

Date: ESPOO 28.11.2013

Page: 1 (18)

Appendices –

Number:
No. 1 / 1

239892BI

Date of handing in: 02.07.2013

Tested by:



Pekka Kälviäinen, Test Engineer

Reviewed by:



Timo Leismala, Test Manager

SORT OF EQUIPMENT:

2.4 GHz Transceiver

TRADE MARK:

TYPE:

MANUFACTURER:

instalink-usb

Mirion Technologies (RADOS) Oy

CLIENT:

Mirion Technologies (RADOS) Oy

ADDRESS:

P.O. Box 506 (Mustionkatu 2), FI – 20101 Turku, Finland

TEST LABORATORY:

Nemko Oy

FCC REG. NO.

359859 October 20, 2011

IC FILE NO.

2040F-1 November 22, 2012

SUMMARY:

In regard to the performed tests the equipment under test fulfils the requirements defined in the test specifications, see page 2 for details

The test results are valid for the tested unit only. Without a written permission of Nemko Oy it is allowed to copy this report as a whole, but not partially.

Summary of performed tests and test results

<i>Section in CFR 47</i>	<i>Section in RSS-GEN or RSS-210, Issue 8</i>		<i>Result</i>
15.249 (a)	A2.9	Field strength of fundamental	PASS
15.249 (d)(e), 15.209	A2.9	Band-edge compliance of RF emissions	PASS
15.249 (d)(e), 15.209	A2.9	Spurious radiated emissions	PASS
15.215		20 dB bandwidth	X
15.107	7.2.2	AC power line conducted emissions	N/A

Explanations:

PASS The EUT passed that particular test.
FAIL The EUT failed that particular test.
N.A. The test not applicable, battery operated equipment
X The measurement was done, but there is no applicable performance criteria.

Contents

Summary of performed tests and test results	2
1. EUT and Accessory Information	4
1.1 EUT description	4
1.2 EUT and accessories	4
1.3 Additional information related to testing	4
2. Test setups	5
3. Standards and measurement methods	6
4. Test results	6
4.1 Field strength of fundamental	6
4.1.1 EUT operation mode	6
4.1.2 Test method and limit	6
4.1.3 Test results	7
4.2 Band-edge compliance of RF emissions	9
4.2.1 EUT operation mode	9
4.2.2 Test method and limit	9
4.2.3 Test results	10
4.3 Spurious radiated emission	11
4.3.1 EUT operation mode	11
4.3.2 Test method and limit	11
4.3.3 Test results	13
4.4 20 dB bandwidth	14
4.4.1 EUT operation mode	14
4.4.2 Test method and limit	14
4.4.3 Test results	14
4.5 Duty cycle correction factor, Transmit time in 100 ms	16
4.5.1 Test data	16
5. List of test equipment	17
6. Photographs	18

1. EUT and Accessory Information

1.1 EUT description

2.4 GHz transceiver, Digital modulated, 80 channels

1.2 EUT and accessories

Setup1

	<i>unit</i>	<i>type</i>	<i>s/n</i>
<i>EUT</i>	Transceiver	instalink-usb	8715

Operating voltages

5.0 VDC from **USB-connector**

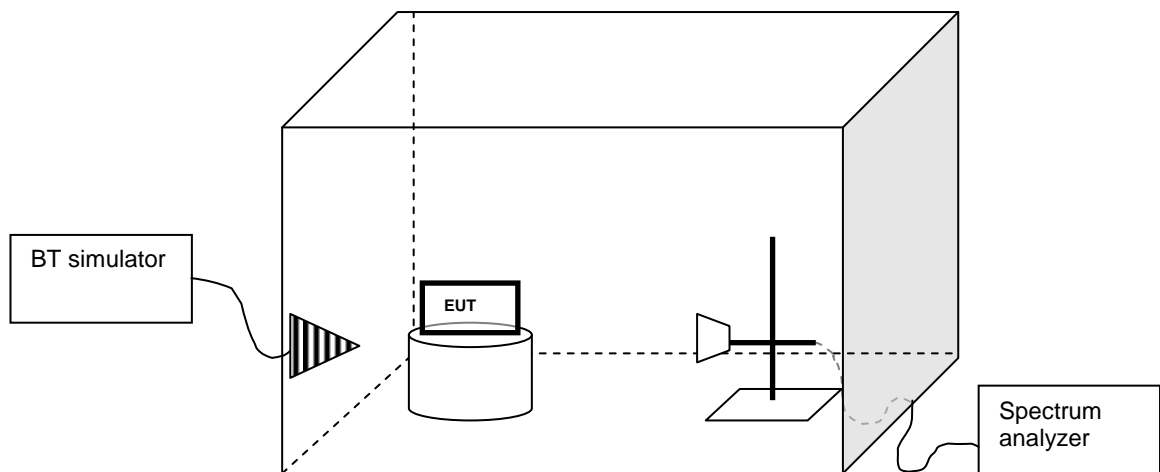
1.3 Additional information related to testing

Tested Technology:	Digital modulated, 80 channels	
Antenna:	Integral	
Type of Unit	Transmitter	
Modulation:	BT	
Power Supply Requirement:	Nominal	5.0V
Transmit Frequency Range	2400 MHz to 2483.5 MHz	
Transmit Channels Tested:	Channel Frequency (MHz)	
	2402	
	2426	
	2480	

2. Test setups

Setup (Radiated measurements)

The test was performed inside a semi anechoic shielded room. For the duration of the test the EUT was placed on a non-conductive support 0.8 m high standing on the turntable. The tower and turn table were remotely controlled to turn the EUT and change the antenna polarization. The measured signal was routed from the measuring antenna to the spectrum analyzer. A BT simulator was not used.



3. Standards and measurement methods

The test were performed in guidance of the CFR 47, FCC Rules Part 15 Subpart C, ANSI C63.4 (2003), CISPR 22 Ed. 6.0, Public notice DA 00-705, ANSI C63.10 (2009), IC standards RSS-GEN (Issue 3, December 2010) and RSS-210 (Issue 8, December 2010).

4. Test results

4.1 Field strength of fundamental

The test was performed as a compliance test. The test parameters concerned were as follows:

<i>EUT</i>	setup1
<i>Site name</i>	Nemko Oy / Perkkaa
<i>FCC rule part</i>	§ 15.249 (a)
<i>Section in RSS-210</i>	A2.9
<i>Date of testing</i>	02.07.2013
<i>Test equipment</i>	566, 525, 350
<i>Test conditions</i>	24 °C, 51 % RH

4.1.1 EUT operation mode

<i>EUT frequency (MHz)</i>	2402, 2426 and 2480
----------------------------	----------------------------

4.1.2 Test method and limit

<i>Frequency range (MHz)</i>	<i>Limit Average (dBµV/m)</i>	<i>Limit Peak (dBµV/m)</i>
2400 – 2483.5	≤ 94	≤ 114

The measurement results were obtained as described below.

$$E [\text{dB}(\mu\text{V/m})] = U_{RX} + A_{CABLE} + AF$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

Duty Cycle correction factor(dB) -55.49 dB was used. (RFon 0.168ms/100ms)

4.1.3 Test results

frequency (MHz)	E Average (dB μ V/m)	E Peak (dB μ V/m)	Result
2402	43.42	98.91	PASS
2426	42.63	98.12	PASS
2480	41.50	96.99	PASS

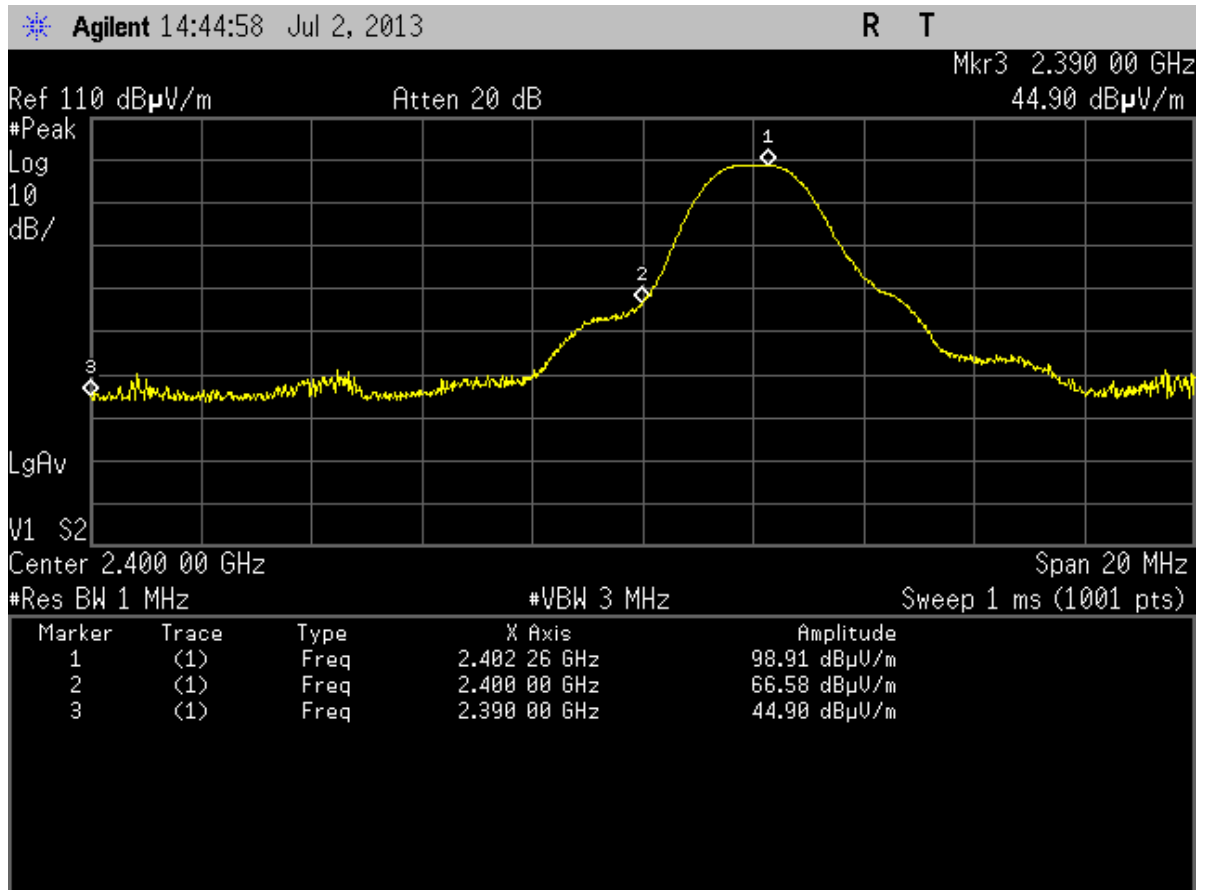


Figure 1. 2402MHz, Field strength of fundamental, peak and Band-edge compliance, low end, peak

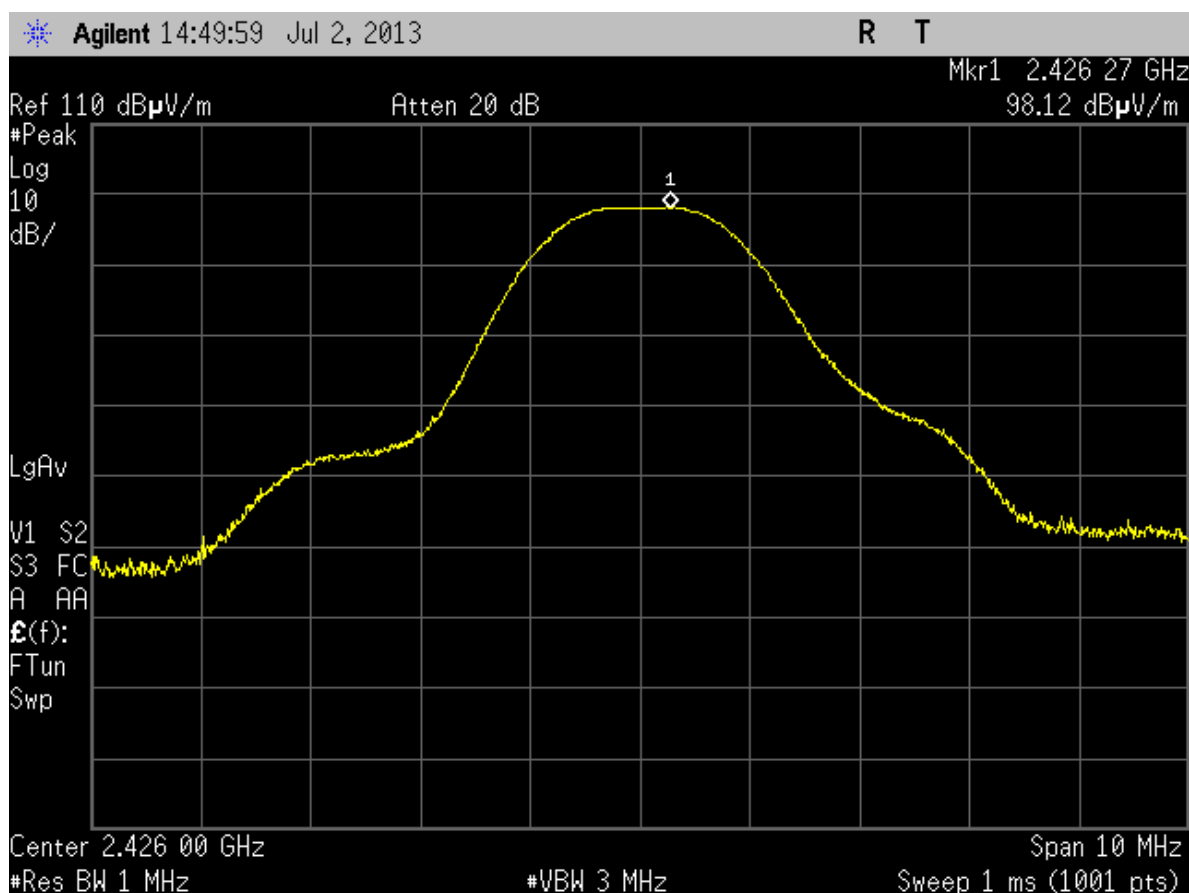


Figure 2. 2426MHz, Field strength of fundamental

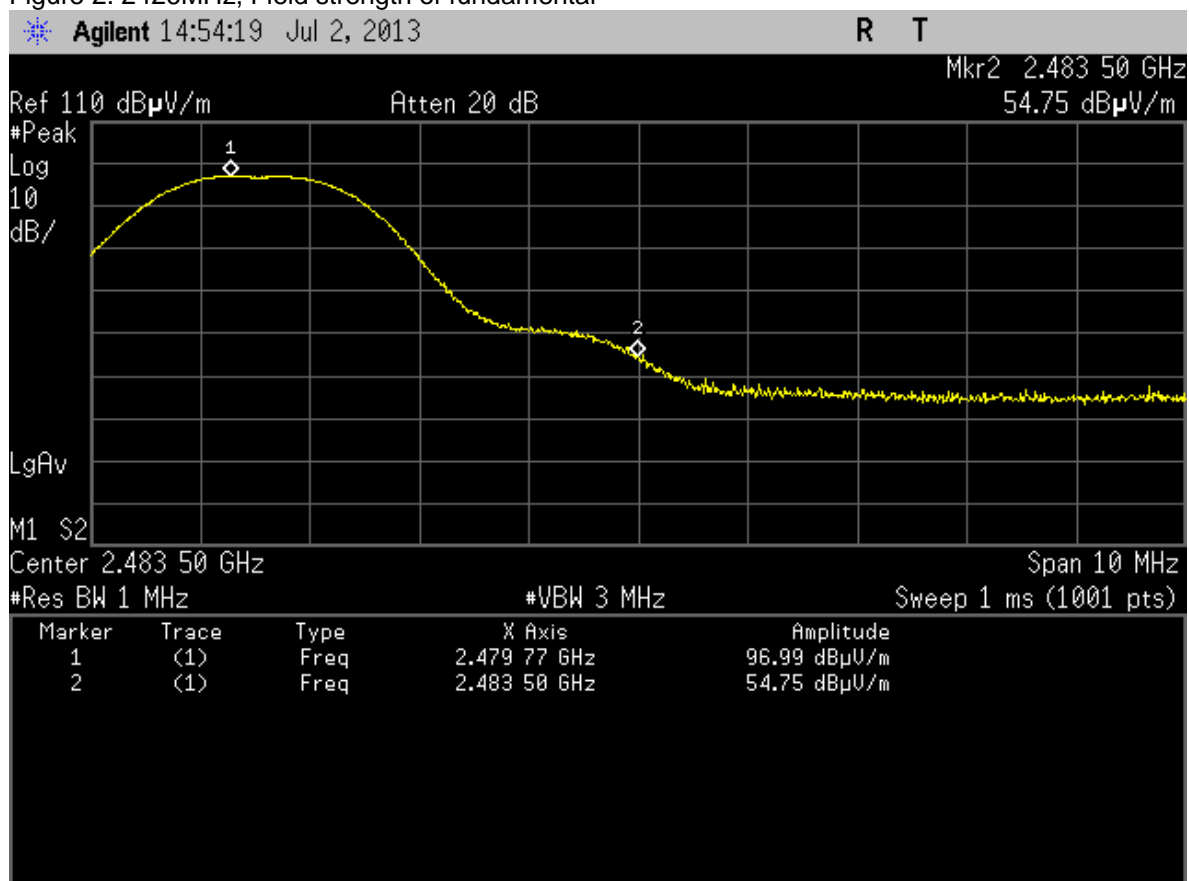


Figure 3. 2480MHz, Field strength of fundamental and Band-edge compliance, high end

4.2 Band-edge compliance of RF emissions

The test was performed as a compliance test. The test parameters concerned were as follows:

<i>EUT</i>	setup1
<i>Site name</i>	Nemko Oy / Perkkaa
<i>FCC rule part</i>	§ 15.249 (d)(e), § 15.209
<i>Section in RSS-210</i>	A2.9
<i>Date of testing</i>	02.07.2013
<i>Test equipment</i>	566, 525, 350
<i>Test conditions</i>	24 °C, 51 % RH
<i>Test result</i>	PASS

4.2.1 EUT operation mode

<i>EUT frequency (MHz)</i>	2402 and 2480
----------------------------	----------------------

4.2.2 Test method and limit

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

3m measurement distance

<i>Frequency range (MHz)</i>	<i>Limit Average (dBμV/m)</i>	<i>Limit Peak (dBμV/m)</i>
Below 2390 and above 2483.5	≤ 54	≤ 74

The measurement results were obtained as described below.

$$E [\text{dB}(\mu\text{V/m})] = U_{RX} + A_{CABLE} + AF$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

Duty Cycle correction factor(dB) -55.49 dB was used. (RFon 0.168ms/100ms)

4.2.3 Test results

2402 MHz:

Below 2400 MHz:

<i>Detector (RBW: 1MHz)</i>	<i>E (dBμV/m)</i>	<i>Result</i>
Peak	66.58	PASS
Average	11.09	PASS

2480 MHz:

Above 2483.5 MHz:

<i>Detector (RBW: 1MHz)</i>	<i>E (dBμV/m)</i>	<i>Result</i>
Peak	54.75	PASS
Average	-0.74	PASS

4.3 Spurious radiated emission

The test was performed as a compliance test. The test parameters concerned were as follows:

<i>EUT</i>	setup1
<i>Site name</i>	Nemko Oy / Perkkaa
<i>FCC rule part</i>	§ 15.249 (d)(e), § 15.209
<i>Section in RSS-210</i>	A2.9
<i>Date of testing</i>	02.07.2013
<i>Test equipment</i>	566, 709, 564, 559, 525, 319, 544, 350, 88, 710
<i>Test conditions</i>	24 °C, 52 % RH

4.3.1 EUT operation mode

<i>EUT frequency(MHz)</i>	2402, 2426 and 2480
---------------------------	----------------------------

4.3.2 Test method and limit

The test was performed in a semi-anechoic shielded room. The EUT was placed on a non-conductive 0.8 m high table standing on the turntable. During the test the distance from the EUT to the measuring antenna was 3 m. The excess length of the cables of the EUT was made into bundles 30-40 cm in length (see photograph 1). In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna and the lay-out of the EUT cables were varied during the tests. The test was performed with the measuring antenna being both in horizontal and vertical polarizations.

Vertical and horizontal polarizations in the frequency range 30 – 1000 MHz was measured by using the peak detector. During the peak detector scan, the turntable was rotated from 0° to 360° with 30° step with the antenna heights 1.0 m and 3.0 m. The highest levels of the radiated interference field strength measured by using the quasi-peak detector were recorded.

Vertical and horizontal polarizations in the frequency range 1000 – 25000 MHz was measured by using the peak detector. During the peak detector scan, the turntable was rotated from 0° to 360° with 15° step with the antenna heights 1.0 m, 1.5m, 2.0m, 2.5m and 3.0 m. The highest levels of the radiated interference field strength measured by using the average and peak detectors were recorded.

Minimum Standard: Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

Emissions falling in the restricted bands of 15.205 shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions.

3m measuring distance, FCC Part 15.209

<i>Frequency band MHz</i>	<i>limit, Quasi peak detector dB(μV/m)</i>
30 - 88	40
88 - 216	43.5
216 - 960	46
960 - 1000	54

<i>Frequency band MHz</i>	<i>limit, average detector dB(μV/m)</i>	<i>limit, peak detector dB(μV/m)</i>
1000 - 25000	54	74

The EUT was tested on three orthogonal axes.

The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency per 15.33.

The device was tested on three channels per 15.31(l).

The CFR 47 Part 15. Subpart B. Class B limit of 500 μV/m has been calculated to correspond 54 dB(μV/m) as follows: $[dB(\mu V/m)] = 20 \log[\mu V/m]$.

The measurement results were obtained as described below.

$$E [dB(\mu V/m)] = U_{RX} + A_{CABLE} + AF - G_{PREAMP}$$

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

Duty Cycle correction factor(dB) -55.49 dB was used. (RFon 0.168ms/100ms)

4.3.3 Test results

setup1:

below 1GHz: RBW 120kHz

above 1GHz: peak, RBW 1MHz, VBW 3MHz

2402MHz

<i>Frequency MHz</i>	<i>Peak dB(μV/m)</i>	<i>Limit dB(μV/m)</i>	<i>Margin dB</i>	<i>Result</i>
7206	54.4	74	19.6	PASS

<i>Frequency MHz</i>	<i>Average dB(μV/m)</i>	<i>Limit dB(μV/m)</i>	<i>Margin dB</i>	<i>Result</i>
7206	-1.1	54	55.1	PASS

2426MHz

<i>Frequency MHz</i>	<i>Peak dB(μV/m)</i>	<i>Limit dB(μV/m)</i>	<i>Margin dB</i>	<i>Result</i>
7278	56.3	74	17.7	PASS

<i>Frequency MHz</i>	<i>Average dB(μV/m)</i>	<i>Limit dB(μV/m)</i>	<i>Margin dB</i>	<i>Result</i>
7278	0.8	54	53.2	PASS

2480MHz

<i>Frequency MHz</i>	<i>Peak dB(μV/m)</i>	<i>Limit dB(μV/m)</i>	<i>Margin dB</i>	<i>Result</i>
7440	56.6	74	17.4	PASS

<i>Frequency MHz</i>	<i>Average dB(μV/m)</i>	<i>Limit dB(μV/m)</i>	<i>Margin dB</i>	<i>Result</i>
7440	1.1	54	52.9	PASS

4.4 20 dB bandwidth

The test was performed as a compliance test. The test parameters concerned were as follows:

<i>EUT</i>	setup 1
<i>Site name</i>	Nemko Oy / Perkkaa
<i>FCC rule part</i>	§ 15.215
<i>Date of testing</i>	30.10.2013
<i>Test equipment</i>	566, 525, 350
<i>Test conditions</i>	22 °C, 31 % RH

4.4.1 EUT operation mode

<i>EUT frequency (MHz)</i>	2402, 2426 and 2480
----------------------------	----------------------------

4.4.2 Test method and limit

The measurement is made according to Public notice DA 00-705 and IC standard RSS-210.

<i>Limit (MHz)</i>
N/A

4.4.3 Test results

<i>EUT frequency (MHz)</i>	<i>20 dB bandwidth (MHz)</i>
2402	1.208
2426	1.191
2480	1.225

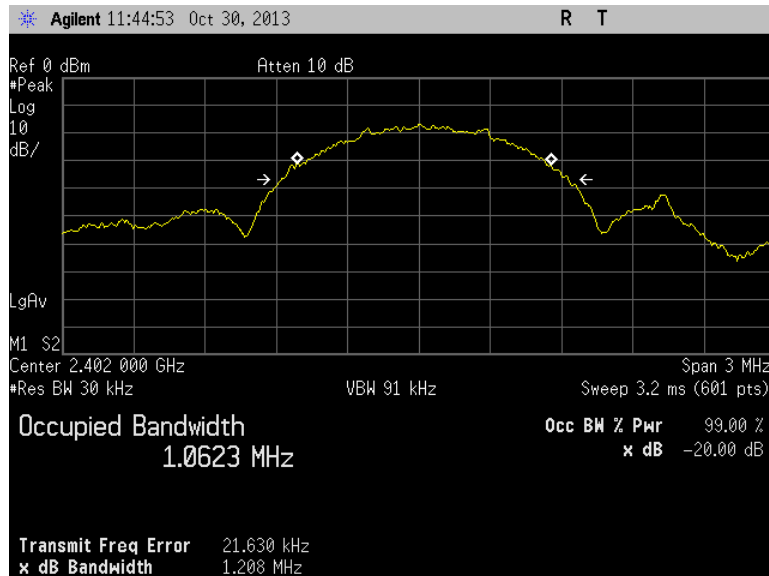


Figure 4. 2402MHz, 20 dB bandwidth

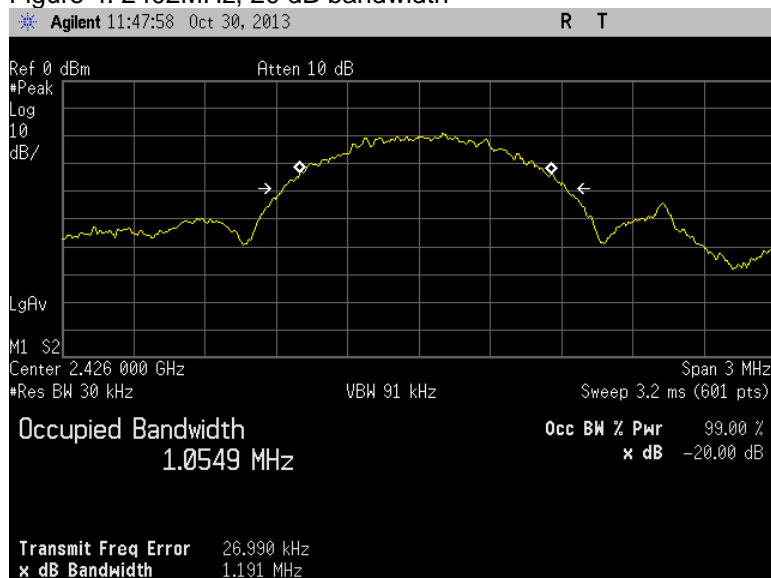


Figure 5. 2426MHz, 20 dB bandwidth

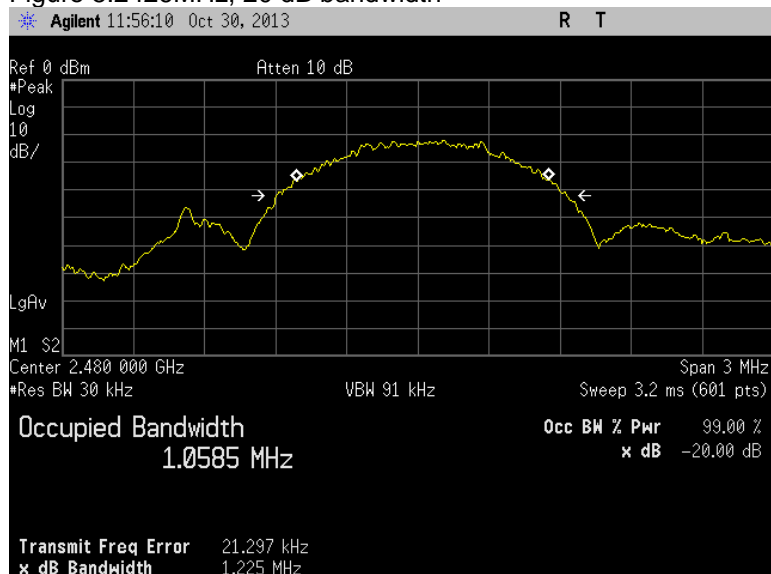


Figure 6. 2480MHz, 20 dB bandwidth

4.5 Duty cycle correction factor, Transmit time in 100 ms

Spectrum analyzer with zero span was used to investigate spectrum.

15.35(c) Unless otherwise specified, e.g. § 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

4.5.1 Test data

Pulses/100ms=1

Length of one pulse = 0.168ms

*DutyCycleCorrectionFactor=20*log(Tocc/100)=20*log(1*0.168/100)=-55.49dB*

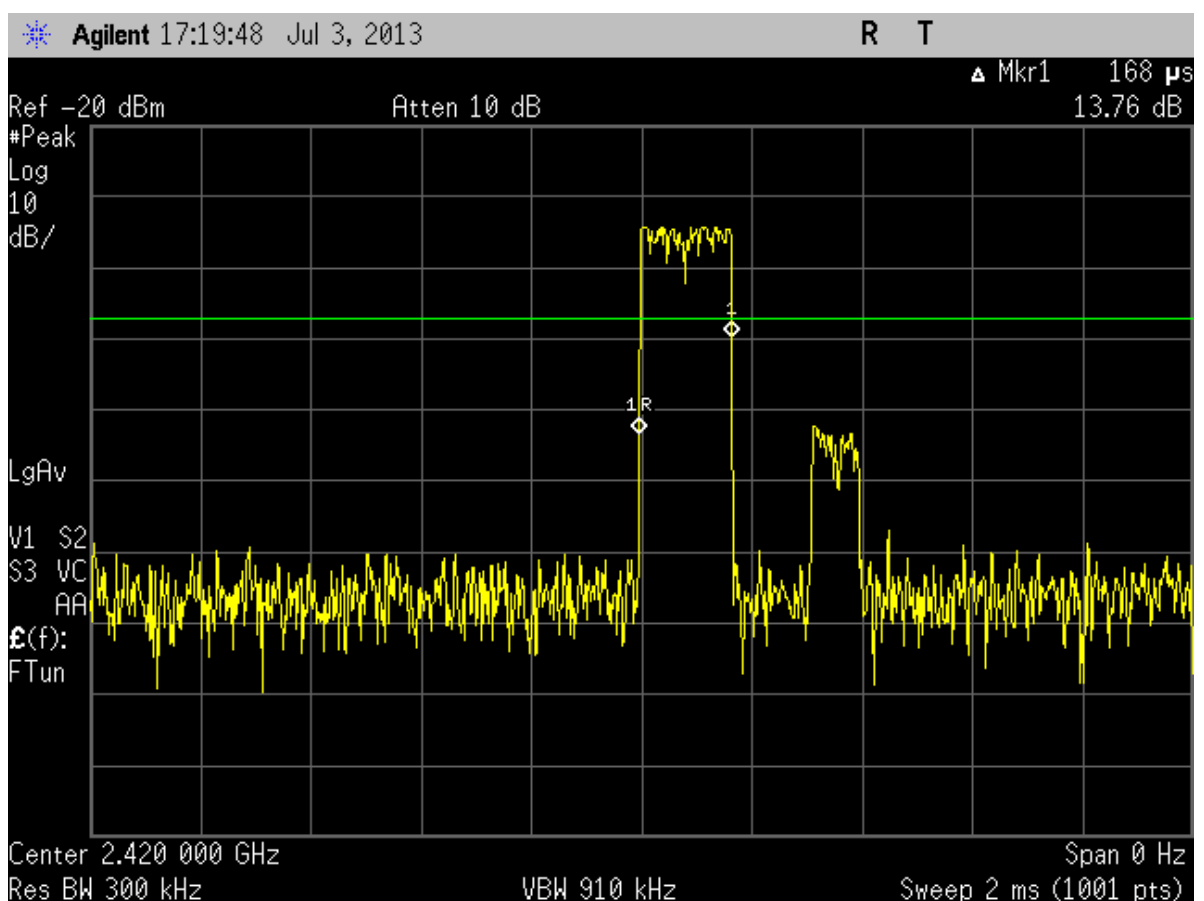


Figure 4. Duration of one transmission, 2420MHz

5. List of test equipment

Nr.	Equipment	Type	Manufacturer	Serial number	Cal date	Cal due
375	RF attenuator PAD	757 C - 20 dB	Narda	-	10.12.2011	12.2013
383	Hybrid	3033B	Narda	01727		
390	RF attenuator PAD	WA2-10	Weinschel	3784	10.12.2011	12.2013
694	EMI Test Receiver	ESPC	Rohde & Schwarz	842888/023	11.12.2012	12.2013
566	Spectrum analyzer	E4448A	Agilent	US42510236	17.4.2013	4.2014
709	EMI test receiver	ESU8	Rohde & Schwarz	100297	24.07.2013	7.2014
567	RF generator	E8257C	Agilent	MY43320736	25.2.2013	2.2014
544	RF-amplifier	ZFL-2000VH2	Mini-Circuits	QA0749010	9.1.2013	1.2014
564	RF amplifier	CA018-4010	CIAO Wireless	132	9.1.2013	1.2014
710	RF-amplifier	ALS 1826-41-12	ALC Microwave Inc.	0011	28.10.2011	10.2013
745	2-Line V-Network	ENV216	Rohde & Schwarz	101466	11.6.2013	06.2014
319	Antenna	CBL6112	Chase	2018	12.7.2012	1.2014
525	Double-Ridged Horn	3115	Emco	6691	10.10.2012	4.2014
542	Double-Ridged Horn	3115	Emco	00023905	10.10.2012	4.2014
546	Bluetooth Test Set	MT8850A	Anritsu	6K00000092	-	-
559	Highpass Filter	WHKX3.0/18G-10SS	Wainwright Instruments	1	7.12.2011	12.2013
88	Waveguide horn	638	Narda	8003	-	-
371	AC Power source	500i-400	California Instr.	HK 52064	23.5.2012	5.2013
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327	26.10.2012	10.2014
348	Shielded room	RFSD-100	Euroshield Oy	1320	-	-

6. Photographs

See Appendix: 239892BI Test setup Photographs rev 2