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

TEST AND MEASUREMENT REPORT

For

Aiut sp. z o.o.

ul. Wyczolkowskiego 113, Gliwice 44-109, Poland

FCC ID: 2AKQSALE1F5
IC: 22378-ALEVEL1F5

Report Type:	**Product Type:**
Original Report	Smart Tank Level Sensor

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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1908263-247	Original Report	2020-03-04

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Aiut sp. z o.o.* and their product model: ALEVEL 1F5, FCC ID: 2AKQSALE1F5; IC: 22378-ALEVEL1F5 or the "EUT" as referred to in this report. It is a Smart Tank Level Sensor that operates within the 902-928 MHz frequency range using Sigfox RC2 communication mode in the North America.

1.2 Mechanical Description of EUT

The EUT measures approximately 17 cm (Length), 2.9 cm (Width), and 2 cm (Height) and weighs less than 1kg.

The data gathered are from a typical production sample provided by Aiut sp. z o.o with BACL assigned serial numbers: R1908263-1 and R1908263-2.

1.3 Objective

This report was prepared on behalf of *Aiut sp. z o.o.,* in accordance with Part 2, Subpart J, and Part 15, Subpart C of the Federal Communication Commission's rules and ISEDC RSS-247 Issue 2, February 2017.

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

1.4 Related Submittal(s)/Grant(s)

None

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

1.6 Measurement Uncertainty

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

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

1.7 Test Facility Registrations

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

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02)*****,** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report.

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)

- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 System Test Configuration

2.1 Justification

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

2.2 EUT Exercise Software

N/A

2.3 Duty Cycle Correction Factor

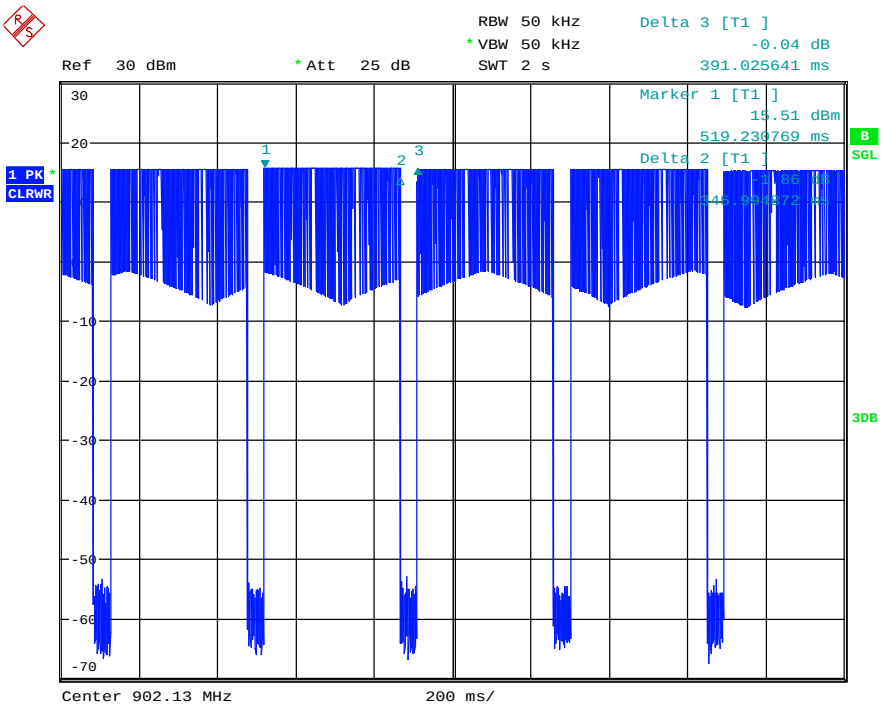
According to KDB 558074 D01 DTS Meas Guidance v05r02 section 6.0:

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).

Radio frequency (MHz)	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
902.13	345.99	391.02	88.5	0.53

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

Please refer to the following plots.



2.4 Equipment Modifications

None

2.5 Local Support Equipment

N/A

2.6 Remote Support Equipment

N/A

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
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	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 RSS-Gen §8.9, §8.10	Radiated Spurious Emissions	Compliant
FCC §15.247(a)(1)(i) ISEDC RSS-247 §5.1 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 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 quarter wave antenna.

External/Internal/Integral	Frequency Range (MHz)	Antenna Type	Maximum Antenna Gain (dBi)
Integral	902-928 MHz	Quarter Wave	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 MHz[6] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

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

5.2 MPE Prediction

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

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

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

5.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	14.63
Maximum peak output power at antenna input terminal (mW):	29.04
Prediction distance (cm):	20
Prediction frequency (MHz):	902.13
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0058
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.60

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0058 mW/cm^2. Limit is 0.60 mW/cm^2.

5.4 RF exposure evaluation exemption for IC

Maximum EIRP power = 14.63dBm + 0 dBi = 14.63 dBm which is lesser than $1.31\times10^{-2}f^{0.6834}$ = 1.3706 W = 31.4 dBm.

Therefore the RF exposure Evaluation is exempt.

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

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

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

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

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

As per ISEDC RSS-Gen 8.9,

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

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

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

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

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

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

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 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

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:

$$CA = Ai + AF + CL + Atten – Ga$$

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

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

$$Margin = Corrected\ Amplitude – Limit$$

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
HP	Pre-Amplifier	8449B	3008A01978	2019-09-27	1 year

Note[1]: cable and notch filter included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL *attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

6.6 Test Environmental Conditions

Temperature:	19 ºC
Relative Humidity:	34 %
ATM Pressure:	102.2 kPa

The testing was performed by Christian McCaig from 2020-02-18 to 2020-02-21 in 5m chamber 3.

6.7 Summary of Test Results

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

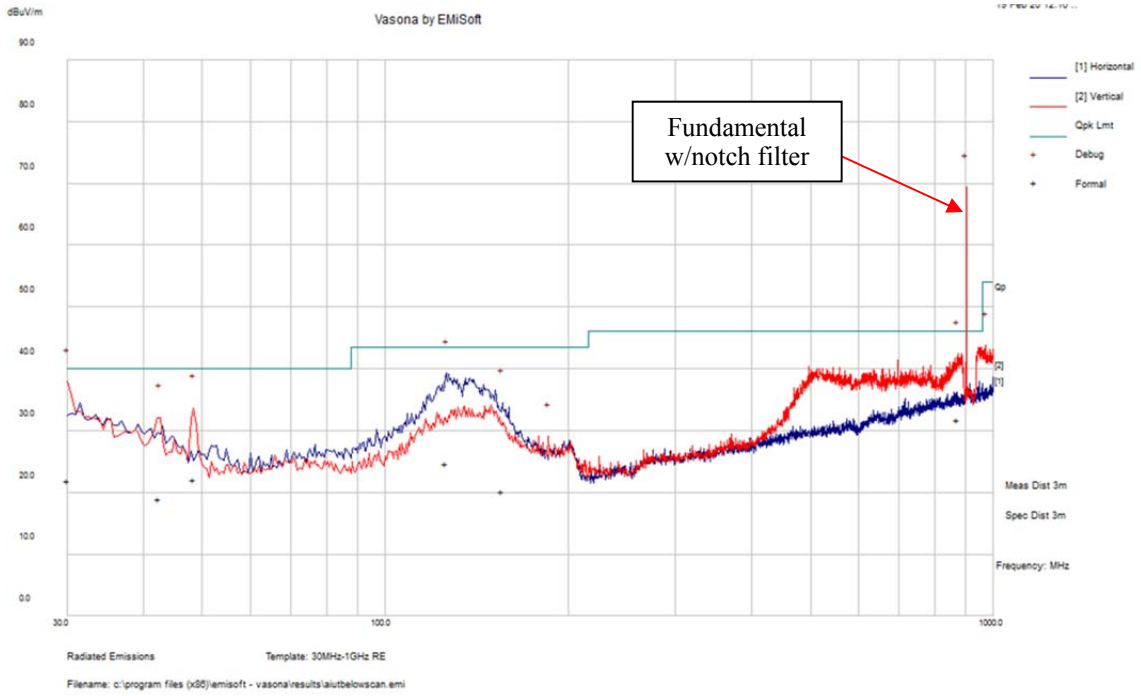
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Transmitting Channel**
-4.479	**2706**	**Vertical**	**902.13 MHz**

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: 902.13 MHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
30.00574	21.91	237	V	350	40	-18.09	QP
873.2703	31.77	106	V	134	46	-14.23	QP
125.961	24.7	274	H	1	43.5	-18.8	QP
48.48325	22.03	105	V	351	40	-17.97	QP
42.36475	19.02	168	V	336	40	-20.98	QP
155.5515	20.21	293	H	309	43.5	-23.29	QP

2) 1–10 GHz, Measured at 3 Meters

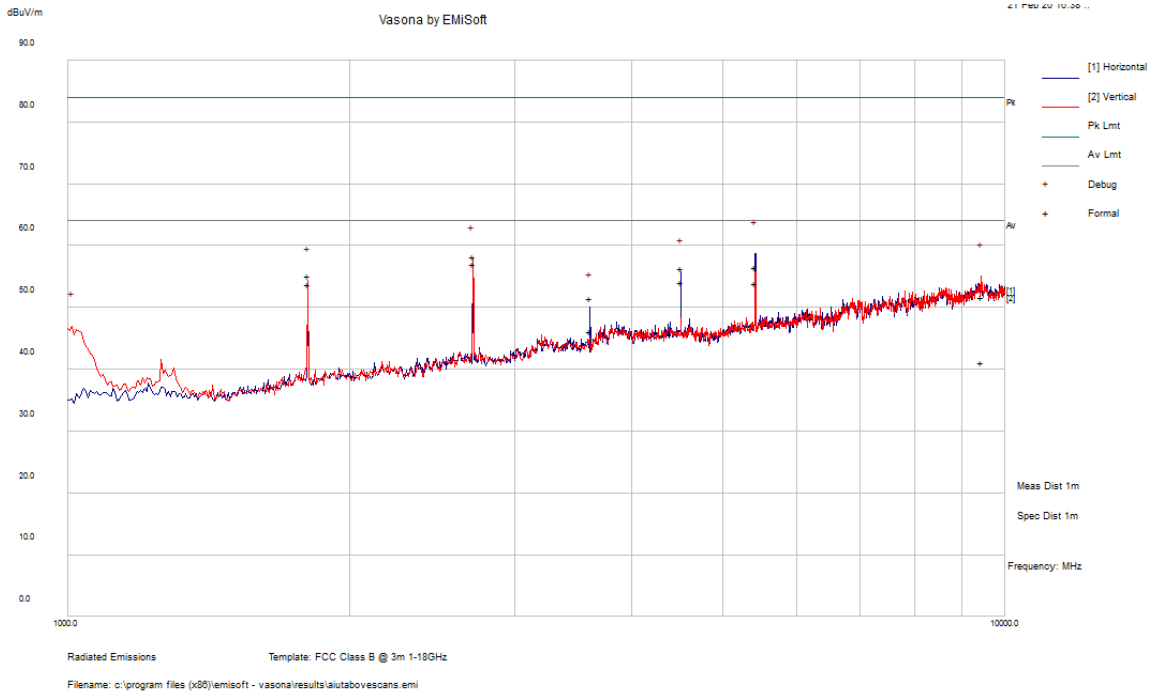
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel Frequency: 902.13 MHz											
902.13	112.72	25	110	V	29.5	3.6	27.982	117.838	-	-	Fund.
902.13	96.34	205	110	H	29.5	3.6	27.982	101.458	-	-	Fund.
902	92.85	10	105	V	23.581	4.32	40.543	80.208	97.838	-17.63	Peak
902	71.05	100	160	H	23.667	4.32	40.543	58.494	81.458	-22.964	Peak
1001	56.91	90	120	V	23.581	4.32	40.543	44.268	74	-29.732	Peak
1001	51.60	0	200	H	23.667	4.32	40.543	39.044	74	-34.956	Peak
1001	41.52	90	120	V	23.581	4.32	40.543	28.878	54	-25.122	Ave
1001	36.65	0	200	H	23.667	4.32	40.543	24.094	54	-29.906	Ave
1804	57.92	80	100	V	27.142	6.3	39.774	51.588	97.838	-46.25	Peak
1804	54.08	112	100	H	27.128	6.3	39.774	47.734	81.458	-33.724	Peak
2706	56.48	210	280	V	29.316	6.64	38.905	53.531	74	-20.469	Peak
2706	51.51	255	100	H	29.31	6.64	38.905	48.555	74	-25.445	Peak
2706	52.47	210	280	V	29.316	6.64	38.905	49.521	54	**-4.479**	Ave
2706	42.47	255	100	H	29.31	6.64	38.905	39.515	54	-14.485	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Pol (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel Frequency: 903.41 MHz											
903.41	112.6	25	110	V	29.5	3.6	27.982	117.718	-	-	Fund.
903.41	94.57	205	110	H	29.5	3.6	27.982	99.688	-	-	Fund.
1001	56.67	90	120	V	23.581	4.32	40.543	44.028	74	-29.972	Peak
1001	51.91	0	200	H	23.667	4.32	40.543	39.354	74	-34.646	Peak
1001	41.38	90	120	V	23.581	4.32	40.543	28.738	54	-25.262	Ave
1001	37.43	0	200	H	23.667	4.32	40.543	24.874	54	-29.126	Ave
1806	57.98	160	115	V	27.142	6.3	39.774	51.648	97.718	-46.07	Peak
1806	54.28	100	105	H	27.128	6.3	39.774	47.934	79.688	-31.754	Peak
2709	55.25	195	284	V	29.316	6.64	38.905	52.301	74	-21.699	Peak
2709	52.18	100	205	H	29.31	6.64	38.905	49.225	74	-24.775	Peak
2709	50.31	195	284	V	29.316	6.64	38.905	47.361	54	-6.639	Ave
2709	44.3	100	205	H	29.31	6.64	38.905	41.345	54	-12.655	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Note
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel Frequency: 904.66 MHz											
904.66	112.2	25	110	V	29.5	3.6	27.982	117.328	-	-	Fund.
904.66	93.07	205	110	H	29.5	3.6	27.982	98.188	-	-	Fund.
928	55.44	0	100	V	29.095	5.848	36.148	54.235	97.328	-43.093	Peak
928	55.68	0	100	H	29.169	5.848	36.148	54.549	78.188	-23.639	Peak
1001	56.30	90	120	V	23.581	4.32	40.543	43.658	74	-30.342	Peak
1001	52.12	0	200	H	23.667	4.32	40.543	39.564	74	-34.436	Peak
1001	41.35	90	120	V	23.581	4.32	40.543	28.708	54	-25.292	Ave
1001	37.44	0	200	H	23.667	4.32	40.543	24.884	54	-29.116	Ave
1808	58.41	135	118	V	27.142	6.3	39.774	52.078	97.328	-45.25	Peak
1808	55.05	290	245	H	27.128	6.3	39.774	48.704	78.188	-29.484	Peak
2712	55.93	190	290	V	29.316	6.64	38.905	52.981	74	-21.019	Peak
2712	52	180	210	H	29.31	6.64	38.905	49.045	74	-24.955	Peak
2712	51.13	190	290	V	29.316	6.64	38.905	48.181	54	-5.819	Ave
2712	43.57	180	210	H	29.31	6.64	38.905	40.615	54	-13.385	Ave

Worst Case: 902.13 MHz

1 – 10 GHz Worst Case Pre-Scan, 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

99% OBW:

Span = approximately 2 to 5 times the 99% OBW, centered on a hopping channel
RBW = 1% to 5 % of the 99% OBW
VBW ≥ 3RBW
Sweep = auto
Detector function = peak
Trace = max hold

Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

20dB OBW:

Span = approximately 2 to 5 times the OBW, centered on a hopping channel
RBW = 1% to 5 % of the 99% OBW
VBW ≥ 3RBW
Sweep = auto
Detector function = peak
Trace = max hold

Determine reference level as highest level of displayed trace

Determine the "−20 dB down amplitudes" using [(reference value) − 20] and record frequency difference as the occupied bandwidth

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rhode & Schwarz	Spectrum Analyzer	FSV40	1321.3008K39-101203-UW	2019-08-06	1 year
-	20 dB attenuator	-	-	Each time[1]	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

7.4 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2020-02-19 at RF Bench.

7.5 Test Results

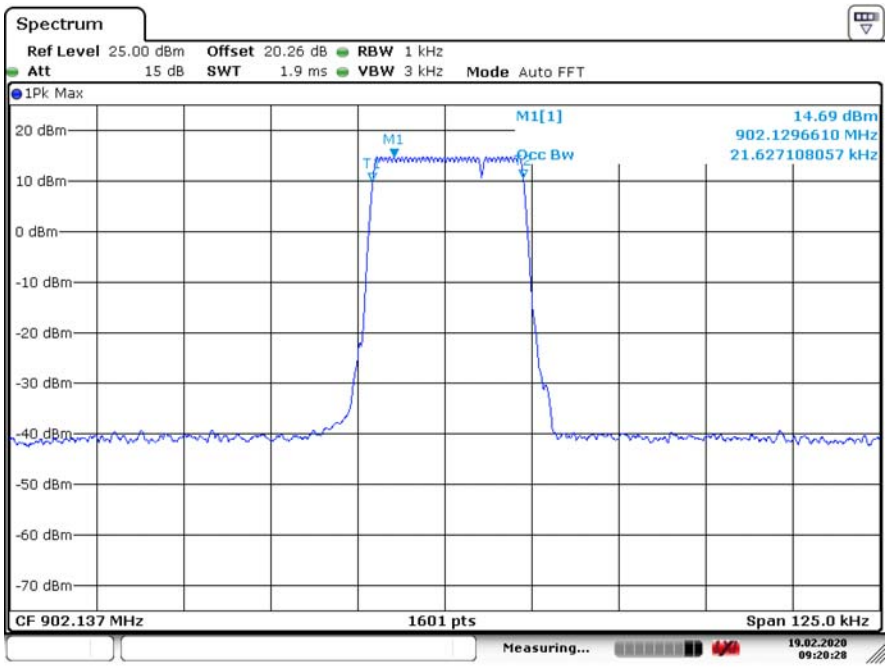
Mode: Sigfox RC2

Channel	Frequency (MHz)	99% OBW (kHz)	20 dB OBW (kHz)
Low	902.13	21.627	23.345
Middle	903.41	21.610	23.313
High	904.66	21.613	23.313

Please refer to the following plots for detailed test results.

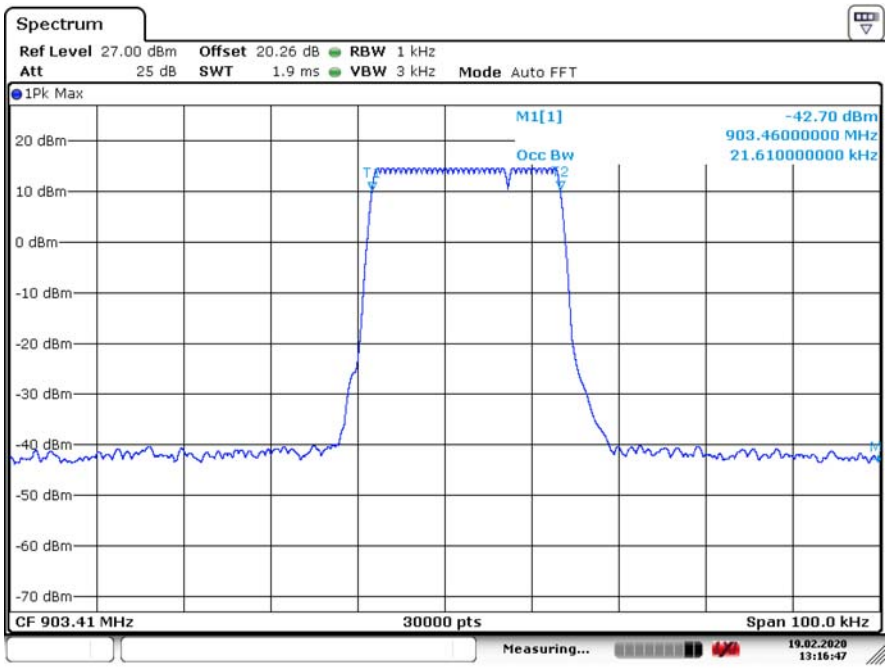
99% OBW

Low Channel 902.13 MHz



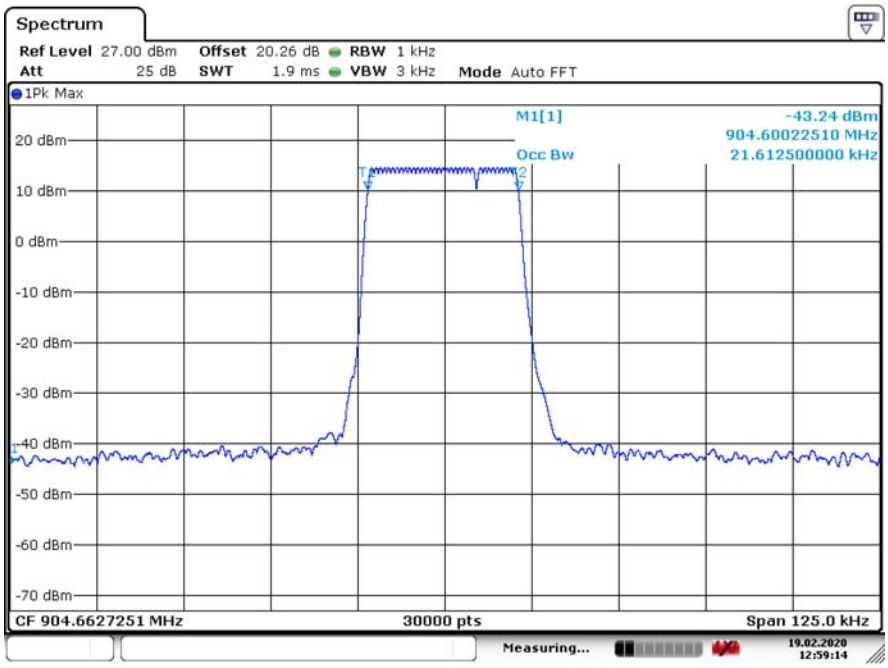
Date: 19.FEB.2020 09:20:28

Middle Channel 903.41 MHz



Date: 19.FEB.2020 13:16:47

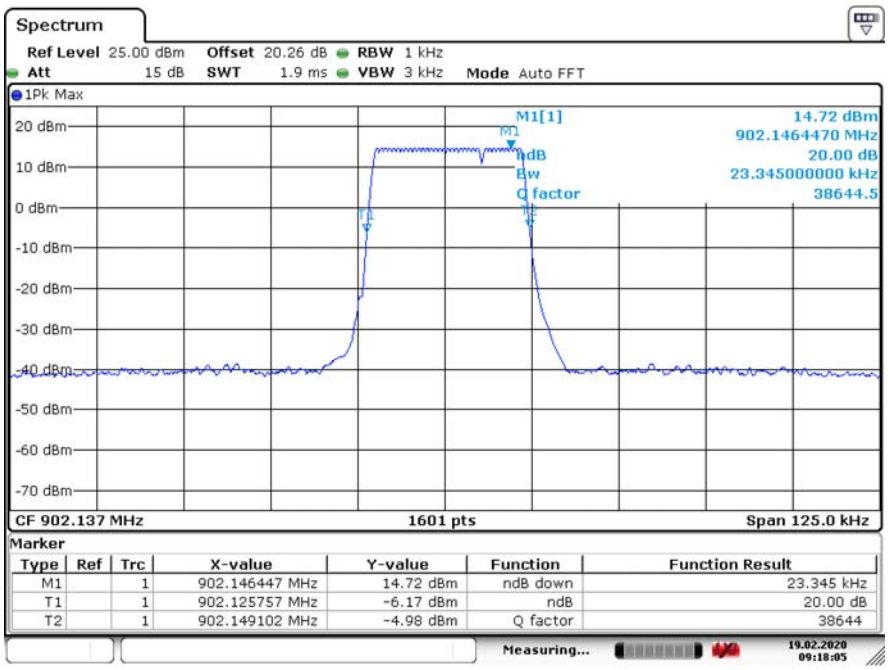
High Channel 904.66 MHz



Date: 19.FEB.2020 12:59:15

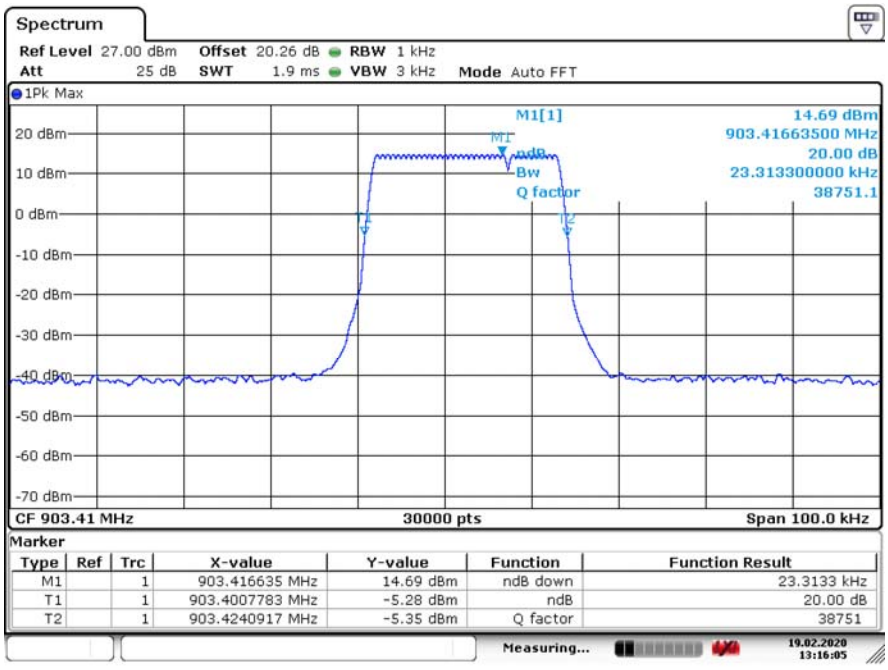
20 dB OBW

Low Channel 902.13 MHz



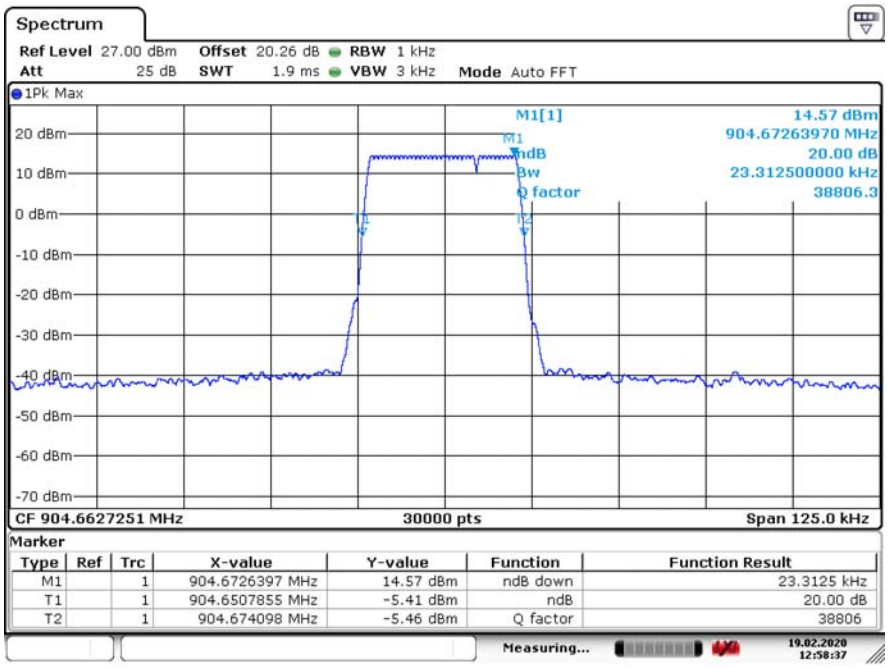
Date: 19.FEB.2020 09:18:05

Middle Channel 903.41 MHz



Date: 19.FEB.2020 13:16:06

High Channel 904.66 MHz



Date: 19.FEB.2020 12:58:37

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 operat not exceed 4 W if the hopset uses 75 or more hopping channels; the maxim ing 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 um 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 ≥ 5 times the 20 dB bandwidth, centered on a hopping channel
RBW > the 20 dB bandwidth of the emission being measured
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Spectrum Analyzer	FSQ26	200749	2019-11-07	2years
-	20 dB attenuator	-	-	Each time[1]	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

8.4 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2020-02-19 at RF Bench.

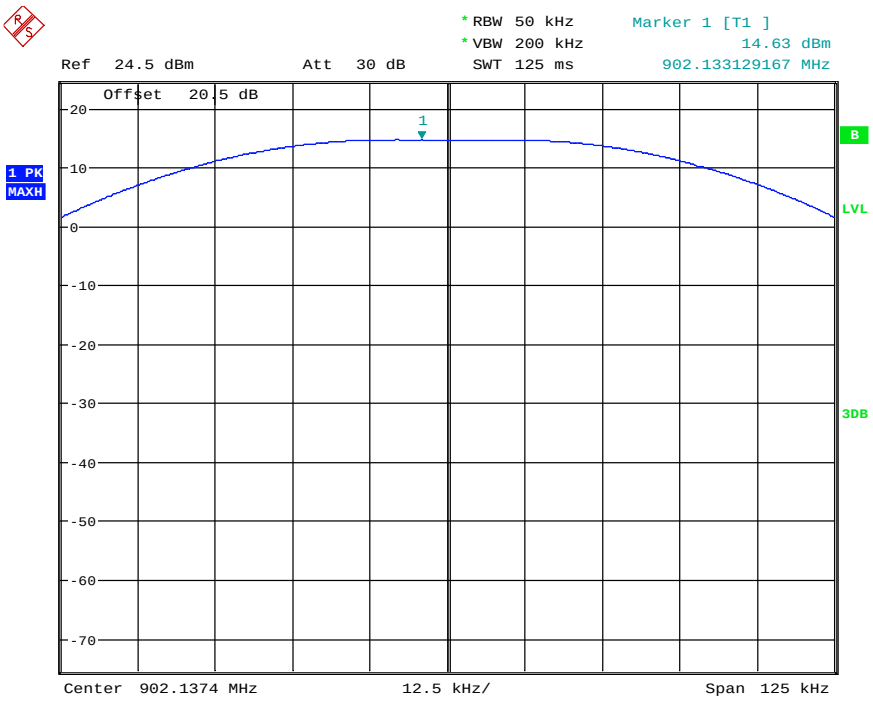
8.5 Test Results

Mode: Sigfox RC2

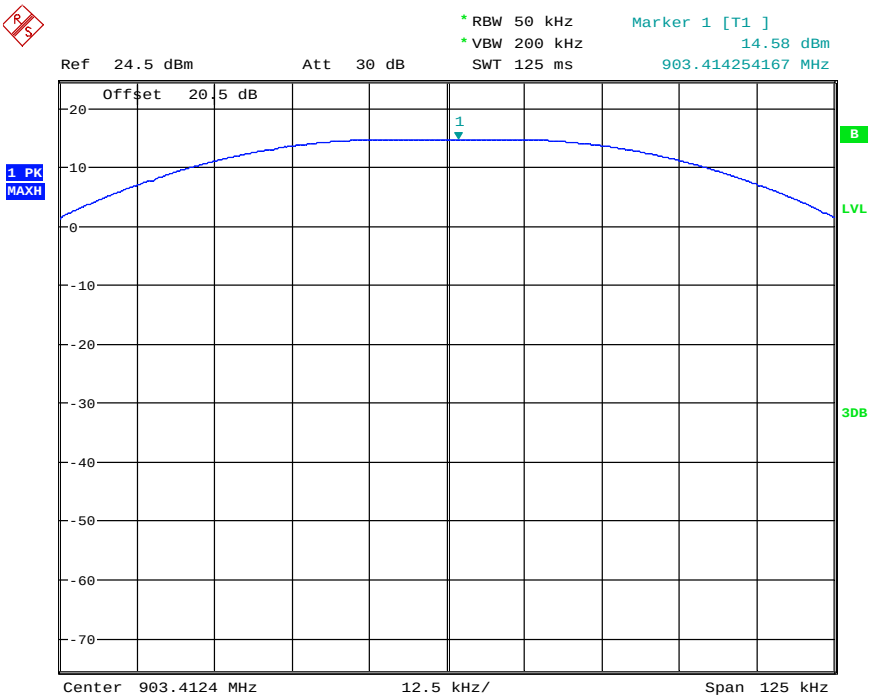
Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC/ISEDC Limit (dBm)
Low	902.13	14.63	30
Middle	903.41	14.58	30
High	904.66	14.60	30

Please refer to the following plots for detailed test results.

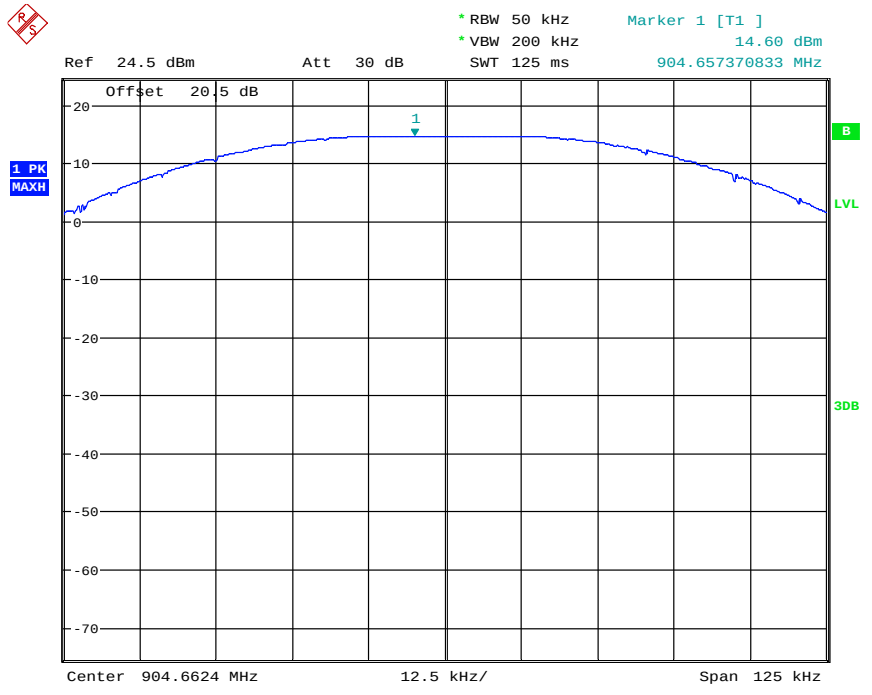
Low Channel 902.13 MHz



Middle Channel 903.41 MHz



High Channel 904.66 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
Rhode & Schwarz	Spectrum Analyzer	FSV40	1321.3008K39-101203-UW	2019-08-06	1 year
-	20 dB attenuator	-	-	Each time[1]	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

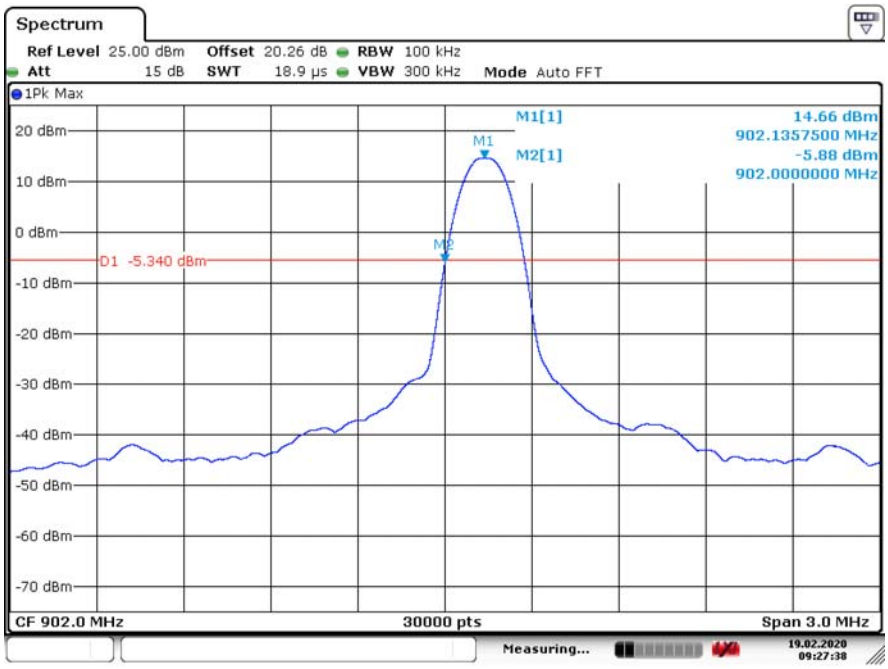
9.4 Test Environmental Conditions

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

The testing was performed by Christian McCaig on 2020-02-19 at RF Bench.

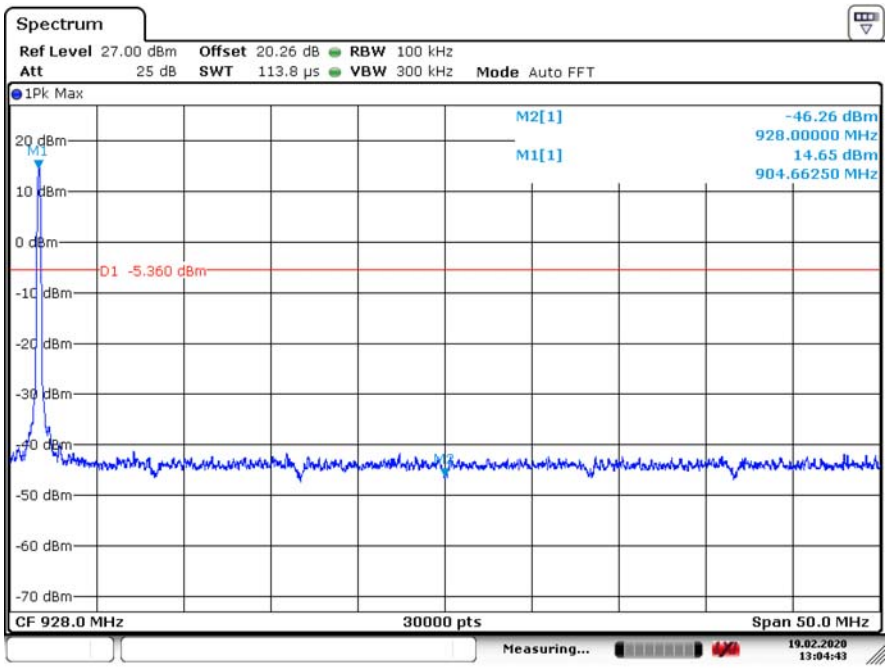
9.5 Test Results

Low Channel 902.13 MHz



Date: 19.FEB.2020 09:27:38

High Channel 904.66 MHz



Date: 19.FEB.2020 13:04:43

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

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

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

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

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

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	2years
-	10 dB attenuator	-	-	Each time[1]	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

10.4 Test Environmental Conditions

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

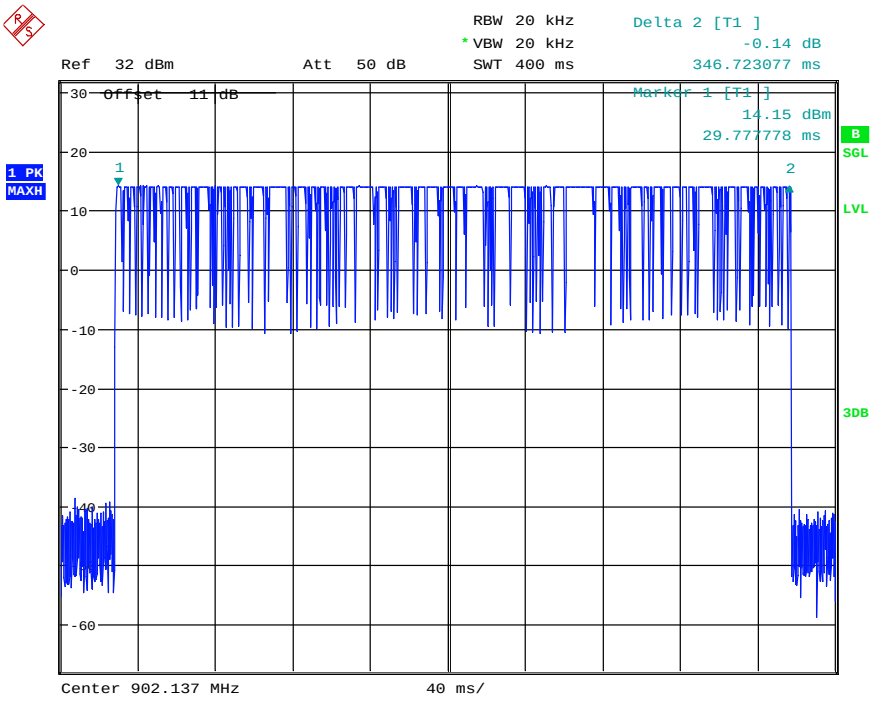
The testing was performed by Christian McCaig on 2020-02-24 at RF Bench.

10.5 Test Results

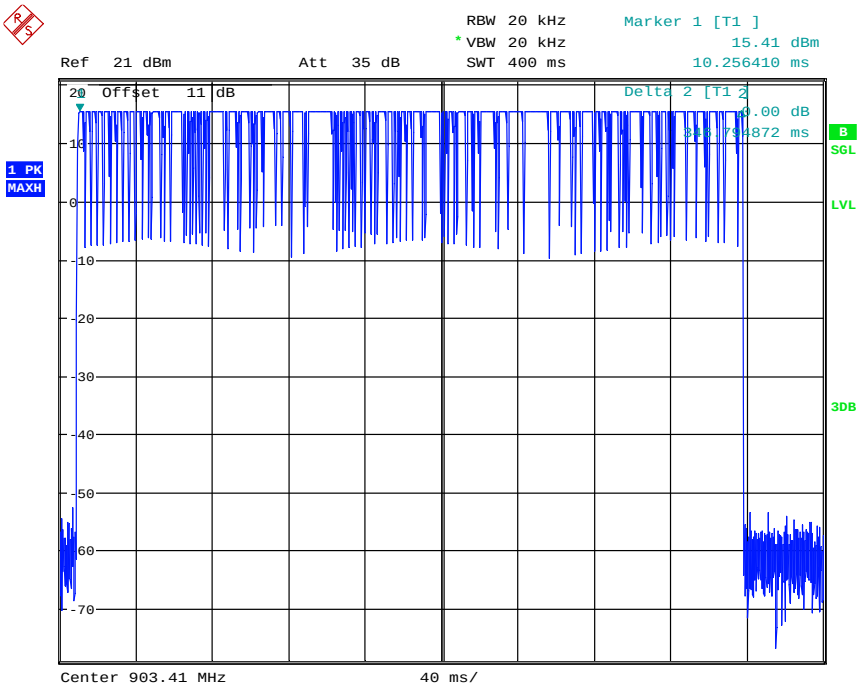
Channel	Pulse Width (ms) [1]	Limit (ms)	Results
Low	346.7	400	Compliant
Middle	346.8	400	Compliant
High	346.9	400	Compliant

Note[1]: Per manufacture: the transmitter cannot return to a given channel before 20s. Therefore, the single pulse width measured is sufficient to show compliance to limit.

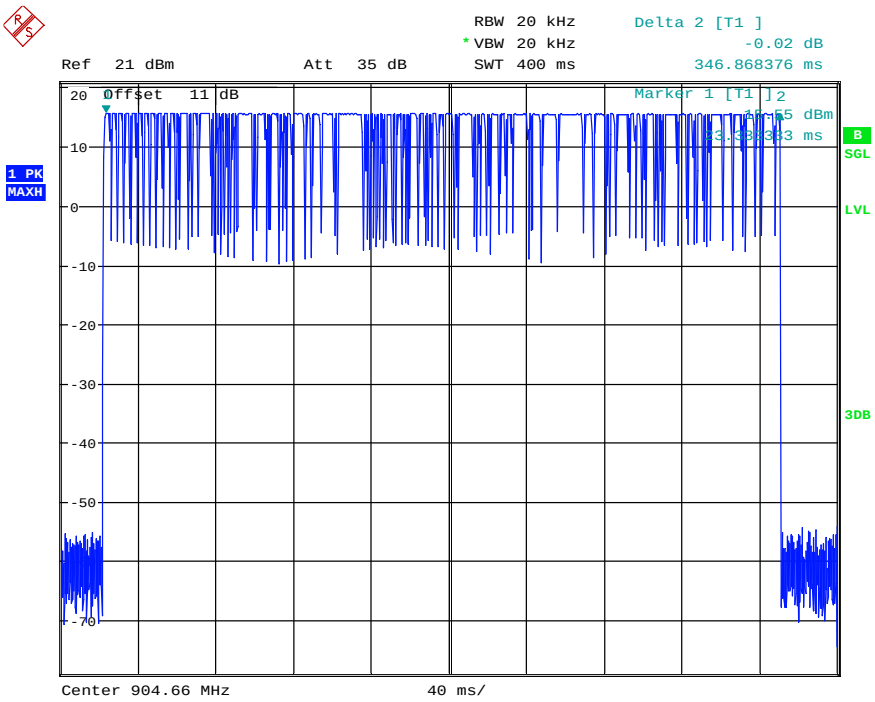
Low Channel



Middle Channel



High Channel



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
Rohde & Schwarz	Spectrum Analyzer	FSQ26	200749	2019-11-07	2years
-	20 dB attenuator	-	-	Each time[1]	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

11.4 Test Environmental Conditions

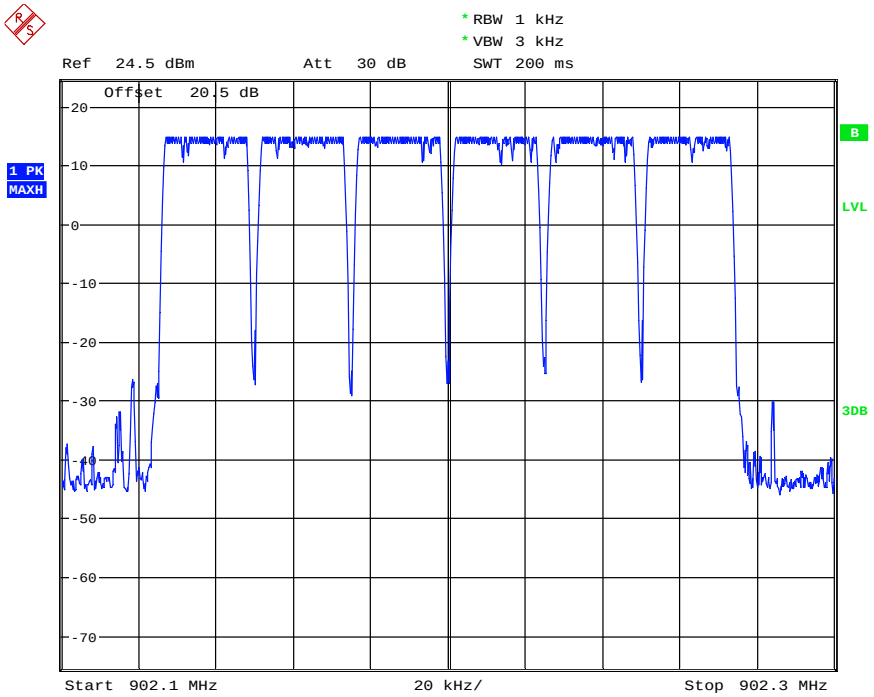
Temperature:	21º C
Relative Humidity:	39 %
ATM Pressure:	102.0 KPa

The testing was performed by Christian McCaig on 2020-02-19 at RF Bench.

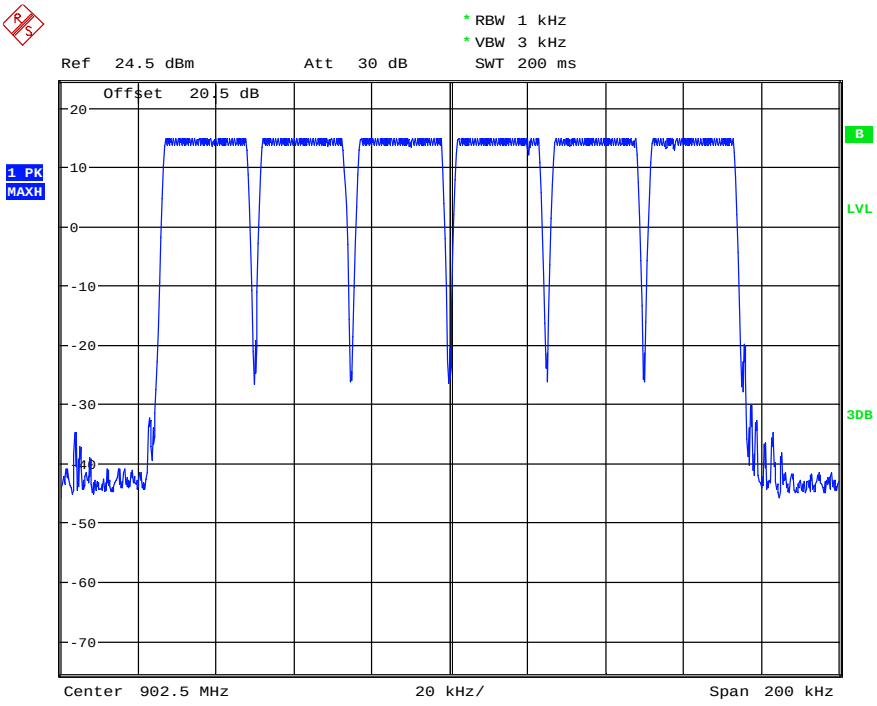
11.5 Test Results

The radio contains 9 macro channels, and each macro channel contains 6 micro channels. Therefore, total 54 channels within the operating frequency range; please refer to the plots hereinafter.

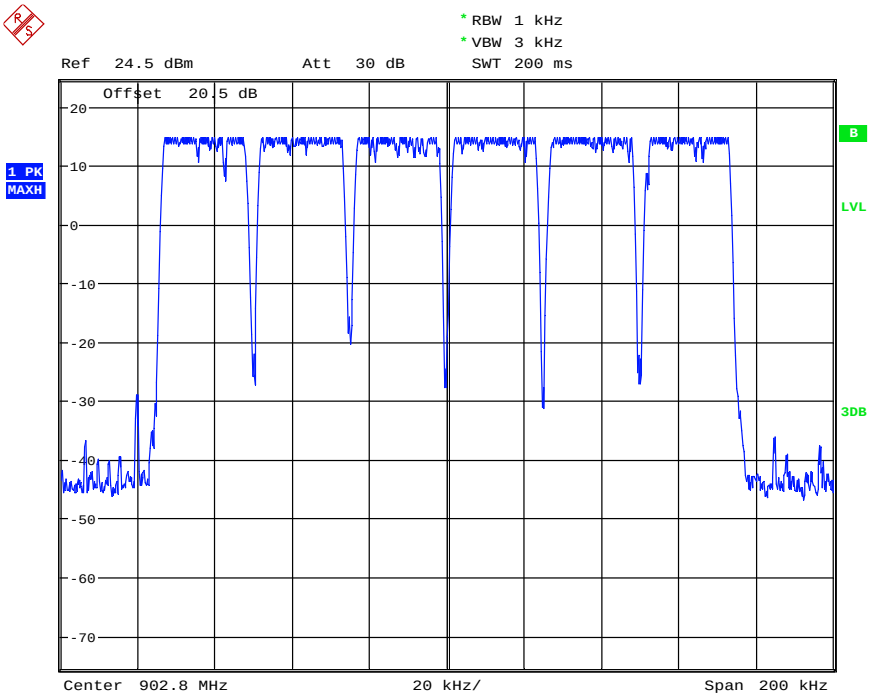
6 Micro Channels centered on 902.2 MHz



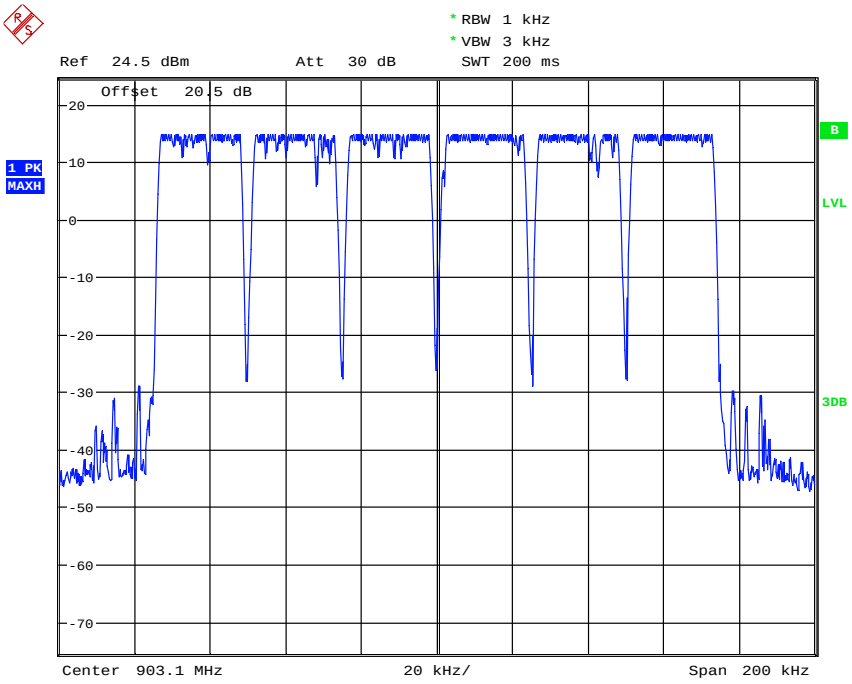
6 Micro Channels centered on 902.5 MHz



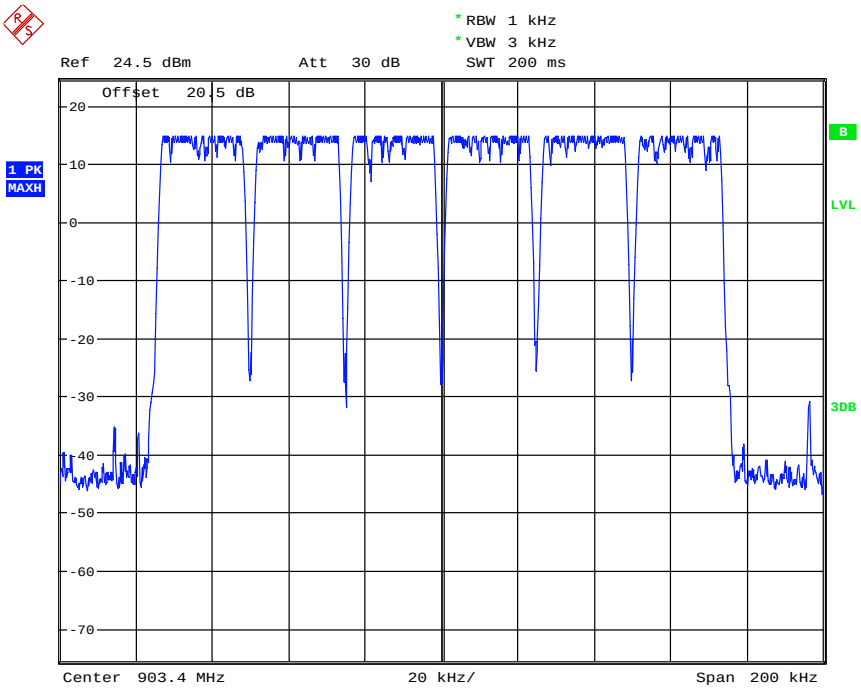
6 Micro Channels centered on 902.8 MHz



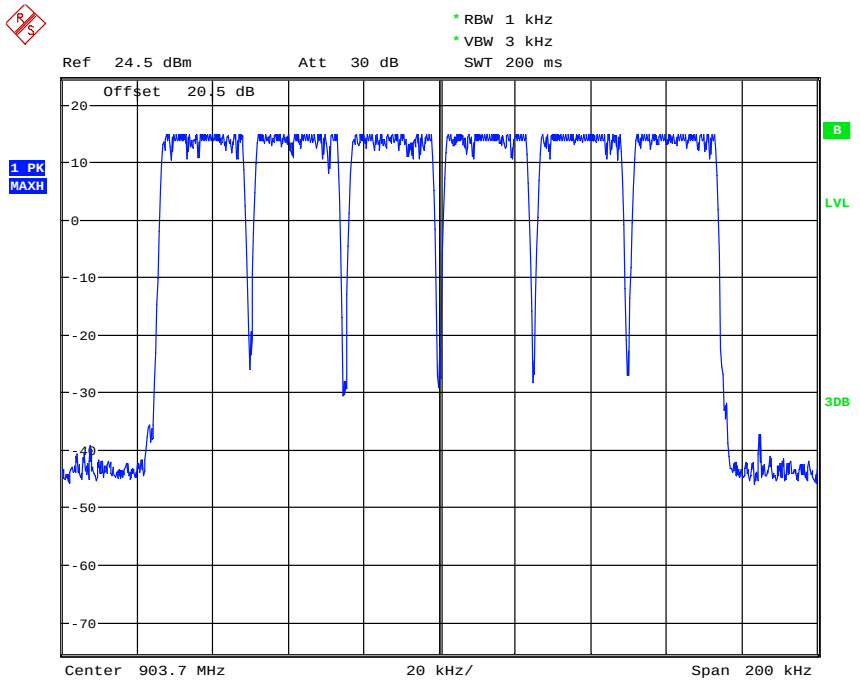
6 Micro Channels centered on 903.1 MHz



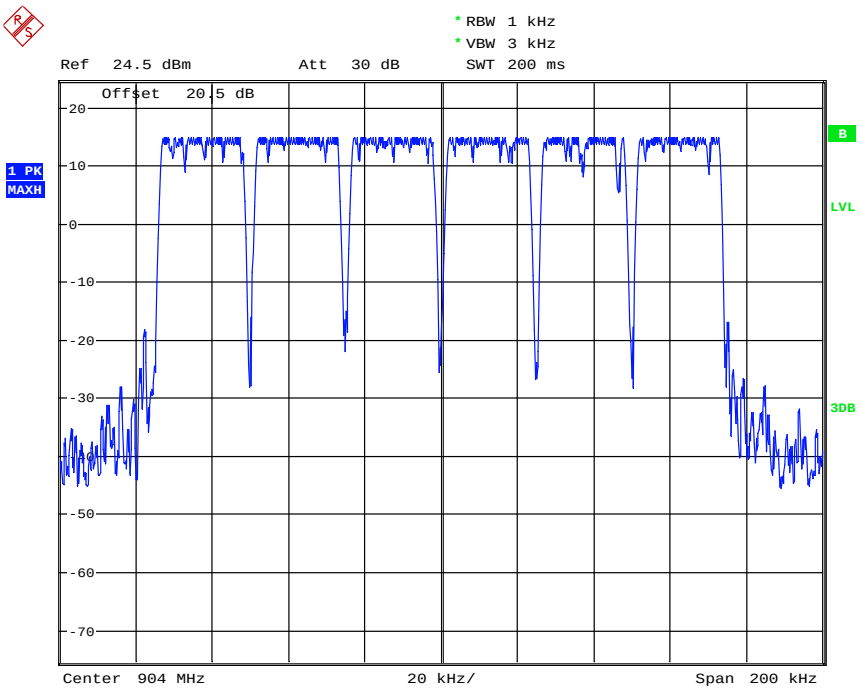
6 Micro Channels centered on 903.4 MHz



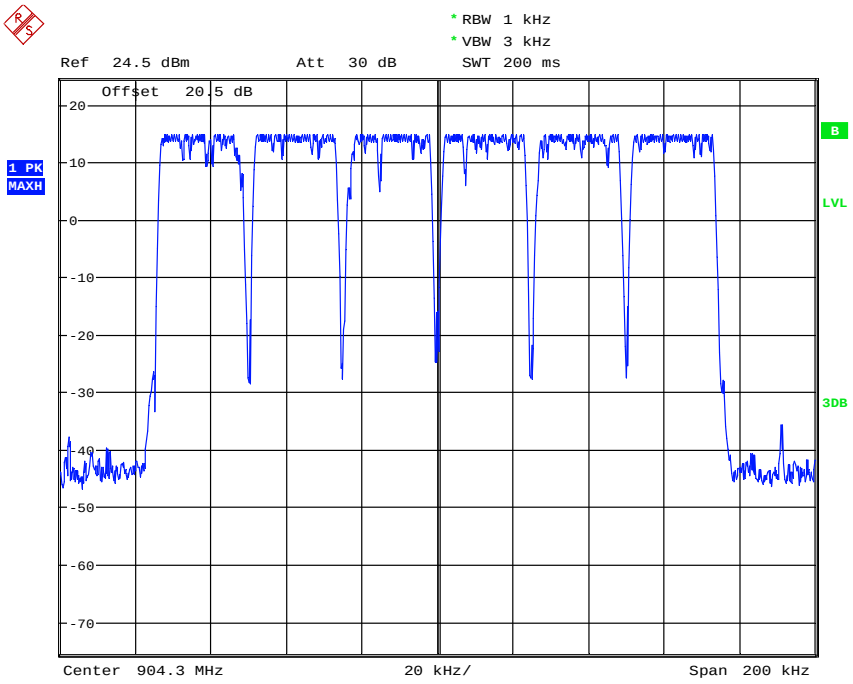
6 Micro Channels centered on 903.7 MHz



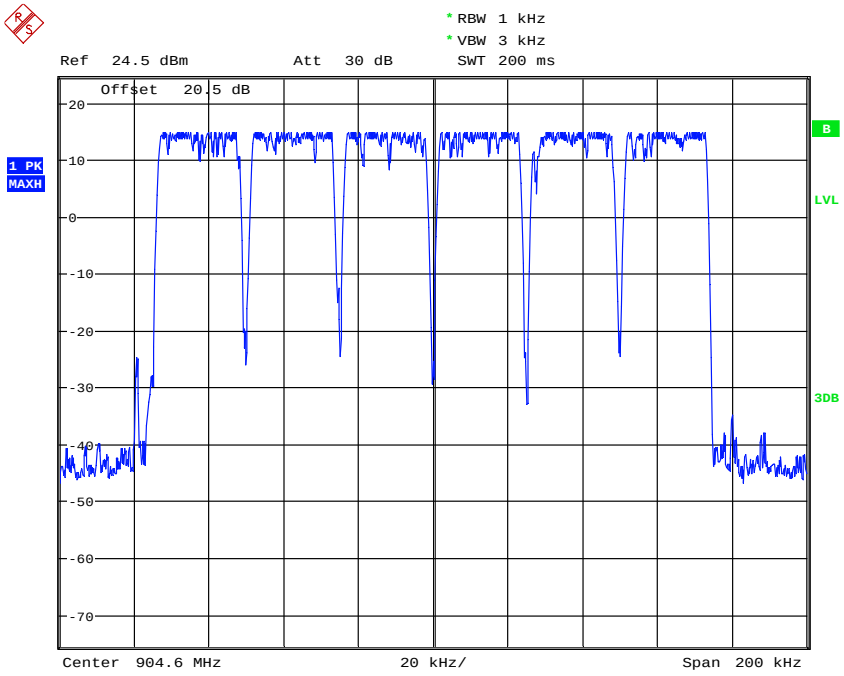
6 Micro Channels centered on 904.0 MHz



6 Micro Channels centered on 904.3 MHz



6 Micro Channels centered on 904.6 MHz



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) ≈ 30% of the channel spacing, adjust as necessary to best identify the center of each individual channel

Video (or Average) Bandwidth (VBW) ≥RBW
Sweep = auto
Detector function = peak
Trace = max hold

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rhode & Schwarz	Spectrum Analyzer	FSV40	1321.3008K39-101203-UW	2019-08-06	1 year
-	20 dB attenuator	-	-	Each time[1]	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all 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 Christian McCaig on 2020-02-19 at RF Bench.

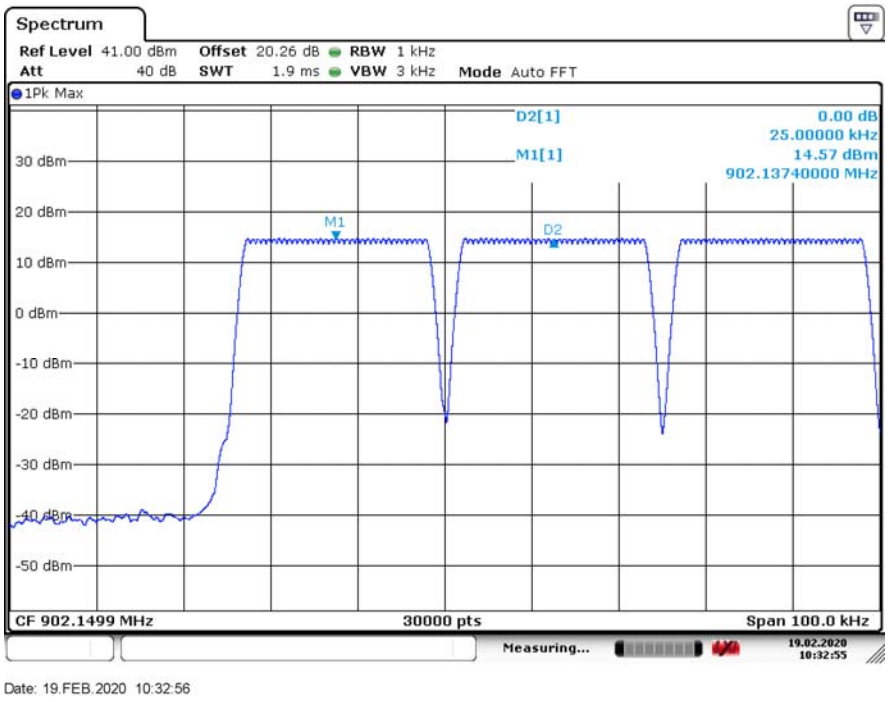
12.5 Test Results

Mode: Sigfox RC2

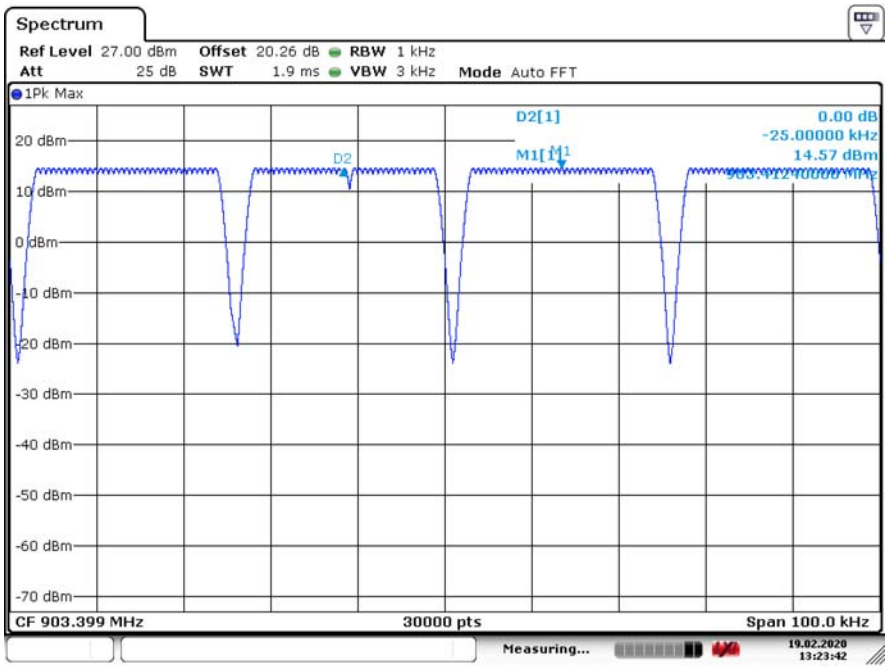
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit ≥ 25 kHz
Low	902.13	25	Pass
Middle	903.41	25	Pass
High	904.66	25	Pass

Please refer to following plots.

Low Channel 902.13 MHz

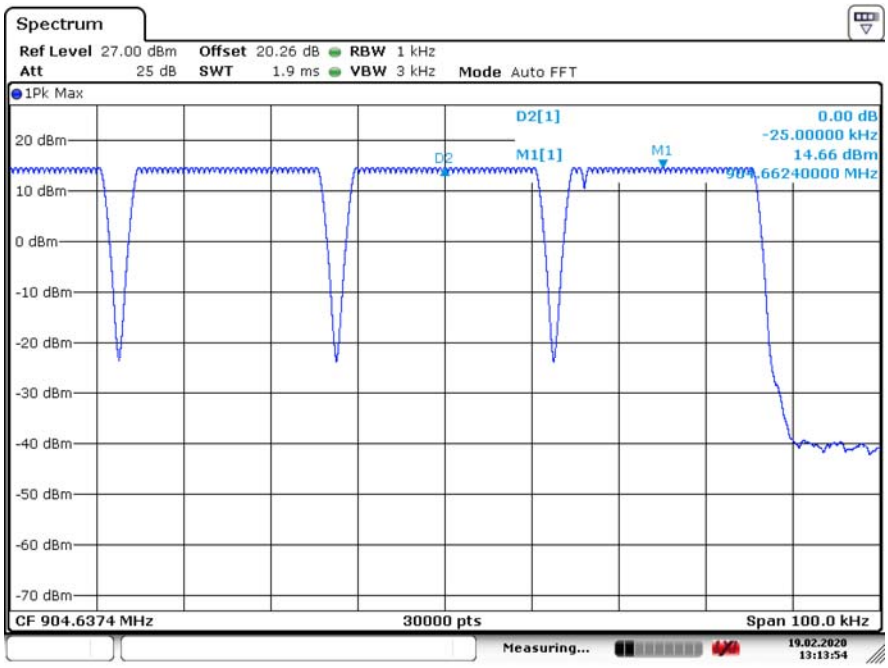


Middle Channel 903.41 MHz



Date: 19.FEB.2020 13:23:42

High Channel 904.66 MHz



Date: 19.FEB.2020 13:13:55

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
Rohde & Schwarz	Spectrum Analyzer	FSQ26	200749	2019-11-07	2years
-	10 dB attenuator	-	-	Each time[1]	N/A
-	SMA cable	-	-	Each time[1]	N/A

Note[1]: cable included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

13.4 Test Environmental Conditions

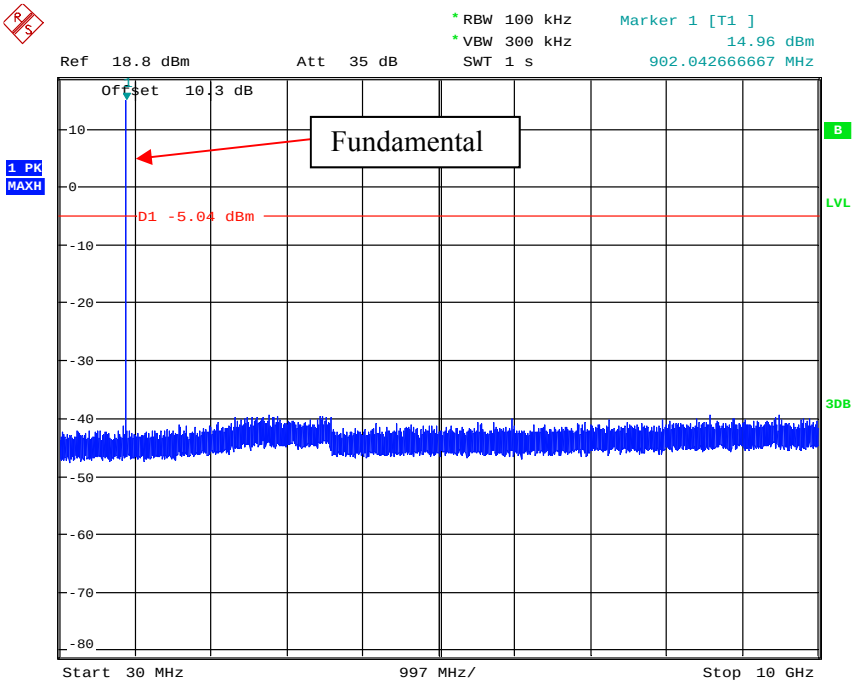
Temperature:	21º C
Relative Humidity:	39 %
ATM Pressure:	102.0 KPa

The testing was performed by Christian McCaig on 2020-02-19 at RF Bench.

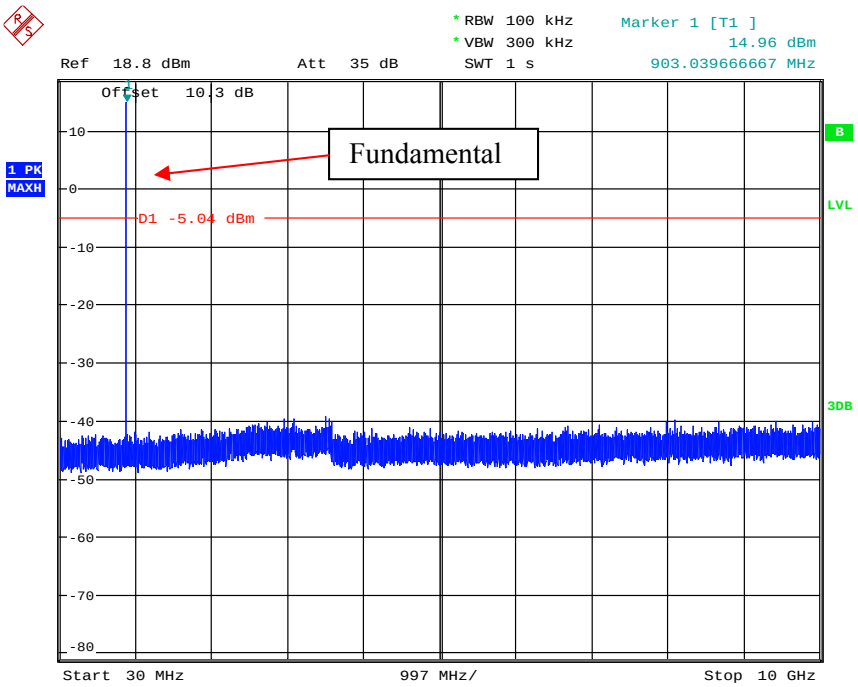
13.5 Test Results

Please refer to following plots.

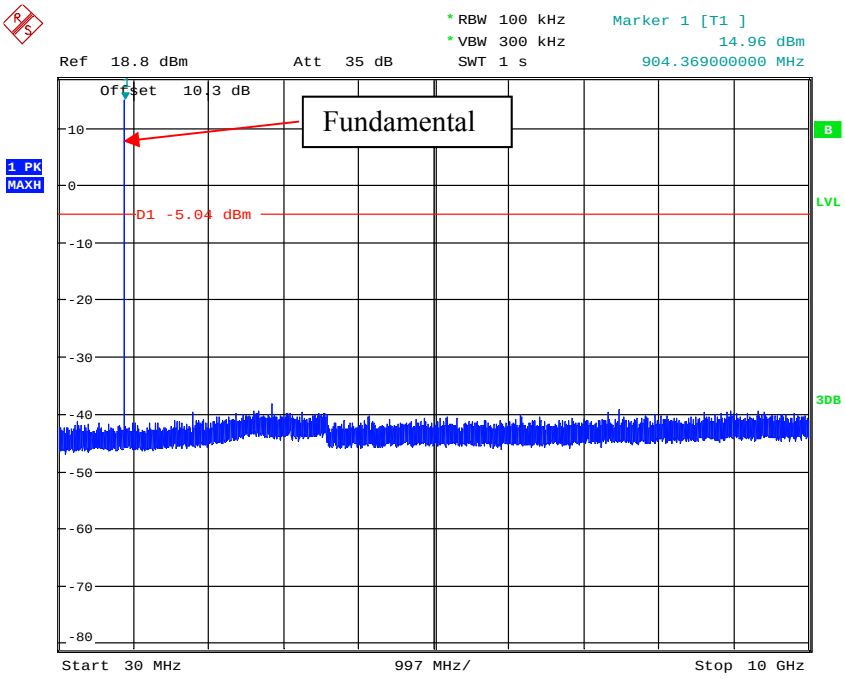
Low Channel 902.13 MHz



Middle Channel 903.41 MHz



High Channel 904.66 MHz



14 Annex A (Normative) - Test Setup Photographs

Please refer to the attachment

15 Annex B (Normative) - EUT External Photographs

Please refer to the attachment

16 Annex C (Normative) - EUT Internal Photographs

Please refer to the attachment

17 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 2nd day of October 2018.

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 ---