InterLab®

FCC Measurement / Technical Report on

GSM gateway
iGATE GSM 32 VoIP

Report Reference: MUS_USNetserve_0801_FCCdCoLoc

Test Laboratory:

DAT-P-192/99-01

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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.

Table of Contents

0 Summary

0.1 Technical Report Summary

Type of Authorization
Certification for a GSM cellular radiotelephone device

Applicable FCC Rules

Prepared in accordance with the requirements of FCC Rules and Regulations as listed in 47 CFR Ch.1 (10-1-08 Edition).

The following parts and subparts are applicable to the results in this test report.

- Part 2, Subpart J - Equipment Authorization Procedures, Certification

Especially for this report:

For the representative worst-case combinations of operating modes listed in the test matrix the following tests shall be performed:

- Radiated spurious emissions tests according to the standard:
  Part 22: Subpart H, § 22.917 Emission limitations for cellular equipment
  Part 24: Subpart E, § 24.238 Emission limitations for Broadband PCS equipment
  in combination with:
  Part 2: § 2.1053 Measurement required: Field strength of spurious radiation

- Radiated RF power output tests according to:
  Part 22: Subpart H, § 22.913 Effective radiated power limits
  Part 24: Subpart E, § 24.232 Power and antenna height limits
  in combination with:
  Part 2: § 2.1046 Measurement required: RF power output

Note:
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Summary Test Results:

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

0.2 Measurement Summary

FCC Part 22 / 24		**§§ 22.917, 24.238**	
Radiated spurious emissions, 2 antennas radiating			
The measurement was performed according Part 2: § 2.1053			10-1-08
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 1	setup_01	Enclosure	passed
op-mode 2	setup_01	Enclosure	passed
op-mode 3	setup_01	Enclosure	passed
op-mode 4	setup_01	Enclosure	passed
op-mode 5	setup_01	Enclosure	passed
op-mode 6	setup_01	Enclosure	passed
op-mode 7	setup_01	Enclosure	passed
op-mode 8	setup_01	Enclosure	passed
op-mode 9	setup_01	Enclosure	passed

FCC Part 22 / 24		**§§ § 22.913, 24.232**	
Radiated RF power output, 1 antenna radiating			
The measurement was performed according to FCC §2.1046			10-1-08
OP-Mode	**Setup**	**Port**	**Final Result**
op-mode 10	setup_01	Enclosure	passed
op-mode 11	setup_01	Enclosure	passed
op-mode 12	setup_01	Enclosure	passed
op-mode 13	setup_01	Enclosure	passed
op-mode 14	setup_01	Enclosure	passed
op-mode 15	setup_01	Enclosure	passed

Responsible for Accreditation Scope: _____ Responsible for Test Report: _____

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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. DAT-P-192/99-01
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Thomas Hoell Dipl.-Ing. Andreas Petz
Report Template Version:	2009-03-20

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Carsten Steinröder
Receipt of EUT:	2009-02-23
Date of Test(s):	2009-02-26 to 2009-03-03
Date of Report:	2009-12-15

1.3 Applicant Data

Company Name:	TELES AG
Address:	Ernst-Reuter-Platz 8 10587 Berlin Germany
Contact Person:	Mr. Martin Herrscher

1.4 Manufacturer Data

Company Name:	please see at Applicant Data
Address:	
Contact Person:	

2 Test object Data

2.1 General EUT Description

Equipment under Test	GSM gateway
Type Designation:	iGATE GSM 32 VoIP
Kind of Device:	GSM 850/900/1800/1900 transceiver
(optional)	
Voltage Type:	AC 50 Hz / 60 Hz, tested at 60 Hz
Voltage level:	100 - 240 V, tested at 120 V

General product description:

The Equipment Under Test (EUT) is a GSM 850/900/1800/1900 gateway.
In GSM 850 mode the EUT operates in channel blocks A and B from 824,2 MHz (lowest channel = 128) to 848,8 MHz (highest channel = 251).
In PCS1900 mode the EUT operates in blocks A through F from 1850,2 MHz (lowest channel = 512) to 1909,8 MHz (highest channel = 810).

The GSM modules built-in to the EUT can operate independently from each other and transmission at the same time is possible for one of these scenarios:
(GSM850 AND GSM850) OR (GSM1900 AND GSM1900) OR (GSM850 AND GSM1900)

Therefore, co-location testing is applicable to simultaneous GSM transmission for representative worst-case combinations.

Specific product description for the EUT:

The Equipment Under Test (EUT) is a 19” case which can be mounted to e.g. a standard 19” rack. Radiated spurious emissions are performed for a fixed horizontal EUT mounting position.
The EUT incorporates a Mainboard which is supplied by the internal AC/DC converter of EUT. Up to 8 GSM Cards can be inserted which are controlled and powered via the Mainboard. On each GSM Card are mounted 4 GSM Modules. Each GSM Module (max. 32 pcs) is equipped with a permanent antenna connector.
GSM signals use a separate feeder line to separate external antennas. All antennas are arranged on a ground plane and have a distance to the nearest neighbour of approx. 0.1 m. For the tests 1 resp. 2 antennas are selected as representative configuration. For details please refer also to chapter 5.

The EUT provides the following ports:

Ports
Enclosure
Antenna (external)
Antenna connector
AC Mains
LAN (2 connectors)
PRI (E1/T1, 2 connectors)

The main components of the 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 (Code: DQ000a01)	GSM gateway	iGATE GSM 32 VoIP	–	–	14.5	2009-02-23
EUT A incorporates	Mainboard (1 pcs)	–	–	2.1	–	2009-02-23
EUT A incorporates	GSM-Card (of 8 pcs) S/N_ 3806807840 0592	"Active module 1"	IMEI: 35371600.0 59112.719	1.67	–	2009-02-23
EUT A incorporates	same GSM-Card (see above)	"Active module 2"	IMEI: 35371600.0 59113.519	1.67	–	2009-02-23

Remark: EUT A is equipped with a permanent antenna connector (32 pcs, one for each GSM module).

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 nevertheless Ancillary Equipment can influence the test results.

Short Description	Equipment under Test	Type Designation	HW Status	SW Status	Serial no.	FCC ID
AE1	External Antenna	Hirschmann MCA 1890 MH/PB/ SMAm 921797-004	–	–	–	–

Remark: According to the applicant AE1 has a nominal antenna gain of 5.1 dBi. Together with the assembled antenna cable (by antenna manufacturer) of the type RG174 it is reduced by the cable loss of approx. 2.5 dB which leads to the effective antenna gain of 2.6 dBi.

2.4 EUT Setups

This chapter describes the combination of EUTs and ancillary equipment used for testing.

Setup No.	Combination of EUTs	Description
setup_01	EUT A + AE1	setup for radiated measurements, 1 or 2 antennas active

2.5 Operating Modes

This chapter describes the operating modes of the EUTs used for testing according to the test matrix (sub-clause 2.6).

Op. Mode	Description of Operating Modes	Remarks
op-mode 1	Call established on TCH 128, Carrier Frequency 824,2 MHz (module 1) and simultaneously on TCH 133, Carrier Frequency 825,2 MHz (module 2)	Traffic Channel (TCH) 128 is the lowest channel of GSM 850 band
op-mode 2	Call established on TCH 251, Carrier Frequency 848,8 MHz (module 1) and simultaneously on TCH 246, Carrier Frequency 847,8 MHz (module 2)	Traffic Channel (TCH) 251 is the highest channel of GSM 850 band
op-mode 3	Call established on TCH 190, Carrier Frequency 836,6 MHz (module 1) and simultaneously on TCH 195, Carrier Frequency 837,6 MHz (module 2)	Traffic Channel (TCH) 190 is a mid channel of GSM 850 band
op-mode 4	Call established on TCH 128, Carrier Frequency 824,2 MHz (module 1) and simultaneously on TCH 251, Carrier Frequency 848,8 MHz (module 2)	Traffic Channel (TCH) 128 is the lowest channel of GSM 850 band, Traffic Channel (TCH) 251 is the highest channel of GSM 850 band
op-mode 5	Call established on TCH 512, Carrier Frequency 1850,2 MHz (module 1) and simultaneously on TCH 517, Carrier Frequency 1851,2 MHz (module 2)	Traffic Channel (TCH) 512 is the lowest channel of GSM 1900 band
op-mode 6	Call established on TCH 810, Carrier Frequency 1909,8 MHz (module 1) and simultaneously on TCH 805, Carrier Frequency 1908,8 MHz (module 2)	Traffic Channel (TCH) 810 is the highest channel of GSM 1900 band
op-mode 7	Call established on TCH 661, Carrier Frequency 1880,0 MHz (module 1) and simultaneously on TCH 666, Carrier Frequency 1881,0 MHz (module 2)	Traffic Channel (TCH) 661 is a mid channel of GSM 1900 band
op-mode 8	Call established on TCH 512, Carrier Frequency 1850,2 MHz (module 1) and simultaneously on TCH 810, Carrier Frequency 1909,8 MHz (module 2)	Traffic Channel (TCH) 512 is the lowest channel of GSM 1900 band, Traffic Channel (TCH) 810 is the highest channel of GSM 1900 band
op-mode 9	Call established on TCH 190, Carrier Frequency 836,6 MHz (module 1) and simultaneously on TCH 661, Carrier Frequency 1880,0 MHz (module 2)	Traffic Channel (TCH) 190 is a mid channel of GSM 850 band, Traffic Channel (TCH) 661 is a mid channel of GSM 1900 band

In order to verify Radiated RF power output with the external antenna , the following operating modes are used which provides the highest output power as “worst-case-scenario”:

Op. Mode	Description of Operating Modes	Remarks
op-mode 10	Call established on TCH 128, Carrier Frequency 824,2 MHz (module 1)	Traffic Channel (TCH) 128 is the lowest channel of GSM 850 band
op-mode 11	Call established on TCH 190, Carrier Frequency 836,6 MHz (module 1)	Traffic Channel (TCH) 190 is a mid channel of GSM 850 band
op-mode 12	Call established on TCH 251, Carrier Frequency 848,8 MHz (module 1)	Traffic Channel (TCH) 251 is the highest channel of GSM 850 band
op-mode 13	Call established on TCH 512, Carrier Frequency 1850,2 MHz (module 1)	Traffic Channel (TCH) 512 is the lowest channel of GSM 1900 band
op-mode 14	Call established on TCH 661, Carrier Frequency 1880,0 MHz (module 1)	Traffic Channel (TCH) 661 is a mid channel of GSM 1900 band
op-mode 15	Call established on TCH 810, Carrier Frequency 1909,8 MHz (module 1)	Traffic Channel (TCH) 810 is the highest channel of GSM 1900 band

2.6 Test Matrix Co-Location (GSM 850 / 1900 bands)

→ TCH ↓	128	190	251	512	661	810	Operating Mode	Remark
133	X						op-mode 1	Measurement: 0.03–10 GHz
195		X					op-mode 3	Measurement: 0.03–10 GHz
246			X				op-mode 2	Measurement: 0.03–10 GHz
251	X						op-mode 4	Measurement: 1–5 GHz
517				X			op-mode 5	Measurement: 0.03–20 GHz
661		X					op-mode 9	Measurement: 1–10 GHz
666					X		op-mode 7	Measurement: 0.03–20 GHz
805						X	op-mode 6	Measurement: 0.03–20 GHz
810				X			op-mode 8	Measurement: 1–10 GHz

Notes:
X = to be tested.
All numerical values are given in TCH (Traffic Channel) numbers.

3 Test Results

3.1 Field strength of spurious radiation

Standard FCC Part 22, 10-1-08 Subpart H
FCC Part 24, 10-1-08 Subpart E

The test was performed according to: FCC §2.1053, 10-1-08

3.1.1 Test Description

1) The EUT was placed inside an anechoic chamber. Refer to chapter "Setup Drawings". Between the base station simulator (R&S CMU200 Digital Communication Tester) which was located outside the chamber and the EUT a GSM link was established over air (no cable connections). The measurement distance between the measurement antenna and the EUT was 3m.

2) A call was established on a Traffic Channel (TCH) between the EUT and the base station simulator (R&S CMU200 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR11-1 (Pseudo Random Sequence)
- Output Power: Maximum
- Channel : Varied during measurements

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 lamda/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 10 resp. 20 GHz (up to the 10th harmonic of the transmit frequency) or otherwise stated.

5) Important Analyser Settings
- [Resolution Bandwidth / Video Bandwidth]:
a) [3 kHz / 10 kHz] in the Span of 1 MHz directly below and above the GSM-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 "GSM 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.

3.1.2 Test Requirements / Limits

§ 2.1053 Measurements required: Field strength of spurious radiation.

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.

§ 22.917 Emission limitations for cellular equipment

(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of 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.

(b) Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. 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. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 100 kHz or 1 percent of emission bandwidth, as specified).

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) Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas [...].
(d) If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

§ 24.238 Emission limitations for Broadband PCS equipment

(a) The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of 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.

(b) Compliance with these rules 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. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 1 MHz or 1 percent of emission bandwidth, as specified). 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) Licensees in this service may establish an alternative out of band emission limit to be used at specified band edge(s) in specified geographical areas [...].
(d) If any emission from a transmitter operating in this service results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

3.1.3 Test Protocol

Temperature: 23 – 24 °C
Air Pressure: 1019 hPa
Humidity: 34 – 33 %

Op. Mode	Setup	Port
op-mode 1	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
824	Vertical	3	-29.3	-13.0

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

Op. Mode	Setup	Port
op-mode 2	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
849	Vertical	3	-25.1	-13.0

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

Op. Mode	Setup	Port
op-mode 3	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
-	-	-	-	-13.0

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

Op. Mode	Setup	Port
op-mode 4	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
814	Vertical	1000	-31.9	-13.0
824	Vertical	3	-21.8	-13.0
849	Vertical	3	-27.1	-13.0

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.
The measurement was performed in the frequency range 1–5 GHz.

Op. Mode	Setup	Port
op-mode 5	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
1850	Vertical	3	-21.6	-13.0

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

Op. Mode	Setup	Port
op-mode 6	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
1910	Vertical	3	-23.5	-13.0

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

Op. Mode	Setup	Port
op-mode 7	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
-	-	-	-	-13.0

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

Op. Mode	Setup	Port
op-mode 8	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
1791	Vertical	1000	-18.5	-13.0
1850	Vertical	3	-21.6	-13.0
1910	Vertical	3	-20.9	-13.0
1968	Vertical	1000	-15.7	-13.0

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.
The measurement was performed in the frequency range 1–10 GHz.

Op. Mode	Setup	Port
op-mode 9	setup_01	Enclosure

Frequency MHz	Antenna Polarisation	Bandwidth kHz	Measured Level dBm	Limit dBm
-	-	-	-	-13.0

Remark: No (further) spurious emissions were found in the range 20 dB below the limit.
The measurement was performed in the frequency range 1–10 GHz.

3.1.4 Test result: Spurious radiated emissions

FCC Part 22 / 24	Op. Mode	Result
	op-mode 1	passed
	op-mode 2	passed
	op-mode 3	passed
	op-mode 4	passed
	op-mode 5	passed
	op-mode 6	passed
	op-mode 7	passed
	op-mode 8	passed
	op-mode 9	passed

3.2 RF Power Output

Standard FCC Part 22, 10-1-08 Subpart H
FCC Part 24, 10-1-08 Subpart E

The test was performed according to: FCC §2.1046, 10-1-08

3.2.1 Test Description (radiated measurement procedure)

1) The EUT was placed inside an anechoic chamber. Refer to chapter "Setup Drawings". Between the base station simulator (R&S CMU200 Digital Communication Tester) which was located outside the chamber and the EUT a GSM link was established over air (no cable connections). The measurement distance between the measurement antenna and the EUT was 2.05 m and the EUT was placed in 1.1 m height above the floor.
2) A call was established on a Traffic Channel (TCH) between the EUT and the base station simulator (R&S CMU200 Digital Communication Tester).
Important Settings:
- Discontinuous Transmission: OFF
- Modulation Signal: PSR11-1 (Pseudo Random Sequence)
- Output Power: Maximum
- Channel: Varied during measurements
3) A pre-calibration procedure is used and the measured values represent directly the equivalent radiated power (related to a half wave dipole) ERP for GSM850 band according to FCC Part 22 and the equivalent isotropically radiated power (related to an isotropic radiator) EIRP for GSM1900 band according to FCC Part 24.
4) All measurements were performed with a power meter and the appropriate calibrated antennas.
5) The measurement was performed in steps:
The EUT was rotated in order to find the position of maximum radiated output power. This was performed for both polarisations of the measurement antenna (Vertical + Horizontal) and for a scan over the spherical surface in 22.5° steps (two-axis rotation, 3D). The maximum radiated output power as ERP resp. EIRP is measured. The measurement time is chosen long enough to allow the the measurement value to stabilize.
The steps described above were repeated for the different operating modes. The corrected value of the maximum output power (ERP resp. EIRP) is recorded in this test report.

3.2.2 Test Description (conducted measurement procedure)

1) The EUT was coupled to a Spectrum Analyser and a Digital Communication Tester through a Power Divider. Refer to chapter "Setup Drawings".
2) The total insertion losses for signal path 1 and signal path 2 were measured. The values were used to correct the readings from the Spectrum Analyser and the Digital Communication Tester.
3) A call was established on a Traffic Channel between the EUT and the Digital Communication Tester.
Important Settings:
- Channel (Frequency): please refer to the detailed results
4) The transmitted power of the EUT was recorded by using a spectrum analyser.

3.2.3 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.

§22.913 Effective radiated power limits

(a) Maximum ERP. … The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

§24.232 Power and antenna height limits

(c) Mobile/portable stations are limited to 2 watts EIRP peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

(d) 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.

3.2.4 Test Protocol (radiated measurement procedure)

Temperature: 25 °C
Air Pressure: 1020 hPa
Humidity: 35 %

Op. Mode	Setup	Port
op-mode 10	setup_01	Enclosure

Frequency MHz	Measured Level ERP dBm	Active Antenna	Limit dBm
824,2	26.2	module / antenna 1	38.45

Op. Mode	Setup	Port
op-mode 11	setup_01	Enclosure

Frequency MHz	Measured Level ERP dBm	Active Antenna	Limit dBm
836,6	28.0	module / antenna 1	38.45

Op. Mode	Setup	Port
op-mode 12	setup_01	Enclosure

Frequency MHz	Measured Level ERP dBm	Active Antenna	Limit dBm
848,8	27.8	module / antenna 1	38.45

Op. Mode	Setup	Port
op-mode 13	setup_01	Enclosure

Frequency MHz	Measured Level EIRP dBm	Active Antenna	Limit dBm
1850,2	28.4	module / antenna 1	33.0

Op. Mode	Setup	Port
op-mode 14	setup_01	Enclosure

Frequency MHz	Measured Level EIRP dBm	Active Antenna	Limit dBm
1880,0	28.9	module / antenna 1	33.0

Op. Mode	Setup	Port
op-mode 15	setup_01	Enclosure

Frequency MHz	Measured Level EIRP dBm	Active Antenna	Limit dBm
1909,8	29.9	module / antenna 1	33.0

3.2.5 Test Protocol (conducted measurement procedure)

Temperature: 26 °C
Air Pressure: 1024 hPa
Humidity: 32 %

Op. Mode	Setup	Port
op-mode 10	setup_01	Enclosure

Frequency MHz	detector	conducted level / dBm	Limit dBm
824,2	peak	32.40	38.45
824,2	average	32.03	38.45
824,2	rms	32.03	38.45

Op. Mode	Setup	Port
op-mode 11	setup_01	Enclosure

Frequency MHz	detector	conducted level / dBm	Limit dBm
836,6	peak	32.54	38.45
836,6	average	32.19	38.45
836,6	rms	32.20	38.45

Op. Mode	Setup	Port
op-mode 12	setup_01	Enclosure

Frequency MHz	detector	conducted level / dBm	Limit dBm
848,8	peak	32.71	38.45
848,8	average	32.35	38.45
848,8	rms	32.37	38.45

Op. Mode	Setup	Port
op-mode 13	setup_01	Enclosure

Frequency MHz	detector	conducted level / dBm	Limit dBm
1850,2	peak	30.31	33.0
1850,2	average	29.95	33.0
1850,2	rms	29.96	33.0

Op. Mode	Setup	Port
op-mode 14	setup_01	Enclosure

Frequency MHz	detector	conducted level / dBm	Limit dBm
1880,0	peak	30.23	33.0
1880,0	average	29.86	33.0
1880,0	rms	29.87	33.0

Op. Mode	Setup	Port
op-mode 15	setup_01	Enclosure

Frequency MHz	detector	conducted level / dBm	Limit dBm
1909,8	peak	29.97	33.0
1909,8	average	29.60	33.0
1909,8	rms	29.61	33.0

3.2.6 Test result: RF Power Output

FCC Part 22 / 24	Op. Mode	Result
	op-mode 10	passed
	op-mode 11	passed
	op-mode 12	passed
	op-mode 13	passed
	op-mode 14	passed
	op-mode 15	passed

4 Test Equipment

Please refer to the separate report on “Test Equipment Calibration”.

5 Photo Report

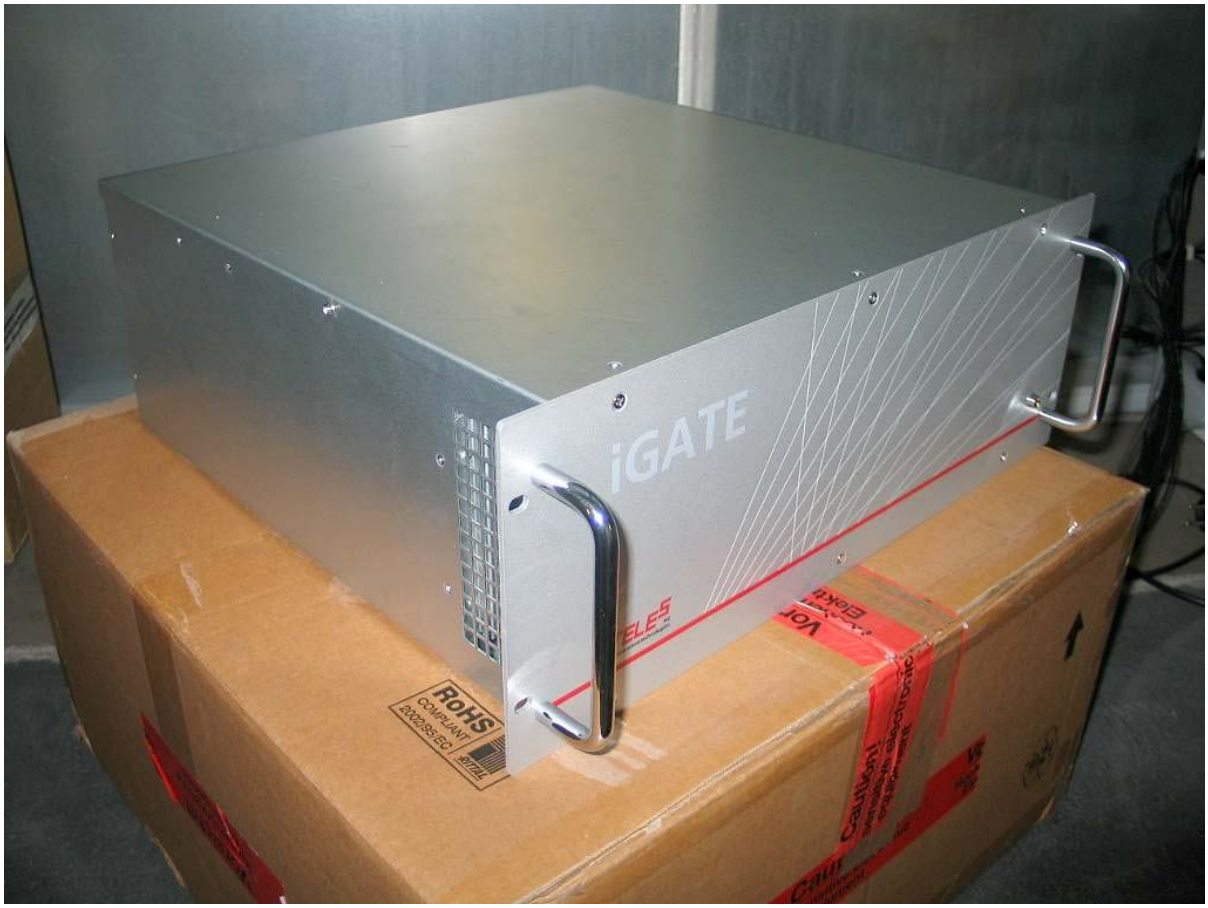


Photo 1: EUT (front and left side)

Photo 2: EUT (rear side, 8 GSM Cards inserted)

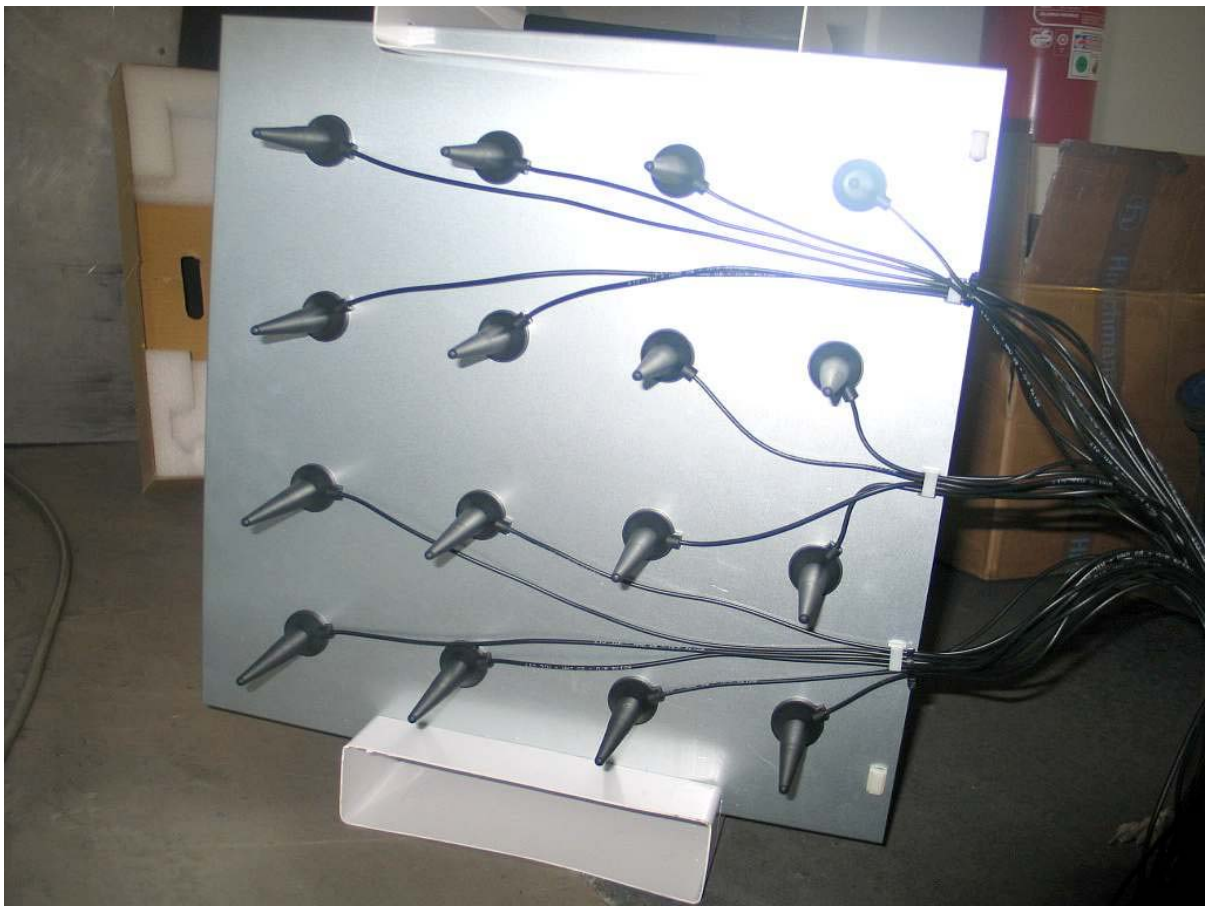


Photo 3: Assembly of antennas (shortest antenna-to-antenna distance: approx. 0.1 m)

Photo 4: Assembly of antennas (16 on top side, 16 on bottom side of ground plane)

Photo 5: Setup for tests field strength of spurious radiation

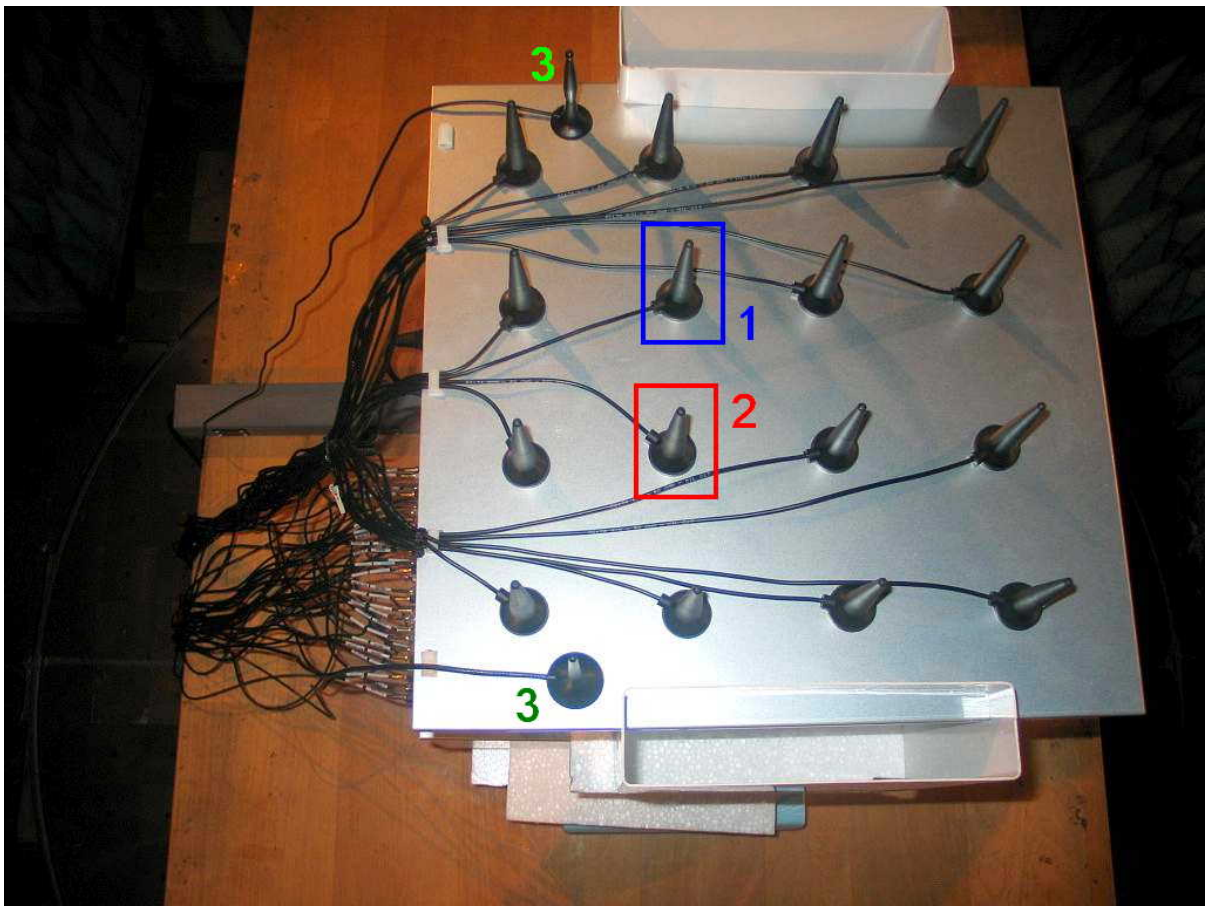


Photo 6: Antenna assembly used for RF radiated field strength tests:
1: connected to module 1 (see next photo), active radio link
2: connected to module 2 (see next photo), active radio link (spurious only)
3: auxiliary signalling antennas, not part of the antenna assembly.

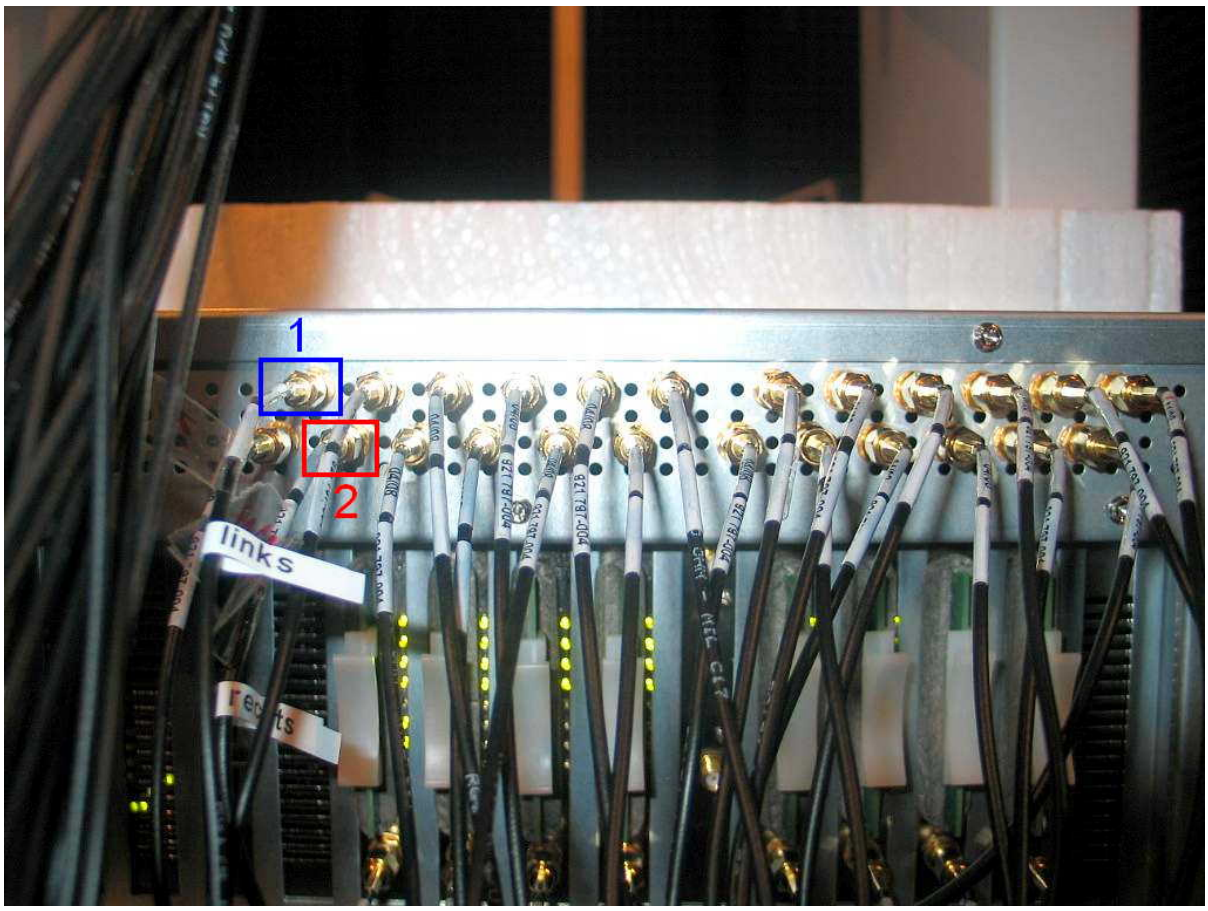


Photo 7: Setup for RF radiated field strength tests:
1: output of module 1, connected to antenna 1 (see photo above)
2: output of module 2, connected to antenna 2 (see photo above)

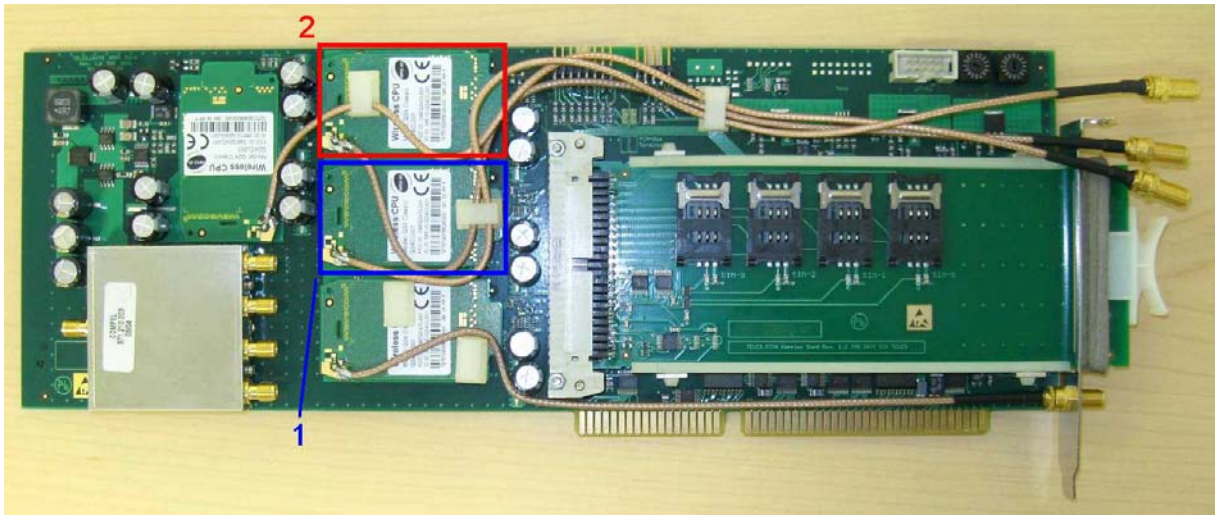


Photo 8: GSM Card, PCB (top view, with SIM card holder, active modules are marked)

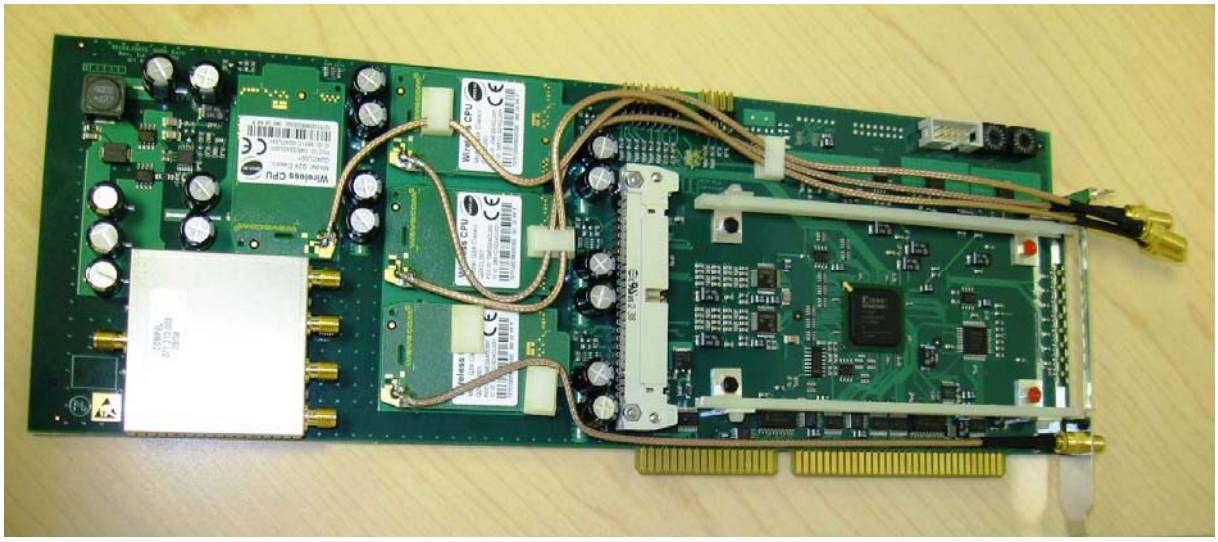


Photo 9: GSM Card, PCB (top view, without SIM card holder)

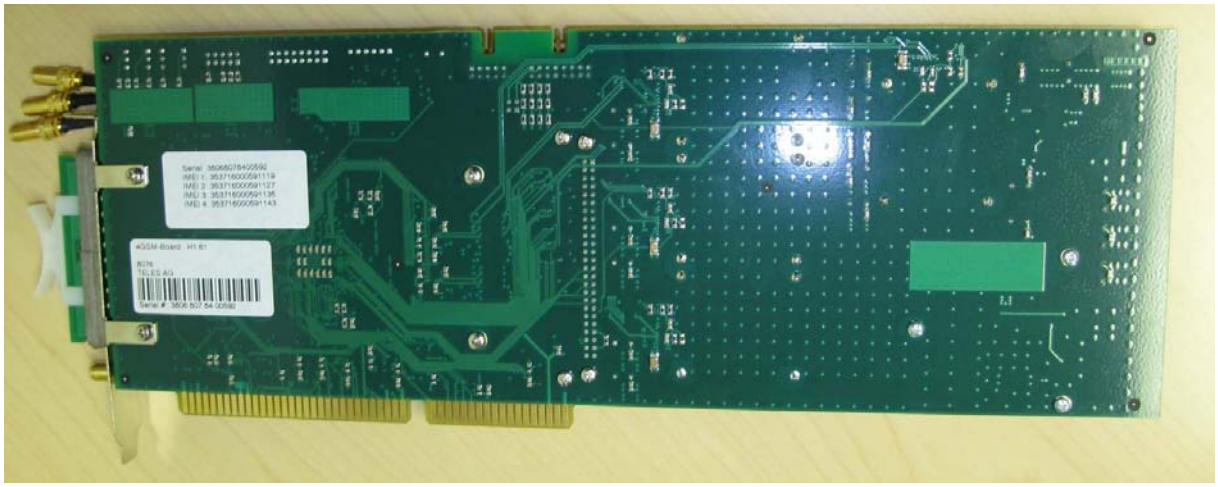
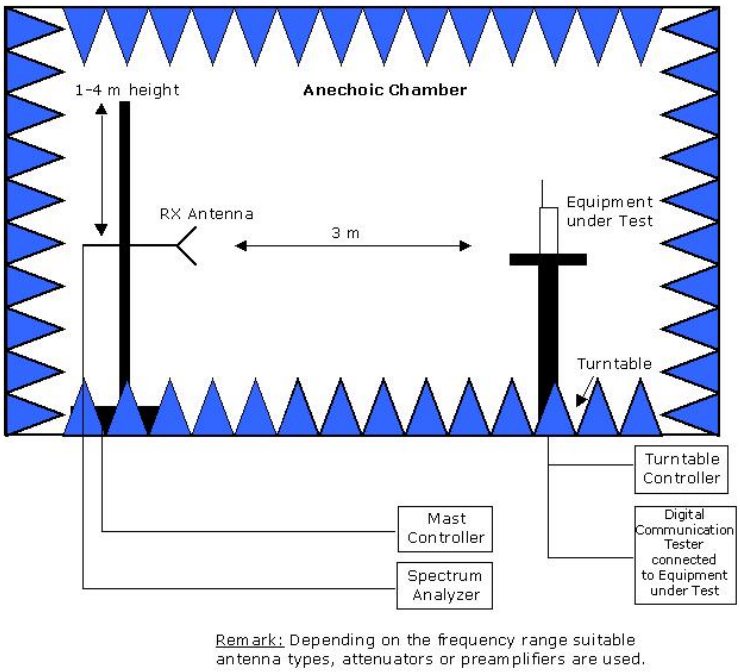


Photo 10: GSM Card, PCB (rear view)

Photo 11: Mainboard built-in to EUT, assembled with 8 GSM cards

6 Setup Drawings



Drawing 1: Setup in the Anechoic chamber. For measurements below 1 GHz the ground was replaced by a conducting ground plane.