

TEST REPORT

No.: 17-1-0105501T07a-C2

According to:
FCC Regulations
 Part 1.1310
 Part 2.1091

for

Daimler Trucks North America

7 620 000 296
 66-10777-001

FCC: 2AKC8CTP10777001

Laboratory Accreditation and Listings			
 Deutsche Akkreditierungsstelle D-PL-12047-01-01	 FEDERAL COMMUNICATIONS COMMISSION USA MRA US-EU 0003	 Industry Canada 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	 Authorized TM 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 Equipment Under Test (in this report, hereinafter referred as EUT) supports WLAN 2.4 GHz, Bluetooth Low Energy & Cellular radiofrequency technologies with build in GSM850/1900, WCDMA FDDII/IV/V and LTE B2/4/5/7/17 (integrated cellular module: FCC ID: XPYTOBYL200)

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	1	1 to 8	Pass Remark 1+2
			§15.247(b)(3)	1 Watt Peak			
--	RF Power (radiated)	Cabinet	§2.1046 §22.913(a)(2)	< 7 Watt ERP	2	1 to 8	Pass Remark 1+2
			§24.232(c)	< 2Watt (EIRP)			
			§27.50(c)(10)	< 3 Watt (ERP)			
			§27.50(d)	< 1 Watt (EIRP)			
			§15.247(b)(4)	< 4 Watt (EIRP) for antenna with directional gain less 6dBi			
--	Radio frequency Exposure Evaluation (MPE)	Cabinet	§1.1310 §2.1091 §2.1093	FCC: §1.1310 Table 1, Limits for General Population	2	1 to 8	Pass, Remark 1+2

Remark:

- 1.) See separate test reports & corresponding annexes for following installed technologies
 GSM850/1900: CETECOM_TR17-1-0105501T02a-C2
 W-CDMA FDD Band 2 & FDD Band 5: CETECOM_TR17-1-0105501T03a-C2
 LTE B2/4/5/7/17: CETECOM_TR17-1-0105501T04a-C2
 WLAN 2.4 GHz : CETECOM_TR17-1-0105501T05a-C2
 Bluetooth Low Energy: CETECOM_TR17-1-0105501T06a-C2
- 2.) Calculations based on Tune-Up Info delivered by applicant

The current version of the Test Report CETECOM_TR17-1-0105501T07a-C2 replaces the Test Report CETECOM_TR17-1-0105501T07a-C1 dated 2018-01-08. The replaced test report is herewith invalid.



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



.....
Dipl.-Ing. N. Perez
Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Dipl.-Ing. Rachid Acharkaoui
Deputy:	Dipl.-Ing. Niels Jeß

2.2. Test location

2.2.1. Test laboratory "CTC"

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

Responsible for test report and project leader:	Dipl.-Ing. N. Perez
Receipt of EUT:	2017-08-17
Date(s) of test:	2017-08-18 to 2017-10-05
Date of report:	2018-01-31

Version of template:	13.02

2.4. Applicant's details

Applicant's name:	Daimler Trucks North America
Address:	4747 N. Channel Ave. Portland, OR 97217 U.S.A.
Contact person:	Mr. Jürgen Weber

2.5. Manufacturer's details

Manufacturer's name:	Bosch Car Multimedia Portugal, S.A.
Address:	Rua Max Grundig 35 4705-820 Braga Portugal

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=fy%2FvplxCthQV%2Bcew9PD2Q%3D%3D&fcc_id=XPYTOBYL200
Antenna Type	☐ Integrated (enclosure) ☐ External - dedicated, no RF- connector ☒ External, separate RF-connector
Antenna Gain Tx* ¹	GSM850/FDD Band 5: 0dBi GSM1900 / FDD Band 2: 0dBi
Peak Output Power : Conducted GSM 850 Conducted EDGE850 Conducted GSM 1900 Conducted EDGE 1900	31.4dBm (Peak) 29.4dBm (Peak) 28.7dBm (Peak) 28.0dBm (Peak)
Peak EIRP: GSM 850 EDGE850 GSM 1900 EDGE 1900	=Peak Max Output Power + Antenna Gain 31.4dBm + 0dBi = 31.4dBm 29.4dBm + 0dBi = 29.4dBm 28.7dBm + 0dBi = 28.7dBm 28.0dBm + 0dBi = 28.0dBm
Peak ERP: GSM 850 EDGE850 GSM 1900 EDGE 1900	= Peak EIRP – 2.15dBi 31.4dBm – 2.15dBi = 29.25dBm 29.4dBm – 2.15dBi = 27.25dBm 28.7dBm – 2.15dBi = 26.55dBm 28.0dBm – 2.15dBi = 25.85dBm

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)
Power supply	☒ DC power only: 24V DC
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

Remark: *¹)please refer to antenna data sheet “D126-0153A - HCEL-AG-0205A Installation Instruction Rev1”

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 – 4185 – 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=fy%2FxFVplxCthQV%2BcBew9PD2Q%3D%3D&fcc_id=XPYTOBYL200
Antenna Type	☐ Integrated (enclosure) ☐ External - dedicated, no RF- connector ☒ External, separate RF-connector
Antenna Gain Tx ^{*1)}	GSM850/FDD Band 5/LTE B5: 0dBi GSM1900 / FDD Band 2/ LTE B5: 0dBi FDD Band 4/ LTE B4: 0dBi
Max. Output Power:	
Conducted FDD-Mode 2	25.73dBm (peak) / 22.51dBm (AV)
Conducted FDD-Mode 4	26.01dBm (Peak) / 22.73dBm (AV)
Conducted FDD-Mode 5	25.73dBm (Peak) / 22.39dBm (AV)
Peak EIRP:	= Peak Max Output Power + Antenna Gain
Conducted FDD-Mode 2	25.73dBm + 0dBi = 25.73dBm
Conducted FDD-Mode 4	26.01dBm + 0dBi = 26.01dBm
Conducted FDD-Mode 5	25.73dBm + 0dBi = 25.73dBm
Peak ERP:	= Peak EIRP – 2.15dBi
Conducted FDD-Mode 2	25.73dBm – 2.15dBi = 23.58dBm
Conducted FDD-Mode 4	26.01dBm – 2.15dBi = 23.86dBm
Conducted FDD-Mode 5	25.73dBm – 2.15dBi = 23.58dBm

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)		
Power supply	☒ DC power only: 24V DC via battery		
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	

Remark: *1) please refer to antenna data sheet "D126-0153A - HCEL-AG-0205A Installation Instruction Rev1"

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 7: 824 - 849 MHz (Uplink), 869-894 MHz (Downlink) ☐ LTE Band 13: 777 - 787 MHz (Uplink), 746-756 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 (See Note in 3GPP-Standard about channels not to be used depending on channel bandwidths)	☒ LTE Band 2: UARFCN range 18600 - 19199 ☒ LTE Band 4: UARFCN range 19950 - 20399 ☒ LTE Band 5: UARFCN range 20400 - 20649 ☒ LTE Band 7: UARFCN range 20750 - 21449 ☐ LTE Band 13: UARFCN range 23180 - 23279 ☒ LTE Band 17: UARFCN range 23730 - 23849		
Emission designator(s)	Nominal 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=fy%2FxFVplxCthQV%2Bcew9PD2Q%3D%3D&fcc_id=XPYTOBYL200	See original grant under: https://apps.fcc.gov/oetcf/tcb/reports/Tcb731GrantForm.cfm?mode=COPY&RequestTimeout=500&tcb_code=&application_id=fy%2FxFVplxCthQV%2Bcew9PD2Q%3D%3D&fcc_id=XPYTOBYL200
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector		
Antenna Gain Tx *1)	☒ Values: 850MHz Band: 0dBi 1700MHz band: 0dBi 1900MHz Band: 0dBi		

MAX Average Output Power:	
Conducted	LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 7 LTE-Mode 17
	22.22 dBm (AV) 22.21 dBm (AV) 22.24 dBm (AV) 21.81 dBm (AV) 22.42 dBm (AV)
EIRP	conducted output power + antenna gain LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 7 LTE-Mode 17
	22.22 dBm + 0 dBi = 22.22 dBm 22.21 dBm + 0 dBi = 22.21 dBm 22.24 dBm + 0 dBi = 22.24 dBm 21.81 dBm + 0 dBi = 21.81 dBm 22.42 dBm + 0 dBi = 22.42 dBm
ERP	EIRP – 2.15dBi LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 7 LTE-Mode 17
	22.22 dBm – 2.15 dBi = 20.07 dBm 22.21 dBm – 2.15 dBi = 20.06 dBm 22.24 dBm – 2.15 dBi = 20.09 dBm 21.81 dBm – 2.15 dBi = 19.66 dBm 22.42 dBm – 2.15 dBi = 20.27 dBm
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, Bluetooth®, ANT+ wireless technologies ☒ GPS (not tested within this test report)
Power supply	☒ DC power only: 24 V DC Nominal
Special EMI components	--
EUT sample type	☐ Production ☒ Pre-Production ☐ Engineering
FCC label attached	☐ yes ☒ no

Remark: *1) please refer to antenna data sheet “D126-0153A - HCEL-AG-0205A Installation Instruction Rev1”

3.4. TECHNICAL WLAN 2.4 GHZ DATA OF MAIN EUT DECLARED BY APPLICANT

Main function	Common telematics platform		
Type	Electronic control unit		
Frequency range (US/Canada -bands)	☒ 2412 MHz (Channel 1) to 2462 MHz (Channel 11) for 20MHz BW ☐ 2422 MHz (Channel 3) to 2453 MHz (channel 9) for 40MHz BW		
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	Max. 1.7dBi gain according applicants information in 2.4 GHz band		
MAX Field strength (radiated):	98.28dBμV/m@3m distance on nominal 2412 MHz		
Installed options (not tested within this test report)	☒ GSM 850 and GSM 1900 Bands (USA/Canada) ☒ GSM 900 and GSM 1800 Bands (not usable in USA/Canada) ☒ W-CDMA FDD Band II and FDD Band V (USA/Canada) ☒ W-CDMA Band I and Band VIII (not usable in USA/Canada) ☒ Bluetooth Low Energy ☒ GPS		
Power supply	☒ DC power only: 12 / 24 Volt ☒ Nominal Test Voltage : 24 Volt		
Special EMI components	--		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

3.5. TECHNICAL BLUETOOTH LOW ENERGY DATA OF MAIN EUT DECLARED BY APPLICANT

Main function	Common telematic platform		
Type	Electronic control unit		
Frequency range (US/Canada -bands)	☒ 2402 MHz (Channel 37) to 2480 MHz (Channel 39)		
Type of modulation	GFSK		
Number of channels (USA/Canada -bands)	37 - 39		
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector		
Antenna Gain	Max. 1.7dBi gain according applicants information in 2.4 GHz band		
MAX Field strength (radiated):	89.568 dBμV/m@3m distance on nominal		
Installed options (not tested within this test report)	☒ GSM 850 and GSM 1900 Bands (USA/Canada) ☒ GSM 900 and GSM 1800 Bands (not usable in USA/Canada) ☒ W-CDMA FDD Band II and FDD Band V (USA/Canada) ☒ W-CDMA Band I and Band VIII (not usable in USA/Canada) ☒ WLAN 2.4 GHz ☒ GPS		
Power supply	☒ DC power only: 12 / 24 Volt ☒ Nominal Test Voltage : 24 Volt		
Special EMI components	--		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

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	CTPMIDDTNA4G	7 620 000 296	2960006922	0601G01	17.02.S.016
EUT B	CTPMIDDTNA4G	7 620 000 296	2960006201	0601G01	17.02.S.016
EUT C	HCEL-AG-0205-01 / 955-180-001 (DTNA PN 66-03942-002)	4G LTE/GNSS Low Profile Adhesive Mount Antenna	--	--	--
EUT D	HWLN-AX-0115A-01	WiFi Low Profile Adhesive Mount Antenna	--	--	--

*) 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 wiring long with load box	--	--	--	--
AE 2	Main wiring short	--	--	--	--
AE 3	Laptop	--	--	--	--
AE 4	USB -cable	0.3m	--	-	-
AE 5	Test Laptop	--	--	-	-

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

3.8. EUT set-ups

EUT set-up no. *)	Combination of EUT and AE	Remarks
set. 1	EUT B + AE 2 + AE 3 + AE 4 + AE 5	Set-up for conducted RF-tests.
set. 2	EUT A + EUT C + EUT D + AE1 + AE 3 + AE 4 + AE 5	Set-up for radiated tests

*) 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 wiring	--	--	--	3 m

3.10. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	GPRS 850 TCH mode TCH=128/192/251	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 33 dBm (power class 4; power control level 5). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (33dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
op. 2	E-GPRS 850 TCH mode TCH=128/192/251	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 33 dBm (power class 4; power control level 5). USF_Duty CYCLE set to 100%, coding scheme 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 TCH mode TCH=512/661/810	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 30 dBm (power class 1; power control level 0). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (30dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
op. 4	E-GPRS 1900 TCH mode PCL=0 (max. power) TCH=512/661/810	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 26 dBm (power class 1; power control level 0). USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8-PSK modulation, slot 3 active, uplink gamma: 5 (26dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
op. 5	FDD-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	

op. 8	LTE Band2: Channel: 18606 and 19175	A communication link is established between the mobile station (UE) and the test simulator
op. 9	LTE FDD4 Channel: 19965 and 20300	A communication link is established between the mobile station (UE) and the test simulator
op. 10	LTE FDD5 Channel : 20425 and 20625	A communication link is established between the mobile station (UE) and the test simulator
op. 11	LTE FDD7 Channel : 20750 and 21449	A communication link is established between the mobile station (UE) and the test simulator
op. 12	LTE FDD 17 Channel: 23755 and 23800	A communication link is established between the mobile station (UE) and the test simulator
op. 13	WLAN 2.4 GHz TX-Mode	With help of special test firmware a continuous traffic modes : - 802.11 b -Mode (DSSS System) - 802.11 g -Mode (OFDM system) - 802.11 n -Mode (OFDM system) ☒ 2412 MHz (Channel 1) to 2462 MHz (Channel 11) for 20MHz BW
op. 14	BLUETOOTH LOW ENERGY TX-Mode	With help of special test firmware a continuous traffic mode: -BT-LE (GFSK 1 Mbps) ☒ 2402 MHz (Channel 37) to 2480 MHz (Channel 39)

*) 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: $f/1500$ 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
- 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) were applied

Valid for W-CDMA/LTE Mode:

- The power was considered for 3 frequencies (lowest/middle/highest) within each operable FDD-band (see separate report for W-CDMA and LTE technology)
- No duty-cycle correction factor is applicable

4.1.5. Cellular (licensed services) references for evaluation

Please find in the following tables the calculations based on **applicants or manufacturer's documents**:

LTE Wireless Module: Original MPE-Report for Wireless-Module with FCC-ID XPYTOBYL200:

“MDE_UBLOX_1808_MPEa” dated 2014-10-22 Version 003, which can be found under:

https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=fy%2FvplxCthQV%2Bcew9PD2Q%3D%3D&fcc_id=XPYTOBYL200

Reported power conducted including tune-up info for GSM, W-CDMA and LTE operating mode are considered herewith.

Cellular Antenna data-sheet: “D126-0153A - HCEL-AG-0205A Installation Instruction Rev1”

4.1.6. Un-licensed services references for evaluation

Please find in the following tables the calculations based on **applicants or manufacturer's documents**:

W-LAN Wireless Module:

According to applicant's declaration 17dBm max conducted power.

Bluetooth® Low-Energy Wireless Module: UGKZ7A2001A_ApprovalSpecification_Rev102_06Jul2016

The results are based on maximum stated power values of 4dBm measured on Bluetooth®-LE operating mode

2.4GHz Antenna data-sheet: HWLN-AX-0115A-SPEC SHEET showing a value of 1.7dBi for WiFi Low Profile Adhesive Mount antenna

4.2. Results for fixed and mobile operations

4.2.1. Results for lower operational band: GSM850, FDD Band 5, LTE B5, LTE B17

4.2.1.1. MPE results

Distance	20	cm										
Operating Mode	Frequency on channel	Declared maximum conducted output power	Antenna Gain	Calculated maximum output power	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)	(dBi)	(dBm)	%	(W)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)		
GSM/GPRS (Avg. Burst Power)	824,2	33,0	0	33,25	50%	2,113	1057	0,5495	0,2102	0,3392	0,3826	0,3826
	837,0	33,0	0	33,25		2,113	1057	0,5580	0,2102	0,3478	0,3768	
	848,8	33,0	0	33,25		2,113	1057	0,5659	0,2102	0,3556	0,3715	
WCDMA FDD Band 5 (RMS-Value)	826,4	24,5	0	24,5	100%	0,282	282	0,5509	0,0561	0,4949	0,1018	0,1018
	836,4	24,5	0	24,5		0,282	282	0,5576	0,0561	0,5015	0,1006	
	846,6	24,5	0	24,5		0,282	282	0,5644	0,0561	0,5083	0,0993	
LTE Band 5 (RMS-Value)	824,7	24,0	0	24	100%	0,251	251	0,5498	0,0500	0,4998	0,0909	0,0909
	836,5	24,0	0	24		0,251	251	0,5577	0,0500	0,5077	0,0896	
	848,3	24,0	0	24		0,251	251	0,5655	0,0500	0,5156	0,0884	
LTE Band 17 (RMS-Value)	709	24,0	0	24	100%	0,251	251	0,4727	0,0500	0,4227	0,1057	0,1057
	710	24,0	0	24		0,251	251	0,4733	0,0500	0,4234	0,1056	
	711	24,0	0	24		0,251	251	0,4740	0,0500	0,4240	0,1054	

Maximum calculated MPE value:		
Lowest MPE-Limit in Frequency-Band:	0,4665	[mW/cm ²]
Highest MPE value in frequency-band:	0,2102	[mW/cm ²]
Lowest margin to limit in frequency-band:	0,3392	[mW/cm ²]

4.2.2. Results for upper operational band: FDD 2, GSM1900, LTE B2

4.2.2.1. MPE results

Safety-Distance	20	cm										
Operation Mode	Frequency on channel	Declared maximum conducted output power	Antenna Gain	Calculated maximum output power	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)	(dBi)	(dBm)	%	(W)	(mW)	(mW/cm ²)	(mW/cm ²)	(W/m ²)		
GSM/GPRS (AV Burst Power)	1850,2	30,2	0,0	30,2	50%	1,047	524	1,0000	0,1042	0,8958	0,104160	0,1041598
	1880,0	30,2	0,0	30,2		1,047	524	1,0000	0,1042	0,8958	0,104160	
	1909,8	30,2	0,0	30,2		1,047	524	1,0000	0,1042	0,8958	0,104160	
W-CDMA FDD Band 2 (RMS-Value)	1852,4	24,5	0,0	24,5	100%	0,282	282	1,0000	0,0561	0,9439	0,056070	0,0560699
	1880,0	24,5	0,0	24,5		0,282	282	1,0000	0,0561	0,9439	0,056070	
	1907,6	24,5	0,0	24,5		0,282	282	1,0000	0,0561	0,9439	0,056070	
LTE Band 2 (RMS-Value)	1860,0	24,0	0,0	24	100%	0,251	251	1,0000	0,0500	0,9500	0,049972	0,0499724
	1880,0	24,0	0,0	24		0,251	251	1,0000	0,0500	0,9500	0,049972	
	1909,3	24,0	0,0	24		0,251	251	1,0000	0,0500	0,9500	0,049972	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ²]
Highest MPE value in frequency-band:	0,1042	[mW/cm ²]
Margin to limit in frequency-band:	0,8958	[mW/cm ²]

4.2.3. Results for upper operational band: FDD 4, LTE B4

4.2.3.1. MPE results

Distance:	20	cm										
Operating Mode	Frequency on channel (MHz)	Declared maximum conducted output power (dBm)	Antenna Gain (dBi)	Calculated maximum output power (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	24,5	0,0	24,5	100%	0,2818	281,8	1,0000	0,0561	0,9439	0,056070	0,0560699
	1740,0	24,5	0,0	24,5		0,2818	281,8	1,0000	0,0561	0,9439	0,056070	
	1752,6	24,5	0,0	24,5		0,2818	281,8	1,0000	0,0561	0,9439	0,056070	
LTE Band 4 (RMS-Value)	1710,7	24,0	0,0	24	100%	0,2512	251,2	1,0000	0,0500	0,9500	0,049972	0,0499724
	1732,5	24,0	0,0	24		0,2512	251,2	1,0000	0,0500	0,9500	0,049972	
	1754,3	24,0	0,0	24		0,2512	251,2	1,0000	0,0500	0,9500	0,049972	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ²]
Highest MPE value in frequency-band:	0,0561	[mW/cm ²]
Lowest margin to limit in frequency-band:	0,94	[mW/cm ²]

4.2.4. Results for upper operational band: LTE B7

4.2.4.1. MPE results

Safety-Distance	20	cm										
Operation Mode	Frequency on channel (MHz)	Declared maximum conducted output power (dBm)	Antenna Gain (dBi)	Calculated maximum output power (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: (W/m ²)	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
LTE Band 7 (RMS-Value)	2500,7	24,0	0,00	24,0	100%	0,251	251	1,0000	0,0500	0,9500	0,049972	0,0499724
	2535,0	24,0	0,00	24,0		0,251	251	1,0000	0,0500	0,9500	0,049972	
	2569,3	24,0	0,00	24,0		0,251	251	1,0000	0,0500	0,9500	0,049972	

Maximum calculated MPE value:		
Lowest MPE-Limit in frequency-band:	1,0000	[mW/cm ²]
Highest MPE value in frequency-band:	0,0500	[mW/cm ²]
Margin to limit in frequency-band:	0,9500	[mW/cm ²]

4.2.5. Results for Un-licensed transmitters

Distance	20	cm										
Operation Mode	Frequency on channel	Declared maximum conducted output power	Antenna Gain	Declared maximum ERP (Measured+ Tune-up)	Duty cycle	Declared Maximum conducted output power	Equivalent conducted output power (output power 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)	(dBi)	(dBm)	%	(W)	(mW)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)		
W-LAN 2.4GHz	2412,0	13,3	1,7	15,0	100%	0,0318	31,8	1,0000	0,00632	0,9937	0,006320	0,0063202
	2437,0	13,3	1,7	15,0		0,0318	31,8	1,0000	0,00632	0,9937	0,006320	
	2462,0	13,3	1,7	15,0		0,0318	31,8	1,0000	0,00632	0,9937	0,006320	
Bluetooth Low-Energy 2.4GHz	2402,0	-2,61	1,7	-0,9	100%	0,0008	0,8	1,0000	0,00016	0,9998	0,000161	0,0001613
	2442,0	-2,61	1,7	-0,9		0,0008	0,8	1,0000	0,00016	0,9998	0,000161	
	2480,0	-2,61	1,7	-0,9		0,0008	0,8	1,0000	0,00016	0,9998	0,000161	

4.2.6. Co-location assessment (scenario)

Following table shows calculations with W-LAN and Bluetooth® Low-Energy technology active in the device which can simultaneously driven to the cellular services.

Also it shows the MPE calculations on a scenario when additional to the cellular transmitter a non-licensed modular transmitter is active at same time. Special limitations such as interractions between the transmitting RF-antennas due small physical distance between them, are not sufficient modeled by the far field formula for power density. For such cases a non-linear program electromagnetic software or MPE measurements should be performed.

According KDB447498 D01 v06 simultanuos transmission MPE test exclusion applies, when the sum of ratio MPE-Value/MPE-Limit for all active transmitters is equal/less 1. (≤ 1).

		GSM/G-PRS/ 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	LTE Band 7	W-LAN 2.4GHz	BT LE 2.4GHz
	Ratio of MPE- Value/Limit	0,382612186	0,101772653	0,090891948	0,105724385	0,056069947	0,049972393	0,104159803	0,056069947	0,049972393	0,049972393	0,00632019	0,000161336
W-LAN 2.4GHz	0,00632019	0,388932376	0,108092843	0,097212138	0,112044575	0,06239014	0,056292583	0,110479993	0,062390137	0,056292583	0,056292583	--	0,006481526
BT LE 2.4GHz	0,000161336	0,382773521	0,101933988	0,091053283	0,105885721	0,05623128	0,050133728	0,104321138	0,056231282	0,050133728	0,050133728	0,006481526	--
Maximum-Value		0,388932376											

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 Measur.	FCC, Federal Communications Commission Laboratory Division, USA
337 487 550 558	3462D-1 3462D-2 3462D-2 3462D-3	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR)	IC, Industry Canada Certification and Engineering Bureau
487 550 348 348	R-2666 G-301 C-2914 T-1967	Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

7. Instruments and Ancillary

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

7.0.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	EMI Test Receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
053	Audio Analyzer	UPA3	860612/022	Firm. V 4.3
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
140	Signal Generator	SMHU	831314/006	Firm.= 3.21
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
263	Signal Generator	SMP 04	826190/0007	Firm.=3.21
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
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	-	Spuri 7.2.5 or 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
607	Signal Generator	SMR 20	832033/011	V1.25
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
670	Univ. Radio Communication Tester	CMU 200	106833	µP1 =V8.50, Firmware = V.20
689	Vector Signal Generator	SMU200	100970	02.20.360.142
692	Bluetooth Tester	CBT 32	100236	CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF)

7.0.2. 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
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
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	-	Spuri 7.2.5 or 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
607	Signal Generator	SMR 20	832033/011	V1.25
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
670	Univ. Radio Communication Tester	CMU 200	106833	µP1 =V8.50, Firmware = V.20
689	Vector Signal Generator	SMU200	100970	02.20.360.142
692	Bluetooth Tester	CBT 32	100236	CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF)

7.0.3. 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	-	16.05.2018
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	15.05.2018
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	17.05.2018
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	15.05.2019
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	30.05.2019
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	-	15.05.2019
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	-	30.05.2019
133	horn antenna 18 GHz (Meas 1)	3115	9012-3629	EMCO	36 M	1c	10.03.2020
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	36 M	-	10.03.2020
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	-	30.05.2018
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	-	30.05.2018
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	30.05.2018
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	30.05.2019
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	30.05.2018
266	Peak Power Sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	30.05.2018
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	-	17.05.2018
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	-	14.03.2020
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	20.03.2020
331	Climatic Test Chamber -40/+180 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	30.10.2018
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	30.05.2018
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	17.05.2019
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	-	30.05.2018
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	24.05.2019
371	Bluetooth Tester	CBT32	100153	R&S	36 M	-	30.05.2019
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	12 M	-	17.05.2018
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	15.05.2018
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	18.05.2018
405	Thermo-/Hygrometer	OPUS 10 THI	126.0604.0003.3.3.3.22	LUFFT Mess u. Regeltechnik	24 M	-	30.03.2019
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	24.05.2018
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	10.03.2020
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.09.2017
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	
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	30.05.2018

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	-	16.05.2019
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Bri)	-	1d	
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	31.09.2017
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	18.05.2019
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwright	12 M	1c	30.06.2017
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	18.05.2019
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	-	30.03.2018
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	30.04.2017
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.07.2018
550	System CTC S-VSWR Verification SAR-EMI	System EMI Field SAR S-VSWR	-	ETS Lindgren/CETECOM	24 M	-	31.07.2017
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	31.03.2019
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	pre-m	-	
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	17.05.2019
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	15.05.2019
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	-	30.05.2018
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	16.05.2018
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. Luft GmbH	24 M	-	30.03.2019
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	-	KogitLink	-	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	-	24.05.2018
644	Amplifier	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	24 M	-	30.05.2018
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	-	17.05.2018
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	29.03.2019
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	17.05.2018
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	12 M	-	16.05.2018
691	OSP120 Base Unit	OSP120	101183	Rohde & Schwarz	12 M	-	22.05.2018
692	Bluetooth Tester	CBT 32	100236	Rohde & Schwarz	36 M	-	29.05.2020
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	
703	INNCO Antennen Mast	MA 4010-KT080-XPET-ZSS3	MA4170-KT100-XPET-	INNCO	pre-m	-	
704	INNCON Controller	CO 3000-4port	CO3000/933/38410516/L	INNCO Systems GmbH	pre-m	-	
711	Harmonic Mixer 90 GHz - 140GHz	RPG FS-Z140	101004	RPG	12 M	-	22.02.2018
712	Harmonic Mixer 75 GHz - 110GHz	FS-Z110	101468	Rohde & Schwarz	12 M	-	22.02.2018
713	Harmonic Mixer, 50 GHz - 75GHz	FS-Z75	101022	Rohde & Schwarz	12 M	-	22.05.2018
714	Signal Analyzer 67GHz	FSW67	104023	Rohde & Schwarz	24 M	-	03.03.2019
715	Harmonic Mixer, 140 GHz - 220GHz	FS-Z220	101009	RPG Radiometer Physics	12 M	-	03.08.2018
716	Harmonic Mixer 220 GHz to 325 GHz	FS-Z325	101005	RPG Radiometer Physics	12 M	-	13.02.2018
747	Spectrum Analyzer	FSU 26	200152	Rohde & Schwarz	12 M	-	18.05.2018
748	Pickett-Potter Horn Antenna	FH-PP 4060	010001	Radiometer Physics	-	-	
749	Pickett-potter Horn Antenna	FH-PP 60-90	010003	Radiometer Physics	-	-	
750	Pickett-Potter Horn Antenna	FH-PP 140-220	010011	Radiometer Physics	-	-	

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. Test report version

Version	Applied changes	Date of release
--	Initial release	2017-10-10
C1	EUT identification changed	2018-01-08
C2	Power values for WLAN and BT corrected	2018-01-31