T E S T R E P O R T
No.: 16-1-0219301T12a

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

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

for

ACTIA Nordic

TEM4G Telematics Module

FCC-ID: 2AGKKTEM4G
ISED: 20839- TEM4G
PMN: TEM4G
HVIN: TEM4G
FVIN: 13

Laboratory Accreditation and Listings		
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01 Accredited EMC-Test Laboratory	Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	Voluntary Controls for Electromagnetic Emissions Reg. No.: R-20013, C-20009, T-20006, G-20013
Wi Fi ALLIANCE AUTHORIZED RF LABORATORY	ctia Authorized™ Test Lab Lab Code: 20011130-00	FEDERAL COMMUNICATIONS COMMISSION USA FC MRA US-EU 0003
accredited according to DIN EN ISO/IEC 17025		

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Laboratory Accreditation and Listings

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The listed attachments are an integral part of this report.

1. Summary of test results

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests. Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies and use an already approved cellular module with FCC-ID: QIPALS3-USR3 and ISED IC: 20839-TEM4G. This test report shows results for LTE technology only. Other implemented wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2, Part 22, Subpart H, Part 24, Subpart E (Broadband PCS) and FCC Part 27, Subpart C, of the FCC CFR Title 47 Rules, Edition 4th November 2016 and Canada RSS-132 Issue 3, RSS-133 Issue 6 and RSS-Gen Issue 4 standards.

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

No. of Diagram group	Test case	Port	References & Limits			EUT set-up	EUT op-mode	Result
			FCC Standard	RSS Section	Test limit			
1	AC-Power Lines Emissions Conducted (0,15 - 30 MHz)	AC-Power lines (conducted)	§15.207	RSS-Gen, Issue 4: Chapter 8.8	§15.207 limits ISED: Table 3, Chapter 8.8	--	--	Remark 1.)
2	General field strength emissions (9 kHz - 30 MHz)	Cabinet + inter-connecting cables (radiated)	§15.209(a)	RSS-Gen, Issue 4: Chapter 8.9, Table 5+6	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	2	1+2+3 +4	passed
7	RF-Power (ERP/EIRP)		§2.1046 §22.913(a)(2)	RSS-132, Issue 3: Chapter 5.4 SRSP-503: 5.1.3	< 7 Watt (ERP)	2	1+2+3 +4	Calculated passed
			§24.232(c)	RSS-133, Issue 6 Chapter 4.1/6.4 SRSP-510: 5.1.2	< 2 Watt (EIRP)			
			§27.50 (d)(4)	RSS-139: Issue 3 Chapter 6.5 SRSP-513: 5.1.2	< 1 Watt (EIRP)			
			§27.50(c)(10)	RSS-130, Issue 1, Chapter 4.4	< 3 Watt (ERP)			
8	Spurious emissions		§2.1053(a) §2.1057	RSS-Gen., Issue 4	43+10log(P) dBc	2	1+2+3 +4	passed
			§22.917(a)(b)	RSS-132: Chapter 5.5(i)(ii)				
9	Band-Edge compliance		§24.238(a)(b)	RSS-133: Chapter 6.5.1(i)(ii)		2	1+2+3 +5	passed
			§27.53(h)(1)(3) (i)(ii)(iii)	RSS-139: Issue 3 Chapter 6.6 (i) (ii)				
			§27.53(g)	RSS-130: Issue 1 Chapter 4.6.1				

30	RF Power	Antenna terminal (conducted)	§2.1046	--	N/A	1	1+2+3 +4	passed
34	26dB Emission bandwidth		§2.1049(h)	RSS-Gen, Issue 4, Chapter 6.6	26dBc Emissions BW 99% Power	--	--	Not performed see initial modules's certification
35	99% Occupied bandwidth							
36	Spurious emissions		§2.1051 §2.1057 §22.917(a)(b) §24.238(a)(b) §27.53	RSS-132, Issue 3: 5.5(i)(ii) RSS-133, Issue 6: 6.5.1(i)(ii) RSS-139, Issue 3 Chapt. 6.6 (i) (ii) RSS-130, Issue 1 Chapt. 4.6.1 Chapt. 4.6.2	43+10log(P) dBc			Not performed see initial modules's certification
37	Band-Edge compliance							Not performed see initial modules's certification
38	Frequency stability		§22.355, table C-1 §24.235 §2.1055(a)(2) §27.54	RSS-132, Issue 3: Chapter 5.3 RSS-133, Issue 6: Chapter 6.3 RSS-130, Issue 1: Chapter 4.3 RSS-139, Issue 3, Chapter 6.4	< ±2.5ppm			Not performed see initial modules's certification

1.2. RX mode, tests overview according FCC Part 15B and Canadian RSS Standards

No. of Diagram group	Test case	Port	References & Limits			EUT set-up	EUT op-mode	Result
			FCC Standard	RSS Section	Test limit			
1	AC-Power Lines conducted Emissions	AC-Power lines	§15.107 §15.207	RSS-Gen, Issue 8: Chapter 8.8	FCC §15.107 class B limits §15.207 limits RSS-Gen: Table 3	--	--	Remark 1
3	Receiver radiated emissions	Cabinet + Interconnecting cables	§15.109 §15.33 §15.35	RSS-132, Issue 3: 6.6 RSS-Gen, Issue 4: 5.3 RSS 133, Issue 6: 6.6	FCC 15.109 class B limits RSS-Gen: Chapter 5.3+Chapter 7.1.2	--	--	Passed, Remark 2

Remark:
1.) not applicable since powered within car-environment
2.) See separate test report no. CETECOM_TR16-1-0219301T10b for measurements according Part 15, Subpart B / RSS-Gen (ICES-003)

1.3. Attestation:

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

Digital unterschrieben von Niels Jeß
Datum: 2017.08.04 08:33:17 +02'00'

.....
Dipl.-Ing. Niels Jeß
Responsible for test section

Christian Lorenz
2017.08.04 08:21:39 +02'00'

.....
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:	2017-03-20
Date(s) of test:	2017-03-20 to 2017-06-29
Date of report:	2017-08-04
Version of template: 13.02	

2.4. Applicant's details

Applicant's name:	ACTIA Nordic
Address:	Hammerbacken 4A 19149 Sollentuna Sweden
Contact person:	Mr. Salah Alazawi

2.5. Manufacturer's details

Manufacturer's name:	please see Applicant's details
Address:	please see Applicant's details

3. Equipment under test (EUT)

3.1. SUMMARY OF RESULTS AND TECHNICAL 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/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=N1R4OGyLaKCotehafTuv1g%3D%3D&fcc_id=QIPALS3-USR3	See original grant under: https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=N1R4OGyLaKCotehafTuv1g%3D%3D&fcc_id=QIPALS3-USR3
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector TX-Main + Secondary		
Antenna Gain Tx (main)	☒ Values: 850MHz Band: 0.4 dBd (2.55dBi) 1700MHz band: 4.62 dBi 1900MHz Band: 4.89 dBi		
Antenna Gain Dx (diversity)	Accord. Document: *ACUII-05 / ACUII-06 Backup Antenna Specification Rev.1.0* 850MHz Band: -5.05 dBd (-2.9dBi) 1700MHz band: 2.5 dBi 1900MHz Band: 2.5 dBi		

MAX PEAK Output Power:				
Radiated	LTE-Mode 2	27,139 dBm (PK)		
	LTE-Mode 4	27,741 dBm (PK)		
	LTE-Mode 5	20,743 dBm (PK)		
	LTE-Mode 17	26,299 dBm (PK)		
MAX PEAK Output Power:				
Conducted	LTE-Mode 2	26,4327 dBm(PK)		
	LTE-Mode 4	26,9346 dBm(PK)		
	LTE-Mode 5	28,2233 dBm(PK)		
	LTE-Mode 17	27,6722 dBm(PK)		
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: 12 V DC Nominal (Car-environment)		
Special EMI components		--		
EUT sample type		☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached		☐ yes	☒ no	

3.2. EUT: Type, S/N etc. and short descriptions used in this test report

Short descrip-tion*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	TEM4G	Telematics Module	20071090027	H1	13
EUT B	TEM4G	Telematics Module	20071090026	H1	13
EUT C	TEM4G	Telematics Module	20071090035	H1	13
EUT D	External Antenna	31409875	#1	--	--

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

3.3. Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

AE short descrip-tion *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	Main harness with power supply cables	For TEM4G	1007-141-06	Rev A1.1	--
AE 2	External SIM card holder	For TEM4G	--	--	--
AE 3	Button Unit/Microphone	30710477	--	--	--
AE 4	USB Termination	--	--	--	--

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

3.4. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT A + AE 1+ AE 2 + AE 2 + AE 4	Conducted measurement set-up
set. 2	EUT B + EUT D + AE 1+ AE 2 + AE 2 + AE 4	Radiated Set-up (main TX external-antenna activated)
set. 3	EUT C + EUT D + AE 1+ AE 2 + AE 2 + AE 4	Radiated Set-up (Backup antenna activated)

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

3.5. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	LTE Band2: Channel: 18606 and 19175	A communication link is established between the mobile station (UE) and the test simulator
op. 2	LTE FDD4 Channel: 19965 and 20300	A communication link is established between the mobile station (UE) and the test simulator
op. 3	LTE FDD5 Channel : 20425 and 20625	A communication link is established between the mobile station (UE) and the test simulator
op. 4	LTE FDD 17 Channel: 23755 and 23800	A communication link is established between the mobile station (UE) and the test simulator

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

3.6. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	Cable harness	For TEM4G	1007-141-06	Rev A1.1	-

4. Description of test system set-up's

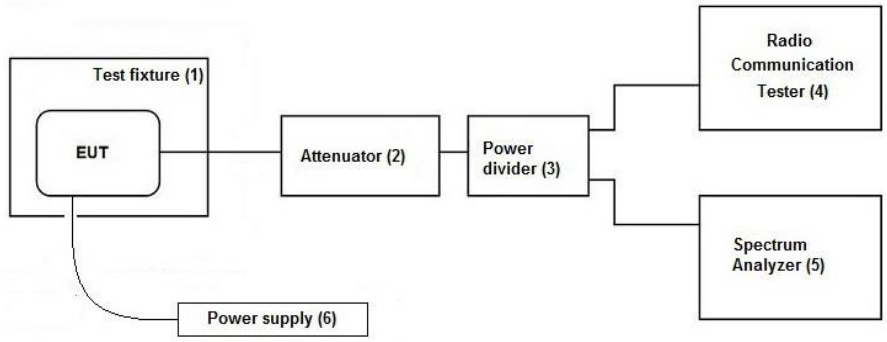
4.1. Test system set-up for conducted measurements on antenna port

Cellular Conducted RF-Setup 1 (Cel-1 Set-up)

Tests Specification: Conducted spurious emissions, Emission Bandwidth

General Description: The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) before it is 0° divided by a power divider (3). One of the RF-signal path is connected to the test unit communication tester (4), other RF-path is connected to the spectrum – analyzer (5) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

Schematic:



Used Equipment:

Passive Elements	Test Equipment	Remark:
☒ 10 dB Attenuator (#530)	☒ CMW500	See List of equipment under each test case and chapter 8. for calibration info
☒ Low loss RF-cables	☒ DC-Power Supply	
☒ 6 dB resistive power divider/coupler (#529)	☒ Spectrum-Analyser	

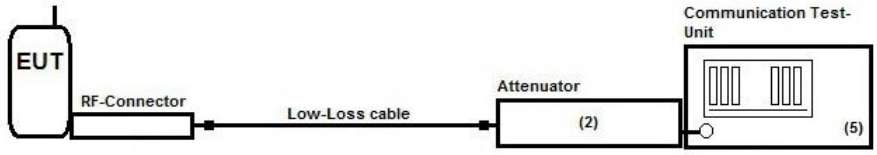
Testing method: ANSI C63.10:2013, KDB 971168 D01 v02r02

Measurement uncertainty: See chapter Measurement Uncertainties (Cel-1)

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

Tests Specification: Conducted Carrier power, Frequency Error

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



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

Used Equipment	Passive Elements	Test Equipment	Remark:
	☒ 20 dB Attenuator (#613)	☒ CMW500	See List of equipment under each test case and chapter 8. for calibration info
	☒ Low loss RF-cables	☒ DC-Power Supply	

Measurement uncertainty See chapter Measurement Uncertainties (Cel-2)

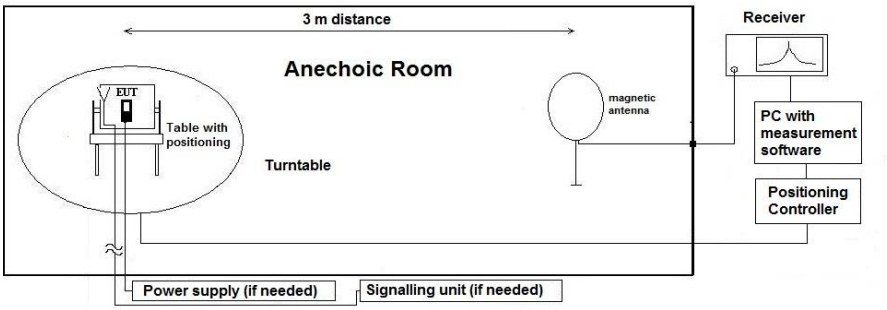
4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

Specification: ANSI C63.4-2014 §5.3, §8.2.1, §8.3.1.1+§8.3.2.1 , ANSI C63.10-2013 chapter 6.4 (§6.4.4.2)

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

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

Schematic:



Testing method:

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

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

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

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

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

Formula:

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

$M = L_T - E_C$

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

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

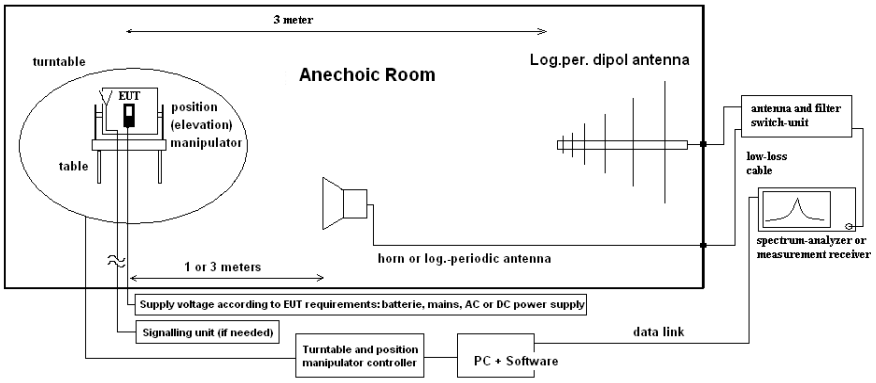
Distance correction: Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

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

Specification: ANSI C63.4-2014 chapter 8.3, ANSI C63.10-2013 chapter 6.6.3.3 & 6.6.4, ANSI C63.26-2015, Chapter 4.6.3.3

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

Schematic:



Testing method:

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

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by main-taining the EUT's worst-case operation mode, cable position, etc.
First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.
Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions.
On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.
The readings on the spectrum analyzer are corrected with conversion value between field strength and E(I)RP, so the readings shown are equivalent to ERP/EIRP values. Critical measurements near the limit are re-measured with a substitution method accord. ANSI/TIA/EIA 603 C/D

Formula:

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

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

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

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

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

5. Measurements

5.1. RF-Parameter - RF Peak power output conducted and PAPR

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

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

5.1.2. Requirements and limits

FCC	§2.1046, §27.50
IC	RSS-132: 5.4 + SRSP 503:5.1.3 for FDD Band 5 RSS-133: 4.1/6.4 + SRSP-510:5.1.2 for FDD Band 2 RSS-139, Issue 3: 6.5 RSS-199: Issue 1, §4.4 + PAR PK-AV ≤ 13 dB RSS-130, Issue 1 + SRSP-518
Limit	Maximum Power Output of the mobile phone should be determined while measured conducted.
	Limit LTE Band 5: 7 Watt ERP (38.4 dBm)
	Limit LTE Band 2: 2 Watt EIRP (33.0 dBm)
	Limit LTE Band 4: 1 Watt EIRP (30.0 dBm)
	Limit LTE Band 7: 2 Watt EIRP (33.0 dBm)
	FCC: Limit LTE Band 12/13/17: 3 Watt ERP (34.7dBm)
FCC Limit	FCC: Limit LTE Band 12/13/17: 3 Watt ERP (34.7dBm)
ISED Limit	ISED Limit LTE Band 12: 5 Watt EIRP (37dBm)
	ISED Limit LTE Band 13: 5 Watt EIRP (37dBm)
	ISED-Limit LTE Band 17: 5 Watt EIRP (37dBm)

5.1.3. Test condition and test set-up

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

5.1.4. Power results

5.1.4.1. LTE Band 2 results

LTE-Band 2				QPSK-Modulation			16-QAM-Modulation						
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	max- modulation QPSK	max. modulation 16QAM	max. bandwidth	absolute max. value channels/bandwidths
1.4 MHz	18607	1850,7	1RB low	25,3527	19,7751	5,5776	25,514	19,3	6,214	20,0122	20,4849	20,4849	20,487
			1RB high	25,4278	20,0122	5,4156	25,3193	19,7827	5,5366				
			50% RB mid	25,8722	19,9735	5,8987	27,1451	20,4849	6,6602				
			100% RB	25,1664	18,972	6,1944	26,045	18,2308	7,8142				
	18900	1880	1RB low	25,9096	20,1164	5,7932	25,0009	19,3197	5,6812	20,1429	19,6764		
			1RB high	25,864	20,1429	5,7211	24,8789	19,2139	5,665				
			50% RB mid	26,4303	20,1125	6,3178	26,7943	19,6764	7,1179				
			100% RB	25,3892	19,2445	6,1447	25,9594	18,399	7,5604				
	19193	1909,3	1RB low	24,6853	19,5178	5,1675	23,9256	18,6114	5,3142	19,5178	18,6114		
			1RB high	24,4447	19,3611	5,0836	23,6823	18,372	5,3103				
			50% RB mid	24,7953	19,3059	5,4894	24,868	18,4738	6,3942				
			100% RB	24,9124	18,5291	6,3833	24,7197	17,6059	7,1138				
3 MHz	18615	1851,5	1RB low	25,346	19,7935	5,5525	24,6546	19,0217	5,6329	20,1601	19,2959	20,1893	
			1RB high	25,4815	20,1601	5,3214	24,7887	19,2959	5,4928				
			50% RB mid	25,6943	19,1443	6,55	26,0621	19,1748	6,8873				
			100% RB	26,4327	19,0283	7,4044	25,6349	18,3701	7,2648				
	18900	1880	1RB low	26,0031	20,1893	5,8138	24,607	19,1484	5,4586	20,1893	19,4585		
			1RB high	25,7813	20,1349	5,6464	24,6372	19,2114	5,4258				
			50% RB mid	25,5865	19,1998	6,3867	26,109	19,4585	6,6505				
			100% RB	25,7726	19,0963	6,6763	25,4074	18,2806	7,1268				
	19185	1908,5	1RB low	24,8137	19,6488	5,1649	25,466	19,5895	5,8765	19,6488	19,5895		
			1RB high	24,1742	19,3347	4,8395	24,5717	19,1721	5,3996				
			50% RB mid	24,976	18,4857	6,4903	24,6453	18,7646	5,8807				
			100% RB	24,7125	18,5357	6,1768	24,9168	17,8123	7,1045				
5 MHz	18625	1852,5	1RB low	25,713	19,9427	5,7703	25,6263	18,7844	6,8419	20,487	19,5543	20,487	
			1RB high	25,7342	20,487	5,2472	25,6207	19,3008	6,3199				
			50% RB mid	26,2193	19,2827	6,9366	26,0739	19,5543	6,5196				
			100% RB	25,5726	19,1366	6,436	26,1485	18,322	7,8265				
	18900	1880	1RB low	25,9506	20,1431	5,8075	25,8448	19,4377	6,4071	20,1727	19,4671		
			1RB high	25,6491	20,1727	5,4764	25,5802	19,4671	6,1131				
			50% RB mid	26,3181	19,1244	7,1937	25,9707	19,1429	6,8278				
			100% RB	26,011	19,0308	6,9802	26,8013	18,1325	8,6688				
	19175	1907,5	1RB low	25,8875	20,2199	5,6676	24,9998	19,0226	5,9772	20,2199	19,0226		
			1RB high	24,5097	19,3426	5,1671	24,1132	18,4229	5,6903				
			50% RB mid	25,6109	18,7054	6,9055	25,3058	18,7741	6,5317				
			100% RB	25,2067	18,4973	6,7094	25,5015	17,7428	7,7587				

LTE-Band 2				QPSK-Modulation			16-QAM-Modulation			max- modulation QPSK	max. modulation 16QAM	max. bandwidth	absolute max. value channels/bandwidths
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]				
10 MHz	18650	1855	1RB low	25,4452	19,8964	5,5488	24,8748	18,9354	5,9394	20,3108	19,3297	20,3108	
			1RB high	25,3995	20,3108	5,0887	24,9772	19,3297	5,6475				
			50% RB mid	25,5962	19,2418	6,3544	25,5077	18,5731	6,9346				
			100% RB	25,511	19,1267	6,3843	25,8772	18,2633	7,6139				
	18900	1880	1RB low	25,9868	20,103	5,8838	24,6261	19,1261	5,5	20,1572	19,1261		
			1RB high	25,5761	20,1572	5,4189	24,437	19,1162	5,3208				
			50% RB mid	25,8215	19,0663	6,7552	26,2658	18,2273	8,0385				
			100% RB	25,6837	18,9355	6,7482	25,6046	17,9947	7,6099				
	19150	1905	1RB low	25,2797	20,1574	5,1223	25,88	19,9533	5,9267	20,1574	19,9533		
			1RB high	24,2781	19,3303	4,9478	24,531	19,1421	5,3889				
			50% RB mid	25,4648	18,7655	6,6993	25,381	18,0923	7,2887				
			100% RB	25,3485	18,6046	6,7439	25,814	17,7964	8,0176				
15 MHz	18675	1857,5	1RB low	25,1791	19,8752	5,3039	24,8481	19,5182	5,3299	20,1753	19,718	20,1985	21,2821
			1RB high	25,2094	20,1753	5,0341	24,8661	19,718	5,1481				
			50% RB mid	25,8127	19,0875	6,7252	25,9284	19,3956	6,5328				
			100% RB	25,7659	19,0293	6,7366	25,384	18,1107	7,2733				
	18900	1880	1RB low	25,9773	20,146	5,8313	24,6241	19,1281	5,496	20,1985	19,1709		
			1RB high	25,4327	20,1985	5,2342	24,3323	19,1334	5,1989				
			50% RB mid	25,6983	18,8999	6,7984	26,6827	19,1709	7,5118				
			100% RB	26,0556	18,8648	7,1908	25,7941	17,9414	7,8527				
	19125	1902,5	1RB low	24,879	20,1932	4,6858	25,1977	20,0762	5,1215	20,1932	20,0762		
			1RB high	24,4535	19,7449	4,7086	24,6309	19,5558	5,0751				
			50% RB mid	25,8799	18,8946	6,9853	26,0145	19,2112	6,8033				
			100% RB	25,765	18,6935	7,0715	25,3747	17,8289	7,5458				
20 MHz	18700	1860	1RB low	25,6793	20,0476	5,6317	25,6081	19,8152	5,7929	20,1986	20,0119	20,2507	
			1RB high	25,8391	20,1986	5,6405	25,7971	20,0119	5,7852				
			50% RB mid	25,7243	19,0412	6,6831	25,7604	19,2883	6,4721				
			100% RB	25,9849	19,1172	6,8677	25,9056	18,1529	7,7527				
	18900	1880	1RB low	25,7163	20,2507	5,4656	26,2296	19,4896	6,74	20,2507	19,4896		
			1RB high	24,9484	20,2477	4,7007	25,059	19,341	5,718				
			50% RB mid	25,8682	18,8981	6,9701	26,313	19,0642	7,2488				
			100% RB	25,8026	18,8983	6,9043	25,9257	18,0113	7,9144				
	19100	1900	1RB low	24,816	20,2158	4,6002	24,7978	19,498	5,2998	20,2158	19,498		
			1RB high	24,5699	19,776	4,7939	24,4521	18,6463	5,8058				
			50% RB mid	25,513	18,8527	6,6603	25,5834	19,2781	6,3053				
			100% RB	25,5652	18,9797	6,5855	26,1239	18,0064	8,1175				

5.1.4.2. LTE Band 4 Results

LTE-Band 4				QPSK-Modulation			16-QAM-Modulation			max- modulation QPSK	max. modualtion 16-QAM	max. channel	absolute max. value
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]				
14 MHz	19957	1710,7	1RB low	24,9303	21,1167	3,8136	24,3265	20,1589	4,1676	21,1629	20,3578	21,2046	
			1RB high	24,9936	21,0744	3,9192	24,4203	20,1392	4,2811				
			50% RB mid	25,1623	21,1629	3,9994	24,8802	20,3578	4,5224				
			100% RB	25,5142	20,2203	5,2939	25,292	19,0993	6,1927				
	20175	1732,5	1RB low	26,5655	20,9467	5,6188	25,124	19,8805	5,2435	21,0677	20,0684		
			1RB high	26,5701	21,0677	5,5024	25,1897	20,0684	5,1213				
			50% RB mid	26,9346	20,811	6,1236	26,1177	19,8092	6,3085				
			100% RB	25,8913	19,9189	5,9724	25,8531	18,8286	7,0245				
	20393	1754,3	1RB low	26,4766	21,2046	5,272	25,7774	20,0024	5,775	21,2046	20,0024		
			1RB high	26,4596	21,0015	5,4581	25,7328	19,8788	5,854				
			50% RB mid	26,6003	21,0604	5,5399	26,2828	19,9916	6,2912				
			100% RB	26,611	20,0564	6,5546	26,2303	18,9806	7,2497				
3 MHz	19965	1711,5	1RB low	24,8137	21,0906	3,7231	24,3664	20,0972	4,2692	21,2821	20,0972	21,2821	21,770
			1RB high	25,4417	21,2821	4,1596	24,5252	19,92	4,6052				
			50% RB mid	25,0633	20,0911	4,9722	24,8664	19,9779	4,8885				
			100% RB	26,0174	20,0553	5,9621	25,4772	19,0994	6,3778				
	20175	1732,5	1RB low	26,5183	20,8881	5,6302	24,9734	19,7582	5,2152	20,9397	20,1856		
			1RB high	26,4068	20,9397	5,4671	24,7665	19,742	5,0245				
			50% RB mid	25,8241	19,9424	5,8817	26,4973	20,1856	6,3117				
			100% RB	25,9282	19,8434	6,0848	26,181	18,8177	7,3633				
	20385	1753,5	1RB low	25,8624	21,0006	4,8618	25,8164	20,5643	5,2521	21,0006	20,5643		
			1RB high	25,9799	20,8849	5,095	26,3593	20,5205	5,8388				
			50% RB mid	26,0875	20,0367	6,0508	25,9299	20,105	5,8249				
			100% RB	26,3544	20,0016	6,3528	26,2698	19,0721	7,1977				
5 MHz	19975	1712,5	1RB low	24,9422	21,2352	3,707	24,7571	19,891	4,8661	21,2352	20,1618	21,2352	
			1RB high	25,7438	20,9275	4,8163	25,2091	19,6867	5,5224				
			50% RB mid	25,4966	20,02	5,4766	25,0935	20,1618	4,9317				
			100% RB	25,7685	19,95	5,8185	25,5129	18,9655	6,5474				
	20175	1732,5	1RB low	26,3508	20,7625	5,5883	26,0785	19,9174	6,1611	20,9422	20,0316		
			1RB high	26,1955	20,9422	5,2533	25,5356	20,0316	5,504				
			50% RB mid	26,3055	19,8874	6,4181	25,8986	19,7132	6,1854				
			100% RB	26,5347	19,7697	6,765	26,7704	18,7018	8,0686				
	20375	1752,5	1RB low	26,2475	21,217	5,0305	25,2266	20,0437	5,1829	21,217	20,0437		
			1RB high	26,5608	20,9572	5,6036	25,6506	19,8678	5,7828				
			50% RB mid	26,1079	19,9357	6,1722	25,7242	19,9078	5,8164				
			100% RB	26,1791	19,878	6,3011	26,2357	19,1743	7,0614				

LTE-Band 4				QPSK-Modulation			16-QAM-Modulation			max- modulation QPSK	max. modualtion 16-QAM	max. channel	absolute max. value
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]				
10 MHz	20000	1715	1RB low	24,8391	20,951	3,8881	24,4266	19,8688	4,5578	20,951	19,8688	21,376	21,770
			1RB high	26,2638	20,8639	5,3999	25,0098	19,6751	5,3347				
			50% RB mid	25,5918	19,8302	5,7616	25,3448	19,0205	6,3243				
			100% RB	25,8743	19,7522	6,1221	26,0114	18,8085	7,2029				
	20175	1732,5	1RB low	26,4981	20,7522	5,7459	24,9014	19,5922	5,3092	21,1594	20,0268		
			1RB high	26,2107	**21,1594**	5,0513	24,7707	20,0268	4,7439				
			50% RB mid	25,9995	19,6543	6,3452	26,0742	18,7836	7,2906				
			100% RB	26,0877	19,6271	6,4606	26,0663	18,612	7,4543				
	20350	1750	1RB low	25,4353	21,376	4,0593	25,6438	20,7554	4,8884	21,376	21,0419		
			1RB high	25,8985	20,8614	5,0371	26,1146	21,0419	5,0727				
			50% RB mid	25,6967	19,97	5,7301	25,4765	19,1936	6,2829				
			100% RB	25,9572	19,8207	6,1365	26,2675	18,9463	7,3212				
15 MHz	20025	1717,5	1RB low	24,8953	21,0309	3,8644	24,6747	20,45	4,2247	21,0309	20,45	21,679	
			1RB high	25,9586	20,6867	5,2719	25,3741	20,1309	5,2432				
			50% RB mid	26,1833	19,5783	6,605	26,1259	19,7151	6,4108				
			100% RB	26,3111	19,5133	6,7978	25,9046	18,4348	7,4698				
	20175	1732,5	1RB low	26,4263	20,716	5,7103	24,9204	19,6437	5,2767	21,3606	19,9418		
			1RB high	26,0081	21,3606	4,6475	24,5926	19,9418	4,6508				
			50% RB mid	25,8949	19,6255	6,2694	26,4023	19,7469	6,6554				
			100% RB	26,4305	19,6142	6,8163	26,0205	18,6803	7,3402				
	20325	1747,5	1RB low	25,4284	21,1831	4,2453	25,6712	20,7029	4,9683	21,679	20,9588		
			1RB high	26,2289	21,679	4,5499	25,9718	20,9588	5,013				
			50% RB mid	25,7355	20,0234	5,7121	25,6272	20,1772	5,45				
			100% RB	26,4395	19,9086	6,5309	25,8146	18,9853	6,8293				
20 MHz	20050	1720	1RB low	25,1067	**20,9997**	4,107	24,9497	20,6321	4,3176	21,00	20,6321	21,7704	
			1RB high	26,474	20,9215	5,5525	26,3716	20,5206	5,851				
			50% RB mid	26,4199	19,5331	6,8868	26,4903	19,7346	6,7557				
			100% RB	26,4282	19,646	6,7822	25,9594	18,5381	7,4213				
	20175	1732,5	1RB low	26,1524	20,8096	5,3428	26,5996	19,865	6,7346	21,3347	20,3103		
			1RB high	25,6781	21,3347	4,3434	25,2224	20,3103	4,9121				
			50% RB mid	25,9831	19,5911	6,392	26,8657	20,193	6,6727				
			100% RB	26,141	19,6939	6,4471	27,1403	19,0026	8,1377				
	20300	1745	1RB low	25,8948	20,9966	4,8982	25,7477	20,7793	4,9684	21,7704	20,8893		
			1RB high	26,2801	21,7704	4,5097	26,087	20,8893	5,1977				
			50% RB mid	25,7122	20,0384	5,6738	25,363	20,4561	4,9069				
			100% RB	26,0362	19,9701	6,0661	25,9965	19,2321	6,7644				

5.1.4.3. LTE Band 5 Results

LTE-Band 5				QPSK-Modulation			16-QAM-Modulation			max- modulation QPSK	max. modulation 16-QAM	max. channel	absolute max. value
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]				
14 MHz	20407	824.7	1RB low	26,8366	22,5921	4,2445	26,1805	21,5258	4,6547	22,69	22,09	23,25	23,37
			1RB high	26,735	22,5484	4,1866	26,1633	21,6369	4,5264				
			50% RB mid	27,0508	22,6928	4,358	27,1068	22,0857	5,0211				
			100% RB	27,2512	21,7783	5,4729	27,1238	20,8466	6,2772				
	20525	836.5	1RB low	27,8549	22,7049	5,15	26,7016	21,5357	5,1659	22,70	21,54		
			1RB high	27,8686	22,6598	5,2088	26,6858	21,5352	5,1506				
			50% RB mid	28,22	22,5499	5,6734	27,9882	21,5346	6,4536				
			100% RB	27,5289	21,694	5,8349	27,7234	20,6604	7,063				
	20643	848.3	1RB low	27,4954	23,2456	4,2498	27,1449	21,9537	5,1912	**23,25**	22,31		
			1RB high	27,5372	**22,9383**	4,5989	27,3248	22,2755	5,0493				
			50% RB mid	27,7603	22,9847	4,7756	27,6276	22,3082	5,3194				
			100% RB	28,0192	21,9422	6,077	27,7949	20,9867	6,8082				
3 MHz	20415	825.5	1RB low	26,8333	22,5803	4,253	26,2689	21,5998	4,6691	22,75	21,74	23,37	
			1RB high	26,76	22,7492	4,0108	26,2186	21,7426	4,476				
			50% RB mid	26,6986	21,6852	5,0134	26,7305	21,6203	5,1102				
			100% RB	27,6862	21,6935	5,9927	27,4906	20,7818	6,7088				
	20525	836.5	1RB low	27,7726	22,6358	5,1368	26,6657	21,5406	5,1251	22,73	21,87		
			1RB high	27,8328	22,727	5,1058	26,7235	21,5815	5,142				
			50% RB mid	27,6167	21,6471	5,9696	27,8631	21,8715	5,9916				
			100% RB	27,9601	21,5501	6,41	28,2268	20,6645	7,5623				
	20635	847.5	1RB low	27,298	23,3745	3,9235	27,456	23,0947	4,3613	23,37	23,09		
			1RB high	27,2729	22,7848	4,4881	27,5495	22,4896	5,0599				
			50% RB mid	27,4976	21,9495	5,5481	27,3292	22,5972	4,732				
			100% RB	27,8513	21,8045	6,0468	27,6184	21,1034	6,515				
5 MHz	20425	826.5	1RB low	26,9969	22,6865	4,3104	26,6718	21,5303	5,1415	22,86	21,92	**23,37**	
			1RB high	27,0573	**22,8624**	4,1949	26,9686	21,6181	5,3505				
			50% RB mid	27,0358	21,7787	5,2571	26,7033	21,9225	4,7808				
			100% RB	27,1208	21,5815	5,5393	27,6249	20,7141	6,9108				
	20525	836.5	1RB low	27,7413	**22,6137**	5,1276	27,6197	21,8964	5,7233	**22,77**	21,90		
			1RB high	27,7708	22,77	5,0017	27,5956	21,8564	5,7392				
			50% RB mid	28,2193	21,5824	6,6369	27,8043	21,522	6,2823				
			100% RB	27,9615	21,5373	6,4242	28,6287	20,5778	8,0509				
	20625	846.5	1RB low	27,5872	23,3702	4,217	27,0631	21,966	5,0971	23,37	22,02		
			1RB high	27,65	22,8629	4,7871	27,1717	21,9529	5,2188				
			50% RB mid	27,7765	21,9587	5,8178	27,2494	22,0223	5,2271				
			100% RB	27,7982	21,8645	5,9337	28,0428	20,9446	7,0982				
10 MHz	20450	829	1RB low	26,7929	22,6455	4,1474	26,2278	21,5657	4,6621	22,70	21,67	22,82	
			1RB high	27,7075	22,7006	5,0069	27,0041	21,673	5,3311				
			50% RB mid	27,232	21,6786	5,5534	26,8029	20,9581	5,8448				
			100% RB	27,6053	21,5169	6,0884	27,6535	20,5554	7,0981				
	20525	836.5	1RB low	27,6455	22,794	4,8515	26,7327	21,6576	5,0751	22,79	21,73		
			1RB high	27,4412	22,7298	4,7114	26,6925	21,7341	4,9584				
			50% RB mid	27,8537	21,4704	6,3833	27,9594	20,6703	7,2891				
			100% RB	27,8513	21,311	6,5403	27,75	20,4795	7,2705				
	20600	844	1RB low	27,4127	22,6045	4,8082	27,7964	22,4008	5,3956	22,82	22,50		
			1RB high	27,2676	22,8195	4,4481	27,4255	22,5045	4,921				
			50% RB mid	27,3592	21,8281	5,5311	27,1364	20,9636	6,1728				
			100% RB	27,7381	21,684	6,0541	28,0095	20,712	7,2975				

5.1.4.4. LTE Band 17 Results

LTE-Band 17				QPSK-Modulation			16-QAM-Modulation						
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	max- modulation QPSK	max. modulation 16-QAM	max. channel	absolute max. value
5 MHz	23755		1RB low	26,5721	21,4468	5,1253	26,146	20,4656	5,6804	21,4468	21,4547	21,45	21,56
			1RB high	27,0766	21,2916	5,785	26,4648	20,4075	6,0573				
			50% RB mid	27,0042	20,1843	6,8199	26,6843	20,3107	6,3736				
			100% RB	26,6793	20,2184	6,4609	27,2856	19,1966	8,089				
	23790		1RB low	26,8287	21,3018	5,5269	26,1299	20,2855	5,8444	21,4547			
			1RB high	26,8823	21,4547	5,4276	26,3536	20,4629	5,8907				
			50% RB mid	27,3905	20,2156	7,1749	27,4523	20,2609	7,1914				
			100% RB	26,8371	20,093	6,7441	26,4925	19,2142	7,2783				
	23825		1RB low	27,6722	21,3392	6,333	26,9453	20,2151	6,7302	21,3392			
			1RB high	26,5934	21,2623	5,3311	26,1547	20,1183	6,0364				
			50% RB mid	27,1378	20,3973	6,7405	27,0356	20,5899	6,4457				
			100% RB	26,4992	20,203	6,2962	27,2069	19,3282	7,8787				
10 MHz	23780		1RB low	26,2329	21,1637	5,0692	25,4501	20,2546	5,1955	21,2649	21,5646	21,56	
			1RB high	26,4242	21,2649	5,1593	25,558	20,3093	5,2487				
			50% RB mid	26,7318	20,1588	6,573	26,8919	19,3571	7,5348				
			100% RB	26,5438	19,9652	6,5786	26,8658	19,0928	7,773				
	23790		1RB low	26,5538	21,293	5,2608	25,2065	20,2087	4,9978	21,5646			
			1RB high	26,5574	21,5646	4,9928	25,3961	20,4389	4,9572				
			50% RB mid	26,853	20,1993	6,6537	27,3269	19,3309	7,996				
			100% RB	26,492	19,9556	6,5364	26,5651	19,1227	7,4424				
	23800		1RB low	26,3925	21,3358	5,0567	27,1033	21,025	6,0783	21,3358			
			1RB high	25,972	21,2551	4,7169	26,589	20,987	5,602				
			50% RB mid	26,8716	20,227	6,6446	26,8828	19,3635	7,5193				
			100% RB	26,5023	20,0368	6,4655	26,8085	19,1211	7,6874				

5.1.5. PAPR results

5.1.5.1. Test condition and test set-up

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

5.1.5.2. PAPR-results

According KDB 5.7.1 two method are allowed.

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

LTE Band 2		
	Max. PAPR Max. PAPR level with 0.1% probability / [dB]	
Signal-Bandwidth / [MHz]	QPSK Modulation	16-QAM Modulation
1.4	5.71	6.75 (100% RBs) / 6.35 (50% RBs)
3.0	5.42	6.50
5.0	5.38	6.25 (50% RBs) / 6.73 (100% RBs)
10	5.96	6.79
15	5.04	6.29
20	6.19	6.54

Remark: pls. see annex 1 for graphical plots

LTE Band 4		
	Max. PAPR level with 0.1% probability / [dB]	
Signal-Bandwidth / [MHz]	QPSK Modulation	16-QAM Modulation
1.4	5.56	6.21
3.0	5.65	6.06
5.0	5.94	6.29
10	5.46	6.38 (100% RBs) / 6.23 (1RB high)
15	4.81	6.19
20	5.79 (50% RBS) 5.08 (1RB high)	5.06

Remark: pls. see annex 1 for graphical plots

LTE Band 5		
Signal-Bandwidth / [MHz]	Max. PAPR level with 0.1% probability / [dB]	
	QPSK Modulation	16-QAM Modulation
1.4	5.08	6.46
3.0	5.46	6.71 (100%RBs) / 5.44 (1 RB low)
5.0	5.54 (50% RBs) / 4.25 (1RB low)	6.69
10	5.77	6.35

Remark: pls. see annex 1 for graphical plots

LTE Band 17		
Signal-Bandwidth / [MHz]	Max. PAPR level with 0.1% probability / [dB]	
	QPSK Modulation	16-QAM Modulation
5.0	5.98	6.10
10	4.92 (1RB high) 5.90 (50% RBs)	6.31 (50% RB) / 5.58 (1RB high)

Remark: pls. see annex 1 for graphical plots

5.1.5.3. Conclusion

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

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

5.2.1. Test location and equipment

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☒ 441 EMI SAR	☐ 487 SAR NSA	☐ 347 Radio.lab.		☐	☐
receiver	☐ 377 ESCS30	☒ 001 ESS	☐	☐	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☐	☐	☐
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☐ 289 CBL 6141	☒ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 392 MT8820A	☐ 371 CBT32	☐ 547 CMU	☐ 594 CMW		
otherwise	☐ 400 FTC40x15E	☐ 401 FTC40x15E	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 378 RadiSense	
DC power	☐ 456 EA 3013A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V 60 Hz via PAS 5000			

5.2.2. Requirements

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

5.2.3. Test condition and test set-up

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

5.2.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

Table of measurement results:

Diagram No.	Carrier Channel		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
2.10	Low	23755	9 kHz-30 MHz	2	4	External antenna used	☒	☐	☐	passed
2.12	Low	20425	9 kHz-30 MHz	2	3	Internal antenna used	☒	☐	☐	passed
2.14	Low	19965	9 kHz-30 MHz	2	2	Internal antenna used	☒	☐	☐	passed
2.16	Low	18607	9 kHz-30 MHz	2	1	Internal antenna used	☒	☐	☐	passed
2.11	High	23800	9 kHz-30 MHz	2	4	Internal antenna used	☒	☐	☐	passed
2.13	High	20625	9 kHz-30 MHz	2	3	External antenna used	☒	☐	☐	passed
2.15	High	20300	9 kHz-30 MHz	2	2	External antenna used	☒	☐	☐	passed
2.17	High	19175	9 kHz-30 MHz	2	1	External antenna used	☒	☐	☐	passed

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

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

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

5.3. RF-Parameter - Radiated out of Band RF emissions and Band Edge

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☒ 443 FAR	☐ 347 Radio.lab.1	☐ 347 Radio.lab.2	
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ ESU 26		
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☒ 264 FSEK			
antenna	☒ 608 HL 562	☒ 549 HL 025	☐ 302 BBHA9170	☐ 289 CBL 6141	☐ 030 HFH-Z2	☐ 477 GPS
signaling	☐ 017 CMD 65	☐ 323 CMD 55	☐ 340 CMD 55			
signaling	☐ 392 MT8820A	☐ 546 CMU	☐ 547 CMU	☒ 642 CMW500		
power supply	☒ 611 E3632A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 529 6dB divider	☐ 530 6dB Att.	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 431 Near field	
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 110 V/ 60 Hz via PAS 5000			

5.3.2. Requirements and limits

FCC	General: §2.1053(a) , §2.1057(a) ☒ LTE Band 5: Part 22: §22.917(a)(b) ☒ LTE Band 2: Part 24: §24.238(a)(b) ☒ LTE Band 4: Part 27: §27.53(h) ☒ LTE Band 12: Part 27: §27.53(g)☐ LTE Band 13: Part 27: §27.53(c) , §27.53(f) ☒ LTE Band 17: Part 27: §27.53(g)
IC	☒ FDD Band 5: RSS-132, Issue 3: 5.5(i)(ii) ☒ FDD Band 2: RSS-133, Issue 6: 6.5.1(i)(ii) ☒ FDD Band 4: RSS-139, Issue 3: 6.6 (i)(ii) ☒ FDD Band 12: RSS-130, Issue 1: 4.6.1 ☐ FDD Band 13: RSS-130, Issue 1: 4.6.2(a)(i)(ii) + 4.6.2(b)☒ FDD Band 17: RSS-130, Issue 1: 4.6.1
Limit	„the power of emissions shall be attenuated below the transmitter output power (p) by at least 43+10Log(P) dB“ -> Resulting limits for all power levels of the Mobile Phone: -13dBm

5.3.3. Test condition and test set-up

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

Spectrum-Analyzer settings for LTE band 2

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att. [dB]	Detector
Sweep 1 (subrange 1)	30	1000	1	10	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	10	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	20000	1	10	60	10	MaxH-PK
Sweep 2a (Band-Edge)	1849	1850	0.03	0.3	30	35	MaxH-PK
Sweep 2b (Band-Edge)	1849	1850	0.03	0.3	30	35	MaxH-AV
Sweep 3a (Band-Edge)	1910	1911	0.03	0.3	30	35	MaxH-PK
Sweep 3b (Band-Edge)	1910	1911	0.03	0.3	30	35	MaxH-AV

Spectrum-analyzer settings for FDD Band 4

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	10	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	10	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	18000	1	10	160	10	MaxH-PK
Sweep 2a (Band-Edge)	1709	1710	0.03	0.3	30	35	MaxH-PK
Sweep 2b (Band-Edge)	1709	1710	0.03	0.3	30	35	MaxH-AV
Sweep 3a (Band-Edge)	1755	1756	0.03	0.3	30	35	MaxH-PK
Sweep 3b (Band-Edge)	1755	1756	0.03	0.3	30	35	MaxH-AV

Spectrum-analyzer settings for LTE Band 5

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	10	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	1	10	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	9000	1	10	160	10	MaxH-PK
Sweep 2a (Band-Edge)	823	824	0.02	0.2	30	35	MaxH-PK
Sweep 2b (Band-Edge)	823	824	0.02	0.2	30	35	MaxH-AV
Sweep 3a (Band-Edge)	850	851	0.02	0.2	30	35	MaxH-PK
Sweep 3b (Band-Edge)	850	851	0.02	0.2	30	35	MaxH-AV

Spectrum-analyzer settings for LTE Band 17

	Start freq. MHz	Stop freq. MHz	R-BW kHz	V-BW kHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	100	300	10	10	MaxH-PK
Sweep 1 (subrange 2)	1000	2800	100	300	15	0	MaxH-PK
Sweep 1 (subrange 3)	2800	9000	100	300	160	10	MaxH-PK
Sweep 2a (Band-Edge)	703	704	50	300	30	35	MaxH-PK, Signal-BW=5MHz
Sweep 2b (Band-Edge)	703	704	100	300	30	35	MaxH-PK, Signal-BW=10MHz
Sweep 3a (Band-Edge)	716	717	500	300	30	35	MaxH-PK, Signal-BW=5MHz
Sweep 3b (Band-Edge)	716	717	100	300	30	35	MaxH-PK, Signal-BW=10MHz

5.3.4. Results

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

5.3.4.1. LTE Band 2: Op. Mode 1, Set-up 1

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.20_Ch18607_Laying_ExtAnt	Low	18607	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results External antenna used QPSK modulation	☒	☐	☐	passed
8.20_Ch18607_Laying_IntAnt	Low	18607	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results Internal antenna used 16-QAM modulation	☒	☐	☐	passed
8.20_Ch18607_Standing_ExtAnt	Low	18607	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results External antenna used 16-QAM modulation	☒	☐	☐	passed
8.20_Ch18607_Standing_IntAnt	Low	18607	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results Internal antenna used 16-QAM modulation	☒	☐	☐	passed
8.22_Ch19175_Laying_ExtAnt	High	19175	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results External antenna used QPSK modulation	☒	☐	☐	passed
8.22_Ch19175_Laying_IntAnt	High	19175	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results Internal antenna used QPSK modulation	☒	☐	☐	passed
8.22_Ch19175_Standing_IntAnt	High	19175	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results Internal antenna used QPSK modulation	☒	☐	☐	passed
8.22_Ch19175_Standing_ExtAnt	High	19175	30 MHz to 20 GHz	1	Carrier visible on diagram. Not relevant for results External antenna used QPSK modulation	☒	☐	☐	passed

Remark1: LTE EUT channel bandwidth of 1.4MHZ (low channel) and 5MHz (high channel) was chosen as worst-case as determined within power measurements

5.3.4.1.1. Band-Edge Low: 1849-1850 MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.33_CH18625_BW5_ 1RB_low_QPSK_ Ext_Ant_laying	18625	2	☒ 1RB low	☒ QPSK modulation	☒	☐	passed
9.34_CH18265_BW5_ 25RB_QPSK_ Ext_Ant_laying	18625	2	☒ full: 25	☒ QPSK modulation	☒	☐	passed
9.35_CH18625_BW5_ 1RB_low_QAM_ Ext_Ant_laying	18625	2	☒ 1RB low	☒ 16-QAM modulation	☒	☐	passed
9.36_CH18625_BW5_ 25RB_QAM_ Ext_Ant_Laying	18625	2	☒ full: 25	☒ 16-QAM modulation	☒	☐	passed
9.37_CH18625_BW5_ 1RB_Low_QPSK_ Ext_Ant_standing	18625	2	☒ 1RB low	☒ QPSK modulation	☒	☐	passed
9.38_CH18625_BW5_ 25RB_QPSK_ Ext_Ant_standing	18625	2	☒ full: 25	☒ QPSK modulation	☒	☐	passed
9.39_CH18625_BW5_ 1RB_Low_QAM_ Ext_Ant_standing	18625	2	☒ 1RB low	☒ 16-QAM modulation	☒	☐	passed
9.40_CH18625_BW5_ 25RB_QAM_ Ext_Ant_standing	18625	2	☒ full: 25	☒ 16-QAM modulation	☒	☐	passed

Remark:

1.) LTE EUT channel bandwidth of 5MHz used for measurements as worst-case as determined within power measurements
2.) External antenna used

5.3.4.1.2. Band-Edge High: 1910-1911MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.41_CH19175_BW5_ 1RB_high_QPSK_ Int_Ant_Hor	19175	1	☒ 1RB high	☒ QPSK modulation	☒	☐	passed
9.42_CH19175_BW5_1 RB_high_QAM_ Int_Ant_Hor	19175	1	☒ 1RB high	☒ QAM modulation	☒	☐	passed
9.43_CH19175_BW5_2 5RB_high_QPSK_ Int_Ant_Hor	19175	1	☒ full: 25	☒ QPSK modulation	☒	☐	passed
9.44_CH19175_BW5_2 5RB_high_QAM_ Int_Ant_Hor	19175	1	☒ full: 25	☒ 16-QAM modulation	☒	☐	Passed
9.45_CH19175_BW5_ 1RB_high_QPSK_ Int_Ant_Ver	19175	1	☒ 1RB high	☒ QPSK modulation	☒	☐	Passed [3.)]
9.46_CH19175_BW5_ 1RB_high_QAM_Int_ Ant_Ver	19175	1	☒ 1RB high	☒ 16-QAM modulation	☒	☐	Passed [3.)]
9.47_CH19175_BW5_ 25RB_high_QPSK_ Int_Ant_Ver	19175	1	☒ full: 25	☒ QPSK modulation	☒	☐	passed
9.48_CH19175_BW5_ 25RB_high_QAM_ Int_Ant_Ver	19175	1	☒ full: 25	☒ 16-QAM modulation	☒	☐	passed

Remark:
1.) LTE EUT channel bandwidth of 5MHz used for measurements as worst-case as determined within power measurements
2.) Internal antenna used
3.) designation: Laying_EUT position = hor / Standing EUT position = ver

5.3.4.2. LTE Band 4: Op. Mode 2, Set-up 2

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.40_Ch19965_ Laying_ExtAnt	Low	19965	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Laying EUT position External antenna used	☒	☐	☐	passed
8.40_Ch19965_ Standing_ExtAnt	Low	19965	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Standing EUT position External antenna used	☒	☐	☐	passed
8.40_Ch19965_ Laying_IntAnt	Low	19965	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Laying EUT position Internal antenna used	☒	☐	☐	passed
8.40_Ch19965_ Standing_IntAnt	Low	19965	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Standing EUT position Internal antenna used	☒	☐	☐	passed
8.42_Ch20300_ Laying_IntAnt	High	20300	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Laying EUT position Internal antenna used	☒	☐	☐	passed
8.42_Ch20300_ Standing_IntAnt	High	20300	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Standing EUT position Internal antenna used	☒	☐	☐	passed
8.42_Ch20300_ Laying_ExtAnt	High	20300	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Laying EUT position External antenna used	☒	☐	☐	passed
8.42_Ch20300_ Standing_ExtAnt	High	20300	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results Standing EUT position External antenna used	☒	☐	☐	passed

Remark1: LTE EUT channel bandwidth of 3MHz (Low Channel) and 20MHz (High channel) was chosen as worst-case as determined within power measurements

5.3.4.2.1. Band-Edge Low: 1709-1710 MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.01_CH19965_BW3_1RB_low_QPSK_Ext_Ant_Hor	19965	2	☒ 1RB low	☒ QPSK modulation	☒	☐	passed
9.02_CH19965_BW3_1RB_low_QAM_Ext_Ant_Hor	19965	2	☒ 1RB low	☒ 16-QAM modulation	☒	☐	passed
9.03_CH19965_BW3_15RB_low_QPSK_Ext_Ant_Hor	19965	2	☒ full: 15	☒ QPSK modulation	☒	☐	passed
9.04_CH19965_BW3_15RB_low_QAM_Ext_Ant_Hor	19965	2	☒ full: 15	☒ 16-QAM modulation	☒	☐	passed
9.05_CH19965_BW3_1RB_low_QPSK_Ext_Ant_Ver	19965	2	☒ 1RB low	☒ QPSK modulation	☒	☐	passed
9.06_CH19965_BW3_1RB_low_QAM_Ext_Ant_Ver	19965	2	☒ 1RB low	☒ 16-QAM modulation	☒	☐	passed
9.07_CH19965_BW3_15RB_low_QPSK_Ext_Ant_Ver	19965	2	☒ full: 15	☒ QPSK modulation	☒	☐	passed
9.08_CH19965_BW3_15RB_low_QAM_Ext_Ant_Ver	19965	2	☒ full: 15	☒ 16-QAM modulation	☒	☐	passed

Remark:

1.) LTE EUT channel bandwidth of 3MHz used for measurements as worst-case as determined within power measurements
2.) External antenna used
3.) designation: Laying_EUT position = hor / Standing EUT position = ver

5.3.4.2.2. Band-Edge High: 1755-1756MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.09_CH20300_BW20_1RB_high_QPSK_Int_Ant_Hor	20300	2	☒ 1RB high	☒ QPSK modulation	☒	☐	passed
9.10_CH20300_BW20_1RB_high_QAM_Int_Ant_Hor	20300	2	☒ 1RB high	☒ 16-QAM modulation	☒	☐	passed
9.11_CH20300_BW20_100RB_high_QPSK_Int_Ant_Hor	20300	2	☒ full: 100	☒ QPSK modulation	☒	☐	passed
9.12_CH20300_BW20_100RB_high_QAM_Int_Ant_Hor	20300	2	☒ full: 100	☒ 16-QAM modulation	☒	☐	Passed
9.13_CH20300_BW20_1RB_high_QPSK_Int_Ant_Ver	20300	2	☒ 1RB high	☒ QPSK modulation	☒	☐	Passed
9.14_CH20300_BW20_1RB_high_QAM_Int_Ant_Ver	20300	2	☒ 1RB high	☒ 16-QAM modulation	☒	☐	Passed
9.15_CH20300_BW20_100RB_high_QPSK_Int_Ant_Ver	20300	2	☒ full: 100	☒ QPSK modulation	☒	☐	passed
9.16_CH20300_BW20_100RB_high_QAM_Int_Ant_Ver	20300	2	☒ full: 100	☒ 16-QAM modulation	☒	☐	passed

Remark:
1.) LTE EUT channel bandwidth of 20MHz used for measurements as worst-case as determined within power measurements
2.) Internal antenna antenna used
3.) designation: Laying_EUT position = hor / Standing EUT position = ver

5.3.4.3. LTE Band 5: Op. Mode 3, Set-up 2

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.50_Ch20425_ Laying_ExtAnt	Low	20425	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation External antenna used	☒	☐	☐	passed
8.50_Ch20425_ Standing_ExtAnt	Low	20425	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation External antenna used	☒	☐	☐	passed
8.50_Ch20425_ Laying_IntAnt	Low	20425	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation Internal antenna used	☒	☐	☐	passed
8.51_Ch20525_ Laying_ExtAnt	Middle	20525	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation External antenna used	☒	☐	☐	passed
8.51_Ch20525_ Standing_ExtAnt	Middle	20525	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation External antenna used	☒	☐	☐	passed
8.52_Ch20625_ Laying_ExtAnt	High	20625	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation External antenna used	☒	☐	☐	passed
8.52_Ch20625_ Standing_ExtAnt	High	20625	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation External antenna used	☒	☐	☐	passed

Remark:
1.) LTE nominal channel bandwidth of 5 MHz used for measurements

5.3.4.3.1. Band-Edge Low: 823-824MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.508a_BE_R_Ch20425_1RB_BW5_QAM_Laying_ExtAntenna	20425	3	☒ 1RB low	☒ 16-QAM modulation	☒	☐	passed
9.508b_BE_R_Ch20425_1RB_BW5_QAM_Standing_IntAntenna	20425	3	☒ 1RB low	☒ 16-QAM modulation	☒	☐	passed
9.508a_BE_R_Ch20425_1RB_BW5_QPSK_Laying_ExtAntenna	20425	3	☒ 1RB low	☒ QPSK modulation	☒	☐	passed
9.508b_BE_R_Ch20425_1RB_BW5_QPSK_Standing_ExtAntenna	20425	3	☒ 1RB low	☒ QPSK modulation	☒	☐	passed
9.510a_BE_R_Ch20425_25RB_BW5_QAM_Laying_ExtAntenna	20425	3	☒ full: 25	☒ 16-QAM modulation	☒	☐	passed
9.510b_BE_R_Ch20425_25RB_BW5_QAM_Standing_ExtAntenna	20425	3	☒ full: 25	☒ 16-QAM modulation	☒	☐	passed
9.510a_BE_R_Ch20425_25RB_BW5_QPSK_Laying_ExtAntenna	20425	3	☒ full: 25	☒ QPSK modulation	☒	☐	passed
9.510b_BE_R_Ch20425_25RB_BW5_QPSK_Standing_ExtAntenna	20425	3	☒ full: 25	☒ QPSK modulation	☒	☐	passed

Remark:

4.) LTE EUT channel bandwidth of 5MHz used for measurements as worst-case as determined within power measurements

5.) Internal antenna/External antenna used

5.3.4.3.2. Band-Edge High: 849-850MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.502a_BE_R_Ch20643_1RB_BW_1_4_QPSK_Laying_ExtAntenna	20643	3	☒ 1RB high	☒ QPSK modulation	☒	☐	passed
9.502b_BE_R_Ch20643_1RB_BW_1_4_QPSK_Standing_ExtAntenna	20643	3	☒ 1RB high	☒ QPSK modulation	☒	☐	passed
9.502a_BE_R_Ch20643_1RB_BW_1_4_QAM_Laying_ExtAntenna	20643	3	☒ 1RB high	☒ 16-QAM modulation	☒	☐	passed
9.502b_BE_R_Ch20643_1RB_BW_1_4_QAM_Standing_ExtAntenna	20643	3	☒ 1RB high	☒ 16-QAM modulation	☒	☐	Passed
9.502b_BE_R_Ch20643_1RB_BW_1_4_QAM_Standing_IntAntenna	20643		☒ 1RB high	☒ 16-QAM modulation	☐	☒	Passed [3.)]
9.502b_BE_R_Ch20643_1RB_BW_1_4_QPSK_Standing_IntAntenna	20643	3	☒ 1RB high	☒ QPSK modulation	☐	☒	Passed [3.)]
9.503a_BE_R_Ch20643_6RB_1_4_QPSK_Laying_ExtAntenna	20643	3	☒ full: 6	☒ QPSK modulation	☒	☐	passed
9.503b_BE_R_Ch20643_6RB_1_4_QPSK_Standing_ExtAntenna	20643	3	☒ full: 6	☒ QPSK modulation	☒	☐	passed
9.503a_BE_R_Ch20643_6RB_1_4_QAM_Laying_ExtAntenna	20643	3	☒ full: 6	☒ 16-QAM modulation	☒	☐	passed
9.503b_BE_R_Ch20643_6RB_1_4_QAM_Standing_ExtAntenna	20643	3	☒ full: 6	☒ 16-QAM modulation	☒	☐	passed

Remark:
1.) LTE EUT channel bandwidth of 1.4MHz used for measurements as worst-case as determined within power measurements
2.) Internal antenna/External antenna used
3.) Pre-measurement with PK-detector, Final measurement with RMS detector (see result table)

5.3.4.4. LTE Band 17: Op. Mode 4 Set-up 1

Radiated spurious emission measurements:

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.01_ExtAnt_Laying	Low	23755	30 MHz to 9 GHz	4	Carrier visible on diagram. Not relevant for results External antenna used QPSK Modulation Laying position	☒	☐	☐	passed
8.02_ExtAnt_Standing	Low	23755	30 MHz to 9GHz	4	Carrier visible on diagram. Not relevant for results External antenna used QPSK Modulation Standing position	☒	☐	☐	passed
8.03_IntAnt_Laying	High	23800	30 MHz to 9 GHz	4	Carrier visible on diagram. Not relevant for results Internal antenna used QPSK Modulation Laying position	☒	☐	☐	passed
8.04_IntAnt_standing	High	23800	30 MHz to 9 GHz	4	Carrier visible on diagram. Not relevant for results Internal antenna used QPSK Modulation Standing position	☒	☐	☐	passed

Band-Edge Low: 703-704MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.17_CH23755_BW5_1RB_low_QPSK_Ext_Ant_Hor	23755	4	☒ 1RB low	☒ QPSK modulation	☐	☒	passed
9.18_CH23755_BW5_1RB_low_QAM_Ext_Ant_Hor	23755	4	☒ 1RB low	☒ 16-QAM modulation	☐	☒	passed
9.19_CH23755_BW5_25RB_low_QPSK_Ext_Ant_Hor	23755	4	☒ full: 25	☒ QPSK modulation	☐	☒	passed
9.20_CH23755_BW25_25RB_low_QAM_Ext_Ant_Hor	23755	4	☒ full: 25	☒ 16-QAM modulation	☐	☒	passed

9.21_CH23755_BW5_1RB_low_QPSK_Ext_Ant_Ver	23755	4	☒ 1RB low	☒ QPSK modulation	☐	☒	passed
9.22_CH23755_BW5_1RB_low_QAM_Ext_Ant_Ver	23755	4	☒ 1RB low	☒ 16-QAM modulation	☐	☒	passed
9.23_CH23755_BW5_25RB_low_QPSK_Ext_Ant_Ver	23755	4	☒ full: 25	☒ QPSK modulation	☐	☒	passed
9.24_CH23755_BW5_25RB_low_QAM_Ext_Ant_Ver	23755	4	☒ full: 25	☒ 16-QAM modulation	☐	☒	passed

Remark:
1.) LTE EUT channel bandwidth of 5MHz used for measurements as worst-case as determined within power measurements
2.) External antenna used for Low Channel Band-Edge
3.) designation: Laying_EUT position = hor / Standing EUT position = ver

Band-Edge High: 716-717MHz

Diagram No.	Channel no.	Op.Mode	Number of RBs	Modulation scheme	Detector		Verdict
					PK	RMS	
9.25_CH23800_BW10_1RB_high_QPSK_Int_Ant_Hor	23800	4	☒ 1RB high	☒ QPSK modulation	☐	☒	passed
9.26_CH23755_BW10_1RB_high_QAM_Int_Ant_Hor	23800	4	☒ 1RB low	☒ 16-QAM modulation	☐	☒	passed
9.27_CH23800_BW10_50RB_high_QPSK_Int_Ant_Hor	23800	4	☒ full: 25	☒ QPSK modulation	☐	☒	passed
9.28_CH23800_BW10_50RB_high_QAM_Int_Ant_Hor	23800	4	☒ full: 25	☒ 16-QAM modulation	☐	☒	passed
9.29_CH23800_BW10_1RB_high_QPSK_Int_Ant_Ver	23800	4	☒ 1RB high	☒ QPSK modulation	☐	☒	passed
9.30_CH23800_BW10_1RB_high_QAM_Int_Ant_Ver	23800	4	☒ 1RB low	☒ 16-QAM modulation	☐	☒	passed
9.31_CH23800_BW10_50RB_high_QPSK_Int_Ant_Ver	23800	4	☒ full: 25	☒ QPSK modulation	☐	☒	passed
9.32_CH23800_BW10_50RB_high_QAM_Int_Ant_Ver	23800	4	☒ full: 25	☒ 16-QAM modulation	☐	☒	passed

Remark:
1.) LTE EUT channel bandwidth of 10MHz used for measurements as worst-case as determined within power measurements
2.) Internal antenna used for High Channel Band-Edge
3.) designation: Laying_EUT position = hor / Standing EUT position = ver

5.4. Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.
For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U_{CISPR})	CISPR 16-2-1	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Radiated emissions Enclosure	CISPR 16-2-3	30 MHz - 1 GHz 1 GHz - 18 GHz	4.2 dB 5.1 dB						E-Field
Disturbance power	CISPR 16-2-2	30 MHz - 300 MHz	-						-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB						Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	-
		12.75 - 26.5GHz	N/A	0.82	--	N/A	N/A	--	
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable
		2.8 GHz - 12.75GHz	1.48	N/A	1.51	N/A	1.43	--	
		12.75 GHz - 18GHz	1.81	N/A	1.83	N/A	1.77	--	
		18 GHz - 26.5GHz	1.83	N/A	1.85	N/A	1.79	--	
Power density	-	1 – 2.8GHz	1.40 dB						--
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			1.0 dB						Power
Emission bandwidth	- -	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			See above: 0.70 dB						Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm						-
Radiated emissions Enclosure	-	150 kHz - 30 MHz 30 MHz - 1 GHz 1 GHz - 20 GHz	5.0 dB 4.2 dB 3.17 dB						Magnetic field E-field Substitution

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Abbreviations used in this report

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

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

Ref.-No.	Accreditation Certificate	Valid for laboratory area or test site	Accreditation Body
-	D-PL-12047-01-01	All laboratories and test sites of CETECOM GmbH, Essen	DAkkS, Deutsche Akkreditierungsstelle GmbH
337 487 558 348 348	(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 Measurem.	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- 4452 G- 20013 C- 20009 T- 20006	Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

8. Instruments and Ancillary

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

8.0.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	EMI Test Receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
053	Audio Analyzer	UPA3	860612/022	Firm. V 4.3
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
140	Signal Generator	SMHU	831314/006	Firm.= 3.21
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
263	Signal Generator	SMP 04	826190/0007	Firm.=3.21
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)

8.0.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	EMI Test Receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	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 (Brl)	-	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	Wainwrght	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. Lufft 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	-	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	-	24.05.2018
644	Amplifierer	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 Physiscs	-	-	
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

9. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2017-08-04