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Appendices -

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201496

Date of handing in: 02.04.2012

Tested by:



Timo Hietala, Test Engineer

Reviewed by:



Janne Nyman, Compliance Specialist

SORT OF EQUIPMENT:

Sport watch access point

MARKETING NAME:

TYPE:

MANUFACTURER:

BM-USDB4

Texas Instruments

CLIENT:

ADDRESS:

TELEPHONE:

Texas Instruments, Germany

Haggertystrasse 1, Freising, D-85356, Germany

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TEST LABORATORY:

FCC REG. NO.

IC FILE NO.

Nemko Oy

359859 October 20, 2011

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-210</i>		<i>Result</i>
15.249, a	A2.9 (a)	Peak output power	PASS
15.249, a	A2.9 (a)	Band-edge compliance	PASS
15.249, a	A2.9 (a)	Spurious radiated emissions	PASS
15.215 (c)		20 dB bandwidth	PASS
15.35 (c)	RSS-Gen 4.5	Duty cycle	PASS

Explanations:

PASS The EUT passed that particular test.

FAIL The EUT failed that particular test.

X The measurement was done, but there is no applicable performance criteria.

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1. EUT and Accessory Information

1.1 EUT description

The EUT is a sport watch access point.

Alignment range: **902-928 MHz**

Channels: **1**

Operating Voltage: **5.0 VDC from USB connector**

Battery: -

Antenna: **Integral**

Modulation: **DSSS, Gaussian frequency-shift keying (2-GFSK) data rate of 76.7 kBaud**

1.2 EUT and accessories

	<i>unit</i>	<i>type</i>	<i>S/N</i>
<i>EUT</i>	BM-USDB4	BM-USDB4	15

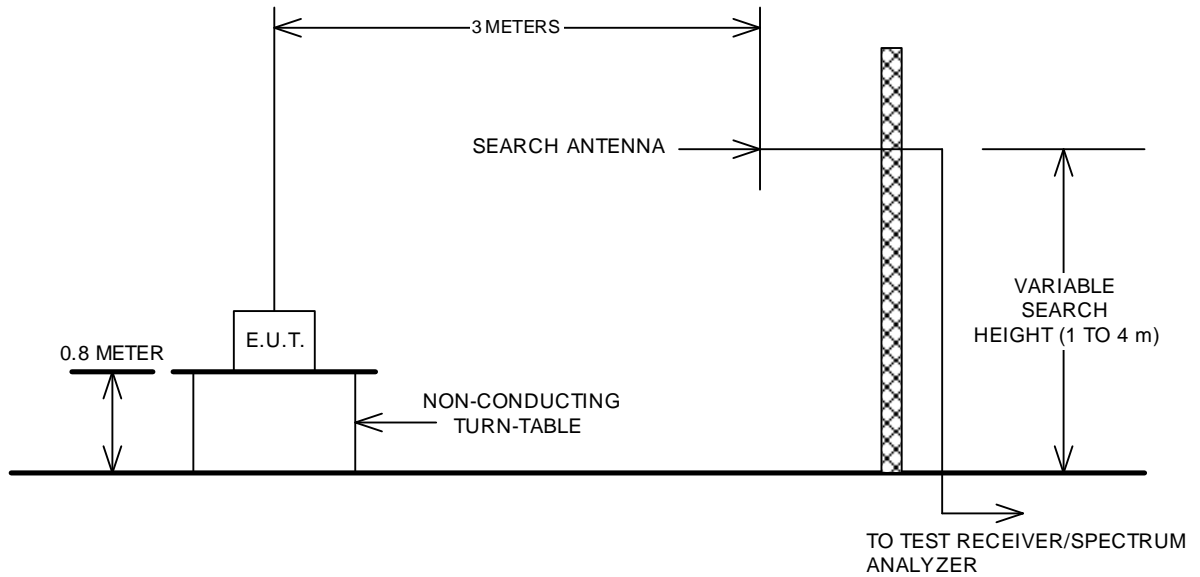
Peripherals

Laptop computer: HP ProBook 5320, S/N: CND0241M8M

2. Test setups

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 and height. The measured signal was routed from the measuring antenna to the spectrum analyzer.



3. Standards and measurement methods

The test were performed in guidance of the CFR 47 Part 15, SUBPART C, Paragraph 15.249 (2010), ANSI C63.4 (2003), RSS-210 (Issue 8, December 2010), RSS-Gen (Issue 3, December 2010) and CISPR 22

4. Test results

4.1 Fundamental output power

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

<i>Site name</i>	Nemko Oy / Perkaa
<i>FCC rule part</i>	§ 15.249 a
<i>Section in RSS-210</i>	A2.9 (a)
<i>Date of testing</i>	11.04.2012
<i>Test equipment</i>	319, 709, 544
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	PASS

4.1.1 EUT operation mode

<i>EUT operation mode</i>	TX on without modulation
<i>EUT channel</i>	903.5, 915.0, 926.5 MHz
<i>EUT TX power level</i>	Nominal
<i>EUT operation voltage</i>	5.0 VDC

4.1.2 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 (photograph 1). During the test distance from the EUT to the measuring antenna was 3.0 m. The test was performed with the measuring antenna being both in horizontal and vertical polarizations. The EUT was tested on three orthogonal axis.

The CFR 47 Part 15.249 limit of 50 mV/m has been calculated to correspond 94 dB(μ V/m) as follows:
 $[dB(\mu V/m)] = 20 \log[\mu V/m]$.

Limit (3m measuring distance)

<i>Frequency band MHz</i>	<i>Peak dB(μV/m)</i>
902 - 928	94.0

4.1.3 Test results

The measurement results were obtained as described below.

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

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

TX on low channel

<i>Frequency MHz</i>	<i>Result PK dB($\mu\text{V/m}$)</i>	<i>Limit dB($\mu\text{V/m}$)</i>	<i>Margin dB</i>
903.5	90.6	94.0	3.4

TX on middle channel

<i>Frequency MHz</i>	<i>Result PK dB($\mu\text{V/m}$)</i>	<i>Limit dB($\mu\text{V/m}$)</i>	<i>Margin dB</i>
915.0	93.8	94.0	0.2

TX on high channel

<i>Frequency MHz</i>	<i>Result PK dB($\mu\text{V/m}$)</i>	<i>Limit dB($\mu\text{V/m}$)</i>	<i>Margin dB</i>
926.5	92.5	94.0	1.5

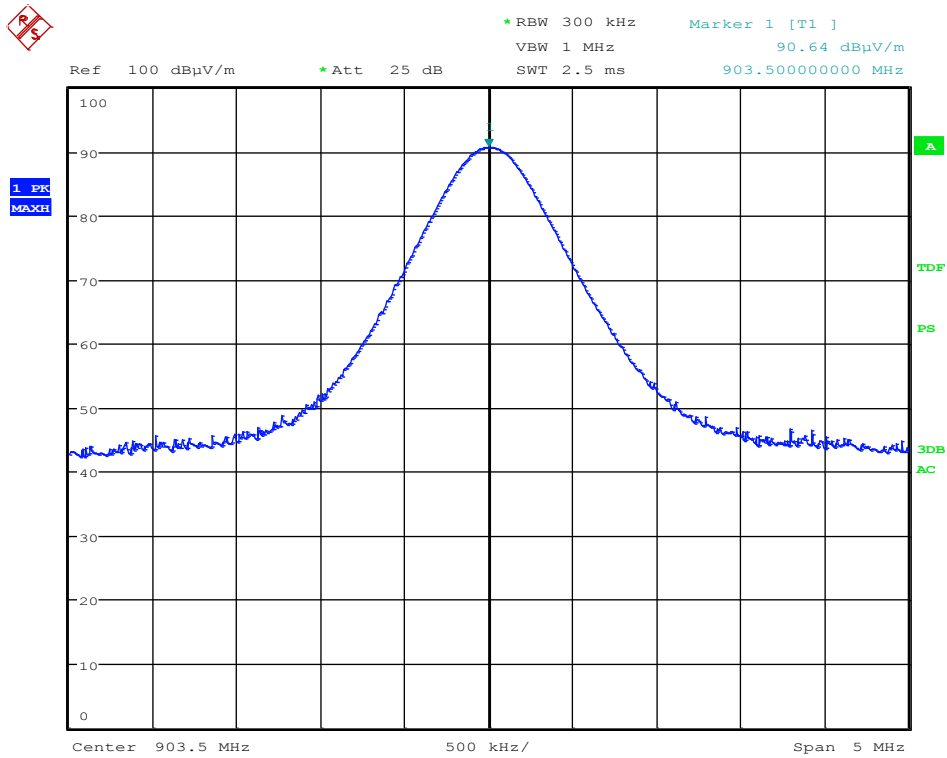


Figure 1. Fundamental output power, peak detector, channel 903.5 MHz

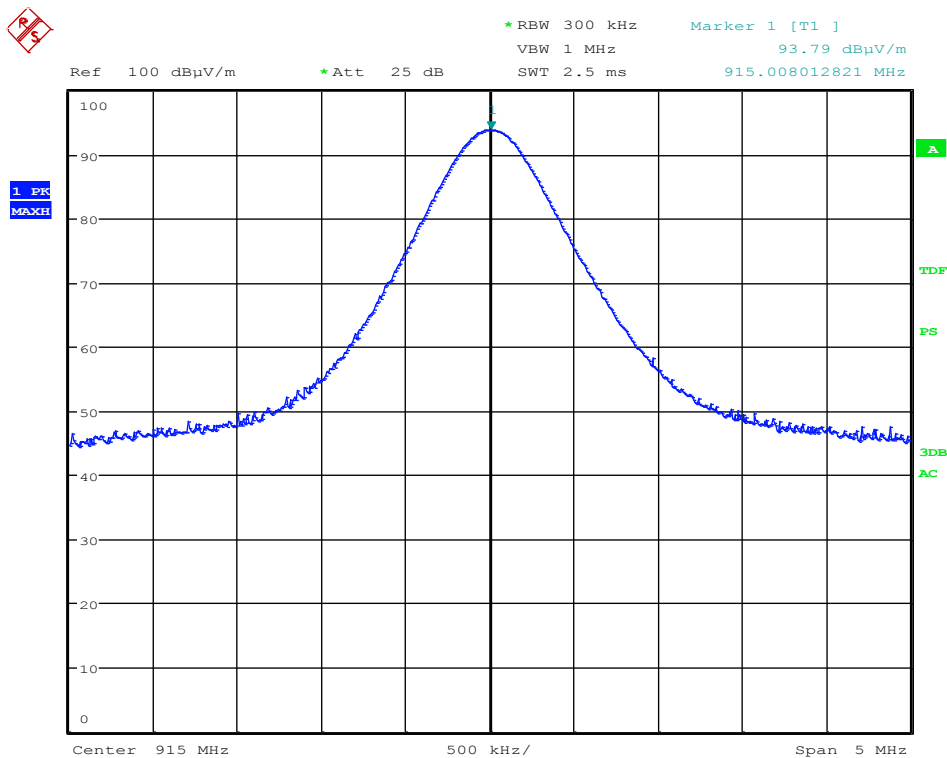


Figure 2. Fundamental output power, peak detector, channel 915.0 MHz

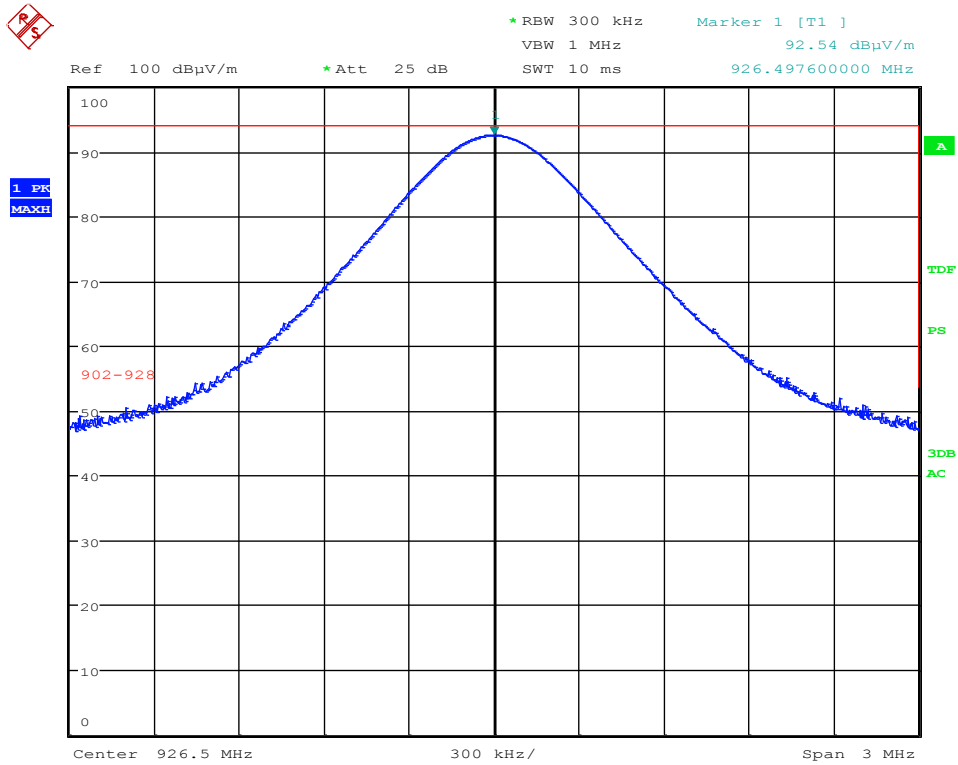


Figure 3. Fundamental output power, peak detector, channel 926.5 MHz

4.2 Band-edge compliance

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

<i>Site name</i>	Nemko Oy / Perkkaa
<i>FCC rule part</i>	§ 15.249 a
<i>Section in RSS-210</i>	A2.9 (a)
<i>Date of testing</i>	11.04.2012
<i>Test equipment</i>	319, 709, 544
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	PASS

4.2.1 EUT operation mode

<i>EUT operation mode</i>	TX on with modulation
<i>EUT channel</i>	903.5 and 926.5 MHz
<i>EUT TX power level</i>	Nominal
<i>EUT operation voltage</i>	5.0 VDC

4.2.2 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 (photograph 1). During the test distance from the EUT to the measuring antenna was 3 m. The test was performed with the measuring antenna being both in horizontal and vertical polarizations.

The CFR 47 Part 15.249 limit of 500 $\mu\text{V}/\text{m}$ has been calculated to correspond 54 $\text{dB}(\mu\text{V}/\text{m})$ as follows: $[\text{dB}(\mu\text{V}/\text{m})]=20\log[\mu\text{V}/\text{m}]$.

Limit (3m measuring distance)

<i>Frequency band MHz</i>	<i>QPeak dB($\mu\text{V}/\text{m}$)</i>
902 -928	54

4.2.3 Limits and test results

The measurement results were obtained as described below.

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

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

TX on channel 903.5 MHz

Frequency MHz	Result peak dB($\mu\text{V/m}$)	Limit dB($\mu\text{V/m}$)	Margin dB
902.0	42.1	-	-

Frequency MHz	Result Qpeak dB($\mu\text{V/m}$)	Limit dB($\mu\text{V/m}$)	Margin dB
902.0	20.1	54	33.9

TX on channel 926.5 MHz

Frequency MHz	Result peak dB($\mu\text{V/m}$)	Limit dB($\mu\text{V/m}$)	Margin dB
928.0	48.5	-	-

TX on channel 926.5 MHz

Frequency MHz	Result Qpeak dB($\mu\text{V/m}$)	Limit dB($\mu\text{V/m}$)	Margin dB
928.0	26.5	54	27.5

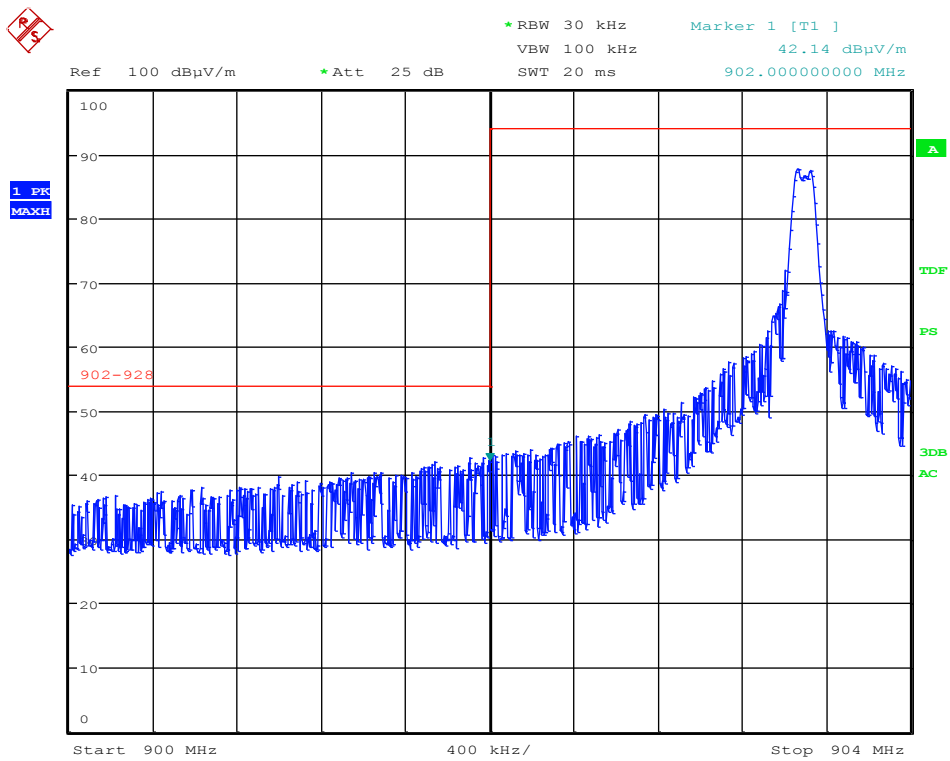


Figure 4. Band-edge compliance, low end, peak detector

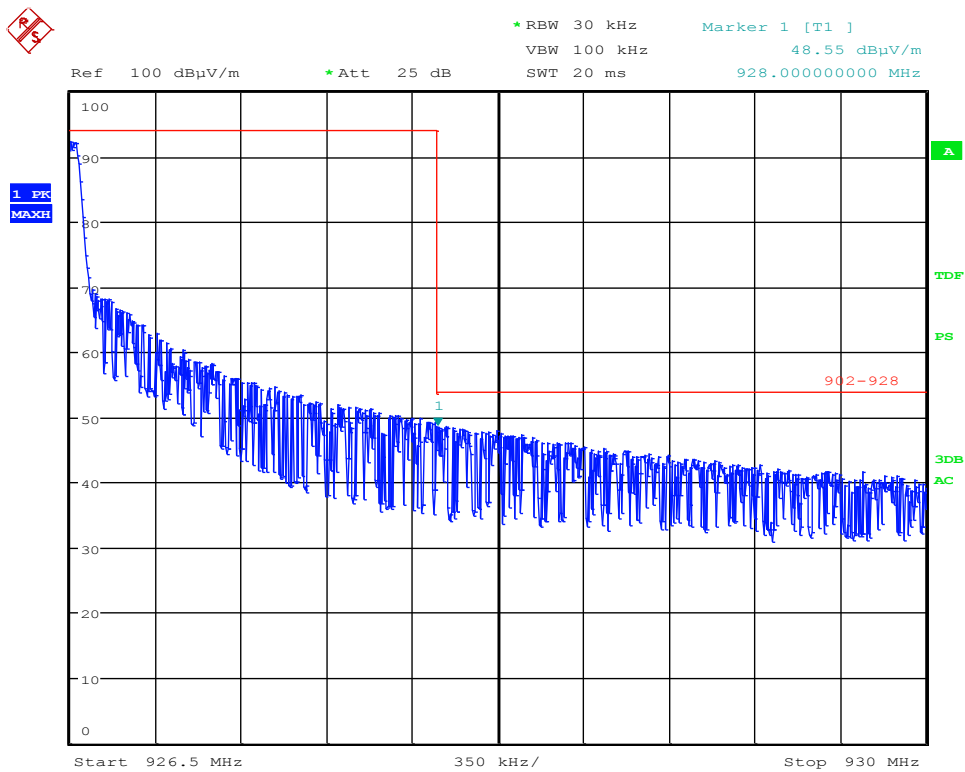


Figure 5. Band-edge compliance, high end, peak detector

4.3 Spurious radiated emission

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

<i>Site name</i>	Nemko Oy / Perkkaa
<i>FCC rule part</i>	§ 15.249
<i>Section in RSS-210</i>	A2.9 (a)
<i>Date of testing</i>	7-11.04.2012
<i>Test equipment</i>	319, 544, 709, 542, 564, 566
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	PASS

4.3.1 EUT operation mode

<i>EUT operation mode</i>	TX on with modulation
<i>EUT channel</i>	903.5, 915.0, 926.5 MHz
<i>EUT TX power level</i>	Nominal
<i>EUT operation voltage</i>	5.0 VDC

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 (photograph 2). During the test in the frequency range 30-1000 MHz the distance from the EUT to the measuring antenna was 3 m. During the test in the frequency range 1000-10000 MHz the distance from the EUT to the measuring antenna was 3.0 m. 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 separately with the measuring antenna being both in horizontal and vertical polarizations and the EUT being in three different orthogonal positions.

The CFR 47 Part 15.209 limit of 500 $\mu\text{V/m}$ has been calculated to correspond 54 $\text{dB}(\mu\text{V/m})$ as follows: $[\text{dB}(\mu\text{V/m})]=20\log[\mu\text{V/m}]$.

FCC Part 15.209 / RSS 210 Limit values (3m measuring distance)

<i>Frequency band MHz</i>	<i>Quasi-peak $\mu\text{V/m}$</i>	<i>Quasi-peak $\text{dB}(\mu\text{V/m})$</i>
30 - 88	100	40.0
88 - 216	150	43.5
216-960	200	46.0
960-1000	500	54.0

FCC Part 15.209 / RSS 210 Limit values (3m measuring distance)

<i>Frequency band MHz</i>	<i>Average limit $\text{dB}(\mu\text{V/m})$</i>	<i>Peak limit $\text{dB}(\mu\text{V/m})$</i>
1000 – 10000	54	74

4.3.3 Test results

The measurement results were obtained as described below.

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

Where

U_{RX} receiver reading

A_{CABLE} attenuation of the cable

AF antenna factor

G_{PREAMP} gain of the preamplifier

TX on channel 903.5 MHz

Frequency MHz	Quasi-peak(Qp) / Average (Av)			Peak		
	Result dB(μ V/m)	Limit dB(μ V/m)	Margin dB	Result dB(μ V/m)	Limit dB(μ V/m)	Margin dB
1807.0	13.1 Av	54	40.9	43.7	74	30.3
2710.5	10.7 Av	54	43.3	41.3	74	32.7
3614.0	11.5 Av	54	42.5	42.1	74	31.9
5421.0	15.5 Av	54	38.5	46.1	74	27.9

TX on channel 915.0 MHz

Frequency MHz	Quasi-peak(Qp) / Average (Av)			Peak		
	Result dB(μ V/m)	Limit dB(μ V/m)	Margin dB	Result dB(μ V/m)	Limit dB(μ V/m)	Margin dB
1830.0	13.8 Av	54	40.2	44.4	74	29.6
2745.0	7.4 Av	54	46.6	38.0	74	36.0
3660.0	8.9 Av	54	45.1	39.5	74	34.5
5490.0	12.7 Av	54	41.3	43.3	74	30.7

TX on channel 926.5 MHz

Frequency MHz	Quasi-peak(Qp) / Average (Av)			Peak		
	Result dB(μ V/m)	Limit dB(μ V/m)	Margin dB	Result dB(μ V/m)	Limit dB(μ V/m)	Margin dB
1853.0	20.2 Av	54	33.8	50.8	74	23.2
2779.5	12.4 Av	54	41.6	43.0	74	31.0
3706.0	13.2 Av	54	40.8	43.8	74	30.2
5559.0	15.8 Av	54	38.2	46.4	74	27.6

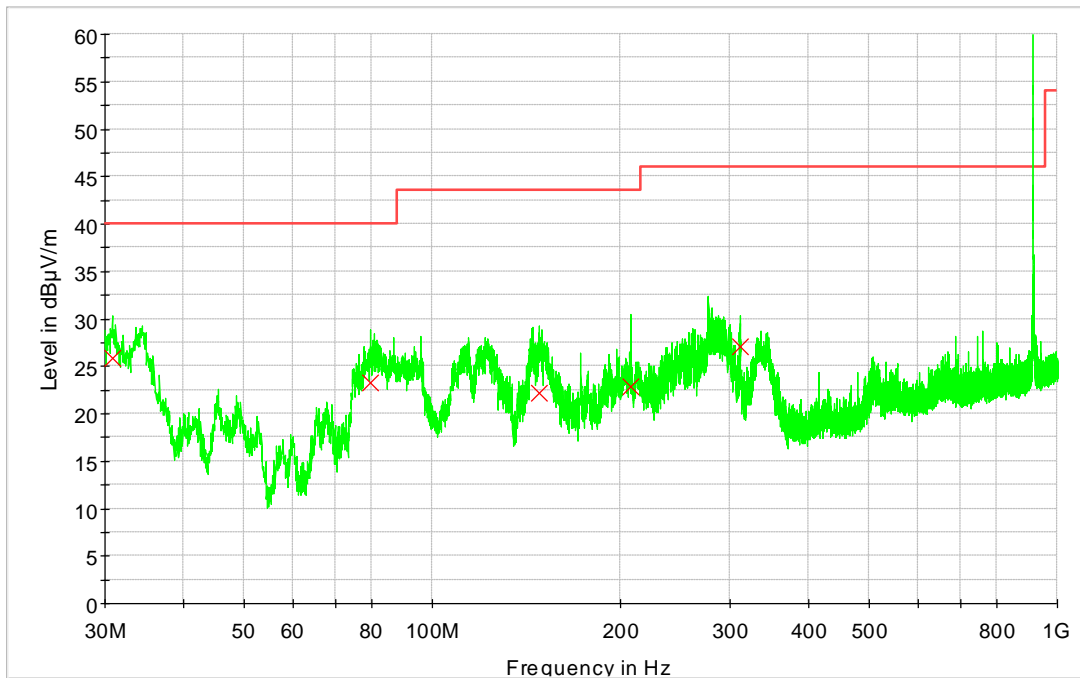


Figure 6. Spurious emissions, 30-1000 MHz, channel 915.0 MHz

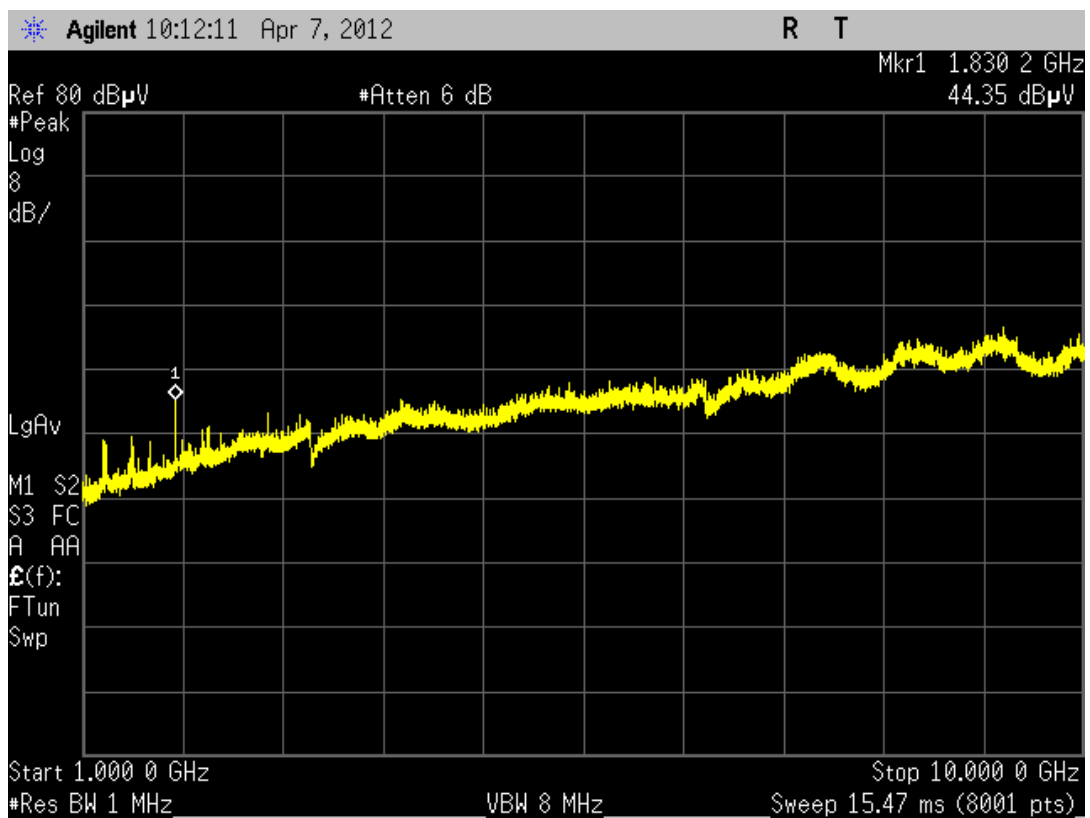


Figure 7. Spurious emissions, 1000-10000 MHz, channel 915.0 MHz

4.4 20 dB Bandwidth

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

Site name	Nemko Oy / Perkaa
FCC rule part	§ 15.215 (c)
Section in RSS-210	
Date of testing	13.04.2012
Test equipment	542, 564, 566
Test conditions	22 °C, 30 % RH
Test result	PASS

4.4.1 EUT operation mode

EUT operation mode	Transmitting
EUT channel	903.5, 915.0, 926.5 MHz
EUT TX power level	Nominal

4.4.2 Test data

EUT Channel (MHz)	Figure	Measured value (kHz)
903.5	8	83.9
915.0	9	84.0
926.5	10	84.1

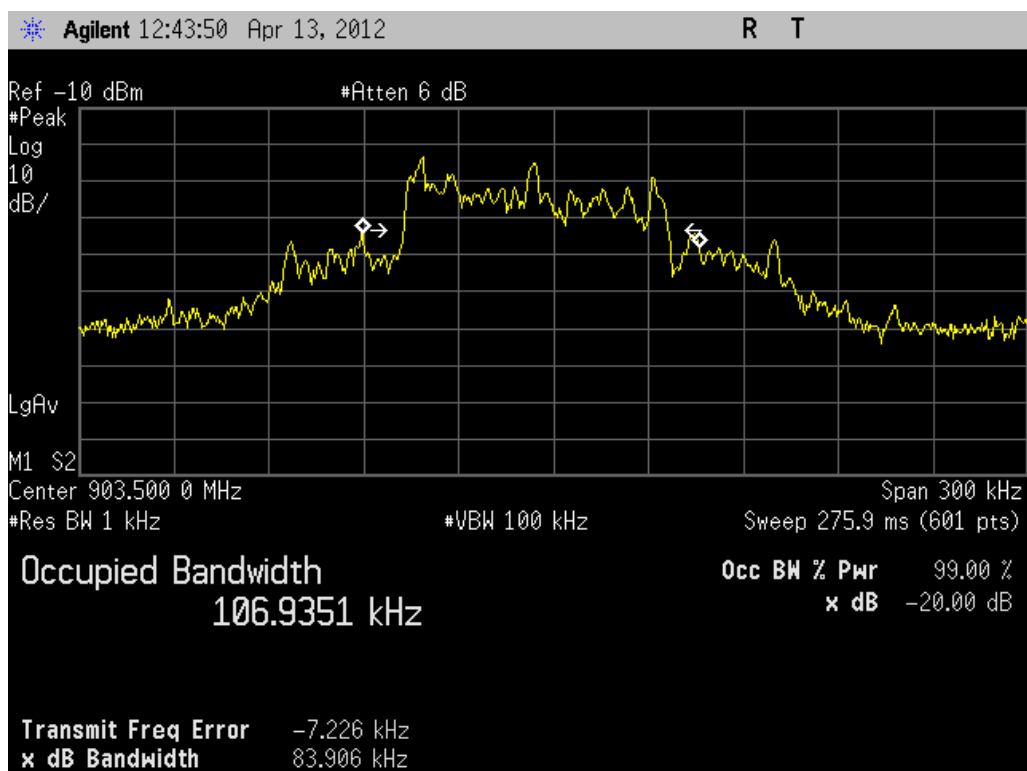


Figure 8. 20 dB bandwidth, channel 903.5 MHz.

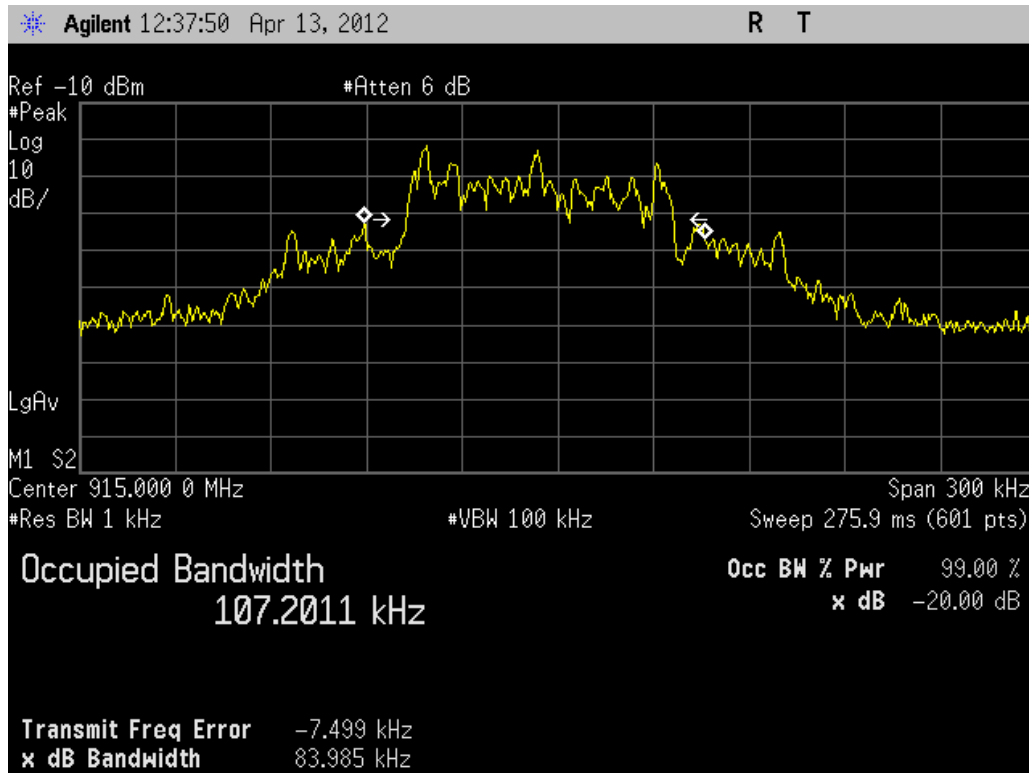


Figure 9. 20 dB bandwidth, channel 915.0 MHz.

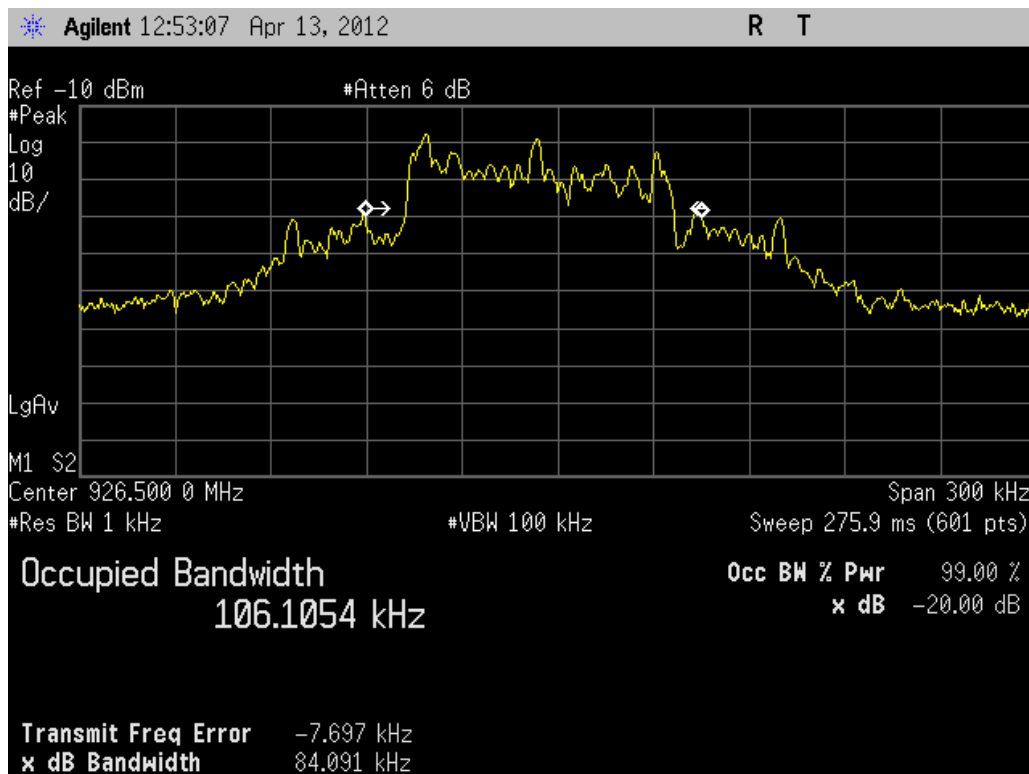


Figure 10. 20 dB bandwidth, channel 926.5 MHz.

4.5 Duty cycle

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

<i>Site name</i>	Nemko Oy / Perkaa
<i>FCC rule part</i>	§ 15.35(c)
<i>Section in RSS-Gen</i>	4.5
<i>Date of testing</i>	13.04.2012
<i>Test equipment</i>	542, 564, 566
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	PASS

4.5.1 EUT operation mode

<i>EUT operation mode</i>	TX on with modulation
<i>EUT channel</i>	903.5
<i>EUT TX power level</i>	Nominal
<i>EUT operation voltage</i>	5.0 VDC

4.5.2 Test method and limit

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.

4.5.3 Test data

Pulses/100ms=1

Length of one pulse = 2.93ms

*DutyCycleCorrectionFactor=20*log(Tocc/100)=20*log(1*2.93/100)=-30.6dB*

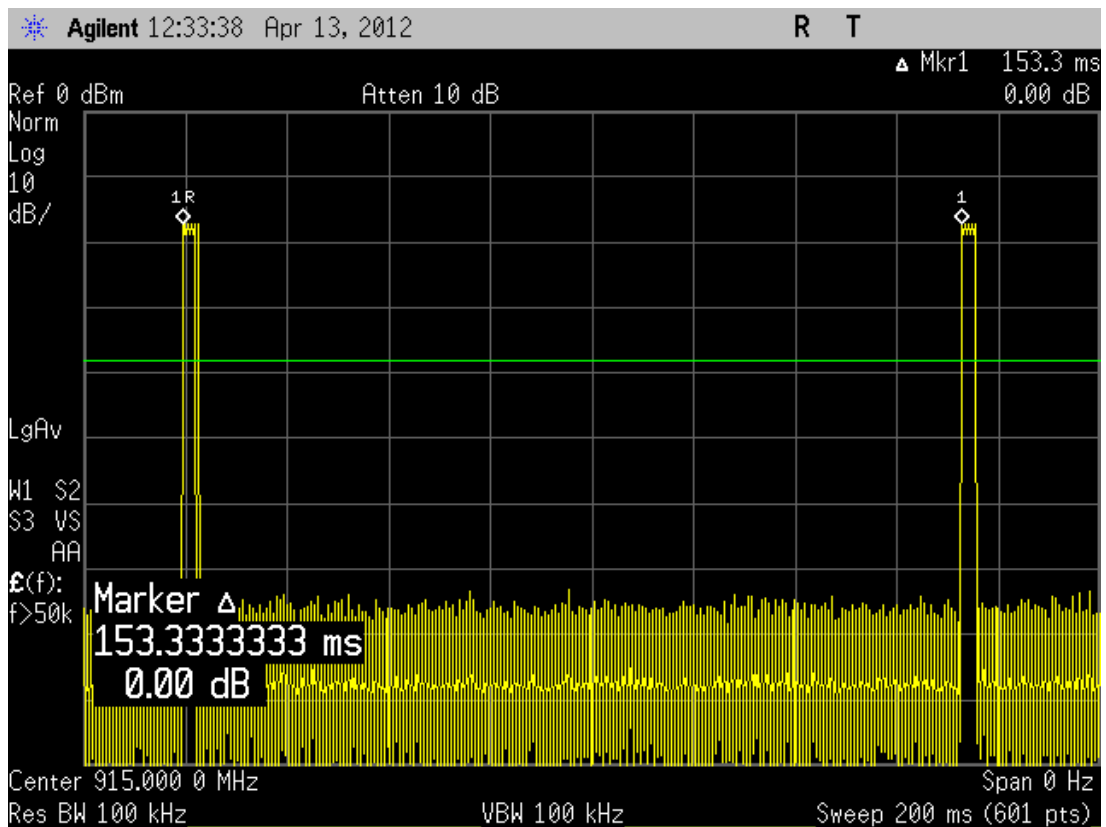


Figure 11. 200ms plot, channel 915.0 MHz.

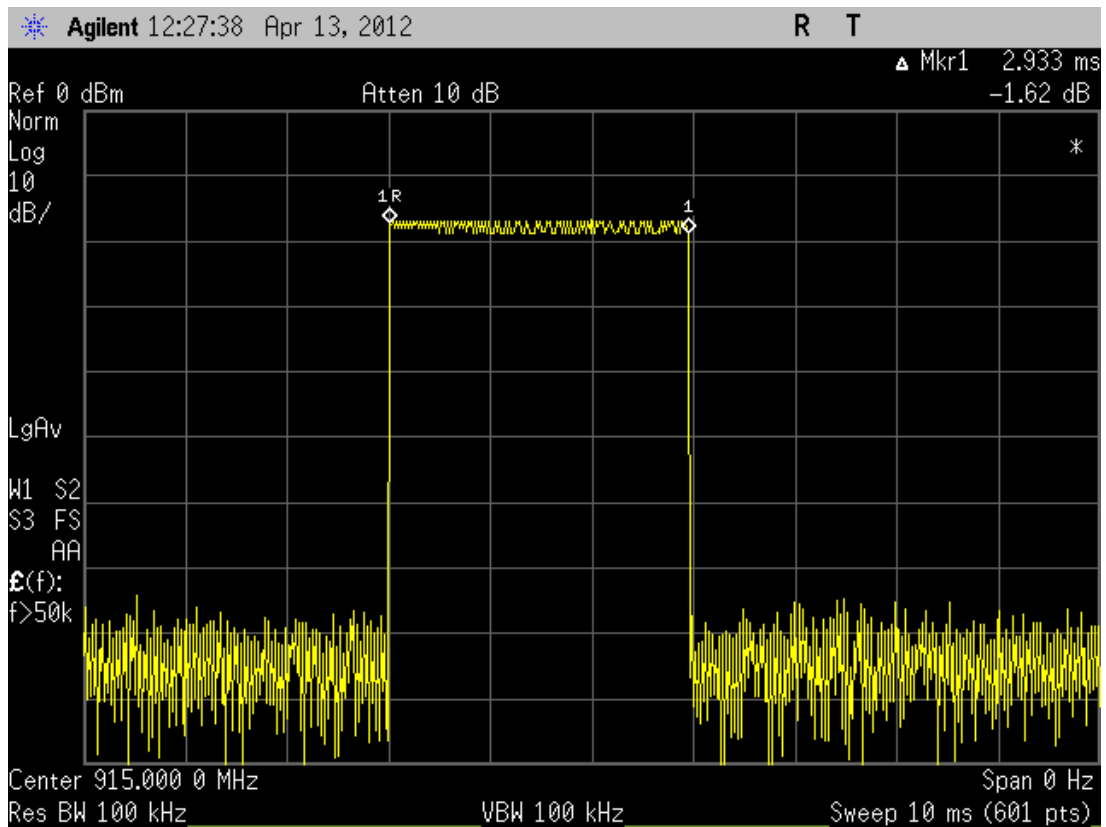


Figure 12. 10 ms plot, channel 915.0 MHz.

5. List of test equipment

Each active test equipment is calibrated once a year, antennas every 18 months and other passive equipment every 24 months.

Nr.	Equipment	Type	Manufacturer	Serial number	Cal. due
88	Standard Gain Horn	638	Narda	8003	4/2014
319	Antenna	CBL6112	Chase	2018	1/2014
348	Shielded room	RFSD-100	Euroshield Oy	1320	-
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327	10/2014
542	Double-Ridged Horn	3115	Emco	00023905	4/2014
544	RF-amplifier	ZFL-2000VH2	Mini-Circuits	D01080	1/2014
559	Highpass Filter	WHKX3.0/18G-10SS	Wainwright Instruments	1	12/2013
572	High Pass Filter	WHKX1.5/15G-12SS	Wainwright Instruments	4	12/2013
564	RF-amplifier	CA018-4010	CIAO Wireless	132	1/2014
566	Spectrum analyzer	E4448A	Agilent	US42510236	4/2014
709	EMI test receiver	ESU8	Rohde & Schwarz	100297	7/2013
710	RF amplifier	ALS1826-41-12	ALC Microwave Inc.	0011	10/2013

6. Photographs



Photograph 1, Radiated max power test setup



Photograph 2, Spurious emissions test setup