

# **GSM1900 test report for RH-26**

Report Date: December 02, 2003

Signatures:

Tested by:



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Contents approved:



Tomi Nyberg      Laboratory Manager

## CONTENTS

|      |                                   |    |
|------|-----------------------------------|----|
| 1    | LABORATORY INFORMATION .....      | 4  |
| 2    | CUSTOMER INFORMATION .....        | 4  |
| 3    | SUMMARY OF TEST RESULTS .....     | 5  |
| 4    | EUT INFORMATION .....             | 6  |
| 4.1  | EUT description .....             | 6  |
| 5    | EUT TEST SETUPS .....             | 7  |
| 6    | APPLICABLE STANDARDS .....        | 7  |
| 7    | RADIATED RF OUTPUT POWER .....    | 8  |
| 7.1  | Test setup .....                  | 8  |
| 7.2  | Test method .....                 | 9  |
| 7.3  | EUT operation mode .....          | 9  |
| 7.4  | Limit .....                       | 9  |
| 7.5  | Results .....                     | 10 |
| 8    | 99% OCCUPIED BANDWIDTH .....      | 12 |
| 8.1  | Test setup .....                  | 12 |
| 8.2  | EUT operation mode .....          | 12 |
| 8.3  | Results .....                     | 13 |
| 8.4  | Screen shots .....                | 14 |
| 9    | BAND-EDGE COMPLIANCE .....        | 17 |
| 9.1  | Test setup .....                  | 17 |
| 9.2  | EUT operation mode .....          | 17 |
| 9.3  | Limit .....                       | 18 |
| 9.4  | Results .....                     | 18 |
| 9.5  | Screen shots .....                | 19 |
| 10   | RADIATED SPURIOUS EMISSIONS ..... | 21 |
| 10.1 | Test setup .....                  | 21 |
| 10.2 | Test method .....                 | 22 |
| 10.3 | EUT operation mode .....          | 22 |
| 10.4 | Limit .....                       | 22 |
| 10.5 | Results .....                     | 23 |

|      |                                                  |    |
|------|--------------------------------------------------|----|
| 11   | FREQUENCY STABILITY, TEMPERATURE VARIATION ..... | 27 |
| 11.1 | Test setup.....                                  | 27 |
| 11.2 | EUT operation mode .....                         | 27 |
| 11.3 | Limit .....                                      | 27 |
| 11.4 | Test method .....                                | 28 |
| 11.5 | Results .....                                    | 28 |
| 12   | FREQUENCY STABILITY, VOLTAGE VARIATION .....     | 29 |
| 12.1 | Test setup.....                                  | 29 |
| 12.2 | EUT operation mode .....                         | 29 |
| 12.3 | Limit .....                                      | 29 |
| 12.4 | Test method .....                                | 30 |
| 12.5 | Results .....                                    | 30 |
| 13   | TEST EQUIPMENT .....                             | 31 |
| 13.1 | Conducted measurements.....                      | 31 |
| 13.2 | Radiated measurements .....                      | 31 |
| 14   | TEST SETUP PHOTOGRAPHS .....                     | 32 |

## 1 LABORATORY INFORMATION

|                                                           |                                                                                                                                                                                            |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Laboratory</b>                                    | Konette Design Center Oy<br>EMC Laboratory<br>Koneenkatu 12 / K17<br>05830 Hyvinkää<br>FINLAND<br><br>Tel: +358 20 475 2800<br>Fax: +358 20 475 2719<br>e-mail: firstname.surname@ette.com |
| <b>FCC registration number:</b><br><b>IC file number:</b> | 910391 (January 27, 2003)<br>IC 4616 (May 14, 2003)                                                                                                                                        |

## 2 CUSTOMER INFORMATION

|                        |                                                                                                                                                                                                              |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Client</b>          | Nokia Corporation<br>Keilalahdentie 2-4<br>02150 Espoo<br>PL 226<br>00045 NOKIA GROUP<br><br>Tel: 07180 08000                                                                                                |
| <b>Contact person:</b> | Jarkko Luoma<br>Nokia Corporation / TCC Salo<br>P.O. Box 86 (Joensuunkatu 7E / Kiila 1B)<br>FIN -24101 SALO<br>FINLAND<br><br>Tel: +358 7180 42913<br>Fax: +358 7180 45220<br>E-mail: jarkko.luoma@nokia.com |
| <b>Receipt of EUT:</b> | October 28, 2003                                                                                                                                                                                             |
| <b>Testing date:</b>   | October 30 – December 02, 2003                                                                                                                                                                               |
| <b>Report date:</b>    | December 02, 2003                                                                                                                                                                                            |

The tests listed in this report have been done to demonstrate compliance with the applicable requirements in FCC rules Part 24 and 2 and IC standard RSS-133.

### 3 SUMMARY OF TEST RESULTS

| Section in CFR 47          | Section in RSS-133 | Test                                       | Result |
|----------------------------|--------------------|--------------------------------------------|--------|
| §2.1046 (a)                | 6.2                | Conducted RF output                        | -      |
| §24.232 (b)                | 6.2                | Radiated RF output                         | PASS   |
| §2.1049 (h)                | 5.6                | 99% occupied bandwidth                     | PASS   |
| §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                | 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

- Not done

#### 4 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<br>number |
|--------------------|-----------------------|-------|--------------------|---------------|
| <b>EUT</b>         | GSM 1900 Mobile phone | RH-26 | 004400 21 165122 7 | 07001         |
|                    | GSM 1900 Mobile phone | RH-26 | 004400 21 165135 9 | 07002         |
|                    |                       |       |                    |               |
| <b>Accessories</b> | Battery               | BL-5C |                    | 07003         |
|                    | Battery               | BL-5C |                    | 07004         |
|                    |                       |       |                    |               |

Notes: -

##### 4.1 EUT description

EUT is a triple band (GSM850 / GSM 1800 / GSM 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.

The test setup photographs are in the document referenced in section 14.

## **6 APPLICABLE STANDARDS**

The tests were performed in guidance of CFR 47 part 24, part 2, ANSI C63.4-1992, ANSI/TIA/EIA-603-A-2001 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.

## 7 RADIATED RF OUTPUT POWER

|                                     |                  |        |          |
|-------------------------------------|------------------|--------|----------|
| <b>EUT</b>                          | 07001            |        |          |
| <b>Accessories</b>                  | 07003, 07004     |        |          |
| <b>Temp, Humidity, Air Pressure</b> | 22 °C            | 55 RH% | 1012 hPa |
| <b>Date of measurement</b>          | October 28, 2003 |        |          |
| <b>FCC rule part</b>                | §24.232 (b)      |        |          |
| <b>RSS-133 section</b>              | 6.2              |        |          |
| <b>Measured by</b>                  | Marko Turkkila   |        |          |

### 7.1 Test setup

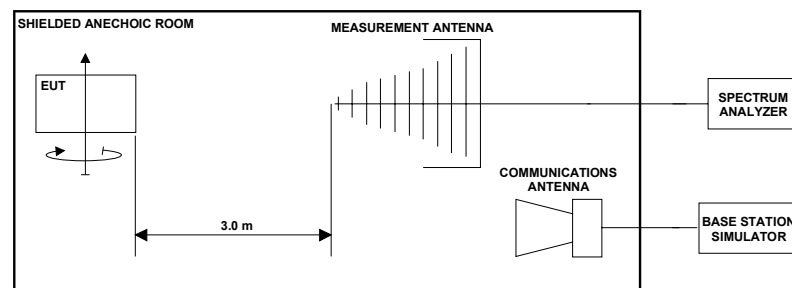
The EUT was set on a non-conductive turntable in a semi-anechoic chamber. In the corner of the chamber there was a communications antenna, which was connected to the BS simulator located outside the chamber.

The radiated power from the EUT was measured with an antenna fixed to an antenna tower. Antenna polarization and height can be changed remotely. The turntable is remotely controlled to turn the EUT

The EUT was set at 0.8m height. Measuring antenna was scanned 1 – 4 m in height.

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.



Picture 1: Test setup for radiated RF output power measurement



## 7.2 Test method

1. Substitution method calibration was made for determining correction factors for horizontal and vertical polarization. In the calibration the EUT was substituted with a signal generator and antenna, which gain over isotropic and dipole radiator was known.
2. The maximum power level was searched by moving the turntable, by manipulating the EUT and by changing the measurement antenna polarization and height. The maximum measured level ( $P_{EUT}$ ) was recorded.
3. The measured power from EUT was corrected with the correction factor in an automated test system to give the EUT EIRP.

## 7.3 EUT operation mode

|                           |                                                           |
|---------------------------|-----------------------------------------------------------|
| <b>EUT operation mode</b> | TX on, 1 time slot transmission,<br>PRBS 2E9-1 modulation |
| <b>EUT channel</b>        | 512, 661, 810                                             |
| <b>EUT TX power level</b> | GSM 0 (30dBm)<br>EDGE E2 (+26dBm)                         |

## 7.4 Limit

| <b>EIRP [W]</b> |          |
|-----------------|----------|
| FCC             | $\leq 2$ |
| IC              | $\leq 2$ |

## 7.5 Results

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

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

where the variables are as follows:

|                                 |                                                                                                                                                                                                    |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $P_{EUT [dBm]}$                 | Measured power level (from step 2 in 7.2) from the EUT                                                                                                                                             |
| $P_{Subst\_TX [dBm]}$           | Power (step 1 in 7.2) fed to the substituting antenna                                                                                                                                              |
| $P_{Subst\_RX [dBm]}$           | Power (step 1 in 7.2) 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                                                                                                                            |
| $CF [dB]$                       | Correction factor combined from the $P_{Subst\_TX [dBm]}$ , $P_{Subst\_RX [dBm]}$ , $G_{Substitute\_antenna [dBi]}$ and $L_{Cable [dB]}$ used in the automated measurement system (step 3 in 7.2). |

In the tables below, the abbreviated column titles are:

|            |                                                          |
|------------|----------------------------------------------------------|
| EUT H / V  | EUT orientation, Horizontal / Vertical                   |
| Pol H / V  | Measuring antenna polarization, Horizontal / Vertical    |
| Height [m] | Measuring antenna height from reference ground in meters |
| TT [deg]   | Turn table angle in degrees                              |

Table 1: Radiated RF output power measurement results, GSM GMSK, flip closed.

| EUT Channel | P <sub>EUT</sub> [dBm] | CF [dB] | EIRP [dBm] | EIRP [W] | EUT H / V | Pol. H / V | Height [m] | TT [deg] |
|-------------|------------------------|---------|------------|----------|-----------|------------|------------|----------|
| 512         | -15,1                  | 44,1    | 29,0       | 0,79     | H         | H          | 125,0      | 45,0     |
| 661         | -14,5                  | 44,2    | 29,7       | 0,93     | H         | H          | 123,0      | 38,0     |
| 810         | -13,1                  | 44,4    | 31,3       | 1,35     | H         | H          | 122,0      | 40,0     |

Table 2: Radiated RF output power measurement results, GSM GMSK, flip open.

| EUT Channel | P <sub>EUT</sub> [dBm] | CF [dB] | EIRP [dBm] | EIRP [W] | EUT H / V | Pol. H / V | Height [m] | TT [deg] |
|-------------|------------------------|---------|------------|----------|-----------|------------|------------|----------|
| 512         | -15,5                  | 44,1    | 28,6       | 0,72     | H         | H          | 126,0      | 52,0     |
| 661         | -15,2                  | 44,2    | 29,0       | 0,79     | H         | H          | 122,0      | 55,0     |
| 810         | -15                    | 44,4    | 29,4       | 0,87     | H         | H          | 122,0      | 65,0     |

Table 3: Radiated RF output power measurement results, flip closed, GSM EDGE 8 PSK modulation.

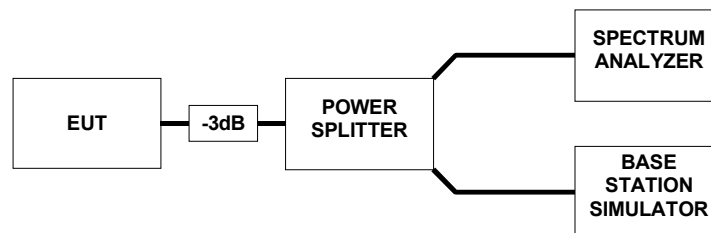
| EUT Channel | P <sub>EUT</sub> [dBm] | CF [dB] | EIRP [dBm] | EIRP [W] | EUT H / V | Pol. H / V | Height [m] | TT [deg] |
|-------------|------------------------|---------|------------|----------|-----------|------------|------------|----------|
| 512         | -17,8                  | 44,1    | 26,3       | 0,43     | H         | H          | 120,0      | 40,0     |
| 661         | -20,9                  | 44,2    | 23,3       | 0,21     | V         | V          | 100,0      | 195,0    |
| 810         | -16,3                  | 44,4    | 28,1       | 0,65     | H         | V          | 120,0      | 40,0     |

## 8 99% OCCUPIED BANDWIDTH

|                                     |                   |        |          |
|-------------------------------------|-------------------|--------|----------|
| <b>EUT</b>                          | 07002             |        |          |
| <b>Accessories</b>                  | 07003, 07004      |        |          |
| <b>Temp, Humidity, Air Pressure</b> | 22°C              | 48 RH% | 1025 hPa |
| <b>Date of measurement</b>          | November 12, 2003 |        |          |
| <b>FCC rule part</b>                | §2.1049 (h)       |        |          |
| <b>RSS-133 section</b>              | 5.6               |        |          |
| <b>Measured by</b>                  | Marko Turkkila    |        |          |

### 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.



Picture 2: Test setup for 99% occupied bandwidth measurement

### 8.2 EUT operation mode

|                           |                                    |
|---------------------------|------------------------------------|
| <b>EUT operation mode</b> | TX on, 1 time slot transmission,   |
| <b>EUT channel</b>        | 512, 661, 810                      |
| <b>EUT TX power level</b> | GSM 0 (+30dBm)<br>EDGE E2 (+26dBm) |

### 8.3 Results

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.

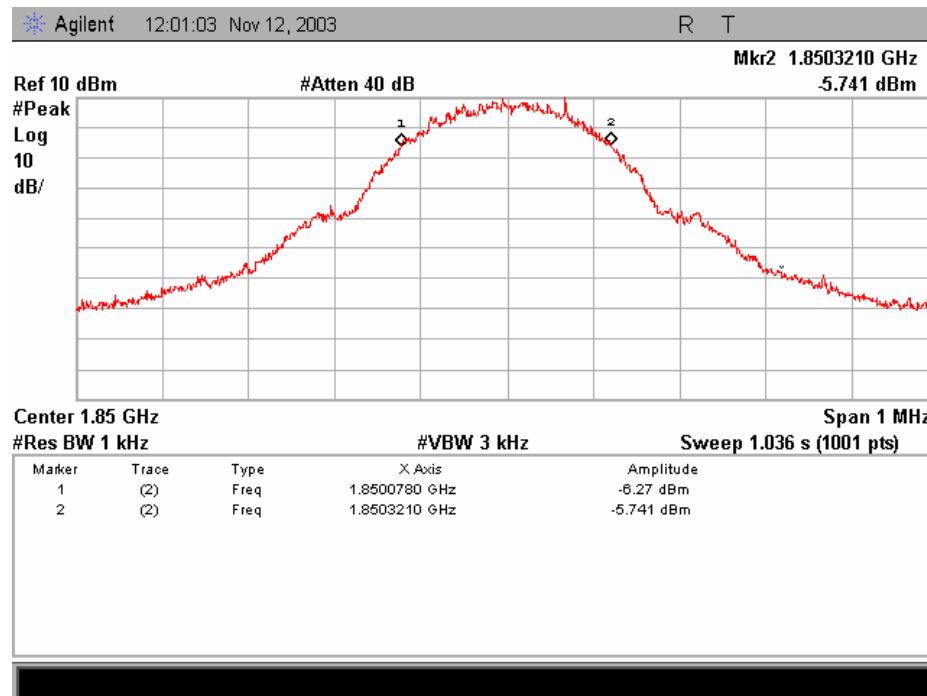
Table 4: 99% occupied bandwidth measurement results, GSM GMSK modulation

| <b>EUT Channel</b> | <b>99% occupied bandwidth [kHz]</b> |
|--------------------|-------------------------------------|
| 512                | 244                                 |
| 661                | 244                                 |
| 810                | 243                                 |

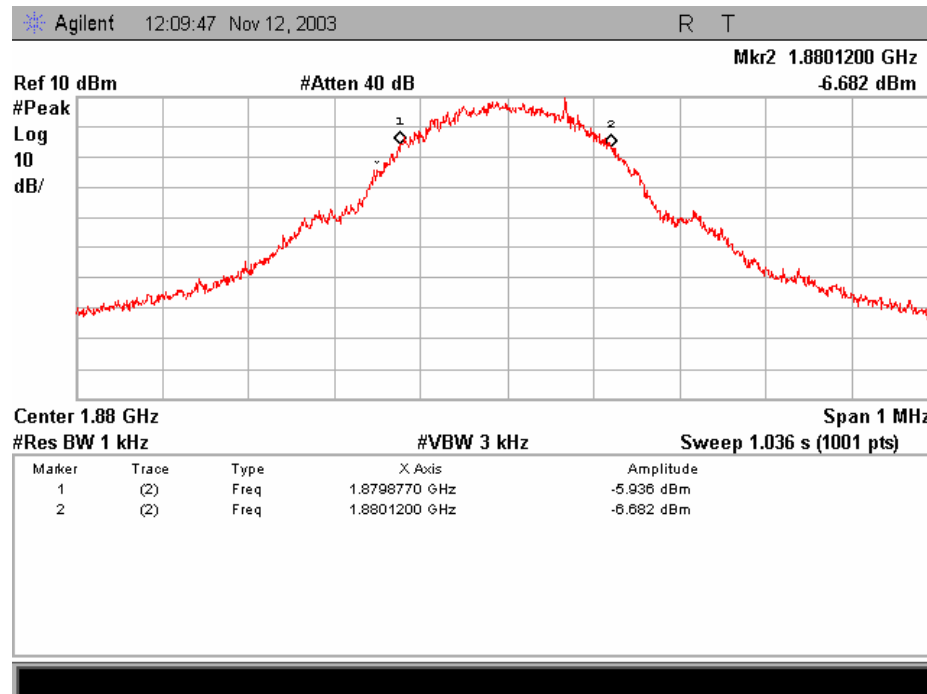
Table 5: 99% occupied bandwidth measurement results, GSM EDGE 8PSK modulation

| <b>EUT Channel</b> | <b>99% occupied bandwidth [kHz]</b> |
|--------------------|-------------------------------------|
| 512                | 245                                 |
| 661                | 242                                 |
| 810                | 245                                 |

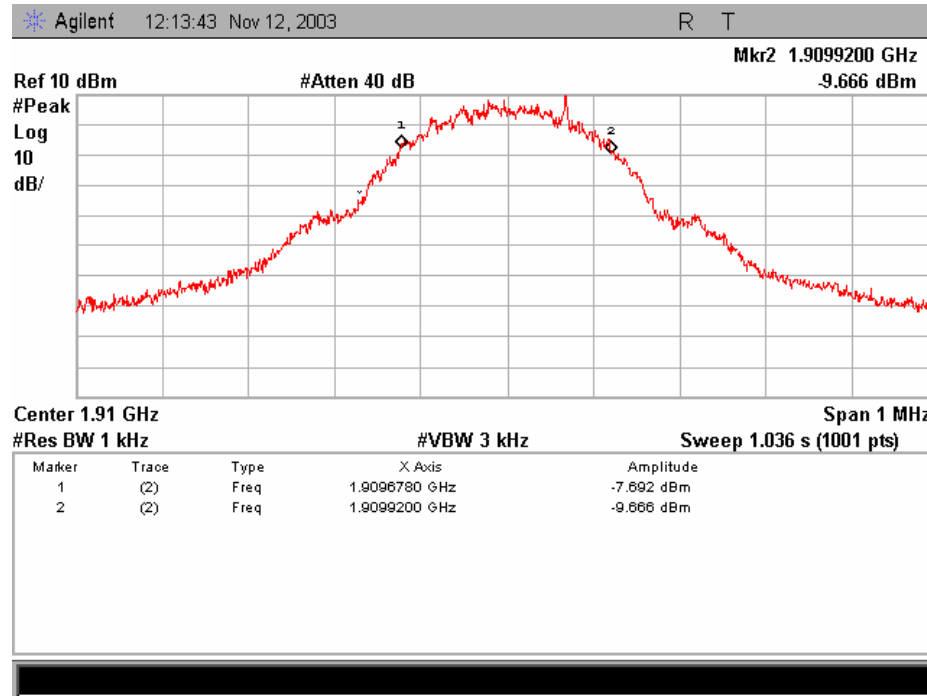
#### 8.4 Screen shots



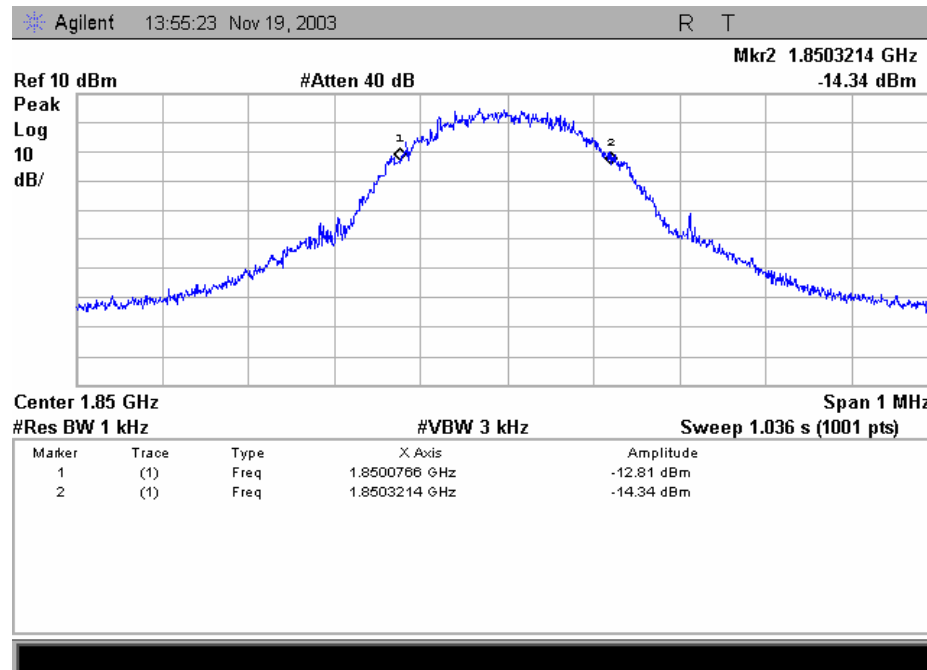
Picture 3: 99% occupied bandwidth, GSM GMSK, channel 512



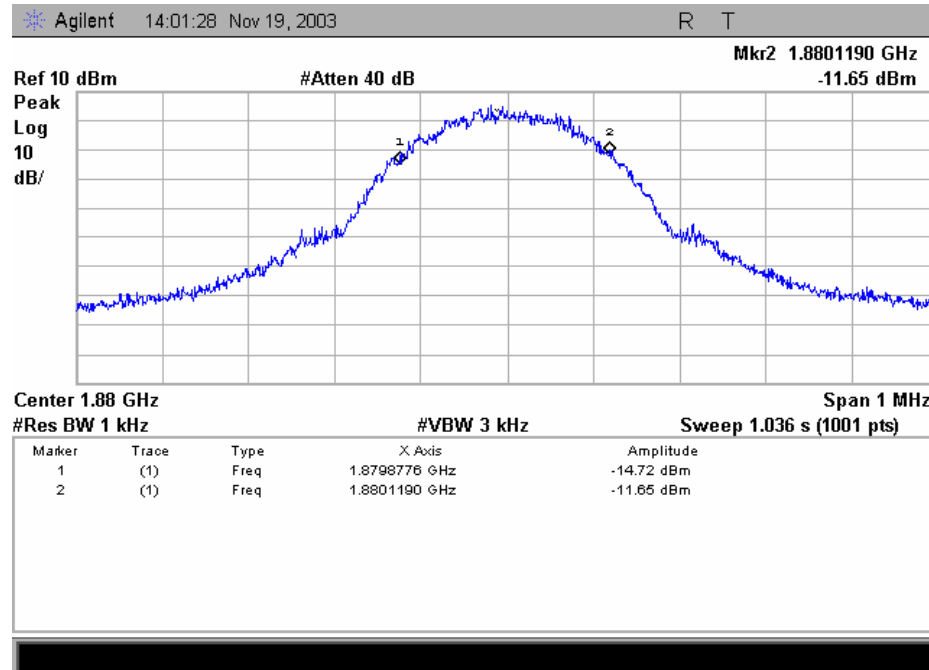
Picture 4: 99% occupied bandwidth, GSM GMSK, channel 661



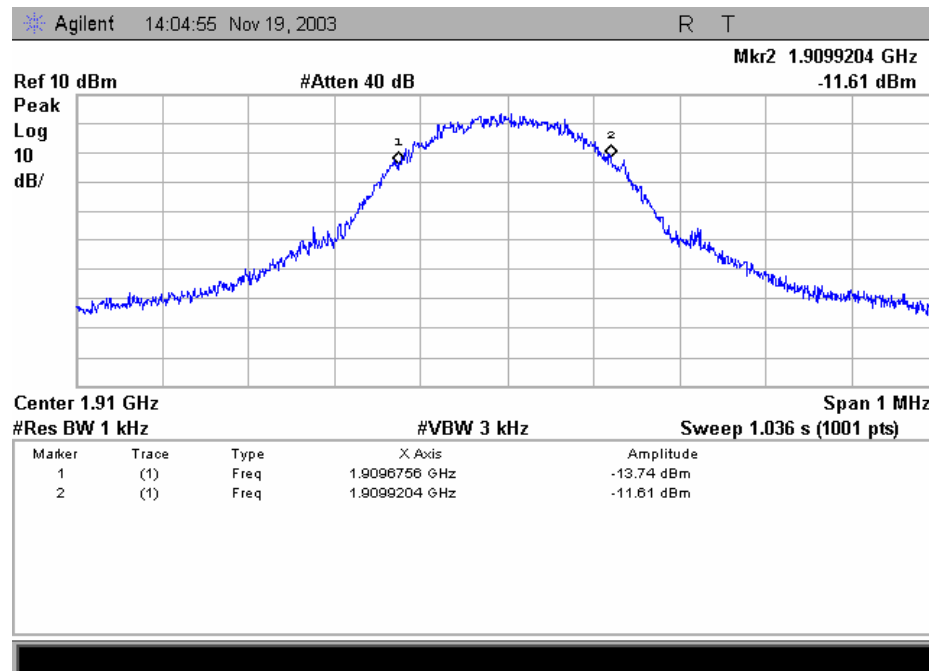
Picture 5: 99% occupied bandwidth, GSM GMSK, channel 810



Picture 6: 99% occupied bandwidth, GSM EDGE 8PSK, channel 512



Picture 7: 99% occupied bandwidth, GSM EDGE 8PSK, channel 661



Picture 8: 99% occupied bandwidth, GSM EDGE 8PSK, channel 810

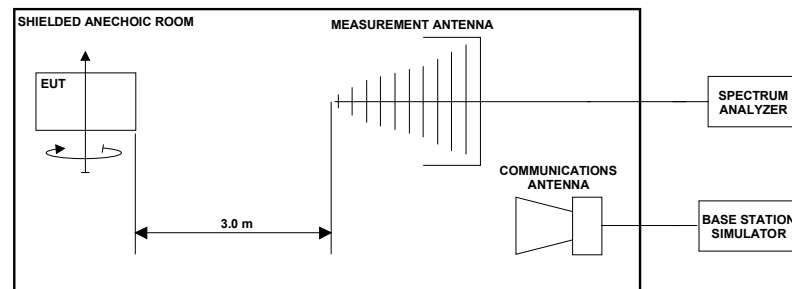


## 9 BAND-EDGE COMPLIANCE

|                                     |                   |        |          |
|-------------------------------------|-------------------|--------|----------|
| <b>EUT</b>                          | 07001             |        |          |
| <b>Accessories</b>                  | 07003, 07004      |        |          |
| <b>Temp, Humidity, Air Pressure</b> | 21°C              | 55 RH% | 1023 hPa |
| <b>Date of measurement</b>          | December 02, 2003 |        |          |
| <b>FCC rule part</b>                | §24.238 (a)       |        |          |
| <b>RSS-133 section</b>              | 6.3               |        |          |
| <b>Measured by</b>                  | Marko Turkkila    |        |          |

### 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.



Picture 9: Test setup for band edge compliance measurement

Band edge power measurements were made as radiated measurement similar to radiated power measurement. The worst turntable angle, antenna height and antenna polarisation found in radiated power measurements were used.

Base station simulator was used to set the EUT channel, modulation and power level.

Power level at the band edge was measured with spectrum analyzer. Measured reading was corrected in the spectrum analyzer by setting correction factor calculated in radiated power measurement section (7.5), as offset.

### 9.2 EUT operation mode

|                           |                                    |
|---------------------------|------------------------------------|
| <b>EUT operation mode</b> | TX on, 1 time slot transmission    |
| <b>EUT channel</b>        | Channels listed in section 9.4     |
| <b>EUT TX power level</b> | GSM 0 (+30dBm)<br>EDGE E2 (+26dBm) |

### 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. The results were corrected with “offset” value described in test setup section.

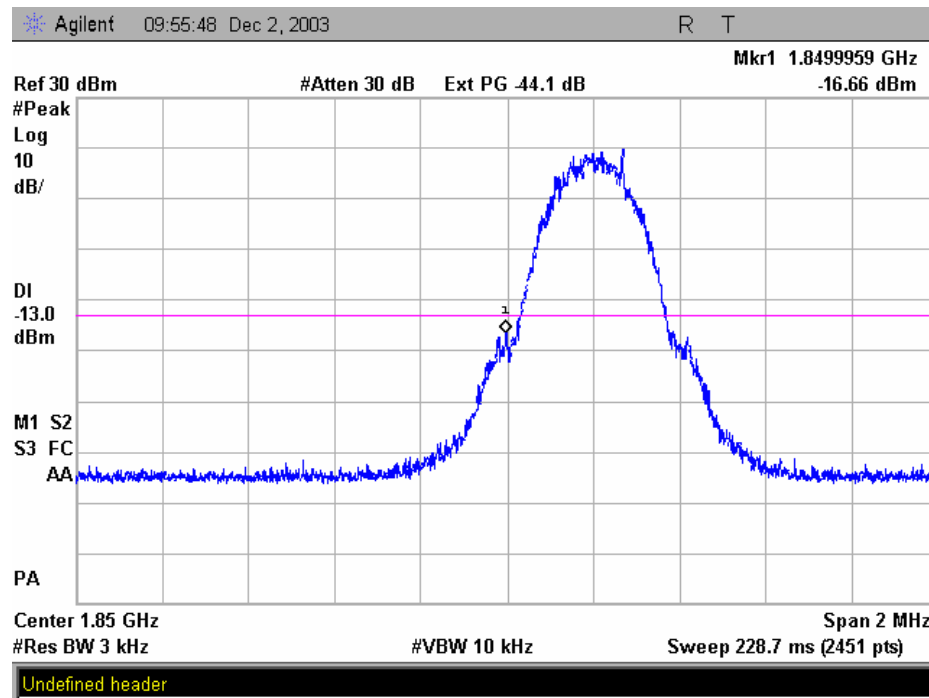
Table 6: Band edge compliance measurement results, GSM GMSK modulation

| EUT Channel | Offset [dB] | Band edge power [dBm] | Antenna Height | Antenna Pol. | EUT Orient. | Turn table Angle |
|-------------|-------------|-----------------------|----------------|--------------|-------------|------------------|
| 512         | 44.1        | -16.66                | 1.3            | H            | H           | 45               |
| 810         | 44.4        | -13.54                | 1.2            | H            | H           | 40               |

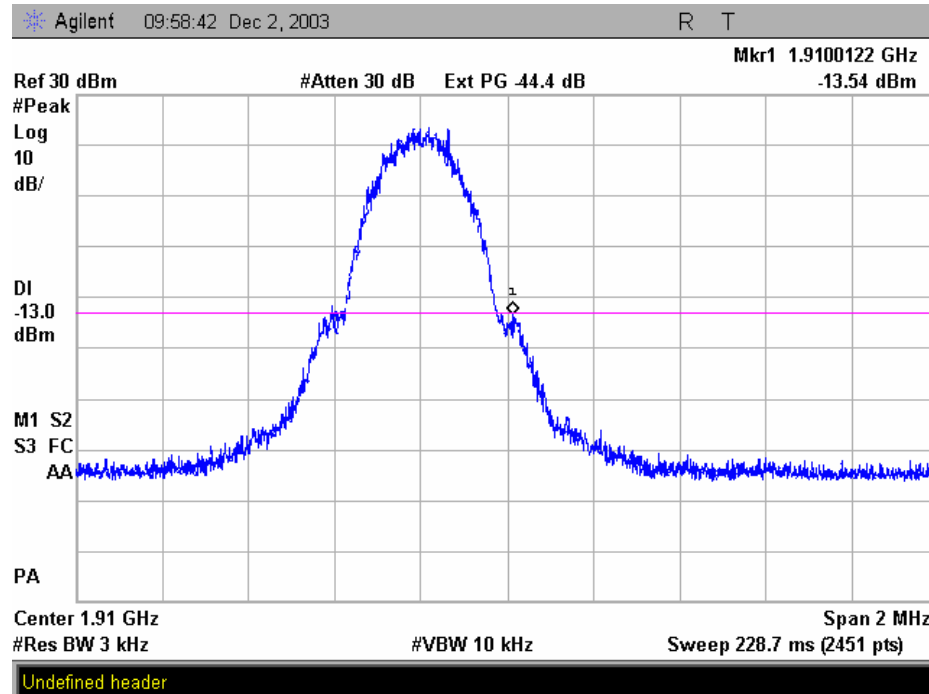
Table 7: Band edge compliance measurement results, GSM EDGE 8PSK modulation

| EUT Channel | Offset [dB] | Band edge power [dBm] | Antenna Height | Antenna Pol. | EUT Orient. | Turn table Angle |
|-------------|-------------|-----------------------|----------------|--------------|-------------|------------------|
| 512         | 44.1        | -21.35                | 1.3            | H            | H           | 45               |
| 810         | 44.4        | -19.49                | 1.2            | V            | H           | 40               |

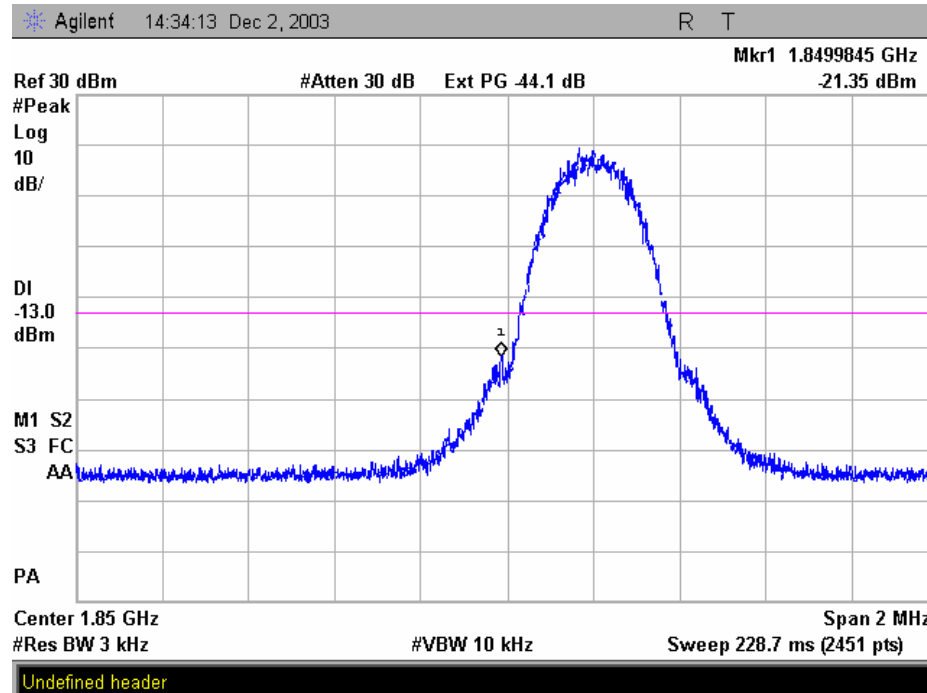
## 9.5 Screen shots



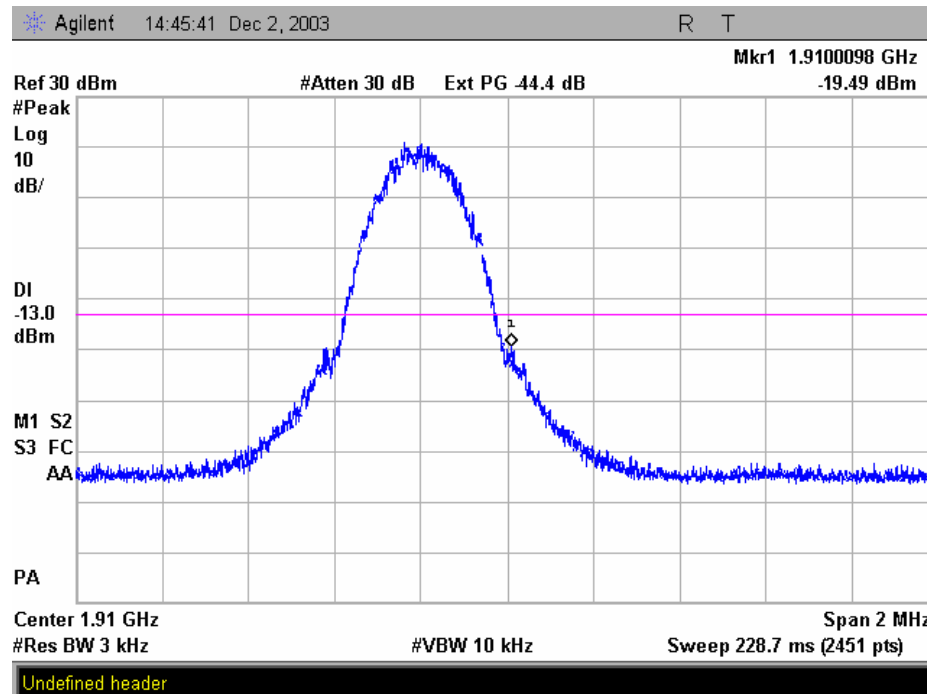
Picture 10: GSM GMSK, channel 512



Picture 11: GSM GMSK, channel 810



Picture 12: GSM EDGE 8PSK, channel 512



Picture 13: GSM EDGE 8PSK, channel 810

## 10 RADIATED SPURIOUS EMISSIONS

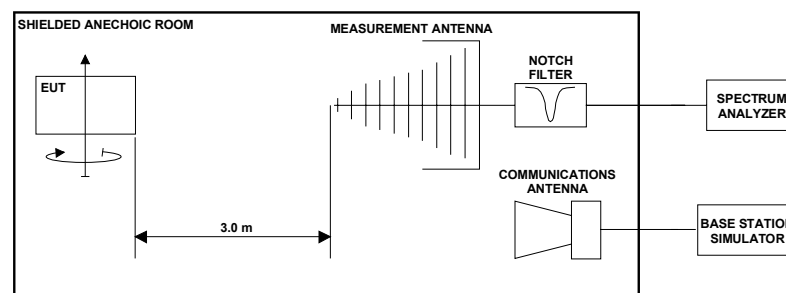
|                                     |                                          |        |          |
|-------------------------------------|------------------------------------------|--------|----------|
| <b>EUT</b>                          | 07001                                    |        |          |
| <b>Accessories</b>                  | 07003, 07004                             |        |          |
| <b>Temp, Humidity, Air Pressure</b> | 21°C                                     | 55 RH% | 1015 hPa |
| <b>Date of measurement</b>          | November 02 – 18, 2003                   |        |          |
| <b>FCC rule part</b>                | §24.238 (a), §2.1053                     |        |          |
| <b>RSS-133 section</b>              | 6.3                                      |        |          |
| <b>Measured by</b>                  | Marko Turkkila, Kimmo Aarnio, Tuomo Hahl |        |          |

### 10.1 Test setup

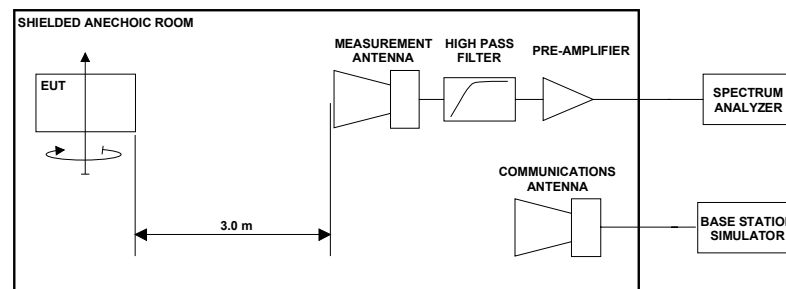
Band reject and high pass filters was used to prevent overloading the spectrum analyzer and preamplifier.

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 equipment was controlled by a computer.



Picture 14: Test setup for radiated spurious emissions measurement on below 3 GHz frequencies



Picture 15: Test setup for radiated spurious emissions measurement on 3 GHz and above frequencies

## 10.2 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 correction factor given by a substitution calibration made before the measurements. The calibration is made separately for vertical and horizontal polarization and the system uses different correction factors depending on the measuring antenna polarization.
4. The corrected values, giving the EUT radiated spurious emission levels as e.i.r.p, are reported.

## 10.3 EUT operation mode

|                           |                                   |
|---------------------------|-----------------------------------|
| <b>EUT operation mode</b> | TX on, 1 time slot transmission,  |
| <b>EUT channel</b>        | 512, 661, 810                     |
| <b>EUT TX power level</b> | GSM 0 (+30dBm)<br>EDGE E2(+26dBm) |

## 10.4 Limit

| <b>Frequency [MHz]</b> | <b>Level [dBm]</b> |
|------------------------|--------------------|
| 30 – 19100             | -13                |

## 10.5 Results

The formula below was used to calculate the EIRP of the spurious emissions.

$$\begin{aligned} P_{\text{Emission[dBm]}} &= P_{\text{Measured[dBm]}} + (P_{\text{SubstRX[dBm]}} - P_{\text{SubstTX[dBm]}} + L_{\text{Cable[dB]}} - G_{\text{Antenna[dBi]}}) \\ &= P_{\text{Measured[dBm]}} + CF_{\text{[dB]}} \end{aligned}$$

where the variables are as follows:

|                              |                                                                                                                                                               |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $P_{\text{Measured [dBm]}}$  | Measured emission level (from step 2 in 10.2)                                                                                                                 |
| $P_{\text{Subst\_TX [dBm]}}$ | Signal generator power (from step 4 in 10.2) fed to the substituting antenna                                                                                  |
| $P_{\text{Subst\_RX [dBm]}}$ | Measured power (from step 4 in 10.2) in the substitution calibration                                                                                          |
| $L_{\text{Cable [dB]}}$      | Loss of the cable between antenna and signal generator (from step 4 in 10.2)                                                                                  |
| $G_{\text{Antenna [dBi]}}$   | Gain of the substitutive antenna over isotropic radiator                                                                                                      |
| $CF_{\text{[dB]}}$           | Correction factor combined from the $P_{\text{Subst\_TX [dBm]}}$ , $L_{\text{Cable [dB]}}$ and $G_{\text{Antenna [dBi]}}$ used in the automated test software |

Measurement system noise level was 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.

In the tables below, the abbreviated column titles are:

|            |                                                          |
|------------|----------------------------------------------------------|
| $f$ [MHz]  | Measured frequency                                       |
| EUT H / V  | EUT orientation, Horizontal / Vertical                   |
| Pol H / V  | Measuring antenna polarization, Horizontal / Vertical    |
| Height [m] | Measuring antenna height from reference ground in meters |
| TT [deg]   | Turn table angle in degrees                              |

### GSM GMSK modulation, flip closed

Table 8: Radiated spurious emission levels, GSM GMSK, flip closed, Channel 512

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3700.4       | -30.2                          | 7.2          | -23.0                          | V            | V             | 1.6           | 200.0       |
| 5550.6       | -45.9                          | 14.7         | -31.2                          | H2           | V             | 1.2           | 243.0       |
| 7400.8       | -57.7                          | 18.4         | -39.3                          | H2           | V             | 1.8           | 184.0       |
| 9251.0       | -54.2                          | 18.9         | -35.3                          | V            | V             | 1.5           | 260.0       |
| 11101.2      | -55.7                          | 22.6         | -33.1                          | H2           | V             | 1.4           | 176.0       |

Table 9: Radiated spurious emission levels, GSM GMSK, flip closed, Channel 661

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3760.0       | -35.1                          | 7.3          | -27.8                          | V            | V             | 1.0           | 210.0       |
| 5640.0       | -50.1                          | 14.9         | -35.2                          | H2           | V             | 1.2           | 226.0       |
| 7520.0       | -56.9                          | 18.2         | -38.7                          | V            | V             | 1.2           | 170.0       |
| 9400.0       | -55.7                          | 18.6         | -37.1                          | V            | V             | 1.0           | 260.0       |
| 11280.0      | -57.5                          | 23.1         | -34.4                          | H2           | V             | 1.3           | 29.0        |

Table 10: Radiated spurious emission levels, GSM GMSK, flip closed, Channel 810

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3819.6       | -38.0                          | 7.5          | -30.5                          | V            | V             | 1.0           | 220.0       |
| 5729.4       | -53.8                          | 15.1         | -38.7                          | H2           | V             | 1.7           | 229.0       |
| 7639.2       | -54.6                          | 18.5         | -36.1                          | V            | V             | 1.0           | 180.0       |
| 9549.0       | -57.2                          | 18.5         | -38.7                          | V            | V             | 1.5           | 100.0       |
| 11458.8      | -57.0                          | 23.6         | -33.4                          | H1           | V             | 1.6           | 100.0       |



**GSM GMSK modulation, flip open**

Table 11: Radiated spurious emission levels, GSM GMSK, flip open, Channel 512

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3700.4       | -29.5                          | 7.2          | -22.3                          | V            | V             | 1.2           | 210.0       |
| 5550.6       | -47.4                          | 14.7         | -32.7                          | H2           | V             | 1.0           | 267.0       |
| 7400.8       | -56.1                          | 18.4         | -37.7                          | V            | V             | 1.4           | 160.0       |
| 9251.0       | -54.4                          | 18.9         | -35.6                          | H1           | V             | 1.6           | 300.0       |
| 11101.2      | -57.2                          | 22.6         | -34.5                          | H1           | V             | 1.2           | 300.0       |

Table 12: Radiated spurious emission levels, GSM GMSK, flip open, Channel 661

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3760.0       | -35.6                          | 7.3          | -28.3                          | V            | V             | 1.4           | 240.0       |
| 5640.0       | -51.0                          | 14.9         | -36.1                          | H2           | V             | 1.6           | 230.0       |
| 7520.0       | -54.8                          | 18.2         | -36.6                          | V            | V             | 1.1           | 180.0       |
| 9400.0       | -57.3                          | 18.6         | -38.7                          | H1           | V             | 1.5           | 280.0       |
| 11280.0      | -57.3                          | 23.1         | -34.2                          | H2           | V             | 1.3           | 114.0       |

Table 13: Radiated spurious emission levels, GSM GMSK, flip open, Channel 810

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3819.6       | -37.3                          | 7.5          | -29.9                          | V            | V             | 1.0           | 250.0       |
| 5729.4       | -53.8                          | 15.1         | -38.7                          | H2           | V             | 1.0           | 184.0       |
| 7639.2       | -55.4                          | 18.5         | -37.0                          | V            | V             | 1.0           | 180.0       |
| 9549.0       | -57.5                          | 18.5         | -38.9                          | V            | V             | 1.0           | 100.0       |
| 11458.8      | -56.2                          | 23.6         | -32.6                          | H2           | V             | 1.3           | 1.0         |

### GSM EDGE 8PSK modulation, flip closed

Table 14: Radiated spurious emission levels, GSM EDGE 8PSK, flip closed, Channel 512

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3700.4       | -31.7                          | 7.2          | -24.6                          | V            | V             | 1.6           | 200.0       |
| 5550.6       | -47.8                          | 14.7         | -33.1                          | H2           | V             | 1.1           | 238.0       |
| 7400.8       | -60.8                          | 18.4         | -42.5                          | V            | V             | 1.0           | 0.0         |
| 9251.0       | -57.2                          | 18.9         | -38.3                          | V            | V             | 1.5           | 260.0       |
| 11101.2      | -57.0                          | 22.6         | -34.4                          | H2           | V             | 1.4           | 184.0       |

Table 15: Radiated spurious emission levels, GSM EDGE 8PSK, flip closed, Channel 661

| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3760.0       | -36.3                          | 7.3          | -29.0                          | V            | V             | 1.0           | 220.0       |
| 5640.0       | -53.5                          | 14.9         | -38.6                          | H2           | V             | 1.6           | 228.0       |
| 7520.0       | -58.2                          | 18.2         | -40.0                          | V            | V             | 1.0           | 180.0       |
| 9400.0       | -59.5                          | 18.6         | -40.9                          | V            | V             | 1.0           | 100.0       |
| 11280.0      | -56.6                          | 23.1         | -33.5                          | H2           | V             | 1.3           | 34.0        |

Table 16: Radiated spurious emission levels, GSM EDGE 8PSK, flip closed, Channel 810

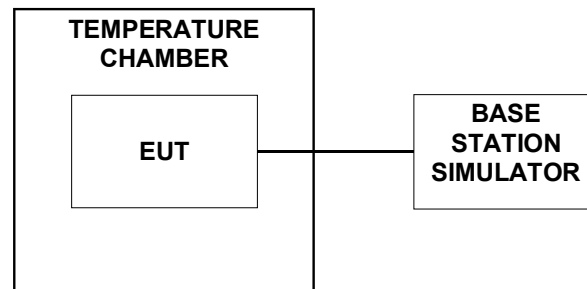
| $f$<br>[MHz] | $P_{\text{Measured}}$<br>[dBm] | $CF$<br>[dB] | $P_{\text{Emission}}$<br>[dBm] | EUT<br>H / V | Pol.<br>H / V | Height<br>[m] | TT<br>[deg] |
|--------------|--------------------------------|--------------|--------------------------------|--------------|---------------|---------------|-------------|
| 3819.6       | -40.2                          | 7.5          | -32.8                          | V            | V             | 1.5           | 210.0       |
| 5729.4       | -56.8                          | 15.1         | -41.7                          | H2           | V             | 1.6           | 220.0       |
| 7639.2       | -57.2                          | 18.5         | -38.7                          | H2           | V             | 1.6           | 181.0       |
| 9549.0       | -60.1                          | 18.5         | -41.6                          | V            | V             | 1.0           | 120.0       |
| 11458.8      | -56.1                          | 23.6         | -32.5                          | H1           | V             | 1.5           | 100.0       |

## 11 FREQUENCY STABILITY, TEMPERATURE VARIATION

|                                     |                            |       |       |
|-------------------------------------|----------------------------|-------|-------|
| <b>EUT</b>                          | 07002                      |       |       |
| <b>Accessories</b>                  | 07003                      |       |       |
| <b>Temp, Humidity, Air Pressure</b> | - °C                       | - RH% | - hPa |
| <b>Date of measurement</b>          | October 30, 2003           |       |       |
| <b>FCC rule part</b>                | §24.235, §2.1055 (a)(1)(b) |       |       |
| <b>RSS-133 section</b>              | 7                          |       |       |
| <b>Measured by</b>                  | Marko Turkkila             |       |       |

### 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

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

### 11.3 Limit

| <b>Frequency deviation [ppm]</b> |
|----------------------------------|
| ± 2.5                            |

#### 11.4 Test method

1. The climate chamber temperature was set to the minimum value and the temperature was allowed to stabilize.
2. The EUT was placed in the chamber
3. The EUT was set in idle mode for 45 minutes.
4. The EUT was set to transmit.
5. The maximum of transmit frequency error was measured immediately from BS simulator
6. The steps 3 - 5 were repeated for each temperature

#### 11.5 Results

Table 17: Frequency stability over temperature measurement results

| Temperature [°C] | Deviation [Hz] | Deviation [ppm] |
|------------------|----------------|-----------------|
| -30              | 40             | 0,021           |
| -20              | 28             | 0,015           |
| -10              | 25             | 0,013           |
| 0                | 27             | 0,014           |
| 10               | 32             | 0,017           |
| 20               | 24             | 0,013           |
| 30               | 23             | 0,012           |
| 40               | 33             | 0,018           |
| 50               | 34             | 0,018           |

## 12 FREQUENCY STABILITY, VOLTAGE VARIATION

|                                     |                            |        |          |
|-------------------------------------|----------------------------|--------|----------|
| <b>EUT</b>                          | 07002                      |        |          |
| <b>Accessories</b>                  | 07003                      |        |          |
| <b>Temp, Humidity, Air Pressure</b> | 22 °C                      | 43 RH% | 1015 hPa |
| <b>Date of measurement</b>          | November 24, 2003          |        |          |
| <b>FCC rule part</b>                | §24.235, §2.1055 (d)(1)(2) |        |          |
| <b>RSS-133 section</b>              | 7                          |        |          |
| <b>Measured by</b>                  | Marko Turkkila             |        |          |

### 12.1 Test setup

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



Picture 16: Test setup for frequency deviation over voltage variation measurement

### 12.2 EUT operation mode

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

### 12.3 Limit

| <b>Frequency deviation [ppm]</b> |
|----------------------------------|
| $\pm 2.5$                        |

## 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

Table 18: Frequency stability over voltage variation measurement results

| Level                 | Voltage [V] | Deviation [Hz] | Deviation [ppm] |
|-----------------------|-------------|----------------|-----------------|
| Nominal               | 3.7         | -13.80         | 0.007           |
| Battery cut-off point | 3.4         | 62.9           | 0.033           |

### 13 TEST EQUIPMENT

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

#### 13.1 Conducted measurements

| Equipment                  | Manufacturer      | Model     |
|----------------------------|-------------------|-----------|
| Spectrum Analyzer          | Agilent           | E7405A    |
| GSM Base station simulator | Rohde & Schwarz   | CMU 200   |
| GSM Base station simulator | Anritsu           | MT8820A   |
| Signal Generator           | Rohde & Schwarz   | SMR27     |
| Attenuator 3 dB            | Narda             | 779-3     |
| Power splitter             | Mini Circuits     | ZFSC-2-4  |
| Power splitter             | Narda             | 4426-2    |
| Temperature chamber        | Finero            | LK 540    |
| DC power supply            | Delta Elektronika | SM 120-13 |
| Multimeter                 | Fluke             | 179       |

#### 13.2 Radiated measurements

| Equipment                            | Manufacturer           | Model                       |
|--------------------------------------|------------------------|-----------------------------|
| Spectrum Analyzer                    | Agilent                | E7405A                      |
| GSM Base station simulator           | Rohde & Schwarz        | CMU 200                     |
| Antenna                              | Chase                  | CBL 6140                    |
| Antenna                              | Schwarzbeck            | BBHA 9120D                  |
| Antenna                              | Chase                  | CBL 6141                    |
| Antenna                              | EMCO                   | 3115                        |
| Signal Generator                     | Rohde & Schwarz        | SMR27                       |
| Tunable notch filter                 | Wainwright Instruments | WRCD 1700/2000-0.2/40-10EEK |
| Tunable notch filter                 | Wainwright Instruments | WRCT 800/960-0.2/40-8EEK    |
| High pass filter                     | Wainwright Instruments | WHK3/18GST                  |
| High pass filter                     | Wainwright Instruments | WHK 2.1/18GST               |
| Band Reject filter                   | Wainwright instruments | WRCT2400/2483-45/10EE       |
| Pre-amplifier                        | JCA                    | 118-400                     |
| Turn table / antenna mast controller | EMCO                   | 2090                        |
| Antenna mast                         | EMCO                   | 2075-2                      |

## 14 TEST SETUP PHOTOGRAPHS

Test setup photographs can be found in a separate document

T03-070A-EMC\_PHOTOS.doc