FCC PART 15, SUBPART C
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Sindarin Inc.

431 Bryant Street
San Francisco, CA 94107, USA

FCC ID: 2BAHC-READER1
IC: 30424-READER1

Report Type:	**Product Type:**
Original Report	VR Reading Glasses

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Report Number:	R2303302-247
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2303302-247	Original Report	2023-07-25

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test was prepared on behalf of *Sindarin Inc.* and their product model: ED1-READER1, FCC ID: 2BAHC-READER1, IC: 30424-READER1, the “EUT” as referred to in this report. The EUT has 2.4GHz WiFi and Bluetooth Low Energy capabilities.

Model Number	ED1-READER1
FCC ID	2BAHC-READER1
IC	30424-READER1
Antenna Type	Chip
Operating Frequency	2412MHz – 2462MHz(Wifi), 2402MHz – 2480MHz(BLE)
Modulation	DSSS(802.11b), OFDM(802.11g/n),GFSK(BLE)
Channel Spacing	5MHz(802.11b), 5MHz(802.11g), 5MHz(802.11n20), 5MHz(802.11n40), 2MHz(LE)
Omnidirectional Antenna Gain	1.0 dBi
Measured RF Output Power	16.70 dBm (802.11b) 16.71 dBm (802.1g) 15.67 dBm (802.11n20) 14.94 dBm (802.11n40) 0.48 dBm (BLE)

1.2 Objective

This report is prepared on behalf of *Sindarin Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission’s rules and ISEDC RSS-247 Issue 2, February 2017.

The objective was to determine compliance with FCC Part 15.247 and ISEDC RSS-247 for Antenna Requirement, RF Exposure, Emission Bandwidth, Spurious Emissions, 100 kHz Band Edges, Maximum Output Power, and Peak Power Spectrum Density.

1.3 Related Submittal(s)/Grant(s)

N/A

1.4 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

1.5 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	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 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.

1.7 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 "Putty", provided by Sindarin Inc., the software is compliant with the standard requirements being tested against.

Modulation	Frequency (MHz)	Attenuation Setting
802.11b	2412	16
	2437	16
	2462	16
802.11g	2412	16
	2437	16
	2462	16
802.11n20	2412	16
	2437	16
	2462	16
802.11n40	2422	16
	2437	16
	2452	16

Data Rates Tested:
802.11b mode: 1Mbps
802.11g mode: 6Mbps
802.11n HT20 mode: MCS0
802.11n HT40 mode: MCS0

Modulation	Frequency (MHz)	Power Setting
BLE	2402	8
	2442	8
	2480	8

Data Rates Tested:
GFSK (LE): LE1 (1 Mbps)

2.3 Duty Cycle Correction Factor

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

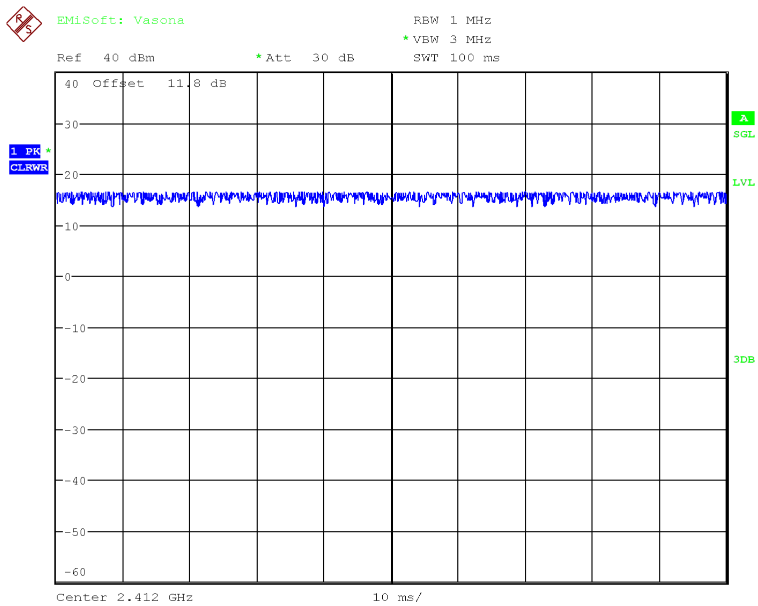
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized 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 its 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 Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	-	-	100	0
802.11g	5.464744	5.512820	99.1	0.04
802.11n20	5.048077	5.160256	97.8	0.09
802.11n40	-	-	100	0
BLE	2.096	2.5	83.8	0.77

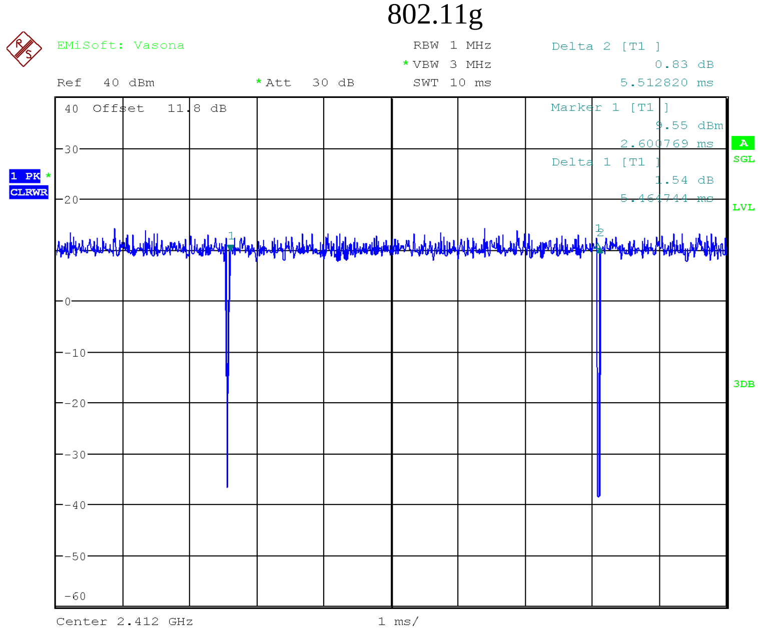
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

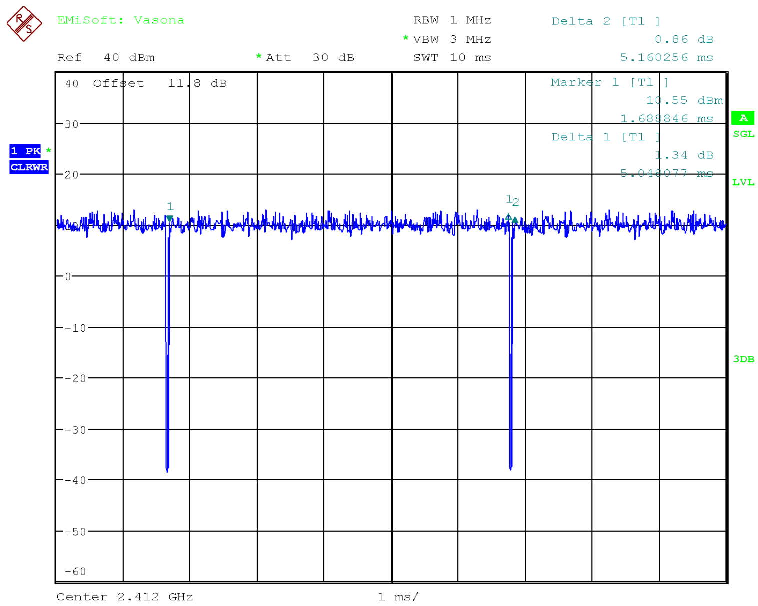
802.11b



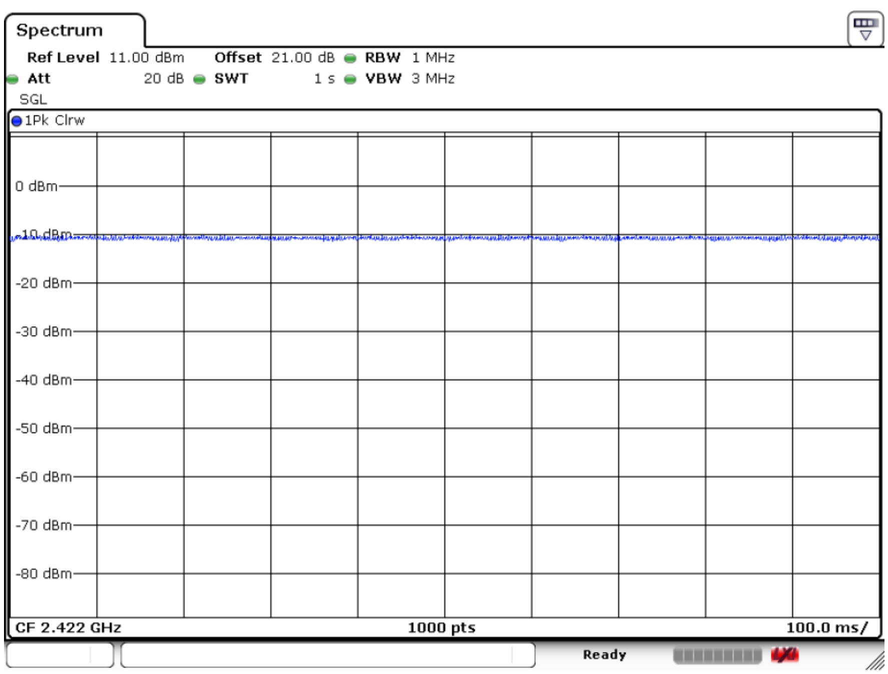
802.11g



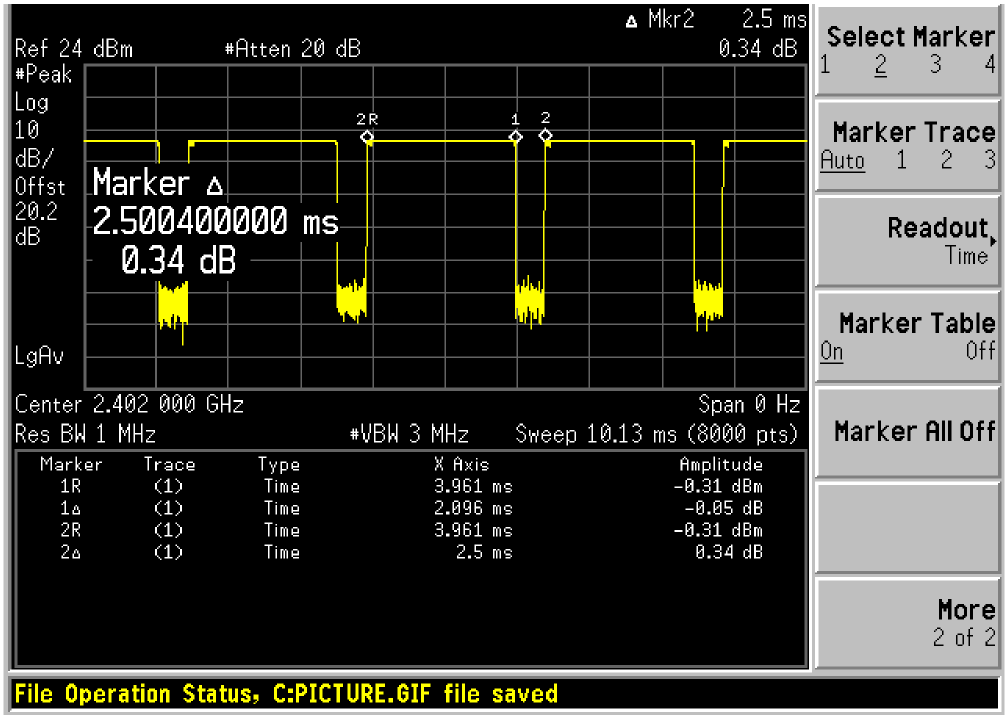
802.11n20



802.11n40



BLE


Δ Mkr2 2.5 ms
Ref 24 dBm #Atten 20 dB 0.34 dB
#Peak
Log
10
dB/
Offst
20.2
dB
LgAv
Marker Δ
2.500400000 ms
0.34 dB
Center 2.402 000 GHz
Span 0 Hz
Res BW 1 MHz #VBW 3 MHz Sweep 10.13 ms (8000 pts)
Marker Trace Type X Axis Amplitude
1R (1) Time 3.961 ms -0.31 dBm
1Δ (1) Time 2.096 ms -0.05 dB
2R (1) Time 3.961 ms -0.31 dBm
2Δ (1) Time 2.5 ms 0.34 dB
Select Marker 1 2 3 4
Marker Trace Auto 1 2 3
Readout Time
Marker Table On Off
Marker All Off
More 2 of 2
File Operation Status, C:PICTURE.GIF file saved

2.4 Equipment Modification

None.

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Remote Support Equipment

Manufacturer	Description	Model
-	USB to RS232 FTDI Adapter	N/A

2.7 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
Jumper Wires (x3)	< 1	FTDI Adapter	EUT
Jumper Wires (x2)	< 1	Battery	EUT
Micro USB	< 1	FTDI Adapter	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[1]
FCC §2.1093, §15.247(i) ISED RSS-102	RF Exposure	Compliant[1]
FCC §15.35(b), §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §8.10	Spurious Emissions	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	N/A[2]
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) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(e) ISEDC RSS-247 §5.2(2)	Peak Power Spectral Density	Compliant

Note[1]: Antenna gain (1.0 dBi @ 2.4 GHz) was obtained from antenna specification "2450AT07A0100" issued by Johanson Technology Inc.
Note[2]: Per client, device cannot transmit while charging.

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.

4.2 Antenna Description

External/Internal / Integral	Part Number	Antenna Type	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Internal	2450AT07A0100T	Trace	2400-2500	1.0

5 FCC §15.247(i) §2.1093 & ISED RSS-102 - RF Exposure

5.1 Applicable Standards

According to FCC KDB 447498 D01 General RF Exposure Guidance v06 Section 4.3.1, Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.

1) The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

    [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

    • f (GHz) is the RF channel transmit frequency in GHz
    • Power and distance are rounded to the nearest mW and mm before calculation
    • The result is rounded to one decimal place for comparison
    • 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

    The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

2) At 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:

    a) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
    b) [Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz

3) At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:

    a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by [1 + log(100/f(MHz))] for test separation distances > 50 mm and < 200 mm
    b) The power threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by ½ for test separation distances ≤ 50 mm

c) SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

According to FCC KDB 447498 D01 General RF Exposure Guidance v06 Section 2.2.1, as discussed in § 1.1307(b)(3)(ii)(A), the 1-mW exemption intended for single transmitters may be also applied to simultaneous transmission conditions, within the same host device, according one of the following criteria:

a) When maximum available power each individual transmitting antenna within the same time averaging period is ≤ 1 mW, and the nearest parts of the antenna structures of the simultaneously operating transmitters are separated by at least 2 cm.
b) When the aggregate maximum available power of all transmitting antennas is ≤ 1 mW in the same time-averaging period.

This exemption may not be combined with any other exemption

According to ISED RSS-102 Issue 5 Section 2.5.1 Exemption Limits for Routine Evaluation-SAR Evaluation:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in table below,

Frequency (MHz)	**Exemption Limits (mW)**				
	At separation distance of ≤5 mm	**At separation distance of 10 mm**	**At separation distance of 15 mm**	**At separation distance of 20 mm**	**At separation distance of 25 mm**
≤300	71	101	132	162	193
450	52	70	88	106	123
835	17	30	42	55	67
1900	7	10	18	34	60
2450	4	7	15	30	52
3500	2	6	16	32	55
5800	1	6	15	27	41

Frequency (MHz)	**Exemption Limits (mW)**				
	At separation distance of 30 mm	**At separation distance of 35 mm**	**At separation distance of 40 mm**	**At separation distance of 45 mm**	**At separation distance of ≥50 mm**
≤300	223	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431
2450	83	123	173	235	309
3500	86	124	170	225	290
5800	56	71	85	97	106

5.2 RF Exposure Evaluation Exemption for FCC

2.4Wifi:

The maximum power of channel, including tune-up tolerance is 4.42dBm(2.77mW). According to FCC KDB 447498,

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] [$\sqrt{f(GHz)}$] = (2.77 mW/5mm)* $\sqrt{2.462}$ = 0.87, which is less than 3.0. Therefore, FCC SAR testing is excluded.

BLE:

The maximum power of channel, including tune-up tolerance is 2dBm(1.58mW). According to FCC KDB 447498,

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] [$\sqrt{f(GHz)}$] = (1.58 mW/5mm)* $\sqrt{2.480}$ = 0.50, which is less than 3.0. Therefore, FCC SAR testing is excluded.

Simultaneous Transmission evaluation:

WiFi Contribution	BLE Contribution	Simultaneous Contribution	Limit
0.29	0.17	0.46	< 1.0

Note: Radio contributions are the evaluated power divided by the exposure limit

5.3 RF Exposure Evaluation Exemption for IC

802.11g 2437 MHz

4.42dBm + 1.0 dBi = 5.42 dBm(3.48mW) < 4mW

BLE, 2442 MHz

2dBm + 1.0 dBi = 3 dBm(2mW) < 4mW

Therefore, RF exposure is not required.

Note: Worst case distance of 5mm was used for calculations
Note: For Wi-Fi, the time-averaged output power was derived from the maximum measured power (i.e. 16.71 dBm) and duty cycle (5.9%). For example, the time-averaged output power = measured output power – 10*log(1/duty cycle)=16.71-12.29= 4.42 dBm.
Note: Normal Operation Duty Cycle clearly shown in section 1.4.2.3 of customer provided document titled "626-00006-001-_001 Wireless Analysis of Sol E-reader"
Note: Antenna Gain info provided by customer

6 FCC §15.35(b), §15.205, §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10- Spurious 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 when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 or Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

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

Frequency (MHz)	Field Strength (µv/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960*	500

* Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for 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 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

For the radiated emissions test, the EUT host and all support equipment power cords were 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 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 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

6.5 Test Equipment List and Details

BACL No	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
124	Rhode & Schwarz	EMI Test Receiver	ESCI 1166.5950K 03	100044	2021-05-14	2 years
624	Agilent	Spectrum Analyzer	E4446A	MY48250 238	2022-08-01	1 year
655	Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2022-02-07	2 years
327	Sunol Sciences	Controller, System	SC110V	122303-1	N/A	N/A
316	Sonoma Instruments	Preamplifier 10 kHz - 2.5 GHz	317	260406	2023-04-12	6 months
658	HP/ Agilant	Pre Amplifier	8449B OPT HO2	3008A01 103	2022-07-22	1 year
827	AH Systems	Preamplifier	PAM 1840 VH	170	2022-11-01	1 year
91	Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2022-03-08	2 years
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2; 1504	2021-11-22	2 years
1192	ETS Lindgren	Horn Antenna	3117	00218973	2022-09-29	2 years
1186	Pasternack	Coaxial Cable, RG214	PE3062-1050CM	-	2023-04-14	6 months
1247	Uti flex	Micro - Coax	-	-	2022-07-22	1 year
1248	Pasternack	RG214 COAX Cable	PE3062	-	2023-04-14	6 months
1249	Time Microwave	LMR-400 Cable Dc-3 GHz	AE13684	2k80612-5 6fts	2023-04-14	6 months
1295	Carlisle	10m Ultra Low Loss Coaxial Cable	UFB142A-1-3937-200200	64639890 912-001	2023-05-04	6 months
1328	Centric RF	2.92mm short coaxial cable	C547-107-12B	CW10S3 4123	2022-12-09	6 months
1346	RFMW	2.92mm 10ft RF cable	KMSE-160SAW-240.0-KSME	-	2023-02-03	6 months
1354	RFMW	2.92mm 10ft RF Cable DC to 40 GHz	P1CA-29M29M-F150-120	-	2023-02-24	6 months
388	Micro Tronics	2.4~2.5 GHz Notch Filter	-	-	2023-03-02	1 year
672	Micro Tronics	2.4-2.6 GHz Notch Filter	BRM50701	160	2023-03-09	1 year
1245	-	6dB Attenuator	PE7390-6	01182018 A	2021-11-22	2 years
1246	HEWLET PACKARD	RF Limiter	11867A	01734	2023-04-13	1 year

Note[1]: cable and notch filters 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".*

6.6 Test Environmental Conditions

Temperature:	24° C
Relative Humidity:	45 %
Barometric Pressure:	101.1 kPa

The testing was performed by Arturo Reyes on 2023-05-04 and by Deepak Mishra from 2023-05-12 to 2023-05-14 in 5m chamber 3.

6.7 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:

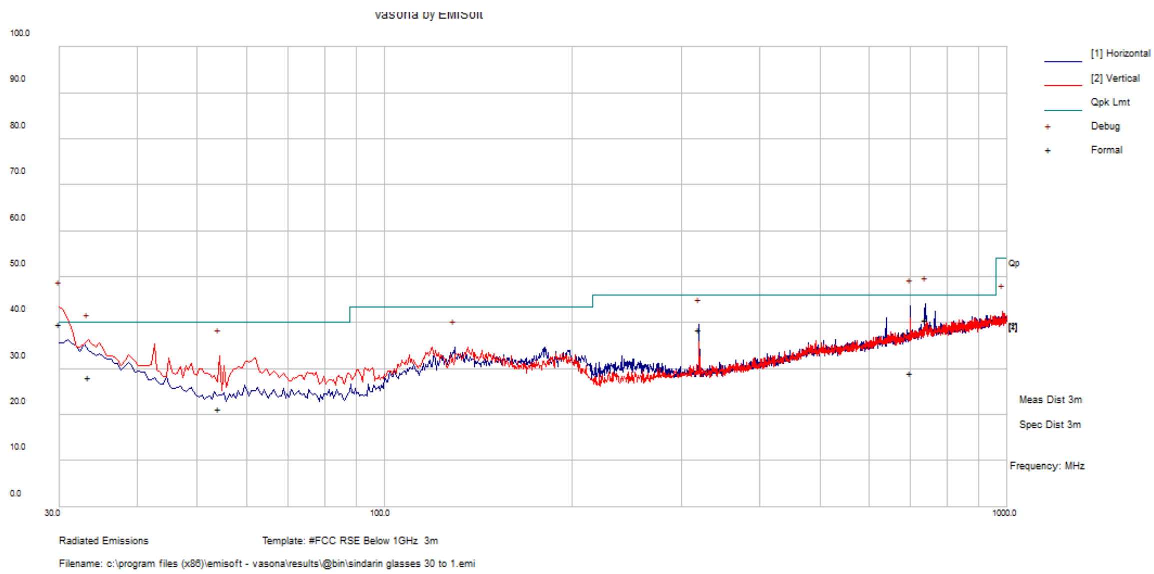
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Configuration**
-0.035	2483.5	Horizontal	802.11b, 2462MHz

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

6.8 Radiated Emissions Test Results

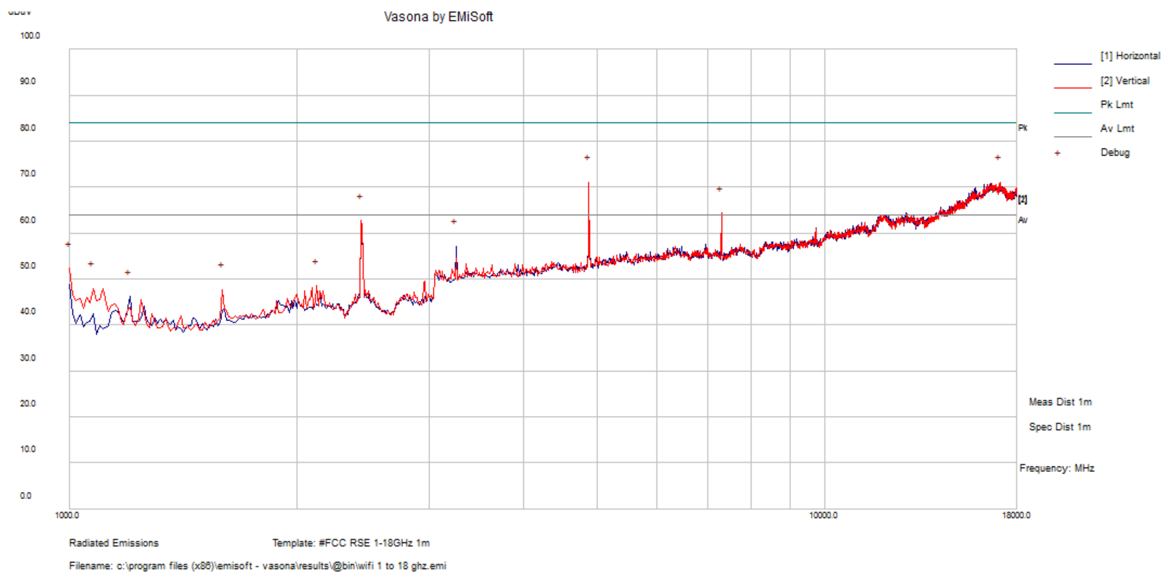
Note: Pre-scans were performed in order to investigate the x,y and z orientations of the EUT for radiated emissions testing. Worst case positioning of EUT determined can be seen in the test setup photos.
Note: EUT does not contain any metal materials that may affect emissions from the EUT. Thus, for radiated spurious emissions, testing is sufficient done without full enclosure attached as seen in test setup photos.
Note: Worst-case plots shown show spurious emissions for worst-case config: 802.11b 2437MHz + BLE 2442MHz. Data for worst-emissions for all modulations and channels shown in"1 – 18 Spurious Emissions at 3 meters".

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



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)	Comment
30	40.66	-0.97	39.69	113	V	197	40	-0.31	QP
740.252	38.86	1.74	40.6	207	H	344	46	-5.4	QP
698.93675	28.02	1.16	29.18	192	H	270	46	-16.82	QP
33.49075	31.5	-3.3	28.2	181	V	239	40	-11.8	QP
319.992	45.58	-7.01	38.57	110	H	173	46	-7.43	QP
54.13175	34.97	-13.6	21.37	243	V	56	40	-18.63	QP

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



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
7311.23	62	8.07	70.07	V	170	281	84	-13.93	Peak
17086.895	46.96	20.25	67.21	V	224	67	84	-16.79	Peak
4875.21	53.31	4.83	58.14	V	128	286	84	-25.86	Peak
7311.23	54.44	8.07	62.51	V	170	281	64	-1.49	Avg
17086.895	36.68	20.25	56.93	V	224	67	64	-7.07	Avg
4875.21	47.35	4.83	52.18	V	128	286	64	-11.82	Avg

1 – 18 Spurious Emissions at 3 meters

BLE:

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBμV/m)	FCC/ISEDC		Detector (Peak /Avg.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel: 2402 MHz											
2390	50.020	133	150	H	32.142	4.980	37.896	49.246	74	-24.754	Peak
2390	51.150	206	212	V	32.142	4.980	37.896	50.376	74	-23.624	Peak
2390	38.480	133	150	H	32.142	4.980	37.896	37.706	54	-16.294	Avg.
2390	39.550	206	212	V	32.142	4.980	37.896	38.776	54	-15.224	Avg.
4804	46.060	360	150	H	34.360	7.230	36.786	50.864	74	-23.136	Peak
4804	45.770	360	150	V	34.360	7.230	36.786	50.574	74	-23.426	Peak
4804	33.970	360	150	H	34.360	7.230	36.786	38.774	54	-15.226	Avg.
4804	34.450	360	150	V	34.360	7.230	36.786	39.254	54	-14.746	Avg.
Middle Channel: 2442 MHz											
4884	44.310	360	150	H	34.360	7.230	36.786	49.114	74	-24.886	Peak
4884	44.540	360	150	V	34.360	7.230	36.786	49.344	74	-24.656	Peak
4884	34.040	360	150	H	34.360	7.230	36.786	38.844	54	-15.156	Ave
4884	34.030	360	150	V	34.360	7.230	36.786	38.834	54	-15.166	Ave
High Channel: 2480 MHz											
2483.5	60.250	155	150	H	32.672	5.080	37.913	60.089	74	-13.911	Peak
2483.5	48.830	360	150	V	32.672	5.080	37.913	48.669	74	-25.331	Peak
2483.5	42.540	155	150	H	32.672	5.080	37.913	42.379	54	-11.621	Ave
2483.5	36.610	360	150	V	32.672	5.080	37.913	36.449	54	-17.551	Ave
4960	46.890	360	150	H	34.360	7.230	36.786	51.694	74	-22.306	Peak
4960	46.730	360	150	V	34.360	7.230	36.786	51.534	74	-22.466	Peak
4960	35.610	360	150	H	34.360	7.230	36.786	40.414	54	-13.586	Ave
4960	35.630	360	150	V	34.360	7.230	36.786	40.434	54	-13.566	Ave

802.11b:

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Detector (Peak /Avg.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 2412 MHz											
2390	54.040	183	200	H	32.142	5.100	37.896	53.386	74	-20.614	Peak
2390	56.770	286	175	V	32.142	5.100	37.896	56.116	74	-17.884	Peak
2390	40.260	183	200	H	32.142	5.100	37.896	39.606	54	-14.394	Avg.
2390	41.660	286	175	V	32.142	5.100	37.896	41.006	54	-12.994	Avg.
4824	50.010	302	115	H	34.479	7.396	36.816	55.069	74	-18.931	Peak
4824	50.900	202	104	V	34.479	7.396	36.816	55.959	74	-18.041	Peak
4824	40.690	302	115	H	34.479	7.396	36.816	45.749	54	-8.251	Avg.
4824	43.030	202	104	V	34.479	7.396	36.816	48.089	54	-5.911	Avg.
Middle Channel: 2437 MHz											
4874	49.440	50	254	H	34.479	7.508	36.816	54.611	74	-19.389	Peak
4874	50.370	185	160	V	34.479	7.508	36.816	55.541	74	-18.459	Peak
4874	42.510	50	254	H	34.479	7.508	36.816	47.681	54	-6.319	Ave
4874	48.020	185	160	V	34.479	7.508	36.816	53.191	54	-0.809	Ave
High Channel: 2462 MHz											
2483.5	62.580	34	200	H	32.672	5.226	37.913	62.565	74	-11.435	Peak
2483.5	62.090	235	167	V	32.672	5.226	37.913	62.075	74	-11.925	Peak
2483.5	53.980	34	200	H	32.672	5.226	37.913	53.965	54	-0.035	Ave
2483.5	52.850	235	167	V	32.672	5.226	37.913	52.835	54	-1.165	Ave
4924	52.680	343	146	H	34.479	7.508	36.816	57.851	74	-16.149	Peak
4924	54.370	162	231	V	34.479	7.508	36.816	59.541	74	-14.459	Peak
4924	42.420	343	146	H	34.479	7.508	36.816	47.591	54	-6.409	Ave
4924	46.170	162	231	V	34.479	7.508	36.816	51.341	54	-2.659	Ave

802.11g:

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Detector (Peak /Avg.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 2412 MHz											
2390	61.680	183	200	H	32.142	4.980	37.896	60.906	74	-13.094	Peak
2390	61.843	280	175	V	32.142	4.980	37.896	61.069	74	-12.931	Peak
2390	40.060	183	200	H	32.142	4.980	37.896	39.286	54	-14.714	Avg.
2390	40.447	280	175	V	32.142	4.980	37.896	39.673	54	-14.327	Avg.
4824	53.120	171	284	H	34.479	7.230	36.816	58.013	74	-15.987	Peak
4824	53.270	216	173	V	34.479	7.230	36.816	58.163	74	-15.837	Peak
4824	43.170	171	284	H	34.479	7.230	36.816	48.063	54	-5.937	Avg.
4824	41.230	216	173	V	34.479	7.230	36.816	46.123	54	-7.877	Avg.
Middle Channel: 2437 MHz											
4874	50.310	50	254	H	34.479	7.508	36.816	55.481	74	-18.519	Peak
4874	49.110	185	160	V	34.479	7.508	36.816	54.281	74	-19.719	Peak
4874	37.341	50	254	H	34.479	7.508	36.816	42.512	54	-11.488	Ave
4874	37.010	185	160	V	34.479	7.508	36.816	42.181	54	-11.819	Ave
High Channel: 2462 MHz											
2483.5	67.910	26	153	H	32.672	5.080	37.913	67.749	74	-6.251	Peak
2483.5	65.080	255	167	V	32.672	5.080	37.913	64.919	74	-9.081	Peak
2483.5	52.030	26	153	H	32.672	5.080	37.913	51.869	54	-2.131	Ave
2483.5	49.730	255	167	V	32.672	5.080	37.913	49.569	54	-4.431	Ave
4924	50.125	122	120	H	34.479	7.230	36.816	55.018	74	-18.982	Peak
4924	50.314	68	177	V	34.479	7.230	36.816	55.207	74	-18.793	Peak
4924	37.315	122	120	H	34.479	7.230	36.816	42.208	54	-11.792	Ave
4924	37.425	68	177	V	34.479	7.230	36.816	42.318	54	-11.682	Ave

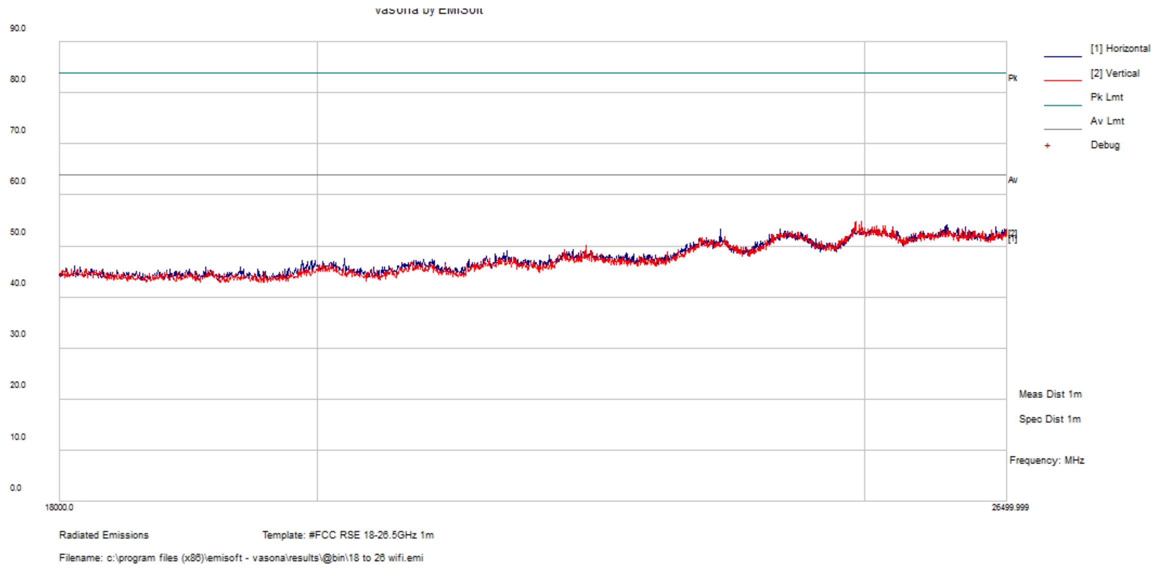
802.11n20:

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Detector (Peak /Avg.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 2412 MHz											
2390	71.850	14	148	H	32.142	4.980	37.896	71.076	74	-2.924	Peak
2390	64.490	207	101	V	32.142	4.980	37.896	63.716	74	-10.284	Peak
2390	54.561	14	148	H	32.142	4.980	37.896	53.787	54	-0.213	Avg.
2390	49.494	207	101	V	32.142	4.980	37.896	48.720	54	-5.280	Avg.
4824	53.145	298	106	H	34.479	7.230	36.816	58.038	74	-15.962	Peak
4824	54.321	159	265	V	34.479	7.230	36.816	59.214	74	-14.786	Peak
4824	41.825	298	106	H	34.479	7.230	36.816	46.718	54	-7.282	Avg.
4824	41.934	159	265	V	34.479	7.230	36.816	46.827	54	-7.173	Avg.
Middle Channel: 2437 MHz											
4874	53.340	298	106	H	34.479	7.508	36.816	58.511	74	-15.489	Peak
4874	54.620	159	265	V	34.479	7.508	36.816	59.791	74	-14.209	Peak
4874	41.330	298	106	H	34.479	7.508	36.816	46.501	54	-7.499	Ave
4874	42.250	159	265	V	34.479	7.508	36.816	47.421	54	-6.579	Ave
High Channel: 2462 MHz											
2483.5	66.820	25	121	H	32.672	5.080	37.913	66.659	74	-7.341	Peak
2483.5	61.320	113	153	V	32.672	5.080	37.913	61.159	74	-12.841	Peak
2483.5	53.163	25	121	H	32.672	5.080	37.913	53.002	54	-0.998	Ave
2483.5	46.530	113	153	V	32.672	5.080	37.913	46.369	54	-7.631	Ave
4924	53.637	298	106	H	34.479	7.230	36.816	58.530	74	-15.470	Peak
4924	53.914	159	265	V	34.479	7.230	36.816	58.807	74	-15.193	Peak
4924	41.298	298	106	H	34.479	7.230	36.816	46.191	54	-7.809	Ave
4924	42.001	159	265	V	34.479	7.230	36.816	46.894	54	-7.106	Ave

802.11n40:

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBμV/m)	FCC/ISEDC		Detector (Peak /Avg.)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel: 2422 MHz											
2390	60.120	20	150	H	32.142	4.980	37.896	59.346	74	-14.654	Peak
2390	60.390	210	151	V	32.142	4.980	37.896	59.616	74	-14.384	Peak
2390	46.325	20	150	H	32.142	4.980	37.896	45.551	54	-8.449	Avg.
2390	45.250	210	151	V	32.142	4.980	37.896	44.476	54	-9.524	Avg.
4844	51.366	299	110	H	34.479	7.230	36.816	56.259	74	-17.741	Peak
4844	51.285	157	247	V	34.479	7.230	36.816	56.178	74	-17.822	Peak
4844	40.114	299	110	H	34.479	7.230	36.816	45.007	54	-8.993	Avg.
4844	40.328	157	247	V	34.479	7.230	36.816	45.221	54	-8.779	Avg.
Middle Channel: 2437 MHz											
4874	51.220	299	110	H	34.479	7.508	36.816	56.391	74	-17.609	Peak
4874	52.260	157	247	V	34.479	7.508	36.816	57.431	74	-16.569	Peak
4874	39.140	299	110	H	34.479	7.508	36.816	44.311	54	-9.689	Ave
4874	40.080	157	247	V	34.479	7.508	36.816	45.251	54	-8.749	Ave
High Channel: 2452 MHz											
2483.5	57.620	314	150	H	32.672	5.080	37.913	57.459	74	-16.541	Peak
2483.5	56.915	180	165	V	32.672	5.080	37.913	56.754	74	-17.246	Peak
2483.5	42.580	314	150	H	32.672	5.080	37.913	42.419	54	-11.581	Ave
2483.5	42.285	180	165	V	32.672	5.080	37.913	42.124	54	-11.876	Ave
4904	51.024	300	100	H	34.479	7.230	36.816	55.917	74	-18.083	Peak
4904	51.258	150	250	V	34.479	7.230	36.816	56.151	74	-17.849	Peak
4904	40.344	300	100	H	34.479	7.230	36.816	45.237	54	-8.763	Ave
4904	40.325	150	250	V	34.479	7.230	36.816	45.218	54	-8.782	Ave

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



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)	Comment
24924.249	38.7	14.8	53.5	101	V	7	64	-10.5	Peak

Note: Worst case peak emission was compared to average limit to show compliance.

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

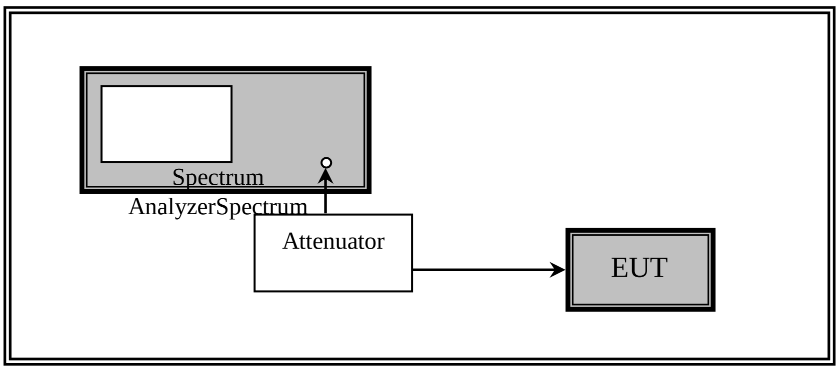
7.1 Applicable Standards

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

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.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
-	-	20dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
-	-	10dB attenuator	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

7.5 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

The testing was performed by Christian Schwartz from 2023-05-15 to 2023-05-19 at the RF site.

7.6 Test Results

Mode	Frequency (MHz)	6 dB OBW (MHz)	99% OBW (MHz)	6 dB OBW Limit (kHz)	Result
802.11 b	2412	9.069	13.1471	≥ 500	pass
	2437	9.067	13.2315	≥ 500	pass
	2462	8.975	13.0296	≥ 500	pass
802.11 g	2412	16.320	17.2873	≥ 500	pass
	2437	16.329	17.2740	≥ 500	pass
	2462	16.323	17.2797	≥ 500	pass
802.11 n20	2412	17.556	18.2433	≥ 500	pass
	2437	17.555	18.2512	≥ 500	pass
	2462	17.565	18.2412	≥ 500	pass
802.11 n40	2422	32.563	34.9250	≥ 500	pass
	2437	32.571	34.9198	≥ 500	pass
	2452	32.571	34.9663	≥ 500	pass
BLE	2402	0.615093	1.0425	≥ 500	pass
	2442	0.616580	1.0413	≥ 500	pass
	2480	0.616222	1.0411	≥ 500	pass

Note: See Annex E for 99 Occupied Bandwidth results
Note: See Annex G for 6dB Bandwidth results

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.

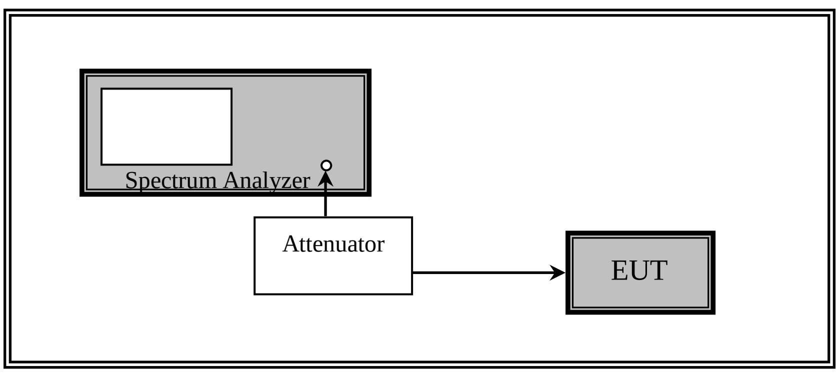
According to RSS-247 §5.4: For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

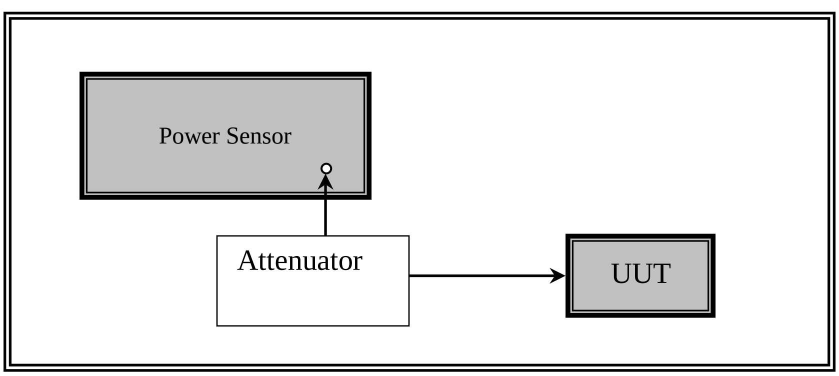
8.2 Measurement Procedure

The measurements are based on ANSI C63.10-2013, Section 11.9.2.3.1 for 2.4GHz Wifi.

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

8.3 Test Setup Block Diagram





8.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
-	-	20dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
697	ETS- Lindgren	Power Sensor	7002-006	160097	2023-02-20	1 year
424	Agilent	Spectrum Analyzer	E4440A	US45303156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

8.5 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

The testing was performed by Christian Schwartz from 2023-05-15 to 2023-05-19 at the RF site.

8.6 Test Results

Frequency (MHz)	Conducted Output Power (dBm)	Output Power Limit (dBm)	Result
802.11b mode			
2412	16.7	≤30	Pass
2437	16.56	≤30	Pass
2462	16.68	≤30	Pass
802.11g mode			
2412	16.66	≤30	Pass
2437	16.71	≤30	Pass
2462	16.32	≤30	Pass
802.11n20 mode			
2412	15.6	≤30	Pass
2437	15.67	≤30	Pass
2462	15.39	≤30	Pass
802.11n40 mode			
2422	14.94	≤30	Pass
2437	14.88	≤30	Pass
2452	14.91	≤30	Pass
BLE			
2402	0.46	≤30	Pass
2442	0.48	≤30	Pass
2480	0.18	≤30	Pass

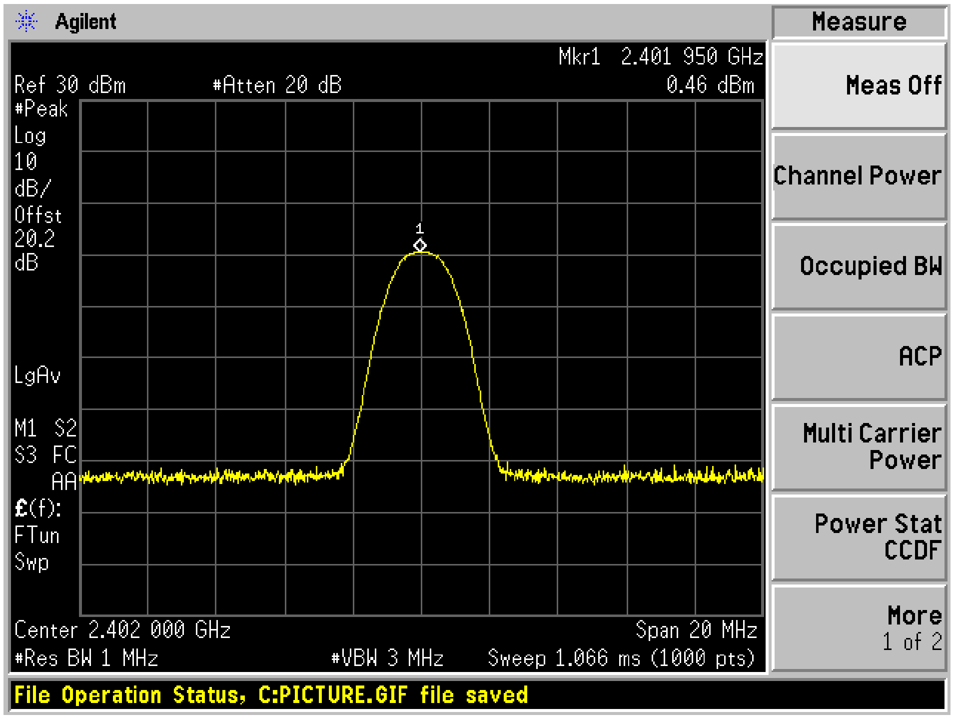
Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)
802.11b mode				
2412	16.7	1	17.7	≤36
2437	16.56	1	17.56	≤36
2462	16.68	1	17.68	≤36
802.11g mode				
2412	16.66	1	17.66	≤36
2437	16.71	1	17.71	≤36
2462	16.32	1	17.32	≤36
802.11n20 mode				
2412	15.6	1	16.6	≤36
2437	15.67	1	16.67	≤36
2462	15.39	1	16.39	≤36
802.11n40 mode				
2422	14.94	1	15.94	≤36
2437	14.88	1	15.88	≤36
2452	14.91	1	15.91	≤36
BLE				
2402	0.46	1	1.46	≤36
2442	0.48	1	1.48	≤36
2480	0.18	1	1.18	≤36

Note: The antenna gain provided by the customer
Note: EIRP(dBm) = Conducted Power (dBm) + Antenna Gain (dBi)

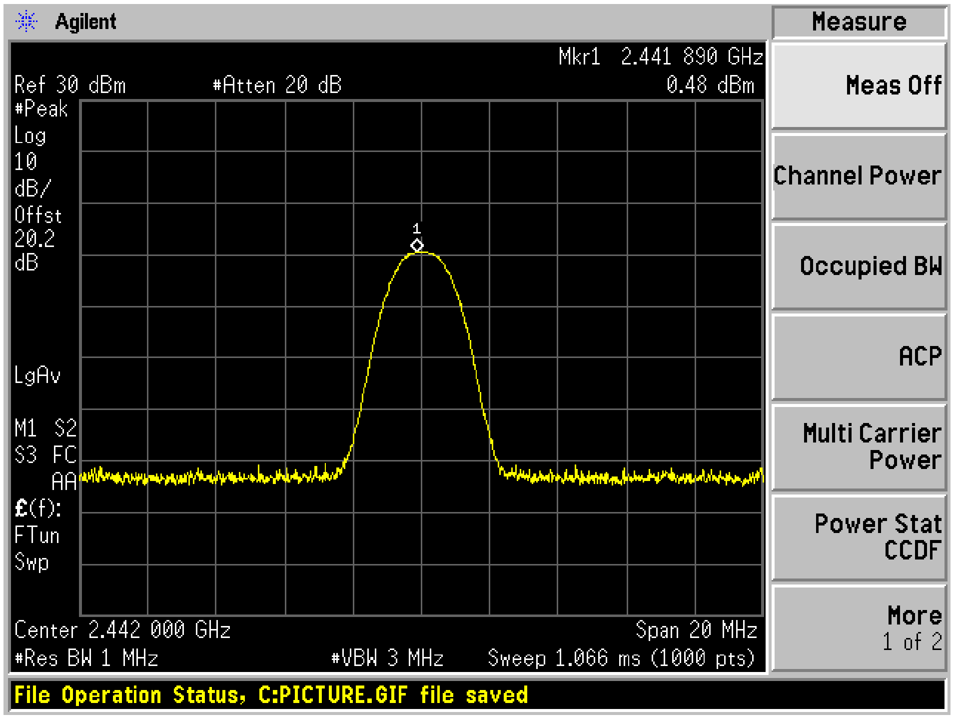
Note: Duty Cycle correction factor has already been added to the measurement.
Note: BLE power used Peak detection and Wi-Fi used average detection
See plots below for BLE data.

BLE

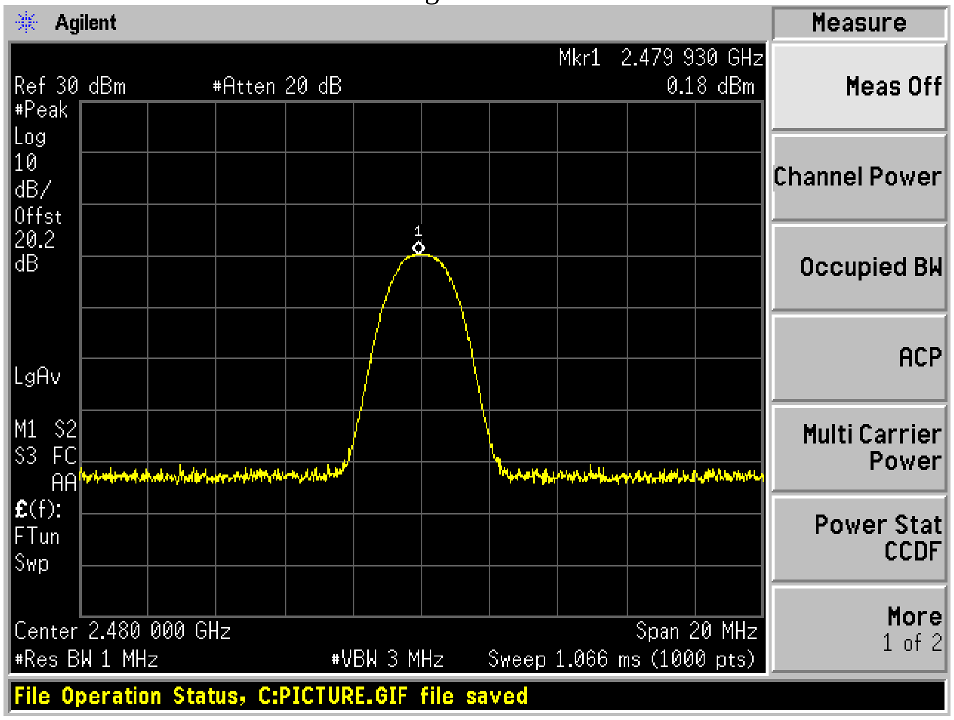
Low Channel



Mid Channel



High Channel



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

9.1 Applicable Standards

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

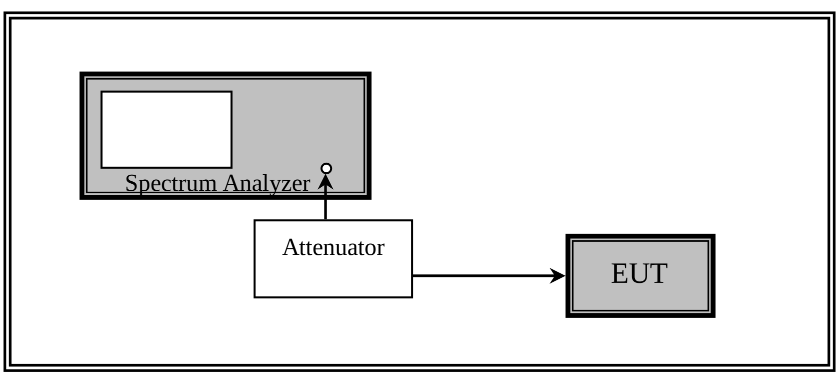
According to ISEDC RSS-247 §5.5.In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the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

9.2 Measurement Procedure

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

RBW = 100 kHz
VBW = 300 kHz
Sweep = coupled
Detector function = peak
Trace = max hold

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
-	-	10dB attenuator	-	-	Each time[1]	N/A
-	-	20dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

9.5 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

The testing was performed by Christian Schwartz from 2023-05-15 to 2023-05-19 at the RF site.

9.6 Test Results

Please refer to Annex H for test results.

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

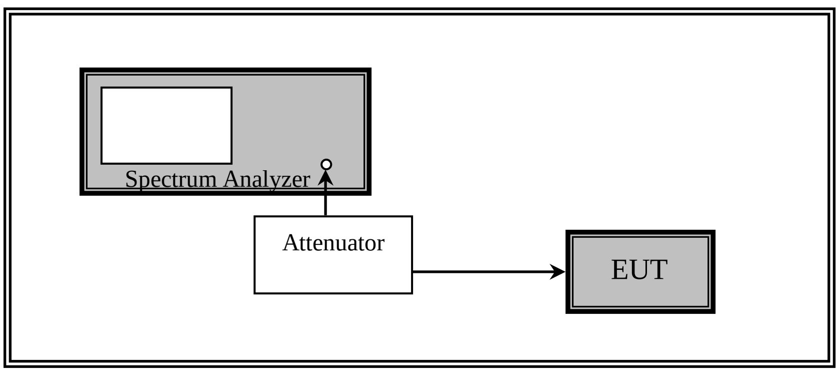
10.1 Applicable Standards

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.

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

BACL Number	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
-	-	10dB attenuator	-	-	Each time[1]	N/A
-	-	20dB attenuator	-	-	Each time[1]	N/A
-	-	RF cable	-	-	Each time[1]	N/A
424	Agilent	Spectrum Analyzer	E4440A	US45303156	2022-12-19	1 year

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.

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

10.5 Test Environmental Conditions

Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.1 kPa

The testing was performed by Christian Schwartz from 2023-05-15 to 2023-05-19 at the RF site.

10.6 Test Results

Channel	Frequency (MHz)	Peak PSD (dBm/3kHz)	Limit (dBm/3kHz)
802.11b mode			
Low	2412	-7.02	≤8
Middle	2437	-6.90	≤8
High	2462	-8.31	≤8
802.11g mode			
Low	2412	-9.74	≤8
Middle	2437	-10.27	≤8
High	2462	-9.88	≤8
802.11n20 mode			
Low	2412	-9.95	≤8
Middle	2437	-10.51	≤8
High	2462	-10.85	≤8
802.11n40 mode			
Low	2422	-12.06	≤8
Middle	2437	-11.44	≤8
High	2452	-11.80	≤8
BLE mode			
Low	2402	-0.16	≤8
Middle	2442	-0.02	≤8
High	2480	-0.34	≤8

Note: See Annex F for test results

11 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

12 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

14 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

15 Annex 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 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 ---