ONE WORLD ○ OUR APPROVAL

Test report

FCC-15.247 and RSS-247 BT 2015_293975

Date of issue: December 23, 2015

Applicant: Greenlee Textron

Product: Hand-held telecom test set

Model: Datascout 10Gx Model variant: N/A

FCC ID: 2AGDS-DS IC Registration number: 20877-DS

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.247

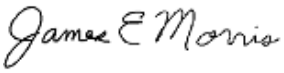
  Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

- 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

Company name	Nemko USA, Inc.
Address	2210 Faraday Ave, Suite 150
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	Feng You, Sr. Wireless Engineer
Reviewed by	James Morris
Review date	December 23, 2015
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.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Greenlee Textron
Address	1390 Aspen Way
City	Vista
Province/State	CA
Postal/Zip code	92081
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	FCC ID and IC Registration Number Updated
3	Updated based on review comment.

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[1]
§15.203	Antenna requirement	Pass[2]
§15.205	Restricted bands of operation	Pass

Notes: [1] Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the supply voltage varied between the rated supply voltage range. No noticeable output power variation was observed. Test also performed with freshly charged battery.

[2] The Antennas are located within the protective cover of EUT and uses a unique antenna coupling (R-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	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	Pass
§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	Pass
§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	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 1, 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	Not applicable
5.1 (4)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Pass
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	Not applicable
5.4 (2)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Pass
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 FHS in the 2400-2483.5MHz band

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	October 5, 2015
Nemko sample ID number	1

3.2 EUT information

Product name	Hand-held telecom test set
Model	Datascout 10Gx
Model variant	N/A
Serial number	N/A

3.3 Technical information

Applicant IC company number	20877
IC UPN number	DS
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)	2402
Frequency Max (MHz)	2480
RF power Min (W), Conducted/ERP/EIRP	N/A
RF power Max (W), Conducted/ERP/EIRP	0.0020 (Conducted)
Field strength, Units @ distance	N/A
Measured BW (kHz) (20 dB)	210
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	GFSK
Emission classification (F1D, G1D, D1D)	F1D
Transmitter spurious, Units @ distance	53.7 dBµV/m @ 3m
Power requirements	Rechargeable battery with 100V-240V AC charger
Antenna information	2dBi gain monopole antenna under protective cover with R-SMA connector. The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

EUT is hand-held telecom test set with adaptive frequency hopping BT Class 1 radio interface. Enhanced data rate (EDR) modes are not activated in this device. Only GFSK modulation is utilized.

3.5 EUT exercise details

Depends on test cases, the EUT is set either to fixed channel or frequency hopping mode, with following setting
External power: 255
Internal power: 52
Voltage regulator: 13

3.6 EUT setup diagram

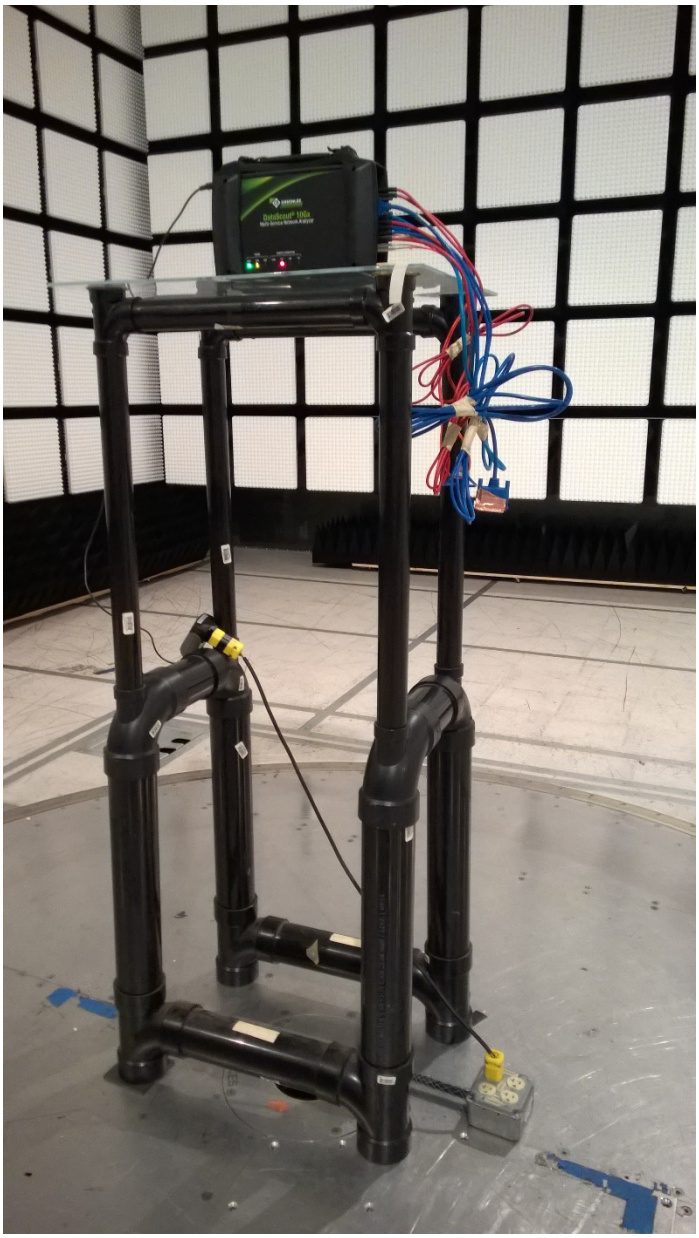


Figure 3.6-1: *Setup Photo – Radiated Emissions > 1GHz*

Figure 3.6-2: *Setup Photo – Radiated Emissions < 1GHz*

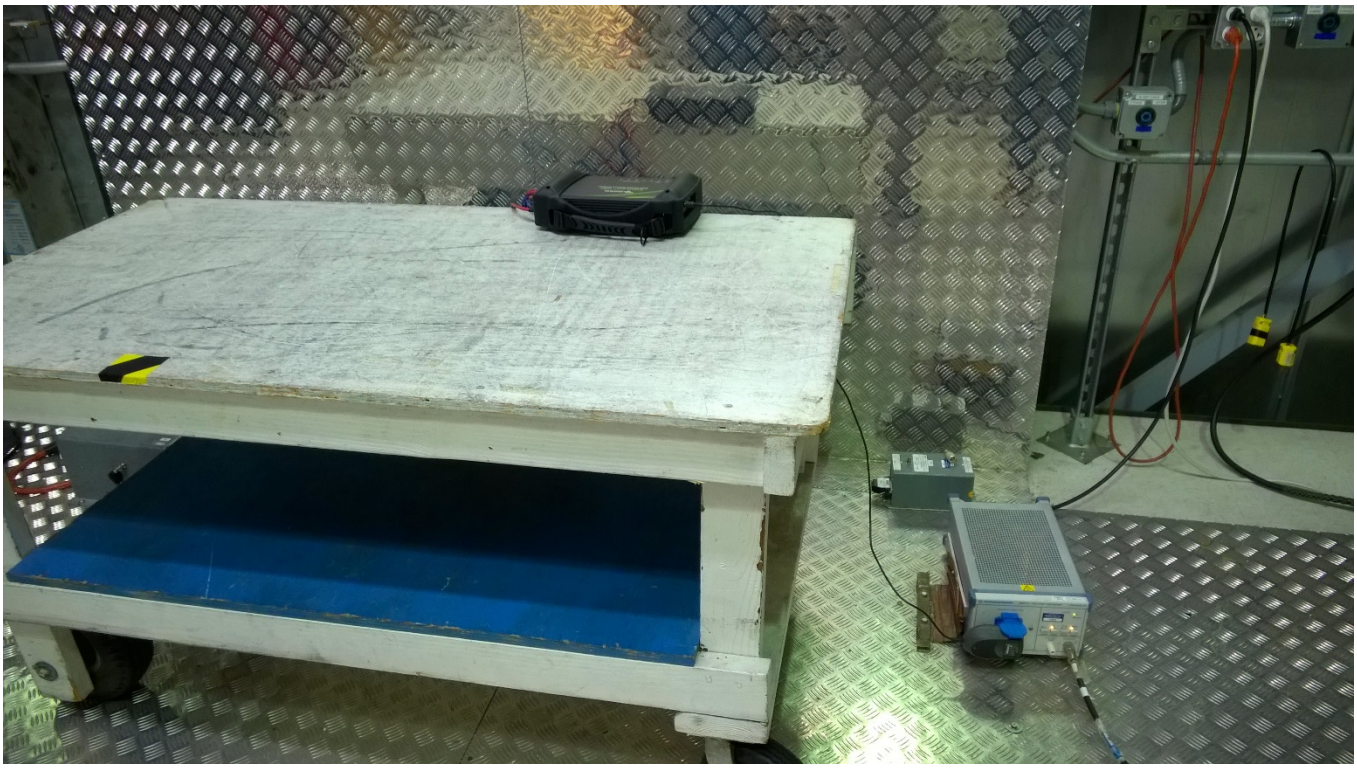


Figure 3.6-3: *Setup Photo – AC Powerline Conducted Emissions*

3.7 EUT sub assemblies

Table 3.7-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
Hand-held telecom test set	Greenlee Textron	Datascout 10Gx	N/A
AC Charger	Greenlee Textron	100-240V AC	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.

Rated 100-240V AC charger/power supply and internal rechargeable battery.

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	08-Dec-2016
835	Spectrum Analyzer	Rohde & Schwarz	FSEK30	829058/0005	04-Aug-2017
E1017	9kHz to 7GHz Spectrum Analyzer	Rohde & Schwarz	FSP7	839337/0022	03-Nov-2015
E1035	Variac (Variable Transformer) 3KVA	Shanghai China	TDGC	N/A	Verify
1480	Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	18-May-2016
1767	Receiver, EMI Test 20Hz - 26.5 GHz - 150 - +30 dBm LCD	Rohde & Schwartz	ESIB26	837491/0002	04-Nov-2015
4043	True RMS Multimeter	Fluke	115	22620350	20-Jan-2016
E1019	Two Line V-Network	Rohde & Schwarz	ENV216	101045	15-May-2016
E1064	Spectrum Analyzer	Agilent	E4440A	US42221762	22-Dec-2015

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

Section 8. Testing data

8.1 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits

8.1.1 Definitions and limits

FCC:
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.

IC:
A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which 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 table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.1-1: *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: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

8.1.2 Test summary

Test date	October 5, 2015	Temperature	21 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	70 %

8.1.3 Observations, settings and special notes

The EUT was set up as tabletop configuration.

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.

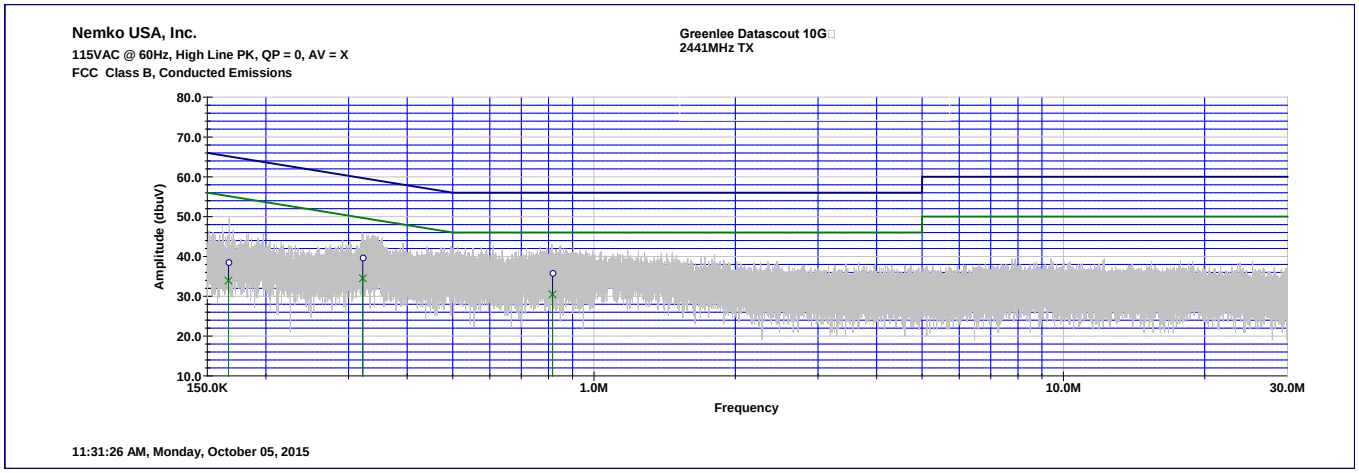
Receiver settings for preview measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average
Trace mode	Max Hold
Measurement time	1000 ms

Receiver settings for final measurements:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Quasi-Peak and Average
Trace mode	Max Hold
Measurement time	1000 ms

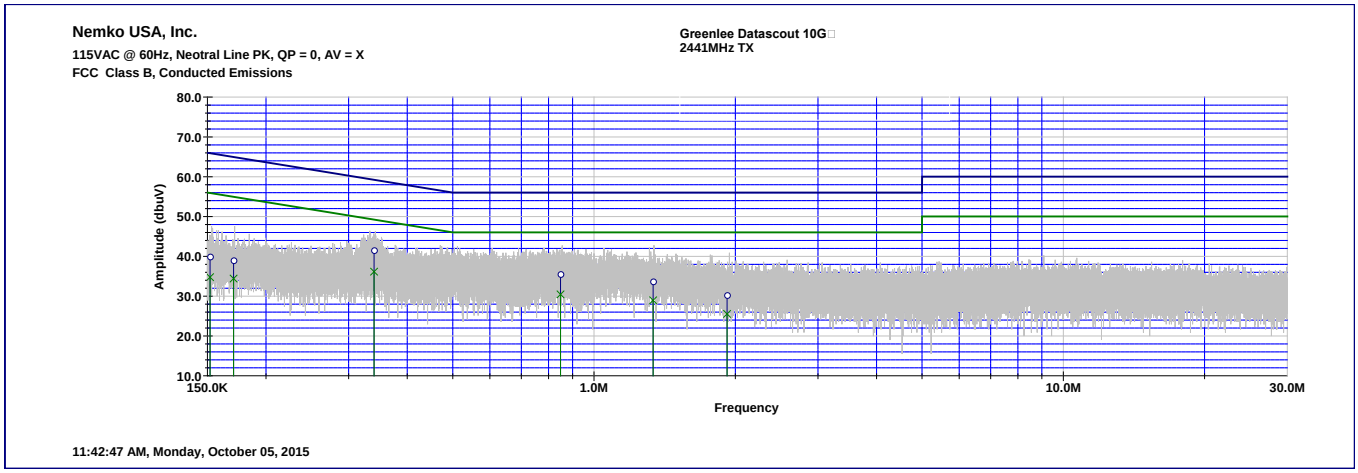
8.1.4 Test data



Plot 8.1-1: *Conducted emissions on phase line*

Table 8.1-2: *Conducted emissions results on phase line*

Frequency	QP	AV	QP_Limit	AV_Limit	QP_Margin	AV_Margin
kHz	dBµV	dBµV	dBµV	dBµV	dB	dB
166.45	38.6	33.9	65.5	55.1	26.9	21.2
321.61	39.7	34.5	61.1	49.7	21.4	15.2
816.17	35.9	30.5	56	46	20.1	15.5



Plot 8.1-2: *Conducted emissions on neutral line*

Table 8.1-3: *Conducted emissions results on neutral line*

Frequency	QP	AV	QP_Limit	AV_Limit	QP_Margin	AV_Margin
kHz	dBµV	dBµV	dBµV	dBµV	dB	dB
151.97	39.9	34.8	65.9	55.9	26	21.1
170.62	39	34.4	65.4	54.9	26.4	20.5
339.86	41.5	36.1	60.6	49.2	19.1	13.1
848.32	35.5	30.4	56	46	20.5	15.6
1336.28	33.7	28.9	56	46	22.3	17.1
1920.65	30.3	25.5	56	46	25.7	20.5

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

8.2.1 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.

8.2.2 Test summary

Test date	October 16, 2015	Temperature	23 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	71 %

8.2.3 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

8.2.4 Test data

Table 8.2-1: *20 dB bandwidth results*

Modulation	Frequency, MHz	20 dB bandwidth, MHz	Channel Bandwidth, MHz	Margin, MHz
GFSK	2402	0.210	1	0.790
	2441	0.162	1	0.838
	2480	0.156	1	0.844

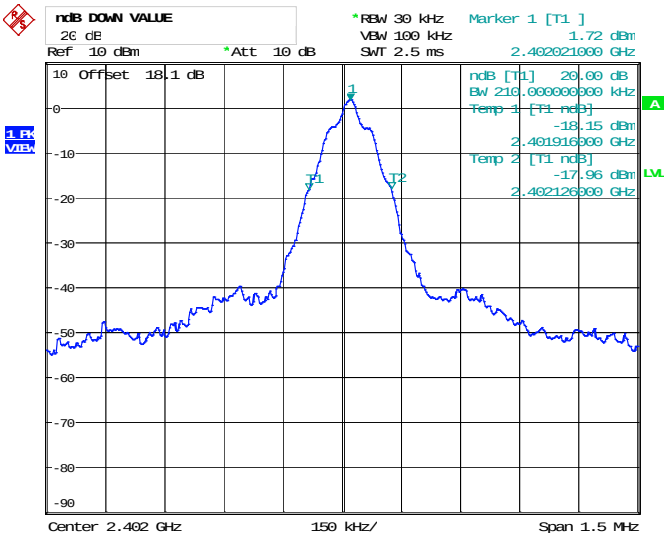


Figure 8.2-1: *20 dB bandwidth, 2402MHz*

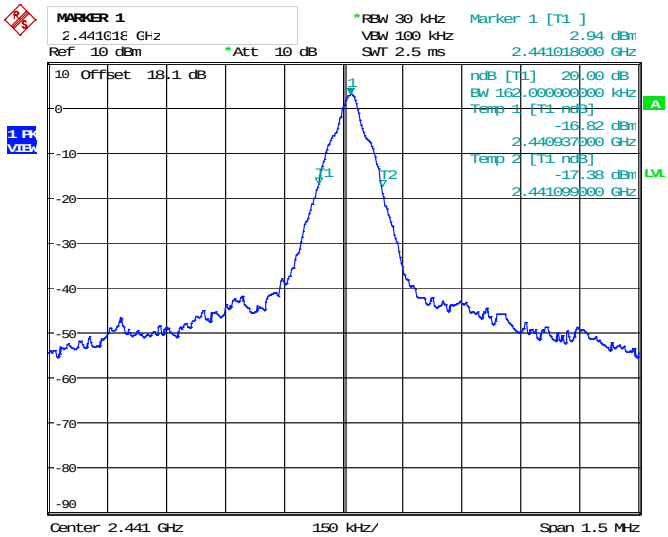


Figure 8.2-2: *20 dB bandwidth, 2441MHz*

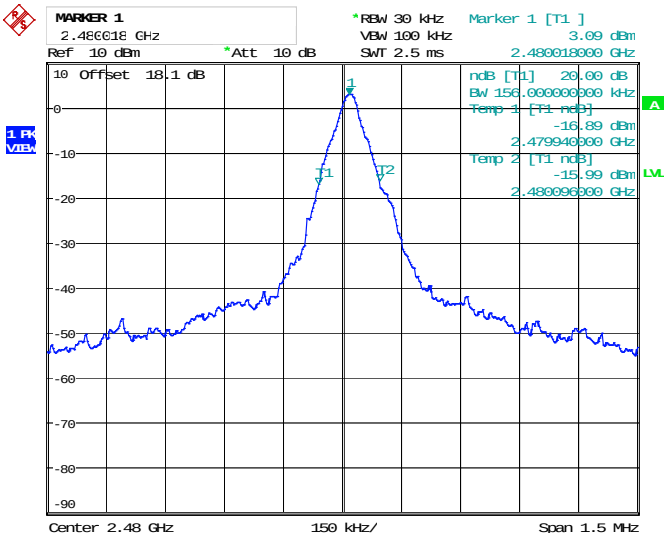


Figure 8.2-3: *20 dB bandwidth, 2480MHz*

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

8.3.1 Definitions and limits

FCC:

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

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(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.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(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 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.

(c) Operation with directional antenna gains greater than 6 dBi.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

IC:

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

(2) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W and the e.i.r.p. shall not exceed 4 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W and the e.i.r.p. shall not exceed 0.5 W if the hopset uses less than 75 hopping channels (see Section 5.4(5) for exceptions).

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.

8.3.2 Test summary

Test date	October 16, 2015	Temperature	23 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	71 %

8.3.3 Observations, settings and special notes

8.3.4 Test data

Table 8.3-1: *Output power measurements results*

Power Source	Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
		Measured	Limit					
Battery	2402	2.74	30	27.26	2	4.74	36	31.26
	2441	2.83	30	27.17	2	4.83	36.00	31.17
	2480	2.74	30	27.26	2	4.74	36.00	31.26
100V AC	2402	2.52	30	27.48	2	4.52	36	31.48
	2441	2.86	30	27.14	2	4.86	36.00	31.14
	2480	2.89	30	27.11	2	4.89	36.00	31.11
115V AC	2402	2.49	30	27.51	2	4.49	36	31.51
	2441	2.86	30	27.14	2	4.86	36.00	31.14
	2480	2.89	30	27.11	2	4.89	36.00	31.11
230V AC	2402	2.55	30	27.45	2	4.55	36	31.45
	2441	2.89	30	27.11	2	4.89	36.00	31.11
	2480	2.89	30	27.11	2	4.89	36.00	31.11
240V AC	2402	2.55	30	27.45	2	4.55	36	31.45
	2441	2.86	30	27.14	2	4.86	36.00	31.14
	2480	2.92	30	27.08	2	4.92	36.00	31.08

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

8.4.1 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 8.4-1: *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 8.4-2: *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 8.4-2 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 8.4-3: *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			

8.4.2 Test summary

Test date	October 16, 2015	Temperature	23 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	71 %

8.4.3 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, the EUT was transmitting on both MIMO chains simultaneously.
Since fundamental power was tested using average method, the spurious emissions limit is −30 dBc/100 kHz

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

8.4.4 Test data

Table 8.4-4: *Radiated field strength measurement results for low channel*

Frequency	Field strength	Limit	Margin	Polarity
MHz	dBµV/m	dBµV/m	dB	H/V
59.5101	1.49	40	38.51	H
184.228	22.44	43.5	21.06	H
204.273	20.58	43.5	22.92	H
290.471	13.06	46	32.94	H
302.454	19.57	46	26.43	H
314.802	10.36	46	35.64	H
358.526	20.94	46	25.06	H
508.186	15.81	46	30.19	H
800.356	40.02	46	5.98	H
967.855	21.98	54	32.02	H
182.851	21.82	43.5	21.68	V
241.922	21.99	46	24.01	V
387.049	24.35	46	21.65	V
800.355	32.78	46	13.22	V

Frequency	Avg. Measurement	Peak Measurement	Avg. Limit	Peak Limit	Avg. Margin	Peak Margin	Polarity
MHz	dBµV/m	dBµV/m	dBµV/m	dBµV/m	dB	dB	H/V
1600.34	53.4	57.1	54	74	0.6	16.9	H
1599.95	49.4	52.7	54	74	4.6	21.3	V
4801.94	44.3	45.3	54	74	9.7	28.7	H
9604.26	41.5	48.4	54	74	12.5	25.6	H
4801.97	53.7	53.9	54	74	0.3	20.1	V

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.4-5: *Radiated field strength measurement results for mid channel*

Frequency	Field strength	Limit	Margin	Polarity
MHz	dBµV/m	dBµV/m	dB	H/V
57.4959	13.17	40	26.83	H
120.963	26.22	43.5	17.28	H
204.047	24.75	43.5	18.75	H
290.538	10.9	46	35.1	H
813.663	34.6	46	11.4	H
183.869	23.31	43.5	20.19	V
387.039	24.31	46	21.69	V
813.742	26.98	46	19.02	V

Frequency	Avg. Measurement	Peak Measurement	Avg. Limit	Peak Limit	Avg. Margin	Peak Margin	Polarity
MHz	dBµV/m	dBµV/m	dBµV/m	dBµV/m	dB	dB	H/V
1627.22	45.3	48.5	54	74	8.7	25.5	H
1627.67	45.3	52.1	54	74	8.7	21.9	V
4881.91	48.5	49.1	54	74	5.5	24.9	H
4882.16	49.3	50.5	54	74	4.7	23.5	V
7321.81	40.1	43.5	54	74	13.9	30.5	V

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.4-6: *Radiated field strength measurement results for high channel*

Frequency	Field strength	Limit	Margin	Polarity
MHz	dBµV/m	dBµV/m	dB	H/V
59.1506	19.12	40	20.88	H
120.962	22.76	43.5	20.74	H
183.866	24	43.5	19.5	H
289.982	9.82	46	36.18	H
314.81	11.46	46	34.54	H
351.012	22.4	46	23.6	H
967.942	21.59	54	32.41	H
184.23	18.48	43.5	25.02	V
241.94	20.02	46	25.98	V
387.05	23.14	46	22.86	V
1653.15	45.7	54	8.3	H
1900.28	44.4	54	9.6	H
1653	47.4	54	6.6	V
4959.88	45.9	54	8.1	H
4960.11	48.9	54	5.1	V
7440.18	41.2	54	12.8	V

Frequency	Avg. Measurement	Peak Measurement	Avg. Limit	Peak Limit	Avg. Margin	Peak Margin	Polarity
MHz	dBµV/m	dBµV/m	dBµV/m	dBµV/m	dB	dB	H/V
1653.15	45.7	51.7	54	74	8.3	22.3	H
1900.28	44.4	49.3	54	74	9.6	24.7	H
1653	47.4	50.8	54	74	6.6	23.2	V
4959.88	45.9	49.3	54	74	8.1	24.7	H
4960.11	48.9	50.8	54	74	5.1	23.2	V
7440.18	41.2	43	54	74	12.8	31	V

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

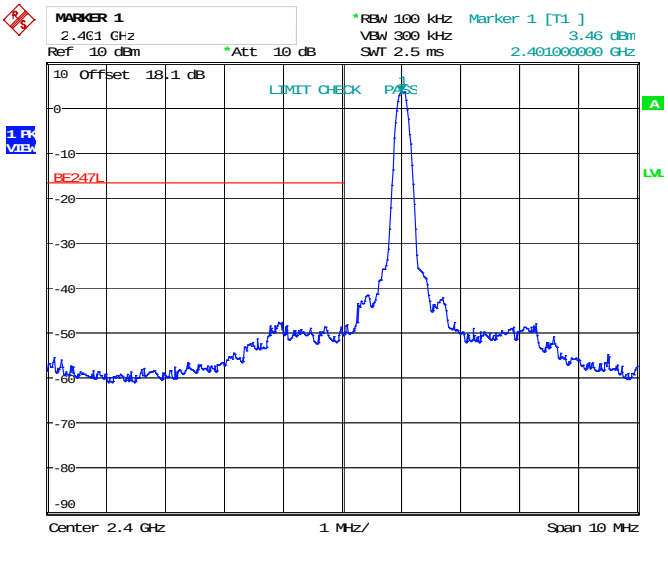


Figure 8.4-1: *Low Bandedge Measurement*

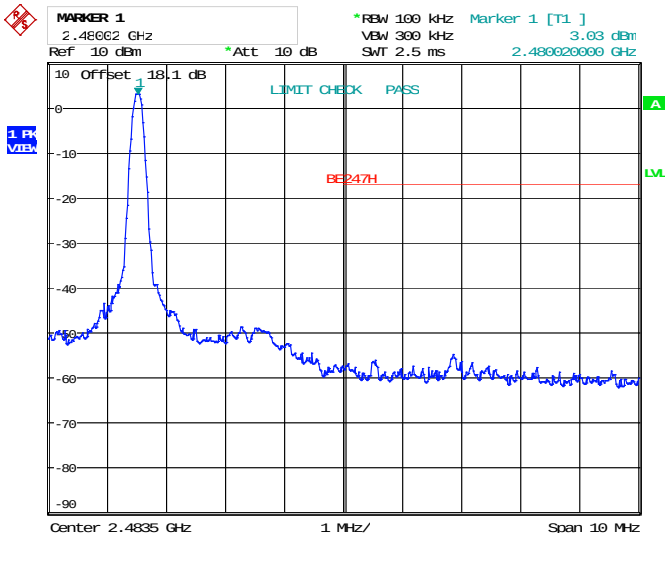


Figure 8.4-2: *High Bandedge Measurement*

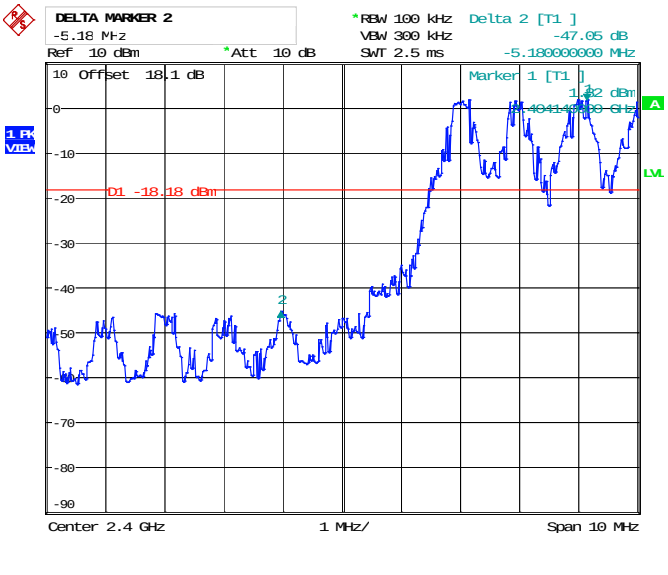


Figure 8.4-3: *Low Bandedge Measurement, hopping*

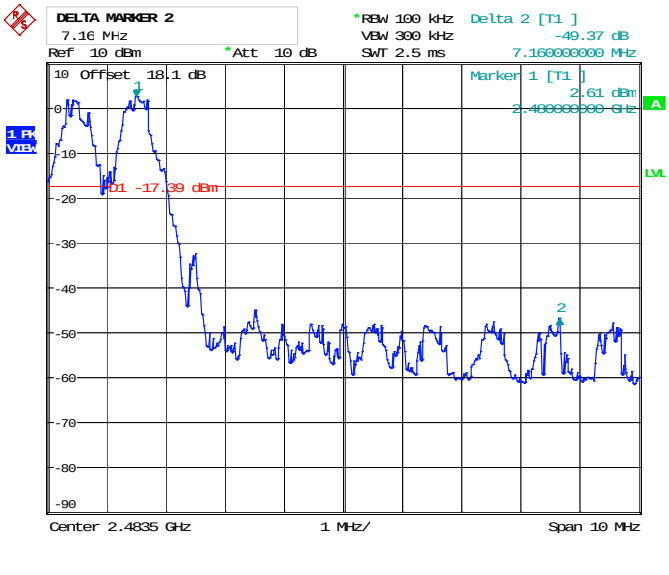


Figure 8.4-4: *High Bandedge Measurement, hopping*

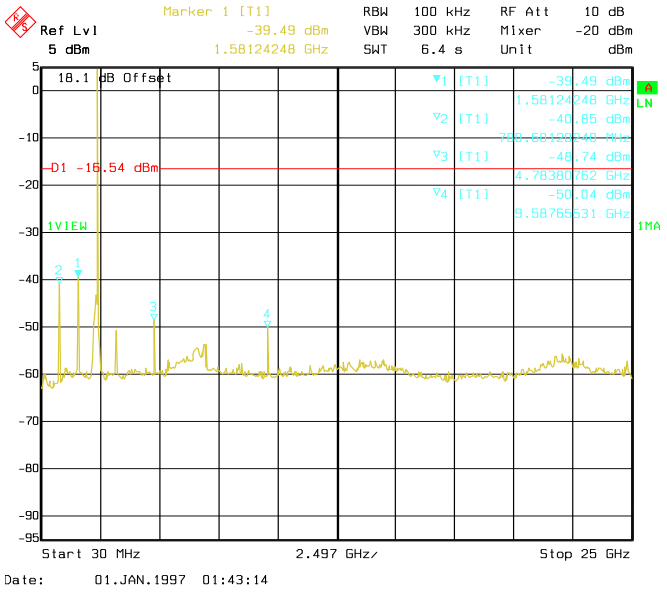


Figure 8.4-5: *Conducted spurious emissions, low channel*

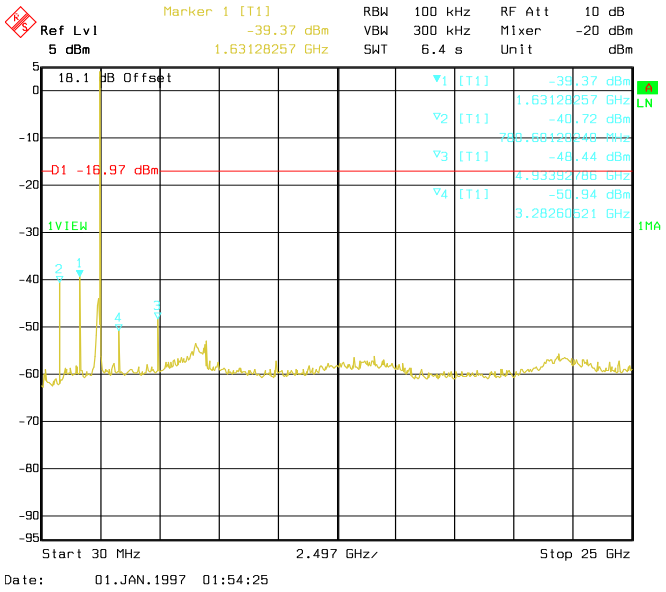


Figure 8.4-6: *Conducted spurious emissions, high channel*

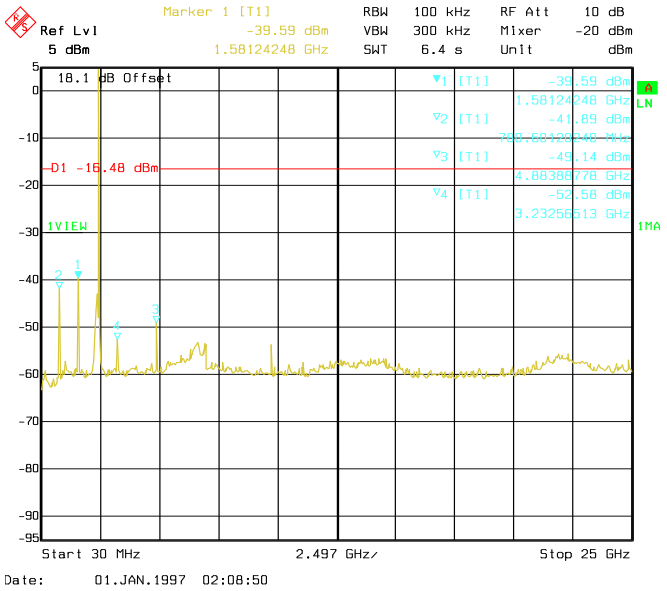


Figure 8.4-7: *Conducted spurious emissions, mid channel*

Peaks within 2400-2483.5MHz are transmitter fundamentals.

8.5 FCC 15.247(a)(1)(iii) and RSS-247 5.1(4) Frequency hopping systems in the 2400-2483.5MHz

8.5.1 Definitions and limits

FCC:
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.
IC:
FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

8.5.2 Test summary

Test date	October 16, 2015	Temperature	23 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	71 %

8.5.3 Observations, settings and special notes

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

8.5.4 Test data

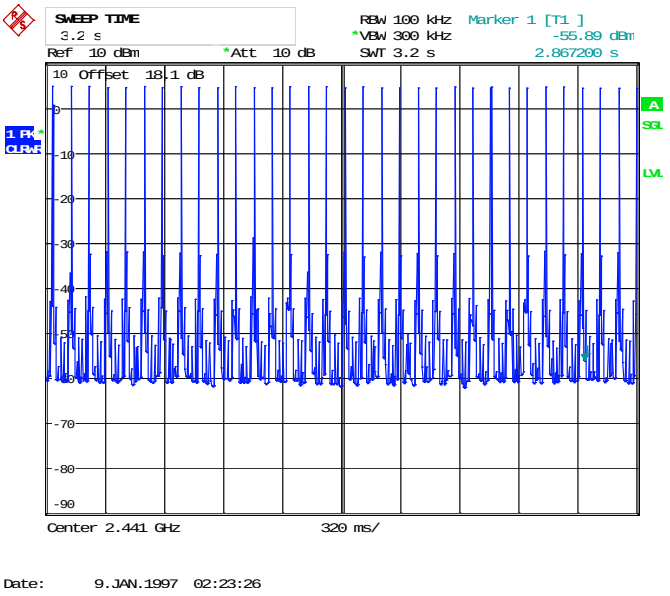


Diagram 8.5-1: *Pulse count in 3.2s, 2441MHz*

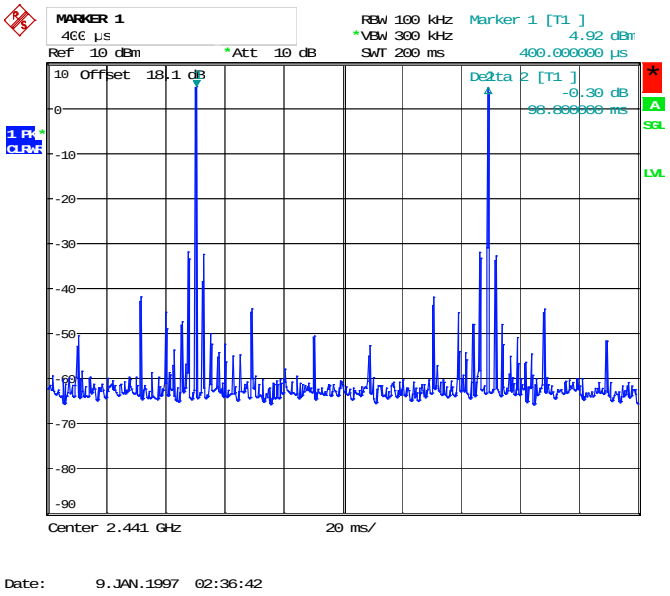


Diagram 8.5-2: *TX-Gap, 2441MHz*

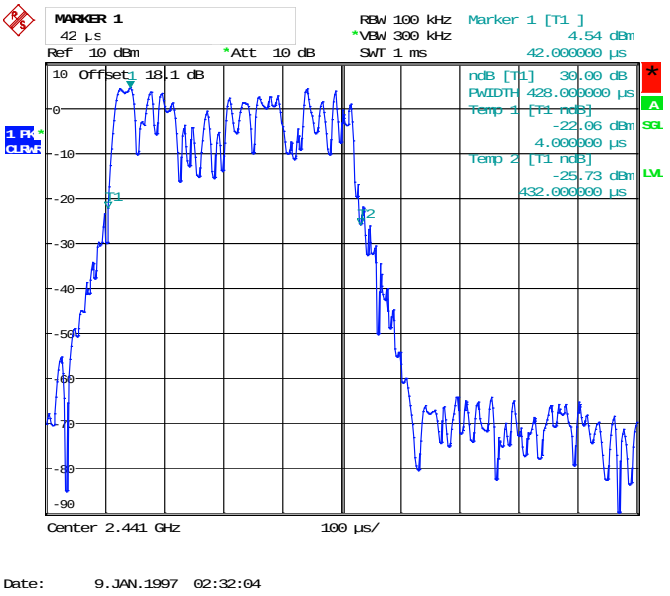


Diagram 8.5-3: *Pulse width, 2441MHz*

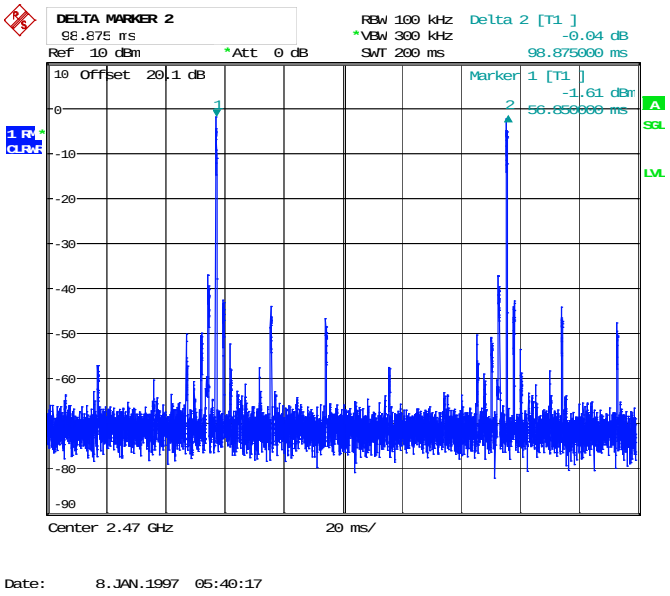


Diagram 8.3-4: *TX-Gap, 2470MHz*

Table 8.5-1: *Time of occupancy*

Frequency MHz	Pulse count in 3.2s	TX-Gap (ms)	Pulse width (ms)	Time of occupancy Time (ms)	Limit (ms)
2441	32	98.8	0.428	136.9	400

Table 8.5: *Hopping Frequencies*

Minimum Hopping Frequencies	Measured Hopping Frequencies	Result
15	79	Pass

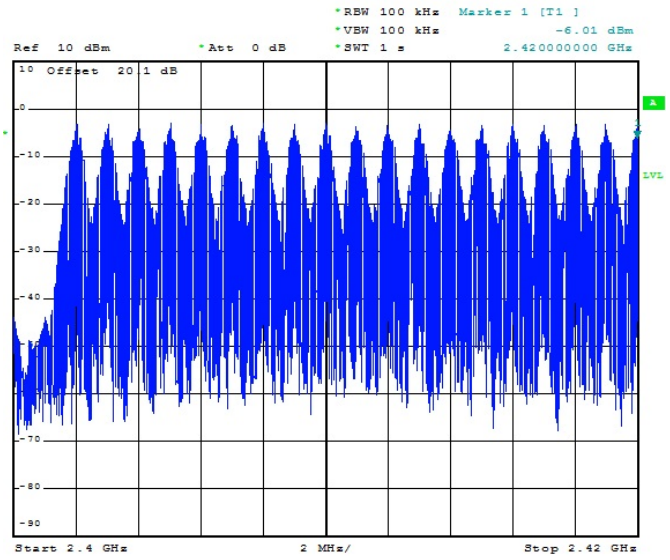


Diagram 8.5-5: *Hopping channels 19 (2400 - 2420MHz)*

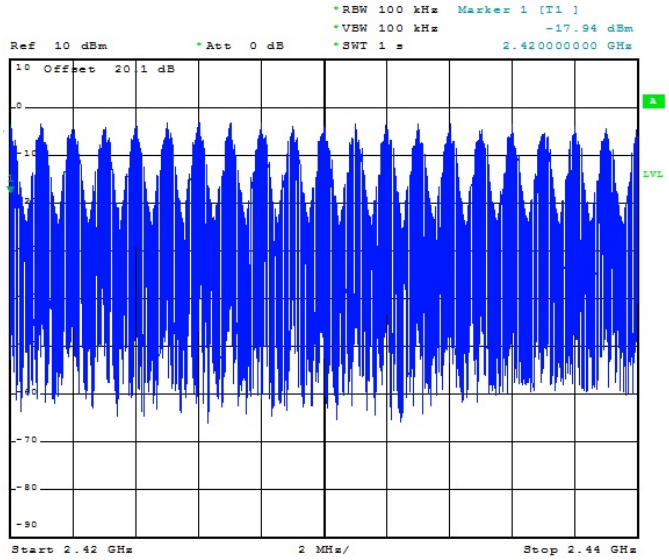


Diagram 8.5-6: *Hopping channels 20 (>2420 – 2440MHz)*

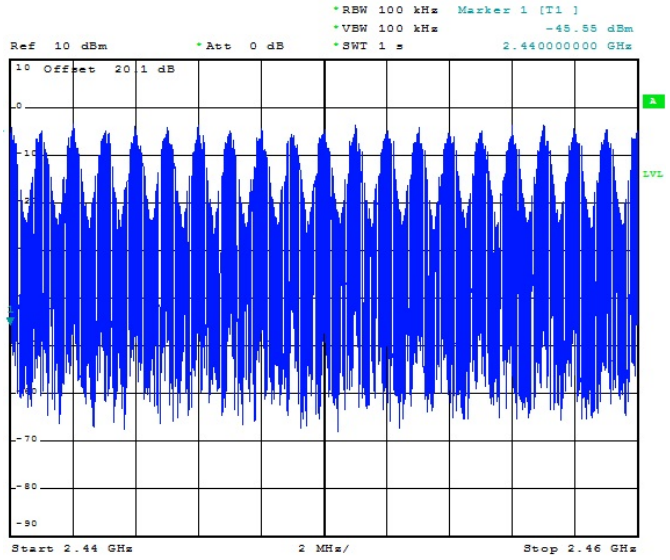


Diagram 8.5-7: *Hopping channels 20 (>2440 – 2460MHz)*

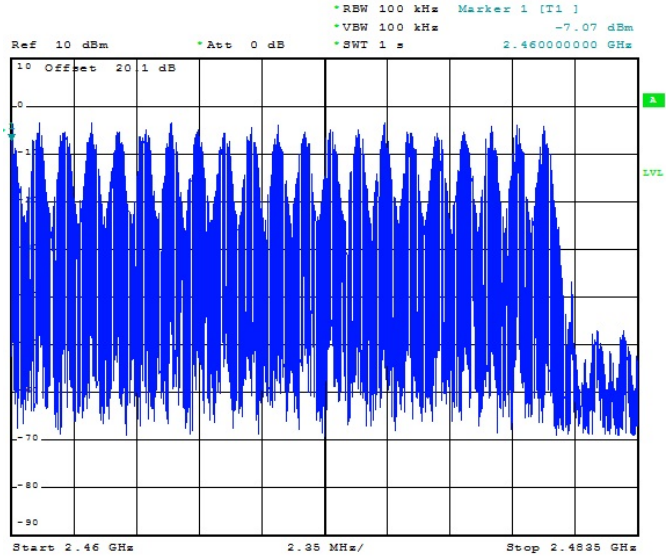


Diagram 8.3-8: *Hopping channels 20 (>2460 – 2483.5MHz)*

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

8.6.1 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.

8.6.2 Test summary

Test date	October 16, 2015	Temperature	23 °C
Test engineer	Feng You	Air pressure	1003 mbar
Verdict	Pass	Relative humidity	71 %

8.6.3 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

8.6.4 Test data

Table 8.6-1: *Hopping Frequency Separation*

Modulation	Frequency, kHz	Minimum, kHz (20dB OBW)	Margin, kHz
GFSK	996.375	213	783.375

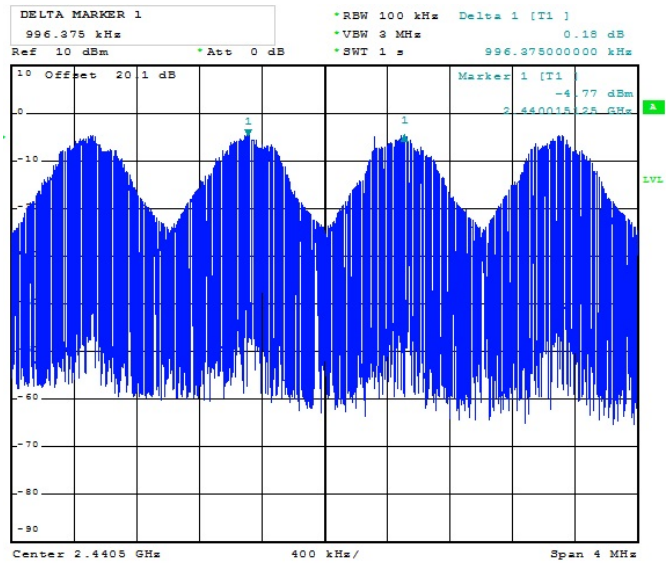
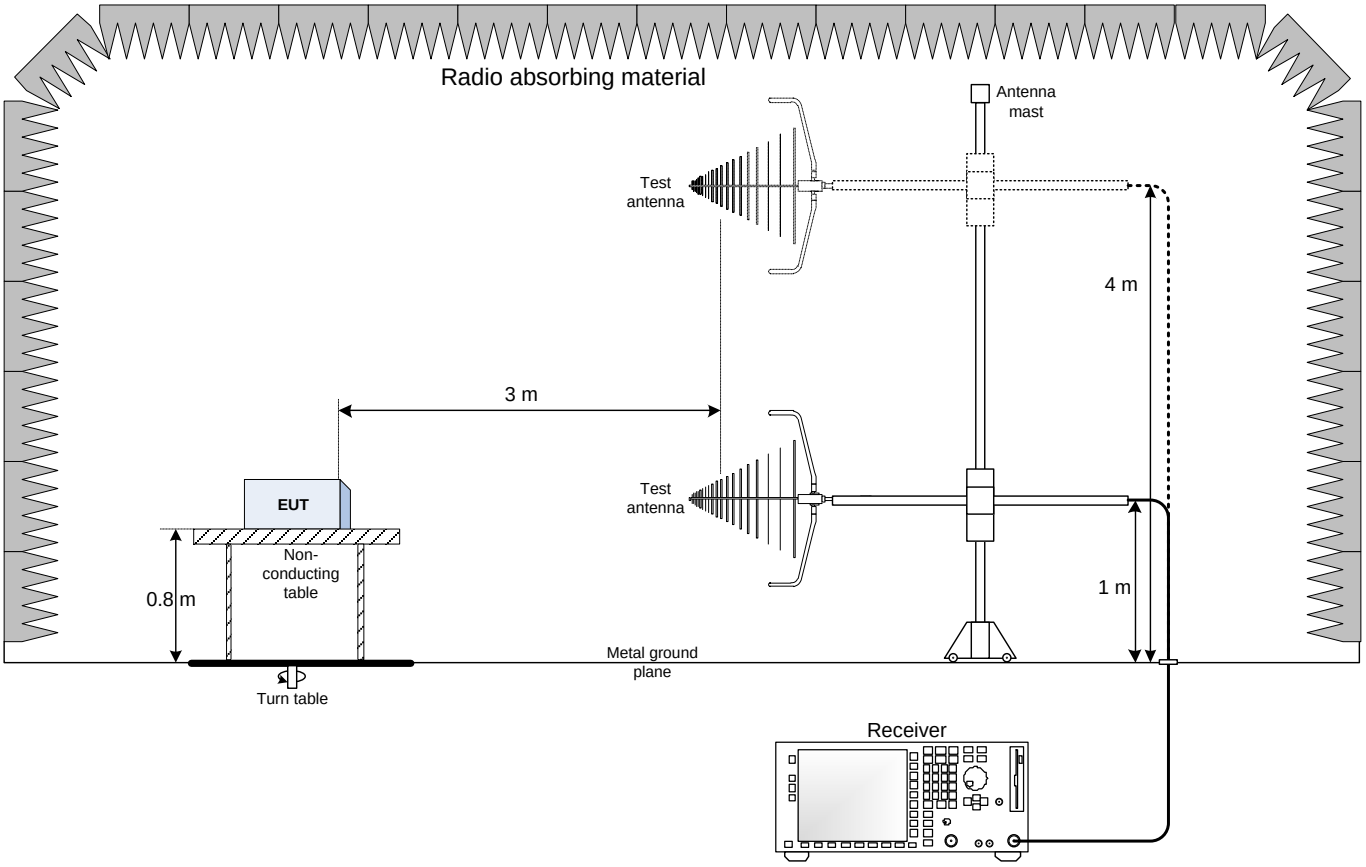


Figure 8.6-1: *Hopping Frequency Separation*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Conducted emissions set-up