

TEST REPORT

No.: **6-0668-15-3-13e**

According to:
FCC Regulations
 Part 1.1310 , Part 2.1091

for

ACTIA Nordic AB

Telematic Unit for automotive use
ACUII-06

FCC-ID: 2AGKKACUII-06

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

Table of contents

1. SUMMARY OF TEST RESULTS.....	3
1.1. TX mode, tests overview FCC Part 2.1091	3
2. ADMINISTRATIVE DATA	4
2.1. Identification of the testing laboratory	4
2.2. Test location	4
2.3. Organizational items	4
2.4. Applicant's details	4
2.5. Manufacturer's details	4
3. EQUIPMENT UNDER TEST (EUT)	5
3.1. TECHNICAL GSM/GPRS/E-GPRS DATA OF MAIN EUT DECLARED BY APPLICANT	5
3.2. TECHNICAL W-CDMA DATA OF MAIN EUT DECLARED BY APPLICANT	6
3.3. TECHNICAL LTE DATA OF MAIN EUT DECLARED BY APPLICANT	7
3.4. EUT: Type, S/N etc. and short descriptions used in this test report	9
3.5. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions	9
3.6. EUT set-ups	11
3.7. Configuration of cables used for testing	12
3.8. GSM/GPRS/E-GPRS EUT operating modes	13
3.9. W-CDMA EUT operating modes	13
3.10. EUT LTE operating modes	14
4. MEASUREMENTS	15
4.1. Radio Frequency Exposure Evaluation §2.1091	15
4.2. Results for fixed and mobile operations	17
4.3. Measurement uncertainties	23
5. ABBREVIATIONS USED IN THIS REPORT	24
6. ACCREDITATION DETAILS OF CETECOM'S LABORATORIES AND TEST SITES	24
7. INSTRUMENTS AND ANCILLARY	25
8. VERSIONS OF TEST REPORTS (CHANGE HISTORY)	28

Table of annex

Total pages

Annex 2: External photographs of EUT	12
Annex 3: Test set-up photographs	6
Annex 4: Internal photographs of EUT	7

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

Also a W-LAN module is build-in, it is an already approved with FCC-ID VPYLB1ES and IC 772C-LB1ES. 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 11	passed Remark 1
--	RF Power (radiated)	Cabinet	§2.1046 §22.913(a)(2)	< 7 Watt ERP	1	1 to 11	passed Remark 2
			§24.232(c)	< 2 Watt (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 11	Passed, Remark3

Remark:

- 1.) See separate test report 6-0668-15-3-13b (cellular) and 6-0668-15-3-13c/d (W-LAN) and corresponding annexes
- 2.) Calculations based on stated antenna gain and path losses due cable length of 2.5m



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



.....
GmbH
Im Teufelbach 150
45219 Essen
Tel.: +49 (0) 20 54 70 11 10
Fax: +49 (0) 20 54 70 11 11



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

2. Administrative Data

2.1. Identification of the testing laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
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. C. Lorenz
Receipt of EUT:	2015-10-23
Date(s) of test:	2015-12-28 to 2016-02-09
Date of report:	2016-04-19

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=QIPA LS3-USR3
Antenna Type	☒ Integrated (enclosure) : Backup/emergency antenna ☒ External, separate RF-connector
Antenna Gain Tx	First antenna (main TX/RX): 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 (Diversity RX): 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	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	Cable loss of 3.0dB considered: External main TX/RX antenna: 27.3 dBm + 5.5dBi – 3.0dB = 29.8 dBm eirp 23.5 dBm + 5.5dBi – 3.0dB = 23.65 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	21.53 dBm (AV)
	FDD-Mode 4	22.41 dBm (AV)
	FDD-Mode 5	22.71 dBm (AV)
MAX PEAK Output Power: Radiated	FDD-Mode 2	21.53 dBm + 5.5dBi – 3.0dB = 24.03 dBm eirp
	FDD-Mode 4	22.41 dBm + 5.0dBi – 3.0dB = 24.41 dBm eirp
	FDD-Mode 5	22.71 dBm + 1.85dBd – 1.8dB = 22.76 dBm erp
	FDD-Mode 2	Backup antenna (emergency): 21.53 dBm + 2.7dB (Internal Loss correction) +2.5dBi = 26.73 dBm eirp
	FDD-Mode 4	22.41 dBm + 2.7dB (Internal Loss correction) +2.5dBi = 27.61 dBm eirp
	FDD-Mode 5	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=N1R4OGyLaKCoehafTuv1g%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=N1R4OGyLaKCoehafTuv1g%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	Measured / (dBm) LTE-Mode 2 20.83 (AV) LTE-Mode 4 21.76 (AV) LTE-Mode 5 21.51 (AV) LTE-Mode 17 21.91 (AV)		
MAX PEAK Output Power: radiated	Cable loss considered: First antenna: LTE-Mode 2 20.83 dBm + 5.5 dBi – 3.0 dB = 23.33 dBm eirp LTE-Mode 4 21.76 dBm + 5.0 dBd – 3.0 dB = 23.76 dBm eirp LTE-Mode 5 21.51 dBm + 1.85 dBd – 1.8 dB = 21.56 dBm erp LTE-Mode 17 21.91 dBm + 1.85 dBd – 1.8 dB = 21.96 dBm erp Backup antenna (emergency): LTE-Mode 2 20.83 dBm + 2.7dB (Internal Loss correction) +2.5 dBi = 26.03 dBm eirp LTE-Mode 4 21.76 dBm + 2.7dB (Internal Loss correction) +2.5 = 26.96 dBm eirp LTE-Mode 5 21.51 dBm + 2.5dB (Internal Loss correction) – 5.05 dBd = 18.96 dBm erp LTE-Mode 17 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 ☒ 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, electrodynamic microphones, etc.?	☐ yes ☒ no		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

3.4. TECHNICAL 2.4GHZ W-LAN DATA OF MAIN EUT DECLARED BY APPLICANT

Frequency range (US/Canada -bands)	2412 MHz (Channel 1) to 2462 MHz (Channel 11)		
Type of modulation	See chapter 3.2		
Number of channels (USA/Canada -bands)	1 to 11		
Antenna Type	☒ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector		
Antenna Gain and Path Loss	Wifi-External (upward)	Max. 3.9 dBi gain according applicants information in 2.4 GHz band Path-Loss of External cables to antenna: 3.6dB Internal Loss: 2.0dB	
	Wifi-Internal (downward)	Max. 7.4 dBi gain according applicants information in 2.4 GHz band Path-Loss of External cables to antenna: 3.6dB Internal Loss: 2.0dB	

Pls. see applicants document ACUII-06 Technical description, Rev. 1.2, dated 2015-12-22 for further details

3.5. Technical 5GHz W-LAN data of main EUT declared by applicant

Frequency range and channels	U-NII 1 (5150-5250MHz)	☒ Ch. 36 to Ch. 48 (Nominal 20MHz signal bandwidth) ☒ Ch. 38 to Ch. 46 (Nominal 40MHz signal bandwidth)
	U-NII2A (5250-5350MHz)	☐ Ch. 52 to Ch. 64 (Nominal 20MHz signal bandwidth) ☐ Ch. 54 to Ch. 62 (Nominal 40MHz signal bandwidth)
	U-NII 2C (5470-5725MHz)	☐ Ch. 100 to 140 (Nominal 20MHz signal bandwidth) ☐ Ch. 102 to 134 (Nominal 40MHz signal bandwidth)
	U-NII-3	☒ Ch. 149 to 165 (Nominal 20MHz signal bandwidth) ☒ Ch. 151 to 159 (Nominal 40MHz signal bandwidth)
Type of modulation (packet types)	☒ BPSK ☒ QPSK ☒ 16-QAM ☒ 64-QAM ☒ 256-QAM	
Number of channels (USA/Canada -bands)	☒ 20MHz bandwidth: 36/40/44/48/149/153/157/161/165 ☒ 40MHz bandwidth: 38/46/151/159	
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector	
Antenna Gain	<u>From data sheet WiFi internal antenna variant 7:</u> 5150 to 5250 MHz: 8.25 dBi 5250 to 5350 MHz: 7.5 dBi 5470 to 5700 MHz: 7.2 dBi 5725 to 5850 MHz: 7.0 dBi	

Pls. see applicants document ACUII-06 Technical description, Rev. 1.2, dated 2015-12-22 for further details

3.6. 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	Multiband Antenna 434-WLAN-GNSS-SDARS-LTE	VCC-Number: 31438105	SDARS Modified #1	15W421 (Portugal AD801)	--

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

3.7. 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 <i>SOS</i> One button <i>ON CALL</i>	--
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

3.8. 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, Downward antenna (internal antenna). Pls. see applicants document <i>ACUII Test Setup for certification Testing, Rev.1.2</i> , 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, Upward antenna (external antenna). Pls. see applicants document <i>ACUII Test Setup for certification Testing, Rev.1.2</i> , 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.

3.9. 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 (AE2)	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)	--

3.10. 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.

3.11. 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	
op. 7	FDD-Band 5 12.2 kbps RMC	

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

3.12. 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	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. 10	LTE-Band 5 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. 11	LTE-Band 17 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.

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

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 and table chapter 4.2 of RSS-102 standard and it is subject for evaluation of the RF exposure prior to equipment authorization. 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 v06

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).
- Peak was considered (see separate report for GSM/GPRS/E-GPRS technology)
- Only one uplink slot (1 TX) was considered. 4 TX slots are maximum possible for this device and calculated as worst-case
- A duty-cycle correction factor of $10 \cdot \log_{10}$ (max. number of possible active slots / 8 slots) 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 measured values.**

4.2. Results for fixed and mobile operations

Following documents have been used:

- Used main antenna specification document “MAM – Multiband antenna Module2, dated 2016-04-22
- Used “6001_80040_antenna path loss_1_1” document, dated 2016-04-19 used
- Backup antenna specification for ACUII-06 according supplied document Rev1.0, Page 4 used.

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 for external antenna (EUT C)

Distance	20 cm													
Operating Mode	Frequency on channel	Measured maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Ext. Path Loss to antenna (external cables)	Calculated maximum ERP (declared+ Tune-up+ antenna Gain) (dBm)	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 (AV)	824,2	29,9	0,5	1,85	1,8	30,45	50%	1,109	555	0,5495	0,1809	0,3685	0,3293	0,3293
	837	29,8	0,5	1,85	1,8	30,35		1,084	542	0,5580	0,1768	0,3812	0,3169	
	848,8	29,6	0,5	1,85	1,8	30,15		1,035	518	0,5659	0,1689	0,3970	0,2984	
EDGE (AV)	824,2	23,6	0,5	1,85	1,8	24,15	50%	0,260	130	0,5495	0,0424	0,5070	0,0772	0,0772
	837	23,3	0,5	1,85	1,8	23,85		0,243	121	0,5580	0,0396	0,5184	0,0709	
	848,8	23,1	0,5	1,85	1,8	23,68		0,233	117	0,5659	0,0381	0,5278	0,0673	
WCDMA FDD Band 5 (RMS- Value)	826,4	22,40	0,5	1,85	1,8	22,95	100%	0,197	197	0,5509	0,0644	0,4865	0,1168	0,1240
	836,4	22,71	0,5	1,85	1,8	23,26		0,212	212	0,5576	0,0691	0,4885	0,1240	
	846,6	22,01	0,5	1,85	1,8	22,56		0,180	180	0,5644	0,0588	0,5056	0,1042	
LTE Band 17 (QPSK, #RB=1, RMS- Value)	706,5	21,91	0,5	1,85	1,8	22,46	100%	0,176	176	0,4710	0,0575	0,4135	0,1221	0,1221
	710	21,91	0,5	1,85	1,8	22,46		0,176	176	0,4733	0,0575	0,4158	0,1215	
	713,5	21,91	0,5	1,85	1,8	22,46		0,176	176	0,4757	0,0575	0,4182	0,1209	
LTE Band 17 (16QAM, #RB=1, RMS- Value)	706,5	20,82	0,5	1,85	1,8	21,37	100%	0,137	137	0,4710	0,0447	0,4263	0,0950	0,0950
	710	20,82	0,5	1,85	1,8	21,37		0,137	137	0,4733	0,0447	0,4286	0,0945	
	713,5	20,82	0,5	1,85	1,8	21,37		0,137	137	0,4757	0,0447	0,4309	0,0940	
LTE Band 5 (QPSK, #RB=1, RMS- Value)	824,7	21,51	0,5	1,85	1,8	22,06	100%	0,161	161	0,5498	0,0524	0,4974	0,0954	0,0954
	836,5	21,51	0,5	1,85	1,8	22,06		0,161	161	0,5577	0,0524	0,5052	0,0940	
	848,3	21,51	0,5	1,85	1,8	22,06		0,161	161	0,5655	0,0524	0,5131	0,0927	
LTE Band 5 (16QAM, #RB=1, RMS- Value)	824,7	20,45	0,5	1,85	1,8	21,00	100%	0,126	126	0,5498	0,0411	0,5087	0,0747	0,0747
	836,5	20,45	0,5	1,85	1,8	21,00		0,126	126	0,5577	0,0411	0,5166	0,0737	
	848,3	20,45	0,5	1,85	1,8	21,00		0,126	126	0,5655	0,0411	0,5245	0,0726	

Maximum calculated MPE value:		
Lowest MPE-Limit in Frequency-Band:	0,4710	[mW/cm ²]
Highest MPE value in frequency-band:	0,1809	[mW/cm ²]
Lowest margin to limit in frequency band:	0,3685	[mW/cm ²]

4.2.1.2. MPE results for backup antenna (inside EUTA/B)

Distance	20	cm												
Operating Mode	Frequency on channel	Measured maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain inkl. RF-Path Loss	Correction Internal Path Loss to 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 (AV)	824,2	29,9	0,5	-5,05	2,5	27,85	50%	0,610	305	0,5495	0,0994	0,4500	0,1810	0,1810
	837	29,8	0,5	-5,05	2,5	27,75		0,596	298	0,5580	0,0972	0,4608	0,1741	
	848,8	29,6	0,5	-5,05	2,5	27,55		0,569	284	0,5659	0,0928	0,4731	0,1640	
EDGE (AV)	824,2	23,6	0,5	-5,05	2,5	21,55	50%	0,143	71	0,5495	0,0233	0,5262	0,0424	0,0424
	837	23,3	0,5	-5,05	2,5	21,25		0,133	67	0,5580	0,0218	0,5362	0,0390	
	848,8	23,1	0,5	-5,05	2,5	21,08		0,128	64	0,5659	0,0209	0,5449	0,0370	
WCDMA FDD Band 5 (RMS-Value)	826,4	22,40	0,5	-5,05	2,5	20,35	100%	0,108	108	0,5509	0,0354	0,5156	0,0642	0,0681
	836,4	22,71	0,5	-5,05	2,5	20,66		0,116	116	0,5576	0,0380	0,5196	0,0681	
	846,6	22,01	0,5	-5,05	2,5	19,96		0,099	99	0,5644	0,0323	0,5321	0,0573	
LTE Band 17 (QPSK, #RB=1, RMS-Value)	706,5	21,91	0,5	-5,05	2,5	19,86	100%	0,097	97	0,4710	0,0316	0,4394	0,0671	0,0671
	710	21,91	0,5	-5,05	2,5	19,86		0,097	97	0,4733	0,0316	0,4417	0,0667	
	713,5	21,91	0,5	-5,05	2,5	19,86		0,097	97	0,4757	0,0316	0,4441	0,0664	
LTE Band 17 (16QAM, #RB=1, RMS-Value)	706,5	20,82	0,5	-5,05	2,5	18,77	100%	0,075	75	0,4710	0,0246	0,4464	0,0522	0,0522
	710	20,82	0,5	-5,05	2,5	18,77		0,075	75	0,4733	0,0246	0,4488	0,0519	
	713,5	20,82	0,5	-5,05	2,5	18,77		0,075	75	0,4757	0,0246	0,4511	0,0517	
LTE Band 5 (QPSK, #RB=1, RMS-Value)	824,7	21,51	0,5	-5,05	2,5	19,46	100%	0,088	88	0,5498	0,0288	0,5210	0,0524	0,0524
	836,5	21,51	0,5	-5,05	2,5	19,46		0,088	88	0,5577	0,0288	0,5289	0,0517	
	848,3	21,51	0,5	-5,05	2,5	19,46		0,088	88	0,5655	0,0288	0,5367	0,0509	
LTE Band 5 (16QAM, #RB=1, RMS-Value)	824,7	20,45	0,5	-5,05	2,5	18,40	100%	0,069	69	0,5498	0,0226	0,5272	0,0411	0,0411
	836,5	20,45	0,5	-5,05	2,5	18,40		0,069	69	0,5577	0,0226	0,5351	0,0405	
	848,3	20,45	0,5	-5,05	2,5	18,40		0,069	69	0,5655	0,0226	0,5430	0,0399	

Maximum calculated MPE value:		
Lowest MPE-Limit in Frequency-Band:	0,4710	[mW/cm ²]
Highest MPE value in frequency-band:	0,0994	[mW/cm ²]
Lowest margin to limit in frequency band:	0,4394	[mW/cm ²]

4.2.2. Results for upper operational band: FDD band 4 and LTE band 4

4.2.2.1. MPE results for external antenna (EUT C)

Distance:	20	cm												
Operating Mode	Frequency on channel (MHz)	Measured maximum conducted output power (dBm)	Max. positive tolerance according manufacturer (dB)	Antenna Gain (dBi)	Ext. Path Loss to antenna (external cables) (dB)	Calculated maximum ERP (declared+ Tune-up+ antenna Gain) (dBm)	Duty cycle %	Declared Maximum ERP (W)	Equivalent ERP (maximum ERP x duty cycle) (mW)	MPE Limit accord. Table 1 (mW/cm ²)	MPE-Value (mW/cm ²)	Margin to limit: (mW/cm ²)	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
W-CDMA Band 4 (RMS-Value)	1712,4	22,41	0,5	5,00	3,00	24,91	100%	0,3097	309,7	1,0000	0,0616	0,9384	0,061621	0,0616212
	1740,0	21,94	0,5	5,00	3,00	24,44		0,2780	278,0	1,0000	0,0553	0,9447	0,055301	
	1752,6	21,91	0,5	5,00	3,00	24,41		0,2761	276,1	1,0000	0,0549	0,9451	0,054920	
LTE Band 4 (QPSK, #1RB, RMS-Value)	1710,7	21,76	0,5	5,00	3,00	24,26	100%	0,2667	266,7	1,0000	0,0531	0,9469	0,053055	0,0530555
	1732,5	21,76	0,5	5,00	3,00	24,26		0,2667	266,7	1,0000	0,0531	0,9469	0,053055	
	1754,3	21,76	0,5	5,00	3,00	24,26		0,2667	266,7	1,0000	0,0531	0,9469	0,053055	
LTE Band 4 (16QAM, #1RB, RMS-Value)	1710,7	20,76	0,5	5,00	3,00	23,26	100%	0,2118	211,8	1,0000	0,0421	0,9579	0,042143	0,0421435
	1732,5	20,76	0,5	5,00	3,00	23,26		0,2118	211,8	1,0000	0,0421	0,9579	0,042143	
	1754,3	20,76	0,5	5,00	3,00	23,26		0,2118	211,8	1,0000	0,0421	0,9579	0,042143	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ²]
Highest MPE value in frequency-band:	0,0616	[mW/cm ²]
Lowest margin to limit in frequency-band:	0,9384	[mW/cm ²]

4.2.2.2. MPE results for backup antenna (inside EUTA/B)

Distance:	20	cm												
Operating Mode	Frequency on channel (MHz)	Measured maximum conducted output power (dBm)	Max. positive tolerance according manufacturer (dB)	Antenna Gain incl. RF-Path Loss (dBd)	Correction Internal Path Loss to antenna (dB)	Calculated maximum ERP (declared+ Tune-up+ antenna Gain) (dBm)	Duty cycle %	Declared Maximum ERP (W)	Equivalent ERP (maximum ERP x duty cycle) (mW)	MPE Limit accord. Table 1 (mW/cm ²)	MPE-Value (mW/cm ²)	Margin to limit: (mW/cm ²)	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
W-CDMA Band 4 (RMS-Value)	1712,4	22,41	0,5	2,50	2,7	28,11	100%	0,6471	647,1	1,0000	0,1287	0,8713	0,128745	0,1287449
	1740,0	21,94	0,5	2,50	2,7	27,64		0,5808	580,8	1,0000	0,1155	0,8845	0,115539	
	1752,6	21,91	0,5	2,50	2,7	27,61		0,5768	576,8	1,0000	0,1147	0,8853	0,114744	
LTE Band 4 (QPSK, #1RB, RMS-Value)	1710,7	21,76	0,5	2,50	2,7	27,46	100%	0,5572	557,2	1,0000	0,1108	0,8892	0,110849	0,1108486
	1732,5	21,76	0,5	2,50	2,7	27,46		0,5572	557,2	1,0000	0,1108	0,8892	0,110849	
	1754,3	21,76	0,5	2,50	2,7	27,46		0,5572	557,2	1,0000	0,1108	0,8892	0,110849	
LTE Band 4 (16QAM, #1RB, RMS-Value)	1710,7	20,76	0,5	2,50	2,7	26,46	100%	0,4426	442,6	1,0000	0,0881	0,9119	0,088050	0,0880502
	1732,5	20,76	0,5	2,50	2,7	26,46		0,4426	442,6	1,0000	0,0881	0,9119	0,088050	
	1754,3	20,76	0,5	2,50	2,7	26,46		0,4426	442,6	1,0000	0,0881	0,9119	0,088050	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ²]
Highest MPE value in frequency-band:	0,1287	[mW/cm ²]
Lowest margin to limit in frequency-band:	0,8713	[mW/cm ²]

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

4.2.3.1. MPE results for external antenna (EUT C)

Safety-Distance			20 cm											
Operation Mode	Frequency on channel	Measured maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Ext. Path Loss to antenna (external cables)	Declared maximum ERP (Measured+ Tune-up+ Antenna Gain) (dBm)	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)		%	(W)	(mW)	(mW/cm²)	(mW/cm²)	(W/m²)		
GSM/GPRS (AV-Burst value)	1850,2	27,20	0,50	5,50	3,00	30,20	50%	1,047	524	1,0000	0,1042	0,89584	0,10416	0,10659
	1880,0	27,30	0,50	5,50	3,00	30,30		1,072	536	1,0000	0,1066	0,89341	0,10659	
	1909,8	27,30	0,50	5,50	3,00	30,30		1,072	536	1,0000	0,1066	0,89341	0,10659	
EDGE (AV-Burst value)	1850,2	23,30	0,50	5,50	3,00	26,30	50%	0,427	213	1,0000	0,0424	0,95757	0,04243	0,04443
	1880,0	23,40	0,50	5,50	3,00	26,40		0,437	218	1,0000	0,0434	0,95658	0,04342	
	1909,8	23,50	0,50	5,50	3,00	26,50		0,447	223	1,0000	0,0444	0,95557	0,04443	
W-CDMA FDD Band 2 (RMS-Value)	1852,4	21,53	0,50	5,50	3,00	24,53	100%	0,284	284	1,0000	0,0565	0,94354	0,05646	0,05646
	1880,0	21,53	0,50	5,50	3,00	24,53		0,284	284	1,0000	0,0565	0,94354	0,05646	
	1907,6	20,83	0,50	5,50	3,00	23,83		0,242	242	1,0000	0,0481	0,95195	0,04805	
LTE Band 2 (QPSK, #1RB, RMS-Value)	1850,7	20,83	0,50	5,50	3,00	23,83	100%	0,242	242	1,0000	0,0481	0,95195	0,04805	0,04805
	1880,0	20,83	0,50	5,50	3,00	23,83		0,242	242	1,0000	0,0481	0,95195	0,04805	
	1909,3	20,83	0,50	5,50	3,00	23,83		0,242	242	1,0000	0,0481	0,95195	0,04805	
LTE Band 2 (16QAM, #1RB, RMS-Value)	1850,7	20,26	0,50	5,50	3,00	23,26	100%	0,212	212	1,0000	0,0421	0,95786	0,04214	0,04214
	1880,0	20,26	0,50	5,50	3,00	23,26		0,212	212	1,0000	0,0421	0,95786	0,04214	
	1909,3	20,26	0,50	5,50	3,00	23,26		0,212	212	1,0000	0,0421	0,95786	0,04214	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,00000	[m W/cm ^2]
Highest MPE value in frequency-band:	0,10659	[m W/cm ^2]
Margin to limit in frequency-band:	0,89341	[m W/cm ^2]

4.2.3.2. MPE results for backup antenna (inside EUTA/B)

Safety-Distance	20	cm												
Operation Mode	Frequency on channel	Measured maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain inkl. RF-Path Loss	Correction Internal Path Loss to antenna	Declared maximum ERP (Measured+ Tune-up+ Antenna Gain) (dBm)	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)		%	(W)	(m W)	(m W/cm ^2)	(m W/cm ^2)	(W/m ^2)		
GSM/GPRS (AV-Burst value)	1850.2	27.20	0.50	2.50	2.70	32.90	50%	1.950	975	1.0000	0.19395	0.80605	0.19395	0.19847
	1880.0	27.30	0.50	2.50	2.70	33.00		1.995	998	1.0000	0.19847	0.80153	0.19847	
	1909.8	27.30	0.50	2.50	2.70	33.00		1.995	998	1.0000	0.19847	0.80153	0.19847	
EDGE (AV-Burst value)	1850.2	23.30	0.50	2.50	2.70	29.00	50%	0.794	397	1.0000	0.07901	0.92099	0.07901	0.08274
	1880.0	23.40	0.50	2.50	2.70	29.10		0.813	406	1.0000	0.08085	0.91915	0.08085	
	1909.8	23.50	0.50	2.50	2.70	29.20		0.832	416	1.0000	0.08274	0.91726	0.08274	
W-CDMA FDD Band 2 (RMS-Value)	1852.4	21.53	0.50	2.50	2.70	27.23	100%	0.528	528	1.0000	0.10513	0.89487	0.10513	0.10513
	1880.0	21.53	0.50	2.50	2.70	27.23		0.528	528	1.0000	0.10513	0.89487	0.10513	
	1907.6	20.83	0.50	2.50	2.70	26.53		0.450	450	1.0000	0.08948	0.91052	0.08948	
LTE Band 2 (QPSK, #1RB, RMS-Value)	1850.7	20.83	0.50	2.50	2.70	26.53	100%	0.450	450	1.0000	0.08948	0.91052	0.08948	0.08948
	1880.0	20.83	0.50	2.50	2.70	26.53		0.450	450	1.0000	0.08948	0.91052	0.08948	
	1909.3	20.83	0.50	2.50	2.70	26.53		0.450	450	1.0000	0.08948	0.91052	0.08948	
LTE Band 2 (16QAM, #1RB, RMS-Value)	1850.7	20.26	0.50	2.50	2.70	25.96	100%	0.394	394	1.0000	0.07847	0.92153	0.07847	0.07847
	1880.0	20.26	0.50	2.50	2.70	25.96		0.394	394	1.0000	0.07847	0.92153	0.07847	
	1909.3	20.26	0.50	2.50	2.70	25.96		0.394	394	1.0000	0.07847	0.92153	0.07847	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[m W/cm ^2]
Highest MPE value in frequency-band:	0,1985	[m W/cm ^2]
Margin to limit in frequency-band:	0,8015	[m W/cm ^2]

4.2.4. Results for 2.4GHz W-Lan Mode

4.2.4.1. MPE results

Following table shows calculations with Wireless LAN 2.4GHz technology active in the device.

Internal antenna of EUT C with a maximum gain of 7.4dBi was considered as worst case over External antenna with a gain of 3.9dBi.

Distance	20	cm												
Operation Mode	Frequency on channel	Declared maximum conducted output power	Max. positive tolerance according manufacturer	Antenna Gain	Path Loss to ext. antenna connector according manufacturer	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)			
W-LAN or Bluetooth or Zigbee 2.4GHz	2412,0	20,20	0,5	7,4	3,6	28,1	100%	0,6457	645,7	1,0000	0,1284	0,8716	0,128449	0,1505671
	2437,0	20,89	0,5	7,4	3,6	28,8		0,7568	756,8	1,0000	0,1506	0,8494	0,150567	
	2462,0	19,36	0,5	7,4	3,6	27,3		0,5321	532,1	1,0000	0,1059	0,8941	0,105860	

Maximum calculated MPE value:		
Lowest MPE-Limit:	1,00000	[mW/cm ²]
Highest MPE value:	0,15057	[mW/cm ²]
Lowest Margin to limit:	0,84943	[mW/cm ²]

4.2.5. Results for 5GHz W-LAN Mode

4.2.5.1. MPE results

Following table shows calculations with wireless LAN 5GHz technology active in the device.

Distance=20cm														
Operation Mode	Frequency on channel	Measured maximum conducted output power	Max. positive tolerance according manufacturer's tune-up info	Declared Antenna Gain	Path Loss to ext. antenna connector according manufacturer	ERP	Duty cycle	Maximum ERP	Equivalent ERP (ERP x duty cycle)	MPE-Value	MPE-Value	Margin	Fraction for Co-location calculations	Maximum Fraction Value within Frequency band
	(MHz)	(dBm)	(dB)	(dBi)	(dB)	(dBm)	(%)	(W)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)		
W-LAN 5GHz (20MHz BW)	5180,0	12,98	0,50	8,25	4,90	16,83	100%	0,0482	48,19	1,0000	0,00959	0,99041	0,00959	0,00959
	5200,0	12,98	0,50	8,25	4,90	16,83	100%	0,0482	48,19	1,0000	0,00959	0,99041	0,00959	
	5240,0	12,98	0,50	8,25	4,90	16,83	100%	0,0482	48,19	1,0000	0,00959	0,99041	0,00959	
W-LAN 5GHz (20MHz BW)	5260,0	12,71	0,50	7,50	4,90	15,81	100%	0,0381	38,11	1,0000	0,00758	0,99242	0,00758	0,00758
	5280,0	12,71	0,50	7,50	4,90	15,81	100%	0,0381	38,11	1,0000	0,00758	0,99242	0,00758	
	5320,0	12,71	0,50	7,50	4,90	15,81	100%	0,0381	38,11	1,0000	0,00758	0,99242	0,00758	
W-LAN 5GHz (20MHz BW)	5500,0	12,65	0,50	7,20	4,90	15,45	100%	0,0351	35,08	1,0000	0,00698	0,99302	0,00698	0,00698
	5580,0	12,65	0,50	7,20	4,90	15,45	100%	0,0351	35,08	1,0000	0,00698	0,99302	0,00698	
	5700,0	12,65	0,50	7,20	4,90	15,45	100%	0,0351	35,08	1,0000	0,00698	0,99302	0,00698	
W-LAN 5GHz (20MHz BW)	5745,0	11,28	0,50	7,00	4,90	13,88	100%	0,0244	24,43	1,0000	0,00486	0,99514	0,00486	0,00486
	5785,0	11,28	0,50	7,00	4,90	13,88	100%	0,0244	24,43	1,0000	0,00486	0,99514	0,00486	
	5825,0	11,28	0,50	7,00	4,90	13,88	100%	0,0244	24,43	1,0000	0,00486	0,99514	0,00486	
W-LAN 5GHz (40MHz BW)	5190,0	10,51	0,50	8,25	4,90	14,36	100%	0,0273	27,29	1,0000	0,00543	0,99457	0,00543	0,00543
	5230,0	10,51	0,50	8,25	4,90	14,36	100%	0,0273	27,29	1,0000	0,00543	0,99457	0,00543	
	5270,0	10,40	0,50	7,50	4,90	13,50	100%	0,0224	22,39	1,0000	0,00445	0,99555	0,00445	0,00445
W-LAN 5GHz (40MHz BW)	5310,0	10,40	0,50	7,50	4,90	13,50	100%	0,0224	22,39	1,0000	0,00445	0,99555	0,00445	
	5510,0	9,40	0,50	7,20	4,90	12,20	100%	0,0166	16,60	1,0000	0,00330	0,99670	0,00330	0,00330
	5550,0	9,40	0,50	7,20	4,90	12,20	100%	0,0166	16,60	1,0000	0,00330	0,99670	0,00330	
	5670,0	9,40	0,50	7,20	4,90	12,20	100%	0,0166	16,60	1,0000	0,00330	0,99670	0,00330	
W-LAN 5GHz (40MHz BW)	5755,0	8,27	0,50	7,00	4,90	10,87	100%	0,0122	12,22	1,0000	0,00243	0,99757	0,00243	0,00243
	5795,0	8,27	0,50	7,00	4,90	10,87	100%	0,0122	12,22	1,0000	0,00243	0,99757	0,00243	

Maximum calculated MPE value:		
5GHz		
Lowest MPE-Limit:	1,00000	[W/m ²]
Highest MPE value:	0,00959	[W/m ²]
Margin to limit	0,99041	[W/m ²]

4.2.6. Co-location assessment for external antenna (scenario)

According KDB447498 D01 v05r02 simultaneous transmission MPE test exclusion applies, when the sum of ratio MPE-Value/MPE-Limit for all active transmitters is equal/less 1. (≤ 1)

		GSM/GPRS/ E-GPRS Band-850	W-CDMA Band 5	LTE- Band 5	LTE Band 17	W-CDMA Band 4	LTE Band 4	GSM/GPRS/ E-GPRS Band 1900	W-CDMA Band 2	LTE Band 2	W-LAN 2.4GHz	W-LAN 5GHz
	Ratio of MPE- Value/Limit	0,329308276	0,12395134	0,095360662	0,1220543	0,061621199	0,053055467	0,106585996	0,056458605	0,048054066	0,15056712	0,009588047
W-LAN 2.4GHz	0,15056712	0,479875397	0,274518461	0,245927782	0,272621421	0,21218832	0,203622588	0,257153117	0,207025726	0,198621187	--	0,160155167
W-LAN 5GHz	0,009588047	0,338896323	0,133539387	0,104948709	0,131642347	0,07120925	0,062643514	0,116174043	0,066046652	0,057642113	0,160155167	--
Maximum-Value		0,479875397										

4.2.7. Co-location assessment for internal backup antenna (scenario)

		GSM/GPRS/ E-GPRS Band-850	W-CDMA Band 5	LTE- Band 5	LTE Band 17	W-CDMA Band 4	LTE Band 4	GSM/GPRS/ E-GPRS Band 1900	W-CDMA Band 2	LTE Band 2	W-LAN 2.4GHz	W-LAN 5GHz
	Ratio of MPE- Value/Limit	0,180968358	0,068116328	0,052404582	0,067073827	0,128744933	0,110848583	0,198472413	0,105130842	0,089480859	0,15056712	0,009588047
W-LAN 2.4GHz	0,15056712	0,331535478	0,218683448	0,202971702	0,217640947	0,27931205	0,261415703	0,349039533	0,255697963	0,240047979	--	0,160155167
W-LAN 5GHz	0,009588047	0,190556405	0,077704375	0,061992628	0,076661874	0,13833298	0,120436629	0,208060459	0,114718889	0,099068906	0,160155167	--
Maximum-Value		0,349039533										

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 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	--	--	--			
		12.75 - 26.5GHz	N/A	0.82	--	--	--			
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	--	--	--		N/A - not applicable	
		2.8 GHz - 12.75GHz	1.48	N/A	--	--	--			
		12.75 GHz - 18GHz	1.81	N/A	--	--	--			
		18 GHz - 26.5GHz	1.83	N/A	--	--	--			
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 Measurment.	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 Measurment.	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	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
460	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	31.05.2016
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)	-	Id	
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	2016-04-19
--	--	--