

Wireless test report – 345397-1TRFWL

Applicant:

Alert Labs, Inc.

Product name:

Alert Labs Floodie Companion Sensor

Model:

ALF-000002-006

FCC ID:

2AKXF-ALB020

ISED Registration number:

22365-ALB020

Specifications:

◆ **FCC 47 CFR Part 15 Subpart C, §15.247**

Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz

◆ **RSS-247, Issue 2, Feb 2017, Section 5**

Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs)
and Licence-Exempt Local Area Network (LE-LAN) Devices

5) Standard specifications for frequency hopping systems and digital transmission systems operating in the
bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz

Date of issue: **December 20, 2017**

Test engineer(s): **Yong Huang, Wireless/EMC Specialist**

Signature:



Reviewed by: **Kevin Rose, Wireless/EMC Specialist**

Signature:



Test location(s)

Company name	Nemko Canada Inc.	
Address	303 River Road	292 Labrosse Avenue
City	Ottawa	Pointe-Claire
Province	Ontario	Quebec
Postal code	K1V 1H2	H9R 5L8
Country	Canada	Canada
Telephone	+1 613 737 9680	+1 514 694 2684
Facsimile	+1 613 737 9691	+1 514 694 3528
Toll free	+1 800 563 6336	
Website	www.nemko.com	www.nemko.com
Site number	FCC: CA2040; ISED: 2040A-4 (3 m SAC)	FCC: CA2041; ISED: 2040G-5 (3 m SAC)

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
© Nemko Canada Inc.

Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test specifications	4
1.3 Test methods	4
1.4 Statement of compliance	4
1.5 Exclusions	4
1.6 Test report revision history	4
Section 2. Summary of test results	5
2.1 FCC Part 15 Subpart C, general requirements test results	5
2.2 FCC Part 15 Subpart C, intentional radiators test results for digital transmission systems (DTS)	5
2.3 ISED RSS-GEN, Issue 4, test results	6
2.4 ISED RSS-247, Issue 2, test results for digital transmission systems (DTS)	6
Section 3. Equipment under test (EUT) details	7
3.1 Sample information	7
3.2 EUT information	7
3.3 Technical information	7
3.4 Product description and theory of operation	7
3.5 EUT exercise details	7
3.6 EUT setup diagram	8
Section 4. Engineering considerations	9
4.1 Modifications incorporated in the EUT	9
4.2 Technical judgment	9
4.3 Deviations from laboratory tests procedures	9
Section 5. Test conditions	10
5.1 Atmospheric conditions	10
5.2 Power supply range	10
Section 6. Measurement uncertainty	11
6.1 Uncertainty of measurement	11
Section 7. Test equipment	12
7.1 Test equipment list	12
Section 8. Testing data	13
8.1 FCC 15.247(a)(2) and RSS-247 5.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques	13
8.2 FCC 15.247(b) and RSS-247 5.4 (d) Transmitter output power and e.i.r.p. requirements for DTS in 900 MHz	16
8.3 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) unwanted emissions	19
8.4 FCC 15.247(e) and RSS-247 5.2(b) Power spectral density for digitally modulated devices	29
Section 9. Block diagrams of test set-ups	31
9.1 Radiated emissions set-up for frequencies below 1 GHz	31
9.2 Radiated emissions set-up for frequencies above 1 GHz	32
9.3 Conducted antenna port set-up	32

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Alert Labs, Inc.
Address	44 Gaukel St.
City	Kitchener
Province/State	ON
Postal/Zip code	N2L 6R5
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
RSS-247, Issue 2, Feb 2017, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.3 Test methods

558074 D01 DTS Meas Guidance v04 (April 5, 2017)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.5 below. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Exclusions

None

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	December 20, 2017	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass ¹
§15.203	Antenna requirement	Pass ²

Notes: ¹ For battery operated equipment, the equipment tests were performed using a fully-charged battery.

² The Antennas are located within the enclosure of EUT and not user accessible.

2.2 FCC Part 15 Subpart C, intentional radiators test results for digital transmission systems (DTS)

Part	Test description	Verdict
§15.247(a)(2)	Minimum 6 dB bandwidth	Pass
§15.247(b)(3)	Maximum peak output power in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Pass
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density	Pass
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 ISED RSS-GEN, Issue 4, test results

Part	Test description	Verdict
7.1.2	Receiver radiated emission limits	Not applicable
7.1.3	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Not applicable ²

Notes: ¹ According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

² EUT is battery operated device.

2.4 ISED RSS-247, Issue 2, test results for digital transmission systems (DTS)

Part	Test description	Verdict
5.2 (a)	Minimum 6 dB bandwidth	Pass
5.2 (b)	Maximum power spectral density	Pass
5.3	Hybrid Systems	
5.3 (a)	Digital modulation turned off	Not applicable
5.3 (b)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (d)	Systems employing digital modulation techniques	Pass
5.4 (e)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (f)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Unwanted emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	December 15, 2017
Nemko sample ID number	Item #1,#2,#3

3.2 EUT information

Product name	Alert Labs Floodie Companion Sensor
Model	ALF-000002-006

3.3 Technical information

Applicant ISED company number	22365
ISED UPN number	ALB020
All used ISED test site(s) Reg. number	2040G-5
RSS number and Issue number	RSS-247 Issue 2, Feb 2017
Frequency band	902–928 MHz
Frequency Min (MHz)	903
Frequency Max (MHz)	927.5
RF power Min (W), Conducted/ERP/EIRP	N/A
RF power Max (W), Conducted	0.0923(19.65 dBm)
Field strength, Units @ distance	N/A
Measured BW (kHz) (6 dB)	759.8
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	Chirp Spread Spectrum
Emission classification (F1D, G1D, D1D)	F1D
Transmitter spurious, Units @ distance	51.0 dB μ V/m @ 3 m, at 4575 MHz
Power requirements	3 V _{DC} from 2 "AA" type of battery
Antenna information	The EUT uses a non-detachable antenna to the intentional radiator. Helical PCB Antenna, max gain 3.37 dBi

3.4 Product description and theory of operation

The Alert Labs Floodie Companion Sensor helps to prevent water damage by sending instant flood alerts to your phone.

3.5 EUT exercise details

During tests, the EUT is configured to transmit at one frequency at its maximum RF power and with the maximum possible duty cycle by the test firmware.

3.6 EUT setup diagram

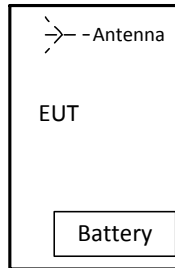


Figure 3.6-1: Setup diagram

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Spectrum analyzer	Rohde & Schwarz	FSV 40	FA002731	1 year	July 10/18
50 Ω coax cable	C.C.A.	None	FA002603	—	VOU
50 Ω coax cable	C.C.A.	None	FA002605	—	VOU
50 Ω coax cable	C.C.A.	None	FA002831	—	VOU
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	Oct. 5/18
Horn antenna (1–18 GHz)	EMCO	RGA-60	FA002577	1 year	May 5/18
Pre-amplifier (0.5–18 GHz)	COM-POWER	PAM-118A	FA002561	1 year	May 8/18
High Pass Filter (> 1200 MHz)	Microwave Circuits	H1G212G1	FA002689	—	VOU
50 Ω coax cable	HUBER+SUHNER	SUCOFLEX 100	FA002564	—	VOU
Power source	California Instruments	5001ix	FA001770	1 year	Feb 1/18
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	May 3/18

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 15.247(a)(2) and RSS-247 5.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.1.1 Definitions and limits

FCC and ISSED:

- (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:
- (2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.1.2 Test summary

Test date	December 16, 2017	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	45 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Frequency span	3 MHz
Detector mode	Peak
Trace mode	Max Hold

Section 8

Testing data

Test name

FCC 15.247(a)(2) and RSS-247 5.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

Specification

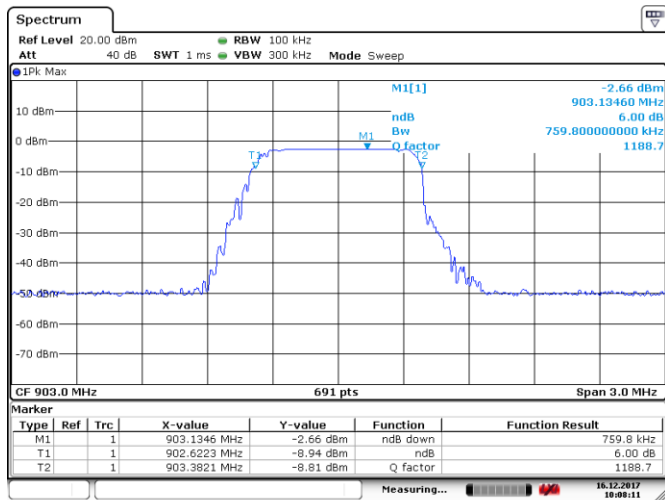
FCC Part 15 Subpart C and RSS-247, Issue 2



8.1.4 Test data

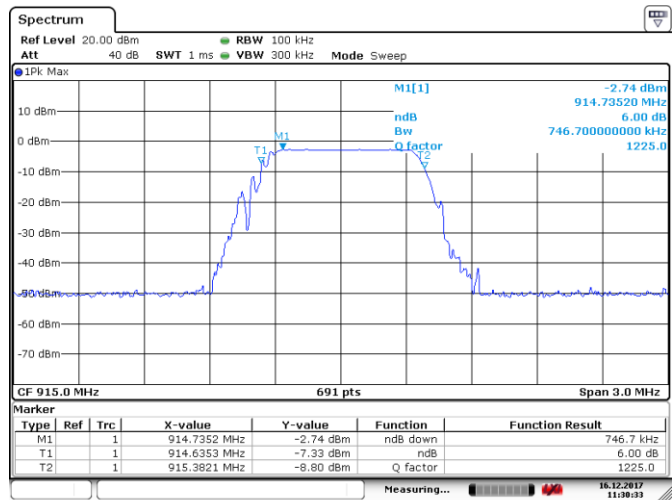
Table 8.1-1: 6 dB bandwidth results

Frequency, MHz	6 dB bandwidth, kHz	Minimum Limit, kHz	Margin, kHz
903	759.8	500	259.8
915	746.7	500	246.7
927.5	755.4	500	255.4



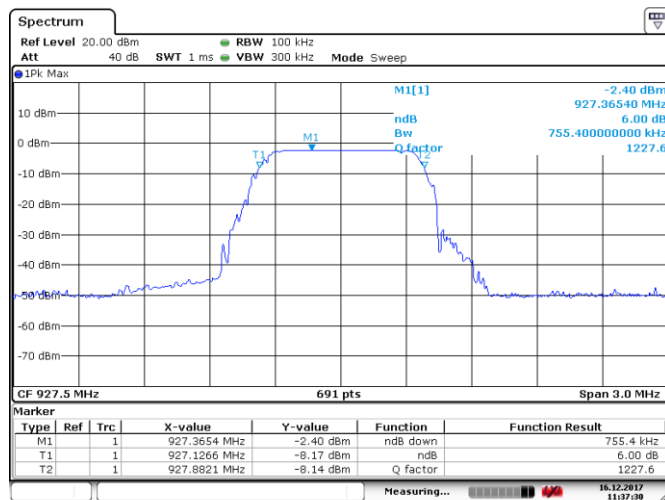
Date: 16.DEC.2017 10:08:11

Figure 8.1-1: 6 dB bandwidth on low channel



Date: 16.DEC.2017 11:30:34

Figure 8.1-2: 6 dB bandwidth on mid channel



Date: 16.DEC.2017 11:37:29

Figure 8.1-3: 6 dB bandwidth on high channel

Section 8

Testing data

Test name

FCC 15.247(a)(2) and RSS-247 5.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

Specification

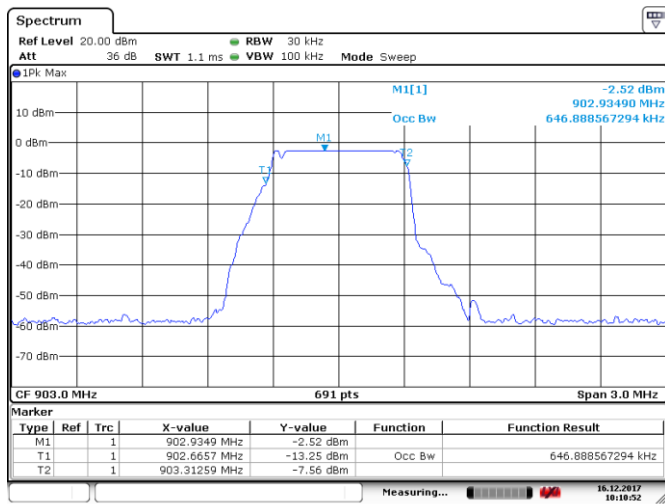
FCC Part 15 Subpart C and RSS-247, Issue 2



8.1.4 Test data, continued

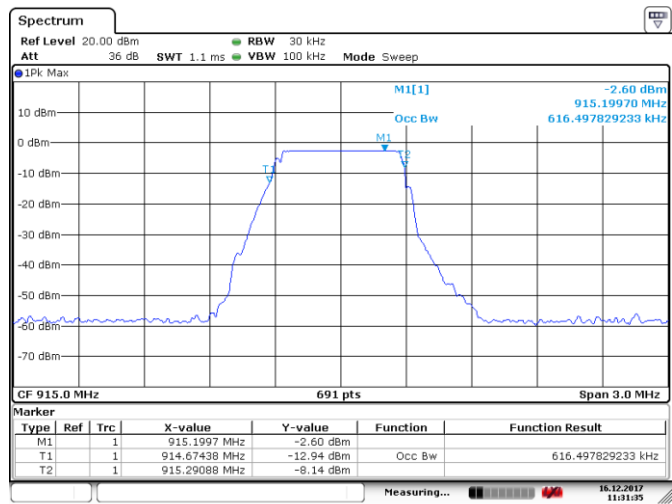
Table 8.1-2: 99% bandwidth results

Frequency, MHz	99% bandwidth, kHz
903	646.9
915	616.5
927.5	607.8



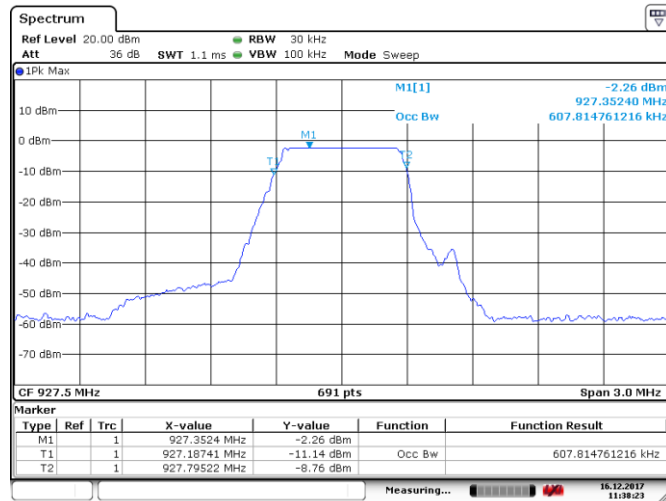
Date: 16 DEC.2017 10:10:52

Figure 8.1-4: 99% bandwidth on low channel



Date: 16 DEC.2017 11:31:35

Figure 8.1-5: 99% bandwidth on mid channel



Date: 16 DEC.2017 11:38:24

Figure 8.1-6: 99% bandwidth on high channel



8.2 FCC 15.247(b) and RSS-247 5.4 (d) Transmitter output power and e.i.r.p. requirements for DTS in 900 MHz

8.2.1 Definitions and limits

FCC:

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
 - (3) For systems using digital modulation in the 902–928 MHz band: 1 W (30 dBm). 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.
 - (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.
- (c) Operation with directional antenna gains greater than 6 dBi.
 - (1) Fixed point-to-point operation:
 - (iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

ISED:

d. For DTSs employing digital modulation techniques operating in the 902–928 MHz band, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling 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 transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

8.2.2 Test summary

Test date	December 16, 2017	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	45 %

8.2.3 Observations, settings and special notes

The test was performed according to DTS guidelines section 9.2.2.2 Method AVGSA-1 (trace averaging with the EUT transmitting at full power throughout each sweep).

EUT was set to transmit mode with maximum duty cycle during the test. Sweep triggering/signal gating was implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered)

Spectrum analyzer settings:

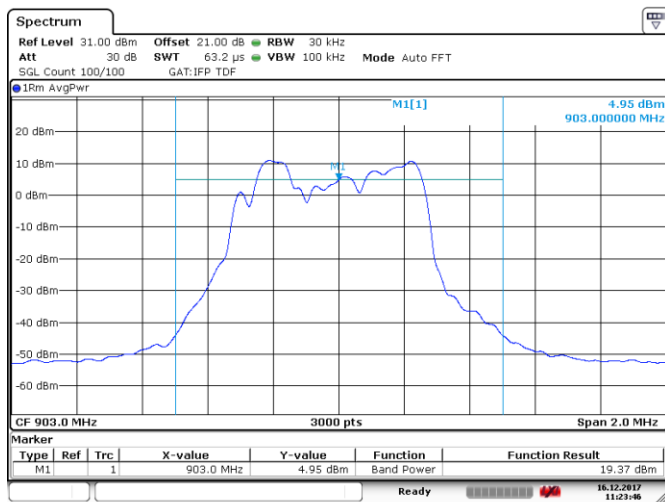
Resolution bandwidth	30 kHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Frequency span	2 MHz
Detector mode	RMS (power averaging)
Trace mode	Average
Band power function	Power integration
Band power bandwidth	1 MHz

8.2.4 Test data

Table 8.2-1: Output power and EIRP results

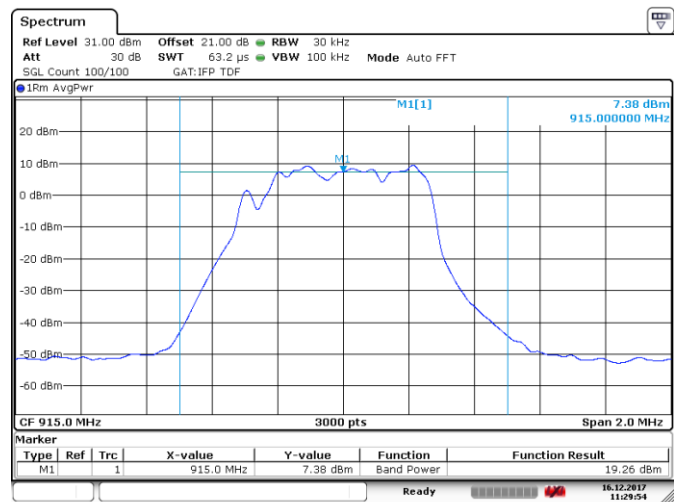
Frequency, MHz	Output power, dBm	Output power limit, dBm	Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
903	19.37	30	10.63	3.37	22.74	36	13.26
915	19.26	30	10.74	3.37	22.63	36	13.37
927.5	19.65	30	10.35	3.37	23.02	36	12.98

EIRP = Output power + Antenna gain



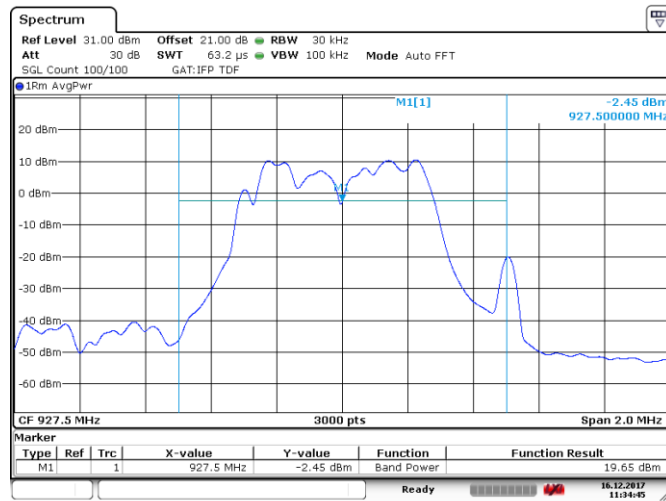
Date: 16 DEC.2017 11:23:47

Figure 8.2-1: Output power on low channel



Date: 16 DEC.2017 11:29:54

Figure 8.2-2: Output power on mid channel



Date: 16 DEC.2017 11:34:45

Figure 8.2-3: Output power on high channel

8.3 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) unwanted emissions

8.3.1 Definitions and limits

FCC:

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)).

ISED:

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

Table 8.3-1: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	67.6 – 20 × log ₁₀ (F)	300
0.490–1.705	24000/F	87.6 – 20 × log ₁₀ (F)	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

Table 8.3-2: ISED restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677–5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.3-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard



Table 8.3-3: FCC restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
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	2690–2900	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	Above 38.6
13.36–13.41			

8.3.2 Test summary

Test date	December 16, 2017 to December 17, 2017	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	45 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.

EUT was set to transmit with maximum duty cycle.

Radiated measurements were performed at a distance of 3 m. For cabinet radiated spurious emission measurements, the EUT transmit antenna was replaced with a termination with 50 Ω impedance.

Since fundamental power was tested using average method, the spurious emissions limit is -30 dBc/100 kHz

Spectrum analyser settings for measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

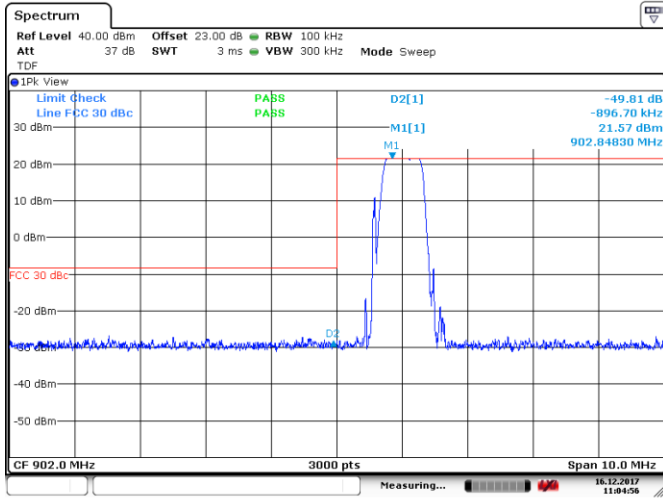
Spectrum analyser settings for measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

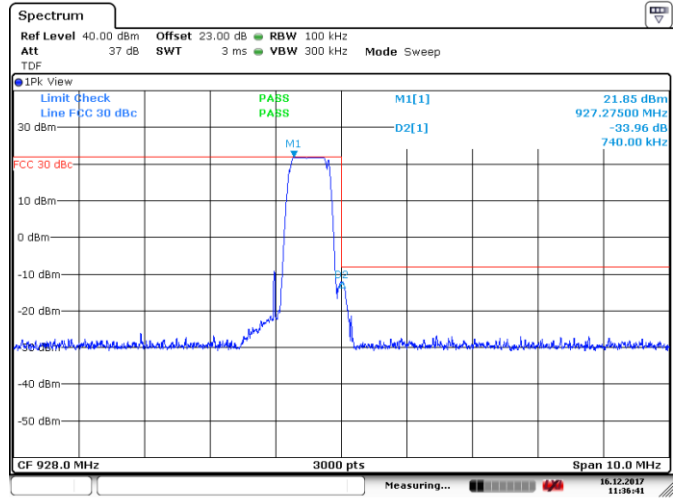
Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.3.4 Test data



Date: 16.DEC.2017 11:04:56

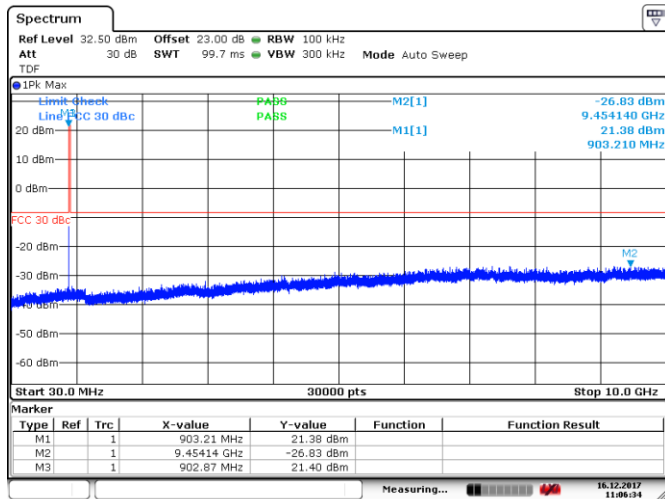
Figure 8.3-1: Conducted spurious emission at band edge outside restricted band, low channel



Date: 16.DEC.2017 11:36:42

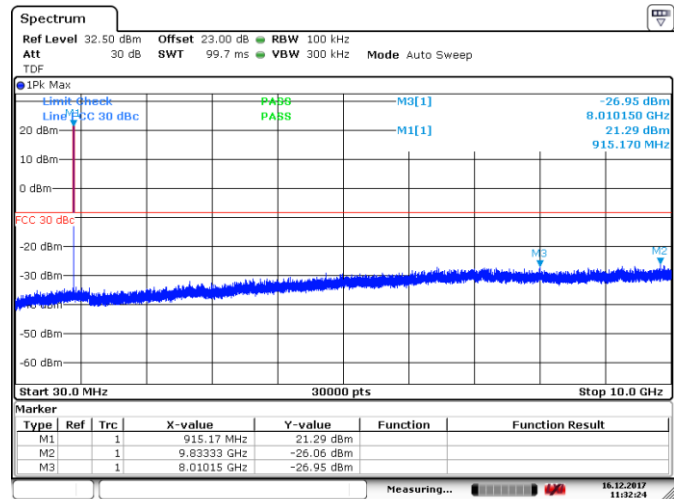
Figure 8.3-2: Conducted spurious emissions at band edge outside restricted band, High channel

8.3.4 Test data, continued



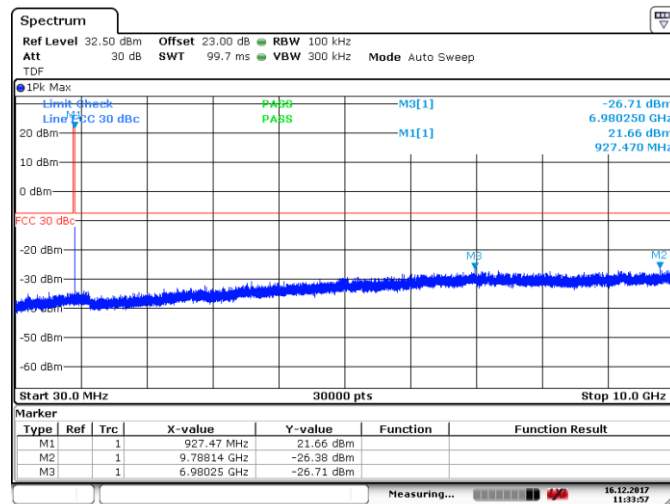
Date: 16.DEC.2017 11:06:34

Figure 8.3-3: Conducted spurious emissions outside restricted band, Low channel



Date: 16.DEC.2017 11:32:25

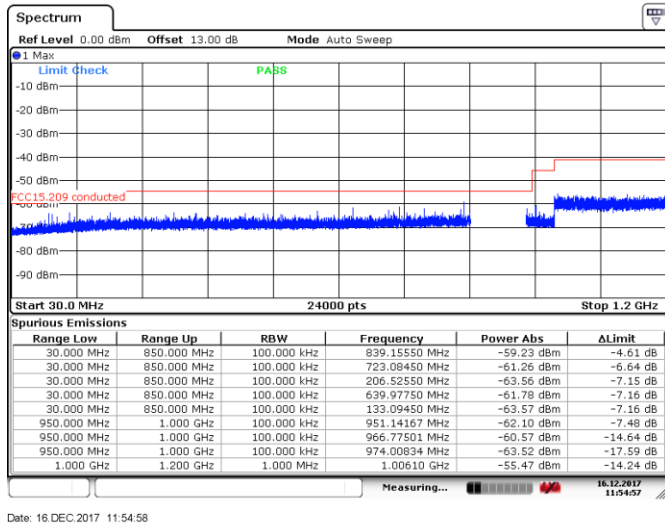
Figure 8.3-4: Conducted spurious emissions outside restricted band, mid channel



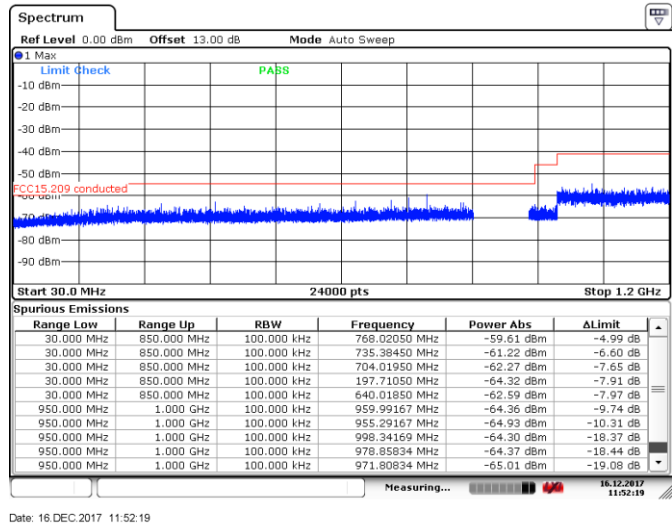
Date: 16.DEC.2017 11:33:57

Figure 8.3-5: Conducted spurious emissions outside restricted band, High channel

8.3.4 Test data, continued



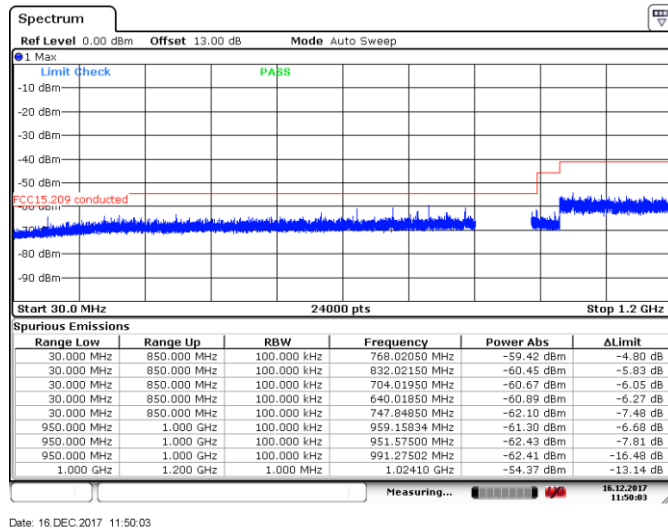
Date: 16 DEC 2017 11:54:58



Date: 16 DEC 2017 11:52:19

Figure 8.3-6: Conducted spurious emission of restricted band 30 MHz to 1.2 GHz, low channel

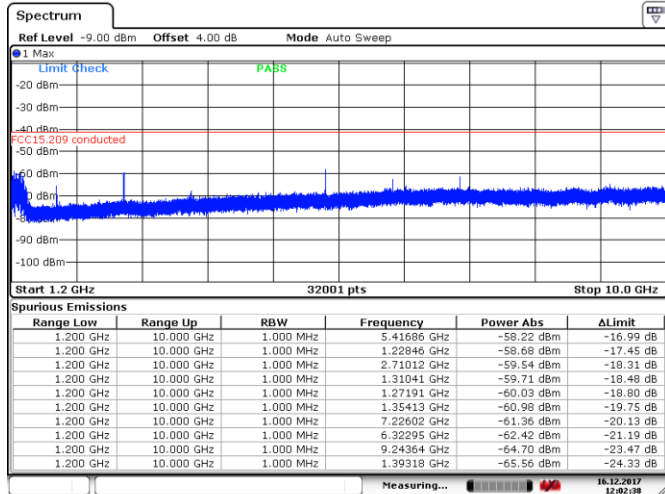
Figure 8.3-7: Conducted spurious emission of restricted band 30 MHz to 1.2 GHz, mid channel



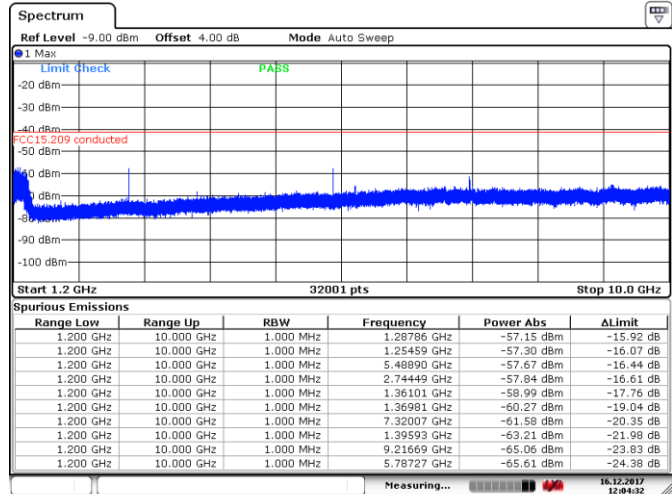
Date: 16 DEC 2017 11:50:03

Figure 8.3-8: Conducted spurious emissions of restricted band 30 MHz to 1.2 GHz, High channel

8.3.4 Test data, continued



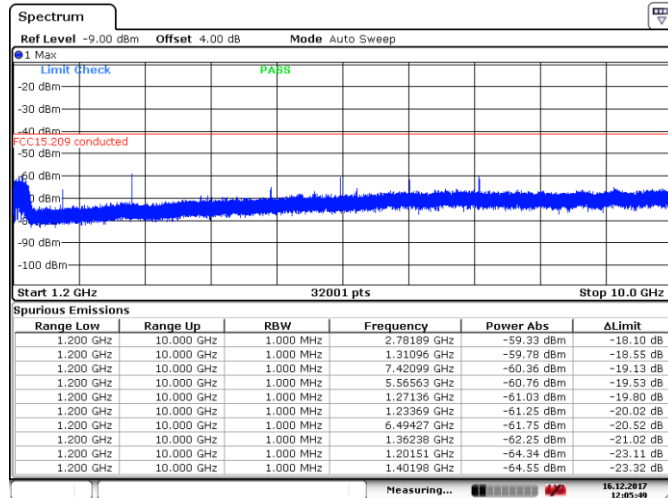
Date: 16 DEC 2017 12:02:39



Date: 16 DEC 2017 12:04:32

Figure 8.3-9: Conducted spurious emission of restricted band 1.2 GHz to 10 GHz, low channel

Figure 8.3-10: Conducted spurious emission of restricted band 1.2 GHz to 10 GHz, mid channel



Date: 16 DEC 2017 12:05:49

Figure 8.3-11: Conducted spurious emissions of restricted band 1.2 GHz to 10 GHz, High channel

8.3.4 Test data, continued

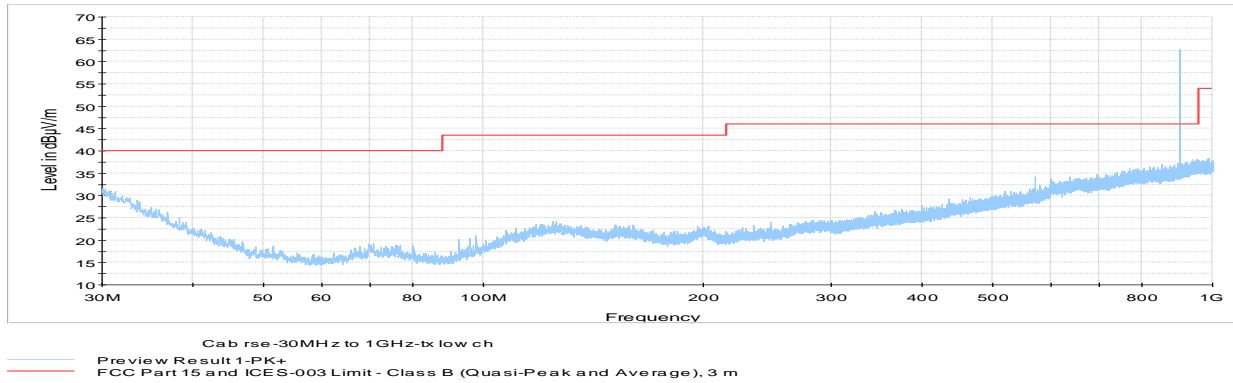


Figure 8.3-12: Cabinet Radiated spurious emissions 30 MHz to 1 GHz, Low channel

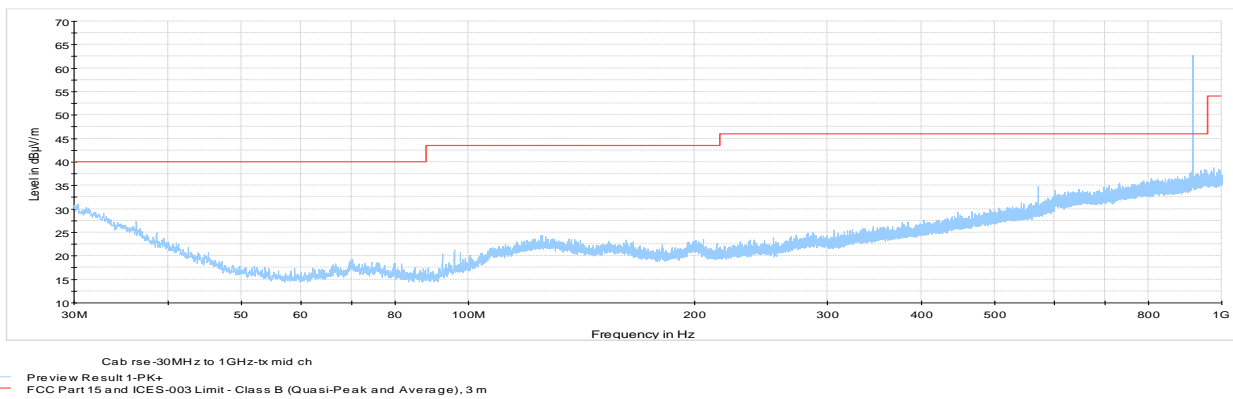


Figure 8.3-13: Cabinet Radiated spurious emissions 30 MHz to 1 GHz, Mid channel

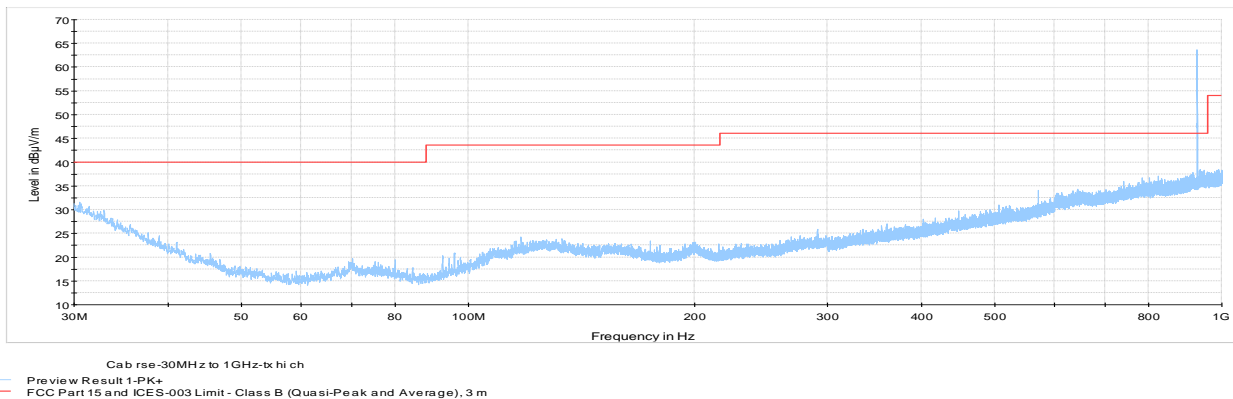


Figure 8.3-14: Cabinet Radiated spurious emissions 30 MHz to 1 GHz, High channel

Note: Emissions in band 902 to 928 MHz of plots above are from intentional transmissions.

8.3.4 Test data, continued

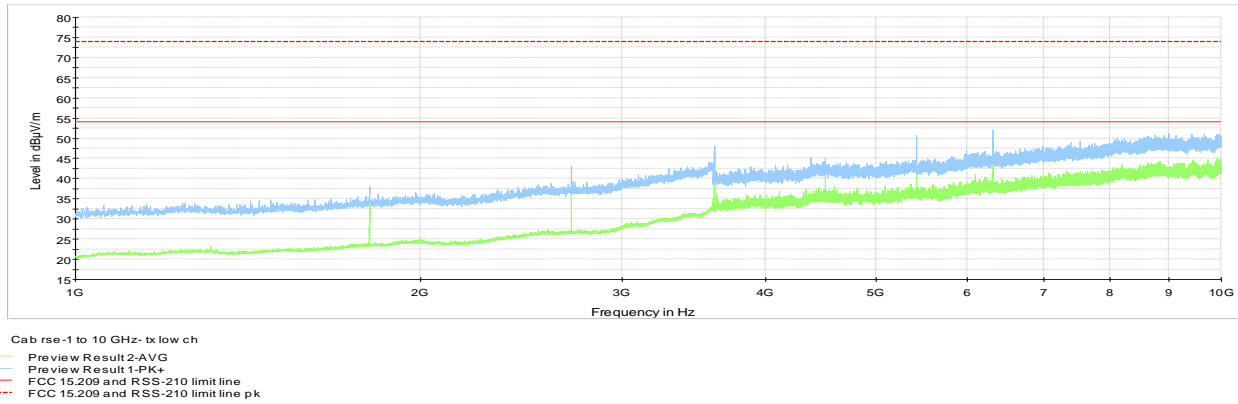


Figure 8.3-15: Cabinet Radiated spurious emissions 1 to10 GHz, Low channel

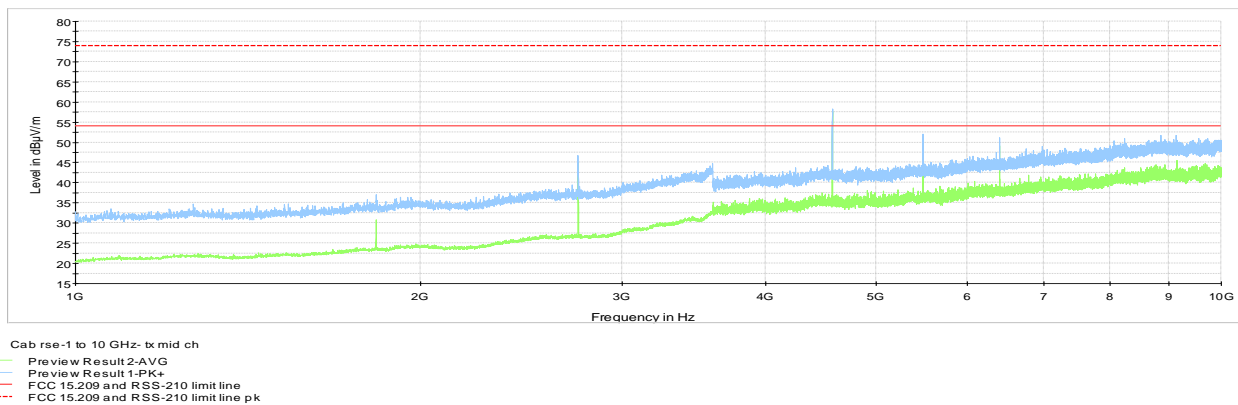


Figure 8.3-16: Cabinet Radiated spurious emissions 1 to10 GHz, Mid channel

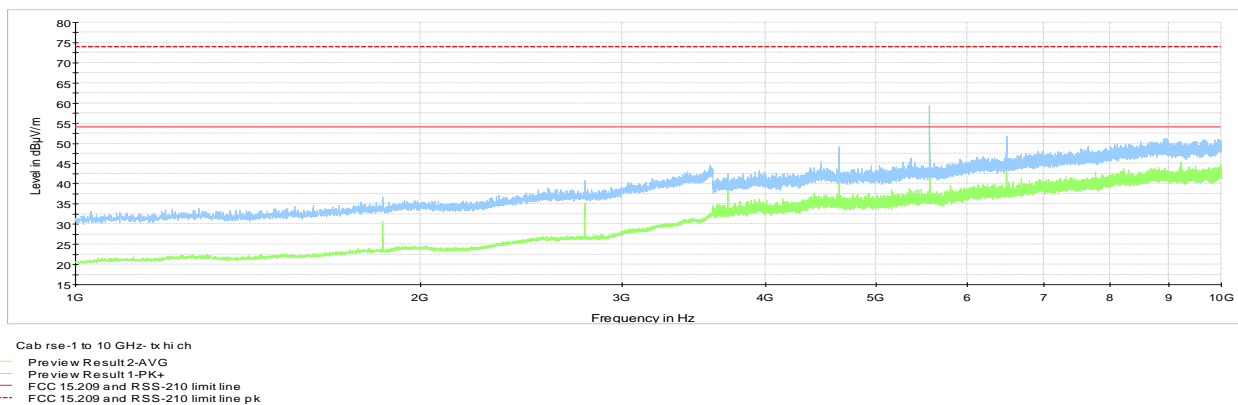


Figure 8.3-17: Cabinet Radiated spurious emissions 1 to10 GHz, High channel



8.3.4 Test data

Table 8.3-4: Radiated field strength measurement results

Channel	Frequency, MHz	Peak Field strength, dB μ V/m		Margin, dB	Average Field strength, dB μ V/m		Margin, dB
		Measured	Limit		Measured	Limit	
Low	2709	43.1	74	30.9	39.7	54	14.3
Low	3612	48.1	74	25.9	46.3	54	7.7
Low	5418	50.7	74	23.3	48.0	54	6.0
Low	6320	52.1	--	--	50.2	--	--
Mid	2745	46.8	74	27.2	45.1	54	8.9
Mid	3560	44.7	--	--	35.2	--	--
Mid	4575	58.3	74	15.7	51.0	54	3.0
Mid	5491	52.1	74	21.9	49.8	54	4.2
Mid	6404	49.1	--	--	51.2	--	--
High	4638	49.1	74	24.9	47.2	54	6.8
High	5565	59.5	--	--	49.3	--	--
High	6494	51.7	--	--	49.9	--	--

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
 Only the emissions within restricted bands were compared with the limits.
 For emissions outside of restrict band, test result is for information purpose only.

8.4 FCC 15.247(e) and RSS-247 5.2(b) Power spectral density for digitally modulated devices

8.4.1 Definitions and limits

FCC:

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

ISED:

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

8.4.2 Test summary

Test date	December 16, 2017	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1010 mbar
Verdict	Pass	Relative humidity	45 %

8.4.3 Observations, settings and special notes

The test was performed using method described in section 10.3 Method AVGPS-1 (average PSD). EUT was set to transmit mode with maximum duty cycle during the test. Sweep triggering/signal gating was implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered)

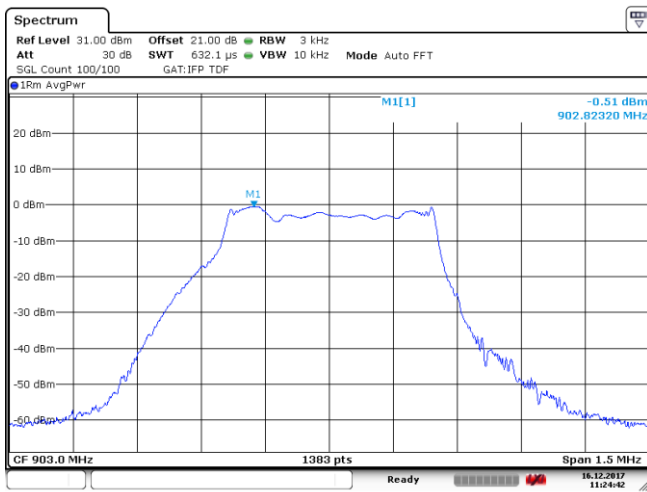
Spectrum analyzer settings:

Resolution bandwidth:	$3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$
Video bandwidth:	$\geq 3 \times \text{RBW}$
Frequency span:	1.5 MHz
Detector mode:	RMS
Trace mode:	Average

8.4.4 Test data

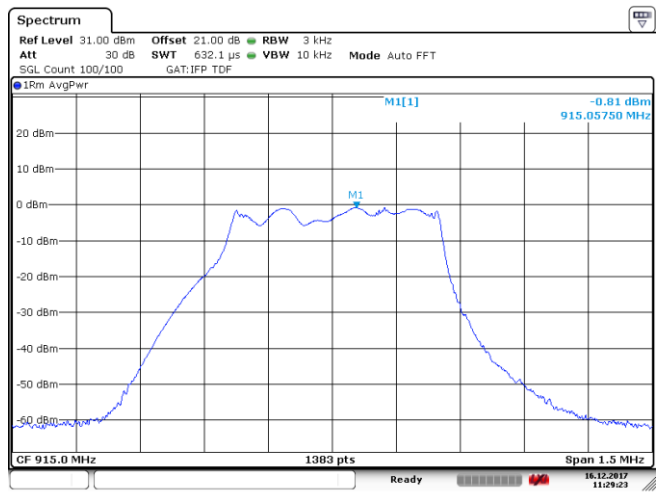
Table 8.4-1: PSD measurements results

Frequency, MHz	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
903	-0.51	8	8.51
915	-0.81	8	8.81
927.5	-0.31	8	8.31



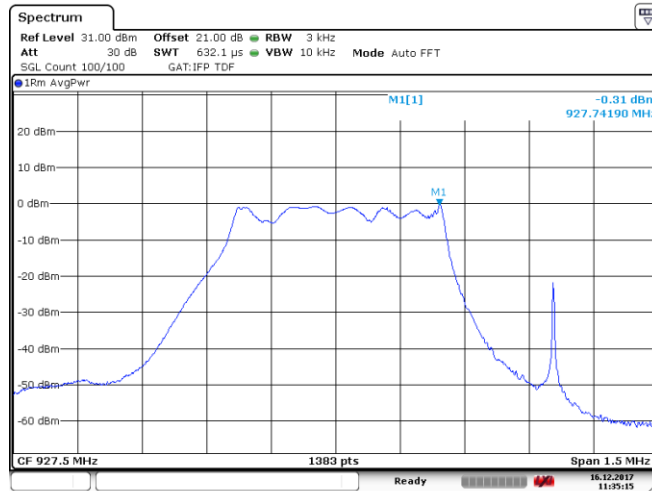
Date: 16 DEC 2017 11:24:42

Figure 8.4-1: PSD plot on Low channel



Date: 16 DEC 2017 11:29:23

Figure 8.4-2: PSD plot on mid channel

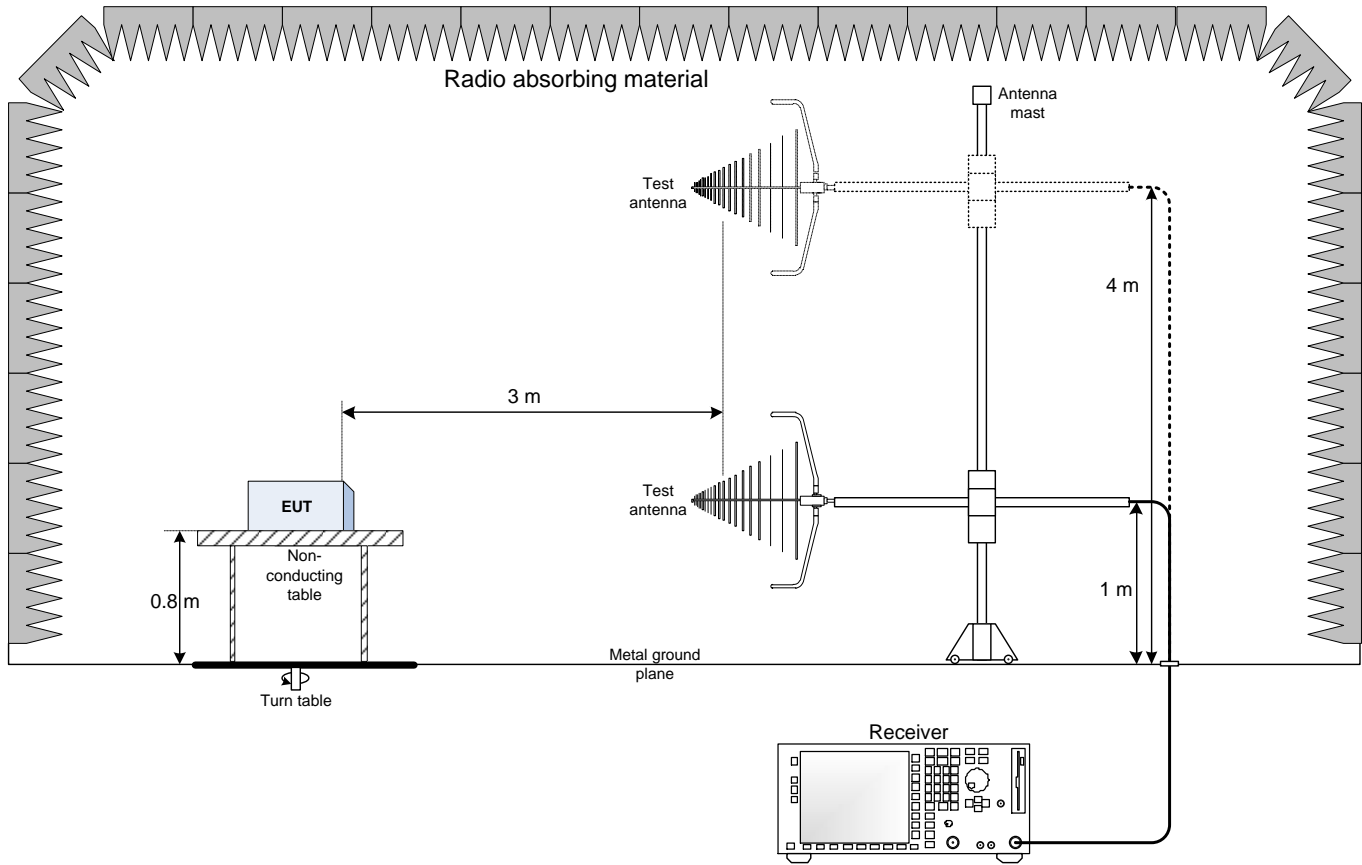


Date: 16 DEC 2017 11:35:15

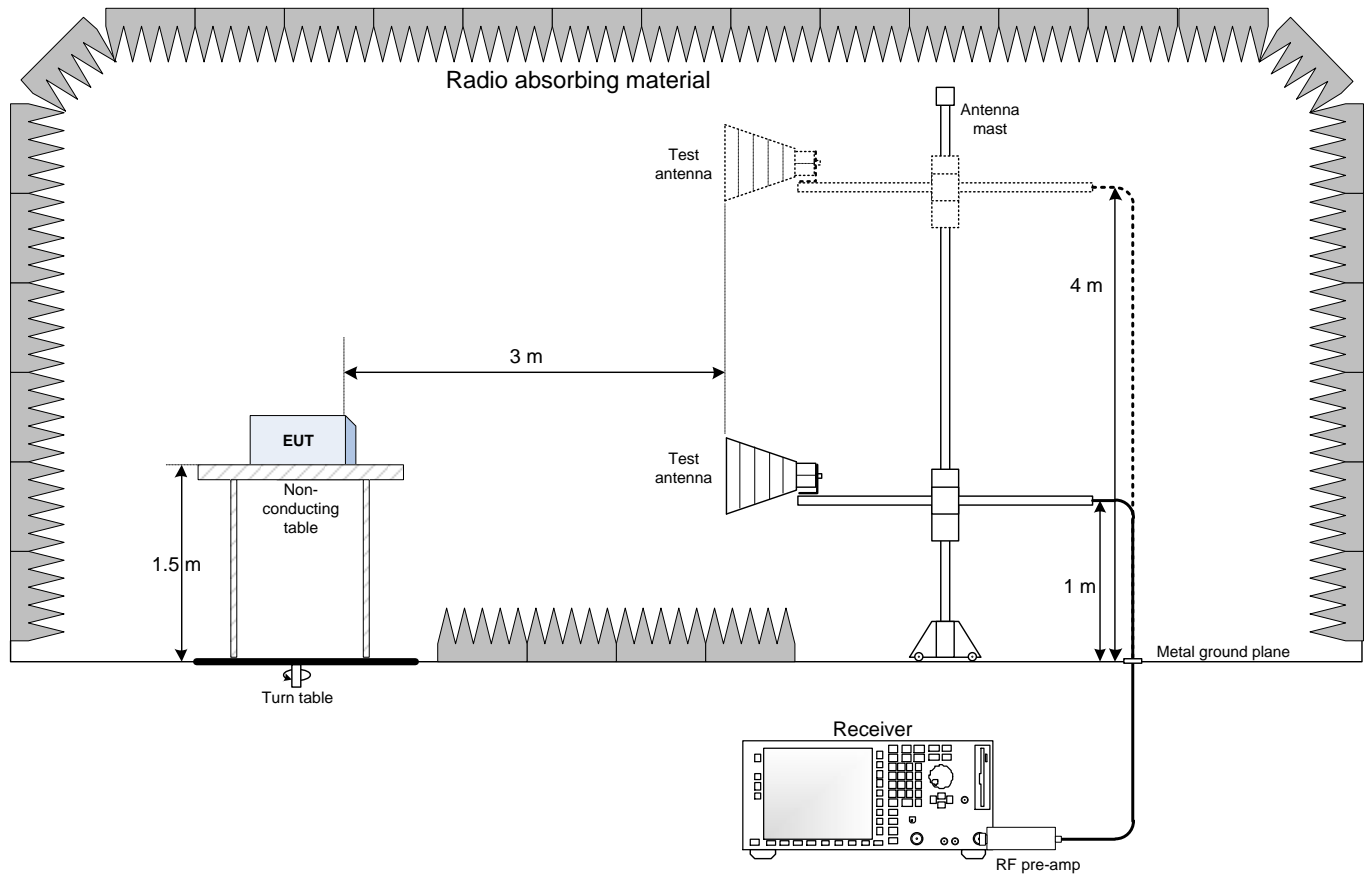
Figure 8.4-3: PSD plot on high channel

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted antenna port set-up

