TCC
Copenhagen

DANAK
Reg. Nr. 416

GSM 1900 Test Report for RH-37

Test Report no.:	DTX09595-EN	**Date of Report:**	June 9, 2004
Number of pages:	22	**Customer's Contact person:**	Jukka Pekkala
		Responsible Test engineer:	Ruben Hansen
Testing laboratory:	TCC Copenhagen Nokia Danmark A/S Frederikskaj DK-1790 Copenhagen V Denmark Tel. +45 33 29 29 29 Fax. +45 33 29 20 01 FCC Reg. # 99059, June 2003 IC File # 4820, January 2004 IC File # 4820-1, February 2004	**Client:**	Nokia Corporation Lise Meitner Strasse 10 89081 ULM Germany Tel. +49 731 1754 0 Fax. +49 731 1754 6800
Tested devices/ accessories:	**Phone: RH-37 and Battery: BL- 5B**		
Supplement reports:			
Testing has been carried out in accordance with:	The tests listed in this report have been done to demonstrate compliance with the applicable requirements in FCC rules Part 24 and IC standard RSS-133.		
Documentation:	The documentation of the testing performed on the tested devices is archived for 15 years at TCC Copenhagen.		
Test Results:	The tested device complies with the requirements in respect of all parameters subject to the test. The test results and statements relate only to the items tested. The test report shall not be reproduced except in full, without written approval of the laboratory.		

Date and signatures for the contents: 6/9/2004

Peter Langhede
Deputy for TCC Manager

Ruben Hansen
EMC Team Leader

CONTENTS

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Frederikskaj, DK-1790 Copenhagen V, Denmark
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1. Summary of test results

Section in CFR 47	Section in RSS-133		Result
§2.1049 (a)	6.2	Conducted RF output	NA
§24.232 (b)	6.2	Radiated RF output	PASS
§2.1049 (h)	5.6	99% occupied bandwidth	PASS
§24.238 (a)	6.3	Bandedge compliance	PASS
§24.238 (a), §2.1051	6.3	Spurious emission at antenna terminal	NA
§24.238 (a), §2.1053	6.3	Radiated spurious emissions	PASS
§24.235, §2.1055 (a)(1)(b)	7	Frequency stability, temperature variation	PASS
§24.235, §2.1055 (d)(1)(2)	7	Frequency stability, voltage variation	PASS

PASS Pass
FAIL Fail
X Measured, but there is no applicable performance criteria
NA Not Applicable

2. EUT Information

Product	Type	SN	HW	MV	SW	DUT
Phone	RH-37	004400/40/178917/5	4167		A3.01.1	233859
Battery	BL-5B	0670455363807 L103C20101934				233861
Phone	RH-37	004400/29/162772/5	4167		A3.01.1	233839
Battery	BL-5B	0670455363807 L103C20101898				233829

2.1. EUT description

The EUT is a triple band (900MHz/1800MHz/1900MHz) E-GPRS (EDGE) GSM mobile phone.
The EUT was not modified during the tests.

3. EUT Test Setup

For each test the EUT was excercised to find the worst case of operation modes and device configuration.
The test setup photograph are in Appendix A

4. Applicable Standards

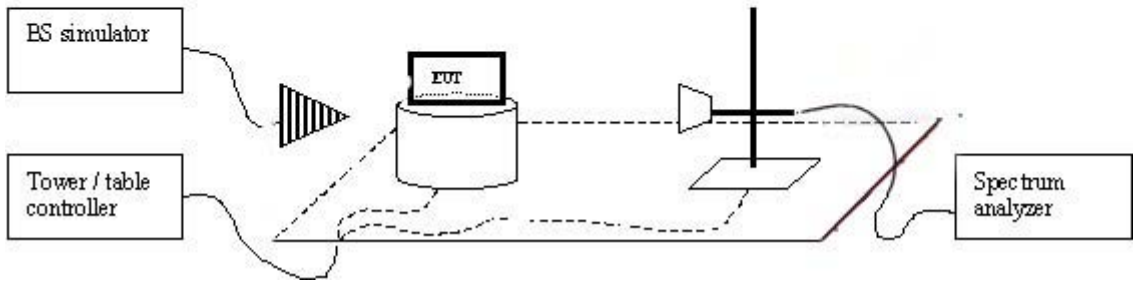
The tests were performed in guidance of CFR 47, part 24 and part 2, ANSI/TIA/EIA-603-A and RSS-133. Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under “Test method” for each test case.

5. Radiated RF output power

EUT(s)	233859		
Accessories	233862		
Temp, Humidity, Air Pressure	14 ºC	70 RH%	1022 mbar
Date of measurement	5/14/2004		
FCC rule part	§24.232 (b)		
RSS-133 section	6.2		
Measured by	Ruben Hansen		
Result	**PASSED**		

5.1. Test setup

The EUT was set on a non-conductive turn table, 80 cm high, on the OATS. In the corner of the ground plane there was a communication antenna, which was connected to the BS simulator located in the operaters shed. The radiated power from the EUT was measured with an antenna fixed to a antenna tower. The tower and turn table were remotely controlled to turn the EUT, change the antenna polarization and hoist/lower the antenna. The scan heigth was from 1 to 4 meter. The measured signal was routed from the measuring antenna to the spectrum analyzer. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns. The measuring distance was 10 meter.



5.2. Test method

a) The maximum power level was searched by moving the turn table and the measuring antenna and manipulating the EUT. This level (P_{EUT}) was recorded.

b) The EUT was replaced with a substituting antenna.

c) The substituting antenna was fed with the power (P_{Subst_TX}) giving a convenient reading on the spectrum analyzer. That reading (P_{Subst_RX}) on spectrum analyzer was recorded.

5.3. EUT operation mode

	GSM	EGPRS
EUT operation mode	TX on, 1 time slot transmission, GMSK modulation	TX on, 2 time slot transmission, 8PSK modulation
EUT channel	512, 661, 810	512, 661, 810
EUT TX power level	0 (+30dBm)	0 (+30dBm)

5.4. Limit

EIRP [W]
≤ 2

5.5. Results

The formula below was used to calculate the EIRP of the EUT.

$$P_{EIRP[W]} = \frac{10^{(P_{Subst\_TX[dBm]}+(P_{EUT[dBm]}-P_{Subst\_RX[dBm]})+G_{Substitute\_antenna[dBi]}-L_{Cable[dB]})/10}}{1000}$$

where the variables are as follows:

$P_{EUT\ [dBm]}$	Measured power level (from step a in 5.2) from the EUT
$P_{Subst\_TX\ [dBm]}$	Power (from step c in 5.2) fed to the substituting antenna
$P_{Subst\_RX\ [dBm]}$	Power (from step c in 5.2) received with the spectrum analyzer
$G_{Substitute\_antenna\ [dBi]}$	Gain of the substitutive antenna over isotropic radiator
$L_{Cable\ [dB]}$	Loss of the cable between signal generator and the substituting antenna

EUT: 233859 Mode: GSM 1900

EUT Channel	P eut [dBm]	P subst TX [dBm]	P subst RX [dBm]	Cable Loss [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP [W]
512	-17,9	-3	-49	9,5	12,5	31,1	1,288
661	-17,8	-3	-49,2	9,6	12,5	31,3	1,349
810	-17,3	-3	-49,5	9,7	12,5	32	1,585

EUT: 233859 Mode: EGPRS

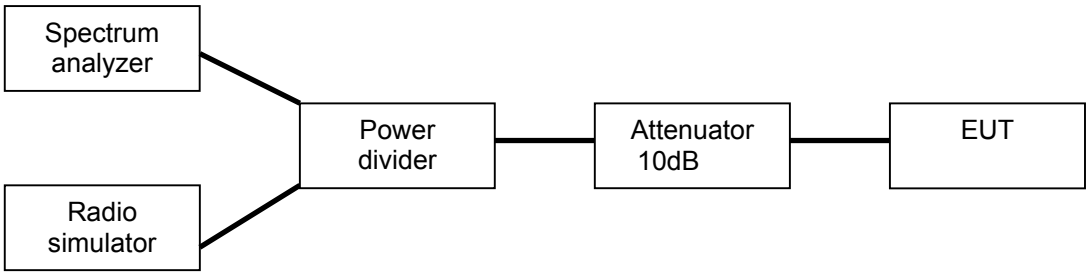
EUT Channel	P eut [dBm]	P subst TX [dBm]	P subst RX [dBm]	Cable Loss [dB]	Ant. Gain [dBi]	EIRP [dBm]	EIRP [W]
512	-20,3	-3	-49	9,5	12,5	28,7	0,741
661	-20,2	-3	-49,2	9,6	12,5	28,9	0,776
810	-19,4	-3	-49,5	9,7	12,5	29,9	0,977

6. 99% occupied bandwidth

EUT	RH-37 dut 233839		
Accessories	BL-5B dut 233829		
Temp, Humidity, Air Pressure	21.6 ºC	41.5 RH%	1020.7 mbar
Date of measurement	13-05-2004		
	§2.1049 (h)		
	5.6		
	Jan Engelbrechtsen		

6.1. Test setup

The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



6.2. EUT operation mode

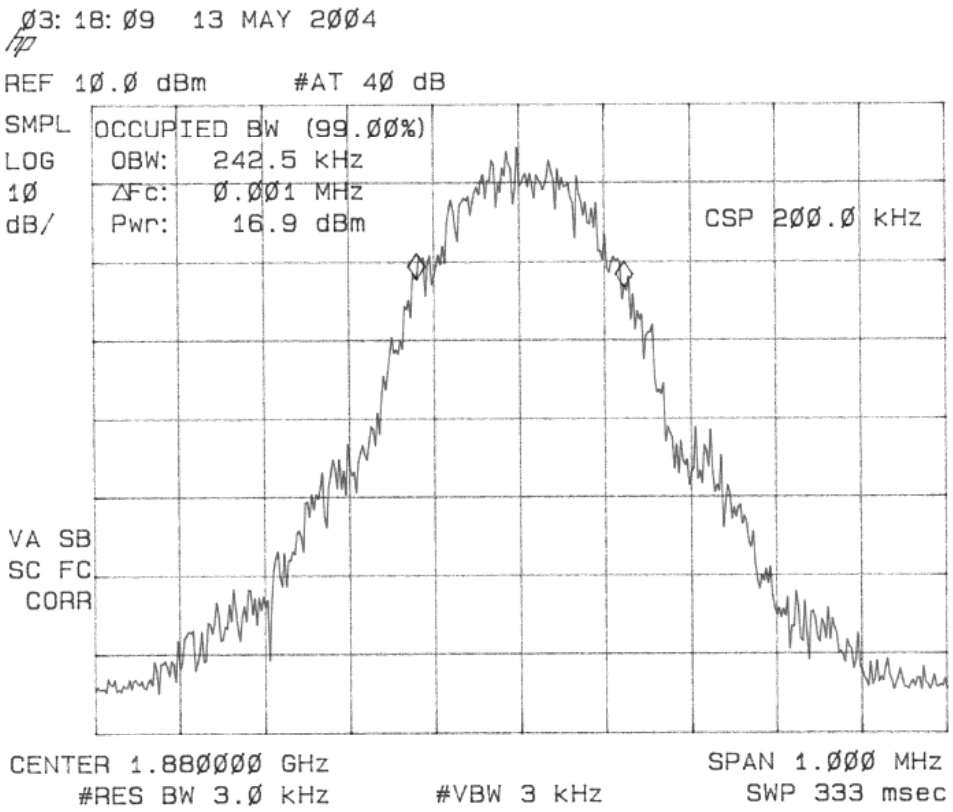
EUT operation mode	TX on, 1 time slot transmission, PRBS 2E9-1 modulation
EUT channel	661
EUT TX power level	0 (+30dBm)

6.3. Results

The 99% occupied bandwidth was measured using the in-built function of the spectrum analyzer.

EUT Channel	99% occupied bandwidth [kHz]
661	242,5

6.4. Screen shot



Picture 4. 99% occupied bandwidth, channel 661

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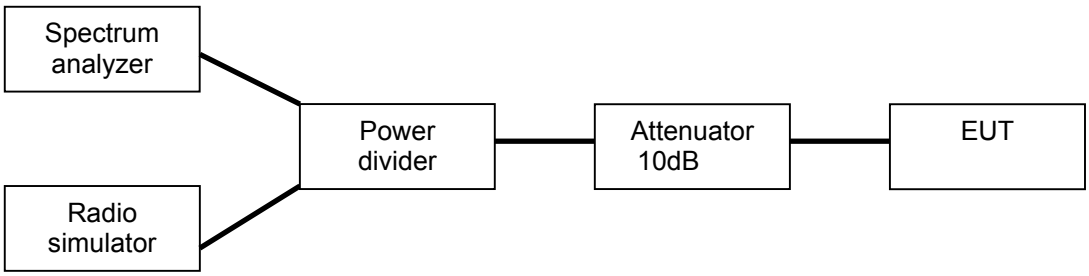
7. Bandedge compliance

EUT	RH-37 dut 233839		
Accessories	BL-5B dut 233829		
Temp, Humidity, Air Pressure	22.2 ºC	42.0 RH%	1013.5 mbar
Date of measurement	25-0502004		
	§24.238 (a)		
	6.3		
	Jan Engelbrechtsen		
	Passed		

7.1. Test setup

The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



7.2. EUT operation mode

EUT operation mode	TX on, 1 time slot transmission, PRBS 2E9-1 modulation
EUT channel	See section 7.4
EUT TX power level	0 (+30dBm)

7.3. Limit

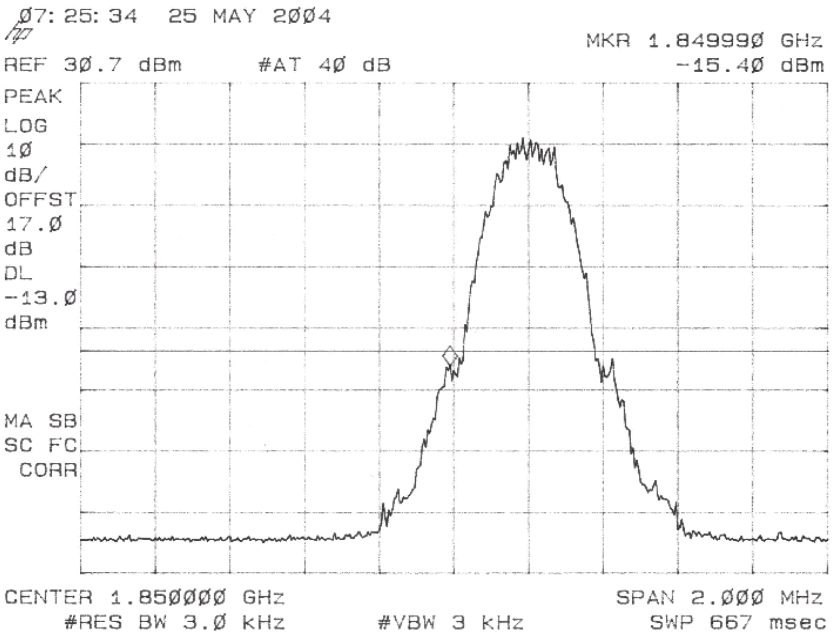
Frequency [MHz]	Level [dBm]
<1850 or 1910<	-13

7.4. Results

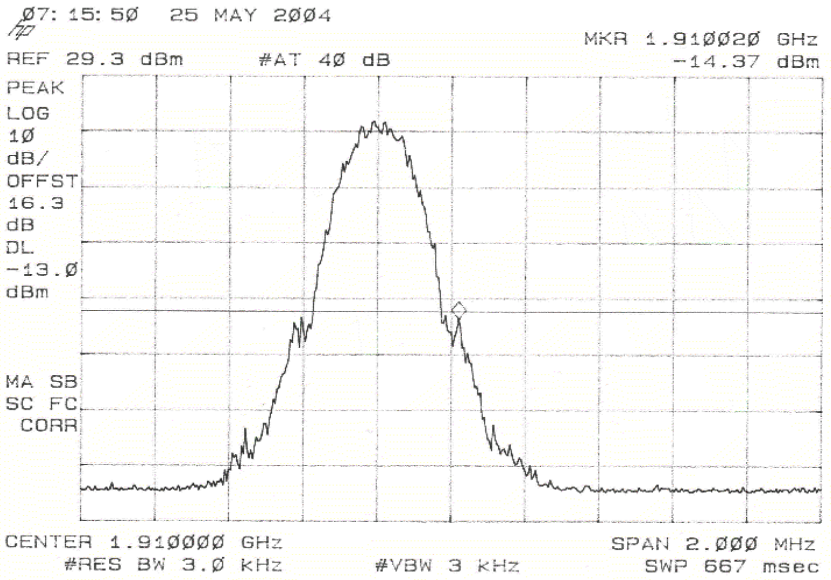
The line in the screen shots is the -13dBm limit line. The results were corrected with measurement path loss set as “offset” in the spectrum analyzer.

EUT Channel	Level [dBm]
512	-15.40
810	-14.37

7.5. Screen shots



Picture 5. Lower bandedge, channel 512



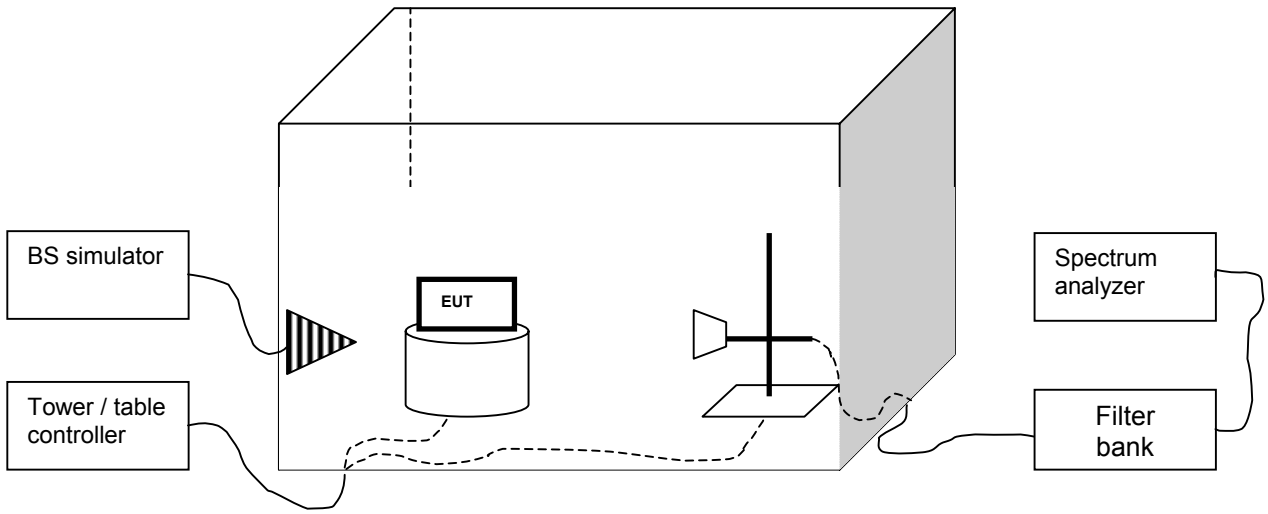
Picture 6. Upper bandedge, channel 810

8. Spurious radiated emission

EUT	233859		
Accessories	233862		
Temp, Humidity, Air Pressure	22.7 ºC	37.5 RH%	1018 mbar
Date of measurement	6/1/2004		
FCC rule part	§24.238 (a), §2.1053		
RSS-133 section	6.3		
	Jesper Nielsen		
	PASSED		

8.1. Test setup

A set of LP/HP/BS filters was used to prevent overloading the spectrum analyzer. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns. The test was done manually.



8.2. Test method

a) The emissions were searched and maximized by moving the turn table and measuring antenna and manipulating the EUT.

b) All suspicious frequencies with emission levels were recorded.

c) The EUT was replaced with a substituting antenna.

d) For each frequency recorded, the substituting antenna was fed with the power (from signal generator) giving the same reading as in (b). These power levels were reported.

8.3. EUT operation mode

	GSM	EGPRS
EUT operation mode	TX on, 1 time slot transmission, GMSK modulation	TX on, 2 time slot transmission, 8PSK modulation
EUT channel	512, 661, 810	512, 661, 810
EUT TX power level	0 (+30dBm)	0 (+30dBm)

8.4. Limit

Frequency [MHz]	Level [dBm]
30 – 19100	-13

8.5. Results

The formula below was used to calculate the EIRP of the spurious emissions. If there were no emissions closer than 20dB below the limit line, then the emission levels were documented only at the transmitter's mid-channel harmonics.

$$P_{Emission[dBm]} = P_{SubstTX[dBm]} - L_{Cable[dB]} + G_{Antenna[dBi]}$$

where the variables are as follows:

$P_{Measured\ [dBm]}$ Measured emission level (from step b in 8.2)

$P_{Subst\_TX\ [dBm]}$ Signal generator power (from step d in 8.2) fed to the substituting antenna

$L_{Cable\ [dB]}$ Loss of the cable between antenna and signal generator (from step d in 8.2)

$G_{Antenna\ [dBi]}$ Gain of the substitutive antenna over isotropic radiator

Emission levels, EUT 233859, channel 661, GMSK

Frequency [MHz]	$P_{Measured}$ [dBm]	$P_{Subst\ TX}$ [dBm]	L_{Cable} [dB]	$G_{Antenna}$ [dBi]	$P_{Emission}$ [dBm]
3760,00	-61.39	-46.40	8.73	15.80	-39.33
5640,00	-66.21	-45.60	11.53	18.03	-39.10

Emission levels, EUT 233859, channel 661, 8PSK

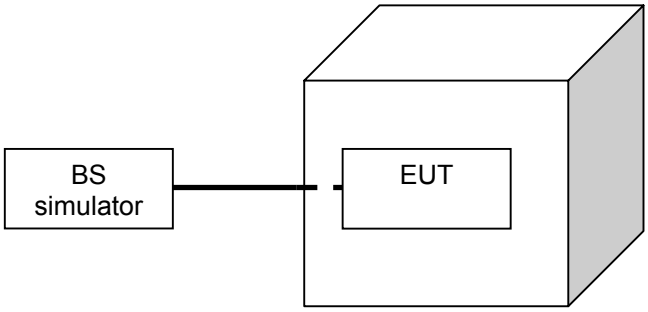
Frequency [MHz]	$P_{Measured}$ [dBm]	$P_{Subst\ TX}$ [dBm]	L_{Cable} [dB]	$G_{Antenna}$ [dBi]	$P_{Emission}$ [dBm]
3760,00	-62.02	-45.90	8.73	15.80	-38.83
5640,00	-68.69	-48.00	11.53	18.03	-41.50

9. Frequency stability, temperature variation

EUT	RH-37 dut 233839		
Accessories	BL-5B dut 233829		
Temp, Humidity, Air Pressure	21.6 ºC	42.5 RH%	1024.2 mbar
Date of measurement	03-05-2004		
	§24.235, §2.1055 (a)(1)(b)		
	7		
	Jan Engelbrechtsen		
	Passed		

9.1. Test setup

The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



9.2. EUT operation mode

EUT operation mode	TX on, 1 time slot transmission, PRBS 2E9-1 modulation
EUT channel	661
EUT TX power level	0 (+30dBm)

9.3. Limit

Frequency deviation [ppm]
± 2.5

9.4. Test method

a) The climate chamber temperature was set to the minimum value and the temperature was allowed to stabilize.

b) The EUT was placed in the chamber

c) Temperature changed and The EUT was set in idle mode for 45 minutes.

d) The EUT was set to transmit.

e) The transmit frequency error was measured immediately

f) The steps c - e were repeated for each temperature

9.5. Results

Temperature [ºC]	Deviation [Hz]	Deviation [ppm]
-30	+66	0.035
-20	-1	0.0005
-10	+4	0.002
0	+4	0.002
10	+1	0.0005
20	0, reference	0
30	0	0
40	-1	0.0005
50	-18	0,01

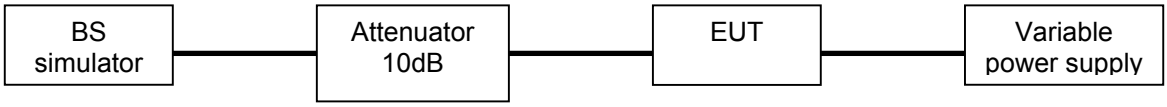
Table 15. Frequency deviation, temperature variation

10. Frequency stability, voltage variation

EUT	RH-37 dut 233839		
Accessories	Battery eliminator SF-17D dut 233837		
Temp, Humidity, Air Pressure	21.6 ºC	41.5 RH%	1020.7 mbar
Date of measurement	13-05-2004		
FCC rule part	§24.235, §2.1055 (d)(1)(2)		
	7		
	Jan Engelbrechtsen		
	Passed		

10.1. Test setup

The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



10.2. EUT operation mode

EUT operation mode	TX on, 1 time slot transmission, PRBS 2E9-1 modulation
EUT channel	661
EUT TX power level	0 (+30dBm)

10.3. Limit

Frequency deviation [ppm]
± 2.5

10.4. Test method

The EUT battery was replaced with an adjustable power supply. The frequency stability was measured at nominal voltage and at the battery cut-off point.

10.5. Results

Level	Voltage [V]	Deviation [Hz]	Deviation [ppm]
Nominal	3.7	23	0.013
Battery cut-off point	3.3	24	0.013

Table 16. Frequency deviation, voltage variation

11. Test equipment

Each test equipment is calibrated once a year, except antennas which are calibrated every second year.

11.1. Conducted measurements

Equipment #	Equipment	Type	Serial #	Manufacturer
13357	Signal Generator	SMP 02		Rohde & Schwarz
13302	Spectrum Analyzer	8596E		Hewlet Packard
13524	BS Simulator	CMD-55		Rohde & Schwartz
17277	Multimeter	34401A		Agilent
15761	DC Power Supply	E3632A		Hewlet Packard
13371	Temperature chamber	2800		Thermotron
-	RF Attenuator	23-10-34		Weinchel
-	Power Divider	-		Suhner
17796	BS Simulator	4400M		Wavetek
-	Antenna Mast	-		Deisel
14900	Antenna Mast Controller	HD-100		Deisel
15191	Turn Table	G-800SDX		Yaesu
13668	Antenna	CBL6112A		Chase
13935	Two Line Artificial Mains Network	ESH-3-Z5		Rohde & Schwarz
13666	EMI Test Receiver	ESPC		Rohde & Schwarz

11.2. Radiated measurements

Equipment #	Equipment	Type	Serial #	Manufacturer
	10 meter OATS			
14993	EMI Test Receiver 9KHz-2750MHz	ESCS30	847124/001	Rohde&Schwarz
15191	Turntable Contoller Unit	G-800SDX	ONO10000	YAESU
14900	Antenna Controller	HD100	100\552	HD GmbH
18792	Multi Device Controller	2090	1606	ETS-EMCO
13829	Turntable Controller	4630-100	100/510	Comtest
14963	RF Preamplifier 100MHz-4GHz (Metal Chassis)	AFS3-00100400	571131	Miteq/NMP Cph

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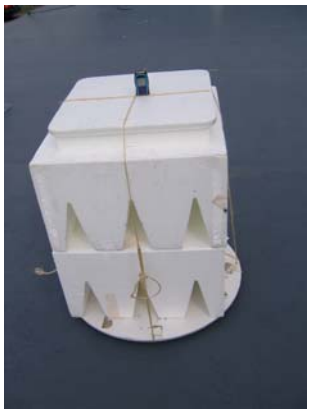
13668	BiLog Antenna 30-2000MHz	BiLog-CBL6112A	2259	Chase
18861	EMI Test Receiver 20Hz-26,5GHz	ESI	833362/004	Rohde&Schwarz
12679	Dual Log Periodic Antenna 1-26.5 GHz	HL025	----------	Rohde&Schwarz
18860	Ultra Broadband Antenna Ultralog 30-3000MHz	HL562	100154	Rohde&Schwarz
18773	Shielded Chamber	RFD-100	2420	ETS-Lindgren
18774	Shielded Chamber	RFSD-F/A-100	2425	ETS-Lindgren
18324	High Pass Filter 3GHz SMA f Conn	WHJS3000-10SS	1	Wainwright
14114	Highpass Filter 1000MHz-4500MHz	WHK1000-12SS	1	Wainwright
13918	Highpass Filter 2000-4000MHz 50OHM SMA Conn	WHKS2000-10SS		Wainwright Instruments
13937	Ultra Stable Notch Filter 902,4MHz	WRCA902.4-0.2/40-6SS		Wainwright Instruments
13936	Ultra Stable Notch Filter 1747,5MHz	WRCD1747.5-0.2/40-10SS		Wainwright Instruments
16633	Ultra Stable Notch Filter 1880,0MHz	WRCD1880.0-0.2/40-10SS		Wainwright Instruments

12. Test setup photographs

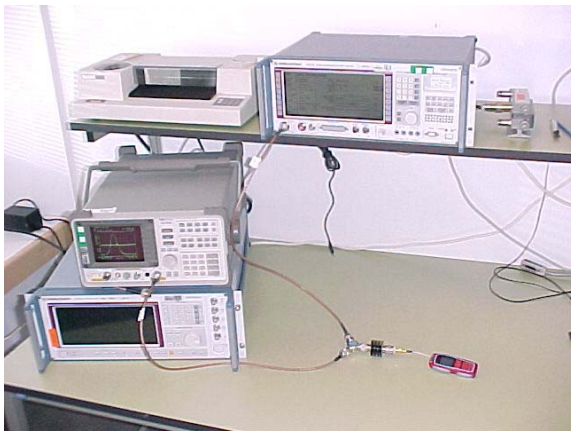
12.1. Radiated RF output power



The Turntable

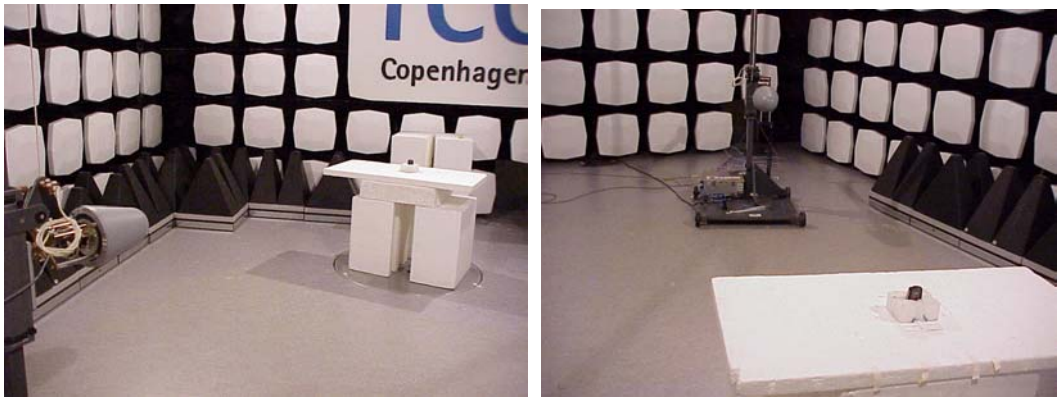
The Mast and the Shed

12.2. 99% occupied bandwidth/ Bandedge compliance



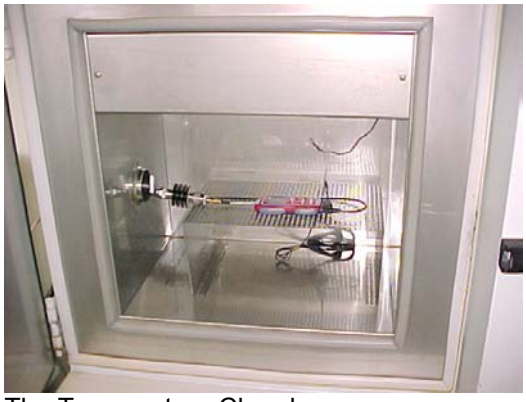
The setup

12.3. Spurious radiated emission



The Anechoic Chamber

12.4. Frequency Stability, Temperature Variation



The Temperature Chamber