# Test Report

**FCC ID: 2AKCY-0550000716**
**IC: 4706A-0550000716**

**FCC Rule Part: 15.247**
**ISED Canada Radio Standards Specification: RSS-247**

**Report Number: AT72161430-1C1**

Manufacturer: COOPER LIGHING LLC
Model: 0550-000716

Test Begin Date: July 16, 2020
Test End Date: March 19, 2021

Report Issue Date: May 13, 2021

FOR THE SCOPE OF ACCREDITATION UNDER Certificate Number: 2955.09

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, NIST, or any agency of the Federal Government.

**Prepared By:**

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**TÜV SÜD America Inc.**

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**TÜV SÜD America Inc.**



**This report contains 36 pages**

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# 1 GENERAL

## 1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Innovation, Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

## 1.2 Applicant Information

Cooper Lighting LLC.
NAFSC-1030
PO BOX 818044
CLEVELAND, OH 44181-8044

## 1.3 Product Description

Wave Linx Econ Sensor Integrated, single Chip, (model 0550-000716) will be used as part of light fixture for occupancy detention, ambient light sensor and controlling light over wireless network.

Technical Details:

| Detail | Description |
|---|---|
| Frequency Range (MHz) | 2402 – 2480 |
| Number of Channels | 40 |
| Channel Spacing | 2 MHz |
| Modulation Format | GFSK |
| Data Rates | 1Mbps |
| Operating Voltage | 12-24 Vdc |
| Antenna Type(s) / Gain(s) | Isolated Magnetic Dipole/ 2.6dBi |

Test Sample Serial Number(s): Not Labeled

Test Sample Condition: The equipment was provided in good condition without any physical damage.

## 1.4 Test Methodology and Considerations

All modes of operation, including all data rates, were evaluated and the data presented in this report represents the worst case where applicable.

For radiated emissions, the EUT was evaluated in three orthogonal orientations. The worst-case orientation was the X-orientation.

For antenna port conducted emissions, an SMA pigtail was used to directly connect the DUT to the measuring equipment through suitable attenuation.

For AC Power Line Conducted emissions measurements, the EuT was connected to a representative LED Driver Power Supply.

Power setting during test: 12.7 dBm.

# 2 TEST FACILITIES

## 2.1 Location

The radiated and conducted emissions test sites are located at the following addresses:

TÜV SÜD America, Inc.
5945 Cabot Pkwy, Suite 100
Alpharetta, GA 30005
Phone: (678) 341-5900

## 2.2 Laboratory Accreditations/Recognitions/Certifications

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by the American Association for Laboratory Accreditation/A2LA accreditation program and has been issued certificate number 2955.09 in recognition of this accreditation.

Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scopes of accreditation.

The Semi-Anechoic Chamber Test Sites and Conducted Emissions Sites have been fully described, submitted to, and accepted by the FCC, ISED Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

| | |
|---|---|
| FCC Designation Accreditation Number: | US1233 |
| ISED Canada Lab Code: | 23932 |
| VCCI Member Number: | 1831 |
| • VCCI Registration Number | A-0295 |

## 2.3 Radiated Emissions Test Site Description

### 2.3.1 Semi-Anechoic Chamber Test Site – Chamber A

The Semi-Anechoic Chamber Test Site consists of a 20’ x 30’ x 18’ shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 5’ in diameter and is located 5’6” from the back wall of the chamber. The chamber is grounded via 1 - 8’ copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted EMCO Model 1060 installed in an all steel frame. The table is remotely operated from inside the control room located 25’ from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3’ x 6’ x 4’ deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4” PVC chase from the turntable to the pit that allows for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

The chamber rear wall is covered with a mixture of Siepel pyramidal absorber. The side walls of the chamber are partially covered with Siepel pyramidal absorber.

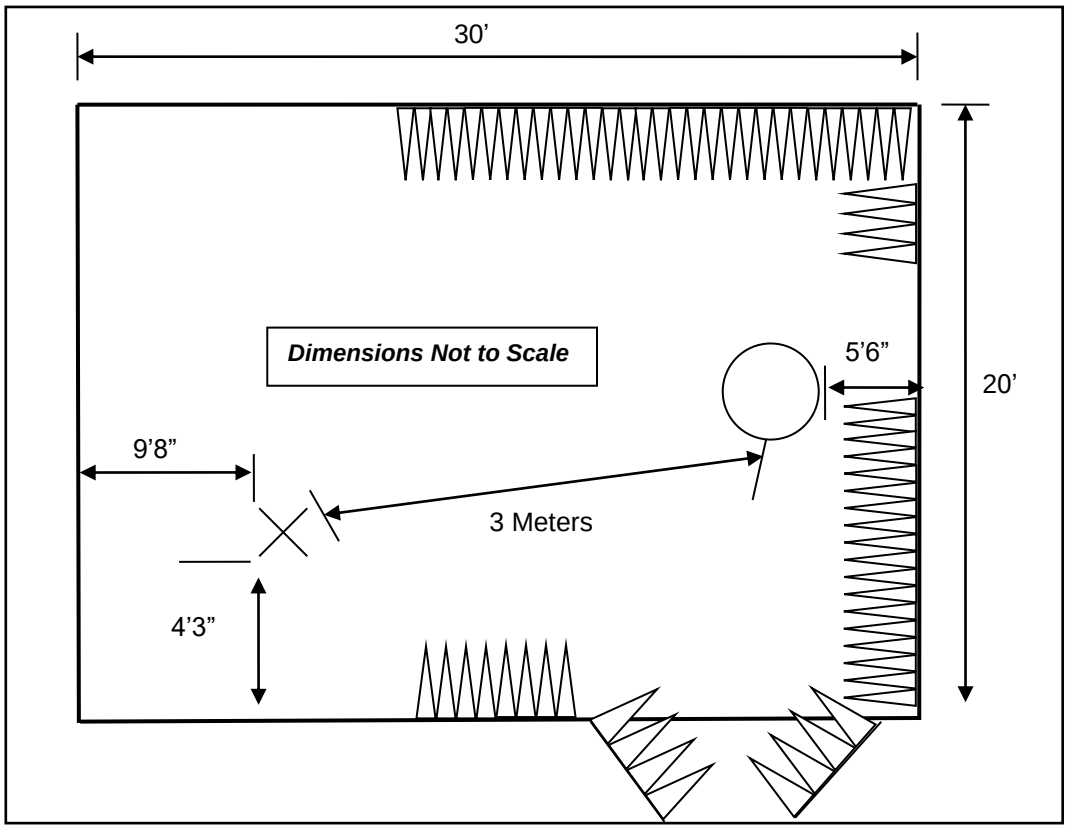



**Figure 2.3.1-1: Semi-Anechoic Chamber Test Site – Chamber A**

### 2.3.2 Semi-Anechoic Chamber Test Site – Chamber B

The Semi-Anechoic Chamber Test Site consists of a 20'W x 30'L x 20'H shielded enclosure. The chamber is lined with ETS-Lindgren Ferrite Absorber, model number FT-1500. The ferrite tile 600 mm x 600 mm (2.62 in x 23.62 in) panels and are mounted directly on the inner walls of the chamber shield.

The specular regions of the chamber are lined with additional ETS-Lindgren PS-600 hybrid absorber to extend its frequency range up to 18GHz and beyond.

The turntable is a 2m ETS-Lindgren Model 2170 and installed off the center axis is located 5'6" from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the shield using #8 solid copper wire.

The antenna mast is an EMCO 1060 and is remotely controlled from the control room for both antenna height and polarization.

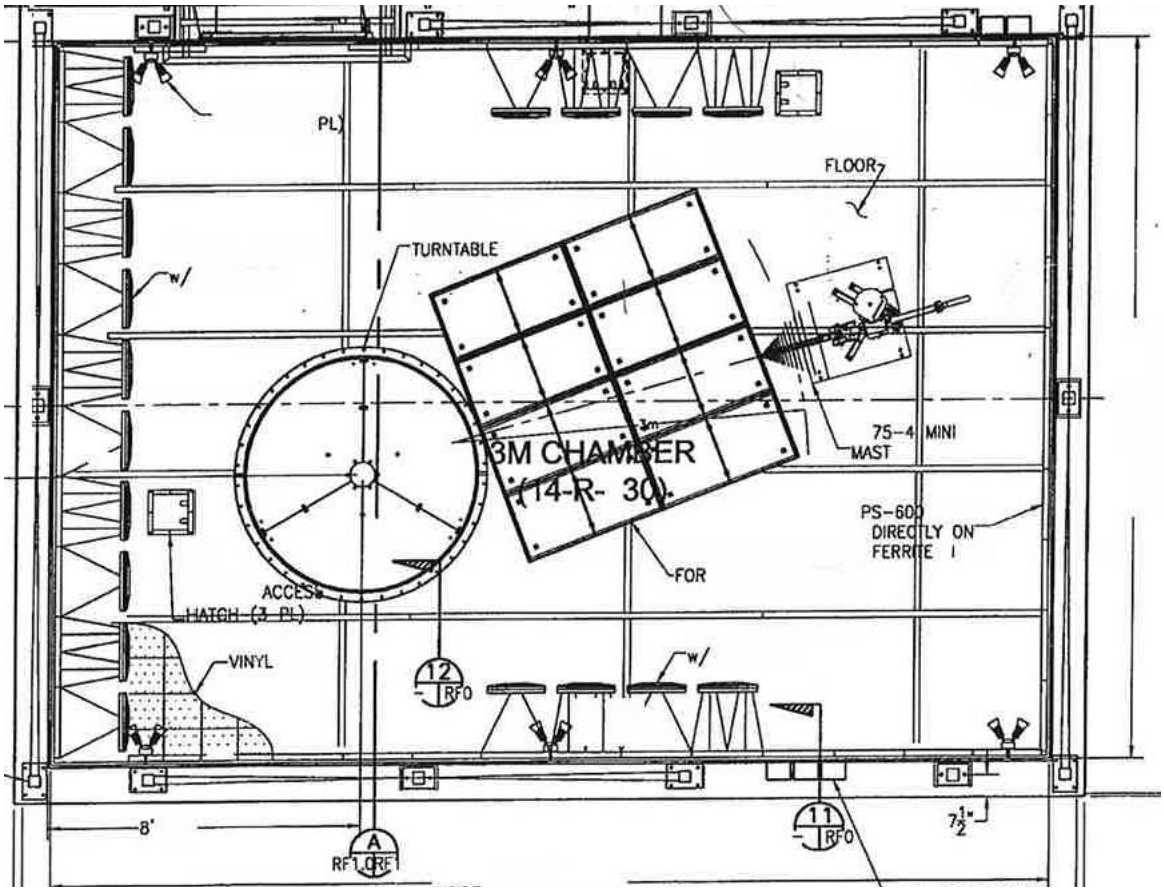



**Figure 2.3.2-1: Semi-Anechoic Chamber Test Site – Chamber B**

## 2.4 Conducted Emissions Test Site Description

### 2.4.1 Conducted Emissions Test Site

The AC mains conducted EMI site is located in the main EMC lab. It consists of a 12' x 10' horizontal coupling plane (HCP) as well as a 12'x8' vertical coupling plane (VCP). The HGP is constructed of 4' x 10' sheets of particle board sandwiched by galvanized steel sheets. These panels are bonded using 11AWG 1/8" x 2" by 10' galvanized sheet steel secured to the panels via by screws. The VCP is constructed of three 4'x8' sheets of 11AWG solid aluminum.

The HCP and VCP are electrically bonded together using 1"x1" angled aluminum secured with screws.

The site is of sufficient size to test tabletop and floor standing equipment in accordance with section 6.1.4 of ANSI C63.10.

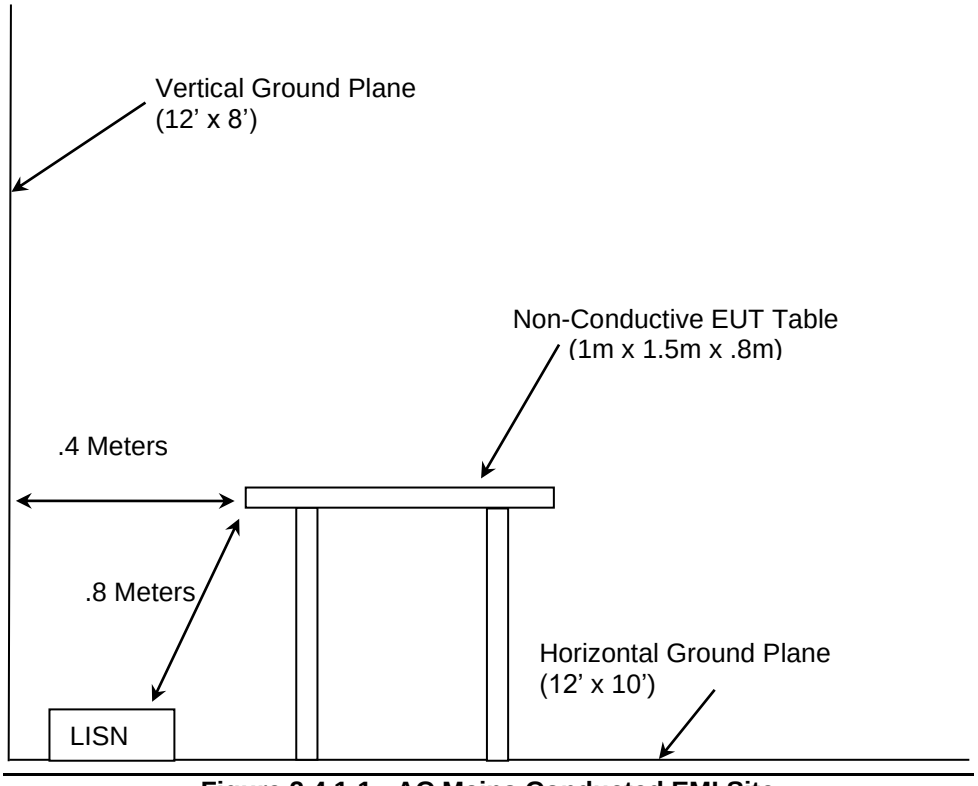



**Figure 2.4.1-1: AC Mains Conducted EMI Site**

## 3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2020
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2020
- FCC KDB 558074 D01 15.247 Measure Guidance v05r02 – Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating Under Section 15.247 of the FCC Rules, April 2, 2019
- ISED Canada Radio Standards Specification: RSS-247 – Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ISED Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1 (March 2019), Amendment 2 (February 2021)

## 4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

**Table 4-1: Test Equipment**

| Asset ID | Manufacturer | Model | Equipment Type | Serial Number | Last Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|---|
| 168 | Hewlett Packard | 11947A | Transient Pulse Limiter | 44829 | 03/03/2021 | 03/03/2022 |
| 861 | Com-Power Corporation | LI-1100C | Line Impedance Stabilization Network | 20180038 | 02/26/2021 | 02/26/2022 |
| 862 | Com-Power Corporation | LI01100C | Line Impedance Stabilization Network | 20180039 | 02/26/2021 | 02/26/2022 |
| 813 | PMM | 9010 | EMI Receiver; RF Input 50ohm; 10Hz-50MHz; 10Hz-30MHz | 697WW30606 | 03/03/2020 | 06/03/2021 |
| 871 | TUV SUD | RF Cable | RF Cable(CE Cable) | 871 | 04/23/2020 | 04/23/2021 |
| 494 | Omega | iBTHX-W | Environmental Sensor | 9460211 | 11/03/2020 | 11/03/2021 |
| 827 | TUV SUD | TS8997 Rack Cable Set | TS8997 Rack Cable Set | N/A | 09/04/2020 | 09/04/2021 |
| 638 | Rohde & Schwarz | OSP 120 | Open Switch and Control Unit | 101229 | 06/11/2019 | 06/11/2021 |
| 622 | Rohde & Schwarz | FSV40 (v3.40) | FSV Signal Analyzer 10Hz to 40GHz | 101338 | 08/24/2020 | 08/24/2021 |
| 432 | Microwave Circuits | H3G020G4 | Highpass Filter | 264066 | 06/09/2020 | 06/09/2021 |
| 22 | Hewlett Packard | 8449B | High Frequency Pre-Amp | 3008A00526 | 10/19/2020 | 10/19/2021 |
| 628 | EMCO | 6502 | Active Loop Antenna 10kHz-30MHz | 9407-2877 | 02/11/2019 | 05/11/2021 |
| 422 | Florida RF | SMS-200AW-72.0-SMR | Cable | 805 | 11/27/2017 | 11/27/2018 |
| 335 | Suhner | SF-102A | Cable (40GHZ) | 882/2A | 06/23/2020 | 06/23/2021 |
| 345 | Suhner Sucoflex | 102A | Cable 42(GHZ) | 1077/2A | 06/23/2020 | 06/23/2021 |
| 882 | Rohde & Schwarz | ESW44 | ESW44 EMI TEST RECEIVER | 101961 | 07/28/2020 | 07/28/2021 |
| 857 | ETS Lindgren | 3117 | Horn Antenna 1-18GHz | 00153608 | 11/12/2019 | 11/12/2021 |
| 3161 | Teseq; Huber+Suhner | CBL 6112D;6804-17-A | Bilog Antenna; Attenuator | 51323; 01252019A | 3/19/2021 | 3/19/2022 |
| 334 | Rohde & Schwarz | 3160-09 | HF 18 - 26.5GHz | 49404 | NCR | NCR |

**NCR = No Calibration Required**
**NOTE: All test equipment was used only during active calibration cycles as reported above.**

## 5 SUPPORT EQUIPMENT

**Table 5-1: Support Equipment**

| Item | Equipment Type | Manufacturer | Model Number | Serial Number |
|---|---|---|---|---|
| 1 | Sensor Module | Eaton Cooper Lighting | 0550-000716 | Not Labeled |
| 2 | LED Electronic Driver Power Supply | Eaton Cooper Lighting | X1040C110V054PST2 | 1934734JTJ78367 |
| 3 | 3W Constant Voltage LED Driver Power Supply | XenerQi | XEL-003CBU-V012XB-NNA01P | XELAA2501929000162 |

**Note:** 1. Item 2 is used for RF Conducted and Radiated Emissions Test.
2. Item 3 is used for Power Line Conducted Emissions Test.

**Table 5-2: Cable Description**

| Item | Cable Type | Length | Shield |
|---|---|---|---|
| A | AC Power Cord | 100 cm | No |
| B | DC Power Cable | 50 cm | Yes |

## 6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

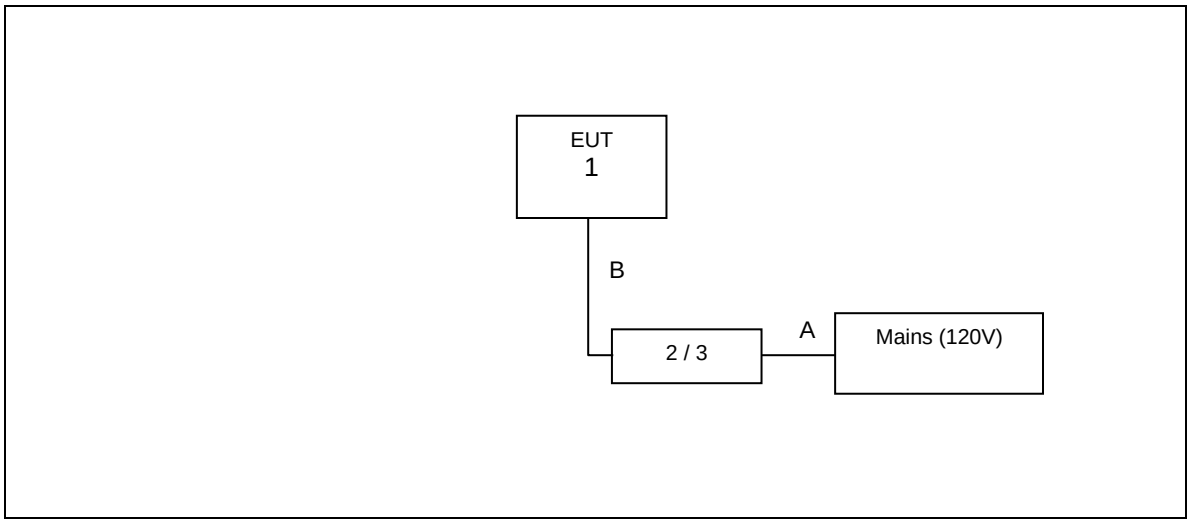



**Figure 6-1: Test Setup Block Diagram**

# 7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

## 7.1 Antenna Requirement – FCC: 15.203

The EUT utilizes Isolated Magnetic Dipole Antenna which is internal to the enclosure and affixed to the PCB via a UFL cable.

## 7.2 Power Line Conducted Emissions – FCC: 15.207, ISED Canada: RSS-Gen 8.8

### 7.2.1 Measurement Procedure

Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**
**Margin = Corrected Reading - Applicable Limit**

### 7.2.2 Measurement Results

Performed by: Eugene Sello

**Table 7.2.2-1: Conducted EMI Results – 120VAC/60Hz – Line 1**

| Frequency (MHz) | Corrected Reading | | Limit | | Margin | | Correction (dB) |
|---|---|---|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average | Quasi-Peak | Average | |
| | (dBµV) | (dBµV) | (dBµV) | (dBµV) | (dB) | (dB) | |
| 0.15 | 41.79 | 31.69 | 66 | 56 | -24.21 | -24.31 | 10.16 |
| 0.162 | 40.25 | 25.52 | 65.36 | 55.36 | -25.11 | -29.84 | 10.15 |
| 0.174 | 37.83 | 24.57 | 64.77 | 54.77 | -26.94 | -30.2 | 10.14 |
| 0.186 | 36.42 | 23.47 | 64.21 | 54.21 | -27.79 | -30.74 | 10.13 |
| 0.198 | 35.23 | 22.95 | 63.69 | 53.69 | -28.46 | -30.74 | 10.12 |
| 0.21 | 33.32 | 22.52 | 63.21 | 53.21 | -29.89 | -30.69 | 10.1 |
| 2.514 | 25.85 | 11.17 | 56 | 46 | -30.15 | -34.83 | 10.08 |
| 2.998 | 25.89 | 11.54 | 56 | 46 | -30.11 | -34.46 | 10.08 |
| 10.014 | 20.41 | 11.61 | 60 | 50 | -39.59 | -38.39 | 10.1 |
| 29.982 | 22.54 | 14.2 | 60 | 50 | -37.46 | -35.8 | 10.21 |

**Table 7.2.2-2: Conducted EMI Results – 120VAC/60Hz – Line 2**

| Frequency (MHz) | Corrected Reading | | Limit | | Margin | | Correction (dB) |
|---|---|---|---|---|---|---|---|
| | Quasi-Peak | Average | Quasi-Peak | Average | Quasi-Peak | Average | |
| | (dBµV) | (dBµV) | (dBµV) | (dBµV) | (dB) | (dB) | |
| 0.15 | 41.73 | 31.99 | 66 | 56 | -24.27 | -24.01 | 10.21 |
| 0.154 | 41.58 | 31.41 | 65.78 | 55.78 | -24.2 | -24.37 | 10.21 |
| 0.166 | 40.61 | 26.92 | 65.16 | 55.16 | -24.55 | -28.24 | 10.19 |
| 0.178 | 38.21 | 25.69 | 64.58 | 54.58 | -26.37 | -28.89 | 10.18 |
| 0.198 | 35.66 | 25.86 | 63.69 | 53.69 | -28.03 | -27.83 | 10.16 |
| 0.21 | 33.2 | 25.66 | 63.21 | 53.21 | -30.01 | -27.55 | 10.15 |
| 2.546 | 25.36 | 11.21 | 56 | 46 | -30.64 | -34.79 | 10.11 |
| 2.734 | 25.78 | 11.26 | 56 | 46 | -30.22 | -34.74 | 10.11 |
| 2.986 | 24.65 | 11.34 | 56 | 46 | -31.35 | -34.66 | 10.11 |
| 29.982 | 22.56 | 14.22 | 60 | 50 | -37.44 | -35.78 | 10.23 |

## 7.3 6dB / 99% Bandwidth – FCC: 15.247(a)(2), ISED Canada: RSS-247 5.2(a), RSS-GEN 6.7

### 7.3.1 Measurement Procedure

The 6dB bandwidth was measured in accordance with the FCC KDB 558074 D01 Section 8.2 which references Subclause 11.8 of ANSI C63.10. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold with a peak detector active. The marker-delta function of the spectrum analyzer was utilized to determine the 6dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The resolution bandwidth was set from 1% to 5% of the occupied bandwidth and the video bandwidth set to at least 3 times the resolution bandwidth. A peak detector was used.

### 7.3.2 Measurement Results

Performed by: Divya Adusumilli

**Table 7.3.2-1: 6dB / 99% Bandwidth**

| Modulation | Frequency [MHz] | 6dB Bandwidth [MHz] | 99% Bandwidth [MHz] |
|---|---|---|---|
| GFSK / 1Mbps | 2402 | 0.792 | 1.040 |
| | 2440 | 0.792 | 1.040 |
| | 2480 | 0.753 | 1.040 |

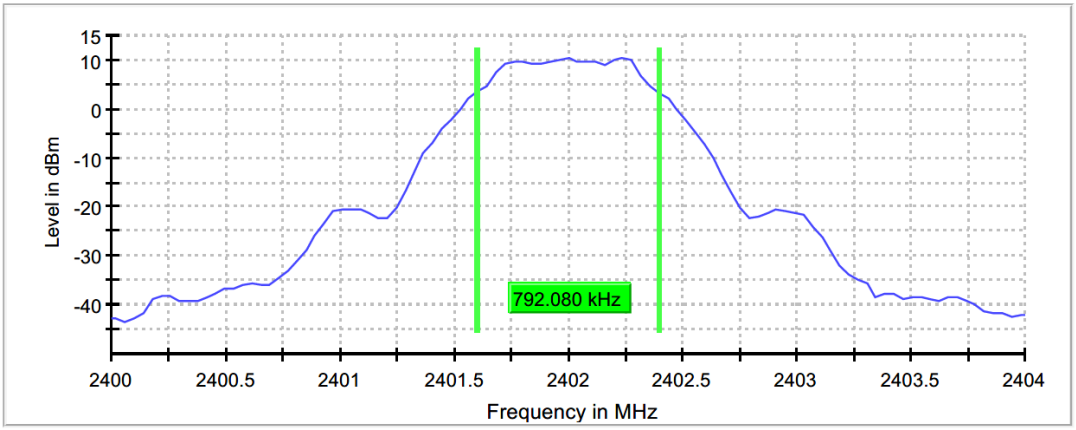



**Figure 7.3.2-1: 2402MHz - 6dB BW**

**Table 7.3.2-2: Measurement Settings (6dB BW)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.40000 GHz | 2.40000 GHz |
| Stop Frequency | 2.40400 GHz | 2.40400 GHz |
| Span | 4.000 MHz | 4.000 MHz |
| RBW | 100.000 kHz | ~ 100.000 kHz |
| VBW | 300.000 kHz | ~ 300.000 kHz |
| Sweep Points | 101 | ~ 80 |
| Sweep time | 18.938 µs | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 7 / max. 150 | max. 150 |
| Stable | 5 / 5 | 5 |
| Max Stable Difference | 0.16 dB | 0.50 dB |

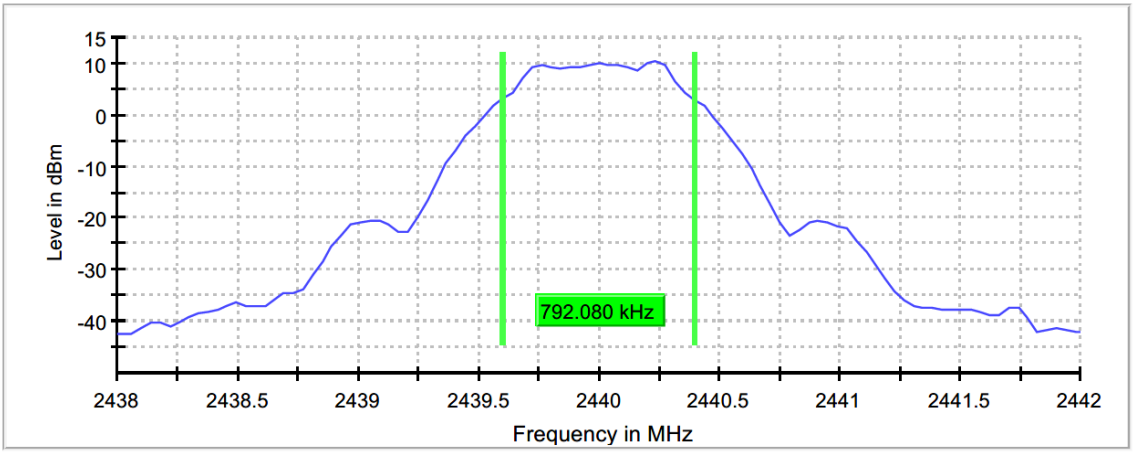



**Figure 7.3.2-2: 2440MHz - 6dB BW**

**Table 7.3.2-3: Measurement Settings (6dB BW)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.43800 GHz | 2.43800 GHz |
| Stop Frequency | 2.44200 GHz | 2.44200 GHz |
| Span | 4.000 MHz | 4.000 MHz |
| RBW | 100.000 kHz | ~ 100.000 kHz |
| VBW | 300.000 kHz | ~ 300.000 kHz |
| Sweep Points | 101 | ~ 80 |
| Sweep time | 18.938 µs | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 8 / max. 150 | max. 150 |
| Stable | 5 / 5 | 5 |
| Max Stable Difference | 0.10 dB | 0.50 dB |

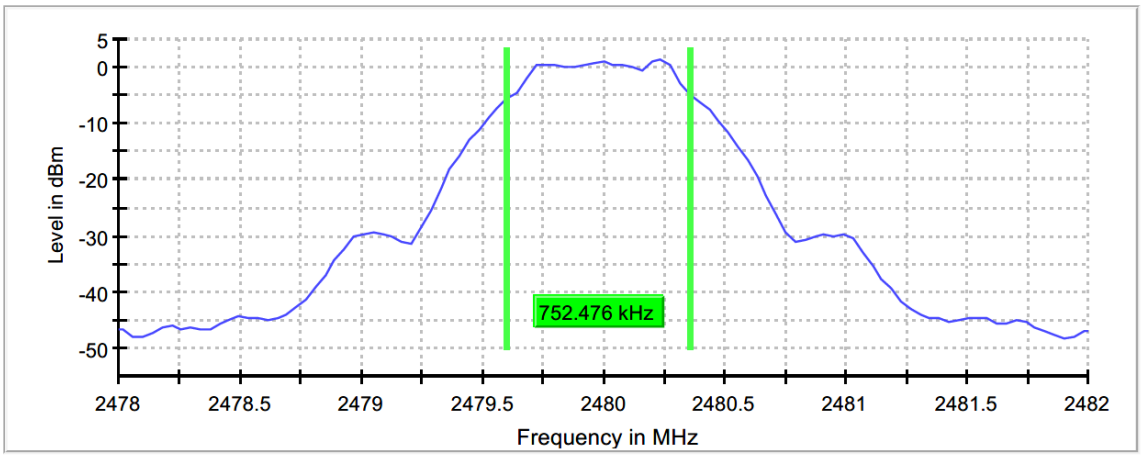



**Figure 7.3.2-3: 2480MHz - 6dB BW**

**Table 7.3.2-4: Measurement Settings (6dB BW)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.47800 GHz | 2.47800 GHz |
| Stop Frequency | 2.48200 GHz | 2.48200 GHz |
| Span | 4.000 MHz | 4.000 MHz |
| RBW | 100.000 kHz | ~ 100.000 kHz |
| VBW | 300.000 kHz | ~ 300.000 kHz |
| Sweep Points | 101 | ~ 80 |
| Sweep time | 18.938 µs | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 9 / max. 150 | max. 150 |
| Stable | 5 / 5 | 5 |
| Max Stable Difference | 0.03 dB | 0.50 dB |

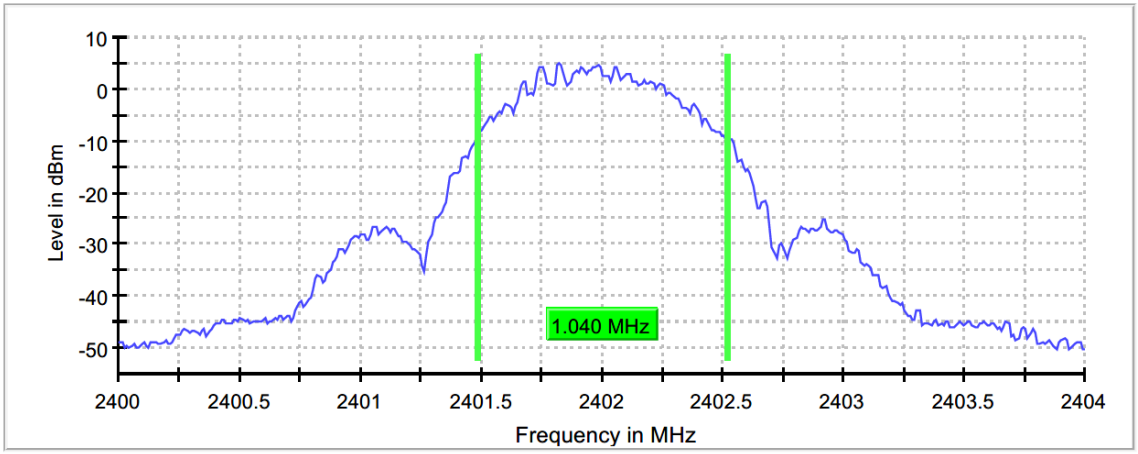



**Figure 7.3.2-4: 2402MHz - 99% OBW**

**Table 7.3.2-5: Measurement Settings (OBW)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.40000 GHz | 2.40000 GHz |
| Stop Frequency | 2.40400 GHz | 2.40400 GHz |
| Span | 4.000 MHz | 4.000 MHz |
| RBW | 20.000 kHz | >= 20.000 kHz |
| VBW | 100.000 kHz | >= 60.000 kHz |
| Sweep Points | 400 | ~ 400 |
| Sweep time | 94.824 µs | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.30 dB | 0.30 dB |
| Run | 6 / max. 150 | max. 150 |
| Stable | 3 / 3 | 3 |
| Max Stable Difference | 0.03 dB | 0.30 dB |

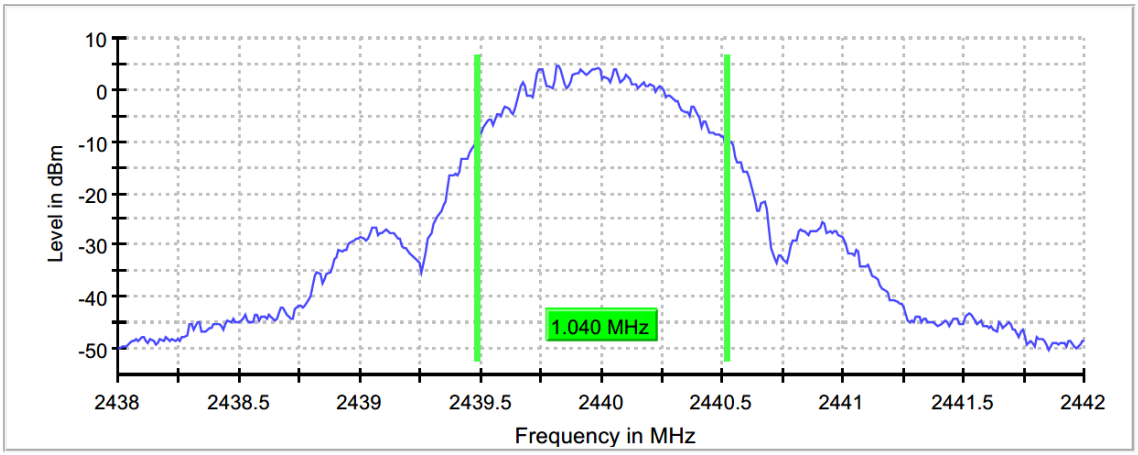



**Figure 7.3.2-5: 2440MHz - 99% OBW**

**Table 7.3.2-6: Measurement Settings (OBW)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.43800 GHz | 2.43800 GHz |
| Stop Frequency | 2.44200 GHz | 2.44200 GHz |
| Span | 4.000 MHz | 4.000 MHz |
| RBW | 20.000 kHz | >= 20.000 kHz |
| VBW | 100.000 kHz | >= 60.000 kHz |
| Sweep Points | 400 | ~ 400 |
| Sweep time | 94.824 µs | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.30 dB | 0.30 dB |
| Run | 6 / max. 150 | max. 150 |
| Stable | 3 / 3 | 3 |
| Max Stable Difference | 0.04 dB | 0.30 dB |

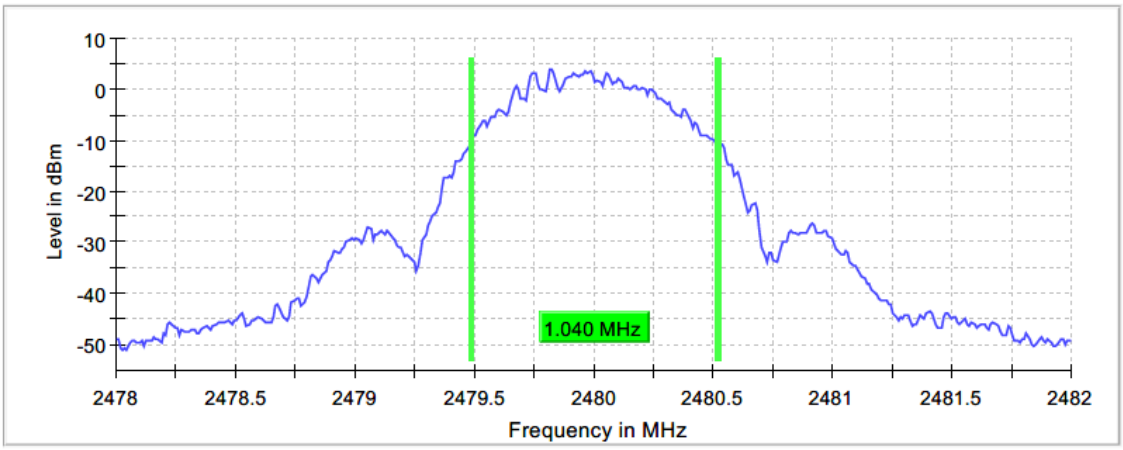



**Figure 7.3.2-6: 2480MHz - 99% OBW**

**Table 7.3.2-7: Measurement Settings (OBW)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.47800 GHz | 2.47800 GHz |
| Stop Frequency | 2.48200 GHz | 2.48200 GHz |
| Span | 4.000 MHz | 4.000 MHz |
| RBW | 20.000 kHz | >= 20.000 kHz |
| VBW | 100.000 kHz | >= 60.000 kHz |
| Sweep Points | 400 | ~ 400 |
| Sweep time | 94.824 µs | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.30 dB | 0.30 dB |
| Run | 5 / max. 150 | max. 150 |
| Stable | 3 / 3 | 3 |
| Max Stable Difference | 0.08 dB | 0.30 dB |

## 7.4 Fundamental Emission Output Power – FCC: 15.247(b)(3), ISED Canada: RSS-247 5.4(d)

### 7.4.1 Measurement Procedure

The maximum conducted output power was measured in accordance with FCC KDB 558074 D01 utilizing the RBW ≥ DTS Bandwidth method. The RF output of the equipment under test was directly connected to the input of the analyzer applying suitable attenuation. Worst-case power across all data rates is reported.

### 7.4.2 Measurement Results

Performed by: Divya Adusumilli

**Table 7.4.2-1: Conducted Output Power**

| Modulation | Frequency [MHz] | Peak Power [dBm] |
|---|---|---|
| GFSK / 1Mbps | 2402 | 11.3 |
| | 2440 | 11.0 |
| | 2480 | 10.4 |

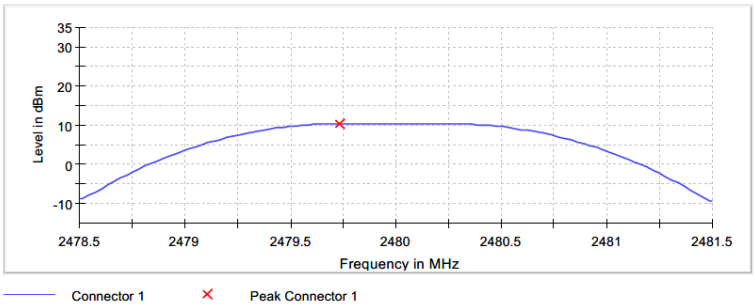



**Figure 7.4.2-1: 2402MHz Plot**

**Table 7.4.2-2: Measurement Settings**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.40050 GHz | 2.40050 GHz |
| Stop Frequency | 2.40350 GHz | 2.40350 GHz |
| Span | 3.000 MHz | 3.000 MHz |
| RBW | 1.000 MHz | >= 792.081 kHz |
| VBW | 3.000 MHz | >= 3.000 MHz |
| Sweep Points | 101 | ~ 101 |
| Sweep time | 1.907 µs | AUTO |
| Reference Level | 20.000 dBm | 20.000 dBm |
| Attenuation | 40.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 4 / max. 150 | max. 150 |
| Stable | 3 / 3 | 3 |
| Max Stable Difference | 0.04 dB | 0.50 dB |

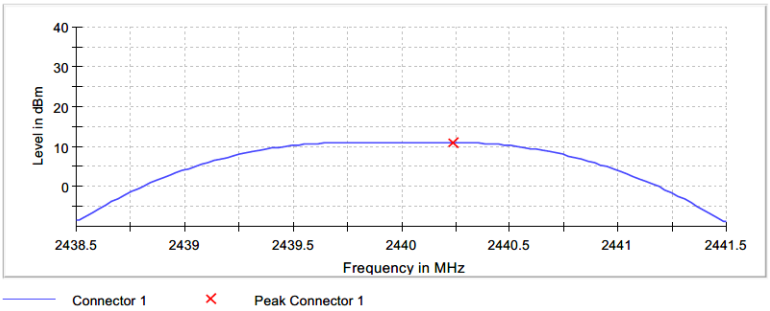



**Figure 7.4.2-2: 2440MHz Plot**

**Table 7.4.2-3: Measurement Settings**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.43850 GHz | 2.43850 GHz |
| Stop Frequency | 2.44150 GHz | 2.44150 GHz |
| Span | 3.000 MHz | 3.000 MHz |
| RBW | 1.000 MHz | >= 792.081 kHz |
| VBW | 3.000 MHz | >= 3.000 MHz |
| Sweep Points | 101 | ~ 101 |
| Sweep time | 1.907 µs | AUTO |
| Reference Level | 20.000 dBm | 20.000 dBm |
| Attenuation | 40.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 4 / max. 150 | max. 150 |
| Stable | 3 / 3 | 3 |
| Max Stable Difference | 0.02 dB | 0.50 dB |

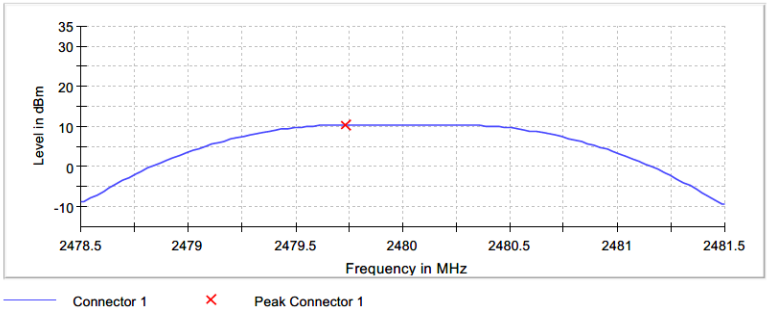



**Figure 7.4.2-3: 2480MHz Plot**

**Table 7.4.2-4: Measurement Settings**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.47850 GHz | 2.47850 GHz |
| Stop Frequency | 2.48150 GHz | 2.48150 GHz |
| Span | 3.000 MHz | 3.000 MHz |
| RBW | 1.000 MHz | >= 752.477 kHz |
| VBW | 3.000 MHz | >= 3.000 MHz |
| Sweep Points | 101 | ~ 101 |
| Sweep time | 1.907 µs | AUTO |
| Reference Level | 20.000 dBm | 20.000 dBm |
| Attenuation | 40.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | FFT | AUTO |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 4 / max. 150 | max. 150 |
| Stable | 3 / 3 | 3 |
| Max Stable Difference | 0.01 dB | 0.50 dB |

## 7.5 Emission Levels

### 7.5.1 Emissions into Non-restricted Frequency Bands – FCC: 15.247(d); ISED Canada: RSS-247 5.5

#### *7.5.1.1* Measurement Procedure

The unwanted emissions into non-restricted bands were measured conducted in accordance with FCC KDB 558074 D01 Section 8.5. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz. The Video Bandwidth (VBW) was set to ≥ 300 kHz. The resulting spectrum analyzer peak level was used to determine the reference level with respect to the 20 dBc limit at the band edges. The spectrum span was then adjusted for the measurement of spurious emissions from 30MHz to 25GHz, 10 times the highest fundamental frequency. The worst-case for each modulation was investigated at the lower and upper band edges.

#### *7.5.1.2* Measurement Results

Performed by: Divya Adusumilli

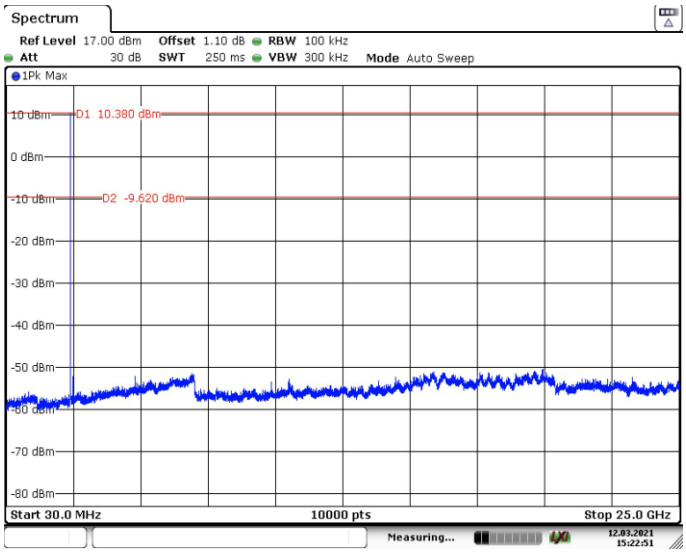



Figure 7.5.1.2-1: LCH – 30MHz–25GHz (1Mbps)

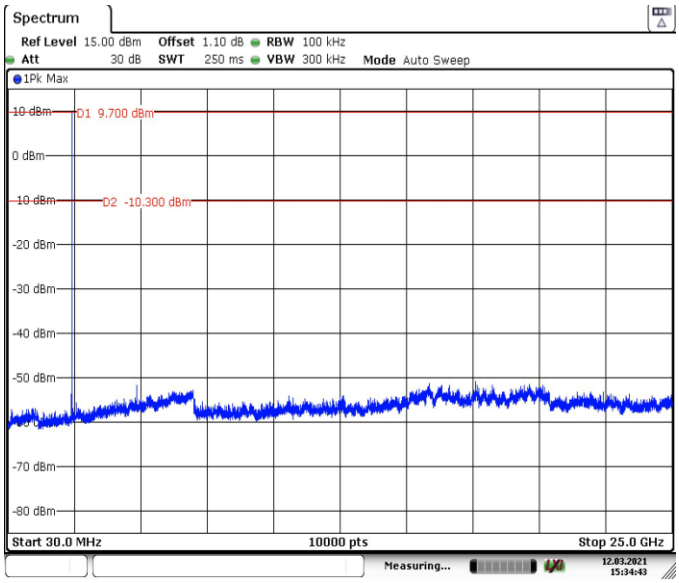



Figure 7.5.1.2-2: MCH – 30MHz–25GHz (1Mbps)

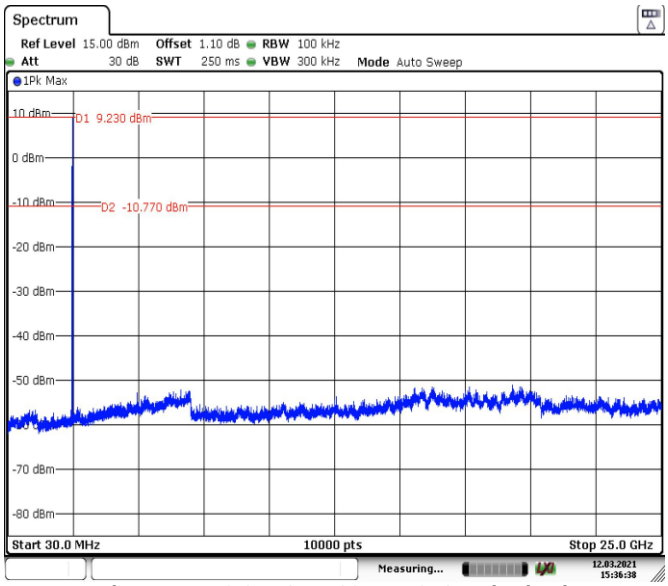



Figure 7.5.1.2-3: HCH – 30MHz–25GHz (1Mbps)

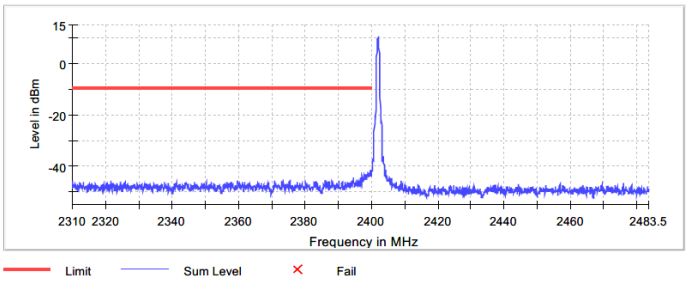



Figure 7.5.1.2-4: Lower Band-edge (1Mbps)

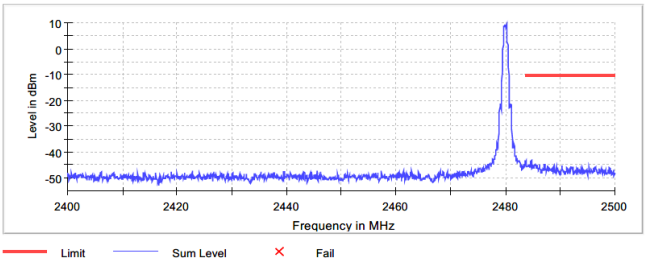



Figure 7.5.1.2-5: Upper Band-edge (1Mbps)

Table 7.5.1.2-1: Lower Band-edge- Low Channel (1Mbps)

| Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|---|---|---|---|---|
| 2399.875000 | -41.6 | 32.2 | -9.5 | PASS |
| 2399.925000 | -41.7 | 32.2 | -9.5 | PASS |
| 2399.825000 | -41.7 | 32.2 | -9.5 | PASS |
| 2399.975000 | -41.8 | 32.3 | -9.5 | PASS |
| 2399.775000 | -42.1 | 32.6 | -9.5 | PASS |
| 2398.875000 | -42.3 | 32.8 | -9.5 | PASS |
| 2398.975000 | -42.4 | 32.9 | -9.5 | PASS |
| 2399.025000 | -42.5 | 33.0 | -9.5 | PASS |
| 2399.675000 | -42.5 | 33.0 | -9.5 | PASS |
| 2399.625000 | -42.5 | 33.0 | -9.5 | PASS |
| 2399.325000 | -42.6 | 33.2 | -9.5 | PASS |
| 2398.825000 | -42.7 | 33.2 | -9.5 | PASS |
| 2399.725000 | -43.0 | 33.5 | -9.5 | PASS |
| 2399.425000 | -43.0 | 33.5 | -9.5 | PASS |
| 2399.475000 | -43.1 | 33.6 | -9.5 | PASS |

Table 7.5.1.2-2: Upper Band-edge – High Channel (1Mbps)

| Frequency (MHz) | Level (dBm) | Margin (dB) | Limit (dBm) | Result |
|---|---|---|---|---|
| 2483.575000 | -43.1 | 32.6 | -10.5 | PASS |
| 2484.725000 | -43.3 | 32.8 | -10.5 | PASS |
| 2483.625000 | -43.4 | 32.9 | -10.5 | PASS |
| 2483.725000 | -43.5 | 33.0 | -10.5 | PASS |
| 2484.675000 | -43.7 | 33.2 | -10.5 | PASS |
| 2483.525000 | -43.8 | 33.3 | -10.5 | PASS |
| 2483.775000 | -43.8 | 33.3 | -10.5 | PASS |
| 2484.775000 | -44.5 | 34.0 | -10.5 | PASS |
| 2485.575000 | -44.8 | 34.3 | -10.5 | PASS |
| 2487.175000 | -44.8 | 34.3 | -10.5 | PASS |
| 2487.125000 | -44.8 | 34.3 | -10.5 | PASS |
| 2483.675000 | -44.9 | 34.4 | -10.5 | PASS |
| 2485.425000 | -44.9 | 34.4 | -10.5 | PASS |
| 2486.225000 | -44.9 | 34.4 | -10.5 | PASS |
| 2485.025000 | -45.0 | 34.5 | -10.5 | PASS |

### 7.5.2 Emissions into Restricted Frequency Bands – FCC: 15.205, 15.209; ISED Canada: RSS-Gen 8.9 / 8.10

#### *7.5.2.1* Measurement Procedure

The unwanted emissions into restricted bands were measured radiated over the frequency range of 30MHz to 25GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1 meter to 4 meters so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak and average measurements were made with RBW and VBW of 1 MHz and 3 MHz respectively.

Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in section 15.209.

#### *7.5.2.2* Measurement Results

Performed by: Paul Villarreal

**Table 7.5.2.2-1: Radiated Spurious Emissions Tabulated Data – Isolated Magnetic Dipole Antenna**

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity | Correction Factors | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | pk | Qpk/Avg | (H/V) | (dB) | pk | Qpk/Avg | pk | Qpk/Avg | pk | Qpk/Avg |
| **Channel 0 (2402 MHz) 1Mbps** | | | | | | | | | | |
| 4804 | 41.90 | 28.70 | H | 9.72 | 51.62 | 38.42 | 74.0 | 54.0 | 22.4 | 15.6 |
| 4804 | 42.70 | 30.30 | V | 9.72 | 52.42 | 40.02 | 74.0 | 54.0 | 21.6 | 14.0 |
| 2389.68 | 43.50 | 28.60 | H | 4.83 | 48.33 | 33.43 | 74.0 | 54.0 | 25.7 | 20.6 |
| 2389.44 | 44.00 | 29.70 | V | 4.83 | 48.83 | 34.53 | 74.0 | 54.0 | 25.2 | 19.5 |
| **Channel 19 (2440 MHz) 1Mbps** | | | | | | | | | | |
| **7320** | **41.70** | **28.00** | **H** | **13.01** | **54.71** | **41.01** | **74.0** | **54.0** | **19.3** | **13.0** |
| **Channel 39 (2480 MHz) 1Mbps** | | | | | | | | | | |
| 4960 | 42.90 | 29.10 | H | 9.98 | 52.88 | 39.08 | 74.0 | 54.0 | 21.1 | 14.9 |
| 4960 | 42.80 | 29.70 | V | 9.98 | 52.78 | 39.68 | 74.0 | 54.0 | 21.2 | 14.3 |
| 2483.78 | 52.60 | 38.40 | H | 4.95 | 57.55 | 43.35 | 74.0 | 54.0 | 16.5 | 10.7 |
| 2483.82 | 54.70 | 40.70 | V | 4.95 | 59.65 | 45.65 | 74.0 | 54.0 | 14.4 | 8.4 |

Sample Calculation:

$R_C = R_U + CF_T$

Where:

| | | |
|---|---|---|
| $CF_T$ | = | Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only) |
| $R_U$ | = | Uncorrected Reading |
| $R_C$ | = | Corrected Level |
| AF | = | Antenna Factor |
| CA | = | Cable Attenuation |
| AG | = | Amplifier Gain |
| DC | = | Duty Cycle Correction Factor |

**Example Calculation: Peak – LCH**

Corrected Level: 41.90 + 9.72 = 51.62dBuV/m
Margin: 74dBuV/m – 51.62dBuV/m = 22.38dB

**Example Calculation: Average – LCH**

Corrected Level: 28.7 + 9.72 - 0 = 38.42dBuV
Margin: 54dBuV – 38.42dBuV = 15.58dB

## 7.6 Maximum Power Spectral Density in the Fundamental Emission – FCC: 15.247(e) ISED Canada: RSS-247 5.2(b)

### 7.6.1 Measurement Procedure

The power spectral density was measured in accordance with the FCC KDB 558074 D01 utilizing Section 8.4. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer applying suitable attenuation. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 10 kHz. The Video Bandwidth (VBW) was set to 30 kHz. Span was set to 1.5 times the channel bandwidth. The trace was set to max hold with the peak detector active.

### 7.6.2 Measurement Results

Performed by: Divya Adusumilli

**Table 7.6.2-1: Power Spectral Density**

| Modulation | Frequency [MHz] | PSD [dBm] |
|---|---|---|
| GFSK / 1Mbps | 2402 | 1.232 |
| | 2440 | 0.996 |
| | 2480 | 0.363 |

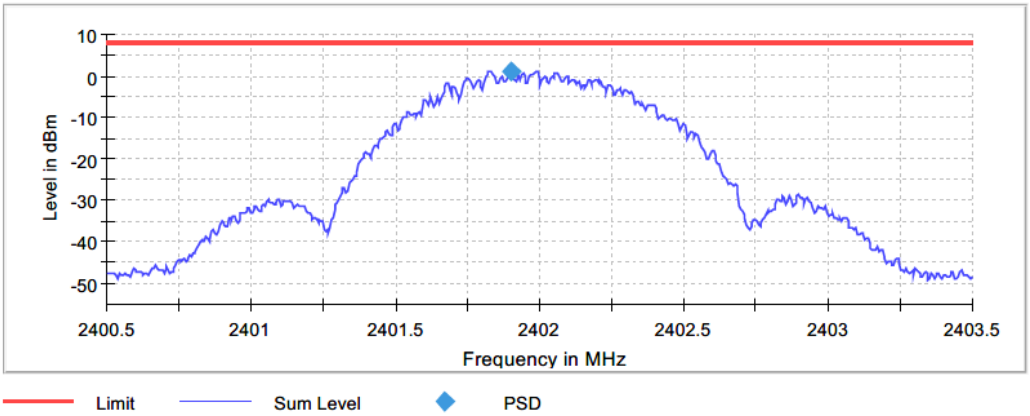



**Figure 7.6.2-1: 2402MHz PSD Plot**

**Table 7.6.2-2: Measurement Settings (PSD)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.40050 GHz | 2.40050 GHz |
| Stop Frequency | 2.40350 GHz | 2.40350 GHz |
| Span | 3.000 MHz | 3.000 MHz |
| RBW | 10.000 kHz | <= 10.000 kHz |
| VBW | 30.000 kHz | >= 30.000 kHz |
| Sweep Points | 600 | ~ 600 |
| Sweep time | 3.000 ms | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | Sweep | Sweep |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 4 / max. 150 | max. 150 |
| Stable | 2 / 2 | 2 |
| Max Stable Difference | 0.06 dB | 0.50 dB |

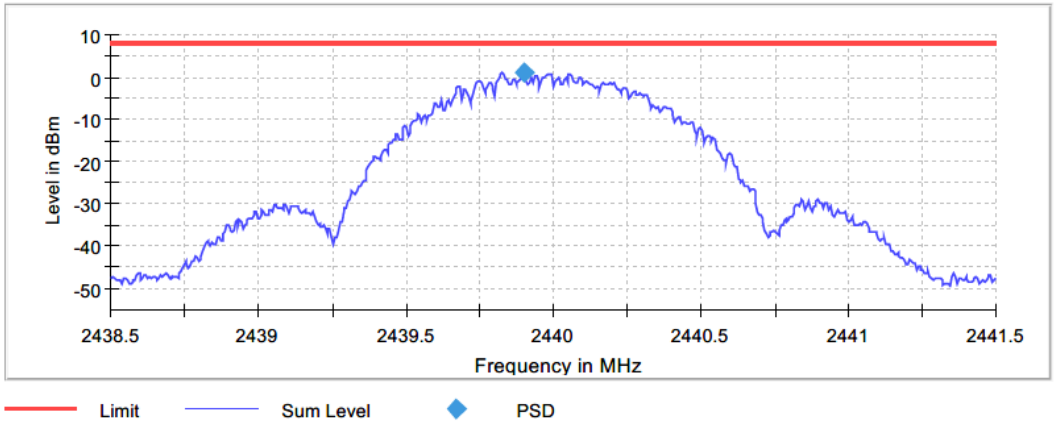



**Figure 7.6.2-2: 2440MHz PSD Plot**

**Table 7.6.2-3: Measurement Settings (PSD)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.43850 GHz | 2.43850 GHz |
| Stop Frequency | 2.44150 GHz | 2.44150 GHz |
| Span | 3.000 MHz | 3.000 MHz |
| RBW | 10.000 kHz | <= 10.000 kHz |
| VBW | 30.000 kHz | >= 30.000 kHz |
| Sweep Points | 600 | ~ 600 |
| Sweep time | 3.000 ms | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | Sweep | Sweep |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 3 / max. 150 | max. 150 |
| Stable | 2 / 2 | 2 |
| Max Stable Difference | 0.11 dB | 0.50 dB |

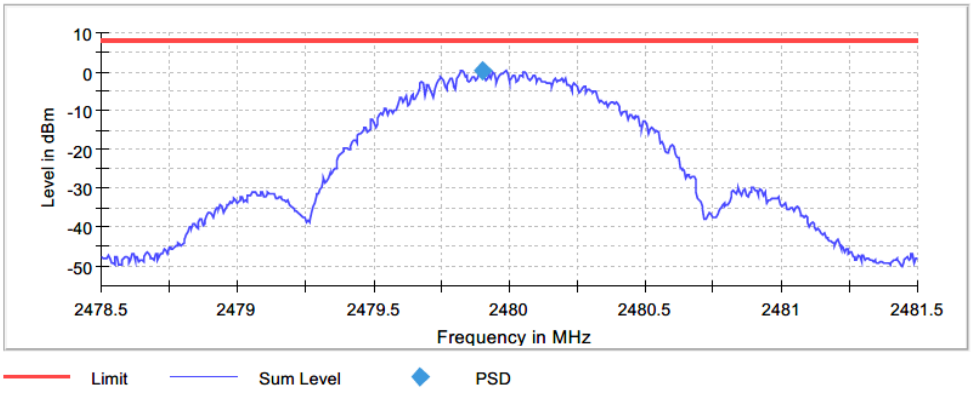



**Figure 7.6.2-3: 2480MHz PSD Plot**

**Table 7.6.2-4: Measurement Settings (PSD)**

| Setting | Instrument Value | Target Value |
|---|---|---|
| Start Frequency | 2.47850 GHz | 2.47850 GHz |
| Stop Frequency | 2.48150 GHz | 2.48150 GHz |
| Span | 3.000 MHz | 3.000 MHz |
| RBW | 10.000 kHz | <= 10.000 kHz |
| VBW | 30.000 kHz | >= 30.000 kHz |
| Sweep Points | 600 | ~ 600 |
| Sweep time | 3.000 ms | AUTO |
| Reference Level | 10.000 dBm | 10.000 dBm |
| Attenuation | 30.000 dB | AUTO |
| Detector | Max Peak | Max Peak |
| Sweep Count | 100 | 100 |
| Filter | 3 dB | 3 dB |
| Trace Mode | Max Hold | Max Hold |
| Sweep type | Sweep | Sweep |
| Preamp | off | off |
| Stable mode | Trace | Trace |
| Stable value | 0.50 dB | 0.50 dB |
| Run | 3 / max. 150 | max. 150 |
| Stable | 2 / 2 | 2 |
| Max Stable Difference | 0.08 dB | 0.50 dB |

## 8 ESTIMATION OF MEASUREMENT UNCERTAINTY

The expanded laboratory measurement uncertainty figures ($U_{Lab}$) provided below correspond to an expansion factor (coverage factor) k = 1.96 which provide confidence levels of 95%.

**Table 8-1: Estimation of Measurement Uncertainty**

| Parameter | $U_{lab}$ |
|---|---|
| Occupied Channel Bandwidth | ± 0.009 % |
| RF Conducted Output Power | ± 0.349 dB |
| Power Spectral Density | ± 0.372 dB |
| Antenna Port Conducted Emissions | ± 1.264 dB |
| Radiated Emissions ≤ 1 GHz | ± 5.814 dB |
| Radiated Emissions > 1 GHz | ± 4.318 dB |
| Temperature | ± 0.860 °C |
| Radio Frequency | ± 2.832 x $10^{-8}$ |
| AC Power Line Conducted Emissions | ± 3.360 dB |

## 9 CONCLUSION

In the opinion of TUV SUD the WaveLinx Econ Sensor Integrated, Single Chip (model 0550-000716), manufactured by Cooper Lighting LLC meets the requirements of FCC Part 15 subpart C and ISED Canada's Radio Standards Specification RSS-247 for the tests documented herein.

# Appendix A: Plots

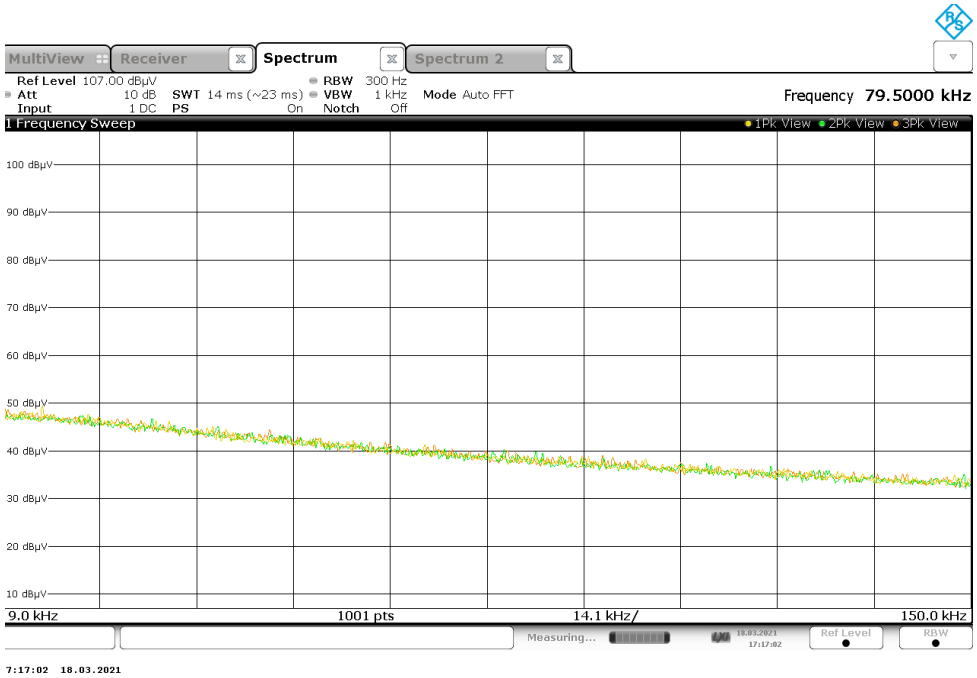
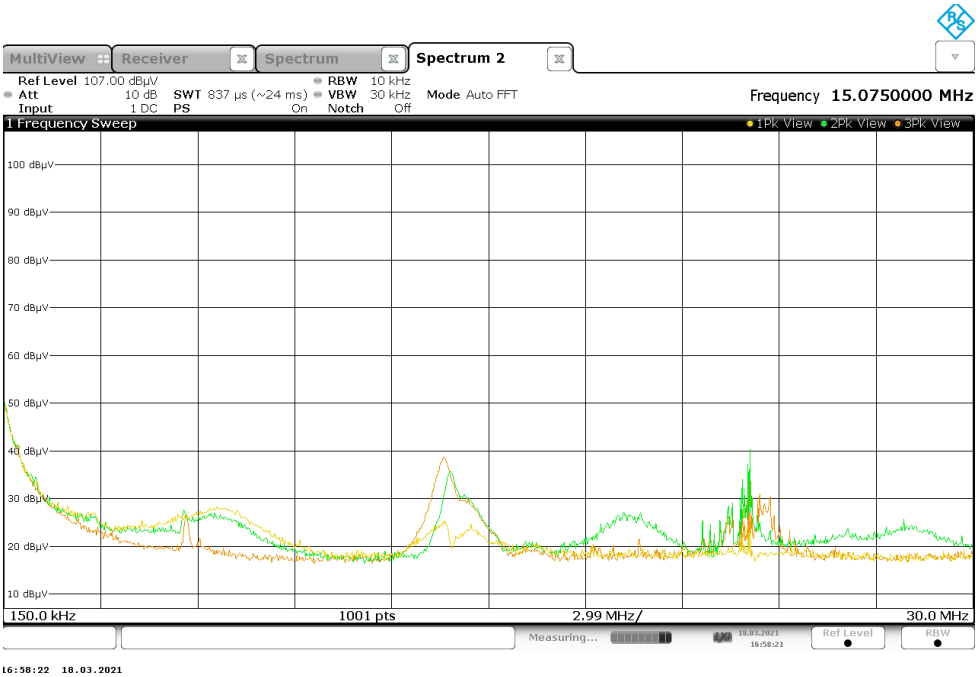
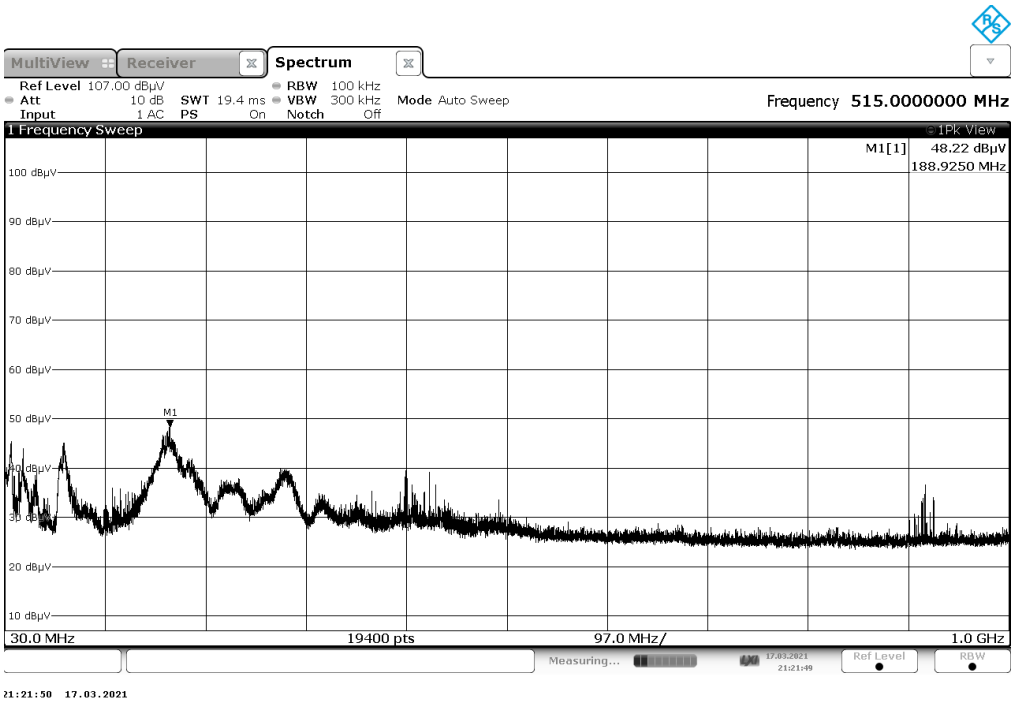



**Figure A-1: 9kHz-150kHz**



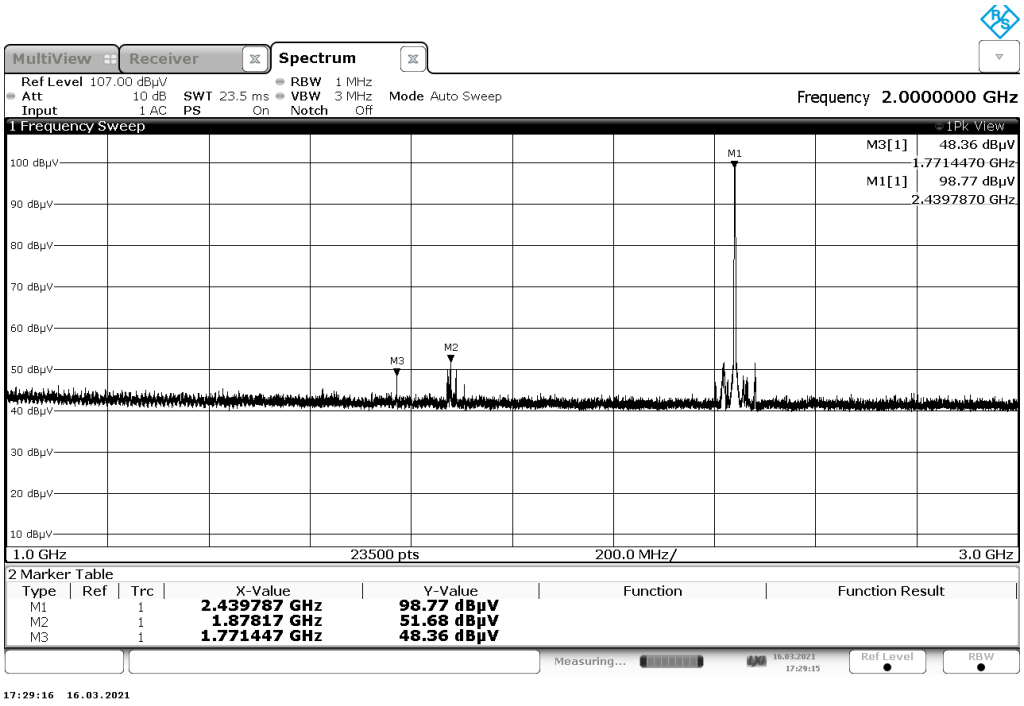

**Note: Emissions above the noise floor are not associated with the DUT.**

**Figure A-2: 150kHz-30MHz**




**Note: Emissions above the noise floor are not associated with the radio.**

**Figure A-3: 30MHz-1GHz**




**Note: Emissions above the noise floor are not associated with the radio, except fundamental emission**

**Figure A-4: 1GHz-3GHz**

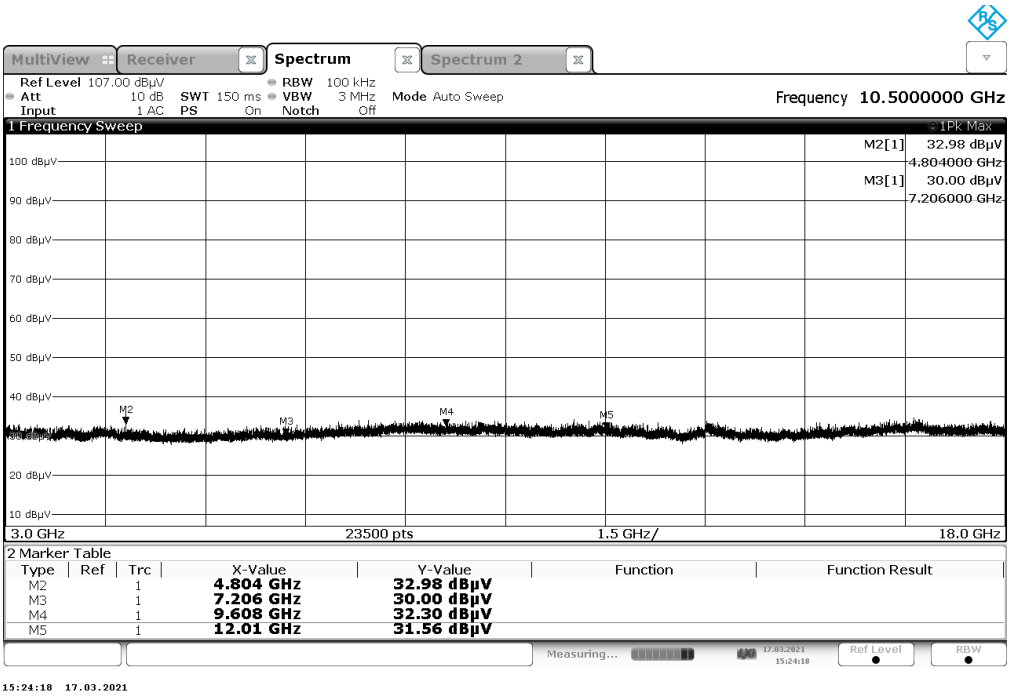



**Figure A-5: 3GHz-18GHz**

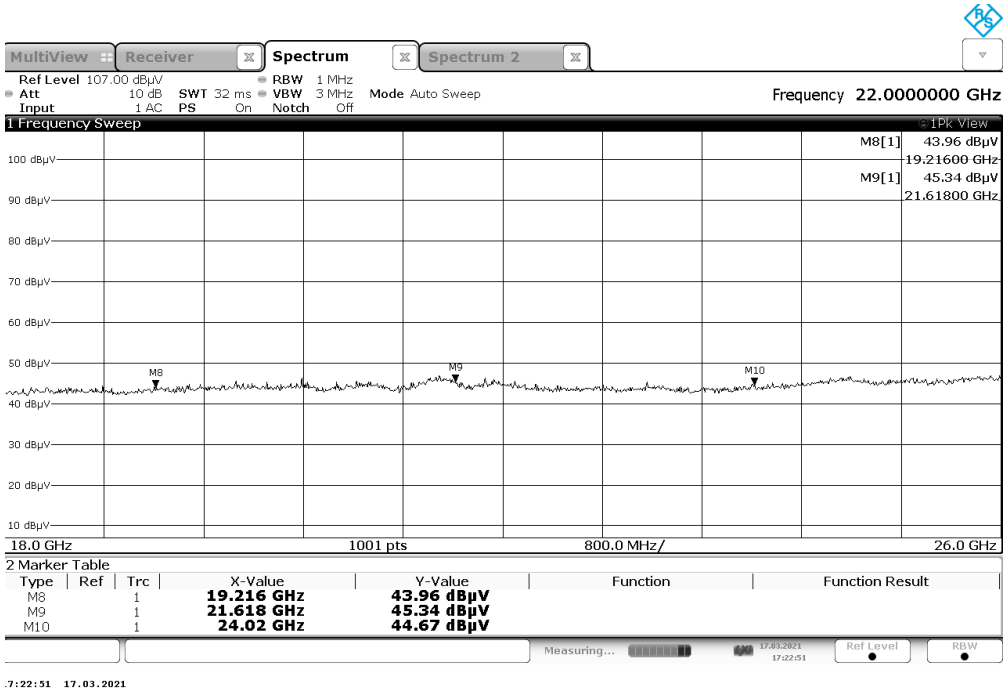



**Figure A-6: 18GHz-26GHz**

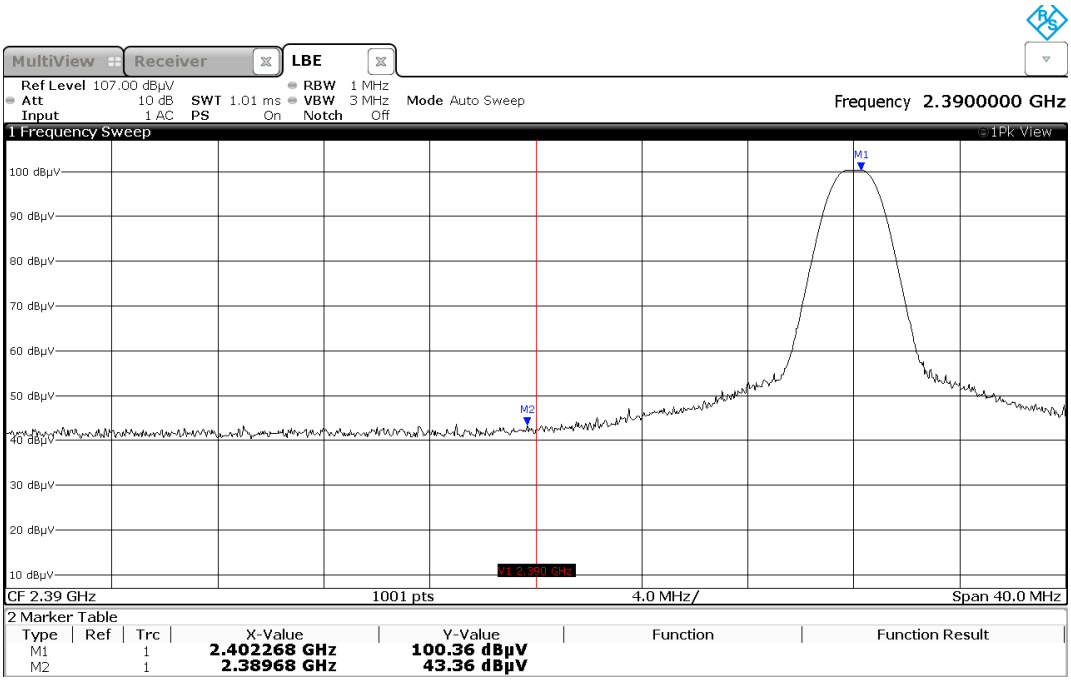



**Figure A-7: Restricted Band Edge Low – 2402MHz**

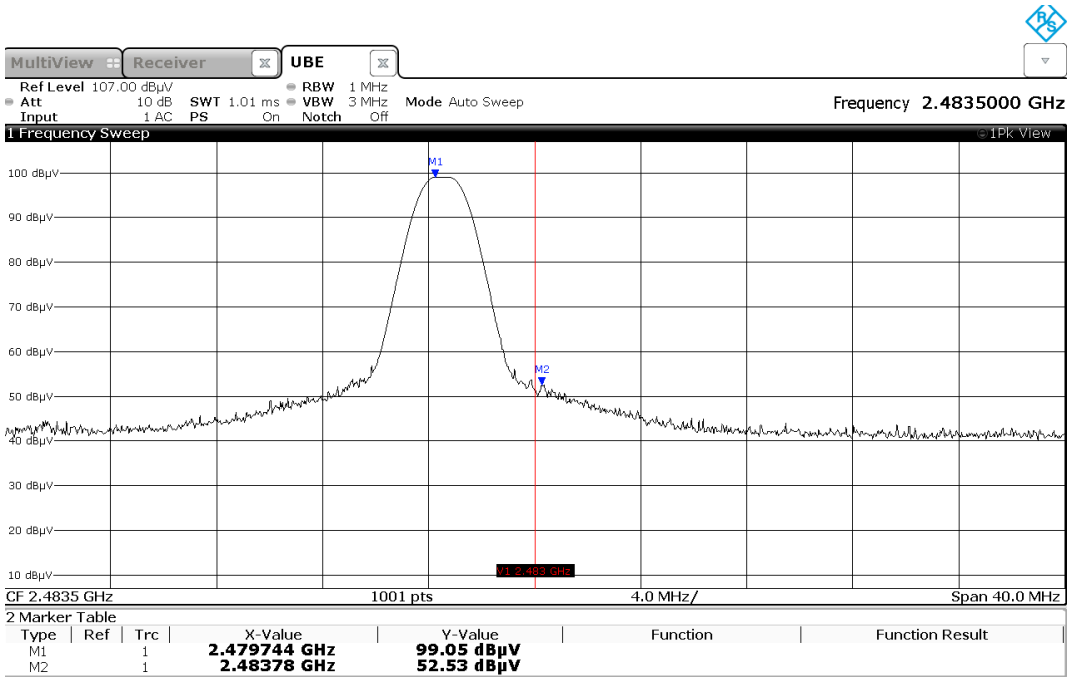



**Figure A-8: Restricted Band Edge High – 2480MHz**

# END REPORT