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

TEST REPORT

For

hard&softWERK GmbH

Bahnhof Str. 10 D-78112 St.
Georgen im Schwarzwald, Germany

FCC ID: 2BBC6-JJ660
IC: 30643-JJ660

Report Type:	**Product Type:**
Original Report	Battery powered BLE beacon

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Report Number:	R2412203-247
Report Date:	2025-01-20
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ACCREDITED
CERTIFICATE #3297.02

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2412203-247	Original Report	2025-01-20

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test was prepared on behalf of *hard&softWERK GmbH*, and their product model: AESCULAP Aicon® - RTLS beacon, FCC ID: 2BBC6-JJ660, IC: 30643-JJ660, the "EUT" as referred to in this report. The EUT is equipped with a non-removable battery, and is designed to be placed on a container for asset tracking purposes.

Model Number	AESCULAP Aicon® - RTLS beacon
FCC ID	2BBC6-JJ660
IC	30643-JJ660
Radio Type	BLE Beacon
Operating Frequency	2402-2480 MHz
Modulation	GFSK
Channel Spacing	2 MHz
Antenna Gain	2.2 dBi

1.2 Objective

This report is prepared on behalf of *hard&softWERK GmbH* in accordance with Part 2, Subpart J, and Part 15, Subpart 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 for Antenna Requirement, RF Exposure, AC Line Conducted Emissions, Emission Bandwidth, Radiated & Conducted Spurious Emissions, 100 kHz Band Edges, Maximum Output Power, and Peak Power Spectrum Density

In order to determine compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product maybe which result in lowering the immunity should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing and/or I/O cable changes, etc.).

1.3 Mechanical Description of EUT

Dimensions: 5.5 cm (L) x 3.5 cm (W) x 2.15 cm (H)
Weight: 0.028 kg
Serial Number: *2DED*
EUT Photos: See Attachments Appendix B and Appendix C.

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices and FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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, 3rd-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):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - 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:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - 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 according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v05r02.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2 EUT Exercise Software

The test utility used was the "BTool – Bluetooth Low Energy Application – v1.43.03" provided by *hard&softWERK GmbH*. The software is compliant with the standard requirements being tested against.

Radio	Frequency (MHz)	Data Rate (MBPS)	Power Setting
2.4 GHz BLE	2402	1	5
	2440	1	5
	2480	1	5
	2402	2	5
	2440	2	5
	2480	2	5

2.3 Duty Cycle Correction Factor

According to KDB 558074 D01 DTS Meas Guidance v05r02 section 6.0:

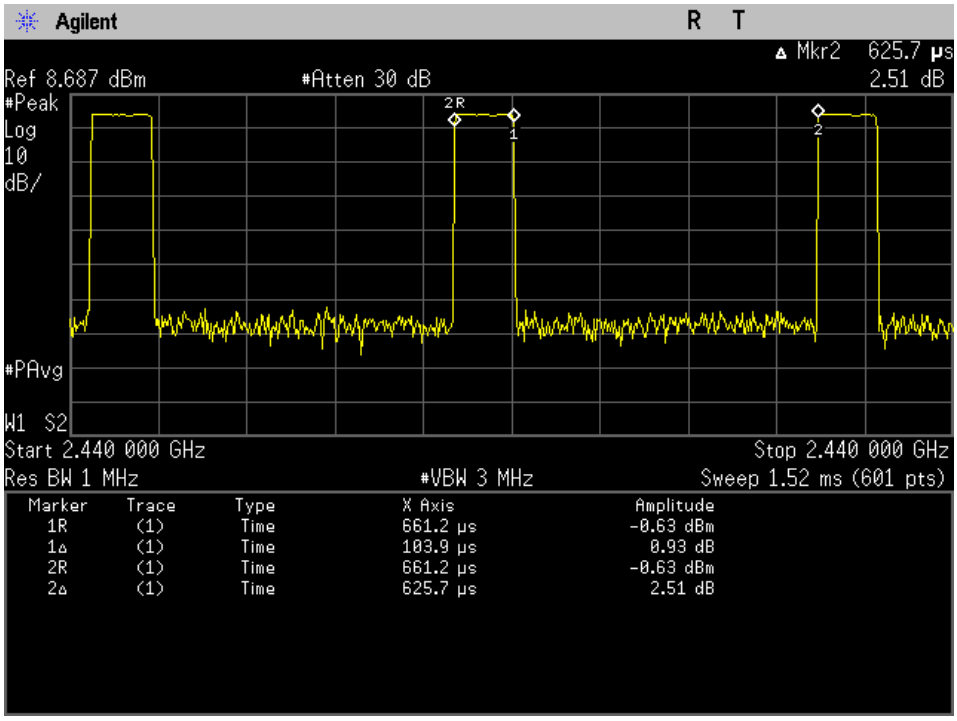
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (µs)	Period (µs)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
1 MBPS	103.90	625.70	16.61	7.80
2 MBPS	63.33	623.20	10.16	9.93

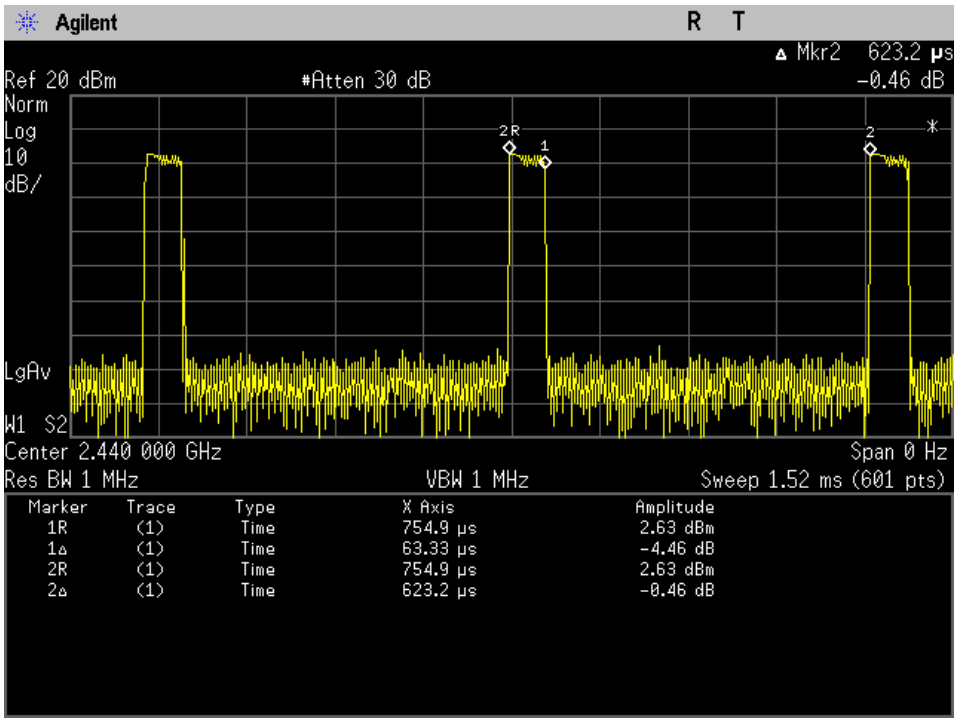
Note: Duty Cycle Correction Factor (dB) = 10*log(1/duty cycle)

Please refer to the following plots

BLE 1 MBPS



BLE 2 MBPS



2.4 Equipment Modification

None

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E7440

2.6 Remote Support Equipment

None

2.7 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
USB UART	1	EUT	Laptop

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirements	Compliant
FCC §2.1091, §15.247(i) ISED RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	N/A[1]
FCC §2.1053, §15.35(b), §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)(2) ISEDC RSS-247 §5.2 RSS-Gen §6.7	6 dB & 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4	Maximum Output Power	Compliant
FCC §15.247(d), §2.1051 ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge & Spurious Emissions at Antenna Port	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2(2)	Peak Power Spectral Density	Compliant

Note[1]: Device is battery powered.

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 isotopically 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 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

External/Internal/ Integral	Antenna Type	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Internal	PCB Antenna	2400-2480	2.2

5 FCC §15.247(i) §2.1091 & ISED RSS-102 - RF Exposure

5.1 Applicable Standards

According to FCC §15.247(i), Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

According to FCC §2.1091 and §1.1310(e)(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.

Limits for General Population/Uncontrolled Exposure

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

f = frequency in MHz
* = Plane-wave equivalent power density

According to ISEDC RSS-102 Issue 6 Section 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/f0.5W4.49/f0.5W (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 1.31×10−2f0.6834W1.31×10−2f0.6834W (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 MPE Result

Radio	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Maximum EIRP (mW)	Power Density at 20cm (mW/cm^2)	Limit (mW/cm^2)
BLE	2402	2.2	4.64	6.84	4.83	0.00096	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.00096 mW/cm^2 for BLE. Limit is 1 mW/cm^2.

5.4 RF exposure evaluation exemption for IC

The EIRP of this device is 6.84 dBm (4.83 mW) which is less than the exemption threshold, i.e., 1.31*10^(-2) * f^(0.6834) = 2.68 W. Therefore, the RF exposure evaluation is exempt.

6 FCC §15.35(b), §15.205, §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(b): 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) 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 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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 where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in table 5 and table 6. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

Table 5 – General field strength limits at frequencies above 30 MHz

Frequency (MHz)	Field Strength (µV/m at 3 m)
30 – 88	100
88 – 216	150
216 – 960	200
Above 960	500

Table 6 – General field strength limits at frequencies below 30 MHz

Frequency	Field Strength (micro volts/meter)	Measurement Distance (meters)
9 – 490 kHz[Note 1]	6.37/F (F in kHz)	300
490 – 1705 kHz	63.7/F (F in kHz)	30
1.705 – 30 MHz	0.08	30

Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.

As per ISED RSS-Gen 8.10(c),

Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

Table 7 – Restricted frequency bands[Note 1]

MHz	MHz	GHz
0.090 – 0.110	149.9 – 150.05	9.0 – 9.2
0.495 – 0.505	156.52475 – 156.52525	9.3 – 9.5
2.1735 – 2.1905	156.7 – 156.9	10.6 – 12.7
3.020 – 3.026	162.0125 –167.17	13.25 – 13.4
4.125 – 4.128	167.72 – 173.2	14.47 – 14.5
4.17725 – 4.17775	240 – 285	15.35 – 16.2
4.20725 – 4.20775	322 – 335.4	17.7 – 21.4
5.677 – 5.683	399.9 – 410	22.01 – 23.12
6.215 – 6.218	608 – 614	23.6 – 24.0
6.26775 – 6.26825	960 – 1427	31.2 – 31.8
6.31175 – 6.31225	1435 – 1626.5	36.43 – 36.5
8.291 – 8.294	1645.5 – 1646.5	Above 38.6
8.362 – 8.366	1660 – 1710	
8.37625 – 8.38675	1718.8 – 1722.2	
8.41425 – 8.41475	2200 – 2300	
12.29 – 12.293	2310 – 2390	
12.51975 – 12.52025	2483.5 – 2500	
12.57675 – 12.57725	2655 – 2900	
13.36 – 13.41	3260 – 3267	
16.42 – 16.423	3332 – 3339	
16.69475 – 16.69525	3345.8 – 3358	
16.80425 – 16.80475	3500 – 4400	
25.5 – 25.67	4500 – 5150	
37.5 – 38.25	5350 – 5460	
73 – 74.6	7250 – 7750	
74.8 – 75.2	8025 – 8500	
108 – 138		

Note 1: Certain frequency bands listed in table 7 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

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 and 10-meter chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISEDC RSS-247.

The spacing between the peripherals was 10 centimeters.

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

6.3 Test Procedure

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 meters, and the EUT was placed on a turntable, which was 0.8 meters and 1.5 meters 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's polarity should be changed between horizontal and vertical.

The spectrum analyzer or receiver was set as:

Below 1000 MHz:

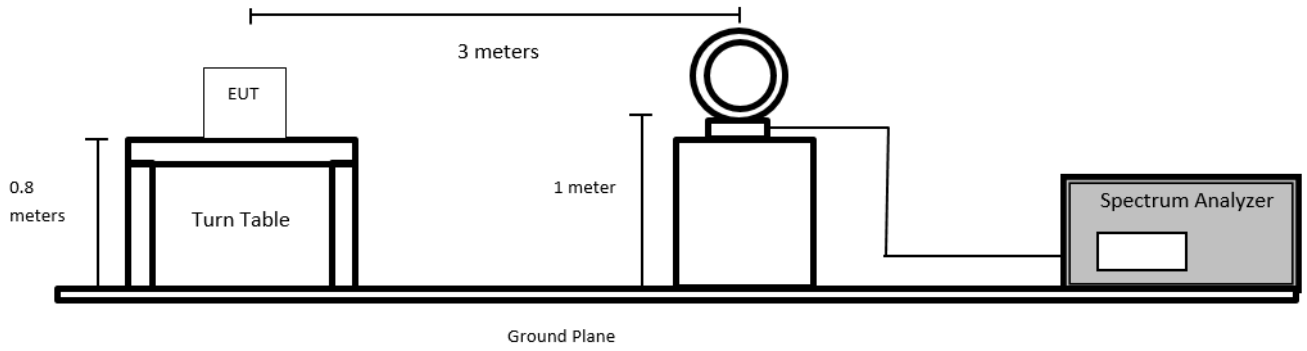
RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

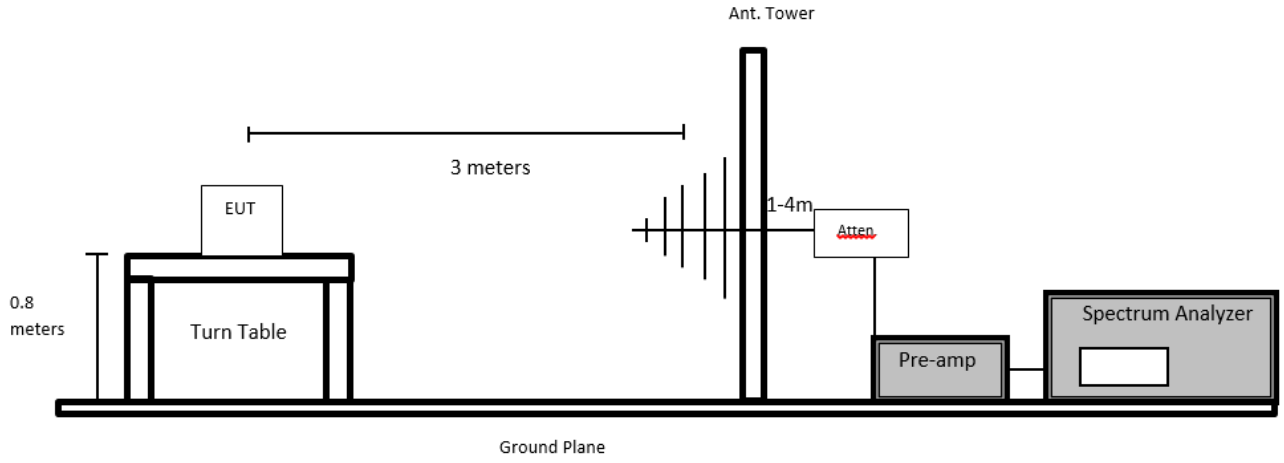
(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz or 1/T / Sweep = Auto

6.4 Test Setup Diagram

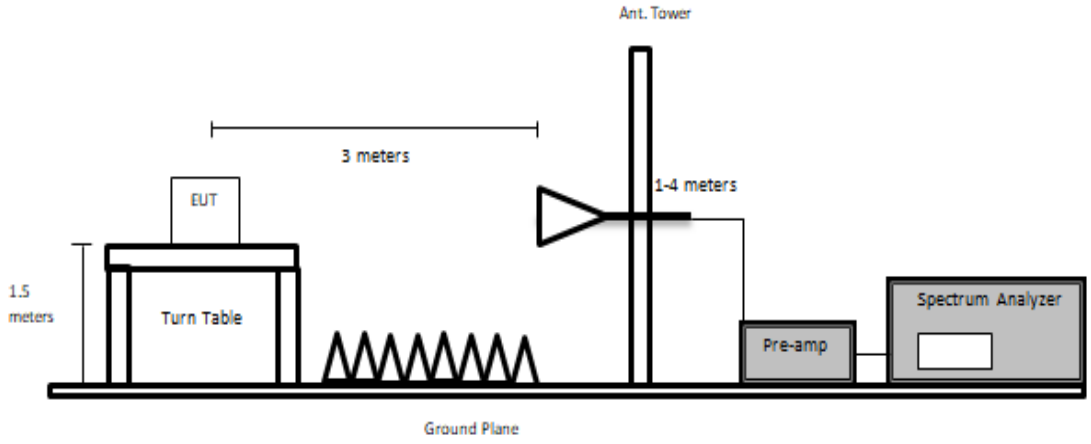
9 kHz to 30 MHz



30 MHz to 1 GHz



Above 1 GHz



6.5 Corrected Amplitude and Margin Calculation

For emissions below 1 GHz,

The Corrected Amplitude (CA) is calculated by adding the Correction Factor to the S.A. Reading. The basic equation is as follows:

CA = S.A. Reading + Correction Factor

For example, a corrected amplitude of 40.3 dBuV/m = S.A. Reading (32.5 dBuV) + Correction Factor (7.8 dB/m)

The Correction Factor is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) together. This calculation is done in the measurement software, and reported in the test result section. The basic equation is as follows:

Correction Factor = AF + CL + Atten – Ga

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:

Margin = Corrected Amplitude – Limit

For emission above 1 GHz,

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 + 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:

Margin = Corrected Amplitude – Limit

6.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
424	Agilent	Spectrum Analyzer	E4440A	US45303156	2024-03-06	12 Months
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	2024-01-15	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	2024-06-14	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
1359	Pasternack	N 600 in RF Cable	PE3496LF-600	-	2024-07-26	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
-	-	RF Cable	-	-	Each Time[1]	N/A
393	Com-Power	Loop Antenna, Active	AL-130	17043	2023-05-26	2 years

Note[1]: cable 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".*

6.7 Test Environmental Conditions

Temperature:	23.2ºC
Relative Humidity:	38%
Barometric Pressure:	101.7 kPa

The testing was performed by Michael Papa from 2025-01-06 to 2025-01-07 and 2025-01-15 in 5m chamber 3.

6.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.209, 15.247 and ISEDC RSS-247 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Configuration**
-1.93	191.7728	Vertical	2402 MHz, 1 MBPS

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

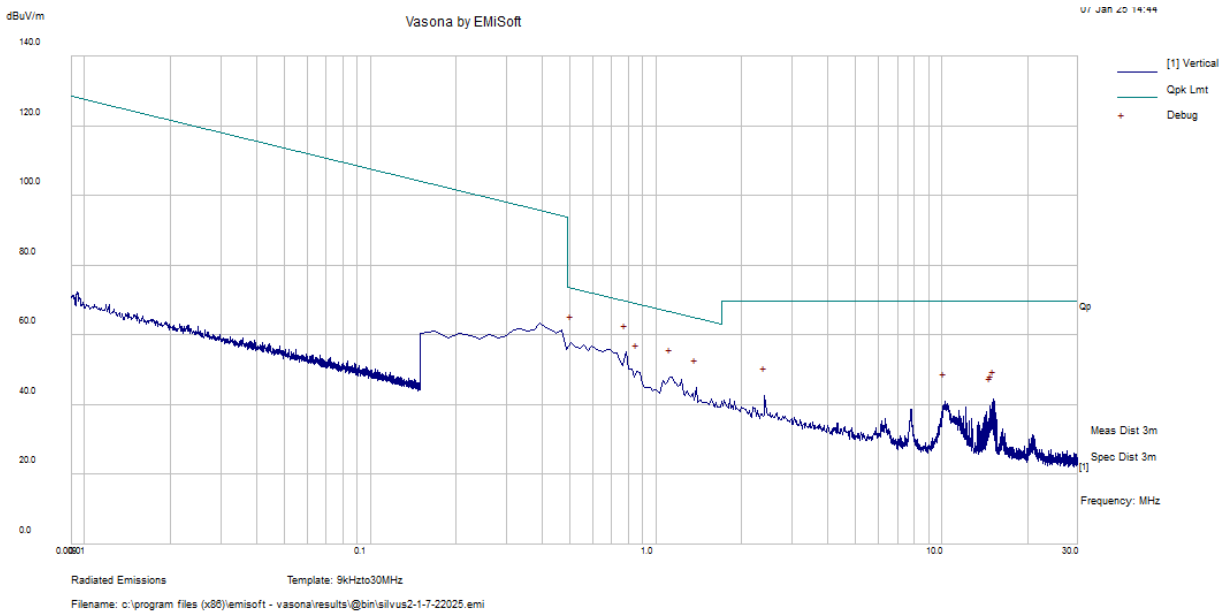
6.9 Radiated Emissions Test Results

Note: Below test data are the radiated measurements. For conducted band edge measurements at the antenna port please refer to ANNEX *A.*
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 4.64dBm. Per ANSI 63.10-2013 Section 11.12.2.2: E[dBµV/m] = EIRP [dBM] + 95.3, for d = 3meters. Thus Limit [dBµV/m @ 3m]=6.74[dBm] - 20 + 95.3=82.04[dBµV/m @ 3m]

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

Note: 1MBPS at 2402MHz is the worst case configuration and is used to show compliance for 9 kHz to 30 MHz.

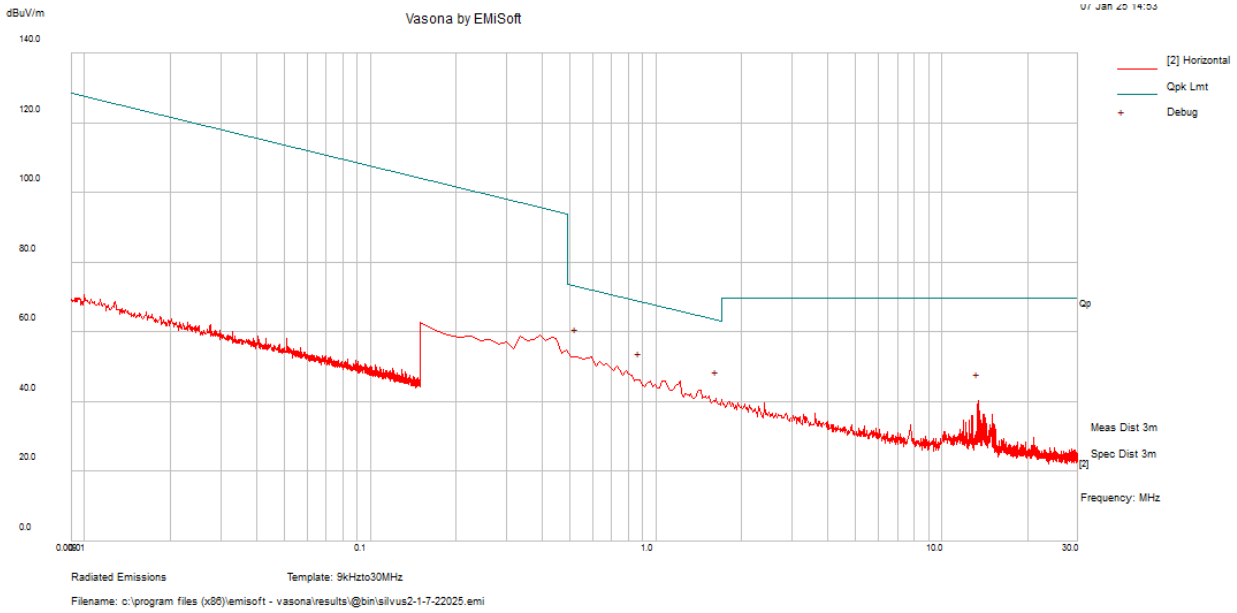
2402 MHz, Parallel



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
0.784313	44.86	10.16	55.02	69.72	-14.69	Peak
0.504469	47.47	10.23	57.7	73.55	-15.85	Peak
1.120125	37.78	10.18	47.96	66.62	-18.66	Peak
0.858938	39.22	10.14	49.36	68.93	-19.57	Peak
1.381313	34.62	10.27	44.89	64.8	-19.91	Peak
2.407406	32.04	10.49	42.53	69.54	-27.01	Peak

Note: Peak emissions are compared to QP limits to show worst-case compliance.

2402 MHz, Perpendicular



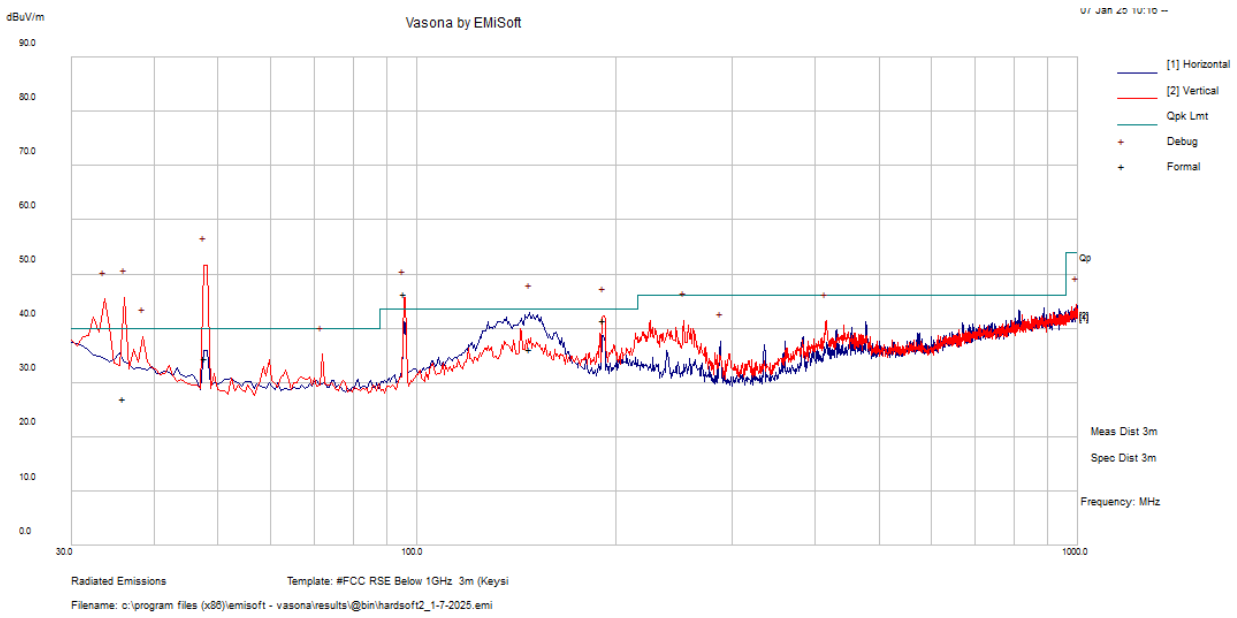
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Detector
0.523125	42.7	10.23	52.93	73.23	-20.31	Peak
1.623844	30.51	10.35	40.86	63.39	-22.53	Peak
0.877594	36	10.13	46.13	68.74	-22.61	Peak
13.41459	29.39	10.79	40.18	69.54	-29.36	Peak

Note: Peak emissions are compared to QP limits to show worst-case compliance.

Note: 1 MBPS mode was used for the following testing, as pretesting determined it to be the worst-case configuration for demonstrating compliance (i.e. produced the highest power/psd per modulation family).

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

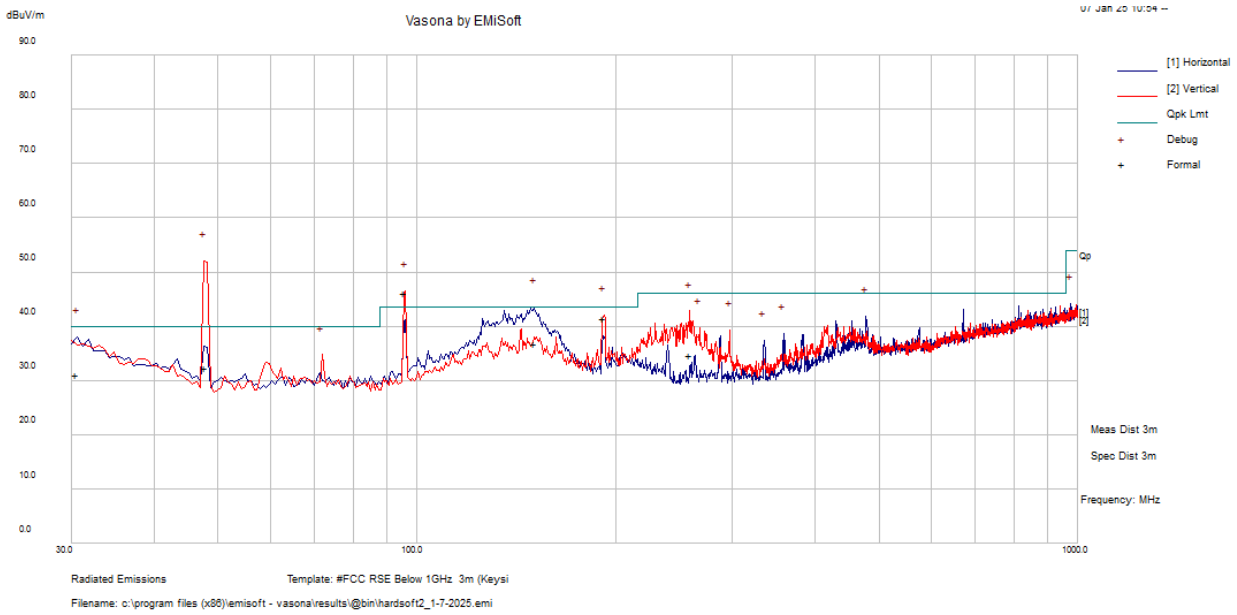
2402 MHz



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
95.6635	57.37	-11.09	46.28	111	V	207	82.04	-36.76	QP[1]
191.7728	**50.25**	**-8.68**	**41.57**	**103**	**V**	**164**	**43.5**	**-1.93**	**QP**
47.82438	46.97	-12.5	34.47	282	V	54	40	-5.53	QP
147.9825	44.08	-7.89	36.19	281	H	169	43.5	-7.320	QP
35.95	31.75	-4.78	26.97	143	V	149	40	-13.03	QP
33.415	48.65	-3.21	45.44	100	V	182	82.04	-36.60	QP[1]

Note[1]: Emissions found fall outside restricted bands. Thus they were compared to 15.247(d) spurious emissions limits instead.

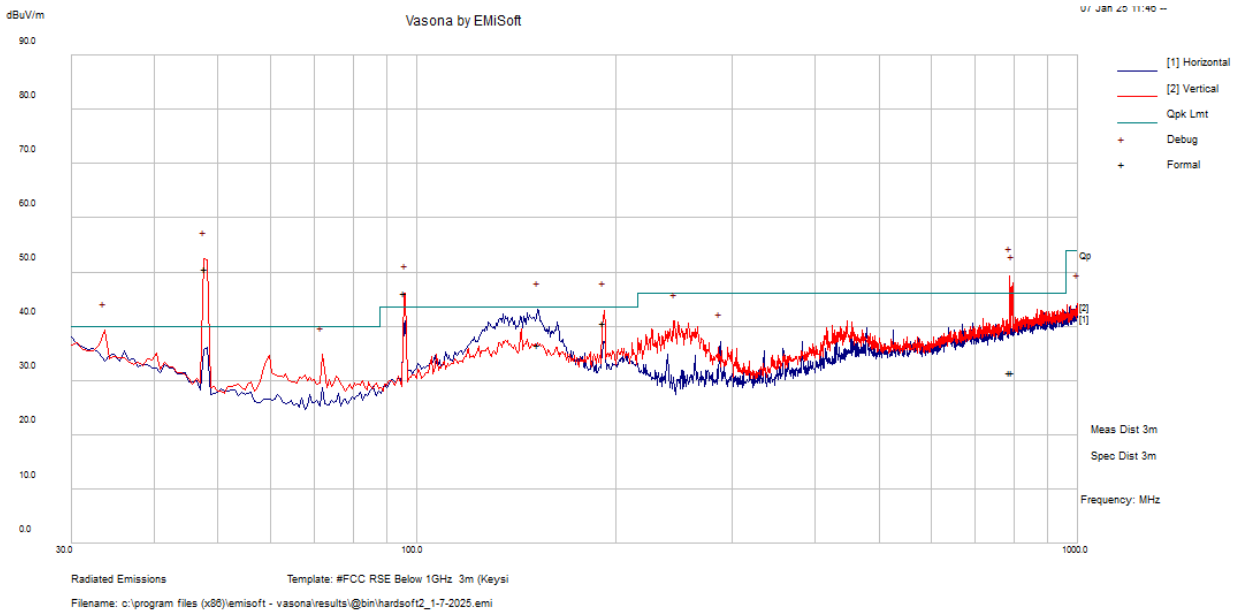
2440 MHz



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
47.79656	44.84	-12.49	32.35	243	V	82	40	-7.65	QP
95.90469	57.17	-11.02	46.15	120	V	224	82.04	-35.89	QP[1]
150.6203	44.76	-7.98	36.78	202	H	32	43.5	-6.72	QP
191.8347	50.21	-8.67	41.54	100	V	105	43.5	-1.97	QP
30.49094	32.23	-1.1	31.13	281	H	265	40	-8.87	QP
258.7216	42.49	-7.91	34.58	100	V	107	46	-11.43	QP

Note[1]: Emissions found fall outside restricted bands. Thus they were compared to 15.247(d) spurious emissions limits instead.

2480 MHz

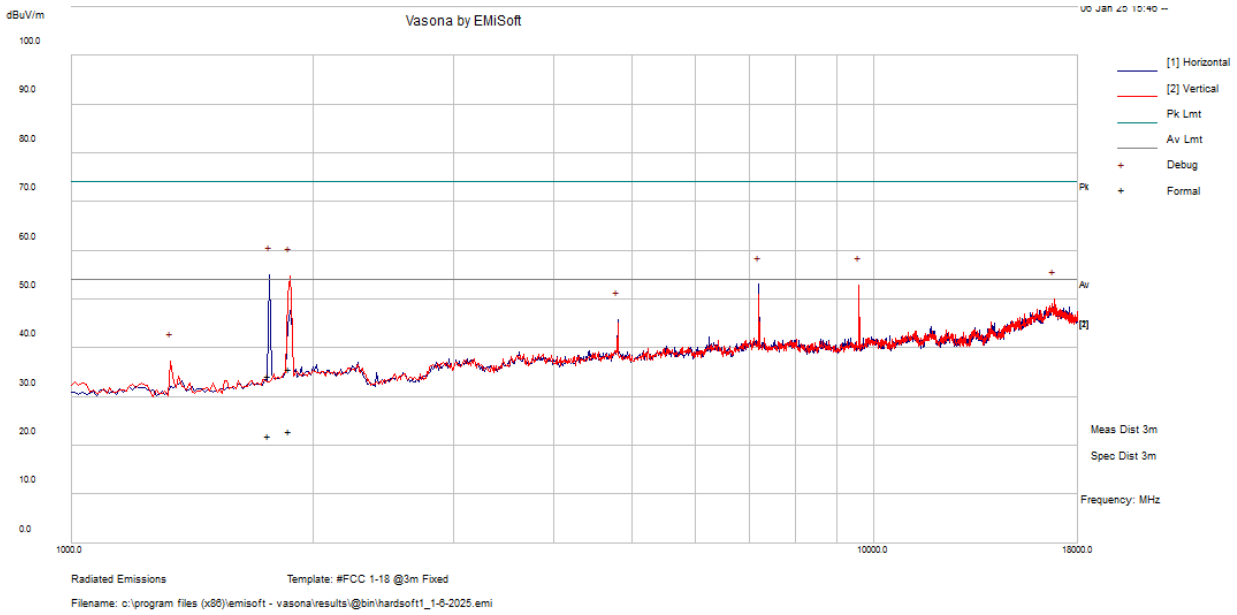


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector
47.74906	62.99	-12.47	50.52	100	V	47	82.04	-31.52	QP[1]
789.0994	28.38	3.16	31.54	119	V	122	46	-14.46	QP
95.91688	57.2	-11.02	46.18	119	V	210	82.04	-35.86	QP[1]
796.7963	28.22	3.35	31.57	224	V	199	46	-14.43	QP
152.5803	44.7	-8.06	36.64	290	H	275	43.5	-6.86	QP
191.8494	49.21	-8.67	40.54	101	V	132	43.5	-2.96	QP

Note[1]: Emissions found fall outside restricted bands. Thus they were compared to 15.247(d) spurious emissions limits instead.

3) 1 – 18 GHz, Measured at 3 meter

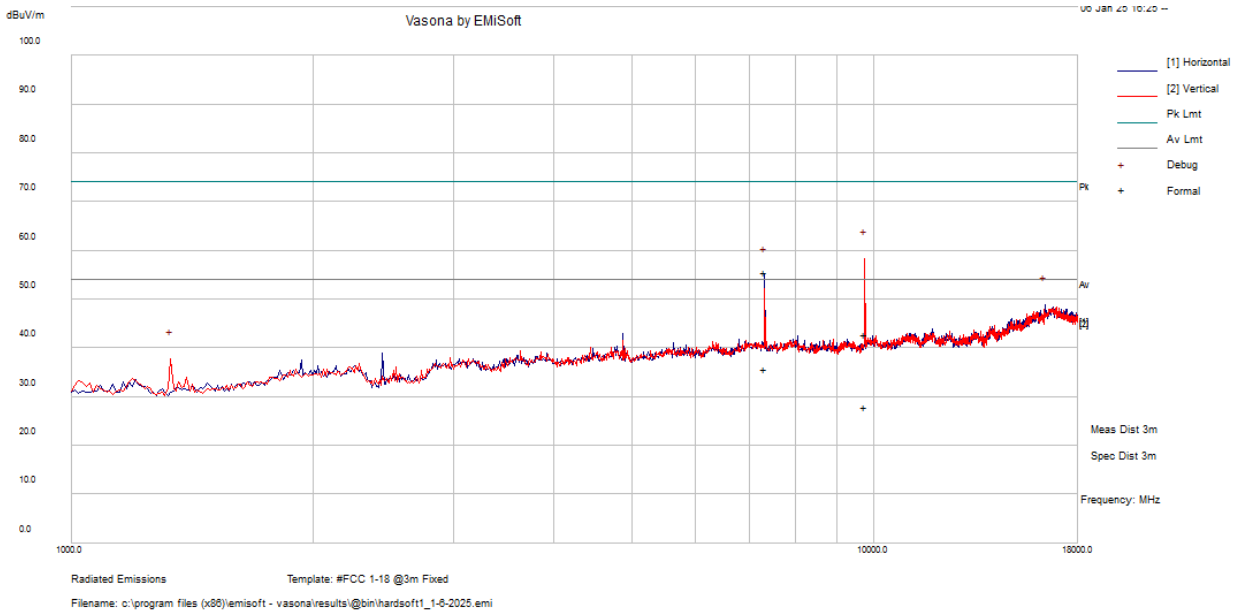
2402 MHz



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
1764.718	41.66	-7.32	34.34	164	H	205	74	-39.66	Peak
1870.875	41.95	-6.18	35.77	198	V	26	74	-38.24	Peak
1764.718	29.32	-7.31	22.01	164	H	205	54	-31.99	Average
1870.875	29.17	-6.18	22.99	198	V	26	54	-31.01	Average

Note: All other peak emissions in the plot above are shown to be below the average limit.

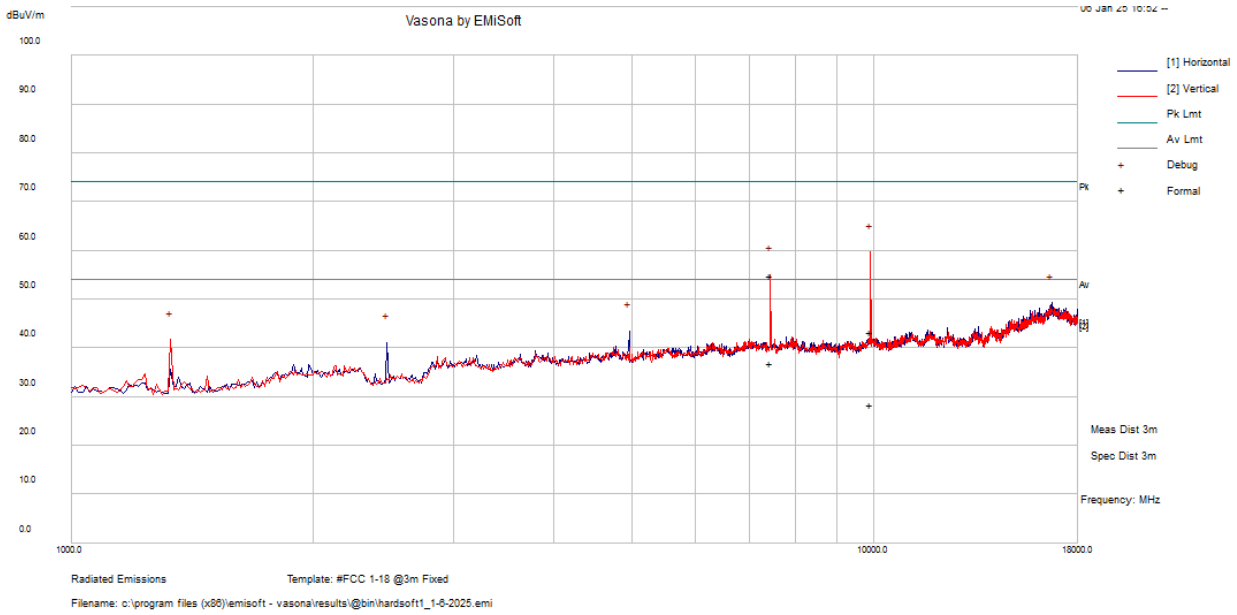
2440 MHz



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
9767.55	37.05	5.7	42.75	142	V	229	74	-31.25	Peak
7320.078	52.95	2.56	55.51	286	H	166	74	-18.49	Peak
9767.55	22.24	5.69	27.93	142	V	229	54	-26.07	Average
7320.078	33.18	2.55	35.73	286	H	166	54	-18.27	Average

Note: All other peak emissions in the plot above are shown to be below the average limit.

2480 MHz

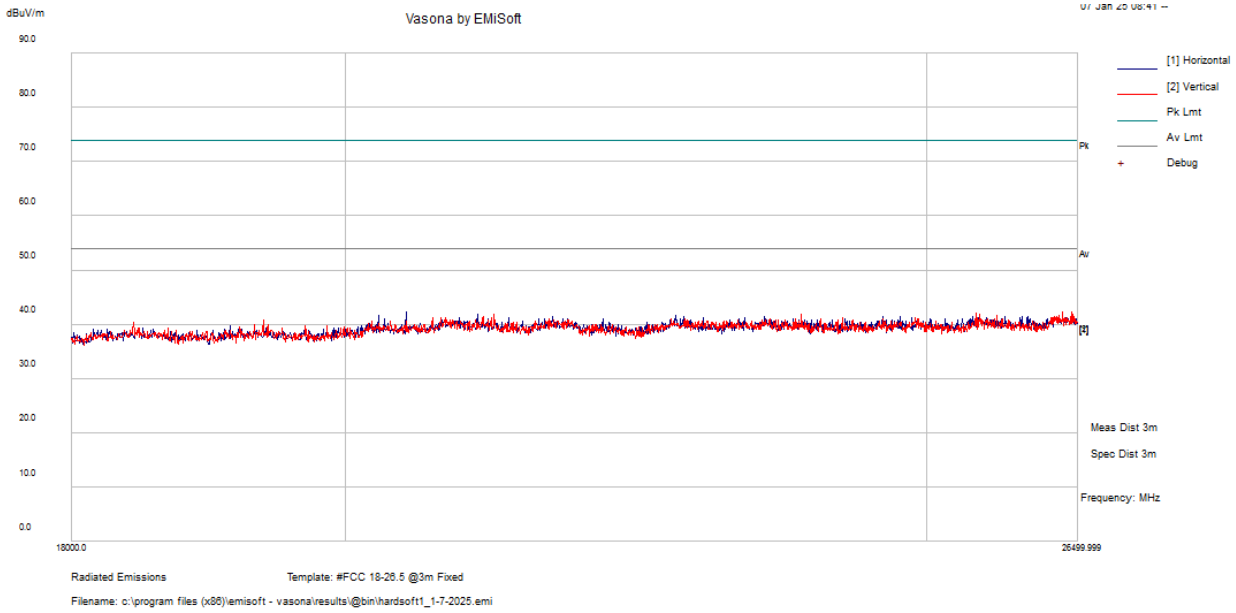


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector
9915.633	37.24	6.06	43.3	233	V	333	74	-30.7	Peak
7439.488	52.46	2.4	54.86	101	V	352	74	-19.14	Peak
9915.633	22.31	6.05	28.36	233	V	333	54	-25.64	Average
7439.488	34.54	2.4	36.94	101	V	352	54	-17.06	Average

Note: All other peak emissions in the plot above are shown to be below the average limit.

4) 18 - 26.5 GHz, Measured at 3 meter

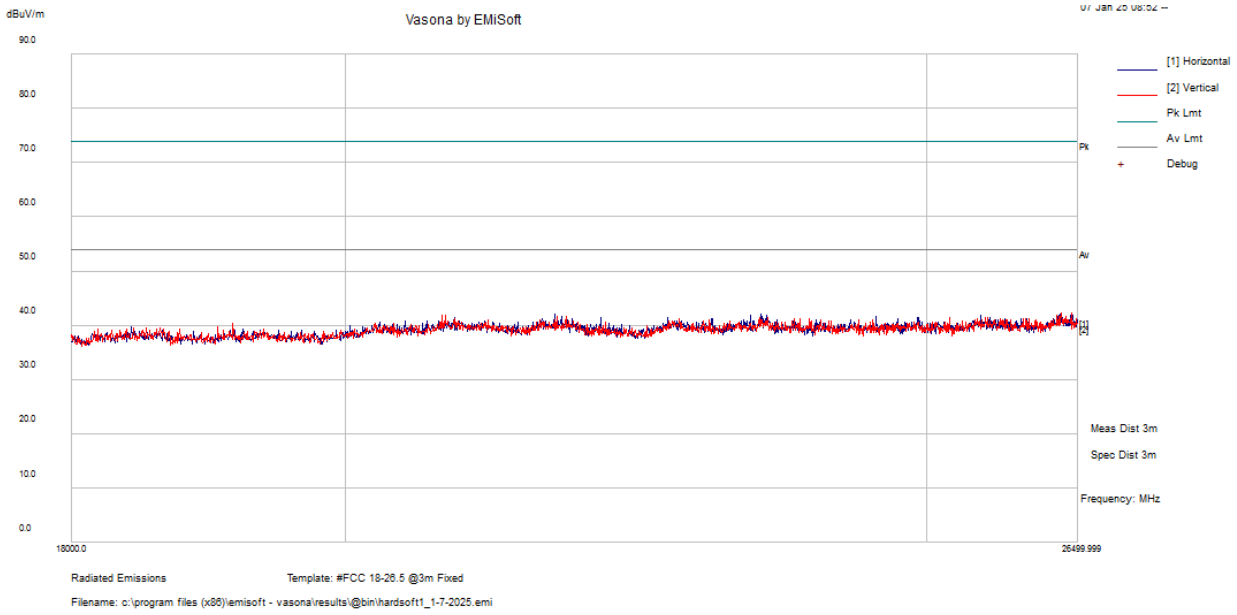
2402 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/m)	Margin (dB)	Detector
23109.11	39.14	0.14	39.28	H	54	-14.72	Peak

Note: Peak emissions are compared to average limit to show worst-case compliance.

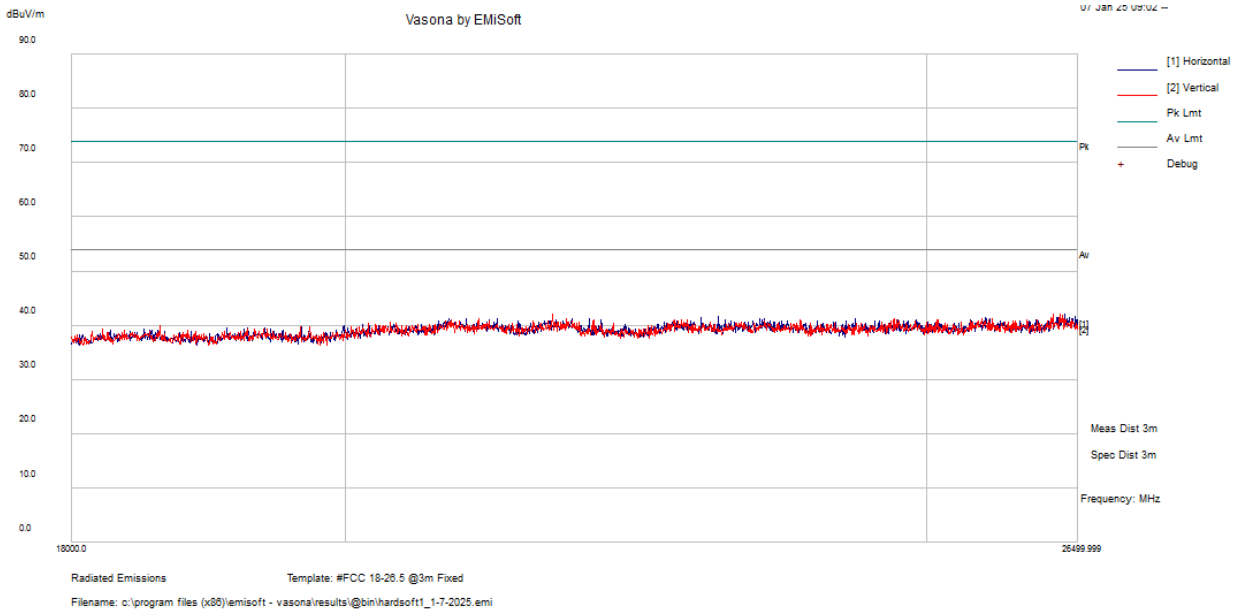
2440 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Limit (dBµV/m)	Margin (dB)	Detector
22948.79	39.62	0.40	40.02	H	54	-13.98	Peak

Note: Peak emissions are compared to average limit to show worst-case compliance.

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
21676.2	39.85	-0.07	39.78	H	54	-14.22	Peak

Note: Peak emissions are compared to average limit to show worst-case compliance.

7 FCC §15. 247(a) (2) & ISEDC RSS-247 §5.2, RSS-Gen §6.7 - Emission Bandwidth

7.1 Applicable Standards

According to RSS-247 §6.7: The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs. In some cases, the "x dB bandwidth" is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

According to FCC §15.247(a) (2) and ISEDC RSS-247 §5.2: the minimum 6 dB bandwidth shall be 500 kHz.

7.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8: DTS bandwidth.

As per ANSI C63.10 Clause 6.9: Occupied Bandwidth Tests

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:

a.) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b.) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c.) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d.) Step a) through step c) might require iteration to adjust within the specified range.

e.) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

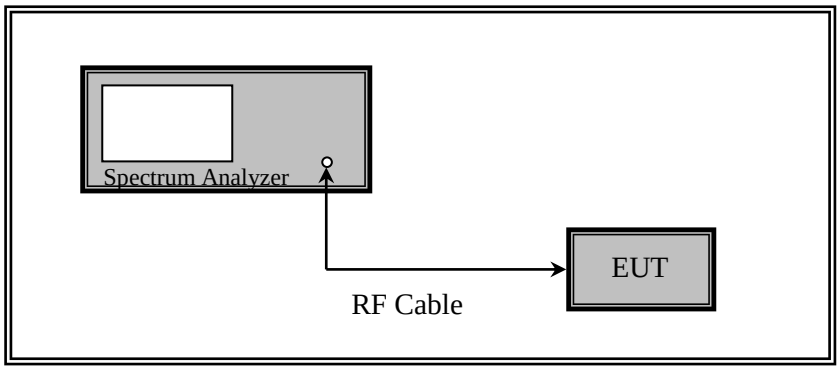
f.) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between

g.) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).these two frequencies.

As per ANSI C63.10 Clause 11.8: DTS bandwidth

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described in 11.8.1 (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, and peak detector with maximum hold) is implemented by the instrumentation function.
When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥6 dB.

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
00424	Agilent	Spectrum Analyzer	E4440A	US45303156	2024-03-06	12 Months
-	-	RF Cable	-	-	Each Time[1]	N/A

Note[1]: cable 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:	19.5℃
Relative Humidity:	34.3%
ATM Pressure:	102.4 kPa

The testing was performed by Michael Papa on 2025-01-15 at RF Bench.

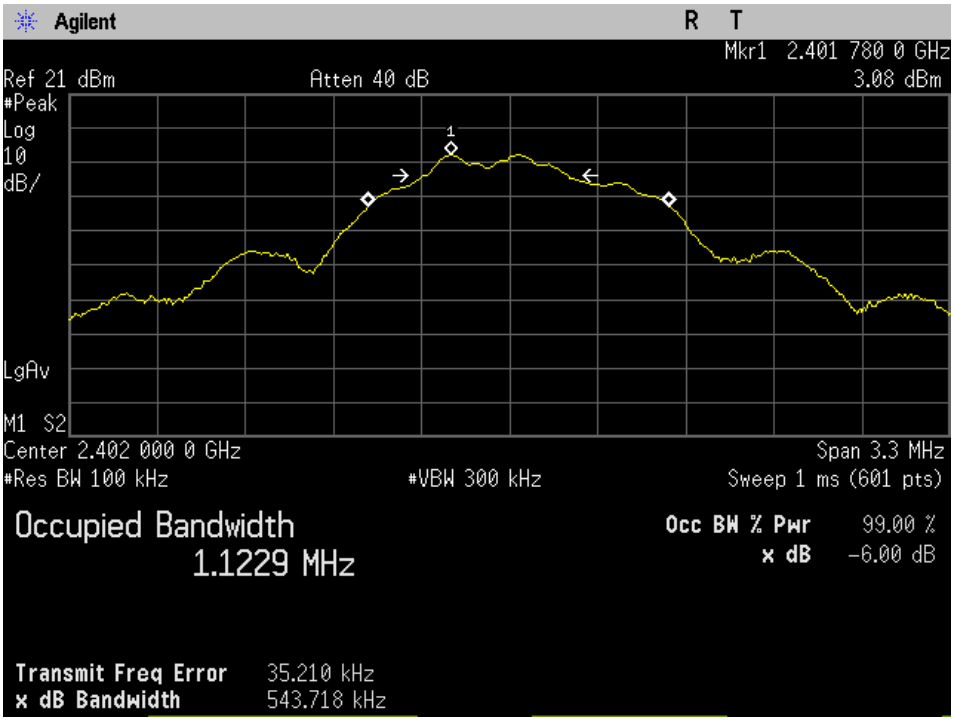
7.6 Test Results

Radio Mode	Channel	Frequency (MHz)	6 dB OBW (kHz)	99% OBW (MHz)	6 dB OBW Limit (kHz)	Result
1MBPS	0	2402	543.718	1.054	≥ 500	Pass
	19	2440	546.541	1.044	≥ 500	Pass
	39	2480	534.464	1.047	≥ 500	Pass
2MBPS	0	2402	853.268	2.051	≥ 500	Pass
	19	2440	863.673	2.056	≥ 500	Pass
	39	2480	875.469	2.057	≥ 500	Pass

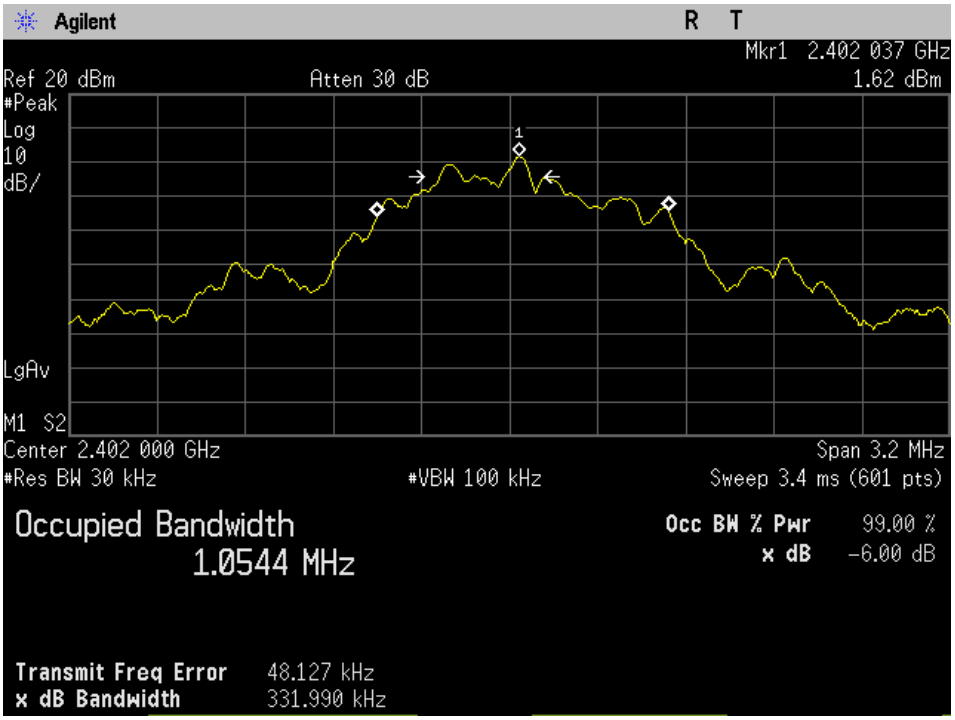
Note: Refer to following plots for 6dB OBW and 99 OBW test results.

1 MBPS

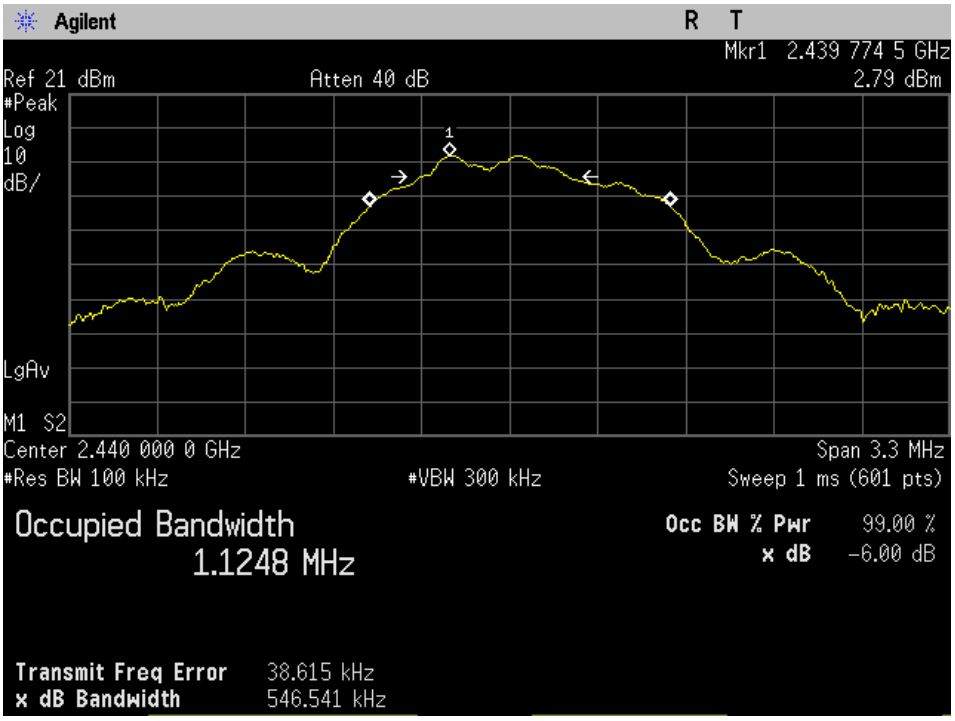
2402 MHz 6dB OBW



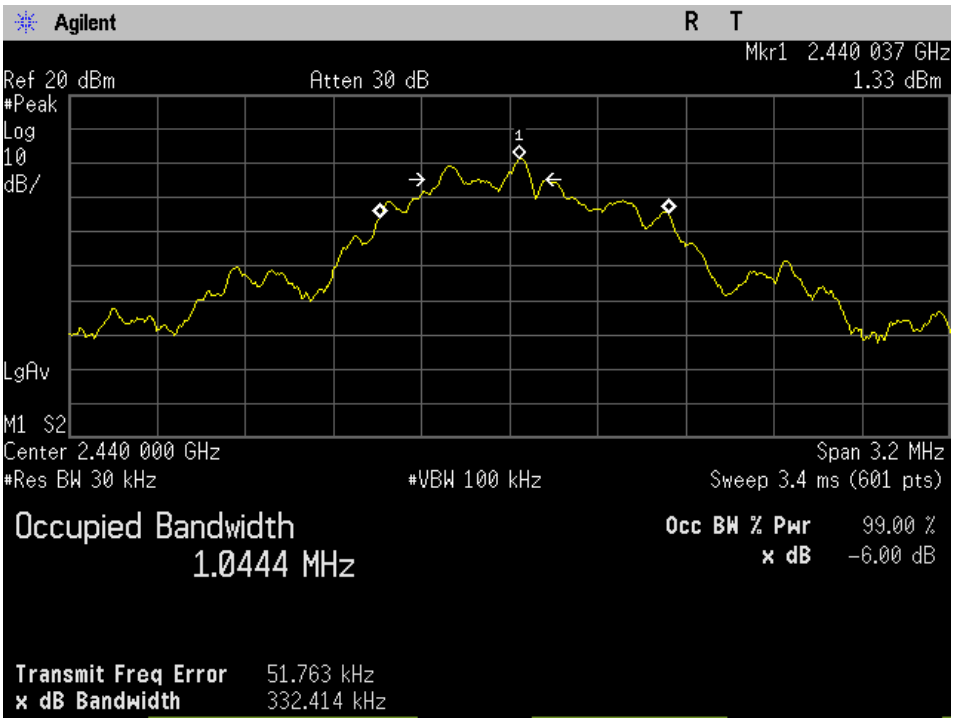
2402 MHz 99% OBW



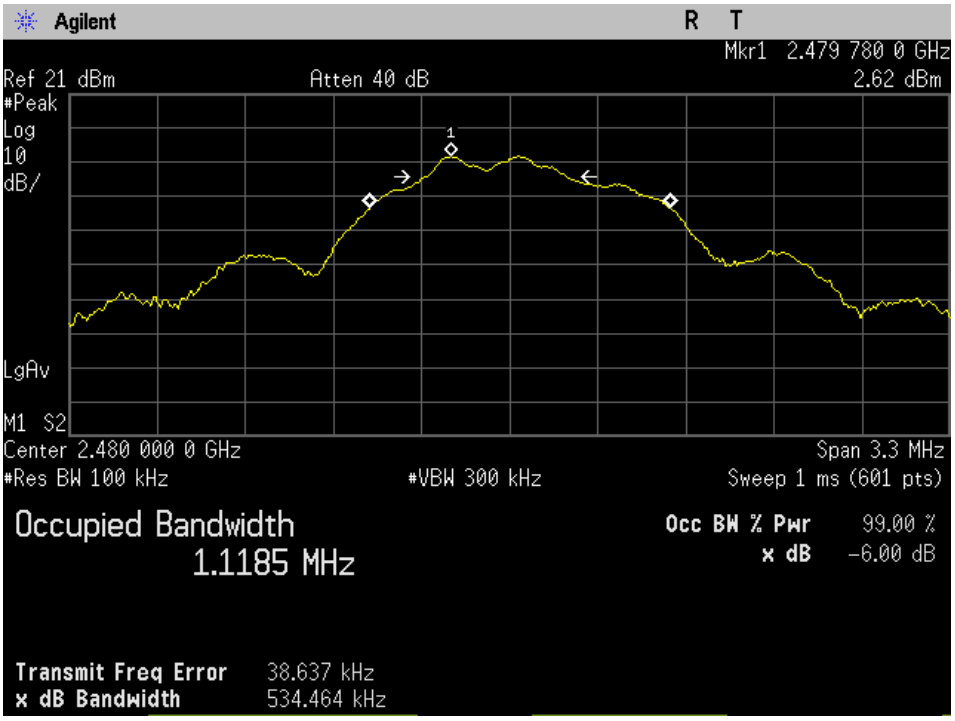
2440 MHz 6dB OBW



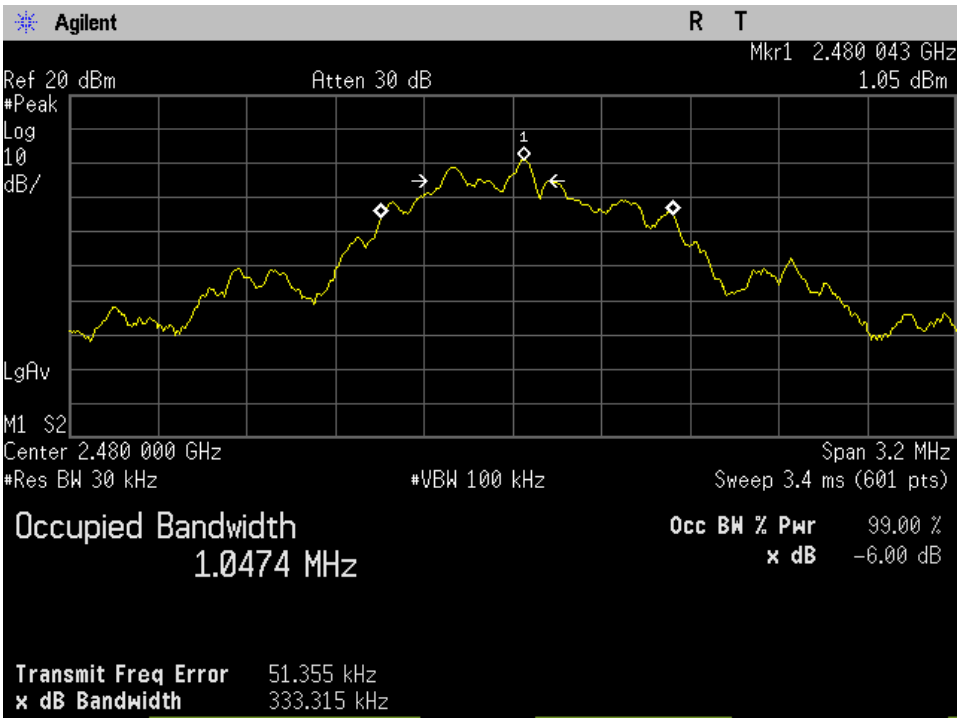
2440 MHz 99% OBW



2480 MHz 6dB OBW

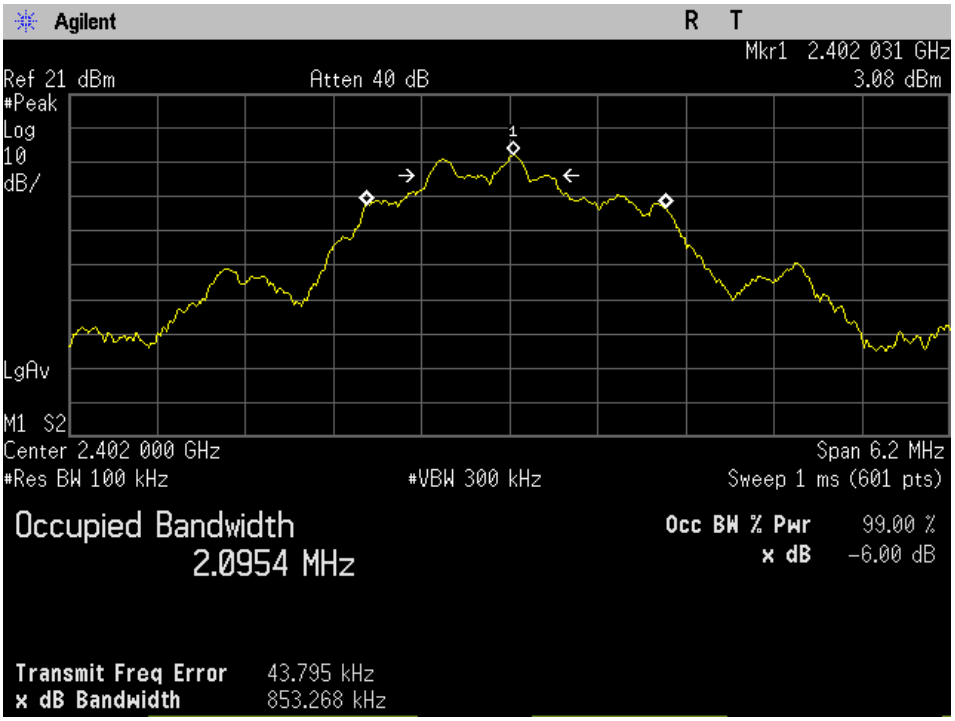


2480 MHz 99% OBW



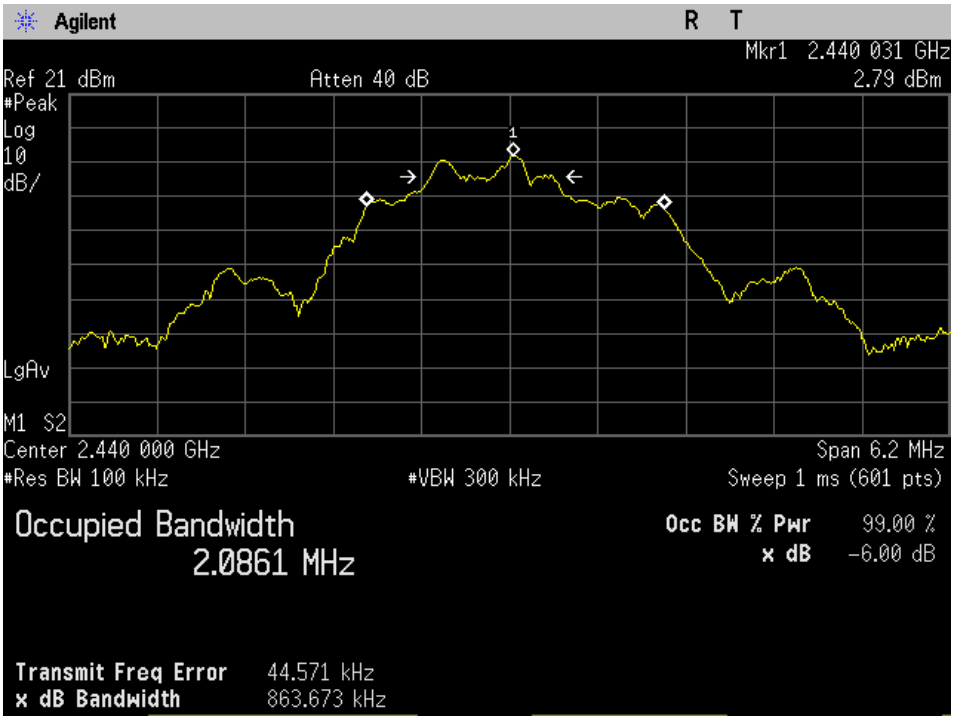
2 MBPS

2402 MHz 6dB OBW

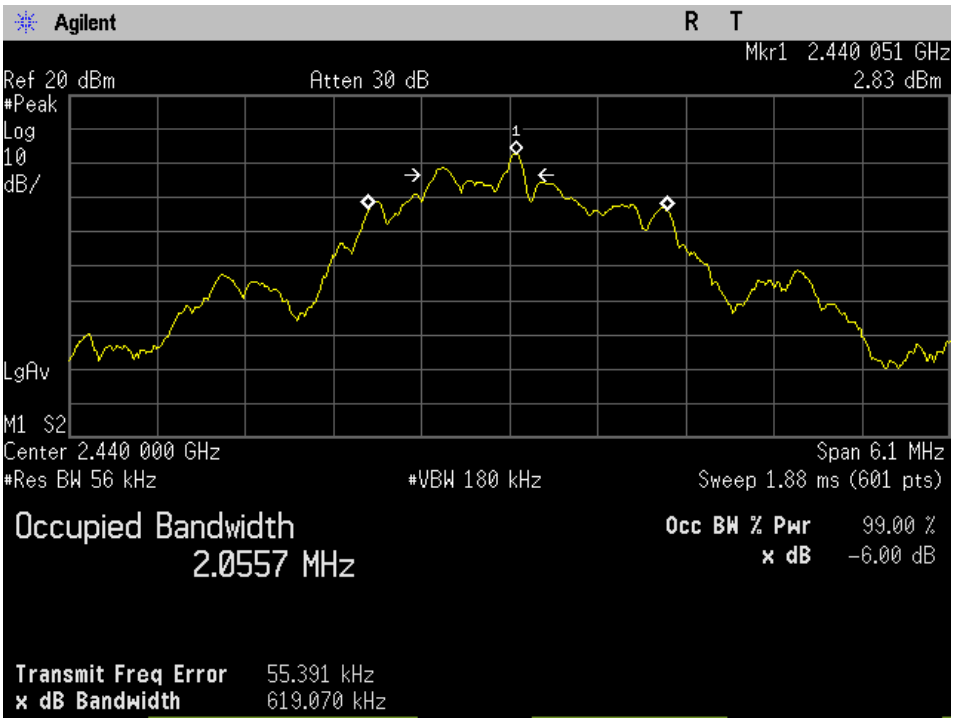


2402 MHz 99% OBW

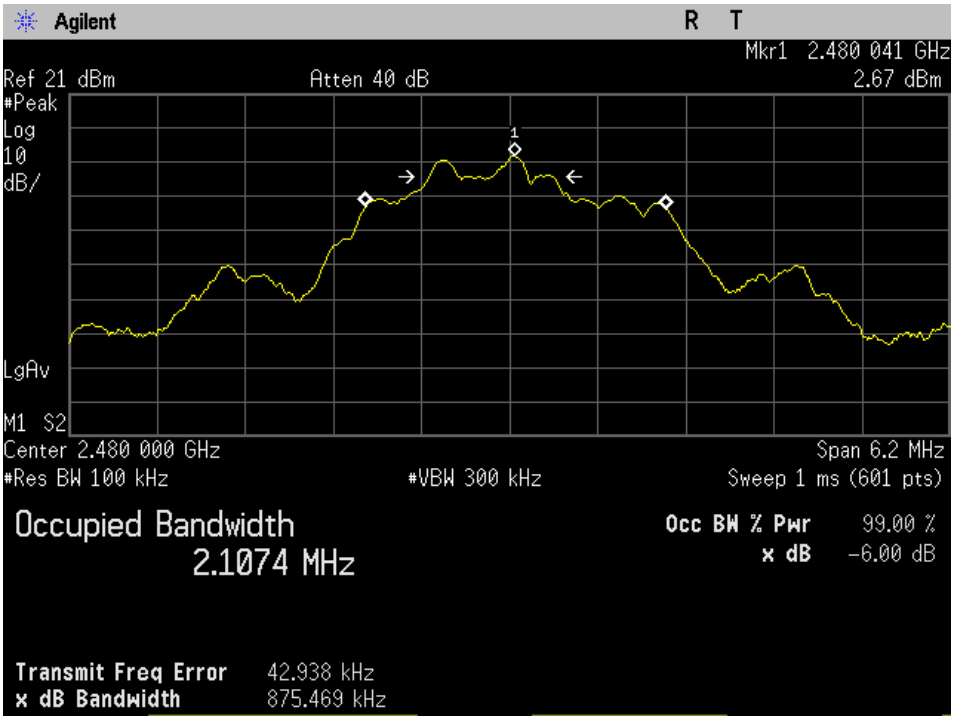
2440 MHz 6dB OBW



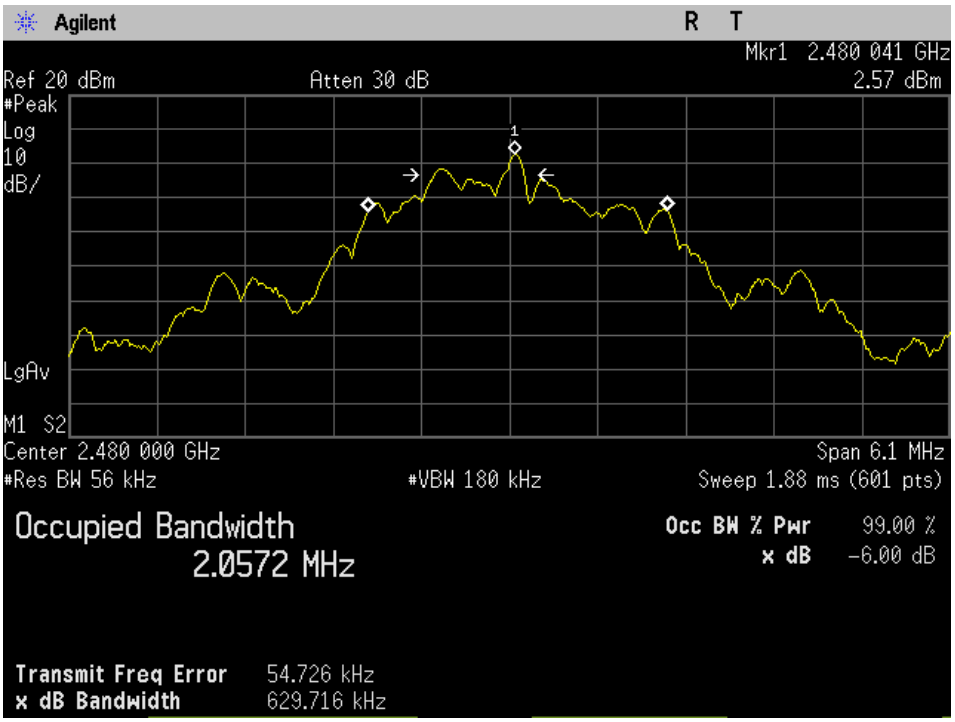
2440 MHz 99% OBW



2480 MHz 6dB OBW



2480 MHz 99% OBW



8 FCC §15.247(b)(3) & ISEDC RSS-247 §5.4 - Maximum Output Power

8.1 Applicable Standards

According to FCC §15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to RSS-247 §5.4: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

8.2 Measurement Procedure

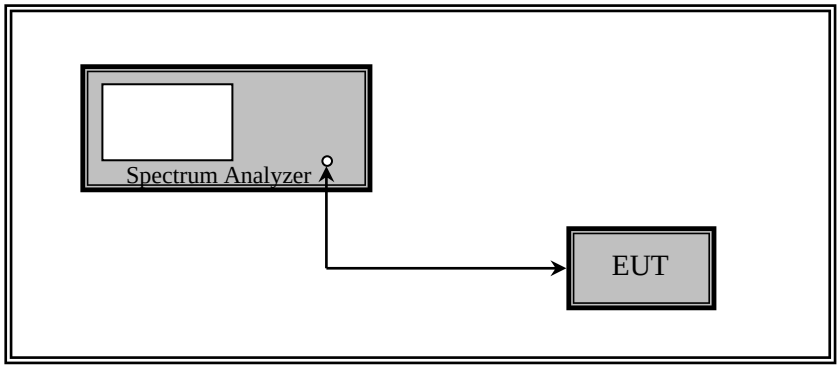
The measurements are based on ANSI C63.10-2013, Section 11.9.1.1

11.9.1.1 RBW ≥ bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a. Set the RBW ≥ DTS bandwidth
b. Set VBW ≥ [3 × RBW].
c. Set span ≥ [3 × RBW].
d. Sweep time = auto couple.
e. Detector = peak.
f. Trace mode = max hold.
g. Allow trace to fully stabilize.
h. Use peak marker function to determine the peak amplitude level.

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
00424	Agilent	Spectrum Analyzer	E4440A	US45303156	2024-03-06	12 Months
-	-	RF Cable	-	-	Each Time[1]	N/A

Note[1]: cable 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".*

8.5 Test Environmental Conditions

Temperature:	21.5°C
Relative Humidity:	35%
ATM Pressure:	102.1 kPa

The testing was performed by Michael Papa on 2025-01-03 at RF Bench.

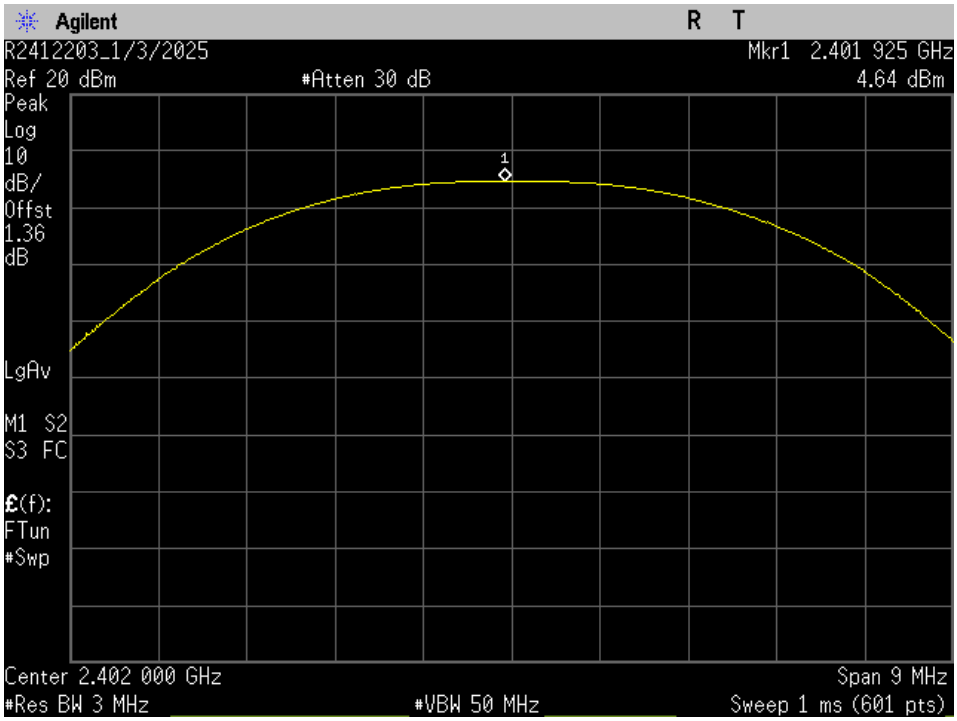
8.6 Test Results

Radio Mode	Channel	Frequency (MHz)	Antenna Gain (dBi)	Conducted Output Power (dBm)	Output Power Limit (dBm)	EIRP (dBm)	EIRP Limit (dBm)	Result
1 MBPS	0	2402	2.2	4.64	30	6.74	36	Pass
	19	2440	2.2	4.30	30	6.40	36	Pass
	39	2480	2.2	3.93	30	6.03	36	Pass
2 MBPS	0	2402	2.2	4.61	30	6.71	36	Pass
	19	2440	2.2	4.27	30	6.37	36	Pass
	39	2480	2.2	3.94	30	6.04	36	Pass

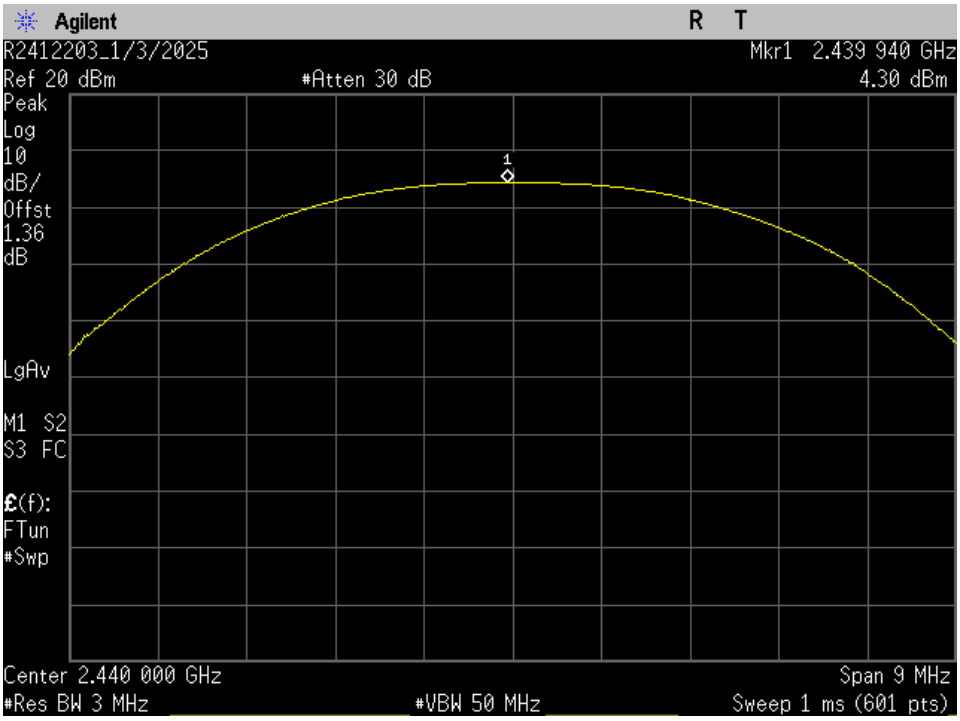
Note: EIRP [dBm] = Conducted Output Power [dBm]+Antenna Gain [dBi]
Note: Refer to following plots for Output Power test results.

1 MBPS

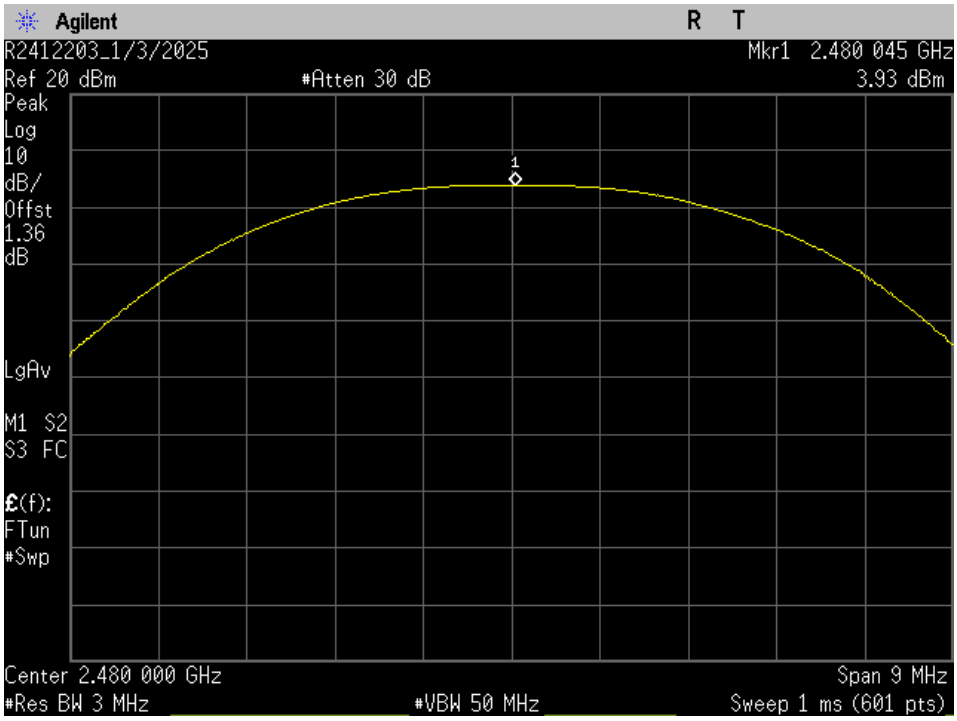
2402 MHz



2440 MHz

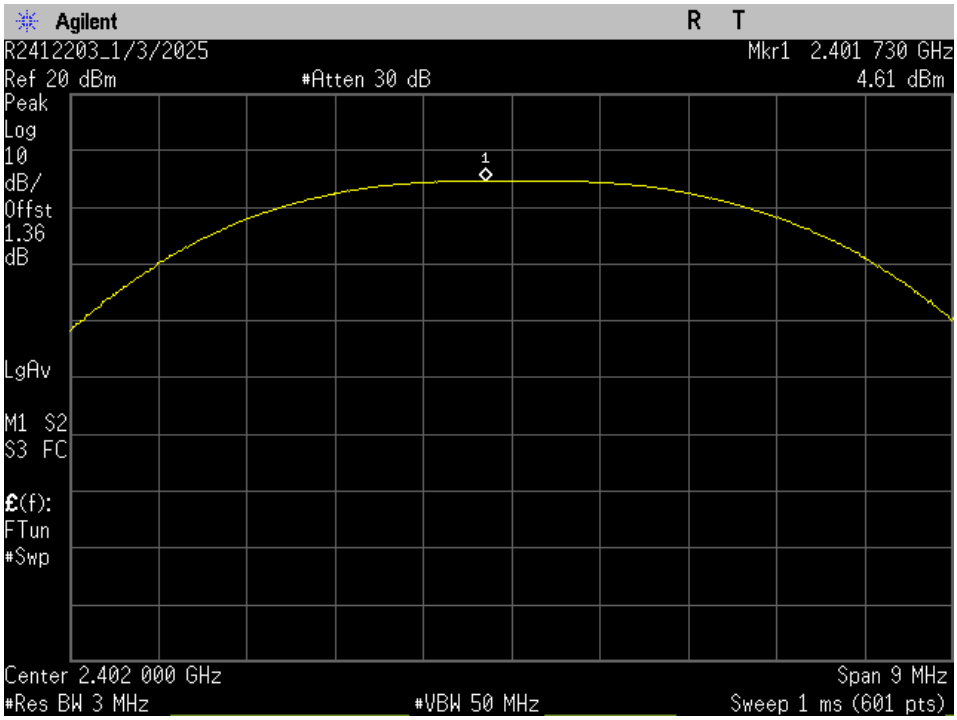


2480 MHz

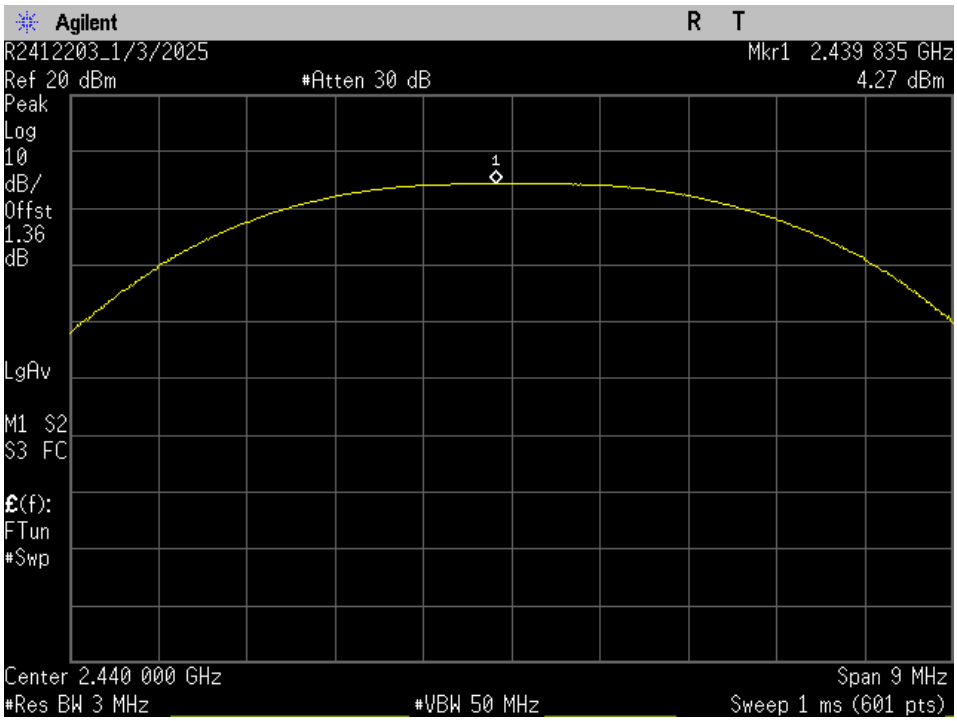

Agilent
R T
R2412203_1/3/2025
Mkr1 2.480 045 GHz
Ref 20 dBm
#Atten 30 dB
3.93 dBm
Peak
Log
10
dB/
Offst
1.36
dB
1
LgAv
M1 S2
S3 FC
£(f):
FTun
#Swp
Center 2.480 000 GHz
Span 9 MHz
#Res BW 3 MHz
#VBW 50 MHz
Sweep 1 ms (601 pts)

2 MBPS

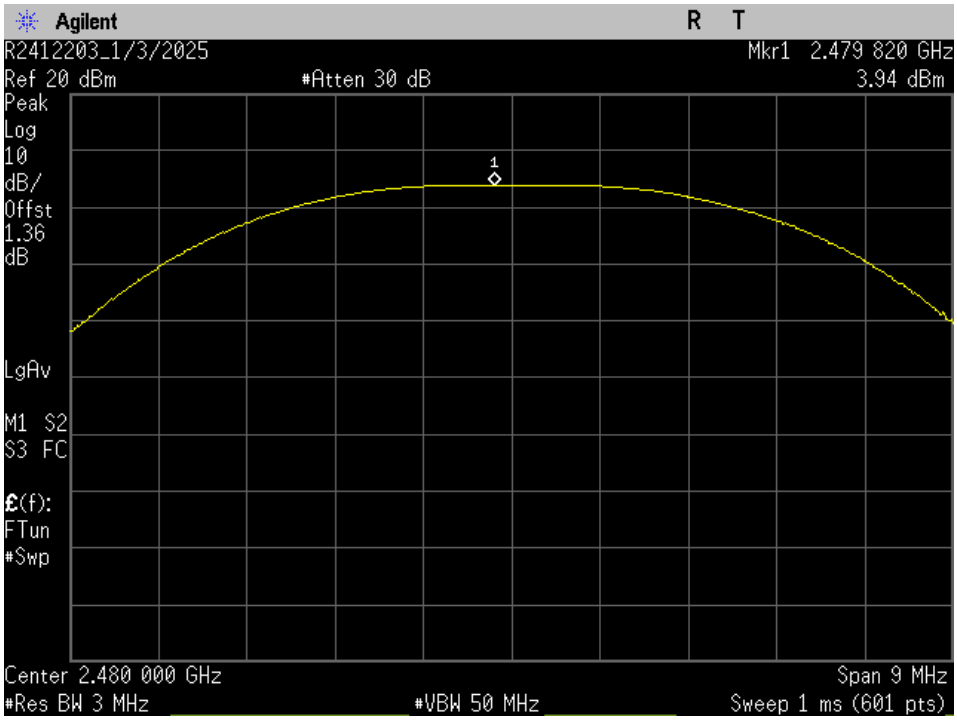
2402 MHz



2440 MHz



2480 MHz


Agilent
R T
R2412203_1/3/2025
Mkr1 2.479 820 GHz
Ref 20 dBm
#Atten 30 dB
3.94 dBm
Peak
Log
10
dB/
Offst
1.36
dB
1
LgAv
M1 S2
S3 FC
£(f):
FTun
#Swp
Center 2.480 000 GHz
Span 9 MHz
#Res BW 3 MHz
#VBW 50 MHz
Sweep 1 ms (601 pts)

9 FCC §15.247(d) & ISEDC RSS-247 §5.5 - 100 kHz Spurious Emissions at Antenna Terminal

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).

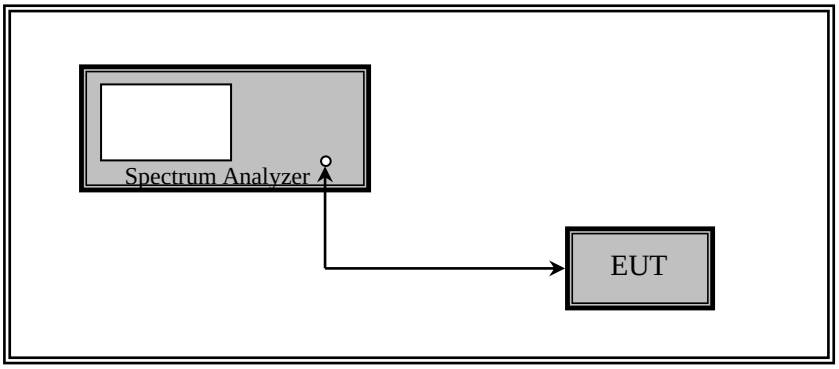
According to ISEDC RSS-247 §5.5.In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the 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
00424	Agilent	Spectrum Analyzer	E4440A	US45303156	2024-03-06	12 Months
-	-	RF Cable	-	-	Each Time[1]	N/A

Note[1]: cable 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

Temperature:	21.5°C
Relative Humidity:	35%
ATM Pressure:	102.1 kPa

The testing was performed by Michael Papa on 2024-12-31 at RF Bench.

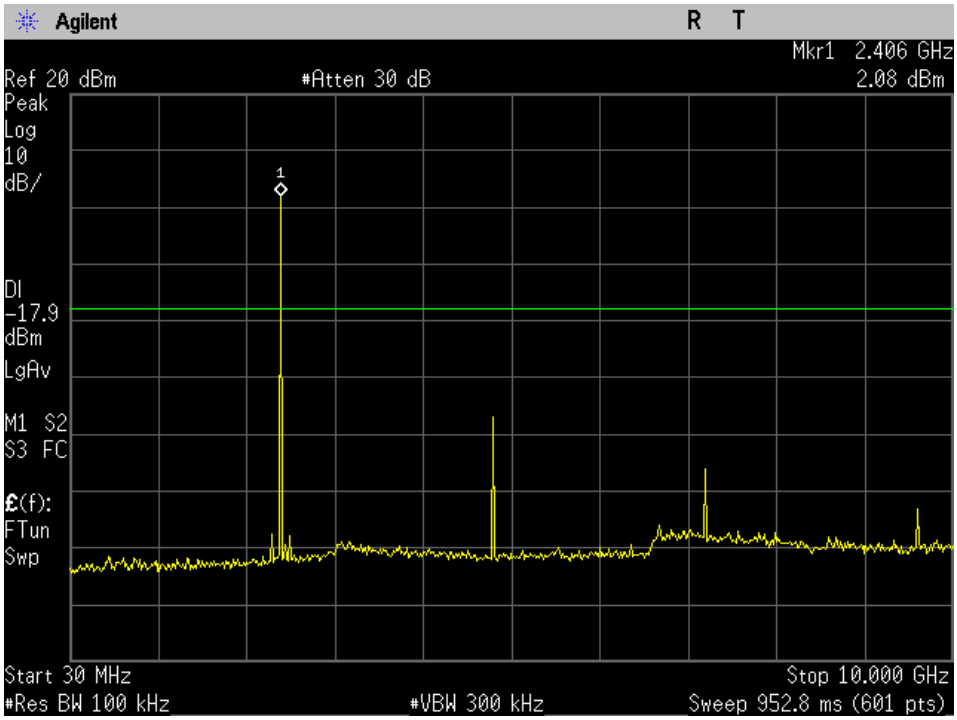
9.6 Test Results

Test Result: Pass

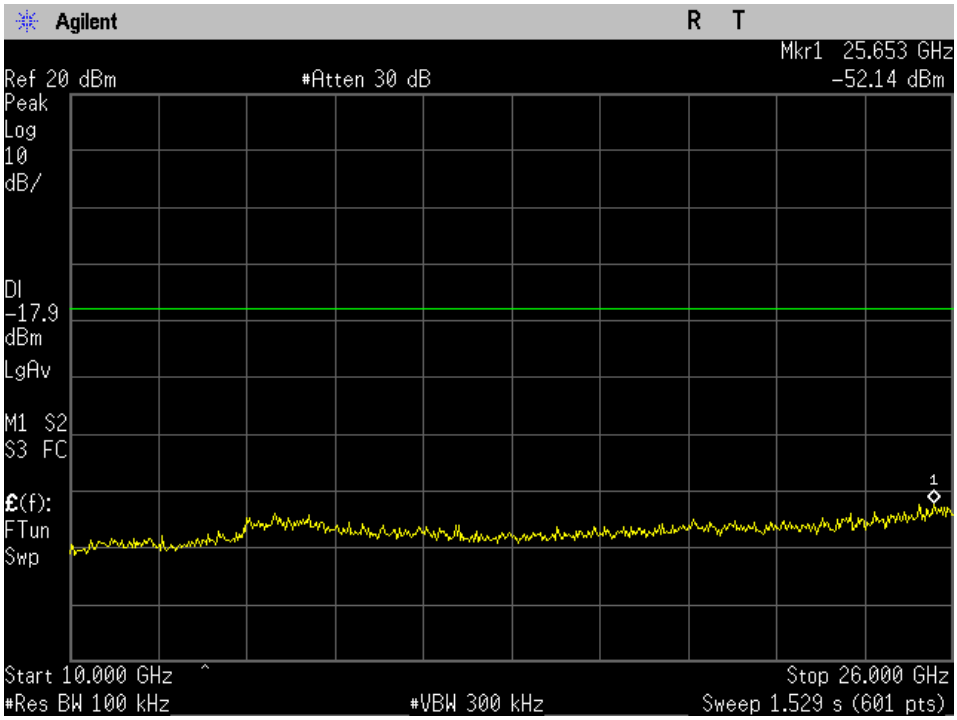
Please refer to the following plots for detailed test results.

1 MBPS

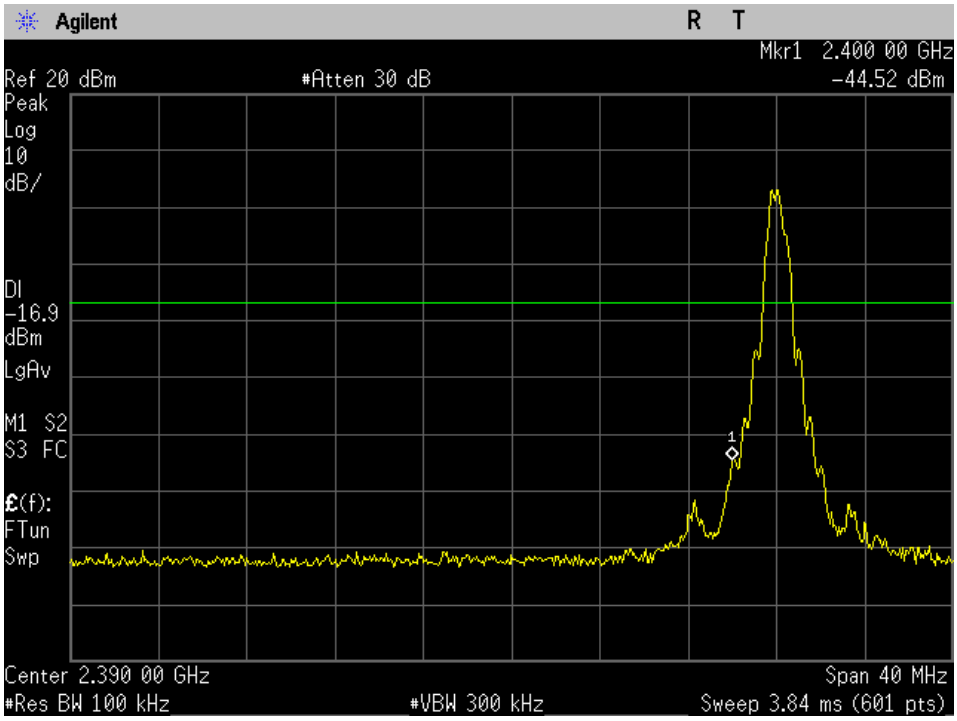
2402 MHz 30 MHz-10 GHz



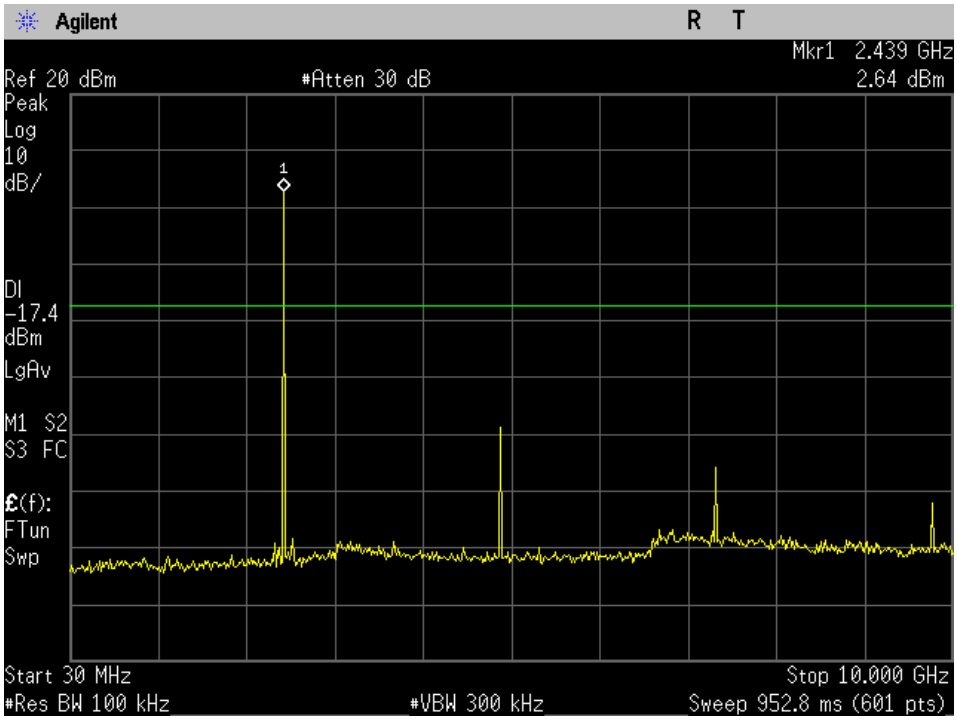
2402 MHz 10-26 GHz



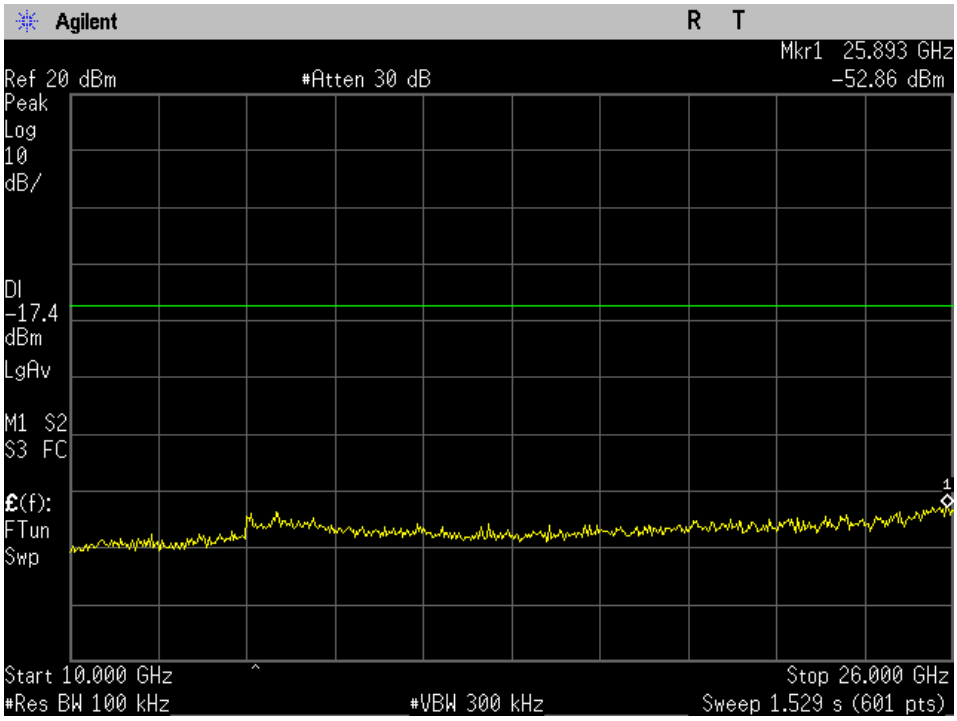
2402 MHz Lower Band Edge



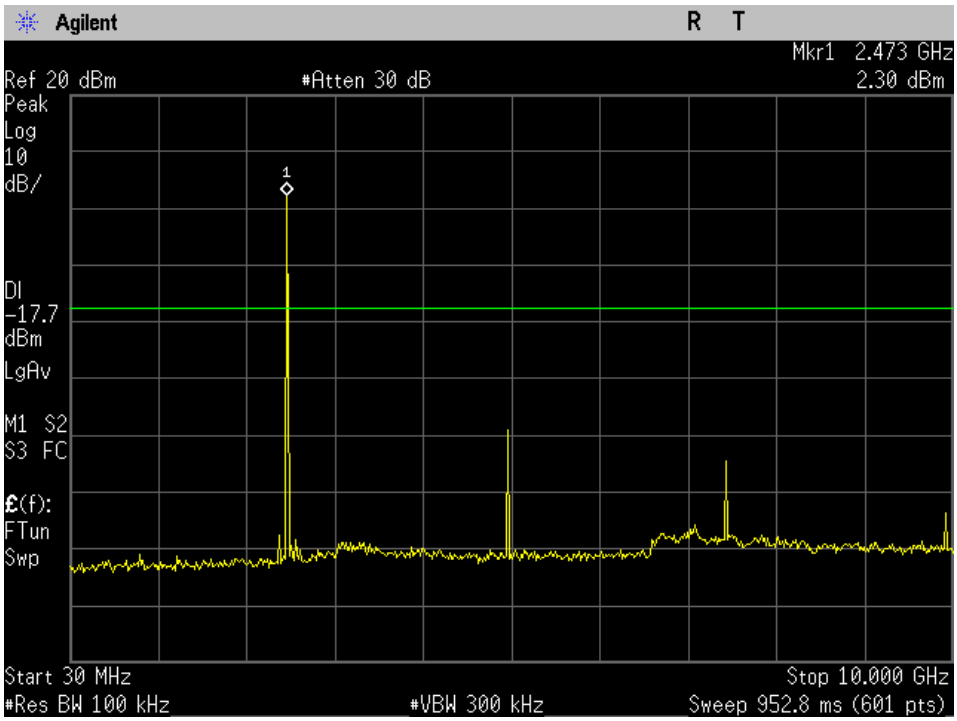
2440 MHz 30MHz-10 GHz



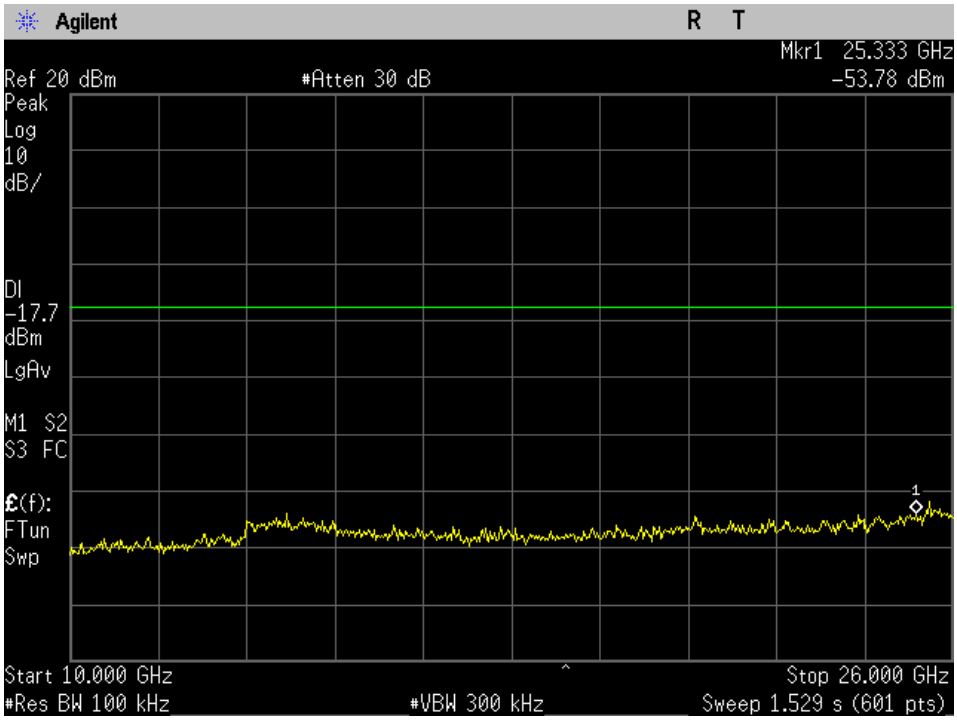
2440 MHz 10-26 GHz



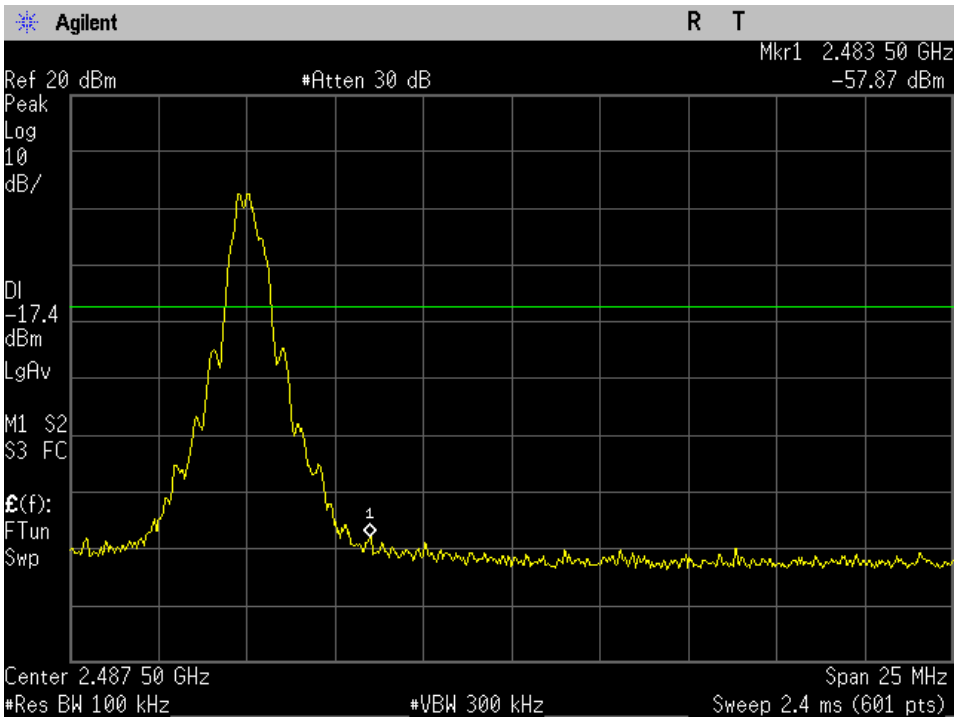
2480 MHz 30 MHz-10 GHz



2480 MHz 10-26 GHz

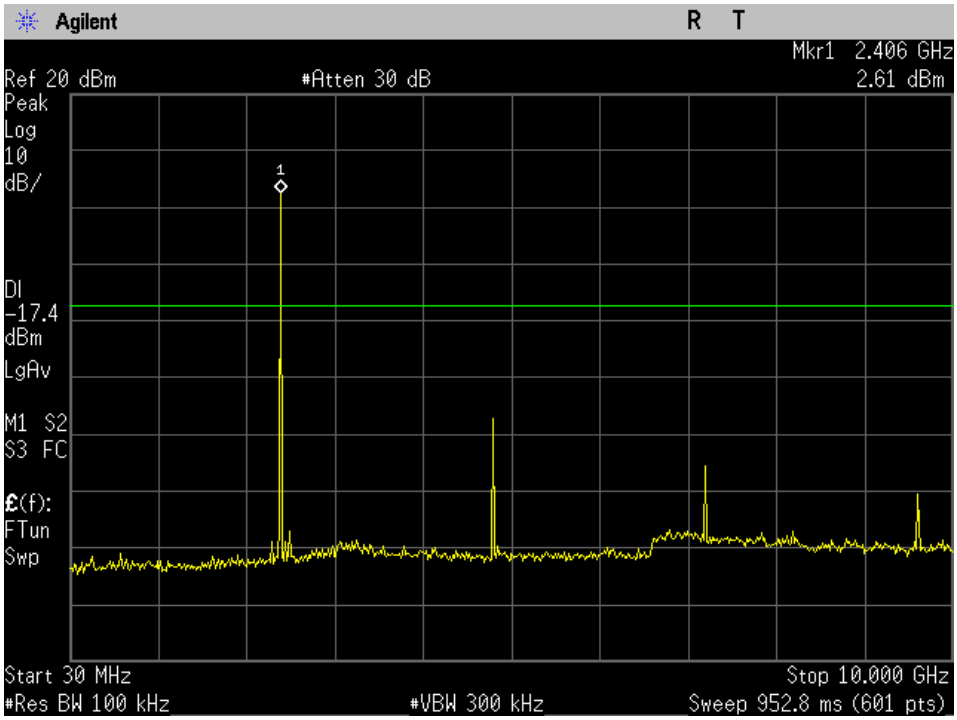


2480 MHz Upper Band Edge

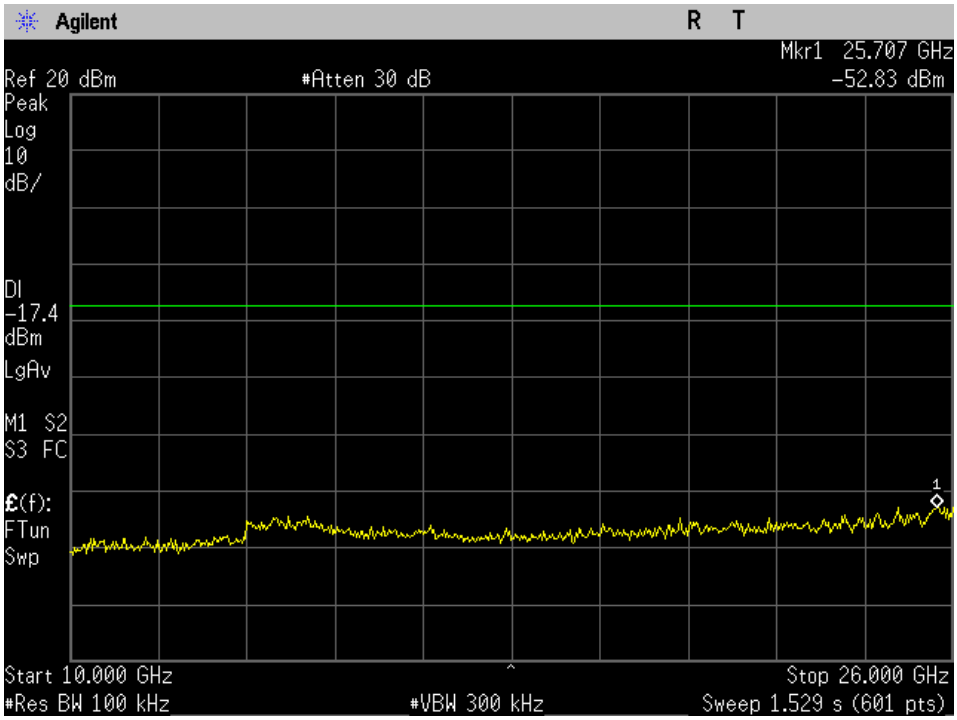


2 MBPS

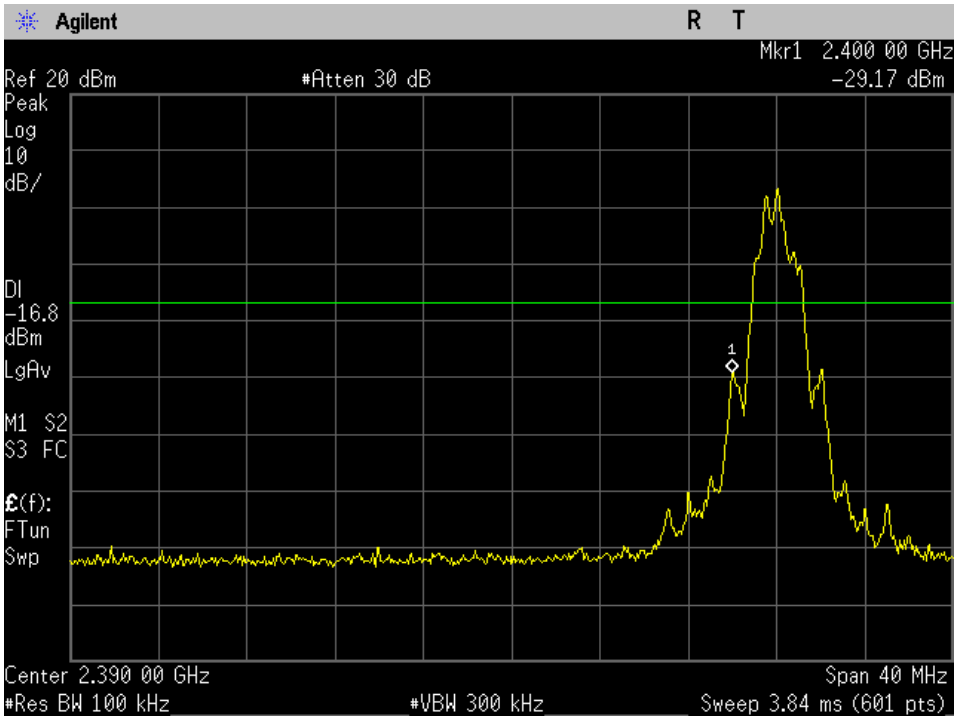
2402 MHz 30 MHz-10 GHz



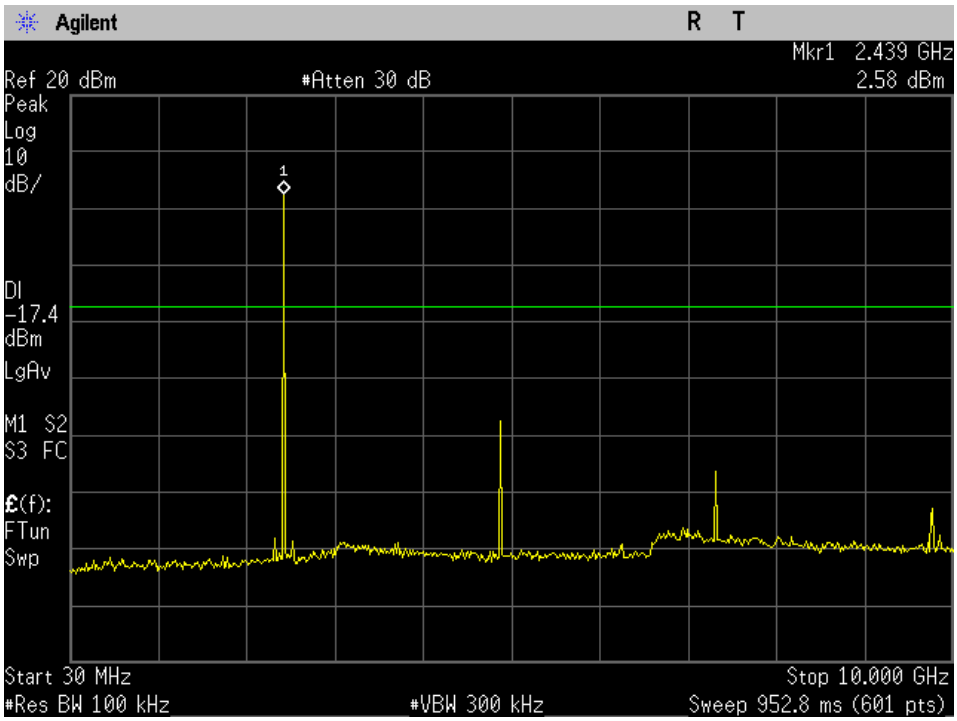
2402 MHz 10-26 GHz



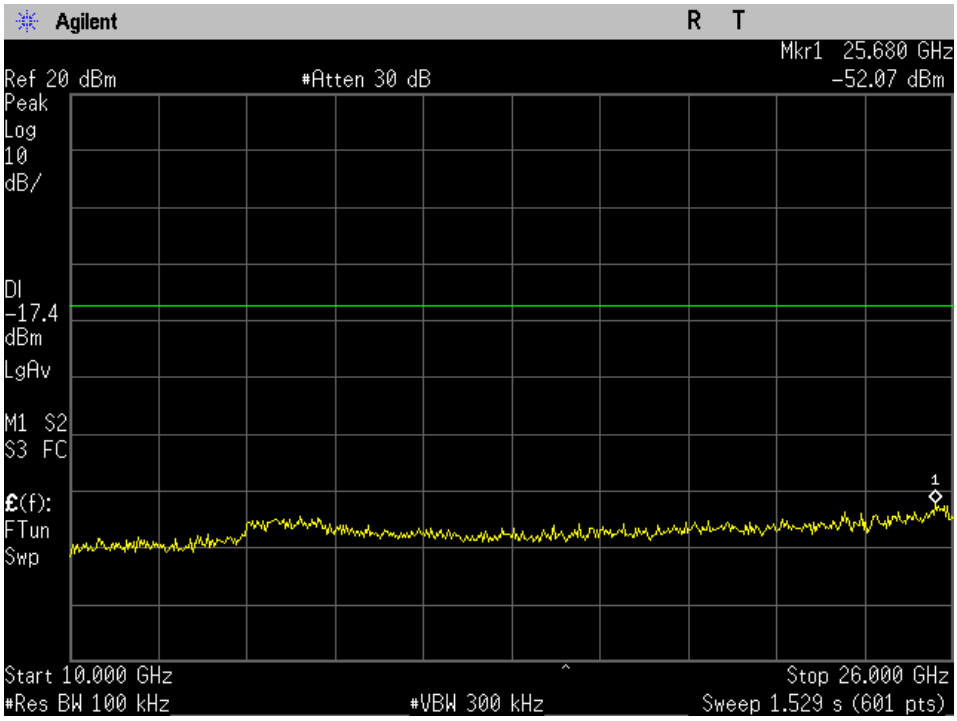
2402 MHz Lower Band Edge



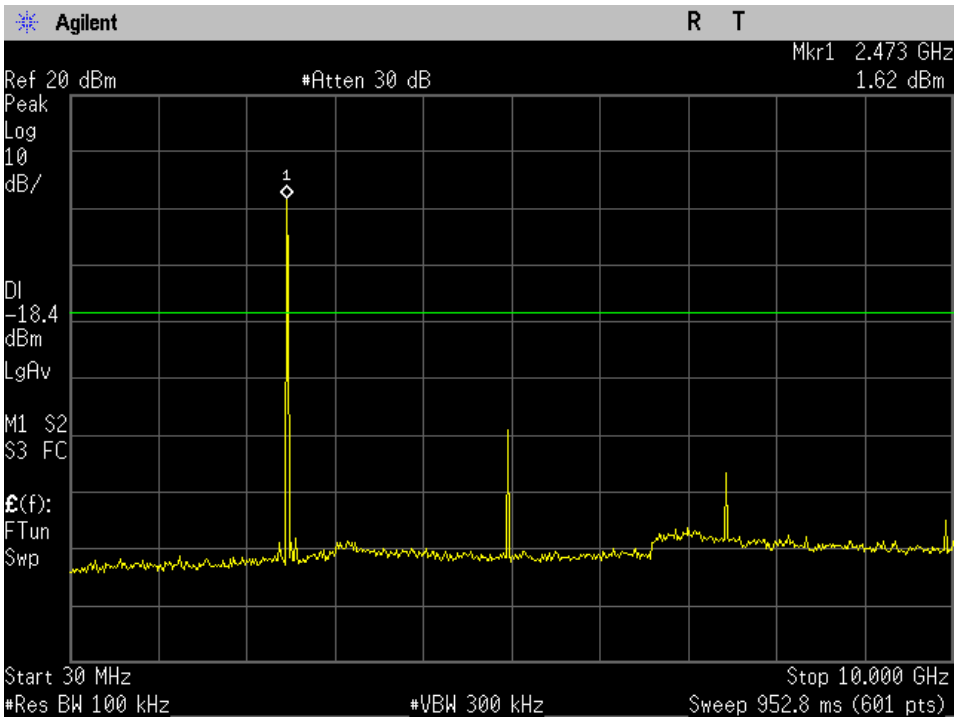
2440 MHz 30MHz-10 GHz



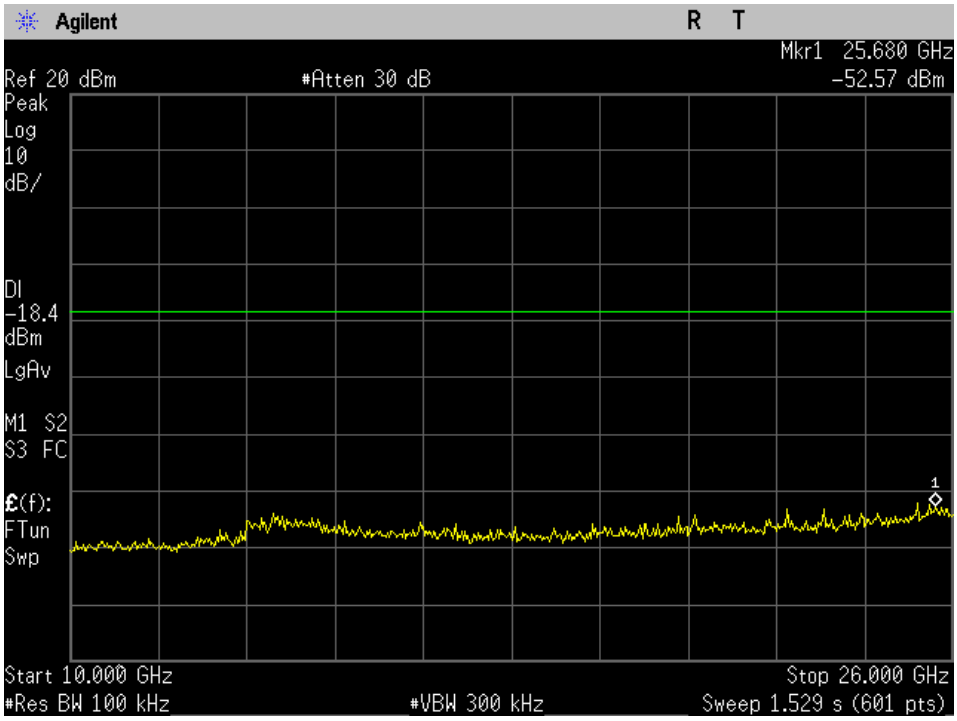
2440 MHz 10-26 GHz



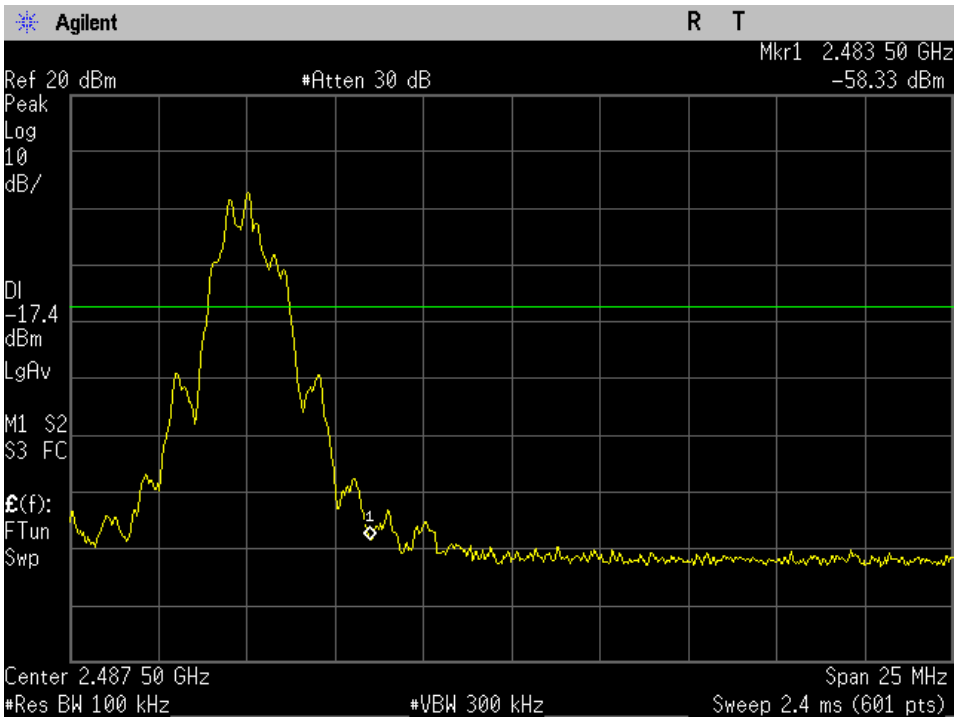
2480 MHz 30 MHz-10 GHz



2480 MHz 10-26 GHz



2480 MHz Upper Band Edge



10 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) – Peak Power Spectral Density

10.1 Applicable Standards

According to ECFR §15.247(e) and RSS-247 §5.2 (2) , for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

10.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 8.4: Maximum power spectral density level in the fundamental emission.

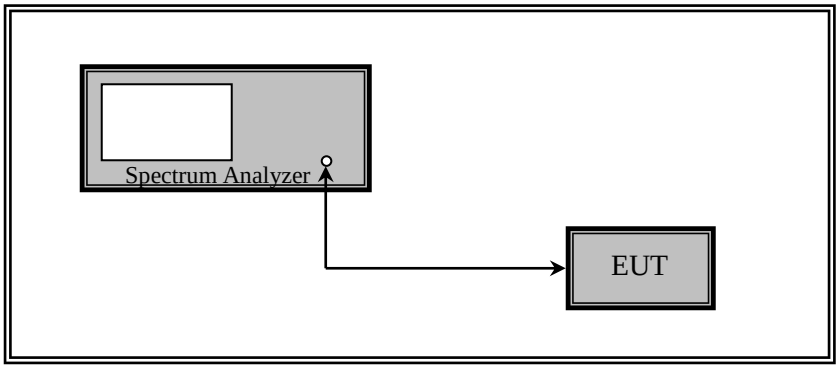
As per ANSI C63.10 Clause 11.10: Maximum power spectral density level in the fundamental emission

Some regulatory requirements specify a conducted PSD limit within the DTS bandwidth during any time interval of continuous transmission.88 Such specifications require that the same method as used to determine the conducted output power shall be used to determine the power spectral density. If maximum peak conducted output power was measured, then the peak PSD procedure 11.10.2 (method PKPSD) shall be used. If maximum conducted output power was measured, then one of the average PSD procedures shall be used, as applicable based on the following criteria (the peak PSD procedure is also an acceptable option):

Method PKPSD (peak PSD): The following procedure shall be used if maximum peak conducted output power was used to determine compliance, and it is optional if the maximum conducted (average) output power was used to determine compliance:

a. Set analyzer center frequency to DTS channel center frequency.
b. Set the span to 1.5 times the DTS bandwidth.
c. Set the RBW to 3 kHz ≤ RBW ≤ 100 kHz.
d. Set the VBW ≥ [3 × RBW].
e. Detector = peak.
f. Sweep time = auto couple.
g. Trace mode = max hold.
h. Allow trace to fully stabilize.
i. Use the peak marker function to determine the maximum amplitude level within the RBW.
j. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

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
00424	Agilent	Spectrum Analyzer	E4440A	US45303156	2024-03-06	12 Months
-	-	RF Cable	-	-	Each Time[1]	N/A

Note[1]: cable 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:	21.5°C
Relative Humidity:	35%
ATM Pressure:	102.1 kPa

The testing was performed by Michael Papa on 2023-12-08 at RF Bench.

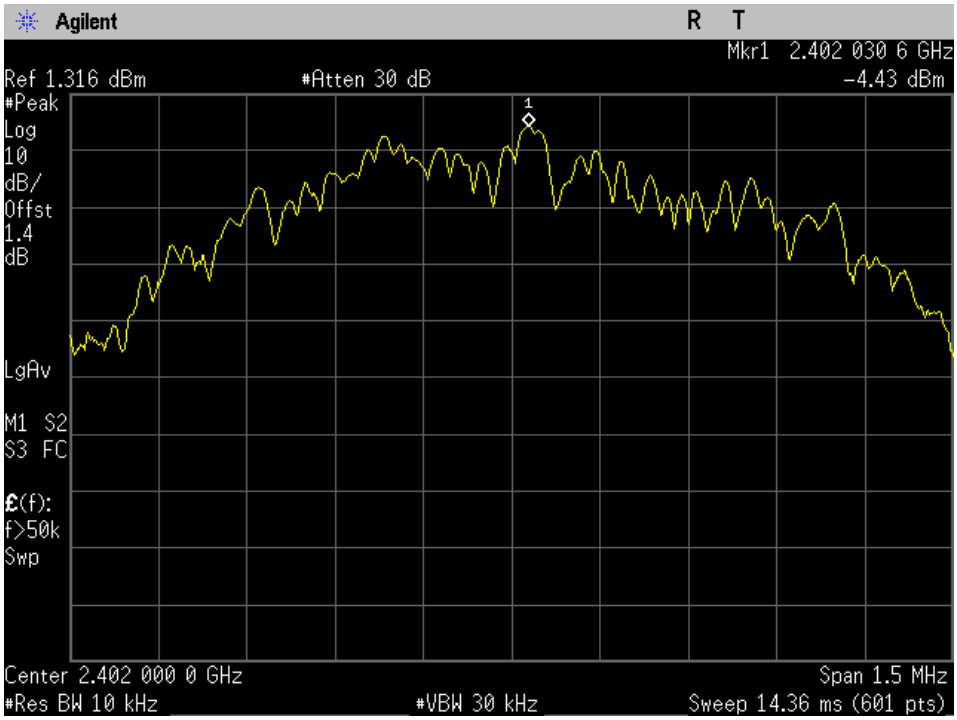
10.6 Test Results

Radio Mode	Channel	Frequency (MHz)	PSD (dBm/10kHz)	Limit (dBm/3kHz)
1 MBPS	0	2402	-4.43	8
	19	2440	-4.84	8
	39	2480	-5.36	8
2 MBPS	0	2402	-4.68	8
	19	2440	-5.19	8
	39	2480	-5.16	8

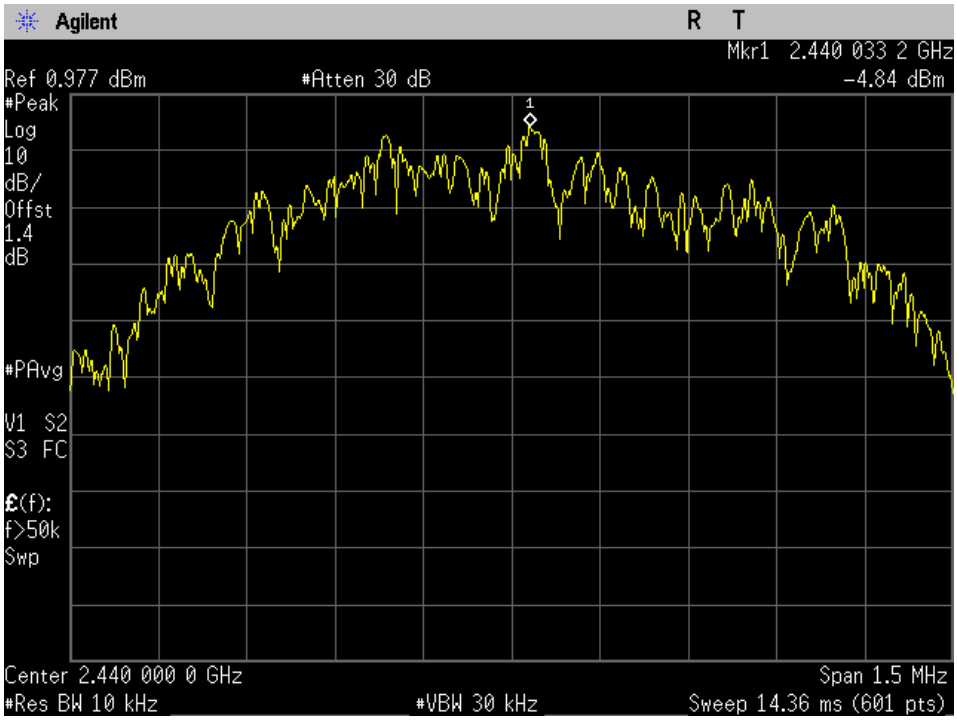
Note: The EUT passed with wider RBW of 10 kHz, thus it complies with FCC/IC RBW requirement of 3kHz as compliance is shown under a worse-case circumstance
Note: Refer to following plots for Power Spectrum Density test results.

1 MBPS

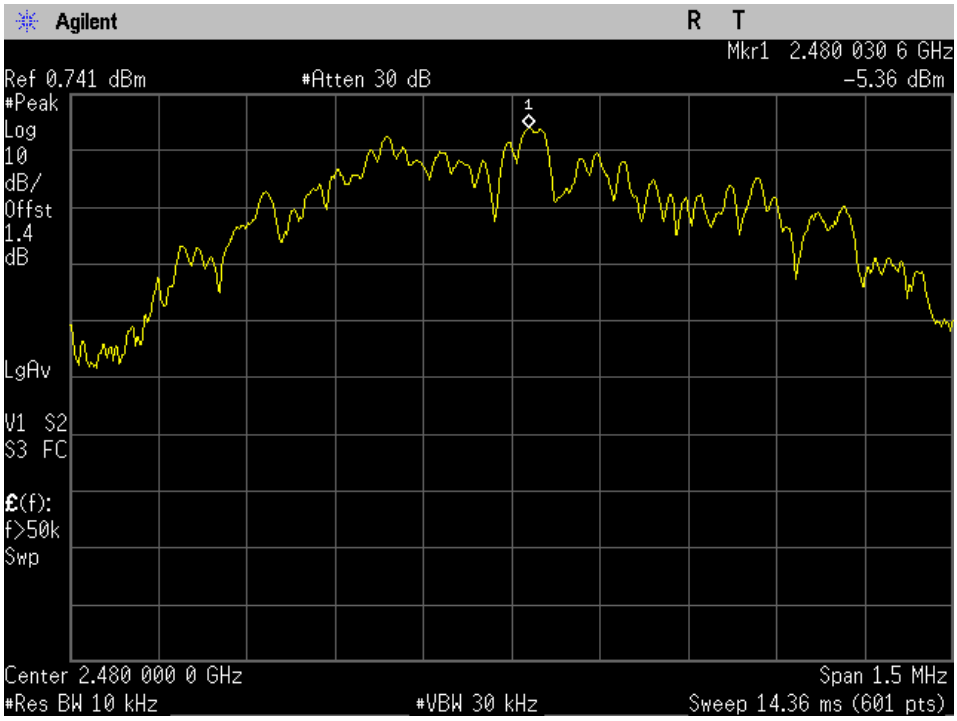
2402 MHz PSD



2440 MHz PSD

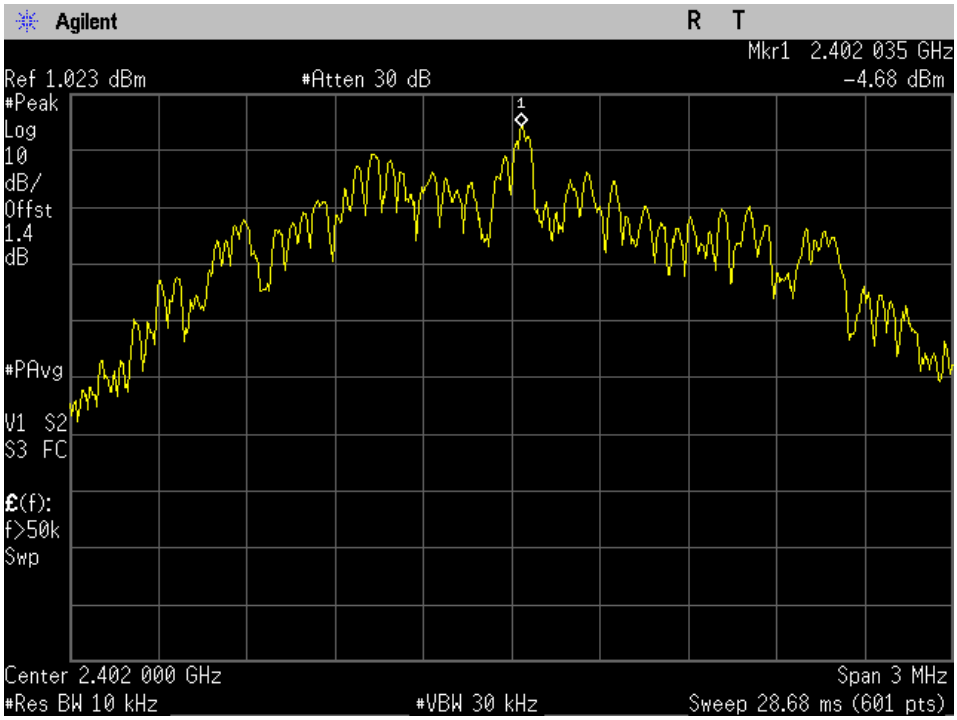


2480 MHz PSD

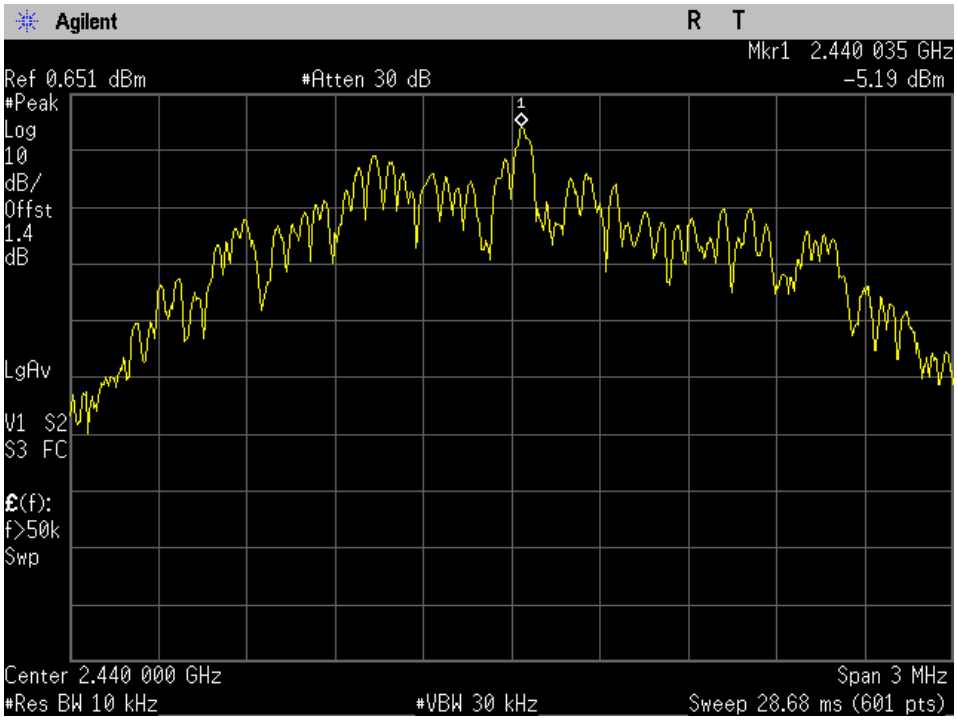

Agilent
R T
Mkr1 2.480 030 6 GHz
Ref 0.741 dBm
#Atten 30 dB
-5.36 dBm
#Peak
Log
10
dB/
Offst
1.4
dB
LgAv
V1 S2
S3 FC
£(f):
f>50k
Swp
Center 2.480 000 0 GHz
Span 1.5 MHz
#Res BW 10 kHz
#VBW 30 kHz
Sweep 14.36 ms (601 pts)

2 MBPS

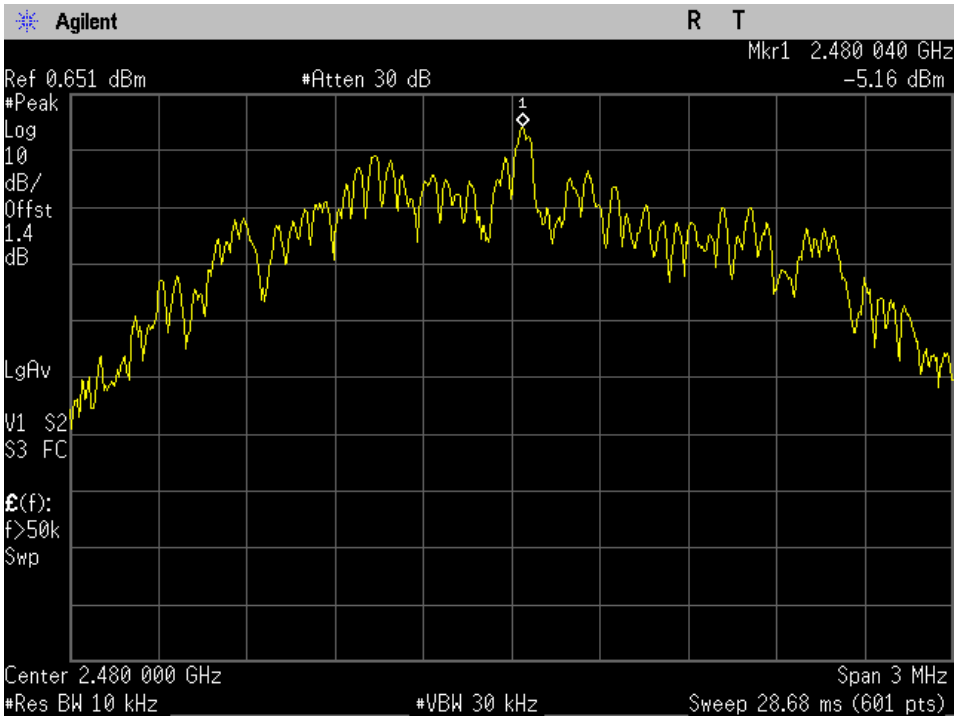
2402 MHz PSD



2440 MHz PSD



2480 MHz PSD


Agilent
R T
Mkr1 2.480 040 GHz
Ref 0.651 dBm
#Atten 30 dB
-5.16 dBm
#Peak
Log
10
dB/
Offst
1.4
dB
1
LgAv
V1 S2
S3 FC
£(f):
f>50k
Swp
Center 2.480 000 GHz
Span 3 MHz
#Res BW 10 kHz
#VBW 30 kHz
Sweep 28.68 ms (601 pts)

11 Annex A – 15.209 Conducted

Please refer to the attachment.

12 Appendix A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

13 Appendix B (Normative) –External Photographs

Please refer to the attachment

14 Appendix C (Normative) – Internal Photographs

Please refer to the attachment

15 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 13th day of September 2024.

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 ---