


**REPORT:** **FCC / IC Radio Frequency (RF) test report**  
This report replaces the old test report: 200530B-RF.

**PRODUCT:**


Test item description:	Mobile computer for data collection
Trade Mark:	Nordic ID Merlin
Model/Type reference:	805-2B
Serial number:	L104831340 L112632261
Customer:	Nordic ID Oy Myllyojankatu 2A 24100 SALO FINLAND
Contact person:	Hannu Heino
Manufacturer:	Nordic ID Oy Myllyojankatu 2A 24100 SALO FINLAND

**ORIGINAL DATE:** 7.9.2011  
**CORRECTED DATE:** 7.12.2011

**TESTED BY:**

  
\_\_\_\_\_  
Matti Virkki ; Test engineer

**APPROVED BY:**

  
\_\_\_\_\_  
Tuomo Hahl ; Test engineer

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## 1 LABORATORY INFORMATION

<b>Test Laboratory</b>	Intertek ETL Semko OY Koneenkatu 12 / K17 05830 Hyvinkää FINLAND
<b>FCC registration number:</b> <b>IC file number:</b>	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, §15.209, §15.225 and IC standard RSS-GEN / RSS-210.

### BT Transmitter measurements

Section in CFR 47	Section in RSS-210	Test	Result
15.247, a 1	A8.1 (2)	Carrier frequency separation	PASS
15.247, a 1 iii	A8.1 (4)	Number of hopping frequencies	PASS
15.247, a 1 iii	A8.1 (4)	Time of occupancy	PASS
15.247, a	A8.1 (1)	20dB bandwidth	PASS
15.247, b 1	A8.4 (2)	Peak output power	PASS
15.247, d	A8.5	Band-edge compliance of RF emissions	PASS
	RSS-GEN 4.6.1	99% bandwidth	PASS
		Field strength of fundamental	X
15.247, d	A8.5	Spurious radiated emissions	PASS

### RFID Transmitter measurements

Section in CFR 47	Section in RSS-210	Test	Result
§ 15.225 (a)	Annex 2.6	Field strength of fundamental	PASS
§ 15.209 (a) (d)	2.6	Spurious radiated emissions	PASS
§ 15.225 (e)	Annex 2.6	Frequency tolerance	PASS
	RSS-GEN 4.6.1	99% bandwidth	PASS

### RFID Transmitter measurements

Section in CFR 47	Section in RSS-210	Test	Result
15.247, b 1	A8.4 (2)	output power	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	PASS
§15.109	7.2.3	5.5	Radiated emissions	PASS

PASS Pass

FAIL Fail

X Measured, but there is 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
<b>EUT</b>	Nordic ID Merlin	805-2B	L104831340	1
	Nordic ID Merlin	805-2B	L112632261	2 *
	Nordic ID Merlin Pistol grip	ACN00103	L112504929	3
	Nordic ID Merlin Pistol grip	ACN00103	L104803873	4
<b>Accessories</b>	-			

Notes:

\* Antennas replaced with SMA-connectors

### 3.1 EUT description

EUT is a mobile computer that includes WLAN, Bluetooth, HF RFID and 1D/2D barcode reader.

The EUT was not modified during the tests.

## 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 21.

## 5 APPLICABLE STANDARDS

The tests were performed in guidance of:

CFR 47 Part:

- §15.107
- §15.109
- §15.209
- §15.247
- ANSI C63.4 (2009)

IC standard:

- RSS-GEN, Issue 3
- RSS-210, Issue 8
- ANSI C63.4 (2009)

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

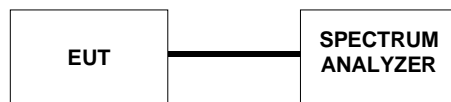
## 6 BLUETOOTH CARRIER FREQUENCY SEPARATION

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	26 °C	46 RH%	1009 mbar
<b>Date of measurement</b>	July 11, 2011		
<b>FCC rule part</b>	15.247, a 1		
<b>RSS-210 section</b>	A8.1 (2)		
<b>Measured by</b>	Simo Ojanen		

### 6.1 Test setup and testing method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 1: Test setup for carrier frequency separation measurement

Spectrum analyzer was set to sweep the Bluetooth operating band 2,40 – 2,483 GHz. 30 kHz resolution bandwidth and maximum hold function was used to measure the EUT transmission over sufficient time. Carrier frequency separation was read from the screen.

## 6.2 EUT operation mode

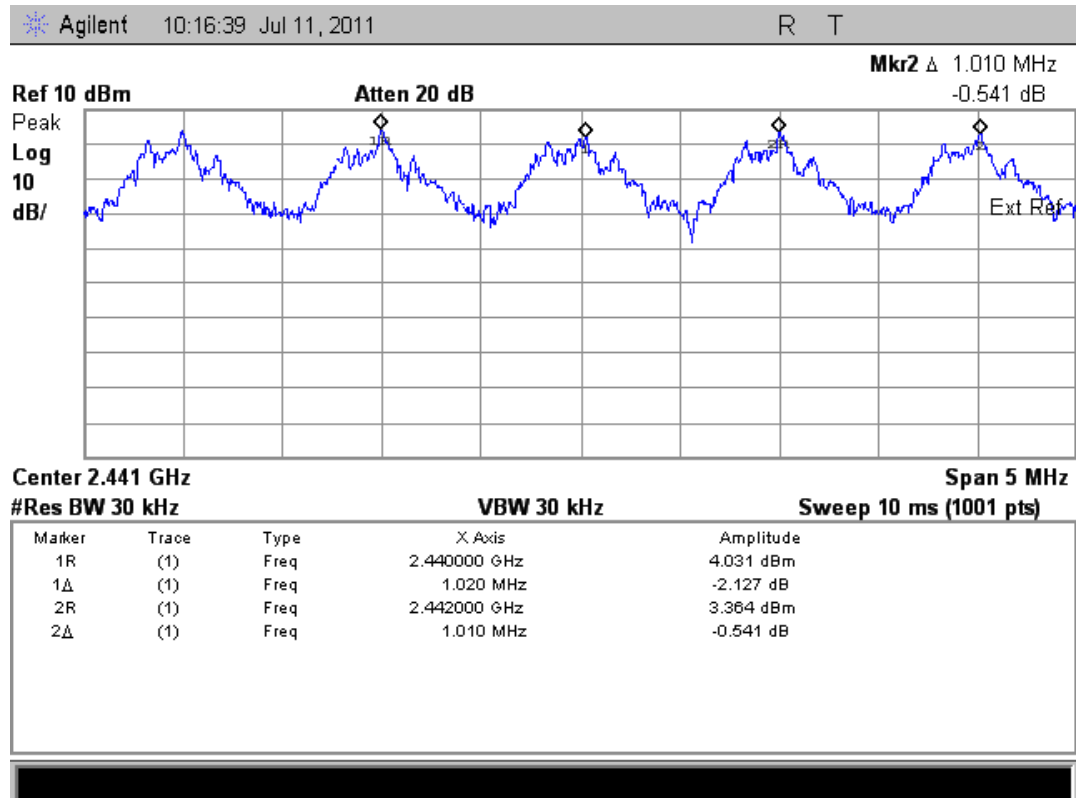
<b>EUT operation mode</b>	Connection, FSK modulation, DH5 packet type
<b>EUT channel</b>	Hopping
<b>EUT TX power level</b>	max

## 6.3 Results

Table 1: Carrier frequency separation measurement results

Limit	Result
2/3 * 20dB bandwidth	1,0 MHz

## 6.4 Screen shots



Picture 2: Carrier frequency separation, Channels 38 and 39



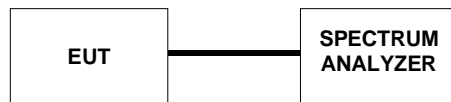
## 7 BLUETOOTH NUMBER OF HOPPING FREQUENCIES

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	26 °C	46 RH%	1009 mbar
<b>Date of measurement</b>	July 11, 2011		
<b>FCC rule part</b>	15.247, a 1 iii		
<b>RSS-210 section</b>	A8.1 (4)		
<b>Measured by</b>	Simo Ojanen		

### 7.1 Test setup

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 3: Test setup for measurement of number of hopping frequencies

Spectrum analyzer was set to sweep the Bluetooth operating band 2,40 – 2,483 GHz. 300 kHz resolution bandwidth and maximum hold function was used to measure the EUT transmission over sufficient time. Number of hopping frequencies was calculated from the screen.

## 7.2 EUT operation mode

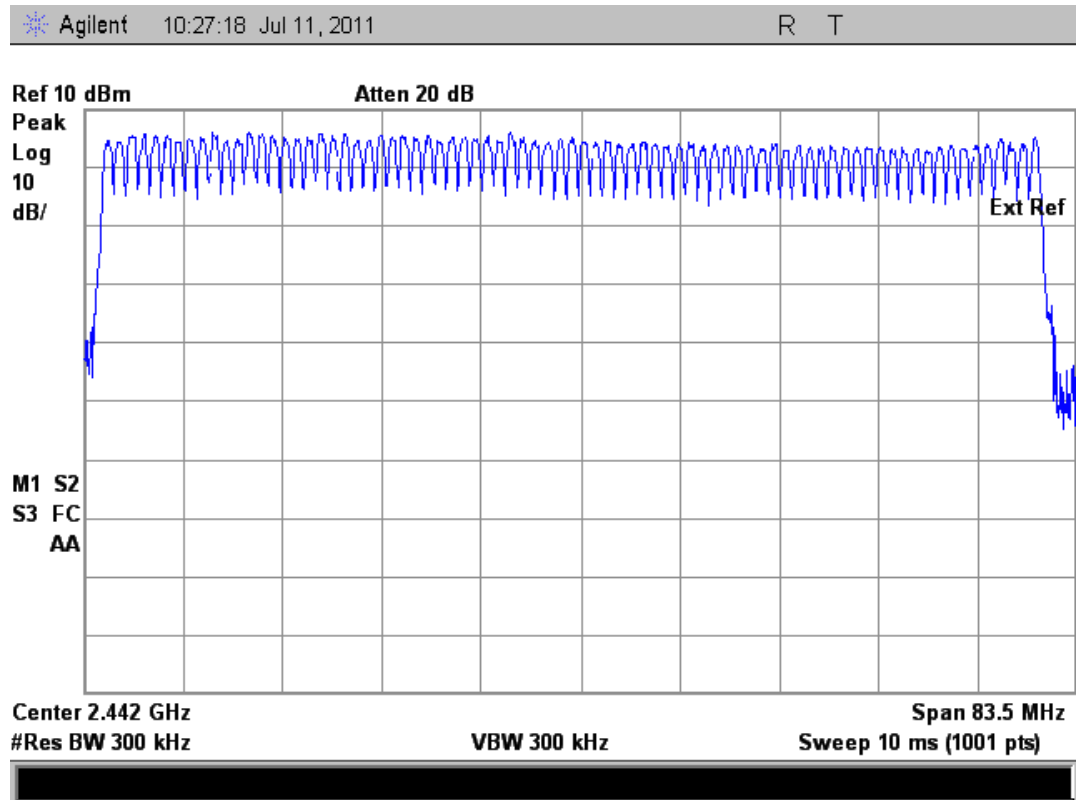
<b>EUT operation mode</b>	Connection, FSK modulation, DH5 packet type
<b>EUT channel</b>	Hopping
<b>EUT TX power level</b>	max

## 7.3 Results

Table 2: Number of hopping frequencies measurement results

Limit	Result
$\geq 75$	79

## 7.4 Screen shots



Picture 4: Number of hopping frequencies measurement

## 8 BLUETOOTH TIME OF OCCUPANCY

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	26 °C	46 RH%	1009 mbar
<b>Date of measurement</b>	July 11, 2011		
<b>FCC rule part</b>	15.247, a 1 iii		
<b>RSS-210 section</b>	A8.1 (4)		
<b>Measured by</b>	Simo Ojanen		

### 8.1 Test setup and testing method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 5: Test setup for measurement of time of occupancy

Spectrum analyzer with single sweep and 0 Hz span was used to monitor the transmitter operation over time.

## 8.2 Connection mode

### 8.2.1 EUT operation mode

<b>EUT operation mode</b>	Connection, FSK modulation, DH5 packet type
<b>EUT channel</b>	Hopping
<b>EUT TX power level</b>	max

### 8.2.2 Results

Table 3: Time of occupancy during connection mode measurement results

Limit	Result
$\leq 0,4$ s over 31,6 s period	0,114 s

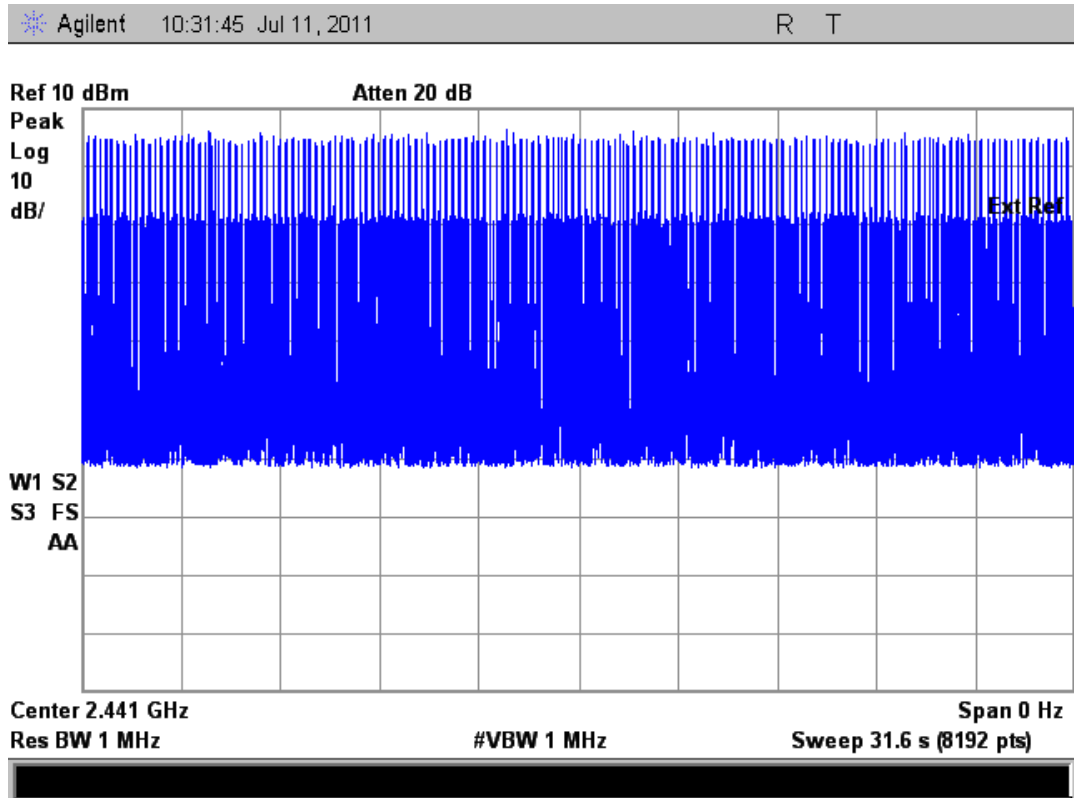
#### Limit:

In the connection mode Bluetooth uses 79 channels. As defined in 15.247, a 1 iii, the limit for time of occupancy is 0,4s over time of number of channels multiplied with 0,4s ( $79 * 0,4s = 31,6$  s).

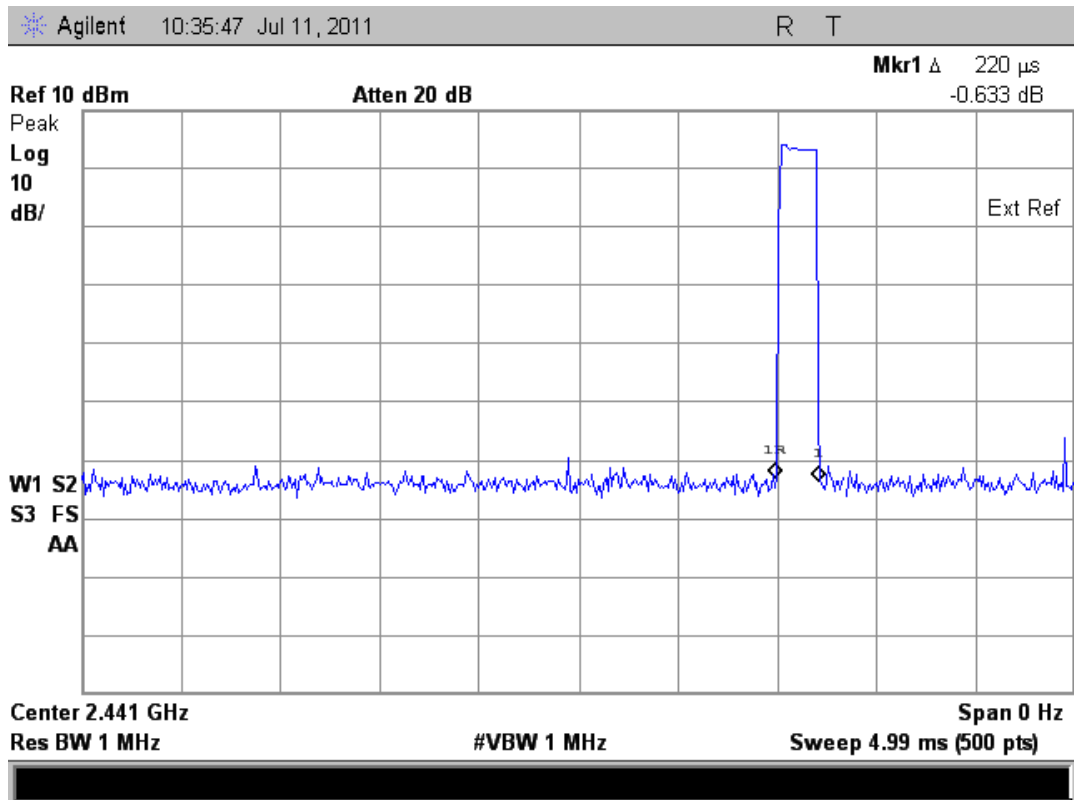
#### Results:

In measurement time of 31,6 s, total of 516 transmissions occurred. The duration of one transmission was 0,22ms. Based on these measurements the transmitter operated  $516 * 0,22$  ms = 0,114 s during the 31,6 s period

8.2.3 Screen shots



Picture 6: Number of transmissions on connection state, channel 39



Picture 7: Duration of one transmission on connection state, channel 39

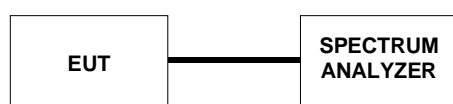
## 9 BLUETOOTH 20 dB BANDWIDTH

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	26 °C	46 RH%	1009 mbar
<b>Date of measurement</b>	July 11, 2011		
<b>FCC rule part</b>	15.247, a		
<b>RSS-210 section</b>	A8.1 (1)		
<b>Measured by</b>	Simo Ojanen		

### 9.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 8: Test setup for measurement of 20dB bandwidth

The 20dB bandwidth was measured using 10 kHz resolution bandwidth and maximum hold function of the spectrum analyzer. 20dB bandwidth was defined by measuring the maximum level on the measured channel and by placing delta markers 20 dB below this value and read the value.

### 9.2 EUT operation mode

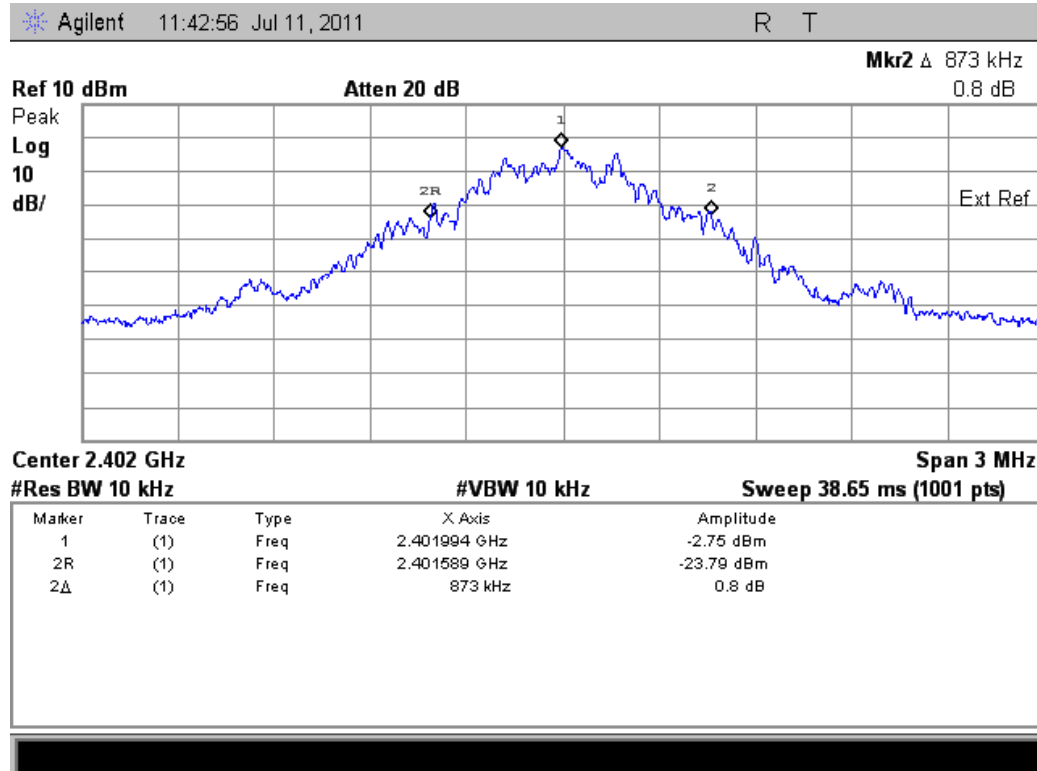
<b>EUT operation mode</b>	Connection, FSK modulation, DH5 packet type
<b>EUT channel</b>	0, 39 and 78
<b>EUT TX power level</b>	max

### 9.3 Results

Table 4: 20dB bandwidth measurement results

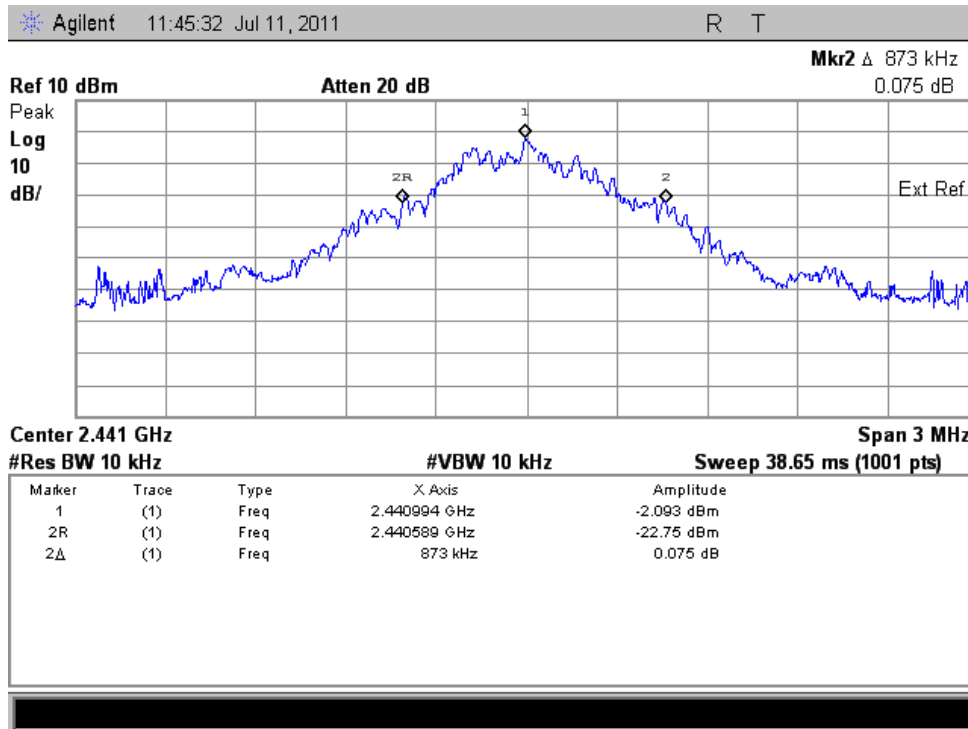
EUT Channel	Limit (MHz)	Measured value (MHz)
0	≤ 1,0	0,873
39		0,873
78		0,873

### 9.4 Screen shots

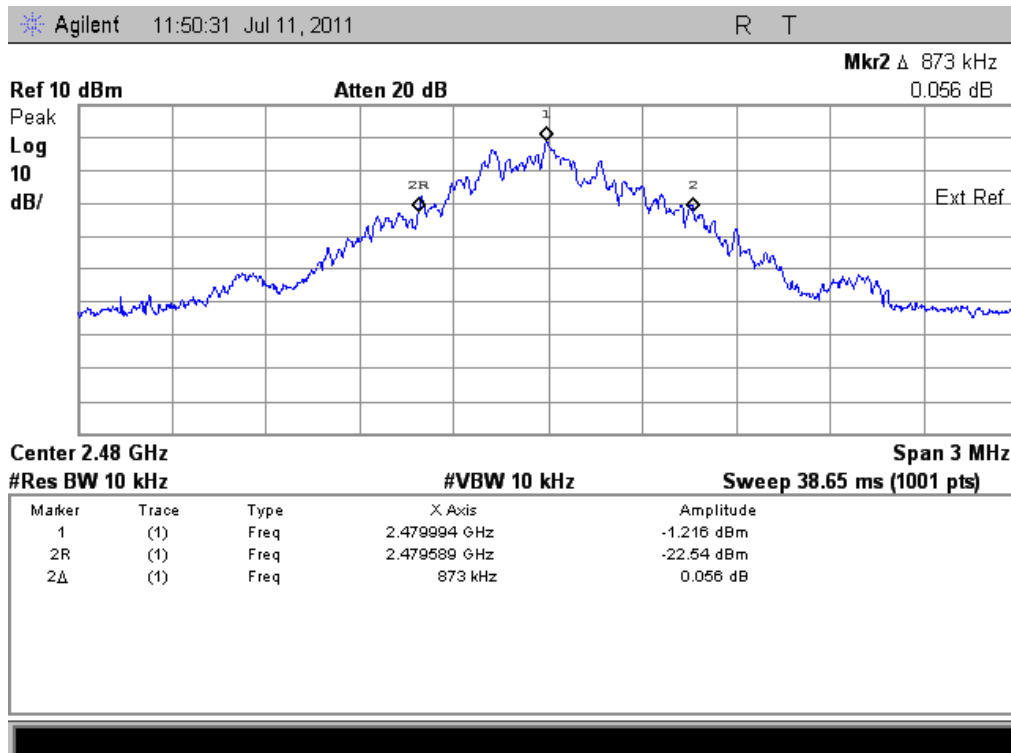


Picture 9: 20dB Bandwidth measurement result, Channel 0





Picture 10: 20dB Bandwidth measurement result, Channel 39



Picture 11: 20dB Bandwidth measurement result, Channel 78

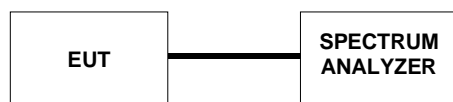
## 10 BLUETOOTH PEAK OUTPUT POWER

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	26 °C	46 RH%	1009 mbar
<b>Date of measurement</b>	July 11, 2011		
<b>FCC rule part</b>	15.247, b 1		
<b>RSS-210 section</b>	A8.4 (2)		
<b>Measured by</b>	Simo Ojanen		

### 10.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 12: Test setup for measurement of peak output power

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.

### 10.2 EUT operation mode

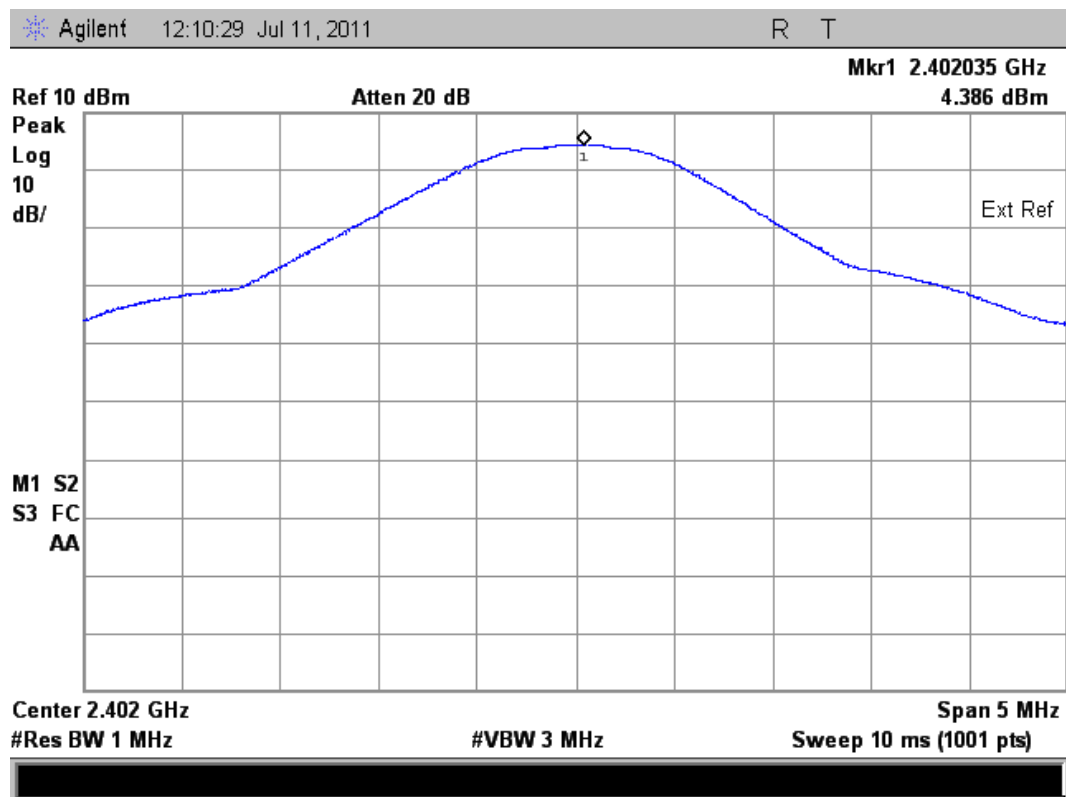
<b>EUT operation mode</b>	Connection, FSK modulation, DH5 packet type
<b>EUT channel</b>	0, 39 and 78
<b>EUT TX power level</b>	max

### 10.3 Results

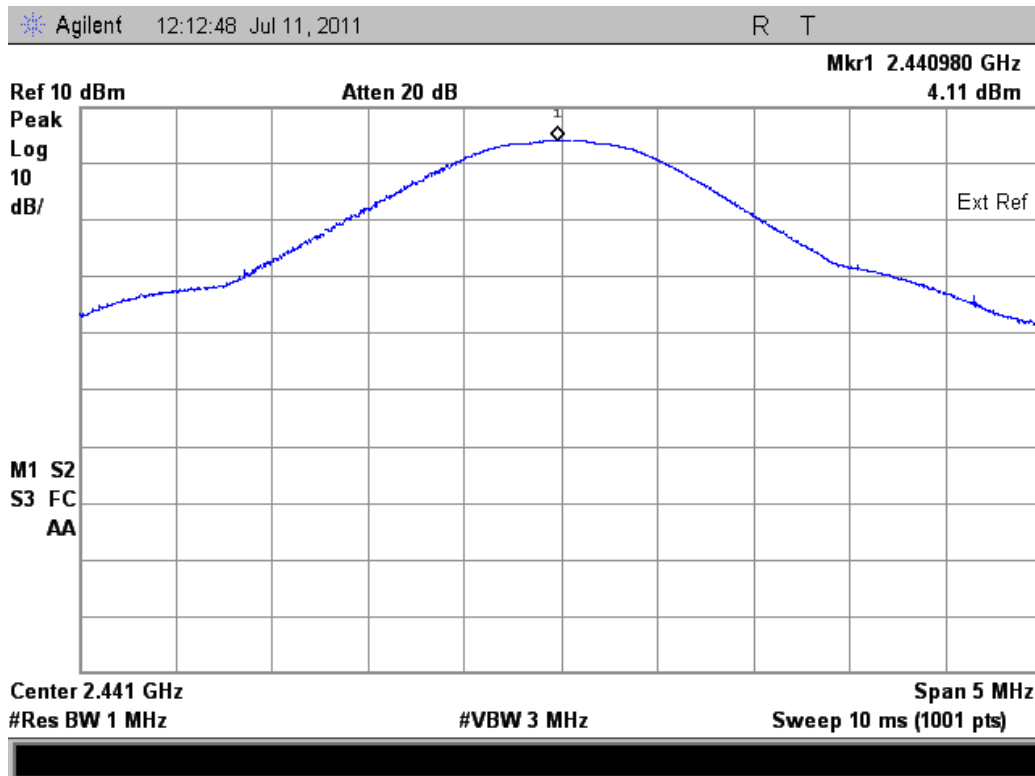
Table 5: Peak output power measurement results

EUT Channel	Limit (dBm)	Measured result (dBm)	Cable attenuation (dB)	Test result (dBm)
0	≤ 30	4,4	0,5	4,9
39		4,1		4,5
78		4,5		5,0

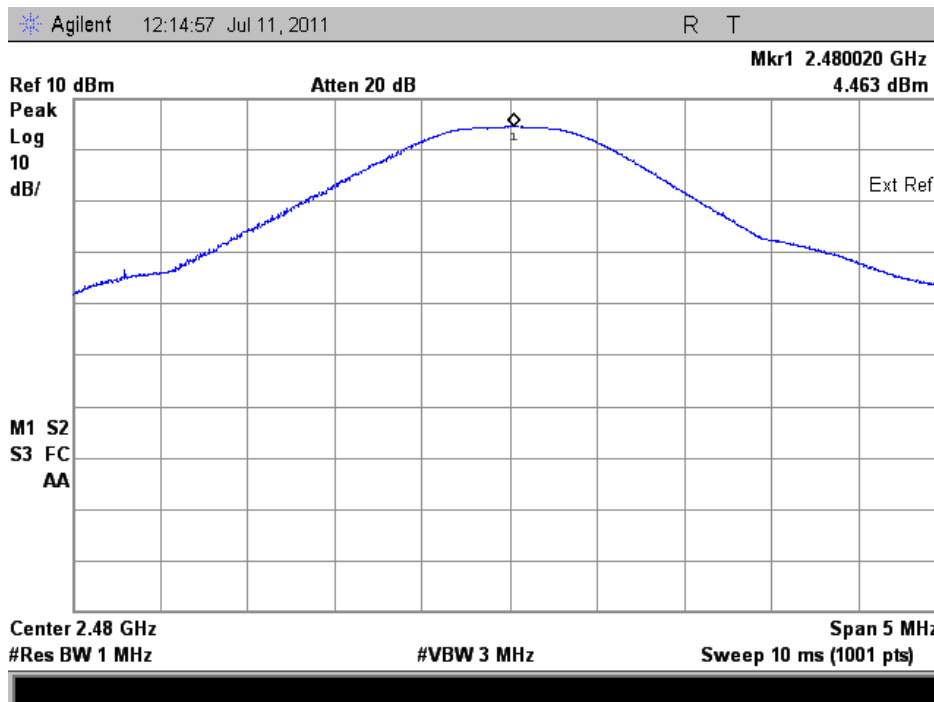
### 10.4 Screen shots



Picture 13: Peak output power, channel 0



Picture 14: Peak output power, channel 39



Picture 15: Peak output power, channel 78

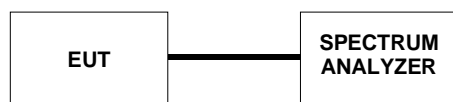
## 11 WLAN OUTPUT POWER

<b>EUT</b>	2		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	21 °C	44 RH%	998 mbar
<b>Date of measurement</b>	December 5, 2011		
<b>FCC rule part</b>	15.247, b 1		
<b>RSS-210 section</b>	A8.4 (2)		
<b>Measured by</b>	Matti Virkki		

### 11.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode



Picture 16: Test setup for measurement of peak output power

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 analyzer's band power function.

### 11.2 EUT operation mode

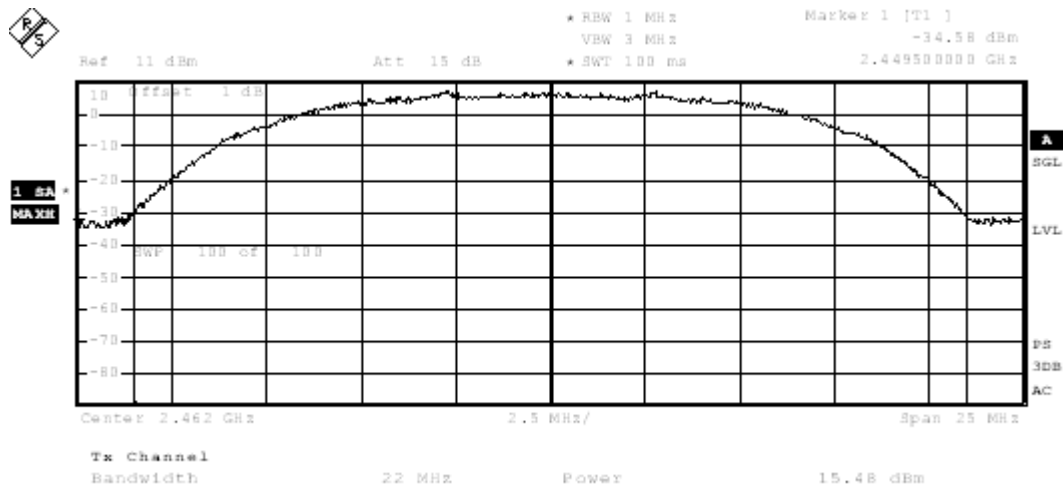
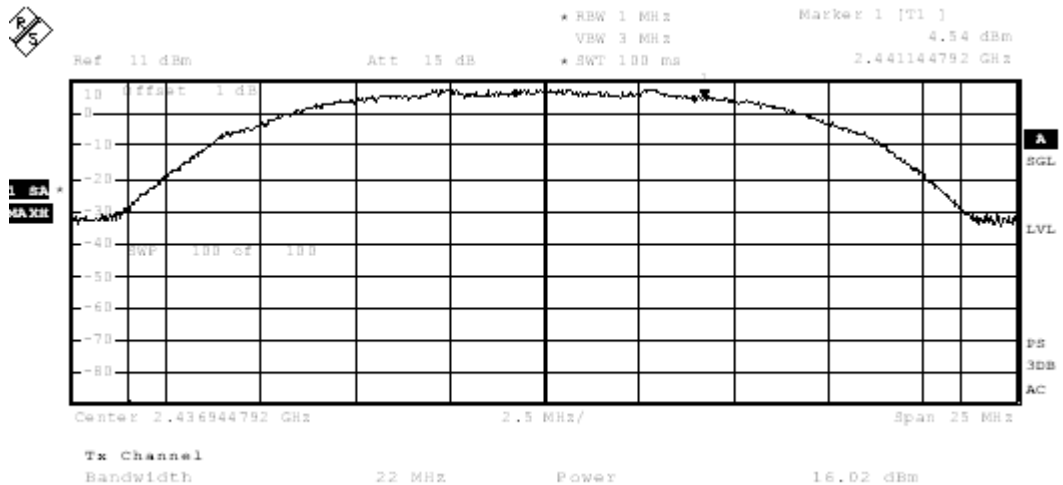
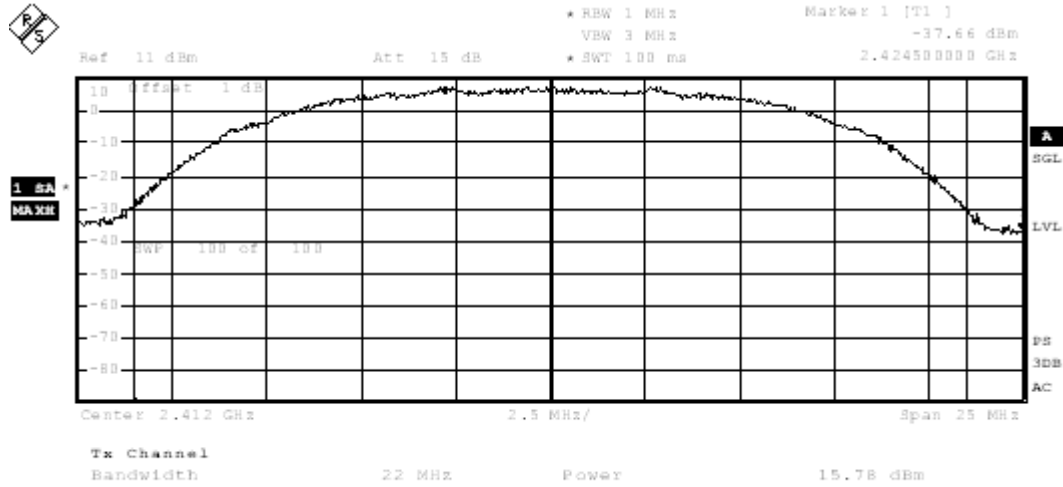
<b>EUT operation mode</b>	Connection, 54 MBit/s and 5,5 MBit/s data speed
<b>EUT channel</b>	1, 6, 11
<b>EUT TX power level</b>	max

## 11.3 Results

Table 6: Peak output power measurement results. 5,5 MBit/s data speed provide highest power levels and is reported.

EUT Channel	Limit (dBm)	Measured result (dBm)	Cable attenuation (dB)	Test result (dBm)
1	$\leq 30$	15,8	0,5	16,3
6		16,0		16,5
1		15,5		16,0

### 11.4 Screen shots



Test results are valid for the tested unit only.

The report may be copied only in its entirety

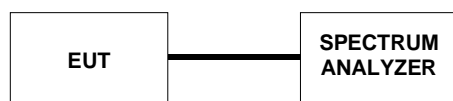
## 12 BLUETOOTH Band-edge compliance of RF conducted emissions

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	26 °C	46 RH%	1009 mbar
<b>Date of measurement</b>	July 11, 2011		
<b>FCC rule part</b>	15.247, d		
<b>RSS-210 section</b>	A8.5		
<b>Measured by</b>	Simo Ojanen		

### 12.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 17: Test setup for measurement of band edge compliance

Band edge compliance of RF-conducted emissions was measured by setting the band edge as center frequency in the spectrum analyzer and measuring the power on the transmission on channels 0 and 79. The measured power and power on the band edge was then compared.



## 12.2 Hopping enabled

### 12.2.1 EUT operation mode

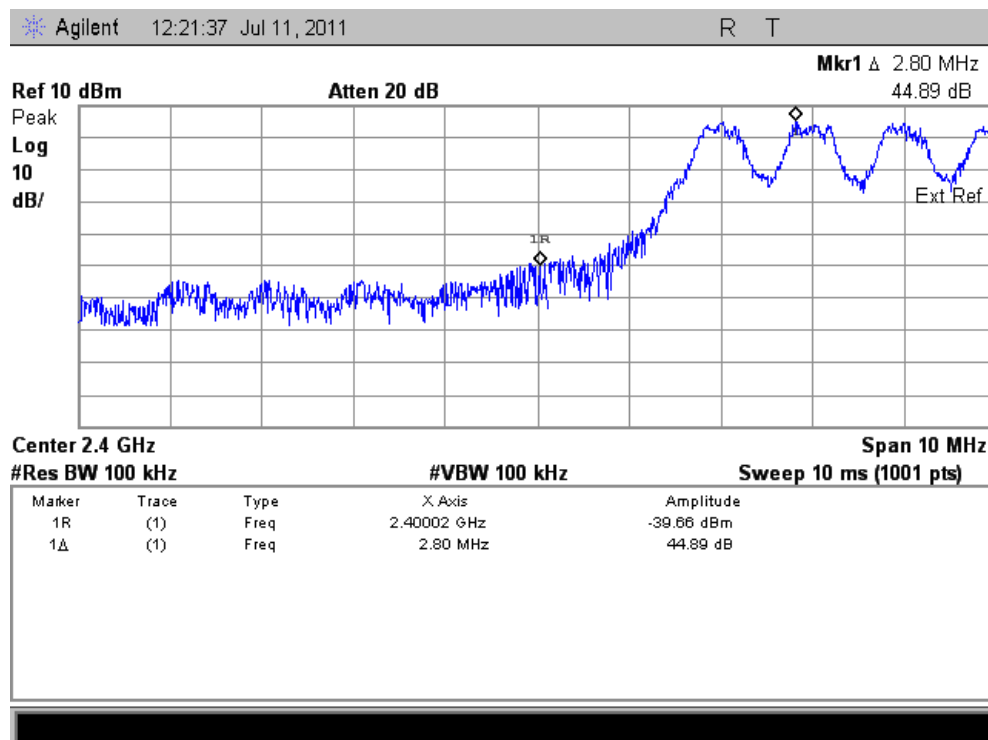
<b>EUT operation mode</b>	Connection, FSK modulation, DH5 packet type
<b>EUT channel</b>	Hopping
<b>EUT TX power level</b>	max

### 12.2.2 Results

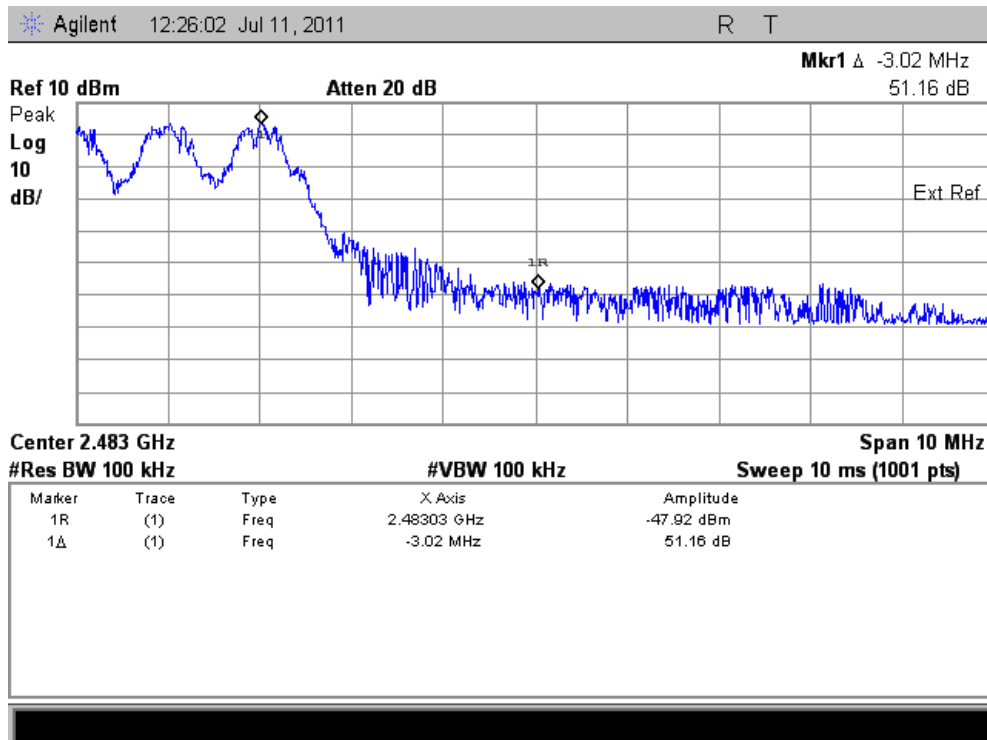
Table 7: Number of hopping frequencies measurement results

EUT Channel	Limit (dBc)	Test result (dBc)
0	≤ -20	-44,9
78		-51,1

### 12.2.3 Screen shots



Picture 18: Band edge compliance, channel 0, hopping enabled



Picture 19: Band edge compliance, channel 78, hopping enabled

### 12.3 Hopping disabled

#### 12.3.1 EUT operation mode

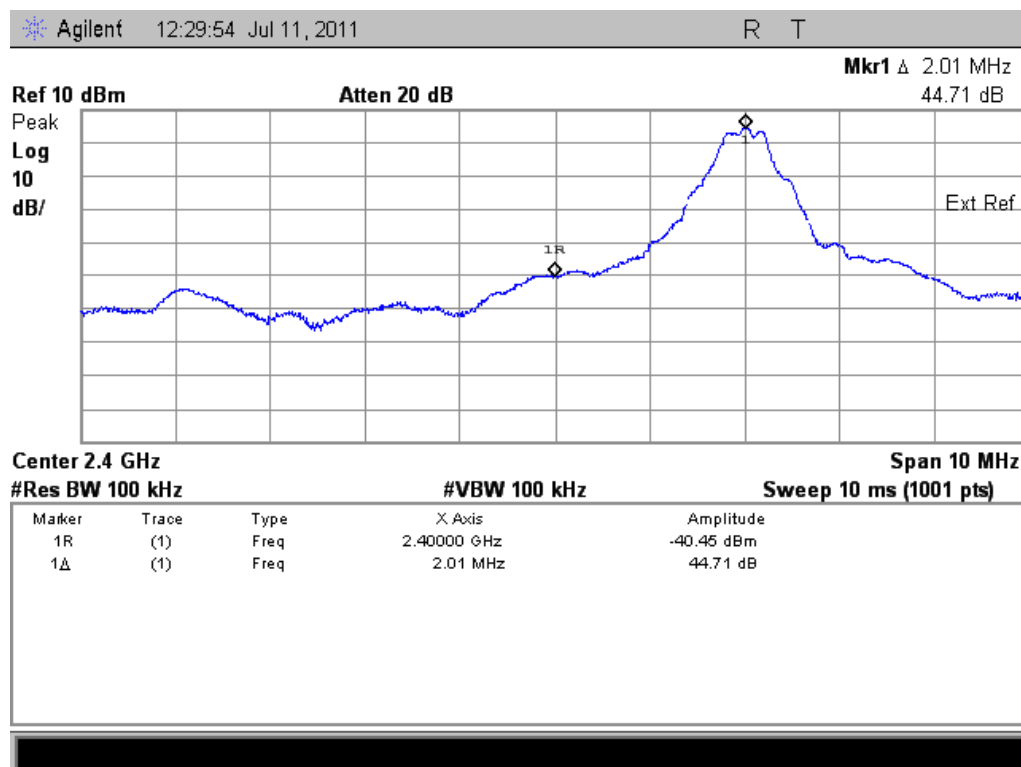
<b>EUT operation mode</b>	Connection, FSK modulation, DH5 packet type
<b>EUT channel</b>	0 (2402 MHz), 78 (2480 MHz)
<b>EUT TX power level</b>	max

#### 12.3.2 Results

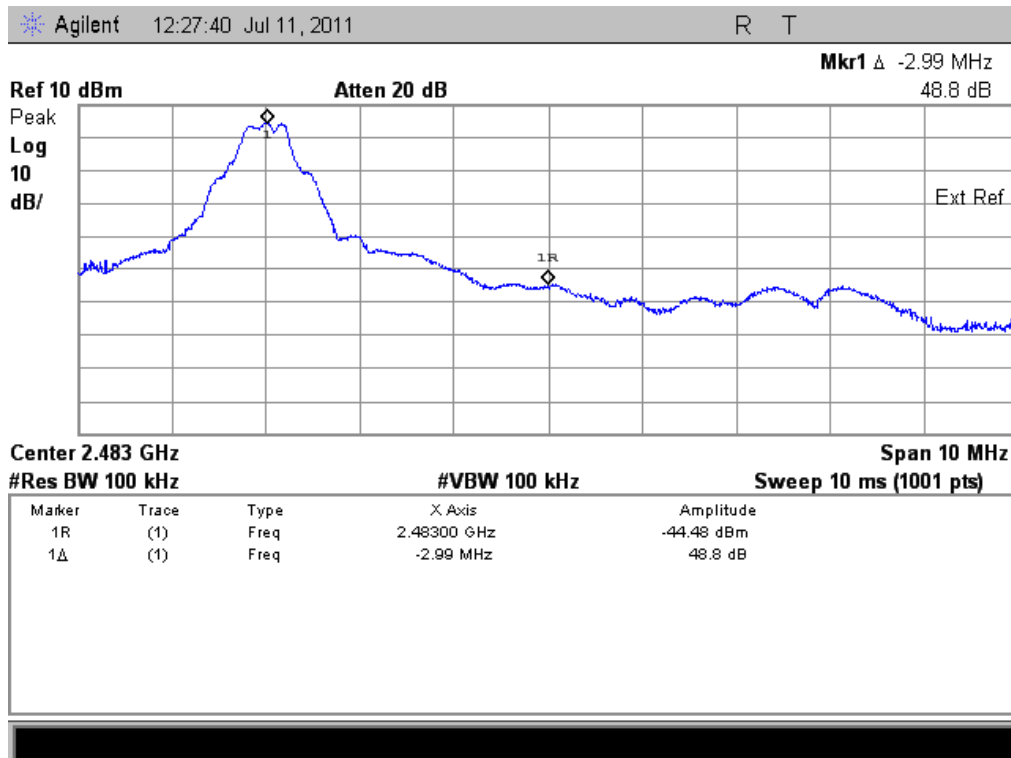
Table 8: Band edge compliance measurement results

EUT Channel	Limit (dBc)	Test result (dBc)
0	≤ -20	-44,7
78		-48,8

#### 12.3.3 Screen shots



Picture 20: Band edge compliance, channel 0, hopping disabled



Picture 21: Band edge compliance, channel 78, hopping disabled

### 13 BLUETOOTH 99 % BANDWIDTH

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	26 °C	46 RH%	1009 mbar
<b>Date of measurement</b>	July 11, 2011		
<b>FCC rule part</b>			
<b>RSS-GEN section</b>	4.6.1		
<b>Measured by</b>	Simo Ojanen		

#### 13.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 22: Test setup for 99% bandwidth measurement

The 99% occupied bandwidth was calculated with spectrum analyzers internal measurement software.

#### 13.2 EUT operation mode

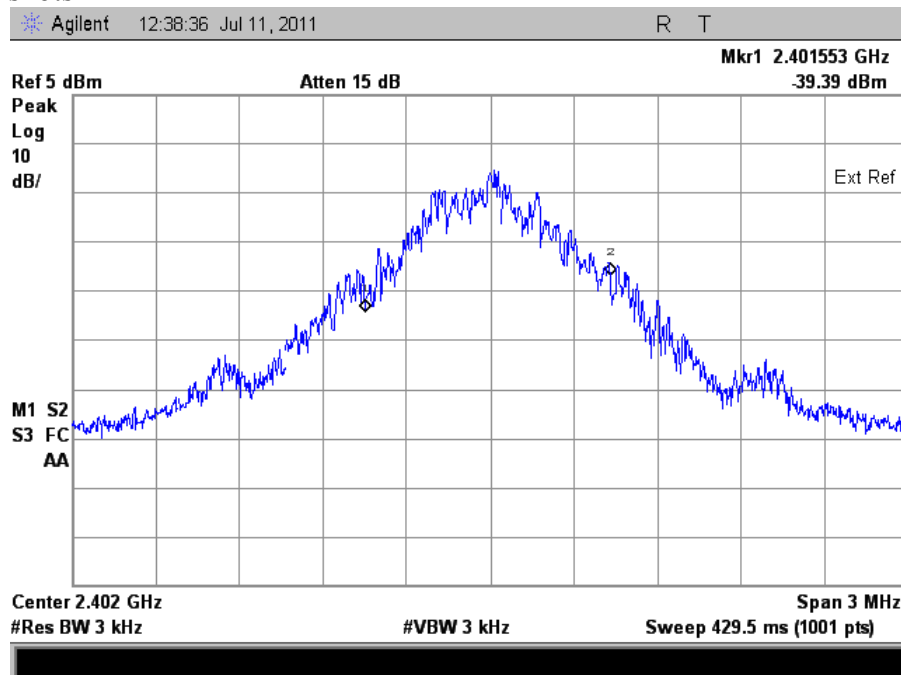
<b>EUT operation mode</b>	Modulation ON, ASK modulation
<b>EUT frequency</b>	2402 MHz, 2441 MHz and 2480 MHz
<b>EUT TX power level</b>	max

### 13.3 Results

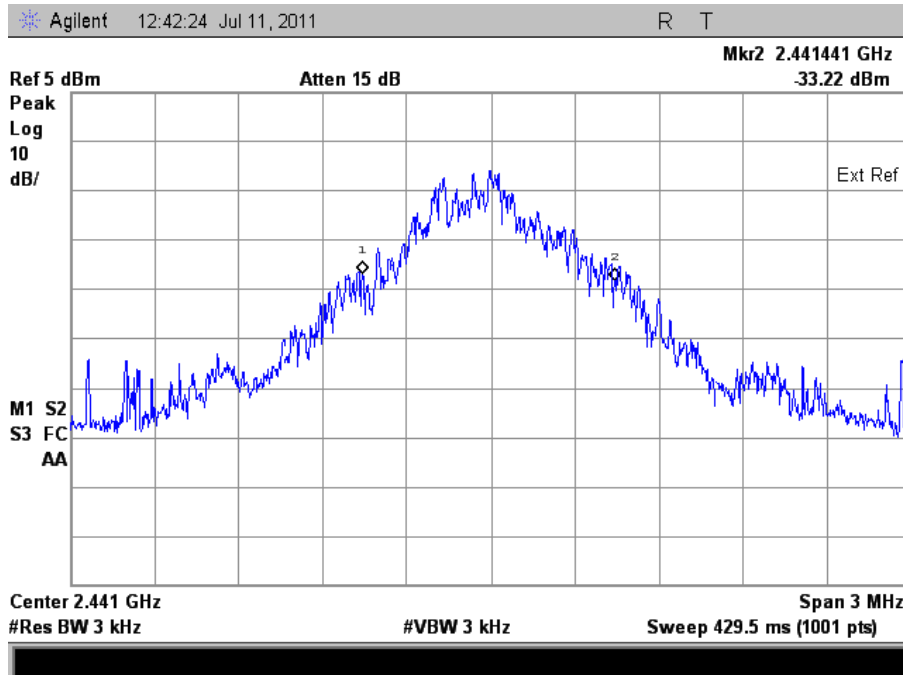
Table 9: 99% bandwidth measurement results

EUT Frequency MHz	Limit kHz	Measured value kHz
2402	-	0,876
2441	-	0,897
2480	-	0,891

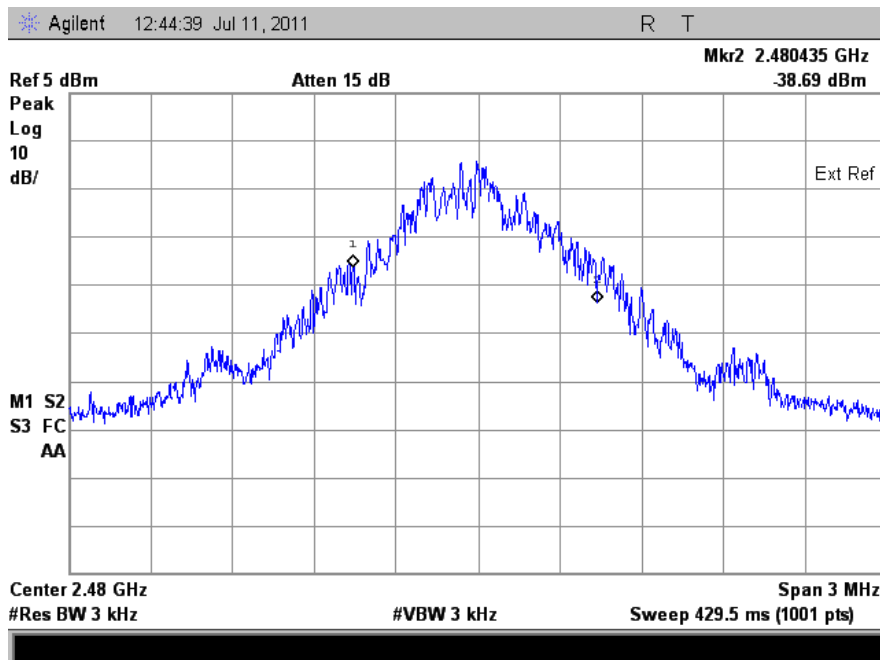
### 13.4 Screen shots



Picture 23: 99% Bandwidth measurement result, ch 0



Picture 24: 99% Bandwidth measurement result, ch 39



Picture 25: 99% Bandwidth measurement result, ch 78

## 14 RFID 99 % BANDWIDTH

<b>EUT</b>	2		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	21 °C	44 RH%	998 mbar
<b>Date of measurement</b>	November 11, 2011		
<b>FCC rule part</b>			
<b>RSS-GEN section</b>	4.6.1		
<b>Measured by</b>	Matti Virkki		

### 14.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping



Picture 26: Test setup for 99% bandwidth measurement

The 99% occupied bandwidth was calculated with spectrum analyzers internal measurement software.

### 14.2 EUT operation mode

<b>EUT operation mode</b>	Modulation ON, ASK modulation
<b>EUT frequency</b>	2402 MHz, 2441 MHz and 2480 MHz
<b>EUT TX power level</b>	max



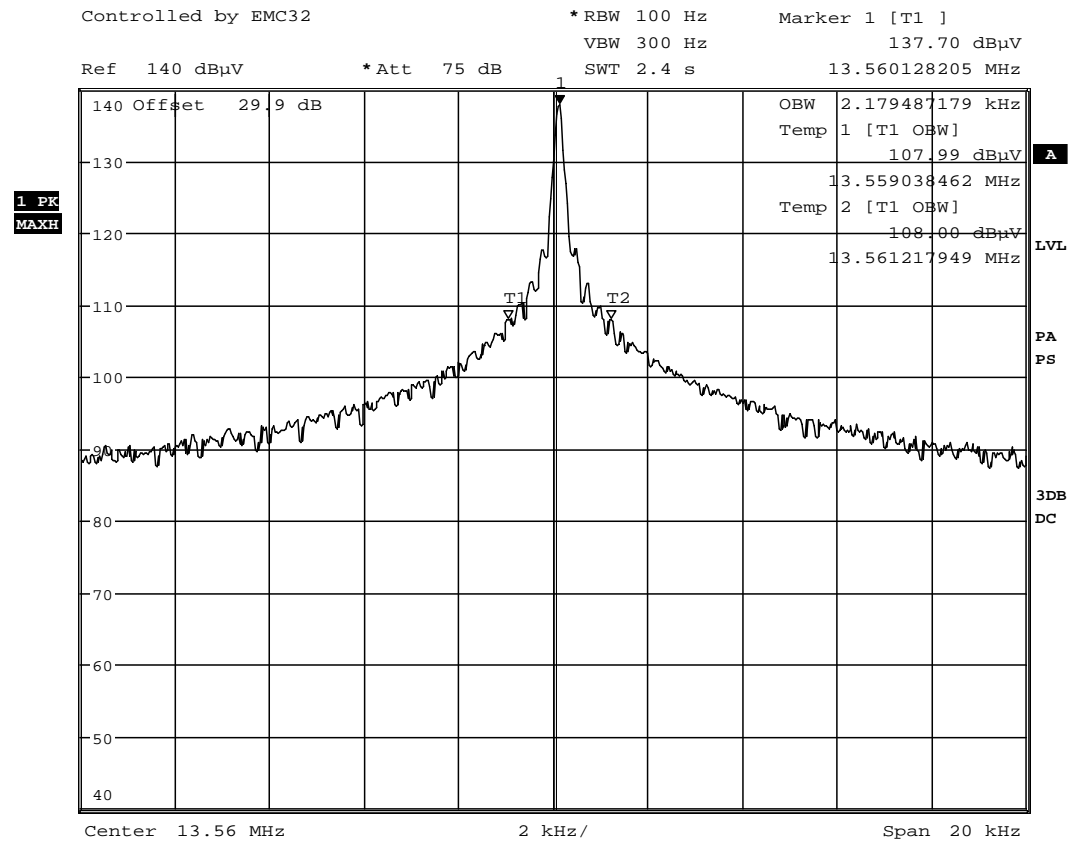
### 14.3 Results

Table 10: 99% bandwidth measurement results

EUT Frequency MHz	Limit kHz	Measured value kHz
13,56	-	2,18

### 14.4 Screen shots

Picture 27: 99% Bandwidth measurement result,

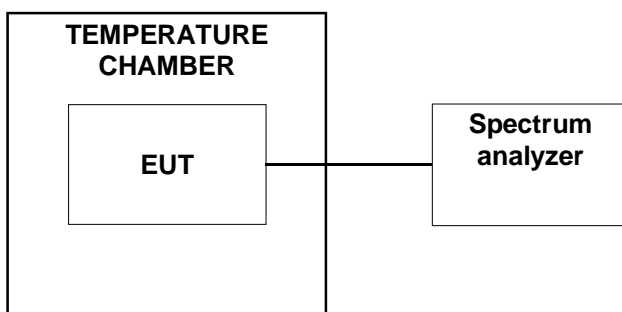


Date: 11.NOV.2011 08:29:44

## 15 RFID FREQUENCY TOLERANCE

<b>EUT</b>	2,3		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	28°C	43%RH	1000mbar
<b>Date of measurement</b>	July 7, 2011		
<b>FCC rule part</b>	§15.225 (e)		
<b>RSS-210 section</b>	Annex 2.6		
<b>Measured by</b>	Päivi Punta		

### 15.1 Test setup and measurement method



Picture 9: Frequency tolerance test setup

1. The climate chamber temperature was set to the maximum value and the temperature was allowed to stabilize
2. The EUT was placed in the chamber at active mode
3. The EUT temperature was allowed to stabilize for 30 minute
4. Transmitter peak frequency was measured with spectrum analyzer
5. The steps 3 - 4 were repeated for each temperature

### 15.2 EUT operation mode

<b>EUT operation mode</b>	Continuous transmission
<b>EUT channel</b>	13,56 MHz

## 15.3 Results

Table 14 : Frequency tolerance limit

<b>Frequency tolerance</b>	+/- 0,01%
----------------------------	-----------

Table 15: Frequency tolerance measurement results

<b>Temperature (°C)</b>	<b>Transmitter frequency (MHz)</b>
50	13,5600
40	13,5601
30	13,5601
20	13,5601
10	13,5602
0	13,5602
-10	13,5602
-20	13,5602

## 16 BLUETOOTH FIELD STRENGTH OF FUNDAMENTAL

<b>EUT</b>	1,4		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	22 °C	35 %RH	996 mbar
<b>Date of measurement</b>	May 16, 2011		
<b>FCC rule part</b>			
<b>RSS-210 section</b>			
<b>Measured by</b>	Simo Ojanen		

### 16.1 Test setup and measurement method

The EUT was set on a non-conductive turntable in a semi-anechoic chamber. The EUT was set at 0,8m height. Measuring antenna was scanned 1 – 4 m in height. The measurements were repeated in three EUT orientations and two antenna polarizations. The measured signal was routed from the measuring antenna to the spectrum analyzer. The measurement was made using 1 MHz resolution bandwidth and 1 MHz video bandwidth and maximum hold function to record the maximum peak output power.

### 16.2 EUT operation mode

<b>EUT operation mode</b>	Modulation ON, ASK modulation
<b>EUT frequency</b>	2402 MHz, 2441 MHz and 2480 MHz
<b>EUT TX power level</b>	max

### 16.3 Results

Table 11: Maximum field strength of fundamental (Peak value)

Freq MHz	Measured Value dB $\mu$ V	EUT orientation	Antenna Pol.	Antenna height m	Turntable angle deg
2402	100,2	Pos 2	Ver	1,0	32
2441	100,1	Pos 2	Ver	1,0	288
2480	101,4	Pos 2	Ver	1,0	289

## 17 RFID FIELD STRENGTH OF FUNDAMENTAL

<b>EUT</b>	1,4		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	23 °C	55 %RH	1008 mbar
<b>Date of measurement</b>	August 25, 2011		
<b>FCC rule part</b>	§15.225 (a)		
<b>RSS-210 section</b>	Annex 2.6		
<b>Measured by</b>	Simo Ojanen		

### 17.1 Test setup and measurement method

The EUT was set on a non-conductive turntable in a semi-anechoic chamber. The EUT was set at 0,8m height.

The measurements were repeated in three EUT orientations and two antenna polarizations.

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

The measurement was made using 1 MHz resolution bandwidth and 1 MHz video bandwidth and maximum hold function to record the maximum peak output power.

### 17.2 EUT operation mode

<b>EUT operation mode</b>	Continuous transmission
<b>EUT frequency</b>	13,56 MHz

### 17.3 Limit

Table 12: Field strength of fundamental

Frequency (MHz)	mV/m ( @3m)	dBµV/m ( @3m)
13,56	1 584,800	124

### 17.4 Results

Table 13: Maximum field strength of fundamental @ 3m distance

Freq MHz	Measured Value dBµV	EUT orientation	Antenna Pol.	Antenna height m	Turntable angle deg
13,56	96,6	Pos 1	Ver	1,0	273

## 18 RADIATED SPURIOUS EMISSIONS

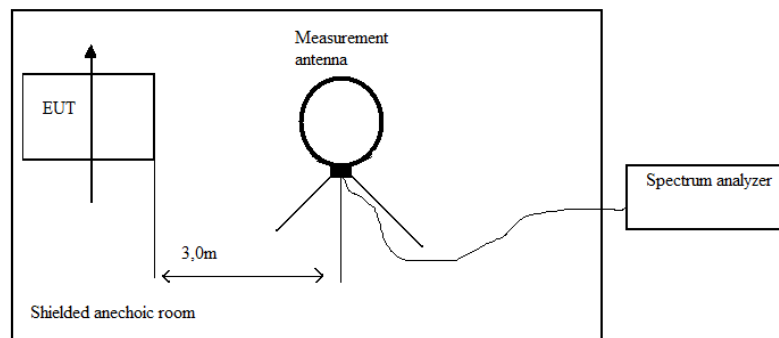
<b>EUT</b>	1,4		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	23 °C	55 %RH	1008 mbar
<b>Date of measurement</b>	August 24-29, 2011		
<b>FCC rule part</b>	15.247, d		
<b>RSS-210 section</b>	A8.5		
<b>Measured by</b>	Simo Ojanen		

### 18.1 Test setup

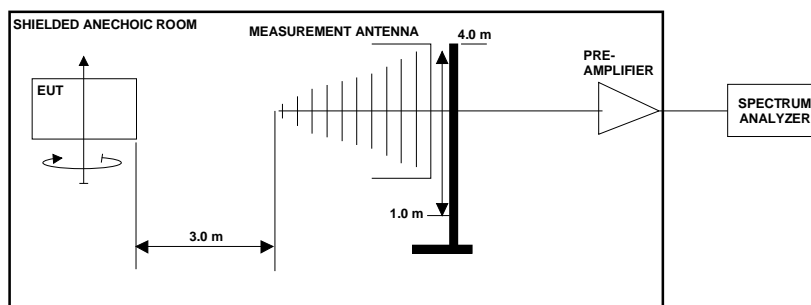
EUT software was used to:

- set the EUT channel
- set the EUT to TX or RX mode
- enable/disable frequency hopping

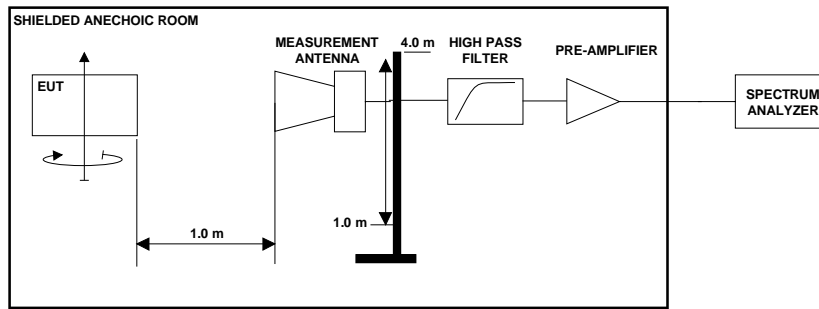
The test was done using an automated test system, where a computer controlled the measurement equipment.



Picture 28: Test setup for radiated spurious emissions measurement  
9 kHz - 30 MHz frequencies



Picture 29: Test setup for radiated spurious emissions measurement  
30 MHz - 1 GHz frequencies



Picture 30: Test setup for radiated spurious emissions measurement  
1 GHz – 25 GHz frequencies

## 18.2 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  $\text{dB}\mu\text{V/m}$  at 3 m distance, are reported.

## 18.3 EUT operation mode

### Bluetooth

<b>EUT operation mode</b>	Modulation ON, ASK modulation
<b>EUT channel</b>	2402 MHz, 2441 MHz and 2480 MHz
<b>EUT TX power level</b>	max

### WLAN

<b>EUT operation mode</b>	TX, 54Mbps
<b>EUT channel</b>	2412MHz, 2437MHz and 2472MHz
<b>EUT TX power level</b>	max

### RFID

<b>EUT operation mode</b>	CW
<b>EUT channel</b>	13,56MHz
<b>EUT TX power level</b>	max

## 18.4 Limit

Table 14: Radiated spurious emission limits at measurement distance 3m

Frequency band (MHz)	3m Limit ( $\mu\text{V/m}$ )	3m Limit (dB $\mu\text{V/m}$ )	Detector
0,009-0,490	2660725-48977,9	128,5-93,8*	AVG
0,49-1,705	4897,8-1412,5	73,8-63*	AVG
1,705-30	2985,4	69,5	AVG
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

\* The limit decreases linearly with the logarithm of the frequency

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.



## 18.5 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.

Table 15: Emission levels PEAK (QP) detector, lo ch Bluetooth, WLAN and RFID

Freq MHz	Measured Value dB $\mu$ V	Correction Factor dB	Result dB $\mu$ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height cm
27,12	45,4	20,2	65,6	3,9	Pos 1	Ver	100
40,7	13,2	21,2	34,4	5,6	Pos 3	Ver	100
67,8	21,1	13,1	34,2	5,8	Pos 2	Ver	125
94,9	21	13,1	34,1	9,4	Pos 3	Ver	100
122,0	19,9	15,9	35,8	7,7	Pos 3	Ver	100
149,2	23,6	15,3	38,9	4,6	Pos 1	Hor	175
176,3	24,5	14,7	39,2	4,3	Pos 1	Hor	125
203,4	21,5	15,3	36,8	6,7	Pos 1	Hor	144
339,0	20,9	18,6	39,5	6,5	Pos 1	Hor	100
366,1	21,6	19,5	41,1	4,9	Pos 2	Hor	100
393,2	25,5	20,4	45,9	0,1	Pos 2	Ver	125
461,0	17,1	21,7	38,8	7,2	Pos 1	Ver	100
542,4	17	22,9	39,9	6,1	Pos 3	Ver	100
556,0	24,3	23,1	47,4	-1,4*	Pos 2	Hor	158
569,5	23,3	23,3	46,6	-0,6*	Pos 2	Hor	152
583,1	24,3	23,5	47,8	-1,8*	Pos 2	Hor	150
596,6	19,3	23,6	42,9	3,1	Pos 3	Ver	100
647,3	9,5	24,1	33,6	12,4	Pos 2	Hor	125
652,3	4,6	24,1	28,7	17,3	Pos 1	Hor	100
657,1	0,8	24,2	25	21	Pos 1	Hor	119
1063,7	53,3	-14,7	38,6	35,3	Pos 2	Hor	100
1197,1	52,1	-15,4	36,7	37,2	Pos 2	Hor	100
1329,7	58,7	-15,5	43,2	30,7	Pos 3	Ver	100
1463,0	61	-16,2	44,8	29,1	Pos 3	Ver	100
1596,0	57,7	-17,2	40,5	33,4	Pos 2	Hor	100
1728,7	55,5	-17,7	37,8	36,1	Pos 2	Hor	100
3216	57,1	-13,1	44,0	30,0	Pos 3	Hor	100
4804	69,3	-8,5	60,8	13,2	Pos 1	Hor	100

\* outside the restricted band and complies with the -20dBc requirement.

Peak values: 556,0 MHz = 48,0 dB $\mu$ V

569,5 MHz = 48,1 dB $\mu$ V

583,1 MHz = 48,4 dB $\mu$ V

Table 16: Emission levels PEAK (QP) detector, middle channel Bluetooth and WLAN

Freq MHz	Measured Value dBµV	Correction Factor dB	Result dBµV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
647,2	5,5	24,1	29,6	16,4	Pos 1	Hor	119
652,5	12,8	24,1	36,9	9,1	Pos 1	Hor	208
665,0	21,5	24,3	45,8	0,2	Pos 2	Hor	119
668,0	0,4	24,3	24,7	21,3	Pos 1	Hor	100
672,0	-1,2	24,3	23,1	22,9	Pos 1	Hor	100
1064	53,1	-14,7	38,4	35,6	Pos 1	Hor	100
1197	53,3	-15,4	37,9	36,1	Pos 3	Ver	100
1330	58,1	-15,5	42,6	31,4	Pos 3	Ver	100
1463	60,4	-16,2	44,2	29,8	Pos 3	Ver	100
1596	57,4	-17,2	40,2	33,8	Pos 2	Hor	100
1729	53,9	-17,7	36,2	37,8	Pos 3	Ver	100
3249	60,2	-13,1	47,1	26,9	Pos 3	Hor	100
4882	70,8	-8,3	62,5	11,5	Pos 2	Hor	100

Table 17: Emission levels PEAK (QP) detector, high channel Bluetooth and WLAN

Freq MHz	Measured Value dBµV	Correction Factor dB	Result dBµV/m	Marginal dB	EUT Position	Ant Pol.	Ant height
637,5	12,2	24,0	36,2	9,8	Pos 1	Hor	100
642,6	3,8	24,0	27,8	18,2	Pos 1	Hor	125
662,3	3,4	24,2	27,6	18,4	Pos 1	Hor	125
665,0	18,5	24,3	42,8	3,2	Pos 2	Hor	225
688,7	1,5	24,5	26,0	20	Pos 1	Hor	100
1064	53,1	-14,7	38,4	35,6	Pos 1	Hor	100
1197	53,3	-15,4	37,9	36,1	Pos 2	Hor	100
1330	58,8	-15,5	43,3	30,7	Pos 3	Ver	100
1384	51,1	-15,7	35,4	38,6	Pos 3	Ver	100
1463	60,6	-16,2	44,4	29,6	Pos 3	Ver	100
1596	58,1	-17,2	40,9	33,1	Pos 2	Hor	100
1729	56,8	-17,7	39,1	34,9	Pos 1	Hor	100
3296	60,1	-13,3	46,8	27,2	Pos 1	Hor	100
4966	68,3	-7,8	60,5	13,4	Pos 1	Hor	100
7449	53,6	1,0	54,6	19,4	Pos 1	Ver	100

Table 18: Emission levels AVERAGE detector, lo ch Bluetooth, WLAN and RFID

Freq MHz	Measured Value dB $\mu$ V	Correction Factor dB	Result dB $\mu$ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height
4804	46,1	-8,5	37,6	16,4	Pos 1	Hor	100

Table 19: Emission levels AVERAGE detector, middle channel Bluetooth and WLAN

Freq MHz	Measured Value dB $\mu$ V	Correction Factor dB	Result dB $\mu$ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height
4882	46,9	-8,3	38,6	15,4	Pos 2	Hor	100

Table 20: Emission levels AVERAGE detector, high channel Bluetooth and WLAN

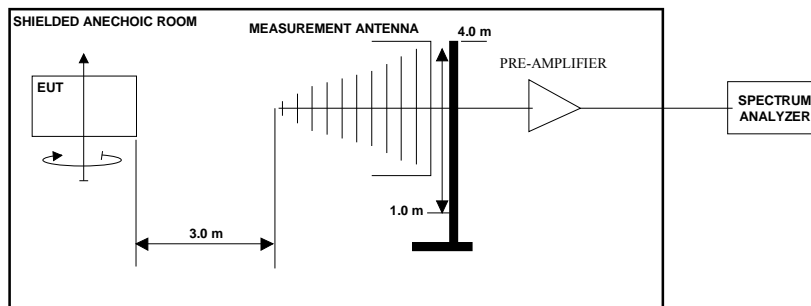
Freq MHz	Measured Value dB $\mu$ V	Correction Factor dB	Result dB $\mu$ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height
4966	49,7	-7,8	41,9	12,1	Pos 1	Hor	100
7449	35,2	1,0	36,2	17,8	Pos 1	Ver	100

## 19 RECEIVER RADIATED EMISSION

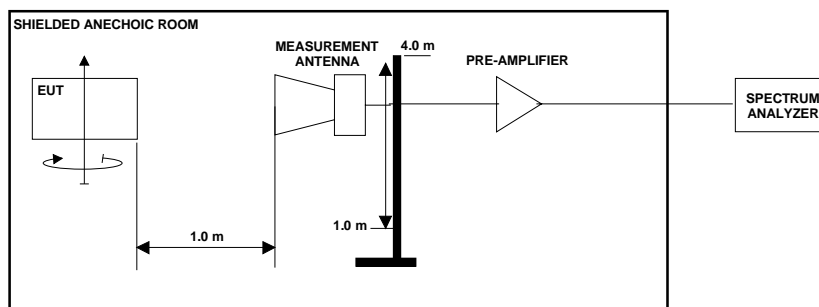
<b>EUT</b>	1,4		
<b>Accessories</b>	-		
<b>Temp, Humidity, Air Pressure</b>	23 °C	55 %RH	1008 mbar
<b>Date of measurement</b>	August 24-29, 2011		
<b>FCC rule part</b>	§15.109		
<b>RSS-GEN section</b>	7.2.3		
<b>ICES-003 section</b>	5.5		
<b>Measured by</b>	Simo Ojanen		

### 19.1 Test setup

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



Picture 31: Test setup for radiated spurious emissions measurement  
30 MHz - 1 GHz frequencies



Picture 32: Test setup for radiated spurious emissions measurement  
1 GHz – 12,4 GHz frequencies

## 19.2 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 $\mu$ V/m at 3 m distance, are reported.

## 19.3 EUT operation mode

<b>EUT operation mode</b>	Receiver mode
<b>EUT frequency</b>	Na
<b>EUT TX power level</b>	Na

## 19.4 Limit

Table 21: Radiated spurious emission limits at measurement distance 3m

<b>Frequency band (MHz)</b>	<b>3m Limit (<math>\mu</math>V/m)</b>	<b>3m Limit (dB<math>\mu</math>V/m)</b>	<b>Detector</b>
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.

## 19.5 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 22, 23 and 24.

Table 22: Radiated emissions using Quasi peak detector

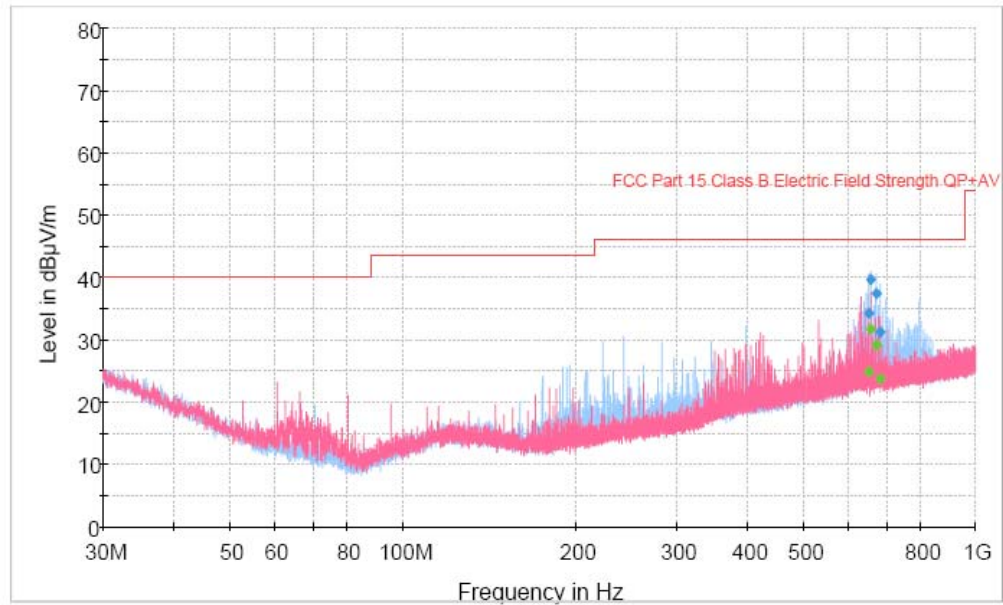
Freq MHz	Measured Value dB $\mu$ V	Correction Factor dB	Result dB $\mu$ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height	TT angle
651,8	0,8	24,1	24,9	21,1	Pos 1	Hor	100	9
657,6	7,5	24,2	31,7	14,3	Pos 1	Hor	100	173
672,3	4,8	24,3	29,1	16,9	Pos 1	Hor	216	22
682,8	-0,6	24,4	23,8	22,2	Pos 1	Hor	201	160

Table 23: Radiated emissions using Peak detector

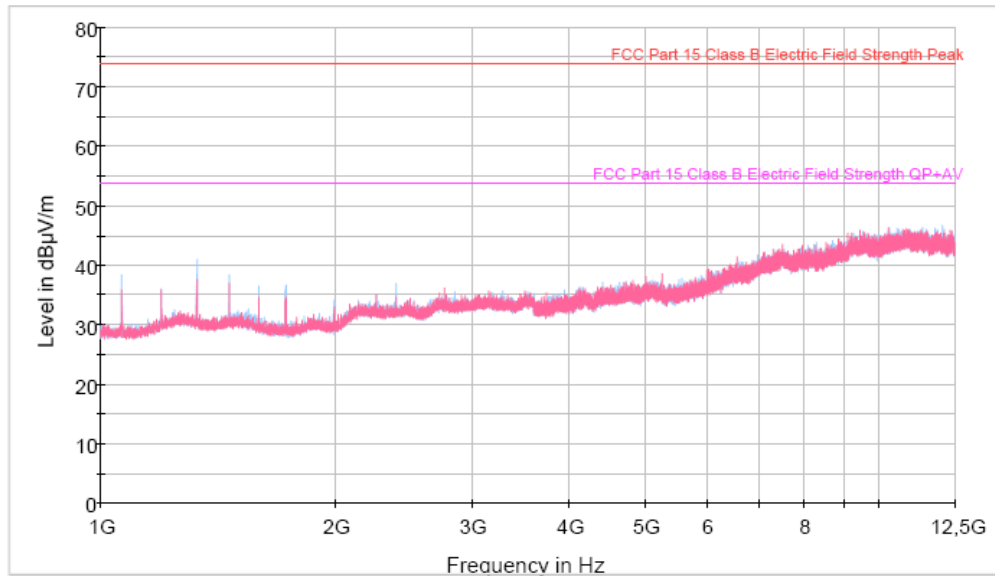
Freq MHz	Measured Value dB $\mu$ V	Correction Factor dB	Result dB $\mu$ V/m	Marginal dB	EUT Position	Ant Pol.	Ant height	TT angle
N/A								

Table 24: Radiated emissions using Average detector

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



Picture 33: radiated emission results, 30 – 1000 MHz,  
blue = horizontal polarization, = red vertical polarization



Picture 34: radiated emission results, 1 – 12,5 GHz,  
blue = horizontal polarization, = red vertical polarization

## 20 TEST EQUIPMENT

### 20.1 Conducted measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
Spectrum analyser	Agilent E7405A	131	MY42000072
EMI test receiver	Rohde & Schwarz ESCS30	020	849650/0016

### 20.2 Radiated measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
EMI test receiver	Rohde & Schwarz ESCS30	020	849650/0016
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 WHKS1000	150	1
3m Semi-anechoic chamber	ETS Euroshield	081	-
Measuring software	R&S EMC32	-	Ver 8.51.0



## 21 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

200530A-RF\_PHOTOS.doc