QAI Laboratories
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Burnaby, BC, V5J 5K5 Canada

# ELECTROMAGNETIC COMPATIBILITY TEST REPORT

**PREPARED FOR NEURIO TECHNOLOGY INC.**
**BY QAI LABORATORIES**

| | |
|---|---|
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| | |
|---|---|
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**Laboratory Accreditations (per ISO/IEC 17025:2005):**

**American Association for Laboratory Accreditation Certificate Number: 3657.02**

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| | |
|---|---|
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| | |
|---|---|
| **Applicable Test Standards:** | FCC Title 47 Part 15 Subpart C & Subpart B, RSS-247 Issue 1, RSS-Gen Issue 4, ICES-003 Issue 6, ETSI EN 301 489-1 V1.9.2 & ETSI EN 300 328 V1.8.1 |

| | |
|---|---|
| Equipment Tested | Stand-Alone Radio Module |
| Model Number: | W1 |
| FCC ID: | W72-W1 |
| IC Certification Number: | 8253A-W1 |
| Manufacturer: | Neurio Technology Inc. |

## REVISION HISTORY

| Date | Report Number | Rev # | Details | Author's Initials |
|---|---|---|---|---|
| Sept 2 2016 | E10720-1605 | 0.0 | Draft report | AJ |
| Sept 11 2016 | E10720-1605 | 1.0 | Final report | AJ |
| Sept 29 2016 | E10720-1605 | 2.0 | Final report | JQ |
| | | | | |
| | | | | |

*All previous versions of this report have been superseded by the latest dated revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.*

## REPORT AUTHORIZATION

The data documented in this report is for the test equipment provided by Neurio Technology Inc. Tests were conducted on the sample equipment as requested by Neurio Technology Inc. for the purpose of demonstrating compliance with FCC Title 47 Part 15 Subpart C & Subpart B, RSS-247 Issue 1, RSS-Gen Issue 4, ICES-003 Issue 6, ETSI EN 301 489-1 V1.9.2 & ETSI EN 300 328 V1.8.1 as agreed upon by Neurio Technology Inc. as per Quote 16SH05112.

Neurio Technology Inc. is responsible for the tested product configuration, continued product compliance, and for the appropriate auditing of subsequent products as required. This report may comprise partial list of tests that are required for FCC or IC Declaration of Conformity and can only be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.

X

**Written by Jack Qin**
**RF/EMC Test Engineer/Technical Writer**

X

**Reviewed by Arnan Jathaul,**
**EMC Project Manager**

## QAI FACILITIES

Founded in 1994 by a group of experienced certification and testing experts, QAI is an independent third-party testing, inspection and certification organization which serves the building industry, government and individuals with cost effective solutions through our in-house capabilities / services, and an established world-wide network of qualified affiliates. To help get your product to market, trust the provider that many leading global manufacturers do: QAI.

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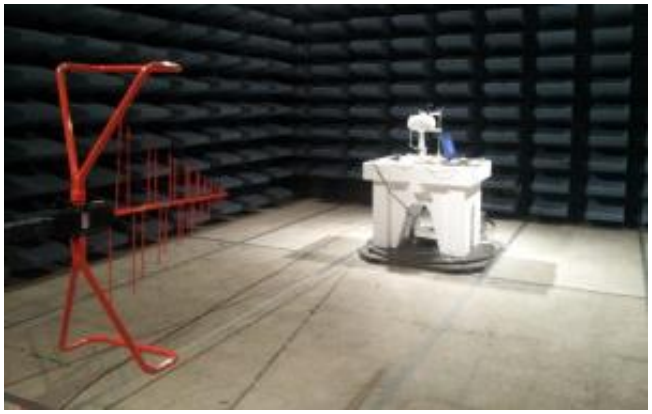
## QAI EMC ACCREDITATION

QAI EMC is your one-stop regulatory compliance partner for electromagnetic compatibility (EMC) and electromagnetic interference (EMI). Products are tested to the latest and applicable EMC/EMI requirements for domestic and international markets. QAI EMC goes above and beyond being a testing facility—we are your regulatory compliance partner. QAI EMC has the capability to perform RF Emissions and Immunity for all types of electronics manufacturing including Industrial, Scientific, Medical, Information Technology, Telecom, Wireless, Automotive, Marine and Avionics.

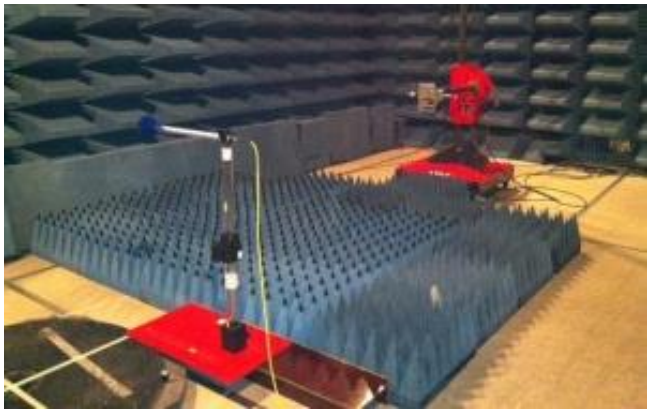
| EMC Laboratory Location | FCC Designation (3m SAC) | IC Registration (3m SAC) | A2LA Certificate |
|---|---|---|---|
| Burnaby, BC Canada | CA9543 | 21146-1 | 3657.02 |
| Everett, Washington USA | 307482 | 11876A-1 | 3657.02 |

**Headquarters & EMC Laboratory in Burnaby, BC**

**EMC Laboratory in Everett, Washington**



**3 m Semi-Anechoic Chamber (SAC) in Burnaby, BC**



**3 m Semi-Anechoic Chamber (SAC) in Burnaby, BC**

**10 m Open Area Test Site (OATS) in British Columbia, Canada**

**5 m Semi-Anechoic Chamber (SAC) in Everett, Washington**

**5 m Semi-Anechoic Chamber (SAC) in Everett, Washington**

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# Section I: EXECUTIVE SUMMARY

### 1.1 Purpose

The purpose of this report is to demonstrate and document the compliance of "W1" device as per Sections 1.2 & 1.3.

### 1.2 Scope

This report is prepared to demonstrate the compliance of W1 device manufactured by Neurio Technology Inc. under Class II permissive changes as per FCC and IC permissive change policies.

Following modifications was performed on original equipment certified under FCC ID W72-W1 and IC 8253A-W1.

- Added RS485 Transceiver.
- Upgraded power supply module to a nearly identical version with an extended temperature range.
-

The information documented in this report is based on the test methods and levels as per Quote SH-2015-032702:

- **FCC Title 47 Part 15 –** Radio Frequency Devices, Subpart C – Intentional Radiators. 15.205 Restricted Bands of Operation
- **FCC Title 47 Part 15 –** Radio Frequency Devices, Subpart C – Intentional Radiators. 15.207 Conducted Limits
- **FCC Title 47 Part 15 –** Radio Frequency Devices, Subpart C – Intentional Radiators. 15.209 Radiated Emissions Limits: General Requirements
- **FCC Title 47 Part 15 –** Radio Frequency Devices, Subpart C – Intentional Radiators. 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz
- **RSS-247 Issue 1 –** Digital Transmission Systems, Frequency Hopping Systems & License Exempt Local Area Network Device
- **RSS-Gen Issue 4 –** General Requirements and Information for the Certification of Radio Apparatus – Section 3.2 Modular Approvals for Category I Equipment or Category II Equipment
- **ICES-003 Issue 6 –** Digital Apparatus Spectrum - Information Technologies and Telecommunications
- **CFR Title 47 FCC Part 15 –** Radio Frequency Devices, Subpart B – Unintentional Radiators.

The tests documented in this report were performed in accordance with ANSI C63.4-2014, ANSI C63.10-2013, RSS-Gen Issue 4 and FCC KDB 558074 D01 DTS Meas Guidance v03r05.

### 1.3 Summary of Results

The following tests demonstrate the testimony to "FCC, IC & CE" Mark Electromagnetic compatibility testing for "W1" manufactured by Neurio Technology Inc.

**The following testing was performed pursuant to FCC Title 47 Part 15 Subpart B & Subpart C**

| Test or Measurement | Applicable FCC Rule Parts | Description | Performance Criteria |
|---|---|---|---|
| RF Peak Power Output | FCC Part 15.247 (b)(3) | Maximum peak conducted output power shall not exceed 1 W. Except as provided in Section RSS 210 A8.4 (5), the e.i.r.p. shall not exceed 4 W. | Complies |
| Radiated Spurious Emissions – Transmit Mode | FCC Part 15.247 (d), FCC Part 15.209 (a), FCC Part 15.205 | Radiated emissions requirements as stated in the Standards. | Complies |
| Conducted Spurious Emissions | FCC Part 15.247 (d), FCC Part 15.209 (a) | In any 100 kHz bandwidth outside the frequency band in which the digitally modulated device is operating, the RF power that is produced shall be at least 20dB. | Complies |
| Radiated Spurious Emissions – Receive Mode | FCC Part 15.247 (d), FCC Part 15.209 (a) | Radiated emissions requirements as stated in the Standards | Complies |
| RF Exposure | FCC 47 CFR §1.1310 | RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm | Complies |
| Power Line Conducted Emissions | FCC Part 15.207 | The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range. | Complies |

**The following testing was performed pursuant to Industry Canada ICES-003 Issue 6**

| Test or Measurement | Applicable Industry Canada Rule Parts | Description | Performance Criteria |
|---|---|---|---|
| RF Peak Power Output | RSS 247 | Maximum peak conducted output power shall not exceed 1 W. Except as provided in Section RSS 210 A8.4 (5), the e.i.r.p. shall not exceed 4 W. | Complies |
| Radiated Spurious Emissions – Transmit Mode | RSS-247 & RSS-Gen Issue 4 | Radiated emissions requirements as stated in the Standards. | Complies |
| Conducted Spurious Emissions | RSS 247 | In any 100 kHz bandwidth outside the frequency band in which the digitally modulated device is operating, the RF power that is produced shall be at least 20dB. | Complies |
| Radiated Spurious Emissions – Receive Mode | ICES-003 Issue 6 | Radiated emissions requirements as stated in the Standards | Complies |
| RF Exposure | RSS-102 Section 2.5.2 | RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm | Complies |
| Power Line Conducted Emissions | ICES-003 Issue 6 Class B Limits | The Conducted Emissions are measured on the phase and Neutral Power lines in the 0.15 - 30.0 MHz range. | Complies |

# Section II: GENERAL INFORMATION

### 2.1 Product Description

The information provided in this section is for the Equipment Under Test (EUT) and the corresponding Auxiliary Equipment needed to perform the tests as complete system.

**Equipment Under Test (EUT) Information**

| | |
|---|---|
| **EUT** | Neurio Sensor W1 |
| **Functional Description** | WiFi-enabled residential energy monitor |
| **Operational Description** | Utilizes split-core current transformers to monitor the energy consumption of a home. Utilizes a 802.11n-compliant Wi-Fi module to transmit this energy data to a cloud service for further analysis |
| **FRN** | 0018589234 |
| **FCC ID** | W72-W1 |
| **IC** | 8253A-W1 |
| **Manufacturer** | Neurio |
| **Model/Type** | W1 |
| **Transmitter Type** | 802.11n-compliant |
| **Frequency Range** | 2412-2462Mhz |
| **Transmit Power** | 18.1 dBm |
| **Modulation** | IEEE 802.11 b, g, n |
| **Number of Channels** | 11 |
| **Antenna** | Quarter-wave dipole whip antenna |
| **Software and Firmware** | 0.2.2 |

**Neurio W1 Sensor**

## 2.2 Environmental Conditions

The equipment under test was operated and tested under the following environmental conditions:

| Parameter | Conditions |
|---|---|
| Location | Indoors |
| Temperature | 22-28ºC |
| Relative Humidity | 39.7 - 54.4% |

## 2.3 Measurement Uncertainty

| Parameter | Uncertainty |
|---|---|
| Radiated Emissions, 30MHz-1GHz | ± 2.40 dB |
| Radiated Emissions, 1GHz-40GHz | ± 2.48 dB |
| Radio Frequency | ±1,5 x 10-5 MHz |
| Total RF Power Conducted | ±1.36 dB |
| Spurious Emissions, Conducted | ±1.36 dB |
| RF Power Density, Conducted | ±1.36 dB |
| Temperature | ±1ºC |
| Humidity | ±5 % |
| DC and low frequency voltages | ±3 % |

## 2.4 Worst Test Case

Worst-case orientation was determined during the preliminary testing. The final radiated emissions were performed in the worst-case orientation.

## 2.5 Sample Calculations of Emissions Data

Radiated and conducted emissions were performed using EMC32 software developed by Rohdes & Schwarz. Transducer factors like Antenna factors, Cable Losses and Amplifier gains were stored in the test templates which are used to perform the emissions measurements. After test is finished, data is generated from the EMC32 consisting of product details, emission plots and final data tables as shown below.

| Frequency (MHz) | Quasi-Peak (dBµV/m) | Meas. Time (ms) | Bandwidth (kHz) | Antenna height (cm) | Polarity | Turntable position (deg) | Corr. (dB) | Margin (dB) | Limit (dBµV/m) |
|---|---|---|---|---|---|---|---|---|---|
| 42.663900 | 33.0 | 1000.000 | 120.000 | 100.0 | H | 70.0 | 13.2 | 7.5 | 40.5 |

Quasi Peak reading shown in the table above is already corrected by the software using correction factor shown in column “Corr.” The correction factor listed under “Corr.” table calculated as:

**Corr.(dB) = Antenna factor + Cable loss**

Or

**Corr.(dB) = Antenna factor + Cable Loss - Amp gain (if pre-amplifier was used)**

The final Quasi peak reading shown in the data is calculated by the software using following equation:

**Corrected Quasi Peak(dBµV/m) = Raw Quasi Peak Reading + Antenna factor + Cable loss**

To obtain the final Quasi-Peak or Average reading during power line conducted emissions, transducer factors are included in the final measurement as shown below.

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|
| 0.150 | 44.3 | 1000.000 | 9.000 | 0.6 | 21.7 | 66.0 |

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|
| 0.150 | 27.2 | 1000.000 | 9.000 | 0.6 | 28.8 | 56.0 |

Quasi Peak or Average reading shown in above table is already corrected by the software using the correction factor shown in column "Corr." The correction factor listed under "Corr." table calculated as:

**Corr.(dB) = Antenna factor + Cable loss**

The final Quasi peak or Average reading shown in the data is calculated by the software using following equation:

**Corr. Quasi Peak/Average Reading (dBµV) = Raw Quasi Peak/Average Reading + Antenna factor + Cable loss**

The allowable margin from the limits, as per the standards, were calculated for both radiated and conducted emissions:

**Margin(dB) = Limit – Quasi-Peak or Average reading**

## 2.6 Test Equipment List

The tables below contain all the equipment used by QAI Laboratories in conducting all tests on the Equipment Under Test (EUT) as per Section 1.3.

**Emissions Test Equipment**

| Manufacturer | Model | Description | Serial No. | Calibration Due Date |
|---|---|---|---|---|
| Sunol Sciences | SM46C | Turntable | 051204-2 | N/A |
| Sunol Sciences | TWR95 | Mast | TREML0001 | N/A |
| Sunol Sciences | JB3 | Biconilog Antenna 30MHz – 3GHz | A120106 | 24-Sep-2017 |
| ETS Lindgren | 2165 | Turntable | 00043677 | N/A |
| ETS Lindgren | 2125 | Mast | 00077487 | N/A |
| Rohde & Schwarz | ESU40 | EMI Receiver | 100011 | 20-Nov-2017 |
| Fischer | FCC-LISN-50-25-2-08 | LISN (150kHz-30MHz) | 2041 | 19-Nov-2018 |
| ETS Lindgren | S201 | 5-meter Semi-Anechoic Chamber | 1030 | N/A |
| ETS Lindgren | 3117 | Horn Antenna 1GHz-18GHz | 00075944 | 29-Aug-2016 |
| AH Systems | PAM118 | Amplifier 10KHz-18GHz | 189 | Conditional Use |
| Mini Circuit | 8400+ | High Pass Filter | N/A | N/A |
| Mini Circuit | 2700A+ | High Pass Filter | N/A | N/A |
| EMCO | 3160-09 | Standard gain Horn Antenna | 9701-1071 | 30 August 2016 |
| EMCO | 6502 | Loop Antenna | 2178 | 21 August 2017 |
| A.H. Systems Inc. | PAM-1840VH | Pre-Amp | 152 | 14 June 2019 |

**Measurement Software List**

| Manufacturer | Model | Version | Description |
|---|---|---|---|
| Rhode & Schwarz | EMC 32 | 6.20.0 | Emissions Pre-scan Test Software |

# Section III: REQUIREMENTS FOR THE US MARKET (FCC) & THE CANADIAN MARKET (IC) – Exigences pour le Marché Canadien

## 3.1 RF Peak Power Output

The purpose of this test is to make certain that for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz does not exceed the maximum conducted output power as per the standards, FCC Part 15.247 (b)(3), RSS 247 & RSS 210 Issue 8 Annex 8.

The test was conducted as defined by the standards above with the antenna port of the EUT directly connected to a spectrum analyzer. The maximum peak conducted power for systems employing digital modulation techniques operating in the bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz shall not exceed 1W. Except as provided in RSS 247 Section 5.4, the Equivalent Isotropically Radiated Power (E.I.R.P.) shall not exceed 4 W.

The EUT was tested without any modifications and was deemed compliant to the standards on Aug 3, 2016

Please refer to Appendix A of this report for the RF Peak Power Output Data.

## 3.2 Radiated Spurious Emissions – Transmit Mode

The purpose of this test is to make certain that the radiated spurious emissions from the Equipment Under Test (EUT) while in transmit mode does not exceed the limits as per the standards, FCC Part 15.247 (d), FCC Part 15.209 (a), FCC Part 15.205, IC RSS-210 Issue 8 Annex 2 Section (A2.2) (b), RSS-Gen Issue 4.

The test was conducted as defined by the standards above. The EUT was positioned in the center of the turntable in the SAC and was connected to a 3Vdc battery. The transmitter was set for continuous transmission. The lowest, middle and highest channels in the 2400-2483.5 MHz band were measured for all radiated emissions 10kHz to 18 GHz.

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen Issue 4, whichever is less stringent. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency if the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Unwanted emissions falling into restricted bands of shall comply with the limits specified below.

| Frequency (MHz) | Field Strength | |
|---|---|---|
| | uV/m @ 3-m | Calculated dBµV/m at 3m |
| 30 – 88 | 100 | 40.0 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46.0 |
| 960 - 1000 | 500 | 54.0 |

For frequencies below 30 MHz, an active loop antenna was used to make measurements. There were no significant emission levels detected during the test. Thus, the said results were not included in this report.

**FCC PART 15.205 – Restricted Bands of Operation:**

(a) Except as shown in paragraph (d) of FCC PART 15.205, 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 | 2690-2900 | 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 | | | |

***Note 1:*** **FCC-specific*

***Note 2:*** *Canada-specific frequency ranges - 3.020-3.026, 5.677–5.683, 121.94-123.0. 149.9-150.05, 162.0125-167.17, 167.72-173.2, 1300-1427, 2483.5-2500, 3500-3600,*

***Note 3:*** *(2) Above 38,6 GHz*

(b) Except as provided in paragraphs (d) and (e) FCC PART 15.205, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

**RESTRICTED FREQUENCY BANDS (RSS-GEN ISSUE 4)**

| MHz |
|---|
| 0.090-0.110 |
| 2.1735-2.1905 |
| 3.020-3.026 |
| 4.125-4.128 |
| 4.17725-4.17775 |
| 4.20725-4.20775 |
| 5.677-5.683 |
| 6.215-6.218 |
| 6.26775-6.26825 |
| 6.31175-6.31225 |
| 8.291-8.294 |
| 8.362-8.366 |
| 8.37625-8.38675 |
| 8.41425-8.41475 |
| 12.29-12.293 |
| 12.51975-12.52025 |
| 12.57675-12.57725 |
| 13.36-13.41 |
| 16.42-16.423 |
| 16.69475-16.69525 |
| 16.80425-16.80475 |
| 25.5-25.67 |
| 37.5-38.25 |
| 73-74.6 |
| 74.8-75.2 |
| 108-138 |
| 156.52475-156.52525 |
| 156.7-156.9 |

| MHz |
|---|
| 240-285 |
| 322-335.4 |
| 399.9-410 |
| 608-614 |
| 960-1427 |
| 1435-1626.5 |
| 1645.5-1646.5 |
| 1660-1710 |
| 1718.8-1722.2 |
| 2200-2300 |
| 2310-2390 |
| 2655-2900 |
| 3260-3267 |
| 3332-3339 |
| 3345.8-3358 |
| 3500-4400 |
| 4500-5150 |
| 5350-5460 |
| 7250-7750 |
| 8025-8500 |

| GHz |
|---|
| 9.0-9.2 |
| 9.3-9.5 |
| 10.6-12.7 |
| 13.25-13.4 |
| 14.47-14.5 |
| 15.35-16.2 |
| 17.7-21.4 |
| 22.01-23.12 |
| 23.6-24.0 |
| 31.2-31.8 |
| 36.43-36.5 |
| Above 38.6 |

**Note:** Certain frequency bands listed in Table 3 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200– and 300– series RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

Measurements were made by using a spectrum analyzer, receiver, 200Hz RBW average detector for the frequency range 9-150KHz, 9kHz RBW average detector for the Frequency range 150kHz to 30MHz, 120kHz RBW quasi-peak detector using the appropriate antennas, amplifiers and filters. The measurement results are obtained as described below:

E [dBµV/m] = Un-Corrected Value + ATOT  Where ATOT = total correction factor including cable loss, antenna factor and preamplifier gain (ATOT = LCABLES + AF - AMP).

Radiated spurious emissions was measured up to 10th harmonics of fundamental frequency using the procedures described in ANSI C63.4:2014 and ANSI C63.10:2013 but no radiated emissions were found and reported other than reported in Appendix B of this report.

The EUT was tested without any modifications and was deemed compliant to the standards on Aug 3, 2016.

Please refer to Appendix B of this report for the Radiated Spurious Emissions – Transmit Mode data.

### 3.3 Conducted Spurious Emissions

The purpose of this test is to make certain that the conducted spurious emissions from the Equipment Under Test (EUT) does not exceed the limits as per the standards, FCC Part 15.247 (d), FCC Part 15.207, FCC Part 15.209 (a), RSS 247 & RSS 210 Issue 8 Annex 8.

The test was conducted as defined by the standards above. In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits.

The EUT was tested without any modifications and was deemed compliant to the standards on Aug 5, 2016

Please refer to Appendix C of this report for the Conducted Spurious Emissions data.

### 3.4 Radiated Spurious Emissions – Unintentional

The purpose of this test is to make certain that the radiated spurious emissions by the Equipment Under Test (EUT) while in receive mode does not exceed the limits as per the standards, FCC Part 15.247 (d), FCC Part 15.209 (a), RSS-210 Issue 8 Annex 2 Section A2.2 (b), & ICES-003 Issue 6.

The test was conducted as defined by the standards above. The EUT was positioned in the center of the turntable in the SAC and was connected to a 3Vdc battery. The transmitter was set for continuous transmission. The lowest, middle and highest channels in the 2400-2483.5 MHz band were measured for all radiated emissions 10kHz to 18 GHz.

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen Issue 4, whichever is less stringent.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency … if the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Unwanted emissions falling into restricted bands of shall comply with the limits specified below.

| Frequency (MHz) | Field Strength | |
|---|---|---|
| | uV/m @ 3-m | Calculated dBµV/m at 3m |
| 30 – 88 | 100 | 40.0 |
| 88 - 216 | 150 | 43.5 |
| 216 - 960 | 200 | 46.0 |
| 960 - 1000 | 500 | 54.0 |

Measurements were made by using a spectrum analyzer, receiver, 200Hz RBW average detector for the frequency range 9-150KHz, 9kHz RBW average detector for the Frequency range 150kHz to 30MHz, 120kHz RBW quasi-peak detector using the appropriate antennas, amplifiers and filters. The measurement results are obtained as described below:

E [dBµV/m] = Un-Corrected Value + ATOT  Where ATOT = total correction factor including cable loss, antenna factor and preamplifier gain (ATOT = LCABLES + AF - AMP).

The EUT was tested without any modifications and was deemed compliant to the standards on Aug 2, 2016.

Please refer to Appendix E of this report for the Radiated Spurious Emissions – Receive Mode data.

## 3.5 RF Exposure Evaluation

The purpose of this test is to make certain that the Equipment Under Test (EUT) complies with the RF exposure requirements as per the standards, RSS-102 Section 2.5.2 & FCC 47 CFR §1.1310

**RSS-102 Section 2.5.2**

*"RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:*

- *at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1.31 x 10-2 f^0.6834 W (adjusted for tune-up tolerance), where f is in MHz*

*In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived."*

**FCC 47 CFR §1.1310**

*"Radiofrequency radiation exposure limits for General Population/Uncontrolled Exposure at Frequency range 1500 - 100000 MHz: 1.0 mW/cm^2"*

**Exposure Evaluation**:

1.) The highest conducted power measured was 2.97dBm when the EUT was operated at 2405 MHz
2.) The Antenna gain: 3dBi.
3.) E.I.R.P = 18.1dBm + 3dBi = 21.1dBm = 128.8mW
4.) Power Density at 20cm distance = 128.8mW/(4X3.14X20X20 $cm^2$) = 0.02564mW/$cm^2$

The radiated emissions of the EUT is far below the exemption limit 2.7W as per RSS-102 Section 2.5.2. The maximum power density at 20 cm distance is 0.02564mW/cm2 and is far below the limit 1.0 mW/$cm^2$ as per FCC 47 CFR §2.1091 & §1.1310.

The EUT was deemed compliant to the standards based on these measurements and calculations.

## 3.6 AC Mains Conducted Emissions

The purpose of this test is to make certain that the unintentional emitted RF energy from the Equipment Under Test (EUT) to its power source does not exceed the limits defined in the table below as per the standards, ICES-003 Issue 6 & FCC CFR47 Part 15 Subpart B, for Class B equipment. This will prevent the EUT from causing any unwanted interference to other electronic devices.

| Frequency (MHz) | Conducted Limit (dBµV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15 – 0.50 | 66 to 56 | 56 to 46 |
| 0.50 – 5 | 56 | 46 |
| 5 – 30 | 60 | 50 |

***Note 1:*** *The lower limit shall apply at the transition frequencies.*
***Note 2:*** *The limit decreases linearly with the logarithm of the frequency in the 0.15 to 0.50 MHz*

The test was conducted as defined by the standards above. The Line Impedance Stabilizing Network (LISN) was used to make conducted emissions measurements. The equipment was operated and tested at 120Vac 60Hz while in "Continuous Mode" of operation. Measurements were made by using an EMI test receiver with 9 kHz bandwidth, CISPR Quasi-Peak and Average detector capabilities. Test receiver requirements, including the bandwidths used, for the test receiver are those specified in CISPR 16-1-1.

The EUT was tested without any modifications and was deemed compliant to Class B standards on Aug 3, 2016.

Please refer to Appendix D of this report for the AC Mains Conducted Emissions data.

# Appendix A: RF PEAK POWER OUTPUT DATA

**Table 1: Conducted output power measurements**

| Modulation | Channel | Frequency | Raw Peak Output Power (dBm) | Cable Loss with Attenuator (dB) | Corrected Peak Output Power (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| IEEE 802.11 b | Low | 2412 | -13.86 | 31.96 | 18.1 | 30 | 11.9 |
| | Middle | 2437 | -13.8 | 31.9 | 18.1 | 30 | 11.9 |
| | High | 2462 | -14.9 | 31.98 | 17.08 | 30 | 12.92 |
| IEEE 802.11 g | Low | 2412 | -15.73 | 31.96 | 16.23 | 30 | 13.77 |
| | Middle | 2437 | -16.19 | 31.9 | 15.71 | 30 | 14.29 |
| | High | 2462 | -16.9 | 31.98 | 15.08 | 30 | 14.92 |
| IEEE 802.11 n | Low | 2412 | -15.76 | 31.96 | 16.2 | 30 | 13.8 |
| | Middle | 2437 | -16.1 | 31.9 | 15.8 | 30 | 14.2 |
| | High | 2462 | -16.89 | 31.98 | 15.09 | 30 | 14.91 |

**Table 2: E.I.R.P. measurements**

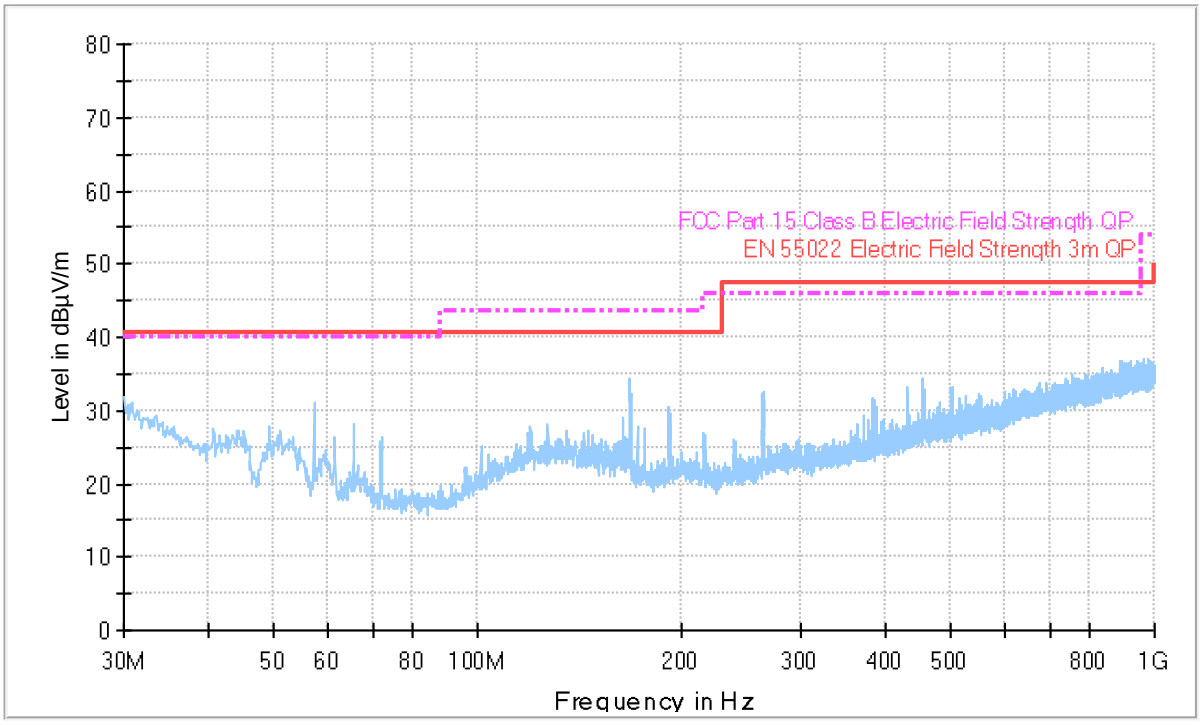
| Modulation | Channel | Frequency | Field Strength (dBuV/m) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|
| IEEE 802.11 b | Low | 2412 | 116.73 | 21.47 | 36.02 | 14.55 |
| | Middle | 2437 | 115.37 | 20.11 | 36.02 | 15.91 |
| | High | 2462 | 114.21 | 18.95 | 36.02 | 17.07 |
| IEEE 802.11 g | Low | 2412 | 114.65 | 19.39 | 36.02 | 16.63 |
| | Middle | 2437 | 112.94 | 17.68 | 36.02 | 18.34 |
| | High | 2462 | 112.7 | 17.44 | 36.02 | 18.58 |
| IEEE 802.11 n | Low | 2412 | 113.07 | 17.81 | 36.02 | 18.21 |
| | Middle | 2437 | 112.05 | 16.79 | 36.02 | 19.23 |
| | High | 2462 | 111.71 | 16.45 | 36.02 | 19.57 |

# Appendix B: RADIATED SPURIOUS EMISSIONS-TRANSMIT MODE

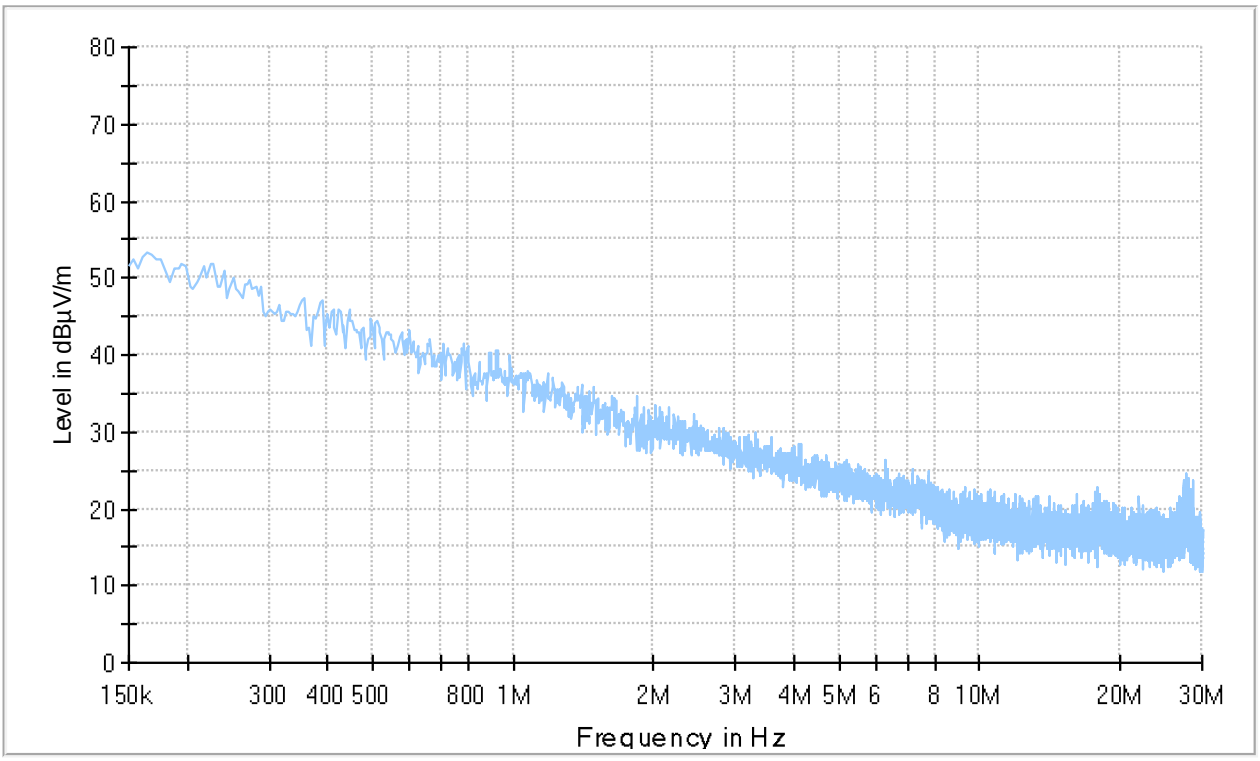
***Note:*** *Radiated spurious emissions was measured up to 10th harmonics of fundamental frequency using the procedures described in ANSI C63.4:2014 and ANSI C63.10:2013 but no radiated emissions were found and reported above 18GHz.*

**Table 3: Radiated Spurious Emissions data below 1GHz**

| Frequency | QuasiPeak | Meas. Time | Bandwidth | Antenna height | Polarity | Turntable position | Corr. | Margin | Limit |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBµV/m) | (ms) | (kHz) | (cm) | | (deg) | (dB) | (dB) | (dBµV/m) |
| 57.35865 | 28.2 | 1000 | 120 | 100 | V | 1 | 14.5 | 11.8 | 40 |
| 61.46105 | 27.4 | 1000 | 120 | 100 | V | 42 | 14.2 | 12.6 | 40 |
| 167.8929 | 27.4 | 1000 | 120 | 199 | H | 314 | 19 | 16.1 | 43.5 |
| 191.76425 | 26 | 1000 | 120 | 120 | V | 130 | 18.7 | 17.5 | 43.5 |
| 216.10465 | 26.7 | 1000 | 120 | 100 | V | 1 | 18.7 | 19.7 | 46.4 |
| 505.5124 | 31.2 | 1000 | 120 | 130 | H | 195 | 25.7 | 15.2 | 46.4 |




**Plot 1: Radiated spurious Emissions 30-1000MHz**




**Plot 2: Radiated spurious Emissions 150k-30MHz**

**Table 4: Radiated Spurious Emissions data – IEEE 802.11 b**

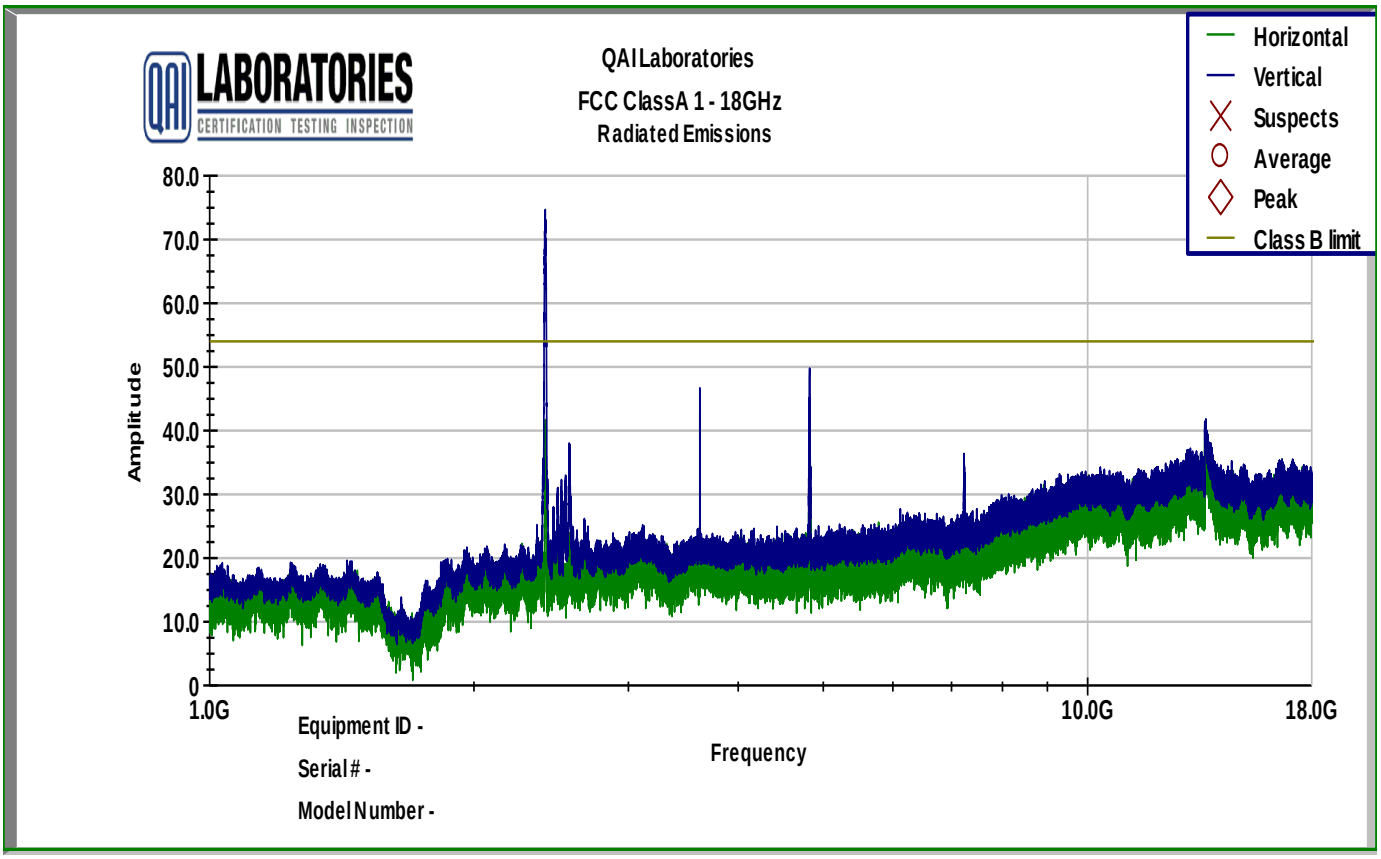
| IEEE 802.11 b Low Channel 2412MHz | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3618 | 55.53 | V | 121 | 85 | -30.7 | 32.9 | 57.73 | -24.09 | 33.64 | 74 | 54 |
| 4824 | 62.7 | V | 150 | 135 | -26.85 | 34.1 | 69.95 | -24.09 | 45.86 | 74 | 54 |
| 4824 | 59.9 | H | 140 | 165 | -26.85 | 34.1 | 67.15 | -24.09 | 43.06 | 74 | 54 |
| 7236 | 51.9 | V | 131 | 128 | -26.85 | 34.1 | 59.15 | -24.09 | 35.06 | 74 | 54 |
| 7236 | 47.38 | H | 141 | 105 | -26.85 | 34.1 | 54.63 | -24.09 | 30.54 | 74 | 54 |
| 9648 | 34.23 | V | 140 | 48 | -26.85 | 37 | 44.38 | -24.09 | 20.29 | 74 | 54 |
| 9648 | 33.36 | H | 135 | 76 | -26.85 | 37 | 43.51 | **-24.09** | 19.42 | 74 | 54 |
| **IEEE 802.11 b Middle Channel 2437MHz** | | | | | | | | | | | |
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3655 | 55.86 | V | 100 | 85 | -30.7 | 32.9 | 58.06 | -24.09 | 33.97 | 74 | 54 |
| 4874 | 62.8 | V | 138 | 134 | -26.71 | 34.1 | 70.19 | -24.09 | 46.1 | 74 | 54 |
| 4874 | 60.13 | H | 144 | 74 | -26.71 | 34.1 | 67.52 | -24.09 | 43.43 | 74 | 54 |
| 7311 | 50.99 | V | 109 | 117 | -22.56 | 35.5 | 63.93 | -24.09 | 39.84 | 74 | 54 |
| 7311 | 43.37 | H | 123 | 168 | -22.56 | 35.5 | 56.31 | -24.09 | 32.22 | 74 | 54 |
| 9748 | 33.1 | V | 140 | 48 | -16.42 | 37.2 | 53.88 | -24.09 | 29.79 | 74 | 54 |
| 9748 | 33.36 | H | 135 | 76 | -16.42 | 37.2 | 54.14 | -24.09 | 30.05 | 74 | 54 |
| **IEEE 802.11 b High Channel 2462MHz** | | | | | | | | | | | |
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3693 | 55.07 | V | 100 | 90 | -30.7 | 32.9 | 57.27 | -24.09 | 33.18 | 74 | 54 |
| 4924 | 62.97 | V | 112 | 125 | -26.52 | 34.1 | 70.55 | -24.09 | 46.46 | 74 | 54 |
| 4924 | 59.86 | H | 177 | 84 | -26.52 | 34.1 | 67.44 | -24.09 | 43.35 | 74 | 54 |
| 7386 | 50.53 | V | 132 | 115 | -21.88 | 35.5 | 64.15 | -24.09 | 40.06 | 74 | 54 |
| 7386 | 41.9 | H | 100 | 260.1 | -21.88 | 35.5 | 55.52 | -24.09 | 31.43 | 74 | 54 |
| 9848 | 33.3 | V | 100 | 171.7 | -16.12 | 37.2 | 54.38 | -24.09 | 30.29 | 74 | 54 |
| 9848 | 32.6 | H | 100 | 155.8 | -16.12 | 37.2 | 53.68 | -24.09 | 29.59 | 74 | 54 |

**Table 5: Radiated Spurious Emissions data – IEEE 802.11 g**

| IEEE 802.11 g - Low Channel (2412MHz) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3618 | 51.84 | V | 121 | 85 | -30.7 | 32.9 | 54.04 | -24.09 | 29.95 | 74 | 54 |
| 4824 | 60.83 | V | 150 | 93 | -26.85 | 34.1 | 68.08 | -24.09 | 43.99 | 74 | 54 |
| 4824 | 57.86 | H | 150 | 80 | -26.85 | 34.1 | 65.11 | -24.09 | 41.02 | 74 | 54 |
| 7236 | 49.2 | V | 104 | 113 | -22.84 | 35.5 | 61.86 | -24.09 | 37.77 | 74 | 54 |
| 7236 | 44.57 | H | 171 | 54 | -22.84 | 35.5 | 57.23 | -24.09 | 33.14 | 74 | 54 |
| **IEEE 802.11 g - Middle Channel (2437MHz)** | | | | | | | | | | | |
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3655 | 53.62 | V | 100 | 85 | -30.7 | 32.9 | 55.82 | -24.09 | 31.73 | 74 | 54 |
| 4874 | 60.79 | V | 100 | 135 | -26.71 | 34.1 | 68.18 | -24.09 | 44.09 | 74 | 54 |
| 4874 | 56.56 | H | 100 | 112 | -26.71 | 34.1 | 63.95 | -24.09 | 39.86 | 74 | 54 |
| 7311 | 48.57 | V | 100 | 122 | -22.56 | 35.5 | 61.51 | -24.09 | 37.42 | 74 | 54 |
| 7311 | 42.87 | H | 100 | 360 | -22.56 | 35.5 | 55.81 | -24.09 | 31.72 | 74 | 54 |
| | | | | | | | | | | | |
| **IEEE 802.11 g - High Channel (2462MHz)** | | | | | | | | | | | |
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3693 | 53.35 | V | 100 | 90 | -30.7 | 32.9 | 55.55 | -24.09 | 31.46 | 74 | 54 |
| 4924 | 59.93 | V | 129 | 129 | -26.52 | 34.1 | 67.51 | -24.09 | 43.42 | 74 | 54 |
| 4924 | 57.6 | H | 111 | 164 | -26.52 | 34.1 | 65.18 | -24.09 | 41.09 | 74 | 54 |
| 7386 | 48.72 | V | 129 | 121 | -21.88 | 35.5 | 62.34 | -24.09 | 38.25 | 74 | 54 |
| 7386 | 42.2 | H | 135 | 181 | -21.88 | 35.5 | 55.82 | -24.09 | 31.73 | 74 | 54 |

**Table 6: Radiated Spurious Emissions data – IEEE 802.11 n**

| IEEE 802.11 n- Low Channel (2412MHz) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3618 | 53.59 | V | 121 | 85 | -30.7 | 32.9 | 55.79 | -24.09 | 31.7 | 74 | 54 |
| 4824 | 60.4 | V | 113 | 90 | -26.85 | 34.1 | 67.65 | -24.09 | 43.56 | 74 | 54 |
| 4824 | 57.5 | H | 127 | 164 | -26.85 | 34.1 | 64.75 | -24.09 | 40.66 | 74 | 54 |
| 7236 | 49.72 | V | 109 | 130 | -22.84 | 35.5 | 62.38 | -24.09 | 38.29 | 74 | 54 |
| 7236 | 46.47 | H | 131 | 114 | -22.84 | 35.5 | 59.13 | -24.09 | 35.04 | 74 | 54 |
| **IEEE 802.11 n- Middle Channel (2437 MHz)** | | | | | | | | | | | |
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3655 | 54.28 | V | 100 | 85 | -30.7 | 32.9 | 56.48 | -24.09 | 32.39 | 74 | 54 |
| 4874 | 60.78 | V | 100 | 134 | -26.71 | 34.1 | 68.17 | -24.09 | 44.08 | 74 | 54 |
| 4874 | 56.47 | H | 100 | 112 | -26.71 | 34.1 | 63.86 | -24.09 | 39.77 | 74 | 54 |
| 7311 | 48.9 | V | 100 | 130 | -22.56 | 35.5 | 61.84 | -24.09 | 37.75 | 74 | 54 |
| 7311 | 44.3 | H | 165 | 9 | -22.56 | 35.5 | 57.24 | -24.09 | 33.15 | 74 | 54 |
| **IEEE 802.11 n- High Channel (2462 MHz)** | | | | | | | | | | | |
| **Frequency (MHz)** | **Peak-Raw (dBuV/m)** | **Polarization (V/H)** | **Antenna Height (cm)** | **Angle (deg)** | **Gain/Loss (dB)** | **Antenna factor (dBm)** | **Peak-Corrected (dBuV/m)** | **Duty Cycle Correction factor (dB)** | **Avg (dBuV/m)** | **Peak Limit (dB)** | **Average Limit** |
| 3693 | 53.22 | V | 100 | 90 | -30.7 | 32.9 | 55.42 | -24.09 | 31.33 | 74 | 54 |
| 4924 | 59.95 | V | 116 | 129 | -26.52 | 34.1 | 67.53 | -24.09 | 43.44 | 74 | 54 |
| 4924 | 56.86 | H | 110 | 133 | -26.52 | 34.1 | 64.44 | -24.09 | 40.35 | 74 | 54 |
| 7386 | 49.29 | V | 140 | 120 | -21.88 | 35.5 | 62.91 | -24.09 | 38.82 | 74 | 54 |
| 7386 | 43.8 | H | 120 | 88 | -21.88 | 35.5 | 57.42 | -24.09 | 33.33 | 74 | 54 |




**Plot 3: Radiated spurious Emissions 1 – 18GHz**

# Appendix C: Conducted Spurious Emissions

**Table 7: Conducted spurious emissions IEEE802.11 b**

| IEEE 802.11 b Low Channel 2412 MHz | | | | | |
|---|---|---|---|---|---|
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Cable Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3618 | -54.04 | 1.5 | -52.54 | -10.87 | 41.67 |
| 4824 | -51.64 | 1.78 | -49.86 | -10.87 | 38.99 |
| 7236 | -58.58 | 3.41 | -55.17 | -10.87 | 44.3 |
| 9648 | -67.67 | 4.01 | -63.66 | -10.87 | 52.79 |
| **IEEE 802.11 b Mid Channel 2437 MHz** | | | | | |
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3655 | -53.9 | 1.5 | -52.4 | -11.6 | 40.8 |
| 4874 | -47.48 | 2.66 | -44.82 | -11.6 | 33.22 |
| 7311 | -60.8 | 2.94 | -57.86 | -11.6 | 46.26 |
| 9748 | -66.5 | 4.26 | -62.24 | -11.6 | 50.64 |
| **IEEE 802.11 b Hi Channel 2462 MHz** | | | | | |
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3693 | -54.69 | 1.5 | -53.19 | -11.8 | 41.39 |
| 4924 | -40.5 | 2.93 | -37.57 | -11.8 | 25.77 |
| 7386 | -59.18 | 3.09 | -56.09 | -11.8 | 44.29 |
| 9848 | -67.7 | 4.92 | -62.78 | -11.8 | 50.98 |

***Note: The limit for conducted spurious emissions was established according to reference level measurements described in clause 11.2 of KDB 558074 D01 DTS Meas Guidance v03r05.***

**Table 8: Conducted spurious emissions IEEE802.11 g**

| IEEE 802.11 g Low Channel 2412 MHz | | | | | |
|---|---|---|---|---|---|
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3618 | -57.92 | 1.5 | -56.42 | -12.92 | 43.5 |
| 4824 | -59.91 | 1.78 | -58.13 | -12.92 | 45.21 |
| 7236 | -60.9 | 3.41 | -57.49 | -12.92 | 44.57 |
| 9648 | -67.38 | 4.01 | -63.37 | -12.92 | 50.45 |
| **IEEE 802.11 b Mid Channel 2437 MHz** | | | | | |
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3655 | -56.14 | 1.5 | -54.64 | -14.45 | 40.19 |
| 4874 | -57.54 | 2.66 | -54.88 | -14.45 | 40.43 |
| 7311 | -64.31 | 2.94 | -61.37 | -14.45 | 46.92 |
| 9748 | -68.09 | 4.26 | -63.83 | -14.45 | 49.38 |
| **IEEE 802.11 b Hi Channel 2462 MHz** | | | | | |
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3693 | -56.41 | 1.5 | -54.91 | -15.02 | 39.89 |
| 4924 | -50.56 | 2.93 | -47.63 | -15.02 | 32.61 |
| 7386 | -62.2 | 3.09 | -59.11 | -15.02 | 44.09 |
| 9848 | -67.93 | 4.92 | -63.01 | -15.02 | 47.99 |

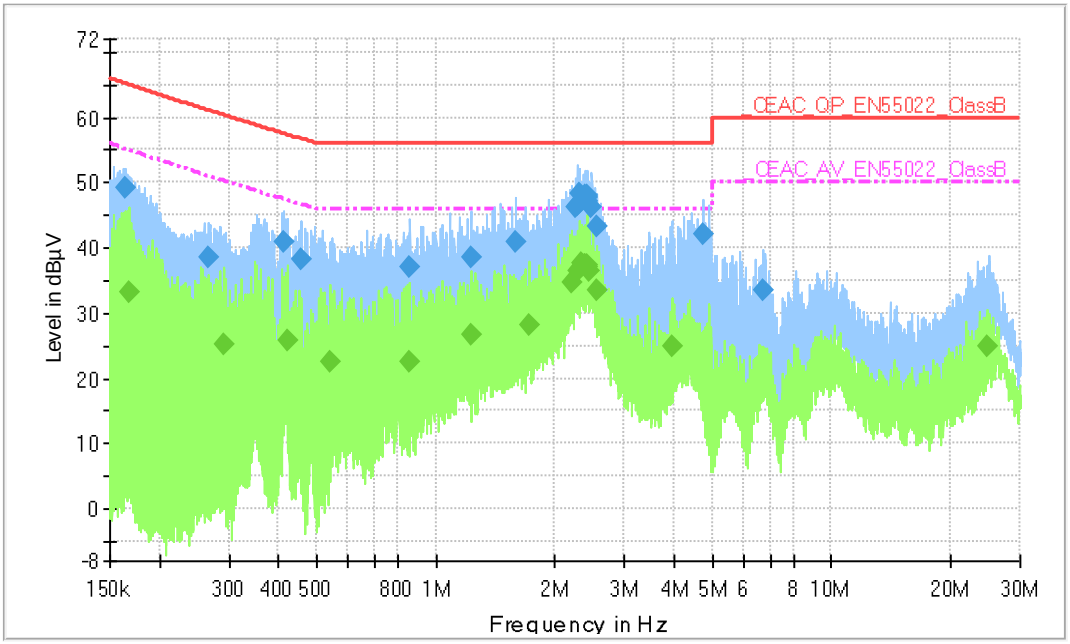
***Note: The limit for conducted spurious emissions was established according to reference level measurements described in clause 11.2 of KDB 558074 D01 DTS Meas Guidance v03r05.***

**Table 9**: **Conducted spurious emissions IEEE802.11 n**

| IEEE 802.11 n Low Channel 2412 MHz | | | | | |
|---|---|---|---|---|---|
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3618 | -56.17 | 1.5 | -54.67 | -15.11 | 39.56 |
| 4824 | -64.71 | 1.78 | -62.93 | -15.11 | 47.82 |
| 7236 | -65.54 | 3.41 | -62.13 | -15.11 | 47.02 |
| 9648 | -66.7 | 4.01 | -62.69 | -15.11 | 47.58 |
| **IEEE 802.11 n Middle Channel 2437 MHz** | | | | | |
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3655 | -55.48 | 1.5 | -53.98 | -16.26 | 37.72 |
| 4874 | -58.62 | 2.66 | -55.96 | -16.26 | 39.7 |
| 7311 | -64.97 | 2.94 | -62.03 | -16.26 | 45.77 |
| 9748 | -67.79 | 4.26 | -63.53 | -16.26 | 47.27 |
| **IEEE 802.11 n High Channel 2462 MHz** | | | | | |
| **Frequency (MHz)** | **Raw Peak (dBm)** | **Loss (dB)** | **Corrected Peak (dBm)** | **Limit (dBm)** | **Margin (dB)** |
| 3693 | -56.54 | 1.5 | -55.04 | -16.38 | 38.66 |
| 4924 | -49.25 | 2.93 | -46.32 | -16.38 | 29.94 |
| 7386 | -62.44 | 3.09 | -59.35 | -16.38 | 42.97 |
| 9848 | -67.1 | 4.92 | -62.18 | -16.38 | 45.8 |

***Note: The limit for conducted spurious emissions was established according to reference level measurements described in clause 11.2 of KDB 558074 D01 DTS Meas Guidance v03r05.***

# Appendix D: AC MAINS CONDUCTED EMISSIONS DATA & PLOTS



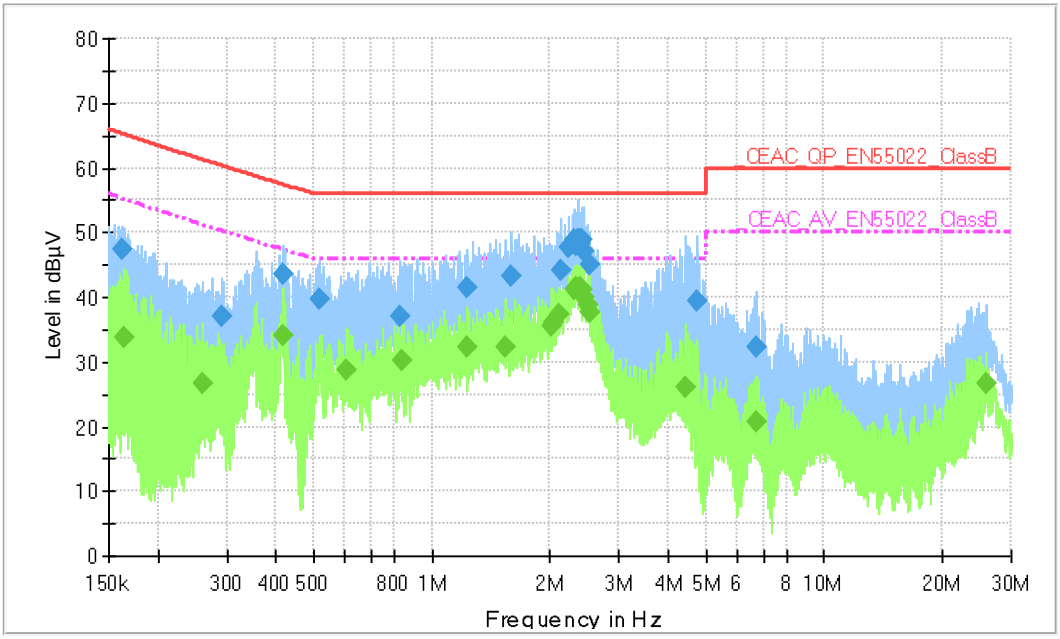

**Plot 1: AC Mains Conducted Emissions for FCC/IC Class B Line 1 120Vac/60Hz**

**Table 10: Quasi-Peak data AC Mains Conducted Emissions for FCC/IC Class B Line 1 120Vac/60Hz**

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.164119 | 49.3 | 1000.000 | 9.000 | GND | L1 | 0.5 | 15.9 | 65.2 |
| 0.265961 | 38.5 | 1000.000 | 9.000 | GND | L1 | 0.4 | 22.5 | 61.0 |
| 0.412456 | 40.8 | 1000.000 | 9.000 | GND | L1 | 0.4 | 16.7 | 57.5 |
| 0.459012 | 38.2 | 1000.000 | 9.000 | GND | L1 | 0.4 | 18.5 | 56.7 |
| 0.862436 | 37.1 | 1000.000 | 9.000 | GND | L1 | 0.4 | 18.9 | 56.0 |
| 1.223641 | 38.6 | 1000.000 | 9.000 | GND | L1 | 0.4 | 17.4 | 56.0 |
| 1.589946 | 40.8 | 1000.000 | 9.000 | GND | L1 | 0.4 | 15.2 | 56.0 |
| 2.254859 | 46.1 | 1000.000 | 9.000 | GND | L1 | 0.5 | 9.9 | 56.0 |
| 2.270690 | 46.6 | 1000.000 | 9.000 | GND | L1 | 0.5 | 9.4 | 56.0 |
| 2.314224 | 48.2 | 1000.000 | 9.000 | GND | L1 | 0.5 | 7.8 | 56.0 |
| 2.358592 | 47.3 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.7 | 56.0 |
| 2.375152 | 47.9 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.1 | 56.0 |
| 2.389438 | 47.7 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.3 | 56.0 |
| 2.406215 | 47.7 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.3 | 56.0 |
| 2.413440 | 47.9 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.1 | 56.0 |
| 2.420688 | 47.2 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.8 | 56.0 |
| 2.481937 | 46.1 | 1000.000 | 9.000 | GND | L1 | 0.5 | 9.9 | 56.0 |
| 2.562602 | 43.1 | 1000.000 | 9.000 | GND | L1 | 0.5 | 12.9 | 56.0 |
| 4.747960 | 42.0 | 1000.000 | 9.000 | GND | L1 | 0.5 | 14.0 | 56.0 |
| 6.723045 | 33.6 | 1000.000 | 9.000 | GND | L1 | 0.6 | 26.4 | 60.0 |

**Table 11: Average data AC Mains Conducted Emissions for FCC/IC Class B Line 1 120Vac/60Hz**

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.168103 | 33.2 | 1000.000 | 9.000 | GND | L1 | 0.5 | 21.8 | 55.0 |
| 0.289833 | 25.2 | 1000.000 | 9.000 | GND | L1 | 0.4 | 25.1 | 50.3 |
| 0.424162 | 25.6 | 1000.000 | 9.000 | GND | L1 | 0.4 | 21.7 | 47.3 |
| 0.541311 | 22.6 | 1000.000 | 9.000 | GND | L1 | 0.4 | 23.4 | 46.0 |
| 0.857279 | 22.6 | 1000.000 | 9.000 | GND | L1 | 0.4 | 23.4 | 46.0 |
| 1.232232 | 26.7 | 1000.000 | 9.000 | GND | L1 | 0.4 | 19.3 | 46.0 |
| 1.717142 | 28.0 | 1000.000 | 9.000 | GND | L1 | 0.5 | 18.0 | 46.0 |
| 2.199213 | 34.6 | 1000.000 | 9.000 | GND | L1 | 0.5 | 11.4 | 46.0 |
| 2.270690 | 36.3 | 1000.000 | 9.000 | GND | L1 | 0.5 | 9.7 | 46.0 |
| 2.300387 | 36.8 | 1000.000 | 9.000 | GND | L1 | 0.5 | 9.2 | 46.0 |
| 2.344490 | 37.5 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.5 | 46.0 |
| 2.360950 | 37.3 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.7 | 46.0 |
| 2.375152 | 37.5 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.6 | 46.0 |
| 2.389438 | 37.3 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.7 | 46.0 |
| 2.406215 | 37.3 | 1000.000 | 9.000 | GND | L1 | 0.5 | 8.7 | 46.0 |
| 2.420688 | 36.9 | 1000.000 | 9.000 | GND | L1 | 0.5 | 9.1 | 46.0 |
| 2.452346 | 36.3 | 1000.000 | 9.000 | GND | L1 | 0.5 | 9.7 | 46.0 |
| 2.547280 | 33.5 | 1000.000 | 9.000 | GND | L1 | 0.5 | 12.5 | 46.0 |
| 3.974122 | 24.8 | 1000.000 | 9.000 | GND | L1 | 0.5 | 21.2 | 46.0 |
| 24.819369 | 24.9 | 1000.000 | 9.000 | GND | L1 | 0.8 | 25.1 | 50.0 |




**Plot 2: AC Mains Conducted Emissions for FCC/IC Class B Line 2 120Vac/60Hz**

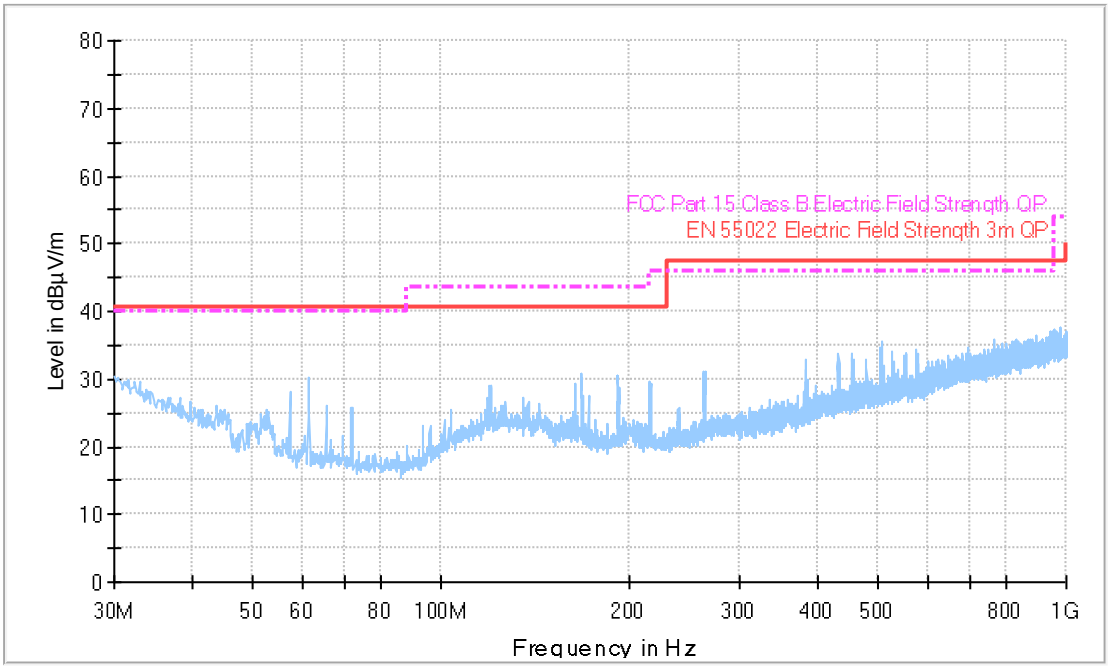
**Table 12: Quasi-Peak data AC Mains Conducted Emissions for FCC/IC Class B Line 2 120Vac/60Hz**

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.162649 | 47.5 | 1000.000 | 9.000 | GND | L2 | 0.5 | 17.8 | 65.3 |
| 0.292160 | 36.9 | 1000.000 | 9.000 | GND | L2 | 0.4 | 23.4 | 60.3 |
| 0.419105 | 43.4 | 1000.000 | 9.000 | GND | L2 | 0.4 | 14.0 | 57.4 |
| 0.518539 | 39.7 | 1000.000 | 9.000 | GND | L2 | 0.4 | 16.3 | 56.0 |
| 0.826981 | 36.9 | 1000.000 | 9.000 | GND | L2 | 0.4 | 19.1 | 56.0 |
| 1.227315 | 41.5 | 1000.000 | 9.000 | GND | L2 | 0.4 | 14.5 | 56.0 |
| 1.589946 | 43.2 | 1000.000 | 9.000 | GND | L2 | 0.4 | 12.8 | 56.0 |
| 2.129987 | 44.3 | 1000.000 | 9.000 | GND | L2 | 0.5 | 11.7 | 56.0 |
| 2.241377 | 47.8 | 1000.000 | 9.000 | GND | L2 | 0.5 | 8.2 | 56.0 |
| 2.284348 | 48.3 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.7 | 56.0 |
| 2.316538 | 48.8 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.2 | 56.0 |
| 2.330472 | 48.1 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.9 | 56.0 |
| 2.358592 | 49.0 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.0 | 56.0 |
| 2.375152 | 48.9 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.1 | 56.0 |
| 2.391828 | 48.2 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.8 | 56.0 |
| 2.406215 | 49.0 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.0 | 56.0 |
| 2.452346 | 47.1 | 1000.000 | 9.000 | GND | L2 | 0.5 | 8.9 | 56.0 |
| 2.532050 | 45.0 | 1000.000 | 9.000 | GND | L2 | 0.5 | 11.0 | 56.0 |
| 4.724291 | 39.4 | 1000.000 | 9.000 | GND | L2 | 0.5 | 16.6 | 56.0 |
| 6.696220 | 32.2 | 1000.000 | 9.000 | GND | L2 | 0.6 | 27.8 | 60.0 |

**Table 13: Average data AC Mains Conducted Emissions for FCC/IC Class B Line 2 120Vac/60Hz**

| Frequency (MHz) | Average (dBµV) | Meas. Time (ms) | Bandwidth (kHz) | PE | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|---|---|---|
| 0.164283 | 33.7 | 1000.000 | 9.000 | GND | L2 | 0.5 | 21.5 | 55.2 |
| 0.261741 | 26.7 | 1000.000 | 9.000 | GND | L2 | 0.4 | 24.4 | 51.1 |
| 0.419105 | 34.2 | 1000.000 | 9.000 | GND | L2 | 0.4 | 13.1 | 47.3 |
| 0.606035 | 28.7 | 1000.000 | 9.000 | GND | L2 | 0.4 | 17.3 | 46.0 |
| 0.841994 | 30.2 | 1000.000 | 9.000 | GND | L2 | 0.4 | 15.8 | 46.0 |
| 1.235932 | 32.2 | 1000.000 | 9.000 | GND | L2 | 0.4 | 13.8 | 46.0 |
| 1.533753 | 32.3 | 1000.000 | 9.000 | GND | L2 | 0.4 | 13.7 | 46.0 |
| 2.024133 | 35.6 | 1000.000 | 9.000 | GND | L2 | 0.5 | 10.4 | 46.0 |
| 2.050605 | 36.2 | 1000.000 | 9.000 | GND | L2 | 0.5 | 9.8 | 46.0 |
| 2.117251 | 37.2 | 1000.000 | 9.000 | GND | L2 | 0.5 | 8.8 | 46.0 |
| 2.300387 | 41.2 | 1000.000 | 9.000 | GND | L2 | 0.5 | 4.8 | 46.0 |
| 2.330472 | 41.4 | 1000.000 | 9.000 | GND | L2 | 0.5 | 4.6 | 46.0 |
| 2.375152 | 41.4 | 1000.000 | 9.000 | GND | L2 | 0.5 | 4.6 | 46.0 |
| 2.406215 | 41.1 | 1000.000 | 9.000 | GND | L2 | 0.5 | 4.9 | 46.0 |
| 2.452346 | 40.0 | 1000.000 | 9.000 | GND | L2 | 0.5 | 6.0 | 46.0 |
| 2.484419 | 38.9 | 1000.000 | 9.000 | GND | L2 | 0.5 | 7.1 | 46.0 |
| 2.532050 | 37.6 | 1000.000 | 9.000 | GND | L2 | 0.5 | 8.4 | 46.0 |
| 4.418282 | 26.1 | 1000.000 | 9.000 | GND | L2 | 0.5 | 19.9 | 46.0 |
| 6.696220 | 20.7 | 1000.000 | 9.000 | GND | L2 | 0.6 | 29.3 | 50.0 |
| 25.967788 | 26.6 | 1000.000 | 9.000 | GND | L2 | 0.8 | 23.4 | 50.0 |

# Appendix E: UNINTENTIONAL RADIATED SPURIOUS EMISSIONS DATA




**Plot 6: Radiated Spurious Emissions Data from 30MHz to 1GHz**

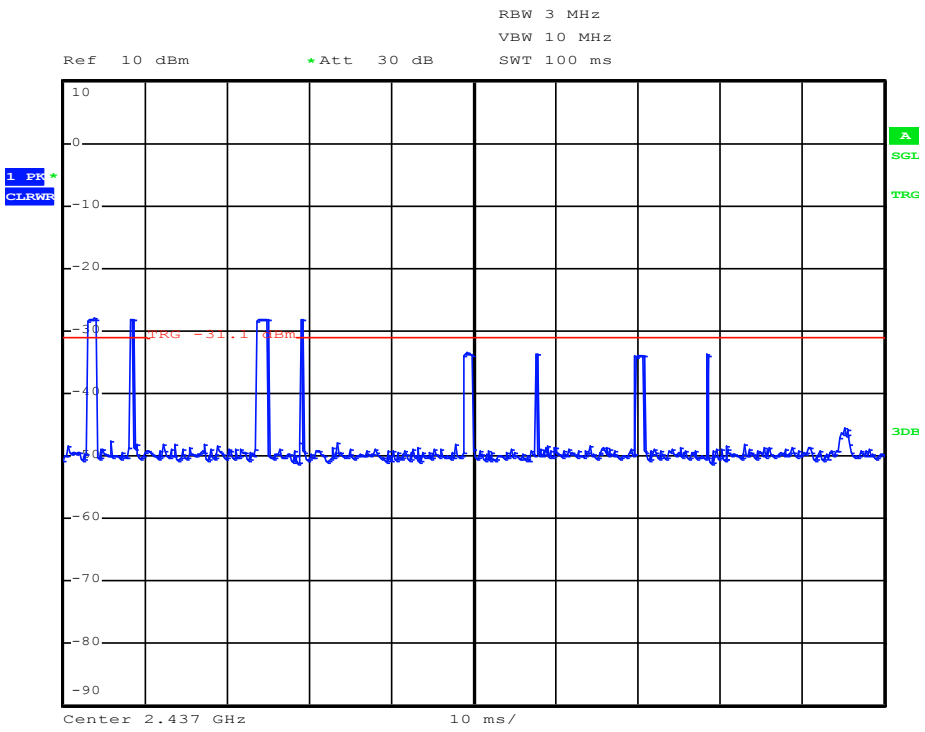
**Table 14: Radiated Spurious Emissions for FCC/IC Class B**

| Frequency | QuasiPeak | Meas. Time | Bandwidth | Antenna height | Polarity | Turntable position | Corr. | Margin | Limit |
|---|---|---|---|---|---|---|---|---|---|
| (MHz) | (dBµV/m) | (ms) | (kHz) | (cm) | | (deg) | (dB) | (dB) | (dBµV/m) |
| 57.35865 | 28.2 | 1000 | 120 | 100 | V | 1 | 14.5 | 11.8 | 40 |
| 61.46105 | 27.4 | 1000 | 120 | 100 | V | 42 | 14.2 | 12.6 | 40 |
| 167.8929 | 27.4 | 1000 | 120 | 199 | H | 314 | 19 | 16.1 | 43.5 |
| 191.76425 | 26 | 1000 | 120 | 120 | V | 130 | 18.7 | 17.5 | 43.5 |
| 216.10465 | 26.7 | 1000 | 120 | 100 | V | 1 | 18.7 | 19.3 | 46 |
| 505.5124 | 31.2 | 1000 | 120 | 130 | H | 195 | 25.7 | 14.8 | 46 |

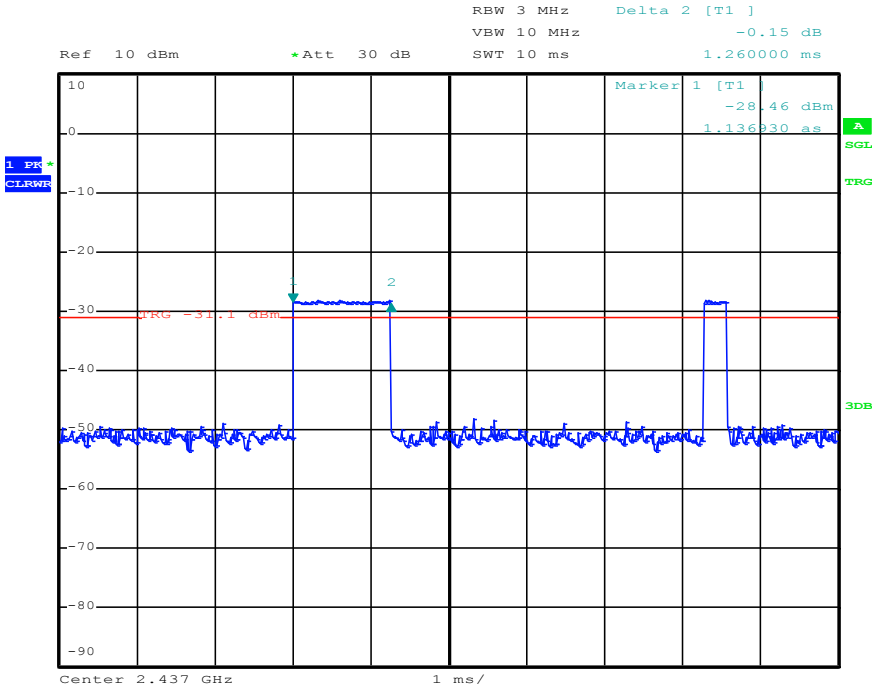
# Appendix F: Duty Cycle Correction Factor

Duty cycle correction factor was measured as per ANSI C63.10:2013 and RSS-GEN issue 4

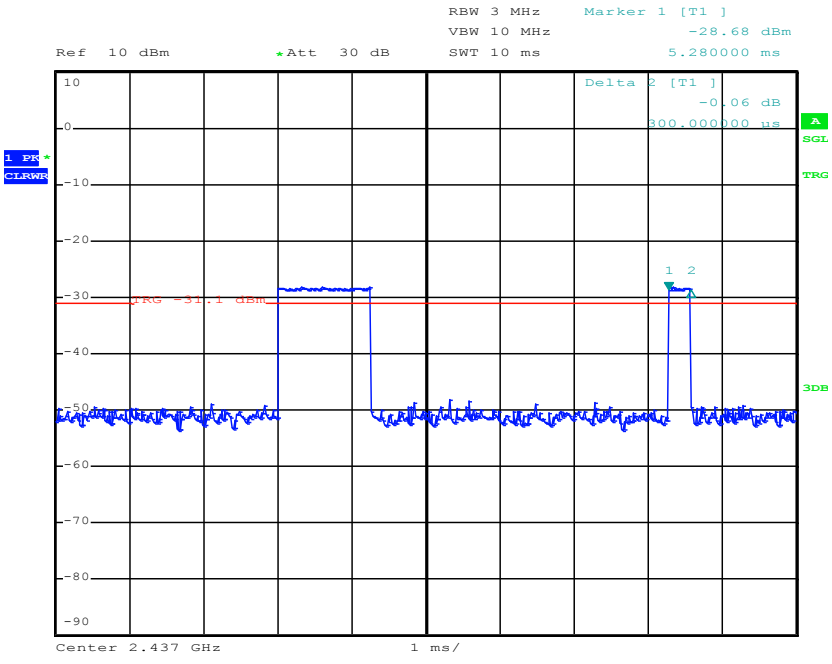
| | |
|---|---|
| **Longer Pulse time (ms)** | 1.26 |
| **Shorter pulse time (ms)** | 0.3 |
| **No. of longer Pulse** | 4 |
| **No. of short Pulse** | 4 |
| **Total time on in 100msec (ms)** | 6.24 |
| **Duty Cycle correction factor (dB)** | -24.09630821 |




**Plot 7: Pulse Train in 100msec**




**Plot 8: Time ON -Pulse 1**




**Plot 2: Time ON -Pulse 2**

# Appendix G: TEST SETUP PICTURES

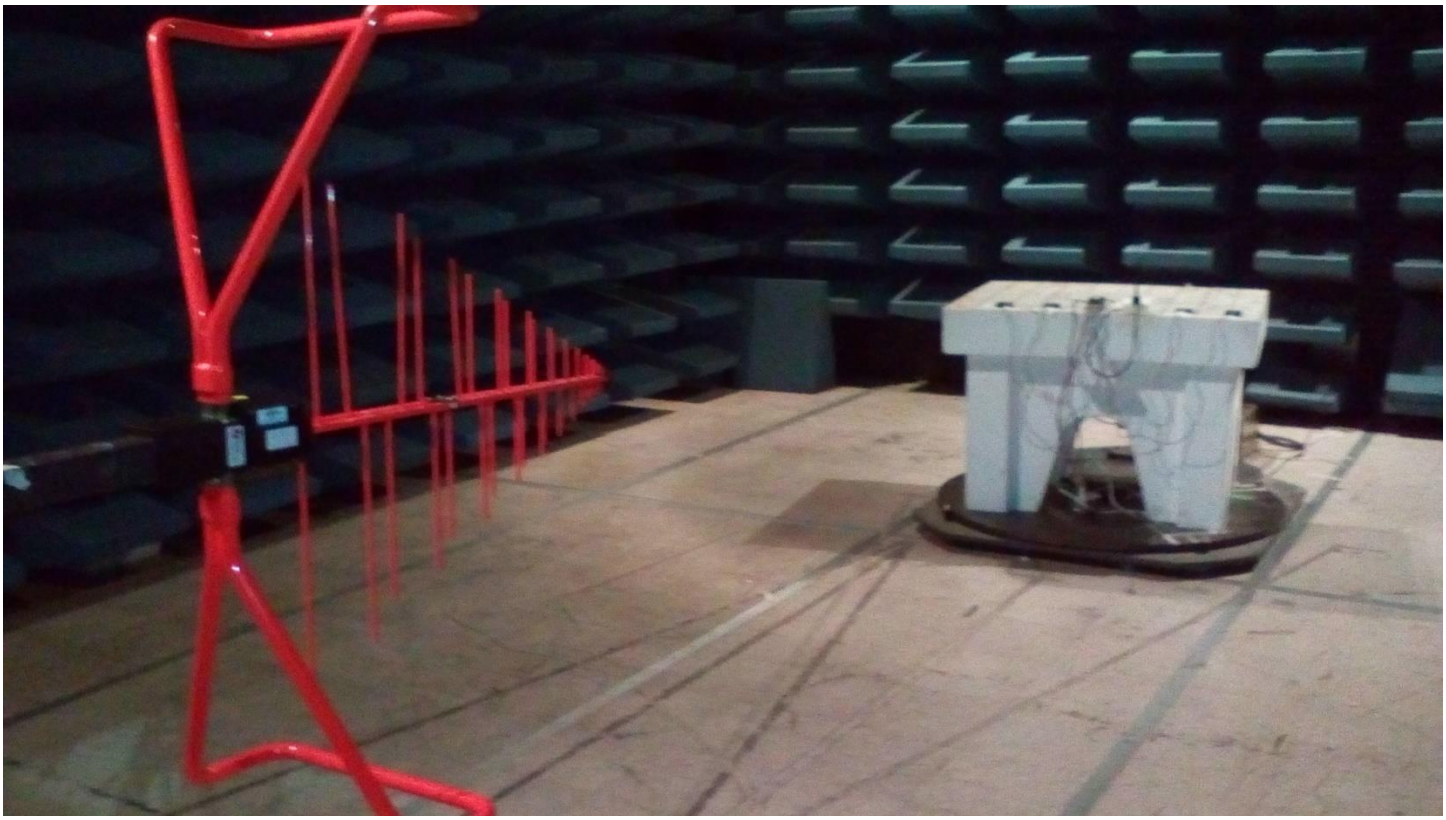


**Figure 1: Radiated Spurious Emissions Test Setup 30-1000MHz**

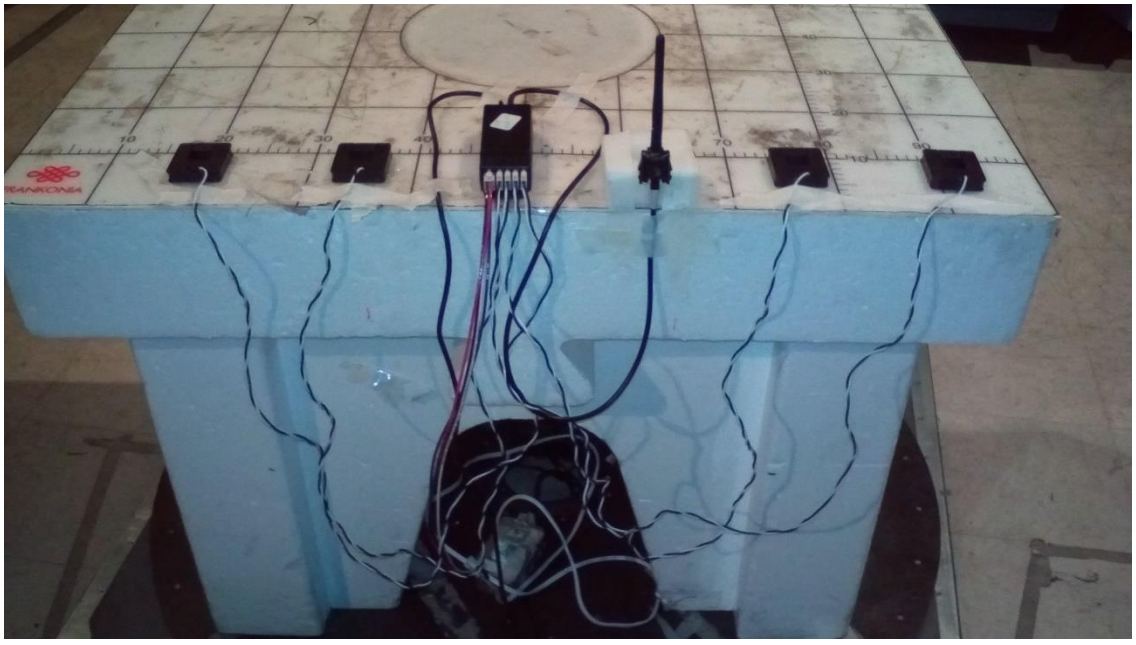


**Figure 2: Radiated Spurious Emissions Test Setup Below 1000MHz**

**Figure 3: Radiated Spurious Emissions Test Setup Below 30MHz**

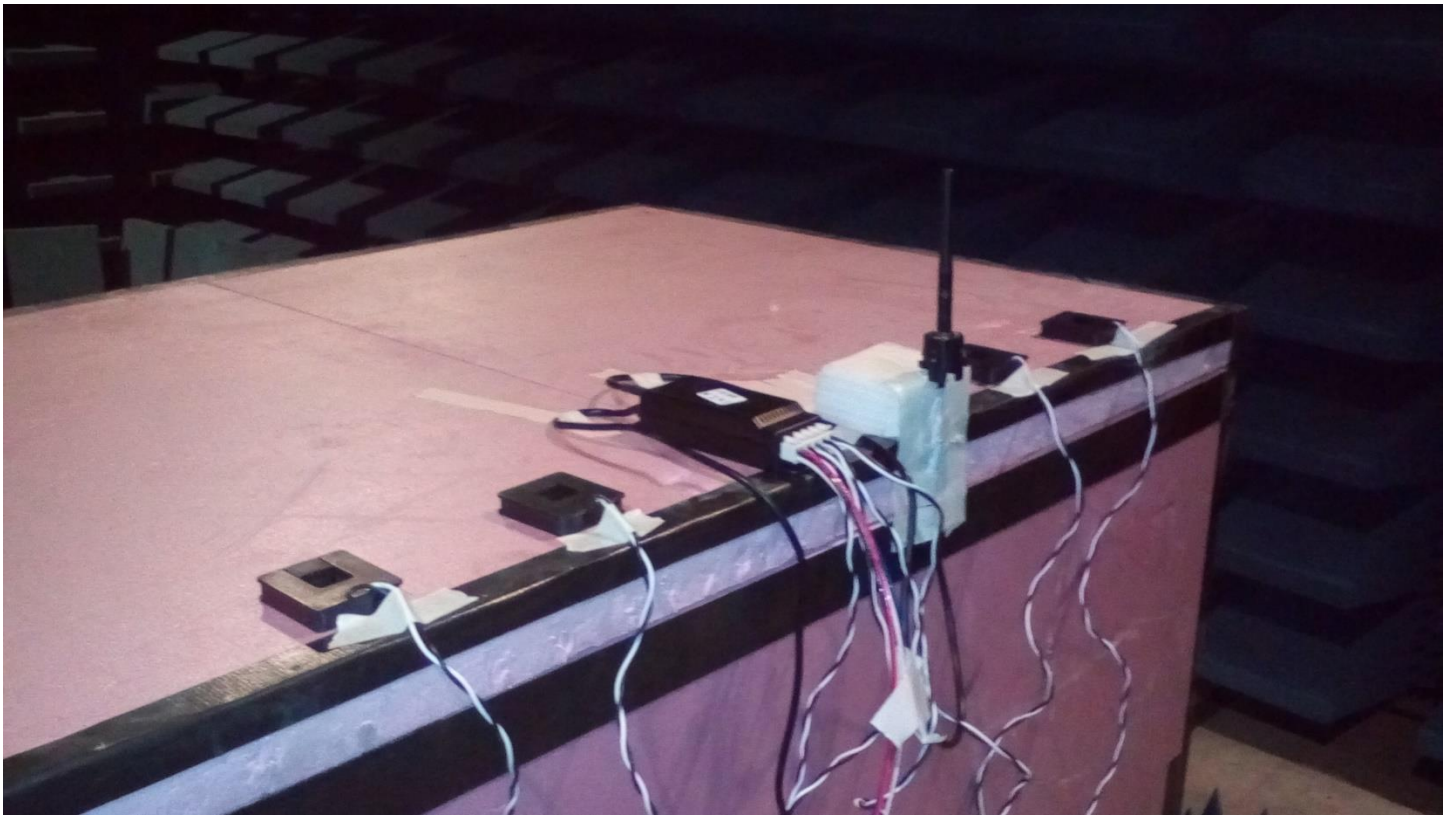


**Figure 4: Radiated Spurious Emissions Test Setup Above 1GHz**

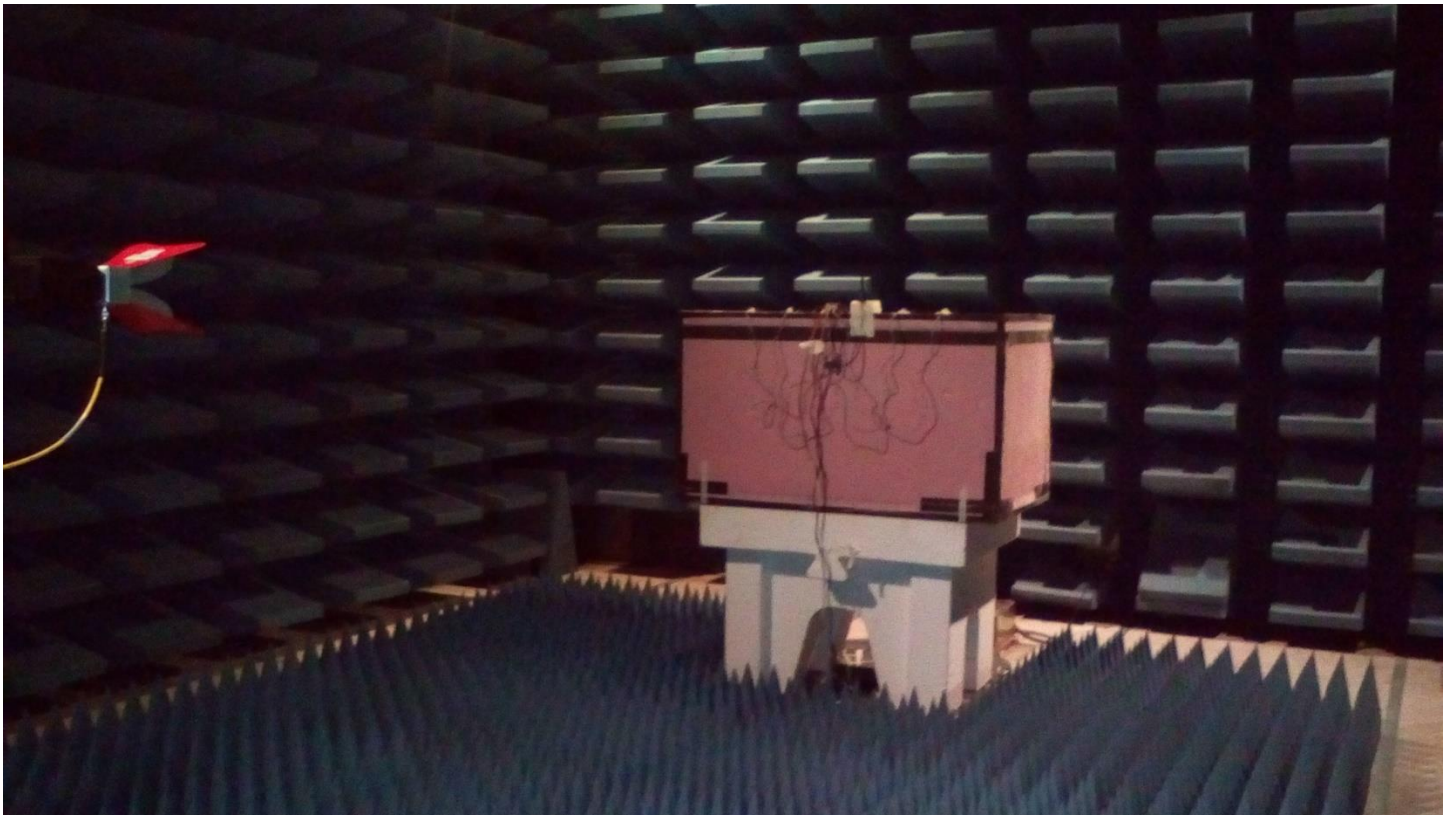


**Figure 5: Radiated Spurious Emissions Test Setup above 1GHz**

# Appendix K: ABBREVIATIONS

| Abbreviation | Definition |
|---|---|
| AC | Alternating Current |
| CE | European Conformity |
| CISPR | Comité International Spécial des Perturbations Radioélectriques |
| DC | Direct Current |
| EFT | Electrical Fast Transient |
| E.I.R.P. | Equivalent Isotropically Radiated Power |
| EMC | ElectroMagnetic Compatibility |
| EMI | ElectroMagnetic Interference |
| ESD | ElectroStatic Discharge |
| EUT | Equipment Under Test |
| FCC | Federal Communications Commission |
| IC | Industry Canada |
| ICES | Interference-Causing Equipment Standard |
| LISN | Line Impedance Stabilizing Network |
| OATS | Open Area Test Site |
| RF | Radio Frequency |
| RMS | Root-Mean-Square |
| SAC | Semi-Anechoic Chamber |

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# END OF REPORT