FCC and ISED Canada Testing of the

Esprit Model Inc.
JETIDS16G2US

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

America

Add value.
Inspire trust.

Prepared for: Esprit Model Inc.
1240 Clearmont st. NW
Palm Bay, FL 32905

FCC ID: ONTJETIDS16G2US
IC: 10491A-JETDS16G2US

COMMERCIAL-IN-CONFIDENCE

Document Number: TP72163751.200 | Version Number: 01

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Authorized Signatory	Peter Walsh	2021 -April-12	
Testing	Peter Walsh	2021-April-12	

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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Contents

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-April-12

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	Esprit Model Inc.
Manufacturer	Esprit Model Inc.
Applicant's Email Address	zb@espritmodel.com
Model Number(s)	JETIDS16G2US
Serial Number(s)	203600148
FCC ID	ONTJETIDS16G2US
ISED Certification Number	10491A-JETDS16G2US
Hardware Version(s)	DS-16II
Software Version(s)	5.05
Number of Samples Tested	1
Test Specification/Issue/Date	US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2021 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	2020-October-12
Order Number	72163751
Date	2020-October-16
Date of Receipt of EUT	2020-November-10
Start of Test	2020-November-12
Finish of Test	2021-February-15
Name of Engineer(s)	Thierry Jean-Charles and Jean N. Rene
Related Document(s)	ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices FCC OET KDB Pubilication 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, April 2, 2019. US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2021. 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	-------	10
Carrier Frequency Separation	Yes	Pass	15.247(a)(1)	RSS-247 5.1(b)	11
Number of Hopping Channels	Yes	Pass	15.247(a)(1)(iii)	RSS-247 5.1(d)	15
Channel Dwell Time	Yes	Pass	15.247(a)(1)(iii)	RSS-247 5.1(d)	19
20 dB Bandwidth	Yes	Pass	15.247(a)(1)(i)	RSS-247 5.1(a)	27
99% Bandwidth	Yes	Pass	-------	RSS-GEN 6.7	36
Peak Output Power	Yes	Pass	15.247(b)(1)	RSS-247 5.4(b)	45
Band-Edge Compliance of RF Conducted Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	54
RF Conducted Spurious Emissions	Yes	Pass	15.247(d)	RSS-247 5.5	62
Radiated Spurious Emissions into Restricted Frequency Bands	Yes	Pass	15.205, 15.209	RSS-GEN 8.9, 8.10	70
Power Line Conducted Emissions	Yes	Pass	15.207	RSS-GEN 8.8	79

1.4 Product Information

1.4.1 Technical Description

The Equipment Under Test (EUT) was a remote control which includes one 900 MHz LoRa and two 2.4 GHz transceivers. Each of the 2.4 GHz transceivers is configured with two antenna ports. The 900 MHz and 2.4 GHz transceivers can transmit simultaneously.

Technical Details
Mode of Operation: IEEE 802.15.4; 2.4 GHz FHSS
Frequency Range: 2405 MHz - 2480 MHz
Number of Channels: 16
Channel Separation: 5 MHz
Modulations: O-QPSK
Antenna Type/Gain: Whip Antenna / 2.1 dBi
Input Power: 3.6 VDC Battery, 12 VDC Power Supply

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

Table 1.4.1-1 – Cable Descriptions

Cable/Port	Description
Audio	1.2m, Not Shielded, Earbuds to EUT
Power	1.8 m, Not Shielded, Power Supply to EUT

Table 1.4.1-2 – Support Equipment Descriptions

Make/Model	Description
N/A	Earbuds
Jeti Model / SYS1531-2412-W2	12 VDC Power Supply, S/N: G190405015683

Declaration of Build Status

EQUIPMENT DESCRIPTION	
Model Name/Number	JETI Duplex DS-16 G2
Part Number	JETI DS-16II
Hardware Version	DS-16II
Software Version	5.05
FCC ID (if applicable)	ONTJETIDS16G2US
ISED ID (if applicable)	10491A-JETDS16G2US
Technical Description (Please provide a brief description of the intended use of the equipment)	Transmitter for radio-controlled toys

UN-INTENTIONAL RADIATOR	
Highest frequency generated or used in the device or on which the device operates or tunes	2.480 GHz
Lowest frequency generated or used in the device or on which the device operates or tunes	16 MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☐ Class B Digital Device (Use in residential environment only) ☒	

Power Source			
AC	Single Phase	Three Phase	Nominal Voltage
	☒	☐	
External DC	Nominal Voltage	Maximum Current	
	12 vdc	500 ma	
Battery	Nominal Voltage	Battery Operating End Point Voltage	
	3.6 vdc	3.3 vdc	

EXTREME CONDITIONS					
Maximum temperature	+85	°C	Minimum temperature	-40	°C

Ancillaries
Please list all ancillaries which will be used with the device.

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

Name: Danny Melnik

Position held: Engineer Date: 4-12-2021

1.4.2 Modes of Operation

The EUT was evaluated for the 2.4 GHz radio, where applicable, the worst case results are reported.

The power attenuation settings used during the evaluation are as follows:

Channels 11 to 25: Attenuation 7
Channel 26: Attenuation 15.

1.4.3 Monitoring of Performance

The transmitter powers off when connected to the AC Mains. The power line conducted emissions were performed for the EUT off and charging as per normal operation.

Preliminary radiated emissions measurements were performed for the EUT in three orthogonal orientations on the table top. The worst-case orientations and antenna port configurations were tested in full and are listed below.

Radiated Band-Edge Emissions: AP1 / EUT on Side; AS1 / EUT Flat
Radiated Spurious Emissions: AP2 / EUT on Side; AS2 / EUT on Side

The EUT was also evaluated for radiated intermodulation products for the 2.4 GHz and 900 MHz transmitters operating simultaneously. All intermodulations products were found to be in compliance.

For the RF conducted measurements, temporary RF connectors were connected to the antenna ports to allow direct coupling to the spectrum analyzer

1.4.4 Performance Criteria

The EUT was evaluated to the requirements listed below.

Table 1.4.4 -1: Performance Criteria

Parameter	Requirement
Antenna Requirement	FCC: Section 15.203. 15.204
Carrier Frequency Separation	FCC: Section 15.247(a)(1); ISED Canada:RSS-247 5.1(b)
Number of Hopping Channels	FCC: Section 15.247(a)(1)(iii); ISED Canada: RSS-247 5.1(d)
Dwell Time	FCC; Section 15.247(a)(1)(iii); ISED Canada: RSS-247 5.1(d)
20 dB Bandwidth	FCC: Section 15.247(a)(1)(i); ISED Canada: RSS-247 5.1(a)
99% Bandwidth	ISED Canada: RSS-GEN 6.7
Peak Output Power	FCC: Section 15.247(b)(1); ISED Canada:RSS-247 5.4(b)
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 Line Conducted Emissions	FCC: Section 15.207; ISED Canada: RSS-GEN 8.8

1.5 Deviations from the Standard

The evaluation was performed without andy deviations from the test standards.

1.6 EUT Modification Record

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

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
None			

No modification was necessary to meet the radio requirements. The modifications that were implemented to meet the unintentional emissions requirements are reported in the supplier's declaration of conformity test report.

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 and Battery Powered Operating		
Antenna Requirement	Thierry Jean-Charles	A2LA
Carrier Frequency Separation	Thierry Jean-Charles	A2LA
Number of Hopping Channels	Thierry Jean-Charles	A2LA
Dwell Time	Thierry Jean-Charles	A2LA
20 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 and Jean N. Rene	A2LA
AC 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: 203600148

2.1.3 Date of Test

2/3/2021

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 is using internal 2.1 dBi whip antennas which connect to the transmitter PCB via U.FL. connectors. The antennas is not easily accessible or replaceable by the end-user and therefore meet 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 was a visual inspection, no test equipment was used.

2.2 Carrier Frequency Separation

2.2.1 Specification Reference

FCC: Section 15.247(a)(1)
ISED Canada: RSS-247 5.1(b)

2.2.2 Equipment Under Test and Modification State

S/N: 203600148

2.2.3 Date of Test

2/8/2021 to 2/9/2021

2.2.4 Test Method

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to approximately 30% of the channel spacing.

2.2.5 Environmental Conditions

Ambient Temperature	24.5°C
Relative Humidity	45.4 %
Atmospheric Pressure	1019.4 mbar

2.2.6 Test Results

Battery Powered Operating

Limit Clause FCC Part 15.247(a)(1); ISED RSS-247 5.1 (b)

The Carrier Frequency Separation was measured to be 5 MHz.

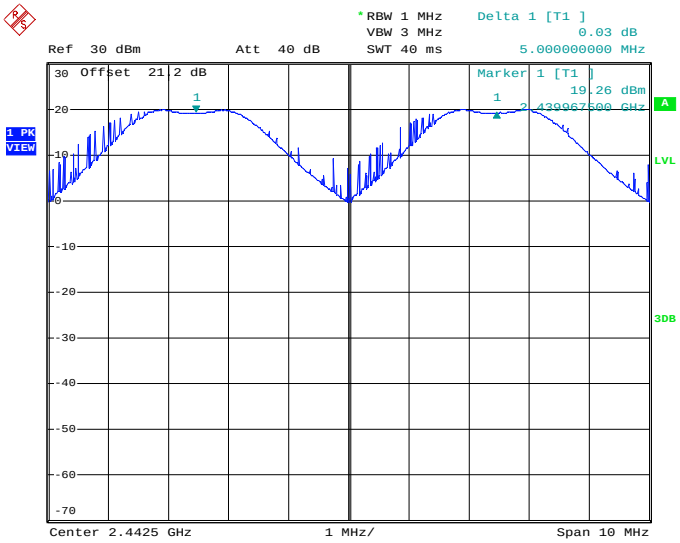

Figure 2.2.6-1: Carrier Frequency Separation Test Results – AP1

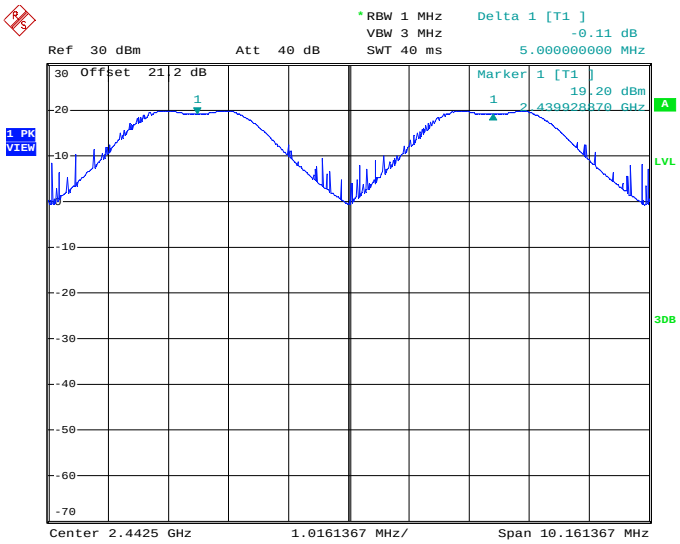

Figure 2.2.6-2: Carrier Frequency Separation Test Results – AP2

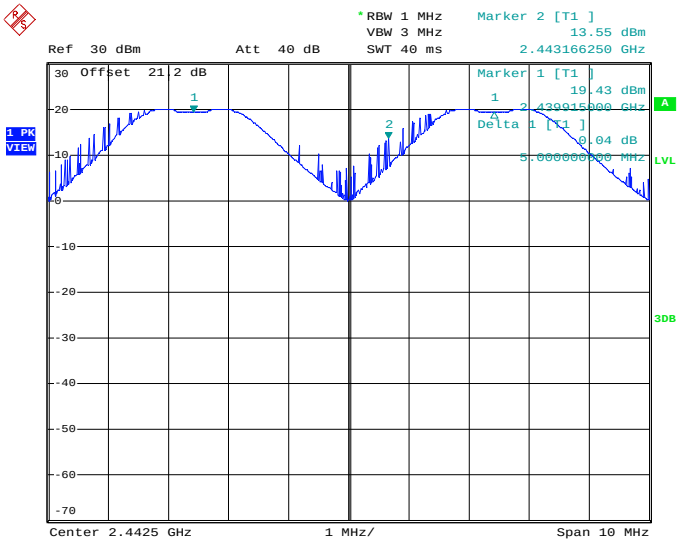

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Figure 2.2.6-3: Carrier Frequency Separation Test Results – AS1

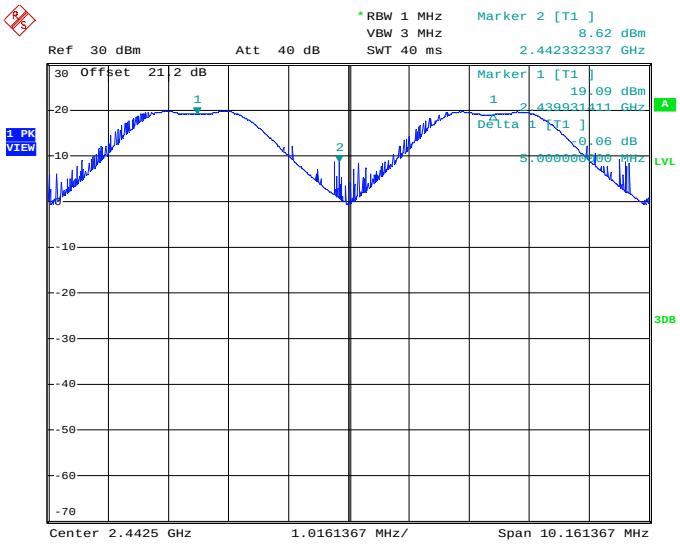

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Figure 2.2.6-4: Carrier Frequency Separation Test Results – AS2

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 26.5 GHz	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 Number of Hopping Channels

2.3.1 Specification Reference

FCC: Section 15.247(a)(1)(iii)
ISED Canada: RSS-247 5.1(d)

2.3.2 Equipment Under Test and Modification State

S/N: 203600148

2.3.3 Date of Test

2/8/2021 To 2/9/2021

2.3.4 Test Method

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture the number of hopping channels. The peak detector max hold function was enabled for the measurements.

2.3.5 Environmental Conditions

Ambient Temperature	24.5°C
Relative Humidity	45.4 %
Atmospheric Pressure	1019.4 mbar

2.3.6 Test Results

Battery Powered Operating

Limit Clause FCC Part 15.247(a)(1)(iii); ISED RSS-247 5.1(d)

The number of hopping frequencies was measured to be 16.

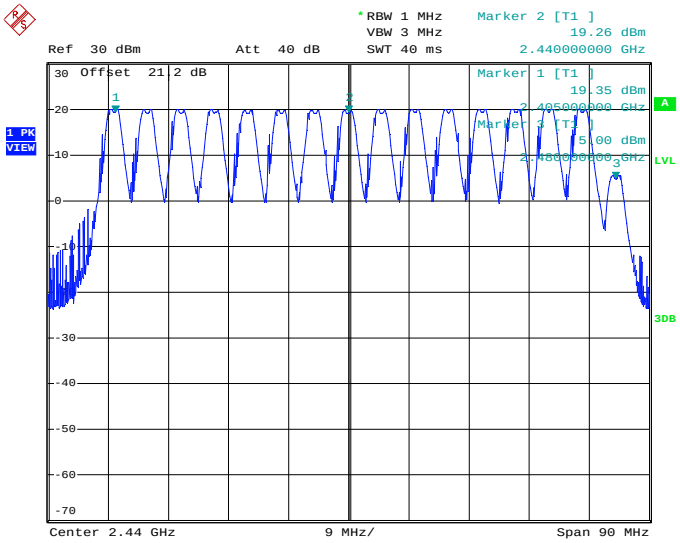

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Figure 2.3.6-1: Number of Hopping Channels Test Results – AP1

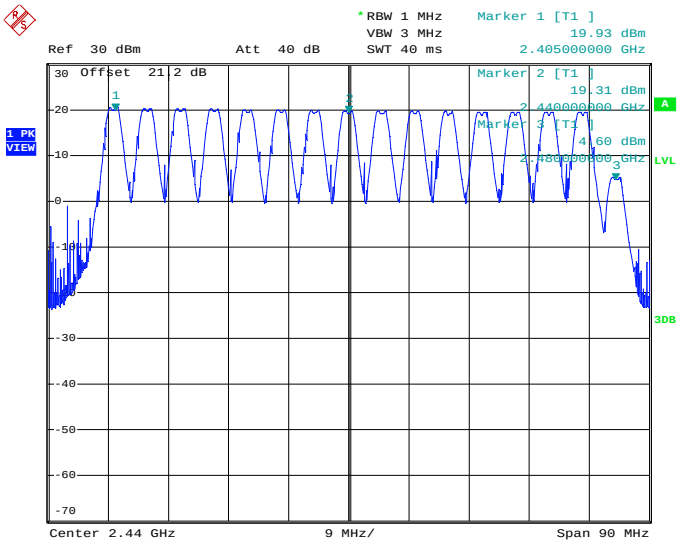

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Figure 2.3.6-2: Number of Hopping Channels Test Results – AP2

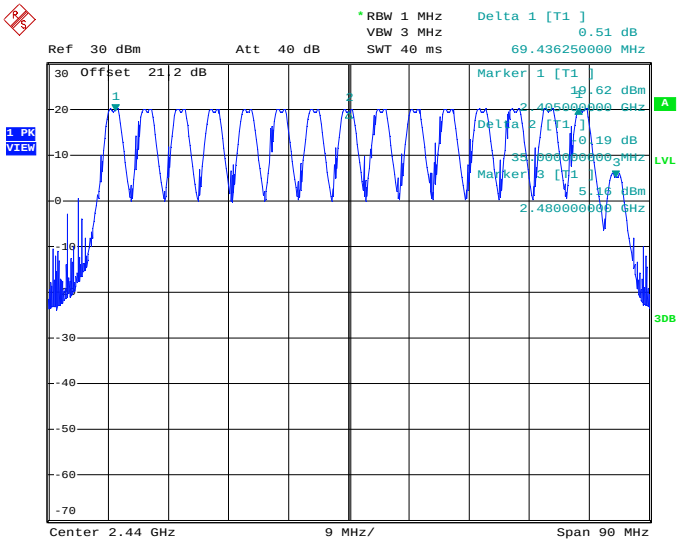

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Figure 2.3.6-3: Number of Hopping Channels Test Results – AS1

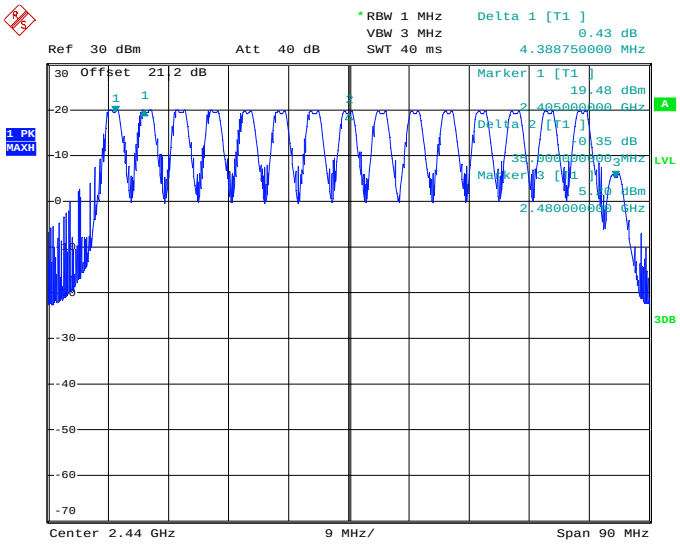

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Figure 2.3.6-4: Number of Hopping Channels Test Results – AS2

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 26.5 GHz	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 Channel Dwell Time

2.4.1 Specification Reference

FCC: Section 15.247(a)(1)(iii)
ISED Canada: RSS-247 5.1(d)

2.4.2 Equipment Under Test and Modification State

S/N: 203600148

2.4.3 Date of Test

2/8/2021 to 2/9/2021

2.4.4 Test Method

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set 0 Hz centered on a hopping channel. The RBW was set to less than 30% of the channel spacing and the sweep time adjusted to capture the entire dwell time per channel with peak detector max hold function.

2.4.5 Environmental Conditions

Ambient Temperature	24°C
Relative Humidity	44.7 %
Atmospheric Pressure	1020.5 mbar

2.4.6 Test Results

Battery Powered Operating

Limit Clause FCC Part 15.247(a)(1)(iii); ISED RSS-247 5.1(d)

Table 2.4.6-1: Dwell Time Test Results

Antenna Port	Number of Hops Per Sec. (NHPS)	Number of Hops per Channel Per Sec. (NHPCPS)	Number of hops on a 6.4 s Cycle (NHPC)	Measured Dwell Times (ms)	Dwell Times on a 6.4 s Cycle (ms)	Limit (ms)	Status
AP1	100	6.25	40	2.020	80.80	400	PASS
AP2	100	6.25	40	2.025	81.00	400	PASS
AS1	100	6.25	40	2.020	80.80	400	PASS
AS2	100	6.25	40	2.021	80.83	400	PASS

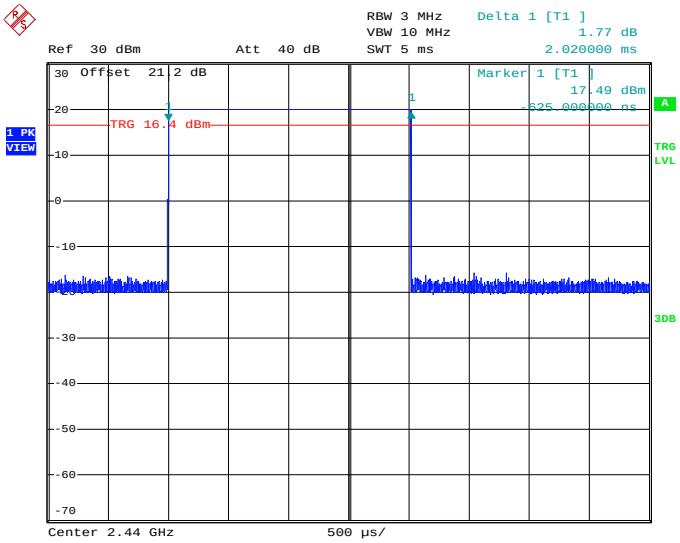

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Figure 2.4.6-1: Channel Dwell Time Test Results – AP1

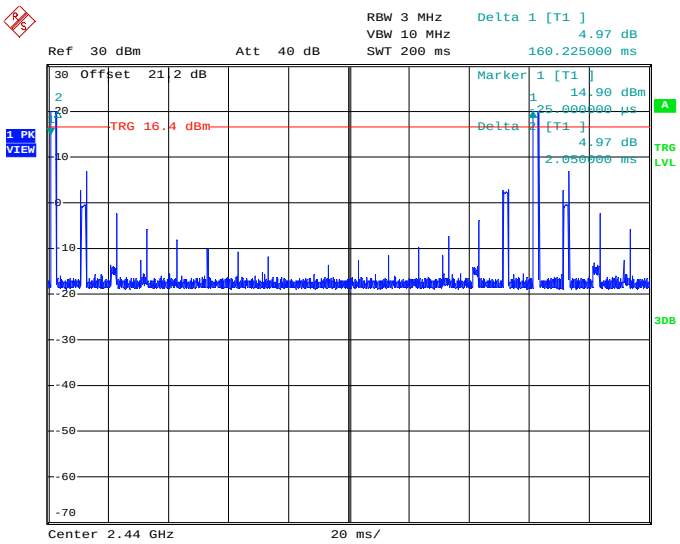

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Figure 2.4.6-2: Channel Dwell Time Test Results – AP1

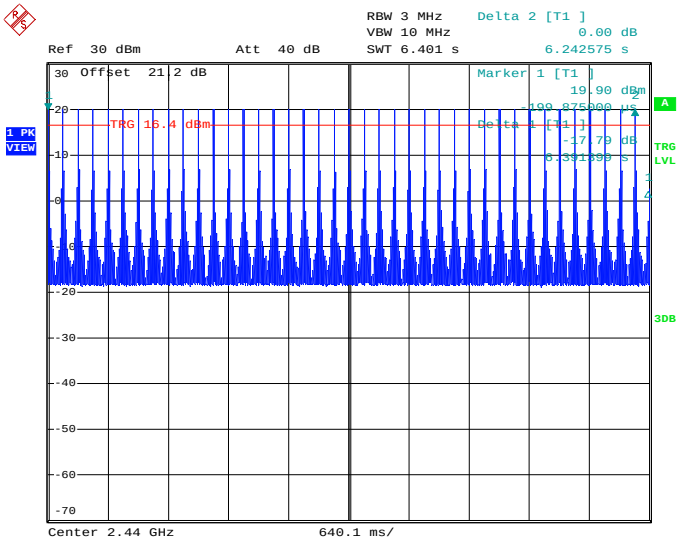

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Figure 2.4.6-3: Channel Dwell Time Test Results – AP1

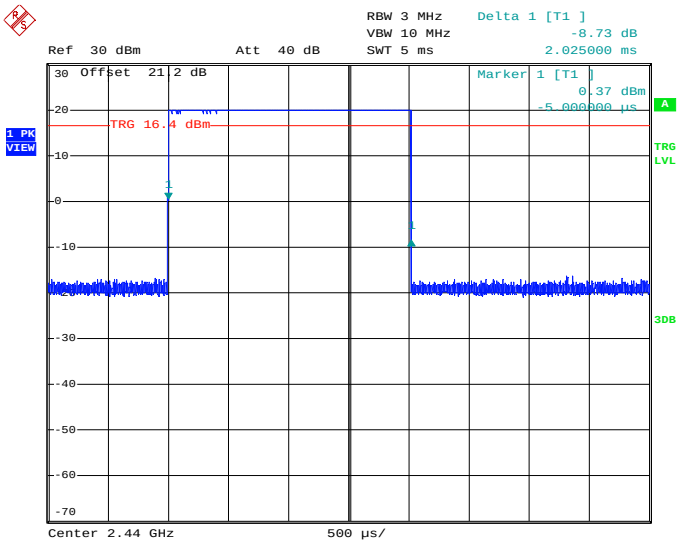

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Figure 2.4.6-4: Channel Dwell Time Test Results – AP2

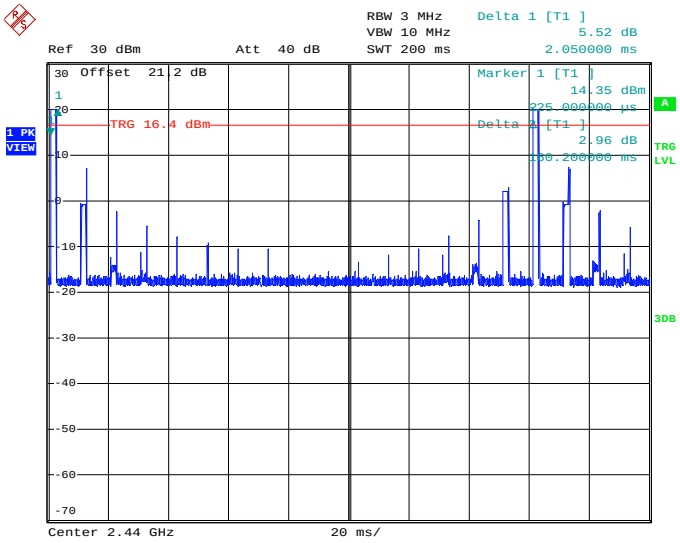

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Figure 2.4.6-5: Channel Dwell Time Test Results – AP2

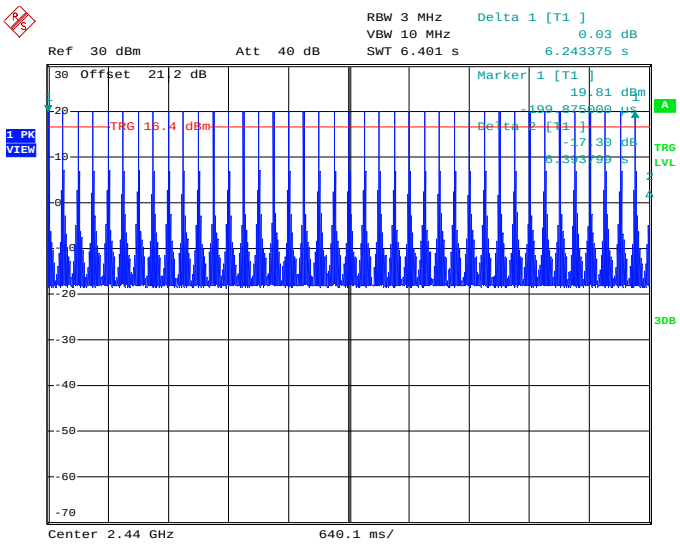

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Figure 2.4.6-6: Channel Dwell Time Test Results – AP2

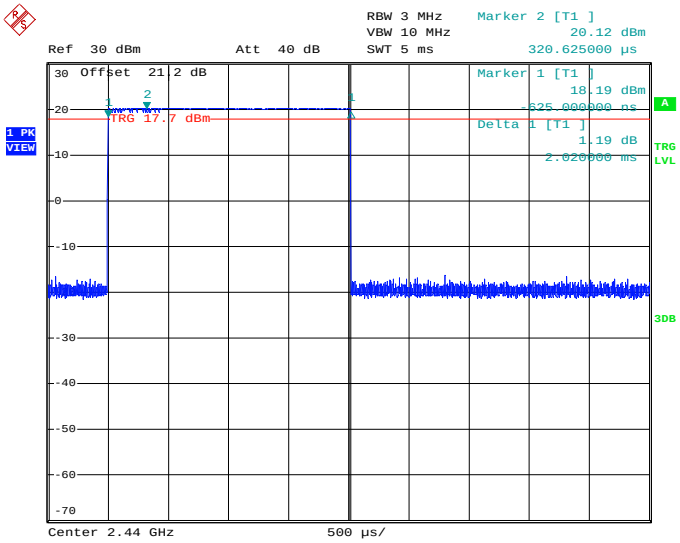

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Figure 2.4.6-7: Channel Dwell Time Test Results – AS1

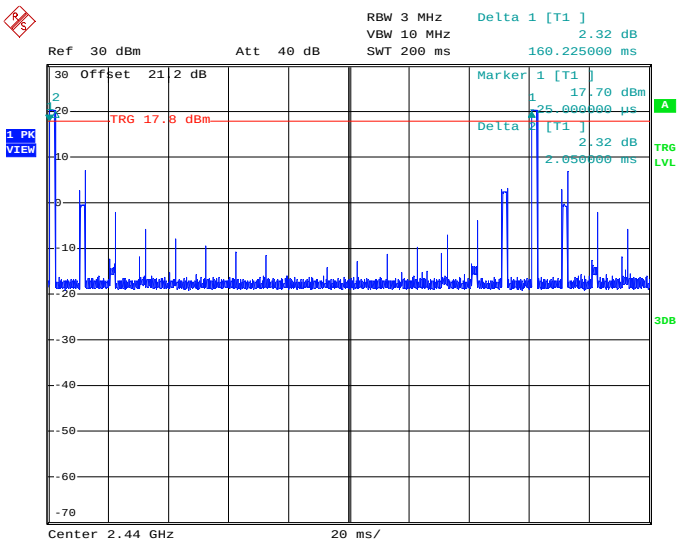

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Figure 2.4.6-8: Channel Dwell Time Test Results – AS1

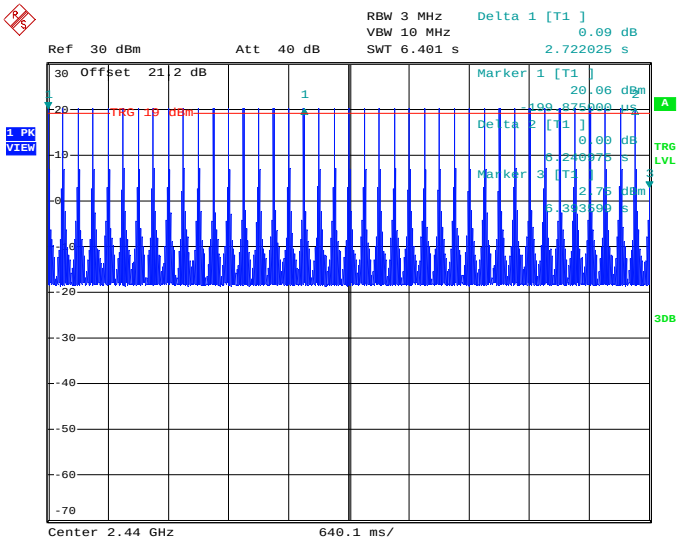

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Figure 2.4.6-9: Channel Dwell Time Test Results – AS1

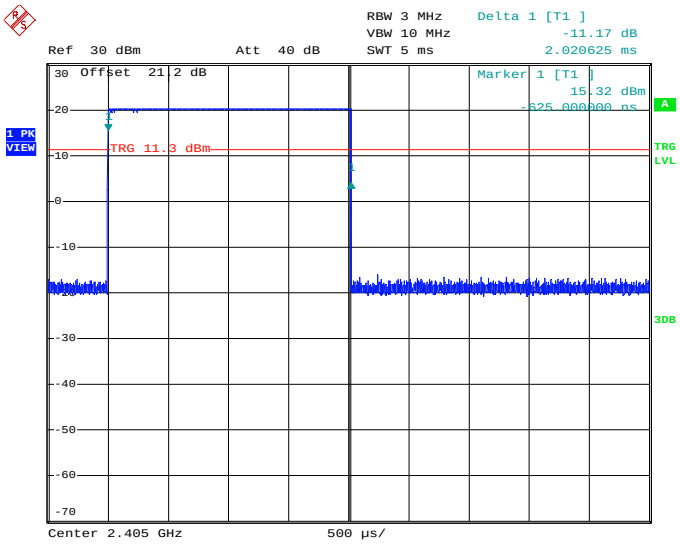

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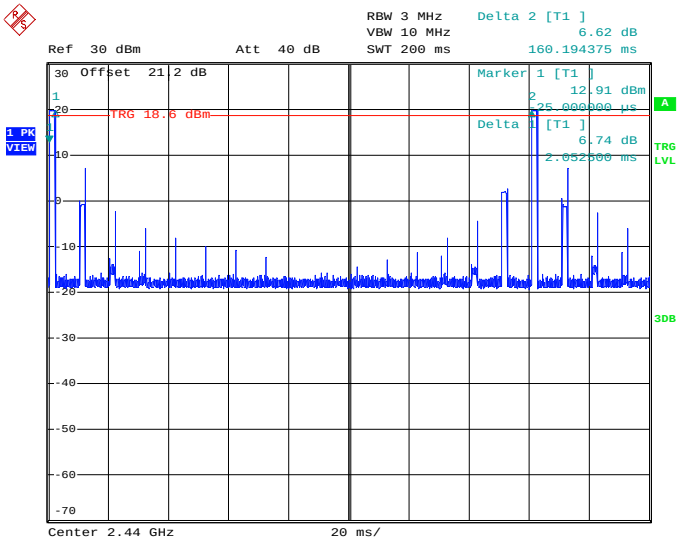
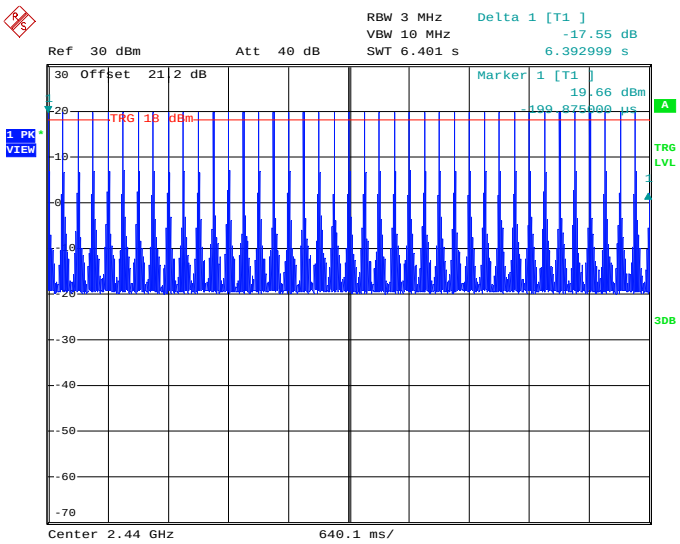
Figure 2.4.6-10: Channel Dwell Time Test Results – AS2



Date: 8.FEB.2021 18:17:12

Figure 2.4.6-11: Channel Dwell Time Test Results – AS2



Date: 8.FEB.2021 18:25:44

Figure 2.4.6-12: Channel Dwell Time Test Results – AS2

2.4.7 Test Location and Test Equipment Used

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

Instrument	Manufacturer	Type No	TE No	Software / Firmware Revision	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSP40	BEMC00283	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 26.5 GHz	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

2.5 20 dB Bandwidth

2.5.1 Specification Reference

FCC: Section 15.247(a)(1)(i)
ISED Canada: RSS-247 5.1(a)

2.5.2 Equipment Under Test and Modification State

S/N: 203600148

2.5.3 Date of Test

2/2/2021 to 2/9/2021

2.5.4 Test Method

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set to 1% to 5% of the estimated emission bandwidth. The trace was recorded using the max hold function with a peak detector.

2.5.5 Environmental Conditions

Ambient Temperature	24.2°C
Relative Humidity	45.1 %
Atmospheric Pressure	1020.4 mbar

2.5.6 Test Results

Battery Powered Operating

Limit Clause FCC Part 15.247(a)(1)(i), ISED RSS-247 5.1(a)

Table 2.5.6-1: 20 dB Bandwidth Test Results – AP1

Frequency (MHz)	20 dB Bandwidth (MHz)
2405	2.5765
2440	2.5786
2480	2.6064

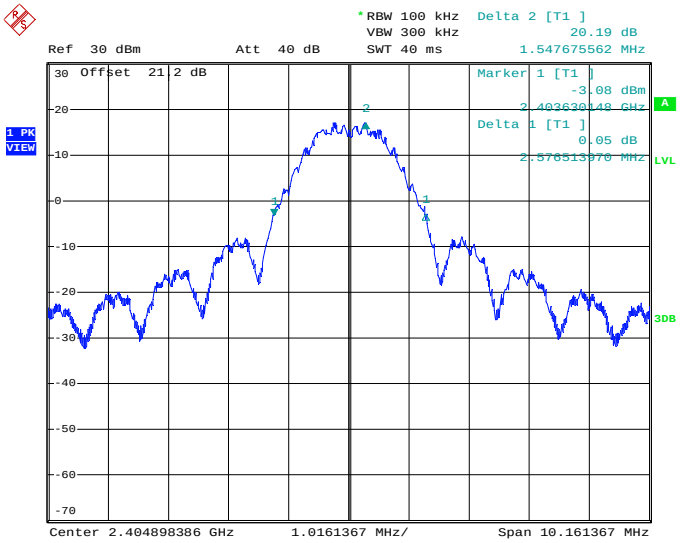


Figure 2.5.6-1: 20 dB Bandwidth Test Results – Low Channel – AP1

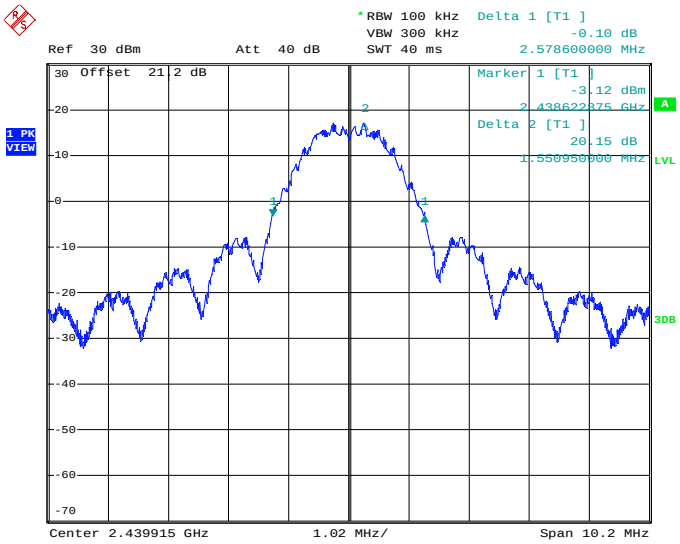


Figure 2.5.6-2: 20 dB Bandwidth Test Results – Middle Channel – AP1

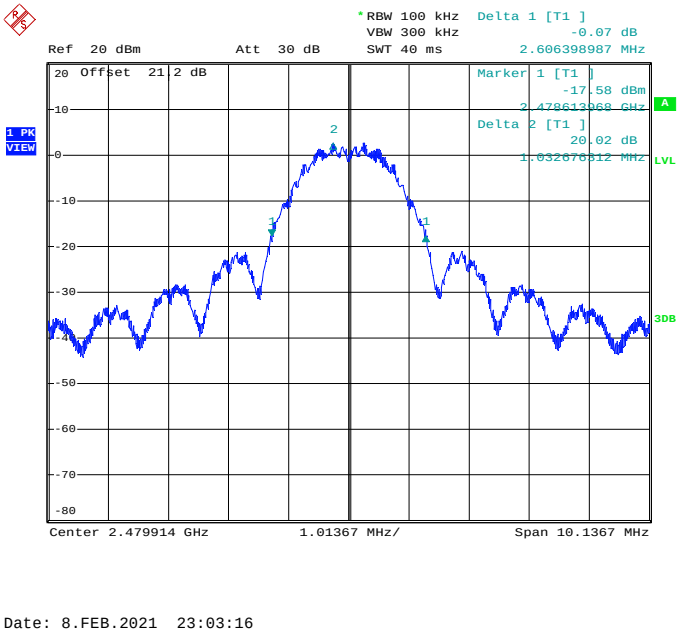


Figure 2.5.6-3: 20 dB Bandwidth Test Results – High Channel – AP1

Table 2.5.6-2: 20 dB Bandwidth Test Results – AP2

Frequency (MHz)	20 dB Bandwidth (MHz)
2405	2.5632
2440	2.5734
2480	2.6026

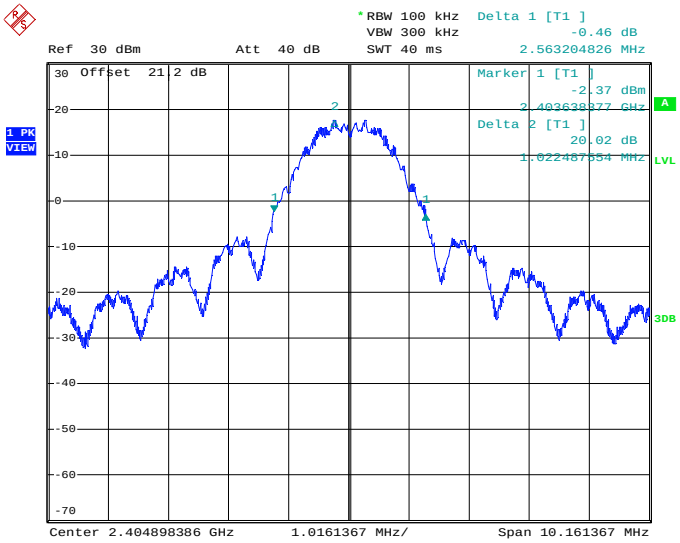


Figure 2.5.6-4: 20 dB Bandwidth Test Results – Low Channel – AP2

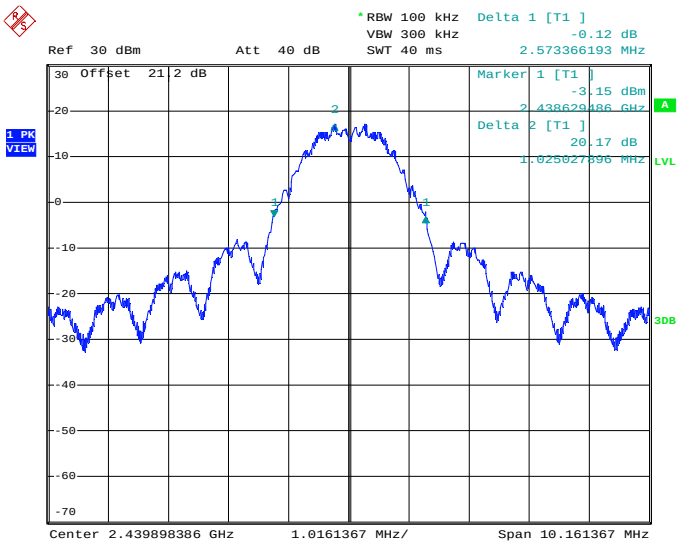


Figure 2.5.6-5: 20 dB Bandwidth Test Results – Middle Channel – AP2

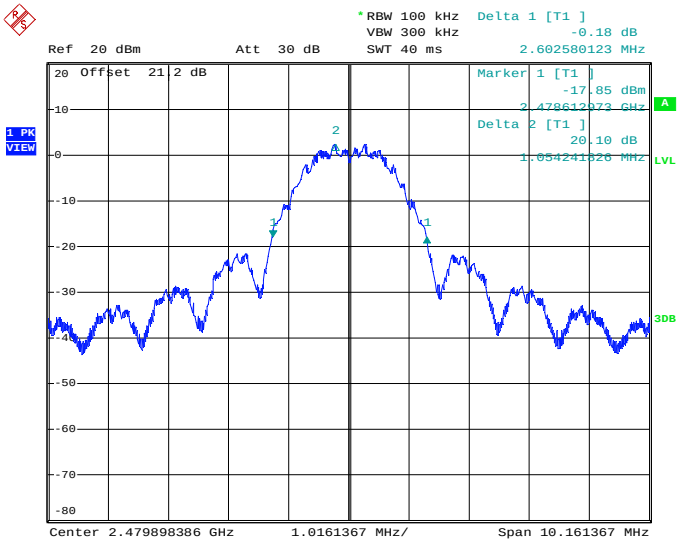


Figure 2.5.6-6: 20 dB Bandwidth Test Results – High Channel –AP2

Table 2.5.6-3: 20 dB Bandwidth Test Results – AS1

Frequency (MHz)	20 dB Bandwidth (MHz)
2405	2.5740
2440	2.5873
2480	2.6051

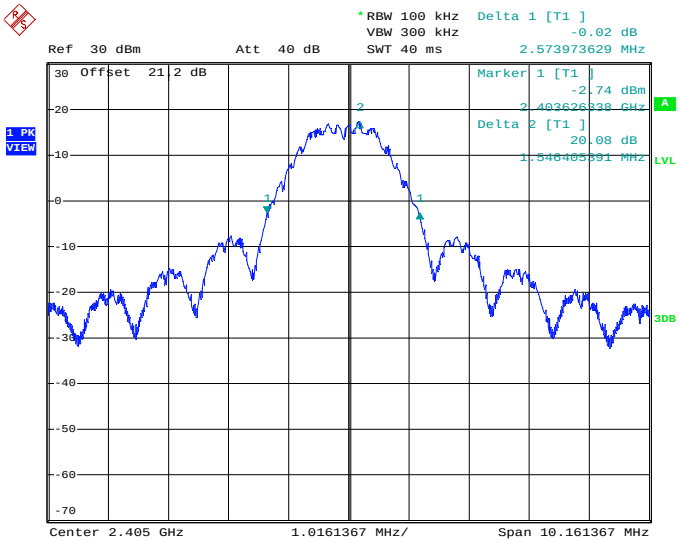


Figure 2.5.6-7: 20 dB Bandwidth Test Results – Low Channel – AS1

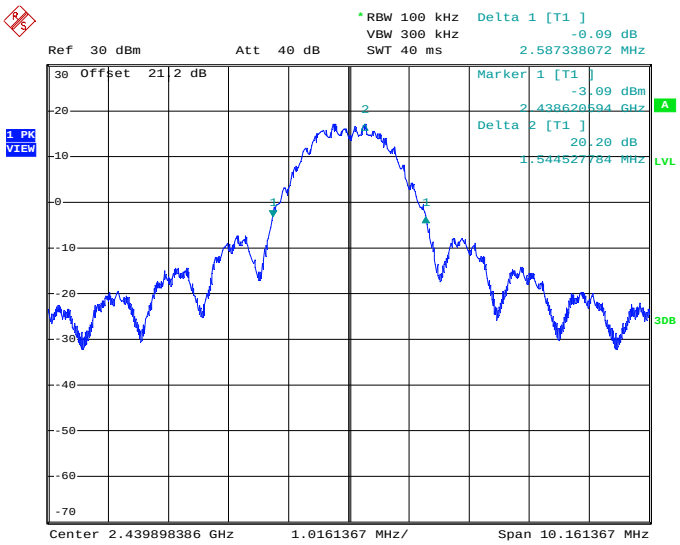


Figure 2.5.6-8: 20 dB Bandwidth Test Results – Middle Channel – AS1

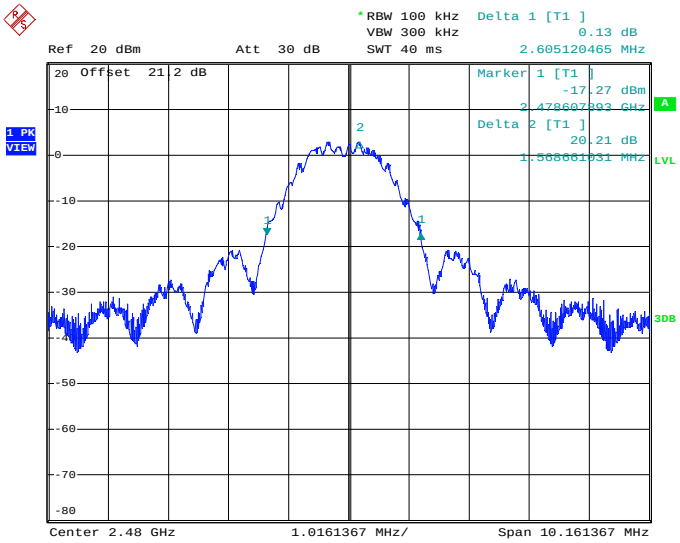


Figure 2.5.6-9: 20 dB Bandwidth Test Results – High Channel – AS1

Table 2.5.6-4: 20 dB Bandwidth Test Results – AS2

Frequency (MHz)	20 dB Bandwidth (MHz)
2405	2.5651
2440	2.5772
2480	2.6127

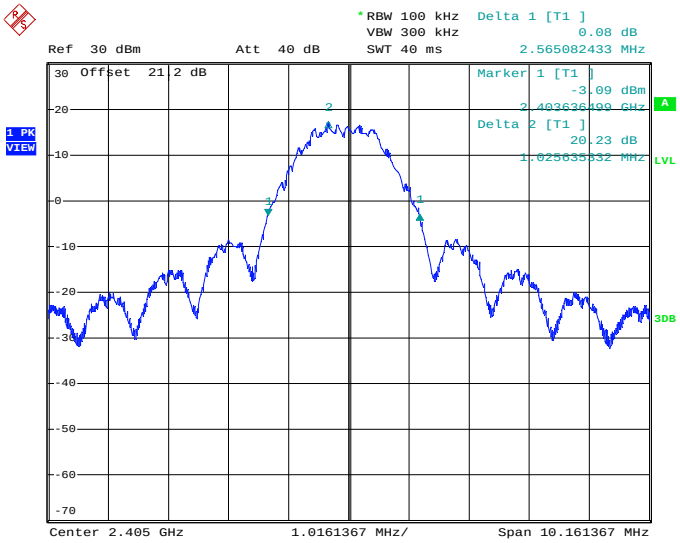


Figure 2.5.6-10: 20 dB Bandwidth Test Results – Low Channel – AS2

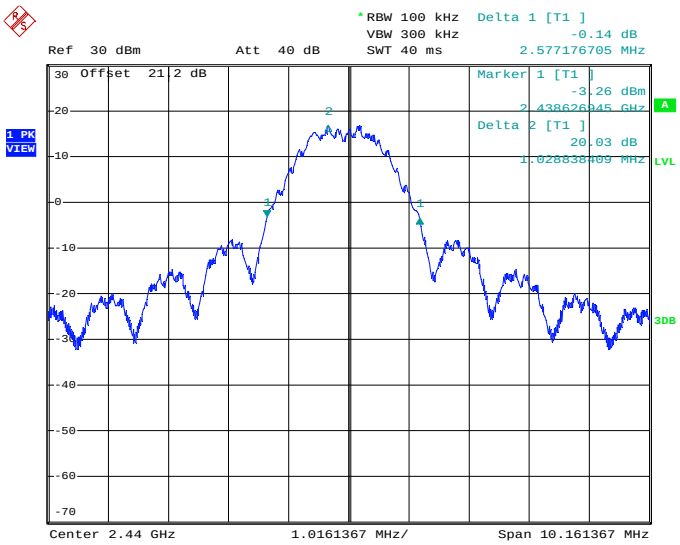


Figure 2.5.6-11: 20 dB Bandwidth Test Results – Middle Channel – AS2

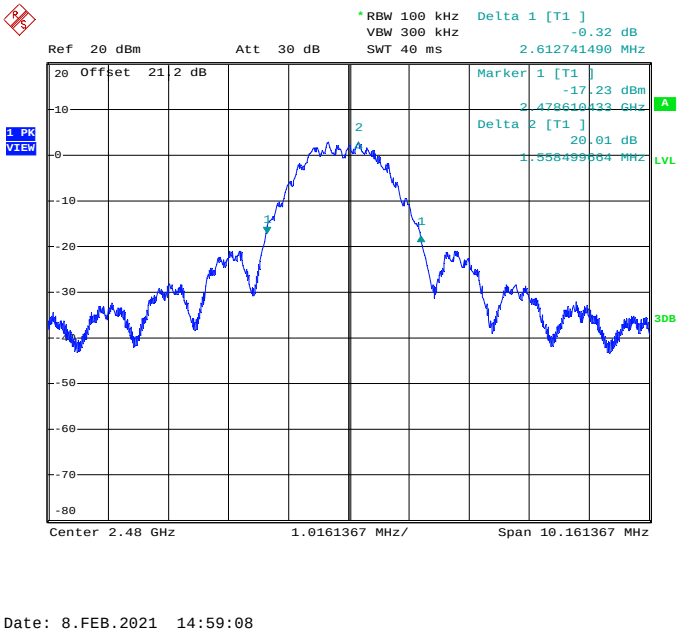


Figure 2.5.6-12: 20 dB Bandwidth Test Results – High Channel –AS2

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 26.5 GHz	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 99% Bandwidth

2.6.1 Specification Reference

ISED Canada: RSS-GEN 6.7

2.6.2 Equipment Under Test and Modification State

S/N: 203600148

2.6.3 Date of Test

2/2/2021 to 2/9/2021

2.6.4 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 the bandwidth measurement function of the spectrum analyzer with a peak detector.

2.6.5 Environmental Conditions

Ambient Temperature	24.2°C
Relative Humidity	45.3 %
Atmospheric Pressure	1020.2 mbar

2.6.6 Test Results

Battery Powered Operating

Limit Clause ISED RSS-GEN 6.6

Table 2.6.6-1: 99% Bandwidth Test Results - AP1

Frequency (MHz)	99% Bandwidth (MHz)
2405	2.2538
2440	2.3025
2480	2.3625

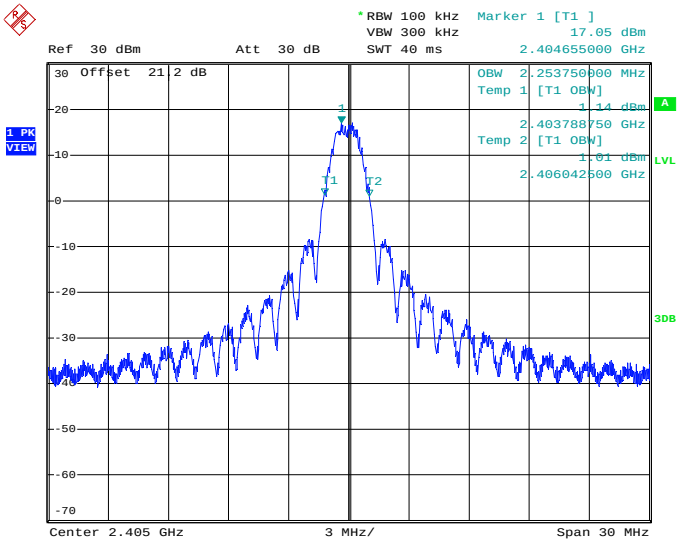


Figure 2.6.6- 1: 99% Bandwidth Test Results – Low Channel – AP1

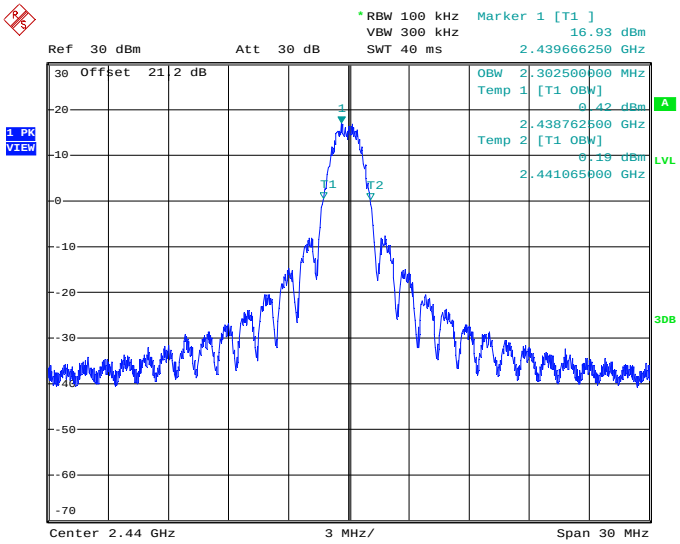


Figure 2.6.6- 2: 99% Bandwidth Test Results – Middle Channel – AP1

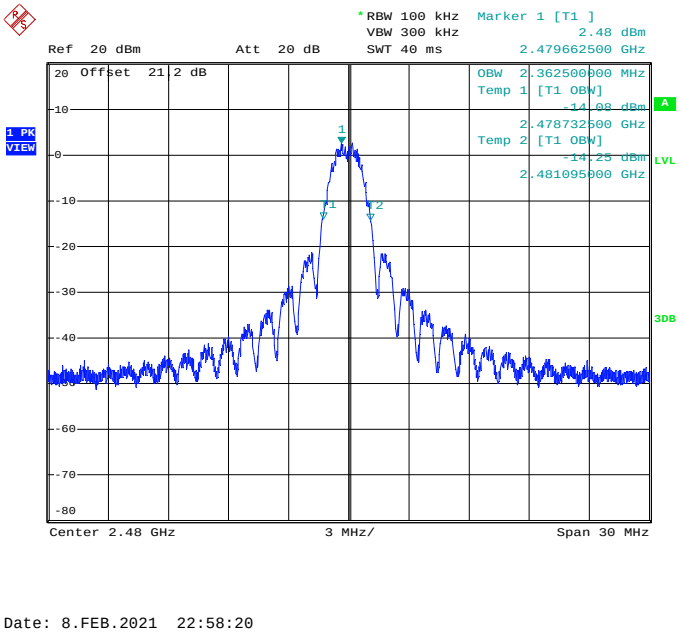


Figure 2.6.6- 3: 99% Bandwidth Test Results – High Channel – AP1

Table 2.6.6-2: 99% Bandwidth Test Results - AP2

Frequency (MHz)	99% Bandwidth (MHz)
2405	2.2388
2440	2.2613
2480	2.3700

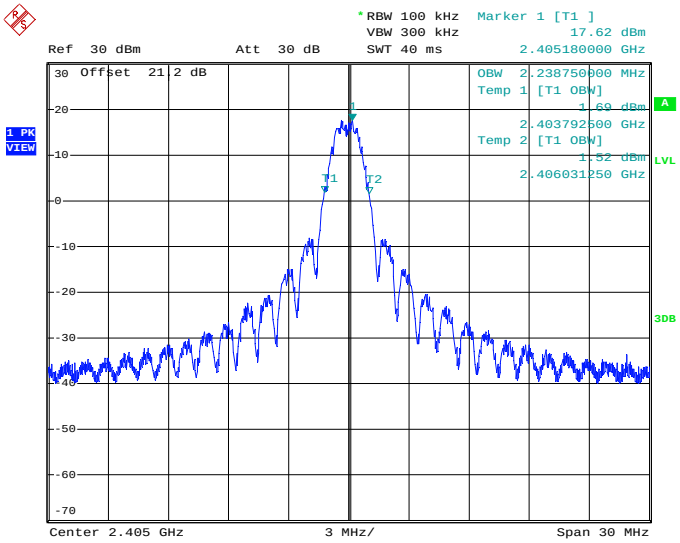


Figure 2.6.6- 4: 99% Bandwidth Test Results – Low Channel – AP2

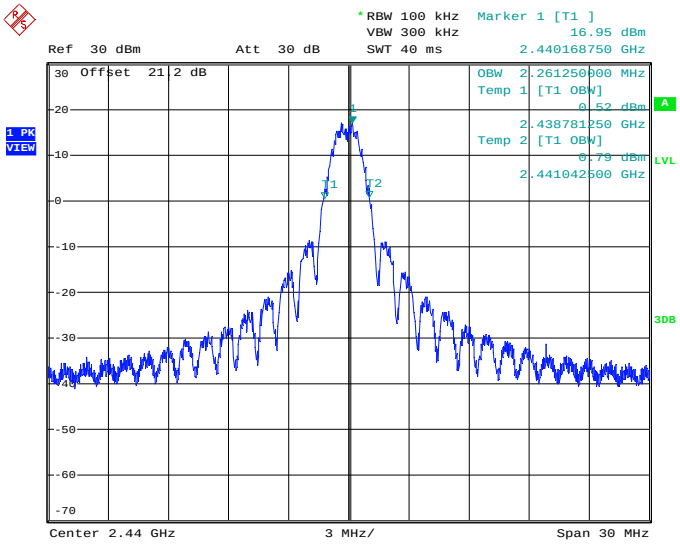


Figure 2.6.6- 5: 99% Bandwidth Test Results – Middle Channel – AP2

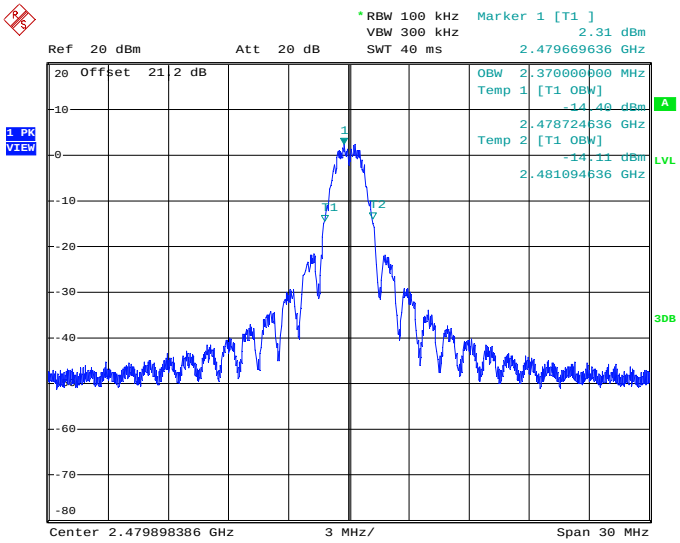


Figure 2.6.6- 6: 99% Bandwidth Test Results – High Channel – AP2

Table 2.6.6-3: 99% Bandwidth Test Results - AS1

Frequency (MHz)	99% Bandwidth (MHz)
2405	2.2725
2440	2.3063
2480	2.3513

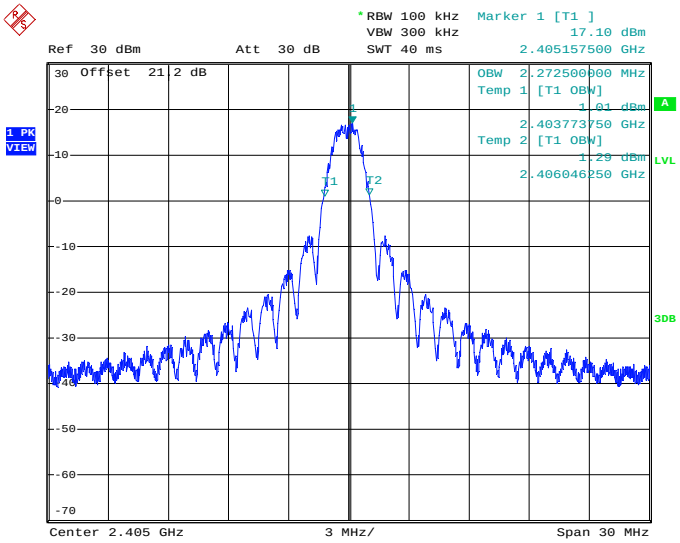


Figure 2.6.6- 7: 99% Bandwidth Test Results – Low Channel – AS1

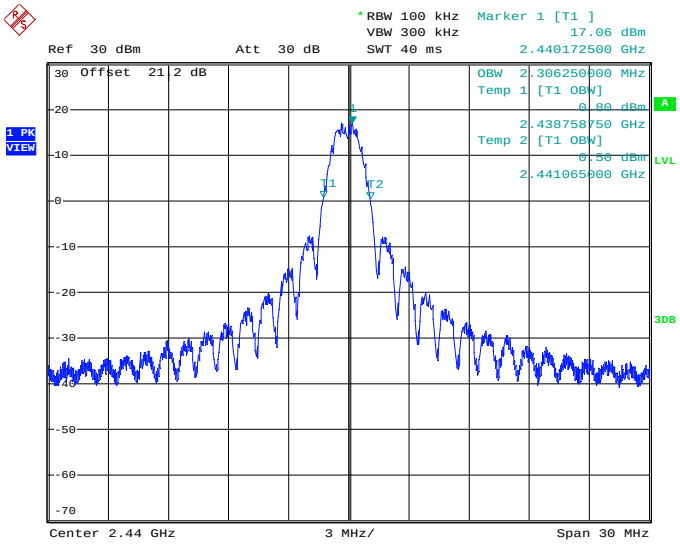


Figure 2.6.6- 8: 99% Bandwidth Test Results – Middle Channel – AS1

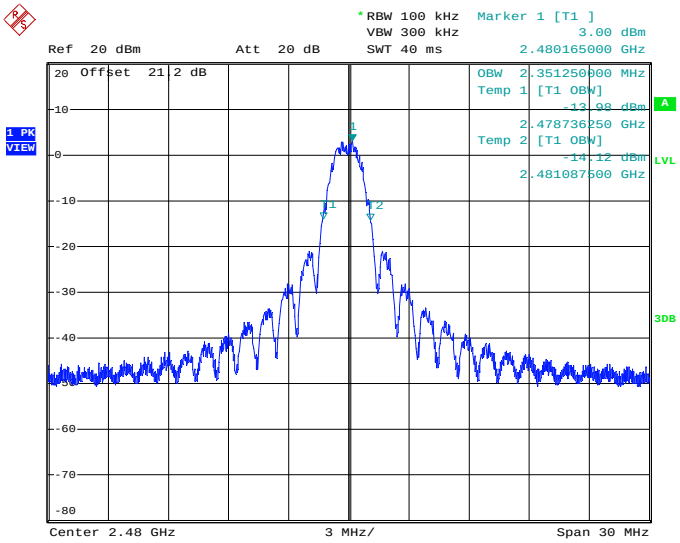


Figure 2.6.6- 9: 99% Bandwidth Test Results – High Channel – AS1

Table 2.6.6-4: 99% Bandwidth Test Results - AS2

Frequency (MHz)	99% Bandwidth (MHz)
2405	2.2500
2440	2.2913
2480	2.3663

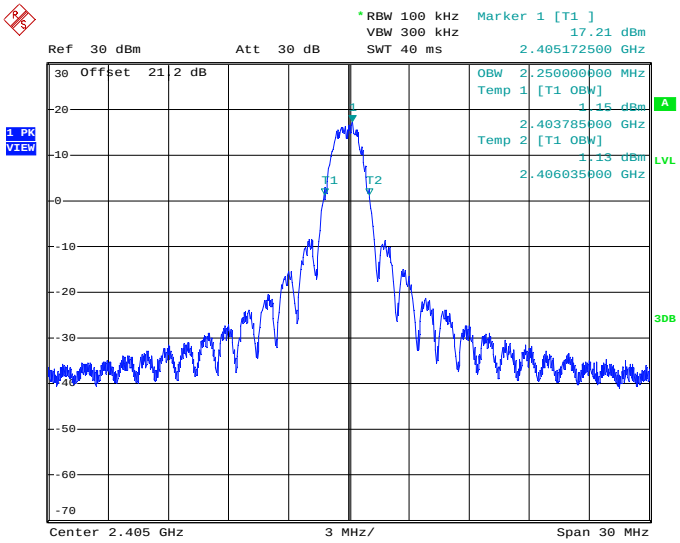


Figure 2.6.6- 10: 99% Bandwidth Test Results – Low Channel – AS2

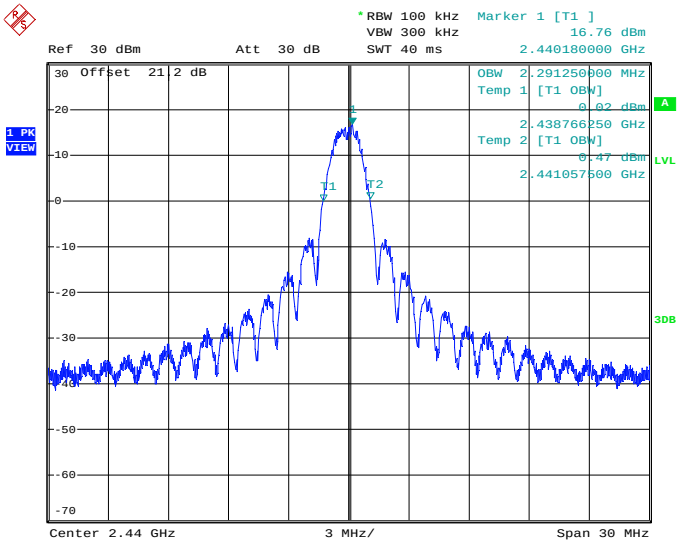


Figure 2.6.6- 11: 99% Bandwidth Test Results – Middle Channel – AS2

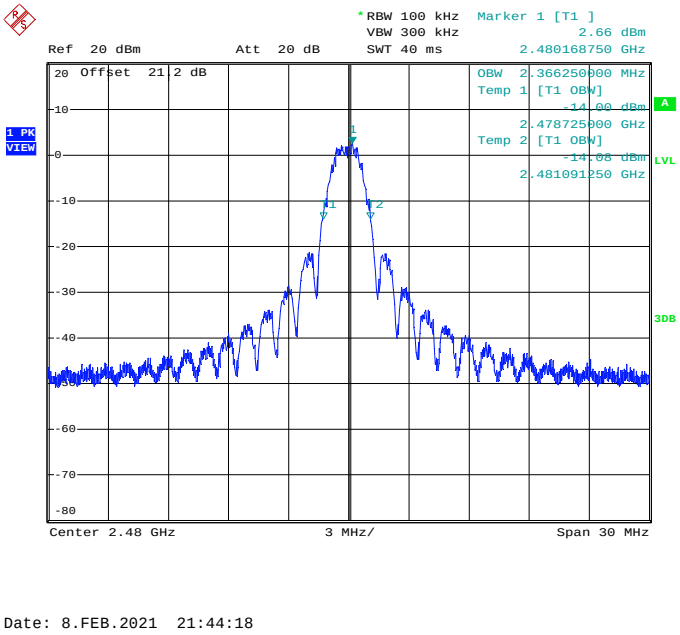


Figure 2.6.6- 12: 99% Bandwidth Test Results – High Channel – AS2

2.6.7 Test Location and Test Equipment Used

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

Instrument	Manufacturer	Type No	TE No	Software / Firmware Revision	Calibration Period (months)	Calibration Due
Spectrum Analyzer	Rohde & Schwarz	FSP40	BEMC00283	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 26.5 GHz	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 Peak Output Power

2.7.1 Specification Reference

FCC Section: 15.247(b)(1)
ISED Canada: RSS-247 5.4(b)

2.7.2 Equipment Under Test and Modification State

S/N: 203600148

2.7.3 Date of Test

2/2/2021 to 2/3/2021

2.7.4 Test Method

The fundamental emission output power was measured in accordance with ANSI 63.10 Subclause 7.8.5. The RF output of the equipment under test was directly connected to the input of the spectrum analyzer through suitable attenuation.

2.7.5 Environmental Conditions

Ambient Temperature	25.7°C
Relative Humidity	32.8 %
Atmospheric Pressure	1018.6 mbar

2.7.6 Test Results

Battery Powered Operating

Limit Clause FCC Part 15.247(b)(1), ISED RSS-247 5.4(b)

The Maximum Output Power allowed for frequency hopping systems employing at least 75 non-overlapping hopping channels is 1 Watt (30 dBm). For all other frequency hopping systems in the 2400 – 2483.5 MHz band the power limit is 0.125 watts (21 dBm).

Table 2.7.6-1: Peak Output Power Test Results – AP1

Frequency (MHz)	Power (dBm)
2405	19.65
2440	19.53
2480	5.86

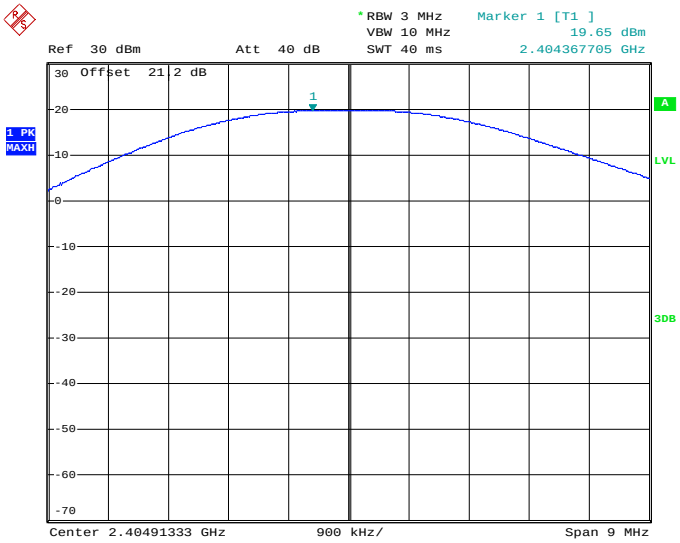


Figure 2.7.6-1: Peak Output Power Test Results – Low Channel – AP1

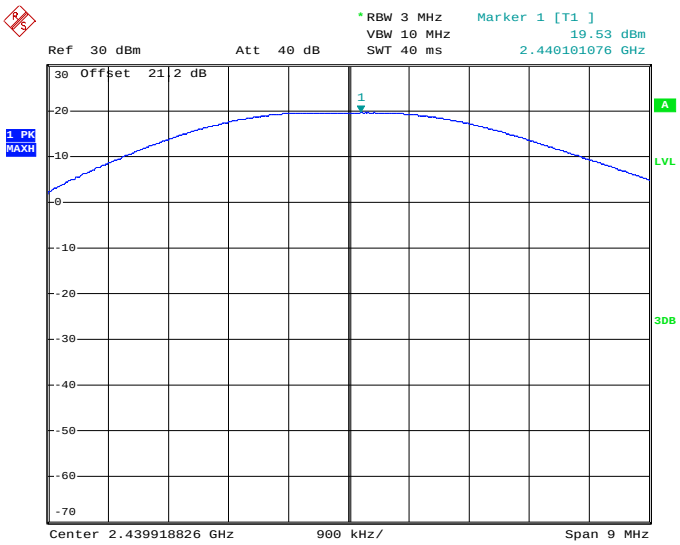


Figure 2.7.6-2: Peak Output Power Test Results – Middle Channel – AP1

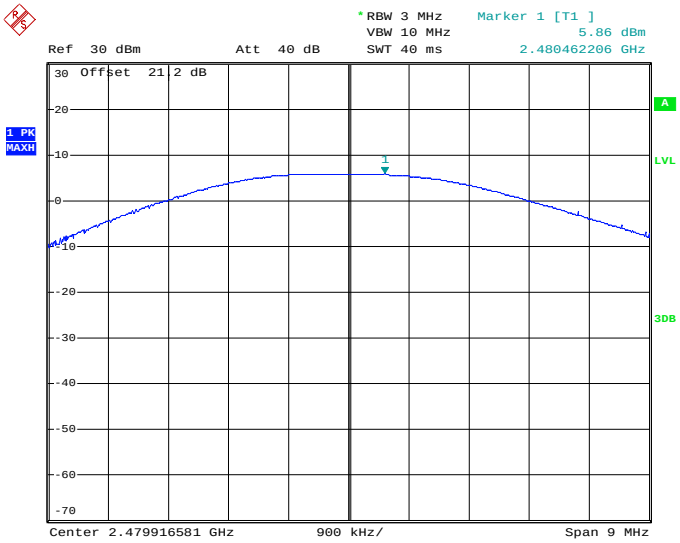


Figure 2.7.6-3: Peak Output Power Test Results – High Channel – AP1

Table 2.7.6-2: Peak Output Power Test Results – AP2

Frequency (MHz)	Power (dBm)
2405	20.14
2440	19.44
2480	5.67

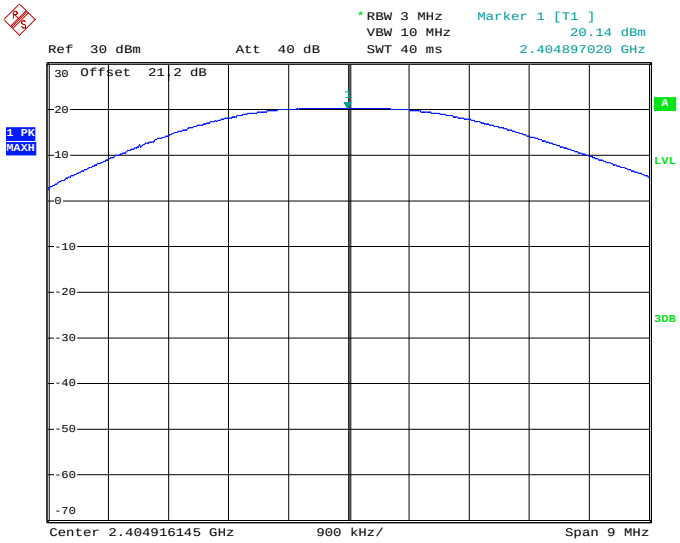


Figure 2.7.6-4: Peak Output Power Test Results – Low Channel – AP2

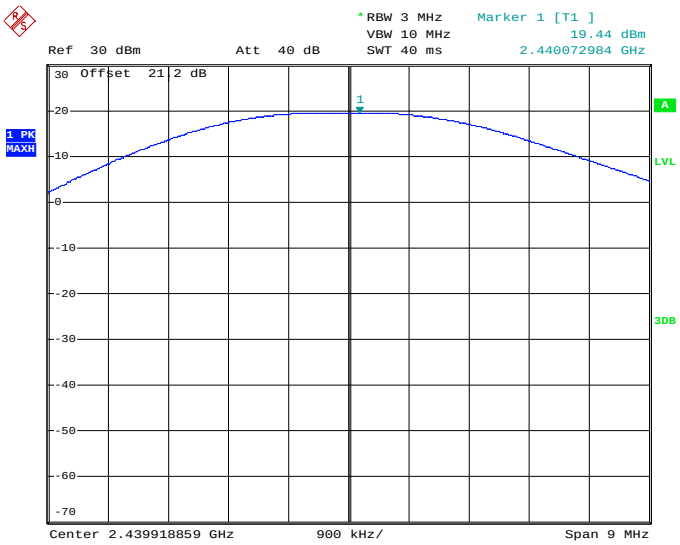


Figure 2.7.6-5: Peak Output Power Test Results – Middle Channel – AP2

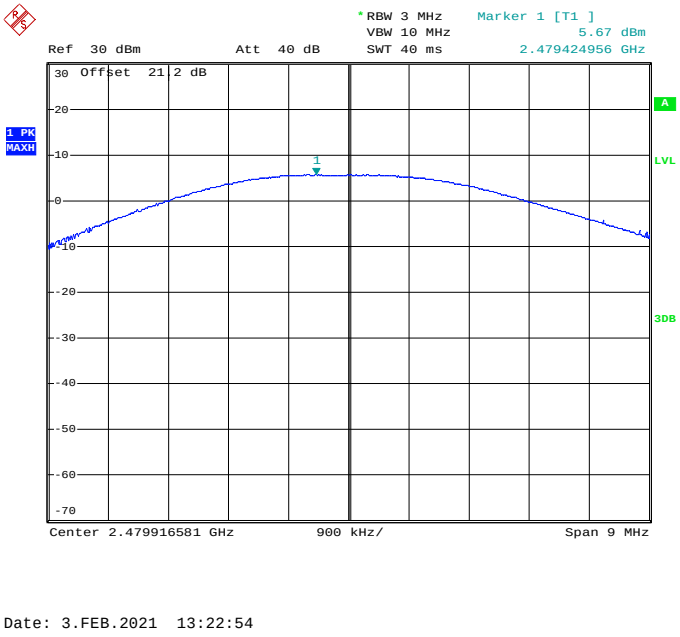


Figure 2.7.6-6: Peak Output Power Test Results – High Channel – AP2

Table 2.7.6-3: Peak Output Power Test Results – AS1

Frequency (MHz)	Power (dBm)
2405	19.87
2440	19.77
2480	6.35

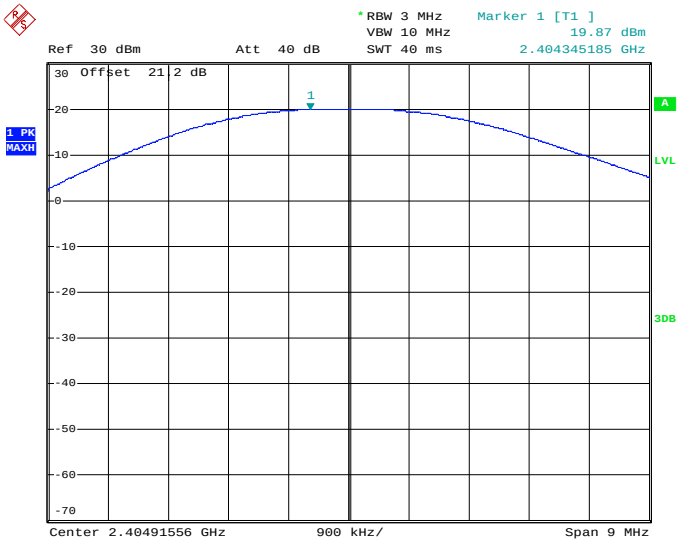


Figure 2.7.6-7: Peak Output Power Test Results – Low Channel – AS1

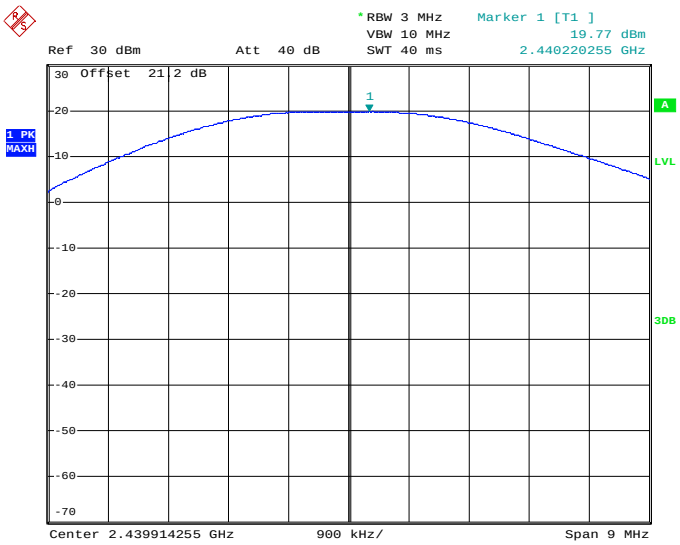


Figure 2.7.6-8: Peak Output Power Test Results – Middle Channel – AS1

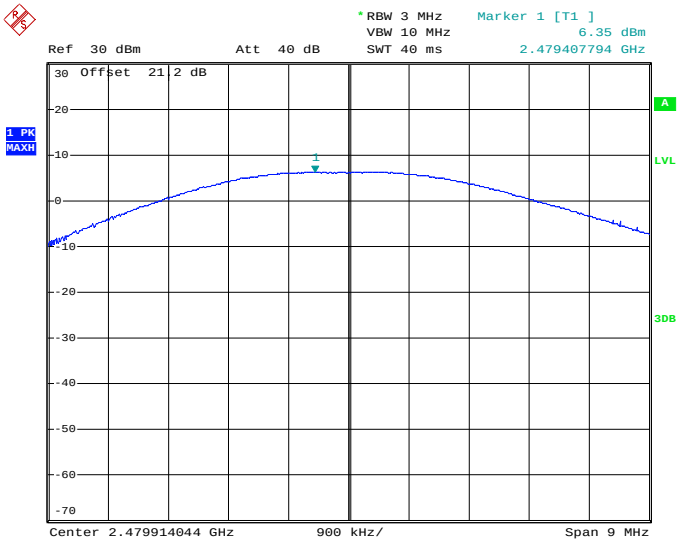


Figure 2.7.6-9: Peak Output Power Test Results – High Channel – AS1

Table 2.7.6-4: Peak Output Power Test Results – AS2

Frequency (MHz)	Power (dBm)
2405	19.80
2440	19.44
2480	6.25

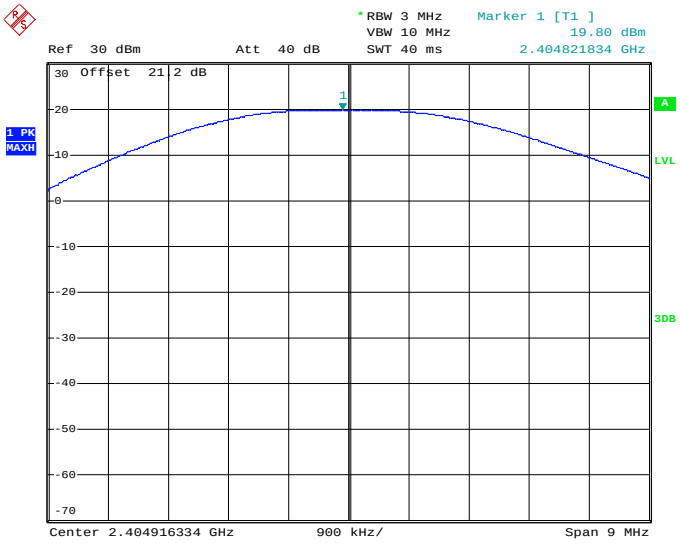


Figure 2.7.6-10: Peak Output Power Test Results – Low Channel – AS2

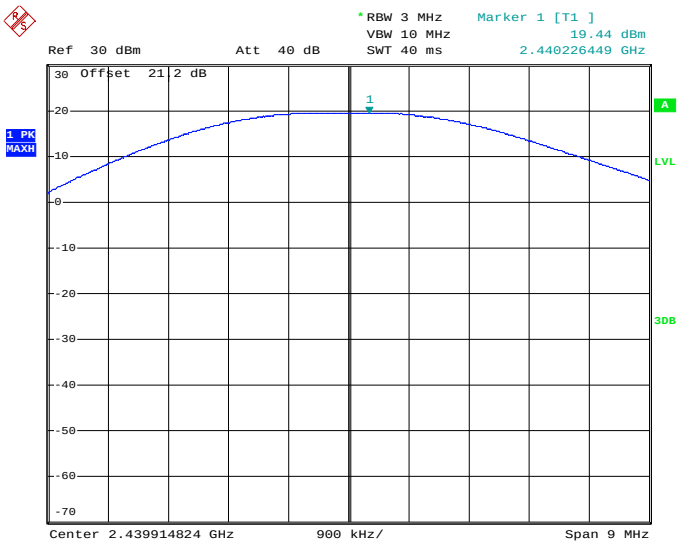


Figure 2.7.6-11: Peak Output Power Test Results – Middle Channel – AS2

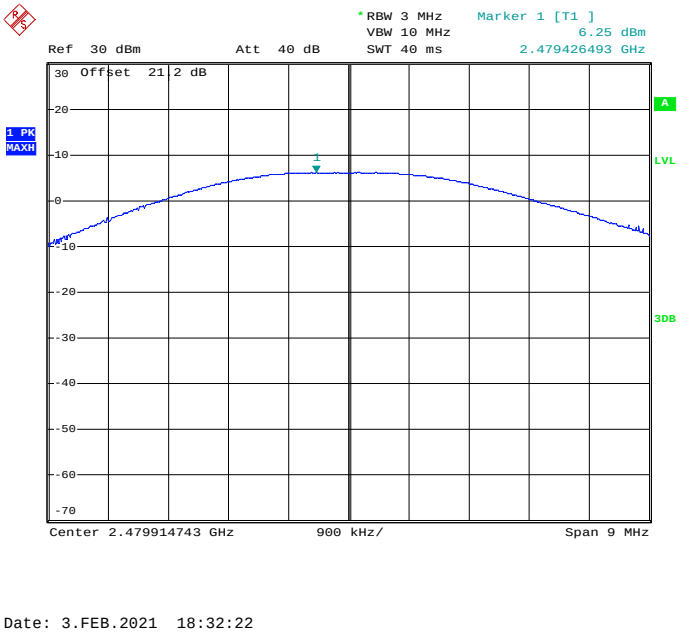


Figure 2.7.6-12: Peak Output Power Test Results – High Channel – AS2

2.7.7 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 26.5 GHz	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

2.8 Band-Edge Compliance of RF Conducted Emissions

2.8.1 Specification Reference

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

2.8.2 Equipment Under Test and Modification State

S/N: 203600148

2.8.3 Date of Test

2/2/2021 to 2/9/2021

2.8.4 Test Method

The RF Conducted Emissions at the Band-Edges were measured in accordance with Subclause 7.8.6 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 >= 300 kHz.

2.8.5 Environmental Conditions

Ambient Temperature	26.2 °C
Relative Humidity	31.9 %
Atmospheric Pressure	1017.8 mbar

2.8.6 Test Results

Battery 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.

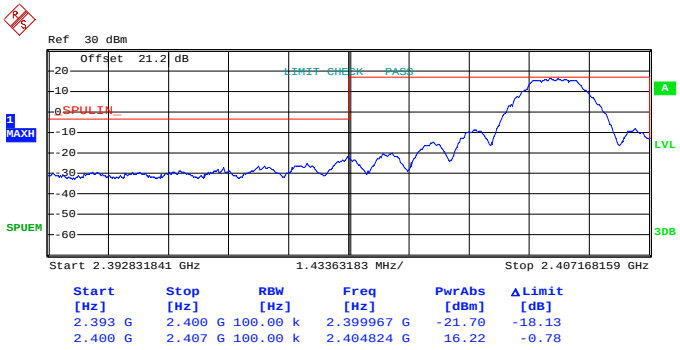


Figure 2.8.6- 1: RF Conducted Band-Edge – Not Hopping - Low Channel – AP1

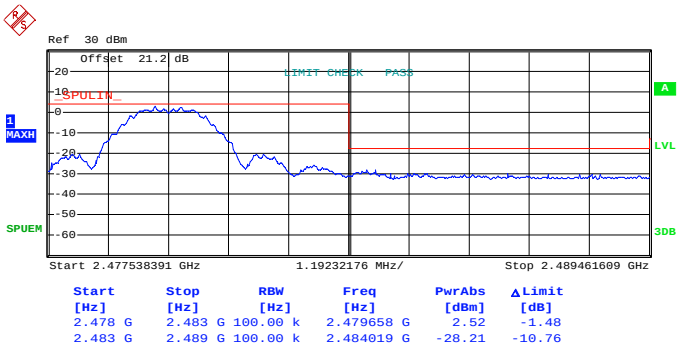


Figure 2.8.6- 2: RF Conducted Band-Edge – Not Hopping - High Channel – AP1

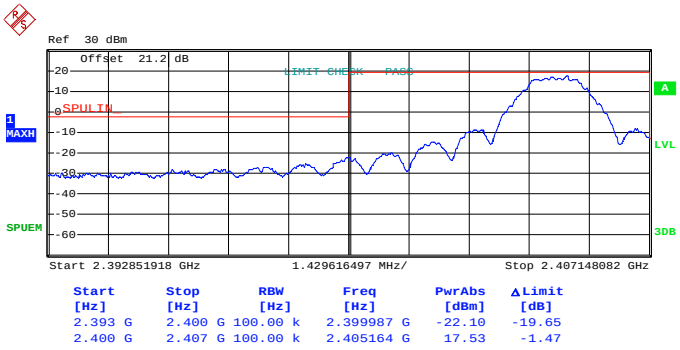


Figure 2.8.6- 3: RF Conducted Band-Edge – Not Hopping - Low Channel – AP2

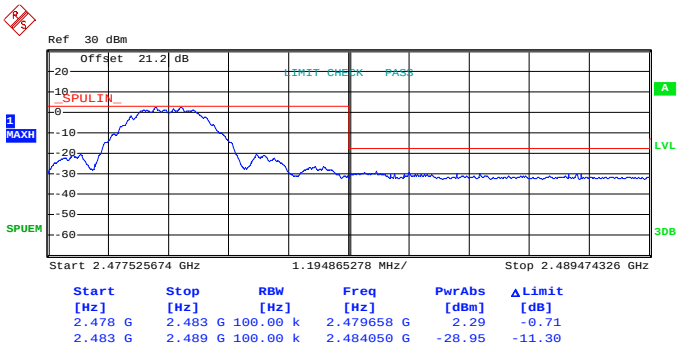


Figure 2.8.6- 4: RF Conducted Band-Edge – Not Hopping - High Channel – AP2

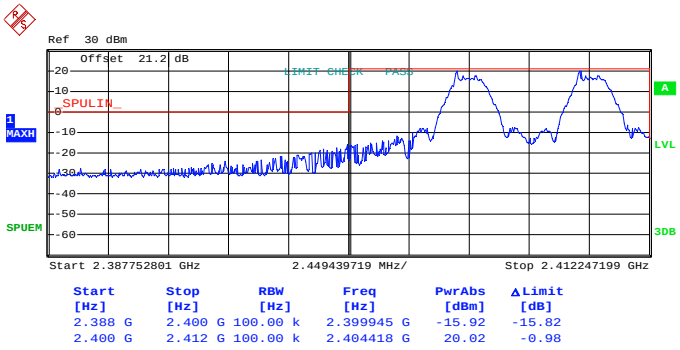


Figure 2.8.6- 5: RF Conducted Band-Edge – Worst-Case Hopping – AP2

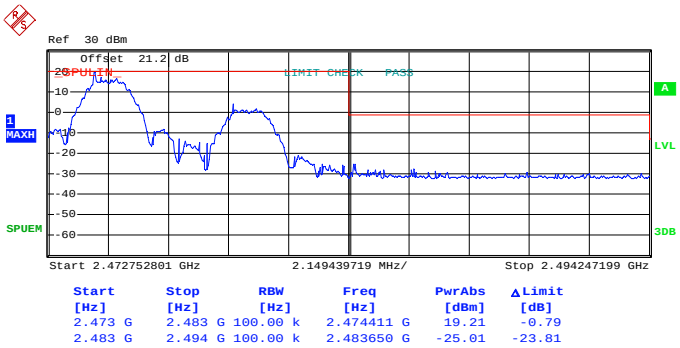


Figure 2.8.6- 6: RF Conducted Band-Edge – Worst-Case Hopping – AP2

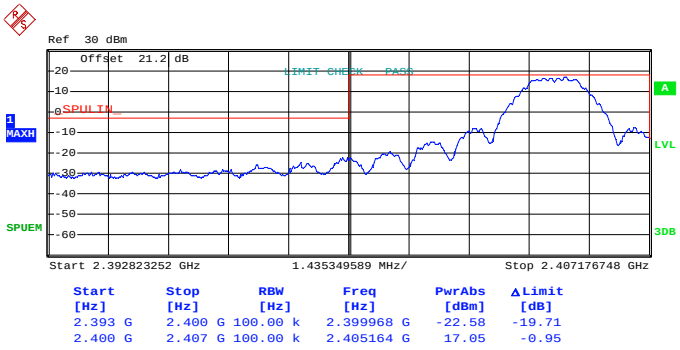


Figure 2.8.6- 7: RF Conducted Band-Edge – Not Hopping - Low Channel – AS1

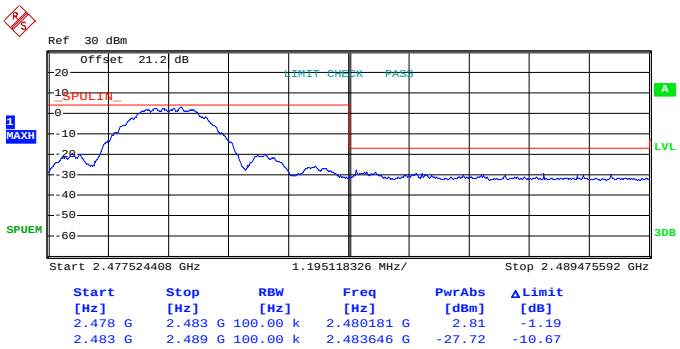


Figure 2.8.6- 8: RF Conducted Band-Edge – Not Hopping - High Channel – AS1

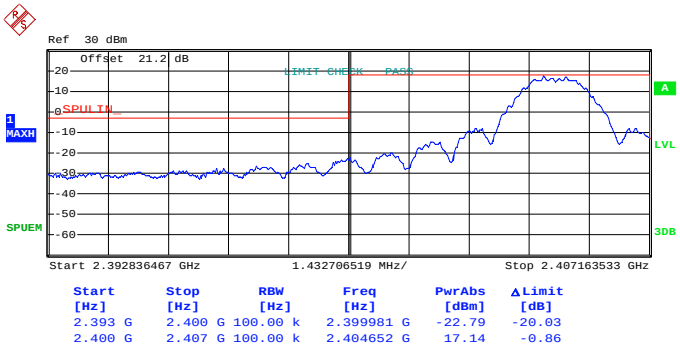


Figure 2.8.6- 9: RF Conducted Band-Edge – Not Hopping - Low Channel – AS2

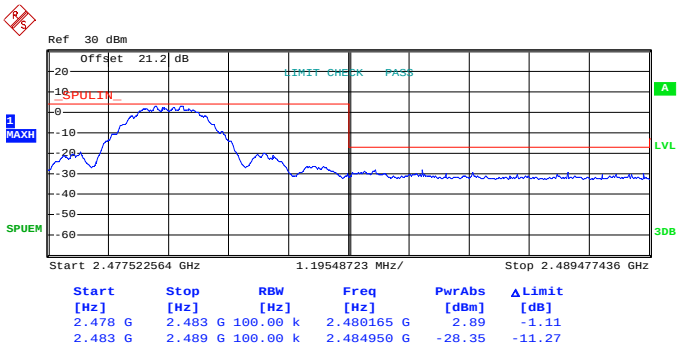
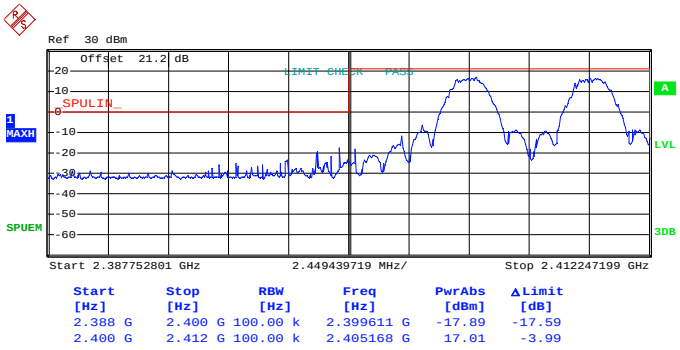


Figure 2.8.6- 10: RF Conducted Band-Edge – Not Hopping - High Channel – AS2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
2.388 G	2.400 G	100.00 k	2.399611 G	-17.89	-17.59
2.400 G	2.412 G	100.00 k	2.405168 G	17.01	-3.99

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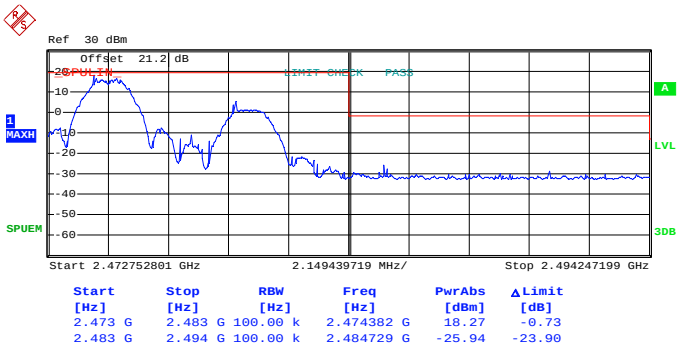
Figure 2.8.6- 11: RF Conducted Band-Edge – Worst-Case Hopping – AS2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
2.473 G	2.483 G	100.00 k	2.474382 G	18.27	-0.73
2.483 G	2.494 G	100.00 k	2.484729 G	-25.94	-23.90

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Figure 2.8.6- 12: RF Conducted Band-Edge –Worst-Case Hopping – AS2

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 26.5 GHz	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 RF Conducted Spurious Emissions

2.9.1 Specification Reference

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

2.9.2 Equipment Under Test and Modification State

S/N: 203600148

2.9.3 Date of Test

2/2/2021 to 2/3/2021

2.9.4 Test Method

The RF Conducted Spurious Emissions were measured in accordance with Subclause 7.8.8 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.

2.9.5 Environmental Conditions

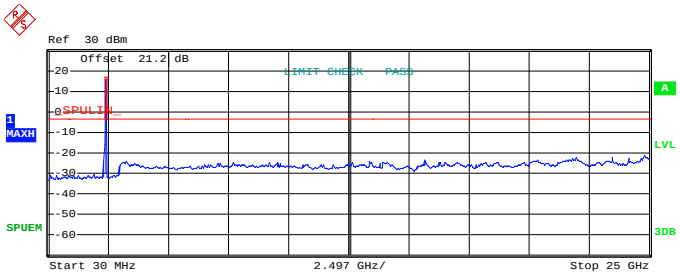
Ambient Temperature	25.2 °C
Relative Humidity	33.4 %
Atmospheric Pressure	1018.7 mbar

2.9.6 Test Results

Battery 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.



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	113.821000 M	-31.13	-27.56
902.000 M	928.000 M	100.00 k	909.644000 M	-31.09	-27.52
928.000 M	2.400 G	100.00 k	2.399816 G	-27.01	-23.44
2.400 G	2.483 G	100.00 k	2.404822 G	15.86	-1.14
2.483 G	5.725 G	100.00 k	3.273616 G	-24.19	-20.62
5.725 G	5.850 G	100.00 k	5.749344 G	-26.75	-23.18
5.850 G	13.500 G	100.00 k	13.346044 G	-24.13	-20.56
13.500 G	20.000 G	100.00 k	15.675875 G	-23.77	-20.21
20.000 G	25.000 G	100.00 k	24.800625 G	-21.40	-17.84

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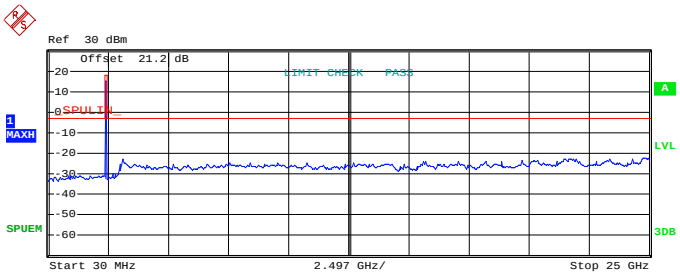
Figure 2.9.6-1: Conducted Spurious Emissions – Low Channel – AP1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	351.986000 M	-31.53	-28.25
902.000 M	928.000 M	100.00 k	919.803500 M	-30.98	-27.70
928.000 M	2.400 G	100.00 k	984.672000 M	-31.17	-27.89
2.400 G	2.483 G	100.00 k	2.439840 G	15.13	-2.87
2.483 G	5.725 G	100.00 k	3.144766 G	-23.05	-19.77
5.725 G	5.850 G	100.00 k	5.804188 G	-26.12	-22.84
5.850 G	13.500 G	100.00 k	12.691012 G	-24.71	-21.44
13.500 G	20.000 G	100.00 k	19.683937 G	-23.72	-20.45
20.000 G	25.000 G	100.00 k	24.728125 G	-22.11	-18.84

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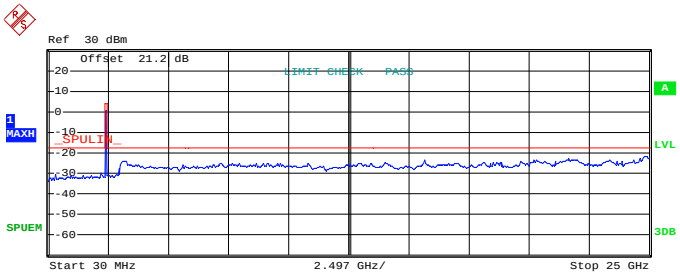
Figure 2.9.6-2: Conducted Spurious Emissions – Middle Channel – AP1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	339.342000 M	-30.72	-13.28
902.000 M	928.000 M	100.00 k	902.201500 M	-31.73	-14.29
928.000 M	2.400 G	100.00 k	2.240840 G	-29.94	-12.49
2.400 G	2.483 G	100.00 k	2.479482 G	0.75	-3.25
2.483 G	5.725 G	100.00 k	3.162189 G	-24.11	-6.66
5.725 G	5.850 G	100.00 k	5.731156 G	-26.61	-9.16
5.850 G	13.500 G	100.00 k	7.686956 G	-25.05	-7.61
13.500 G	20.000 G	100.00 k	15.682375 G	-23.76	-6.31
20.000 G	25.000 G	100.00 k	24.784375 G	-21.59	-4.14

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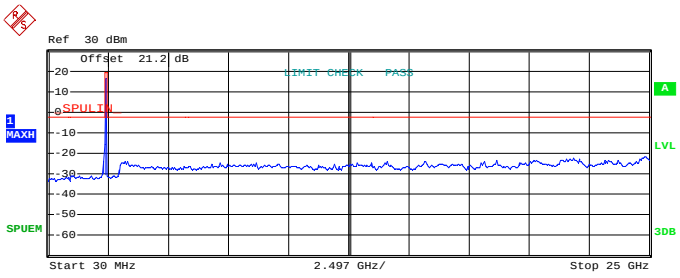
Figure 2.9.6-3: Conducted Spurious Emissions – High Channel – AP1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	779.484000 M	-31.97	-29.51
902.000 M	928.000 M	100.00 k	926.267750 M	-31.89	-29.44
928.000 M	2.400 G	100.00 k	2.399816 G	-26.34	-23.89
2.400 G	2.483 G	100.00 k	2.404822 G	16.26	-2.74
2.483 G	5.725 G	100.00 k	3.208380 G	-24.20	-21.75
5.725 G	5.850 G	100.00 k	5.746516 G	-26.79	-24.34
5.850 G	13.500 G	100.00 k	12.852619 G	-24.51	-22.06
13.500 G	20.000 G	100.00 k	18.672375 G	-23.76	-21.31
20.000 G	25.000 G	100.00 k	24.847500 G	-21.47	-19.01

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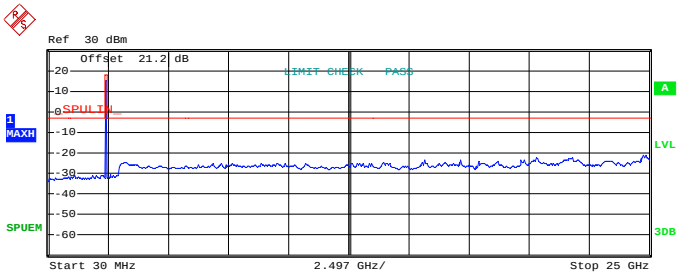
Figure 2.9.6-4: Conducted Spurious Emissions – Low Channel– AP2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	820.795000 M	-32.05	-28.81
902.000 M	928.000 M	100.00 k	913.297000 M	-31.62	-28.38
928.000 M	2.400 G	100.00 k	1.109792 G	-30.89	-27.65
2.400 G	2.483 G	100.00 k	2.440017 G	15.09	-2.91
2.483 G	5.725 G	100.00 k	3.208786 G	-24.49	-21.25
5.725 G	5.850 G	100.00 k	5.753984 G	-26.60	-23.36
5.850 G	13.500 G	100.00 k	13.457925 G	-24.99	-21.75
13.500 G	20.000 G	100.00 k	15.650688 G	-23.58	-20.34
20.000 G	25.000 G	100.00 k	24.870625 G	-21.34	-18.10

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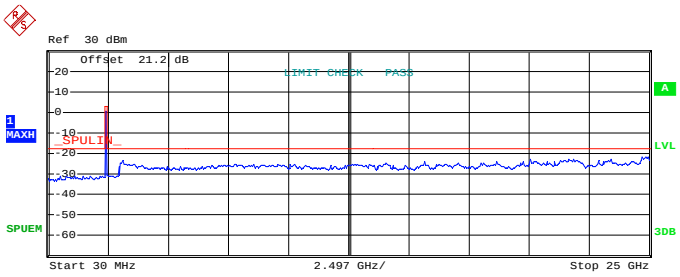
Figure 2.9.6-5: Conducted Spurious Emissions – Middle Channel – AP2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	789.730000 M	-30.90	-13.26
902.000 M	928.000 M	100.00 k	904.158000 M	-31.45	-13.81
928.000 M	2.400 G	100.00 k	2.262000 G	-30.97	-13.33
2.400 G	2.483 G	100.00 k	2.479816 G	0.75	-2.25
2.483 G	5.725 G	100.00 k	3.120860 G	-23.62	-5.98
5.725 G	5.850 G	100.00 k	5.799750 G	-26.79	-9.14
5.850 G	13.500 G	100.00 k	7.771106 G	-25.10	-7.46
13.500 G	20.000 G	100.00 k	19.779000 G	-24.23	-6.58
20.000 G	25.000 G	100.00 k	24.930625 G	-21.64	-4.00

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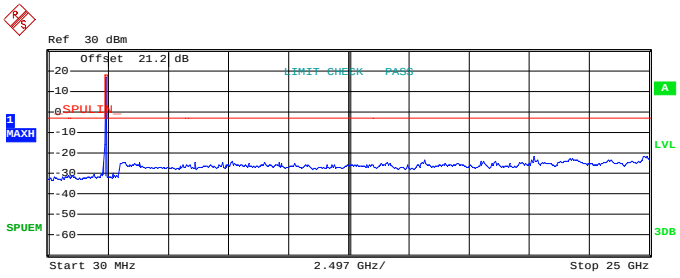
Figure 2.9.6-6: Conducted Spurious Emissions – High Channel – AP2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	710.705000 M	-31.59	-28.72
902.000 M	928.000 M	100.00 k	903.439750 M	-30.86	-27.99
928.000 M	2.400 G	100.00 k	2.399816 G	-26.54	-23.67
2.400 G	2.483 G	100.00 k	2.405177 G	17.12	-0.88
2.483 G	5.725 G	100.00 k	3.154896 G	-24.39	-21.52
5.725 G	5.850 G	100.00 k	5.767594 G	-26.05	-23.18
5.850 G	13.500 G	100.00 k	7.674525 G	-24.32	-21.45
13.500 G	20.000 G	100.00 k	15.660438 G	-23.78	-20.91
20.000 G	25.000 G	100.00 k	24.805625 G	-21.75	-18.88

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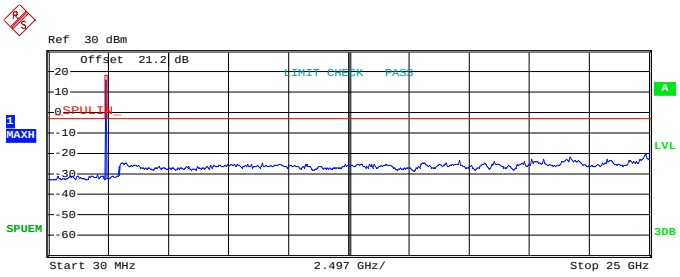
Figure 2.9.6-7: Conducted Spurious Emissions – Low Channel – AS1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	452.811000 M	-31.29	-28.26
902.000 M	928.000 M	100.00 k	923.869250 M	-31.66	-28.63
928.000 M	2.400 G	100.00 k	2.089224 G	-30.72	-27.69
2.400 G	2.483 G	100.00 k	2.439673 G	15.42	-2.58
2.483 G	5.725 G	100.00 k	3.114782 G	-24.74	-21.71
5.725 G	5.850 G	100.00 k	5.752422 G	-26.41	-23.39
5.850 G	13.500 G	100.00 k	8.916694 G	-24.89	-21.86
13.500 G	20.000 G	100.00 k	17.101000 G	-23.34	-20.31
20.000 G	25.000 G	100.00 k	24.827500 G	-20.32	-17.29

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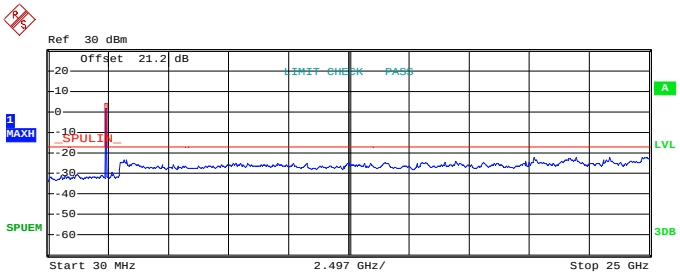
Figure 2.9.6-8: Conducted Spurious Emissions – Middle Channel – AS1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	705.582000 M	-31.23	-14.18
902.000 M	928.000 M	100.00 k	912.416250 M	-31.48	-14.43
928.000 M	2.400 G	100.00 k	1.232152 G	-30.60	-13.55
2.400 G	2.483 G	100.00 k	2.480003 G	1.83	-2.17
2.483 G	5.725 G	100.00 k	3.292254 G	-23.58	-6.53
5.725 G	5.850 G	100.00 k	5.735469 G	-26.45	-9.40
5.850 G	13.500 G	100.00 k	7.829438 G	-25.03	-7.98
13.500 G	20.000 G	100.00 k	16.971812 G	-23.90	-6.85
20.000 G	25.000 G	100.00 k	24.893125 G	-22.10	-5.04

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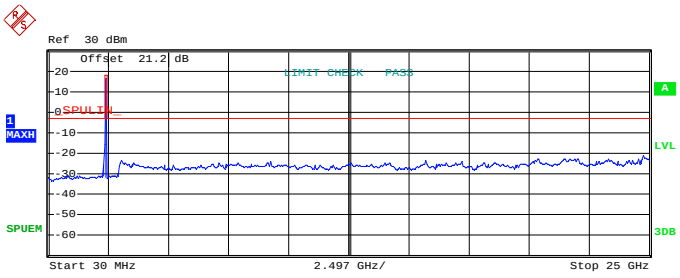
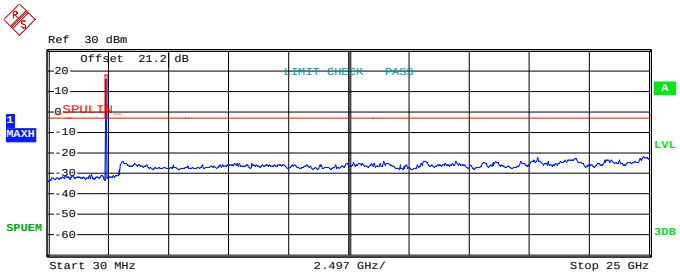
Figure 2.9.6-9: Conducted Spurious Emissions – High Channel – AS1



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	885.432000 M	-31.20	-28.44
902.000 M	928.000 M	100.00 k	920.086250 M	-30.99	-28.23
928.000 M	2.400 G	100.00 k	2.399816 G	-26.03	-23.27
2.400 G	2.483 G	100.00 k	2.405167 G	16.17	-1.83
2.483 G	5.725 G	100.00 k	3.052383 G	-23.47	-20.71
5.725 G	5.850 G	100.00 k	5.734031 G	-26.82	-24.05
5.850 G	13.500 G	100.00 k	9.287719 G	-24.31	-21.54
13.500 G	20.000 G	100.00 k	15.710000 G	-23.62	-20.86
20.000 G	25.000 G	100.00 k	24.769375 G	-21.42	-18.66

Date: 3.FEB.2021 19:55:33

Figure 2.9.6-10: Conducted Spurious Emissions – Low Channel– AS2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	719.425000 M	-31.08	-27.77
902.000 M	928.000 M	100.00 k	914.229750 M	-31.57	-28.25
928.000 M	2.400 G	100.00 k	1.806048 G	-30.82	-27.50
2.400 G	2.483 G	100.00 k	2.439819 G	15.65	-2.35
2.483 G	5.725 G	100.00 k	3.126127 G	-24.33	-21.01
5.725 G	5.850 G	100.00 k	5.804688 G	-26.70	-23.38
5.850 G	13.500 G	100.00 k	12.730219 G	-24.51	-21.19
13.500 G	20.000 G	100.00 k	15.684813 G	-24.12	-20.80
20.000 G	25.000 G	100.00 k	24.739375 G	-21.76	-18.45

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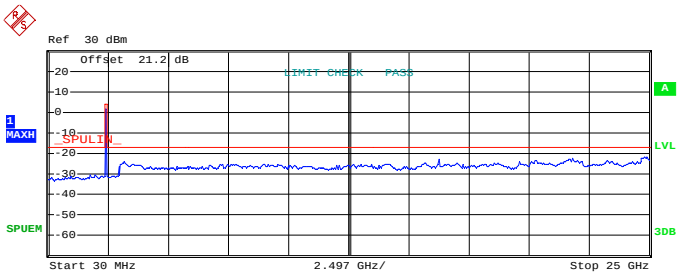
Figure 2.9.6-11: Conducted Spurious Emissions – Middle Channel – AS2



Start [Hz]	Stop [Hz]	RBW [Hz]	Freq [Hz]	PwrAbs [dBm]	ΔLimit [dB]
30.000 M	902.000 M	100.00 k	168.321000 M	-31.41	-14.34
902.000 M	928.000 M	100.00 k	926.995750 M	-31.75	-14.67
928.000 M	2.400 G	100.00 k	2.001824 G	-30.63	-13.56
2.400 G	2.483 G	100.00 k	2.479826 G	1.54	-2.46
2.483 G	5.725 G	100.00 k	3.161379 G	-24.14	-7.07
5.725 G	5.850 G	100.00 k	5.817734 G	-26.39	-9.32
5.850 G	13.500 G	100.00 k	9.559294 G	-24.99	-7.92
13.500 G	20.000 G	100.00 k	16.269000 G	-23.16	-6.08
20.000 G	25.000 G	100.00 k	24.785625 G	-21.62	-4.55

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Figure 2.9.6-12: Conducted Spurious Emissions – High Channel – AS2

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 26.5 GHz	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 Radiated Spurious Emissions into Restricted Frequency Bands

2.10.1 Specification Reference

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

2.10.2 Equipment Under Test and Modification State

S/N: 203600148

2.10.3 Date of Test

11/12/2020 to 2/1/2021

2.10.4 Test Method

Radiated emissions tests were made over the frequency range of 9 kHz to 25 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.

2.10.5 Duty Cycle Correction

The EUT was transmitting at 100 % duty cycle during the evaluation. A duty cycle correction factor corresponding to the logarithm of the dwell time was used for the average measurements.

Duty Cycle Correction = 20*log(2.025/100) = -33.87 dB

2.10.6 Environmental Conditions

Ambient Temperature	28.4 °C
Relative Humidity	44.9 %
Atmospheric Pressure	1015.9 mbar

2.10.7 Test Results

Battery 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 2.10.7-1: TX Radiated Spurious Emissions Results – Primary Antennas (AP1/AP2)

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
2390	61.67	51.90	H	-5.22	56.45	12.81	74.0	54.0	17.5	41.2
2390	66.89	58.11	V	-5.22	61.67	19.02	74.0	54.0	12.3	35.0
4810	49.62	42.38	H	-0.21	49.41	8.30	74.0	54.0	24.6	45.7
4810	50.00	43.10	V	-0.21	49.79	9.02	74.0	54.0	24.2	45.0
12025	48.59	41.69	H	11.45	60.04	19.27	74.0	54.0	14.0	34.7
12025	48.01	41.39	V	11.45	59.46	18.97	74.0	54.0	14.5	35.0
19240	46.62	39.03	H	11.74	58.36	16.90	83.5	63.5	25.1	46.6
19240	47.76	40.83	V	11.74	59.50	18.70	83.5	63.5	24.0	44.8
Middle Channel										
4880	49.27	42.04	H	-0.09	49.18	8.08	74.0	54.0	24.8	45.9
4880	48.98	41.99	V	-0.09	48.89	8.03	74.0	54.0	25.1	46.0
7320	67.64	62.48	H	3.71	71.35	32.32	74.0	54.0	2.6	21.7
7320	64.28	59.00	V	3.71	67.99	28.84	74.0	54.0	6.0	25.2
12200	47.86	41.14	H	11.07	58.93	18.34	74.0	54.0	15.1	35.7
12200	43.52	36.09	V	11.07	54.59	13.29	74.0	54.0	19.4	40.7
19520	43.36	34.20	H	11.64	55.00	11.97	83.5	63.5	28.5	51.5
19520	43.15	33.87	V	11.64	54.79	11.64	83.5	63.5	28.7	51.9
High Channel										
2483.5	68.25	57.95	H	-5.05	63.20	19.02	74.0	54.0	10.8	35.0
2483.5	77.60	68.28	V	-5.05	72.55	29.35	74.0	54.0	1.5	24.6
4960	42.51	30.38	H	0.05	42.56	-3.44	74.0	54.0	31.4	57.4
4960	42.83	30.46	V	0.05	42.88	-3.36	74.0	54.0	31.1	57.4
7440	41.70	28.93	H	3.81	45.51	-1.14	74.0	54.0	28.5	55.1
7440	41.29	28.76	V	3.81	45.10	-1.31	74.0	54.0	28.9	55.3

Notes:

- **All emissions in the restricted bands above 19.52 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **The average measurements were corrected using a duty cycle correction factor corresponding to the logarithm of the dwell time over 100 ms.**
- **The emissions above 18 GHz were assessed a test distance of 1m. The limits are adjusted accordingly.**
- **The emissions generated by the digital circuits were assessed in the SDOC test report.**

Table 2.10.7-2: TX Radiated Spurious Emissions Results – Secondary Antennas (AS1/AS2)

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Low Channel										
2390	61.26	51.36	H	-5.22	56.04	12.27	74.0	54.0	18.0	41.7
2390	58.20	47.44	V	-5.22	52.98	8.35	74.0	54.0	21.0	45.6
4810	51.88	45.65	H	-0.21	51.67	11.57	74.0	54.0	22.3	42.4
4810	53.63	47.50	V	-0.21	53.42	13.42	74.0	54.0	20.6	40.6
12025	45.98	39.38	H	11.45	57.43	16.96	74.0	54.0	16.6	37.0
12025	44.70	37.34	V	11.45	56.15	14.92	74.0	54.0	17.8	39.1
19240	48.16	41.27	H	11.74	59.90	19.14	83.5	63.5	23.6	44.4
19240	46.86	39.80	V	11.74	58.60	17.67	83.5	63.5	24.9	45.8
Middle Channel										
4880	56.98	50.74	H	-0.09	56.89	16.78	74.0	54.0	17.1	37.2
4880	56.31	50.15	V	-0.09	56.22	16.19	74.0	54.0	17.8	37.8
7320	68.75	63.14	H	3.71	72.46	32.98	74.0	54.0	1.5	21.0
7320	58.06	52.15	V	3.71	61.77	21.99	74.0	54.0	12.2	32.0
12200	51.13	44.82	H	11.07	62.20	22.02	74.0	54.0	11.8	32.0
12200	47.42	40.36	V	11.07	58.49	17.56	74.0	54.0	15.5	36.4
19520	51.70	44.00	H	11.64	63.34	21.77	83.5	63.5	20.2	41.7
19520	48.28	40.07	V	11.64	59.92	17.84	83.5	63.5	23.6	45.7
High Channel										
2483.5	76.45	66.89	H	-5.05	71.40	27.96	74.0	54.0	2.6	26.0
2483.5	68.94	58.83	V	-5.05	63.89	19.90	74.0	54.0	10.1	34.1
4960	45.32	35.29	H	0.05	45.37	1.47	74.0	54.0	28.6	52.5
4960	45.60	35.64	V	0.05	45.65	1.82	74.0	54.0	28.3	52.2
7440	42.19	29.79	V	3.81	46.00	-0.28	74.0	54.0	28.0	54.3

Notes:

- **All emissions in the restricted bands above 19.52 GHz were attenuated below the limits and the noise floor of the measurement equipment.**
- **The average measurements were corrected using a duty cycle correction factor corresponding to the logarithm of the dwell time over 100 ms.**
- **The emissions above 18 GHz were assessed a test distance of 1m. The limits are adjusted accordingly.**
- **The emissions generated by the digital circuits were assessed in the SDOC test report.**

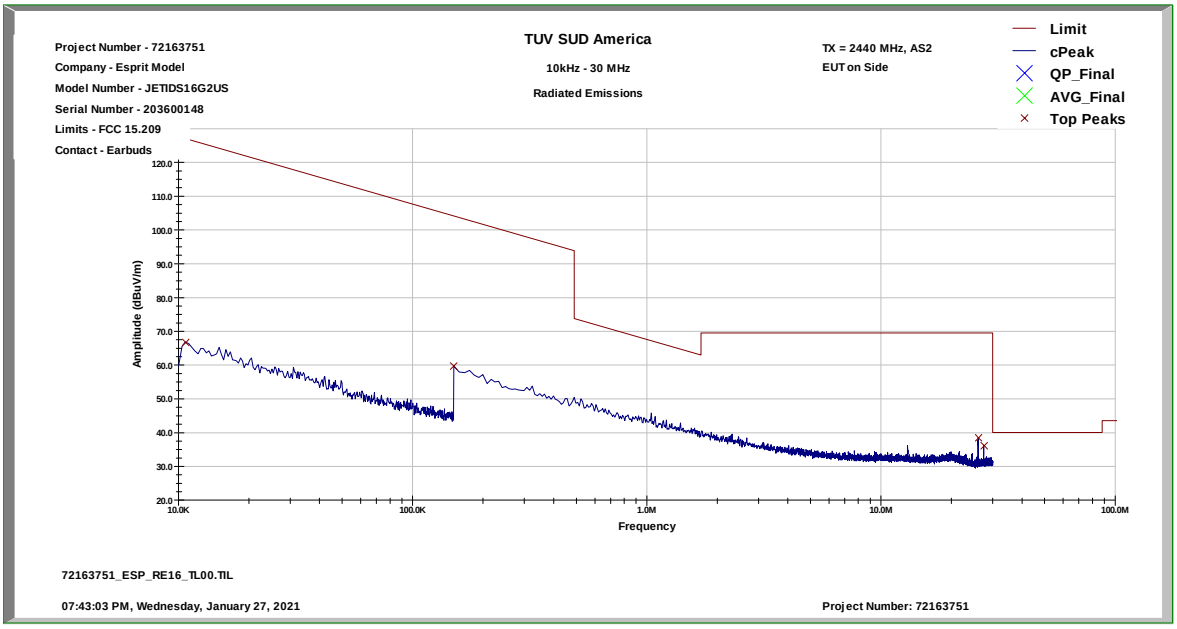

Figure 2.10.7-1: TX Radiated Spurious Emissions – Pre-Scan Plot below 30 MHz

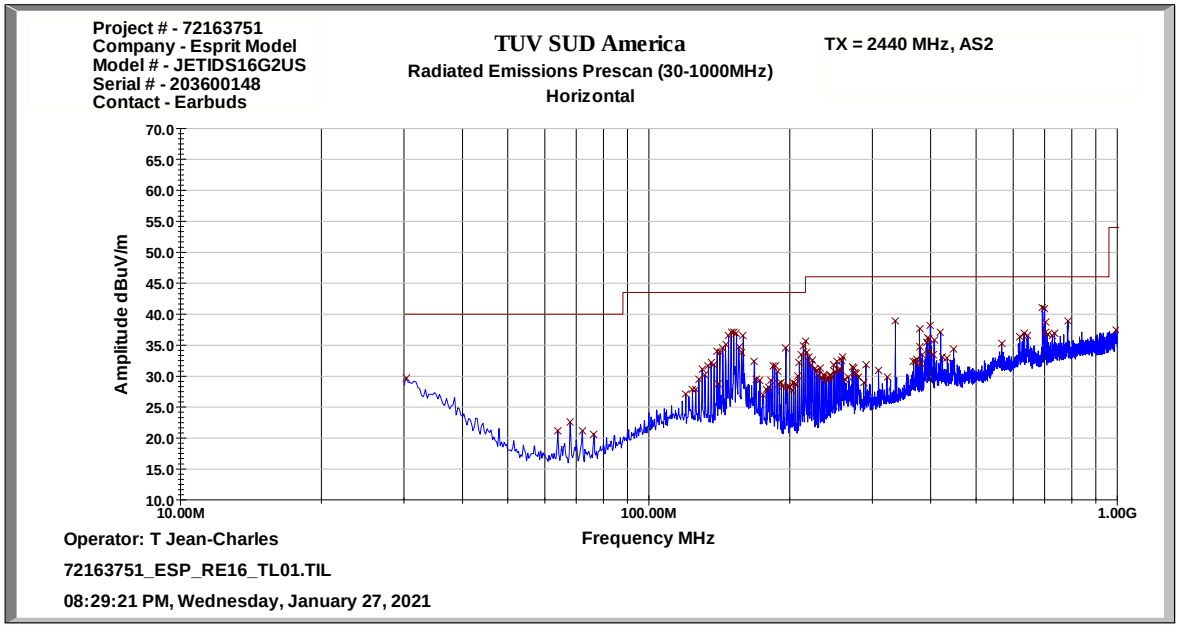

Figure 2.10.7-2: TX Radiated Spurious Emissions – Pre-Scan Plot 30 MHz – 1 GHz – Horizontal Polarization

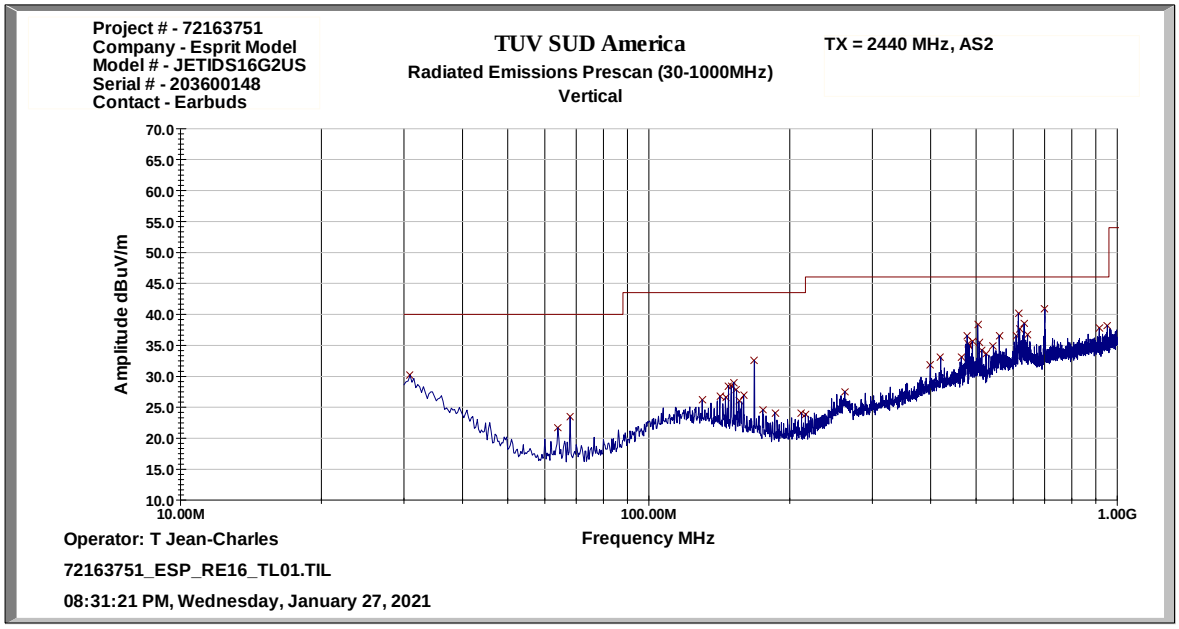

Figure 2.10.7-3: TX Radiated Spurious Emissions – Pre-Scan Plot 30 MHz – 1 GHz – Vertical Polarization

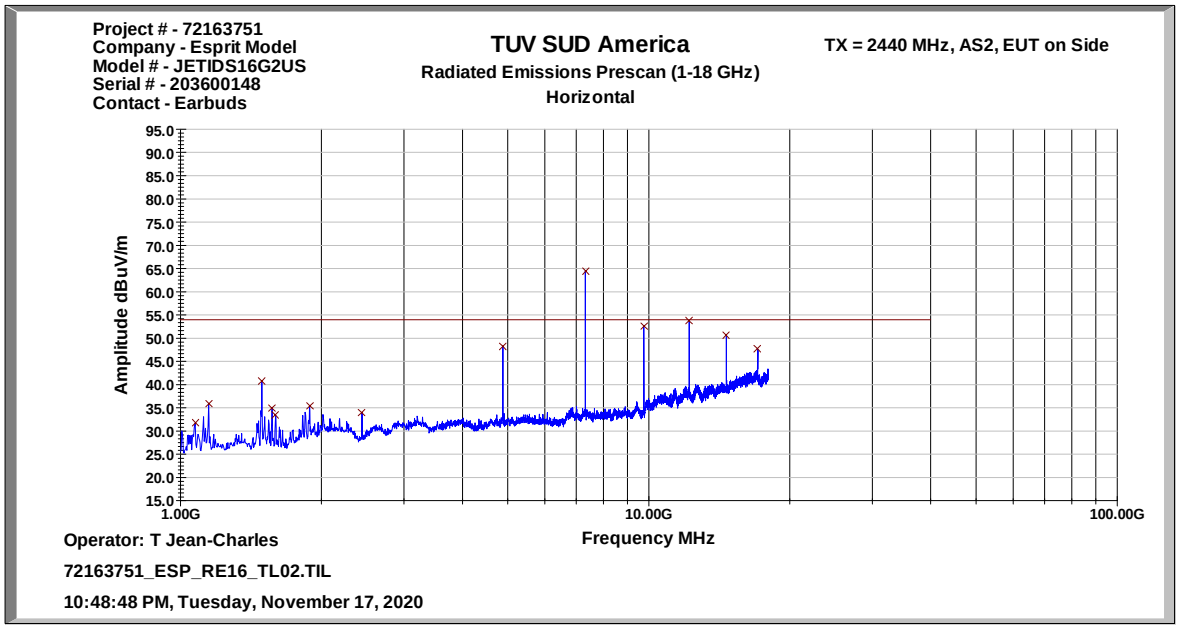

Figure 2.10.7-4: TX Radiated Spurious Emissions – Pre-Scan Plot 1 GHz – 18 GHz – Horizontal Polarization

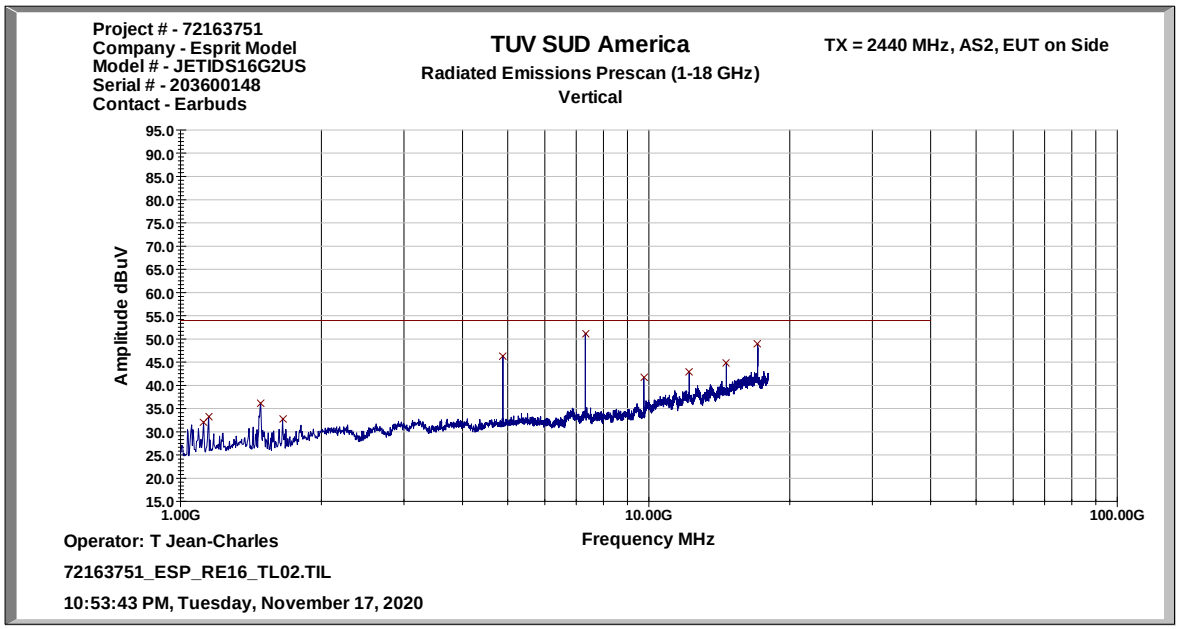

Figure 2.10.7-5: TX Radiated Spurious Emissions – Pre-Scan Plot 1 GHz – 18 GHz – Vertical Polarization

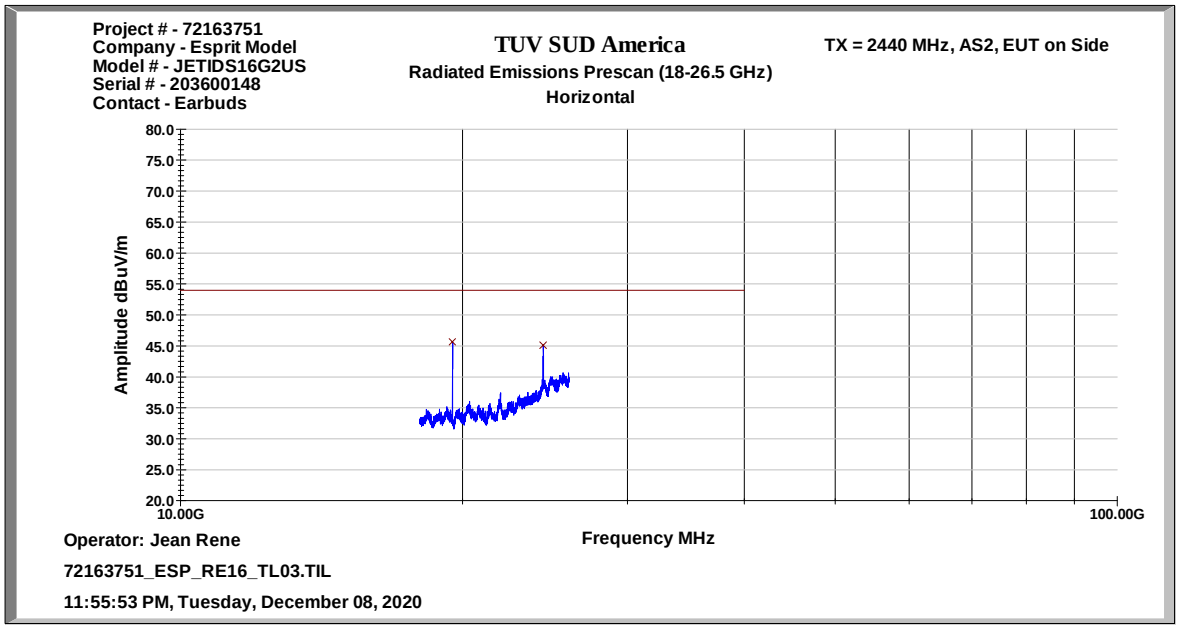

Figure 2.10.7-6: TX Radiated Spurious Emissions – Pre-Scan Plot 18 GHz – 26 GHz – Horizontal Polarization

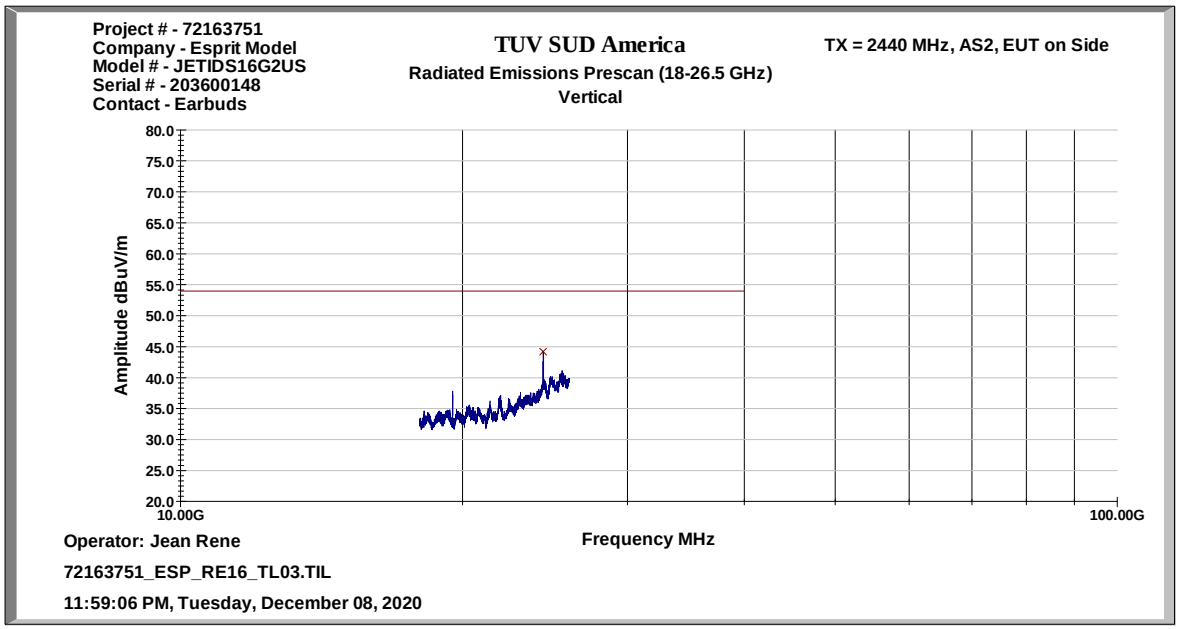

Figure 2.10.7-7: TX Radiated Spurious Emissions – Pre-Scan Plot 18 GHz – 26 GHz – Vertical Polarization

2.10.8 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: 61.67 + (-5.22) = 56.45 dBµV/m
Margin: 74 dBµV/m – 56.45 dBµV/m = 17.55 dB

Example Calculation: Average
Corrected Level: 51.9 + (-5.22) -33.87 = 12.81 dBµV/m
Margin: 54 dBµV/m – 12.81 dBµV/m = 41.19 dB

2.10.9 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
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
EMC Analyzer	Agilent	E7405A	TEMC00012	A.09.02	24	27-Mar-2022
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	24	28-Jan-2023
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	16-Mar-2021
PAM-118A	Com-Power Corporation	PAM-118A	TEMC00160	N/A	12	16-Mar-2021
2.4 GHz Notch Filter	Micro-Tronics	BRM50702-01	TEMC00176	N/A	12	12-Mar-2021
A81-0303 18 GHz Cable Set	Teledyne Storm Products	A81-0303-360/96	TEMC00201	N/A	12	22-Apr-2021
1571AN 40 GHz Cable	IW Microwave	KPS-1571AN	TEMC00218	N/A	12	06-Jul-2021

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

2.11 Power Line Conducted Emissions

2.11.1 Specification Reference

FCC: Section 15.207
ISED Canada: RSS-GEN 8.8

2.11.2 Equipment Under Test and Modification State

S/N: 203600148

2.11.3 Date of Test

1/29/2021

2.11.4 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

2.11.5 Environmental Conditions

Ambient Temperature	24.5 °C
Relative Humidity	45.2 %
Atmospheric Pressure	1018.3 mbar

2.11.6 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 2.11.6-1: Power Line Conducted Emissions – Quasi-Peak Detector Results

Frequency (MHz)	Quasi-peak (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	55.32	N	10.2	10.68	66.00
0.213000	44.11	N	10.3	18.98	63.09
0.406500	37.32	N	10.3	20.40	57.72
0.753000	28.69	N	10.4	27.31	56.00
2.004000	27.60	N	10.5	28.40	56.00
3.115500	26.45	N	10.6	29.55	56.00
3.493500	26.77	N	10.6	29.23	56.00
4.092000	26.57	N	10.6	29.43	56.00
8.254500	30.58	N	10.9	29.42	60.00

Table 2.11.6-2: Power Line Conducted Emissions – Average Detector Results

Frequency (MHz)	Average (dBµV)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	39.03	N	10.2	16.97	56.00
0.177000	32.57	N	10.2	22.06	54.63
0.222000	32.52	N	10.3	20.23	52.74
0.384000	27.26	N	10.3	20.93	48.19
0.406500	28.15	N	10.3	19.57	47.72
0.762000	20.27	N	10.4	25.73	46.00
2.031000	21.12	N	10.5	24.88	46.00
2.188500	20.81	N	10.5	25.19	46.00
8.088000	24.86	N	10.9	25.14	50.00

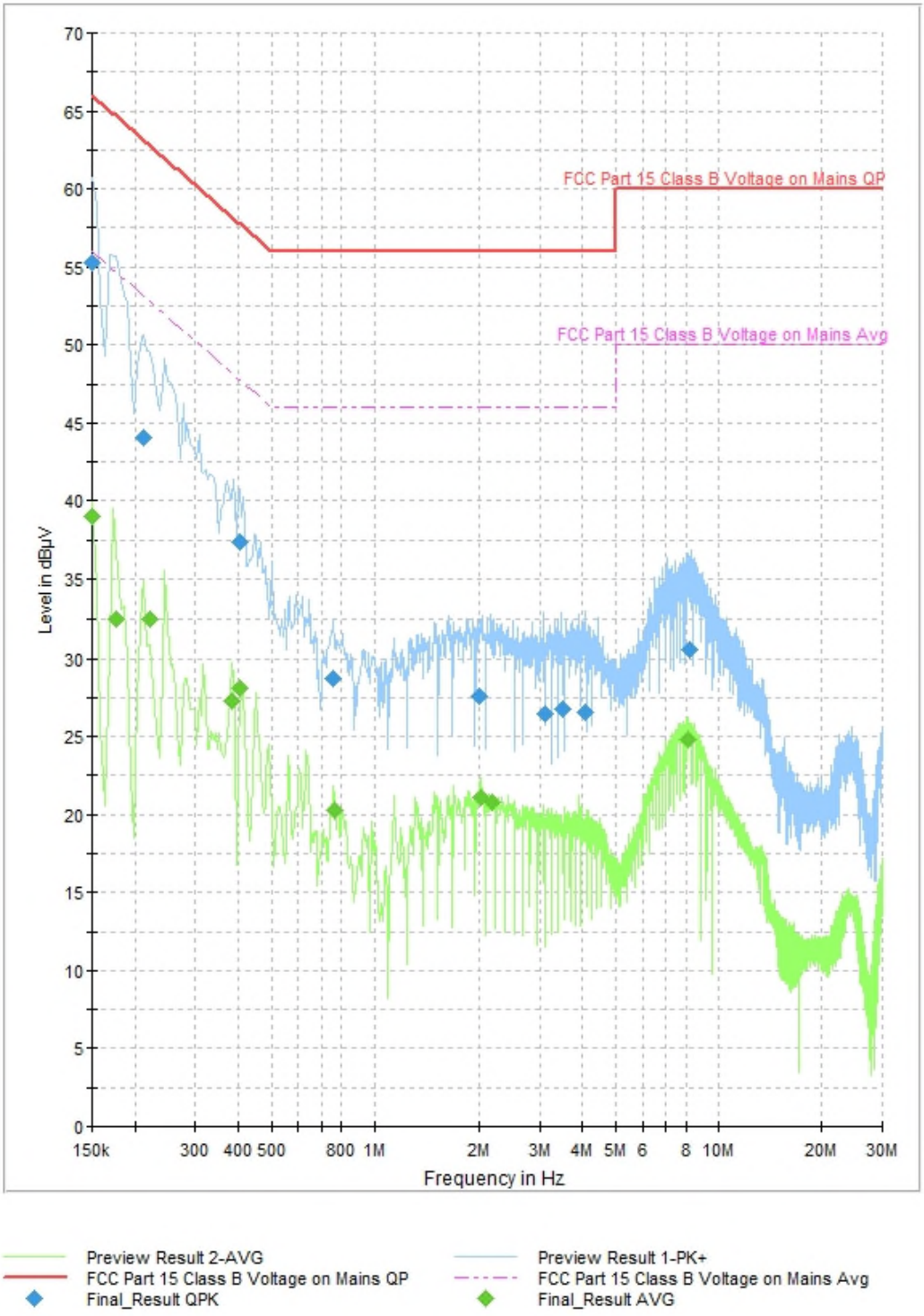

Figure 2.11.6-1: Graphical Results – AC Mains Composite Line and Neutral Plots

2.11.7 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	24	30-Sep-2021
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

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
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 26.5GHz	Teledyne Storm Products	921-0101-036	BEMC02112	N/A	12	19-Oct-2021
LISN	Rohde & Schwarz	ESH3-Z5	TEMC00002	N/A	24	30-Sep-2021
BI LOG PERIODIC, ANTENNA	Schaffner	CBL6112B	TEMC00005	N/A	24	31-Oct-2021
EMI Test Receiver	Rohde & Schwarz	ESCS30	TEMC00011	2.3002.0102.36	24	03-Oct-2021
EMC Analyzer	Agilent	E7405A	TEMC00012	A.09.02	24	27-Mar-2022
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	24	28-Jan-2023
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	16-Mar-2021
PAM-118A	Com-Power Corporation	PAM-118A	TEMC00160	N/A	12	16-Mar-2021
2.4 GHz Notch Filter	Micro-Tronics	BRM50702-01	TEMC00176	N/A	12	12-Mar-2021
Test Software	Rohde & Schwarz	EMC32	TEMC00184	10.50.00	N/A	NCR
A81-0303 18 GHz Cable Set	Teledyne Storm Products	A81-0303-360/96	TEMC00201	N/A	12	22-Apr-2021
1571AN 40 GHz Cable	IW Microwave	KPS-1571AN	TEMC00218	N/A	12	06-Jul-2021

TU - Traceability Unscheduled
O/P MON - Traceability Unscheduled
N/A - Not Applicable
NCR – No Calibration Required

4 Diagram of Test Set-ups

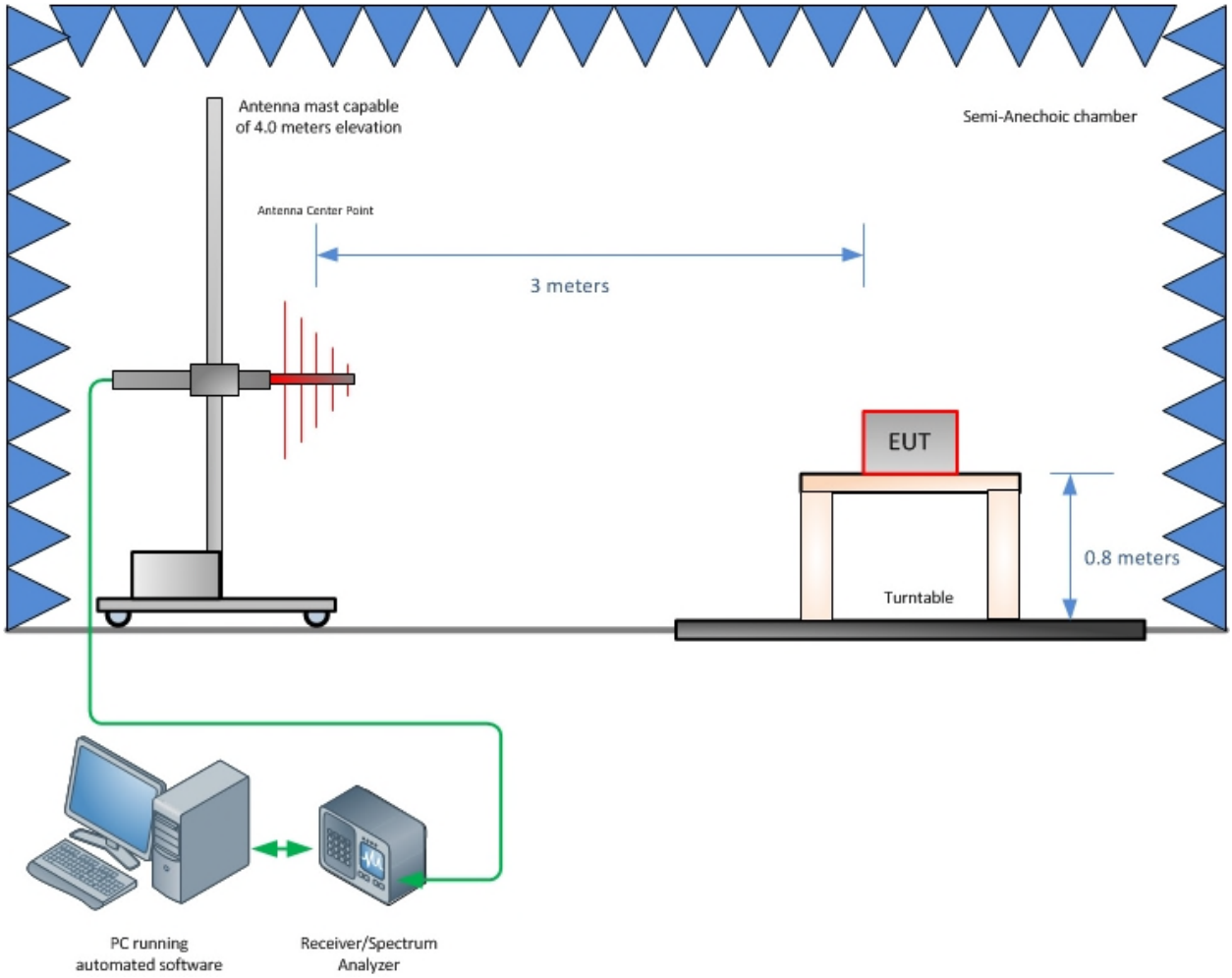

Figure 4-1 - Radiated Emissions Test Setup up to 1 GHz

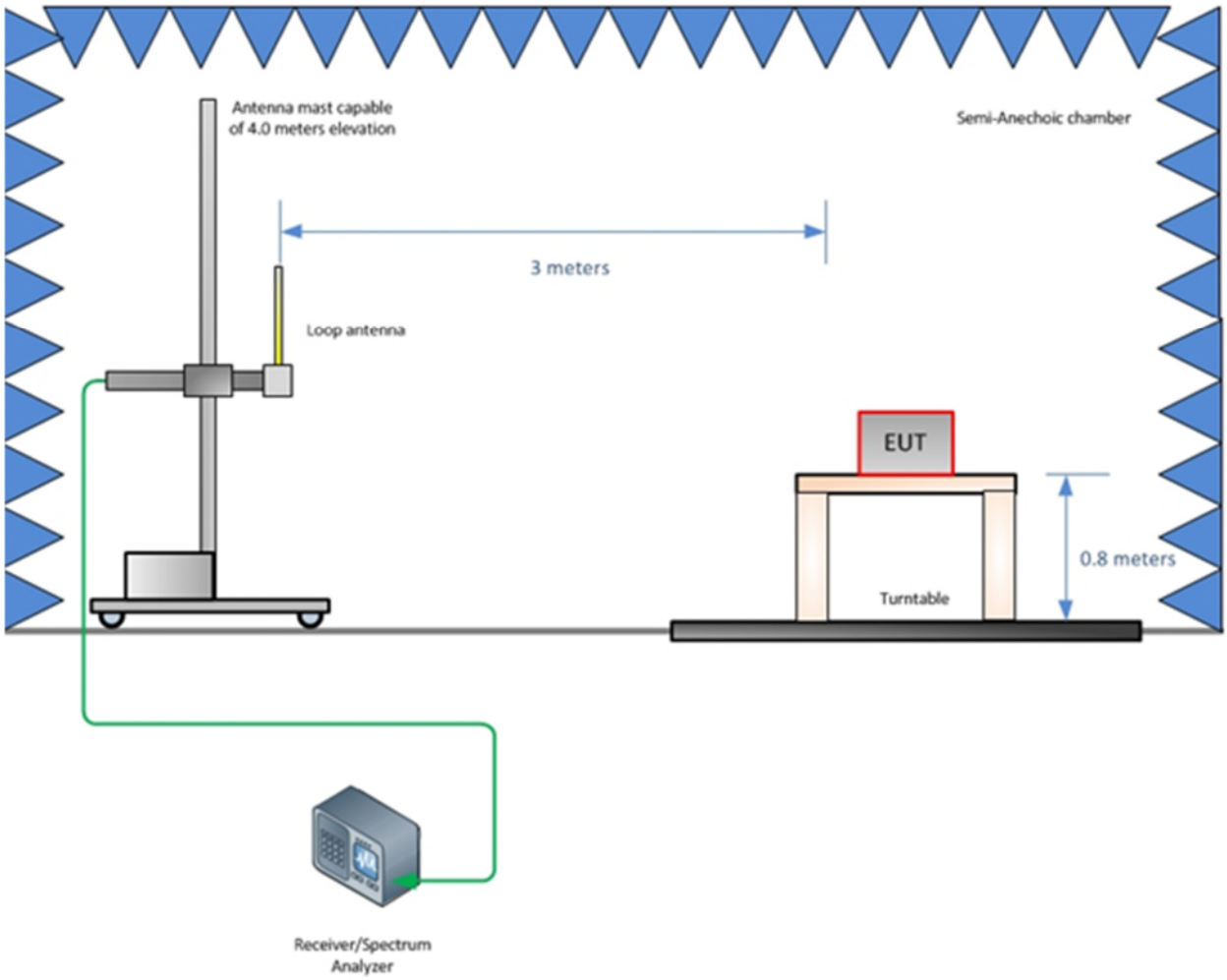

Figure 4-2 - Radiated Emissions Test Setup up to 30 MHz

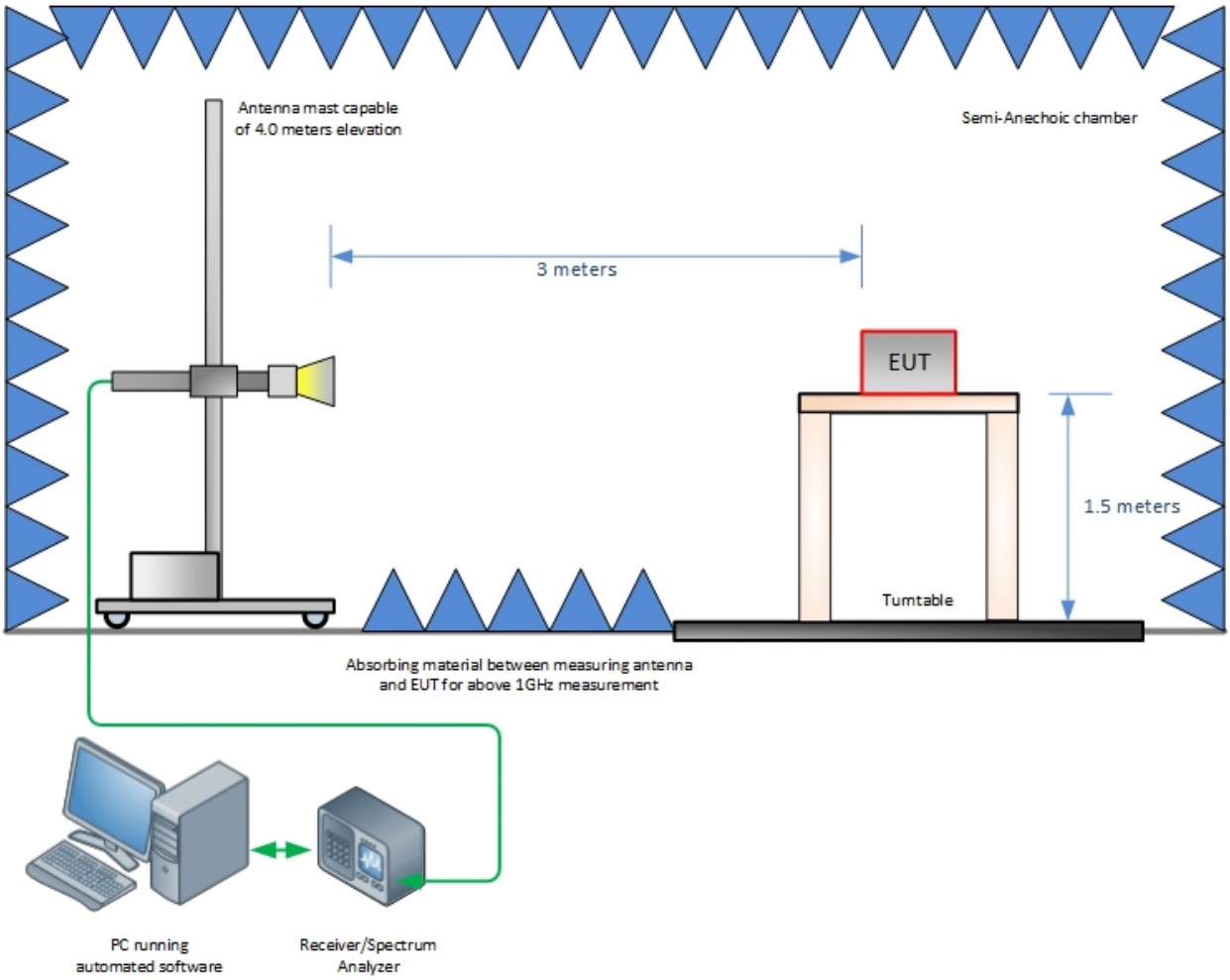

Figure 4-3 - Radiated Emissions Test Setup above 1 GHz

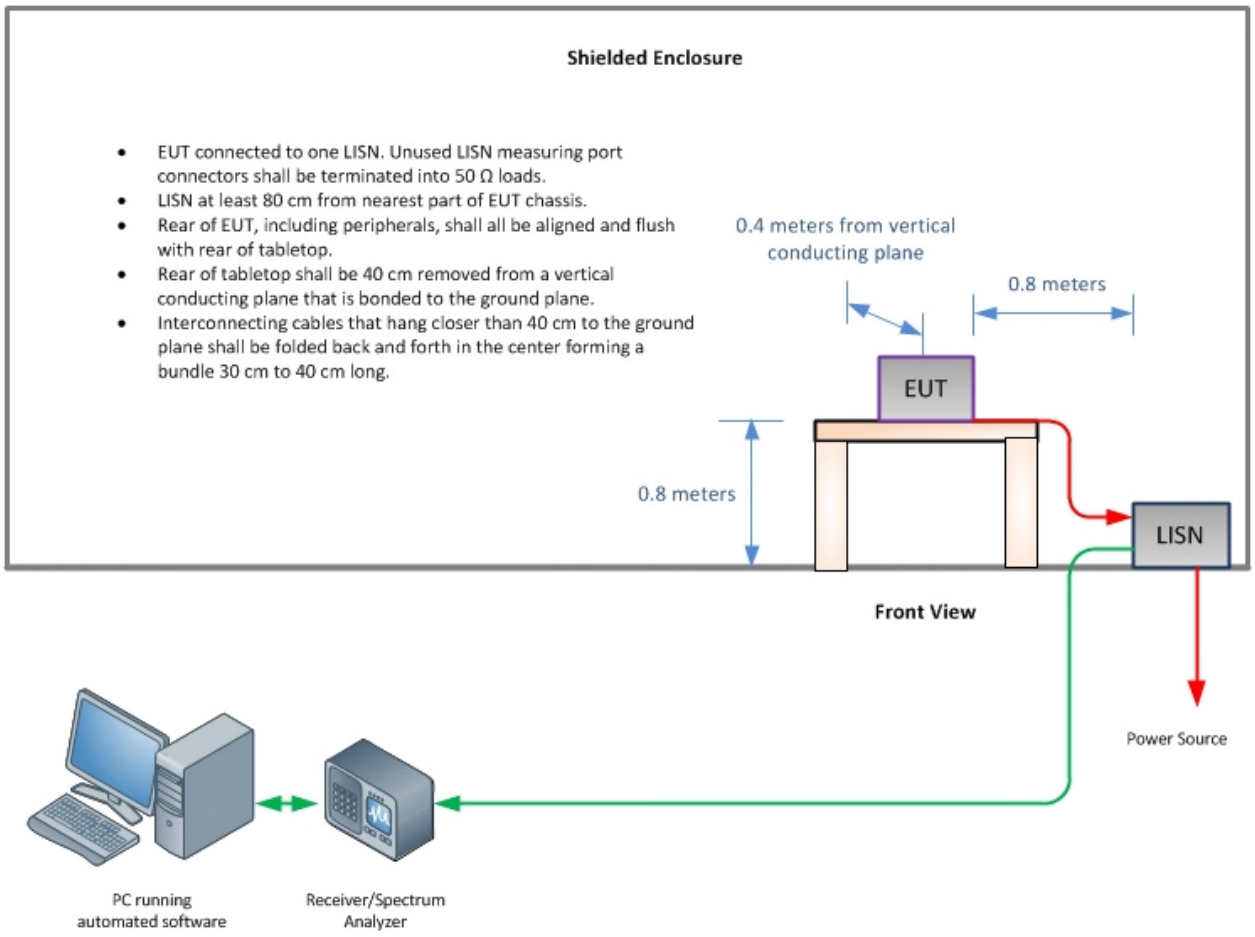

Figure 4-4 – Conducted Emissions Test Setup

5 Measurement Uncertainty

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

Table 5-1 - Values of U_{cispr} and U_{Lab}

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

Notes:

U_{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.

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