FCC PART 15, SUBPART C
ISEDC RSS-210, ISSUE 10, DECEMBER 2019

TEST REPORT

For

Alphawave Golf (Pty) Ltd

18 Techno Avenue, Technopark,
Stellenbosch 7600, South Africa

FCC ID: 2AO3F-EA-XRN-9300
IC: 26855-9300

Report Type:	**Product Type:**
Original Report	Golf Radar Sensor

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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	R2012221-245	Original Report	2021-03-30

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test report was prepared on behalf of *Alphawave Golf (Pty) Ltd* and their product model: EA-XRN-9300 and EA-XRN-9301, FCC ID: 2AO3F-EA-XRN-9300, IC: 26855-9300 or the "EUT" as referred to in this report. It is a field disturbance radar sensor radio that operates within the 10.5-10.55 GHz frequency range.

1.2 Mechanical Description of EUT

EUR measures approximately 50 cm (Length) x 50 cm (Width) x 8 cm (High), and weighs approximately 9kg.

The data gathered are from two production samples provided by Alphawave Golf (Pty) Ltd SN 4007 and 4009.

1.3 Objective

This report was prepared on behalf of *Alphawave Golf (Pty) Ltd* in accordance with Part 2, Subpart J, and Part 15, Subpart C of the Federal Communication Commission's rules and ISEDC RSS-210 Issue 10, December 2019.

The objective was to determine compliance with FCC Part 15.245 and ISEDC RSS-210 for Antenna Requirement, RF Exposure, , Emission Bandwidth, Radiated Spurious Emissions, Band Edges and Field Strength.

1.4 Related Submittal(s)/Grant(s)

None

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.

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

1.7 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 17025:2005 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: (Innovation, Science and Economic development Canada - ISEDC) 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 in accordance to ANSI C63.10.

2.2 EUT Exercise Software

The software "AlphawaveGoldControlSoftware" was used to transmit signal for all the modules. The software was provided by *Alphawave Golf (Pty) Ltd.* and verified by Zhao Zhao to comply with the standard requirements being tested against.

The radio transmission consists of three separated unmodulated tones. Minimum separation between Tone 1 and Tone 3 is 3 MHz; maximum separation between Tone 1 and Tone 3 is 15 MHz. considering the intermodulation products caused by the multi-tone signal and the emission limit at the operating band-edge frequency, the frequency for Tone 1 was determined as shown in the table below. the minimum tone separation results lowest and highest frequency for Tone 1; maximum tone separation results widest transmission span. Therefore, the configurations listed in the table below were evaluated.

Test Mode	Channel	Tone 1 Frequency (MHz)	Tone 2 Frequency (MHz)	Tone 3 Frequency (MHz)	Power Setting (dBm)
Mode 1	Low	10504.5	10506	10507.5	24.45
	Middle	10523.5	10525	10526.5	24.45
	High	10542.5	10544	10545.5	24.45
Mode 2	Low	10516.5	10518	10531.5	24.45
	Middle	10517.5	10519	10532.5	24.45
	High	10518.5	10520	10533.5	24.45

2.3 Equipment Modifications

None

2.4 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
Volteq	DC Power Supply	HY5003D	160402343
ASUS	Laptop	FX504G	J6NRCX037440249

2.5 Remote Support Equipment

Manufacturer	Description	Model
TP-Link	Router	MC200L

2.6 Interface Ports and Cabling

Cable Descriptions	Length (m)	From	To
Power Cable	> 5 m	DC Source	EUT
Fiber Cable	> 3 m	Router	EUT
Ethernet Cable	< 1 m	Router	Laptop

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & ISEDC Rules	Description of Test	Results
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirements	Compliant
ISEDC RSS-102	RF Exposure	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §15.209, §15.245(b) ISEDC RSS-210 Annex F.2 RSS-Gen §8.9, §8.10	Field Strength and Radiated Spurious Emissions	Compliant
FCC §2.1049 & §15.215 RSS-Gen §6.7	20 dB & 99% Emission Bandwidth	Compliant
FCC §15.245(3) ISEDC RSS-210 Annex F.2	Frequency Band Edge	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.

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

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

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

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

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

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

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

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

4.2 Antenna Description

External/Internal/ Integral	Frequency Range (MHz)	Antenna Type	Maximum Antenna Gain (dBi)
Internal	10500 - 10550 MHz	Patch array	10.5

Antenna gain is information provided by customer.

5 ISEDC RSS-102 - RF Exposure

5.1 Applicable Standards

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 RF exposure evaluation exemption for IC

Maximum Field Strength at 3 meters is 121.15 dBuV/m, Maximum EIRP power = 23.77 dBm which is lesser than 5 W = 37 dBm.

Therefore, the RF exposure Evaluation is exempt.

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

6.1 Applicable Standards

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

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

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

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

6.2 Test Setup

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

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

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

6.3 Test Procedure

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

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

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

6.4 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the 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:

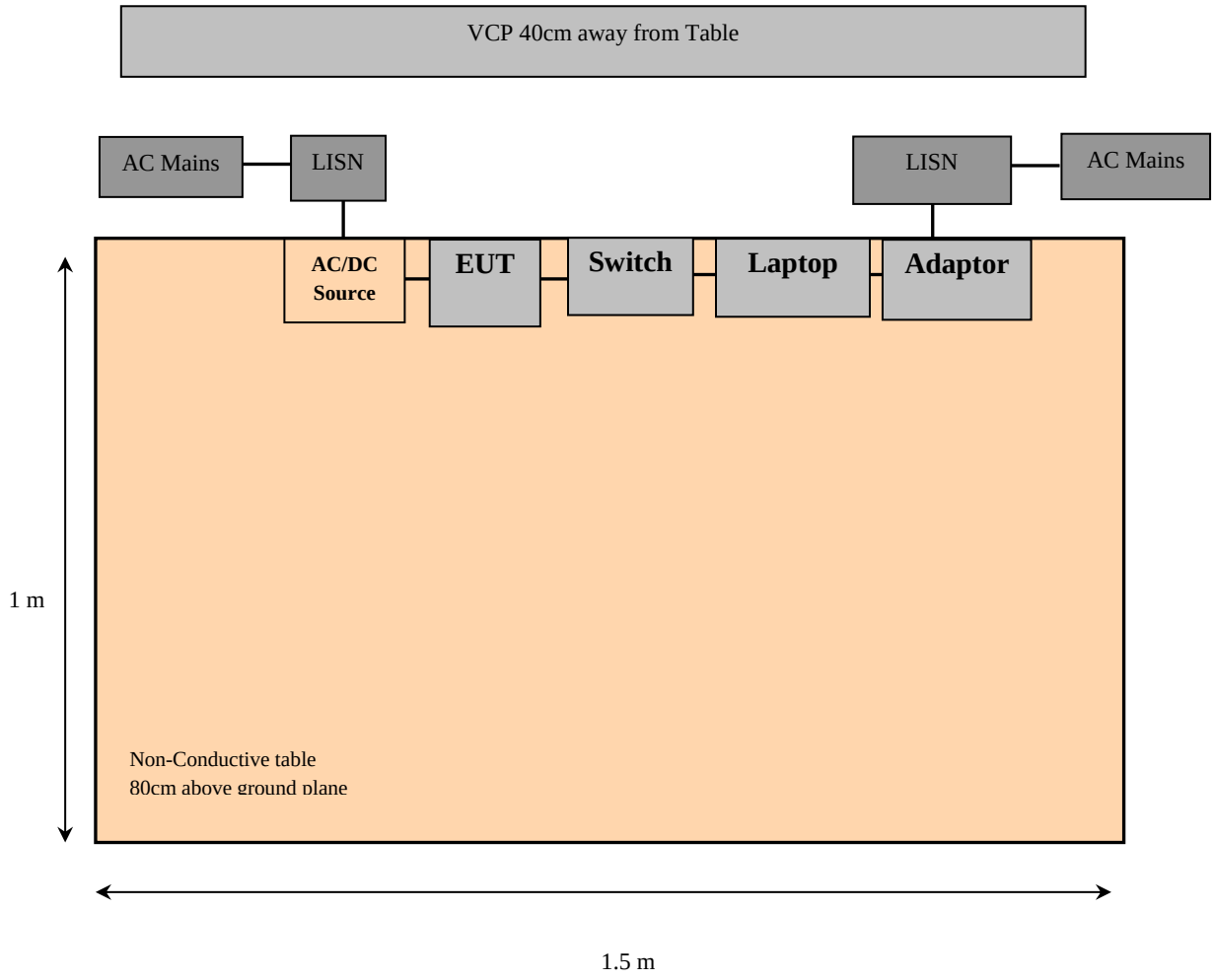
CF= CL + Attenuator

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

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100044	2018-10-26	2.5 years
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2020-07-01	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150204	2021-03-02	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160130	2020-10-13	1 year
HP	DC Source	E3617A	KR32500606	N/R	N/A
Vasona	Test software	V6.0 build 11	10400213	N/R	N/A

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:	20º C
Relative Humidity:	53 %
ATM Pressure:	101.6 kPa

The testing was performed by Zhao Zhao on 2021-03-30 in the Ground Plane test site.

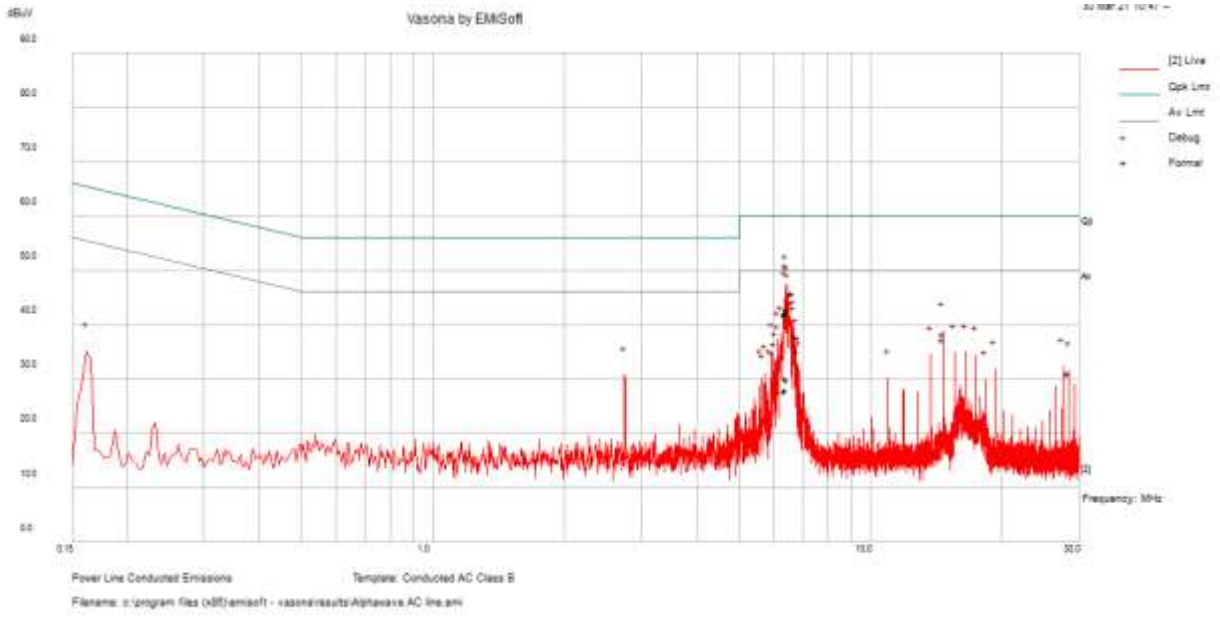
6.8 Summary of Test Results

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:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-12.78	14.615544	Line	0.15-30

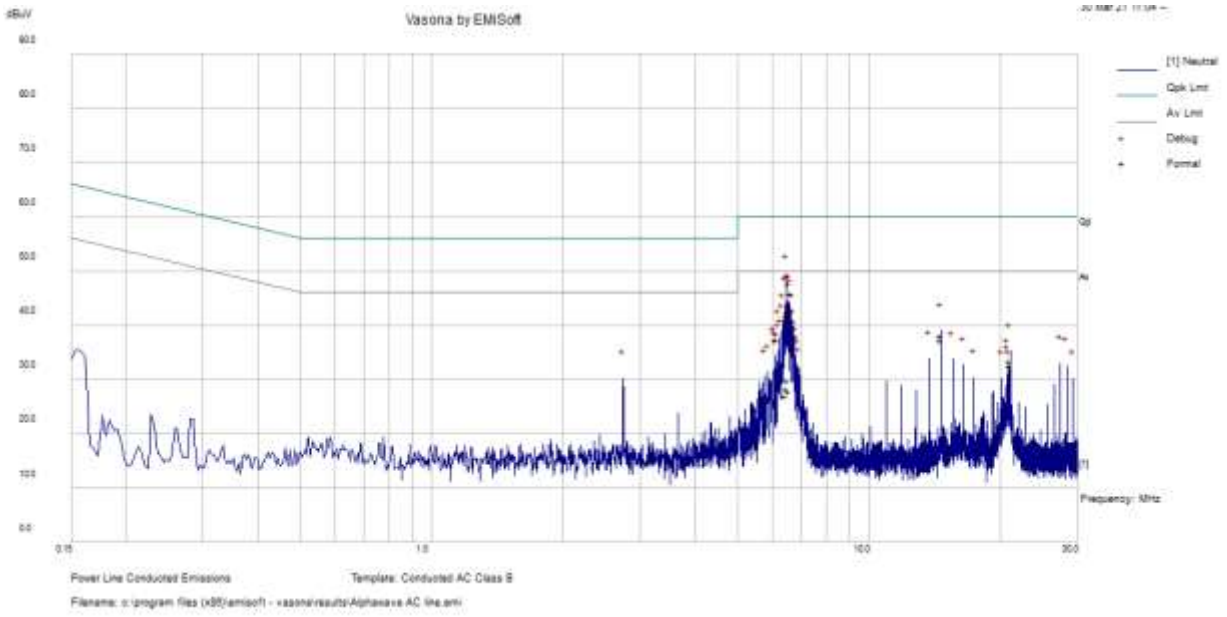
6.9 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
6.415514	32.41	9.99	42.4	60	-17.6	QP
6.396328	32.17	9.99	42.16	60	-17.84	QP
6.43787	32.91	9.99	42.9	60	-17.1	QP
6.377216	31.74	9.99	41.73	60	-18.27	QP
14.615544	28.15	10.19	38.33	60	-21.67	QP
28.314531	20.82	10.26	31.08	60	-28.92	QP
6.415514	18.03	9.99	28.02	50	-21.98	Ave
6.396328	20.31	9.99	30.3	50	-19.7	Ave
6.43787	19.85	9.99	29.84	50	-20.16	Ave
6.377216	17.69	9.99	27.68	50	-22.32	Ave
14.615544	27.03	10.19	37.22	50	-12.78	Ave
28.314531	20.8	10.26	31.06	50	-18.94	Ave

120 V, 60 Hz – Neutral



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
6.473201	31.92	9.99	41.91	60	-18.09	QP
6.552749	31.7	9.99	41.68	60	-18.32	QP
6.506081	32.64	9.99	42.62	60	-17.38	QP
6.4498	30.99	9.99	40.98	60	-19.02	QP
14.603315	27.89	10.19	38.08	60	-21.92	QP
20.990452	23.11	10.28	33.39	60	-26.61	QP
6.473201	18.36	9.99	28.35	50	-21.65	Ave
6.552749	17.85	9.99	27.84	50	-22.16	Ave
6.506081	19.79	9.99	29.78	50	-20.22	Ave
6.4498	17.1	9.99	27.09	50	-22.91	Ave
14.603315	27.02	10.19	37.21	50	-12.79	Ave
20.990452	22.19	10.28	32.47	50	-17.53	Ave

7 FCC §15.209, §15.245(b) & ISEDC RSS-210 Annex F.2, RSS-Gen §8.9, §8.10 – Field Strength and 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 §15.245 (b) and RSS 210 Annex F1 The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25.0
24075-24175	2500	25.0

(1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:
(i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.
(ii) For all other field disturbance sensors, 7.5 mV/m.
(iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075-24175 MHz band, fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).
(2) Field strength limits are specified at a distance of 3 meters.
(3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
(4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

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.

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-210 limits.

The spacing between the peripherals was 10 centimeters.

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

7.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

7.4 Corrected Amplitude & Margin Calculation

For emissions below 1 GHz,

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

CA = S.A. Reading + Correction Factor

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

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

Correction Factor = AF + CL + Atten – Ga

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

Margin = Corrected Amplitude – Limit

For emission above 1 GHz,

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

CA = Ai + AF + CL + Atten – Ga

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

For the emissions from 40 GHz and above

The Corrected Amplitude (CA) is calculated by adding the Conversion Factor (CF), Distance Correction Factor (DCF) and The basic equation is as follows:

$$CR = SA + CF + DCF$$

For example, a corrected amplitude of 49.26 dBuV/m = S.A. Reading (25.16 dBuV) + Conversion Factor (33.64 dB) + DCF (20*log(1/3) = -9.54)

The test was at 1 meter, the DCF converted the field strength level from 1 meter to 3meters

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	EMI Test Receiver	ESCI 1166.5950K03	100044	2020-10-26	2 years
Agilent	Spectrum Analyzer	E4446A	US44300386	2019-08-24	2 years
Sunol Science Corp	System Controller	SC110V	122303-1	N/R	N/A
HP	Pre-Amplifier	8447D	2944A07030	2020-08-17	1 year
HP	Pre-Amplifier	8449B OPT HO2	3008A0113	2020-04-15	1 year
AH System	Pre-Amplifier	PAM 1840 VH	170	2020-11-09	1 year
BACL	RF Sensitivity Box	1	2	2020-10-27	1 year
Wisewave	Horn Antenna	ARH-4223-02	10555-02	2020-03-02	2 years
Wisewave	Horn Antenna	ARH-4223-02	10555-01	2020-03-02	2 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2.5 years
Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2019-11-20	2 years
OML	Harmonic Mixer Set	M19HWA	170615-1	N/A	N/A
-	RF cable	-	-	Each time[1]	N/A
Insulted Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2020-02-28	1 year
Insulted Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-02-28	1 year
MDP Digital	Times Microwave LMR 400 UltraFex Coaxial Cable 35\'	LMR400UF	BACL1904161	2020-05-20	1 year
IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs	KPS-1571AN-2400	DC 1922	2020-06-06	1 year

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

7.6 Test Environmental Conditions

Temperature:	21-24 ºC
Relative Humidity:	42-47 %
ATM Pressure:	102.2 kPa

The testing was performed by Zhao Zhao and Allen Huang on 2020-02-19 and 2021-03-02 at 5 meter chamber 3.

7.7 Summary of Test Results

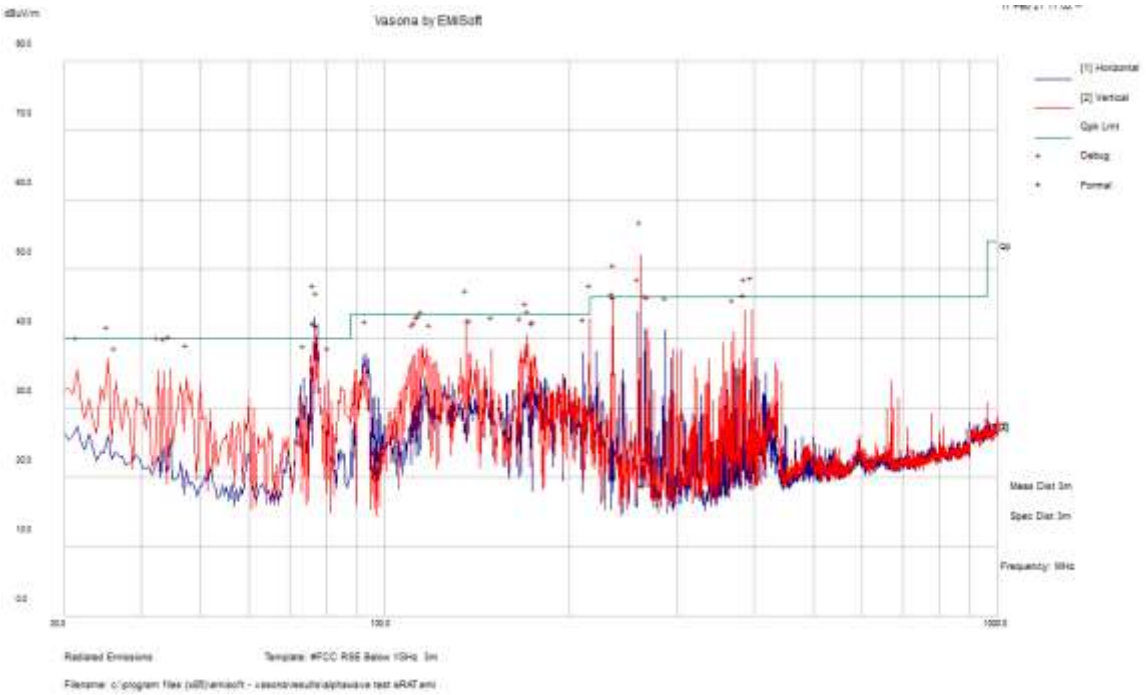
According to the data hereinafter, the EUT complied with FCC Part 15C and ISEDC RSS-210 standard's radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Transmitting Channel (MHz)**
-1.29	73.82175	H	Low Channel

7.8 Radiated Emissions Test Results

Note: Test Mode 1 was determined to be the worst case after pre-scanning both Test Modes as described in Section 2.2 of this report. Therefore, Test Mode 1 was selected for formal testing.

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



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
261.58625	29.86	-10.95	18.91	167	V	352	46	-27.09	QP
76.551*	58.66	-16.2	42.46	224	H	80	71.15	-29.76	QP
72.918*	57.26	-15.87	41.39	287	H	53	71.15	-28.69	QP
236.125*	46.01	-12.16	33.85	146	V	178	71.15	-37.3	QP
182.29*	46.94	-12.74	45.44	142	V	138	71.15	-25.71	QP
73.82175	54.6	-15.89	38.71	257	H	111	40	-1.29	QP

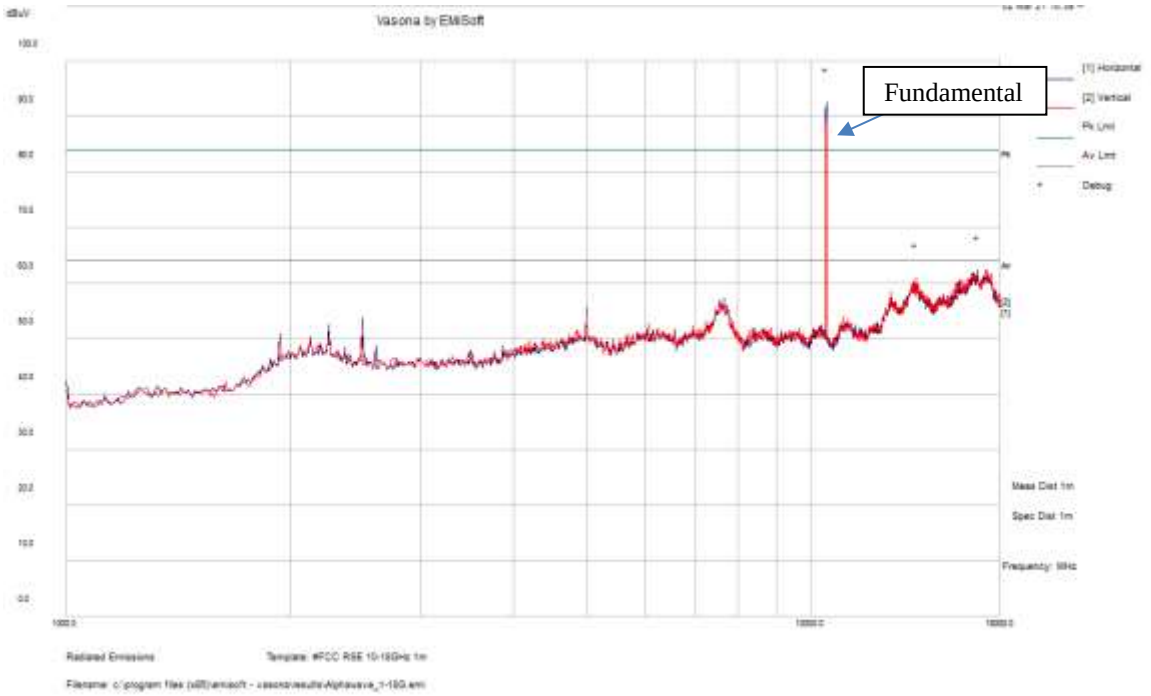
Note: The frequency which falls outside the restrict band, limit was 50dBc from the fundamental.*

2) Fundamental Field Strength, Harmonics and Band Edge measurement.

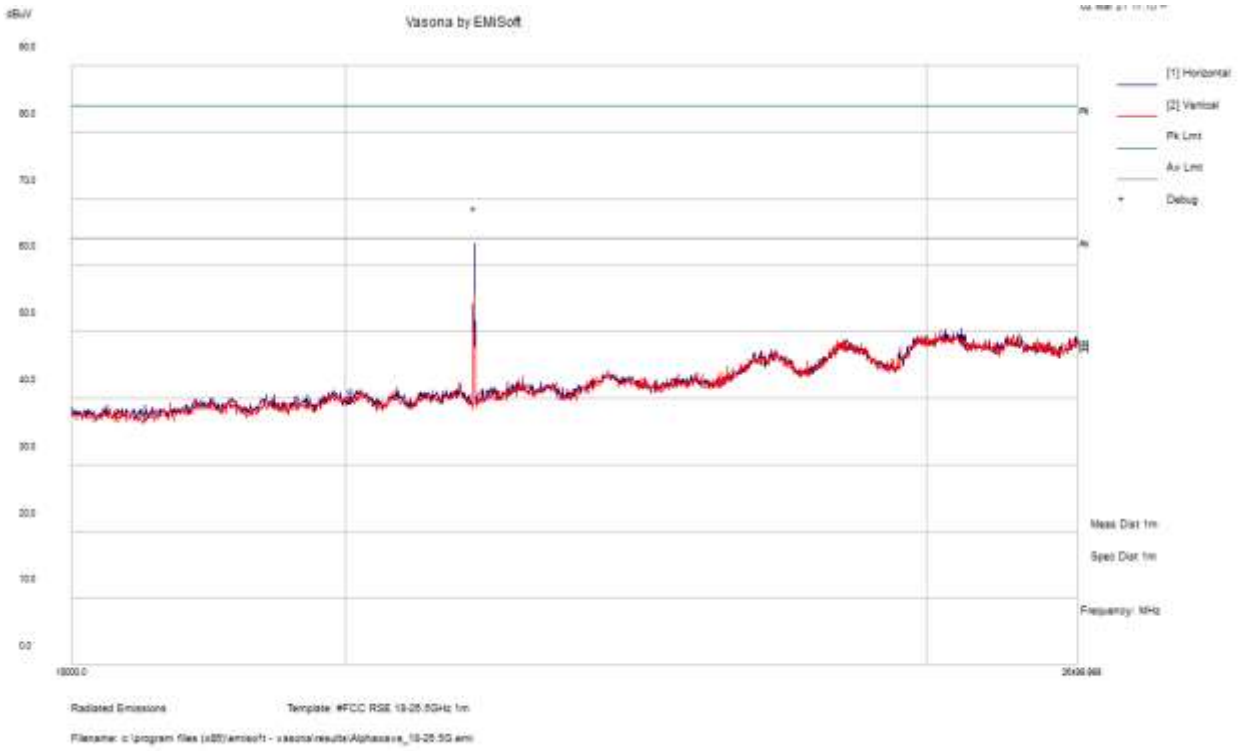
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel											
10504.5	76.21	360	232	V	38.20	6.74		121.15	127.95	-6.80	Ave
10506	75.6	360	232	V	38.20	6.74		120.54	127.95	-7.41	Ave
10507.5	75.89	360	232	V	38.20	6.74		120.83	127.95	-7.12	Ave
10500	23.79	360	232	V	38.20	6.74		68.73	71.15	-2.42	Ave
10550	22.21	360	232	V	38.20	6.74		67.15	71.15	-4.00	Ave
21015	40.62	355	150	H	34.89	20.20	21.65	74.07	107.50	-33.44	Peak
21015	37.35	320	117	V	34.89	20.20	21.65	70.80	107.50	-36.71	Peak
21015	38.37	355	150	H	34.89	20.20	21.65	71.81	87.50	-15.69	Ave
21015	33.00	320	117	V	34.89	20.20	21.65	66.45	87.50	-21.05	Ave
31518	40.49	307	150	H	39.52	35.33	34.84	80.50	107.50	-27.00	PK
31518	41.86	323	185	V	39.52	35.33	34.84	81.87	107.50	-25.63	PK
31518	33.24	307	150	H	39.52	35.33	34.84	73.25	87.50	-14.25	Ave
31518	34.42	323	185	V	39.52	35.33	34.84	74.43	87.50	-13.07	Ave
Middle Channel											
10523.5	76.17	360	232	V	38.20	6.74		121.11	127.95	-6.84	Ave
10525	75.33	360	232	V	38.20	6.74		120.27	127.95	-7.68	Ave
10526.5	75.94	360	232	V	38.20	6.74		120.88	127.95	-7.07	Ave
21053	23.48	360	232	V	38.20	6.74		68.42	71.11	-2.69	Peak
21053	22.37	360	232	V	38.20	6.74		67.31	71.11	-3.80	Peak
21053	41.80	345	150	V	34.89	20.20	21.65	75.25	107.50	-32.26	Peak
21053	37.62	317	140	V	34.89	20.20	21.65	71.07	107.50	-36.44	Peak
31575	38.99	345	150	H	34.89	20.20	21.65	72.43	87.50	-15.07	Ave
31575	31.97	317	140	V	34.89	20.20	21.65	65.41	87.50	-22.09	Ave
31575	41.27	12	150	H	39.52	35.33	34.84	81.28	107.50	-26.22	Peak
31575	39.66	350	150	V	39.52	35.33	34.84	79.67	107.50	-27.83	Peak
High Channel											
10542.5	75.79	360	232	V	38.20	6.74		120.73	127.95	-7.22	Ave
10544	75.74	360	232	H	38.20	6.74		120.68	127.95	-7.27	Ave
10546.5	74.9	360	232	V	38.20	6.74		119.84	127.95	-8.11	Ave
10500	23.58	360	232	H	38.20	6.74		68.52	70.73	-2.21	Ave
10550	24.47	360	232	V	38.20	6.74		69.41	70.73	-1.32	Ave
21085	42.98	335	150	H	34.89	20.20	21.65	76.43	107.50	-31.08	Peak
21085	38.85	320	115	V	34.89	20.20	21.65	72.30	107.50	-35.21	Peak
21085	39.53	335	150	H	34.89	20.20	21.65	72.98	87.50	-14.52	Ave
21085	35.42	320	115	V	34.89	20.20	21.65	68.86	87.50	-18.64	Ave
31632	42.67	330	190	H	39.52	35.33	34.84	82.68	107.50	-24.82	Peak
31632	40.14	350	150	V	39.52	35.33	34.84	80.15	107.50	-27.35	Peak
31632	36.07	330	190	H	39.52	35.33	34.84	76.08	87.50	-11.43	Ave
31632	31.57	350	150	V	39.52	35.33	34.84	71.57	87.50	-15.93	Ave

Note: The band edge limit is 50dBc from the fundamental.
Note: The fundamental and the band edge was measured at 3 meters with the radiated sample. The harmonics was measured at 1 meter with the conducted sample. The output at the antenna port was terminated.

1 – 18 GHz Worst Case Pre-Scan, Measured at 1 meter

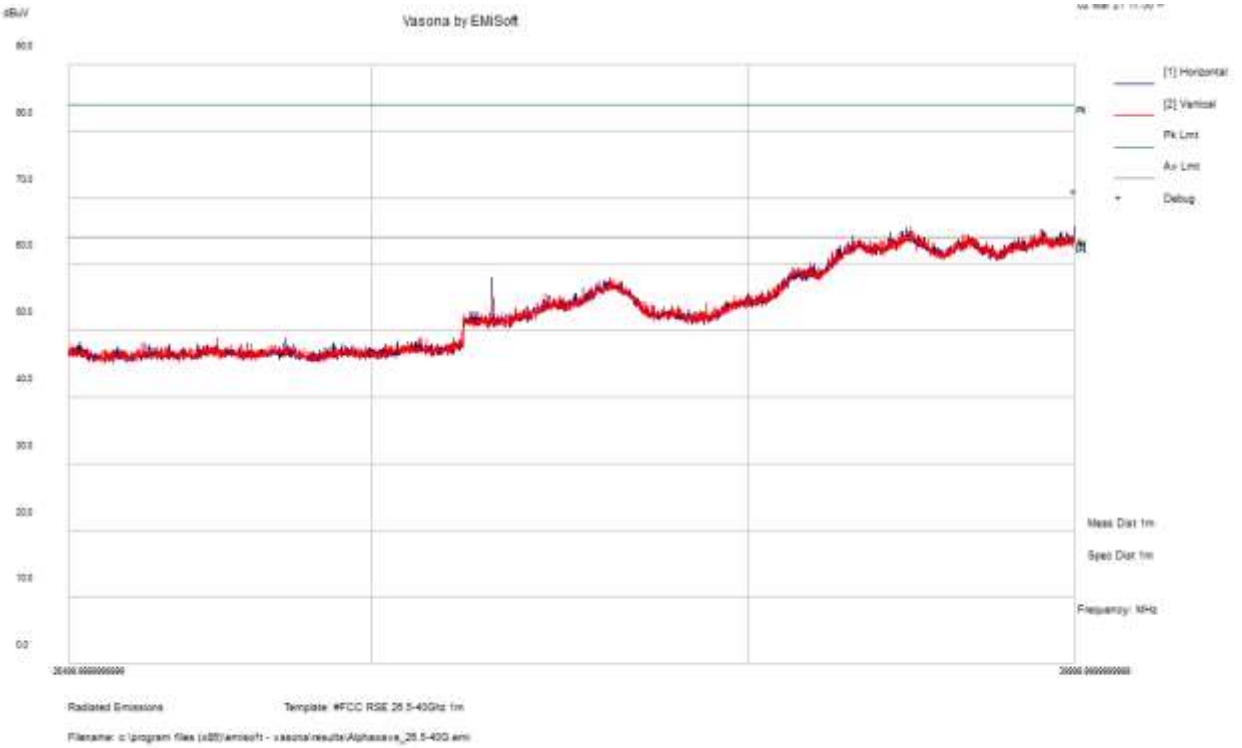


18 – 26.5 GHz Worst Case Pre-Scan, Measured at 1 meter



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
21015.053	51.2	5.77	56.97	183	H	29	84	-27.03	Peak
21015.053	54.07	5.77	59.84	183	H	29	64	-4.16	Average

26.5 – 40 GHz Worst Case Pre-Scan, Measured at 1 meter



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
39995.584	51.36	11.37	62.73	126	V	243	101.15	-38.42	Peak
39995.584	40.38	11.37	61.3	115	H	243	81.15	-19.85	Average

Above 40GHz, Measured at 1 meter

Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
40.30	25.16	24.1	49.26	100	H	0	101.15	-51.89	Peak
40.30	25.18	24.1	49.28	100	V	0	101.15	-51.87	Peak
40.33	13.43	24.1	37.53	100	H	0	81.15	-43.62	Average
40.33	12.83	24.1	36.93	100	V	0	81.15	-44.22	Average

8 FCC §15.215 (2) & ISEDC RSS-Gen §6.7 - Emission Bandwidth

8.1 Applicable Standards

FCC §15.215 and ISEDC RSS- Gen.

8.2 Measurement Procedure

The measurements are based on ANSI C63.10-2013 Section 6.9 Occupied bandwidth tests.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2019-11-07	2 years
-	RF cable	-	-	Each time[1]	N/A
-	Attenuator	-	-	Each time[1]	N/A

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

8.4 Test Environmental Conditions

Temperature:	24º C
Relative Humidity:	46 %
ATM Pressure:	102.1 KPa

The testing was performed by Zhao Zhao on 2021-03-04 at RF test site.

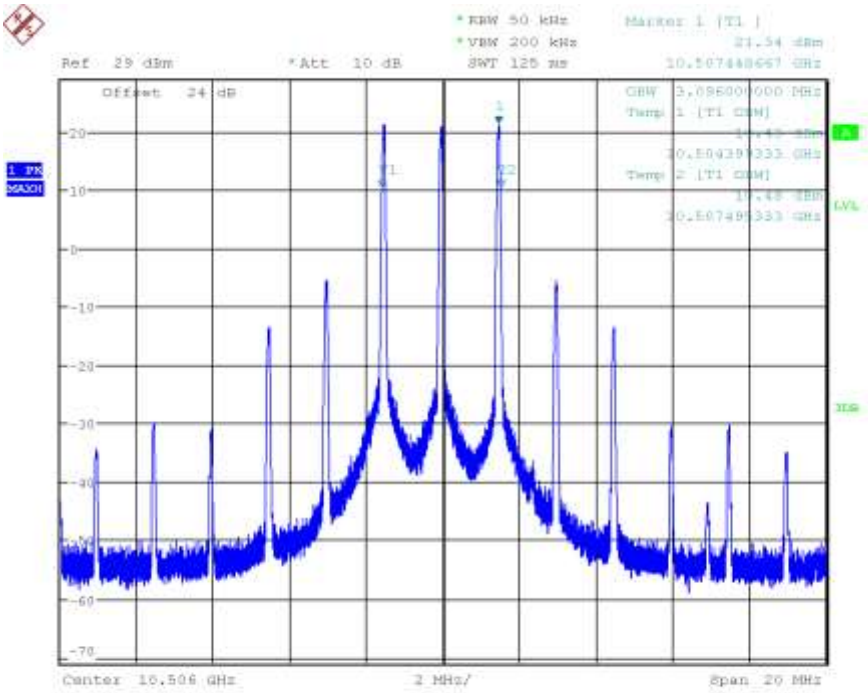
8.5 Test Results

Tone Configuration	Channel	99% OBW (MHz)	-20 dB OBW (MHz)
Minimum Tone Separation	Low	3.096	3.125
	Middle	3.096	3.269
	High	3.100	3.129
Maximum Tone Separation	Low	15.516	15.645
	Middle	15.462	15.725
	High	15.518	15.645

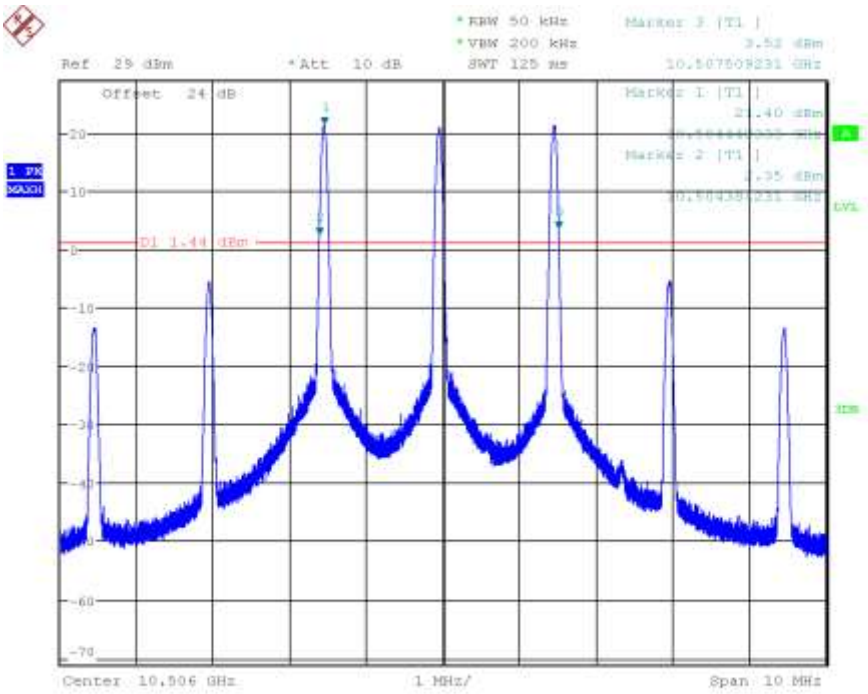
Please refer to the following plots for detailed test results.

Minimum Tone Separation

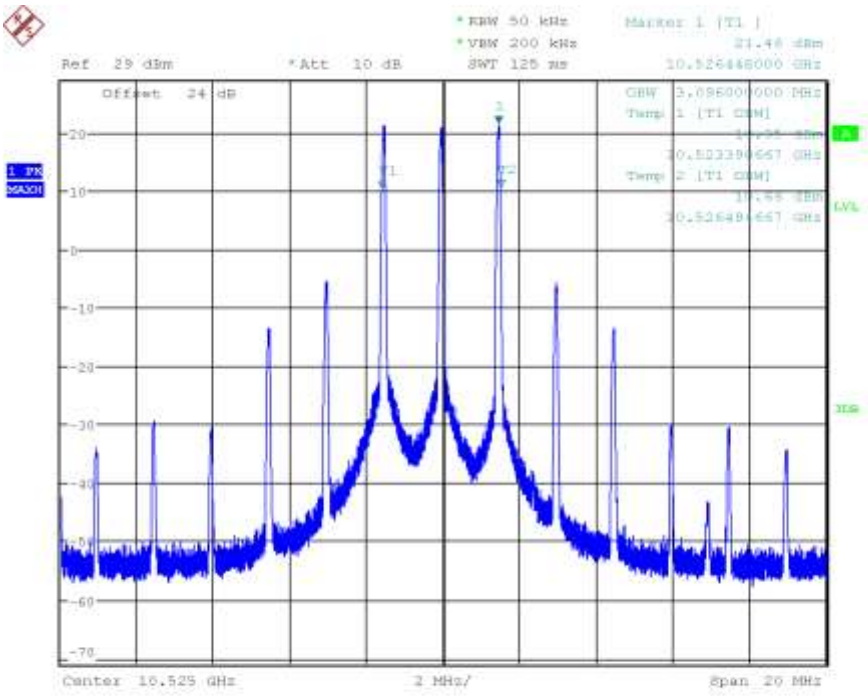
99% OBW, Low Channel



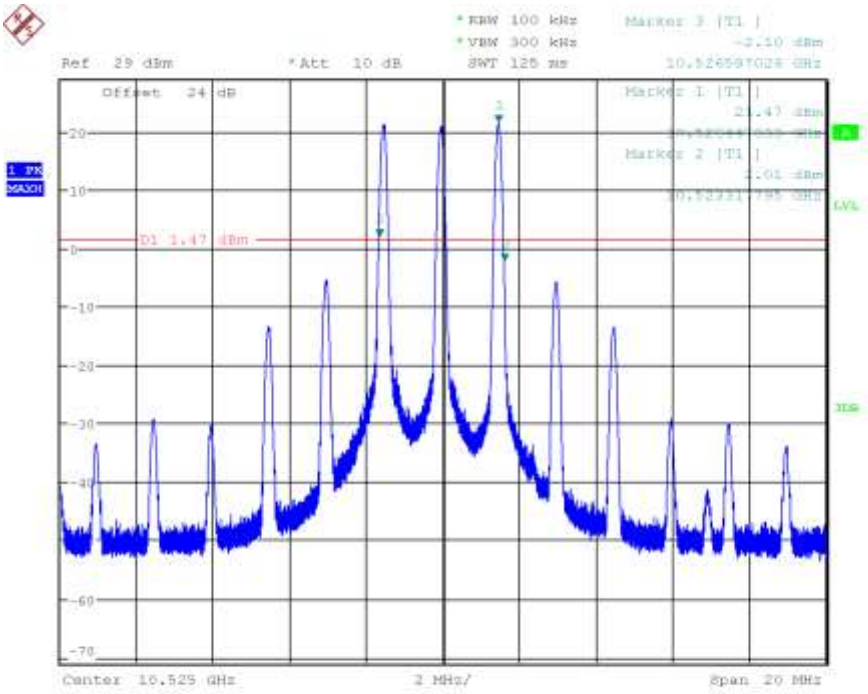
20dB OBW, Low Channel



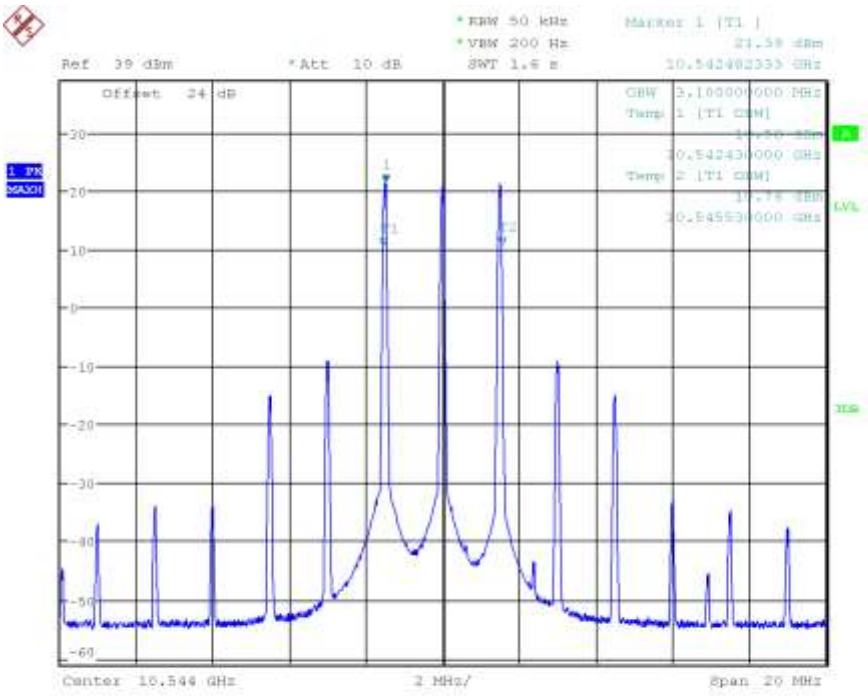
99% OBW, Mid Channel



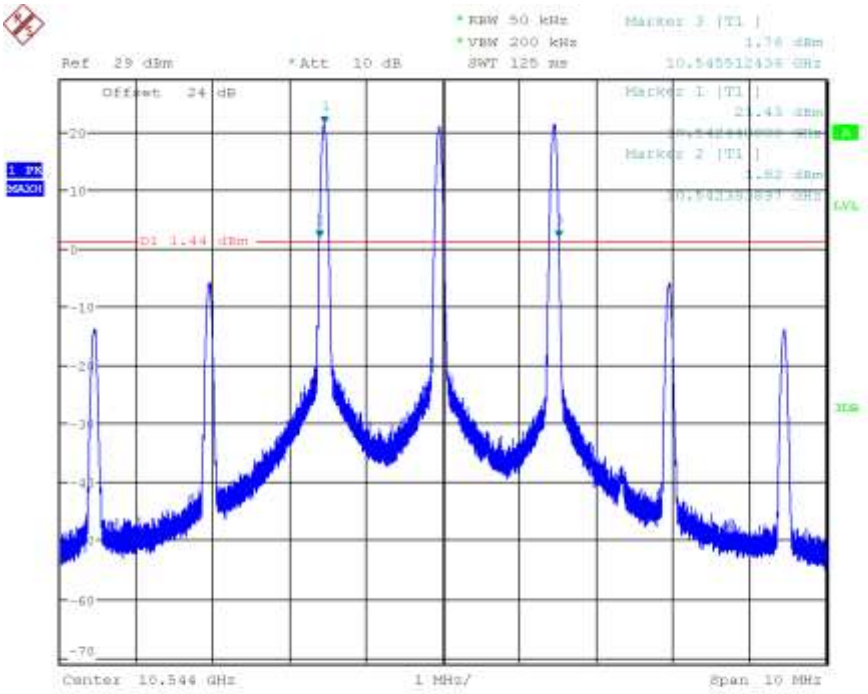
20dB OBW, Mid Channel



99% OBW, High Channel

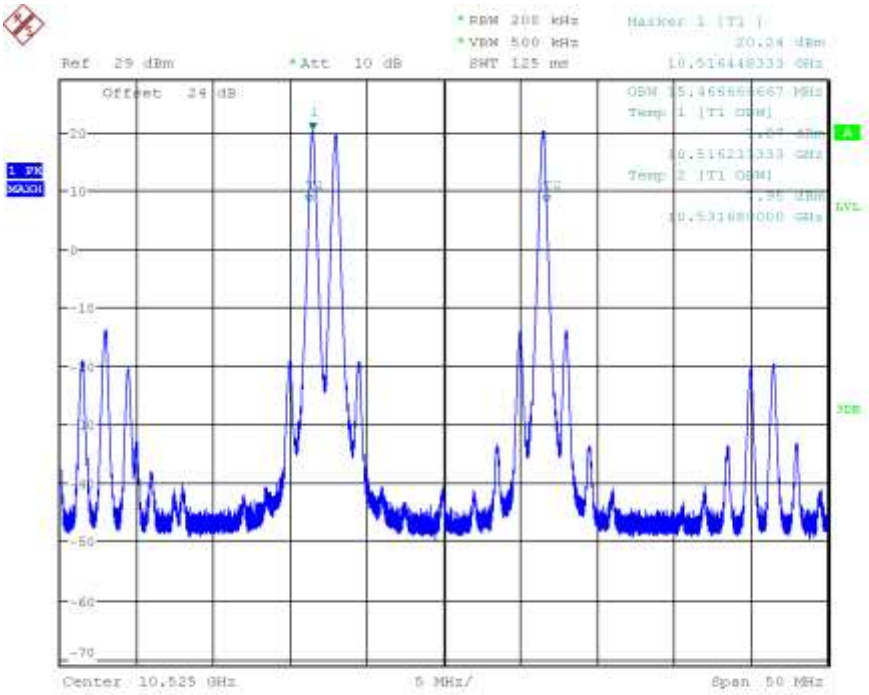


20dB OBW, High Channel

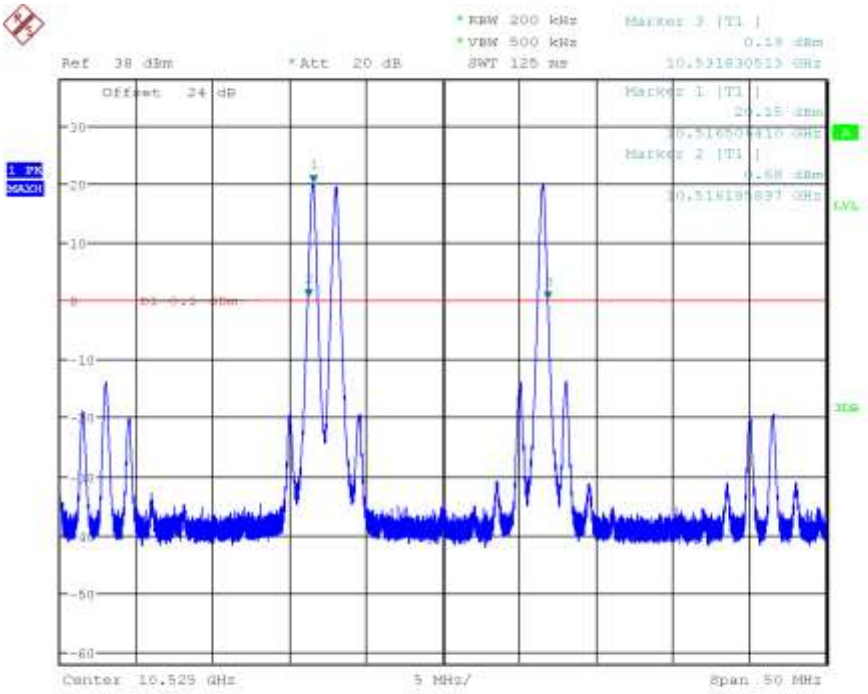


Maximum Tone Separation

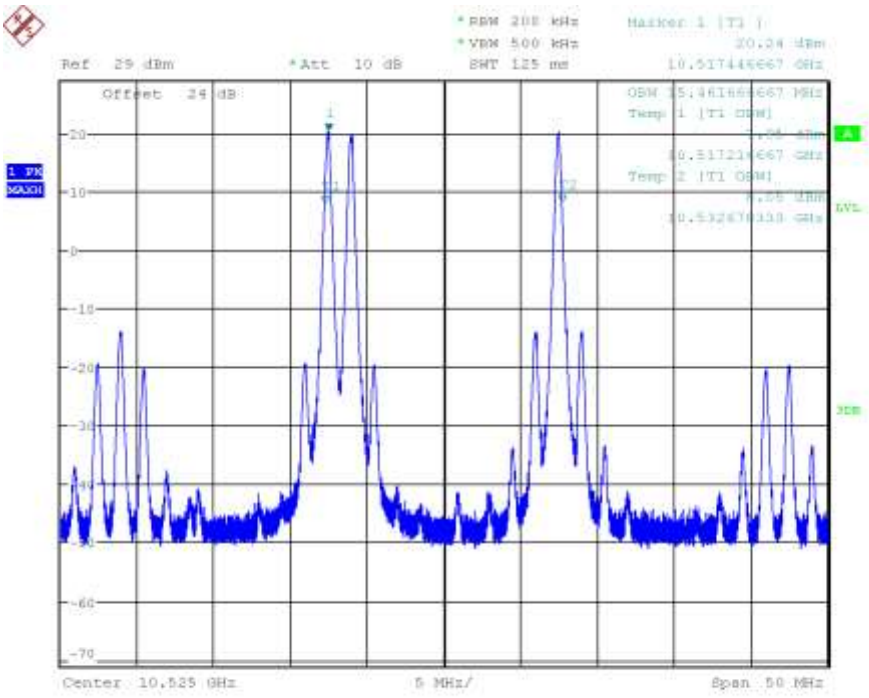
99% OBW, Low Channel



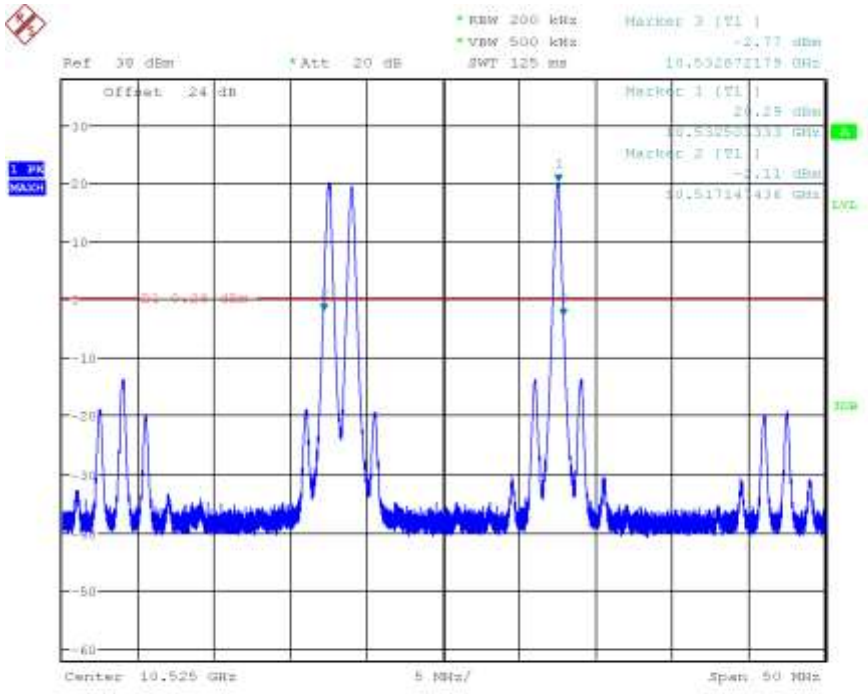
20dB OBW, Low Channel



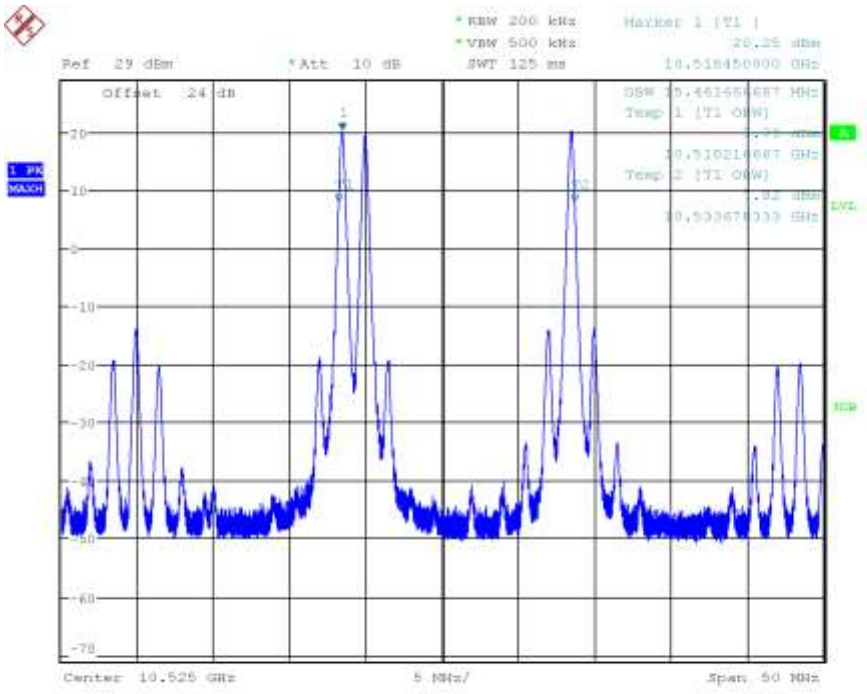
99% OBW, Mid Channel



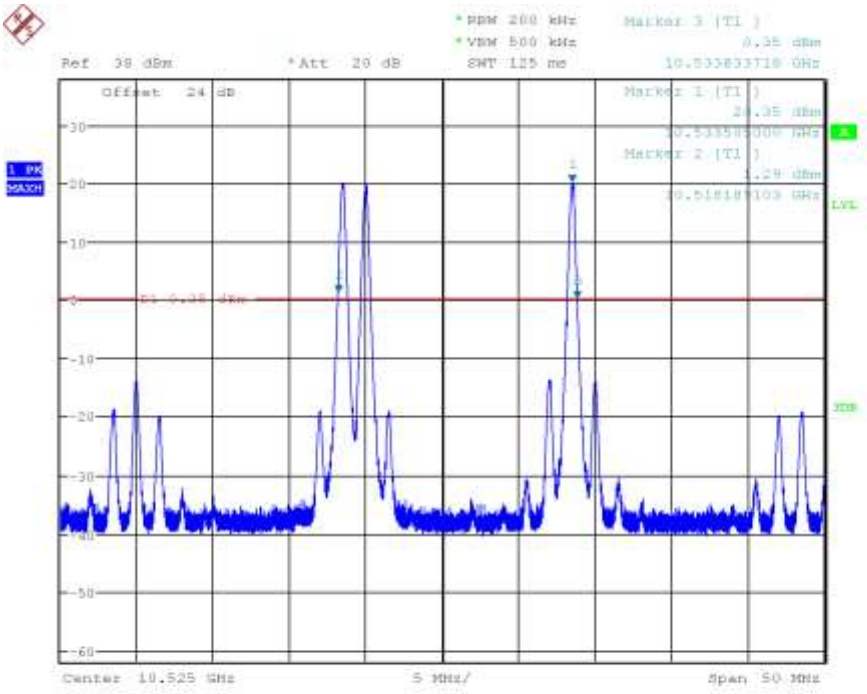
20dB OBW, Mid Channel



99% OBW, High Channel



20dB OBW, High Channel



9 FCC §15.245(b) & ISEDC RSS-210 Annex F1 e - Band Edges

9.1 Applicable Standards

According to FCC §15.245(b) (3), Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

According to ISEDC RSS-210 Annex F1 e. Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits specified in RSS-Gen, whichever is less stringent

9.2 Measurement Procedure

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

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

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSQ26	200749	2019-11-07	2 years
-	RF cable	-	-	Each time[1]	N/A
-	Attenuator	-	-	Each time[1]	N/A

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

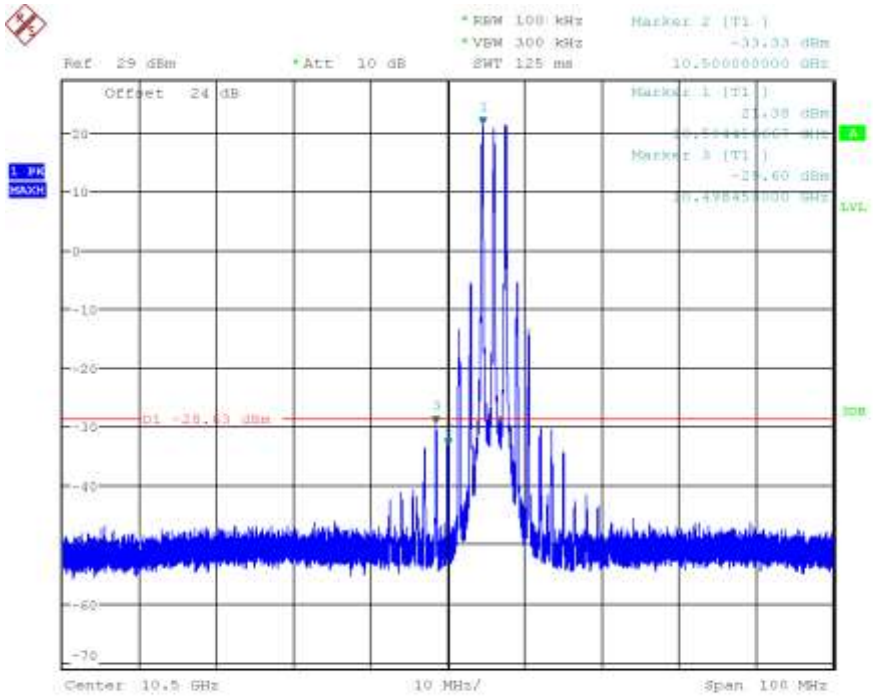
9.4 Test Environmental Conditions

Temperature:	24º C
Relative Humidity:	46 %
ATM Pressure:	102.1 KPa

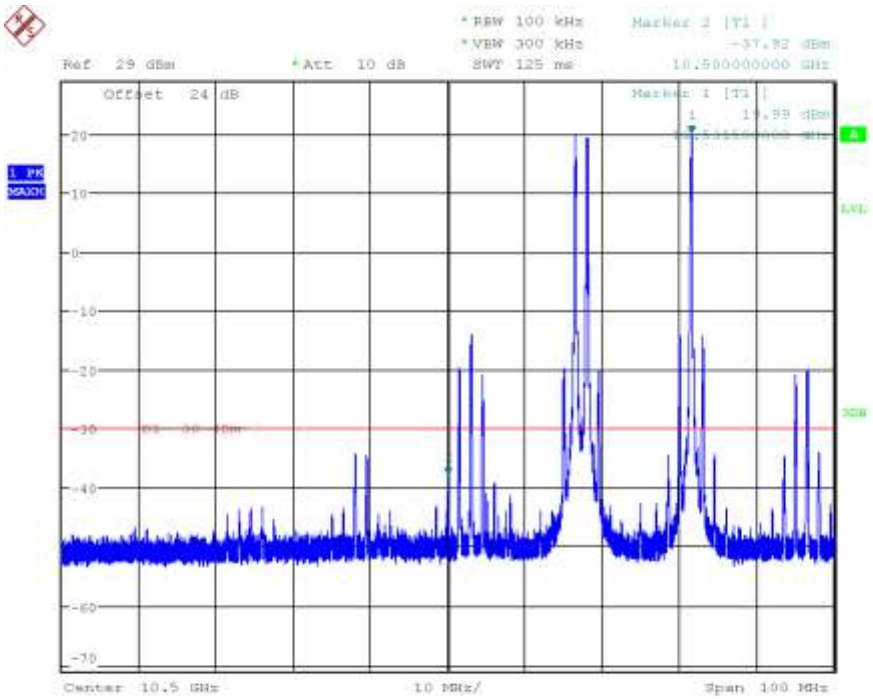
The testing was performed by Zhao Zhao on 2021-03-04 at RF test site.

9.5 Test Results

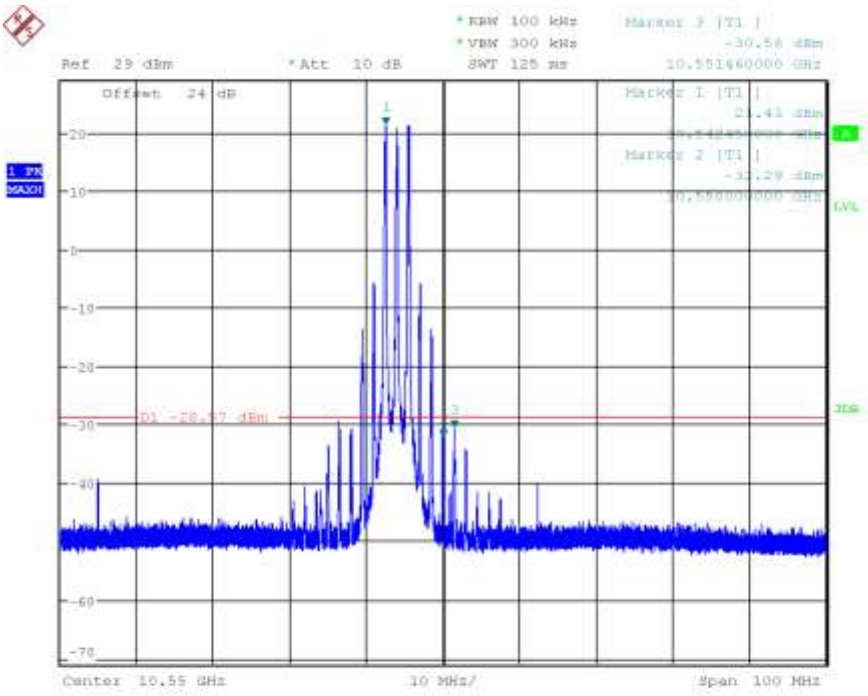
Low Channel, Minimum Tone Separation



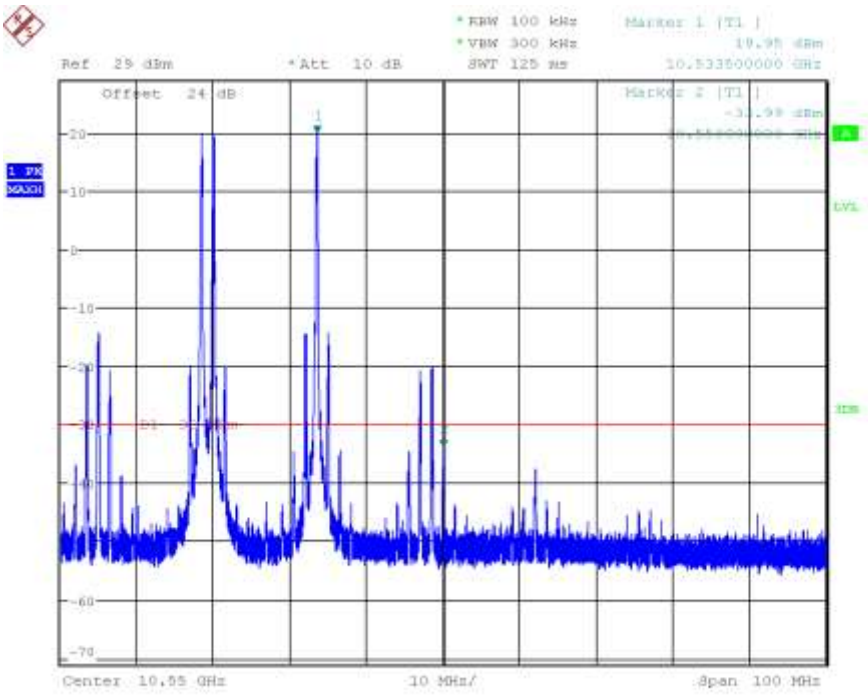
Low Channel, Maximum Tone Separation



High Channel, Minimum Tone Separation



High Channel, Maximum Tone Separation



10 Annex A (Normative) - Test Setup Photographs

Please refer to the attachment

11 Annex B (Normative) - EUT External Photographs

Please refer to the attachment

12 Annex C (Normative) - EUT Internal Photographs

Please refer to the attachment

13 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

--- END OF REPORT ---