

FCC and ISED Canada Testing of the

HID Global Bluvision Inc MiniMini

In accordance with FCC 47 CFR part 15.247 and
ISED Canada's Radio Standards Specifications
RSS-247

Prepared for: HID Global Bluvision Inc
600 Corporate Dr, 300
Fort Lauderdale, FL 33334

FCC ID: SL6MINIMINI
IC: 24824-MINIMINI



America

Add value.
Inspire trust.

COMMERCIAL-IN-CONFIDENCE

Date: 10. January 2020

Document Number: TP72155614.101 | Version Number: 02

| RESPONSIBLE FOR | NAME | DATE | SIGNATURE |
|----------------------|----------------------|------------------|-----------|
| Authorized Signatory | Peter Walsh | 2020 -January-10 | |
| Testing | Thierry Jean Charles | 2020-January-10 | |

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

FCC Accreditation
Designation Number US1063 Tampa, FL Test Laboratory
Innovation, Science, and Economic Development Canada
Accreditation
Site Number 2087A-2 Tampa, FL Test Laboratory

EXECUTIVE SUMMARY

Samples of this product were tested and found to be in compliance with 15.247 and ISED Canada's RSS-247.



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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.

| Issue | Description of Change | Date of Issue |
|-------|---------------------------------|-----------------|
| 1 | First Issue | 2020-January-02 |
| 2 | Corrected typo in Table 2.4.6-1 | 2020-January-10 |



1.2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.



| | |
|-------------------------------|--|
| Applicant | HID Global Bluvision Inc |
| Manufacturer | HID Global Bluvision |
| Applicant's Email Address | efren@bluvision.com |
| Model Number(s) | MiniMini |
| Serial Number(s) | N/A |
| FCC ID | SL6MINIMINI |
| ISED Certification Number | 24824-MINIMINI |
| Hardware Version(s) | V1.1 |
| Software Version(s) | V435 |
| Number of Samples Tested | 2 |
| Test Specification/Issue/Date | US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2018 Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-247 — Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017 |
| Test Plan/Issue/Date | 2019-December-04 |
| Order Number | 72155614 |
| Date | 2019-December-10 |
| Date of Receipt of EUT | 2019-December-16 |
| Start of Test | 2019-December-16 |
| Finish of Test | 2019-December-18 |
| Name of Engineer(s) | Jean N. Rene, Thierry Jean-Charles |
| Related Document(s) | ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices. US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2018. FCC OET KDB 558074 D01 15.247 Meas Guidance v05r02: Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices Operating under Section 15.247 of the FCC Rules. Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN - General Requirements for Compliance of Radio Apparatus, Issue 5, Amendment 1, March 2019. |



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC Part 15.247 and ISED Canada's RSS-247 is shown below.

Table 1.3-1: Test Result Summary

| Test Parameter | Test Plan (Yes/No) | Test Result | FCC 47 CFR Rule Part | ISED Canada's RSS | Test Report Page No |
|---|-----------------------|----------------|-------------------------|----------------------|---------------------------|
| Antenna Requirement | Yes | Pass | 15.203, 15.204 | ----- | 12 |
| 6 dB Bandwidth | Yes | Pass | 15.247(a)(2) | RSS-247 5.2(a) | 13 |
| 99% Bandwidth | Yes | Pass | ----- | RSS-GEN 6.6 | 16 |
| Peak Output Power | Yes | Pass | 15.247(b)(3) | RSS-247 5.4(d) | 19 |
| Band-Edge Compliance of RF Conducted Emissions | Yes | Pass | 15.247(d) | RSS-247 5.5 | 22 |
| RF Conducted Spurious Emissions | Yes | Pass | 15.247(d) | RSS-247 5.5 | 25 |
| Radiated Spurious Emissions into Restricted Frequency Bands | Yes | Pass | 15.205, 15.209 | RSS-GEN 8.9, 8.10 | 28 |
| Power Spectral Density | Yes | Pass | 15.247(e) | RSS-247 5.2(b) | 35 |
| Power Line Conducted Emissions | No | ----- | 15.207 | RSS-GEN 8.8 | 38 |



1.4 Product Information

1.4.1 Technical Description

The EUT is a BLE Beacon with a 3D Axial Accelerometer.

Technical Details

| | |
|---------------------|--|
| Mode of Operation: | IEEE 802.15.1 Bluetooth Low Energy (BLE) |
| Frequency Range: | 2402 - 2480 MHz |
| Number of Channels: | 40 |
| Channel Separation: | 2 MHz |
| Data Rate: | 1 Mbps |
| Modulations: | GFSK |
| Antenna Type/Gain: | PCB Embedded Antenna / 0 dBi |
| Input Power: | 3 VDC (CR1216 Coin Battery) |

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

Table 1.4.1-1 – Cable Descriptions

| Cable/Port | Description |
|--------------|--|
| Signal Leads | 0.05m, Not Shielded, EUT to FTDI Friend |
| USB | 0.9 m, Shielded, FTDI Friend to Laptop |
| Power | 1.8m, Not Shielded, Molded Ferrite, Power Supply to Laptop |
| Power | 0.9 m, Not Shielded, Power Supply to AC Mains |

Note: The EUT is a battery-operated standalone equipment. The adapter, laptop and cables were used for evaluation purposes.

Table 1.4.1-2 – Support Equipment Descriptions

| Make/Model | Description |
|-----------------------|--|
| FTDI / FTDI Friendd | RS232 to USB adapter |
| Dell / Latitude E7250 | Laptop, S/N: 8BCHF72 |
| Dell / LA65NS2-01 | 19 VDC, 65W Power Supply, SN: CN-06TMIC-72438-54L-8611-A04 |

Note: The EUT is a battery-operated standalone equipment. The adapter, laptop and cables were used for evaluation purposes.



Declaration of Build Status

| EQUIPMENT DESCRIPTION | |
|---|---|
| Model Name/Number | MINIMINI |
| Part Number | BVMINIMINI |
| Hardware Version | V1.1 |
| Software Version | V435 |
| FCC ID (if applicable) | SL6MINIMINI |
| ISED ID (if applicable) | 24824-MINIMINI |
| Technical Description (Please provide a brief description of the intended use of the equipment) | This is a BLE Beacon with a 3D Axial Accelerometer. |

| UN-INTENTIONAL RADIATOR | |
|--|----------------------------|
| Highest frequency generated or used in the device or on which the device operates or tunes | 2.5GHz |
| Lowest frequency generated or used in the device or on which the device operates or tunes | 2.4GHz |
| Class A Digital Device (Use in commercial, industrial or business environment) | <input type="checkbox"/> X |
| Class B Digital Device (Use in residential environment only) | <input type="checkbox"/> |

| Power Source | | | |
|--------------|-----------------|--------------------------|-------------------------------------|
| AC | Single Phase | Three Phase | Nominal Voltage |
| | | <input type="checkbox"/> | |
| External DC | Nominal Voltage | | Maximum Current |
| | | | |
| Battery | Nominal Voltage | | Battery Operating End Point Voltage |
| | 3.0V | | 1.8V |

| EXTREME CONDITIONS | | | | | |
|---------------------|-----|----|---------------------|-----|----|
| Maximum temperature | +60 | °C | Minimum temperature | -30 | °C |

| Ancillaries | |
|---|--|
| Please list all ancillaries which will be used with the device. | |
| NONE | |

I hereby declare that the information supplied is correct and complete.

Name: Efren Gonzalez

Position held: Sr. Hardware/RF Engineer Date: 12/19/2019



1.4.2 Modes of Operation

The EUT was evaluated in the TX Mode.

The BLE radio was set to 37 bytes PRBS9 payload leading to a transmission duty cycle of 65.4%. The EUT TX output power was not configurable via the GUI test application. The EUT was operating at the maximum TX Output Power per the equipment manufacturer.

1.4.3 Monitoring of Performance

The EUT was evaluated while connected to a laptop computer via a USB to UART interface for testing purposes.

Preliminary radiated emissions evaluations were performed for the EUT in three orthogonal orientations. The test report documents the results for the EUT orientations leading to the highest emissions with respect to the limits as described below:

- EUT Standing - Worst for Radiated Band-Edge Emissions
- EUT on Side - Worst for Radiated Spurious Emissions

The RF conducted emissions were performed on a sample modified with an SMA connector at the antenna port.

The EUT is standalone battery operated without any provision for connection to external power sources. The EUT is exempted from the power line conducted emissions requirements.

1.4.4 Performance Criteria

The report documents the compliance of the BLE radio with the FCC Section 15.247 and ISED Canada RSS-247 requirements. A summary of the parameters that were evaluated is provided below.

Table 1.4.4 -1: Performance Criteria

| Parameter | Requirement |
|---|--|
| Antenna Requirement | FCC: Section 15.203, 15.204 |
| 6 dB Bandwidth | FCC: Section 15.247(a)(2); ISED Canada: RSS-247 5.2(a) |
| 99% Bandwidth | ISED Canada: RSS-GEN 6.6 |
| Peak Output Power | FCC: Section 15.247(b)(3); ISED Canada: RSS-247 5.4(d) |
| Band-Edge Compliance of RF Conducted Emissions | FCC: Section 15.247(d); ISED Canada: RSS-247 5.5 |
| RF Conducted Spurious Emissions | FCC: Section 15.247(d); ISED Canada: RSS-247 5.5 |
| Radiated Spurious Emissions into Restricted Frequency Bands | FCC: Sections 15.205, 15.209; ISED Canada: RSS-GEN 8.9, 8.10 |
| Power Spectral Density | FCC: Section 15.247(e); ISED Canada: RSS-247(b) |



1.5 Deviations from the Standard

The evaluation was performed without any deviation from the test standard.

1.6 EUT Modification Record

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

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

The equipment was tested as provided without any modifications.



1.7 Test Location

TÜV SÜD Product Service conducted the following tests at our Tampa FL Test Laboratory.

| Test Name | Name of Engineer(s) | Accreditation |
|---|------------------------------------|---------------|
| DC Powered Operating | | |
| Antenna Requirement | Thierry Jean-Charles | A2LA |
| 6 dB Bandwidth | Thierry Jean-Charles | A2LA |
| 99% Bandwidth | Thierry Jean-Charles | A2LA |
| Peak Output Power | Thierry Jean-Charles | A2LA |
| Band-Edge Compliance of RF Conducted Emissions | Thierry Jean-Charles | A2LA |
| RF Conducted Spurious Emissions | Thierry Jean-Charles | A2LA |
| Radiated Spurious Emissions into Restricted Frequency Bands | Jean N. Rene, Thierry Jean-Charles | A2LA |
| Power Spectral Density | Thierry Jean-Charles | A2LA |

Office Address:

TÜV SÜD America, Inc.
5610 W. Sligh Ave, Suite 100
Tampa, FL 33634
USA



2 Test Details

2.1 Antenna Requirements

2.1.1 Specification Reference

FCC: Section 15.203, 15.204

2.1.2 Equipment Under Test and Modification State

N/A

2.1.3 Date of Test

12/19/2019

2.1.4 Test Method

N/A

2.1.5 Environmental Conditions

Ambient Temperature N/A

Relative Humidity N/A

Atmospheric Pressure N/A

2.1.6 Test Results

Limit Clause FCC Sections: 15.203, 15.204

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 EUT uses an integral 0 dBi PCB antenna that is etched to the PCB. The antenna is not removable nor replaceable and therefore meets the requirements of FCC Section 15.203 and 15.204.

2.1.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

As this is a visual inspection, no test equipment was used.



2.2 6 dB Bandwidth

2.2.1 Specification Reference

FCC: Section 15.247(a)(2)
 ISED Canada: RSS-247 5.2(a)

2.2.2 Equipment Under Test and Modification State

N/A

2.2.3 Date of Test

12/17/2019

2.2.4 Test Method

The 6dB bandwidth was measured in accordance with ANSI C63.10 Subclause 11.8.1 Option 1. The RBW of the spectrum analyzer was set to 100 kHz and VBW 300 kHz. Span was set large enough to capture the emissions and >> RBW. A peak detector was used for the measurements.

2.2.5 Environmental Conditions

| | |
|----------------------|-------------|
| Ambient Temperature | 24.9°C |
| Relative Humidity | 45.2 % |
| Atmospheric Pressure | 1011.7 mbar |

2.2.6 Test Results

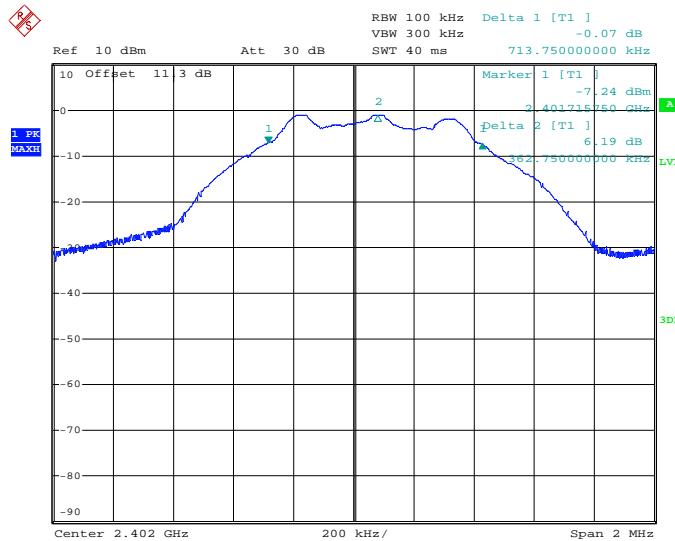
DC Powered Operating

Limit Clause FCC Part 15.247(a)(2), ISED RSS-247 5.2(a)

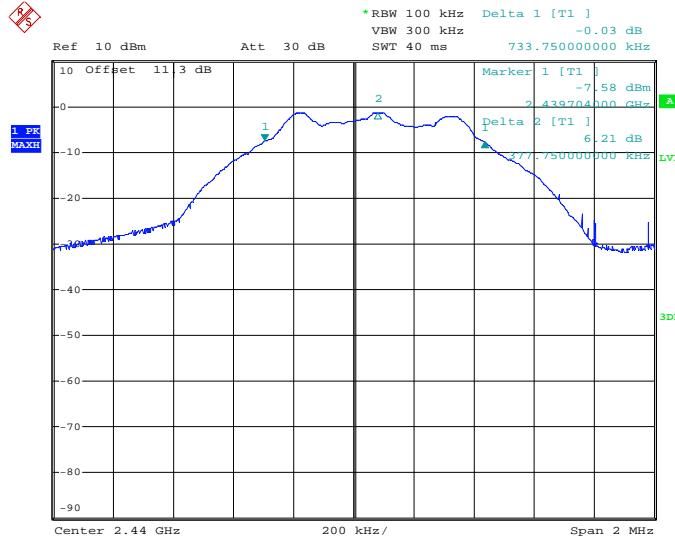
The minimum 6 dB bandwidth shall be at least 500 kHz.

Table 2.2.6-1: 6 dB Bandwidth Test Results

| Frequency (MHz) | 6 dB Bandwidth (kHz) |
|--------------------|-------------------------|
| 2402 | 713.75 |
| 2440 | 733.75 |
| 2480 | 734.00 |

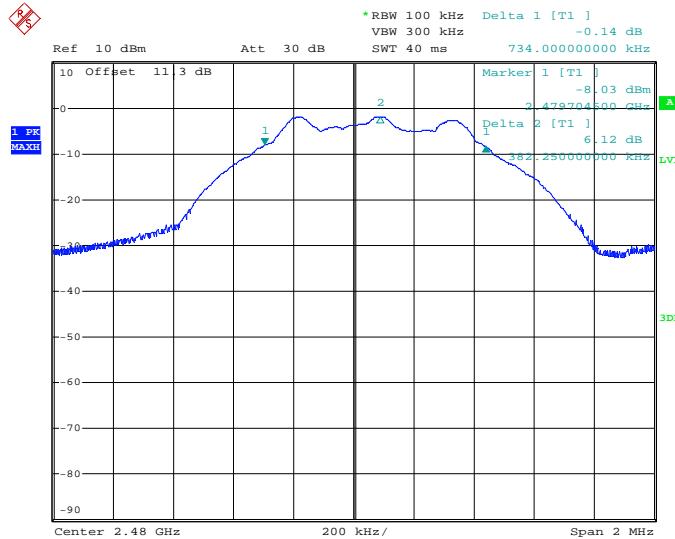


Date: 17.DEC.2019 14:36:35

Figure 2.2.6-1: 6 dB Bandwidth – Low Channel

Date: 17.DEC.2019 15:16:28

Figure 2.2.6-2: 6 dB Bandwidth – Middle Channel



Date: 17.DEC.2019 15:38:14

Figure 2.2.6-3: 6 dB Bandwidth – High Channel

2.2.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--|-------------------------|--------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | BEMC00283 | N/A | 24 | 10/4/2021 |
| Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet | 40AH2W-10 | BEMC02110 | N/A | 12 | 27-Jul-2020 |
| Duratest High Frequency Cable Max. frequency 26.5GHz | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A | 12 | 12-Oct-2020 |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



2.3 99% Bandwidth

2.3.1 Specification Reference

ISED Canada: RSS-GEN 6.6

2.3.2 Equipment Under Test and Modification State

N/A

2.3.3 Date of Test

12/17/2019

2.3.4 Test Method

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using 99% bandwidth equipment function of the spectrum analyzer using a peak detector.

2.3.5 Environmental Conditions

| | |
|----------------------|-------------|
| Ambient Temperature | 25.2°C |
| Relative Humidity | 45.3 % |
| Atmospheric Pressure | 1011.8 mbar |

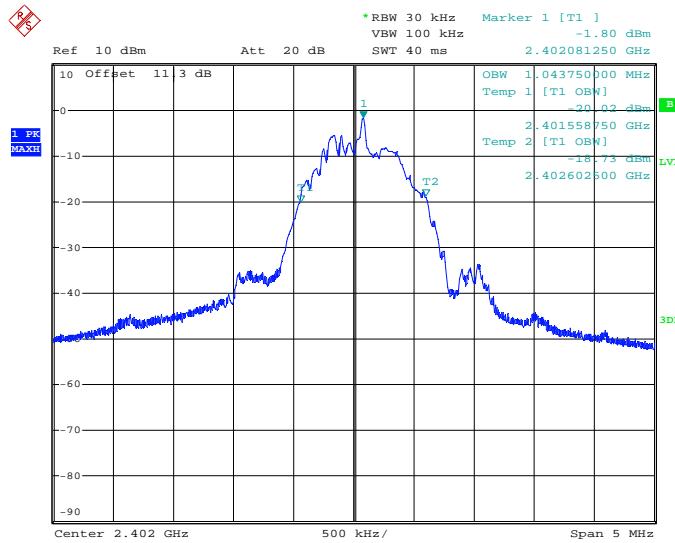
2.3.6 Test Results

DC Powered Operating

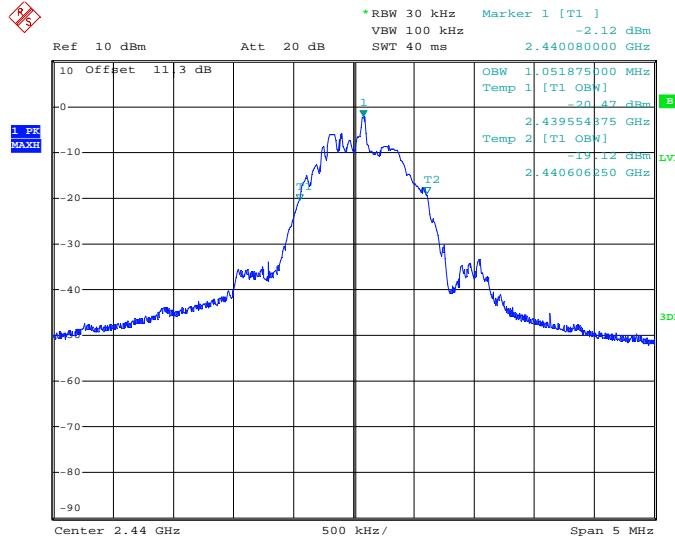
Limit Clause ISED RSS-GEN 6.6

Table 2.3.6-1: 99% Bandwidth Test Results

| Frequency (MHz) | 99% Bandwidth (kHz) |
|--------------------|------------------------|
| 2402 | 1043.750 |
| 2440 | 1051.875 |
| 2480 | 1051.250 |

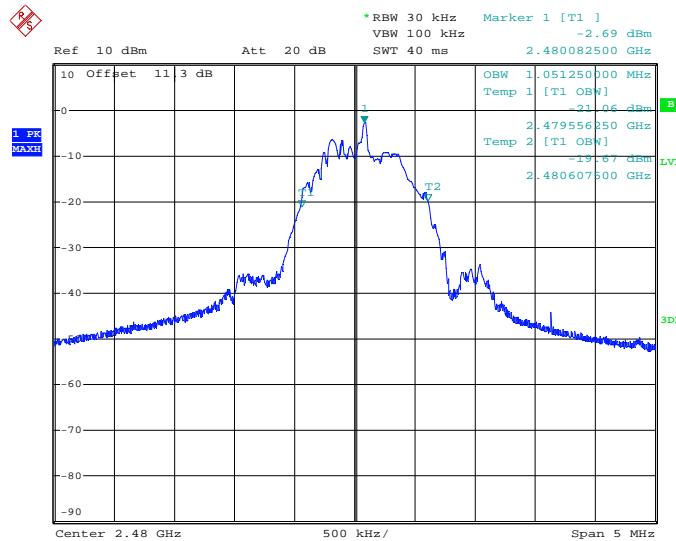


Date: 17.DEC.2019 14:45:12

Figure 2.3.6-1: 99% Bandwidth – Low Channel

Date: 17.DEC.2019 14:53:56

Figure 2.3.6-2: 99% Bandwidth – Middle Channel



Date: 17.DEC.2019 15:33:55

Figure 2.3.6-3: 99% Bandwidth – High Channel

2.3.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--|-------------------------|--------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | BEMC00283 | N/A | 24 | 10/4/2021 |
| Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet | 40AH2W-10 | BEMC02110 | N/A | 12 | 27-Jul-2020 |
| Duratest High Frequency Cable Max. frequency 26.5GHz | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A | 12 | 12-Oct-2020 |

TU - Traceability Unscheduled
 O/P MON - Traceability Unscheduled
 N/A - Not Applicable



2.4 Peak Output Power

2.4.1 Specification Reference

FCC Section 15.247(b)(3)
ISED Canada: RSS-247 5.4(d)

2.4.2 Equipment Under Test and Modification State

N/A

2.4.3 Date of Test

12/17/2019

2.4.4 Test Method

The fundamental emission output power was measured in accordance with ANSI C63.10 Subclause 11.9.1.1 RBW \geq DTS bandwidth. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer through suitable attenuation.

2.4.5 Environmental Conditions

| | |
|----------------------|-------------|
| Ambient Temperature | 29.4°C |
| Relative Humidity | 45.2 % |
| Atmospheric Pressure | 1011.9 mbar |

2.4.6 Test Results

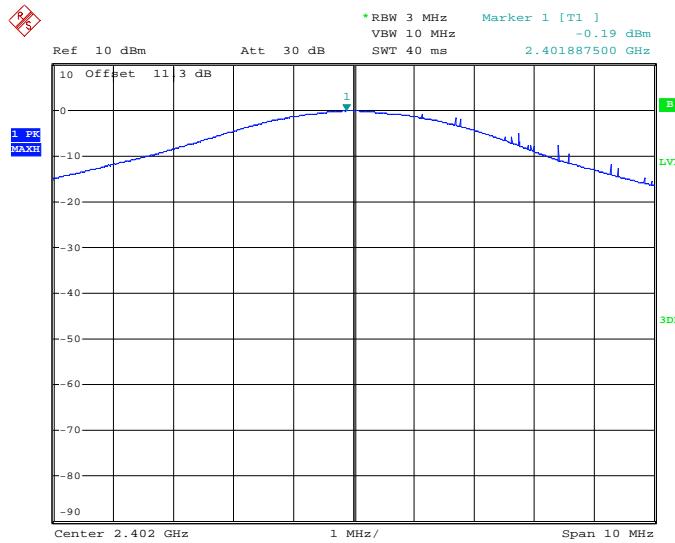
DC Powered Operating

Limit Clause FCC Part 15.247(b)(3), ISED RSS-247 5.4(d)

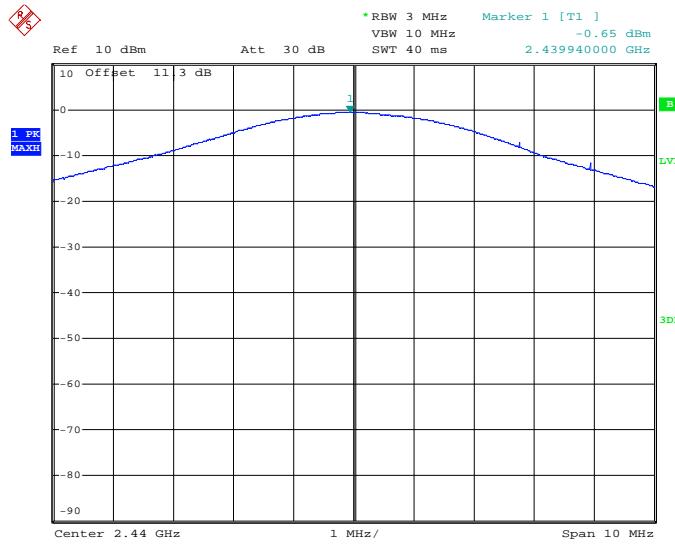
The Maximum Output Power allowed for systems using digital modulation is 1 Watt (30 dBm)

Table 2.4.6-1: RF Output Power Test Results

| Frequency (MHz) | Power (dBm) |
|--------------------|----------------|
| 2402 | -0.19 |
| 2440 | -0.65 |
| 2480 | -1.26 |

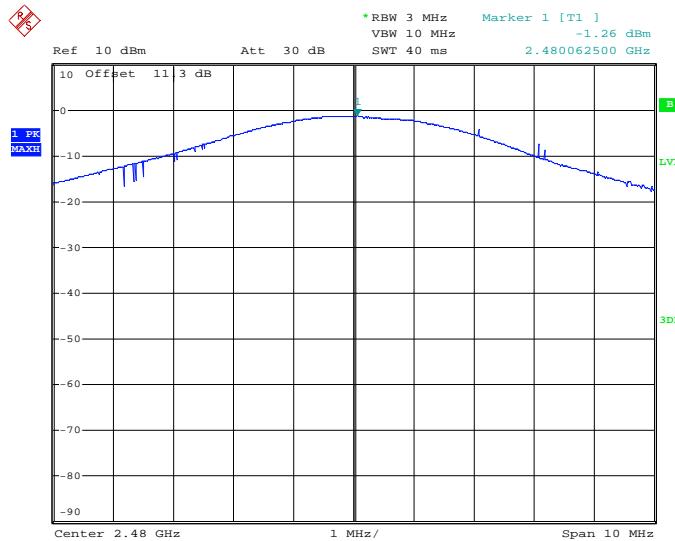


Date: 17.DEC.2019 14:32:07

Figure 2.4.6-1: RF Output Power – Low Channel

Date: 17.DEC.2019 15:00:25

Figure 2.4.6-2: RF Output Power – Middle Channel



Date: 17.DEC.2019 15:29:33

Figure 2.4.6-3: RF Output Power – High Channel

2.4.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--|-------------------------|--------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | BEMC00283 | N/A | 24 | 10/4/2021 |
| Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet | 40AH2W-10 | BEMC02110 | N/A | 12 | 27-Jul-2020 |
| Duratest High Frequency Cable Max. frequency 26.5GHz | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A | 12 | 12-Oct-2020 |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



2.5 Band-Edge Compliance of RF Conducted Emissions

2.5.1 Specification Reference

FCC: Section 15.247(d)
ISED Canada: RSS-247 5.5

2.5.2 Equipment Under Test and Modification State

N/A

2.5.3 Date of Test

12/17/2019

2.5.4 Test Method

The RF Conducted Emissions at the Band-Edges were measured in accordance with Subclause 11.11 of ANSI C63.10. The RF output port of the EUT was connected to the input of the spectrum analyzer through suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, and the VBW was set to \geq 300 kHz.

2.5.5 Environmental Conditions

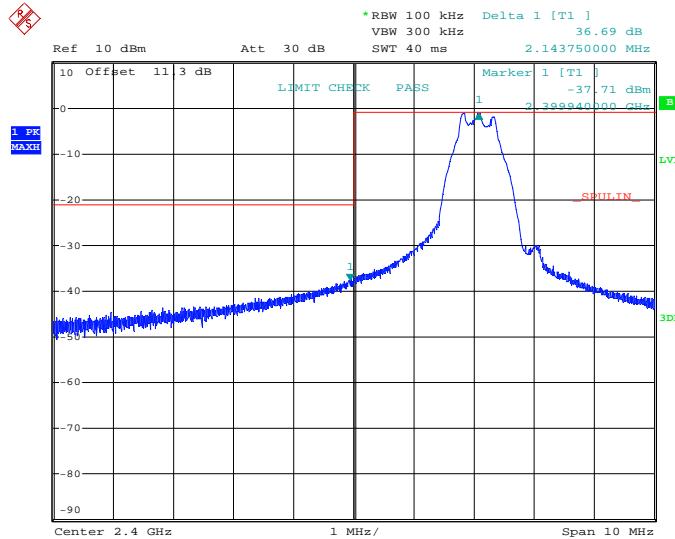
| | |
|----------------------|-------------|
| Ambient Temperature | 24.8 °C |
| Relative Humidity | 44.6 % |
| Atmospheric Pressure | 1011.7 mbar |

2.5.6 Test Results

DC Powered Operating

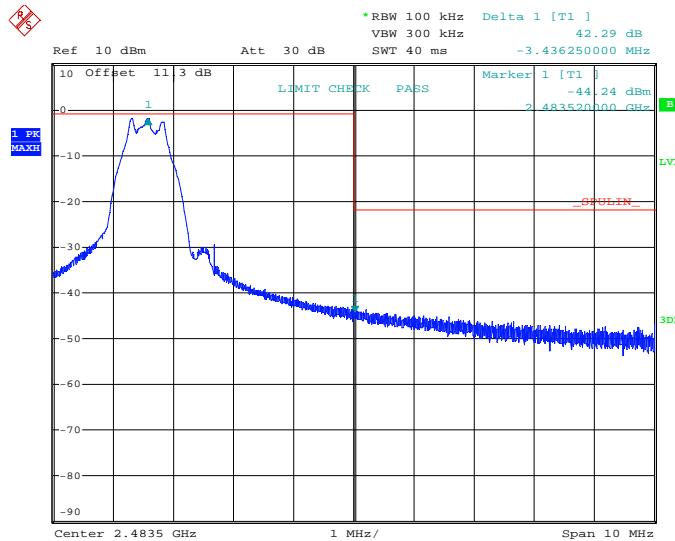
Limit Clause FCC Section 15.247(d), ISED Canada: RSS-247 5.5

In any 100 kHz bandwidth outside of the frequency band the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.



Date: 17.DEC.2019 16:16:05

Figure 2.5.6-1: Lower Band-Edge



Date: 17.DEC.2019 16:02:54

Figure 2.5.6-2: Upper Band-Edge



2.5.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--|-------------------------|--------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | BEMC00283 | N/A | 24 | 10/4/2021 |
| Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet | 40AH2W-10 | BEMC02110 | N/A | 12 | 27-Jul-2020 |
| Duratest High Frequency Cable Max. frequency 26.5GHz | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A | 12 | 12-Oct-2020 |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



2.6 RF Conducted Spurious Emissions

2.6.1 Specification Reference

FCC: Section 15.247(d)
ISED Canada: RSS-247 5.5

2.6.2 Equipment Under Test and Modification State

N/A

2.6.3 Date of Test

12/17/2019

2.6.4 Test Method

The RF Conducted Spurious Emissions were measured in accordance with Subclause 11.11 of ANSI C63.10. The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30 MHz to 25 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak Max Hold function of the analyzer was utilized.

2.6.5 Environmental Conditions

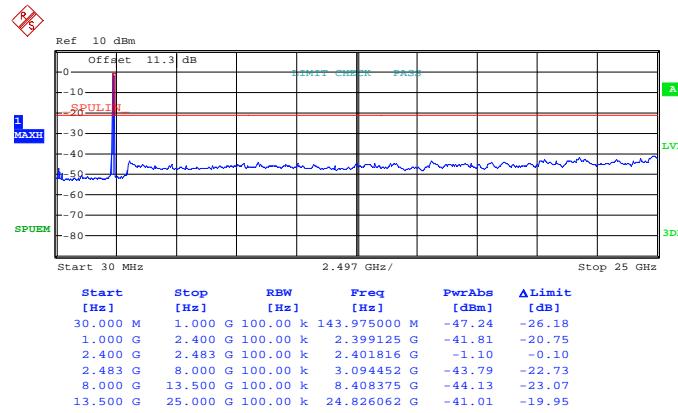
| | |
|----------------------|-------------|
| Ambient Temperature | 24.8 °C |
| Relative Humidity | 44.6 % |
| Atmospheric Pressure | 1011.7 mbar |

2.6.6 Test Results

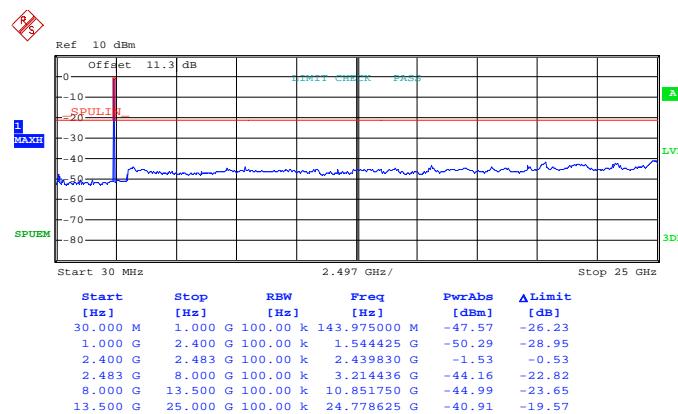
DC Powered Operating

Limit Clause FCC Section 15.247(d), ISED Canada: RSS-247 5.5

In any 100 kHz bandwidth outside of the frequency band the radio frequency power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

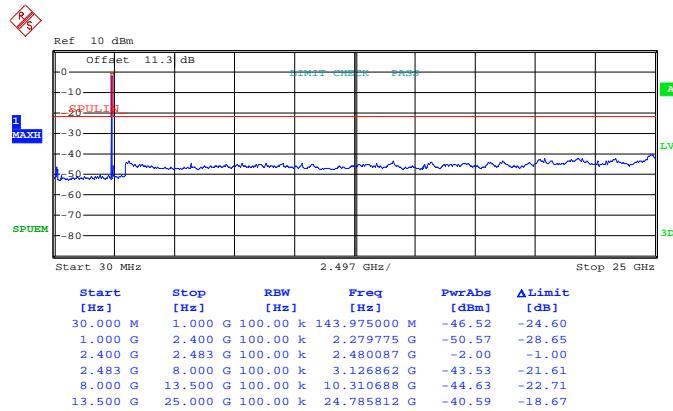


Date: 17.DEC.2019 16:13:00

Figure 2.6.6-1: Conducted Spurious Emissions – Low Channel

Date: 17.DEC.2019 16:08:24

Figure 2.6.6-2: Conducted Spurious Emissions – Low Channel



Date: 17.DEC.2019 15:59:06

Figure 2.6.6-3: Conducted Spurious Emissions – High Channel

2.6.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--|-------------------------|--------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | BEMC00283 | N/A | 24 | 10/4/2021 |
| Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet | 40AH2W-10 | BEMC02110 | N/A | 12 | 27-Jul-2020 |
| Duratest High Frequency Cable Max. frequency 26.5GHz | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A | 12 | 12-Oct-2020 |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



2.7 Radiated Spurious Emissions into Restricted Frequency Bands

2.7.1 Specification Reference

FCC Sections: 15.205, 15.209;
ISED Canada: RSS-GEN 8.9, 8.10

2.7.2 Equipment Under Test and Modification State

N/A

2.7.3 Date of Test

12/16/2019 to 12/17/2019

2.7.4 Test Method

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

For measurements below 30 MHz, the receive antenna height was set to 1 m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

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

2.7.5 Duty Cycle Correction

The EUT was configured to transmit at 65.4 % duty cycle during the evaluation. No duty cycle correction factor was used.

2.7.6 Environmental Conditions

| | |
|----------------------|-----------|
| Ambient Temperature | 23.5 °C |
| Relative Humidity | 41 % |
| Atmospheric Pressure | 1007 mbar |



2.7.7 Test Results

DC Powered Operating

Limit Clause FCC Sections 15.205, 15.209, ISED Canada: RSS-GEN 8.9, 8.10

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 0.009-0.490 | 2400/F(kHz) | 300 |
| 0.4090-1.705 | 24000/F(kHz) | 30 |
| 1.705-30.0 | 30 | 30 |
| 30-88 | 100** | 3 |
| 88-216 | 150** | 3 |
| 216-960 | 200** | 3 |
| Above 960 | 500 | 3 |

Table 2.7.7-1: Radiated Emissions Test Results

| Frequency (MHz) | Level (dBuV) | | Antenna Polarity (H/V) | Correction Factors (dB) | Corrected Level (dBuV/m) | | Limit (dBuV/m) | | Margin (dB) | |
|-----------------------|--------------|---------|------------------------|-------------------------|--------------------------|---------|----------------|---------|-------------|---------|
| | Pk | Qpk/Avg | | | Pk | Qpk/Avg | Pk | Qpk/Avg | Pk | Qpk/Avg |
| Low Channel | | | | | | | | | | |
| 2390 | 63.94 | 44.57 | H | -2.12 | 61.82 | 42.45 | 74.0 | 54.0 | 12.2 | 11.5 |
| 2390 | 61.31 | 40.66 | V | -2.12 | 59.19 | 38.54 | 74.0 | 54.0 | 14.8 | 15.5 |
| 4804 | 50.60 | 45.52 | H | 4.10 | 54.70 | 49.62 | 74.0 | 54.0 | 19.3 | 4.4 |
| 4804 | 47.71 | 41.73 | V | 4.10 | 51.81 | 45.83 | 74.0 | 54.0 | 22.2 | 8.2 |
| Middle Channel | | | | | | | | | | |
| 4880 | 47.73 | 41.90 | H | 4.26 | 51.99 | 46.16 | 74.0 | 54.0 | 22.0 | 7.8 |
| 4880 | 47.24 | 41.28 | V | 4.26 | 51.50 | 45.54 | 74.0 | 54.0 | 22.5 | 8.5 |
| 7320 | 41.12 | 30.98 | H | 9.25 | 50.37 | 40.23 | 74.0 | 54.0 | 23.6 | 13.8 |
| 7320 | 40.52 | 30.01 | V | 9.25 | 49.77 | 39.26 | 74.0 | 54.0 | 24.2 | 14.7 |
| High Channel | | | | | | | | | | |
| 2483.5 | 68.93 | 44.67 | H | -1.91 | 67.02 | 42.76 | 74.0 | 54.0 | 7.0 | 11.2 |
| 2483.5 | 66.67 | 44.30 | V | -1.91 | 64.76 | 42.39 | 74.0 | 54.0 | 9.2 | 11.6 |
| 4960 | 45.13 | 39.58 | H | 4.43 | 49.56 | 44.01 | 74.0 | 54.0 | 24.4 | 10.0 |
| 4960 | 43.95 | 39.44 | V | 4.43 | 48.38 | 43.87 | 74.0 | 54.0 | 25.6 | 10.1 |
| 7440 | 40.19 | 31.54 | H | 9.42 | 49.61 | 40.96 | 74.0 | 54.0 | 24.4 | 13.0 |
| 7440 | 39.05 | 29.69 | V | 9.42 | 48.47 | 39.11 | 74.0 | 54.0 | 25.5 | 14.9 |

Notes:

- All the emissions above 7.44 GHz were attenuated below the limits and the noise floor of the measurement equipment.

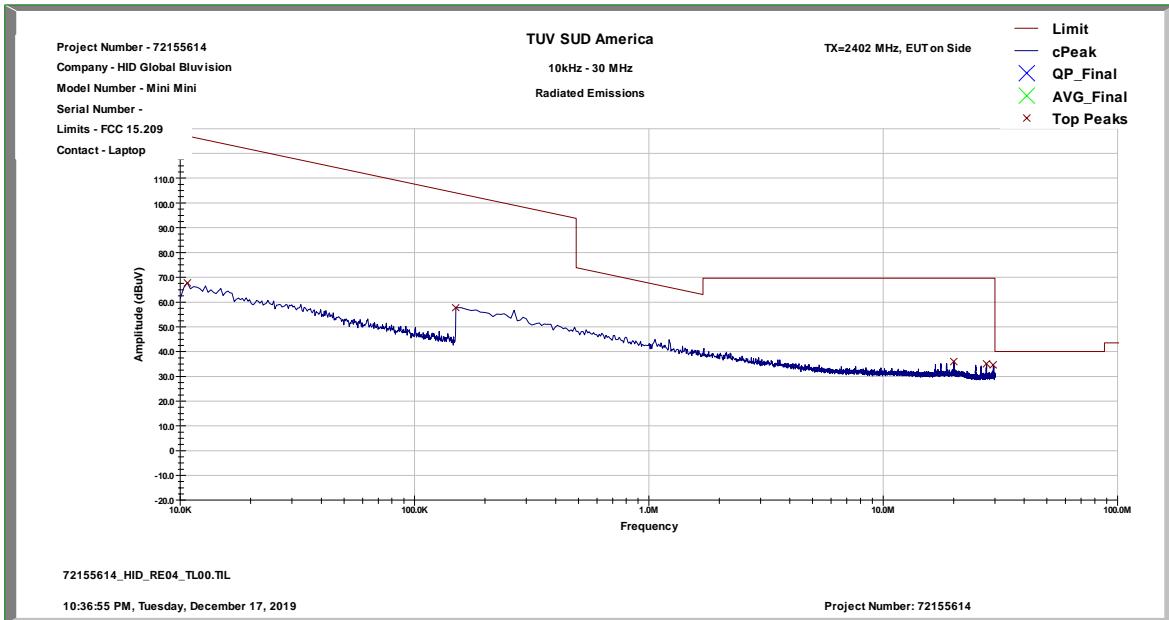


Figure 2.7.7-1: Sample Radiated Emissions Pre-scan – below 30 MHz

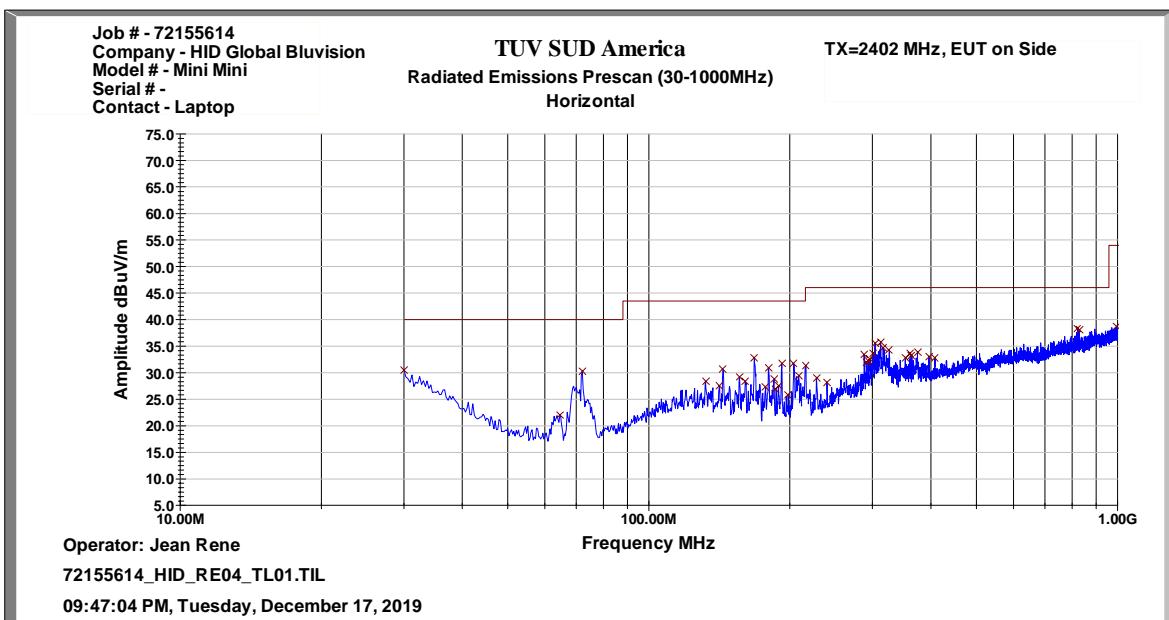


Figure 2.7.7-2: Sample Radiated Emissions Pre-scan – 30 MHz – 1 GHz – Horizontal Polarization

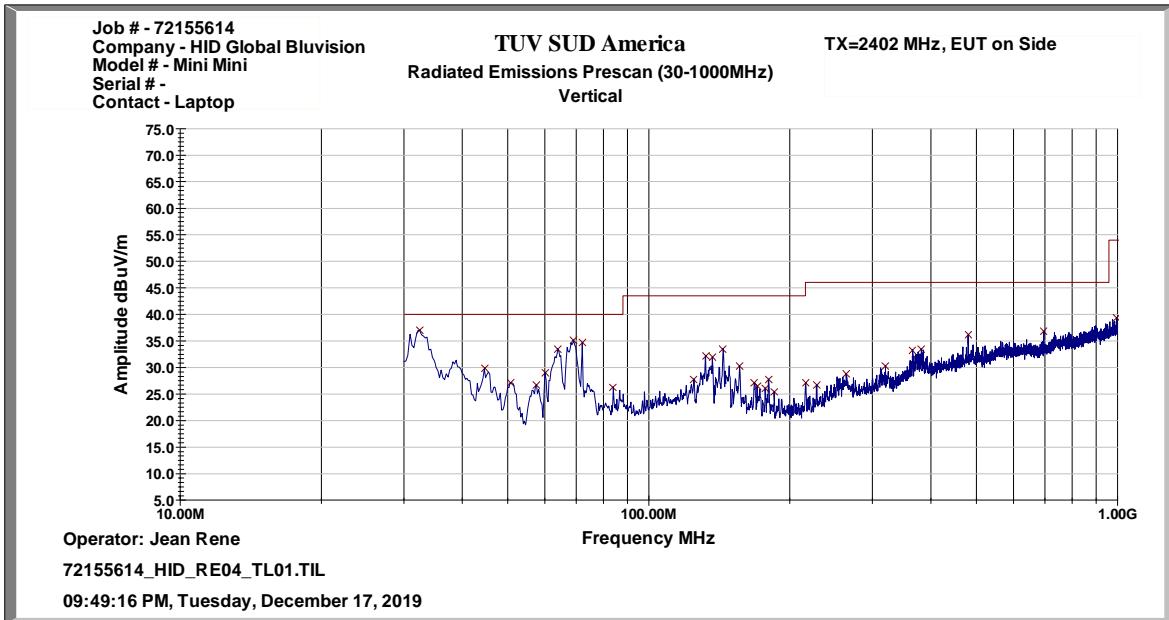


Figure 2.7.7-3: Sample Radiated Emissions Pre-scan – 30 MHz – 1 GHz – Vertical Polarization

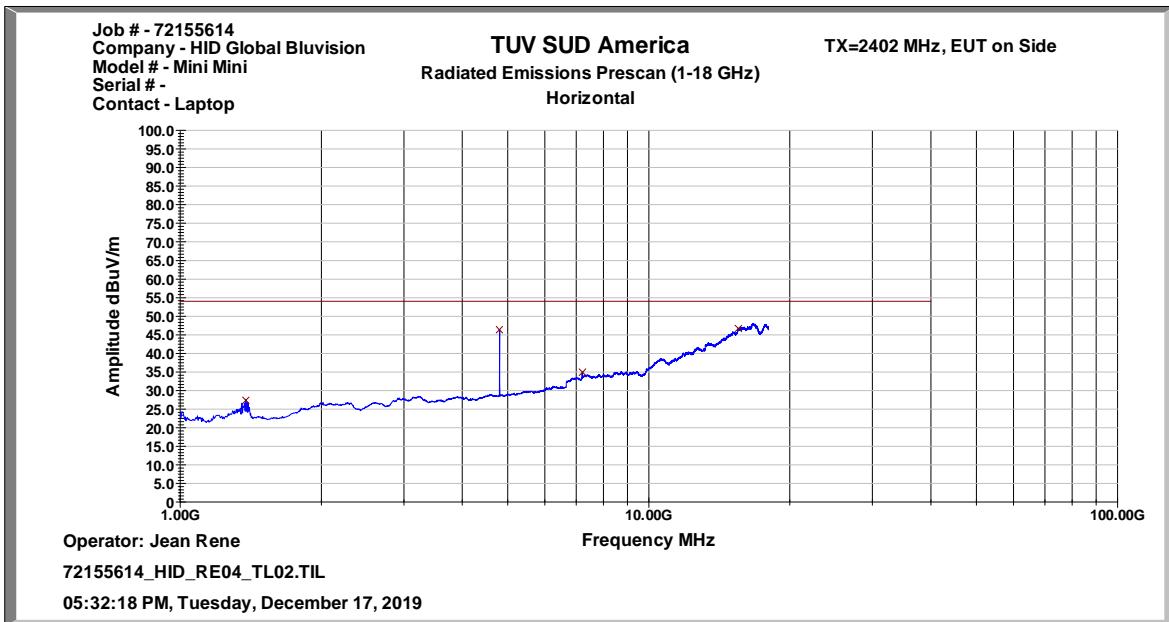


Figure 2.7.7-4: Sample Radiated Emissions Pre-scan – 1 GHz – 18 GHz – Horizontal Polarization

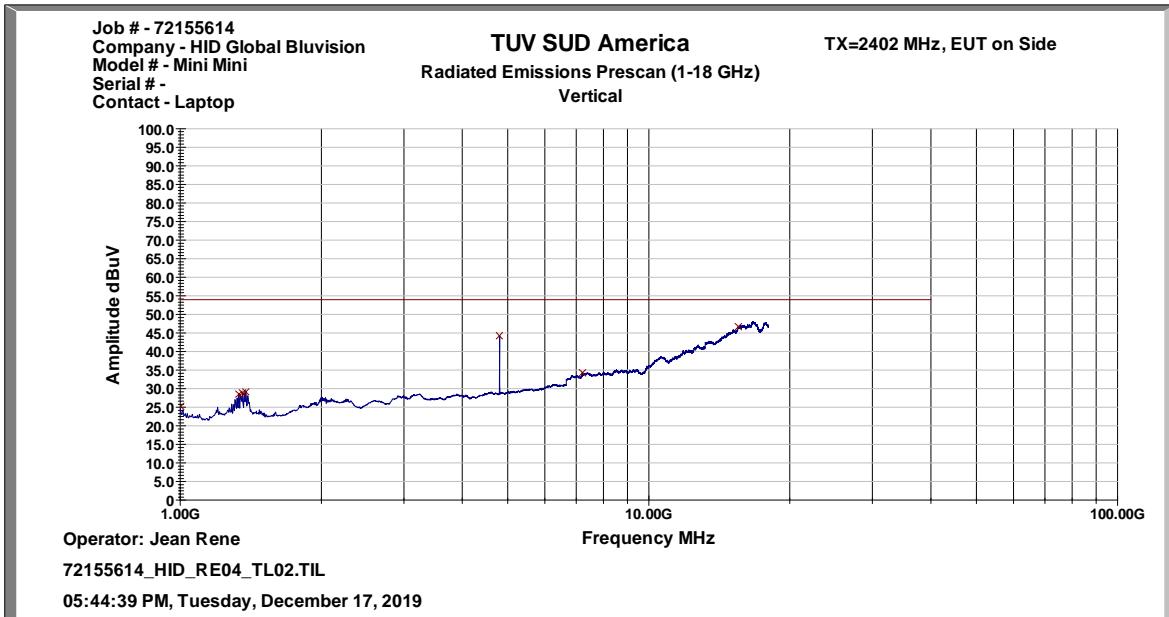


Figure 2.7.7-5: Sample Radiated Emissions Pre-scan – 1 GHz – 18 GHz – Vertical Polarization

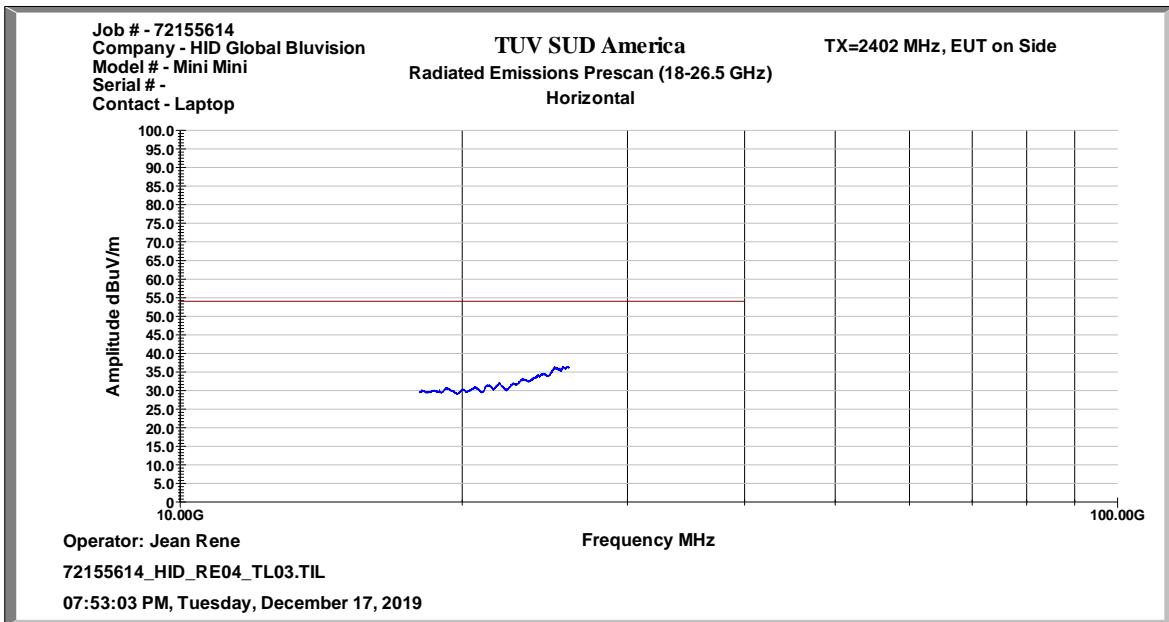


Figure 2.7.7-6: Sample Radiated Emissions Pre-scan – 18 GHz – 26 GHz – Horizontal Polarization

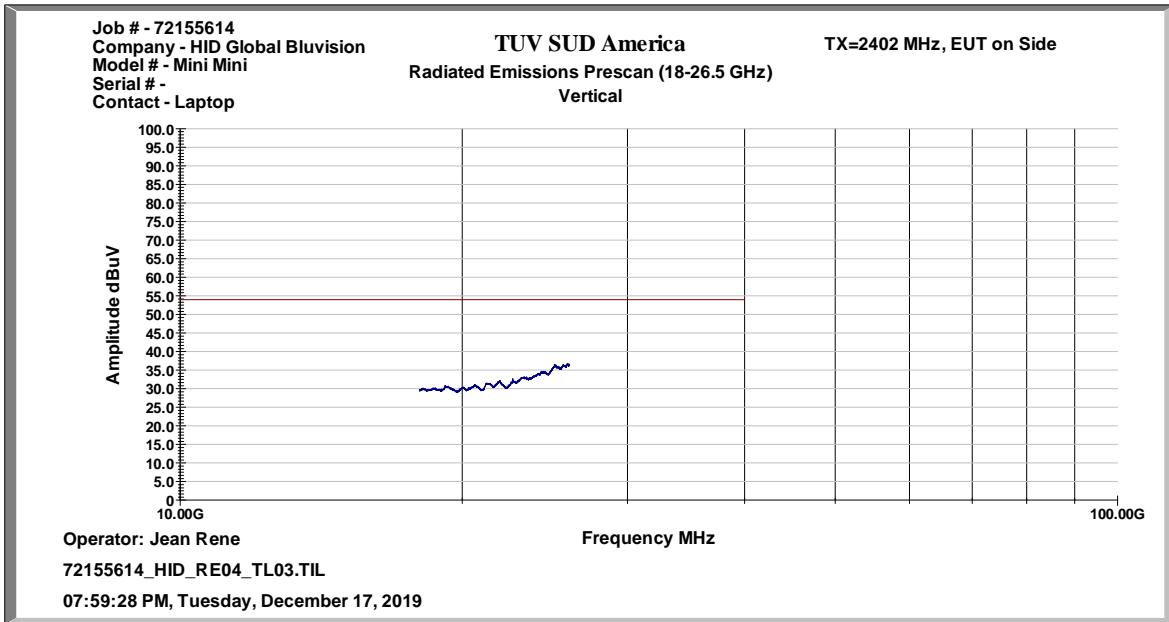


Figure 2.7.7-7: Sample Radiated Emissions Pre-scan – 18 GHz – 26 GHz – Vertical Polarization

2.7.8 Sample Calculations

$$R_C = R_U + CF_T$$

Where:

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

Example Calculation: Peak

$$\text{Corrected Level: } 63.94 + (-2.12) = 61.82 \text{ dB}\mu\text{V/m}$$

$$\text{Margin: } 74 \text{ dB}\mu\text{V/m} - 61.82 \text{ dB}\mu\text{V/m} = 12.18 \text{ dB}$$

Example Calculation: Average

$$\text{Corrected Level: } 44.57 + (-2.12) -0 = 42.45 \text{ dB}\mu\text{V/m}$$

$$\text{Margin: } 54 \text{ dB}\mu\text{V/m} - 42.45 \text{ dB}\mu\text{V/m} = 11.55 \text{ dB}$$



2.7.9 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--------------------------------------|-----------------------|------------------------|-----------|------------------------------|-----------------------------|-----------------|
| 9kHz-26.5GHz EMC analyzer/HYZ | Agilent | E7405A | BEMC00523 | A.14.06 | 24 | 27-Nov-2020 |
| 10dB Attenuator | Merrimac | FAN-6-10K | BEMC02086 | N/A | 12 | 12-Oct-2020 |
| Tile Automation Software | ETS Lindgren | TILE4! - Version 4.2.A | BEMC02095 | 4.2A | N/A | NCR |
| BI LOG PERIODIC, ANTENNA | Schaffner | CBL6112B | TEMC00005 | N/A | 24 | 31-Oct-2021 |
| Loop Antenna | Com Power | AL-130 | TEMC00025 | N/A | 24 | 26-Sep-2021 |
| Horn Antenna | Schwarzbeck | BBHA-9170 | TEMC00029 | N/A | 60 | 23-Aug-2021 |
| EMC Chamber | Panashield | N/A | TEMC00031 | N/A | 24 | 28-Jan-2020 |
| Double Ridge Guide Horn | ETS Lindgren | 3117 | TEMC00061 | N/A | 24 | 13-Feb-2020 |
| 18 GHz-40 GHz Microwave Preamplifier | COM-power | PAM-840A | TEMC00147 | N/A | 24 | 30-May-2020 |
| PAM-118A | Com-Power Corporation | PAM-118A | TEMC00160 | N/A | 12 | 27-Apr-2020 |
| 4A & 4B Test Cables | MegaPhase, LLC | 1GVT4 | TEMC00171 | N/A | 24 | 30-May-2020 |
| 2.4 GHz Notch Filter | Micro-Tronics | BRM50702-01 | TEMC00176 | N/A | 12 | 10-Apr-2020 |
| Radiated Cable Set 30 MHz - 1 GHz | TUV SUD Tampa | Cable 2 | TEMC00179 | N/A | 12 | 07-May-2020 |
| Radiated Cable Set 9 kHz - 30 MHz | TUV SUD Tampa | Cable 2 | TEMC00186 | N/A | 12 | 08-May-2020 |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable

NCR - No Calibration Required



2.8 Power Spectral Density

2.8.1 Specification Reference

FCC: Section 15.247(e)
 ISED Canada: RSS-247 5.2(b)

2.8.2 Equipment Under Test and Modification State

N/A

2.8.3 Date of Test

12/17/2019

2.8.4 Test Method

The power spectral density was measured in accordance with ANSI C63.10 Subclause 11.10.2 Method PKPSD (peak PSD). The RF output port of the EUT was directly connected to the input of the spectrum analyzer. Offset values were input for cable and external attenuation. The spectrum analyzer RBW was set to 3 kHz and VBW to 10 kHz. The Span was adjusted to 1.5 times the DTS bandwidth and the sweep time was set to auto. The measurements were performed using a Peak detector.

2.8.5 Environmental Conditions

| | |
|----------------------|-------------|
| Ambient Temperature | 24.2 °C |
| Relative Humidity | 45.6 % |
| Atmospheric Pressure | 1011.9 mbar |

2.8.6 Test Results

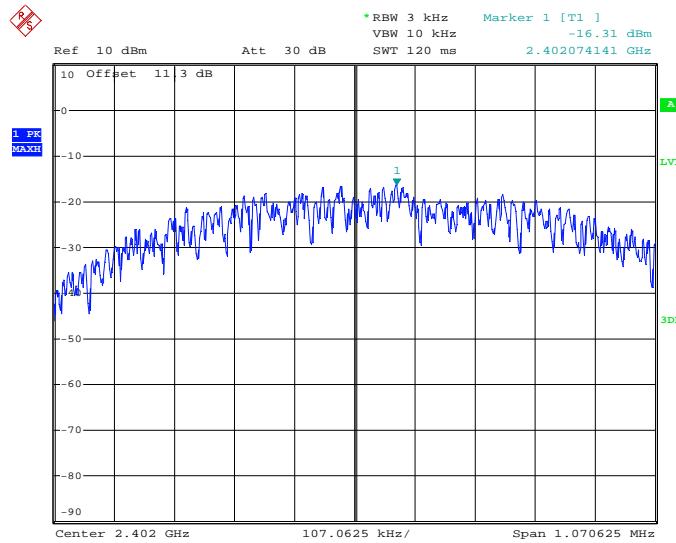
DC Powered Operating

Limit FCC: Section 15.247(e), ISED Canada: RSS-247 5.2(b)

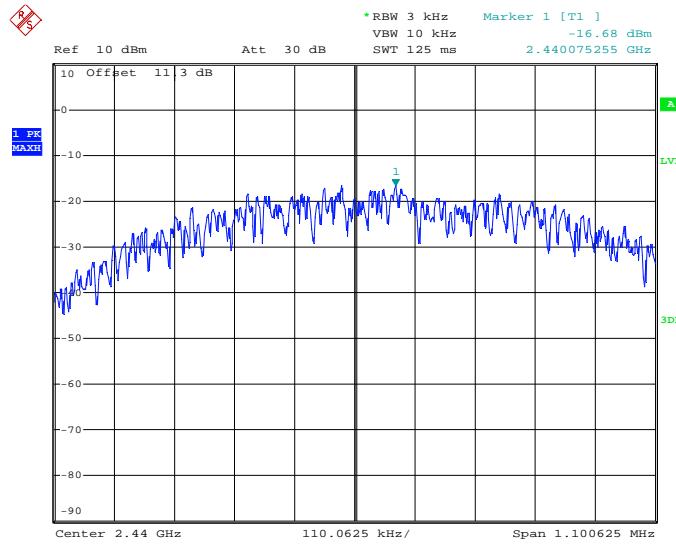
The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time of continuous transmission.

Table 2.8.6-1: Power Spectral Density Test Results

| Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|--------------------|--------------|----------------|----------------|
| 2402 | -16.31 | 8 | 24.31 |
| 2440 | -16.68 | 8 | 24.68 |
| 2480 | -17.66 | 8 | 25.66 |

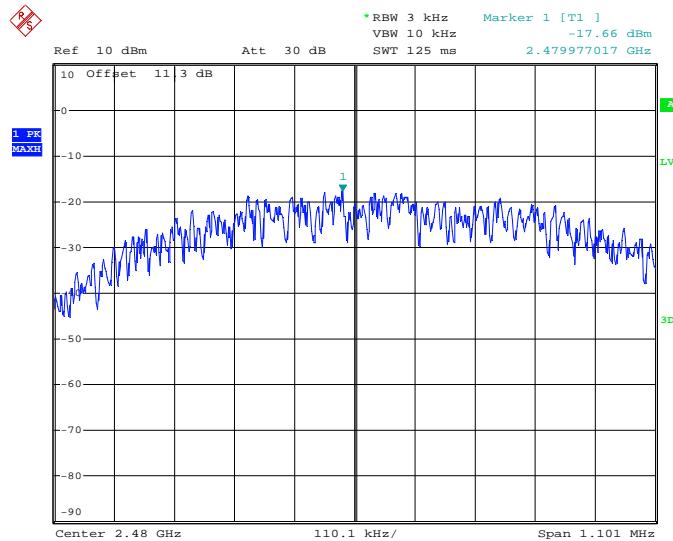


Date: 17.DEC.2019 14:41:29

Figure 2.8.6-1: Power Spectral Density – Low Channel

Date: 17.DEC.2019 15:25:55

Figure 2.8.6-2: Power Spectral Density – Middle Channel



Date: 17.DEC.2019 15:41:35

Figure 2.8.6-3: Power Spectral Density – High Channel

2.8.7 Test Location and Test Equipment Used

This test was carried out in TÜV SÜD America, Inc., 5610 W. Sligh Ave, Suite 100, Tampa, FL 33634, USA.

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--|-------------------------|--------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | BEMC00283 | N/A | 24 | 10/4/2021 |
| Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet | 40AH2W-10 | BEMC02110 | N/A | 12 | 27-Jul-2020 |
| Duratest High Frequency Cable Max. frequency 26.5GHz | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A | 12 | 12-Oct-2020 |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



2.9 Power Line Conducted Emissions

2.9.1 Specification Reference

FCC: Section 15.207
ISED Canada; RSS-GEN 8.8

2.9.2 Test Results

| Frequency of Emission (MHz) | Conducted Limit (dB μ V) | |
|-----------------------------|------------------------------|-----------|
| | Quasi-Peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

The EUT is battery operated only. The unit does not include any provision for power through the AC Mains. The EUT is exempted from the power line conducted emissions requirements.



3 Test Equipment Information

3.1 General Test Equipment Used

| Instrument | Manufacturer | Type No | TE No | Software / Firmware Revision | Calibration Period (months) | Calibration Due |
|--|-------------------------|------------------------|-----------|------------------------------|-----------------------------|-----------------|
| Spectrum Analyzer | Rohde & Schwarz | FSP40 | BEMC00283 | N/A | 24 | 10/4/2021 |
| 9kHz-26.5GHz EMC analyzer/HYZ | Agilent | E7405A | BEMC00523 | A.14.06 | 24 | 27-Nov-2020 |
| 10dB Attenuator | Merrimac | FAN-6-10K | BEMC02086 | N/A | 12 | 12-Oct-2020 |
| Tile Automation Software | ETS Lindgren | TILE4! - Version 4.2.A | BEMC02095 | 4.2A | N/A | NCR |
| Attenuator 10dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet | 40AH2W-10 | BEMC02110 | N/A | 12 | 27-Jul-2020 |
| Duratest High Frequency Cable Max. frequency 26.5GHz | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A | 12 | 12-Oct-2020 |
| BI LOG PERIODIC, ANTENNA | Schaffner | CBL6112B | TEMC00005 | N/A | 24 | 31-Oct-2021 |
| Loop Antenna | Com Power | AL-130 | TEMC00025 | N/A | 24 | 26-Sep-2021 |
| Horn Antenna | Schwarzbeck | BBHA-9170 | TEMC00029 | N/A | 60 | 23-Aug-2021 |
| EMC Chamber | Panashield | N/A | TEMC00031 | N/A | 24 | 28-Jan-2020 |
| Double Ridge Guide Horn | ETS Lindgren | 3117 | TEMC00061 | N/A | 24 | 13-Feb-2020 |
| 18 GHz-40 GHz Microwave Preamplifier | COM-power | PAM-840A | TEMC00147 | N/A | 24 | 30-May-2020 |
| PAM-118A | Com-Power Corporation | PAM-118A | TEMC00160 | N/A | 12 | 27-Apr-2020 |
| 4A & 4B Test Cables | MegaPhase, LLC | 1GVT4 | TEMC00171 | N/A | 24 | 30-May-2020 |
| 2.4 GHz Notch Filter | Micro-Tronics | BRM50702-01 | TEMC00176 | N/A | 12 | 10-Apr-2020 |
| Radiated Cable Set 30 MHz - 1 GHz | TUV SUD Tampa | Cable 2 | TEMC00179 | N/A | 12 | 07-May-2020 |
| Radiated Cable Set 9 kHz - 30 MHz | TUV SUD Tampa | Cable 2 | TEMC00186 | N/A | 12 | 08-May-2020 |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable

4 Diagram of Test Set-ups

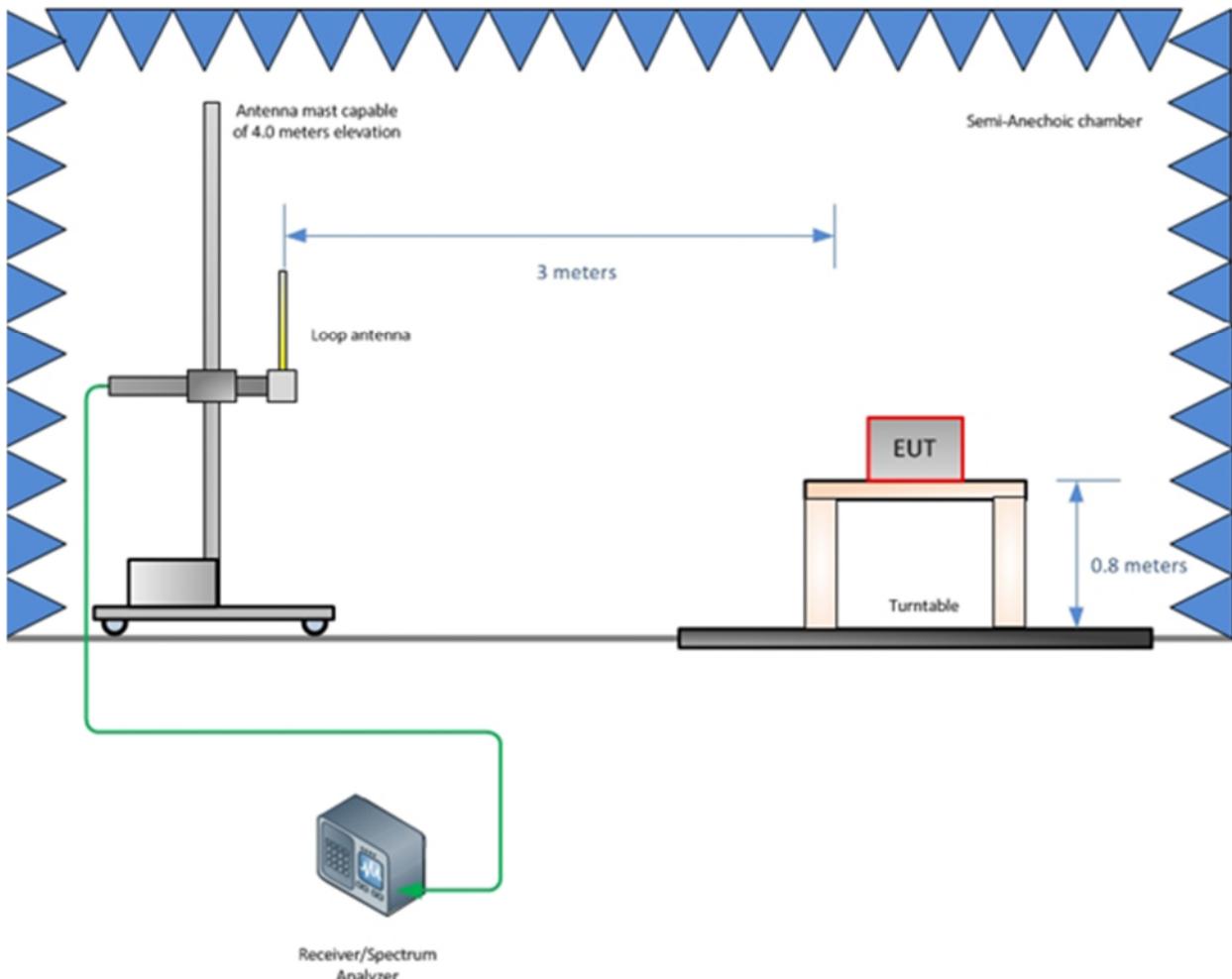


Figure 4-1 - Radiated Emissions Test Setup up to 30 MHz

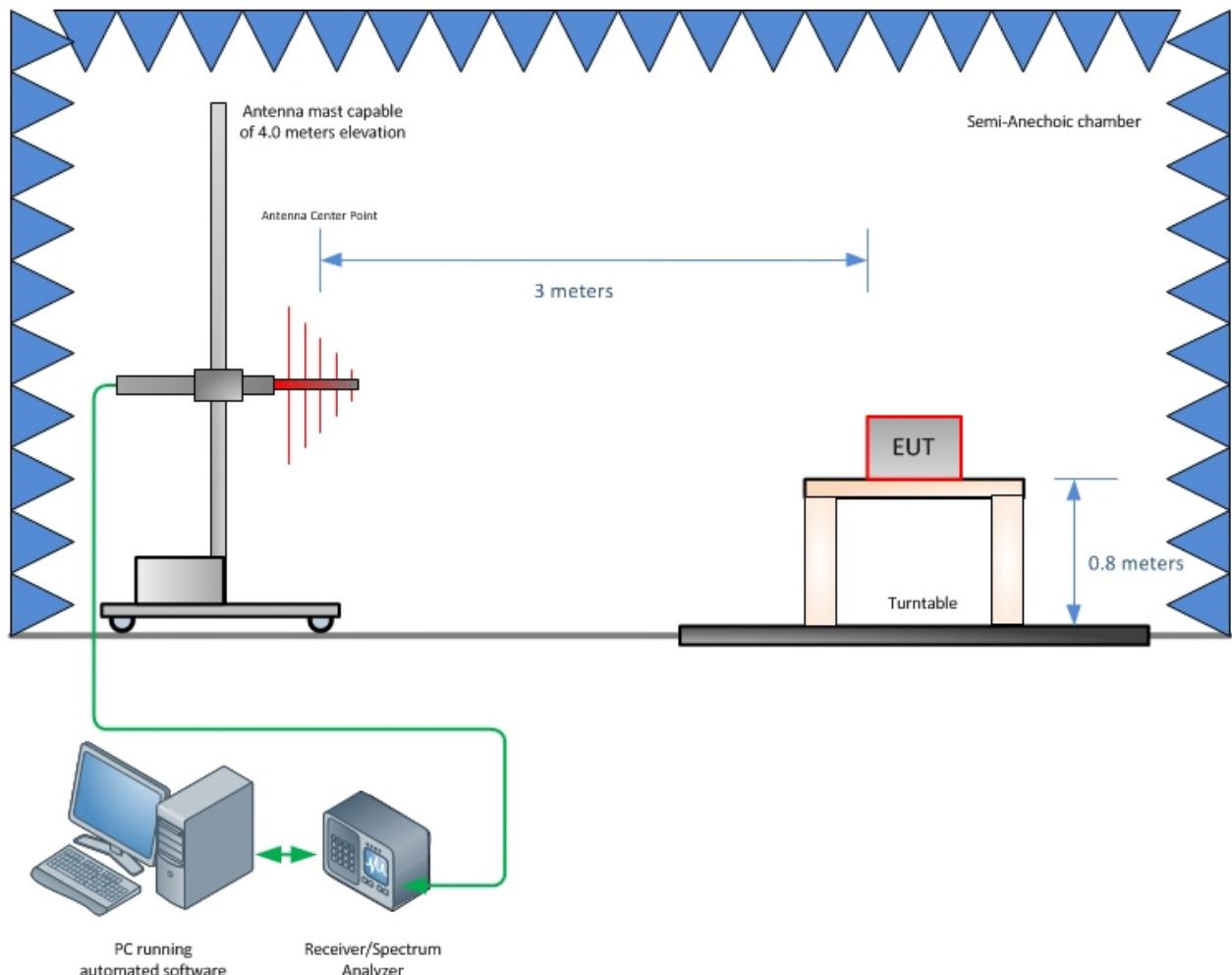


Figure 4-2 - Radiated Emissions Test Setup up to 1 GHz

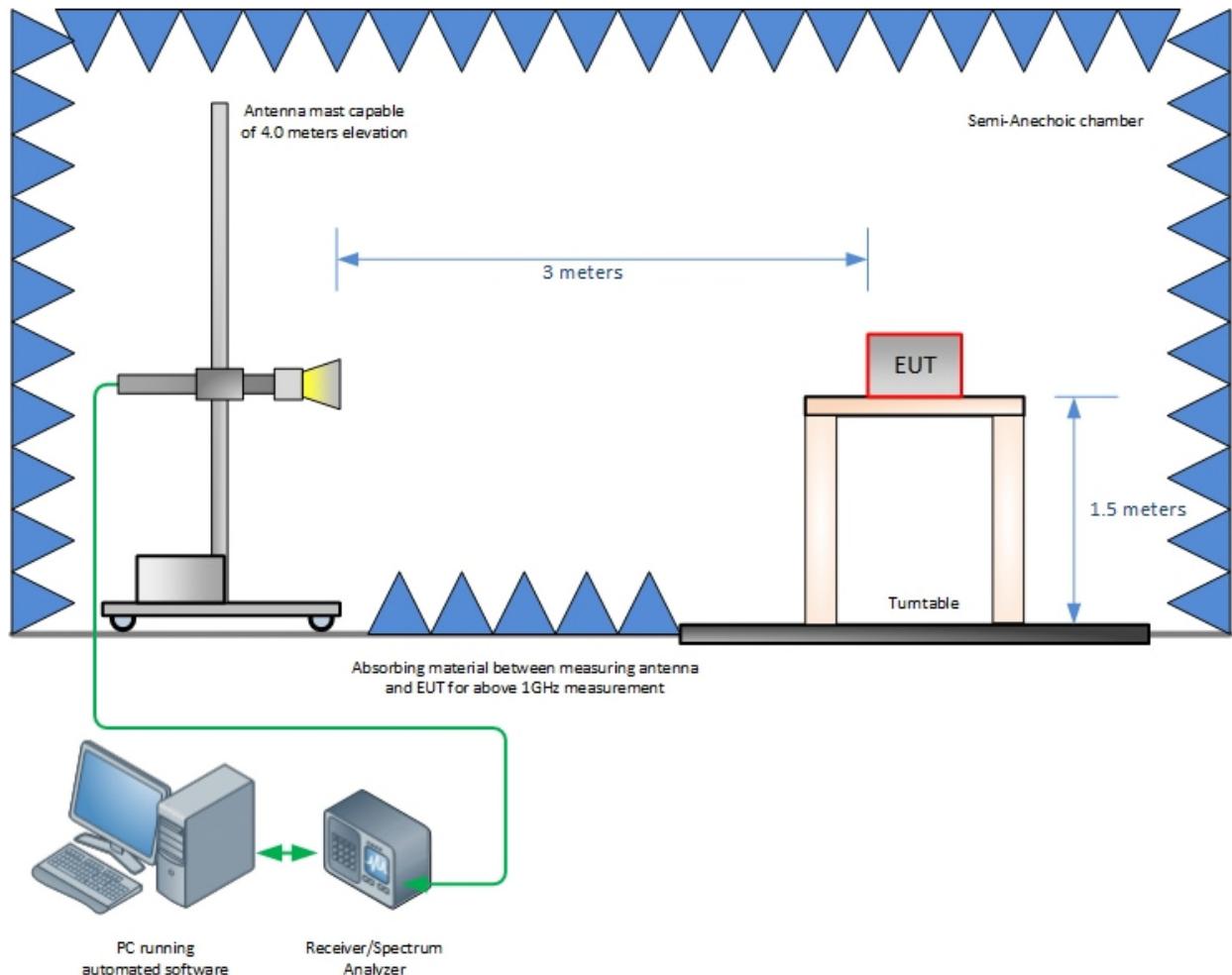


Figure 4-3 - Radiated Emissions Test Setup above 1 GHz

Shielded Enclosure

- EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated into $50\ \Omega$ loads.
 - LISN at least 80 cm from nearest part of EUT chassis.
 - Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.
 - Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.
 - Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 cm to 40 cm long.

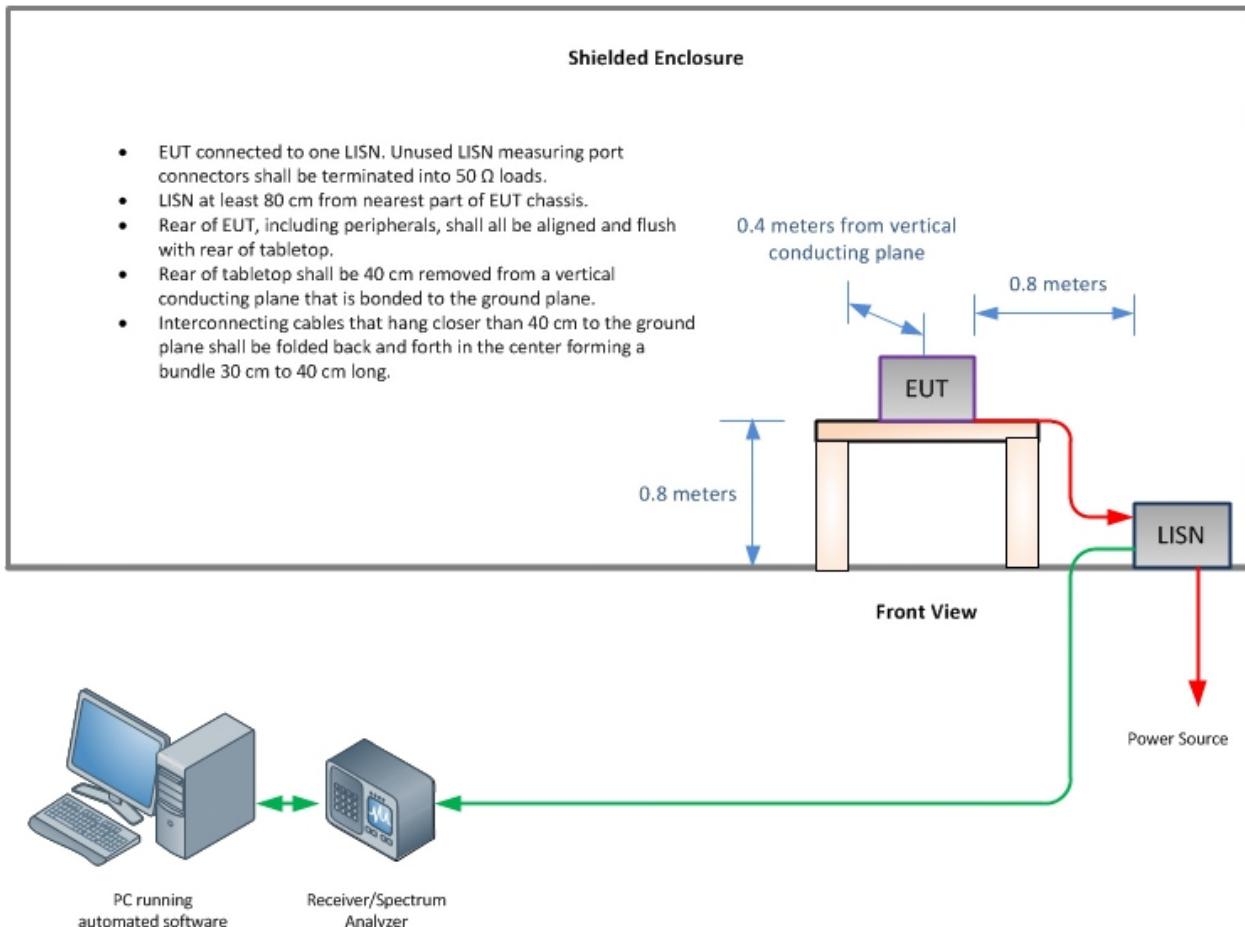


Figure 4-4 – Conducted Emissions Test Setup



5 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

Table 6-1 - Values of $U_{\text{cisp}}r$ and U_{Lab}

| Measurement | $U_{\text{cisp}}r$ | U_{Lab} |
|--|----------------------------|-------------------------------|
| Conducted disturbance (mains port) (9 kHz – 150 kHz) (150 kHz – 30 MHz) | 3.8 dB 3.4 dB | 3.71 dB 3.31 dB |
| Conducted disturbance (telecom port) (150 kHz – 30 MHz 55 dB LCL) (150 kHz – 30 MHz 65 dB LCL) (150 kHz – 30 MHz 75 dB LCL) | 5.0 dB 5.0 dB 5.0 dB | 4.11 dB 4.50 dB 4.94 dB |
| Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1 000 MHz) (1 – 6 GHz) (6-18 GHz) | 6.3 dB 5.2 dB 5.5 dB | 5.85 dB 4.48 dB 4.48 dB |

Notes:

$U_{\text{cisp}}r$ resembles a value of measurement uncertainty for a specific test, which was determined by considering uncertainties associated with the quantities listed in CISPR 16-4-2:2011.



6 Accreditation, Disclaimers and Copyright

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