

TEST REPORT

No.: 15-1-0017001T40a

According to:
FCC Regulations
Part 1.1310, Part 2.1091

for

peiker acoustic GmbH & Co. KG

ATM-01 R2-US-4GW
FCC-ID: QWY-ATM-R-622

Laboratory Accreditation and Listings			
 DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	 FEDERAL COMMUNICATIONS COMMISSION USA MRA US-EU 0003	 Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	 Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2666 C-2914, T-1967, G-301
 AUTHORIZED RF LABORATORY	 AuthorizedTM Test Lab Lab Code: 20011130-00		
accredited according to DIN EN ISO/IEC 17025			
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The listed attachments are an integral part of this report.

1. Summary of test results

The test results apply exclusively to the test samples as presented in this Report. 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 test results apply exclusively to the test samples as presented in this Report. 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. Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. Following tests have been performed to show compliance with applicable FCC Part 2.1091 and FCC Part 1.1310 of the FCC CFR 47 Rules..

1.1. TX mode, tests overview FCC Part 2.1091

No. of Diagram group	Test Cases	Port	References & Limits		EUT set-up	EUT op-mode	Result
			FCC Standard	Test limits			
--	RF Power (conducted)	Antenna terminal (conducted)	§2.1046	N/A	2	1 to 10	passed Remark 1
--	RF Power (radiated)	Cabinet	§2.1046 §22.913(a)(2)	< 7 Watt ERP	1	1 to 10	passed Remark 2
			§24.232(c)	< 2Watt (EIRP)			
			§27.50(c)(10)	< 3 Watt (ERP)			
			§27.50(d)	< 1 Watt (EIRP)			
--	Radio frequency Exposure Evaluation (MPE)	Cabinet	§1.1310 §2.1091	FCC: §1.1310 Table 1, Limits for General Population	1	1 to 10	Passed, Remark 3

Remark:

- 1.) See separate test reports 15-1-0017001T37a and T41a and corresponding annexes
- 2.) Calculations based on RF-conducted power and stated antenna gain.
- 3.) Based on info delivered by applicant, see annex 5


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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
Responsible for testing laboratory:	Dipl.-Ing. Rachid Acharkaoui
Deputy:	Dipl.-Ing. Niels Jeß

2.2. Test location

2.2.1. Test laboratory "CTC"

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

Responsible for test report and project leader:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2016-01-06
Date(s) of test:	2016-01-07 to 2016-04-22
Date of report:	2016-05-10

Version of template:	13.02

2.4. Applicant's details

Applicant's name:	peiker acoustic GmbH & Co. KG
Address:	Max-Planck-Straße 28-32 61381 Friedrichsdorf Germany
Contact person:	Mr. Martin Fleckenstein

2.5. Manufacturer's details

Manufacturer's name:	see applicant
Address:	

3. Equipment under test (EUT)

3.1. TECHNICAL GSM/GPRS/E-GPRS DATA OF MAIN EUT DECLARED BY APPLICANT

GSM Frequency range (US/Canada -bands)	☒ GSM 850: 824 – 849 MHz (Uplink), 869-894 MHz (Downlink) ☒ GSM1900: 1850-1910 MHz (Uplink), 1930-1990 MHz (Downlink)	
Type of modulation	☒ GSM,GPRS, GMSK ☒ EGPRS-Mode: 8-PSK	
Number of channels (USA/Canada -bands)	☒ GSM 850: 128 – 251, 125 channels ☒ GSM1900: 512 – 810, 300 channels	
Test Channel frequencies	☒ GSM/E-GPRS 850 MHz Band: Channel 128/192/251 ☒ GSM/E-GPRS 1900 MHz Band: Channel 512/661/810	
Emission designator(s)	See original module's grant:	
Antenna Type	☐ Integrated (enclosure) ☒ External - dedicated, no RF- connector (proprietary)	
Antenna Gain Tx (main)	☒ Values taken from data sheet Model no. 34105-US-4G Band 5: 2.8dBi (0.65dBd) Band 2: 1.9dBi	
Antenna Gain Dx (diversity)	☒ No information from customer	
Measured Output Power [dBm]: Conducted GSM 850 Conducted EDGE850	32.7 (PK) 29.6 (PK)	
Measured Output Power [dBm]:: Radiated GSM 850 Radiated EDGE 850	External Roof-Antenna	Internal PCB antenna
	30.55 dBm erp	31.2 dBm erp
	27.45 dBm erp	28.1 dBm erp
Measured Output Power [dBm]:: Conducted GSM 1900 Conducted EDGE 1900	30.0 (PK) 29.1 (PK)	
Measured Output Power [dBm]:: Radiated GSM 1900 Radiated EDGE1900	External Roof-Antenna	Internal PCB antenna
	26.90 dBm eirp	30.90 dBm eirp
	26.00 dBm eirp	30.0 dBm eirp

3.2. TECHNICAL W-CDMA DATA OF MAIN EUT DECLARED BY APPLICANT

TX-frequency range	☒ FDD Band 2: 1852.4–1907.6 MHz (Uplink), 1930-1990 MHz (Downlink) ☒ FDD Band 5: 826.4-846.6 MHz (Uplink), 869-894 MHz (Downlink)	
Type of modulation	☒ FDD-Mode Release99: QPSK ☒ FDD Mode Release 5+6: 16QAM additional	
Number of channels	☒ FDD Band 2: UARFCN range 9262 – 9400 – 9538 ☒ FDD Band 5: UARFCN range 4132 – 4183 – 4233	
UMTS-HSPA connectivity	☒ Uplink speed: 5.76 Mb/s (category 6) ☐ Uplink speed:	
Emission designator(s)	See original module's grant:	
Antenna Type	☐ Integrated (enclosure) ☒ External - dedicated, no RF- connector (proprietary)	
Antenna Gain Tx (main)	☒ Values taken from data sheet Model no. 34105-US-4G Band 5: 2.8dBi (0.65dBd) Band 2: 1.9dBi	
Antenna Gain Dx (diversity)	☒ No information from customer	
MAX PEAK Output Power:	External Roof-Antenna	Internal PCB antenna
Radiated		
FDD-Mode 2	21.37 dBm eirp	25.37 dBm eirp
FDD-Mode 5	21.58 dBm erp	22.2 dBm erp
MAX PEAK Output Power:		
Conducted		
FDD-Mode 2	24.47 (AV) dBm	
FDD-Mode 5	23.73 (AV) dBm	

3.3. TECHNICAL LTE DATA OF MAIN EUT DECLARED BY APPLICANT

TX-frequency range (E-UTRA operating bands)	LTE Band 2: 1850 - 1910 MHz (Uplink), 1930-1990 MHz (Downlink) LTE Band 4: 1710 - 1755 MHz (Uplink), 2110 - 2155 MHz (Downlink) LTE Band 5: 824 - 849 MHz (Uplink), 869-894 MHz (Downlink) LTE Band 17: 704 - 716 MHz (Uplink), 734 - 746 MHz (Downlink)		
Type of modulation	QPSK, 16-QAM		
Data rates	Cat3, Downlink: max. 100Mbps, Uplink: max. 50Mbps		
Number of channels – Table 5.4.4-1 accord. 3GPP TS36.521-1	LTE Band 2: UARFCN range 18600 - 19199 LTE Band 4: UARFCN range 19950 - 20399 LTE Band 5: UARFCN range 20400 – 20649 LTE Band 17: UARFCN range 23730 - 23849		See Note about channels not to be used depending on channel bandwidths
Emission designator(s) (Max. Value across all operating bands)	Channel bandwidth	QPSK Modulation:	16-QAM Modulation
	1.4 MHz 3 MHz 5 MHz 10 MHz 15 MHz 20 MHz	See original grant of module	See original grant of module
Antenna Gain	☒ Values taken from data sheet Model no. 34105-US-4G Band 17: 1.8 dBi (-0.34dBd) Band 5: 2.8dBi (0.65dBd) Band 4: 2.4dBi Band 2: 1.9dBi		
MAX average Output Power: Conducted LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 17	Measured: 24.82 (AV) dBm 24.42 (AV) dBm 23.73 (AV) dBm 23.77 (AV) dBm		
MAX PEAK Output Power: radiated LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 17	External Roof-Antenna		Internal PCB antenna
	21.72 dBm eirp 21.30 dBm eirp 21.57 dBm erp 21.03 dBm erp		25.72 dBm eirp 25.12 dBm eirp 22.18 dBm erp 22.02 dBm erp
Installed option	☒ GSM 900 and GSM 1800 Bands (not usable in USA/Canada) ☒ W-CDMA Band I and Band VIII (not usable in USA/Canada) ☒ GPS/GNSS (not tested within this test report)		
Power supply	☒ DC power only: 14.0 V		
Special EMI components	--		
Does EUT contain devices susceptible to magnetic fields, e.g. Hall elements, electrodynamics microphones, etc.?	☐ yes ☒ no		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

3.4. 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	Advanced Telecommunication Module (ATM) RoofVersion	ATM-01 R2-US-4GW	IMEI: 35381307-000307-3 S/N: 747793 512	113.002.002	001.024.047
EUT B	Advanced Telecommunication Module (ATM) Roof Version	ATM-01 R2-US-4GW	IMEI: 35381307-00349-5 S/N: 744748 #518	113.002.002	001.024.047
EUT C	AutomotiveAntenna Roof-Pod (US-Version)	Model No.: 34105 (US-4G)	#01	4G MIMO GPS SDARS US	--

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

3.5. 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	Loudspeaker	KL3/4-Ohm	--	--	--
AE 2	Microphone	ME39	--	--	--
AE 3	Cable harness	Testing	#1	See chapter 3.1 of Annex 5	--
AE 4	RF connection cable	shielded	--	One branch 2.62m length other branch 4m length	--
AE 5	Notebook	Dell D2120	--	--	Windows 7
AE 6	FAKRA-SMA Adapter	--	--	--	--

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

3.6. EUT set-ups

EUT set-up no. *)	Combination of EUT and AE	Remarks
set. 1	EUT A + EUT C + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6 (+ AE 7)	Radiated measurements. AE 7 used temporary for connection set-up
set. 2	EUT B + AE 5 (+ AE 7) + AE 8	Conducted RF-measurements. AE 7 used temporary for connection set-up

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

3.7. GSM/GPRS/E-GPRS EUT operating modes

EUT operating mode no. *)	Description of operating modes	Additional information
op. 1	GPRS 850 Data Traffic channels = 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 (33 dBm). 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 Data Traffic channels = 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	GPRS 1900 Data Traffic channels = 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 (30 dBm). 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 Data traffic channels = 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 (26 dBm). 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.

3.8. W-CDMA EUT operating modes

EUT operating mode no. *)	Description of operating modes	Additional information
op. 5	FDD-Band 2 12.2 kbps RMC	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: 21 dBm or 24dBm nominal. 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.
op. 6	FDD-Band 5 12.2 kbps RMC	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: 21 dBm or 24dBm nominal. 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.

3.9. EUT LTE operating modes

EUT operating mode no. *)	Description of operating modes	Additional information
op. 7	LTE-Band 2 RMC 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: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM 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. NS_01 Network signalling value was used, no A-MPR was used therefore for this band.
op. 8	LTE-Band 4 RMC Mode	
op. 9	LTE-Band 5 RMC Mode	
op. 10	LTE-Band 17 RMC Mode	

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

3.10. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	Cable harness	-	--	--	2.62m
Cable 2	RF-connection cable	--	--	--	Max. 4m
Cable 3	Loudspeaker cable	--	--	--	1.5m
Cable 4	GPS cable	--	--	--	3m
Cable 5	DC-power cable	--	--	--	2m

4. Measurements

4.1. Radio Frequency Exposure Evaluation §2.1091

4.1.1. 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
	For Evaluation instruments are not needed. Results are determined by calculation based on applicants delivered Tune-Up procedure.		

4.1.2. Requirements

FCC: §1.1310	<i>The criteria used for the evaluation of human exposure to radio frequency radiation is table 1 according FCC §1.1310. As the mobile equipment is authorized under Part 22 (Subpart H) and Part 24 of the FCC Rules, it is subject for evaluation of the RF exposure prior to equipment authorization.</i>
FCC § 2.1091	<i>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." 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.</i>

4.1.2.1. Valid for FCC

Table 1: LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)				
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 - 100,0	-	-	1.0	30

For given Power density limit at a single frequency (accord. Table 1 Limits) the maximum antenna gain can be calculated.

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

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

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

4.1.3. General Limits:

FCC: §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)
FCC §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)
FCC §1.1310	LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) Table 1(B) Limits for General Population/Uncontrolled Exposure 300–1500 MHz: $f/1500 \text{ mW/cm}^2$ 1500–100,000 MHz: 1.0 mW/cm^2
FCC §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.
FCC §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. b) Mobile/portable stations are limited to 2 watts e.i.r.p. peak power, ...
FCC §22.913	(a) Maximum ERP. The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.
FCC §27.50 (C)(10)	(10) Portable stations (hand-held devices) are limited to 3 watts ERP; and
FCC §27.50(d)	(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP.
KDBs	No. 447498 D01 v05r02

4.1.4. Evaluation Method

Valid for GSM/GPRS/EDGE mode:

- The power was considered on 3 frequencies (lowest/middle/highest) within each operable bands and the results compared to applicant's declared power values (tune-up info).
- One uplink slot (1 TX) was considered for voice operation, 4 TX slots are maximum possible for this device and calculated as worst-case regarding GPRS class
- A duty-cycle correction factor of $10 \cdot \log_{10}$ (max. number of possible active slots / 8 slots) were applied

Please find in the following tables the calculations based on applicants tune-up information for the power values. Also the maximum admissible allowed antenna gain is calculated which is not exceeding the MPE limit for fixed and mobile operations.

Valid for W-CDMA/LTE Mode:

- The power was considered on 3 frequencies (lowest/middle/highest) within each operable FDD-band (see separate report for W-CDMA technology) and the results compared to applicant's declared power values (tune-up info). A RMS detector was used.
- No duty-cycle correction factor is applicable

Please find in the following tables **the calculations** based on applicants tune-up information for cellular Rev.1.1, Annex 5 and document "RF path loss and antenna gain information for ATM Roof Version" Rev. 3.1. Also the measured W-LAN conducted power is considered according test report 15-1-0017001T41a.

4.2. Results for fixed and mobile operations

4.2.1. Results for lower operational band: LTE Band 5 and LTE band 17, GSM850 and FDD Band 5

4.2.1.1. MPE results – external antenna

Distance	20	cm												
Operating Mode	Frequency on channel	Declared maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss to external antenna	Calculated maximum ERP (declared+ Tune-up+ antenna Gain)	Duty cycle	Declared Maximum ERP	Equivalent ERP (maximum ERP x duty cycle)	MPE Limit accord. Table 1	MPE Value	Margin to limit:	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
	(MHz)	(dBm)	(dB)	(dBd)	(dB)	(dBm)	%	(W)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)		
GSM/GPRS (1Slot)	824,2	32,5	1,5	0,64	2,8	31,84	12,5%	1,528	191	0,5495	0,0623	0,4872	0,1134	0,1134
	837	32,5	1,5	0,64	2,8	31,84		1,528	191	0,5580	0,0623	0,4957	0,1116	
	848,8	32,5	1,5	0,64	2,8	31,84		1,528	191	0,5659	0,0623	0,5036	0,1101	
GSM/GPRS (4Slots)	824,2	32,0	1,5	0,64	2,8	31,34	50,0%	1,361	681	0,5495	0,2221	0,3274	0,4042	0,4042
	837	32,0	1,5	0,64	2,8	31,34		1,361	681	0,5580	0,2221	0,3359	0,3980	
	848,8	32,0	1,5	0,64	2,8	31,34		1,361	681	0,5659	0,2221	0,3438	0,3925	
EDGE (1Slot)	824,2	26,5	2,5	0,64	2,8	26,84	12,5%	0,483	60	0,5495	0,0197	0,5298	0,0359	0,0359
	837	26,5	2,5	0,64	2,8	26,84		0,483	60	0,5580	0,0197	0,5383	0,0353	
	848,8	26,5	2,5	0,64	2,8	26,84		0,483	60	0,5659	0,0197	0,5462	0,0348	
EDGE (4Slots)	824,2	26,5	2,5	0,64	2,8	26,84	50,0%	0,483	242	0,5495	0,0788	0,4707	0,1434	0,1434
	837	26,5	2,5	0,64	2,8	26,84		0,483	242	0,5580	0,0788	0,4792	0,1412	
	848,8	26,5	2,5	0,64	2,8	26,84		0,483	242	0,5659	0,0788	0,4871	0,1393	
WCDMA FDD Band 5 (RMS-Value)	826,4	23,0	2,0	0,64	2,8	22,84	100,0%	0,192	192	0,5509	0,0627	0,4882	0,1139	0,1139
	836,4	23,0	2,0	0,64	2,8	22,84		0,192	192	0,5578	0,0627	0,4949	0,1125	
	846,6	23,0	2,0	0,64	2,8	22,84		0,192	192	0,5644	0,0627	0,5017	0,1112	
LTE Band 17 (QPSK, #RB=1, RMS-Value)	706,5	23,0	2,0	-0,34	2,4	22,26	100,0%	0,168	168	0,4710	0,0549	0,4161	0,1166	0,1166
	710	23,0	2,0	-0,34	2,4	22,26		0,168	168	0,4733	0,0549	0,4184	0,1160	
	713,5	23,0	2,0	-0,34	2,4	22,26		0,168	168	0,4757	0,0549	0,4208	0,1154	
LTE Band 17 (16QAM, #RB=1, RMS-Value)	706,5	23,0	2,0	-0,34	2,4	22,26	100,0%	0,168	168	0,4710	0,0549	0,4161	0,1166	0,1166
	710	23,0	2,0	-0,34	2,4	22,26		0,168	168	0,4733	0,0549	0,4184	0,1160	
	713,5	23,0	2,0	-0,34	2,4	22,26		0,168	168	0,4757	0,0549	0,4208	0,1154	
LTE Band 5 (QPSK, #RB=1, RMS-Value)	824,7	23,0	2,0	0,64	2,8	22,84	100,0%	0,192	192	0,5498	0,0627	0,4871	0,1141	0,1141
	836,5	23,0	2,0	0,64	2,8	22,84		0,192	192	0,5577	0,0627	0,4949	0,1125	
	848,3	23,0	2,0	0,64	2,8	22,84		0,192	192	0,5655	0,0627	0,5028	0,1109	
LTE Band 5 (16QAM, #RB=1, RMS-Value)	824,7	23,0	2,0	0,64	2,8	22,84	100,0%	0,192	192	0,5498	0,0627	0,4871	0,1141	0,1141
	836,5	23,0	2,0	0,64	2,8	22,84		0,192	192	0,5577	0,0627	0,4949	0,1125	
	848,3	23,0	2,0	0,64	2,8	22,84		0,192	192	0,5655	0,0627	0,5028	0,1109	

Maximum calculated MPE value:		
Lowest MPE-Limit in Frequency-Band:	0,4710	[m W/cm ²]
Highest MPE value in frequency-band:	0,2221	[m W/cm ²]
Lowest margin to limit in frequency band:	0,3274	[m W/cm ²]

4.2.1.2. MPE results – internal antenna

Distance	20	cm												
Operating Mode	Frequency on channel	Declared maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss to Internal antenna	Calculated maximum ERP (declared+ Tune-up+ antenna Gain)	Duty cycle	Declared Maximum ERP	Equivalent ERP (maximum ERP x duty cycle)	MPE Limit accord. Table 1	MPE Value	Margin to limit:	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
	(MHz)	(dBm)	(dB)	(dBd)	(dB)	(dBm)	%	(W)	(m W)	(m W/cm ²)	(m W/cm ²)	(m W/cm ²)		
GSM/GPRS (1Slot)	824,2	32,5	1,5	-0,85	0,7	32,45	12,5%	1,758	220	0,5495	0,0717	0,4778	0,1305	0,1305
	837	32,5	1,5	-0,85	0,7	32,45		1,758	220	0,5580	0,0717	0,4863	0,1285	
	848,8	32,5	1,5	-0,85	0,7	32,45		1,758	220	0,5659	0,0717	0,4942	0,1267	
GSM/GPRS (4Slots)	824,2	32,0	1,5	-0,85	0,7	31,95	50,0%	1,567	783	0,5495	0,2556	0,2939	0,4652	0,4652
	837	32,0	1,5	-0,85	0,7	31,95		1,567	783	0,5580	0,2556	0,3024	0,4580	
	848,8	32,0	1,5	-0,85	0,7	31,95		1,567	783	0,5659	0,2556	0,3103	0,4517	
EDGE (1Slot)	824,2	26,5	2,5	-0,85	0,7	27,45	12,5%	0,556	69	0,5495	0,0227	0,5268	0,0413	0,0413
	837	26,5	2,5	-0,85	0,7	27,45		0,556	69	0,5580	0,0227	0,5353	0,0406	
	848,8	26,5	2,5	-0,85	0,7	27,45		0,556	69	0,5659	0,0227	0,5432	0,0401	
EDGE (4Slots)	824,2	26,5	2,5	-0,85	0,7	27,45	50,0%	0,556	278	0,5495	0,0907	0,4588	0,1650	0,1650
	837	26,5	2,5	-0,85	0,7	27,45		0,556	278	0,5580	0,0907	0,4673	0,1625	
	848,8	26,5	2,5	-0,85	0,7	27,45		0,556	278	0,5659	0,0907	0,4752	0,1603	
WCDMA FDD Band 5 (RMS-Value)	826,4	23,0	2,0	-0,85	0,7	23,45	100,0%	0,221	221	0,5509	0,0722	0,4787	0,1311	0,1311
	836,4	23,0	2,0	-0,85	0,7	23,45		0,221	221	0,5578	0,0722	0,4854	0,1295	
	846,6	23,0	2,0	-0,85	0,7	23,45		0,221	221	0,5644	0,0722	0,4922	0,1279	
LTE Band 17 (QPSK, #RB=1, RMS-Value)	706,5	23,0	2,0	-1,05	0,7	23,25	100,0%	0,211	211	0,4710	0,0690	0,4020	0,1464	0,1464
	710	23,0	2,0	-1,05	0,7	23,25		0,211	211	0,4733	0,0690	0,4044	0,1457	
	713,5	23,0	2,0	-1,05	0,7	23,25		0,211	211	0,4757	0,0690	0,4067	0,1450	
LTE Band 17 (16QAM, #RB=1, RMS-Value)	706,5	23,0	2,0	-1,05	0,7	23,25	100,0%	0,211	211	0,4710	0,0690	0,4020	0,1464	0,1464
	710	23,0	2,0	-1,05	0,7	23,25		0,211	211	0,4733	0,0690	0,4044	0,1457	
	713,5	23,0	2,0	-1,05	0,7	23,25		0,211	211	0,4757	0,0690	0,4067	0,1450	
LTE Band 5 (QPSK, #RB=1, RMS-Value)	824,7	23,0	2,0	-0,85	0,7	23,45	100,0%	0,221	221	0,5498	0,0722	0,4776	0,1313	0,1313
	836,5	23,0	2,0	-0,85	0,7	23,45		0,221	221	0,5577	0,0722	0,4855	0,1295	
	848,3	23,0	2,0	-0,85	0,7	23,45		0,221	221	0,5655	0,0722	0,4933	0,1277	
LTE Band 5 (16QAM, #RB=1, RMS-Value)	824,7	23,0	2,0	-0,85	0,7	23,45	100,0%	0,221	221	0,5498	0,0722	0,4776	0,1313	0,1313
	836,5	23,0	2,0	-0,85	0,7	23,45		0,221	221	0,5577	0,0722	0,4855	0,1295	
	848,3	23,0	2,0	-0,85	0,7	23,45		0,221	221	0,5655	0,0722	0,4933	0,1277	

Maximum calculated MPE value:		
Lowest MPE-Limit in Frequency-Band:	0,4710	[m W/cm ²]
Highest MPE value in frequency-band:	0,2556	[m W/cm ²]
Lowest margin to limit in frequency band:	0,2939	[m W/cm ²]

4.2.2. Results for upper operational band: LTE band 4

4.2.2.1. MPE results – External antenna

Distance:	20	cm												
Operating Mode	Frequency on channel	Declared maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss to external antenna	Calculated maximum ERP (declared+ Tune-up+ antenna Gain)	Duty cycle	Declared Maximum ERP	Equivalent ERP (maximum ERP x duty cycle)	MPE Limit accord. Table 1	MPE-Value	Margin to limit:	Fraction for Co-Location calculations	Max. Fraction Value within Frequency-Band
	(MHz)	(dBm)	(dB)	(dBi)	(dB)	(dBm)	%	(W)	(mW)	(mW/cm^2)	(mW/cm^2)	(mW/cm^2)		
LTE Band 4 (QPSK, #1RB, RMS-Value)	1710,7	23,0	2,0	2,40	4,90	22,50	100%	0,1778	177,8	1,0000	0,0354	0,9646	0,035378	0,0353777
	1732,5	23,0	2,0	2,40	4,90	22,50		0,1778	177,8	1,0000	0,0354	0,9646	0,035378	
	1754,3	23,0	2,0	2,40	4,90	22,50		0,1778	177,8	1,0000	0,0354	0,9646	0,035378	
LTE Band 4 (16QAM, #1RB, RMS-Value)	1710,7	23,0	2,0	2,40	4,90	22,50	100%	0,1778	177,8	1,0000	0,0354	0,9646	0,035378	0,0353777
	1732,5	23,0	2,0	2,40	4,90	22,50		0,1778	177,8	1,0000	0,0354	0,9646	0,035378	
	1754,3	23,0	2,0	2,40	4,90	22,50		0,1778	177,8	1,0000	0,0354	0,9646	0,035378	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ²]
Highest MPE value in frequency-band:	0,0354	[mW/cm ²]
Lowest margin to limit in frequency-band:	0,96	[mW/cm ²]

4.2.2.2. MPE results – internal antenna

Distance:	20	cm												
Operating Mode	Frequency on channel	Declared maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss to internal antenna	Calculated maximum BRP (declared+ Tune-up+ antenna Gain)	Duty cycle	Declared Maximum BRP	Equivalent BRP (maximum BRP x duty cycle)	MPE Limit accord. Table 1	MPE-Value	Margin to limit:	Fraction for Co-Location calculations	Max. Fraction within Frequency-Band
	(MHz)	(dBm)	(dB)	(dBi)	(dB)	(dBm)	%	(W)	(mW)	(mW/cm^2)	(mW/cm^2)	(mW/cm^2)		
LTE Band 4 (QPSK, #1RB, RMS-Value)	1710,7	23,0	2,0	1,80	1,10	25,70	100%	0,3715	371,5	1,0000	0,0739	0,9261	0,073915	0,0739146
	1732,5	23,0	2,0	1,80	1,10	25,70		0,3715	371,5	1,0000	0,0739	0,9261	0,073915	
	1754,3	23,0	2,0	1,80	1,10	25,70		0,3715	371,5	1,0000	0,0739	0,9261	0,073915	
LTE Band 4 (16QAM, #1RB, RMS-Value)	1710,7	23,0	2,0	1,80	1,10	25,70	100%	0,3715	371,5	1,0000	0,0739	0,9261	0,073915	0,0739146
	1732,5	23,0	2,0	1,80	1,10	25,70		0,3715	371,5	1,0000	0,0739	0,9261	0,073915	
	1754,3	23,0	2,0	1,80	1,10	25,70		0,3715	371,5	1,0000	0,0739	0,9261	0,073915	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ²]
Highest MPE value in frequency-band:	0,0739	[mW/cm ²]
Lowest margin to limit in frequency-band:	0,93	[mW/cm ²]

4.2.3. Results for upper operational band: FDD 2, LTE 2 and GSM1900

4.2.3.1. MPE results – external antenna

Safety-Distance	20	cm												
Operation Mode	Frequency on channel	Declared maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss to external antenna	Declared maximum ERP (Measured+ Tune-up+ Antenna Gain)	Duty cycle	Declared Maximum ERP	Equivalent ERP (maximum ERP x duty cycle)	MPE Limit accord. Table 1	MPE-Value	Margin to limit:	Fraction for Co-Location calculations	Max. Fraction Value within Frequency-Band
	(MHz)	(dBm)	(dB)	(dBi)	(dB)	(dBm)	%	(W)	(mW)	(mW/cm ^2)	(mW/cm ^2)	(W/m ^2)		
GSM/GPRS (1Slot)	1850.2	29.5	1.50	1.9	5.0	27.90	12.5%	0.617	77	1.0000	0.0153	0.9847	0.015333	0.0153335
	1880.0	29.5	1.50	1.9	5.0	27.90		0.617	77	1.0000	0.0153	0.9847	0.015333	
	1909.8	29.5	1.50	1.9	5.0	27.90		0.617	77	1.0000	0.0153	0.9847	0.015333	
GSM/GPRS (4Slots)	1850.2	29.5	1.50	1.9	5.0	27.90	50.0%	0.617	308	1.0000	0.0613	0.9387	0.061334	0.0613338
	1880.0	29.5	1.50	1.9	5.0	27.90		0.617	308	1.0000	0.0613	0.9387	0.061334	
	1909.8	29.5	1.50	1.9	5.0	27.90		0.617	308	1.0000	0.0613	0.9387	0.061334	
EDGE (1Slot)	1850.2	25.5	2.50	1.9	5.0	24.90	12.5%	0.309	39	1.0000	0.0077	0.9923	0.007685	0.0076849
	1880.0	25.5	2.50	1.9	5.0	24.90		0.309	39	1.0000	0.0077	0.9923	0.007685	
	1909.8	25.5	2.50	1.9	5.0	24.90		0.309	39	1.0000	0.0077	0.9923	0.007685	
EDGE (4Slots)	1850.2	25.5	2.50	1.9	5.0	24.90	50.0%	0.309	155	1.0000	0.0307	0.9693	0.030740	0.0307397
	1880.0	25.5	2.50	1.9	5.0	24.90		0.309	155	1.0000	0.0307	0.9693	0.030740	
	1909.8	25.5	2.50	1.9	5.0	24.90		0.309	155	1.0000	0.0307	0.9693	0.030740	
W-CDMA FDD Band 2 (RMS-Value)	1852.4	23.0	2.00	1.9	5.0	21.90	100.0%	0.155	155	1.0000	0.0308	0.9692	0.030813	0.0308127
	1880.0	23.0	2.00	1.9	5.0	21.90		0.155	155	1.0000	0.0308	0.9692	0.030813	
	1907.6	23.0	2.00	1.9	5.0	21.90		0.155	155	1.0000	0.0308	0.9692	0.030813	
LTE Band 2 (QPSK, #1RB, RMS-Value)	1850.7	23.0	2.00	1.9	5.0	21.90	100.0%	0.155	155	1.0000	0.0308	0.9692	0.030813	0.0308127
	1880.0	23.0	2.00	1.9	5.0	21.90		0.155	155	1.0000	0.0308	0.9692	0.030813	
	1909.3	23.0	2.00	1.9	5.0	21.90		0.155	155	1.0000	0.0308	0.9692	0.030813	
LTE Band 2 (16QAM, #1RB, RMS-Value)	1850.7	23.0	2.00	1.9	5.0	21.90	100.0%	0.155	155	1.0000	0.0308	0.9692	0.030813	0.0308127
	1880.0	23.0	2.00	1.9	5.0	21.90		0.155	155	1.0000	0.0308	0.9692	0.030813	
	1909.3	23.0	2.00	1.9	5.0	21.90		0.155	155	1.0000	0.0308	0.9692	0.030813	
Maximum calculated MPE value:														
Lowest MPE Limit in frequency-band:	1,0000	[mW/cm ^2]												
Highest MPE value in frequency-band:	0,0613	[mW/cm ^2]												
Margin to limit in frequency-band:	0,9387	[mW/cm ^2]												

4.2.3.2. MPE results – internal antenna

Safety-Distance	20	cm												
Operation Mode	Frequency on channel	Declared maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss to internal antenna	Declared maximum ERP (Measured+ Tune-up+ Antenna Gain)	Duty cycle	Declared Maximum ERP	Equivalent ERP (maximum ERP x duty cycle)	MPE Limit accord. Table 1	MPE-Value	Margin to limit:	Fraction for Co-Location calculations	Max. Fraction Value within Frequency-Band
	(MHz)	(dBm)	(dB)	(dBi)	(dB)	(dBm)	%	(W)	(m W)	(m W/cm ^2)	(m W/cm ^2)	(W/m^2)		
GSM/GPRS (1Slot)	1850.2	29.5	1.50	2.0	1.1	31.90	12.5%	1.549	194	1.0000	0.0385	0.9615	0.038516	0.0385159
	1880.0	29.5	1.50	2.0	1.1	31.90		1.549	194	1.0000	0.0385	0.9615	0.038516	
	1909.8	29.5	1.50	2.0	1.1	31.90		1.549	194	1.0000	0.0385	0.9615	0.038516	
GSM/GPRS (4Slots)	1850.2	29.5	1.50	2.0	1.1	31.90	50.0%	1.549	774	1.0000	0.1541	0.8459	0.154064	0.1540636
	1880.0	29.5	1.50	2.0	1.1	31.90		1.549	774	1.0000	0.1541	0.8459	0.154064	
	1909.8	29.5	1.50	2.0	1.1	31.90		1.549	774	1.0000	0.1541	0.8459	0.154064	
EDGE (1Slot)	1850.2	25.5	2.50	2.0	1.1	28.90	12.5%	0.776	97	1.0000	0.0193	0.9807	0.019304	0.0193037
	1880.0	25.5	2.50	2.0	1.1	28.90		0.776	97	1.0000	0.0193	0.9807	0.019304	
	1909.8	25.5	2.50	2.0	1.1	28.90		0.776	97	1.0000	0.0193	0.9807	0.019304	
EDGE (4Slots)	1850.2	25.5	2.50	2.0	1.1	28.90	50.0%	0.776	388	1.0000	0.0772	0.9228	0.077215	0.0772147
	1880.0	25.5	2.50	2.0	1.1	28.90		0.776	388	1.0000	0.0772	0.9228	0.077215	
	1909.8	25.5	2.50	2.0	1.1	28.90		0.776	388	1.0000	0.0772	0.9228	0.077215	
W-CDMA FDD Band 2 (RMS-Value)	1852.4	23.0	2.00	2.0	1.1	25.90	100.0%	0.389	389	1.0000	0.0774	0.9226	0.077398	0.0773981
	1880.0	23.0	2.00	2.0	1.1	25.90		0.389	389	1.0000	0.0774	0.9226	0.077398	
	1907.6	23.0	2.00	2.0	1.1	25.90		0.389	389	1.0000	0.0774	0.9226	0.077398	
LTE Band 2 (QPSK, #1RB, RMS-Value)	1850.7	23.0	2.00	2.0	1.1	25.90	100.0%	0.389	389	1.0000	0.0774	0.9226	0.077398	0.0773981
	1880.0	23.0	2.00	2.0	1.1	25.90		0.389	389	1.0000	0.0774	0.9226	0.077398	
	1909.3	23.0	2.00	2.0	1.1	25.90		0.389	389	1.0000	0.0774	0.9226	0.077398	
LTE Band 2 (16QAM, #1RB, RMS-Value)	1850.7	23.0	2.00	2.0	1.1	25.90	100.0%	0.389	389	1.0000	0.0774	0.9226	0.077398	0.0773981
	1880.0	23.0	2.00	2.0	1.1	25.90		0.389	389	1.0000	0.0774	0.9226	0.077398	
	1909.3	23.0	2.00	2.0	1.1	25.90		0.389	389	1.0000	0.0774	0.9226	0.077398	
Maximum calculated MPE value:														
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ^2]												
Highest MPE value in frequency-band:	0,1541	[mW/cm ^2]												
Margin to limit in frequency-band:	0,8459	[mW/cm ^2]												

4.2.4. Results for W-LAN

4.2.4.1. MPE results

Distance	20	cm												
Operation Mode	Frequency on channel	Measured conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss W-LAN Chip to internal antenna	Declared maximum ERP (Measured-Tune-up)	Duty cycle	Declared Maximum conducted output power	Equivalent conducted output power (output power x duty cycle) (mW)	MPE Limit accord. Table 1	MPE-Value	Margin to Limit:	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
	(MHz)	(dBm)	(dB)	(dBi)	(dB)	(dBm)	%	(W)		(mW/cm ²)	(mW/cm ²)	(mW/cm ²)		
W-LAN 2.4GHz	2412,0	1,26	1,0	5,0	0,7	6,6	100%	0,0045	4,5	1,0000	0,0009	0,9991	0,000901	0,0009010
	2437,0	1,21	1,0	5,0	0,7	6,5		0,0045	4,5	1,0000	0,0009	0,9991	0,000891	
	2472,0	1,14	1,0	5,0	0,7	6,4		0,0044	4,4	1,0000	0,0009	0,9991	0,000876	

4.2.5. Results for Co-Location W-LAN – Cellular Internal Antenna

		GSM/G-PRS/ E-GPRS Band-850	W-CDMA Band 5	LTE- Band 5	LTE Band 17	LTE Band 4	GSM/GPRS/ E-GPRS Band 1900	W-CDMA Band 2	LTE Band 2	W-LAN 2.4GHz
	Ratio of MPE- Value/Limit	0,465160304	0,131061442	0,131331607	0,146404048	0,073914585	0,154063638	0,077398072	0,077398072	0,000901011
W-LAN 2.4GHz	0,000901011	0,466061315	0,131962453	0,132232618	0,147305059	0,074815596	0,154964649	0,078299083	0,078299083	--
Maximum-Value		0,466061315								

4.2.6. Results for Co-Location W-LAN – Cellular External Antenna

		GSM/G-PRS/ E-GPRS Band-850	W-CDMA Band 5	LTE- Band 5	LTE Band 17	LTE Band 4	GSM/GPRS/ E-GPRS Band 1900	W-CDMA Band 2	LTE Band 2	W-LAN 2.4GHz
	Ratio of MPE- Value/Limit	0,404205898	0,113887207	0,114121969	0,116560952	0,035377745	0,061333839	0,030812728	0,030812728	0,000901011
W-LAN 2.4GHz	0,000901011	0,405106909	0,114788218	0,11502298	0,117461963	0,036278756	0,06223485	0,031713739	0,031713739	--
Maximum-Value		0,405106909								

4.3. 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 to its statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%							Remarks
Conducted emissions (U _{CISPR})	CISPR 16-2-1	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB							-
Radiated emissions Enclosure	CISPR 16-2-3	30 MHz - 1 GHz 1 GHz - 18 GHz	4.2 dB 5.1 dB							E-Field
Disturbance power	CISPR 16-2-2	30 MHz - 300 MHz	-							-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB							Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--		
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	-	
		12.75 - 26.5GHz	N/A	0.82	--	N/A	N/A	--		
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable	
		2.8 GHz - 12.75GHz	1.48	N/A	1.51	N/A	1.43	--		
		12.75 GHz - 18GHz	1.81	N/A	1.83	N/A	1.77	--		
		18 GHz - 26.5GHz	1.83	N/A	1.85	N/A	1.79	--		
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)							Frequency error
			1.0 dB							Power
Emission bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)							Frequency error
	-		See above: 0.70 dB							Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm							-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.0 dB							Magnetic field E-field Substitution
		30 MHz - 1 GHz	4.2 dB							
		1 GHz - 20 GHz	3.17 dB							

Table: measurement uncertainties, valid for conducted/radiated measurements

5. Abbreviations used in this report

The abbreviations	
ANSI	American National Standards Institute
AV , AVG, CAV	Average detector
EIRP	Equivalent isotropically radiated power, determined within a separate measurement
EGPRS	Enhanced General Packet Radio Service
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
IC	Industry Canada
n.a.	not applicable
Op-Mode	Operating mode of the equipment
PK	Peak
RBW	resolution bandwidth
RF	Radio frequency
RSS	Radio Standards Specification, Dokuments from Industry Canada
Rx	Receiver
TCH	Traffic channel
Tx	Transmitter
QP	Quasi peak detector
VBW	Video bandwidth
ERP	Effective radiated power

6. Accreditation details of CETECOM's laboratories and test sites

Ref.-No.	Accreditation Certificate	Valid for laboratory area or test site	Accreditation Body
-	D-PL-12047-01-01	All laboratories and test sites of CETECOM GmbH, Essen	DAkkS, Deutsche Akkreditierungsstelle GmbH
337 487 558 348 348	MRA US-EU 0003	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur.	FCC, Federal Communications Commission Laboratory Division, USA
337 487 550 558	3462D-1 3462D-2 3462D-2 3462D-3	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR)	IC, Industry Canada Certification and Engineering Bureau
487 550 348 348	R-2666 G-301 C-2914 T-1967	Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

7. Instruments and Ancillary

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

7.0.1. 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
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	-	EMC 32 Ver. 9.15.00
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 9.15.00
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
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 V03.02.20
692	Bluetooth Tester	CBT 32	100236	CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF)

7.0.2. 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	-	31.05.2016
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	31.05.2016
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	31.05.2016
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	30.04.2017
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	31.05.2016
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2017
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	30.04.2018
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	30.04.2018
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	30.04.2017
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	
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	
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	-	30.04.2018
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	30.04.2018
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	31.05.2016
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	36 M	-	30.04.2018
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	31.05.2016
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	-	31.05.2016
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	31.05.2016
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	31.05.2016
264	Spectrum Analyzer	FSEK 30	826939/005	Rohde & Schwarz	12 M	-	31.05.2016
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	31.05.2016
266	Peak Power Sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	31.05.2016
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	
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	12 M	-	31.05.2016
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	-	31.03.2017
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2017
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	30.12.2016
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	31.05.2016
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	30.04.2017
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	-	31.05.2016
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	30.04.2017
371	Bluetooth Tester	CBT32	100153	R&S	24 M	-	31.05.2016
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	24 M	-	30.04.2017
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	31.05.2016
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	30.04.2017
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	31.05.2016
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	31.05.2016
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	31.03.2017
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	CETECOM	12 M	5	30.01.2016
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.09.2016
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	-	31.05.2016

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.05.2016
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	36 M	-	30.04.2018
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	36 M	-	30.04.2018
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	30.04.2017
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	ld	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	30.09.2016
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	31.07.2017
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.05.2016
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	
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	30.04.2017
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	-	31.05.2016
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	31.05.2016
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH	-	-	
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36 M	-	31.07.2018
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.09.2016
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	31.05.2016
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
594	Wideband Radio Communication Tester	CMW 500	101757	Rohde & Schwarz	12 M	-	31.05.2016
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	36 M	-	31.05.2016
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	30.04.2017
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	30.04.2017
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	30.04.2017
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	
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	-	31.05.2016
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	
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	201.0999.9302.6.4.1.4 3	G. Lufft GmbH	24 M	-	30.04.2017
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
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	12 M	-	31.05.2016
644	Amplifierer	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	24 M	-	31.05.2016
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	
678	Power Meter	NRP	101638	Rohde&Schwarz	pre-m	-	
683	Spectrum Analyzer	FSU 26	200571	Rohde & Schwarz	12 M	-	31.05.2016
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	30.04.2017
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	31.05.2016
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
692	Bluetooth Tester	CBT 32	100236	Rohde & Schwarz	24 M	-	31.05.2016
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	

7.0.3. 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

8. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2016-05-10
--	--	--