ENGINEERING TEST REPORT

Model: Alert Labs RN2903
FCC ID: 2AKXF-ALB010

Applicant:

Alert Labs Inc.
44 Gaukel St.
Kitchener, ON
N2G 4P3 Canada

In Accordance With

Federal Communications Commission (FCC)
Part 15, Subpart C, Section 15.247
Digital Modulation Systems (DTS) Operating in 903 – 927.5 MHz Band

UltraTech's File No.: 17SWIFT042_FCC15C247DTS

This Test report is Issued under the Authority of Tri M. Luu Vice President of Engineering UltraTech Group of Labs Date: March 17, 2017	
Report Prepared by: Santhosh Fernandez Issued Date: March 17, 2017	Tested by: Hung Trinh and Wei Wu Test Dates: February 1-March 7, 2017

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by any agency of the US Government.*

UltraTech

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Part 15, Subpart C, Section 15.247
Title:	Code of Federal Regulations (CFR), Title 47 – Telecommunication, Part 15 – Radio Frequency Devices
Purpose of Test:	Equipment Certification for Digital Modulation Systems (DTS) Transmitter Operating in the Frequency Band 2400-2483.5 MHz.
Test Procedures:	▪ ANSI C63.4 ▪ ANSI C63.10 ▪ FCC KDB Publication No. 558074 D01 DTS Meas Guidance v03r04
Environmental Classification:	[x] Commercial, industrial or business environment [x] Residential environment

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
47 CFR Parts 0-19	2016	Code of Federal Regulations (CFR), Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 KHz to 40 GHz
ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CISPR 16-1-1 +A1 +A2	2006 2006 2007	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-1: Measuring Apparatus
CISPR 16-1-2 +A1 +A2	2003 2004 2006	Specification for radio disturbance and immunity measuring apparatus and methods. Part 1-2: Conducted disturbances
FCC, KDB Publication No. 558074 D01 DTS Meas Guidance v03r04	2016	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

APPLICANT	
Name:	Alert Labs Inc.
Address:	44 Gaukel St. Kitchener, ON N2G 4P3 Canada
Contact Person:	Mr. Kevin wright Phone #: 1-266-600-211 Email Address: Kevin@alertlabs.com

MANUFACTURER	
Name:	Alert Labs Inc.
Address:	44 Gaukel St. Kitchener, ON N2G 4P3 Canada
Contact Person:	Mr. Kevin wright Phone #: 1-266-600-211 Email Address: Kevin@alertlabs.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Alert Labs Inc.
Product Name:	Alert Labs RN2903
Model Name or Number:	Alert Labs RN2903
Serial Number:	Test Sample
Type of Equipment:	Digital Transmission System (DTS)
Input Power Supply Type:	External DC Power Supply
Primary User Functions of EUT:	The Alert Labs RN2903 is a low power long range transceiver module

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	• Mobile
Intended Operating Environment:	▪ Commercial, industrial or business environment ▪ Residential environment
Power Supply Requirement:	5 VDC/3VDc applied to Host, Module is rated 3.3Vdc
RF Output Power Rating:	0.081W
Operating Frequency Range:	903-927.5 MHz
RF Output Impedance:	50 Ω
Modulation Type:	FSK
Antenna Connector Types:	PCB Trace

2.4. ASSOCIATED ANTENNA DESCRIPTIONS

Antenna Type	Maximum Gain (dBi)
Helical PCB Antenna	2.33dBi (903-927.5 MHz)

2.5. LIST OF EUT'S PORTS

The EUT is a module was tested when housed in two hosts:
Alert Labs Flowie Water Sensor and Alert Labs Floodie Companion Sensor with the Antenna described above.

2.6. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

Alert Labs Flowie Water Sensor was powered by AC adaptor (Weihei Honglin electronic Co. Ltd, ACDC-13BA UE) and Alert Labs Floodie Companion Sensor was powered by a pair of AA batteries.

EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21 to 23 °C
Humidity:	45 to 58%
Pressure:	102 kPa
Power Input Source:	5 VDC for Sensor and 3Vdc for Detector

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TESTS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	Test software provided by the Applicant to operate the EUT at each channel frequency continuously and in the range of typical modes of operation.
Special Hardware Used:	Test Jig
Transmitter Test Antenna:	The EUT is tested with the antenna fitted in a manner typical of normal intended use as described with the test results.

Transmitter Test Signals	
Frequency Band(s):	903-927.5 MHz
Frequency(ies) Tested:	903 MHz, 914.9 MHz, 927.5 MHz
RF Power Output: (measured maximum output power at antenna terminals)	19.93 dBm Peak (original)
Normal Test Modulation:	FSK
Modulating Signal Source:	Internal

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).

- Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with FCC office (FCC File No.: 91038) and Industry Canada office (Industry Canada File No.: 2049A-3, Expiry : 2020-03-27).

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Compliance (Yes/No)
15.203	Antenna requirements	Yes
15.207(a)	AC Power Line Conducted Emissions	Yes
15.247(a)(2)	6 dB Bandwidth	N/A*
15.247(b)(3)	Peak Conducted Output Power - DTS	Yes
15.247(d)	Band-Edge and RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
15.247(d), 15.209 & 15.205	Transmitter Spurious Radiated Emissions	Yes
15.247(e)	Power Spectral Density	N/A*
15.247(i), 1.1307, 1.1310, 2.1091	RF Exposure	Yes

N/A*- Not required for class 2 permissive change

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

The Antenna match circuitry was modified to meet spurious emissions.

EXHIBIT 5. TEST DATA

5.1. POWER LINE CONDUCTED EMISSIONS [§15.207(a)]

5.1.1. Limit(s)

The equipment shall meet the limits of the following table:

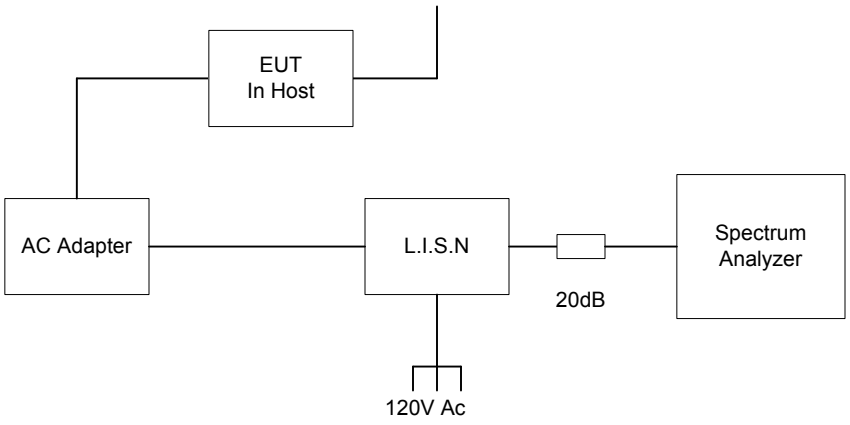
Frequency of emission (MHz)	Conducted Limits (dBμV)	
	Quasi-peak	Average
0.15–0.5 .....……..	66 to 56*	56 to 46*
0.5–5 .....……..	56	46
5-30 ……..	60 ...……..	50

*Decreases linearly with the logarithm of the frequency

5.1.2. Method of Measurements

ANSI C63.4-2009

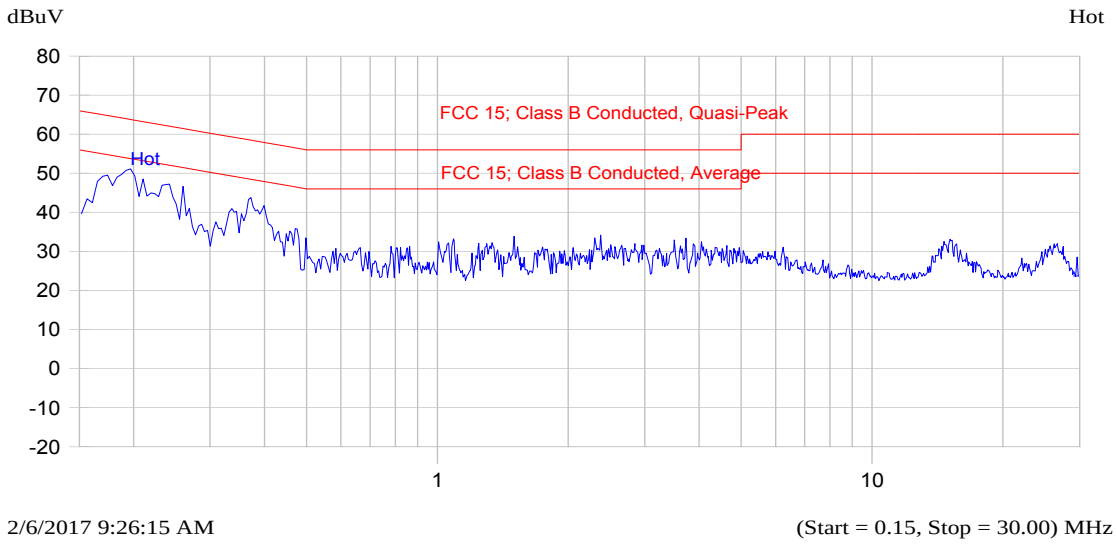
5.1.3. Test Arrangement



Test Data

Plot 5.1.3.1. Power Line Conducted Emissions; Line Voltage: 120 VAC; Line Tested: Hot

Alert Labs Flowie Water Sensor

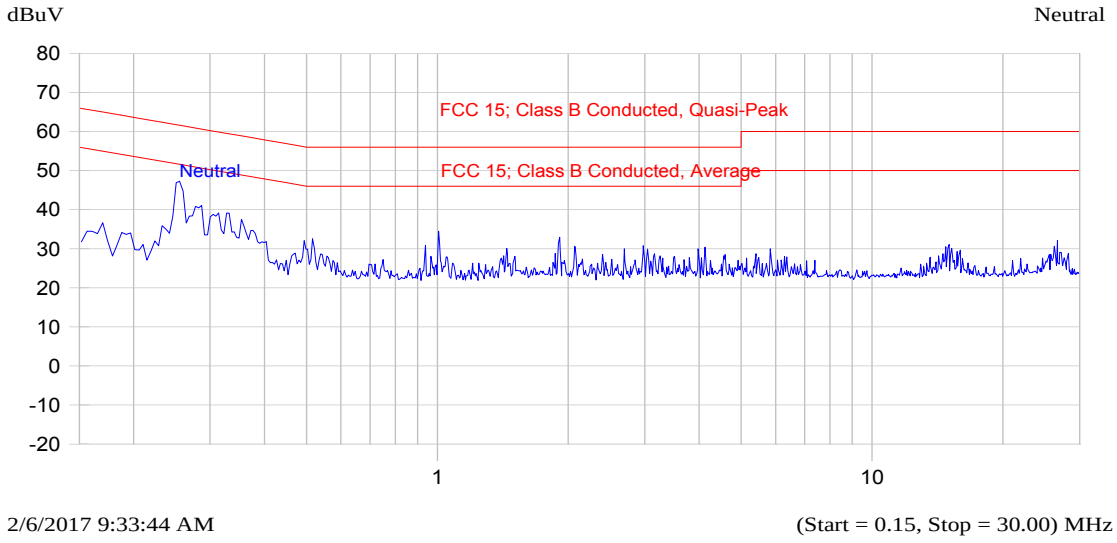


Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.194	51.9	46.7	-17.2	34.8	-19.1	Hot
0.243	51.9	46.7	-15.3	33.5	-18.6	Hot
2.361	36.9	32.3	-23.7	25.7	-20.3	Hot
15.115	36.7	30.1	-29.9	23.2	-26.8	Hot

Plot 5.1.3.2. Power Line Conducted Emissions; Line Voltage120 VAC; Line Tested: Neutral

Alert Labs Flowie Water Sensor



Current List

Frequency MHz	Peak dBuV	QP dBuV	QP-QP Limit dB	Avg dBuV	Avg-Avg Limit dB	Trace Name
0.250	50.0	42.2	-19.6	31.2	-20.6	Neutral
1.016	36.8	30.6	-25.4	24.2	-21.8	Neutral
1.909	35.5	30.6	-25.4	24.5	-21.5	Neutral

5.2. PEAK CONDUCTED OUTPUT POWER - DTS [§ 15.247(b)(3)]

5.2.1. Limit(s)

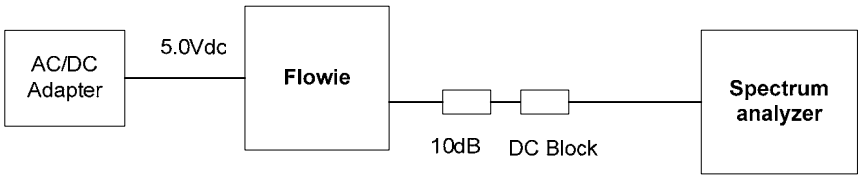
§ 15.247(b)(3): For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

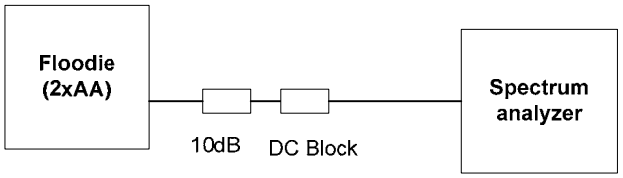
§ 15.247(b)(4): The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2.2. Method of Measurements & Test Arrangement

KDB 558074 D01 DTS Meas Guidance v03r04, Section 9.1.2 PKPM1 Peak power meter method

5.2.3. **Test Arrangement**





5.2.4. **Test Data**

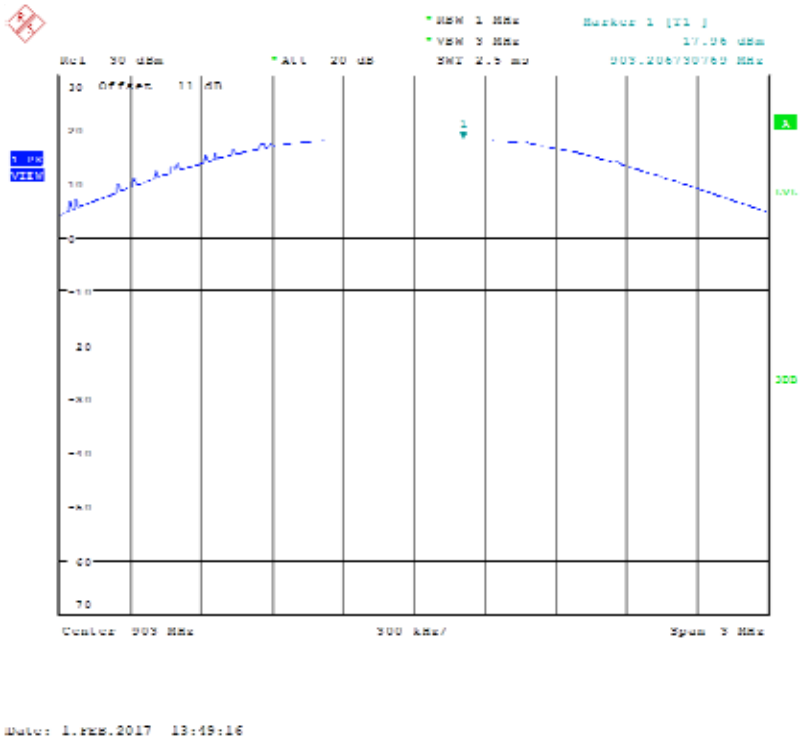
Remarks:
1. The EIRP shall be calculated based on the transmitter antenna gain (G_{dBi}), cable loss (CL_{dB}) and peak output power at antenna terminal (P_{dBm}). Calculated EIRP = P_{dBm} + G_{dBi} - CL_{dB}

2. EIRP shall not exceed 36 dBm limit (Power Setting = 36 dBm - G_{dBi} + CL_{dB}). See Operating Manual for instruction of power setting.

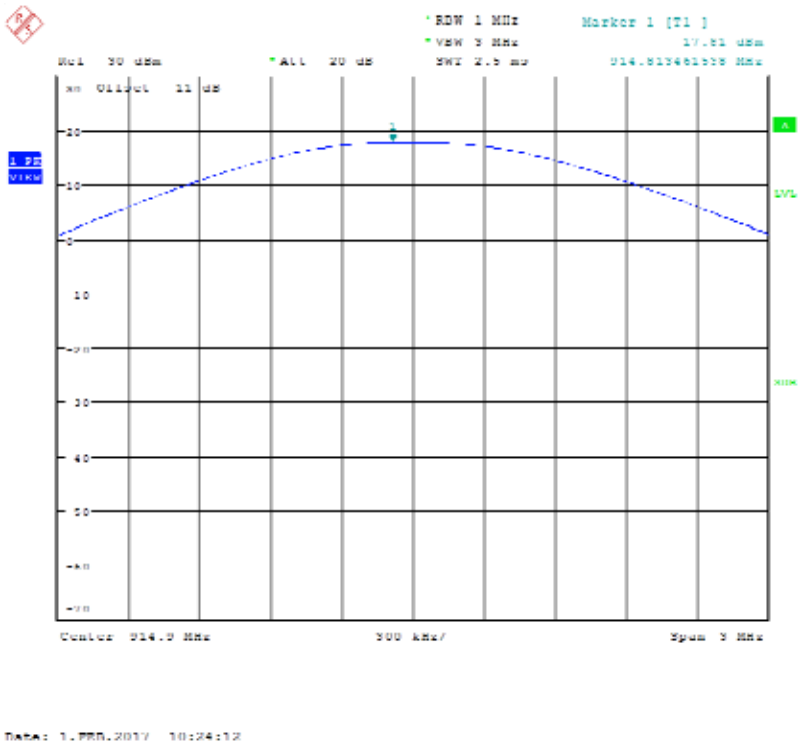
Peak Conducted Output Power Alert Labs Flowie Water Sensor

Modulation	Frequency (MHz)	PCOP (dBm)	Limit (dBm)
LoRa (CSS)	903.0	17.96	30
LoRa (CSS)	914.9	17.81	30
LoRa (CSS)	927.5	17.74	30

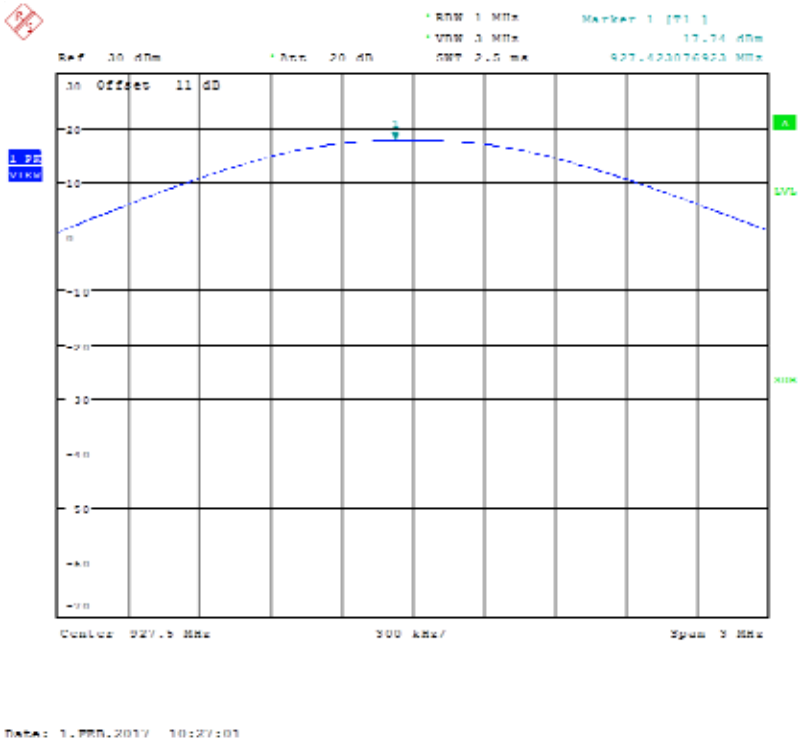
903 MHz



914.9 MHz



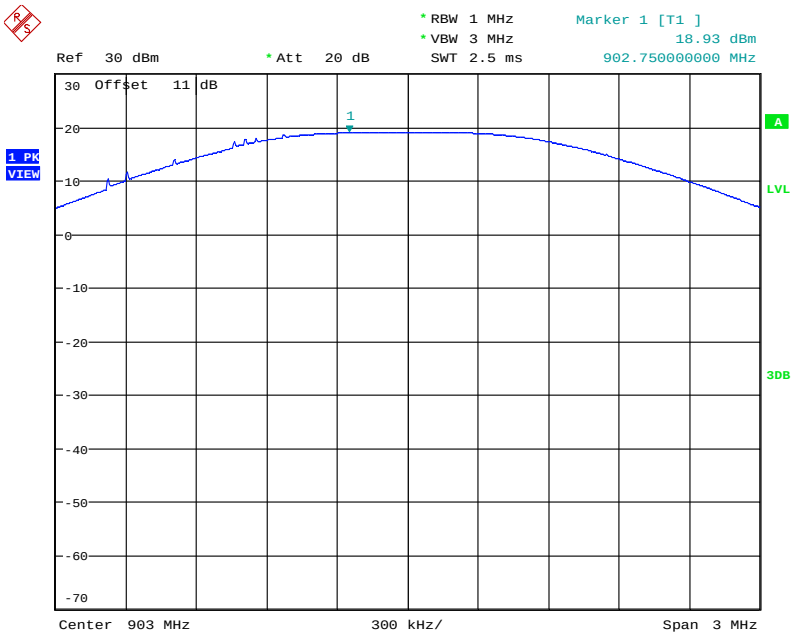
927.5 MHz



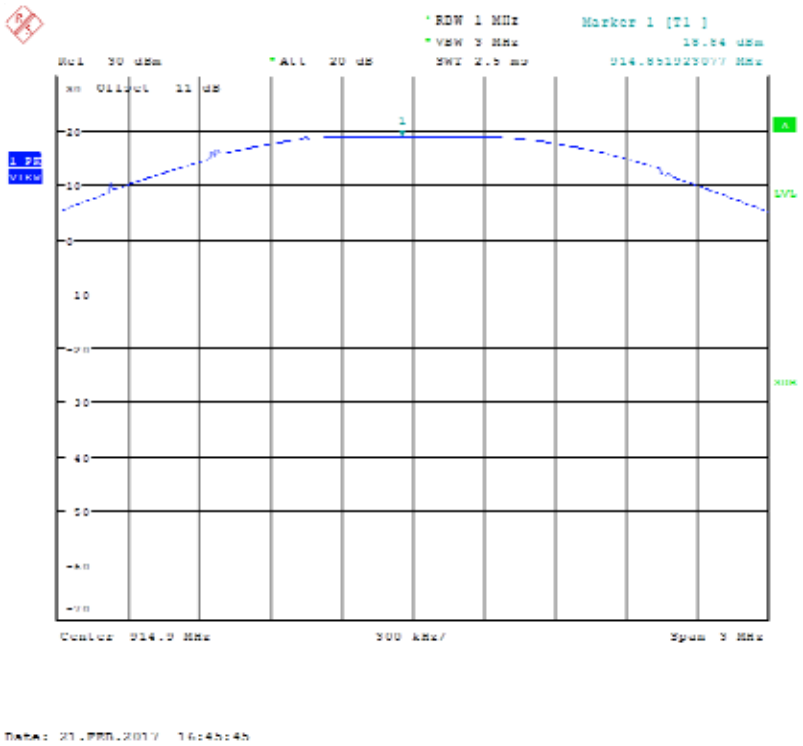
Peak Conducted Output Power Alert Labs Floodie Companion Sensor

Modulation	Frequency (MHz)	PCOP (dBm)	Limit (dBm)
LoRa (CSS)	903.0	18.93	30
LoRa (CSS)	914.9	18.84	30
LoRa (CSS)	927.5	18.55	30

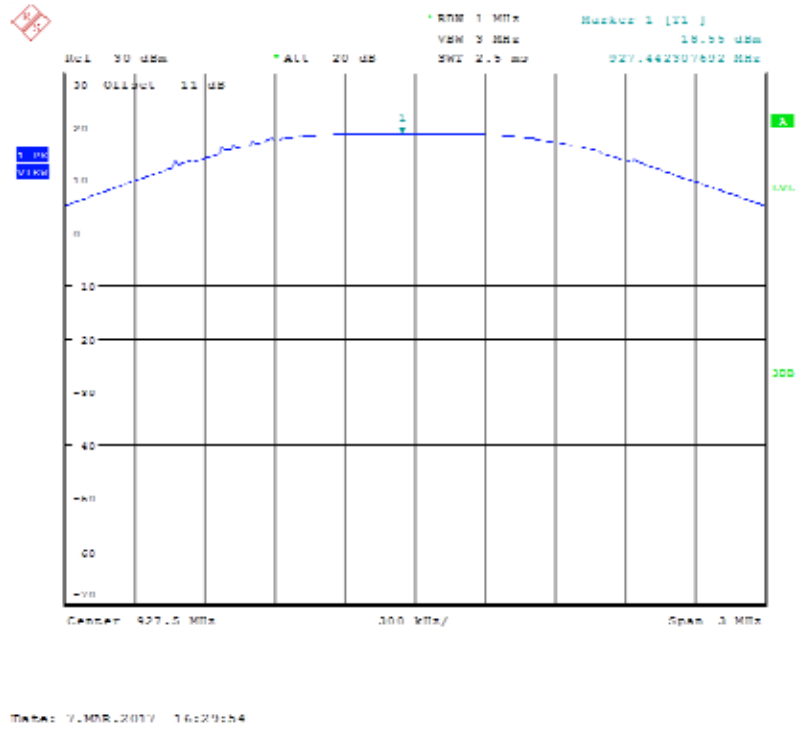
903 MHz



914.9 MHz



927.5 MHz



5.3. 5.3 TRANSMITTER BAND-EDGE RADIATED EMISSIONS [§ 15.247(d)]

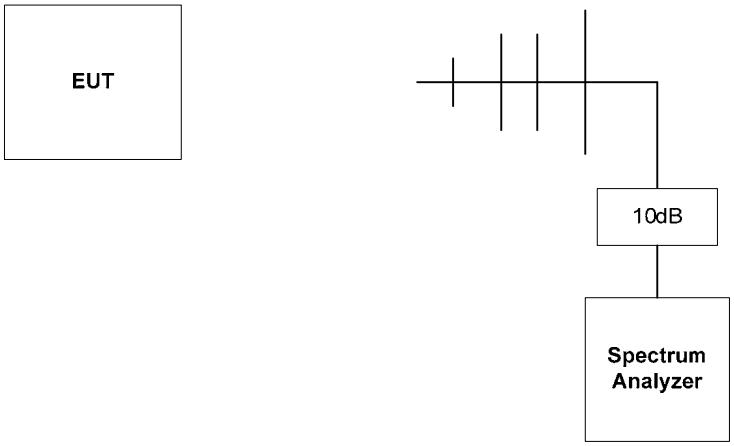
5.3.1. Limit(s)

§ 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)).

5.3.2. Method of Measurements

KDB 558074 D01 DTS Meas Guidance V03r04, Sections 11, 12 and 13.

5.3.3. Test Arrangement

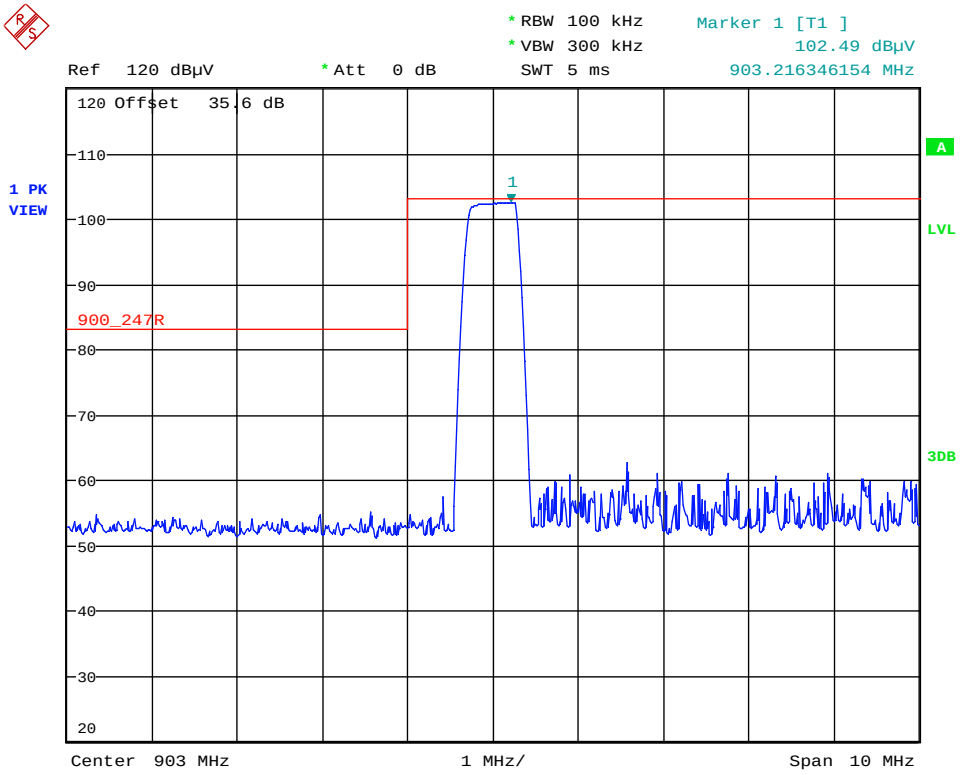


5.3.4. **Test Data**

Remark(s): Exploratory tests performed to determined worst-case test configurations, the following test results represent the worst-case.

Band-Edge RF Radiated Emissions- Alert Labs Flowie Water Sensor

903 MHz- Vertical



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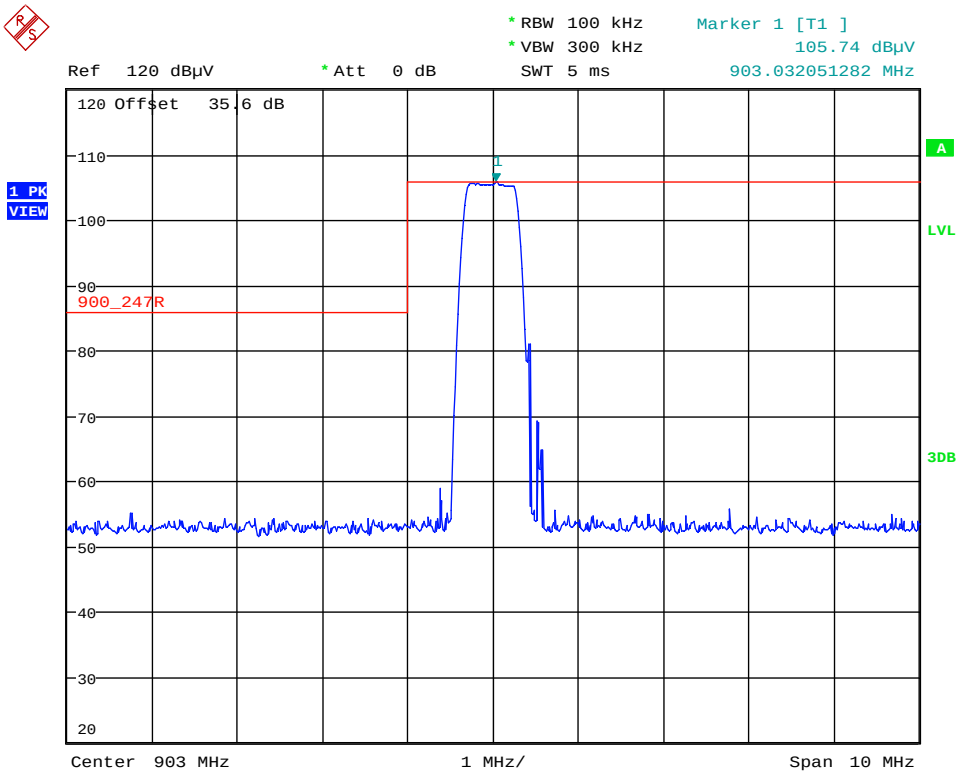
903 MHz- Horizontal



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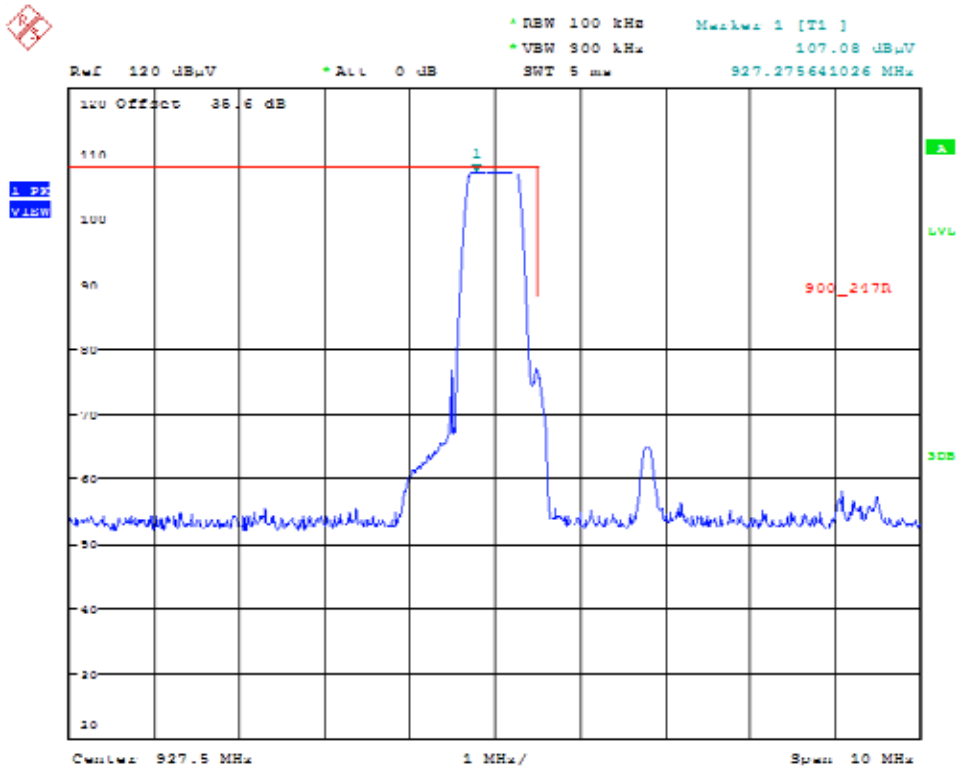
927.5 MHz- Vertical



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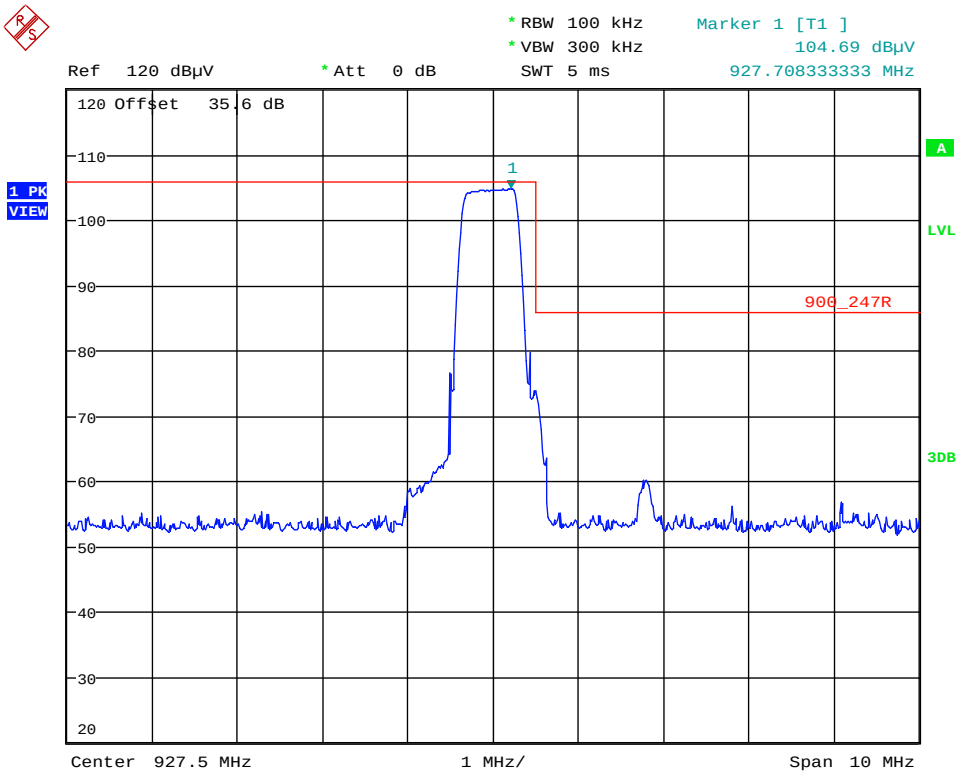
927.5 MHz - Horizontal



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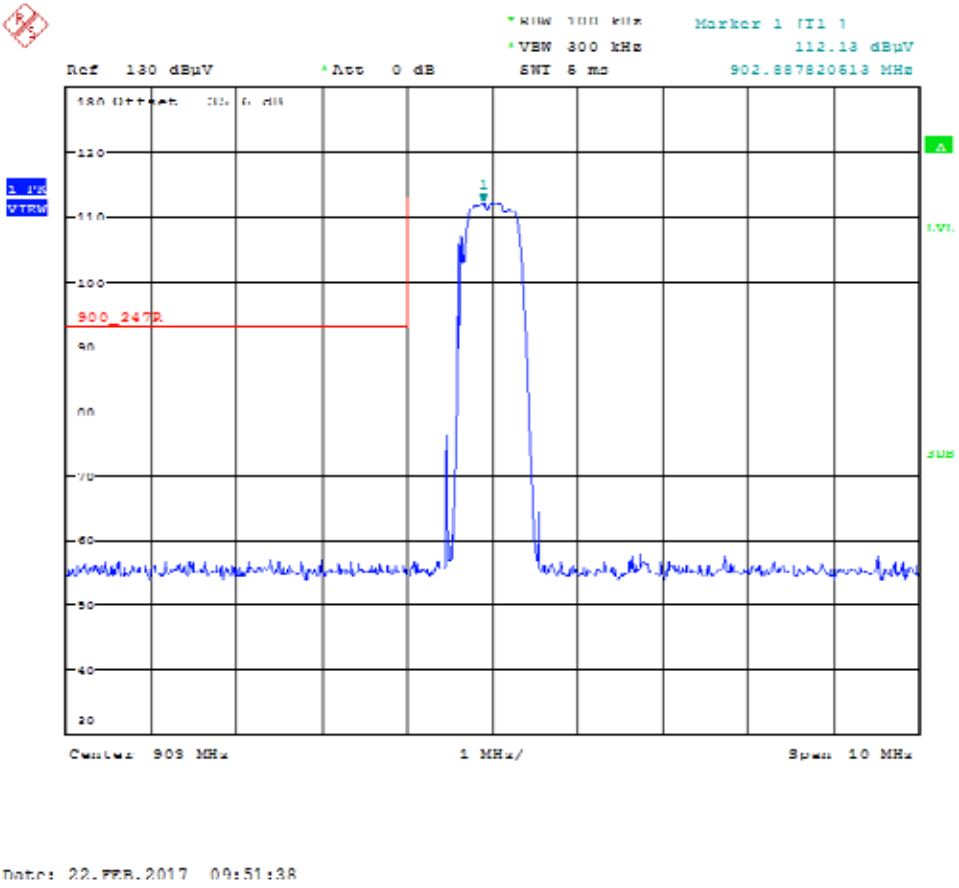
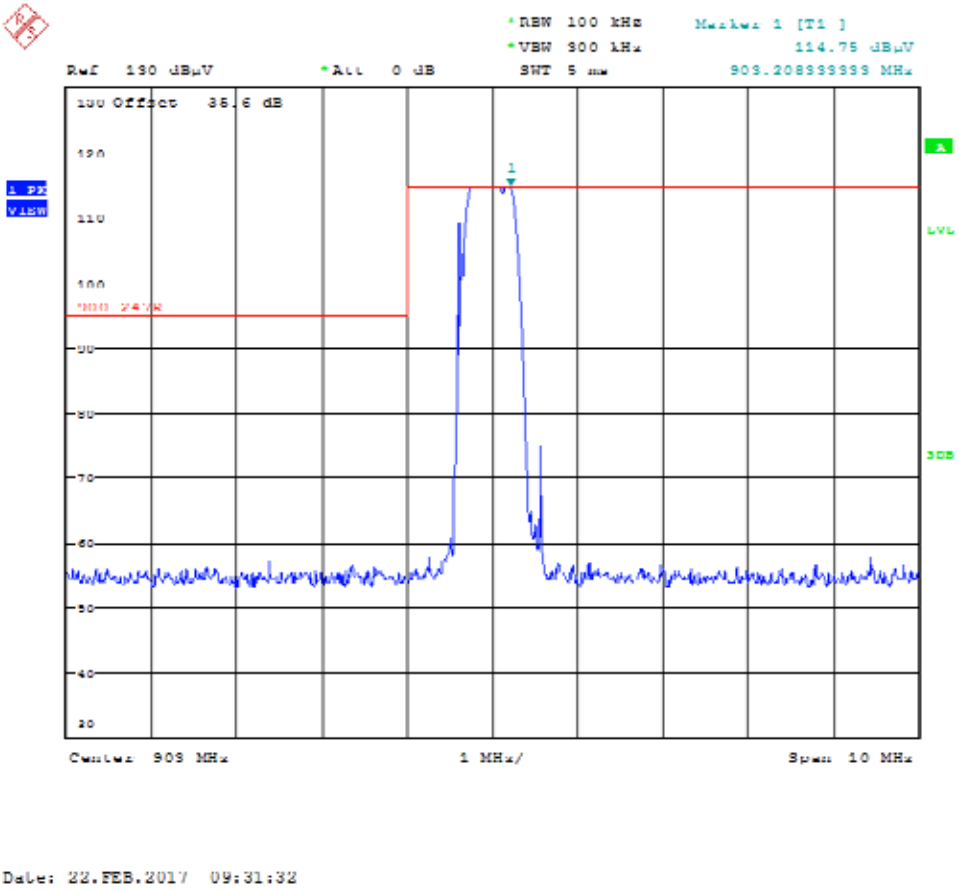
Band-Edge RF Radiated Emissions- Alert Labs Floodie Companion Sensor

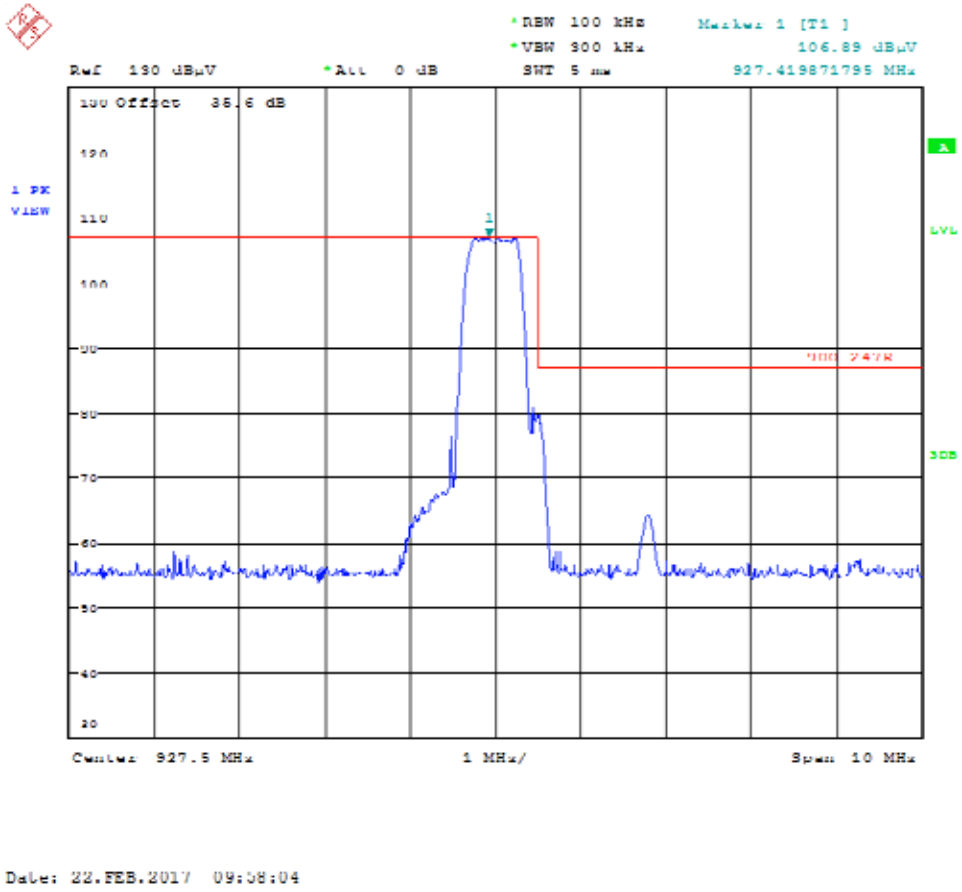
903 MHz- Vertical



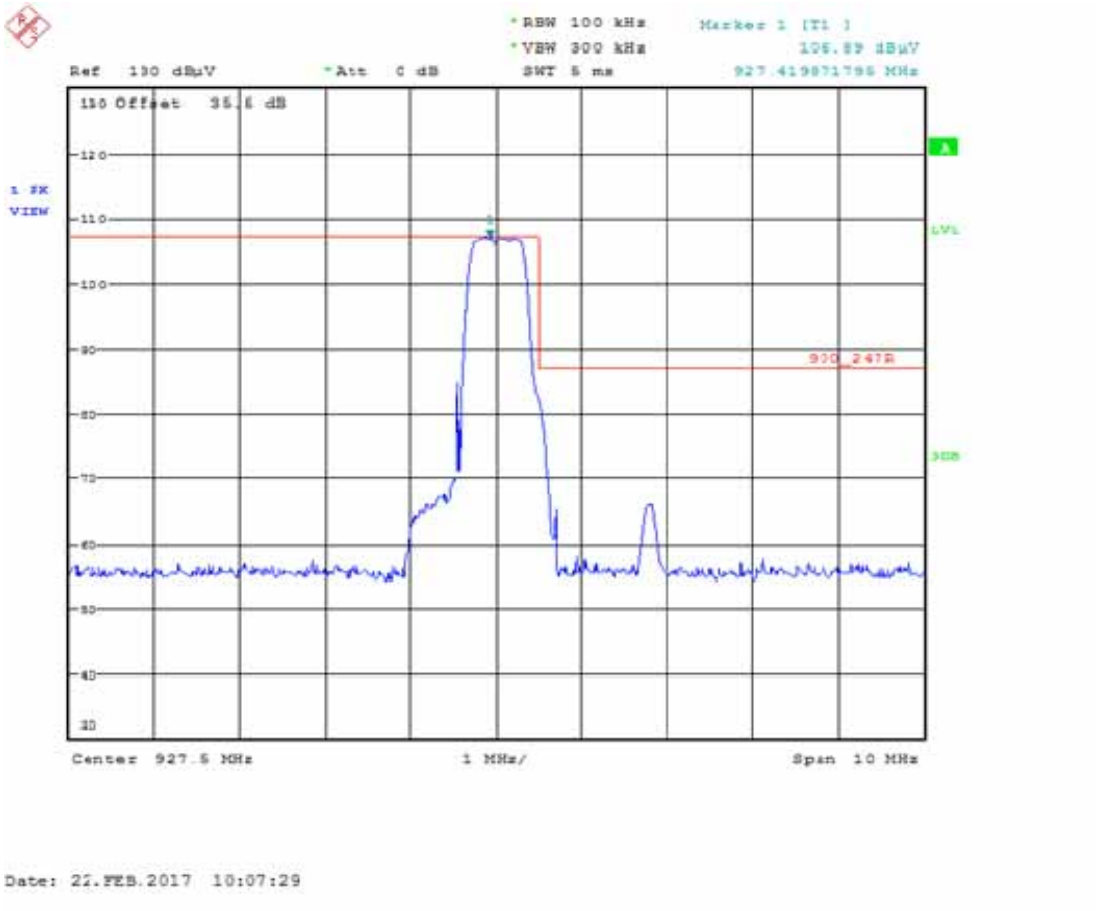
903 MHz- Horizontal



927.5 MHz- Vertical



927.5 MHz – Horizontal



5.4. TRANSMITTER SPURIOUS RADIATED EMISSIONS AT 3 METERS [§§ 15.247(d), 15.209 & 15.205]

5.4.1. Limit(s)

§ 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Section 15.205(a) - Restricted Bands of Operation

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2655–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

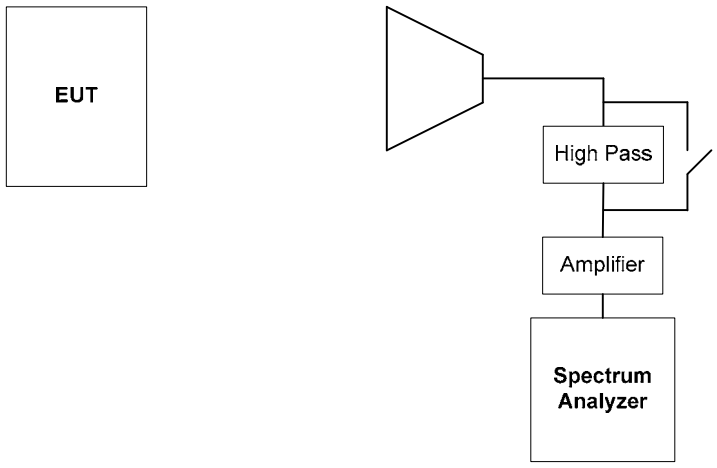
Section 15.209(a) - Field Strength Limits within Restricted Frequency Bands

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2,400 / F (kHz)	300
0.490 - 1.705	24,000 / 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

5.4.2. **Method of Measurements**

KDB 558074D01 DTS Meas Guidance v03r04, Section Section 12.2.7 and ANSI C63.10.

5.4.3. **Test Arrangement**



5.4.4. **Test Data**

Remark(s):

- All spurious emissions that are in excess of 20 dB below the specified limit shall be recorded.
- EUT shall be tested in three orthogonal positions.
- Exploratory tests performed to determined worst-case test configurations, the following test results at high power setting represent the worst-case.

Tx with PCB Antenna- Alert Labs Flowie Water Sensor

Fundamental Frequency:	903 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
903	102.49	--	V	--	--	--	--
903	105.74	--	H	--	--	--	--
2709	57.09	52.85	V	54	82.49	-1.15	Pass*
2709	54.91	47.05	H	54	82.49	-6.95	Pass*
3612	51.55	34.2	V	54	82.49	-19.8	Pass*
3612	50.19	38.56	H	54	82.49	-15.44	Pass*
4515	59.49	52.5	V	54	82.49	-1.5	Pass*
4515	58.96	51.79	H	54	82.49	-2.21	Pass*
5418	53.66	42.56	V	54	82.49	-11.44	Pass*
5418	50.51	39.21	H	54	82.49	-14.79	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	914.9 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
914.9	103.77	--	V	--	--	--	--
914.9	103.29	--	H	--	--	--	--
2744.7	53.01	43.87	V	54	83.29	-10.13	Pass*
2744.7	50.54	42.87	H	54	83.29	-11.13	Pass*
3659.6	52.28	47.08	V	54	83.29	-6.92	Pass*
3659.6	52.59	42.35	H	54	83.29	-11.65	Pass*
4574.5	57.64	47.86	V	54	83.29	-6.14	Pass*
4574.5	55.46	48.36	H	54	83.29	-5.64	Pass*
7319.2	51.84	39.8	V	54	83.29	-14.2	Pass*
7319.2	50.3	38.55	H	54	83.29	-15.45	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	927.5 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
927.5	107.08	--	V	--	--	--	--
927.5	104.69	--	H	--	--	--	--
2782.5	51.99	45.42	V	54	84.69	-8.58	Pass*
2782.5	49.29	42.7	H	54	84.69	-11.3	Pass*
3710	50.86	41.23	V	54	84.69	-12.77	Pass*
3710	50.03	39.72	H	54	84.69	-14.28	Pass*
4637.5	52.92	44.48	V	54	84.69	-9.52	Pass*
4637.5	50.44	40.51	H	54	84.69	-13.49	Pass*
7420	53.48	40.28	V	54	84.69	-13.72	Pass*
7420	52.12	39.27	H	54	84.69	-14.73	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Tx with PCB Antenna- Alert Labs Floodie Companion Sensor

Fundamental Frequency:	903 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
903	112.13	--	V	--	--	--	--
903	114.75	--	H	--	--	--	--
2709	56.48	48.44	V	54	92.3	-5.56	Pass*
2709	56.16	48.55	H	54	92.3	-5.45	Pass*
3612	52.08	42.48	V	54	92.3	-11.52	Pass*
3612	49.88	36.17	H	54	92.3	-17.83	Pass*
4515	50.8	38.73	V	54	92.3	-15.27	Pass*
4515	48.12	35.98	H	54	92.3	-18.02	Pass*
5418	57.66	45.3	V	54	92.3	-8.7	Pass*
5418	54.27	42.25	H	54	92.3	-11.75	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	914.9 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
914.9	110.27	--	V	--	--	--	--
914.9	109.34	--	H	--	--	--	--
2744.7	57.75	49.05	V	54	89.34	-4.95	Pass*
2744.7	53.95	46.51	H	54	89.34	-7.49	Pass*
3659.6	52.73	43.42	V	54	89.34	-10.58	Pass*
3659.6	50.48	38.97	H	54	89.34	-15.03	Pass*
4574.5	58.57	45.79	V	54	89.34	-8.21	Pass*
4574.5	52.47	41.22	H	54	89.34	-12.78	Pass*
7319.2	52.32	39.87	V	54	89.34	-14.13	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

Fundamental Frequency:	927.5 MHz						
Frequency Test Range:	30 MHz – 10 GHz						
Frequency (MHz)	**RF Peak Level (dBµV/m)**	**RF Avg Level (dBµV/m)**	**Antenna Plane (H/V)**	**Limit 15.209 (dBµV/m)**	**Limit 15.247 (dBµV/m)**	**Margin (dB)**	**Pass/ Fail**
927.5	106.89	--	V	--	--	--	--
927.5	106.88	--	H	--	--	--	--
2782.5	51.73	44.66	V	54	86.88	-9.34	Pass*
2782.5	49.95	41.5	H	54	86.88	-12.5	Pass*
3710	50.98	41.59	V	54	86.88	-12.41	Pass*
3710	50	40.07	H	54	86.88	-13.93	Pass*
4637.5	49.79	38.59	V	54	86.88	-15.41	Pass*
4637.5	51.98	41.24	H	54	86.88	-12.76	Pass*
7420	53.37	41.13	V	54	86.88	-12.87	Pass*
All other spurious emissions and harmonics are more than 20 dB below the applicable limit.							

*Field strength of emissions appearing within restricted frequency bands shall not exceed the limits in § 15.209.

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5.5. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

5.5.1. Limits

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) 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

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.5.2. **Method of Measurements**

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

$$r = \sqrt{\frac{PG}{4\pi \cdot S}} = \sqrt{\frac{EIRP}{4\pi \cdot S}}$$

5.5.3. **RF Evaluation**

Separation distance specified by Manufacturer is 31cm, the power density and MPE ratio are calculated for this distance

Configuration 1: Alert Labs RN2903 radio-Standalone

Frequency (MHz)	Equivalent Output Conducted Power (mW)	Maximum Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)	Distance, r (cm)	Power Density, S (mW/cm^2)	MPE Limit (mW/cm^2)	Margin (mW/cm^2)	RN2903 MPE Ratio
903	81	2.33	21.41	138.36	31	0.0114	0.602	-0.590	0.019

Configuration 2: Co-location

Pursuant to KDB 447498 D01 General RF Exposure Guidance v06, Section 7.2:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.

As per the Manufacturer the EUT Alert Labs RN2903, can simultaneously transmit with either the cellular radio (SARA-U260) or Wifi radio (Espressif Systems WROOM Module)

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Configuration 2.1- EUT (RN2903) co-location with Cellular radio module- SARA-U260 GSM/UMTS Module
FCC ID: XPYSARAU260
IC: 8595A-SARAU260

Frequency (MHz)	Equivalent Output Conducted Power (mW)	Maximum Antenna Gain (dBi)	EIRP (mW)	Distance (cm)	SARA-U260 Power Density (mW/cm^2)	FCC MPE Limit (mW/cm^2)	SARA-U260 MPE Ratio	RN2903 MPE Ratio	SARA-U260 and RN2903 MPE Ratio Sum
848.8	1256.03	3.50	2811.90	31	0.233	0.566	0.411	0.019	0.430
1850.2	629.51	3.10	1285.29	31	0.106	1.000	0.106	0.019	0.125
846.6	1258.93	3.50	2818.38	31	**0.233**	0.564	0.414	0.019	**0.433**
846.6	251.19	3.50	562.34	31	0.047	0.564	0.083	0.019	0.102
836.6	251.19	3.50	562.34	31	0.047	0.558	0.083	0.019	0.102
1852.4	251.19	3.10	512.86	31	0.042	1.000	0.042	0.019	0.061
1907.6	251.19	3.10	512.86	31	0.042	1.000	0.042	0.019	0.061
1880.0	251.19	3.10	512.86	31	0.042	1.000	0.042	0.019	0.061

Configuration 2.2- EUT(RN2903) co-location with Wifi radio module- Espressif Systems WROOM Wi-Fi Module
FCC ID: 2AC7Z-ESPWROOM02
IC: 21098-ESPWROOM02

Frequency (MHz)	Equivalent Output Conducted Power (mW)	Maximum Antenna Gain (dBi)	EIRP (mW)	Distance (cm)	WROOM Wi-Fi Power Density (mW/cm^2)	FCC MPE Limit (mW/cm^2)	WROOM Wi-Fi MPE Ratio	RN2903 MPE Ratio	WROOM Wi-Fi and RN2903 MPE Ratio Sum
2412.0	225	2.00	356.45	31	0.030	1.000	0.030	0.019	0.049

* The test data of the radio modules represented in the above tables are the worst-case configuration (maximum MPE ratio) derived from the original radio modules MPE reports. Refer to these reports for details.

Verdict: The user manual specified distance of 31 cm is sufficient to meet the MPE exposure limits ie, Sum of MPE ratio $\leq$1.

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Spectrum Analyzer	Hewlett Packard	HP 8593EM	3412A00103	9 kHz–26.5 GHz	Apr 9, 2017
Attenuator	Pasternack	PE7010-20	07	DC–2 GHz	Mar 26, 2017
L.I.S.N	EMCO	3825/2	1531	0.10 -100 MHz	Nov 11, 2017
AC/DC Adapter	Weihei Honglin electronic Co. Ltd	ACDC-13BA UE	---	---	Cal on use
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	Jul 21, 2018
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	Cal on use
Attenuator	Pasternack	7024-10	4	DC–26.5 GHz	Cal on use
Spectrum Analyzer	Rohde & Schwarz	FSEK30	100077	20Hz–40 GHz	Dec 5, 2018
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	May 5, 2017
High Pass Filter	K & L	11SH10-1500/T8000	2	Cut off 900 MHz	Cal on use
Log Periodic	ETS-Lindgren	3148	23845	200 – 2000 MHz	Jul 20, 2018
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	May 8, 2017
RF Amplifier	Com-Power	PAM-0118A	551016	0.5 – 18 GHz	Jul 14, 2017
Biconilog	Emco	3142	9601-1005	26-1000 MHz	May 12, 2018
Horn Antenna	Emco	3155	5955	1 – 18 GHz	Apr 21, 2017
Band Reject Filter	Micro-Tronics	BRC50722	001	Cut off 900 MHz	Cal on use

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

	Line Conducted Emission Measurement Uncertainty (9 kHz – 30 MHz):	**Measured**	**Limit**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.44**	**± 1.8**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 2.89**	**± 3.6**

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

	Radiated Emission Measurement Uncertainty @ 3m, Horizontal (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.79**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3m, Vertical (30-1000 MHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 2.39**	**± 2.6**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 4.78**	**± 5.2**

	Radiated Emission Measurement Uncertainty @ 3 m, Horizontal & Vertical (1 – 18 GHz):	**Measured (dB)**	**Limit (dB)**
u_c	**Combined standard uncertainty:** $u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)}$	**± 1.87**	**Under consideration**
U	**Expanded uncertainty U:** $U = 2u_c(y)$	**± 3.75**	**Under consideration**