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

TEST REPORT

For

Roost, Inc.

1250 Borregas Ave., Sunnyvale, CA 94089, USA

FCC ID: 2AE5A-SRZEUS2
IC: 20891-SRZEUS2

Report Type:	**Product Type:**
Original Report	Smart Base

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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2106094-247	Original Report	2021-07-30

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1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report was prepared on behalf of *Roost, Inc.* and their product model: *RSB-320, FCC ID: 2AE5A-SRZEUS2; IC: 20891-SRZEUS2* or the "EUT" as referred to in this report. It is a 900 MHz Radio Hub (Roost Smart Base). Collocated with Cellular Radio (*FCC ID: XMR2020BG95M2, IC: 10224A-2020BG95M2)* and 2.4 GHz Wi-Fi Radio (*FCC ID: 2ADHKATWINC1500, IC: 20266-WINC1500)* in the EUT.

1.2 Mechanical Description of EUT

The EUT measures approximately 14 cm (Φ), 4.5 cm (H) and weigh around 300g.

The test data gathered are from typical production samples, serial number: 21610112700060, 21610112700064 and 21610112700066

1.3 Objective

This report was prepared on behalf of *Roost, 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 Output Power, Antenna Requirements, 20 dB Bandwidth, 100 kHz Bandwidth of Band Edges Measurement, Conducted and Radiated Spurious Emissions, Number of Hopping Channels, Dwell Time, and Hopping Channel Separation.

1.4 Related Submittal(s)/Grant(s)

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.

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.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 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 17025:2005 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 17025:2005 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: (Industry Canada - IC) 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/EC US-EU EMC & Telecom MRA CAB
  - Radio & Teleterminal Equipment (R&TTE) Directive 1995/5/EC US -EU EMC & Telecom MRA CAB

  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 Development Authority - IDA) 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;

Vietnam: APEC Tel MRA -Phase I

2 System Test Configuration

2.1 Justification

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

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

2.2 EUT Exercise Software

The 900 MHz radio configurations were pre-configured in the testing firmware on the EUT. No special software was used. The test utility used was MCHP_WIFI-_Simple_Gui_1v6.5.1 for Wi-Fi and Tera Term for LTE; the software was verified to comply with the standard requirements being tested against.

Radio Frequency (MHz)	Power Setting
902.2	Default
915	Default
927.78	Default

2.3 Duty Cycle Correction Factor

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

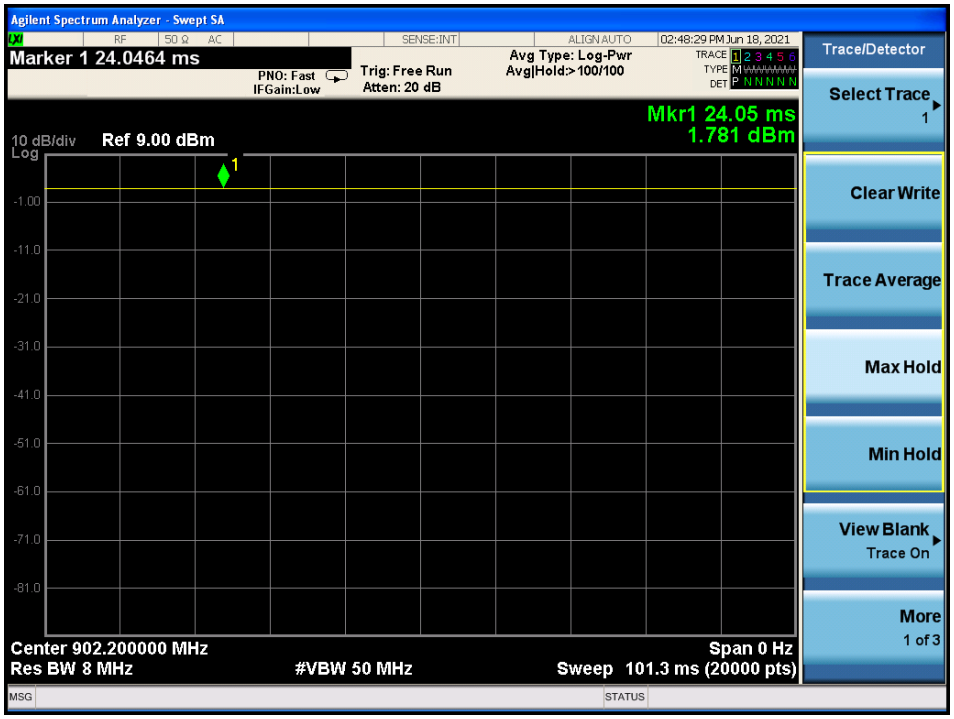
Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized 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 it's 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 frequency (MHz)	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
902.2	-	-	100	0
915	-	-	100	0
927.78	-	-	100	0

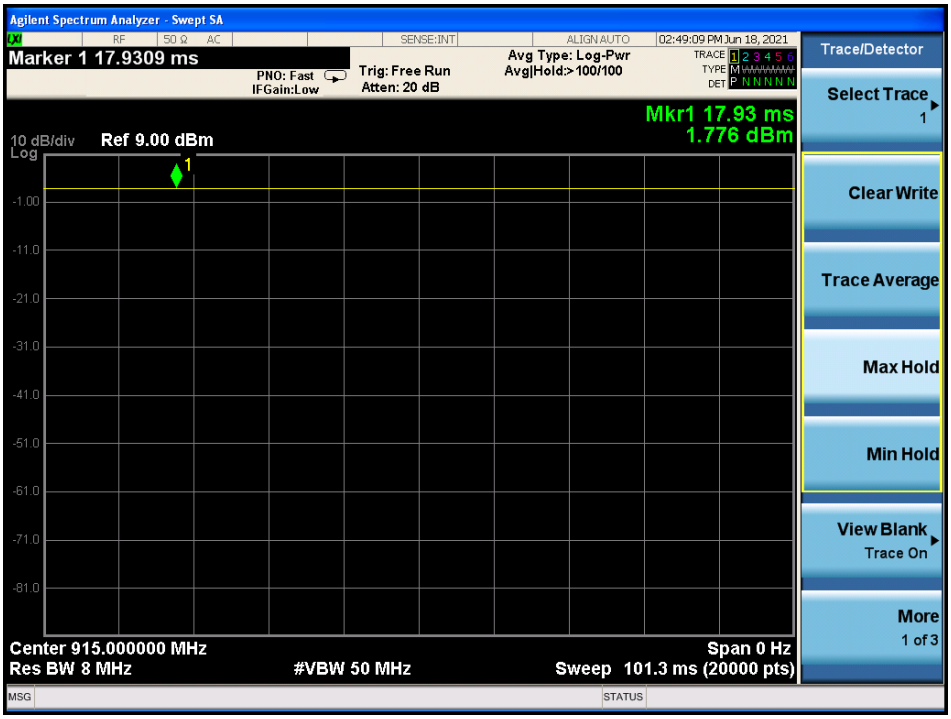
Duty Cycle = On Time (ms)/ Period (ms)
Duty Cycle Correction Factor (dB) = 10*log(1/Duty Cycle)

Please refer to the following plots.

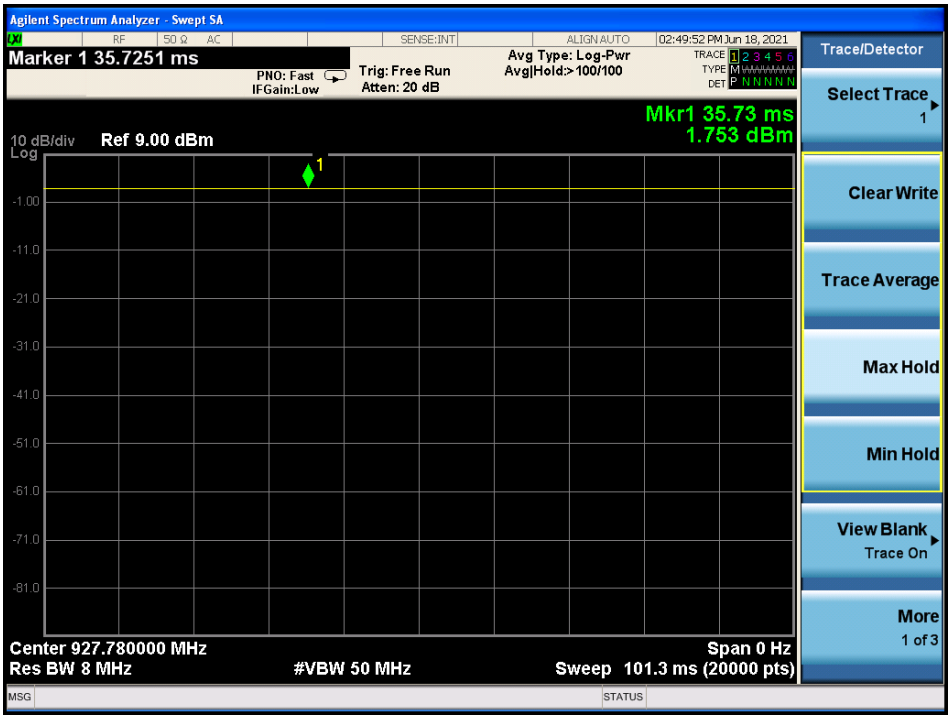
902.2 MHz



915 MHz



927.78 MHz


Agilent Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
02:49:52 PM Jun 18, 2021
Marker 1 35.7251 ms
PNO: Fast
IFGain:Low
Trig: Free Run
Atten: 20 dB
Avg Type: Log-Pwr
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P N N N N N
Mkr1 35.73 ms
1.753 dBm
10 dB/div
Log
Ref 9.00 dBm
-1.00
-11.0
-21.0
-31.0
-41.0
-51.0
-61.0
-71.0
-81.0
Center 927.780000 MHz
Res BW 8 MHz
#VBW 50 MHz
Span 0 Hz
Sweep 101.3 ms (20000 pts)
MSG
STATUS
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

2.4 Equipment Modifications

N/A

2.5 Remote Support Equipment

Manufacturer	Description	Model
Xiamen Innov Electronics Tech Co., Ltd.	Power Adapter	IVP0500-2000W
AARDVARK	Debug board	I^2C/SPI
HP	Laptop	3165NGW

2.6 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Power cable	1.5	EUT	Power Adapter
SMA Cable	< 1 m	EUT	PSA
USB Communication Cable	2.0	EUT	Laptop
USB Communication Cable	2.0	EUT -Debug Board	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 Requirement	Compliant
FCC §15.207, §15.212 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1091, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1)(i) ISEDC RSS-247 §5.1 ISEDC RSS-Gen §6.6	20 dB & 99% Emission Bandwidth	Compliant
FCC §15.247(b)(2) ISEDC RSS-247 §5.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(a)(1)(i) ISEDC RSS-247 §5.1(c)	Number of Hopping Channels	Compliant
FCC §15.247(a)(1) ISEDC RSS-247 §5.1(c)	Hopping Channel Separation	Compliant
FCC §15.247(a)(1)(i) ISEDC RSS-247 §5.1(c)	Dwell Time	Compliant

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

4.1 Applicable Standards

According to FCC §15.203:

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

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

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

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

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

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

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

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

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

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

4.2 Antenna Description

The antennas used by the EUT have unique coupling to the intentional radiator.

Antenna usage	Frequency Range (MHz)	Antenna Type	Manufacturer /Model	Maximum Antenna Gain (dBi)
902 MHz ISM Band	902-928	Chip Antenna	N/A	-5.0
2.4 GHz Wi-Fi	2400-2483.5	PCB Trace Antenna	N/A	-6.16
Cellular Radio	Band 2 1850-1910	Embedded Antenna	Taoglas/PCS.06.A	2.76
	Band 4 1710-1755			2.95
	Band 12 699-716			-1.05

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

5.1 Applicable Standards

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

Limits for General Population/Uncontrolled Exposure

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

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

According to ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

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

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

5.2 MPE Prediction

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

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

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

5.3 MPE Results for the FCC

Standalone

900 MHz (FCC ID: 2AE5A-SRZEUS2)

Maximum output power at antenna input terminal (dBm):	12.386
Maximum output power at antenna input terminal (mW):	17.322
Prediction distance (cm):	20
Prediction frequency (MHz):	927.8
Maximum Antenna Gain, typical (dBi):	-5.0
Maximum Antenna Gain (numeric):	0.316
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.001090
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.6185
MPE Ratio(numeric):	0.002

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.001090 mW/cm^2. Limit is 0.6185 mW/cm^2.

Wi-Fi Radio (FCC ID: 2ADHKATWINC1500)

Maximum output power at antenna input terminal (dBm):	23.03
Maximum output power at antenna input terminal (mW):	200.9
Prediction distance (cm):	20
Prediction frequency (MHz):	2437
Maximum Antenna Gain, typical (dBi):	-6.16
Maximum Antenna Gain (numeric):	0.242
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.010
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE Ratio(numeric):	0.010

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.02003 mW/cm^2. Limit is 1.0 mW/cm^2.

Cellular Radio (FCC ID: XMR2020BG95M2)

Band 2:

Maximum output power at antenna input terminal (dBm):	22
Maximum output power at antenna input terminal (mW):	158.49
Prediction distance (cm):	20
Prediction frequency (MHz):	1850
Maximum Antenna Gain, typical (dBi):	2.76
Maximum Antenna Gain (numeric):	1.89
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0595
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE Ratio(numeric):	0.0595

Band 4:

Maximum output power at antenna input terminal (dBm):	22
Maximum output power at antenna input terminal (mW):	158.49
Prediction distance (cm):	20
Prediction frequency (MHz):	1710
Maximum Antenna Gain, typical (dBi):	2.95
Maximum Antenna Gain (numeric):	1.97
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0622
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0
MPE Ratio(numeric):	**0.0622**

Band 12:

Maximum output power at antenna input terminal (dBm):	22
Maximum output power at antenna input terminal (mW):	158.49
Prediction distance (cm):	20
Prediction frequency (MHz):	699
Maximum Antenna Gain, typical (dBi):	-1.05
Maximum Antenna Gain (numeric):	0.79
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0248
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.466
MPE Ratio(numeric):	0.0531

Co-location

The 900 MHz radio can transmit with Wi-Fi simultaneously or with LTE cellular radio simultaneously. The combined MPE radio is 0.002 + 0.010 = 0.012 or 0.002 + 0.0622 = 0.0642 which are less than the limit of 1.0.

5.4 RF exposure evaluation exemption for IC

900 MHz (IC: 20891-SRZEUS2)

Maximum Conducted power = 12.386 dBm which is lesser than $1.31\times10^{-2}f^{0.6834}$ = 1.3706 W = 31.37 dBm

The RF exposure evaluation is exempt.

2.4 GHz Wi-Fi (IC: 20266-WINC1500PB)

Maximum Conducted power = 23.03 dBm which is lesser than $1.31\times10^{-2}f^{0.6834}$ = 2.703014 W = 34.32 dBm

The RF exposure evaluation is exempt.

Cellular Radio (IC: 10224A-2020BG95M2)

Maximum EIRP power = 22 dBm + 2.95 dBi = 24.95 dBm for LTE band 4 which is lesser than $1.31\times10^{-2}f^{0.6834}$ = 2.121782 W = 33.27 dBm

The RF exposure evaluation is exempt.

6 FCC §15.207, §15.212 & ISEDC RSS-Gen §8.8 - AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC 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, §15.212 and IC 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 EUT module was connected to a dc power supply that is 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), LISN calibration factor, and attenuation of the impulse limiter and the high pass filter. The basic equation is as follows:

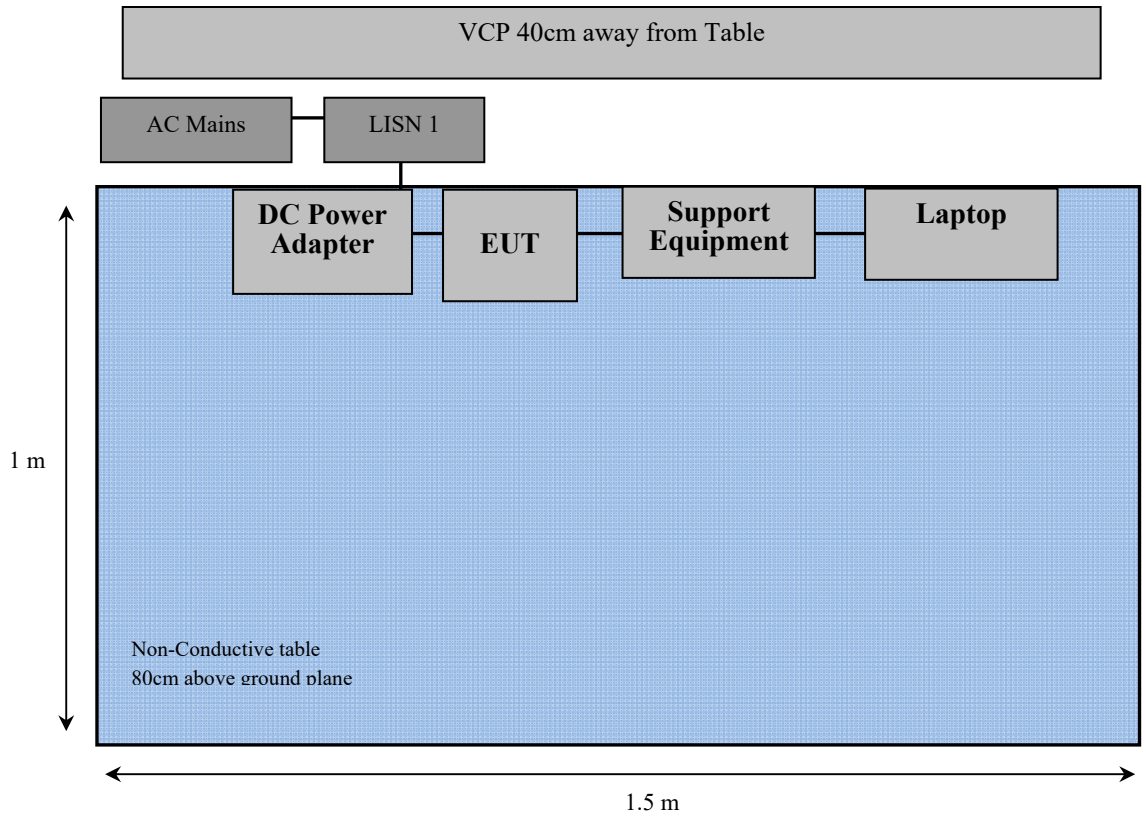
$$CF= CL + LISN\ calibration\ factor + Attenuation$$

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.5 dB) + LISN calibration factor (0.2 dB) + Attenuator (10 dB)

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

$$Margin = Corrected\ Amplitude - Limit$$

6.5 Test Setup Block Diagram



6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2020-03-17	18 months
Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101964	2021-07-07	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150203	2021-03-02	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2020-10-12	1 year
Fairview Microwave	Micro-Coax Cable	FMC0101223-240	1907181	2020-08-25	1 year
California Instruments	AC Power Source	5001ix-208	57079	Calibration not Required	Calibration not Required

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

6.7 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	44 %
ATM Pressure:	102.1 kPa

The testing was performed by Giriraj Gurjar on 2021-07-19.

6.8 Summary of Test Results

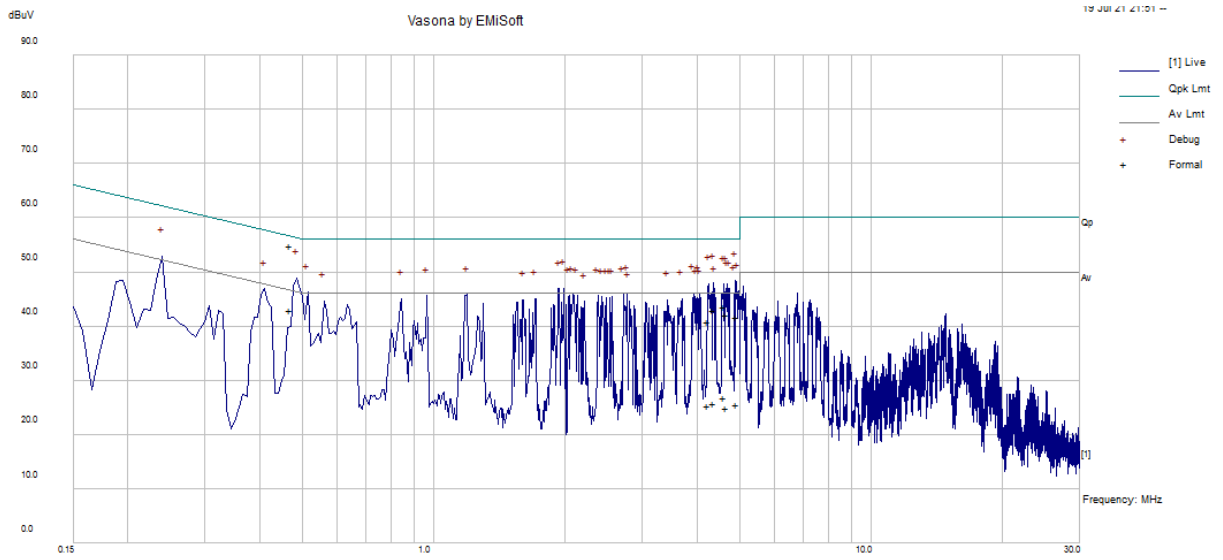
According to the recorded data in following table, the EUT complied with the FCC 15C and IC RSS-Gen standard's conducted emissions limits, with the margin reading of:

Connection: EUT was connected to DC Power adapter. The DC Source was connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Live/Neutral)**	**Range (MHz)**
-0.62	0.46872	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

902.2 MHz + LTE mode

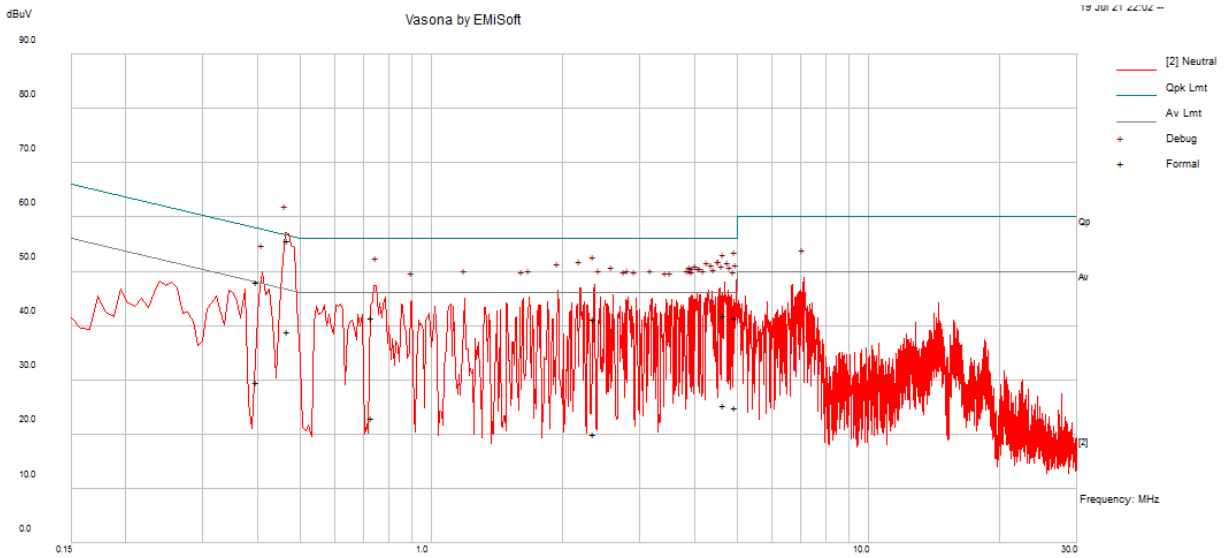
120 V, 60 Hz – Line



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.469883	44.51	10.31	54.81	Line	56.52	-1.7	QP
4.921145	31.64	10.00	41.64	Line	56	-14.36	QP
4.359012	32.89	9.99	42.88	Line	56	-13.12	QP
4.248014	30.93	9.98	40.92	Line	56	-15.08	QP
4.663574	32.16	9.99	42.15	Line	56	-13.85	QP
4.615401	33.62	9.99	43.61	Line	56	-12.39	QP

Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.469883	32.63	10.31	42.93	Line	46.52	-3.58	Ave
4.921145	15.58	10	25.57	Line	46	-20.43	Ave
4.359012	15.84	9.99	25.83	Line	46	-20.17	Ave
4.248014	15.35	9.98	25.34	Line	46	-20.66	Ave
4.663574	14.98	9.99	24.97	Line	46	-21.03	Ave
4.615401	16.79	9.99	26.78	Line	46	-19.22	Ave

120 V, 60 Hz – Neutral

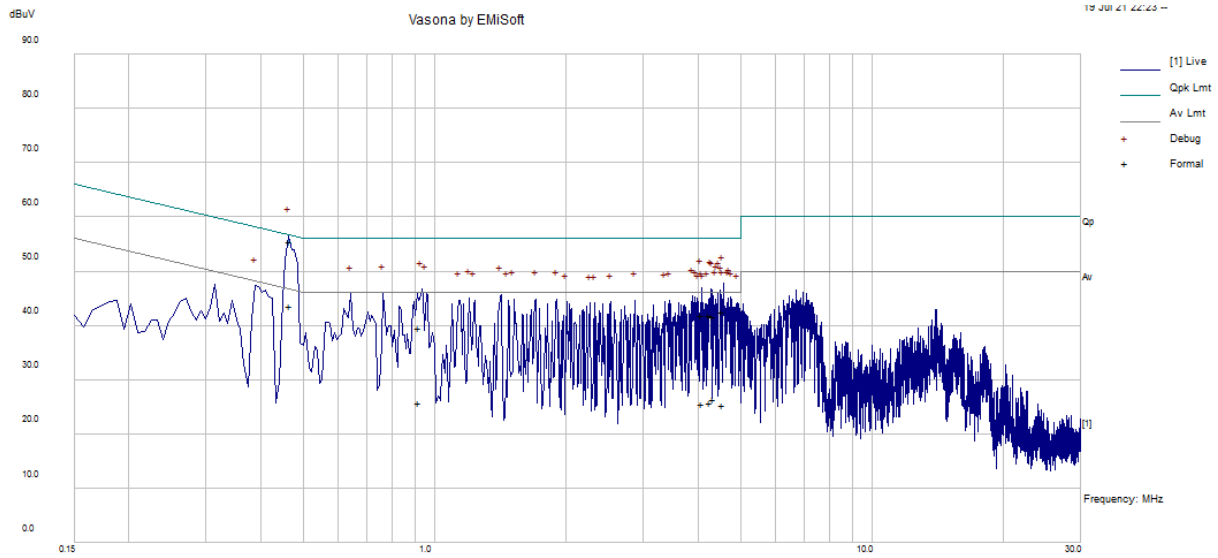


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.470805	45.49	10.31	55.8	Neutral	56.5	-0.7	QP
4.970937	31.53	10.00	41.52	Neutral	56	-14.48	QP
0.397652	37.74	10.39	48.12	Neutral	57.9	-9.78	QP
4.676408	31.95	9.99	41.94	Neutral	56	-14.06	QP
2.359476	31.17	10.00	41.17	Neutral	56	-14.83	QP
0.731286	31.23	10.19	41.42	Neutral	56	-14.58	QP

Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.470805	28.67	10.31	38.98	Neutral	46.5	-7.52	Ave
4.970937	14.98	10.00	24.97	Neutral	46	-21.03	Aver
0.397652	19.29	10.39	29.67	Neutral	47.9	-18.23	Ave
4.676408	15.26	9.99	25.25	Neutral	46	-20.75	Aver
2.359476	10.04	10.00	20.03	Neutral	46	-25.97	Ave
0.731286	12.8	10.19	22.99	Neutral	46	-23.01	Ave

902.2 MHz + 2.4 GHz Wi-Fi mode

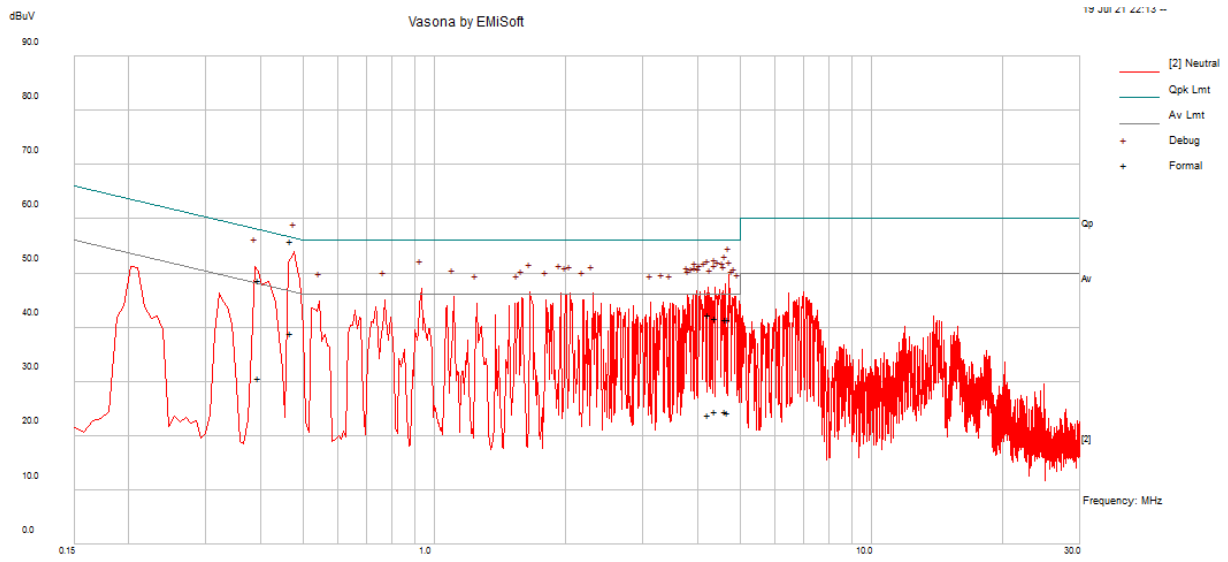
120 V, 60 Hz – Line



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.467169	45.28	10.31	55.59	Line	56.56	-0.97	QP
4.56086	32.53	9.99	42.52	Line	56	-13.48	QP
4.074977	31.91	9.98	41.89	Line	56	-14.11	QP
4.272695	31.89	9.99	41.88	Line	56	-14.12	QP
0.921305	29.51	10.14	39.65	Line	56	-16.35	QP
4.332075	31.69	9.99	41.68	Line	56	-14.32	QP

Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.467169	33.19	10.31	43.49	Line	46.56	-3.07	Ave
4.56086	15.31	9.99	25.30	Line	46	-20.7	Ave
4.074977	15.62	9.98	25.60	Line	46	-20.4	Ave
4.272695	15.78	9.99	25.77	Line	46	-20.23	Ave
0.921305	15.65	10.14	25.79	Line	46	-20.21	Ave
4.332075	16.41	9.99	26.39	Line	46	-19.61	Ave

120 V, 60 Hz – Neutral



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.46872	**45.61**	**10.31**	**55.91**	**Neutral**	**56.54**	**-0.62**	**QP**
4.710444	31.4	9.99	41.39	Neutral	56	-14.61	QP
0.396918	38.31	10.39	48.7	Neutral	57.92	-9.22	QP
4.636781	31.43	9.99	41.42	Neutral	56	-14.58	QP
4.39013	31.76	9.99	41.75	Neutral	56	-14.25	QP
4.243554	32.26	9.98	42.25	Neutral	56	-13.75	QP

Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBuV)	Conductor (Line/ Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
0.46872	28.70	10.31	39.01	Neutral	46.54	-7.53	Ave
4.710444	14.29	9.99	24.28	Neutral	46	-21.72	Ave
0.396918	20.30	10.39	30.69	Neutral	47.92	-17.23	Ave
4.636781	14.54	9.99	24.53	Neutral	46	-21.47	Ave
4.39013	14.57	9.99	24.56	Neutral	46	-21.44	Ave
4.243554	13.76	9.98	23.74	Neutral	46	-22.26	Ave

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

7.1 Applicable Standards

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

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

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

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

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

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

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

As per ISEDC RSS-Gen 8.9,

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

General Field Strength Limits for Licence-Exemption Transmitters at Frequencies above 30 Mhz

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

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

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

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

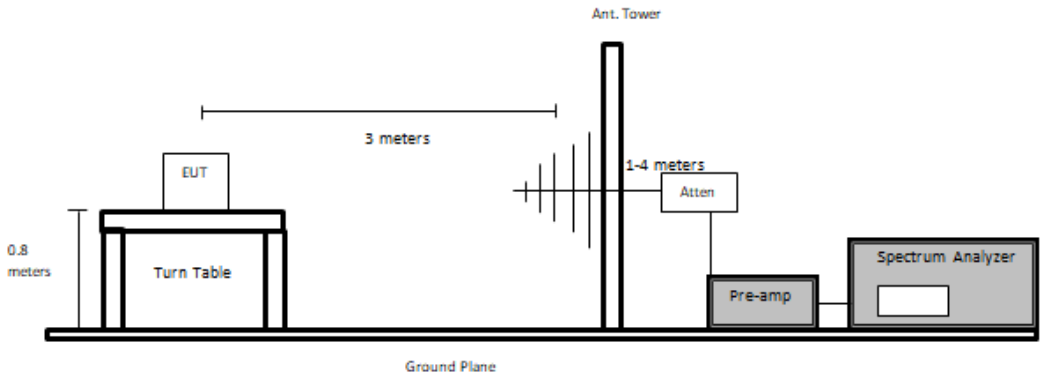
7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15 Subpart C and ISEDC RSS-247 limits.

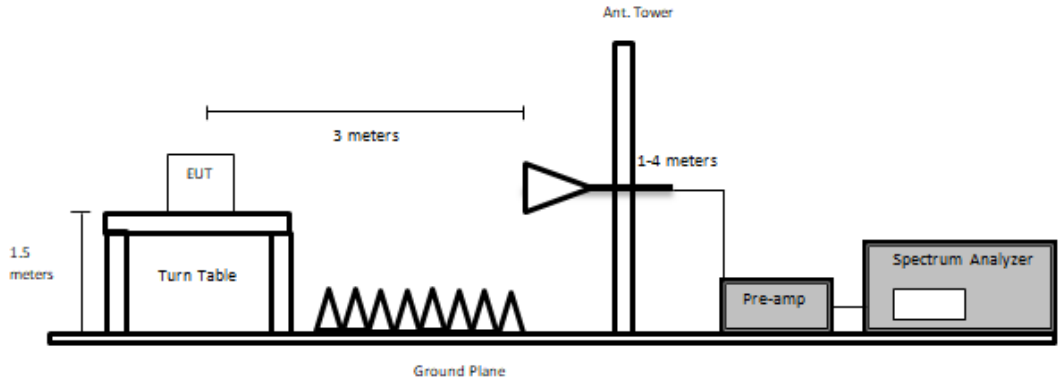
The spacing between the peripherals was 10 centimeters.

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

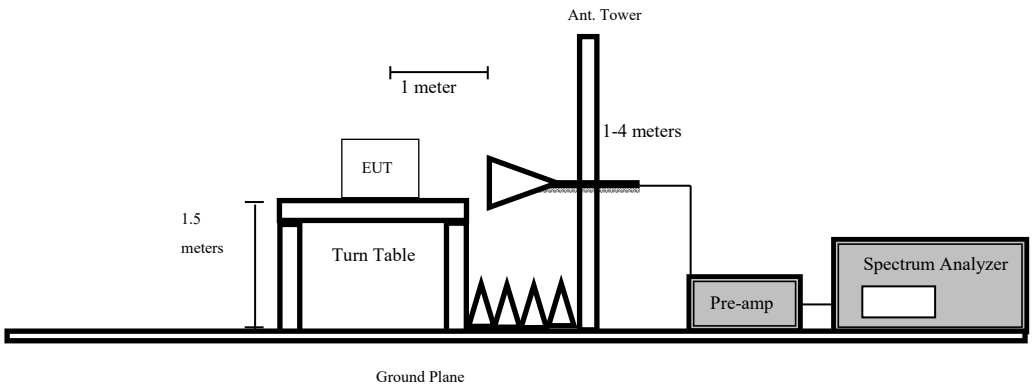
Below 1GHz:



Above 1 GHz at 3m:



Above 1 GHz at 1m:



7.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

7.4 Corrected Amplitude & Margin Calculation

For emissions below 1 GHz and for above 1GHz scans.

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 Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2020-03-17	18 months
Agilent	Spectrum Analyzer 44 GHz	E4446A	US44300386	2019-08-24	2 years
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2019-11-20	2 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2.5 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-01	2020-02-27	2 years
Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	1 year
MDP DIgital	Times Microwave LMR 400 UltraFex Coaxial Cable 35\'	LMR400UF	BACL1904161	2020-05-20	18 months
-	SMA cable	-	-	Each time[1]	N/A
AH Systems	Preamplifier	PAM 1840 VH	170	2020-11-09	1 year
Agilent	Preamplifier	8449B	3147A00400	2021-03-02	1 year
HP	Pre Amplifier	8447D	2944A07030	2020-08-17	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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

7.6 Test Environmental Conditions

Temperature:	22 ºC
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Giriraj Gurjar from 2021-06-16 in 5m chamber 3.

7.7 Summary of Test Results

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

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Transmitting Channel**
-3.37	1096.788	Vertical	LTE + 902.2 MHz

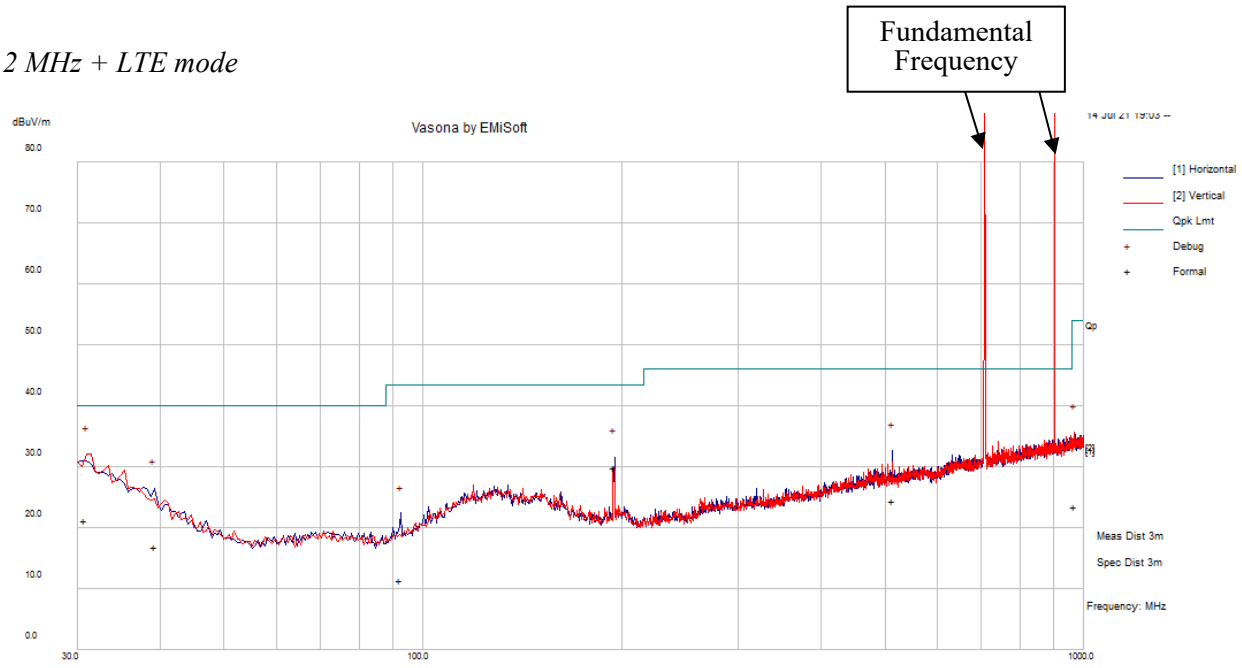
Please refer to the following table and plots for specific test result details.

7.8 Radiated Emissions Test Results

Note: The duty cycle correction factors are already added in the final result.

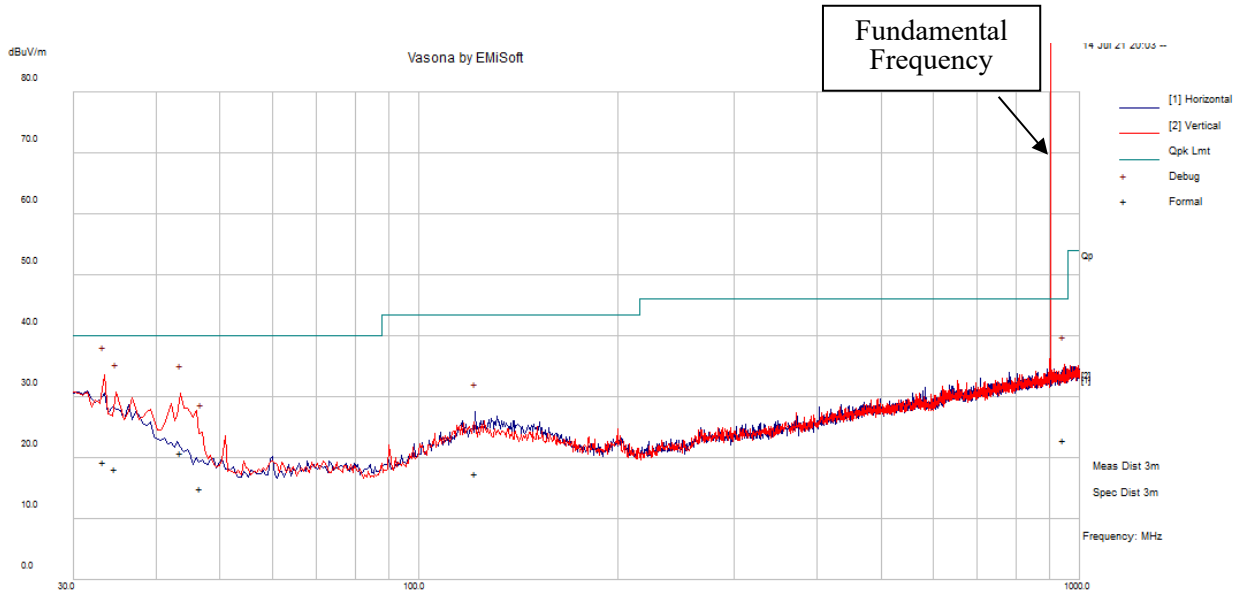
1) 30 MHz – 1 GHz Worst Case, Measured at 3 meters

902.2 MHz + LTE mode



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
30.732	19.29	1.94	21.23	158	V	290	40	-18.77	QP
194.93675	36.09	-6.31	29.79	147	H	202	43.5	-13.71	QP
513.3595	24.7	-0.24	24.46	285	H	102	46	-21.54	QP
39.2435	21.53	-4.67	16.87	251	V	96	40	-23.13	QP
968.01775	17.76	5.68	23.44	174	H	184	54	-30.56	QP
92.36775	21.36	-9.99	11.36	147	V	174	43.5	-32.14	QP

902.2 MHz + 2.4 GHz Wi-Fi mode



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
33.3605	19.43	-0.15	19.28	232	V	111	40	-20.72	QP
34.698	19.38	-1.14	18.24	135	V	212	40	-21.76	QP
43.5785	28.53	-7.68	20.86	143	V	295	40	-19.14	QP
946.35925	17.27	5.59	22.86	236	V	179	46	-23.14	QP
46.72825	24.38	-9.52	14.87	231	V	77	40	-25.13	QP
121.88575	21.6	-4.1	17.49	228	H	352	43.5	-26.01	QP

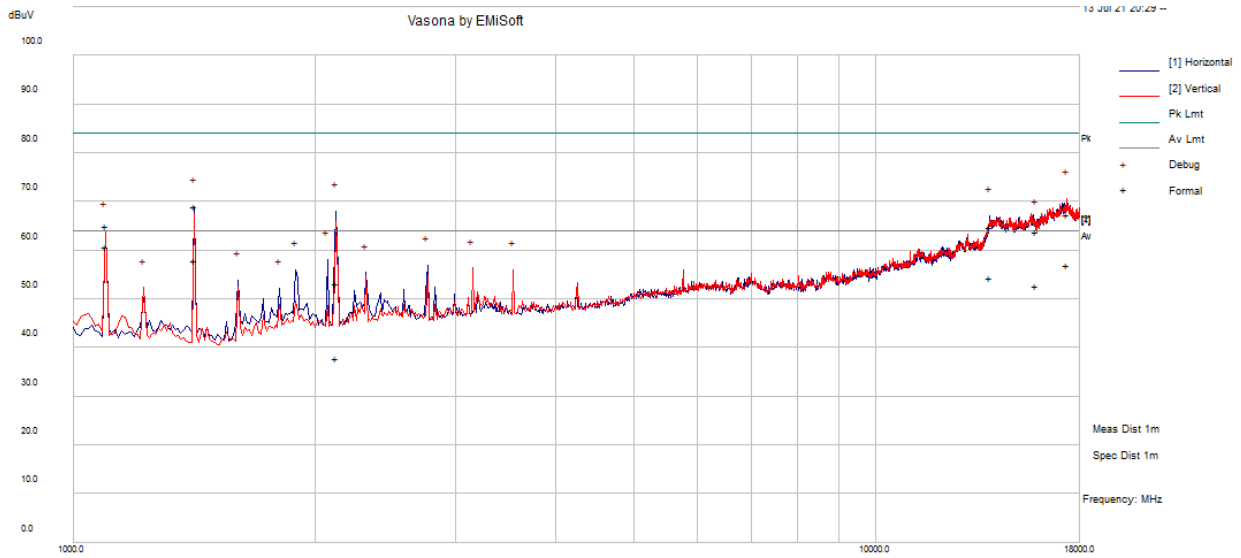
2) 1–10 GHz Measured at 3 meters

900 MHz Radio Standalone

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 902.2 MHz Power Setting: Default											
1060	48.59	217	150	H	27.60	4.93	36.86	44.26	74	-29.74	PK
1060	37.13	217	150	H	27.60	4.93	36.86	32.80	54	-21.20	AV
1225	49.05	257	150	V	28.70	4.98	37.58	45.15	74	-28.85	PK
1225	37.07	257	150	V	28.70	4.98	37.58	33.17	54	-20.83	AV
1822	47.25	0	150	H	30.90	5.56	37.25	46.46	74	-27.54	PK
1822	34.91	0	150	H	30.90	5.56	37.25	34.12	54	-19.88	AV
1843	47.42	348	150	V	31.30	5.56	37.25	47.03	74	-26.97	PK
1843	35.24	348	150	V	31.30	5.56	37.25	34.85	54	-19.15	AV
2736	46.86	0	150	H	32.70	6.97	36.79	49.74	74	-24.26	PK
2736	34.35	0	150	H	32.70	6.97	36.79	37.23	54	-16.77	AV
2658	47.59	79	150	V	32.70	6.21	36.79	49.71	74	-24.29	PK
2658	34.68	79	150	V	32.70	6.21	36.79	36.80	54	-17.20	AV
Middle Channel Frequency: 915 MHz Power Setting: Default											
1315	54.07	266	150	H	28.90	5.02	37.78	50.21	74	-23.79	PK
1315	40.92	266	150	H	28.90	5.02	37.78	37.06	54	-16.94	AV
1165	54.00	0	150	V	28.30	4.98	38.03	49.25	74	-24.75	PK
1165	41.48	0	150	V	28.30	4.98	38.03	36.73	54	-17.27	AV
1796	48.12	82	150	H	30.90	5.56	37.25	47.33	74	-26.67	PK
1796	35.58	82	150	H	30.90	5.56	37.25	34.79	54	-19.21	AV
1784	47.33	0	150	V	30.40	5.56	37.25	46.04	74	-27.96	PK
1784	35.46	0	150	V	30.40	5.56	37.25	34.17	54	-19.83	AV
2700	47.17	172	150	H	32.60	6.97	36.79	49.95	74	-24.05	PK
2700	34.89	172	150	H	32.60	6.97	36.79	37.67	54	-16.33	AV
2781	46.32	114	150	V	32.70	6.97	36.74	49.25	74	-24.75	PK
2781	34.75	114	150	V	32.70	6.97	36.74	37.68	54	-16.32	AV
High Channel Frequency: 927.8 MHz Power Setting: Default											
1045	48.52	315	150	H	27.60	4.47	38.03	42.56	74	-31.44	PK
1045	37.14	315	150	H	27.60	4.47	38.03	31.18	54	-22.82	AV
1090	48.72	223	150	V	27.80	4.52	38.03	43.01	74	-30.99	PK
1090	36.99	223	150	V	27.80	4.52	38.03	31.28	54	-22.72	AV
1830	48.45	226	150	H	31.30	5.56	37.25	48.06	74	-25.94	PK
1830	35.31	226	150	H	31.30	5.56	37.25	34.92	54	-19.08	AV
1823	47.83	340	150	V	30.90	5.56	37.25	47.04	74	-26.96	PK
1823	35.44	340	150	V	30.90	5.56	37.25	34.65	54	-19.35	AV
2759	46.73	0	150	H	32.70	6.97	36.79	49.61	74	-24.39	PK
2759	34.01	0	150	H	32.70	6.97	36.79	36.89	54	-17.11	AV
2739	46.91	0	150	V	32.70	6.97	36.79	49.79	74	-24.21	PK
2739	34.86	0	150	V	32.70	6.97	36.79	37.74	54	-16.26	AV

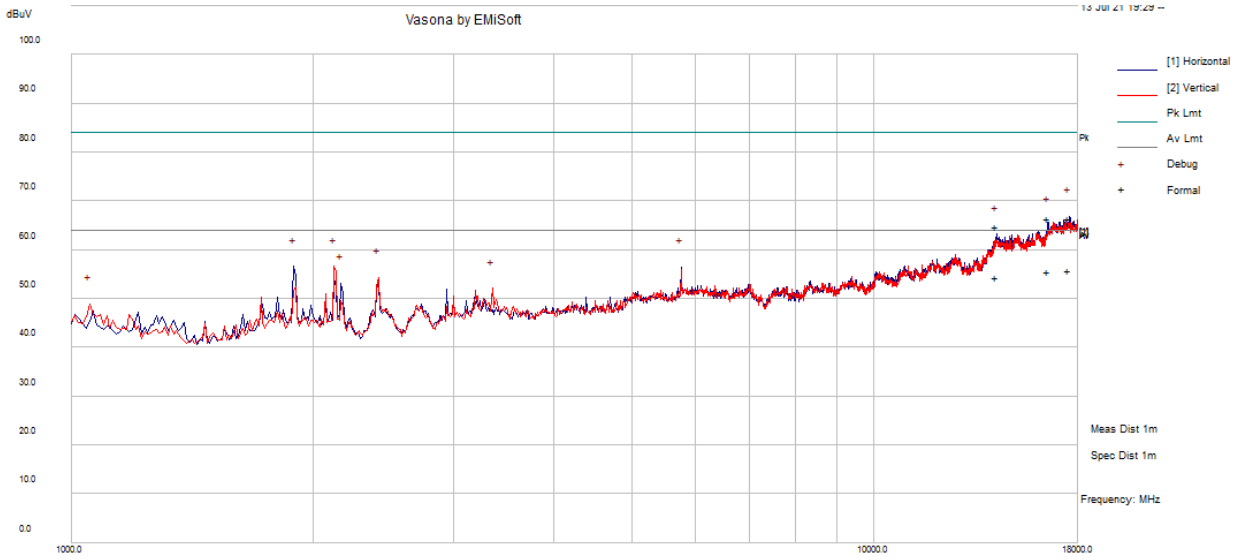
3) 1 GHz – 18 GHz Worst Case, Measured at 1 meter

902.2 MHz + LTE Mode



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
17341.78	43.76	23.67	67.44	134	V	130	84	-16.56	PK
1414.82	74.62	-5.53	69.09	101	H	341	84	-14.91	PK
2124.313	53.97	-0.75	53.22	152	H	7	84	-30.78	PK
13899.64	43.28	21.42	64.71	230	H	76	84	-19.29	PK
15896.07	43.35	20.49	63.84	151	H	206	84	-20.16	PK
1096.788	71.3	-6.34	64.96	183	V	188	84	-19.04	PK
17341.78	33.22	23.67	56.9	134	V	130	64	-7.1	Ave
1414.82	63.31	-5.53	57.78	101	H	341	64	-6.22	Ave
2124.313	38.46	-0.75	37.7	152	H	7	64	-26.3	Ave
13899.64	33	21.42	54.42	230	H	76	64	-9.58	Ave
15896.07	32.32	20.49	52.81	151	H	206	64	-11.19	Ave
1096.788	**66.97**	**-6.34**	**60.63**	**183**	**V**	**188**	**64**	**-3.37**	**Ave**

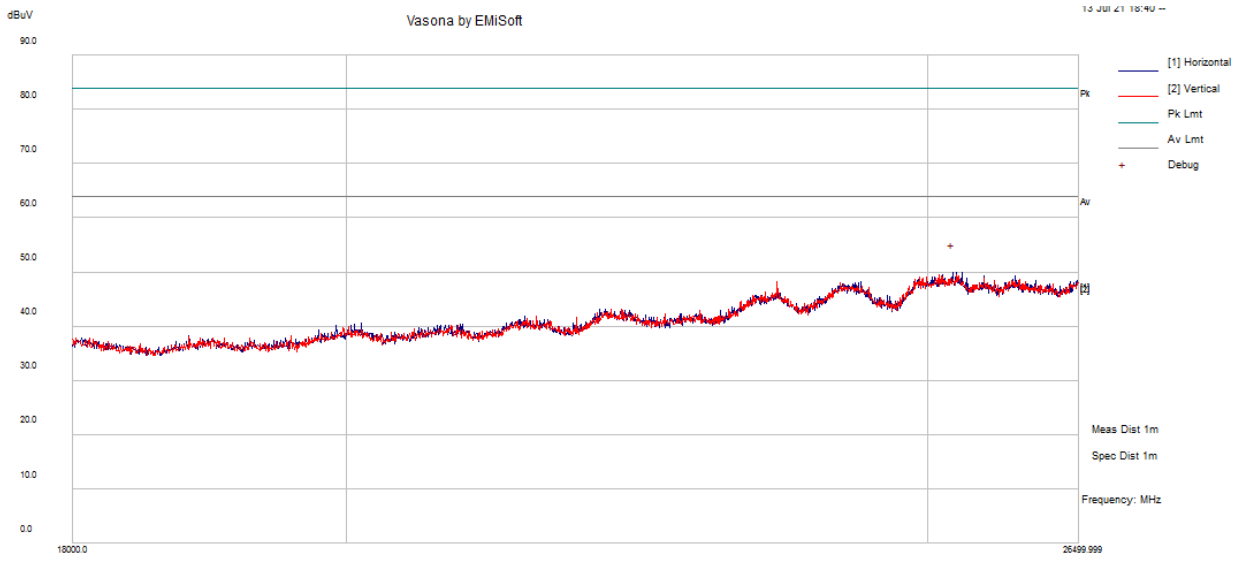
902.2 MHz + 2.4 GHz Wi-Fi



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
17554.81	42.63	23.84	66.48	274	H	302	84	-17.52	PK
16538.54	43.56	22.87	66.43	287	H	141	84	-17.57	PK
14253.98	42.63	22.17	64.81	194	H	336	84	-19.19	PK
17554.81	31.98	23.84	55.83	274	H	302	64	-8.17	Ave
16538.54	32.71	22.87	55.59	287	H	141	64	-8.41	Ave
14253.98	32.14	22.17	54.31	194	H	336	64	-9.69	Ave

4) 18 GHz – 26.5 GHz Worst Case, Measured at 1 meter

902.2 MHz + 2.4 GHz Wi-Fi



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

8.1 Applicable Standards

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

8.2 Measurement Procedure

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

RBW = 1% to 5 % of the 99% occupied bandwidth

VBW = 3RBW

Sweep = auto

Detector function = peak

Trace = max hold

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Signal Analyzer	N9010A	MY48030852	2020-02-16	18 months
-	SMA cable	-	-	Each time[1]	N/A
-	10 dB attenuator	-	-	Each time[1]	N/A

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

8.4 Test Environmental Conditions

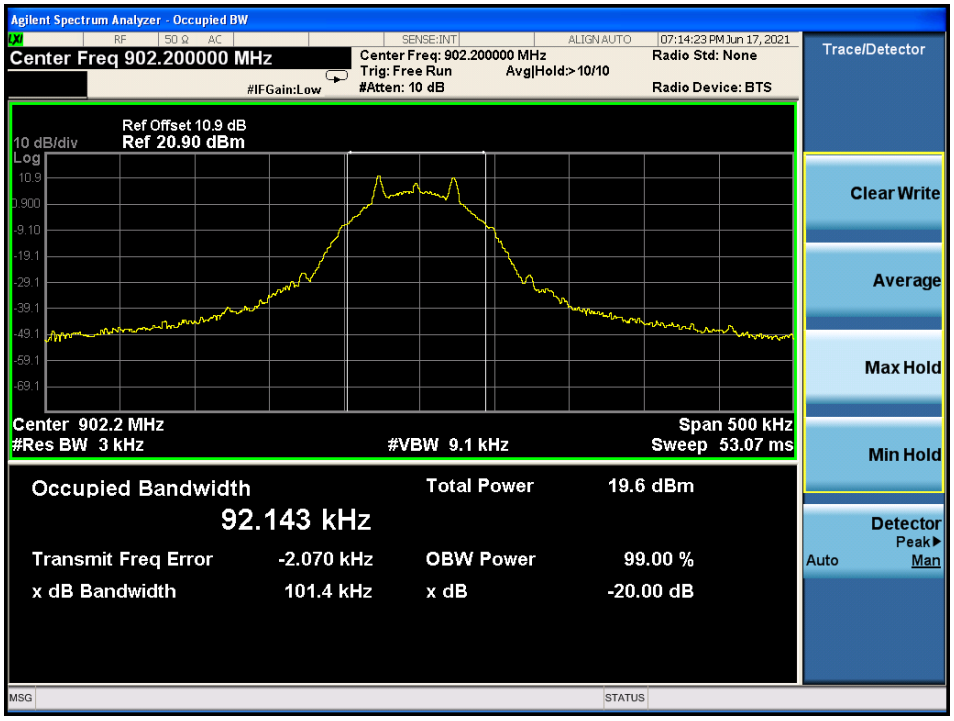
Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Giriraj Gurjar on 2021-06-17 in RF Bench.

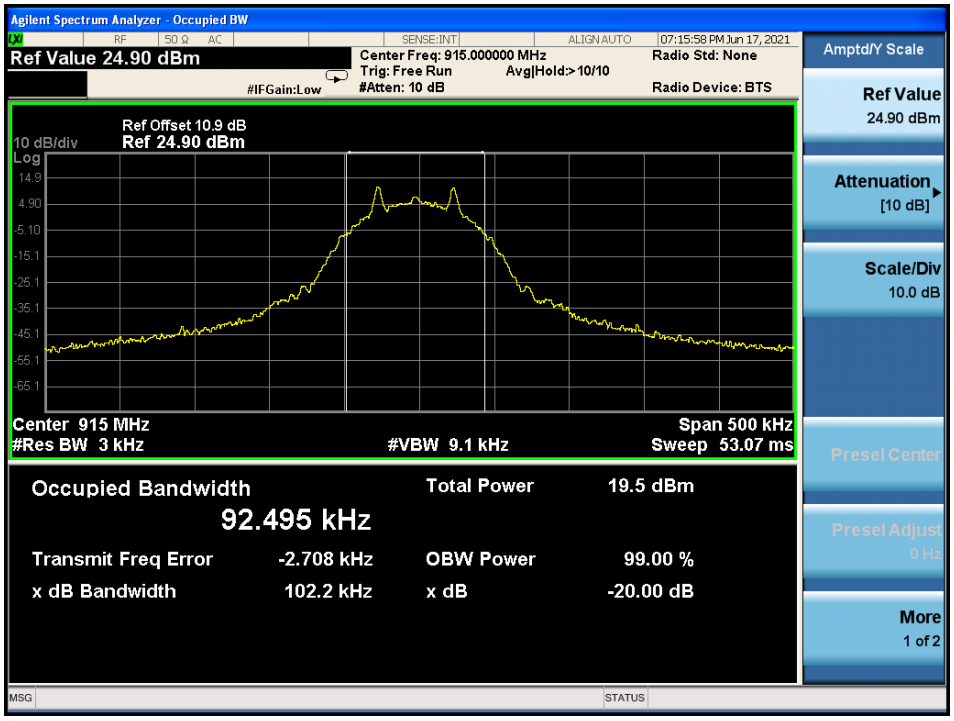
8.5 Test Results

Channel	Frequency (MHz)	99% OBW (kHz)	20 dB OBW (kHz)
Low	902.2	92.143	101.4
Middle	915	92.495	102.2
High	927.8	92.216	102.6

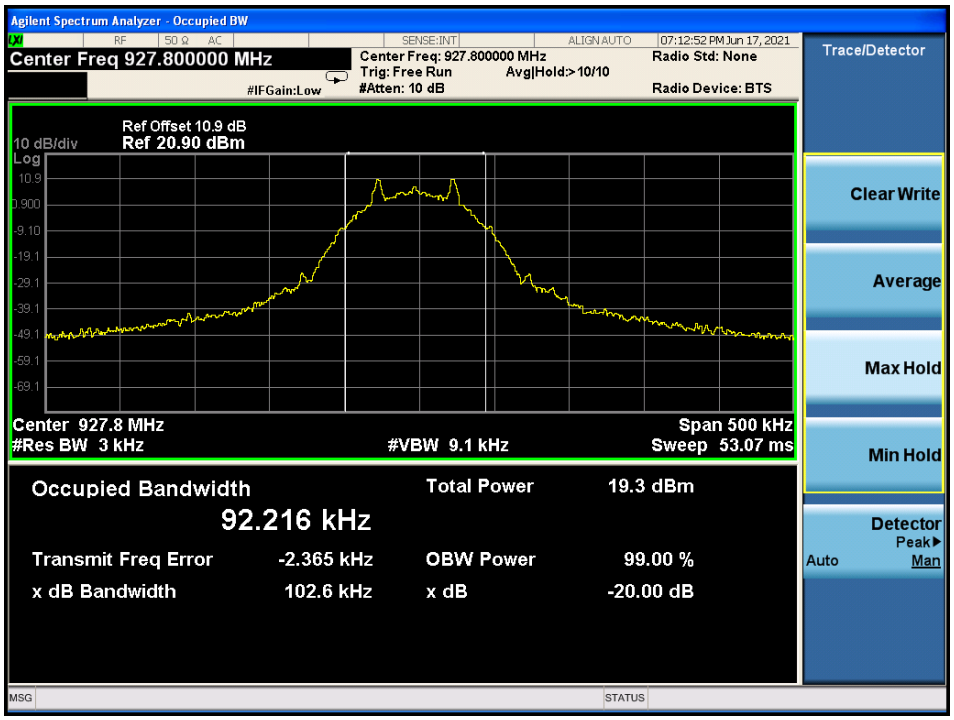
Low Channel 902.2 MHz



Middle Channel 915 MHz



High Channel 927.8 MHz



9 FCC §15.247(b) (2) & ISEDC RSS-247 §5.4 - Output Power

9.1 Applicable Standards

According to FCC §15.247(b) (2): For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

According to RSS-247 §5.4: For frequency hopping systems operating in the band 902-928 MHz, For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

9.2 Measurement Procedure

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Signal Analyzer	N9010A	MY48030852	2020-02-16	18 months
-	SMA cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

9.4 Test Environmental Conditions

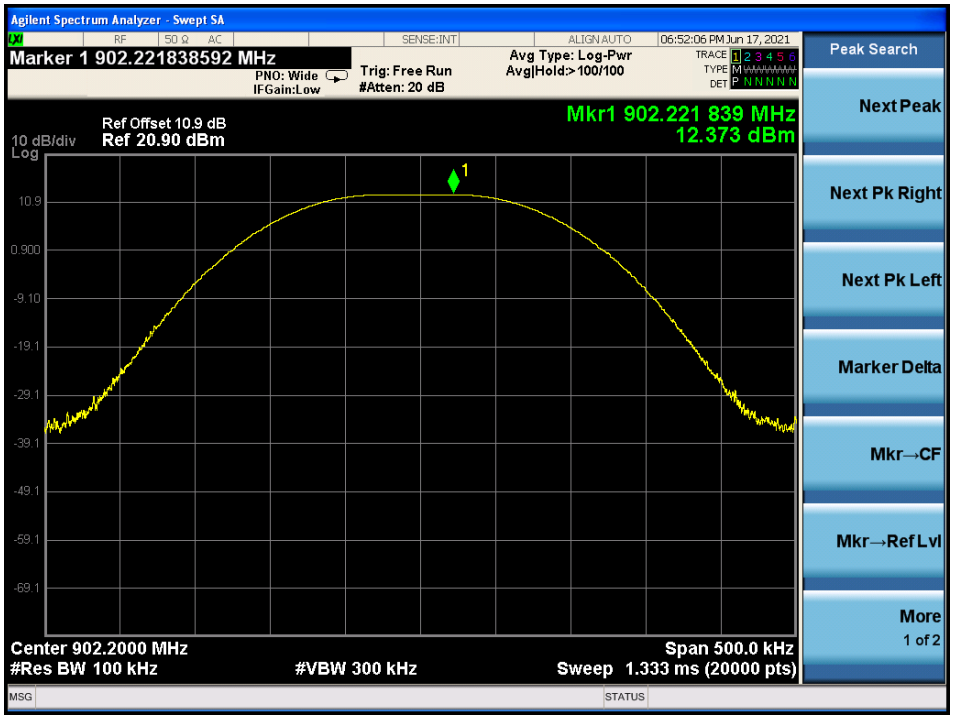
Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Giriraj Gurjar on 2021-06-17 in RF Bench.

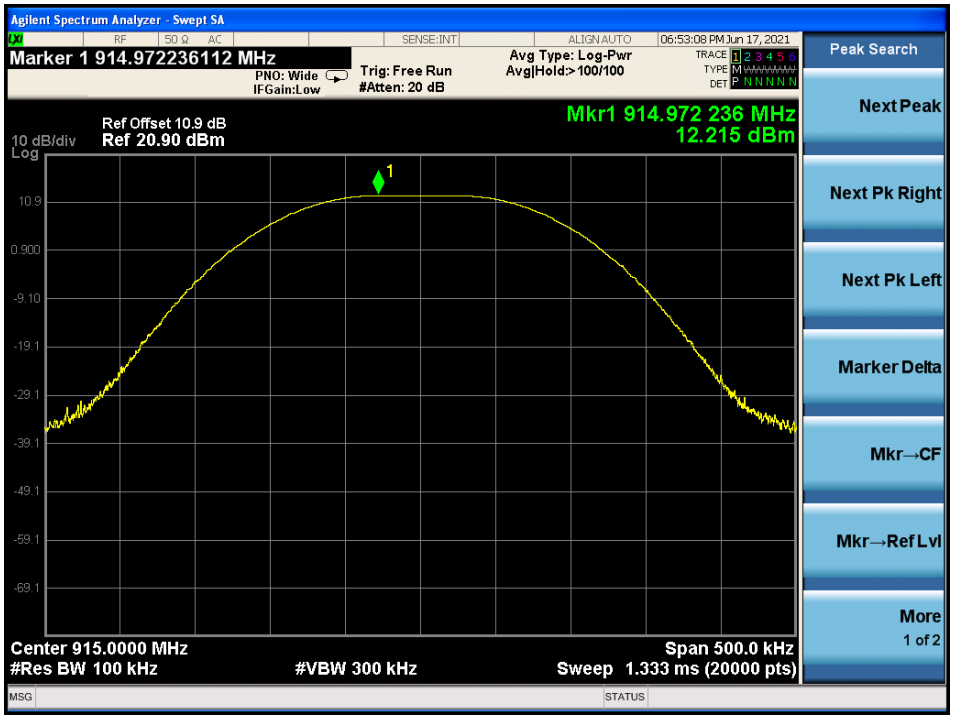
9.5 Test Results

Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
Low	902.2	12.373	30
Middle	915	12.215	30
High	927.8	12.386	30

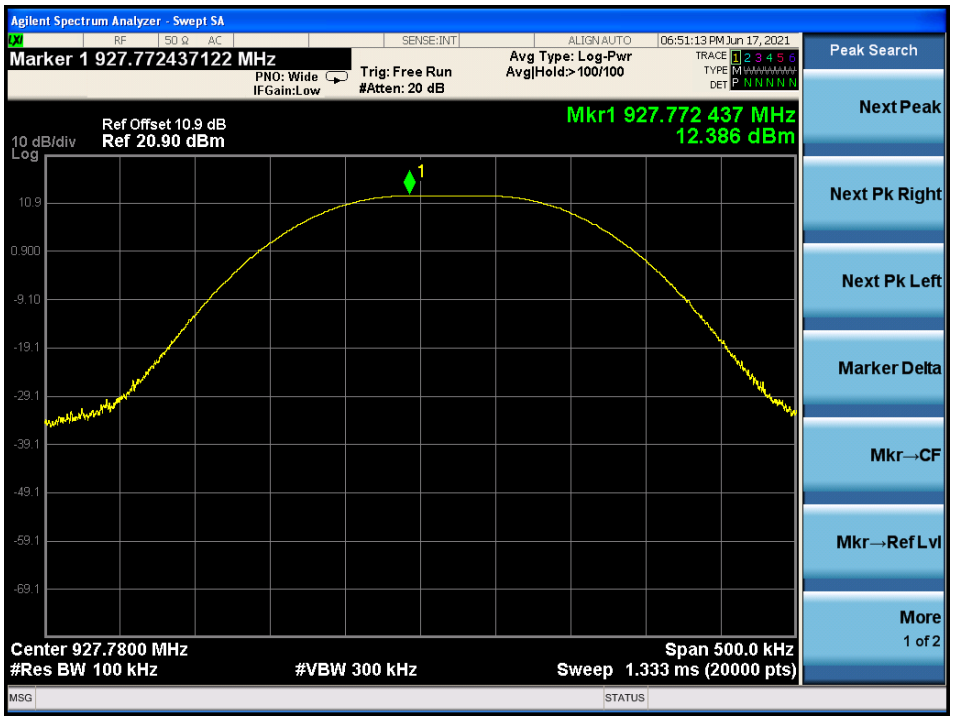
Low Channel 902.2 MHz



Middle Channel 915 MHz



High Channel 927.8 MHz



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

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 Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Signal Analyzer	N9010A	MY48030852	2020-02-16	18 months
-	SMA cable	-	-	Each time[1]	N/A
-	10 dB attenuator	-	-	Each time[1]	N/A

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

10.4 Test Environmental Conditions

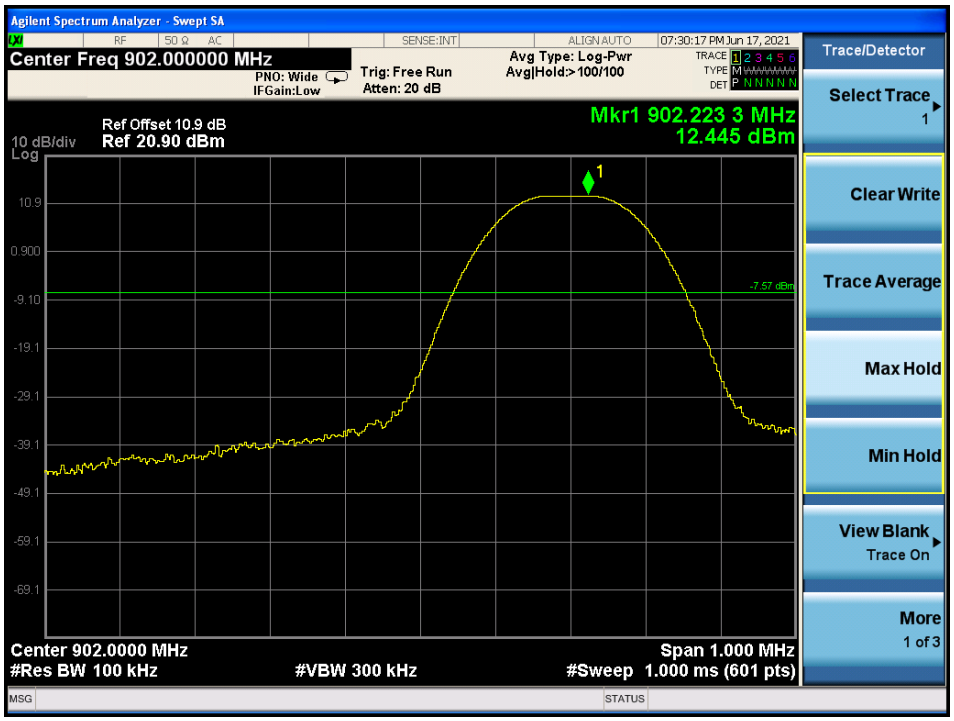
Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Giriraj Gurjar on 2021-06-17 in RF Bench.

10.5 Test Results

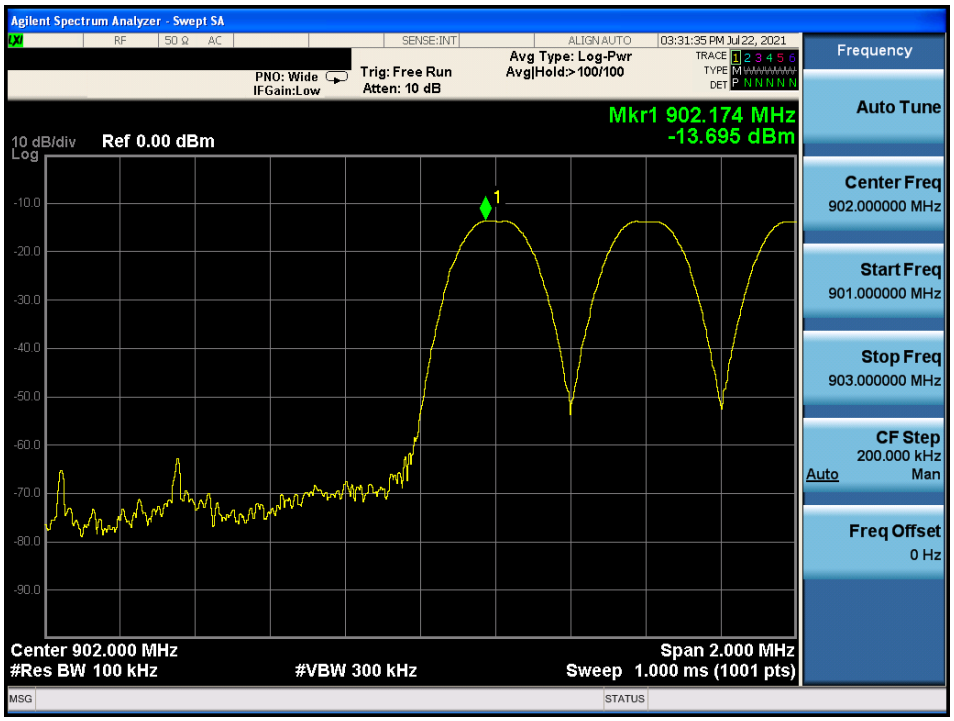
Please refer to the following plots for detailed test results.

Low Channel 902.2 MHz

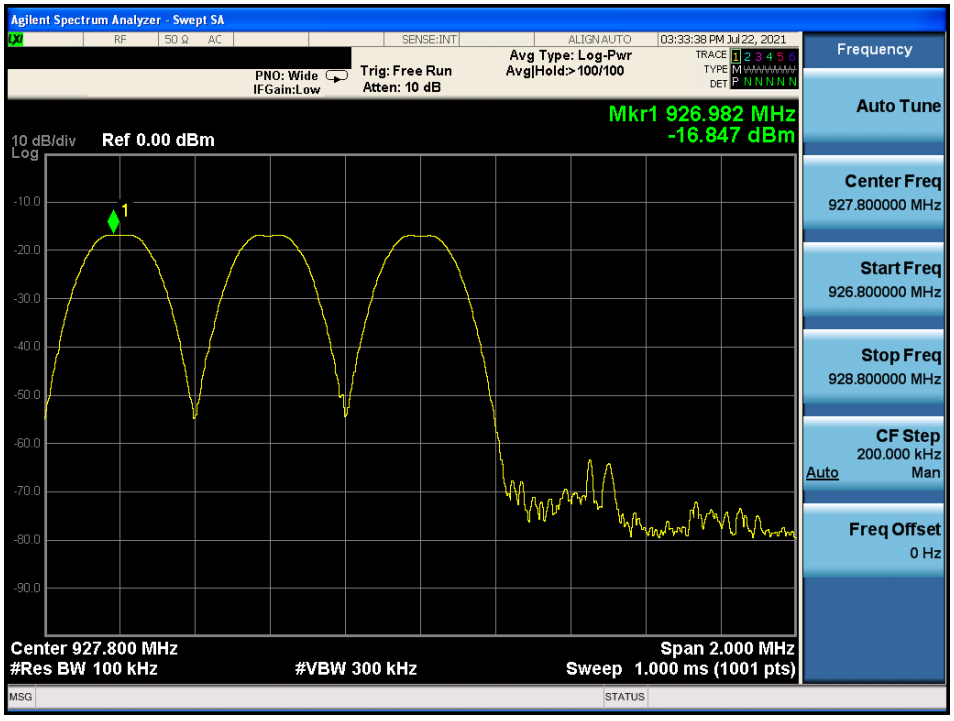


High Channel 927.8 MHz

Hopping mode at Low Edge 902.2 MHz



Hopping mode at High Edge 927.8 MHz



11 FCC §15.247(a) (1) (i) & ISEDC RSS-247 §5.1(c) - Dwell Time

11.1 Applicable Standards

According to FCC §15.247(a) (1) (i) and RSS-247 §5.1(c): For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

11.2 Measurement Procedure

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

Span = zero span, centered on a hopping channel
RBW ≤ channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

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

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

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

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

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	1 year
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2019-04-02	2.5 years
-	RF Cable	-	-	Each time[1]	-

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

11.4 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Giriraj Gurjar from 2021-07-21 and 2021-07-22 in in RF Bench.

11.5 Test Results

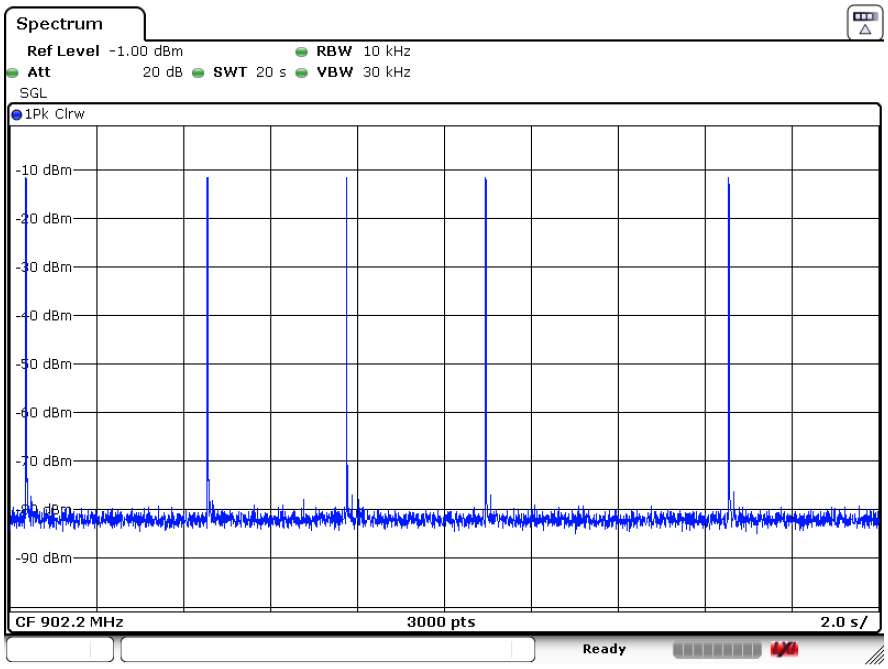
Channel	Frequency	No. of Pulses (per 20 sec)	Pulse Width (ms)	Total Dwell Time (sec)	Limit (sec)	Results
Low	902.2	5	11.337	0.05668	0.400	compliant
Middle	915	5	11.337	0.05668	0.400	compliant
High	927.8	5	11.337	0.05668	0.400	compliant

Total Dwell Time (*sec*) = (Number of Pulses per 20 seconds x Pulse Width (*ms*))/1000

Please refer to the following plots for detailed test results.

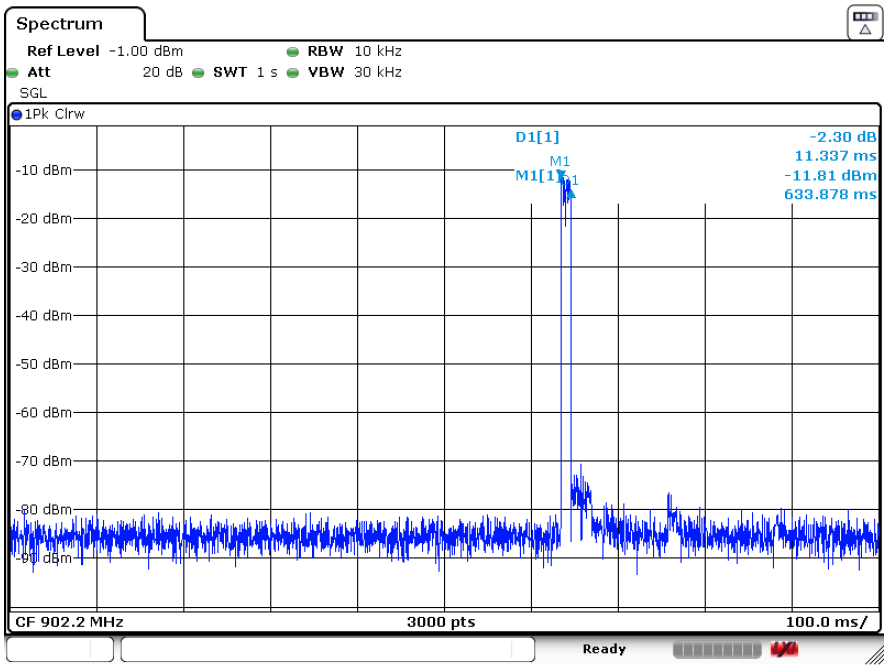
Low Channel 902.2 MHz

Number of Pulses



Date: 21.JUL.2021 18:10:03

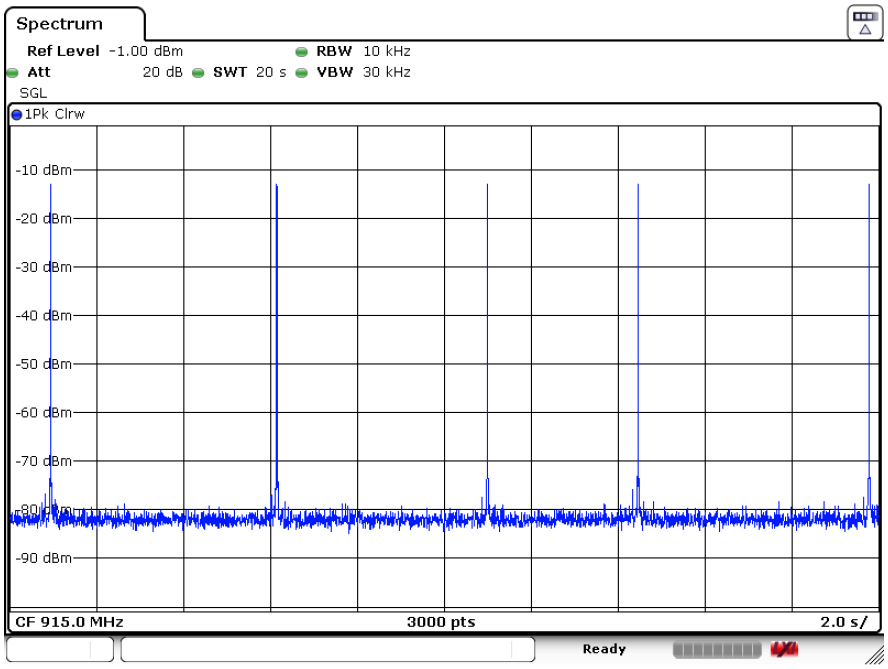
Pulse Duration



Date: 21.JUL.2021 18:10:52

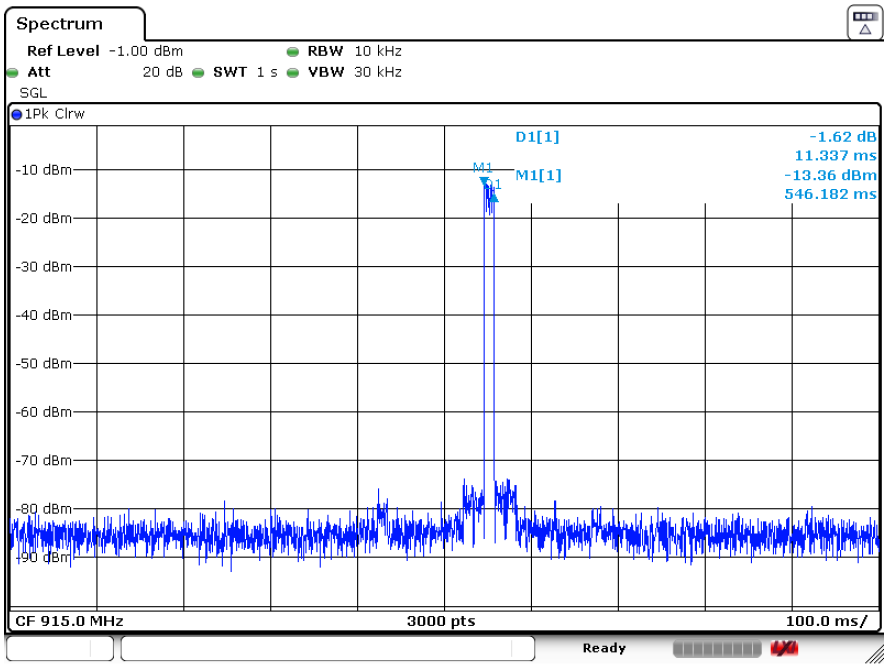
Mid Channel 915 MHz

Number of Pulses



Date: 21.JUL.2021 18:09:23

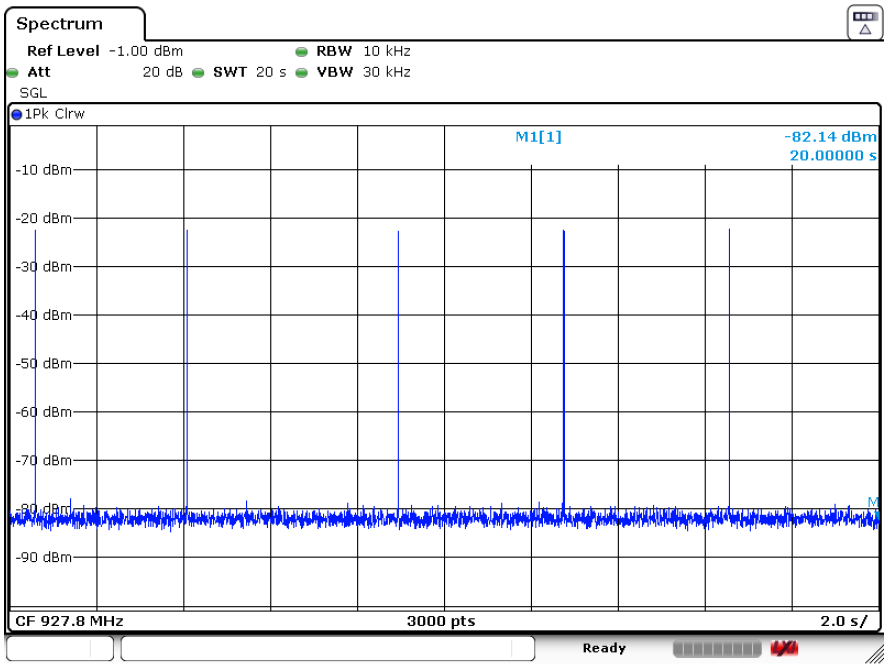
Pulse Duration



Date: 21.JUL.2021 18:08:12

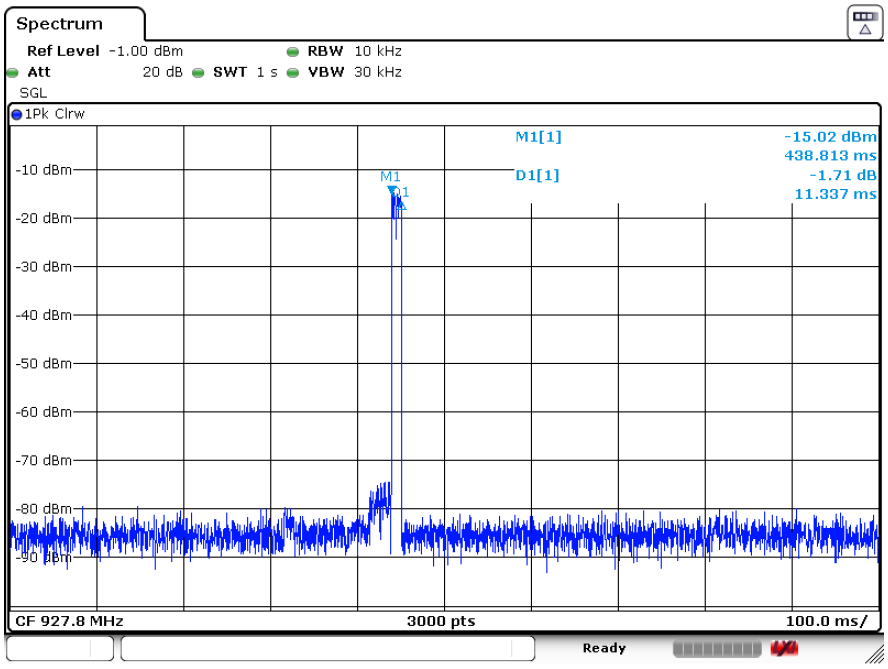
High Channel 927.8 MHz

Number of Pulses



Date: 22.JUL.2021 15:22:16

Pulse Duration



Date: 21.JUL.2021 18:06:15

12 FCC §15.247(a)(1)(i) & ISEDC RSS-247 §5.1(c) - Number of Hopping Channels

12.1 Applicable Standards

According to FCC §15.247(a) (1) (i) and ISEDC RSS-247 §5.1(c)-: For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

12.2 Test Procedure

Span = the frequency band of operation

RBW < 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	1 year
-	SMA cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

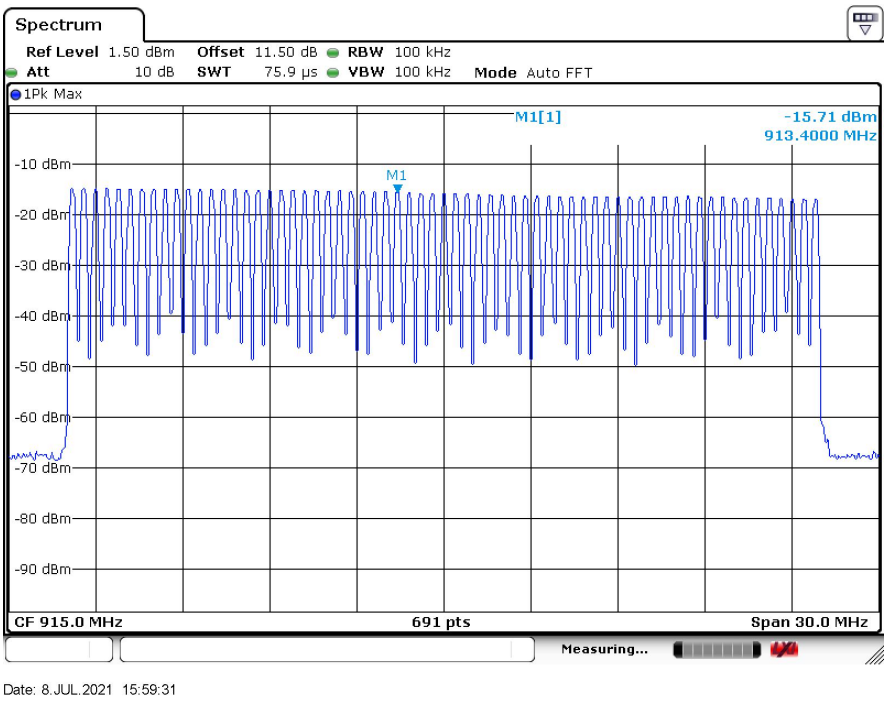
12.4 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

The testing was performed by Giriraj Gurjar on 2021-07-08 in RF Bench.

12.5 Test Results

Total 65 channels; please refer to the plots hereinafter.



13 FCC §15.247(a) (1) & ISEDC RSS-247 §5.1(c) - Hopping Channel Separation

13.1 Applicable Standards

According to FCC §15.247(a) (1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

According to FCC §15.247(a) (1) (i) and ISEDC RSS-247 §5.1(c): For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz

13.2 Test Procedure

Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) ≈ 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel
Video (or Average) Bandwidth (VBW) ≥RBW
Sweep = auto
Detector function = peak
Trace = max hold

13.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	1 year
-	SMA cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

13.4 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	42 %
ATM Pressure:	102.7 kPa

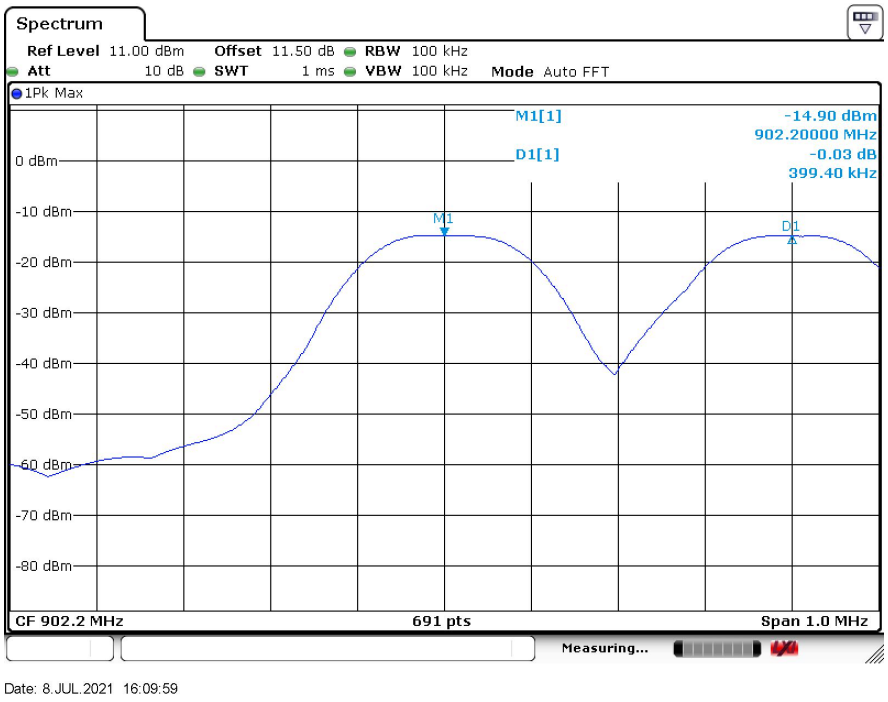
The testing was performed by Giriraj Gurjar on 2021-07-08 in RF Bench.

13.5 Test Results

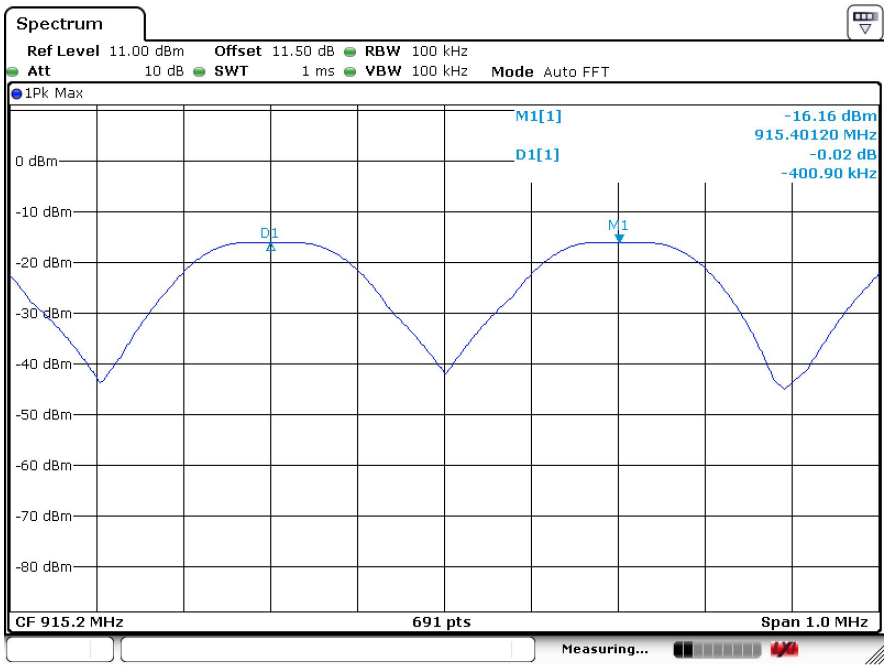
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 20 dB OBW (kHz)
Low	902.2	399.4	101.4
Middle	915	400.9	102.2
High	927.7	400.9	102.6

Please refer to following plots.

Low Channel 902.2 MHz

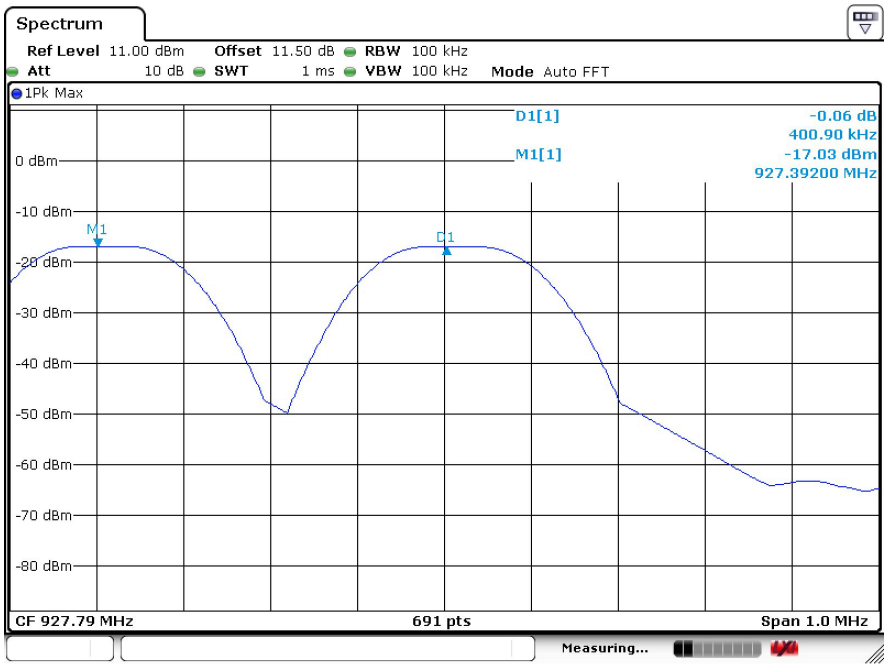


Middle Channel 915 MHz



Date: 8.JUL.2021 16:08:33

High Channel 927.8 MHz



Date: 8.JUL.2021 16:05:53

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

14.1 Applicable Standards

For FCC §15.247(d) and ISEDC RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

14.2 Test Procedure

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

14.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Signal Analyzer	N9010A	MY48030852	2020-02-16	18 Months
-	SMA cable	-	-	Each time[1]	N/A
-	10dB attenuator	-	-	Each time[1]	N/A

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 A2LA Policy P102 "A2LA Policy on Metrological Traceability".*

14.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	40 %
ATM Pressure:	101.8 kPa

The testing was performed by Giriraj Gurjar on 2021-06-18 in RF Bench.

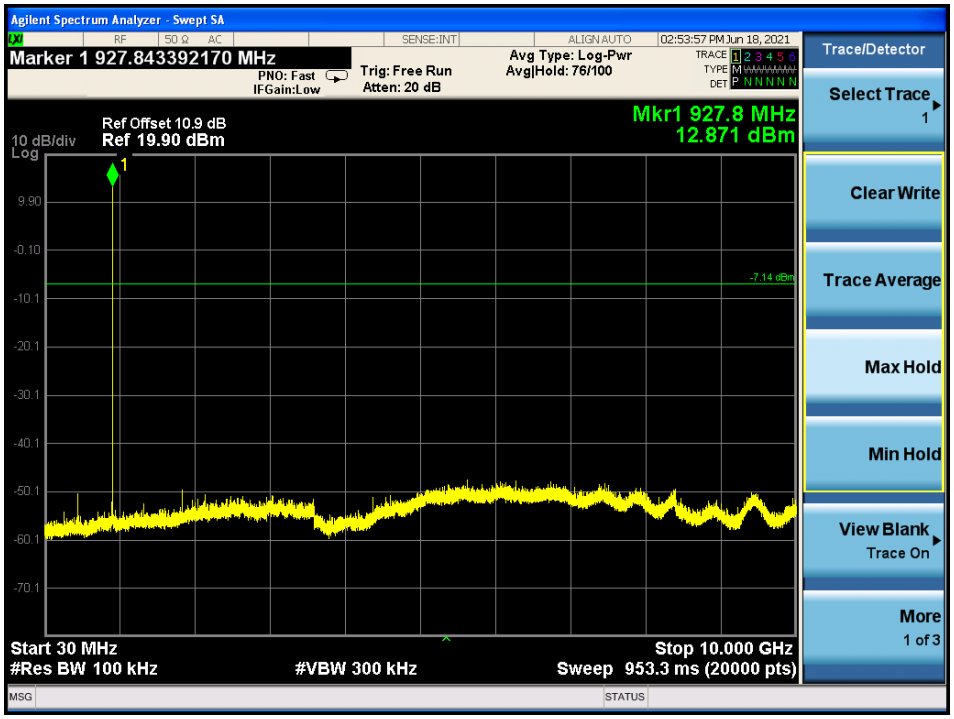
14.5 Test Results

Please refer to the plots hereinafter.

Low Channel

Middle Channel

High Channel



15 Annex A - Test Setup Photographs

Please refer to attachment.

16 Annex B - EUT External Photographs

Please refer to attachment.

17 Annex C - EUT Internal Photographs

Please refer to attachment.

18 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 10th day of March 2021.

Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2022

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

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