

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

PRODUCT:

Test item description:	Radio remote control
Trade Mark:	-
Model/Type reference:	DRC-DC6
Serial number:	PROTOTYPE
Customer:	SCANRECO Industrielektronik AB BOX 47144 / Årsta Skolgränd 22 S-100 74 Stockholm Sweden
Contact person:	-
Manufacturer:	SCANRECO Industrielektronik AB BOX 47144 / Årsta Skolgränd 22 S-100 74 Stockholm Sweden

DATE: 17.7.2009

TESTED BY: 
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APPROVED BY: 
Matti Virkki ; Test engineer

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1 LABORATORY INFORMATION

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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 (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
15.247, d	A8.5	Spurious RF conducted emissions	PASS
15.247, d	A8.5	Spurious radiated emissions	PASS
	RSS-GEN 4.4.1	99% bandwidth	PASS

Receiver measurements

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

PASS Pass

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	Radio remote control	DRC-DC6	-	1**
	Radio remote control	DRC-DC6	-	2 *
Accessories	-	-	-	3
	-	-	-	4

Notes:

- * Antenna replaced with SMA-connector
- ** Continuous carrier

3.1 EUT description

EUT is handheld transmitter operating in the 900MHz ISM frequency band. The system supports only simplex communication.

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 16.

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 1

RSS-210, Issue 7

CISPR 22, 2002

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	-		
Temp, Humidity, Air Pressure	25 °C	20 RH%	1004 hPa
Date of measurement	May 12, 2009		
FCC rule part	15.247, a 1		
RSS-210 section	A8.1 (2)		
Measured by	Simo Ojanen		

6.1 Test setup and testing method



Picture 1: Test setup for carrier frequency separation measurement

Spectrum analyzer was set to sweep the EUT operating band 902 – 928 MHz. 10 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

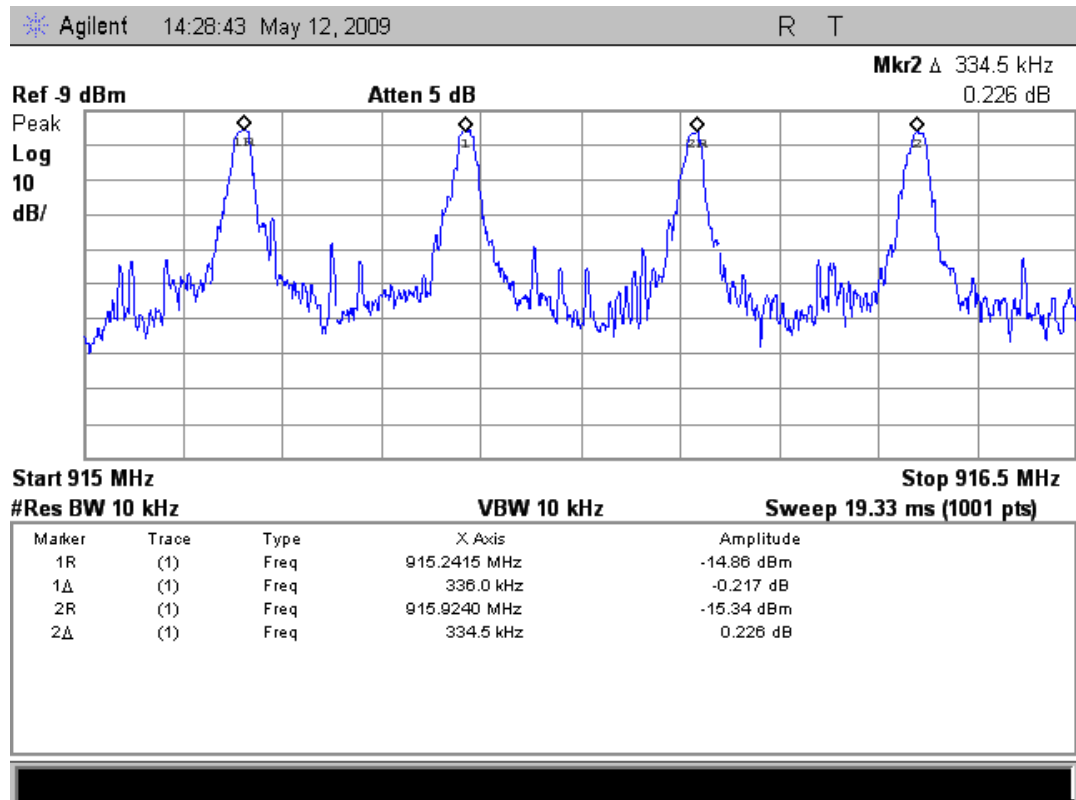
EUT operation mode	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Hopping
EUT TX power level	max

6.3 Results

Table 1: Carrier frequency separation measurement results

Limit	Result
>25 kHz	334,5 kHz

6.4 Screen shots



Picture 2: Carrier frequency separation.

7 NUMBER OF HOPPING FREQUENCIES

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	25 °C	20 RH%	1004 hPa
Date of measurement	May 12, 2009		
FCC rule part	15.247, a 1 iii		
RSS-210 section	A8.1 (4)		
Measured by	Simo Ojanen		

7.1 Test setup



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

Spectrum analyzer was set to sweep the EUT operating band 902 – 928 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

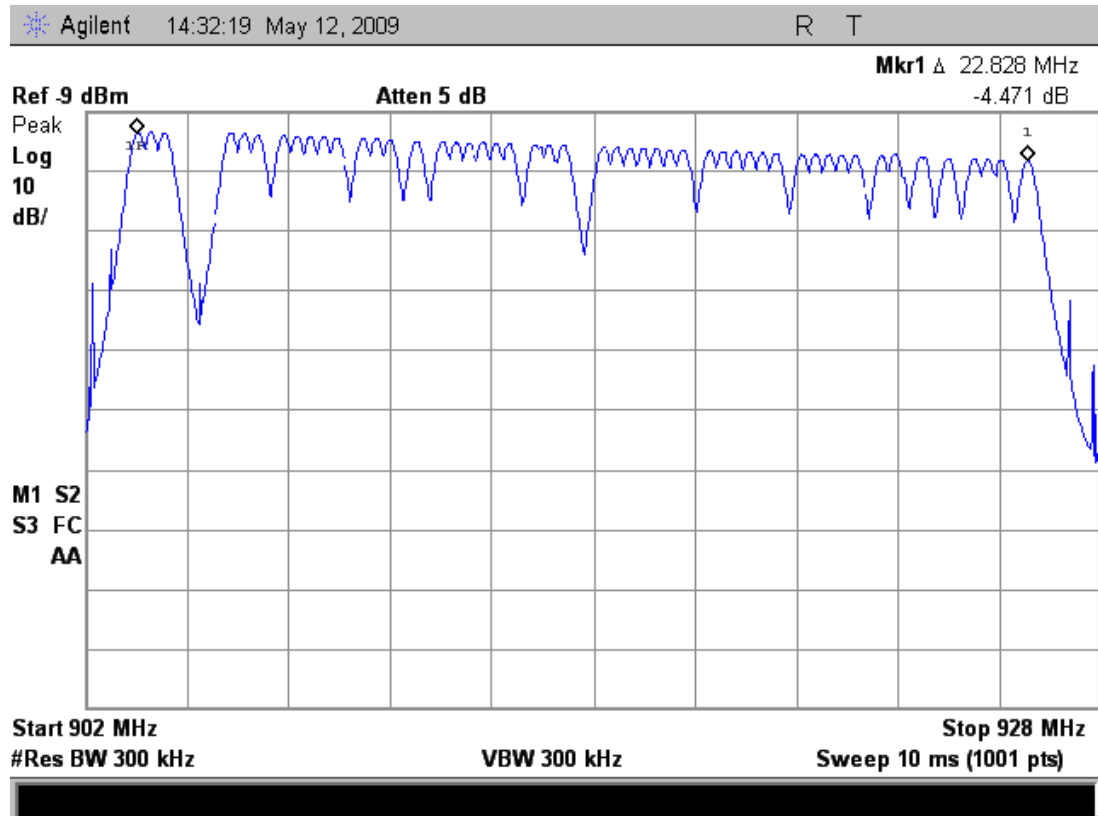
EUT operation mode	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Hopping
EUT TX power level	max

7.3 Results

Table 2: Number of hopping frequencies measurement results

Limit	Result
≥ 50	50

7.4 Screen shots

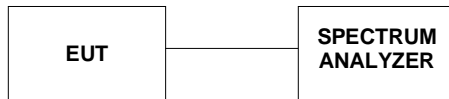


Picture 4: Number of hopping frequencies measurement

8 TIME OF OCCUPANCY

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	25 °C	20 RH%	1004 hPa
Date of measurement	May 12, 2009		
FCC rule part	15.247, a 1 iii		
RSS-210 section	A8.1 (4)		
Measured by	Simo Ojanen		

8.1 Test setup and testing method



Picture 5: Test setup for conducted RF output power 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	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Hopping
EUT TX power level	max

8.3 Results

Table 3: Time of occupancy during connection mode measurement results

Limit	Result
≤ 0,4 s over 20 s period	0,0616 s

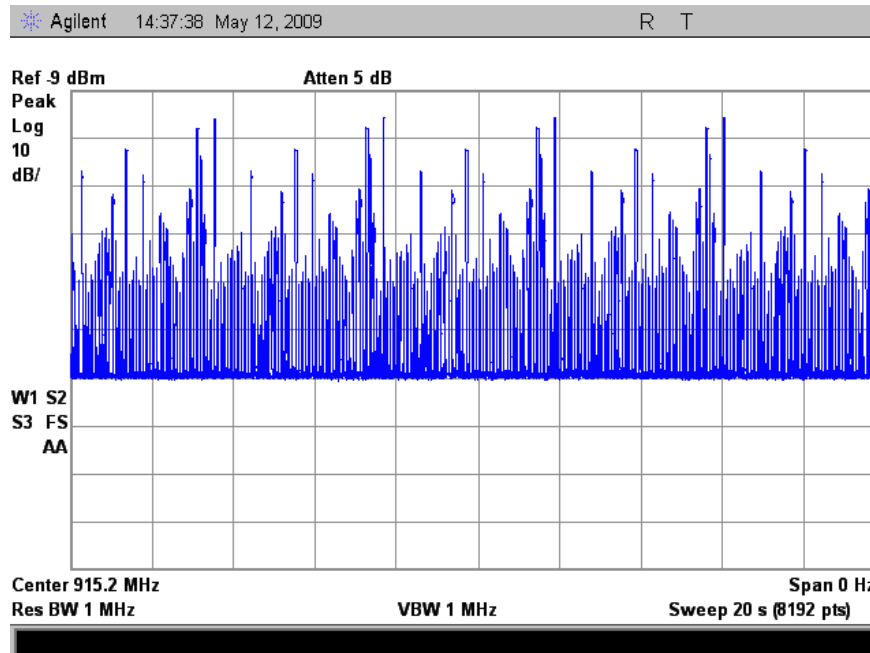
Limit:

EUT's 20 dB bandwidth is less than 250 kHz. As defined in 15.247, a 1 i, the limit for time of occupancy is 0.4s within a 20 second period.

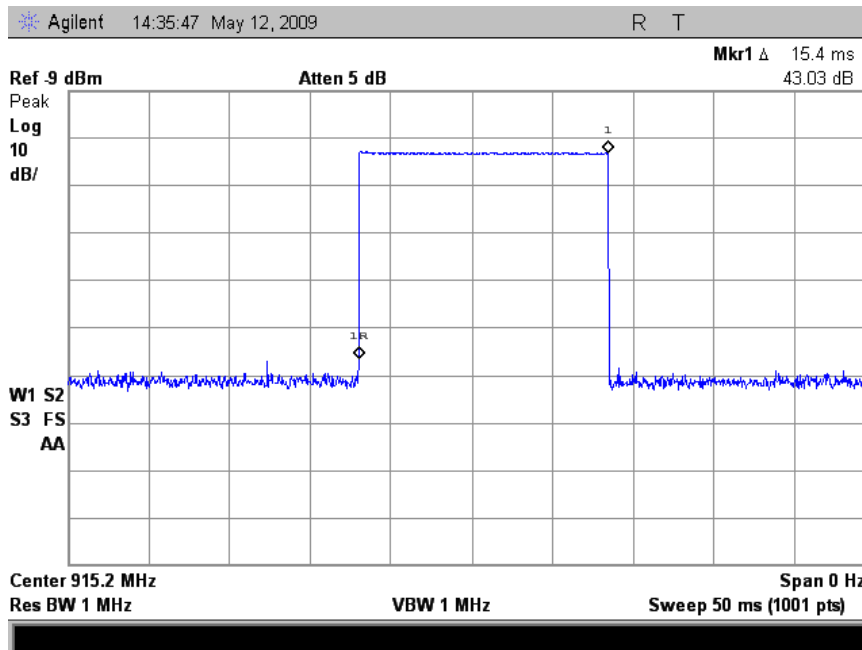
Results:

In measurement time of 20 s, total of 4 transmissions occurred. The duration of one transmission was 15,4 ms. Based on these measurements the transmitter operated $4 * 15,4 \text{ ms} = 0,0616 \text{ s}$ during the 20 s period

8.4 Screen shots



Picture 6: Number of transmissions on connection state



Picture 7: Duration of one transmission on connection state

9 20 dB BANDWIDTH

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	23 °C	31 RH%	993 hPa
Date of measurement	Jul 7, 2009		
FCC rule part	15.247, a		
RSS-210 section	A8.1 (1)		
Measured by	Päivi Punta		

9.1 Test setup and measurement method



Picture 8: Test setup for conducted RF output power measurement

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

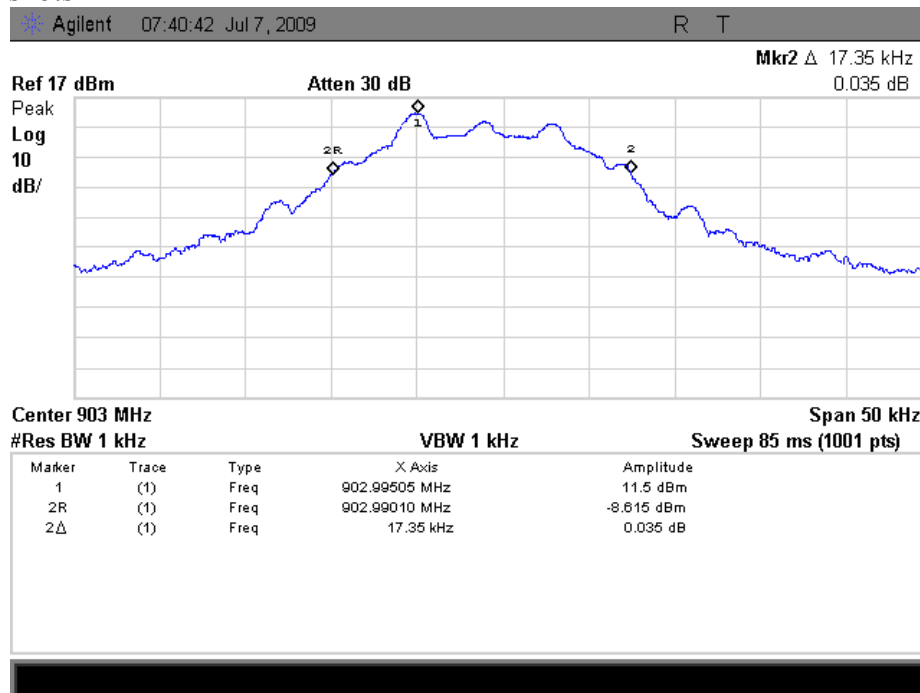
EUT operation mode	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Low, middle, high
EUT TX power level	max

9.3 Results

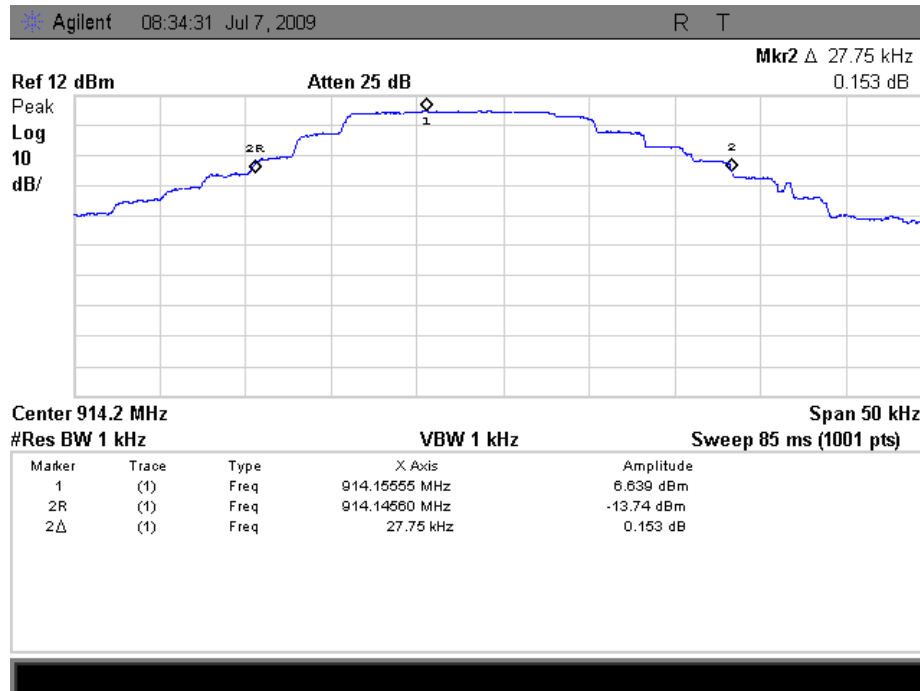
Table 4: 20dB bandwidth measurement results

EUT Channel	Limit (kHz)	Measured value (kHz)
Low	≤ 500	17,35
Middle		27,75
High		17,40

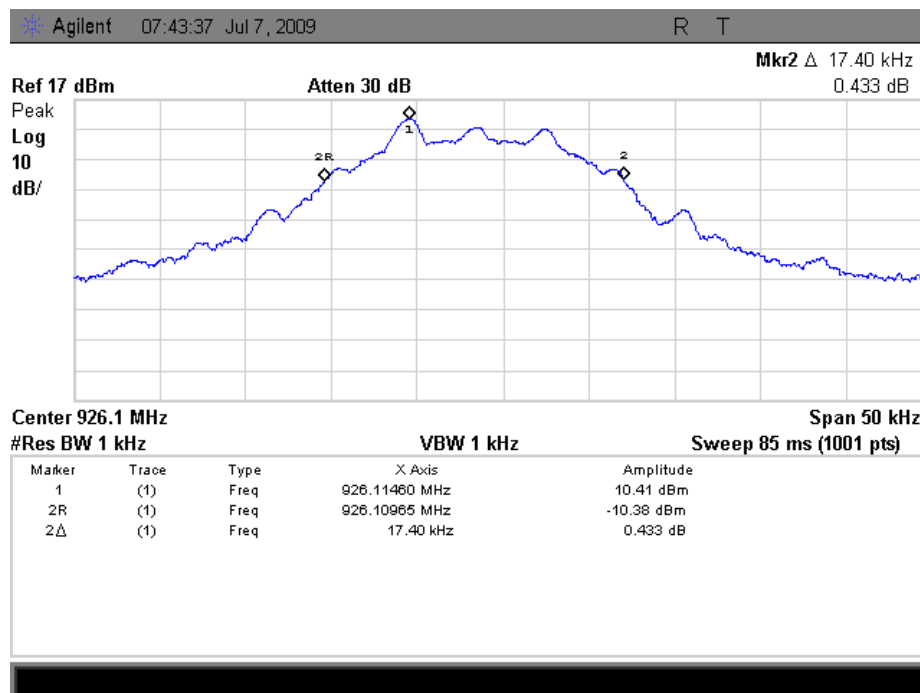
9.4 Screen shots



Picture 9: 20dB Bandwidth measurement result, Low Channel



Picture 10: 20dB Bandwidth measurement result, middle Channel



Picture 11: 20dB Bandwidth measurement result, high Channel

10 PEAK OUTPUT POWER

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	23 °C	31 RH%	993 hPa
Date of measurement	Jul 7, 2009		
FCC rule part	15.247, b 1		
RSS-210 section	A8.4 (2)		
Measured by	Päivi Punta		

10.1 Test setup and measurement method



Picture 12: Test setup for conducted RF output power measurement

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

The measurement was made using 3 MHz resolution bandwidth and 3 MHz video bandwidth and maximum hold function to record the maximum peak output power.

10.2 EUT operation mode

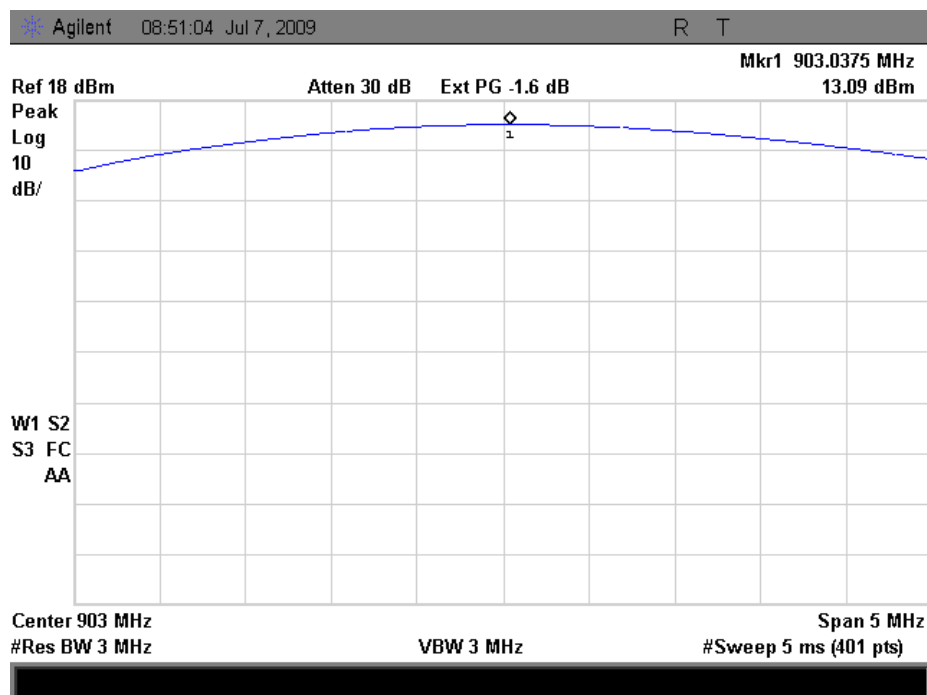
EUT operation mode	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Low, middle, high
EUT TX power level	max

10.3 Results

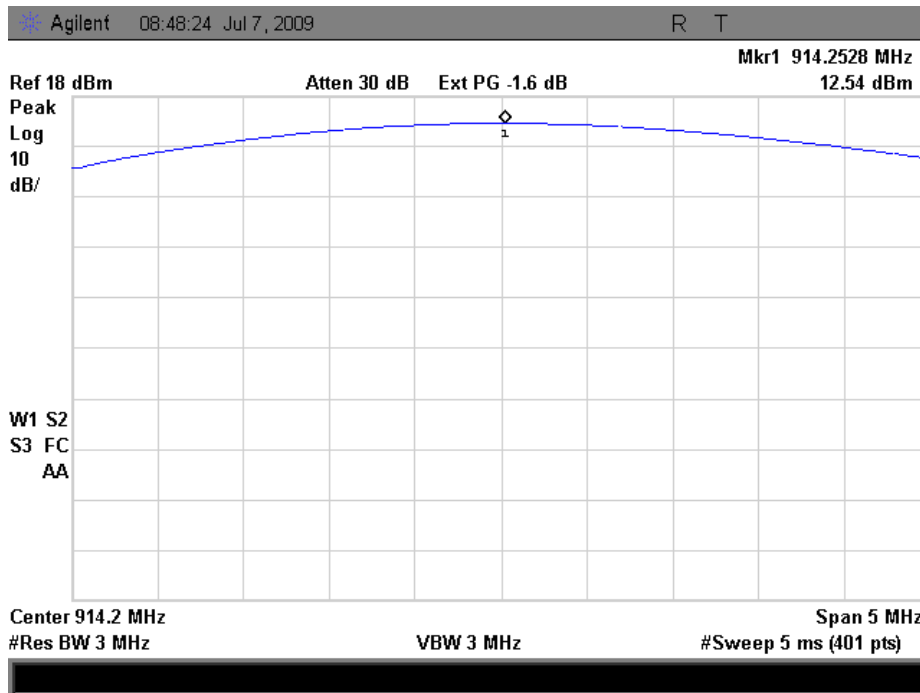
Table 5: Peak output power measurement results

EUT Channel	Limit (W)	Test result (W)	Limit (dBm)	Test result (dBm)
Low	≤ 1	0,02042	≤ 30	13,1
Middle		0,01778		12,5
High		0,01738		12,0

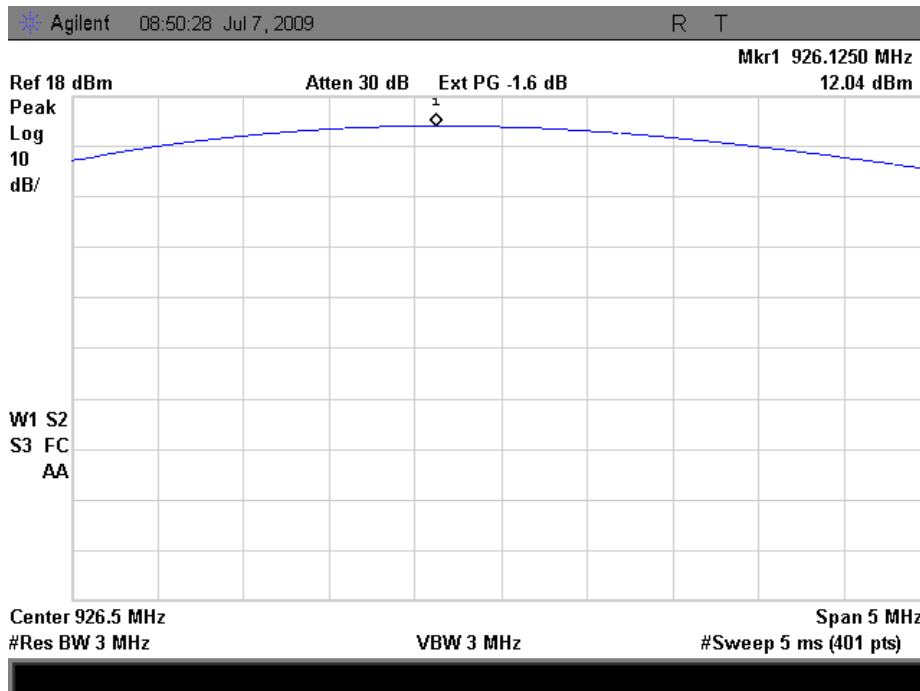
10.4 Screen shots



Picture 13: Peak output power, low channel



Picture 14: Peak output power, middle channel



Picture 15: Peak output power, high channel

11 BAND-EDGE COMPLIANCE OF RF CONDUCTED EMISSIONS

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	25 °C	20 RH%	1004 hPa
Date of measurement	May 12, 2009		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Simo Ojanen		

11.1 Test setup and measurement method



Picture 16: 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 0 and 79. The measured power and power on the band edge was then compared.

11.2 Hopping enabled

11.2.1 EUT operation mode

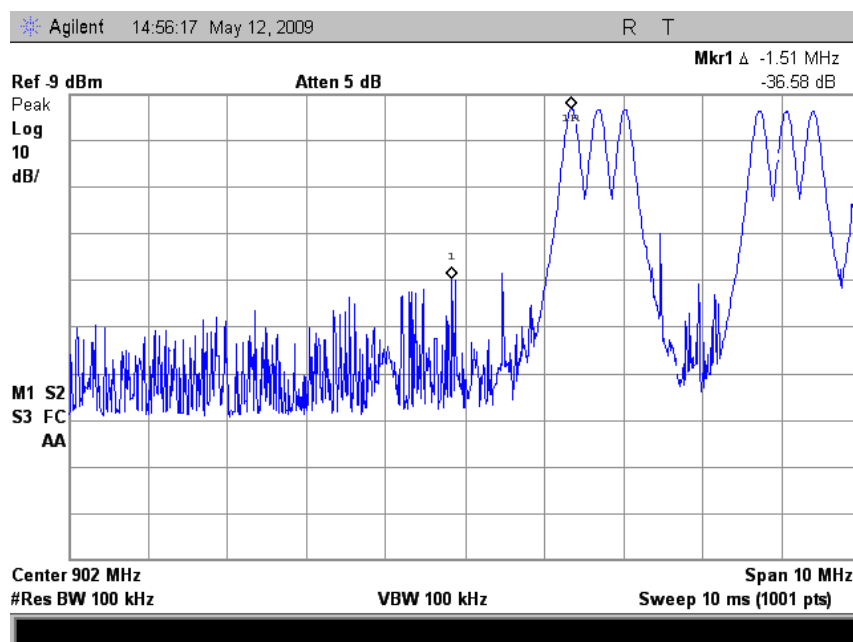
EUT operation mode	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Hopping
EUT TX power level	max

11.2.2 Results

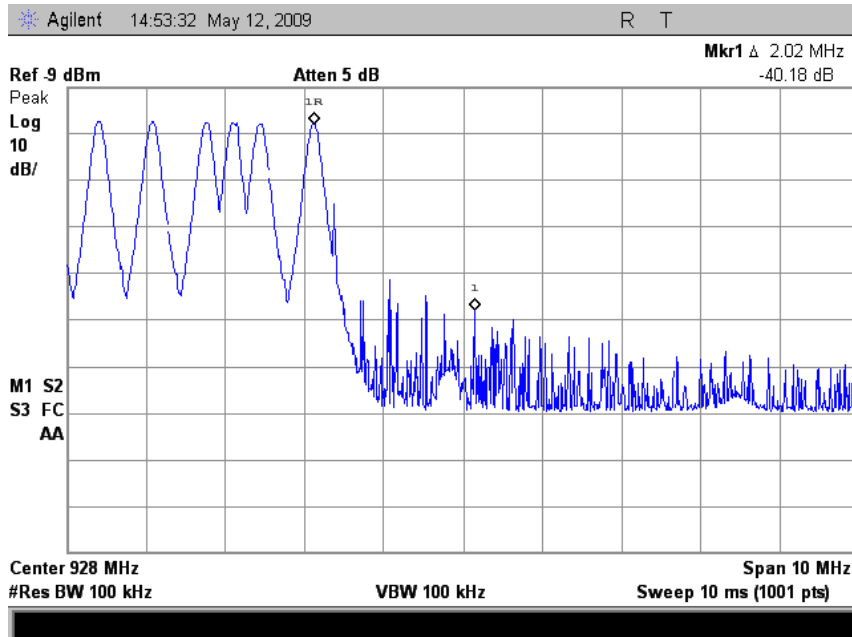
Table 6: Number of hopping frequencies measurement results

EUT Channel	Limit (dBc)	Test result (dBc)
Low	≤ -20	-36,58
High		-40,18

11.2.3 Screen shots



Picture 17: Band edge compliance, low channel , hopping enabled



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

11.3 Hopping disabled

11.3.1 EUT operation mode

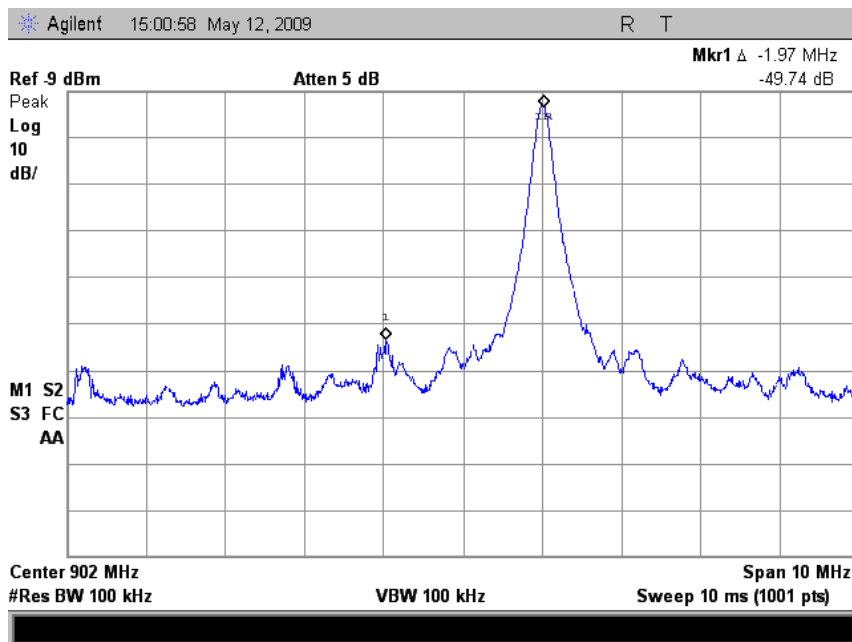
EUT operation mode	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Low, high
EUT TX power level	max

11.3.2 Results

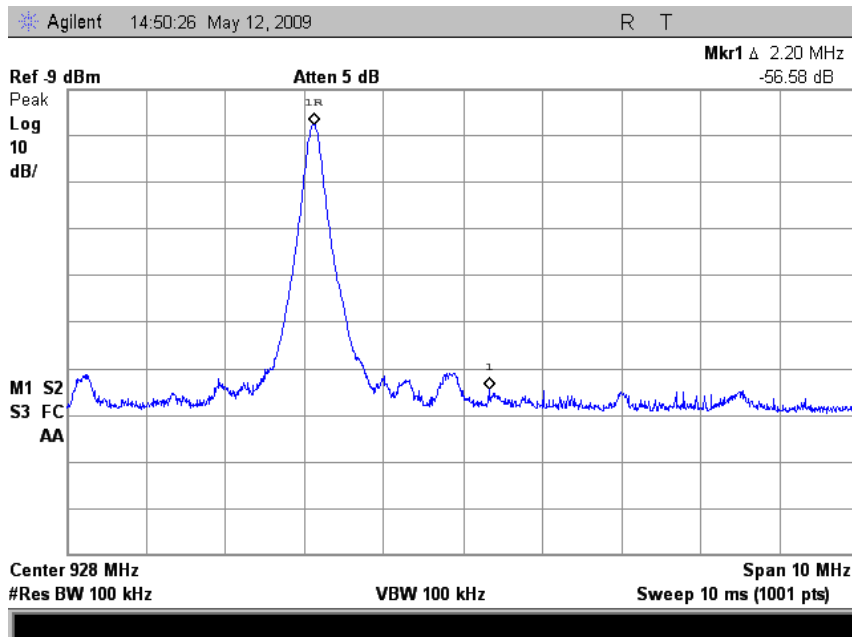
Table 7: Band edge compliance measurement results

EUT Channel	Limit (dBc)	Test result (dBc)
Low	≤ -20	-40,8
High		-51,9

11.3.3 Screen shots



Picture 19: Band edge compliance, low channel, hopping disabled



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

12 SPURIOUS RF CONDUCTED EMISSIONS

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	23 °C	54 RH%	984- hPa
Date of measurement	Jul 9, 2009		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Päivi Punta		

12.1 Test setup and measurement method



Picture 21: Test setup for band edge compliance 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 100 kHz resolution bandwidth and 50 kHz steps. Spurious emissions levels relative to the carrier level were read from the measured results.

12.2 EUT operation mode

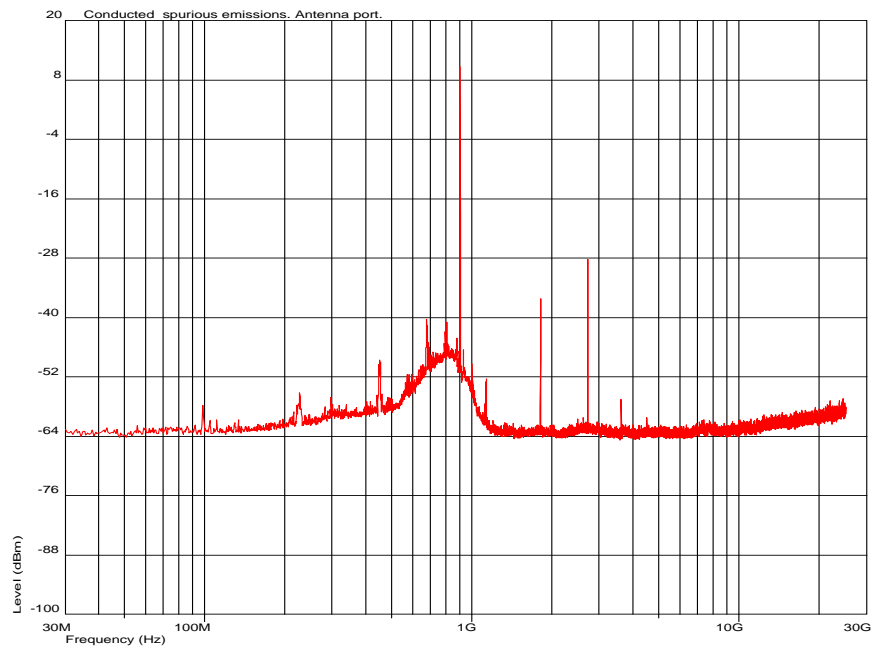
EUT operation mode	Transmit, FSK modulation, Data rate 8kbit
EUT channel	Low, middle, high
EUT TX power level	max

12.3 Limit

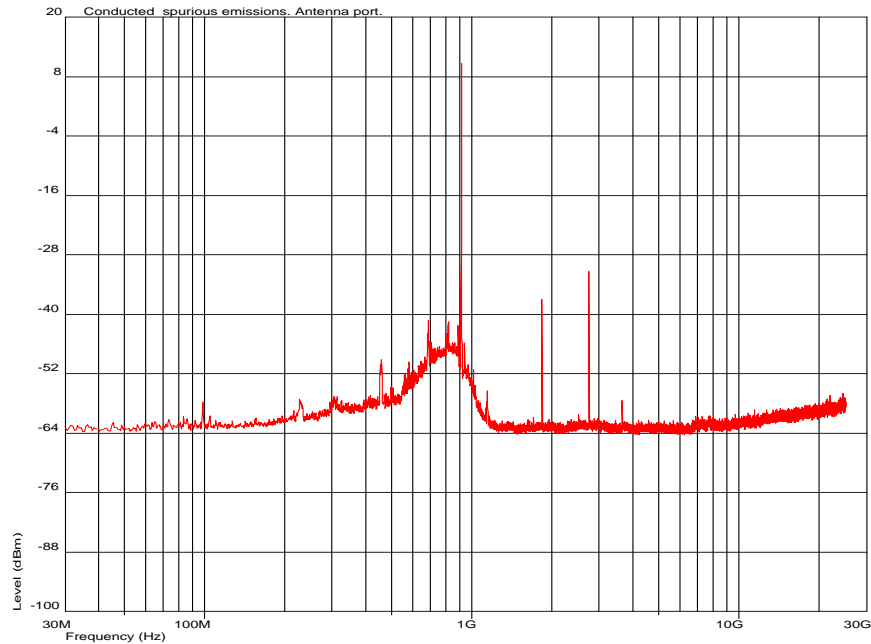
EUT Channel	Limit (dBc)
Low	≤ -20
Middle	
High	

12.4 Results

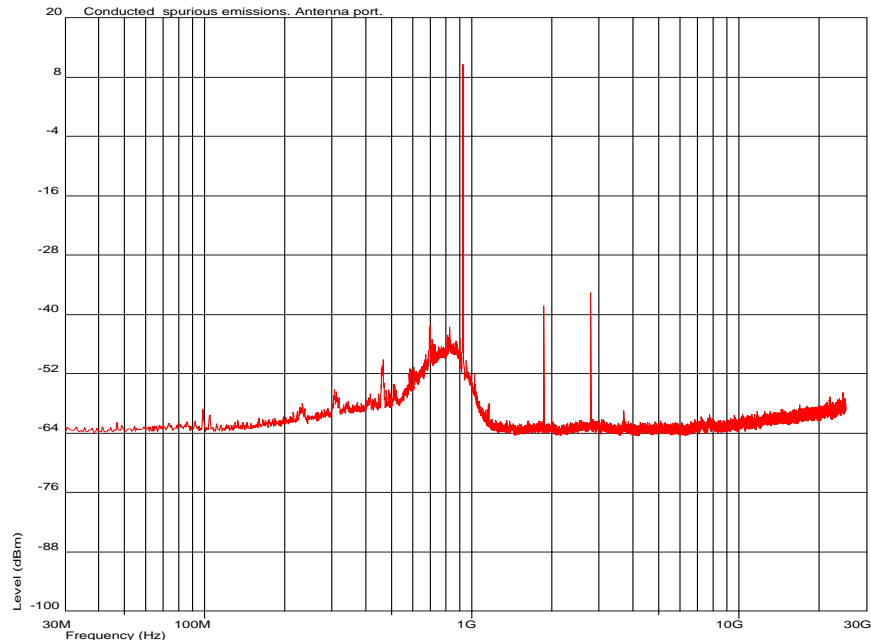
All spurious emissions measured were least 35 dB below the carrier level.



Picture 22: Conducted spurious emissions on antenna port, low channel



Picture 23: Conducted spurious emissions on antenna port, middle channel



Picture 24: Conducted spurious emissions on antenna port, high channel

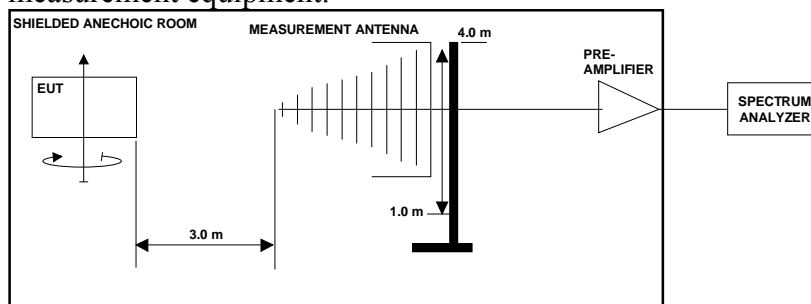
13 RADIATED SPURIOUS EMISSIONS

EUT	2		
Accessories	-		
Temp, Humidity, Air Pressure	24 °C	26 RH%	993 hPa
Date of measurement	May 4 – May 8, 2009 and Jul 9, 2009 and		
FCC rule part	15.247, d		
RSS-210 section	A8.5		
Measured by	Simo Ojanen and Päivi Punta		

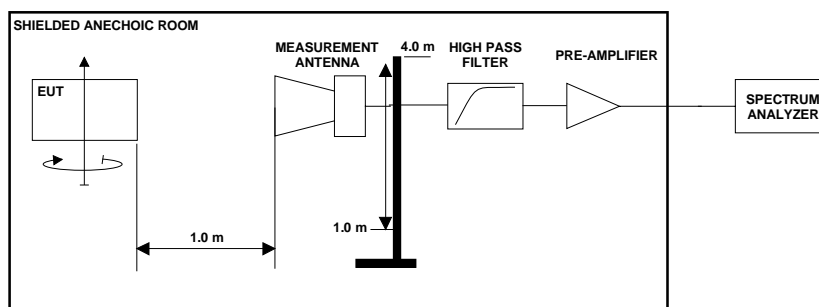
13.1 Test setup

The EUT's buttons were used to configure the EUT to transmit at high or low channel continuously.

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



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



Picture 26: Test setup for radiated spurious emissions measurement
1 GHz – 10 GHz frequencies

13.2 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.

13.3 EUT operation mode

EUT operation mode	Continous transmission
EUT channel	Low, middle, high
EUT TX power level	max

13.4 Limit

Table 8: 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.

13.5 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 9: Emission levels PEAK (QP) detector, low channel

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height m
94,7	23,70	-13,28	10,42	-33,08	Pos 1	Hor	1,0
395,7	23,91	-5,65	18,26	-27,74	Pos 1	Hor	1,0
696,7	26,65	-0,59	26,06	-19,94	Pos 1	Hor	1,0
748,3	37,05	0,24	37,29	-8,71	Pos 1	Hor	1,0
792,4	50,17	0,92	51,09	5,09*	Pos 1	Hor	2,1
798,5	42,90	1,01	43,91	-2,09	Pos 2	Hor	1,9
804,7	41,61	1,09	42,7	-3,3	Pos 2	Hor	2,0
878,4	35,91	2,00	37,91	-8,09	Pos 1	Hor	2,0
892,3	38,49	2,16	40,65	-5,35	Pos 1	Hor	1,7
909,5	32,48	2,39	34,87	-11,13	Pos 3	Ver	1,7
912,5	32,45	2,43	34,88	-11,12	Pos 1	Hor	1,0
1806	91,15	-26,61	64,54	-9,46	Pos 1	Hor	1,0
2709	82,48	-22,36	60,12	-13,88	Pos 3	Hor	1,0
3612	68,72	-19,58	49,14	-24,86	Pos 1	Hor	1,2
4515	64,66	-17,41	47,25	-26,75	Pos 3	Hor	1,0
5418	55,59	-15,71	39,88	-34,12	Pos 2	Hor	1,1
6321	53,59	-12,37	41,22	-32,78	Pos 2	Hor	1,1
7224	52,73	-6,68	46,05	-27,95	Pos 2	Hor	1,3

* Emission is outside the restricted band and complies the -20dBc requirement.
(Carrier level = 106,4 dBuV/m @ 903 MHz)

Table 10: Emission levels PEAK (QP) detector, middle channel

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height m
782,94	32,7	0,8	33,5	-12,5	Pos 2	Hor	1
803,94	44,8	1,1	45,9	-0,1	Pos 1	Hor	2,1
810,12	38,3	1,2	39,4	-6,6	Pos 1	Hor	2,2
1829,0	76,9	-26,5	50,5	-23,5	Pos 1	Hor	1,4
1829,0	78,9	-26,5	52,4	-21,6	Pos 3	Hor	1,2
3658,0	64,6	-19,5	45,1	-28,9	Pos 2	Ver	1,1
7316,5	55,5	-6,6	48,9	-25,1	Pos 2	Hor	1,2

* Emission is outside the restricted band and complies the -20dBc requirement.
(Carrier level = 102 dBuV/m @ 914,56 MHz)

Table 11: Emission levels PEAK (QP) detector, high channel

Freq MHz	Measured Value dBuV	Correction Factor dB	Result dBuV/m	Marginal dB	EUT Position	Ant Pol.	Ant height m
729,5	39,56	-0,07	39,49	-6,51	Pos 2	Hor	1,2
770,3	35,69	0,59	36,28	-9,72	Pos 2	Hor	2,0
803,3	34,89	1,08	35,97	-10,03	Pos 2	Hor	1,9
804,8	34,25	1,10	35,35	-10,65	Pos 2	Hor	2,0
807,7	33,58	1,13	34,71	-11,29	Pos 2	Hor	2,0
809,4	40,92	1,16	42,08	-3,92	Pos 3	Ver	1,3
811,0	36,43	1,18	37,61	-8,39	Pos 2	Hor	2,0
815,5	50,11	1,24	51,35	5,35*	Pos 2	Hor	2,0
817,7	39,56	1,26	40,82	-5,18	Pos 2	Hor	1,0
821,6	43,85	1,30	45,15	-0,85	Pos 2	Hor	2,0
823,3	36,96	1,33	38,29	-7,71	Pos 1	Hor	2,0
827,8	34,43	1,38	35,81	-10,19	Pos 2	Hor	1,9
829,4	33,52	1,40	34,92	-11,08	Pos 2	Hor	1,9
915,4	31,03	2,47	33,5	-12,5	Pos 2	Hor	1,0
932,6	29,78	2,72	32,5	-13,5	Pos 2	Hor	2,7
935,7	25,68	2,76	28,44	-17,56	Pos 2	Hor	1,0
1852,5	79,81	-26,47	53,34	-20,66	Pos 1	Hor	1,0
2778,5	80,82	-22,12	58,7	-15,3	Pos 2	Hor	1,0
3704,5	63,28	-19,42	43,86	-30,14	Pos 2	Ver	1,0
4630,5	53,05	-16,93	36,12	-37,88	Pos 1	Hor	1,0
5557	49,73	-15,54	34,19	-39,81	Pos 1	Ver	1,3
7409	51,90	-6,34	45,56	-28,44	Pos 2	Hor	1,2

* Emission is outside the restricted band and complies the -20dBc requirement.
(Carrier level = 103,0 dBuV/m @ 926,12 MHz)

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

Average level \leq Peak level – 20 log (duty cycle).

The measured burst time is 15,4 ms and the transmitter is ON 61,6 ms in 20 s period time.

Therefore,

$$\text{Average level} \leq \text{Peak level} - 20 \log ((100 \text{ ms} - 15,4\text{ms}) / 15,4\text{ms})$$

$$\text{Average level} \leq \text{Peak level} - \mathbf{14,8 \text{ dB}}$$

14 99 % BANDWIDTH

EUT	1		
Accessories	-		
Temp, Humidity, Air Pressure	23 °C	31 RH%	993 hPa
Date of measurement	Jul 8.2009		
FCC rule part			
RSS-GEN section	4.4.1		
Measured by	Päivi Punta		

14.1 Test setup and measurement method

The 99% occupied bandwidth was calculated from spectrum analyzer measurements.

The measurement data was read from the analyzer to computer.

Software in computer calculated the total power from the measurement data and defined the frequency band containing 99% of the total power.

Markers in the spectrum analyzer were then placed between the calculated frequencies to show the calculated 99% power band in the screenshots.

14.2 EUT operation mode

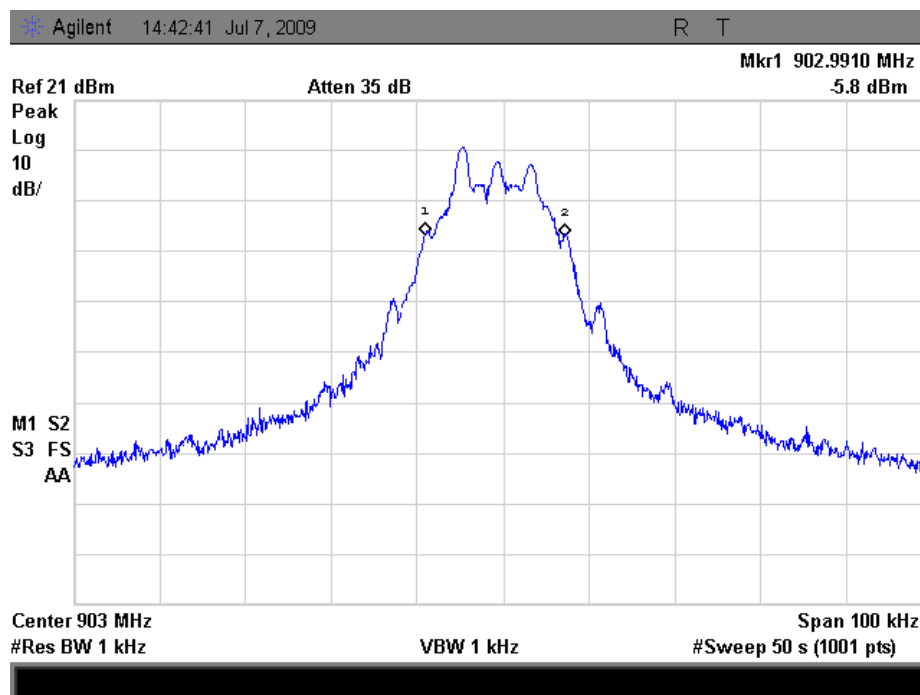
EUT operation mode	Continuous transmission
EUT frequency	Low, Middle, High
EUT TX power level	Max.

14.3 Results

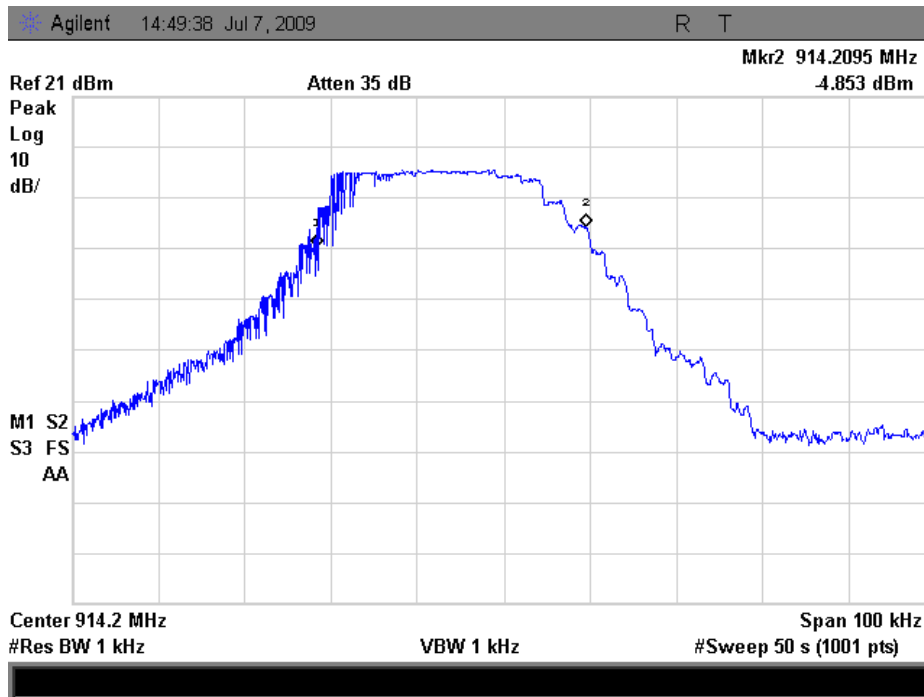
Table 12: 99% bandwidth measurement results

EUT Channel	Limit kHz	Measured value kHz
Low	-	16,1
Middle	-	31,1
High	-	16,2

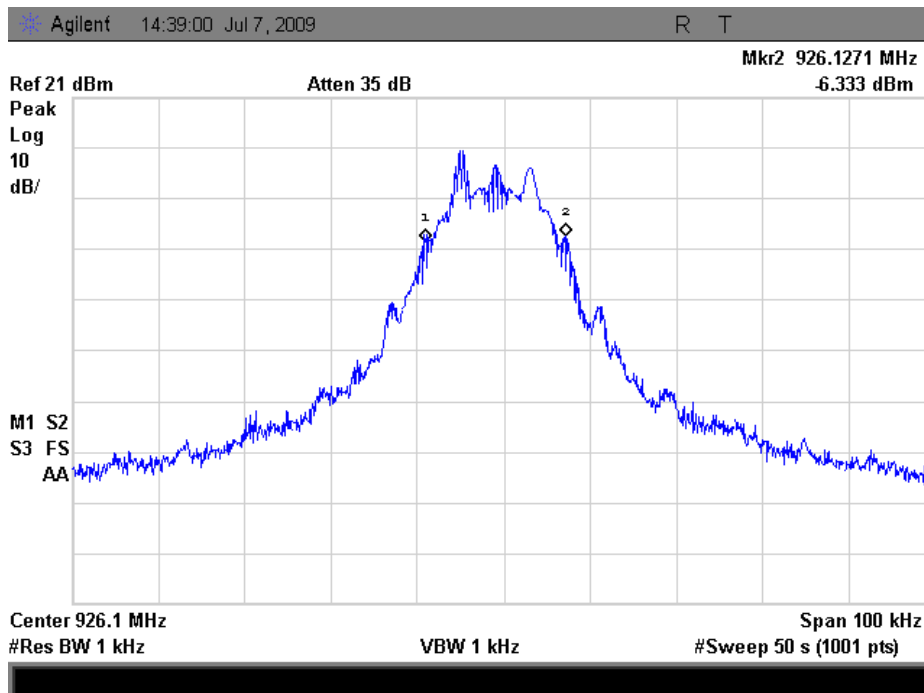
14.4 Screen shots



Picture 27: 99% Bandwidth measurement result; low channel



Picture 28: 99% Bandwidth measurement result; middle channel



Picture 29: 99% Bandwidth measurement result; high result

15 TEST EQUIPMENT

All testing and measurement equipment has been calibrated once a year, except the antennas which are calibrated every two years.

15.1 Conducted measurements

Equipment	Manufacturer	Model
Spectrum Analyzer	Agilent	E7405A
Measurement receiver	Rohde & Schwarz	ESCS 30
Power splitter	Narda	4426-2
Transient limiter / 10 dB attenuator	Chase	CFL 9206
Line Impedance Stabilization Network (LISN)	Rohde & Schwarz	ESH 3-Z5

15.2 Radiated measurements

Equipment	Manufacturer	Model
Spectrum Analyzer	Agilent	E7405A
Antenna	Chase	CBL 6141
Antenna	Schwarzbeck	BBHA 9120D
Antenna	Schwarzbeck	BBHA 9170
High pass filter	Wainwright Instruments	WHK3.0/18GST
Pre-amplifier	JCA	118-400
Pre-amplifier	Miteq	AMF-6F-18002650-25-10P
Turn table / antenna mast controller	EMCO	2090
Antenna mast	EMCO	2075-2

16 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

T09-217A-RF_PHOTOS.doc