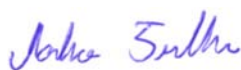


# Electromagnetic Compatibility (EMC) test report for **RM-1**

Report Date: September 1, 2004

Signatures:

Tested by:



Marko Turkkila      Testing Engineer

Contents approved:



Tomi Nyberg      Laboratory Manager

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## 1 LABORATORY INFORMATION

|                                                           |                                                                                                                                                                              |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Test Laboratory</b>                                    | NATLABS OY<br>EMC Laboratory<br>Koneenkatu 12 / K17<br>05830 Hyvinkää<br>FINLAND<br><br>Tel: +358 20 475 2600<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>P.O. Box 226<br>00045 NOKIA GROUP<br><br>Tel: 07180 08000                   |
| <b>Contact person:</b> | Tero Huhtala<br>Nokia Corporation<br>P.O. Box 68<br>FIN -33721 TAMPERE<br>FINLAND<br><br>Tel: +358 7180 08000<br>Fax: +358 7180 44123 |
| <b>Receipt of EUT:</b> | August 30, 2004                                                                                                                       |
| <b>Testing date:</b>   | August 30 – September 01, 2004                                                                                                        |
| <b>Report date:</b>    | September 01, 2004                                                                                                                    |

The tests listed in this report have been done to demonstrate compliance with the applicable requirements in FCC rules Part 15 and IC standard RS133 and ICES-003.

### 3 SUMMARY OF TEST RESULTS

| Section in CFR 47 | Section in ICES-003 | RSS 133 | Test                            | Result |
|-------------------|---------------------|---------|---------------------------------|--------|
| §15.107           | 5.3                 |         | Conducted emissions to AC-mains | PASS   |
| §15.109           | 5.5                 | 9       | Radiated emissions              | 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 number |
|--------------------|-----------------|---------------------|--------------------|------------|
| <b>EUT</b>         | GSM 1900 phone  | RM-1                | 004400/271747/55/0 | 07701      |
| <b>Accessories</b> | Charger         | ACP-12U             |                    | 07702      |
|                    | USB cable       | DKU-2               | JK42083821         | 07703      |
|                    | Laptop PC       | DELL;<br>PP01L      |                    | 07704      |
|                    | Laptop PC power | DELL                | AA20031            | 07705      |
|                    | Serial mouse    | Logitech;<br>M-CQ38 | LZB83902452        | 07706      |
|                    | Printer         | HP Deskjet<br>890C  | SG7811908Z         | 07707      |

Notes:

#### 4.1 EUT description

EUT is a GSM 900, GSM 1800 and GSM 1900 mobile phone with WCDMA and BT functions.

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 10.

## 6 APPLICABLE STANDARDS

The tests were performed in guidance of CFR 47 part 15, ANSI C63.4-2003 and ICES-003.

Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method" for each test case.

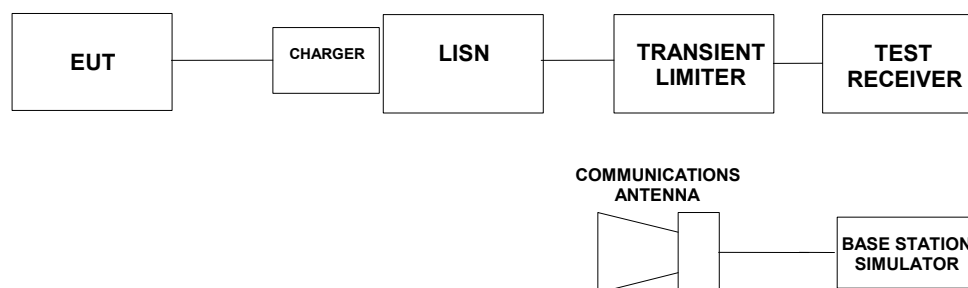
## 7 CONDUCTED EMISSIONS TO AC-MAINS

|                                     |                                          |        |          |
|-------------------------------------|------------------------------------------|--------|----------|
| <b>EUT</b>                          | 07701                                    |        |          |
| <b>Accessories</b>                  | 07702, 07703, 07704, 07705, 07706, 07707 |        |          |
| <b>Temp, Humidity, Air Pressure</b> | 24 °C                                    | 69 RH% | 1011 hPa |
| <b>Date of measurement</b>          | August 31, 2004                          |        |          |
| <b>FCC rule part</b>                | §15.107                                  |        |          |
| <b>ICES-003 section</b>             | 5.3                                      |        |          |
| <b>Measured by</b>                  | Marko Turkkila                           |        |          |

### 7.1 Test setup

The BS simulator was used to provide the common control and broadcasting channel to the EUT to keep the EUT receiver on.

EUT charger was connected to line impedance stabilization network and conducted emissions to AC-mains were measured using measurement receiver.



Picture 1: Test setup for measurement of conducted emissions to AC-mains

### 7.2 EUT operation mode

EUT was set in idle mode so, that EUT receiver and other functions except the transmitter are on. EUT was connected to a charger.

### 7.3 Limits

| <b>Frequency of emission [MHz]</b> | <b>Limit [dBμV] Quasi peak</b> | <b>Limit [dBμV] Average</b> |
|------------------------------------|--------------------------------|-----------------------------|
| 0,15 – 0,50                        | 66 – 56*                       | 56 – 46*                    |
| 0,50 – 5                           | 56                             | 46                          |
| 5 - 30                             | 60                             | 50                          |

\* The limit decreases linearly with the logarithm of the frequency

## 7.4 Results

The measured interference values using peak and average detectors are shown in the pictures 2 and 3 below.

All signals closer than 6 dB to the limit have been measured using Quasi peak and Average detector are reported in the tables 1 to 4.

Table 1: AC-mains conducted RF output power Quasi-peak measurement results, AC line

| Frequency | Measured value<br>[dB $\mu$ V] | Limit<br>[dB $\mu$ V] | Margin to limit<br>[dB] |
|-----------|--------------------------------|-----------------------|-------------------------|
| 0.33      | 34.4                           | 59.6                  | 25.2                    |
| 1.06      | 32.1                           | 56.0                  | 23.9                    |
| 3.32      | 29.6                           | 56.0                  | 26.4                    |
| 26.71     | 39.2                           | 60.0                  | 20.8                    |

Table 2: AC-mains conducted RF output power Average measurement results, AC line

| Frequency | Measured value<br>[dB $\mu$ V] | Limit<br>[dB $\mu$ V] | Margin to limit<br>[dB] |
|-----------|--------------------------------|-----------------------|-------------------------|
| 0.33      | 24.3                           | 49.6                  | 25.3                    |
| 1.06      | 22.9                           | 46.0                  | 23.1                    |
| 3.32      | 22.3                           | 46.0                  | 23.7                    |
| 26.71     | 31.0                           | 50.0                  | 19.0                    |

Table 3: AC-mains conducted RF output power Quasi-peak measurement results, AC neutral

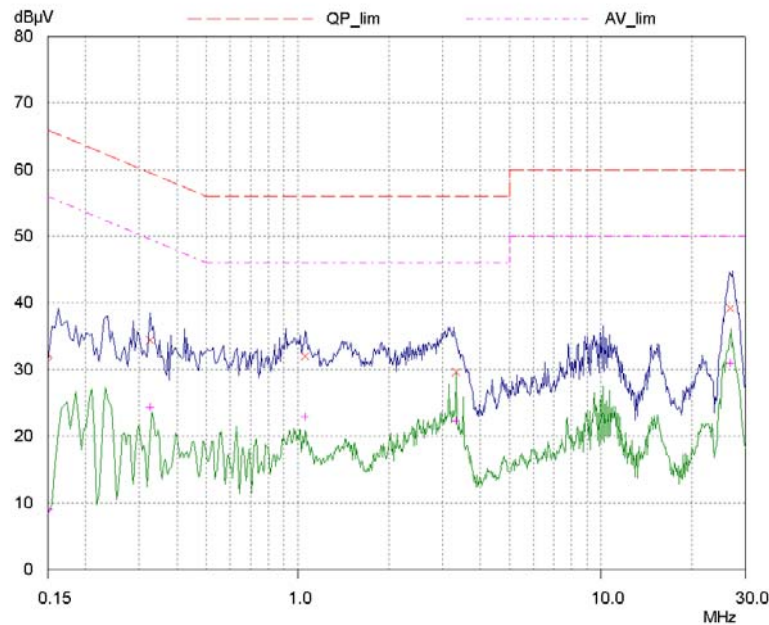
| Frequency | Measured value<br>[dB $\mu$ V] | Limit<br>[dB $\mu$ V] | Margin to limit<br>[dB] |
|-----------|--------------------------------|-----------------------|-------------------------|
| 0.49      | 28.5                           | 56.2                  | 27.7                    |
| 1.4       | 24.5                           | 56.0                  | 31.5                    |
| 3.15      | 31.8                           | 56.0                  | 24.2                    |
| 10.06     | 36.1                           | 60.0                  | 23.9                    |
| 27.10     | 43.1                           | 60.0                  | 16.9                    |

Table 4: AC-mains conducted RF output power Average measurement results, AC neutral

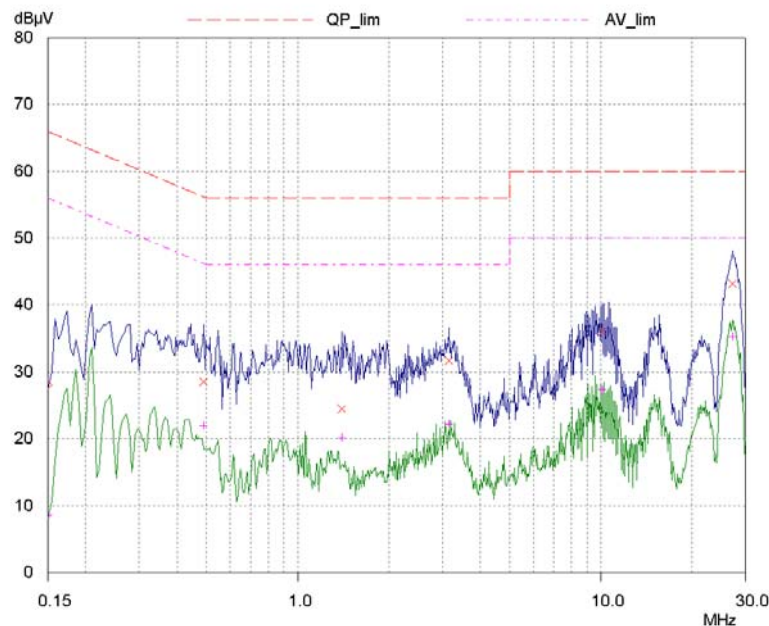
| Frequency | Measured value<br>[dB $\mu$ V] | Limit<br>[dB $\mu$ V] | Margin to limit<br>[dB] |
|-----------|--------------------------------|-----------------------|-------------------------|
| 0.49      | 22.0                           | 46.2                  | 24.2                    |
| 1.4       | 20.2                           | 46.0                  | 25.8                    |
| 3.15      | 22.2                           | 46.0                  | 23.8                    |
| 10.06     | 27.4                           | 50.0                  | 22.6                    |
| 27.10     | 35.3                           | 50.0                  | 14.7                    |



## 7.5 Screen shots



Picture 2: AC-mains conducted RF output power measurement results, AC line, battery charging.



Picture 3: AC-mains conducted RF output power measurement results, AC neutral, battery charging.

## 8 RADIATED EMISSION

|                                     |                                          |        |          |
|-------------------------------------|------------------------------------------|--------|----------|
| <b>EUT</b>                          | 07701                                    |        |          |
| <b>Accessories</b>                  | 07702, 07703, 07704, 07705, 07706, 07707 |        |          |
| <b>Temp, Humidity, Air Pressure</b> | 24 °C                                    | 69 RH% | 1011 hPa |
| <b>Date of measurement</b>          | August 31, 2004                          |        |          |
| <b>FCC rule part</b>                | §15.109                                  |        |          |
| <b>ICES-003 section</b>             | 5.5                                      |        |          |
| <b>Measured by</b>                  | Jani Kiiski                              |        |          |

### 8.1 Test setup

Below 1 GHz:

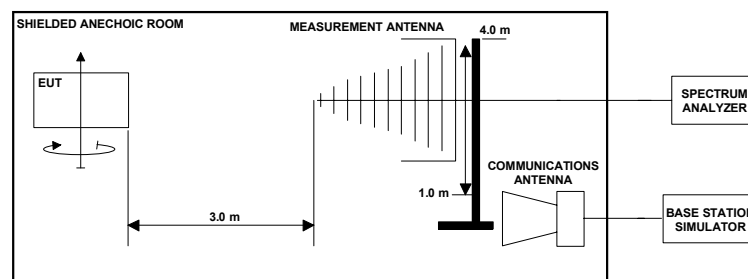
The EUT was set on a non-conductive turntable 0.80m height from reference ground plane in a semi-anechoic chamber.

Above 1 GHz:

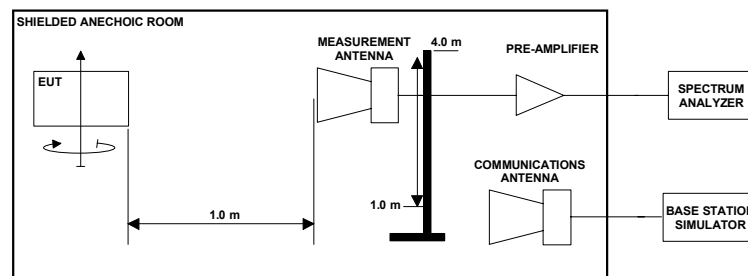
The EUT was set on a non-conductive turntable 0.80m height from reference ground plane in a semi-anechoic chamber.

In the corner of the chamber there was a communications antenna, which was connected to the BS simulator located outside the chamber.

The BS simulator was used to provide the common control and broadcasting channel to the EUT to keep the EUT receiver on.



Picture 4: Test setup for radiated emission measurement below 1 GHz



Picture 5: Test setup for radiated emission measurement above 1 GHz

## 8.2 Test method

The test system used is computer controlled. The measurement antenna calibrated antenna factors and connecting cable losses are added in a computer software to the measured results. The results corrected with antenna factors and cable losses are recorded.

Measurement procedure below 1 GHz frequencies:

1. The maximum emission levels were searched by rotating and manipulating the EUT and by scanning the measurement antenna in height from 1.0 to 4.0 m using peak detector.
2. All signal levels closer to 6 dB to the limit were measured using Quasi peak detector and recorded

Measurement procedure above 1 GHz frequencies:

1. The maximum emission levels were searched by rotating and manipulating the EUT and by scanning the measurement antenna in height from 1.0 to 4.0 m and by using peak detector.
2. All signal levels closer to 6 dB to the limit were measured using peak and average detectors and recorded

## 8.3 EUT operation mode

EUT was set in idle mode so, that EUT receiver and other functions except the transmitter are on.

## 8.4 Limit

Table 5: Radiated emission limits for FCC class B and IC class B digital devices, measurement distance 3.0 m

| FCC                         |                                       |                                              |                            |                           |
|-----------------------------|---------------------------------------|----------------------------------------------|----------------------------|---------------------------|
| Frequency of emission [MHz] | 3m Limit [ $\mu\text{V} / \text{m}$ ] | 3m Limit [ $\text{dB}\mu\text{V}/\text{m}$ ] | Resolution bandwidth [kHz] | Measurement detector type |
| 30 – 88                     | 100                                   | 40                                           | 120                        | Quasi peak                |
| 88 – 216                    | 150                                   | 43,5                                         | 120                        | Quasi peak                |
| 216 – 960                   | 200                                   | 46                                           | 120                        | Quasi peak                |
| 960 – 1000                  | 500                                   | 54                                           | 120                        | Quasi peak                |
| Above 1000                  | 500                                   | 54                                           | 1000                       | Average                   |
| Above 1000                  | 5000                                  | 74                                           | 1000                       | Peak                      |

## 8.5 Results

The above 1GHz measurements are made from 1-meter measurement distance. The results are corrected by automated measurement system to correspond the 3-meter measurement distance.

The measured interference values using peak detector is shown in the pictures below.

All signals closer than 6 dB to the limit have been measured using quasi peak or average detector and reported in the tables 6, 7 and 8

Table 6: Radiated emissions using Quasi peak detector at measurement distance 3m

| Frequency [MHz] | Measured value [dB $\mu$ V] | Limit [dB $\mu$ V/m] | Margin to limit [dB] |
|-----------------|-----------------------------|----------------------|----------------------|
| 37.38           | 29.03                       | 40                   | -10.97               |
| 37.92           | 31.86                       | 40                   | -8.14                |
| 47.94           | 28.79                       | 40                   | -11.21               |
| 500.64          | 37.02                       | 46                   | -8.98                |

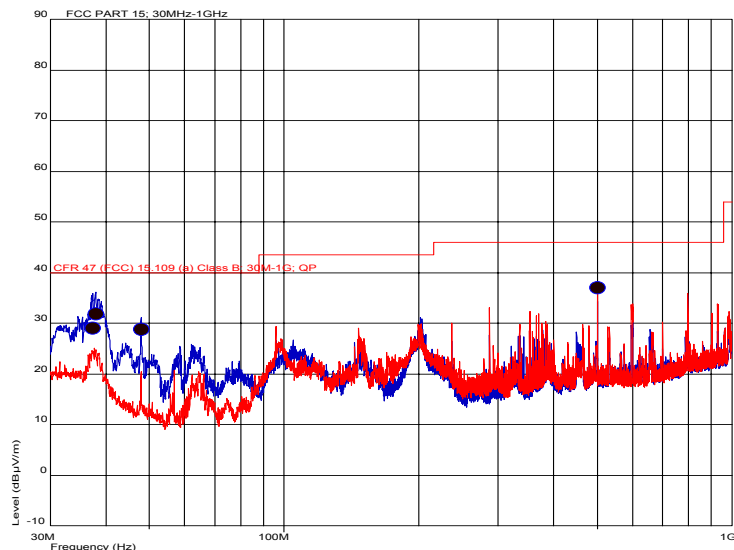
Table 7: Radiated emissions using Peak detector at measurement distance 3m.

| Frequency [MHz] | Measured value [dB $\mu$ V] | Limit [dB $\mu$ V/m] | Margin to limit [dB] |
|-----------------|-----------------------------|----------------------|----------------------|
| 1064            | 50.8                        | 74                   | -23.2                |

Table 8: Radiated emissions using Average detector at measurement distance 3m.

| Frequency [MHz] | Measured value [dB $\mu$ V] | Limit [dB $\mu$ V/m] | Margin to limit [dB] |
|-----------------|-----------------------------|----------------------|----------------------|
| 1064            | 18.06                       | 54                   | -35.94               |

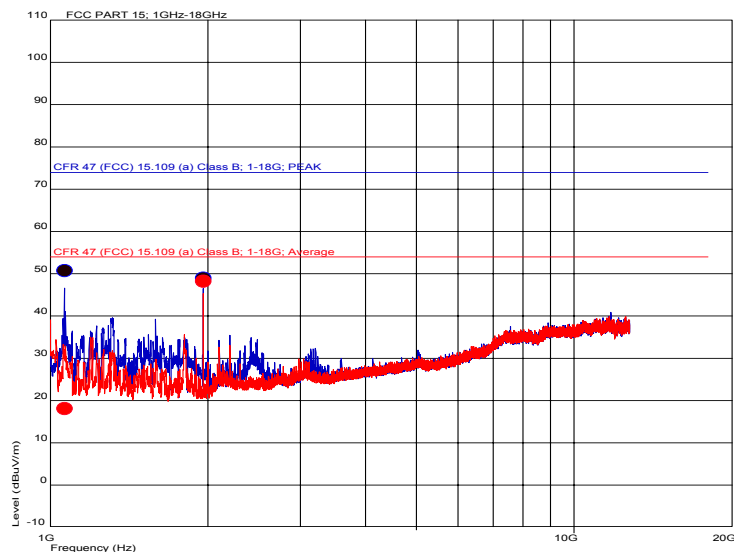
### GSM 1900, Ch 661



Picture 6: radiated emission results using PEAK detector, 30 – 1000 MHz, EUT vertical.

Prescan: Red = horizontal, Blue = vertical

Final: Blue dot = Peak



1960 MHz:  
Tester downlink  
signal

Picture 7: radiated emission results using PEAK detector, 1 – 12.75 GHz, EUT vertical.

Prescan: Red = horizontal, Blue = vertical

Final : Blue dot = Peak, Red dot = Average

## 9 TEST EQUIPMENT

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

### 9.1 Radiated measurements

| Equipment                            | Manufacturer | Model          |
|--------------------------------------|--------------|----------------|
| Spectrum Analyzer                    | Agilent      | E7405A         |
| GSM Base station simulator           | HP           | 8922M + 83220E |
| GSM Base station simulator           | Anritsu      | MT8820A        |
| Antenna                              | Chase        | CBL 6141       |
| Antenna                              | Chase        | CBL 6140       |
| Antenna                              | Schwarzbeck  | BBHA 9120D     |
| Pre-amplifier                        | JCA          | 118-400        |
| Turn table / antenna mast controller | EMCO         | 2090           |
| Antenna mast                         | EMCO         | 2075-2         |

## 10 TEST SETUP PHOTOGRAPHS

Test setup photograph can be found in a separate document

T04-077A-EMC\_PHOTOS.doc