

Channel	Frequency (MHz)	Output Power (mW)	Limit (mW)	Pass / Fail
0	2402	4.75	125	Pass
19	2440	4.43	125	Pass
39	2480	5.08	125	Pass

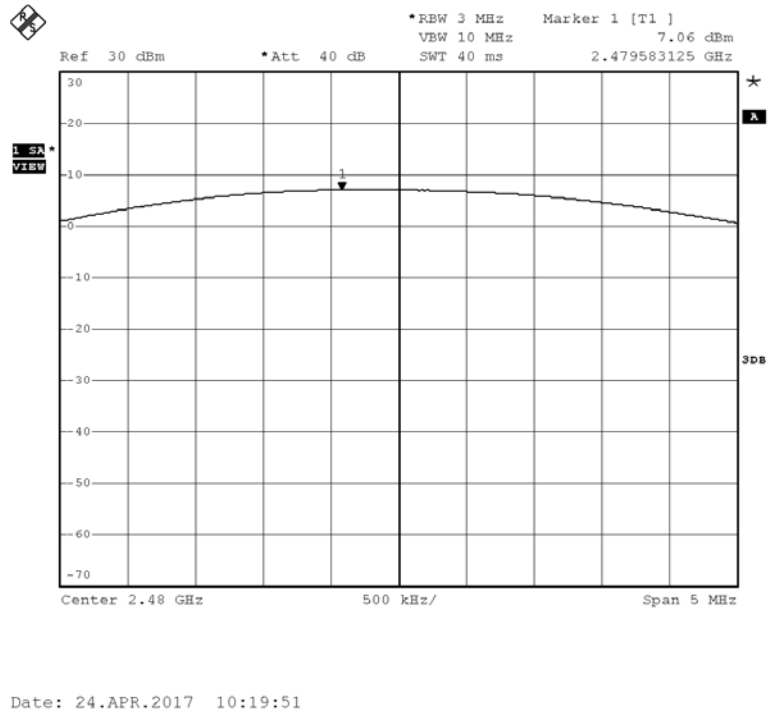
Max Output Power Channel 0



Max Output Power Channel 19



Max Output Power Channel 39



5 20dB Bandwidth

5.1 Test Limits

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

5.2 Test Procedure

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

5.3 Test Equipment Used:

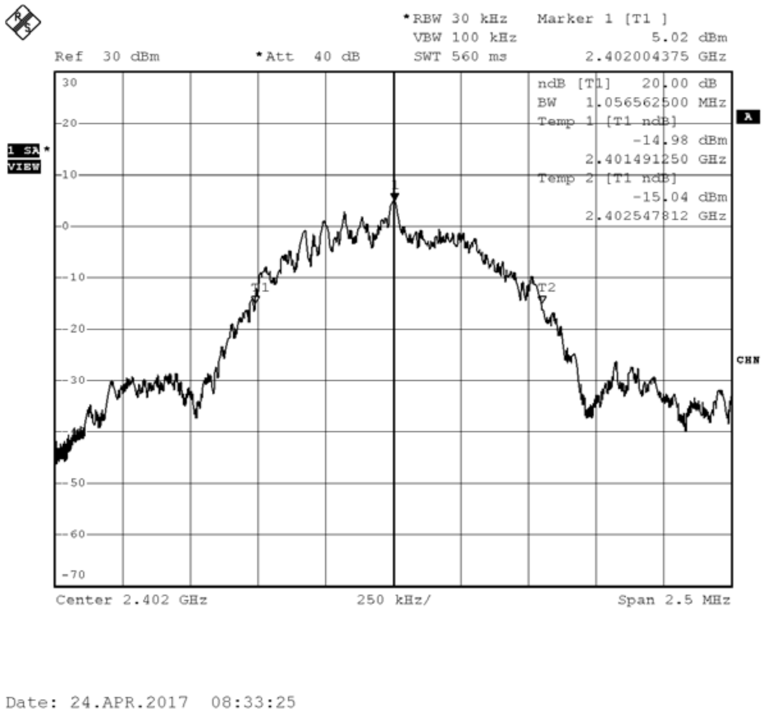
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/20/2016	9/20/2017

5.4 Results:

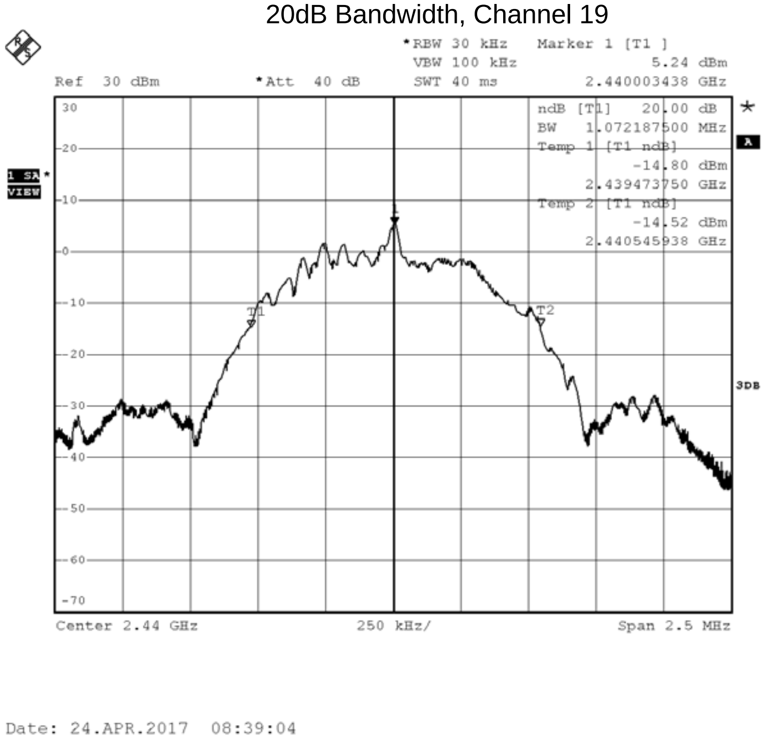
The 20dB bandwidth measurements are shown below. A 99% bandwidth measurement was also performed.

Channel	Frequency (MHz)	20dB Bandwidth (MHz)
0	2402	1.057
19	2440	1.072
39	2480	1.075

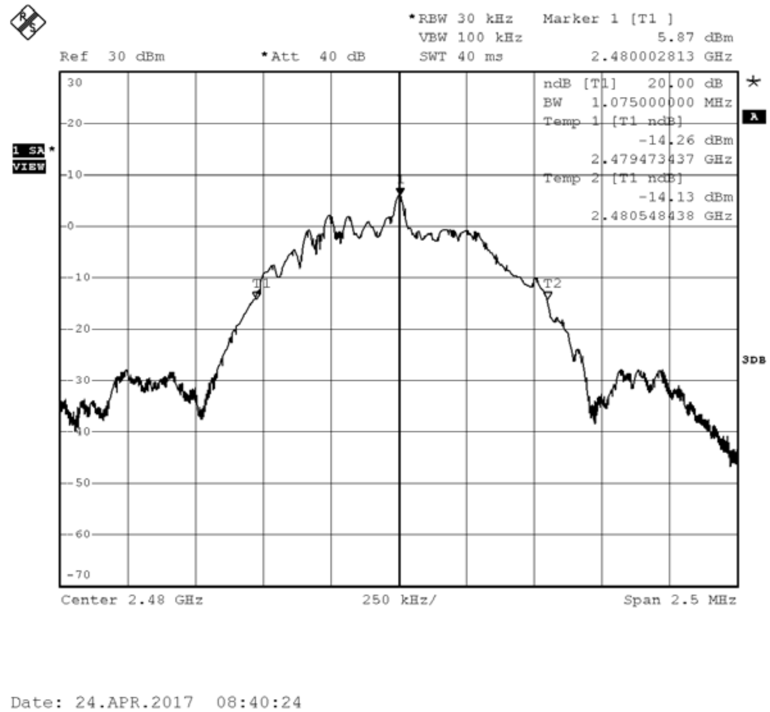
20dB Bandwidth, Channel 0



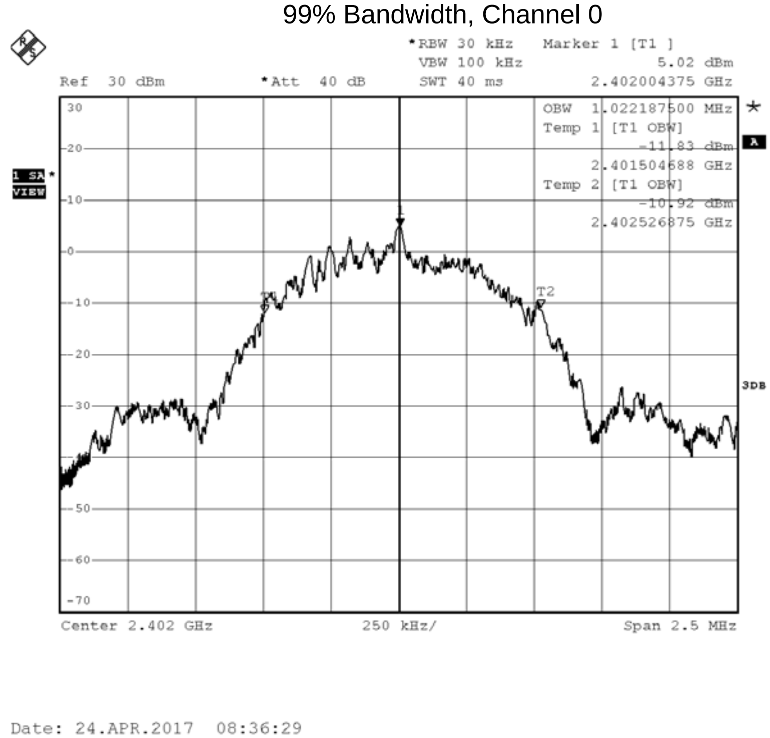
20dB Bandwidth, Channel 19



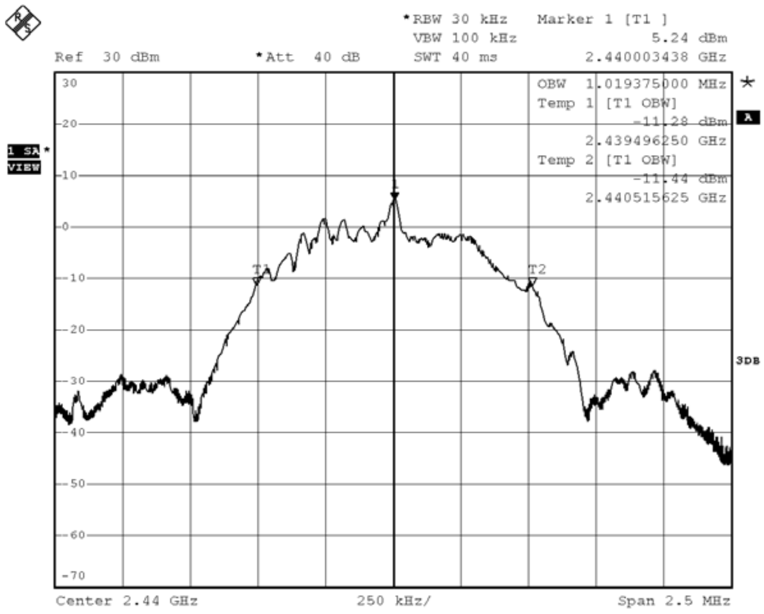
20dB Bandwidth, Channel 39



99% Bandwidth, Channel 0



99% Bandwidth, Channel 19



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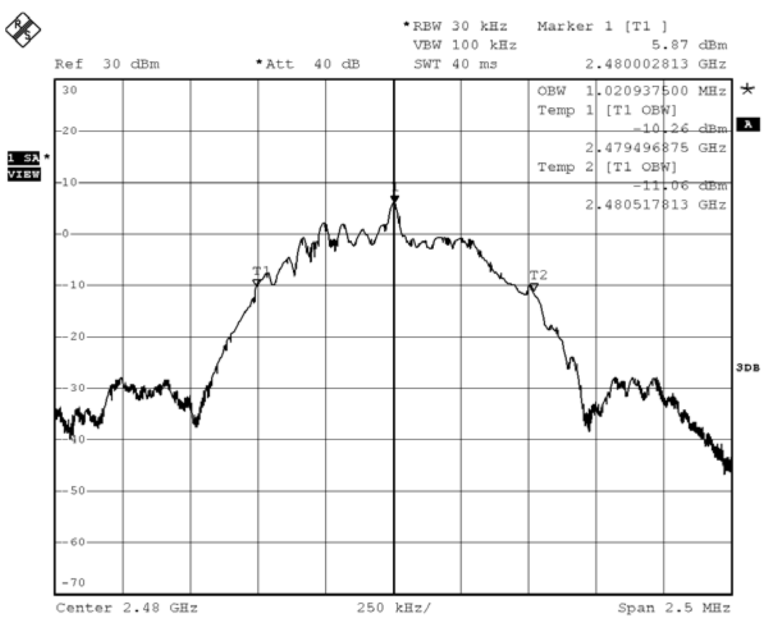
99% Bandwidth, Channel 39



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6 Channel Separation

6.1 Test Limits

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

6.2 Test Procedure

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

6.3 Test Equipment Used:

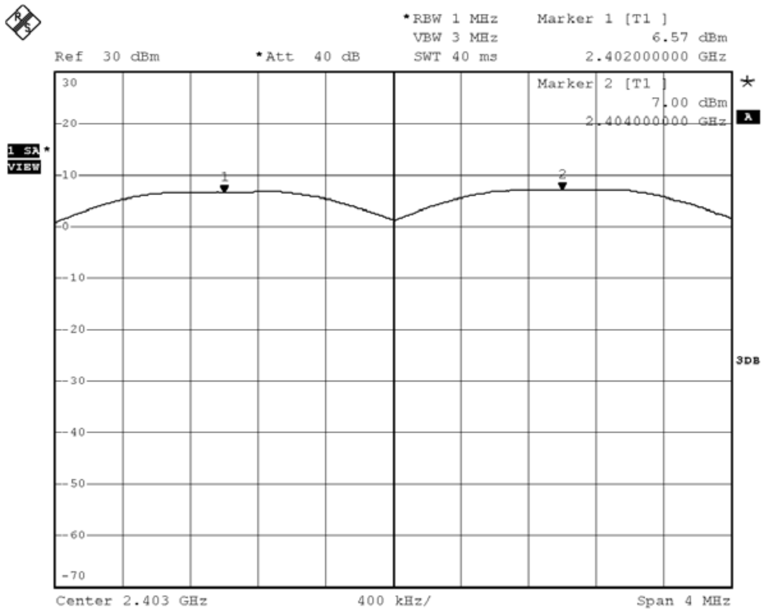
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/20/2016	9/20/2017

6.4 Results:

Channel	Frequency (MHz)	Adjacent Channel Separation (kHz)	Minimum Limit (kHz)*	Pass / Fail
0	2402	2000	705	Pass

*Limit is derived from 2/3 of the the 20dB bandwidth

Hopping Channel Separation (Ch. 0 and Ch. 1)



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7 Number of Hopping Channels

7.1 Test Limits

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

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

7.2 Test Procedure

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

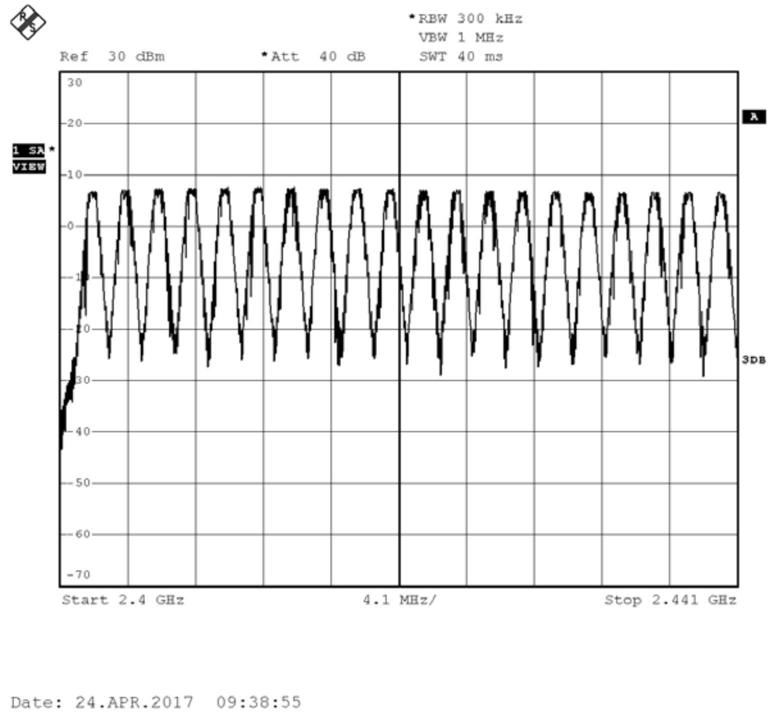
7.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/20/2016	9/20/2017

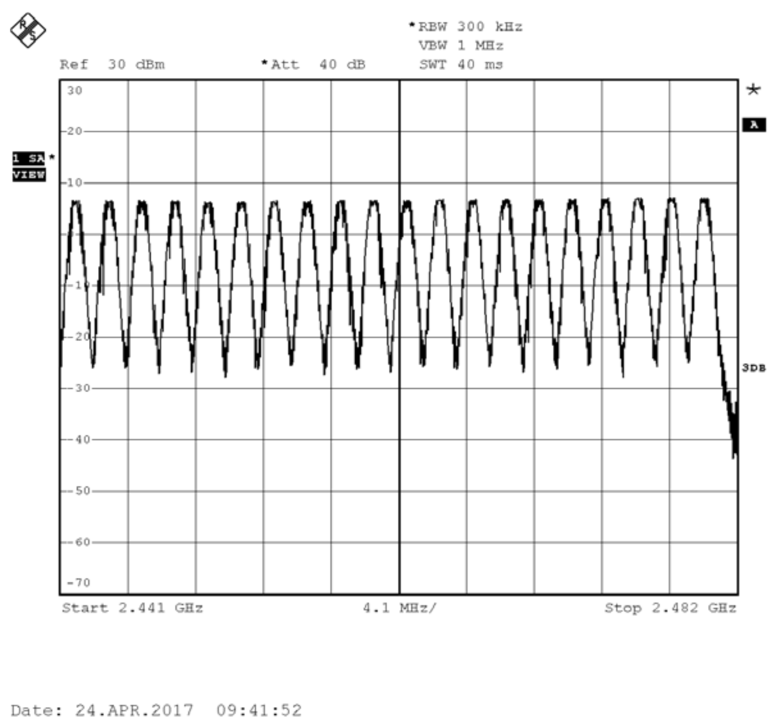
7.4 Results:

The P14W used 40 hopping channels as shown in the following plots.

Number of Hopping Channels 0 – 19



Number of Hopping Channels 20 – 39



8 Time of Occupancy

8.1 Test Limits

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

(1)(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used

8.2 Test Procedure

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

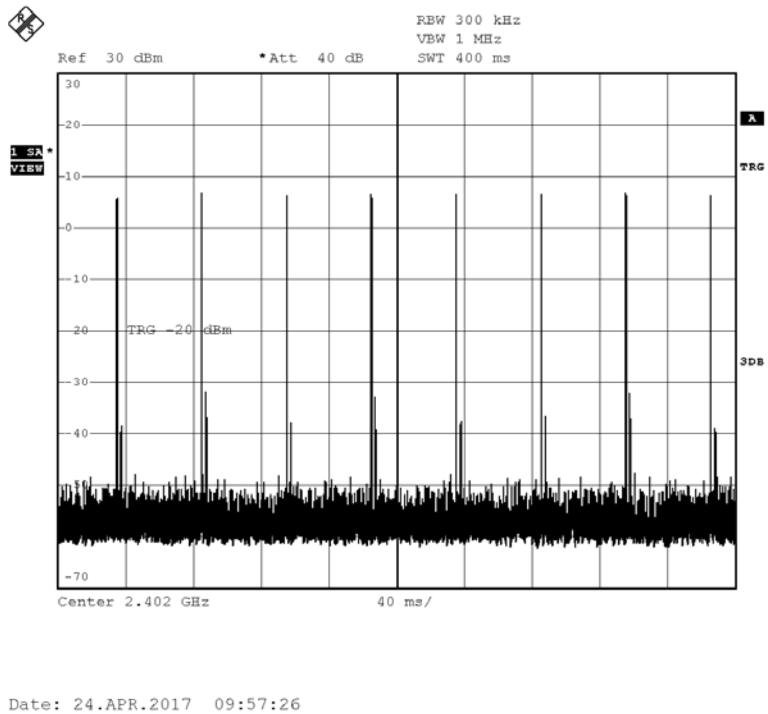
8.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/20/2016	9/20/2017

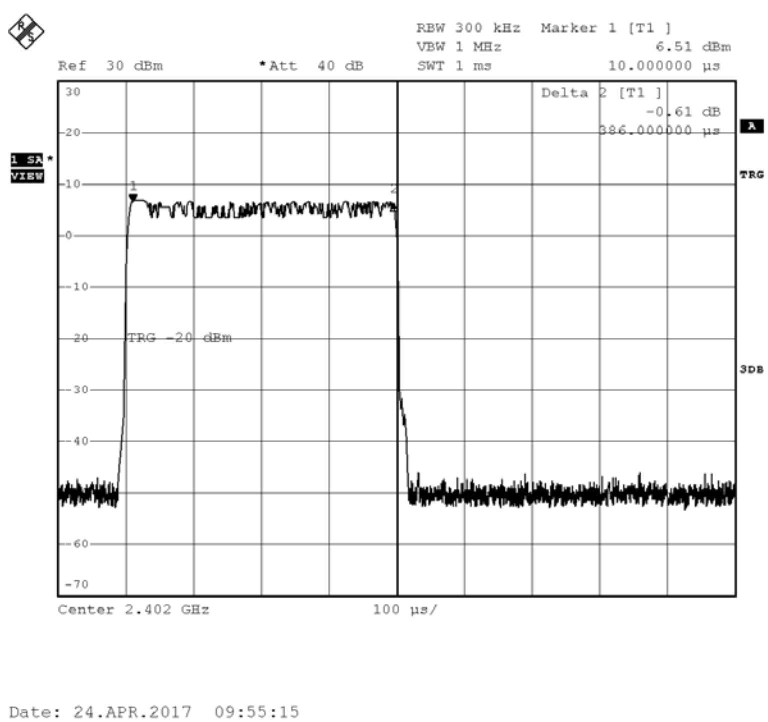
8.4 Results:

Mode	Number of Transmissions in a 16s Frame (80 Hopping Ch x 0.4s)	Transmission Time (mS)	Result (mS)	Limit (mS)
BTLE	8 (times in 0.4sec) * (16sec / 0.4sec) = 320	0.376	120.32	400
Time of occupancy = Transmission Time x Number of Transmissions				

Dwell Time, BTLE



Dwell Time, DH1 (Single Pulse)



9 Conducted Spurious Emissions

9.1 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.

9.2 Test Procedure

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

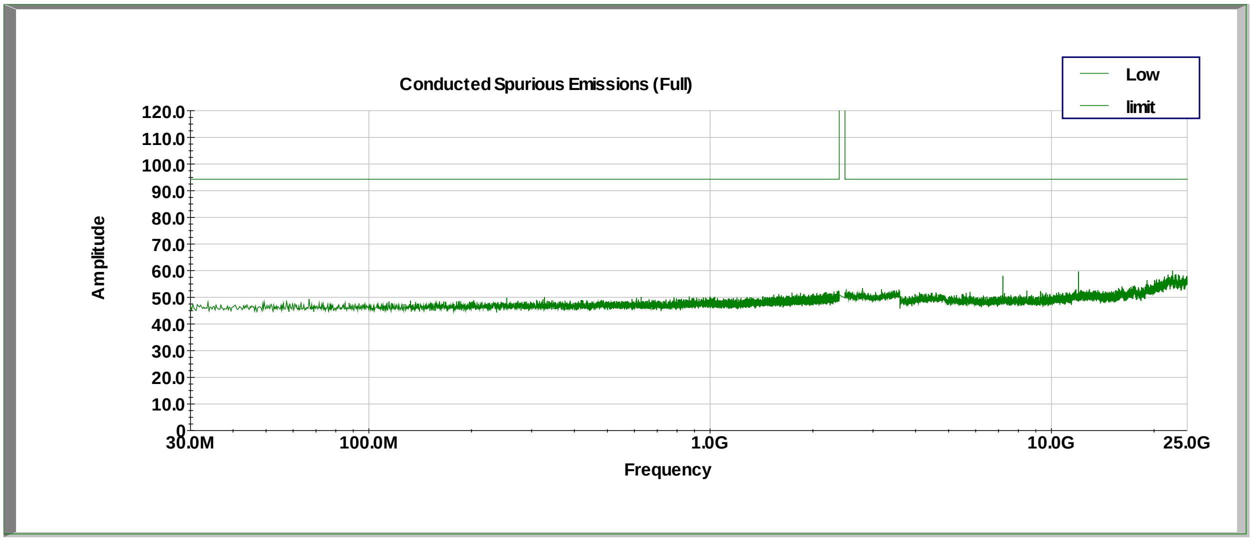
9.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
Spectrum Analyzer	3099	Rohde & Schwarz	FSP7	9/20/2016	9/20/2017

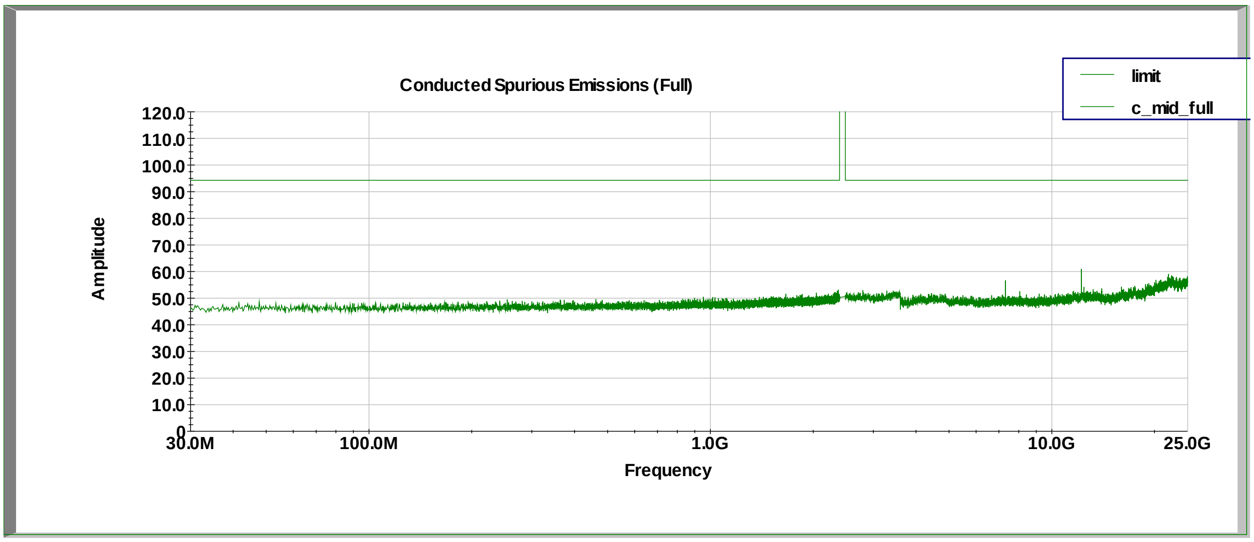
9.4 Results:

The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria. Plots are also presented showing the band edge compliance.

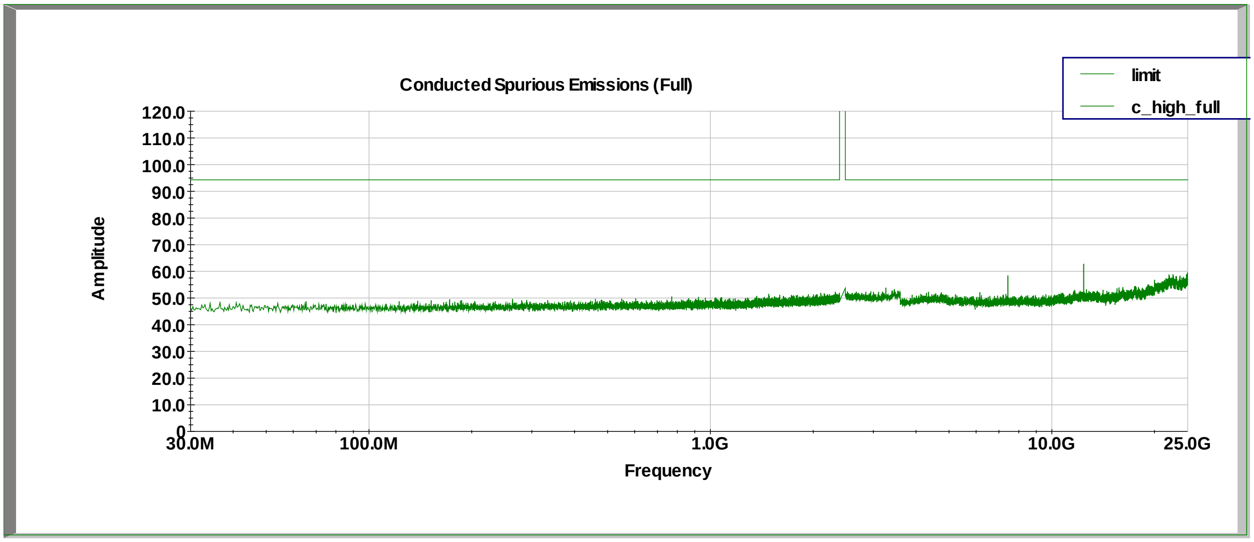
Conducted Spurious Emissions at Antenna Port Channel 0 (Excluding Transmit Band)



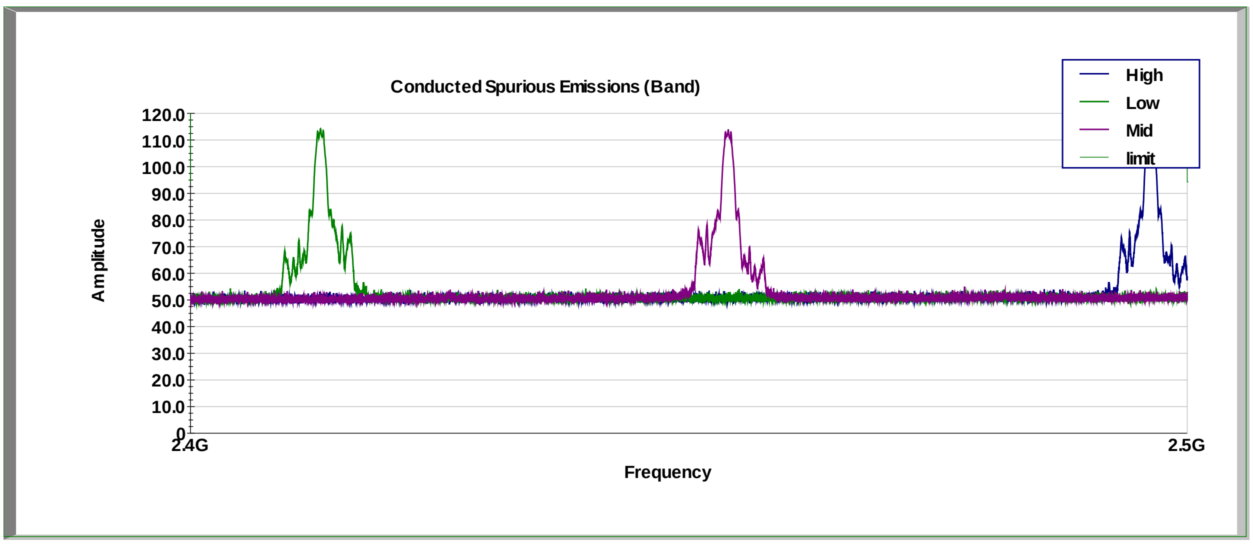
Conducted Spurious Emissions at Antenna Port Channel 19 (Excluding Transmit Band)



Conducted Spurious Emissions at Antenna Port Channel 39 (Excluding Transmit Band)



Band Edge Plot (2390MHz – 2483.5MHz)wa



10 Power Spectral Density

10.1 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.

10.2 Test Procedure

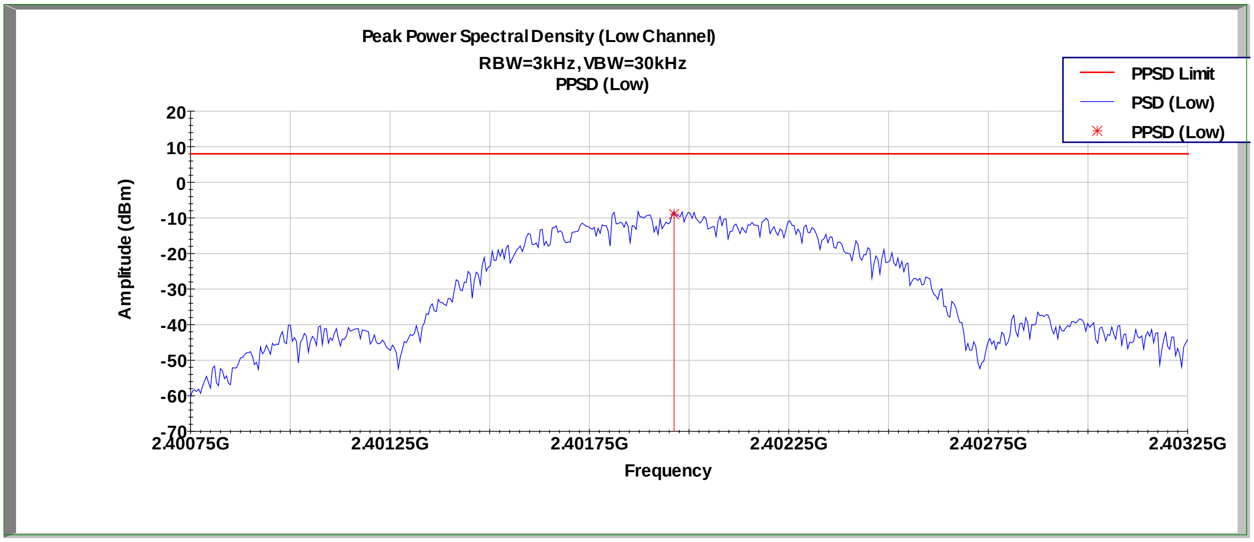
ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

10.3 Test Equipment Used:

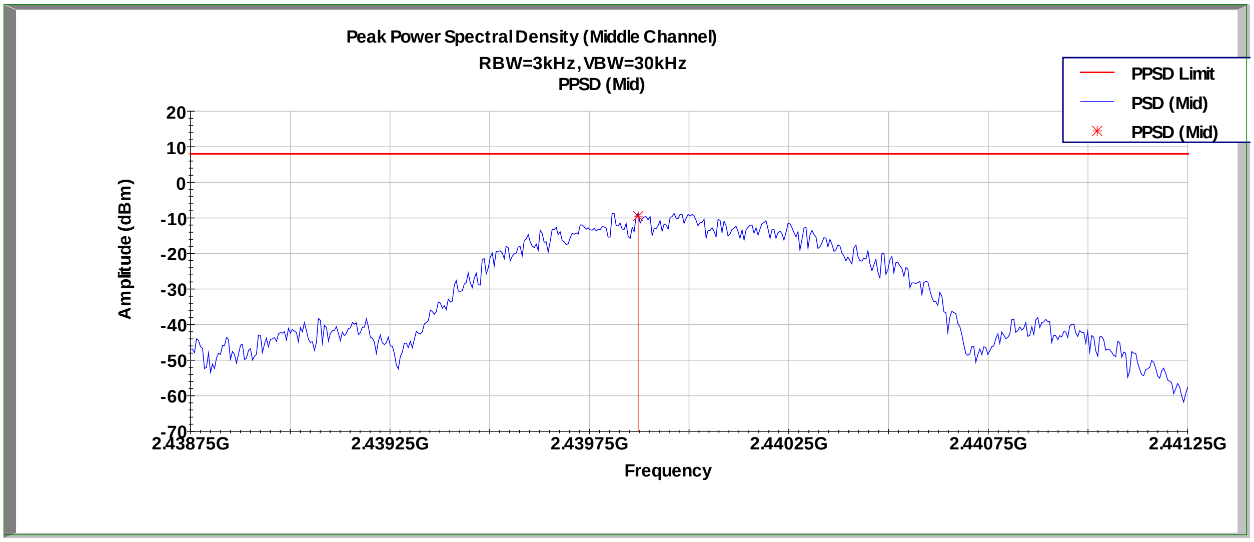
Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017

10.4 Results:

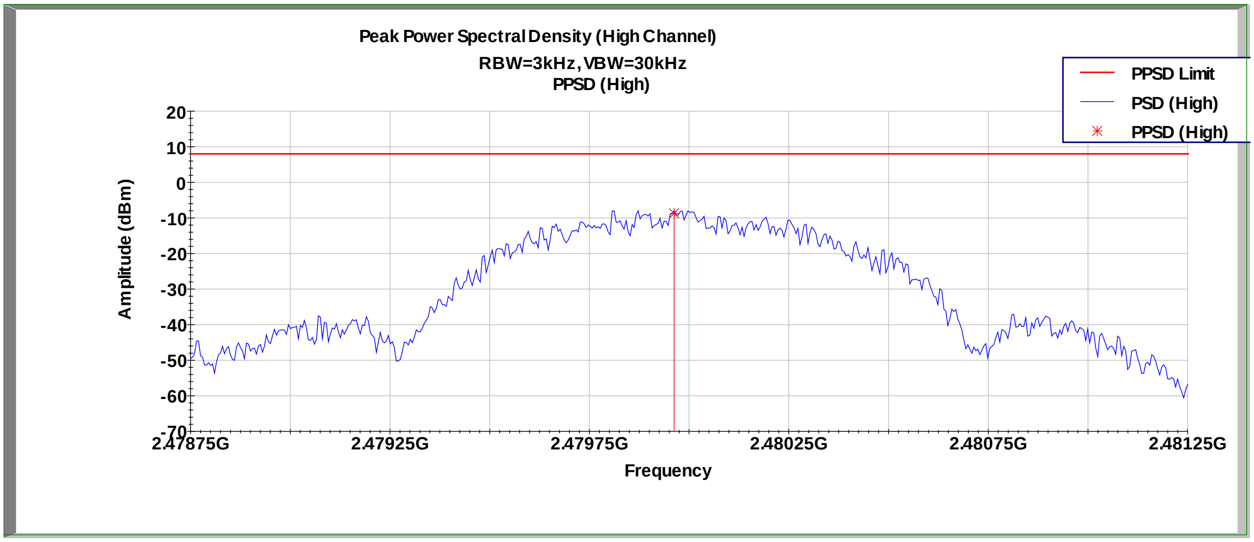
Mode	Channel Number	Frequency (MHz)	PSD in 3kHz BW (dBm)	Limit (dBm)	Margin (dBm)	Result
BLE	0	2402	-8.967	8	16.967	Pass
BLE	19	2440	-9.510	8	17.510	Pass
BLE	39	2480	-8.739	8	16.739	Pass



Power Spectral Density – Channel 0



Power Spectral Density – Channel 19



Power Spectral Density – Channel 39

11 Radiated Spurious Emissions (Transmitter)

11.1 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

11.2 Test Procedure

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

11.3 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

11.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
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	11/14/2016	11/14/2017

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

11.5 Results:

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.

Worst Case Spurious Measurements

*Emissions were investigated with the test sample in its normal operating position.

Bluetooth Channel 0 (2402MHz) Spurious Emissions

Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.000000	48.61	74.00	25.39	1000.000	229.0	H	306.0	7.5
7205.600000	50.32	74.00	23.68	1000.000	278.0	H	330.0	10.4
9610.000000	47.02	74.00	26.98	1000.000	233.0	H	289.0	13.6
12011.200000	54.38	74.00	19.62	1000.000	206.0	H	309.0	17.4
14402.800000	48.58	74.00	25.42	1000.000	252.0	V	284.0	17.0
16820.400000	53.21	74.00	20.79	1000.000	239.0	H	291.0	21.5

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4804.000000	38.91	54.00	15.09	1000.000	229.0	H	306.0	7.5
7205.600000	38.69	54.00	15.31	1000.000	278.0	H	330.0	10.4
9610.000000	34.68	54.00	19.32	1000.000	233.0	H	289.0	13.6
12011.200000	41.25	54.00	12.75	1000.000	206.0	H	309.0	17.4
14402.800000	36.07	54.00	17.93	1000.000	252.0	V	284.0	17.0
16820.400000	40.93	54.00	13.07	1000.000	239.0	H	291.0	21.5

Bluetooth Channel 19 (2440MHz) Spurious Emissions

Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4880.000000	50.23	74.00	23.77	1000.000	303.0	H	318.0	7.4
7319.600000	50.44	74.00	23.56	1000.000	213.0	V	304.0	10.5
9769.600000	46.93	74.00	27.07	1000.000	210.0	V	0.0	13.8
12198.800000	54.28	74.00	19.72	1000.000	202.0	H	312.0	17.2
14639.600000	49.45	74.00	24.55	1000.000	227.0	V	342.0	17.3
17070.400000	53.75	74.00	20.25	1000.000	233.0	H	140.0	21.4

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4880.000000	40.71	54.00	13.29	1000.000	303.0	H	318.0	7.4
7319.600000	42.37	54.00	11.63	1000.000	213.0	V	304.0	10.5
9769.600000	33.88	54.00	20.12	1000.000	210.0	V	0.0	13.8
12198.800000	41.83	54.00	12.17	1000.000	202.0	H	312.0	17.2
14639.600000	37.02	54.00	16.98	1000.000	227.0	V	342.0	17.3
17070.400000	40.89	54.00	13.11	1000.000	233.0	H	140.0	21.4

Bluetooth Channel 39 (2480MHz) Spurious Emissions

Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4960.000000	46.52	74.00	27.48	1000.000	204.0	H	312.0	7.2
7439.600000	51.86	74.00	22.14	1000.000	410.0	H	248.0	10.9
9919.200000	52.17	74.00	21.83	1000.000	235.0	H	306.0	14.0
12398.800000	52.24	74.00	21.76	1000.000	231.0	H	304.0	16.9
14887.200000	50.24	74.00	23.76	1000.000	210.0	H	129.0	18.3
17368.800000	52.23	74.00	21.77	1000.000	205.0	V	169.0	20.6

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4960.000000	35.49	54.00	18.51	1000.000	204.0	H	312.0	7.2
7439.600000	40.71	54.00	13.29	1000.000	410.0	H	248.0	10.9
9919.200000	40.31	54.00	13.69	1000.000	235.0	H	306.0	14.0
12398.800000	39.36	54.00	14.64	1000.000	231.0	H	304.0	16.9
14887.200000	37.82	54.00	16.18	1000.000	210.0	H	129.0	18.3
17368.800000	39.80	54.00	14.20	1000.000	205.0	V	169.0	20.6

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

Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	52.50	74.00	21.50	1000.000	303.0	H	297.0	37.7

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	41.83	54.00	12.17	1000.000	303.0	H	297.0	37.7

Bluetooth Low Band Edge, Frequency Hopping Enabled

Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	52.22	74.00	21.78	1000.000	303.0	V	159.0	37.7

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2390.000000	41.71	54.00	12.29	1000.000	303.0	V	159.0	37.7

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

Peak

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.500000	58.87	74.00	15.13	1000.000	410.0	H	0.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.500000	45.79	54.00	8.21	1000.000	410.0	H	0.0	37.8

Bluetooth High Band Edge, Frequency Hopping Enabled

Peak

Frequency (MHz)	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	339.0	V	288.0	37.8

Average

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2483.500000	42.57	54.00	11.43	1000.000	339.0	V	288.0	37.8

12 Radiated Spurious Emissions (Receiver)

12.1 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

12.2 Test Procedure

ANSI C63.4: 2003

12.3 Example of Field Strength Calculation Method:

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

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

Example Calculation:
RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

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

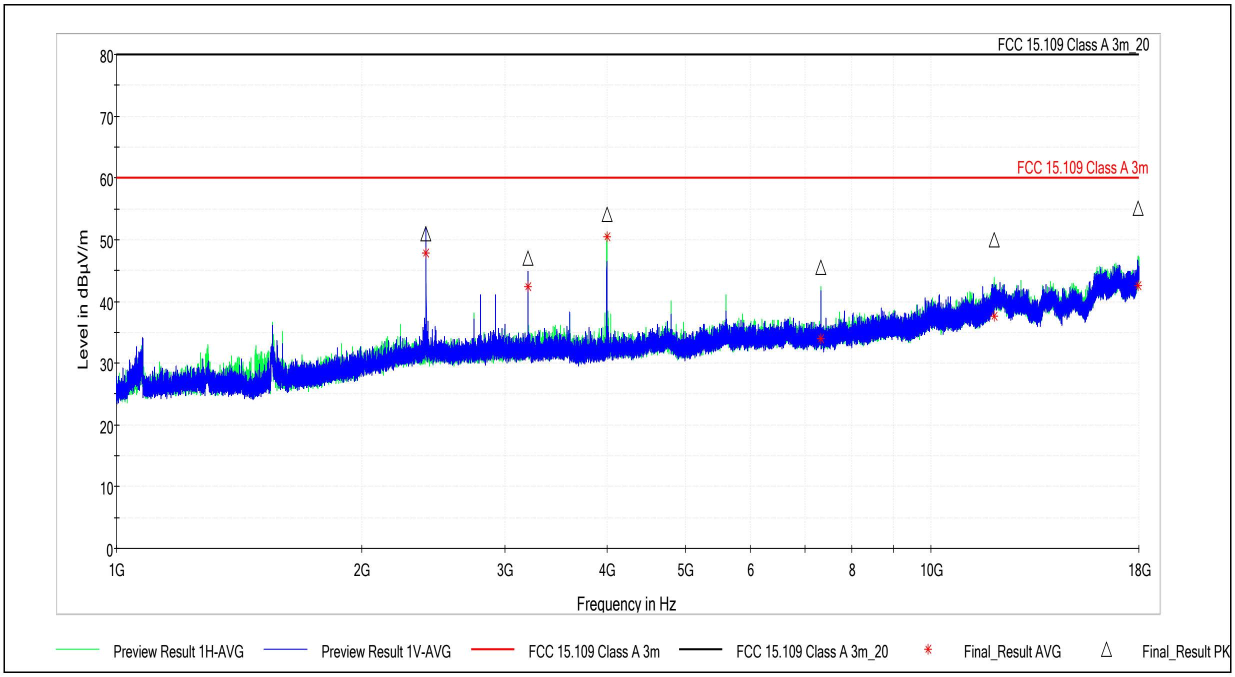
12.4 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
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	11/14/2016	11/14/2017

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

12.5 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. All peak detected emissions were at least 15dB below the limit.



Final_Result_PK+

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2399.870000	50.94	80.00	29.06	1000.000	200.0	V	0.0	3.9
3199.874500	46.96	80.00	33.04	1000.000	135.0	V	22.0	5.0
4000.002255	54.13	80.00	25.87	1000.000	177.0	H	0.0	6.1
7319.581000	45.55	80.00	34.45	1000.000	100.0	V	22.0	10.5
11961.695500	49.98	80.00	30.02	1000.000	171.0	V	38.0	17.5
17961.433500	55.10	80.00	24.90	1000.000	173.0	H	17.0	22.6

Final_Result_AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
2399.870000	47.90	60.00	12.10	1000.000	200.0	V	0.0	3.9
3199.874500	42.45	60.00	17.55	1000.000	135.0	V	22.0	5.0
4000.002255	50.46	60.00	9.54	1000.000	177.0	H	0.0	6.1
7319.581000	34.03	60.00	25.97	1000.000	100.0	V	22.0	10.5
11961.695500	37.66	60.00	22.34	1000.000	171.0	V	38.0	17.5
17961.433500	42.48	60.00	17.52	1000.000	173.0	H	17.0	22.6

13 AC Powerline Conducted Emissions

13.1 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.

13.2 Test Procedure

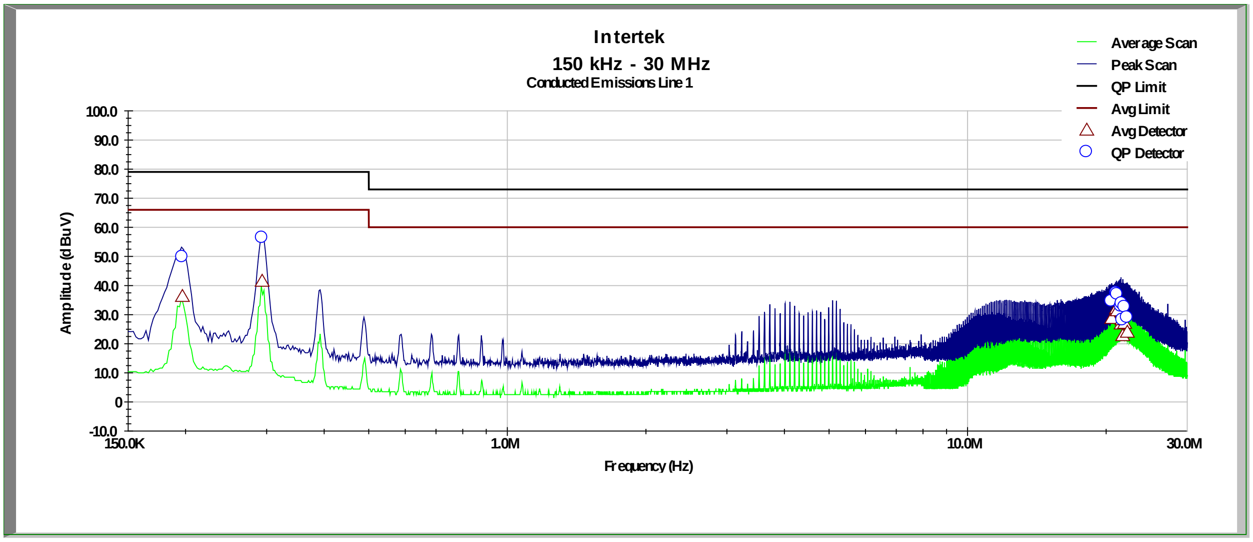
ANSI C63.4: 2003

13.3 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
LISN	3333	Teseq	NNB52	6/3/2016	6/3/2017
Cable	COND 2			11/19/2016	11/19/2017

13.4 Results:

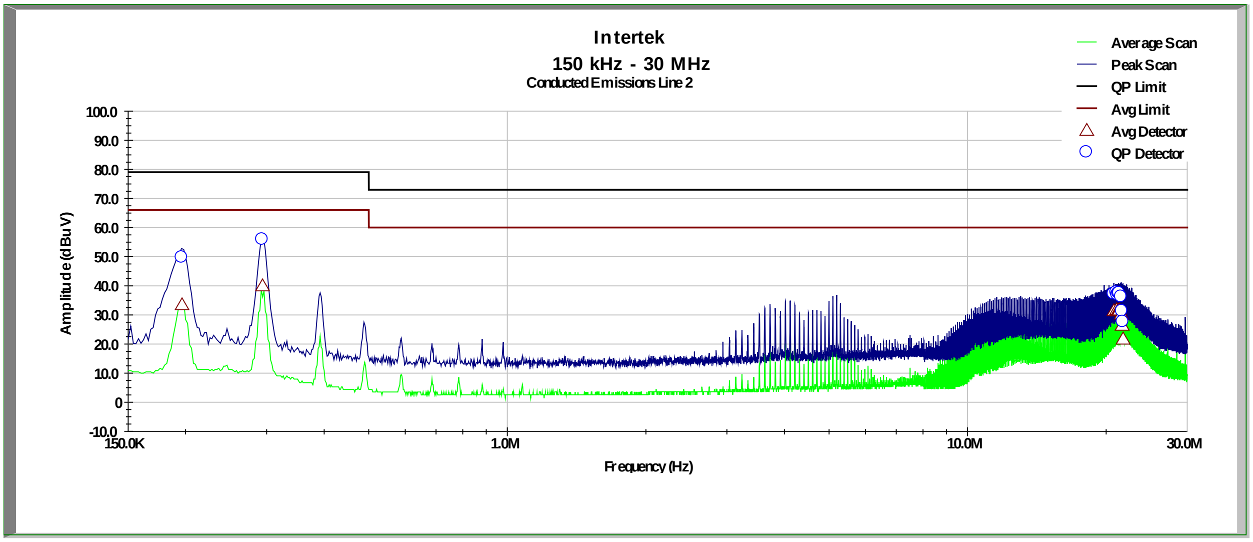
Quasi-Peak and Average Measurements (Bluetooth Transmitting Mode)



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
196.800 KHz	49.748	79.000	29.252	36.249	66.000	29.751
293.300 KHz	56.325	79.000	22.675	41.471	66.000	24.529
20.569 MHz	34.481	73.000	38.519	28.662	60.000	31.338
21.062 MHz	37.329	73.000	35.671	32.099	60.000	27.901
21.160 MHz	36.898	73.000	36.102	31.311	60.000	28.689
21.550 MHz	32.740	73.000	40.260	26.764	60.000	33.236
21.650 MHz	33.731	73.000	39.269	28.224	60.000	31.776
21.735 MHz	28.093	73.000	44.907	22.768	60.000	37.232
21.945 MHz	32.527	73.000	40.473	26.996	60.000	33.004
22.238 MHz	28.912	73.000	44.088	23.940	60.000	36.060

Line

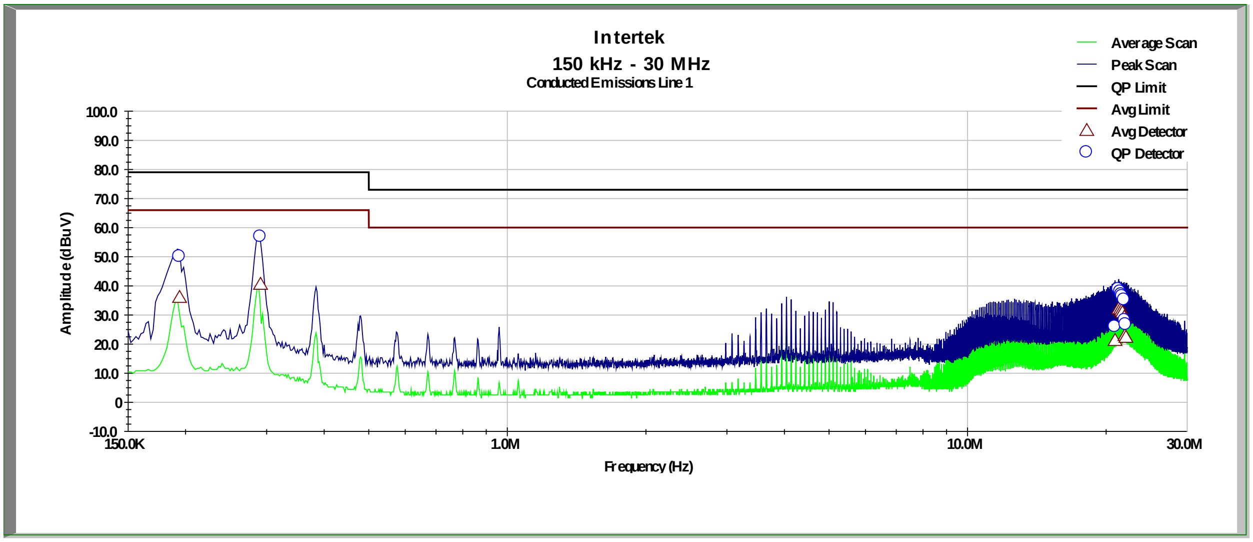


Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
196.400 KHz	49.687	79.000	29.313	33.447	66.000	32.553
293.900 KHz	55.824	79.000	23.176	39.946	66.000	26.054
20.791 MHz	37.143	73.000	35.857	31.394	60.000	28.606
21.087 MHz	37.606	73.000	35.394	31.813	60.000	28.187
21.184 MHz	36.835	73.000	36.165	31.349	60.000	28.651
21.285 MHz	37.370	73.000	35.630	31.537	60.000	28.463
21.384 MHz	37.410	73.000	35.590	31.663	60.000	28.337
21.578 MHz	36.127	73.000	36.873	30.285	60.000	29.715
21.664 MHz	31.208	73.000	41.792	26.433	60.000	33.567
21.769 MHz	27.521	73.000	45.479	21.664	60.000	38.336

Neutral

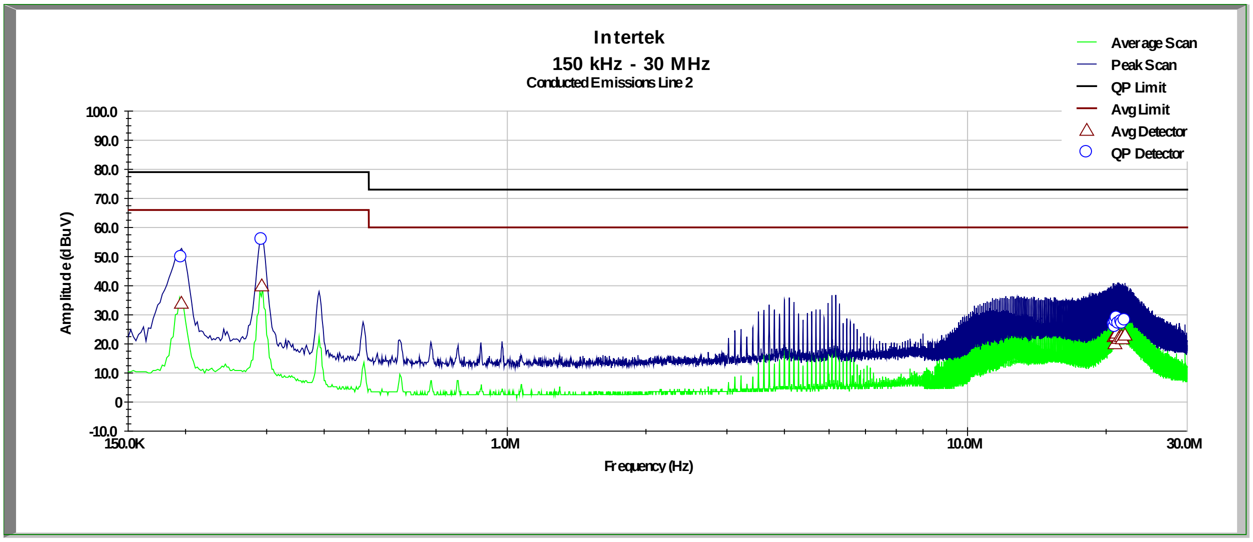
Quasi-Peak and Average Measurements (Receive Mode)



Line

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
194.000 KHz	49.990	79.000	29.010	36.016	66.000	29.984
290.900 KHz	56.804	79.000	22.196	40.509	66.000	25.491
20.913 MHz	25.867	73.000	47.133	21.207	60.000	38.793
21.292 MHz	38.763	73.000	34.237	32.051	60.000	27.949
21.492 MHz	37.906	73.000	35.094	32.040	60.000	27.960
21.594 MHz	36.956	73.000	36.044	31.416	60.000	28.584
21.697 MHz	36.371	73.000	36.629	30.807	60.000	29.193
21.897 MHz	35.121	73.000	37.879	29.190	60.000	30.810
21.977 MHz	28.089	73.000	44.911	22.940	60.000	37.060
22.079 MHz	26.641	73.000	46.359	22.295	60.000	37.705

Line



Neutral

Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Margin (dB)	Average (dBuV)	Average Limit (dBuV)	Average Margin (dB)
195.800 KHz	49.724	79.000	29.276	33.952	66.000	32.048
292.800 KHz	55.798	79.000	23.202	39.920	66.000	26.080
20.814 MHz	26.672	73.000	46.328	22.456	60.000	37.544
20.900 MHz	25.812	73.000	47.188	20.039	60.000	39.961
20.992 MHz	27.584	73.000	45.416	22.805	60.000	37.195
21.111 MHz	28.844	73.000	44.156	23.677	60.000	36.323
21.299 MHz	26.946	73.000	46.054	21.877	60.000	38.123
21.594 MHz	27.646	73.000	45.354	22.525	60.000	37.475
21.695 MHz	26.945	73.000	46.055	21.756	60.000	38.244
21.978 MHz	28.061	73.000	44.939	23.005	60.000	36.995

Neutral

14 Antenna Requirement per FCC Part 15.203

14.1 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.

14.2 Results:

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

15 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	

16 Revision History

Revision Level	Date	Report Number	Notes
0	5/4/2017	102945895LEX-001a	Original Issue