# FCC Part 15.249
# RSS-GEN ISSUE 5 February 2021 AMENDMENT 2
# RSS-210, ISSUE 10, April 2020 AMENDMENT
# TEST REPORT

For

## Jasco Products Company LLC

**10 e memorial road Office Attn M Simpkins oklahoma city, OK 73114**

**FCC ID: QOBZWA1003**
**IC: 6924A-ZWA1003**

| **Report Type:** | **Product Type:** |
|---|---|
| Original Report | Z-Wave In-Wall Receptacle |

**Report Producer :** Nana Hsu

**Report Number :** RXZ220615001RF01

**Report Date :** 2022-08-01

**Reviewed By:** David Hsu David.Hsu

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# Revision History

| Revision | No. | Report Number | Issue Date | Description | Author/ Revised by |
|---|---|---|---|---|---|
| 0.0 | RXZ220615001 | RXZ220615001RF01 | 2022-08-01 | Original Report | Nana Hsu |

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# 1. General Information

## 9.1 Product Description for Equipment under Test (EUT)

| | |
|---|---|
| Applicant | Jasco Products Company LLC |
| | 10 e memorial road Office Attn M Simpkins, oklahoma city, United States 73114 |
| Manufacturer | Jasco Products Company LLC |
| | 10 e memorial road Office Attn M Simpkins, oklahoma city, United States 73114 |
| Brand(Trade) Name | Jasco/enbrighten |
| Product (Equipment) | Z-Wave In-Wall Receptacle |
| Main Model Name | ZWA1003JAS |
| Series Model Name | ZWA1003ENB |
| Model Discrepancy | The major electrical and mechanical constructions of series models are identical to the basic model, except different model name. The model, ZWA1003JAS is the testing sample, and the final test data are shown on this test report. |
| HVIN | ZWA10031JAS, ZWA1003ENB |
| Frequency Range | 908.4 / 916 MHz |
| Antenna Specification | MONOPOLE antenna / -1.24 dBi |
| Power Operation (Voltage Range) | ☒ AC 120V/60Hz<br>☐ Adapter<br>☐ By AC Power Cord<br>☐ PoE |
| | ☐ DC Type<br>☐ from Battery<br>☐ DC Power Supply<br>☐ External from USB Cable<br>☐ External DC Adapter |
| | ☐ Host System |
| Received Date | Jun. 17, 2022 |
| Date of Test | Jul. 01. 2022 ~ Jul. 06, 2022 |

*All measurement and test data in this report was gathered from production sample serial number: RXZ220615001-01 (Assigned by BACL, New Taipei Laboratory).

## 9.1 Objective

This report is prepared on behalf of Jasco Products Company LLC in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commission's rules, and RSS-210, Issue 10, April 2020 Amendment of the Innovation, Science and Economic Development Canada, and RSS-Gen Issue 5, February 2021 Amendment 2, General Requirements for Compliance of Radio Apparatus.

## 9.1 Related Submittal(s)/Grant(s)

N/A.

## 9.1 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, and RSS-210, Issue 10, April 2020 Amendment of the Innovation, Science and Economic Development Canada, and RSS-Gen Issue 5, February 2021 Amendment 2, General Requirements for Compliance of Radio Apparatus.

## 9.1 Statement of Compliance

Decision Rule: No, (The test results do not include MU judgment)


Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.
Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is not responsible for the authenticity of the information provided by the applicant that affects the test results.

## 9.1 Measurement Uncertainty

| Parameter | | Uncertainty |
|---|---|---|
| Emissions Bandwidth | | +/- 0.35 MHz |
| Unwanted Emissions, conducted | | +/- 1.69 dBm |
| Emissions, radiated | 30 MHz~1GHz | +/- 5.22 dB |
| | 1 GHz~18 GHz | +/- 6.12 dB |
| | 18 GHz~40 GHz | +/- 4.99 dB |
| Temperature | | +/- 1.27 °C |
| Humidity | | +/- 3 % |

## 9.1 Environmental Conditions

| Test Site | Test Data | Temperature (℃) | Relative Humidity (%) | ATM Pressure (hPa) | Test Engineer |
|---|---|---|---|---|---|
| AC Line Conducted Emissions | 2022/07/06 | 24.1 | 41 | 1010 | Andy Cheng |
| Radiation Spurious Emissions | 2022/07/01~ 2022/07/06 | 22.2 | 60 | 1010 | Jim Chen |
| Emission Bandwidth | 2022/07/05 | 24.5 | 52 | 1010 | Boris Kao |

## 9.1 Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) to collect test data is located on

☒70, Lane 169, Sec. 2, Datong Road, Xizhi Dist., New Taipei City 22183, Taiwan, R.O.C.

Bay Area Compliance Laboratories Corp. (New Taipei Laboratory) is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3732) and the FCC designation No.TW3732 under the Mutual Recognition Agreement (MRA) in FCC Test.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: TW3732.

# 2. System Test Configuration

## 2.1 Description of Test Configuration

The system was configured for testing in an engineering mode, which was provided by manufacturer.

The engineering mode was configured the system transmitting with maximum power.

**Channel List**

| Channel | Frequency (MHz) |
|---|---|
| 1 | 908.4 |
| 2 | 916.0 |

Tested with channel 1 and 2.

## 2.2 Equipment Modifications

No modification was made to the EUT.

## 2.3 EUT Exercise Software

Use the button to switch the test channel.

| Test Frequency | Low | High |
|---|---|---|
| Power Level Setting | Default | Default |

## 2.4 Support Equipment List and Details

| Description | Manufacturer | Model Number | S/N |
|---|---|---|---|
| Light Bubble*9 | Yousheng Industrial | 120V200W | N/A |

## 2.5 External Cable List and Details

| Cable Description | Length (m) | From | To |
|---|---|---|---|
| Power Cable | 0.8 | EUT | Light Bubble |

## 2.6 Test Mode

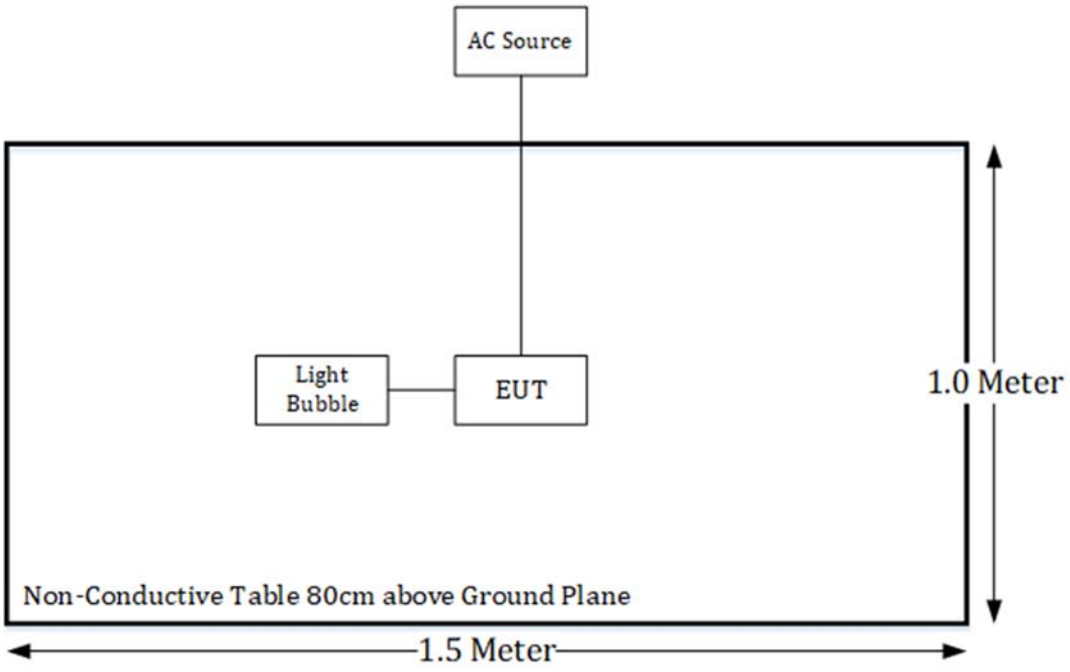
Full System for all test item.

## 2.7 Block Diagram of Test Setup

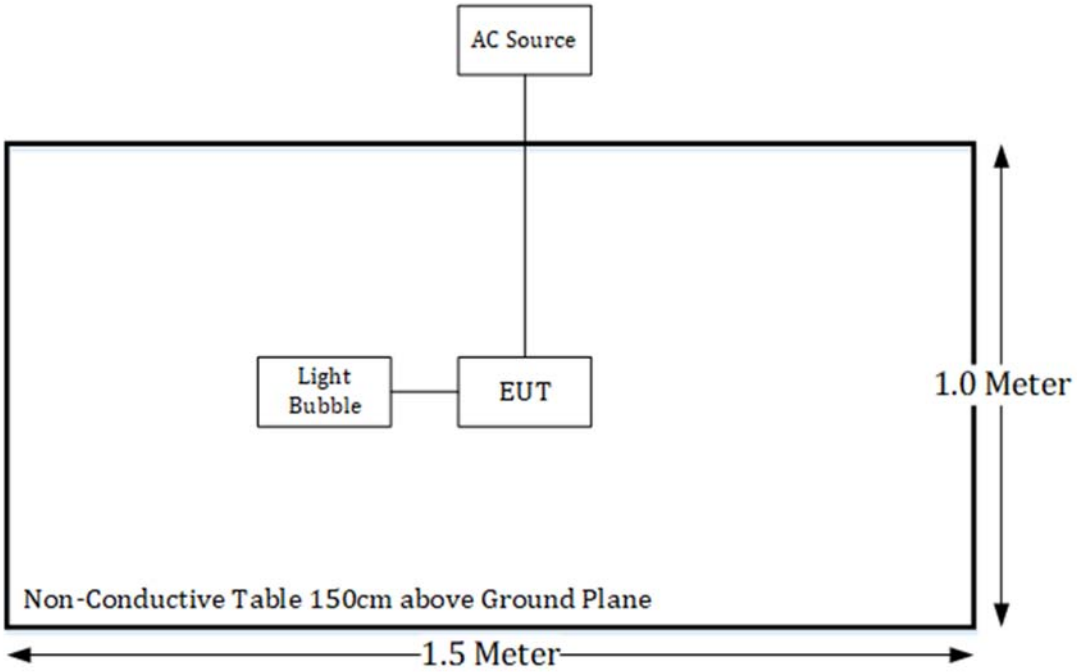
See test photographs attached in setup photos for the actual connections between EUT and support equipment.

### Radiation:

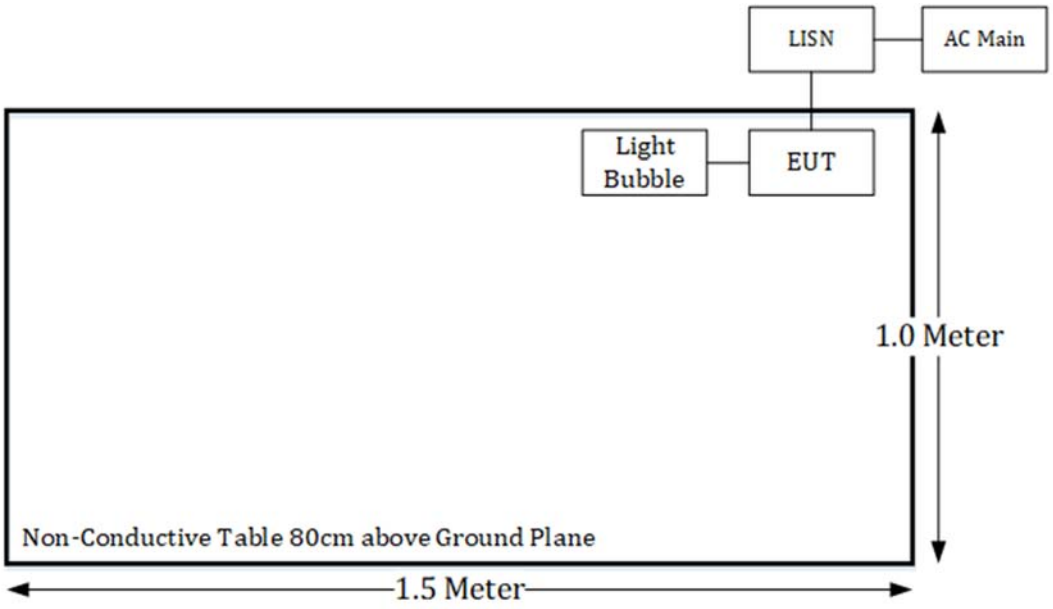
Below 1GHz:




Above 1GHz:



**Conduction:**


LISN
AC Main
Light Bubble
EUT
1.0 Meter
Non-Conductive Table 80cm above Ground Plane
1.5 Meter

# 3. Summary of Test Results

| FCC Rules | Description of Test | Results |
|---|---|---|
| §RSS-102 Clause 2.5.2 | Exemption Limits From Routine Evaluation- RF Exposure Evaluation | Compliance |
| §15.203<br>RSS-GEN Clause 6.8 | Antenna Requirement | Compliance |
| §15.207 (a)<br>RSS-Gen Clause 8.8 | AC Line Conducted Emissions | Compliance |
| §15.205, §15.209,§15.249<br>RSS-210 Annex B.10<br>RSS-Gen Clause 8.10 | Radiated Emissions | Compliance |
| §15.215 (c)<br>RSS-Gen Clause 6.7 | 20 dB Emission Bandwidth<br>99% Occupied Bandwidth | Compliance |

# 4. Test Equipment List and Details

| Description | Manufacturer | Model | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|---|
| AC Line Conduction Room (CON-A) | | | | | |
| LISN | Rohde & Schwarz | ENV216 | 101612 | 2022/1/14 | 2023/1/13 |
| LISN | Rohde & Schwarz | ENV216 | 101248 | 2022/06/22 | 2023/06/21 |
| EMI Test Receiver | Rohde & Schwarz | ESW8 | 100947 | 2021/7/23 | 2022/7/22 |
| Pulse Limiter | Rohde & Schwarz | ESH3Z2 | TXZEM104 | 2021/7/29 | 2022/7/28 |
| RF Cable | EMEC | EM-CB5D | 001 | 2022/06/07 | 2023/06/06 |
| Software | AUDIX | E3 | V9.150826k | N.C.R | N.C.R |
| Radiation 3M Room (966-A) | | | | | |
| Bilog Antenna with 6 dB Attenuator | SUNOL SCIENCES & MINI-CIRCUITS | JB6/UNAT-6+ | A050115/15542_01 | 2022/2/14 | 2023/2/13 |
| Horn Antenna | EMCO | 3115 | 9809-5583 | 2021/9/1 | 2022/8/31 |
| Horn Antenna | ETS-Lindgren | 3116 | 62638 | 2021/8/11 | 2022/8/10 |
| Preamplifier | Sonoma | 310N | 130602 | 2022/06/16 | 2023/06/15 |
| Preamplifier | A.H. system Inc. | PAM-0118P | 466 | 2021/11/4 | 2022/11/3 |
| Microware Preamplifier | EM Electronics Corporation | EM18G40G | 60656 | 2021/12/27 | 2022/12/26 |
| Spectrum Analyzer | Rohde & Schwarz | FSV40 | 101435 | 2022/1/13 | 2023/1/12 |
| EMI Test Receiver | Rohde & Schwarz | ESR7 | 101419 | 2021/11/9 | 2022/11/8 |
| Micro flex Cable | UTIFLEX | UFB197C-1-2362-70U-70U | 225757-001 | 2022/1/24 | 2023/1/23 |
| Coaxial Cable | COMMATE | PEWC | 8Dr | 2021/12/24 | 2022/12/23 |
| Coaxial Cable | UTIFLEX | UFB311A-Q-1440-300300 | 220490-006 | 2022/1/24 | 2023/1/23 |
| Coaxial Cable | JUNFLON | J12J102248-00-B-5 | AUG-07-15-044 | 2021/12/24 | 2022/12/23 |
| Cable | EMC | EMC105-SM-SM-10000 | 201003 | 2022/1/24 | 2023/1/23 |
| Coaxial Cable | ROSNOL | K1K50-UP0264-K1K50-450CM | 160309-1 | 2022/1/24 | 2023/1/23 |
| Coaxial Cable | ROSNOL | K1K50-UP0264-K1K50-50CM | 15120-1 | 2022/1/18 | 2023/1/17 |
| Software | AUDIX | E3 | V9.150826k | N.C.R | N.C.R |
| Conducted Room | | | | | |
| Spectrum Analyzer | Rohde & Schwarz | FSV40 | 101140 | 2022/2/18 | 2023/2/17 |
| Cable | UTIFLEX | UFA210A | 9435 | 2021/10/5 | 2022/10/4 |

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements.*

# 5. FCC §1.1307(b)(3)(i) – RF Exposure

## 5.1 Applicable Standard

According to subpart 15.247(i) and subpart §1.1307(b)(3)(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

For single RF sources (*i.e.,* any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);
(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold *Pth* (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). *Pth* is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^x & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where $\lambda$ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

Expand Table

| RF Source frequency (MHz) | Threshold ERP (watts) |
|---|---|
| 0.3-1.34 | 1,920 $R^2$. |
| 1.34-30 | 3,450 $R^2/f^2$. |
| 30-300 | 3.83 $R^2$. |
| 300-1,500 | 0.0128 $R^2f$. |
| 1,500-100,000 | 19.2$R^2$. |

## 5.2 Calculated Data:

Calculate the EIRP from the radiated field strength in the far field using Equation

EIRP= 103.23dBμV/m -95.2 = 8.03 dBm

Tune-up power = 8.5 dBm

Project info

| Band | Freq (MHz) | Tune-up powe (dBm) | Ant Gain (dBi) | Distances (mm) | Tune-up powe (mW) | ERP (dBm) | ERP (mW) |
|---|---|---|---|---|---|---|---|
| Z-Wave | 916 | 8.5 | -1.24 | 200 | 7.08 | 5.11 | 3.24 |

Option A

The available maximum time-averaged power is no more than 1 mW

| Band | Freq (MHz) | Result Option A |
|---|---|---|
| Z-Wave | 916 | not exempt |

Option C

The available maximum time-averaged power or effective radiated power (ERP), whichever is greater

ERP (watts) is no more than the calculated value prescribed for that frequency

R must be at least $\lambda/2\pi$

$\lambda$ is the free-space operating wavelength in meters

| Band | Freq (MHz) | λ/2π (mm) | Distances applies | ERP Limit (mW) | Result Option C |
|---|---|---|---|---|---|
| Z-Wave | 916 | 52.12 | apply | 468.99 | exempt |

**Result:** The device meets the exemption requirement.

# 6. RSS-102 § 2.5.2 – EXEMPTION LIMITS FROM ROUTINE EVALUATION - RF EXPOSURE EVALUATION

## 6.1 Applicable Standard

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:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where $f$ is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- 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 $1.31 \times 10^{-2}\ f^{0.6834}$ W (adjusted for tune-up tolerance), where $f$ is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

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.

## 6.2 RF Exposure Evaluation Result

EIRP= 103.23dBμV/m -95.2 = 8.03 dBm

Tune-up power = 8.5 dBm = 7.079 mW

Exemption from Routine Evaluation Limit is:

$1.31 \times 10^{-2}\ f^{0.6834} = 1.31 \times 10^{-2} \times 908.4^{0.6834} = 1.38\text{W} > 7.079\text{mW}$

**Result:** The device meets the exemption requirement.

# 7. FCC §15.203 & RSS-GEN CLAUSE 6.8 – Antenna Requirements

## 7.1 Applicable Standard

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

According to RSS-Gen §6.8, The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. fo transmitters with detachable antenna),
indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.
For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).
When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer. The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.
For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

*This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.*

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

## 7.2 Antenna Information

| Type | Antenna Gain | Impedance |
|---|---|---|
| MONOPOLE antenna | -1.24 dBi | 50Ω |

**Result:** Compliance.

# 8. FCC §15.207(a) & RSS-GEN CLAUSE 8.8 – AC Line Conducted Emissions

## 8.1 Applicable Standard

According to §15.207

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

According to RSS-GEN CLAUSE 8.8

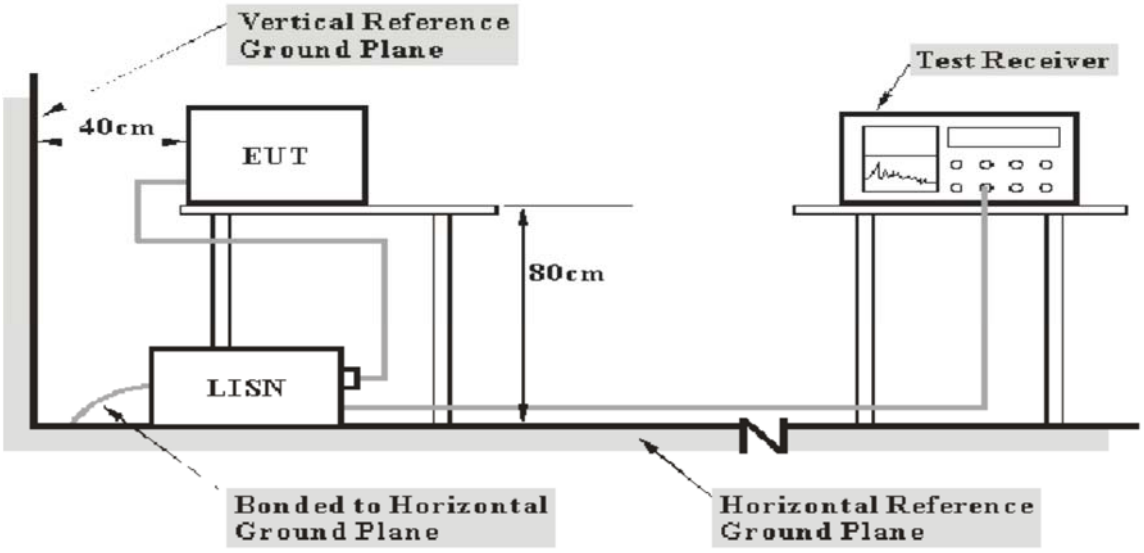
Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μH / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for compliance with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | Quasi-Peak | Average |
| 0.15-0.5 | 66 to 56 Note 1 | 56 to 46 Note 1 |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Note 1: Decreases with the logarithm of the frequency.*

## 8.2 EUT SETUP




Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 and RSS-GEN limits.

## 8.3 EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150kHz to 30MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations

| Frequency Range | IF B/W |
|---|---|
| 150kHz – 30MHz | 9kHz |

## 8.4 Test Procedure

During conducted emission tests, the EUT is connected to the LISN socket.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

## 8.5 Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

The "Over Limit" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

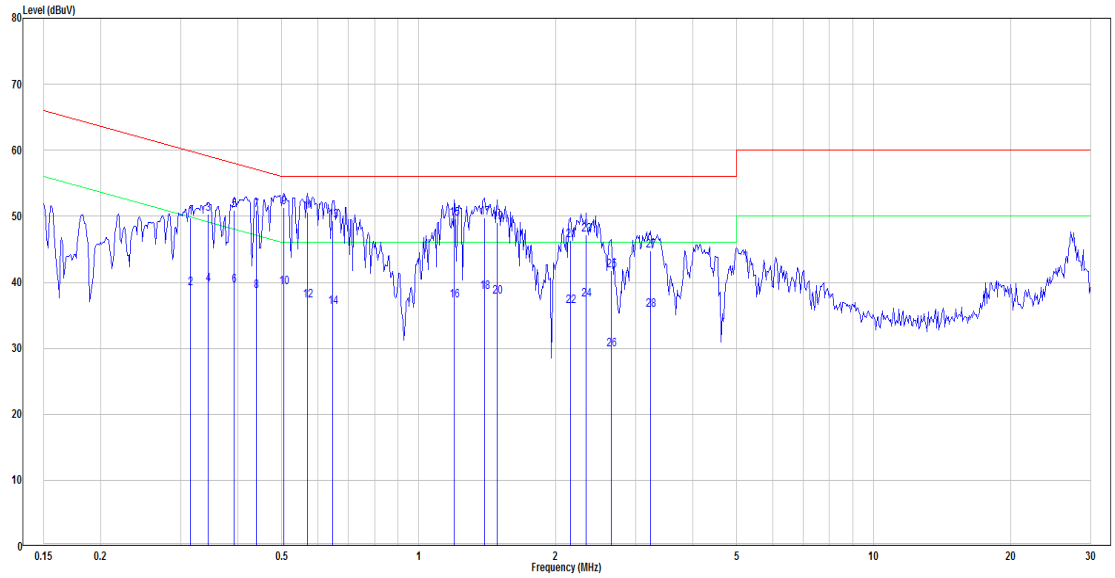
Over Limit = Level – Limit Line

## 8.6 Test Results

*Test mode: full system mode*

(worst case is HIGH channel)

**Main: AC120 V, 60 Hz, Line**




| No. | Frequency (MHz) | Reading (dBµV) | Correct Factor(dB) | Result (dBµV) | Limit (dBµV) | Over limit (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.315 | 30.21 | 19.52 | 49.73 | 59.84 | -10.11 | QP |
| 2 | 0.315 | 19.52 | 19.52 | 39.04 | 49.84 | -10.80 | Average |
| 3 | 0.345 | 30.78 | 19.52 | 50.30 | 59.09 | -8.79 | QP |
| 4 | 0.345 | 20.18 | 19.52 | 39.70 | 49.09 | -9.39 | Average |
| 5 | 0.393 | 31.42 | 19.53 | 50.95 | 57.99 | -7.04 | QP |
| 6 | 0.393 | 20.00 | 19.53 | 39.53 | 47.99 | -8.46 | Average |
| 7 | 0.440 | 31.38 | 19.53 | 50.91 | 57.07 | -6.16 | QP |
| 8 | 0.440 | 19.16 | 19.53 | 38.69 | 47.07 | -8.38 | Average |
| 9 | 0.505 | 31.84 | 19.53 | 51.37 | 56.00 | -4.63 | QP |
| 10 | 0.505 | 19.62 | 19.53 | 39.16 | 46.00 | -6.84 | Average |
| 11 | 0.570 | 31.10 | 19.53 | 50.63 | 56.00 | -5.37 | QP |
| 12 | 0.570 | 17.65 | 19.53 | 37.18 | 46.00 | -8.82 | Average |
| 13 | 0.647 | 29.73 | 19.54 | 49.27 | 56.00 | -6.73 | QP |
| 14 | 0.647 | 16.71 | 19.54 | 36.24 | 46.00 | -9.76 | Average |
| 15 | 1.197 | 30.00 | 19.56 | 49.56 | 56.00 | -6.44 | QP |
| 16 | 1.197 | 17.72 | 19.56 | 37.28 | 46.00 | -8.72 | Average |
| 17 | 1.396 | 30.14 | 19.57 | 49.71 | 56.00 | -6.29 | QP |
| 18 | 1.396 | 18.98 | 19.57 | 38.55 | 46.00 | -7.45 | Average |
| 19 | 1.487 | 29.44 | 19.57 | 49.01 | 56.00 | -6.99 | QP |
| 20 | 1.487 | 18.17 | 19.57 | 37.74 | 46.00 | -8.26 | Average |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 21 | 2.155 | 26.76 | 19.60 | 46.36 | 56.00 | -9.64 | QP |
| 22 | 2.155 | 16.70 | 19.60 | 36.30 | 46.00 | -9.70 | Average |
| 23 | 2.334 | 27.65 | 19.61 | 47.25 | 56.00 | -8.75 | QP |
| 24 | 2.334 | 17.71 | 19.61 | 37.32 | 46.00 | -8.68 | Average |
| 25 | 2.650 | 22.15 | 19.61 | 41.77 | 56.00 | -14.23 | QP |
| 26 | 2.650 | 10.22 | 19.61 | 29.84 | 46.00 | -16.16 | Average |
| 27 | 3.241 | 25.19 | 19.63 | 44.81 | 56.00 | -11.19 | QP |
| 28 | 3.241 | 16.21 | 19.63 | 35.84 | 46.00 | -10.16 | Average |

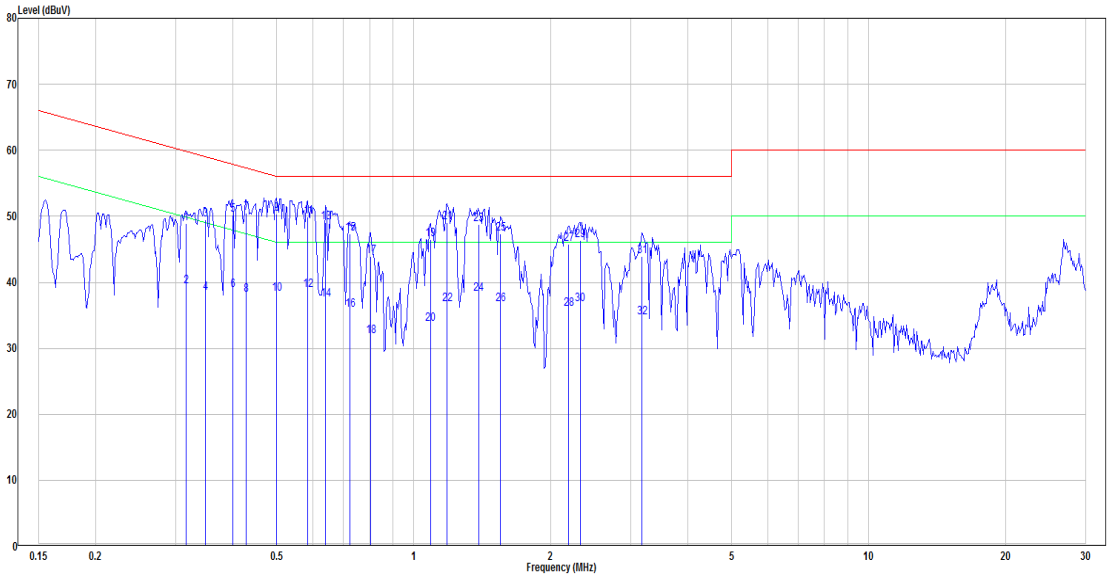
Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

**Main: AC120 V, 60 Hz, Neutral**




| No. | Frequency | Reading | Correct | Result | Limit | Over limit | Remark |
|---|---|---|---|---|---|---|---|
| | (MHz) | (dBµV) | Factor(dB) | (dBµV) | (dBµV) | (dB) | |
| 1 | 0.317 | 29.43 | 19.52 | 48.95 | 59.80 | -10.84 | QP |
| 2 | 0.317 | 19.91 | 19.52 | 39.43 | 49.80 | -10.37 | Average |
| 3 | 0.348 | 30.01 | 19.52 | 49.53 | 59.00 | -9.47 | QP |
| 4 | 0.348 | 18.80 | 19.52 | 38.33 | 49.00 | -10.68 | Average |
| 5 | 0.400 | 30.62 | 19.53 | 50.15 | 57.86 | -7.71 | QP |
| 6 | 0.400 | 19.28 | 19.53 | 38.80 | 47.86 | -9.06 | Average |
| 7 | 0.428 | 30.93 | 19.53 | 50.46 | 57.29 | -6.83 | QP |
| 8 | 0.428 | 18.57 | 19.53 | 38.10 | 47.29 | -9.19 | Average |
| 9 | 0.499 | 30.86 | 19.53 | 50.39 | 56.01 | -5.62 | QP |
| 10 | 0.499 | 18.63 | 19.53 | 38.16 | 46.01 | -7.85 | Average |
| 11 | 0.585 | 30.38 | 19.53 | 49.91 | 56.00 | -6.09 | QP |
| 12 | 0.585 | 19.25 | 19.53 | 38.78 | 46.00 | -7.22 | Average |
| 13 | 0.641 | 29.47 | 19.53 | 49.00 | 56.00 | -7.00 | QP |
| 14 | 0.641 | 17.82 | 19.53 | 37.35 | 46.00 | -8.65 | Average |
| 15 | 0.724 | 27.74 | 19.53 | 47.28 | 56.00 | -8.72 | QP |
| 16 | 0.724 | 16.21 | 19.53 | 35.75 | 46.00 | -10.25 | Average |
| 17 | 0.804 | 24.36 | 19.54 | 43.90 | 56.00 | -12.10 | QP |
| 18 | 0.804 | 12.22 | 19.54 | 31.76 | 46.00 | -14.24 | Average |
| 19 | 1.088 | 26.88 | 19.54 | 46.42 | 56.00 | -9.58 | QP |
| 20 | 1.088 | 14.07 | 19.54 | 33.61 | 46.00 | -12.39 | Average |
| 21 | 1.184 | 29.53 | 19.55 | 49.08 | 56.00 | -6.92 | QP |
| 22 | 1.184 | 17.06 | 19.55 | 36.61 | 46.00 | -9.39 | Average |
| 23 | 1.388 | 29.27 | 19.56 | 48.83 | 56.00 | -7.17 | QP |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 24 | 1.388 | 18.61 | 19.56 | 38.17 | 46.00 | -7.83 | Average |
| 25 | 1.552 | 27.75 | 19.57 | 47.32 | 56.00 | -8.68 | QP |
| 26 | 1.552 | 17.15 | 19.57 | 36.72 | 46.00 | -9.28 | Average |
| 27 | 2.190 | 26.20 | 19.60 | 45.80 | 56.00 | -10.20 | QP |
| 28 | 2.190 | 16.27 | 19.60 | 35.86 | 46.00 | -10.14 | Average |
| 29 | 2.321 | 26.68 | 19.60 | 46.28 | 56.00 | -9.72 | QP |
| 30 | 2.321 | 17.07 | 19.60 | 36.67 | 46.00 | -9.33 | Average |
| 31 | 3.173 | 24.28 | 19.62 | 43.90 | 56.00 | -12.10 | QP |
| 32 | 3.173 | 15.05 | 19.62 | 34.67 | 46.00 | -11.33 | Average |

Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

# 9. FCC §15.209, §15.205 , §15.249 & RSS-210 ANNEX B.10, RSS-GEN CLAUSE 8.10 - Radiated Emissions

## 9.1 Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|---|---|---|
| 902-928 MHz | 50 | 500 |
| 2400-2483.5 MHz | 50 | 500 |
| 5725-5875 MHz | 50 | 500 |
| 24.0-24.25 GHz | 250 | 2500 |

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to RSS-210 Issue 10 Clause Annex B B.10 (a): The field strength of fundamental and harmonic emissions, measured at 3 m, shall not exceed 50 mV/m and 0.5 mV/m respectively.

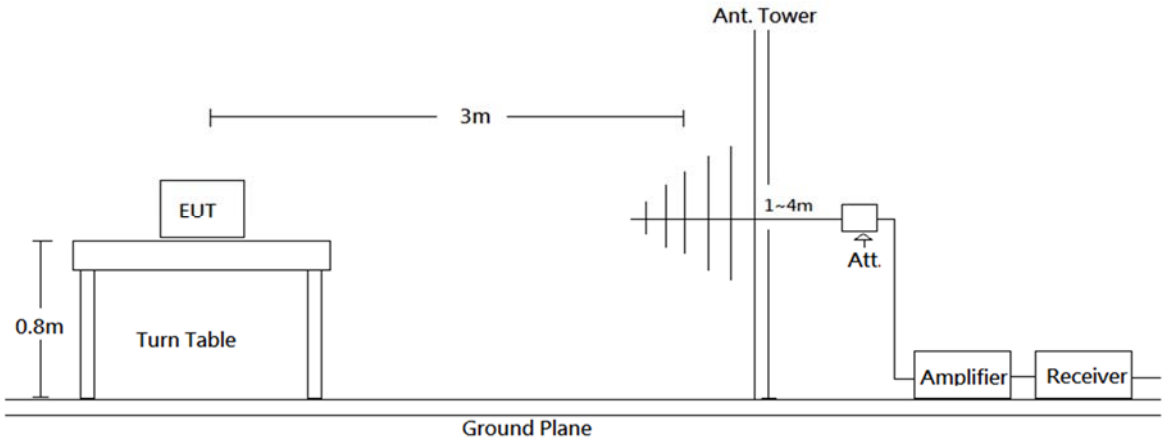
According to RSS-210 Issue 10 Clause Annex B B.10 (b): Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-GEN Issue 5, whichever is less stringent.

| Field strength limits at various frequencies | | |
|---|---|---|
| Fundamental frequency | Field strength (mV/m) | |
| | Fundamental emissions | Harmonic emissions |
| 902-928 MHz | 50 | 0.5 |
| 2400-2483.5 MHz | 50 | 0.5 |
| 5725-5875 MHz | 50 | 0.5 |
| 24.0-24.25 GHz | 250 | 2.5 |

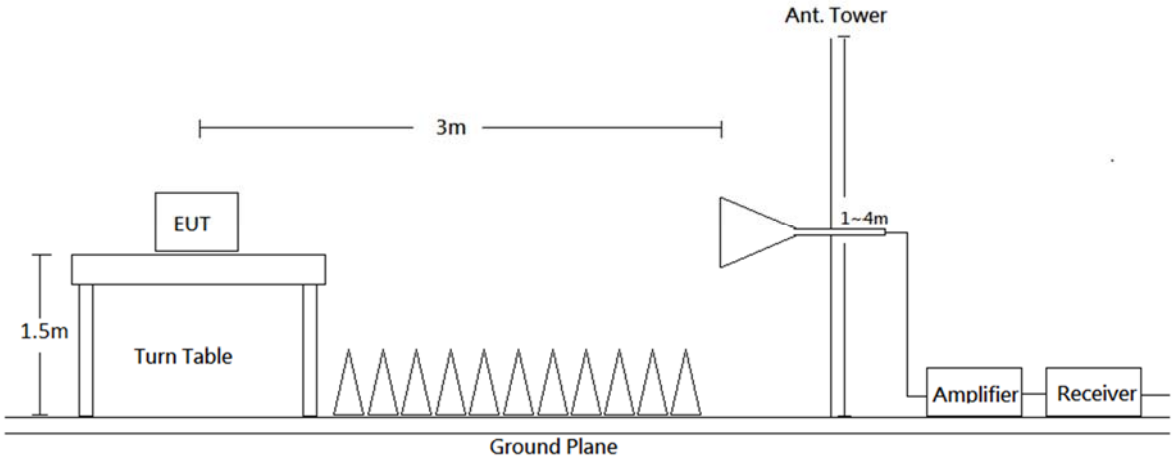
As per RSS-210 Issue 10 Clause Annex B B.10, Field strength limits are specified at a distance of 3 meters.

## 9.2 EUT Setup

Below 1 GHz:




Above 1 GHz:




Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.205, FCC 15.209, FCC 15.249 and RSS-GEN, RSS-210 limits.

## 9.3 EMI Test Receiver & Spectrum Analyzer Setup

The system was studied from 30 MHz to 10 GHz. During radiated emission testing, the EMI test setup refers to ANSI C63.10 4.1.4.2.4.

## 9.4 Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz and Fundamental.

## 9.5 Corrected Factor & Margin Calculation

The Correct Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

The "Margin" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Margin = Result – Limit

## 9.6 Test Results Summary

According to the data in the following table, the EUT complied with the FCC 15.205, FCC 15.209, FCC 15.249 and RSS-210, RSS-Gen Limit.

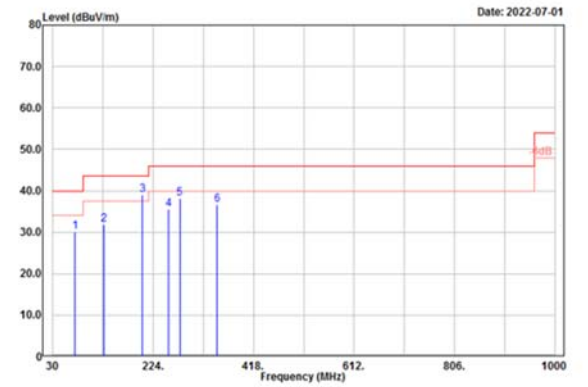
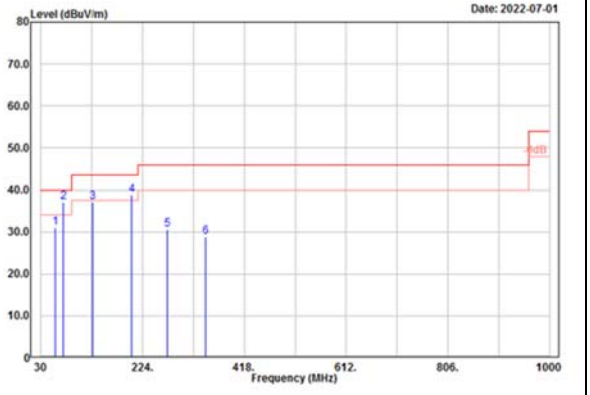
## 9.7 Test Results

*Test mode: full system mode*

(Pre-scan with three orthogonal axis, and worse case as Z axis.)

(worst case is High channel)

30MHz-1GHz

| Horizontal | Vertical |
|---|---|
|  |  |

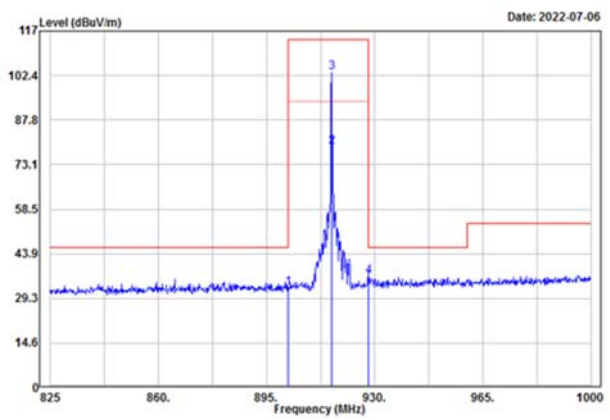
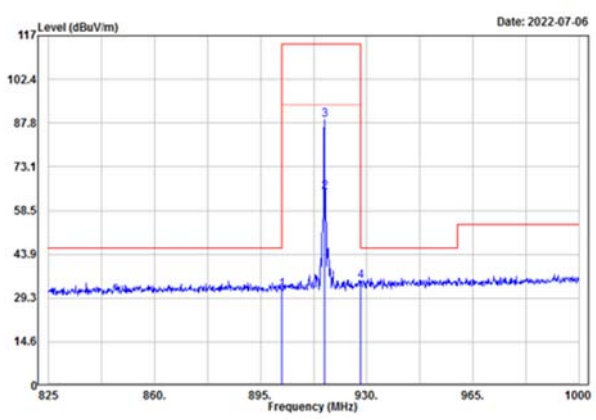


| Freq. | Reading | Factor | Level | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|
| MHz | dBuV | dB/m | dBuV/m | dBuV/m | dB | (cm) | (°) | |
| 72.680 | 44.61 | -14.58 | 30.03 | 40.00 | -9.97 | 100 | 339 | QP |
| 127.970 | 39.97 | -8.16 | 31.81 | 43.50 | -11.69 | 100 | 69 | QP |
| 203.630 | 49.28 | -10.32 | 38.96 | 43.50 | -4.54 | 100 | 128 | QP |
| 254.070 | 45.40 | -9.83 | 35.57 | 46.00 | -10.43 | 100 | 8 | QP |
| 275.410 | 46.10 | -7.97 | 38.13 | 46.00 | -7.87 | 100 | 87 | QP |
| 347.190 | 43.20 | -6.48 | 36.72 | 46.00 | -9.28 | 100 | 315 | QP |

| Freq. | Reading | Factor | Level | Limit | Margin | Height | Degree | Remark |
|---|---|---|---|---|---|---|---|---|
| MHz | dBuV | dB/m | dBuV/m | dBuV/m | dB | (cm) | (°) | |
| 57.160 | 46.49 | -15.58 | 30.91 | 40.00 | -9.09 | 100 | 323 | QP |
| 72.680 | 51.75 | -14.58 | 37.17 | 40.00 | -2.83 | 100 | 73 | QP |
| 128.940 | 45.12 | -8.06 | 37.06 | 43.50 | -6.44 | 100 | 3 | QP |
| 202.660 | 48.75 | -10.02 | 38.73 | 43.50 | -4.77 | 100 | 156 | QP |
| 271.530 | 38.68 | -8.08 | 30.60 | 46.00 | -15.40 | 100 | 100 | QP |
| 344.280 | 35.41 | -6.58 | 28.83 | 46.00 | -17.17 | 100 | 85 | QP |

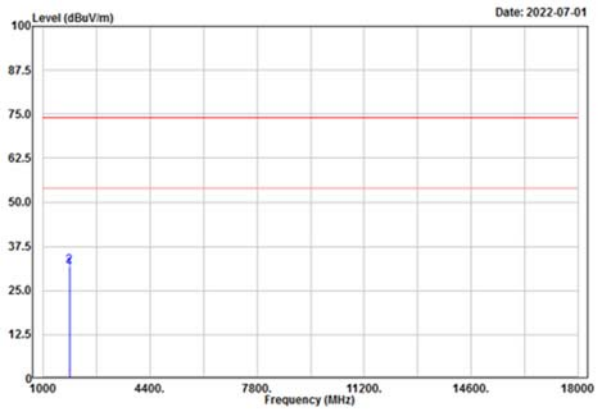
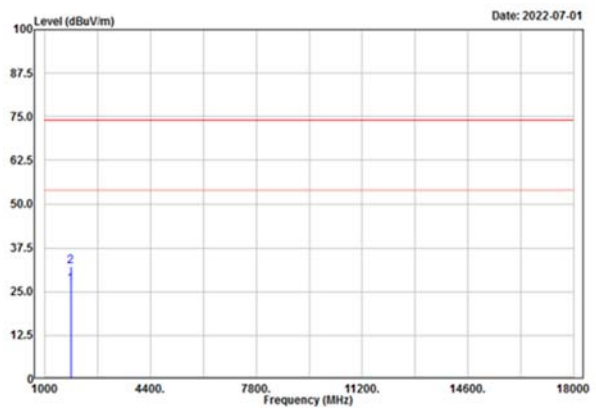
Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

Fundamental:

| Horizontal | Vertical |
|---|---|
|  |  |



1GHz-10GHz

| Horizontal | Vertical |
|---|---|
|  |  |

**908.4 MHz**

**Horizontal**

| Freq. (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 902.000 | 29.18 | 5.33 | 34.51 | 46.00 | -11.49 | 100 | 261 | Peak |
| 908.400 | 101.42 | -24.15 | 77.27 | 94.00 | -16.73 | 100 | 261 | Average |
| 908.400 | 95.88 | 5.54 | 101.42 | 114.00 | -12.58 | 100 | 261 | Peak |
| 928.000 | 27.68 | 6.22 | 33.90 | 46.00 | -12.10 | 100 | 261 | Peak |

| Freq. MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 1816.800 | 34.57 | -12.61 | 21.96 | 54.00 | -32.04 | 165 | 121 | Average |
| 1816.800 | 44.85 | -12.61 | 32.24 | 74.00 | -41.76 | 165 | 121 | Peak |

**Vertical**

| Freq. (MHz) | Reading (dBuV) | Factor (dB/m) | Level (dBuV/m) | Limit (dBuV/m) | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 902.000 | 26.40 | 5.33 | 31.73 | 46.00 | -14.27 | 100 | 349 | Peak |
| 908.400 | 93.63 | -24.15 | 69.48 | 94.00 | -24.52 | 100 | 349 | Average |
| 908.400 | 88.09 | 5.54 | 93.63 | 114.00 | -20.37 | 100 | 349 | Peak |
| 928.000 | 29.92 | 6.22 | 36.14 | 46.00 | -9.86 | 100 | 349 | Peak |

| Freq. MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 1816.800 | 33.76 | -12.61 | 21.15 | 54.00 | -32.85 | 151 | 181 | Average |
| 1816.800 | 44.55 | -12.61 | 31.94 | 74.00 | -42.06 | 151 | 181 | Peak |

**916 MHz**

**Horizontal**

| Freq. MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 902.000 | 27.38 | 5.33 | 32.71 | 46.00 | -13.29 | 100 | 349 | Peak |
| 916.000 | 73.43 | 5.65 | 79.08 | 94.00 | -14.92 | 100 | 349 | Average |
| 916.000 | 97.58 | 5.65 | 103.23 | 114.00 | -10.77 | 100 | 349 | Peak |
| 928.000 | 30.29 | 6.22 | 36.51 | 46.00 | -9.49 | 100 | 349 | Peak |

| Freq. MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 1832.000 | 43.64 | -12.45 | 31.19 | 54.00 | -22.81 | 155 | 204 | Average |
| 1832.000 | 44.30 | -12.45 | 31.85 | 74.00 | -42.15 | 155 | 204 | Peak |

**Vertical**

| Freq. MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 902.000 | 26.71 | 5.33 | 32.04 | 46.00 | -13.96 | 100 | 328 | Peak |
| 916.000 | 59.07 | 5.65 | 64.72 | 94.00 | -29.28 | 100 | 328 | Average |
| 916.000 | 83.22 | 5.65 | 88.87 | 114.00 | -25.13 | 100 | 328 | Peak |
| 928.000 | 28.56 | 6.22 | 34.78 | 46.00 | -11.22 | 100 | 328 | Peak |

| Freq. MHz | Reading dBuV | Factor dB/m | Level dBuV/m | Limit dBuV/m | Margin dB | Height (cm) | Degree (°) | Remark |
|---|---|---|---|---|---|---|---|---|
| 1832.000 | 39.56 | -12.45 | 27.11 | 54.00 | -26.89 | 146 | 0 | Average |
| 1832.000 | 44.73 | -12.45 | 32.28 | 74.00 | -41.72 | 146 | 0 | Peak |

Result = Reading + Correct Factor
Margin = Result – Limit
Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain
Spurious emissions more than 20 dB below the limit were not reported.

# 10 FCC §15.215(c) & RSS-GEN CLAUSE 6.7 – 20 dB Bandwidth Testing and 99% OCCUPIED BANDWIDTH

## 10.1 Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

According to RSS-Gen Clause 6.7:
The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum inband power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

## 10.2 Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

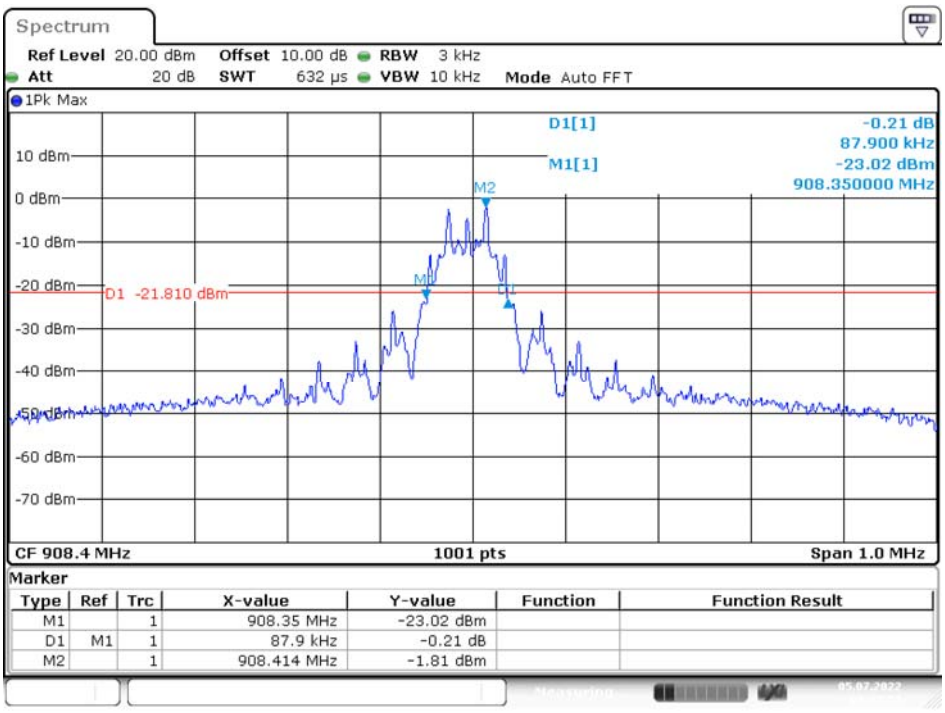
## 10.3 Test Results

| Channel | Frequency (MHz) | 20 dB Emission Bandwidth (kHz) | 99% Occupied Bandwidth (kHz) |
|---|---|---|---|
| Low | 908.4 | 87.90 | 93.91 |
| High | 916 | 115.90 | 113.89 |

Please refer to the following plots

**20 dB Emission Bandwidth**

## Low Channel

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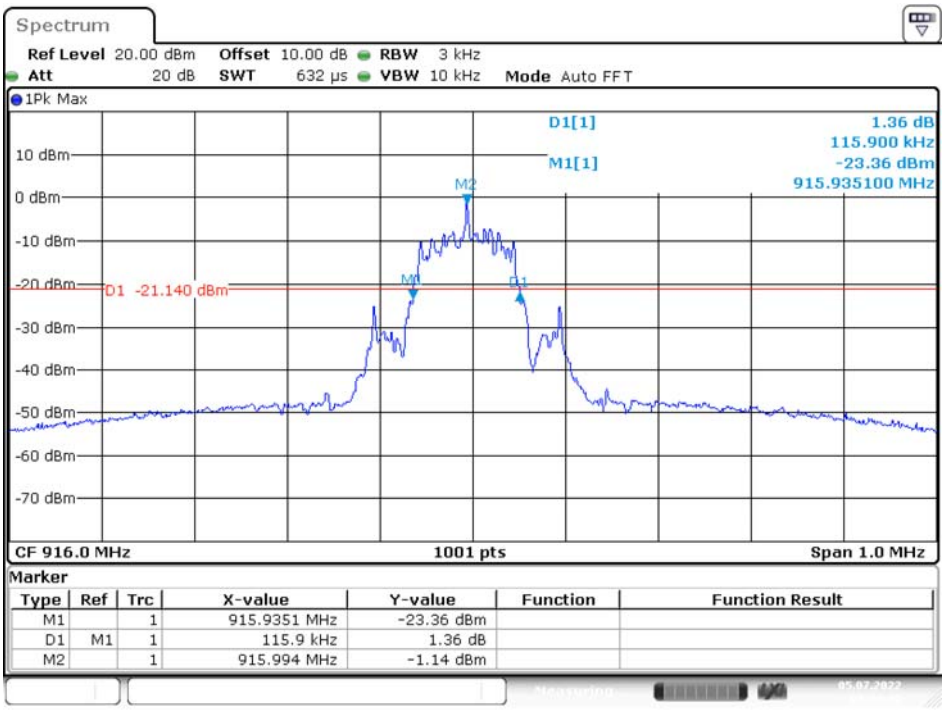
## High Channel

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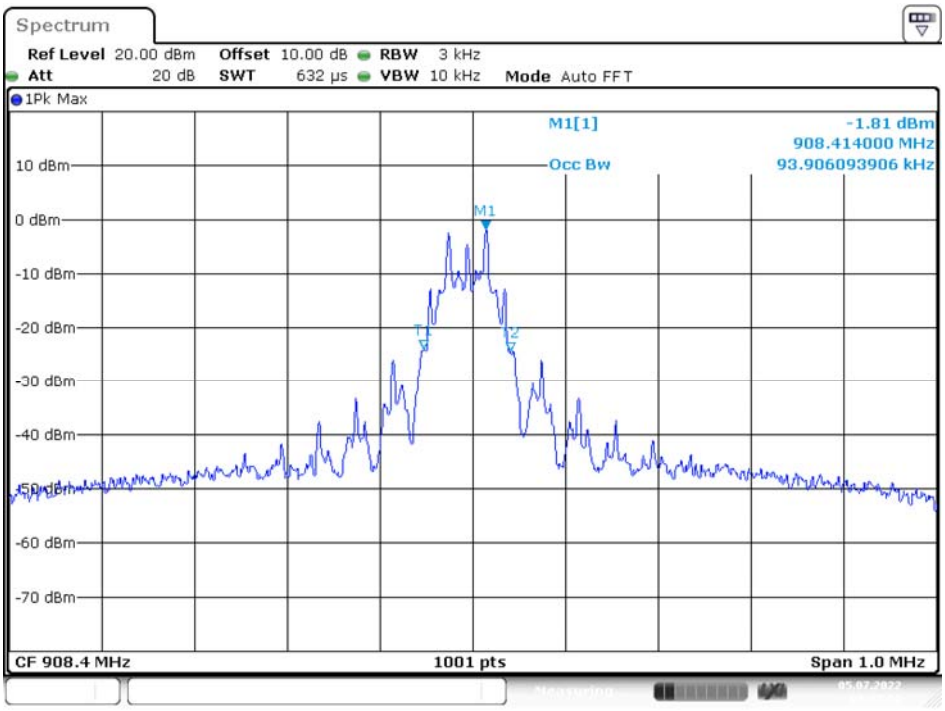
**99% Occupied Bandwidth**

## Low Channel

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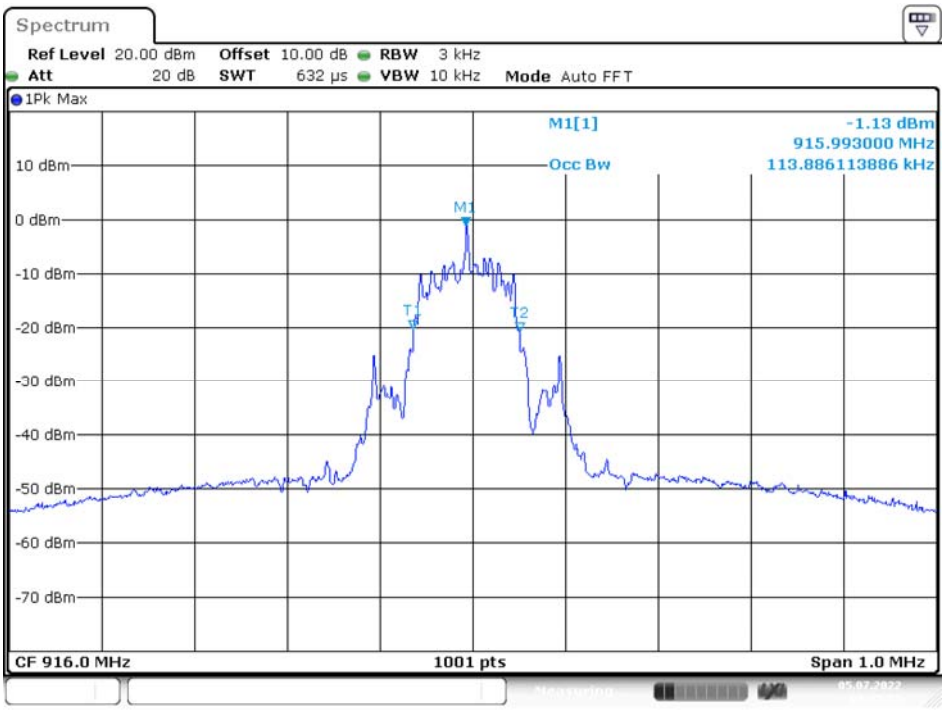
## High Channel

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