



Inter**Lab**<sup>®</sup>

# EMC Measurement/Technical Report on PCMCIA card Magnum

**Report Reference:** 4\_Opti\_0404\_GSM\_FCCa

## Test Laboratory (Headquarter):

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Germany



TTI-P-G 178/99

### Note:

The following test results relate only to the devices specified in this document. This report shall not be reproduced in parts without the written approval of the testing laboratory.

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## Table of Contents

|                                             |           |
|---------------------------------------------|-----------|
| <b>0. Summary</b>                           | <b>3</b>  |
| 0.1 Technical Report Summary                | 3         |
| 0.2 Measurement Summary                     | 4         |
| <b>1. Administrative Data</b>               | <b>5</b>  |
| 1.1 Testing Laboratory                      | 5         |
| 1.2 Project Data                            | 5         |
| 1.3 Applicant Data                          | 5         |
| 1.4 Manufacturer Data                       | 5         |
| <b>2. Testobject Data</b>                   | <b>6</b>  |
| 2.1 General EUT Description                 | 6         |
| 2.2 EUT Main Components                     | 7         |
| 2.3 Ancillary Equipment                     | 7         |
| 2.4 EUT Setups                              | 7         |
| 2.5 Operating Modes                         | 7         |
| <b>3. Test Results</b>                      | <b>8</b>  |
| 3.1 RF Power Output                         | 8         |
| 3.2 Frequency Stability                     | 12        |
| 3.3 Spurious Emissions at Antenna Terminals | 15        |
| 3.4 Field Strength of Spurious Radiation    | 19        |
| 3.5 Emission and Occupied Bandwidth         | 23        |
| <b>4. Testequipment</b>                     | <b>26</b> |
| <b>5. Foto Report</b>                       | <b>29</b> |
| <b>6. Setup Drawings</b>                    | <b>31</b> |
| <b>7. Annex</b>                             | <b>34</b> |

Measurement plots



## **0 Summary**

### **0.1 Technical Report Summary**

#### **Type of Authorization**

Certification for a broadband PCS device

#### **Applicable FCC Rules:**

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 Parts 0 to 19 and Parts 20 to 69 (10-1-98 Edition). The following subparts are applicable to the results in this test report.

##### **Part 2**

Subpart J - Equipment Authorization Procedures, Certification

- § 2.1046 Measurement required: RF power output
- § 2.1049 Measurement required: Occupied bandwidth
- § 2.1051 Measurement required: Spurious emissions at antenna terminals
- § 2.1053 Measurement required: Field strength of spurious emission
- § 2.1055 Measurement required: Frequency stability
- § 2.1057 Frequency spectrum to be investigated

##### **Part 24**

Subpart E - Broadband PCS

- § 24.232 Power and antenna height limits
- § 24.235 Frequency stability
- § 24.238 Emission limits

#### **Summary Test Results:**

**The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary.**

## 0.2 Measurement Summary

### RF Power Output

The measurement was performed according to FCC §2.1046 10-01-1998

| OP-Mode   | Setup    | Port           | Final Result |
|-----------|----------|----------------|--------------|
| op-mode 1 | 37s20e01 | ant. connector | passed       |
| op-mode 2 | 37s20e01 | ant. connector | passed       |
| op-mode 3 | 37s20e01 | ant. connector | passed       |

### Frequency stability

The measurement was performed according to FCC §2.1055 10-01-1998

| OP-Mode   | Setup    | Port           | Final Result |
|-----------|----------|----------------|--------------|
| op-mode 2 | 37s20e01 | ant. connector | passed       |

### Spurious emissions at antenna terminals

The measurement was performed according to FCC §2.1051 10-01-1998

| OP-Mode   | Setup    | Port           | Final Result |
|-----------|----------|----------------|--------------|
| op-mode 1 | 37s20e01 | ant. connector | passed       |
| op-mode 2 | 37s20e01 | ant. connector | passed       |
| op-mode 3 | 37s20e01 | ant. connector | passed       |

### Field strength of spurious radiation

The measurement was performed according to FCC §2.1053 10-01-1998

| OP-Mode   | Setup    | Port      | Final Result |
|-----------|----------|-----------|--------------|
| op-mode 1 | 37s20a01 | enclosure | passed       |
| op-mode 2 | 37s20a01 | enclosure | passed       |
| op-mode 3 | 37s20a01 | enclosure | passed       |

### Emission and Occupied Bandwidth

The measurement was performed according to FCC §2.1049 10-01-1998

| OP-Mode   | Setup    | Port           | Final Result |
|-----------|----------|----------------|--------------|
| op-mode 1 | 37s20e01 | ant. connector | passed       |
| op-mode 2 | 37s20e01 | ant. connector | passed       |
| op-mode 3 | 37s20e01 | ant. connector | passed       |

Responsible for  
Accreditation Scope: \_\_\_\_\_

Responsible  
for Test Report: \_\_\_\_\_

## **1. Administrative Data**

### **1.1 Testing Laboratory**

Company Name: 7 Layers AG  
Address: Borsigstr. 11  
40880 Ratingen  
Germany

This facility has been fully described in a report submitted to the FCC and accepted under the registration number 96716 .

The test facility is also accredited by the following accreditation organisation:

- Deutscher Akkreditierungs Rat      DAR-Registration no. TTI-P-G 178/99

Responsible for Accreditation Scope: Dipl.-Ing Bernhard Retka  
Dipl.-Ing Arndt Stöcker  
Dipl.-Ing Thomas Hoell

### **1.2 Project Data**

Responsible for testing and report: Dipl.-Ing. Robert Machulec  
Receipt of EUT: 2004-09-15  
Date of Test(s): 2004-09-16 to 2004-09-28  
Date of Report: 2004-10-20

### **1.3 Applicant Data**

Company Name: Option International NV SA  
Address: Kolonel Begaultlaan 45  
3012 Leuven  
Belgium  
Contact Person: Mr. Stefan Lodeweyckx

### **1.4 Manufacturer Data**

Company Name: please see Applicant data  
Address:

Contact Person:

## **2. Testobject Data**

### **2.1 General EUT Description**

|                                       |                       |
|---------------------------------------|-----------------------|
| <b>Equipment under Test:</b>          | PCMCIA card           |
| <b>Type Designation:</b>              | Magnum                |
| <b>Kind of Device:<br/>(optional)</b> | GSM 850/900/1800/1900 |
| <b>Voltage Type:</b>                  | DC                    |
| <b>Nominal Voltage:</b>               | 3,5 V                 |
| <b>Maximum Voltage:</b>               | 3,5 V                 |
| <b>Minimum Voltage:</b>               | 3,15 V                |

#### **General product description:**

The Equipment Under Test (EUT) is a GSM 850/900/1800 / PCS 1900 PCMCIA card. In the PCS1900 mode the card operates in blocks A through F from 1850,2 MHz (lowest channel = 512) to 1909,8 MHz (highest channel = 810).

#### **The EUT provides the following ports:**

##### **Ports**

ant. connector  
enclosure

**The main components of EUT are listed and described in Chapter 2.2**

## 2.2 EUT Main components:

### Type, S/N, Short Descriptions etc. used in this Test Report

| Short Description                            | Equipment under Test | Type Designation | Serial No. | HW Status | SW Status | Date of Receipt |
|----------------------------------------------|----------------------|------------------|------------|-----------|-----------|-----------------|
| EUT A<br>(37020e01)                          | PCMCIA card          | Magnum           | none       | v.1.0.0   | v.1.0.0   | 2004-09-15      |
| EUT A is equipped with an antenna connector. |                      |                  |            |           |           |                 |
| EUT B<br>(37020a01)                          | PCMCIA card          | Magnum           | none       | v.1.0.0   | v.1.0.0   | 2004-09-15      |
| EUT B is equipped with an integral antenna.  |                      |                  |            |           |           |                 |

**NOTE: The short description is used to simplify the identification of the EUT in this test report**

## 2.3 Ancillary Equipment

For the purposes of this test report, ancillary equipment is defined as equipment which is used in conjunction with the EUT to provide operational and control features to the EUT. It is necessary to configure the system in a typical fashion, as a customer would normally use it. But never the less Ancillary Equipment can influence the test results.

| Short Description | Equipment under Test | Type Designation    | HW Status | SW Status | Serial No. | FCC Id |
|-------------------|----------------------|---------------------|-----------|-----------|------------|--------|
| AUX 2             | IBM Thinkpad         | PC (Laptop)         | -         | -         | -          | -      |
| AUX 1             | Daantje cradle       | PCMCIA host adapter | V1.0      | -         | -          | -      |

## 2.4 EUT Setups

This chapter describes the combination of EUT's and ancillary equipment used for testing.

| Setup No. | Combination of EUTs | Description                                             |
|-----------|---------------------|---------------------------------------------------------|
| 37s20a01  | EUT B + AUX 2       | PC Card + PC, used for radiated measurements            |
| 37s20e01  | EUT A + AUX 1       | PC Card + host adapter, used for conducted measurements |

## 2.5 Operating Modes

This chapter describes the operating modes of the EUT's used for testing.

| Op. Mode  | Description of Operating Modes                                              | Remarks                                                   |
|-----------|-----------------------------------------------------------------------------|-----------------------------------------------------------|
| op-mode 1 | Call established on Traffic Channel (TCH) 512, Carrier Frequency 1850,2 MHz | 512 is the lowest channel                                 |
| op-mode 2 | Call established on Traffic Channel (TCH) 661, Carrier Frequency 1880 MHz   | 661 is a mid channel of the full PCS band (blocks A to F) |
| op-mode 3 | Call established on Traffic Channel (TCH) 810, Carrier Frequency 1909,8 MHz | 810 is the highest channel                                |

### 3. Test Results

#### 3.1 RF Power Output

**Standard** FCC Part 24, 10-01-98  
Subpart E

**The test was performed according to:** FCC §2.1046 10-01-1998

##### 3.1.1 Test Description

1) The mobile station was coupled to the R&S Spectrum Analyser and the R&S CMD55 Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".

2) The total insertion losses for RF Path 1 and RF Path 2 were measured. The values were used to correct the readings from the R&S Spectrum Analyser and the R&S CMD55 Digital Communication Tester.

3) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).

Important Settings:

- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Varied during measurements
- Channel (Frequency): Varied during measurements

4) The transmitted power of the mobile station was recorded for all possible power control level by using an internal measurement function of the CMD55.

5) During this test the Spectrum Analyser was only used to check if the results are comprehensible.

##### 3.1.2 Test Requirements / Limits

§2.1046 Measurements Required: RF Power Output

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the output terminals when this test is made shall be stated.

§24.232 Power and antenna height limits

(b) Mobile/portable stations are limited to 2 watts e.i.r.p peak power and the equipment must employ means to limit the power to the minimum necessary for succesful communications.

(c) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any



instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

### 3.1.3 Test Protocol

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 49 %

| Op. Mode | Setup | Port |
|----------|-------|------|
|----------|-------|------|

|           |          |                   |
|-----------|----------|-------------------|
| op-mode 1 | 37s20e01 | ant.<br>connector |
|-----------|----------|-------------------|

| Power Control Level | Output power Nominal (dBm) | Output power Measured (dBm) | Difference dB |
|---------------------|----------------------------|-----------------------------|---------------|
| 0                   | 30                         | 28,8                        | -1,20         |
| 1                   | 28                         | 27,3                        | -0,70         |
| 2                   | 26                         | 25,7                        | -0,30         |
| 3                   | 24                         | 23,8                        | -0,20         |
| 4                   | 22                         | 21,7                        | -0,30         |
| 5                   | 20                         | 19,8                        | -0,20         |
| 6                   | 18                         | 17,8                        | -0,20         |
| 7                   | 16                         | 15,9                        | -0,10         |
| 8                   | 14                         | 13,9                        | -0,10         |
| 9                   | 12                         | 11,9                        | -0,10         |
| 10                  | 10                         | 10,5                        | 0,50          |
| 11                  | 8                          | 8,9                         | 0,90          |
| 12                  | 6                          | 7,4                         | 1,40          |
| 13                  | 4                          | 5,8                         | 1,80          |
| 14                  | 2                          | 4,3                         | 2,30          |
| 15                  | 0                          | 2,8                         | 2,80          |

Remark: The EIRP including antenna gain (-4.0 dBi) is 24.8 dBm.

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 49 %

| Op. Mode  | Setup    | Port              |
|-----------|----------|-------------------|
| op-mode 2 | 37s20e01 | ant.<br>connector |

| Power Control Level | Output power Nominal (dBm) | Output power Measured (dBm) | Difference dB |
|---------------------|----------------------------|-----------------------------|---------------|
| 0                   | 30                         | 29                          | -1,00         |
| 1                   | 28                         | 27,5                        | -0,50         |
| 2                   | 26                         | 25,9                        | -0,10         |
| 3                   | 24                         | 23,9                        | -0,10         |
| 4                   | 22                         | 21,9                        | -0,10         |
| 5                   | 20                         | 20                          | 0,00          |
| 6                   | 18                         | 18                          | 0,00          |
| 7                   | 16                         | 16                          | 0,00          |
| 8                   | 14                         | 13,9                        | -0,10         |
| 9                   | 12                         | 11,9                        | -0,10         |
| 10                  | 10                         | 10,6                        | 0,60          |
| 11                  | 8                          | 8,9                         | 0,90          |
| 12                  | 6                          | 7,5                         | 1,50          |
| 13                  | 4                          | 5,8                         | 1,80          |
| 14                  | 2                          | 4,3                         | 2,30          |
| 15                  | 0                          | 2,7                         | 2,70          |

Remark: The EIRP including antenna gain (-4.0 dBi) is 25.0 dBm.

Temperature: 24 %  
Air Pressure: 1020 hPa  
Humidity: 49 %

| Op. Mode  | Setup    | Port              |
|-----------|----------|-------------------|
| op-mode 3 | 37s20e01 | ant.<br>connector |

| Power Control Level | Output power Nominal (dBm) | Output power Measured (dBm) | Difference dB |
|---------------------|----------------------------|-----------------------------|---------------|
| 0                   | 30                         | 28,8                        | -1,20         |
| 1                   | 28                         | 27,4                        | -0,60         |
| 2                   | 26                         | 25,7                        | -0,30         |
| 3                   | 24                         | 23,7                        | -0,30         |
| 4                   | 22                         | 21,7                        | -0,30         |
| 5                   | 20                         | 19,8                        | -0,20         |
| 6                   | 18                         | 17,7                        | -0,30         |
| 7                   | 16                         | 15,7                        | -0,30         |
| 8                   | 14                         | 13,6                        | -0,40         |
| 9                   | 12                         | 11,6                        | -0,40         |
| 10                  | 10                         | 10,2                        | 0,20          |
| 11                  | 8                          | 8,5                         | 0,50          |
| 12                  | 6                          | 7                           | 1,00          |
| 13                  | 4                          | 5,3                         | 1,30          |
| 14                  | 2                          | 3,8                         | 1,80          |
| 15                  | 0                          | 2,2                         | 2,20          |

Remark: The EIRP including antenna gain (-4.0 dBi) is 24.8 dBm.

### 3.1.4 Test result: RF Power Output

FCC Part 24, Subpart E

| Op. Mode  | Setup    | Port              | Result        |
|-----------|----------|-------------------|---------------|
| op-mode 1 | 37s20e01 | ant.<br>connector | <b>passed</b> |
| op-mode 2 | 37s20e01 | ant.<br>connector | <b>passed</b> |
| op-mode 3 | 37s20e01 | ant.<br>connector | <b>passed</b> |

### **3.2 Frequency stability**

**Standard** FCC Part 24, 10-01-98  
Subpart E

**The test was performed according to:** FCC §2.1055 10-01-1998

#### **3.2.1 Test Description**

- 1) The PCS1900 mobile station was placed inside the climatic chamber.
- 2) The mobile station was coupled to the R&S CMD55 Digital Communication Tester.  
Refer to chapter "Setup Drawings".
- 3) The climatic chamber was cycled down/up to a certain temperature, starting with  $-30^{\circ}\text{C}$ .
- 4) After the temperature was stabilized (at least one hour) the mobile station was switched on and a speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).  
Important Settings:
  - Discontinuous Transmission: OFF
  - Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
  - Output Power: Maximum
  - Channel : 661 [1880 MHz]
- 5) The frequency error of the mobile station were recorded by using an internal measurement function of the CMD55 immediately after the call was established, five minutes after the call was established and ten minutes after the call was established.
- 6) This measurement procedure was performed for all combinations of voltage (low, nominal, high) and temperature (from  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  in increments of  $10^{\circ}\text{C}$ ).

#### **3.2.2 Test Requirements / Limits**

§2.1055 Measurements required: Frequency stability

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From  $-30^{\circ}$  to  $+50^{\circ}$  centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than  $10^{\circ}$  centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the

temperature variation test.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

#### §24.235 Frequency stability

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

### **3.2.3 Test Protocol**

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 40 %

**Op. Mode Setup Port**  
op-mode 2 37s20e01 ant.  
connector

| Temperature<br>°C | Duration<br>min | Minimum Voltage / V         |                          | Normal Voltage / V          |                          | Maximum Voltage / V         |                          |
|-------------------|-----------------|-----------------------------|--------------------------|-----------------------------|--------------------------|-----------------------------|--------------------------|
|                   |                 | 3,15 V                      |                          | 3,5 V                       |                          | 3,5 V                       |                          |
|                   |                 | Freq. error<br>Average (Hz) | Freq. error<br>Max. (Hz) | Freq. error<br>Average (Hz) | Freq. error<br>Max. (Hz) | Freq. error<br>Average (Hz) | Freq. error<br>Max. (Hz) |
| -10               | 0               | -15                         | -38                      | -18                         | -44                      |                             |                          |
| -10               | 5               | -17                         | -37                      | -17                         | -37                      |                             |                          |
| -10               | 10              | -15                         | -34                      | -12                         | -38                      |                             |                          |
| 0                 | 0               | -17                         | -34                      | -11                         | -31                      |                             |                          |
| 0                 | 5               | -16                         | -30                      | -11                         | -27                      |                             |                          |
| 0                 | 10              | -10                         | -30                      | -12                         | -29                      |                             |                          |
| 10                | 0               | -10                         | -30                      | -12                         | -30                      |                             |                          |
| 10                | 5               | -12                         | -33                      | -12                         | -30                      |                             |                          |
| 10                | 10              | -11                         | -30                      | -10                         | -31                      |                             |                          |
| 20                | 0               | -12                         | -28                      | -10                         | -40                      |                             |                          |
| 20                | 5               | -9                          | -26                      | -10                         | -30                      |                             |                          |
| 20                | 10              | -11                         | -34                      | -7                          | -27                      |                             |                          |
| 30                | 0               | -12                         | -26                      | -10                         | -29                      |                             |                          |
| 30                | 5               | -13                         | -35                      | -13                         | -24                      |                             |                          |
| 30                | 10              | -12                         | -28                      | -15                         | -26                      |                             |                          |
| 40                | 0               | -14                         | -25                      | -11                         | -31                      |                             |                          |
| 40                | 5               | -14                         | -26                      | -13                         | -26                      |                             |                          |
| 40                | 10              | -13                         | -32                      | -13                         | -31                      |                             |                          |
| 50                | 0               | -14                         | -32                      | -11                         | -29                      |                             |                          |
| 50                | 5               | -13                         | -31                      | -17                         | -35                      |                             |                          |
| 50                | 10              | -11                         | -35                      | -11                         | -31                      |                             |                          |

Remark: The applicant declared that normal = maximum voltage. The EUT does not operate at -20 and -30 °C.

### 3.2.4 Test result: Frequency stability

FCC Part 24, Subpart E

| Op. Mode  | Setup    | Port              | Result        |
|-----------|----------|-------------------|---------------|
| op-mode 2 | 37s20e01 | ant.<br>connector | <b>passed</b> |

### 3.3 Spurious emissions at antenna terminals

**Standard** FCC Part 24, 10-01-98  
Subpart E

**The test was performed according to:** FCC §2.1051 10-01-1998

#### 3.3.1 Test Description

1) The mobile station was coupled to the R&S Spectrum Analyser and the R&S CMD55 Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".

2) The total insertion losses for RF Path 1 and RF Path 2 were measured. The values were used to correct the readings from the R&S Spectrum Analyser and the R&S CMD55 Digital Communication Tester.

3) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).

Important Settings:

- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Maximum
- Channel : Varied during measurements  
(lowest channel: 512, mid channel: 661 and highest channel: 810)

4) Important Analyser Settings

- [Resolution Bandwidth / Video Bandwidth]:

a) [3 kHz / 10 kHz] in the Span of 1 MHz directly below and above the PCS-Band,

b) [10 kHz / 30 kHz] in case the curve of the analyser IF-Filter leads to an exceeding of the limit, in this case a worst case correction factor of 20 dB (1 MHz -> 10 kHz) was used

c) [1 MHz / 3 MHz] otherwise

- Sweep Time: Calculated by using a formula given in the Product Standard "PCS 11.10-1 edition 4" for spurious emissions measurements (depending on the transmitting signal, the span and the resolution bandwidth)

5) The spurious emissions (peak) were measured in the frequency range from 9 kHz to 20 GHz (up to the 10th harmonic) during the call is established on the lowest channel (512), mid channel (661) and on the highest channel (810).

#### 3.3.2 Test Requirements / Limits

§ 2.1051 Spurious emissions at antenna terminals

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in Sec. 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

§ 2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§ 24.238 Emission Limits

(a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB.

Remark of the test laboratory: This is calculated to be -13 dBm.

(b) Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(c) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(d) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

(e) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

### 3.3.3 Test Protocol



Temperature: 24 °C  
Air Pressure: 1025 hPa  
Humidity: 46 %

---

**Op. Mode    Setup                    Port**

op-mode 1   37s20e01            ant.  
                                         connector

| Frequency<br>MHz | Bandwidth<br>kHz | Measured Level<br>dBm | Limit<br>dBm |
|------------------|------------------|-----------------------|--------------|
| 1849,90          | 3,00             | -14,65                | -13,00       |
| 3670,70          | 1000,00          | -38,28                | -13,00       |
| 5542,90          | 1000,00          | -35,00                | -13,00       |
| 11089,90         | 1000,00          | -39,46                | -13,00       |
| 14799,60         | 1000,00          | -41,78                | -13,00       |

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.

Temperature: 24 °C  
Air Pressure: 1025 hPa  
Humidity: 46 %

---

**Op. Mode    Setup                    Port**

op-mode 2   37s20e01            ant.  
                                         connector

| Frequency<br>MHz | Bandwidth<br>kHz | Measured Level<br>dBm | Limit<br>dBm |
|------------------|------------------|-----------------------|--------------|
| 1958,40          | 1000,00          | -34,10                | -13,00       |
| 3740,10          | 1000,00          | -37,55                | -13,00       |
| 5612,20          | 1000,00          | -32,65                | -13,00       |
| 9391,20          | 1000,00          | -41,44                | -13,00       |
| 11263,30         | 1000,00          | -38,66                | -13,00       |

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.

Temperature: 24 °C  
Air Pressure: 1025 hPa  
Humidity: 46 %

---

**Op. Mode    Setup                    Port**

op-mode 3   37s20e01            ant.  
                                         connector

| Frequency<br>MHz | Bandwidth<br>kHz | Measured Level<br>dBm | Limit<br>dBm |
|------------------|------------------|-----------------------|--------------|
| 1910,00          | 3,00             | -16,59                | -13,00       |
| 3809,40          | 1000,00          | -38,53                | -13,00       |
| 5716,20          | 1000,00          | -33,95                | -13,00       |
| 9529,80          | 1000,00          | -38,26                | -13,00       |

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.

### 3.3.4 Test result: Spurious emissions at antenna terminals

| FCC Part 24, Subpart E |  | Op. Mode  | Setup        | Port              | Result        |
|------------------------|--|-----------|--------------|-------------------|---------------|
|                        |  | op-mode 1 | 37s20e<br>01 | ant.<br>connector | <b>passed</b> |
|                        |  | op-mode 2 | 37s20e<br>01 | ant.<br>connector | <b>passed</b> |
|                        |  | op-mode 3 | 37s20e<br>01 | ant.<br>connector | <b>passed</b> |

### 3.4 Field strength of spurious radiation

**Standard** FCC Part 24, 10-01-98  
Subpart E

**The test was performed according to:** FCC §2.1053 10-01-1998

#### 3.4.1 Test Description

1) The mobile station was placed inside a anechoic chamber. Refer to chapter "Setup Drawings". The mobile station was coupled to the R&S CMD55 Digital Communication Tester which was located outside the chamber via coaxial cable.

2) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).

Important Settings:

- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Maximum
- Channel : Varied during measurements  
(lowest channel: 512, mid channel: 661 and highest channel: 810)

3) A pre-calibration procedure is used so that the readings from the spectrum analyser are corrected and represent directly the equivalent radiated power (related to a  $\lambda/2$  dipole).

4) All spurious radiation measurements were made with spectrum analyser and the appropriate calibrated antennas for the frequency range of 30 MHz to 20 GHz (up to the 10th harmonic of the transmit frequency).

5) Important Analyser Settings

- [Resolution Bandwidth / Video Bandwidth]:
  - a) [3 kHz / 10 kHz] in the Span of 1 MHz directly below and above the PCS-Band,
  - b) [10 kHz / 30 kHz] in case the curve of the analyser IF-Filter leads to an exceeding of the limit, in this case a worst case correction factor of 20 dB (1 MHz  $\rightarrow$  10 kHz) was used
  - c) [1 MHz / 3 MHz] otherwise
- Sweep Time: Calculated by using a formula given in the Product Standard "PCS 11.10-1 edition 4" for spurious emissions measurements (depending on the transmitting signal, the span and the resolution bandwidth)

6) The spurious emissions (peak) were measured in both vertical and horizontal antenna polarisation during the call is established on the lowest channel (512), mid channel (661) and on the highest channel (810).

#### 3.4.2 Test Requirements / Limits

§ 2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the

magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of Sec. 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(2) All equipment operating on frequencies higher than 25 MHz.

§ 2.1057 Frequency spectrum to be investigated.

(a) In all of the measurements set forth in Secs. 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:

(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

(b) Particular attention should be paid to harmonics and subharmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked.

(c) The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

(d) Unless otherwise specified, measurements above 40 GHz shall be performed using a minimum resolution bandwidth of 1 MHz.

§ 24.238 Emission limits

(a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB.

This is calculated to be -13 dBm (effective radiated power) which corresponds to 84.6 dBµV/m (field strength) in a distance of 3 m.

### **3.4.3 Test Protocol**

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 40 %

**Op. Mode    Setup            Port**  
op-mode 1   37s20a01    enclosure

| Frequency MHz | Antenna Polarisation vertical / horizontal | Bandwidth kHz | Measured Level dBm | Limit dBm |
|---------------|--------------------------------------------|---------------|--------------------|-----------|
| 1850,00       | Horizontal                                 | 3,00          | -17,21             | -13,00    |
| 5551,50       | Horizontal                                 | 1000,00       | -33,80             | -13,00    |
| 9261,52       | Horizontal                                 | 1000,00       | -37,88             | -13,00    |
| 11101,20      | Horizontal                                 | 1000,00       | -36,58             | -13,00    |
| 12971,54      | Horizontal                                 | 1000,00       | -28,53             | -13,00    |
| 14811,22      | Vertical                                   | 1000,00       | -34,49             | -13,00    |
| 16650,90      | Horizontal                                 | 1000,00       | -35,65             | -13,00    |

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 40 %

**Op. Mode    Setup            Port**  
op-mode 2   37s20a01    enclosure

| Frequency MHz | Antenna Polarisation vertical / horizontal | Bandwidth kHz | Measured Level dBm | Limit dBm |
|---------------|--------------------------------------------|---------------|--------------------|-----------|
| 5643,49       | Horizontal                                 | 1000,00       | -33,55             | -13,00    |
| 7513,83       | Horizontal                                 | 1000,00       | -41,23             | -13,00    |
| 9384,17       | Horizontal                                 | 1000,00       | -42,23             | -13,00    |
| 11285,17      | Horizontal                                 | 1000,00       | -36,60             | -13,00    |
| 13155,51      | Vertical                                   | 1000,00       | -23,81             | -13,00    |
| 16926,85      | Horizontal                                 | 1000,00       | -29,92             | -13,00    |

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 40 %

**Op. Mode    Setup            Port**  
op-mode 3   37s20a01    enclosure

| Frequency<br>MHz | Antenna Polarisation<br>vertical / horizontal | Bandwidth<br>kHz | Measured Level<br>dBm | Limit<br>dBm |
|------------------|-----------------------------------------------|------------------|-----------------------|--------------|
| 1910,00          | Horizontal                                    | 3,00             | -17,05                | -13,00       |
| 5735,47          | Horizontal                                    | 1000,00          | -33,39                | -13,00       |
| 7636,47          | Horizontal                                    | 1000,00          | -40,69                | -13,00       |
| 11469,14         | Horizontal                                    | 1000,00          | -34,93                | -13,00       |
| 13370,14         | Vertical                                      | 1000,00          | -25,04                | -13,00       |
| 15301,80         | Vertical                                      | 1000,00          | -40,22                | -13,00       |
| 17202,80         | Horizontal                                    | 1000,00          | -29,11                | -13,00       |

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.

#### 3.4.4 Test result: Field strength of spurious radiation

| FCC Part 24, Subpart E | Op. Mode  | Setup    | Port      | Result        |
|------------------------|-----------|----------|-----------|---------------|
|                        | op-mode 1 | 37s20a01 | enclosure | <b>passed</b> |
|                        | op-mode 2 | 37s20a01 | enclosure | <b>passed</b> |
|                        | op-mode 3 | 37s20a01 | enclosure | <b>passed</b> |

### 3.5 Emission and Occupied Bandwidth

**Standard** FCC Part 24, 10-01-98  
Subpart E

**The test was performed according to:** FCC §2.1049 10-01-1998

#### 3.5.1 Test Description

1) The mobile station was coupled to the R&S Spectrum Analyser and the R&S CMD55 Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".

2) The total insertion losses for RF Path 1 and RF Path 2 were measured. The values were used to correct the readings from the R&S Spectrum Analyser and the R&S CMD55 Digital Communication Tester.

3) A speech call was established on a Traffic Channel (TCH) between the mobile station and the base station simulator (R&S CMD55 Digital Communication Tester).

Important Settings:

- Discontinuous Transmission: OFF
- Modulation Signal: PSR16-1 (Pseudo Random Sequenz)
- Output Power: Maximum
- Channel : Varied during measurements  
(lowest channel: 512, mid channel: 661 and highest channel: 810)

4) Important Analyser Settings:

- Resolution Bandwidth: 3 kHz (1% of the manufacturers stated occupied bandwidth)
- Video Bandwidth: 10 kHz (three times the Resolution Bandwidth)
- Sweep Span: 1 MHz ( at least 250% of the emission bandwidth)

5) The maximum spectral level of the modulated signal was recorded as the reference.

6) The emission bandwidth is measured as follows:  
the two furthest frequencies above and below the frequency of the maximum reference level where the spectrum is -26 dB down have to be found.

7) The occupied bandwidth (99% Bandwidth) is measured as follows:  
the occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power.

#### 3.5.2 Test Requirements / Limits

§ 2.1049 Measurements required: Occupied bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions (as applicable):

(h) Transmitters employing digital modulation techniques - when

modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

(i) Transmitters designed for other types of modulation -

### 3.5.3 Test Protocol

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 49 %

| Op. Mode | Setup | Port |
|----------|-------|------|
|----------|-------|------|

|           |          |                   |
|-----------|----------|-------------------|
| op-mode 1 | 37s20e01 | ant.<br>connector |
|-----------|----------|-------------------|

| Bandwidth<br>kHz | Remarks          |
|------------------|------------------|
| 310              | please see annex |

Remark: The given value is the result of the 26dB bandwidth measurement. The 99% Bandwidth is 241 kHz.

Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 49 %

| Op. Mode | Setup | Port |
|----------|-------|------|
|----------|-------|------|

|           |          |                   |
|-----------|----------|-------------------|
| op-mode 2 | 37s20e01 | ant.<br>connector |
|-----------|----------|-------------------|

| Bandwidth<br>kHz | Remarks          |
|------------------|------------------|
| 314              | please see annex |

Remark: The given value is the result of the 26dB bandwidth measurement. The 99% Bandwidth is 242 kHz.



Temperature: 24 °C  
Air Pressure: 1020 hPa  
Humidity: 49 %

| Op. Mode  | Setup    | Port              |
|-----------|----------|-------------------|
| op-mode 3 | 37s20e01 | ant.<br>connector |

| Bandwidth<br>kHz | Remarks          |
|------------------|------------------|
| 314              | please see annex |

Remark: The given value is the result of the 26dB bandwidth measurement. The 99% Bandwidth is 241kHz.

### 3.5.4 Test result: Emission and Occupied Bandwidth

FCC Part 24, Subpart E

| Op. Mode  | Setup    | Port              | Result        |
|-----------|----------|-------------------|---------------|
| op-mode 1 | 37s20e01 | ant.<br>connector | <b>passed</b> |
| op-mode 2 | 37s20e01 | ant.<br>connector | <b>passed</b> |
| op-mode 3 | 37s20e01 | ant.<br>connector | <b>passed</b> |

## 4. Test Equipment

### *EUT Digital Signalling System*

| Equipment                                        | Type    | Serial No. | Manufacturer    |
|--------------------------------------------------|---------|------------|-----------------|
| Digital Radio Communication Tester               | CMD 55  | 831050/020 | Rohde & Schwarz |
| Signalling Unit for Bluetooth Spurious Emissions | PTW60   | 100004     | Rohde & Schwarz |
| Universal Radio Communication Tester             | CMU 200 | 102366     | Rohde & Schwarz |

### *EMI Test System*

| Equipment                | Type    | Serial No. | Manufacturer    |
|--------------------------|---------|------------|-----------------|
| Comparison Noise Emitter | CNE III | 99/016     | York            |
| EMI Analyzer             | ESI 26  | 830482/004 | Rohde & Schwarz |
| Signal Generator         | SMR 20  | 846834/008 | Rohde & Schwarz |

### *EMI Radiated Auxiliary Equipment*

| Equipment                       | Type                 | Serial No.      | Manufacturer      |
|---------------------------------|----------------------|-----------------|-------------------|
| Antenna mast 4m                 | MA 240               | 240/492         | HD GmbH H. Deisel |
| Biconical dipole                | VUBA 9117            | 9117108         | Schwarzbeck       |
| Broadband Amplifier 18MHz-26GHz | JS4-18002600-32-5P   | 849785          | Miteq             |
| Broadband Amplifier 30MHz-18GHz | JS4-00101800-35-5P   | 896037          | Miteq             |
| Broadband Amplifier 45MHz-27GHz | JS4-00102600-42-5A   | 619368          | Miteq             |
| Cable "ESI to EMI Antenna"      | RTK081+Aircell7      | W18.01+W38.01a  | Huber+Suhner      |
| Cable "ESI to Horn Antenna"     | RTK 081              | W18.04+3599/001 | Rosenberger       |
| Double-ridged horn              | HF 906               | 357357/002      | Rohde & Schwarz   |
| Double-ridged horn              | HF 906               | 357357/001      | Rohde & Schwarz   |
| High Pass Filter                | 5HC3500/12750-1.2-KK | 200035008       | Trilithic         |
| High Pass Filter                | 5HC2700/12750-1.5-KK | 9942012         | Trilithic         |
| High Pass Filter                | 4HC1600/12750-1.5-KK | 9942011         | Trilithic         |
| KUEP pre amplifier              | Kuep 00304000        | 001             | 7layers           |
| Log.-per. Antenna               | HL 562 Ultralog      | 830547/003      | Rohde & Schwarz   |
| Loop Antenna                    | HFH2-Z2              | 829324/006      | Rohde & Schwarz   |
| Pyramidal Horn Antenna 26,5 GHz | Model 3160-09        | 9910-1184       | EMCO              |

### *EMI Conducted Auxiliary Equipment*

| <b>Equipment</b>    | <b>Type</b> | <b>Serial No.</b> | <b>Manufacturer</b> |
|---------------------|-------------|-------------------|---------------------|
| Cable "LISN to ESI" | RG214       | W18.03+W48.03     | Huber+Suhner        |
| Two-Line V-Network  | ESH 3-Z5    | 828304/029        | Rohde & Schwarz     |
| Two-Line V-Network  | ESH 3-Z5    | 829996/002        | Rohde & Schwarz     |

### *Auxiliary Test Equipment*

| <b>Equipment</b>                    | <b>Type</b>       | <b>Serial No.</b> | <b>Manufacturer</b> |
|-------------------------------------|-------------------|-------------------|---------------------|
| Broadband Resist. Power Divider N   | 1506A / 93459     | LM390             | Weinschel           |
| Broadband Resist. Power Divider SMA | 1515 / 93459      | LN673             | Weinschel           |
| Digital Multimeter 01               | Voltcraft M-3860M | IJ096055          | Conrad              |
| Digital Multimeter 02               | Voltcraft M-3860M | IJ095955          | Conrad              |
| Digital Oscilloscope                | TDS 784C          | B021311           | Tektronix           |
| Fibre optic link Satellite          | FO RS232 Link     | 181-018           | Pontis              |
| Fibre optic link Transceiver        | FO RS232 Link     | 182-018           | Pontis              |
| I/Q Modulation Generator            | AMIQ-B1           | 832085/018        | Rohde & Schwarz     |
| Notch Filter ultra stable           | WRCA800/960-6EEK  | 24                | Wainwright          |
| Spectrum Analyzer 9KHz To 3GHz      | FSP3              | 838164/004        | Rohde & Schwarz     |
| Temperature Chamber                 | VT 4002           | 58566002150010    | Vötsch              |
| Temperature Chamber                 | KWP 120/70        | 59226012190010    | Weiss               |
| ThermoHygro_01                      | 430202            |                   | Fischer             |

### *Anechoic Chamber*

| <b>Equipment</b>                  | <b>Type</b>    | <b>Serial No.</b> | <b>Manufacturer</b> |
|-----------------------------------|----------------|-------------------|---------------------|
| Air Compressor (pneumatic)        |                |                   | Atlas Copco         |
| Controller                        | HD 100         | 100/603           | HD GmbH H. Deisel   |
| EMC Camera                        | CE-CAM/1       |                   | CE-SYS              |
| EMC Camera for observation of EUT | CCD-400E       | 0005033           | Mitsubishi          |
| Filter ISDN                       | B84312-C110-E1 |                   | Siemens&Matsushita  |
| Filter telephone systems / modem  | B84312-C40-B1  |                   | Siemens&Matsushita  |
| Filter Universal 1A               | B84312-C30-H3  |                   | Siemens&Matsushita  |
| Fully/Semi AE Chamber             | 10.58x6.38x6   |                   | Frankonia           |
| Turntable                         | DS 420S        | 420/573/99        | HD GmbH, H. Deisel  |
| Valve Control Unit (pneum.)       | VE 615P        | 615/348/99        | HD GmbH, H. Deisel  |

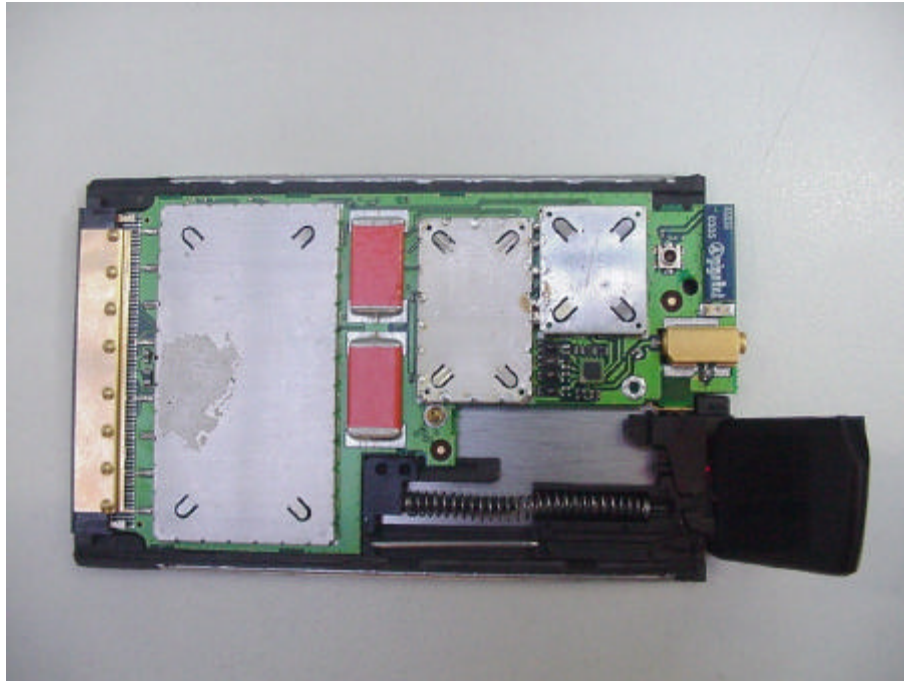


*7 layers Bluetooth™ Full RF Test Solution*

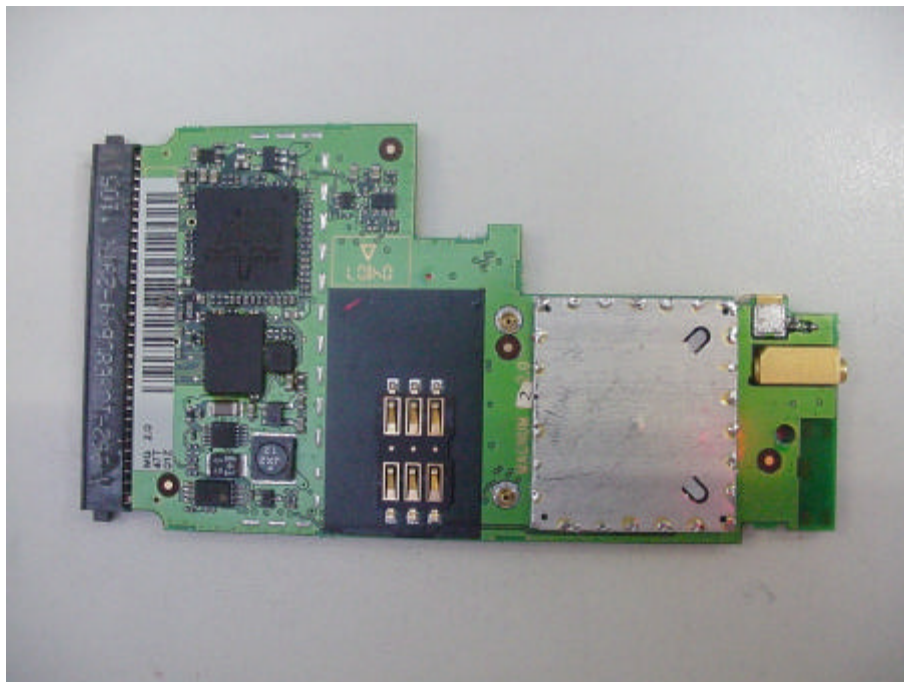
*Bluetooth RF Conformance Test System TS8960*

| <b>Equipment</b>                          | <b>Type</b>      | <b>Serial No.</b> | <b>Manufacturer</b> |
|-------------------------------------------|------------------|-------------------|---------------------|
| 10MHz Reference                           | MFS              | 5489/001          | Efratom             |
| Power Meter<br>832025/059                 | NRVD             | 832025/059        | Rohde & Schwarz     |
| Power Sensor A<br>832279/013              | NRV-Z1           | 832279/013        | Rohde & Schwarz     |
| Power Sensor B<br>832279/015              | NRV-Z1           | 832279/015        | Rohde & Schwarz     |
| Power Supply                              | E3632A           | MY40003776        | Agilent             |
| Power Supply                              | PS-2403D         | -                 | Conrad              |
| RF Step Attenuator<br>833695/001          | RSP              | 833695/001        | Rohde & Schwarz     |
| Rubidium Frequency Normal                 | MFS              | 002               | Efratom             |
| Signal Analyser FSIQ26<br>832695/007      | FSIQ26           | 832695/007        | Rohde & Schwarz     |
| Signal Analyser FSP30<br>100051           | FSP30            | 100051            | Rohde & Schwarz     |
| Signal Generator<br>101175                | SMIQ03B          | 101175            | Rohde & Schwarz     |
| Signal Generator<br>833680/003            | SMP 03           | 833680/003        | Rohde & Schwarz     |
| Signal Generator A<br>834344/002          | SMIQ03B          | 834344/002        | Rohde & Schwarz     |
| Signal Generator B<br>832870/017          | SMIQ03B          | 832870/017        | Rohde & Schwarz     |
| Signal Switching and<br>Conditioning Unit | SSCU             | 338826/005        | Rohde & Schwarz     |
| Signalling Unit PTW60<br>838312/014       | PTW60 for TS8960 | 838312/014        | Rohde & Schwarz     |
| System Controller<br>829323/008           | PSM12            | 829323/008        | Rohde & Schwarz     |

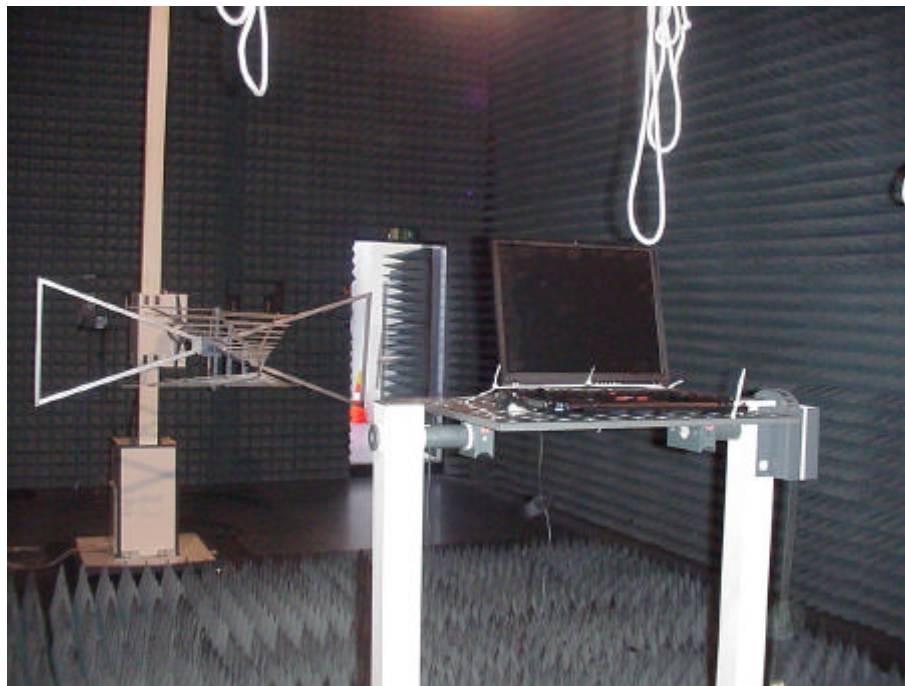
## 5. Foto Report



Picture 1 : EUT (top side, without housing)

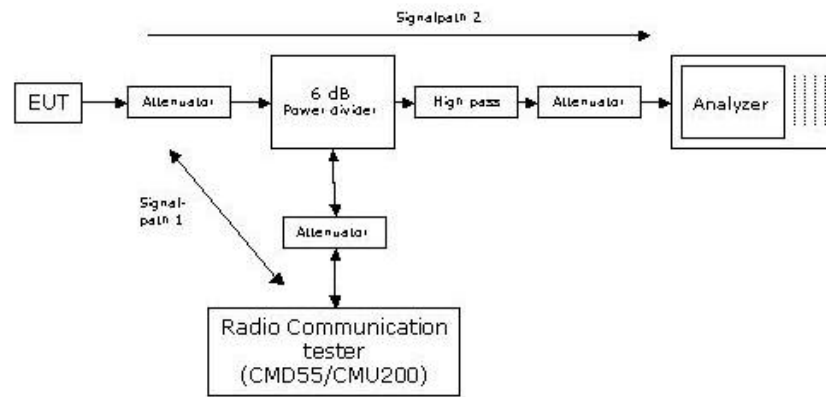


Picture 2 : EUT (bottom side, without housing)



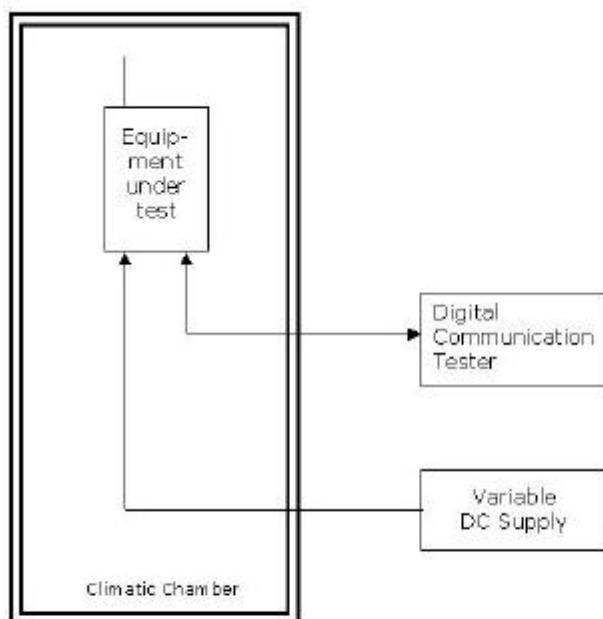
**Picture 3** : Setup for radiated measurements

## 6. Setup Drawings



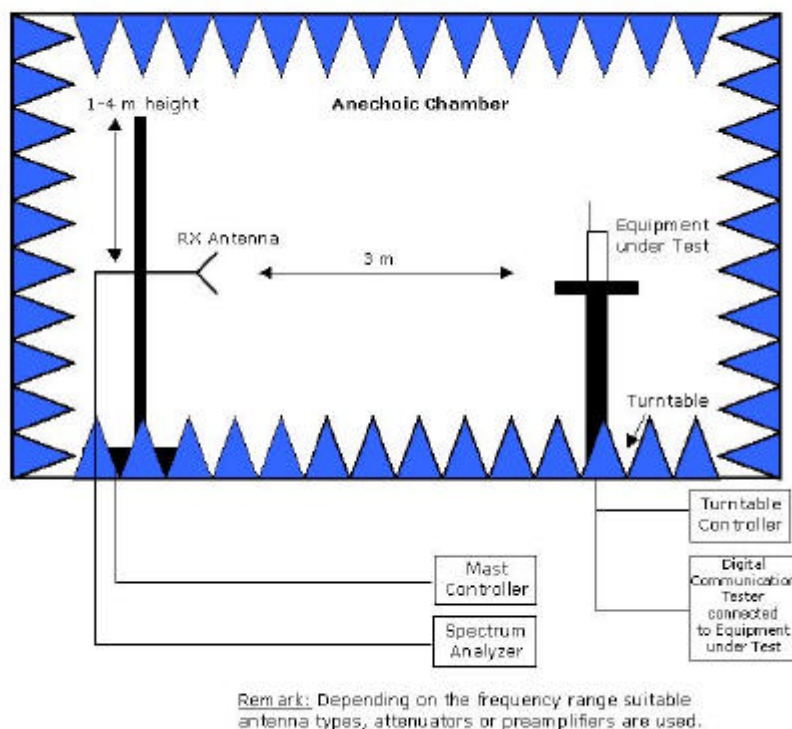
Remark: Depending on the frequency range suitable attenuators or high pass are used.

**Drawing 1 : Setup for conducted measurements under nominal conditions (in principle)**



**Drawing 2 : Principle setup for tests under extreme test conditions**





**Drawing 3 : Principle setup for radiated measurements**

## **7. Annex**

### **Measurement plots**