# GSM1900 test report
# For
# RM-36



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# CONTENTS





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# 1 LABORATORY INFORMATION

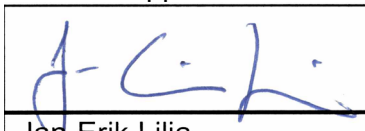
| | |
|---|---|
| Test laboratory: | TCC Tampere<br>Sinitaival 5<br>FIN-33720 TAMPERE<br><br>Tel. +358 7180 46800<br>Fax. +358 7180 46880 |
| FCC registration number:<br>IC file number: | 94436 (June 14, 2002)<br>IC 3608 (March 5, 2003) |

# 2 CUSTOMER INFORMATION

| | |
|---|---|
| Client: | Nokia Corporation<br>P.O. Box 68<br>Sinitaival 5<br>FIN-33721 TAMPERE, FINLAND<br>Tel. +358 (0) 7180 08000<br>Fax. +358 (0) 7180 46880 |
| Contact person: | Tero Huhtala |
| Receipt of EUT: | 20.12.2004 |
| Date of testing: | 22-29.12.2004 |
| Date of report: | 30.12.2004 |

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:



Jan-Erik Lilja
Senior Test Engineer

# 3 SUMMARY OF TEST RESULTS

| Section in CFR 47 | Section in RSS-133 | | Result |
|---|---|---|---|
| §2.1046 (a) | 6.2 | Conducted RF output | - |
| §24.232 (b) | 6.2 | Radiated RF output | - |
| §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 emissions at antenna terminals | - |
| §24.238 (a), §2.1053 | 6.3 | Spurious radiated emission | 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
- 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** | Phone | RM-36 | 004400471619757 | 40140 |
| | Phone | RM-36 | 004400471619989 | 40141 |
| | Phone | RM-36 | 004400471619914 | 40145 |
| **Accessories** | Charger | ACP-12 | - | 40121 |
| | Battery | BL-5C | - | 40123 |
| | Battery | BL-5C | - | 40124 |
| | Dummy battery | 01-00 | - | 40146 |

Notes: -

## 4.1 EUT description

The EUT is a triple band (GSM 900//1800/1900) 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.

# 6 APPLICABLE STANDARDS

The tests were performed in guidance of CFR 47 part 24, 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.



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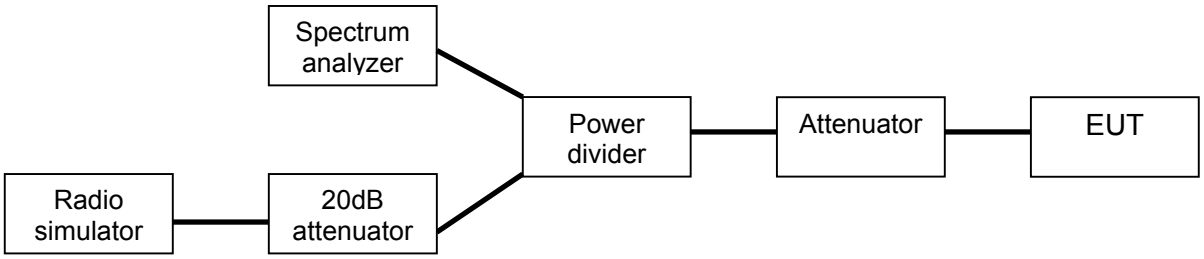
# 7 99% OCCUPIED BANDWIDTH

| | | | |
|---|---|---|---|
| EUT | 40141 | | |
| Accessories | 40124 | | |
| Temp, Humidity, Air Pressure | 21 ºC | 46 RH% | 1010 mbar |
| Date of measurement | 27.12.2004 | | |
| FCC rule part | §2.1049 (h) | | |
| RSS-133 section | 5.6 | | |
| Measured by | Jari Jantunen | | |

## 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 | 661 |
| EUT TX power level | 0 (+30dBm) |

## 7.3 Results

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

| EUT Channel | EUT operation mode | 99% occupied bandwidth [kHz] |
|---|---|---|
| 661 | GSM | 245.192 |
| 661 | EGPRS | 233.974 |



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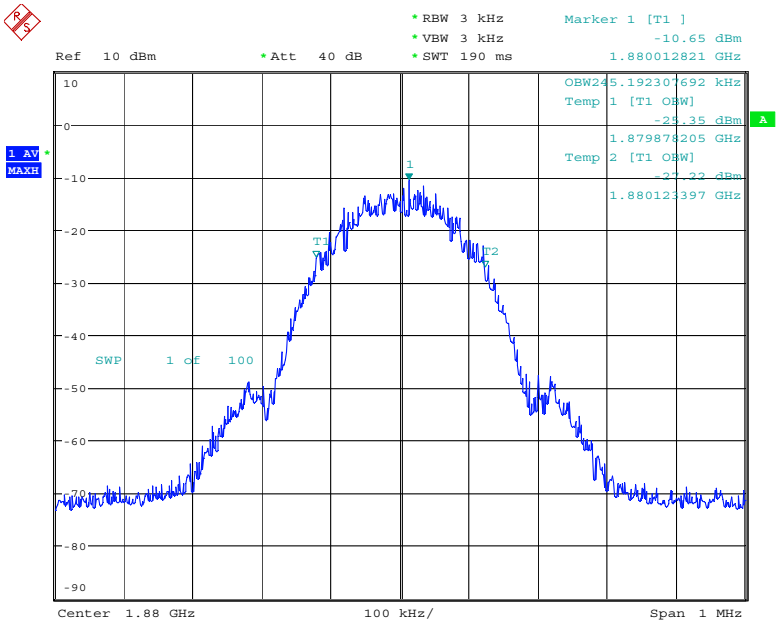
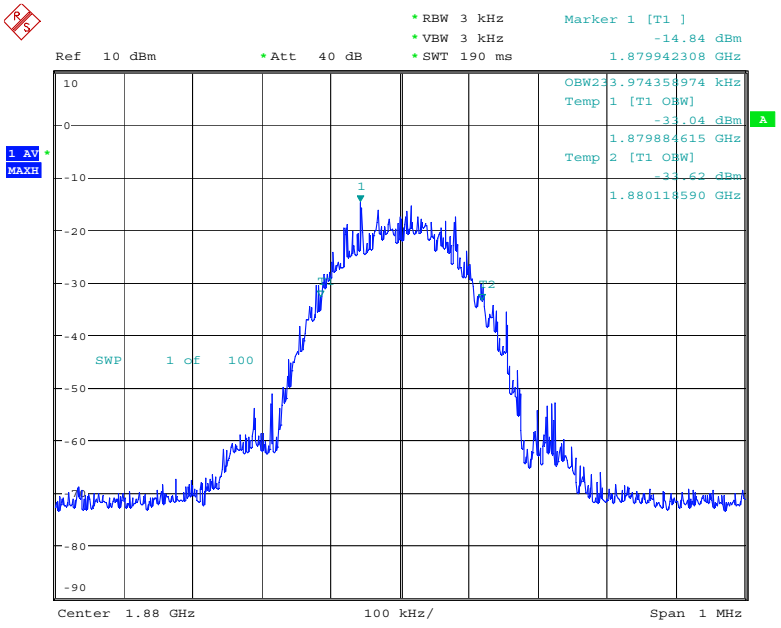
## 7.4 Screen shot




**Picture 1 99% occupied bandwidth, GSM 1900 channel 661**




**Picture 2 99% occupied bandwidth, EGPRS 1900 channel 661**



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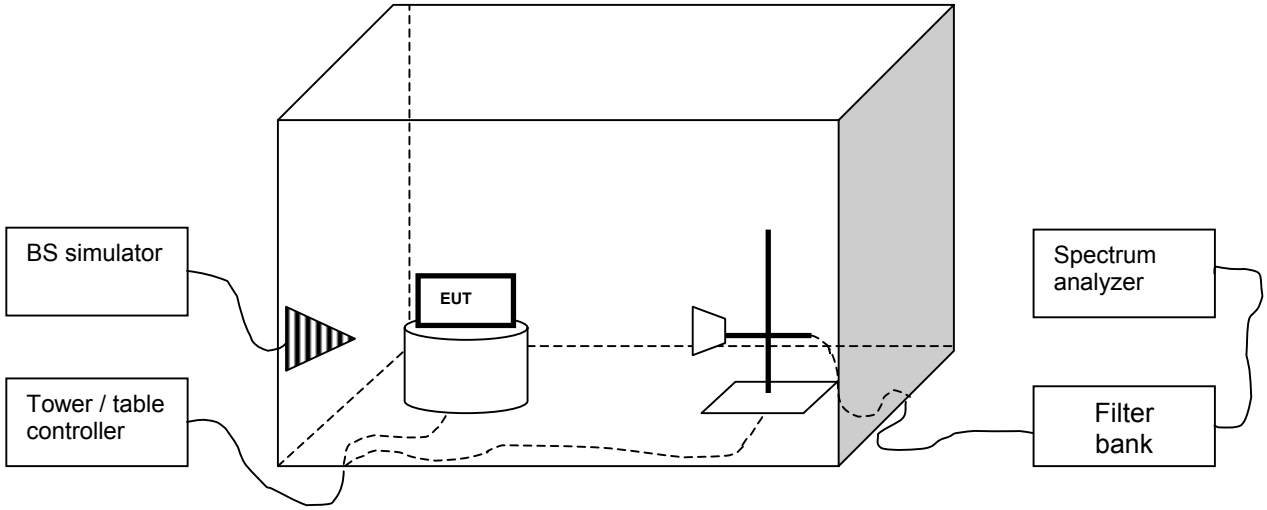
# 8 BANDEDGE COMPLIANCE

| | | | |
|---|---|---|---|
| EUT | 40140 | | |
| Accessories | 40121, 40123 | | |
| Temp, Humidity, Air Pressure | 21 ºC | 486RH% | 1010 mbar |
| Date of measurement | 27.12.2004 | | |
| FCC rule part | §24.238 (a) | | |
| RSS-133 section | 6.3 | | |
| Measured by | Jari Jantunen | | |
| Result | PASS | | |

## 8.1 Test setup

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




## 8.2 EUT operation mode

| | |
|---|---|
| EUT operation mode | TX on, 1 time slot transmission, PRBS 2E9-1 modulation |
| EUT channel | See section 8.5 |
| EUT TX power level | 0 (+30dBm) |



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## 8.3 Spectrum analyzer settings

| Parameter | Value |
|---|---|
| Center frequency | Band edge frequency (lo & hi) |
| Span | 2MHz |
| Sweep mode | Count, 10 sweeps |
| RBW | 3kHz |
| VBW | 3kHz |
| Detector | Peak |
| Internal attenuator | 40dB |
| Reference level | 10dBm |
| Trace | Max hold |

## 8.4 Limit

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

## 8.5 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 | EUT operation mode | Level [dBm] |
|---|---|---|
| 512 | GSM | -17.90 |
| 810 | GSM | -16.75 |
| 512 | EGPRS | -22.96 |
| 810 | EGPRS | -27.63 |



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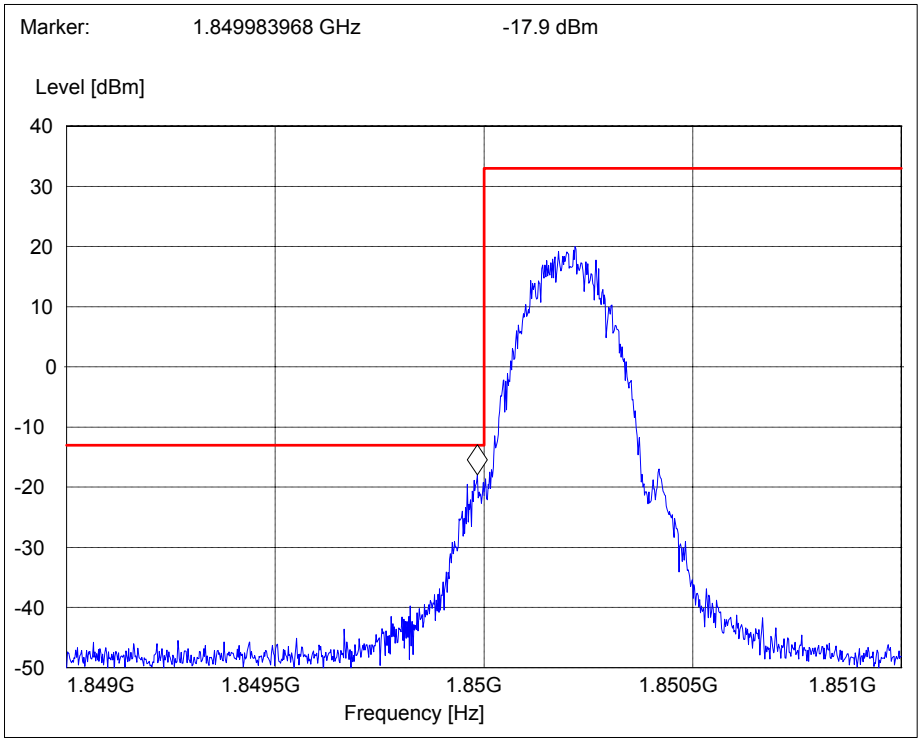
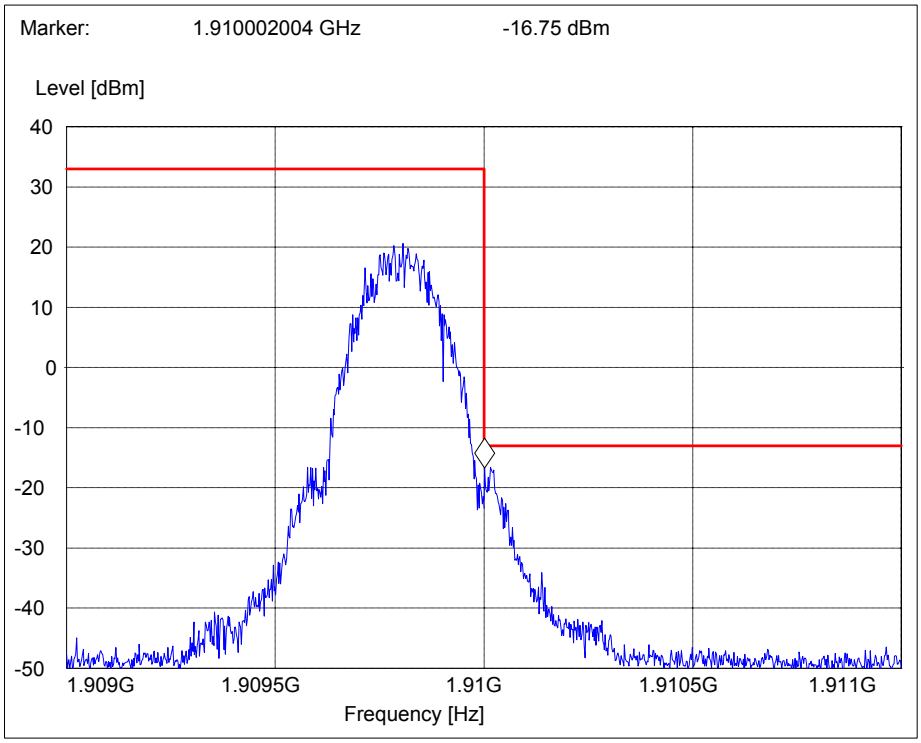
## 8.6 Screen shots




**Picture 3 Lower bandedge, GSM 1900 channel 512**




**Picture 4 Upper bandedge, GSM 1900 channel 810**



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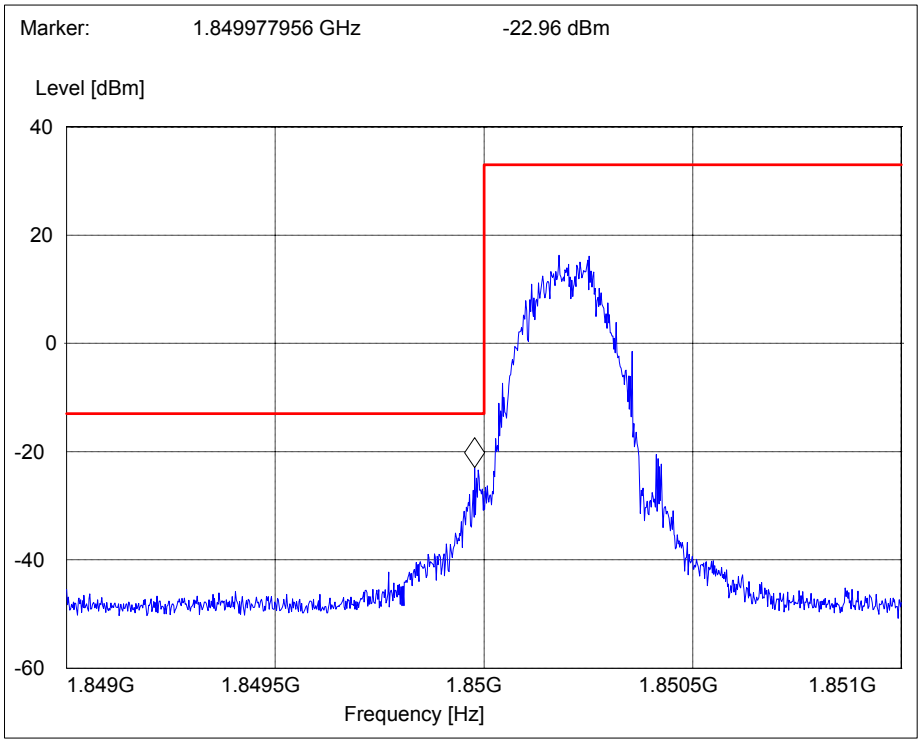
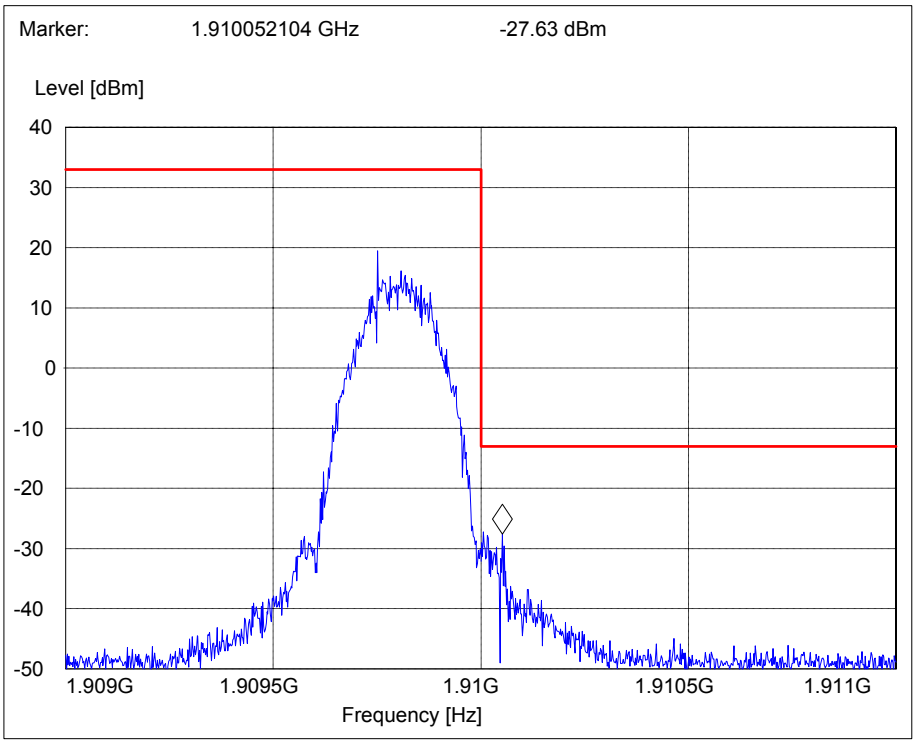



**Picture 5 Lower bandedge, EGPRS 1900 channel 512**




**Picture 6 Upper bandedge, EGPRS 1900 channel 810**



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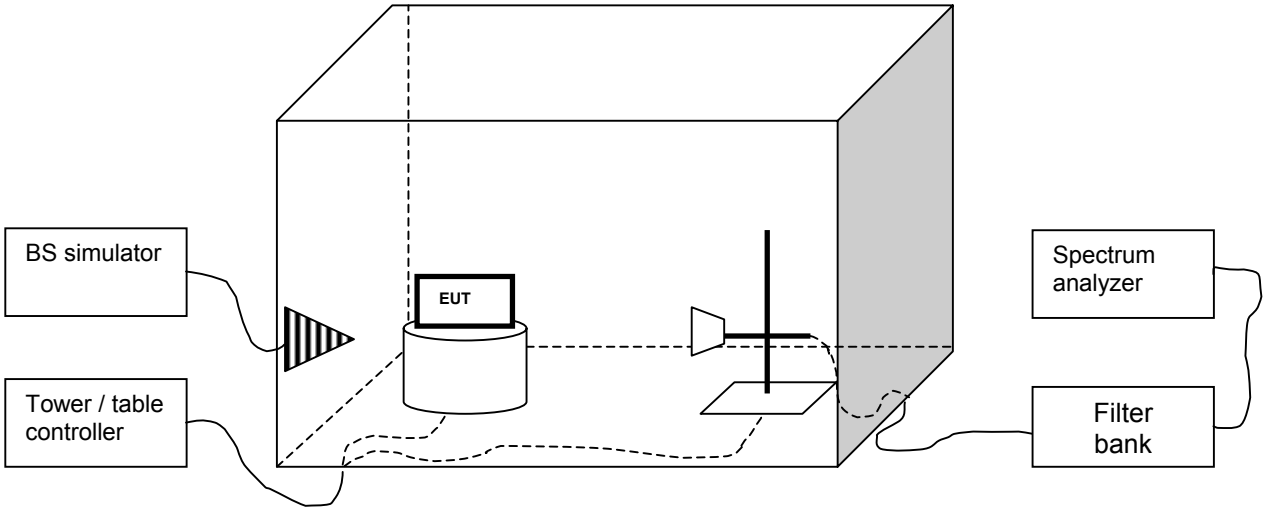
# 9 SPURIOUS RADIATED EMISSION

| | | | |
|---|---|---|---|
| EUT | 40140 | | |
| Accessories | 40121, 40123 | | |
| Temp, Humidity, Air Pressure | 22°C | 47 %RH | 998 mbar |
| Date of measurement | 22.12.2004 | | |
| FCC rule part | §24.238 (a), §2.1053 | | |
| RSS-133 section | 6.3 | | |
| Measured by | Jan-Erik Lilja | | |
| Result | PASS | | |

## 9.1 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 using an automated test system, where the measurement devices were controlled by a computer.




## 9.2 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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## 9.3 EUT operation mode

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

## 9.4 Limit

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

## 9.5 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.

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

$$Correction\ \ Factor = P_{measured[dBm]} - P_{SubstTX[dBm]} - L_{Cable[dB]} + G_{Antenna[dBi]}$$

where the variables are as follows:

$P_{Measured\ [dBm]}$ Measured emission level (from step b in 9.2)

$P_{Subst\_TX\ [dBm]}$ Signal generator power (from step d in 9.2) fed to the substituting antenna

$L_{Cable\ [dB]}$ Loss of the cable between antenna and signal generator (from step d in 9.2)

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

Correction Factor Factor [dB] to be added to $P_{Measured\ [dBm]}$

Example Calculation:

| Frequency [MHz] | $P_{Measured}$ [dBm] | $P_{Subst\ TX}$ [dBm] | $L_{Cable}$ [dB] | $G_{Antenna}$ [dBi] | $P_{Emission}$ [dBm] |
|---|---|---|---|---|---|
| 3760,02 | -57.3 | -48.24 | -9.05 | 9.29 | -48 |

**Table 1 Emission levels, channel 661**

| Frequency [MHz] | $P_{Measured}$ [dBm] | Correction Factor [dB] | $P_{Emission}$ [dBm] |
|---|---|---|---|
| 3760,02 | -57.3 | -9.3 | -48 |
| 5640,00 | -61 | -11.80 | -49.2 |
| 7520,00 | -64.1 | -14.90 | -49.2 |
| 9400,00 | -66.5 | -19.0 | -47.5 |
| 11280,00 | -64.4 | -19.60 | -44.8 |
| 13160,00 | -65.5 | -21.50 | -44.0 |
| 15040,00 | -66.3 | -22.80 | -43.5 |
| 16920,00 | -67.1 | -25.90 | -41.2 |



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## 9.6 EUT operation mode

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

**Table 2 Emission levels, EGPRS 1900 channel 661**

| Frequency [MHz] | $P_{Measured}$ [dBm] | Correction Factor | $P_{Emission}$ [dBm] |
|---|---|---|---|
| 3760,00 | -60.6 | -9.3 | -51.30 |
| 5640,00 | -62.1 | -11.80 | -50.30 |
| 7520,00 | -62.3 | -14.90 | -47.40 |
| 9400,00 | -67 | -19.0 | -48.00 |
| 11280,00 | -65.5 | -19.60 | -45.90 |
| 13160,00 | -64.1 | -21.50 | -42.60 |
| 15040,00 | -65.2 | -22.80 | -42.40 |
| 16920,00 | -67.5 | -25.90 | -41.60 |



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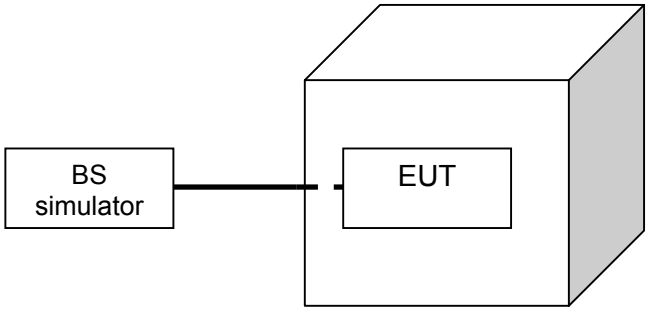
# 10 FREQUENCY STABILITY, TEMPERATURE VARIATION

| | | | |
|---|---|---|---|
| EUT | 40145 | | |
| Accessories | 40124 | | |
| Temp, Humidity, Air Pressure | 19 ºC | 50 RH% | 1008 mbar |
| Date of measurement | 28.12.2004 | | |
| FCC rule part | §24.235, §2.1055 (a)(1)(b) | | |
| RSS-133 section | 7 | | |
| Measured by | Jari Jantunen | | |
| Result | PASS | | |

## 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

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



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

### 10.5 Results

**Table 3. Frequency deviation, temperature variation**

| Temperature [ºC] | Deviation [Hz] | Deviation [ppm] |
|---|---|---|
| -20 | 27 | 0.014361702 |
| -10 | 23 | 0.012234043 |
| 0 | -25 | -0.013297872 |
| 10 | -27 | -0.014361702 |
| 20 | 28 | 0.014893617 |
| 30 | 25 | 0.013297872 |
| 40 | 25 | 0.013297872 |
| 50 | -20 | -0.010638298 |



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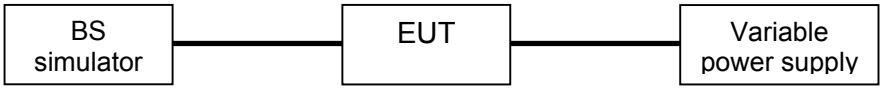
# 11 FREQUENCY STABILITY, VOLTAGE VARIATION

| | | | |
|---|---|---|---|
| EUT | 40145 | | |
| Accessories | 40146 | | |
| Temp, Humidity, Air Pressure | 19 ºC | 49 RH% | 1015 mbar |
| Date of measurement | 29.12.2004 | | |
| FCC rule part | §24.235, §2.1055 (d)(1)(2) | | |
| RSS-133 section | 7 | | |
| Measured by | Jari Jantunen | | |
| Result | PASS | | |

## 11.1 Test setup

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




## 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

| Frequency deviation [ppm] |
|---|
| ± 2.5 |

## 11.4 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.

## 11.5 Results

**Table 4. Frequency deviation, voltage variation**

| Level | Voltage [V] | Deviation [Hz] | Deviation [ppm] |
|---|---|---|---|
| Nominal | 3.70 | -33 | -0.017553191 |
| Battery cut-off point | 3.25 | 31 | 0.016489362 |



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# 12 TEST EQUIPMENT

Each test equipment is calibrated once a year.

## 12.1 Conducted measurements

| Equipment | Manufacturer | Model |
|---|---|---|
| Spectrum analyzer | Rohde & Schwarz | FSU |
| Radio communication tester | Rohde & Schwarz | CMU-200 |
| Attenuator 10 dB | Huber+Suhner AG | 6251.17.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 | HP | 6632A |
| Multimeter | Fluke | 87 |

## 12.2 Radiated measurements

| Equipment | Manufacturer | Model |
|---|---|---|
| 3m semi-anechoic chamber | TDK | |
| EMI receiver | Rohde & Schwarz | ESI 40 |
| Preamplifier | MITEQ | AMF-5D-020180-26-10P |
| Preamplifier | MITEQ | AMF-4D-10M-3G-25-20P |
| Dipole antenna | EMCO | 3125-870 |
| Dipole antenna | EMCO | 3125-1880 |
| Biconilog antenna | Rohde & Schwarz | HL562 |
| Double ridged waveguide antenna | EMCO | 3115 |
| Horn antenna | EMCO | 3116 |
| Reference dipole set | Schwarzbeck | UHAP/VHAP |
| Communication antenna | EMC Automation | LPA-8020 |
| 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 |
| Turntable controller | Deisel | HD-100 |
| Turntable | Deisel | DS412 |
| Antenna mast controller | EMCO | 2090 |
| Antenna mast | EMCO | 2075 |
| Temperature chamber | Vötsch | VT4002 |
| DC power supply | Hewlett-Packard | 6632A |
| Multimeter | Fluke | 87 |



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