# Report on the Testing of the

# ELK Products, Inc.
# E27-RF2

## FCC ID: ELK-E27RF9
## IC: 4353A -E27RF9

## In accordance with:
## FCC 47 CFR Part 15.247
## FCC 47 CFR Part 15.207
## ISED RSS-247 Issue 2, February 2017
## ISED RSS-GEN Issue 5, April 2018

America

**Add value.**
**Inspire trust.**

Prepared for: ELK Products, Inc.
PO BOX 100
Hildebran, NC 28637, USA

## COMMERCIAL-IN-CONFIDENCE

Document Number: NC72168535.2 | Issue: 1

| SIGNATURE | | | |
|---|---|---|---|
| | | | |
| **NAME** | **JOB TITLE** | **RESPONSIBLE FOR** | **ISSUE DATE** |
| Sean Sellergren | Sr EMC Engineer | **Authorized Signatory** | 05 October 2021 |

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD America, Inc. document control rules.

| | |
|---|---|
| FCC Accreditation Designation Number US1148 New Brighton, MN Test Laboratory | Innovation, Science, and Economic Development Canada Accreditation Site Number 4512A New Brighton, MN Test Laboratory |

**EXECUTIVE SUMMARY**
A sample of this product was tested and found to be compliant with the standards listed above and the tests shown in Table 1.3.1 of this report.

A2LA Cert. No. 2955.11



**ACCREDITATION**
Our A2LA Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our A2LA Accreditation.

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# 1 Report Summary

## 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

**Table 1.1-1 – Modification Record**

| Issue | Description of Change | Date of Issue |
|---|---|---|
| 1 | First Issue | 05 October 2021 |

## 1.2 Introduction

| | |
|---|---|
| Applicant | ELK Products, Inc. |
| Manufacturer | ELK Products, Inc. |
| Applicant's Email Address | don.lamb@elkproducts.com |
| Model Number(s) | E27-RF2 |
| Serial Number(s) | n/a |
| Number of Samples Tested | 1 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15.247<br>FCC 47 CFR Part 15.207<br>ISED RSS-247 Issue 2, February 2017<br>ISED RSS-GEN Issue 5, April 2018 |
| Order Number | 72168535 |
| Date of Receipt of EUT | 25 June 2021 |
| Start of Test | 01 July 2021 |
| Finish of Test | 13 July 2021 |
| Related Document(s) | KDB 558074 D01<br>ANSI C63.10 2013 |

## 1.3 Scope of Testing

To perform certification testing to confirm that the wireless device(s) meet the requirements of the applicable standards and guidance documents (KDB 558074 D01).

## 1.4 Summary of Results

A summary of the tests carried out in accordance with the specifications shown below.

**Table 1.4-1 – Summary of Results**

| Report Section | Specification Clause | | Test Description | Accreditation | Base Standard |
|---|---|---|---|---|---|
| 2.1 | 15.203 | RSS-GEN | Antenna Requirements | A2LA | FCC Part 15.203 |
| 2.2 | 15.247(a)(1)(i) | RSS-247 (5.1a) | 20dB / 99% Bandwidth | A2LA | ANSI C63.10:2013 |
| 2.3 | 15.247(a)(1) | RSS-247 (5.1b) | Hopping Channel Separation | A2LA | ANSI C63.10:2013 |
| 2.4 | 15.247(a)(1)(i) | RSS-247 (5.1c) | Number of Hopping Channels | A2LA | ANSI C63.10:2013 |
| 2.5 | 15.247(a)(1)(i) | RSS-247 (5.1d) | Average Occupancy Period | A2LA | ANSI C63.10:2013 |
| 2.6 | 15.247(b)(2) | RSS-247 (5.4d) | Peak Conducted Output Power | A2LA | ANSI C63.10:2013 |
| 2.7 | 15.247(d) | RSS-247 (5.5) | Conducted Spurious Emissions | A2LA | ANSI C63.10:2013 |
| 2.8 | 15.247(d) | RSS-247 (5.5) | Conducted Band-Edge | A2LA | ANSI C63.10:2013 |
| 2.9 | 15.207 | RSS-GEN | Conducted Emissions | A2LA | ANSI C63.4:2013 |
| 2.10 | 15.247(d) | RSS-GEN | Radiated Spurious Emissions | A2LA | ANSI C63.10:2013 |
| 2.11 | 15.205 | RSS-GEN | Radiated Restricted Bands of Emissions | A2LA | ANSI C63.10:2013 |

**Table 1.4-2 – Test Accreditation**

| Test Name | Name of Tester(s) | Results / Comments |
|---|---|---|
| Antenna Requirements | Franklin Rose | Pass |
| 20dB / 99% Bandwidth | Franklin Rose | Pass |
| Hopping Channel Separation | Franklin Rose | Pass |
| Number of Hopping Channels | Franklin Rose | Pass |
| Average Occupancy Period | Franklin Rose | Pass |
| Peak Conducted Output Power | Franklin Rose | Pass |
| Conducted Spurious Emissions | Franklin Rose | Pass |
| Conducted Band-Edge | Franklin Rose | Pass |
| Conducted Emissions | Franklin Rose | Pass |
| Radiated Spurious Emissions | Franklin Rose | Pass |
| Radiated Restricted Bands of Emissions | Franklin Rose | Pass |

## 1.5 Product Information

### 1.5.1 Technical Description

The Equipment Under Test (EUT): 900 MHz radio module for Security Alarm Control Panel. For Residential and Commercial applications. The EUT monitors door, window, motion, and fire sensors. Reports alarms to Internet server and/or user's smartphone.

**Table 1.5-1 – Wireless Module Technical Information**

| Detail | Description |
|---|---|
| FCC ID | ELK-E27RF9 |
| IC | 4353A -E27RF9 |
| Transceiver Model # | E27-RF2 |
| Operating Frequency | 902.989 – 926.988 MHz |
| Modulation Format | GFSK |
| Antenna Type / Gain: | Monopole, 0.0 dBi |

A full description and detailed product specification details are available from the manufacturer.

**Table 1.5-2 – Cable Descriptions**

| Cable/Port | Description |
|---|---|
| Data/IO | E27-MC to E27-XDD & E27-KP |
| I/O | Test Jig interface cable |
| DC Power | Cable for 120 V AC to 14 V DC 1.7 A adapter |

**Table 1.5-3 – Support Equipment Descriptions**

| Make/Model | Description |
|---|---|
| E27-MC | Main Control Unit |
| E27-XDD | Telephone Dialler |
| E27-KP | Keypad & Display |
| E27-XIN | Zone Input Expander |
| E27-XOU | 8 Output Expander Board |

### 1.5.2 Modes of Operation

**Table 1.5-4 – Test Frequencies & Modes of Operation**

| Channel | Frequency (MHz) | Mode(s) |
|---|---|---|
| Low End | 903 MHz | n/a |
| Middle | 915 MHz | n/a |
| High End | 927 MHz | n/a |

## 1.6 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

## 1.7 EUT Modification Record

The table below details modifications made to the EUT during the test program. The modifications incorporated during each test are recorded on the appropriate test pages.

**Table 1.7-1 – Modification Record**

| Modification State | Description of Modification fitted to EUT | Modification Fitted By | Date Modification Fitted |
|---|---|---|---|
| 0 | Initial State | | |

## 1.8 Test Location

TÜV SÜD conducted the following tests at our New Brighton, MN Test Laboratory.
Office address:

TÜV SÜD America
141 14th Street NW
New Brighton, MN  55112 USA

# 2 Test Details

## 2.1 Antenna Requirements

### 2.1.1 Specification Reference

FCC 47 CFR Part 15 Subpart C, 15.203
RSS-GEN Issue 5

### 2.1.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.1.3 Antenna Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Note: Above statement is taken from FCC Part 15 Subpart C §15.203

**Table 2.1-1 – Antenna Used In EUT**

| Antenna Type | Connection Type | Antenna Gain |
|---|---|---|
| Monopole | Terminal Block (internal) | 0.0 dBi |

## 2.2 20dB / 99% Bandwidth

### 2.2.1 Specification Reference

FCC 47 CFR Part 15.247(a)(2)
RSS-247 5.2(a)

### 2.2.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.2.3 Date of Test

01 July 2021

### 2.2.4 Test Method

The 20dB bandwidth was measured in accordance with the FCC KDB 558074 D01 15.247 Meas Guidance. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 100 kHz and the Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold using a peak detector. The marker-delta function of the spectrum analyzer was utilized to determine the 20dB bandwidth of the emission.

The occupied bandwidth measurement function of the spectrum analyzer was used to measure the 99% bandwidth value. The span of the analyzer was set to capture all products of the modulation process, including the emission sidebands. The RBW to 1-5% of the occupied bandwidth and the VBW set to ≥ 3 times the RBW.

### 2.2.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.2.6 Test Results

**Table 2.2-1 – 20 dB / 99% Bandwidth Results**

| Frequency (MHz) | 20 dB Bandwidth (kHz) | 20 dB Bandwidth Limit (kHz) |
|---|---|---|
| 903 | 272.12 | 500 |
| 915 | 262.69 | 500 |
| 927 | 276.92 | 500 |

| Frequency (MHz) | 99% Bandwidth (MHz) |
|---|---|
| 903 | 259.62 |
| 915 | 265.38 |
| 927 | 254.81 |

**Test Summary**: The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.

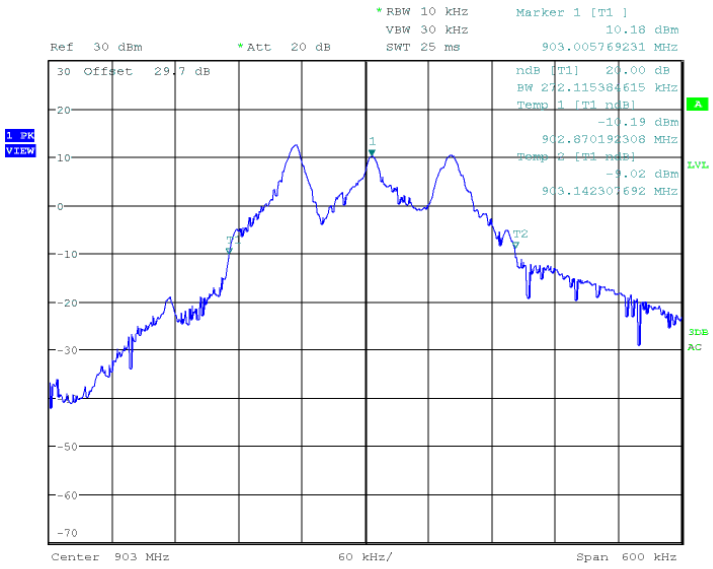



**Figure 2-1 – 20dB Bandwidth – Low Channel**

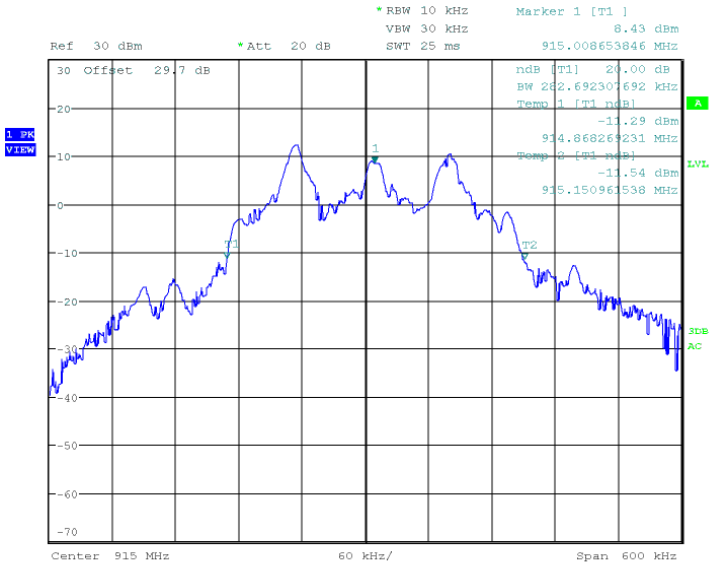



**Figure 2-2 – 20dB Bandwidth – Middle Channel**

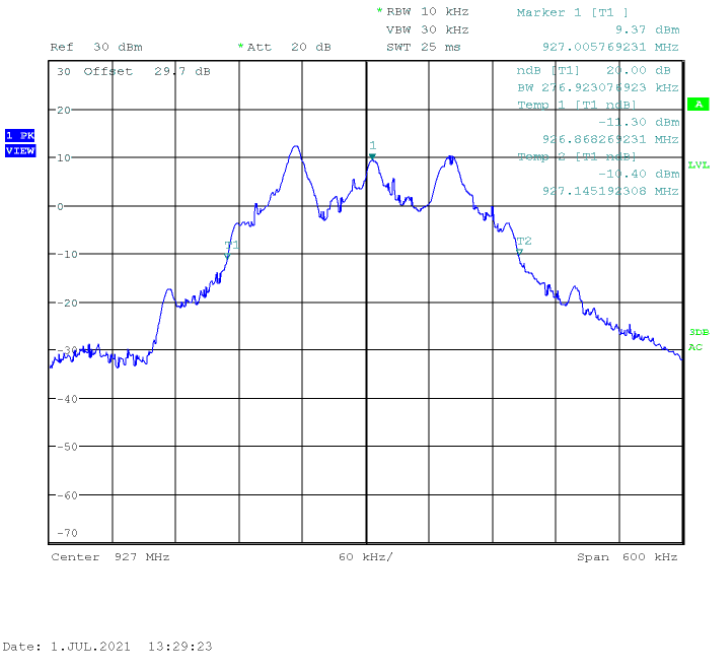



**Figure 2-3 – 20dB Bandwidth – High Channel**

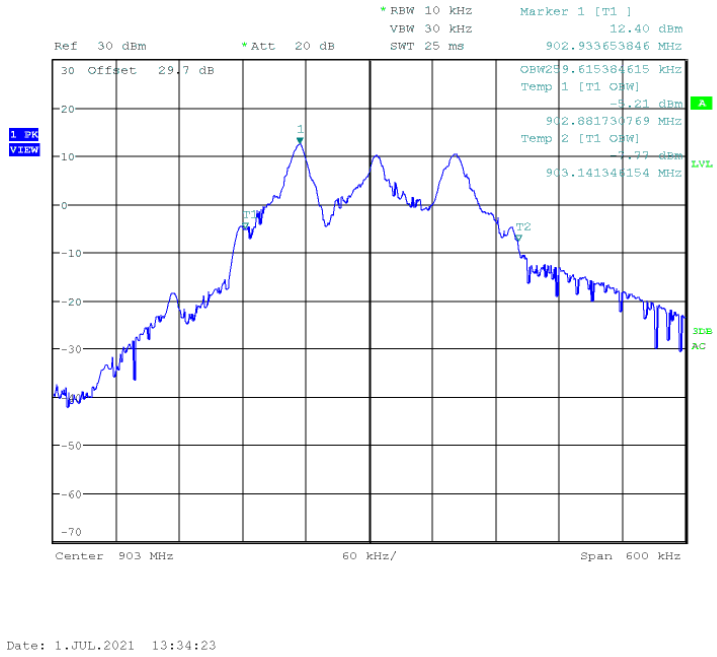



**Figure 2-4 – 99% Bandwidth – Low Channel**

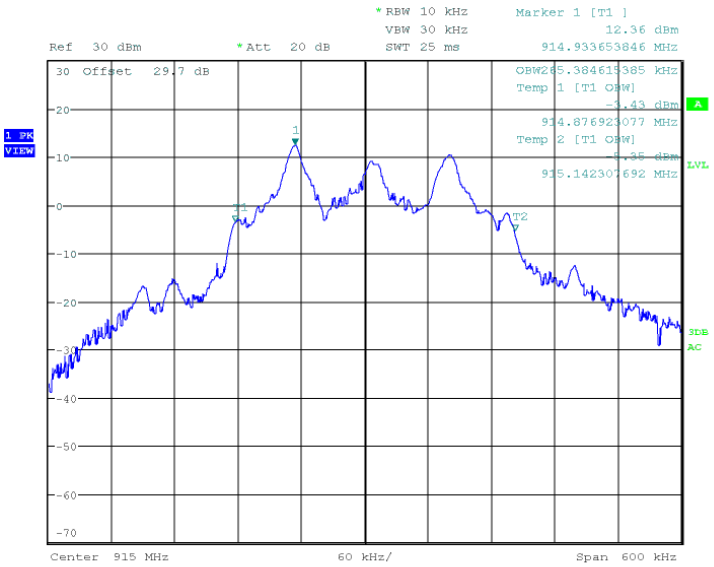



**Figure 2-5 – 99% Bandwidth – Middle Channel**

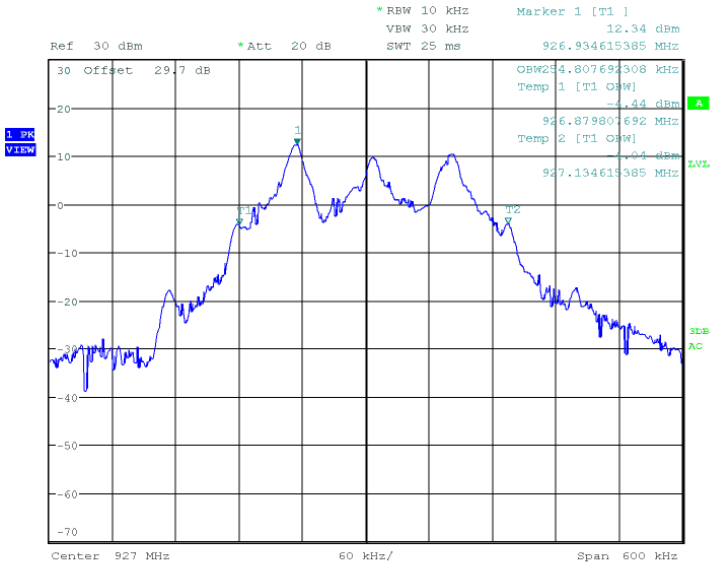



**Figure 2-6 – 99% Bandwidth – High Channel**

### 2.2.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: CSAC1

**Table 2.2-2 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE10998 | Rohde & Schwarz | Receiver, 20 Hz-26.5 GHz | ESU 26 | 100379 | G | 05/21/2020 | 11/20/2021 |
| WRLE11398 | Meca | Attenuator, 20dB | 603-20-1F18 | 11398 | B | 11/02/2020 | 11/02/2021 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.3 Hopping Channel Separation

### 2.3.1 Specification Reference

FCC 47 CFR Part 15.247(a)(1)
RSS-247 5.1(b)

### 2.3.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.3.3 Date of Test

01 July 2021

### 2.3.4 Test Method

The Hopping Channel Separation was measured in accordance with ANSI C63.10-2013 Section 7.8.2. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to 30% of the channel spacing and the Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold using a peak detector. The marker-delta function of the spectrum analyzer was utilized to determine the channel separation of the adjacent channels.

### 2.3.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.3.6 Test Results

**Table 2.3-1 – Hopping Channel Separation Results**

| Frequency 1 (MHz) | Frequency 2 (MHz) | Separation (MHz) | 20dB Bandwidth (MHz) |
|---|---|---|---|
| 915 | 915.5 | 0.5 | 0.27692 |

**Test Summary**: The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

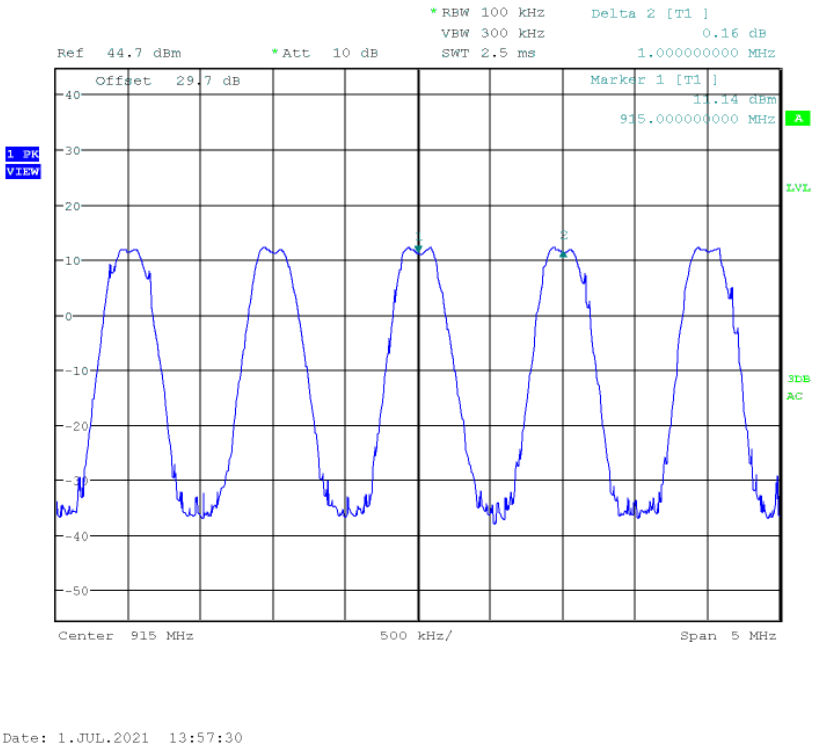



**Figure 2-7 – Hopping Channel Separation**

### 2.3.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: CSAC1

**Table 2.3-2 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE10998 | Rohde & Schwarz | Receiver, 20 Hz-26.5 GHz | ESU 26 | 100379 | G | 05/21/2020 | 11/20/2021 |
| WRLE11398 | Meca | Attenuator, 20dB | 603-20-1F18 | 11398 | B | 11/02/2020 | 11/02/2021 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.4 Number of Hopping Channels

### 2.4.1 Specification Reference

FCC 47 CFR Part 15.247(a)(1)(i)
RSS-247 5.1(c)

### 2.4.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.4.3 Date of Test

01 July 2021

### 2.4.4 Test Method

The Number of Hopping Channels was measured in accordance with ANSI C63.10-2013 Section 7.8.3. The Resolution Bandwidth (RBW) of the spectrum analyzer was set to ≤ 30% of the channel spacing or the 20dB Bandwidth, and the Video Bandwidth (VBW) was set to ≥ 3 times the RBW. The trace was set to max hold using a peak detector. The spectrum analyzer automatic peak list function was utilized to determine the number of channels.

### 2.4.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.4.6 Test Results

**Table 2.4-1 – Number of Hopping Channel Results**

| Number of Hopping Channels | Hopping Channel Limit |
|---|---|
| 25 | ≥ 25 |

**Test Summary**: The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

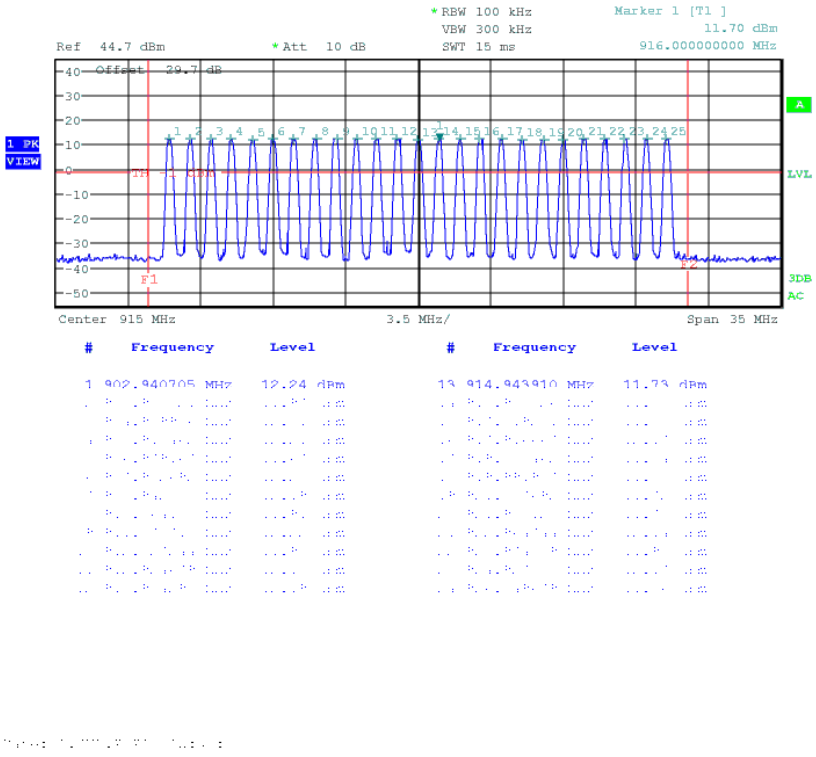



**Figure 2-8 – Number of Hopping Channels**

### 2.4.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: CSAC1

**Table 2.4-2 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE10998 | Rohde & Schwarz | Receiver, 20 Hz-26.5 GHz | ESU 26 | 100379 | G | 05/21/2020 | 11/20/2021 |
| WRLE11398 | Meca | Attenuator, 20dB | 603-20-1F18 | 11398 | B | 11/02/2020 | 11/02/2021 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.5 Average Occupancy Period

### 2.5.1 Specification Reference

FCC 47 CFR Part 15.247(a)(1)(i)
RSS-247 5.1(d)

### 2.5.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.5.3 Date of Test

01 July 2021

### 2.5.4 Test Method

The Average Occupancy Period (Dwell Time) was measured in accordance with ANSI C63.10-2013 Section 7.8.4. The spectrum analyzer was put into a 0 Hz Span (time domain) measurement mode, and the Resolution Bandwidth (RBW) of the spectrum analyzer was set less than or equal to the channel spacing and where possible was set > 1/T, where T is the dwell time. The sweep time was set high enough to encompass the entire time on the channel. Triggering was set to video trigger at a level high enough to negate interference from adjacent channels. The trace was set to max hold using a peak detector. The marker-delta function of the spectrum analyzer was utilized to determine the occupancy time on the channel. The test was then repeated (if necessary) to measure the period until returning to the channel.

The Average Occupancy Period is calculated with the following formula:

*(Number of Hops within the Requirement Period) = (Number of Observed Hops) * (Requirement Period / Analyzer Sweep Time)*

### 2.5.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.5.6 Test Results

**Table 2.5-1 – Average Occupancy Period Results**

| Frequency (MHz) | Analyzer Sweep Time (s) | Number of Hops Observed | Requirement Time Period (s) | Dwell Time per Hop (ms) | Average Occupancy Period (ms) | Average Occupancy Limit (s) | Margin (s) |
|---|---|---|---|---|---|---|---|
| 915 | 10 | 26 | 10 | 13.69 | 355.94 | 0.4 | -0.04 |

**Test Summary**: The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

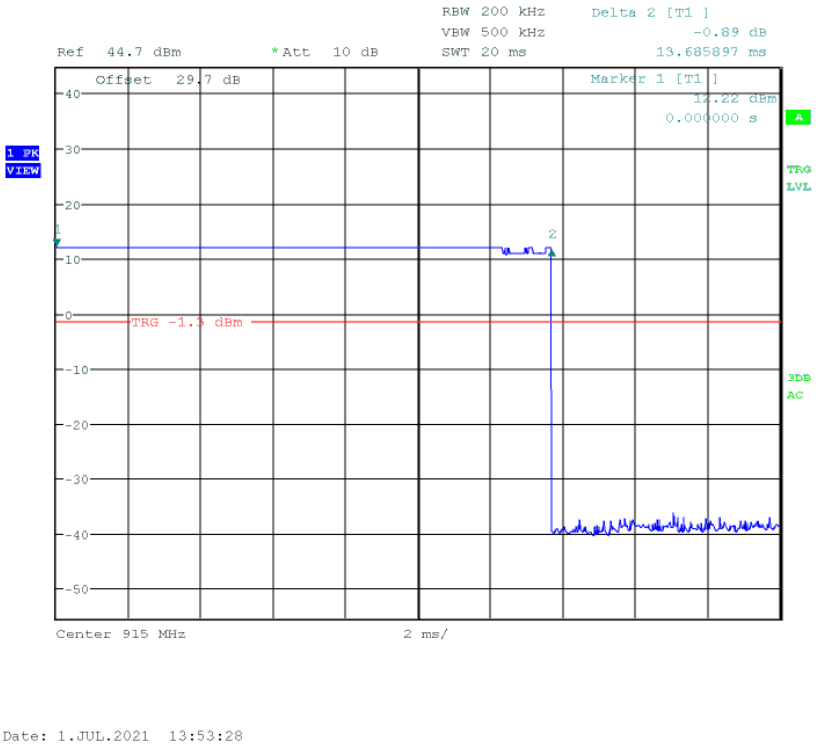



**Figure 2-9 – Dwell Time of Single Hop**

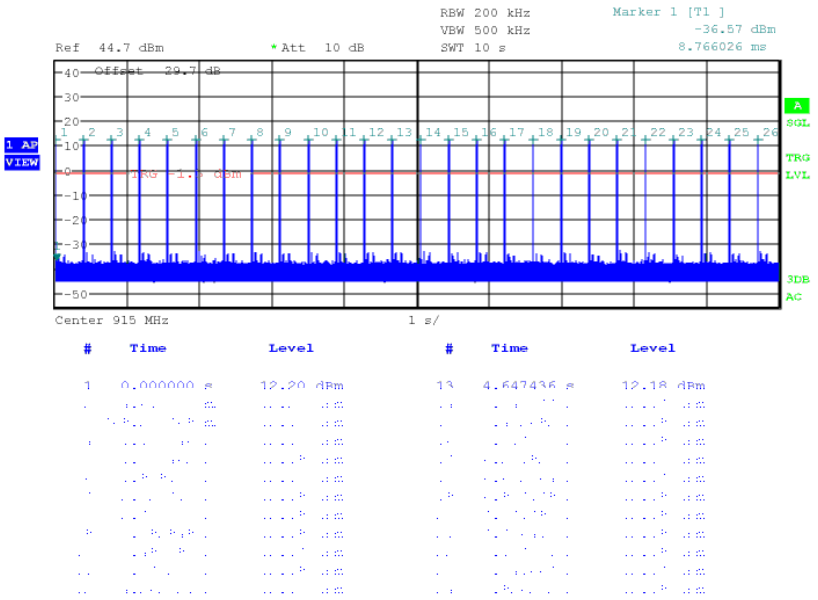



**Figure 2-10 – Number of Hops in 10 s**

### 2.5.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: CSAC1

**Table 2.5-2 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE10998 | Rohde & Schwarz | Receiver, 20 Hz-26.5 GHz | ESU 26 | 100379 | G | 05/21/2020 | 11/20/2021 |
| WRLE11398 | Meca | Attenuator, 20dB | 603-20-1F18 | 11398 | B | 11/02/2020 | 11/02/2021 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.6 Peak Conducted Output Power

### 2.6.1 Specification Reference

FCC 47 CFR Part 15.247(b)(2)
RSS-247 5.2(d)

### 2.6.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.6.3 Date of Test

01 July 2021

### 2.6.4 Test Method

The maximum peak conducted output power was measured in accordance with ANSI C63.10-2013 Section 7.8.5. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The Resolution Bandwidth (RBW) was > 20dB of the emission and the VBW was set to ≥ 3 times the RBW. The trace was set to max hold using a peak detector. The marker-to-peak function of the spectrum analyzer was utilized to determine the peak level of the emission.

### 2.6.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.6.6 Test Results

**Table 2.6-1 – Peak Conducted Output Power Results**

| Frequency (MHz) | Measured Output Power (dBm) | Output Power Limit (dBm) | Margin (dB) |
|---|---|---|---|
| 903 | 12.42 | 24.00 | -11.58 |
| 915 | 12.41 | 24.00 | -11.59 |
| 927 | 12.35 | 24.00 | -11.65 |

**Table 2.6-2 – Peak Conducted Output Power E.I.R.P Results**

| Frequency (MHz) | Measured Output Power (dBm) | ERP to EIRP Correction (dB) | Output Power Limit (dBm) | Margin (dB) |
|---|---|---|---|---|
| 903 | 12.42 | 14.57 | 30.00 | -15.43 |
| 915 | 12.41 | 14.56 | 30.00 | -15.44 |
| 927 | 12.35 | 14.50 | 30.00 | -15.50 |

**Note:** Output Power EIRP is used to assess the EUT for compliance against EIRP limits only.

**Test Summary**: The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

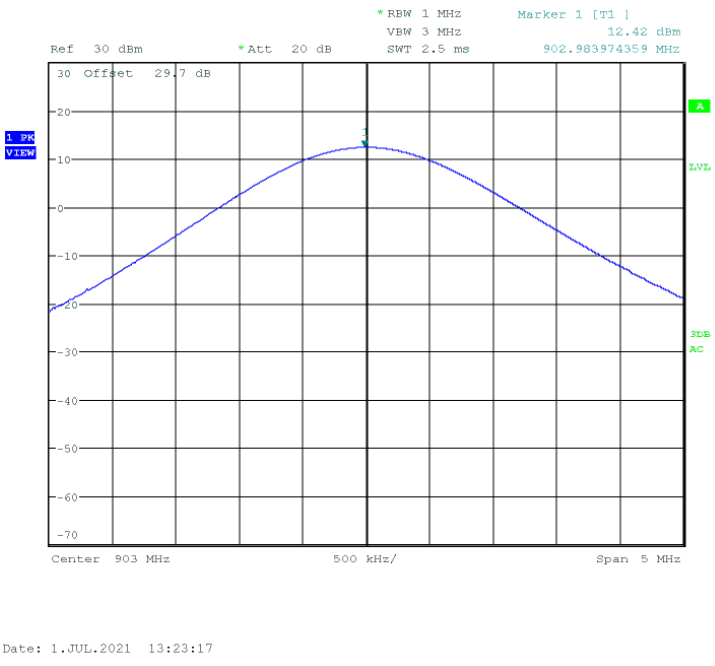



**Figure 2-11 – Peak Conducted Output Power – Low Channel**

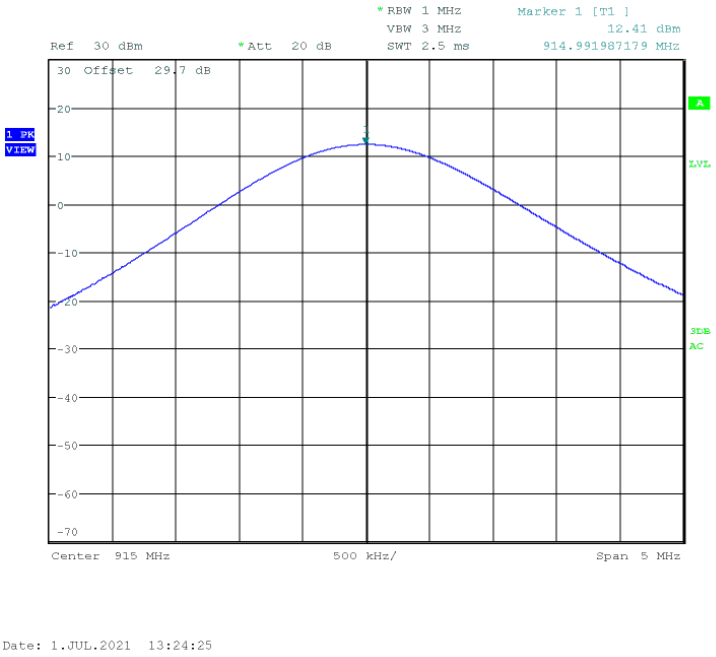



**Figure 2-12 – Peak Conducted Output Power – Middle Channel**

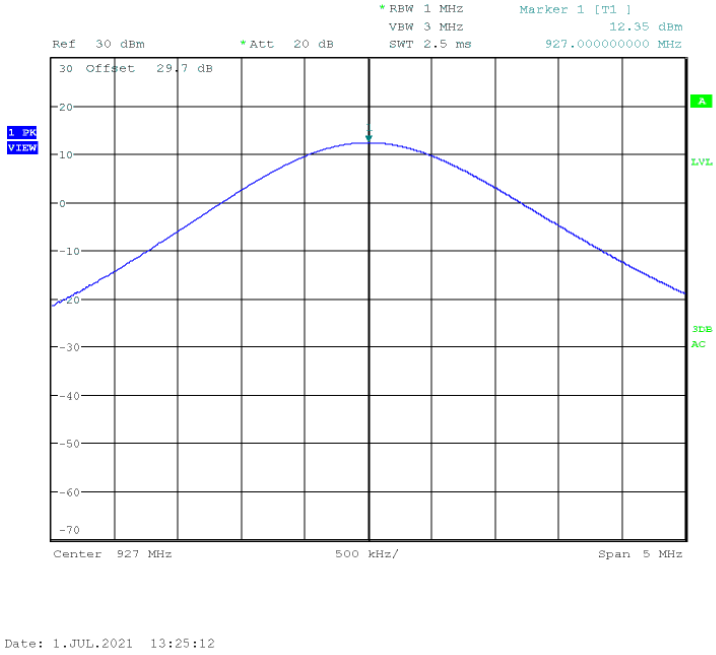



**Figure 2-13 – Peak Conducted Output Power – High Channel**

### 2.6.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: CSAC1

**Table 2.6-3 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE10998 | Rohde & Schwarz | Receiver, 20 Hz-26.5 GHz | ESU 26 | 100379 | G | 05/21/2020 | 11/20/2021 |
| WRLE11398 | Meca | Attenuator, 20dB | 603-20-1F18 | 11398 | B | 11/02/2020 | 11/02/2021 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.7 Conducted Spurious Emissions

### 2.7.1 Specification Reference

FCC 47 CFR Part 15.247(d)
RSS-247 5.2(5.5)

### 2.7.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.7.3 Date of Test

01 September 2021

### 2.7.4 Test Method

The maximum peak conducted output power was measured in accordance with ANSI C63.10-2013 Section 7.8.8. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The RBW of the spectrum analyzer was set to 100kHz and the VBW was set to ≥ 3 times the RBW. The spectrum analyzer span was set to cover the entire frequency range of 30MHz to 5 times the highest intentional radiator and the trace was set to max hold using the peak detector.

### 2.7.5 Environmental Conditions

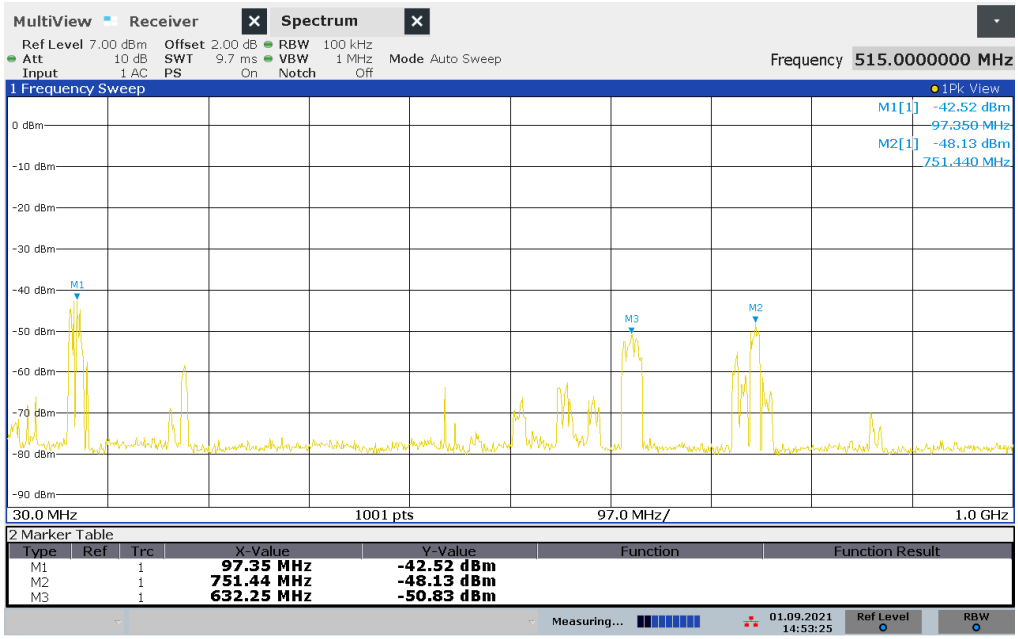
The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.7.6 Test Results

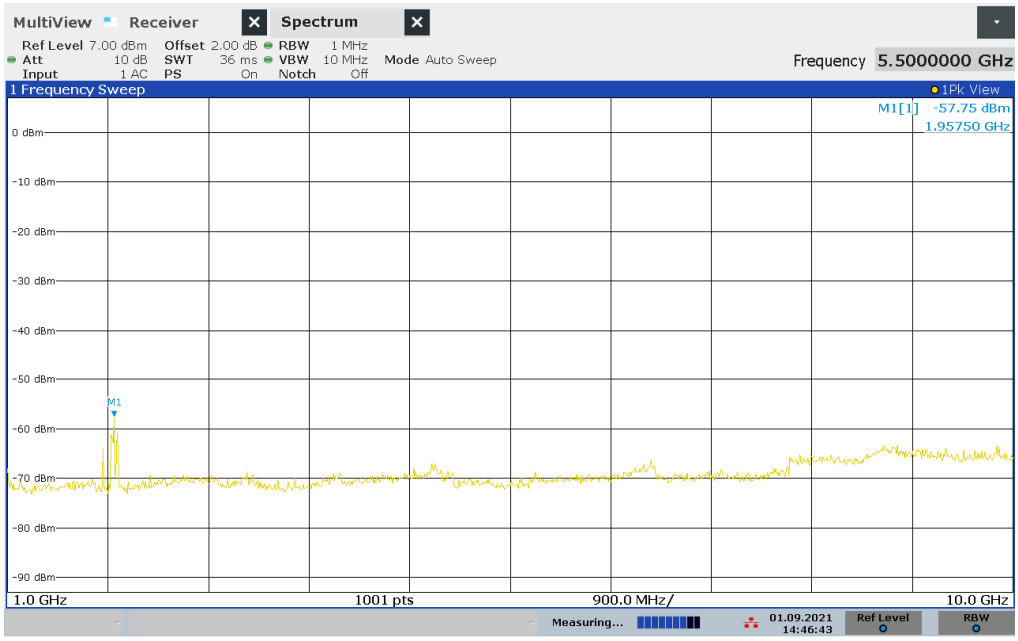
**Test Summary**: The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.




**14:53:26 01.09.2021**

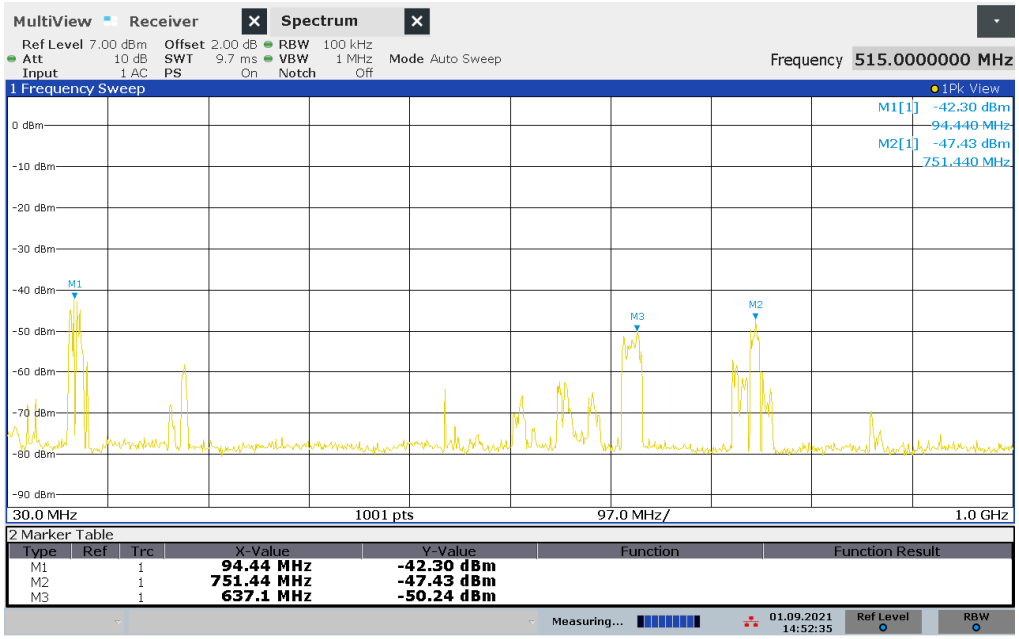



**14:46:43 01.09.2021**

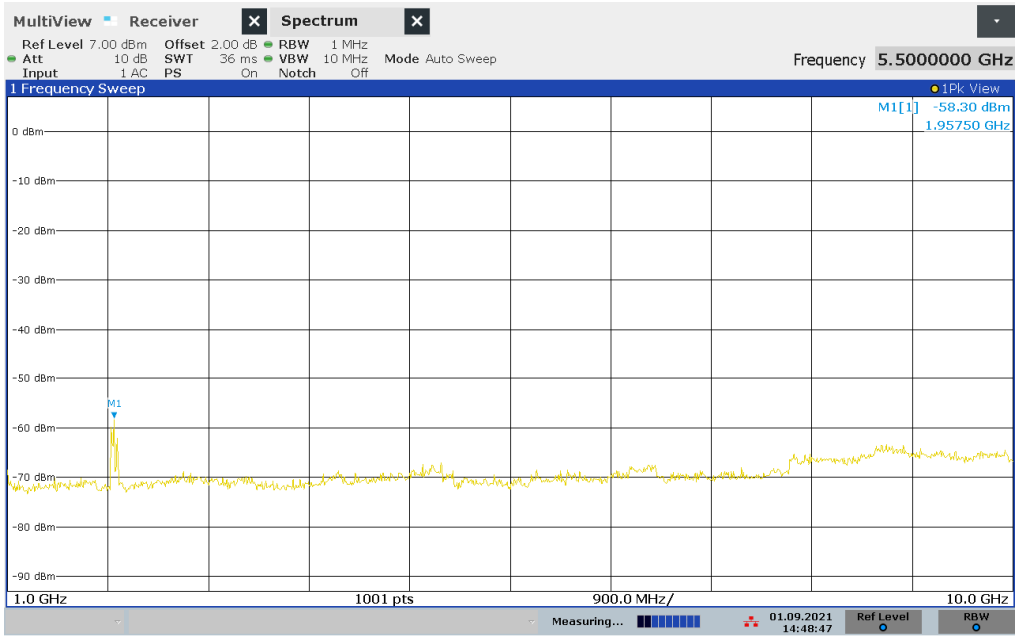
**Figure 2-14 – Conducted Spurious Emissions 30 MHz – 10 GHz – Low Channel**

**Table 2.7-1 – Conducted Spurious Emissions 30 MHz – 10 GHz Results**

| Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Margin (dBm) |
|---|---|---|---|
| 97.35 | -42.52 | -7.58 | -34.94 |
| 751.44 | -48.13 | -7.58 | -40.55 |
| 632.25 | -50.83 | -7.58 | -43.25 |
| 1957.50 | -57.75 | -7.58 | -50.17 |




**14:52:36 01.09.2021**

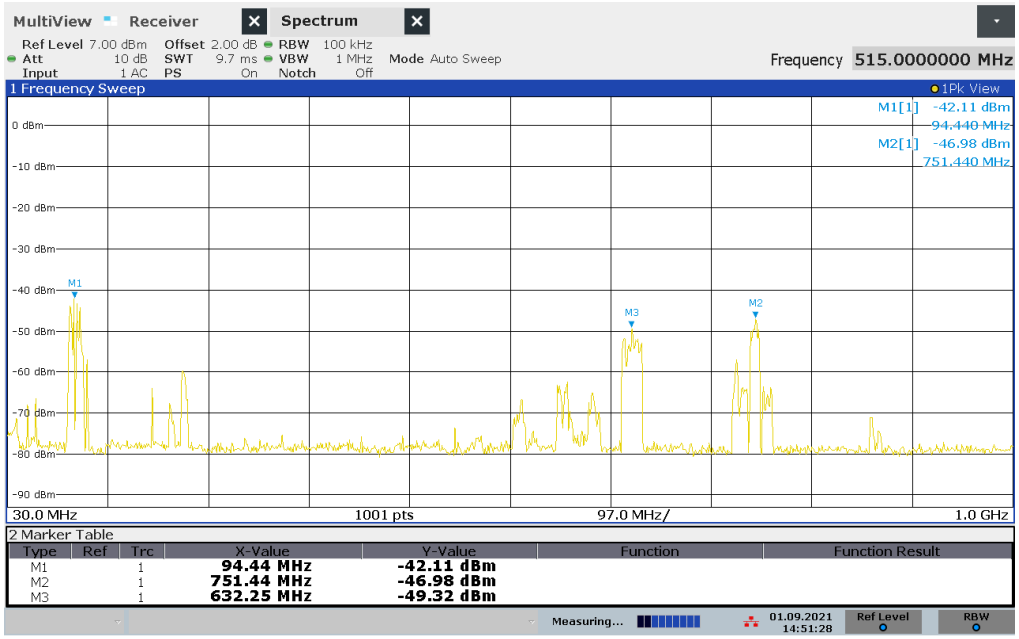



**14:48:48 01.09.2021**

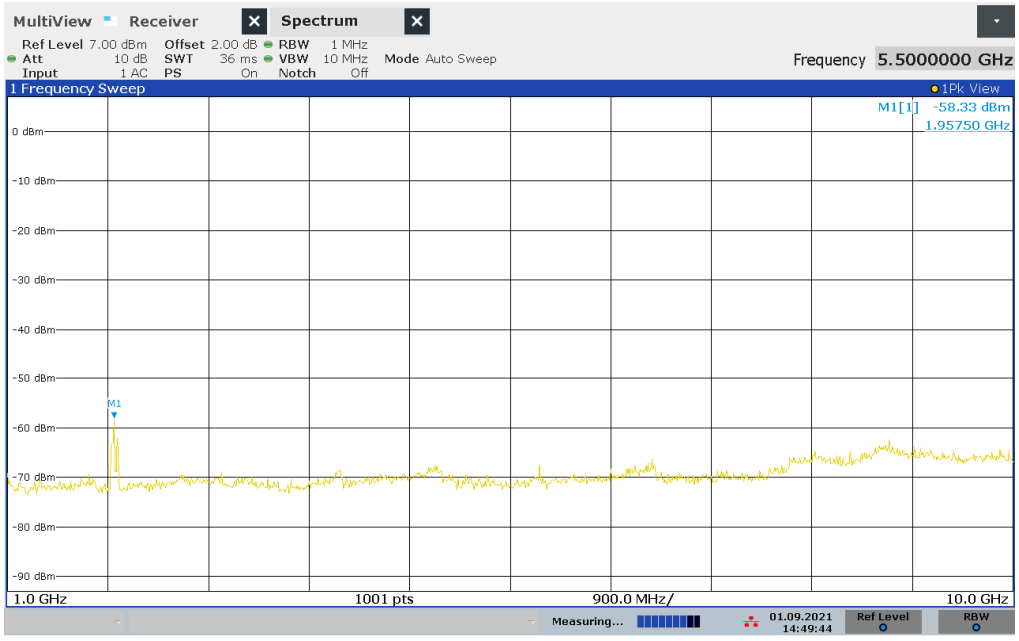
**Figure 2-15 – Conducted Spurious Emissions 30 MHz – 10 GHz – Mid Channel**

**Table 2.7-2 – Conducted Spurious Emissions 30 MHz – 10 GHz Results**

| Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Margin (dBm) |
|---|---|---|---|
| 94.44 | -42.30 | -7.58 | -34.72 |
| 751.44 | -47.43 | -7.58 | -39.85 |
| 637.10 | -50.24 | -7.58 | -42.66 |
| 1957.50 | -58.30 | -7.58 | -50.72 |




**14:51:28 01.09.2021**




**14:49:45 01.09.2021**

**Figure 2-16 – Conducted Spurious Emissions 30 MHz – 10 GHz – High Channel**

**Table 2.7-3 – Conducted Spurious Emissions 30 MHz – 10 GHz Results**

| Frequency (MHz) | Measured Level (dBm) | Limit (dBm) | Margin (dBm) |
|---|---|---|---|
| 94.44 | -42.11 | -7.58 | -34.53 |
| 751.44 | -46.98 | -7.58 | -39.40 |
| 632.25 | -49.32 | -7.58 | -41.74 |
| 1975.50 | -58.33 | -7.58 | -50.75 |

### 2.7.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: 3mSAC

**Table 2.7-4 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE11398 | Meca | Attenuator, 20dB | 603-20-1F18 | 11398 | B | 11/02/2020 | 11/02/2021 |
| NBLE11555 | Rohde & Schwarz | Receiver, 2 Hz-44 GHz | ESW44 | 101537 | G | 12/31/2020 | 12/31/2021 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.8 Conducted Band-Edge

### 2.8.1 Specification Reference

FCC 47 CFR Part 15.247(d)
RSS-247 5.2(5.5)

### 2.8.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.8.3 Date of Test

01 July 2021

### 2.8.4 Test Method

The maximum peak conducted output power was measured in accordance with ANSI C63.10-2013 Section 7.8.8. The RF output of the EUT was directly connected to the input of the spectrum analyzer along with a suitable external attenuator. The RBW of the spectrum analyzer was set to 100kHz and the VBW was set to ≥ 3 times the RBW. The spectrum analyzer span was set to cover the entire frequency range of 30MHz to 5 times the highest intentional radiator and the trace was set to max hold using the peak detector.

### 2.8.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.8.6 Test Results

**Test Summary**: The EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.

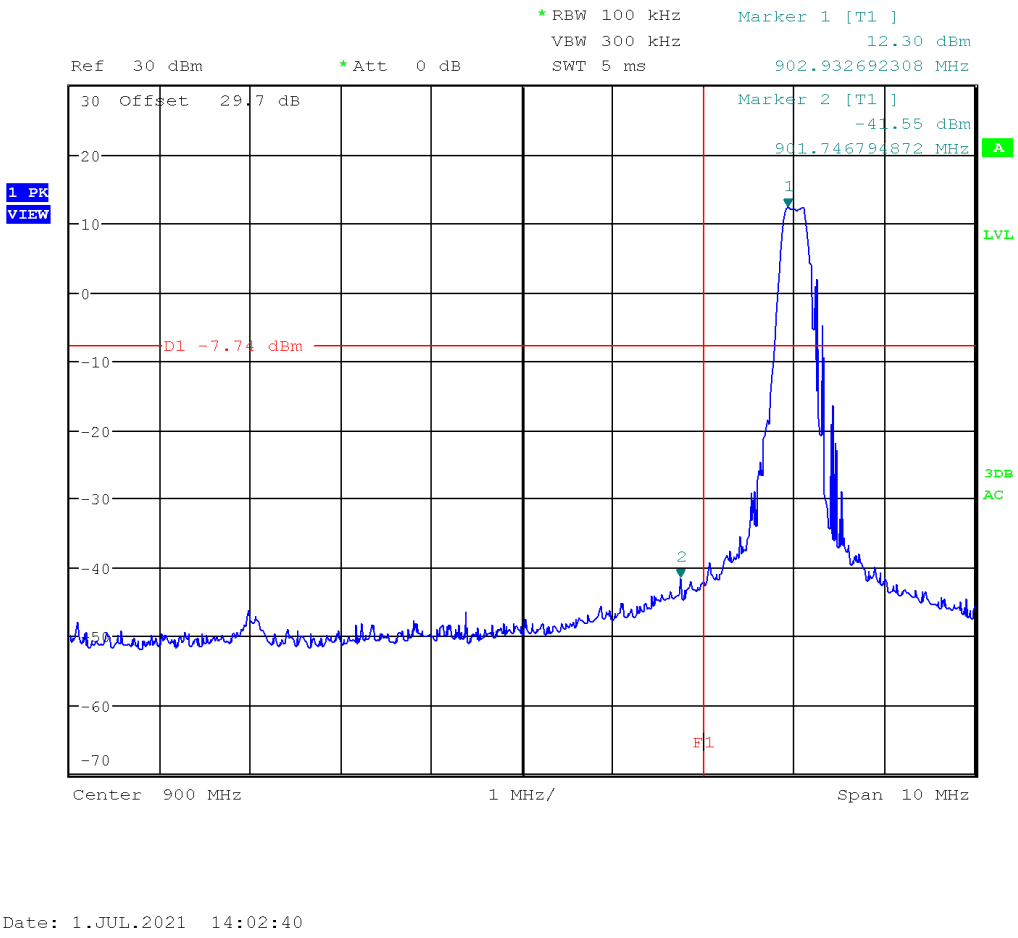



**Figure 2-17 – Conducted Band-Edge – Low Channel, Stopped**

**Table 2.8-1 – Conducted Band-Edge Results**

| Frequency (MHz) | Measured Level (dBm) | Delta (dB) |
|---|---|---|
| 901.75 | -41.55 | 53.85 |

**Note:** The Emission was < 2 MHz within the band edge, and the Marker-Delta method was applied. Please see the section "Radiated Band Edge" for compliance.

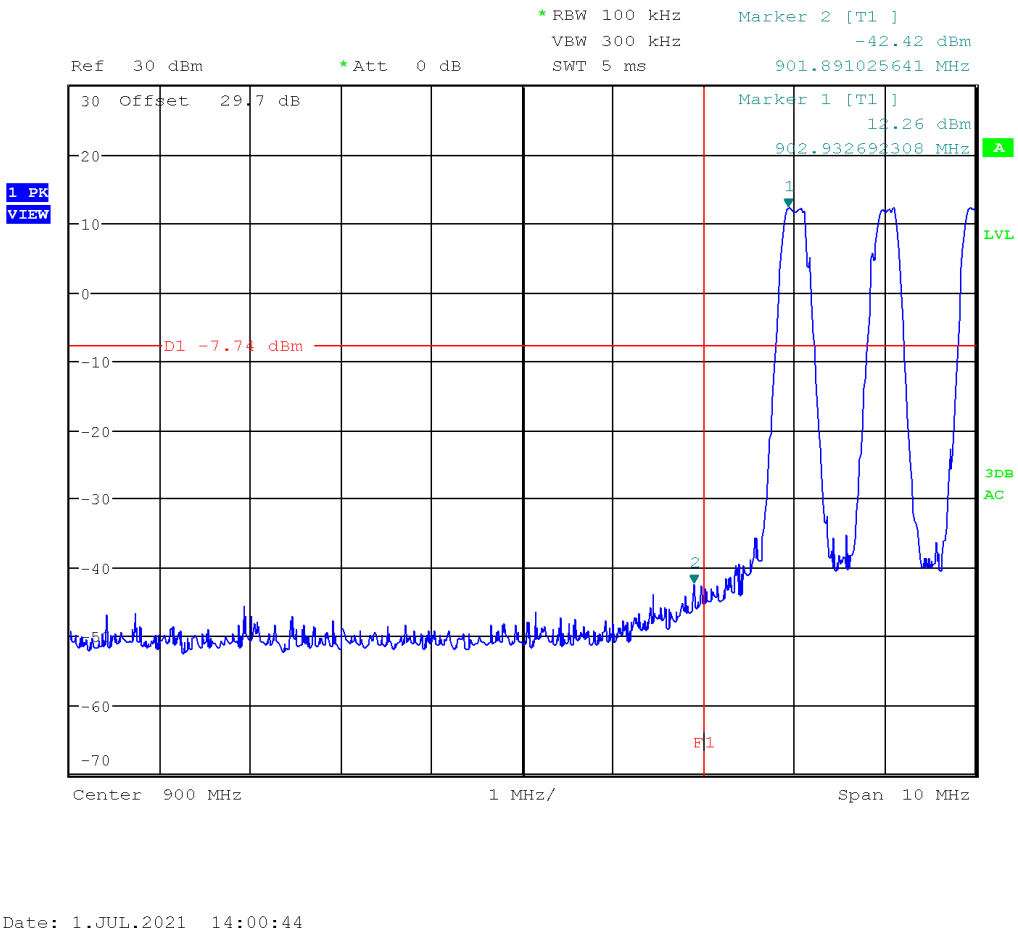



**Figure 2-18 – Conducted Band-Edge – Low Channel, Hopping**

**Table 2.8-2 – Conducted Band-Edge Results**

| Frequency (MHz) | Measured Level (dBm) | Delta (dB) |
|---|---|---|
| 901.89 | -42.42 | 54.68 |

**Note:** The Emission was < 2 MHz within the band edge, and the Marker-Delta method was applied. Please see the section "Radiated Band Edge" for compliance.

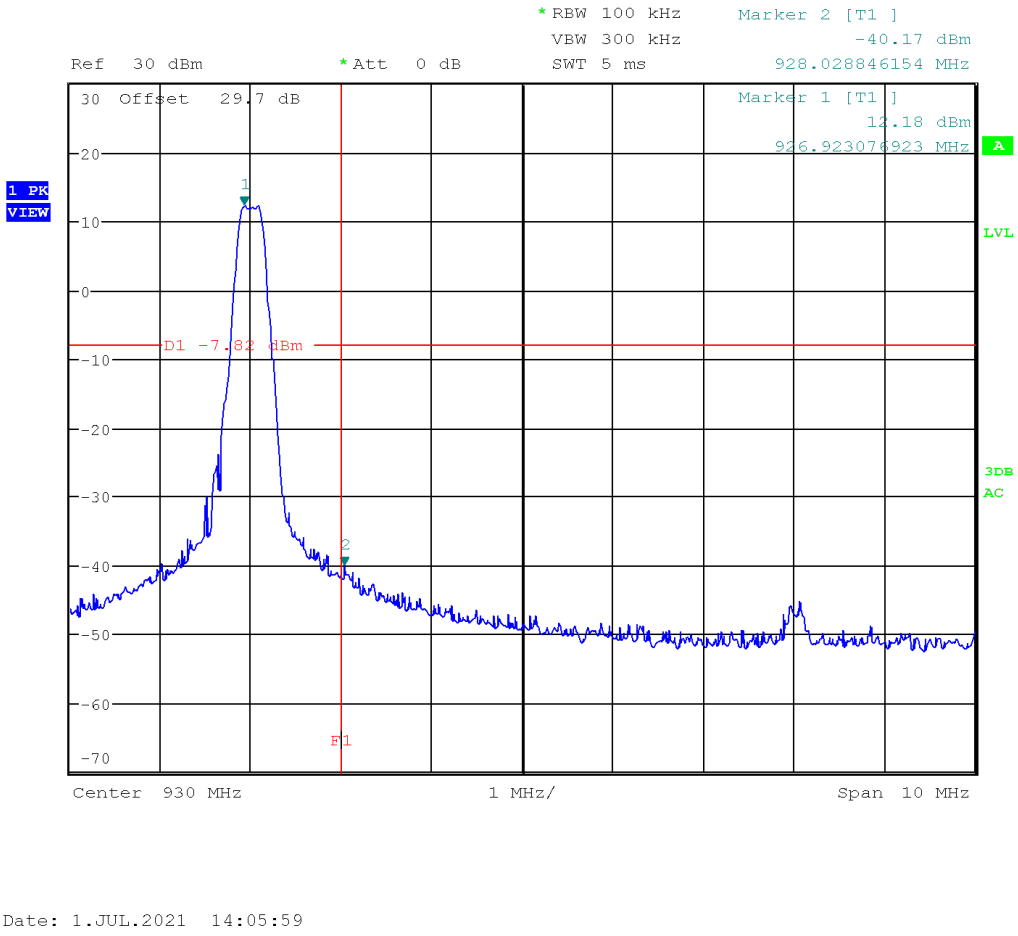



**Figure 2-19 – Conducted Band-Edge – High Channel, Stopped**

**Table 2.8-3 – Conducted Band-Edge Results**

| Frequency (MHz) | Measured Level (dBm) | Delta (dB) |
|---|---|---|
| 928.03 | -40.17 | 52.35 |

**Note:** The Emission was < 2 MHz within the band edge, and the Marker-Delta method was applied. Please see the section "Radiated Band Edge" for compliance.

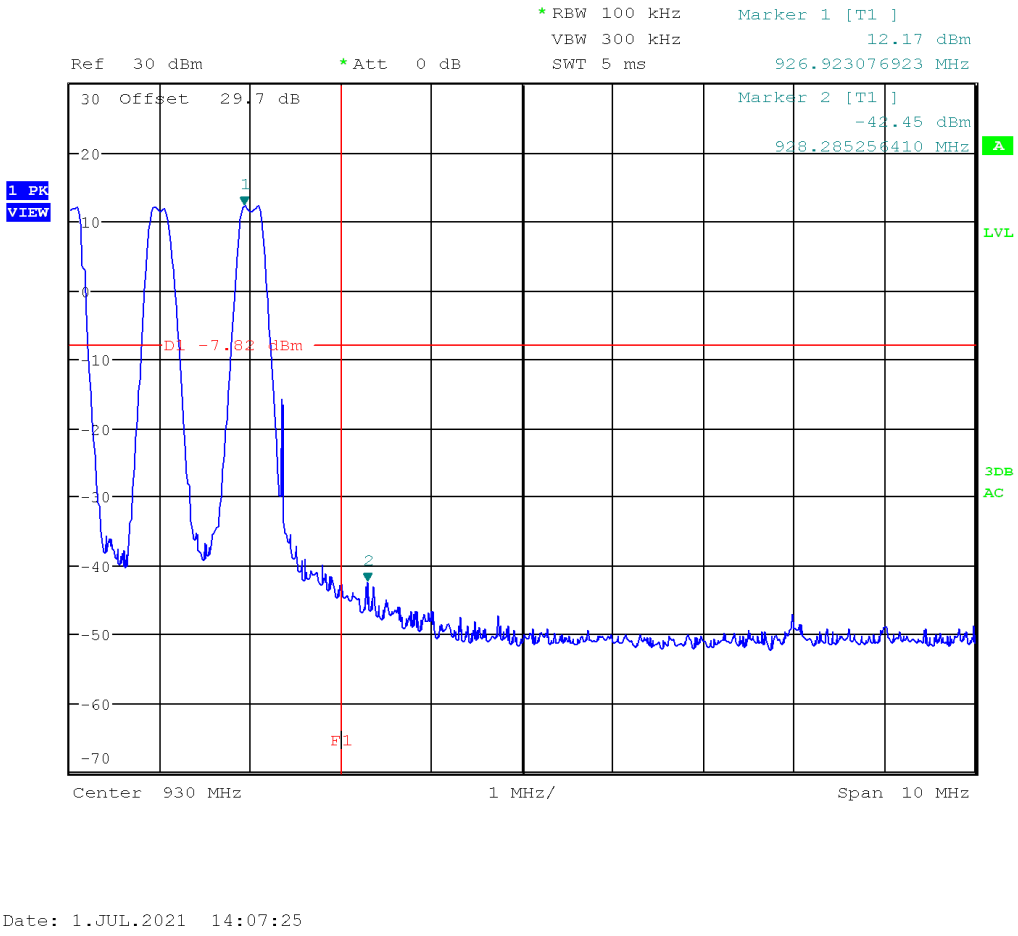



**Figure 2-20 – Conducted Band-Edge – High Channel, Hopping**

**Table 2.8-4 – Conducted Band-Edge Results**

| Frequency (MHz) | Measured Level (dBm) | Delta (dB) |
|---|---|---|
| 928.29 | -42.45 | 54.62 |

**Note:** The Emission was < 2 MHz within the band edge, and the Marker-Delta method was applied. Please see the section "Radiated Band Edge" for compliance.

### 2.8.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: CSAC1

**Table 2.8-5 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE10998 | Rohde & Schwarz | Receiver, 20 Hz-26.5 GHz | ESU 26 | 100379 | G | 05/21/2020 | 11/20/2021 |
| WRLE11398 | Meca | Attenuator, 20dB | 603-20-1F18 | 11398 | B | 11/02/2020 | 11/02/2021 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.9 Conducted Emissions 15.207

### 2.9.1 Specification Reference

FCC 47 CFR Part 15 Subpart C, 15.207
RSS-GEN Issue 5

### 2.9.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.9.3 Date of Test

01 September 2021

### 2.9.4 Test Method

The EUT was placed on a non-conductive table 0.8 m above a reference ground plane and 0.4 m away from a vertical coupling plane.

All power was connected to the EUT through an Artificial Mains Network (AMN). Conducted emissions measurements on mains lines were made at the output of the AMN. The AMN was placed 0.8m from the boundary of the EUT and bonded to the reference ground plane.

The EUT was tested with each transmitter operating in the worst-case channel and mode as determined in the original FCC report. Transmitters were tested individually.

The EUT was assessed against the limits of FCC 15.207.

### 2.9.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.9.6 Additional Observations

Measurements were performed using BAT-EMC (v3.18) automated software. The reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only.

### 2.9.7 Sample Computation (Conducted Emission)

| | | | |
|---|---|---|---|
| Measuring equipment raw measurement (dBµV) @ 150 kHz | | | 30.0 |
| Correction Factor (dB) | TEMC00002 - LISN | 0.03 | 10.53 |
| | Cable 1 | 10.50 | |
| | | | |
| | | | |
| Reported Quasi-peak Final Measurement (dBµV) @ 150 kHz | | | 40.53 |

### 2.9.8 Test Results

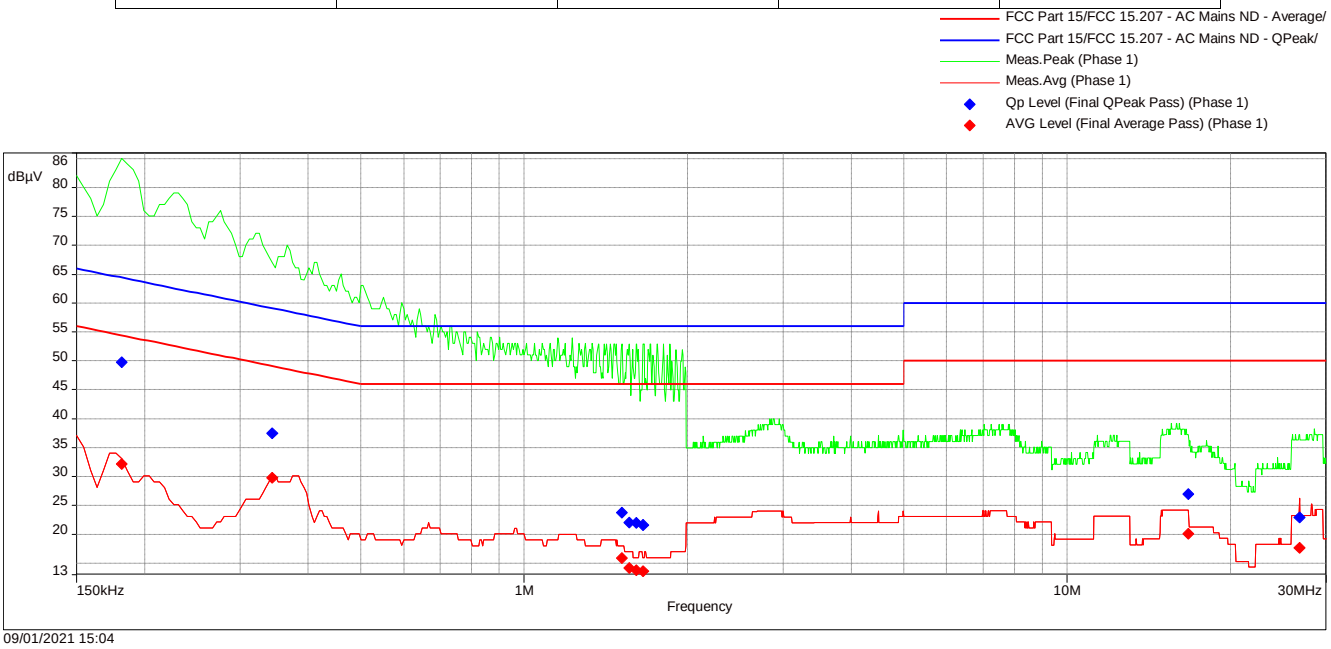
**Test Summary**: EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.

## 15.207 L1

| Frequency Range | Line Tested | RBW | Step Size | Sweep Time |
|---|---|---|---|---|
| 150kHz- 30MHz | L1 | 9kHz | 4.5kHz | 5000 ms/MHz |




| Limit: | Class | Test Results: |
|---|---|---|
| FCC 15.207 - AC Mains | ND | Pass |

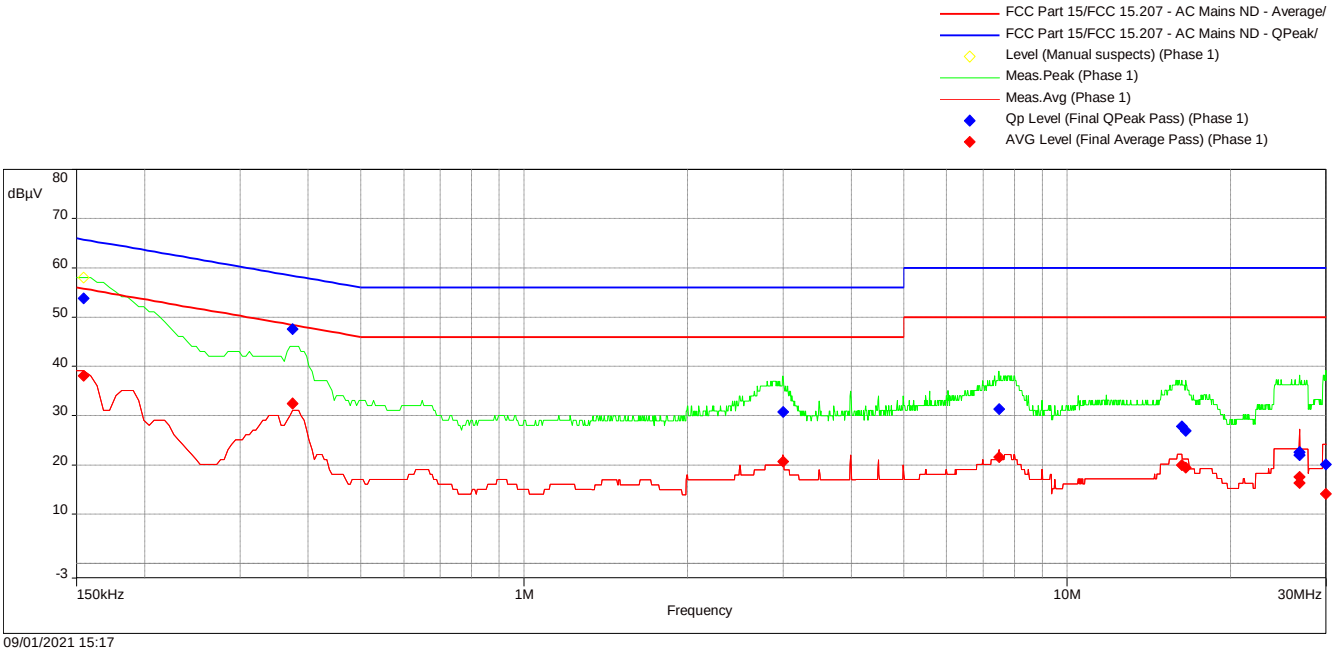
**Figure 2-21 – Graphical Results – AC Mains L1 Plot**

**Table 2.9-1 – Conducted Emissions Results on the AC Power Port (L1)**

| Frequency | Average (dBuV) | Average Limit (dBuV) | Average Margin (dB) | QPeak (dBuV) | QPeak Limit (dBuV) | QPeak Margin (dB) | Results |
|---|---|---|---|---|---|---|---|
| 181.5kHz | 32.19 | 54.42 | -22.23 | 49.77 | 64.42 | -14.65 | PASS |
| 343.5kHz | 29.77 | 49.12 | -19.35 | 37.48 | 59.12 | -21.64 | PASS |
| 1.5135MHz | 15.81 | 46.00 | -30.19 | 23.73 | 56.00 | -32.27 | PASS |
| 1.563MHz | 14.10 | 46.00 | -31.90 | 21.99 | 56.00 | -34.01 | PASS |
| 1.608MHz | 13.76 | 46.00 | -32.24 | 21.94 | 56.00 | -34.06 | PASS |
| 1.6575MHz | 13.64 | 46.00 | -32.36 | 21.58 | 56.00 | -34.42 | PASS |
| 16.71MHz | 20.08 | 50.00 | -29.92 | 26.91 | 60.00 | -33.09 | PASS |
| 26.799MHz | 17.65 | 50.00 | -32.35 | 22.89 | 60.00 | -37.11 | PASS |

## 15.207 L2

| Frequency Range | Line Tested | RBW | Step Size | Sweep Time |
|---|---|---|---|---|
| 150kHz- 30MHz | L2 | 9kHz | 4.5kHz | 5000 ms/MHz |




| Limit: | Class | EUT Orientation: | Test Results: |
|---|---|---|---|
| FCC 15.207 - AC Mains | ND | X axis | Pass |

**Figure 2-22 – Graphical Results – AC Mains L2 Plot**

**Table 2.9-2 – Conducted Emissions Results on the AC Power Port (L2)**

| Frequency | QPeak (dBuV) | QPeak Limit (dBuV) | QPeak Margin (dB) | Average (dBuV) | Average Limit (dBuV) | Average Margin (dB) | Results |
|---|---|---|---|---|---|---|---|
| 154.5kHz | 53.82 | 65.75 | -11.93 | 38.15 | 55.75 | -17.60 | PASS |
| 375kHz | 47.57 | 58.39 | -10.81 | 32.43 | 48.39 | -15.95 | PASS |
| 2.9985MHz | 30.73 | 56.00 | -25.27 | 20.66 | 46.00 | -25.34 | PASS |
| 7.494MHz | 31.31 | 60.00 | -28.69 | 21.59 | 50.00 | -28.41 | PASS |
| 16.269MHz | 27.87 | 60.00 | -32.13 | 19.99 | 50.00 | -30.01 | PASS |
| 16.539MHz | 26.94 | 60.00 | -33.06 | 19.48 | 50.00 | -30.52 | PASS |
| 26.799MHz | 22.60 | 60.00 | -37.40 | 17.54 | 50.00 | -32.46 | PASS |
| 26.8035MHz | 21.96 | 60.00 | -38.04 | 16.38 | 50.00 | -33.62 | PASS |
| 29.9445MHz | 20.11 | 60.00 | -39.89 | 14.09 | 50.00 | -35.91 | PASS |

### 2.9.9 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: GRP1

**Table 2.9-3 – Conducted Emissions Test Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| WRLE10945 | Fischer Custom Comm. | LISN | FCC-LISN-50-25-2-10 | 120309 | G | 08/23/2021 | 08/23/2023 |
| WRLE11121 | Aeroflex Weinschel | Attenuator, 20dB | 34-20-33 | CE0613 | B | 09/29/2020 | 09/29/2021 |
| NBLE11720 | PMM | EMI Receiver | 9010F | 030WW80601 | G | 05/08/2020 | 05/08/2022 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.10 Radiated Spurious Emissions

### 2.10.1 Specification Reference

FCC 47 CFR Part 15 Subpart C, 15.247
RSS-GEN Issue 5

### 2.10.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.10.3 Date of Test

01 July 2021

### 2.10.4 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table 0.8 m above a reference ground plane for 30-1000 MHz and 1.5m above the ground plane for above 1 GHz.

For 30-1000 MHz a pre-scan of the EUT emissions profile was made while varying the antenna-to-EUT azimuth and antenna-to-EUT polarization using a peak detector; measurements were taken at a 3m distance.

For above 1 GHz a pre-scan of the EUT emissions profile was made while varying the antenna-to-EUT azimuth and antenna-to-EUT polarization using peak and average detectors; measurements were taken at a 3m distance.

For all frequency ranges the final readings were maximized by adjusting the antenna height, polarization and turntable azimuth, in accordance with the specification. For final measurements below 1 GHz a quasi-peak detector was used and above 1 GHz final measurements were re-measured with peak and average detectors.

The EUT was assessed against the limits specified in FCC 47 CFR Part 15C §15.209.

### 2.10.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.10.6 Additional Observations

The highest frequency to which the DUT was measured in accordance with §15.33(a)(1).

Automated measurements used BAT-EMC (v3.18) software. Measurements were done at a 3m distance. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only.

### 2.10.7 Sample Computation (Radiated Emissions)

| | | | |
|---|---|---|---|
| Measuring equipment raw measurement (dBµV) @ 30 MHz | | | 20.0 |
| Correction Factor (dB) | Cable 2 | 0.24 | 18.94 |
| | TEMC00011 (antenna) | 18.70 | |
| | | | |
| | | | |
| | | | |
| Reported Quasi-peak Final Measurement (dBµV/m) @ 30 MHz | | | 38.94 |

### 2.10.8 Test Results

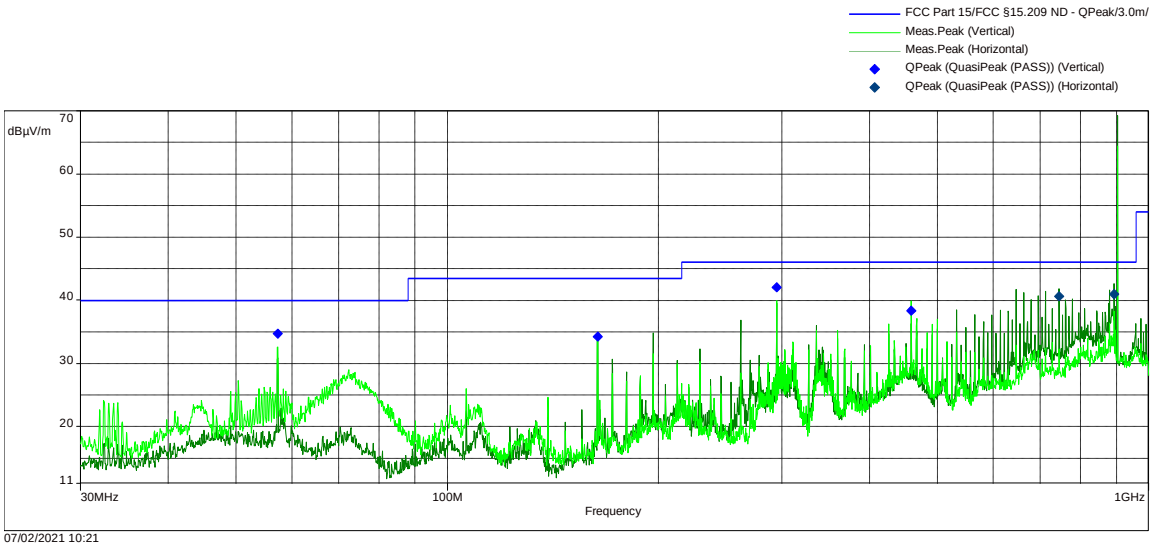
**Test Summary**: Measurements between 1-18 GHz were taken with a 900 MHz notch filter in front of the pre-amp to prevent overloading. EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.

# Spurious Emissions 30M-1GHz (TX 903 MHz)

| Frequency Range | Polarity | Antenna Distance | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| 30MHz- 1GHz | Vertical | 3m | 100kHz | 18001Pts | Auto |
| 30MHz- 1GHz | Horizontal | 3m | 100kHz | 18001Pts | Auto |




**Limit:**
FCC §15.209

**Test Results:**
Pass

**Note:** The emission at 903 MHz was the fundamental and was not subject to this limit.

**Figure 2-23 – RE Spurious Emissions 30-1000 MHz – Low Channel**

**Table 2.10-1 – RE Spurious Emissions 30-1000 MHz – Low Channel**

| Frequency | QP Level (dBuV/m) | QP Limit (dBuV/m) | Margin (dB) | Azimuth (º) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 57.344372MHz | 34.68 | 40.00 | -5.32 | 241.00 | 3.22 | Vertical | PASS |
| 163.84102MHz | 34.26 | 43.50 | -9.24 | 200.00 | 1.24 | Vertical | PASS |
| 294.91382MHz | 42.03 | 46.00 | -3.97 | 207.00 | 2.00 | Vertical | PASS |
| 458.75477MHz | 38.37 | 46.00 | -7.63 | 200.00 | 1.00 | Vertical | PASS |
| 745.47655MHz | 40.64 | 46.00 | -5.36 | 208.00 | 1.03 | Horizontal | PASS |
| 892.93364MHz | 41.00 | 46.00 | -5.00 | 310.00 | 2.26 | Horizontal | PASS |

# Spurious Emissions 1 - 9.28GHz (TX 903 MHz)

| Frequency Range | Polarity | Antenna Distance | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| 1GHz- 9.28GHz | Vertical | 3m | 1MHz | 18001Pts | Auto |
| 1GHz- 9.28GHz | Horizontal | 3m | 1MHz | 18001Pts | Auto |

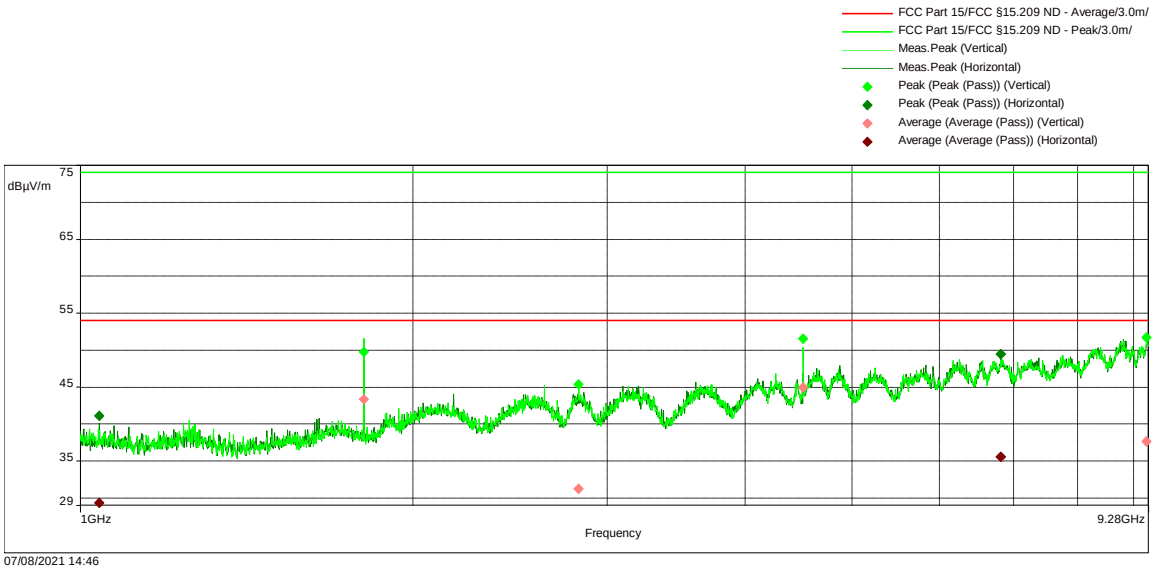


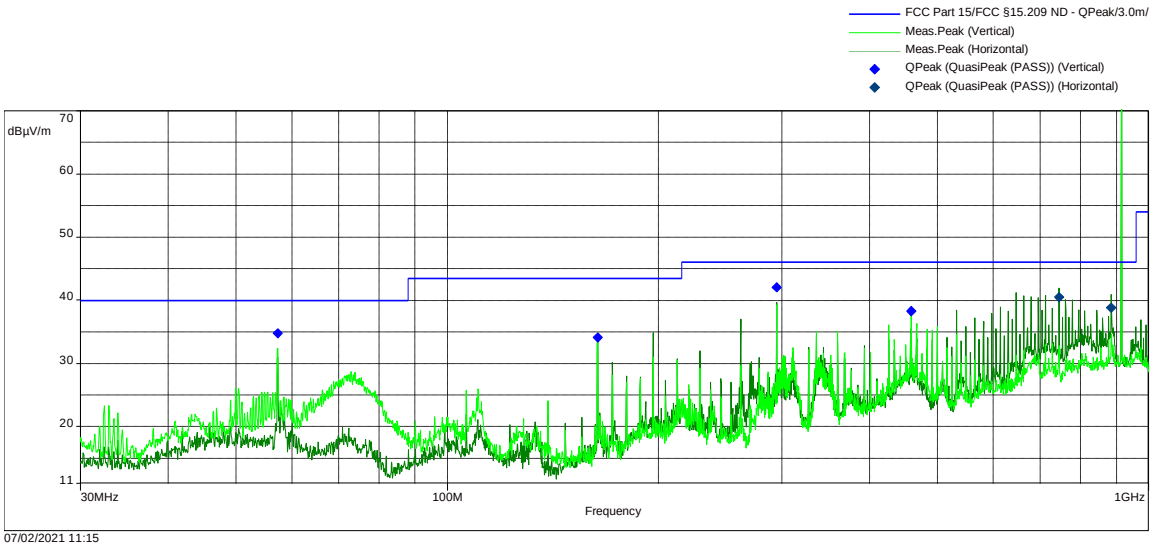

**Figure 2-24 – RE Spurious Emissions 1-18 GHz – Low Channel**

**Table 2.10-2 – RE Spurious Emissions 1-18 GHz – Low Channel**

| Frequency | Peak Level (dBuV/m) | Peak Limit (dBuV/m) | Peak Margin (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (º) | Height (m) | Polarity | Peak Result | Average Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.04002GHz | 41.12 | 74.00 | -32.88 | 29.32 | 54.00 | -24.68 | 119.00 | 2.61 | Horizontal | PASS | PASS |
| 1.80546GHz | 49.77 | 74.00 | -24.23 | 43.33 | 54.00 | -10.67 | 13.00 | 1.00 | Vertical | PASS | PASS |
| 2.82712GHz | 45.37 | 74.00 | -28.63 | 31.24 | 54.00 | -22.76 | 160.00 | 3.27 | Vertical | PASS | PASS |
| 4.51486GHz | 51.53 | 74.00 | -22.47 | 44.99 | 54.00 | -9.01 | 42.00 | 2.00 | Vertical | PASS | PASS |
| 6.81946GHz | 49.46 | 74.00 | -24.54 | 35.59 | 54.00 | -18.41 | 360.00 | 1.54 | Horizontal | PASS | PASS |
| 9.23538GHz | 51.69 | 74.00 | -22.31 | 37.67 | 54.00 | -16.33 | 351.00 | 1.49 | Vertical | PASS | PASS |

# Spurious Emissions 30M-1GHz (TX 915 MHz)

| Frequency Range | Polarity | Antenna Distance | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| 30MHz- 1GHz | Vertical | 3m | 100kHz | 18001Pts | Auto |
| 30MHz- 1GHz | Horizontal | 3m | 100kHz | 18001Pts | Auto |




**Limit:**
FCC §15.209

**Test Results:**
Pass

**Note:** The emission at 915 MHz was the fundamental and was not subject to this limit.

**Figure 2-25 – RE Spurious Emissions 30-1000 MHz – Mid Channel**

**Table 2.10-3 – RE Spurious Emissions 30-1000 MHz – Mid Channel**

| Frequency | QP Level (dBuV/m) | QP Limit (dBuV/m) | Margin (dB) | Azimuth (º) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 57.344372MHz | 34.80 | 40.00 | -5.20 | 248.00 | 2.96 | Vertical | PASS |
| 163.8409MHz | 34.13 | 43.50 | -9.37 | 215.00 | 1.00 | Vertical | PASS |
| 294.91382MHz | 42.03 | 46.00 | -3.97 | 208.00 | 2.00 | Vertical | PASS |
| 458.75477MHz | 38.29 | 46.00 | -7.71 | 193.00 | 1.04 | Vertical | PASS |
| 745.47655MHz | 40.49 | 46.00 | -5.51 | 207.00 | 1.04 | Horizontal | PASS |
| 884.78873MHz | 38.83 | 46.00 | -7.17 | 296.00 | 2.10 | Horizontal | PASS |

# Spurious Emissions 1 - 9.28GHz (TX 915 MHz)

| Frequency Range | Polarity | Antenna Distance | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| 1GHz- 9.28GHz | Vertical | 3m | 1MHz | 18001Pts | Auto |
| 1GHz- 9.28GHz | Horizontal | 3m | 1MHz | 18001Pts | Auto |

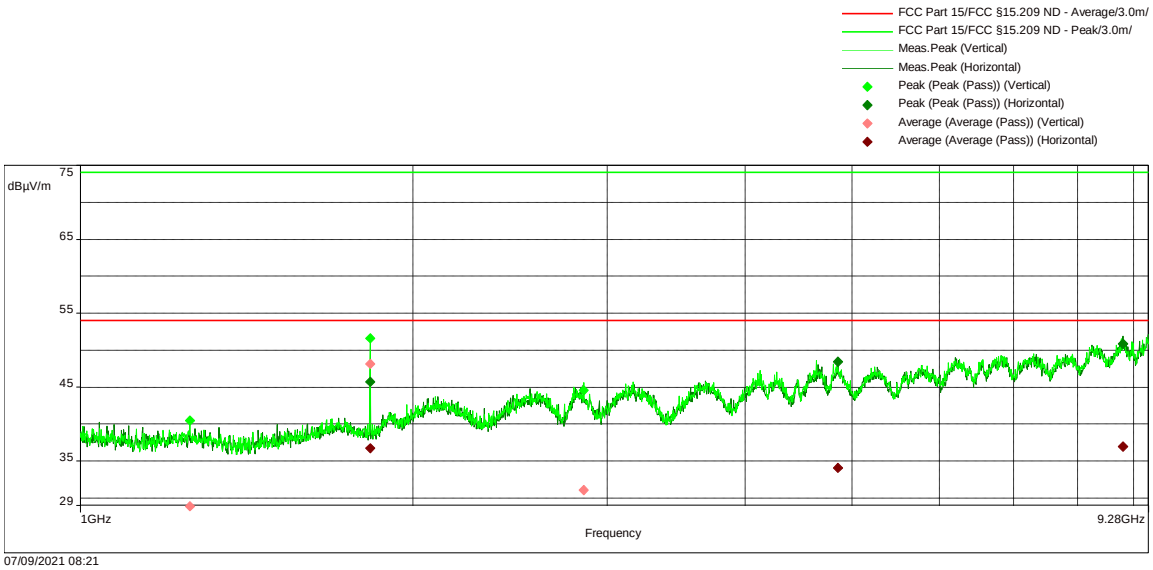


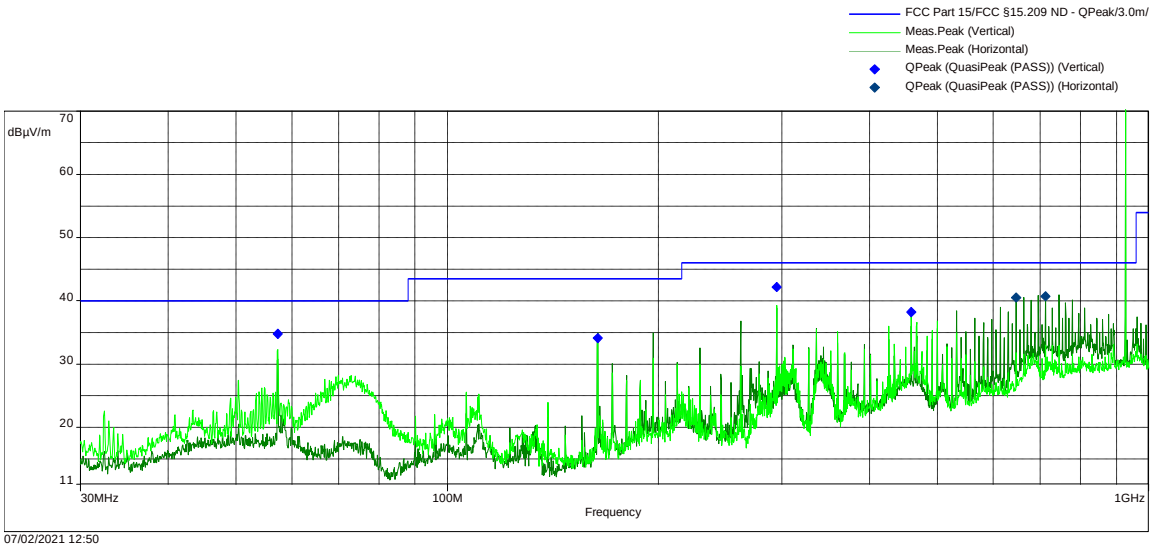

**Figure 2-26 – RE Spurious Emissions 1-18 GHz – Mid Channel**

**Table 2.10-4 – RE Spurious Emissions 1-18 GHz – Mid Channel**

| Frequency | Peak Level (dBuV/m) | Peak Limit (dBuV/m) | Peak Margin (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (º) | Height (m) | Polarity | Peak Result | Average Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.25622GHz | 40.46 | 74.00 | -33.54 | 26.41 | 54.00 | -27.59 | 6.00 | 2.61 | Vertical | PASS | PASS |
| 1.82938GHz | 45.75 | 74.00 | -28.25 | 36.74 | 54.00 | -17.26 | 68.00 | 1.09 | Horizontal | PASS | PASS |
| 1.82984GHz | 51.61 | 74.00 | -22.39 | 48.15 | 54.00 | -5.85 | 13.00 | 1.34 | Vertical | PASS | PASS |
| 2.85518GHz | 44.56 | 74.00 | -29.44 | 31.10 | 54.00 | -22.90 | 299.00 | 1.34 | Vertical | PASS | PASS |
| 4.85526GHz | 48.41 | 74.00 | -25.59 | 34.05 | 54.00 | -19.95 | 79.00 | 2.26 | Horizontal | PASS | PASS |
| 8.80068GHz | 50.84 | 74.00 | -23.16 | 36.99 | 54.00 | -17.01 | 57.00 | 3.17 | Horizontal | PASS | PASS |

# Spurious Emissions 30M-1GHz (TX 927 MHz)

| Frequency Range | Polarity | Antenna Distance | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| 30MHz- 1GHz | Vertical | 3m | 100kHz | 18001Pts | Auto |
| 30MHz- 1GHz | Horizontal | 3m | 100kHz | 18001Pts | Auto |




**Limit:**
FCC §15.209

**Test Results:**
Pass

**Note:** The emission at 927 MHz was the fundamental and was not subject to this limit.

**Figure 2-27 – RE Spurious Emissions 30-1000 MHz – High Channel**

**Table 2.10-5 – RE Spurious Emissions 30-1000 MHz – High Channel**

| Frequency | QP Level (dBuV/m) | QP Limit (dBuV/m) | Margin (dB) | Azimuth (º) | Height (m) | Polarity | Result |
|---|---|---|---|---|---|---|---|
| 57.34425MHz | 34.76 | 40.00 | -5.24 | 240.00 | 3.73 | Vertical | PASS |
| 163.84102MHz | 34.13 | 43.50 | -9.37 | 193.00 | 1.00 | Vertical | PASS |
| 294.91382MHz | 42.17 | 46.00 | -3.83 | 208.00 | 2.15 | Vertical | PASS |
| 458.75465MHz | 38.24 | 46.00 | -7.76 | 193.00 | 1.00 | Vertical | PASS |
| 647.17182MHz | 40.47 | 46.00 | -5.53 | 222.00 | 1.19 | Horizontal | PASS |
| 712.7082MHz | 40.70 | 46.00 | -5.30 | 207.00 | 1.00 | Horizontal | PASS |

# Spurious Emissions 1 - 9.28GHz (TX 927 MHz)

| Frequency Range | Polarity | Antenna Distance | RBW | Step Size | Sweep Time |
|---|---|---|---|---|---|
| 1GHz- 9.28GHz | Vertical | 3m | 1MHz | 18001Pts | Auto |
| 1GHz- 9.28GHz | Horizontal | 3m | 1MHz | 18001Pts | Auto |

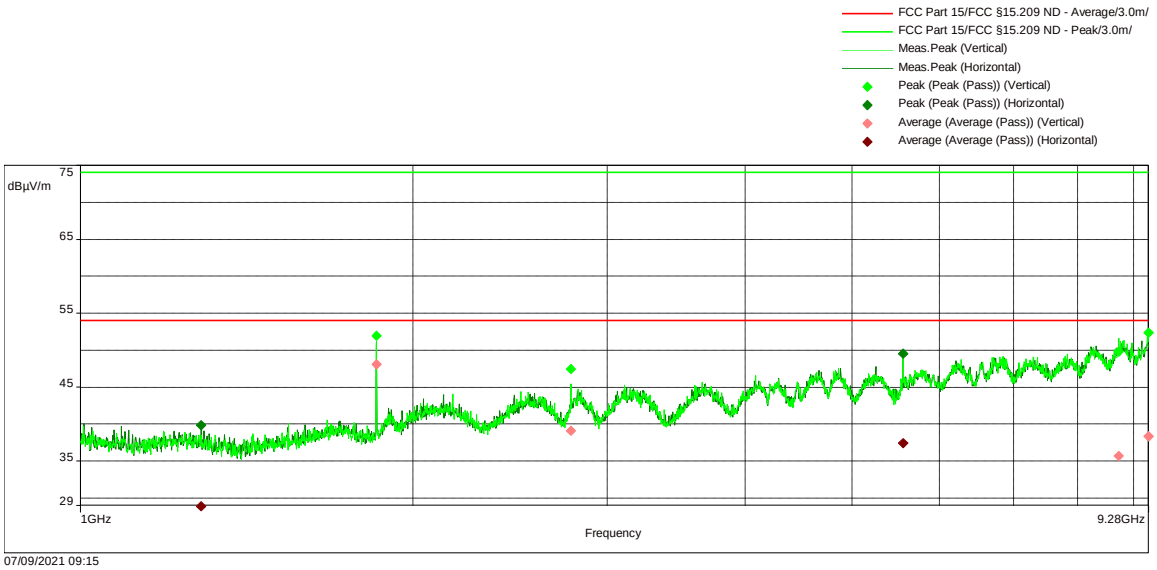



**Figure 2-28 – RE Spurious Emissions 1-18 GHz – High Channel**

**Table 2.10-6 – RE Spurious Emissions 1-18 GHz – High Channel**

| Frequency | Peak Level (dBuV/m) | Peak Limit (dBuV/m) | Peak Margin (dB) | Average Level (dBuV/m) | Average Limit (dBuV/m) | Average Margin (dB) | Azimuth (º) | Height (m) | Polarity | Peak Result | Average Result |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.28612GHz | 39.84 | 74.00 | -34.16 | 26.23 | 54.00 | -27.77 | 138.00 | 2.97 | Horizontal | PASS | PASS |
| 1.85376GHz | 51.95 | 74.00 | -22.05 | 48.06 | 54.00 | -5.94 | 13.00 | 1.29 | Vertical | PASS | PASS |
| 2.78112GHz | 47.46 | 74.00 | -26.54 | 39.09 | 54.00 | -14.91 | 6.00 | 1.39 | Vertical | PASS | PASS |
| 5.56136GHz | 49.55 | 74.00 | -24.45 | 37.43 | 54.00 | -16.57 | 6.00 | 1.04 | Horizontal | PASS | PASS |
| 8.72064GHz | 49.80 | 74.00 | -24.20 | 35.67 | 54.00 | -18.33 | 13.00 | 1.00 | Vertical | PASS | PASS |
| 9.28GHz | 52.33 | 74.00 | -21.67 | 38.35 | 54.00 | -15.65 | 64.00 | 3.17 | Vertical | PASS | PASS |

### 2.10.9 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: 3mSAC

**Table 2.10-7 – Radiated Emissions Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| NBLE11141 | Hewlett-Packard | Preamplifier, 100 kHz-1300 MHz | 8447D | 2944A08773 | B | 01/08/2021 | 01/08/2022 |
| NBLE11460 | ETS-Lindgren | Antenna, Horn 1-18 GHz | 3117 | 155005 | G | 02/17/2021 | 02/17/2023 |
| WRLE10517 | Mini-Circuits Lab | Filter, 900-950 MHz Notch | N03915M1 | 138901 | B | 03/31/2021 | 03/31/2022 |
| WRLE11519 | Com-Power Corp. | Preamp, 500 MHz-18 GHz | PAM-118A | 18040002 | B | 01/08/2021 | 01/08/2022 |
| NBLE11555 | Rohde & Schwarz | Receiver, 2 Hz-44 GHz | ESW44 | 101537 | G | 12/31/2020 | 12/31/2021 |
| NBLE11607 | Pasternack | Attenuator, 10 dB | PE7017-10 | 11607 | B | 11/03/2020 | 11/03/2021 |
| NBLE11630 | ETS-Lindgren | Antenna, 1-18 GHz | 3117 | 00218816 | G | 09/04/2020 | 09/04/2022 |
| NBLE11645 | SCHWARZBECK MESS-ELEKTRONIK | Antenna, Trilog Broadband, 30-7000 MHz | VULB 9162 | 0254 | G | 04/09/2021 | 04/09/2023 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

## 2.11 Radiated Band-Edge

### 2.11.1 Specification Reference

FCC 47 CFR Part 15 Subpart C, 15.247
RSS-GEN Issue 5

### 2.11.2 Equipment Under Test and Modification State

As shown in §1.4 with modification state “0”, as noted in §1.6.

### 2.11.3 Date of Test

02 July 2021

### 2.11.4 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table 1.5 m above a reference ground plane. Measurements were taken at a 3m distance. The fundamental signal was maximized while varying the antenna-to-EUT azimuth and antenna-to-EUT polarization using a peak detector. Band-edge measurements were made with the device in its maximized position using a peak and average detector as described in ANSI C63.10.

The EUT was assessed against the limits specified in FCC 47 CFR Part 15C §15.209.

### 2.11.5 Environmental Conditions

The EUT was evaluated within the climatic range of the EUT as specified by the manufacturer. When the manufacturer does not specify climatic parameters for the EUT, all tests are performed within the ambient climatic conditions of the laboratory.

### 2.11.6 Test Results

**Test Summary**: EUT operated as intended before, during, and after testing.

**Test Result: Pass**

See data below for detailed results.

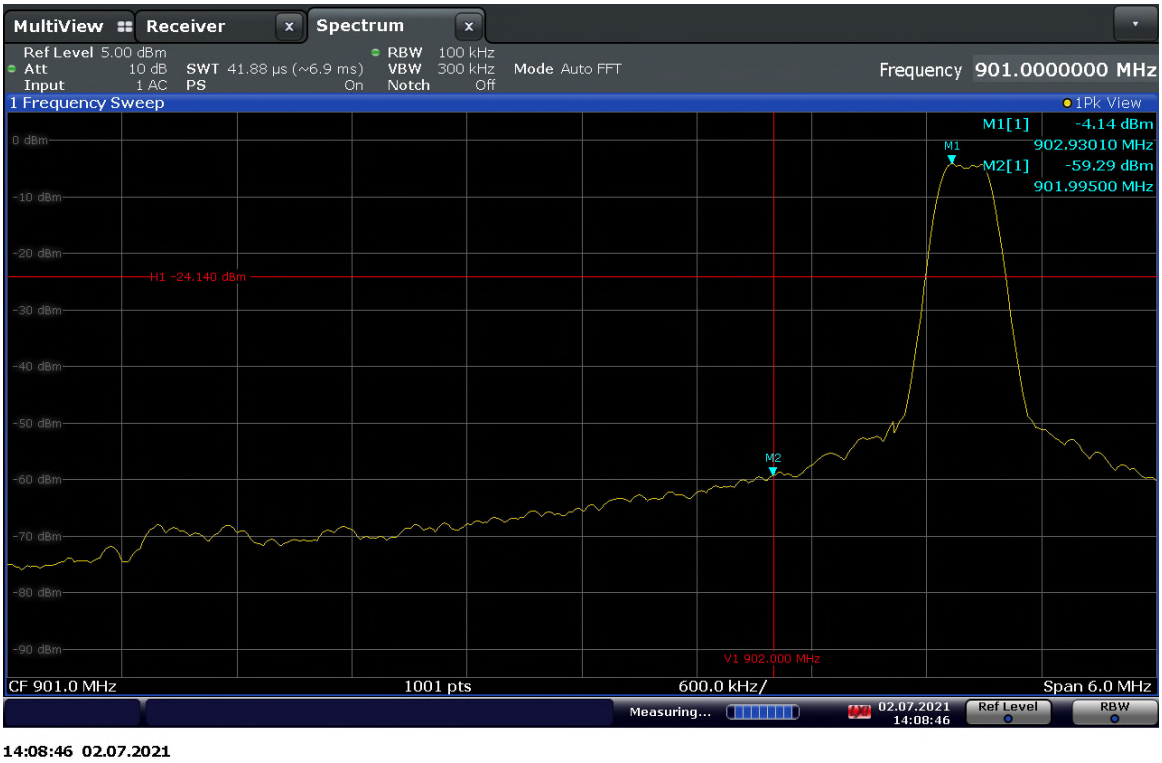



**Figure 2-29 – Band-Edge, Low Channel – Peak, Stopped**

**Table 2.11-1 – Radiated Band-Edge Marker Delta Results**

| Measured Peak Level (dBm) | Measured Peak Level (dBuV/m) | Correction (dB/m) | Delta (dB) | Bandedge Level (dBuV/m) |
|---|---|---|---|---|
| -4.14 | 102.86 | 2.18 | 53.85 | 51.19 |

**Note:** Peak value complies with Average Limit of 54.00 dBuV/m. No Average data was taken.

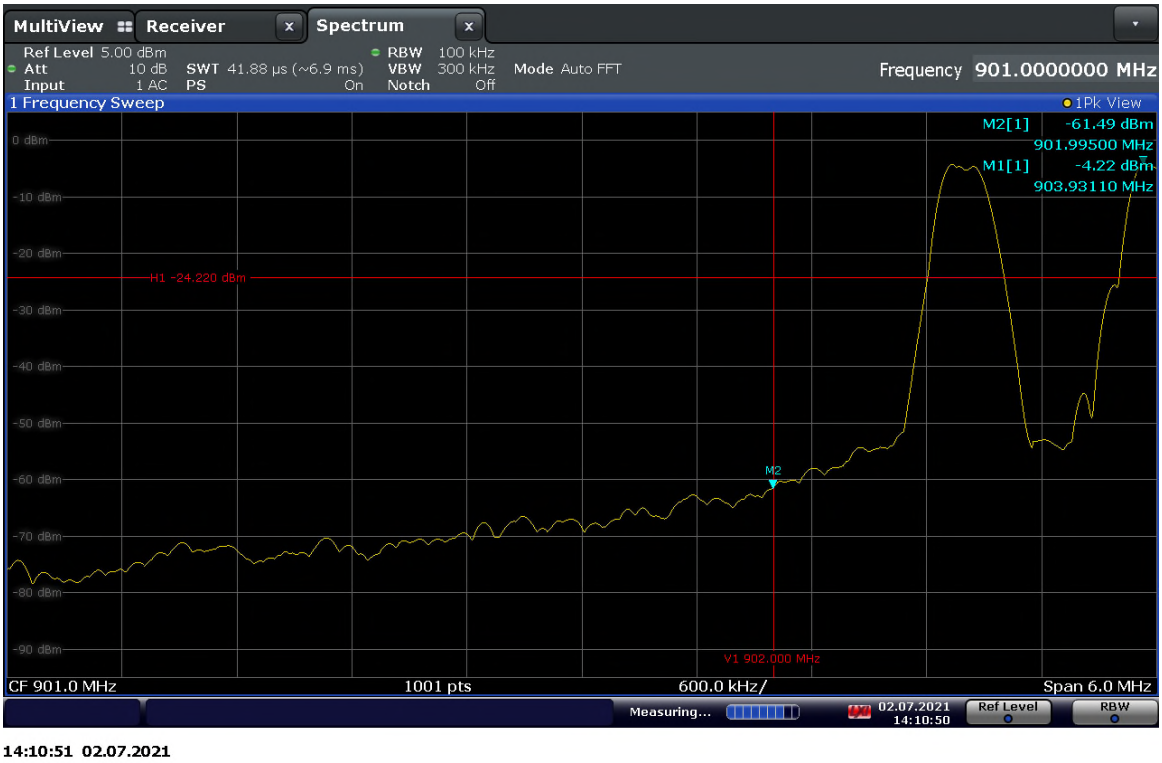



**Figure 2-30 – Band-Edge, Low Channel – Peak, Hopping**

**Table 2.11-2 – Radiated Band-Edge Marker Delta Results**

| Measured Peak Level (dBm) | Measured Peak Level (dBuV/m) | Correction (dB/m) | Delta (dB) | Bandedge Level (dBuV/m) |
|---|---|---|---|---|
| -4.22 | 102.78 | 2.18 | 54.68 | 50.19 |

**Note:** Peak value complies with Average Limit of 54.00 dBuV/m. No Average data was taken.


**Figure 2-31 – Band-Edge, High Channel – Peak, Stopped**

**Table 2.11-3 – Radiated Band-Edge Marker Delta Results**

| Measured Peak Level (dBm) | Measured Peak Level (dBuV/m) | Correction (dB/m) | Delta (dB) | Bandedge Level (dBuV/m) |
|---|---|---|---|---|
| -3.24 | 103.76 | 2.34 | 52.35 | 53.75 |

**Note:** Peak value complies with Average Limit of 54.00 dBuV/m. No Average data was taken.


**Figure 2-32 – Band-Edge, High Channel – Peak, Hopping**

**Table 2.11-4 – Radiated Band-Edge Marker Delta Results**

| Measured Peak Level (dBm) | Measured Peak Level (dBuV/m) | Correction (dB/m) | Delta (dB) | Bandedge Level (dBuV/m) |
|---|---|---|---|---|
| -3.25 | 103.75 | 2.34 | 54.62 | 51.47 |

**Note:** Peak value complies with Average Limit of 54.00 dBuV/m. No Average data was taken.

### 2.11.7 Test Location and Test Equipment Used

The tests were carried out in New Brighton, MN.
Test Area: 3mSAC

**Table 2.11-5 – Restricted Band Edge Equipment List**

| Device # | Manufacturer | Description | Model | Serial # | Cal Code | Cal Date | Cal Due |
|---|---|---|---|---|---|---|---|
| NBLE11141 | Hewlett-Packard | Preamplifier, 100 kHz-1300 MHz | 8447D | 2944A08773 | B | 01/08/2021 | 01/08/2022 |
| NBLE11460 | ETS-Lindgren | Antenna, Horn 1-18 GHz | 3117 | 155005 | G | 02/17/2021 | 02/17/2023 |
| WRLE11519 | Com-Power Corp. | Preamp, 500 MHz-18 GHz | PAM-118A | 18040002 | B | 01/08/2021 | 01/08/2022 |
| NBLE11555 | Rohde & Schwarz | Receiver, 2 Hz-44 GHz | ESW44 | 101537 | G | 12/31/2020 | 12/31/2021 |
| NBLE11630 | ETS-Lindgren | Antenna, 1-18 GHz | 3117 | 00218816 | G | 09/04/2020 | 09/04/2022 |
| NBLE11645 | SCHWARZBECK MESS-ELEKTRONIK | Antenna, Trilog Broadband, 30-7000 MHz | VULB 9162 | 0254 | G | 04/09/2021 | 04/09/2023 |

Cal Code G = Calibration performed by an accredited outside source.
Cal Code B = Calibration verification performed internally.
Cal Code Y = Passive Device, or Calibration not required when used with other calibrated equipment.

# 3 Diagram of Test Setups

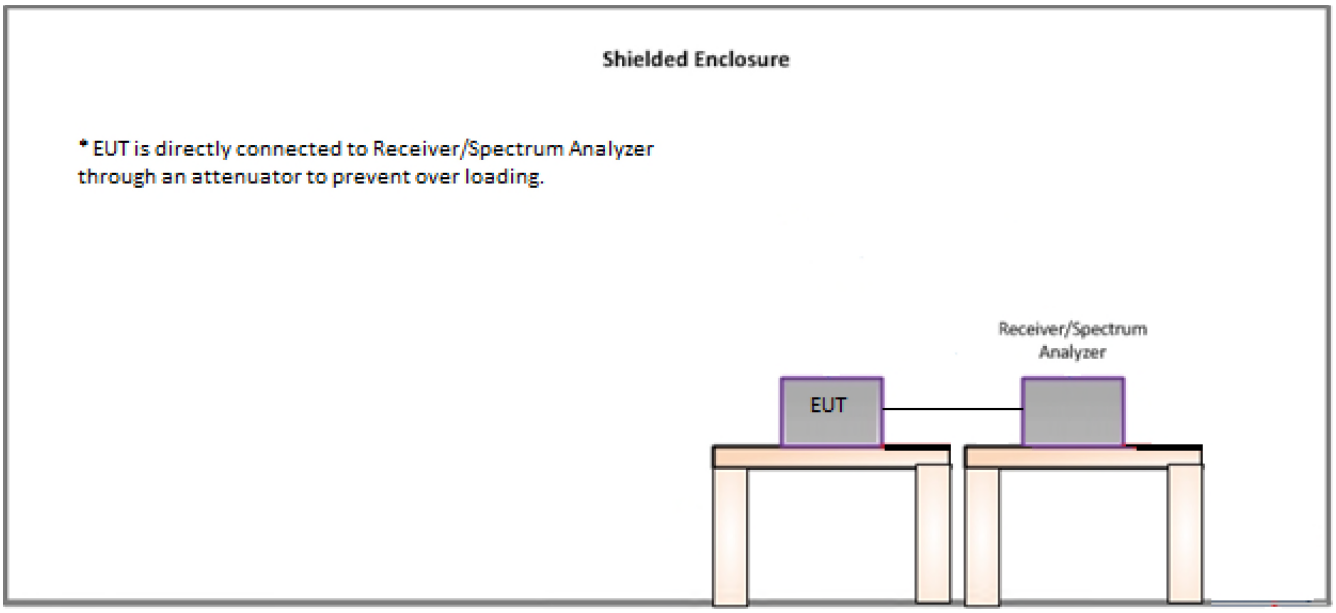



**Figure 3-1 – Conducted Test Setup**

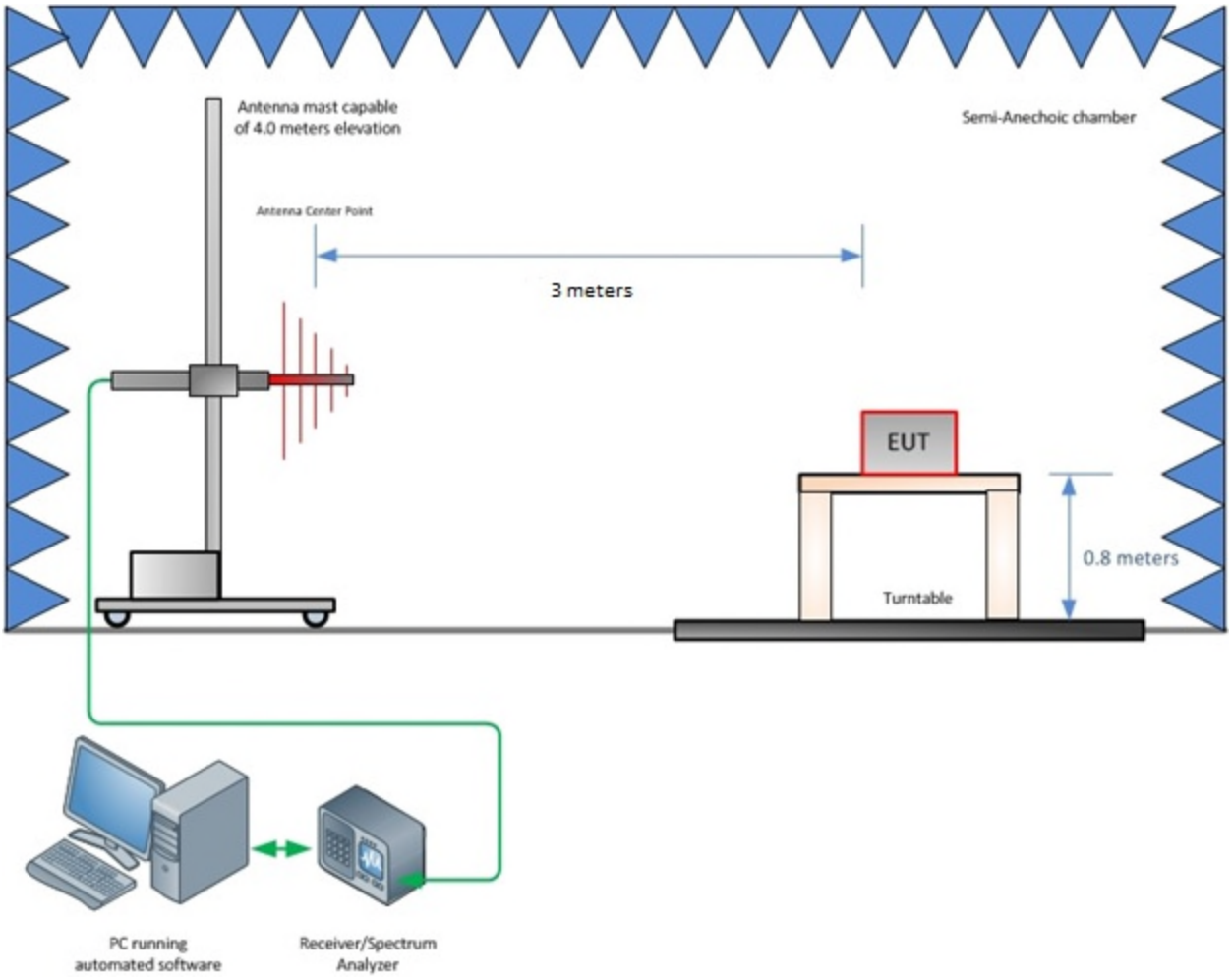



**Figure 3-2 – Radiated Emissions Test Setup up to 1 GHz**

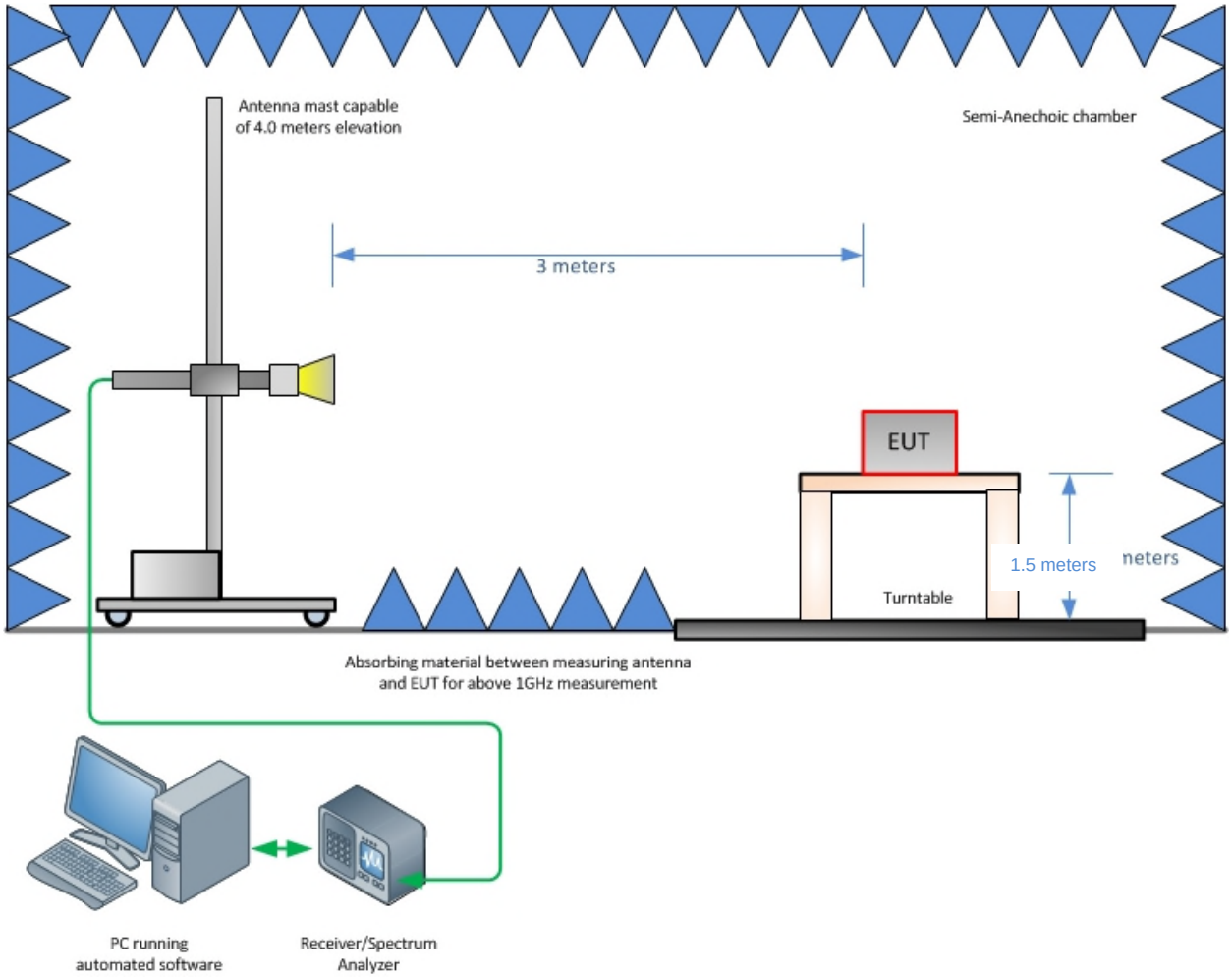



**Figure 3-3 – Radiated Emissions Test Setup above 1 GHz**

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**STATEMENT OF MEASUREMENT UNCERTAINTY – Emissions**

The test system for conducted emissions is defined as the LISN, tuned receiver or spectrum analyzer, and coaxial cable. This test system has a measurement uncertainty of ±3.30 dB. The test system for radiated emissions is defined as the antenna, the pre-amplifier, the spectrum analyzer and the coaxial cable. This test system for 30 MHz-1000 MHz has a measurement uncertainty of ±5.88 dB and above 1 GHz a measurement uncertainty of ±4.47 dB. The measurement uncertainty values for conducted and radiated emissions meet the requirements as expressed in CISPR 16-4-2. The equipment comprising the test systems is calibrated on an annual basis.

**TEST EQUIPMENT**

All measurement instrumentation is traceable to the National Institute of Standards and Technology and is calibrated to meet test method standard requirements and/or manufacturer's specifications