



# FCC PART 15, SUBPART C ISED C RSS-247, ISSUE 3, AUGUST 2023

## TEST REPORT

For

**Roku, Inc.**

1173 Coleman Ave  
San Jose, CA 95110, USA

**FCC ID: TC2-R1055**  
**IC: 5959A-R1053**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Streaming Player
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**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by A2LA\*, NIST, or any agency of the Federal Government.

\* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "\*" (Rev.2)

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**DOCUMENT REVISION HISTORY**

Revision Number	Report Number	Description of Revision	Date of Revision
0	R24111816-DSS	Original Report	2025-03-03

## 1 General Description

### 1.1 Product Description for Equipment Under Test (EUT)

This test report is prepared on behalf of *Roku, Inc.*, and their product model: 3830X, FCC ID: TC2-R1055, IC: 5959A-R1053, the “EUT” as referred to in this report. The EUT has 2.4 GHz/ 5 GHz Wi-Fi and 2.4 GHz BLE/BT Classic capabilities.

<b>Model Number</b>	3830X
<b>FCC ID</b>	TC2-R1055
<b>IC</b>	5959A-R1053
<b>Radio Type</b>	BT Classic
<b>Operating Frequency</b>	2400-2483.5 MHz
<b>Modulation</b>	GFSK, $\pi/4$ -DQPSK, 8PSK

### 1.2 Mechanical Description of EUT

The UUT measures approximately 95mm (L) x 24mm (W) x 14mm (H) and weighs approximately < 0.05 kg.

*The data gathered was from a production sample provided by Roku, Inc. with BACL assigned S/N: R24111816-1,2,3*

### 1.3 Objective

This report was prepared on behalf of *Roku, Inc.*, in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission’s rules and ISEDC RSS-247 Issue 3, August 2023.

The objective was to determine compliance with FCC Part 15.247 and ISEDC RSS-247 rules for Output Power, Antenna Requirements, 20 dB Bandwidth, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions, Number of Hopping Channels, Dwell Time, and Hopping Channel Separation.

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

FCC Part 15, Subpart C, Equipment DTS with FCC ID: TC2-R1055 IC: 5959A-R1053

FCC Part 15, Subpart E, Equipment NII with FCC ID: TC2-R1055 IC: 5959A-R1053

### 1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2020 American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

## 1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5%
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48 dB
Unwanted Emissions, conducted	±1.57 dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2°C
Humidity	±5%
DC and low frequency voltages	±1.0%
Time	±2%
Duty Cycle	±3%

## 1.7 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-428.

## 1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

**A- An independent, 3<sup>rd</sup>-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02),** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (\*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2017 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2017 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices,

Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

**B- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03) to certify**

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

**C- A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01) to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:**

- 1 Electronics and Office Equipment:
  - for Telephony (ver. 3.0)
  - for Audio/Video (ver. 3.0)
  - for Battery Charging Systems (ver. 1.1)
  - for Set-top Boxes & Cable Boxes (ver. 4.1)
  - for Televisions (ver. 6.1)
  - for Computers (ver. 6.0)
  - for Displays (ver. 6.0)
  - for Imaging Equipment (ver. 2.0)
  - for Computer Servers (ver. 2.0)

- 2 Commercial Food Service Equipment
  - for Commercial Dishwashers (ver. 2.0)
  - for Commercial Ice Machines (ver. 2.0)
  - for Commercial Ovens (ver. 2.1)
  - for Commercial Refrigerators and Freezers
- 3 Lighting Products
  - For Decorative Light Strings (ver. 1.5)
  - For Luminaires (including sub-components) and Lamps (ver. 1.2)
  - For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
  - For Integral LED Lamps (ver. 1.4)
- 4 Heating, Ventilation, and AC Products
  - for Residential Ceiling Fans (ver. 3.0)
  - for Residential Ventilating Fans (ver. 3.2)
- 5 Other
  - For Water Coolers (ver. 3.0)

**D- A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:**

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISED) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - o ENERGY STAR Recognized Test Laboratory – US EPA
  - o Telecommunications Certification Body (TCB) – US FCC;
  - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;



## 2 System Test Configuration

### 2.1 Justification

The EUT was configured for testing in accordance to ANSI C63.10-2020

The worst-case data rates are determined by measuring the peak power across all data rates.

### 2.2 EUT Exercise Software

The test software used was “TeraTerm”. The software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Power Setting
GFSK	2402	default
	2441	default
	2480	default
$\pi/4$ -DQPSK	2402	default
	2441	default
	2480	default
8PSK	2402	default
	2441	default
	2480	default

### 2.3 Duty Cycle Correction Factor

According to ANSI C63.10-2020 section 7.5:

Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 s (100 ms). In cases where the pulse train exceeds 0.1 s, the measured field strength shall be determined during a 0.1 s interval. The following procedure is an example of how the average value may be determined. The average field strength may be found by measuring the peak pulse amplitude (in log equivalent units) and determining the duty cycle correction factor (in dB) associated with the pulse modulation as shown in following equation:

$$\delta(\text{dB}) = 10\log(1/\Delta)$$

**Where:**

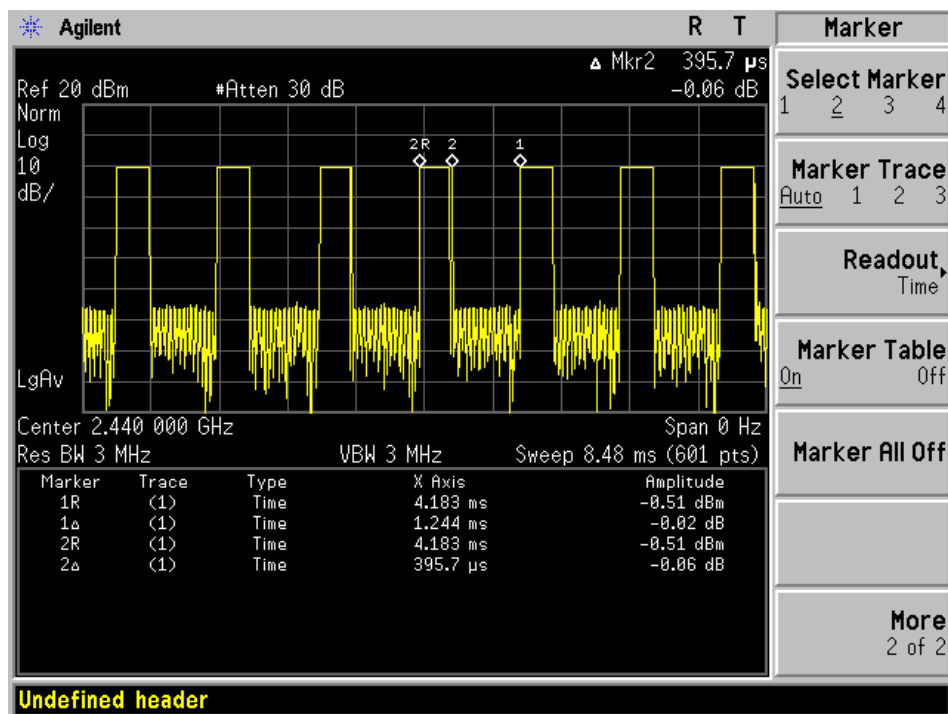
$\delta$  is the duty cycle correction factor (dB)

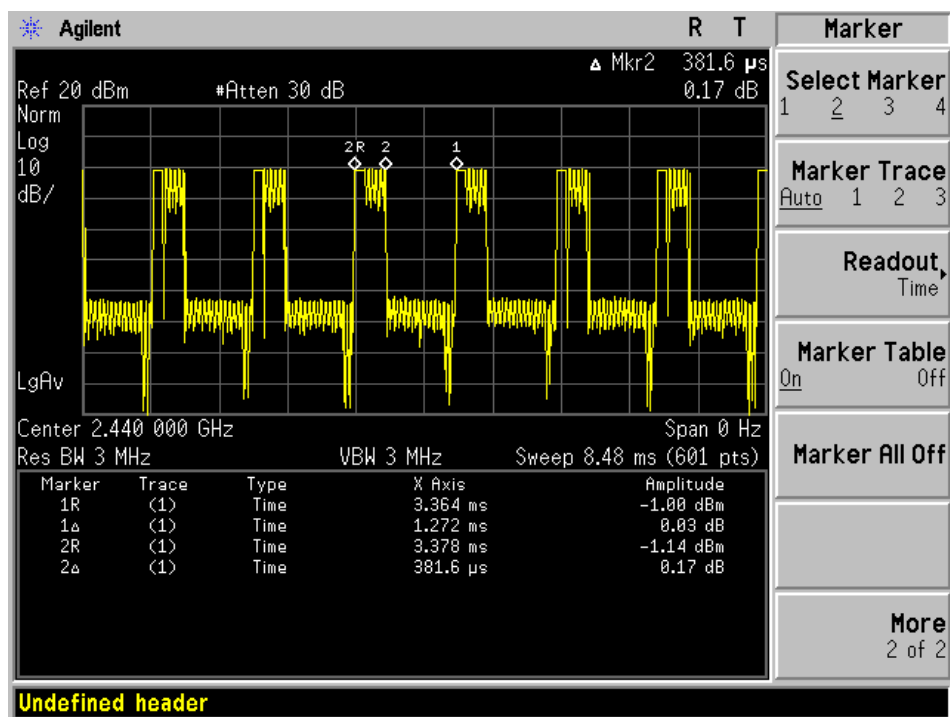
$\Delta$  is the duty cycle (dimensionless)

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
GFSK	0.3957	1.244	31.80868	4.974543
$\pi/4$ -DQPSK	0.3816	1.272	30	5.228787
8DPSK	0.3675	1.258	29.21304	5.344233

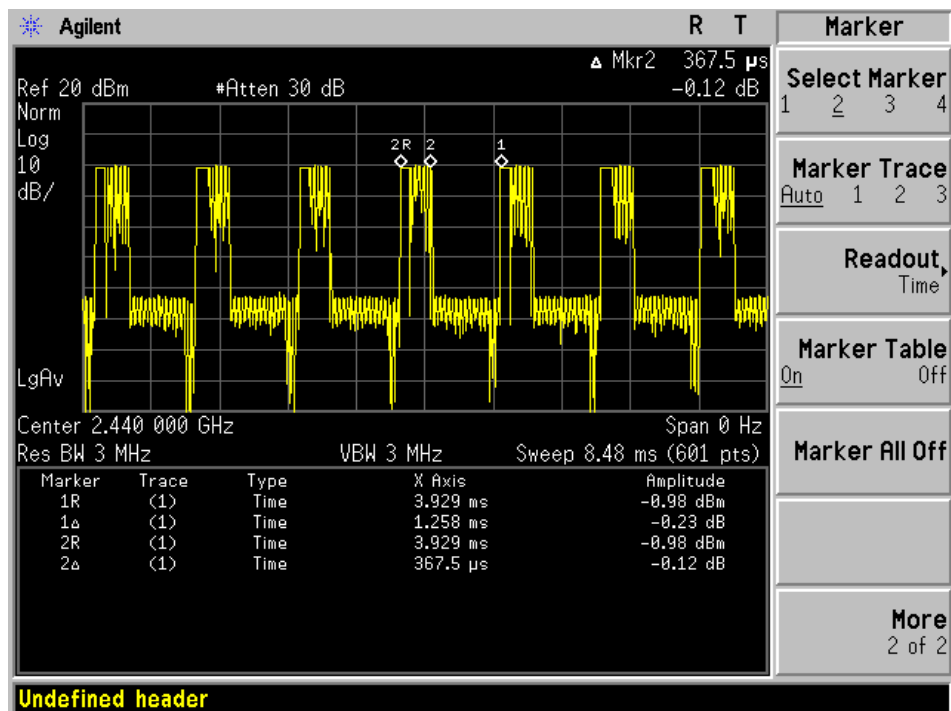
Duty Cycle = On Time (ms)/ Period (ms)

### GFSK Duty cycle



$\pi/4$ -DQPSK Duty Cycle

## 8DPSK Duty Cycle



## 2.4 Equipment Modifications

N/A

## 2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E7440

## 2.6 Support Equipment

N/A

## 2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	< 1 m	Laptop	EUT
RF Cable	< 1 m	EUT	PSA

### 3 Summary of Test Results

Results reported relate only to the product tested.

FCC and ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §2.1091, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant <sup>1</sup>
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §2.1053, §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1) ISEDC RSS-247 §5.1 (1)	20 dB and 99% Emission Bandwidth	Compliant
FCC §15.247(b)(1) ISEDC RSS-247 §5.1(2)	Maximum Peak Output Power	Compliant
FCC §15.247(a)(1)(iii) ISEDC RSS-247 §5.1(4)	Number of Hopping Channels	Compliant
FCC §15.247(a)(1) ISEDC RSS-247 §5.1 (2)	Hopping Channel Separation	Compliant
FCC §15.247(a)(1)(iii) ISEDC RSS-247 §5.1 (4)	Dwell Time	Compliant

*Note<sup>1</sup>: Please refer to report R24111816-DTS for AC Line Conducted Emissions results.*

*BACL is responsible for all the information provided in this report, except when information is provided by the customer as identified in this report. Information provided by the customer, e.g., antenna gain, can affect the validity of results.*

## 4 FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements

### 4.1 Applicable Standards

According to FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For license-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

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

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

## 4.2 Antenna Description

The antennas used by the EUT are permanent attached antennas.

External/Internal/ Integral	Antenna Usage	Antenna Type	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Integral	2.4 GHz BT	Chip	2402-2480	0

Note: The above antenna gain is provided by the customer

## 5 FCC §2.1091, §15.247(i) & ISEDC RSS-102 - RF Exposure

### 5.1 Applicable Standards

According to FCC §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to KDB 447 498 Section (7.2), "simultaneous transmission of MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on calculated or measured field strengths or power density, is  $\leq 1.0$ . The MPE ratio of each antenna is determined at the minimum *test separation distance* required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency.

#### Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minutes)
<b>Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* (180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

Where: f = frequency in MHz

\* = Plane-wave equivalent power density

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF field.



According to ISED RSS-102 Issue 6:

#### 6.6 Field reference level exposure exemption limits

Field reference level (FRL) exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm (i.e. mobile devices), except when the device operates as follows:

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

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the EIRP was derived.

## 5.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

### 5.3 RF exposure evaluation for FCC

***Worst Case: 8DPSK, 2441 MHz***

<u>Maximum output power at antenna input terminal (dBm):</u>	<u>11.41</u>
<u>Maximum output power at antenna input terminal (mW):</u>	<u>13.835</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>2441</u>
<u>Maximum Directional Antenna Gain, typical (dBi):</u>	<u>0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.0027</u>
<u>FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

The device is compliant with the requirement FCC MPE limit for uncontrolled exposure. The maximum power density at the distance of 20cm is 0.0027 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

Worst case colocation: BT Classic ratio + 5Wifi ratio.  $0.0027/1 + 0.03/1 = 0.0327 < 1$

Worst case colocation: BT Classic ratio + 2.4Wifi ratio  $0.0027/1 + 0.017/1 = 0.0197 < 1$

### 5.4 RF exposure evaluation exemption for IC

*Worst Case: 2441MHz frequency used for formula*

Maximum EIRP power = 11.41 dBm + 0 dBi = 11.41 dBm which is less than  $1.31 \times 10^{-2} \times f^{0.6834} = 2.706 \text{ W} = 34.32 \text{ dBm}$

Therefore the RF exposure Evaluation is not required.

## 6 FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions

### 6.1 Applicable Standards

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) and RSS-Gen except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3.3458 – 3.358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 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

\*\* Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

As per ISED RSS-Gen 8.9,

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

**Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz**

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

\* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

*Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.*

As per ISED RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## 6.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2020. The specification used was the FCC 15 Subpart C and ISERC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

## 6.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords was connected to the AC floor outlet.

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

The EUT was set 3 meter away from the testing antenna, which was varied from 1-4 meter, and the EUT was placed on a turntable, which was 0.8 meter and 1.5 meter above the ground plane for below and above 1000 MHz measurements, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

$$RBW = 100 \text{ kHz} / VBW = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000 MHz:

- (1) Peak:  $RBW = 1\text{MHz} / VBW = 1\text{MHz} / \text{Sweep} = \text{Auto}$
- (2) Average:  $RBW = 1\text{MHz} / VBW = 1\text{kHz} / \text{Sweep} = \text{Auto}$

## 6.4 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + \text{Atten} - Ga$$

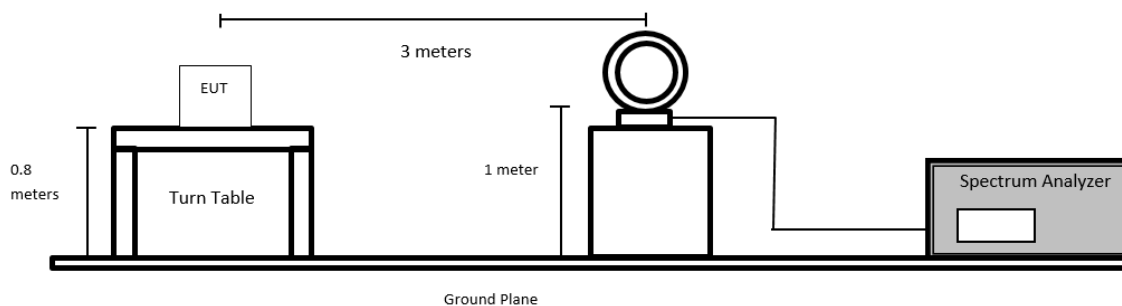
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

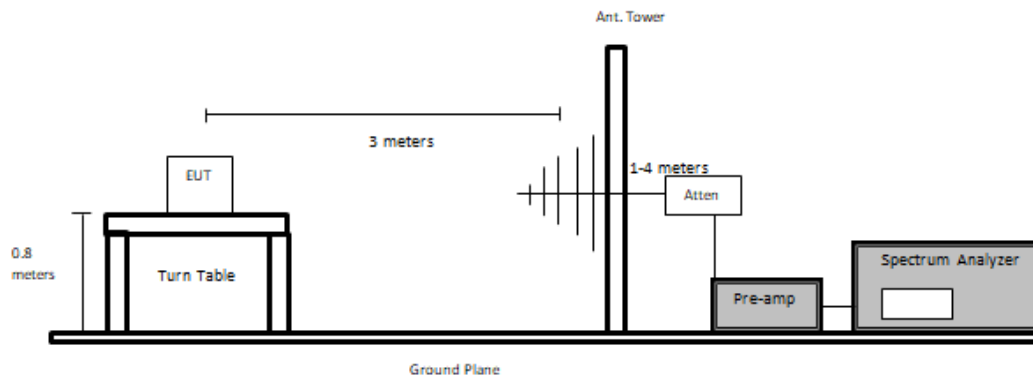
$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

## 6.5 Test Setup and Block Diagram

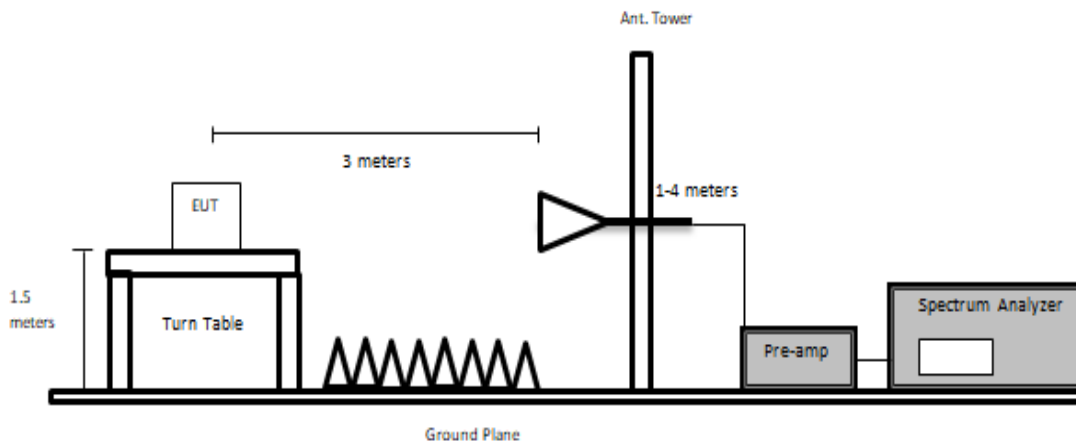
### 9 kHz to 30 MHz



### 30 MHz to 1 GHz



### Above 1 GHz



## 6.6 Test Equipment List and Details

### 9kHz-30MHz Test Equipment

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
327	Sunol Sciences	System Controller	SC110V	122303-1	N/R	N/R
1075	Sunol Sciences	Boresight Tower	TLT3	050119-7	N/R	N/R
1388	Sunol Sciences	Flush Mount Turntable	FM	112005-2	N/R	N/R
1432	Keysight Technologies	MXE EMI Receiver, Multi-touch	N9038B	MY60180008	2025-01-03	1 year
1246	Hewlett Packard	RF Limiter	11867A	1734	2024-04-09	1 year
1248	Pasternack	RG214 COAX Cable	PE3062	-	2024-10-01	6 months
1249	Time microwave	LMR-400 Cable Dc-3 GHz	AE13684	2k80612-5 6fts	2024-04-09	1 year
393	Com-Power	Loop Antenna, Active	AL-130	17043	2023-05-26	2 years

**Statement of Traceability:** *BACL Corp.* attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 “A2LA Policy on Metrological Traceability”.

**30MHz to 26.5GHz Test Equipment**

<b>BACL No.</b>	<b>Manufacturer</b>	<b>Description</b>	<b>Model No.</b>	<b>Serial No.</b>	<b>Calibration Date</b>	<b>Calibration Interval</b>
327	Sunol Sciences	System Controller	SC110V	122303-1	N/R	N/R
1075	Sunol Sciences	Boresight Tower	TLT3	050119-7	N/R	N/R
1388	Sunol Sciences	Flush Mount Turntable	FM	112005-2	N/R	N/R
1432	Keysight Technologies	MXE EMI Receiver, Multi-touch	N9038B	MY60180008	2025-01-03	1 year
316	Sonoma Instruments	Preamplifier 10 kHz - 2.5 GHz	317	260406	2024-08-30	6 months
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2; 1504	2023-12-18	2 years
1245	-	6dB Attenuator	PE7390-6	01182018A	2023-12-18	2 years
1246	Hewlet Packard	RF Limiter	11867A	1734	2024-04-09	1 year
1248	Pasternack	RG214 COAX Cable	PE3062	-	2024-10-01	6 months
1249	Time microwave	LMR-400 Cable Dc-3 GHz	AE13684	2k80612-5 6fts	2024-04-09	1 year
1533	Pasternack	Coaxial Cable	NA	NA	2024-12-31	6 months
1192	ETS Lindgren	Horn Antenna	3117	218973	2024-10-23	2 years
1397	Mini Circuit	CBL ASSY 2.92MM PLUG TO PLUG 12"	FL086-12KM+	QN2318110-2318	2024-08-16	6 months
1449	BACL	Preamplifier	BACL1313-A100M18G	4052472	2024-08-19	6 months
90	Wisewave	Horn Antenna	ARH-4223-02	10555-01	2023-05-02	2 years
1394	Mini Circuit	CBL ASSY 2.92MM PLUG TO PLUG 12"	FL086-12KM+	QN2318110-2318	2024-08-16	6 months
1451	BACL	Preamplifier	BACL-1313-A1840	4052432	2024-08-16	6 months
1334	Micro-Tronics	Notch Filter	BRM50702	G361	2024-12-31	1 year

**Statement of Traceability: BACL Corp.** attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".



## 6.7 Test Environmental Conditions

<b>Temperature:</b>	20– 22.5°C
<b>Relative Humidity:</b>	55%
<b>ATM Pressure:</b>	101.85 kPa

*The testing was performed by Arturo Reyes and Michael Papa from 2025-01-13 to 2025-01-16 and 2025-01-31 in 5m chamber 3.*

## 6.8 Summary of Test Results

According to the data hereinafter, the EUT complied with FCC Title 47, Part 15C and ISEDC RSS-247 standard's radiated emissions limits, and had the worst margin of:

<b>Mode: Transmitting</b>			
<b>Margin (dB)</b>	<b>Frequency (MHz)</b>	<b>Polarization (Horizontal/Vertical)</b>	<b>Mode, Channel</b>
-0.45	1765	Horizontal	8DPSK, 2480 MHz

Please refer to the following table and plots for specific test result details.

## 6.9 Radiated Emissions Test Results

**Note:** Below test data are the radiated measurements. For conducted band edge measurements at the antenna port please refer to ANNEX C.

**Note:** Pre-scan was performed in order to determine worst-case orientation of device with respect to measurement antenna in the X/Y/Z axis. Plots/data shown represent measurements made in worst-case orientation.

**Note:** As per FCC Part 15.247(d), emissions outside the restricted bands shall be at least 20 dB below the measured RF output power. The highest output power measurement is 11.41dBm. Per ANSI 63.10-2020 Section 11.12.2.2:  $E[dB\mu V/m] = EIRP[dBM] + 95.3$ , for  $d = 3meters$ . Thus Limit  $[dB\mu V/m @ 3m] = 11.41[dBm] - 20 + 95.3 = 86.71[dB\mu V/m @ 3m]$

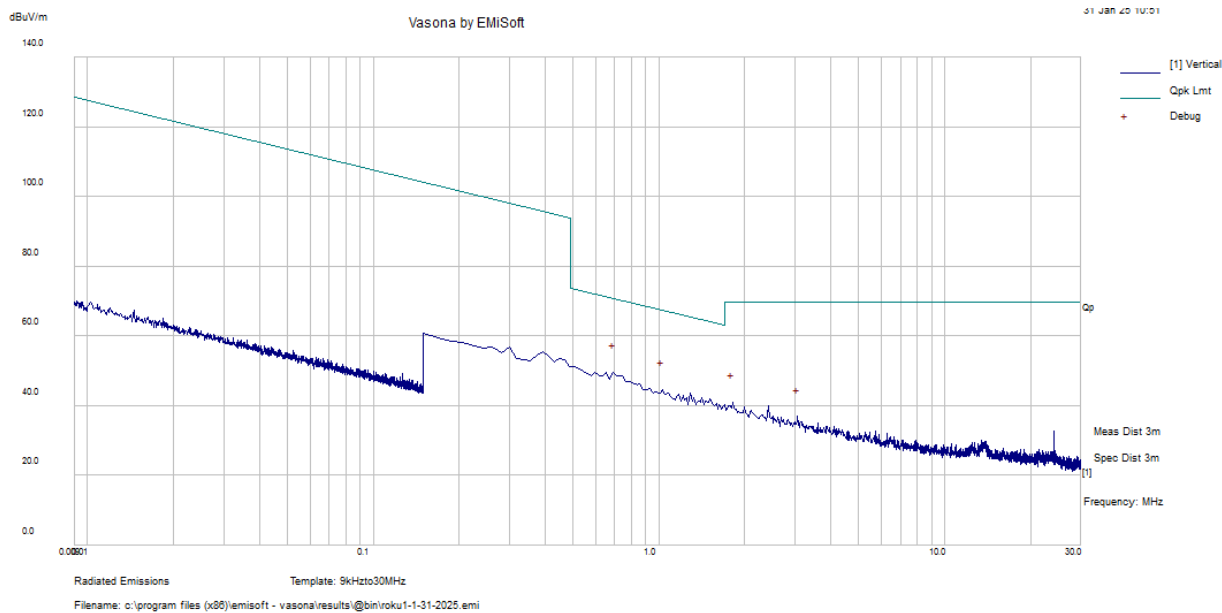
**Note:** worst-case scans performed on worst configs per modulation family(i.e. 8DPSK).

**Note:** For Co-location Radiated Spurious Emissions results, please refer to report R24111816-DTS.

### 1) 9 kHz – 30 MHz Worst Case, Measured at 3 meters

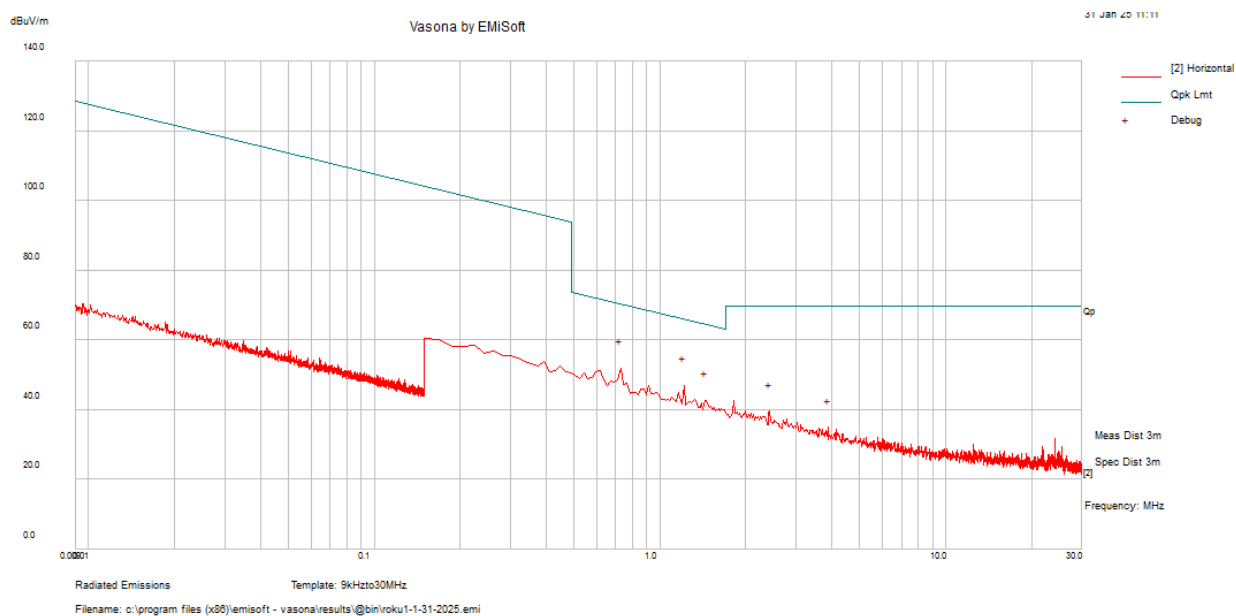
Worst-case emissions:

#### Parallel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
0.691031	39.4	10.13	49.53	V	70.82	-21.28	Peak
1.026844	34.59	10.07	44.66	V	67.37	-22.72	Peak
1.810406	30.68	10.3	40.98	V	69.54	-28.56	Peak
3.060375	26.42	10.41	36.83	V	69.54	-32.71	Peak

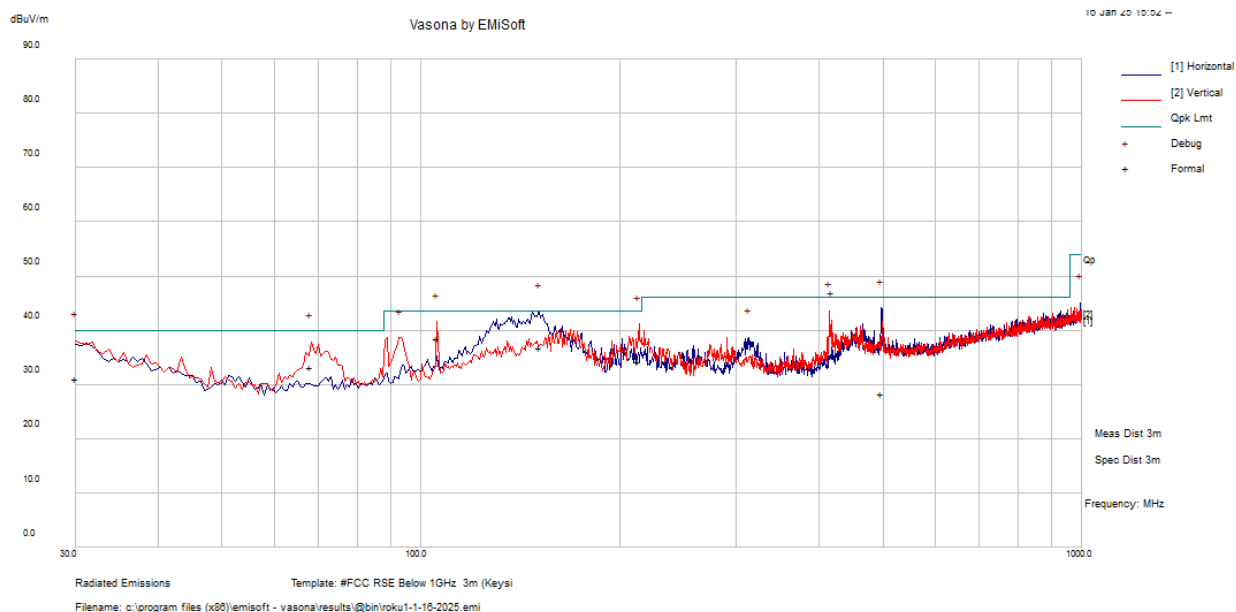
## Perpendicular



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
0.728344	41.85	10.12	51.97	H	70.36	-18.39	Peak
1.213406	36.89	10.14	47.03	H	65.92	-18.9	Peak
1.437281	32.51	10.2	42.71	H	64.45	-21.74	Peak
2.426063	29.18	10.37	39.55	H	69.54	-29.99	Peak
3.88125	24.45	10.37	34.82	H	69.54	-34.73	Peak

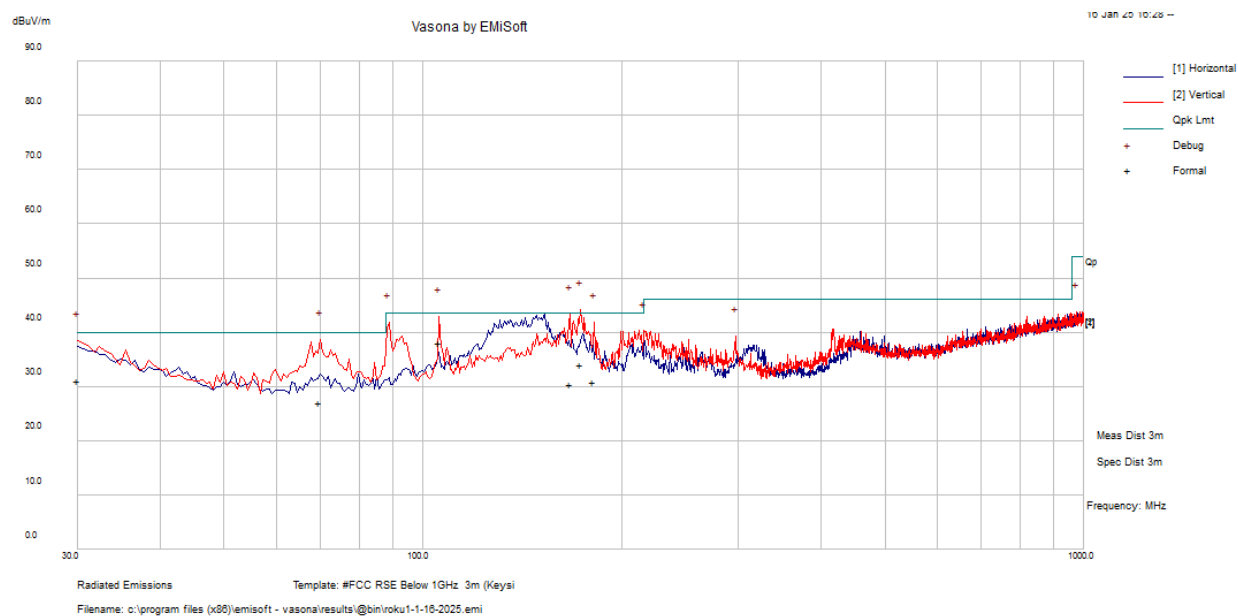
## 2) 30 MHz – 1 GHz Worst Case, Measured at 3 meters

## 8DPSK, 2402 MHz



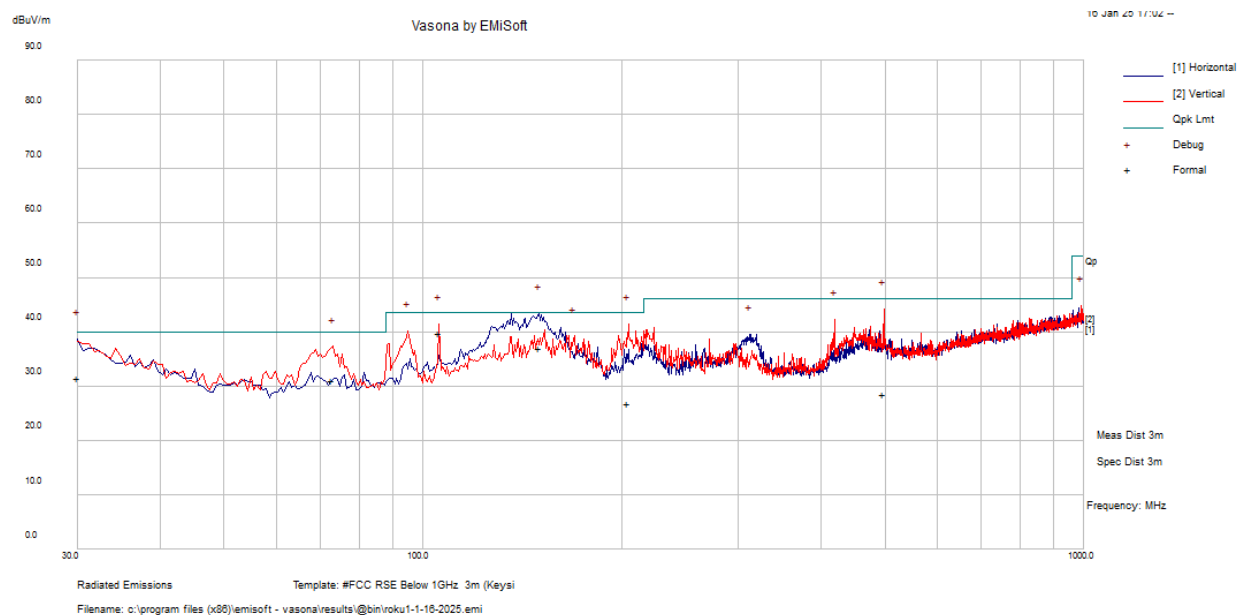
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Detector
151.1356	44.75	-8.00	36.75	298	H	177	43.5	-6.75	QP
497.0394	29.38	-1.15	28.23	256	H	190	46	-17.77	QP
105.7575	47.04	-8.59	38.45	197	V	194	43.5	-5.05	QP
30	31.82	-0.72	31.1	284	V	219	40	-8.9	QP
68.0475	46.23	-13.04	33.19	122	V	254	40	-6.81	QP
213.7584	43.93	-9.76	34.17	121	V	128	43.5	-9.33	QP

## 8DPSK, 2441 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBuV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV/m)	Margin (dB)	Detector
173.1616	43.03	-8.9	34.13	130	V	182	43.5	-9.37	QP
166.9331	38.84	-8.5	30.34	239	V	134	43.5	-13.16	QP
105.7269	46.68	-8.6	38.08	196	V	82	43.5	-5.42	QP
69.84031	40.12	-12.99	27.13	292	V	101	40	-12.88	QP
30	31.84	-0.72	31.12	143	V	164	40	-8.88	QP
181.3806	40.12	-9.21	30.91	207	V	125	43.5	-12.59	QP

## 8DPSK, 2480 MHz



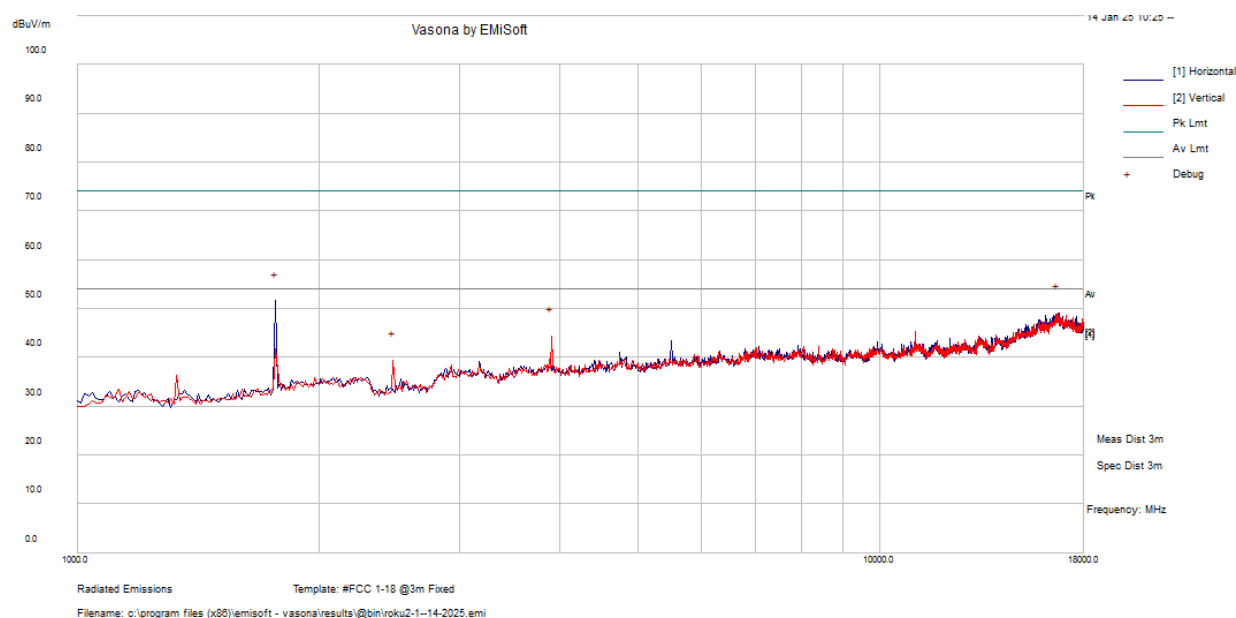
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Detector
150.2694	44.94	-7.96	36.98	204	H	27	43.5	-6.52	QP
30	32.21	-0.71	31.5	294	H	97	40	-8.5	QP
498.0028	29.62	-1.14	28.48	173	V	352	46	-17.52	QP
105.6972	48.28	-8.6	39.68	209	V	148	43.5	-3.82	QP
204.3756	35.98	-9.16	26.82	253	V	193	43.5	-16.68	QP
72.95219	44.17	-13.01	31.16	137	V	199	40	-8.84	QP

FCC/IC Limits for 1 GHz to 26.5 GHz			
Applicability	(dBm)	(uV/m at 3meters)	(dBuV/m at 3meters)
Restricted Band Average Limit	-	500	54
Restricted Band Peak Limit <sup>1</sup>	-	-	74

Note<sup>1</sup>: Restricted Band Peak Limit is defined to be 20dB higher than Average Limit.

### 3) 1 –18 GHz Scan at 3 Meters

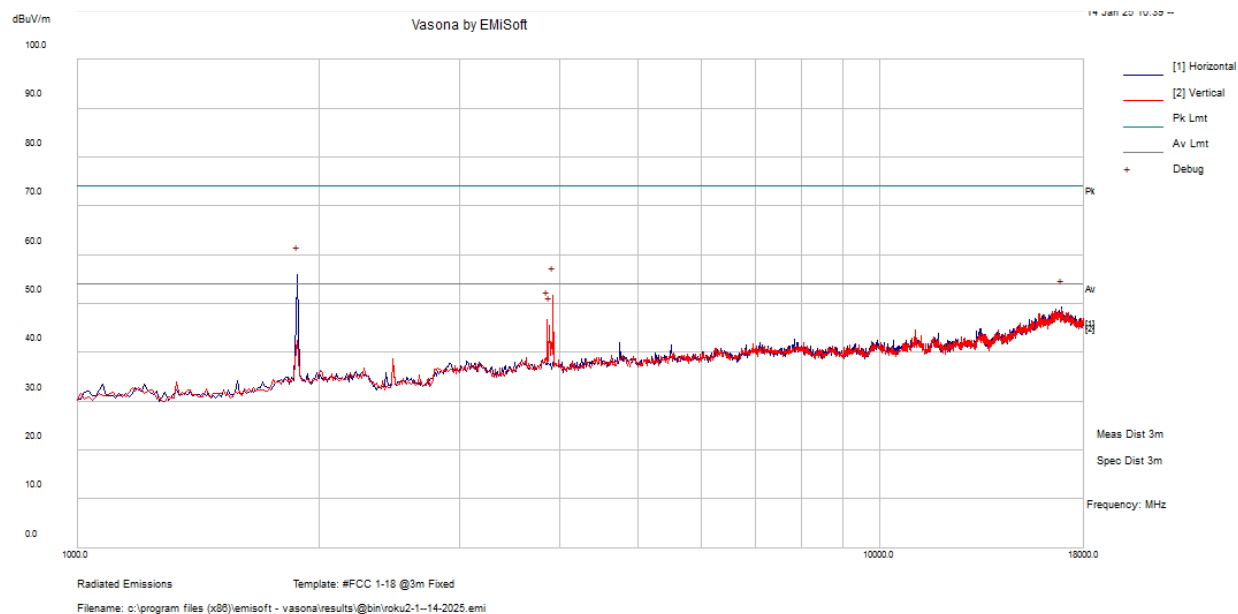
#### 8DPSK, 2402 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
1765	58.87	-7.31	51.56	H	54	-2.45	Peak
16693.13	33.59	15.57	49.16	V	54	-4.84	Peak
3900.625	46.18	-1.83	44.35	V	54	-9.65	Peak
2476.875	43.75	-4.29	39.46	V	54	-14.55	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.

## 8DPSK, 2441 MHz

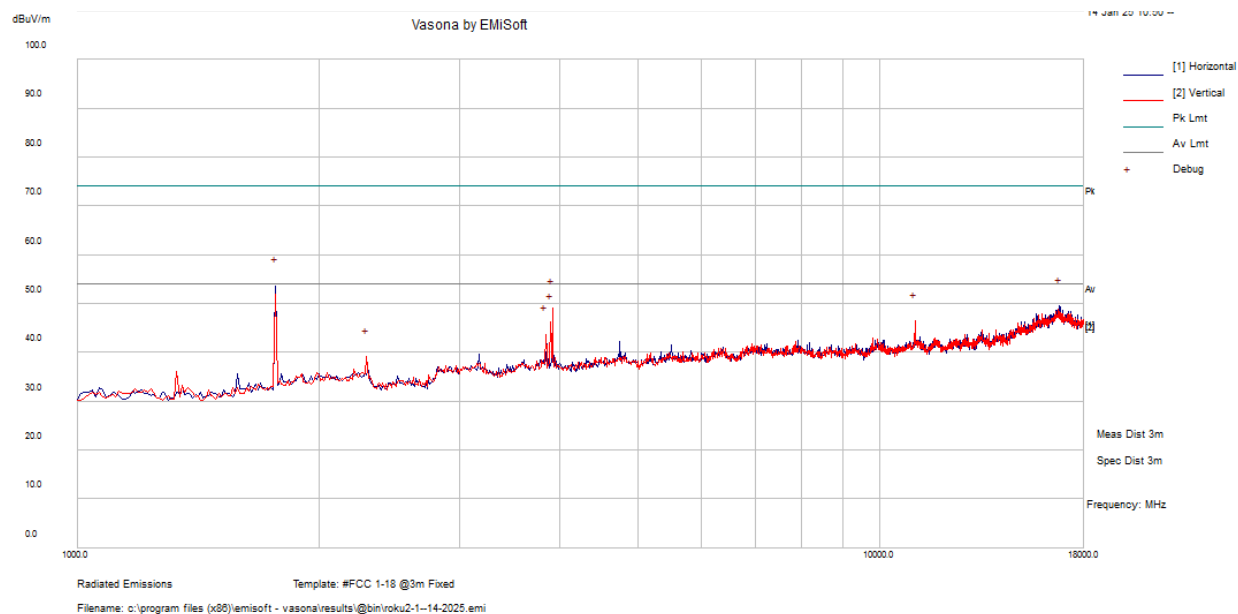


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
1881.875	62.09	-6.07	56.02	H	86.71	-30.69	Peak <sup>1</sup>
3921.875	53.64	-1.89	51.75	V	54	-2.25	Peak
16895	33.76	15.46	49.22	H	54	-4.78	Peak
3858.125	48.58	-1.83	46.75	V	54	-7.26	Peak
3879.375	47.44	-1.83	45.61	V	54	-8.39	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.

Note<sup>1</sup>: Emission is outside the restricted bands. Thus they were compared to the 15.247 (d) spurious emissions limits instead.



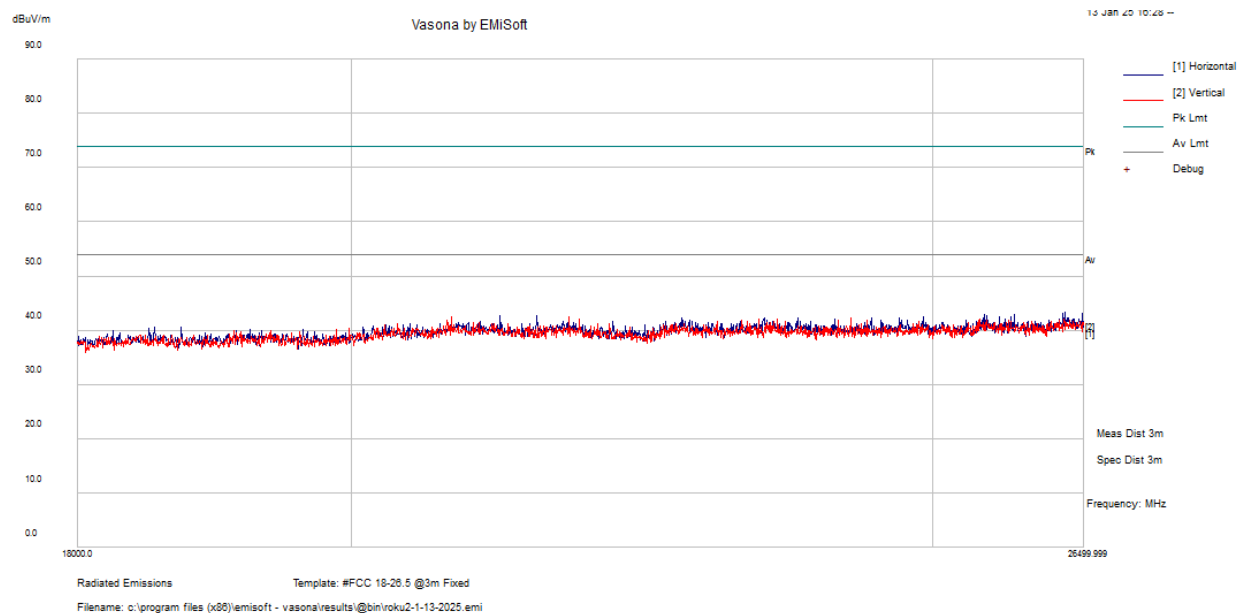
**8DPSK, 2480 MHz**

Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
<b>1765</b>	<b>60.87</b>	<b>-7.32</b>	<b>53.55</b>	<b>H</b>	<b>54</b>	<b>-0.45</b>	<b>Peak</b>
16778.13	33.9	15.59	49.49	H	54	-4.52	Peak
3911.25	51.01	-1.85	49.16	V	54	-4.84	Peak
11083.13	38.54	7.85	46.39	V	54	-7.61	Peak
3890	47.98	-1.82	46.16	V	54	-7.85	Peak
3836.875	45.45	-1.84	43.61	V	54	-10.39	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.

#### 4) 18 GHz – 26.5 GHz Worst Case Scan at 3 Meters

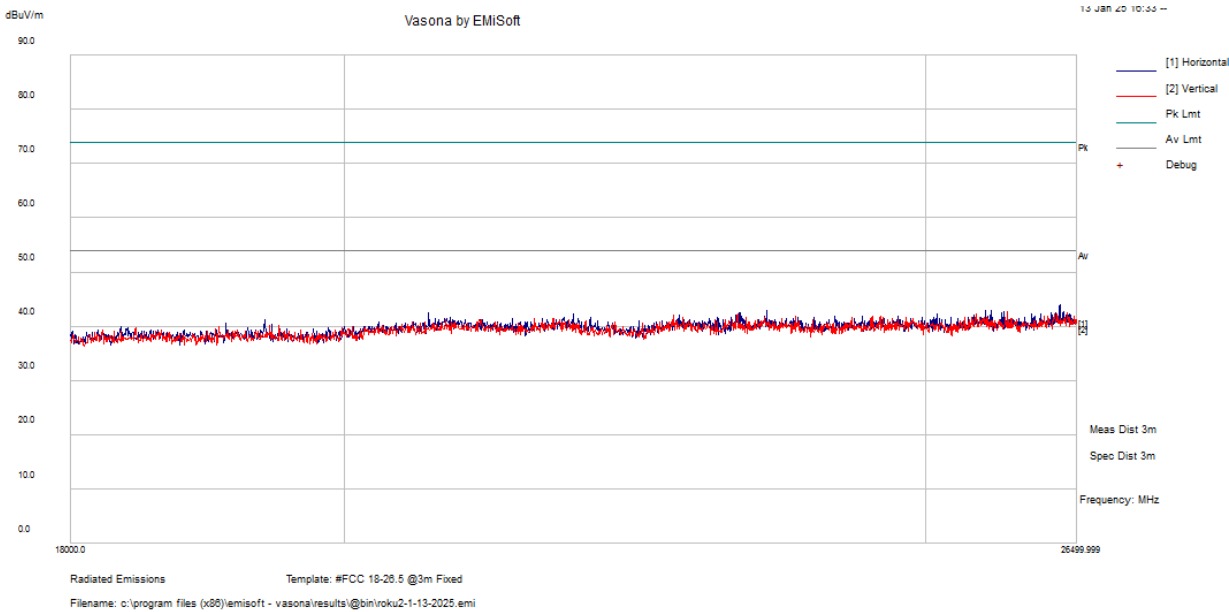
##### 8DPSK, 2402 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
26295.8	39.03	3.09	42.12	H	54	-11.88	Peak

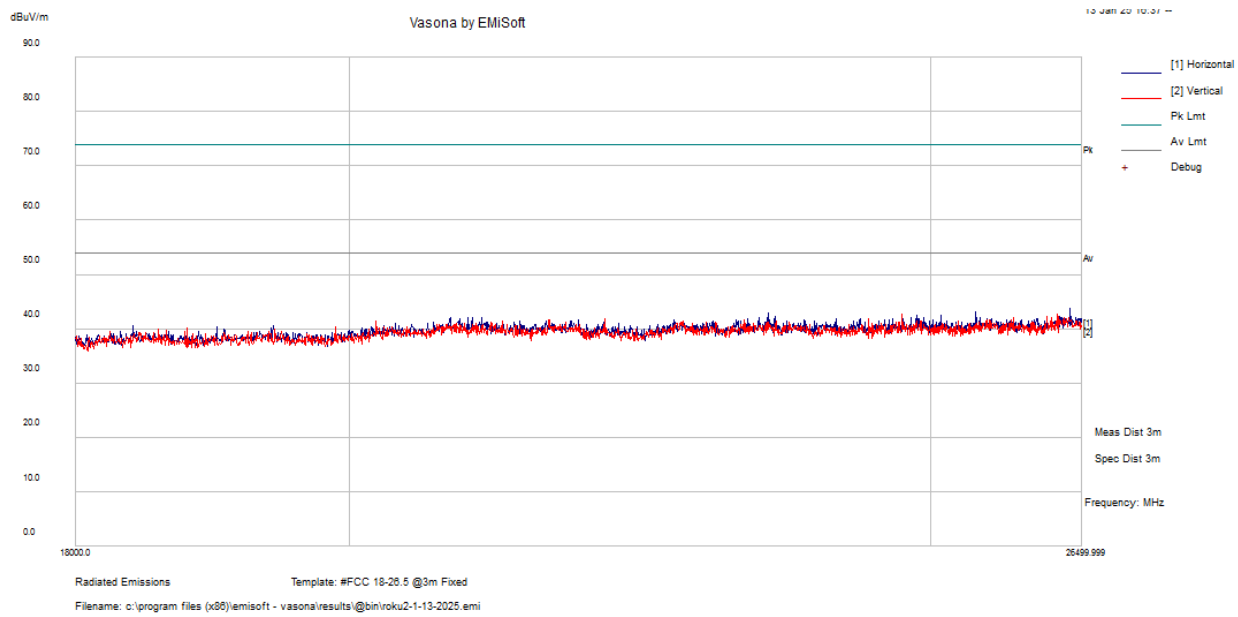
*Note: Peak measurement is used to compare to the average limit to show compliance.*

8DPSK, 2441 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
22723.56	40.62	0.78	41.40	H	54	-12.60	Peak

*Note: Peak measurement is used to compare to the average limit to show compliance.*

**8DPSK, 2480 MHz**

Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Polarity (H/V)	Limit (dBμV/m)	Margin (dB)	Detector
24708.29	38.89	1.63	40.52	H	54	-13.48	Peak

*Note: Peak measurement is used to compare to the average limit to show compliance.*

## 7 FCC §15.247(a) (1) & ISEDC RSS-247 §5.1, RSS-Gen §6.6 - Emission Bandwidth

### 7.1 Applicable Standards

According to FCC §15.247(a) (1) and ISEDC RSS-247 §5.1: the maximum 20 dB bandwidth of the hopping channel shall be presented.

### 7.2 Measurement Procedure

Span = approximately 2 to 5 times the 99% occupied bandwidth, centered on a hopping channel

RBW = 1% to 5 % of the 99% occupied bandwidth or 100 kHz

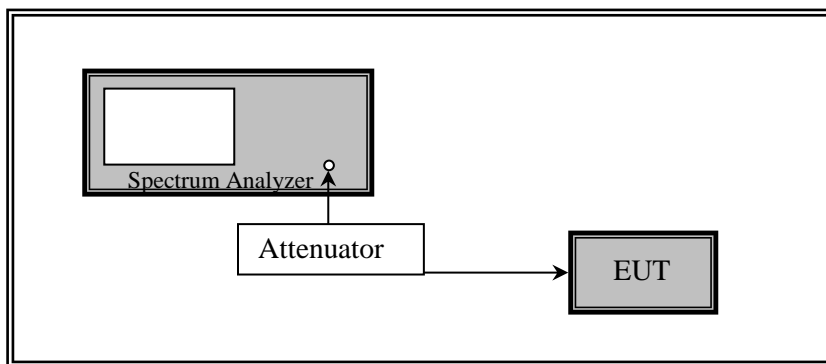
VBW = 3RBW

Sweep = auto

Detector function = peak

Trace = max hold

### 7.3 Test Setup Block Diagram



## 7.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2024-06-14	1 year
-	-	10dB Attenuator	-	-	-	-

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

**Statement of Traceability:** *BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 “A2LA Policy on Metrological Traceability”.*

## 7.5 Test Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.5 kPa

The testing was performed by Libass Thiaw from 2025-01-10 to 2025-01-13 at RF test site.

## 7.6 Test Results

Channel	Frequency (MHz)	20 dB OBW (kHz)	99% OBW (kHz)
<b>GFSK</b>			
Low	2402	867.084	801.496
Middle	2441	866.568	820.655
High	2480	828.433	818.380
<b><math>\pi/4</math>-DQPSK</b>			
Low	2402	1210	1135.0
Middle	2441	1255	1121.6
High	2480	1284	1148.4
<b>8DPSK</b>			
Low	2402	1215	1157.2
Middle	2441	1227	1134.9
High	2480	1224	1132.3

Please refer to Annex A for detailed test results.

## 8 FCC §15.247(b) (1) & ISEDC RSS-247 §5.4 - Output Power

### 8.1 Applicable Standards

According to FCC §15.247(b) (1): For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

According to RSS-247 §5.4: For frequency hopping systems operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels.

### 8.2 Measurement Procedure

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

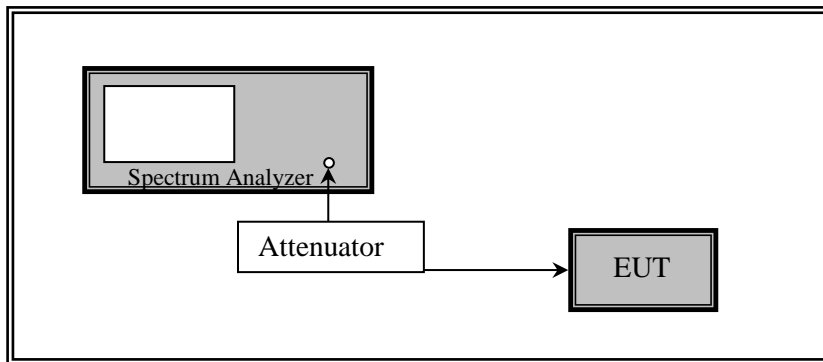
VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

### 8.3 Test Setup Block Diagram





## 8.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2024-06-14	1 year
-	-	10dB Attenuator	-	-	-	-

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

**Statement of Traceability:** *BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

## 8.5 Test Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.5 kPa

The testing was performed by Libass Thiaw on 2025-01-06 to 2025-02-15 at RF test site.

## 8.6 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	EIRP (dBm)	Conducted Power Limit (dBm)	EIRP Limit (dBm)
<b>GFSK</b>					
Low	2402	11.11	11.11	30	36
Middle	2441	11.35	11.35	30	36
High	2480	11.21	11.21	30	36
<b><math>\pi/4</math>-DQPSK</b>					
Low	2402	10.55	10.55	30	36
Middle	2441	10.89	10.89	30	36
High	2480	10.77	10.77	30	36
<b>8DPSK</b>					
Low	2402	11.12	11.12	30	36
Middle	2441	11.41	<b>11.41</b>	30	36
High	2480	11.29	11.29	30	36

Note: Antenna Gain is 0 dBi

Please refer to Annex B for detailed test results.

## 9 FCC §15.247(d) & ISEDC RSS-247 §5.5 – Spurious Emissions at Antenna Terminals 100 kHz Bandwidth of Band Edges

### 9.1 Applicable Standards

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

According to ISEDC RSS-247 §5.5. In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

### 9.2 Measurement Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation

RBW = 100 kHz

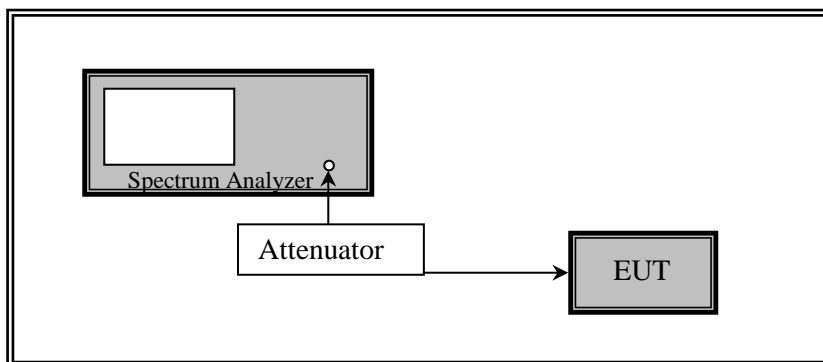
VBW = 300 kHz

Sweep = coupled

Detector function = peak

Trace = max hold

### 9.3 Test Setup Block Diagram



#### 9.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2024-06-14	1 year
-	-	10dB Attenuator	-	-	-	-

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

**Statement of Traceability:** *BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

## 9.5 Test Environmental Conditions

<b>Temperature:</b>	22°C
<b>Relative Humidity:</b>	53%
<b>ATM Pressure:</b>	101.5 kPa

*The testing was performed by Libass Thiaw on 2025-01-07 at RF test site.*

## 9.6 Test Results

Please refer to Annex D for detailed test results.

## 10 FCC §15.247(a) (1) (iii) & ISEDC RSS-247 §5.1 (4) - Dwell Time

### 10.1 Applicable Standards

According to FCC §15.247(a) (1) (iii) and RSS-247 §5.1(4), Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 10.2 Measurement Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW  $\leq$  channel spacing and where possible RBW should be set  $\gg 1/T$ , where  $T$  is the expected dwell time per channel

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements.

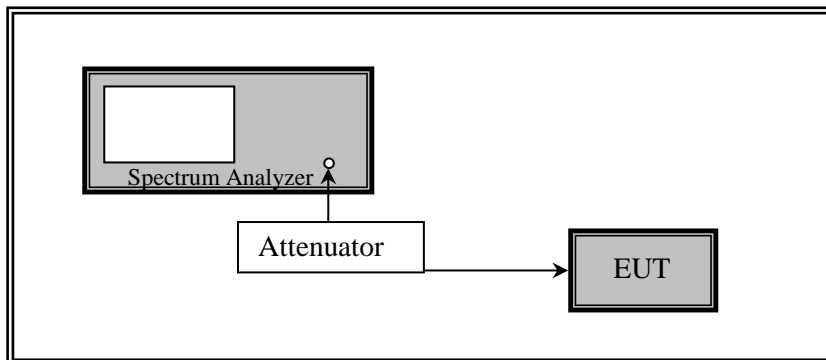
Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =

(Number of hops on spectrum analyzer) x (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

### 10.3 Test Setup Block Diagram



### 10.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2024-06-14	1 year
-	-	10dB Attenuator	-	-	-	-

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

**Statement of Traceability:** *BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 “A2LA Policy on Metrological Traceability”.*

### 10.5 Test Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.5 kPa

The testing was performed by Shankar Pangen on 2024-12-12 at RF test site.

## 10.6 Test Results

Mode	Channel	Pulse Width (ms)	Dwell Time (Sec.)	Limit (Sec.)	Result
DH1	-	1.108	0.343	< 0.4	Pass
	<i>Note: Dwell Time = 310*1.108</i>				
2DH1	-	1.075	0.204	< 0.4	Pass
	<i>Note: = Dwell time = 190*1.075</i>				
3DH1	-	1.075	0.118	< 0.4	Pass
	<i>Note: Dwell time = 110*1.075</i>				
DH3	-	2.367	0.331	< 0.4	Pass
	<i>Note: Dwell time = 140*2.367</i>				
2DH3	-	2.35	0.376	< 0.4	Pass
	<i>Note: Dwell time = 160*2.35</i>				
3DH3	-	2.35	0.306	< 0.4	Pass
	<i>Note: Dwell time = 130*2.35</i>				
DH5	-	3.608	0.397	< 0.4	Pass
	<i>Note: Dwell time = 110*3.608</i>				
2DH5	-	3.608	0.361	< 0.4	Pass
	<i>Note: Dwell time = 100*3.608</i>				
3DH5	-	3.608	0.397	< 0.4	Pass
	<i>Note: Dwell time = 110*3.608</i>				

*Note: (Number of hops in the period specified in the requirements) =  
(Number of hops on spectrum analyzer) x (period specified in the requirements / analyzer sweep time)*

Please refer to Annex E for detailed test results.

## 11 FCC §15.247(a)(1)(iii) & ISEDC RSS-247 §5.1(4) - Number of Hopping Channels

### 11.1 Applicable Standards

According to FCC §15.247(a) (1) (iii) and RSS-247 §5.1(4): Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 11.2 Test Procedure

Span = the frequency band of operation

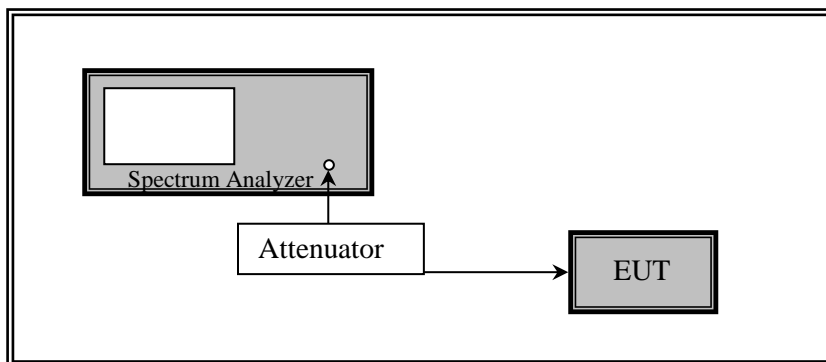
VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

### 11.3 Test Setup Block Diagram





#### 11.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2024-06-14	1 year
-	-	10dB Attenuator	-	-	-	-

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

**Statement of Traceability:** *BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

#### 11.5 Test Environmental Conditions

Temperature:	22°C
Relative Humidity:	53%
ATM Pressure:	101.5 kPa

The testing was performed by Shankar Pangeni on 2024-12-12 at RF test site.

#### 11.6 Test Results

Total 79 channels; please refer to Annex G for detailed test results.

## 12 FCC §15.247(a) (1) & ISEDC RSS-247 §5.1(2) - Hopping Channel Separation

### 12.1 Applicable Standards

According to FCC §15.247(a) (1) and RSS-247 §5.1(2): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

### 12.2 Test Procedure

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW)  $\approx$  30% of the channel spacing, adjust as necessary to best identify the center of each individual channel

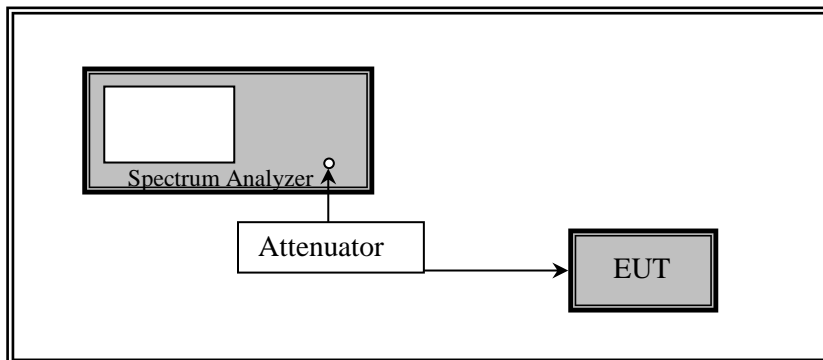
Video (or Average) Bandwidth (VBW)  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

### 12.3 Test Setup Block Diagram



## 12.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2024-06-14	1 year
-	-	10dB Attenuator	-	-	-	-

Note<sup>1</sup>: cable and attenuator included in the test set-up will be checked each time before testing.

**Statement of Traceability:** *BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

## 12.5 Test Environmental Conditions

<b>Temperature:</b>	22°C
<b>Relative Humidity:</b>	53%
<b>ATM Pressure:</b>	101.5 kPa

The testing was performed by Shankar Pangeni on 2024-12-12 at RF test site.

## 12.6 Test Results

Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 2/3 20 dB OBW (kHz)
<b>GFSK</b>			
Middle	2441	833	577.712
<b><math>\pi/4</math>-DQPSK</b>			
Middle	2441	1108	836.6667
<b>8DPSK</b>			
Middle	2441	1183	818

Please refer to Annex F for detailed test results.

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## **13 Appendix A (Normative) - EUT Test Setup Photographs**

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Please refer to the attachment.

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## **14 Appendix B (Normative) - EUT External Photographs**

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Please refer to the attachment.

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## **15 Appendix C (Normative) - EUT Internal Photographs**

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Please refer to the attachment.

## 16 Appendix D (Normative) - A2LA Electrical Testing Certificate



### Accredited Laboratory

A2LA has accredited

### BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

### Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA R222 - Specific Requirements EPA ENERGY STAR Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 13<sup>th</sup> day of September 2024.

A blue ink signature of Mr. Trace McInturff.

Mr. Trace McInturff, Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 3297.02  
Valid to September 30, 2026

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope.

<https://www.a2la.org/scopepdf/3297-02.pdf>

--- END OF REPORT ---