

Test report

321144-1TRFWL

Date of issue: May 23, 2017

Applicant:

ESKI Inc.

Product name:

Hub

Model:

PX-HUB1

FCC ID:

2ADS4HUB1

IC Registration number:

7254A-HUB1

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, Section 5**

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

Test location

Company name	Nemko Canada Inc.
Address	303 River Road
City	Ottawa
Province	Ontario
Postal code	K1V 1H2
Country	Canada
Telephone	+1 613 737 9680
Facsimile	+1 613 737 9691
Toll free	+1 800 563 6336
Website	www.nemko.com
Site number	FCC: 72254; IC: 2040G-5 (3 m semi anechoic chamber)

Tested by	Avul Nzenza, EMC/Wireless Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Review date	May 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 Canada's ISO/IEC 17025 accreditation.

Copyright notification

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

Table of contents

Table of contents	3
Section 1. Report summary	4
1.1 Applicant and manufacturer	4
1.2 Test specifications	4
1.3 Test methods	4
1.4 Statement of compliance	4
1.5 Exclusions	4
1.6 Test report revision history	4
Section 2. Summary of test results	5
2.1 FCC Part 15 Subpart C, general requirements test results	5
2.2 FCC Part 15 Subpart C, intentional radiators test results	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	7
3.5 EUT exercise details	7
3.6 EUT setup diagram	8
Section 4. Engineering considerations	9
4.1 Modifications incorporated in the EUT	9
4.2 Technical judgment	9
4.3 Deviations from laboratory tests procedures	9
Section 5. Test conditions	10
5.1 Atmospheric conditions	10
5.2 Power supply range	10
Section 6. Measurement uncertainty	11
6.1 Uncertainty of measurement	11
Section 7. Test equipment	12
7.1 Test equipment list	12
Section 8. Testing data	13
8.1 FCC 15.207(a) and RSS-Gen 8.8 AC power line conducted emissions limits	13
8.2 FCC 15.247(a)(2) and RSS-247 5.2(1): 6 dB bandwidth (DTS-BLE)	18
8.3 FCC 15.247(b) and RSS-247 5.4 (4) Transmitter output power and e.i.r.p. requirements	21
8.4 FCC 15.247(d) and RSS-247 5.5 Spurious (out-of-band) emissions	24
8.5 FCC 15.247(e) and RSS-247 5.2(2) Power spectral density for digitally modulated devices	33
Section 9. Block diagrams of test set-ups	36
9.1 Radiated emissions set-up for frequencies below 1 GHz	36
9.2 Radiated emissions set-up for frequencies above 1 GHz	36
9.3 Conducted emissions set-up	37

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	ESKI Inc
Address	103 Louvain O., Montreal, QC, Canada, H2N 1A3

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.
RSS-247, Issue 1, May 2015, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

1.3 Test methods

558074 D01 DTS Meas Guidance v03 r05 (April 8, 2016)	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was 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

Table 1.6-1: Test report revision history

Revision #	Details of changes made to test report
TRF	Original report issued
Notes:	None

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Table 2.1-1: FCC part 15 Subpart C 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

Notes: ¹ Equipment is AC powered.

² The equipment will be professionally installed.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Table 2.2-1: FCC part 15 Subpart C, §15.247 test results

Part	Test description	Verdict
§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

Notes: None

2.3 IC RSS-GEN, Issue 4, test results

Table 2.3-1: RSS GEN test results

Part	Test description	Verdict
7.1.2	Receiver radiated emission limits	Not applicable ¹
7.1.3	Receiver conducted emission limits	Not applicable ¹
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	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

Table 2.4-1: RSS 247 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 Transmission Systems (DTSs)	
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	Out-of-band emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	August 11, 2016
Nemko sample ID number	133002688

3.2 EUT information

Product name	Hub
Model	PX-HUB1
Serial number	N/A

3.3 Technical information

Applicant IC company number	7254A
IC UPN number	HUB
All used IC test site(s) Reg. number	2040G-5
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 (W), Conducted	0.0069 (8.41 dBm)
Field strength, Units @ distance	N/A
Measured BW (MHz) (99%)	1.07
Calculated BW (kHz), as per TRC-43	N/A
Type of modulation	GFSK
Emission classification (F1D, G1D, D1D)	1M07F1D
Transmitter spurious, Units @ distance	60.52 dBμV/m Peak and 51.59 dBμV/m Average @ 3 m @ 2483.5 MHz
Power requirements	110–220 Vac; 50/60 Hz
Antenna information	The EUT is professionally installed. Antenna: 6 dBi

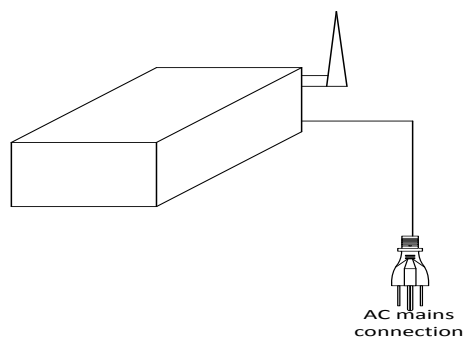
3.4 Product description and theory of operation

This is a Bluetooth transmitter/receiver (2.4 GHz) combined with a 900 MHz transmitter/receiver used to control different products also designed by PixMob and collect data from these products.

3.5 EUT exercise details

For the test purpose, the EUT was controlled by a computer via the DMX input of the Hub to change the output channel and level. Each test was performed at the lowest, middle, and highest channels. When the EUT was running, a pseudo-random sequence was modulated and transmitted.

3.6 EUT setup diagram



Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

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

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

5.2 Power supply range

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

Section 6. Measurement uncertainty

6.1 Uncertainty of measurement

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

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002532	2 year	May 25/17
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Power source	California Instruments	5001ix	FA002494	1 year	April 29/17
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	March 23/17
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	Oct. 5/17
Horn antenna (1–18 GHz)	EMCO	3115	FA001451	1 year	Feb. 22/17
Pre-amplifier (0.5–18 GHz)	COM-POWER	PAM-118A	FA002561	1 year	May 6/17
Pre-amplifier (18–40 GHz)	COM-POWER	PAM-840	FA002508	1 year	May 6/17
2400-2483 MHz Notch Filter	Microwave Circuits	N0324413	FA002693	—	VOU

Notes: VOU - verify on use

Table 7.1-2: test software

Test description	Manufacturer of Software	Details
Radiated emissions – Ottawa	Rhode & Schwarz	EMC32, Software for EMC Measurements, Version 9.26.01

Notes: None

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 §15.207 (a):

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.

RSS-GEN, Clause 8.8:

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: AC power line conducted emissions limits

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

Notes: * - The level decreases linearly with the logarithm of the frequency.

** - A linear average detector is required.

8.1.2 Test summary

Verdict	Pass				
Test date	January 18, 2017	Test engineer	Avul Nzenza		
Temperature	24 °C	Relative humidity	34.5 %	Air pressure	1009 mbar

8.1.3 Notes

None

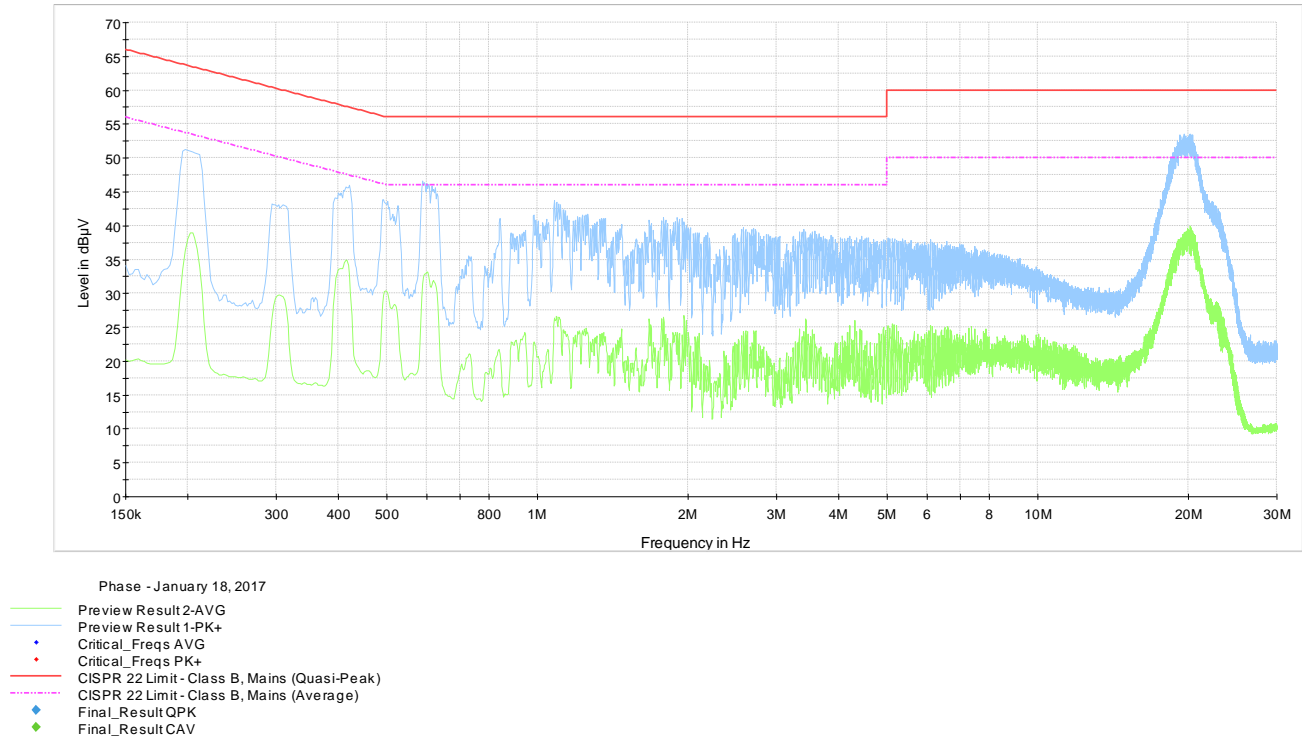
8.1.4 Setup details

Port under test	AC input
EUT setup configuration	Table top
Measurement details	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:

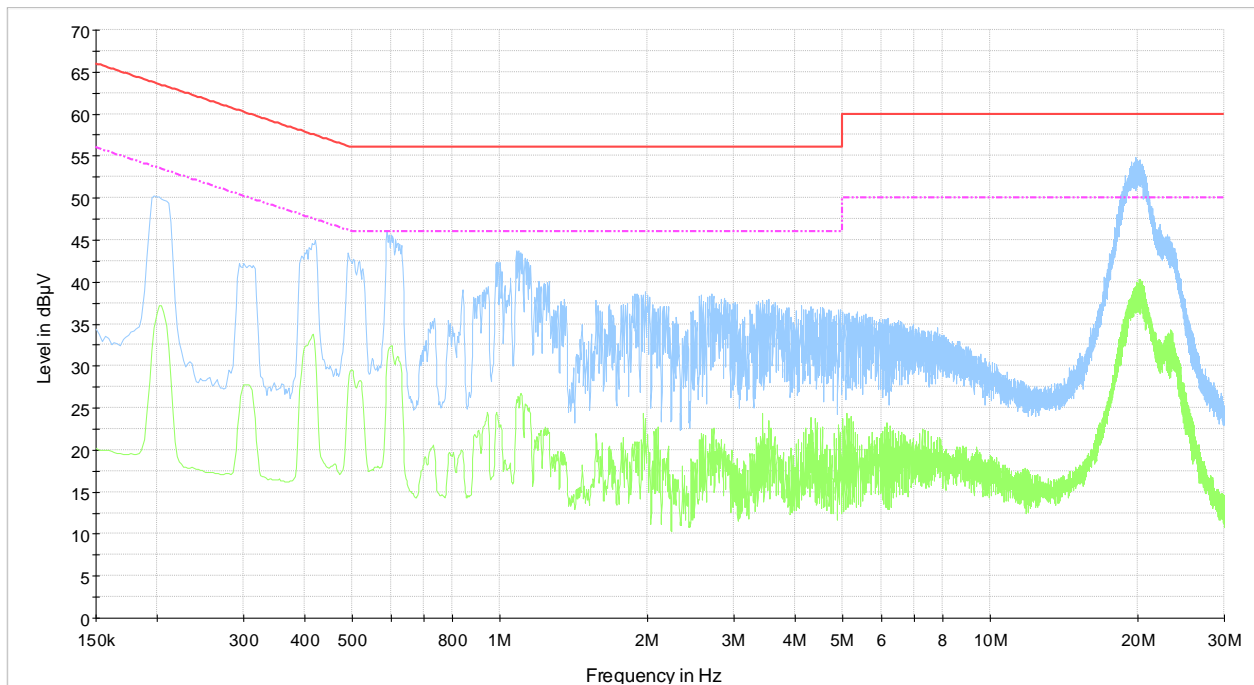
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average (Preview measurement), Quasi-peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	<ul style="list-style-type: none">– 100 ms (Peak and Average preview measurement)– 160 ms (Quasi-peak final measurement)– 160 ms (CAverage final measurement)

8.1.5 Test data



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.1-1: AC power line conducted emissions limits – phase line



- Neutral - January 18, 2017
- Preview Result 2-AVG
- Preview Result 1-PK+
- Critical_Freqs AVG
- Critical_Freqs PK+
- CISPR 22 Limit - Class B, Mains (Quasi-Peak)
- CISPR 22 Limit - Class B, Mains (Average)
- Final_Result QPK
- Final_Result CAV

The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

Figure 8.1-2: AC power line conducted emissions limits – neutral line

8.1.6 Setup photos

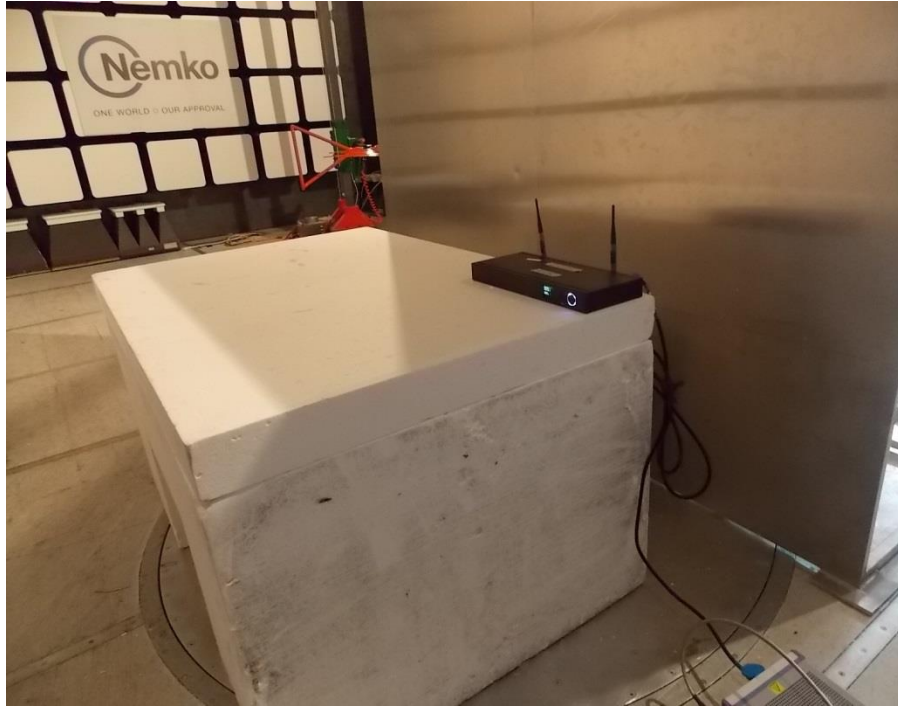


Figure 8.1-3: AC power line conducted emissions limits setup photo



Figure 8.1-4: AC power line conducted emissions limits setup photo

8.2 FCC 15.247(a)(2) and RSS-247 5.2(1): 6 dB bandwidth (DTS-BLE)

8.2.1 Definitions and limits

FCC §15.247 (a)(2):

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

RSS-247, Clause 5.2 (1):

The minimum 6 dB bandwidth shall be 500 kHz.

8.2.2 Test summary

Verdict	Pass				
Test date	February 16, 2017	Test engineer	Avul Nzenza		
Temperature	24 °C	Relative humidity	36.2 %	Air pressure	1012 mbar

8.2.3 Notes

Measurements were performed as per 558074 D01 DTS Meas Guidance v03r05 (The test was performed using method described in Section 8.1)

8.2.4 Setup details

Spectrum analyser settings: for 6 dB bandwidth test:

Resolution bandwidth	100 kHz
Video bandwidth	$\geq 3 \times \text{RBW}$
Frequency span	2 MHz
Detector mode	Peak
Trace mode	Max Hold

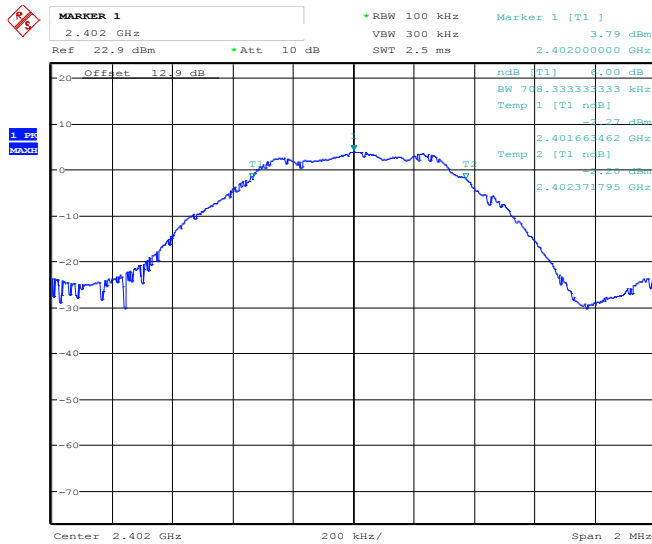
8.2.5 Test data

Table 8.2-1: 6 dB bandwidth results

Frequency, MHz	6 dB bandwidth, kHz	Minimum limit, kHz	Margin, kHz
2402	743	500.0	243
2426	740	500.0	240
2480	705	500.0	205

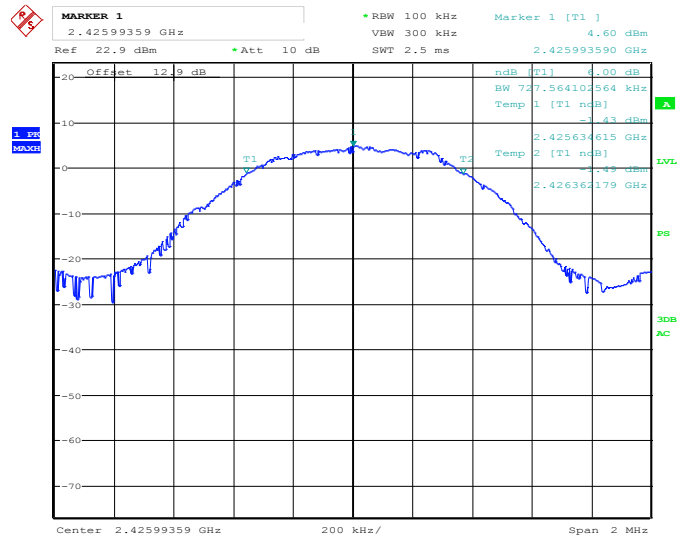
Notes: None

8.2.6 Test data, continued



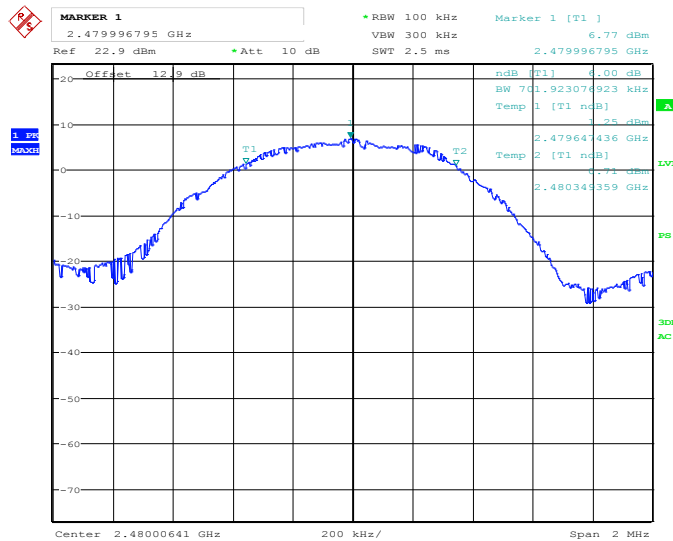
Date: 16.FEB.2017 12:50:47

Figure 8.2-1: 6 dB bandwidth on low channel



Date: 16.FEB.2017 12:48:14

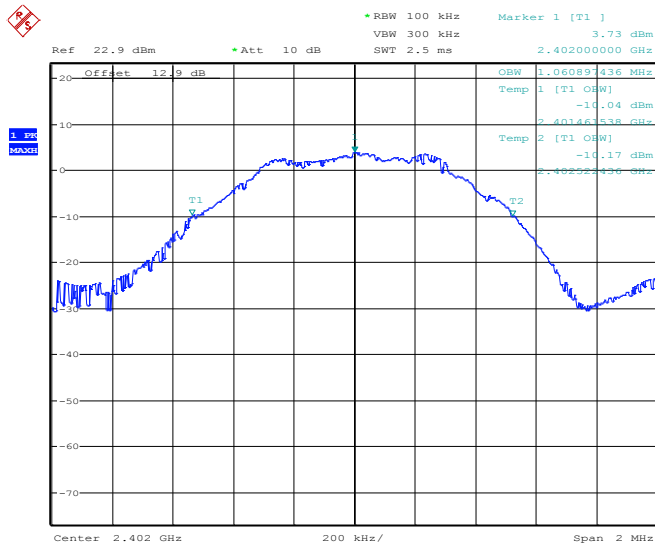
Figure 8.2-2: 6 dB bandwidth on mid channel



Date: 16.FEB.2017 12:45:13

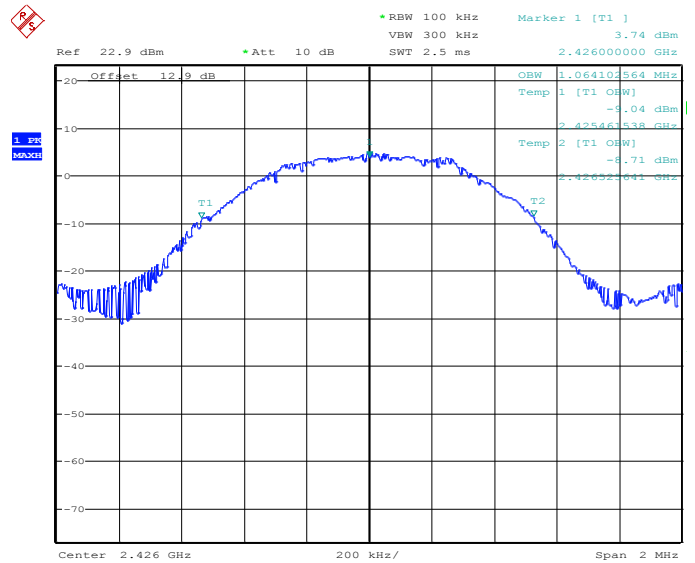
Figure 8.2-3: 6 dB bandwidth on high channel

8.2.7 Test data, continued



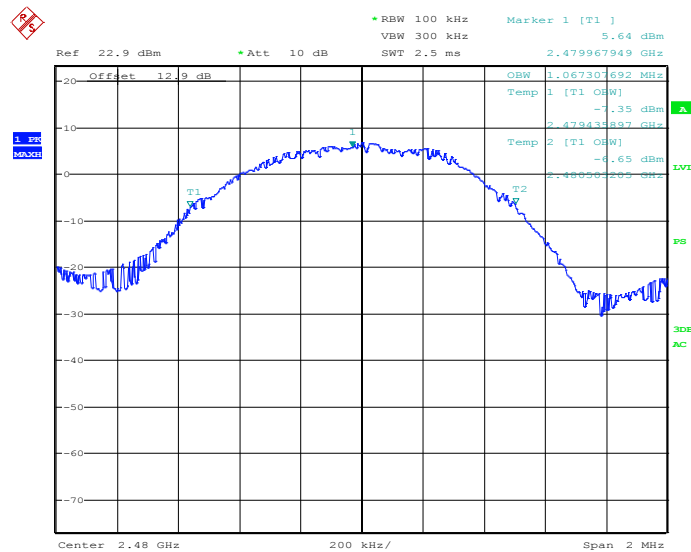
Date: 16.FEB.2017 12:52:27

Figure 8.2-4: 99% bandwidth on low channel



Date: 16.FEB.2017 12:54:25

Figure 8.2-5: 99% bandwidth on mid channel



Date: 16.FEB.2017 12:56:24

Figure 8.2-6: 99% bandwidth on high channel

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 §15.247 (b)(3,4):

(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 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.
- (4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247, Clause 5.4 (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.

Fixed point-to-point systems in the bands 2400–2483.5 MHz and 5725–5850 MHz are permitted to have an e.i.r.p. higher than 4 W provided that the higher e.i.r.p. is achieved by employing higher gain directional antennas and not higher transmitter output powers. Point-to-multipoint systems, omnidirectional applications and multiple co-located transmitters transmitting the same information are prohibited from exceeding an e.i.r.p. of 4 W.

8.3.2 Test summary

Verdict	Pass				
Test date	February 16, 2017	Test engineer	Avul Nzenza		
Temperature	24 °C	Relative humidity	36.2 %	Air pressure	1012 mbar

8.3.3 Notes

The test was performed according to 558074 D01 DTS Meas Guidance v03r05 (The test was performed using method described in Section 9.1.1 Method Peak Power Measurements.

8.3.4 Setup details

Spectrum analyser settings:

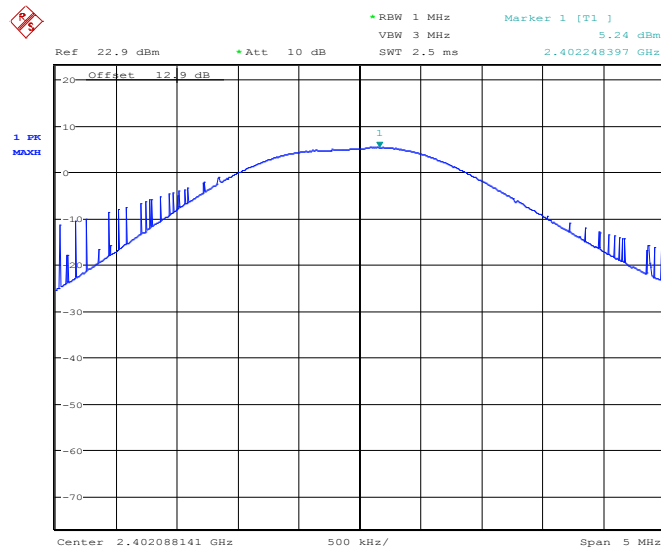
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Frequency span	5 MHz
Detector mode	Peak
Trace mode	Max Hold

8.3.5 Test data

Table 8.3-1: Output power measurements results

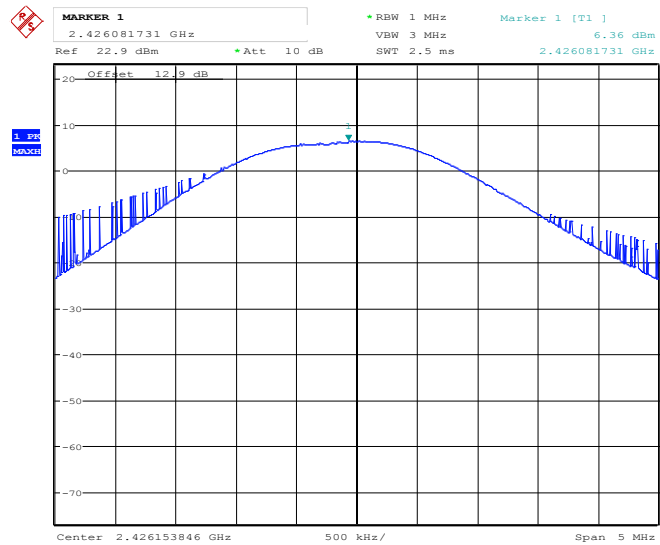
Frequency, MHz	Conducted output power, dBm		Margin, dB	Antenna gain, dBi	EIRP, dBm	EIRP limit, dBm	EIRP margin, dB
	Measured	Limit					
2402	5.24	30	24.76	6	11.24	36	24.76
2426	6.36	30	23.64	6	12.36	36	23.64
2480	8.41	30	21.59	6	14.41	36	21.59

Notes: EIRP = Output power + Antenna gain



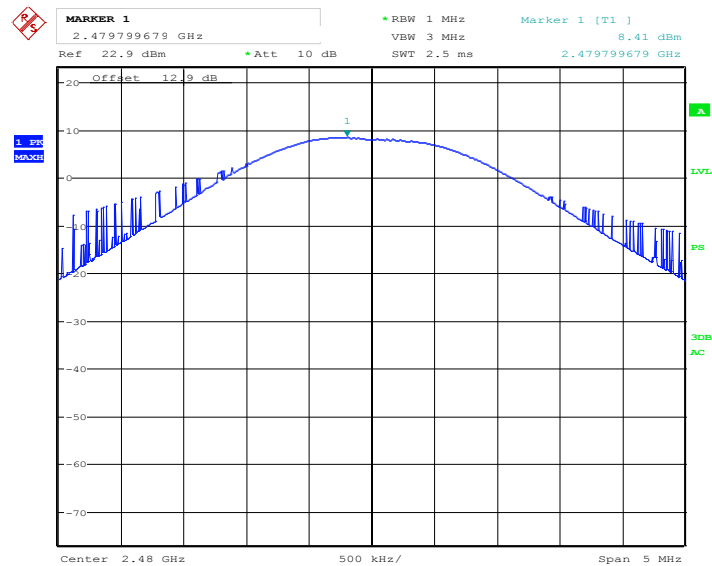
Date: 16.FEB.2017 12:37:44

Figure 8.3-1: Output power on low channel



Date: 16.FEB.2017 12:40:35

Figure 8.3-2: Output power on mid channel



Date: 16.FEB.2017 12:41:55

Figure 8.3-3: Output power on high channel

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

8.4.1 Definitions and limits

FCC §15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

RSS-247, Clause 5.5:

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.

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

Notes: Certain frequency bands listed in this table 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

Verdict	Pass				
Test date	February 16, 2017	Test engineer	Avul Nzenza		
Temperature	24 °C	Relative humidity	36.2 %	Air pressure	1012 mbar

8.4.3 Notes

- The spectrum was searched from 30 MHz to the 10th harmonic.
- Since fundamental power was tested using Peak method, the spurious emissions limit is –20 dBc/100 kHz

8.4.4 Setup details

Spectrum analyser settings for conducted measurements:

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

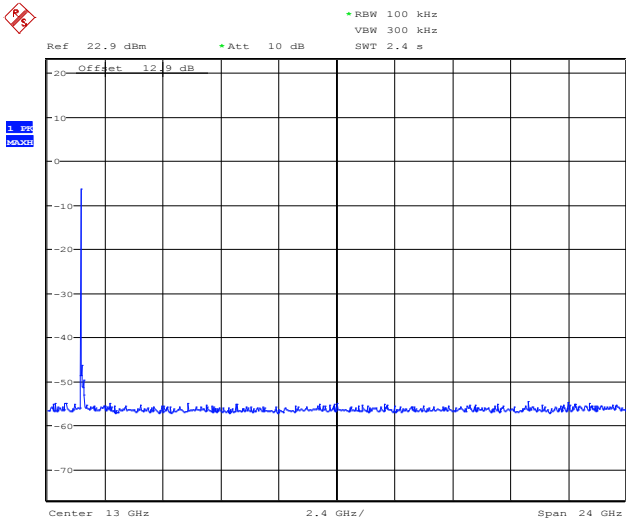
Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

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:

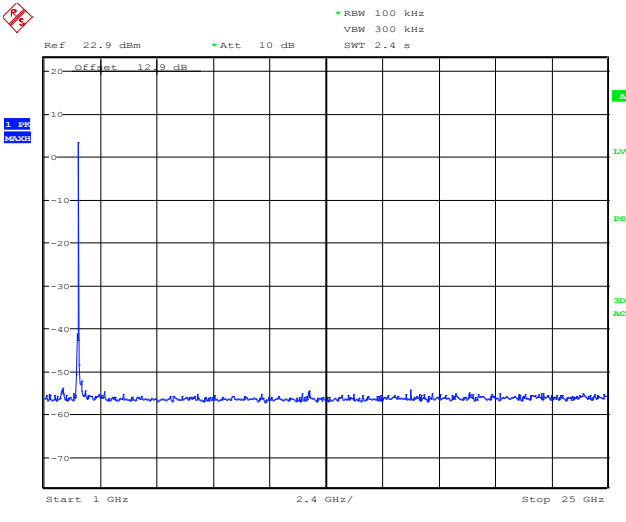
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.4.5 Test data



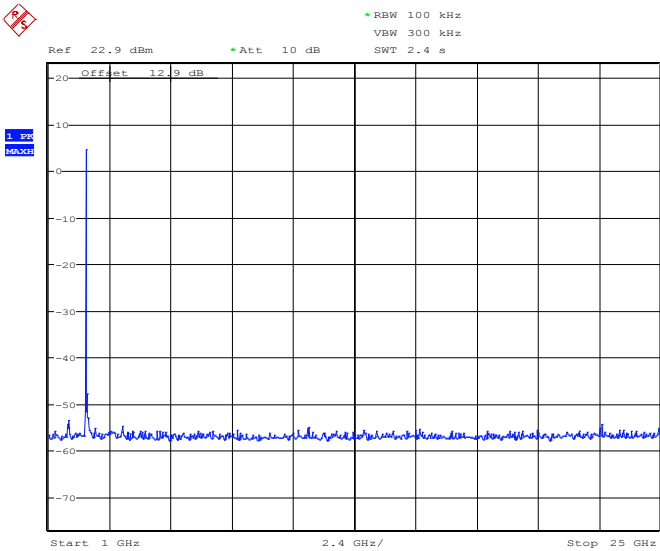
Date: 16.FEB.2017 13:40:46

Figure 8.4-1: Conducted spurious (out-of-band) emissions, low channel



Date: 16.FEB.2017 13:33:54

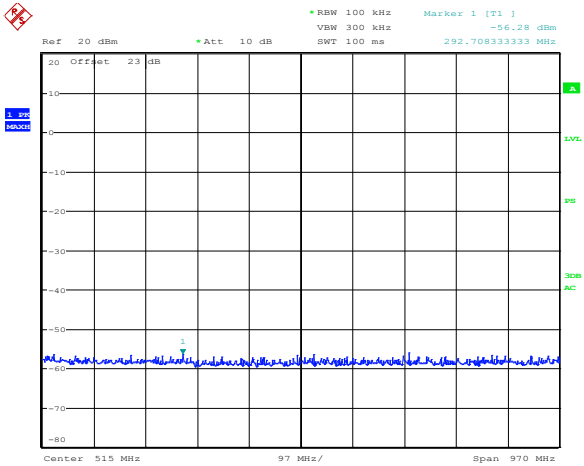
Figure 8.4-2: Conducted spurious (out-of-band) emissions, mid channel



Date: 16.FEB.2017 13:23:38

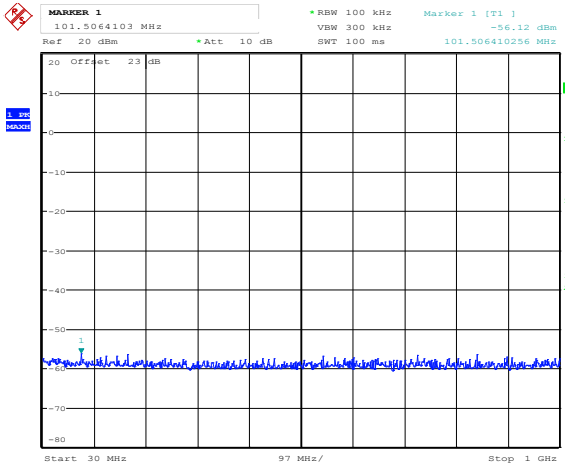
Figure 8.4-3: Conducted spurious (out-of-band) emissions, high channel

8.4.5 Test data, continued



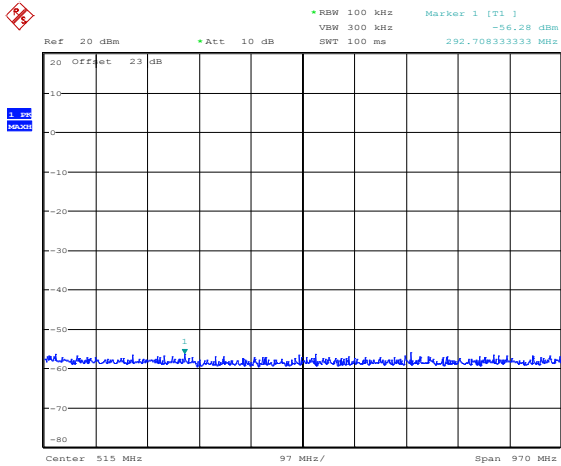
Date: 18.JAN.2017 09:51:48

Figure 8.4-4: Radiated spurious (out-of-band) emissions, low channel, 30 to 1000 MHz



Date: 18.JAN.2017 10:20:38

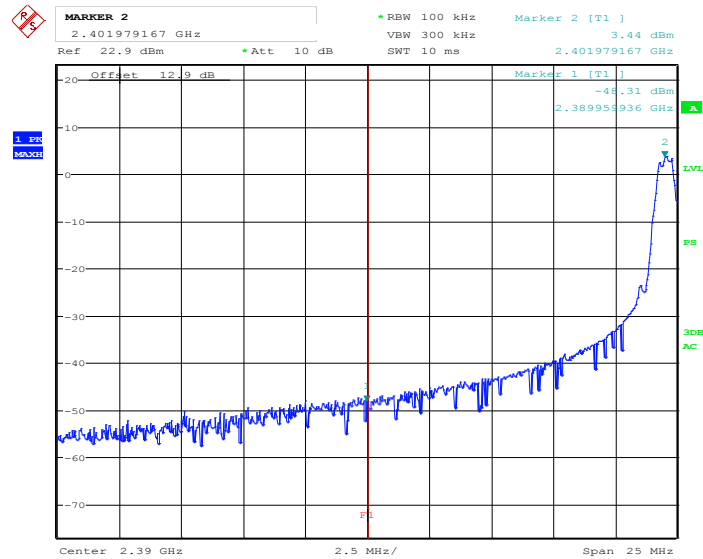
Figure 8.4-5: Radiated spurious (out-of-band) emissions, mid channel, 30 to 1000 MHz



Date: 18.JAN.2017 09:51:48

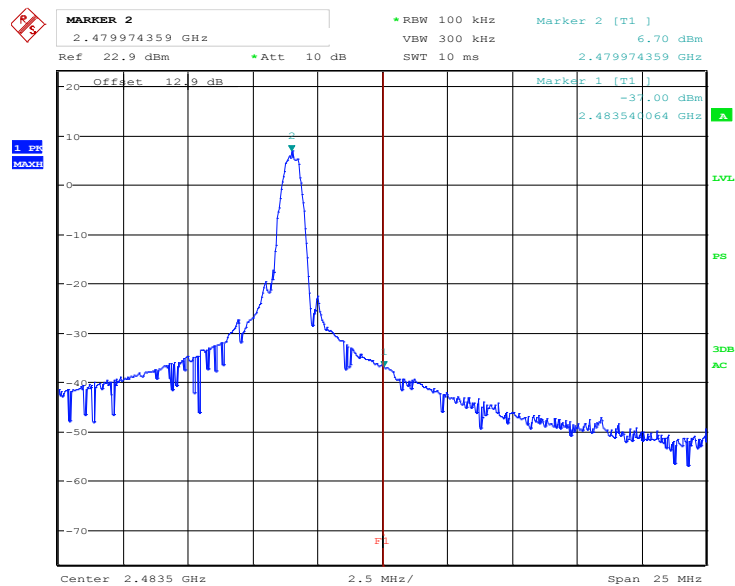
Figure 8.4-6: Radiated spurious (out-of-band) emissions, high channel, 30 to 1000 MHz

8.4.6 Test data, continued



Date: 16.FEB.2017 13:05:17

Figure 8.4-7: Conducted spurious (out-of-band) emissions Lower band, low channel



Date: 16.FEB.2017 13:00:31

Figure 8.4-8: Conducted spurious (out-of-band) emissions upper band, high channel

8.4.5 Test data, continued

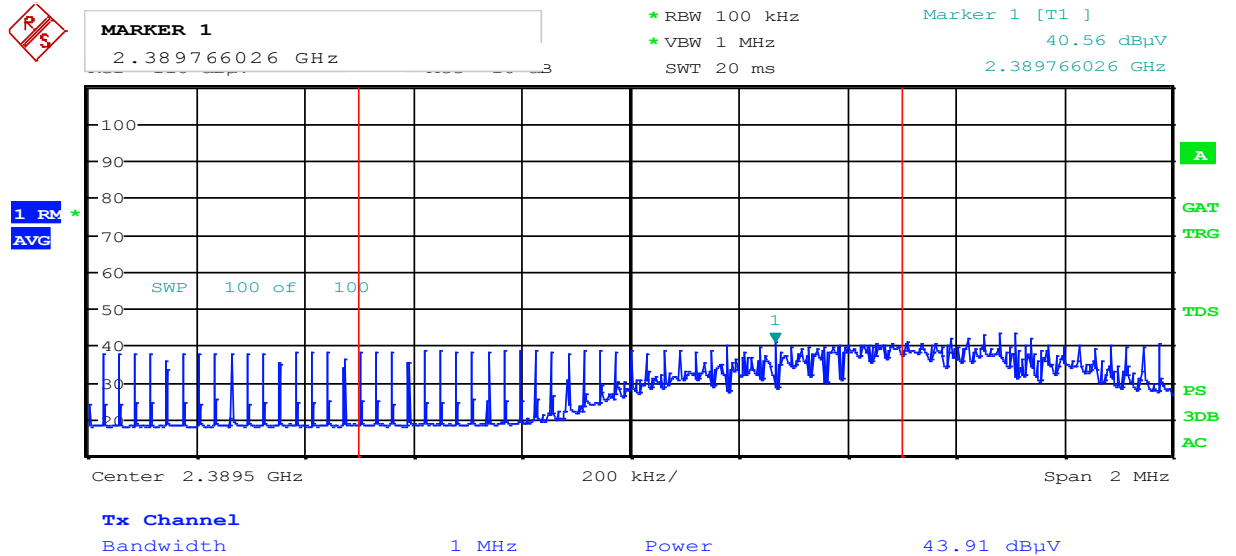


Figure 8.4-9: Radiated spurious (out-of-band) emissions Lower band edge emission, low channel_Avg

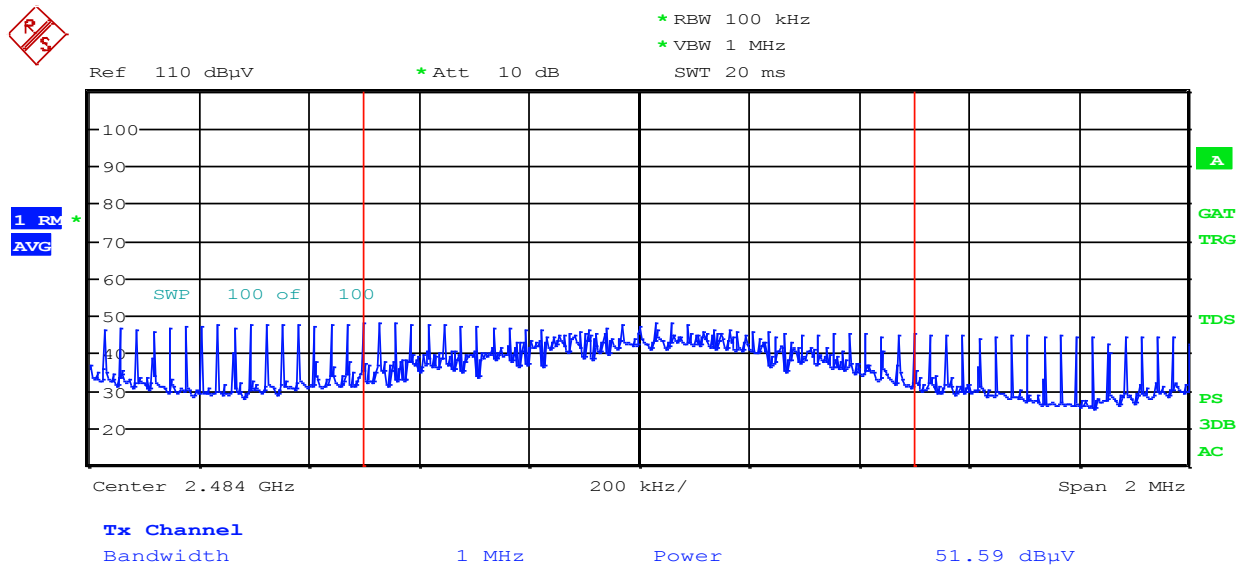


Figure 8.4-10: Radiated spurious (out-of-band) emissions Upper band edge emission -Avg

8.4.6 Test data, continued

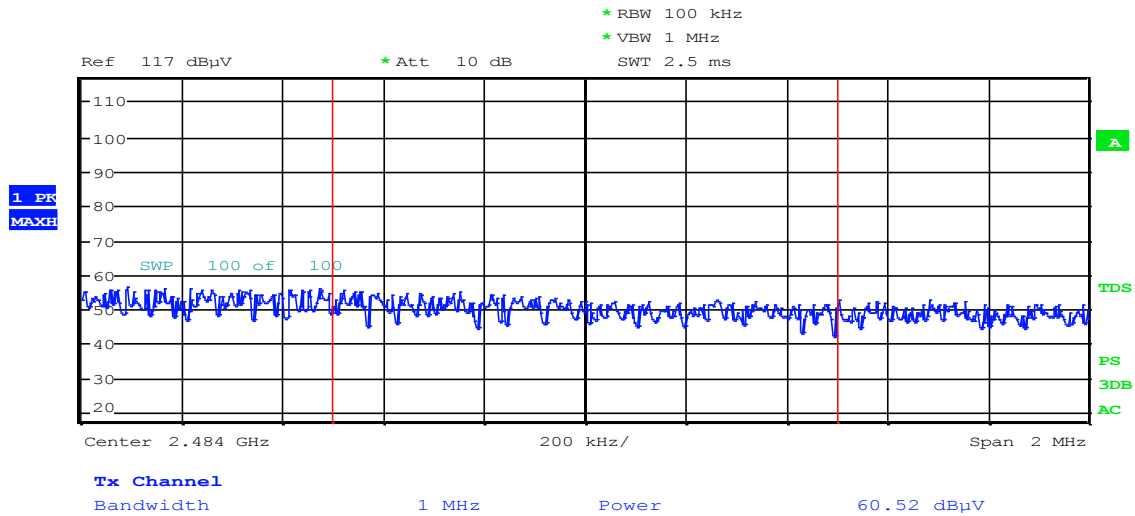


Figure 8.4-11: Radiated spurious (out-of-band) emissions upper band edge emission, low channel_Peak

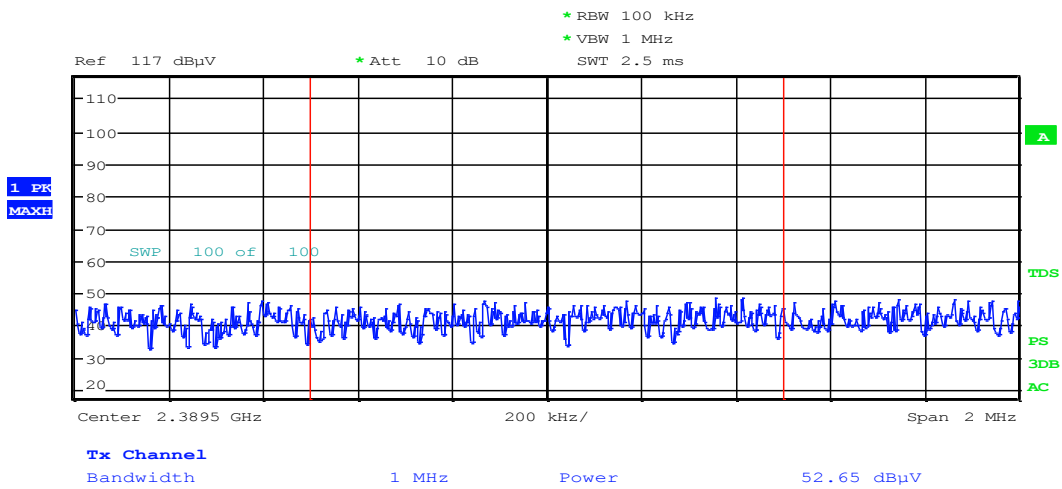
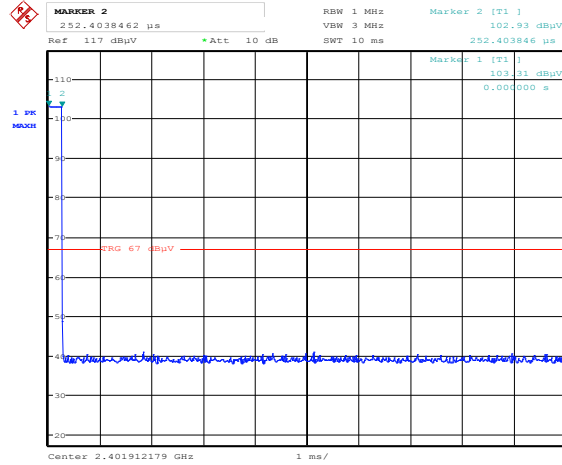


Figure 8.4-12: Radiated spurious (out-of-band) emissions lower band edge emission -Peak

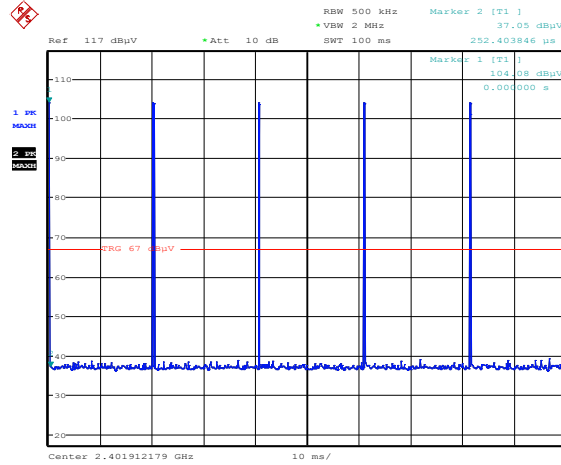
8.4.5 Test data, continued

Duty Cycle



Date: 16.FEB.2017 12:09:06

Figure 8.4-13: Pulse width



Date: 16.FEB.2017 12:09:59

Figure 8.4-14: Number of pulses within 100 ms time frame

Duty Cycle Calculation:

Tx on Time: $0.236 \text{ ms} \times 10$ (10 pulses within 100 ms time frame) = 2.36 ms

8.4.5 Test data, continued

Table 8.4-4: Radiated field strength measurement results

Channel	Frequency, MHz	Peak Field strength, dBμV/m		Peak margin, dB	Average Field strength, dBμV/m		Margin, dB
		Measured	Limit		Measured	Limit	
High	2483.5	60.52	74	5.68	51.59	54	2.41
Low	2390.0	52.65	74	18.42	43.91	54	10.09

Notes: Field strength (dBμV/m) = Spectrum analyzer value (dBμV) + transducer factors (dB)
Transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).
All other emissions were greater than 20 dB from limit.

8.4.6 Setup photos, continued



Figure 8.4-15: Radiated spurious (out-of-band) emissions setup photo – above 1 GHz



Figure 8.4-16: Radiated spurious (out-of-band) emissions setup photo – above 1 GHz

8.5 FCC 15.247(e) and RSS-247 5.2(2) Power spectral density for digitally modulated devices

8.5.1 Definitions and limits

FCC §15.247 (e):

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.

RSS-247, Clause 5.2 (2):

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of Section 5.4(4), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

8.5.2 Test summary

Verdict	Pass				
Test date	February 16, 2017	Test engineer	Avul Nzenza		
Temperature	24 °C	Relative humidity	36.2 %	Air pressure	1012 mbar

8.5.3 Notes

Measurements were performed as per 558074 D01 DTS Meas Guidance v03r05. (The test was performed using method described in section 10.2 Method (Peak PSD))

8.5.4 Setup details

Spectrum analyser settings:

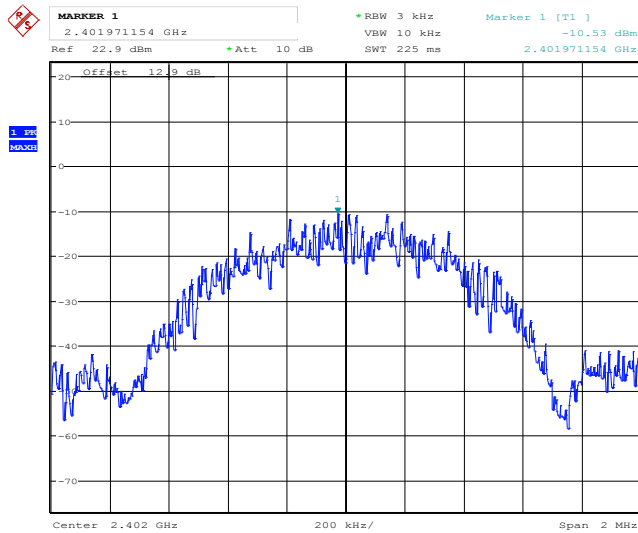
Resolution bandwidth:	3 kHz
Video bandwidth:	10 kHz
Frequency span:	2 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.5.5 Test data

Table 8.5-1: PSD measurements results

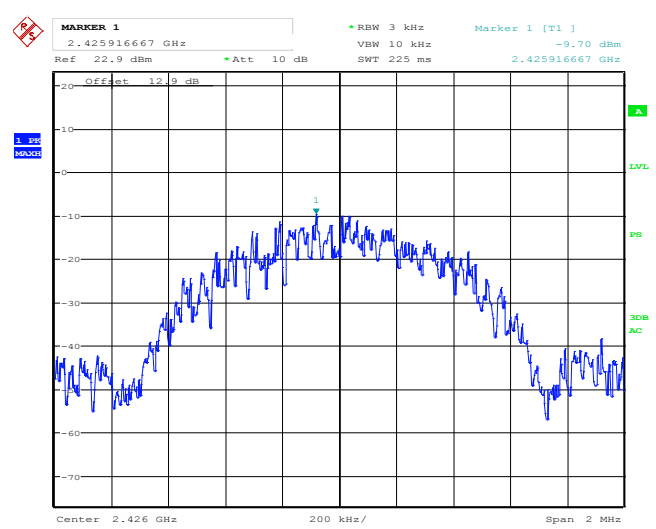
Frequency, MHz	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
2402	-10.53	8.00	18.53
2426	-9.70	8.00	16.70
2480	-7.43	8.00	15.43

Notes: Power setting set to 5 via remote PC



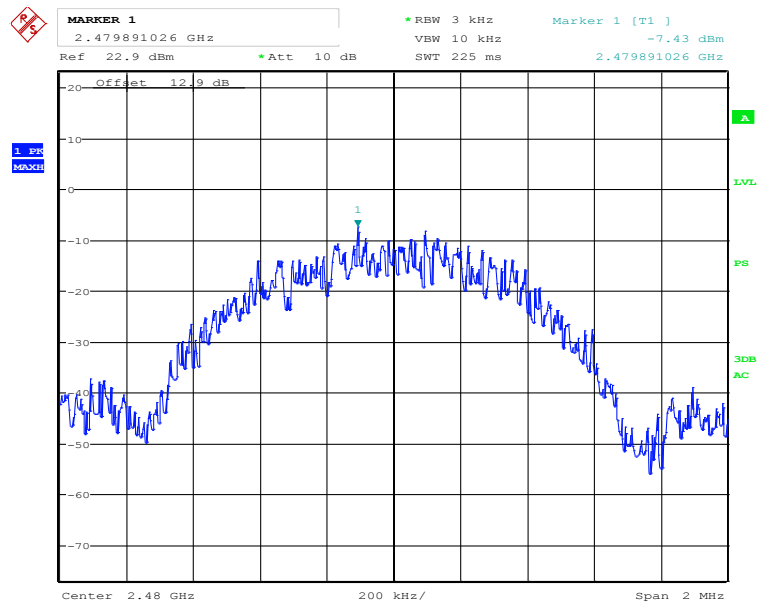
Date: 16.FEB.2017 13:09:17

Figure 8.5-1: PSD sample plot on low channel



Date: 16.FEB.2017 13:11:39

Figure 8.5-2: PSD sample plot on mid channel

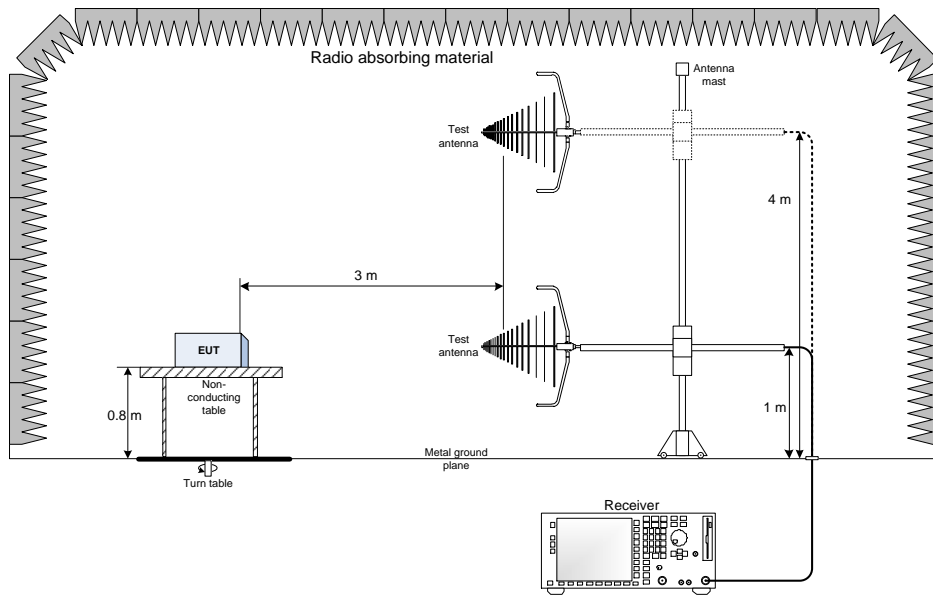


Date: 16.FEB.2017 13:13:51

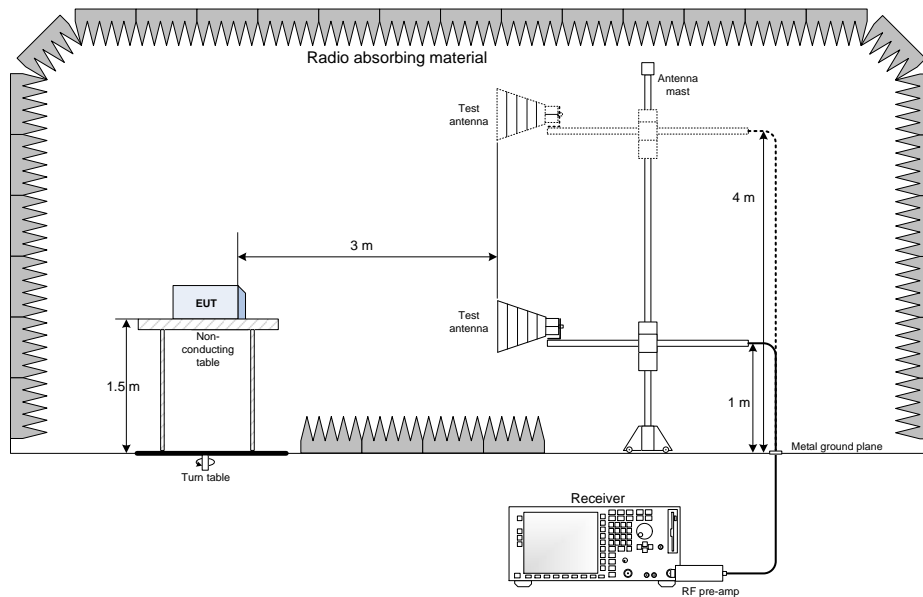
Figure 8.5-3: PSD sample plot on high channel

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up

