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Test report

FCC-15.247 and RSS-247 DTS Arris DCX860 #319000

Date of issue: February 1, 2017

Applicant: ARRIS GROUP INC

Product: Single tuner HD set-top box.

Model: DCX860/R4CC/9322

FCC ID: ACQ-DCX860 IC Registration number: 109AS-DCX860

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 1, May 2015

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

Test location

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Province	California
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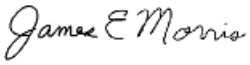
Website	www.nemko.com
Site number	FCC: US5058; IC: 2040B

Tested by	Feng You, Sr. Wireless Engineer
Reviewed by	James Morris
Review date	February 13, 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 **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 5

2.3 IC RSS-GEN, Issue 4, test results 5

2.4 IC RSS-247, Issue 1, test results 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 8

3.5 EUT exercise details 8

3.6 EUT setup diagram 8

3.7 EUT sub assemblies 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. Test Data **13**

8.1 FCC 15.247(a) (2) and RSS-247 5.2(1) Minimum 6 dB bandwidth 13

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(e) and RSS-247 5.2(2) Power Spectrum Density 31

8.5 FCC 15.207(a) AC power line conducted emissions limits 34

Section 9. Block diagrams of test set-ups **39**

9.1 Radiated emissions set-up – Below 1GHz 39

9.2 Radiated emissions set-up – Above 1GHz 40

9.3 Conducted emissions set-up 40

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	ARRIS GROUP INC
Address	6450 Sequence Drive
City	San Diego
Province/State	CA
Postal/Zip code	92121
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 1	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	Report updated according to review.
3	Report updated according to review.

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	Pass[1]
§15.205	Restricted bands of operation	Pass

Notes: [1] The EUT uses trace antennas on PCB.

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	Not applicable
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
§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	Pass
§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	Not applicable
§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	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 for digitally modulated devices	Pass
§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 1, test results

Part	Test description	Verdict
5.1	Frequency hopping systems (FHSs)	
5.1 (1)	Bandwidth of a frequency hopping channel	Not applicable
5.1 (2)	Minimum channel spacing for frequency hopping systems	Not applicable
5.1 (3)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
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	Pass
5.2 (2)	Maximum power spectral density	Pass
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	Not applicable
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	Pass
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

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	November 29, 2016
Nemko sample ID number	319000-1, -2

3.2 EUT information

Product name	Single tuner HD set-top box
Model	DCX860/R4CC/9322
Model variant	N/A
Serial number	DE60AC13713C579
FCC ID	ACQ-DCX860
IC Registration Number	109AS-DCX860

3.3 Technical information

Applicant IC company number	109AS
IC UPN number	DCX860
All used IC test site(s) Reg. number	2040B
RSS number and Issue number	RSS-247, Issue 1, May 2015
Frequency band	2400-2483.5 MHz
Frequency Min (MHz)	2405
Frequency Max (MHz)	2475
RF power Min (W), Conducted/ERP/EIRP	N/A
RF power Max (W), Conducted/ERP/EIRP	0.0016 (Conducted)
Field strength, Units @ distance	N/A
Measured BW (kHz) (6 dB)	1392
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	OQPSK
Emission classification (F1D, G1D, D1D)	W7D
Transmitter spurious, Units @ distance	61.72 dBµV/m @ 3m Peak / 46.05 dBµV/m @ 3m AVG
Power requirements	External 12V DC Power Supply, AC power 100-120V 50-60Hz
Antenna information	2 trace antennas on PCB. The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

EUT is a single tuner HD set-top box. It can be used as a standalone HD set-top box as well as an IP client box. The radio interface is RF4CE (2.4GHz DSSS).

There are 2 identical antennas on PCB. Both can used at the same time for receiver diversity, but only one can transmit at a time.

3.5 EUT exercise details

A test software was used that allows the change of different RF modes/channels. EUT is set to fixed channel test mode with modulation. Both antenna paths are tested separately, worst case was selected for most Radiated test.

RF conducted test was performed on unit with temporary RF output modification (50Ω SMA before antennas).
TX Power Level = 0.

3.6 EUT setup diagram

Setup Photo in separate exhibit for confidentiality reason

Figure 3.6-1: *Radiated Emissions Test Setup – below 1GHz*

Setup Photo in separate exhibit for confidentiality reason

Figure 3.6-2: *Radiated Emissions Test Setup – above 1GHz*

Setup Photo in separate exhibit for confidentiality reason

Figure 3.6-3: *AC Powerline Conducted Emissions Setup*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
EUT – Radiated Unit	Arris	DCX860/R4CC/9322	DE60AC13713C579
EUT – RF Conducted Unit	Arris	DCX860/R4CC/9322	N012324A
AC Power Supply	ADP	WA-12M12FU	Y16310133017
AC Power Supply	NetBit	NBS12E120100VU	N/A
Control Cable – USB to Serial	Arris	N/A	N/A

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 ±5 %, for which the equipment was designed.
120VAC 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 #	Next Cal
529	Antenna, DRWG	EMCO	3115	2505	01-Feb-2017
815	Multimeter	Fluke	111	78130066	02-Feb-2017
E1019	Two Line V-Network	Rohde & Schwarz	ENV216	101045	15-Jun-2017
E1035	Variac (Variable Transformer) 3KVA	Shanghai China	TDGC	N/A	VOU
1480	Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	21-Jul-2017
E1120	Signal and Spectrum Analyzer	Rohde & Schwarz	FSV40	101395	25-May-2017
E1121	EMI Test Receiver	Rohde & Schwarz	ESU 40	100064	28-Apr-2017
E1026	EMI Test Receiver 9kHz to 7GHz	Rohde & Schwarz	ESCI 7	100800	17-Mar-2017

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

Section 8. Test Data

8.1 FCC 15.247(a) (2) and RSS-247 5.2(1) Minimum 6 dB bandwidth

8.1.1 Definitions and limits

FCC 15.247:

(a) (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.

IC RSS-247

5.2 (1) The minimum 6 dB bandwidth shall be 500 kHz.

8.1.2 Test summary

Test date	November 30, 2016	Temperature	20 °C
Test engineer	Feng You	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	36 %

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	≥3 × RBW
Frequency span	1.5 MHz
Detector mode	Peak
Trace mode	Max Hold

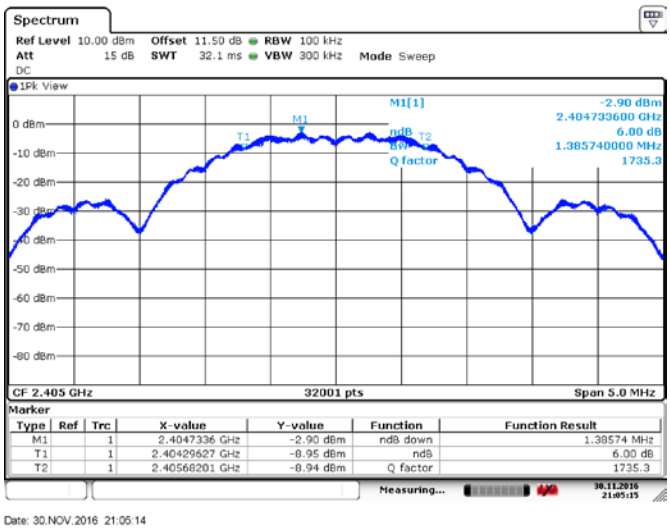
8.1.4 Test data

Table 8.1-1: *6 dB bandwidth results – Antenna 0*

Modulation	Frequency, MHz	6dB bandwidth, kHz	Limit, kHz	Margin, kHz
OQPSK	2405	1386	500	886
	2440	1382	500	882
	2475	1358	500	858

Table 8.1-2: *6 dB bandwidth results – Antenna 1*

Modulation	Frequency, MHz	6dB bandwidth, kHz	Limit, kHz	Margin, kHz
OQPSK	2405	1369	500	869
	2440	1392	500	892
	2475	1329	500	829



Date: 30.NOV.2016 21:05:14

Figure 8.1-1: *6 dB bandwidth, Low CH, Ant 0*

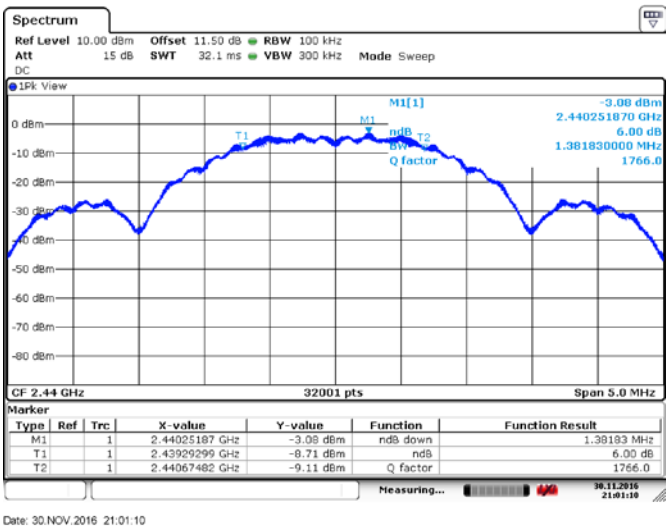


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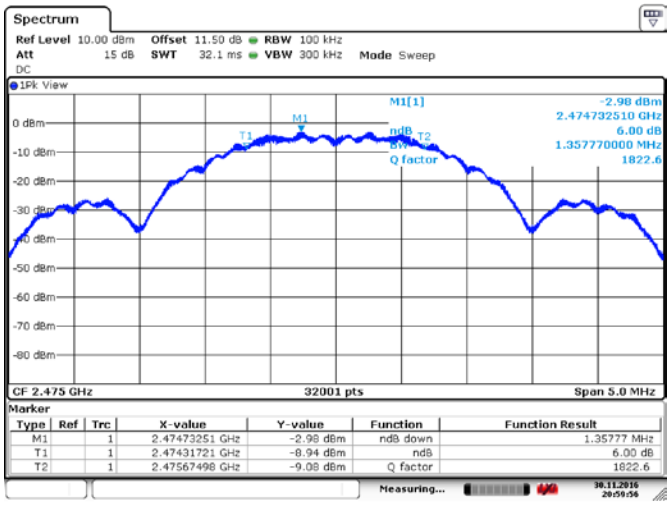
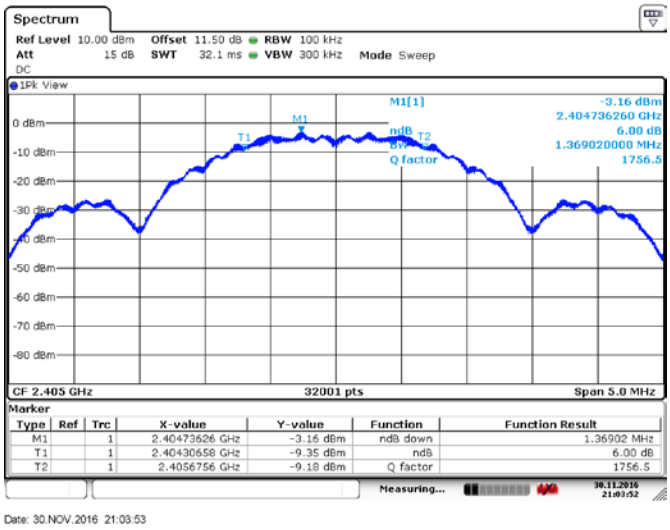
Figure 8.1-2: *6 dB bandwidth, Mid CH, Ant 0*



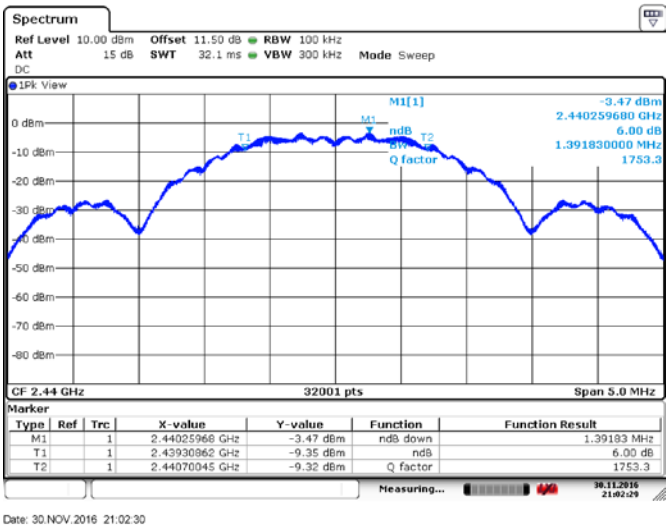
Date: 30.NOV.2016 20:59:56

Figure 8.1-3: *6 dB bandwidth, High CH, Ant 0*



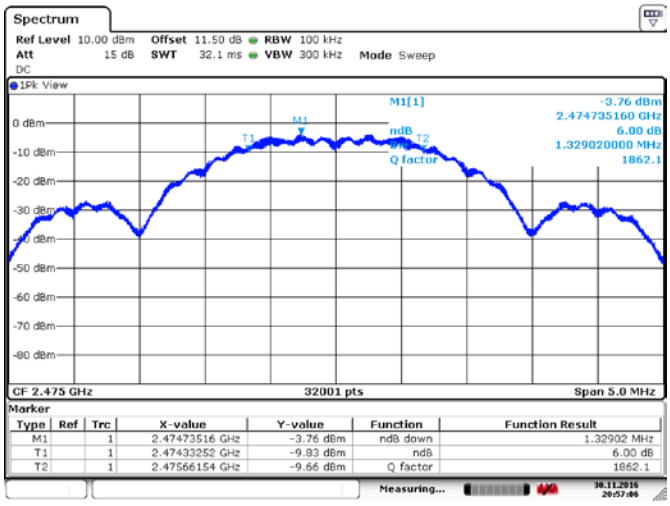
Date: 30.NOV.2016 21:03:53

Figure 8.1-4: *6 dB bandwidth, Low CH, Ant 1*



Date: 30.NOV.2016 21:02:30

Figure 8.1-5: *6 dB bandwidth, Mid CH, Ant 1*



Date: 30.NOV.2016 20:57:06

Figure 8.1-6: *6 dB bandwidth, High CH, Ant 1*

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:

(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.

(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

(4) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. Except as provided in Section 5.4(5), the e.i.r.p. shall not exceed 4 W.

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	November 30, 2016	Temperature	20 °C
Test engineer	Feng You	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	36 %

8.2.3 Observations, settings and special notes

Peak Conducted Power Measured
Spectrum analyser settings:

Resolution bandwidth	≥ Channel BW (3MHz)
Video bandwidth	≥ 3 × RBW (10MHz)
Frequency span	≥ 3 x RBW (10MHz)
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: *Output power measurements results – ant 0*

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	2405	2.05	30	27.95	3	5.05	36	30.95
	2440	1.9	30	28.1	3	4.9	36	31.1
	2475	1.93	30	28.07	3	4.93	36	31.07
85V AC	2405	2.03	30	27.97	3	5.03	36	30.97
	2440	1.9	30	28.1	3	4.9	36	31.1
	2475	1.92	30	28.08	3	4.92	36	31.08
138V AC	2405	2.04	30	27.96	3	5.04	36	30.96
	2440	1.9	30	28.1	3	4.9	36	31.1
	2475	1.93	30	28.07	3	4.93	36	31.07

Table 8.2-2: *Output power measurements results – ant 1*

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	2405	1.7	30	28.3	3	4.7	36	31.3
	2440	1.45	30	28.55	3	4.45	36	31.55
	2475	1.08	30	28.92	3	4.08	36	31.92
85V AC	2405	1.7	30	28.3	3	4.7	36	31.3
	2440	1.46	30	28.54	3	4.46	36	31.54
	2475	1.08	30	28.92	3	4.08	36	31.92
138V AC	2405	1.73	30	28.27	3	4.73	36	31.27
	2440	1.46	30	28.54	3	4.46	36	31.54
	2475	1.08	30	28.92	3	4.08	36	31.92

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 of Table 8.4-1 except for apparatus complying under RSS-287;
(b) Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
(c) Unwanted emissions that do not fall within the restricted frequency bands of Table 8.4-1 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	January 4, 2017	Temperature	20 °C
Test engineer	Feng You	Air pressure	1007 mbar
Verdict	Pass	Relative humidity	48 %

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.
Antenna 0 path was selected for most radiated test cases as worst case.

Spectrum analyser settings for conducted spurious emissions measurements:

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

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:	3 MHz
Detector mode:	AVG
Trace mode:	Max Hold

8.3.4 Test data

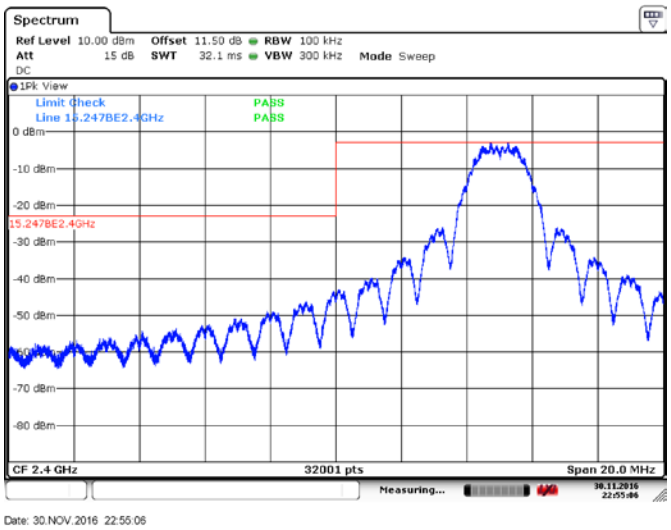


Figure 8.3.1: *Bandedge Measurement, low channel, ant 0*

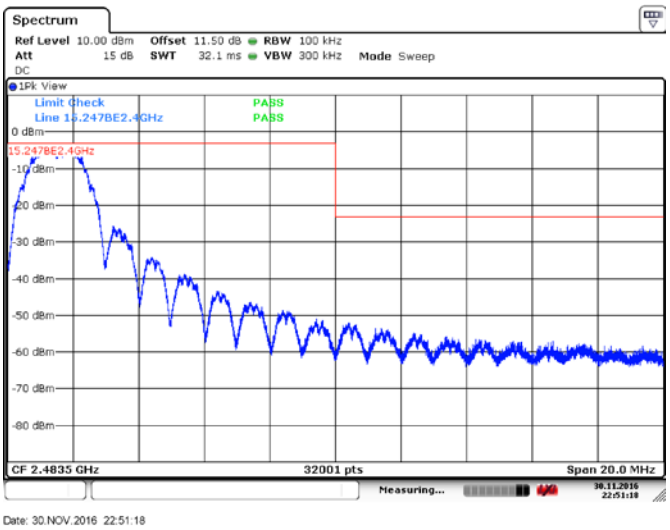


Figure 8.3.2: *Bandedge Measurement, high channel, ant 0*

Table 8.3-4: *Reference PSD in 100kHz, ant 0*

Modulation	Frequency, MHz	PSD dBm/100kHz
OQPSK	2405	-2.94
	2440	-3.09
	2475	-3.21

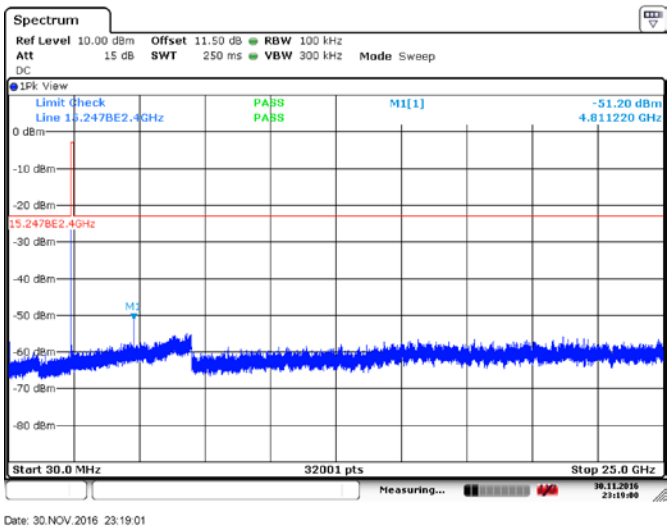


Figure 8.3.3: *Conducted spurious emissions, low channel, ant 0*

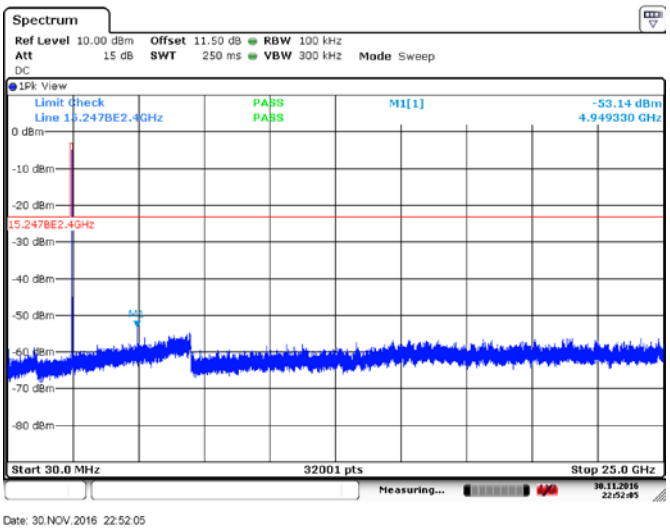


Figure 8.3.4: *Conducted spurious emissions, high channel, ant 0*

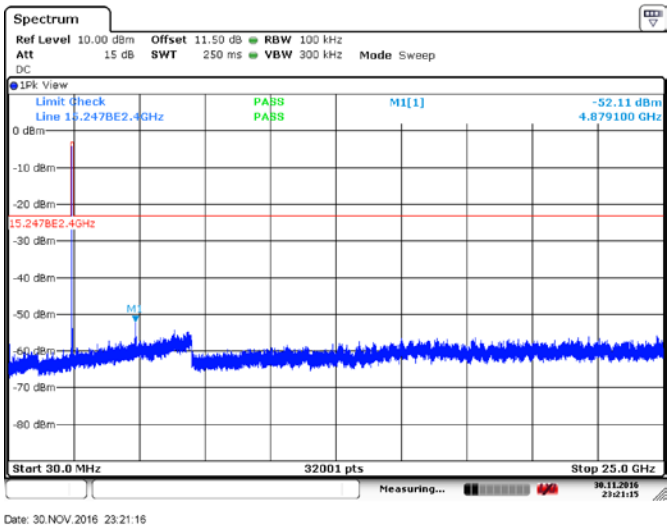


Figure 8.3.5: *Conducted spurious emissions, mid channel, ant 0*

Peaks within 2400-2483.5MHz are transmitter fundamentals.

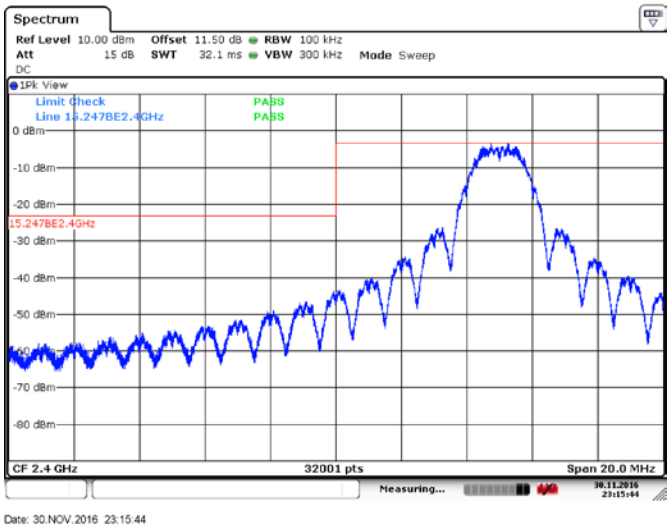


Figure 8.3.6: *Bandedge Measurement, low channel, ant 1*

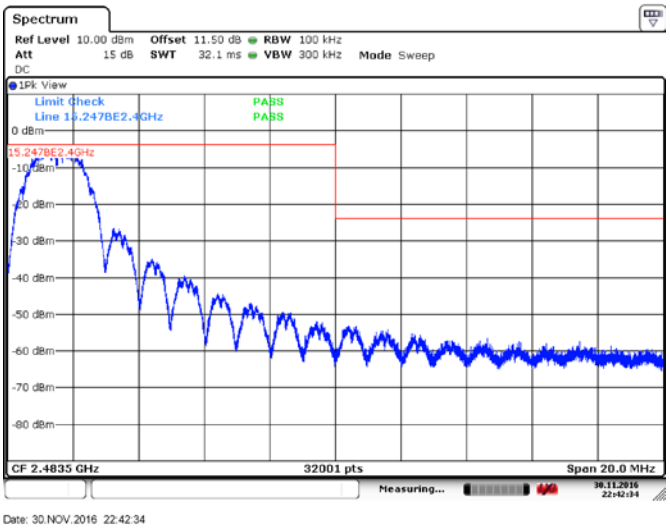


Figure 8.3.7: *Bandedge Measurement, high channel, ant 1*

Table 8.3-5: *Reference PSD in 100kHz, ant 1*

Modulation	Frequency, MHz	PSD dBm/100kHz
OQPSK	2405	-3.23
	2440	-3.52
	2475	-3.84

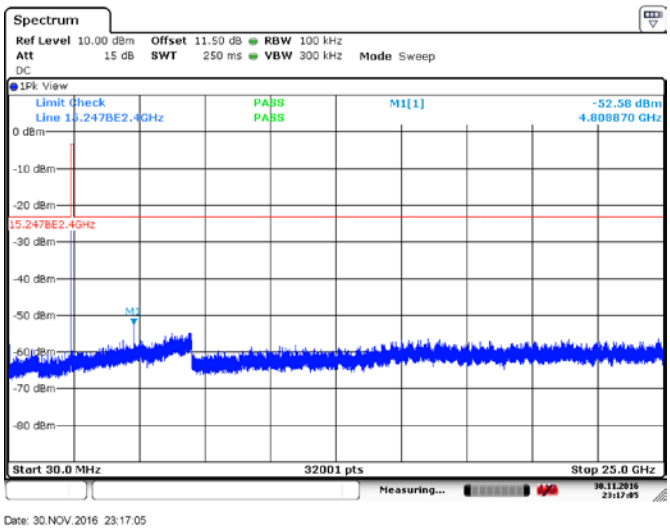


Figure 8.3.8: *Conducted spurious emissions, low channel, ant 1*

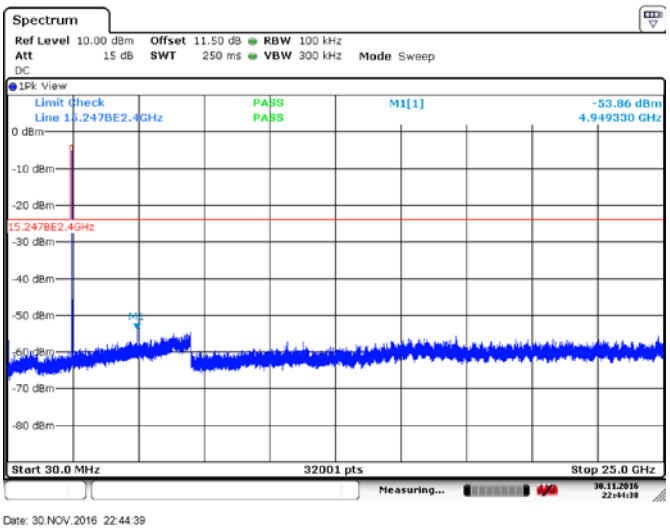


Figure 8.3.9: *Conducted spurious emissions, high channel, ant 1*

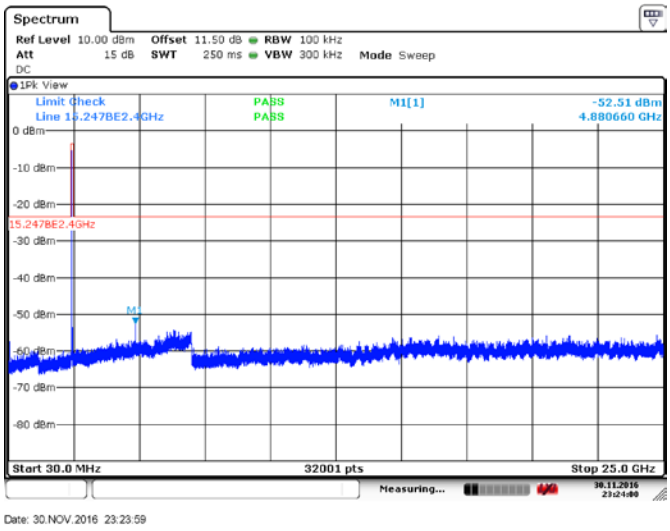


Figure 8.3.10: *Conducted spurious emissions, mid channel, ant 1*

Peaks within 2400-2483.5MHz are transmitter fundamentals.

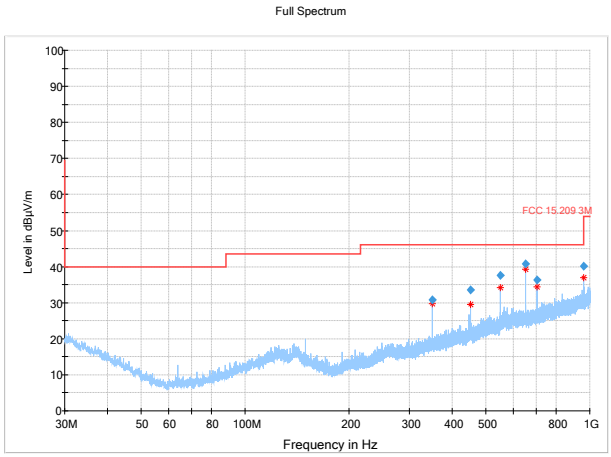


Figure 8.3.11: *Radiated spurious emissions, low channel, 30-1000MHz, ant 0*

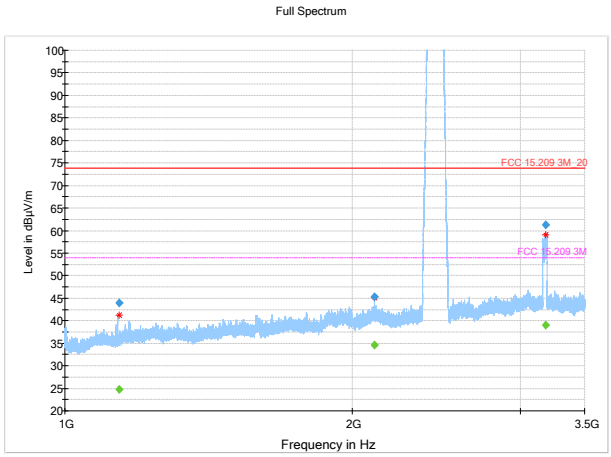


Figure 8.3.12: *Radiated spurious emissions, low channel, 1-3.5GHz, ant 0*

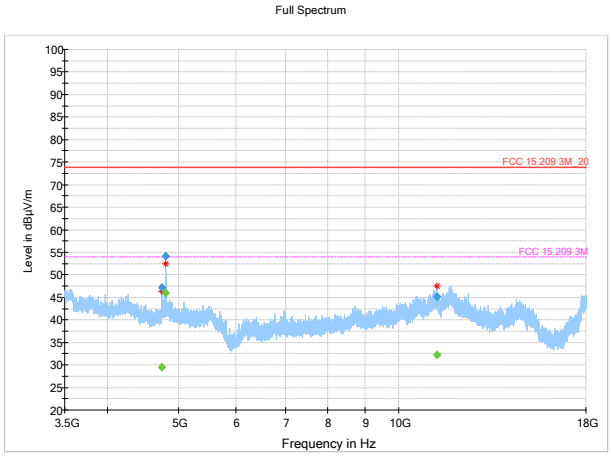


Figure 8.3.13: *Radiated spurious emissions, low channel, 3.5-18GHz, ant 0*

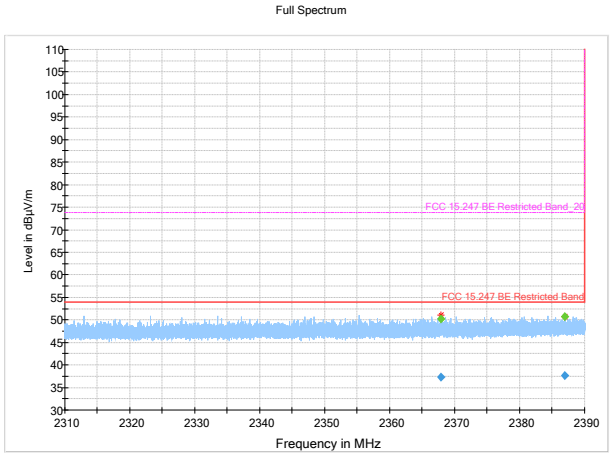


Figure 8.3.14: *Radiated Bandedge in Restricted Band, low channel, ant 0*

Table 8.3-6: *Radiated field strength measurement results for low channel 2405MHz, ant 0*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
350.023000	30.75	46.00	15.25	1000.0	120.000	130.2	H	174.0
449.990000	33.62	46.00	12.38	1000.0	120.000	189.0	H	177.0
549.997000	37.65	46.00	8.35	1000.0	120.000	110.6	V	302.0
650.004000	40.75	46.00	5.25	1000.0	120.000	110.9	V	283.0
702.772000	36.32	46.00	9.68	1000.0	120.000	127.2	V	349.0
958.318500	40.17	46.00	5.83	1000.0	120.000	206.0	H	315.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1139.6500	---	24.75	53.90	29.15	1000.0	1000.000	122.8	H	28.0
1139.6500	43.96	---	73.90	29.94	1000.0	1000.000	122.8	H	28.0
2108.4500	---	34.59	53.90	19.31	1000.0	1000.000	131.4	V	0.0
2108.4500	45.24	---	73.90	28.66	1000.0	1000.000	131.4	V	0.0
3187.3166	---	39.00	53.90	14.90	1000.0	1000.000	119.0	V	270.0
3187.3166	61.19	---	73.90	12.71	1000.0	1000.000	119.0	V	270.0
4747.5166	47.21	---	73.90	26.69	1000.0	1000.000	116.7	H	270.0
4747.5166	---	29.52	53.90	24.38	1000.0	1000.000	116.7	H	270.0
4811.0000	54.13	---	73.90	19.77	1000.0	1000.000	142.0	H	296.0
4811.0000	---	46.05	53.90	7.85	1000.0	1000.000	142.0	H	296.0
11277.000	---	32.20	53.90	21.70	1000.0	1000.000	290.7	H	289.0
11277.000	45.14	---	73.90	28.76	1000.0	1000.000	290.7	H	289.0
2367.8320	50.14	---	73.90	23.76	1000.0	1000.000	113.0	V	34.0
2367.8320	---	37.37	53.90	16.53	1000.0	1000.000	113.0	V	34.0
2386.9680	50.79	---	73.90	23.11	1000.0	1000.000	233.0	V	65.0
2386.9680	---	37.61	53.90	16.29	1000.0	1000.000	233.0	V	65.0

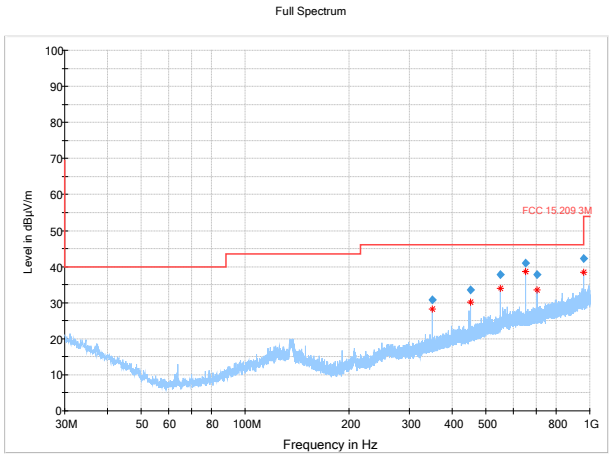


Figure 8.3.15: *Radiated spurious emissions, mid channel, 30-1000MHz, ant 0*

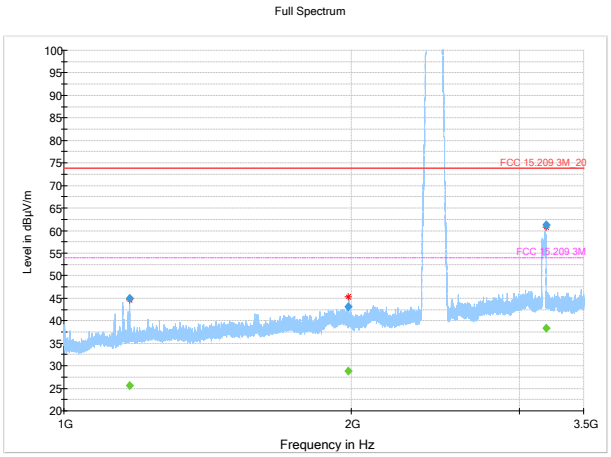


Figure 8.3.16: *Radiated spurious emissions, mid channel, 1-3.5GHz, ant 0*

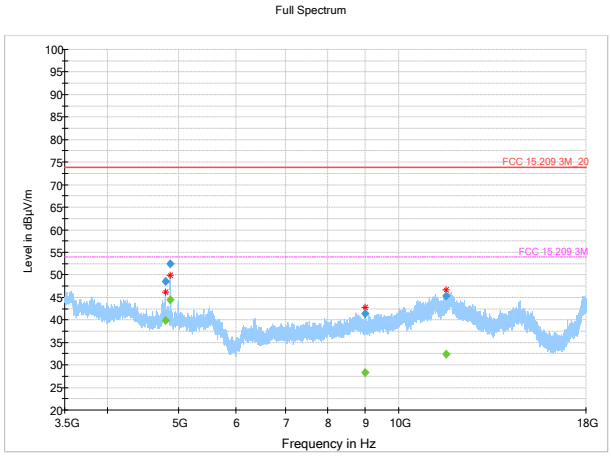


Figure 8.3.17: *Radiated spurious emissions, mid channel, 3.5-18GHz, ant 0*

Table 8.3-7: *Radiated field strength measurement results for mid channel 2440 MHz, ant 0*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
349.983000	30.87	46.00	15.13	1000.0	120.000	103.9	H	140.0
449.990000	33.50	46.00	12.50	1000.0	120.000	206.5	H	178.0
549.997000	37.72	46.00	8.28	1000.0	120.000	163.5	H	0.0
650.004000	41.05	46.00	4.95	1000.0	120.000	102.4	V	271.0
702.772000	37.75	46.00	8.25	1000.0	120.000	101.0	V	329.0
958.327000	42.15	46.00	3.85	1000.0	120.000	126.4	H	323.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1170.6500	45.00	---	73.90	28.90	1000.0	1000.000	152.7	H	0.0
1170.6500	---	25.61	53.90	28.29	1000.0	1000.000	152.7	H	0.0
1984.1333	43.02	---	73.90	30.88	1000.0	1000.000	236.7	H	212.0
1984.1333	---	28.82	53.90	25.08	1000.0	1000.000	236.7	H	212.0
3196.1666	---	38.42	53.90	15.48	1000.0	1000.000	120.1	V	273.0
3196.1666	61.35	---	73.90	12.55	1000.0	1000.000	120.1	V	273.0
4799.8833	---	39.92	53.90	13.98	1000.0	1000.000	137.9	H	80.0
4799.8833	48.46	---	73.90	25.44	1000.0	1000.000	137.9	H	80.0
4879.0000	---	44.43	53.90	9.47	1000.0	1000.000	157.0	H	294.0
4879.0000	52.52	---	73.90	21.38	1000.0	1000.000	157.0	H	294.0
8995.3500	---	28.33	53.90	25.57	1000.0	1000.000	344.9	V	206.0
8995.3500	41.35	---	73.90	32.55	1000.0	1000.000	344.9	V	206.0
11601.083	---	32.35	53.90	21.55	1000.0	1000.000	346.8	V	153.0
11601.083	45.23	---	73.90	28.67	1000.0	1000.000	346.8	V	153.0

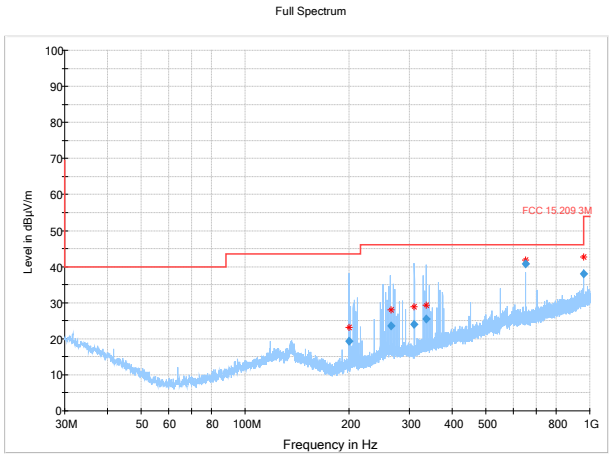


Figure 8.3.18: *Radiated spurious emissions, high channel, 30-1000MHz, ant 0*

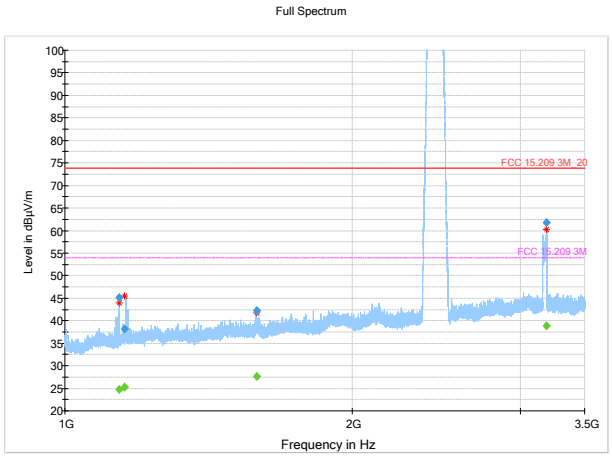


Figure 8.3.19: *Radiated spurious emissions, high channel, 1-3.5GHz, ant 0*

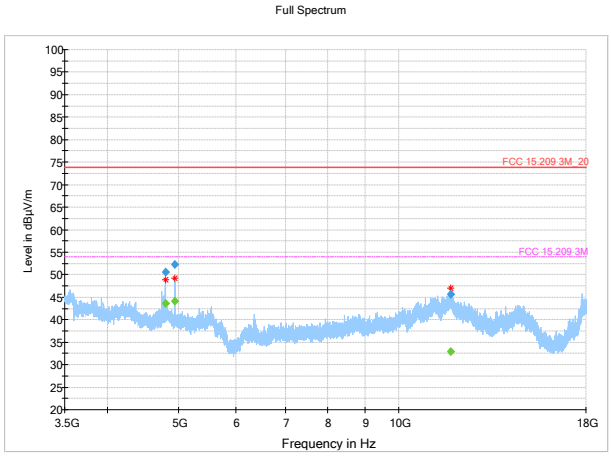


Figure 8.3.20: *Radiated spurious emissions, high channel, 3.5-18GHz, ant 0*

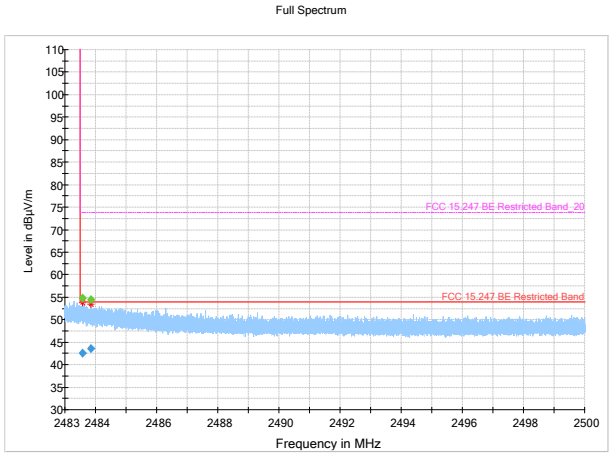


Figure 8.3.21: *Radiated Bandedge in Restricted Band, high channel, ant 0*

Table 8.3-8: *Radiated field strength measurement results for high channel 2475MHz, ant 0*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
200.432500	19.28	43.50	24.22	1000.0	120.000	292.8	V	171.0
264.615000	23.65	46.00	22.35	1000.0	120.000	326.9	V	148.0
309.293500	24.07	46.00	21.93	1000.0	120.000	257.2	V	63.0
336.030000	25.41	46.00	20.59	1000.0	120.000	128.4	V	172.0
649.984000	40.68	46.00	5.32	1000.0	120.000	100.0	V	269.0
958.107000	38.08	46.00	7.92	1000.0	120.000	277.5	H	204.0

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1140.3666	---	24.68	53.90	29.22	1000.0	1000.000	113.1	H	287.0
1140.3666	45.09	---	73.90	28.81	1000.0	1000.000	113.1	H	287.0
1154.8500	---	25.19	53.90	28.71	1000.0	1000.000	123.2	H	292.0
1154.8500	38.20	---	73.90	35.70	1000.0	1000.000	123.2	H	292.0
1587.2500	42.33	---	73.90	31.57	1000.0	1000.000	330.3	V	304.0
1587.2500	---	27.61	53.90	26.29	1000.0	1000.000	330.3	V	304.0
3193.6666	61.72	---	73.90	12.18	1000.0	1000.000	122.0	V	272.0
3193.6666	---	38.88	53.90	15.02	1000.0	1000.000	122.0	V	272.0
4799.8833	50.57	---	73.90	23.33	1000.0	1000.000	173.5	V	0.0
4799.8833	---	43.53	53.90	10.37	1000.0	1000.000	173.5	V	0.0
4949.1666	52.30	---	73.90	21.60	1000.0	1000.000	133.9	V	57.0
4949.1666	---	44.18	53.90	9.72	1000.0	1000.000	133.9	V	57.0
11765.900	---	32.86	53.90	21.04	1000.0	1000.000	160.2	H	128.0
11765.900	45.68	---	73.90	28.22	1000.0	1000.000	160.2	H	128.0
2483.5825	54.75	---	73.90	19.15	1000.0	1000.000	131.9	H	14.0
2483.5825	---	42.61	53.90	11.29	1000.0	1000.000	131.9	H	14.0
2483.8590	54.53	---	73.90	19.37	1000.0	1000.000	145.0	H	33.0
2483.8590	---	43.65	53.90	10.25	1000.0	1000.000	145.0	H	33.0

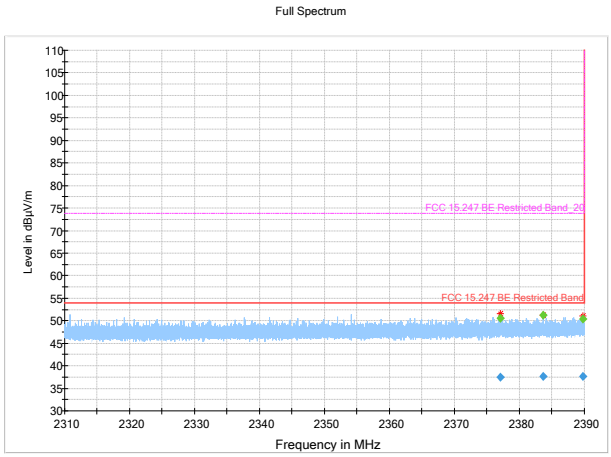


Figure 8.3.22: *Radiated Bandedge in Restricted Band, low channel, ant 1*

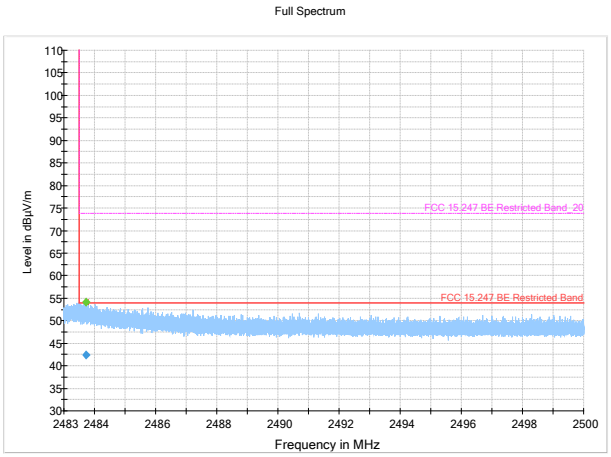


Figure 8.3.23: *Radiated Bandedge in Restricted Band, high channel, ant 1*

Table 8.3-9: *Radiated field strength measurement results for low channel 2405MHz, ant 1*

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2377.0533	37.50	---	53.90	16.40	1000.0	1000.000	139.0	V	116.0
2377.0533	---	50.55	73.90	23.35	1000.0	1000.000	139.0	V	116.0
2383.6213	37.72	---	53.90	16.18	1000.0	1000.000	176.4	H	42.0
2383.6213	---	51.23	73.90	22.67	1000.0	1000.000	176.4	H	42.0
2389.8080	---	50.34	73.90	23.56	1000.0	1000.000	132.1	V	298.0
2389.8080	37.69	---	53.90	16.21	1000.0	1000.000	132.1	V	298.0

Table 8.3-10: *Radiated field strength measurement results for high channel 2475MHz, ant 1*

Frequency (MHz)	Average (dBµV/m)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2483.7253	---	54.16	73.90	19.74	1000.0	1000.000	178.3	H	60.0
2483.7253	42.38	---	53.90	11.52	1000.0	1000.000	178.3	H	60.0

8.4 FCC 15.247(e) and RSS-247 5.2(2) Power Spectrum Density

8.4.1 Definitions and limits

FCC and IC:
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.

8.4.2 Test summary

Test date	November 30, 2016	Temperature	20 °C
Test engineer	Feng You	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	36 %

8.4.3 Observations, settings and special notes

3kHz RBW

8.4.4 Test data

Table 8.4-1: *Power Spectrum Density*

Antenna	Frequency, MHz	Conducted PSD@3kHz, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured	Limit					
0	2405	-14.56	8	22.56	3	-11.56	14	25.56
	2440	-15.04	8	23.04	3	-12.04	14	26.04
	2475	-14.54	8	22.54	3	-11.54	14	25.54

Antenna	Frequency, MHz	Conducted PSD@3kHz, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured	Limit					
1	2405	-15.2	8	23.2	3	-12.2	14	26.2
	2440	-14.98	8	22.98	3	-11.98	14	25.98
	2475	-15.52	8	23.52	3	-12.52	14	26.52

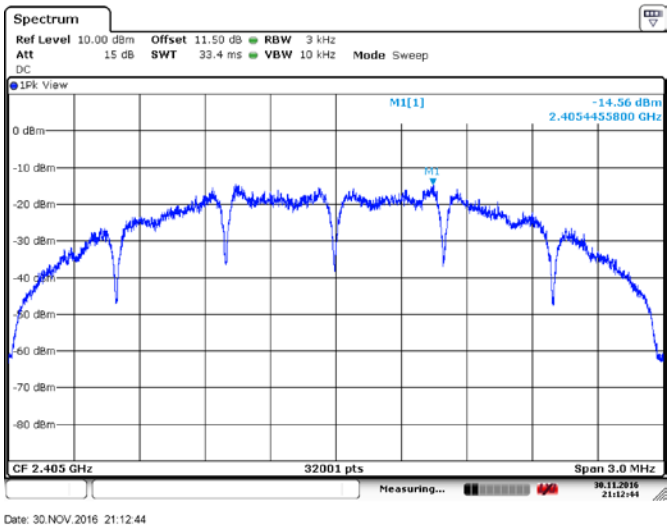


Figure 8.4-1: *PSD, Low CH, ant 0*

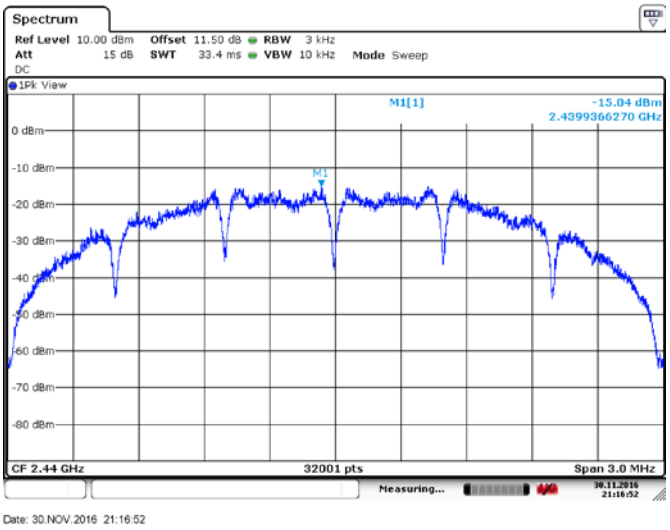


Figure 8.4-2: *PSD, Mid CH, ant 0*

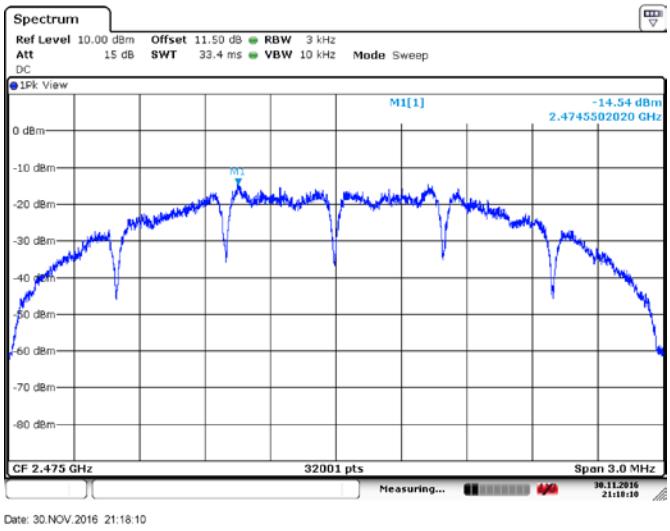


Figure 8.4-3: *PSD, High CH, ant 0*

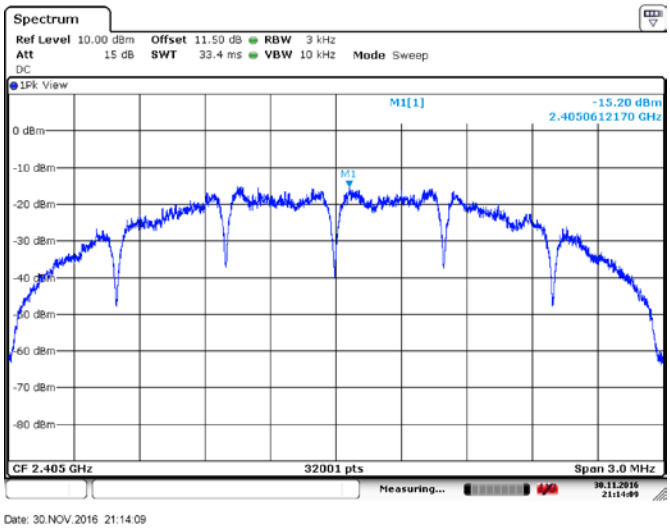


Figure 8.4-4: *PSD, Low CH, ant 1*

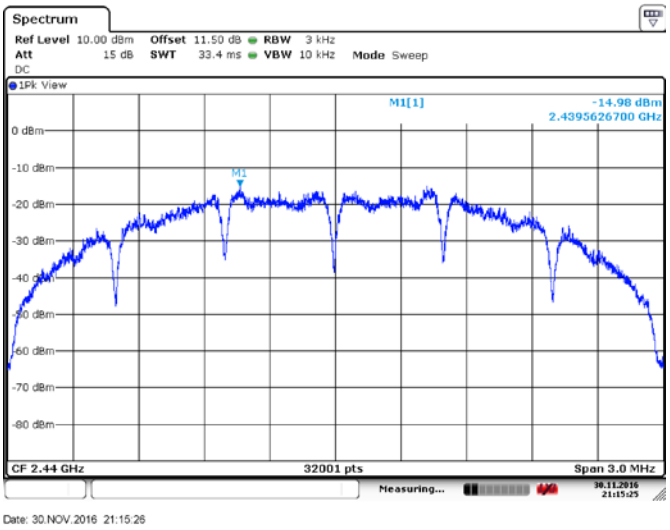


Figure 8.4-5: *PSD, Mid CH, ant 1*

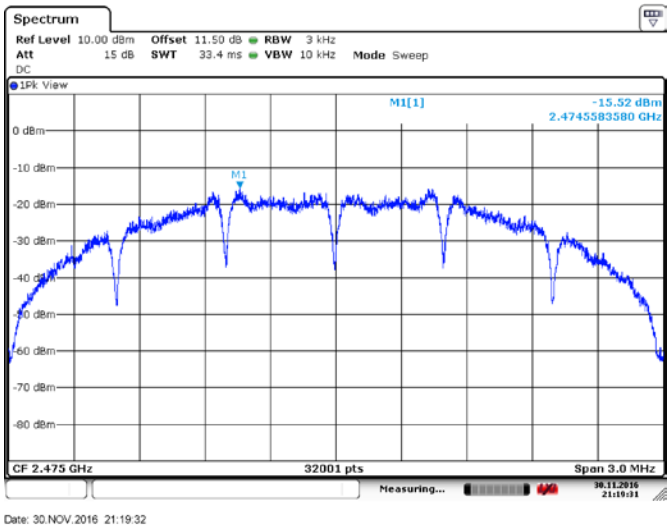


Figure 8.4-6: *PSD, High CH, ant 1*

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

8.5.1 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 µH/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 µH line impedance stabilization network (LISN).

Table 8.6-1: *Conducted emissions limit*

Frequency of emission (MHz)	Conducted limit (dBµV)	
	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.

8.5.2 Test summary

Test date	November 30, 2016	Temperature	20 °C
Test engineer	Feng You	Air pressure	1004 mbar
Verdict	Pass	Relative humidity	36 %

8.5.3 Observations, settings and special notes

This is tested with Low CH TX on.

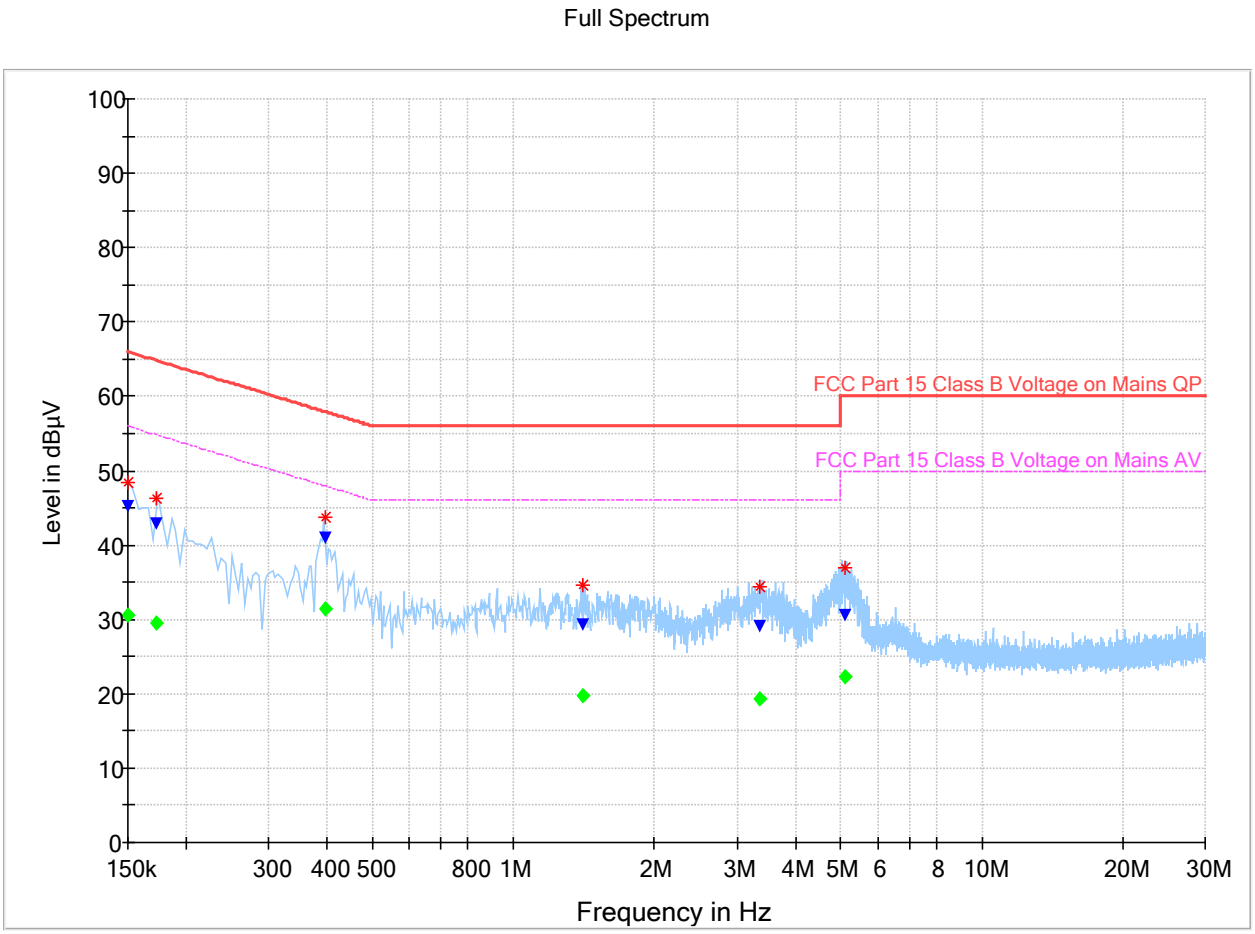
The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance.

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

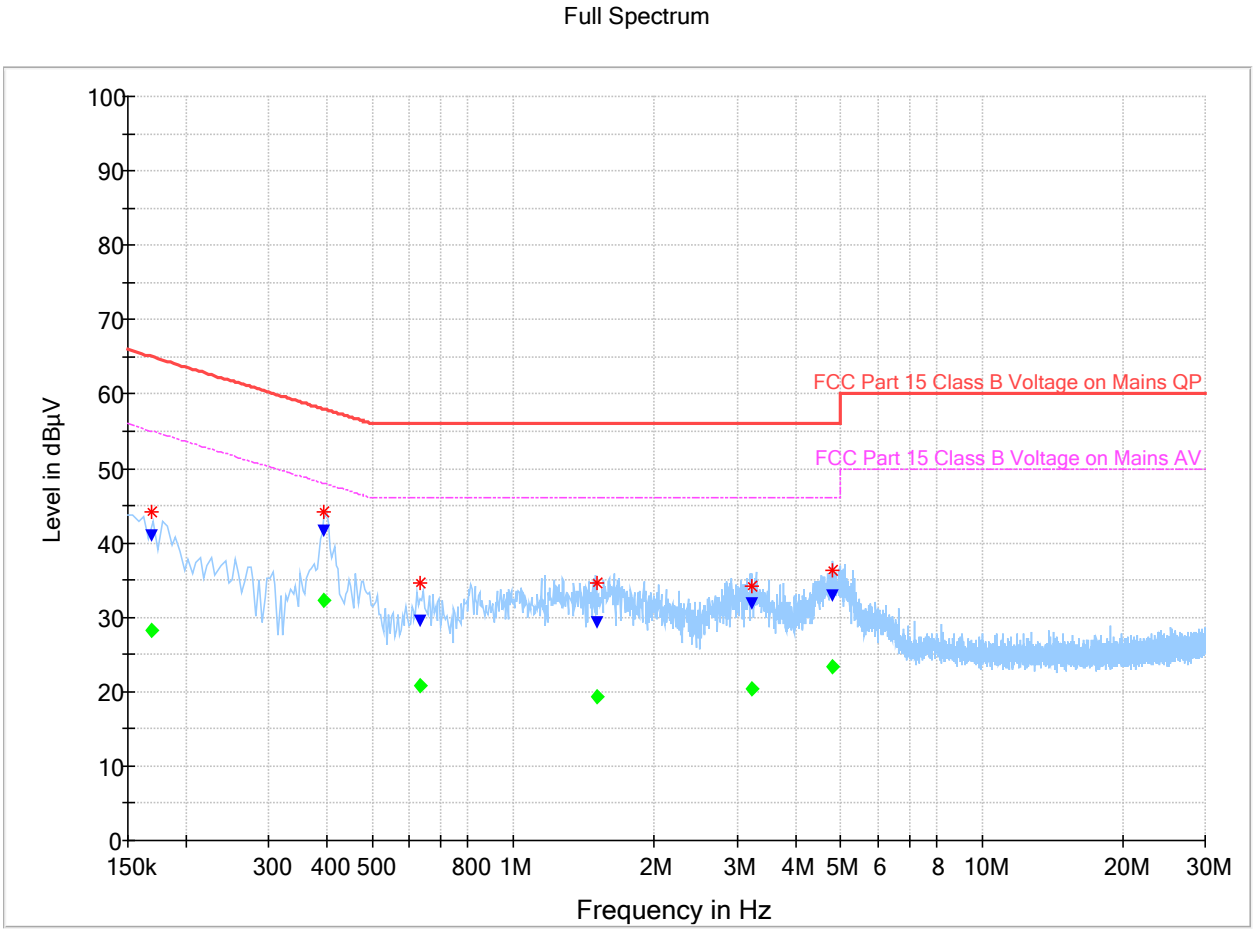
8.5.4 Test data



Plot 8.6-1: *Conducted emissions, ant 0, ADP Supply*

Table 8.6-2: *Quasi-Peak and Average conducted emissions results, ant 0, ADP Supply*

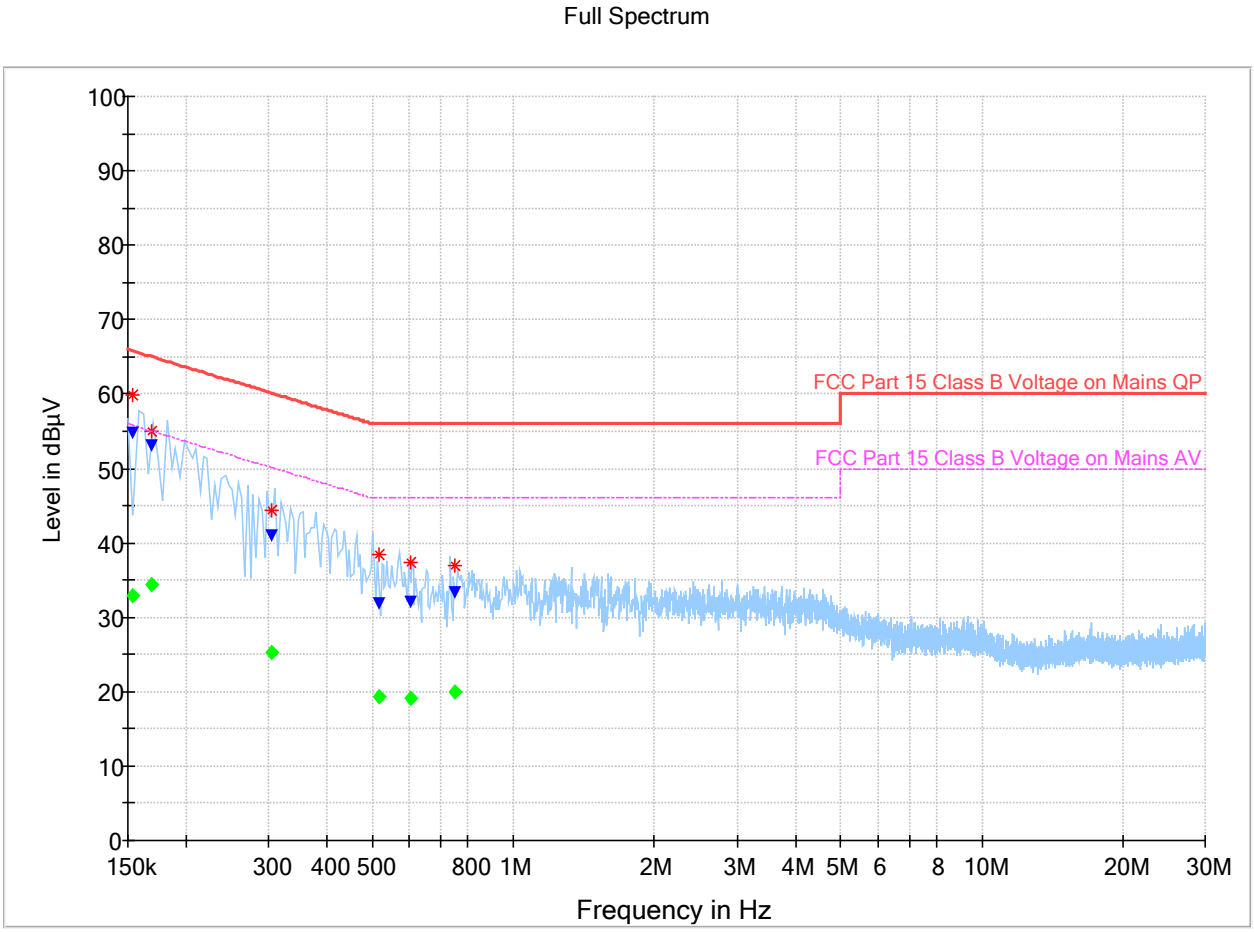
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
0.150000	---	30.48	56.00	25.52	5000.0	9.000	L1	ON
0.150000	45.25	---	66.00	20.75	5000.0	9.000	L1	ON
0.172500	---	29.45	54.84	25.39	5000.0	9.000	L1	ON
0.172500	42.84	---	64.84	22.00	5000.0	9.000	L1	ON
0.396500	---	31.46	47.93	16.47	5000.0	9.000	L1	ON
0.396500	40.95	---	57.93	16.97	5000.0	9.000	L1	ON
1.400500	---	19.85	46.00	26.15	5000.0	9.000	L1	ON
1.400500	29.25	---	56.00	26.75	5000.0	9.000	L1	ON
3.360500	---	19.35	46.00	26.65	5000.0	9.000	L1	ON
3.360500	29.09	---	56.00	26.91	5000.0	9.000	L1	ON
5.116500	---	22.33	50.00	27.67	5000.0	9.000	L1	ON
5.116500	30.60	---	60.00	29.40	5000.0	9.000	L1	ON



Plot 8.5-2: *Conducted emissions, ant 1, ADP Supply*

Table 8.5-3: *Quasi-Peak and Average conducted emissions results, ant 1, ADP Supply*

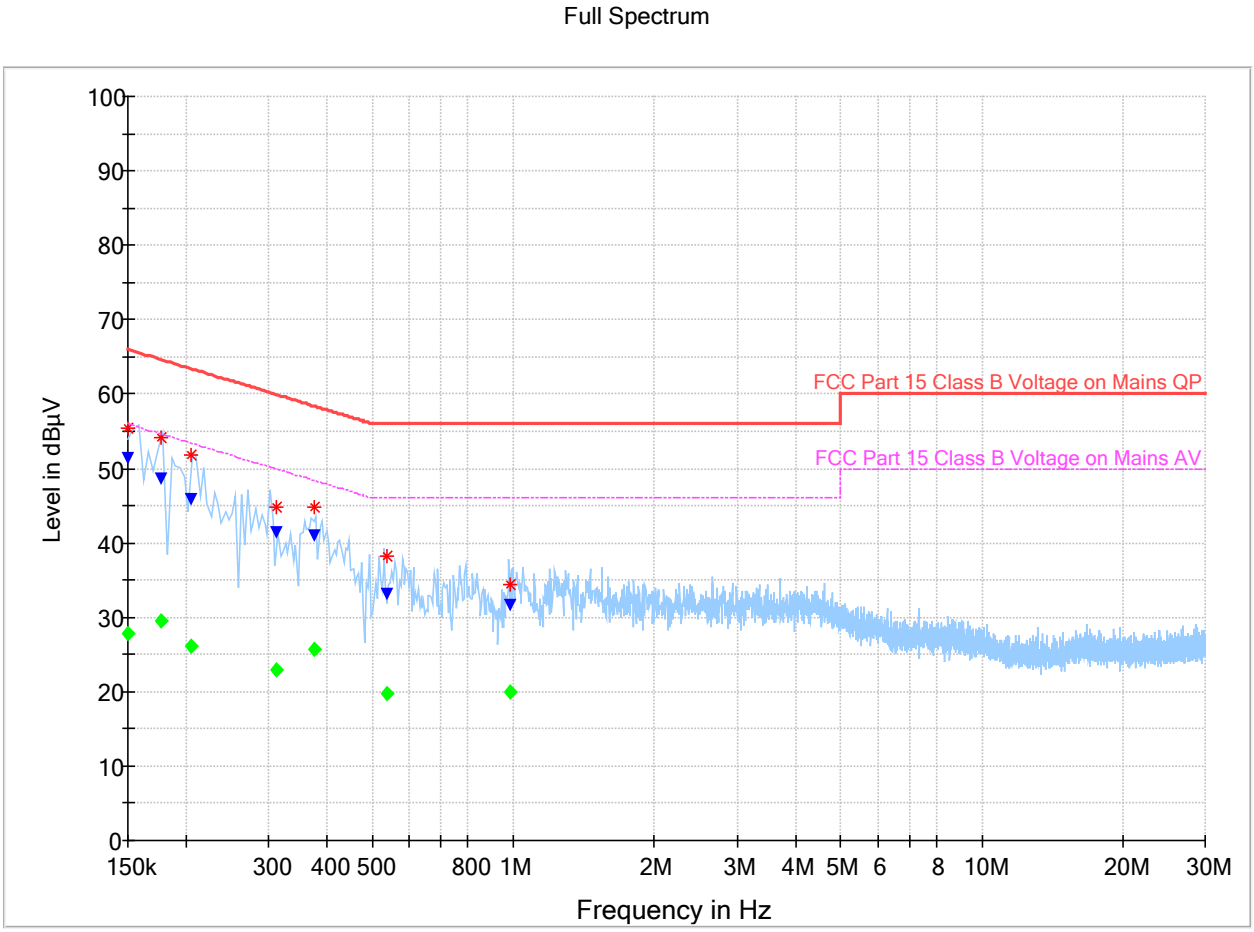
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
0.168500	---	28.19	55.03	26.85	5000.0	9.000	L1	ON
0.168500	40.99	---	65.03	24.04	5000.0	9.000	L1	ON
0.392500	---	32.33	48.01	15.68	5000.0	9.000	L1	ON
0.392500	41.70	---	58.01	16.31	5000.0	9.000	L1	ON
0.632500	---	20.77	46.00	25.23	5000.0	9.000	L1	ON
0.632500	29.49	---	56.00	26.51	5000.0	9.000	L1	ON
1.511500	---	19.25	46.00	26.75	5000.0	9.000	L1	ON
1.511500	29.20	---	56.00	26.80	5000.0	9.000	L1	ON
3.216500	---	20.29	46.00	25.71	5000.0	9.000	L1	ON
3.216500	31.87	---	56.00	24.13	5000.0	9.000	L1	ON
4.804500	---	23.32	46.00	22.68	5000.0	9.000	L1	ON
4.804500	32.98	---	56.00	23.02	5000.0	9.000	L1	ON



Plot 8.5-3: *Conducted emissions, ant 0, NetBit Supply*

Table 8.5-4: *Quasi-Peak and Average conducted emissions results, ant 0, NetBit Supply*

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
0.154000	---	32.94	55.78	22.84	5000.0	9.000	L1	ON
0.154000	54.72	---	65.78	11.06	5000.0	9.000	L1	ON
0.168500	---	34.45	55.03	20.59	5000.0	9.000	L1	ON
0.168500	53.04	---	65.03	12.00	5000.0	9.000	L1	ON
0.304500	---	25.22	50.12	24.90	5000.0	9.000	L1	ON
0.304500	40.91	---	60.12	19.20	5000.0	9.000	L1	ON
0.515500	---	19.25	46.00	26.75	5000.0	9.000	L1	ON
0.515500	31.91	---	56.00	24.09	5000.0	9.000	L1	ON
0.600500	---	19.11	46.00	26.89	5000.0	9.000	L1	ON
0.600500	31.96	---	56.00	24.04	5000.0	9.000	L1	ON
0.747500	---	19.85	46.00	26.15	5000.0	9.000	L1	ON
0.747500	33.43	---	56.00	22.57	5000.0	9.000	L1	ON



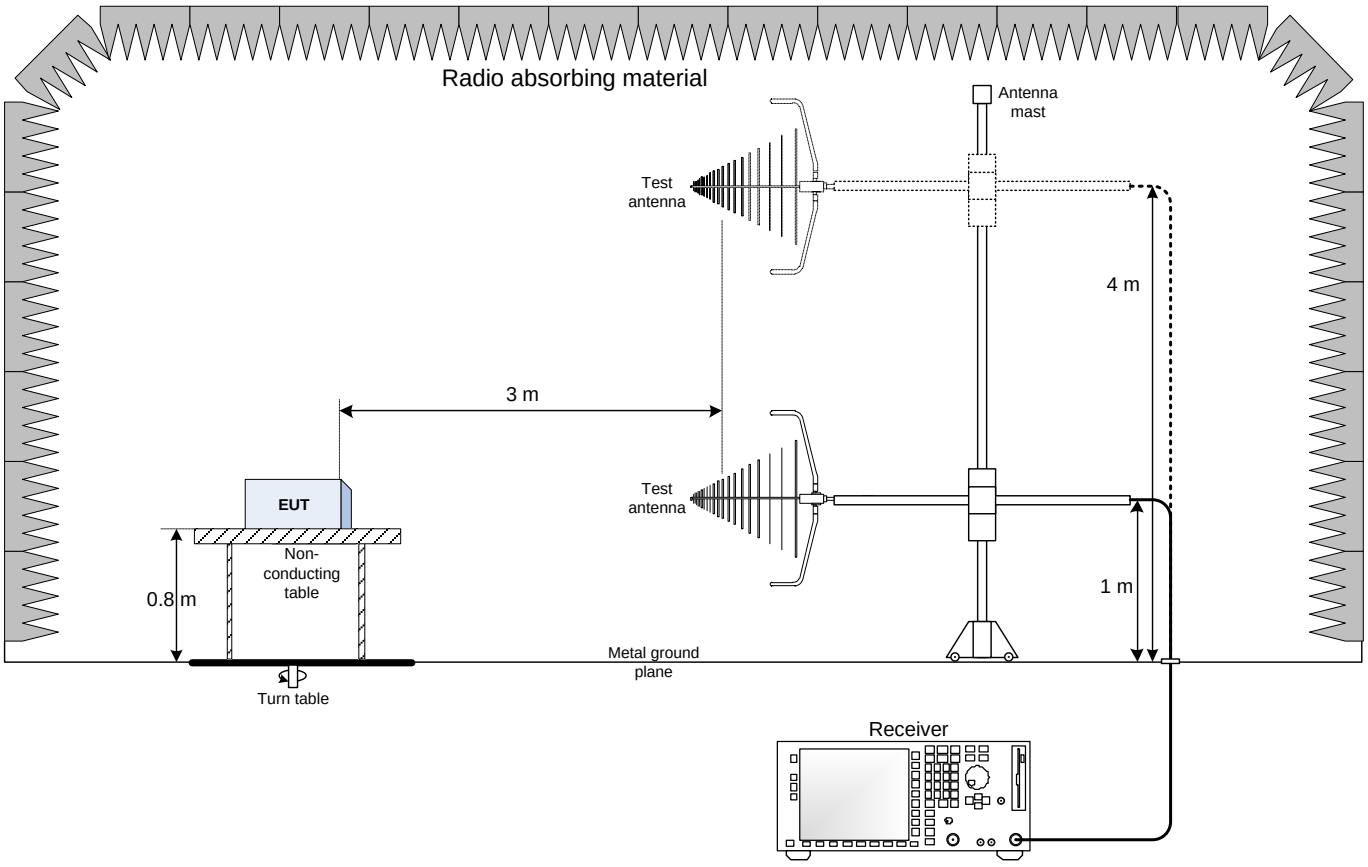
Plot 8.5-4: *Conducted emissions, ant 1, NetBit Supply*

Table 8.5-5: *Quasi-Peak and Average conducted emissions results, ant 1, NetBit Supply*

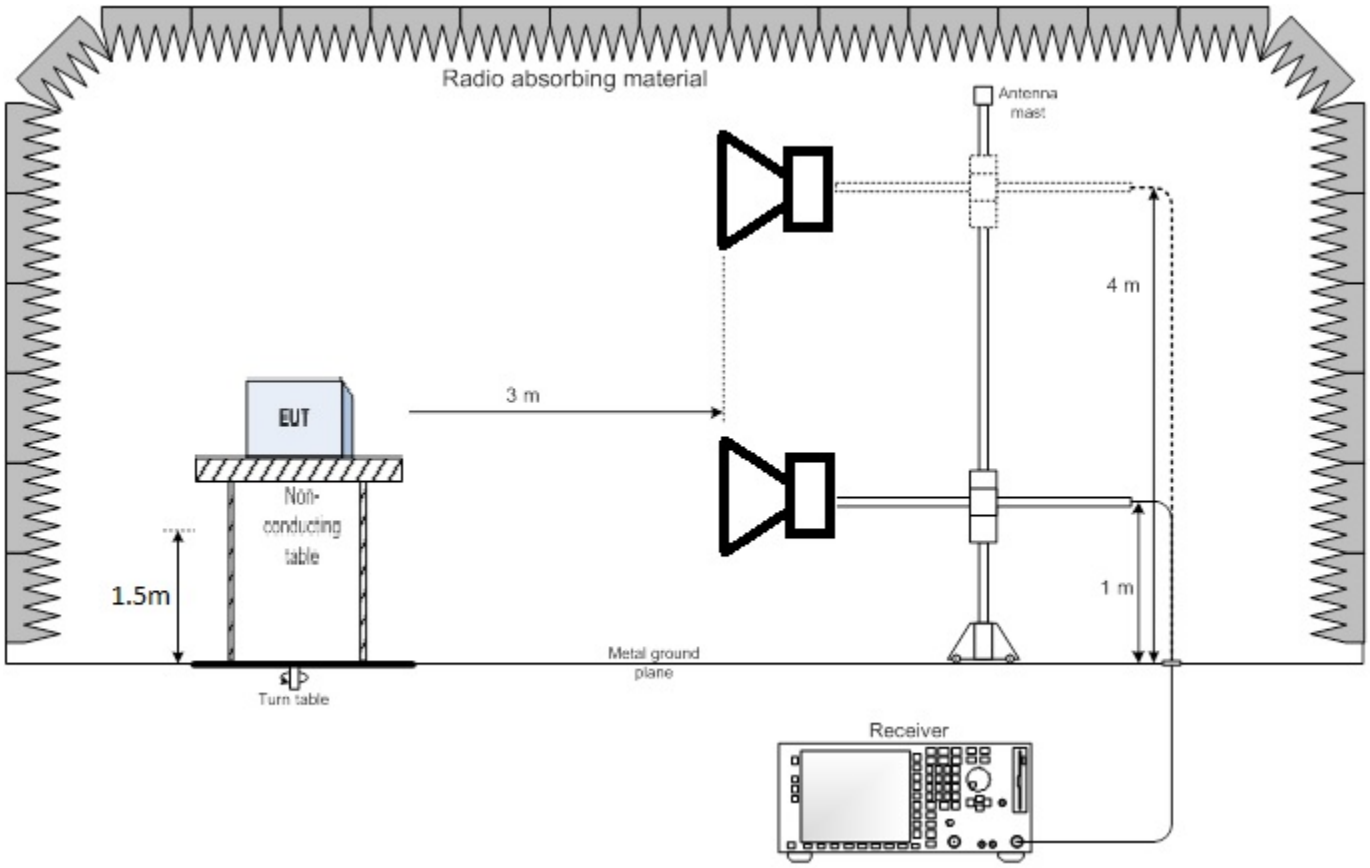
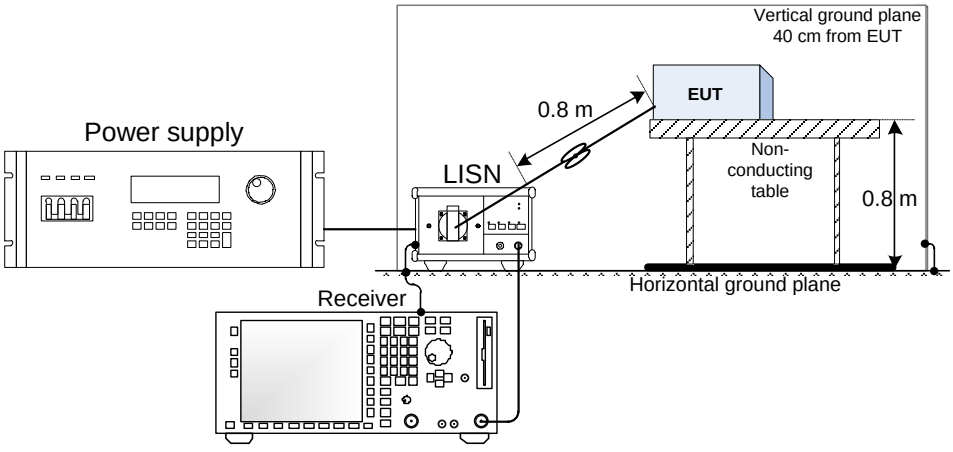
Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter
0.150000	---	27.84	56.00	28.16	5000.0	9.000	L1	ON
0.150000	51.46	---	66.00	14.54	5000.0	9.000	L1	ON
0.176500	---	29.57	54.65	25.08	5000.0	9.000	L1	ON
0.176500	48.63	---	64.65	16.02	5000.0	9.000	L1	ON
0.204500	45.78	---	63.43	17.65	5000.0	9.000	N	ON
0.204500	---	26.05	53.43	27.37	5000.0	9.000	N	ON
0.312500	41.39	---	59.90	18.52	5000.0	9.000	N	ON
0.312500	---	22.89	49.90	27.01	5000.0	9.000	N	ON
0.376500	---	25.69	48.36	22.66	5000.0	9.000	N	ON
0.376500	41.04	---	58.36	17.31	5000.0	9.000	N	ON
0.536500	33.08	---	56.00	22.92	5000.0	9.000	L1	ON
0.536500	---	19.79	46.00	26.21	5000.0	9.000	L1	ON
0.984500	31.58	---	56.00	24.42	5000.0	9.000	L1	ON
0.984500	---	19.86	46.00	26.14	5000.0	9.000	L1	ON

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up – Below 1GHz



9.2 Radiated emissions set-up – Above 1GHz



9.3 Conducted emissions set-up