Test Report
for
RH-4

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CONTENTS

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1 LABORATORY INFORMATION

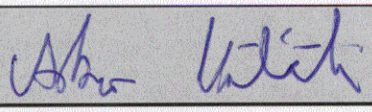
Test laboratory:	TCC Tampere Sinitaival 5 FIN-33720 TAMPERE Tel. +358 7180 46800 Fax. +358 7180 46880
FCC registration number: IC file number:	94436 (June 14, 2002) IC 3608 (April 14, 2000)

2 CUSTOMER INFORMATION

Client:	Nokia Corporation Nokia Tower Pacific Century Place 2A Gong Ti Bei Lu Chaoyang District 100027 BEIJING, PRC Tel. +86 10 65392828 Fax. +86 10 65393838
Contact person:	Kari Koskela
Receipt of EUT:	14.3.2003
Date of testing:	17-27.3.2003
Date of report:	31.3.2003

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.

Contents approved:



Asko Välimäki
Quality Manager

3 SUMMARY OF TEST RESULTS

Section in CFR 47	Section in RSS-133		Result
§2.146 (a)	6.2	Conducted RF output	-
§24.232 (b)	6.2	Radiated RF output	PASS
§2.1049 (h)	5.6	99% occupied bandwidth	X
§24.238 (a)	6.3	Band-edge compliance	PASS
§24.238 (a), §2.1051	6.3	Spurious emissions at antenna terminals	-
§24.238 (a), §2.1053	6.3	Field strength of spurious radiation	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 The EUT passed that particular test
FAIL The EUT failed that particular test
X The measurement was done, but there is no applicable performance criteria
- Not done

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4 EUT INFORMATION

The EUT and accessries 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	GSM 1900 Mobile Phone GSM 1900 Mobile Phone GSM 1900 Mobile Phone	RH-4 RH-4 RH-4	004400/18/172203/2 004400/18/172190/1 004400/18/172235/4	03292 03294 03296
Accessories	Battery Battery Dummy Battery	BL-5C BL-5C	067039811124245511 067039811124245511	03293 03295 03297

Notes: -

4.1 EUT description

The EUT is a triple band (900MHz/1800MHz/1900MHz) GSM Mobile Phone

The EUT was not modified during the tests.

5 EUT TEST SETUPS

For each test the EUT was exercised to find out the worst case of operation modes and device configuration.

The test setup photographs are in section 14.

6 APPLICABLE STANDARDS

The tests were performed in guidance of CFR 47 part 24, part 2, ANSI C63.4-1992 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.

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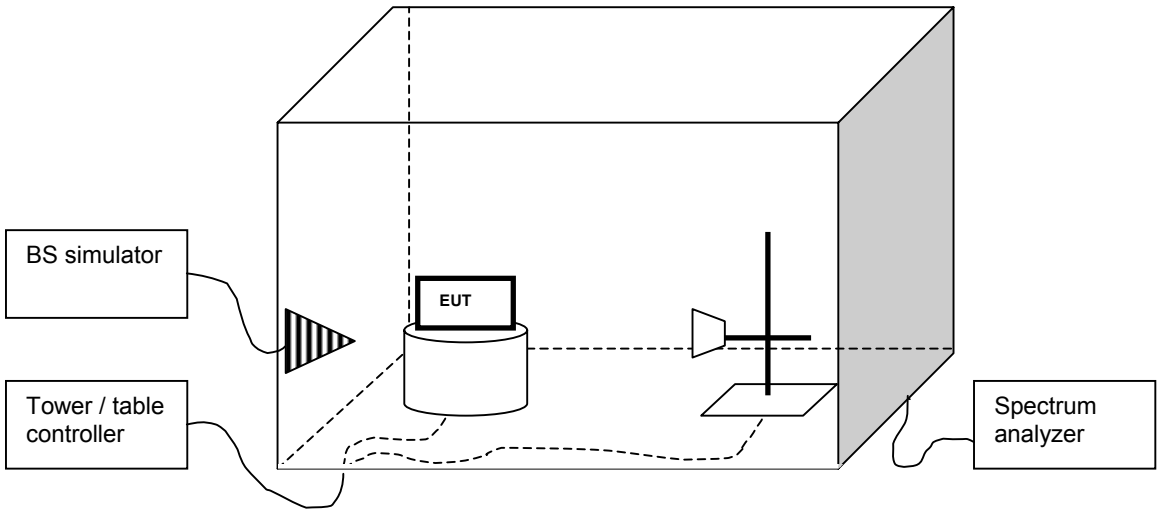
7 RADIATED RF OUTPUT POWER

EUT	03292		
Accessories	03293		
Temp, Humidity, Air Pressure	19ºC	55RH%	1020 mbar
Date of measurement	17-18.3.2003		
FCC rule part	§24.232 (b)		
RSS-133 section	6.2		
Measured by	Tero Huhtala		
Result	PASS		

7.1 Test setup

The test setup was as in the block diagram below. The EUT was set on a non-conductive turn table in a semi anechoic chamber. In the corner of the chamber there was a communication antenna, which was connected to the BS simulator located outside the chamber. 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 and change the antenna polarization. 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.



7.2 Test method

a) The maximum power level was searched by moving the turn table and 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.

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7.3 EUT operation mode

EUT operation mode	TX on, 1 time slot transmission, PRBS 2E9-1 modulation
EUT channel	512, 661, 810
EUT TX power level	0 (+30dBm)

7.4 Limit

Watts, EIRP
≤ 2

7.5 Results

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

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

where the variables are as follows:

$P_{EUT\ [dBm]}$	Measured power level (from step a in 7.2) from the EUT
$P_{Subst\_TX\ [dBm]}$	Power (from step c in 7.2) fed to the substituting antenna
$P_{Subst\_RX\ [dBm]}$	Power (from step c in 7.2) received with the spectrum analyzer
$G_{Substitute\_antenna\ [dBi]}$	Gain of the substitutive antenna over isotropic radiator
$L_{Cable\ [dB]}$	Cable attenuation from generator to substituting antenna.

EUT Channel	P_{EUT} [dBm]	P_{Subst_TX} [dBm]	P_{Subst_RX} [dBm]	L_{Cable} [dB]	Antenna gain [dBi]	Output power [dBm]	Output power [W]
512	-18.31	18.0	-27.39	5.08	8.75	30.75	1.189
661	-18.40	18.0	-28.34	5.27	8.76	31.43	1.390
810	-17.46	18.0	-27.52	5.09	8.78	31.75	1.496

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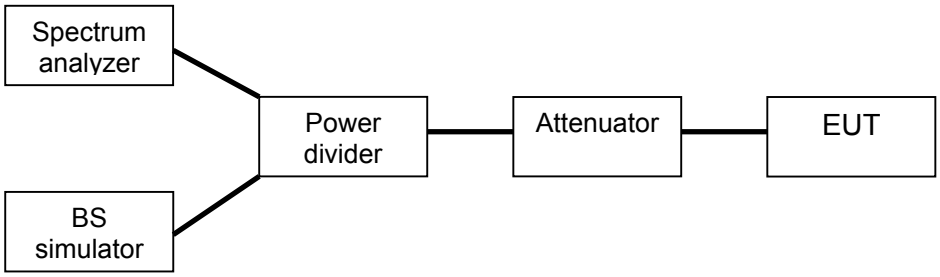
8 99% OCCUPIED BANDWIDTH

EUT	03296		
Accessories	03295		
Temp, Humidity, Air Pressure	22ºC	49RH%	1031mbar
Date of measurement	21.3.2003		
FCC rule part	§2.1049 (h)		
RSS-133 section	5.6		
Measured by	Tero Huhtala		

8.1 Test setup

The test setup was as in the block diagram below. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



8.2 EUT operation mode

EUT operation mode	TX on, 1 time slot transmission, PRBS 2E9-1 modulation
EUT channel	512, 661, 810
EUT TX power level	0 (+30dBm)

8.3 Results

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

EUT Channel	99% occupied bandwidth [kHz]
512	242.48
661	242.48
810	242.48

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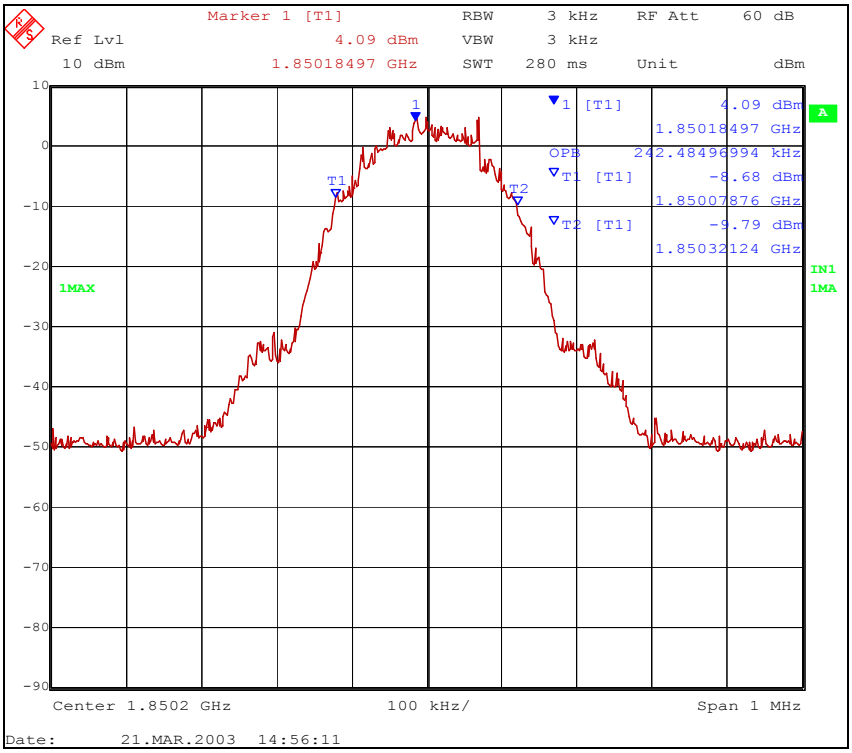
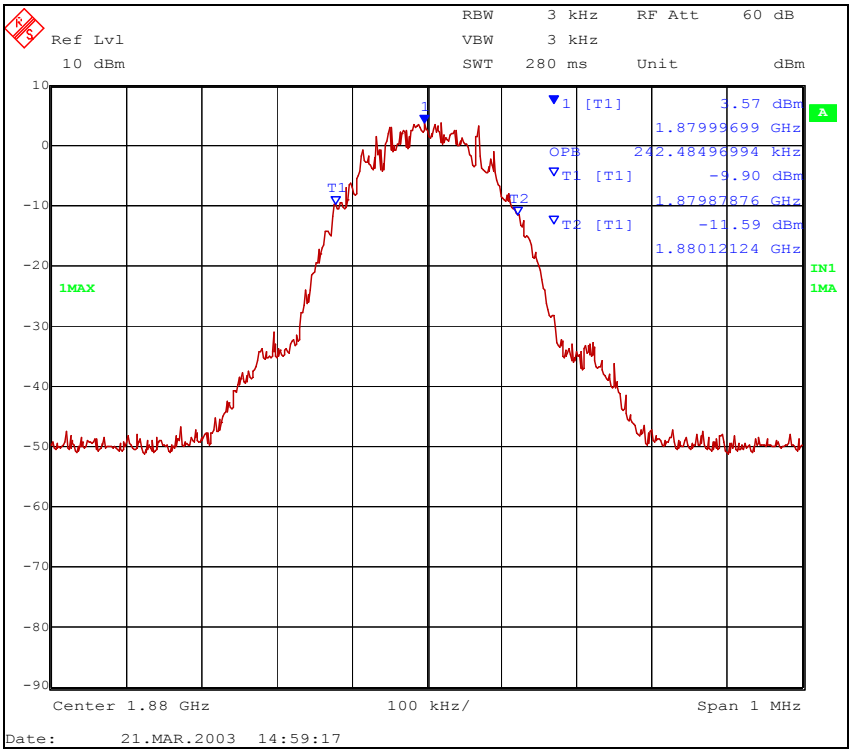
8.4 Screen shots



Picture 4. 99% occupied bandwidth, channel 512



Picture 5. 99% occupied bandwidth, channel 661

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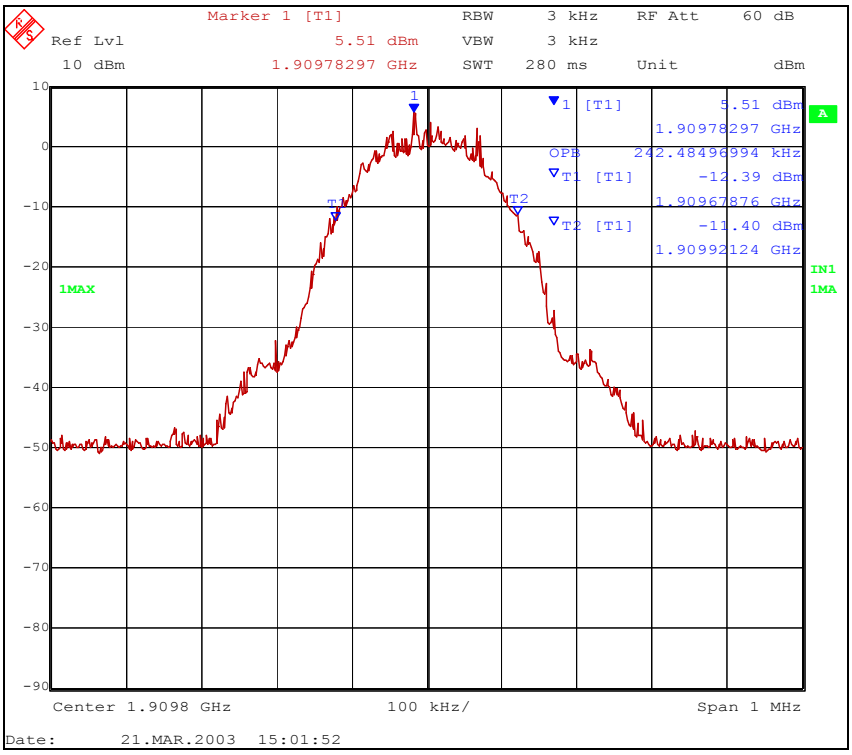

Picture 6. 99% occupied bandwidth, channel 810

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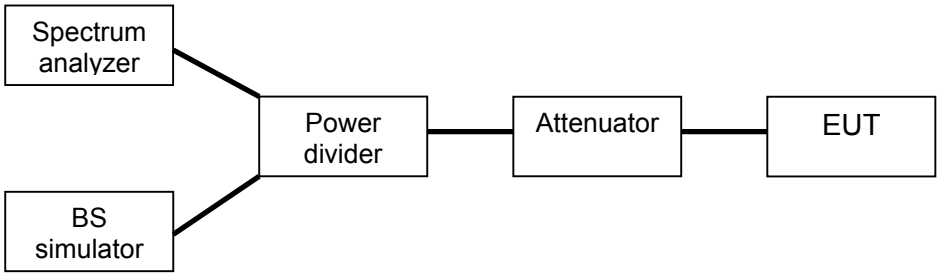
9 BAND-EDGE COMPLIANCE

EUT	03296		
Accessories	03295		
Temp, Humidity, Air Pressure	22ºC	49RH%	1031mbar
Date of measurement	21.3.2003		
FCC rule part	§24.238 (a)		
RSS-133 section	6.3		
Measured by	Tero Huhtala		
Result	PASS		

9.1 Test setup

The test setup was as in the block diagram below. 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	512, 661, 810
EUT TX power level	0 (+30dBm)

9.3 Limit

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

9.4 Results

The line in the screen shots is the -13dBm limit line. It's value has been corrected with the combined attenuation of cables, attenuator and divider, shown in the screen shots as "offset". The values used to offset the limit line were taken from table 9.5

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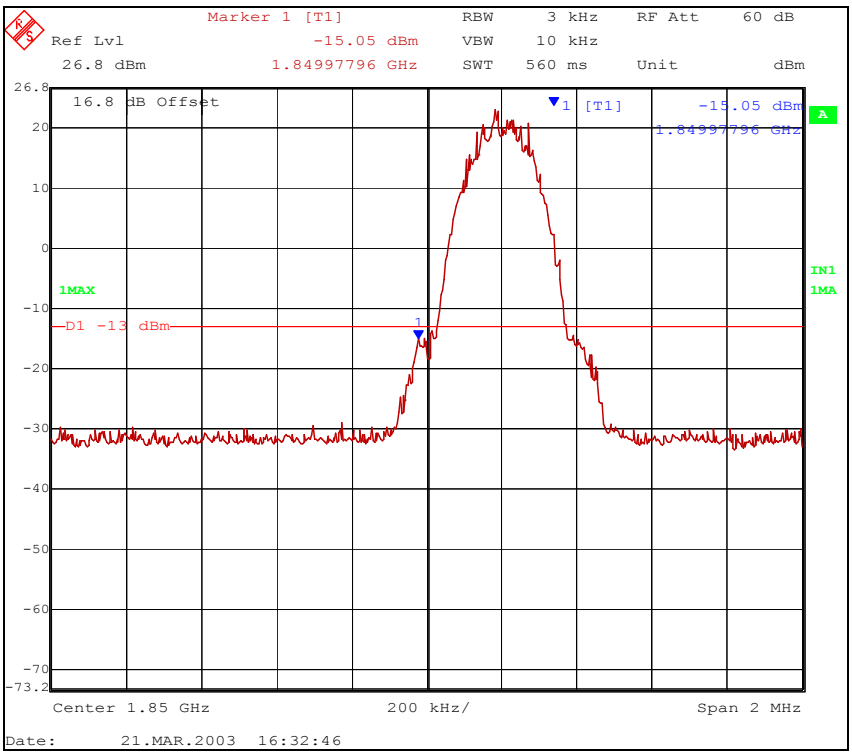
9.5 Table

EUT Channel	Signal path loss [dB]
512	16.75
810	17.20

9.6 Screen shots



Picture 7. Lower band edge, channel 512

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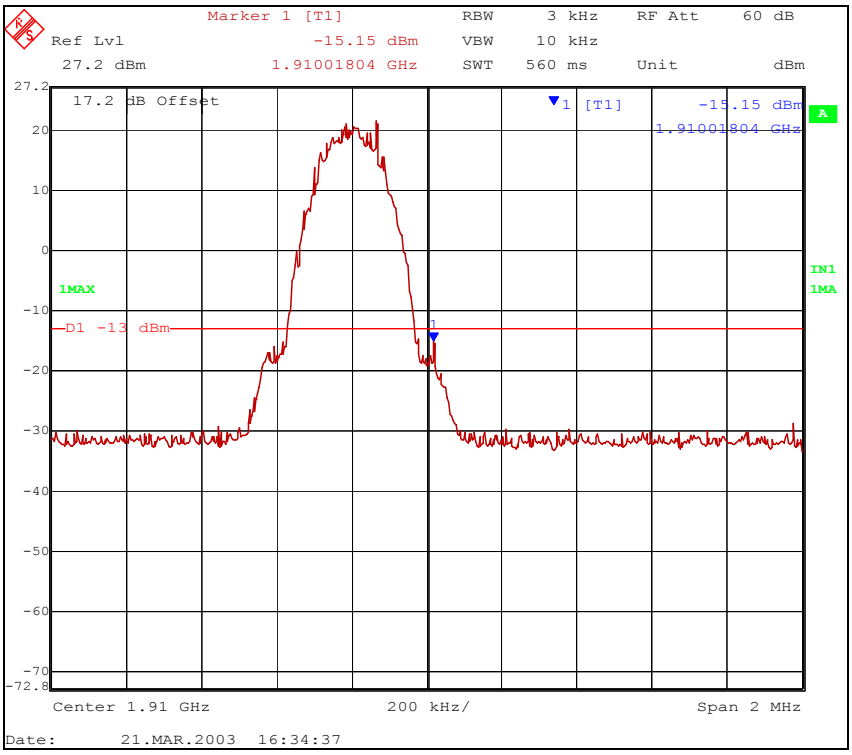

Picture 8. Higher band edge, channel 810

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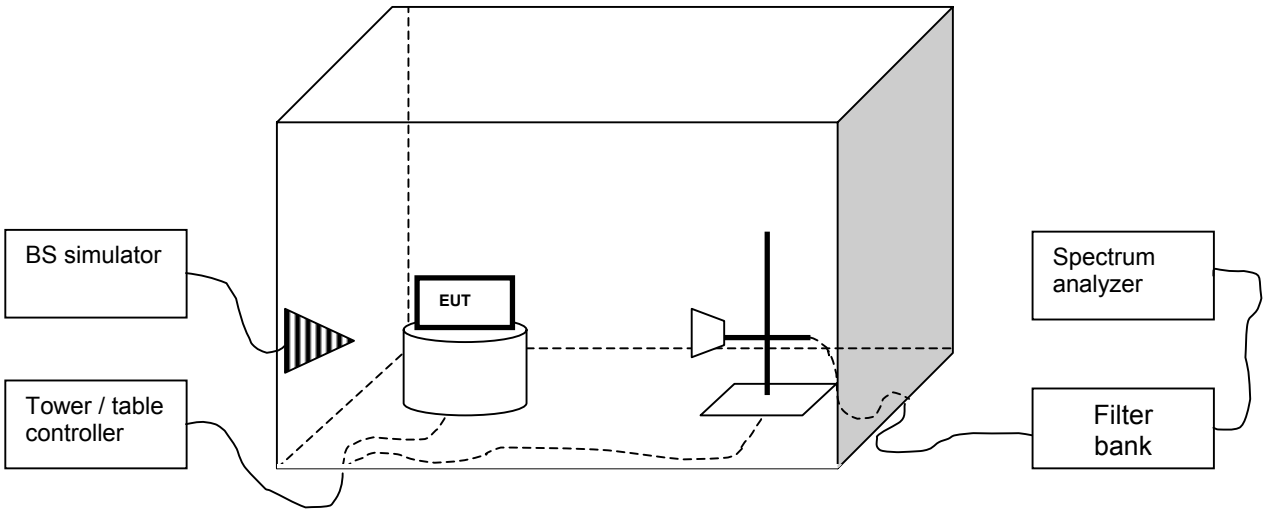
10 FIELD STRENGTH OF SPURIOUS RADIATION

EUT	03294		
Accessories	03295		
Temp, Humidity, Air Pressure	21ºC	48RH%	1008-1031mbar
Date of measurement	19-21.3.2003		
FCC rule part	§24.238 (a), §2.1053		
RSS-133 section	6.3		
Measured by	Tero Huhtala		
Result	PASS		

10.1 Test setup

The test setup was as in the block diagram below. 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 using an automated test system, where the measurement devices were controlled by a computer.



10.2 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.

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10.3 EUT operation mode

EUT operation mode	TX on, 1 time slot transmission, PRBS 2E9-1 modulation
EUT channel	512, 661, 810
EUT TX power level	0 (+30dBm)

10.4 Limit

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

10.5 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 measured at the transmitter's 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 10.2)

$P_{Subst\_TX\ [dBm]}$ Signal generator power (from step d in 10.2) fed to the substituting antenna

$L_{Cable\ [dB]}$ Loss of the cable between antenna and signal generator (from step d in 10.2)

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

Frequency [MHz]	$P_{Measured}$ [dBm]	P_{Subst_TX} [dBm]	L_{Cable} [dB]	$G_{Antenna}$ [dBi]	$P_{Emission}$ [dBm]
3700,40	-59.00	-36.10	7.95	9.6	-34.45
5550,60	-70.46	-47.20	10.05	11.15	-46.10

Table 12. Emission levels, channel 512

Frequency [MHz]	$P_{Measured}$ [dBm]	P_{Subst_TX} [dBm]	L_{Cable} [dB]	$G_{Antenna}$ [dBi]	$P_{Emission}$ [dBm]
3760,00	-62.40	-39.40	8.08	9.5	-37.98
5640,00	-70.78	-47.50	10.05	11.35	-46.20

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Table 13. Emission levels, channel 661

Frequency [MHz]	$P_{Measured}$ [dBm]	P_{Subst_TX} [dBm]	L_{Cable} [dB]	$G_{Antenna}$ [dBi]	$P_{Emission}$ [dBm]
3819,60	-65.59	-43.30	8.29	9.4	-42.19
5729,40	-71.51	-48.20	10.17	11.5	-46.87

Table 14. Emission levels, channel 810

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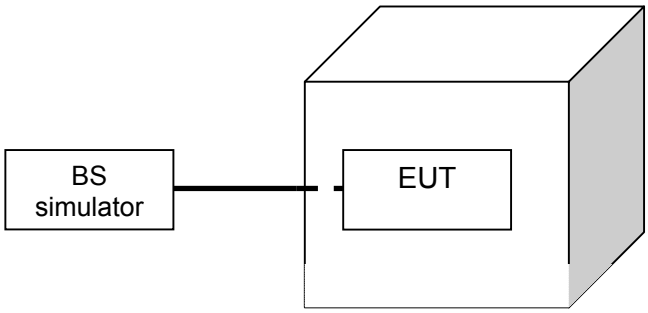
11 FREQUENCY STABILITY, TEMPERATURE VARIATION

EUT	03296		
Accessories	03295		
Temp, Humidity, Air Pressure	22ºC	49RH%	1014-1018mbar
Date of measurement	24-25.3.2003		
FCC rule part	§24.235, §2.1055 (a)(1)(b)		
RSS-133 section	7		
Measured by	Tero Huhtala		
Result	PASS		

11.1 Test setup

The test setup was as in the block diagram below. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



11.2 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)

11.3 Limit

ppm
± 2.5

11.4 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

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c) 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

11.5 Results

The measured values are reported in the table below.

Temperature [ºC]	Deviation [Hz]	ppm
-30	- *	-
-20	-1.7	0.0009
-10	+10	0.0053
0	-3.4	0.0018
10	-5.6	0.0030
20	0	0
30	-2.5	0.0013
40	+3.4	0.0018
50	-9.1	0.0048

Table 15. Frequency deviation, temperature variation

Note: * Phone not work in this temperature .

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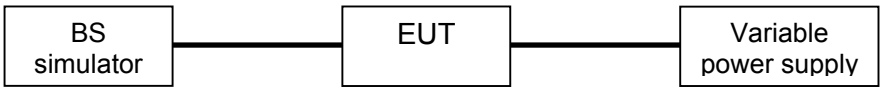
12 FREQUENCY STABILITY, VOLTAGE VARIATION

EUT	03296		
Accessories	03297		
Temp, Humidity, Air Pressure	22ºC	47RH%	1013mbar
Date of measurement	27.3.2003		
FCC rule part	§24.235, §2.1055 (d)(1)(2)		
RSS-133 section	7		
Measured by	Tero Huhtala		
Result	PASS		

12.1 Test setup

The test setup was as in the block diagram below. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



12.2 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)

12.3 Limit

ppm
± 2.5

12.4 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.

12.5 Results

The measured values are reported in the table below.

Level	Voltage [V]	Deviation [Hz]	ppm
Nominal	4.0	56.6	0.030
Battery cut-off point	3.4	54.4	0.029

Table 16. Frequency deviation, voltage variation

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13 TEST EQUIPMENT

Each test equipment is calibrated once a year.

13.1 Conducted measurements

Equipment	Manufacturer	Model
EMI receiver	Rohde & Schwarz	ESI 40
GSM MS Test Set	Hewlett-Packard	8922M
DCS/PCS MS Test Set	Hewlett-Packard	83220E
Digital radio test set	Racal	6103E
Radio communication tester	Rohde & Schwarz	CMU-200
Attenuator 10 dB	Huber+Suhner AG	6810.17.A
Step attenuator 110dB	Hewlett-Packard	8496A
Power splitter	Hewlett-Packard	11667A
High pass filter	Trilithic	WHK2010-10SS
Low pass filter	Trilithic	WLK1750-10SS
Tunable notch filter	Wainwright	WRCD1850/1910-0.2/40
Temperature chamber	Vötsch	VT4002
DC power supply	Thurlby-Thandar	PL330QMD
Multimeter	Fluke	87

13.2 Radiated measurements

Equipment	Manufacturer	Model
3m semi-anechoic chamber	TDK	
EMI receiver	Rohde & Schwarz	ESI 40
Preamplifier	Hewlett-Packard	8447F
Preamplifier	Hewlett-Packard	8449B
Biconilog antenna	EMCO	3142
Double ridged waveguide antenna	EMCO	3115
Double ridged waveguide antenna	EMCO	3115
Horn antenna	EMCO	3116
Reference dipole set	Schwarzbeck	UHAP/VHAP

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Communication antenna	EMC Automation	LPA-8020
GSM MS Test Set	Hewlett-Packard	8922M
DCS/PCS MS Test Set	Hewlett-Packard	83220E
Digital radio test set	Racal	6103E
Radio communication tester	Rohde & Schwarz	CMU-200
Signal generator	Hewlett-Packard	83640L
Step attenuator 110dB	Hewlett-Packard	8496A
Power splitter	Hewlett-Packard	11667A
High pass filter	Trilithic	WHK2010-10SS
Low pass filter	Trilithic	WLK1750-10SS
Tunable notch filter	Wainwright	WRCD1850/1910-0.2/40
Antenna/turntable controller	Deisel	HD-100
Antenna mast	Deisel	MA240
Turntable	Deisel	DS412
Temperature chamber	Vötsch	VT4002
DC power supply	Thurlby-Thandar	PL330QMD
Multimeter	Fluke	87

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14 TEST SETUP PHOTOGRAPHS

See "RH4_test_setup_photographs.doc".

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