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

TEST REPORT

For

Xiant Technologies, Inc

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Greeley, CO 80634, USA

FCC ID: 2BFLZR0501
IC: 32426-R0501

Report Type:	**Product Type:**
Original Report	LED Lamp

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Report Number:	R2404091-247	
Report Date:	2024-05-21	
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ACCREDITED
CERTIFICATE #3297.02

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)

TABLE OF CONTENTS

1 General Description 5
1.1 Product Description for Equipment Under Test (EUT) 5
1.2 Mechanical Description of EUT 5
1.3 Objective 5
1.4 Related Submittal(s)/Grant(s) 5
1.5 Test Methodology 6
1.6 Measurement Uncertainty 6
1.7 Test Facility Registrations 6
1.8 Test Facility Accreditations 7
2 System Test Configuration 9
2.1 Justification 9
2.2 EUT Exercise Software 9
2.3 Duty Cycle Correction Factor 10
2.4 Local Support Equipment 12
2.5 Remote Support Equipment 12
2.6 Power Supply and Line Filters 12
2.7 Interface Ports and Cabling 12
3 Summary of Test Results 13
4 FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements 14
4.1 Applicable Standards 14
4.2 Antenna Description 14
5 FCC §2.1091, §15.247(i) & ISEDC RSS-102 - RF Exposure 15
5.1 Applicable Standards 15
5.2 MPE Prediction 16
5.3 MPE Results 16
5.4 RF Exposure Evaluation Exemption for IC 16
6 FCC §15.207 & ISEDC RSS-Gen §8.8 – AC Line Conducted Emissions 17
6.1 Applicable Standards 17
6.2 Test Setup 17
6.3 Test Procedure 17
6.4 Corrected Amplitude and Margin Calculation 18
6.5 Test Setup Block Diagram 18
6.6 Test Equipment List and Details 19
6.7 Test Environmental Conditions 19
6.8 Summary of Test Results 19
6.9 Conducted Emissions Test Plots and Data 20
7 FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions 22
7.1 Applicable Standards 22
7.2 Test Setup 23
7.3 Test Procedure 24
7.4 Corrected Amplitude & Margin Calculation 25
7.5 Test Setup Block Diagram 26
7.6 Test Equipment List and Details 27
7.7 Test Environmental Conditions 28
7.8 Summary of Test Results 28
7.9 Radiated Emissions Test Results 29
8 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2, RSS-Gen §6.7 - Emission Bandwidth 42
8.1 Applicable Standards 42
8.2 Measurement Procedure 42
8.3 Test Setup Block Diagram 44
8.4 Test Equipment List and Details 44
8.5 Test Environmental Conditions 44
8.6 Test Results 44
9 FCC §15.247(b) (3) & ISEDC RSS-247 §5.4 – Maximum Output Power 45
9.1 Applicable Standards 45
9.2 Measurement Procedure 45
9.3 Test Setup Block Diagram 46

9.4 Test Equipment List and Details 46
9.5 Test Environmental Conditions 47
9.6 Test Results 47
10 FCC §15.247(e) & ISEDC RSS-247 §5.2(2) – Peak Power Spectral Density 48
10.1 Applicable Standards 48
10.2 Measurement Procedure 48
10.3 Test Setup Block Diagram 49
10.4 Test Equipment List and Details 49
10.5 Test Environmental Conditions 49
10.6 Test Results 50
11 FCC §15.247(d) & ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges 51
11.1 Applicable Standards 51
11.2 Measurement Procedure 51
11.3 Test Setup Block Diagram 51
11.4 Test Equipment List and Details 52
11.5 Test Environmental Conditions 52
11.6 Test Results 52
12 FCC §15.247(d) & ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals 53
12.1 Applicable Standards 53
12.2 Test Procedure 53
12.3 Test Setup Block Diagram 53
12.4 Test Equipment List and Details 53
12.5 Test Environmental Conditions 53
12.6 Test Results 54
13 Annex E (Normative) - Test Setup Photographs 55
14 Annex F (Normative) - EUT External Photographs 56
15 Annex G (Normative) - EUT Internal Photographs 57
16 Annex H (Normative) - A2LA Electrical Testing Certificate 58

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2404091-247	Original Report	2024-05-21

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report is prepared on behalf of *Xiant Technologies, Inc*, and their product model: XTI-R05-01, FCC ID: 2BFLZR0501, IC: 32426-R0501 the "EUT" as referred to in this report. The EUT has 2.4 GHz BLE capabilities.

Model Number	XTI-R05-01
FCC ID	2BFLZR0501
IC	32426-R0501
Radio Type	BLE
Operating Frequency	2.4~2.48 GHz
Rate	1MBit, 2MBit

1.2 Mechanical Description of EUT

The EUT measures approximately 13.3 cm (L) x 8.4 cm (W) x 13.3 cm (H) and weighs approximately 0.15kg

Serial Number R2404091-07 assigned by BACL

1.3 Objective

This report is prepared on behalf of *Xiant Technologies, Inc* 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 is to determine compliance with FCC Part 15.247 and ISEDC RSS-247 for Antenna Requirement, RF Exposure, AC Line Conducted Emissions, Radiated & Conducted Spurious Emissions, Emission Bandwidth, Maximum Output Power, Peak Power Spectral Density, and 100 kHz Band Edges.

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.).

1.4 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	±2ºC
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-1, 3062A-2, and 3062A-3.

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-0027.

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 exercising software used during testing was STMCubeMonitor-RF the software is compliant with the standard requirements being tested against.

Radio	Frequency	Configuration	Power Setting
2.4 GHz BLE	2402	1 MBit	6dBm
	2440		6dBm
	2480		6dBm
	2402	2 MBit	6dBm
	2440		6dBm
	2480		6dBm

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2.3 Duty Cycle Correction Factor

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

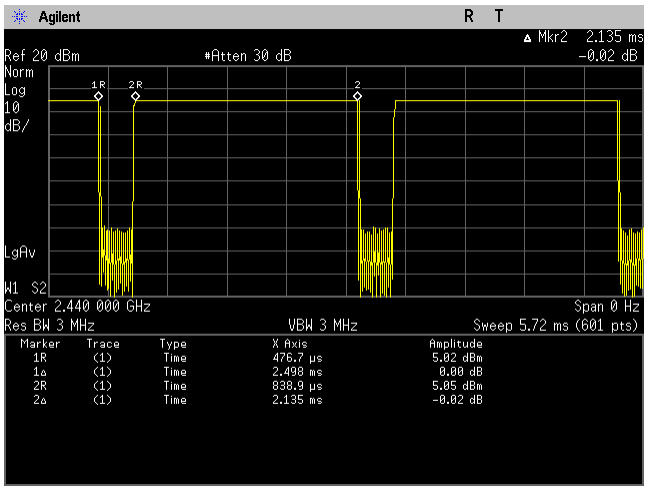
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at itPs maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

Radio	Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
2.4 GHZ BLE	1MBit	2.135	2.498	85.%	0.68
	2MBit	1.0600	2.487	42.6%	3.71

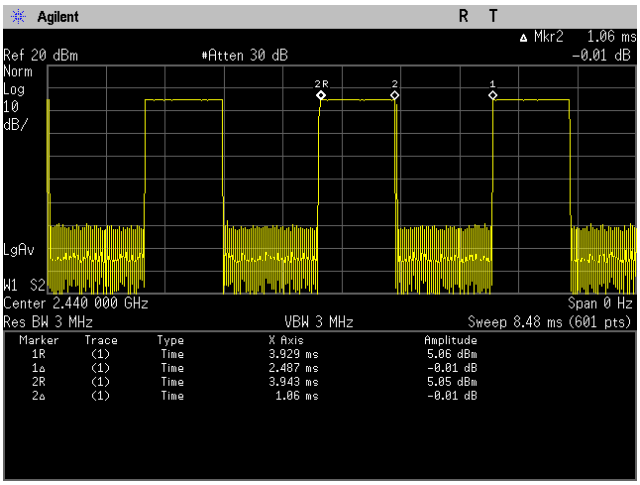
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

1MBIT


Agilent
R T
Mkr2 2.135 ms
Ref 20 dBm
#Atten 30 dB
-0.02 dB
Norm
Log
10
dB/
1R
2R
2
LgAv
W1 S2
Center 2.440 000 GHz
Span 0 Hz
Res BW 3 MHz
VBW 3 MHz
Sweep 5.72 ms (601 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 476.7 µs 5.02 dBm
1Δ (1) Time 2.498 ms 0.00 dB
2R (1) Time 838.9 µs 5.05 dBm
2Δ (1) Time 2.135 ms -0.02 dB

2MBIT


Agilent
R T
Mkr2 1.06 ms
Ref 20 dBm
#Atten 30 dB
-0.01 dB
Norm
Log
10
dB/
2R
2
1
LgAv
W1 S2
Center 2.440 000 GHz
Span 0 Hz
Res BW 3 MHz
VBW 3 MHz
Sweep 8.48 ms (601 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 3.929 ms 5.06 dBm
1Δ (1) Time 2.487 ms -0.01 dB
2R (1) Time 3.943 ms 5.05 dBm
2Δ (1) Time 1.06 ms -0.01 dB

2.4 Local Support Equipment

N/A

2.5 Remote Support Equipment

Manufacturer	Description	Model
Xiant Technologies	Debug Board	-
Dell	Laptop	Precision 3510

2.6 Power Supply and Line Filters

Manufacturer	Description	Model
CUI INC	AC Adaptor	SWI6-3.3-N-P6
OMNIHIL	AC Adaptor	SAW-0502500

2.7 Interface Ports and Cabling

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

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) ISEDC RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §15.209, §15.247(d) ISEDC RSS-247 §5.5 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(e) ISEDC RSS-247 §5.2(2)	Peak Power Spectral Density	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant

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 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	Frequency Range (MHz)	Antenna Type	Maximum Antenna Gain (dBi)
Integral	2400-2483.5 MHz	Trace Antenna	0.5

Antenna gain is information provided by 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.

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 ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF 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, except when the device operates as follows:

- below 20 MHz[6] and the source-based, time-averaged maximum e.i.r.p. 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 e.i.r.p. 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 e.i.r.p. 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 e.i.r.p. 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 e.i.r.p. 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 e.i.r.p. 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 Results

BLE Standalone

Maximum peak output power at antenna input terminal (dBm):	6.03
Maximum peak output power at antenna input terminal (mW):	4.01
Prediction distance (cm):	20
Prediction frequency (MHz):	2402
Maximum Antenna Gain, typical (dBi):	0.5
Maximum Antenna Gain (numeric):	1.12
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.000893
FCC MPE limit for uncontrolled exposure at prediction frequency:	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 0.000893 mW/cm^2. Limit is 1.0 mW/cm^2.

5.4 RF Exposure Evaluation Exemption for IC

BLE
Maximum EIRP power = 6.03 dBm + 0.5 dBi = 6.53 dBm which is less than $1.31\times10^{-2}f^{0.6834}$ = 2.6764 W = 34.276 dBm.

Therefore, the RF exposure Evaluation is exempt.

6 FCC §15.207 & ISEDC RSS-Gen §8.8 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and ISEDC RSS-Gen Section 8.8: Conducted limits

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.
Note2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used were FCC §15.207 and ISEDC RSS-Gen §8.8 limits.

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

The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cords of support equipment were connected to LISN-2.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data were recorded in the peak, quasi-peak, and average detection mode. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Corrected Amplitude and Margin Calculation

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

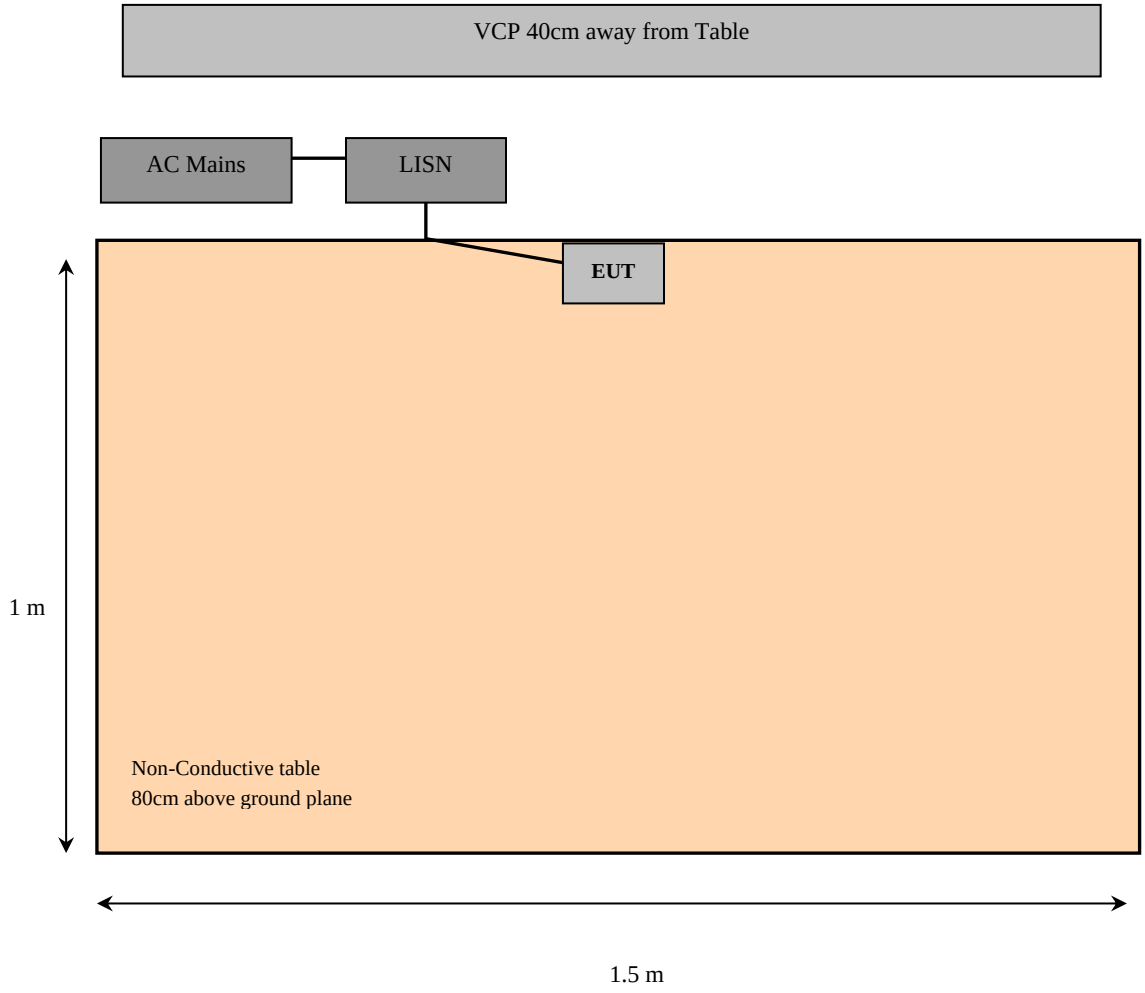
$$CA = Ai + CL + Atten$$

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 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:

$$Margin = Corrected\ Amplitude - Limit$$

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
310	Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2023-05-11	1 year
680	Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101964	2024-03-22	1 year
724	Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2024-03-22	1 year
732	FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2023-09-12	1 year
1425	Fairview Microwave	Micro-Coax Cable	FMC0101223-240	210241	2024-01-12	6 Months
348	California Instruments	AC Power Source	5001ix-208	57079	Calibration not Required	Calibration not Required

Note[1]: cables, attenuators and notch filters included in the test set-up were 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:	21.9 to 22.0ºC
Relative Humidity:	49.6 to 50.4%
ATM Pressure:	101.9 kPa

The testing was performed by Libass Thiaw from 2024-04-22 in 5m chamber 3

6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15C and ISEDC RSS-Gen standard's conducted emissions limits, with the margin reading of:

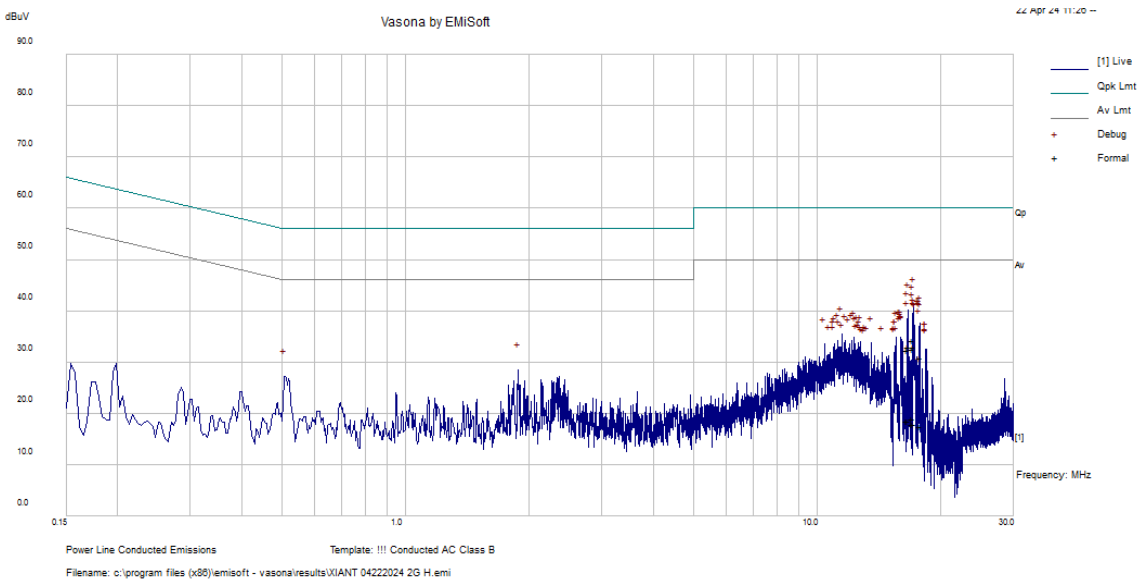
Worst Mode: 2MBit, Low Channel, 2402MHz

Worst Case – AC Line: 120 V, 60 Hz			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Hot/Neutral)**	**Range (MHz)**
-25.84	17.10771	Hot	0.15 to 30

Please refer to the tables and plots in the next section for detailed test results.

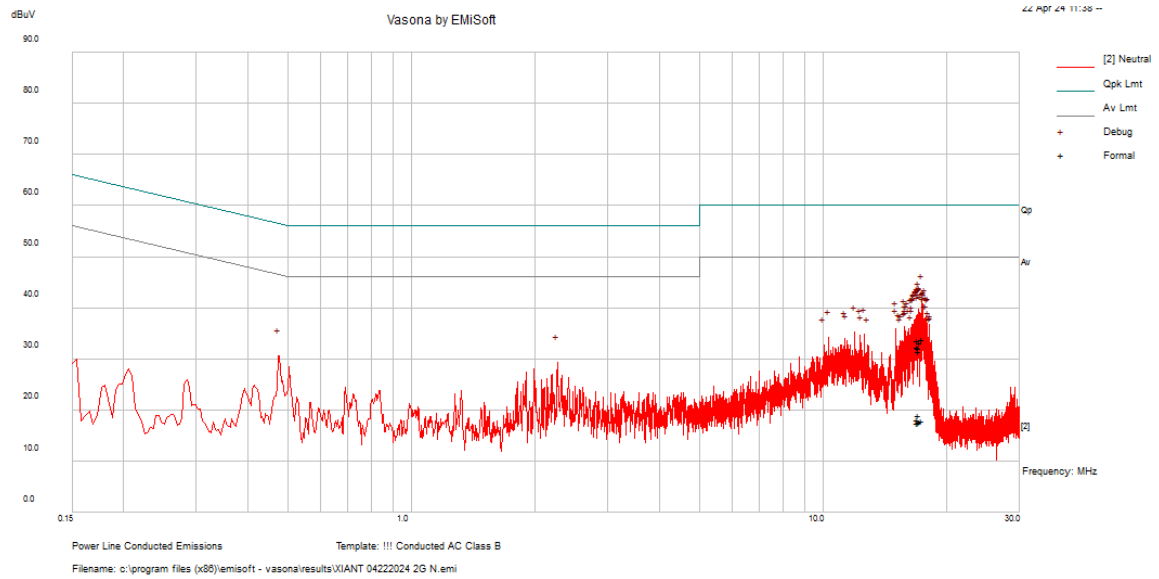
6.9 Conducted Emissions Test Plots and Data

AC Line: 120 V, 60 Hz – Hot Conductor



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
17.12996	22.7	10.35	33.05	60	-26.95	QP
16.61565	22.53	10.34	32.87	60	-27.13	QP
17.09546	22.24	10.35	32.59	60	-27.41	QP
16.55423	21.91	10.34	32.25	60	-27.75	QP
17.10771	**23.81**	**10.35**	**34.16**	**60**	**-25.84**	**QP**
17.81272	20.38	10.37	30.75	60	-29.25	QP
17.12996	7.63	10.35	17.98	50	-32.02	Ave
16.61565	8.18	10.34	18.52	50	-31.48	Ave
17.09546	7.55	10.35	17.9	50	-32.1	Ave
16.55423	8.16	10.34	18.5	50	-31.5	Ave
17.10771	8.66	10.35	19.01	50	-30.99	Ave
17.81272	7.18	10.37	17.55	50	-32.45	Ave

AC Line (via AC/DC Adapter): 120 V, 60 Hz – Neutral Conductor



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
17.393905	23.44	10.37	33.81	60	-26.19	QP
17.012949	23.16	10.35	33.51	60	-26.49	QP
17.173547	22.82	10.35	33.17	60	-26.83	QP
16.972426	21.89	10.35	32.24	60	-27.76	QP
17.122266	21.2	10.35	31.55	60	-28.45	QP
17.093882	21.83	10.35	32.18	60	-27.82	QP
17.393905	7.44	10.37	17.81	50	-32.19	Ave
17.012949	7.19	10.35	17.54	50	-32.46	Ave
17.173547	7.23	10.35	17.58	50	-32.42	Ave
16.972426	7.85	10.35	18.2	50	-31.8	Ave
17.122266	8.66	10.35	19.01	50	-30.99	Ave
17.093882	7.15	10.35	17.5	50	-32.5	Ave

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

7.1 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 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 ISEDC RSS-Gen 8.9,

Except when the requirements applicable to a given device state otherwise, emission from license-exempt transmitters shall company with the field strength limits shown in the table below. Additional, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

General Field Strength Limits for License-Exemption Transmitters at Frequencies above 30 MHz

Frequency (MHz)	Field Strength (µv/m at 3 meters)
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 license-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 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.

7.2 Test Setup

The radiated emissions tests were performed in the 5-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 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.

7.3 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 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10kHz / Sweep = Auto

7.4 Corrected Amplitude & 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

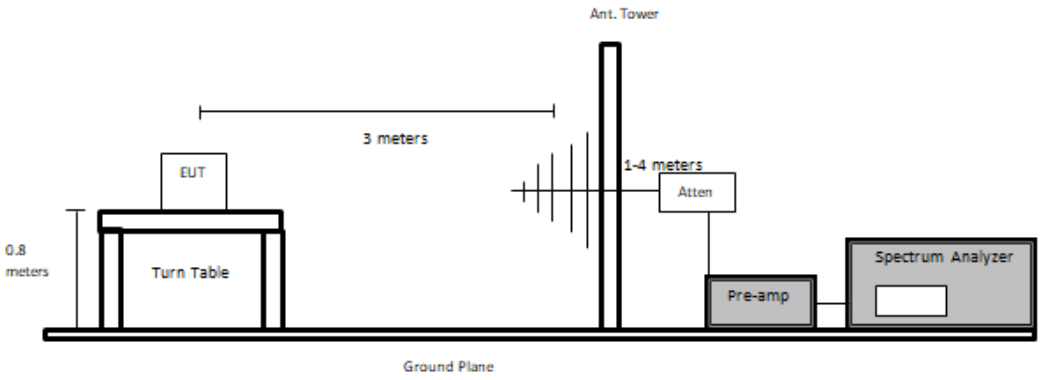
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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:

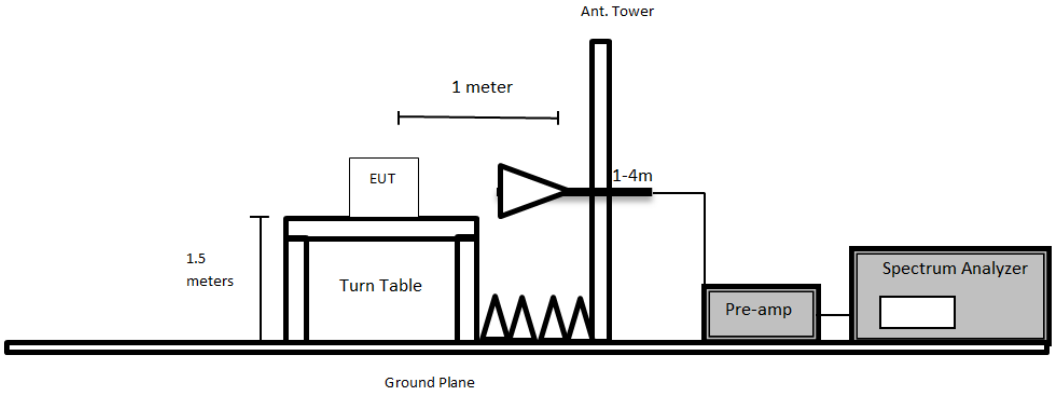
Margin = Corrected Amplitude – Limit

7.5 Test Setup Block Diagram

Below 1 GHz:



Above 1 GHz:



7.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
310	Rohde & Schwarz	EMI test receiver 9 KHZ to 3 GHZ	ESCI 1166.5950.03	100338	2023-05-11	1 year
316	Sonoma Instruments	Preamplifier 10 kHz - 2.5 GHz	317	260406	2024-02-27	6 months
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2; 1504	2023-12-18	2 years
1186	Pasternack	Coaxial Cable, RG214	PE3062-1050CM	-	2024-04-09	6 months
1245	-	6dB Attenuator	PE7390-6	01182018A	2023-12-18	2 years
1246	HP	RF Limiter	11867A	01734	2024-04-09	1 year
1248	Pasternack	RG214 COAX Cable	PE3062	-	2024-04-04	6 months
1249	Time microwave	LMR-400 Cable Dc-3 GHz	AE13684	2k80612-5 6fts	2024-04-09	6 months
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2023-05-12	1 year
658	HP/ Agilant	Preamplifier	8449B OPT HO2	3008A01103	2023-12-01	6 months
188	Sunol Sciences	Horn Antenna	DRH-118	A052704	2023-11-06	2 years
1247	Uti flex	Micro - Coax	-	-	2023-12-01	6 months
1353	RFMW	2.92mm 10ft RF Cable DC to 40 GHz	-	-	2024-01-24	1 year
1346	RFMW	2.92mm 10ft RF Cable	KMSE-160SAW-240.0-KSME	-	2023-06-23	1 year
672	Micro -Tronics	2.4-2.6 GHz Notch Filter	BRM50701	160	2024-03-06	1 year
90	Wisewave	Horn Antenna	ARH-4223-02	10555-01	2023-05-02	2 years
827	AH Systems	Preamplifier	PAM 1840 VH	170	2023-11-08	6 months
1329	Pasternack	2.92mm short coaxial cable	PE360-12	-	2023-11-28	6 months
327	Sunol Sciences	System Controller	SC110V	122303-1	NR	NR
1075	Sunol Sciences	Boresight Tower	TLT3	050119-7	NR	NR
1388	Sunol Sciences	Flush Mount Turntable	FM	112005-2	NR	NR

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".*

7.7 Test Environmental Conditions

Temperature:	20 – 23 ºC
Relative Humidity:	40 – 50 %
ATM Pressure:	108.13 kPa

The testing was performed by Xavier Kelley 2024-04-29 and by Arturo Reyes on 2024-04-30 in 5m chamber 3.

7.8 Summary of Test Results

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

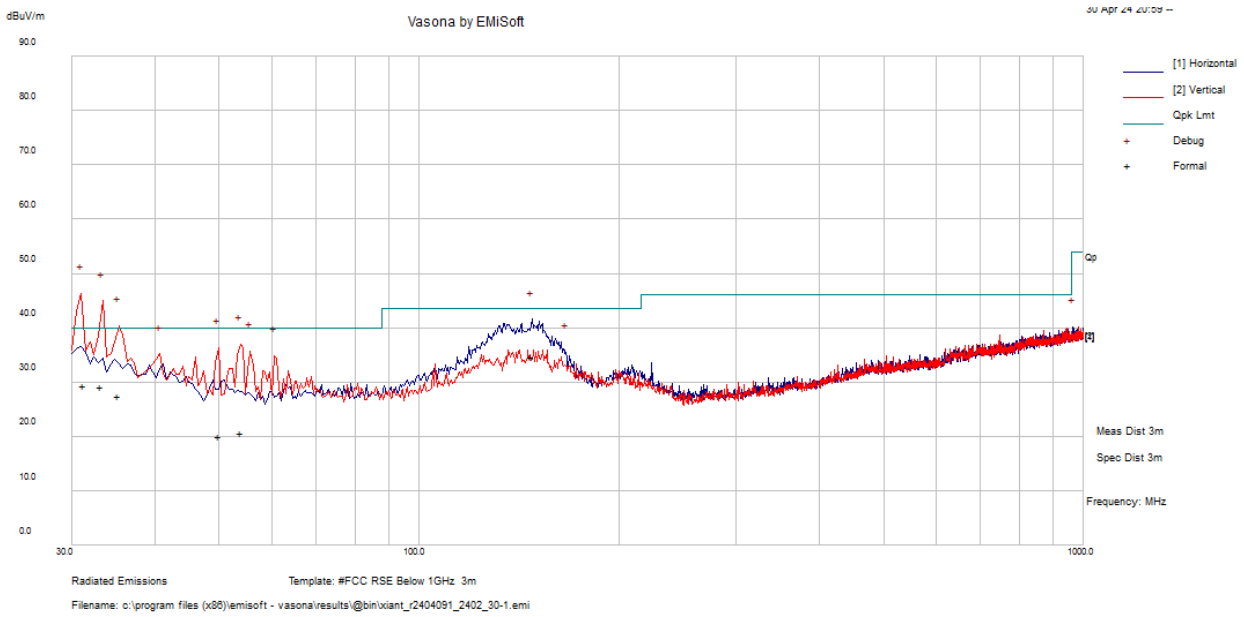
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Transmitting Channel (MHz)**
-3.72	3836.875	Horizontal	1MBIT, 2480 MHz

7.9 Radiated Emissions Test Results

Note 1: For conducted in-lieu of radiated bandedge measurements performed at the antenna port, please refer to Annex D
Note 2: The EUT is not transmitting at below 30 MHz, thus 9 kHz to 30 MHz was not evaluated for Spurious Emissions.
Note 3: Pre-scans were performed on all shown configurations in order to determine worst-case results. Following this, a formal scan was performed on the worst-case detailed below
Note 4: Pre-scan was performed in order to determine worst-case orientation of device with respect to measurement antenna. Plots/data shown represent measurements made in worst-case orientation.

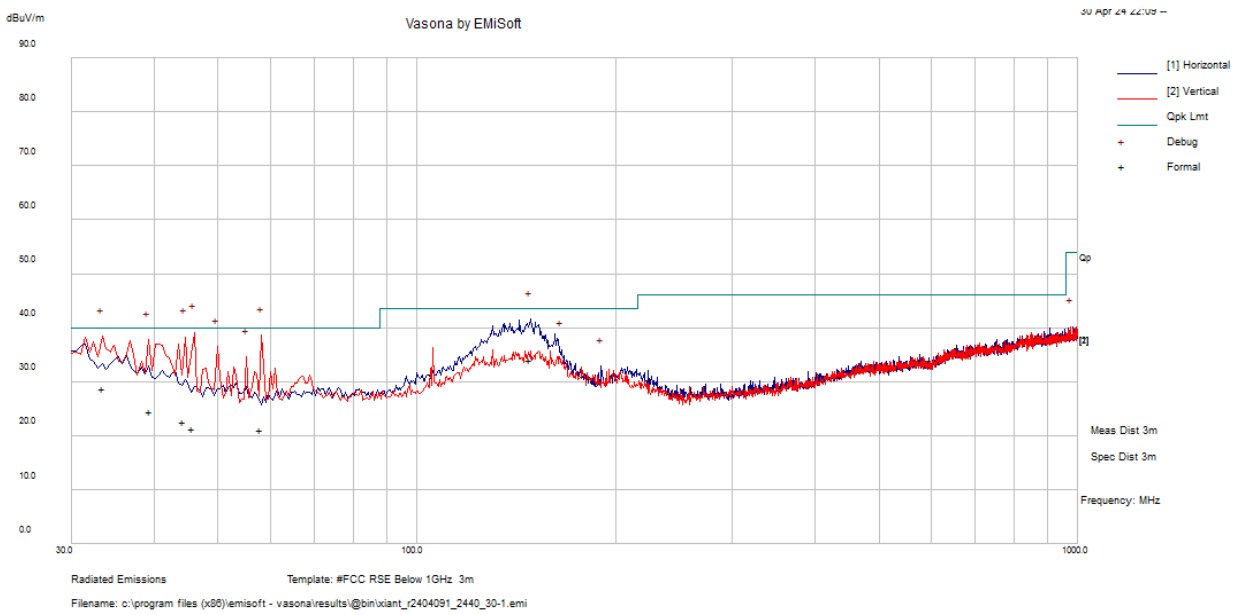
1) 30 MHz – 1 GHz, Measured at 3 meters

Worst Case: BLE, 1MBIT: 2402 MHz



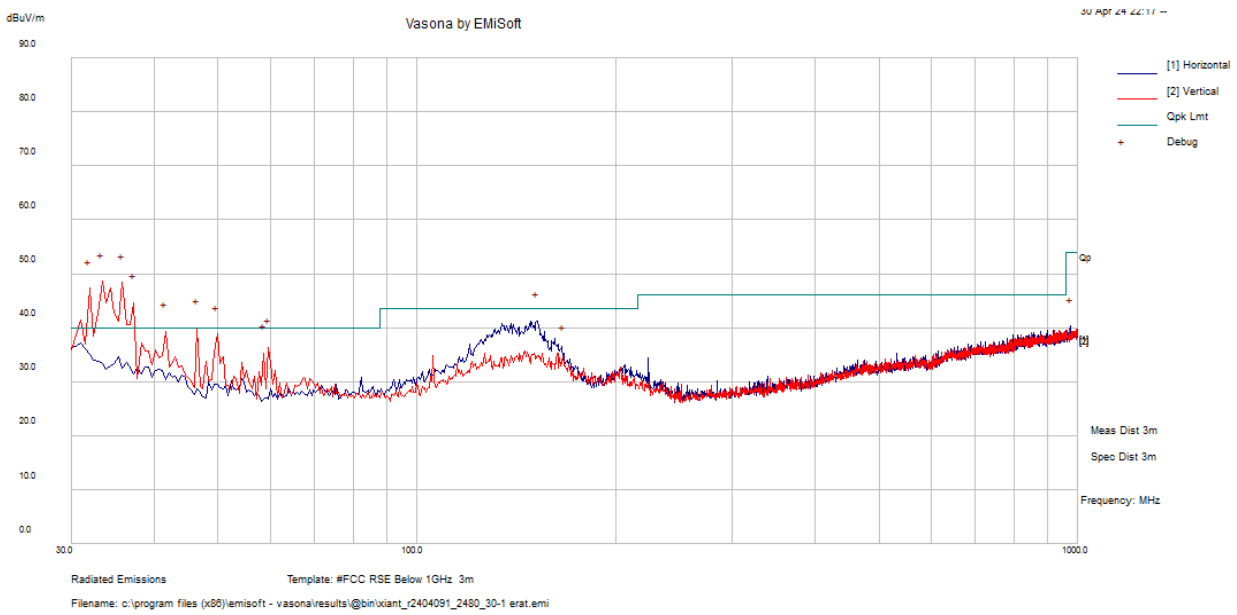
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector
31.22	31.17	-1.88	29.29	287	V	352	40	-10.71	QP
33.21675	32.51	-3.3	29.21	256	V	101	40	-10.79	QP
35.2355	31.84	-4.51	27.34	257	V	294	40	-12.66	QP
147.6698	42.64	-8.04	34.61	279	H	140	43.5	-8.89	QP
53.861	34.9	-14.15	20.75	240	V	281	40	-19.25	QP
49.914	33.71	-13.61	20.1	254	V	174	40	-19.9	QP

BLE, 1MBIT: 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
45.79325	33.02	-11.66	21.36	232	V	296	40	-18.64	QP
58.06225	35	-13.97	21.03	251	V	227	40	-18.97	QP
33.47925	32.21	-3.45	28.76	284	V	75	40	-11.24	QP
44.369	33.36	-10.84	22.51	218	V	77	40	-17.49	QP
148.265	42.11	-8.05	34.07	245	H	204	43.5	-9.43	QP
39.42025	31.89	-7.4	24.48	199	V	334	40	-15.52	QP

BLE, 1MBIT: 2480 MHz



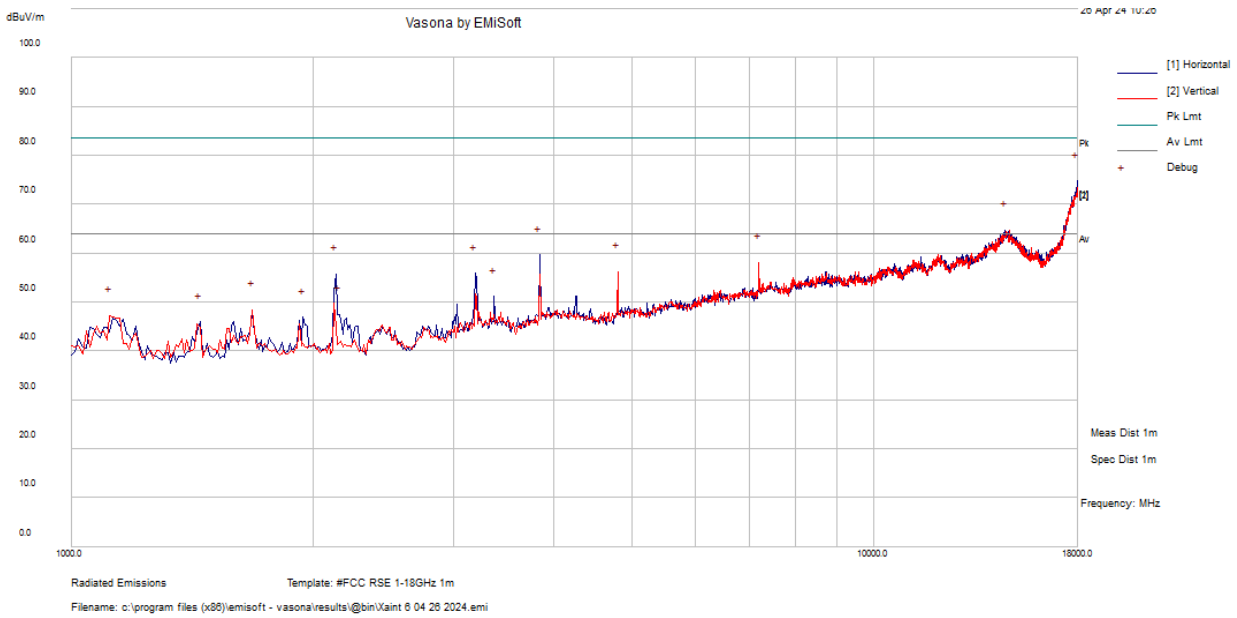
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector
33.312	32.81	-3.36	29.46	285	V	151	40	-10.54	QP
35.75775	31.78	-4.85	26.94	180	V	243	40	-13.06	QP
32.03725	31.06	-2.51	28.54	247	V	139	40	-11.46	QP
37.463	31.43	-5.99	25.44	181	V	330	40	-14.56	QP
46.69875	33.8	-12.11	21.68	289	V	234	40	-18.32	QP
41.4535	33.43	-8.79	24.64	130	V	24	40	-15.36	QP

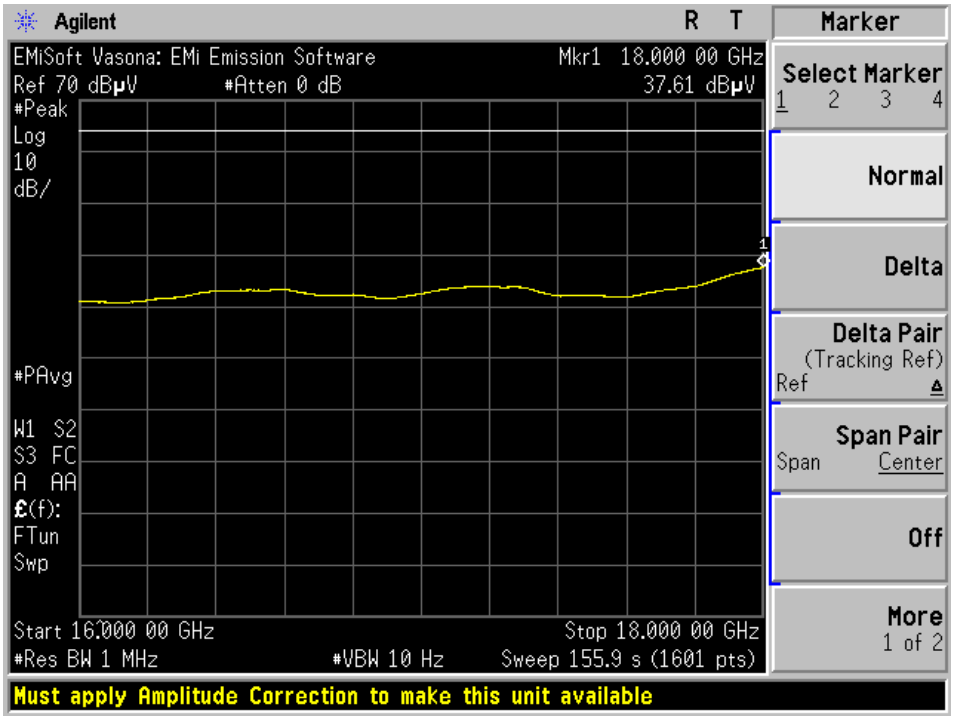
FCC/IC Limits for 1 GHz to 26.5 GHz				
Applicability	**(dBm)**	**(uV/m at 3meters)**	**(dBuV/m at 3meters)**	**(dBuV/m at 1meter)[2]**
Restricted Band Average Limit	-	500	54	63.54
Restricted Band Peak Limit[1]	-	-	74	83.54

Note 1: Restricted Band Peak Limit is defined to be 20dB higher than Average Limit.
Note 2: Above 1GHz limit calculation:
dBuV/m = 20*log(V/m) + 120 = 20*log((500 [uV/m]/1000000)) + 120 = 54 [dBuV/m]
Note 3: Limits at 1 meter are determined by applying a Distance correction factor accounts for extrapolation from 1 meter to 3 meters. Formula used is as follows: 20*log (3 meters / 1 meter) = 9.54 (According to ANSI C63.10-2013 Section 9.4). Extrapolation calculation from 3m to 1m distance:
54 [dBuV/m at 3m] + 9.54 [dB] = 63.54 [dBuV/m at 1m]

2) 1 GHz – 18 GHz, Measured at 1 meter

BLE, 1MBIT: 2402 MHz





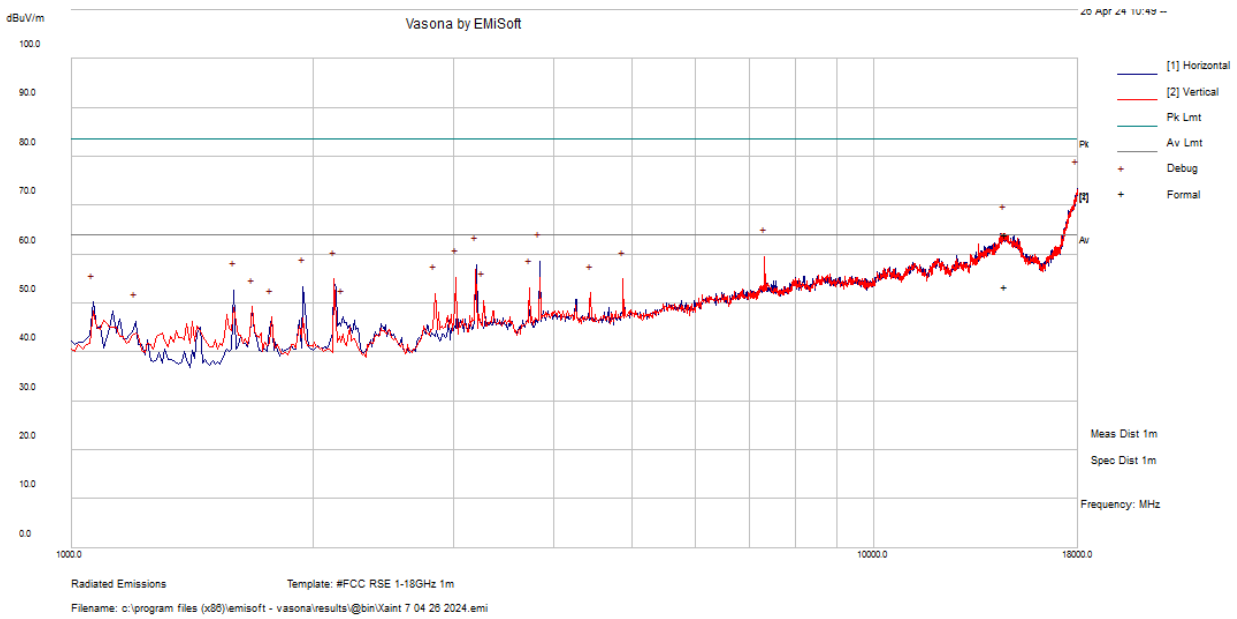
Note: Above plot shows reduced VBW to make average measurements comparing to average limits and thus show compliance in range of 16-18GHz

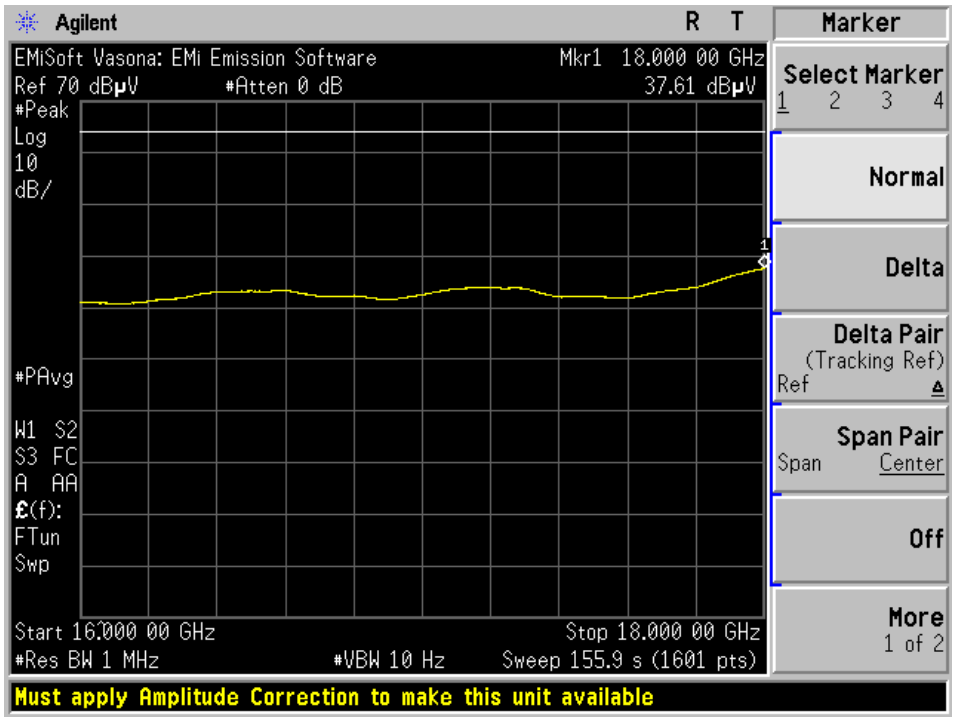
Note: Above plot shows all peak emissions below 16GHz pass under average limits

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
3836.875	58.85	0.74	59.6	100	H	0	63.54	-3.94	Peak
7205	50.8	7.24	58.04	100	V	0	63.54	-5.5	Peak
4803.75	55.06	1.2	56.26	200	V	0	63.54	-7.28	Peak
3188.75	57.83	-1.96	55.87	100	H	0	63.54	-7.67	Peak
2136.875	62.54	-6.74	55.8	100	H	0	63.54	-7.74	Peak

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

BLE, 1MBIT: 2440 MHz





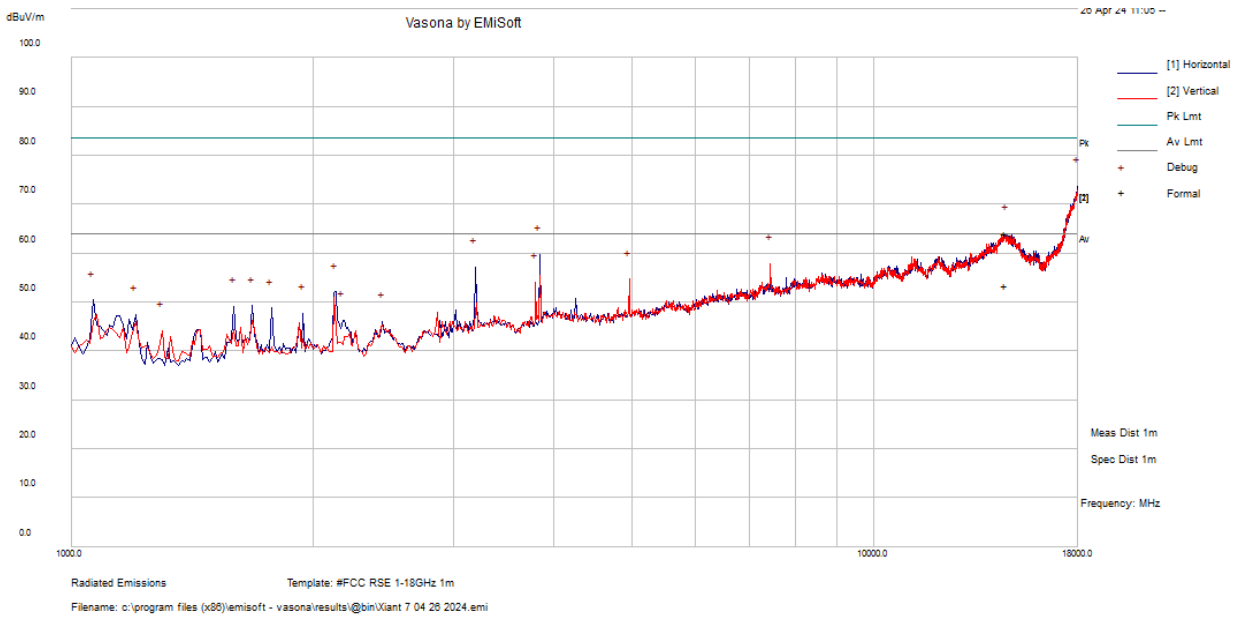
Note: Above plot shows reduced VBW to make average measurements comparing to average limits and thus show compliance in range of 16-18GHz

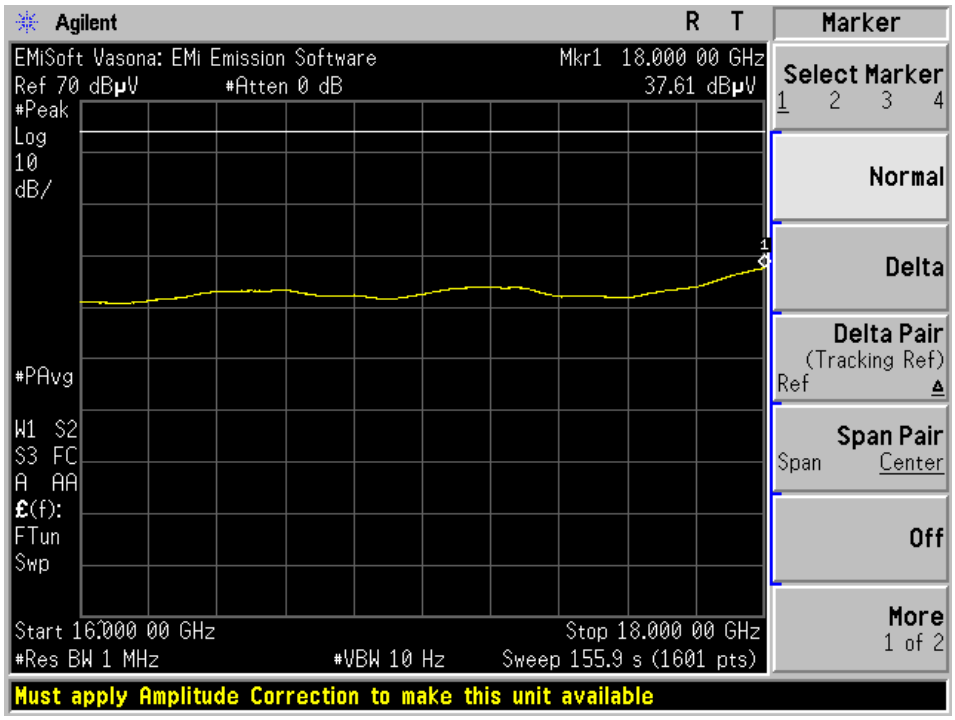
Note: Above plot shows all peak emissions below 16GHz pass under average limits

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
7321.875	51.65	7.81	59.46	100	V	0	63.54	-4.08	Peak
3836.875	57.81	0.74	58.55	100	H	0	63.54	-4.99	Peak
3199.375	59.71	-1.91	57.8	100	H	0	63.54	-5.74	Peak
3018.750	58.61	-3.42	55.19	100	V	0	63.54	-8.35	Peak
2126.250	61.85	-6.92	54.94	100	V	0	63.54	-8.6	Peak

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

BLE, 1MBIT: 2480 MHz





Note: Above plot shows reduced VBW to make average measurements comparing to average limits and thus show compliance in range of 16-18GHz

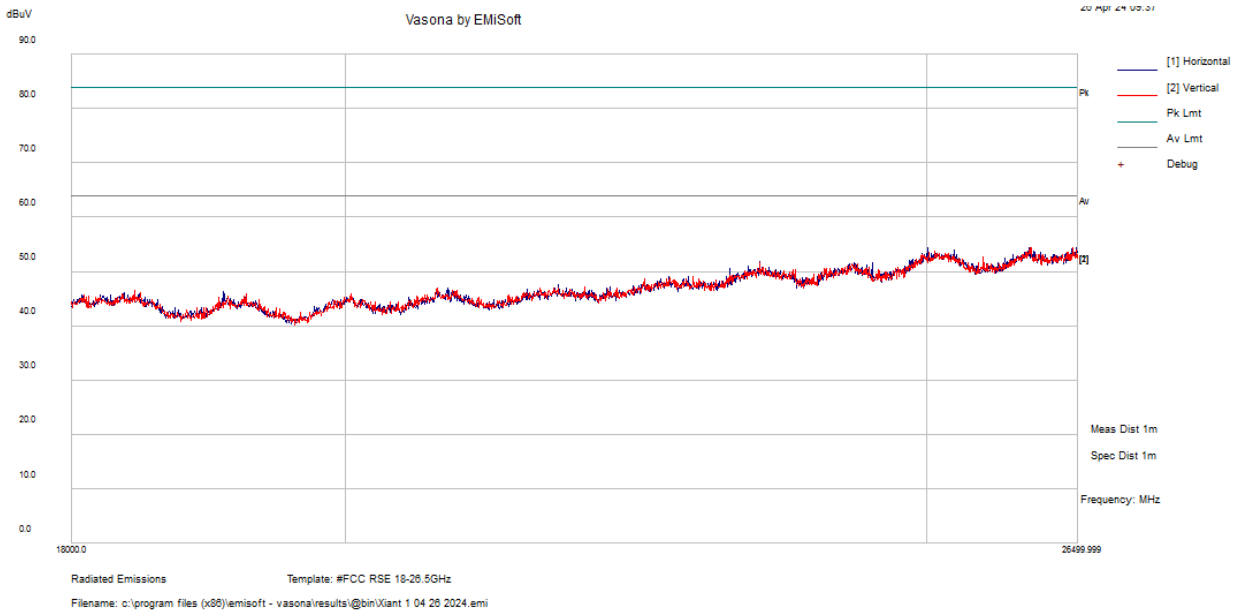
Note: Above plot shows all peak emissions below 16GHz pass under average limits

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
3836.875	59.07	0.74	59.82	100	H	0	63.54	-3.72	Peak
7438.750	50.04	7.77	57.81	100	V	0	63.54	-5.73	Peak
3188.750	59.1	-1.96	57.15	100	H	0	63.54	-6.39	Peak
4963.125	52.93	1.76	54.69	100	V	0	63.54	-8.85	Peak
3794.375	53.48	0.59	54.07	100	V	0	63.54	-9.47	Peak

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

3) 18 GHz – 26.5 GHz, Measured at 1 meter

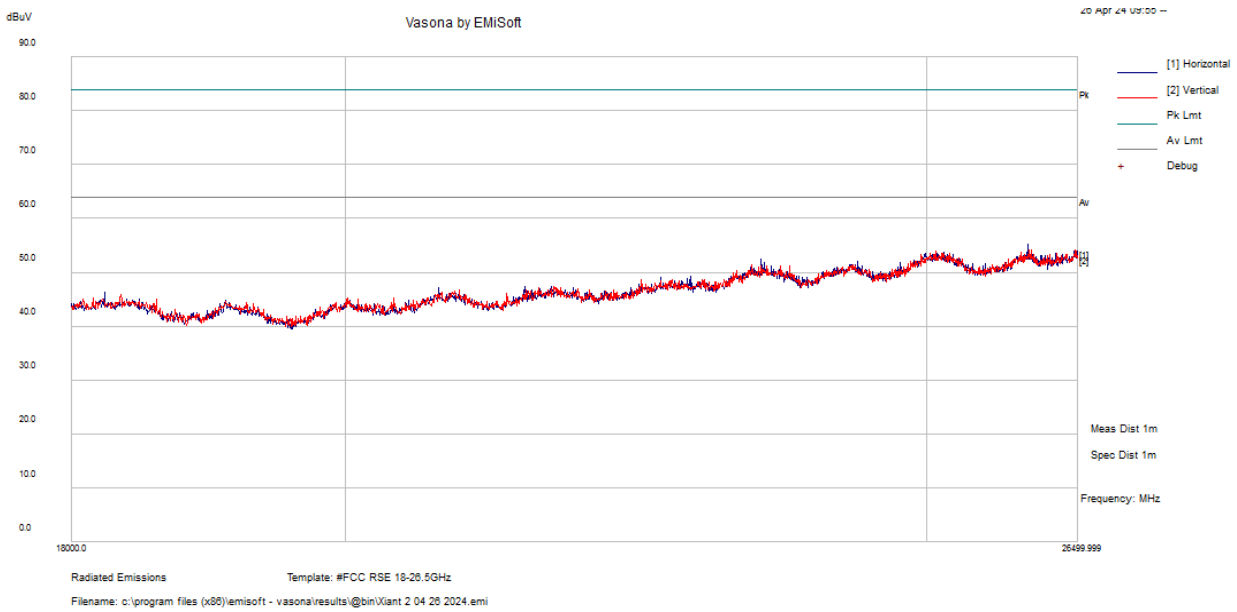
BLE, 1MBIT: 2402 MHz



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
18451.12	34.13	10.32	44.45	100	V	352	63.54	-19.09	Peak
19260.51	34.46	9.56	44.02	100	V	352	63.54	-19.52	Peak
20817.59	34.35	10.43	44.78	100	V	352	63.54	-18.76	Peak
22483.15	33.55	12.76	46.31	100	V	352	63.54	-17.23	Peak
24281.97	35.31	15.18	50.49	100	V	352	63.54	-13.05	Peak
26007.53	36.46	17.48	53.94	100	V	352	63.54	-9.6	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.
Note: The plot above shows that there were no emissions above the noise floor at 18-26.5GHz frequency range.

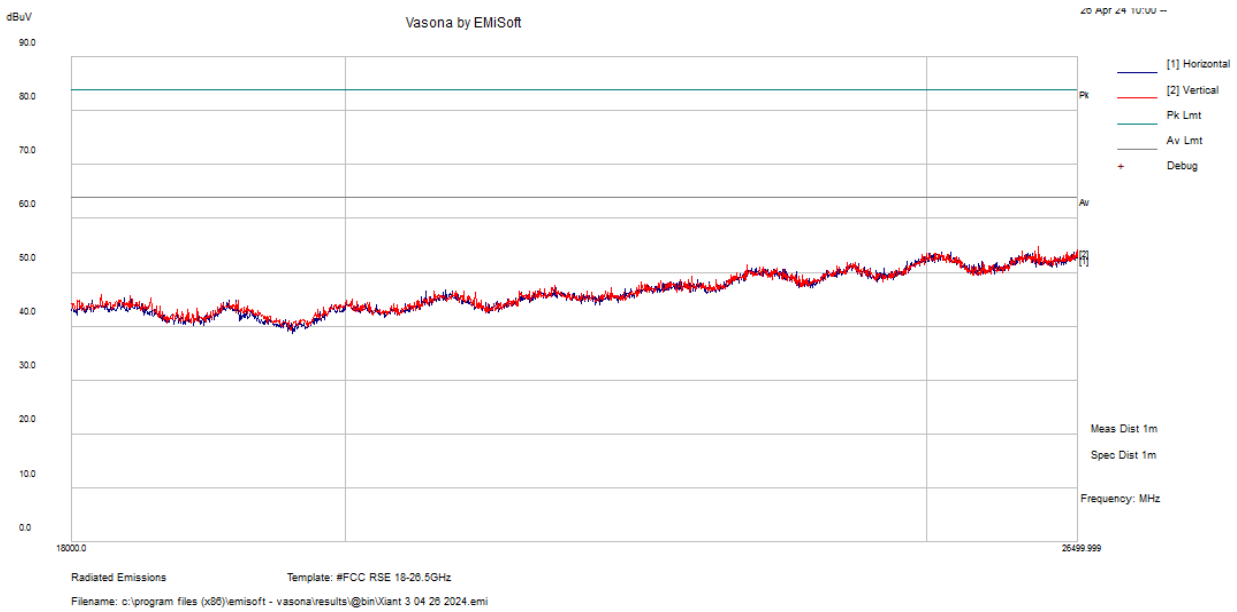
BLE, 1MBIT: 2440 MHz



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
18280.64	33.78	10.39	44.17	100	V	352	63.54	-19.37	Peak
19996.84	33.79	9.78	43.57	100	V	352	63.54	-19.97	Peak
21542.5	34.58	11.41	45.99	100	V	352	63.54	-17.55	Peak
23510.3	35.28	14.28	49.56	100	V	352	63.54	-13.98	Peak
24357.22	35.58	15.35	50.93	100	V	352	63.54	-12.61	Peak
25069.27	36.3	16.4	52.7	100	V	352	63.54	-10.84	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.
Note: The plot above shows that there were no emissions above the noise floor at 18-26.5GHz frequency range.

BLE, 1MBIT: 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
18280.64	32.48	10.39	42.87	100	V	352	63.54	-20.67	Peak
19141.69	33.65	9.74	43.4	100	V	352	63.54	-20.14	Peak
20801.5	34.75	10.43	45.19	100	V	352	63.54	-18.35	Peak
22544.11	33.64	12.89	46.53	100	V	352	63.54	-17.01	Peak
24338.38	34.9	15.31	50.2	100	V	352	63.54	-13.34	Peak
26042.76	34.55	17.4	51.95	100	V	352	63.54	-11.59	Peak

Note: Peak measurement is used to compare to the average limit to show compliance.
Note: The plot above shows that there were no emissions above the noise floor at 18-26.5GHz frequency range.

8 FCC §15.247(a) (2) & ISEDC RSS-247 §5.2, RSS-Gen §6.7 - Emission Bandwidth

8.1 Applicable Standards

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

8.2 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 11.8: DTS bandwidth

One of the following procedures may be used to determine the modulated DTS bandwidth.

Option 1:

a. Set RBW = 100 kHz.
b. Set the VBW ⩾ [3 × RBW].
c. Detector = peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize.
g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by00206 dB relative to the maximum level measured in the fundamental emission.

Option 2:
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.

As per the ANSI 63.10 Clause 6.9.3: Occupied Bandwidth

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. Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g. 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 these two frequencies.

h. 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).

8.3 Test Setup Block Diagram

8.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Cal Date	Cal Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2023-05-12	1 year
-	-	RF Cable	-	-	-	-

Note1: 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:	22.6 °C
Relative Humidity:	42.2 %
ATM Pressure:	101.9 kPa

The testing was performed by Libass Thiaw from on 2024-04-18 at RF Site.

8.6 Test Results

1MBIT

Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (kHz)	6 dB OBW limit (kHz)
Low	2402	1.0216	668.746	> 500
Middle	2440	1.0243	679.555	> 500
High	2480	1.0176	665.370	> 500

2MBIT

Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)	6 dB OBW limit (kHz)
Low	2402	2.0553	1.178	> 500
Middle	2440	2.0599	1.129	> 500
High	2480	2.0575	1.166	> 500

Please refer to Annex A for detailed test results.

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

9.1 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).

9.2 Measurement Procedure

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

11.9.1.1 RBW ≥ DTS 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 > RBW.
c. Set span ≥ [3 × RBW].
d. Sweep time = auto couple. Sweep time = auto.
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.

9.3 Test Setup Block Diagram

9.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Cal Date	Cal Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	05-15-2023	1 year
-	-	RF Cable	-	-	-	-

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:	22.6 °C
Relative Humidity:	42.2 %
ATM Pressure:	101.9 kPa

The testing was performed by Libass Thiaw from on 2024-04-18 at RF Site.

9.6 Test Results

1MBIT

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/ISEDC Limit (dBm)
Low	2402	5.99	30
Middle	2440	5.73	30
High	2480	5.71	30

2MBIT

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/ISEDC Limit (dBm)
Low	2402	6.03	30
Middle	2440	5.82	30
High	2480	5.75	30

1MBIT

Channel	Frequency (MHz)	EIRP (dBm)	EIRP Limit (dBm)
Low	2402	6.49	36
Middle	2440	6.23	36
High	2480	6.21	36

2MBIT

Channel	Frequency (MHz)	EIRP (dBm)	EIRP Limit (dBm)
Low	2402	6.53	36
Middle	2440	6.32	36
High	2480	6.25	36

Note: EIRP(dBm) = Conducted Power (dBm) + Antenna Gain (dBi)
Note: Antenna gain info was provided by the customer.

Please refer to Annex B for detailed test results

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 $\leqslant$ RBW $\leqslant$ 100 kHz.
d. Set the VBW $\geqslant$ [3 $\times$ 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 Number	Manufacturer	Description	Model	Serial Number	Cal Date	Cal Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	05-15-2023	1 year
-	-	RF Cable	-	-	-	-

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:	22.6 °C
Relative Humidity:	42.2 %
ATM Pressure:	101.9 kPa

The testing was performed by Libass Thiaw from on 2024-04-18 at RF Site.

10.6 Test Results

1MBIT

Channel	Frequency (MHz)	Conducted PSD (dBm/10 kHz)	FCC/ISEDC Limit (dBm/3 kHz)
Low	2402	0.26	8
Middle	2440	-4.14	8
High	2480	-0.19	8

2MBIT

Channel	Frequency (MHz)	Conducted PSD (dBm/10 kHz)	FCC/ISEDC Limit (dBm/3 kHz)
Low	2402	-0.62	8
Middle	2440	-0.16	8
High	2480	-0.96	8

Note: The EUT passed with stringent RBW of 10kHz, thus complied with FCC and IC RBW requirement of 3kHz.

Please refer to Annex C for detailed test results

11 FCC §15.247(d) & ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges

11.1 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.

11.2 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

11.3 Test Setup Block Diagram

11.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Cal Date	Cal Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	05-15-2023	1 year
-	-	RF Cable	-	-	-	-

11.5 Test Environmental Conditions

Temperature:	22.6 °C
Relative Humidity:	42.2 %
ATM Pressure:	101.9 kPa

The testing was performed by Libass Thiaw from on 2024-04-18 at RF Site.

11.6 Test Results

The test data of the EUT is complied with FCC §15.247(d) and ISEDC RSS-247 §5.5 for 100kHz bandwidth of bandedges.

Please refer to Annex D for detailed test results

12 FCC §15.247(d) & ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals

12.1 Applicable Standards

For FCC §15.247(d) and ISEDC RSS-247 §5.5, 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)).

12.2 Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

12.3 Test Setup Block Diagram

12.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Cal Date	Cal Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	05-15-2023	1 year
-	-	RF Cable	-	-	-	-

12.5 Test Environmental Conditions

Temperature:	22.6 °C
Relative Humidity:	42.2 %
ATM Pressure:	101.9 kPa

The testing was performed by Libass Thiaw from on 2024-04-18 at RF Site.

12.6 Test Results

The test data of the EUT is complied with FCC §15.247(d) and ISEDC RSS-247 §5.5 for spurious emissions at antenna terminal.

Please refer to Annex D for detailed test results

13 Annex E (Normative) - Test Setup Photographs

Please refer to the attachment

14 Annex F (Normative) - EUT External Photographs

Please refer to the attachment

15 Annex G (Normative) - EUT Internal Photographs

Please refer to the attachment

16 Annex H (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 21st day of December 2022.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2024

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 ---