




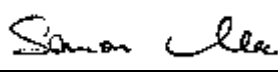
FCC PART 15, SUBPART C  
ISED C RSS-247, ISSUE 2, FEBRUARY 2017  
TEST REPORT

For

**Next Century Submetering Systems, LLC**

PO BOX 360 Tybee Island  
Florida 31328, USA

**FCC ID: 2AB8I-DC301**  
**IC: 20949-DC301**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Wireless Programmer
<b>Prepared By:</b>	Christian McCaig Test Engineer 
<b>Report Number</b>	R2001241-DSS
<b>Report Issue Date:</b>	2020-04-20
<b>Reviewed By:</b>	Simon Ma RF Supervisor 
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: (408) 732-9162, Fax: (408) 732-9164	



**Note:** This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by A2LA\*, NIST, or any agency of the Federal Government.

\* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "\*" (Rev 2)

## TABLE OF CONTENTS

<b>1</b>	<b>General Description.....</b>	<b>5</b>
1.1	Product Description for Equipment Under Test (EUT) .....	5
1.2	Mechanical Description of EUT .....	5
1.3	Objective.....	5
1.4	Related Submittal(s)/Grant(s) .....	5
1.5	Test Methodology .....	5
1.6	Measurement Uncertainty .....	6
1.7	Test Facility Registrations .....	6
1.8	Test Facility Accreditations .....	7
<b>2</b>	<b>System Test Configuration.....</b>	<b>9</b>
2.1	Justification.....	9
2.2	EUT Exercise Software.....	9
2.3	Equipment Modifications.....	9
2.4	Local Support Equipment .....	9
2.5	Remote Support Equipment.....	9
2.6	Interface Ports and Cabling.....	9
<b>3</b>	<b>Summary of Test Results .....</b>	<b>10</b>
<b>4</b>	<b>FCC §15.203 &amp; ISEDC RSS-Gen §6.8 - Antenna Requirements .....</b>	<b>11</b>
4.1	Applicable Standards .....	11
4.2	Antenna Description .....	11
<b>5</b>	<b>FCC §2.1093, §15.247(i) &amp; ISEDC RSS-102 - RF Exposure.....</b>	<b>12</b>
5.1	Applicable Standards .....	12
5.2	RF Exposure Evaluation Exemption for FCC.....	13
5.3	RF Exposure Evaluation Exemption for IC .....	13
<b>6</b>	<b>FCC §15.207 &amp; ISEDC RSS-Gen §8.8 - AC Line Conducted Emissions.....</b>	<b>14</b>
6.1	Applicable Standards .....	14
6.2	Test Setup .....	14
6.3	Test Procedure .....	14
6.4	Corrected Amplitude and Margin Calculation .....	15
6.5	Test Equipment List and Details.....	15
6.6	Test Environmental Conditions .....	15
6.7	Summary of Test Results .....	16
6.8	Conducted Emissions Test Plots and Data.....	17
<b>7</b>	<b>FCC §15.209, §15.247(d) &amp; ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions.....</b>	<b>19</b>
7.1	Applicable Standards .....	19
7.2	Test Setup .....	21
7.3	Test Procedure .....	21
7.4	Corrected Amplitude & Margin Calculation.....	22
7.5	Test Equipment List and Details.....	22
7.6	Test Environmental Conditions .....	23
7.7	Summary of Test Results .....	23
7.8	Radiated Emissions Test Results .....	24
<b>8</b>	<b>FCC §15.247(a)(1)(i) &amp; ISEDC RSS-247 §5.1(c) - Emission Bandwidth .....</b>	<b>28</b>
8.1	Applicable Standards .....	28
8.2	Measurement Procedure.....	28
8.3	Test Equipment List and Details.....	28
8.4	Test Environmental Conditions .....	28
8.5	Test Results.....	29
<b>9</b>	<b>FCC §15.247(b)(2) &amp; ISEDC RSS-247 §5.4(a) - Output Power .....</b>	<b>30</b>
9.1	Applicable Standards .....	30
9.2	Measurement Procedure.....	30
9.3	Test Equipment List and Details.....	30
9.4	Test Environmental Conditions .....	30
9.5	Test Results.....	31

<b>10 FCC §15.247(d) &amp; ISEDC RSS-247 §5.5 - 100 kHz Bandwidth of Band Edges.....</b>	<b>33</b>
10.1 Applicable Standards .....	33
10.2 Measurement Procedure.....	33
10.3 Test Equipment List and Details .....	33
10.4 Test Environmental Conditions .....	33
10.5 Test Results.....	34
<b>11 FCC §15.247(a)(1)(i) &amp; ISEDC RSS-247 §5.1(c) - Dwell Time.....</b>	<b>36</b>
11.1 Applicable Standards .....	36
11.2 Measurement Procedure.....	36
11.3 Test Equipment List and Details .....	36
11.4 Test Environmental Conditions .....	37
11.5 Test Results.....	37
<b>12 FCC §15.247(a)(1)(i) &amp; ISEDC RSS-247 §5.1(c) - Number of Hopping Channels .....</b>	<b>39</b>
12.1 Applicable Standards .....	39
12.2 Test Procedure .....	39
12.3 Test Equipment List and Details .....	39
12.4 Test Environmental Conditions .....	39
12.5 Test Results.....	40
<b>13 FCC §15.247(a)(1) &amp; ISEDC RSS-247 §5.1(b) - Hopping Channel Separation .....</b>	<b>41</b>
13.1 Applicable Standards .....	41
13.2 Test Procedure .....	41
13.3 Test Equipment List and Details .....	41
13.4 Test Environmental Conditions .....	41
13.5 Test Results.....	42
<b>14 FCC §15.247(d) &amp; ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals .....</b>	<b>43</b>
14.1 Applicable Standards .....	43
14.2 Test Procedure .....	43
14.3 Test Equipment List and Details .....	43
13.4 Test Environmental Conditions .....	44
13.5 Test Results.....	44
<b>15 Annex A (Normative) - Test Setup Photographs.....</b>	<b>46</b>
<b>16 Annex B (Normative) - EUT External Photographs.....</b>	<b>47</b>
<b>17 Annex C (Normative) - EUT Internal Photographs .....</b>	<b>48</b>
<b>18 Annex D (Normative) - A2LA Electrical Testing Certificate.....</b>	<b>49</b>

## DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2001241-DSS	Original Report	2020-04-20

## **1 General Description**

---

### **1.1 Product Description for Equipment Under Test (EUT)**

This test and measurement report was prepared on behalf of *Next Century Submetering Systems, LLC* and their product model: *DC301*, FCC ID: 2AB8I-DC301; IC: 20949-DC301 or the “EUT” as referred to in this report. It is a Wireless Programmer that operates within the 910.2 - 920 MHz frequency range.

### **1.2 Mechanical Description of EUT**

The EUT measures approximately 65 mm (Length), 65 mm (Width), 24 mm (Thickness), and weighs 0.15kg.

*The data gathered are from a typical production sample provided by Next Century Submetering Systems, LLC with serial number: F1000012.*

### **1.3 Objective**

This report was prepared on behalf of *Next Century Submetering Systems, LLC*, in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission’s rules and ISED RSS-247 Issue 2, February 2017.

The objective was to determine compliance with FCC Part 15.247 and ISED RSS-247 for Antenna Requirements, Conducted and Radiated Spurious Emissions, 99% & 20 dB Bandwidth, Output Power, 100 kHz Bandwidth of Band Edges Measurement, Dwell Time, Number of Hopping Channels, and Hopping Channel Separation.

### **1.4 Related Submittal(s)/Grant(s)**

Equipment Class: DTS

### **1.5 Test Methodology**

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

## 1.6 Measurement Uncertainty

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

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

## 1.7 Test Facility Registrations

BACL's 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, 3<sup>rd</sup>-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 - ISED) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - o 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:
  - o ENERGY STAR Recognized Test Laboratory – US EPA
  - o Telecommunications Certification Body (TCB) – US FCC;
  - o Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;



## 2 System Test Configuration

### 2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 558074 D01 DTS Meas Guidance v05r02.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case configuration are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations. The final testing was conducted with the following power setting.

	Channel Frequency (MHz)	Power Setting
Low Channel	910.2	59
Middle Channel	915.0	59
High Channel	920.0	59

### 2.2 EUT Exercise Software

The test utility used was PuTTY; the software was verified by *Christopher Casteel* to comply with the standard requirements being tested against.

### 2.3 Equipment Modifications

None

### 2.4 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

### 2.5 Remote Support Equipment

None

### 2.6 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB to UART Cable	< 1 m	Laptop	EUT
SMA Cable	< 1 m	EUT	PSA

### 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 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
FCC §2.1093, §15.247(i) ISEDC RSS-102	RF Exposure	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(c)	99% & 20 dB Emission Bandwidth	Compliant
FCC §15.247(b)(2) ISEDC RSS-247 §5.4(a)	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)	Dwell Time	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(b)	Hopping Channel Separation	Compliant
FCC §2.1051, §15.247(d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	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 antenna used by the EUT is a PCB trace antenna.

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Inverted F Antenna	902 – 928	0

## 5 FCC §2.1093, §15.247(i) & ISEDC RSS-102 - RF Exposure

### 5.1 Applicable Standards

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

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

$$\frac{[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})]}{\sqrt{f(\text{GHz})}} \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

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

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

- 2) At 100 MHz to 6 GHz and for test separation distances  $> 50$  mm, the SAR test exclusion threshold is determined according to the following, and as illustrated in Appendix B:
  - a)  $[\text{Power allowed at numeric threshold for 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot (f(\text{MHz})/150)] \text{ mW}$ , at 100 MHz to 1500 MHz
  - b)  $[\text{Power allowed at numeric threshold for 50 mm in step 1}) + (\text{test separation distance} - 50 \text{ mm}) \cdot 10] \text{ mW}$  at  $> 1500$  MHz and  $\leq 6$  GHz
- 3) At frequencies below 100 MHz, the following may be considered for SAR test exclusion, and as illustrated in Appendix C:
  - a) The power threshold at the corresponding test separation distance at 100 MHz in step 2) is multiplied by  $[1 + \log(100/f(\text{MHz}))]$  for test separation distances  $> 50$  mm and  $< 200$  mm
  - b) The power threshold determined by the equation in a) for 50 mm and 100 MHz is multiplied by  $\frac{1}{2}$  for test separation distances  $\leq 50$  mm
  - c) SAR measurement procedures are not established below 100 MHz. When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any test results to be acceptable.

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

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

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

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

## 5.2 RF Exposure Evaluation Exemption for FCC

The maximum peak conducted output power measured from the EUT is 16.76 dBm (47.42 mW), the antenna gain is 0 dBi. Therefore, the maximum EIRP is 16.76 dBm (47.42 mW). Applying the Duty Cycle factor (2%)[Note<sup>1</sup>], the maximum average EIRP then becomes 0.9484 mW

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] [\sqrt{f(\text{GHz})}] = (0.9484 \text{ mW}/5\text{mm}) * \sqrt{0.9102} = 0.181$ , which is less than 3.0. Therefore, FCC SAR testing is excluded.

## 5.3 RF Exposure Evaluation Exemption for IC

Maximum peak EIRP power = 16.76 dBm + 0 dBi = 16.76 dBm (47.42 mW). Applying the Duty Cycle factor (2%)[Note<sup>1</sup>], the maximum average EIRP then becomes 0.9484 mW, which is less than 16.29 mW at 910.2 MHz. Therefore, IC SAR testing is not required.

Note<sup>1</sup>: Per manufacturer: Radio implements 50 channel FHSS with no transmission taking more than 400ms on each channel used, with no channel reused by a single device for 20 seconds

## 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  $\mu$ H/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 <sup>Note1</sup>	56 to 46 <sup>Note2</sup>
0.5-5	56	46
5-30	60	50

*Note1: Decreases with the logarithm of the frequency.*

*Note2: A linear average detector is required*

### 6.2 Test Setup

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

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

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

### 6.3 Test Procedure

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

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

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

## 6.4 Corrected Amplitude and Margin Calculation

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

$$CA = A_i + CL + \text{Atten}$$

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

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

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

## 6.5 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	2018-07-05	2 years
Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101964	2019-07-31	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2020-02-27	1 year
Fairview Microwave	Micro-Coax Cable	FMC0101223-360	102515	2019-07-27	1 year
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160130	2019-04-11	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

**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 (dated 02 October 2018) “A2LA Policy on Metrological Traceability”.

## 6.6 Test Environmental Conditions

Temperature:	19 °C
Relative Humidity:	34 %
ATM Pressure:	102.2 kPa

The testing was performed by Christian McCaig on 04-08-2020 in ground plane test site.

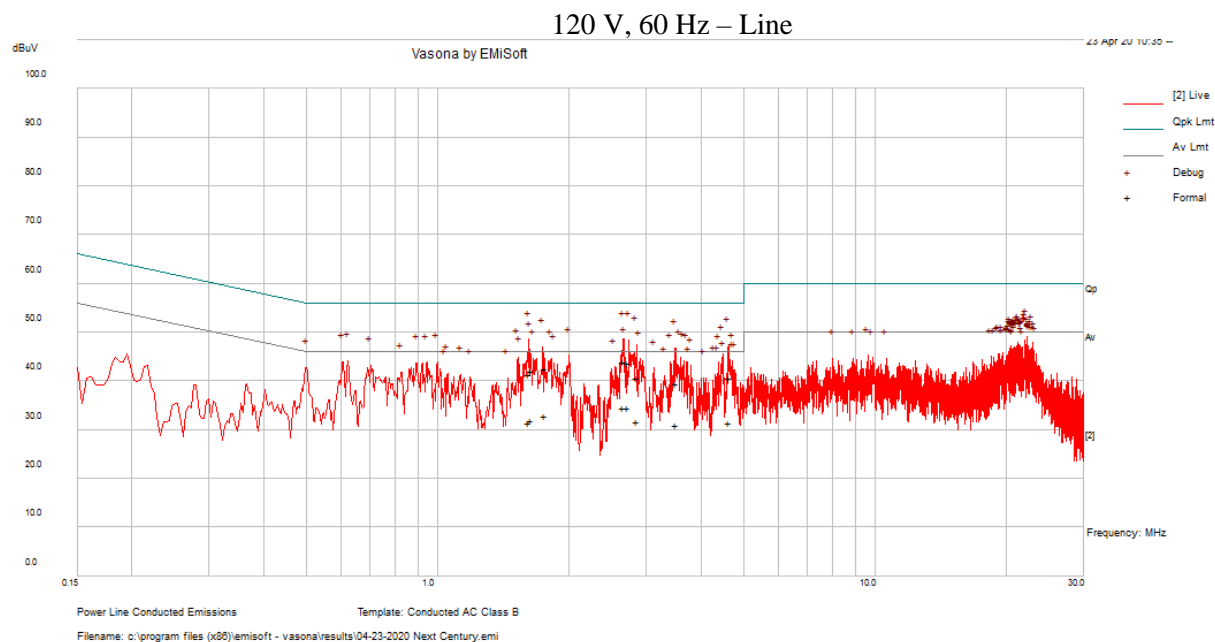
## 6.7 Summary of Test Results

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)
-11.39	2.662644	Line	0.15-30

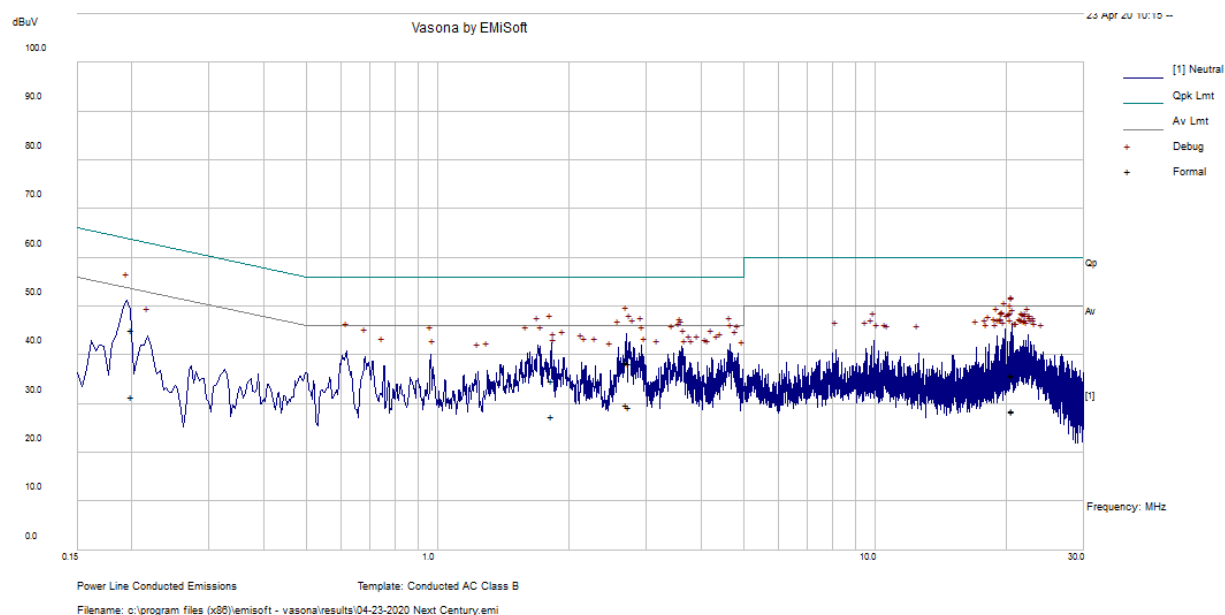


## 6.8 Conducted Emissions Test Plots and Data



Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
2.662644	44.03	Line	56	-11.97	QP
1.614062	41.41	Line	56	-14.59	QP
2.722718	43.82	Line	56	-12.18	QP
2.855795	40.69	Line	56	-15.31	QP
4.629278	40.61	Line	56	-15.39	QP
1.757619	42.6	Line	56	-13.4	QP
3.50273	39.52	Line	56	-16.48	QP
1.634586	42.11	Line	56	-13.89	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
2.662644	34.61	Line	46	-11.39	Ave.
1.614062	31.38	Line	46	-14.62	Ave.
2.722718	34.59	Line	46	-11.41	Ave.
2.855795	31.67	Line	46	-14.33	Ave.
4.629278	31.37	Line	46	-14.63	Ave.
1.757619	32.77	Line	46	-13.23	Ave.
3.50273	31.01	Line	46	-14.99	Ave.
1.634586	31.99	Line	46	-14.01	Ave.

**120 V, 60 Hz – Neutral**

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
2.708664	38.52	Neutral	56	-17.48	QP
0.199962	45.03	Neutral	63.61	-18.58	QP
2.737775	38.23	Neutral	56	-17.77	QP
1.827341	34.84	Neutral	56	-21.16	QP
20.55617	35.71	Neutral	60	-24.29	QP
20.57031	35.83	Neutral	60	-24.17	QP

Frequency (MHz)	Corrected Amplitude (dBuV)	Conductor (Line/Neutral)	Limit (dBuV)	Margin (dB)	Detector (QP/Ave.)
2.708664	29.87	Neutral	46	-16.13	Ave.
0.199962	31.38	Neutral	53.61	-22.23	Ave.
2.737775	29.38	Neutral	46	-16.62	Ave.
1.827341	27.37	Neutral	46	-18.63	Ave.
20.55617	28.5	Neutral	50	-21.5	Ave.
20.57031	28.44	Neutral	50	-21.56	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(b): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per FCC §15.205(a) 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 ISED RSS-Gen §8.9, except when the requirements applicable to a given device state otherwise, emission from licence-exempt transmitters shall comply with the field strength limits shown in the table below. Additionally, 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**

<b>Frequency (MHz)</b>	<b>Field Strength (<math>\mu\text{V/m}</math> at 3 meters)</b>
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 ISED RSS-247 §5.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section 5.4(d), 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 ISED RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

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

## 7.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto

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

## 7.4 Corrected Amplitude & Margin Calculation

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

## 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	2018-10-26	2 years
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	1 year
Sunol Sciences	System Controller	SC110V	122303-1	N/R	N/A
Sunol Sciences	Biconi-Log Antenna	JB3	A020106-2	2019-11-20	2 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2 years
IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs on Both Sides	KPS-1571AN-2400	DC 1922	2019-06-07	1 year
-	SMA cable	-	-	Each time <sup>1</sup>	N/A
-	Notch Filter	-	-	Each time <sup>1</sup>	N/A
MDP Digital	Times Microwave LMR 400 UltraFex Coaxial Cable 35'	LMR400UF	BACL1904161	2019-04-16	1 year
Agilent	Pre-Amplifier	8447D	2443A04374	2019-08-13	1 year
Vasona	Test Software	V6.0 build 11	10400213	N/R	N/A
-	Sensitivity Box	-	-	2019-10-02	1 Year
HP/Agilent	Pre-Amplifier	8449B	3008A0113	2019-09-30	1 year

Note<sup>1</sup>: 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 A2LA Policy P102 (dated 02 October 2018) “A2LA Policy on Metrological Traceability”.*

## 7.6 Test Environmental Conditions

<b>Temperature:</b>	19 °C
<b>Relative Humidity:</b>	34 %
<b>ATM Pressure:</b>	102.2 kPa

*The testing was performed by Christian McCaig from 04-08-2020 to 04-13-2020 in 5m chamber 3.*

## 7.7 Summary of Test Results

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

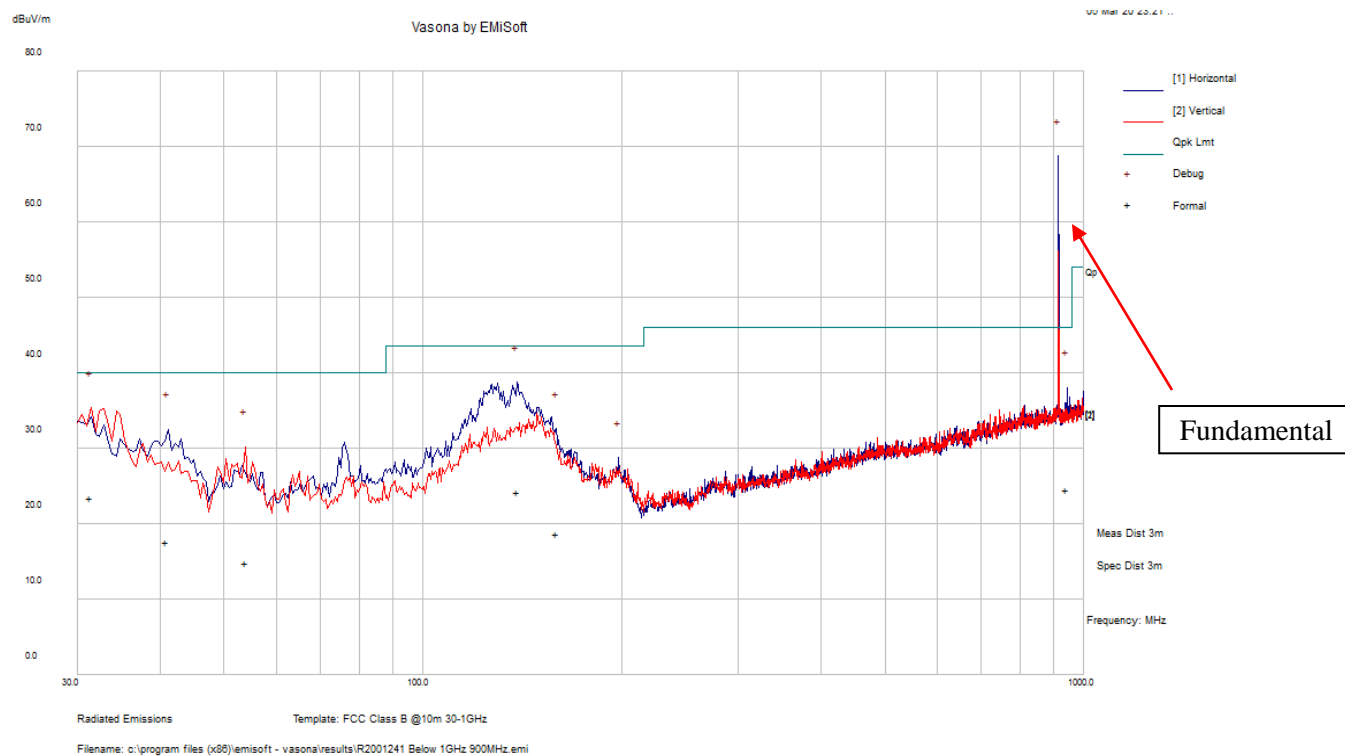
<b>Mode: Transmitting</b>			
<b>Margin (dB)</b>	<b>Frequency (MHz)</b>	<b>Polarization (Horizontal/Vertical)</b>	<b>Transmitting Channel (MHz)</b>
-0.91	4600	V	915

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

## 7.8 Radiated Emissions Test Results

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

*Worst Case: 2-GFSK 915 MHz*



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comment
31.3935	23.51	157	V	341	40	-16.49	QP
138.8833	24.21	200	H	26	43.5	-19.29	QP
40.84175	17.64	249	H	198	40	-22.36	QP
942.929	24.56	264	H	145	46	-21.44	QP
53.95225	14.84	126	H	302	40	-25.16	QP
159.1585	18.71	272	H	150	43.5	-24.79	QP

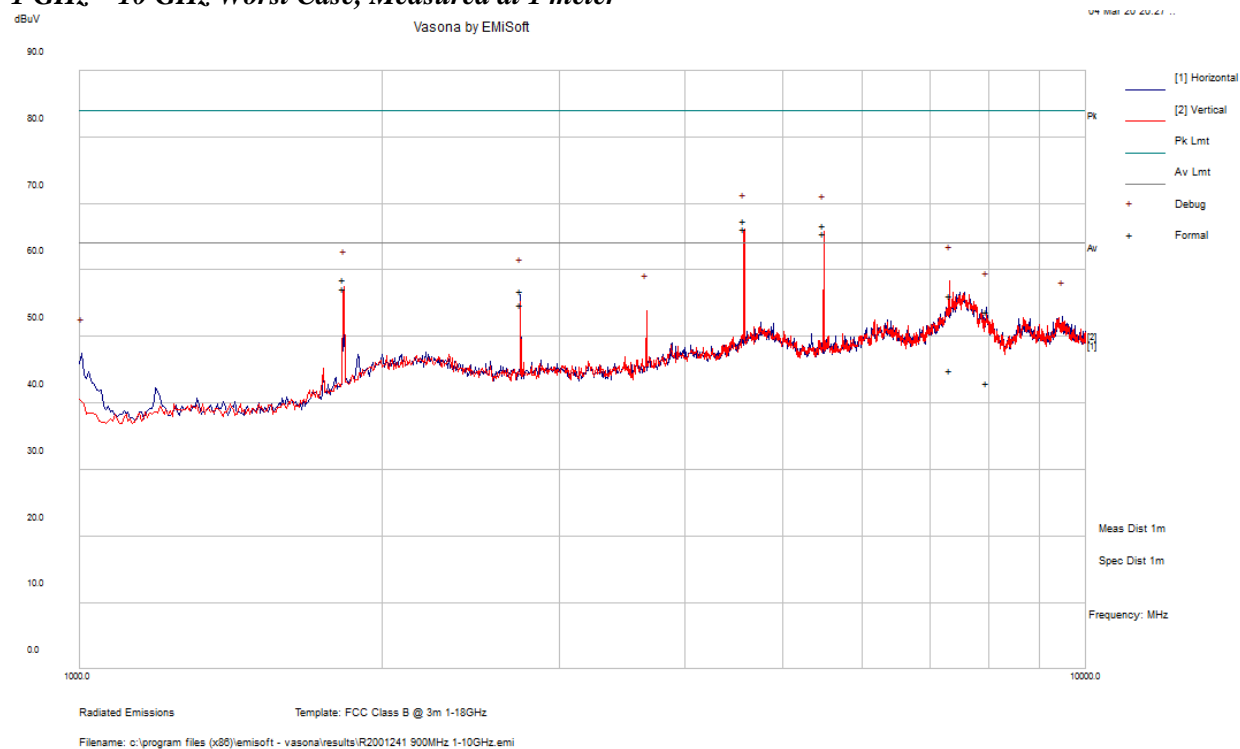


**2) 1-10 GHz****2-GFSK mode**

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/ISED		Comment
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel Frequency: 910.2 MHz											
Fund.	118.55	10	100	H	28.40	1.85	24.31	124.50	-	-	PK
Fund.	117.69	255	110	V	28.40	1.85	24.31	123.64	-	-	PK
4575	51.70	40	100	H	34.40	9.72	37.47	58.35	74	-15.65	PK
4575	44.89	40	100	H	34.40	9.72	37.47	51.54	54	-2.46	AV
4575	52.52	345	300	V	34.40	9.72	37.47	59.17	74	-14.83	PK
4575	46.37	345	300	V	34.40	9.72	37.47	53.02	54	-0.98	AV
5490	52.39	55	260	H	34.80	11.72	37.44	61.47	104.5	-43.03	PK <sup>1</sup>
5490	56.78	5	290	V	34.80	11.72	37.44	65.86	103.64	-37.78	PK <sup>1</sup>
1830	52.67	280	140	H	30.60	6.14	39.77	49.64	104.5	-54.86	PK <sup>1</sup>
1830	51.89	0	245	V	30.60	6.14	39.77	48.86	103.64	-54.78	PK <sup>1</sup>
2745	51.82	50	145	H	32.30	6.78	38.91	52.00	74	-22.01	PK
2745	42.26	50	145	H	32.30	6.78	38.91	42.44	54	-11.56	AV
2745	51.62	310	245	V	32.30	6.78	38.91	51.80	74	-22.21	PK
2745	41.99	310	245	V	32.30	6.78	38.91	42.16	54	-11.84	AV

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/ISED		Comment
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Middle Channel Frequency: 915 MHz											
Fund.	118.55	10	100	H	28.40	1.85	24.31	124.50	-	-	PK
Fund.	117.69	255	110	V	28.40	1.85	24.31	123.64	-	-	PK
4600	51.98	45	100	H	34.40	9.72	37.47	58.63	74	-15.37	PK
4600	44.26	45	100	H	34.40	9.72	37.47	50.92	54	-3.09	AV
4600	53.75	5	300	V	34.40	9.72	37.47	60.40	74	-13.60	PK
4600	46.44	5	300	V	34.40	9.72	37.47	53.09	54	-0.91	AV
5520	53.00	325	100	H	34.80	11.72	37.44	62.08	104.5	-42.42	PK <sup>1</sup>
5520	56.95	0	300	V	34.80	11.72	37.44	66.03	103.64	-37.61	PK <sup>1</sup>
1840	52.26	315	130	H	30.60	6.14	39.77	49.23	104.5	-55.27	PK <sup>1</sup>
1840	51.79	15	300	V	30.60	6.14	39.77	48.76	103.64	-54.88	PK <sup>1</sup>
2760	51.42	80	110	H	32.30	6.78	38.91	51.60	74	-22.41	PK
2760	42.14	80	110	H	32.30	6.78	38.91	42.31	54	-11.69	AV
2760	51.47	15	285	V	32.30	6.78	38.91	51.65	74	-22.36	PK
2760	41.98	15	285	V	32.30	6.78	38.91	42.16	54	-11.84	AV

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/ISED		Comment
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
High Channel Frequency: 920 MHz											
Fund.	118.55	10	100	H	28.40	1.85	24.31	124.50	-	-	PK
Fund.	117.69	255	110	V	28.40	1.85	24.31	123.64	-	-	PK
4551	50.75	40	110	H	34.40	9.72	37.47	57.40	74	-16.60	PK
4551	43.76	40	110	H	34.40	9.72	37.47	50.41	54	-3.59	AV
4551	52.54	360	300	V	34.40	9.72	37.47	59.19	74	-14.81	PK
4551	46.44	360	300	V	34.40	9.72	37.47	53.10	54	-0.91	AV
5461.2	51.75	315	230	H	34.80	11.72	37.44	60.83	104.5	-43.67	PK <sup>1</sup>
5461.2	56.15	0	260	V	34.80	11.72	37.44	65.23	103.64	-38.41	PK <sup>1</sup>
1820.4	51.75	300	160	H	30.60	6.14	39.77	48.72	104.5	-55.78	PK <sup>1</sup>
1820.4	51.31	360	300	V	30.60	6.14	39.77	48.28	103.64	-55.36	PK <sup>1</sup>
2730.6	51.44	30	160	H	32.30	6.78	38.91	51.62	74	-22.39	PK
2730.6	41.19	30	160	H	32.30	6.78	38.91	41.36	54	-12.64	AV
2730.6	50.77	15	280	V	32.30	6.78	38.91	50.95	74	-23.06	PK
2730.6	40.28	15	280	V	32.30	6.78	38.91	40.46	54	-13.54	AV

**Worst Case: 2-GFSK mode 915 MHz****1 GHz – 10 GHz Worst Case, Measured at 1 meter**

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comment
5490.0875	71.6	208	V	15	113.64	-42.04	PK <sup>1,2</sup>
4575.045	64.47	208	V	352	84	-19.53	PK
7466.0225	59.93	300	H	155	84	-24.07	PK
4575.045	59	208	V	352	64	-5	AVG
7466.0225	48.17	240	V	327	64	-15.83	AVG

Note<sup>1</sup>: Emission outside of restricted bands therefore limit is determined from 20dB down from fundamental emission.

Note<sup>2</sup>: Additional 10dB added to limit to account for extrapolation from 3meters to 1meter.

## 8 FCC §15.247(a)(1)(i) & ISEDC RSS-247 §5.1(c) - Emission Bandwidth

### 8.1 Applicable Standards

According to FCC §15.247(a)(1)(i) and ISEDC RSS-247 §5.1(c), the maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

### 8.2 Measurement Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Frequency Hopping System (FHSS) Equipment Under Section 15.247.

### 8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	1 year
-	SMA cable	-	-	Each time <sup>1</sup>	N/A
-	20dB attenuator	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: 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 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".

### 8.4 Test Environmental Conditions

Temperature:	21° C
Relative Humidity:	38 %
ATM Pressure:	101.9 KPa

The testing was performed by Christopher Casteel on 2020-02-28 at RF site.

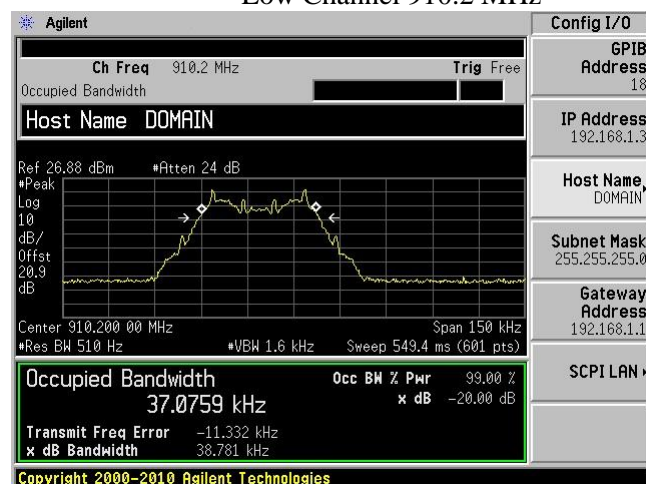
## 8.5 Test Results

### 2-GFSK mode

Channel	Frequency (MHz)	99% OBW (kHz)	20 dB OBW (kHz)
Low	910.2	37.0759	38.781
Middle	915	37.1964	38.927
High	920	37.1762	38.777
Hopping	910.2-920	10003.7	10421.0

Please refer to the following plots for detailed test results.

Low Channel 910.2 MHz



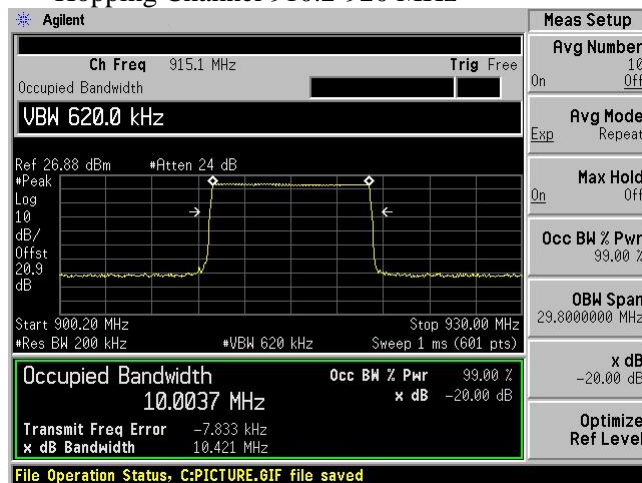
Middle Channel 915 MHz



High Channel 920 MHz



Hopping Channel 910.2-920 MHz



## 9 FCC §15.247(b)(2) & ISEDC RSS-247 §5.4(a) - 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(a): 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

The measurements were based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Frequency Hopping System (FHSS) Equipment Under Section 15.247.

### 9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Spectrum Analyzer	FSQ26	200749	2019-11-07	2 years
-	SMA cable	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: 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 A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

### 9.4 Test Environmental Conditions

Temperature:	21° C
Relative Humidity:	39 %
ATM Pressure:	102.0 KPa

The testing was performed by Christian McCaig on 2020-04-10 at RF site.

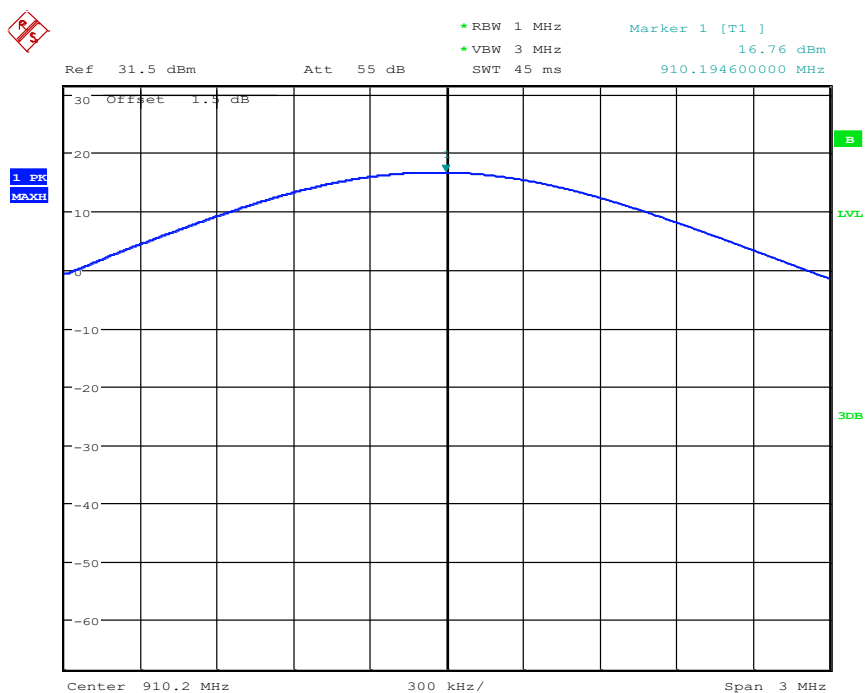
## 9.5 Test Results

### 2-GFSK mode

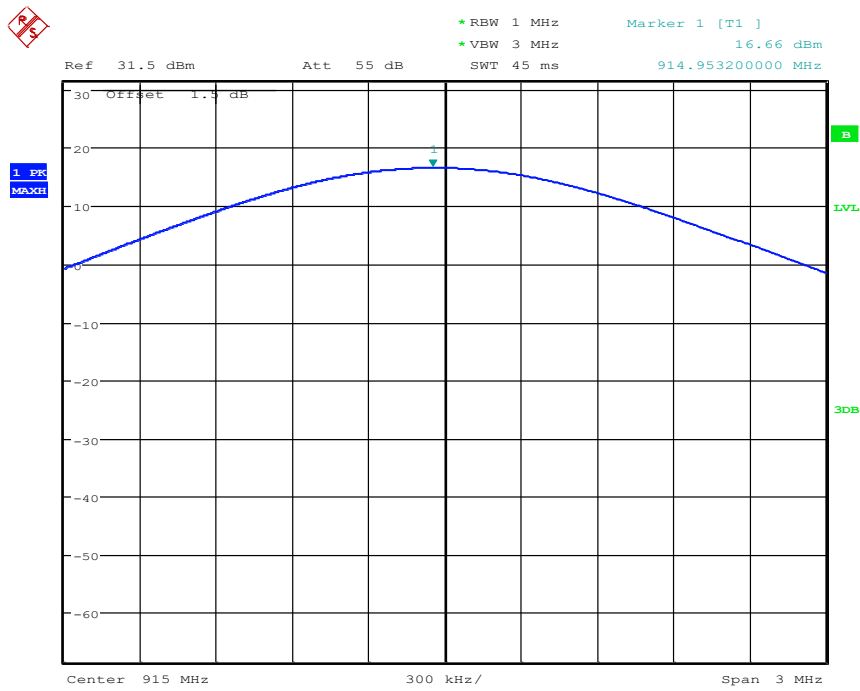
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
Low	910.2	16.76	<30
Middle	915	16.66	<30
High	920	16.59	<30

Please refer to the following plots for detailed test results.

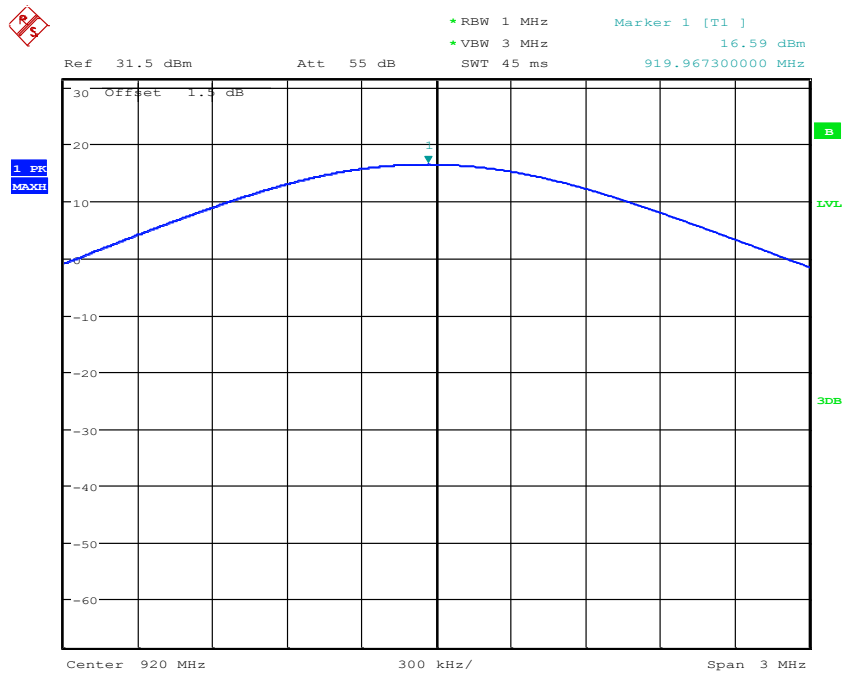
### Low Channel 910.2 MHz



Middle Channel 915 MHz



High Channel 920 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 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)).

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

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Frequency Hopping System (FHSS) Equipment Under Section 15.247.

### 10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Spectrum Analyzer	FSQ26	200749	2019-11-07	2 years
-	SMA cable	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: 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 A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".

### 10.4 Test Environmental Conditions

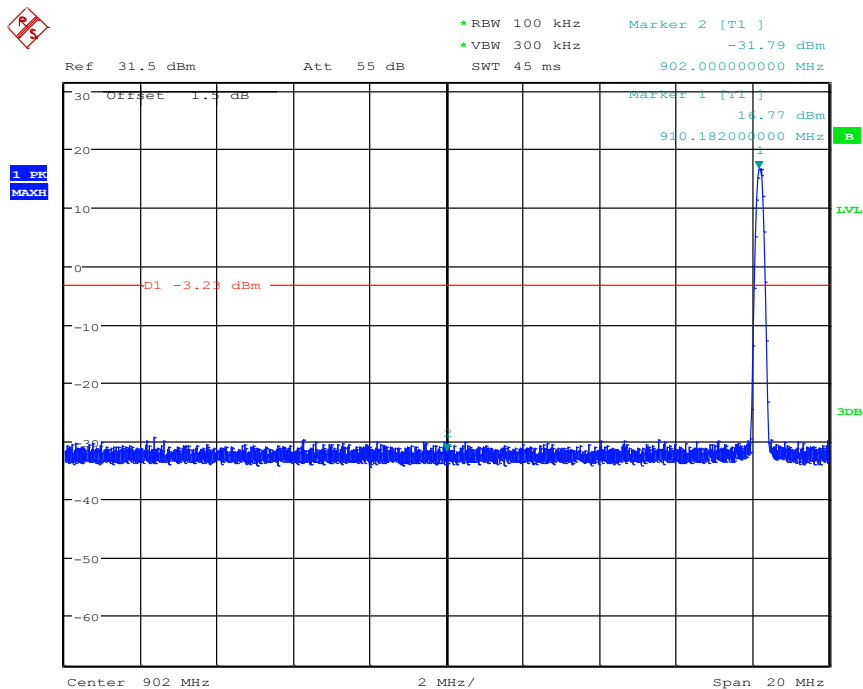
Temperature:	21° C
Relative Humidity:	39 %
ATM Pressure:	102.0 KPa

The testing was performed by Christian McCaig on 2020-04-10 at RF site.

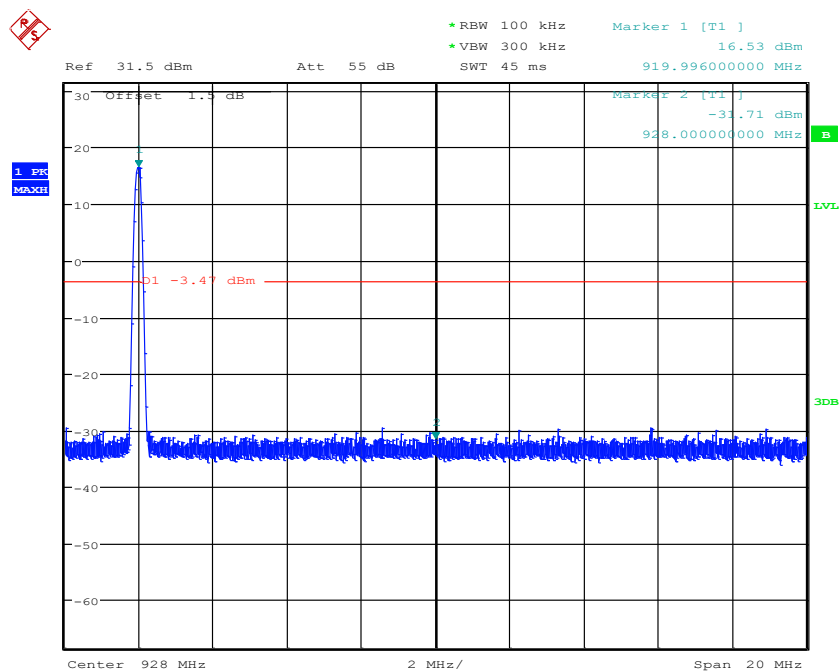
## 10.5 Test Results

### Single Channel Mode

#### Low Channel 910.2 MHz

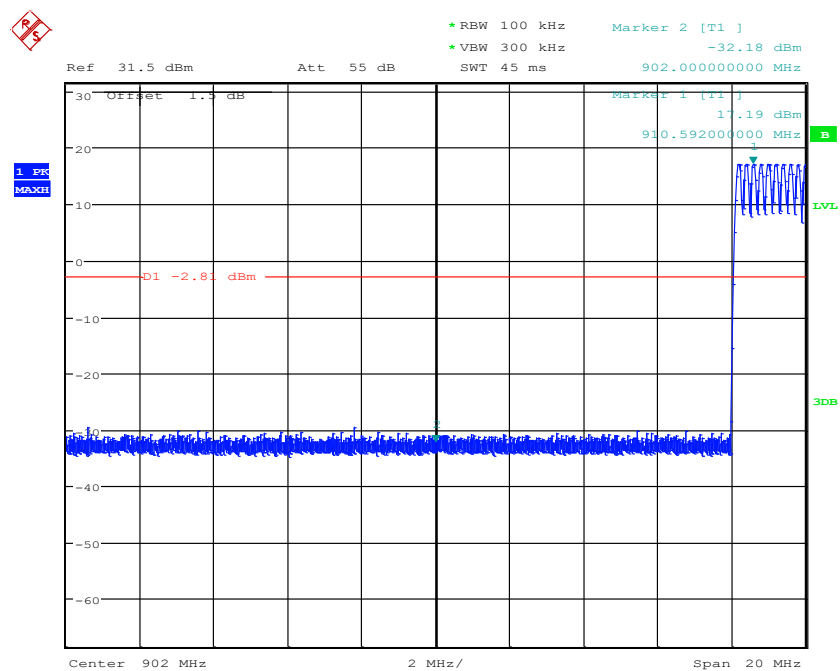


#### High Channel 920 MHz

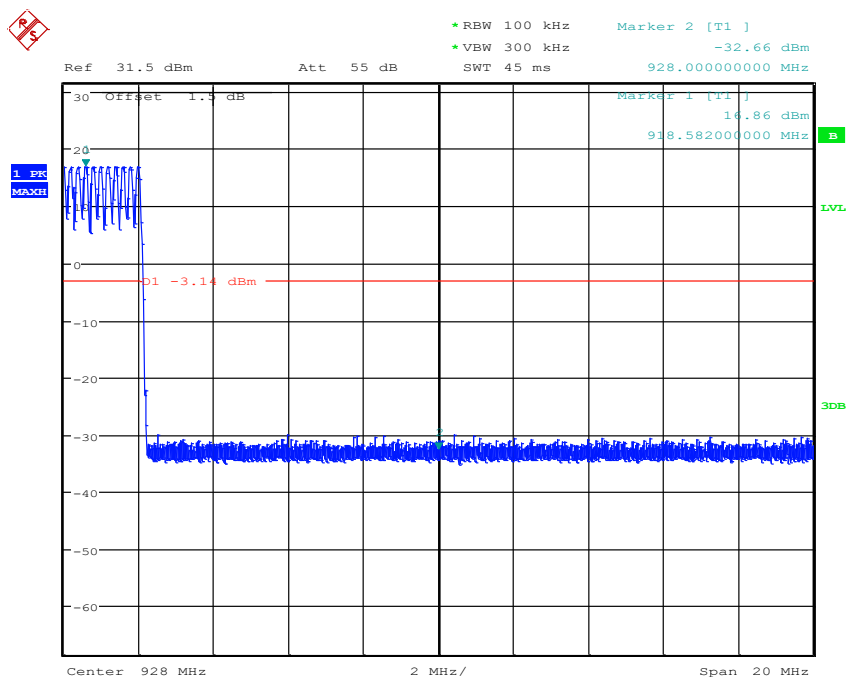


## Hopping Mode

### Lower band-edge



### Higher band-edge



## 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 measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Frequency Hopping System (FHSS) Equipment Under Section 15.247.

### 11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	1 year
-	SMA cable	-	-	Each time <sup>1</sup>	N/A
-	20dB attenuator	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: 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 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

## 11.4 Test Environmental Conditions

<b>Temperature:</b>	21° C
<b>Relative Humidity:</b>	30 %
<b>ATM Pressure:</b>	102.5 KPa

*The testing was performed by Christopher Casteel on 2020-02-26 at RF site.*

## 11.5 Test Results

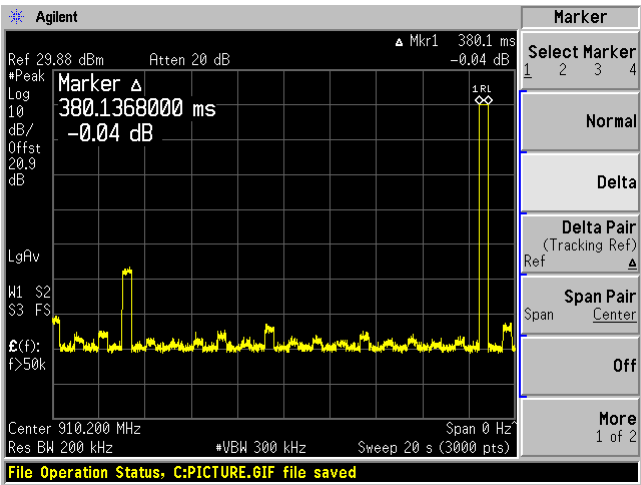
### 2-GFSK mode

Channel	Pulse Width (ms)	Number of Hops Per Period	Average Time of Occupancy (s)	Limit (sec)	Results
Low	380.13	< 1	0.380	0.4	Compliant
Middle	380.13	< 1	0.380	0.4	Compliant
High	380.13	< 1	0.380	0.4	Compliant

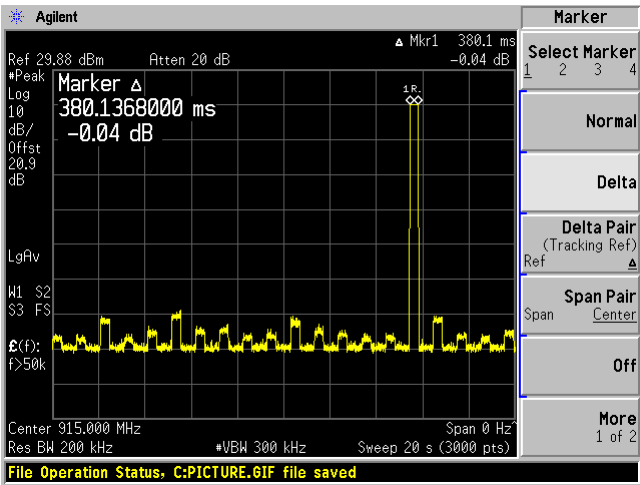
Please refer to the following plots for detailed test results.

2-GFSK mode

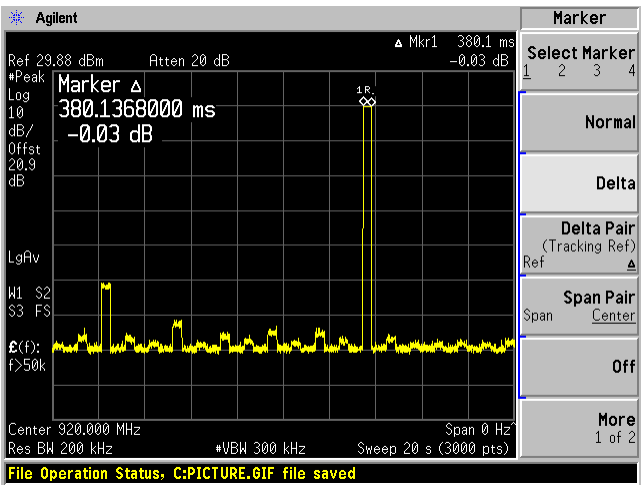
Low Channel



Middle Channel



High Channel



## 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

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Frequency Hopping System (FHSS) Equipment Under Section 15.247.

### 12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	1 year
-	SMA cable	-	-	Each time <sup>1</sup>	N/A
-	20dB attenuator	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: 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 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

### 12.4 Test Environmental Conditions

Temperature:	21° C
Relative Humidity:	30 %
ATM Pressure:	102.5 KPa

The testing was performed by Christopher Casteel on 2020-02-26 at RF site.





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

### 13.1 Applicable Standards

According to FCC §15.247(a)(1) and ISEDC RSS-247 §5.1(b): 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.

### 13.2 Test Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Frequency Hopping System (FHSS) Equipment Under Section 15.247.

### 13.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	1 year
-	SMA cable	-	-	Each time <sup>1</sup>	N/A
-	20dB attenuator	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: 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 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

### 13.4 Test Environmental Conditions

Temperature:	21° C
Relative Humidity:	30 %
ATM Pressure:	102.5 KPa

The testing was performed by Christopher Casteel on 2020-02-26 at RF site.

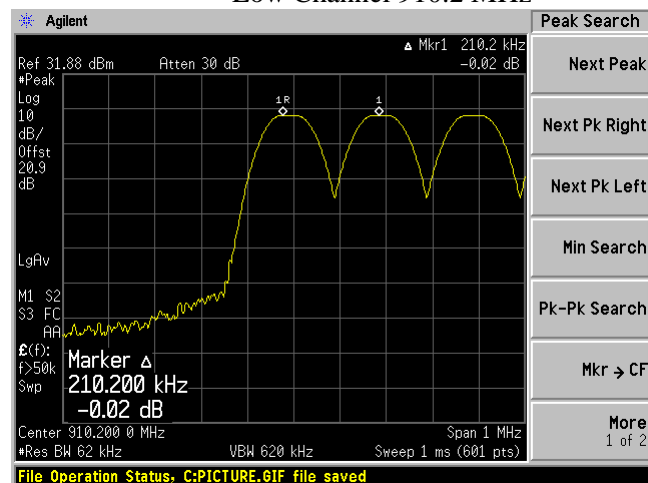
## 13.5 Test Results

### 2-GFSK mode

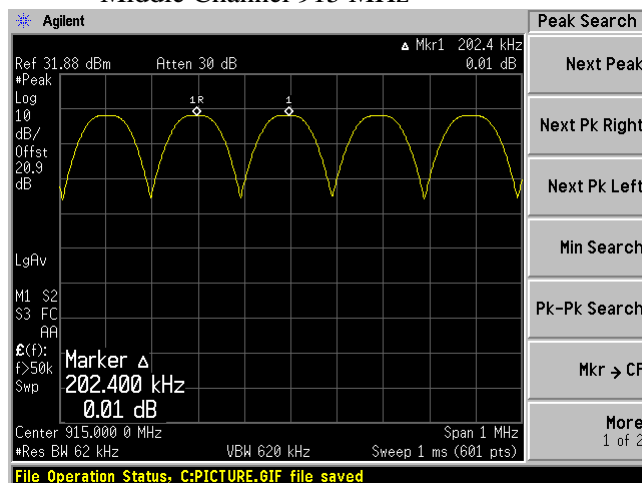
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 20 dB OBW (kHz)
Low	910.2	210.2	38.781
Middle	915	202.4	38.927
High	920	193.2	38.777

Please refer to following plots.

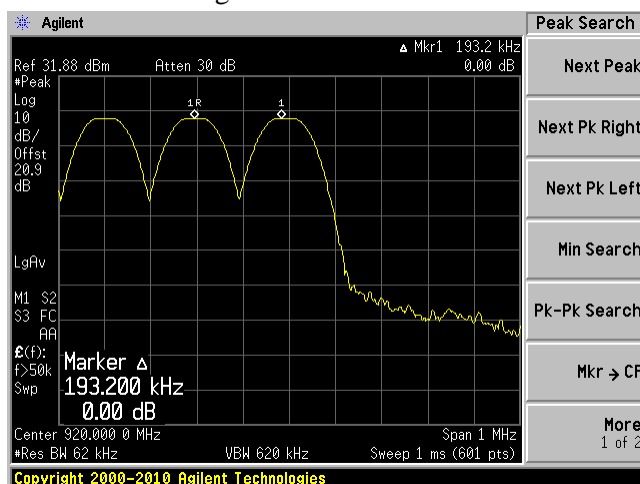
Low Channel 910.2 MHz



Middle Channel 915 MHz



High Channel 920 MHz



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

### 14.1 Applicable Standards

According to 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)).

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(d), 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.

### 14.2 Test Procedure

The measurements are based on FCC KDB 558074 D01 DTS Meas Guidance v05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 9: Frequency Hopping System (FHSS) Equipment Under Section 15.247.

### 14.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Spectrum Analyzer	FSQ26	200749	2019-11-07	2 years
-	SMA cable	-	-	Each time <sup>1</sup>	N/A

Note<sup>1</sup>: 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 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".

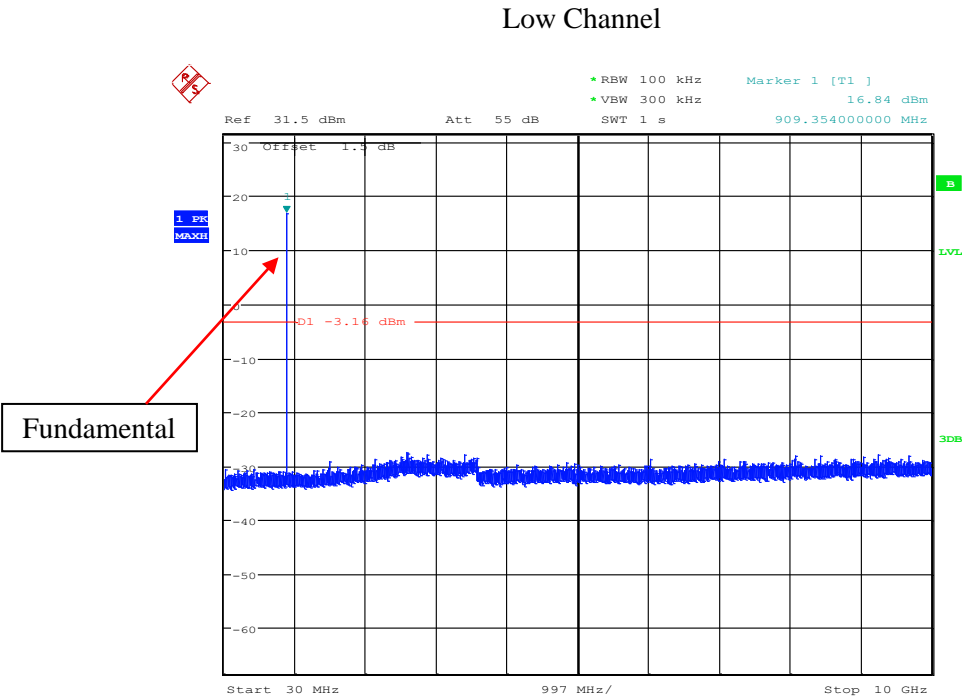
13.4 Test Environmental Conditions

Temperature:	21° C
Relative Humidity:	39 %
ATM Pressure:	102.0 KPa

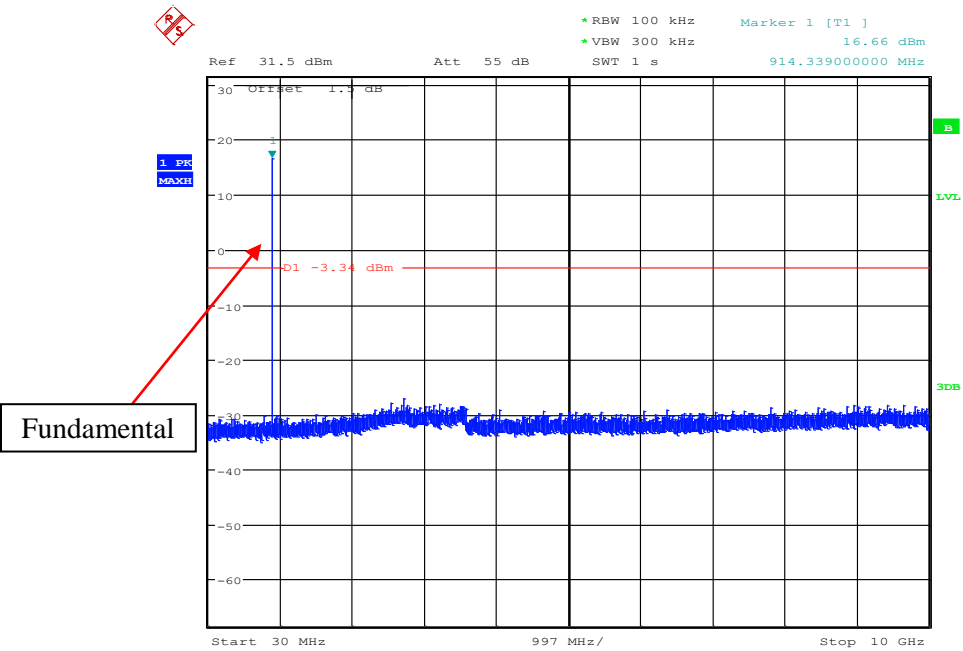
The testing was performed by Christian McCaig on 2020-04-10 at RF site.

13.5 Test Results

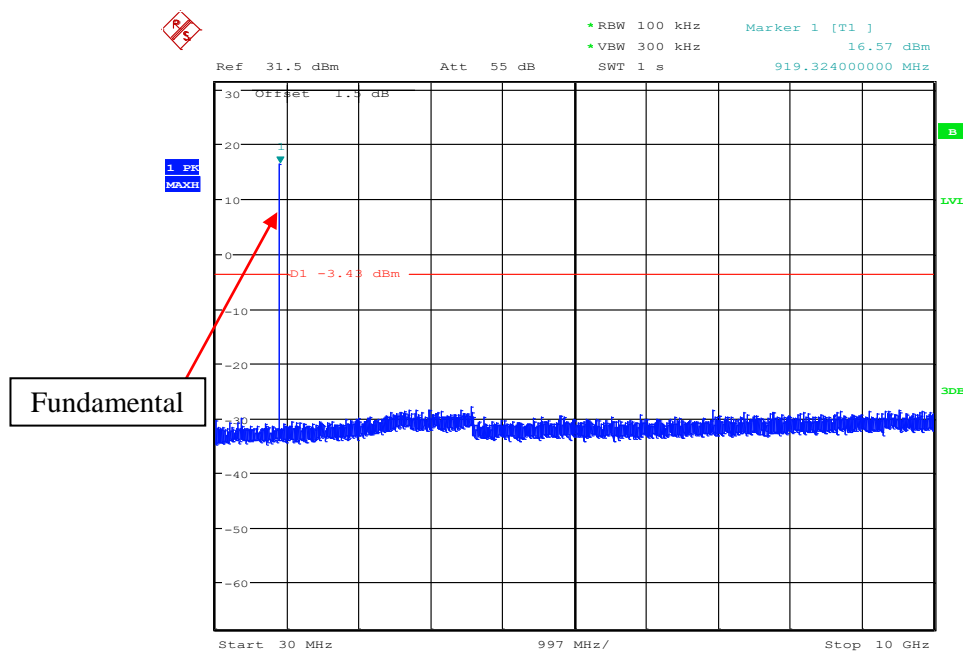
Please refer to following plots.



Middle Channel



High Channel



---

## **15 Annex A (Normative) - Test Setup Photographs**

---

Please refer to the attachment

---

## **16 Annex B (Normative) - EUT External Photographs**

---

Please refer to the attachment

---

## **17 Annex C (Normative) - EUT Internal Photographs**

---

Please refer to the 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 17025:2005 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 2<sup>nd</sup> day of October 2018.

A blue ink signature of the Vice President, Accreditation Services.

Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 3297.02  
Valid to September 30, 2020  
Revised June 5, 2019

*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 ---**