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October 7, 2019

Lutron Electronics Co., Inc.
7200 Suter Road
Coopersburg, PA 18036

Dear Dan Osle,

Enclosed is the EMC Wireless test report for compliance testing of the Lutron Electronics Co., Inc., Ketra RF Module as tested to the requirements of Title 47 of the CFR, Ch. 1 (10-1-06 ed.), Part 15 Subpart C for Intentional Radiators.

Thank you for using the services of Eurofins MET Labs, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
EUROFINS MET LABS, INC.

Joel Huna
Documentation Department

Reference: (\Lutron Electronics Co., Inc.\EMC104252B-FCC247 Rev. 3)

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# Electromagnetic Compatibility Criteria
# Test Report

for the

**Lutron Electronics Co., Inc.**
**Ketra RF Module**

**Tested under**
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

**MET Report: EMC104252B-FCC247 Rev. 3**

October 7, 2019

**Prepared For:**

**Lutron Electronics Co., Inc.**
**7200 Suter Road**
**Coopersburg, PA 18036**

**Prepared By:**
**Eurofins MET Labs, Inc.**
914 West Patapsco Avenue,
Baltimore, MD 21230

# Electromagnetic Compatibility Criteria
# Test Report

for the

## Lutron Electronics Co., Inc.
## Ketra RF Module

**Tested under**
the FCC Certification Rules
contained in
15.247 Subpart C for Intentional Radiators

Deepak Giri, Project Engineer
Electromagnetic Compatibility Lab

Joel Huna
Documentation Department

**Engineering Statement:** The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC Rules Part 15.247 under normal use and maintenance.

Christopher Dennison,
Manager, Electromagnetic Compatibility Lab

# Report Status Sheet

| Revision | Report Date | Reason for Revision |
|---|---|---|
| ∅ | August 13, 2019 | Initial Issue. |
| 1 | August 18, 2019 | Update to Plots |
| 2 | September 13, 2019 | Inserted FCC ID. |
| 3 | October 7, 2019 | Corrections for TCB. |

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# List of Terms and Abbreviations

| | |
|---|---|
| **AC** | **A**lternating **C**urrent |
| **ACF** | **A**ntenna **C**orrection **F**actor |
| **Cal** | **Cal**ibration |
| ***d*** | **M**easurement **D**istance |
| **dB** | **D**eci**b**els |
| **dBµA** | **D**eci**b**els above one **micro**amp |
| **dBµV** | **D**eci**b**els above one **micro**volt |
| **dBµA/m** | **D**eci**b**els above one **micro**amp **per m**eter |
| **dBµV/m** | **D**eci**b**els above one **micro**volt **per m**eter |
| **DC** | **D**irect **C**urrent |
| **E** | **E**lectric Field |
| **DSL** | **D**igital **S**ubscriber **L**ine |
| **ESD** | **E**lectro**s**tatic **D**ischarge |
| **EUT** | **E**quipment **U**nder **T**est |
| ***f*** | **F**requency |
| **FCC** | **F**ederal **C**ommunications **C**ommission |
| **GRP** | **G**round **R**eference **P**lane |
| **H** | Magnetic Field |
| **HCP** | **H**orizontal **C**oupling **P**lane |
| **Hz** | **H**ert**z** |
| **IEC** | **I**nternational **E**lectrotechnical **C**ommission |
| **kHz** | **k**ilo**h**ert**z** |
| **kPa** | **k**ilo**pa**scal |
| **kV** | **k**ilo**v**olt |
| **LISN** | **L**ine **I**mpedance **S**tabilization **N**etwork |
| **MHz** | **M**ega**h**ertz |
| **µH** | **micro**h**e**nry |
| **µ** | **micro**farad |
| **µs** | **micros**econds |
| **NEBS** | **N**etwork **E**quipment-**B**uilding **S**ystem |
| **PRF** | **P**ulse **R**epetition **F**requency |
| **RF** | **R**adio **F**requency |
| **RMS** | **R**oot-**M**ean-**S**quare |
| **TWT** | **T**raveling **W**ave **T**ube |
| **V/m** | **V**olts **per m**eter |
| **VCP** | **V**ertical **C**oupling **P**lane |

# I. Executive Summary

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## A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Lutron Electronics Co., Inc. Ketra RF Module, with the requirements of Part 15, §15.247. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Ketra RF Module. Lutron Electronics Co., Inc. should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Ketra RF Module, has been **permanently** discontinued.

## B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, §15.247, in accordance with Lutron Electronics Co., Inc., purchase order number 5196962. All tests were conducted using measurement procedure ANSI C63.10-2013.

| FCC Reference 47 CFR Part 15.247 | Description | Compliance |
|---|---|---|
| Title 47 of the CFR, Part 15 §15.203 | Antenna Requirement | Compliant |
| Title 47 of the CFR, Part 15 §15.207(a) | Conducted Emission Limits | Compliant |
| Title 47 of the CFR, Part 15 §15.247(a)(2) | 6dB Occupied Bandwidth | Compliant |
| Title 47 of the CFR, Part 15 §15.247(b) | Peak Power Output | Compliant |
| Title 47 of the CFR, Part 15 §15.247(c) | Spurious Emissions in Non-restricted Bands | Compliant |
| Title 47 of the CFR, Part 15 §15.247(d); §15.209; §15.205 | Radiated Spurious Emissions Requirements | Compliant |
| Title 47 of the CFR, Part 15; §15.247(e) | Peak Power Spectral Density | Compliant |
| Title 47 of the CFR, Part 15 §15.247(i) | Maximum Permissible Exposure (MPE) | Compliant |

**Table 1. Executive Summary of EMC Part 15.247 ComplianceTesting**

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# II. Equipment Configuration

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# A. Overview

Eurofins MET Labs, Inc. was contracted by Lutron Electronics Co., Inc. to perform testing on the Ketra RF Module, under Lutron Electronics Co., Inc.'s purchase order number 5196962.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Lutron Electronics Co., Inc., Ketra RF Module.

The results obtained relate only to the item(s) tested.

| | | |
|---|---|---|
| **Model(s) Tested:** | Ketra RF Module | |
| **Model(s) Covered:** | Ketra RF Module | |
| **EUT Specifications:** | Primary Power: 120VAC | |
| | FCC ID: JPZ0124 | |
| | Type of Modulations: | O-QPSK |
| | Equipment Code: | DTS |
| | Peak RF Output Power: | 18.42dBm |
| | EUT Frequency Ranges: | 2405-2480 MHz |
| **Analysis:** | The results obtained relate only to the item(s) tested. | |
| **Environmental Test Conditions:** | Temperature: 15-35º C | |
| | Relative Humidity: 30-60% | |
| | Barometric Pressure: 860-1060 mbar | |
| **Evaluated by:** | Deepak Giri | |
| **Report Date(s):** | October 7, 2019 | |

**Table 2. EUT Summary Table**


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## B. References

| | |
|---|---|
| **CFR 47, Part 15, Subpart C** | Federal Communication Commission, Code of Federal Regulations, Title 47, Part 15: General Rules and Regulations, Allocation, Assignment, and Use of Radio Frequencies |
| **ANSI C63.4:2014** | Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz |
| **ISO/IEC 17025:2017** | General Requirements for the Competence of Testing and Calibration Laboratories |
| **ANSI C63.10-2013** | American National Standard for Testing Unlicensed Wireless Devices |
| **KDB 558074 v05r02** | Guidance For Performing Compliance Measurements On Digital Transmission Systems (DTS) Operating Under Section 15.247 |

**Table 3. References**

## C. Test Site

All testing was performed at Eurofins MET Labs, Inc., 914 West Patapsco Avenue, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

## D. Measurement Uncertainty

| Test Method | Typical Expanded Uncertainty | K | Confidence Level |
|---|---|---|---|
| **RF Frequencies** | ±4.52 Hz | 2 | 95% |
| **RF Power Conducted Emissions** | ±2.32 dB | 2 | 95% |
| **RF Power Conducted Spurious Emissions** | ±2.25 dB | 2 | 95% |
| **RF Power Radiated Emissions** | ±3.01 dB | 2 | 95% |

**Table 4. Uncertainty Calculations Summary**

## E. Description of Test Sample

The Lutron Electronics Co., Inc. Ketra RF Module, Equipment Under Test (EUT), is a 2.4GHz transceiver module that will be utilized in multiple end products to allow RF communication in those devices. In technological perspective, EUT considered in this report is ZigBee.
EUT can operate with two different antennae – Integral printed Antenna with 0 dBi gain and External printed antenna with -1 dBi gain.

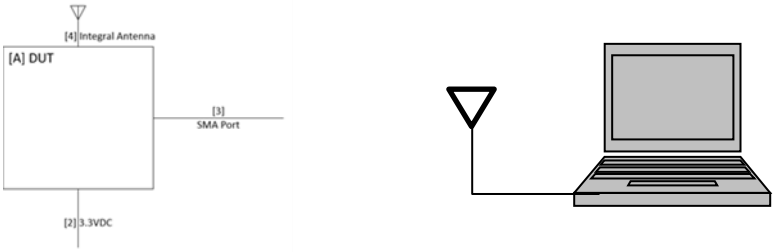


**Figure 1. Block Diagram of Test Configuration**

## F. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

| Ref. ID | Slot # | Name / Description | Model Number | Part Number (White / Light Almond) | Serial Number | Rev. # |
|---|---|---|---|---|---|---|
| A.1 | | DUT | -- | 470-4614 | -- | B |
| A.2 | | Daughterboard | -- | 470-4621 | -- | A |

**Table 5. Equipment Configuration**

## G. Support Equipment

The EUT did not require support equipment for testing or monitoring.

## H. Ports and Cabling Information

| Ref. ID | Port name on EUT | Cable Description or reason for no cable | Qty | Length as tested (m) | Max Length (m) | Shielded? (Y/N) | Termination Box ID & Port Name |
|---|---|---|---|---|---|---|---|
| 1 | UART | 2-wire | 1 | 1 | 1 | N | [C] FTDI |
| 2 | DC Input | 2-wire | 1 | 1 | - | N | 3.3VDC |
| 3 | SMA | SMA coaxial cable | 1 | 1 | - | Y | SMA |
| 4 | Antenna | N/A – Radiated | 1 | - | - | - | Antenna |

**Table 6. Ports and Cabling Information**

## I. Mode of Operation

The Module will be put into various operating modes (channel, etc.) to exercise simulated normal operating conditions.

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Test modes include:

1. Continuous transmission – generates a stream of modulated packets at a selected frequency
2. Constant wave (unused) – generates a single unmodulated tone at a selected frequency

Both test modes will run continuously until power is cycled or "Stop current test mode" command is sent. Continuous transmission mode was used for testing.

## J. Method of Monitoring EUT Operation

1. When the DUT is functional it will send back an "ACK" (acknowledgement) back to the scripting software. There will be measurable RF transmission and a change in the current draw from the device.
2. When the DUT is not functional it will not send an "ACK" (acknowledgement) back to the scripting software and there will be no measurable RF transmission or change in current draw from the device.

## K. Modifications

### a) Modifications to EUT

No modifications were made to the EUT.

### b) Modifications to Test Standard

No modifications were made to the test standard.

## L. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Lutron Electronics Co., Inc. upon completion of testing.


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# III. Electromagnetic Compatibility Criteria for Intentional Radiators

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# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.203 Antenna Requirement

**Test Requirement:** **§ 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.

The structure and application of the EUT were analyzed to determine compliance with Section 15.203 of the Rules. Section 15.203 states that the subject device must meet at least one of the following criteria:

a.) Antenna must be permanently attached to the unit.

b.) Antenna must use a unique type of connector to attach to the EUT.

c.) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

**Results:** The EUT as tested is compliant the criteria of §15.203. The module (transmitter) will be soldered onto a host PCB, through which the external antenna will be connected. This will be a permanently soldered connection which will not be modifiable by the end user.

**Test Engineer(s):** Deepak Giri

**Test Date(s):** August 5, 2019

| Antenna | Integral Printed Antenna | External Printed Antenna |
|---|---|---|
| Gain dBi | 0 | -1 |

**Table 7. Antenna List**

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# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.207(a) Conducted Emissions Limits

**Test Requirement(s):** **§ 15.207 (a):** 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 30MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 Ω 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 range (MHz) | § 15.207(a), Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-Peak | Average |
| * 0.15- 0.5 | 66 - 56 | 56 - 46 |
| 0.5 - 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |

**Table 8. Conducted Limits for Intentional Radiators from FCC Part 15 § 15.207(a)**

**Test Procedure:** The EUT was placed on a 0.8 m-high wooden table inside a screen room. The EUT was situated such that the back of the EUT was 0.4 m from one wall of the vertical ground plane, and the remaining sides of the EUT were no closer than 0.8 m from any other conductive surface. The EUT was powered from a 50 Ω/50 μH Line Impedance Stabilization Network (LISN). The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. Conducted Emissions measurements were made in accordance with *ANSI C63.10-2013* The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω/50 μH LISN as the input transducer to an EMC/field intensity meter. For the purpose of this testing, the transmitter was turned on. Scans were performed with the transmitter on.

**Test Results:** The EUT was compliant with this requirement. EUT was tested using the power supply provided by manufacturer.

**Test Engineer(s):** Deepak Giri

**Test Date(s):** October 9, 2019

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## 15.207(a) Conducted Emissions Test Results

| Line Under Test: | | Phase | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Uncorrected Meter Reading (dBuV) QP | Cable Loss (dB) | External Attenuation (dB) | Corrected Measurement (dBuV) QP | Limit (dBuV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBuV) Avg. | Cable Loss (dB) | External Attenuation (dB) | Corrected Measurement (dBuV) AVG | Limit (dBuV) AVG | Margin (dB) AVG |
| 0.165 | 41.22 | 0 | 10 | 51.22 | 65.21 | -13.99 | 17.21 | 0 | 10 | 27.21 | 55.21 | -28 |
| 0.1887 | 43.89 | 0 | 10 | 53.89 | 64.09 | -10.2 | 16.41 | 0 | 10 | 26.41 | 54.09 | -27.68 |
| 0.196 | 39.41 | 0 | 10 | 49.41 | 63.78 | -14.37 | 16.77 | 0 | 10 | 26.77 | 53.78 | -27.01 |
| 0.299 | 36.33 | 0 | 10 | 46.33 | 60.27 | -13.94 | 15.95 | 0 | 10 | 25.95 | 50.27 | -24.32 |
| 0.563 | 19.45 | 0 | 10 | 29.45 | 56 | -26.55 | 11.29 | 0 | 10 | 21.29 | 46 | -24.71 |
| 1.571 | 13.66 | 0 | 10 | 23.66 | 56 | -32.34 | 5.71 | 0 | 10 | 15.71 | 46 | -30.29 |
| 30 | 15.97 | 0 | 10 | 25.97 | 60 | -34.03 | 14.78 | 0 | 10 | 24.78 | 50 | -25.22 |

**Table 9. Conducted Emissions, 15.207(a), Phase Line, Test Results**

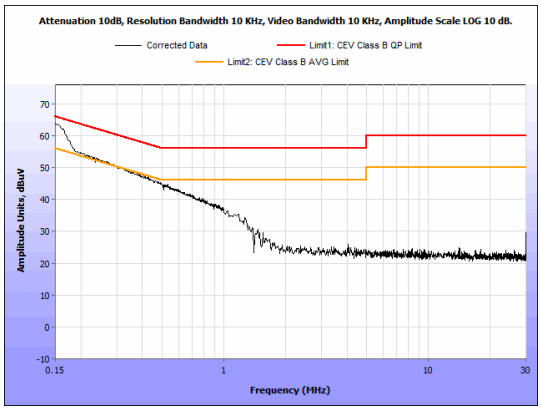


**Figure 2: Conducted Emissions, Phase ZigBee**


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## 15.207(a) Conducted Emissions Test Results

| Line Under Test: | | Neutral | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Uncorrected Meter Reading (dBuV) QP | Cable Loss (dB) | External Attenuation (dB) | Corrected Measurement (dBuV) QP | Limit (dBuV) QP | Margin (dB) QP | Uncorrected Meter Reading (dBuV) Avg. | Cable Loss (dB) | External Attenuation (dB) | Corrected Measurement (dBuV) AVG | Limit (dBuV) AVG | Margin (dB) AVG |
| 0.1632 | 40.58 | 0 | 10 | 50.58 | 65.3 | -14.72 | 13.56 | 0 | 10 | 23.56 | 55.3 | -31.74 |
| 0.199 | 36.31 | 0 | 10 | 46.31 | 63.65 | -17.34 | 11.77 | 0 | 10 | 21.77 | 53.65 | -31.88 |
| 0.296 | 30.87 | 0 | 10 | 40.87 | 60.35 | -19.48 | 4.42 | 0 | 10 | 14.42 | 50.35 | -35.93 |
| 0.529 | 24.42 | 0 | 10 | 34.42 | 56 | -21.58 | 4.47 | 0 | 10 | 14.47 | 46 | -31.53 |
| 1.06 | 15.92 | 0 | 10 | 25.92 | 56 | -30.08 | 4.41 | 0 | 10 | 14.41 | 46 | -31.59 |
| 30 | 15.41 | 0 | 10 | 25.41 | 60 | -34.59 | 14.16 | 0 | 10 | 24.16 | 50 | -25.84 |

**Table 10. Conducted Emissions, 15.207(a), Neutral Line, Test Results**

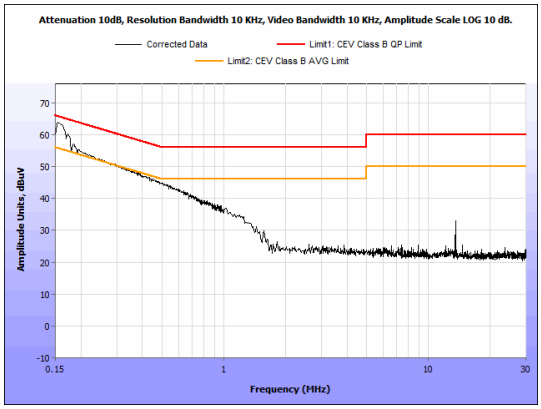


**Figure 3: Conducted Emissions, Neutral ZigBee**


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## Electromagnetic Compatibility Criteria for Intentional Radiators

### § 15.247(a)(2) 6 dB Bandwidth

**Test Requirements:** **§ 15.247(a)(2):** Operation under the provisions of this section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

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

**Test Procedure:** The transmitter was on and transmitting at the highest output power. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using a RBW = 100kHz, VBW = 3*RBW. The 6 dB Bandwidth was measured and recorded. The measurements were performed on the low, mid and high channels according to the DTS bandwidth measurement guidance specified in ANSI C63.10 2013.

.

**Test Results** The EUT was compliant with § 15.247 (a)(2).

The 6 dB Bandwidth was determined from the plots on the following pages.

**Test Engineer(s):** Deepak Giri

**Test Date(s):** August 5, 2019

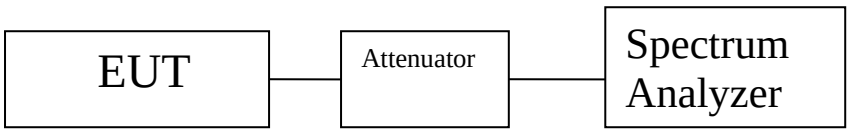


**Figure 4. Block Diagram, Occupied Bandwidth Test Setup**

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# Occupied Bandwidth Test Results

| Occupied Bandwidth | | | |
|---|---|---|---|
| **Carrier Channel** | **Frequency (MHz)** | **Measured 6 dB Bandwidth (MHz)** | **Limit ( KHz)** |
| Low | 2405 | 1.67 | ≥500 |
| Mid | 2440 | 1.66 | ≥500 |
| High | 2480 | 1.66 | ≥500 |

**Table 11. 6 dB Occupied Bandwidth, Test Results**


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# 6 dB Occupied Bandwidth Test Results

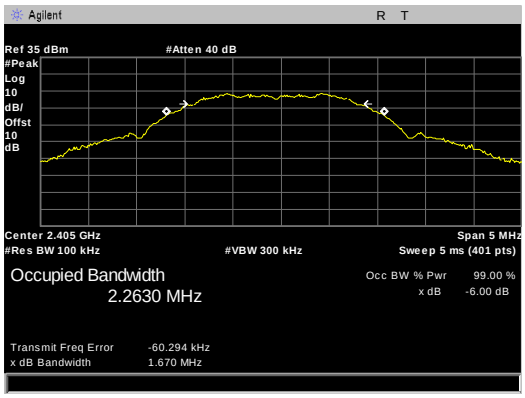


**Figure 5: 6 dB Occupied Bandwidth, ZigBee Low channel**

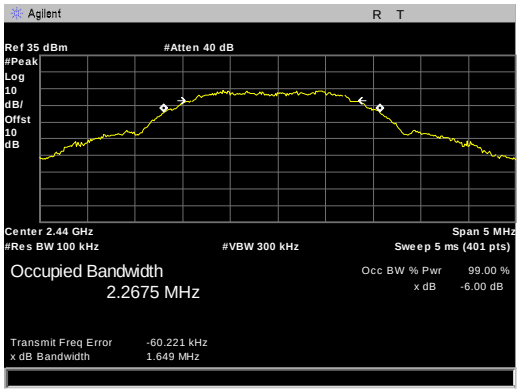


**Figure 6: 6 dB Occupied Bandwidth, ZigBee Mid channel**

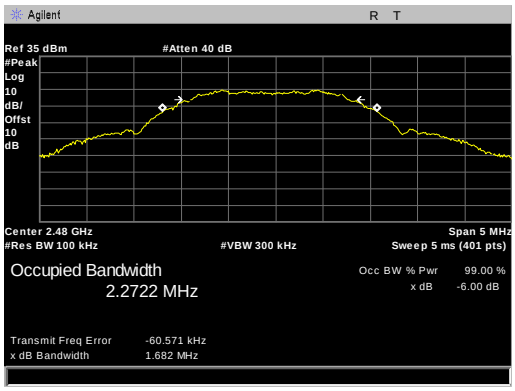


**Figure 7: 6 dB Occupied Bandwidth, ZigBee High channel**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(b) Peak Power Output

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

| Digital Transmission Systems (MHz) | Output Limit (Watts) |
|---|---|
| 2400–2483.5 | 1.000 |

**Table 12. Output Power Requirements from §15.247(b)**

**§15.247(c):** if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Test Procedure:** The EUT was measured at the low, mid and high channels of each band at the maximum power level. Measurements were performed on a conducted setup. Peak conducted power measurement setup was used as specified in ANSI C63.10 2013.

**Test Results:** The EUT was compliant with the Peak Power Output limits of **§15.247(b)**.

**Test Engineer(s):** Deepak Giri

**Test Date(s):** August 5, 2019

## Duty Cycle

**Test Procedure:** The EUT was connected to a spectrum analyzer and was ran at the maximum achievable duty cycle for all modes. The duty cycle was measured in accordance with section 11.6 of ANSI C63.10-2013.

| Frequency (MHz) | ON Time (ms) | Period (ms) | Duty Cycle (%) | Duty Factor (dB) |
|---|---|---|---|---|
| 2405 | 1 | 1 | 100 | 0 |
| 2405 | 100 | 100 | 100 | 0 |

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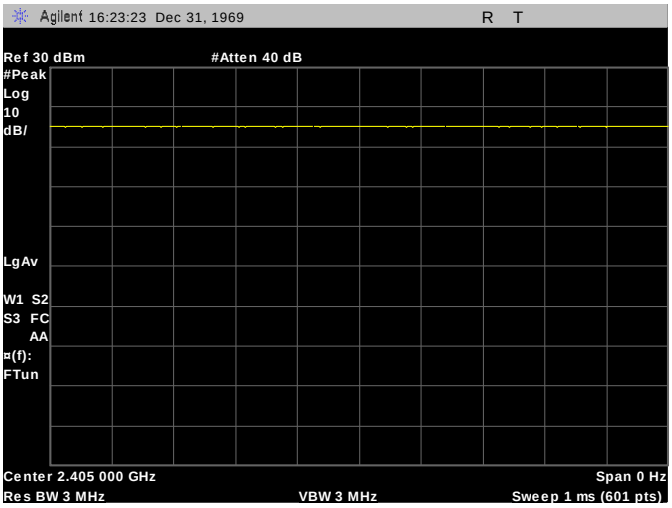
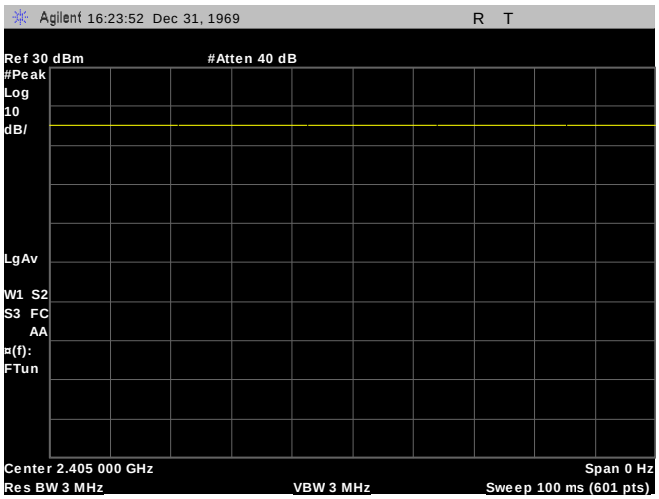



**Duty Cycle 1ms Span**




**Duty Cycle 100ms Span**

## Peak Power Output Test Results

| Peak Conducted Output Power | | | | | |
|---|---|---|---|---|---|
| **Carrier Channel** | **Frequency (MHz)** | **Antenna Gain (dBi) Antenna 1** | **Antenna Gain (dBi) Antenna 2** | **Measured Peak Conducted Power (dBm)** | **Limit (dBm)** |
| Low | 2405 | 0 | -1 | 17.36 | 30 |
| Mid | 2440 | 0 | -1 | 17.75 | 30 |
| High | 2480 | 0 | -1 | 18.42 | 30 |

**Table 13. Peak Power Output, Test Results**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# Peak Power Output Test Results

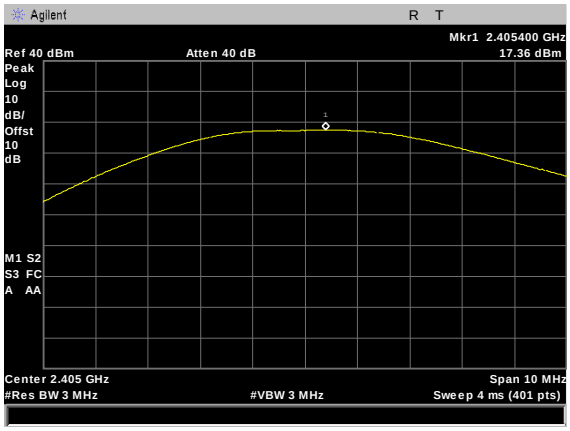


**Figure 8: Conducted Power, ZigBee Low channel Peak**

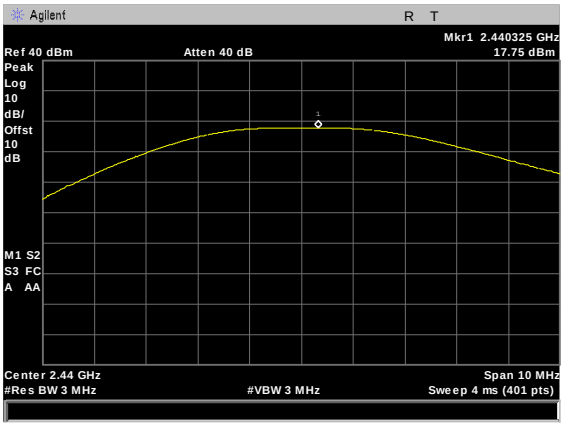


**Figure 9: Conducted Power, ZigBee Mid channel Peak**

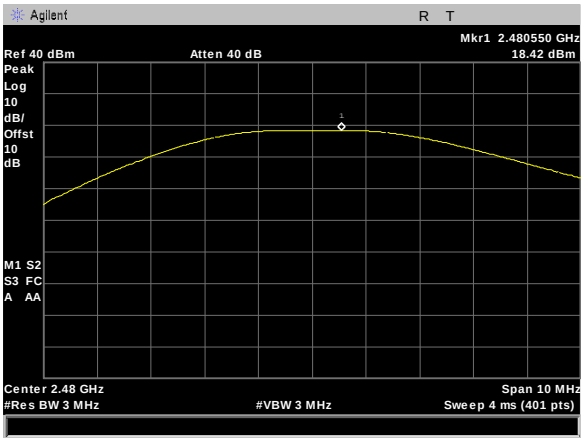


**Figure 10: Conducted Power, ZigBee High channel Peak**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.209 Radiated Spurious Emissions Requirements and Band Edge

**Test Requirements:** **§15.247(d); §15.205:** Emissions outside the frequency band.

**§15.205(a):** Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| 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]) |

**Table 14. Restricted Bands of Operation**

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

**Test Requirement(s):** **§ 15.209 (a):** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in Table 15.

| Frequency (MHz) | § 15.209(a),Radiated Emission Limits (dBµV) @ 3m |
|---|---|
| 30 - 88 | 40.00 |
| 88 - 216 | 43.50 |
| 216 - 960 | 46.00 |
| Above 960 | 54.00 |

**Table 15. Radiated Emissions Limits Calculated from FCC Part 15, § 15.209 (a)**

**Test Procedures:** The transmitter was turned on. EUT was setup in accordance with ANSI C63.10 2013. Measurements were performed of the low, mid and high Channels. The EUT was rotated orthogonally through all three axes, thus plots shown are cumulative. Average measurements were performed as stated in 11.12.1 and 4.1.4.2.3 of ANSI C63.10-2013 without reducing VBW below 1Hz. Emissions were maximized as specified in ANSI C63.10 2013. Plots shown are corrected for antenna correction factor, distance and other in-line factors and compared to a limit specified under 15.209.

**Test Results:** The EUT was compliant with the Radiated Spurious Emission limits of **§ 15.247(d) and § 15.209**. Emissions close to the limit line were re-evaluated with applicable resolution and detectors and were found compliant.

**Test Engineer(s):** Deepak Giri

**Test Date(s):** August 5, 2019

## Radiated Spurious Emissions, Test Results

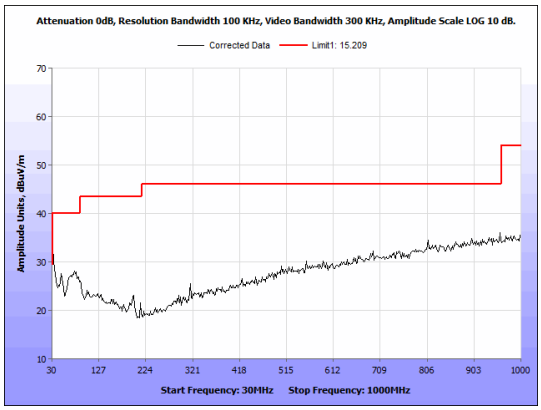


**Figure 11: Receiver Spurious Emissions, 30 MHz - 1 GHz Antenna 1**

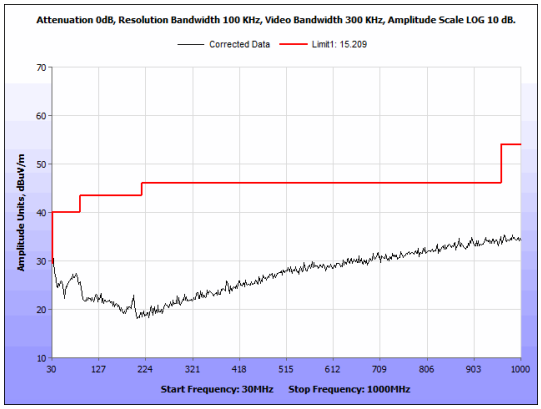


**Figure 12: Radiated Emissions, ZigBee 30 MHz - 1 GHz, Low Channel, Antenna 1**

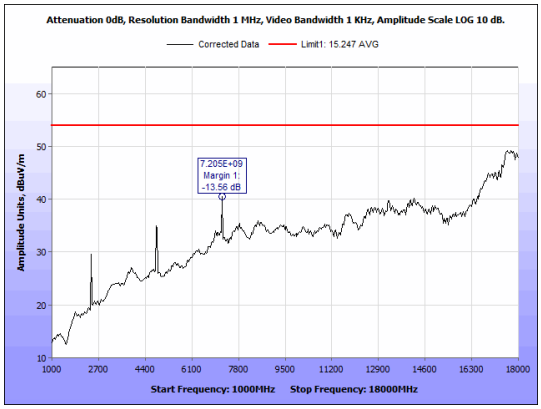


**Figure 13: Radiated Emissions, ZigBee, 1GHz - 18GHz, Average, Low Channel, Antenna 1**

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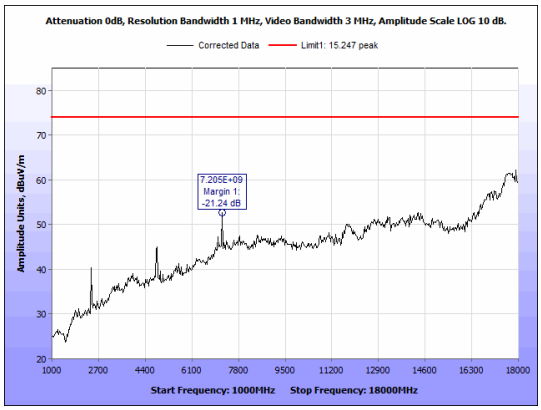


**Figure 14: Radiated Emissions, ZigBee, 1GHz - 18GHz Peak, Low Channel, Antenna 1**

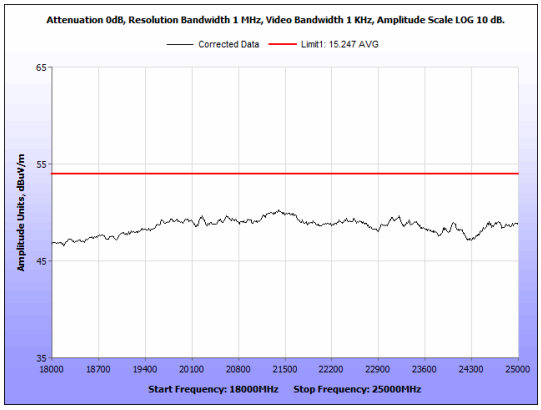


**Figure 15: Radiated Emissions, ZigBee, 18GHz - 25GHz, Average, Low Channel, Antenna 1**

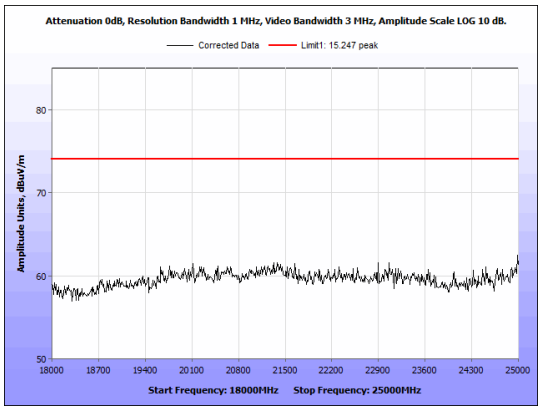


**Figure 16: Radiated Emissions, ZigBee, 18GHz - 25GHz Peak, Low Channel, Antenna 1**

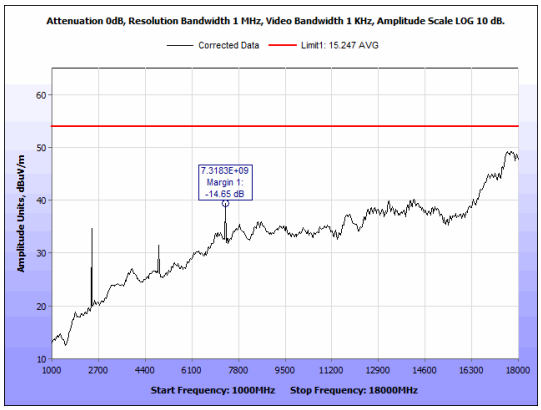


**Figure 17: Radiated Emissions, ZigBee, 1GHz - 18GHz, Average, Mid Channel, Antenna 1**

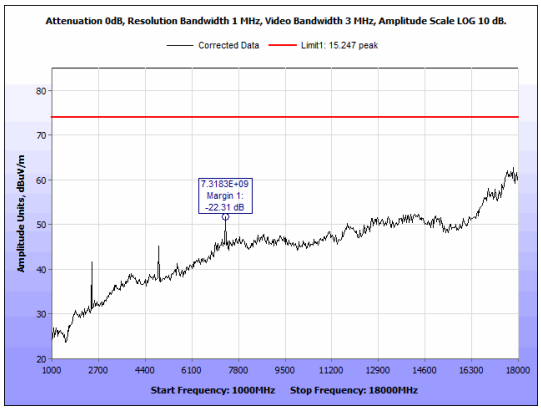


**Figure 18: Radiated Emissions, ZigBee, 1GHz - 18GHz Peak, Mid Channel, Antenna 1**

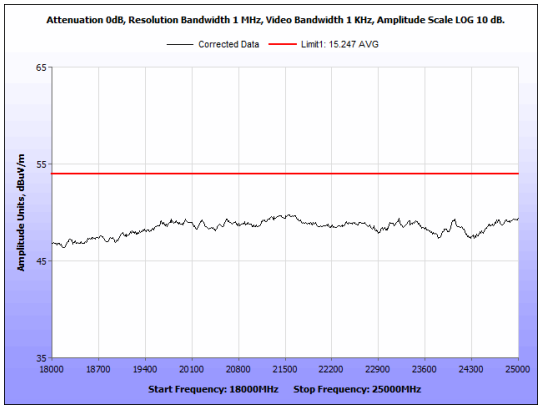


**Figure 19: Radiated Emissions, ZigBee, 18GHz - 25GHz, Average, Mid Channel, Antenna 1**

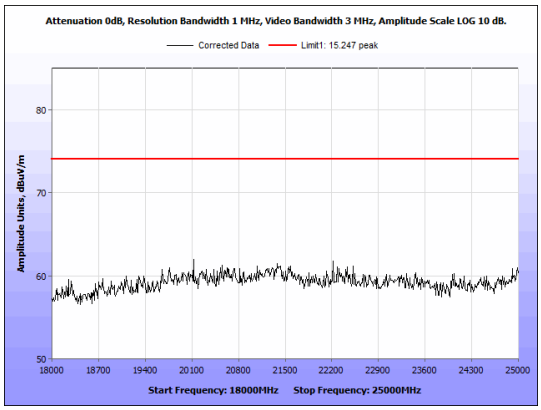


**Figure 20: Radiated Emissions, ZigBee, 18GHz - 25GHz Peak, Mid Channel, Antenna 1**

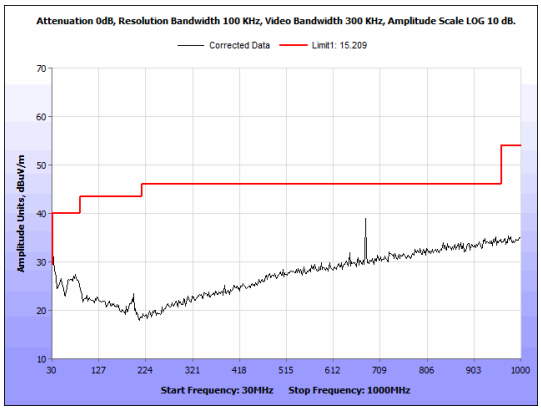


**Figure 21: Radiated Emissions, ZigBee, 30 MHz - 1 GHz, High channel, Antenna 1**

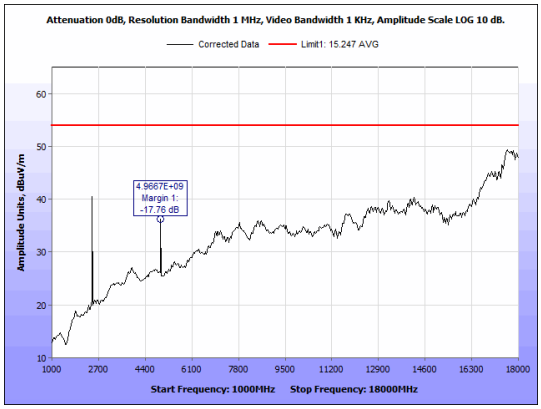


**Figure 22: Radiated Emissions, ZigBee,1GHz - 18GHz, Average, High channel, Antenna 1**

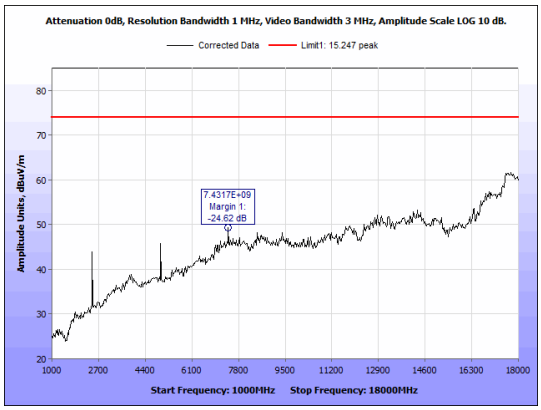


**Figure 23: Radiated Emissions, ZigBee, 1GHz - 18GHz Peak, High channel, Antenna 1**

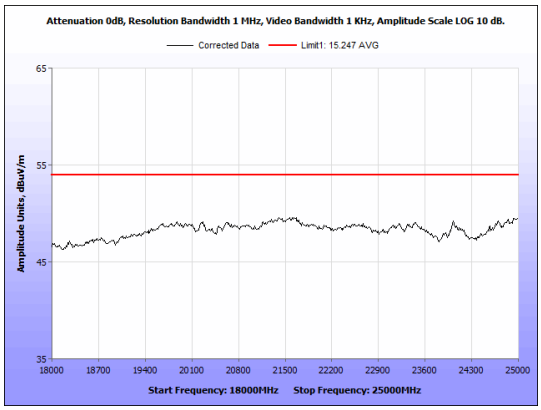


**Figure 24: Radiated Emissions, ZigBee, 8GHz - 25GHz, Average, High channel, 1Antenna 1**

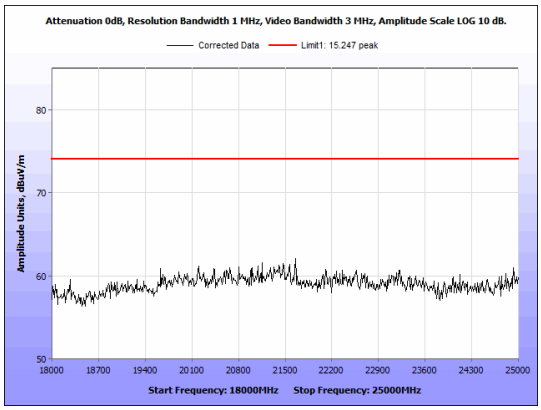


**Figure 25: Radiated Emissions, ZigBee, 18GHz - 25GHz Peak, High channel, Antenna 1**

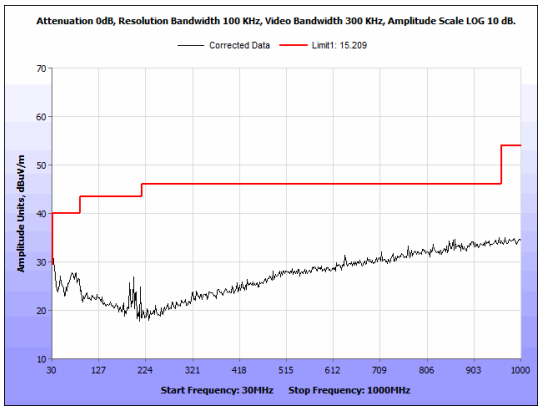


**Figure 26: Receiver Spurious Emissions, 30 MHz - 1 GHz Antenna 2**

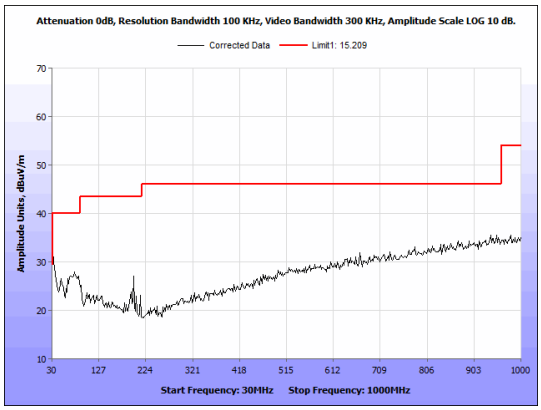


**Figure 27: Radiated Emissions, ZigBee 30 MHz - 1 GHz, Low Channel, Antenna 2**

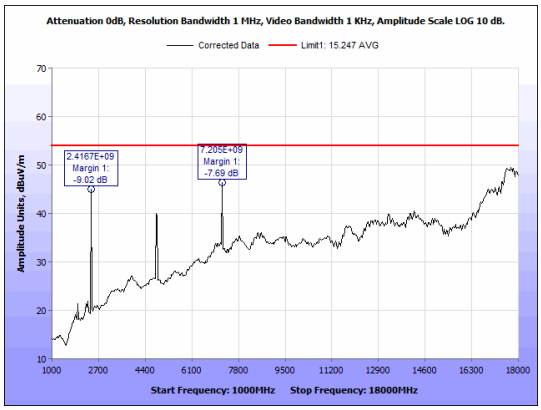


**Figure 28: Radiated Emissions, ZigBee, 1GHz - 18GHz, Average, Low Channel, Antenna 2**

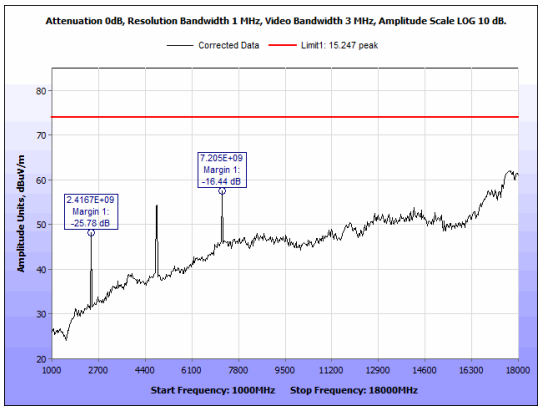


**Figure 29: Radiated Emissions, ZigBee, 1GHz - 18GHz Peak, Low Channel, Antenna 2**

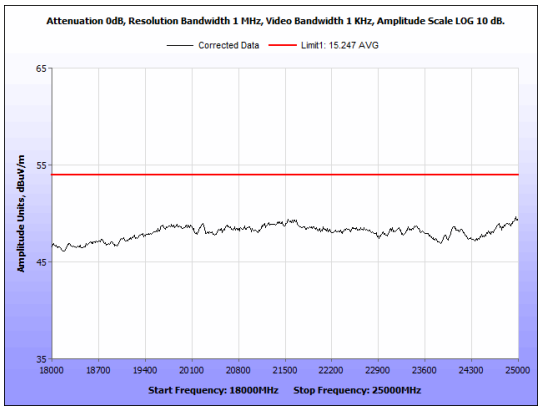


**Figure 30: Radiated Emissions, ZigBee, 18GHz - 25GHz, Average, Low Channel, Antenna 2**

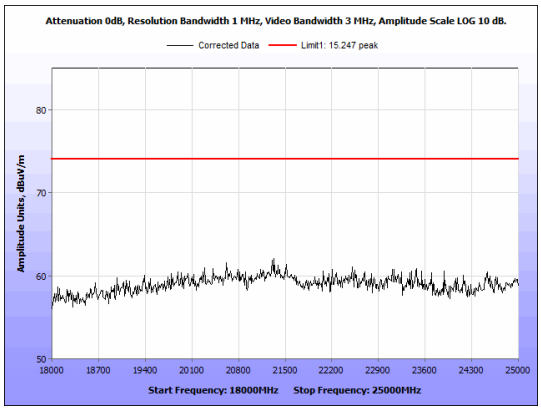


**Figure 31: Radiated Emissions, ZigBee, 18GHz - 25GHz Peak, Low Channel, Antenna 2**

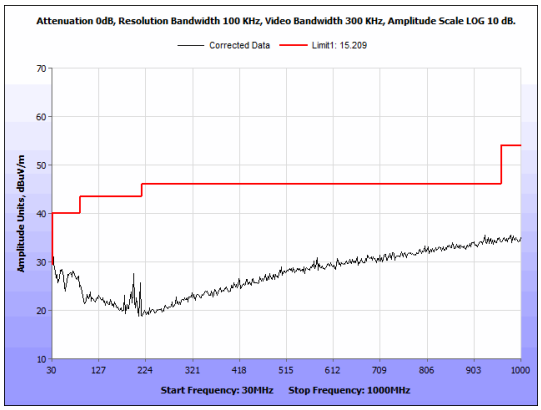


**Figure 32: Radiated Emissions, ZigBee 30 MHz - 1 GHz, Mid Channel, Antenna 2**

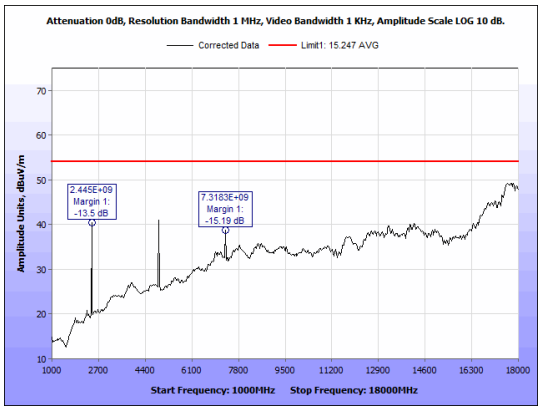


**Figure 33: Radiated Emissions, ZigBee, 1GHz - 18GHz, Average, Mid Channel, Antenna 2**

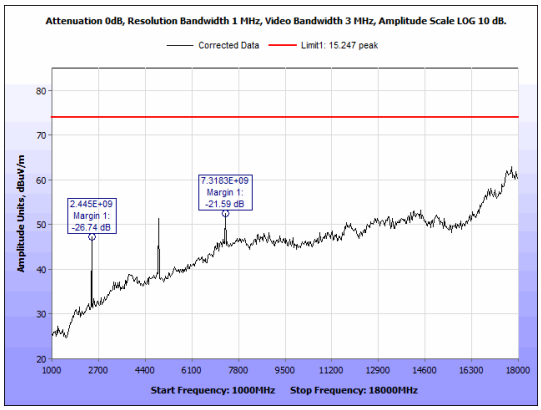


**Figure 34: Radiated Emissions, ZigBee, 1GHz - 18GHz Peak, Mid Channel, Antenna 2**

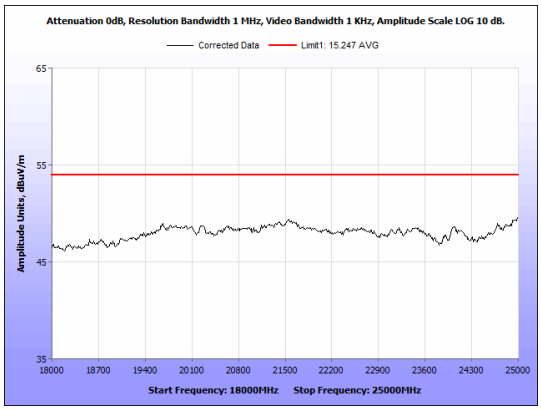


**Figure 35: Radiated Emissions, ZigBee, 18GHz - 25GHz, Average, Mid Channel, Antenna 2**

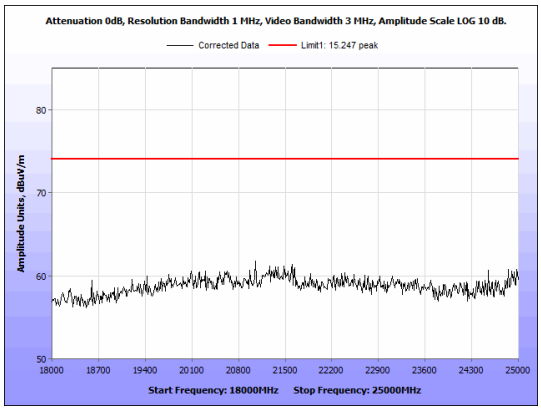


**Figure 36: Radiated Emissions, ZigBee, 18GHz - 25GHz Peak, Mid Channel, Antenna 2**

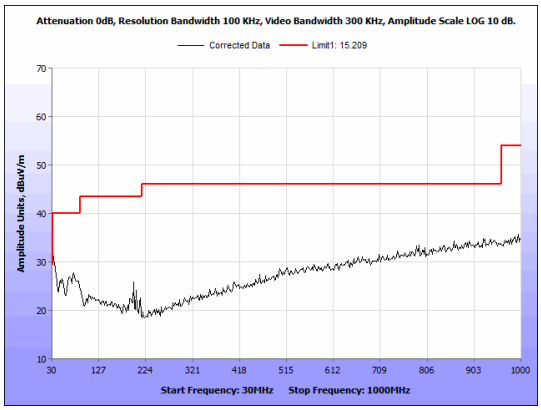


**Figure 37: Radiated Emissions, ZigBee 30 MHz - 1 GHz, High channel, Antenna 2**

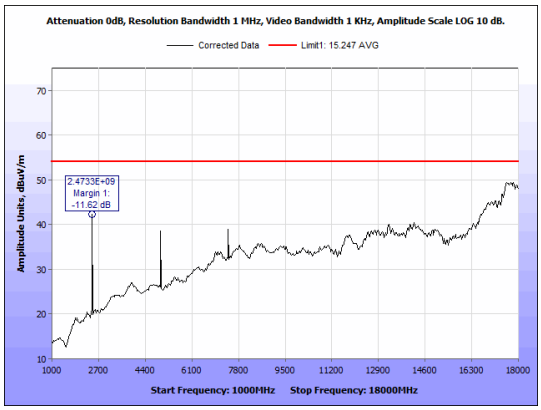


**Figure 38: Radiated Emissions, ZigBee, 1GHz - 18GHz, Average, High channel, Antenna 2**

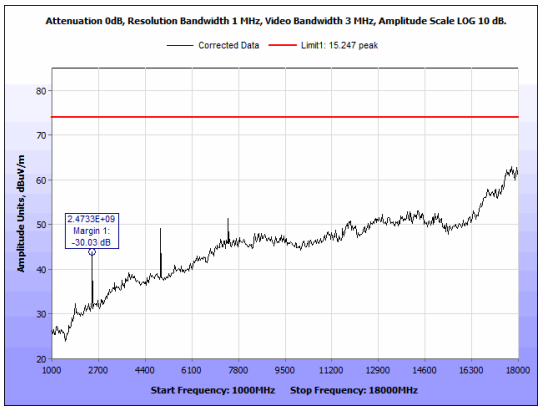


**Figure 39: Radiated Emissions, ZigBee, 1GHz - 18GHz Peak, High channel, Antenna 2**

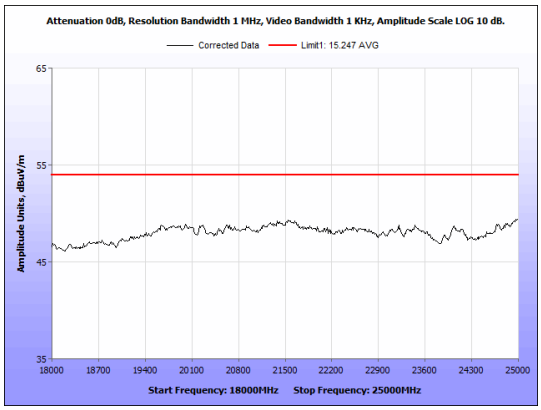


**Figure 40: Radiated Emissions, ZigBee, 18GHz - 25GHz, Average, High channel, Antenna 2**

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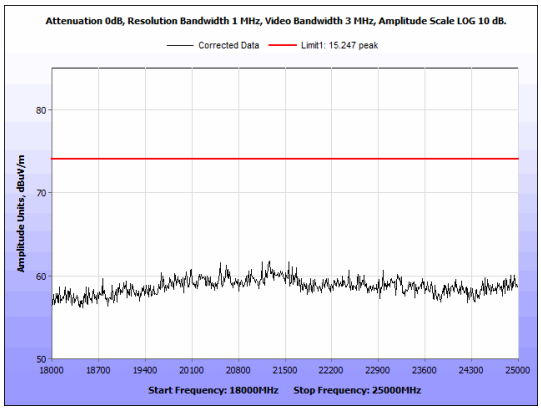


**Figure 41: Radiated Emissions, ZigBee, 18GHz - 25GHz Peak, High channel, Antenna 2**

## Radiated Band Edge Measurements

**Test Procedures:** The transmitter was turned on. Measurements were performed of the low and high Channels. The EUT was rotated orthogonally through all three axes to obtain cumulative emissions. Plots shown are corrected for antenna correction factor distance and other in-line factors and compared to required limit specified under 15.209.

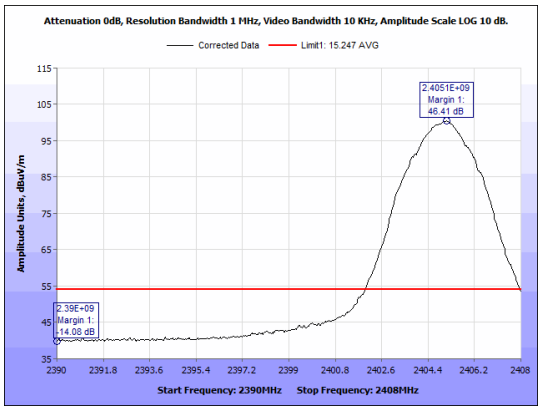


**Figure 42: Radiated Emissions, ZigBee Low Channel Band Edge, Average, Antenna 1**

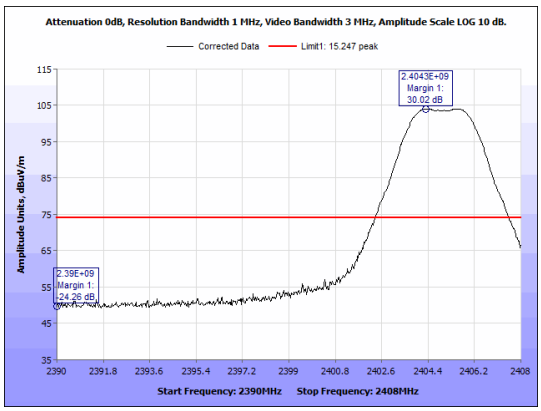


**Figure 43: Radiated Emissions, ZigBee Low Channel Band Edge, Peak, Antenna 1**

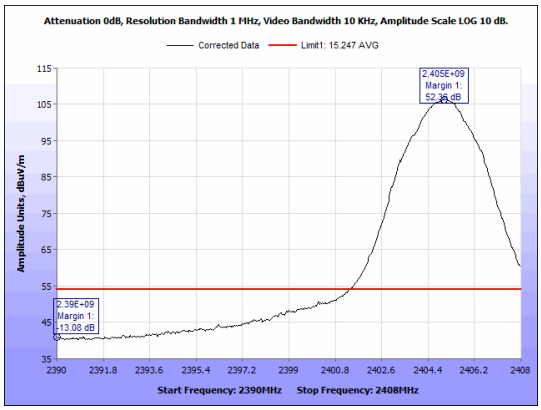


**Figure 44: Radiated Emissions, ZigBee Low Channel Band Edge, Average, Antenna 2**

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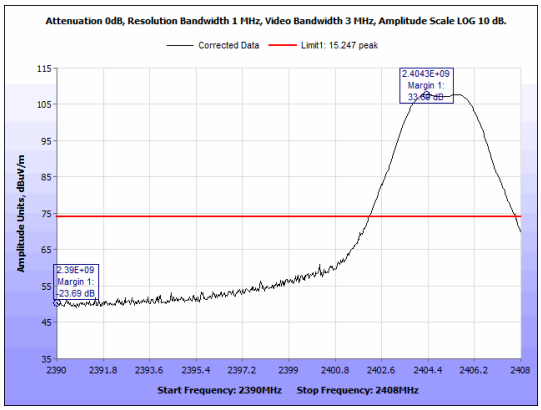


**Figure 45: Radiated Emissions, ZigBee Low Channel Band Edge, Peak, Antenna 2**

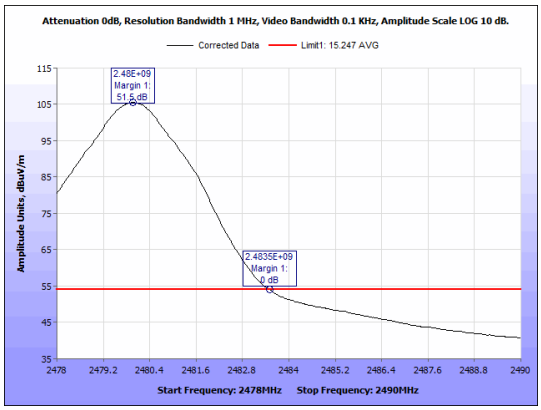


**Figure 46: Radiated Emissions, ZigBee High Channel Band Edge, Average, 100Hz Antenna 2**

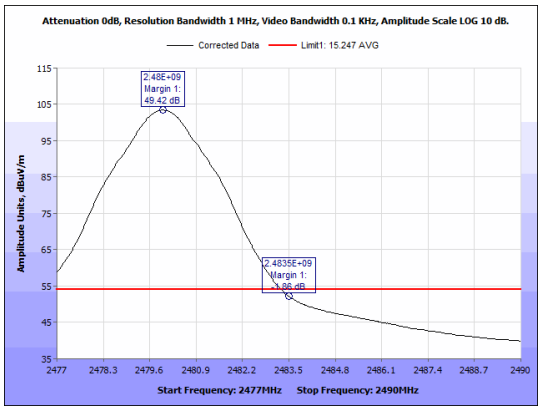


**Figure 47: Radiated Emissions, ZigBee High Channel Band Edge, Average, 100Hz Antenna 1**

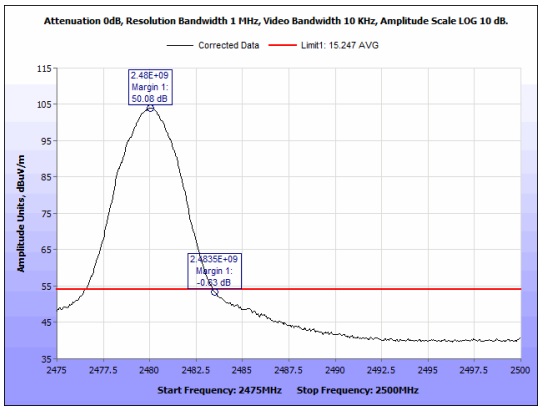


**Figure 48: Radiated Emissions, ZigBee High Channel Band Edge, Average, Antenna 1**

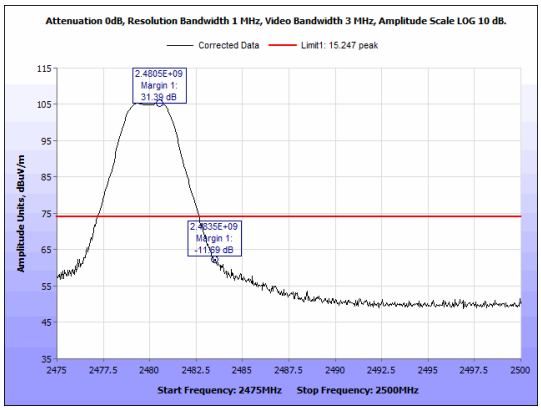


**Figure 49: Radiated Emissions, ZigBee High Channel Band Edge, Peak, Antenna 1**

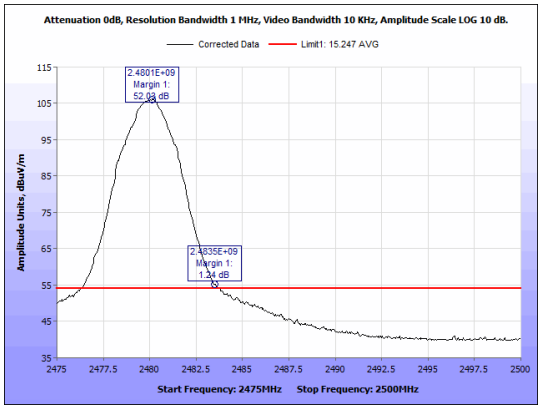


**Figure 50: Radiated Emissions, ZigBee High Channel Band Edge, Average, Antenna 2**

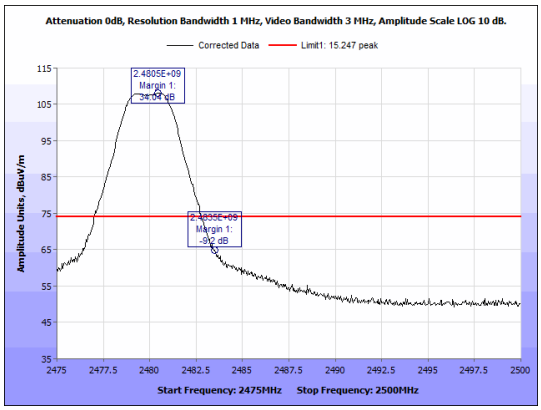


**Figure 51: Radiated Emissions, ZigBee High Channel Band Edge, Peak, Antenna 2**

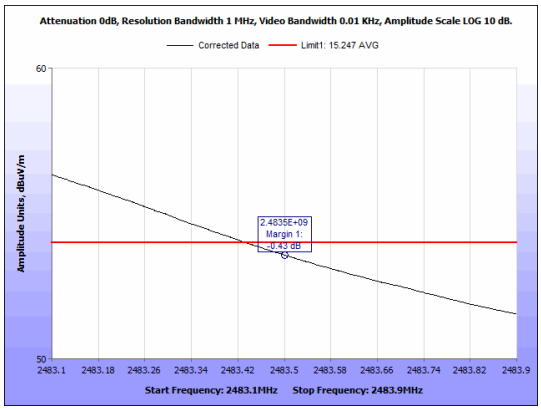


**Figure 52: Radiated Emissions, ZigBee High Channel Band Edge, Average, 10Hz Antenna 2**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(d) Spurious Emissions in Non-restricted Bands

**Test Requirement:** **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.

**Test Procedure:** For intentional radiators with a digital device portion which operates below 10 GHz, the spectrum was investigated as per §15.33(a)(1) and §15.33(a)(4); i.e., the lowest RF signal generated or used in the device up to the 10$^{th}$ harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

Measurements were taken in conducted setup.

**Test Results:** The EUT was compliant with the Spurious Emission limits of **§15.247(d)**. Emissions observed were below 20dBc.

**Test Engineer(s):** Deepak Giri

**Test Date(s):** July 30, 2019

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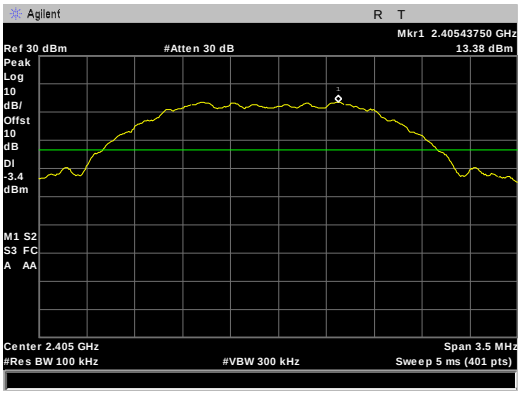


**Figure 53: Conducted Spurious Emissions, ZigBee low channel reference level measurement**

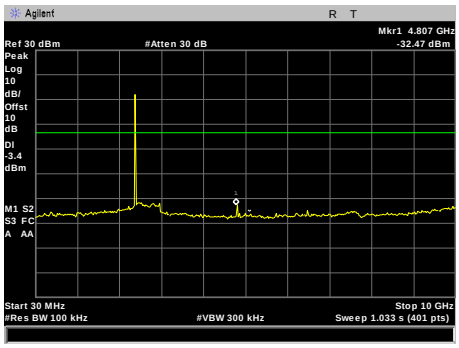


**Figure 54: Conducted Spurious Emissions, ZigBee low channel 30 MHz - 10 GHz**

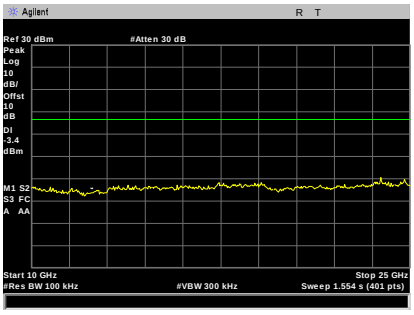


**Figure 55: Conducted Spurious Emissions, ZigBee low channel 10 GHz - 25 GHz**

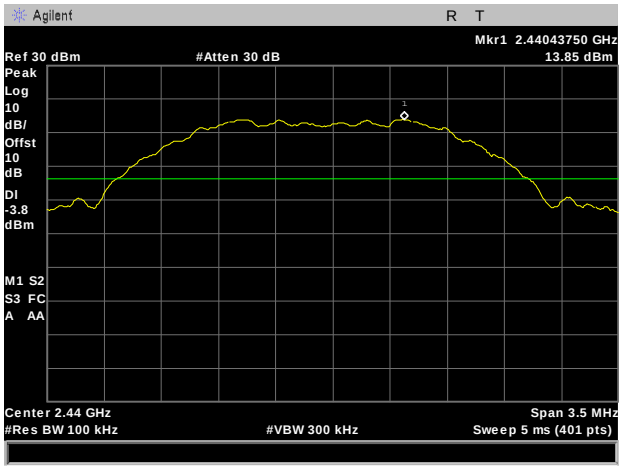


**Figure 56: Conducted Spurious Emissions, ZigBee mid channel reference level measurement**

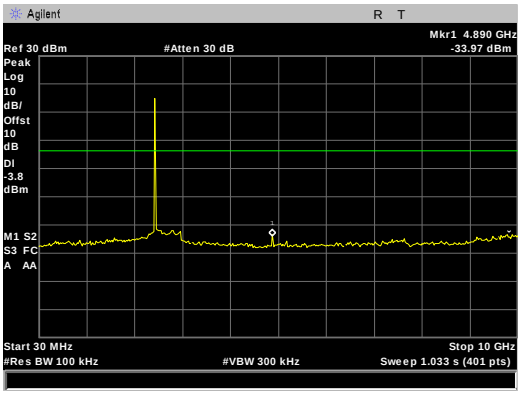


**Figure 57: Conducted Spurious Emissions, ZigBee mid channel 30 MHz - 10 GHz**

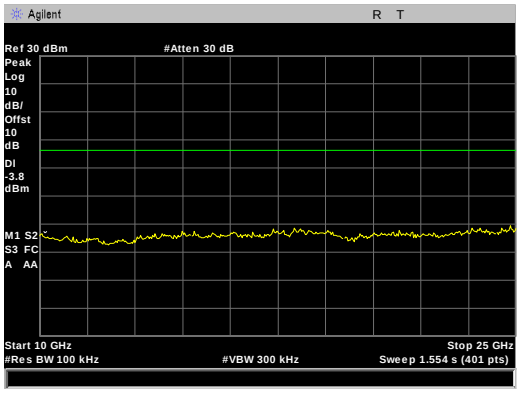


**Figure 58: Conducted Spurious Emissions, ZigBee mid channel 10 GHz - 25 GHz**

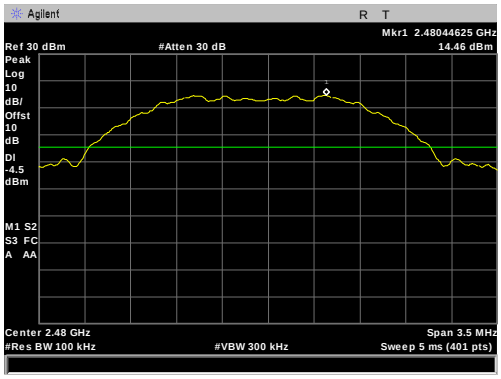


**Figure 59: Conducted Spurious Emissions, ZigBee high channel reference level measurement**

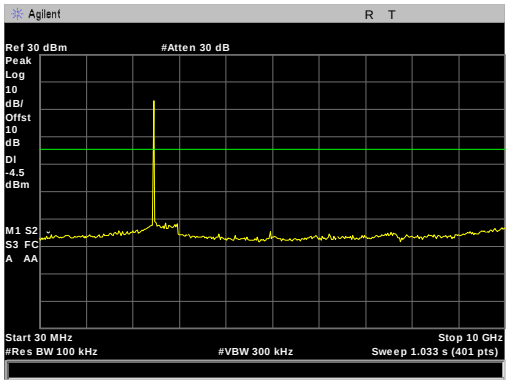


**Figure 60: Conducted Spurious Emissions, ZigBee high channel 30 MHz - 10 GHz**

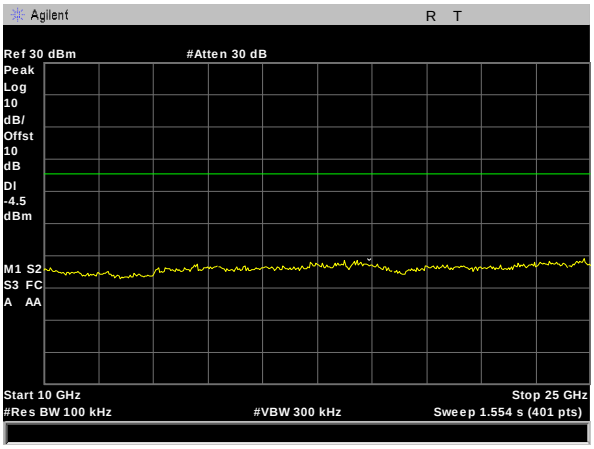


**Figure 61: Conducted Spurious Emissions, ZigBee high channel 10 GHz - 25 GHz**

## Conducted Band Edge Test Results

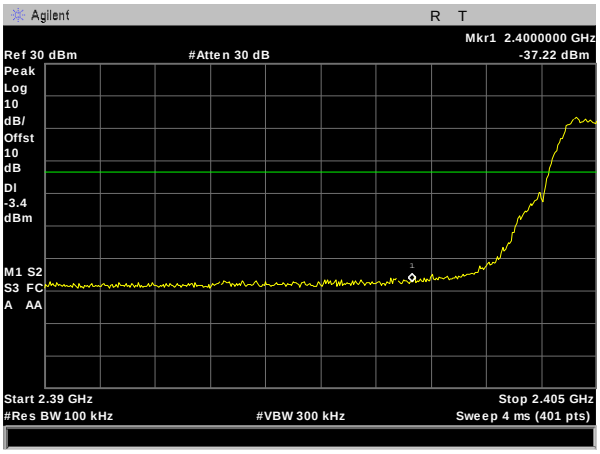


**Figure 62: Conducted Spurious Emissions, ZigBee low channel band edge**

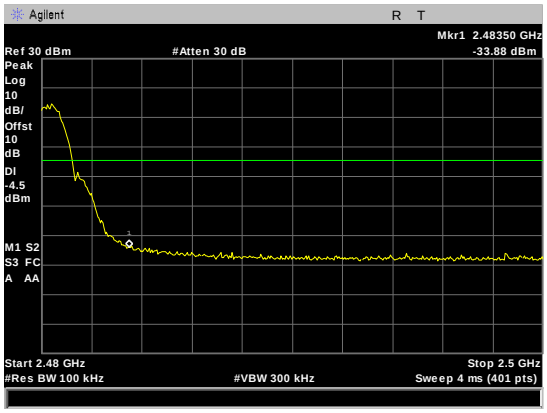


**Figure 63: Conducted Spurious Emissions, ZigBee high channel band edge**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(e) Peak Power Spectral Density

**Test Requirements:** **§15.247(e):** For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

**Test Procedure:** The power level was set to the maximum level. The RBW was set to 3 kHz and a VBW set to 10 kHz. The spectrum analyzer was set to an auto sweep time and a peak detector was used. Measurements were carried out at the low, mid and high channels..

**Test Results:** The EUT was compliant with the peak power spectral density limits of **§ 15.247 (e**
The peak power spectral density was determined from plots on the following page(s).

**Test Engineer:** Deepak Giri

**Test Date:** August 5, 2019

## Peak Power Spectral Density Test Results

| Power Spectral Density | | | |
|---|---|---|---|
| **Carrier Channel** | **Frequency (MHz)** | **Peak Conducted PSD (dBm)** | **Limit (dBm)** |
| Low | 2405 | 1.66 | 8 |
| Mid | 2440 | 2.26 | 8 |
| High | 2480 | 2.86 | 8 |

**Table 16. Peak Power Spectral Density, Test Results**

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## Peak Power Spectral Density

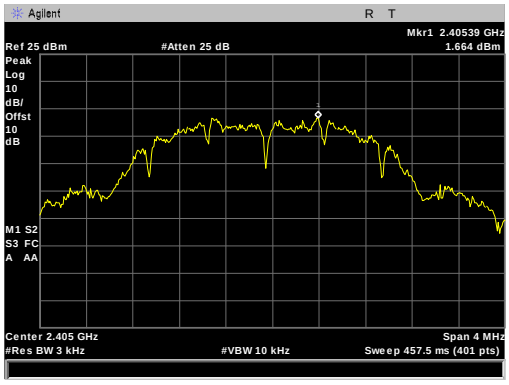


**Figure 64: Peak Power Spectral Density, ZigBee, Low Channel,**

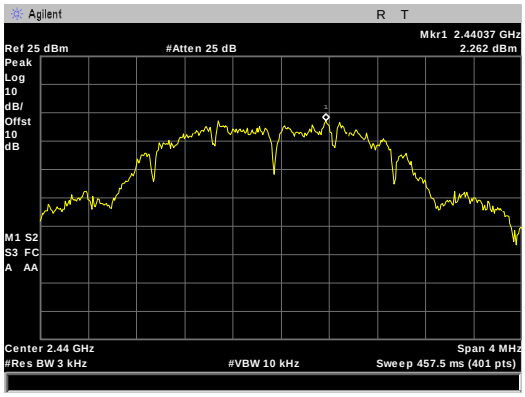


**Figure 65: Peak Power Spectral Density, ZigBee mid channel**

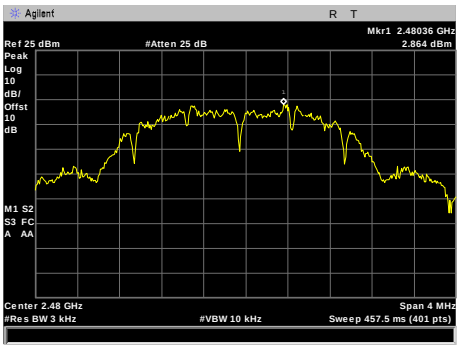


**Figure 66: Peak Power Spectral Density, ZigBee high channel**

# Electromagnetic Compatibility Criteria for Intentional Radiators

## § 15.247(i) Maximum Permissible Exposure

**RF Exposure Requirements:** **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

**RF Radiation Exposure Limit:** **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit: EUT's operating frequencies @ 2405-2480 MHz; **Limit for Uncontrolled exposure: 1 $mW/cm^2$ or 10 $W/m^2$**

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{(PG / 4\pi S)}$$

where, S = Power Density ($mW/cm^2$)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

**Test Results**:

| FCC | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Frequency (MHz)** | **Con. Pwr. (dBm)** | **Con. Pwr. (mW)** | **Ant. Gain (dBi)** | **Ant. Gain numeric** | **Pwr. Density ($mW/cm^2$)** | **Limit ($mW/cm^2$)** | **Margin** | **Distance (cm)** | **Result** |
| 2480 | 18.42 | 69.502 | 0 | 1 | 0.01383 | 1 | 0.98617 | 20 | Pass |
| 2480 | 18.42 | 69.502 | -1 | 0.794 | 0.01098 | 1 | 0.98902 | 20 | Pass |

The safe distance where Power Density is less than the MPE Limit listed above was found to be 20 cm.

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# IV. Test Equipment

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## Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

| Asset | Equipment | Manufacturer | Model | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| 1T4300 | SEMI-ANECHOIC CHAMBER (NSA) | EMC TEST SYSTEMS | NONE | 06/30/2019 | 06/30/2020 |
| 1T4409 | EMI Receiver | Rohde & Schwarz | ESIB7 | 01/04/2019 | 01/04/2021 |
| 1T4771 | PSA Spectrum Analyzer | Agilent Technologies | E4446A | 05/16/2018 | 11/16/2019 |
| 1T4612 | Spectrum Analyzer | Agilent Technologies | E4407B | 05/15/2018 | 11/15/2019 |
| 1T4744 | Antenna, Horn | ETS-Lindgren | 3116 | 11/27/2018 | 11/27/2019 |
| 1T4752 | Pre-Amplifier | Miteq | JS44-18004000-35-8P | Func Verify | |
| 1T4817 | Preamplifier | A.H. Systems, Inc. | PAM-0118P | Func Verify | |
| 1T4814 | Comb Generator | Com-Power | CGO-5100 | Func Verify | |
| 1T4149A | HF Wireless Chamber - NSA | Ray Proof | 18 | 06/30/2019 | 06/30/2020 |
| 1T4757 | Antenna; Horn | ETS-Lindgren | 3117 | 05/11/2018 | 11/11/2019 |

**Table 17. Test Equipment List**

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

# V. Certification & User's Manual Information

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# Certification & User's Manual Information

## A. Certification Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart I — Marketing of Radio frequency devices:

**§ 2.801 Radio-frequency device defined.**

As used in this part, a radio-frequency device is any device which in its operation is capable of Emitting radio-frequency energy by radiation, conduction, or other means. Radio- frequency devices include, but are not limited to:

(a) The various types of radio communication transmitting devices described throughout this chapter.

*(b) The incidental, unintentional and intentional radiators defined in Part 15 of this chapter.*

(c) The industrial, scientific, and medical equipment described in Part 18 of this chapter.

(d) Any part or component thereof which in use emits radio-frequency energy by radiation, conduction, or other means.

**§ 2.803 Marketing of radio frequency devices prior to equipment authorization.**

(a) Except as provided elsewhere in this chapter, no person shall sell or lease, or offer for sale or lease (including advertising for sale or lease), or import, ship or distribute for the purpose of selling or leasing or offering for sale or lease, any radio frequency device unless:

(1) In the case of a device subject to certification, such device has been authorized by the Commission in accordance with the rules in this chapter and is properly identified and labeled as required by §2.925 and other relevant sections in this chapter; or

(2) In the case of a device that is not required to have a grant of equipment authorization issued by the Commission, but which must comply with the specified technical standards prior to use, such device also complies with all applicable administrative (including verification of the equipment or authorization under a Declaration of Conformity, where required), technical, labeling and identification requirements specified in this chapter.

(d) Notwithstanding the provisions of paragraph (a) of this section, the offer for sale solely to business, commercial, industrial, scientific or medical users (but not an offer for sale to other parties or to end users located in a residential environment) of a radio frequency device that is in the conceptual, developmental, design or pre-production stage is permitted prior to equipment authorization or, for devices not subject to the equipment authorization requirements, prior to a determination of compliance with the applicable technical requirements *provided* that the prospective buyer is advised in writing at the time of the offer for sale that the equipment is subject to the FCC rules and that the equipment will comply with the appropriate rules before delivery to the buyer or to centers of distribution.

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(e)(1) Notwithstanding the provisions of paragraph (a) of this section, prior to equipment authorization or determination of compliance with the applicable technical requirements any radio frequency device may be operated, but not marketed, for the following purposes and under the following conditions:

*(i) Compliance testing;*

(ii) Demonstrations at a trade show provided the notice contained in paragraph (c) of this section is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iii) Demonstrations at an exhibition conducted at a business, commercial, industrial, scientific or medical location, but excluding locations in a residential environment, provided the notice contained in paragraphs (c) or (d) of this section, as appropriate, is displayed in a conspicuous location on, or immediately adjacent to, the device;

(iv) Evaluation of product performance and determination of customer acceptability, provided such operation takes place at the manufacturer's facilities during developmental, design or pre-production states; or

(v) Evaluation of product performance and determination of customer acceptability where customer acceptability of a radio frequency device cannot be determined at the manufacturer's facilities because of size or unique capability of the device, provided the device is operated at a business, commercial, industrial, scientific or medical user's site, but not at a residential site, during the development, design or pre-production stages.

(e)(2) For the purpose of paragraphs (e)(1)(iv) and (e)(1)(v) of this section, the term *manufacturer's facilities* includes the facilities of the party responsible for compliance with the regulations and the manufacturer's premises, as well as the facilities of other entities working under the authorization of the responsible party in connection with the development and manufacture, but not the marketing, of the equipment.

(f) For radio frequency devices subject to verification and sold solely to business, commercial, industrial, scientific and medical users (excluding products sold to other parties or for operation in a residential environment), parties responsible for verification of the devices shall have the option of ensuring compliance with the applicable technical specifications of this chapter at each end user's location after installation, provided that the purchase or lease agreement includes a proviso that such a determination of compliance be made and is the responsibility of the party responsible for verification of the equipment.

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## Certification & User's Manual Information

**The following is extracted from Title 47 of the Code of Federal Regulations, Part 2, Subpart J — Equipment Authorization Procedures:**

**§ 2.901 Basis and Purpose**

(a) In order to carry out its responsibilities under the Communications Act and the various treaties and international regulations, and in order to promote efficient use of the radio spectrum, the Commission has developed technical standards for radio frequency equipment and parts or components thereof. The technical standards applicable to individual types of equipment are found in that part of the rules governing the service wherein the equipment is to be operated.[1] *In addition to the technical standards provided, the rules governing the service may require that such equipment be verified by the manufacturer or importer*, be authorized under a Declaration of Conformity, or receive an equipment authorization from the Commission by one of the following procedures: certification or registration.

(b) The following sections describe the verification procedure, the procedure for a Declaration of Conformity, and the procedures to be followed in obtaining certification from the Commission and the conditions attendant to such a grant.

**§ 2.907 Certification.**

(a) Certification is an equipment authorization issued by the Commission, based on representation and test data submitted by the applicant.

(b) Certification attaches to all units subsequently marketed by the grantee which are identical (see Section 2.908) to the sample tested except for permissive changes or other variations authorized by the Commission pursuant to Section 2.1043.

[1] In this case, the equipment is subject to the rules of Part 15. More specifically, the equipment falls under Subpart B (of Part 15), which deals with unintentional radiators.

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## Certification & User's Manual Information

**§ 2.948 Description of measurement facilities.**

(a) Each party making measurements of equipment that is subject to an equipment authorization under Part 15 or Part 18 of this chapter, regardless of whether the measurements are filed with the Commission or kept on file by the party responsible for compliance of equipment marketed within the U.S. or its possessions, shall compile a description of the measurement facilities employed.

(1) If the measured equipment is subject to the verification procedure, the description of the measurement facilities shall be retained by the party responsible for verification of the equipment.

*(i) If the equipment is verified through measurements performed by an independent laboratory, it is acceptable for the party responsible for verification of the equipment to rely upon the description of the measurement facilities retained by or placed on file with the Commission by that laboratory. In this situation, the party responsible for the verification of the equipment is not required to retain a duplicate copy of the description of the measurement facilities.*

(ii) If the equipment is verified based on measurements performed at the installation site of the equipment, no specific site calibration data is required. It is acceptable to retain the description of the measurement facilities at the site at which the measurements were performed.

(2) If the equipment is to be authorized by the Commission under the certification procedure, the description of the measurement facilities shall be filed with the Commission's Laboratory in Columbia, Maryland. The data describing the measurement facilities need only be filed once but must be updated as changes are made to the measurement facilities or as otherwise described in this section. At least every three years, the organization responsible for filing the data with the Commission shall certify that the data on file is current.

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# Certification & User's Manual Information

## 1. Label and User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart A — General:

**§ 15.19 Labeling requirements.**

*(a) In addition to the requirements in Part 2 of this chapter, a device subject to certification or verification shall be labeled as follows:*

(1) Receivers associated with the operation of a licensed radio service, e.g., FM broadcast under Part 73 of this chapter, land mobile operation under Part 90, etc., shall bear the following statement in a conspicuous location on the device:

This device complies with Part 15 of the FCC Rules. Operation is subject to the condition that this device does not cause harmful interference.

(2) A stand-alone cable input selector switch, shall bear the following statement in a conspicuous location on the device:

This device is verified to comply with Part 15 of the FCC Rules for use with cable television service.

(3) All other devices shall bear the following statement in a conspicuous location on the device:

*This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

(4) Where a device is constructed in two or more sections connected by wires and marketed together, the statement specified under paragraph (a) of this section is required to be affixed only to the main control unit.

(5) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (a) of this section on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.

**§ 15.21 Information to user.**

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

## Verification & User's Manual Information

The following is extracted from Title 47 of the Code of Federal Regulations, Part 15, Subpart B — Unintentional Radiators:

**§ 15.105 Information to the user.**

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at own expense.

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

– Reorient or relocate the receiving antenna.

– Increase the separation between the equipment and receiver.

– Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

– Consult the dealer or an experienced radio/TV technician for help.

# End of Report

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