731 Enterprise Drive
Lexington, KY 40510

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

# TEST REPORT

| | |
|---|---|
| **Report Number:** | **102886547LEX-003** |
| **Project Number:** | **G102886547** |
| **Report Issue Date:** | **7/24/2017** |
| **Product Name:** | **XT6372R** |
| **Standards:** | **Title 47 CFR Part 15 Subpart C**<br>**RSS-247 Issue 2** |
| **Radios Under Test:** | **BTLE** |

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

Client:
Xirgo Technologies
188 Camino Ruiz
Camarillo, CA 93012-6700

Report prepared by

Brian Daffin,
Engineer

Report reviewed by

Bryan Taylor,
Team Leader

**TABLE OF CONTENTS**

## 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 |
| 8 | 6dB Bandwidth | § 15.247(a)(1) | RSS-247 5.1(a) | Pass |
| 12 | Power Spectral Density | § 15.247(d) | RSS-247 5.5 | Pass |
| 15 | Conducted Spurious Emissions | § 15.247(d) | RSS-247 5.5 | Pass |
| 17 | Radiated Spurious Emissions (Transmitter) | § 15.247(d), § 15.209, and § 15.205 | RSS-247 5.5 | Pass |
| 22 | AC Powerline Conducted Emissions | § 15.107, § 15.207 | RSS-Gen (7.2.4) | Pass |
| 25 | 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** | Xirgo Technologies |
| **Model Number** | XT6372R |
| **Serial Number** | 1 |
| **Receive Date** | 2/21/2017 |
| **Test Start Date** | 2/21/2017 |
| **Test End Date** | 2/31/2017 |
| **Device Received Condition** | Good |
| **Test Sample Type** | Production |
| **Frequency Band** | 2402 – 2480MHz |
| **Mode(s) of Operation** | Bluetooth Low Energy |
| **Modulation Type** | FHSS |
| **Transmission Control** | Test Commands |
| **Maximum Output Power** | 10.643dBm |
| **Test Channels** | 0, 19, 39 |
| **Antenna Type (15.203)** | Internal |
| **Operating Voltage** | 12VDC |

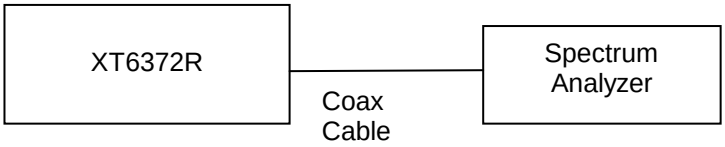
| Description of Equipment Under Test |
|---|
| The XT6372R is a vehicle GPS/Cellular tracking device with Bluetooth. |

**Operating modes of the EUT:**

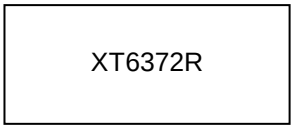
| No. | Descriptions of EUT Exercising |
|---|---|
| 1 | Transmitting BT Signal on low mid or high channels |
| 2 | Receive / idle mode |

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

### 3.2 EUT Block Diagram:




Conducted Output Measurements




Radiated Measurements

### 3.3 Cables:

| Cables | | | | | |
|---|---|---|---|---|---|
| Description | Length | Shielding | Ferrites | Connection | |
| | | | | From | To |
| DC Power Cable | 3ft | None | None | DC Power Supply | Test Sample |

### 3.4 Support Equipment:

No support equipment was used during this evaluation.

# 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:

(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.

## 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.

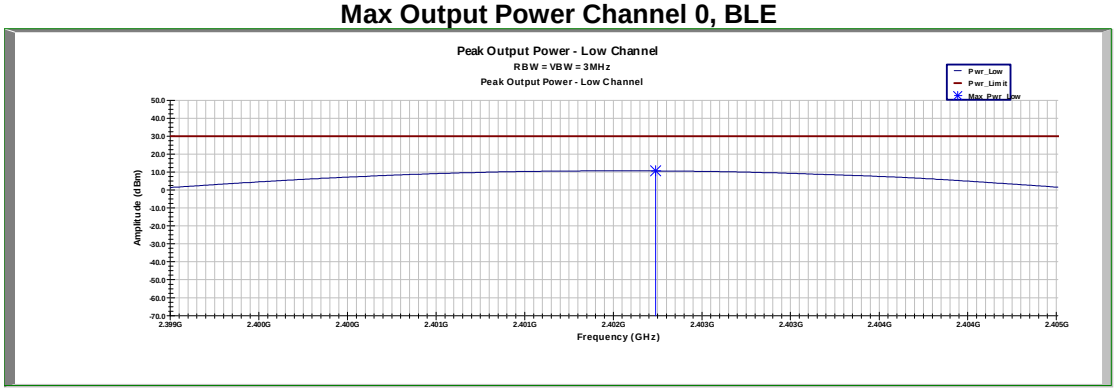
## 4.3 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 10887490.26 | Rohde&Schwarz | ESI26 | 9/20/2016 | 9/20/2017 |
| COND3 | 6026 | | | 11/17/2016 | 11/17/2017 |

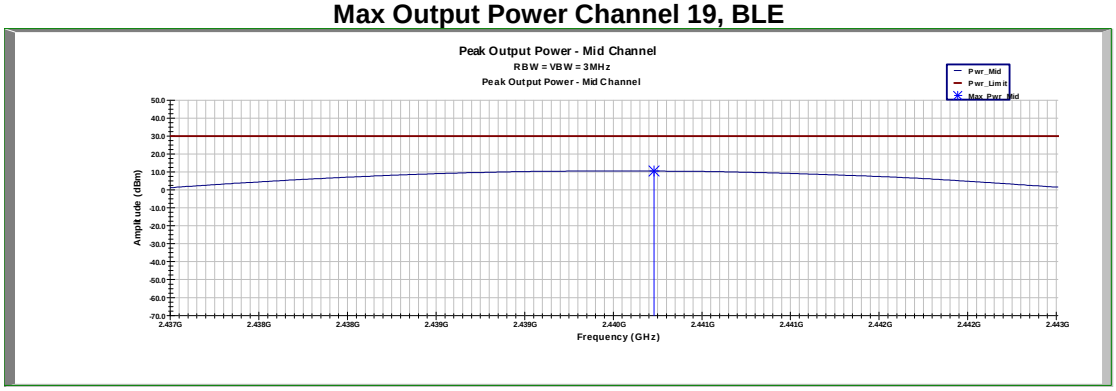
## 4.4 Results:

| Modulation | Channel | Frequency (MHz) | Output Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| BLE | 0 | 2402 | 10.643 | 30 | Compliant |
| | 19 | 2441 | 10.511 | 30 | Compliant |
| | 39 | 2480 | 10.535 | 30 | Compliant |

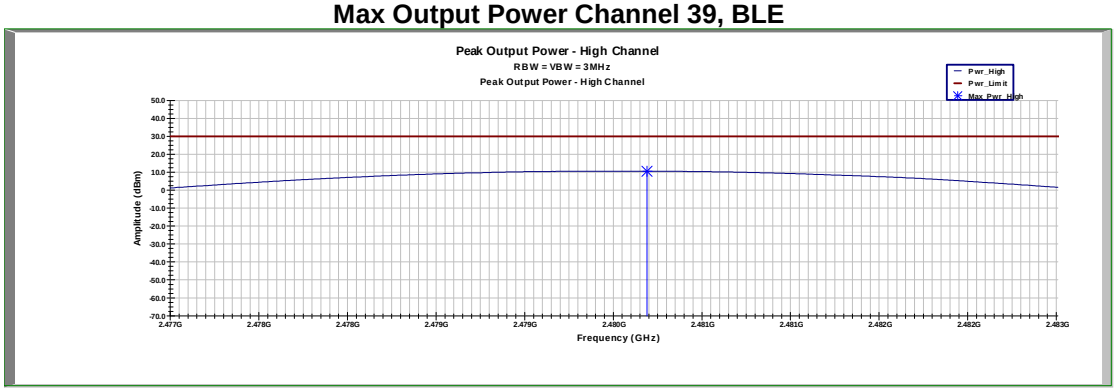
## Max Output Power Channel 0, BLE




## Max Output Power Channel 19, BLE




## Max Output Power Channel 39, BLE



# 5 6dB 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:

(2) Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

## 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.

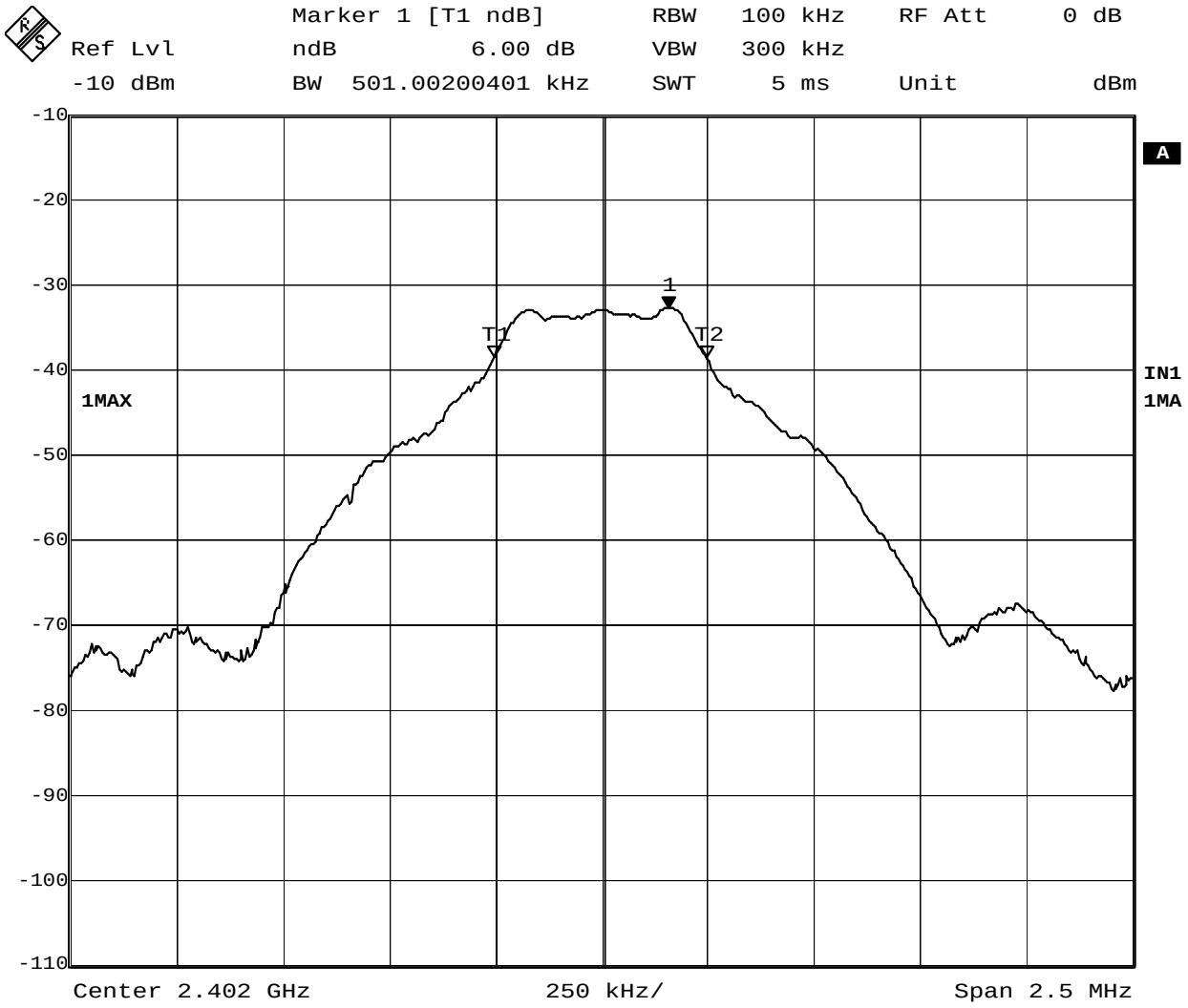
## 5.3 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 10887490.26 | Rohde&Schwarz | ESI26 | 9/20/2016 | 9/20/2017 |
| COND3 | 6026 | | | 11/17/2016 | 11/17/2017 |

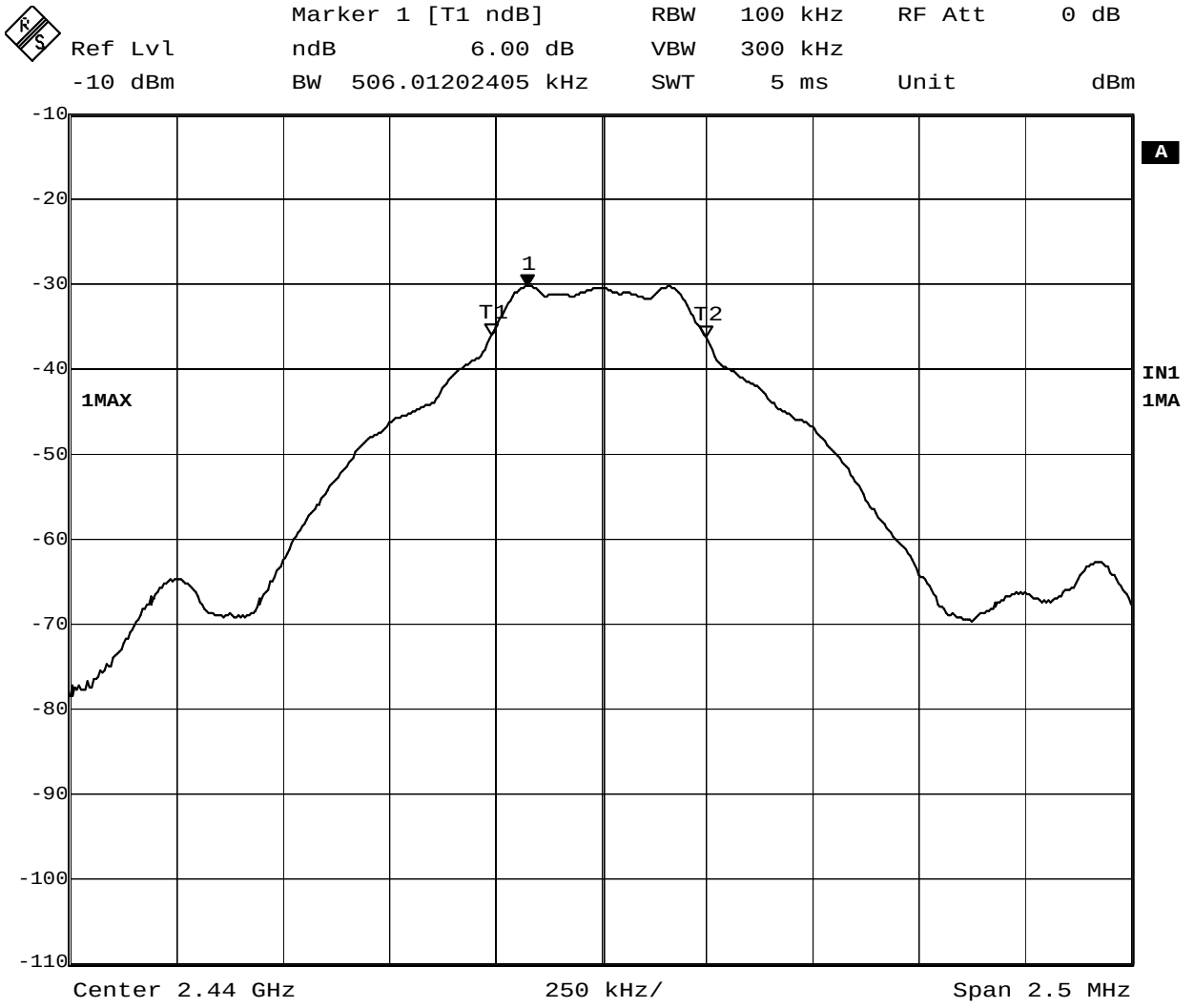
## 5.4 Results:

The 6dB bandwidth measurements are shown below. All bandwidth measurements were above 500kHz

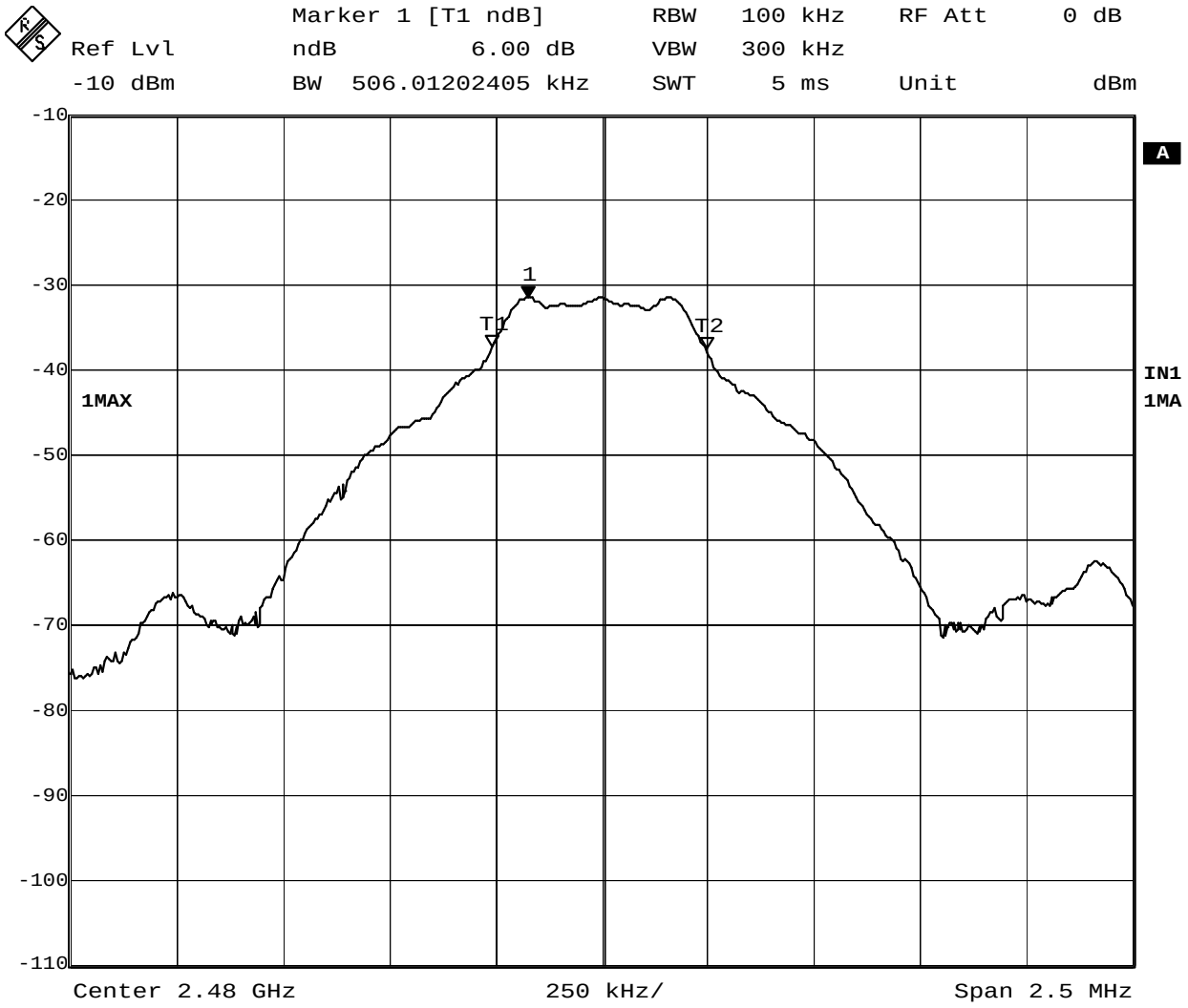
| Channel | Frequency (MHz) | 6dB Bandwidth | Result |
|---|---|---|---|
| BLE | 2402 | 501kHz | Pass |
| BLE | 2440 | 506kHz | Pass |
| BLE | 2480 | 506kHz | Pass |




2402MHz, BLE Mode, 6dB Bandwidth = 501kHz




2440MHz, BLE Mode, 6dB Bandwidth = 506kHz




2480MHz, BLE Mode, 6dB Bandwidth = 506kHz

# 6 Power Spectral Density

## 6.1 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.

## 6.2 Test Procedure

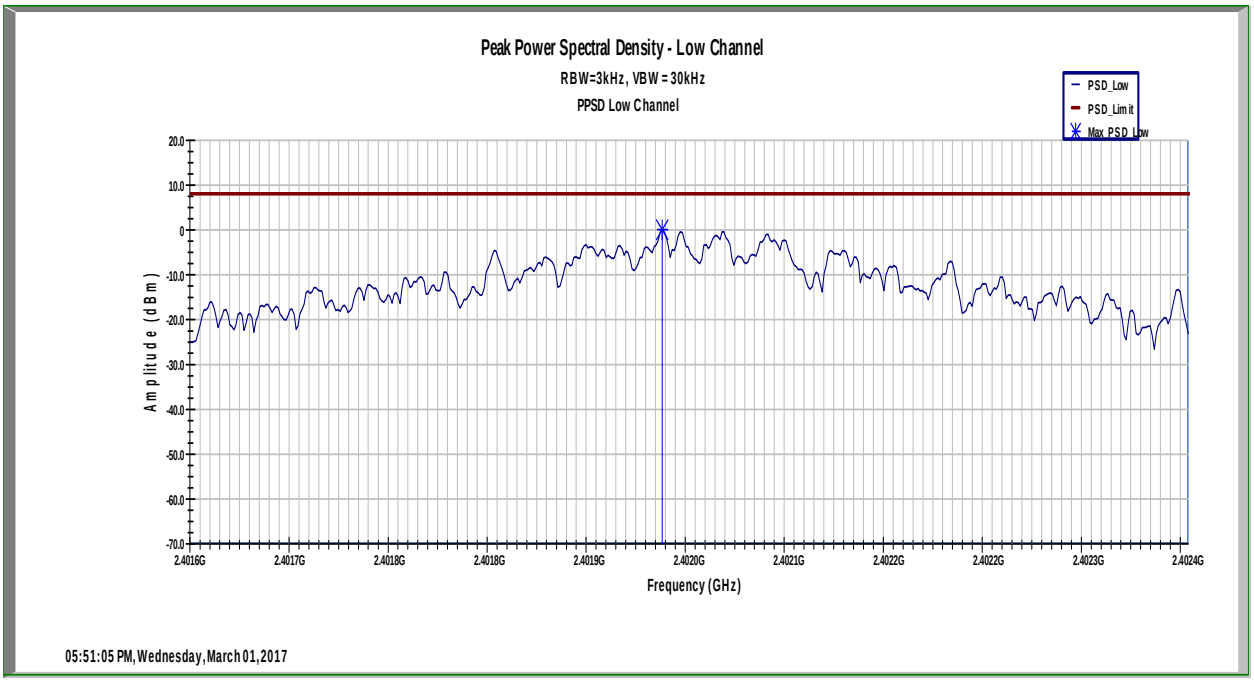
ANSI C63.10: 2013 and KDB Publication No. 558074: Guidance on Measurements for Digital Transmission Systems (47 CFR 15.247)

## 6.3 Test Equipment Used:

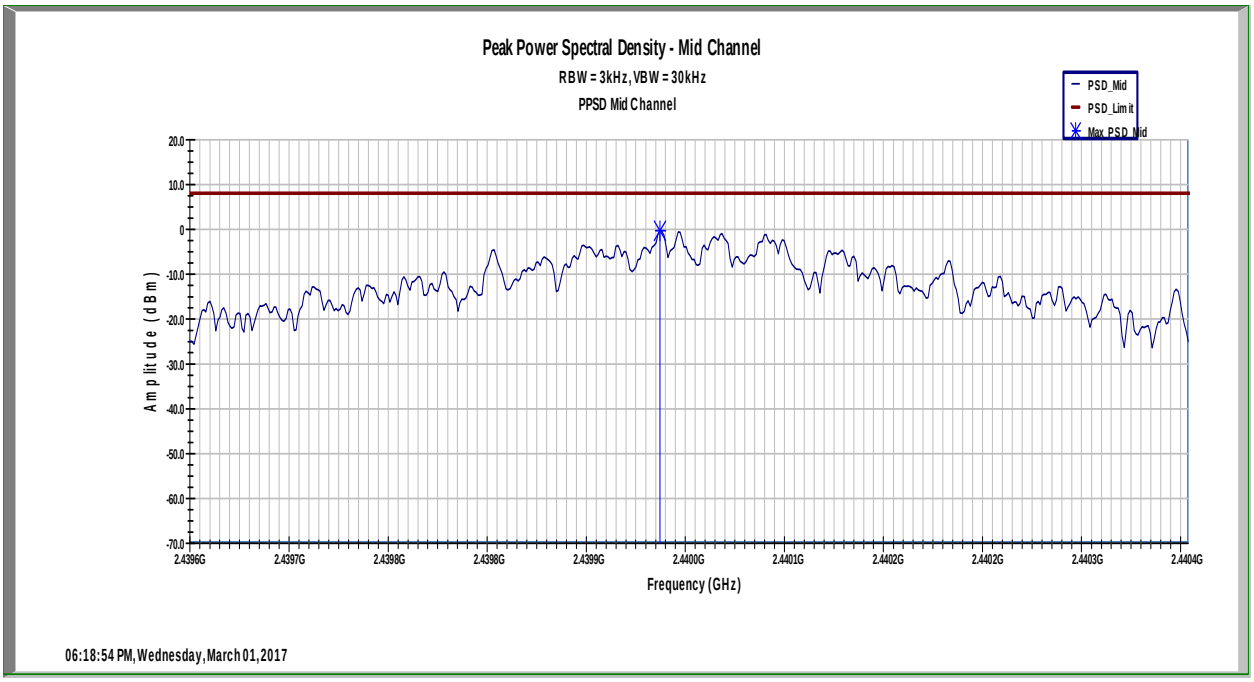
| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 10887490.26 | Rohde&Schwarz | ESI26 | 9/20/2016 | 9/20/2017 |
| COND3 | 6026 | | | 11/17/2016 | 11/17/2017 |

## 6.4 Results:

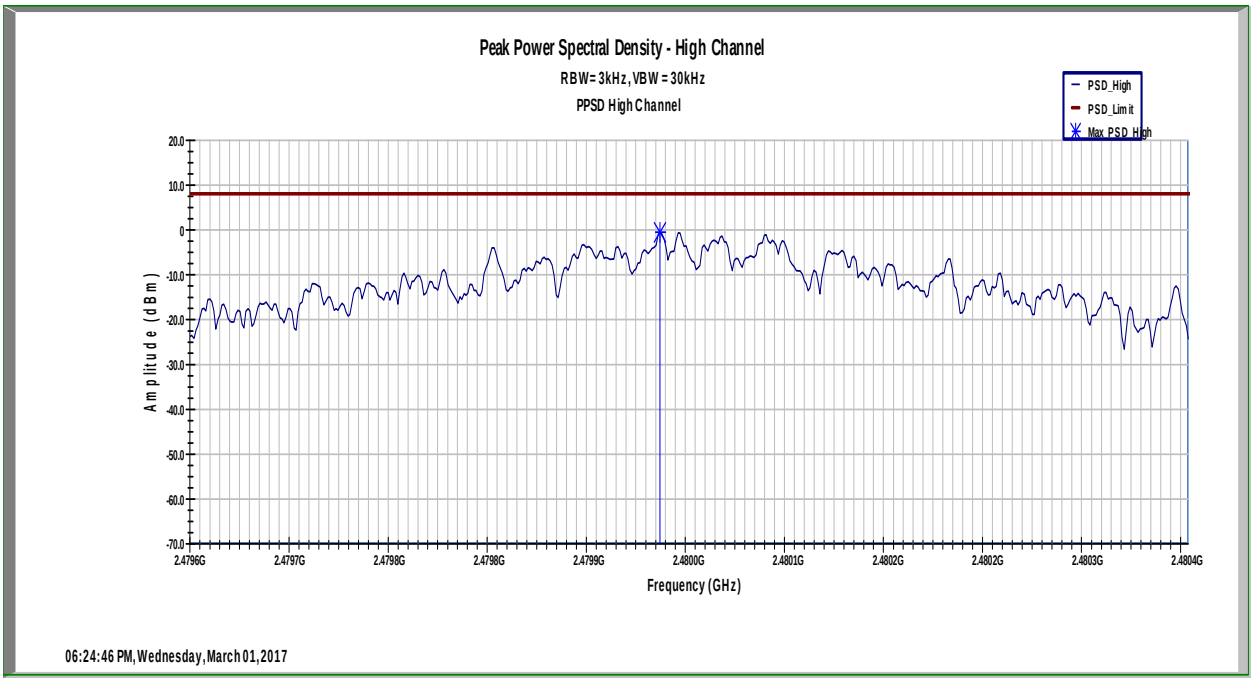
| Mode | Channel Number | Frequency (MHz) | PSD in 3kHz BW (dBm) | Limit (dBm) | Margin (dBm) | Result |
|---|---|---|---|---|---|---|
| BLE | 0 | 2402 | 0.004 | 8 | -7.996 | Pass |
| BLE | 19 | 2440 | -0.329 | 8 | -8.329 | Pass |
| BLE | 39 | 2480 | -0.558 | 8 | -8.558 | Pass |




**Power Spectral Density – Channel 0**




**Power Spectral Density – Channel 19**




**Power Spectral Density – Channel 39**

# 7 Conducted Spurious Emissions

## 7.1 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.

## 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.

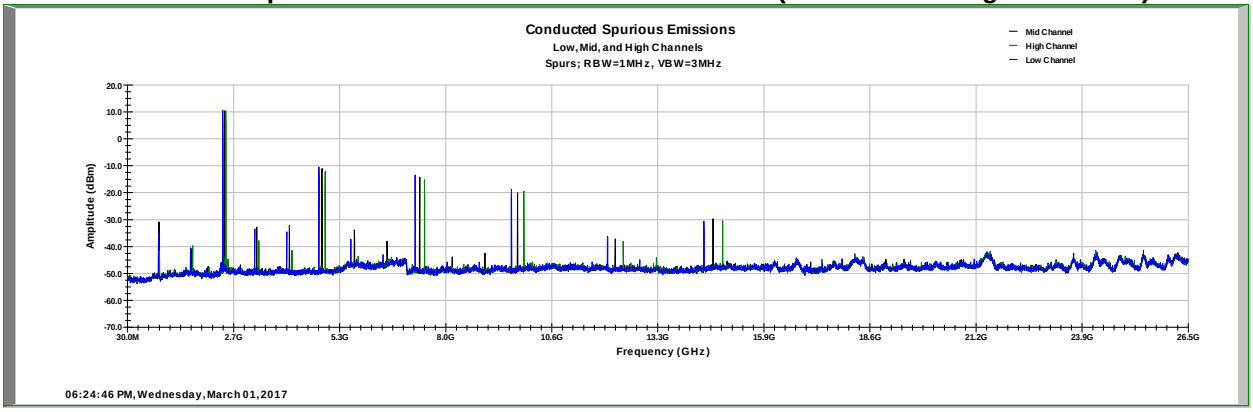
## 7.3 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 10887490.26 | Rohde&Schwarz | ESI26 | 9/20/2016 | 9/20/2017 |
| COND3 | 6026 | | | 11/17/2016 | 11/17/2017 |

## 7.4 Results:

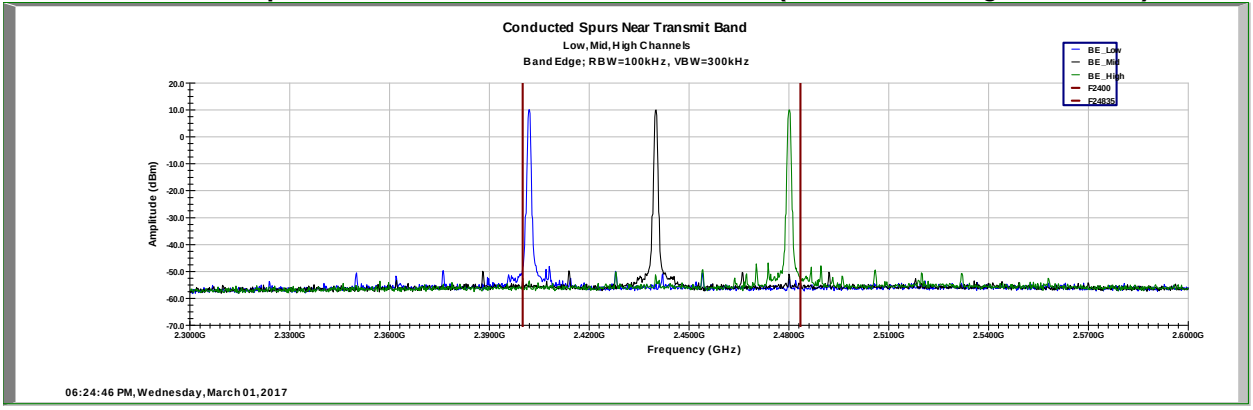
The following plots show that there are no conducted spurious emissions exceeding the 20dB down criteria. Plots are also presented showing the band edge compliance.

## Conducted Spurious Emissions at Antenna Port BLE (Low Mid and High Channels)




| Channel | Frequency (GHz) | Level (dBm) | Limit (dBm) | Margin (dBm) | Result |
|---|---|---|---|---|---|
| Low | 4.804 | -10.44 | -9.36 | 1.08 | Compliant |
| | 7.206 | -13.45 | -9.36 | 4.09 | Compliant |
| Mid | 4.880 | -11.03 | -9.49 | 1.54 | Compliant |
| | 7.320 | -14.42 | -9.49 | 4.93 | Compliant |
| High | 4.960 | -12.11 | -9.47 | 2.65 | Compliant |
| | 7.440 | -15.23 | -9.47 | 5.77 | Compliant |

## Conducted Spurious Emissions at Antenna Port BLE (Low Mid and High Channels)



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

## 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 | 9/26/2016 | 9/26/2017 |
| Preamplifier | 122005 | Rohde&Schwarz | TS-PR18 | 11/17/2016 | 11/17/2017 |
| Preamplifier | 100050 | Rohde&Schwarz | TS-PR26 | 11/17/2016 | 11/17/2017 |
| Horn Antenna (18 – 40GHz) | 00117798 | ETS | 3116c | 6/6/2016 | 6/6/2017 |
| Horn Antenna | 00156319 | ETS | 3117 | 6/3/2016 | 6/3/2017 |
| Bilog Antenna | 2564 | Schaffner | CBL6111C | 3/23/2016 | 3/23/2017 |
| High Pass Filter | 1 | Wainwright | WHKX12-2533.85-2710-1800-40SS | 11/17/2016 | 11/17/2017 |
| 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 |
| 3m Cable Antenna→Preamp | 3074 | | | 11/17/2016 | 11/17/2017 |
| 3m Cable Preamp→Chamber | 2588 | | | 11/17/2016 | 11/17/2017 |
| 3m Cable Chamber→Control Room | 2593 | | | 11/17/2016 | 11/17/2017 |
| 3m Cable Control Room→Receiver | 2592 | | | 11/17/2016 | 11/17/2017 |
| 10m Cable Antenna→Preamp | 3339 | | | 11/17/2016 | 11/17/2017 |
| 10m Cable Preamp→Chamber | 3172 | | | 11/17/2016 | 11/17/2017 |
| 10m Cable Chamber→Control Room | 2590 | | | 11/17/2016 | 11/17/2017 |
| 10m Cable Control Room→Receiver | 2589 | | | 11/17/2016 | 11/17/2017 |

## 8.5 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.

Emissions were investigated with the test sample positioned in 3 orthogonal axis and the worst case reported.

**Bluetooth, Channel 2402, BLE**

**Average**

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 4804.000000 | 38.20 | 54.00 | 15.80 | 1000.000 | 341.0 | H | 131.0 | 7.5 |
| 7206.000000 | 48.99 | 54.00 | 5.01 | 1000.000 | 366.0 | V | 274.0 | 10.4 |
| 9607.600000 | 38.60 | 54.00 | 15.40 | 1000.000 | 206.0 | H | 202.0 | 13.6 |
| 12009.400000 | 37.65 | 54.00 | 16.35 | 1000.000 | 200.0 | H | 293.0 | 17.5 |
| 14411.400000 | 42.45 | 54.00 | 11.55 | 1000.000 | 311.0 | V | 131.0 | 17.0 |

**Max Peak**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 4804.000000 | 45.07 | 74.00 | 28.93 | 1000.000 | 341.0 | H | 131.0 | 7.5 |
| 7206.000000 | 53.58 | 74.00 | 20.42 | 1000.000 | 366.0 | V | 274.0 | 10.4 |
| 9607.600000 | 49.61 | 74.00 | 24.39 | 1000.000 | 206.0 | H | 202.0 | 13.6 |
| 12009.400000 | 50.73 | 74.00 | 23.27 | 1000.000 | 200.0 | H | 293.0 | 17.5 |
| 14411.400000 | 53.11 | 74.00 | 20.89 | 1000.000 | 311.0 | V | 131.0 | 17.0 |

**Bluetooth, Channel 2402, BLE, Band Edge**

**Average**

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2390.000000 | 41.70 | 54.00 | 12.30 | 1000 | 294 | V | 327 | 37.7 |

**Max Peak**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2390.000000 | 52.09 | 74.00 | 21.91 | 1000 | 294 | V | 327 | 37.7 |

**Bluetooth, Channel 2440, BLE**
**Average**

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 4880.000000 | 47.37 | 54.00 | 6.63 | 1000.000 | 308.0 | H | 278.0 | 7.4 |
| 7320.000000 | 47.40 | 54.00 | 6.60 | 1000.000 | 200.0 | V | 317.0 | 10.5 |
| 9759.600000 | 39.07 | 54.00 | 14.93 | 1000.000 | 344.0 | H | 306.0 | 13.7 |
| 12200.400000 | 50.61 | 54.00 | 3.39 | 1000.000 | 100.0 | V | 276.0 | 17.2 |
| 19519.430000 | 53.58 | 54.00 | 0.42 | 1000.000 | 100.0 | H | 0.0 | -27.9 |

**Max Peak**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 4880.000000 | 50.93 | 74.00 | 23.07 | 1000.000 | 308.0 | H | 278.0 | 7.4 |
| 7320.000000 | 52.76 | 74.00 | 21.24 | 1000.000 | 200.0 | V | 317.0 | 10.5 |
| 9759.600000 | 49.92 | 74.00 | 24.08 | 1000.000 | 344.0 | H | 306.0 | 13.7 |
| 12200.400000 | 58.58 | 74.00 | 15.42 | 1000.000 | 100.0 | V | 276.0 | 17.2 |
| 19519.430000 | 64.49 | 74.00 | 9.51 | 1000.000 | 100.0 | H | 0.0 | -27.9 |

**Bluetooth, Channel 2480, BLE**
**Average**

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 4960.000000 | 53.45 | 54.00 | 0.55 | 1000.000 | 309.0 | H | 130.0 | 7.2 |
| 7440.000000 | 47.55 | 54.00 | 6.45 | 1000.000 | 410.0 | H | 134.0 | 10.9 |
| 9920.400000 | 43.51 | 54.00 | 10.49 | 1000.000 | 325.0 | H | 310.0 | 14.0 |
| 12399.400000 | 40.70 | 54.00 | 13.30 | 1000.000 | 200.0 | V | 280.0 | 16.9 |
| 14879.200000 | 41.88 | 54.00 | 12.12 | 1000.000 | 211.0 | V | 261.0 | 18.2 |
| 19840.990000 | 53.89 | 54.00 | 0.11 | 1000.000 | 100.0 | H | 0.0 | -27.9 |

**Max Peak**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 4960.000000 | 55.97 | 74.00 | 18.03 | 1000.000 | 309.0 | H | 130.0 | 7.2 |
| 7440.000000 | 52.83 | 74.00 | 21.17 | 1000.000 | 410.0 | H | 134.0 | 10.9 |
| 9920.400000 | 53.00 | 74.00 | 21.00 | 1000.000 | 325.0 | H | 310.0 | 14.0 |
| 12399.400000 | 51.67 | 74.00 | 22.33 | 1000.000 | 200.0 | V | 280.0 | 16.9 |
| 14879.200000 | 53.05 | 74.00 | 20.95 | 1000.000 | 211.0 | V | 261.0 | 18.2 |
| 19840.990000 | 66.02 | 74.00 | 7.98 | 1000.000 | 100.0 | H | 0.0 | -27.9 |

**Bluetooth, Channel 2480, BLE, Band Edge**
**Average**

| Frequency (MHz) | Average (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2483.500000 | 42.95 | 54.00 | 11.05 | 1000 | 410 | H | 274 | 37.8 |

**Max Peak**

| Frequency (MHz) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 2483.500000 | 53.50 | 74.00 | 20.50 | 1000 | 410 | H | 274 | 37.8 |

# 9 AC Powerline Conducted Emissions

## 9.1 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.

## 9.2 Test Procedure

ANSI C63.4: 2014

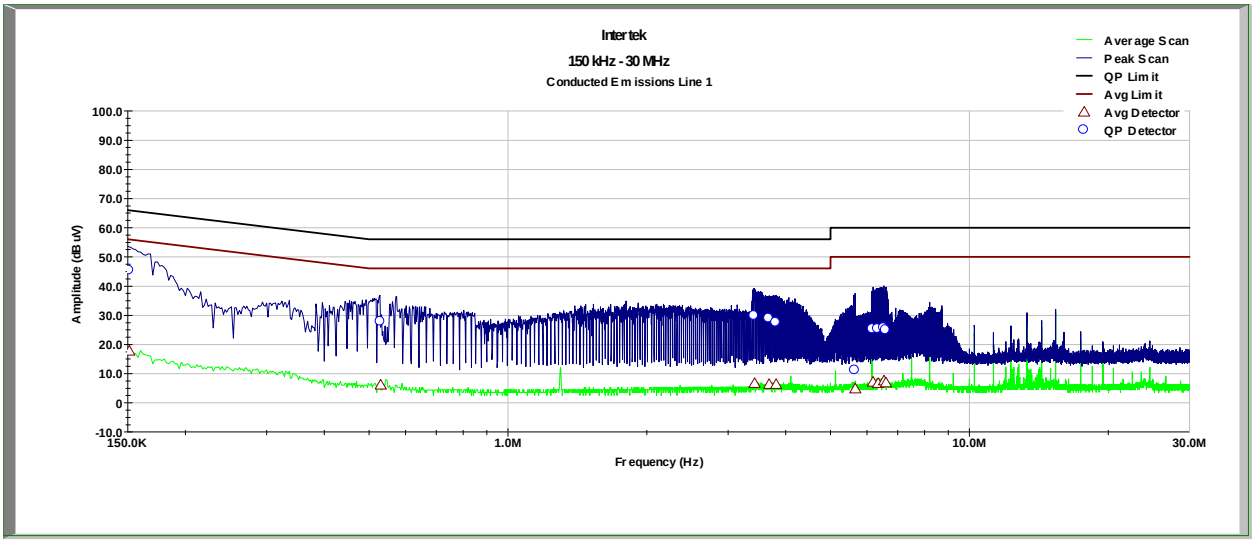
## 9.3 Test Equipment Used:

| 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 |
| COND2 | 5025 | | | 11/17/2016 | 11/17/2017 |

**9.4**

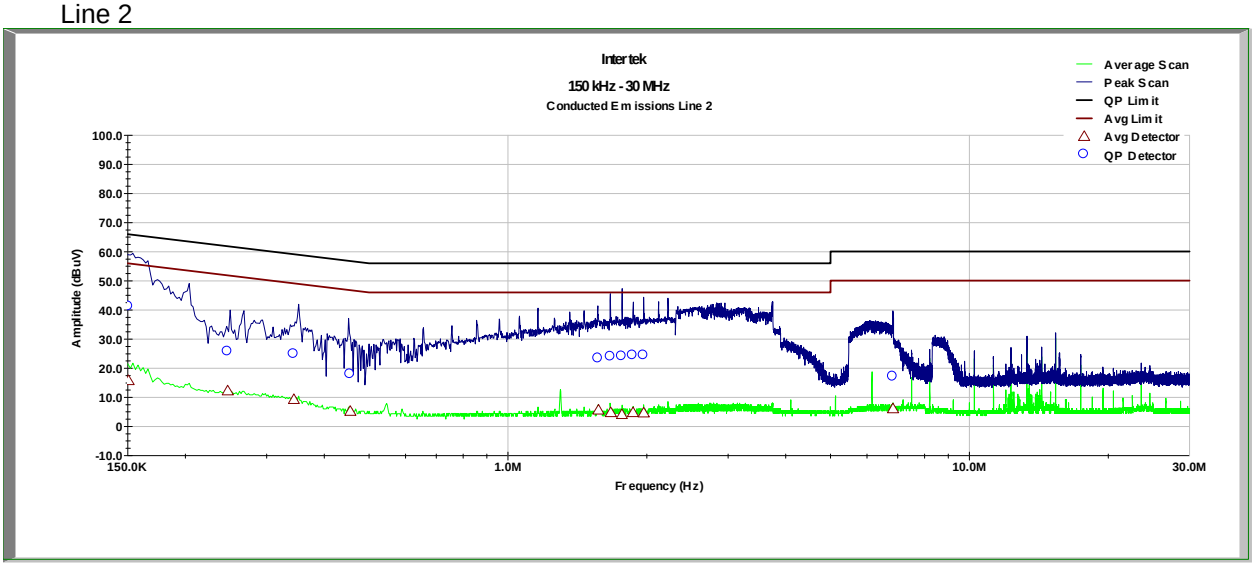
**9.5 Results:**

Line 1




| Frequency (MHz) | Quasi-Peak (dBuV) | Quasi-Peak Limit (dBuV) | Quasi-Peak Margin (dB) | Average (dBuV) | Average Limit (dBuV) | Average Margin (dB) |
|---|---|---|---|---|---|---|
| 151.20 KHz | 45.277 | 65.966 | 20.689 | 17.774 | 55.966 | 38.192 |
| 530.20 KHz | 27.701 | 56.000 | 28.299 | 6.117 | 46.000 | 39.883 |
| 3.425 MHz | 29.663 | 56.000 | 26.337 | 6.620 | 46.000 | 39.380 |
| 3.685 MHz | 28.813 | 56.000 | 27.187 | 6.279 | 46.000 | 39.721 |
| 3.815 MHz | 27.318 | 56.000 | 28.682 | 6.342 | 46.000 | 39.658 |
| 5.658 MHz | 10.982 | 60.000 | 49.018 | 4.822 | 50.000 | 45.178 |
| 6.183 MHz | 25.137 | 60.000 | 34.863 | 7.102 | 50.000 | 42.898 |
| 6.342 MHz | 25.219 | 60.000 | 34.781 | 6.604 | 50.000 | 43.396 |
| 6.534 MHz | 25.536 | 60.000 | 34.464 | 7.475 | 50.000 | 42.525 |
| 6.601 MHz | 24.809 | 60.000 | 35.191 | 6.831 | 50.000 | 43.169 |

Line 2




| Frequency (MHz) | Quasi-Peak (dBuV) | Quasi-Peak Limit (dBuV) | Quasi-Peak Margin (dB) | Average (dBuV) | Average Limit (dBuV) | Average Margin (dB) |
|---|---|---|---|---|---|---|
| 150.60 KHz | 41.120 | 65.983 | 24.862 | 15.778 | 55.983 | 40.205 |
| 247.10 KHz | 25.687 | 63.226 | 37.539 | 12.240 | 53.226 | 40.986 |
| 343.70 KHz | 24.825 | 60.466 | 35.641 | 9.262 | 50.466 | 41.204 |
| 455.50 KHz | 17.855 | 57.271 | 39.417 | 5.240 | 47.271 | 42.031 |
| 1.572 MHz | 23.256 | 56.000 | 32.744 | 5.616 | 46.000 | 40.384 |
| 1.671 MHz | 23.832 | 56.000 | 32.168 | 4.747 | 46.000 | 41.253 |
| 1.767 MHz | 24.003 | 56.000 | 31.997 | 4.079 | 46.000 | 41.921 |
| 1.867 MHz | 24.381 | 56.000 | 31.619 | 4.823 | 46.000 | 41.177 |
| 1.969 MHz | 24.296 | 56.000 | 31.704 | 4.686 | 46.000 | 41.314 |
| 6.834 MHz | 17.020 | 60.000 | 42.980 | 6.139 | 50.000 | 43.861 |

# 10 Antenna Requirement per FCC Part 15.203

## 10.1 Test Limits

**§ 15.203:** An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, §15.213, §15.217, §15.219, or §15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

## 10.2 Results:

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

## 11 Measurement Uncertainty

The measured value related to the corresponding limit will be used to decide whether the equipment meets the requirements.

The measurement uncertainty figures were calculated and correspond to a coverage factor of k = 2, providing a confidence level of respectively 95.45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian).

Measurement uncertainty Table

| Parameter | Uncertainty | Notes |
|---|---|---|
| Radiated emissions, 30 to 1000 MHz | ±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 | |

## 12 Revision History

| Revision Level | Date | Report Number | Notes |
|---|---|---|---|
| 0 | 7/24/2017 | 102886547LEX-003 | Original Issue |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |