T E S T R E P O R T
No.: 2-20732871a/08

According to: FCC Regulations
Part 22 & Part 24

for

Option N.V.

GSM/UMTS/GPS Module CU1407

Laboratory Accreditation and Listings			
Deutscher Akkreditierungs Rat DAR DAT-P176/94-02	FEDERAL COMMUNICATIONS COMMISSION FC USA Reg. No.: 99538 MRA US-EU 0003	Industry Canada Reg. No.: IC 3465	VCI Reg. No.: R-2665, R-2666 C-2914, T-339
accredited according to DIN EN ISO/IEC 17025			

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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.

The presented GSM 850/900/1800/1900 Module can be build inside host applications and extend their capability by wireless GSM technology for data transmission or voice application.

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

1.1. TESTS OVERVIEW FCC Part 22/24

TEST CASES	PORT	REFERENCES & LIMITS			EUT set-up	EUT operating mode	Result
		FCC Standard		TEST LIMIT			
TX-Mode							
RF POWER (conducted)	Antenna terminal (conducted)	§2.1046		N/A	1+3	1+2+3+4	Passed
RF-POWER radiated (ERP/EIRP)	Cabinet	§2.1046 §22.913(a)(2) §24.232(c)		< 7 Watt (ERP) < 2 Watt (EIRP)	2	1+2+3+4	Passed
SPURIOUS EMISSIONS (conducted)	Antenna terminal (conducted)	§2.1051 §22.917(a)(b) §24.238(a)(b)		43+10log(P) dBc	1+3	1+2+3+4	Passed
99% OCCUPIED BANDWIDTH	Antenna terminal (conducted)	§2.202 §2.1049 §22.917(a) §24.238(a)		99% Power	1+3	1+2+3+4	Passed
SPURIOUS EMISSIONS (radiated)	Cabinet + Interconnecting cables (radiated)	§15.209(a)		2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	2	1	Passed
		§2.1053(a) §22.917(a)(b) §24.238(a)(b)		43+10log(P) dBc	2	1+3	Passed
FREQUENCY STABILITY	Antenna terminal (conducted)	§22.355, table C-1 §24.235 §2.1055		< 2.5ppm <0.1 ppm	1+3	1+2+3+4	Passed

RX Mode							
AC-Power Lines Conducted Emissions	AC-Power lines	§15.107		FCC §15.107 Limits IC: Table 2, Chapter 7.2.2	--	--	Not performed, no direct connection from EUT to main power network
RECEIVER Spurious emissions	Cabinet + Interconnecting cables (radiated)	§15.109 §15.33 §15.35		FCC 15.109 class B Limits IC-Limits: Table 1, Chapter 6	2	IDLE Mode	Passed Remark 1

Remark: 1.) See separate test report 2_20732871b/08 for measurements according Part 15, Subpart B.

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Dipl.-Ing. C. 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. 3465 VCCI Registration No. R-2665,R-2666,C-2914,T-339
Responsible for testing laboratory:	Dipl.-Ing. W. Richter
Deputies:	Dipl.-Ing. H. Strehlow, 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.:	20732871
Responsible for test report and project leader:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2008-12-01
Date(s) of test:	2008-12-01 to 2008-12-22
Date of report:	2008-12-29
Version of template: 08.08	

2.4. Applicant’s details

Applicant’s name:	Option N.V.
Address:	Gastoon Geenslaan 14 3001 Leuven Belgium
Contact person:	Mr. Thomas Gulinck

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	GSM/GPRS Module with GPS Receiver		
Type	CU1407		
GSM Frequency range	GSM 850: 824 – 849MHz (Uplink), 869-894MHz (Downlink) GSM1900: 1850-1910MHz (Uplink), 1930-1990MHz (Downlink)		
Type of modulation	GMSK/8-PSK		
Number of channels	GSM 850: 128 – 251, 125 channels GSM1900: 512 – 810, 300 channels		
EMISSION DESIGNATOR(S)	300KGXW (GSM) 300KG7W (EDGE)		
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	☒ radiated: Max. 2 dBi		
MAX PEAK Output Power: GSM 850 Radiated E-GPRS 850 GSM 1900 E-GPRS 1900	26.22 dBm (channel 128) 24.18 dBm (Channel 128) 24.47 dBm (channel 810) 24.59 dBm (Channel 512)		
MAX PEAK Output Power: GSM 850 Conducted E-GPRS 850 GSM 1900 E-GPRS 1900	32.4 dBm (channel 192) 30.9 dBm (channel 192) 29.6 dBm (channel 661) 30.3 dBm (channel 810)		
FCC-ID	NCMOCU1407		
IC	--		
Installed option	☒ GPS		
Special EMI components	--		
Power supply GSM-Module	With external power supply with 3.7Volt Nominal Range 3.2 .. 4.2 Volt		
Power supply JTAG (EUT D-F)	By an external AC/DC adapter (7.5V nominal) which is powered 110V/60Hz		
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	RS 232 cable	--	--	--	Approx. 1.8m
Cable 2	Rf-connection cable	--	--	--	--

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	GSM/UMTS/GPS Module	CU1407	DS548BV03T	5.0	1.4.2793
EUT B	GSM/UMTS/GPS Module	CU1407	DS548BV04Z	5.0	1.4.2793
EUT C	GSM/UMTS/GPS Module	CU1407	DS548BV0BZ	5.0	1.4.2793
EUT D	Deimos JTAG	For DEIMOS	#1	Rev1 MC0	--
EUT E	Deimos JTAG	For DEIMOS	#2	Rev1 MC0	--
EUT F	Deimos JTAG	For DEIMOS	#3	Rev1 MC0	--
EUT G	Multiband Cellular Antenna	MAR-C3G-2F	#1	2dBi gain max.	--

*) 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	Notebook DELL	PP01X Latitude C810	SPQ-Testunit-47	--	Windows XP + Terminal program
AE 2	AC/DC Adapter Cincon Electronics Co. Ltd.	TR1505	#1	--	--
AE 3	AC/DC Adaptor	MW48-0751000U	#1	--	--

*) 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 D + AE 2 (+ AE 1)	Used for: Frequency Error measurements: GSM 1900/ E-GPRS1900 Other conducted measurements GSM 1900/ E-GPRS1900
Set. 2	EUT B + EUT E + EUT G + AE 2 (+ AE 1)	Used for: Magnetic field measurements Field strength measurements f< 1 GHz Spurious emissions according Part 22/24 EIRP according Part 22/24
Set. 3	EUT C + EUT F + AE 3 (+ AE 1)	Used for: Frequency Error measurements: GSM 850/ E-GPRS850 Other conducted measurements GSM 850/ E-GPRS850

*) 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** 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. 2	**E-GPRS 850** TCH Mode PCL=0 (max. power) 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: E2 class – GSM850: 27 dBm USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8-PSK modulation, slot 3 active, uplink gamma: 6 (27dBm). 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** 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. 4	**E-GPRS 1900** TCH Mode PCL=0 (max. power) 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 E2 class – GSM1900: 26 dBm USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8-PSK modulation, slot 3 active, uplink gamma: 7 (26dBm). 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

*) 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:

Parameter	Traffic Mode	Idle Mode
Traffic Channels mobile station (EUT)	GSM 850 TCH_{MS}= 128/ 192 /251 GSM 1900 TCH_{MS} = 512 / 661 / 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: one slot	
MS slot class	Class 12	
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)

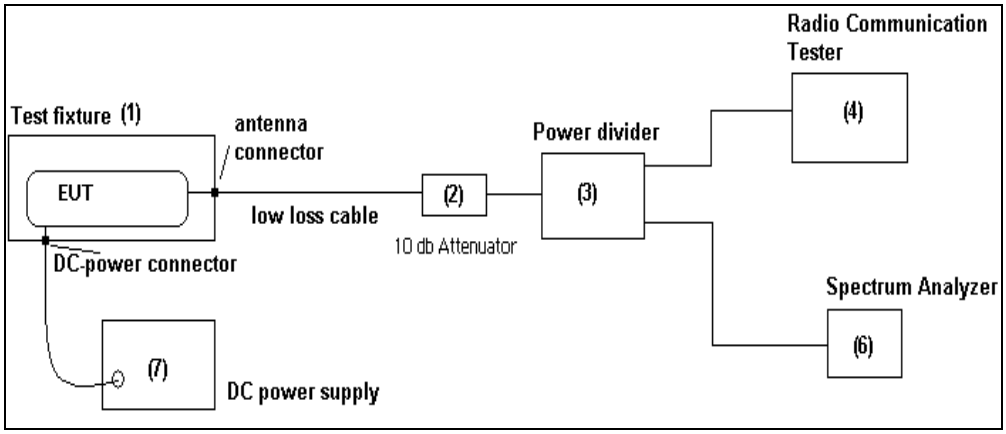
Repetition	Continuous	
Stop condition	None	
Display mode	Max./Min	
Statistic Count	1000 Bursts	
Decoder	Standard	

Additional settings on the base stations CMU200 for frequency stability measurements

4. DESCRIPTION OF TEST SET-UP's

4.1. GSM-Mode Test Set-up for conducted measurements

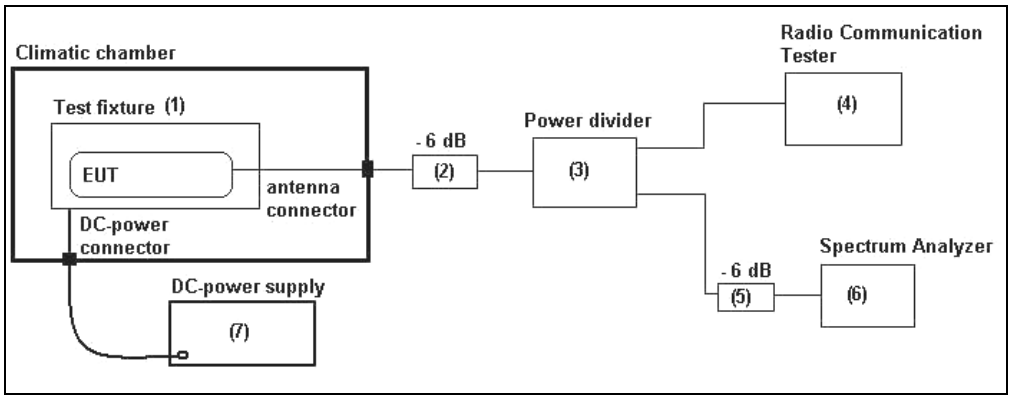
The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first 10 dB attenuated (2) before it is 0° divided by a power divider (3). One of the signal path is connected to the communication base station (4), other branch is connected to the spectrum – analyzer (5). 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

Following modified test set-up schematic apply for tests performed inside the climatic chamber: (Frequency stability)

In case **an external connector is available (test fixture)**, following set-up is used for measurements.



Schematic: Test set-up conducted within climatic chamber

4.2. Test set-up for radiated measurements

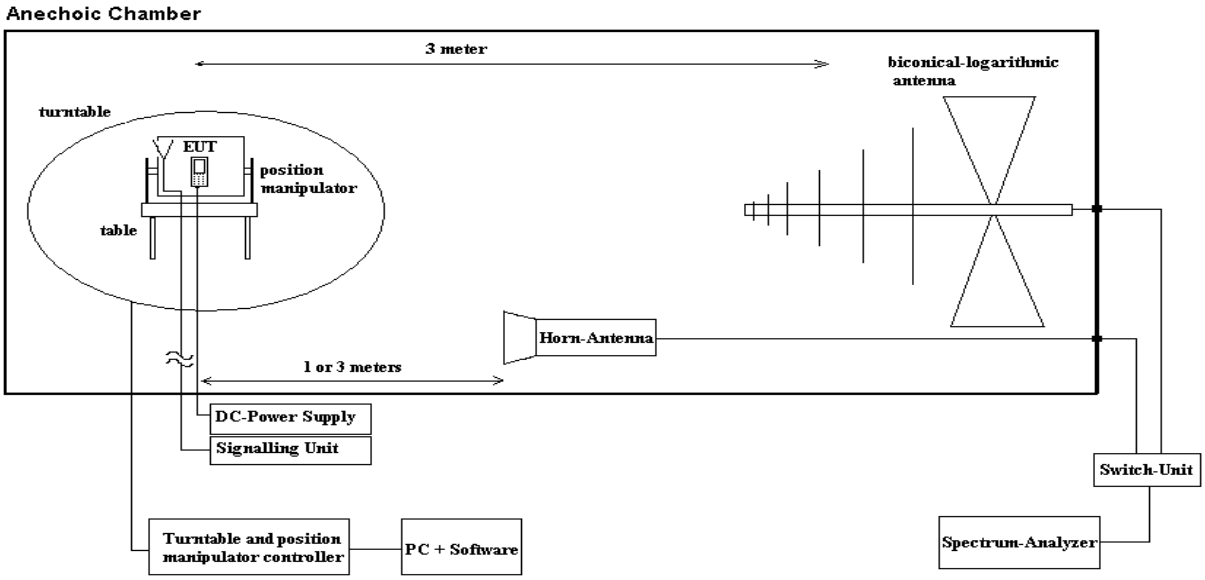
The radiated emissions from the test device are measured first as exploratory measurement in a FCC recognized semi anechoic chamber or fully anechoic chamber with the dimensions of 8.05m x 6.85m x 5.48m. Very critical frequencies within a defined range, can be re-checked on CETECOM's Open Area Test side, 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 position manipulator 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 position manipulator 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 was used. (see equipment list)

The EUT is powered either by internal batteries, an external DC-supply with nominal voltage or a AC/DC power supply as accessory. Details can be found in the set-up description.

The communication signalling is performed from outside the chamber with a communication test simulator (CMU200 from Rohde&Schwarz).



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)

- Maximum Power Output of the mobile phone should be determined while measured conducted and radiated way.
- Limit: GSM 1900: 30dBm nominal (8-PSK)
- Limit GSM850: 33 dBm nominal (GMSK)

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 SETTING

- according 3.7

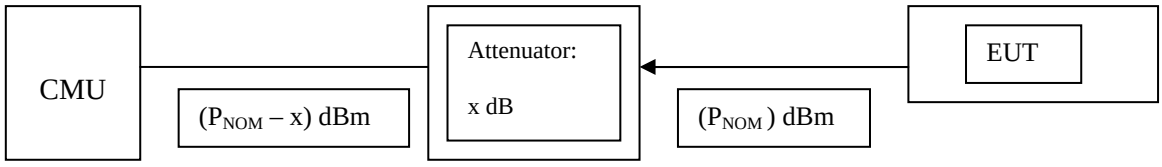
TEST METHOD

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*. 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 1, Set-up 3

Channel/ Frequency (MHz)		Peak Output Power (dBm)	Average Output Power (dBm)
GSM 850	Channel 128/ 824.2 MHz	32.3	32.0
	Channel 192/ 837 MHz	32.4	32.2
	Channel 251/ 848.8 MHz	32.3	32.1

Op. Mode 2, Set-up 3

Channel/ Frequency (MHz)		Peak Output Power (dBm)	Average Output Power (dBm)
E-GPRS 850	Channel 128/ 824.2 MHz	30.8	27.7
	Channel 192/ 837 MHz	30.9	27.8
	Channel 251/ 848.8 MHz	30.7	27.6

Op. Mode 3, Set-up 1

Channel/ Frequency (MHz)		Peak Output Power (dBm)	Average Output Power (dBm)
GSM 1900	Channel 512/ 1850.2 MHz	29.2	29.0
	Channel 661/ 1880.0 MHz	29.6	29.5
	Channel 810/ 1909.8 MHz	29.4	29.2

Op. Mode 4, Set-up 1

Channel/ Frequency (MHz)		Peak Output Power (dBm)	Average Output Power (dBm)
E-GPRS 1900	Channel 512/ 1850.2 MHz	29.8	26.6
	Channel 661/ 1880.0 MHz	30.0	26.8
	Channel 810/ 1909.8 MHz	30.3	27.1

VERDICT: passed

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	22.5 °C
Relative Humidity	29 %
Air pressure	1019 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
460, 463, 517, 529, 530

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 within each operational GSM-band, 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 measurements
RBW	1 MHz
VBW	10 MHz
Span	8 MHz
Detector Mode	Positive max-hold
Trace Average	off
Sweep Time	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
GSM 850	Channel 128/ 824.2 MHz	26.22	ERP-Value	V/H	Passed
	Channel 192/ 837.0 MHz	22.77			
	Channel 251/ 848.8 MHz	20.81			
E-GPRS 850	Channel 128/ 824.2 MHz	24.18	ERP-Value	V/H	Passed
	Channel 192/ 837.0 MHz	19.78			
	Channel 251/ 848.8 MHz	19.01			

Channel/ Frequency (MHz)		Peak Output Power (dBm)		Antenna Polarisation for maximum Power	Verdict
GSM 1900	Channel 512/ 1850.2 MHz	23.57	EIRP-Value	V/H	Passed
	Channel 661/ 1880.0 MHz	23.74			
	Channel 810/ 1909.8 MHz	24.47			
E-GPRS 1900	Channel 512/ 1850.2 MHz	24.59	EIRP-Value	V/H	Passed
	Channel 661/ 1880.0 MHz	23.86			
	Channel 810/ 1909.8 MHz	23.45			

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	22.5 °C
Relative Humidity	29 %
Air pressure	1016 hPa

TEST EQUIPMENT

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

5.2. Occupied bandwidth

REFERENCES

FCC: §2.1049; §22.917(a), §24.238(a)

„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.
- Provisions with the requirements is based on the fact, that EDGE modulation scheme is 8-PSK Modulation for EDGE equipment with a maximum data transmission rate of 69,2 kBit/s per Slot.
- according table 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	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.

DATA RESULTS

Set-up 3, Op-Mode 1

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
GSM 850	Channel 128/ 824.2 MHz	317.3076	243.5897
	Channel 192/ 837.0 MHz	315.7051	243.5897
	Channel 251/ 848.8 MHz	318.9102	246.7948

Remarks: see annex for plots

Set-up 3, Op-Mode 2

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
E-GPRS 850	Channel 128/ 824.2 MHz	307.6923	238.7820
	Channel 192/ 837.0 MHz	310.8974	240.3846
	Channel 251/ 848.8 MHz	306.0897	240.3846

Remarks: see annex for plots

Set-up 1,Op-Mode 3

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
GSM 1900	Channel 512/ 1850.2 MHz	315.7051	246.7948
	Channel 661/ 1880.0 MHz	314.1025	245.1923
	Channel 810/ 1909.8 MHz	310.8974	246.7948

Remarks: see annex for plots

Set-up 1,Op-Mode 4

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
E-GPRS 1900	Channel 512/ 1850.2 MHz	309.2948	245.1923
	Channel 661/ 1880.0 MHz	312.5000	243.5897
	Channel 810/ 1909.8 MHz	304.4871	243.5897

Remarks: see annex for plots

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	22.5 °C
Relative Humidity	29 %
Air pressure	1016 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
460, 463, 489, 517, 529, 530

5.3. Radiated emissions, Intentional Radiators, frequencies below 30 MHz

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	☒ 460 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, §15.209, ANSI C63.4

Frequency [MHz]	Field strength [dBµV/m]	[dBµV/m]	Measurement distance [meters]	Remarks
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f)	300	Correction factor used due to measurement distance of 3m
0.490 – 1.705	24000/f (kHz)	87.6 – 20 Log(f)	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
EMI-Receiver (Analyzer) Settings	Span/Range: 9kHz to 150 kHz 150kHz to 30 MHz RBW/VBW: 200Hz/auto 9 kHz/ auto (CISPR#16) Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements AV/Quasi-Peak, for final		

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 placed on a non-conductive positioning table of 0.8 meter height depending from the frequency range. The measuring distance was set to 3.
The 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 over 3-orthogonal axes 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 9.

Measurement Results:

Set-up No.		2								
Operating Mode		1								
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	18.63	20.402	20	10	1.00	--	--	--	9.13	29.54
3.02	18.63	< 20.00	20	10	1.00	--	--	--	> 9.0	29.54
3.03	18.63	< 20.00	20	10	1.00	--	--	--	> 9.0	29.54

Remark: 1.) diagrams shows PK measurements, Peaks are originated from set-up not EUT
*.) see also plots enclosed in chapter diagrams

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

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	23 °C
Relative Humidity	32 %
Air pressure	1017 hPa

5.4. Emission limits (Spurious emission)

REFERENCES

FCC: §2.1051-conducted, §2.1053(a)-radiated, §22.917(a)(b); §24.238(a)(b)

„the power of emissions shall be attenuated below the transmitter output power (p) by at 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 each operational GSM-band. Choosing three representative TX-carrier frequencies 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 Hold-Max 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 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	10 times the RBW
More than 1 MHz outside and adjacent the frequency blocks	1 MHz	10 MHz

DATA RESULTS (CONDUCTED)

GSM TCH 850: Op. Mode 1, Set-up 3

Lowest channel: 128

Transmitting channel/ frequency: TX = 824.2 MHz						
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.23	702.98	--	-34.80	-13 dBm	Passed
Sweep 2	14.26	875.96	--	-35.09		Passed
Sweep 3	14.29	3579.2	--	-25.65		Passed
Sweep 4 [4.)]	14.43	823.98	--	-28.55		Passed [4.)]

Remark: see diagrams for more details
4.) Band-Block Edge compliance

Middle channel = 192

Transmitting channel/ frequency: TX = 837 MHz						
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.24	709.6	--	-35.26	-13 dBm	Passed
Sweep 2	14.27	875.96	--	-35.14		Passed
Sweep 3	14.30	3578.1	--	-25.58		Passed

Remark: see diagrams for more details

Highest channel: 251

Transmitting channel/ frequency: TX = 848.8 MHz						
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.25	712.1	--	-34.99	-13 dBm	Passed
Sweep 2	14.28	875.96	--	-34.43		Passed
Sweep 3	14.31	3579.7	--	-25.11		Passed
Sweep 5 [4)]	14.44	849.02	--	-29.09		Passed [4.)]

Remark: see diagrams for more details
4.) Band-Block Edge compliance

E-**GSM 850:** Op. Mode 2, Set-up 3

Lowest channel: 128

Transmitting channel/ frequency: TX = 824.2 MHz						
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.32	700.35	--	-34.90	-13 dBm	Passed
Sweep 2	14.35	875.96	--	-34.82		Passed
Sweep 3	14.38	3579.7	--	-25.41		Passed
Sweep 4 [4.)]	14.41	823.9871	--	-25.31		Passed 4.)

Remark: see diagrams for more details

4.) Band-Block Edge compliance

Middle channel = 192

Transmitting channel/ frequency: TX = 837 MHz						
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.33	696.43	--	-35.25	-13 dBm	Passed
Sweep 2	14.36	875.96	--	-35.16		Passed
Sweep 3	14.39	3579.7	--	-24.4		Passed

Remark: see diagrams for more details

Highest channel: 251

Transmitting channel/ frequency: TX = 848.8 MHz						
Sweep frequency range: [MHz]	Diagram number	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.34	703.05	--	-34.55	-13 dBm	Passed
Sweep 2	14.37	893.84	--	-34.25		Passed
Sweep 3	14.40	3579.1	--	-25.50		Passed
Sweep 5 [4)]	14.42	849.0128	--	-25.34		Passed 4.)

Remark: see diagrams for more details

4.) Band-Block Edge compliance

GSM 1900 Mode: Op. Mode 3, Set-up 1

Lowest channel: 512

Transmitting channel/ frequency: TX = 1850,2 MHz						
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.01	884.61	--	-38.44	-13 dBm	Passed
Sweep 2	14.04	Noise floor	--	3.)		Passed
Sweep 3	14.07	3698.7	--	-44.64		Passed
Sweep 4	14.10	1849.99	--	-14.99		Passed 4.)

Remark: see diagrams for more details

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]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.02	898.95	--	-38.65	-13 dBm	Passed
Sweep 2	14.05	Noise floor	--	3.)		Passed
Sweep 3	14.08	3598.6	--	-44.95		Passed

Remark: see diagrams for more details

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]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.03	887.78	--	-37.94	-13 dBm	Passed
Sweep 2	14.06	Noise floor	--	3.)		Passed 3.)
Sweep 3	14.09	3589.7	--	-44.72		Passed
Sweep 4	14.11	1910.001	--	-13.66		Passed 4.)

Remark: see diagrams for more details

3.) Noise floor

4.) Band-Block Edge compliance

E-GPRS 1900 Mode: Op. Mode 4, Set-up 1

Lowest channel: 512

Transmitting channel/ frequency: TX = 1850,2 MHz						
Sweep frequency range: [MHz]	Diagram number (H/V)	Frequency of emission [MHz]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.14	899.04	--	-39.25	-13 dBm	Passed
Sweep 2	14.15	Noise floor	--	4.)		Passed
Sweep 3	14.18	3589.7	--	-44.34		Passed
Sweep 4	14.21	1849.974	--	-18.89		Passed 4.)

Remark: see diagrams for more details
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]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.13	894.23	--	-38.87	-13 dBm	Passed
Sweep 2	14.16	Noise floor	--	4.)		Passed 3.)
Sweep 3	14.19	3589.7	--	-44.59		Passed

Remark: see diagrams for more details
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]	Transducer factor [dB]	Result [dBm]	Limit [dB]	Verdict
Sweep 1	14.12	884.51	--	-38.75	-13 dBm	Passed
Sweep 2	14.17	1990.4	--	-32.74		Passed
Sweep 3	14.20	3589.7	--	-43.91		Passed
Sweep 4	14.22	1910.009	--	-19.10		Passed 4.)

Remark: see diagrams for more details
4.) Band-Block Edge compliance

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	20 °C
Relative Humidity	29.1 %
Air pressure	1016 hPa

TEST EQUIPMENT

Used equipment (see reference in the annex)
460, 463, 489, 517, 529, 530

RESULTS (RADIATED)

GSM 850 Mode: Op 1. Mode , Set-up 2

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 [dB]	Verdict
Sweep 1	8.35 8.36	980.56	H	--	-29.16	-13	Passed
Sweep 2	8.41 8.42	824.00	H	--	-22.29		Passed 4.)
Sweep 4	8.45 8.46	2648.4	H	--	-22.31		Passed
Sweep 5	8.51 8.52	11853.0	H	--	-33.36		Passed

Remark: see diagrams for more details, only worst-case polarisation mentioned
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 [dB]	Verdict
Sweep 1	8.37 8.38	992.21	H	--	-28.32		Passed
Sweep 4	8.47 8.48	2652.1	H	--	-22.06		Passed
Sweep 5	8.53 8.54	11981.0	V	--	-33.46	-13 dBm	Passed

Remark: see diagrams for more details, only worst-case polarisation mentioned

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 [dB]	Verdict
Sweep 1	8.39 8.40	998.06	V	--	-29.00	-13 dBm	Passed
Sweep 3	8.43 8.44	849.01	V	--	-26.13		Passed 4.)
Sweep 4	8.49 8.50	2612.4	H	--	-22..09		Passed
Sweep 5	8.55 8.56	11982.0	V	--	-34.05		Passed

Remark: see diagrams for more details, only worst-case polarisation mentioned
4.) Band-Block Edge compliance

GSM 1900 Mode: Op 3. Mode, 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 [dB]	Verdict
Sweep 1	8.01 8.02	965.01	H	--	-29.97	-13	Passed
Sweep 2	8.07 8.08	2634.1	H	--	-20.83		Passed
Sweep 3	8.13 8.14	1850.0	V	--	-21.91		Passed 4.)
Sweep 5	8.17 8.18	11852.0	V	--	-38.24		Passed
Sweep 6	8.23 8.24	14008.0	V	--	-18.50		Passed
Sweep 7	8.29	19326.92	--	--	-26.36		Passed 5.)

Remark: see diagrams for more details, only worst-case polarisation mentioned
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 [dB]	Verdict
Sweep 1	8.03 8.04	978.62	V	--	-30.31	-13 dBm	Passed
Sweep 2	8.09 8.10	2670.1	H	--	-20.54		Passed
Sweep 5	8.19 8.20	11723.0	H	--	-39.07		Passed
Sweep 6	8.25 8.26	13767.53	V	--	-18.50		Passed
Sweep 7	8.30	19596.15	--	--	-26.71		Passed 5.)

Remark: see diagrams for more details, only worst-case polarisation mentioned

5. Overview measurement only, no critical peaks found

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 [dB]	Verdict
Sweep 1	8.05 8.06	988.19	H	--	-30.12	-13 dBm	Passed
Sweep 2	8.11 8.12	2615.5	H	--	-20.61		Passed
Sweep 4	8.15 8.16	1910	V	--	-22.25		Passed 4.)
Sweep 5	8.21 8.22	11926.0	V	--	-38.60		Passed
Sweep 6	8.27 8.28	13803.60	V	--	-19.53		Passed
Sweep 7	8.31	18842.0	--	--	-26.04		Passed 5.)

Remark: see diagrams for more details, only worst-case polarisation mentioned

4. Band-Block Edge compliance
5. Overview measurement only, no critical peaks found

AMBIENT ENVIRONMENTAL CONDITIONS

Temperature	22.5 °C
Relative Humidity	29 %
Air pressure	1016 hPa

TEST EQUIPMENT

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

5.5. Frequency stability on temperature and voltage variations

REFERENCES

FCC: §2.1055, §22.355, §24.235

§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

- 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.
- according chapter 4.3

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 for GSM1900 mode is considered low enough to ensure this. For the GSM850 band the limit is 2.5ppm according the limits in §22.355, table C-1.

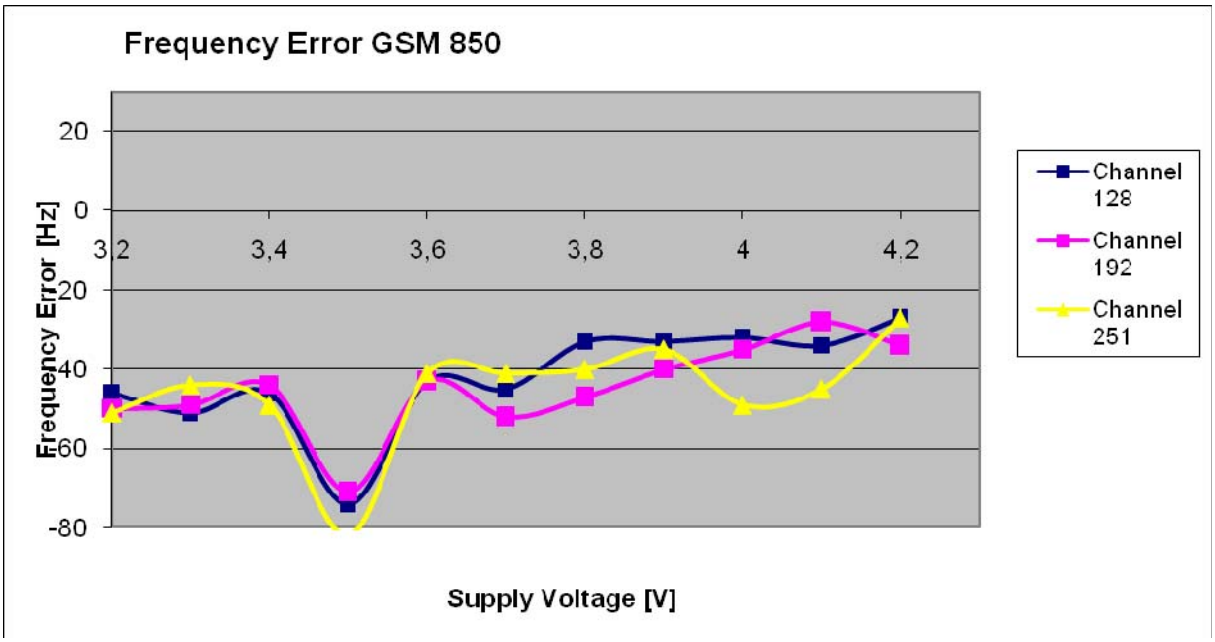
Frequency deviation of carrier against a voltage range at constant nominal temperature of 20° Celsius

1.) determine the carrier frequency on lowest, middle 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

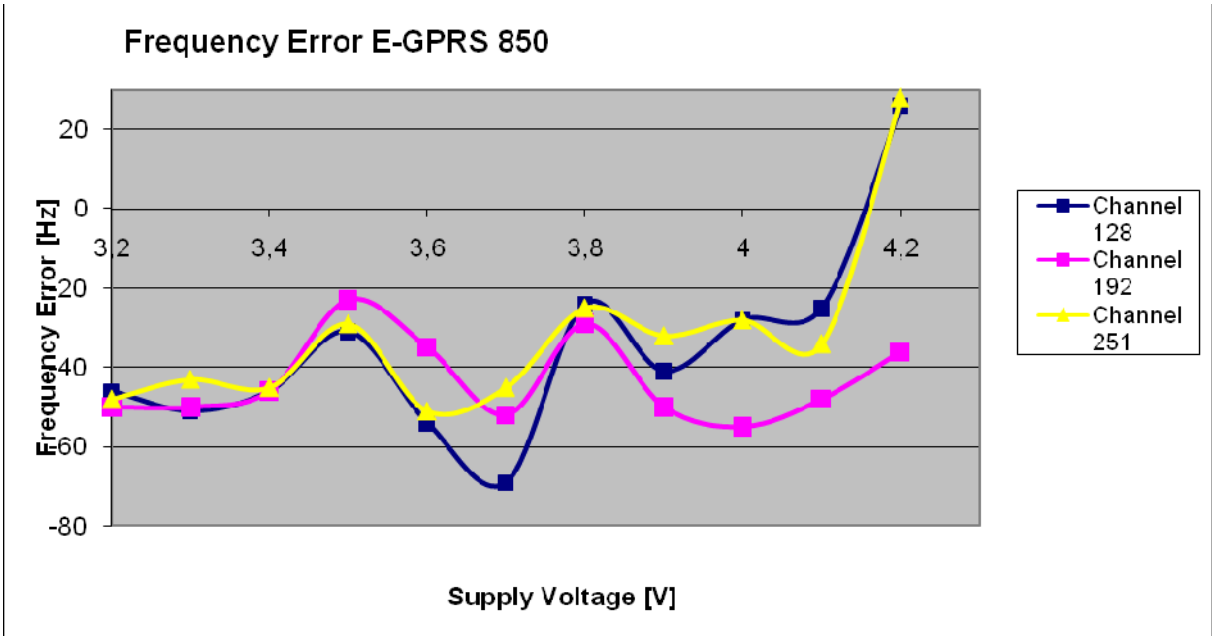
GSM 850 Mode: Op. Mode 1, set-up 3

Voltage	Channel 128	Channel 192	Channel 251	Channel 128 Error [ppm]	Channel 192 Error [ppm]	Channel 251 Error [ppm]
3,2	-46	-50	-51	-0,056	-0,060	-0,060
3,3	-51	-49	-44	-0,062	-0,059	-0,052
3,4	-46	-44	-49	-0,056	-0,053	-0,058
3,5	-74	-71	-82	-0,090	-0,085	-0,097
3,6	-43	-43	-41	-0,052	-0,051	-0,048
3,7	-45	-52	-41	-0,055	-0,062	-0,048
3,8	-33	-47	-40	-0,040	-0,056	-0,047
3,9	-33	-40	-35	-0,040	-0,048	-0,041
4	-32	-35	-49	-0,039	-0,042	-0,058
4,1	-34	-28	-45	-0,041	-0,033	-0,053
4,2	-27	-34	-27	-0,033	-0,041	-0,032



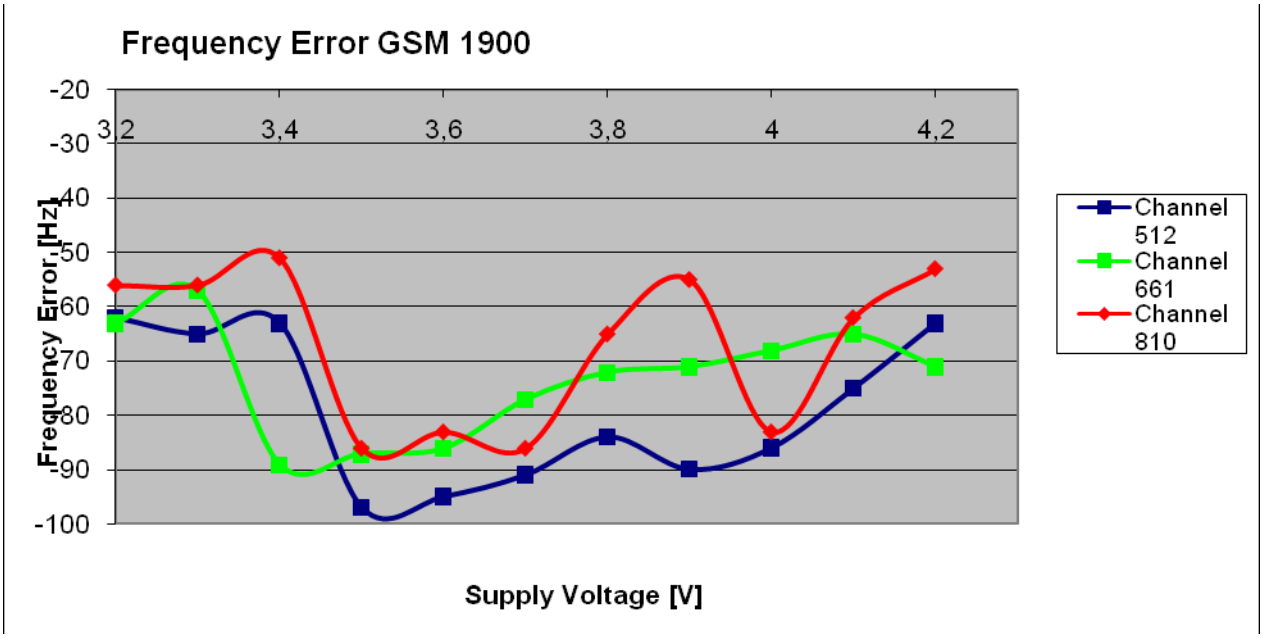
E-GPRS 850 Mode: Op. Mode2, Set-up 3

Voltage	Channel 128	Channel 192	Channel 251	Channel 128 Error [ppm]	Channel 192 Error [ppm]	Channel 251 Error [ppm]
3,2	-46	-50	-48	-0,056	-0,060	-0,057
3,3	-51	-50	-43	-0,062	-0,060	-0,051
3,4	-46	-46	-45	-0,056	-0,055	-0,053
3,5	-31	-23	-29	-0,038	-0,027	-0,034
3,6	-54	-35	-51	-0,066	-0,042	-0,060
3,7	-69	-52	-45	-0,084	-0,062	-0,053
3,8	-24	-29	-25	-0,029	-0,035	-0,029
3,9	-41	-50	-32	-0,050	-0,060	-0,038
4	-28	-55	-28	-0,034	-0,066	-0,033
4,1	-25	-48	-34	-0,030	-0,057	-0,040
4,2	26	-36	28	0,032	-0,043	0,033



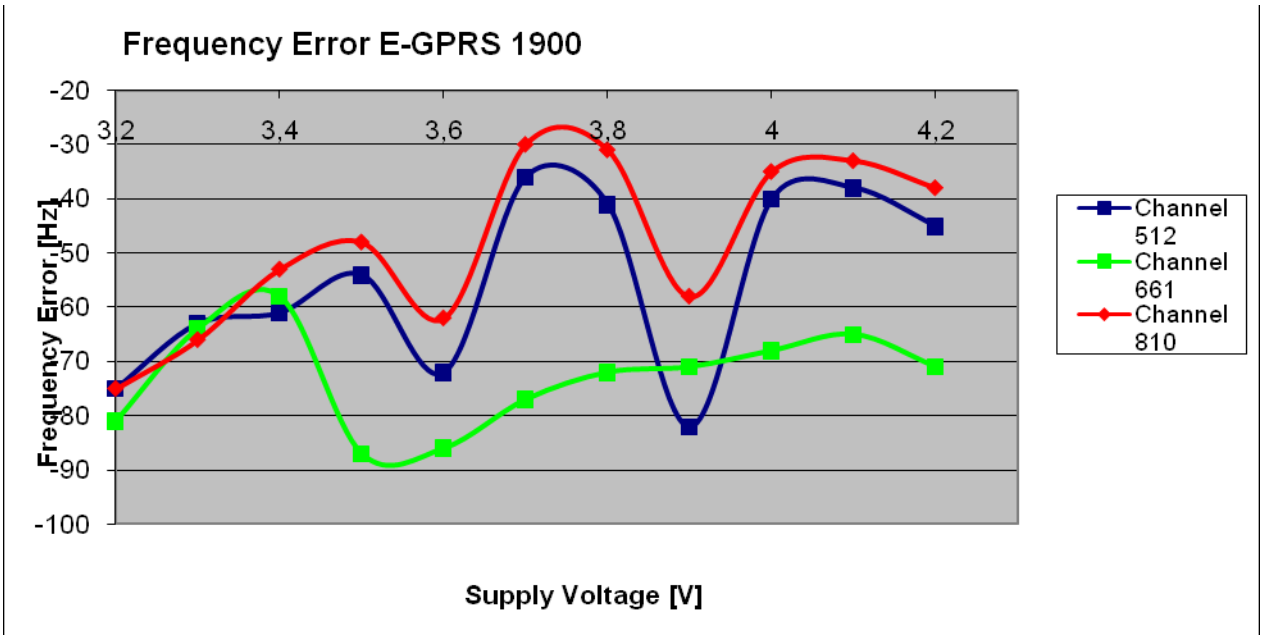
GSM 1900 Mode: Op. Mode 3, Set-up 1

Voltage	Channel 512	Channel 661	Channel 810	Channel 512 Error [ppm]	Channel 661 Error [ppm]	Channel 810 Error [ppm]
3,2	-62	-63	-56	-0,033	-0,034	-0,029
3,3	-65	-57	-56	-0,035	-0,030	-0,029
3,4	-63	-89	-51	-0,034	-0,047	-0,027
3,5	-97	-87	-86	-0,052	-0,046	-0,045
3,6	-95	-86	-83	-0,051	-0,046	-0,043
3,7	-91	-77	-86	-0,049	-0,041	-0,045
3,8	-84	-72	-65	-0,045	-0,038	-0,034
3,9	-90	-71	-55	-0,049	-0,038	-0,029
4,0	-86	-68	-83	-0,046	-0,036	-0,043
4,1	-75	-65	-62	-0,040	-0,035	-0,032
4,2	-63	-71	-53	-0,034	-0,038	-0,028



E-GPRS 1900 Mode: Op. Mode 4, Set-up 1

Voltage	Channel 128	Channel 192	Channel 251	Channel 128 Error [ppm]	Channel 192 Error [ppm]	Channel 251 Error [ppm]
3,2	-75	-81	-75	-0,040	-0,043	-0,039
3,3	-63	-64	-66	-0,034	-0,034	-0,035
3,4	-61	-58	-53	-0,033	-0,031	-0,028
3,5	-54	-87	-48	-0,029	-0,046	-0,025
3,6	-72	-86	-62	-0,039	-0,046	-0,032
3,7	-36	-77	-30	-0,019	-0,041	-0,016
3,8	-41	-72	-31	-0,022	-0,038	-0,016
3,9	-82	-71	-58	-0,044	-0,038	-0,030
4,0	-40	-68	-35	-0,022	-0,036	-0,018
4,1	-38	-65	-33	-0,021	-0,035	-0,017
4,2	-45	-71	-38	-0,024	-0,038	-0,020



TEST EQUIPMENT

Used equipment (see reference in the annex)
331, 354, 460, 463, 517, 529, 530

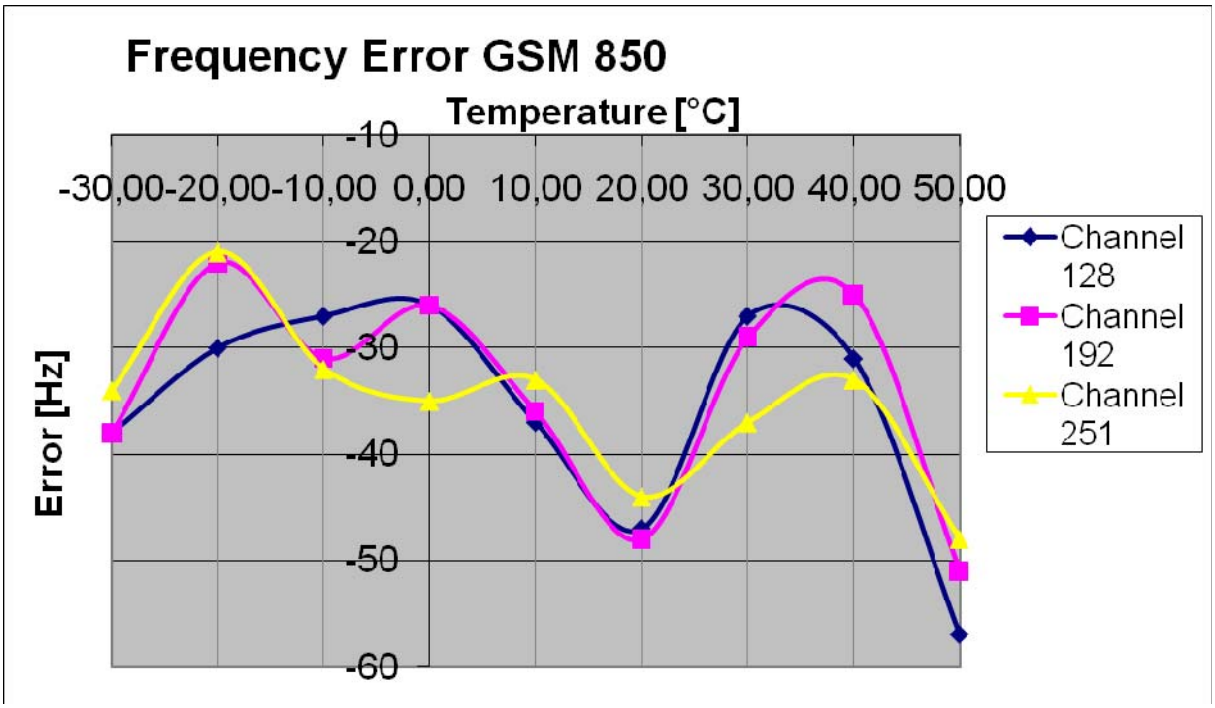
Frequency deviation of carrier against temperature at constant power supply voltage

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

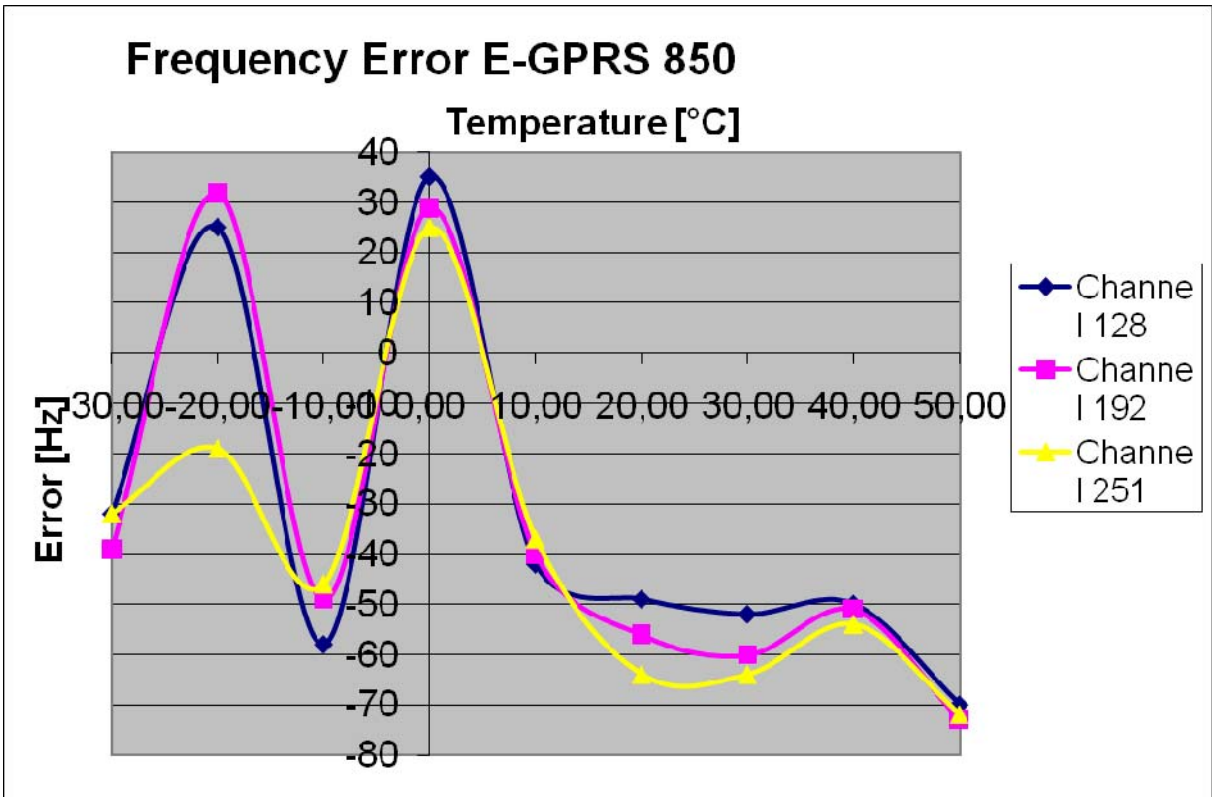
GSM 850 Mode: Op 1. Mode, set-up 3

Temperature	**Channel 128**	**Channel 192**	**Channel 251**	**Channel 128** Error [ppm]	**Channel 192** Error [ppm]	**Channel 251** Error [ppm]
-30	-38	-38	-34	-0,046	-0,045	-0,040
-20	-30	-22	-21	-0,036	-0,026	-0,025
-10	-27	-31	-32	-0,033	-0,037	-0,038
0	-26	-26	-35	-0,032	-0,031	-0,041
10	-37	-36	-33	-0,045	-0,043	-0,039
20	-47	-48	-44	-0,057	-0,057	-0,052
30	-27	-29	-37	-0,033	-0,035	-0,044
40	-31	-25	-33	-0,038	-0,030	-0,039
50	-57	-51	-48	-0,069	-0,061	-0,057



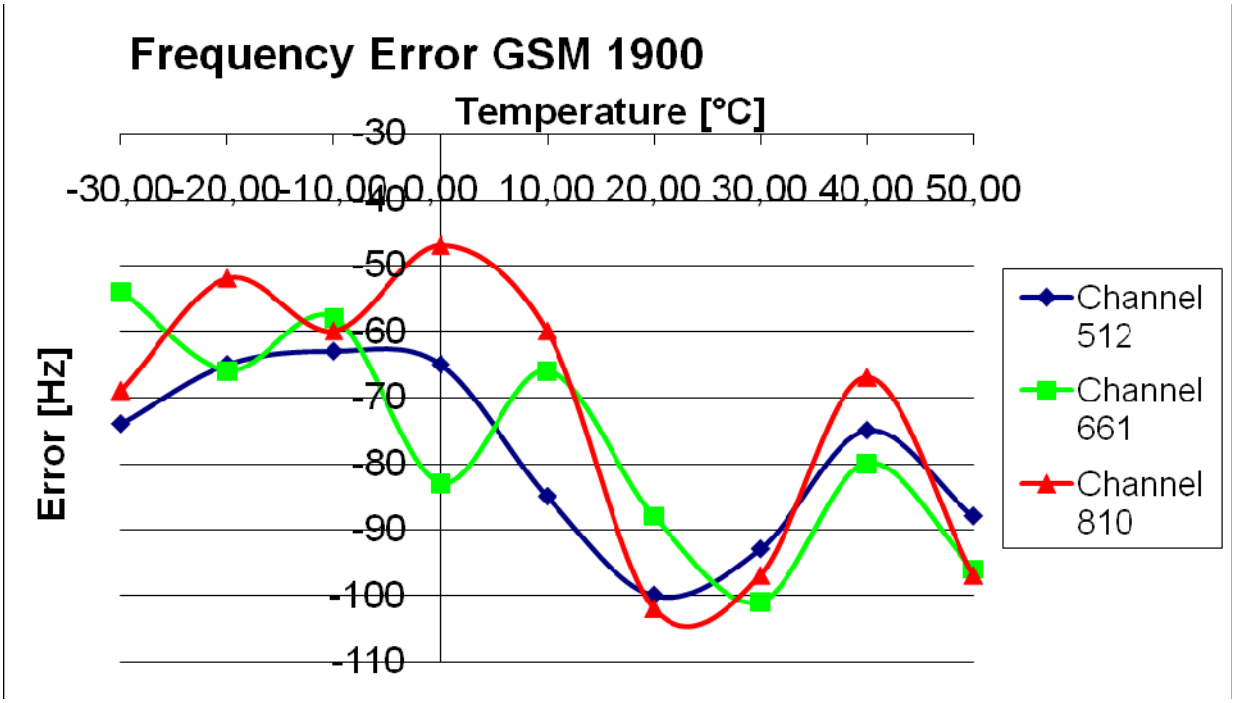
E-GPRS 850 Mode: Op. Mode 2, set-up 3

Temperature	Channel 128	Channel 192	Channel 251	Channel 128 Error [ppm]	Channel 192 Error [ppm]	Channel 251 Error [ppm]
-30	-32	-39	-32	-0,039	-0,047	-0,038
-20	25	32	-19	0,030	0,038	-0,022
-10	-58	-49	-46	-0,070	-0,059	-0,054
0	35	29	25	0,042	0,035	0,029
10	-42	-40	-37	-0,051	-0,048	-0,044
20	-49	-56	-64	-0,059	-0,067	-0,075
30	-52	-60	-64	-0,063	-0,072	-0,075
40	-50	-51	-54	-0,061	-0,061	-0,064
50	-70	-73	-72	-0,085	-0,087	-0,085



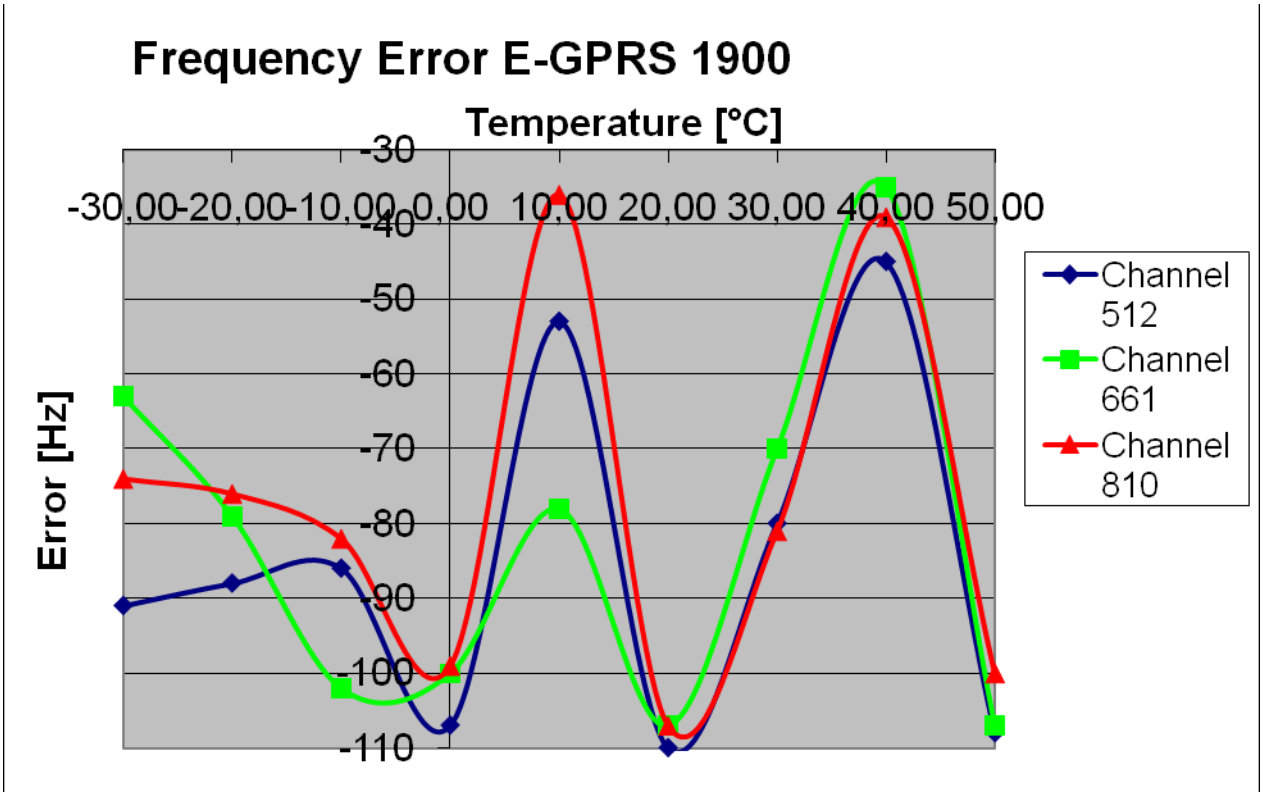
GSM 1900 Mode: Op. Mode 3, set-up 1

Temperature	Channel 512	Channel 661	Channel 810	Channel 512 Error [ppm]	Channel 661 Error [ppm]	Channel 810 Error [ppm]
-30	-74	-54	-69	-0,040	-0,029	-0,036
-20	-65	-66	-52	-0,035	-0,035	-0,027
-10	-63	-58	-60	-0,034	-0,031	-0,031
0	-65	-83	-47	-0,035	-0,044	-0,025
10	-85	-66	-60	-0,046	-0,035	-0,031
20	-100	-88	-102	-0,054	-0,047	-0,053
30	-93	-101	-97	-0,050	-0,054	-0,051
40	-75	-80	-67	-0,040	-0,043	-0,035
50	-88	-96	-97	-0,048	-0,051	-0,051



E-GPRS 1900 Mode: Op. Mode 4, set-up 1

Temperature	Channel 512	Channel 661	Channel 810	Channel 512 Error [ppm]	Channel 661 Error [ppm]	Channel 810 Error [ppm]
-30	-91	-63	-74	-0,049	-0,034	-0,039
-20	-88	-79	-76	-0,048	-0,042	-0,040
-10	-86	-102	-82	-0,046	-0,054	-0,043
0	-107	-100	-99	-0,058	-0,053	-0,052
10	-53	-78	-36	-0,029	-0,041	-0,019
20	-110	-107	-107	-0,059	-0,057	-0,056
30	-80	-70	-81	-0,043	-0,037	-0,042
40	-45	-35	-39	-0,024	-0,019	-0,020
50	-108	-107	-100	-0,058	-0,057	-0,052



TEST EQUIPMENT

Used equipment (see reference in the annex)
331, 354, 460, 463, 517, 529, 530

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.

Thus, 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 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 dB	--
Radiated RF-emissions enclosure	150 kHz .. 30 MHz	5 dB	Magnetic field
	30 MHz .. 1 GHz	4,2 dB	E-Field
	1GHz .. 19 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 emission on AC-mains port (U_{CISPR})	9 kHz .. 150 kHz	4 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

$10 * \mathrm{Log}_{10}(1.64)$ = 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, 264

7.1. 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 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 dB	--
Radiated RF-emissions enclosure	150 kHz .. 30 MHz	5 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 150 kHz .. 30 MHz	4 dB	--

Table : measurement uncertainties, valid for conducted/radiated measurements

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	825878/034	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=4.53, Mess-Software=4.52
441	System CTC-SAR-EMI	System EMI field (SAR)	-	EMC 32 Version 6.10. 3, ESXS-K1 Version 2.20
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=4.52/Messsoftware=4.51
489	emi test receiver	ESU40	1000-30	Firmware=3.93, 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

8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	emi test receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	31.03.2009
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	31.03.2009
007	DC - LISN (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	31.03.2009
009	power meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	12 M	-	31.03.2009
012	signal generator (EMS-cond.)	SMY 01	839069/027	Rohde & Schwarz	36/12 M	-	31.03.2011
013	power meter (EMS cond.)	NRVD	839111/003	Rohde & Schwarz	12 M	-	31.03.2009
014	insertion unit (EMS cond.)	URV5-Z2	838519/029	Rohde & Schwarz	12 M	-	31.03.2009
015	insertion unit (EMS cond.)	URV5-Z4	838570/024	Rohde & Schwarz	12 M	-	31.03.2009
016	line impedance simulating network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	31.10.2010
017	Communication Tester	CMD 60 M	844365/014	Rohde & Schwarz	12 M	-	31.03.2009
020	horn antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2010
021	loop antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	31.03.2010
022	audio measurement amplifier	2636C	1537643	Brüel & Kjaer	12 M	-	31.03.2009
030	loop antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	31.03.2009
031	absorbing clamp	MDS-21	863325/015	Rohde & Schwarz	24/12 M	-	31.03.2009
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	12 M	-	31.03.2009
048	bicon. - log. antenna (SAR)	3143	1108	EMCO	36/12 M	-	30.04.2011
049	current clamp (injection)	F-120-2	48	FCC	12 M	-	31.03.2009
050	3-ph coupling-decoupling-netw. (Burst)	CDN 300	176	Schaffner	12 M	-	31.03.2009
051	VHF-current probe 20-300 MHz	ESV-Z1	872421	Rohde & Schwarz	12 M	-	31.03.2009
052	notch filter DECT	WRCB 1887,82/1889,55SS	12	Wainwright Industries	12 M	-	31.03.2009
053	audio analyzer	UPA3	860612/022	Rohde & Schwarz	36 M	-	31.03.2011
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	-	1a	30.04.2009
058	capacitive clamp (Burst)	IP 4	99	Hafely	-	4	
059	ferrite tube	FGZ 40 X 15 E	4225	Lüthi	36 M	-	31.03.2010
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
061	ferrite tube	FGZ 40 X 15 E	4250	Lüthi	36 M	-	31.03.2010
063	log.-per. antenna (Subst 1)	3146	860941/007	EMCO	36/12 M	-	31.10.2010
065	attenuator, (6 dB) 50 Ohm, 250W	AT 50-6-250	521057	BNOS Electronics	12 M	1b	30.04.2009
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-	5	Wainwright GmbH	12 M	-	31.03.2009
067	coupling decoupling-network	CDN801-M2/M3	272	Lüthi	12 M	-	31.03.2009
068	coupling decoupling-network	CDN 801-M5	95226	Lüthi	12 M	-	31.03.2009
069	EM - clamp	EM101	9535159	Lüthi	36 M	-	31.03.3009
070	ferrite tube	FTC101	4199	Lüthi	24/12 M	-	31.03.2010
071	biconical antenna (Subst 1)	HUF-Z2	863.029/010	Rohde & Schwarz	36/12 M	-	31.10.2010
072	coupling decoupling-network	CDN801-M2/M3	276	Lüthi	12 M	-	31.03.2009
079	4 wire T-network	EZ-10	862 939 / 011	Rohde & Schwarz	24/12 M	-	31.03.2009
083	AC - power supply, 0-10 A	EAC/MT 27010	910502096	EURO TEST	pre-m	2	
084	AC - power supply, 0-5 A	ELABO-8-34214	-	ELABO	pre-m	2	
085	AC - power supply, 0-10 A	R250	-	Schunterm.&Benningh.	pre-m	2	
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
090	Helmholtz coil: 2x10 coils in series	-	-	RWTÜV	pre-m	4	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
094	artificial head (No.1)	4905	1566990	Brüel & Kjaer	pre-m	2	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	12 M	-	31.03.2009
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	12 M	-	31.03.2009
110	USB-LWL-Converter	OLS-1	-	Extreme USB	-	4	
119	RT harmonics analyser/dig. flickermeter	B10	G60547	BOCONSULT	36 M	-	31.03.2010
120	spectrum analyzer	FSEM 30	845538/011	Rohde & Schwarz	12 M	-	31.03.2009
121	notch filter GSM 1900	WRCB 1879,5/1880,5EE	15	Wainwright GmbH	12 M	-	31.03.2009
122	notch filter GSM 1800	WRCB 1747/1748	12	Wainwright GmbH	12 M	-	31.03.2009
123	biconical antenna (Subst 2)	HUF-Z2,	860941/007	Rohde & Schwarz	36/12 M	-	31.03.2010
131	RF-Current Probe	F-52	19	FCC	12 M	-	31.03.2009
132	log.-per. antenna (Subst 2)	HUF-Z3	860862/014	Rohde & Schwarz	36/12 M	-	31.03.2010
133	horn antenna 18 GHz (Meas 1)	3115	9012-3629	EMCO	36/12 M	-	31.03.2010
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	12 M	-	31.03.2009
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	12 M	-	31.03.2009
137	1000 Hz calibrator 94 dB SPL	4230 94 dB	1 594 698	Brüel & Kjaer	12 M	-	31.03.2009
140	signal generator	SMHU	831314/006	Rohde & Schwarz	24/12 M	-	31.03.2010
142	attenuator (6 dB) 2 W, 8 GHz	DGL N	-	Radiall	12 M	1b	30.04.2009
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
254	high pass GSM1800/1900/DECT	5HC 2600/12750-1.5KK	23042	Trilithic	12 M	-	31.03.2009
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
261	thermal power sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24/12 M	-	31.03.2010
262	power meter	NRV-S	825770/0010	Rohde & Schwarz	24/12 M	-	31.03.2010
263	signal generator	SMP 04	826190/0007	Rohde & Schwarz	36/12 M	-	31.03.2010
264	spectrum analyzer	FSEK 30	826939/005	Rohde & Schwarz	12 M	-	31.03.2009
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24/12 M	-	31.03.2010
266	peak power sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24/12 M	-	31.03.2010
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	12 M	-	31.03.2009
268	AC/DC power supply	EA 3050-A	9823636	-	pre-m	2	
270	termination	1418 N	BB6935	Weinschel	pre-m	2	
271	termination	1418 N	BE6384	Weinschel	pre-m	2	
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel	pre-m	2	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
273	attenuator, (10 dB) 100 W	Model 48	BF9229	Weinschel	pre-m	2	
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel	pre-m	2	
275	DC-Block	Model 7003 (N)	C5129	Weinschel	pre-m	2	
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel	pre-m	2	
277	Vector-Networkanalyzer	ZVC	831363/0005	Rohde & Schwarz	12 M	-	31.03.2009
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
284	coupling decoupling network	CDN 801-M1	1661	Lüthi	12 M	-	31.03.2009
285	coupling decoupling network	CDN 801-S1	1642	Lüthi	12 M	-	31.03.2009
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	-	31.03.2009
289	bicon. - log. antenna (OATS)	CBL 6141	4107	Schaffner Chase	36/12 M	-	31.10.2010
290	notch filter GSM 900	WRCA 901,9/903,1SS	3RR	Wainwright GmbH	12 M	-	31.03.2009
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	-	31.03.2009
295	Racal Digital Radio Test Set	6103	1572	Racal	24/12 M	3	31.03.2009
298	Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	12 M	-	31.03.2009
299	audio microphone	134	-	Brüel & Kjaer	pre-m	2	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	12 M	-	31.03.2009
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	24/12 M	-	31.03.2010
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	24/12 M	-	31.03.2010
304	fix dipole antenna 1,6 GHz	EMCO 3125-307	9907-1001	ETS	24/12 M	-	31.03.2009
305	fix dipole antenna 1,8-2,0 GHz	EMCO 3125-306	9907-1001	ETS	24/12 M	-	31.03.2009
306	fix dipole antenna 2,45 GHz	EMCO 3125-308	9907-1001	ETS	24/12 M	-	31.03.2009
307	fix dipole antenna 3 GHz	EMCO 3125-309	9907-1001	ETS	24/12 M	-	31.03.2009
312	Switch unit	TS-RSP	1000147	R&S	12 M	1f	31.03.2009
317	1000 Hz calibrator 94 dB SPL	4230 94dB	1542286	Brüel & Kjaer	12 M	-	31.03.2009
323	Communication Tester	CMD 55	825878/034	Rohde & Schwarz	12 M	-	31.03.2009
331	climatic test chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	31.10.2009
335	System-CTC-EMS-Conducted	System EMS Conducted	-	Rohde & Schwarz	12 M	5	30.04.2009
340	Communication Tester	CMD 55	849709/037	Rohde & Schwarz	12 M	-	31.03.2009
341	digital multimeter	Fluke 112	81650455	Fluke	24 M	-	31.03.2010
342	digital multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	12 M	-	31.03.2009
344	adaptor 150/50 Ohm	150/50	-	Krohne	12 M	-	31.03.2009
345	adaptor 150/50 Ohm	150/50	-	Krohne	12 M	-	31.03.2009
347	laboratory site	radio lab.	-	-	-	3	
348	laboratory site	EMI conducted	-	-	-	3	
349	car battery 12 V	car battery 12 V	without	-	-	3	
350	car battery 12 V	car battery 12 V	without	-	-	3	
354	DC - power supply 40A	NGPE 40/40	448	Rohde & Schwarz	24 M	-	31.03.2010
355	power meter	URV 5	891310/027	Rohde & Schwarz	12 M	-	31.03.2009
356	power sensor	NRV-Z1	882322/014	Rohde & Schwarz	24/12 M	-	31.03.2009
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24/12 M	-	31.03.2009
358	Power Amplifier 10 kHz-220MHz	AR75A220M1	15860	Amplifier Research	12 M	1b	30.04.2009
362	TOSM Calibration Kit 50 Ohm	ZV-Z21/ZV-Z11	without	Rohde&Schwarz	12 M	-	31.03.2009
365	10V Insertion Unit 50 Ohm	URV5-Z2	100880	Rohde & Schwarz	24/12 M	-	31.03.2010
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	EM-Test	12 M	-	31.03.2009
367	audio measurement amplifier	2636	316832/001	Brüel & Kjaer	12 M	-	31.03.2009
369	insertion unit (SAR-EMS, Ch. A)	URV5-Z2	100301	Rohde & Schwarz	24/12 M	-	31.03.2010
370	insertion unit (SAR-EMS, Ch. B)	URV5-Z2	100302	Rohde & Schwarz	24/12 M	-	31.03.2009
371	Bluetooth Tester	CBT32	100153	R&S	12 M	-	31.03.2009
373	V-Network 5µH/50 Ohm	ESH3-Z6	100535	Rohde & Schwarz	other	-	31.03.2010
374	power amplifier 0,8-3 GHz	60S1G3	306528	Amplifier Research	-	1a	30.04.2009
375	directional coupler	DC7144M1	306498	Amplifier Research	-	1a	30.04.2009
376	horn antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck	12 M	-	31.03.2009
377	emi test receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	31.03.2009
378	broadband RF field monitor	RadiSense III	03D00013SNO-08	DARE B.V.	12 M	-	31.03.2009
383	signal generator	SME 03	842 828 /034	Rohde & Schwarz	36/12 M	-	31.03.2010
386	coupling decoupling network	CDN USB/p	19397	Schaffner	12 M	-	31.03.2009
387	coupling decoupling network	CDN L-801 M2	2051	Lüthi	12 M	-	31.03.2009
388	coupling decoupling network	CDN L-801 T2	1929	Lüthi	12 M	-	31.03.2009
389	digital multimeter	Keithley 2000	0583926	Keithley	24/12 M	-	31.03.2009
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	31.03.2009
394	power amplifier 80-1000 MHz	BLWA 0810-250/200	045610	Bonn-Elektronik	-	1a	30.04.2009
400	ferrite tube (>15 dB, EN 55022)	FTC 40 X 15 E	5559	Lüthi	12 M	-	31.03.2009
401	ferrite tube (>15 dB, EN 55022)	FTC 40 X 15 E	5560	Lüthi	12 M	-	31.03.2009
411	Test Cable Kit N 50 Ohm (male)	ZV-Z11	100200	R&S / Rosenberger	pre-m	2	
413	Quad-Ridge Horn Antenna	3164-04	00090667	ETS-Lindgren	12 M	1f	31.03.2009
414	Circulary polarized com. Antenna	3102	00033734	EMCO	-	3	
415	Antenna Position Controller	2090	00035634	ETS-Lindgren	-	4	
416	MAPS Positioner (light duty)	2010	-	ETS-Lindgren	-	4	
420	System CTC CTIA-OTA	System CTC CTIA-OTA	-	ETS-Lindgren/Cetecom	12 M	5	31.03.2009
429	MAPS-Positionier (medium duty)	2015	-	ETS-Lindgren	-	4	
430	Thermo-Hygrometer	H270	54476	Dostmann electronic	24 M	-	30.11.2009
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
432	pre-amplifier 100MHz-26GHz	JS4-00102600-38-5P	1030896	Miteq USA	12 M	-	31.03.2009
436	Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	31.03.2009
439	UltraLog-Antenna	HL 562	100248	Rohde + Schwarz	12 M	-	31.03.2009
441	System CTC-SAR-EMI	System EMI field (SAR)	-	ETS	12 M	5	30.06.2009
442	System CTC-SAR-EMS	System EMS field (SAR)	-	ETS-Lindgren/Cetecom	12 M	5	30.04.2009
443	System CTC-FAR-EMI-Spuri	System CTC-FAR-EMI-	-	ETS-Lindgren/Cetecom	12 M	5	30.04.2009
444	System CTC FAR-EMS	System EMS-Field (FAR)	-	ETS Lindgren/Cetecom	12 M	5	30.04.2009
448	notch filter WCDMA FDD II	WRCT 1850.0/2170.0-	5	Wainwright Instruments	12 M	1c	31.03.2009
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-	1	Wainwright Instruments	12 M	1c	31.03.2009
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
455	Oscilloscope	HP 54602B	US 350 336 45	Hawlett Packard	-	4	
456	DC-Power supply 0-5A	EA 3013 S	207810	Elektro Automatik	pre-m	2	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
457	DC-Power supply, 0-5A	EA-3013 S	9624680	Elektro Automatik	pre-m	2	
459	DC -power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
460	Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	31.03.2009
462	AF-Generator	MX-2020	-	Conrad	-	4	
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
464	Thermo-Hygro-Monitor	WS-9400	without	Europe Supplies Ltd.	24 M	-	30.11.2009
465	Thermo-Hygro-Monitor	WS-9400	without	Europe Supplies Ltd.	24 M	-	30.11.2009
466	digital multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.03.2010
467	digital multimeter	Fluke 112	89680306	Fluke USA	24 M	-	31.03.2010
468	digital multimeter	Fluke 112	90090455	Fluke USA	24 M	-	31.03.2010
470	Thermo-Hygro-Monitor	WS-9400	-	distr. by Conrad	24 M	-	30.11.2009
476	Spectrum Analyzer	FSM	840500/004	Rohde & Schwarz	24/12 M	-	31.03.2009
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
482	filtermatrix	FilterMatrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-	1244554	Miteq	12 M	-	31.03.2009
487	NSA-Verification of CTC-SAR-EMI	System EMI field (SAR)	-	ETS	12 M	-	31.10.2009
489	emi test receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.03.2009
490	high pass 2,65 GHz>18GHz	6HC 2650/18000-3-KK	200709138	Trilithic	12 M	-	31.03.2009
491	ESD Simulator dito	ESD dito	dito307022	EM-Test	24 M	-	31.03.2009
494	power supply (GPIB)	Agilent 66332A	US 37474017	Agilent	24/12 M	-	31.03.2009
498	Power Supply	NGPE 40/40	402	Rohde & Schwarz	-	2	
500	industry Acoustic System	MO 2000 Set	100048	Sennheiser	-	4	
502	band reject filter	WRCG 1709/1786-	SN 9	Wainwright	-	-	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	-	-	
517	relais switc matrix	HF Relais Box Keithley	SE 04	-	-		
522	electronical load	EL 9000	-	ELV	-	-	
523	Digitalmultimeter	L4411A	MY46000154	Agilent	24 M	-	31.03.2009
524	Voltage Drop Simulator	VDS 200	0196-16	EM Test	18 M	-	31.03.2009
525	Koppelnetzwerk	CNA 200	1196-01	EM Test	18 M	-	31.03.2009
526	Burst Generator	EFT 200 A	0496-06	EM Test	18 M	-	31.03.2009
527	Micro Pulse Generator	MPG 200 B	0496-05	EM Test	18 M	-	31.03.2009
528	Load Dump Simulator	LD 200B	0496-06	EM Test	18 M	-	31.03.2009
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	-	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	2		
531	H-field system	Lackman System	without	Lackmann	-	2	
533	Impedance Stabilization Network	ISN T200A	25706	Teseq	12 M	-	29.04.2009
534	Impedance Stabilization Network	ISN T400A	24881	Teseq	12 M	-	29.04.2009
535	Impedance Stabilization Network	ISN T800	26321	Teseq	12 M	-	28.04.2009
536	Impedance Stabilization Network	ISN ST08	25867	Teseq	12 M	-	28.04.2009

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

10. Antenna information used for radiated tests