


REPORT: FCC / IC Radio Frequency (RF) test report

PRODUCT:

Test item description:	Mobile computer for data collection
Trade Mark:	NordicID
Model/Type reference:	805-2A / HTE00072
Serial number:	-
Customer:	Nordic ID Oy Myllyojankatu 2A 24100 SALO FINLAND
Contact person:	Hannu Heino
Manufacturer:	Nordic ID Oy Myllyojankatu 2A 24100 SALO FINLAND

DATE: 21.2.2012

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.

Transmitter measurements

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

Receiver measurements

Section in CFR 47	Section in RSS-GEN	Section in ICES-003	Test	Result
§15.107	7.2.4	5.3	Conducted emissions to AC-power lines	-
§15.109	7.2.5	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
EUT	NordicID Merlin	HTE0072	-	1
	NordicID Merlin	HTE0072	-	2*

Notes: Antenna replaced with sma connentor

3.1 EUT description

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

The EUT has 902-928 MHz RFID radio module (FCC ID: SCCNUR05W), 2402 -2480 MHz BT 2.1 +EDR radio and 2412 – 2462 MHz 802. 11 b/g wlan radio module (FCC ID: TWG-SDCMSD30AG).

Bluetooth radio was commanded to different modes with customer's program Morphic Radio Tester.exe.

RFID module was commanded with NUR Test [dll 1.3.0]
and WLAN module with module manufacturer's program SRU_30AG_3_1_34.exe

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 17.

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

CISPR 22, 2006

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

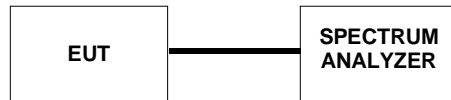
6 CARRIER FREQUENCY SEPARATION

EUT	2		
Accessories	-		
Temp, Humidity, Air Pressure	19°C	18,9RH%	1013hPa
Date of measurement	FEB 14 2012		
FCC rule part	15.247, a 1		
RSS-210 section	A8.1 (b)		
Measured by	Matti Virkki		

6.1 Test setup and testing method

EUT software was used to:

- set the EUT channel (1 – 52)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



Picture 1: Test setup for carrier frequency separation measurement

Spectrum analyzer was set to sweep the RFID operating band 902 – 930 MHz. 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

EUT operation mode	Modulation ON,
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

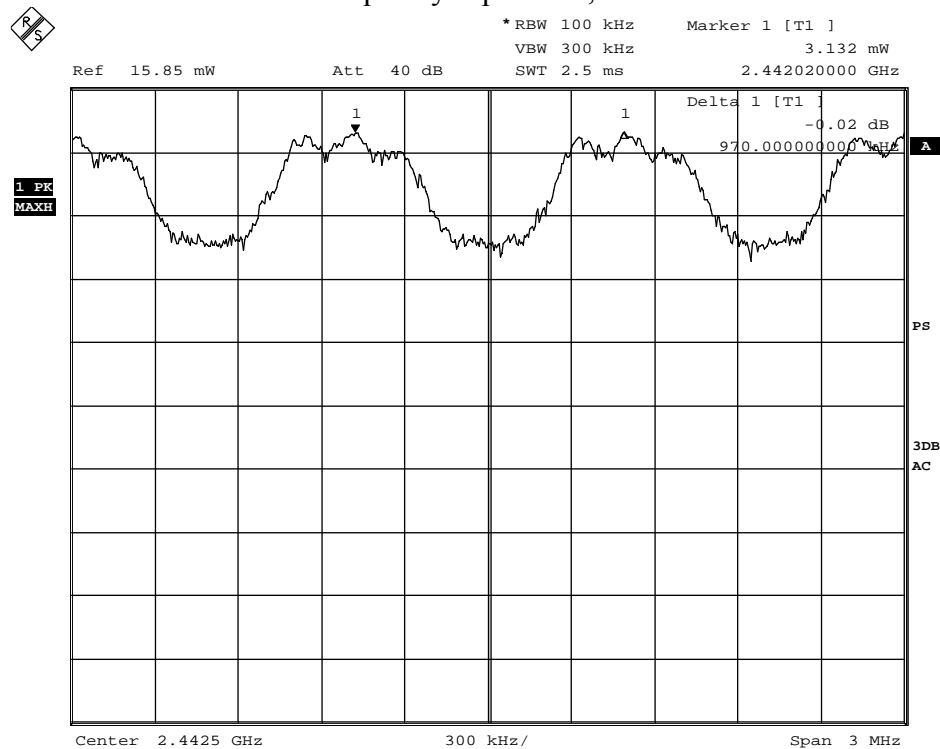
6.3 Results

Table 1: Carrier frequency separation measurement results

Limit	Result
>20dB Bandwidth	970 kHz

6.4 Screen shots

Picture 2: Carrier frequency separation, Channels 40-41



Date: 14.FEB.2012 10:28:50

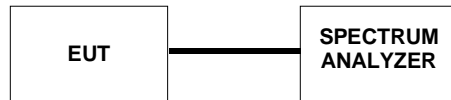
7 NUMBER OF HOPPING FREQUENCIES

EUT	21		
Accessories			
Temp, Humidity, Air Pressure	19°C	18,9RH%	1013hPa
Date of measurement	Feb. 14. 2012		
FCC rule part	15.247, a 1 i		
RSS-210 section	A8.1 (c)		
Measured by	Matti Virkki		

7.1 Test setup

EUT software was used to:

- set the EUT channel (1 – 52)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



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

Spectrum analyzer was set to sweep the RFID operating band 902 – 930 MHz. 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

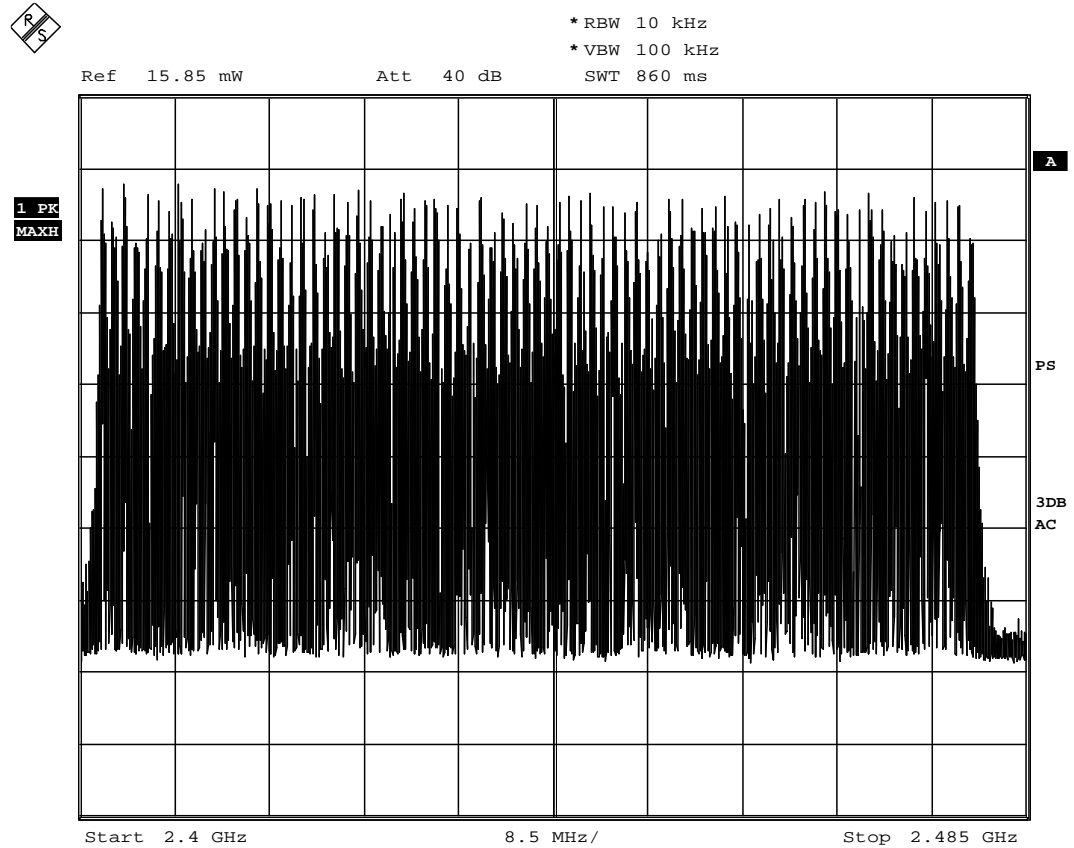
EUT operation mode	Modulation ON, ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

7.3 Results

Table 2: Number of hopping frequencies measurement results

Limit	Result
≥ 50	79

7.4 Screen shots



Date: 14.FEB.2012 10:08:11

Picture 4: Number of hopping frequencies measurement

8 TIME OF OCCUPANCY

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	19°C	18,9RH%	1013hPa
Date of measurement	FEB. 14.2012		
FCC rule part	15.247, a 1 i		
RSS-210 section	A8.1 (c)		
Measured by	Matti Virkki		

8.1 Test setup and testing method

EUT software was used to:

- set the EUT channel (1 – 52)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



Picture 5: Test setup for time of occupancy measurement

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

8.2 EUT operation mode

EUT operation mode	Modulation ON
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

8.3 Results

Table 3: Time of occupancy during connection mode measurement results

Limit	Result
≤ 0,4 s over 30 s period	0,180 s

Limit:

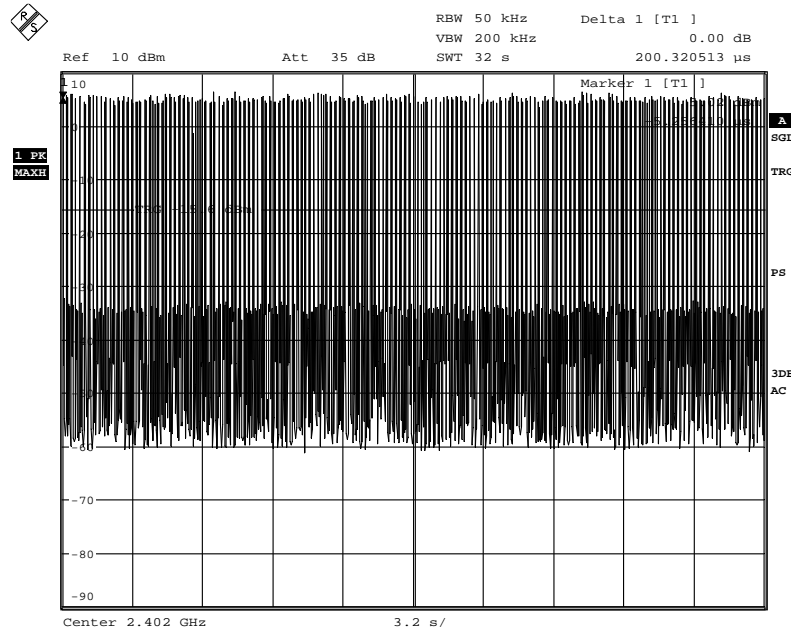
In the connection mode EUT uses 79 channels. As defined in 15.247, a 1 i, the limit for time of occupancy is 0,4s within a 30 second period.

Results:

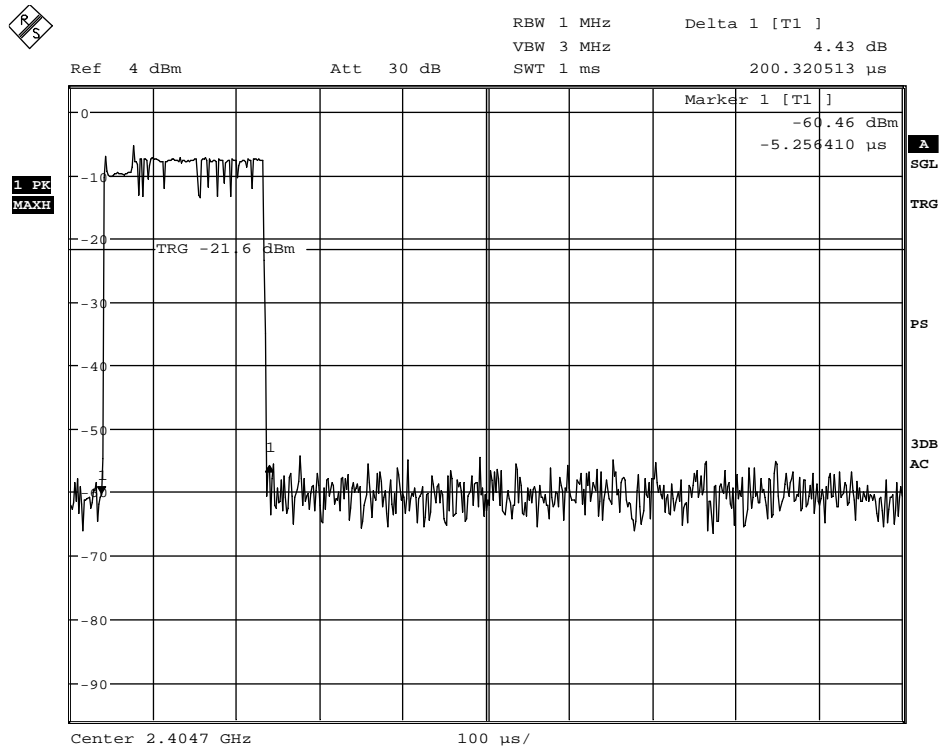
In measurement time of 30 s, total of 900 transmissions occurred. The duration of one transmission was 200µs. Based on these measurements the transmitter operated $900 * 200\mu s = 0,180 s$ during the 30 s period

8.4 Screen shots

Picture 6: Number of transmissions on connection state, channel 1



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Picture 7: Duration of one transmission on connection state, channel 1

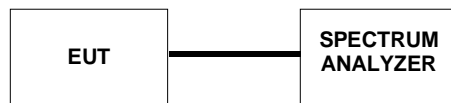
9 20 dB BANDWIDTH

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	FEB. 15.2012		
FCC rule part	15.247, a 1 i		
RSS-210 section	A8.1 (c)		
Measured by	Matti Virkki		

9.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel (1 – 52)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



Picture 8: Test setup for 20 dB bandwidth measurement

The 20dB bandwidth was measured using 30 kHz and 100kHz 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

EUT operation mode	Modulation ON, modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

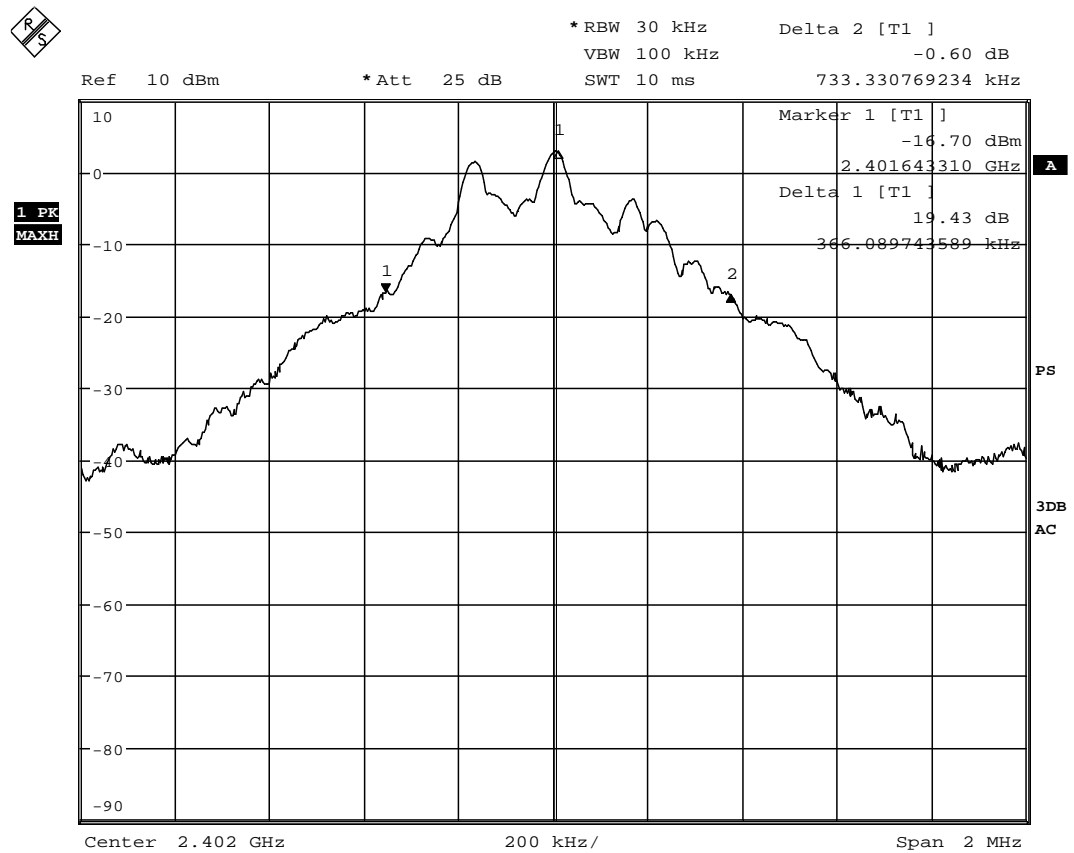
9.3 Results

Table 4: 20dB bandwidth measurement results

EUT Channel	Limit (kHz)	Measured value (kHz)
26	≤ 500	733,3

9.4 Screen shots

Picture 9: 20dB Bandwidth measurement result.



Date: 15.FEB.2012 15:14:45

10 PEAK OUTPUT POWER

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	19°C	18,9RH%	1013hPa
Date of measurement	Feb 14 2012		
FCC rule part	15.247, b 2		
RSS-210 section	A8.4 (1)		
Measured by	Matti Virkki		

10.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel (1 – 79)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



Picture 10: Test setup for conducted RF output power measurement

In the peak output power measurement the cable attenuation was measured prior to the power measurement and set as parameter for external gain 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 1 MHz video bandwidth and maximum hold function to record the maximum peak output power.

10.2 EUT operation mode

EUT operation mode	Hopping on single channel
EUT channel	1, 40, 79
EUT TX power level	TX level 0 (=max)

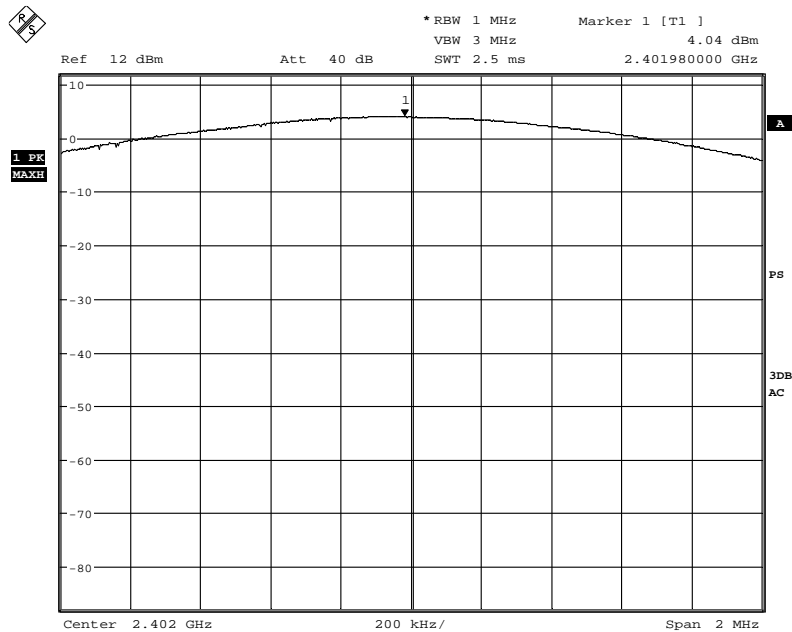
10.3 Results

Table 5: Peak output power measurement results

EUT Channel	Limit (dBm)	Measurement result (dBm)
1	≤ 30	4,04
40		4,66
79		5,87

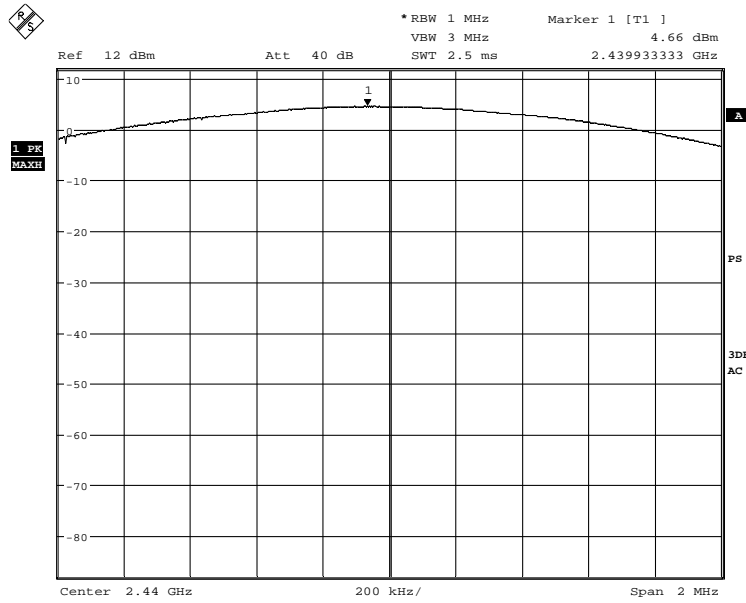
10.4 Screen shots

Picture 11: Peak output power, channel 1



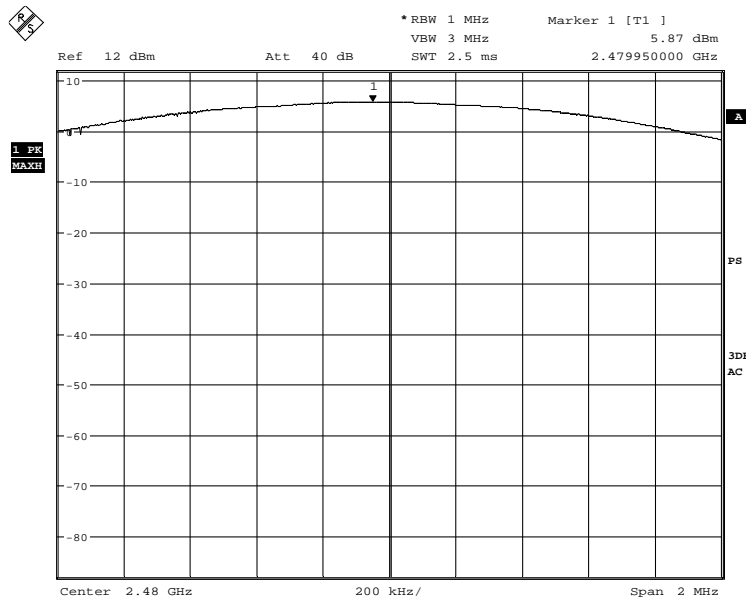
Date: 14.FEB.2012 10:49:11

Picture 12: Peak output power, channel 40



Date: 14.FEB.2012 10:50:07

Picture 13: Peak output power, channel 79



Date: 14.FEB.2012 10:51:11

10.5 EUT operation mode

EUT operation mode	Modulation ON, EDR mode
EUT channel	1, 40, 79
EUT TX power level	TX level 0 (=max)

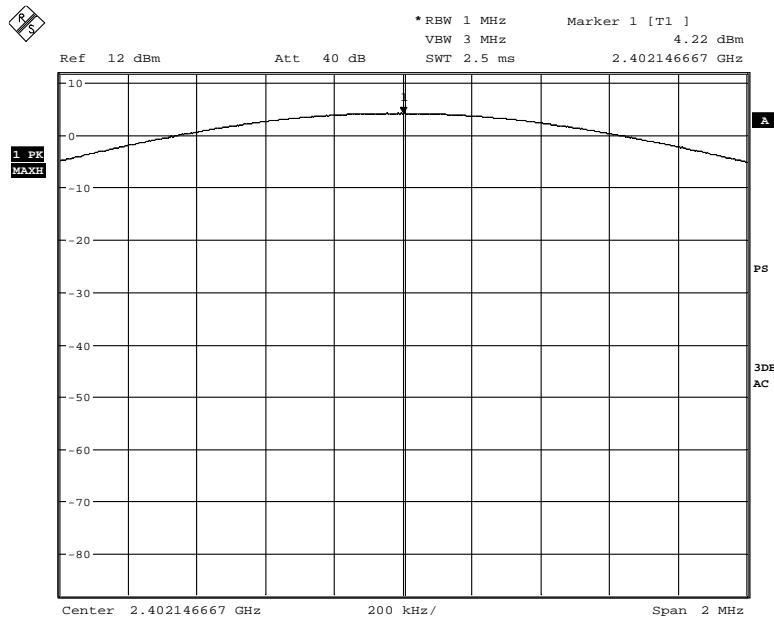
10.6 Results

Table 6: Peak output power measurement results

EUT Channel	Limit (dBm)	Measurement result (dBm)
1	≤ 30	4,22
40		3,50
79		2,62

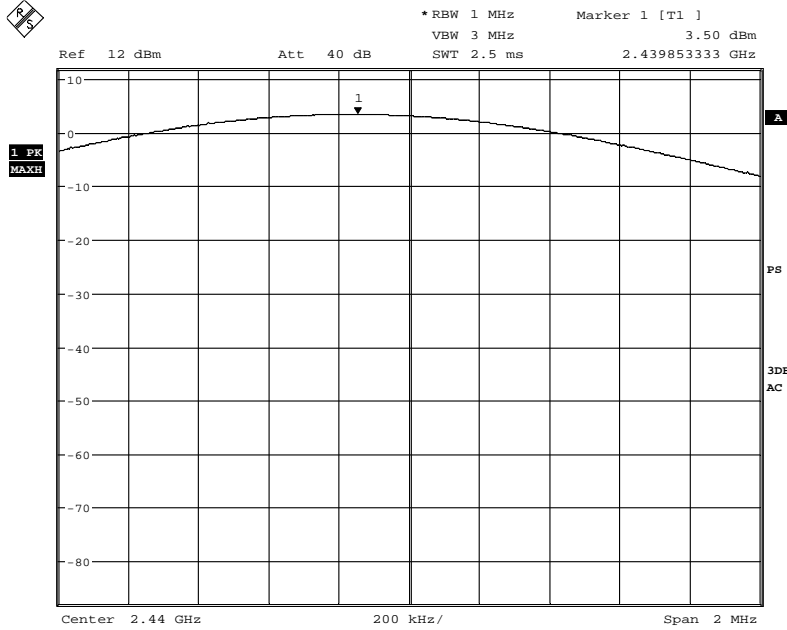
10.7 Screen shots

Picture 14: Peak output power, channel 1



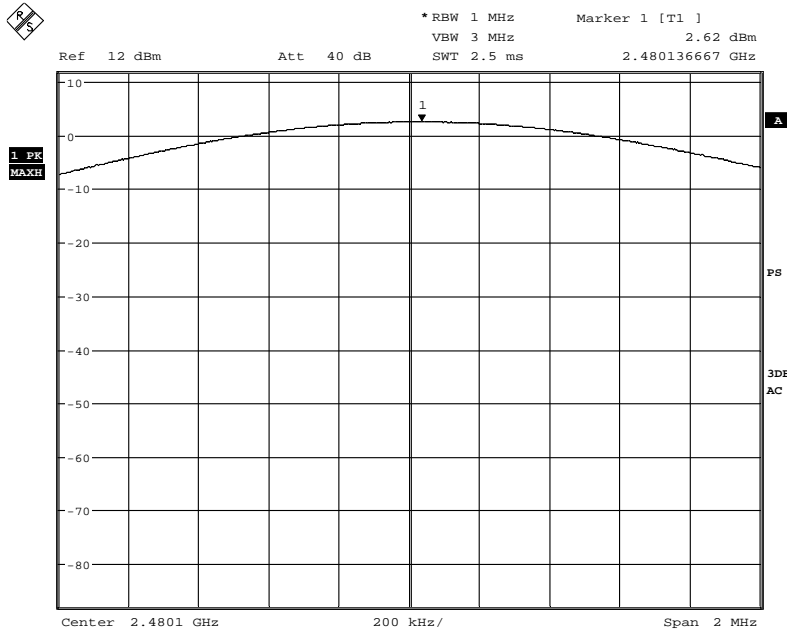
Date: 14.FEB.2012 10:59:28

Picture 15: Peak output power, channel 40



Date: 14.FEB.2012 10:54:08

Picture 16: Peak output power, channel 79



Date: 14.FEB.2012 10:55:07

Test results are valid for the tested unit only.

The report may be copied only in its entirety

11 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	19°C	18,9RH%	1013hPa
Date of measurement	Feb. 14 2012		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Matti Virkki		

11.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel (1 – 52)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



Picture 17: Test setup for band edge compliance measurement

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 1 and 79. The measured power and power on the band edge was then compared.

11.2 Hopping enabled

11.2.1 EUT operation mode

EUT operation mode	Modulation ON,
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

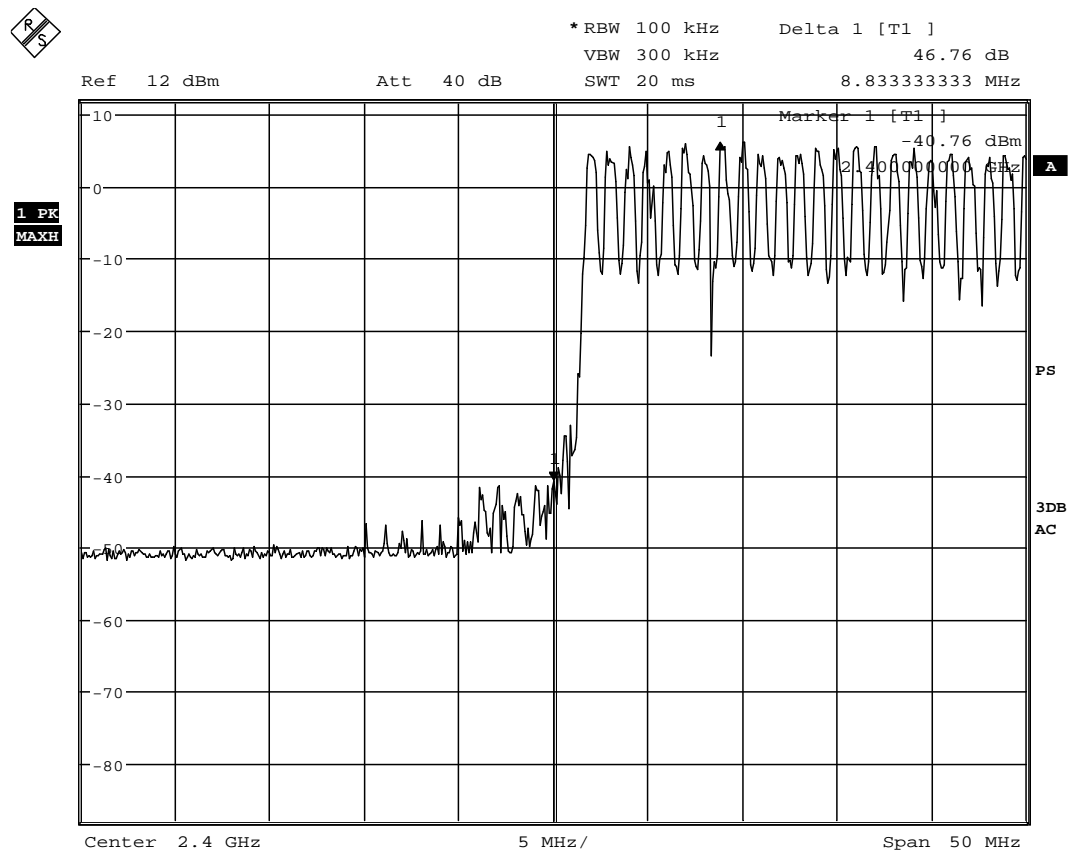
11.2.2 Results

Table 7: Band Edge measurement results

EUT Channel	Limit (dBc)	Test result (dBc)
1	≤ -20	-46,8
79		-51,9

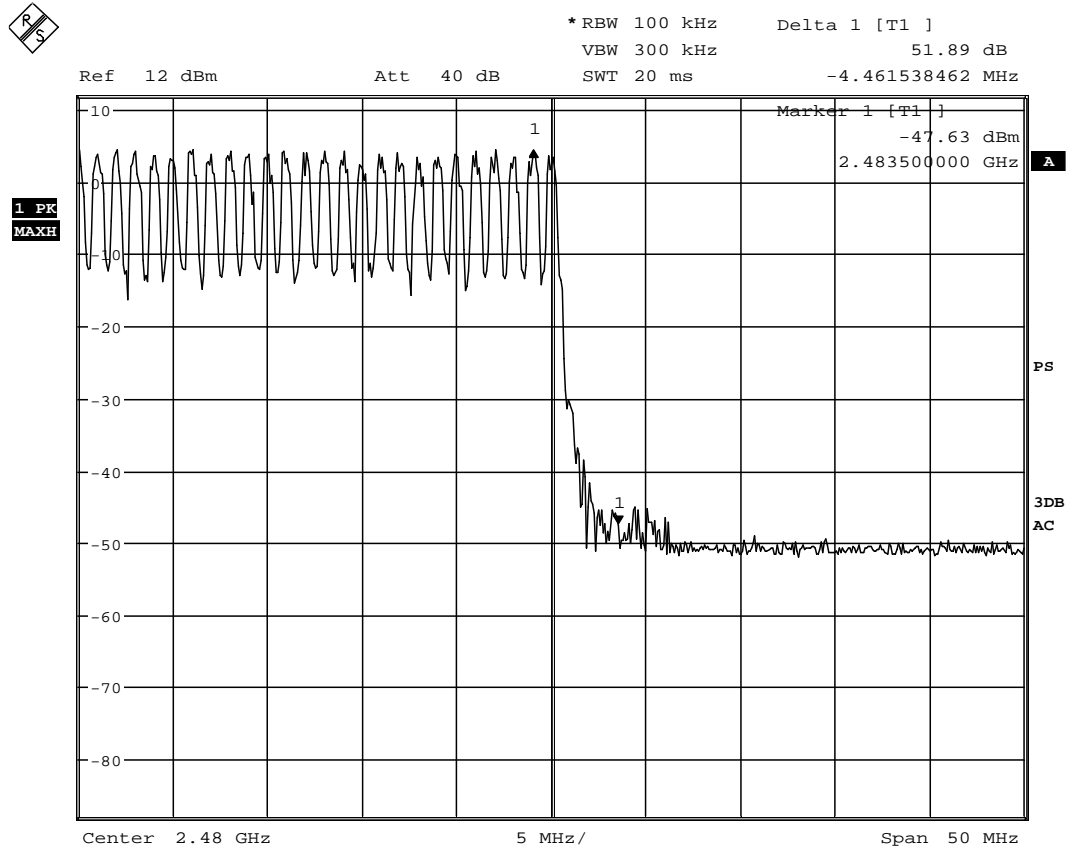
11.2.3 Screen shots

Picture 18: Band edge compliance, channel 1, hopping enabled



Date: 14.FEB.2012 10:46:15

Picture 19: Band edge compliance, channel 79, hopping enabled



Date: 14.FEB.2012 10:42:02

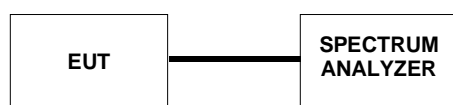
12 99 % BANDWIDTH

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	19°C	18,9RH%	1013hPa
Date of measurement	Feb. 12 2012		
FCC rule part			
RSS-GEN section	4.6.1		
Measured by	Matti Virkki		

12.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel (1 – 52)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



Picture 20: Test setup for 99% bandwidth measurement

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

12.2 EUT operation mode

EUT operation mode	Modulation ON
EUT frequency	Ch1 (2402 MHz)
EUT TX power level	TX level 0 (=max)

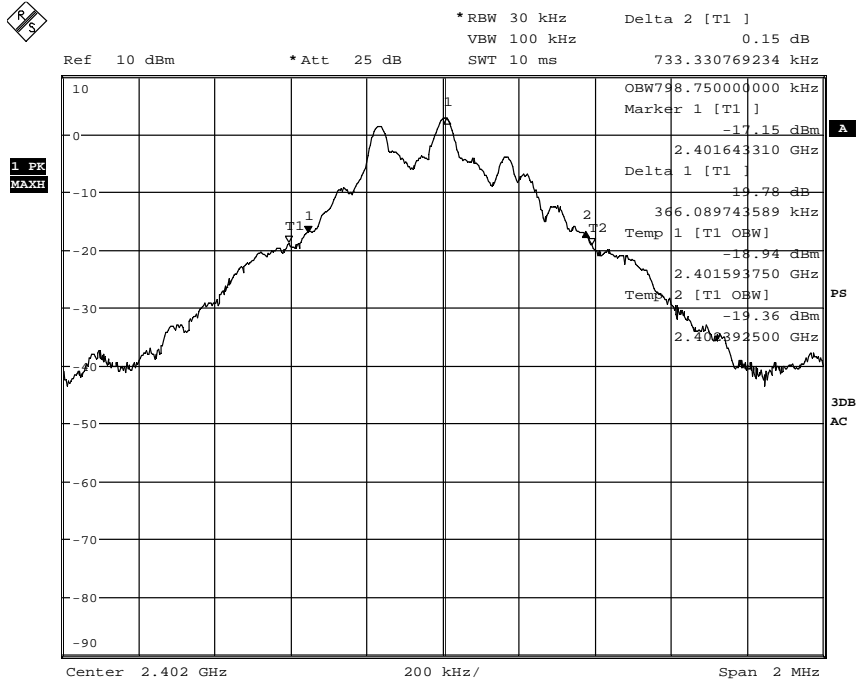
12.3 Results

Table 8: 99% bandwidth measurement results

EUT Frequency MHz	Limit kHz	Measured value kHz
2402	-	798,7

12.4 Screen shots

Picture 21: 99% Bandwidth measurement result, ch 1



Date: 15.FEB.2012 15:15:47

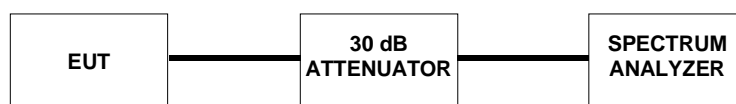
13 SPURIOUS RF CONDUCTED EMISSIONS

EUT	2		
Accessories			
Temp, Humidity, Air Pressure	19°C	18,9RH%	1013hPa
Date of measurement	Feb. 14 2012		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Matti Virkki		

13.1 Test setup and measurement method

EUT software was used to:

- set the EUT channel (1 –79)
- set the EUT to TX or RX mode
- enable/disable frequency hopping
- select modulation type



Picture 22: Test setups for conducted spurious emission measurement

Spectrum analyzer and automated software were used to record conducted spurious emissions on frequency range 30 MHz – 25 GHz. Frequency range was scanned using 1 MHz resolution bandwidth and 500 kHz steps. High pass filter was used over 1GHz measurements to avoid spectrum analyzer input to generate spurious emissions. Spurious emissions levels relative to the carrier level were read from the measured results.

13.2 EUT operation mode

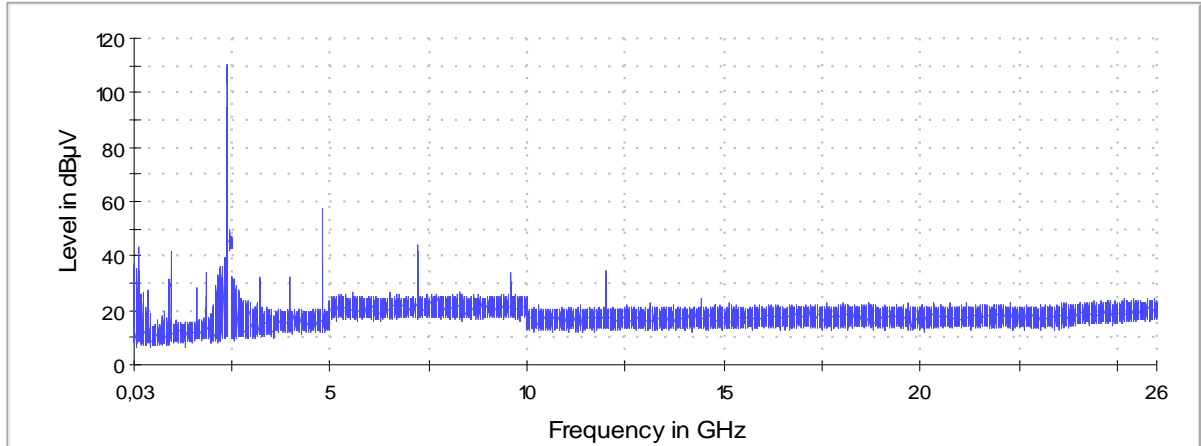
EUT operation mode	Continuous transmission (CW)
EUT channel	1 (2402 MHz), 40 (2440 MHz) and 79 (2480 MHz)
EUT TX power level	TX level 0 (=max)

13.3 Limit

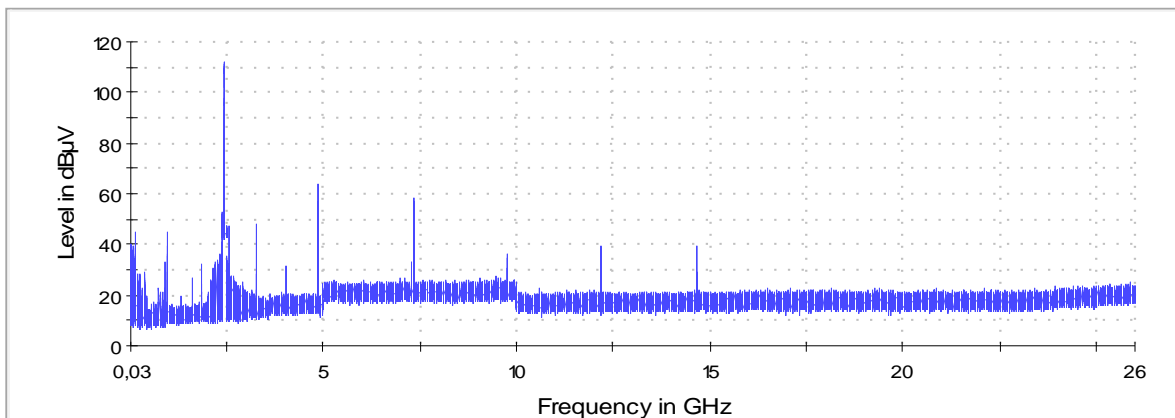
EUT Channel	Limit (dBc)
all	≤ -20

13.4 Results

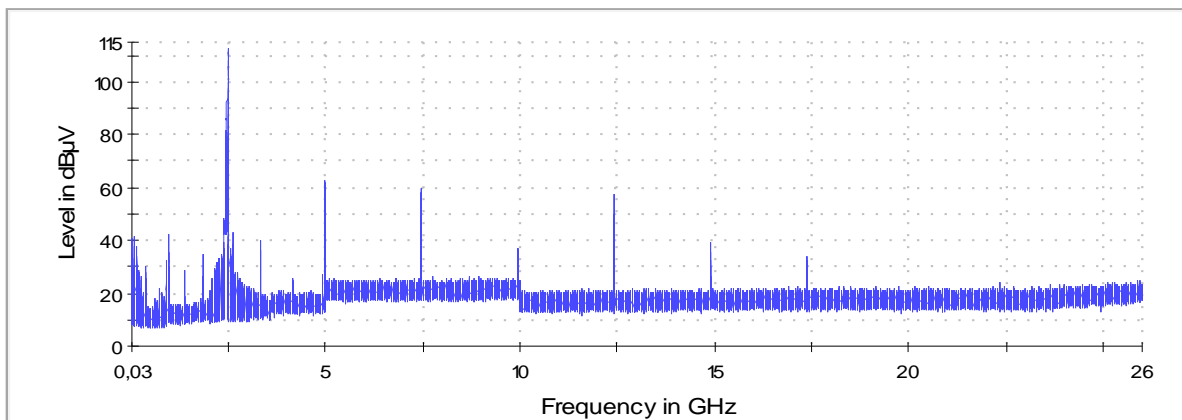
Picture 23: Conducted spurious emissions on antenna port, Channel 1,



Picture 24: Conducted spurious emissions on antenna port, Channel 40,



Picture 25: Conducted spurious emissions on antenna port, Channel 79,



14 FIELD STRENGTH OF FUNDAMENTAL

EUT	1		
Accessories			
Temp, Humidity, Air Pressure	19°C	19RH%	1009hPa
Date of measurement	Feb 13 21012		
FCC rule part			
RSS-210 section			
Measured by	Matti Virkki		

14.1 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 1MHz RBW and 1MHz VBW band width.

14.2 EUT operation mode

EUT operation mode	Continuous transmission, CW
EUT frequency	1 (2402 MHz), 40 (2440 MHz) and 79 (2480 MHz)
EUT TX power level	TX level 0 (=max)

14.3 Results

Table 9: Maximum field strength of fundamental (Peak value)

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dBuV/m	Antenna Pol.	Antenna height	Turntable angle
2402,48	73,9	-22,3	96,2	H	1	274
2440,02	74,6	-22,3	96,9	H	1	291
2479,84	73,9	-24,0	97,9	H	1	274

15 RADIATED SPURIOUS EMISSIONS

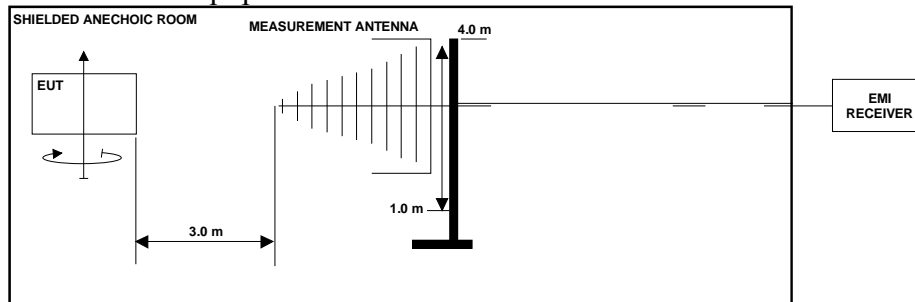
EUT	1		
Accessories			
Temp, Humidity, Air Pressure	19°C	19RH%	1009hPa
Date of measurement	Feb 13 2012		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Matti Virkki		

15.1 Test setup

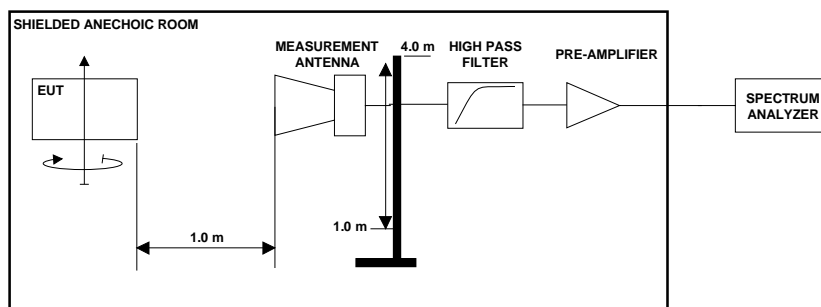
PC software was used to:

- set the EUT channel (1 – 79)
- set the EUT to TX mode
- disable frequency hopping

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



Picture 26: Test setup for radiated spurious emissions measurement
30 MHz - 1 GHz frequencies



Picture 27: Test setup for radiated spurious emissions measurement
1 GHz – 10 GHz frequencies

15.2 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.

15.3 EUT operation mode

EUT BT mode	Continuous transmission, Tx
EUT BT channel	1, 40, 79
EUT TX power level	max

15.4 Limit

Table 10: 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 - 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.

15.5 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 11: Emission levels PEAK (QP) detector, BT channel 1

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	Ant Pol.	Ant height m
4804,7	51,5	-8,5	59,8		H	

Table 12: Emission levels PEAK (QP) detector, BT channel 40

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	Ant Pol.	Ant height m
4880,1	51,9	-9,6	61,5		V	1
7320,2	46,8	0,2	47,0		H	1

Table 13: Emission levels PEAK (QP) detector, BT channel 79

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m PK	Marginal dB	Ant Pol.	Ant height m
4959,9	69,1	-9,2	59,9		H	1
7439,8	50,5	1,0	51,5		V	1

Since the RFID measurements are made with sample that is modified to continuous transmission, average results are calculated from peak results using duty cycle.

$$\text{Average level} \leq \text{Peak level} + 20 \log (\text{duty cycle}).$$

Measured transmission time in clause 8 was 200 μ s. On average 3 transmissions occurred every 100ms period.

Therefore,

$$\text{Average level} \leq \text{Peak level} + 20 \log (3 \cdot 200 \mu\text{s} / 100\text{ms})$$

$$\text{Average level} \leq \text{Peak level} - 44,4 \text{ dB}$$

All peak levels are under 54 dB μ V/m + 44,4 dB = 98,4 dB μ V/m

16 TEST EQUIPMENT

16.1 Conducted measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
EMI test receiver	Rohde & Schwarz ESU26	219	100173

16.2 Radiated measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
EMI test receiver	Rohde & Schwarz ESU26	219	100173
Horn Antenna	Schwarzbeck BBHA9120D	138	365
X-wing BiLog antenna	Teseq CBL6143A	221	29611
3 dB attenuator	Huber+Suhner 3dB/2W	214	-
Pre-amplifier	Agilent 87405B	143	MY39500154
Pre-amplifier	JCA 118-400	142	-
High pass filter	Wainwright Instruments WHK3.0/18GST	141	3
High pass filter	Wainwright Instruments WHKS1000	150	1
Band reject filter	Wainwright WRCT 800/900MHz	135	4
3m Semi-anechoic chamber	ETS Euroshield	081	-
Measuring software	Teseq Compliane3	-	Ver 4.01
Measuring software	R&S EMC32	-	Ver 8.52.0

17 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

100469A-RF_PHOTOS.doc