T E S T R E P O R T
No.: **6-0668-15-3-13b**

According to:
FCC Regulations
Part 22, Part 24, Part 27

IC-Regulations
RSS-132 Issue 3, RSS-133 Issue 6,
RSS-139 Issue 2, RSS-Gen Issue 4
RSS-130, Issue 1

for

ACTIA Nordic AB

FCC-ID: 2AGKKACUII-06
IC: 20839-ACUII06
PMN: ACUII-06
HVIN: ACUII-06

Laboratory Accreditation and Listings			
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	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
Wi Fi ALLIANCE AUTHORIZED RF LABORATORY	ctia Authorized™ 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 surveilance tests.

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. Delta tests apply to check for conformance against valid standards due allready approved celullar wireless module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3.

Following tests have been performed to show compliance with applicable FCC Part 2, Part 22, Subpart H, Part 24, Subpart E (Broadband PCS) and Part 27, Subpart C of the FCC CFR Title 47 Rules, Edition 4th November 2015 and Canada RSS-132 Issue 3, RSS-133 Issue 6, RSS-130 Issue 1 and RSS-Gen Issue 4 standards.

1.1. TX mode, Test overview of FCC and Canada IC (RSS) Standards

No. of Diagram group	Test case	Port	References & Limits			EUT set-up	EUT op-mode	Result
			FCC Standard	RSS Section	Test limit			
1	AC-Power Lines Emissions Conducted (0,15 - 30 MHz)	AC-Power lines (conducted)	§15.207	RSS-Gen, Issue 4: Chapter 8.8	§15.207 limits IC: Table 3, Chapter 8.8	--	--	Not applicable
2	General field strength emissions (9 kHz - 30 MHz)	Cabinet + inter-connecting cables (radiated)	§15.209(a)	RSS-Gen, Issue 4: Chapter 8.9, Table 5+6	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	1+2	1+3+8 +9+11	passed
7	RF-Power (ERP/EIRP)		§2.1046 §22.913(a)(2)	RSS-132, Issue 3: Chapter 5.4 SRSP-503: 5.1.3	< 7 Watt (ERP)	--	--	Only calculated
			§24.232(c)	RSS-133, Issue 6 Chapter 4.1/6.4 SRSP-510: 5.1.2	< 2 Watt (EIRP)			
			§27.50 (d)(4)	RSS-139: Issue 3 Chapter 6.5 SRSP-513: 5.1.2	< 1 Watt (EIRP)			
			§27.50(c)(10)	RSS-130, Issue 1, Chapter 4.4	< 3 Watt (ERP)			
8	Spurious emissions		§2.1053(a) §2.1057	RSS-Gen., Issue 4	43+10log(P) dBc	1+2	1 to 11	passed
			§22.917(a)(b)	RSS-132, Issue 3: Chapter 5.5(i)(ii)				
9	Band-Edge compliance		§24.238(a)(b)	RSS-133, Issue 6: Chapter 6.5.1(i)(ii)		1+2	1 to 11	passed
			§27.53(h)(1)(3) (i)(ii)(iii)	RSS-139: Issue 3 Chapter 6.6 (i) (ii)				
			§27.53(g)	RSS-130: Issue 1 Chapter 4.6.1	43+10log(P) dBc + Spectrum Mask			

30	RF Power	Antenna terminal (conducted)	§2.1046	--	N/A	3	1 to 11	passed
34	26dB Emission bandwidth		§2.1049(h)	RSS-Gen, Issue 4, Chapter 6.6	26dBc Emissions BW 99% Power	--	--	Remark 1
35	99% Occupied bandwidth							
36	Spurious emissions		§2.1051 §2.1057 §22.917(a)(b) §24.238(a)(b) §27.53(h)	RSS-130, Issue 1, chapter 4.6.1 RSS-132, Issue 3: 5.5(i)(ii) RSS-133, Issue 6: 6.5.1(i)(ii) RSS-139, Issue 3 Chapt. 6.6 (i) (ii)	43+10log(P) dBc			
37	Band-Edge compliance							
38	Frequency stability		§22.355, table C-1 §24.235 §2.1055(a)(2) §27.54	RSS-132, Issue 3: Chapter 5.3 RSS-133, Issue 6: Chapter 6.3 RSS-130, Issue 1: Chapter 4.3 RSS-139, Issue 3, Chapter 6.4	< ±2.5ppm			

Remarks:

1. Test reports: 1-9521/15-01-03-A dated 2015-8-04, 1-9521/15-01-02-A dated 2015-8-04, 1-9521/15-01-04-A dated 2015-8-05, 20835060e/15 dated 2015-07-30, 20835060b/15-C1 dated 2015-08-01, 6-0744/15-3-1a dated 2015-08-04

1.2. Attestation:

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All requirements as shown in above table are met in accordance with enumerated standards.

.....
Dipl.-Ing. Rachid Acharkaoui
Responsible for test section

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.....
Dipl.-Ing. Christian 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
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

2.3. Organizational items

Responsible for test report and project leader:	Dipl.-Ing. Christian Lorenz
Receipt of EUT:	2015-10-13
Date(s) of test:	2015-12-28 to 2016-02-19
Date of report:	2016-02-26
Version of template: 13.02	

2.4. Applicant's details

Applicant's name:	ACTIA Nordic AB
Address:	Hammarbacken 4a 19149 Linköping Sweden
Contact person:	Mr. Nicklas Andersson

2.5. Manufacturer's details

Manufacturer's name:	ACTIA Automotive
Address:	10 Avenue Edouard Serres Parc Aeronautique BP60112 31772 Colomiers France

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: https://apps.fcc.gov/oetcf/tcb/reports/Tcb731GrantForm.cfm?mode=COPY&RequestTimeout=500&tcb_code=&application_id=N1R4OGyLaKCotehafTuv1g%3D%3D&fcc_id=QIPALS3-USR3
Antenna Type	☐ Integrated (enclosure) ☐ External - dedicated, no RF- connector ☒ External, separate RF-connector
Antenna Gain Tx	**First antenna:** Lower band (f<1GHz): max. 4.0dBi = max. 1.85dBd Higher bands (f>1GHz): Band FDD/LTE4: 5dBi Band FDD/LTE 2: 5.5 dBi **Second antenna:** Lower band (f<1GHz): 2.5dBi = 0.35dBd Higher bands (f>1GHz): 4dBi **Backup/Emergency antenna:** Lower band (f<1GHz): -2.9dBi = -5.05dBd Higher bands (f>1GHz): 2.5 dBi
Internal Loss from Cellular Module to antenna feed point:	Lower band (f<1GHz): 2.5 dB Higher bands (f>1GHz): 2.7 dB
Cable loss between Wireless Module and antenna (length=2.5m)	Lower band (f<1GHz): 1.8dB Higher bands (f>1GHz): 3.0 dB
Measured Peak Output Power [dBm]: Conducted GSM 850 Conducted EDGE850	 29.9 (AV) 23.6 (AV)
Calculated Output Power [dBm]:: Radiated GSM 850 Radiated EDGE 850 Radiated GSM 850 Radiated EDGE 850	**External main TX/RX antenna:** Cable loss of 1.8dB considered: 29.9dBm + 1.85 dBd – 1.8 dB = 29.95 dBm erp 23.6dBm + 1.85 dBd – 1.8 dB = 23.65 dBm erp **Backup antenna (emergency):** 29.9dBm + 2.5dB (internal loss correction) – 5.05dBd = 27.35 dBm erp 23.6dBm + 2.5dB (internal loss correction) – 5.05dBd = 21.05 dBm erp
Measured Peak Output Power [dBm]: Conducted GSM 1900 Conducted EDGE 1900	 27.3 (AV) 23.5 (AV)
Calculated Peak Output Power [dBm]: Radiated GSM 1900 Radiated EDGE1900 Radiated GSM 1900 Radiated EDGE1900	Cable loss of 3.0dB considered: **First antenna:** 27.3 dBm + 5.5dBi – 3.0dB = 29.8 dBm eirp 23.5 dBm + 5.5dBi – 3.0dB = 26.0 dBm eirp **Backup antenna (emergency):** 27.3 dBm + 2.7dB (Internal Loss correction) +2.5dBi = 32.5 dBm eirp 23.5 dBm + 2.7dB (Internal Loss correction) +2.5dBi = 28.7 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 4: 1712.4–1752.6 MHz (Uplink), 2110-2155 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 4: UARFCN range 1312 – 1450 – 1513☒ 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: https://apps.fcc.gov/oetcf/tcb/reports/Tcb731GrantForm.cfm?mode=COPY&RequestTimeout=500&tcb_code=&application_id=N1R4OGyLaKCotehafTuv1g%3D%3D&fcc_id=QIPALS3-USR3
Antenna Type	☐ Integrated (enclosure) ☐ External - dedicated, no RF- connector ☒ External, separate RF-connector
Antenna Gain Tx	**First antenna:** Lower band (f<1GHz): max. 4.0dBi = max. 1.85dBd Higher bands (f>1GHz): Band FDD/LTE4: 5dBi Band FDD/LTE 2: 5.5 dBi **Second antenna:** Lower band (f<1GHz): 2.5dBi = 0.35dBd Higher bands (f>1GHz): 4dBi **Backup/Emergency antenna:** Lower band (f<1GHz): -2.9dBi = -5.05dBd Higher bands (f>1GHz): 2.5 dBi
Internal Loss from Cellular Module to antenna feed point:	Lower band (f<1GHz): 2.5 dB Higher bands (f>1GHz): 2.7 dB
Cable loss between Wireless Module and antenna (length=2.5m)	Lower band (f<1GHz): 1.8dB Higher bands (f>1GHz): 3.0 dB
MAX PEAK Output Power: Conducted FDD-Mode 2 FDD-Mode 4 FDD-Mode 5	 21.53 dBm (AV) 22.41 dBm (AV) 22.71 dBm (AV)
MAX PEAK Output Power: Radiated FDD-Mode 2 FDD-Mode 4 FDD-Mode 5 FDD-Mode 2 FDD-Mode 4 FDD-Mode 5	Cable loss considered: **First antenna:** 21.53 dBm + 5.5dBi – 3.0dB = 24.03 dBm eirp 22.41 dBm + 5.0dBi – 3.0dB = 24.41 dBm eirp 22.71 dBm + 1.85dBd – 1.8dB = 22.76 dBm erp **Backup antenna (emergency):** 21.53 dBm + 2.7dB (Internal Loss correction) +2.5dBi = 26.73 dBm eirp 22.41 dBm + 2.7dB (Internal Loss correction) +2.5dBi = 27.61 dBm eirp 22.71 dBm + 2.5dB (Internal Loss correction) –5.05 dBd = 20.16 dBm erp

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 under: https://apps.fcc.gov/oetcf/tcb/reports/Tcb731GrantForm.cfm?mode=COPY&RequestTimeout=500&tcb_code=&application_id=N1R4OGyLaKCotehafTuv1g%3D%3D&fcc_id=QIPALS3-USR3	See original grant under: https://apps.fcc.gov/oetcf/tcb/reports/Tcb731GrantForm.cfm?mode=COPY&RequestTimeout=500&tcb_code=&application_id=N1R4OGyLaKCotehafTuv1g%3D%3D&fcc_id=QIPALS3-USR3
Antenna Gain Tx	**First antenna:** Lower band (f<1GHz): max. 4.0dBi = max. 1.85dBd Higher bands (f>1GHz): Band FDD/LTE4: 5dBi Band FDD/LTE 2: 5.5 dBi **Second antenna:** Lower band (f<1GHz): 2.5dBi = 0.35dBd Higher bands (f>1GHz): 4dBi **Backup/Emergency antenna:** Lower band (f<1GHz): -2.9dBi = -5.05dBd Higher bands (f>1GHz): 2.5 dBi		
Internal Loss from Cellular Module to antenna feed point:	Lower band (f<1GHz): 2.5 dB Higher bands (f>1GHz): 2.7 dB		
Cable loss between Wireless Module and antenna (length=2m) (dB)	Lower band (f<1GHz): 1.8 dB Higher bands (f>1GHz): 3.0 dB		
MAX Peak Output Power: Conducted LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 17	Measured / (dBm) 20.83 (AV) 21.76 (AV) 21.51 (AV) 21.91 (AV)		
MAX PEAK Output Power: radiated LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 17 LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 17	Cable loss considered: **First antenna:** 20.83 dBm + 5.5 dBi – 3.0 dB = 23.33 dBm eirp 21.76 dBm + 5.0 dBd – 3.0 dB = 23.76 dBm eirp 21.51 dBm + 1.85 dBd – 1.8 dB = 21.56 dBm erp 21.91 dBm + 1.85 dBd – 1.8 dB = 21.96 dBm erp **Backup antenna (emergency):** 20.83 dBm + 2.7dB (Internal Loss correction) +2.5 dBi = 26.03 dBm eirp 21.76 dBm + 2.7dB (Internal Loss correction) +2.5 = 26.96 dBm eirp 21.51 dBm + 2.5dB (Internal Loss correction) – 5.05 dBd = 18.96 dBm erp 21.91 dBm + 2.5dB (Internal Loss correction) – 5.05 dBd = 19.36 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) ☒ W-LAN 2.4GHz and 5GHz operating bands (not tested within this test report) ☒ GPS/GNSS (not tested within this test report)		
Power supply	☒ DC power only: 13.8V		
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	Telematic unit for automotive use VCM High LTE US	ACUII-06	21790250902642	C	13
EUT B	Telematic unit for automotive use VCM High LTE US	ACUII-06	21790250902643	C	13
EUT C	4G (LTE) version External Antenna	434-WLAN-GNSS-SDARS-LTE 50751424	SDARS Modified #1	15W421 (Portugal AD801)	--

*) 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	Main harness	1007-141-06	--	Rev A1.1 1535 Long branch : 2.03 m length Short branch: 0.68m length	--
AE 2	external SIM card holder	31324668	435614470037	826 14W47 1535	--
AE 3	Alps SOS/ 2 button device	Type: 19206 30710477	06W35T	One button *SOS* One button *ON CALL*	--
AE 4	DLC Ethernet cable + Power Supply White Wire	Maxxtro Patch cable FTP CAT. 5E 26AWG Huber + Suhner Radox 125	1007-142-01	Rev.B1.0 (Length:1.97 m) 0.34 MM2 (Length: 1.85 m)	--
AE 5	Mikrophone /Louspeaker unit	Integrated in Volvo C99ZA	39841393AA	--	--
AE 6	Antenna power supply cable (Twisted red cable 3-pin MQS)	Huber + Suhner Radox 125	--	0.50 MM2 (Length:2.1 m)	--

AE 7	WLAN antenna cable (Orange Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	--
AE 8	GNSS antenna cable (Blue Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	--
AE 9	2G/3G/4G antenna cable (Violet/Bordeaux Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	--
AE 10	3G/4G Diversity antenna cable (Pink Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	--
AE 11	IHU Ethernet Termination (Navy Blue Fakra connectors)	--	--	(Length :0.096 m)	--
AE 12	Notebook	Dell Latitude E5440	CTC432012	--	Windows 7 + ACTIA PC_Application -V1.1.0.9 -V1.1.0.13
AE 13	Flexray/CAN terminations	3 pieces	--	--	--
AE 14	Speaker Termination	1 piece	--	--	--
AE 15	USB cable Termination	resistive	--	--	
AE 16	UART cable Termination	3 Wired resistive	--	--	--
AE 17	Apple USB-Ethernet adapter	A1277	--	(Length:0.20 m)	--

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.
AE17 not used for tests

3.6. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT B + EUT C + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE6 + AE 7 + AE 8 + AE 9 + AE10 + AE11+ AE12 + AE 13 + AE14 + AE 15 + AE 16	Radiated measurements, internal antenna. Pls. see applicants document *ACUII Test Setup for certification Testing, Rev.1.2,* dated 2015-12-22.
set. 2	EUT B + EUT C + AE 1 + AE 2 + AE 3 + AE 4 + AE5 + AE6 + AE 7 + AE 8 + AE 9 + AE10 + AE11+ AE12 + AE 13 + AE14 + AE 15 + AE 16	Radiated measurements. External antenna. Pls. see applicants document *ACUII Test Setup for certification Testing, Rev.1.2,* dated 2015-12-22.
set. 3	EUT A + AE 1 + AE 2 + AE 3 + AE 4 + AE11 + AE12 + AE 13 + AE14 + AE 15 + AE 16	Conducted RF measurements. Software version 1.1.0.17 used

*) 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 4 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. 7	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. 8	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. 9	LTE-Band 4 RMC Mode	
op. 10	LTE-Band 5 RMC Mode	
op. 11	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	Main harness (AE1)	--	1007-141-06	Rev A1.1 (Length : 2.03 m)	--
Cable 2	DLC ethernet cable (AE4)	Maxxtro Patch cable FTP CAT. 5E 26AWG	1007-142-01	Rev.B1.0 (Length:1.97 m)	
Cable 3	Antenna power supply cable (Twisted red cable 3-pin MQS)	Huber + Suhner Radox 125	--	0.50 MM2 (Length:2.1 m)	
Cable 4	WLAN antenna cable (Orange Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	
Cable 5	GNSS antenna cable (Blue Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	
Cable 6	2G/3G/4G antenna cable (Violet/Bordeaux Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	--
Cable 7	3G/4G Diversity antenna cable (Pink Fakra connectors)	Huber + Suhner Enviroflex 400	--	E111025 AWM 522787 (Length: 2m)	--

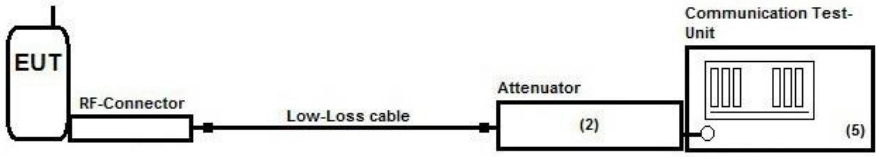
4. Description of test system set-up's

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

Cellular Conducted RF-Setup 2 (Cel-2 Set-up)

Tests Specification: Conducted Carrier power, Frequency Error

Schematic: Following test set-up applies for tests performed inside the climatic chamber (frequency stability) or conducted RF-carrier power-measurement. The EUT RF-Signal is directly connected over suitable RF-connector over low-loss cable and an attenuator (2) to the cellular radio communication test-unit. (5)



Testing method: ANSI C63.10:2013, KDB 971168 D01 v02r02

Used Equipment

Passive Elements	Test Equipment	Remark:
☒ 20 dB Attenuator (#613) ☒ Low loss RF-cables	☒ CMU200 Communication Test-Unit for GSM/W-CDMA ☒ DC-Power Supply	See List of equipment under each test case and chapter 8 for calibration info

Measurement uncertainty See chapter Measurement Uncertainties (Cel-2)

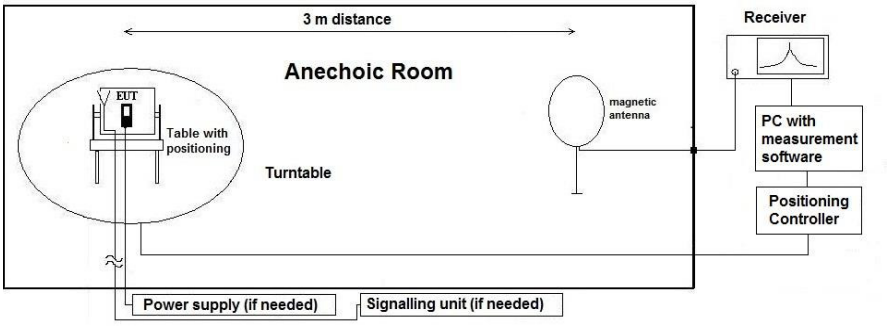
4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

Specification: ANSI C63.10-2013 chapter 6.4 (§6.4.4.2)

General Description: Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

Schematic:



Testing method:

Exploratory, preliminary measurement
The EUT and it's associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0°to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded. 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 results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$

$M = L_T - E_C$

AF =Antenna factor
C_L = Cable loss
D_F= Distance correction factor
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A= Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

Distance correction:

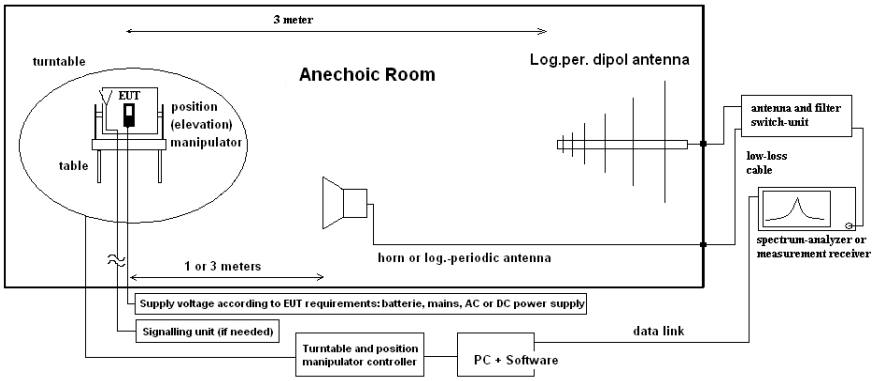
Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

4.3. Test system set-up for radiated spurious emission measurements

Specification: ANSI C63.4-2014 chapter 8.3, ANSI C63.10-2013 chapter 6.6.3.3 & 6.6.4

General Description: Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 16-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

Schematic:



Testing method:

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.50 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 45°) and the EUT itself on 3-orthogonal axis (the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.
First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.
Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions.
On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.
The readings on the spectrum analyzer are corrected with conversion value between field strength and E(I)RP, 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 C/D

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$Ec_{E(I)RP} = Ec - 95.2\ dB$

$M = L_T - Ec_{E(I)RP}$

E_C = Electrical field – corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)
$Ec_{E(I)RP}$ = Electrical field corrected for E(I)RP

All units are dB-units, positive margin means value is below limit.

5. Measurements

5.1. General Limit - Radiated field strength emissions below 30 MHz

5.1.1. Test location and 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	☐ 347 Radio.lab.		☐	☐
receiver	☐ 377 ESCS30	☒ 001 ESS	☐	☐	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☒ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 392 MT8820A	☐ 371 CBT32	☐ 547 CMU	☐ 594 CMW		
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 378 RadiSense	
DC power	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
line voltage	☐ 230 V 50 Hz via public mains		☐ 060 120 V 60 Hz via PAS 5000			

5.1.2. Requirements

FCC	Part 15, Subpart C, §15.205 & §15.209			
IC	RSS-Gen: Issue 4: §8.9 Table 5			
ANSI	C63.10-2013			
Frequency [MHz]	Field strength limit [µV/m]	[dBµV/m]	Distance [m]	Remarks
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3 m
0.490 – 1.705	24000/f (kHz)	87.6 – 20Log(f) (kHz)	30	Correction factor used due to measurement distance of 3 m
1.705 – 30	30	29.5	30	Correction factor used due to measurement distance of 3 m

5.1.3. Test condition and test set-up

Signal link to test system (if used):		☐ air link	☐ cable connection	☐ none
EUT-grounding		☒ none	☐ with power supply	☐ additional connection
Equipment set up		☒ table top		☐ floor standing
Climatic conditions		Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver or Analyzer Settings	Scan data	☒ 9 – 150 kHz RBW/VBW = 200 Hz Scan step = 80 Hz ☒ 150 kHz – 30 MHz RBW/VBW = 9 kHz Scan step = 4 kHz ☐ other:		
	Scan-Mode Detector Mode: Sweep-Time	☒ 6 dB EMI-Receiver Mode ☐ 3dB Spectrum analyser Mode Peak (pre-measurement) and Quasi-PK/Average (final if applicable) Repetitive-Scan, max-hold Coupled – calibrated display if continuous signal otherwise adapted to EUT's individual transmission duty-cycle		
General measurement procedures		Please see chapter "Test system set-up radiated magnetic field measurements below 30 MHz"		

5.1.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1. A representative choice of operating modes shows compliance.

Table of measurement results:

Diagram No.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
2.01	Low	128	9 kHz-30 MHz	2	1	GPRS850, External Antenna	☒	☐	☒	passed
2.03	Low	23755	9 kHz-30 MHz	2	11	LTE Band 17 External Antenna used	☒	☐	☐	passed
2.04	Low	23755	9 kHz-30 MHz	1	11	LTE Band 17 Internal Antenna used	☒	☐	☐	passed
2.05	Low	19975	9 kHz-30 MHz	1	9	LTE Band 4 Internal Antenna used	☒	☐	☐	passed
2.07	Low	18625	9 kHz-30 MHz	1	8	LTE Band 2 Internal Antenna used	☒	☐	☐	passed
2.02	High	251	9 kHz-30 MHz	1	1	GPRS850, Internal antenna	☒	☐	☐	passed
2.08	High	810	9 kHz-30 MHz	2	3	GPRS1900, External Antenna	☒	☐	☐	passed

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

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of 0.625xLambda. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors.

Frequency -Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]	1st Condition (dmeas< $D_{near-field}$)	2'te Condition (Limit distance bigger $d_{near-field}$)	Distance Correction accord. Formula
kHz	9,00E+03	33333,33	5305,17	300	fullfilled	not fullfilled	-80,00
	1,00E+04	30000,00	4774,65		fullfilled	not fullfilled	-80,00
	2,00E+04	15000,00	2387,33		fullfilled	not fullfilled	-80,00
	3,00E+04	10000,00	1591,55		fullfilled	not fullfilled	-80,00
	4,00E+04	7500,00	1193,66		fullfilled	not fullfilled	-80,00
	5,00E+04	6000,00	954,93		fullfilled	not fullfilled	-80,00
	6,00E+04	5000,00	795,78		fullfilled	not fullfilled	-80,00
	7,00E+04	4285,71	682,09		fullfilled	not fullfilled	-80,00
	8,00E+04	3750,00	596,83		fullfilled	not fullfilled	-80,00
	9,00E+04	3333,33	530,52		fullfilled	not fullfilled	-80,00
	1,00E+05	3000,00	477,47		fullfilled	not fullfilled	-80,00
	1,25E+05	2400,00	381,97		fullfilled	not fullfilled	-80,00
	2,00E+05	1500,00	238,73		fullfilled	fullfilled	-78,02
	3,00E+05	1000,00	159,16		fullfilled	fullfilled	-74,49
	4,00E+05	750,00	119,37		fullfilled	fullfilled	-72,00
	4,90E+05	612,24	97,44		fullfilled	fullfilled	-70,23
	5,00E+05	600,00	95,49	30	fullfilled	not fullfilled	-40,00
	6,00E+05	500,00	79,58		fullfilled	not fullfilled	-40,00
	7,00E+05	428,57	68,21		fullfilled	not fullfilled	-40,00
	8,00E+05	375,00	59,68		fullfilled	not fullfilled	-40,00
	9,00E+05	333,33	53,05		fullfilled	not fullfilled	-40,00
MHz	1,00	300,00	47,75		fullfilled	not fullfilled	-40,00
	1,59	188,50	30,00		fullfilled	not fullfilled	-40,00
	2,00	150,00	23,87		fullfilled	fullfilled	-38,02
	3,00	100,00	15,92		fullfilled	fullfilled	-34,49
	4,00	75,00	11,94		fullfilled	fullfilled	-32,00
	5,00	60,00	9,55		fullfilled	fullfilled	-30,06
	6,00	50,00	7,96		fullfilled	fullfilled	-28,47
	7,00	42,86	6,82		fullfilled	fullfilled	-27,13
	8,00	37,50	5,97		fullfilled	fullfilled	-25,97
	9,00	33,33	5,31		fullfilled	fullfilled	-24,95
	10,00	30,00	4,77		fullfilled	fullfilled	-24,04
	10,60	28,30	4,50		fullfilled	fullfilled	-23,53
	11,00	27,27	4,34		fullfilled	fullfilled	-23,21
	12,00	25,00	3,98		fullfilled	fullfilled	-22,45
	13,56	22,12	3,52		fullfilled	fullfilled	-21,39
	15,00	20,00	3,18		fullfilled	fullfilled	-20,51
	15,92	18,85	3,00		fullfilled	fullfilled	-20,00
	17,00	17,65	2,81		not fullfilled	fullfilled	-20,00
	18,00	16,67	2,65		not fullfilled	fullfilled	-20,00
	20,00	15,00	2,39		not fullfilled	fullfilled	-20,00
	21,00	14,29	2,27		not fullfilled	fullfilled	-20,00
	23,00	13,04	2,08		not fullfilled	fullfilled	-20,00
	25,00	12,00	1,91		not fullfilled	fullfilled	-20,00
	27,00	11,11	1,77		not fullfilled	fullfilled	-20,00
	29,00	10,34	1,65		not fullfilled	fullfilled	-20,00
	30,00	10,00	1,59		not fullfilled	fullfilled	-20,00

5.2. RF-Parameter - RF Peak power output conducted and PAPR-value (GSM/GPRS/E-GPRS Mode)

5.2.1. Test location and equipments

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2			
test site	☒ 347 Radio.lab. 1	☐ Radio.lab. 2				
spectr. analys.	☐ 584 FSU	☒ 489 ESU 40	☐ 264 FSEK	☐ 620 ESU 26		
signaling	☐ 392 MT8820A	☒ 436 CMU	☐ 547 CMU			
otherwise	☐ 110 USB LWL					
DC power	☐ 456 EA 3013A	☒ 463 HP3245A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 331 HC 4055	☒ 248 6 dB Att.	☐ 529 Power div.	☒ - cable OTA20		
line voltage	☐ 230 V 50 Hz via public mains		☐ 060 120 V/ 60 Hz via PAS 5000			

5.2.2. Requirements and limits

FCC	§2.1046(a)
IC	RSS-132 : 5.4 + SRSP 503 :5.1.3 for GSM 850 RSS-133 4.1/6.4 + SRSP-510 :5.1.2 for GSM 1900
Limit	Maximum conducted output power of the transmitter should be determined while measured on RF output terminal.
	Limit GSM850: 7 Watt (38.4 dBm)
	Limit GSM1900: 2 Watt (33.0 dBm)
	PAPR≤13 dB

5.2.3. Test condition and test set-up

Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%
Test system set-up	Please see chapter "Test system set-up for conducted measurements on antenna port"	
Measurement method	The measurements were performed with the integrated power measurement function of the „radio communication tester CMU200 from Rohde&Schwarz company. In this way spectrum-analyzers instrument limitations can be avoided or minimized. Instead, CMU manufacturers declared measurement error can be considered for this measurement. 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. 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. (typical 0.3dB for attenuation of antenna connector) Peak and Average Values have been recorded for each channel on test set-up Cel-1. The Peak-to -Average-Power Ratio is determined by devices integrated CCDF capability with corresponding settings. (see annex 1 plots)	
Mobile phone settings	A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200" UE Power should be set to maximum, continuous transmission. DTX or other power saving techniques have been disabled The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.	

5.2.4. Measurement results

Op. Mode 1, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
GSM 850	Low	128	30.2	29.9	Remark 1	38.4	13	Passed
	Middle	192	30.0	29.8				
	High	251	29.8	29.6				

Remark: 1.) see original reports of Cellular Module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3

Op. Mode 2, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
E-GPRS 850	Low	128	26.8	23.6	Remark 1	38.4	13	Passed
	Middle	192	26.5	23.3				
	High	251	26.3	23.1				

Remark: 1.) see original reports of Cellular Module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3

Op. Mode 3, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
GSM 1900	Low	512	27.3	27.2	Remark 1	38.4	13	Passed
	Middle	661	27.5	27.3				
	High	810	27.5	27.3				

Remark: 1.) see original reports of Cellular Module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3

Op. Mode 4, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
E-GPRS 1900	Low	512	26.5	23.3	Remark 1	33.0	13	Passed
	Middle	661	26.6	23.4				
	High	810	26.8	23.5				

Remark: 1.) see original reports of Cellular Module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3

5.3. RF-Parameter - RF Peak power output conducted and PAPR-Value (W-CDMA Mode)

5.3.1. Test location and equipments (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2			
test site	☐ 347 Radio.lab. 1	☒ Radio.lab. 2				
spectr. analys.	☐ 584 FSU	☐ 489 ESU 40	☐ 264 FSEK	☐ 620 ESU 26		
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU	☐ 460 CMU		
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 378 RadiSense	
DC power	☒ 611 E3636A	☐ 463 HP3245A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 331 HC 4055	☐ 248 6 dB Att.	☐ 529 Power div.	☐ - cable OTA20		
line voltage	☐ 230 V 50 Hz via public mains		☐ 060 110 V/ 60 Hz via PAS 5000			

5.3.2. Requirements and limits

FCC	☒ §2.1046 ☒ §22.913(a)(2) ☒ § 24.232(c) ☒ § 27.50(d)(4)
IC	☒ RSS-132, Issue 3: 5.4 + SRSP 503:5.1.3 ☒ RSS-133, Issue 6: 4.1/6.4 + SRSP-510:5.1.2 ☒ RSS-139, Issue 3: 6.5
KDB	971168 D01 v02r02, October 2014
Limits	Maximum Power Output of the wireless device should be determined while measured radiated E(I)RP
	☒ Limit FDD Band 5: 7 Watt ERP (38.4 dBm)
	☒ Limit FDD Band 2: 2 Watt EIRP (33.0 dBm)
	☒ Limit FDD Band 4: 1 Watt EIRP (30.0 dBm)
	PAPR ≤ 13dB

5.3.3. Test condition and test set-up

Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%
Test system set-up	Please see chapter "Test system set-up for conducted measurements on antenna port" ANRITSU	
Measurement method	The measurements were performed with the integrated power measurement function of the „radio communication tester CMU200 from Rohde&Schwarz company. In this way spectrum-analyzers instrument limitations can be avoided or minimized. Instead, CMU manufacturers declared measurement error can be considered for this measurement. 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. 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. (typical 0.3dB for attenuation of antenna connector) Peak and Average Values have been recorded for each channel on test set-up Cel-1. The Peak-to - Average-Power Ratio is determined by devices integrated CCDF capability with corresponding settings. (see annex 1 plots)	
EUT settings	A call was established on highest power transmit conditions in GMSK and RMC99 mode. UE is set TX mode, highest transmit power conditions, DTX, MPR or other power saving techniques have been disabled The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the wireless device, should be sufficient to demonstrate compliance.	

5.3.4. Measurement Results

FDD Band 2								
EUT	Set-up 1, Op. Mode 1							
Test case	**Power value [dBm]**						Limit [dBm]	Result
	UARFCN no. 9262		**UARFCN no. 9400**		**UARFCN no. 9538**			
	PK	AV	PK	AV	PK	AV		
Release 99 12.2kbps RMC	**24.97**	21.53	24.73	21.53	24.10	20.83	33	Passed
Peak-to-Average power ratio on 0.1% probability [dB]	Remark 1						13	Passed

Remark:
1.) see original reports of Cellular Module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3

FDD Band 4								
EUT	Set-up 1, Op. Mode 2							
Test case	**Power value [dBm]**						Limit [dBm]	Result
	UARFCN no. 1312		**UARFCN no. 1450**		**UARFCN no. 1513**			
	PK	AV	PK	AV	PK	AV		
Release 99 12.2kbps RMC	**25.55**	22.41	25.26	21.94	25.36	21.91	30	Passed
Peak-to-Average power ratio on 0.1% probability [dB]	Remark 1						13	Passed

Remark:
1.) see original reports of Cellular Module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3

FDD Band 5								
EUT	Set-up 1, Op. Mode 3							
Test case	**Power value [dBm]**						Limit [dBm]	Result
	UARFCN no. 4132		**UARFCN no. 4183**		**UARFCN no. 4233**			
	PK	AV	PK	AV	PK	AV		
Release 99 12.2kbps RMC	**25.73**	22.40	25.38	22.71	25.49	22.01	38.4	Passed
Peak-to Average ratio [dB]	Remark 1						13	Passed

1.) see original reports of Cellular Module with FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3

5.4. RF-Parameter - RF Peak power output conducted and PAPR (LTE – Mode)

5.4.1. Test location and equipments (for reference numbers please see chapter 'List of test equipment')

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2			
test site	☐ 347 Radio.lab. 1	☒ Radio.lab. 2				
spectr. analys.	☐ 584 FSU	☐ 489 ESU 40	☐ 264 FSEK	☐ 620 ESU 26		
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU	☒ 594 CMW500		
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 378 RadiSense	
DC power	☐ 456 EA 3013A	☐ 463 HP3245A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☒ 611 E3632A
otherwise	☐ 331 HC 4055	☐ 248 6 dB Att.	☐ 529 Power div.	☐ - cable OTA20		☒ 530 10 dB Att.
line voltage	☐ 230 V 50 Hz via public mains		☐ 060 110 V/ 60 Hz via PAS 5000			

5.4.2. Requirements and limits

FCC	§2.1046
IC	RSS-132:5.4 + SRSP 503:5.1.3 for FDD Band 5; RSS-133:4.1/6.4 + SRSP-510:5.1.2 for FDD Band 2 RSS-139, Issue 3: 6.5 , RSS-199: Issue 1, §4.4 + PAR PK-AV ≤ 13 dB
Limit	Maximum Power Output of the mobile phone should be determined while measured conducted.
	Limit LTE Band 5: 7 Watt ERP (38.4 dBm)
	Limit LTE Band 2: 2 Watt EIRP (33.0 dBm)
	Limit LTE Band 4: 1 Watt EIRP (30.0 dBm)
	Limit LTE Band 17: 3 Watt ERP (34.7dBm)

5.4.3. Test condition and test set-up

Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%
Test system set-up	Please see chapter "Test system set-up for conducted measurements on antenna port"	
Measurement method	The measurements were performed with the integrated power measurement function of the „radio communication tester CMU200 from Rohde&Schwarz company. In this way spectrum-analyzers instrument limitations can be avoided or minimized. Instead, CMU manufacturers declared measurement error can be considered for this measurement. 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. 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. (typical 0.3dB for attenuation of antenna connector) Peak and Average Values have been recorded for each channel and band. The Peak-to -Average-Ratio is determined by comparing the total peak power to total average power for each measurement.	
Mobile phone settings	A call was established with a suitable communication test unit (CMW500). UE is set TX mode, highest transmit power conditions (RMC-mode), power saving techniques have been disabled (MPR-techniques) Tests have been performed in different EUT bandwidth settings and various settings for allocated RBs. The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band within the designated range within the allowed channel bandwidths. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.	

5.4.4. Power results

5.4.4.1. LTE Band 2 Results

LTE Band 2				
Signal-BW	QPSK		16-QAM	
	Peak	RMS	Peak	RMS
1.4	25,33	20,66	25,99	19,71
3	25,06	20,59	24,51	19,24
5	25,19	20,71	25,16	19,92
10	25,07	20,71	24,40	19,10
15	25,13	20,83	25,07	20,26
20	25,34	20,74	25,51	19,93

LTE Band 2			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
25,34	20,83	25,99	20,26

5.4.4.2. LTE Band 4 Results

LTE Band 4				
Signal-BW	QPSK		16-QAM	
	Peak	RMS	Peak	RMS
1.4	25,92	21,00	24,94	20,10
3	25,42	21,01	24,83	19,88
5	25,63	21,09	25,02	20,23
10	25,44	21,14	25,04	20,65
15	26,19	21,76	24,90	19,93
20	25,40	20,94	25,56	20,76

LTE Band 4			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
26,19	21,76	25,56	20,76

5.4.4.3. LTE Band 5 Results

LTE Band 5				
Signal-BW	QPSK		16-QAM	
	Peak	RMS	Peak	RMS
1.4	26,71	21,51	26,10	20,17
3	26,50	21,30	24,81	19,31
5	26,04	21,32	25,83	20,45
10	26,08	20,86	25,23	20,04

LTE Band 5			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
26,71	21,51	26,10	20,45

5.4.4.4. LTE Band 17 Results

LTE Band 17				
Signal-BW	QPSK		16-QAM	
	Peak	RMS	Peak	RMS
5	26,34	21,91	26,37	20,80
10	26,46	21,34	27,20	20,82

LTE Band 17			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
26,46	21,91	27,20	20,82

5.4.5. PAPR results

5.4.5.1. Test condition and test set-up

Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%
Test system set-up	Please see chapter "Test system set-up for conducted measurements on antenna port"	
Measurement method	The measurements were performed with the integrated power measurement function of the „radio communication tester CMW500 from Rohde&Schwarz company. 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. 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. (typical 0.3dB for attenuation of antenna connector) The CCDF function of the measurement equipment as described in the operating manual was used (default settings). Futher details can be found in KDB 971168 D01 v02r02 chapter 5.7.1.	
Mobile phone settings	A call was established with a suitable communication test unit (CMW500). UE is set TX mode, highest transmit power conditions (RMC-mode), power saving techniques have been disabled (MPR-techniques) Tests have been performed in different EUT bandwidth settings and various settings for allocated RBs.	

5.4.5.2. PAPR-results

According KDB 5.7.1 two method are allowed.

☐ Chapter 5.7.2 for determining worst-case configuration (Signal bandwidth, modulation, RB allocation)
☐ Chapter 5.7.1 CCDF-Method (0.1% probability)

LTE Band 2		
Signal-Bandwidth / [MHz]	Max. PAPR Max. PAPR level with 0.1% probability / [dB]	
	QPSK Modulation	16-QAM Modulation
1.4 / 3.0 / 5.0 / 10 / 15 / 20	FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3	

LTE Band 4		
Signal-Bandwidth / [MHz]	Max. PAPR level with 0.1% probability / [dB]	
	QPSK Modulation	16-QAM Modulation
1.4 / 3.0 / 5.0 / 10 / 15 / 20	FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3	

LTE Band 5		
Signal-Bandwidth / [MHz]	Max. PAPR level with 0.1% probability / [dB]	
	QPSK Modulation	16-QAM Modulation
1.4 / 3.0 / 5.0 / 10	FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3	

LTE Band 17		
Signal-Bandwidth / [MHz]	Max. PAPR level with 0.1% probability / [dB]	
	QPSK Modulation	16-QAM Modulation
5.0 / 10	FCC-ID: QIPALS3-USR3 and IC 7830A-ALS3USR3	

5.4.5.3. Conclusion

☒ Peak conducted output power - pass
☒ PAPR <13dB - pass

5.5. RF-Parameter - Radiated out of Band RF emissions and Band Edge (GSM/GPRS/E-GPRS Mode)

5.5.1. Test location and equipments (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	☒ 443 FAR	☐ 347 Radio.lab.1	☐ Radio.lab.2	
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ 620 ESU 26		
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☒ 264 FSEK			
antenna	☒ 439 HL 562	☒ 549 HL 025	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 017 CMD 65	☐ 323 CMD 55	☐ 340 CMD 55			
signaling	☐ 392 MT8820A	☒ 546 CMU	☐ 547 CMU			
power supply	☒ 463 HP3245A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 529 6dB divider	☐ 530 6dB Att.	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 431 Near field	
line voltage	☒ 3.8 V DC		☐ 060 120 V/ 60 Hz via PAS 5000			

5.5.2. Requirements and limits (Variante RF-Parameter)

FCC	☒ Part 2.1053(a), Part2.1057(a)(1) ☒ Part 22 Subpart H, §22.917(a)(b) ☒ Part 24 Subpart E, §24.238(a)(b)
IC	☒ RSS-132, Issue 3: 5.5(i)(ii) ☒ RSS-133, Issue 6: 6.5.1(i)(ii)
Limit	**§22.917(a) & §24.238(a):** "The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB" **Limit:** -13dBm for all Power Control Levels of the cellular equipment

5.5.3. Test condition and test set-up

link to test system (if used):	☒ air link	☐ cable connection	
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
Test system set-up	Please see chapter "Test system set-up for radiated spurious emission measurements up to 20 GHz"		
Measurement method	*"§ 2.1057 Frequency spectrum to be investigated. (a) In all of the measurements set forth in § 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz"* The spectrum was scanned from 9 kHz (depend on the equipment, s. §2.1057) to the 10th harmonic of the highest frequency generated within the equipment. A PEAK detector was used except measurements near the block-edge where a AVERAGE detector applied. According chapter "Test system set-up for electric field measurement in the range 30-1000MHz and 1 to 40GHz" and additionally: the readings on the spectrum analyzer are corrected with annually performed chamber path calibration values 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.		
EUT settings	A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200" The UE and used accessories (if any used) were set to work according their intended use/specification stated as by the applicant The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the wireless device, should be sufficient to demonstrate compliance.		

Spectrum-Analyzer settings for GSM/GPRS/E-GPRS 850 Mode

Sweep no.	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att. [dB]	Detector
Sweep 1 (subrange 1)	30	1000	1	1	10	10	MaxH-PK
Sweep 2 (subrange 2)	1000	2800	1	1	15	10	MaxH-PK
Sweep 3 (subrange 3)	2800	9000	1	1	60	10	MaxH-PK
Sweep 4a (Band-Edge)	823	824	0.003	0.01	30	10	MaxH-PK
Sweep 4b (Band-Edge)	849	850	0.003	0.01	30	10	MaxH-PK

Spectrum-analyzer settings for GSM/GPRS/E-GPRS 1900 Mode

Sweep no.	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	1	10	10	MaxH-PK
Sweep 2 (subrange 2)	1000	2800	1	1	15	10	MaxH-PK
Sweep 3 (subrange 3)	2800	20000	1	1	160	10	MaxH-PK
Sweep 4a (Band-Edge)	1849	1850	0.003	0.01	30	10	MaxH-PK
Sweep 4b (Band-Edge)	1910	1911	0.003	0.01	30	10	MaxH-AV

5.5.4. Measurement results

The results are presented below in summary form only. For more information please see each diagram enclosed in annex 1.

5.5.4.1. GPRS 850

Diagram no.	Carrier Channel Range	Carrier Channel No.	Frequency range	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result
8.04b_RSE_R_Ch128_ GPRS_ExtAnt	Low	128	30 MHz – 9 GHz	1	Carrier on diagram, not relevant for results External antenna used	☒	☐	☐	passed
9.03a – Ch128 9.03b – Ch128	Low		823 – 824 MHz		Band Edge Compliance Internal and external antenna tested	☒	☒	☐	passed
--	Middle	192	--		--	☐	☐	☐	--
8.06a_RSE_R_Ch251_ GPRS_IntAnt	High	251	30 MHz – 9 GHz		Carrier on diagram, not relevant for results External antenna used	☒	☐	☐	passed
9.03a – Ch251 9.04b – Ch251	High		849 – 850 MHz		Band-Edge compliance Internal and external antenna tested	☒	☒	☐	passed

Remark: Low and high channels tested, Antennas ex-changed between channels

5.5.4.2. GPRS 1900

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.13_RSE_R_Ch512_GPRS	Low	512	30 MHz – 18 GHz	3	Carrier on diagram, not relevant for results External antenna used	☒	☐	☐	passed
9.02a – Ch512 9.09b – Ch512	Low		1849 – 1850 MHz		Band Edge Compliance Internal and external antenna tested	☒	☒	☐	passed
--	Middle	--	30 MHz – 18 GHz		--	☐	☐	☐	--
8.15b_RSE_R_Ch810_GPRS	High	810	30 MHz – 2.8 GHz		Carrier on diagram, not relevant for results Internal antenna used	☒	☐	☐	passed
			2.8– 18 GHz		Internal antenna used				
9.10a - Ch810 9.10b - Ch810	High		1910 – 1911 MHz		Band-Edge compliance Internal and external antenna tested	☒	☒	☐	passed

Remark: Low and high channels tested, Antennas ex-changed between channels

5.6. RF-Parameter - Radiated out of Band RF emissions and Band Edge (W-CDMA – Mode)

5.6.1. Test location and equipments (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	☒ 443 FAR	☐ 347 Radio.lab.1	☐ 347 Radio.lab.2	
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ ESU 26		
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☒ 264 FSEK			
antenna	☒ 439 HL 562	☒ 549 HL 025	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 017 CMD 65	☐ 323 CMD 55	☐ 340 CMD 55			
signaling	☐ 392 MT8820A	☒ 546 CMU	☐ 547 CMU			
power supply	☒ 611 E3636A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 529 6dB divider	☐ 530 6dB Att.	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 431 Near field	
line voltage	☒ 3.8V DC		☐ 060 110 V/ 60 Hz via PAS 5000			

5.6.2. Requirements and limits

FCC	General: §2.1053(a) , §2.1057(a) ☒ FDD Band 5: Part 22: §22.917(a)(b) ☒ FDD Band 2: Part 24: §24.238(a)(b) ☒ FDD Band 4: Part 27: §27.53(h)
IC	☒ FDD Band 5: RSS-132, Issue 3: 5.5(i)(ii) ☒ FDD Band 2: RSS-133, Issue 6: 6.5.1(i)(ii) ☒ FDD Band 4: RSS-139, Issue 3: 6.6 (i)(ii)
Limit	„the power of emissions shall be attenuated below the transmitter output power (p) by at least 43+10Log(P) dB“ -> Resulting limits for all power levels of the Mobile Phone: -13dBm

5.6.3. Test condition and test set-up

link to test system (if used):	☒ air link	☐ cable connection	☐
EUT-grounding	☒ none	☐ with power supply	☐ additional connection
Equipment set up	☒ table top		☐ floor standing
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%
Test system set-up	Please see chapter “Test system set-up for radiated spurious emission measurements up to 20 GHz”		
Measurement method	The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment. A PEAK detector was used except measurements near the Band-Edge where a AVERAGE detector applied for critical measurements. According chapter 4.3		
EUT settings	A call was established on highest power transmit conditions in RMC99 mode. The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the wireless device, should be sufficient to demonstrate compliance.		

Spectrum-Analyzer settings for FDD band 2

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att. [dB]	Detector
Sweep 1 (subrange 1)	30	1000	1	1	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	1	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	20000	1	1	60	10	MaxH-PK
Sweep 2a (Band-Edge)	1849	1850	0.05	0.5	30	35	MaxH-PK
Sweep 2b (Band-Edge)	1849	1850	0.05	0.5	30	35	MaxH-AV
Sweep 3a (Band-Edge)	1910	1911	0.05	0.5	30	35	MaxH-PK
Sweep 3b (Band-Edge)	1910	1911	0.05	0.5	30	35	MaxH-AV

Spectrum-analyzer settings for FDD Band 4

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	10	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	10	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	20000	1	10	160	10	MaxH-PK
Sweep 2a (Band-Edge)	1709	1710	0.05	0.5	30	35	MaxH-PK
Sweep 2b (Band-Edge)	1709	1710	0.05	0.5	30	35	MaxH-AV
Sweep 3a (Band-Edge)	1755	1756	0.05	0.5	30	35	MaxH-PK
Sweep 3b (Band-Edge)	1755	1756	0.05	0.5	30	35	MaxH-AV

Spectrum-analyzer settings for FDD Band 5

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	1	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	1	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	12000	1	1	160	10	MaxH-PK
Sweep 2a (Band-Edge)	823	824	0.100	0.300	30	35	MaxH-PK
Sweep 2b (Band-Edge)	823	824			30	35	MaxH-AV
Sweep 3a (Band-Edge)	850	851			30	35	MaxH-PK
Sweep 3b (Band-Edge)	850	851			30	35	MaxH-AV

5.6.4. Results

The results are presented below in summary form only. For more information please see each diagramm enclosed in annex 1.

5.6.4.1. FDD Band 2

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.20b	Low	9262	30 MHz to 19.5 GHz	5	Carrier visible on diagram. Not relevant for results External antenna used	☒	☐	☐	passed
9.20a	Low		1849 – 1850 MHz		Band Edge Compliance Internal Antenna	☒	☐	☐	passed
9.20b					Band Edge Compliance External Antenna	☒	☐	☐	passed
--	Middle	--	30 MHz to 18 GHz		--	☐	☐	☐	--
8.22a	High	9538	30 MHz to 19.5 GHz		Carrier visible on diagram. Not relevant for results Internal antenna used	☒	☐	☐	passed
9.21a	High		1910 – 1911 MHz		Band Edge Compliance Internal Antenna	☒	☐	☐	passed
9.21b					Band Edge Compliance External Antenna	☒	☐	☐	passed

Remark: Remark: Low and high channels tested, Antennas ex-changed between channels

5.6.4.2. FDD Band 4

Dia-gram no.	Carrier Channel Range	Carrier Channel No.	Frequency range	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result
8.40b	Low	1312	30 MHz to 18 GHz	6	Carrier visible on diagram. Not relevant for results External antenna used	☒	☐	☐	passed
9.40a	Low	1312	1709 - 1710 MHz	6	Band Edge Compliance Internal Antenna	☒	☒	☐	passed
9.40b	Low	1312	1709 - 1710 MHz	6	Band Edge Compliance External Antenna	☒	☒	☐	passed
--	Middle	--	30 MHz to 18 GHz	6	--	☐	☐	☐	--
8.42a	High	1513	30 MHz to 18 GHz	6	Carrier visible on diagram. Not relevant for results Internal antenna used	☒	☐	☐	passed
9.41a	High	1513	1755 – 1756 MHz	6	Band Edge Compliance Internal Antenna	☒	☒	☐	passed
9.41b	High	1513	1755 – 1756 MHz	6	Band Edge Compliance External Antenna	☒	☒	☐	passed

Remark: Low and high channels tested, Antennas ex-changed between channels

5.6.4.3. FDD Band 5

Dia-gram no.	Carrier Channel Range	Carrier Channel No.	Frequency range	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result
8.50b	Low	4132	30 MHz to 9 GHz	7	Carrier visible on diagram. Not relevant for results External antenna used	☒	☐	☐	passed
9.50a	Low	4132	823 – 824 MHz	7	Band Edge Compliance Internal Antenna	☒	☐	☐	passed
9.50b	Low	4132	823 – 824 MHz	7	Band Edge Compliance External Antenna	☒	☐	☐	passed
--	Middle	4183	--	7	--	☐	☐	☐	--
8.52a	High	4233	30 MHz to 9 GHz	7	Carrier visible on diagram. Not relevant for results Internal antenna used	☒	☐	☐	passed
9.51a	High	4233	849 – 850 MHz	7	Band Edge Compliance Internal Antenna	☒	☐	☐	passed
9.51b	High	4233	849 – 850 MHz	7	Band Edge Compliance External Antenna	☒	☐	☐	passed

Remark: Low and high channels tested, Antennas ex-changed between channels

5.7. RF-Parameter - Radiated out of Band RF emissions and Band Edge (LTE - Mode)

5.7.1. Test location and equipments (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	☒ 443 FAR	☐ 347 Radio.lab.1	☐ 347 Radio.lab.2	
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ ESU 26		
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☒ 264 FSEK			
antenna	☒ 608 HL 562	☒ 549 HL 025	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 017 CMD 65	☐ 323 CMD 55	☐ 340 CMD 55			
signaling	☐ 392 MT8820A	☐ 546 CMU	☐ 547 CMU	☒ 642 CMW500		
power supply	☒ 611 E3632A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 529 6dB divider	☐ 530 6dB Att.	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 431 Near field	
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 110 V/ 60 Hz via PAS 5000			

5.7.2. Requirements and limits

FCC	General: §2.1053(a) , §2.1057(a) ☒ LTE Band 5: Part 22: §22.917(a)(b) ☒ LTE Band 2: Part 24: §24.238(a)(b) ☒ LTE Band 4: Part 27: §27.53(h) ☒ LTE Band 17: Part 27: §27.53(g)
IC	☒ FDD Band 5: RSS-132, Issue 3: 5.5(i)(ii) ☒ FDD Band 2: RSS-133, Issue 6: 6.5.1(i)(ii) ☒ FDD Band 4: RSS-139, Issue 3: 6.6 (i)(ii) ☒ FDD Band 17: RSS-130, Issue 1: 4.6.1
Limit	„the power of emissions shall be attenuated below the transmitter output power (p) by at least 43+10Log(P) dB“ -> Resulting limits for all power levels of the Mobile Phone: -13dBm

5.7.3. Test condition and test set-up

link to test system (if used):		☒ air link	☐ cable connection	☐
EUT-grounding		☒ none	☐ with power supply	☐ additional connection
Equipment set up		☒ table top		☐ floor standing
Climatic conditions		Temperature: (22±3°C)		Rel. humidity: (40±20)%
Test system set-up		Please see chapter “Test system set-up for radiated spurious emission measurements up to 20 GHz”		
Spectrum Analyzer Settings	**Parameter:** Scan Mode RBW VBW Sweep time Sweep mode Detector	Spectrum analyser mode 1 MHz 10 MHz Coupled (Auto) repetitive Peak		
Measurement method		The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment. A PEAK detector was used except measurements near the Band-Edge where a AVERAGE detector applied when results are critical (low margin or limit exceed). Tests have been performed in various settings for the device regarding allocated ressource blocks and channels in order to find worst-case configuration. Due to very big amount of possible combinations only certain combinations have been tested.		
Mobile phone settings		A call was established on highest power transmit conditions in RMC mode. MPR was deactivated. The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band within the designated range within the allowed channel bandwidths. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.		

Spectrum-Analyzer settings for LTE band 2

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att. [dB]	Detector
Sweep 1 (subrange 1)	30	1000	1	10	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	10	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	20000	1	10	60	10	MaxH-PK
Sweep 2a (Band-Edge)	1849	1850	0.1	0.3	30	35	MaxH-PK
Sweep 2b (Band-Edge)	1849	1850	0.1	0.3	30	35	MaxH-AV
Sweep 3a (Band-Edge)	1910	1911	0.1	0.3	30	35	MaxH-PK
Sweep 3b (Band-Edge)	1910	1911	0.1	0.3	30	35	MaxH-AV

Spectrum-analyzer settings for FDD Band 4

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	10	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	10	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	18000	1	10	160	10	MaxH-PK
Sweep 2a (Band-Edge)	1709	1710	0.1	0.3	30	35	MaxH-PK
Sweep 2b (Band-Edge)	1709	1710	0.1	0.3	30	35	MaxH-AV
Sweep 3a (Band-Edge)	1755	1756	0.1	0.3	30	35	MaxH-PK
Sweep 3b (Band-Edge)	1755	1756	0.1	0.3	30	35	MaxH-AV

Spectrum-analyzer settings for LTE Band 5

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	10	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	10	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	9000	1	10	160	10	MaxH-PK
Sweep 2a (Band-Edge)	823	824	0.1	0.3	30	35	MaxH-PK
Sweep 2b (Band-Edge)	823	824	0.1	0.3	30	35	MaxH-AV
Sweep 3a (Band-Edge)	850	851	0.1	0.3	30	35	MaxH-PK
Sweep 3b (Band-Edge)	850	851	0.1	0.3	30	35	MaxH-AV

Spectrum-analyzer settings for LTE Band 17

	Start freq. MHz	Stop freq. MHz	R-BW kHz	V-BW kHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	100	300	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	100	300	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	9000	100	300	160	10	MaxH-PK
Sweep 2a (Band-Edge)	703	704	50	300	30	35	MaxH-PK, Signal-BW=5MHz
Sweep 2b (Band-Edge)	703	704	50	300	30	35	MaxH-PK, Signal-BW=10MHz
Sweep 3a (Band-Edge)	716	717	50	300	30	35	MaxH-PK, Signal-BW=5MHz
Sweep 3b (Band-Edge)	716	717	50	300	30	35	MaxH-PK, Signal-BW=10MHz

5.7.4. Results

The results are presented below in summary form only. Measurements have been performed with both possible modulations QPSK and 16-QAM. Also the allocated RB's were varied between minimum 1RB and 100%RBs over the LTE-signal bandwidth in order to search for worst-case mode.
For more information please see the diagrams enclosed in annex 1.

5.7.4.1. LTE Band 2

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
9.32a 9.33a	Low	18650	1849 – 1850 MHz	8	Band-Edge compliance QPSK modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☒	☐	passed
9.32b 9.33b	Low	18650	1849 – 1850 MHz		Band-Edge compliance QAM modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☒	☐	passed
8.22	Middle	18900	30 MHz to 19.5 GHz		Carrier visible on diagram. Not relevant for results QPSK modulation External antenna used	☒	☐	☐	passed
8.25	Middle	18900	30 MHz to 19.5 GHz		Carrier visible on diagram. Not relevant for results QPSK modulation Internal antenna used	☒	☐	☐	passed
9.34a 9.35a	High	19150	1910 – 1911 MHz		Band-Edge compliance QPSK modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed
9.34b 9.35b	High	19150	1910 – 1911 MHz		Band-Edge compliance QAM modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed

Remark1: A signal bandwidth of 10MHz was chosen for the tests

5.7.4.2. LTE Band 4

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
9.52a 9.53a	Low	20000	1709 - 1710 MHz	9	Band Edge Compliance QPSK modulation, Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☐	☒	☐	passed
9.52b 9.53b	Low	20000	1709 - 1710 MHz		Band Edge Compliance 16-QAM modulation, r Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☐	☒	☐	passed
8.41	Middle	20175	30 MHz to 2.8 GHz		Carrier visible on diagram. Not relevant for results QPSK modulation External antenna	☒	☐	☐	passed
8.44	Middle	20175	30 MHz to 18 GHz		Carrier visible on diagram. Not relevant for results 16-QAM modulation Internal antenna	☒	☐	☐	passed
9.54a 9.55a	High	20350	1755 – 1756 MHz		Band Edge Compliance QPSK modulation, Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☐	☒	☐	passed
9.54b 9.55b	High	20350	1755 – 1756 MHz		Band Edge Compliance 16-QAM modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☐	☒	☐	passed

Remark1: A signal bandwidth of 10MHz was chosen for the tests

5.7.4.3. LTE Band 5

Dia-gram no.	Carrier Channel Range	Carrier Channel No.	Frequency range	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result
9.512a 9.513a	Low	20450	823 – 824 MHz	10	Band Edge Compliance QPSK modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed
9.512b 9.513b	Low	20450	823 – 824 MHz		Band Edge Compliance 16-QAM modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed
8.52	Middle	20525	30 MHz to 9 GHz		Carrier visible on diagram. Not relevant for results QPSK-Modulation External antenna used	☒	☐	☐	passed
8.55	Middle	20525	30 MHz to 9 GHz		Carrier visible on diagram. Not relevant for results QPSK-Modulation Internal antenna used	☒	☐	☐	passed
9.514a 9.515a	High	20600	849 - 850 MHz		Band Edge Compliance QPSK modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed
9.514b 9.515b	High	20600	849 - 850 MHz		Band Edge Compliance 16-QAM modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed

Remark: A LTE signal bandwidth of 10MHz was chosen for the tests

5.7.4.4. LTE Band 17

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
9.1701a 9.1702a	Low	23755	703 - 704 MHz	11	Band Edge Compliance QPSK modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed
9.1701b 9.1702b	Low	23755	703 - 704 MHz		Band Edge Compliance 16-QAM modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed
8.171	Middle	23790	30 MHz to 9 GHz		Carrier visible on diagram. Not relevant for results QPSK modulation External antenna	☒	☐	☐	passed
8.175	Middle	23800	30 MHz to 9 GHz		Carrier visible on diagram. Not relevant for results 16-QAM modulation Internal antenna	☒	☐	☐	passed
9.1703a 9.1704a	High	23825	716 – 717 MHz		Band Edge Compliance QPSK modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed
9.1703b 9.1704b	High	23825	716 – 717 MHz		Band Edge Compliance 16-QAM modulation Internal and External Antenna tested – Suffix ExtAnt or Int Ant	☒	☐	☐	passed

Remark: A LTE signal bandwidth of 5MHz was chosen for the tests

5.8. 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.

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 30 MHz - 1 GHz 1 GHz - 20 GHz	5.0 dB 4.2 dB 3.17 dB						Magnetic field E-field Substitution

Table: measurement uncertainties, valid for conducted/radiated measurements

6. 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

7. 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	736496	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 Measurem.	FCC, Federal Communications Commission Laboratory Division, USA (MRA US-EU 0003)
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 Measurem.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

8. Instruments and Ancillary

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

8.0.1. 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)

8.0.2. 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	-	30.04.2016
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	30.04.2016
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	30.04.2016
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	-	30.04.2016
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	-	30.04.2016
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	-	30.04.2016
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	30.04.2017
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	30.04.2016
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	30.04.2016
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	-	30.04.2016
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.05.2016

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
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)	-	1d	
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	-	30.04.2016
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	-	30.04.2016
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	30.04.2016
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	-	30.04.2016
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	201.0999.9302.6.4.1.43	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	-	30.04.2016
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	-	30.04.2016
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	-	30.04.2016
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	

8.0.3. 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

9. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2016-02-26
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