InterLab®

FCC Measurement/Technical Report on

Hypermedia Systems Ltd.
HG-HyperGateway HG-4000

Report Reference: MDE_HYPER_1101_FCCdMPE

Test Laboratory:

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Deutscher Akkreditierungs Rat
DAR
DGA-PL-192/99-02

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
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 (10-1-09 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 3.1.8 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 Output Power			
The measurement was performed according to FCC §1.1310			2012-06-11
OP-Mode	**Setup**	**Port**	**Final Result** *)
op-mode 1	Setup_a01	Antenna (external)	compliant
op-mode 2	Setup_a01	Antenna (external)	compliant

*) under the terms of chapter **3.1.8 Evaluation of Exposure to RF Emissions**

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. DGA-PL-192/99-02
Responsible for Accreditation Scope:	Dipl.-Ing. Bernhard Retka Dipl.-Ing. Robert Machulec Dipl.-Ing. Thomas Hoell Dipl.-Ing. Andreas Petz
Report Template Version:	2010-10-05

1.2 Project Data

Responsible for testing and report:	Dipl.-Ing. Patrick Lomax
Receipt of EUT:	2012-05-15
Date of Test(s):	2012-06-11
Date of Report:	2012-07-09

1.3 Applicant Data

Company Name:	Hypermedia Systems Ltd.
Address:	Prof. Bergman 2b Rabbin Science Park 76702 Rehovot. Isreal
Contact Person:	Mr. Matti Broza

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:	HG-HyperGateway HG-4000
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 short RF cable.
These GSM feeder lines are routed to a 4-to-1-combiner so that at least max. 4 GSM Modules are using 1 external antenna, totally all 32 GSM Modules are using 8 external antennas. Antennas are arranged on a ground plane (for the tests: the top side cover of the housing). Theoretically, all 32 modules can transmit all together at the same time, but this is unlikely. The assignment of frequencies and time slots can not be controlled by the EUT itself but only by the GSM network. The concrete assignment is statistically distributed can not be predicted.

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: 38180A05)	GSM gateway	HG- Hyper Gateway	3539430412 30969	1.5B	6wg_186	2012-05-15

Remark: EUT A is equipped with a permanent antenna connector (one for 4 GSM modules).
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	Omni Directional	–	–	–	–

Remark: According to the applicant AE1 has a nominal antenna gain of 3 dB including 3 meter antenna cable.

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 is active, the other is at its place but passive)

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) 661, Carrier Frequency 1880,0 MHz	661 is a mid channel of the GSM 850 band
op-mode 2	Call established on Traffic Channel (TCH) 190, Carrier Frequency 836,6 MHz	190 is a mid channel of the GSM 1900 band

3 Test Results

3.1 RF Radiated Output Power

Standard FCC Part 1, 10-01-09

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 is placed inside an anechoic chamber, refer to chapter "Setup Drawings". Between the base station simulator (R&S CMU200 Digital Communication Tester) which is located outside the chamber and the EUT a GSM link is established over air (no cable connections).

2) A call is 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 RF power transmitted from the EUT / Ancillary Equipment is recorded for the different positions of the turntable while the turntable is rotating in steps of 15 degrees. The RF radiated output power is determined by using a spectrum analyser. The measurement result is the peak power, the highest value of all turntable positions is reported in this test report.
The measurement is performed at a distance between the EUT and the measuring antenna of which is reported in chapter 3.1.

3.1.2 Test Protocol (GSM 1900)

Temperature: 25 °C
Air Pressure: 996 hPa
Humidity: 44 %

RF Radiated Output Power

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

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

Frequency MHz	Height of measuring antenna m	Distance EUT – measuring antenna m	Measured EIRP Peak Power dBm	Limit dBm
1880.0	1.4	1.0	13.25	33.0

3.1.3 Test Protocol (GSM 850)

Temperature: 25 °C
Air Pressure: 996 hPa
Humidity: 44 %

RF Radiated Output Power

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

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

Frequency MHZ	Height of measuring antenna m	Distance EUT – measuring antenna m	Measured EIRP Peak Power dBm	Limit dBm
836.6	1.5	3.0	19.75	40.56

3.1.4 Calculation of Electrical Field Strength

According to the following formula the electrical field strength is calculated from the measured RF radiated output power:

$$E_{V/m} = \frac{\sqrt{30 \cdot P_{rad}}}{r}$$

Frequency / MHz	RF power / dBm	RF Power / W	Field Strength E / V/m
1880.0	13.25	0.021	0.80 at 1m
836.6	19.75	0.094	0.56 at 3m

Calculation and Evaluation of MPE

3.1.5 Calculation of the worst case MPE

The calculation is based on the calculated values of the electric field strength (E-Field) from the measured RF radiated output power at the distance as reported in the test protocol(s), please refer to sub-clause 3.1.4.

The Power Density is calculated according to (please refer to “OET Bulletin 65, page 20”)

$$S = \frac{E^2}{120\pi\Omega} \qquad (1)$$

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

$$S_L = \frac{P_S \cdot g_S}{4\pi \cdot r_L{}^2} \qquad (2)$$

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 $g_S = 1.64$).

$$S_M = \frac{P_S \cdot g_S}{4\pi \cdot r_M{}^2} \qquad (3)$$

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:

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

and

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

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/cm²	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	Fre-quency / MHz	E-Field / V/m	Dis-tance / cm	Power Density / mW/cm²	active time slots [1]	max. reflec-tion [2]	Single TX PD [3] / mW/cm²	Limit / mW/cm²	exceed / below	Fraction of Limit
190	836.0	0.56	300	0.000083	1	2	0.00033	0.557	below	0.00060
661	1880.0	0.80	100	0.000170	1	2	0.00068	1.000	below	0.00068

Copied from above			Calculation for Multiple RF Sources				MPE Evaluation		Min. Distances [6]	
TCH	Fraction of Limit	Single TX PD / mW/cm²	No. of sources [4]	30 min. duty cycle [5]	Added up PD / mW/cm²	Added up frac-tions	Limit for added up fractions	exceed / below	100% of Limit / m	5% of Limit / m
190	0.00060	0.00033	32	0.125	0.0013	0.0024	1	below	**0.15**	**0.66**
661	0.00068	0.00068	32	0.125	0.0027	0.0027	1	below	**0.05**	**0.23**
						Absolute min. distance:			**0.15**	**0.66**

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)

Definition:
If the calculated distance is smaller than 0.2 m then the minimum distance will be defined to be 0.2 m.

Note:
Due to the low RF power of this EUT the E-Field strength is not measured directly using an E-Field Probe because its sensitivity is not sufficient. Instead of measuring the E-Field strength directly, the radiated RF output power is determined and the E-Field strength is calculated. The measured values and the calculation can be found in sub-clause 3.1.4.

Further explanations to the calculation are given in the following sub-clause 3.1.6.

3.1.6 Additional Explanation of the Calculation, References and Notes

TCH is the abbreviation for “traffic channel”, the number is taken from the GSM specification.

The Power Density is calculated according to formula (1) and expressed directly in in mW/cm² and not as SI-value, as defined at “OET Bulletin 65, page 8”.

The number of active time slots is the number of time slots used in a GSM link. In a GSM normal speech mode link the transmitter is active for only 1/8 of the whole time.
When using an E-Field probe the probe may already perform a short-term averaging. If the measured value is obtained while one timeslot is active but the EUT is capable to allocate more time slots, the worst-case number of time slots is taken into account in the calculation.
The number of active time slots is also in relation to the average 30 minutes duty cycle which is explained below.

The maximum reflection is a correction coefficient when the EUT is located above conducting ground. The worst-case value is an ideal conductive surface and the coefficient is set to 2, please refer to “OET Bulletin 65, page 20”.

The single TX power density is then calculated from the previous three numbers for Power Density, active time slots and the maximum reflection coefficient, representing the power density for one single transmitter.

The limit is defined at FCC CFR47, Part 1, §1.1310 for General Population / Uncontrolled Area, expressed in mW/cm² and below 1.5 GHz calculated for the transmitter frequency, please refer also to “OET Bulletin 65, page 3”.

Fraction of limit is the relation (ratio) between the contribution of one single transmitter and the limit.

The next group of rows is starting with the values just copied from the rows above for “Fraction of Limit” and “Single TX power density (carry-forward).

The calculation for multiple RF sources now sums up the contributions of the multiple transmitters related to the number of sources (RF transmitters) and the average within a 30 minutes duty cycle resulting in the added up power density resp. fractions which is calculated as for the single transmitter.

The calculation is basing on an average during a duty cycle of 30 minutes as defined at “OET Bulletin 65, page 10 et seqq.” for General Population / Uncontrolled Area.
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 total time slots (here: 1/8 = 0.125).
A worst-case scenario is assumed for an uninterrupted GSM call of 30 minutes length. Statistically, it makes no difference if e.g. theoretically all single transmitters are all sending at the same point of time (worst-case) and all are off for the next 7 time slots or they transmit equally distributed e.g. for 32 transmitters 4 at the same time on all 8 time slots.
Note: The possible distributions of the time slots allocation are randomly assigned by the GSM base station / GSM network operation, the EUT is not capable to control any allocation of any time slot.

The MPE Evaluation is done for the added up fractions of the MPE calculation are normalised values (to 1) so it is compared to the normalised limit of 1, as defined at “OET Bulletin 65, page 35 and 52”

The minimum distances are calculated according to formulae (4) and (5), as defined at “OET Bulletin 65, page 33”.

3.1.7 Far field conditions (GSM 1900 and GSM 850)

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

$$r_{FF} \geq 2 \cdot \frac{d^2}{\lambda_0} \qquad (6)$$

where d is the greatest antenna dimension (e.g. the length or the diameter of the aperture) and λ_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 transmitting antenna.

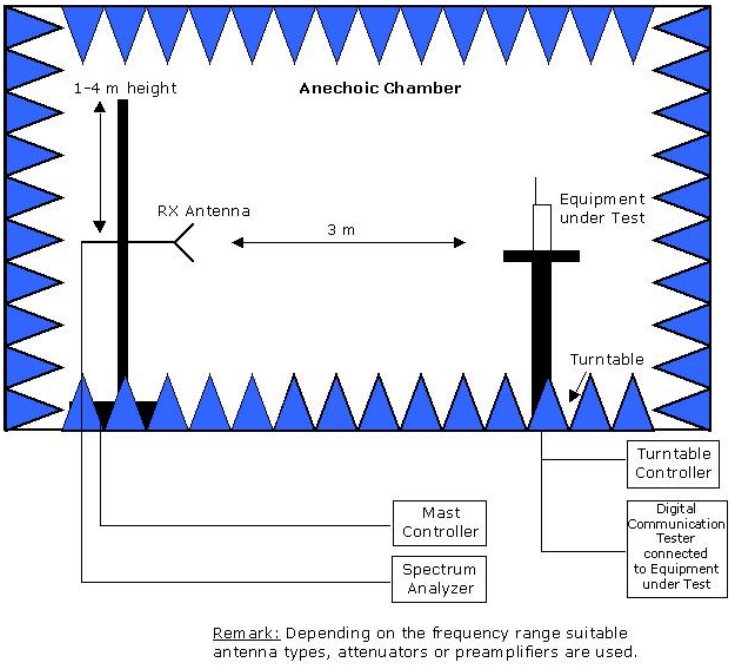
3.1.8 Evaluation of Exposure to RF Emissions

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%	**0.20**
5%	**0.66**

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 Setup Drawings



Drawing 1: Principle set-up for radiated measurements.