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No. 1 / 1**201498**

Date of handing in: 12.05.2012

Tested by:



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Reviewed by:



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SORT OF EQUIPMENT: -

MARKETING NAME:

TYPE:

MANUFACTURER:

**MSP-EXP430F5137R9****Texas Instruments**

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**Nemko Oy**

FCC REG. NO.

**359859 October 20, 2011**

IC FILE NO.

**2040F-1 December 1, 2010****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)	Field strength of fundamental	<b>PASS</b>
15.249, a	A2.9 (a)	Band-edge compliance	<b>PASS</b>
15.249, a	A2.9 (a)	Spurious radiated emissions	<b>PASS</b>
15.215 (c)		20 dB bandwidth	<b>PASS</b>
15.35 (c)	RSS-Gen 4.5	Duty cycle	<b>PASS</b>
15.207		Conducted emissions AC line	<b>Not tested</b> <sup>1)</sup>

1) Only battery operated.

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 development platform for System on Chip.

Alignment range: **902-928 MHz**

Channels: **1**

Operating Voltage: **3.0 VDC**

Battery: **2xAAA**

Antenna: **Chip antenna (integral)**

Modulation: **DSSS, Gaussian frequency-shift keying (2-GFSK) data rate of 1.2 kBaud**

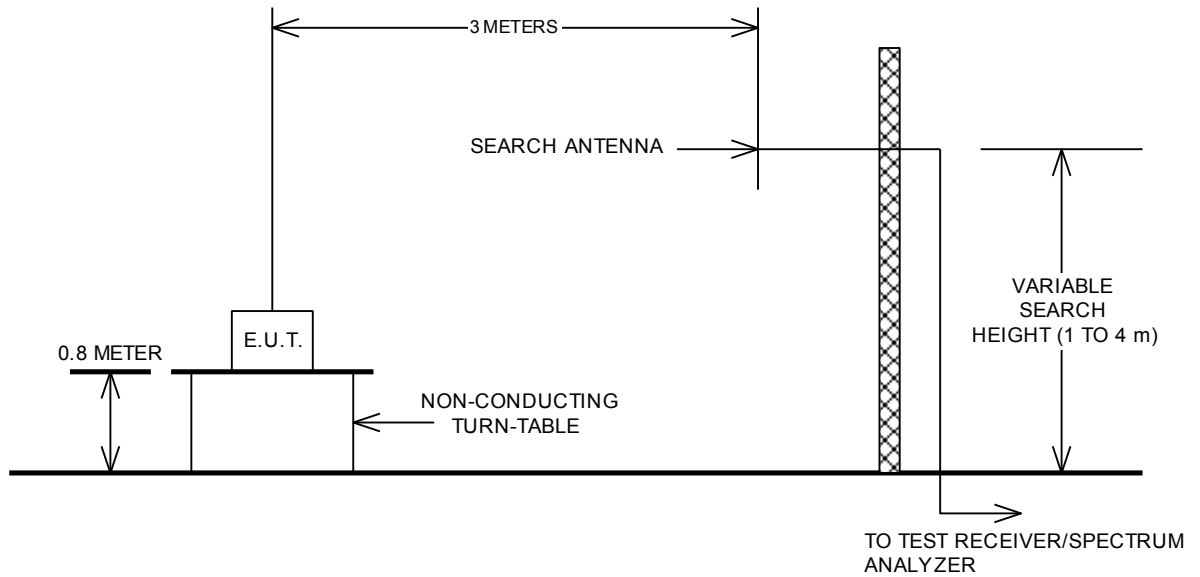
### 1.2 EUT and accessories

	<i>unit</i>	<i>type</i>	<i>S/N</i>
<i>EUT</i>	MSP-EXP430F5137R9	MSP-EXP430F5137R9	<b>105</b>
<i>FCC -ID</i>	Z64EXP4F5137R9		

## 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 Field strength of fundamental

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>	15.05.2012
<i>Test equipment</i>	319, 566, 544
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	<b>PASS</b>

#### 4.1.1 EUT operation mode

<i>EUT operation mode</i>	<b>TX on without modulation</b>
<i>EUT channel</i>	<b>903.490, 914.990, 926.490 MHz</b>
<i>EUT TX power level</i>	<b>Nominal</b>
<i>EUT operation voltage</i>	<b>3.0 VDC</b>

#### 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 CFR 47 Part 15.249 limit of 50 mV/m has been calculated to correspond 94 dB( $\mu$ 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(<math>\mu</math>V/m)</i>
<b>902 - 928</b>	<b>94.0</b>

### 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(<math>\mu\text{V/m}</math>)</i>	<i>Limit dB(<math>\mu\text{V/m}</math>)</i>	<i>Margin dB</i>
<b>903.490</b>	<b>79.33</b>	<b>94.0</b>	<b>14.67</b>

#### *TX on middle channel*

<i>Frequency MHz</i>	<i>Result PK dB(<math>\mu\text{V/m}</math>)</i>	<i>Limit dB(<math>\mu\text{V/m}</math>)</i>	<i>Margin dB</i>
<b>914.990</b>	<b>82.43</b>	<b>94.0</b>	<b>11.57</b>

#### *TX on high channel*

<i>Frequency MHz</i>	<i>Result PK dB(<math>\mu\text{V/m}</math>)</i>	<i>Limit dB(<math>\mu\text{V/m}</math>)</i>	<i>Margin dB</i>
<b>926.490</b>	<b>86.11</b>	<b>94.0</b>	<b>7.89</b>

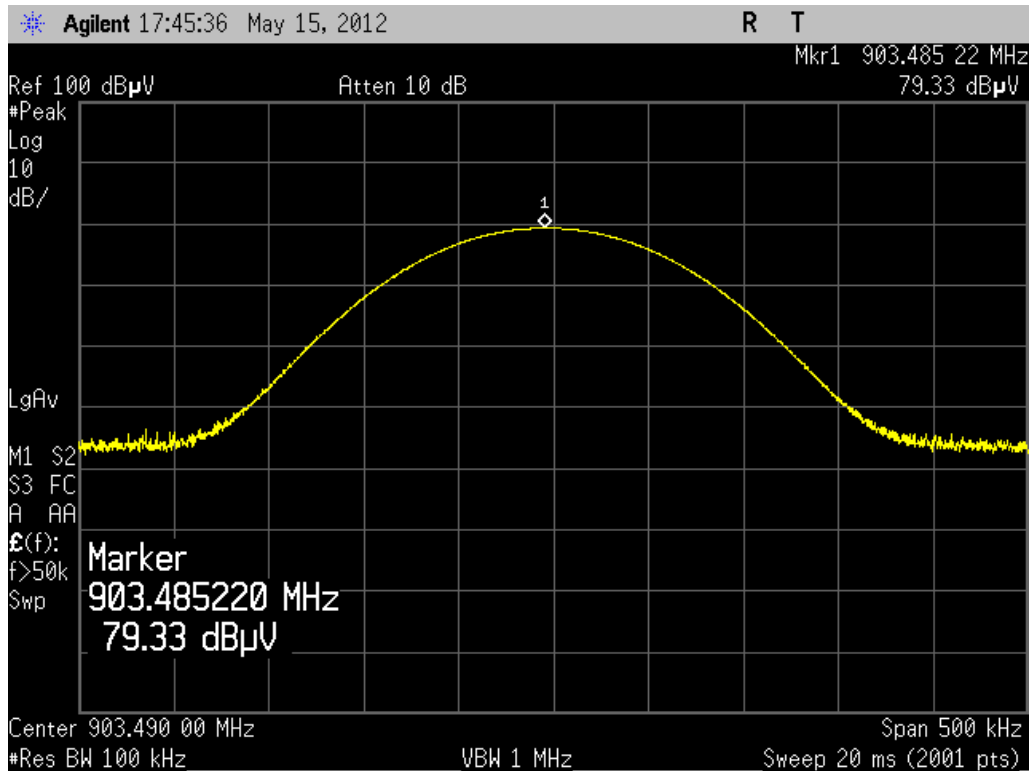


Figure 1. Fundamental output power, peak detector, channel 903.490 MHz

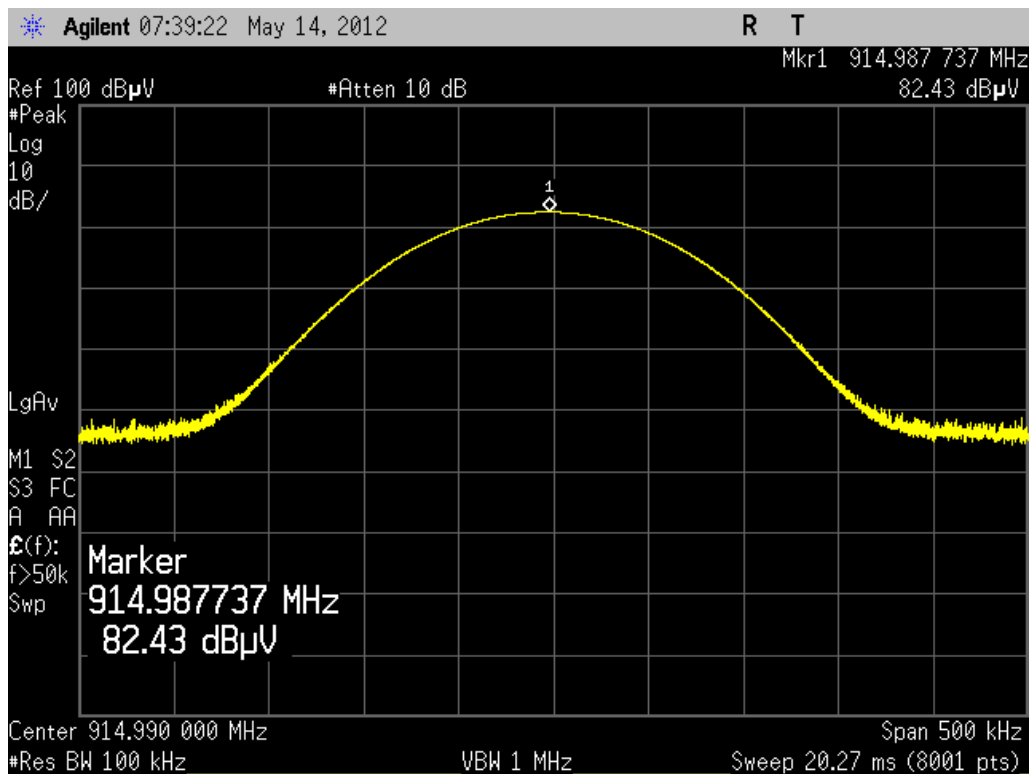


Figure 2. Fundamental output power, peak detector, channel 914.990 MHz



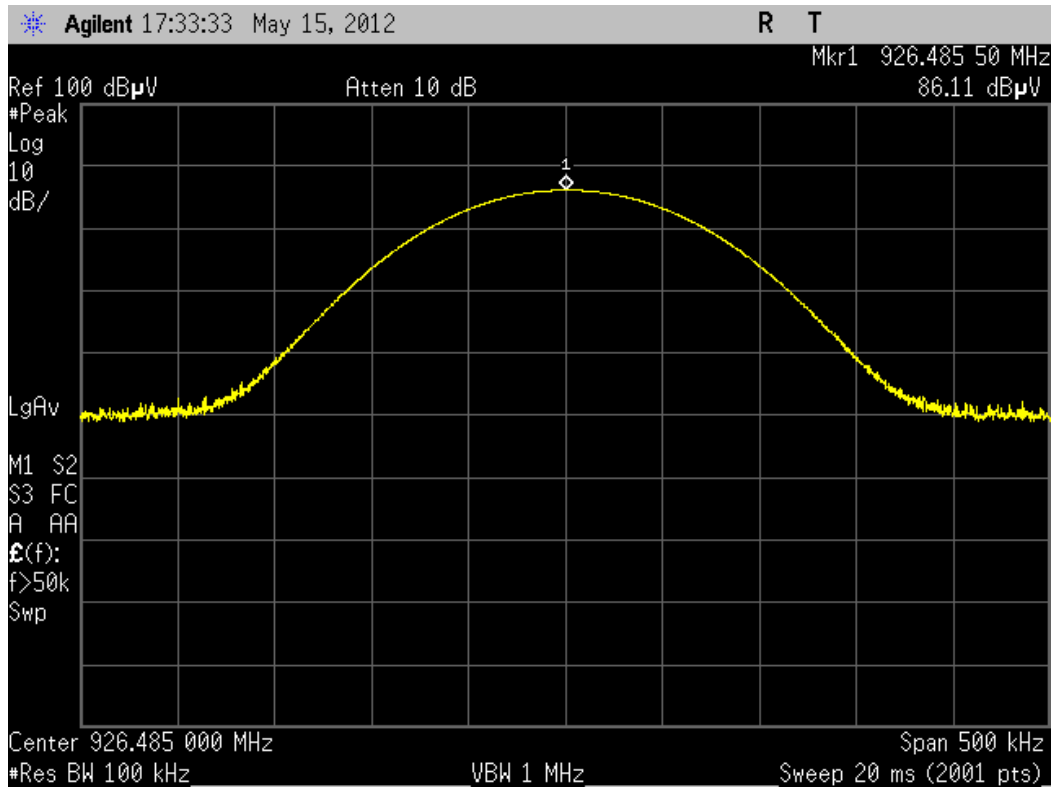


Figure 3. Fundamental output power, peak detector, channel 926.490 MHz

## 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 / Perkkää
<i>FCC rule part</i>	§ 15.249 a
<i>Section in RSS-210</i>	A2.9 (a)
<i>Date of testing</i>	15.05.2012
<i>Test equipment</i>	319, 566, 544
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	<b>PASS</b>

### 4.2.1 EUT operation mode

<i>EUT operation mode</i>	<b>TX on with modulation</b>
<i>EUT channel</i>	<b>903.490 and 926.490 MHz</b>
<i>EUT TX power level</i>	<b>Nominal</b>
<i>EUT operation voltage</i>	<b>3.0 VDC</b>

### 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(<math>\mu\text{V}/\text{m}</math>)</i>
<b>902 -928</b>	<b>54</b>

#### 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 903.490 MHz***

<i>Frequency MHz</i>	<i>Result peak dB(<math>\mu\text{V/m}</math>)</i>	<i>Limit dB(<math>\mu\text{V/m}</math>)</i>	<i>Margin dB</i>
<b>901.88</b>	<b>32.4</b>	-	-

<i>Frequency MHz</i>	<i>Result Qpeak dB(<math>\mu\text{V/m}</math>)</i>	<i>Limit dB(<math>\mu\text{V/m}</math>)</i>	<i>Margin dB</i>
<b>901.88</b>	<b>&lt;24</b>	<b>54</b>	<b>&gt;30</b>

##### ***TX on channel 926.490 MHz***

<i>Frequency MHz</i>	<i>Result peak dB(<math>\mu\text{V/m}</math>)</i>	<i>Limit dB(<math>\mu\text{V/m}</math>)</i>	<i>Margin dB</i>
<b>928.14</b>	<b>36.1</b>	-	-

<i>Frequency MHz</i>	<i>Result Qpeak dB(<math>\mu\text{V/m}</math>)</i>	<i>Limit dB(<math>\mu\text{V/m}</math>)</i>	<i>Margin dB</i>
<b>928.14</b>	<b>&lt;24</b>	<b>54</b>	<b>&gt;30</b>

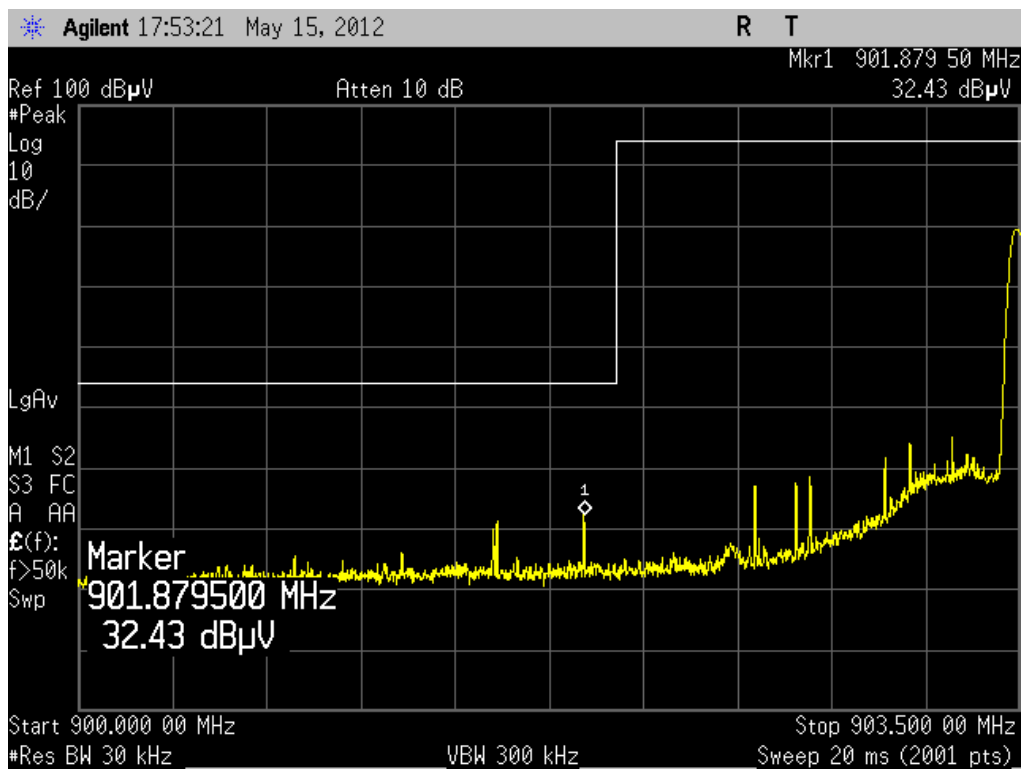


Figure 4. Band-edge compliance, low end, peak detector

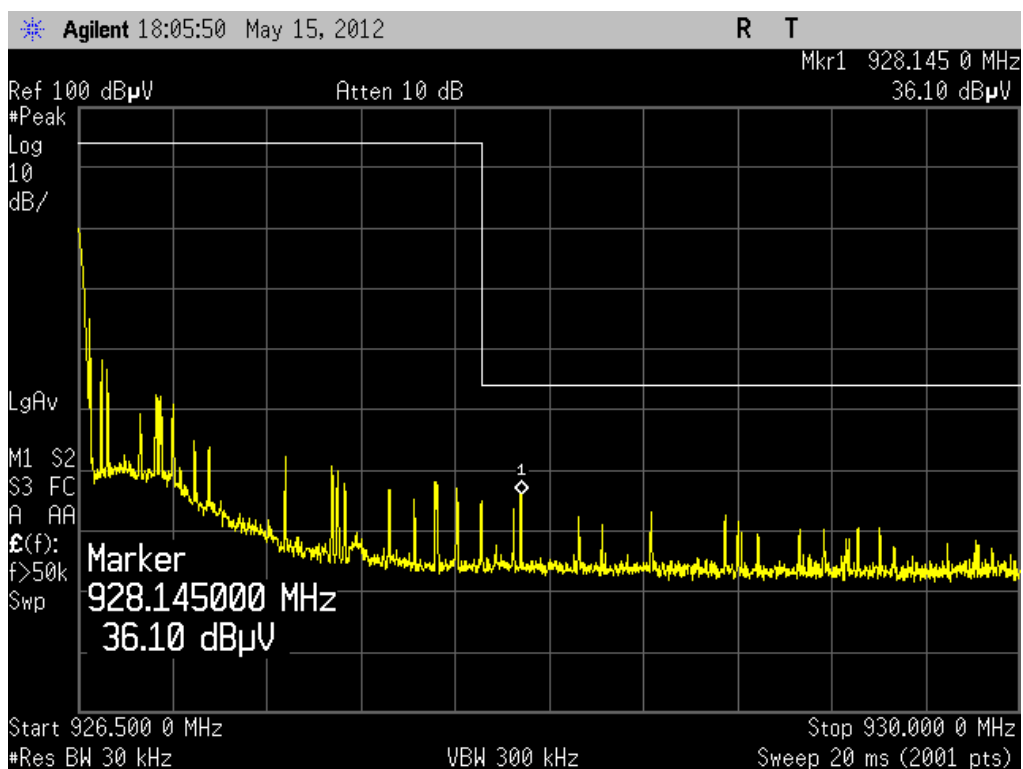


Figure 5. Band-edge compliance, high end, peak detector

### 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>	15-17.05.2012
<i>Test equipment</i>	319, 544, 709, 542, 564, 566
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	<b>PASS</b>

#### 4.3.1 EUT operation mode

<i>EUT operation mode</i>	<b>TX on with modulation</b>
<i>EUT channel</i>	<b>903.490, 914.990 and 926.490 MHz</b>
<i>EUT TX power level</i>	<b>Nominal</b>
<i>EUT operation voltage</i>	<b>3.0 VDC</b>

#### 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 1). 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 <math>\mu\text{V/m}</math></i>	<i>Quasi-peak <math>\text{dB}(\mu\text{V/m})</math></i>
<b>30 - 88</b>	<b>100</b>	<b>40.0</b>
<b>88 - 216</b>	<b>150</b>	<b>43.5</b>
<b>216-960</b>	<b>200</b>	<b>46.0</b>
<b>960-1000</b>	<b>500</b>	<b>54.0</b>

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

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

### 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

AV=PK+duty cycle corr.

**TX on channel 903.490 MHz**

Frequency MHz	Quasi-peak(Qp) / Average (Av)			Peak		
	Result dB( $\mu$ V/m)	Limit dB( $\mu$ V/m)	Margin dB	Result dB( $\mu$ V/m)	Limit dB( $\mu$ V/m)	Margin dB
1806.98	33.1 Av	54	20.9	33.1	74	40.9
2710.47	35.1 Av	54	18.9	35.1	74	38.9
3613.96	36.8 Av	54	17.2	36.8	74	37.2
4517.45	38.2 Av	54	15.8	38.2	74	35.8
5420.94	47.5 Av	54	6.5	47.5	74	26.5
6324.43	41.0 Av	54	13.0	41.0	74	33.0

**TX on channel 914.990 MHz**

Frequency MHz	Quasi-peak(Qp) / Average (Av)			Peak		
	Result dB( $\mu$ V/m)	Limit dB( $\mu$ V/m)	Margin dB	Result dB( $\mu$ V/m)	Limit dB( $\mu$ V/m)	Margin dB
1829.98	32.9 Av	54	21.1	32.9	74	41.1
2744.97	34.5 Av	54	19.5	34.5	74	39.5
3659.96	37.3 Av	54	16.7	37.3	74	36.7
4574.95	38.3 Av	54	15.7	38.3	74	35.7
5489.94	49.5 Av	54	4.5	49.5	74	24.5
6404.93	41.1 Av	54	12.9	41.1	74	32.9

**TX on channel 926.490 MHz**

Frequency MHz	Quasi-peak(Qp) / Average (Av)			Peak		
	Result dB( $\mu$ V/m)	Limit dB( $\mu$ V/m)	Margin dB	Result dB( $\mu$ V/m)	Limit dB( $\mu$ V/m)	Margin dB
1852.98	34.8	54	19.2	34.8	74	39.2
2779.47	35.0	54	19.0	35.0	74	39.0
3705.96	37.8	54	16.2	37.8	74	36.2
4632.45	38.7	54	15.3	38.7	74	35.3
5558.94	47.8	54	6.2	47.8	74	26.2
6485.43	41.4	54	12.6	41.4	74	32.6

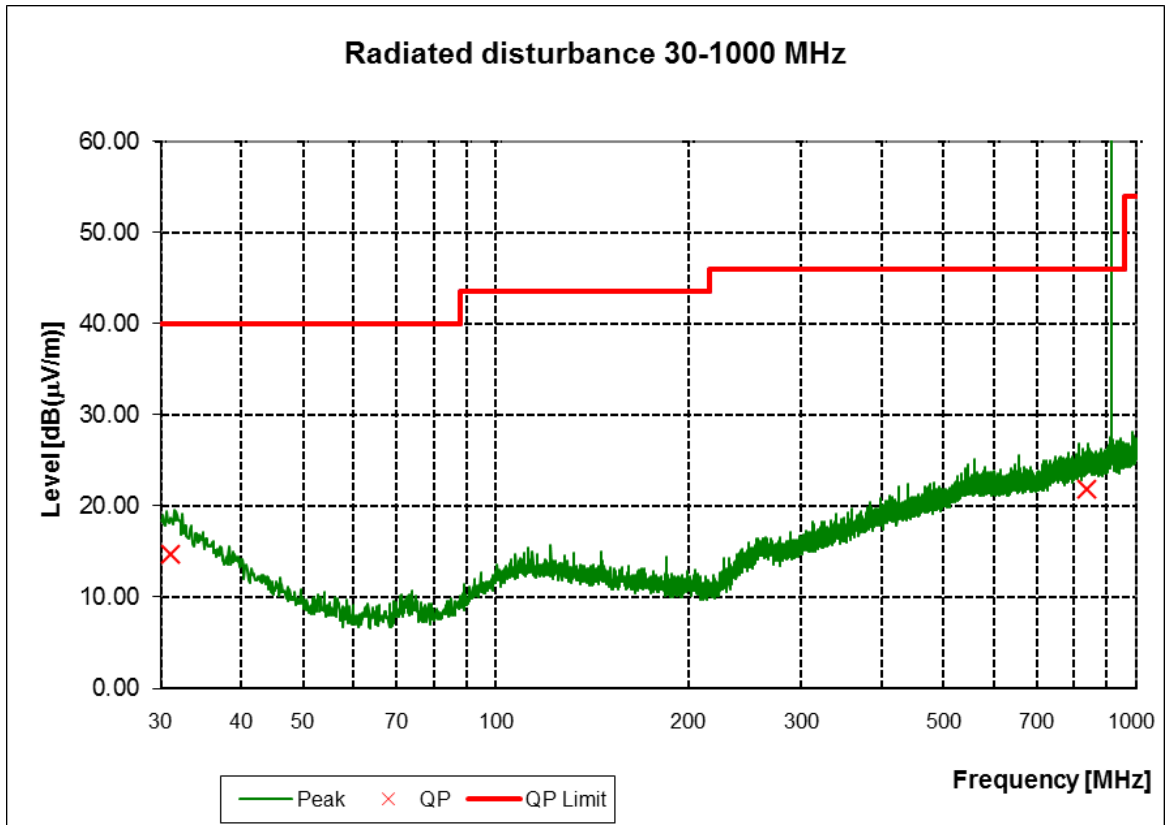


Figure 6. Spurious emissions, 30-1000 MHz, channel 914.990 MHz

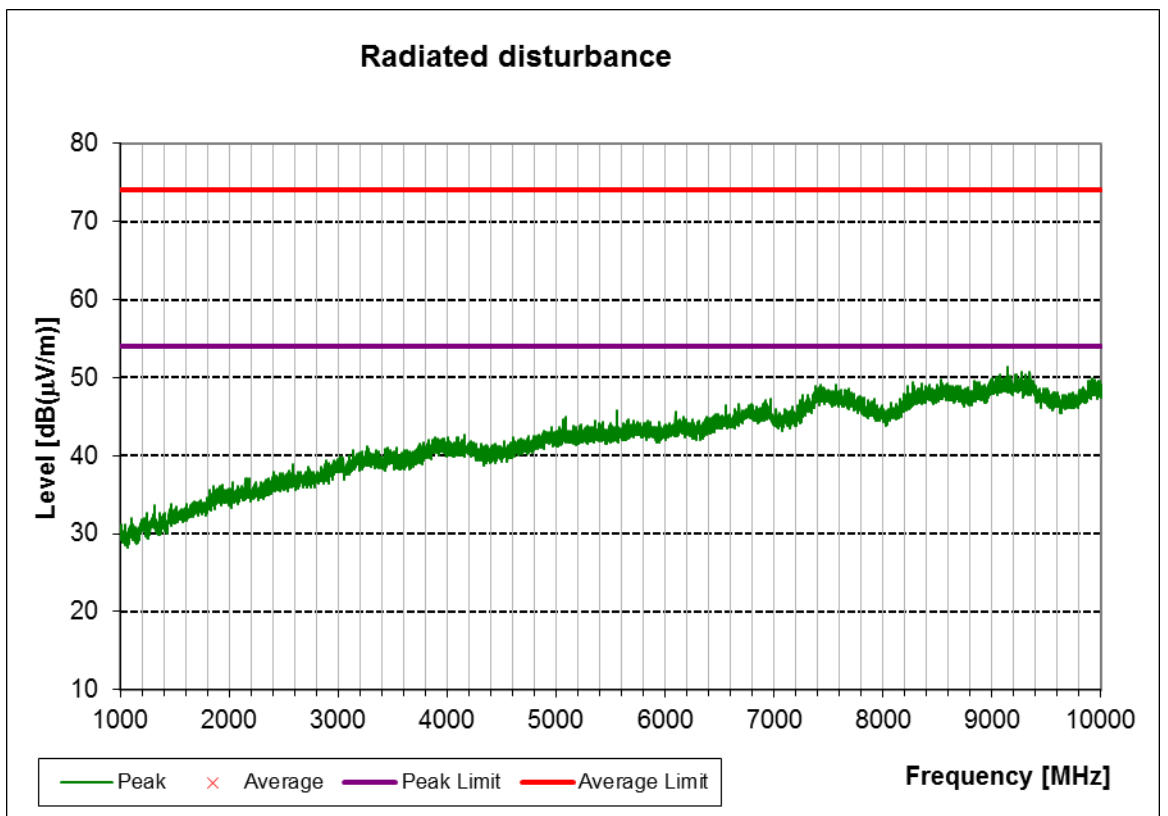


Figure 7. Spurious emissions, 1000-10000 MHz, channel 914.990 MHz



#### 4.4 20 dB Bandwidth

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

Site name	Nemko Oy / Perkkaa
FCC rule part	§ 15.215 (c)
Section in RSS-210	
Date of testing	15.05.2012
Test equipment	542, 564, 566
Test conditions	22 °C, 30 % RH
Test result	<b>PASS</b>

##### 4.4.1 EUT operation mode

EUT operation mode	<b>Transmitting</b>
EUT channel	<b>903.490, 914.990, 926.490 MHz</b>
EUT TX power level	<b>Nominal</b>

##### 4.4.2 Test data

EUT Channel (MHz)	Figure	Measured value (kHz)
<b>903.490</b>	<b>8</b>	<b>11.8</b>
<b>914.990</b>	<b>9</b>	<b>11.6</b>
<b>926.490</b>	<b>10</b>	<b>11.7</b>

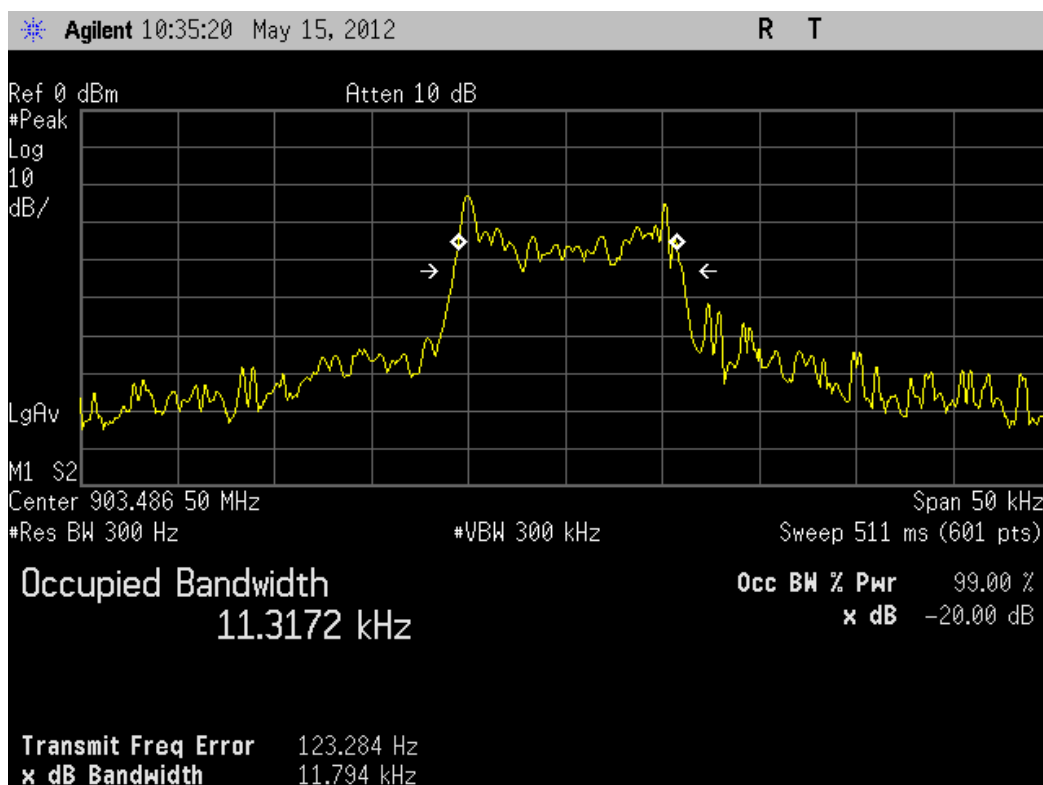


Figure 8. 20 dB bandwidth, channel 903.490 MHz.

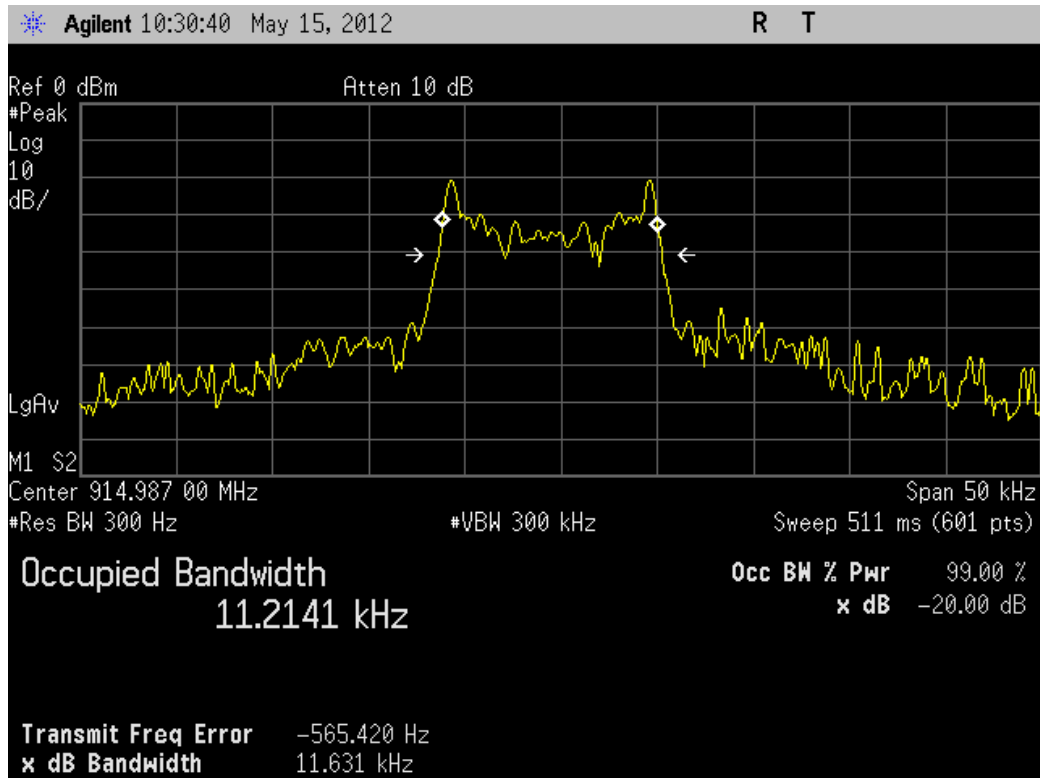


Figure 9. 20 dB bandwidth, channel 914.990 MHz.

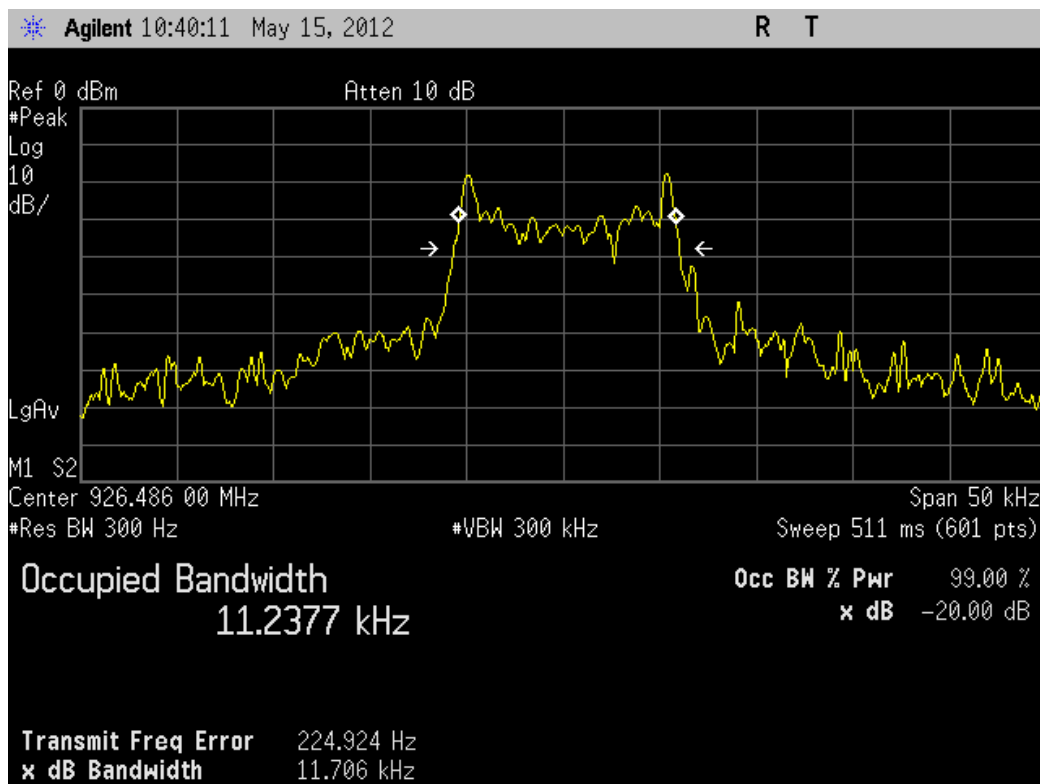


Figure 10. 20 dB bandwidth, channel 926.490 MHz.

#### 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 / Perkkaa
<i>FCC rule part</i>	§ 15.35(c)
<i>Section in RSS-Gen</i>	4.5
<i>Date of testing</i>	15.05.2012
<i>Test equipment</i>	542, 564, 566
<i>Test conditions</i>	22 °C, 30 % RH
<i>Test result</i>	<b>PASS</b>

##### 4.5.1 EUT operation mode

<i>EUT operation mode</i>	<b>TX on with modulation</b>
<i>EUT channel</i>	<b>914.990</b>
<i>EUT TX power level</i>	<b>Nominal</b>
<i>EUT operation voltage</i>	<b>3.0 VDC</b>

##### 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 = 493.3ms*

*DutyCycleCorrectionFactor=20\*log(Tocc/100)=20\*log(1\*100/100)=0dB*

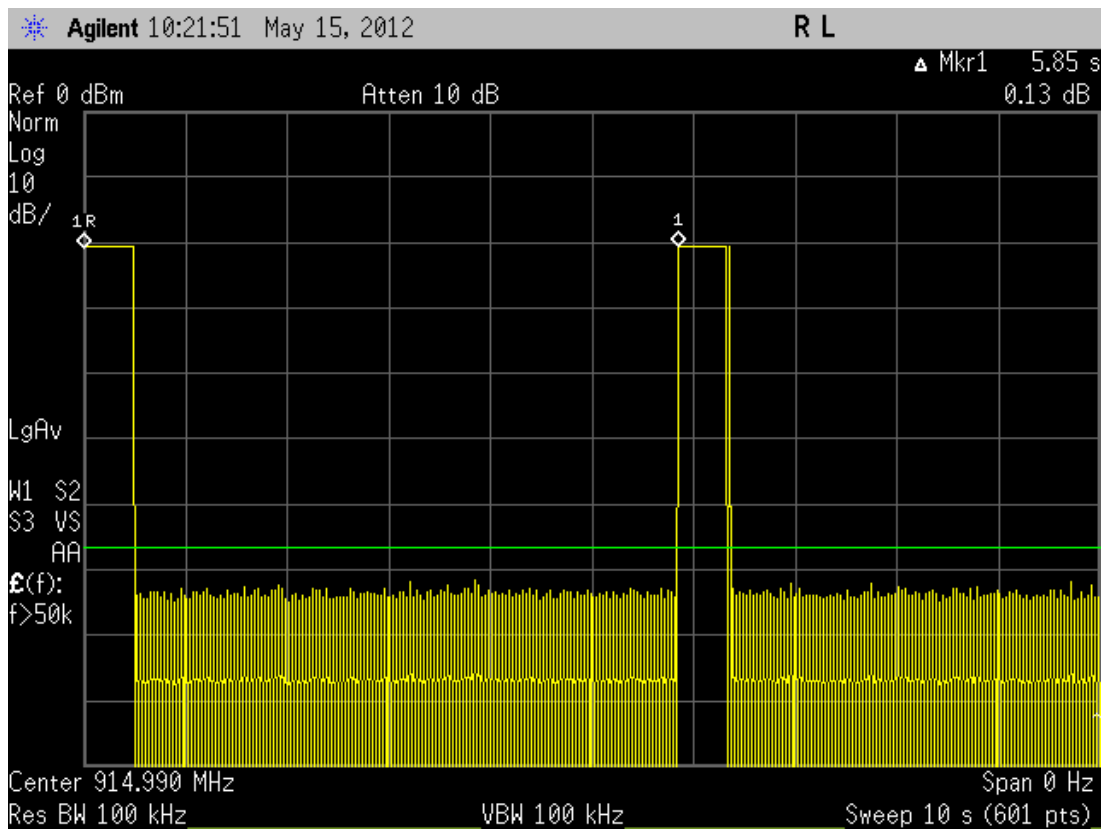


Figure 11. 10 s plot, channel 914.990 MHz.

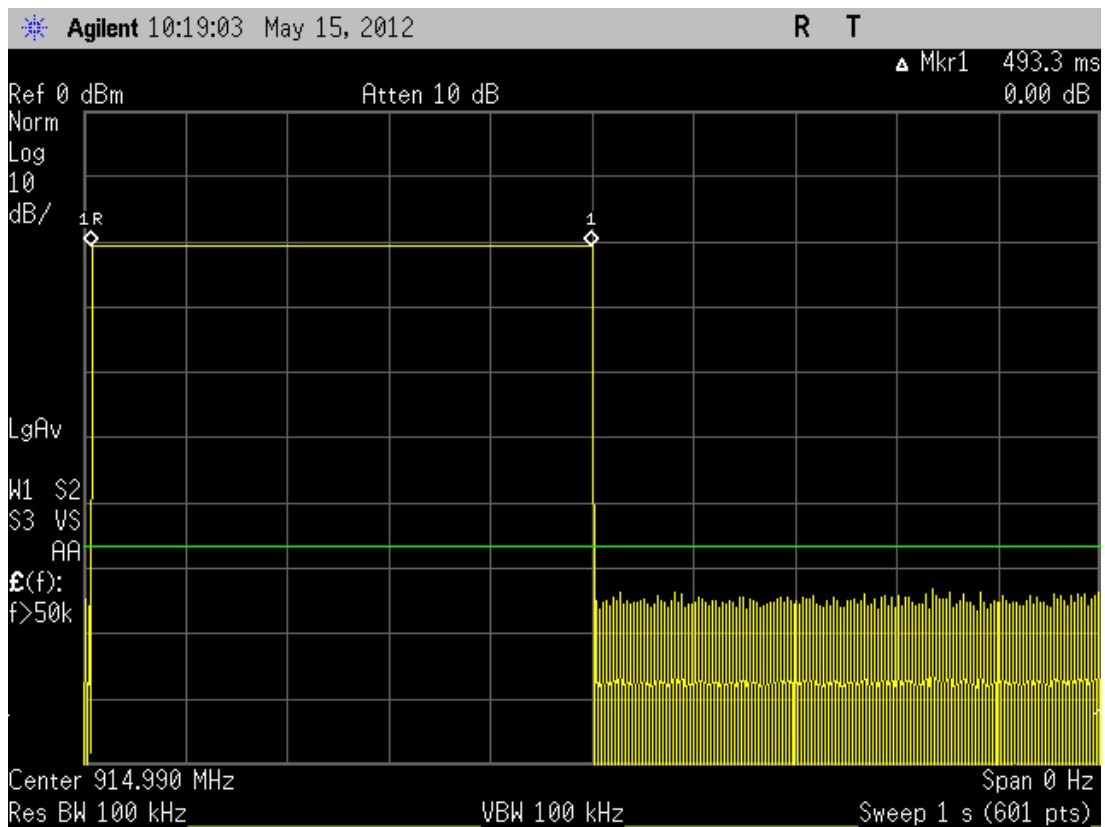


Figure 12. 1000 ms plot, channel 914.990 MHz.

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

## 6. Photographs



*Photograph 1, Radiated emissions test setup*