Nemko TEST REPORT

Date:	**ESPOO 03.11.2003**	Page:	**1 (19)**
		Appendices	–

Number: No. 1 / 1

1031934

Date of handing in: 25.09.2003

Tested by:

FINAS AKKREDITOINTI SUOMI FINLAND

T017 (EN ISO/IEC 17025)

Timo Hietala, Test Engineer

Reviewed by:

Jyrki Leino, Technical Director

SORT OF EQUIPMENT:	**Triple band (900/1800/1900) GSM Mobile phone**
MARKETING NAME:	
TYPE:	***RH-6***
MANUFACTURER:	***Nokia Corporation***
CLIENT:	**Nokia Corporation / TCC Salo**
ADDRESS:	**P.O.Box 86, (Joensuunkatu 7E), FIN-24101 Salo, Finland**
TELEPHONE:	**+358 (0)50 3687123**
TEST LABORATORY:	**Nemko Oy**
FCC REG. NO.	**91087 August 27, 2001**
IC FILE NO.	**IC 4627 July 2, 2003**

SUMMARY: This test report supersedes test report 1031906 dated 14.10.2003

In regard to the performed tests the equipment under test fulfils the requirements defined in the test specifications, see page 2 for details

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Summary of performed tests and test results

Section in CFR 47	*Section in RSS-133*		*Result*
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), 2.1053	6.3	Spurious radiated 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**

Explanations:

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.

Contents

1. EUT and Accessory Information

1.1 EUT description

The EUT is a triple band (900/1800/1900MHz) GSM mobile phone. The highest internal frequency of the EUT is 3979.6 MHz.

1.2 EUT and accessories

	unit	*type*	*S/N*
EUT1	**Mobile phone**	**RH-6**	**004400/25/170120/5**
EUT2	**Mobile phone**	**RH-6**	**004400/25/170130/4**
Accessories	**Battery** **Dummy Battery** **Antenna adapter**	**BL-4C** **Special fixed, EUT2**	**0670386111243333232**

2. Standards and measurement methods

The test were performed in guidance of the CFR 47 part 24, part 2, EIA/TIA-603-A (2001) and RSS-133

3. Test results

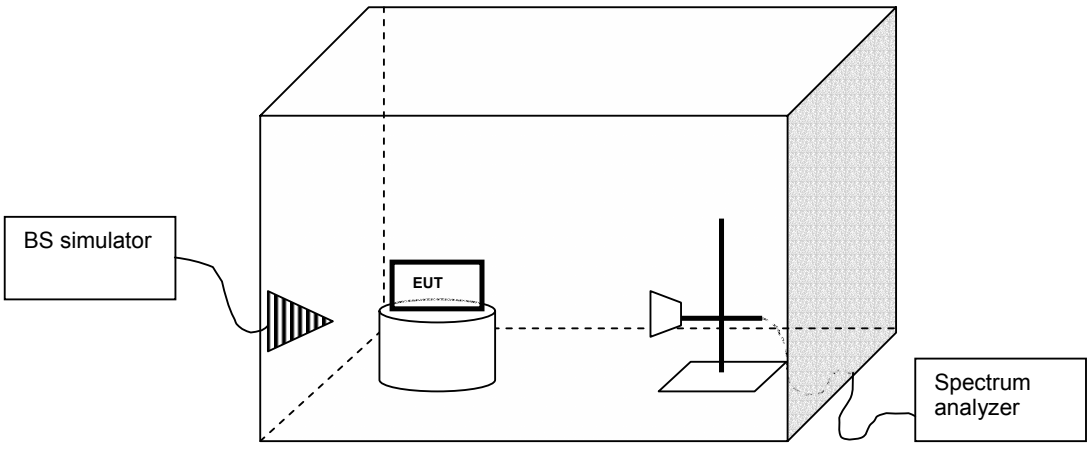
3.1 Radiated RF output power

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT1
Site name	Nemko Oy / Perkkaa
Section in CRF 47	§ 24.232, (b)
Section in RSS-133	6.2
Date of testing	29.09.2003
Test equipment	42, 89, 201, 525, 350, 184, 401
Test conditions	21 °C, 35 % RH
Test result	**PASS**

3.1.1 Test method and limit

The test was performed inside a semi anechoic shielded room. For the duration of the test the EUT was placed on a non-conductive support 0.8 m high standing on the turntable. In the corner of the chamber there was a communication antenna, which was connected to the BS simulator located outside the room. 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. (see photograph 1)



a) The maximum power level was searched at each frequency by rotating the turntable and adjusting the measuring antenna polarization and height (from 1- 4 m). This level (PEUT) was recorded. The measurements were performed the EUT at all three orthogonal planes
b) The EUT was replaced with a substituting antenna.
c) The substituting antenna was fed with the power (P_{Gen}) giving a convenient reading on the spectrum analyzer and the measuring antenna height was adjusted to obtain a maximum reading at spectrum analyzer. That reading (P_{Subst}) on spectrum analyzer was recorded.

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

$$P_{EIRP[dbm]} = P_{Measured[dB]} - P_{Subst[dB]} - L_{Cable[dB]} + G_{Antenna[dBi]} + P_{Gen[dBm]}$$

Where

$P_{Measured[dBm]}$ measured power level from the EUT

$P_{Subst[dBm]}$ measured emission level from substitutive antenna

$L_{Cable[dB]}$ loss of the cable between substitutive antenna and signal generator

$G_{Antenna[dBi]}$ gain of the substitutive antenna

$P_{Gen[dBm]}$ signal generator power fed to the substitutive antenna

3.1.2 Limit

Power level	*EIRP power (dBm)*	*EIRP power (W)*
0	**≤ 33**	**≤ 2**

3.1.3 EUT operation mode

EUT operation mode	**TX ON, GSM 1900 ch 512, + 30 dBm** **TX ON, GSM 1900 ch 661, + 30 dBm** **TX ON, GSM 1900 ch 810, + 30 dBm**
EUT operation voltage	**3.7 V**

3.1.4 Test results

EUT Channel	P_{EUT} [dBm]	P_{Subst_TX} [dBm]	P_{Subst_RX} [dBm]	Cable loss [dB]	Antenna gain [dBi]	EIRP [dBm]	EIRP [W]
512	-17.9	10	-31,25	1.75	8.6	30.2	1.047
661	-18.6	10	-31,45	1.77	8.55	29.7	0.929
810	-20.1	10	-31,10	1.79	8.5	27.8	0.597

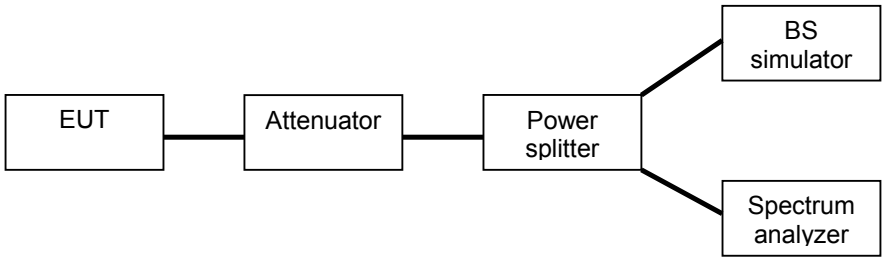
3.2 99% occupied bandwidth

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2
Site name	Nemko Oy / Perkkaa
Section in CRF 47	§ 2.1049, (h)
Section in RSS-133	5.6
Date of testing	02.10.2003
Test equipment	42, 120, 401, Weinschel 1870A sn: 1798
Test conditions	21 °C, 35 % RH
Test result	**PASS**

3.2.1 Test method and limit

The test was performed inside a shielded room. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



3.2.2 Limit

Power level	*99% occupied bandwidth*
0	**--**

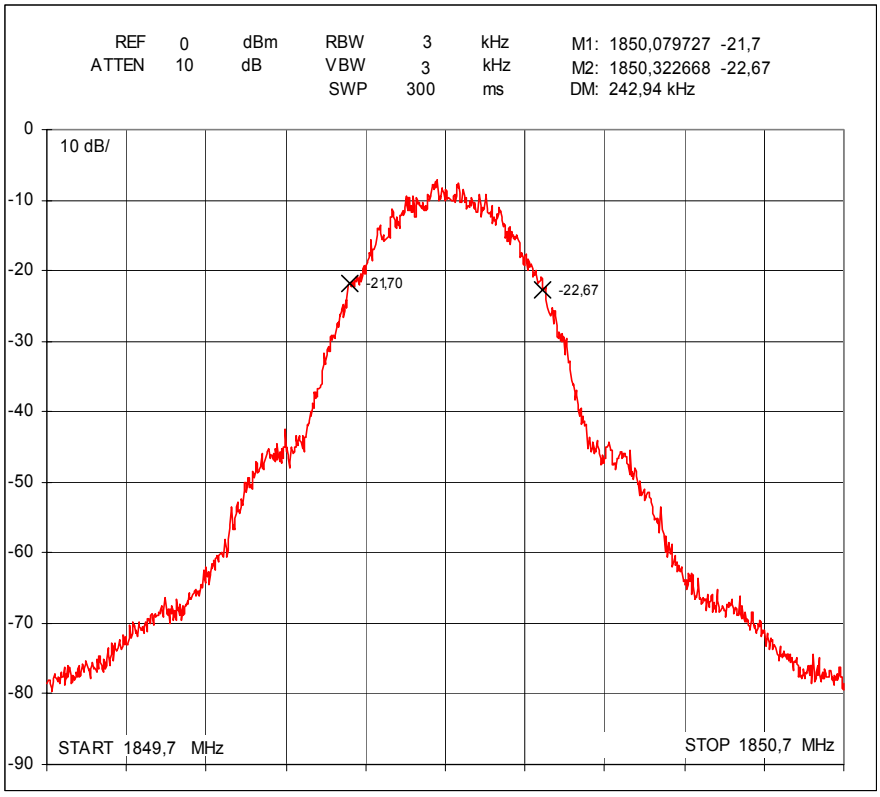
3.2.3 EUT operation mode

EUT operation mode	**TX ON, GSM 1900 ch 512, + 30 dBm** **TX ON, GSM 1900 ch 661, + 30 dBm** **TX ON, GSM 1900 ch 810, + 30 dBm**
EUT operation voltage	**3.7 V**

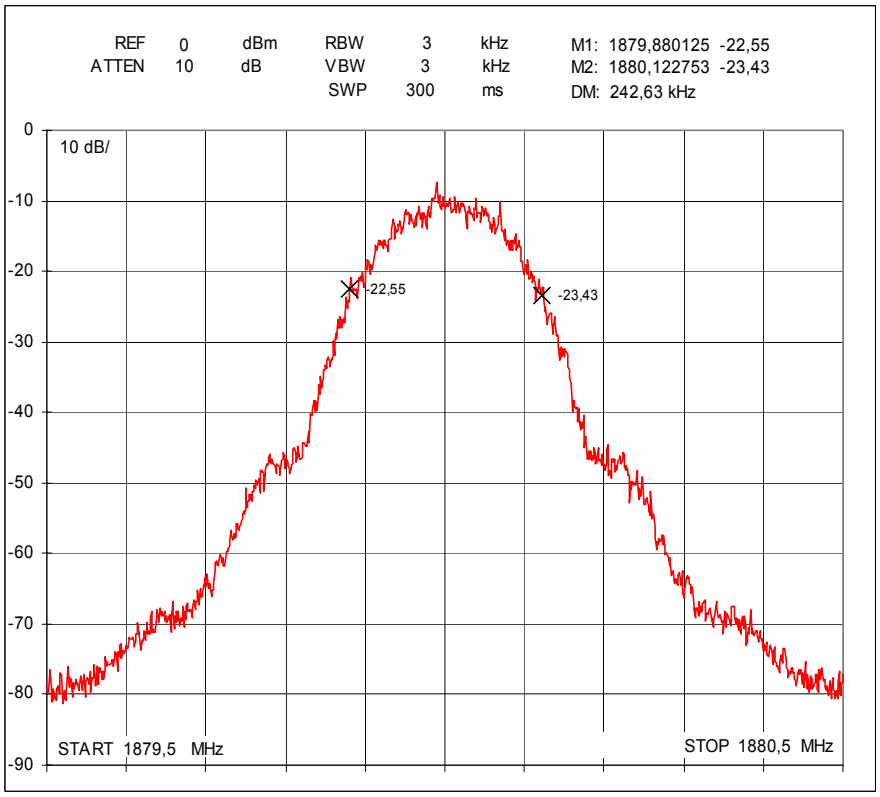
3.2.4 Test results

Channel	*99% occupied bandwidth kHz*
512	**242.94**
661	**242.63**
810	**242.46**

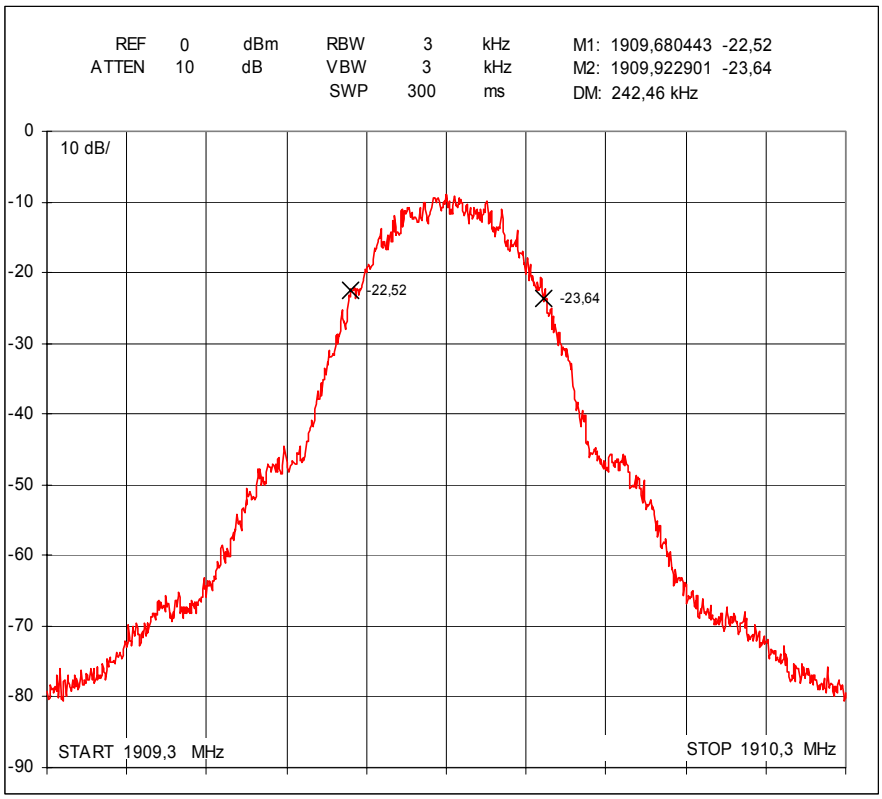
The 99% occupied bandwidth was calculated from the trace data of the spectrum analyzer.



Spectrum analyzer plot channel 512



Spectrum analyzer plot channel 661



Spectrum analyzer plot channel 810

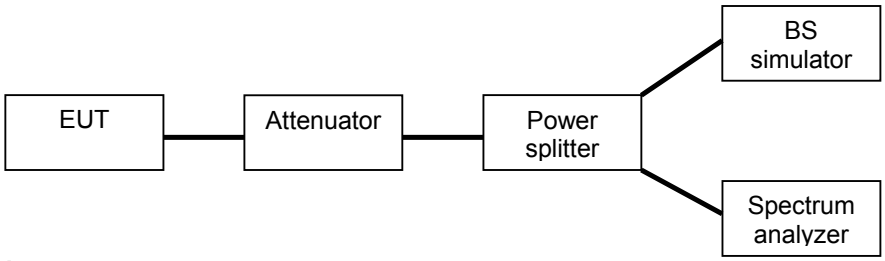
3.3 Band-edge compliance

The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2
Site name	Nemko Oy / Perkkaa
Section in CRF 47	§ 24.238 (a)
Section in RSS-133	6.3
Date of testing	02.10.2003
Test equipment	42, 120, 401, Weinschel 1870A sn: 1798
Test conditions	21 °C, 35 % RH
Test result	**PASS**

3.3.1 Test method and limit

The test was performed inside a shielded room. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.



3.3.2 Limit

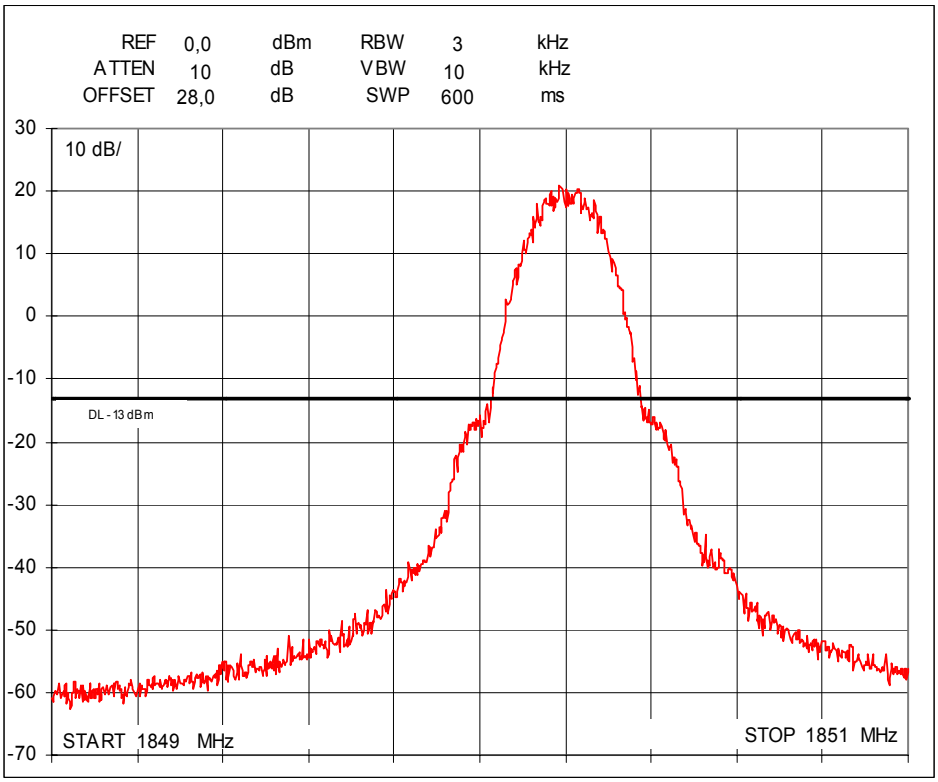
Power level	*Band-edge compliance dBm*
0	**≤ -13**

3.3.3 EUT operation mode

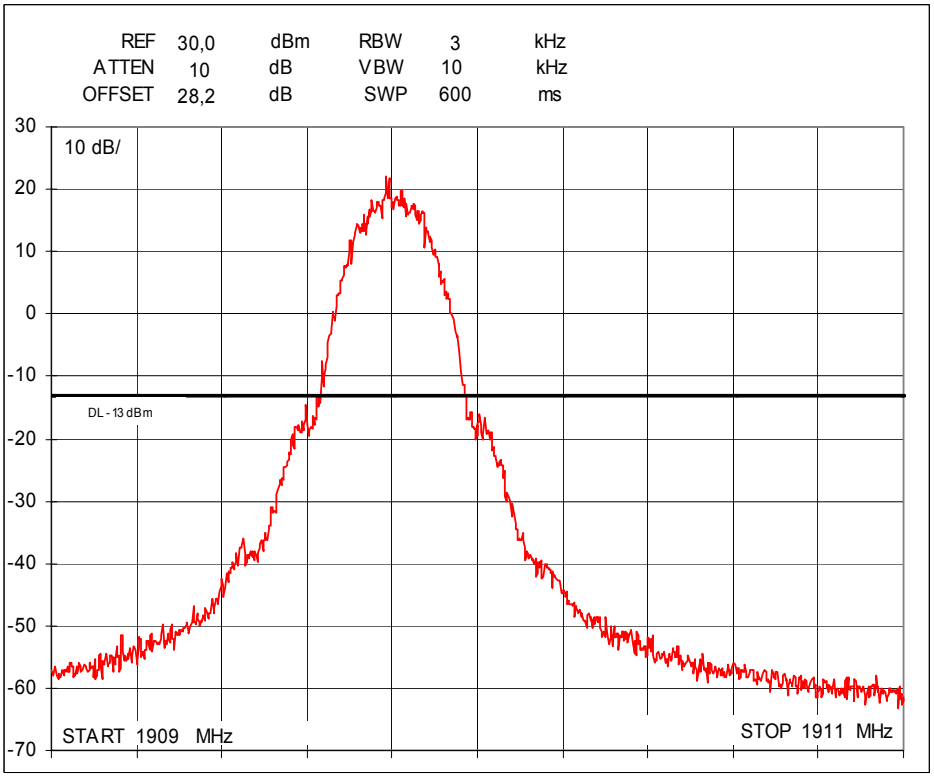
EUT operation mode	**TX ON, GSM 1900 ch 512, + 30 dBm** **TX ON, GSM 1900 ch 810, + 30 dBm**
EUT operation voltage	**3.7 V**

3.3.4 Test results

The line in the spectrum analyzer plot is the -13dBm limit line. The band edge is at the middle of the screen. The results were corrected with combined attenuation of the cables, attenuator and power divider set as “offset” in the spectrum analyzer.



Spectrum analyzer plot channel 512



Spectrum analyzer plot channel 810

3.4 Spurious radiated emission

EUT	EUT1
Site name	Nemko Oy / Perkkaa
Section in CRF 47	§ 24.238 (a), § 2.1053
Section in RSS-133	6.3
Date of testing	29.09.2003
Test equipment	350, 42, 89, 84, 85, 86, 87, 211, 212, 525, 199, 65, 66, 184, 401, hp 8341B s/n: 2802A01090
Test conditions	21 °C, 35 % RH
Test Result	**PASS**

3.4.1 Test method and limit

The test was performed inside a semi anechoic shielded room. For the duration of the test the EUT was placed on a non-conductive support 0.8 m high standing on the turntable. In the corner of the chamber there was a communication antenna, which was connected to the BS simulator located outside the room. 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.
a) The maximum power level was searched at each frequency by rotating the turntable and adjusting the measuring antenna polarization and height (from 1- 4 m). This level (PEUT) was recorded. The measurements were performed the EUT at all three orthogonal planes
b) The EUT was replaced with a substituting antenna.
c) The substituting antenna was fed with the power (P_{Gen}) giving a convenient reading on the spectrum analyzer and the measuring antenna height was adjusted to obtain a maximum reading at spectrum analyzer. That reading (P_{Subst}) on spectrum analyzer was recorded.

limit

Frequency MHz	*Level dBm*
30 - 19100	**- 13**

3.4.2 EUT operation mode

EUT operation mode	**TX on, 1 time slot transmission, PRBS 2E9-1 modulation**
EUT channel	**GSM 1900: ch 512**
EUT channel	**GSM 1900: ch 661**
EUT channel	**GSM 1900: ch 810**
EUT TX power level	**GSM 1900: + 30 dBm**
EUT operation voltage	**3.7 V**

3.4.3 Test results

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

$$P_{Emission[dbm]} = P_{Measured[dB]} - P_{Subst[dB]} - L_{Cable[dB]} + G_{Antenna[dBi]} + P_{Gen[dBm]}$$

Where

$P_{Measured[dBm]}$ measured emission level

$P_{Subst[dBm]}$ measured emission level from substitutive antenna

$L_{Cable[dB]}$ loss of the cable between substitutive antenna and signal generator

$G_{Antenna[dBi]}$ gain of the substitutive antenna

$P_{Gen[dBm]}$ signal generator power fed to the substitutive antenna

Calculation example:

$$P_{3700.4[dbm]} = -21.7_{Measured[dB]} - (1.5)_{Subst[dB]} - 4.5_{Cable[dB]} + 9.4_{Antenna[dBi]} + (-10)_{Gen[dBm]}$$

$$= -28.3_{[dBm]}$$

TX GSM 1900 (ch 512)

Frequency MHz	Result dBm	Limit dBm	Margin dB
3700.4	-28.3	**- 13**	15.3
5550.6	-36.0	**- 13**	23.0
7400.8	-43.6	**- 13**	30.6
9251.0	-37.2	**- 13**	24.2
11101.2	-39.5	**- 13**	26.5
12951.4	-44.6	**- 13**	31.6
14801.6	-43.8	**- 13**	30.8
16651.8	-43.5	**- 13**	30.5
18502.0	-41.4	**- 13**	28.4

TX GSM 1900 (ch 661)

Frequency MHz	Result dBm	Limit dBm	Margin dB
3760.0	-31.3	**- 13**	18.3
5640.0	-35.7	**- 13**	22.7
7520.0	-46.0	**- 13**	33.0
9400.0	-37.8	**- 13**	24.8
11280.0	-36.4	**- 13**	23.4
13160.0	-44.2	**- 13**	31.2
15040.0	-45.4	**- 13**	32.4
16920.0	-42.4	**- 13**	29.4
18800.0	-40.5	**- 13**	27.5

TX GSM 1900 (ch 810)

Frequency MHz	Result dBm	Limit dBm	Margin dB
3819.6	-38.3	**- 13**	25.3
5729.4	-31.6	**- 13**	18.6
7639.2	-44.8	**- 13**	31.8
9549.0	-33.4	**- 13**	20.4
11458.8	-37.9	**- 13**	24.9
13368.6	-41.3	**- 13**	28.3
15278.4	-46.9	**- 13**	33.9
17188.2	-40.9	**- 13**	27.9
19098.0	-34.9	**- 13**	21.9

3.5 Frequency stability, temperature variation

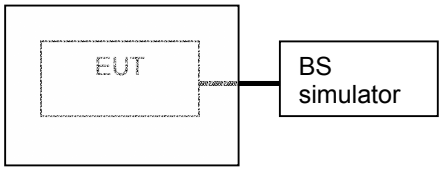
The test was performed as a compliance test. The test parameters concerned were as follows:

EUT	EUT2
Site name	Nemko Oy / Perkkaa
Section in CRF 47	24.235, 2.1055 (a)(1)(b)
Section in RSS-133	7
Date of testing	27.09.2003
Test equipment	401, 157
Test conditions	21 °C, 35 % RH
Test result	**PASS**

3.5.1 Test method and limit

The test was performed EUT placed inside a temperature chamber. The BS simulator was used to set the TX channel and power level and modulate the TX signal with different bit patterns.

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) 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



3.5.2 Limit

Frequency error ppm
± 2.5

3.5.3 EUT operation mode

EUT operation mode	***TX ON, GSM 1900 ch 661, + 30 dBm***
EUT operation voltage	**3.7 V**

3.5.4 Test results

Temperature [ºC]	Deviation [Hz]	Deviation [ppm]
-30	36	0.019
-20	32	0.017
-10	33	0.018
0	38	0.020
10	38	0.020
20	38	0.020
30	38	0.020
40	39	0.021
50	43	0.023

Frequency deviation, temperature variation

3.6 Frequency stability, voltage variation

The test was performed as a compliance test. The test parameters concerned were as follows:

Site name	Nemko Oy / Perkkaa
Section in CRF 47	24.235, 2.1055 (d)(1)(2)
Section in RSS-133	7
Date of testing	28.09.2003
Test equipment	401, 76
Test conditions	21 °C, 35 % RH
Test result	**PASS**

3.6.1 Test method and limit

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

The EUT battery was replaced with an adjustable power supply. The frequency stability was measured at nominal voltage and in 0.1V increments the battery cut-off point.

3.6.2 Limit

Frequency error ppm
± 2.5

3.6.3 EUT operation mode

EUT operation mode	***TX ON, GSM 1900 ch 661, + 30 dBm***
EUT operation voltage	**3.7 -3.25 V**

3.6.4 Test results

Battery level	Voltage [V]	Deviation [Hz]	Deviation [ppm]
Nominal	3.7	38	0.020
	3.6	38	0.020
	3.5	38	0.020
	3.4	38	0.020
	3.3	38	0.020
Cut off-point	3.25	38	0.020

Frequency deviation, voltage variation

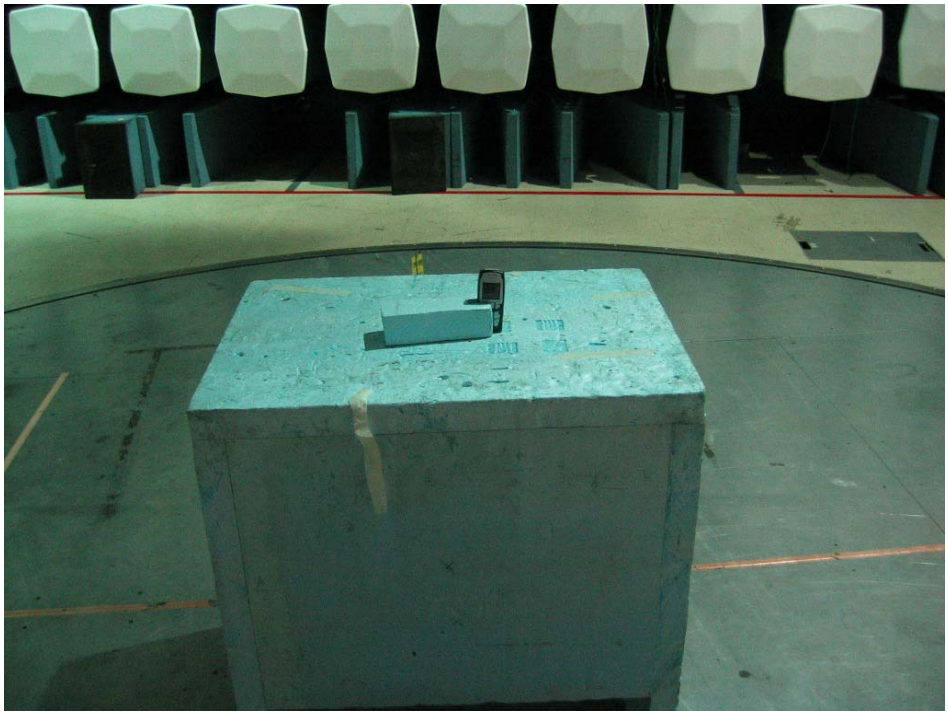
4. List of test equipment

Each active test equipment is calibrated once a year, antennas every 18 months and other passive equipments every 24 months.

Nr.	Equipment	Type	Manufacturer	Serial number
42	Spectrum analyzer	8566B	Hewlett Packard	2637A04102
65	RF amplifier	6616-605N	Watkins-Johnson	
66	RF amplifier	5325-507N	Watkins-Johnson	
76	Power supply	B32-30R	Oltronix	537
79	Power supply	B60-15R	Oltronix	512
84	Antenna	643	Narda	7911
85	Antenna	642	Narda	7912
86	Antenna	640	Narda	09
87	Antenna	639	Narda	7909
89	Antenna	3147	EMCO	9202-1078
120	RF High-Power Attenuator	765	Narda	
157	Temp. test chamber	VMT 04/240	Vötch	31884
184	Temp. & humidity meter	H MI 32	Vaisala	63837
199	RF-Amplifier	ZHL-1042J	Mini-Circuits	
201	RF-Generator	2042	Marconi	119571/062
205	RF-Amplifier	ZHL-1042J	Mini-Circuits	012288-11
211	Bandpass Filter	TTF 1500-5-5EE	Telonic Berkeley Inc	93037-3
212	Bandpass Filter	TTF 3000-5-5EE	Telonic Berkeley Inc	93039-1
319	Antenna	CBL6112	Chase	2018
338	Test receiver	ESS	Rohde & Schwarz	847151/009
348	Shielded room	RFSD-100	Euroshield Oy	1320
350	Semianechoic shielded room	RFD-F-100	Euroshield Oy	1327
351	RF generator	SMT 06	Rohde & Schwarz	845715/001
397	RF-amplifier	ZFL-2000	Mini-Circuits	
401	GSM MS Test System	HP 8922P	Hewlett Packard	3639U01643
525	Double-Ridged Horn	3115	Emco	6691

5. Photographs

See "1031906_test_setup_photographs.doc"



Photograph 1. Spurious radiated emissions test setup