Radio Frequency (RF) - Exposure
TEST REPORT
No.: 6-0147-12-19-6d

According to:
FCC Regulations
Part 2.1091
IC Regulations
RSS-102

for

Gemalto M2M GmbH

Wireless Module EHS6

FCC-ID: QIPEHS6
IC: 7830A-EHS6

Laboratory Accreditation and Listings			
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	FC USA Reg. No.: 736496 MRA US-EU 0003	Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	VCI Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2665, R-2666 C-2914, T-1967, G-301
WiFi ALLIANCE AUTHORIZED RF LABORATORY	CTIA Authorized Test Lab LAB CODE 20011130-00		
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.com • Internet: www.cetecom.com			

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1. Summary of test results

The presented RF-Module can be build inside host applications and extends their capability by wireless GSM and UMTS technologies. Data transmissions application is possible field application.

In order to verify the compliance with applicable rules, a representative configuration consisting of representative auxiliary equipment was chosen. Embedded in this configuration, the GSM/UMTS Module can be tested. Pls. refer to set-up description and photos of report TR-6-0147-12-19-6a and annexes for more details.

Following tests and evaluation have been performed to show compliance with applicable FCC Part 2.1091 and FCC Part 1.1310 of the FCC CFR 47 Rules (2012-10-01 Edition) and Canadian RSS-102 issue 4 regulations.
Only the frequency bands were considered which are operable in US & CANADA.
According to applicant's information only single band operation is possible. Multiple-Transmitter operating and co-location were not considered.

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.

1.1. TESTS OVERVIEW USA FCC Part 2.1091 and Canada IC Standards RSS-102

TEST CASES	PORT	REFERENCES & LIMITS			EUT set-up	EUT opera-ting mode	Result
		FCC Standard	RSS Section	Limits			
TX-Mode							
RF POWER (conducted)	Antenna terminal (conducted)	§2.1046	--	N/A	1	1+2+3+4+5+6	Passed remark 1
Radio frequency Exposure EVALUATION (MPE)	Antenna terminal (conducted)	§1.1310 §2.1091	RSS-102, Issue 4	FCC: §1.1310 Table 1, Limits for General Population IC: Chapter 4.2 RF-Limits	1	1+2+3+4+5+6	Passed (For a distance 20 cm of the antenna) remark 2

Remark:
1.) See separate test report TR-6-0147-12-19-6a/b according Part 22H and 24E
2.) For 850 MHz frequency band the max. antenna gain included cable loss shall be ≤4.02dBi (1.87 dBd)
     For 1900 MHz frequency band the max. antenna gain included cable loss shall be ≤ 2.81 dBi

....
D. Franke
Responsible for testsection

....
Dipl.-Ing. C. Lorenz
Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116
	45219 Essen - Kettwig
	Germany
Laboratory accreditations/Listings:	DAR-Registration No. DGA-PL-176/94-03
	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. N. Jeß
Deputies:	Dipl.-Ing. R. Acharkaoui

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.:	--
Responsible for test report and project leader:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2012-10-29
Date(s) of test:	2013-04-09
Date of report:	2013-04-29
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Version of template: 09.06 _All.Dotm	

2.4. Applicant's details

Applicant's name:	Gemalto M2M GmbH
Address:	Siemensdamm 50
	13629 Berlin
Contact person:	Mr. Heike Axel

2.5. Manufacturer's details

Manufacturer's name:	same as above
Address:	

3. Equipment under test (EUT)

3.1. Additional declaration, results and description of EUT

GSM/FDD

Main function	Wireless Module
Type	EHS6
Type of modulation	GMSK/8-PSK FDD-Mode Release 99 (equivalent to rel. 3): QPSK (UL + DL) FDD Mode Release 5+6+7: QPSK (UL) + 16QAM (DL)
Categories:	HSDPA cat. 8 / HSUPA cat. 6
UMTS-HSPA connectivity	☒ Uplink speed: 5.76 Mb/s (HSUPA category 6, rel. 6 & 7) ☒ Downlink speed: 7.2 Mb/s (HSDPA category 8, rel. 5)
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector
FCC-ID	QIPEHS6
IC	7830A-EHS6
Installed option	☒ GSM 900 and GSM 1800 Bands (not usable in USA/Canada) ☒ GSM 850 and GSM 1900 Bands (reported in TR no. 6-0147-12-19-6a) ☒ W-CDMA Band II and Band V (reported in TR6-0147-12-19-6b) ☒ W-CDMA Band I and Band VIII (not usable in USA/Canada) ☐ W-LAN, Bluetooth©, ANT+ wireless technologies ☐ battery charging option ☐ GPS ☐ FM-Radio (Receiver only)
Power supply	☐ Internal battery Li-Ion, range 3.5V to 4.1V ☐ over AC/DC adapter: 120V/60 Hz ☒ DC power only: 9-12 Volt on DSB75-Adapter Converted to 3.3 V to 4.5 V by DSB75-Adapter for EUT A
Special EMI components	--

EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

3.2. 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	Wireless Module	EHS6	004401080846 922	B2 (rev.2)	Rev 01.004

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

3.3. 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	RS232 cable	2 m	-	-	-
AE 2	DSB75-Adapter	DSB75	-	AH6-DSB75-1	-
AE 3	USB cable	1m	-	-	-
AE 4	Notebook	DELL D610 D	CTC-PC3	-	Windows XP + Terminal Programm
AE 5	Test adapter	For EUT A	--	--	--

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

3.4.EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
Set. 1	EUT A + AE1 + AE2 + AE3+ AE4 + AE 5	RF conducted output power tests performed: AT commands set the device into operating mode conditions with help of AE4.

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

3.5. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	GSM/GPRS 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). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (33dBm). 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	EGPRS 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). USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8PSK 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/GPRS 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). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (30dBm). 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	EGPRS 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 power: 30 dBm (power class 1; power control level 0). USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8-PSK modulation, slot 3 active, uplink gamma: 5 (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
op. 5	FDD Mode 2 RMC99-Mode	A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 24dBm.
op. 6	FDD Mode 5 RMC99-Mode	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 according Table E5.1/Table E5.1A as described in 3GPP TS34.121, Annex E.

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

4. DESCRIPTION OF TEST SET-UP's

4.1. Test system set-up for conducted measurements at antenna port

Specification: ANSI 63-10:2009

General Description: The EUT's RF-signal is coupled out by a suitable antenna coupling connector directly or via test fixture (1). The signal is first attenuated (2) before it is 0° divided by a power divider (3). One of the signal path is connected to the radio communication tester (4), other branch is connected to the spectrum analyzer (5). The specific attenuation losses for all 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.

Further information if applicable: for measurements in the climatic chamber, the same equipment and cables are used. The EUT and test fixture are arranged in a climate chamber. The cables are routed through special openings. No additional connectors are needed.

Schematic:
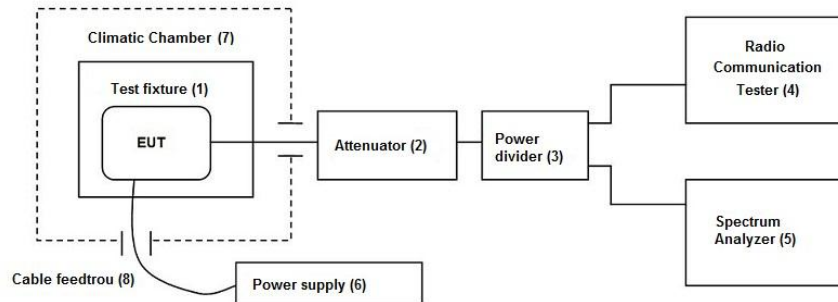
5. Radio Frequency Exposure Evaluation §2.1091, RSS-102

5.1.References

FCC: §1.1310, § 2.1091
IC: RSS-102, Issue 4

The criteria used for the evaluation of human exposure to radio frequency radiation is table 1 according FCC §1.1310 and table chapter 4.2 of RSS-102 standard.

As the mobile equipment is authorized under Part 22 (Subpart H), Part 24 and Part 27 of the FCC Rules, it is subject for evaluation of the RF exposure prior to equipment authorization.

§2.1091: Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, ''Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation.''

1)For purposes of analyzing mobile transmitting devices under the occupational/controlled criteria specified in Sec. 1.1310 of this chapter, time-averaging provisions of the guidelines may be used in conjunction with typical maximum duty factors to determine maximum likely exposure levels.

For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits given in Table 1 of Appendix A.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

Table 1: LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

The used equation to predict the power density in the far-field of one single radiating antenna can be made by following equation:

$$S = \frac{EIRP}{4\pi R^2} = \frac{P*G}{4\pi R^2}$$

Abbreviations:

S: Power density (mW/cm^2)
P: Power Input measured conducted on RF-port (mW)
G: Numeric gain of the antenna relative to an isotropic radiator
R: distance from the surface or antenna of the EUT (cm)

For given power density limit at single frequency (acc.. Table 1 Limits) the maximum antenna gain calculated:

$$G_{NUMERIC} = \frac{S*4\pi R^2}{P}$$

5.2. General Limits

§1.1307
Cellular Radiotelephone Service (subpart H of part 22)
Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP)

§1.1307
Personal Communications Services (part 24)
Broadband PCS (subpart E): non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP)

§1.1310 LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)
Table 1(B) Limits for General Population/Uncontrolled Exposure
300–1500 MHz: f/1500 mW/cm² (f in MHz)
1500–100,000 MHz: 1.0 mW/cm²

§2.1091
Subject to routine evaluation is required when the device operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.

§22.913
(a)Maximum ERP. The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts.
(2)... The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

§24.232
(a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT.
c) Mobile/portable stations are limited to 2 watts EIRP...

§27.50
(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band are limited to 1 watt EIRP. Fixed stations operating in this band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in this band must employ a means for limiting power to the minimum necessary for successful communications

Canadian RSS-102 *standard for uncontrolled environment requires the RF-exposure value in W/m2 unit, therefore the MPE limit value determined in mW/cm2 unit, should be multiplied by 10 to have the required unit. The MPE limits are the same like on FCC §1.1301 at table 1.*

5.3. Methods

Valid for GSM/GPRS/EDGE mode:

- The power was checked on 3 frequencies (lowest/middle/highest) within each operable bands
- Average burst power (slot power) and peak were measured (see separate report for GSM/GPRS/E-GPRS technology)
- Only one uplink slot (1 TX) was measured. 4 TX slots are maximum possible for this device and calculated as worst-case
- A duty-cycle correction factor of $10*\log_{10}$ (max. number of possible active slots / 8 slots) were applied

Please find in the following tables the calculations. Also the maximum admissible allowed antenna gain is calculated which is not exceeding the MPE limit for fixed and mobile operations.

Valid for FDD/W-CDMA Mode:

- The power was checked on 3 frequencies (lowest/middle/highest) within each operable FDD-band (see separate report for W-CDMA technology)RMS detector was used
- No duty-cycle correction factor is applicable

5.3.1. Results for 850 MHz frequency band

Maximum output power considerations including tune-up procedure:

Operating Mode	Frequency on Channel (MHz)	Declared maximum conducted output power (dBm)	Max. Tune-up according manufacturer (dB)	Calculated maximum output power (declared+ Tune-up) (dBm)	Duty cycle	Maximum conducted output power (W)	Equivalent conducted output power (maximum conducted output power x duty cycle) (mW)
GSM/GPRS (PK)	824,2	33,00		33,50		2,239	1119
	837	33,00	0,50	33,50	50%	2,239	1119
	848,8	33,00		33,50		2,239	1119
GSM/GPRS (Avg. Burst Power)	824,2	33,00		33,50		2,239	1119
	837	33,00	0,50	33,50	50%	**2,239**	**1119**
	848,8	33,00		33,50		2,239	1119
EDGE (PK)	824,2	27,00		27,50		0,562	281
	837	27,00	0,50	27,50	50%	0,562	281
	848,8	27,00		27,50		0,562	281
EDGE (Avg. Burst Power)	824,2	27,00		27,50		0,562	281
	837	27,00	0,50	27,50	50%	0,562	281
	848,8	27,00		27,50		0,562	281
WCDMA (RMS)	826,4	24,00		24,50		0,282	282
	836,4	24,00	0,50	24,50	100%	0,282	282
	846,6	24,00		24,50		0,282	282

Antenna gains considerations of 850 MHz band:

P	Selected the highest maximum power input to the antenna incl. Duty cycle (mW): (Avg. Burst Power or RMS)	1119
R	Distance (cm):	20
S	Power density MPE limit acc. §1.1310 and RSS-102 for uncontrolled exposure (mW/cm²): (FCC use mW/cm² & IC use W/m²)	0,55
G_1	Maximum Antenna gain to comply with MPE limit (dBi):	**3,92**

(For G1 selected the lowest measured channel to reach minimum ant. gain)

	ERP power limit according to §2.1091 (W ERP): (Avg. Burst Powor or RMS)	1,50
G_2	Max. Antenna gain to comply with limit incl. Duty cycle (dBi):	**3,42**

(For G2 select the highest max. Avg. Burst Power or RMS value incl. Duty cycle)

	ERP power limit according to §22.913 (W ERP):	7,00
G_3	Max. Antenna gain to comply with limit (dBi):	**7,10**

(For G3 selected the highest Average burst power value excluded Duty cycle)

$G_{850\ MHz\ band}$	**Min (G_1, G_2, G_3) (dBi)**	**3,42**

The max. ant. gain for mobile operation at 850 MHz band to comply with MPE and ERP limits incl. path loss shall not exceed **(dBd):**	**1,27**

(Exemption from Routine Evaluation Limits – RF Exposure Evaluation is not required, if the device below 1.5 GHz and the maximum e.i.r.p. is equal toor less than 2.5 W. However, if the device in question meets the exemption from routine evaluation limits of sections 2.5.1 or 2.5.2 (RSS-102) only a signed declaration of compliance needs to be submitted (see Annex C))

5.3.2. 1900 MHz frequency band

Mode	Frequency on channel	Declared maximum conducted output power	Max. Tune-up according manfacturer	Declared maximum output power (Measured+ Tune-up)	Duty cycle	Declared Maximum conducted output power	Equivalent conducted output power (maximum conducted output power x duty cycle)
	(MHz)	(dBm)	(dB)	(dBm)		(W)	(mW)
GSM/GPRS (PK)	1850,2	30,0	0,50	30,50	50%	1,122	561
	1880,0	30,0		30,50		1,122	561
	1909,8	30,0		30,50		1,122	561
GSM/GPRS (Avg. Burst Power)	1850,2	30,0	0,50	30,50	50%	1,122	561
	1880,0	30,0		30,50		1,122	561
	1909,8	30,0		30,50		1,122	561
EDGE (PK)	1850,2	26,0	0,50	26,50	50%	0,447	223
	1880,0	26,0		26,50		0,447	223
	1909,8	26,0		26,50		0,447	223
EDGE (Avg. Burst Power)	1850,2	26,0	0,50	26,50	50%	0,447	223
	1880,0	26,0		26,50		0,447	223
	1909,8	26,0		26,50		0,447	223
WCDMA (RMS)	1852,4	24,0	0,50	24,50	100%	0,282	282
	1880,0	24,0		24,50		0,282	282
	1907,6	24,0		24,50		0,282	282

Antenna gains considerations of 1900 MHz band:

P	Selected the maximum power input to the antenna incl. Duty cycle (mW): (Avg. Burst Power or RMS)	561
R	Distance (cm):	20
S	Power density MPE limit acc. §1.1310 and RSS-102 for uncontrolled exposure (mW/cm²): (FCC use mW/cm² & IC use W/m²)	1,00
G_1	Maximum Antenna gain to comply with MPE limit (dBi):	**9,52**

(For G1 selected the lowest measured channel to reach minimum ant. gain)

	ERP power limit according to §2.1091 (W ERP): (Avg. Burst Power or RMS)	3,00
G_2	Max. Antenna gain to comply with limit incl. Duty cycle (dBi):	**9,43**

(For G2 selceted the max. Avg. Burst Power or RMS value incl. Duty cycle)

	EIRP power limit according to §24.232 (W EIRP):	2,00
G_3	Max. Antenna gain to comply with limit (dBi):	**2,51**

(For G3 selected the max. Average burst power value excluded Duty cycle)

$G_{850\ MHz\ band}$	**Min (G_1, G_2, G_3)** (dBi)	**2,51**

The max. ant. gain for mobile operation at 1900 MHz band to comply with MPE and EIRP limits incl. path loss shall not exceed **(dBi):**	**2,51**

(Exemption from Routine Evaluation Limits – RF Exposure Evaluation is not required, if the device above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W. However, if the device in question meets the exemption from routine evaluation limits of sections 2.5.1 or 2.5.2 (RSS-102) only a signed declaration of compliance needs to be submitted (see Annex C))

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. Used equipment "CTC"

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

7.1.1. 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	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
053	Audio Analyzer	UPA3	860612/022	Firm. V 4.3
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
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
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used
323	Digital Radiocommunication 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	CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.52
340	Digital Radiocommunication 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 V5,30+ SW-Option K55, K57
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, GSM=4.41#013, W-CDMA= 4.54#004, scenario= 4.52#002
436	Univ. Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR)	-	EMC 32 Version 8.52
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	Spuri 7.2.5 or EMC 32 Ver. 8.53
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 8.40
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used,
489	EMI Test Receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =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
546	Univ. Radio Communication Tester	CMU 200	106436	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used
547	Univ. Radio Communication Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14
584	Spectrum Analyzer	FSU 8	100248	2.82_SP3
594	Wideband Radio Communication Tester	642500	101757	Firmware Base=2.0.20.9, LTE=2.0.20.8. CDMA= 2.0.10
597	Univ. Radio Communication Tester	CMU 200	100347	R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Firmware Bios 3.40 , Analyzer 3.40 Sp 2
620	EMI Test Receiver	ESU 26	100362	4.43_SP3
642	Wideband Radio Communication Tester	CMW 500	126089	Setup V03.26, Test programm component V02.12.01

7.1.2. 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	-	31.03.2014
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	24/12 M	-	31.03.2014
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	24/12 M	-	31.03.2014
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	31.03.2015
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	31.03.2016
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2013
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	31.03.2015
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	31.03.2015
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	31.03.2015
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1g	30.06.2013
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	-	4	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	31.03.2015
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	31.03.2015
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	31.03.2016
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	24 M	-	31.03.2014
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	36 M	-	31.03.2015
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	31.03.2014
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	
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 M	-	31.03.2014
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	31.03.2014
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	31.03.2016
264	Spectrum Analyzer	FSEK 30	826939/005	Rohde & Schwarz	12 M	-	31.03.2014
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	31.03.2014
266	peak power sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	31.03.2014
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	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	
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	
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	30.06.2013
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2013
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	24/12 M	-	31.03.2014
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	36 M	-	31.03.2014
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2014
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	30.11.2014
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	31.03.2014
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	31.03.2015
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
355	Power Meter	URV 5	891310/027	Rohde & Schwarz	24 M	-	31.03.2014
356	power sensor	NRV-Z1	882322/014	Rohde & Schwarz	24 M	-	31.03.2015
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	31.03.2015
371	Bluetooth Tester	CBT32	100153	R&S	24 M	-	31.03.2014
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	24/12 M	-	31.03.2014
376	Horn Antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck	12 M	-	31.03.2014
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	31.03.2014
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	31.03.2015
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	31.03.2014
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	31.03.2014
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	CETECOM	12 M	5	31.10.2013

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.06.2013
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	30.06.2013
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2013
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
456	DC-Power supply 0-5 A	EA 3013 S	207810	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	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	31.03.2014
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.03.2014
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	24 M	-	31.03.2014
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	24 M	-	31.03.2014
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	31.03.2015
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	30.06.2013
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	30.09.2013
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.03.2014
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwrght	12 M	1c	30.06.2013
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	31.03.2015
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	31.03.2014
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	31.03.2014
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH	36 M	-	30.06.2015
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.03.2015
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.06.2013
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	31.07.2013
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	31.03.2016
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	24 M	-	31.03.2014
594	Wideband Radio Communication Tester	642500	101757	Rohde & Schwarz	24 M	-	31.03.2014
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	12 M	-	31.03.2014
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	13.01.2015
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	31.03.2015
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	31.03.2015
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	31.03.2015
608	UltraLog-Antenna	HL 562	830547/009	Rohde & Schwarz	36/12 M	-	31.03.2014
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
616	Digitalmultimeter	Fluke 177	88900339	Fluke	24 M	-	31.03.2014
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	01.03.2014
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
627	data logger	OPUS 1	201.0999.9302.6.4.1.43	G. Lufft GmbH	24 M	-	30.05.2014
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
636	Thermal Imaging camera	Ti32	Ti32-12060213	Fluke Corporation	24 M	-	31.07.2014
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	KogiLink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
642	Wideband Radio Communication Tester	CMW 500	126089	Rohde&Schwarz	24 M	-	31.03.2014
644	Amplifierer	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	12 M	-	31.03.2014
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	

7.1.3. Legend

Note / remarks		Calibrated during system calibration:
	1a	System CTC-SAR-EMS (Ref.-No. 442)
	1b	System-CTC-EMS-Conducted (Ref.-No. 335)
	1c	System CTC-FAR-EMI-RSE (Ref.-No . 443)
	1d	System CTC-SAR-EMI (Ref.-No . 441)
	1e	System CTC-OATS (EMI radiated) (Ref.-No. 337)
	1 f	System CTC-CTIA-OTA (Ref.-No . 420)
	1 g	System CTC-FAR-EMS (Ref.-No . 444)
	2	Calibration or equipment check immediately before measurement
	3	Regulatory maintained equipment for functional check or support purpose
	4	Ancillary equipment without calibration e.g. mechanical equipment or monitoring equipment
	5	Test System

Interval of calibration	12 M	12 month
	24 M	24 month
	36 M	36 month
	24/12 M	Calibration every 24 months, between this every 12 months internal validation
	36/12 M	Calibration every 36 months, between this every 12 months internal validation
	Pre-m	Check before starting the measurement
	-	Without calibration