

REPORT: **FCC / IC Radio Frequency (RF) test report**
This report replaces the old test report: 100502B-RF.

PRODUCT:

Test item description:	Mobile computer for data collection
Trade Mark:	Nordic ID Morphic
Model/Type reference:	811-4A
Serial number:	N121300049 / N121300051
Customer:	NordicID Oy Myllyojankatu 2A 24100 SALO FINLAND
Contact person:	Pekka Maunu
Manufacturer:	NordicID Oy Myllyojankatu 2A 24100 SALO FINLAND

ORIGINAL DATE: 23.5.2012
CORRECTED DATE: 27.6.2012

TESTED BY:



Matti Virkki ; Test engineer



APPROVED BY:

Tuomo Hahl ; Test engineer

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1 LABORATORY INFORMATION

Test Laboratory	Intertek ETL Semko OY Koneenkatu 12 / K17 05830 Hyvinkää FINLAND
FCC registration number: IC file number:	910391 (January 27, 2003) IC 2042C-1 (May 14, 2003)

2 SUMMARY OF TEST RESULTS

The tests listed in this report have been done to demonstrate compliance to the FCC rules section §15.107, §15.109, §15.247 and IC standard RSS-GEN / RSS-210.

This report contains results for following tests.

Transmitter measurements

Section in CFR 47	Section in RSS-210	Test	Result
15.247, a 1 iii	A8.1 (4)	Number of operating frequencies	-
15.247, a	A8.1 (1)	6dB bandwidth	-
15.247, b 1	A8.4 (2)	Power output	PASS
15.247, b 1	A8.4 (2)	Power spectral density	-
15.247, d	A8.5	Band-edge compliance of RF emissions	-
15.247, d	A8.5	Spurious RF conducted emissions	-
15.247, d	A8.5	Spurious RF radiated emissions	PASS

Receiver measurements

Section in CFR 47	Section in RSS-GEN	Section in ICES-003	Test	Result
§15.107	7.2.2	5.3	Conducted emissions to AC-power lines	--
§15.109	7.2.3	5.5	Radiated emissions	PASS

PASS Pass
 FAIL Fail
 X Measured, but there are no applicable performance criteria
 - Not done

3 EUT INFORMATION

The EUT and accessories used in the tests are listed below. Later in this report only EUT numbers are used as reference.

	Device	Type	S/N	EUT number
EUT	Nordic ID Morphic	811-4A	N121300051	1
	Nordic ID Morphic	811-4A	N121300049	2 *

Notes:

* Antenna replaced with SMA-connector

3.1 EUT description

EUT is a battery operated mobile computer for data collection purposes. Battery can be charged with charger.

RFID radio test results are in separate test report 100502A-RF.

The EUT was not modified during the tests.
EUT contains FCC / IC certified radio module.

4 EUT TEST SETUPS

For each test the EUT was exercised to find out the worst case of operation modes and device configuration.

Two different test setups were used: one for conducted measurements, another for radiated measurements. One EUT was equipped with an external antenna connector for conductive measurements.

The test setup photographs are in the document referenced in section 12.

5 APPLICABLE STANDARDS

The tests were performed in guidance of:

CFR 47 Part:

§15.247

§15.407

ANSI C63.4 (2003)

IC standard:

RSS-GEN, Issue 3

RSS-210, Issue 8

Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method" for each test case.

6 POWER OUTPUT for Wi-Fi transmitter

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	25°C	54RH%	990hPa
Date of measurement	June 25th.2012		
FCC rule part	15.247 b 1, 15.407 a 1 2 3		
RSS-210 section	A8.4 (2)		
Measured by	Matti Virkki		

6.1 Test setup and measurement method

In the power output measurement the power splitter and cable attenuations were measured prior to the power measurement and set as parameter for cable loss in the spectrum analyzer to correct the reading of the output power. Spectrum analyzer subtracts the set attenuation value from the measured reading.

The measurement was made using 100 trace averages with 1 MHz resolution bandwidth, 10 MHz video bandwidth and RMS detector to record the output power. Spectrum analyzer's band power function was used to calculate power output.

6.2 EUT operation mode

EUT operation mode	Connection,
EUT channel	1, 6 and 11
EUT TX power level	max

EUT operation mode	Connection,
EUT channel	36 40 48 52 50 64 100 120 140 149 153 and 161
EUT TX power level	max

6.3 Results

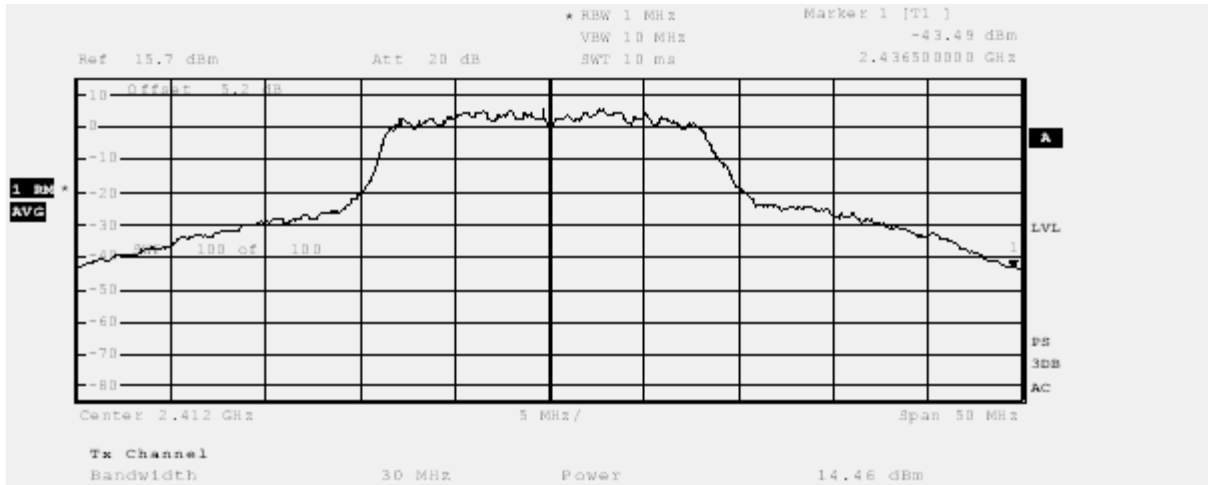
Table 1: Power output measurement results 2,4 GHz Wifi

EUT Channel	Limit (W)	Test result (W)	Limit (dBm)	Test result (dBm)
1	≤ 1	0,028	≤ 30	14,5
6		0,016		12,1
11		0,010		10,1

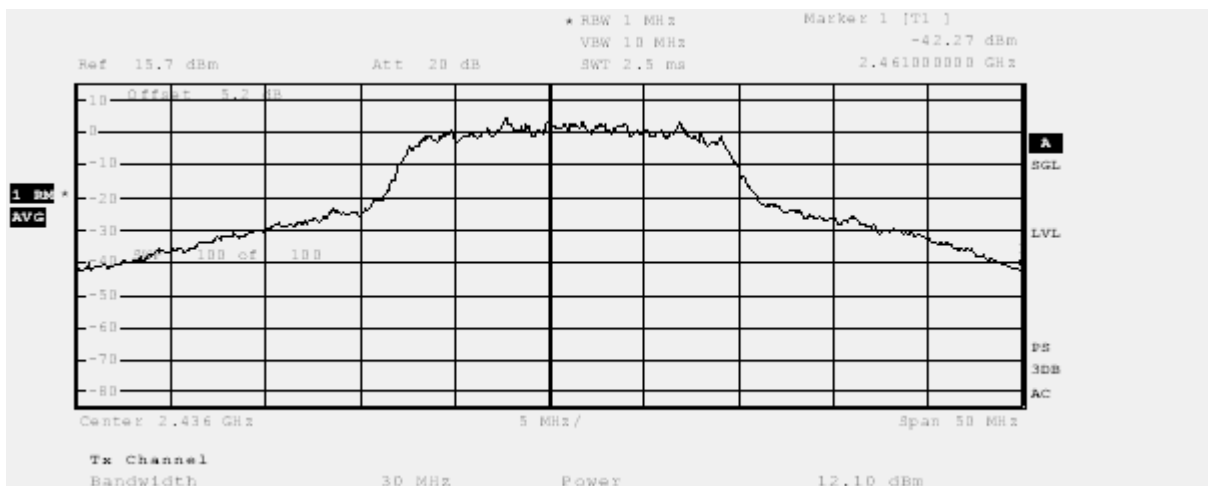
Table 2: Power output measurement results 5 GHz Wifi

EUT Channel	Limit (W)	Test result (W)	Limit (dBm)	Test result (dBm)
36	0,05	0,007	≤ 17	8,7
40	0,05	0,009	≤ 17	9,4
48	0,05	0,010	≤ 17	10,1
52	0,25	0,018	≤ 24	12,5
50	0,25	0,020	≤ 24	12,9
64	0,25	0,008	≤ 24	8,9
100	0,25	0,031	≤ 24	15,0
120	0,25	0,020	≤ 24	13,0
140	0,25	0,011	≤ 24	10,3
149	1	0,036	≤ 30	15,6
153	1	0,033	≤ 30	15,2
161	1	0,032	≤ 30	15,1

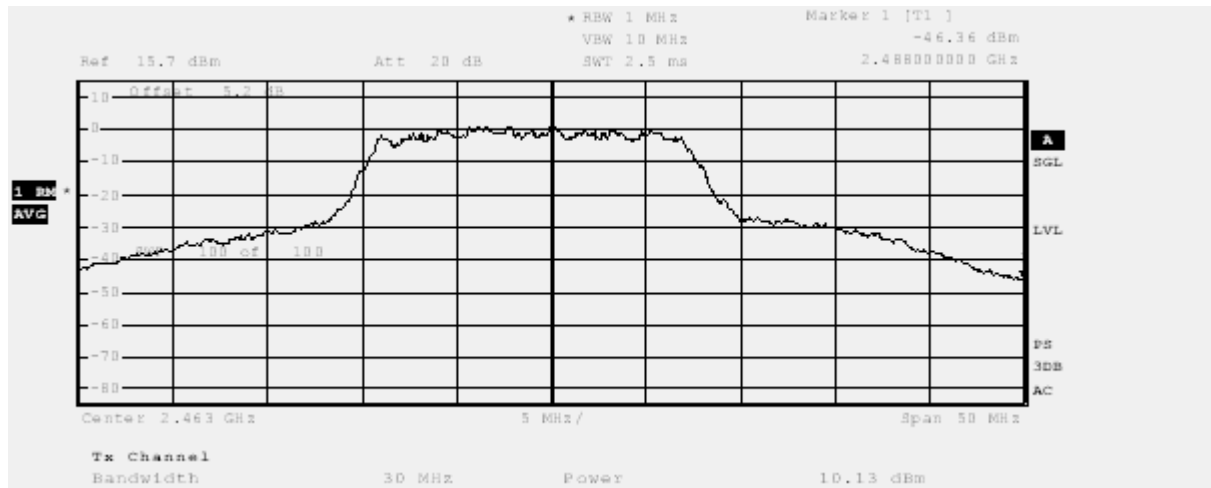
6.4 Screen shots



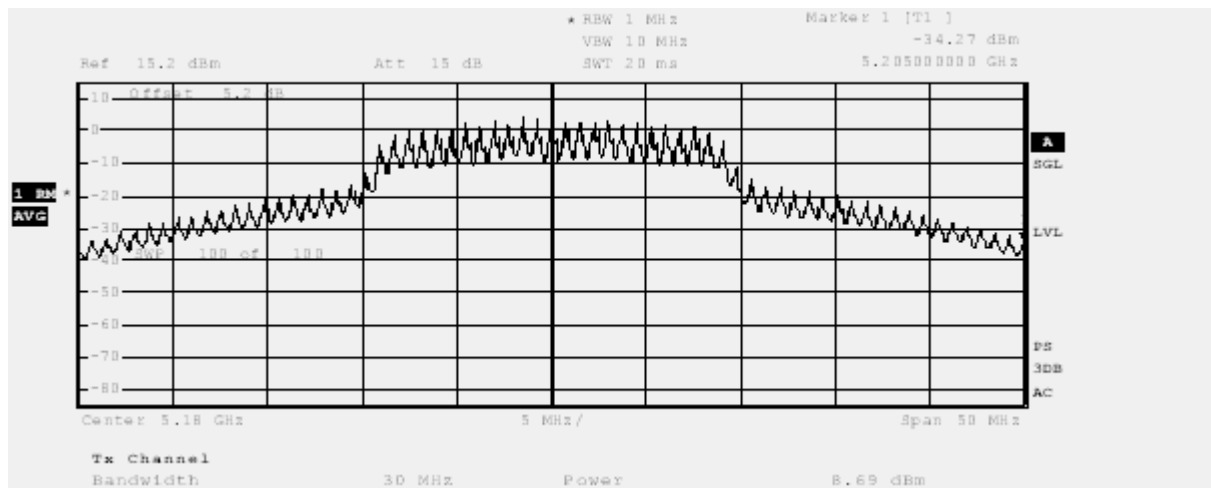
Picture 1: output power, channel 1



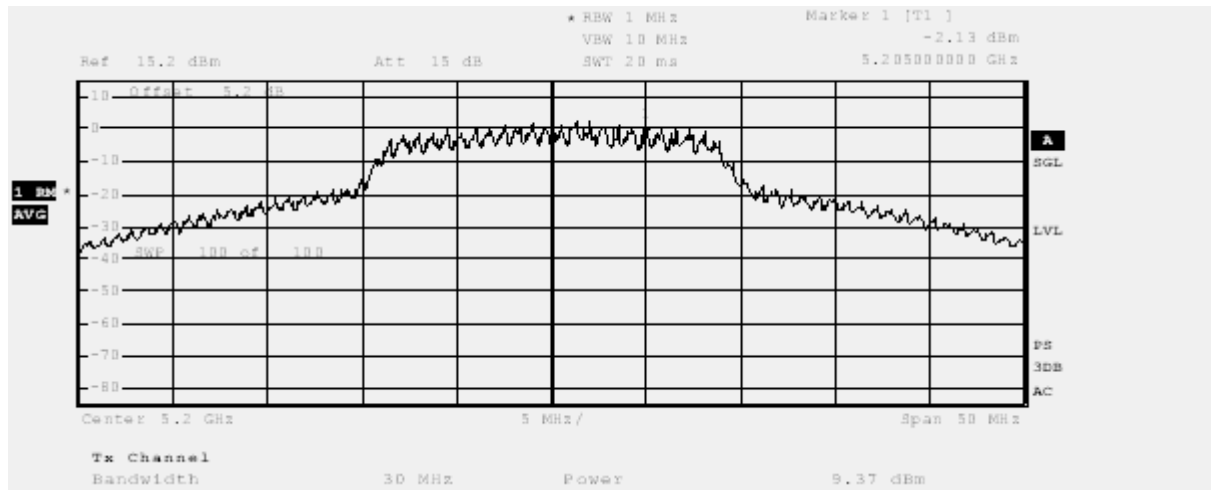
Picture 2: output power, channel 6



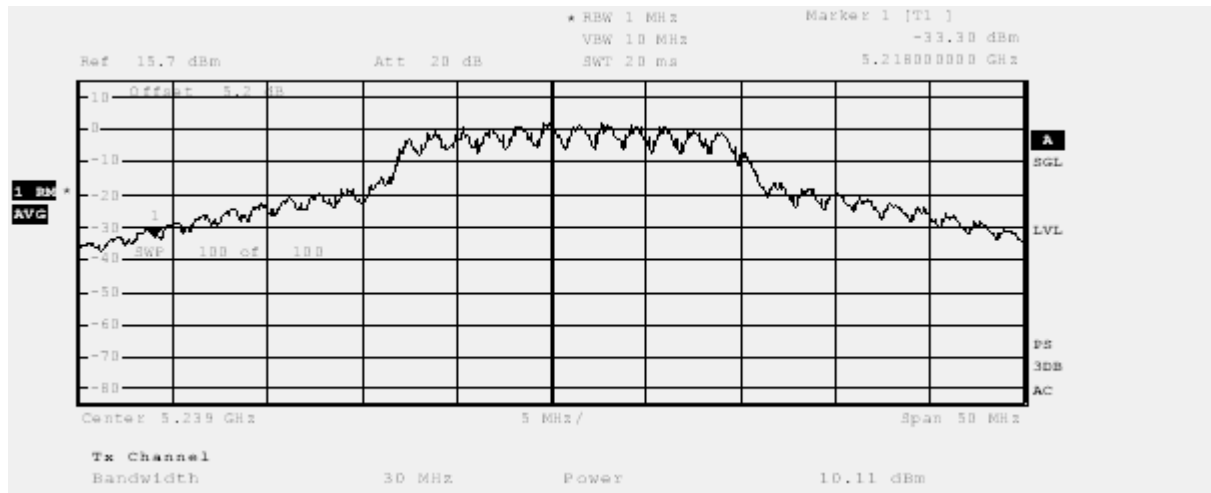
Picture 3: output power, channel 11



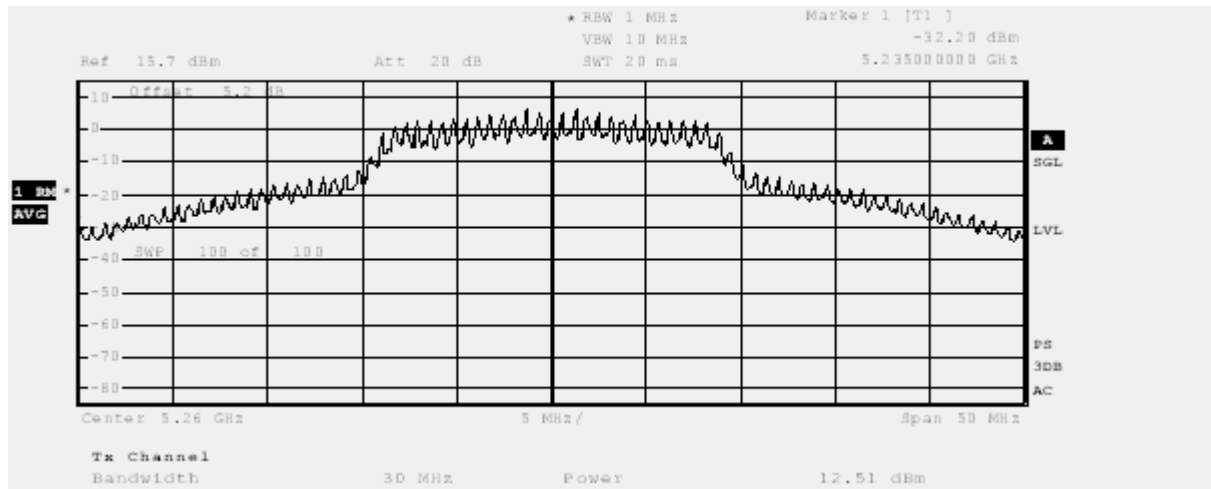
Picture 4: output power, channel 36



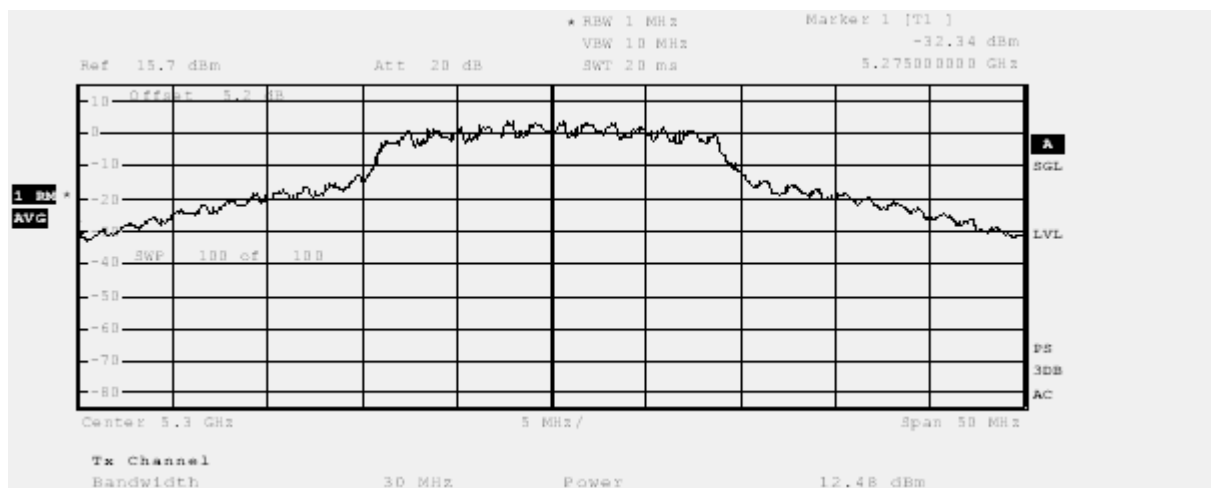
Picture 5: output power, channel 40



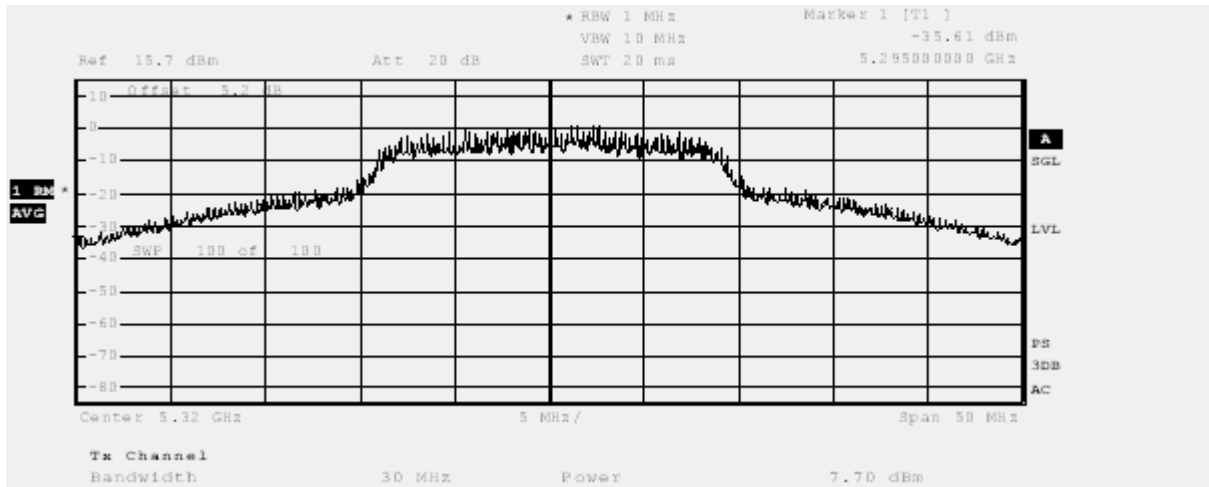
Picture 6: output power, channel 48



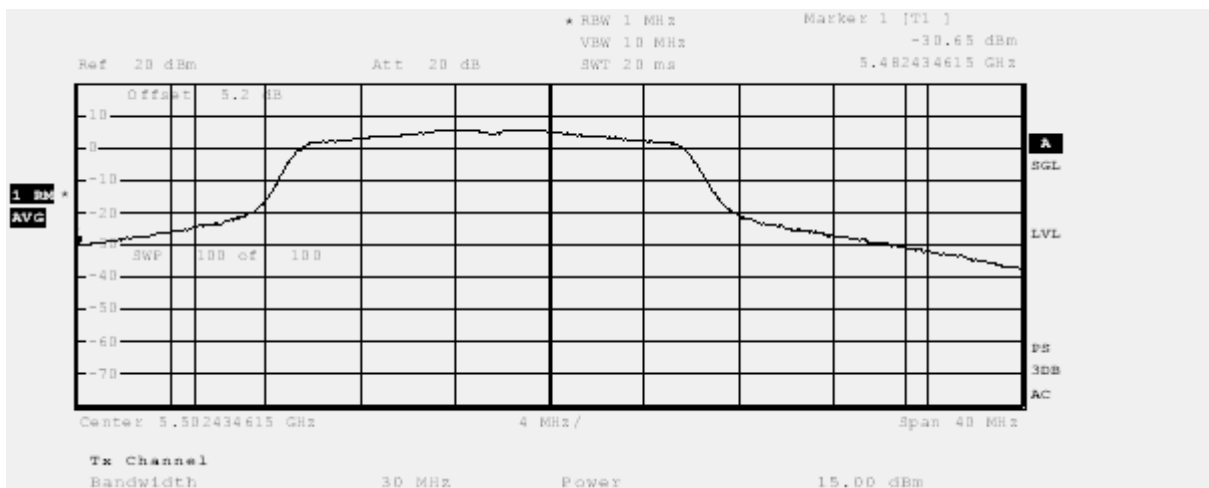
Picture 7: output power, channel 52



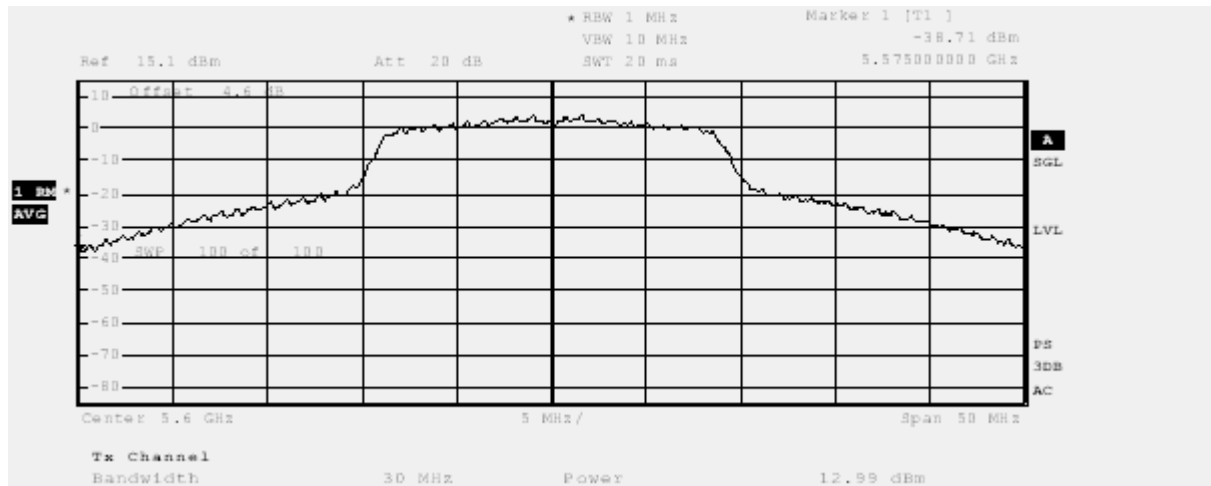
Picture 8: output power, channel 60



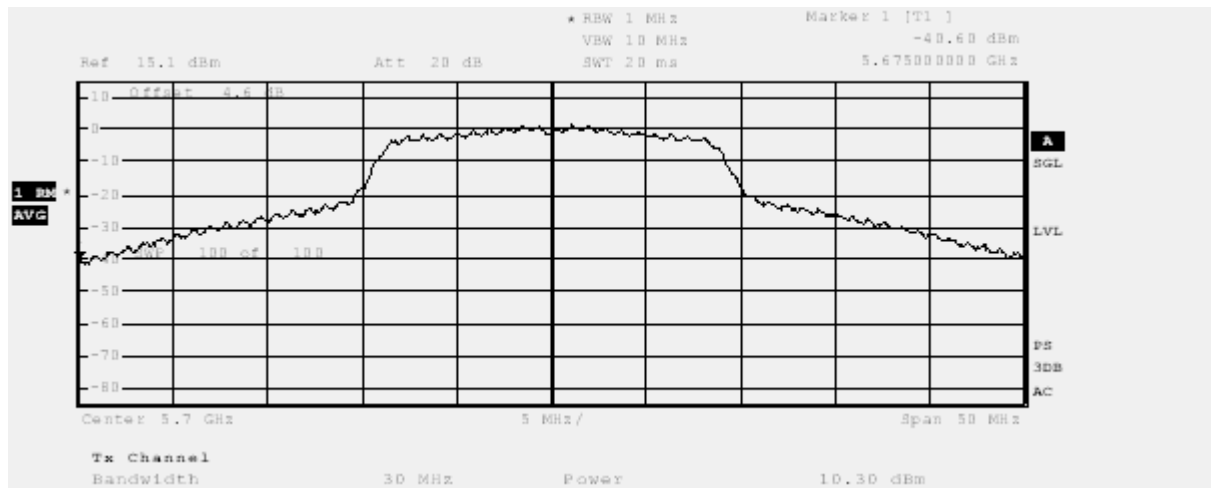
Picture 9: output power, channel 64



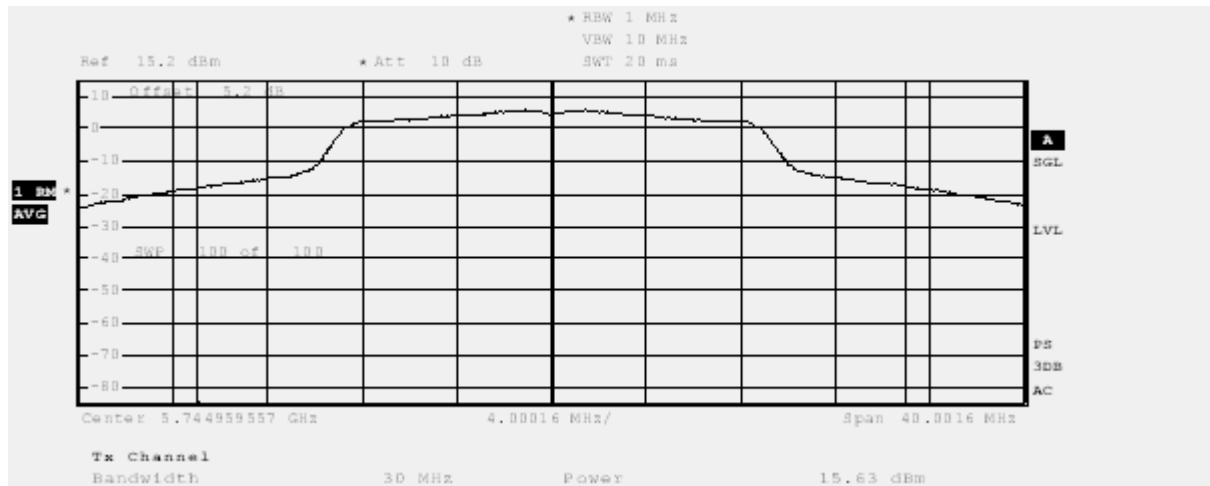
Picture 10: output power, channel 100



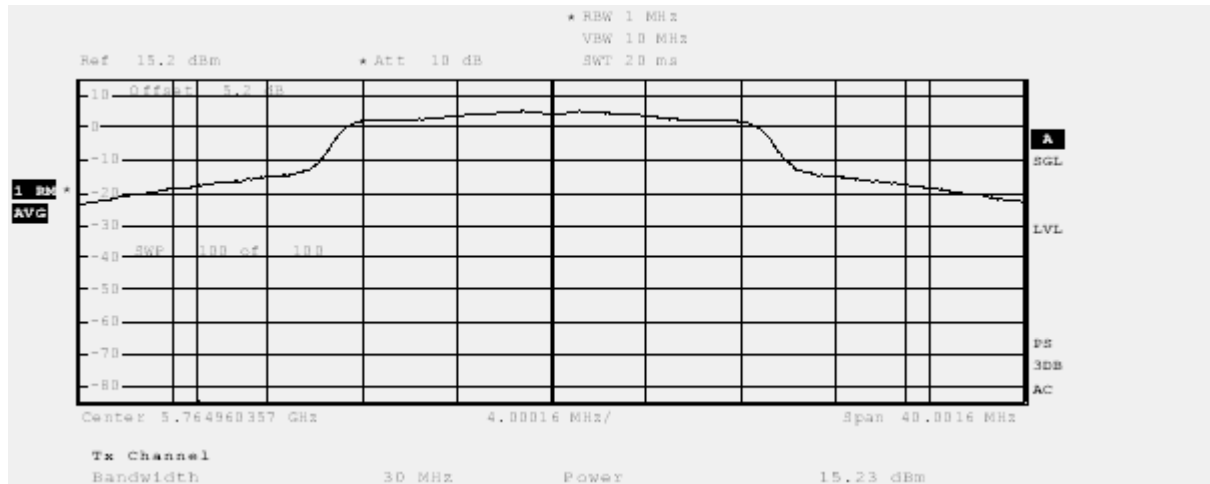
Picture 11: output power, channel 120



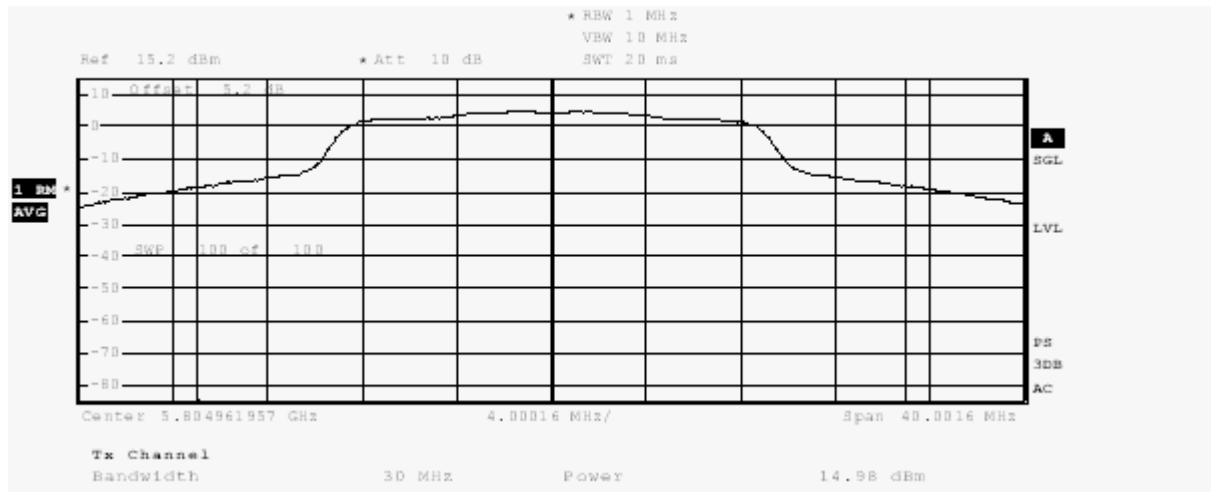
Picture 12: output power, channel 140



Picture 13: output power, channel 149



Picture 14: output power, channel 153

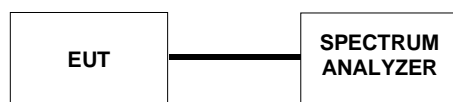


Picture 15: output power, channel 161

7 PEAK OUTPUT POWER for Bluetooth transmitter

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	19°C	27RH%	1005hPa
Date of measurement	April 16 th 2012		
FCC rule part	15.247, b 1		
RSS-210 section	A8.4 (2)		
Measured by	Matti Virkki		

7.1 Test setup and measurement method



Picture 16: Test setup for conducted RF output power measurement

In the peak output power measurement the power splitter and cable attenuations were measured prior to the power measurement and set as parameter for cable loss in the spectrum analyzer to correct the reading of the peak output power. Spectrum analyzer subtracts the set attenuation value from the measured reading. The measurement was made using 1 MHz resolution bandwidth and 3 MHz video bandwidth and maximum hold function to record the maximum peak output power.

7.2 EUT operation mode

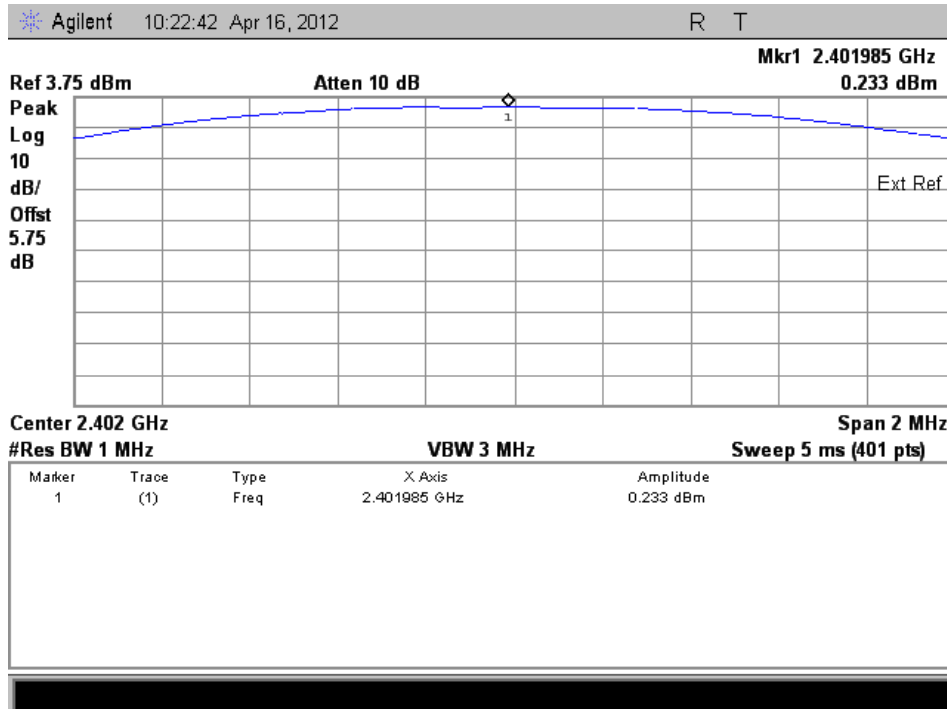
EUT operation mode	Connection, 8PSK
EUT channel	1, 26 and 52
EUT TX power level	max

7.3 Results

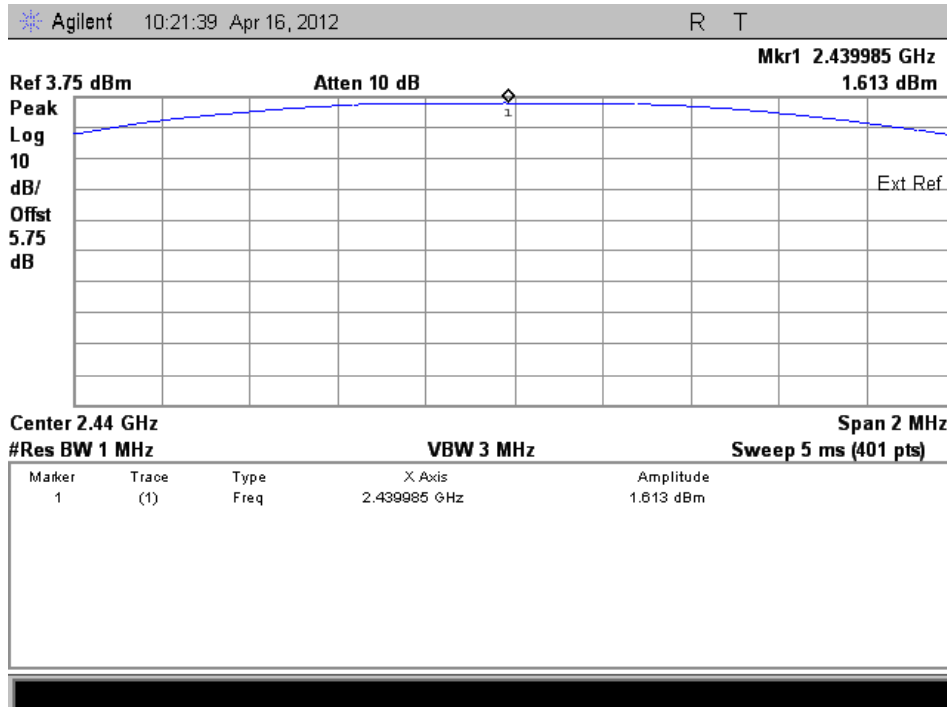
Table 3: Peak output power measurement results

EUT Channel	Limit (W)	Test result (W)	Limit (dBm)	Test result (dBm)
1	≤ 1	0,001	≤ 30	0,22
26		0,001		1,61
52		0,002		1,82

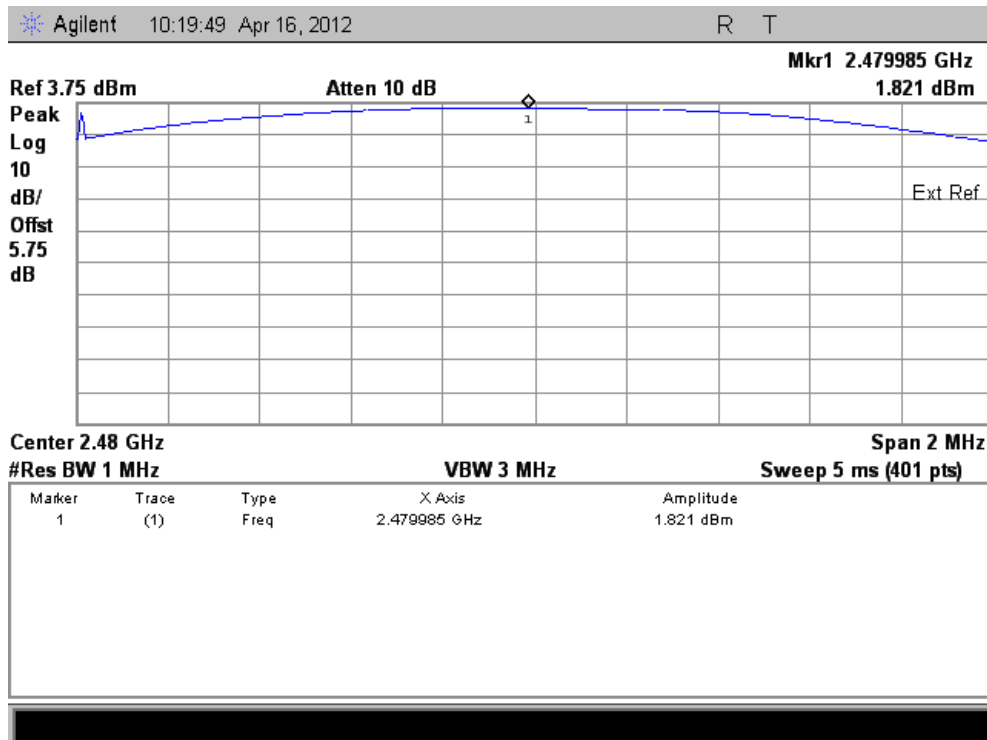
7.4 Screen shots



Picture 17: output power, channel 0



Picture 18: output power, channel 39



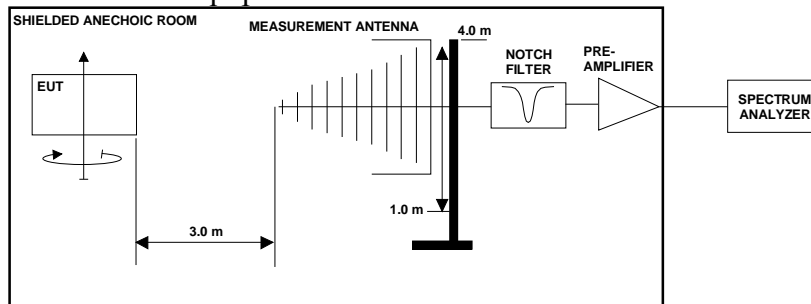
Picture 19: output power, channel 78

8 RADIATED SPURIOUS EMISSIONS

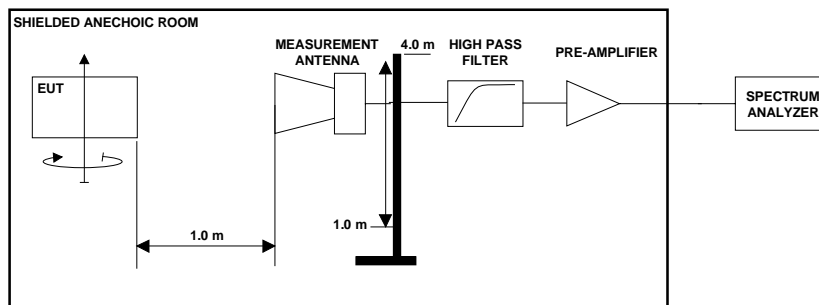
EUT	1		
Accessories			
Temp, Humidity, Air Pressure	22 °C	25 RH%	999 hPa
Date of measurement	April 3 rd 2012		
FCC rule part	15.247 d		
RSS-210 section	A8.5		
Measured by	Matti Virkki		

8.1 Test setup

The test was done using an automated test system, where a computer controlled the measurement equipment.



Picture 20: Test setup for radiated spurious emissions measurement
30 MHz - 3 GHz frequencies



Picture 21: Test setup for radiated spurious emissions measurement
3 GHz – 25 GHz frequencies

8.2 Test method

1. The emissions were searched and maximized by moving the turntable, changing the measuring antenna polarization and height and manipulating the EUT.
2. Levels of suspicious signals and levels of EUT transmitter harmonics were recorded.
3. The recorded levels were corrected in the automated test system with the measurement antenna factor, cable attenuations and filter attenuation.
4. The corrected values, giving the EUT radiated spurious emission levels as dB μ V/m at 3 m distance, are reported.

8.3 EUT operation mode

EUT operation mode	Connection
EUT channel	1, 6 and 11
EUT TX power level	max

8.4 Limit

Table 4: Radiated spurious emission limits at measurement distance 3m

Frequency band (MHz)	3m Limit (μ V/m)	3m Limit (dB μ V/m)	Detector
30 – 88	100	40	QP
88 -216	150	43,5	QP
216 - 960	200	46	QP
960 - 1000	500	54,0	QP
1000 - 25000	500	54,0	AVG
1000 - 25000	5000	74,0	PEAK

As default, all emissions were compared against the general limits. If any emission exceeded that limit, it was further checked, if it was outside the restricted band thus complying with the -20dBc requirement.

8.5 Results

Measurement system noise level was at least 15 dB below the spurious emission limit. Only levels of suspicious signals and transmitter harmonic frequencies, which were above the measurement system noise, are reported.

Results 2,4 GHz Wi-Fi

Table 5: Emission levels, channel 1

Frequency (MHz)	MaxPeak-MaxHold (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2332,290	43,0	100,0	V	174,0	-14,5	10,9	53,9	
2382,963	47,4	100,0	V	183,0	-14,5	6,5	53,9	
2383,055	46,9	100,0	V	177,0	-14,5	7,0	53,9	
2508,910	41,6	100,0	V	187,0	-14,4	11,3	53,9	
2572,107	42,7	100,0	V	273,0	-14,3	11,2	53,9	
4818,900	47,8	100,0	V	246,0	-8,4	6,1	53,9	

Table 6: Emission levels, channel 6

Frequency (MHz)	MaxPeak-MaxHold (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2358,214	44,6	100,0	V	203,0	-14,4	9,3	53,9	
2434,235	50,6	100,0	V	175,0	-14,3	3,3	53,9	
2516,036	46,5	100,0	V	313,0	-14,4	7,4	53,9	
4879,101	40,7	100,0	V	254,0	-8,3	1,2	53,9	

Table 7: Emission levels, channel 11

Frequency (MHz)	MaxPeak-MaxHold (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
2304,733	43,3	100,0	V	193,0	-14,5	10,6	53,9	
2379,140	49,5	100,0	V	187,0	-14,5	4,4	53,9	
2464,794	50,2	100,0	V	190,0	-14,3	3,7	53,9	
2496,666	46,0	100,0	V	213,0	-14,4	7,9	53,9	
2539,420	48,4	100,0	V	317,0	-14,4	5,5	53,9	
4929,000	44,4	100,0	V	239,0	-8,1	9,5	53,9	

Results bluetooth

Table 8: Emission levels, channel 0

Frequency (MHz)	MaxPeak-MaxHold (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
1689,554	36,6	100,0	H	288,0	-17,6	17,3	53,9	
2975,585	38,2	100,0	V	229,0	-12,7	15,7	53,9	

Table 9: Emission levels, channel 39

Frequency (MHz)	MaxPeak-MaxHold (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
1689,514	37,2	100,0	H	285,0	-17,6	16,7	53,9	

Table 10: Emission levels, channel 78

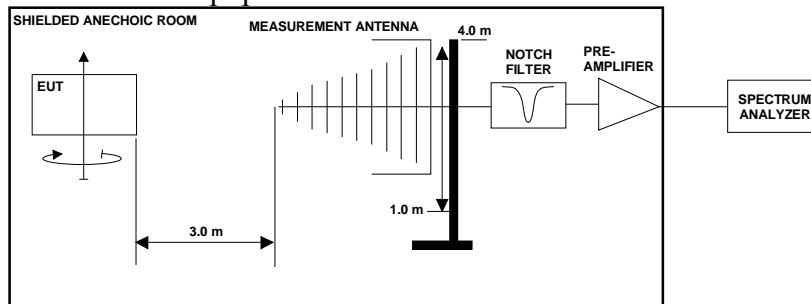
Frequency (MHz)	MaxPeak-MaxHold (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
NA								

9 RADIATED SPURIOUS EMISSIONS

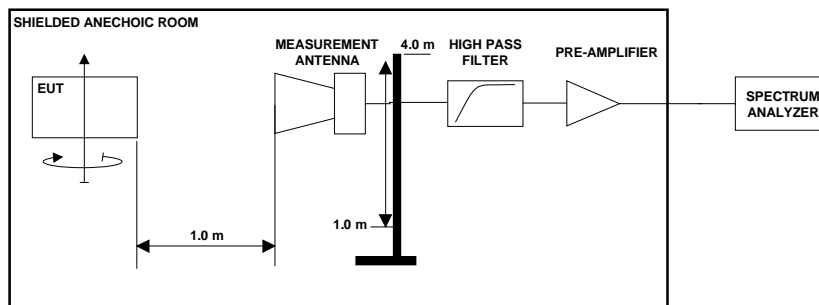
EUT	1		
Accessories			
Temp, Humidity, Air Pressure	22 °C	25 RH%	999 hPa
Date of measurement	April 3 rd 2012		
FCC rule part	15.407 b		
RSS-210 section	A8.5		
Measured by	Matti Virkki		

9.1 Test setup

The test was done using an automated test system, where a computer controlled the measurement equipment.



Picture 22: Test setup for radiated spurious emissions measurement
30 MHz - 3 GHz frequencies



Picture 23: Test setup for radiated spurious emissions measurement
3 GHz – 25 GHz frequencies

9.2 Test method

5. The emissions were searched and maximized by moving the turntable, changing the measuring antenna polarization and height and manipulating the EUT.
6. Levels of suspicious signals and levels of EUT transmitter harmonics were recorded.
7. The recorded levels were corrected in the automated test system with the measurement antenna factor, cable attenuations and filter attenuation.
8. The corrected values, giving the EUT radiated spurious emission levels as dB μ V/m at 3 m distance, are reported.
9. For EUT operations under 15.407 EUT is replaced with calibrated substitution antenna and signal generator
On each suspicious frequency Signal generator level is increased until same reading as with EUT corrected with antenna gain and cable loss is seen on spectrum analyzer.
This level is reported

9.3 EUT operation mode

EUT operation mode	Connection
EUT channel	36, 48, 64, 100,132 and 165
EUT TX power level	max

9.4 Limit

Table 11: Radiated spurious emission limits at measurement distance 3m

Frequency band (MHz)	3m Limit (μV/m)	3m Limit (dBμV/m)	Detector
30 – 88	100	40	QP
88 -216	150	43,5	QP
216 - 960	200	46	QP
960 - 1000	500	54,0	QP
Frequency band (MHz)	Limit (dBm/MHz)		Detector
1000 - 40000	-27		PEAK

9.5 Results

Measurement system noise level was at least 15 dB below the spurious emission limit. Only levels of suspicious signals and transmitter harmonic frequencies, which were above the measurement system noise, are reported.

Result 5 GHz Wi-Fi

Table 12: Emission levels, channel 36

Frequency (MHz)	MaxPeak (dBm)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)	Comment
5344,966	-46,93	155,0	H	9,0	-6,9	19,9	-27	
5397,583	-45,43	100,0	V	45,0	-6,6	18,5	-27	
10359,014	-42,4	100,0	H	171,0	4,0	15,4	-27	

Table 13: Emission levels, channel 48

Frequency (MHz)	MaxPeak (dBm)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)	Comment
5084,716	-50,53	184,0	H	148,0	-7,1	23,5	-27	
5401,883	-46,53	100,0	H	248,0	-6,6	19,5	-27	
10479,923	-43,0	100,0	H	226,0	4,2	16,0	-27	

Table 14: Emission levels, channel 64

Frequency (MHz)	MaxPeak (dBm)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)	Comment
5407,000	-46,33	100,0	V	64,0	-6,6	19,3	-27	
10642,210	-41,93	100,0	H	184,0	4,5	14,9	-27	

Table 15: Emission levels, channel 100

Frequency (MHz)	MaxPeak (dBm)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)	Comment
11001,553	-32,89	100,0	H	187,0	4,9	5,9	-27	

Table 16: Emission levels, channel 132

Frequency (MHz)	MaxPeak (dBm)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)	Comment
11319,764	-36,07	100,0	H	163,0	6,4	9,2	-27	

Table 17: Emission levels, channel 165

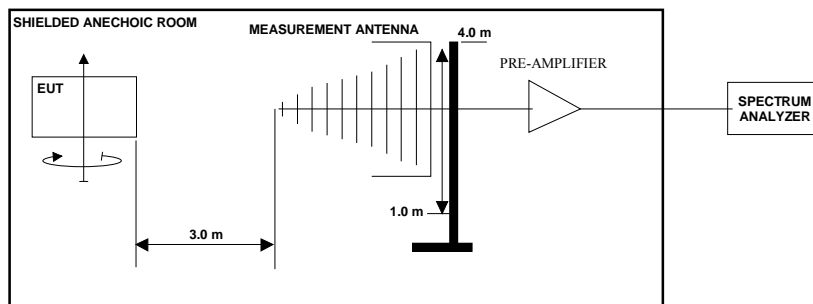
Frequency (MHz)	MaxPeak (dBm)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBm)	Comment
5667,350	-47,43	100,0	H	135,0	-6,1	19,4	-27	
5981,966	-44,63	100,0	H	168,0	-4,9	16,4	-27	
11649,800	-47,57	100,0	H	143,0	6,3	20,6	-27	

10 RECEIVER RADIATED EMISSION

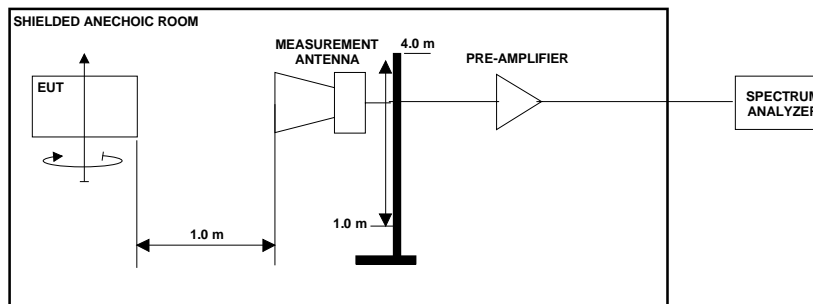
EUT	1		
Accessories			
Temp, Humidity, Air Pressure	20 °C	24 RH%	990 hPa
Date of measurement	April 5 th 2012		
FCC rule part	§15.109		
RSS-GEN section	7.2.3		
ICES-003 section	5.5		
Measured by	Matti Virkki		

10.1 Test setup

The test was done using an automated test system, where a computer controlled the measurement equipments.



Picture 24: Test setup for radiated spurious emissions measurement
30 MHz - 1 GHz frequencies



Picture 25: Test setup for radiated spurious emissions measurement
1 GHz – 26 GHz frequencies

10.2 Test method

1. The emissions were searched and maximized by moving the turntable, changing the measuring antenna polarization and height and manipulating the EUT.
2. Levels of suspicious signals and levels of EUT transmitter harmonics were recorded.
3. The recorded levels were corrected in the automated test system with the measurement antenna factor, cable attenuations and filter attenuation.
4. The corrected values, giving the EUT radiated spurious emission levels as dB μ V/m at 3 m distance, are reported.

10.3 EUT operation mode

EUT operation mode	Receiver mode
EUT frequency	Na
EUT TX power level	Na

10.4 Limit

Table 18: Radiated spurious emission limits at measurement distance 3m

Frequency band (MHz)	3m Limit (μV/m)	3m Limit (dBμV/m)	Detector
30 – 88	100	40	QP
88 -216	150	43,5	QP
216 - 960	200	46	QP
960 - 1000	500	54,0	QP
1000 - 12400	500	54,0	AVG
1000 - 12400	5000	74,0	PEAK

As default, all emissions were compared against the general limits. If any emission exceeded that limit, it was further checked, if it was outside the restricted band thus complying with the -20dBc requirement.

10.5 Results

The measured interference values using Quasi peak and average detectors are shown in the pictures below.

All signals closer than 6 dB to the limit below 1 GHz have been measured using quasi peak or average detector and reported in the table 19, 20 and **Error! Reference source not found.**

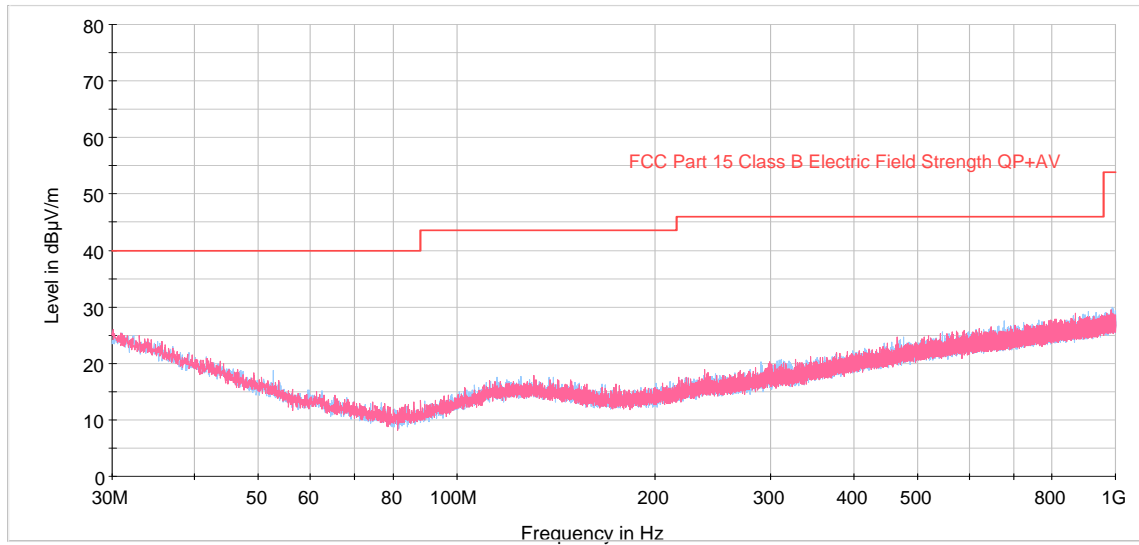
Table 19: Radiated emissions using Quasi peak detector

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height	TT angle
N/A								

Table 20: Radiated emissions using Peak and average detector

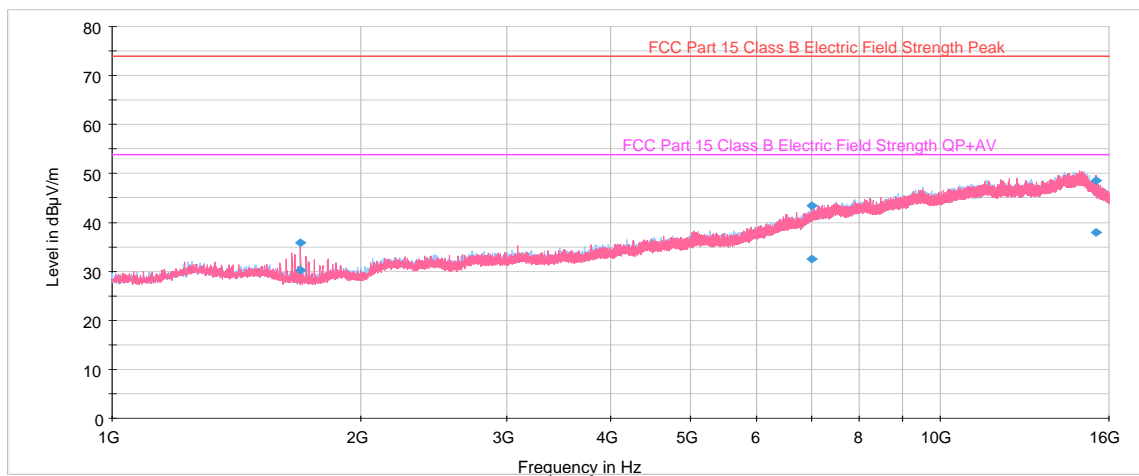
Freq MHz	MaxPeak- (dB μ V/m)	Average- (dB μ V/m)	Height (cm)	Ant Pol.	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
1689,78	35,9	27,2	125,0	V	143,0	-18,4	38,0	73,9
14778,26	50,6	40,3	100,0	V	260,0	7,6	23,3	73,9

FCC part 15 class Class B 3m



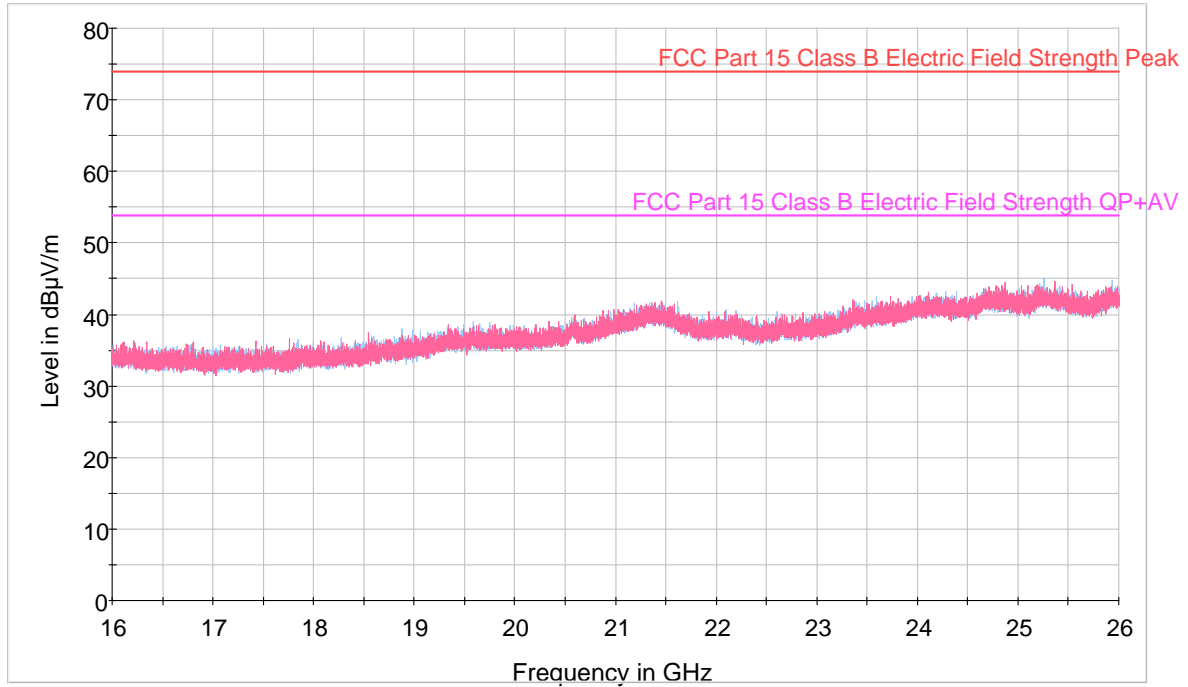
Picture 26: radiated emission results, 30 – 1000 MHz,
Red= horizontal polarization, blue = vertical polarization

FCC part 15 class Class B 1-16 GHz



Picture 27: radiated emission results, 1 – 16 GHz,
Red= horizontal polarization, blue = vertical polarization

FCC part 15 16-26GHz 3m



Picture 28: radiated emission results, 16 – 26 GHz,
Red= horizontal polarization, blue = vertical polarization

11 TEST EQUIPMENT

Calibration period for equipment is 1 year except for antennas which are calibrated every 2 years.

11.1 Conducted measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
Spectrum analyser	Agilent E7405A	131	MY42000072
EMI test receiver	Rohde & Schwarz ESU 26	219	100173

11.2 Radiated measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
EMI test receiver	Rohde & Schwarz ESU 26	219	100173
Bilog antenna	Chase CBL6143A	221	29611
3 dB attenuator	Huber+Suhner 3dB/2W	214	-
Horn Antenna	Schwarzbeck BBHA9120D	138	365
Horn Antenna	Schwarzbeck BBHA 9170	194	0313
Pre-amplifier	JCA 118-400	142	-
Pre-amplifier	Miteq 18-26GHz	191	1128879
High pass filter	Wainwright Instruments WHK3.0/18GST	141	3
High pass filter	Wainwright Instruments WHKX 7.5/18G-8SS	231	20
Band reject filter	Wainwright Instruments WRCT 2400/2483,5	196	2
3m Semi-anechoic chamber	ETS Euroshield	081	-
Measuring software	Rohde & Schwarz EMC 32	-	Ver 8.52

Substitute calibration source

DEVICE	MANUFACTURER	SPKTT	SERIAL
Signal generator	Agilent E8254A	147	US41140103
Biconical antenna	Rohde&Schwarz HUF-Z2	042	860941/009
Logper antenna	Rohde&Schwarz HUF-Z3	023	860944/003
Biconical antenna	Schwarzbeck SBA9113	152	188
Small Biconical antenna	Schwarzbeck SBA9112	156	003
Horn antenna	EMCO 3160-09	512	9806-1109
Coax cable	Sucoflex 104P with ferrite	-	Cable-56

12 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document
100502C-RF_PHOTOS.doc