



Inter**Lab**[®]

FCC Measurement/Technical Report on

GSM gateway

iGATE GSM 32 VoIP

Report Reference: MUS_USNetserve_0801_FCCbMPE

Test Laboratory:

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FCC Registration Number (FRN)
0008074825

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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0 Summary

0.1 Technical Report Summary

Type of Authorization

RF Exposure Report (MPE, Maximum Permissible Exposure) for a GSM cellular multiple transmitter radiotelephone 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 (10-1-08 Edition). The following subparts are applicable to the results in this test report.

Part 1

§ 1.1307 Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared

§ 1.1310 Radiofrequency radiation exposure limits

Additionally, the results are obtained following the

FCC OET Bulletin 65, Edition 97-01 (August 1997)

Supplement C, Edition 01-01 (June 2001), to FCC OET Bulletin 65, Edition 97-01

Summary Test Results:

The EUT complied with all performed tests as listed in chapter 0.2 Measurement Summary and subject to the conditions given in chapter 3.2.4 Evaluation of Exposure to RF Emissions.

The measurements are performed following the requirements of FCC Part 1 § 1.1310 and FCC OET Bulletin 65.

The applicant proposed the measurements.

0.2 Measurement Summary

Radiated Field Strength

The measurement was performed according to FCC §1.1310

10-01-2008

OP-Mode	Setup	Port	Final Result *)
op-mode 1	Setup_a01	Antenna (external)	compliant
op-mode 2	Setup_a01	Antenna (external)	compliant
op-mode 3	Setup_a01	Antenna (external)	compliant
op-mode 4	Setup_a01	Antenna (external)	compliant
op-mode 5	Setup_a01	Antenna (external)	compliant
op-mode 6	Setup_a01	Antenna (external)	compliant

*) under the terms of chapter 3.2.4 Evaluation of Exposure to RF Emissions

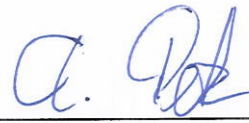


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Responsible for
Accreditation Scope:



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. 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
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Report Template Version:	2009-03-19
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1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Andreas Petz
Receipt of EUT:	2009-02-23
Date of Test(s):	2009-02-27
Date of Report:	2009-03-31

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 applicant data
Address:	
Contact Person:	

2 Testobject Data

2.1 General EUT Description

Equipment under	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).

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)	“Active module”	IMEI: 35371600.0 S/N_ 59112.719	1.67	–	2009-02-23

Remark: EUT A is equipped with a permanent antenna connector (32 pcs, one for each GSM module). 4 GSM modules are placed on each of the 8 GSM Cards. The GSM Cards are controlled and powered via the Mainboard which is supplied by the internal AC/DC converter of EUT A.

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_a01	EUT A + AE1	setup for radiated tests (1 GSM module operating, 1 antenna)

2.5 Operating Modes

This chapter describes the operating modes of the EUTs 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 of the GSM 850 band
op-mode 2	Call established on Traffic Channel (TCH) 661, Carrier Frequency 1880 MHz	661 is a mid channel of the GSM 850 band
op-mode 3	Call established on Traffic Channel (TCH) 810, Carrier Frequency 1909,8 MHz	810 is the highest channel of the GSM 850 band
op-mode 4	Call established on Traffic Channel (TCH) 128, Carrier Frequency 824,2 MHz	128 is the lowest channel of the GSM 1900 band
op-mode 5	Call established on Traffic Channel (TCH) 190, Carrier Frequency 836,6 MHz	190 is a mid channel of the GSM 1900 band
op-mode 6	Call established on Traffic Channel (TCH) 251, Carrier Frequency 848,8 MHz	251 is the highest channel of the GSM 850 band



3 Test Results

3.1 Radiated Field Strength

Standard FCC Part 1, 10-01-2008

The test was performed according to: FCC §1.1310 and FCC OET Bulletin 65, Edition 97-01, August 1997.

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).

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) The electric field strength transmitted from the EUT / Ancillary Equipment was recorded for the different positions of the turntable while the turntable is rotating in steps of 15 degrees. The RF radiated field strength was determined by using a calibrated field probe which measures the vectorial sum of all three axis (x-, y-, z-axis). The measurement result is the average value of the electric field strength (spatial and time averaged) for one turntable position. The highest value of all turntable positions is reported in this test report.

The measurement was performed at a distance between the EUT and the field probe of which is reported in chapter 3.1.

3.1.2 Test Protocol (GSM 1900)

Temperature: 24 °C
Air Pressure: 1018 hPa
Humidity: 35 %

RF Radiated Field Strength

Remark: The height is the height above the ground of the fully anechoic chamber. In the table below the highest value of the field strength is given for the worst case position of the turntable.

Op. Mode	Setup	Port
op-mode 1	setup_a01	Antenna (external)

Frequency MHz	Height of Field Probe m	Distance EUT – Field Probe m	Measured Average Field Strength V/m	Limit V/m
1850.2	1.40	1.25	1.06	–

Op. Mode	Setup	Port
op-mode 2	setup_a01	Antenna (external)

Frequency MHz	Height of Field Probe m	Distance EUT – Field Probe m	Measured Average Field Strength V/m	Limit V/m
1880.0	1.40	1.25	1.31	–

Op. Mode	Setup	Port
op-mode 3	setup_a01	Antenna (external)

Frequency MHz	Height of Field Probe m	Distance EUT – Field Probe m	Measured Average Field Strength V/m	Limit V/m
1909.8	1.40	1.25	1.20	–

3.1.3 Test Protocol (GSM 850)

Temperature: 24 °C
 Air Pressure: 1018 hPa
 Humidity: 35 %

RF Radiated Field Strength

Remark: The height is the height above the ground of the fully anechoic chamber. In the table below the highest value of the field strength is given for the worst case position of the turntable.

Op. Mode	Setup	Port
op-mode 4	setup_a01	Antenna (external)

Frequency MHZ	Height of Field Probe m	Distance EUT – Field Probe m	Measured Average Field Strength V/m	Limit V/m
824.2	1.40	1.25	1.56	–

Op. Mode	Setup	Port
op-mode 5	setup_a01	Antenna (external)

Frequency MHZ	Height of Field Probe m	Distance EUT – Field Probe m	Measured Average Field Strength V/m	Limit V/m
836.6	1.40	1.25	1.47	–

Op. Mode	Setup	Port
op-mode 6	setup_a01	Antenna (external)

Frequency MHZ	Height of Field Probe m	Distance EUT – Field Probe m	Measured Average Field Strength V/m	Limit V/m
848.8	1.40	1.25	1.91	–

3.2 Calculation and Evaluation of MPE

3.2.1 Calculation of the worst case MPE

The calculation is based on the measured values of the electric field strength (E-Field) at the distance as reported in the test protocol(s).

The Power Density is calculated according to

$$S = \frac{E^2}{120p\Omega} \quad (1)$$

The minimum distance is calculated as the distance at which the limit is just reached according to

$$S_L = \frac{P_s \cdot g_s}{4p \cdot r_L^2} \quad (2)$$

where S_L is the power density limit and r_L the related distance. P_s is the RF power and g_s the numerical antenna gain (e.g. for a half-wave dipole with a gain of 2.14 dBi is $g_s = 1.64$).

$$S_M = \frac{P_s \cdot g_s}{4p \cdot r_M^2} \quad (3)$$

where S_M is the measured power density at the distance r_M .

Equation (2) and (3) can be solved for r_L to obtain the distance where 100% or 5% of the limit is reached:

$$r_{L,100\%} = r_M \cdot \sqrt{\frac{S_M}{S_L}} \quad (4)$$

and

$$r_{L,5\%} = r_M \cdot \sqrt{\frac{S_M}{0,05 \cdot S_L}} \quad (5)$$

The calculations are performed within the tables below. The first table shows the values for a single transmitter, the second table uses the calculated values of the first one and the calculation is performed for multiple RF sources (e.g. n transmitters, n channels, n antennas).

The limits of §1.1310, table 1, part B (Limits for General Population/Uncontrolled Exposure) are applied:

Frequency range MHz	Power Density mW/cm ²	Averaging time minutes
300 – 1500	f / 1500	30
1500 – 100000	1.0	30

f is the operating frequency in MHz.

The limit depends on the operating frequency. Where several sources and frequencies are involved the fraction of each limit shall be determined. The sum of all fractional contributions shall not exceed 1.0 (100%).

RF Signal		Measured Values		Calculated Values				MPE Evaluation		
TCH	Frequency / MHz	E-Field / V/m	Distance / cm	Power Density / mW/cm ²	active time slots ¹⁾	max. reflection ²⁾	Single TX PD ³⁾ / mW/cm ²	Limit / mW/cm ²	exceed / below	Fraction of Limit
128	824,2	1,56	125	0,00	1	2	0,003	0,549	below	0,005
190	836,0	1,47	125	0,00	1	2	0,002	0,557	below	0,004
251	848,8	1,91	125	0,00	1	2	0,004	0,566	below	0,007
512	1850,2	1,06	125	0,00	1	2	0,001	1,000	below	0,001
661	1880,0	1,31	125	0,00	1	2	0,002	1,000	below	0,002
810	1909,8	1,20	125	0,00	1	2	0,002	1,000	below	0,002

Copied from above			Calculation for Multiple RF Sources				MPE Evaluation		Min. Distances ⁶⁾	
TCH	Fraction of Limit	Single TX PD / mW/cm ²	No. of sources ⁴⁾	30 min. duty cycle ⁵⁾	Added up PD / mW/cm ²	Added up fractions	Limit for added up fractions	exceed / below	100% of Limit / m	5% of Limit / m
128	0,005	0,003	32	1	0,08	0,15	1	below	0,48	2,17
190	0,004	0,002	32	1	0,07	0,13	1	below	0,45	2,03
251	0,007	0,004	32	1	0,12	0,22	1	below	0,58	2,62
512	0,001	0,001	32	1	0,04	0,04	1	below	0,24	1,09
661	0,002	0,002	32	1	0,06	0,06	1	below	0,30	1,35
810	0,002	0,002	32	1	0,05	0,05	1	below	0,28	1,24
Absolute min. distance:									0,58	2,62

- 1) correction factor if the transmitter is active at more than one time slot (number of time slots) and if not yet included in E-Field
2) correction factor if antenna is placed directly on a metallic ground plane (double field strength => 4 times power density)
3) worst case power density (PD) if only one RF source (module) is active at the same time
4) worst case estimation: no. of sources (modules) which are simultaneously active at the same time
5) duty cycle during the averaging time of 30 min. (fraction (on time)/(off time); 1 = 100% = always on)
6) minimum distance at which the exposure is compliant to the MPE Limit of §1.1310 (100% resp. 5% of the limit is reached)

The calculation is based on the measured values of the electric field strength (E-Field) at the distance as reported in the test protocol(s).

3.2.2 Verification for the electric field strength

With the known values for the antenna gain and the TX on/of ratio and the measured value for the RF power the theoretical field strength (time averaged) is calculated in order to verify the measurements.

The measurement of the RF power is performed at the RF connector of the antenna (including RF cable between the transmitter and the antenna).

The average electric field strength $\overline{E}$ is calculated from the given values for the transmitter's average RF power $\overline{P_s}$, the antenna gain g_s and the distance r according to the equations

$$\overline{S} = \frac{\overline{E}^2}{120p\Omega} \quad (6)$$

and

$$\overline{S} = \frac{\overline{P_s} \cdot g_s}{4p \cdot r^2} \quad (7)$$

which can be solved for E :

$$\overline{E} = \frac{\sqrt{30\Omega \cdot \overline{P_s} \cdot g_s}}{r} \quad (8).$$

The average RF power is the measured RF power of one time slot multiplied by the TX on/off ratio which is the ratio of the active time slots to the inactive time slots.

Temperature: 26 °C
Air Pressure: 1010 hPa
Humidity: 30 %

Frequency MHZ	RF Power (conducted measurement) dBm	Antenna Gain dBi	TX on / off ratio	Distance r m	Electric Field Strength (calculated) V / m
824.2	32.0	2.6	0.125	1.25	2.63
836.0	32.2	2.6	0.125	1.25	2.69
848.8	32.4	2.6	0.125	1.25	2.75
1850.2	30.0	2.6	0.125	1.25	2.09
1880.0	29.9	2.6	0.125	1.25	2.07
1909.8	29.6	2.6	0.125	1.25	2.00

Remark: The distance r is the distance at which the measurement is performed, please refer to in chapter 3.1.

3.2.3 Far field conditions (GSM 1900 and GSM 850)

A minimum distance between the field strength test probe and the transmitting antenna is required where the vectors of the electric field strength and the magnetic field strength are perpendicular and in phase to each other.

A phase error $\frac{2p}{16}$ which is 22.5° is usually acceptable. The minimum distance r_{FF} to fulfil the far field condition can be calculated as

$$r_{FF} \geq 2 \cdot \frac{d^2}{l_0} \quad (9)$$

where d is the greatest antenna dimension (e.g. the length or the diameter of the aperture) and l_0 is the wavelength of the free space.

All formulas within this report are only valid for the far field.

Frequency MHz	Wavelength m	Antenna Length m	Far Field Distance m
836.6 (GSM850)	0.36	0.09	0.05
1880.0 (GSM1900)	0.16	0.09	0.10

Remark: The antenna length is taken from the data sheet of the antenna.

3.2.4 Evaluation of Exposure to RF Emissions

From the previous calculations it is found that the measured results of the electric field strength have comparable size and so the results are comprehensible and correspond to each other.

Assuming that all transmitters transmit at the same time at the frequency which contributes the highest fraction of the MPE limit of §1.1310 the minimum distance is:

Relative Amount of the MPE Limit	Minimum Distance m
100 %	0.58
5 %	2.62

The Minimum Distance is the worst case condition at which the RF exposure is compliant to the MPE Limit of §1.1310 (where 100 % resp. 5 % of the limit is reached).



4 Test Equipment

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

5 Photo Report



Photo 1: EUT (front and left side)

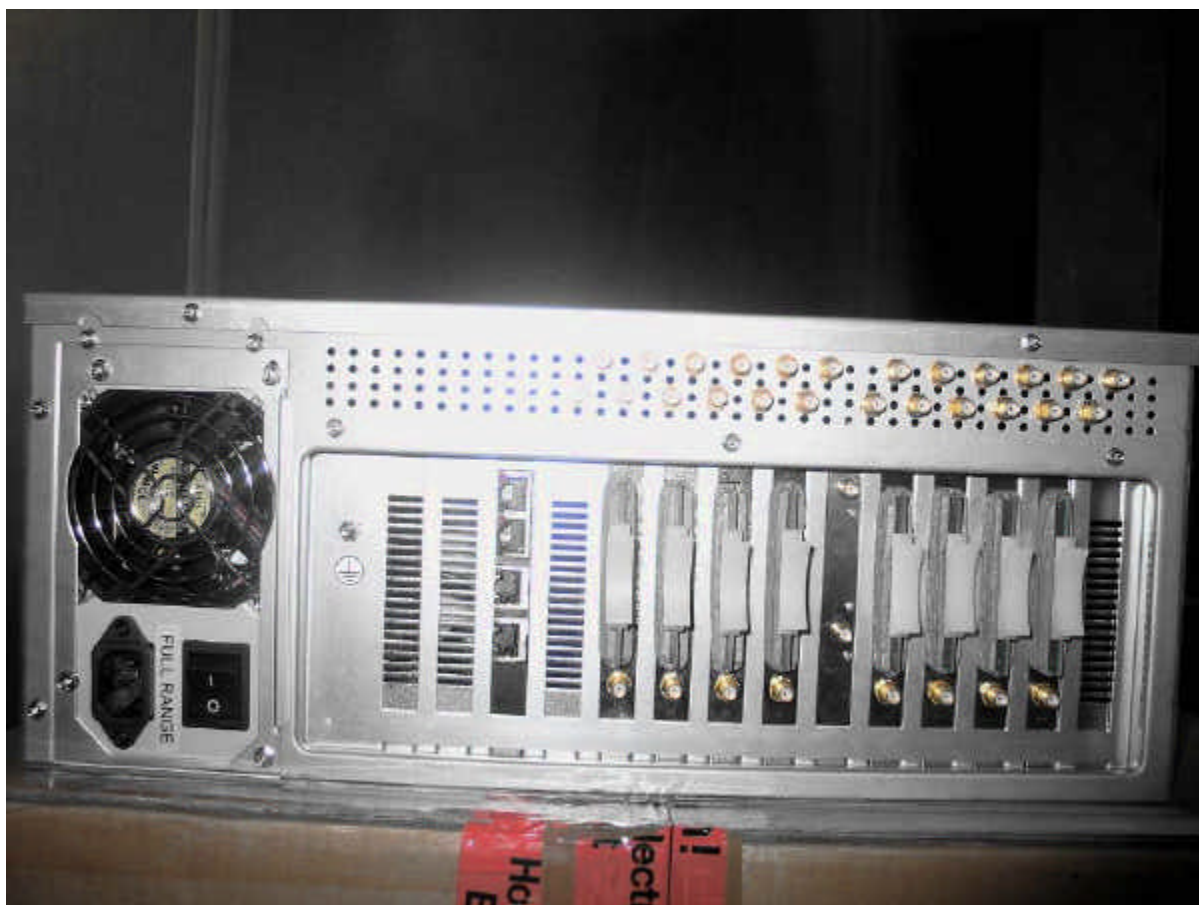


Photo 2: EUT (rear side, 8 GSM Cards inserted)

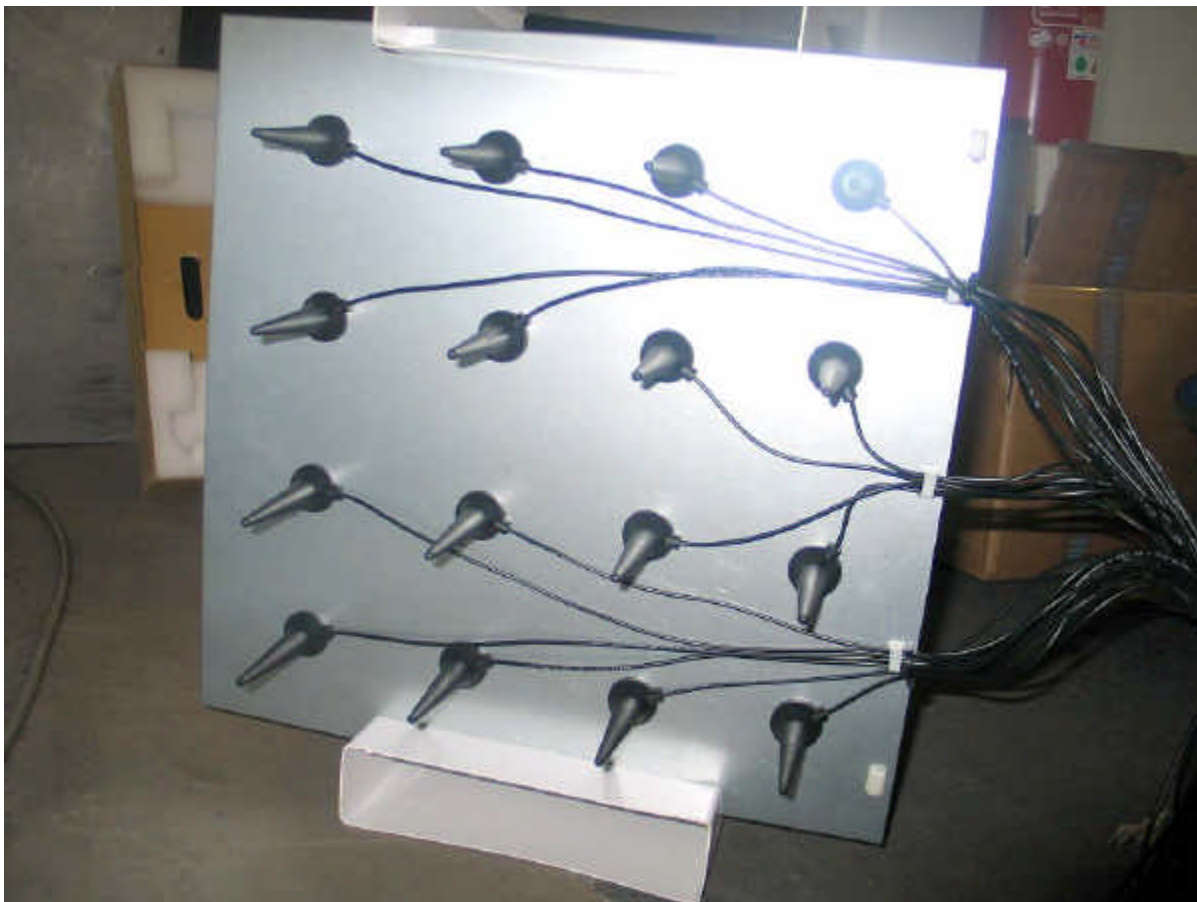


Photo 3: Assembly of antennas (shortest antenna-to-antenna distance: approx. 0.1 m)



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

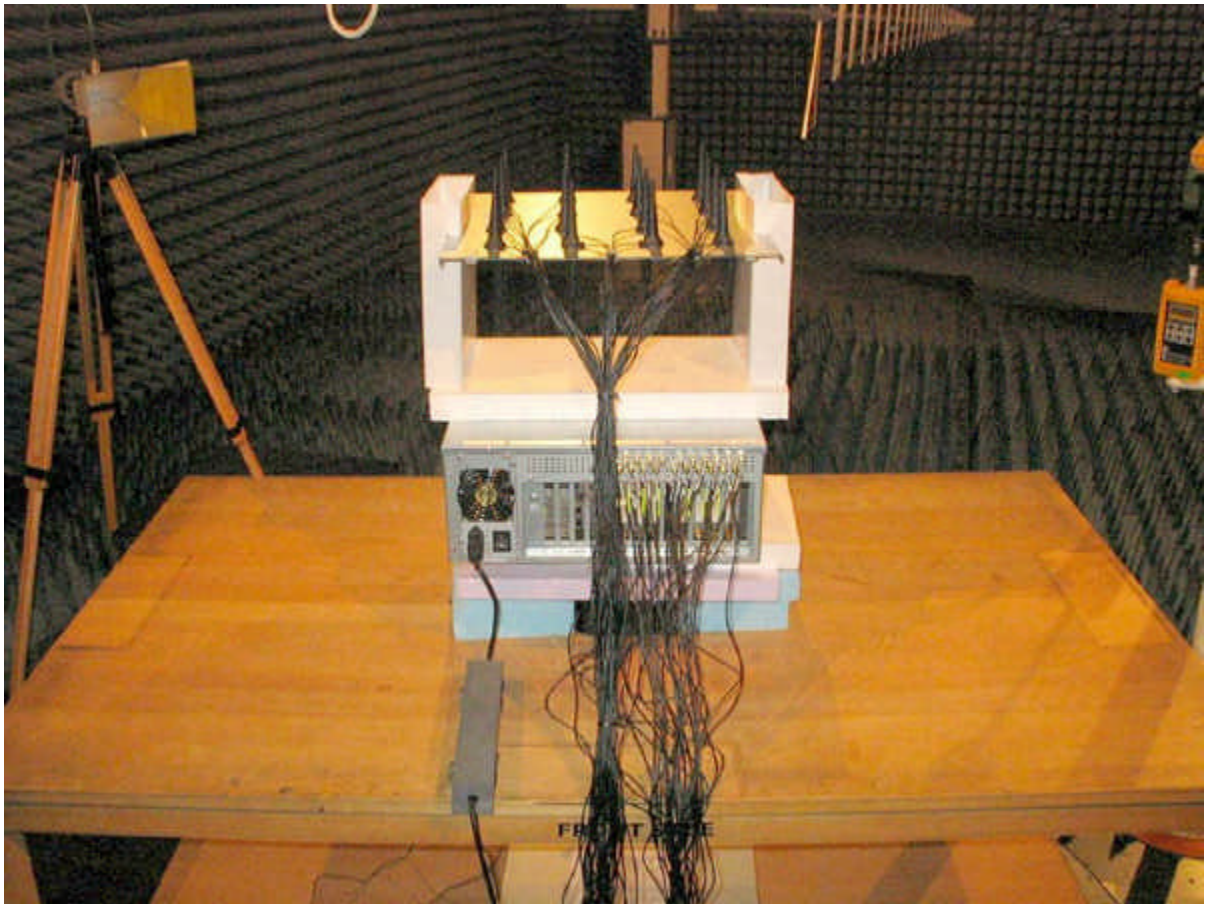


Photo 5: Setup for RF radiated field strength tests:
(left side: horn antenna used for signalling, right side: measuring field probe)

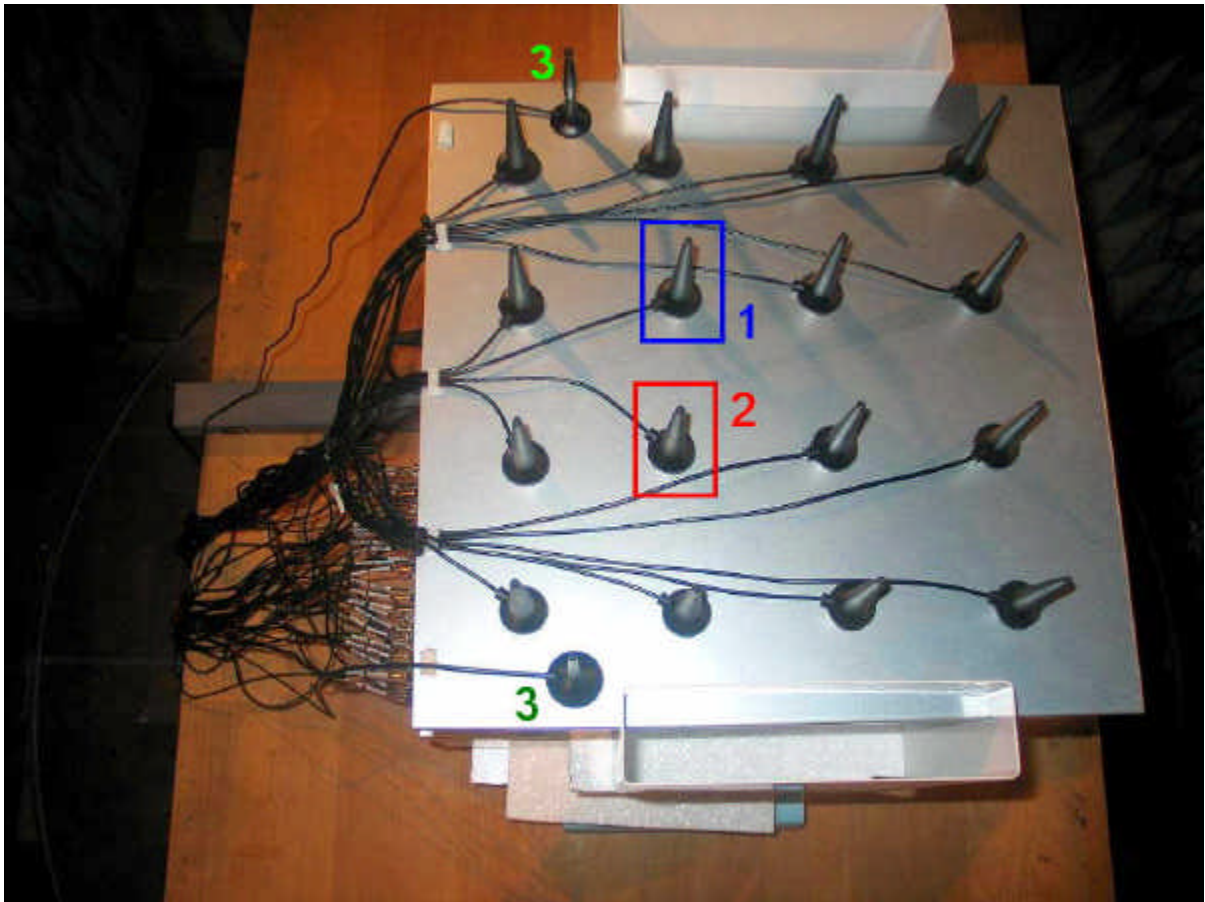


Photo 6: Antenna assembly used for RF radiated field strength tests:
1: connected to module 1 (see next photo), active radio link
2: connected to module 2 (see next photo), inactive (module is switched off)
3: auxiliary signalling antennas, not used at this test setup / measurement.

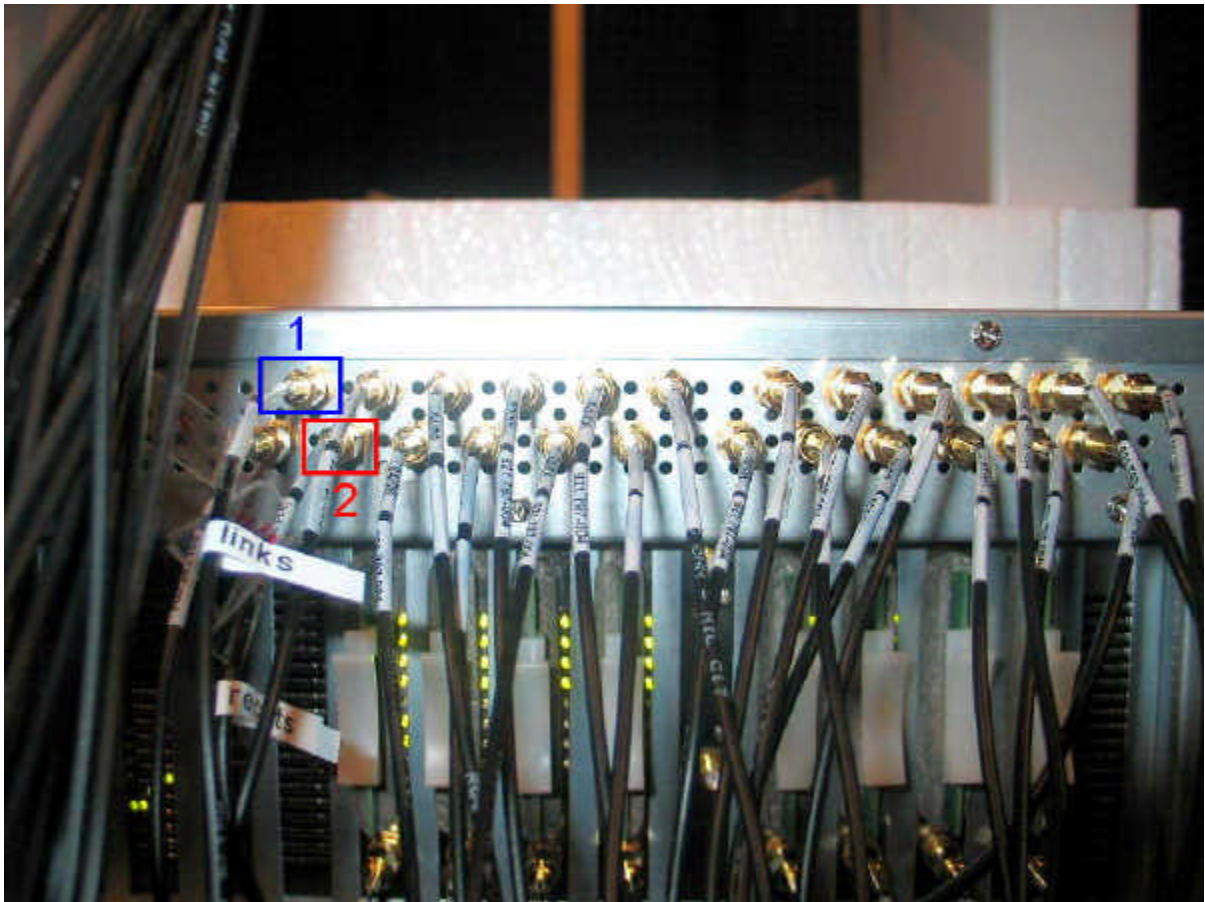


Photo 7: Setup for RF radiated field strength tests:

- 1: output of module 1, connected to antenna 1 (see photo above)
- 2: output of module 2, connected to antenna 2 (see photo above)

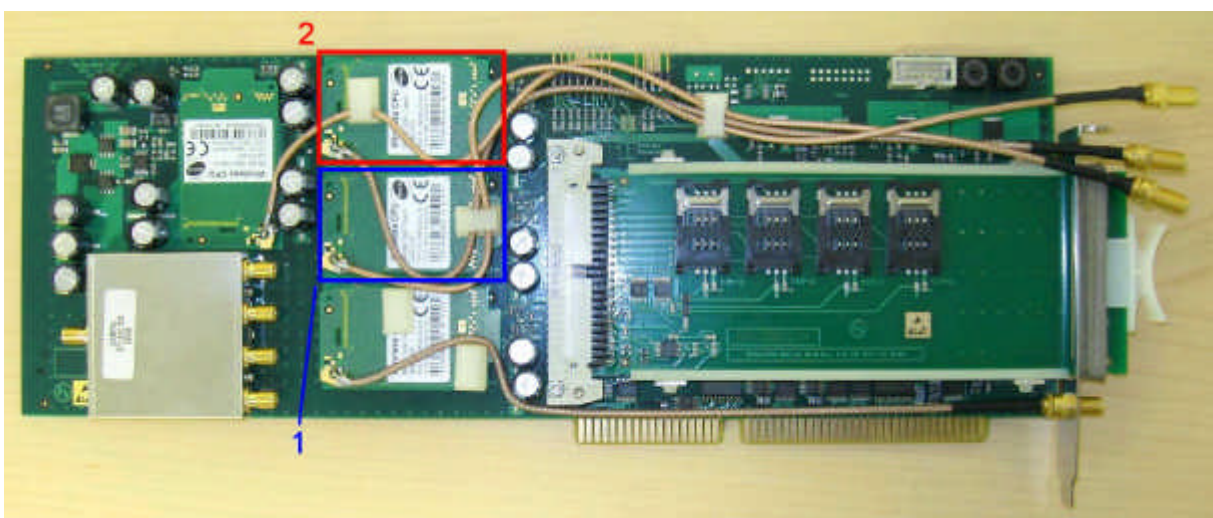
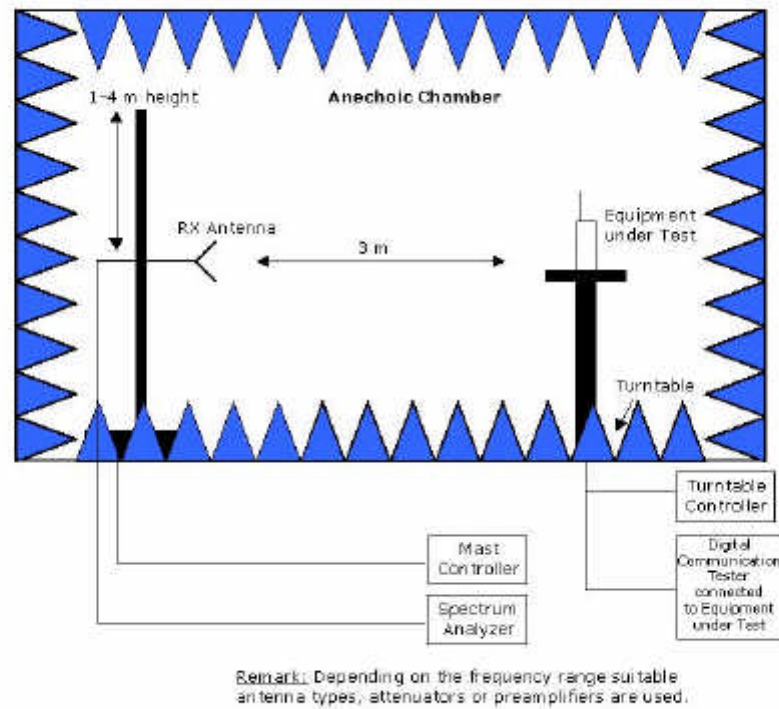


Photo 8: GSM Card, PCB (top view, with SIM card holder, active modules are marked)

6 Setup Drawings



Drawing 1: Principle Setup in the Anechoic chamber.
For the measurement of the radiated field strength a field probe is used instead of the RX antenna.