

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

PRODUCT:

Test item description:	UHF RFID reader module
Trade Mark:	Nordic ID
Model/Type reference:	NUR-05W
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: 24.5.2011

TESTED BY:



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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)
Quality and Environmental :	

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	UHF RFID reader module	Nordic ID NUR-05W	-	1*
Accessories	RFID reader antenna	Huber+Suhner 1309.17.0085	00132	2
	Laptop	Fujitsu Espiro Mobile U9210	FRAB1004 00055815	3
	Power supply	Delta Elektronika SM120-13	0255020009 4	4

Notes:

* Capacitor C68 changed to 33pF before tests.

3.1 EUT description

EUT is RFID module installed to Nordic ID EVA1-RF board. EUT was tested with it's nominal voltage level 5,25VDC. EUT was commanded to different modes with laptop by customers program EasyRFID Demo. Huber+Suhner RFID antenna (1309.17.0085, SPA-915/70/8/0/V) was connected to the module RF output.

Antenna data:

Electrical Data

	Band 1
Frequency (MHz)	902 - 928
VSWR	1.7
Gain	8 dBi
3dB beamwidth (h) (°)	70
3dB beamwidth (v) (°)	70
Front to back ratio	-11 dB
Vertical electrical tilt (°)	0

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 18.

5 APPLICABLE STANDARDS

The tests were performed in guidance of:

CFR 47 Part:

- §15.107
- §15.109
- §15.209
- §15.247
- ANSI C63.4 (2003)

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	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part	15.247, a 1		
RSS-210 section	A8.1 (b)		
Measured by	Simo Ojanen		

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

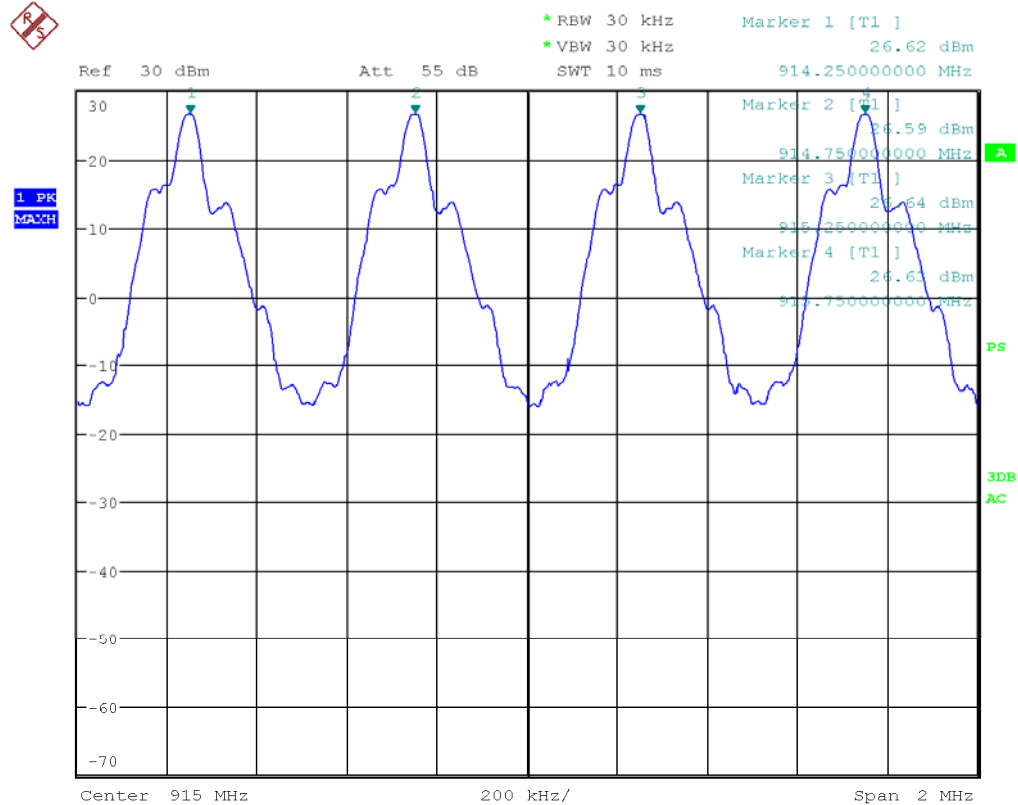
EUT operation mode	Modulation ON, ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

6.3 Results

Table 1: Carrier frequency separation measurement results

Limit	Result
>20dB Bandwidth	500 kHz

6.4 Screen shots



Date: 12.MAY.2011 12:15:42

Picture 2: Carrier frequency separation, Channels 25-28

6.5 EUT operation mode

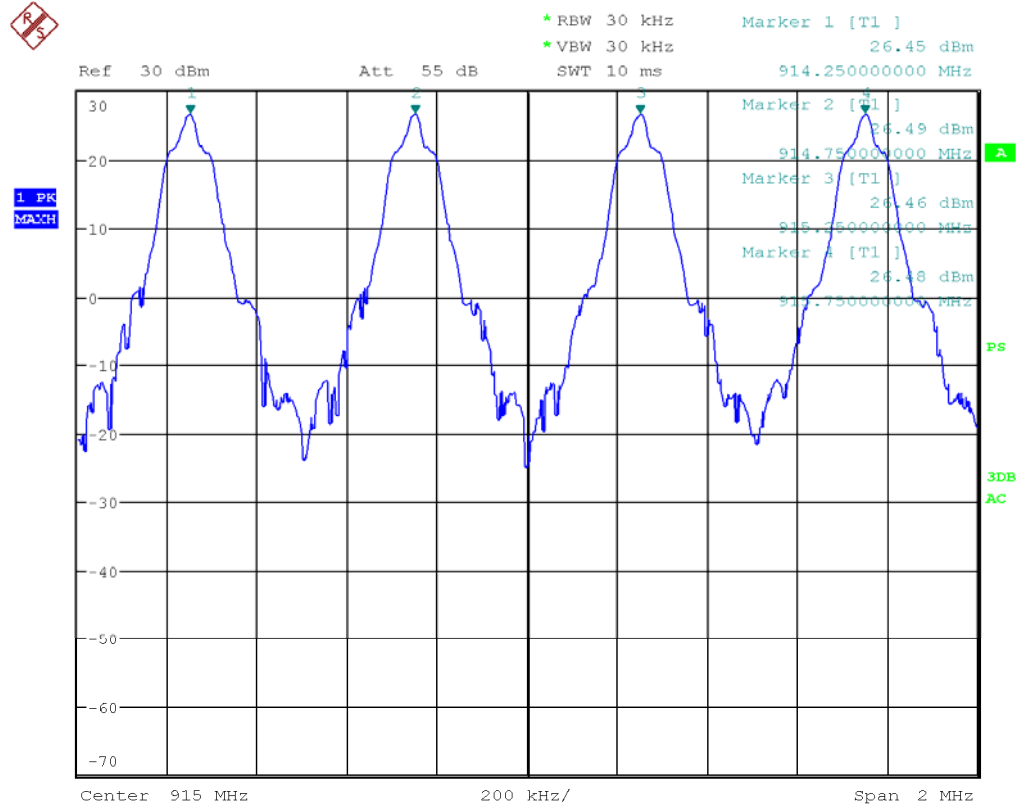
EUT operation mode	Modulation ON, PR-ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

6.6 Results

Table 2: Carrier frequency separation measurement results

Limit	Result
>20dB Bandwidth	500 kHz

6.7 Screen shots



Date: 12.MAY.2011 12:18:12

Picture 3: Carrier frequency separation, Channels 25-28

7 NUMBER OF HOPPING FREQUENCIES

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part	15.247, a 1 i		
RSS-210 section	A8.1 (c)		
Measured by	Simo Ojanen		

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 4: 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

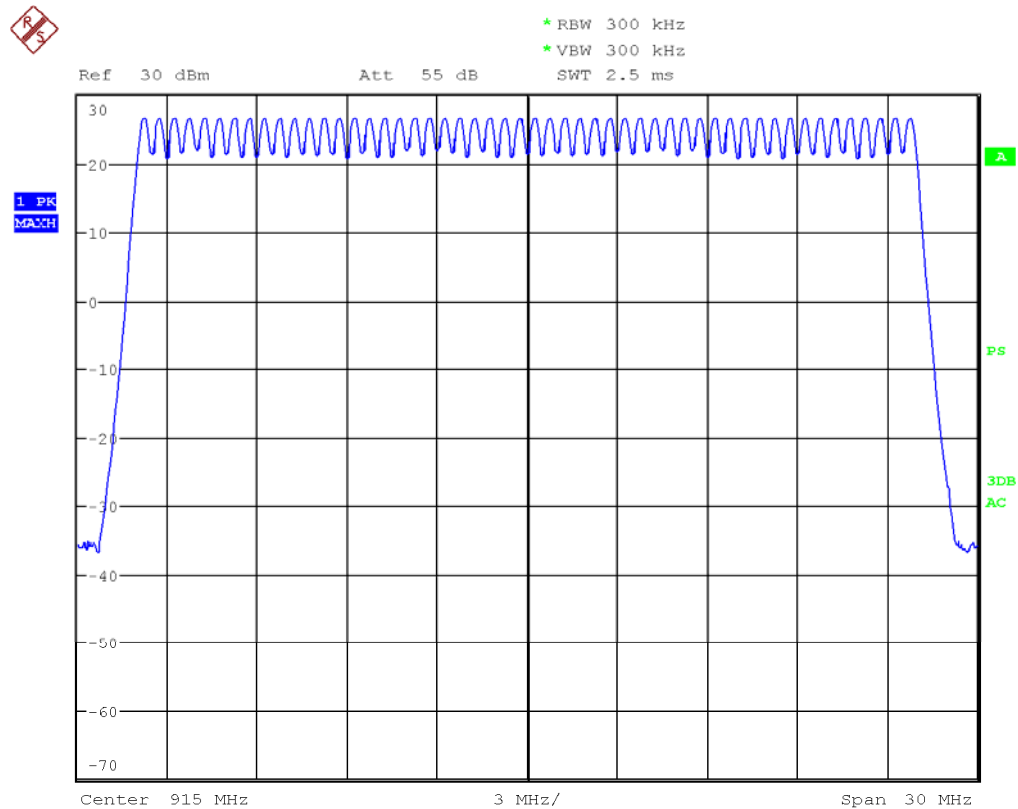
EUT operation mode	Modulation ON, ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

7.3 Results

Table 3: Number of hopping frequencies measurement results

Limit	Result
≥ 50	52

7.4 Screen shots



Date: 12.MAY.2011 12:20:39

Picture 5: Number of hopping frequencies measurement

7.5 EUT operation mode

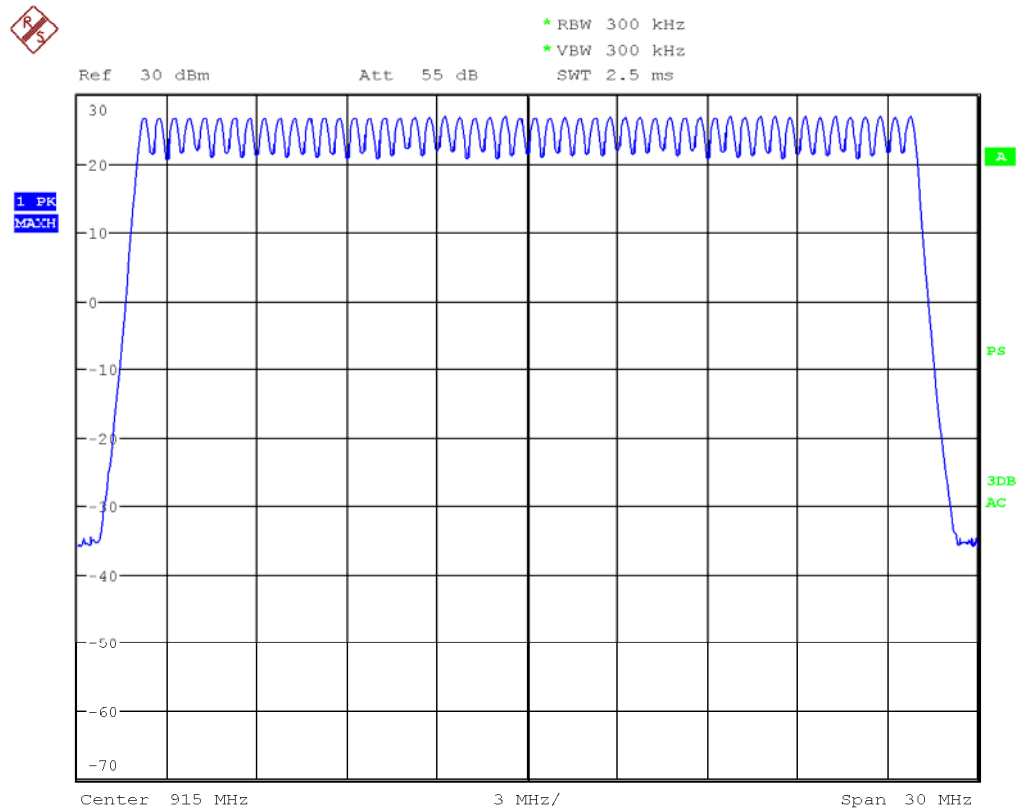
EUT operation mode	Modulation ON, PR-ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

7.6 Results

Table 4: Number of hopping frequencies measurement results

Limit	Result
≥ 50	52

7.7 Screen shots



Date: 12.MAY.2011 12:22:11

Picture 6: Number of hopping frequencies measurement

8 TIME OF OCCUPANCY

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part	15.247, a 1 i		
RSS-210 section	A8.1 (c)		
Measured by	Simo Ojanen		

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 7: 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, ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

8.3 Results

Table 5: Time of occupancy during connection mode measurement results

Limit	Result
≤ 0,4 s over 20 s period	0,348 s

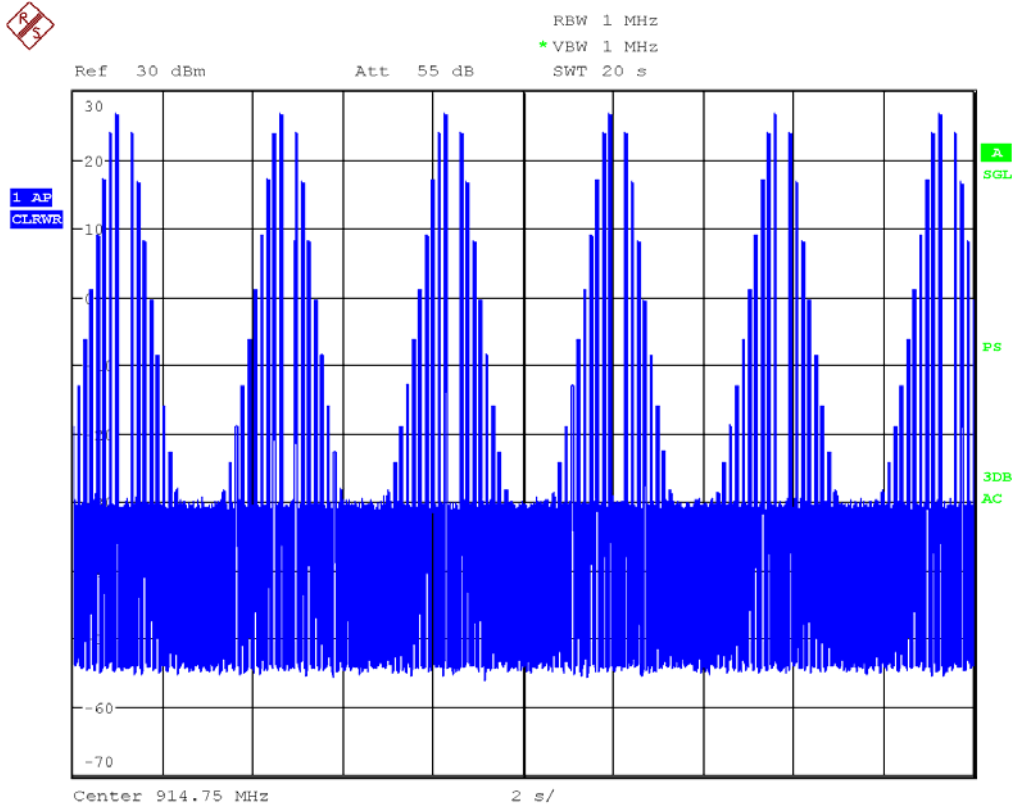
Limit:

In the connection mode EUT uses 52 channels. As defined in 15.247, a 1 i, the limit for time of occupancy is 0,4s within a 20 second period.

Results:

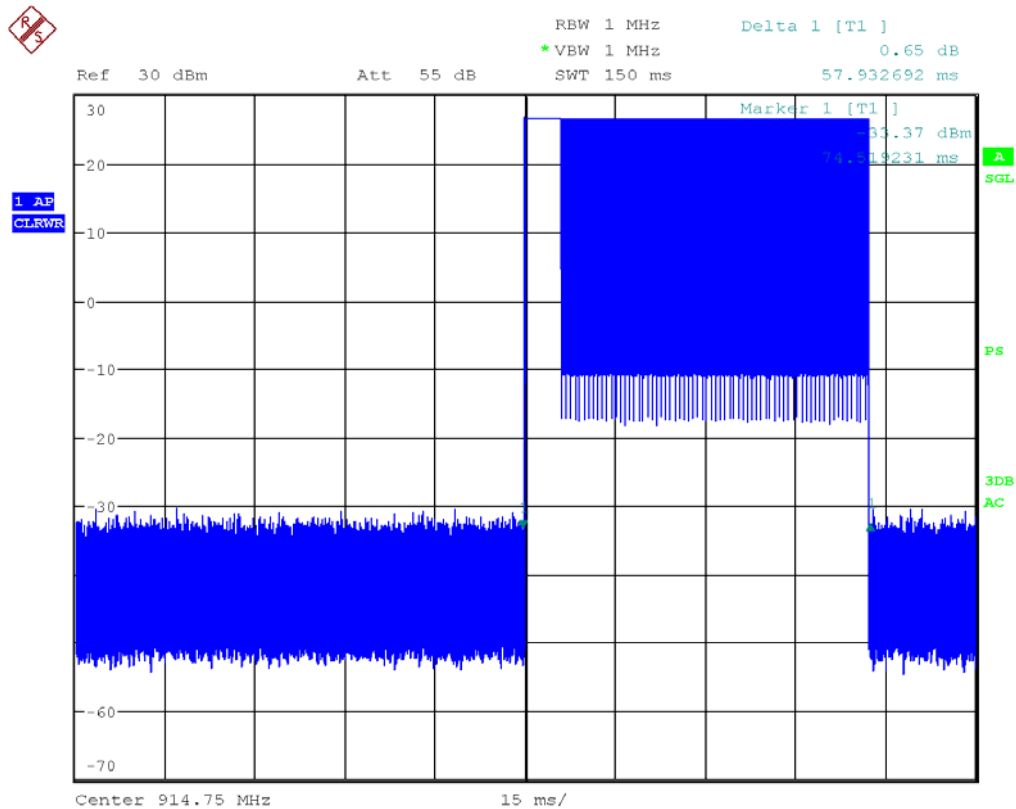
In measurement time of 20 s, total of 6 transmissions occurred. The duration of one transmission was 57,93 ms. Based on these measurements the transmitter operated $6 * 57,93 \text{ ms} = 0,348 \text{ s}$ during the 20 s period

8.4 Screen shots



Date: 12.MAY.2011 12:37:54

Picture 8: Number of transmissions on connection state, channel 26



Date: 12.MAY.2011 12:38:49

Picture 9: Duration of one transmission on connection state, channel 26

8.5 EUT operation mode

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

8.6 Results

Table 6: Time of occupancy during connection mode measurement results

Limit	Result
≤ 0,4 s over 20 s period	0,348 s

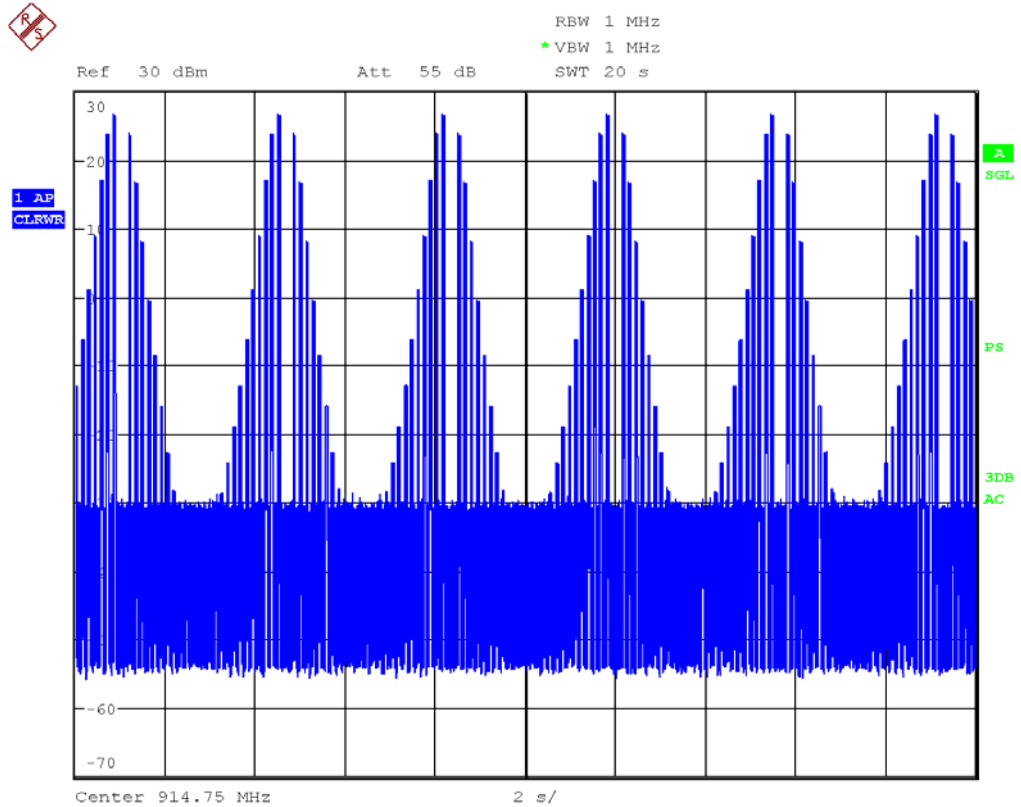
Limit:

In the connection mode EUT uses 52 channels. As defined in 15.247, a 1 i, the limit for time of occupancy is 0,4s within a 20 second period.

Results:

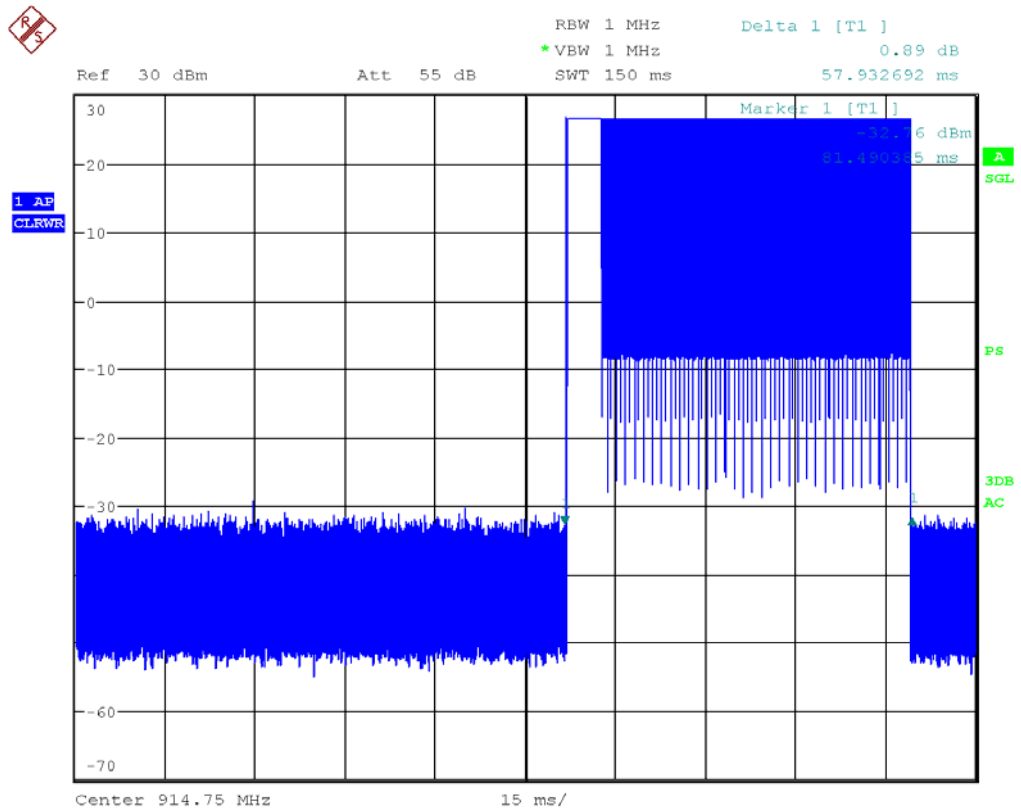
In measurement time of 20 s, total of 6 transmissions occurred. The duration of one transmission was 57,93 ms. Based on these measurements the transmitter operated $6 * 57,93 \text{ ms} = 0,348 \text{ s}$ during the 20 s period

8.7 Screen shots



Date: 12.MAY.2011 12:36:37

Picture 10: Number of transmissions on connection state, channel 26



Date: 12.MAY.2011 12:35:19

Picture 11: Duration of one transmission on connection state, channel 26

9 20 dB BANDWIDTH

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part	15.247, a 1 i		
RSS-210 section	A8.1 (c)		
Measured by	Simo Ojanen		

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 12: Test setup for 20 dB bandwidth measurement

The 20dB bandwidth was measured using 1 kHz and 3kHz 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

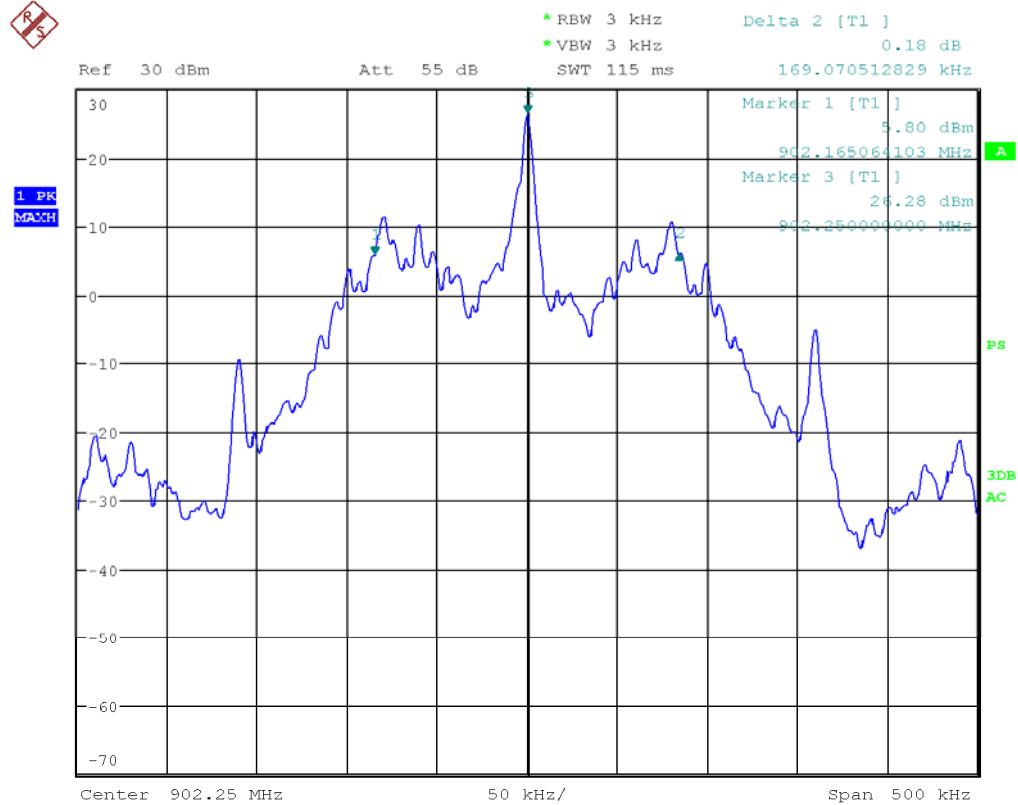
EUT operation mode	Modulation ON, ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

9.3 Results

Table 7: 20dB bandwidth measurement results

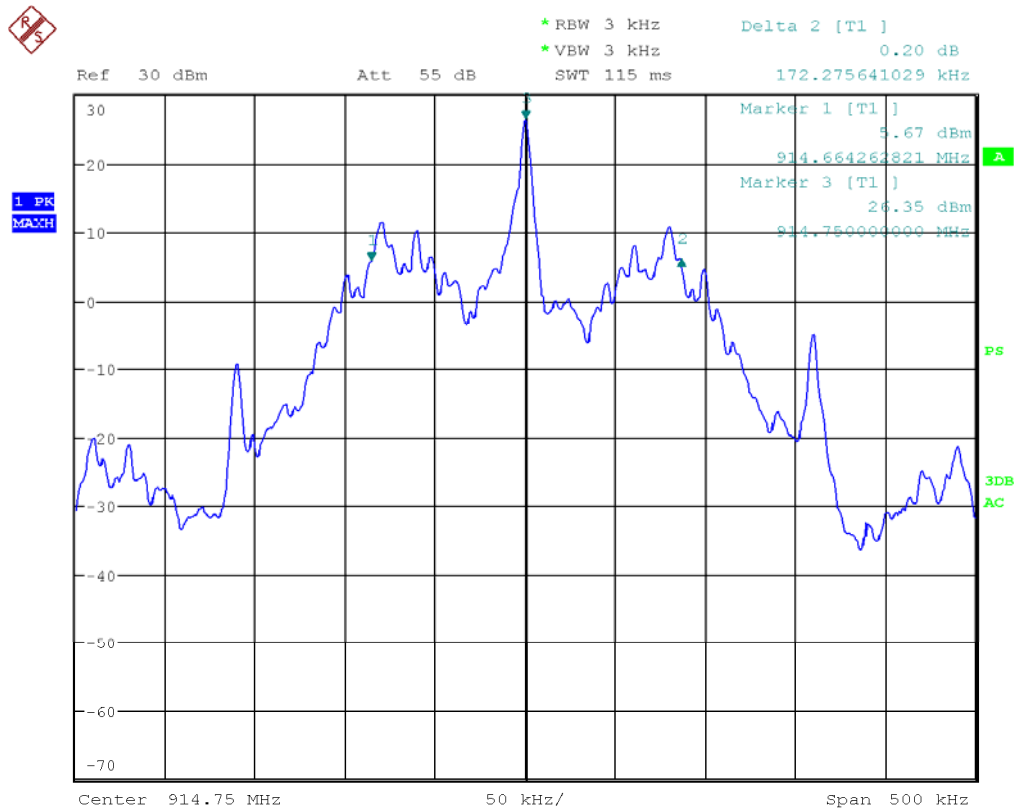
EUT Channel	Limit (kHz)	Measured value (kHz)
1	≤ 500	169
26		172
52		169

9.4 Screen shots



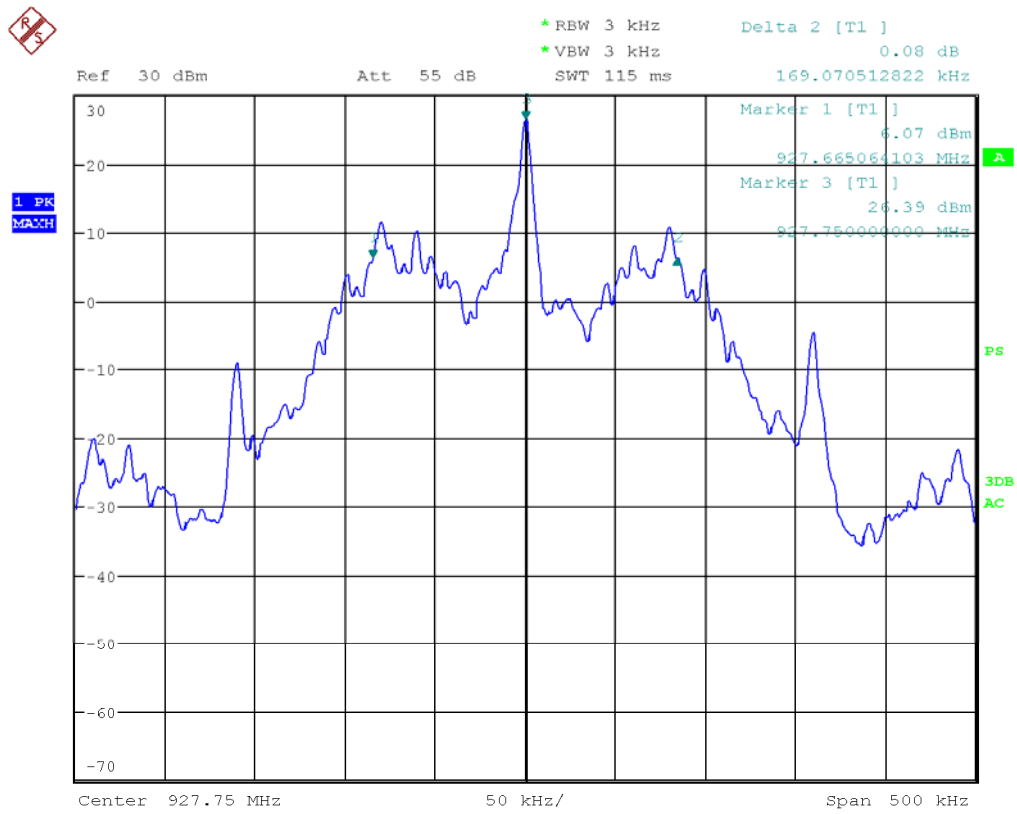
Date: 12.MAY.2011 12:46:01

Picture 13: 20dB Bandwidth measurement result, Channel 1



Date: 12.MAY.2011 12:55:59

Picture 14: 20dB Bandwidth measurement result, Channel 26



Date: 12.MAY.2011 12:59:47

Picture 15: 20dB Bandwidth measurement result, Channel 52

9.5 EUT operation mode

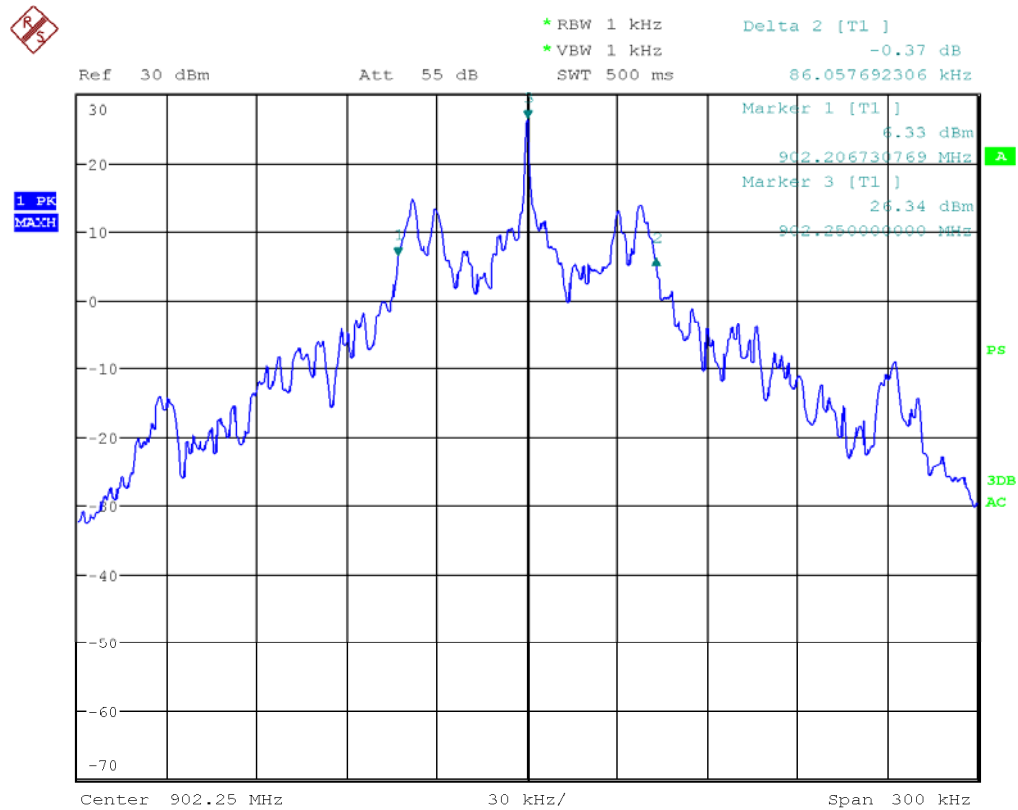
EUT operation mode	Modulation ON, PR-ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

9.6 Results

Table 8: 20dB bandwidth measurement results

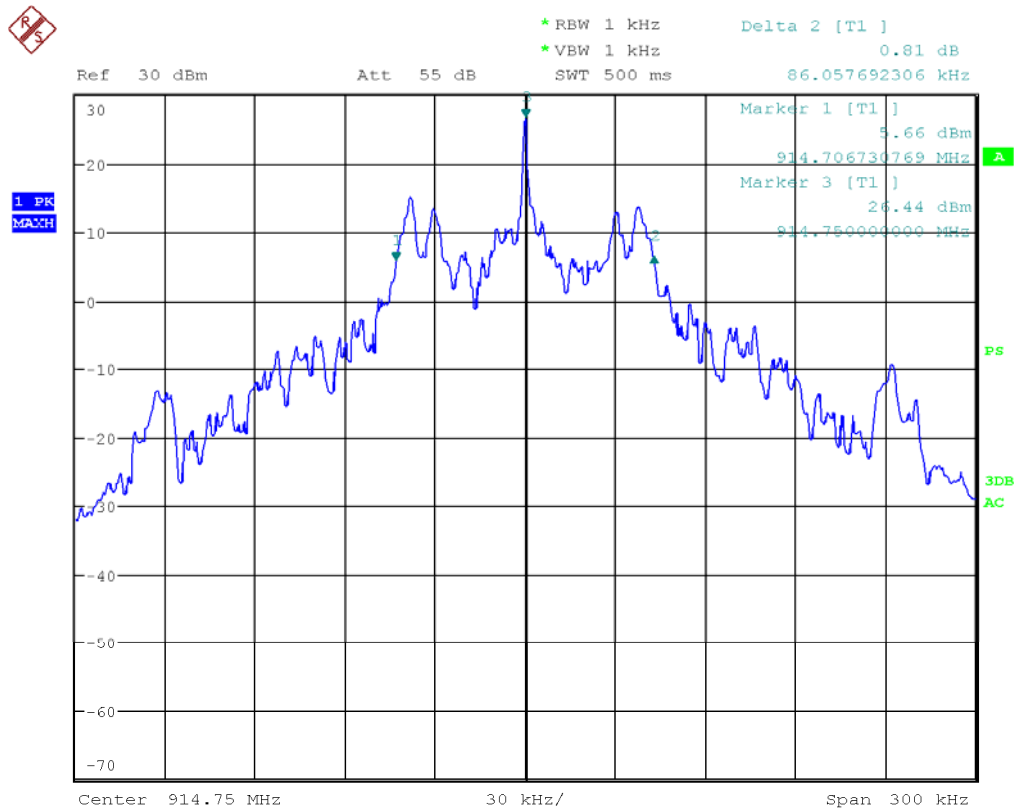
EUT Channel	Limit (kHz)	Measured value (kHz)
1	≤ 500	86
26		86
52		84

9.7 Screen shots



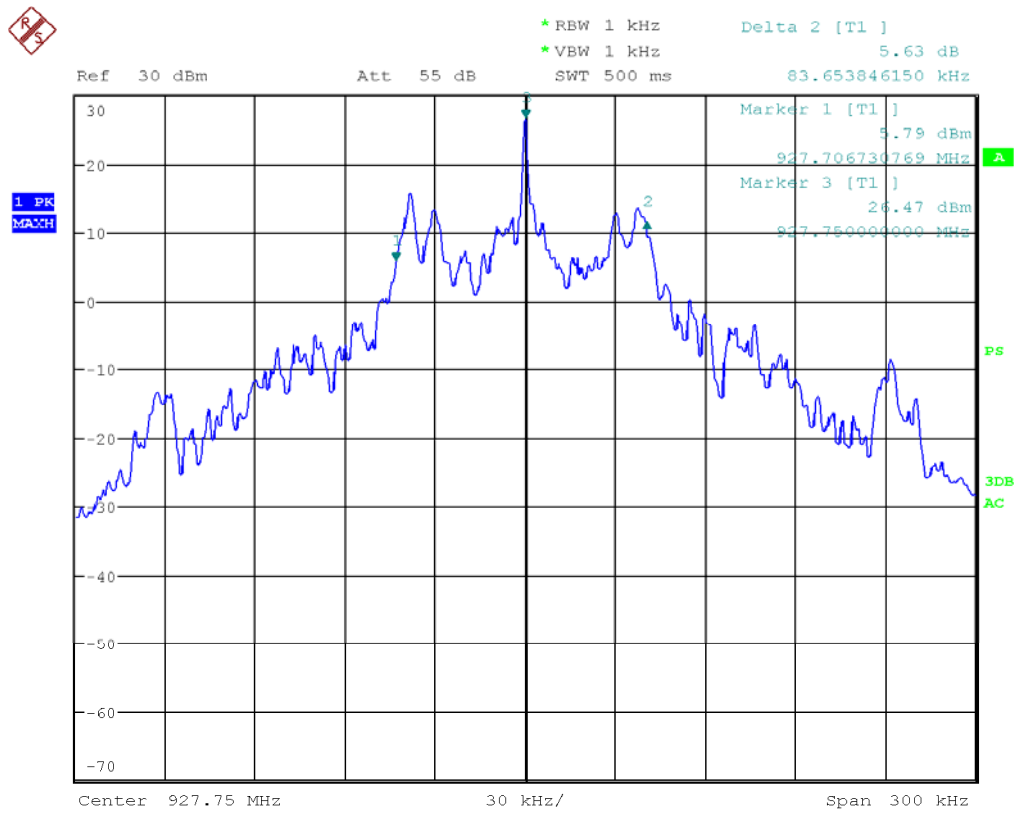
Date: 12.MAY.2011 13:07:00

Picture 16: 20dB Bandwidth measurement result, Channel 1



Date: 12.MAY.2011 13:08:52

Picture 17: 20dB Bandwidth measurement result, Channel 26



Date: 12.MAY.2011 13:14:58

Picture 18: 20dB Bandwidth measurement result, Channel 52

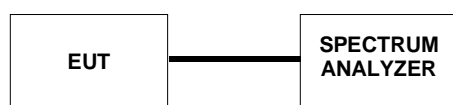
10 PEAK OUTPUT POWER

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part	15.247, b 2		
RSS-210 section	A8.4 (1)		
Measured by	Simo Ojanen		

10.1 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 19: 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

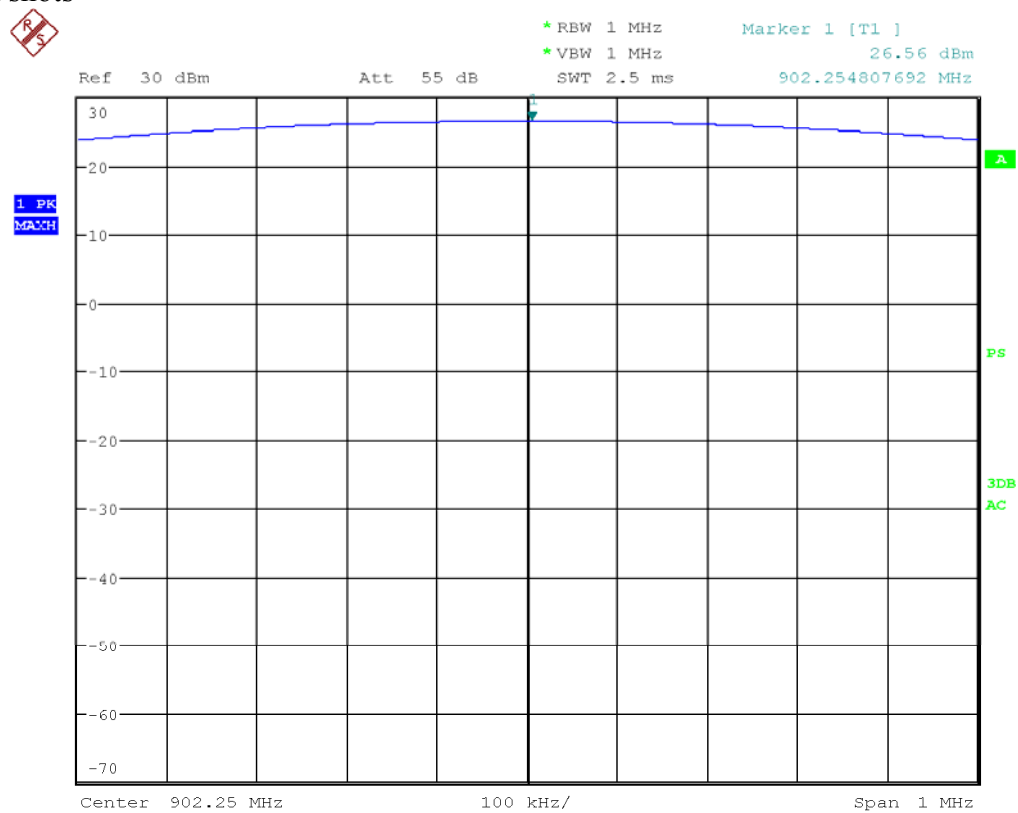
EUT operation mode	Modulation ON, ASK modulation
EUT channel	1, 26 ,52
EUT TX power level	TX level 0 (=max)

10.3 Results

Table 9: Peak output power measurement results

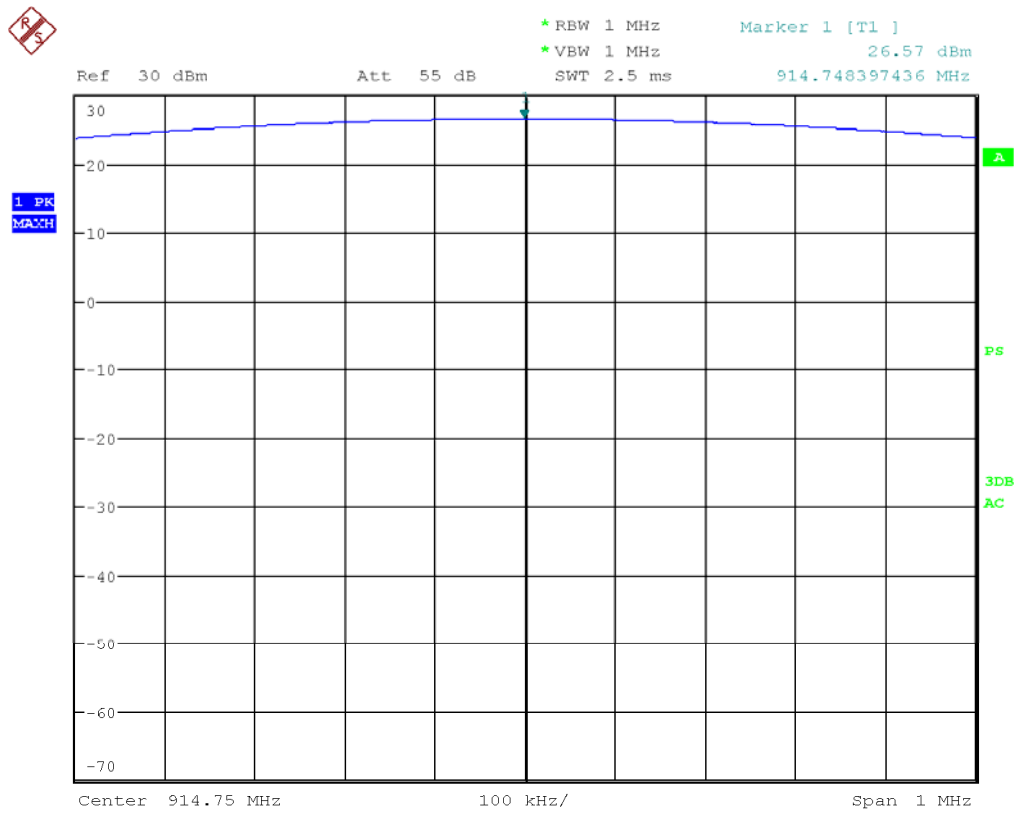
EUT Channel	Limit (dBm)	Measurement result (dBm)	Cable attenuation (dB)	Test result (dBm)
1	≤ 30	26,5	0,5	27,0
26		26,5		27,0
52		26,6		27,1

10.4 Screen shots



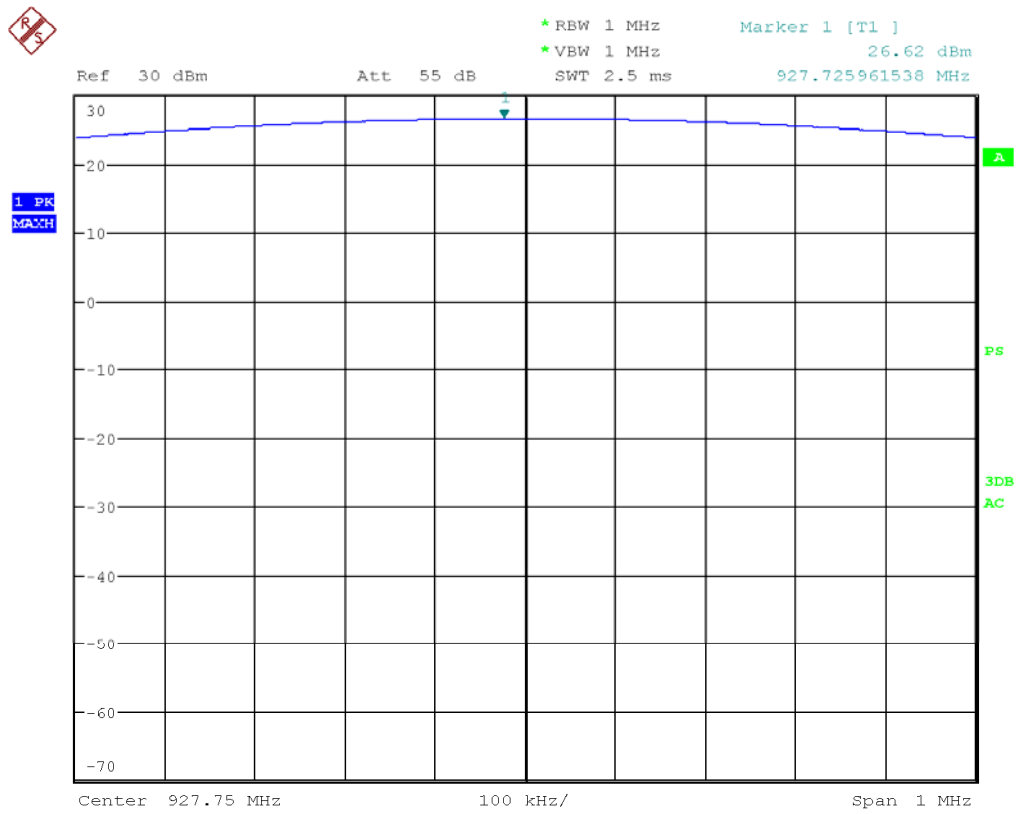
Date: 12.MAY.2011 13:51:22

Picture 20: Peak output power, channel 1



Date: 12.MAY.2011 13:52:26

Picture 21: Peak output power, channel 26



Date: 12.MAY.2011 13:53:24

Picture 22: Peak output power, channel 52

10.5 EUT operation mode

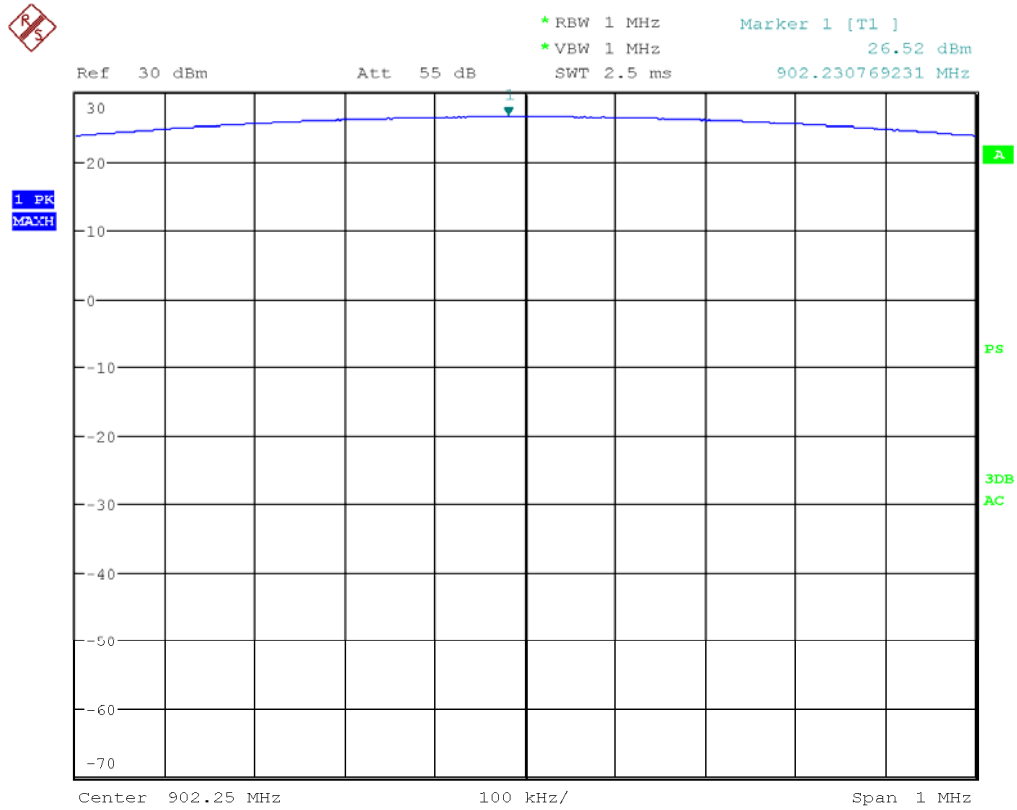
EUT operation mode	Modulation ON, PR-ASK modulation
EUT channel	1, 26 ,52
EUT TX power level	TX level 0 (=max)

10.6 Results

Table 10: Peak output power measurement results

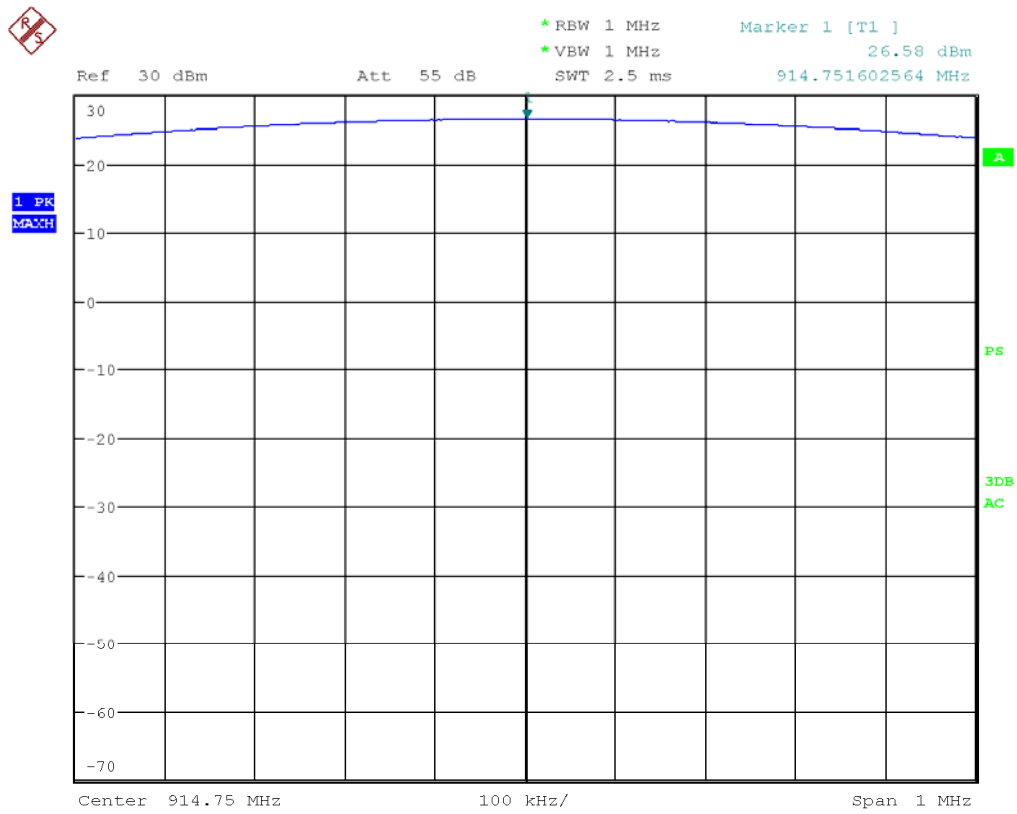
EUT Channel	Limit (dBm)	Measurement result (dBm)	Cable attenuation (dB)	Test result (dBm)
1	≤ 30	26,5	≤ 30	27,0
26		26,5		27,0
52		26,6		27,1

10.7 Screen shots



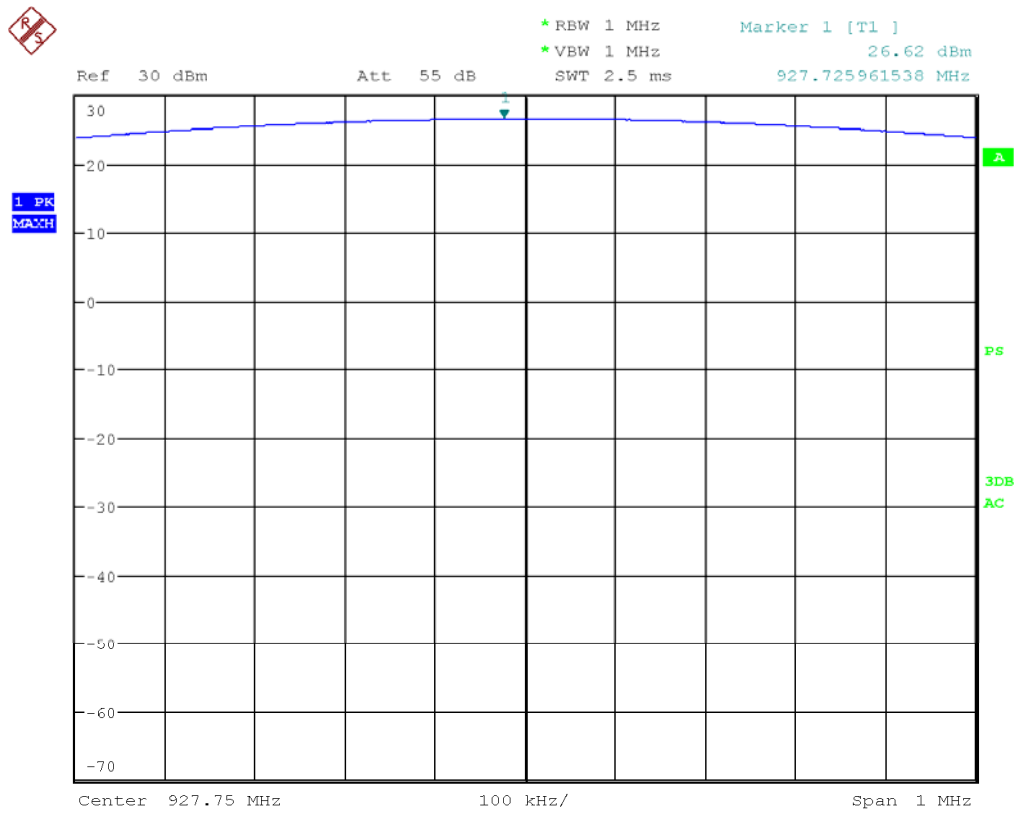
Date: 12.MAY.2011 13:54:41

Picture 23: Peak output power, channel 1



Date: 12.MAY.2011 13:55:33

Picture 24: Peak output power, channel 26



Date: 12.MAY.2011 13:56:25

Picture 25: Peak output power, channel 52

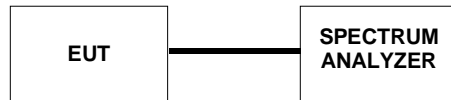
11 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Simo Ojanen		

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 26: 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 52. The measured power and power on the band edge was then compared.

11.2 Hopping enabled

11.2.1 EUT operation mode

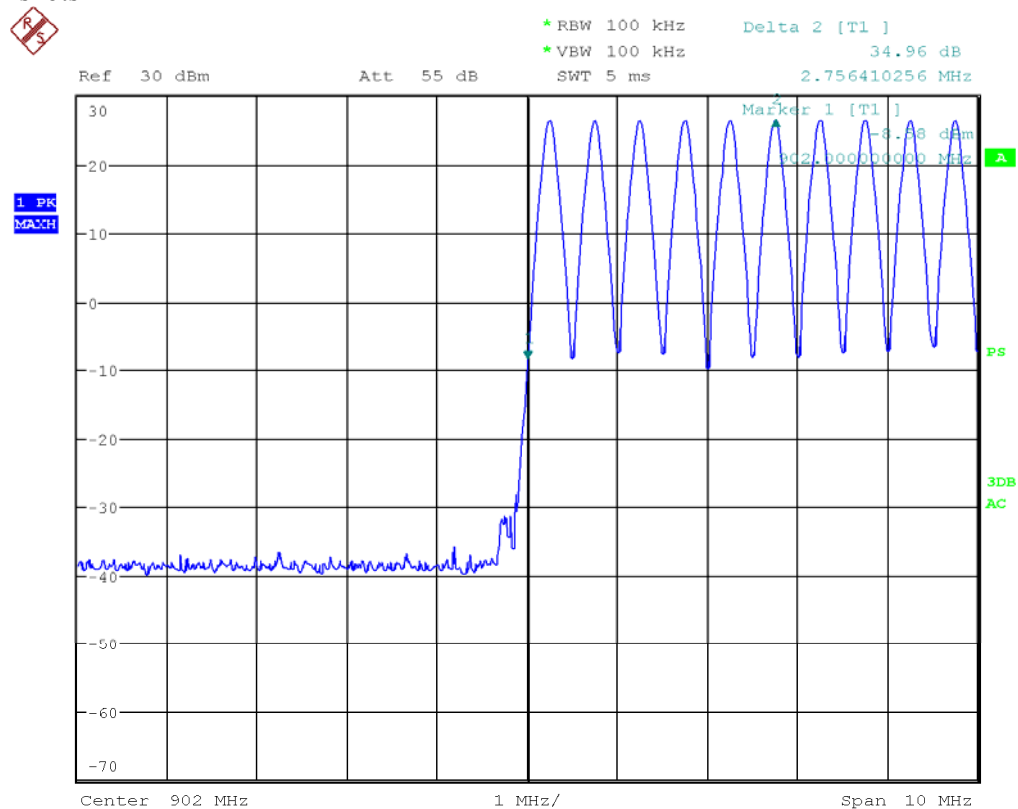
EUT operation mode	Modulation ON, ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

11.2.2 Results

Table 11: Band Edge measurement results

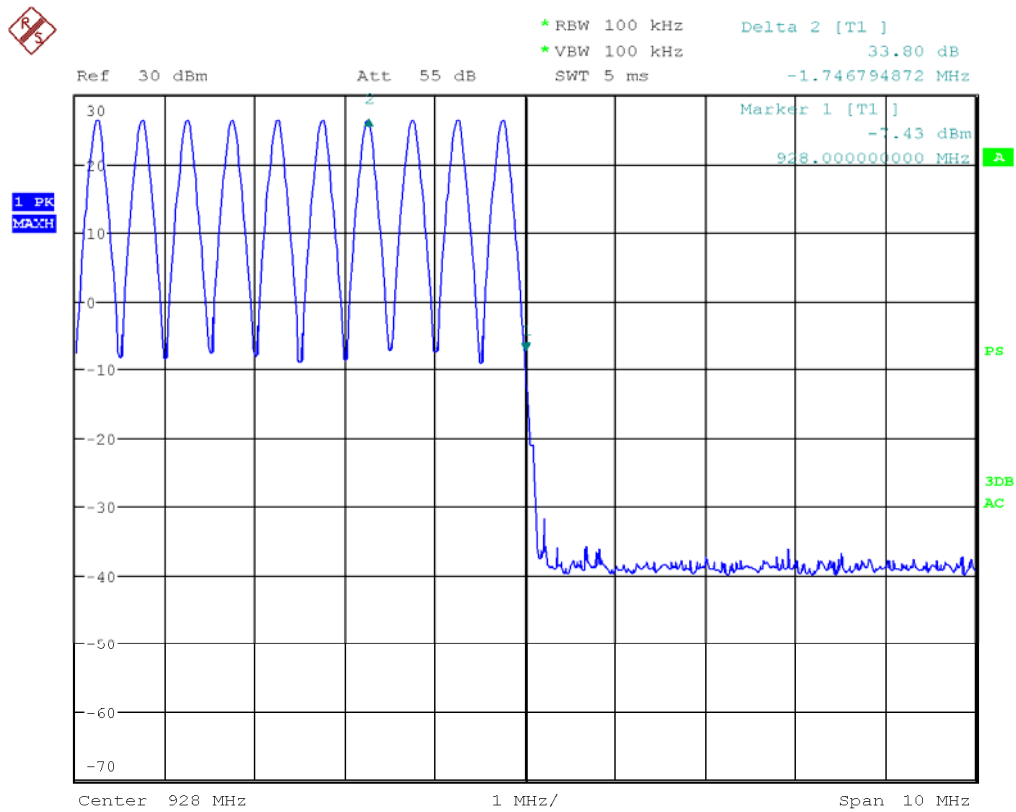
EUT Channel	Limit (dBc)	Test result (dBc)
1	≤ -20	-34,9
52		-33,8

11.2.3 Screen shots



Date: 12.MAY.2011 13:59:14

Picture 27: Band edge compliance, channel 1, hopping enabled



Date: 12.MAY.2011 14:00:53

Picture 28: Band edge compliance, channel 52, hopping enabled

11.2.4 EUT operation mode

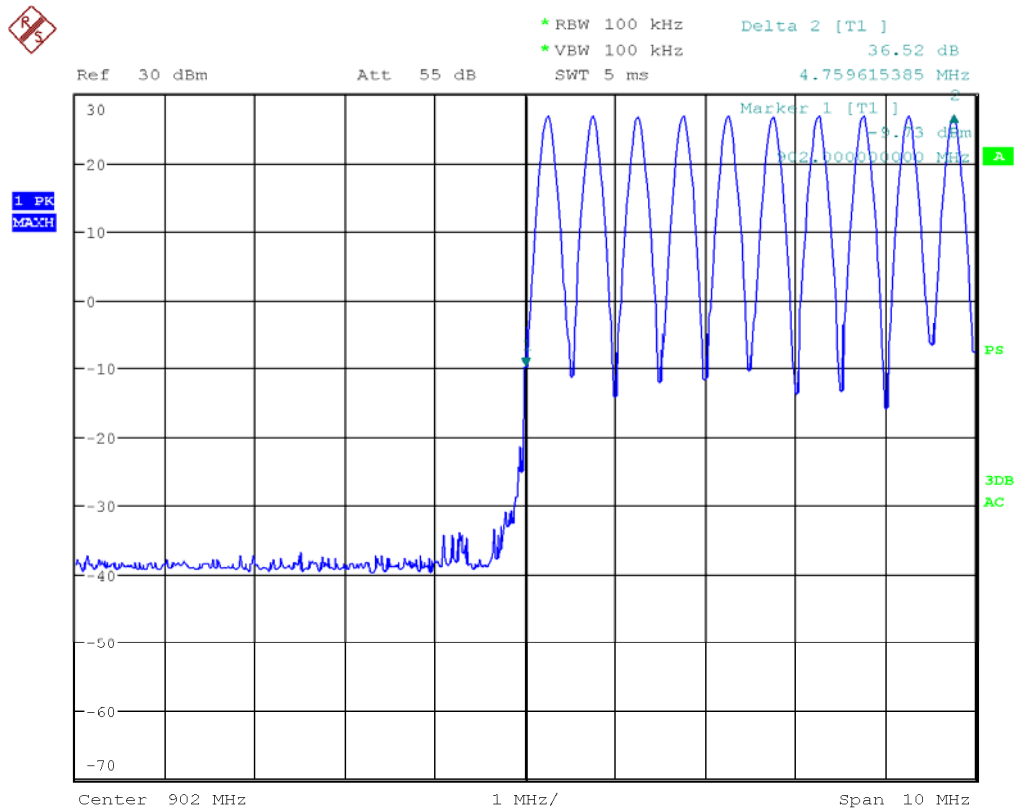
EUT operation mode	Modulation ON, PR-ASK modulation
EUT channel	Hopping
EUT TX power level	TX level 0 (=max)

11.2.5 Results

Table 12: Band Edge measurement results

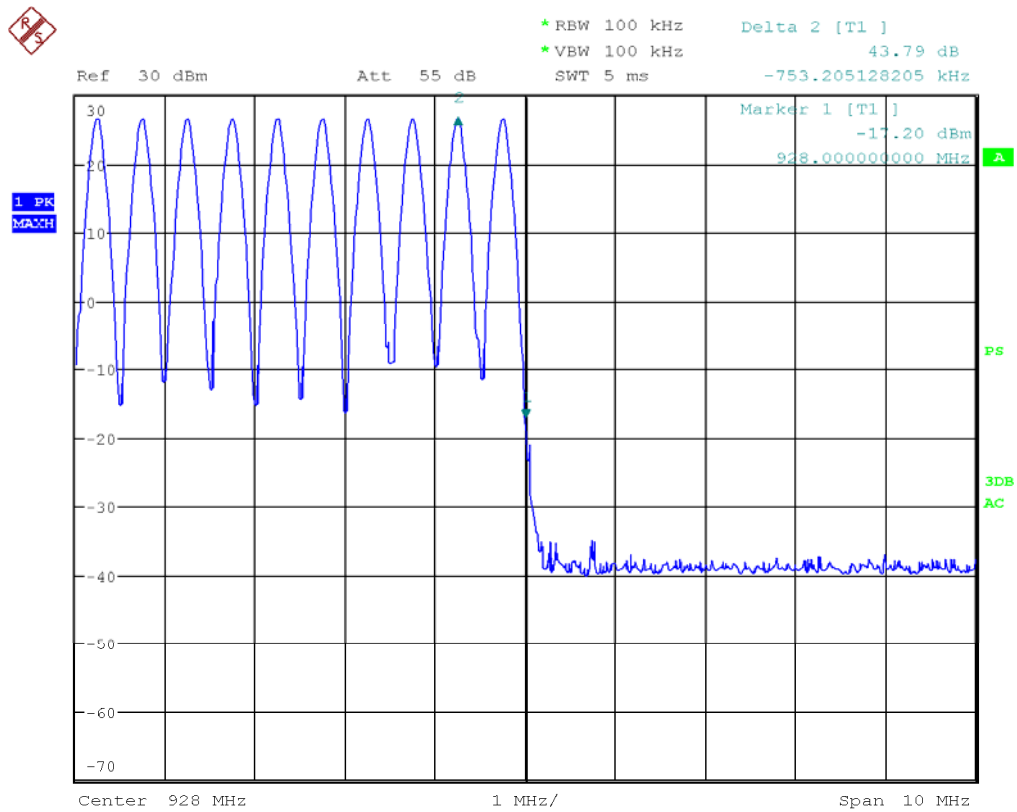
EUT Channel	Limit (dBc)	Test result (dBc)
1	≤ -20	-36,5
52		-43,7

11.2.6 Screen shots



Date: 12.MAY.2011 15:04:36

Picture 29: Band edge compliance, channel 1, hopping enabled



Date: 12.MAY.2011 15:05:53

Picture 30: Band edge compliance, channel 52, hopping enabled

11.3 Hopping disabled

11.3.1 EUT operation mode

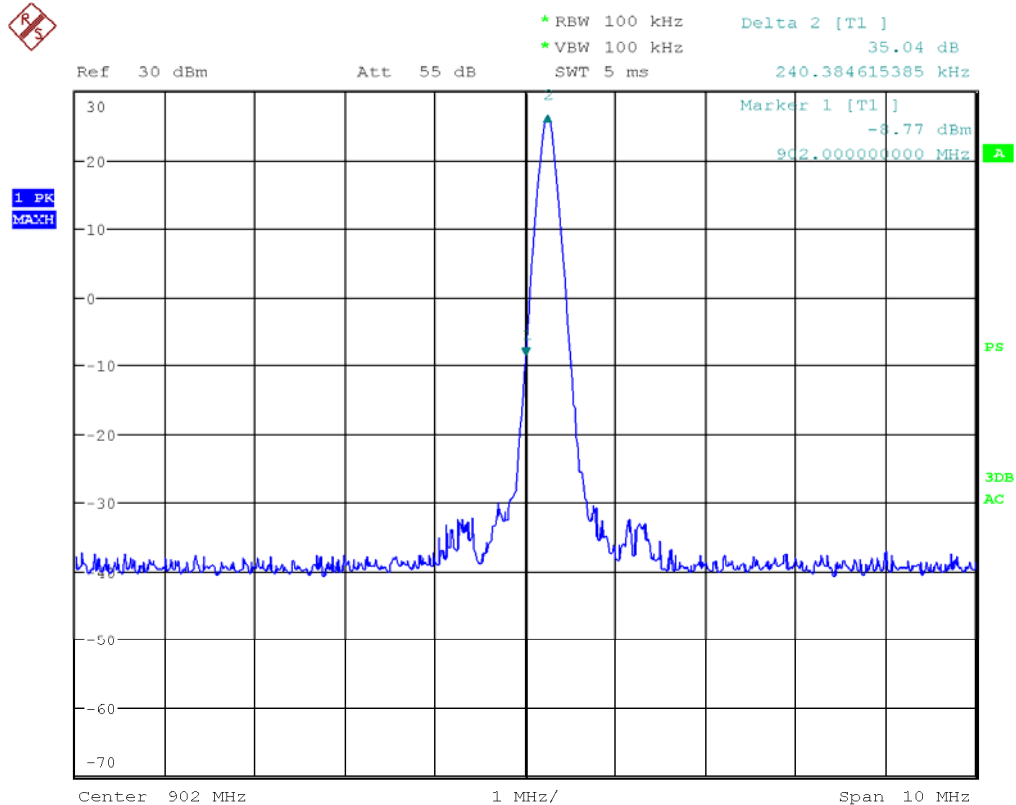
EUT operation mode	Modulation ON, ASK modulation
EUT channel	1 (902,25MHz) and 52 (927,75MHz)
EUT TX power level	TX level 0 (=max)

11.3.2 Results

Table 13: Band edge compliance measurement results

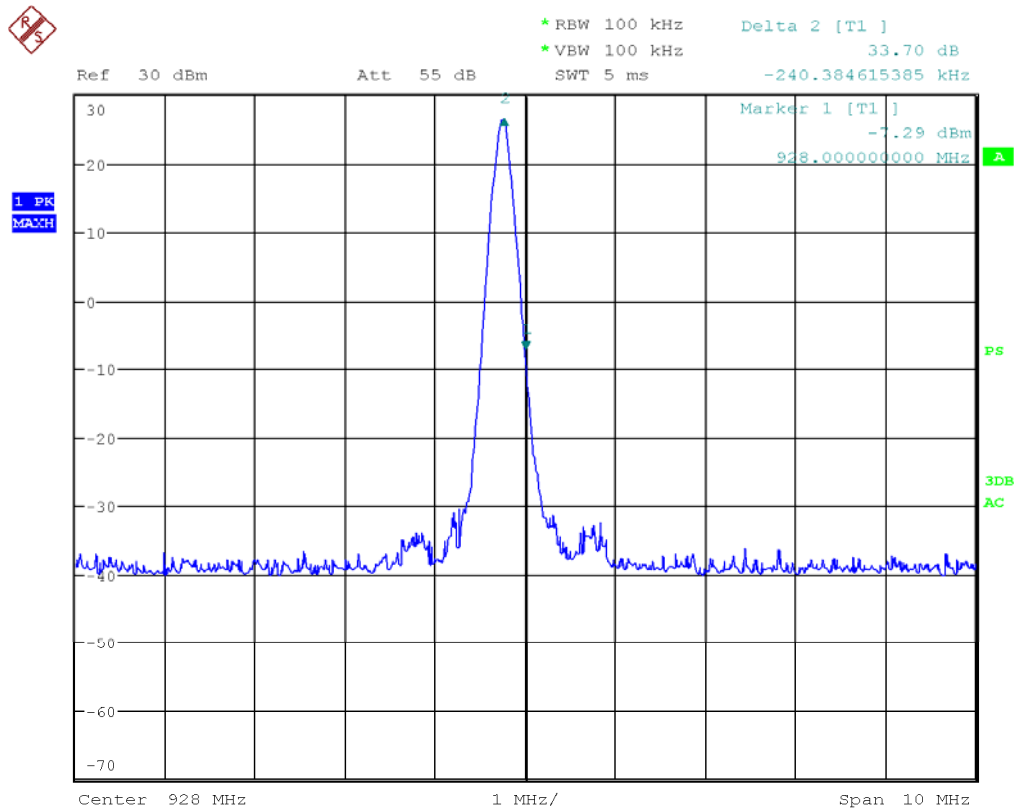
EUT Channel	Limit (dBc)	Test result (dBc)
1	≤ -20	-35,0
52		-33,7

11.3.3 Screen shots



Date: 12.MAY.2011 14:04:17

Picture 31: Band edge compliance, channel 0, hopping disabled



Date: 12.MAY.2011 14:03:11

Picture 32: Band edge compliance, channel 78, hopping disabled

11.3.4 EUT operation mode

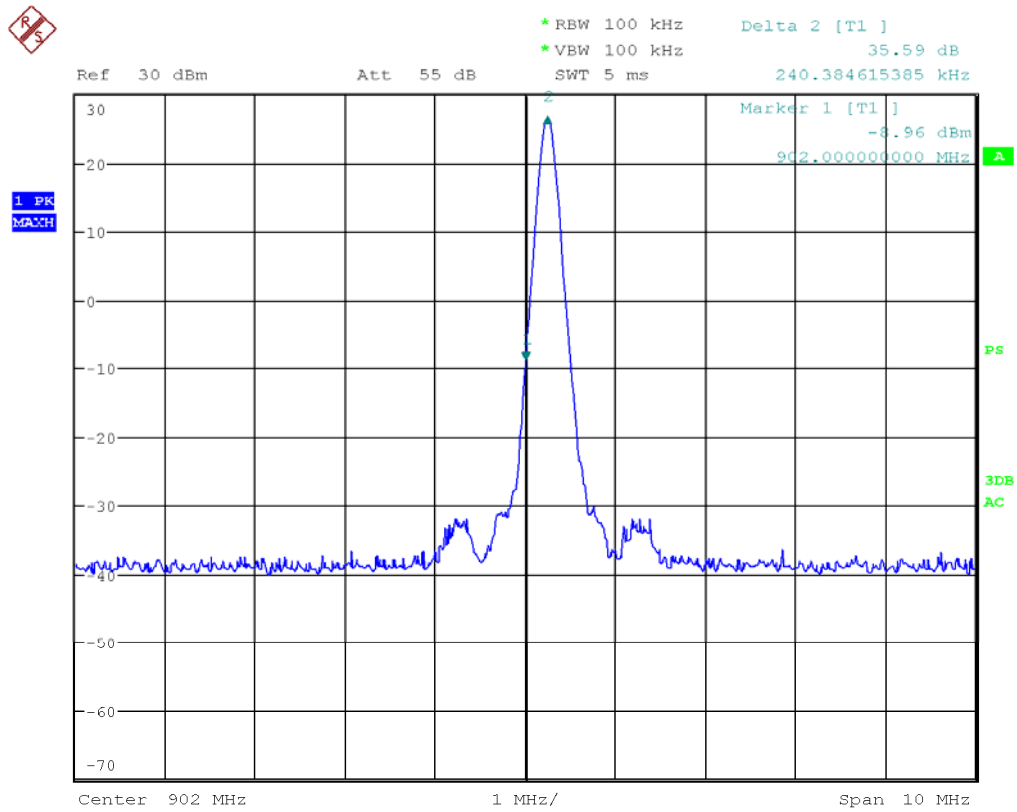
EUT operation mode	Modulation ON, PR-ASK modulation
EUT channel	1 (902,25MHz) and 52 (927,75MHz)
EUT TX power level	TX level 0 (=max)

11.3.5 Results

Table 14: Band edge compliance measurement results

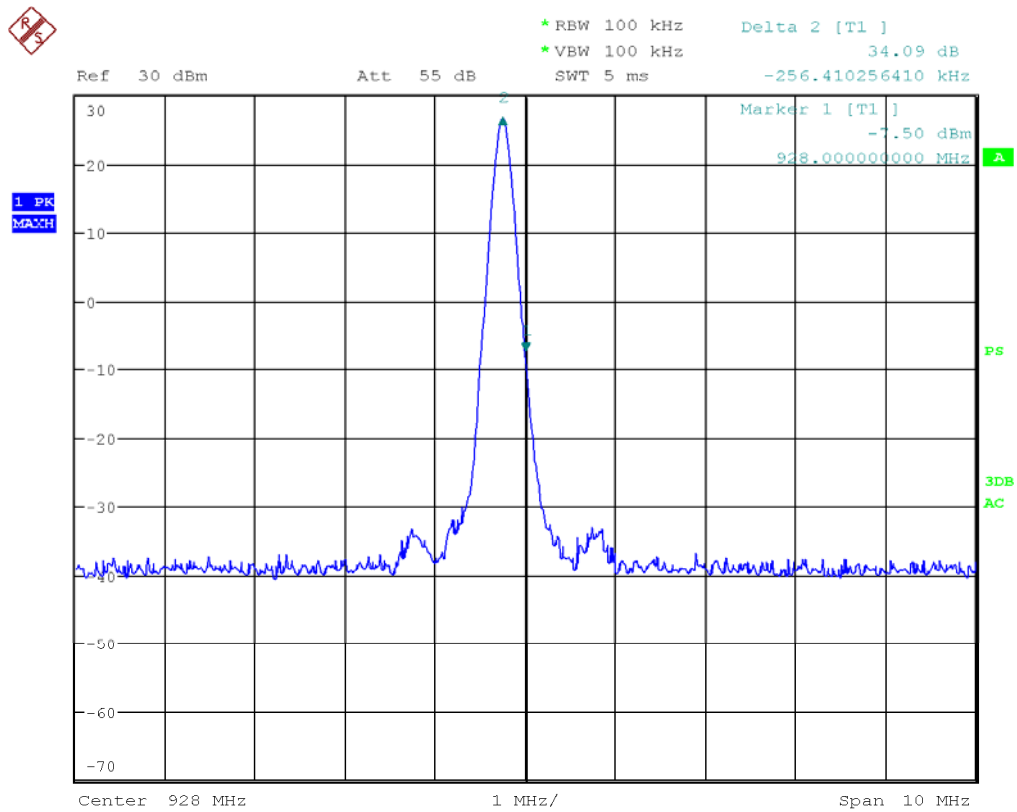
EUT Channel	Limit (dBc)	Test result (dBc)
1	≤ -20	-35,5
52		-34,0

11.3.6 Screen shots



Date: 12.MAY.2011 15:08:51

Picture 33: Band edge compliance, channel 0, hopping disabled



Date: 12.MAY.2011 15:07:25

Picture 34: Band edge compliance, channel 78, hopping disabled

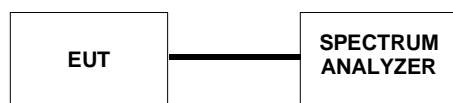
12 99 % BANDWIDTH

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part			
RSS-GEN section	4.6.1		
Measured by	Simo Ojanen		

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 35: Test setup for 99% bandwidth measurement

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

12.2 EUT operation mode

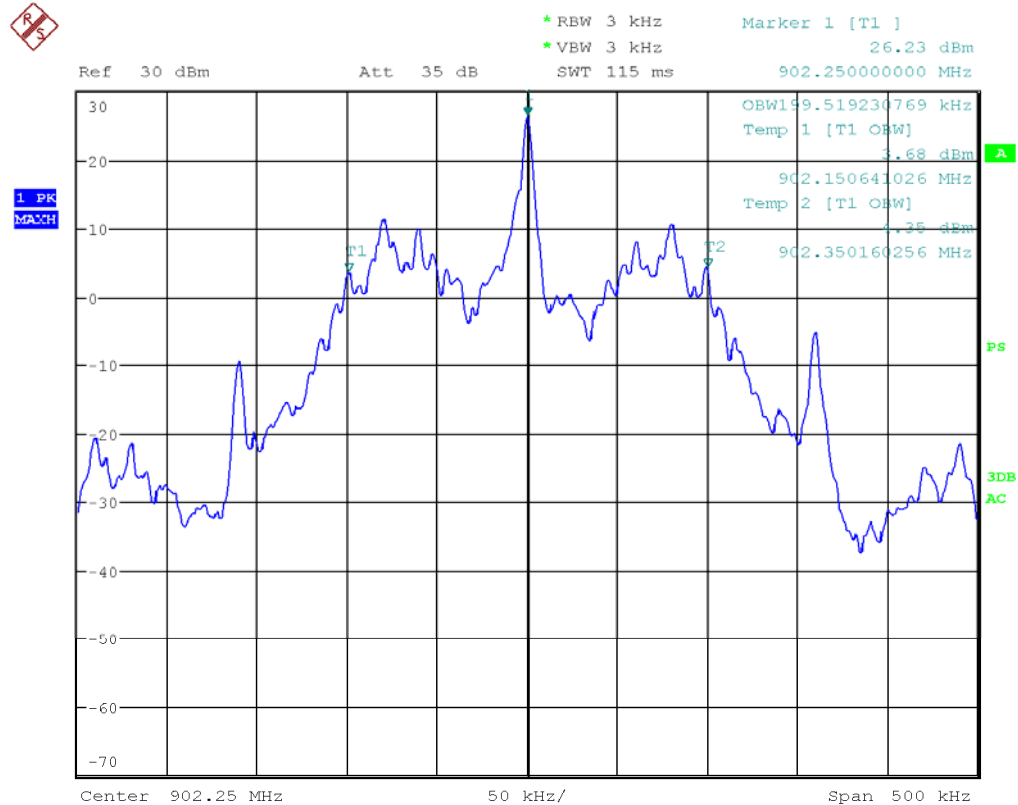
EUT operation mode	Modulation ON, ASK modulation
EUT frequency	ch1 (902,25 MHz), ch26 (914,75 MHz) and ch52 (927,75 MHz)
EUT TX power level	TX level 0 (=max)

12.3 Results

Table 15: 99% bandwidth measurement results

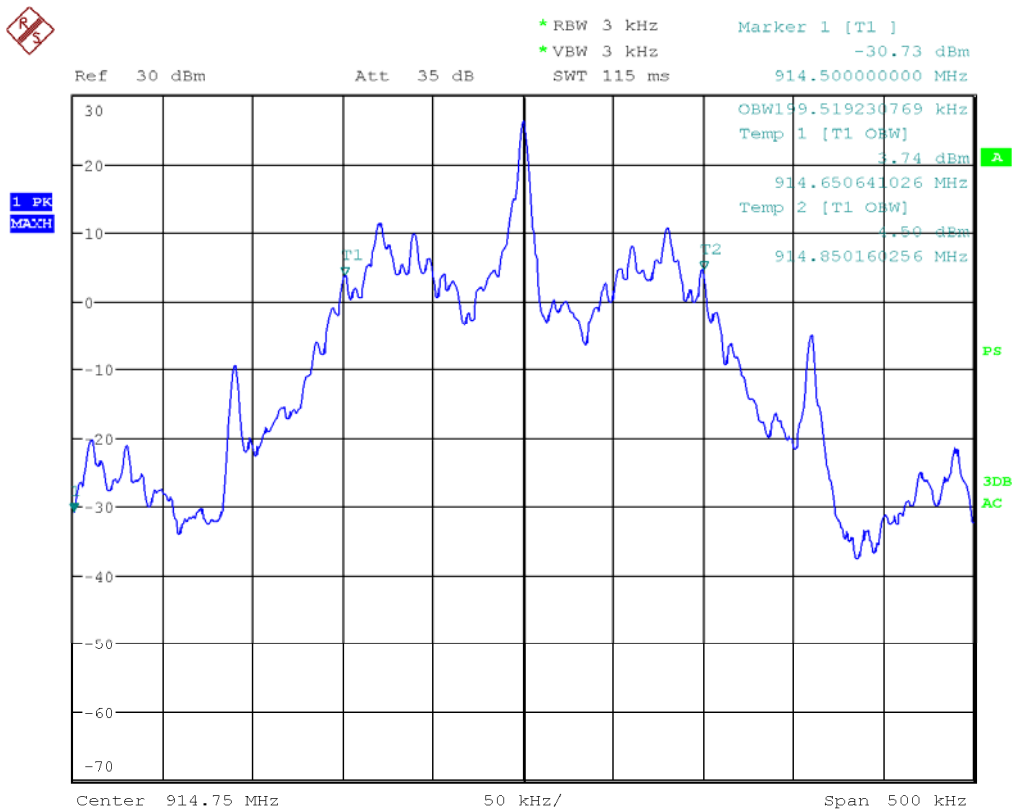
EUT Frequency MHz	Limit kHz	Measured value kHz
902,25	-	199,5
914,75	-	199,5
927,75	-	199,5

12.4 Screen shots



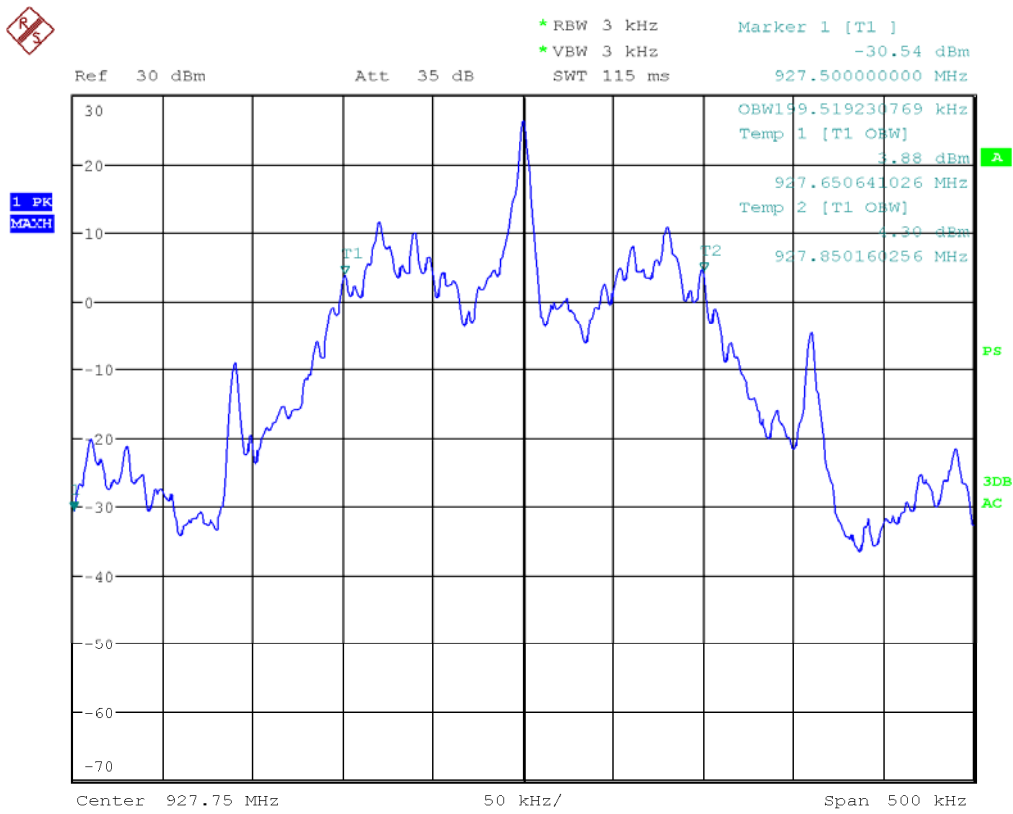
Date: 12.MAY.2011 15:29:14

Picture 36: 99% Bandwidth measurement result, ch 1



Date: 12.MAY.2011 15:32:16

Picture 37: 99% Bandwidth measurement result, ch 26



Date: 12.MAY.2011 15:33:24

Picture 38: 99% Bandwidth measurement result, ch 52

12.5 EUT operation mode

EUT operation mode	Modulation ON, PR-ASK modulation
EUT frequency	ch1 (902,25 MHz), ch26 (914,75 MHz) and ch52 (927,75 MHz)
EUT TX power level	TX level 0 (=max)

12.6 Results

Table 16: 99% bandwidth measurement results

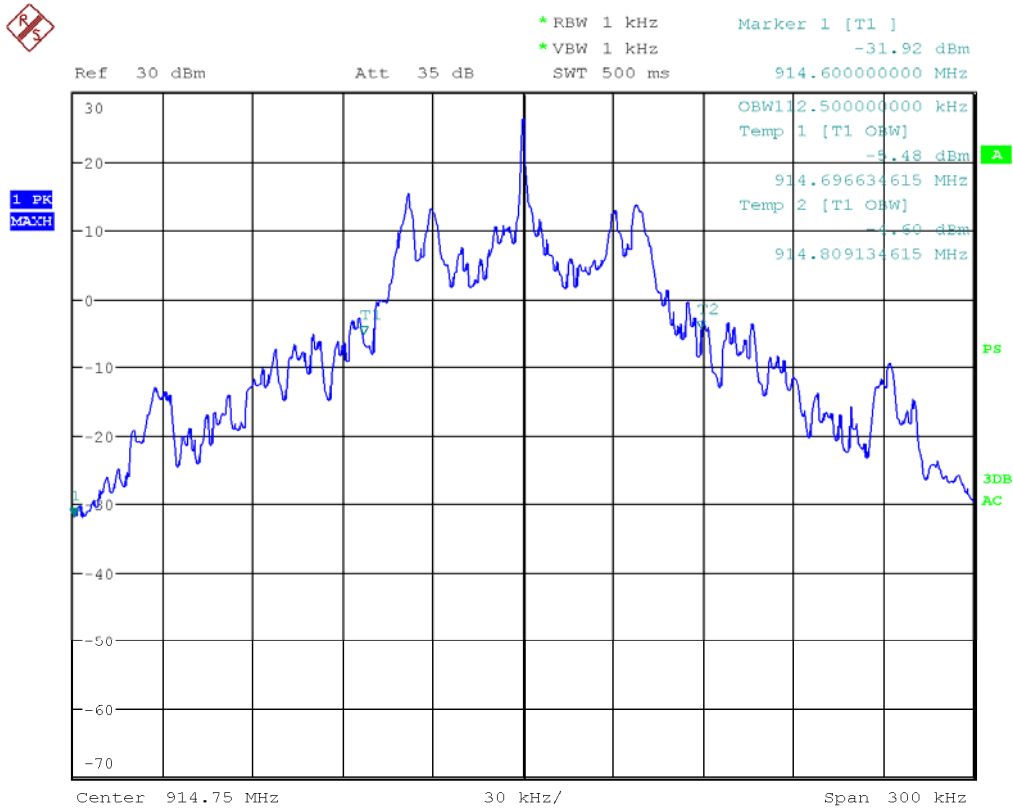
EUT Frequency MHz	Limit kHz	Measured value kHz
902,25	-	113,0
914,75	-	112,5
927,75	-	112,0

12.7 Screen shots



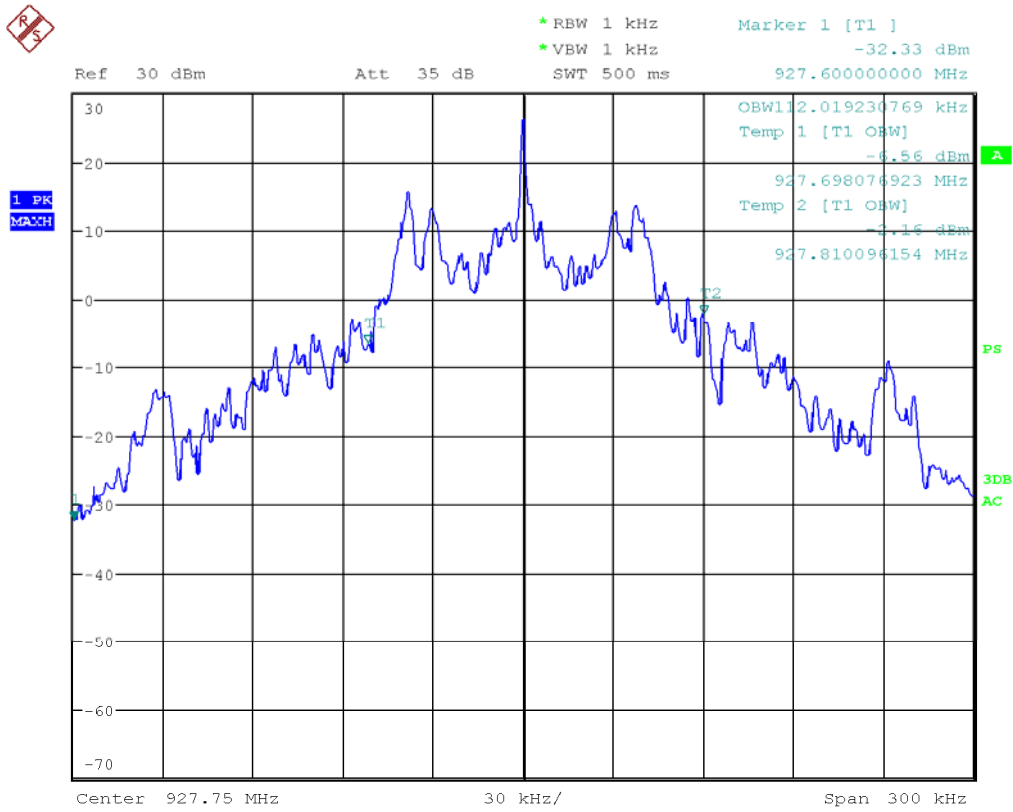
Date: 12.MAY.2011 15:36:21

Picture 39: 99% Bandwidth measurement result, ch 1



Date: 12.MAY.2011 15:38:19

Picture 40: 99% Bandwidth measurement result, ch 26



Date: 12.MAY.2011 15:39:58

Picture 41: 99% Bandwidth measurement result, ch 52

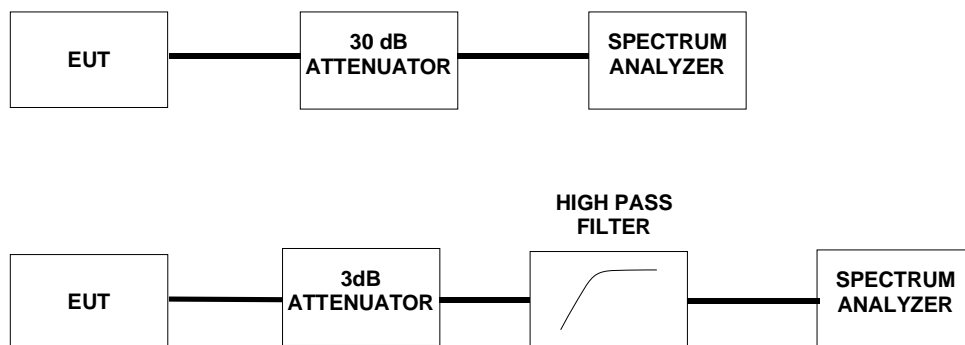
13 SPURIOUS RF CONDUCTED EMISSIONS

EUT	1		
Accessories	3, 4		
Temp, Humidity, Air Pressure	24 °C	26 %RH	1000 hPa
Date of measurement	May 12, 2011		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Simo Ojanen		

13.1 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 42: 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

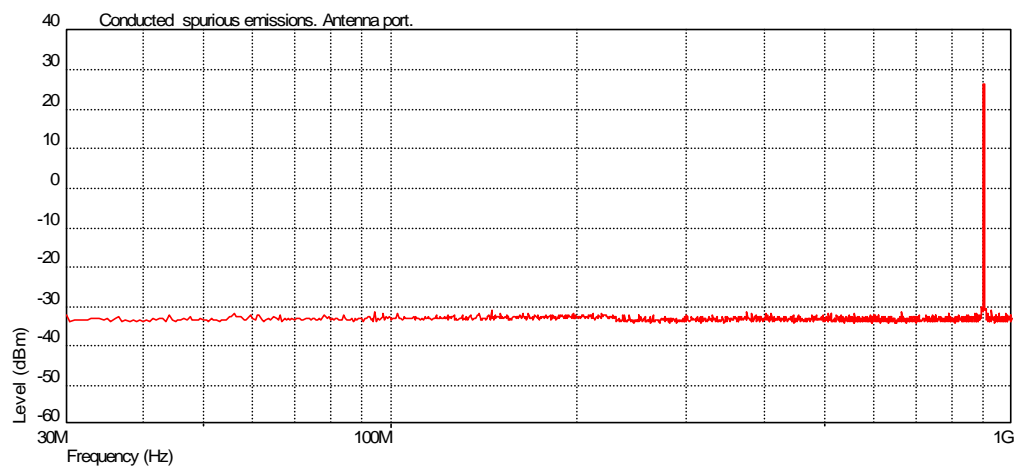
EUT operation mode	Continous transmission (CW)
EUT channel	1 (902,25 MHz), 26 (914,75 MHz) and 52 (927,75 MHz)
EUT TX power level	TX level 0 (=max)

13.3 Limit

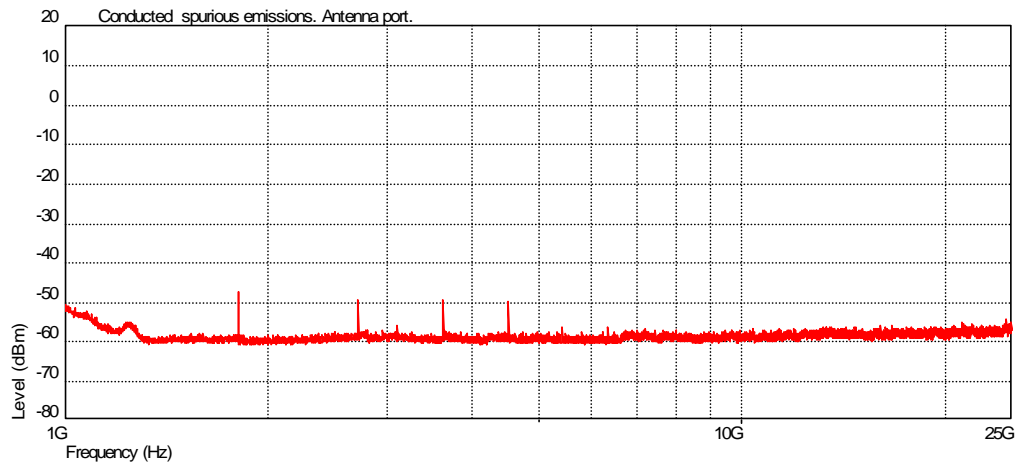
EUT Channel	Limit (dBc)
1	≤ -20
26	
52	

13.4 Results

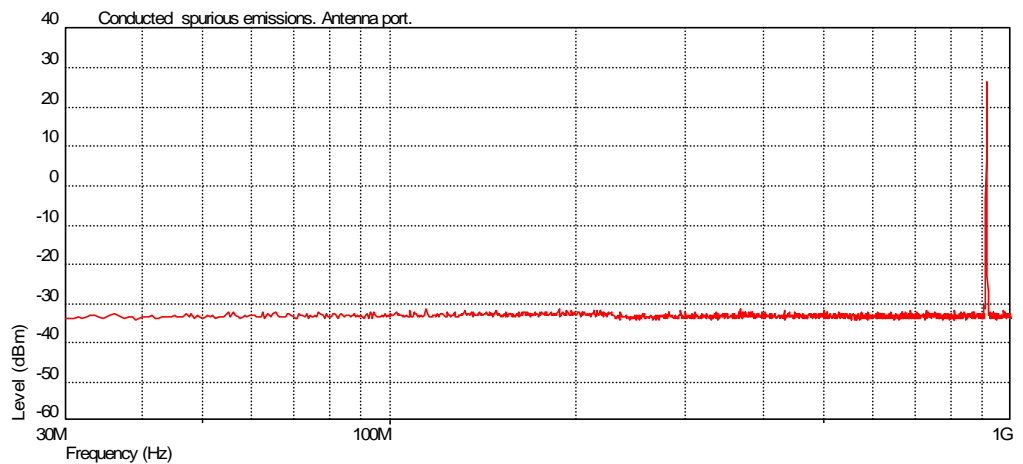
All spurious emissions measured were at least 50 dB below the carrier level.



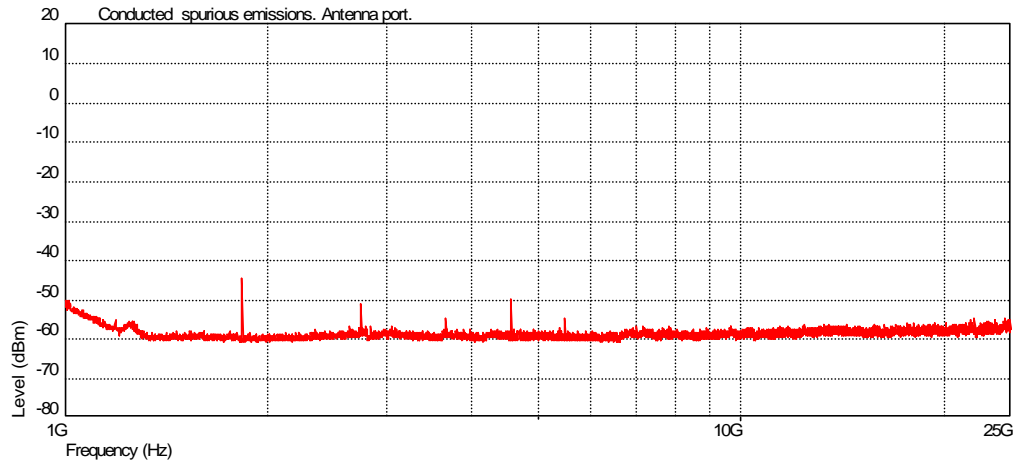
Picture 43: Conducted spurious emissions on antenna port, Channel 1, under 1GHz



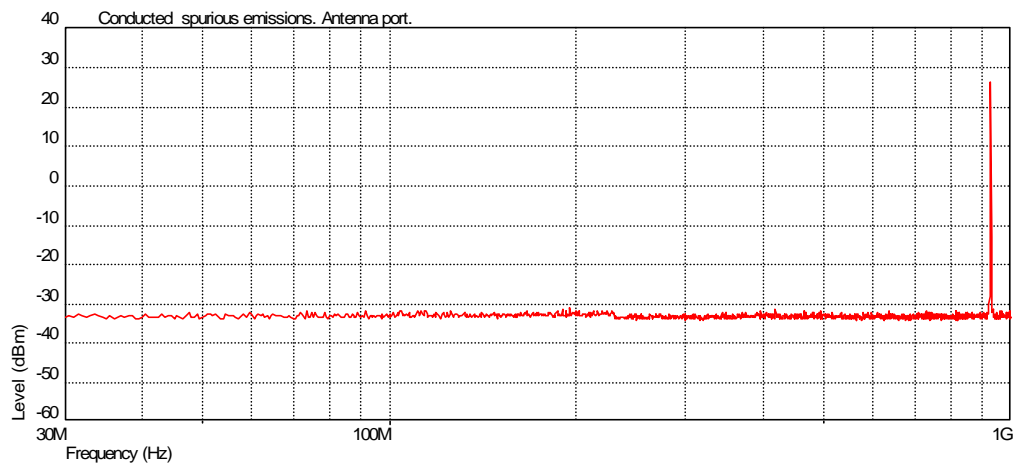
Picture 44: Conducted spurious emissions on antenna port, Channel 1 above 1GHz



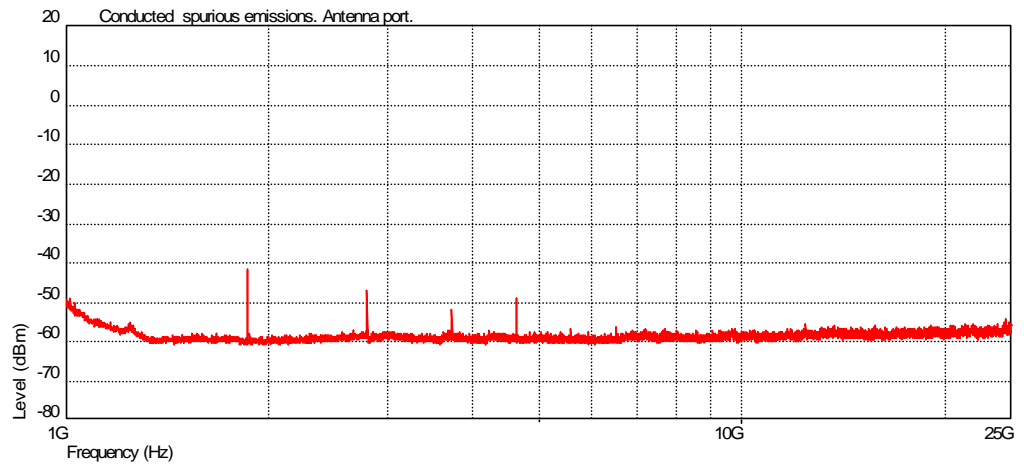
Picture 45: Conducted spurious emissions on antenna port, Channel 26, under 1GHz



Picture 46: Conducted spurious emissions on antenna port, Channel 26, above 1GHz



Picture 47: Conducted spurious emissions on antenna port, Channel 52, under 1GHz



Picture 48: Conducted spurious emissions on antenna port, Channel 52, above 1GHz

14 FIELD STRENGTH OF FUNDAMENTAL

EUT	1		
Accessories	2, 3, 4		
Temp, Humidity, Air Pressure	22 °C	35 %RH	996 hPa
Date of measurement	May 16, 2011		
FCC rule part			
RSS-210 section			
Measured by	Simo Ojanen		

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 1 MHz resolution bandwidth and 1 MHz video bandwidth and maximum hold function to record the maximum peak output power.

14.2 EUT operation mode

EUT operation mode	Continuous transmission, CW
EUT frequency	1 (902,25 MHz), 26 (914,75 MHz) and 52 (927,75 MHz)
EUT TX power level	TX level 0 (=max)

14.3 Results

Table 17: 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
902,25	109,7	20,5	130,2	Ver	1,2	357
914,75	109,9	20,6	130,6	Ver	1,2	0
927,75	109,8	20,7	130,5	Hor	1,2	0

15 RADIATED SPURIOUS EMISSIONS

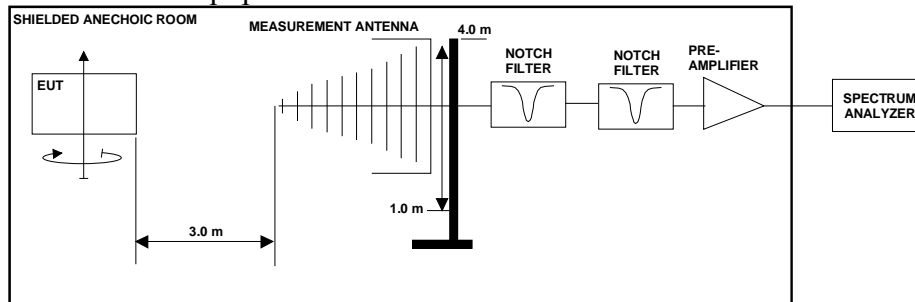
EUT	1		
Accessories	2, 3, 4		
Temp, Humidity, Air Pressure	23 °C	44 %RH	997 hPa
Date of measurement	May 12-23, 2011		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Simo Ojanen		

15.1 Test setup

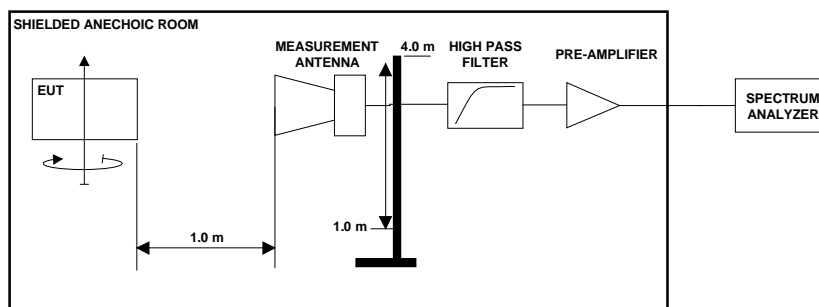
PC software was used to:

- set the EUT channel (1 – 52)
- 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 49: Test setup for radiated spurious emissions measurement
30 MHz - 1 GHz frequencies



Picture 50: 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 RFID mode	Continuous transmission, CW
EUT RFID channel	1 (902,25 MHz), 26 (914,75 MHz) and 52 (927,75 MHz)
EUT TX power level	max

15.4 Limit

Table 18: 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.

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 19: Emission levels PEAK (QP) detector, RFID channel 1

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	Ant Pol.	Ant height m
43,1	2,7	16,5	19,2	20,7	Ver	1,5
44,2	6,0	15,9	22,0	17,9	Ver	1,5
44,5	6,3	15,8	22,1	17,8	Ver	1,0
46,5	7,7	14,8	22,5	17,4	Ver	2,9
48,1	17,9	14,1	31,6	8,3	Ver	1,0
931,0	18,9	20,8	39,7	6,2	Ver	1,1
950,0	18,6	20,9	39,5	6,4	Ver	1,1
1804,5	71,7	-26,6	45,1	28,9	Ver	1,0
2706,8	70,2	-21,6	48,6	25,7	Ver	1,0
3609,0	59,9	-20,0	39,9	34,1	Hor	1,0

Table 20: Emission levels PEAK (QP) detector, RFID channel 26

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	Ant Pol.	Ant height m
48,1	15,3	14,1	29,4	-10,5	Ver	1,1
894,7	19,1	20,5	39,6	-6,3	Ver	1,2
934,7	19,9	20,8	40,7	-5,2	Ver	1,2
946,6	17,7	20,9	38,6	-7,3	Ver	1,1
959,6	15,9	21,0	36,9	-9,0	Ver	1,2
1829,4	63,9	-26,4	37,5	36,5	Ver	1,0
2744,2	64,0	-21,5	42,5	31,5	Ver	1,0
3659,0	58,9	-19,9	39,0	35,0	Hor	1,0

Table 21: Emission levels PEAK (QP) detector, RFID channel 52

Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	Ant Pol.	Ant height m
48,0	14,7	14,1	28,8	-11,1	Ver	1,30
907,7	18,9	20,6	39,5	-6,4	Ver	1,20
913,6	16,5	20,6	37,1	-8,8	Ver	1,30
943,2	17,1	20,8	37,9	-8,0	Ver	1,10
952,3	17,0	20,9	38,0	-7,9	Ver	1,10
1855,5	71,0	-26,2	44,8	29,2	Hor	1,0
2783,3	64,7	-21,3	43,4	30,5	Ver	1,0
3710,9	54,8	-19,8	35,0	39,0	Hor	1,0
5566,4	49,4	-14,7	34,7	39,3	Hor	1,0

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

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

With PR-ASK modulation, measured transmission time in clause 8 was 57,93 ms

Therefore,

$$\begin{aligned} \text{Average level} &\leq \text{Peak level} + 20 \log (57,93\text{ms}/100\text{ms}) \\ \text{Average level} &\leq \text{Peak level} - 4,74 \text{ dB} \end{aligned}$$

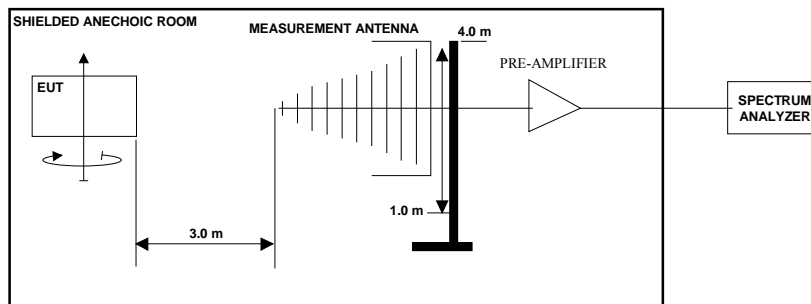
All peak levels are under $54 \text{ dB}\mu\text{V}/\text{m} + 4,74 \text{ dB} = 58,74 \text{ dB}\mu\text{V}/\text{m}$

16 RECEIVER RADIATED EMISSION

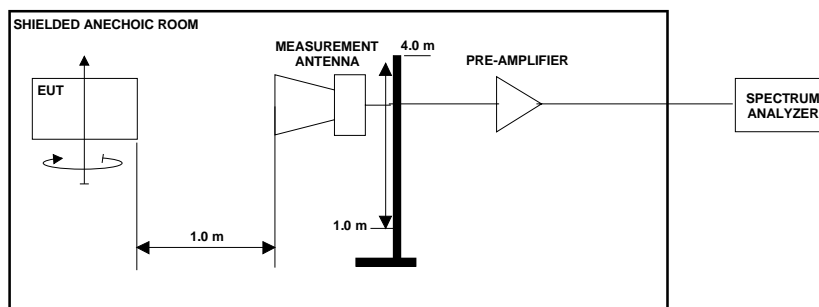
EUT	1		
Accessories	2, 3, 4		
Temp, Humidity, Air Pressure	22 °C	35 %RH	996 hPa
Date of measurement	May 16-17, 2011		
FCC rule part	§15.109		
RSS-GEN section	7.2.5		
ICES-003 section	5.5		
Measured by	Simo Ojanen		

16.1 Test setup

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



Picture 51: Test setup for radiated spurious emissions measurement
30 MHz - 1 GHz frequencies



Picture 52: Test setup for radiated spurious emissions measurement
1 GHz – 5 GHz frequencies

16.2 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.

16.3 EUT operation mode

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

16.4 Limit

Table 22: 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.

16.5 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 23, 24 and 25.

Table 23: Radiated emissions using Quasi peak detector

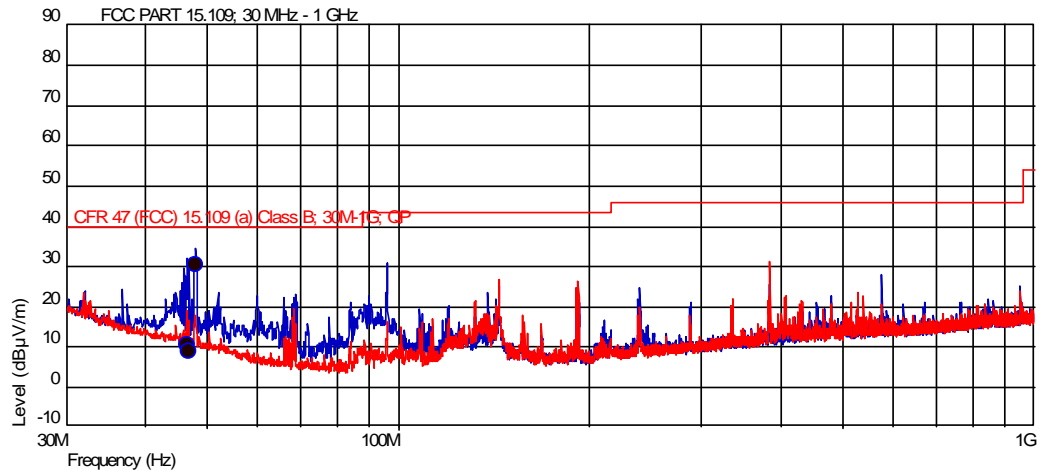
Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	Ant Pol.	Ant height	TT angle
46,5	-4,2	14,8	10,6	29,3	Ver	1,40	5
46,9	-5,9	14,6	8,7	31,2	Ver	2,20	140
48,0	16,2	14,1	30,4	9,5	Ver	1,00	316

Table 24: Radiated emissions using Peak detector

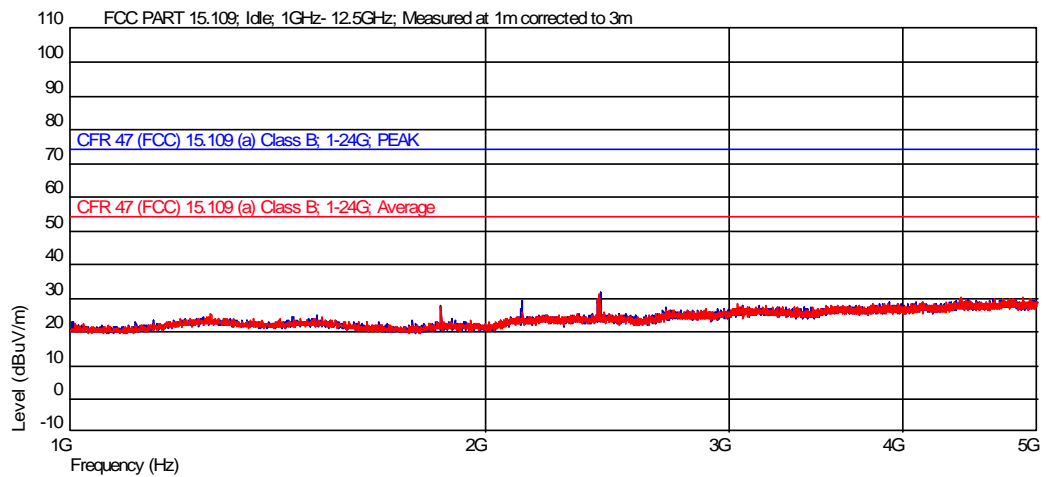
Freq MHz	Measured Value dB μ V	Correction Factor dB	Result dB μ V/m	Marginal dB	Ant Pol.	Ant height	TT angle
N/A							

Table 25: Radiated emissions using Average detector

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



Picture 53: radiated emission results, 30 – 1000 MHz,
Red= horizontal polarization, blue = vertical polarization



Picture 54: radiated emission results, 1 – 12,4 GHz,
Red= horizontal polarization, blue = vertical polarization

17 TEST EQUIPMENT

17.1 Conducted measurements

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

17.2 Radiated measurements

DEVICE	MANUFACTURER	SPKTT	SERIAL
Spectrum analyser	Agilent E7405A	131	MY42000072
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 8.40.0

18 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

100328B-RF_PHOTOS.doc