



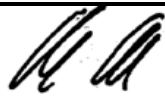
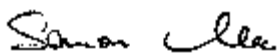
FCC PART 15, SUBPART C
ISED C RSS-247, ISSUE 2, FEBRUARY 2017
TEST AND MEASUREMENT REPORT

For

Next Century Submetering Systems, LLC

PO BOX 360, Tybee Island, GA 31328, USA

FCC ID: 2AB8I-RR301
IC: 20949-RR301

Report Type: Original Report	Product Type: Remote Reader
Prepared By: Christopher Casteel Test Technician	
Report Number: R1912023-247	
Report Issue Date: 2019-01-30	
Reviewed By: Simon Ma EMC Supervisor	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: +1 (408) 732-9162, Fax: +1 (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

1	General Description.....	5
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
2	System Test Configuration.....	9
2.1	Justification.....	9
2.2	EUT Exercise Software.....	9
2.3	Duty Cycle Correction Factor	9
2.4	Equipment Modifications.....	10
2.5	Local Support Equipment	10
2.6	Remote Support Equipment.....	10
2.7	Interface Ports and Cabling.....	11
3	Summary of Test Results	12
4	FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements	13
4.1	Applicable Standards	13
4.2	Antenna Description	13
5	FCC §2.1091, §15.247(i) & ISEDC RSS-102- RF Exposure.....	14
5.1	Applicable Standards	14
5.2	MPE Prediction.....	15
5.3	MPE Results	15
5.4	RF exposure evaluation exemption for IC	15
6	FCC §15.209, §15.247(d) & ISEDC RSS-247 §5.5, RSS-Gen §8.9, §8.10 - Spurious Radiated Emissions.....	16
6.1	Applicable Standards	16
6.2	Test Setup	18
6.3	Test Procedure	18
6.4	Corrected Amplitude & Margin Calculation.....	18
6.5	Test Equipment List and Details.....	19
6.6	Test Environmental Conditions	19
6.7	Summary of Test Results	19
6.8	Radiated Emissions Test Results	20
7	FCC §15.247(a) (1) (i) & ISEDC RSS-247 §5.1, RSS-Gen §6.6- Emission Bandwidth.....	24
7.1	Applicable Standards	24
7.2	Measurement Procedure.....	24
7.3	Test Equipment List and Details.....	24
7.4	Test Environmental Conditions	24
7.5	Test Results.....	25
8	FCC §15.247(b) (2) & ISEDC RSS-247 §5.4 -Output Power	26
8.1	Applicable Standards	26
8.2	Measurement Procedure.....	26
8.3	Test Equipment List and Details.....	26
8.4	Test Environmental Conditions	26
8.5	Test Results.....	27
9	FCC §15.247(d) & ISEDC RSS-247 §5.5- 100 kHz Bandwidth of Band Edges.....	28
9.1	Applicable Standards	28
9.2	Measurement Procedure.....	28

9.3	Test Equipment List and Details	28
9.4	Test Environmental Conditions	28
9.5	Test Results.....	29
10	FCC §15.247(a) (1) (i) & ISEDC RSS-247 §5.1(c) - Dwell Time.....	30
10.1	Applicable Standards	30
10.2	Measurement Procedure.....	30
10.3	Test Equipment List and Details.....	30
10.4	Test Environmental Conditions	31
10.5	Test Results.....	31
11	FCC §15.247(a)(1)(i) & ISEDC RSS-247 §5.1(c) - Number of Hopping Channels	33
11.1	Applicable Standards	33
11.2	Test Procedure	33
11.3	Test Equipment List and Details.....	33
11.4	Test Environmental Conditions	33
11.5	Test Results.....	34
12	FCC §15.247(a) (1) & ISEDC RSS-247 §5.1(c) - Hopping Channel Separation	35
12.1	Applicable Standards	35
12.2	Test Procedure	35
12.3	Test Equipment List and Details.....	35
12.4	Test Environmental Conditions	35
12.5	Test Results.....	36
13	FCC §15.247(d) & ISEDC RSS-247 §5.5 - Spurious Emissions at Antenna Terminals	37
13.1	Applicable Standards	37
13.2	Test Procedure	37
13.3	Test Equipment List and Details.....	37
13.4	Test Environmental Conditions	37
13.5	Test Results.....	38
14	Annex A (Normative) - Test Setup Photographs.....	39
15	Annex B (Normative) - EUT External Photographs.....	40
16	Annex C (Normative) - EUT Internal Photographs	41
17	Annex D (Informative) – Manufacturer Declaration of Similarity	42
18	Annex E (Normative) - A2LA Electrical Testing Certificate	43

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1912023-247	Original	2020-01-30

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: *RR301-TR*, *FCC ID: 2AB8I-RR301*; *IC: 20949-RR301* or the “EUT” as referred to in this report. It is a Remote Reader that operates within the 910.2 MHz and 920 MHz frequency range.

Serial model: RR301 is electrically identical with the tested model: RR301-TR declared by manufacturer. Please refer to the Manufacturer Declaration of Similarity in Annex D of this report for details.

1.2 Mechanical Description of EUT

The mounting plate of the EUT measures approximately 145 mm (Length), 115 mm (Width), and the Remote Reader portion of the EUT measures approximately 110 mm (Diameter), 45 mm (Thickness), and weighs 0.20kg.

The data gathered are from a typical production sample provided by Next Century Submetering Systems, LLC with serial number: EA000170.

1.3 Objective

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

1.4 Related Submittal(s)/Grant(s)

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 ° 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):
 - 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 in accordance to ANSI C63.10.

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 Duty Cycle Correction Factor

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

Preferably, all measurements of maximum conducted (average) output power will be performed with the EUT transmitting continuously (i.e., with a duty cycle of greater than or equal to 98%). When continuous operation cannot be realized, then the use of sweep triggering/signal gating techniques can be utilized to ensure that measurements are made only during transmissions at the maximum power control level. Such sweep triggering/signal gating techniques will require knowledge of the minimum transmission duration (T) over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation. Sweep triggering/signal gating techniques can then be used if the measurement/sweep time of the analyzer can be set such that it does not exceed T at any time that data is being acquired (i.e., no transmitter off-time is to be considered).

2-GFSK mode

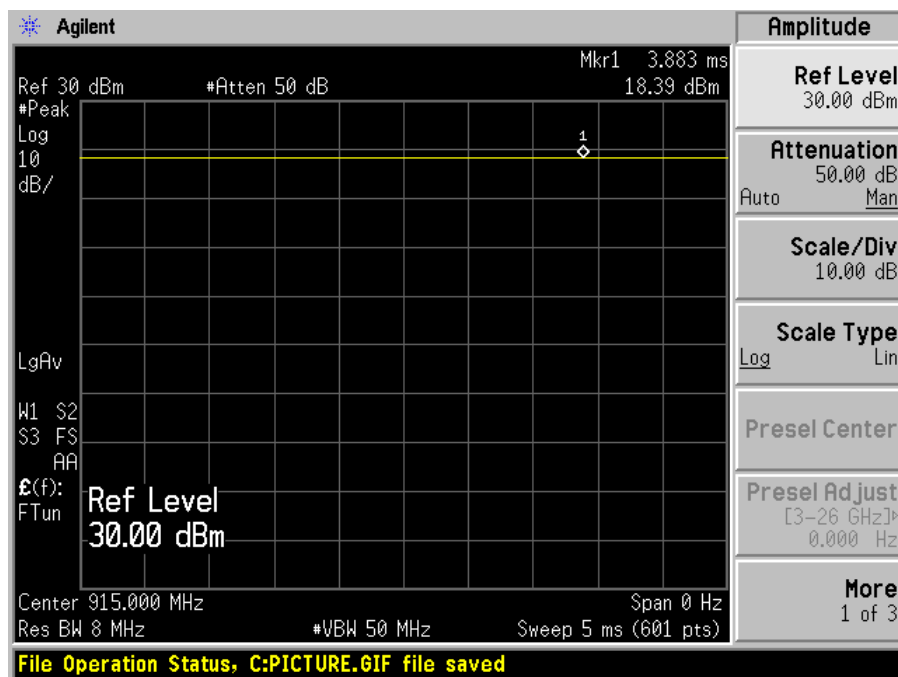
Radio frequency (MHz)	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
915	-	-	100	0

Duty Cycle = On Time (ms)/ Period (ms)

Duty Cycle Correction Factor (dB) = $10 \cdot \log(1/\text{Duty Cycle})$

Please refer to the following plots.

915 MHz



2.4 Equipment Modifications

Sample with S/N: EA000850 was loaded with normal firmware and provided for Dwell Time testing.

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Remote Support Equipment

Manufacturer	Description	Model
Texas Instruments IC	Eval Board	CC1310

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
Type A to Micro B USB Cable	< 1 m	Laptop	Control Board
SMA Cable	< 1 m	EUT	PSA
Jumper Cable	< 1 m	EUT	Control Board
Type B USB	< 1 m	Laptop	Adapter
I ² C/SPI Ribbon Cable	< 1 m	EUT	Adapter

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	N/A*
FCC §2.1091, §15.247(i) ISEDC RSS-102	RF Exposure	Compliant
FCC §2.1051, §15.247 (d) ISEDC RSS-247 §5.5	Spurious Emissions at Antenna Port	Compliant
FCC §2.1053, §15.205, §15.209, §15.247(d) ISEDC RSS-247 §5.5 ISEDC RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1)(i) ISEDC RSS-247 §5.1 ISEDC RSS-Gen §6.6	20 dB & 99% Emission Bandwidth	Compliant
FCC §15.247(b)(2) ISEDC RSS-247 §5.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) ISEDC RSS-247 §5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247(a)(1)(i) ISEDC RSS-247 §5.1(c)	Number of Hopping Channels	Compliant
FCC §15.247(a)(1) ISEDC RSS-247 §5.1(c)	Hopping Channel Separation	Compliant
FCC §15.247(a)(1)(i) ISEDC RSS-247 §5.1(c)	Dwell Time	Compliant

*Note: EUT is battery powered and AC Line testing is not applicable.

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

4.1 Applicable Standards

According to FCC §15.203:

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

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

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

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

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

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

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

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

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

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

4.2 Antenna Description

The antennas used by the EUT is PCB trace antenna.

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
900 MHz ISM Band	902-928 MHz	0

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

5.1 Applicable Standards

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

Limits for General Population/Uncontrolled Exposure

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

f = frequency in MHz

* = Plane-wave equivalent power density

According to ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

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

- below 20 MHz⁶ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

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

5.2 MPE Prediction

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

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

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

5.3 MPE Results

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>18.9</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>77.624</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>910.2</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>0</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>1</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u>	<u>0.0154</u>
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm ²):	<u>0.61</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0154 mW/cm². Limit is 0.61 mW/cm².

5.4 RF exposure evaluation exemption for IC

Maximum EIRP power = 18.9dBm + 0 dBi = 18.9 dBm which is lesser than $1.31 \times 10^{-2} f^{0.6834} = 1.3789 \text{ W} = 31.4 \text{ dBm}$.

Therefore the RF exposure Evaluation is not required.

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

6.1 Applicable Standards

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

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

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5.35 – 5.46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 – 167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3.3458 – 3.358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

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

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

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

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

As per 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

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3 meters)
30-88	100
88-216	150
216-960	200
Above 960*	500

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

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

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

6.2 Test Setup

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

The spacing between the peripherals was 10 centimeters.

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

6.3 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:

$$RBW = 100 \text{ kHz} / VBW = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000 MHz:

- (1) Peak: $RBW = 1\text{MHz} / VBW = 1\text{MHz} / \text{Sweep} = \text{Auto}$
- (2) Average: $RBW = 1\text{MHz} / VBW = 10\text{Hz} / \text{Sweep} = \text{Auto}$

6.4 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:

$$CA = Ai + AF + CL + \text{Atten} - Ga$$

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:

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

6.5 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
Rhode & Schwarz	Signal Analyzer	FSV40	1321.3008K39 -101203-UW	2019-08-06	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Sciences	Antenna, Biconi-Log	JB1	A013105-3	2018-02-26	2 years
Sunol Sciences	Antenna, Horn	DRH-118	A052704	2019-04-02	2 years
Insulated Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2019-05-08	1 year
-	SMA cable	-	-	Each time ¹	N/A
-	Notch Filter	-	-	Each time ¹	N/A
MDP Digital	Times Microwave LMR 400 UltraFex Coaxial Cable 35'	LMR400UF	BACL1904161	2019-04-16	1 year
Agilent	Amplifier, Pre	8447D	2944A10187	2019-04-11	1 year
A. H. Systems	Antenna, Horn	SAS-200/571	261	2019-06-07	2 years
Rohde & Schwarz	EMI Test Receiver	ESU-40	100433	2019-02-06	1 year
HP	Pre-Amplifier	8449B	3008A01978	2019-09-27	1 year

Note¹: cable and notch filter included in the test set-up will be checked each time before testing.

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

6.6 Test Environmental Conditions

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

The testing was performed by Christopher Casteel on 2019-12-30 in 5m chamber 3.

6.7 Summary of Test Results

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

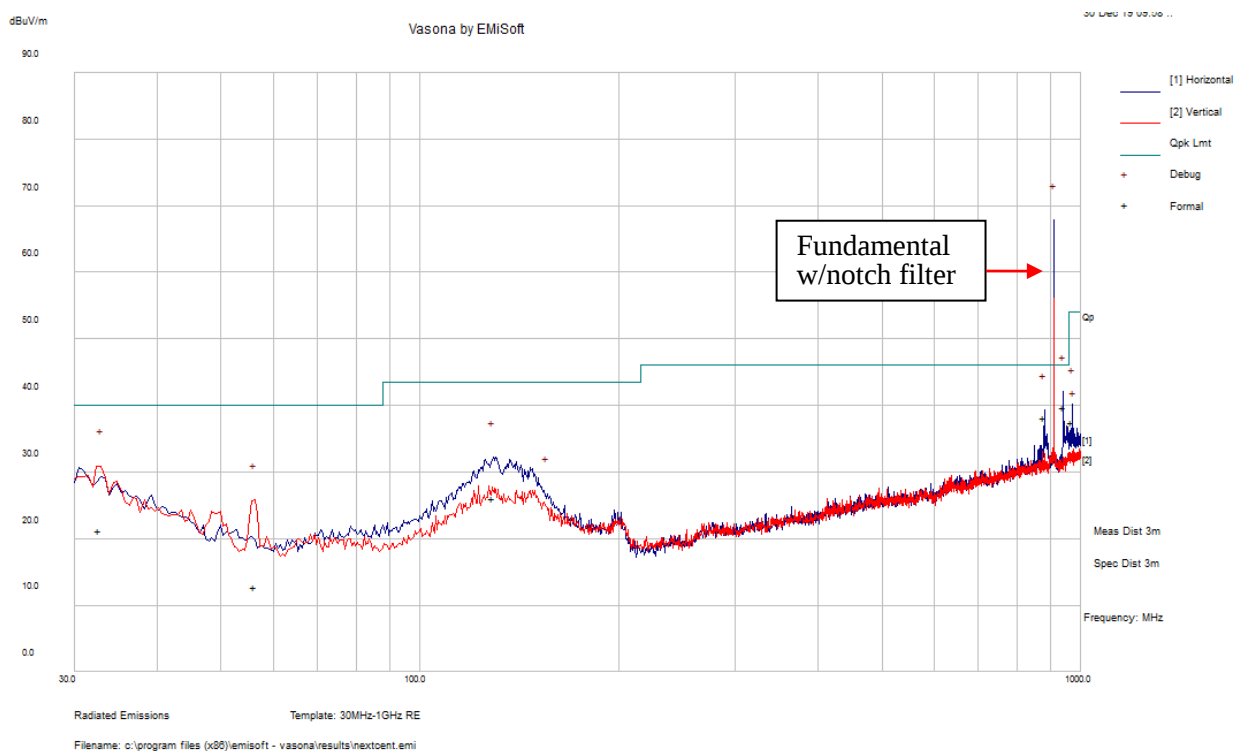
Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Transmitting Channel
-1.168	4551	Vertical	910.2 MHz

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

6.8 Radiated Emissions Test Results

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

Worst Case: 2-GFSK 910.2 MHz



Frequency (MHz)	Corrected Amplitude (dBuV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV/m)	Margin (dB)	Comment
940.179	39.67	103	H	59	46	-6.33	QP
880.2173	38.16	105	H	57	46	-7.84	QP
32.698	21.22	187	V	11	40	-18.78	QP
129.0283	26.09	221	H	249	43.5	-17.41	QP
970.1908	37.5	152	H	53	54	-16.5	QP
56.24125	12.7	289	V	162	40	-27.3	QP

2) 1–10 GHz

2-GFSK mode

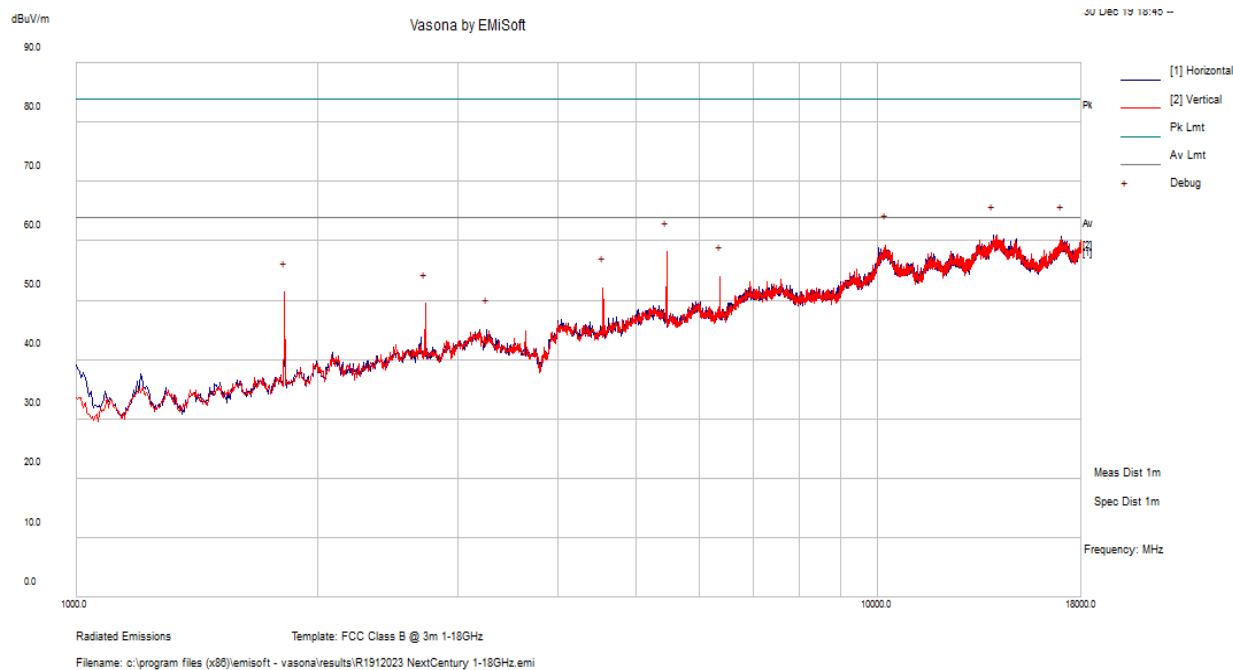
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISED		Comment
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 910.2 MHz											
1820.4	59.68	93	280	H	27.142	4.535	39.774	51.583	68	-16.417	Peak
1820.4	61.74	193	289	V	27.128	4.535	39.774	53.629	68	-14.371	Peak
2730.6	54.66	90	226	H	29.214	5.983	38.905	50.952	74	-23.048	Peak
2730.6	56.2	153	296	V	29.236	5.983	38.905	52.514	74	-21.486	Peak
2730.6	53.14	90	224	H	29.214	5.983	38.905	49.432	54	-4.568	Ave
2730.6	55.23	155	295	V	29.236	5.983	38.905	51.544	54	-2.456	Ave
3640.8	50.65	275	300	H	31.816	7.079	38.147	51.398	74	-22.602	Peak
3640.8	52.22	286	100	V	31.782	7.079	38.147	52.934	74	-21.066	Peak
3640.8	48.10	60	277	H	31.816	7.079	38.147	48.848	54	-5.152	Ave
3640.8	49.30	260	300	V	31.782	7.079	38.147	50.014	54	-3.986	Ave
4551	49.95	334	210	H	32.164	7.716	37.469	52.361	74	-21.639	Peak
4551	51.62	0	259	V	32.115	7.716	37.469	53.982	74	-20.018	Peak
4551	50.14	12	209	H	32.164	7.716	37.469	52.551	54	-1.449	Ave
4551	50.47	285	298	V	32.115	7.716	37.469	52.832	54	-1.168	Ave
5461.2	49.51	250	100	H	33.783	8.982	37.444	54.831	68	-13.169	Peak
5461.2	51.14	206	210	V	33.79	8.982	37.444	56.468	68	-11.532	Peak

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											
1830	56.78	349	197	H	27.121	4.535	39.774	48.662	68	-19.338	Peak
1830	59.26	196	286	V	27.211	4.535	39.774	51.232	68	-16.768	Peak
2745	54.16	85	199	H	29.214	5.983	38.905	50.452	74	-23.548	Peak
2745	56.57	143	292	V	29.236	5.983	38.905	52.884	74	-21.116	Peak
2745	54.10	90	300	H	29.214	5.983	38.905	50.392	54	-3.608	Ave
2745	55.51	145	263	V	29.236	5.983	38.905	51.824	54	-2.176	Ave
3660	50.14	130	300	H	31.816	7.079	38.147	50.888	74	-23.112	Peak
3660	50.4	255	293	V	31.782	7.079	38.147	51.114	74	-22.886	Peak
3660	48.63	271	296	H	31.816	7.079	38.147	49.378	54	-4.622	Ave
3660	49.76	244	300	V	31.782	7.079	38.147	50.474	54	-3.526	Ave
4575	49.92	31	300	H	32.298	7.716	37.469	52.465	74	-21.535	Peak
4575	51.05	259	214	V	32.166	7.716	37.469	53.463	74	-20.537	Peak
4575	48.07	17	100	H	32.298	7.716	37.469	50.615	54	-3.385	Ave
4575	49.91	273	275	V	32.166	7.716	37.469	52.323	54	-1.677	Ave
5490	49.21	252	144	H	33.988	8.982	37.444	54.736	68	-13.264	Peak
5490	51.54	190	242	V	33.953	8.982	37.444	57.031	68	-10.969	Peak

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											
1840	55.56	122	265	H	27.121	4.535	39.774	47.442	68	-20.558	Peak
1840	56.97	360	277	V	27.211	4.535	39.774	48.942	68	-19.058	Peak
2760	54.87	97	300	H	29.214	5.983	38.905	51.162	74	-22.838	Peak
2760	56.41	159	288	V	29.236	5.983	38.905	52.724	74	-21.276	Peak
2760	53.54	85	300	H	29.214	5.983	38.905	49.832	54	-4.168	Ave
2760	54.98	145	291	V	29.236	5.983	38.905	51.294	54	-2.706	Ave
3680	49.74	275	266	H	32.18	7.079	38.147	50.852	74	-23.148	Peak
3680	50.89	264	290	V	32.095	7.079	38.147	51.917	74	-22.083	Peak
3680	48.3	278	264	H	32.18	7.079	38.147	49.412	54	-4.588	Ave
3680	49.25	64	300	V	32.095	7.079	38.147	50.277	54	-3.723	Ave
4600	48.94	19	100	H	32.298	7.716	37.474	51.48	74	-22.52	Peak
4600	50.57	282	300	V	32.166	7.716	37.474	52.978	74	-21.022	Peak
4600	47.11	340	100	H	32.298	7.716	37.474	49.65	54	-4.35	Ave
4600	49.13	269	300	V	32.166	7.716	37.474	51.538	54	-2.462	Ave
5520	48.91	294	204	H	33.988	8.982	37.444	54.436	68	-13.564	Peak
5520	51.52	228	248	V	33.953	8.982	37.444	57.011	68	-10.989	Peak

Worst Case: 2-GFSK mode 910.2 MHz

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



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

7.1 Applicable Standards

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

7.2 Measurement Procedure

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

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

VBW $\geq$ 3RBW

Sweep = auto

Detector function = peak

Trace = max hold

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2019-03-06	1 year
-	SMA cable	-	-	Each time ¹	N/A

Note¹: cable included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

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

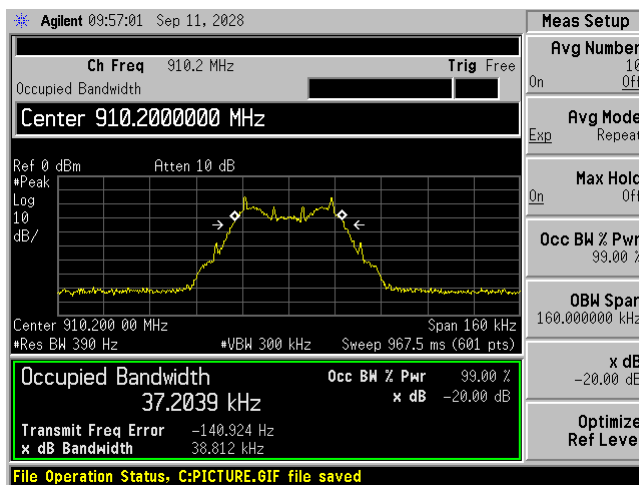
The testing was performed by Christopher Casteel on 2019-12-26 at RF Bench.

7.5 Test Results

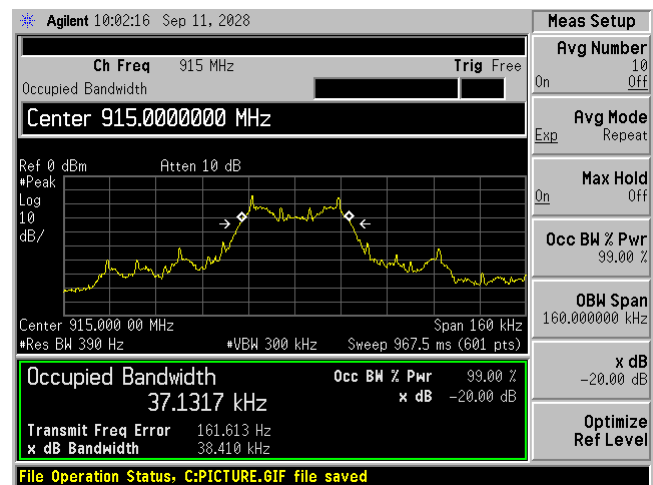
Channel	Frequency (MHz)	99% OBW (kHz)	20 dB OBW (kHz)
Low	910.2	37.2039	38.812
Middle	915	37.1317	38.410
High	920	37.0926	38.951
Hopping	910.2-920	9884	10153

Please refer to the following plots for detailed test results.

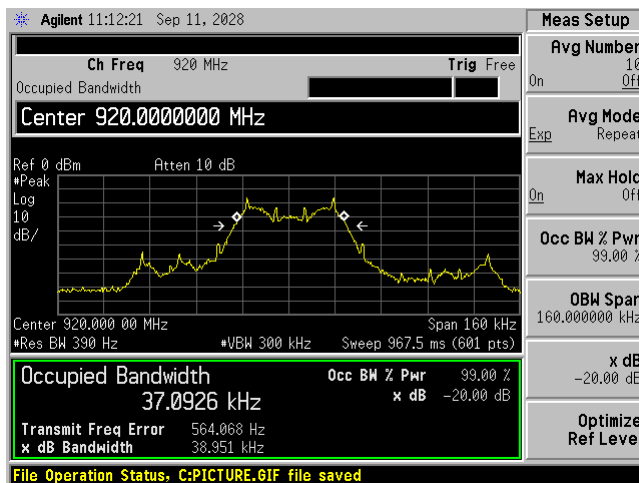
Low Channel 910.2 MHz



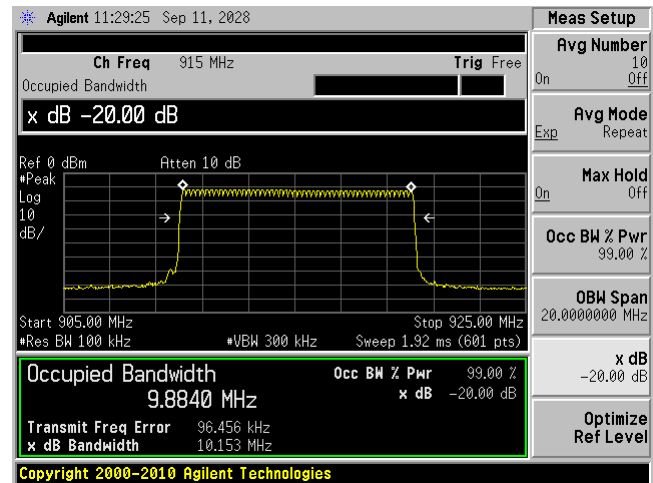
Middle Channel 915 MHz



High Channel 920 MHz



Hopping Channel 910.2-920 MHz



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

8.1 Applicable Standards

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

According to RSS-247 §5.4: For frequency hopping systems operating in the band 2400-2483.5 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 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels.

8.2 Measurement Procedure

Span $\geq$ 5 times the 20 dB bandwidth, centered on a hopping channel

RBW $>$ the 20 dB bandwidth of the emission being measured

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2019-03-06	1 year
-	SMA cable	-	-	Each time ¹	N/A

Note¹: cable included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

8.4 Test Environmental Conditions

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

The testing was performed by Christopher Casteel on 2019-12-26 at RF Bench.

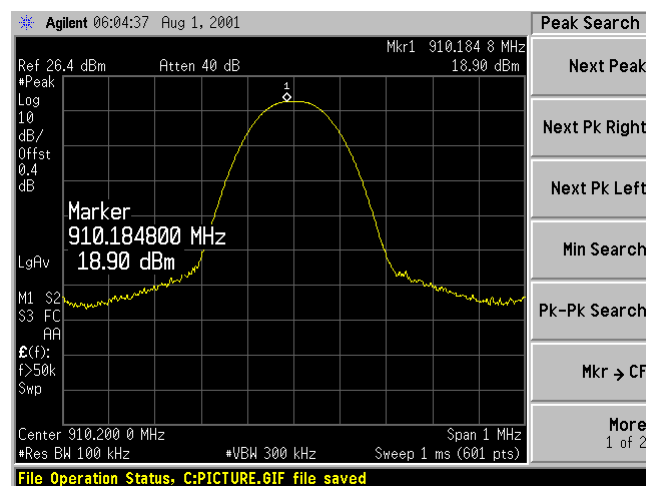
8.5 Test Results

2-GFSK mode

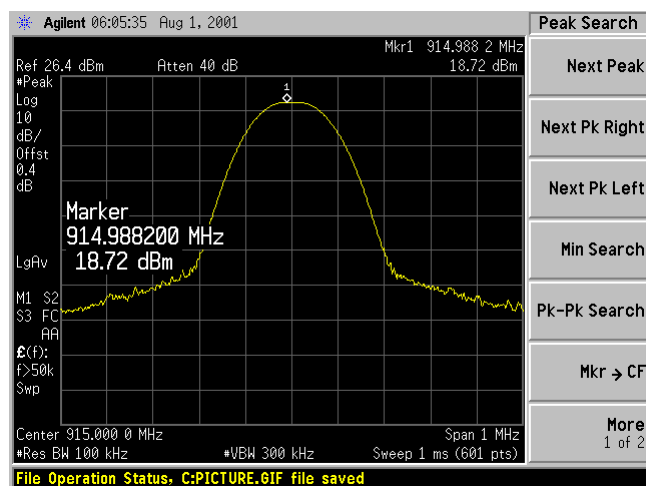
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)
Low	910.2	18.9	30
Middle	915	18.72	30
High	920	18.51	30

Please refer to the following plots for detailed test results.

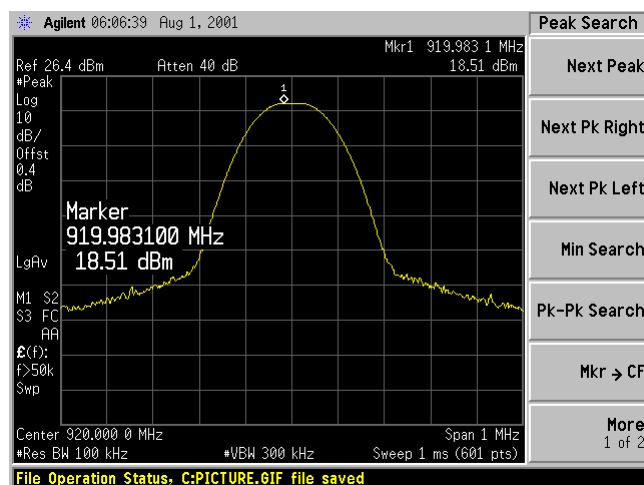
Low Channel 910.2 MHz



Middle Channel 915 MHz



High Channel 920 MHz



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

9.1 Applicable Standards

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

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

9.2 Measurement Procedure

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

RBW = 100 kHz

VBW = 300 kHz

Sweep = coupled

Detector function = peak

Trace = max hold

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2019-03-06	1 year
-	SMA cable	-	-	Each time ¹	N/A

Note¹: cable included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

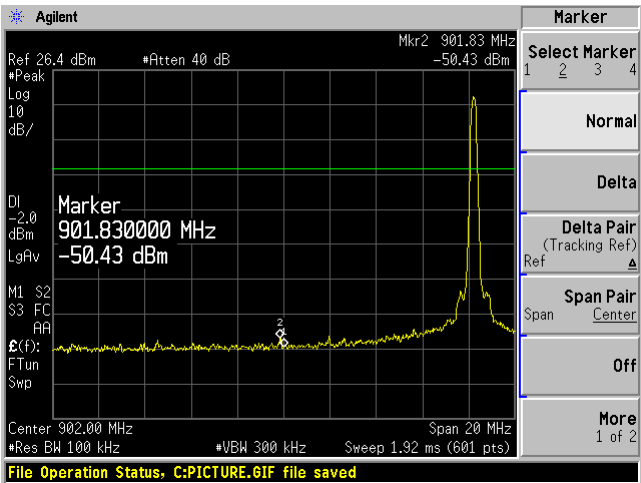
Temperature:	21° C
Relative Humidity:	39 %
ATM Pressure:	102.0 KPa

The testing was performed by Christopher Casteel on 2019-12-26 at RF Bench.

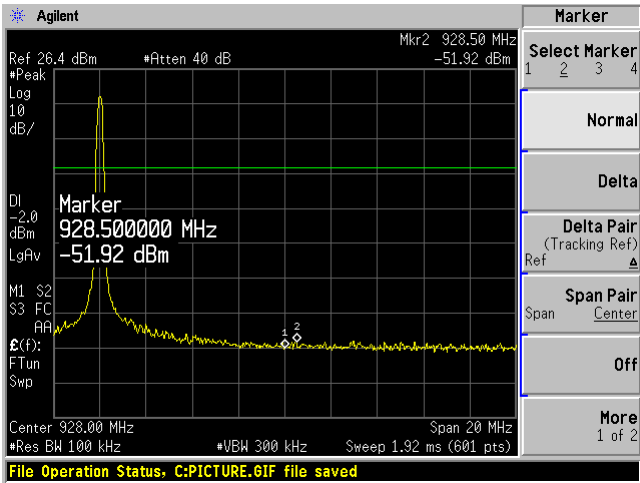
9.5 Test Results

2-GFSK mode (Single Channel Mode)

Low Channel 910.2 MHz

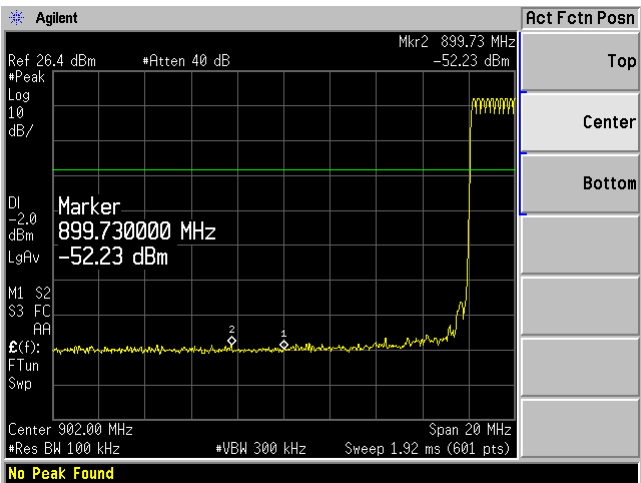


High Channel 920 MHz

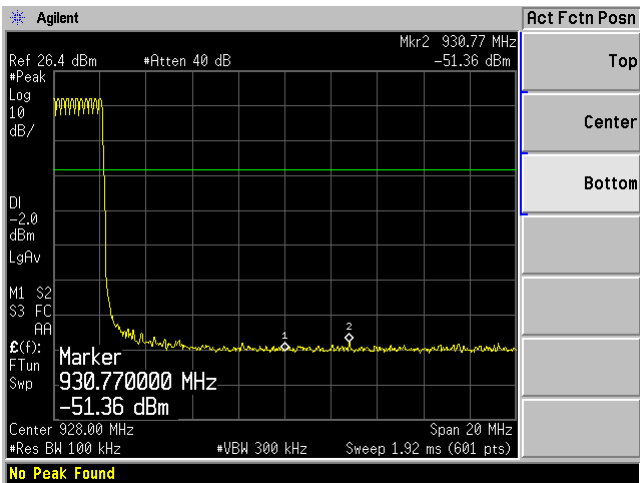


2-GFSK (Hopping Mode)

Lower band-edge



Higher band-edge



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

10.1 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.

10.2 Measurement Procedure

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

Span = zero span, centered on a hopping channel

RBW $\leq$ channel spacing and where possible RBW should be set $\gg 1/T$, where T is the expected dwell time per channel

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

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

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements.

Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

$$(\text{Number of hops in the period specified in the requirements}) = (\text{number of hops on spectrum analyzer}) \times (\text{period specified in the requirements} / \text{analyzer sweep time})$$

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

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Signal Analyzer	FSV40	1321.3008K39-101203-UW	2019-08-05	1 year
-	SMA cable	-	-	Each time ¹	N/A

Note¹: cable included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

10.4 Test Environmental Conditions

Temperature:	18° C
Relative Humidity:	44 %
ATM Pressure:	102.7 KPa

The testing was performed by Matthew Riego de Dios on 2020-01-16 in chamber 5m3.

10.5 Test Results

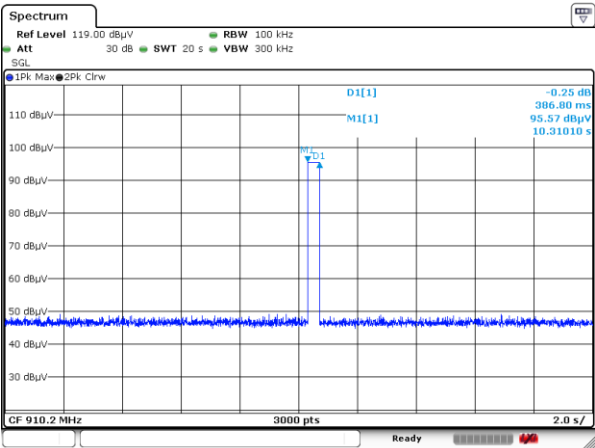
2-GFSK mode

Channel	Pulse Width (ms)	Number of Hops Per Period	Average Time of Occupancy (s)	Limit (sec)	Results
Low	386.80	< 1	0.386	0.4	Compliant
Middle	386.80	< 1	0.386	0.4	Compliant
High	380.13	< 1	0.380	0.4	Compliant

Please refer to the following plots for detailed test results.

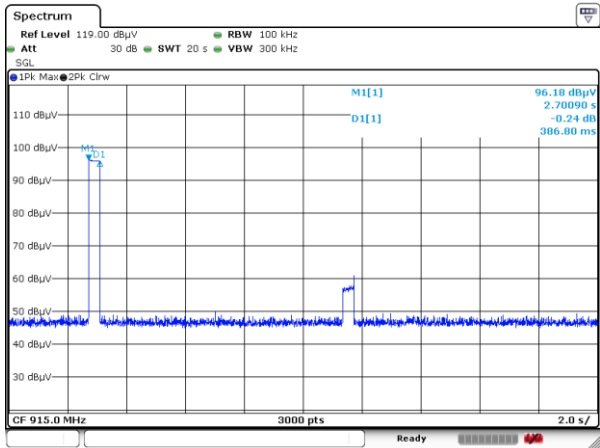
2-GFSK mode

Low Channel



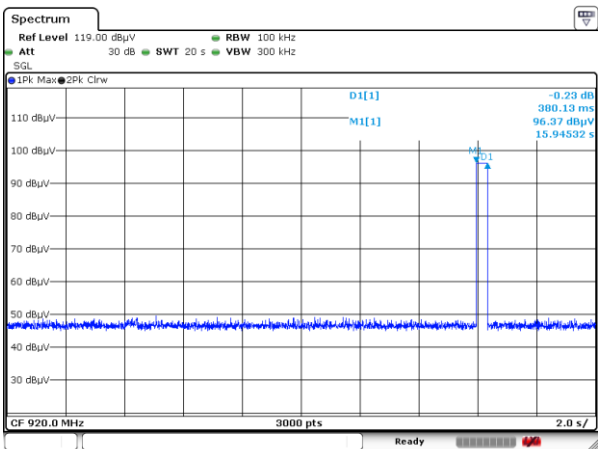
Date: 12 JAN 2020 17:50:14

Middle Channel



Date: 12 JAN 2020 17:47:19

High Channel



Date: 12 JAN 2020 17:52:57

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

11.1 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

11.2 Test Procedure

Span = the frequency band of operation

RBW < 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2019-03-06	1 year
-	SMA cable	-	-	Each time ¹	N/A

Note¹: cable included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

11.4 Test Environmental Conditions

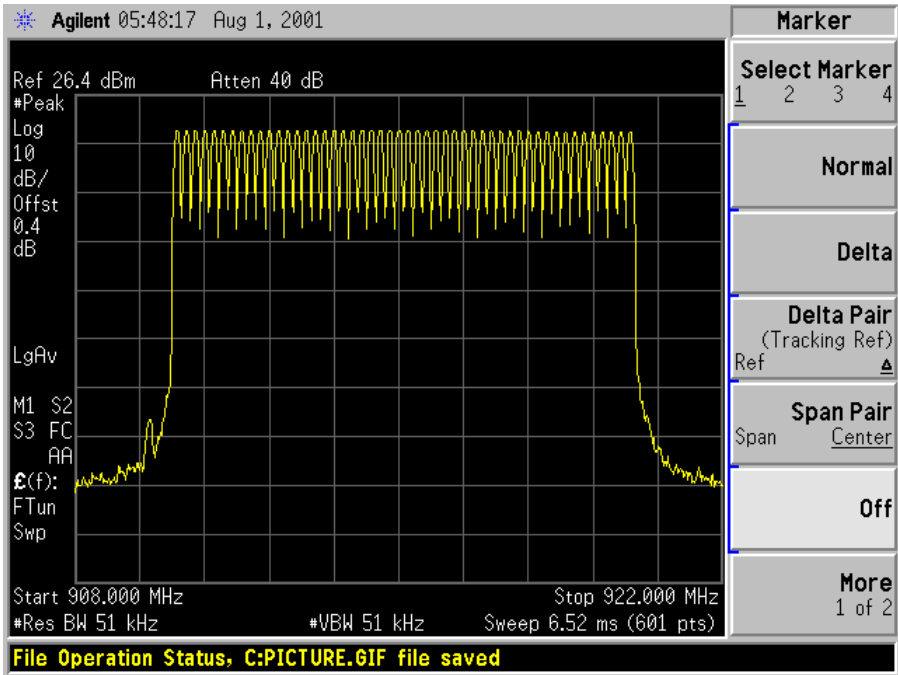
Temperature:	21° C
Relative Humidity:	39 %
ATM Pressure:	102.0 KPa

The testing was performed by Christopher Casteel on 2019-12-26 at RF Bench.

11.5 Test Results

Total 50 channels; please refer to the plot hereinafter.

2-GFSK mode



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

12.1 Applicable Standards

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

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

12.2 Test Procedure

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) $\approx$ 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel

Video (or Average) Bandwidth (VBW) $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2019-03-06	1 year
-	SMA cable	-	-	Each time ¹	N/A

Note¹: cable included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

12.4 Test Environmental Conditions

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

The testing was performed by Christopher Casteel on 2019-12-26 at RF Bench.

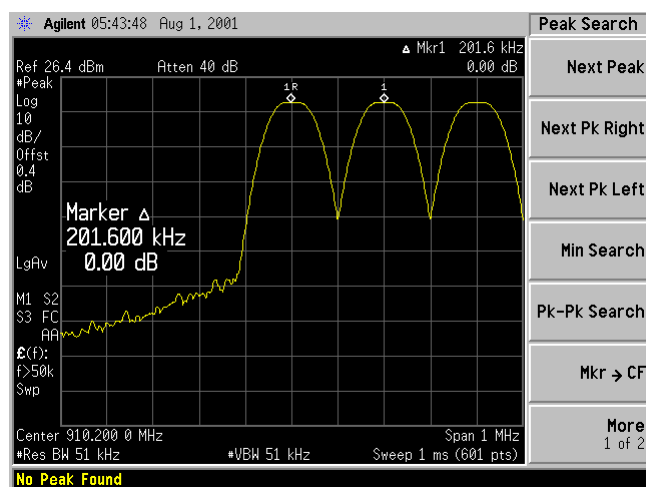
12.5 Test Results

2-GFSK mode

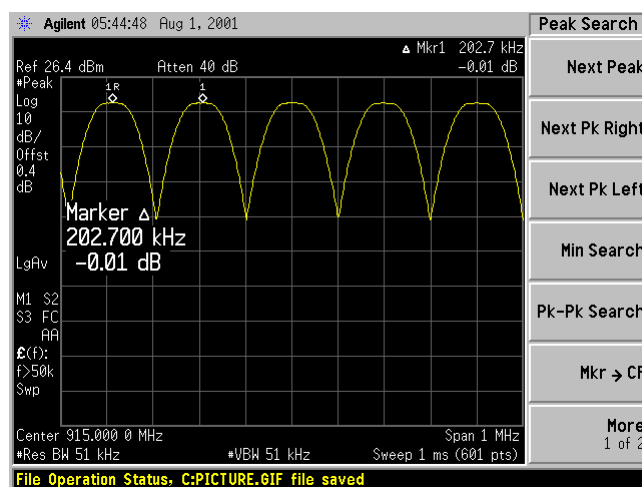
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 20 dB OBW (kHz)
Low	910.2	201.6	38.812
Middle	915	202.7	38.410
High	920	201.6	38.951

Please refer to following plots.

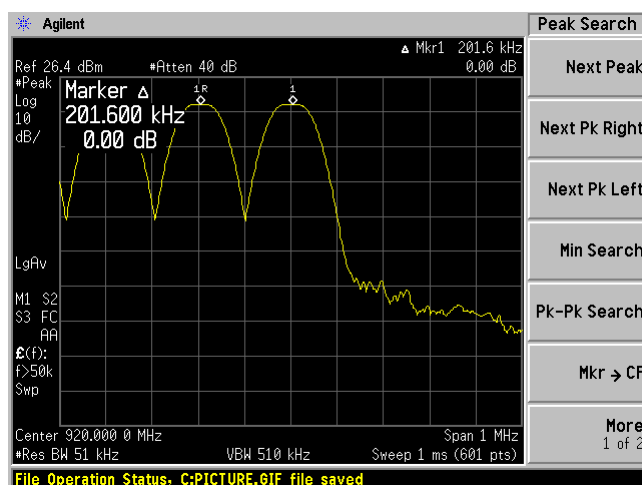
Low Channel 910.2 MHz



Middle Channel 915 MHz



High Channel 920 MHz



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

13.1 Applicable Standards

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

13.2 Test Procedure

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

13.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US45303156	2019-03-06	1 year
-	SMA cable	-	-	Each time ¹	N/A

Note¹: cable included in the test set-up will be checked each time before testing.

Statement of Traceability: *BACL Corp.* attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

13.4 Test Environmental Conditions

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

The testing was performed by Christopher Casteel on 2019-12-26 at RF Bench.

14 Annex A (Normative) - Test Setup Photographs

Please refer to attachment:

15 Annex B (Normative) - EUT External Photographs

Please refer to attachment:

16 Annex C (Normative) - EUT Internal Photographs

Please refer to attachment:

17 Annex D (Informative) – Manufacturer Declaration of Similarity



DECLARATION OF SIMILARITY

12/12/19

To:
Federal Communications Commission
Authorization and Evaluation Division
7435 Oakland Mills Rd
Columbia MD 21046-1609 USA

Innovation, Science and Economic Development Canada
3701 Carling Avenue (Building 94)
P.O. Box 11490, Station H
Ottawa, Ontario K2H 8S2 Canada

Dear Sir or Madam:

We Next Century Submetering Systems, LLC hereby declare that product: *Remote Reader*, model(s): *RR301* is/are electrically identical with the same electromagnetic emissions and electromagnetic compatibility characteristics as model: *RR301-TR* of products tested by BACL, the results of which are featured in BACL project: R1912023

A description of the differences between the tested model and those that are declared similar are as follows:

RR301 and RR301-TR are identical in all electrical and design aspects. The only difference between the two devices is that the RR301-TR has a few software features enabled that the RR301 does not have. They will both utilize all wireless circuitry the exact same way.

Please contact me should there be need for any additional clarification or information.

Best Regards,

A handwritten signature in blue ink, appearing to read 'Adam Paul', written over a light blue grid background.

Adam Paul
Executive Engineer

PO BOX 360
Tybee Island, GA 31328

18 Annex E (Normative) - A2LA Electrical Testing Certificate



Please follow the web link below for a full ISO 17025 scope

<https://www.a2la.org/scopepdf/3297-02.pdf>

--- END OF REPORT ---