TEST REPORT
No.: 2-20773166b/09

According to:
FCC Regulations
Part 22 & Part 24
Part 15.209
IC Regulations
RSS-132
RSS-133
RSS-Gen

for

u-blox AG

Quad Band GSM/GPRS data and voice module
LEON-G200
FCC-ID: XPYLEONG200

Laboratory Accreditation and Listings			
Deutscher Akkreditierungs Rat DAR DAT-P176/94-02	FCC Federal Communications Commission USA Reg. No.: 99538 MRA US-EU 0003	Industry Canada Reg. No.: 3462D-1 3462D-2	VCCI Reg. No.: R-2665, R-2666 C-2914, T-339
accredited according to DIN EN ISO/IEC 17025			

CETECOM GmbH
Laboratory Radio Communications & Electromagnetic Compatibility
Im Teelbruch 116 • 45219 Essen • Germany
Registered in Essen, Germany, Reg. No.: HRB Essen 8984
Tel.: + 49 (0) 20 54 / 95 19-954 • Fax: + 49 (0) 20 54 / 95 19-964
E-mail: info@cetecom.de • Internet: www.cetecom.com

Table of contents

Table of annex

	Total pages
SEPARATE DOCUMENT B_2_20773166B_09_A1.PDF: DIAGRAMS OF TESTING	84
SEPARATE DOCUMENT B_2_20773166B_09_A2.PDF: EUT PHOTOGRAPHS	6
SEPARATE DOCUMENT B_2_20773166B_09_A3.PDF: SET-UP PHOTOGRAPHS	3

1. Summary of test results

The test results apply exclusively to the test samples as presented in chapter 3.1. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

Following tests have been performed to show compliance with applicable FCC Part 2, Part 22-Subpart H and Part 24-Subpart E (Broadband PCS) of the FCC CFR 47 Rules.

The presented GSM 850/900/1800/1900 Module can be build inside host applications and extends their capability by wireless GSM technology. Data transmission or voice application are possible field applications.

The type of the presented test device is LEON-G200.

In order to verify the compliance, a representative configuration consisting of different auxiliary equipment was chosen. Embedded in this configuration, the GSM/GPRS Module can be tested. Pls. refer to set-up description and photos for more details.

1.1. TESTS OVERVIEW FCC Part 15/22/24 and Kanada IC Standards (RSS)

TEST CASES	PORT	REFERENCES & LIMITS			EUT set-up	EUT opera-ting mode	Result
		FCC Standard	RSS Section	TEST LIMIT			
TX-Mode							
RF POWER (conducted)	Antenna terminal (conducted)	§2.1046	--	N/A	2	2+4	Passed
RF-POWER radiated (ERP/EIRP)	Cabinet	§2.1046 §22.913(a)(2) §24.232(c)	RSS-132: 4.4 SRSP-503: 5.1.3 RSS-133:6.4 SRSP-510: 5.1.2	< 7 Watt (ERP) < 2 Watt (EIRP)	1	2+4	Passed
SPURIOUS EMISSIONS (conducted)	Antenna terminal (conducted)	§2.1051 §22.917(a)(b) §24.238(a)(b)	RSS-132: 4.5.1 RSS-133: 6.5.1	43+10log(P) dBc	2	2+4	Passed
99% OCCUPIED BANDWIDTH	Antenna terminal (conducted)	§2.202 §2.1049 §22.917(a) §24.238(a)	RSS-Gen:4.6.1	99% Power	2	2+4	Passed

SPURIOUS EMISSIONS (radiated)	Cabinet + Interconnecting cables (radiated)	§15.209(a)	RSS-Gen: 4.11 RSS-210: Table 3 RSS-310: Table 4	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	1	2	Passed
		§2.1053(a) §22.917(a)(b) §24.238(a)(b)	RSS-132: 4.5.1 RSS 133: 6.5.1	43+10log(P) dBc	1	2+4	Passed
FREQUENCY STABILITY	Antenna terminal (conducted)	§22.355, table C-1 §24.235 §2.1055	RSS-132: 4.3 RSS 133: 6.3	< 2.5ppm <0.1 ppm	2	2+4	Passed

RX Mode							
AC-Power Lines Conducted Emissions	AC-Power lines	§15.107 §15.207	RSS-Gen, Issue 2: Chapter 7.2.2	FCC §15.107 class B limits §15.207 limits IC: Table 2, Chapter 7.2.2	2[1.)] +4[1.)]	1+2+3+4 +5[1.)]	Passed[1.)]
RECEIVER Radiated emissions	Cabinet + Interconnecting cables (radiated)	§15.109 §15.33 §15.35	RSS-132, Issue 2: 4.6 RSS-Gen, Issue 2: 6(a) RSS 133, Issue 3: 6.7(a)	FCC 15.109 class B limits IC-limits: Table 1, Chapter 6	1 +2[1.)] +3[1.)] +4[1.)]	1 +3 +5[1.)]	Passed[1.)]

Remark: 1.) See separate test report B_2_20773166c_09.pdf for measurements according Part 15

.....
D. Franke
Responsible for test section

CETECOM™ GmbH
Im Teelbruch 116
45219 Essen
Tel.: + 49 (0) 20 54 / 95 19 - 0
Fax: + 49 (0) 20 54 / 95 19 - 997

.....
Dipl. Ing. Christian Lorenz
Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

Company name: Address:	CETECOM GmbH Im Teelbruch 116 45219 Essen - Kettwig Germany
Laboratory accreditations/Listings:	DAR-Registration No. DAT-P176/94-02 FCC-Registration No. 99538, MRA US-EU 0003 IC-Registration No. 3462D-1, 3462D-2 VCCI Registration No. R-2665,R-2666,C-2914,T-339
Responsible for testing laboratory:	Dipl.-Ing. W. Richter
Deputies:	D. Franke

2.2. Test location

2.2.1. Test laboratory "CTC"

Company name:	see chapter 2.1. Identification of the testing laboratory

2.3. Organizational items

Order No.:	20776631
Responsible for test report and project leader:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2009-08-03
Date(s) of test:	2009-08-03 to 2009-08-16
Date of report:	2009-08-31

2.4. Applicant's details

Applicant's name:	u-blox AG
Address:	Zürcherstrasse 68 8800 Thalwil Switzerland
Contact person:	Mr. Andreas Thiel

2.5. Manufacturer's details

Manufacturer's name:	please see Applicant's details
Address:	please see Applicant's details

3. Equipment under test (EUT)

3.1. Additional declaration and description of main EUT

Main function	Quad-Band GSM/GPRS voice and data module		
Type	LEON-G200		
GSM Frequency range	GSM 850: 824 – 849MHz (Uplink), 869-894MHz (Downlink) GSM1900: 1850-1910MHz (Uplink), 1930-1990MHz (Downlink)		
Type of modulation	GMSK		
Number of channels	GSM 850: 128 – 251, 125 channels GSM1900: 512 – 810, 300 channels		
EMISSION DESIGNATOR(S)	300KGXW (GSM)		
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector	Frequency range: GSM 850: 824 – 894 MHz GSM 1900: 1710-1990 MHz	
Antenna Gain	Max.2 dBi (commercial antenna, stub version)		
MAX PEAK Output Power: GSM 850 Radiated GSM 1900	25.2 dBm 26.8 dBm		
MAX PEAK Output Power: GSM 850 Conducted GSM 1900	32.8 dBm 30.6 dBm		
FCC-ID	XPYLEONG200		
Canada certification number (IC)	8595A-LEONG200		
Installed option	☒ GSM900 and GSM1800 Bands ☒ battery charging option		
Special EMI components	--		
Power supply	AC/DC power adapter to DC socket J213 of the mainboard DC voltage on port J215 of the mainboard in the range 3.5 to 4.2 Volt		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering

3.2. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	USB cable	MINI-SUB to USB	#1	--	1.83m

3.3. EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	Quad Band GSM/GPRS data and voice module	LEON-G200	IMEI: 004402-09-002411-2	GB01.HW.HR.100001	GB01.SW.SR07.10.00
EUT B	Adapter Board	GB01	#1	GB01_HW_HS_102000	--
EUT C	Motherboard	N7MB3	SN 36	EN01_HW_HS_068C00	--
EUT D	Motherboard	N7MB3	SN 33	EN01_HW_HS_068C00	--
EUT E	Magnetic mount antenna	MAR-C3G-2F	CTC #1	2dBi gain	--

*) EUT short description is used to simplify the identification of the EUT in this test report.

3.4. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

AE short description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	AC to DC Adaptor	0055	--	Input: AC 100-240V 800mA, 50/60Hz Output: changeable	--
AE 2	Handset Votronic for LEON-G200	Type 2	#1	HH-SI-30.3/V2.0/0	--
AE 3	Notebook	Dell D610	PC CTC 4	--	Windows XP + Terminal program
AE 4	USB cable	Mini USB to USB	#1	1.83m	--

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

3.5.EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
Set. 1	EUT A + EUT B + EUT C + EUT E + AE 1 + AE 2 + AE 4 + (AE3)	Tests used with mainboard with regulated external power supply 110V/60Hz, AE1. Used voltage input for tests: J213 Set-up used for radiated emission tests
Set. 2	EUT A + EUT B + EUT D + EUT E + AE 1 + AE 2 + AE 4 + (AE3)	Tests used with mainboard external power supplied in the range 3.5 to 4.2 Volt. Except for climatic tests on extreme voltage range a nominal voltage of 3.8V was used. Used voltage input port for tests: V_{BAT} Set-up used for conducted tests

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

3.6. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	**GSM 850** Idle mode BCCH 50	The mobile station is synchronized to the Broadcast Control Channel (BCCH) and listening to the Common Control Channel (CCCH). Periodic location update is disabled.
op. 2	**GSM 850** TCH mode TCH=128/192/251	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 33 dBm (power class 4; power control level 5). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
op. 3	**GSM 1900** Idle mode BCCH 651	The mobile station is synchronized to the Broadcast Control Channel (BCCH) and listening to the Common Control Channel (CCCH).
op. 4	**GSM 1900** TCH mode TCH=512/661/810	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 30 dBm (power class 1; power control level 0). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link
op. 5	**Charging mode**	Charging a Li-Io battery. $V_{charging}$=6.5V, $I_{charging}$=300mA.

*) EUT operating mode no. is used to simplify the test report.

3.7. Parameter Settings on mobile phone and base station CMU200

Following settings apply to the MS during the measurements in **GSM/(E)GPRS**-Mode only:

Parameter	Traffic Mode	Idle Mode
Traffic Channels mobile station (EUT)	GSM 850 TCH_{MS}= 128/ 192 /251 GSM 1900 TCH_{MS} = 512 / 681 / 810	--
maximum power level (PCL)	GSM 850: PCL = 5 (2 Watt) GSM 1900: PCL = 0 (1 Watt)	--
Modulation	GSM: GMSK-Modulation Scheme EDGE: 8-PSK Modulation Scheme	--
DTX	off	--
Bitstream	PRBS 2E9-1 (pseudo-random-sequence) – CCITT 0.153	
Timeslot	3	
Hopping	off	
Timeslot (slot mode)	GSM-Mode: single GPRS-Mode: maximum allowed uplink slots no. according MS class	
MS slot class	Class 10	
Maximum data transmission rate, single time slot	GSM: 17,6 kBit/s Slot EDGE: 59,2 kBit/s Slot	
Speech transcoding (Traffic Mode)	Full rate Version 1	
Mode	BCCH and TCH	
BCCH – base station (CMU,CMD)	GSM 850: 180 GSM 1900: 651	
TCH – base station (CMD, CMU)	auto	
Power level TCH – base station (used timeslot level)	- 70 dBm	
Power level BCCH – base station (control channel level)	- 80 dBm	
External attenuation RF/AF-Input/Output	Accord. calibration prior to measurements	
Mobile Country Code	310	310
BS_AG_BLKS_RES	Not applicable	0
Paging reorganisation		Off (0)
Signalling channel		SDCCH
Location Update		Auto
Cell access		Disabled (barred)

Settings for CMU (general)

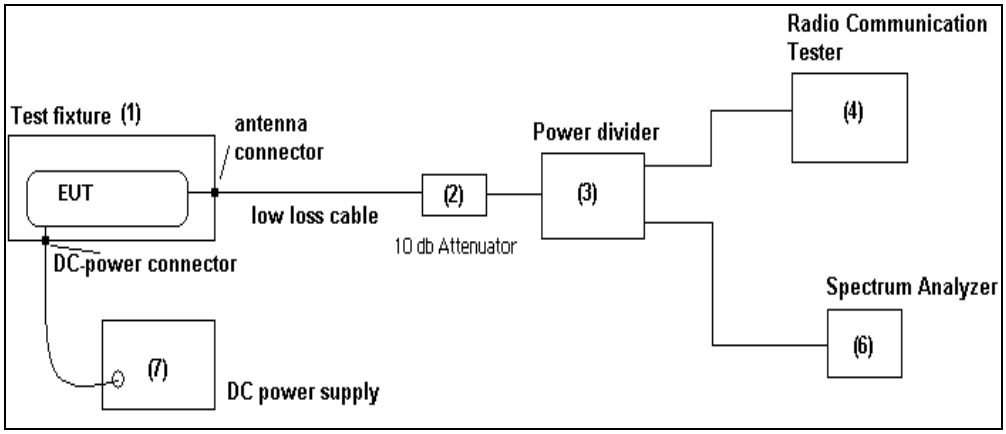
Repetition	Continuous
Stop condition	None
Display mode	Max./Min
Statistic Count	1000 Bursts
Decoder	Standard

Additional settings on the base stations CMU200 for frequency stability measurements

4. DESCRIPTION OF TEST SET-UP's

4.1. Test Set-up for conducted measurements

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first 10 dB attenuated (2) before it is 0° divided by a power divider (3). One of the signal path is connected to the communication base station (4), other branch is connected to the spectrum – analyzer (6). The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.



Schematic: Test set-up conducted

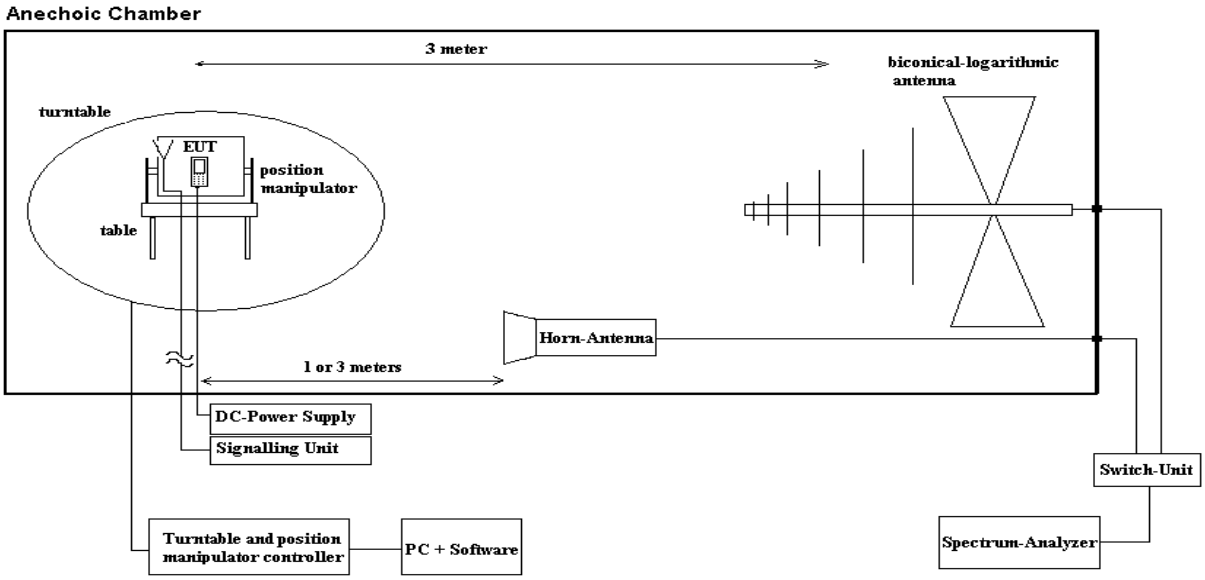
4.2. Test set-up for radiated measurements

The radiated emissions from the test device are measured first as exploratory measurement in a FCC recognized semi anechoic chamber (registration no. 99538) or fully anechoic chamber with the dimensions of 8.05m x 6.85m x 5.48m. Very critical frequencies within a defined range, can be re-checked on CETECOM's Open Area Test side, recognized by the FCC to be compliant with ANSI 63.4: 2001 according registration no. 99538.

The EUT and accessories are placed on a non-conducting tipping table of 0.8 meter height (semi-anechoic chamber) or 1.55m height (fully-anechoic chamber) which is situated in the middle of the turntable. The turntable can rotate the device under test 360 degree, the tipping table can rotate the device from laid to standing position. This way the device under test can be rotated in all three orthogonal planes in order to maximize the detected emissions. The turn- and tipping table are controlled by a controller unit. All positions manipulations are software controlled from a operator PC.
The measurements are performed for both receiving antenna polarisations: vertical and horizontal.

Up to 18GHz a measurement distance of 3 meters is used, above 18GHz the distance is 1meter. A biconical-logarithmic antenna up to 1 GHz and a horn antenna for frequencies above 1 GHz used. (see equipment list)

The EUT is powered either by a external DC-supply with nominal voltage or a AC/DC power supply as accessory. The communication signalling is performed from outside the chamber with a communication test simulator (CMU200 from Rohde&Schwarz) by airlink.



Schematic: radiated measurements test set-up

5. Measurements

5.1. RF power output (Conducted and Radiated)

REFERENCES

FCC: §2.1046 (conducted), §22.913(a)(2), § 24.232(c)
IC: RSS-132:4.4 + SRSP 503:5.1.3 for GSM 850; RSS-133:6.4 + SRSP-510:5.1.2 for GSM 1900

- Maximum Power Output of the mobile phone should be determined while measured conducted and radiated way.
- Limit: 30dBm±2dB Tolerance

TEST SET-UP (CONDUCTED)

- see conducted measurement set-up, description in chapter 4.1
- a suitable artificial antenna or RF-connector is provided by the applicant in order to perform the conducted measurements. Any data provided with the artificial antenna or connector, have been taken in account in order to correct the measurement data.

MOBILE PHONE SETTINGS

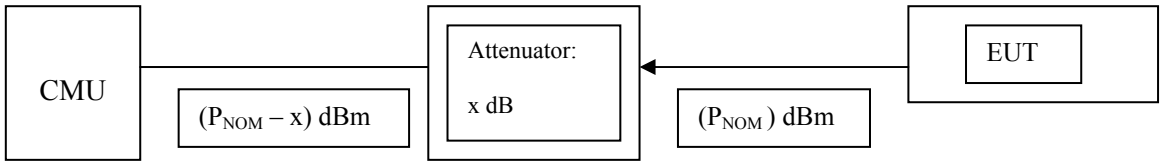
- according 3.7

BASE STATION SETTINGS

- according 3.7

TEST METHOD

1.) The measurements were made at the upper, middle and lower carrier traffic frequencies of the operating band. Choosing three TX-carrier frequencies of the mobile phone within each operable GSM band, should be sufficient to demonstrate compliance.
2.) The measurements were performed with the integrated power measurement function of the „radio communication tester CMU“ from *Rohde&Schwarz* company. In this way spectrum-analyzers instrument limitations can be avoided or minimized. Instead, *CMU* manufacturers declared measurement error can be considered for this measurement.
3.) The attenuation (insertion loss) at the RF Inputs/Outputs of *CMU* were set according the path loss of the test set-up, determined in a step before starting the measurements.
4.) PK and Average Values have been recorded for each channel and band.



RESULTS (CONDUCTED)

Op. Mode 2, Set-up 2

Channel/ Frequency (MHz)		Peak Output Power (dBm)	Average Output Power (dBm)
GSM 850	Channel 128/ 824.2 MHz	32.6	32.4
	Channel 192/ 837 MHz	32.8	32.6
	Channel 251/ 848.8 MHz	32.6	32.4

Op. Mode 4, Set-up 2

Channel/ Frequency (MHz)		Peak Output Power (dBm)	Average Output Power (dBm)
GSM 1900	Channel 512/ 1850.2 MHz	30.6	30.5
	Channel 661/ 1880.0 MHz	30.6	30.4
	Channel 810/ 1909.8 MHz	30.2	30.1

VERDICT: passed

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	23.6 °C
Relative Humidity	67 %
Air pressure	1005 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
298, 463, 517, 529, 530, 489

DATA RESULTS (RADIATED)

TEST METHOD

The measurements were made at the upper, center, and lower carrier traffic frequencies of the PCS band. Choosing three TX-carrier frequencies of the mobile phone (1850.2 MHz, 1880 MHz and 1909.8 MHz), should be sufficient to demonstrate compliance.
The measurements were performed by using the **substitution method** (ANSI/TIA/EIA 603) with a spectrum-analyzer. This method can be described like follows:

1.) choosing of suitable spectrum-analyzer settings for performing the measurements. This settings of the spectrum analyzer must be maintained for both stages of the measurements: EUT emission measurements and also for measurements of the substituted level.

Parameter	Setting for GSM measurements	Settings for UTRA/FDD measurements
RBW	1 MHz	10 MHz
VBW	10 MHz	10 MHz
Span	8 MHz	8 MHz
Detector Mode	Positive max-hold	Positive max-hold
Average	off	off
Sweep Time	coupled	coupled

2.) The maximum level of the peak power was recorded, while the emissions were maximized by rotating the EUT in three orthogonal axes, which was situated on a non-conductive turntable of 1.55 m height ($P_{MEAS,1}$). This was performed for both measuring antenna polarisations (vertical/horizontal), the maximum of both values is used for further measurements and final substitution ($P_{MEAS,\,1,\,MAX}$).

3.) As the maximum emission is recorded, the EUT is replaced by a frequency dependant suitable antenna, which is connected to a RF-signal generator, which is transmitting on the determined worst-case frequency as determined in step 2.

4.) The RF-signal level of the signal generator is adjusted as long the same worst-case level determined first step is measured at the spectrum analyzer ($P_{SMHU}=P_{MEAS,1,\,MAX}$)

5.) Than the RF-signal cable is disconnected from the antenna and connected to a power-level meter. The level is determined ($P_{MEAS,2}$).

6.) The final result is calculated by adding the ERP/EIRP gain of the antenna which substitutes the EUT.
$P_{EUT,SUBST} = P_{MEAS,2} + G_{Antenna}$

GSM RESULTS (RADIATED)

Channel/ Frequency (MHz)		Peak Output Power (dBm)			Antenna Polarisation for maximum Power	Verdict
		PK	AV			
GSM 850	Channel 128/ 824.2 MHz	24.8	24.6	ERP-Value	V/H	Passed
	Channel 192/ 837.0 MHz	22.6	22.4			
	Channel 251/ 848.8 MHz	25.2	25.0			

Channel/ Frequency (MHz)		Peak Output Power (dBm)			Antenna Polarisation for maximum Power	Verdict
		PK	AV			
GSM 1900	Channel 512/ 1850.2 MHz	26.8	26.6	EIRP-Value	V/H	Passed
	Channel 661/ 1880.0 MHz	23.2	23.1			
	Channel 810/ 1909.8 MHz	24.2	24.1			

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	23 °C
Relative Humidity	45 %
Air pressure	1002 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
016, 133, 262, 439, 264, 443, 460

5.2. Occupied bandwidth

REFERENCES

FCC: §2.1049; §22.917(a), §24.238(a)
IC:RSS-Gen:4.6.1

„the **occupied bandwidth** is the frequency bandwidth, such that, below it lower and above it upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated.

TEST SET-UP

- see conducted measurement set-up described in 4.1

MOBILE PHONE SETTINGS

- Provisions with the requirements is based on the fact, that GSM modulation scheme is GMSK Modulation for GSM equipment with a maximum data transmission rate of 17,6 kBit/s per Slot.
- according chapter 3.7 a call was established

SETTINGS OF THE SPECTRUM-ANALYSER

Frequency range	RBW (resolution bandwidth)	VBW (video bandwidth)
1 MHz around carrier frequency	*1% from applicants stated/measured emission bandwidth*	*3..10 times the RBW*

TEST METHOD

The measurements were made at the upper, middle and lower carrier traffic frequencies of the operating band. Choosing three TX-carrier frequencies of the mobile phone within each operable GSM band, should be sufficient to demonstrate compliance

Additionally the emission bandwidth (-26 dBc bandwidth) was recorded for all three channels. The results were taken in order to determine according the §24.238 the measurement resolution bandwidth, which should be approximately 1% of the emission bandwidth.

RESULTS

Set-up 2, Op-Mode 2

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
GSM 850	Channel 128/ 824.2 MHz	250.00	318.91
	Channel 192/ 837.0 MHz	248.39	317.30
	Channel 251/ 848.8 MHz	250.00	315.70

Remarks: see annex A1 for plots

Set-up 2,Op-Mode 4

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
GSM 1900	Channel 512/ 1850.2 MHz	241.98	315.70
	Channel 661/ 1880.0 MHz	240.38	312.50
	Channel 810/ 1909.8 MHz	240.38	312.50

Remarks: see annex A1 for plots

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	23 °C
Relative Humidity	45 %
Air pressure	1002 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
298, 463, 517, 529, 530, 489

5.3. Radiated emissions, below 30 MHz, §15.205 and §15.209, RSS210, RSS132, RSS133, RSS-gen

TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☒ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☐ 347 Radio.lab.	☐	☐
receiver	☐ 377 ESCS30	☒ 001 ESS	☐	☐	☐	☐
spectr. analys.	☐ 381 380 FSBS	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
antenna	☐ 048 EMCO3143	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☒ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 298 CMU	☒ 457 CMU	☐ 295 RACAL	☐ 392 MT8820A		
power supply	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix		

STANDARDS AND LIMITS: CFR 47, PART 15, SUBPART B, §15.205, §15.209, ANSI C63.4

Frequency [MHz]	Field strength [µV/m]	Field strength [dBuV/m]	Measurement distance [meters]	Remarks
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3m
0.490 – 1.705	24000/f (kHz)	87.6 – 20 Log(f) (kHz)	30	Correction factor used due to measurement distance of 3m
1.705 – 30	30	29.54	30	Correction factor used due to measurement distance of 3m
Remark: * decreases with the logarithm of the frequency				

TEST CONDITION AND MEASUREMENT TEST SET-UP

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver (Analyzer) Settings	Span/Range: 9kHz to 150kHz; 150 kHz to 30 MHz RBW/VBW: 200Hz/auto; 10 kHz/ auto (CISPR#16) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements Quasi-Peak, for final measurement on critical frequencies (fy<1GHz)		

GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.4: 2003

The **Equipment under Test** (EUT) was set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

The measurement loop antenna was situated in 3m distance to the EUT. Radiated magnetic emission measurements were made with the antenna situated in 1 meter height. The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions, the EUT itself either over 3-orthogonal axes (no defined usage position) or 2-orthogonal axis (defined usage position) by the position manipulator.

According the standard the compliance should be checked in 30m and 300m measurement distance. Therefore a additional extrapolation factor was used in order to normalize the measurement data. The frequency dependent extrapolation factor used for this reduced measurement distance, can be found in the chapter annexes.

MEASUREMENT RESULTS

Set-up No.		1								
Operating Mode		2								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
3.01	9.2	19.37	10ms	9 kHz	1m	--	0..360°	Chapter 9	10.13	29.50
	20.91	22.61							6.89	29.50

Remark: *.) see also recorded plots enclosed in annex A1

Set-up No.		1								
Operating Mode		2								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
3.02	9.71	21.74	10ms	9 kHz	1m	--	0..360°	Chapter 9	7.76	29.50

Remark: *.) see also recorded plots enclosed in annex A1

Set-up No.		1								
Operating Mode		2								
Diagram no.	Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB) (C_F)	Margin (dB) (M)	Limit (dBµV/m) (L_T)
3.03	9.25	15.61	10ms	9 kHz	1m	--	0..360°	Chapter 9	13.89	29.50
	20.08	22.33							7.17	29.50

Remark: *.) see also plots enclosed in annex A1

Margin to Limit:

$$M = L_T - R_R + C_F + D_F$$
$$= L_T - R_R + (AF_{ANTENNA} + Cable_{LOSS}) + D_F$$

Remark: positive margin means passed result

Abbreviations used:

- R_R : Receiver readings in dBµV/m
- C_F: Transducer in dB = AF (antenna factor) + CL (cable loss)
- D_F : distance correction factor (if different measurement distance used than specified in the standard
- L_T : Limit in dBµV/m

VERDICT

Summary of measurement results for radiated frequencies below 30 MHz: Passed

5.4. Emission limits (Spurious emissions conducted and radiated), f> 30MHz

REFERENCES

FCC: §2.1051-conducted, §2.1053(a)-radiated, §22.917(a)(b); §24.238(a)(b)
IC: RSS-132:4.5.1, RSS-133:6.5.1 - TX-mode
RSS-132:4.6, RSS-133: 6.7(b) – RX-mode

„the power of emissions shall be attenuated below the transmitter output power (p) by at least least 43+10log(P) dB“

FREQUENCY RANGE

The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment. The detector used was Peak.

The specification that all emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range of the mobile phone (1 to 0.001 W) to a constant limit of -13 dBm.

DESCRIPTION OF SET-UP

- see conducted set-up in chapter 4.1
- see radiated set-up in chapter 4.2

SETTINGS ON MOBILE PHONE

The measurements were made at the upper, middle, and lower carrier frequencies of the operating band. Choosing three representative TX-carrier frequencies of the mobile phone within each operable GSM band, should be sufficient to demonstrate compliance with the emissions limits outside and adjacent to the frequency blocks.
The individual settings were made according chapter 3.7

TEST METHOD RADIATED:

By rotating the EUT in three orthogonal planes, the emissions were recorded with Peak-Detector and Max-Hold function of the spectrum-analyzer. If the harmonic could not be detected above the noise floor, the ambient level was recorded. Measurement distance is 3m for frequencies up to 18GHz and 1m for frequencies greater then 18GHz. The readings on the spectrum analyzer are corrected with annually performed chamber path calibration values (see chapter 7), so the readings shown are equivalent to ERP/EIRP values. Critical measurements near the limit are re-measured with a substitution method accord. ANSI/TIA/EIA 603 as described in chapter 5.1

SETTINGS OF SPECTRUM-ANALYSER

Frequency range	RBW (resolution bandwidth)	VBW (video bandwidth)
BAND-EDGE compliance: *1MHz immediately adjacent to the frequency blocks*	*1% from applicants stated/measured emission bandwidth*	*3..10 times the RBW*
More than 1 MHz outside and adjacent the frequency blocks	*1 MHz*	*3..10 MHz*

RESULTS (CONDUCTED)

5.4.0.1. GSM TCH 850: Op. Mode 2, Set-up 2

Lowest channel: 128

Transmitting channel/ frequency: TX = 824.2 MHz							
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	14.01	1.)	--	--	1.)	-13	Passed
Sweep 2	14.04	1.)	--	--	1.)		Passed
Sweep 3	14.07	1677 3580 8174 9831	--	--	-34.4 -25.3 -27.4 -25.8		Passed
Sweep 4 4.)	14.10	823.9967	--	--	-26.13		Passed 4.)

Remark: see diagrams for more details

1.) only results near 20dB to the limit are referenced

4.) Band-Block Edge compliance measurement

Middle channel = 192

Transmitting channel/ frequency: TX = 837 MHz							
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	14.02	1.)	--	--	1.)	-13	Passed
Sweep 2	14.05	1.)	--	--	1.)		Passed
Sweep 3	14.08	1659 3579 5632 9907 12373	--	--	-32.6 -25.3 -28.3 -25.5 -24.4		Passed

Remark: see diagrams for more details

1.) only results near 20dB to the limit are referenced

Highest channel: 251

Transmitting channel/ frequency: TX = 848.8 MHz							
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	14.03	1.)	--	--	1.)	-13	Passed
Sweep 2	14.06	1.)	--	--	1.)		Passed
Sweep 3	14.09	1697 3579 12223	--	--	-30.7 -25.5 -24.2		Passed
Sweep 5 4)	14.11	849.02	--	--	-26.51		Passed 4.)

Remark: see diagrams for more details

1.) only results near 20dB to the limit are referenced

4.) Band-Block Edge compliance measurement

5.4.0.2. GSM 1900 Mode: Op. Mode 4, Set-up 2

Lowest channel: 512

Transmitting channel/ frequency: TX = 1850,2 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	14.12	1.)	--	--	1.)	-13	Passed
Sweep 2	14.15	1.)	--	--	1.)		Passed
Sweep 3	14.18	1.)	--	--	1.)		Passed
Sweep 4 4.)	14.21	1849.99	--	--	-30.28		Passed 4.)

Remark: see diagrams for more details

1.) only results near 20dB to the limit are referenced

4.) Band-Block Edge compliance

Middle channel: 661

Transmitting channel/ frequency: TX = 1880,0 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	14.13	1.)	--	--	1.)	-13	Passed
Sweep 2	14.16	1.)	--	--	1.)		Passed
Sweep 3	14.19	1.)	--	--	1.)		Passed

Remark: see diagrams for more details

1.) only results near 20dB to the limit are referenced

3.) Noise floor

Highest channel: 810

Transmitting channel/ frequency: TX = 1908,8 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	14.14	1.)	--	--	1.)	-13	Passed
Sweep 2	14.17	1959.0	--	--	-33.8		Passed
Sweep 3	14.20	1.)	--	--	1.)		Passed
Sweep 5	14.22	1910.0	--	--	-32.15		Passed 4.)

Remark: see diagrams for more details

1.) only results near 20dB to the limit are referenced

4.) Band-Block Edge compliance

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	23.6 °C
Relative Humidity	67.0 %
Air pressure	1005 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
298, 463, 517, 529, 530, 489

RESULTS (RADIATED)

5.4.0.2.1. GMSK 850 Mode: Op. Mode 2, Set-up 1

Lowest channel: 128

Transmitting channel/ frequency: TX = 824.2 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1 2.)	8.01 8.02	926.08 39.7	H V	--	-28.97 -31.19	-13	Passed 2.)
Sweep 2 4.)	8.07 8.08	823.97 823.97	H V	--	-32.63 -23.18		Passed 4.)
Sweep 4	8.11 8.12	1649.3 1648.7	H V	--	-28.33 -28.58		Passed
Sweep 5	8.17	10414.0	H	--	-37.88		Passed
	8.18	3297.2	V	--	-45.05		Passed

Remarks: see diagrams enclosed in annex A1

1.) only results near 20dB to the limit are referenced or noise level
2.) TX-carrier on the diagram
4.) Band-Block Edge compliance

Middle channel: 192

Transmitting channel/ frequency: TX = 837 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1 2.)	8.03 8.04	937.78 945.57	H V	--	-29.28 -29.77	-13	Passed 2.)
Sweep 4	8.13 8.14	2670.1 2619.6	H V	--	-23.85 -23.99		Passed
Sweep 5	8.19	10783.0	H	--	-37.16		Passed
	8.20	3335 8681	V	--	-45.5 -39.0		Passed

Remarks: see diagrams enclosed in annex A1

1.) only results near 20dB to the limit are referenced or noise level
2.) TX-carrier on the diagram

Highest channel: 251

Transmitting channel/ frequency: TX = 849.8 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1 [2.)]	8.05 8.06	953.35 973.68	H V	--	-29.47 -29.30	-13	Passed [2.)]
Sweep 3 [4.)]	8.09 8.10	849.02 849.02	H V	--	-30.68 -22.23		Passed [4.)]
Sweep 4	8.15 8.16	2637.5 2637.7	H V	--	-23.83 -23.34		Passed
Sweep 5	8.21	[1.)]	H	--	[1.)]		Passed
	8.22	6966.7	V		-39.48		Passed

Remarks: see diagrams enclosed in annex A1

1.) only results near 20dB to the limit are referenced or noise level

2.) TX-carrier on the diagram

4.) Band-Block Edge compliance

5.4.0.3. GSM 1900 Mode: Op. Mode 4, Set-up 2

Lowest channel: 512

Transmitting channel/ frequency: TX = 1850,2 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	8.23 8.24	982.12 893.08	H V	--	-29.16 -27.88	-13	Passed
Sweep 2	8.29 8.30	[1.)] 1454.5	H V	--	[1.)] -27.02		Passed
Sweep 3	8.35 8.36	1850.0 1850.0	H V	--	-22.01 -19.73		Passed [4.)]
Sweep 5	8.40	3685 5547 9253 11742	H	--	-50.3 -46.9 -41.8 -39.4		Passed
	8.41	3758 5639 9400 11281	V	--	-49.7 -43.6 -41.0 -40.0		
Sweep 6	8.45 8.46	[1.)] 13888	H V	--	[1.)] -29.13		Passed
Sweep 7	8.51	[1.)]		--	[1.)]		Passed [5.)]

Remark: see diagrams enclosed in annex A1 for more details

1.) only results near 20dB to the limit are referenced or noise level

4.) Band-Block Edge compliance

5.) overview measurement only, no critical peaks found

Middle channel: 661

Transmitting channel/ frequency: TX = 1880,0 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	8.25 8.26	966.93 937.76	H V	--	-29.96 -29.64	-13	Passed
Sweep 2	8.31 8.32	1.) 1.)	H V	--	< 24dBm, 1.) < 24dBm, 1.)		Passed
Sweep 5	8.41	3758 5639 9400 11281	H	--	-49.7 -43.6 -41.0 -40.0		Passed
	8.42	3759 4550 5639 9400	V	--	-48.9 -51.4 -47.1 -42.5		
Sweep 6	8.47 8.48	14224 13768	H V	--	-29.60 -29.31		Passed
Sweep 7	8.52	1.)		--	1.)		Passed 5.)

Remark: see diagrams enclosed in annex A1 for more details

1.) only results near 20dB to the limit are referenced or noise level

Highest channel: 810

Transmitting channel/ frequency: TX = 1908,8 MHz							
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Worst-Level Polarisation	Transducer factor [dB]	Result [dBm]	Limit [dBm]	Verdict
Sweep 1	8.27 8.28	974.64 916.41	H V	--	-30.11 -30.27	-13	Passed
Sweep 2	8.33 8.34	1.) 1.)	H V	--	1.) 1.)		Passed
Sweep 4	8.37 8.38	1910 1910	H V	--	-27.09 -22.20		Passed 4.)
Sweep 5	8.43	3814 5731	H	--	-48.8 -43.8		Passed
	8.44	3814 5731 7649	V	--	-48.9 -46.3 -43.9		
Sweep 6	8.49 8.50	14080 14128	H V	--	-29.39 -29.09		Passed
Sweep 7	8.53	1.)	--	--	1.)		Passed 5.)

Remark: see diagrams enclosed in annex A1 for more details

1.) only results near 20dB to the limit are referenced or noise level

4.) Band-Block Edge compliance

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	23.6°C
Relative Humidity	67.0 %
Air pressure	1005 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
016, 133, 262, 302, 264, 439, 460, Switch Unit FAR

5.5. Frequency stability on temperature and voltage variations

REFERENCES

FCC: §2.1055, §22.355, §24.235

IC: RSS-Gen:4.7, RSS-132:4.3, RSS-133:4.2+6.3

§22.355 Table C-1; § 24.235
"The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block"

§ 2.1055
(*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.

TEST SET-UP

In order to maintain the voltage constant over the time period of the tests, a dummy battery was connected to a laboratory power supply. The power supply voltage was controlled on the input of the power supply terminals of the EUT.
Compare with the conducted measurement test set-up described in chapter 4.1

MOBILE PHONE SETTINGS

The measurements were made at the upper, middle, and lower carrier frequencies of the operating band. Choosing three representative TX-carrier frequencies of the mobile phone within each operable GSM band, should be sufficient to demonstrate compliance. A call was set-up according chapter 3.7

TEST METHOD

The RF Channel spacing is 200kHz, with a guard band of 200kHz of each band of the sub-bands. The aim of the EUT is to function under all extreme conditions within authorized sub-bands in regard to temperature and voltage variations. The frequency deviation was recorded with base station's build in capability. (CMU)
As the standard requires that the fundamental emissions stays within the authorized band, a limit of 0.1ppm is considered low enough to ensure this.

Frequency shift of carrier against a voltage range at constant nominal temperature of 20° Celsius

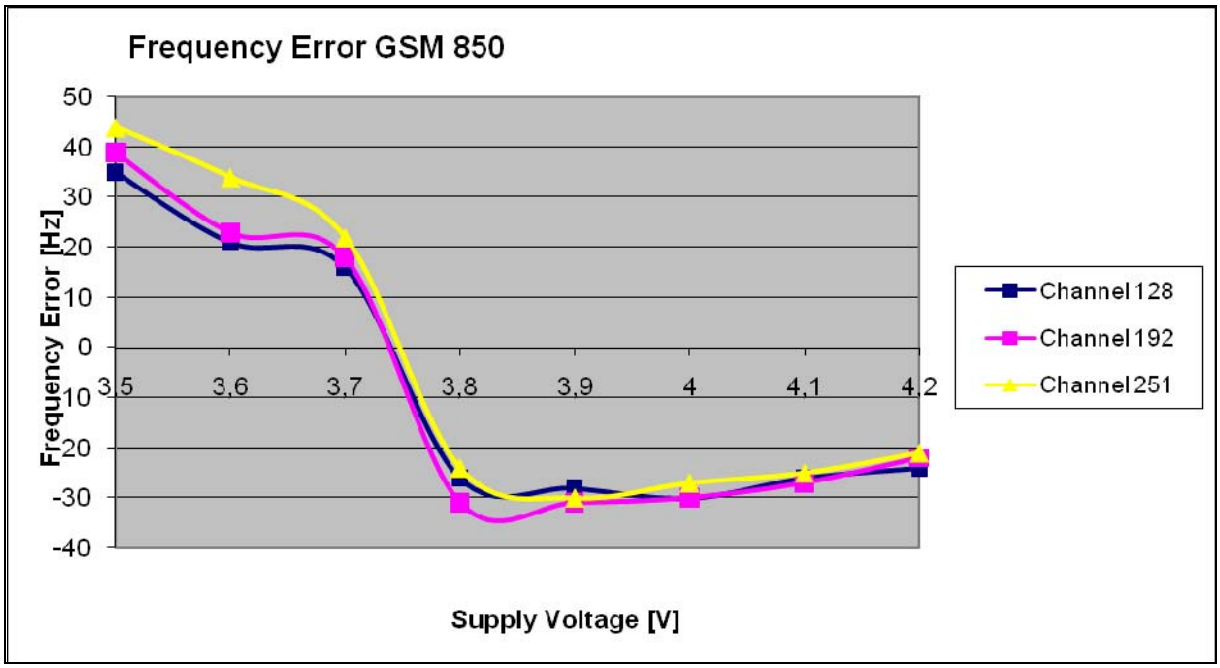
1.) determine the carrier frequency for the lowest and highest channel at room temperature and nominal voltage [20°C]
2.) The voltage was reduced in 0.1V steps to the lower end point, where the mobile phone stops working. (this shall be specified by the manufacturer) Record the carrier frequency shift within 2 minutes after powering on the mobile phone, to prevent for self heating effects.
3.) The voltage was increased in 0.1V steps to the upper declared voltage of the battery. Record the carrier frequency shift within 2 minutes after powering on the mobile phone, to prevent for self heating effects.

RESULTS

5.5.0.1. GSM 850, Op. Mode 2, set-up 2

Declared voltage range from the manufacturer: 3.5V .. 4.2 V

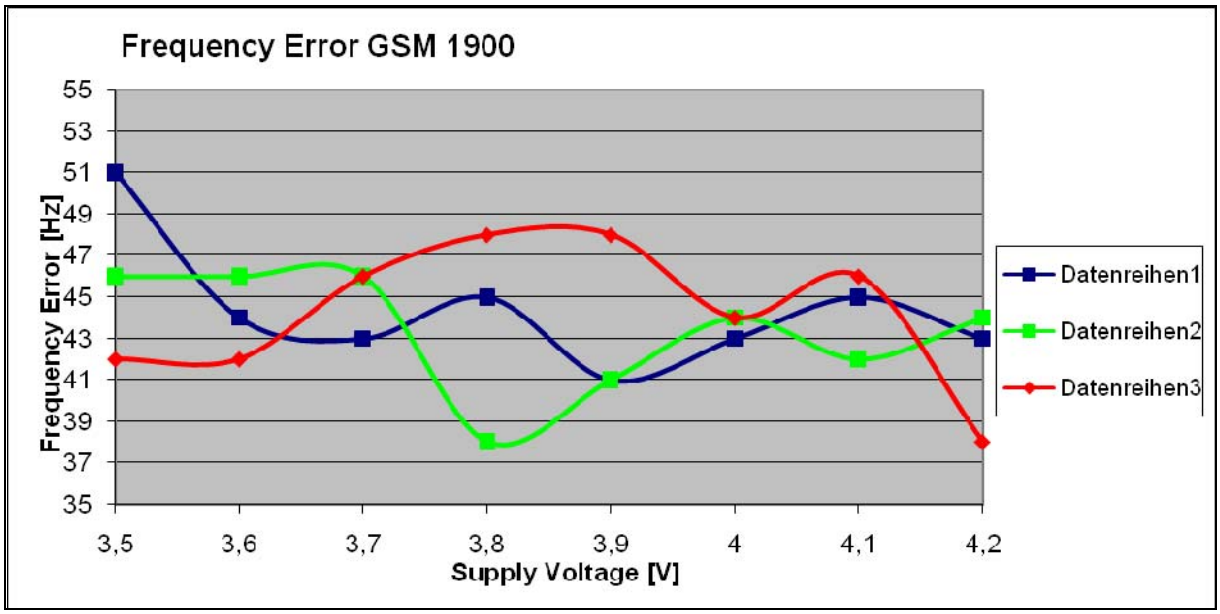
	Maximum frequency error					
Voltage [V]	**Ch 128**	**Ch 192**	**Ch 251**	**ppm Ch 128**	**ppm Ch 192**	**ppm Ch 251**
3,5=Minimum	35	39	44	0,042	0,047	0,052
3,6	21	23	34	0,025	0,027	0,040
3,7	16	18	22	0,019	0,022	0,026
3,8	-26	-31	-24	-0,032	-0,037	-0,028
3,9	-28	-31	-30	-0,034	-0,037	-0,035
4,0	-30	-30	-27	-0,036	-0,036	-0,032
4,1	-26	-27	-25	-0,032	-0,032	-0,029
4,2=Maximum	-24	-22	-21	-0,029	-0,026	-0,025



5.5.0.1.1. GSM 1900, Op. Mode 4, set-up 2

Declared voltage range from the manufacturer: 3.5V .. 4.2 V

	Maximum frequency error					
Voltage [V]	Ch 512	Ch 661	Ch 810	ppm Ch 512	ppm Ch 661	ppm Ch 810
3,5=Minimum	51	46	42	0,028	0,024	0,022
3,6	44	46	42	0,024	0,024	0,022
3,7	43	46	46	0,023	0,024	0,024
3,8	45	38	48	0,024	0,020	0,025
3,9	41	41	48	0,022	0,022	0,025
4	43	44	44	0,023	0,023	0,023
4,1	45	42	46	0,024	0,022	0,024
4,2=Maximum	43	44	38	0,023	0,023	0,020



TEST EQUIPMENT

Used equipment (see reference in the annex)
298, 331, 354, 517, 529, 530

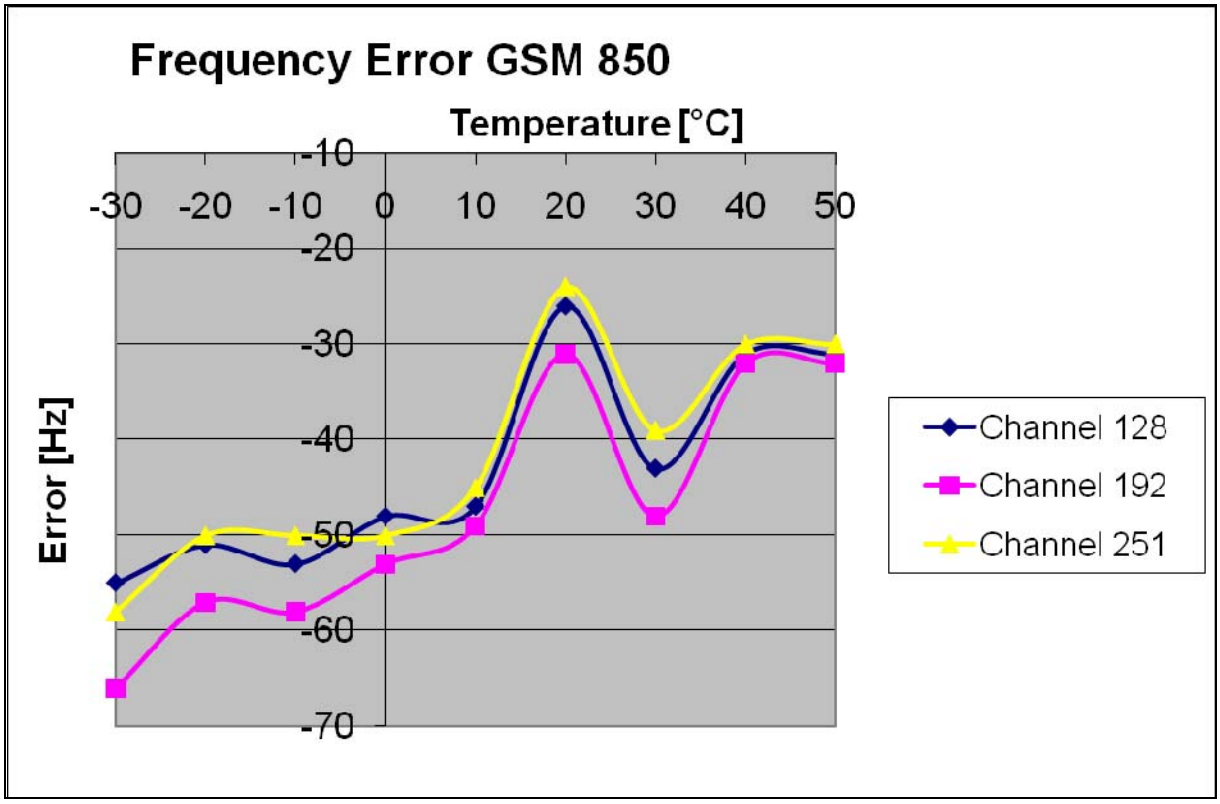
Frequency shift of carrier against temperature at constant power supply voltage

1.) *determine the carrier frequency for the* lowest, middle and highest channel *at room temperature and nominal voltage [20°C]*
2.) *expose the mobile station to –30°C, wait sufficient time to have constant temperature.*
3.) *Perform the carrier frequencies measurements in 10°C increments from –30°C to +60°C. For about half hour at the specified temperature the mobile was powered-off. After powering-on, the measurements were made within 2 minute for the channel lower channel, in order to prevent self-warming of the mobile.*

DATA RESULTS

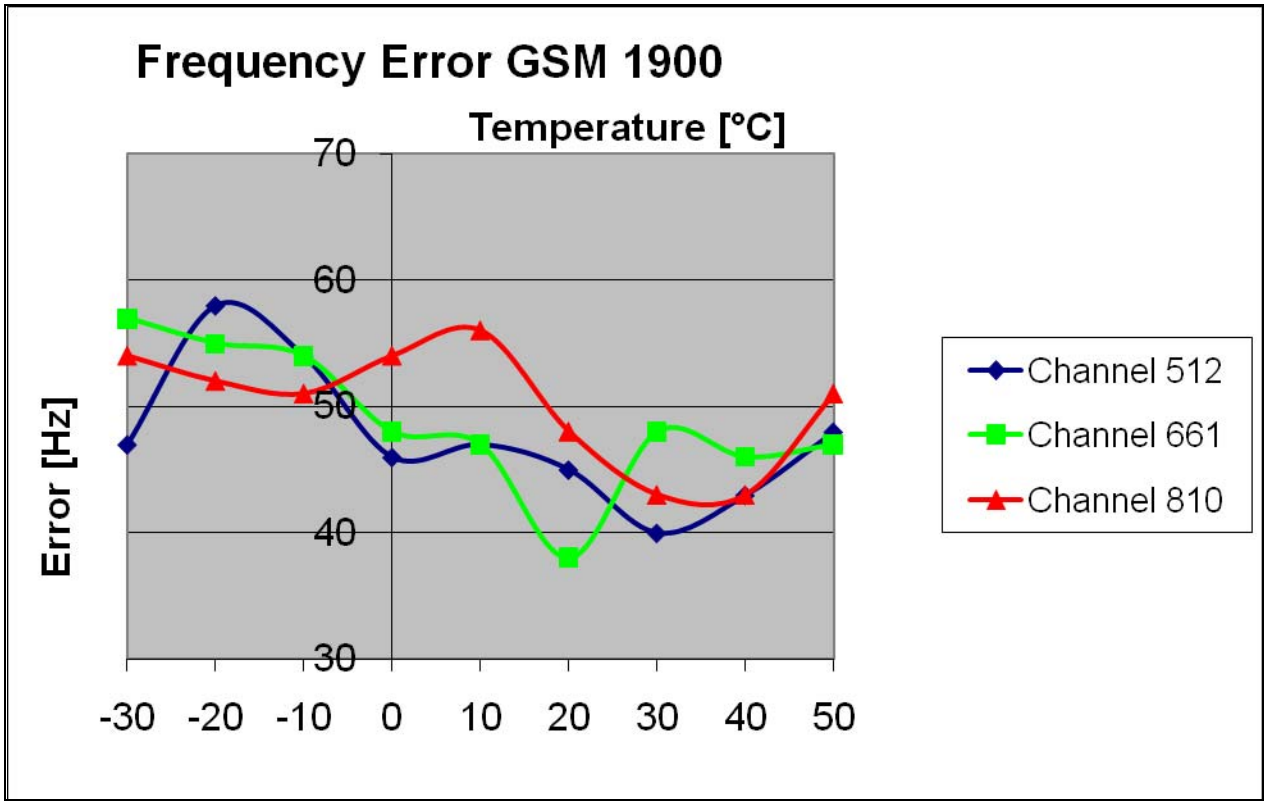
5.5.0.2. GSM 850, Op. Mode 4, set-up 2

Temperature	Maximum frequency error					
	Ch 128	Ch192	Ch 251	ppm Ch 128	ppm Ch 192	ppm Ch 251
-30	-55	-66	-58	-0,067	-0,079	-0,068
-20	-51	-57	-50	-0,062	-0,068	-0,059
-10	-53	-58	-50	-0,064	-0,069	-0,059
0	-48	-53	-50	-0,058	-0,063	-0,059
10	-47	-49	-45	-0,057	-0,059	-0,053
20	-26	-31	-24	-0,032	-0,037	-0,028
30	-43	-48	-39	-0,052	-0,057	-0,046
40	-31	-32	-30	-0,038	-0,038	-0,035
50	-31	-32	-30	-0,038	-0,038	-0,035



5.5.0.3. GSM 1900, Op. Mode 4, set-up 2

Temperature	Maximum frequency error					
	Ch 512	Ch 661	Ch 810	ppm Ch 512	ppm Ch 661	ppm Ch 810
-30	47	57	54	0,025	0,030	0,028
-20	58	55	52	0,031	0,029	0,027
-10	54	54	51	0,029	0,029	0,027
0	46	48	54	0,025	0,026	0,028
10	47	47	56	0,025	0,025	0,029
20	45	38	48	0,024	0,020	0,025
30	40	48	43	0,022	0,026	0,023
40	43	46	43	0,023	0,024	0,023
50	48	47	51	0,026	0,025	0,027



TEST EQUIPMENT

Used equipment (see reference in the annex)
298, 331, 354 517 (RF-Relay Unit Keithley) 529 (6dB RF-Splitter) 530 (10dB Attenuator)

6. Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.

For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

Measurement	Frequency range	Calculated uncertainty based on a confidence level of 95%	Remarks:
RF-Power Output conducted	9 kHz .. 20 GHz	1.0 dB	--
RF-Power Output radiated	30 MHz .. 4 GHz	3.17 dB	Substitution method
Conducted RF-emissions on antenna ports	9 kHz .. 20 GHz	1.0 dB	--
Radiated RF-emissions enclosure	150 kHz .. 30 MHz	5.0 dB	Magnetic field
	30 MHz .. 1 GHz	4.2 dB	E-Field
	1 GHz .. 18GHz	4.8 dB	E-Field
	1 GHz .. 20 GHz	3.17 dB	Substitution method
Occupied bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker method)	Frequency error
		1 dB	Power
Emission bandwidth	9 kHz .. 4 GHz	0.1272 ppm (Delta Marker method)	Frequency error
		1 dB	Power
Frequency stability	9 kHz .. 20 GHz	0.0636 ppm	--
Conducted emissions on AC-mains port (U_{CISPR})	9 kHz .. 150 kHz	4.0 dB	--
	150 kHz .. 30 MHz	3.6 dB	

Table : measurement uncertainties, valid for conducted/radiated measurements

7. Calibration method of anechoic chamber

For non-critical frequencies a pre-calibration method was used for determining the relevant radiated field-strength of radiated spurious in the anechoic chamber.

Generally the measured value is influenced by the characteristics of the used cables, filters, antenna, but also by the characteristic of the anechoic chamber.
By defining a ***transducer*** value, which include all characteristics of the signal propagation path (used equipment, cables, properties of anechoic chamber, etc..) from the source of radiation to the final reading equipment (spectrum-analyzer), the measured value can be corrected in order to get the real value of the device under test.

The method resumes as follows:

1.) determination of the path-loss of all cables used on the TX- and RX-side, which are used for the radiated measurement in the specific set-up for 1 meter and 3 meter distance.
2.) connection of the cables to the relevant antennas used for calibration.
3.) determination of the ***space attenuation loss*** *(G)* in the anechoic-chamber for both horizontal and vertical antenna polarisations:

   A signal generator connected to the TX-antenna sweeps the frequency range of interest (30 MHz to 19.5 GHz) with a level of –30dBm - the readings on the RX-side on the spectrum analyzer gives the ***space attenuation loss.*** The distance between RX- and TX-antenna is 3 meter for frequencies below 18 GHz, and 1 meter for frequencies above 18 GHz.

4.) Mathematical determination of the frequency dependant transducer values ($TD_{H/V}$):

$$TD_{H/V} = G_{H/V} + B_{H/V} - 10 \cdot \log_{10}(1{,}64) + D + E - F$$

Abreviations:

$TD_{H/V}$ = λ/2 transducer values for horizontal /vertical antenna polarisations
$G_{H/V}$ = space attenuation loss horizontal/ vertical
$B_{H/V}$ = Gain of TX-antenna

$10*\text{Log}_{10}(1.64)$ = Gain in dB of λ/2 Dipole relative to isotropic radiator

D = insertion losses of RX cable
E = Loss of filters in signal path (not used for FCC measurements)
F = Gain of pre-amplifiers in signal path

5.) The tables below are showing the transducer values for horizontal and vertical polarisation in two reference distances (1 meter and 3 meter). EIRP can be calculated from ERP by adding the gain of the lambda/2 dipole EIRP = ERP + 2.14 dBi
6.) Definition of transducer tables which are programmed/ loaded in the spectrum analyzer. The readings on the spectrum-analyzer are automatically corrected by this values and can directly be compared with the limits as given in the relevant standards.

Used equiment for calibration (3 meter distance)

Used equipment (see reference)
264, 133, 020, 140, 484, 490

Used equiment for calibration (1 meter distance)

Used equipment (see reference)
302, 303, 140, 264

8. Instruments and Ancillary

8.1. Used equipment "CTC"

The "Ref.-No" in the left column of the following tables allows the clear identification of the laboratory equipment.

8.1.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	emi test receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
012	signal generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	power meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Communication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT Firmware D2.87
053	audio analyzer	UPA3	860612/022	Firm. V 4.3
119	RT harmonics analyser/dig. flickermeter	B10	G60547	Firm.= V 3.1DHG
120	spectrum analyzer	FSEM 30	845538/011	Bios=2.1, Analyzer-Firmware= 3.30.3
140	signal generator	SMHU	831314/006	Firm.= 3.21
261	thermal power sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	power meter	NRV-S	825770/0010	Firm.= 2.6
263	signal generator	SMP 04	826190/0007	Firm.=3.21
264	spectrum analyzer	FSEK 30	826939/005	Bios=2.1, Analyzer= 3.20
277	Vector-Networkanalyzer	ZVC	831363/0005	Bios= 3.3, Analyzer=3.52
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04,
298	Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f.
323	Communication Tester	CMD 55	825878/0034	Firm.= 3.52 .22.01.99
331	climatic test chamber -40/+80 Grad	HC 4055	43146	TSI 1.53
335	System-CTC-EMS-Conducted	System EMS Conducted	-	EMS-K1 Immunity Test-Software 1.20SR10
340	Communication Tester	CMD 55	849709/037	Firm.= 3.52 .22.01.99
355	power meter	URV 5	891310/027	Firm.= 1.31
365	10V Insertion Unit 50 Ohm	URV5-Z2	100880	Eprom Data = 31.03.08
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10
371	Bluetooth Tester	CBT32	100153	CBT V4.6.1 + SW-Option K55
377	emi test receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
378	broadband RF field monitor	RadiSense III	03D00013SNO-08	Firm.= V.03D13
383	signal generator	SME 03	842 828 /034	Firm.= 4.61
389	digital multimeter	Keithley 2000	0583926	Firm. = A13 (Mainboard) A02 (Display)
392	Radio Communication Tester	MT8820A	6K00000788	Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001,
420	System CTC CTIA-OTA	System CTC CTIA-OTA	-	EMQuest EMQ-100 Ver. 1.05
436	Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.01, Mess-Software=
441	System CTC-SAR-EMI	System EMI field (SAR)	-	EMC 32 Version 8.20,
442	System CTC-SAR-EMS	System EMS field (SAR)	-	EMS-K1 Immunity-Software 1.20SR10
443	System CTC-FAR-EMI-Spuri	System CTC-FAR-EMI-	-	Spuri 6.4a und Spuri 7.0
444	System CTC FAR-EMS	System EMS-Field (FAR)	-	EMS-K1 Immunity-Software 1.20SR10
460	Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.01/Messsoftware=
489	emi test receiver	ESU40	1000-30	Firmware=4.33, Bios=V5.1-16-3, Specification=01.00
491	ESD Simulator dito	ESD dito	dito307022	V 2.30
524	Voltage Drop Simulator	VDS 200	0196-16	Software Nr: 000037 Version V4.20a01
526	Burst Generator	EFT 200 A	0496-06	Software Nr. 000034 Version V2.32
527	Micro Pulse Generator	MPG 200 B	0496-05	Software-Nr. 000030 Version V2.43
528	Load Dump Simulator	LD 200B	0496-06	Software-Nr. 000031 Version V2.35a01
547	Universal Radiocommunikation Tester	CMU 200	835390/014	R&S Test Firmware =V5.03 (current Testsoftw. f. all
551	System CTC Conducted Voltage	System Conducted Voltage	-	EMC 32 Version 8.20

8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer
001	emi test receiver	ESS	825132/017	Rohde & Schwarz
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz
007	DC - LISN (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz
009	power meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz
012	signal generator (EMS-cond.)	SMY 01	839069/027	Rohde & Schwarz
013	power meter (EMS cond.)	NRVD	839111/003	Rohde & Schwarz
014	insertion unit (EMS cond.)	URV5-Z2	838519/029	Rohde & Schwarz
015	insertion unit (EMS cond.)	URV5-Z4	838570/024	Rohde & Schwarz
016	line impedance simulating network	Op. 24-D	B6366	Spitzenberger+Spies
017	Communication Tester	CMD 60 M	844365/014	Rohde & Schwarz
020	horn antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO
021	loop antenna (H-Field)	6502	9206-2770	EMCO
022	audio measurement amplifier	2636C	1537643	Brüel & Kjaer
030	loop antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz
031	absorbing clamp	MDS-21	863325/015	Rohde & Schwarz
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz
048	bicon. - log. antenna (SAR)	3143	1108	EMCO
049	current clamp (injection)	F-120-2	48	FCC
050	3-ph coupling-decoupling-netw. (Burst)	CDN 300	176	Schaffner
051	VHF-current probe 20-300 MHz	ESV-Z1	872421	Rohde & Schwarz
052	notch filter DECT	WRCB 1887,82/1889,55SS	12	Wainwright Industries
053	audio analyzer	UPA3	860612/022	Rohde & Schwarz
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz
058	capacitive clamp (Burst)	IP 4	99	Hafely
059	ferrite tube	FGZ 40 X 15 E	4225	Lüthi
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies
061	ferrite tube	FGZ 40 X 15 E	4250	Lüthi
063	log.-per. antenna (Subst 1)	3146	860941/007	EMCO
065	attenuator, (6 dB) 50 Ohm, 250W	AT 50-6-250	521057	BNOS Electronics
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-	5	Wainwright GmbH
067	coupling decoupling-network	CDN801-M2/M3	272	Lüthi
068	coupling decoupling-network	CDN 801-M5	95226	Lüthi
069	EM - clamp	EM101	9535159	Lüthi
070	ferrite tube	FTC101	4199	Lüthi
071	biconical antenna (Subst 1)	HUF-Z2	863.029/010	Rohde & Schwarz
072	coupling decoupling-network	CDN801-M2/M3	276	Lüthi
083	AC - power supply, 0-10 A	EAC/MT 27010	910502096	EURO TEST
084	AC - power supply, 0-5 A	ELABO-8-34214	-	ELABO
085	AC - power supply, 0-10 A	R250	-	Schunterm.&Benningh.
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik
090	Helmholtz coil: 2x10 coils in series	-	-	RWTÜV
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba
094	artificial head (No.1)	4905	1566990	Brüel & Kjaer
098	Wireless Protocol Tester	PTW70Wlan	100093	Rohde&Schwarz
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck
110	USB-LWL-Converter	OLS-1	-	Extreme USB
119	RT harmonics analyser/dig. flickermeter	B10	G60547	BOCONSULT
120	spectrum analyzer	FSEM 30	845538/011	Rohde & Schwarz
121	notch filter GSM 1900	WRCB 1879,5/1880,5EE	15	Wainwright GmbH
122	notch filter GSM 1800	WRCB 1747/1748	12	Wainwright GmbH
123	biconical antenna (Subst 2)	HUF-Z2,	860941/007	Rohde & Schwarz
131	RF-Current Probe	F-52	19	FCC
132	log.-per. antenna (Subst 2)	HUF-Z3	860862/014	Rohde & Schwarz
133	horn antenna 18 GHz (Meas 1)	3115	9012-3629	EMCO
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO
140	signal generator	SMHU	831314/006	Rohde & Schwarz
142	attenuator (6 dB) 2 W, 8 GHz	DGL N	-	Radiall
248	attenuator	SMA 6dB 2W	-	Radiall
249	attenuator	SMA 10dB 10W	-	Radiall
252	attenuator	N 6dB 12W	-	Radiall
254	high pass GSM1800/1900/DECT	5HC 2600/12750-1.5KK	23042	Trilithic
256	attenuator	SMA 3dB 2W	-	Radiall
257	hybrid	4031C	04491	Narda
260	hybrid coupler	4032C	11342	Narda
261	thermal power sensor	NRV-Z55	825083/0008	Rohde & Schwarz
262	power meter	NRV-S	825770/0010	Rohde & Schwarz

263	signal generator	SMP 04	826190/0007	Rohde & Schwarz
264	spectrum analyzer	FSEK 30	826939/005	Rohde & Schwarz
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz
266	peak power sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH
268	AC/DC power supply	EA 3050-A	9823636	-
270	termination	1418 N	BB6935	Weinschel
271	termination	1418 N	BE6384	Weinschel
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel
273	attenuator, (10 dB) 100 W	Model 48	BF9229	Weinschel
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel
275	DC-Block	Model 7003 (N)	C5129	Weinschel
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel
277	Vector-Networkanalyzer	ZVC	831363/0005	Rohde & Schwarz
279	power divider	1515 (SMA)	LH855	Weinschel
284	coupling decoupling network	CDN 801-M1	1661	Lüthi
285	coupling decoupling network	CDN 801-S1	1642	Lüthi
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq
289	bicon. - log. antenna (OATS)	CBL 6141	4107	Schaffner Chase
290	notch filter GSM 900	WRCA 901,9/903,1SS	3RR	Wainwright GmbH
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH
295	Racal Digital Radio Test Set	6103	1572	Racal
298	Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz
299	audio microphone	134	-	Brüel & Kjaer
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck
304	fix dipole antenna 1,6 GHz	EMCO 3125-307	9907-1001	ETS
305	fix dipole antenna 1,8-2,0 GHz	EMCO 3125-306	9907-1001	ETS
306	fix dipole antenna 2,45 GHz	EMCO 3125-308	9907-1001	ETS
307	fix dipole antenna 3 GHz	EMCO 3125-309	9907-1001	ETS
312	Switch unit	TS-RSP	1000147	R&S
317	1000 Hz calibrator 94 dB SPL	4230 94dB	1542286	Brüel & Kjaer
323	Communication Tester	CMD 55	825878/0034	Rohde & Schwarz
331	climatic test chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch
335	System-CTC-EMS-Conducted	System EMS Conducted	-	Rohde & Schwarz
340	Communication Tester	CMD 55	849709/037	Rohde & Schwarz
341	digital multimeter	Fluke 112	81650455	Fluke
342	digital multimeter	Voltcraft M-4660A	IB 255466	Voltcraft
344	adaptor 150/50 Ohm	150/50	-	Krohne
345	adaptor 150/50 Ohm	150/50	-	Krohne
347	laboratory site	radio lab.	-	-
348	laboratory site	EMI conducted	-	-
349	car battery 12 V	car battery 12 V	without	-
350	car battery 12 V	car battery 12 V	without	-
354	DC - power supply 40A	NGPE 40/40	448	Rohde & Schwarz
355	power meter	URV 5	891310/027	Rohde & Schwarz
356	power sensor	NRV-Z1	882322/014	Rohde & Schwarz
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz
362	TOSM Calibration Kit 50 Ohm	ZV-Z21/ZV-Z11	without	Rohde&Schwarz
365	10V Insertion Unit 50 Ohm	URV5-Z2	100880	Rohde & Schwarz
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	EM-Test
367	audio measurement amplifier	2636	316832/001	Brüel & Kjaer
369	insertion unit (SAR-EMS, Ch. A)	URV5-Z2	100301	Rohde & Schwarz
370	insertion unit (SAR-EMS, Ch. B)	URV5-Z2	100302	Rohde & Schwarz
371	Bluetooth Tester	CBT32	100153	R&S
373	V-Network 5µH/50 Ohm	ESH3-Z6	100535	Rohde & Schwarz
374	power amplifier 0,8-3 GHz	60S1G3	306528	Amplifier Research
375	directional coupler	DC7144M1	306498	Amplifier Research
376	horn antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck
377	emi test receiver	ESCS 30	100160	Rohde & Schwarz
378	broadband RF field monitor	RadiSense III	03D00013SNO-08	DARE B.V.
383	signal generator	SME 03	842 828 /034	Rohde & Schwarz
386	coupling decoupling network	CDN USB/p	19397	Schaffner
387	coupling decoupling network	CDN L-801 M2	2051	Lüthi
388	coupling decoupling network	CDN L-801 T2	1929	Lüthi
389	digital multimeter	Keithley 2000	0583926	Keithley
390	Industry Acoustic System	MO 2000 Set	2127100123	Sennheiser
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu
394	power amplifier 80-1000 MHz	BLWA 0810-250/200	045610	Bonn-Elektronik
399	Sound Calibrator	Sound Calibrator 4231	2665101	Bruel & Kjaer
400	ferrite tube (>15 dB, EN 55022)	FTC 40 X 15 E	5559	Lüthi
401	ferrite tube (>15 dB, EN 55022)	FTC 40 X 15 E	5560	Lüthi
411	Test Cable Kit N 50 Ohm (male)	ZV-Z11	100200	R&S / Rosenberger
414	Circulary polarized com. Antenna	3102	00033734	EMCO
415	Antenna Position Controller	2090	00035634	ETS-Lindgren
416	MAPS Positioner (light duty)	2010	-	ETS-Lindgren
429	MAPS-Positionier (medium duty)	2015	-	ETS-Lindgren
430	Thermo-Hygrometer	H270	54476	Dostmann electronic
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO
432	pre-amplifier 100MHz-26GHz	JS4-00102600-38-5P	1030896	Miteq USA
436	Radio Communication Tester	CMU 200	103083	Rohde & Schwarz

439	UltraLog-Antenna	HL 562	100248	Rohde + Schwarz
440	CDN for Datacable	CDN-UTP	CDN-UTP 029	EMC Partner AG,
441	System CTC-SAR-EMI	System EMI field (SAR)	-	ETS
443	System CTC-FAR-EMI-Spuri	System CTC-FAR-EMI-	-	ETS-Lindgren/Cetecom
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg
455	Oscilloscope	HP 54602B	US 350 336 45	Hawlett Packard
456	DC-Power supply 0-5A	EA 3013 S	207810	Elektro Automatik
457	DC-Power supply, 0-5A	EA-3013 S	9624680	Elektro Automatik
459	DC -power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik
460	Radio Communication Tester	CMU 200	108901	Rohde & Schwarz
462	AF-Generator	MX-2020	-	Conrad
463	Universal source	HP3245A	2831A03472	Agilent
464	Thermo-Hygro-Monitor	WS-9400	without	Europe Supplies Ltd.
465	Thermo-Hygro-Monitor	WS-9400	without	Europe Supplies Ltd.
466	digital multimeter	Fluke 112	89210157	Fluke USA
467	digital multimeter	Fluke 112	89680306	Fluke USA
468	digital multimeter	Fluke 112	90090455	Fluke USA
470	Thermo-Hygro-Monitor	WS-9400	-	distr. by Conrad
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink
482	filtermatrix	FilterMatrix SAR 1	-	CETECOM (Brl)
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-	1244554	Miteq
487	NSA-Verification of CTC-SAR-EMI	System EMI field (SAR)	-	ETS
489	emi test receiver	ESU40	1000-30	Rohde & Schwarz
490	high pass 2,65 GHz>18GHz	6HC 2650/18000-3-KK	200709138	Trilithic
491	ESD Simulator dito	ESD dito	dito307022	EM-Test
494	power supply (GPIB)	Agilent 66332A	US 37474017	Agilent
498	Power Supply	NGPE 40/40	402	Rohde & Schwarz
500	industry Acoustic System	MO 2000 Set	100048	Sennheiser
502	band reject filter	WRCG 1709/1786-	SN 9	Wainwright
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright
517	relais switch matrix	HF Relais Box Keithley	SE 04	-
522	electronical load	EL 9000	-	ELV
523	Digitalmultimeter	L4411A	MY46000154	Agilent
524	Voltage Drop Simulator	VDS 200	0196-16	EM Test
525	Koppelnetzwerk	CNA 200	1196-01	EM Test
526	Burst Generator	EFT 200 A	0496-06	EM Test
527	Micro Pulse Generator	MPG 200 B	0496-05	EM Test
528	Load Dump Simulator	LD 200B	0496-06	EM Test
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-
531	H-field system	Lackman System	without	Lackmann
541	Impedance Stabilization Network	ISN T8-Cat6	26373	Teseq Berlin
547	Universal Radiocommunikation Tester	CMU 200	835390/014	Rohde & Schwarz
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH
551	System CTC Conducted Voltage	System Conducted Voltage	-	-

9. Correction factors due to reduced meas. distance (f< 30 MHz)

The used correction factors when the measurement distance is reduced, are taken from IEEC Transaction EMC, Vol 47, No.3, Aug. 2005, Journal Paper *"EXTRAPOLATING NEAR-FIELD EMISSIONS OF LOW-FREQUENCY LOOP TRANSMITTERS"*.

Used Transducer factors (f < 30 MHz)					
1	2	3	4	5	6
					=2+3+4+5
Frequency	Antenna factor	Corection factor		Cable loss	Transducer factor
		300m to 3m	30m to 3m		
kHz	dB µV/m	dB	dB	dB	dB µV/m
9,0	20,0	-116,7		0,0	-96,7
10,6	20,0	-116,7		0,0	-96,7
12,6	20,0	-116,7		0,0	-96,7
14,8	20,0	-116,7		0,0	-96,7
17,5	20,0	-116,6		0,0	-96,6
20,7	20,0	-116,6		0,0	-96,6
24,4	20,0	-116,6		0,0	-96,6
28,9	20,0	-116,6		0,0	-96,6
34,1	20,0	-116,5		0,0	-96,5
40,3	20,0	-116,4		0,0	-96,4
47,6	20,0	-116,3		0,0	-96,3
56,2	20,0	-116,2		0,0	-96,2
66,4	20,0	-116,0		0,0	-96,0
78,4	20,0	-115,8		0,0	-95,8
92,7	20,0	-115,4		0,0	-95,4
109,4	20,0	-115,0		0,0	-95,0
129,3	20,0	-114,5		0,0	-94,5
152,7	20,0	-113,9		0,0	-93,9
180,4	20,0	-113,1		0,0	-93,1
213,1	20,0	-112,2		0,0	-92,2
251,7	20,0	-111,3		0,0	-91,3
297,3	20,0	-108,3		0,0	-88,3
351,2	20,0	-105,2		0,0	-85,2
414,8	20,0	-102,1		0,0	-82,1
490,0	20,0	-99,1		0,0	-79,1
490,0	20,0		-56,4	0,1	-36,3
582,0	20,0		-56,2	0,1	-36,1
690,0	20,0		-56,0	0,2	-35,8
820,0	20,0		-55,7	0,2	-35,5
973,0	20,0		-55,4	0,2	-35,2
1.155,0	20,0		-54,9	0,3	-34,6
1.371,0	20,0		-54,4	0,3	-34,1
1.627,0	20,0		-53,7	0,3	-33,4
1.931,0	20,0		-52,9	0,4	-32,5
2.292,0	20,0		-52,0	0,4	-31,6
2.721,0	20,0		-49,8	0,5	-29,3
3.230,0	20,0		-46,6	0,5	-26,1
3.834,0	20,0		-43,3	0,6	-22,7
4.551,0	20,0		-40,1	0,6	-19,5
5.402,0	20,0		-36,8	0,7	-16,1
6.412,0	20,0		-33,5	0,7	-12,8
7.612,0	20,0		-30,3	0,8	-9,5
9.035,0	20,0		-27,0	0,8	-6,2
10.725,0	20,0		-23,9	0,9	-3,0
12.730,0	20,0		-21,2	0,9	-0,3
15.111,0	20,0		-19,3	1,0	1,7
17.937,0	20,0		-18,4	1,0	2,6
21.292,0	20,0		-18,2	1,1	2,9
25.274,0	20,0		-18,3	1,1	2,8
30.000,0	20,0		-18,4	1,2	2,8