731 Enterprise Drive
Lexington, KY 40510

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

# TEST REPORT

**Report Number:** **101978620LEX-002**
**Project Number:** **G101978620**

**Report Issue Date:** **3/9/2015**

**Model Number:** **XT6350**

**Standards:** **Title 47 CFR Part 15 Subpart C, RSS-210 Issue 8**

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

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

Client:
Xirgo Technologies
188 Camino Ruiz
Camarillo, CA 93012

Report prepared by
Bryan Taylor, Team Leader

Report reviewed by
Jason Centers, Staff Engineer

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## 1 Introduction and Conclusion

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

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

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

## 2 Test Summary

| Page | Test full name | FCC Reference | IC Reference | Result |
|---|---|---|---|---|
| 6 | Peak Conducted Power | § 15.247(b)(3)(4) | RSS-210 (A8.4) | Pass |
| 9 | Occupied Bandwidth | § 15.247(a)(2) | RSS-210 (A8.2), RSS-GEN (4.6.1) | Pass |
| 12 | Conducted Spurious Emissions | § 15.247(d) | RSS-210 (A8.5) | Pass |
| 14 | Power Spectral Density | § 15.247(e) | RSS-210 (A8.2b) | Pass |
| 17 | Radiated Spurious Emissions (Transmitter) | § 15.247(d), § 15.209, and § 15.205 | RSS-210 (2.2) (A8.5) | Pass |
| 22 | Radiated Spurious Emissions (Receiver) | § 15.109 | RSS-Gen (6.1) | Pass |
| 26 | Conducted Voltage Emissions on the AC Mains Terminals | § 15.107, § 15.207 | RSS-Gen (7.2.4) | Pass |
| 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** | Xirgo Technologies |
| **Model Number** | XT6350 |
| **Serial Number** | 1 and 2 |
| **Receive Date** | 1/19/2015 |
| **Test Start Date** | 1/19/2015 |
| **Test End Date** | 3/3/2015 |
| **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** | 12VDC |

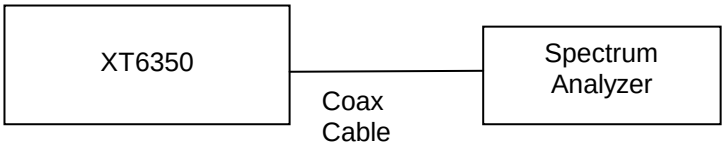
| Description of Equipment Under Test |
|---|
| The XT6350 is a Vehicle GPS/Cellular Tracking Device with BT |

**Operating modes of the EUT:**

| No. | Descriptions of EUT Exercising |
|---|---|
| 1 | Transmitting BTLE 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 Conducted Power

## 4.1 Test Limits

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

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

## 4.2 Test Procedure

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

## 4.3 Test Equipment Used:

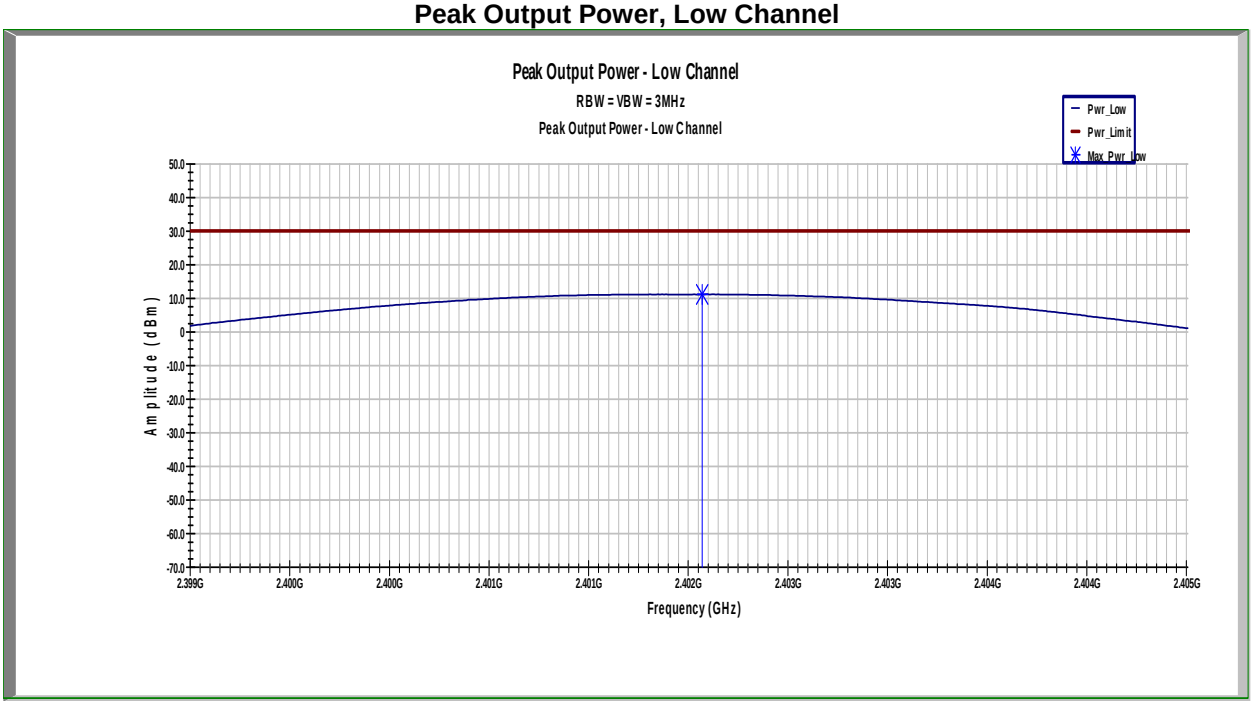
| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| Spectrum Analyzer | 3720 | Rohde&Schwarz | FSEK30 | 9/15/2014 | 9/15/2015 |

## 4.4 Results:

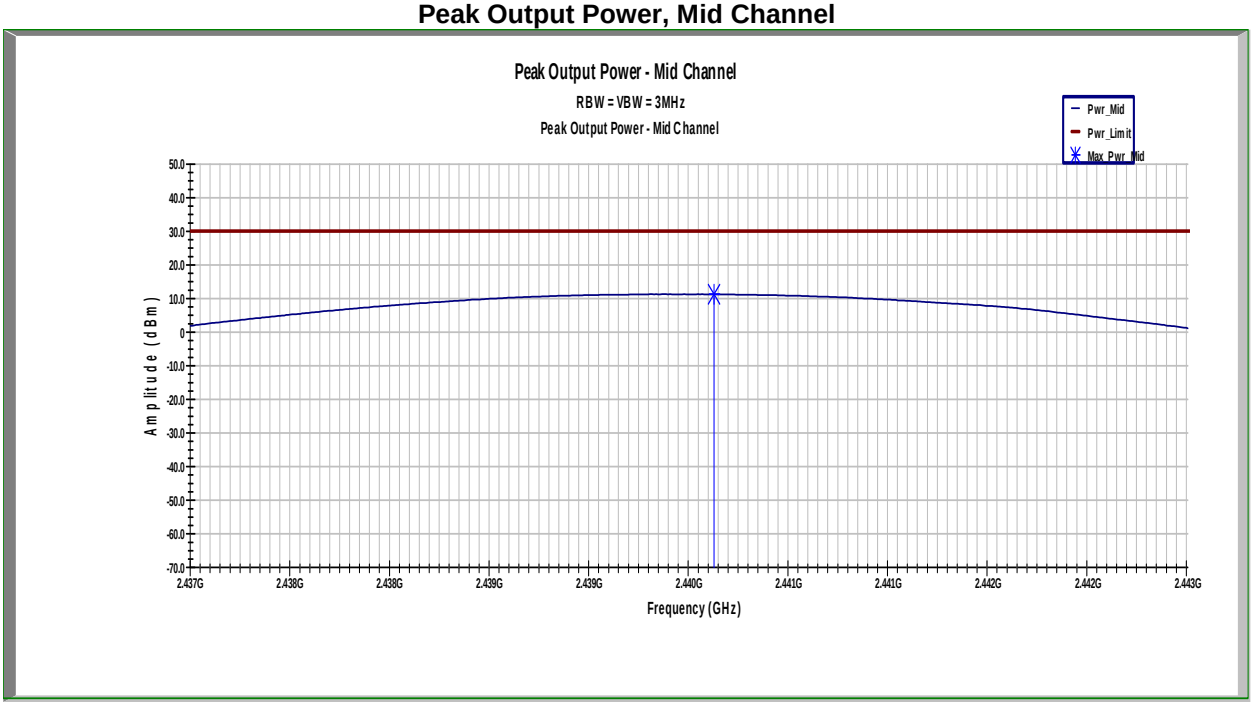
The peak output power measurements were all below the 30dBm limit.

| Mode | Channel Number | Frequency (MHz) | Peak Output Power (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| BTLE | 0 | 2402 | 11.157 | 30 | Pass |
| BTLE | 19 | 2440 | 11.219 | 30 | Pass |
| BTLE | 39 | 2480 | 11.159 | 30 | Pass |

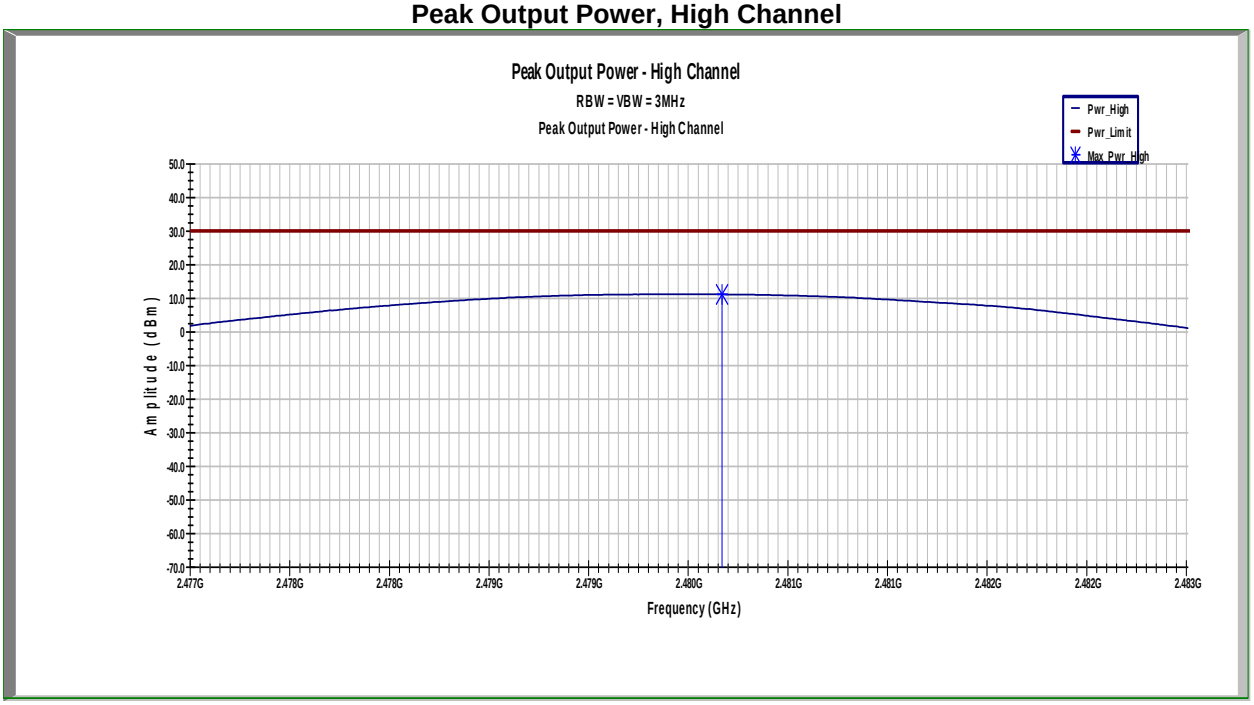
## Peak Output Power, Low Channel




## 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)

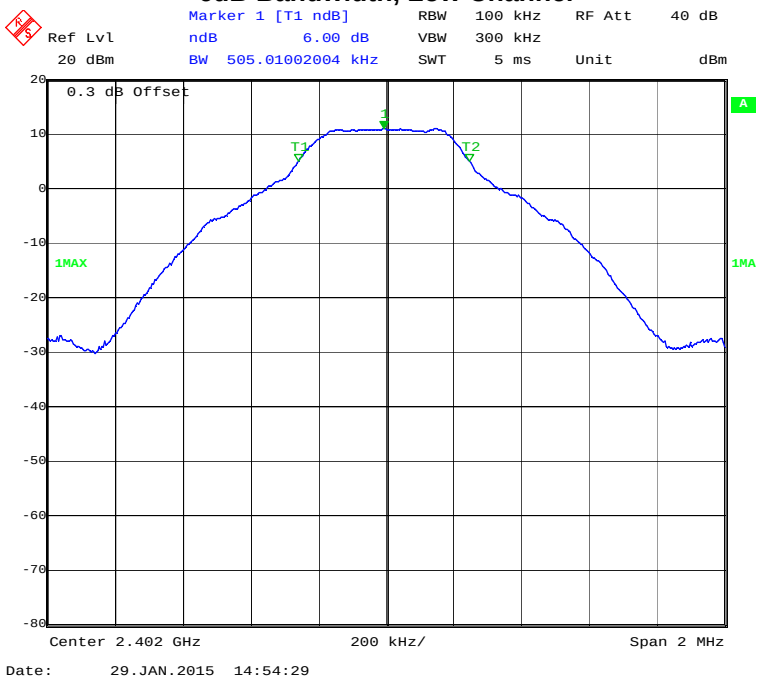
## 5.3 Test Equipment Used:

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

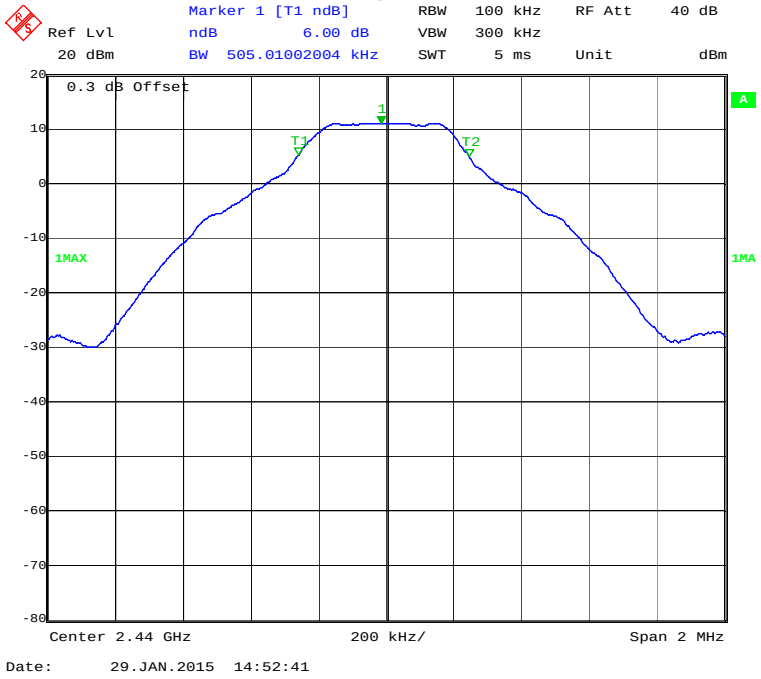
## 5.4 Results:

| Mode | Channel Number | Frequency (MHz) | 6dB Bandwidth | 99% Power Bandwidth | Result |
|---|---|---|---|---|---|
| BTLE | 0 | 2402 | 505kHz | --- | Pass |
| BTLE | 19 | 2440 | 505kHz | 937kHz | Pass |
| BTLE | 39 | 2480 | 513kHz | --- | Pass |

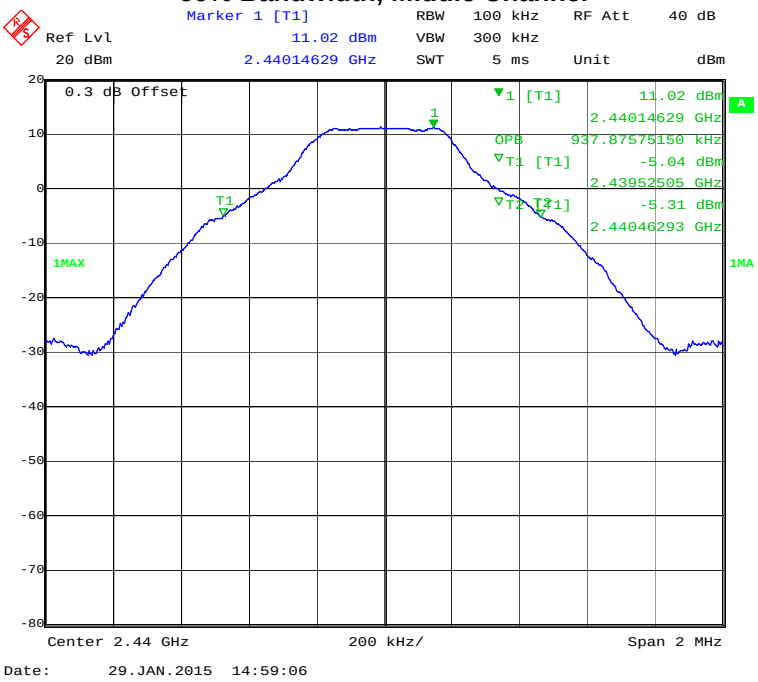
## 6dB Bandwidth, Low Channel



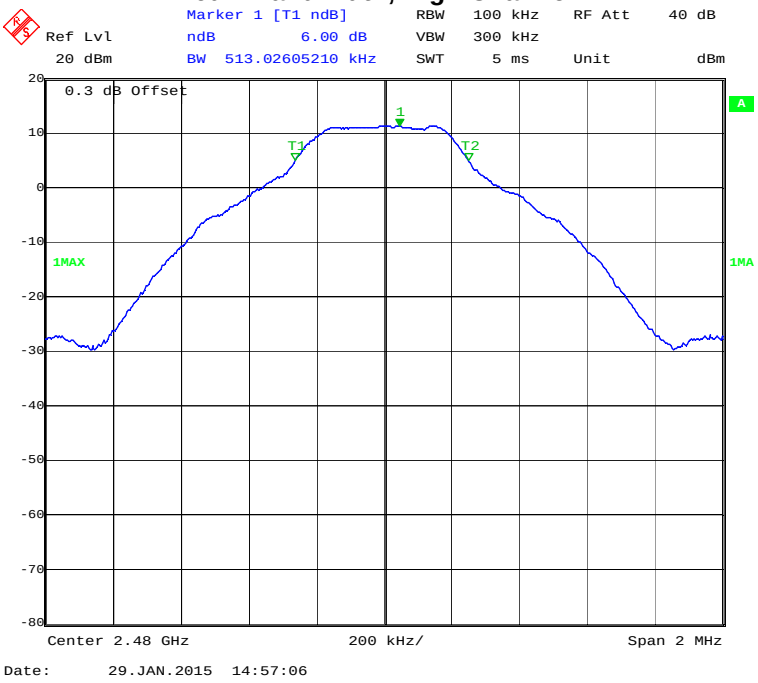

## 6dB Bandwidth, Middle Channel



## 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)

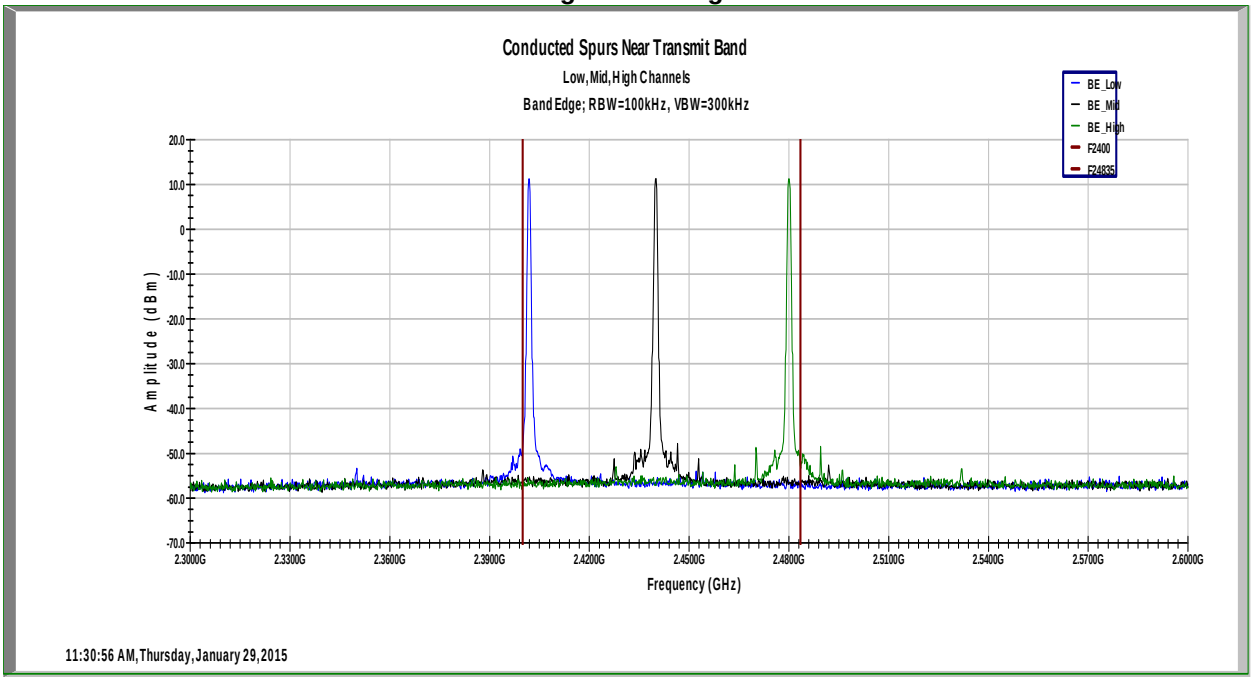
## 6.3 Test Equipment Used:

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

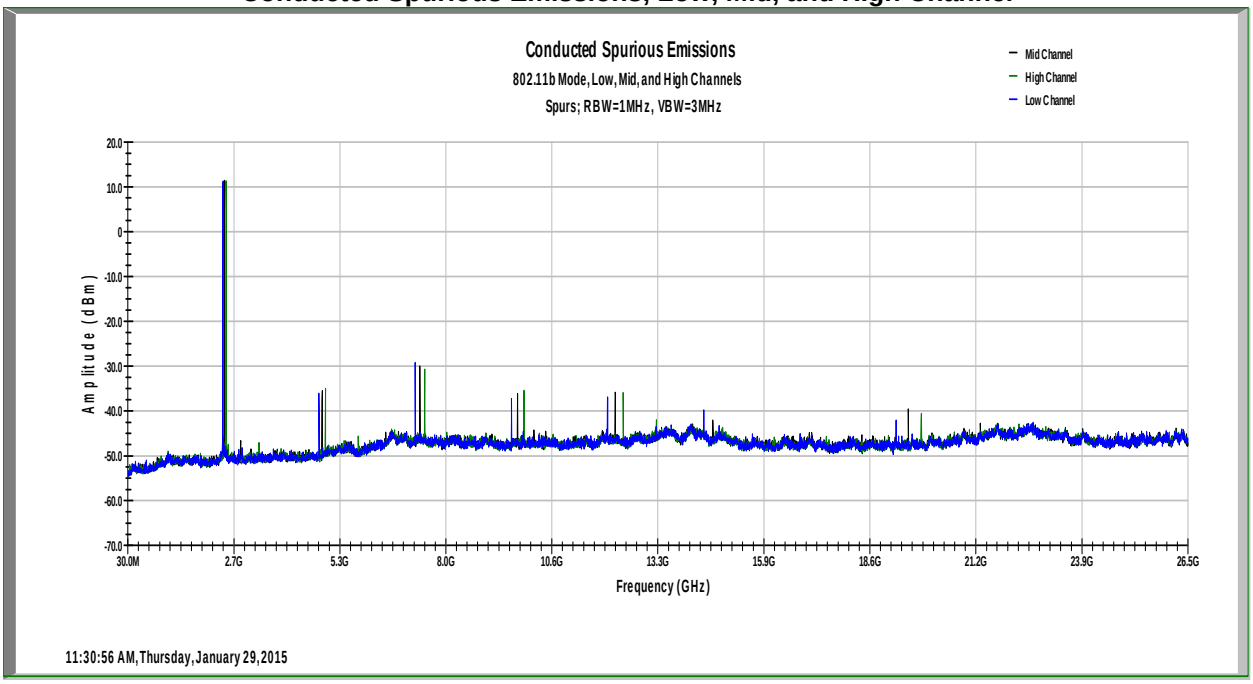
## 6.4 Results:

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:

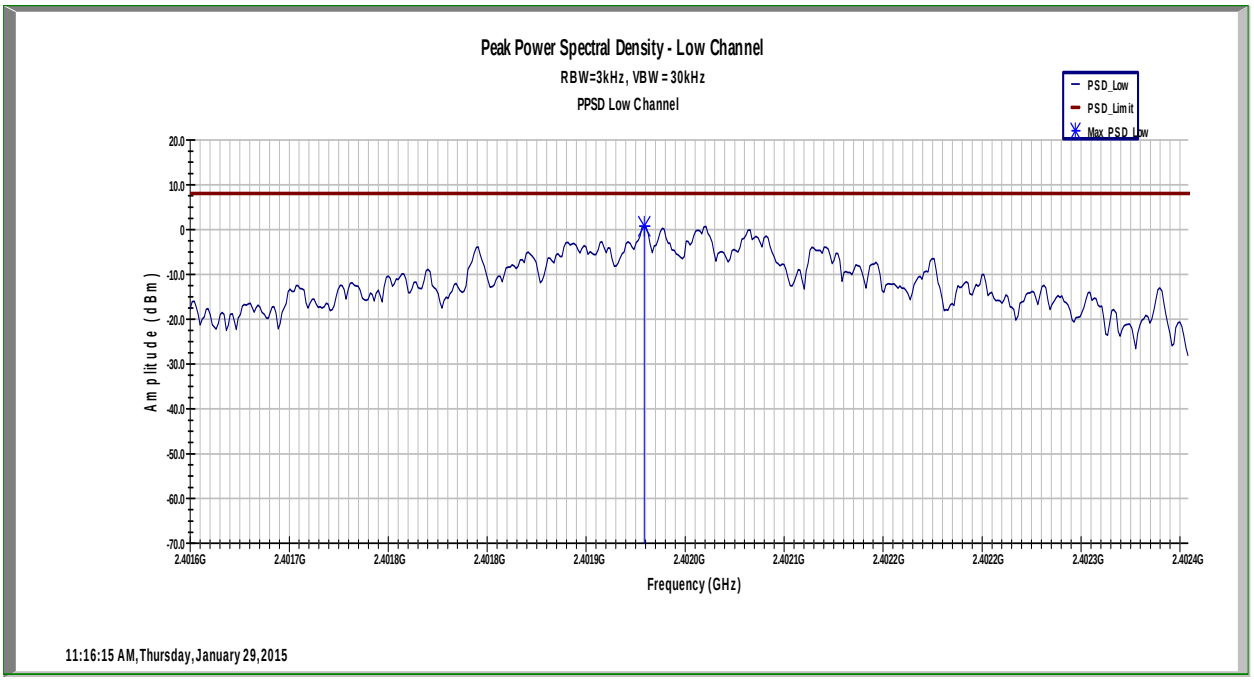
| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| Spectrum Analyzer | 3720 | Rohde&Schwarz | FSEK30 | 9/15/2014 | 9/15/2015 |

## 7.4 Results:

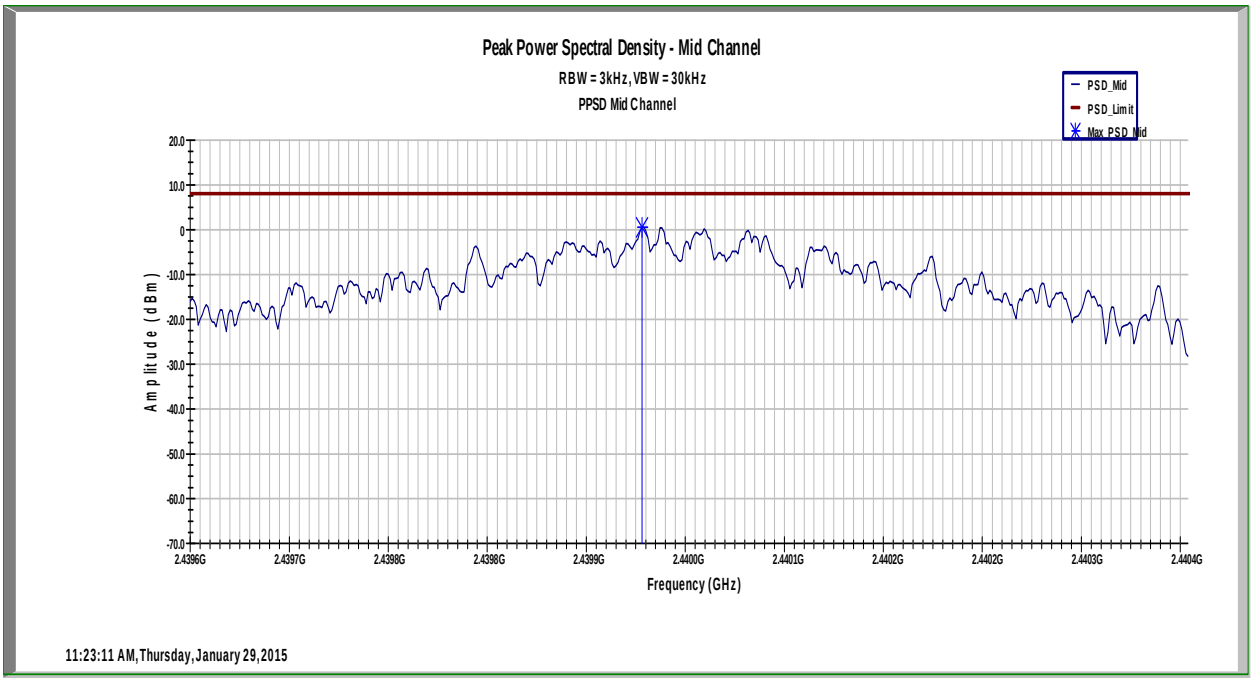
*PSD Option 1 Method

| Mode | Channel Number | Frequency (MHz) | PSD in 3kHz BW (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| BTLE | 0 | 2402 | 0.708 | 8.0 | Pass |
| BTLE | 19 | 2440 | 0.485 | 8.0 | Pass |
| BTLE | 39 | 2480 | 0.476 | 8.0 | Pass |

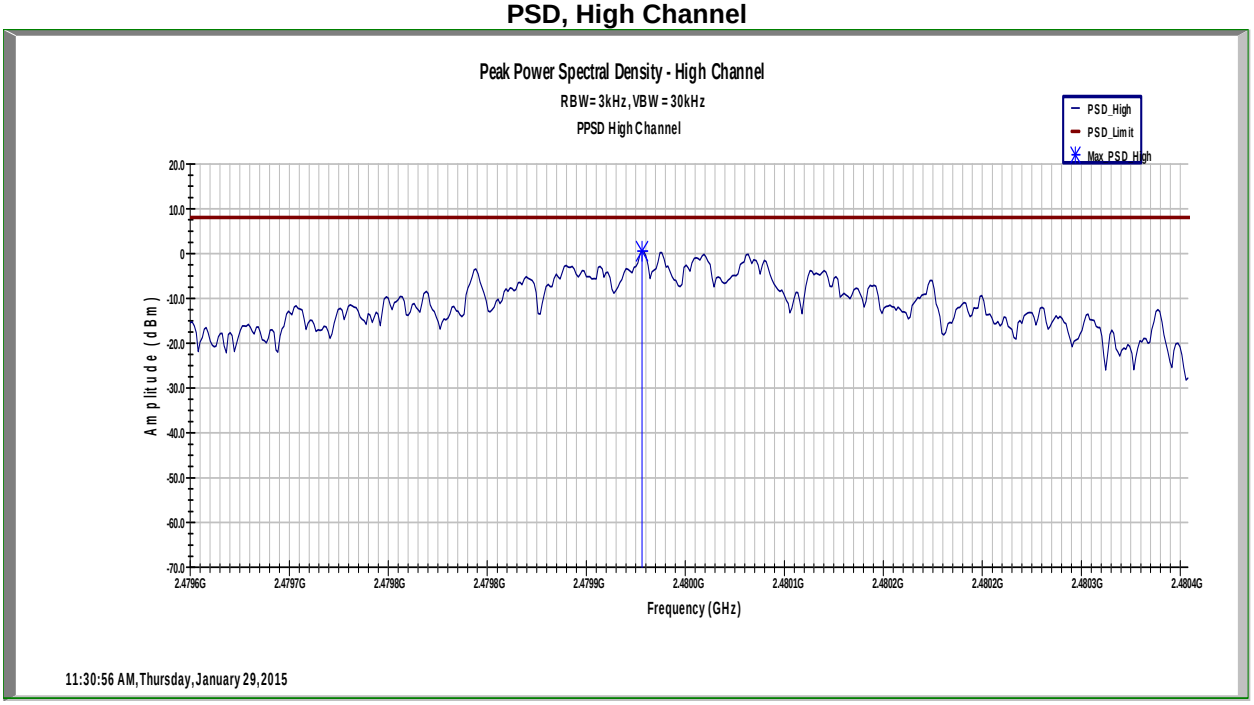
## PSD Low Channel




## PSD Middle Channel



**PSD, High Channel**



# 8 Radiated Spurious Emissions (Transmitter)

## 8.1 Test Limits

**§ 15.247(d):** In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

**Part 15.205(a): Restricted Bands of Operations**

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090–0.110 | 16.42–16.423 | 399.9–410 | 4.5–5.15 |
| [1] 0.495–0.505 | 16.69475–16.69525 | 608–614 | 5.35–5.46 |
| 2.1735–2.1905 | 16.80425–16.80475 | 960–1240 | 7.25–7.75 |
| 4.125–4.128 | 25.5–25.67 | 1300–1427 | 8.025–8.5 |
| 4.17725–4.17775 | 37.5–38.25 | 1435–1626.5 | 9.0–9.2 |
| 4.20725–4.20775 | 73–74.6 | 1645.5–1646.5 | 9.3–9.5 |
| 6.215–6.218 | 74.8–75.2 | 1660–1710 | 10.6–12.7 |
| 6.26775–6.26825 | 108–121.94 | 1718.8–1722.2 | 13.25–13.4 |
| 6.31175–6.31225 | 123–138 | 2200–2300 | 14.47–14.5 |
| 8.291–8.294 | 149.9–150.05 | 2310–2390 | 15.35–16.2 |
| 8.362–8.366 | 156.52475–156.52525 | 2483.5–2500 | 17.7–21.4 |
| 8.37625–8.38675 | 156.7–156.9 | 2655–2900 | 22.01–23.12 |
| 8.41425–8.41475 | 162.0125–167.17 | 3260–3267 | 23.6–24.0 |
| 12.29–12.293 | 167.72–173.2 | 3332–3339 | 31.2–31.8 |
| 12.51975–12.52025 | 240–285 | 3345.8–3358 | 36.43–36.5 |
| 12.57675–12.57725 | 322–335.4 | 3600–4400 | [2] |
| 13.36–13.41. | | | |

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

**Part 15.209(a): Field Strength Limits for Restricted Bands of Operation**

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|---|---|---|
| 0.009 - 0.490 | 2,400 / F (kHz) | 300 |
| 0.490 - 1.705 | 24,000 / F (kHz) | 30 |
| 1.705 - 30.0 | 30 | 30 |
| 30 – 88 | 100 | 3 |
| 88 – 216 | 150 | 3 |
| 216 – 960 | 200 | 3 |
| Above 960 | 500 | 3 |

## 8.2 Test Procedure

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

## 8.3 Example of Field Strength Calculation Method:

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

Formula:
FS = RA + AF + CF

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

Example Calculation:

RA = 19.48 dBμV
AF = 18.52 dB
CF = 0.78 dB

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

## 8.4 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 1302.6005.40 | Rohde&Schwarz | ESU40 | 9/17/2014 | 9/17/2015 |
| Preamplifier | 122005 | Rohde&Schwarz | TS-PR18 | 11/26/2014 | 11/26/2015 |
| Preamplifier | 100050 | Rohde&Schwarz | TS-PR26 | 11/26/2014 | 11/26/2015 |
| Horn Antenna (18 – 40GHz) | 00117798 | ETS | 3116c | 5/13/2014 | 5/13/2015 |
| Horn Antenna | 00156319 | ETS | 3117 | 5/2/2014 | 5/2/2015 |
| Bilog Antenna | 2564 | Schaffner | CBL6111C | 4/21/2014 | 4/21/2015 |
| 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) |
|---|---|---|---|---|---|---|---|---|---|
| 3202.700000 | --- | 43.83 | 74.00 | 30.17 | 1000.000 | 293.0 | H | 327.0 | 5.0 |
| 3202.700000 | 40.22 | --- | 54.00 | 13.78 | 1000.000 | 293.0 | H | 327.0 | 5.0 |
| 4803.900000 | --- | 47.30 | 74.00 | 26.70 | 1000.000 | 410.0 | V | 329.0 | 7.5 |
| 4803.900000 | 42.31 | --- | 54.00 | 11.69 | 1000.000 | 410.0 | V | 329.0 | 7.5 |
| 7205.900000 | --- | 58.39 | 74.00 | 15.61 | 1000.000 | 339.0 | V | 336.0 | 10.4 |
| 7205.900000 | (11.81) | --- | 54.00 | 42.19 | 1000.000 | 339.0 | V | 336.0 | 10.4 |
| 9607.200000 | --- | 55.11 | 74.00 | 18.89 | 1000.000 | 138.0 | H | 72.0 | 13.6 |
| 9607.200000 | 46.24 | --- | 54.00 | 7.76 | 1000.000 | 138.0 | H | 72.0 | 13.6 |
| 9608.500000 | --- | 50.54 | 74.00 | 23.46 | 1000.000 | 208.0 | H | 278.0 | 13.6 |
| 9608.500000 | 44.08 | --- | 54.00 | 9.92 | 1000.000 | 208.0 | H | 278.0 | 13.6 |
| 12010.300000 | --- | 50.85 | 74.00 | 23.15 | 1000.000 | 98.0 | H | 136.0 | 17.4 |
| 12010.300000 | 42.71 | --- | 54.00 | 11.29 | 1000.000 | 98.0 | H | 136.0 | 17.4 |
| 14412.500000 | --- | 50.78 | 74.00 | 23.22 | 1000.000 | 234.0 | H | 260.0 | 17.0 |
| 14412.500000 | 42.77 | --- | 54.00 | 11.23 | 1000.000 | 234.0 | H | 260.0 | 17.0 |
| 16813.500000 | --- | 49.87 | 74.00 | 24.13 | 1000.000 | 296.0 | V | 0.0 | 21.5 |
| 16813.500000 | 41.80 | --- | 54.00 | 12.20 | 1000.000 | 296.0 | V | 0.0 | 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 | --- | 52.57 | 74.00 | 21.43 | 1000.000 | 406.0 | H | 317.0 | 37.7 |
| 2390.000000 | 41.51 | --- | 54.00 | 12.49 | 1000.000 | 406.0 | H | 317.0 | 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 | --- | 57.06 | 74.00 | 16.94 | 1000.000 | 241.0 | V | 336.0 | 7.4 |
| 4879.800000 | (10.41) | --- | 54.00 | 43.59 | 1000.000 | 241.0 | V | 336.0 | 7.4 |
| 7319.800000 | 53.68 | --- | 54.00 | 0.32 | 1000.000 | 233.0 | V | 340.0 | 10.5 |
| 7319.800000 | --- | 57.38 | 74.00 | 16.62 | 1000.000 | 233.0 | V | 340.0 | 10.5 |
| 9760.200000 | 38.49 | --- | 54.00 | 15.51 | 1000.000 | 406.0 | H | 279.0 | 13.7 |
| 9760.200000 | --- | 48.22 | 74.00 | 25.78 | 1000.000 | 406.0 | H | 279.0 | 13.7 |
| 12200.600000 | --- | 53.16 | 74.00 | 20.84 | 1000.000 | 296.0 | V | 190.0 | 17.2 |
| 12200.600000 | 43.42 | --- | 54.00 | 10.58 | 1000.000 | 296.0 | V | 190.0 | 17.2 |
| 14640.600000 | 39.61 | --- | 54.00 | 14.39 | 1000.000 | 222.0 | H | 258.0 | 17.3 |
| 14640.600000 | --- | 50.13 | 74.00 | 23.87 | 1000.000 | 222.0 | H | 258.0 | 17.3 |
| 17079.000000 | 40.07 | --- | 54.00 | 13.93 | 1000.000 | 267.0 | H | 122.0 | 21.3 |
| 17079.000000 | --- | 51.32 | 74.00 | 22.68 | 1000.000 | 267.0 | H | 122.0 | 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) |
|---|---|---|---|---|---|---|---|---|---|
| 3306.800000 | --- | 47.66 | 74.00 | 26.34 | 1000.000 | 323.0 | H | 331.0 | 5.1 |
| 3306.800000 | 44.00 | --- | 54.00 | 10.00 | 1000.000 | 323.0 | H | 331.0 | 5.1 |
| 4959.800000 | (14.64) | --- | 54.00 | 39.36 | 1000.000 | 231.0 | V | 326.0 | 7.2 |
| 4959.800000 | --- | 61.04 | 74.00 | 12.96 | 1000.000 | 231.0 | V | 326.0 | 7.2 |
| 7439.800000 | (11.0) | --- | 54.00 | 43.00 | 1000.000 | 249.0 | V | 343.0 | 10.9 |
| 7439.800000 | --- | 58.95 | 74.00 | 15.05 | 1000.000 | 249.0 | V | 343.0 | 10.9 |
| 9920.200000 | --- | 50.15 | 74.00 | 23.85 | 1000.000 | 406.0 | H | 277.0 | 14.0 |
| 9920.200000 | 42.41 | --- | 54.00 | 11.59 | 1000.000 | 406.0 | H | 277.0 | 14.0 |
| 12399.400000 | --- | 51.49 | 74.00 | 22.51 | 1000.000 | 244.0 | V | 184.0 | 16.9 |
| 12399.400000 | 42.81 | --- | 54.00 | 11.19 | 1000.000 | 244.0 | V | 184.0 | 16.9 |
| 14879.000000 | 39.22 | --- | 54.00 | 14.78 | 1000.000 | 209.0 | H | 284.0 | 18.2 |
| 14879.000000 | --- | 49.65 | 74.00 | 24.35 | 1000.000 | 209.0 | H | 284.0 | 18.2 |
| 17359.000000 | 39.57 | --- | 54.00 | 14.43 | 1000.000 | 241.0 | H | 116.0 | 20.6 |
| 17359.000000 | --- | 49.80 | 74.00 | 24.20 | 1000.000 | 241.0 | H | 116.0 | 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 | 42.49 | --- | 54.00 | 11.51 | 1000.000 | 100.0 | H | 0.0 | 37.8 |
| 2483.500000 | --- | 53.70 | 74.00 | 20.30 | 1000.000 | 100.0 | H | 0.0 | 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 dBµV/m
Level in µV/m = Common Antilogarithm [(38.78 dBµV/m)/20] = 86.89 µV/m

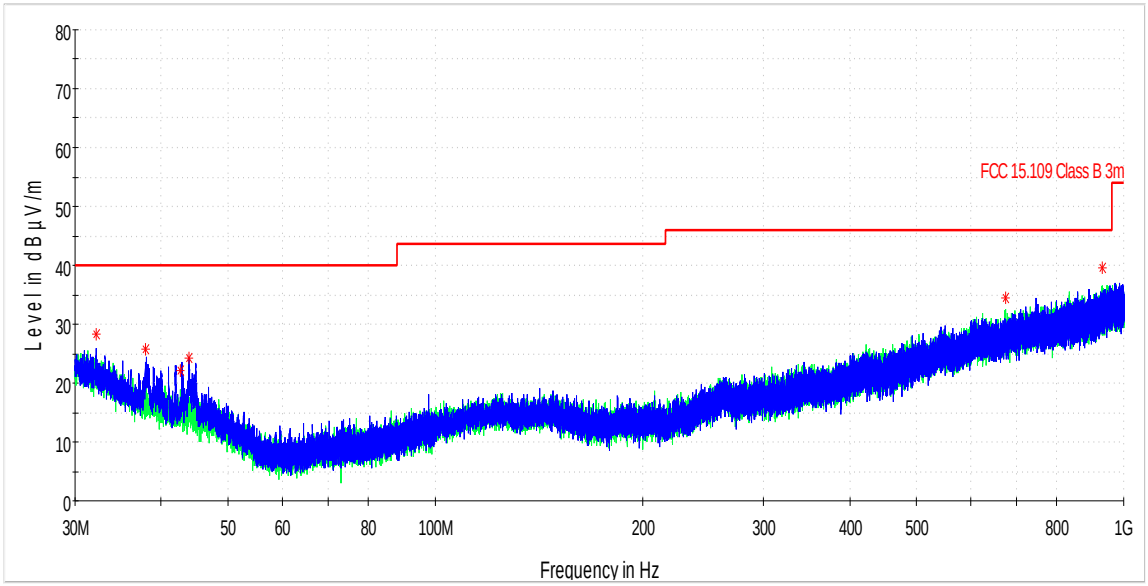
### 9.4 Test Equipment Used:

| Description | Serial Number | Manufacturer | Model | Cal. Date | Cal. Due |
|---|---|---|---|---|---|
| EMI Test Receiver | 1302.6005.40 | Rohde&Schwarz | ESU40 | 9/17/2014 | 9/17/2015 |
| Preamplifier | 122005 | Rohde&Schwarz | TS-PR18 | 11/26/2014 | 11/26/2015 |
| Preamplifier | 100050 | Rohde&Schwarz | TS-PR26 | 11/26/2014 | 11/26/2015 |
| Horn Antenna (18 – 40GHz) | 00117798 | ETS | 3116c | 5/13/2014 | 5/13/2015 |
| Horn Antenna | 00156319 | ETS | 3117 | 5/2/2014 | 5/2/2015 |
| Bilog Antenna | 2564 | Schaffner | CBL6111C | 4/21/2014 | 4/21/2015 |
| System Controller | 121701-1 | Sunol Sciences | SC99V | Time of Use | Time of Use |
| EMC Software | Version 9.15.02 | Rohde&Schwarz | EMC32 | Time of Use | Time of Use |

### 9.5 Results:

All spurious emissions with the test sample in receive mode were below the limits specified in Part 15.109 for a class B digital device and RSS-GEN Section 6.1.

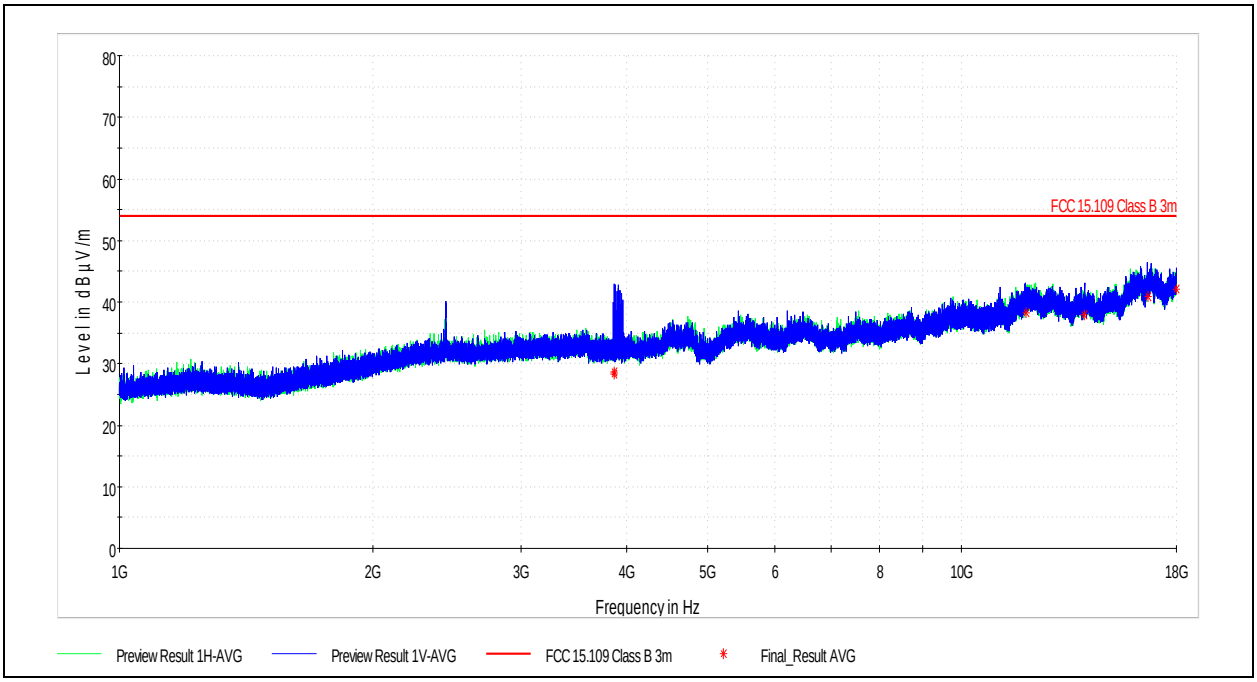
## 9.1 Plot: Bilog




## 9.2 Test Data: Bilog

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|
| 32.179000 | 28.21 | 40.00 | 11.79 | 120.000 | 113.9 | V | 24.0 | 21.1 |
| 38.005000 | 25.74 | 40.00 | 14.26 | 120.000 | 112.3 | V | 26.0 | 16.4 |
| 42.704000 | 22.20 | 40.00 | 17.80 | 120.000 | 105.5 | V | 5.0 | 14.9 |
| 43.884000 | 24.17 | 40.00 | 15.83 | 120.000 | 110.8 | V | 19.0 | 14.6 |
| 673.470000 | 34.49 | 46.02 | 11.53 | 120.000 | 108.6 | H | 23.0 | 26.4 |
| 931.260000 | 39.58 | 46.02 | 6.44 | 120.000 | 400.0 | H | 74.0 | 30.6 |

## 9.1 Plot: Horn




## 9.2 Test Data: Horn

| Frequency (MHz) | Average (dBµV/m) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 3864.400000 | --- | 38.26 | --- | --- | 1000.000 | 391.0 | V | 339.0 | 6.1 |
| 3864.400000 | 28.36 | --- | 54.00 | 25.64 | 1000.000 | 391.0 | V | 339.0 | 6.1 |
| 3869.000000 | --- | 37.69 | --- | --- | 1000.000 | 319.0 | V | 142.0 | 6.1 |
| 3869.000000 | 28.62 | --- | 54.00 | 25.38 | 1000.000 | 319.0 | V | 142.0 | 6.1 |
| 11928.200000 | 38.17 | --- | 54.00 | 15.83 | 1000.000 | 275.0 | V | 338.0 | 17.4 |
| 11928.200000 | --- | 47.58 | --- | --- | 1000.000 | 275.0 | V | 338.0 | 17.4 |
| 14001.000000 | --- | 47.39 | --- | --- | 1000.000 | 403.0 | V | 217.0 | 17.4 |
| 14001.000000 | 37.88 | --- | 54.00 | 16.12 | 1000.000 | 403.0 | V | 217.0 | 17.4 |
| 16649.000000 | --- | 50.34 | --- | --- | 1000.000 | 316.0 | V | 134.0 | 21.6 |
| 16649.000000 | 40.81 | --- | 54.00 | 13.19 | 1000.000 | 316.0 | V | 134.0 | 21.6 |
| 17999.400000 | 42.02 | --- | 54.00 | 11.98 | 1000.000 | 246.0 | V | 119.0 | 23.0 |
| 17999.400000 | --- | 50.44 | --- | --- | 1000.000 | 246.0 | V | 119.0 | 23.0 |

# 10 AC Powerline Conducted Emissions

## 10.1 Test Limits

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

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

*Decreases with the logarithm of the frequency.

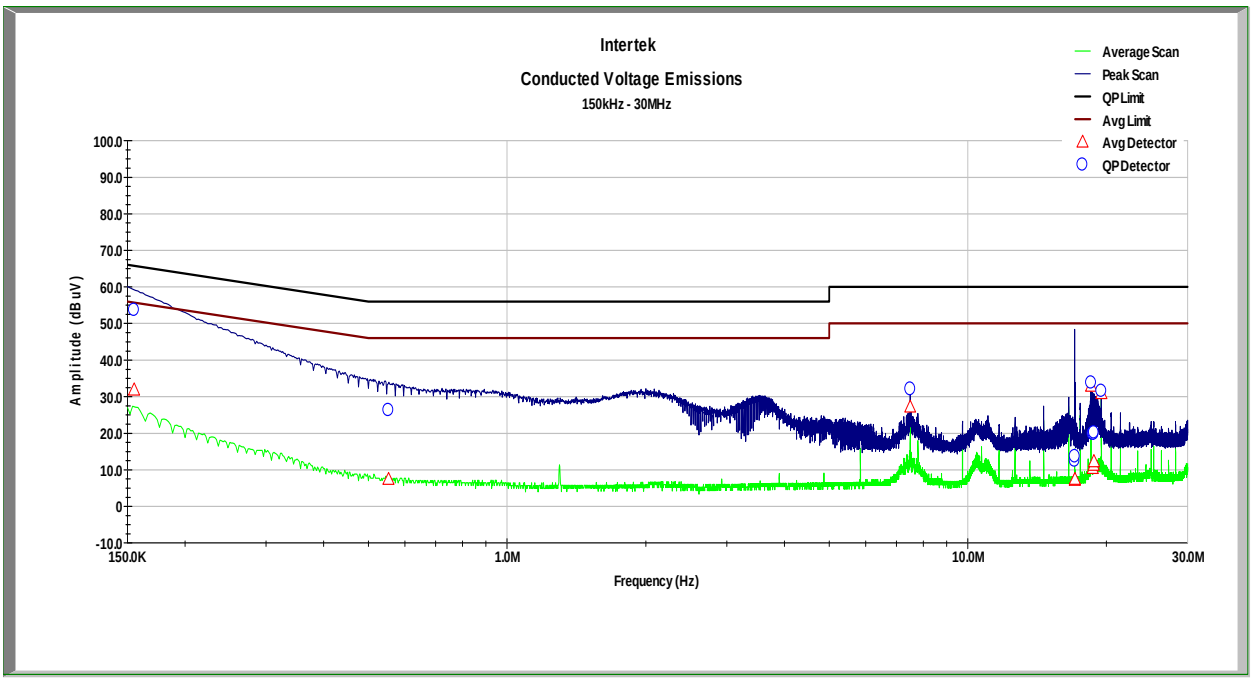
## 10.2 Test Procedure

ANSI C63.4: 2014

## 10.3 Test Equipment Used:

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

## 10.4 Results:

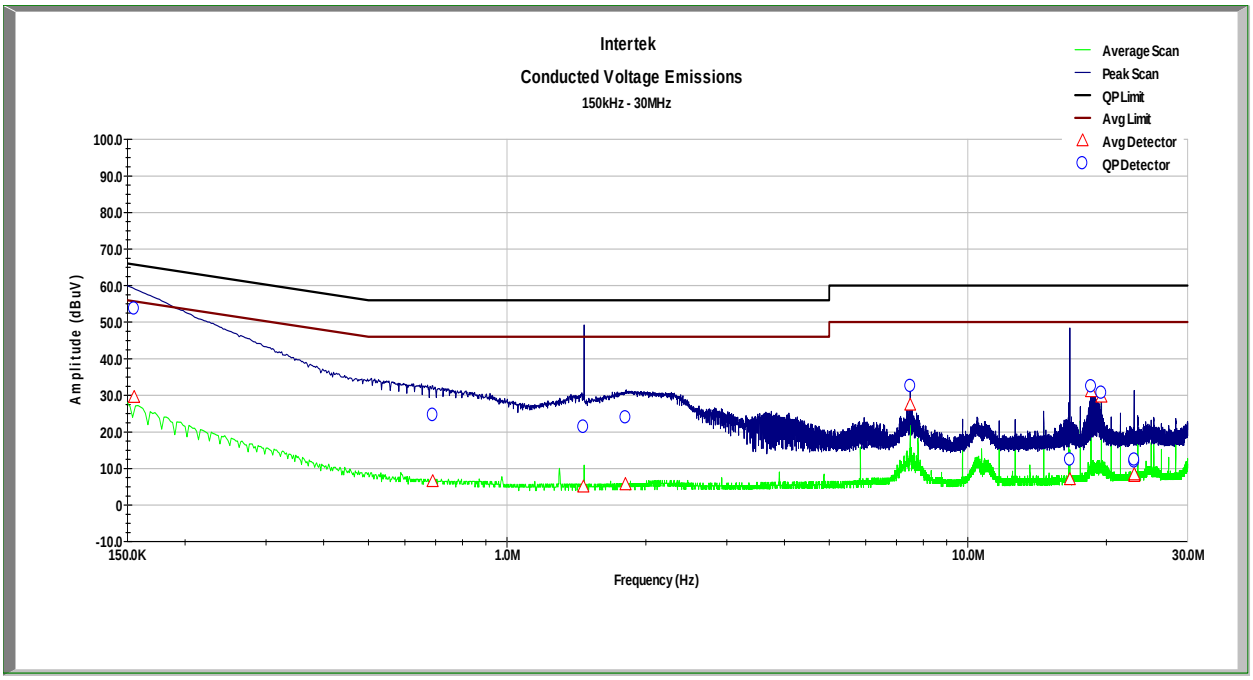



Neutral

| Conducted Voltage Emissions on Power Lines | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Test Engineer:** | Carmen Davis | | **Start Date:** | 1/30/2015 | | **End Date:** | 1/30/2015 | |
| **Temperature:** | 22.1C | | **Humidity:** | 34.20% | | **Pressure:** | 988.6mBar | |
| **Specification:** | FCC Part 15 | | **Test Limit:** | Class B | | **RBW:** | 9kHz | |
| **Notes:** | Transmitting | | | | | | | |

| Line | Frequency (MHz) | Quasi-Peak (dBuV) | Quasi-Peak Limit (dBuV) | Quasi-Peak Delta (dB) | Average (dBuV) | Average Limit (dBuV) | Average Delta (dB) | Results |
|---|---|---|---|---|---|---|---|---|
| Neutral | 155.000 KHz | 53.666 | 65.857 | -12.192 | 31.845 | 55.857 | -24.012 | **Compliant** |
| Neutral | 552.800 KHz | 26.284 | 56 | -29.716 | 7.38 | 46 | -38.62 | **Compliant** |
| Neutral | 7.500 MHz | 32.018 | 60 | -27.982 | 27.133 | 50 | -22.867 | **Compliant** |
| Neutral | 17.064 MHz | 12.443 | 60 | -47.557 | 7.184 | 50 | -42.816 | **Compliant** |
| Neutral | 17.079 MHz | 13.658 | 60 | -46.342 | 7.382 | 50 | -42.618 | **Compliant** |
| Neutral | 18.513 MHz | 33.766 | 60 | -26.234 | 32.836 | 50 | -17.164 | **Compliant** |
| Neutral | 18.667 MHz | 19.799 | 60 | -40.201 | 10.351 | 50 | -39.649 | **Compliant** |
| Neutral | 18.754 MHz | 19.807 | 60 | -40.193 | 11.288 | 50 | -38.712 | **Compliant** |
| Neutral | 18.782 MHz | 20.179 | 60 | -39.821 | 12.205 | 50 | -37.795 | **Compliant** |
| Neutral | 19.488 MHz | 31.544 | 60 | -28.456 | 30.832 | 50 | -19.168 | **Compliant** |

Neutral




Line 1

| Conducted Voltage Emissions on Power Lines | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Test Engineer:** | Carmen Davis | | **Start Date:** | 1/30/2015 | | **End Date:** | 1/30/2015 | |
| **Temperature:** | 22.1C | | **Humidity:** | 34.20% | | **Pressure:** | 988.6mBar | |
| **Specification:** | FCC Part 15 | | **Test Limit:** | Class B | | **RBW:** | 9kHz | |
| **Notes:** | Transmitting | | | | | | | |

| Line | Frequency | Quasi- | Quasi-Peak | Quasi- | Average | Average | Average | Results |
|---|---|---|---|---|---|---|---|---|
| Line 1 | 155.000 KHz | 53.684 | 65.857 | -12.173 | 29.434 | 55.857 | -26.423 | **Compliant** |
| Line 1 | 689.300 KHz | 24.563 | 56 | -31.437 | 6.411 | 46 | -39.589 | **Compliant** |
| Line 1 | 1.464 MHz | 21.324 | 56 | -34.676 | 4.933 | 46 | -41.067 | **Compliant** |
| Line 1 | 1.807 MHz | 23.895 | 56 | -32.105 | 5.566 | 46 | -40.434 | **Compliant** |
| Line 1 | 7.500 MHz | 32.477 | 60 | -27.523 | 27.318 | 50 | -22.682 | **Compliant** |
| Line 1 | 16.654 MHz | 12.411 | 60 | -47.589 | 6.951 | 50 | -43.049 | **Compliant** |
| Line 1 | 18.515 MHz | 32.376 | 60 | -27.624 | 31.042 | 50 | -18.958 | **Compliant** |
| Line 1 | 19.489 MHz | 30.612 | 60 | -29.388 | 29.512 | 50 | -20.488 | **Compliant** |
| Line 1 | 22.982 MHz | 11.879 | 60 | -48.121 | 7.861 | 50 | -42.139 | **Compliant** |
| Line 1 | 22.989 MHz | 12.349 | 60 | -47.651 | 8.297 | 50 | -41.703 | **Compliant** |

Line 1

# 11 Antenna Requirement per FCC Part 15.203

## 11.1 Test Limits

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

## 11.2 Results:

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

## 12 Measurement Uncertainty

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

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

Measurement uncertainty Table

| Parameter | Uncertainty | Notes |
|---|---|---|
| Radiated emissions, 30 to 1000 MHz | ±3.9dB | |
| Radiated emissions, 1 to 18 GHz | ±4.2dB | |
| Radiated emissions, 18 to 40 GHz | ±4.3dB | |
| Power Port Conducted emissions, 150kHz to 30 MHz | ±2.8dB | |

## 13 Revision History

| Revision Level | Date | Report Number | Notes |
|---|---|---|---|
| 0 | 3/9/2015 | 101978620LEX-002 | Original Issue |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |