

Test report

325619-2R2TRFWL (FCC-15.247 and RSS-247)

Date of issue: June 22, 2017

Applicant: Indyme Solutions, Inc.

Product: Control Unit

Model: CU5300

Model variant: N/A

FCC ID: J69-CU5300

IC Registration number: 1809A-CU5300

Specifications:

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

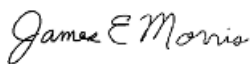
Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

◆ **RSS-247, Issue 2, February 2017**

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

Test location

Company name	Nemko USA, Inc.
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City	Carlsbad
Province	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
Site number	FCC: US5058; IC: 2040B

Tested by	Mark Phillips, Assistant EMC and Wireless Laboratory Manager
Reviewed by	James Morris, EMC and Wireless Divisions Manager
Review date	June 23, 2017
Reviewer signature	

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 USA's ISO/IEC 17025 accreditation.

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Table of contents

Table of contents	3
Section 1. Report summary	5
1.1 Applicant and manufacturer	5
1.2 Test specifications	5
1.3 Test methods	5
1.4 Statement of compliance	5
1.5 Exclusions	5
1.6 Test report revision history	5
Section 2. Summary of test results	6
2.1 FCC Part 15 Subpart C, general requirements test results	6
2.2 FCC Part 15 Subpart C, intentional radiators test results	6
2.3 IC RSS-GEN, Issue 4, test results	6
2.4 IC RSS-247, Issue 2, test results	7
Section 3. Equipment under test (EUT) details	8
3.1 Sample information	8
3.2 EUT information	8
3.3 Technical information	8
3.4 Product description and theory of operation	8
3.5 EUT exercise details	9
3.6 EUT setup diagram	9
3.7 EUT sub assemblies	9
Section 4. Engineering considerations	10
4.1 Modifications incorporated in the EUT	10
4.2 Technical judgment	10
4.3 Deviations from laboratory tests procedures	10
Section 5. Test conditions	11
5.1 Atmospheric conditions	11
5.2 Power supply range	11
Section 6. Measurement uncertainty	12
6.1 Uncertainty of measurement	12
Section 7. Test equipment	13
7.1 Test equipment list	13
Section 8. Testing data	14
8.1 FCC 15.247(a) (1) and RSS-247 5.1(1) 20 dB bandwidth of the hopping channel	14
8.2 FCC 15.247(b) and RSS-247 5.4 (4) Transmitter output power and e.i.r.p. requirements	16
8.3 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) emissions	18
8.4 FCC 15.247(a)(1)(i) and RSS-247 5.1(3) Frequency hopping systems in the 902-928MHz	26
8.5 FCC 15.247(a) (1) and RSS-247 5.1(2) Carrier frequency separation	28
8.6 FCC 15.207(a) AC power line conducted emissions limits	30
Section 9. Block diagrams of test set-ups	32
9.1 Radiated emissions set-up	32

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Indyme Solutions, Inc.
Address	8295 Aero Place Suite 260
City	San Diego
Province/State	CA
Postal/Zip code	92123
Country	U.S.A.

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
RSS-247, Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.3 Test methods

ANSI C64.3-2014	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

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. 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 #	Details of changes made to test report
1	Original report issued
2	Updated according to review comments.

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	Pass
§15.31(e)	Variation of power source	Pass
§15.203	Antenna requirement	Pass1
§15.205	Restricted bands of operation	Pass

Notes: 1. Reverse SMA

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.247(a)(1)	20 dB bandwidth of the hopping channel	Pass
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not applicable
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Not applicable
§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 for digitally modulated devices	Not applicable
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

2.3 IC 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	Pass
8.10	Restricted Frequency Bands	Pass

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.

2.4 IC RSS-247, Issue 2, test results

Part	Test description	Verdict
5.1	Frequency hopping systems (FHSs)	
5.1 (1)	Bandwidth of a frequency hopping channel	Pass
5.1 (2)	Minimum channel spacing for frequency hopping systems	Pass
5.1 (3)	Frequency hopping systems operating in the 902–928 MHz band	Pass
5.1 (4)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.1 (5)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
5.2	Digital modulation systems	
5.2 (1)	Minimum 6 dB bandwidth	Not applicable
5.2 (2)	Maximum power spectral density	Not applicable
5.3	Hybrid systems	
5.3 (1)	Digital modulation turned off	Not applicable
5.3 (2)	Frequency hopping turned off	Not applicable
5.4	Transmitter output power and e.i.r.p. requirements	
5.4 (1)	Frequency hopping systems operating in the 902–928 MHz band	Pass
5.4 (2)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
5.4 (3)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
5.4 (4)	Systems employing digital modulation techniques	Not applicable
5.4 (5)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
5.4 (6)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
5.5	Unwanted Emissions	Pass

Notes: EUT is FHSS in the 902-928 MHz band

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	April 17, 2017
Nemko sample ID number	325619

3.2 EUT information

Product name	Control Unit
Model	CU5300
Model variant	N/A
Serial number	N/A

3.3 Technical information

Applicant IC company number	1809A
IC UPN number	CU5300
All used IC test site(s) Reg. number	2040B
RSS number and Issue number	RSS-247, Issue 2, February 2017
Frequency band	902-928 MHz
Frequency Min (MHz)	918.1
Frequency Max (MHz)	923.0
RF power Min (W), Conducted/ERP/EIRP	N/A
RF power Max (W), Conducted/ERP/EIRP	25.5mW (Conducted)
Field strength, Units @ distance	N/A
Measured BW (kHz) (20 dB)	53.6 kHz
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	FSK
Emission classification (F1D, G1D, D1D)	F1D
Transmitter spurious, Units @ distance	58.4 dBuV/m Pk, 56.2 dBuV/m Avg @3m Frequency not in Restricted Band. Passes 20dBc requirement.
Power requirements	AC 100-240V 50/60Hz
Antenna information	The EUT is professionally installed.
Antennas	2dBi

3.4 Product description and theory of operation

EUT is a wireless control unit for access control notification used with end device.

3.5 EUT exercise details

Depends on test cases, the EUT is set either to fixed channel (L/M/H) or frequency hopping mode, using test FW.

3.6 EUT setup diagram

Please refer to separate photo exhibit for detail.

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
EUT	Indyme	CU5300	None
EUT AC Power Adapter	Indyme	FKS308HSC-1201250U	None

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

The following modifications were performed by client:
Added copper tape shielding to RF output section.

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.

AC 100-240V 50/60Hz

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

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

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
752	Antenna, DRWG	EMCO	3115	9609-4943	04-May-2016	04-May-2017
809	Multimeter	Fluke	111	77790102	29-Jun-2016	29-Jun-2017
E1019	Two Line V-Network	Rohde & Schwarz	ENV216	101045	15-Jun-2016	15-Jun-2017
E1035	Variac (Variable Transformer) 3KVA	Shanghai China	TDGC	N/A	N/R	VOU
1480	Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	21-Jul-2016	21-Jul-2017
E1120	Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	101395	25-May-2016	25-May-2017
E1121	EMI Test Receiver	Rohde & Schwarz	ESU 40	100064	28-Apr-2016	28-Apr-2017
N/A	10m Chamber Cable - HF	N/A	N/A	N/A	VOU	
N/A	10m Chamber Cable - LF	N/A	N/A	N/A	VOU	
N/A	RF Conducted Cables - HF	N/A	N/A	N/A	VOU	
317	Preamp	HP	8449B	N/A	VOU	
N/A	Attenuator	HP	8493A	05391	VOU	

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

Section 8. Testing data

8.1 FCC 15.247(a) (1) and RSS-247 5.1(1) 20 dB bandwidth of the hopping channel

8.1.1 Definitions and limits

FCC and IC:

- (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:
- (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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
- (i) 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.

8.1.2 Test summary

Test date	April 17, 2017	Temperature	20 °C
Test engineer	Mark Phillips	Air pressure	1006 mbar
Verdict	Pass	Relative humidity	55 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	1–5 % of Channel BW (no wider than 100 kHz)
Video bandwidth	$\geq 3 \times \text{RBW}$
Frequency span	2 – 5 times OBW
Detector mode	Peak
Trace mode	Max Hold

8.1.4 Test data

Table 8.1-1: 20 dB bandwidth results

Modulation	Frequency, MHz	20 dB bandwidth, kHz	Channel Bandwidth, kHz	Margin, kHz
FSK	918.1	53.6	500	446.4
	920.5	52.5	500	447.5
	923.0	53.6	500	446.4

Section 8
Test name
Specification

Testing data
FCC 15.247(a)(1) and RSS-247 5.1(1) 20 dB bandwidth of the hopping channel
FCC 15 Subpart C and RSS-247, Issue 2

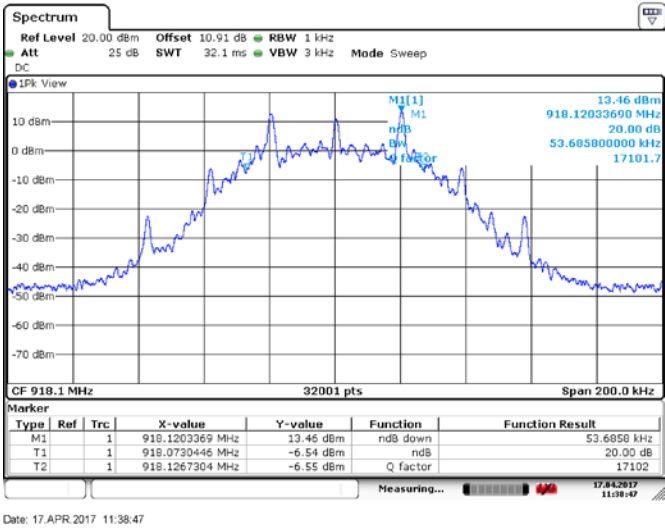


Figure 8.1-1: 20 dB bandwidth, 918.1MHz

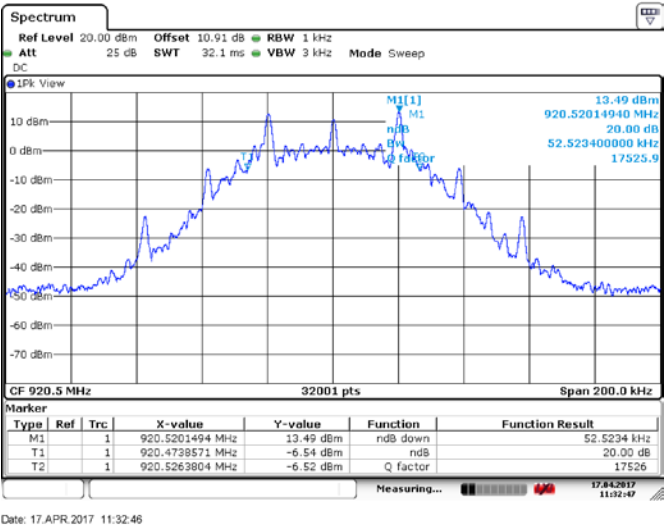


Figure 8.1-2: 20 dB bandwidth, 920.5MHz, RF1

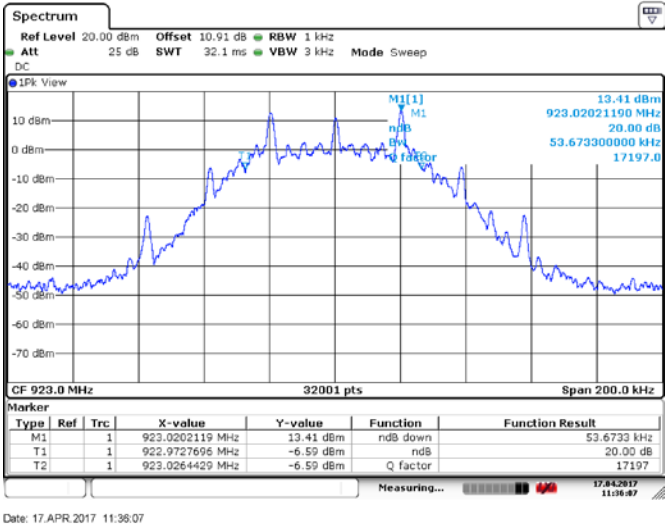


Figure 8.1-3: 20 dB bandwidth, 923MHz

8.2 FCC 15.247(b) and RSS-247 5.4 (4) Transmitter output power and e.i.r.p. requirements

8.2.1 Definitions and limits

FCC:

- (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:
- (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.
 - (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.

IC:

5.4 Transmitter Output Power and Equivalent Isotropically Radiated Power (E.I.R.P.) Requirements

- (1) For FHSs operating in the band 902-928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

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	April 17, 2017	Temperature	20 °C
Test engineer	Mark Phillips	Air pressure	1006 mbar
Verdict	Pass	Relative humidity	52 %

8.2.3 Observations, settings and special notes

Tested with RF Conducted using spectrum analyzer with direct connect to EUT. RBW = 3MHz VBW = 10MHz Peak Detector

8.2.4 Test data

Table 8.2-1: Output power measurements results

Power Source	Frequency, MHz	Conducted output power, dBm		Margin, dB	Max Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured	Limit					
120V AC	918.1	14.07	30	15.93	2	16.07	36	19.93
	920.5	14.06	30	15.94	2	16.06	36	19.94
	923.0	13.94	30	16.06	2	15.94	36	20.06
85V AC	918.1	14.06	30	15.94	2	16.06	36	19.94
	920.5	13.99	30	16.01	2	15.99	36	20.01
	923.0	13.93	30	16.07	2	15.93	36	20.07
276V AC	918.1	14.07	30	15.93	2	16.07	36	19.94
	920.5	13.98	30	16.02	2	15.98	36	19.02
	923.0	13.93	30	16.07	2	15.93	36	20.07

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

IC:

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.

- (a) Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands except for apparatus complying under RSS-287;
- (b) Unwanted emissions that fall into restricted bands shall comply with the limits specified in RSS-Gen; and
- (c) Unwanted emissions that do not fall within the restricted frequency bands shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

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	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	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: IC 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	April 18, 2017	Temperature	20 °C
Test engineer	Mark Phillips	Air pressure	1005 mbar
Verdict	Pass	Relative humidity	52 %

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 100 % duty cycle.
Radiated measurements were performed at a distance of 3 m.

Spectrum analyser settings for radiated 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 peak radiated 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

Spectrum analyser settings for conducted spurious emissions measurements:

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

8.3.4 Test data

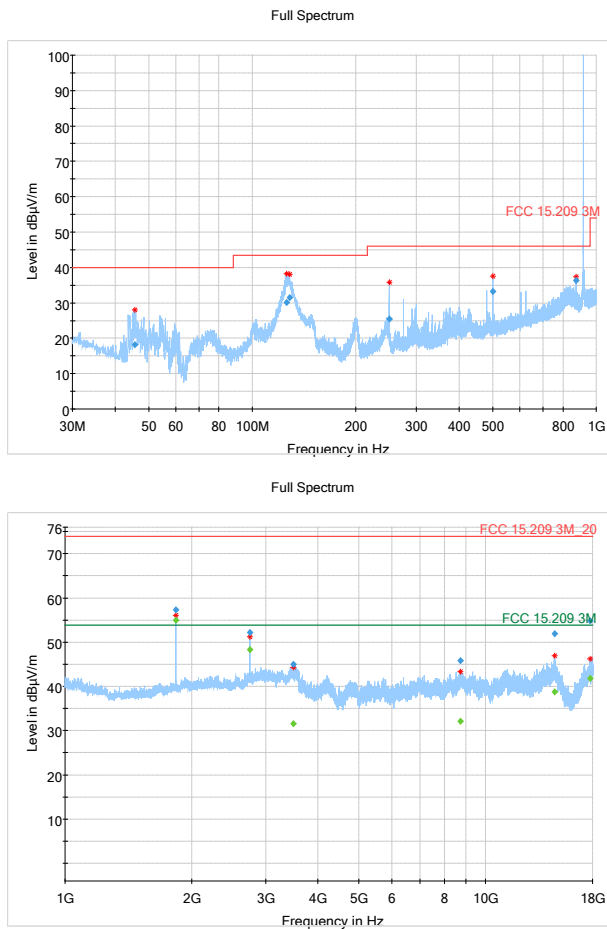


Figure 8.3.1: Radiated spurious emissions, low channel

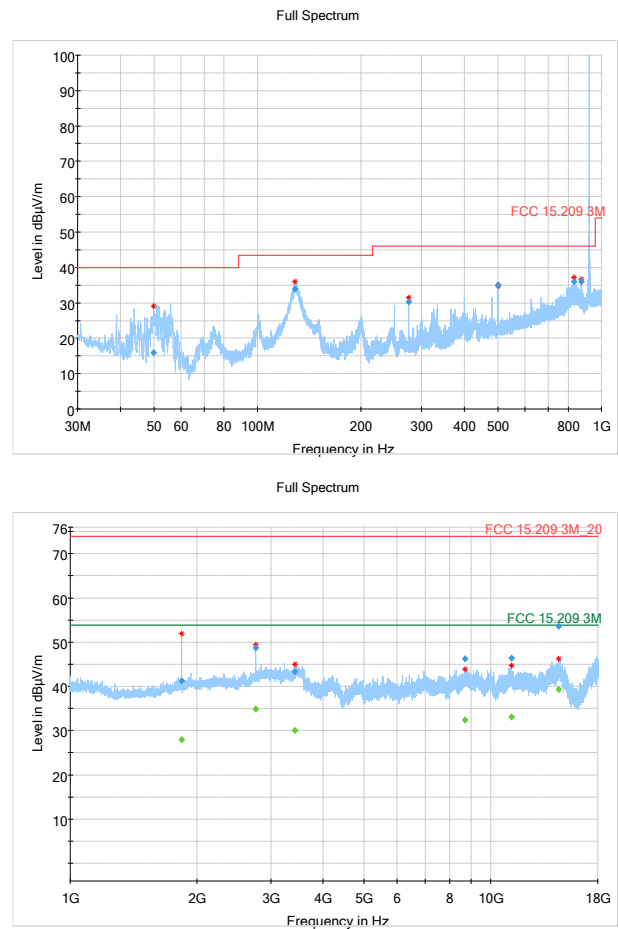


Figure 8.3.2: Radiated spurious emissions, mid channel

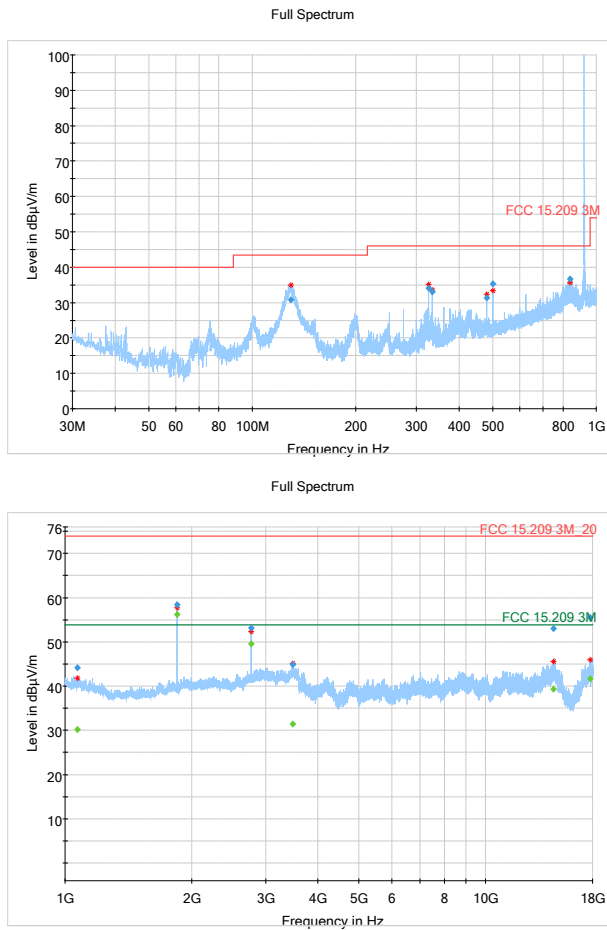


Figure 8.3.3: Radiated spurious emissions, high channel

Peaks within 902-928MHz are transmitter fundamentals.

Table 8.3-4: Radiated field strength measurement results for low channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
45.554500	18.09	40.00	21.91	5000.0	120.000	159.3	V	176.0	12.4
125.887500	30.02	43.50	13.48	5000.0	120.000	295.5	H	159.0	14.0
128.201000	31.57	43.50	11.93	5000.0	120.000	261.6	H	138.0	14.0
249.976000	25.38	46.00	20.62	5000.0	120.000	154.2	H	304.0	15.6
499.993500	33.22	46.00	12.78	5000.0	120.000	145.2	H	152.0	22.1
874.995500	36.34	46.00	9.66	5000.0	120.000	128.4	H	0.0	27.9

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Note
1836.133333	57.34	---	73.90	16.56	5000.0	1000.000	116.5	H	322.0	2.9	
1836.133333	---	54.97	53.90	-1.07	5000.0	1000.000	116.5	H	322.0	2.9	Not in Restricted Band
2754.300000	---	48.25	53.90	5.65	5000.0	1000.000	136.4	H	305.0	5.6	
2754.300000	52.24	---	73.90	21.66	5000.0	1000.000	136.4	H	305.0	5.6	
3492.900000	45.06	---	73.90	28.84	5000.0	1000.000	339.7	V	203.0	7.5	
3492.900000	---	31.58	53.90	22.32	5000.0	1000.000	339.7	V	203.0	7.5	
8716.333333	45.83	---	73.90	28.07	5000.0	1000.000	203.9	H	330.0	21.7	
8716.333333	---	32.19	53.90	21.71	5000.0	1000.000	203.9	H	330.0	21.7	
14615.033333	51.85	---	73.90	22.05	5000.0	1000.000	287.3	H	300.0	29.9	
14615.033333	---	38.72	53.90	15.18	5000.0	1000.000	287.3	H	300.0	29.9	
17756.100000	---	41.78	53.90	12.12	5000.0	1000.000	221.7	H	0.0	32.3	
17756.100000	54.88	---	73.90	19.02	5000.0	1000.000	221.7	H	0.0	32.3	

Table 8.3-5: Radiated field strength measurement results for mid channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
49.896500	15.87	40.00	24.13	5000.0	120.000	250.9	V	54.0	10.2
128.506500	33.96	43.50	9.54	5000.0	120.000	265.0	H	146.0	14.0
274.993500	30.27	46.00	15.73	5000.0	120.000	108.2	H	136.0	16.1
499.993500	35.20	46.00	10.80	5000.0	120.000	186.0	H	139.0	22.1
830.812000	35.93	46.00	10.07	5000.0	120.000	156.5	H	294.0	27.7
874.884000	36.06	46.00	9.94	5000.0	120.000	230.2	H	330.0	27.9

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
1839.633333	---	28.04	53.90	25.86	5000.0	1000.000	197.1	V	54.0	2.9
1839.633333	41.30	---	73.90	32.60	5000.0	1000.000	197.1	V	54.0	2.9
2761.500000	---	34.84	53.90	19.06	5000.0	1000.000	243.2	V	198.0	5.6
2761.500000	48.76	---	73.90	25.14	5000.0	1000.000	243.2	V	198.0	5.6
3424.233333	---	30.04	53.90	23.86	5000.0	1000.000	160.3	H	260.0	7.4
3424.233333	43.39	---	73.90	30.51	5000.0	1000.000	160.3	H	260.0	7.4
8705.333333	---	32.44	53.90	21.46	5000.0	1000.000	153.6	H	332.0	21.6
8705.333333	46.20	---	73.90	27.70	5000.0	1000.000	153.6	H	332.0	21.6
11211.066667	---	33.16	53.90	20.74	5000.0	1000.000	223.7	H	148.0	24.0
11211.066667	46.39	---	73.90	27.51	5000.0	1000.000	223.7	H	148.0	24.0
14529.933333	---	39.29	53.90	14.61	5000.0	1000.000	183.0	V	131.0	30.1
14529.933333	53.52	---	73.90	20.38	5000.0	1000.000	183.0	V	131.0	30.1

Table 8.3-6: Radiated field strength measurement results for high channel

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
129.413500	30.88	43.50	12.62	5000.0	120.000	132.7	H	145.0	14.0
324.997000	34.16	46.00	11.84	5000.0	120.000	110.9	H	306.0	17.5
333.339000	32.99	46.00	13.01	5000.0	120.000	115.9	H	265.0	17.8
480.003000	31.38	46.00	14.62	5000.0	120.000	109.1	H	172.0	21.6
499.993500	35.38	46.00	10.62	5000.0	120.000	144.4	H	161.0	22.1
837.927000	36.74	46.00	9.26	5000.0	120.000	103.3	H	288.0	27.8

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)	Note
1069.166667	44.18	---	73.90	29.72	5000.0	1000.000	151.1	V	254.0	0.9	
1069.166667	---	30.22	53.90	23.68	5000.0	1000.000	151.1	V	254.0	0.9	
1845.933333	58.43	---	73.90	15.47	5000.0	1000.000	116.9	H	321.0	3.0	
1845.933333	---	56.20	53.90	-2.30	5000.0	1000.000	116.9	H	321.0	3.0	Not in Restricted Band
2768.866667	53.20	---	73.90	20.70	5000.0	1000.000	145.4	H	318.0	5.7	
2768.866667	---	49.53	53.90	4.37	5000.0	1000.000	145.4	H	318.0	5.7	
3482.300000	---	31.47	53.90	22.43	5000.0	1000.000	327.1	H	175.0	7.5	
3482.300000	44.87	---	73.90	29.03	5000.0	1000.000	327.1	H	175.0	7.5	
14518.600000	---	39.26	53.90	14.64	5000.0	1000.000	179.3	H	229.0	30.2	
14518.600000	53.02	---	73.90	20.88	5000.0	1000.000	179.3	H	229.0	30.2	
17767.000000	55.47	---	73.90	18.43	5000.0	1000.000	352.8	H	116.0	32.3	
17767.000000	---	41.71	53.90	12.19	5000.0	1000.000	352.8	H	116.0	32.3	

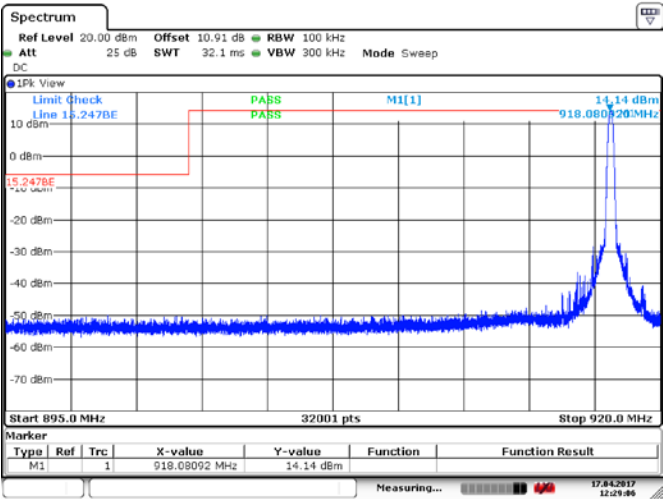


Figure 8.3.4: Low Bandedge Measurement

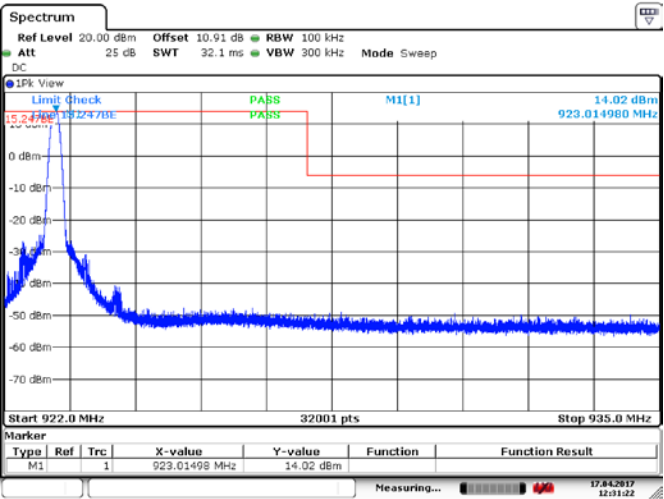


Figure 8.3.5: High Bandedge Measurement

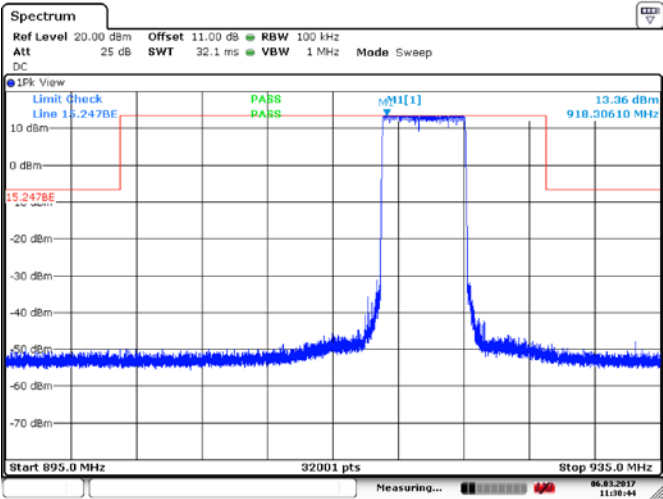


Figure 8.3.6: Bandedge Measurement, hopping

Section 8
Test name
Specification

Testing data
FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) emissions
FCC Part 15 Subpart C and RSS-247, Issue 2

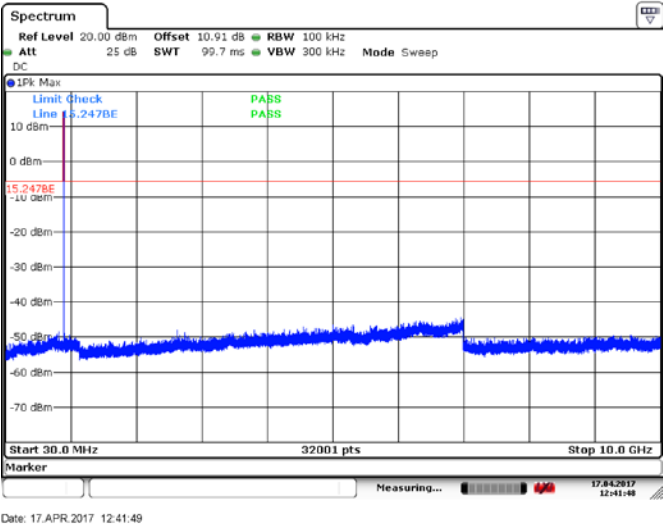


Figure 8.3.7: Conducted spurious emissions, Low Channel

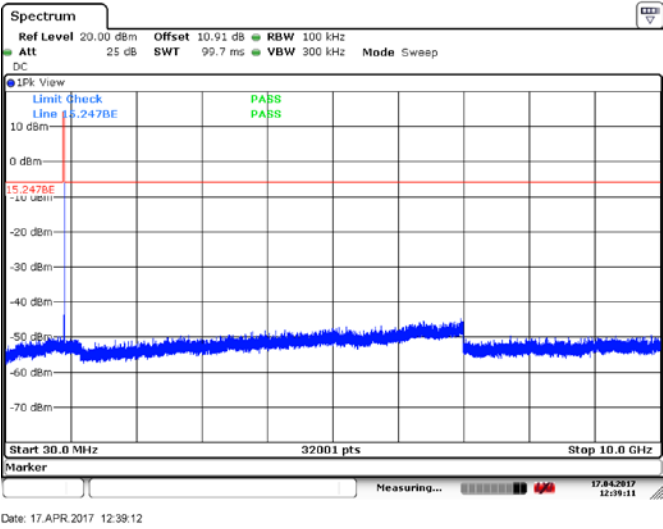


Figure 8.3.8: Conducted spurious emissions, Mid Channel

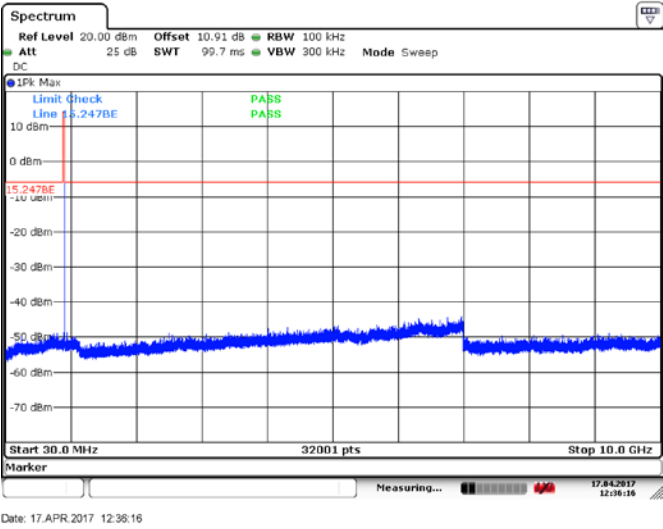


Figure 8.3.9: Conducted spurious emissions, High Channel

8.4 FCC 15.247(a)(1)(i) and RSS-247 5.1(3) Frequency hopping systems in the 902-928MHz

8.4.1 Definitions and limits

FCC:

(i) 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..

IC:

For FHSs in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel 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 channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10-second period. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

8.4.2 Test summary

Test date	March 6, 2017	Temperature	20 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	55 %

8.4.3 Observations, settings and special notes

The test was performed using EUT set to normal hopping operation.

8.4.4 Test data

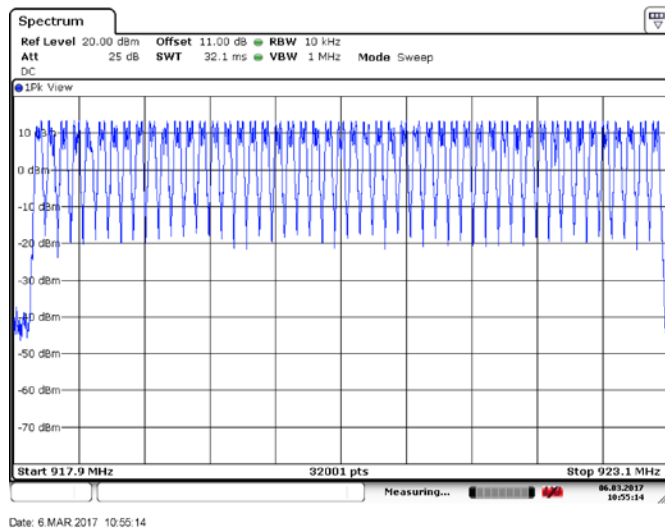
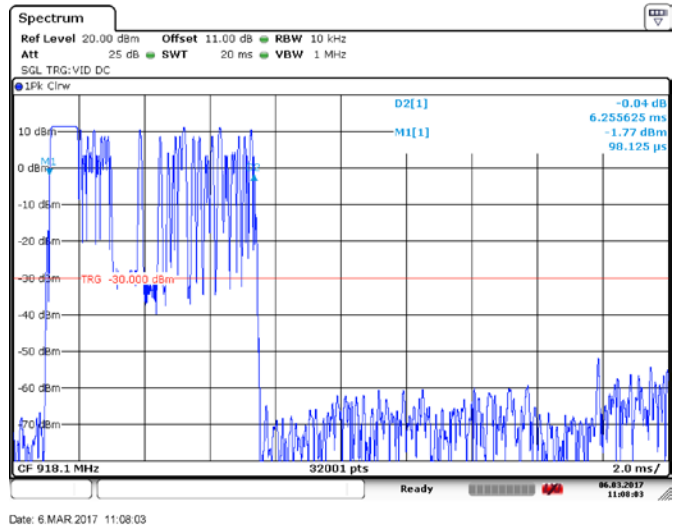
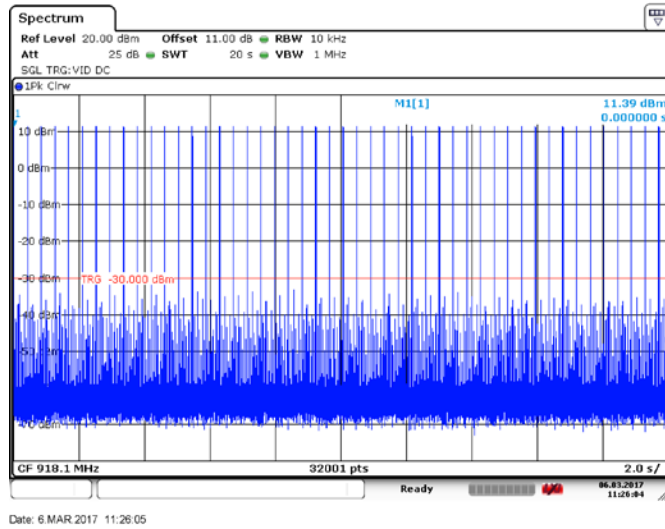


Table 8.4-1: Time of occupancy

Frequency MHz	Pulse count in 20s	Pulse width (ms)	Time of occupancy Time (ms)	Limit (ms)	Margin (ms)
918.1	47	6.25	293.75	400	106.25

Table 8.4: Hopping Frequencies

Minimum Hopping Frequencies	Measured Hopping Frequencies	Result
50	50	Pass

8.5 FCC 15.247(a) (1) and RSS-247 5.1(2) Carrier frequency separation

8.5.1 Definitions and limits

FCC and IC:

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(i) 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.

8.5.2 Test summary

Test date	March 6, 2017	Temperature	20 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	55 %

8.5.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	≥ RBW
Frequency span	4 MHz
Detector mode	Peak
Trace mode	Max Hold

RF Conducted Test with RF Test Board.

8.5.4 Test data

Table 8.5-1: Hopping Frequency Separation

Modulation	Frequency, kHz	Minimum, kHz (20dB OBW)	Margin, kHz
FSK	99.9	53.6	46.3

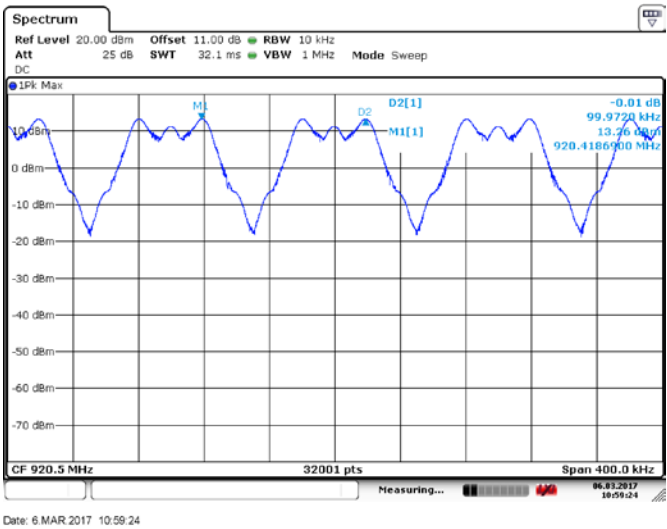


Figure 8.5-1: Hopping Frequency Separation

8.6 FCC 15.207(a) AC power line conducted emissions limits

8.6.1 Definitions and limits

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

The conducted emissions shall be measured with a 50 Ω /50 μ H line impedance stabilization network (LISN).

Table 8.6-1: Conducted emissions limit

Frequency of emission (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Note: * - Decreases with the logarithm of the frequency.

8.6.2 Test summary

Test date	April 19, 2017	Temperature	22 °C
Test engineer	Mark Phillips	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	55 %

8.6.3 Observations, settings and special notes

This is tested with Low CH TX on.

The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

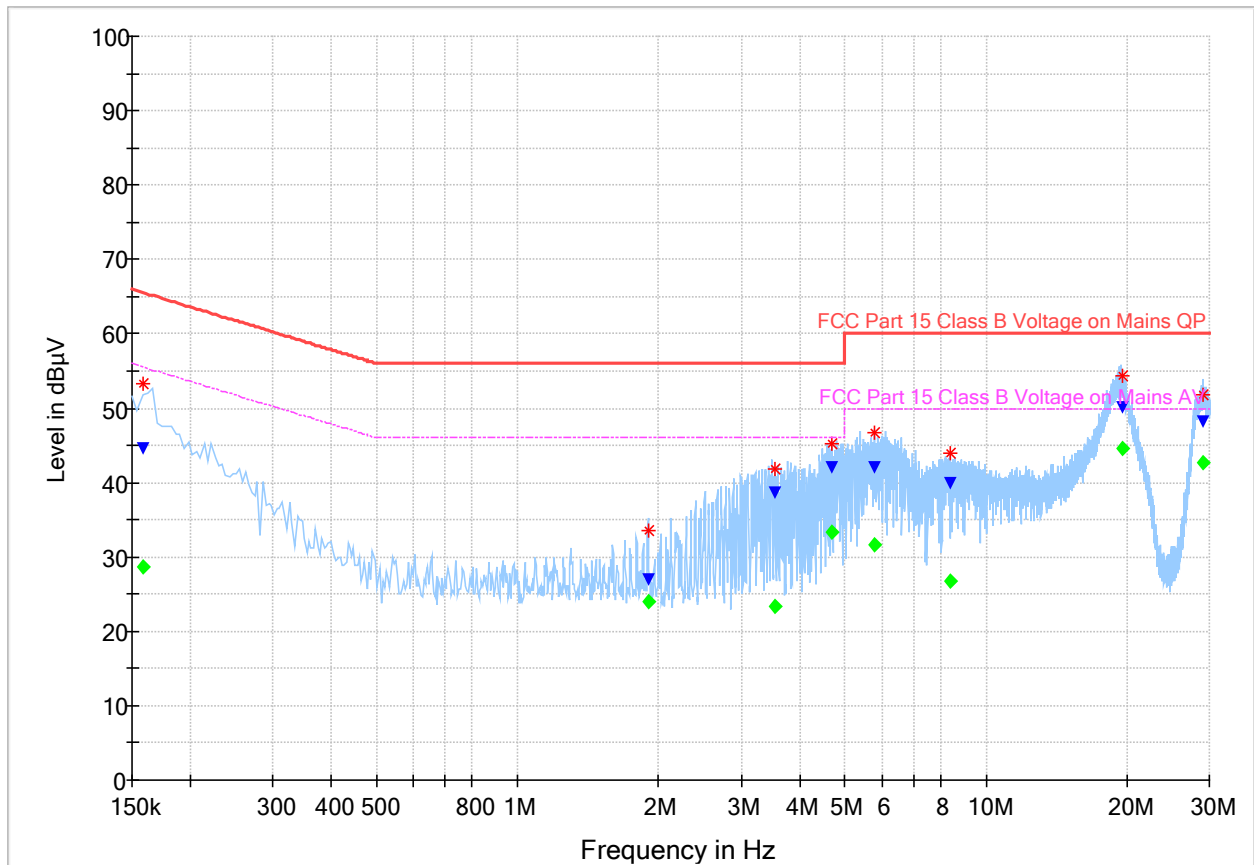
A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Test receiver settings:

Frequency span	150 kHz to 30 MHz
Detector mode	Peak and Average (preview mode); Quasi-Peak (final measurements)
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	1000 ms

8.6.4 Test data

Full Spectrum



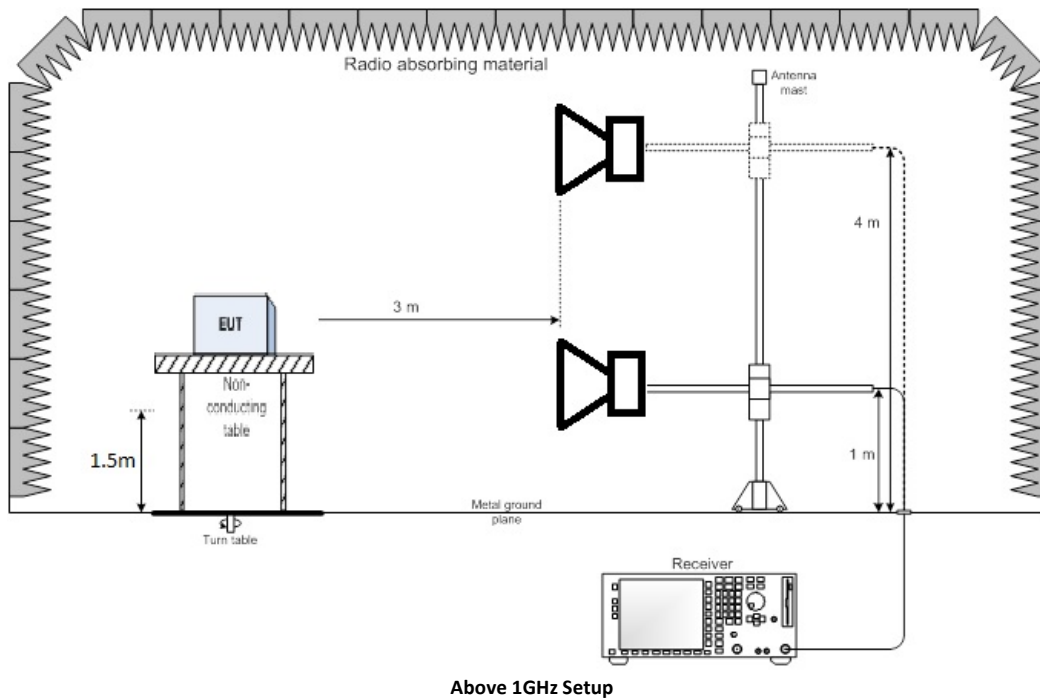
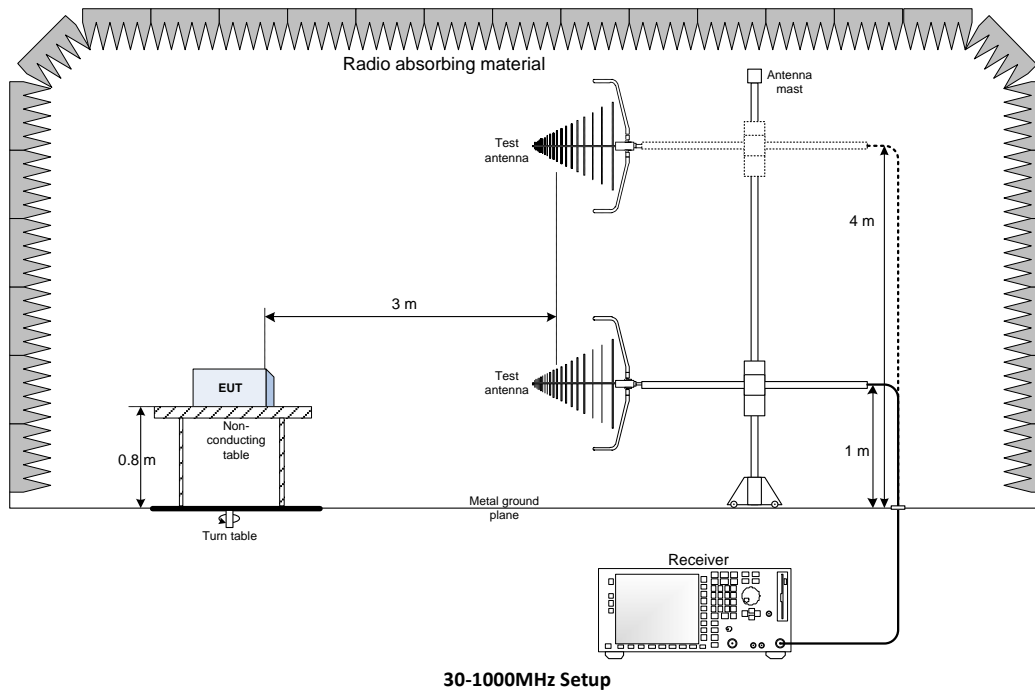
Plot 8.6-1: Conducted emissions

Table 8.6-2: Quasi-Peak and Average conducted emissions results

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
0.158000	---	28.70	55.57	26.87	5000.0	9.000	L1	ON
0.158000	44.52	---	65.57	21.05	5000.0	9.000	L1	ON
1.896500	27.03	---	56.00	28.97	5000.0	9.000	N	ON
1.896500	---	24.09	46.00	21.91	5000.0	9.000	N	ON
3.548500	---	23.45	46.00	22.55	5000.0	9.000	N	ON
3.548500	38.62	---	56.00	17.38	5000.0	9.000	N	ON
4.688500	41.98	---	56.00	14.02	5000.0	9.000	N	ON
4.688500	---	33.39	46.00	12.61	5000.0	9.000	N	ON
5.784500	---	31.63	50.00	18.37	5000.0	9.000	N	ON
5.784500	41.97	---	60.00	18.03	5000.0	9.000	N	ON
8.407500	39.97	---	60.00	20.03	5000.0	9.000	N	ON
8.407500	---	26.75	50.00	23.25	5000.0	9.000	N	ON
19.492500	50.04	---	60.00	9.96	5000.0	9.000	L1	ON
19.492500	---	44.60	50.00	5.40	5000.0	9.000	L1	ON
29.040500	---	42.63	50.00	7.37	5000.0	9.000	N	ON
29.040500	48.15	---	60.00	11.85	5000.0	9.000	N	ON

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



End of Report