FCC PART 15.247
ISEDC RSS-247, ISSUE 3, AUGUST 2023

TEST REPORT

For

Hitachi Energy USA, Inc.

2535 Augustine Drive
Santa Clara, CA 95054, USA

FCC ID: P9J-BLUEFIN24
IC: 4751A-BLUEFIN24

Report Type:	**Model:**
Original	BlueFin 2.4 GHz

Prepared By:	Michael Papa RF Test Engineer
Report Number:	R2310314-247
Report Date:	2024-02-05
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ACCREDITED
CERTIFICATE #3297.02

Note: This test report was 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 test report shall not be used by the customer to claim product certification, approval, or endorsement by A2LA or any agency of the United States Government or any foreign government.
* This test report may contain data and test methods that are not covered by BACL's scope of accreditation as of the test report date shown above. These items are marked within the test report text with an asterisk "*"

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2310314-247	Original Report	2024-02-05

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test was prepared on behalf of *Hitachi Energy USA, Inc.*, and their product model: BlueFin 2.4 GHz, FCC ID: P9J-BLUEFIN24, IC: 4751A-BLUEFIN24, the "EUT" as referred to in this report. The EUT has 2.4 GHz capabilities and supports IEEE 802.11b/g/n20/n40.

Model Number	BlueFin 2.4 GHz
FCC ID	P9J-BLUEFIN24
IC	4751A-BLUEFIN24
Radio Type	2.4 GHz Wi-Fi radio
Operating Frequency	2412-2462 MHz
Modulation	IEEE 802.11b/g/n20/n40
Channel Spacing	20MHz, 40MHz
Antenna Gain	7.4 dBi (MIMO gain: 10.4dBi)
RF Output Power	27.5 dBm

1.2 Objective

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

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

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

1.3 Mechanical Description of EUT

Dimensions: 70mm (Length) 50mm (Width) 3mm (High).
Serial Number: R2311272-1 assigned by *BACL*

1.4 Related Submittal(s)/Grant(s)

N/A

1.5 Test Methodology

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

1.6 Measurement Uncertainty

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

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

1.7 Test Facility Registrations

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

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-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 test utility used was the "Atheros Radio Test 2 (ART2-GUI)", provided by *Hitachi Energy*, the software is compliant with the standard requirements being tested against.

Radio	Frequency (MHz)	Modulation	Power Setting
2.4 GHz Wi-Fi	2412	802.11b	26
	2437		26
	2462		21
	2412	802.11g	21
	2437		26
	2462		26
	2412	802.11n20	20
	2437		23
	2462		22
	2422	802.11n40	20
	2437		22
	2452		23

2.3 Duty Cycle Correction Factor

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 section B:

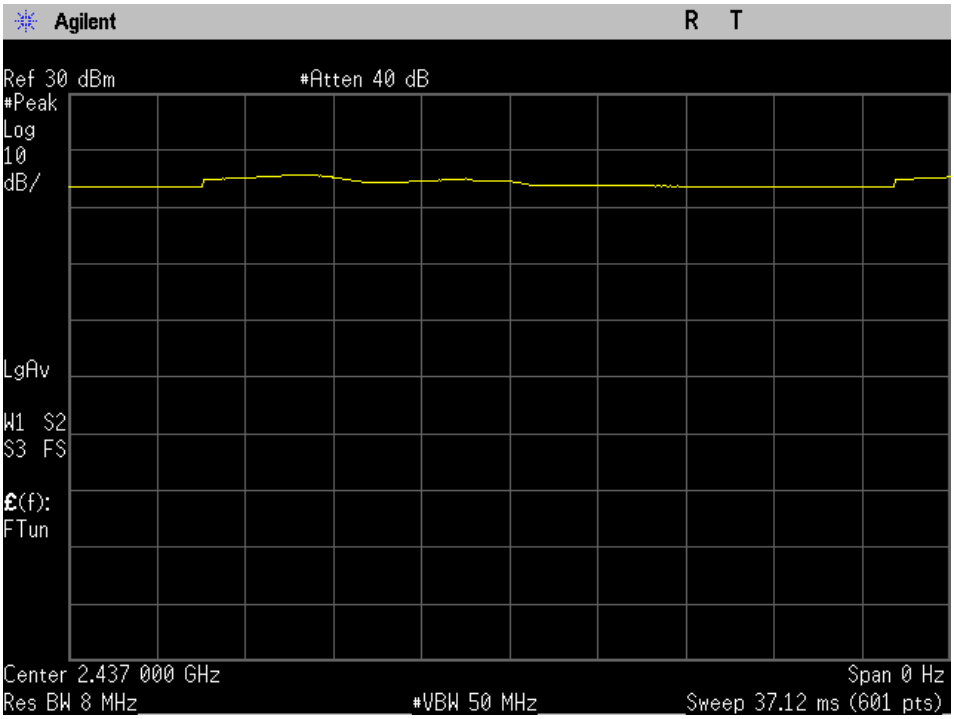
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11b	-	-	100%	0
802.11g	-	-	100%	0
802.11n20	-	-	100%	0
802.11n40	-	-	100%	0

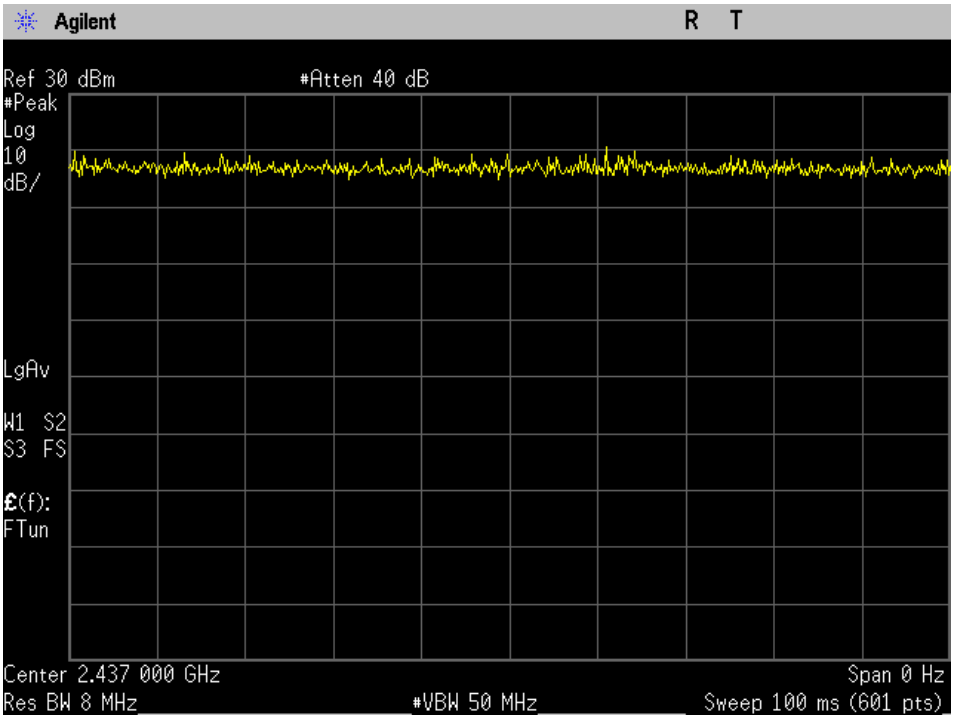
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

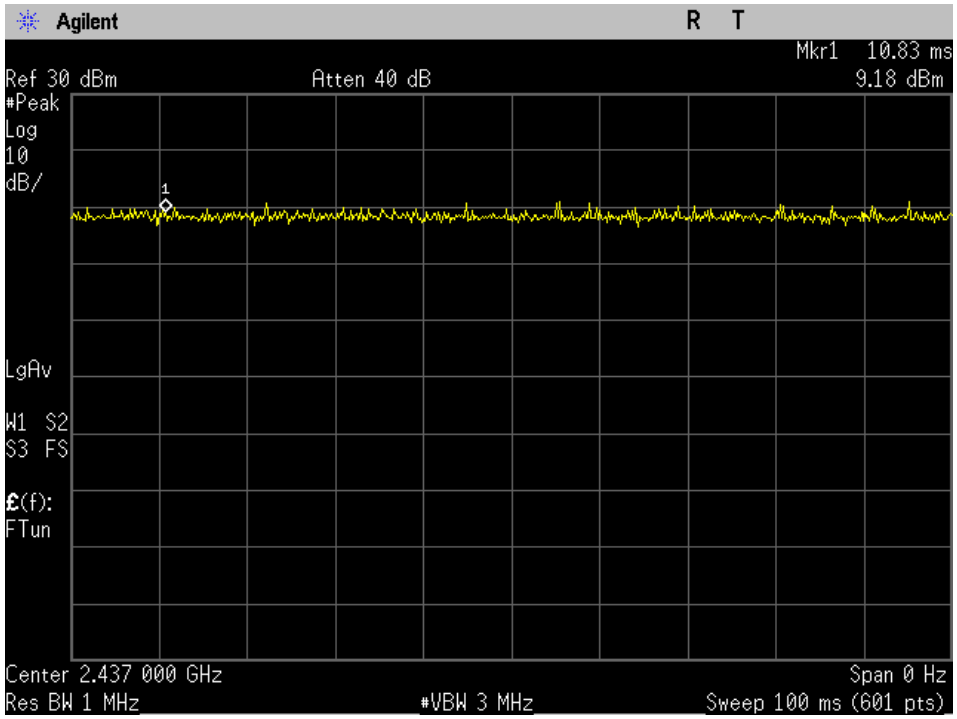
802.11b mode



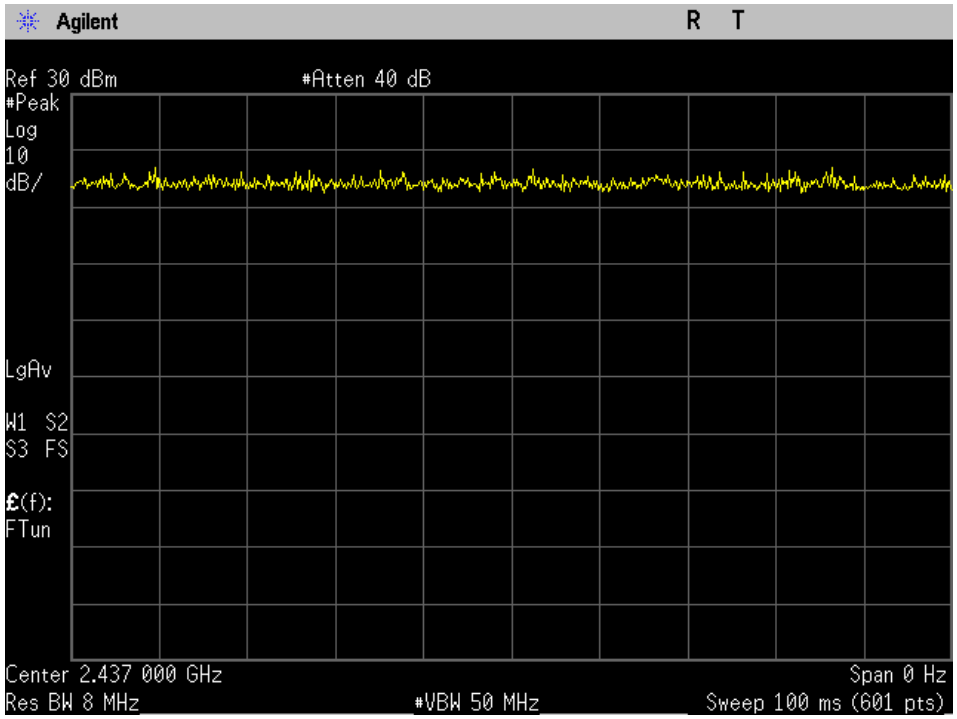
802.11g mode



802.11n20



802.11n40



2.4 Equipment Modification

None

2.5 Local Support Equipment

None

2.6 Remote Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6440
ABB inc.	Support Board	Bluefin pwr dino
ABB inc.	Support Board	Bluefin dino mother
Cincon Electronics Co., LTD.	POE AC Adapter	TR60A-POE-L

2.7 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
Ethernet Cable	1.5	POE	EUT
Ethernet Cable	2	Laptop	POE

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirements	Compliant
FCC §2.1091, §15.247(i) ISED RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1053, §15.35(b), §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(2) ISEDC RSS-247 §5.2 RSS-Gen §6.7	6 dB & 99% Emission Bandwidth	Compliant
FCC §15.247(b)(3) ISEDC RSS-247 §5.4	Maximum Output Power	Compliant
FCC §15.247(d) 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
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 isotopically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

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

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

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

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

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

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

4.2 Antenna Description

External/Internal/ Integral	Part Number	Antenna Type	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
External	SF-245	Omni-Directional	2400-2500	7.4

Note: Device uses unique SMA UFL ports on board by which the antenna will be connected in order to meet 15.203
Note: antenna gain provided by customer

5 FCC §2.1091, §15.407(f) & ISEDC RSS-102 - RF Exposure

5.1 Applicable Standards

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

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

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^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

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

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

According to ISED RSS-102 Issue 5:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	**Electric Field (V/m rms)**	**Magnetic Field (A/m rms)**	**Power Density (W/m^2)**	**Reference Period (minutes)**
0.003-10[21]	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
* Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

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

Note: According to MIMOFCC KDB 662911 D02 MIMO with Cross Polarized Antenna v01, Where an FCC rule specifies limits in radiated terms such as EIRP or ERP, the limits apply to the maximum emission that would be observed by a linearly polarized measurement antenna. Therefore, the highest output power from single antenna power was selected to calculate in this section.

5.3 MPE Results

Worst Case: 802.11n40, 2437 MHz

Maximum output power at antenna input terminal (dBm):	25.56
Maximum output power at antenna input terminal (mW):	359.75
Prediction distance (cm):	25
Prediction frequency (MHz):	2437
Maximum Directional Antenna Gain, typical (dBi):	10.4
Maximum Antenna Gain (numeric):	10.96
Power density of prediction frequency at 25.0 cm (mW/cm^2):	0.502
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement FCC MPE limit for uncontrolled exposure. The maximum power density at the distance of 25cm is 0.502 mW/cm^2. Limit is 1.0 mW/cm^2.

5.4 RF exposure evaluation for IC

Worst Case: 802.11n40, 2437 MHz

Maximum output power at antenna input terminal (dBm):	25.56
Maximum output power at antenna input terminal (W):	0.35975
Prediction distance (m):	0.25
Prediction frequency (MHz):	2437
Maximum Directional Antenna Gain, typical (dBi):	10.4
Maximum Antenna Gain (numeric):	10.96
Power density of prediction frequency at 0.25m (W/m^2):	5.02
IC MPE limit for uncontrolled exposure at prediction frequency (W/m^2):	5.66

The device is compliant with the requirement IC MPE limit for uncontrolled exposure. The maximum power density at the distance of 0.25m is 5.02W/m^2. Limit is 5.66 W/m^2.

Note: Maximum Antenna Gain used is based on Combined Antenna Gain calculation for MIMO transmitting usage (i.e. Combined Antenna Gain(dBi) = Single Antenna Gain(dBi) + 10*log(Number of Antennas)). In this case the Combined Antenna Gain is 10.4 dBi = 7.4 dBi +10*log(2).

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 §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 ISED 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 & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Correction Factor (CF) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + CF$$

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Correction Factor (13.7 dB)

The Correction Factor is calculated by adding Cable loss (CL) and attenuation of the impulse limiter and the high pass filter. The basic equation is as follows:

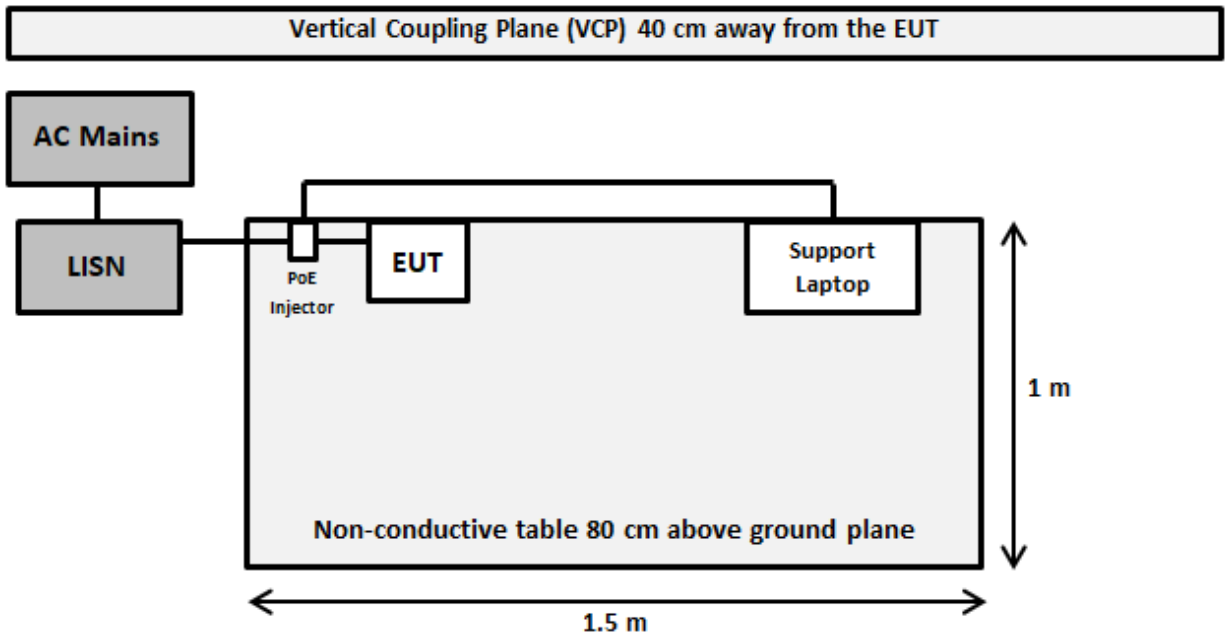
$$CF= CL + Attenuator$$

For example, a corrected amplitude of 13.7 dB = Cable Loss (3.7 dB) + Attenuation (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
124	Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2023-06-16	1 year
681	Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101962	2023-07-12	6 months
726	Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2023-07-24	6 months
732	FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2023-09-12	1 year
1226	Fairview Microwave	Micro-Coax Cable	FMC0101223-240	210241	2023-06-28	6 months

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:	18.3 to 18.7ºC
Relative Humidity:	62.1 to 62.3%
ATM Pressure:	102.6 kPa

The testing was performed by Steven Lianto on 2023-12-04 in the 5 meter chamber 3.

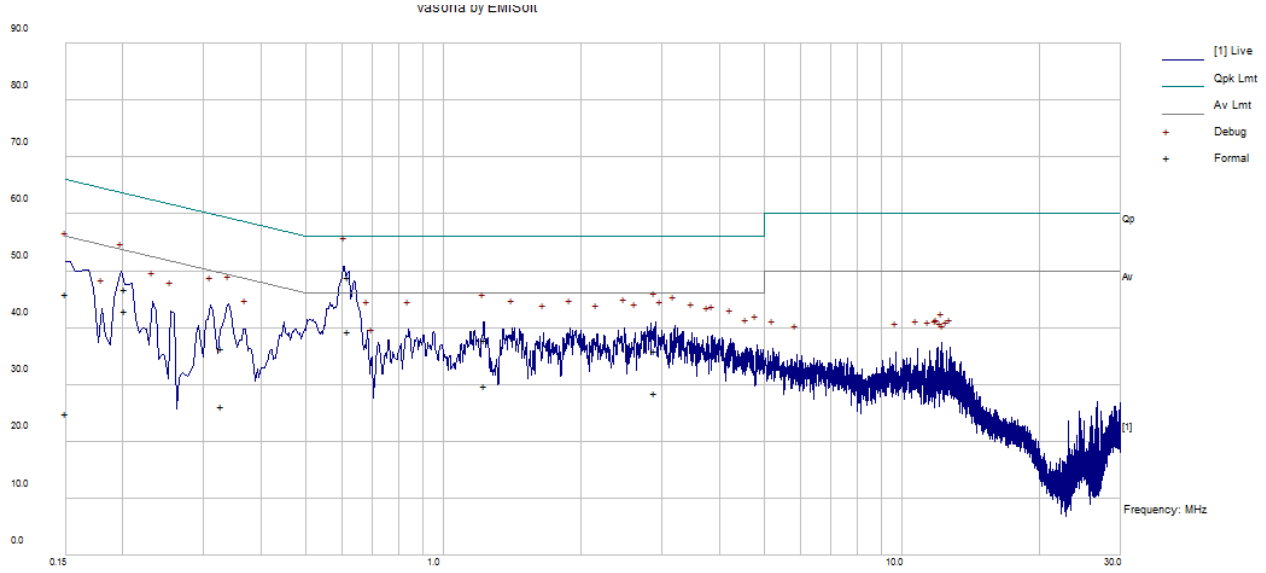
6.8 Summary of Test Results

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 Case – AC Line (via PoE Injector): 120V, 60Hz			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Hot/Neutral)**	**Range (MHz)**
-6.61	0.620081	Hot	0.15 to 30

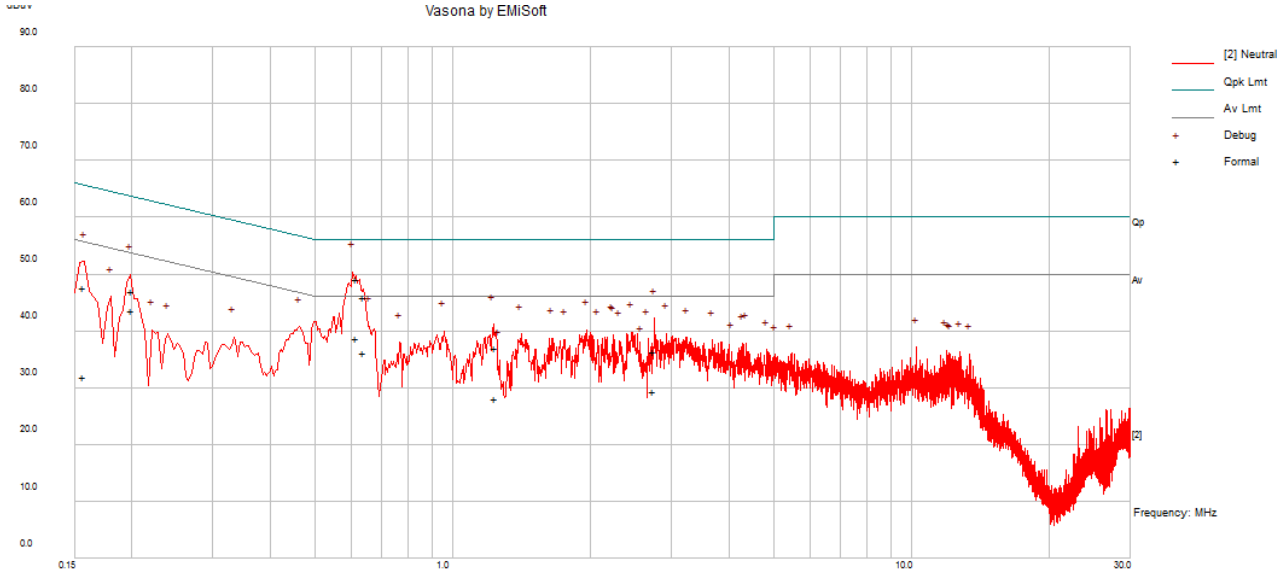
6.9 Conducted Emissions Test Plots and Data

AC Line (via PoE Injector): 120V, 60Hz – Hot Conductor



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.620081	38.74	10.24	48.99	56	-7.01	QP
0.202254	36.15	10.71	46.86	63.52	-16.65	QP
0.15009	35.19	10.8	45.99	65.99	-20.01	QP
2.885464	25.8	10.05	35.85	56	-20.15	QP
1.229707	27.8	10.12	37.93	56	-18.07	QP
0.328013	25.9	10.53	36.43	59.5	-23.08	QP
0.620081	29.15	10.24	39.39	46	-6.61	Ave
0.202254	32.29	10.71	43	53.52	-10.51	Ave
0.15009	14.12	10.8	24.92	55.99	-31.08	Ave
2.885464	18.5	10.05	28.55	46	-17.45	Ave
1.229707	19.72	10.12	29.84	46	-16.16	Ave
0.328013	15.6	10.53	26.13	49.5	-23.38	Ave

AC Line (via PoE Injector): 120V, 60Hz – Neutral Conductor



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.616349	38.97	10.24	49.22	56	-6.78	QP
0.156743	36.77	10.78	47.55	65.63	-18.08	QP
0.200274	36.34	10.72	47.06	63.6	-16.54	QP
2.733954	26.39	10.05	36.45	56	-19.55	QP
1.239216	26.8	10.12	36.92	56	-19.08	QP
0.63961	35.77	10.23	46	56	-10	QP
0.616349	28.54	10.24	38.78	46	-7.22	Ave
0.156743	21.05	10.78	31.84	55.63	-23.8	Ave
0.200274	32.9	10.72	43.61	53.6	-9.99	Ave
2.733954	19.38	10.05	29.44	46	-16.56	Ave
1.239216	17.93	10.12	28.05	46	-17.95	Ave
0.63961	25.99	10.23	36.23	46	-9.77	Ave

7 FCC §15.35(b), §15.205, §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10- Spurious Radiated Emissions

7.1 Applicable Standards

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

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

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

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

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

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

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

As per ISED RSS-Gen 8.9,

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

Table 5 – General Field Strength limits at frequencies above 30 MHz

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

Table 6 – General Field Strength limits at frequencies below 30 MHz

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

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

As per ISED RSS-Gen 8.10(c),

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

Table 7 – Restricted frequency bands[Note 1]

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

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

As per ISED RSS-247 §5.5,

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

7.2 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.

7.3 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

7.4 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

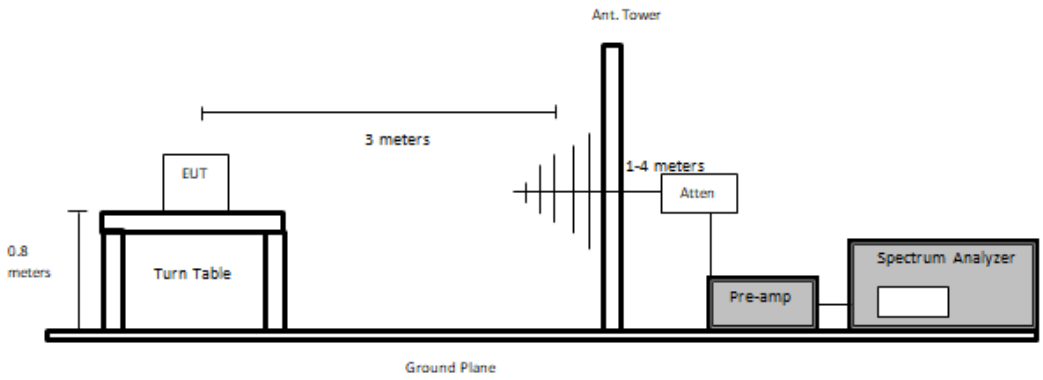
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

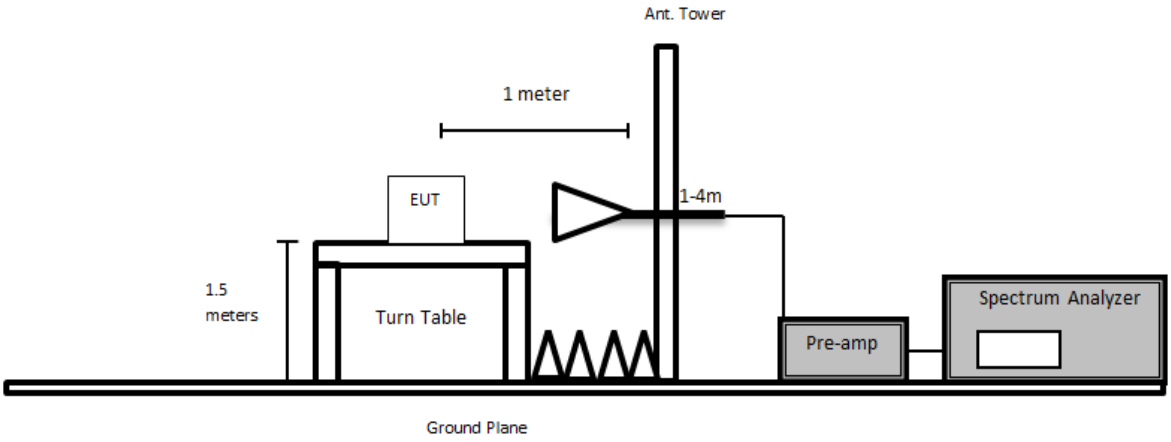
7.5 Test Setup Block Diagram

Below 1GHz:

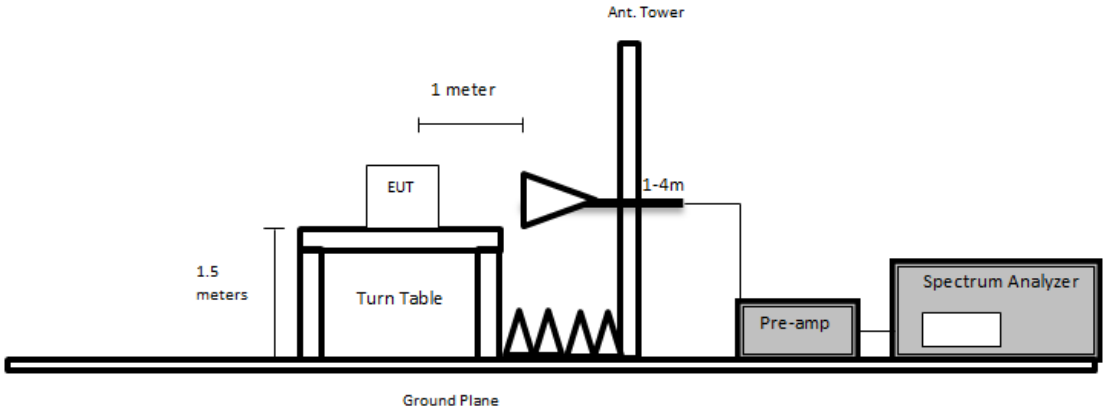


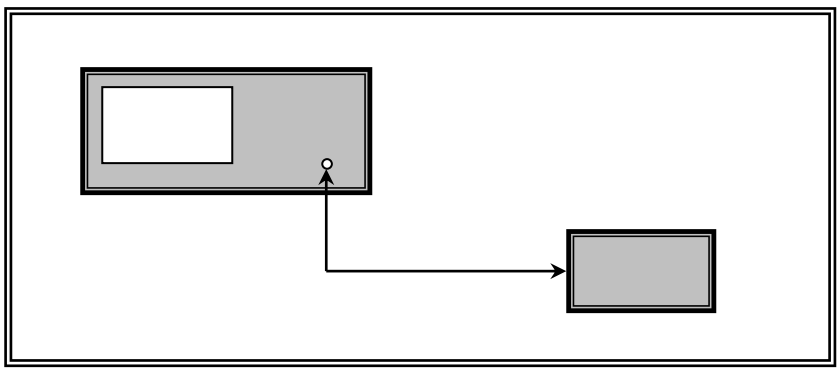
Above 1GHz:

At 1 meter:
Using Asset #1192



Using Asset #91





7.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
310	Rhode & Schwarz	EMI Test Receiver	ESCI 1166.5950.03	100338	2023-05-11	1 year
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2023-05-12	1 year
-	Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
91	Wisewave	Horn Antenna	ARH-4223-02	10555-02	2022-03-08	2 years
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2021-11-22	2 years
1192	ETS Lindgren	Horn Antenna	3117	00218973	2023-09-29	2 years
316	Sonoma Instruments	Pre Amplifier	317	260406	2023-09-26	6 months
658	Agilent	Pre Amplifier	8449B OPT HO2	3008A01103	2023-06-13	6 months
827	AH Systems	Pre Amplifier	PAM 1840 VH	170	2023-05-17	1 year
1186	Pasternack	Coaxial Cable, RG214	PE3062-1050CM	N/A	2023-10-03	6 months
1248	Pasternack	RG214 COAX Cable	PE3062	N/A	2023-10-04	6 months
1249	Time Microwave	LMR-400 Cable DC-3GHz	AE13684	2k80612-5 6fts	2023-10-09	6 months
1295	Carlisle	10m Ultra Low Loss Coaxial Cable	UFB142A-1-3937-200200	64639890912-001	2023-10-31	6 months
1329	Pasternack	2.92mm short coaxial cable	PE360-12	N/A	2023-06-09	6 months
1346	RFMW	2.92mm 10ft RF cable	KMSE-160SAW-240.0-KSME	N/A	2023-11-03	6 months
1245	-	6dB Attenuator	PE7390-6	01182018A	2021-11-22	2 years
-	-	20dB Attenuator	-	-	Each Time[1]	Each Time[1]
1246	HEWLET PACKARD	RF Limiter	11867A	01734	2023-04-13	1 year
1331	Micro-Tronics	Notch Filter	BRM50716	G262	2022-12-20	1 year

Note[1]: 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".*

7.7 Test Environmental Conditions

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

The testing was performed by Will Hu from 2023-11-07 to 2023-11-13 in 5m chamber 3.

7.8 Summary of Test Results

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

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Configuration**
-0.14	52.587	V	802.11n40. 2452 MHz

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

7.9 Radiated Emissions Test Results

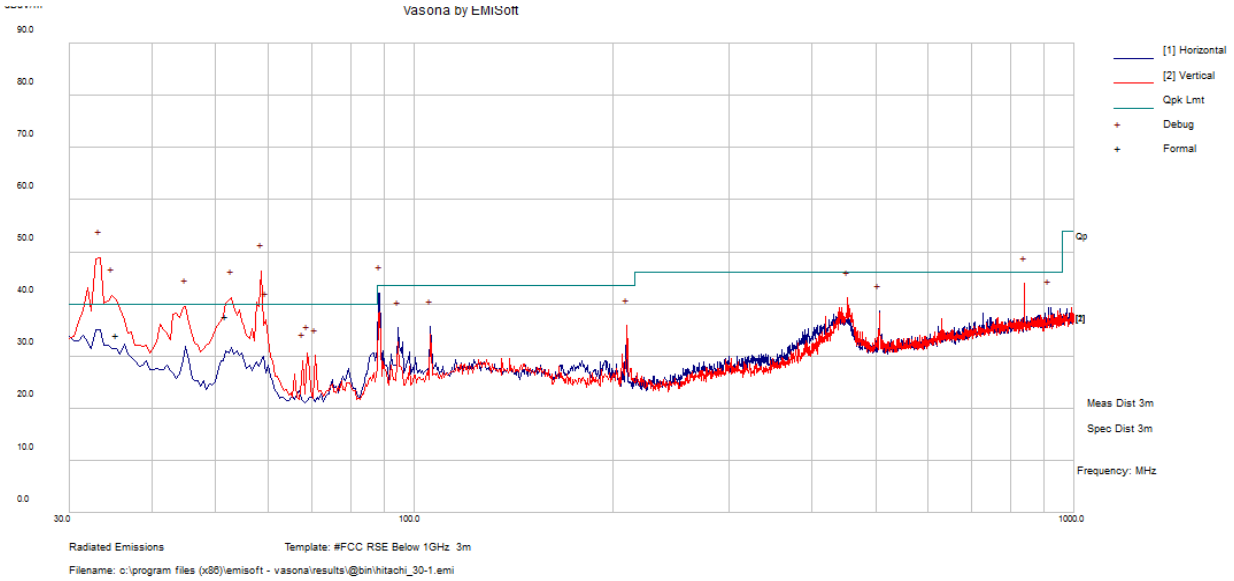
Note: Lowest Frequency emitted by the EUT is greater than 30MHz, thus spurious emission below 30MHz are not needed.
Note: Worst-case modes were chosen based on the highest power measured per modulation family.
Note: Below test data are the radiated cabinet emissions (with the exception of 30MHz-1GHz), for conducted in-lieu of radiated measurements performed at the antenna port please refer to ANNEX E *and* ANNEX D.

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

Note[1]: *All peaks exceeding the limit line in the graph fall out of restricted bands and thus 30dBc limit(FCC 15.247(d)/RSS-247 5.5) was instead applied. Fundamental measured (116.55dBuV/m @3m) – 30dB = 86. 55dBuV/m @3m)*
Note: *Prescans were performed on all shown configs in order to determine worst-case results. Following this, a formal scan was performed on the worst-case detailed below*

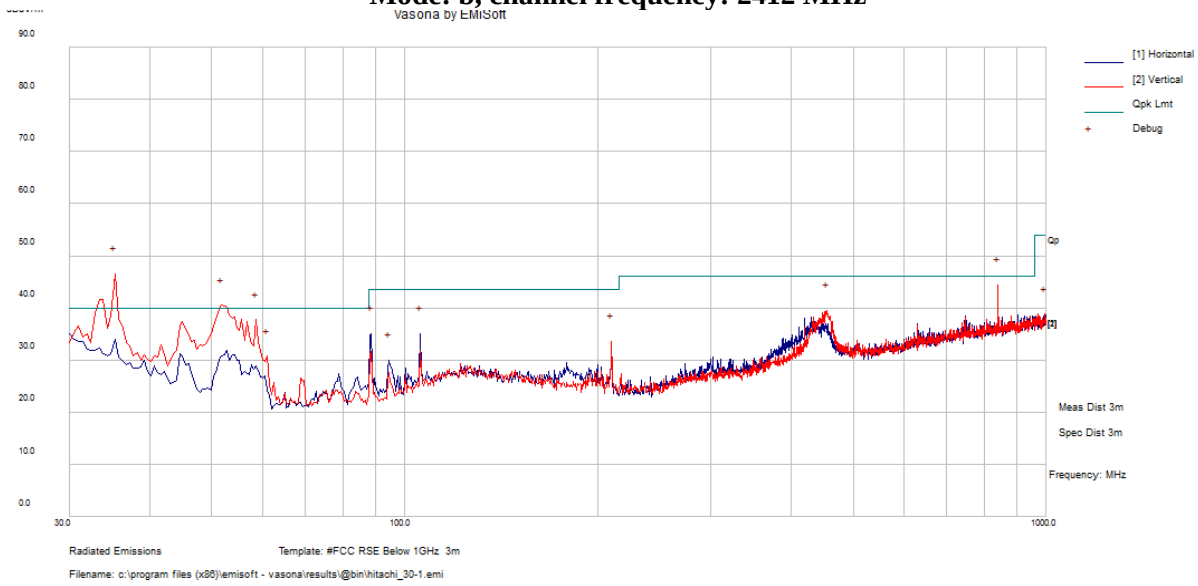
Worst case: 30MHz-1GHz is Mode: n40, channel frequency: 2452 MHz

Mode: n40, channel frequency: 2452 MHz

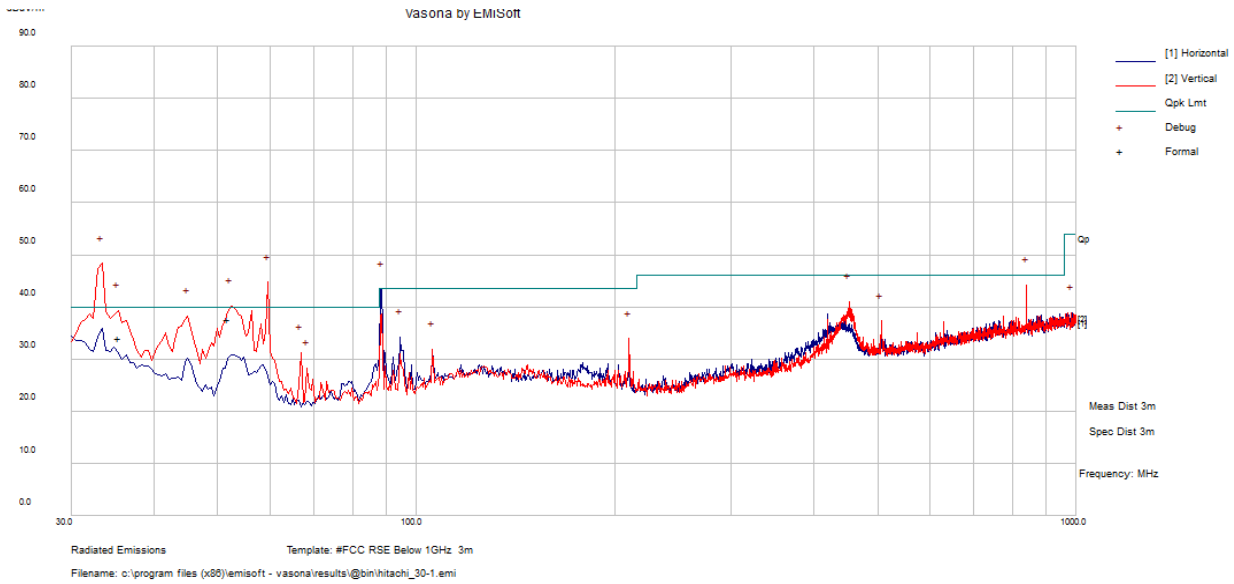


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dBµ V/m)	Margin (dB)	Comment
33.18875	54.22	-3.07	51.15	V	117	344	86.55	-35.4	Pass[1]
58.749	47.09	-13.72	33.36	V	109	52	40	-6.64	Pass
34.65475	37.4	-4.12	33.27	V	176	184	40	-6.73	Pass
52.58775	53.24	-13.38	39.86	V	136	184	40	-0.14	Pass
45.25825	54.58	-10.87	43.71	V	104	71	86.55	-42.84	Pass[1]
88.51	51.42	-12.98	38.44	H	197	286	43.5	-5.06	Pass

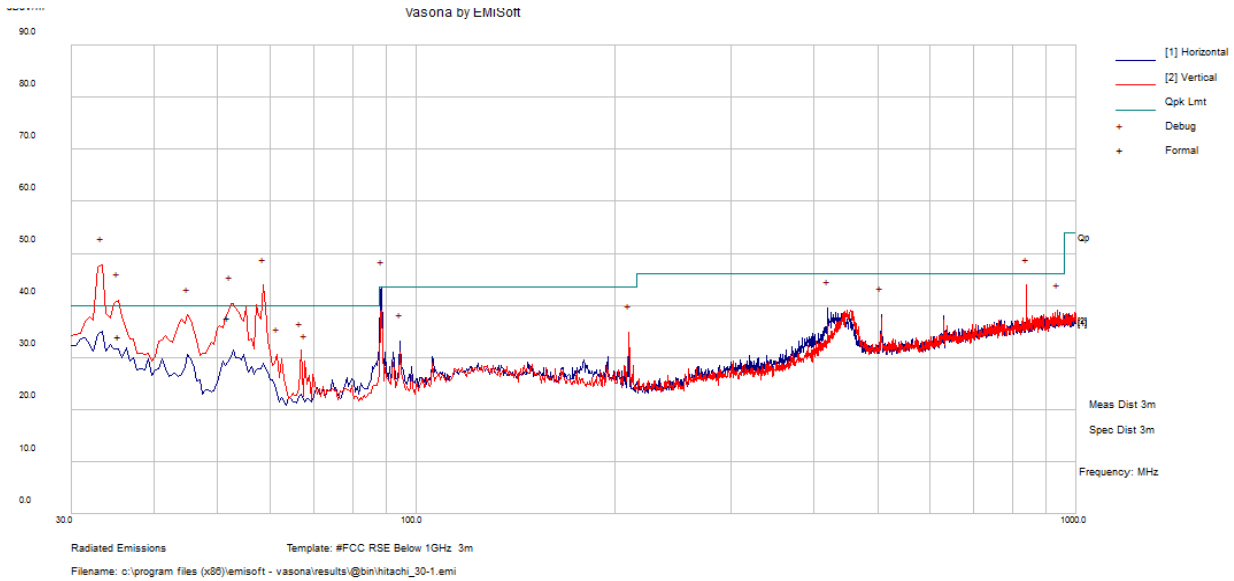
Mode: b, channel frequency: 2412 MHz



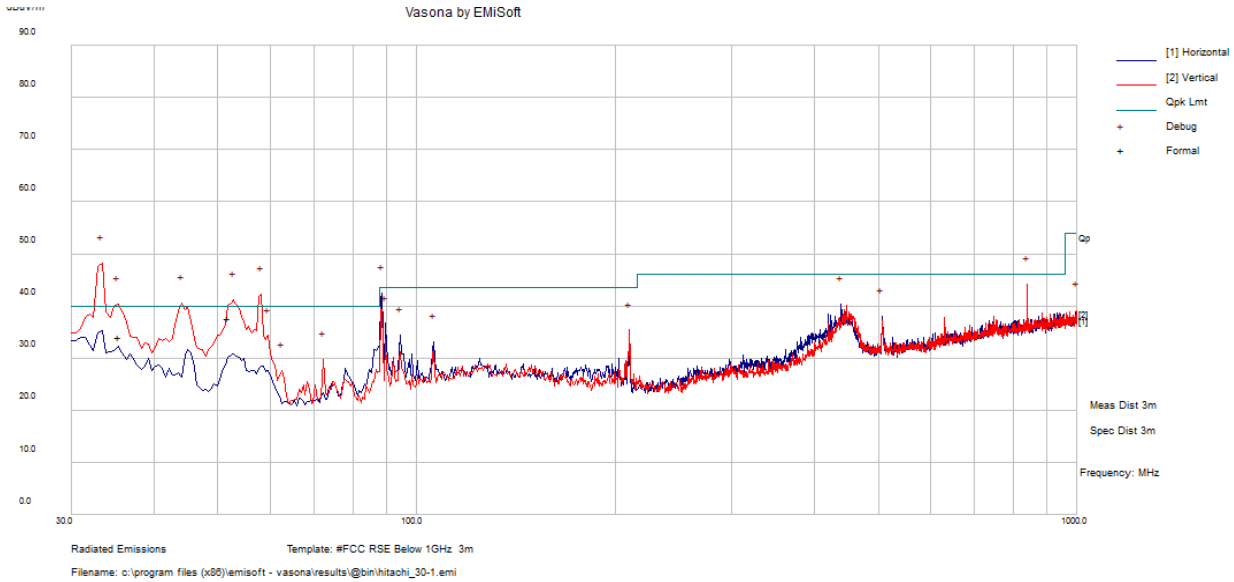
Mode: b, channel frequency: 2437 MHz



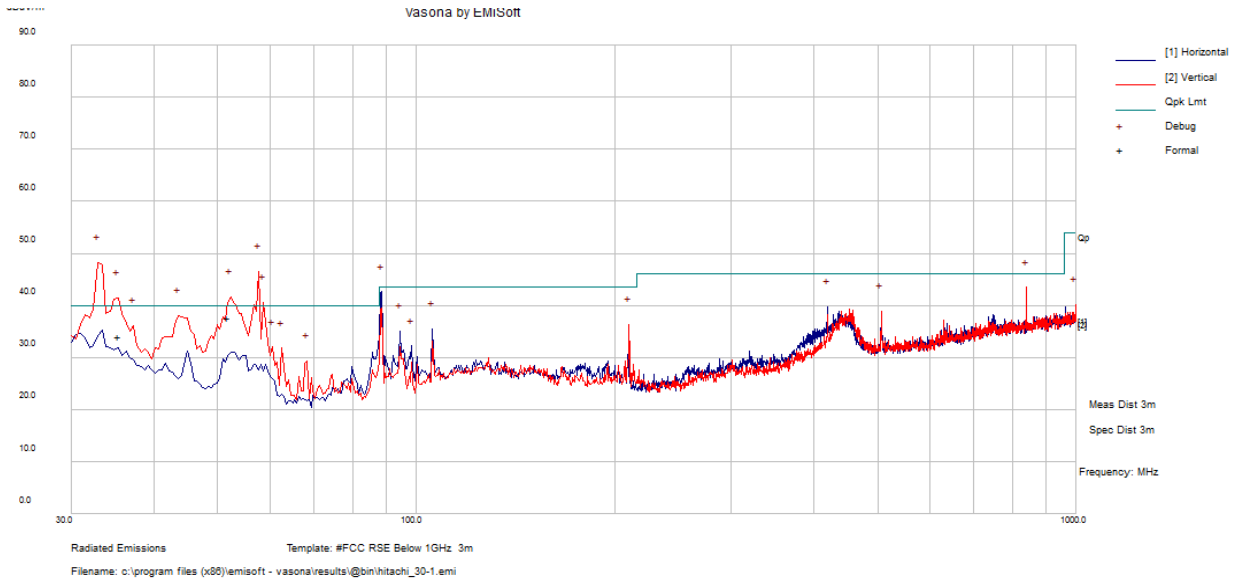
Mode: b, channel frequency: 2462 MHz



Mode: n40, channel frequency: 2422 MHz

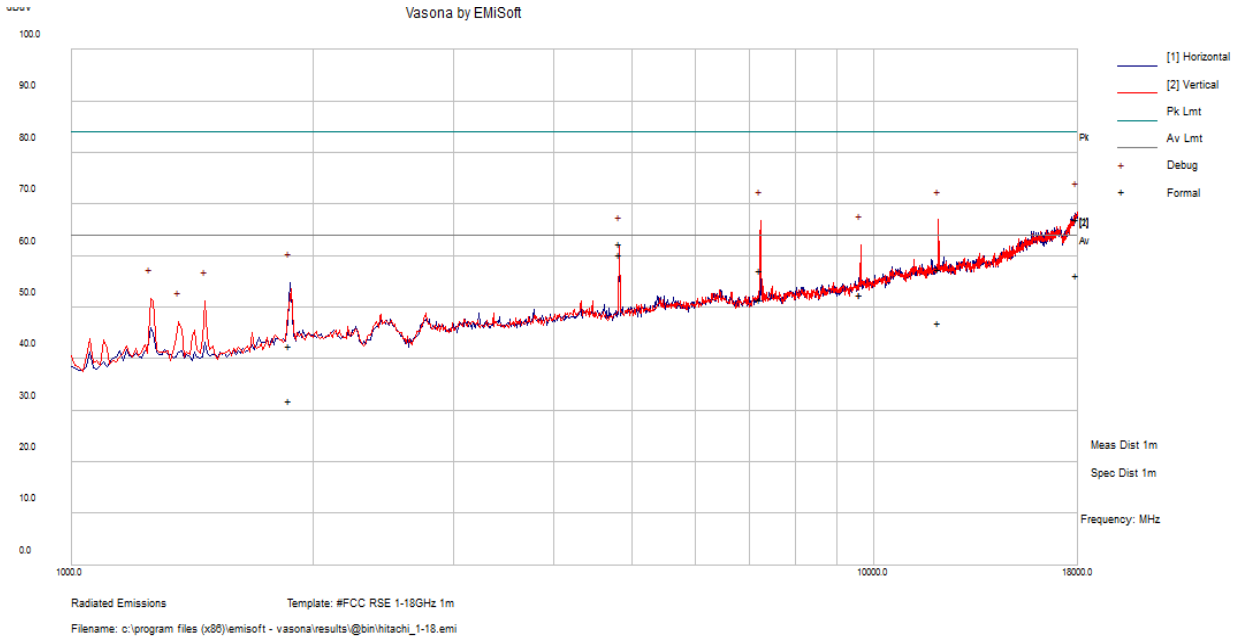


Mode: n40, channel frequency: 2437 MHz

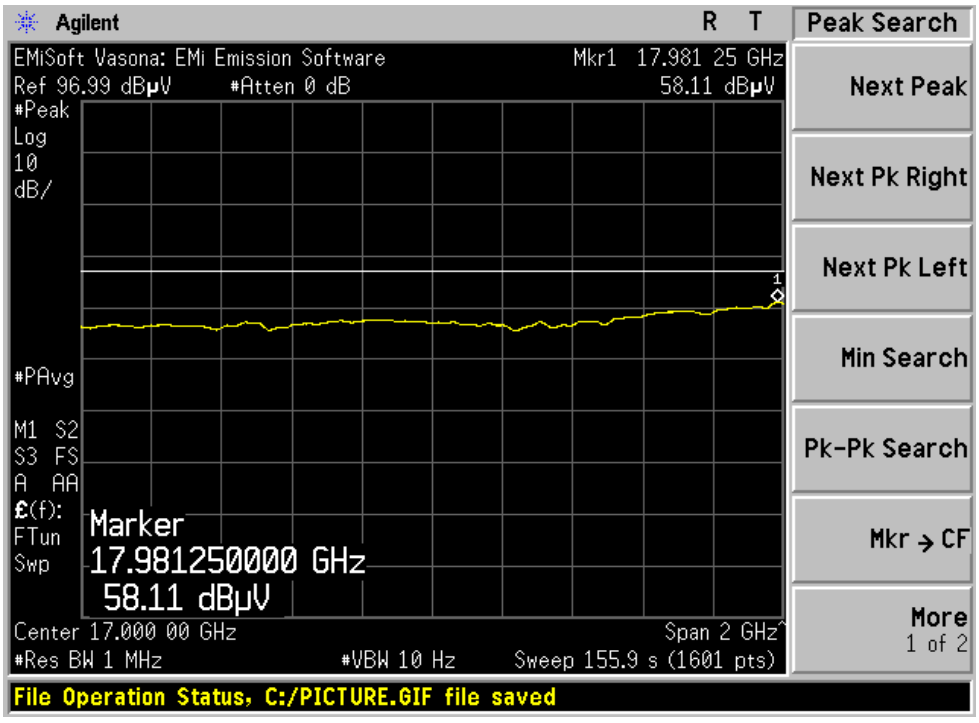


2) 1 – 18 GHz, Measured at 1 meter

Mode: b, channel frequency: 2412 MHz

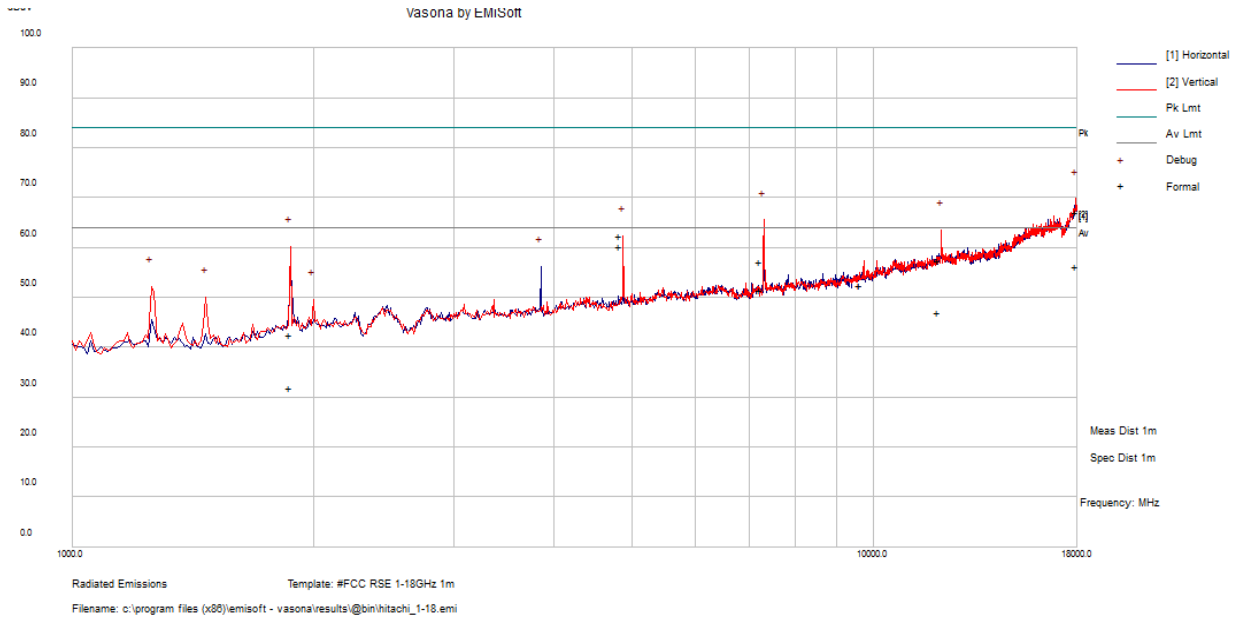


Average plot from 16GHz- 18GHz

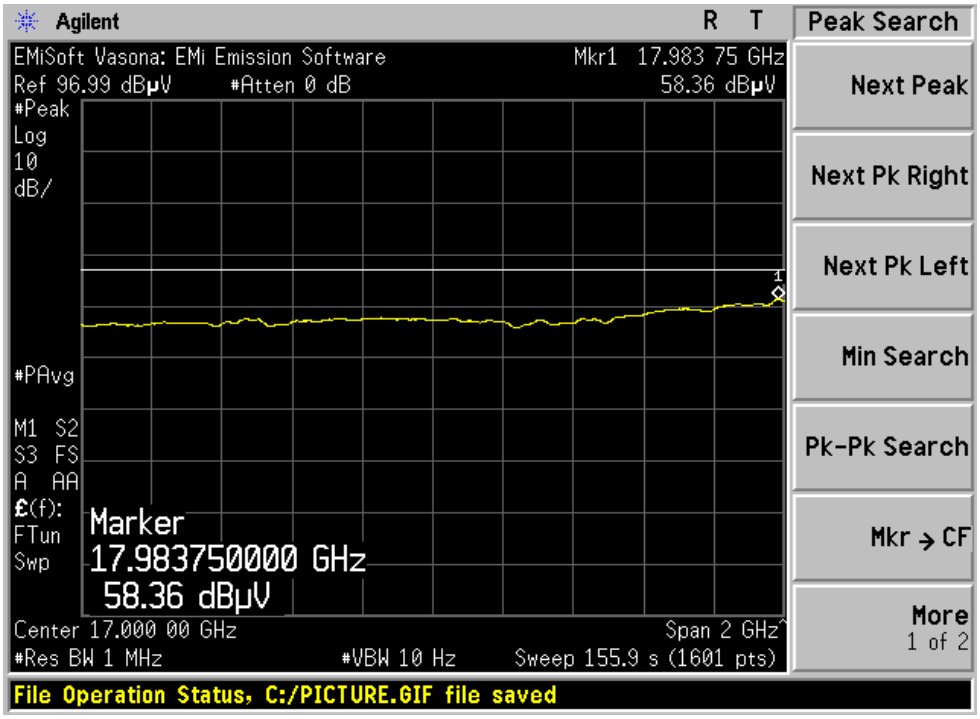


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
12059.63	45.57	11.84	57.41	V	245	7	83.54	-26.13	Peak/Pass
7238.143	50.62	6.51	57.13	V	159	134	83.54	-26.41	Peak/Pass
12059.63	35.13	11.84	46.98	V	245	7	63.54	-16.56	Avg/Pass
7238.143	45.1	6.51	51.62	V	159	134	63.54	-11.92	Avg/Pass

Mode: b, channel frequency: 2437 MHz

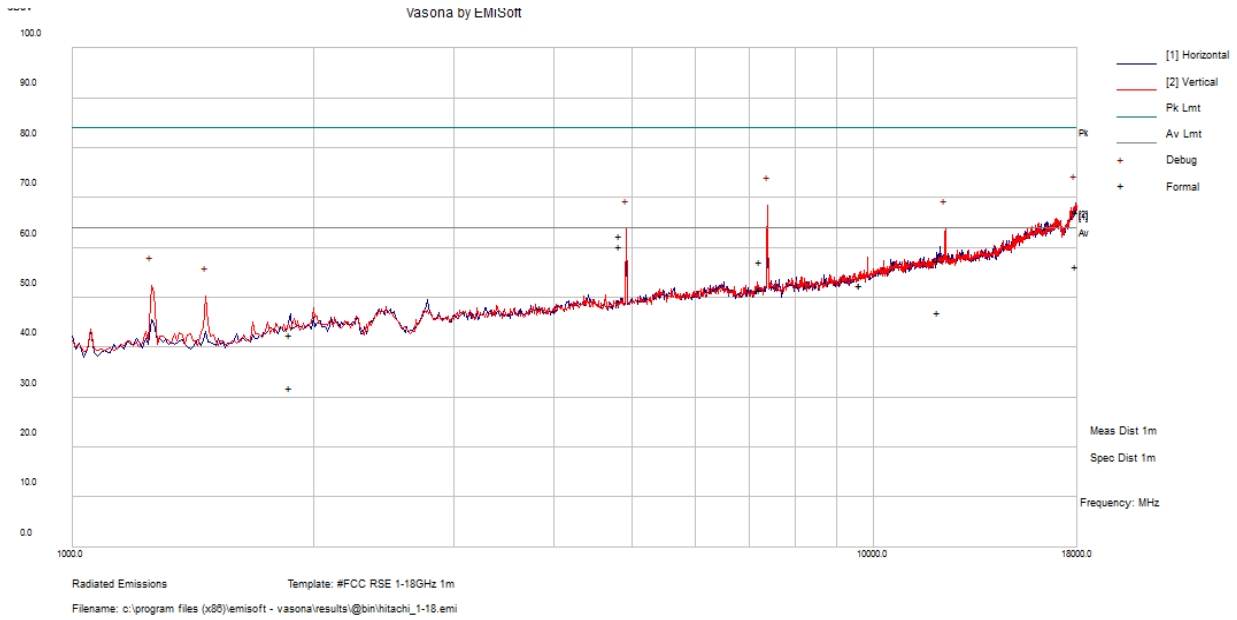


Average plot from 16GHz- 18GHz

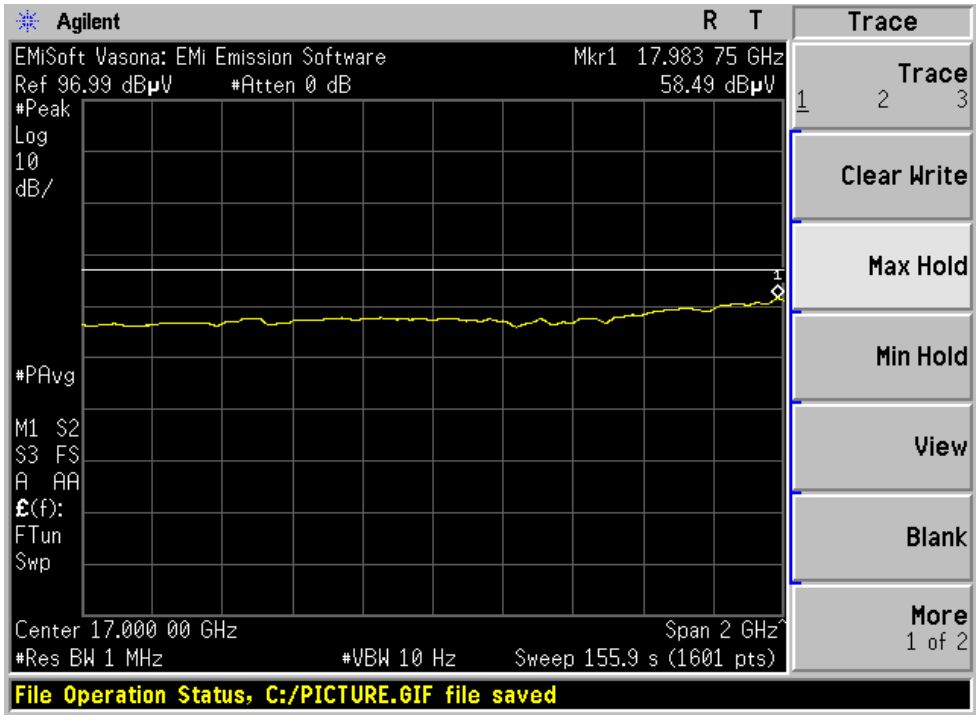


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
7312.498	66.69	6.74	73.43	V	208	277	83.54	-10.11	Peak/Pass
7312.498	52.53	6.74	59.27	V	208	277	63.54	-4.27	Avg/Pass

Mode: b, channel frequency: 2462 MHz

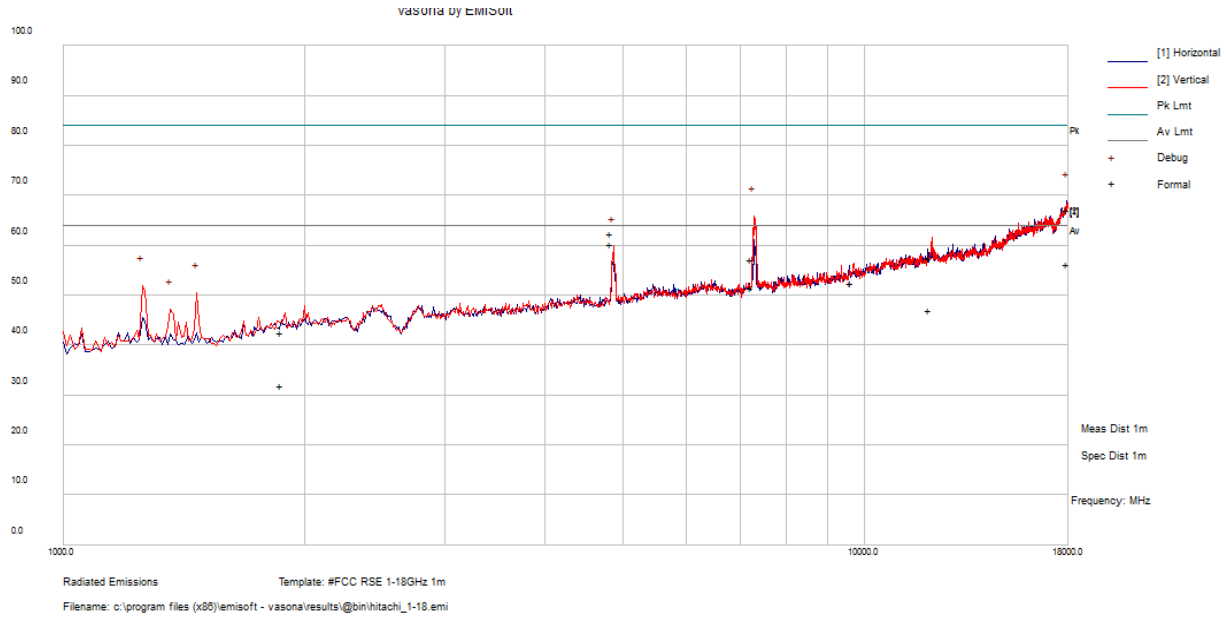


Average plot from 16GHz- 18GHz

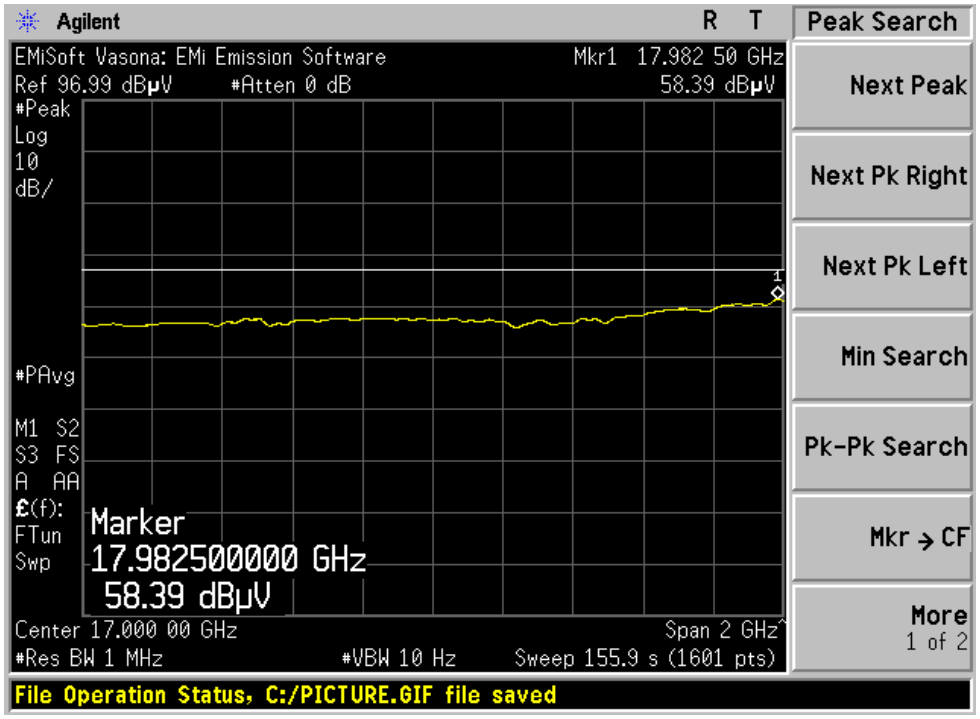


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
7385.293	58.9	6.74	65.64	V	245	57	83.54	-17.9	Peak/ Pass
7385.293	46.07	6.74	52.82	V	245	57	63.54	-10.72	Avg/ Pass

Mode: n40, channel frequency: 2422 MHz

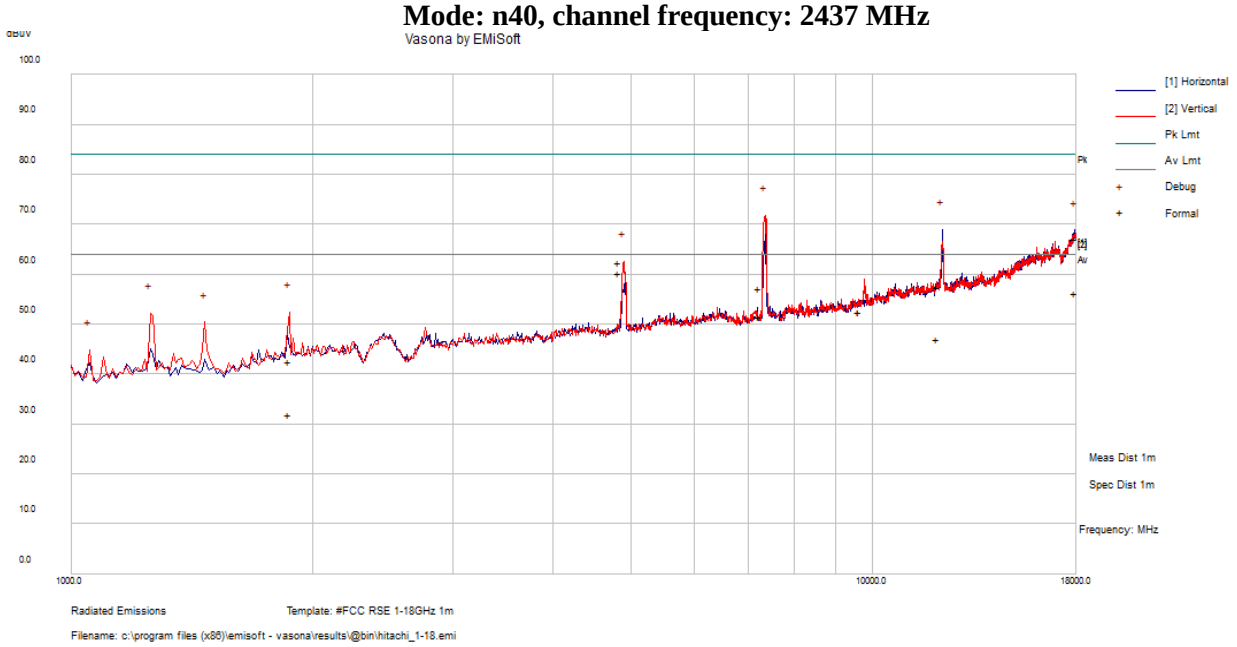


Average plot from 16GHz- 18GHz

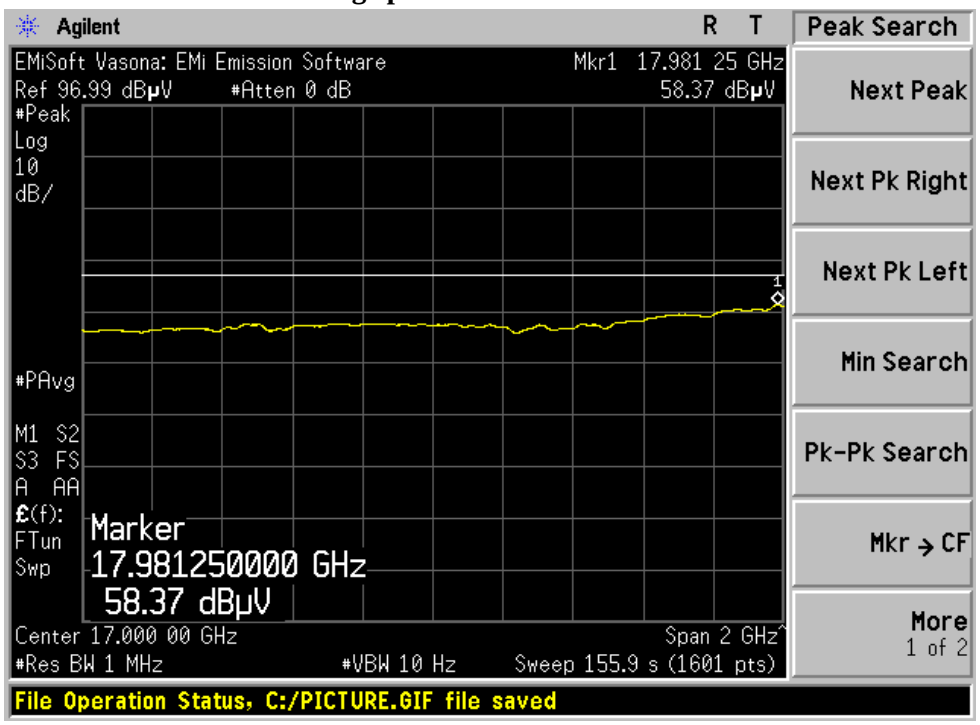


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
7279.375	49.65	6.64	56.28	H	216	258	83.54	-27.26	Peak/Pass
7279.375	37.05	6.64	43.69	H	216	258	63.54	-19.85	Avg /Pass

Mode: n40, channel frequency: 2437 MHz

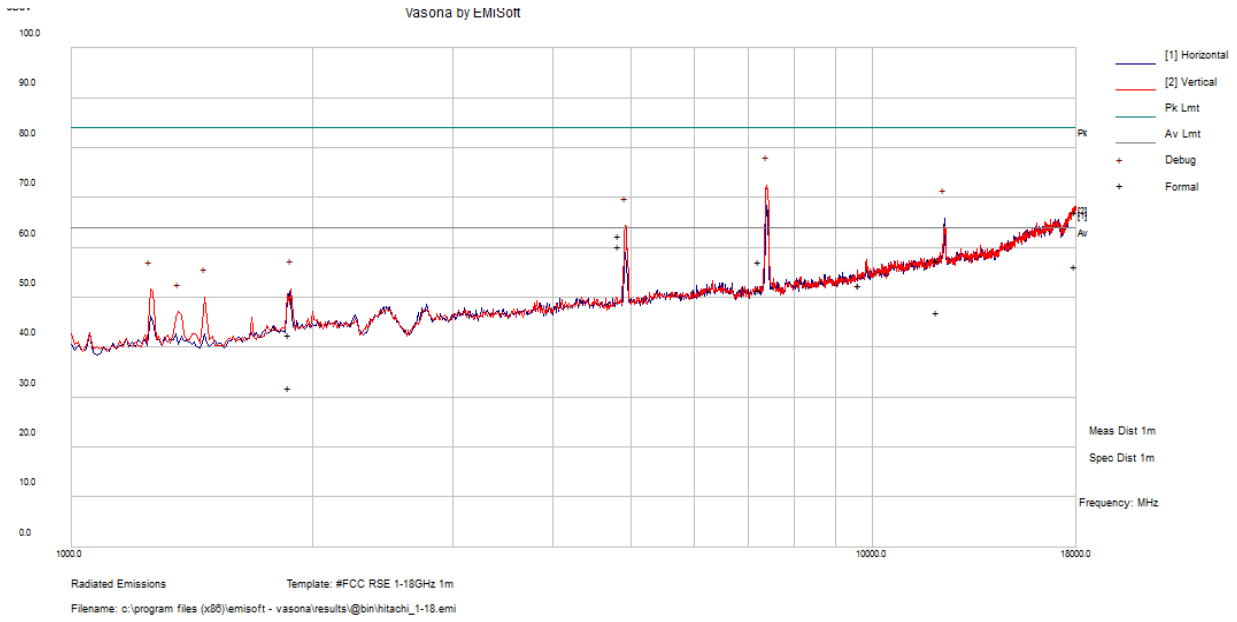


Average plot from 16GHz- 18GHz

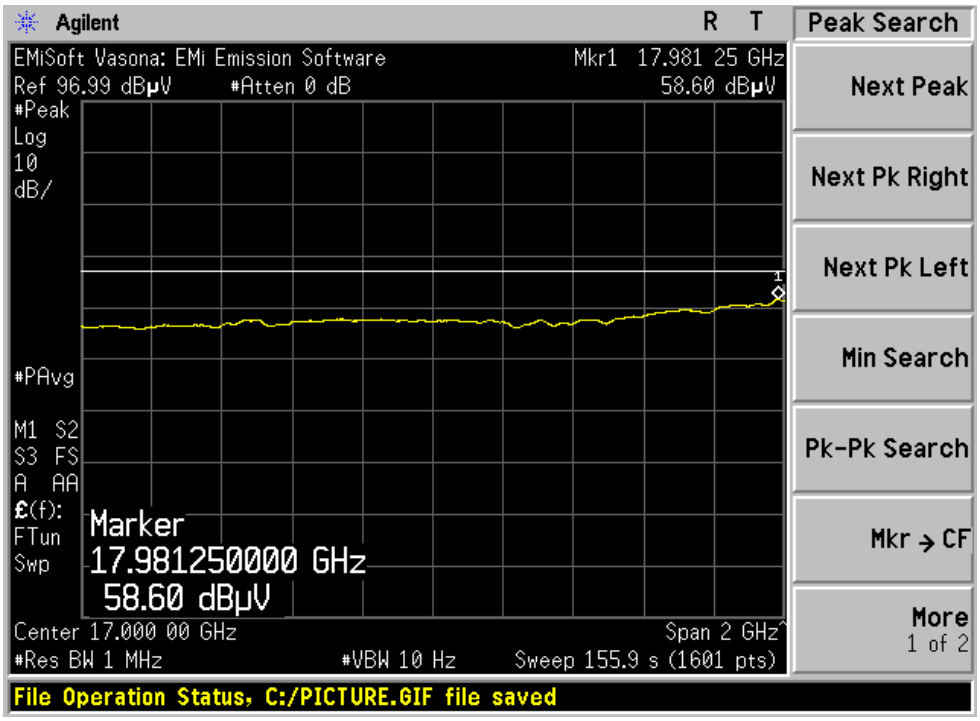


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
7351.443	67.11	6.81	73.92	V	204	248	83.54	-9.62	Peak/Pass
12239.52	53.36	12.04	65.4	V	220	279	83.54	-18.14	Peak/Pass
7351.443	50.09	6.81	56.9	V	204	248	63.54	-6.64	Avg /Pass
12239.52	40.08	12.04	52.12	V	220	279	63.54	-11.42	Avg /Pass

Mode: n40, channel frequency: 2452 MHz



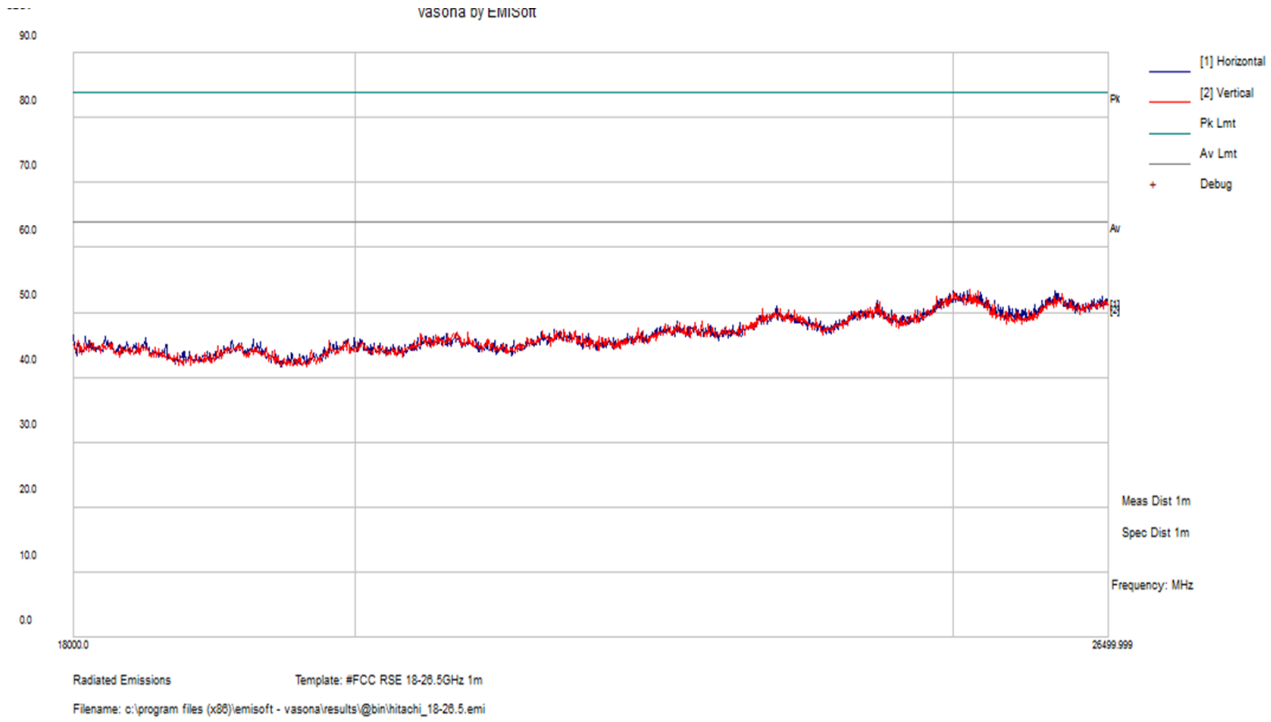
Average plot from 16GHz- 18GHz



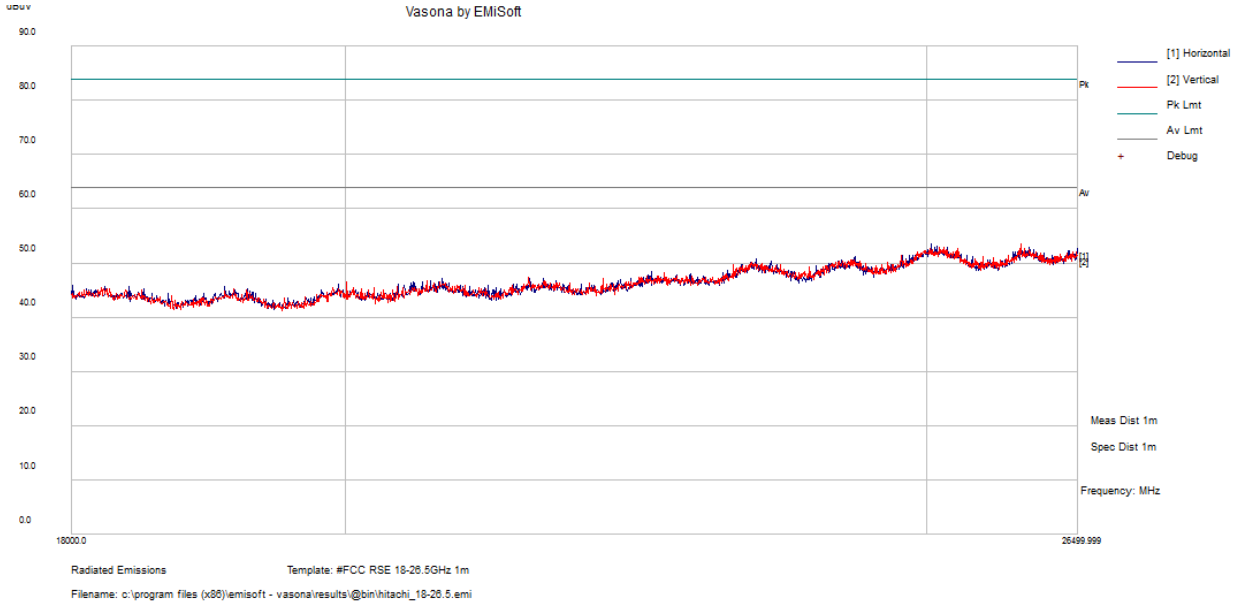
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Ant. Polarity (H/V)	Ant. Height (cm)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Detector (Peak /Avg.)
7384.775	68.41	6.74	75.15	V	204	257	83.54	-8.39	Peak/Pass
12313.64	53.3	11.95	65.25	H	213	205	83.54	-18.29	Peak/Pass
4919.575	53.68	3.12	56.79	V	142	185	83.54	-26.75	Peak/Pass
7384.775	54.23	6.74	60.97	V	204	257	63.54	-2.57	Avg/Pass
12313.64	39.23	11.95	51.18	H	213	205	63.54	-12.36	Avg/Pass
4919.575	41.7	3.12	44.82	V	142	185	63.54	-18.72	Avg/Pass

3) 18 - 26.5 GHz, Measured at 1 meter

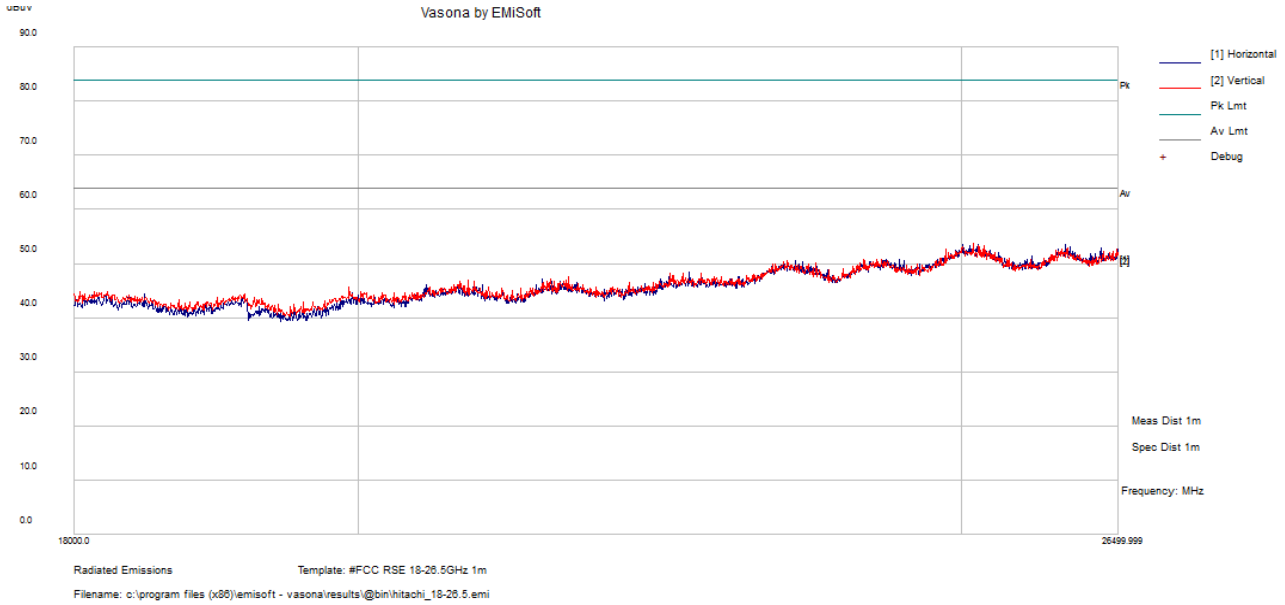
Mode: b, channel frequency: 2412 MHz



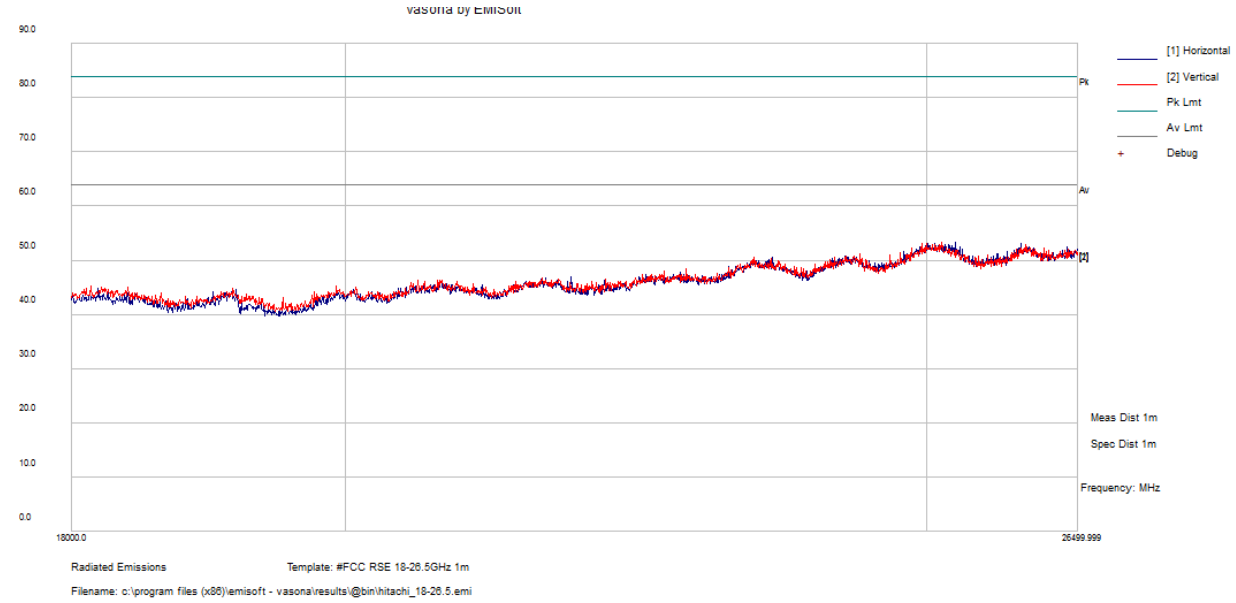
Mode: b, channel frequency: 2437 MHz



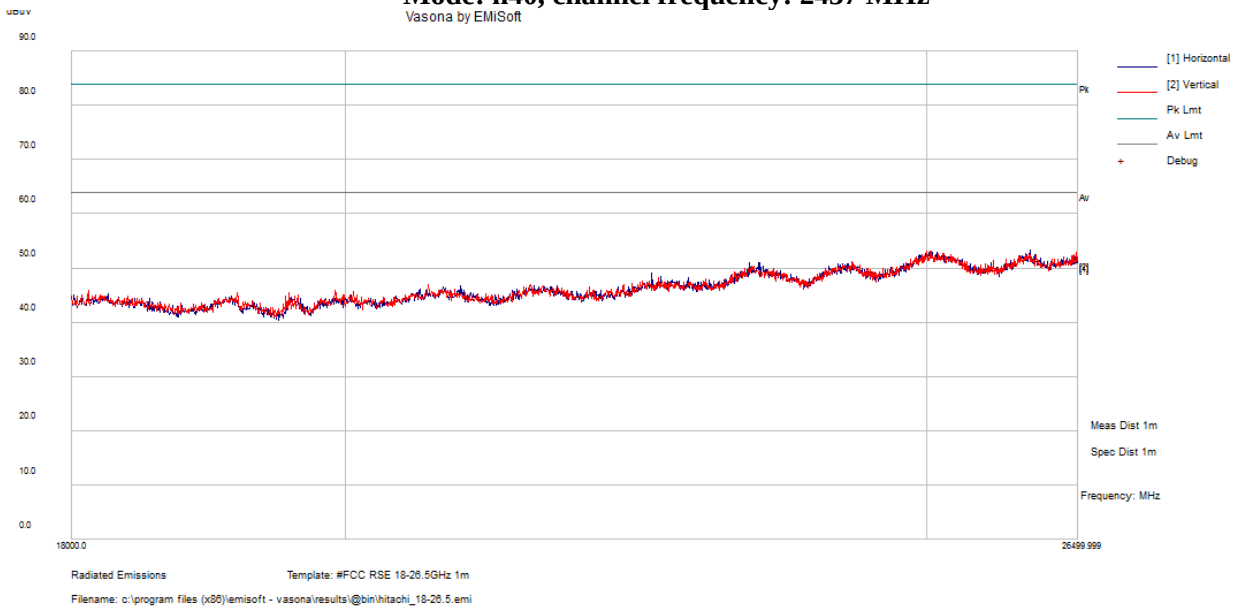
Mode: b, channel frequency: 2462 MHz



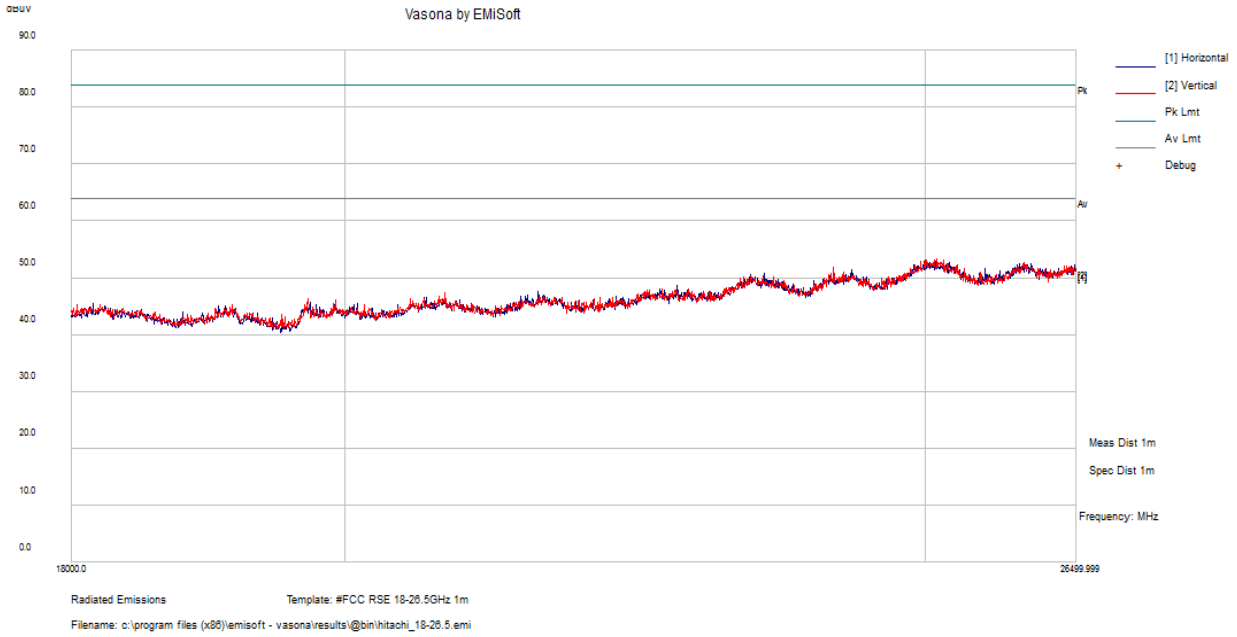
Mode: n40, channel frequency: 2422 MHz



Mode: n40, channel frequency: 2437 MHz



Mode: n40, channel frequency: 2452 MHz



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.

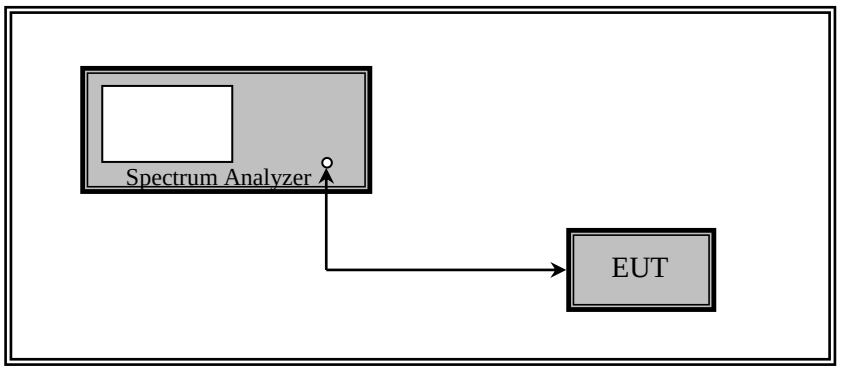
Option 1:

a. Set RBW = 100 kHz.
b. Set the VBW $\geqslant$ [3 $\times$ 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 $\geqslant$ 3 $\times$ 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 $\geqslant$6 dB.

8.3 Test Setup Block Diagram



8.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
00424	Agilent	Spectrum Analyzer	E4440A	US45303156	2022-12-19	12 Months

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:	20.9°C
Relative Humidity:	33%
ATM Pressure:	101.7 kPa

The testing was performed by Michael Papa from 2023-11-06 to 2023-11-29 in RF Bench.

8.6 Test Results

Channel	Frequency (MHz)	6 dB OBW (MHz)		99% OBW (MHz)		6 dB OBW Limit (kHz)	Result
		Antenna A	Antenna B	Antenna A	Antenna B		
802.11b							
Low	2412	10.08	10.20	14.17	13.99	≥ 500	Pass
Middle	2437	10.16	10.12	13.90	13.86	≥ 500	Pass
High	2462	9.91	10.17	13.87	13.82	≥ 500	Pass
802.11g							
Low	2412	16.49	16.42	17.42	17.42	≥ 500	Pass
Middle	2437	16.46	16.40	17.49	17.42	≥ 500	Pass
High	2462	16.21	16.23	17.36	17.43	≥ 500	Pass
802.11n20							
Low	2412	17.62	17.67	18.56	18.69	≥ 500	Pass
Middle	2437	17.57	16.42	18.67	17.94	≥ 500	Pass
High	2462	16.44	16.72	18.41	18.37	≥ 500	Pass
802.11n40							
Low	2422	36.46	36.43	38.19	38.56	≥ 500	Pass
Middle	2437	36.01	36.37	38.49	38.28	≥ 500	Pass
High	2452	36.00	36.05	37.06	37.71	≥ 500	Pass

Note: See Annex A for 6dB OBW and 99OBW test results.

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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).

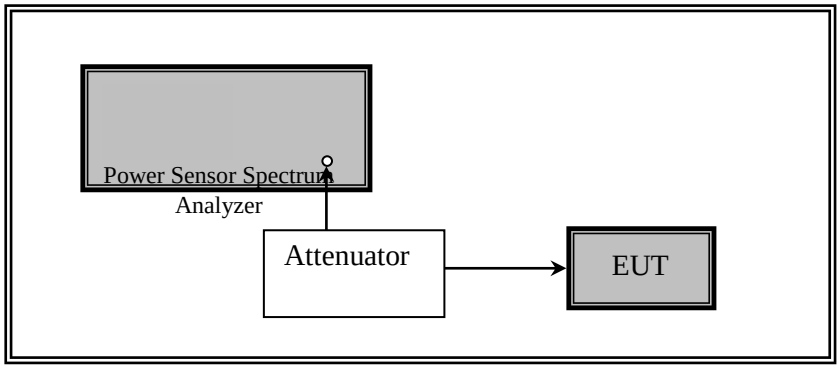
9.2 Measurement Procedure

The measurements are based on ANSI C63.10-2013, Section 11.9.2.2.2.

11.9.2.3 Method AVGPM

Method AVGPM is a measurement using an RF average power meter, as follows: a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied: 1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle. 2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level. 3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five. b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal as described in 11.6. c) Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter. d) Adjust the measurement in dBm by adding [10 log (1 / D)], where D is the duty cycle.

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
00697	ETS-LINDGREN	Power Sensor	7002-006	160097	2023-02-20	12 Months
-	-	20dB Attenuator	-	-	Each Time[1]	Each Time[1]

Note[1]: 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:	20.9°C
Relative Humidity:	33%
ATM Pressure:	101.7 kPa

The testing was performed by Michael Papa from 2023-11-06 to 2023-11-29 in RF Bench.

9.6 Test Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)			Output Power Limit (dBm)	Result
		Antenna A	Antenna B	Total		
802.11b Configuration						
Low	2412	25.5	25.22	-	28.6	Pass
Middle	2437	24.47	24.2	-	28.6	Pass
High	2462	22	21.32	-	28.6	Pass
802.11g Configuration						
Low	2412	21.95	21.25	-	28.6	Pass
Middle	2437	25.5	25.49	-	28.6	Pass
High	2462	25.38	24.85	-	28.6	Pass
802.11n20 Configuration						
Low	2412	20.47	20.06	23.28	25.6	Pass
Middle	2437	22.26	22	25.14	25.6	Pass
High	2462	21.66	21.37	24.53	25.6	Pass
802.11n40 Configuration						
Low	2422	20.23	19.89	23.07	25.6	Pass
Middle	2437	22.73	22.37	25.56	25.6	Pass
High	2452	22.66	22.33	25.51	25.6	Pass

Note: Duty Cycle correction factor has already been added to the measurement.
Note: The antenna gains greater than 6dBi are taken into consideration for the Limit.

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

10.1 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).

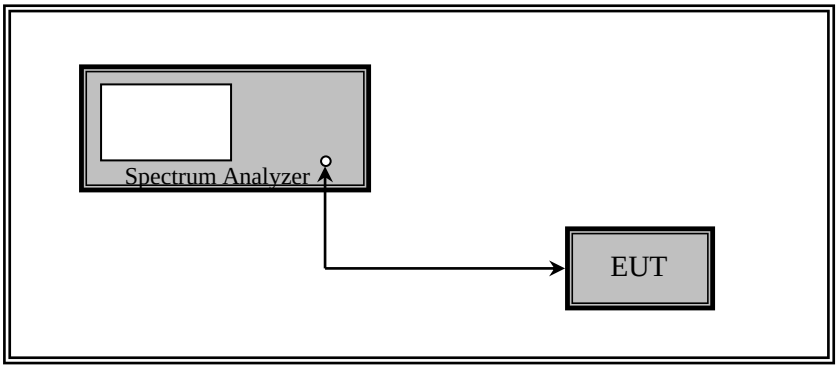
According to ISEDC RSS-247 §5.5.In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the 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.

10.2 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

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
00424	Agilent	Spectrum Analyzer	E4440A	US45303156	2022-12-19	12 Months

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:	20.9°C
Relative Humidity:	33%
ATM Pressure:	101.7 kPa

The testing was performed by Michael Papa from 2023-11-06 to 2023-11-29 in RF Bench.

10.6 Test Results

Please refer to Annex C for detailed test results.

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

11.1 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.

11.2 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.

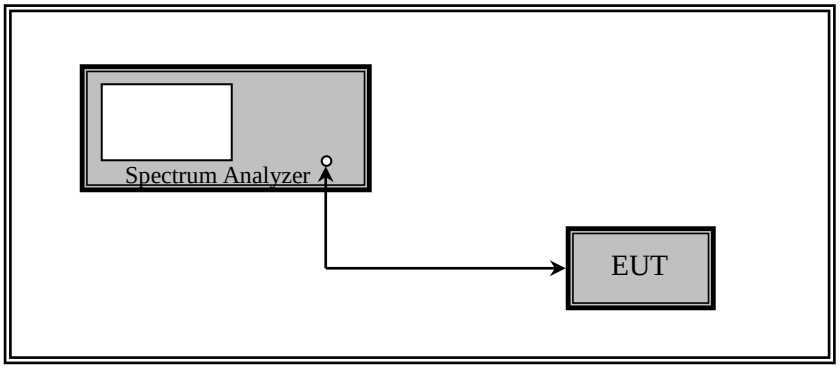
As per ANSI C63.10 Clause 11.10: Maximum power spectral density level in the fundamental emission.

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.

11.3 Test Setup Block Diagram



11.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
00424	Agilent	Spectrum Analyzer	E4440A	US45303156	2022-12-19	12 Months

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

11.5 Test Environmental Conditions

Temperature:	20.9°C
Relative Humidity:	33%
ATM Pressure:	101.7 kPa

The testing was performed by Michael Papa from 2023-11-06 to 2023-11-29 in RF Bench.

11.6 Test Results

Channel	Frequency (MHz)	PSD (dBm/10kHz)			Limit (dBm/3kHz)
		Antenna A	Antenna B	Total	
802.11b					
Low	2412	6.46	1.56	-	6.6
Middle	2437	6.35	5.40	-	6.6
High	2462	2.04	0.43	-	6.6
802.11g					
Low	2412	1.60	0.42	-	6.6
Middle	2437	4.89	6.57	-	6.6
High	2462	4.69	3.94	-	6.6
802.11n20					
Low	2412	-0.40	-0.70	2.46	3.6
Middle	2437	-0.49	-1.49	2.05	3.6
High	2462	-2.75	-3.21	1.85	3.6
802.11n40					
Low	2412	-1.24	-2.53	1.17	3.6
Middle	2437	1.33	-1.46	3.17	3.6
High	2462	-1.29	-1.15	1.79	3.6

Note: The antenna gains greater than 6dBi are taken into consideration for the Limit.
Note: The RBW was set to 10 kHz, and adjusted to 3 kHz to evaluate higher values that are closer to the limit
Note: See Annex B for Power Spectrum Density test results.

12 Appendix A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

13 Appendix B (Normative) – External Photographs

Please refer to the attachment.

14 Appendix C (Normative) – Internal Photographs

Please refer to the attachment.

15 Appendix D (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIACE 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 ---