

# FCC and ISED Canada Testing of the

Attenti US, Inc.  
RTCVZ3

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

Prepared for: Attenti US, Inc.  
1838 Gunn Highway  
Odessa, FL 33556

FCC ID: NC3-24074AVL  
IC: 23669-24074AVL

## COMMERCIAL-IN-CONFIDENCE

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| RESPONSIBLE FOR      | NAME                 | DATE          | SIGNATURE |
|----------------------|----------------------|---------------|-----------|
| Authorized Signatory | Peter Walsh          | 2021 -June-30 |           |
| Testing              | Thierry Jean Charles | 2021-June-30  |           |

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.



A2LA Cert. No. 2955.15

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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           | 2021-June-30  |

## 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                     | Attenti US, Inc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Manufacturer                  | Attenti US, Inc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Applicant's Email Address     | <a href="mailto:sdupont@attentigroup.com">sdupont@attentigroup.com</a>                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Model Number(s)               | RTCVZ3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Serial Number(s)              | 36090015 (RF Conducted Measurements)<br>36090009 (Radiated and Power Line Conducted Measurements)                                                                                                                                                                                                                                                                                                                                                                                              |
| FCC ID                        | NC3-24074AVL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| ISED Certification Number     | 23669-24074AVL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Hardware Version(s)           | Rev B00 and C00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Software Version(s)           | V5.2.2.6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 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, 2021<br>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          | 2021-March-11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Order Number                  | 72169129                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Date                          | 2021-April-24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Date of Receipt of EUT        | 2021-May-12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Start of Test                 | 2021-May-12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Finish of Test                | 2021-June-23                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Name of Engineer(s)           | Thierry Jean-Charles                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Related Document(s)           | ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.<br>US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2021.<br>FCC OET KDB Publication 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. |



FCC KDB Publication 996369 D04 Module Integration Guide  
v01: Modular Transmitter Integration Guide - Guidance for  
Host Product Manufacturers, February 1, 2019.

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       | -----             | 11                  |
| 6 dB Bandwidth                                              | Yes                | Pass        | 15.247(a)(2)         | RSS-247 5.2(a)    | 12                  |
| 99% Bandwidth                                               | Yes                | Pass        | -----                | RSS-GEN 6.7       | 20                  |
| Fundamental Emission Output Power                           | Yes                | Pass        | 15.247(b)(3)         | RSS-247 5.4(d)    | 28                  |
| Band-Edge Compliance of RF Conducted Emissions              | Yes                | Pass        | 15.247(d)            | RSS-247 5.5       | 30                  |
| RF Conducted Spurious Emissions                             | Yes                | Pass        | 15.247(d)            | RSS-247 5.5       | 35                  |
| Radiated Spurious Emissions into Restricted Frequency Bands | Yes                | Pass        | 15.205, 15.209       | RSS-GEN 8.9, 8.10 | 41                  |
| Power Spectral Density                                      | Yes                | Pass        | 15.247(e)            | RSS-247 5.2(b)    | 51                  |
| Duty Cycle                                                  | Yes                | -----       | -----                | -----             | 59                  |
| Power Line Conducted Emissions                              | Yes                | Pass        | 15.207               | RSS-GEN 8.8       | 62                  |



## 1.4 Product Information

### 1.4.1 Technical Description

The EUT is a Handheld Personnel Tracker. This handheld device wirelessly pairs with an ankle-worn non-intelligent bracelet. It can optionally be used with a BU2000 Table-top Base Unit (this is a charging and docking station) as well. The EUT includes 433 MHz ISM and 2.4 GHz Wi-Fi radios as well as an LTE module (FCC ID: R17LE910NAV2 / IC: 5131A-LE910NAV2). The test report documents the compliance of the 2.4 GHz Wi-Fi radio.

#### Technical Details

Mode of Operation: IEEE 802.11b/g/n  
 Frequency Range: 2412 MHz - 2462 MHz  
 Number of Channels: 11  
 Channel Separation: 5 MHz  
 Data Rate: 802.11b: 1, 2, 5.5, 11 Mbps  
 802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps  
 802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65 Mbps  
 Modulations: 802.11b: CCK, DSSS  
 802.11g/n: OFDM  
 Antenna Type/Gain: Embedded SMD PCB Mount On-Ground Antenna, 3.6 dBi  
 Input Power: 12 VDC Power Supply / 3.7 VDC Battery

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

**Table 1.4.1-1 – Cable Descriptions**

| Cable/Port | Description                               |
|------------|-------------------------------------------|
| Power      | 2.74 m, Not Shielded, Power Supply to EUT |

**Table 1.4.1-2 – Support Equipment Descriptions**

| Make/Model               | Description       |
|--------------------------|-------------------|
| JFEC / JF024WR-1200200UH | 12 VDC AC Adapter |



### Declaration of Build Status

| EQUIPMENT DESCRIPTION                                                                           |                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model Name/Number                                                                               | Model Names: RTC AT&T / RTC MC Model # RTCVZ3                                                                                                                                                                                |
| Part Number(s)                                                                                  | 064000024 TOP ASSY RTC V2 AT&T AND 064000022 TOP ASSY RTC V2 MC                                                                                                                                                              |
| Hardware Version                                                                                | Rev B00 and C00                                                                                                                                                                                                              |
| Software Version                                                                                | V5.2.2.6                                                                                                                                                                                                                     |
| FCC ID (if applicable)                                                                          | NC3-24074AVL                                                                                                                                                                                                                 |
| ISED ID (if applicable)                                                                         | 23669-24074AVL                                                                                                                                                                                                               |
| Technical Description (Please provide a brief description of the intended use of the equipment) | Handheld Personnel Tracker. This handheld device wirelessly pairs with an ankle-worn non-intelligent bracelet. It can optionally be used with a BU2000 Table-top Base Unit (this is a charging and docking station) as well. |

| UN-INTENTIONAL RADIATOR                                                                                  |                                                                                                         |
|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Highest frequency generated or used in the device or on which the device operates or tunes               | During Normal Operation: 2.480 GHz (Wi-Fi ISM Band)<br>During Idle (Non-Activated) 12 MHz (MCU Crystal) |
| Lowest frequency generated or used in the device or on which the device operates or tunes                | 32.768 kHz                                                                                              |
| Class A Digital Device (Use in commercial, industrial, or business environment) <input type="checkbox"/> |                                                                                                         |
| Class B Digital Device (Use in residential environment only) <input checked="" type="checkbox"/>         |                                                                                                         |

| Power Source |                                     |                          |                                     |
|--------------|-------------------------------------|--------------------------|-------------------------------------|
| AC           | Single Phase                        | Three Phase              | Nominal Voltage                     |
|              | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 120VAC                              |
| External DC  | Nominal Voltage                     |                          | Maximum Current                     |
|              | 12VDC                               |                          | 2.0 Amps                            |
| Battery      | Nominal Voltage                     |                          | Battery Operating End Point Voltage |
|              | 3.7VDC                              |                          | 3.4 to 4.2V                         |

| EXTREME CONDITIONS  |      |    |                     |
|---------------------|------|----|---------------------|
| Maximum temperature | +50C | °C | Minimum temperature |
|                     |      |    | -20 °C              |

| Ancillaries                                                                                                                                                                                                                                                                    |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Please list all ancillaries which will be used with the device.                                                                                                                                                                                                                |  |
| <ol style="list-style-type: none"> <li>1. Wall Adapter (for Battery Charging Purposes) (FCC SD0C Approved)</li> <li>2. Ankle worn non-intelligent bracelet</li> <li>3. Belt Holster (Plastic)</li> <li>4. BU2000 Table-top Base Unit (charging and docking station)</li> </ol> |  |

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

Name: Stan DuPont

Position held: Electronics Engineer

Date: 6/21/21



#### 1.4.2 Modes of Operation

The was evaluated for the 2.4 GHz Wi-Fi Radio. The TX test power setting used for the evaluation was M3=72 (18 dBm).

The results are reported for the following modes of operation which were representative of the worst case configurations.

802.11b, 1 Mbps  
802.11g, 6 Mbps  
802.11n 20 MHz, 6.5 Mbps

#### 1.4.3 Monitoring of Performance

Preliminary radiated emissions measurements were performed for the EUT in three orthogonal orientations. The results are reported for the orientations leading to the highest emissions.

The EUT was also evaluated for radiated intermodulation products from all radios transmitting simultaneously. All intermodulation products were found to be compliant to the FCC Section 15.209 limits.

The RF Conducted emissions was performed on a test sample configured with a temporary SMA connector at the antenna ports. Preliminary measurements were performed for multiple data rates. The results reported correspond to the worst case.

For the power line conducted emissions evaluation, all the transmitters were transmitting simultaneously.

#### 1.4.4 Performance Criteria

The EUT was evaluated for the parameters listed 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 6.7                                     |
| 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)              |
| Power Line Conducted Emissions                              | FCC: Section 15.207; ISED Canada: RSS-GEN 8.8                |



### 1.5 Deviations from the Standard

The EUT was evaluated without any deviation from the test standards.

### 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 |
|--------------------|-------------------------------------------------|------------------------|--------------------------|
| None               |                                                 |                        |                          |

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 |
|-------------------------------------------------------------|----------------------|---------------|
| AC 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 | Thierry Jean-Charles | A2LA          |
| Power Spectral Density                                      | Thierry Jean-Charles | A2LA          |
| Power Line Conducted Emissions                              | 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

S/N: 36090009

#### 2.1.3 Date of Test

5/21/2021

#### 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 SMD Chip antenna that is directly soldered to the PCB. The antenna is not removable and therefore meets the requirements of FCC Section 15.203.

#### 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**

S/N: 36090015

### **2.2.3 Date of Test**

5/24/2021 to 5/25/2021

### **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  | 26.6°C      |
| Relative Humidity    | 38.2 %      |
| Atmospheric Pressure | 1020.6 mbar |

### **2.2.6 Test Results**

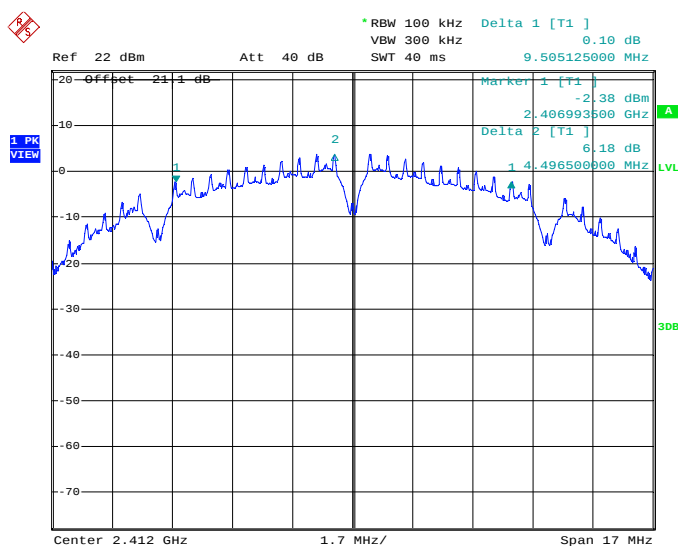
AC Powered Operating

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.

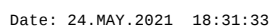
**Table 2.2.6-1: 6 dB Bandwidth Test Results - 802.11b**

| Frequency<br>(MHz) | 6 dB Bandwidth<br>(MHz) |
|--------------------|-------------------------|
| 2412               | 9.505125                |
| 2437               | 9.526375                |
| 2462               | 9.498750                |



Date: 24.MAY.2021 14:51:36

**Figure 2.2.6-1: 6 dB Bandwidth Test Results Low Channel - 802.11b**



1 PK VIEW

Ref 20 dBm Att 30 dB SWT 40 ms RBW 100 kHz VBW 300 kHz Delta 1 [T1] -0.02 dB

20 Offset 21 1 dB

Marker 1 [T1] -6.95 dBm

Delta 2 [T1] 6.20 dB

Marker 2 [T1] 4.494375000 MHz

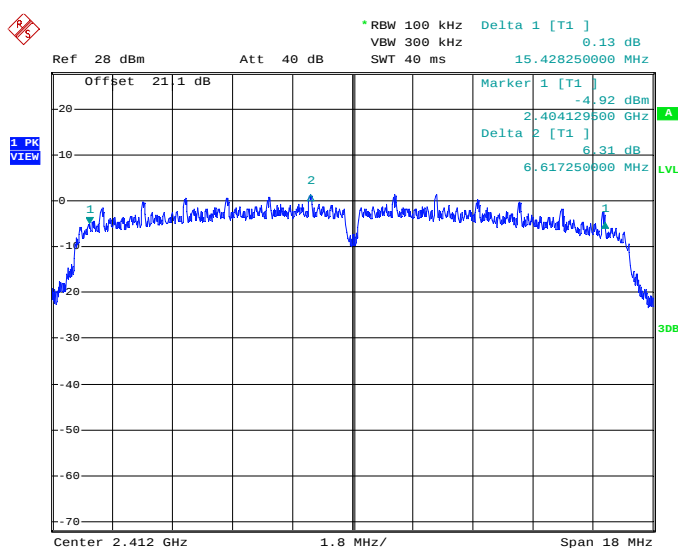
Center 2.462 GHz 1.7 MHz/ Span 17 MHz

**Figure 2.2.6-3: 6 dB Bandwidth Test Results High Channel - 802.11b**



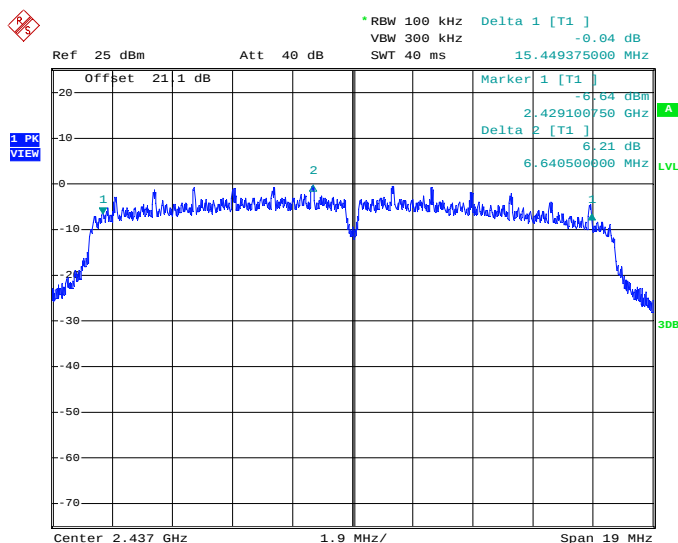
Table 2.2.6-2: 6 dB Bandwidth Test Results - 802.11g

| Frequency (MHz) | 6 dB Bandwidth (MHz) |
|-----------------|----------------------|
| 2412            | 15.428250            |
| 2437            | 15.449375            |
| 2462            | 15.458875            |



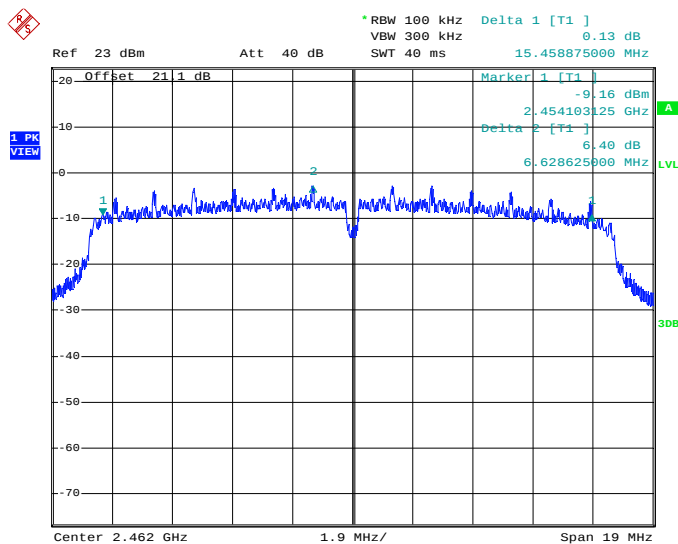
Date: 24.MAY.2021 20:53:12

Figure 2.2.6-4: 6 dB Bandwidth Test Results Low Channel - 802.11g



Date: 25.MAY.2021 19:19:52

Figure 2.2.6-5: 6 dB Bandwidth Test Results Middle Channel - 802.11g

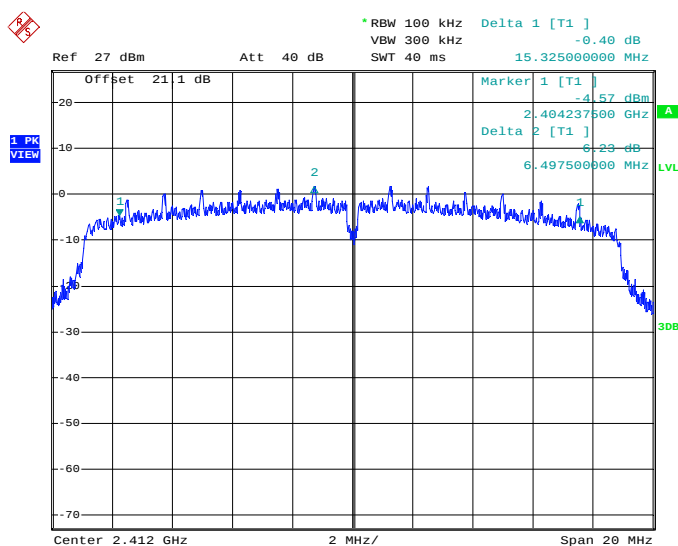


Date: 25.MAY.2021 19:55:42

Figure 2.2.6-6: 6 dB Bandwidth Test Results High Channel - 802.11g

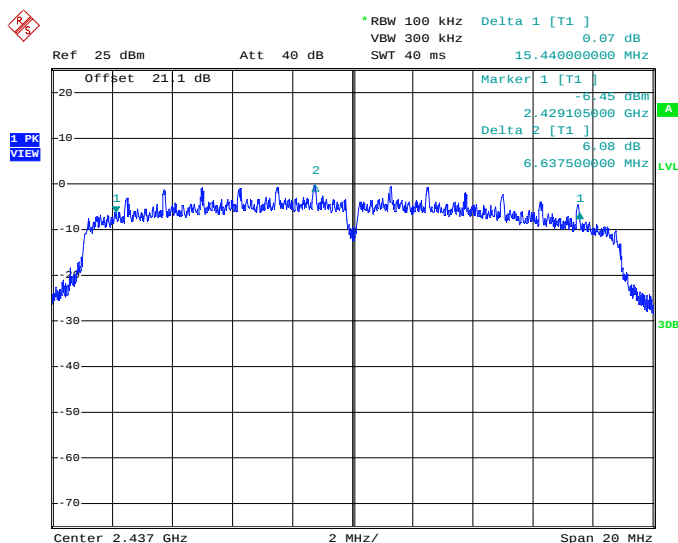
**Table 2.2.6-3: 6 dB Bandwidth Test Results - 802.11n 20 MHz**

| Frequency<br>(MHz) | 6 dB Bandwidth<br>(MHz) |
|--------------------|-------------------------|
| 2412               | 15.325000               |
| 2437               | 15.440000               |
| 2462               | 15.465000               |



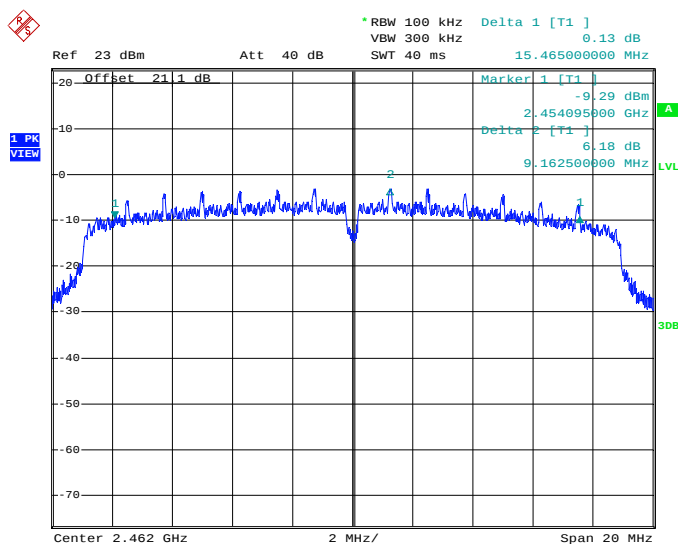
Date: 25.MAY.2021 20:35:59

**Figure 2.2.6-7: 6 dB Bandwidth Test Results Low Channel - 802.11n 20 MHz**



Date: 25.MAY.2021 21:14:34

Figure 2.2.6-8: 6 dB Bandwidth Test Results Middle Channel - 802.11n 20 MHz



Date: 25.MAY.2021 22:17:46

Figure 2.2.6-9: 6 dB Bandwidth Test Results High Channel - 802.11n 20 MHz



### 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 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet          | 40AH2W-20    | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| Duratest High Frequency Cable, 26.5GHz    | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A                          | 12                          | 19-Oct-2021     |

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 6.7

### **2.3.2 Equipment Under Test and Modification State**

S/N: 36090015

### **2.3.3 Date of Test**

5/24/2021 to 5/25/2021

### **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  | 26.5°C      |
| Relative Humidity    | 38.2 %      |
| Atmospheric Pressure | 1020.6 mbar |

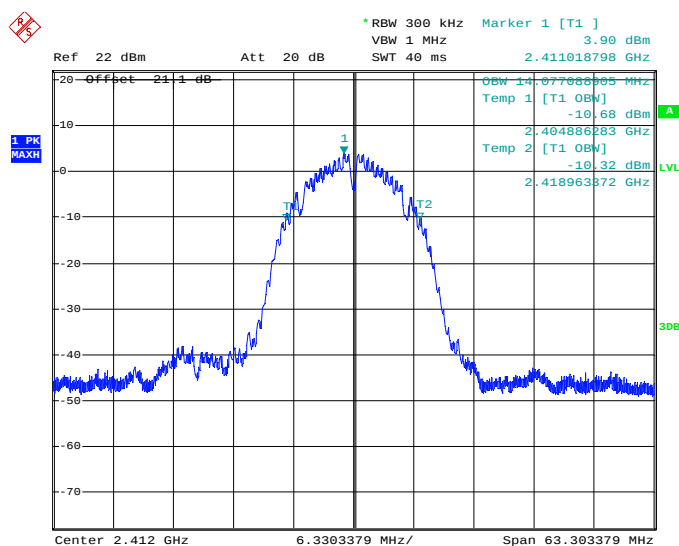
### **2.3.6 Test Results**

AC Powered Operating

Limit Clause ISED RSS-GEN 6.7

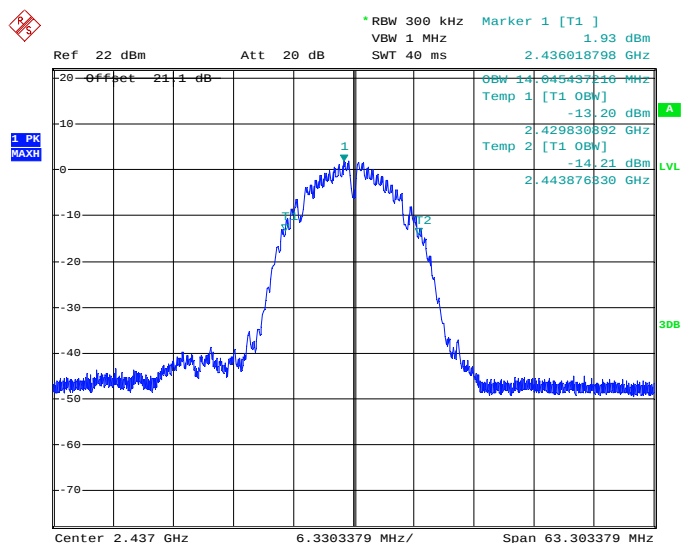
**Table 2.3.6-1: 99% Bandwidth Test Results - 802.11b**

| Frequency<br>(MHz) | 99% Bandwidth<br>(MHz) |
|--------------------|------------------------|
| 2412               | 14.077089              |
| 2437               | 14.045437              |
| 2462               | 14.118702              |



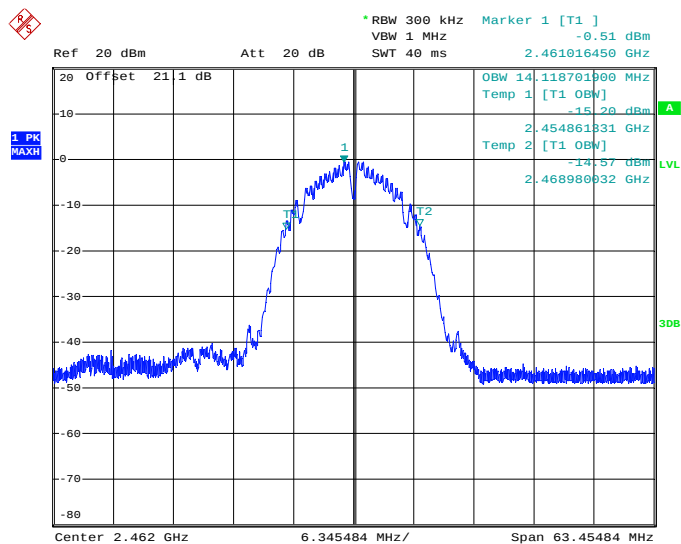
Date: 24.MAY.2021 14:53:18

**Figure 2.3.6-1: 99% Bandwidth Test Results Low Channel - 802.11b**



Date: 24.MAY.2021 18:33:15

Figure 2.3.6-2: 99% Bandwidth Test Results Middle Channel - 802.11b



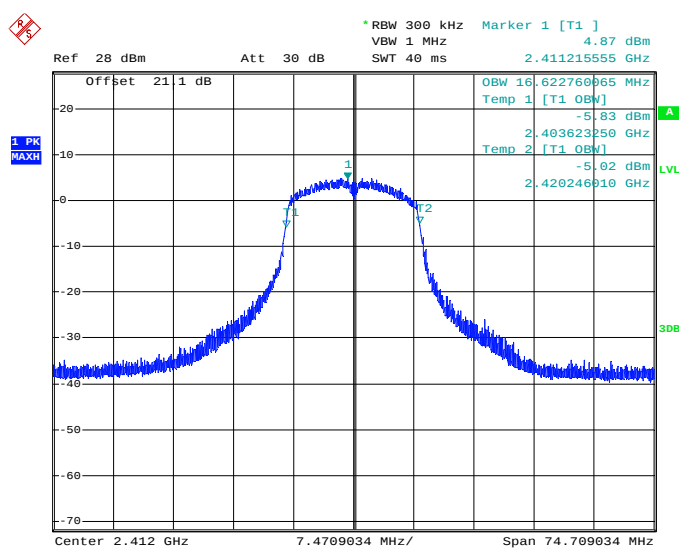
Date: 24.MAY.2021 19:09:26

Figure 2.3.6-3: 99% Bandwidth Test Results High Channel - 802.11b



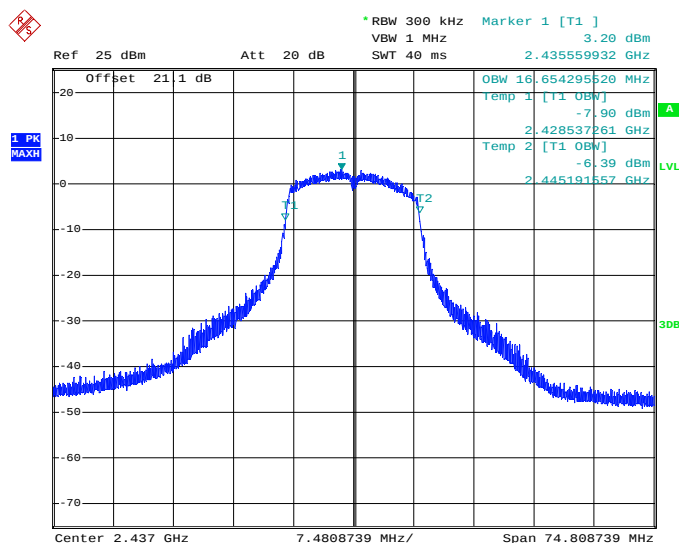
Table 2.3.6-2: 99% Bandwidth Test Results - 802.11g

| Frequency (MHz) | 99% Bandwidth (MHz) |
|-----------------|---------------------|
| 2412            | 16.622761           |
| 2437            | 16.654296           |
| 2462            | 16.703187           |



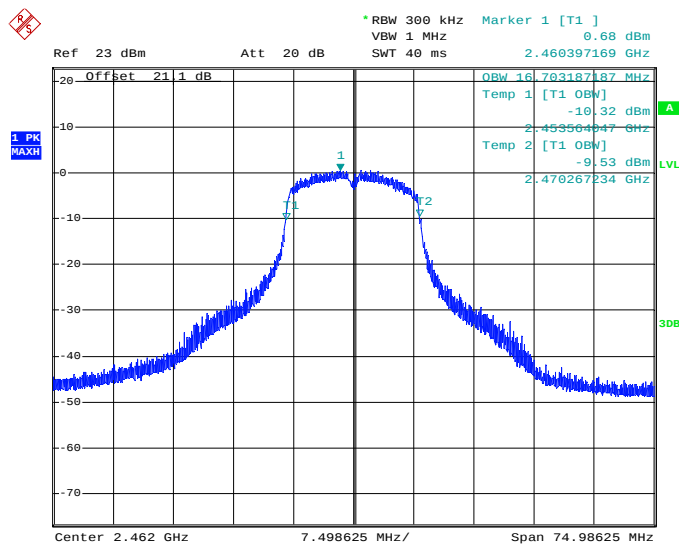
Date: 24.MAY.2021 20:54:51

Figure 2.3.6-4: 99% Bandwidth Test Results Low Channel - 802.11g



Date: 25.MAY.2021 19:21:35

Figure 2.3.6-5: 99% Bandwidth Test Results Middle Channel - 802.11g



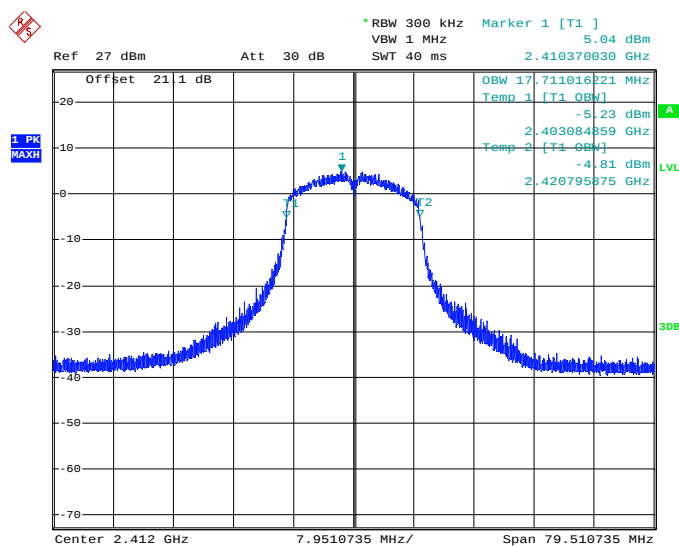
Date: 25.MAY.2021 19:57:23

Figure 2.3.6-6: 99% Bandwidth Test Results High Channel - 802.11g



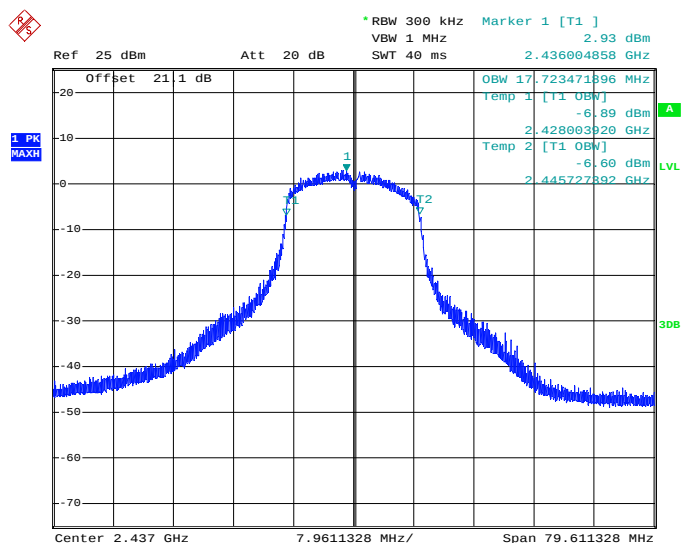
Table 2.3.6-3: 99% Bandwidth Test Results - 802.11n 20 MHz

| Frequency (MHz) | 99% Bandwidth (MHz) |
|-----------------|---------------------|
| 2412            | 17.711016           |
| 2437            | 17.723472           |
| 2462            | 17.785711           |



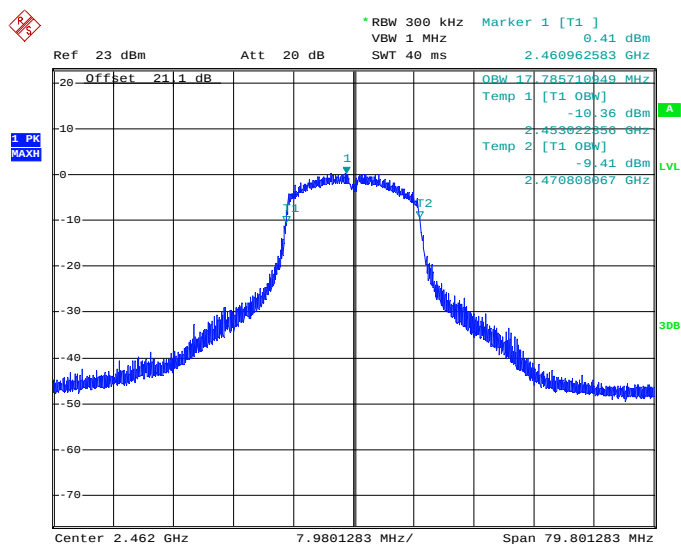
Date: 25.MAY.2021 20:37:41

Figure 2.3.6-7: 99% Bandwidth Test Results Low Channel - 802.11n 20 MHz



Date: 25.MAY.2021 21:16:19

Figure 2.3.6-8: 99% Bandwidth Test Results Middle Channel - 802.11n 20 MHz



Date: 25.MAY.2021 22:19:25

Figure 2.3.6-9: 99% Bandwidth Test Results High Channel - 802.11n 20 MHz



### 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 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet          | 40AH2W-20    | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| Duratest High Frequency Cable, 26.5GHz    | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A                          | 12                          | 19-Oct-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## 2.4 Fundamental Emission 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

S/N: 36090015

### 2.4.3 Date of Test

5/24/2021

### 2.4.4 Test Method

The fundamental emission output power was measured in accordance with ANSI C63.10 Subclause 11.9.1.3 PKPM1 Peak Power Meter Method. The RF output of the equipment under test was directly connected to the input of the power meter through suitable attenuation.

### 2.4.5 Environmental Conditions

|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 26.4°C      |
| Relative Humidity    | 38.7 %      |
| Atmospheric Pressure | 1020.8 mbar |

### 2.4.6 Test Results

AC 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: Maximum Output Power Results - 802.11b**

| Frequency<br>(MHz) | Output Power<br>(dBm) |
|--------------------|-----------------------|
| 2412               | 15.00                 |
| 2437               | 13.10                 |
| 2462               | 11.49                 |

**Table 2.4.6-2: Maximum Output Power Results - 802.11g**

| Frequency (MHz) | Output Power (dBm) |
|-----------------|--------------------|
| 2412            | 20.71              |
| 2437            | 18.52              |
| 2462            | 16.18              |

**Table 2.4.6-3: Maximum Output Power Results - 802.11n 20 MHz**

| Frequency (MHz) | Output Power (dBm) |
|-----------------|--------------------|
| 2412            | 20.52              |
| 2437            | 18.42              |
| 2462            | 15.90              |

#### 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 |
|-----------------------------------------------|-----------------------|---------|-----------|------------------------------|-----------------------------|-----------------|
| USB Wideband Power Sensor 50MHz - 18GHz       | Keysight Technologies | U2021XA | TEMC00197 | N/A                          | 12                          | 29-Oct-2021     |
| 2.92mm Attenuator M/F 40GHz 30dB 2W VSWR 1.45 | Centric RF            | C402-30 | TEMC00222 | N/A                          | 12                          | 08-Mar-2022     |

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**

S/N: 36090015

### **2.5.3 Date of Test**

5/24/2021 to 5/25/2021

### **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  $\geq$  kHz.

### **2.5.5 Environmental Conditions**

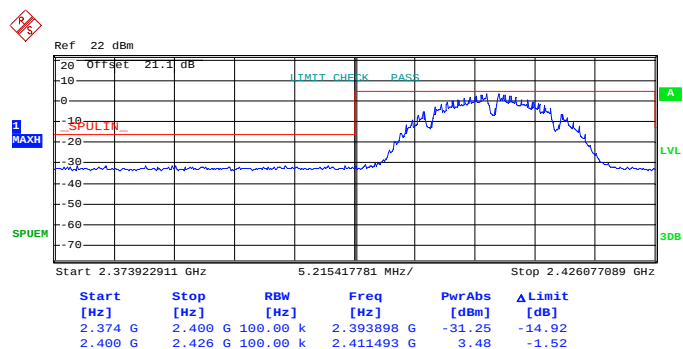
|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 26.6 °C     |
| Relative Humidity    | 37.8 %      |
| Atmospheric Pressure | 1020.4 mbar |

### **2.5.6 Test Results**

AC Powered Operating

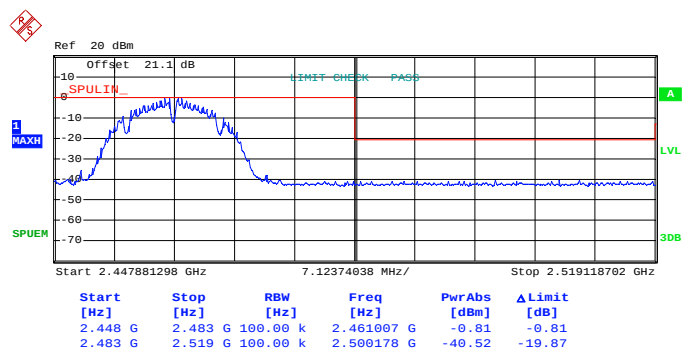
Limit Clause FCC Section 15.247(d), ISED Canada: RSS-247 5.5

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.



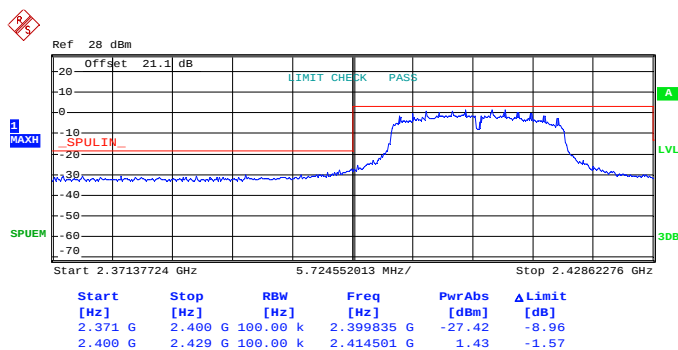
Date: 24.MAY.2021 14:59:48

Figure 2.5.6-1: RF Conducted Band-Edge Results Low Channel - 802.11b



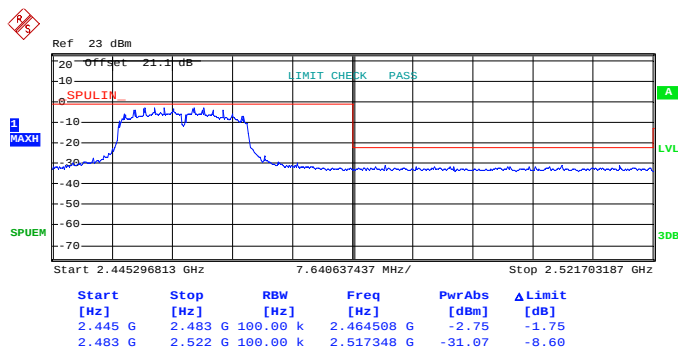
Date: 24.MAY.2021 19:15:55

Figure 2.5.6-2: RF Conducted Band-Edge Results High Channel - 802.11b



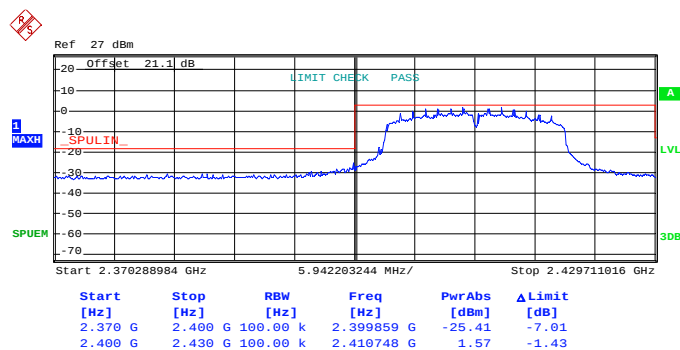
Date: 24.MAY.2021 21:01:22

Figure 2.5.6-3: RF Conducted Band-Edge Results Low Channel - 802.11g



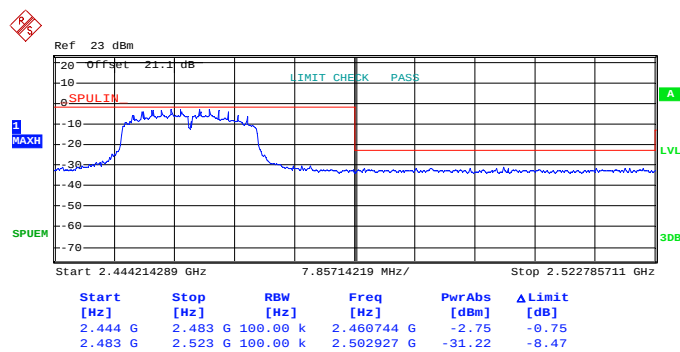
Date: 25.MAY.2021 20:03:55

Figure 2.5.6-4: RF Conducted Band-Edge Results High Channel - 802.11g



Date: 25.MAY.2021 20:44:12

Figure 2.5.6-5: RF Conducted Band-Edge Results Low Channel - 802.11n 20 MHz



Date: 25.MAY.2021 22:25:56

Figure 2.5.6-6: RF Conducted Band-Edge Results High Channel - 802.11n 20 MHz



### 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 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet          | 40AH2W-20    | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| Duratest High Frequency Cable, 26.5GHz    | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A                          | 12                          | 19-Oct-2021     |

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**

S/N: 36090015

### **2.6.3 Date of Test**

5/25/2021

### **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  | 24.1 °C     |
| Relative Humidity    | 43.1 %      |
| Atmospheric Pressure | 1022.2 mbar |

### **2.6.6 Test Results**

AC 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.

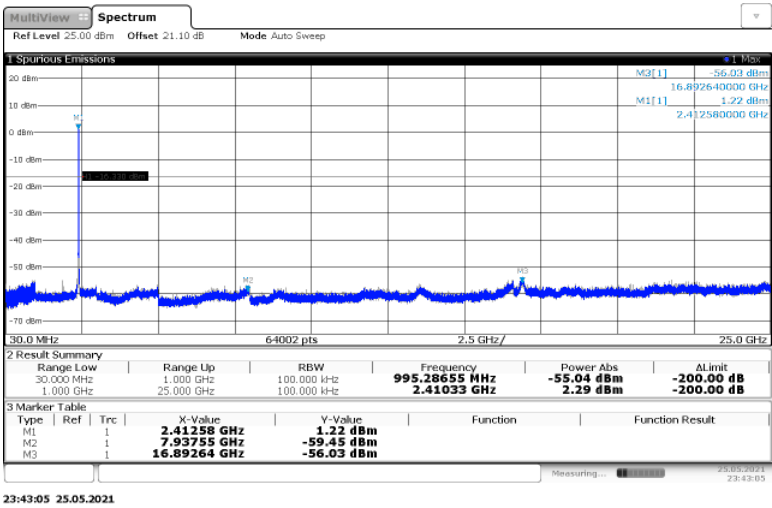


Figure 2.6.6-1: RF Conducted Spurious Emissions Results Low Channel - 802.11b

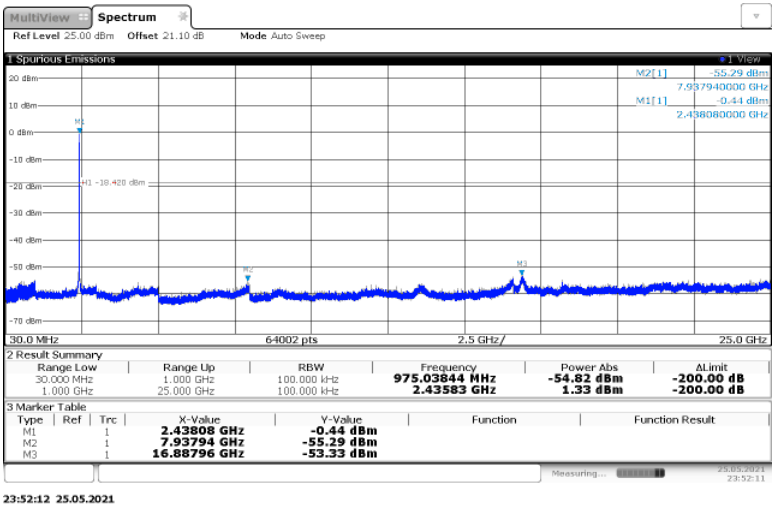


Figure 2.6.6-2: RF Conducted Spurious Emissions Results Middle Channel - 802.11b

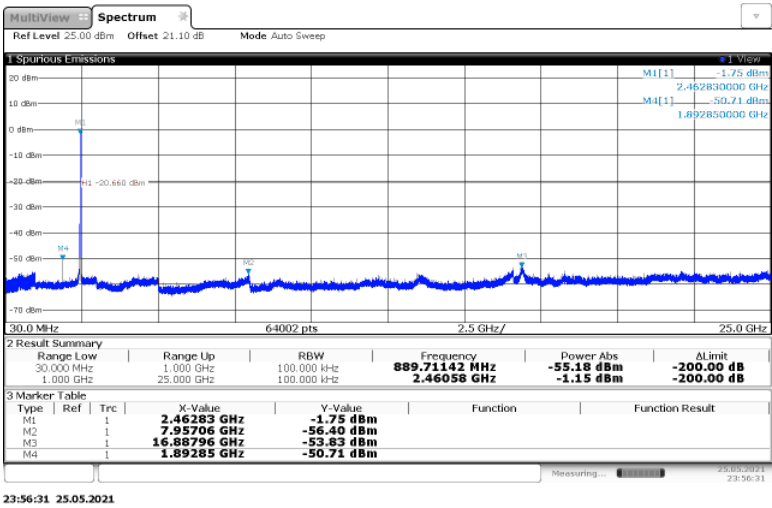


Figure 2.6.6-3: RF Conducted Spurious Emissions Results High Channel - 802.11b

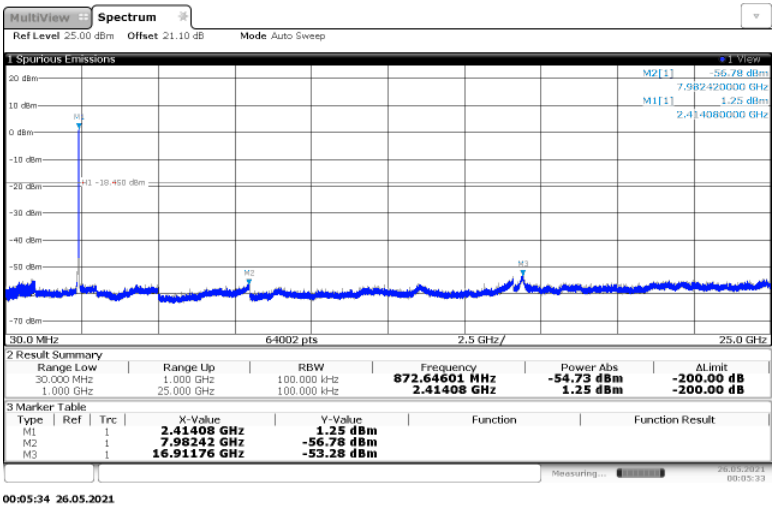


Figure 2.6.6-4: RF Conducted Spurious Emissions Results Low Channel - 802.11g

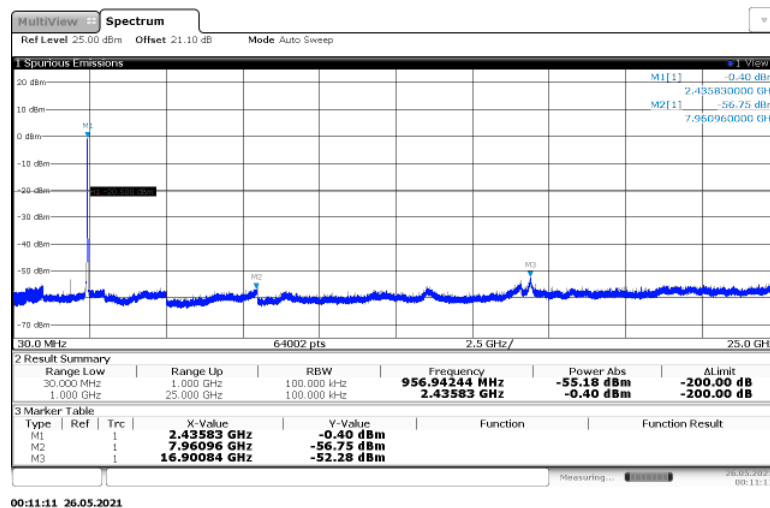


Figure 2.6.6-5: RF Conducted Spurious Emissions Results Middle Channel - 802.11g

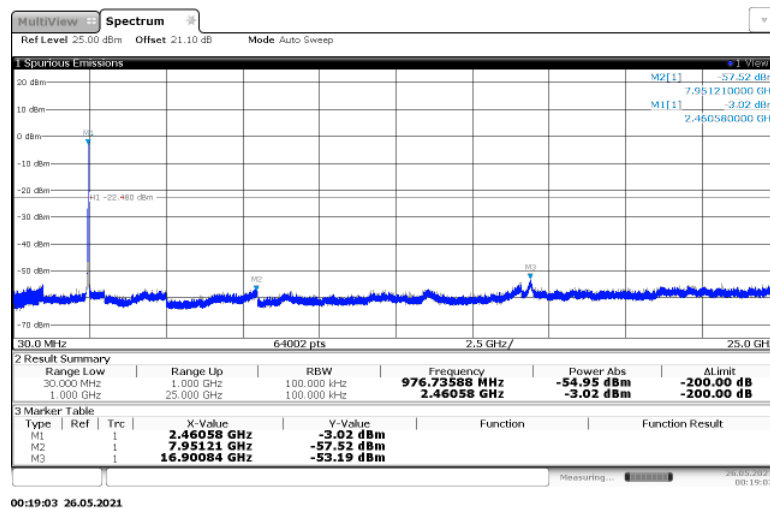


Figure 2.6.6-6: RF Conducted Spurious Emissions Results High Channel - 802.11g

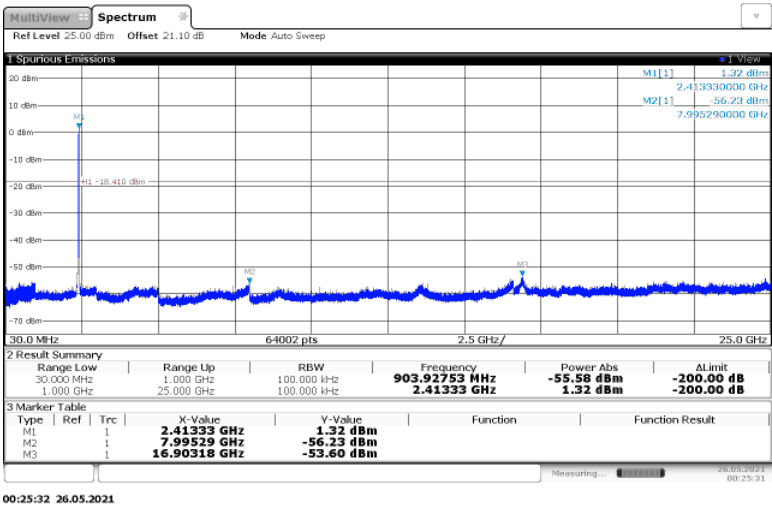


Figure 2.6.6-7: RF Conducted Spurious Emissions Results Low Channel - 802.11n 20 MHz

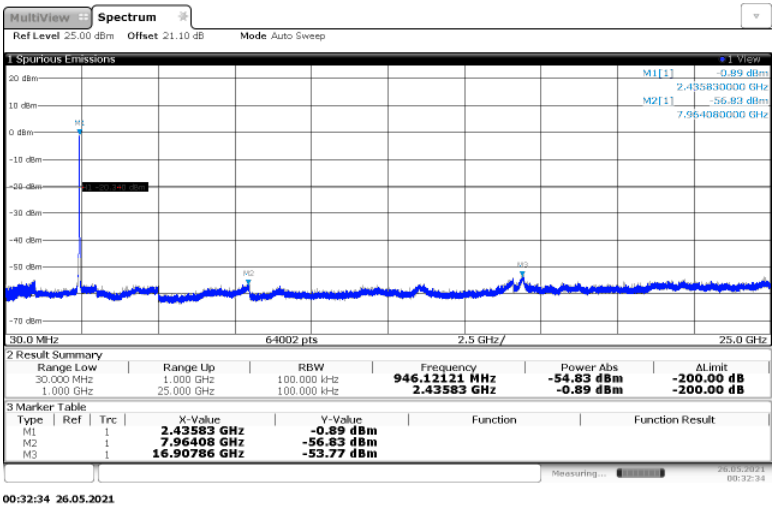


Figure 2.6.6-8: RF Conducted Spurious Emissions Results Middle Channel - 802.11n 20 MHz

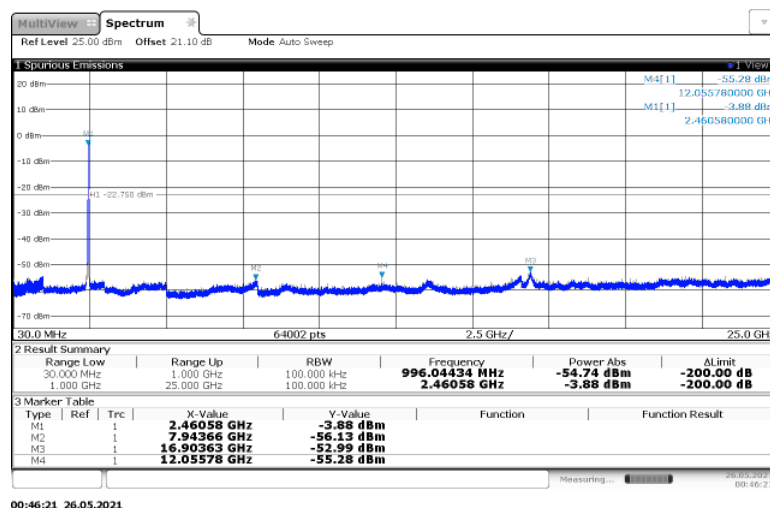


Figure 2.6.6-9: RF Conducted Spurious Emissions Results High Channel - 802.11n 20 MHz

## 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 |
|-------------------------------------------|-------------------------|--------------|-----------|------------------------------|-----------------------------|-----------------|
| Signal & Spectrum Analyzer                | Rohde & Schwarz         | FSW43        | DEMC3085  | N/A                          | 24                          | 07-Dec-2022     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet          | 40AH2W-20    | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| Duratest High Frequency Cable, 26.5GHz    | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A                          | 12                          | 19-Oct-2021     |

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**

S/N: 36090009

### **2.7.3 Date of Test**

5/12/2021 to 6/23/2021

### **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 30 Hz.

### **2.7.5 Duty Cycle Correction**

The EUT was configured to transmit at > 98 duty cycle during the evaluation. No duty cycle correction factors were used for the average measurements.

### **2.7.6 Environmental Conditions**

|                      |             |
|----------------------|-------------|
| Ambient Temperature  | 24.7 °C     |
| Relative Humidity    | 41.8 %      |
| Atmospheric Pressure | 1018.2 mbar |



## 2.7.7 Test Results

### AC 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 - 802.11b

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2390               | 56.90           | 46.12   | H                            | -5.37                         | 51.53                       | 40.75   | 74.0              | 54.0    | 22.5           | 13.3    |
| 2390               | 56.96           | 45.63   | V                            | -5.37                         | 51.59                       | 40.26   | 74.0              | 54.0    | 22.4           | 13.7    |
| 4824               | 43.15           | 31.40   | H                            | -0.18                         | 42.97                       | 31.22   | 74.0              | 54.0    | 31.0           | 22.8    |
| 4824               | 44.42           | 31.00   | V                            | -0.18                         | 44.24                       | 30.82   | 74.0              | 54.0    | 29.8           | 23.2    |
| 14472              | 43.47           | 27.30   | H                            | 11.61                         | 55.08                       | 38.91   | 74.0              | 54.0    | 18.9           | 15.1    |
| 14472              | 43.37           | 27.78   | V                            | 11.61                         | 54.98                       | 39.39   | 74.0              | 54.0    | 19.0           | 14.6    |
| 19296              | 44.03           | 28.14   | H                            | 11.72                         | 55.75                       | 39.86   | 83.5              | 63.5    | 27.8           | 23.6    |
| 19296              | 44.04           | 26.90   | V                            | 11.72                         | 55.76                       | 38.62   | 83.5              | 63.5    | 27.7           | 24.9    |
| Middle Channel     |                 |         |                              |                               |                             |         |                   |         |                |         |
| 4874               | 43.76           | 31.80   | H                            | -0.10                         | 43.66                       | 31.70   | 74.0              | 54.0    | 30.3           | 22.3    |
| 4874               | 43.58           | 30.94   | V                            | -0.10                         | 43.48                       | 30.84   | 74.0              | 54.0    | 30.5           | 23.2    |
| 7311               | 45.40           | 33.91   | H                            | 5.09                          | 50.49                       | 39.00   | 74.0              | 54.0    | 23.5           | 15.0    |
| 7311               | 44.98           | 31.82   | V                            | 5.09                          | 50.07                       | 36.91   | 74.0              | 54.0    | 23.9           | 17.1    |
| 19496              | 43.70           | 28.29   | H                            | 11.64                         | 55.34                       | 39.93   | 83.5              | 63.5    | 28.2           | 23.6    |
| 19496              | 42.47           | 26.62   | V                            | 11.64                         | 54.11                       | 38.26   | 83.5              | 63.5    | 29.4           | 25.2    |
| High Channel       |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2483.5             | 56.01           | 43.55   | H                            | -5.21                         | 50.80                       | 38.34   | 74.0              | 54.0    | 23.2           | 15.7    |
| 2483.5             | 55.56           | 43.81   | V                            | -5.21                         | 50.35                       | 38.60   | 74.0              | 54.0    | 23.6           | 15.4    |
| 4924               | 43.14           | 30.90   | H                            | -0.02                         | 43.12                       | 30.88   | 74.0              | 54.0    | 30.9           | 23.1    |
| 4924               | 43.08           | 29.95   | V                            | -0.02                         | 43.06                       | 29.93   | 74.0              | 54.0    | 30.9           | 24.1    |
| 7386               | 44.89           | 32.58   | H                            | 5.22                          | 50.11                       | 37.80   | 74.0              | 54.0    | 23.9           | 16.2    |
| 7386               | 44.56           | 31.13   | V                            | 5.22                          | 49.78                       | 36.35   | 74.0              | 54.0    | 24.2           | 17.6    |
| 19696              | 43.59           | 27.54   | H                            | 11.66                         | 55.25                       | 39.20   | 83.5              | 63.5    | 28.2           | 24.3    |
| 19696              | 43.42           | 26.16   | V                            | 11.66                         | 55.08                       | 37.82   | 83.5              | 63.5    | 28.4           | 25.7    |

**Notes:**

- The emissions above 18 GHz were performed at a test distance of 1m. The limits are adjusted correspondingly.
- All the emissions above 19.7 GHz were attenuated below the limits and the noise floor of the measurement equipment.



Table 2.7.7-2: Radiated Emissions Test Results - 802.11g

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2390               | 67.27           | 52.27   | H                            | -5.37                         | 61.90                       | 46.90   | 74.0              | 54.0    | 12.1           | 7.1     |
| 2390               | 63.67           | 49.40   | V                            | -5.37                         | 58.30                       | 44.03   | 74.0              | 54.0    | 15.7           | 10.0    |
| 14472              | 42.56           | 27.36   | H                            | 11.61                         | 54.17                       | 38.97   | 74.0              | 54.0    | 19.8           | 15.0    |
| 14472              | 42.69           | 27.81   | V                            | 11.61                         | 54.30                       | 39.42   | 74.0              | 54.0    | 19.7           | 14.6    |
| 19296              | 43.97           | 28.55   | H                            | 11.72                         | 55.69                       | 40.27   | 83.5              | 63.5    | 27.8           | 23.2    |
| 19296              | 43.91           | 26.93   | V                            | 11.72                         | 55.63                       | 38.65   | 83.5              | 63.5    | 27.9           | 24.9    |
| Middle Channel     |                 |         |                              |                               |                             |         |                   |         |                |         |
| 7311               | 44.44           | 30.28   | H                            | 5.09                          | 49.53                       | 35.37   | 74.0              | 54.0    | 24.5           | 18.6    |
| 7311               | 44.80           | 29.80   | V                            | 5.09                          | 49.89                       | 34.89   | 74.0              | 54.0    | 24.1           | 19.1    |
| 19496              | 43.54           | 27.91   | H                            | 11.64                         | 55.18                       | 39.55   | 83.5              | 63.5    | 28.3           | 23.9    |
| 19496              | 43.22           | 26.41   | V                            | 11.64                         | 54.86                       | 38.05   | 83.5              | 63.5    | 28.6           | 25.4    |
| High Channel       |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2483.5             | 70.77           | 51.74   | H                            | -5.21                         | 65.56                       | 46.53   | 74.0              | 54.0    | 8.4            | 7.5     |
| 2483.5             | 65.22           | 48.97   | V                            | -5.21                         | 60.01                       | 43.76   | 74.0              | 54.0    | 14.0           | 10.2    |
| 7386               | 44.47           | 30.37   | H                            | 5.22                          | 49.69                       | 35.59   | 74.0              | 54.0    | 24.3           | 18.4    |
| 7386               | 44.44           | 29.95   | V                            | 5.22                          | 49.66                       | 35.17   | 74.0              | 54.0    | 24.3           | 18.8    |
| 19696              | 42.36           | 26.73   | H                            | 11.66                         | 54.02                       | 38.39   | 83.5              | 63.5    | 29.5           | 25.1    |
| 19696              | 42.20           | 25.76   | V                            | 11.66                         | 53.86                       | 37.42   | 83.5              | 63.5    | 29.6           | 26.1    |

**Notes:**

- The emissions above 18 GHz were performed at a test distance of 1m. The limits are adjusted correspondingly.
- All the emissions above 19.7 GHz were attenuated below the limits and the noise floor of the measurement equipment.



Table 2.7.7-3: Radiated Emissions Test Results - 802.11n 20 MHz

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2390               | 68.92           | 53.35   | H                            | -5.37                         | 63.55                       | 47.98   | 74.0              | 54.0    | 10.5           | 6.0     |
| 2390               | 64.40           | 49.68   | V                            | -5.37                         | 59.03                       | 44.31   | 74.0              | 54.0    | 15.0           | 9.7     |
| 14472              | 42.52           | 27.22   | H                            | 11.61                         | 54.13                       | 38.83   | 74.0              | 54.0    | 19.9           | 15.2    |
| 14472              | 42.70           | 27.10   | V                            | 11.61                         | 54.31                       | 38.71   | 74.0              | 54.0    | 19.7           | 15.3    |
| 19296              | 44.02           | 28.97   | H                            | 11.72                         | 55.74                       | 40.69   | 83.5              | 63.5    | 27.8           | 22.8    |
| 19296              | 43.89           | 26.94   | V                            | 11.72                         | 55.61                       | 38.66   | 83.5              | 63.5    | 27.9           | 24.8    |
| Middle Channel     |                 |         |                              |                               |                             |         |                   |         |                |         |
| 7311               | 44.36           | 30.29   | H                            | 5.09                          | 49.45                       | 35.38   | 74.0              | 54.0    | 24.6           | 18.6    |
| 7311               | 45.20           | 29.89   | V                            | 5.09                          | 50.29                       | 34.98   | 74.0              | 54.0    | 23.7           | 19.0    |
| 19496              | 42.57           | 28.46   | H                            | 11.64                         | 54.21                       | 40.10   | 83.5              | 63.5    | 29.3           | 23.4    |
| 19496              | 43.31           | 26.64   | V                            | 11.64                         | 54.95                       | 38.28   | 83.5              | 63.5    | 28.5           | 25.2    |
| High Channel       |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2483.5             | 69.59           | 49.42   | H                            | -5.21                         | 64.38                       | 44.21   | 74.0              | 54.0    | 9.6            | 9.8     |
| 2483.5             | 67.17           | 49.82   | V                            | -5.21                         | 61.96                       | 44.61   | 74.0              | 54.0    | 12.0           | 9.4     |
| 7386               | 44.09           | 30.07   | H                            | 5.22                          | 49.31                       | 35.29   | 74.0              | 54.0    | 24.7           | 18.7    |
| 7386               | 44.32           | 29.92   | V                            | 5.22                          | 49.54                       | 35.14   | 74.0              | 54.0    | 24.5           | 18.9    |
| 19696              | 42.82           | 26.63   | H                            | 11.66                         | 54.48                       | 38.29   | 83.5              | 63.5    | 29.0           | 25.2    |
| 19696              | 42.71           | 25.70   | V                            | 11.66                         | 54.37                       | 37.36   | 83.5              | 63.5    | 29.1           | 26.1    |

**Notes:**

- The emissions above 18 GHz were performed at a test distance of 1m. The limits are adjusted correspondingly.
- All the emissions above 19.7 GHz were attenuated below the limits and the noise floor of the measurement equipment.

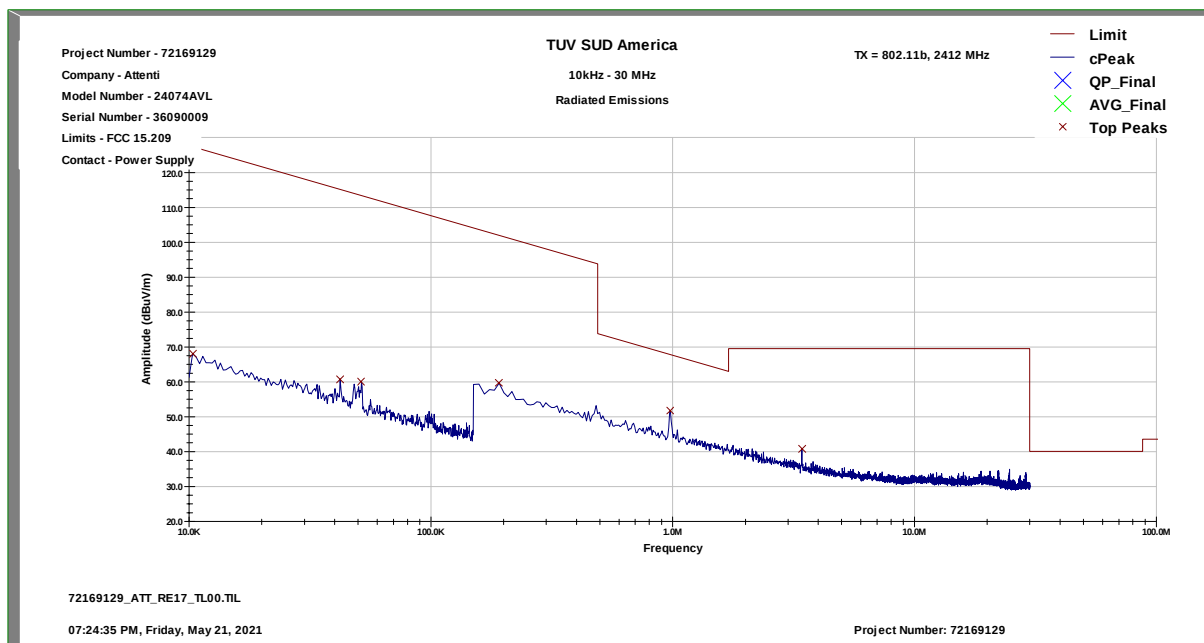


Figure 2.7.7-1: Radiated Emissions Representative Scan below 30 MHz

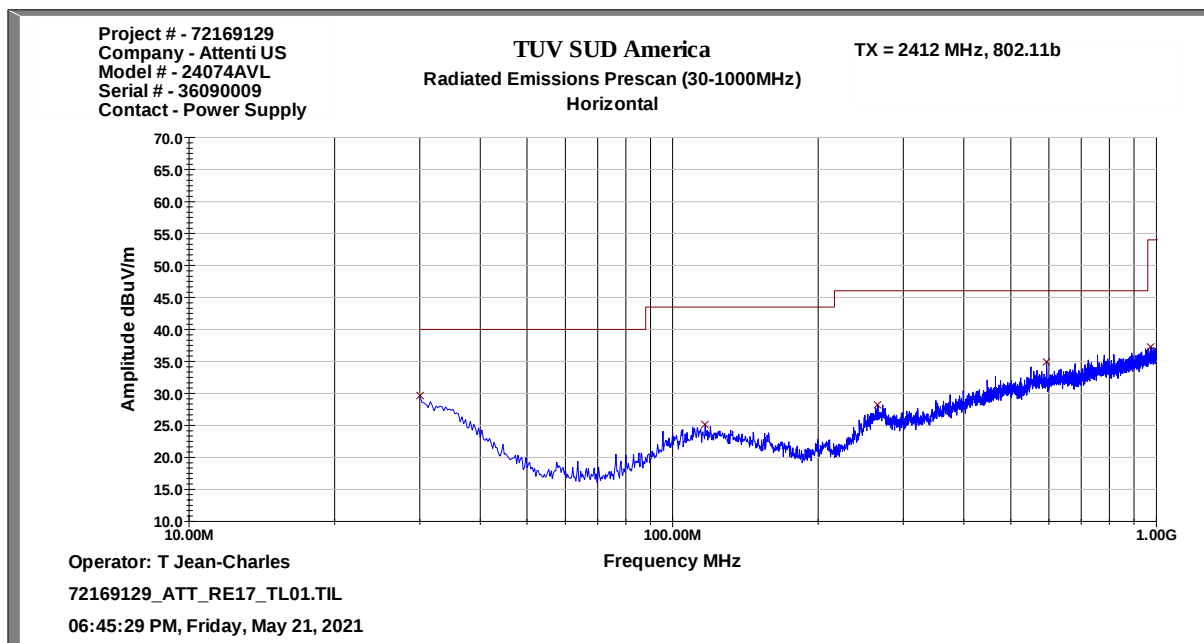


Figure 2.7.7-2: Radiated Emissions Representative Scan - 30 MHz – 1 GHz – Horizontal Polarization

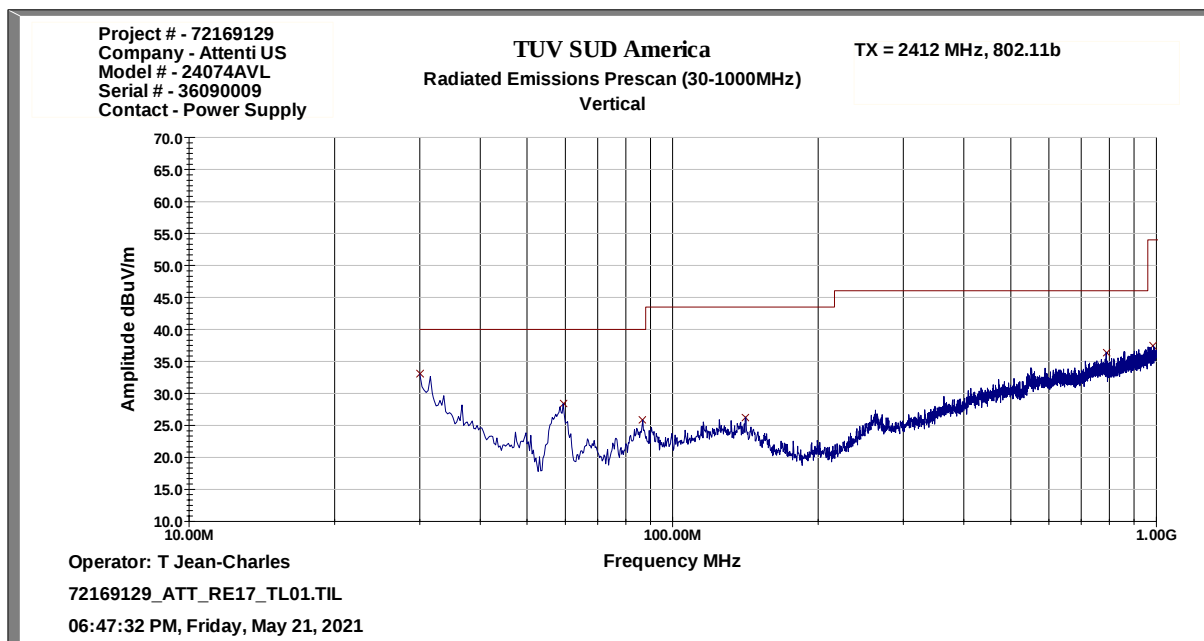


Figure 2.7.7-3: Radiated Emissions Representative Scan - 30 MHz – 1 GHz – Vertical Polarization

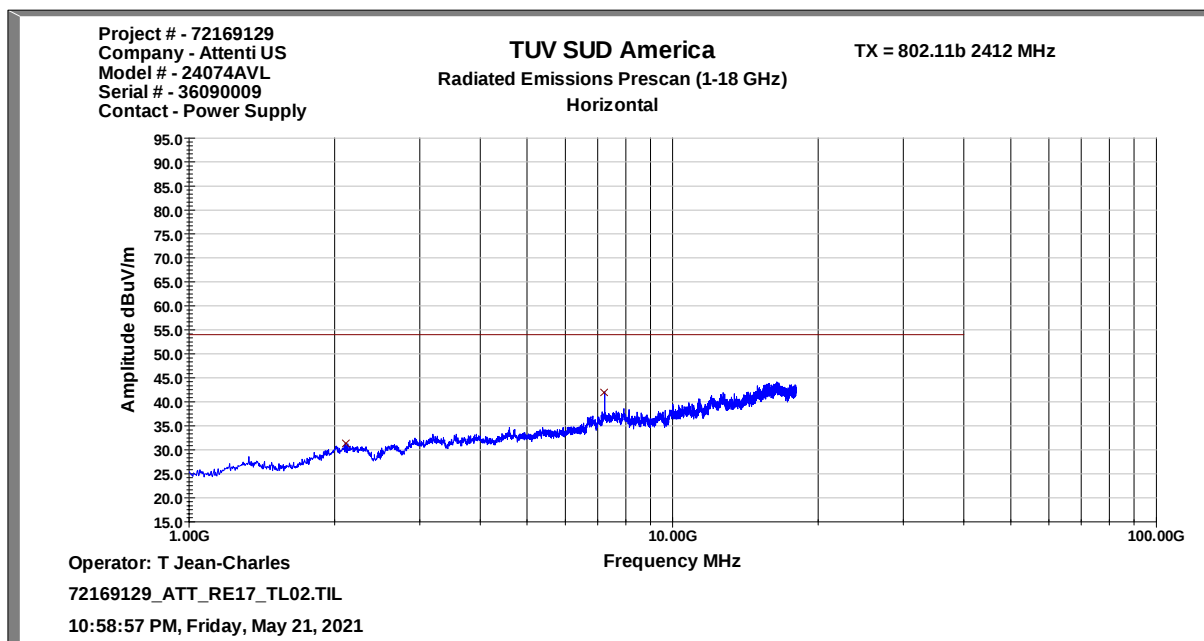


Figure 2.7.7-4: Radiated Emissions Representative Scan – 1 GHz – 18 GHz – Horizontal Polarization

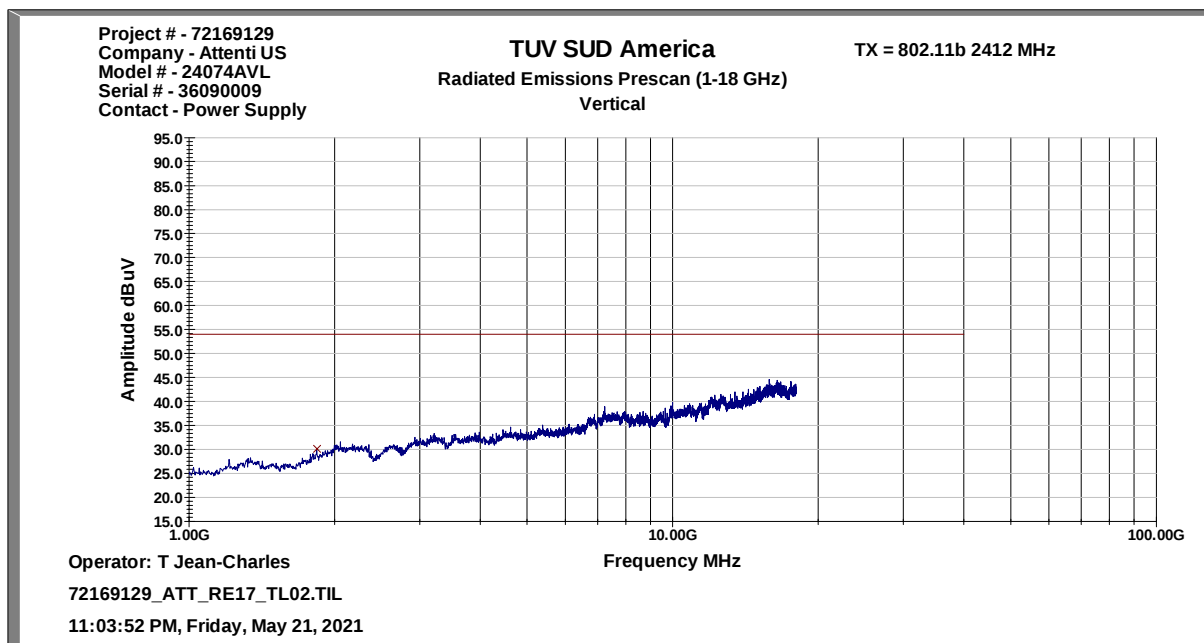


Figure 2.7.7-5: Radiated Emissions Representative Scan – 1 GHz – 18 GHz – Vertical Polarization

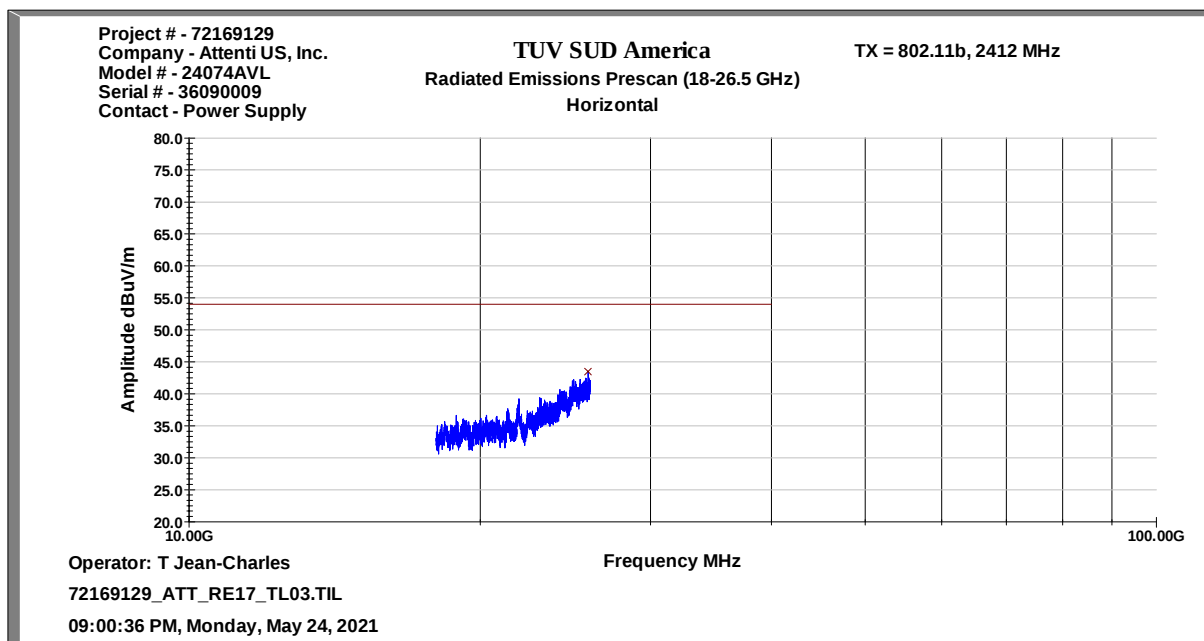
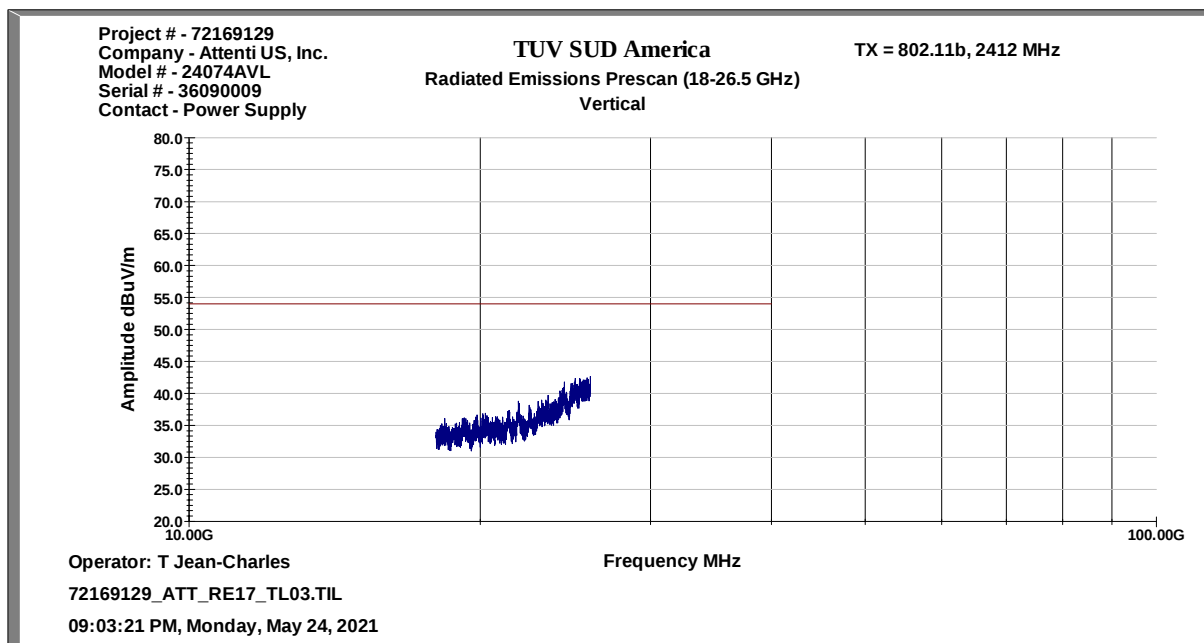


Figure 2.7.7-6: Radiated Emissions Representative Scan – 18 GHz – 26 GHz – Horizontal Polarization



**Figure 2.7.7-7: Radiated Emissions Representative 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

Corrected Level:  $56.9 + -5.37 = 51.53 \text{ dB}\mu\text{V/m}$

Margin:  $74 \text{ dB}\mu\text{V/m} - 51.53 \text{ dB}\mu\text{V/m} = 22.47 \text{ dB}$

#### Example Calculation: Average

Corrected Level:  $46.12 + -5.37 - 0 = 40.75 \text{ dB}\mu\text{V/m}$

Margin:  $54 \text{ dB}\mu\text{V/m} - 40.75 \text{ dB}\mu\text{V/m} = 13.25 \text{ dB}$



### 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                      | 12                          | 25-Feb-2022     |
| 10dB Attenuator                      | Merrimac                | FAN-6-10K              | BEMC02086 | N/A                          | 12                          | 19-Oct-2021     |
| 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                          | Panasheild              | N/A                    | TEMC00031 | N/A                          | 36                          | 28-Jan-2024     |
| Double Ridge Guide Horn              | ETS Lindgren            | 3117                   | TEMC00061 | N/A                          | 24                          | 07-Feb-2022     |
| 18 GHz-40 GHz Microwave Preamplifier | COM-power               | PAM-840A               | TEMC00147 | N/A                          | 12                          | 06-Jul-2021     |
| PAM-118A                             | Com-Power Corporation   | PAM-118A               | TEMC00160 | N/A                          | 12                          | 10-Apr-2022     |
| 2.4 GHz Notch Filter                 | Micro-Tronics           | BRM50702-01            | TEMC00176 | N/A                          | 12                          | 09-Mar-2022     |
| A81-0303 18 GHz Cable Set            | Teledyne Storm Products | A81-0303-360/96        | TEMC00201 | N/A                          | 12                          | 10-Apr-2022     |

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**

S/N: 36090009

### **2.8.3 Date of Test**

5/24/2021 to 5/25/2021

### **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's 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  | 26.1 °C     |
| Relative Humidity    | 38.1 %      |
| Atmospheric Pressure | 1021.6 mbar |

### **2.8.6 Test Results**

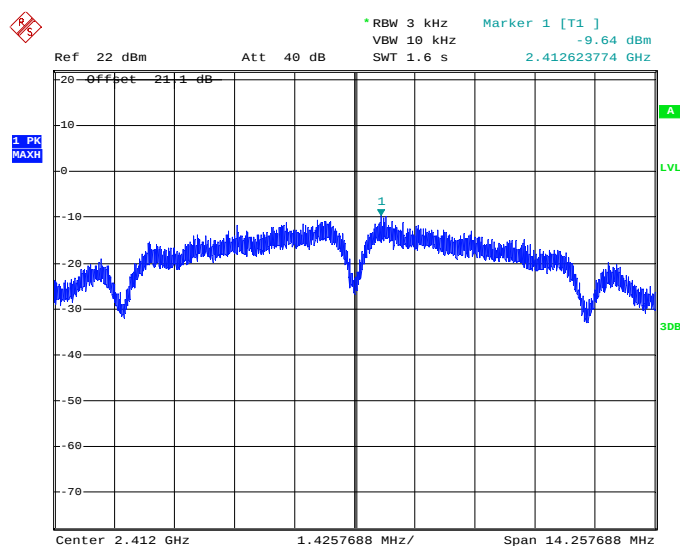
AC Powered Operating

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.

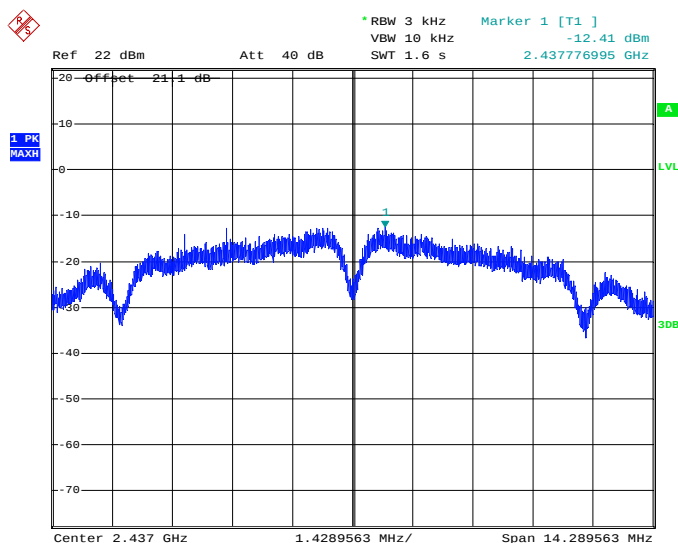
**Table 2.8.6-1: Power Spectral Density Results - 802.11b**

| Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|-----------------|-----------|-------------|-------------|
| 2412            | -9.64     | 8           | 17.64       |
| 2437            | -12.41    | 8           | 20.41       |
| 2462            | -13.74    | 8           | 21.74       |



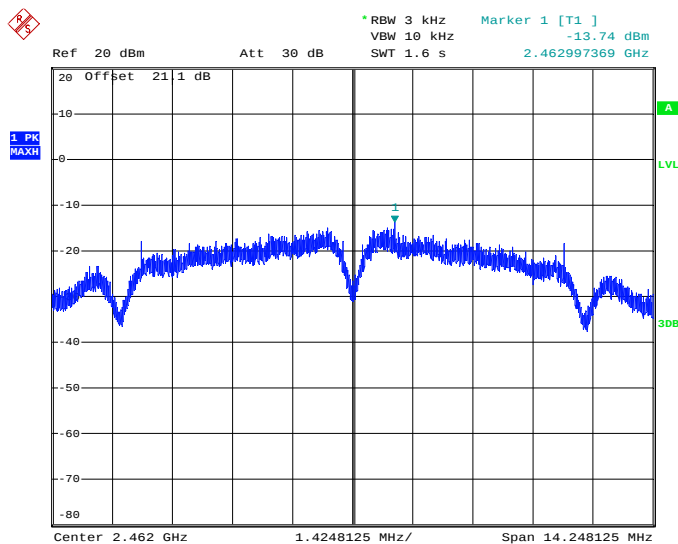
Date: 24.MAY.2021 14:58:09

**Figure 2.8.6-1: Power Spectral Density Results – Low Channel - 802.11b**



Date: 24.MAY.2021 18:38:05

Figure 2.8.6-2: Power Spectral Density Results – Middle Channel - 802.11b

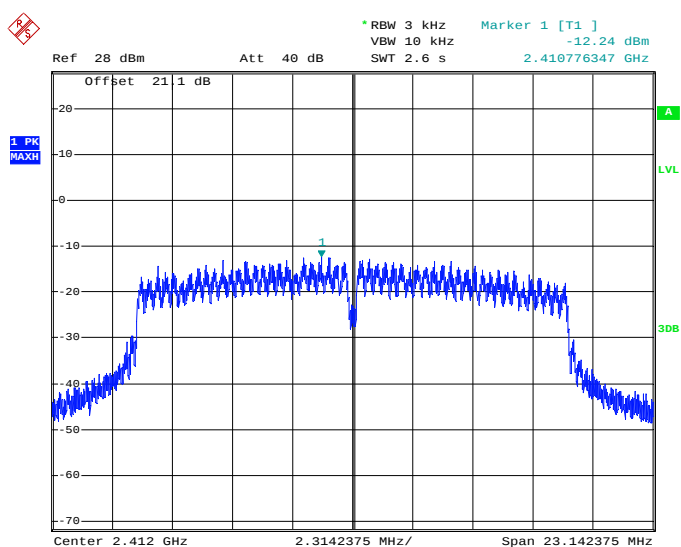


Date: 24.MAY.2021 19:14:16

Figure 2.8.6-3: Power Spectral Density Results – High Channel - 802.11b

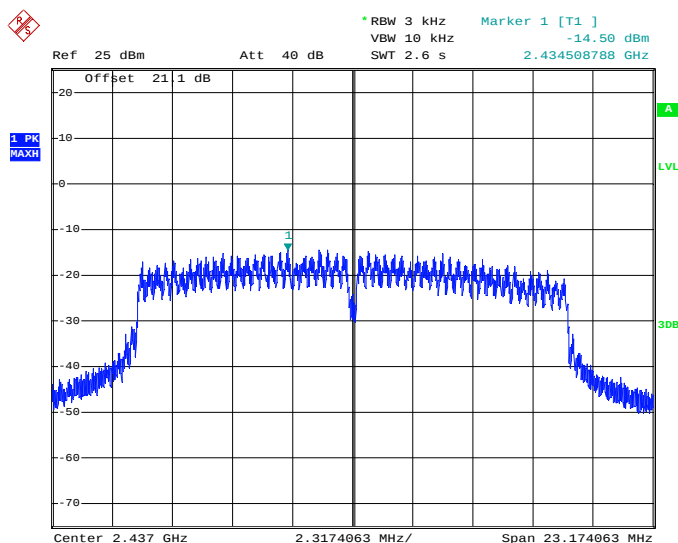
**Table 2.8.6-2: Power Spectral Density Results - 802.11g**

| Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|-----------------|-----------|-------------|-------------|
| 2412            | -12.24    | 8           | 20.24       |
| 2437            | -14.50    | 8           | 22.5        |
| 2462            | -16.82    | 8           | 24.82       |



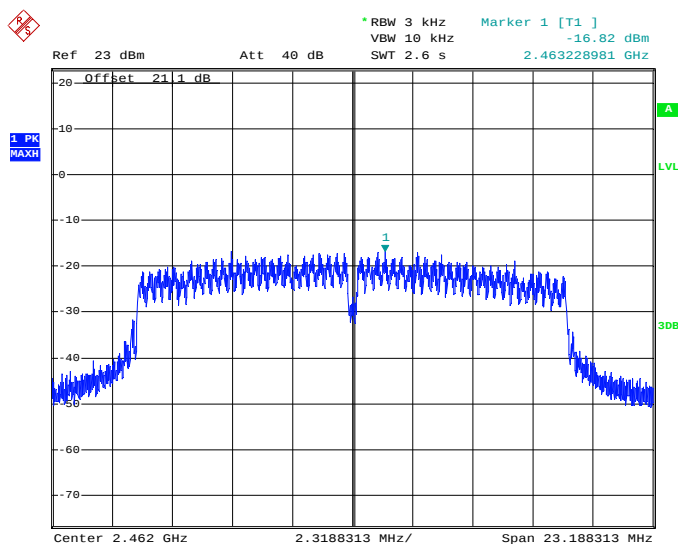
Date: 24.MAY.2021 20:59:43

**Figure 2.8.6-4: Power Spectral Density Results – Low Channel - 802.11g**



Date: 25.MAY.2021 19:26:25

Figure 2.8.6-5: Power Spectral Density Results – Middle Channel - 802.11g

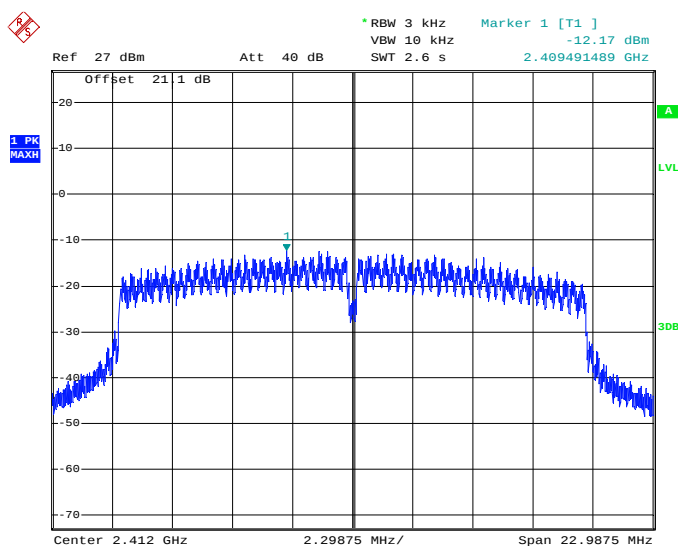


Date: 25.MAY.2021 20:02:16

Figure 2.8.6-6: Power Spectral Density Results – High Channel - 802.11g

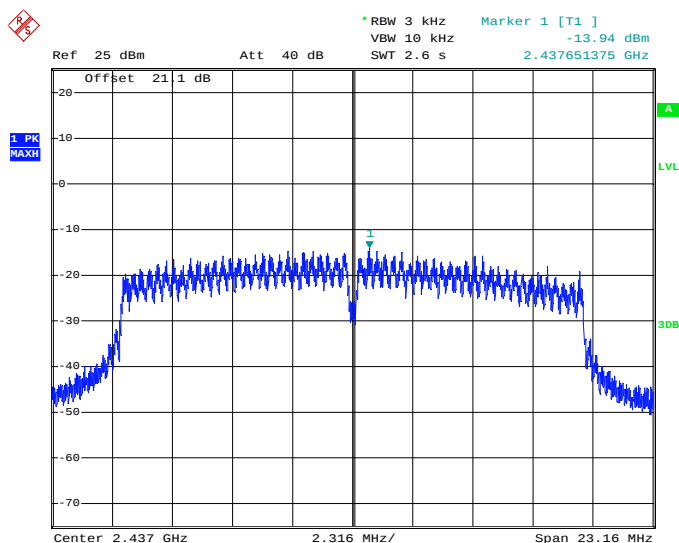
**Table 2.8.6-3: Power Spectral Density Results - 802.11n 20 MHz**

| Frequency (MHz) | PSD (dBm) | Limit (dBm) | Margin (dB) |
|-----------------|-----------|-------------|-------------|
| 2412            | -12.17    | 8           | 20.17       |
| 2437            | -13.94    | 8           | 21.94       |
| 2462            | -16.34    | 8           | 24.34       |



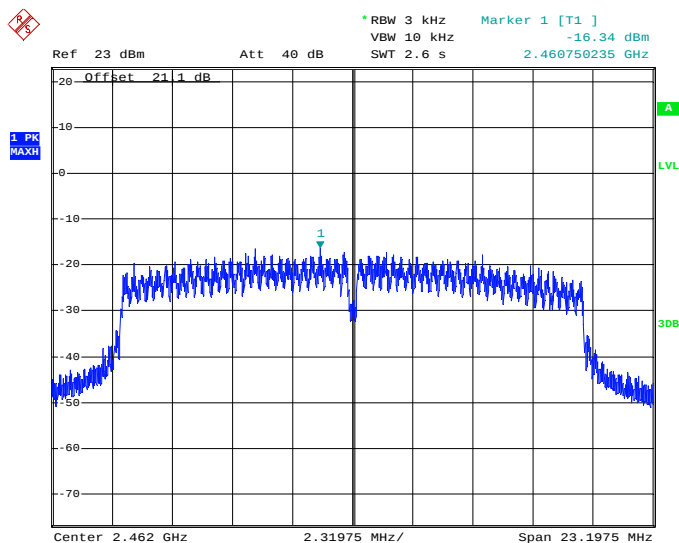
Date: 25.MAY.2021 20:42:33

**Figure 2.8.6-7: Power Spectral Density Results – Low Channel - 802.11n 20 MHz**



Date: 25.MAY.2021 21:21:09

Figure 2.8.6-8: Power Spectral Density Results – Middle Channel - 802.11n 20 MHz



Date: 25.MAY.2021 22:24:16

Figure 2.8.6-9: Power Spectral Density Results – High Channel - 802.11n 20 MHz



### 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 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet          | 40AH2W-20    | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| Duratest High Frequency Cable, 26.5GHz    | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A                          | 12                          | 19-Oct-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## 2.9 Duty Cycle

### 2.9.1 Specification Reference

None

### 2.9.2 Equipment Under Test and Modification State

S/N: 36090009

### 2.9.3 Date of Test

5/24/2021 to 5/25/2021

### 2.9.4 Test Method

The duty cycle was measured in accordance with ANSI C63.10 Section 11.6 Duty cycle (D), transmission duration (T), and maximum power control level. The unit was connected directly to the input of the spectrum analyzer via suitable attenuation. The RBW and VBW were set to 10 MHz and the number of sweep points across duration T was set to exceed 100.

### 2.9.5 Environmental Conditions

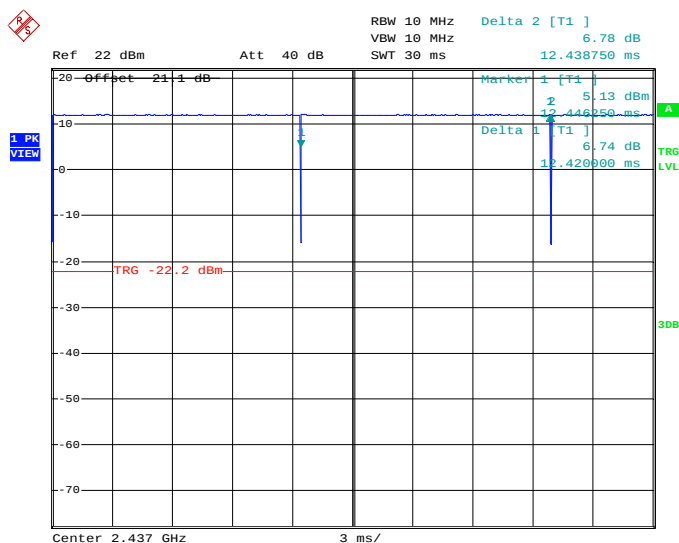
Ambient Temperature 26.2 °C  
Relative Humidity 38.9 %  
Atmospheric Pressure 1018.5 mbar

### 2.9.6 Test Results

AC Powered Operating

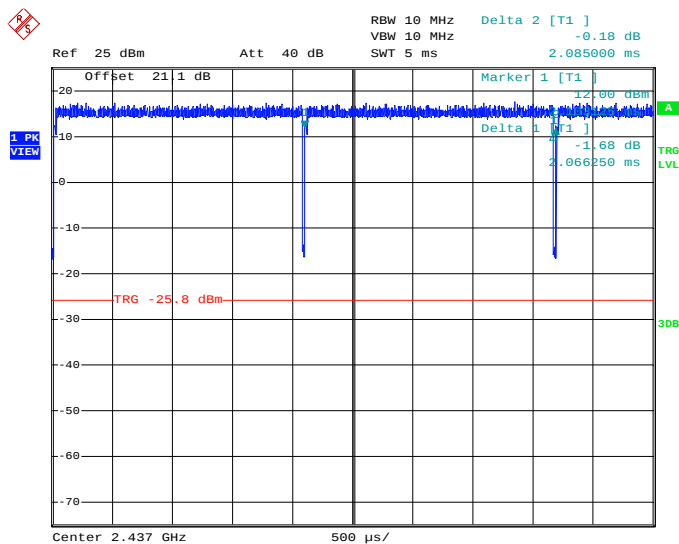
**Table 2.9.6-1: Duty Cycle Correction**

| Mode           | Time On<br>(ms) | Period<br>(ms) | Duty Cycle<br>(%) | Duty Cycle<br>Correction<br>(dB) |
|----------------|-----------------|----------------|-------------------|----------------------------------|
| 802.11b        | 12.42           | 12.43875       | 99.85             | N/A                              |
| 802.11g        | 2.06625         | 2.085          | 99.1              | N/A                              |
| 802.11n 20 MHz | 1.92            | 1.94375        | 98.78             | N/A                              |



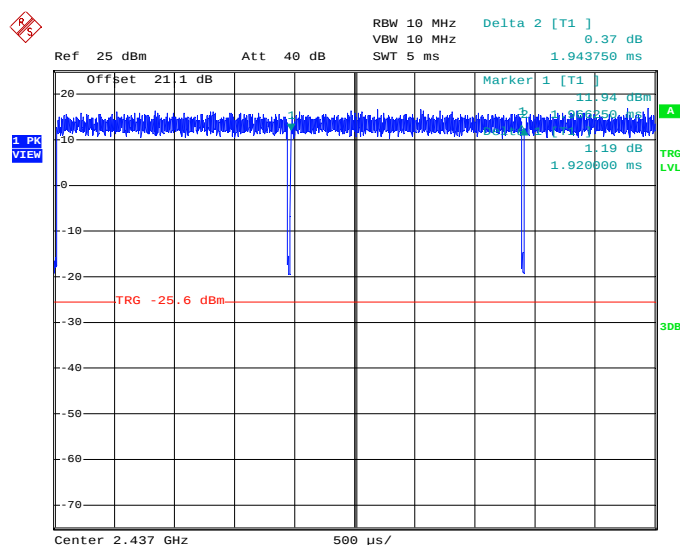
Date: 24.MAY.2021 18:50:11

Figure 2.9.6-1: Duty Cycle – 802.11b



Date: 25.MAY.2021 19:37:15

Figure 2.9.6-2: Duty Cycle – 802.11g



Date: 25.MAY.2021 21:37:02

Figure 2.9.6-3: Duty Cycle – 802.11n 20 MHz

## 2.9.7 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 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W | Aeroflex Inmet          | 40AH2W-20    | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| Duratest High Frequency Cable, 26.5GHz    | Teledyne Storm Products | 921-0101-036 | BEMC02112 | N/A                          | 12                          | 19-Oct-2021     |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable



## 2.10 Power Line Conducted Emissions

### 2.10.1 Specification Reference

FCC: Section 15.207  
ISED Canada; RSS-GEN 8.8

### 2.10.2 Equipment Under Test and Modification State

S/N: 36090009

### 2.10.3 Date of Test

5/25/2021

### 2.10.4 Test Method

ANSI C63.10 section 6.2 was the guiding document for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

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

### 2.10.5 Environmental Conditions

Ambient Temperature 24.4 °C  
Relative Humidity 43.9 %  
Atmospheric Pressure 1022.2 mbar

### 2.10.6 Test Results

| Frequency of Emission (MHz) | Conducted Limit (dBμV) |           |
|-----------------------------|------------------------|-----------|
|                             | 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.

**Table 2.10.6-1: Power Line Conducted Emissions – Quasi-Peak Detector Results**

| Frequency (MHz) | Quasi-peak (dBμV) | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|-------------------|------|------------|-------------|--------------|
| 0.447000        | 44.83             | L1   | 10.0       | 12.10       | 56.93        |
| 0.600000        | 30.15             | N    | 10.4       | 25.85       | 56.00        |
| 0.897000        | 32.29             | N    | 10.4       | 23.71       | 56.00        |
| 1.203000        | 29.00             | N    | 10.5       | 27.00       | 56.00        |
| 1.648500        | 28.48             | N    | 10.5       | 27.52       | 56.00        |
| 2.094000        | 30.37             | L1   | 10.2       | 25.63       | 56.00        |
| 4.110000        | 26.93             | L1   | 10.4       | 29.07       | 56.00        |
| 10.288500       | 27.79             | L1   | 10.8       | 32.21       | 60.00        |
| 10.684500       | 28.15             | L1   | 10.8       | 31.85       | 60.00        |

**Table 2.10.6-2: Power Line Conducted Emissions – Average Detector Results**

| Frequency (MHz) | Average (dBμV) | Line | Corr. (dB) | Margin (dB) | Limit (dBμV) |
|-----------------|----------------|------|------------|-------------|--------------|
| 0.451500        | 25.95          | L1   | 10.0       | 20.90       | 46.85        |
| 0.969000        | 18.88          | L1   | 10.1       | 27.12       | 46.00        |

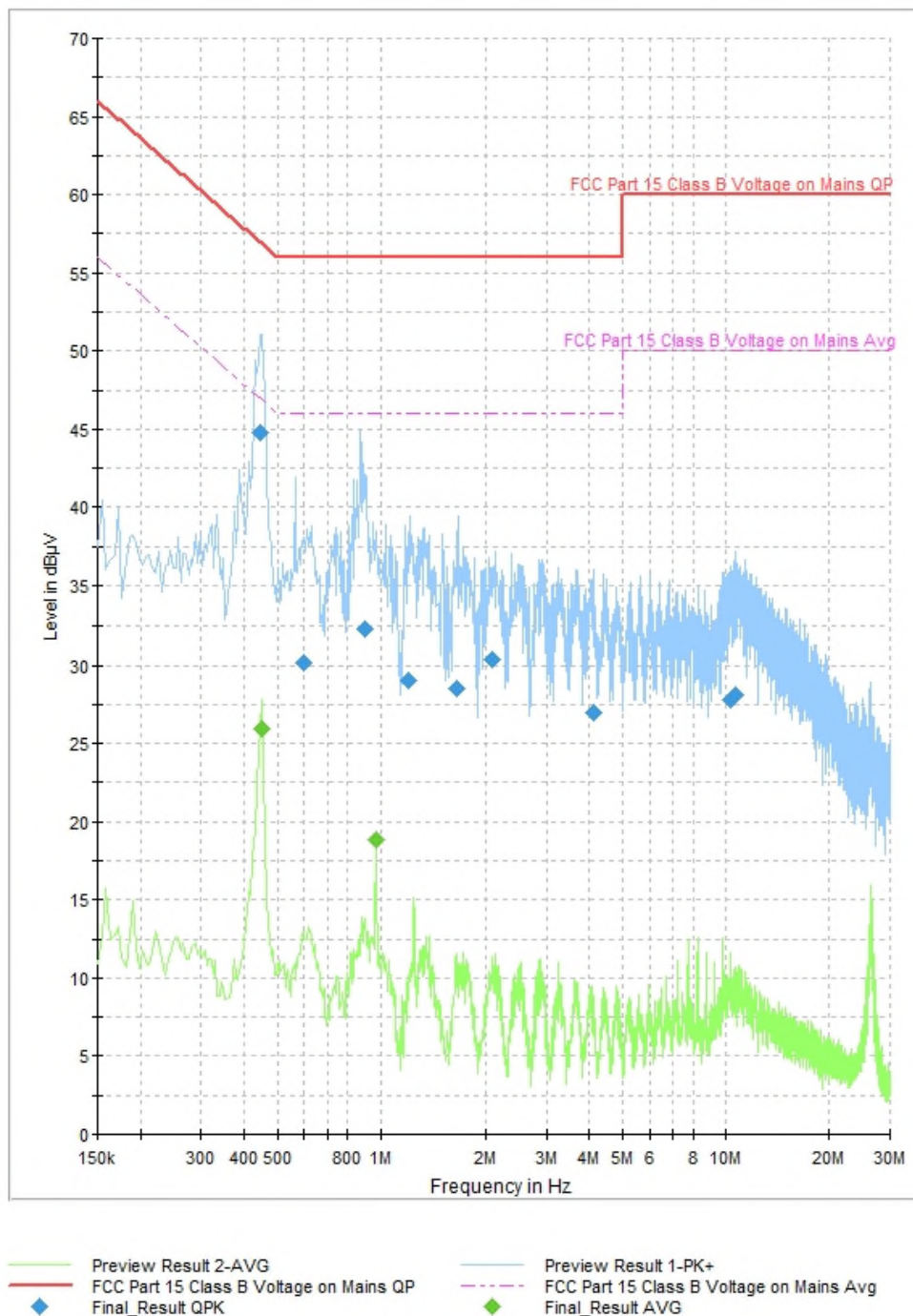


Figure 2.10.6-1: Composite Power Line Conducted Emissions Plots



### 2.10.7 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 |
|----------------------------|---------------------------|---------|-----------|------------------------------|-----------------------------|-----------------|
| LISN                       | Rohde & Schwarz           | ESH3-Z5 | TEMC00002 | N/A                          | 12                          | 04-Feb-2022     |
| EMI Test Receiver          | Rohde & Schwarz           | ESCS30  | TEMC00011 | 2.3002.0102.36               | 24                          | 03-Oct-2021     |
| RFI/EMI Shielded Enclosure | UNIVERSAL SHIELDING CORP. | N/A     | TEMC00100 | N/A                          | N/A                         | NCR             |
| Test Software              | Rohde & Schwarz           | EMC32   | TEMC00184 | 10.50.00                     | N/A                         | NCR             |

TU - Traceability Unscheduled

O/P MON - Traceability Unscheduled

N/A - Not Applicable

NCR – No Calibration Required



### 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 | 4.50 SP5                     | 24                          | 04-Oct-2021     |
| 9kHz-26.5GHz EMC analyzer/HYZ                           | Agilent                   | E7405A                 | BEMC00523 | A.14.06                      | 12                          | 25-Feb-2022     |
| 10dB Attenuator                                         | Merrimac                  | FAN-6-10K              | BEMC02086 | N/A                          | 12                          | 19-Oct-2021     |
| Tile Automation Software                                | ETS Lindgren              | TILE4! - Version 4.2.A | BEMC02095 | 4.2A                         | N/A                         | NCR             |
| Attenuator 20dB, 2.9 mm-M/F, DC-40GHz 2 W               | Aeroflex Inmet            | 40AH2W-20              | BEMC02111 | N/A                          | 12                          | 25-Jul-2021     |
| Duratest High Frequency Cable<br>Max. frequency 26.5GHz | Teledyne Storm Products   | 921-0101-036           | BEMC02112 | N/A                          | 12                          | 19-Oct-2021     |
| Signal & Spectrum Analyzer                              | Rohde & Schwarz           | FSW43                  | DEMC3085  | N/A                          | 24                          | 07-Dec-2022     |
| LISN                                                    | Rohde & Schwarz           | ESH3-Z5                | TEMC00002 | N/A                          | 12                          | 04-Feb-2022     |
| BI LOG PERIODIC, ANTENNA                                | Schaffner                 | CBL6112B               | TEMC00005 | N/A                          | 24                          | 31-Oct-2021     |
| EMI Test Receiver                                       | Rohde & Schwarz           | ESCS30                 | TEMC00011 | 2.3002.010<br>2.36           | 24                          | 03-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                                             | Panasheild                | N/A                    | TEMC00031 | N/A                          | 36                          | 28-Jan-2024     |
| Double Ridge Guide Horn                                 | ETS Lindgren              | 3117                   | TEMC00061 | N/A                          | 24                          | 07-Feb-2022     |
| RFI/EMI Shielded Enclosure                              | UNIVERSAL SHIELDING CORP. | N/A                    | TEMC00100 | N/A                          | N/A                         | NCR             |
| 18 GHz-40 GHz Microwave Preamplifier                    | COM-power                 | PAM-840A               | TEMC00147 | N/A                          | 12                          | 06-Jul-2021     |
| PAM-118A                                                | Com-Power Corporation     | PAM-118A               | TEMC00160 | N/A                          | 12                          | 10-Apr-2022     |
| 2.4 GHz Notch Filter                                    | Micro-Tronics             | BRM50702-01            | TEMC00176 | N/A                          | 12                          | 09-Mar-2022     |
| Test Software                                           | Rohde & Schwarz           | EMC32                  | TEMC00184 | 10.50.00                     | N/A                         | NCR             |
| USB Wideband Power Sensor 50MHz - 18GHz                 | Keysight Technologies     | U2021XA                | TEMC00197 | N/A                          | 12                          | 29-Oct-2021     |
| A81-0303 18 GHz Cable Set                               | Teledyne Storm Products   | A81-0303-360/96        | TEMC00201 | N/A                          | 12                          | 10-Apr-2022     |
| 2.92mm Attenuator M/F 40GHz 30dB 2W VSWR 1.45           | Centric RF                | C402-30                | TEMC00222 | N/A                          | 12                          | 08-Mar-2022     |

TU - Traceability Unscheduled

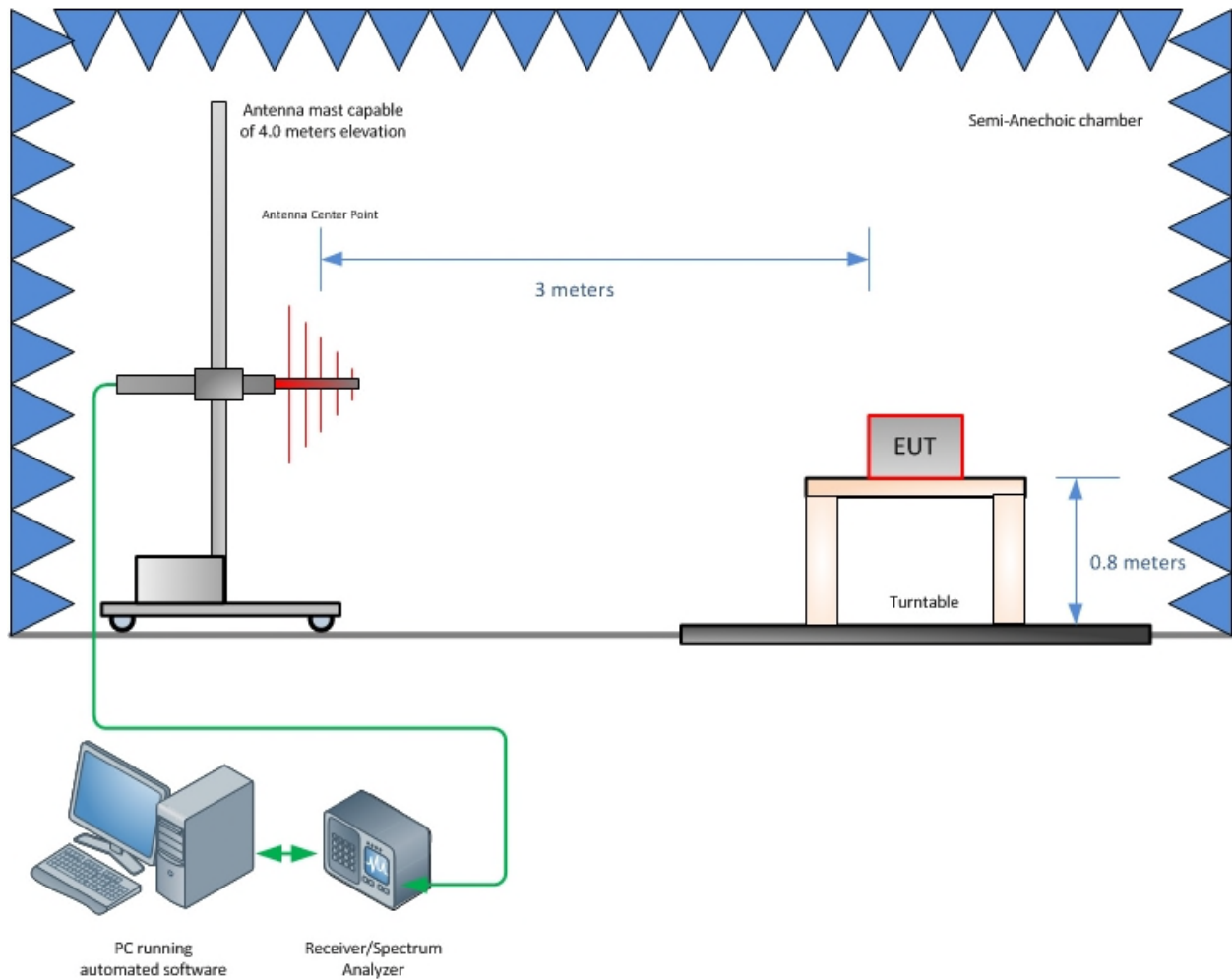


O/P MON - Traceability Unscheduled

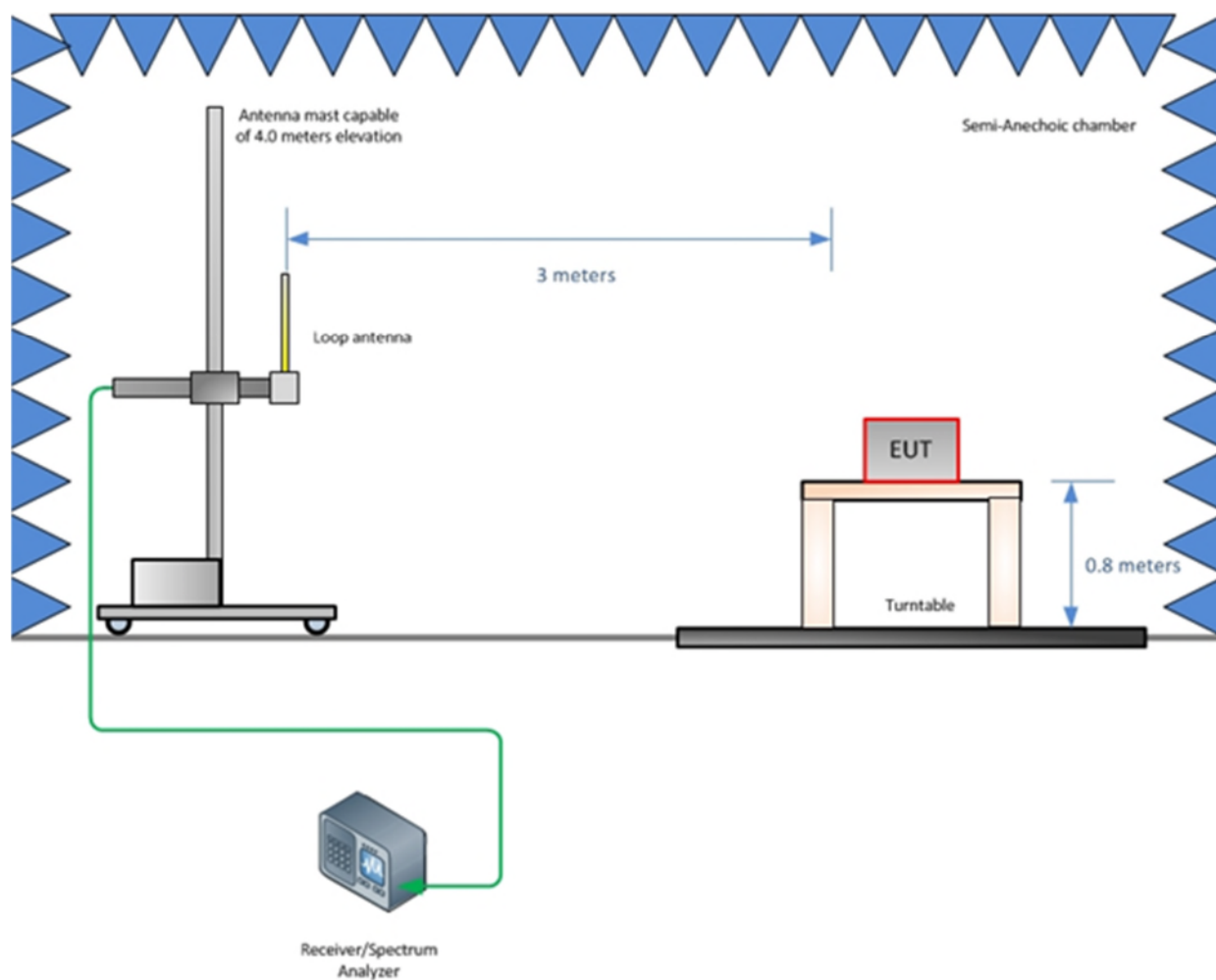
N/A - Not Applicable

NCR – No Calibration Required

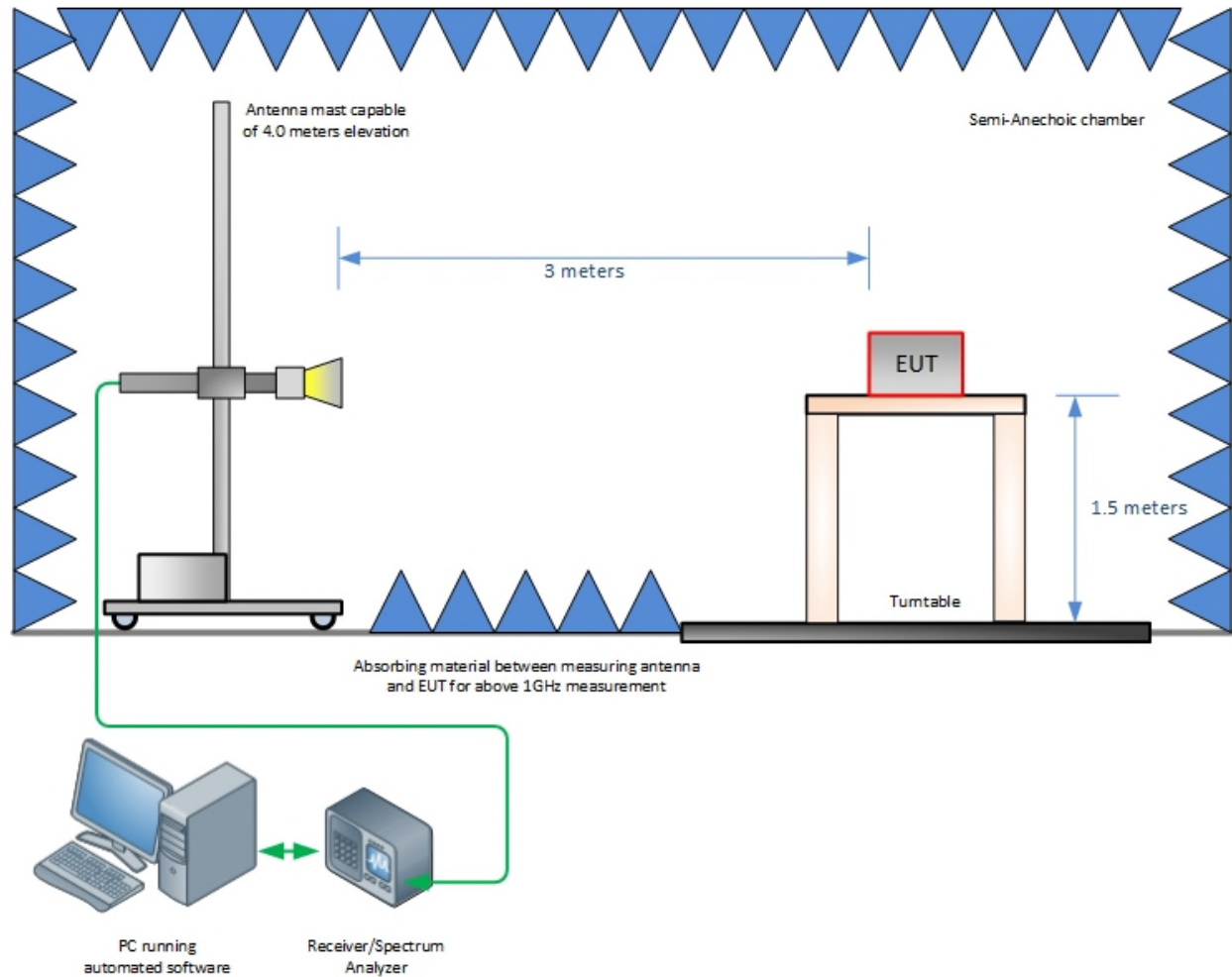
## 4 Diagram of Test Set-ups



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



**Figure 4-2 - Radiated Emissions Test Setup up to 30 MHz**



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

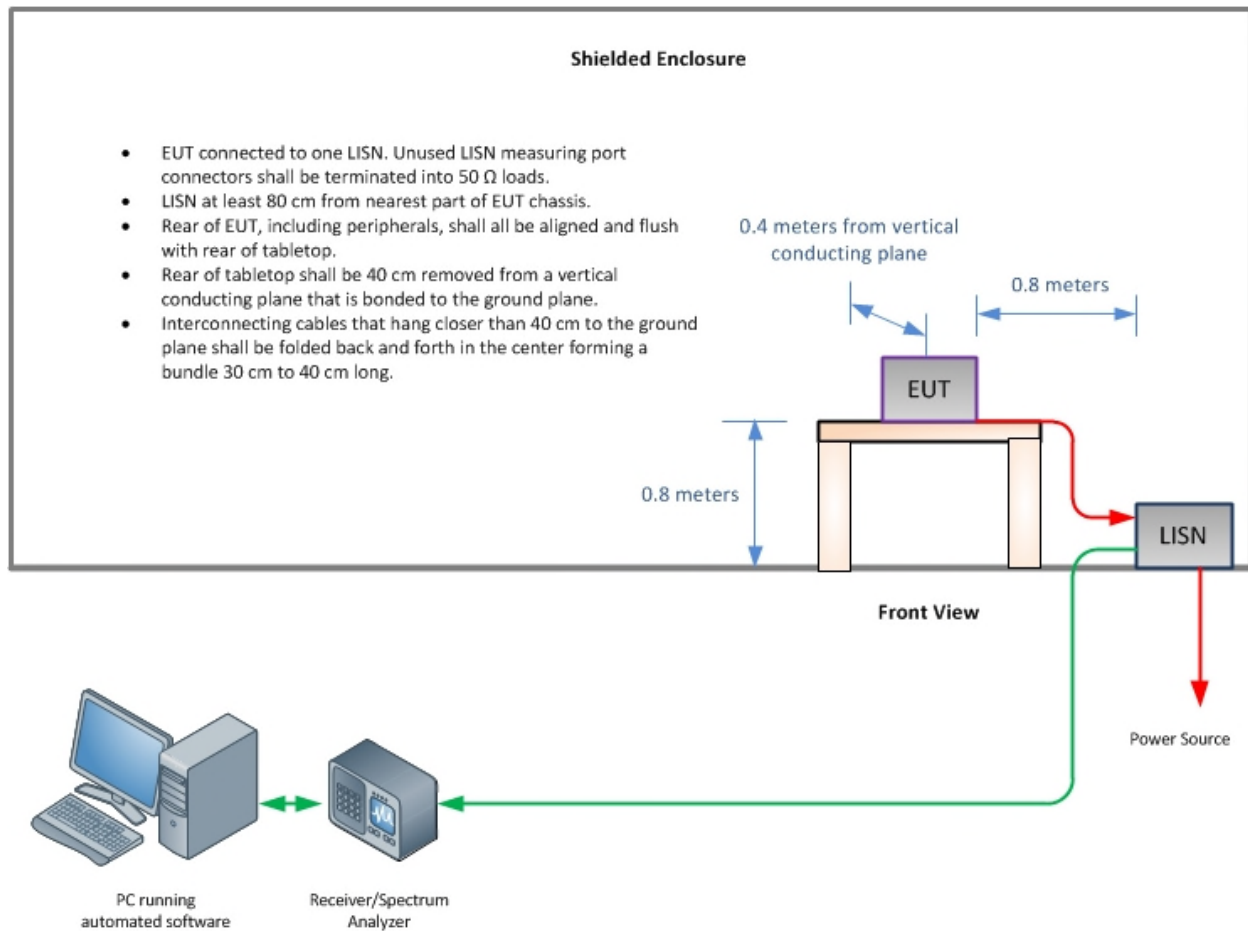


Figure 4-4 – Conducted Emissions Test Setup



## 5 Measurement Uncertainty

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

**Table 5-1 - Values of  $U_{\text{CISPR}}$  and  $U_{\text{Lab}}$**

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

### Notes:

$U_{\text{CISPR}}$  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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