T E S T R E P O R T
No.: 16-1-0109701T05a

According to:
FCC Regulations
Part 24, Part 27, Part 15C - §15.207

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

for

Gemalto M2M GmbH

ELS31-US LTE module

FCC-ID: QIPELS31-US
IC: 7830A-ELS31US

Laboratory Accreditation and Listings			
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	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
Wi Fi ALLIANCE AUTHORIZED RF LABORATORY	ctia Authorized™ Test Lab Lab Code: 20011130-00		
accredited according to DIN EN ISO/IEC 17025			

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Table of contents

Table of annex

	Total pages
Annex 1: SEPARATE DOCUMENT Measurement diagrams	207
Annex 2: SEPARATE DOCUMENT External photographs of EUT	5
Annex 3: SEPARATE DOCUMENT Internal photographs of EUT	TO BE SUPPLIED BY APPLICANT
Annex 4: SEPARATE DOCUMENT Test set-up photographs	6

The listed attachments are an integral part of this report.

1. Summary of test results

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

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

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. This test report shows results for GPRS and (E)GPRS technologies 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 Part 27, Subpart C of the FCC CFR Title 47 Rules, Edition 4th November 2014 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 (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)	Part 15, Subpart C §15.207	RSS-Gen, Issue 4: Chapter 8.8	§15.207 limits IC: Table 3, Chapter 8.8	2	1+2+3	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	Not performed
7	E(I)RP Power		LTE 2: §24.232(c)	RSS-133, Issue 6 Chapter 4.1/6.4 SRSP-510: 5.1.2	< 2 Watt (EIRP)	2	1+2+3	Pass (calculated with conducted vlaues and delivered antenna gain)
			LTE 4: §27.50 (d)(4)	RSS-139: Issue 3 Chapter 6.5 SRSP-513: 5.1.2	< 1 Watt (EIRP)			
			LTE 12: §27.50(c)(10)	RSS-130, Issue 1, Chapter 4.4	Handheld: < 3 Watt (ERP)			
8	Spurious emissions		§2.1053(a) §2.1057	RSS-Gen., Issue 4	43+10log(P) dBc	2	1+2+3	passed
9	Band-Edge compliance		LTE 2: §24.238(a)(b)	RSS-133: Chapter 6.5.1(i)(ii)		2	1+2+3	passed
			LTE4: §27.53(h)(1)(3)(i)(ii)(iii)	RSS-139: Issue 3 Chapter 6.6 (i) (ii)				
			LTE 12:§27.53(g)	RSS-130: Issue 1 Chapter 4.6.1				

30	RF Power	Antenna terminal (conducted)	§2.1046	RSS-130, Issue 1 SRSP-518	Handheld: 3 Watt (ERP)	1	1+2+3	passed
34	26dB Emission bandwidth		§2.1049(h)	RSS-Gen, Issue 4, Chapter 6.6	26dBc Emissions BW 99% Power	1	1+2+3	For information only
35	99% Occupied bandwidth							
36	Spurious emissions		§2.1051 §2.1057 §24.238(a)(b)	RSS-133, Issue 6: 6.5.1(i)(ii) RSS-139, Issue 3 Chapt. 6.6 (i) (ii)	43+10log(P) dBc	1	1+2+3	passed
37	Band-Edge compliance		§27.53	RSS-130, Issue 1 Chapt. 4.6.1 Chapt. 4.6.2				Passed
38	Frequency stability		§24.235 §2.1055(a)(2) §27.54	RSS-133, Issue 6: Chapter 6.3 RSS-130, Issue 1: Chapter 4.3 RSS-139, Issue 3, Chapter 6.4	< ±2.5ppm	3	1+2+3	Passed

Remarks: 1.)

1.2. Attestation:

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

.....	.....
Dipl.-Ing. Rachid Acharkaoui	Dipl.-Ing. Christian Lorenz
Responsible for test section	Responsible for test report

Digitally signed by christian.lorenz@cetecom.com
DN: cn=christian.lorenz@cetecom.com
Date: 2017.01.11 12:54:58 +01'00'

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

Project leader:	Dipl.-Ing. N.Perez
Responsible for test report:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2016-09-14
Date(s) of test:	2016-09-14 to 2016-10-25
Date of report:	2017-01-11

Version of template: 13.02	

2.4. Applicant's details

Applicant's name:	Gemalto M2M GmbH
Address:	Siemensdamm 50 13629 Berlin Germany
Contact person:	Mr. Axel Heike

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. TECHNICAL DATA OF MAIN EUT DECLARED BY APPLICANT

Main function	LTE communication		
Type	LTE module		
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 12: 698 - 716 MHz (Uplink), 728-746 MHz (Downlink)		
Type of modulation	QPSK, 16-QAM		
Data rates	Cat3, Downlink: max. 100Mbps, Uplink: max. 50Mbps		
Number of channels – Table 5.4.4-1 accord. 3GPP TS36.521-1	LTE Band 2: UARFCN range 18600 - 19199 LTE Band 4: UARFCN range 19950 - 20399 LTE Band 12: UARFCN range 23010 - 23179 (only for use in USA)		See Note about channels not to be used depending on channel bandwidths
Emission designator(s)	Channel bandwidth	QPSK Modulation:	16-QAM Modulation Remark 1:
	1.4 MHz	Not supported	Not supported
	3 MHz	Not supported	Not supported
	5 MHz	4M50G7D	4M51W7D
	10 MHz	9M00G7D	5M08W7D, remark1
	15 MHz	13M4G7D	5M08W7D, remark 1
	20 MHz	17M9G7D	5M11W7D, remark 1
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector: main TX + secondary RX connector		
Antenna Gain	f < 1GHz: -1.85dBd / 0.3dBi max. f > 1GHz: 2.1 dBi max.		
MAX PEAK Output Power: Radiated LTE-Mode 2 LTE-Mode 4 LTE-Mode 12	 23.86 dBm + 2.1dBi = 25.96 dBm EIRP 23.86 dBm + 2.1dBi = 25.96 dBm EIRP 23.44 dBm – 1.85dBd = 21.59 dBm ERP		
MAX PEAK Output Power: Conducted LTE-Mode 2 LTE-Mode 4 LTE-Mode 12	 23.86 dBm (AV) 23.86 dBm (AV) 23.44 dBm (AV)		
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: 9-12 Volt on DSB75-Adapter with external AC/DC Adapter Converted to voltage range of 3.3 V to 4.2 V by DSB75-Adapter board or direct connection to DC		
Special EMI components	--		
EUT sample type	☒ Production	☐ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

Remark 1: For 16-QAM maximum 27RBs could be activated in regard to category 1 device (3GPP 36.101, Annex 2.1.3). Therefore nominal signal-bandwidth only teoretical.

3.2. 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	LTE module	ELS31-US (S30960-S4520-A100)	IMEI: 004401081861722	Rev01	4.3.3.0a
EUT B	2 x Broadband Antenna	OmniLOG90200	61765 61810	SMA(male)	--

*) 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 description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	AC/DC Adapter	Model: ECP-25-12E	#1	Input: 100-240V AC, 50/60Hz, 0.8A Output: 12V DC 2.08A	--
AE 2	Eval Board	For EUT A	--	--	--
AE 3	DSB75 Adapter	AH6	--	--	--
AE 4	Development support board (Motherboard)	DSB75	#1	--	--

*) 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 3 + AE 4	RF-Conducted Measurement set-up except frequency stability
set. 2	EUT A + EUT B + AE 1 + AE 2+ AE 3 + AE 4	RF-radiated measurement set-up
set. 3	EUT A + AE 2+ AE 3 + AE 4	RF-conducted measurement for frequency-stability External power supply used

*) 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
1	LTE-Band 2 RMC Mode	A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM Modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
2	LTE-Band 4 RMC Mode	A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM Modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
3	LTE-Band 12 RMC Mode	A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM Modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.

*) 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	AC/DC cable	From AE1	--	--	1.90m

4. Description of test system set-up's

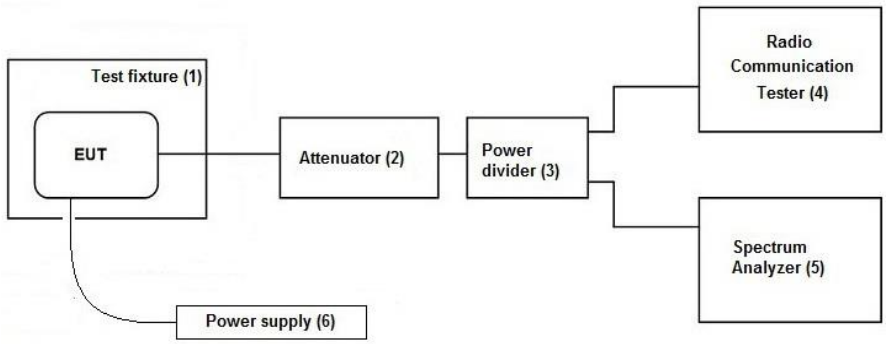
4.1. Test system set-up for conducted measurements on antenna port

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 Communication Test-Unit for LTE	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	

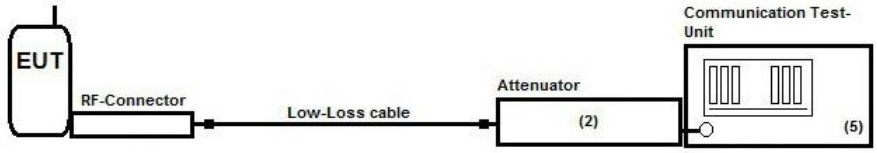
Testing method: ANSI C63.26:2015, KDB 971168 D01 v02r02

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) ☒ Low loss RF-cables	☒ CMW500 Communication Test-Unit for LTE ☒ DC-Power Supply	See List of equipment under each test case and chapter 8 for calibration info

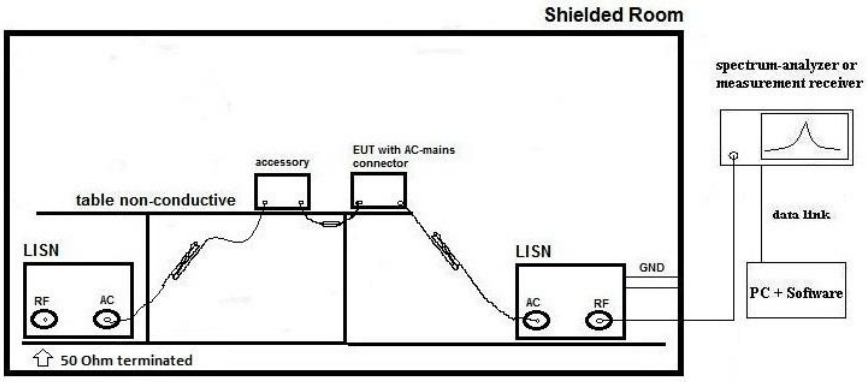
Measurement uncertainty See chapter Measurement Uncertainties (Cel-2)

4.2. Test system set-up for AC power-line conducted emission measurements

Specification: ANSI C63.4-2014 chapter 7, ANSI C63.10-2013chapter 6.2

General Description: The radio frequency voltage conducted back into the AC power line in the frequency range 150 kHz to 30 MHz has to be investigated. Compliance should be tested by measuring the radio frequency voltage between each power line and ground at the power terminals in the stated frequency range.
A 50 Ohm / 50 µH line impedance stabilization network (LISN) is used coupling the interface to the measurement equipment. The EUT power input leads are connected through the LISN to the AC-power source. The LISN enclosure is electrically connected to the ground plane. The measuring instrument is connected to the coaxial output of the LISN.
Tabletop devices were set-up on a 80 cm height above reference ground plane, floor standing equipment 10 cm raised above ground plane. Measurements have been performed on each phase line and neutral line of the devices AC-power lines. The EUT was power supplied with 110 V/60 Hz. The EUT was tested in the defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

Schematic:



Only schematic view, we refer to figure 6, 7 and 8 of ANSI C63.4-2009 for more details.

Testing method: **Exploratory, preliminary measurements** as a first step, determines the worst-case phase line (neutral or phase) as well as the most critical operating mode of the equipment. A complete frequency-sweep with PK-Detector is performed on each current-carrying conductor.

Final testing for power phases and critical frequencies (Margin to AV- or QP limit lower than 3 dB) as a second step includes measurements with receivers detector set to Quasi-Peak and Average.

Formula:

$V_C = V_R + C_L$ (1)

$M = L_T - V_C$ (2)

V_C = measured Voltage –corrected value
V_R = Receiver reading
C_L = Cable loss
M = Margin
L_T = Limit

Values are in dB, positive margin means value is below limit.

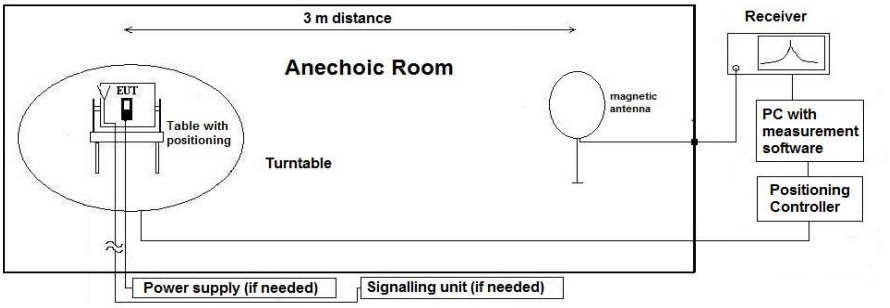
4.3. Test system set-up for radiated magnetic field measurements below 30 MHz

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.

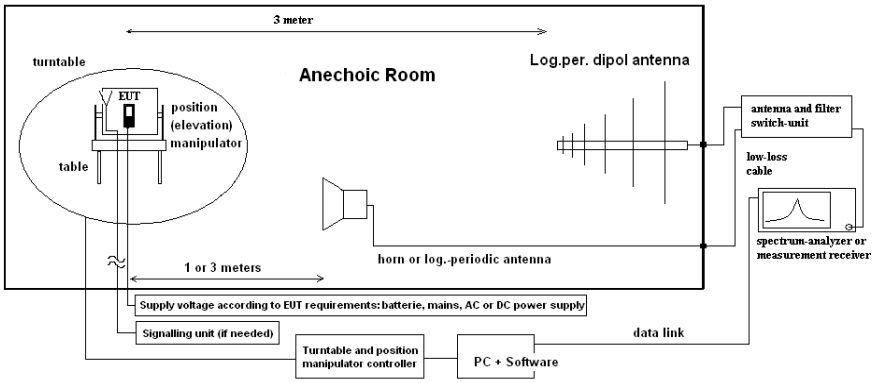
Distance correction: Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

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

Formula:

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

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

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

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

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

5. Measurements

5.1. 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
IC	RSS-133: Issue 6, 4.1/6.4 + SRSP-510:5.1.2 for LTE-FDD Band 2 RSS-139, Issue 3: 6.5 + SRSP-513, Chapter 5.1.2 RSS-130: Issue 1, §4.4 + PAR PK-AV ≤ 13 dB
Limit	Maximum Power Output of the mobile phone should be determined while measured conducted.
	Limit LTE Band 2: 2 Watt EIRP (33.0 dBm)
	Limit LTE Band 4: 1 Watt EIRP (30.0 dBm)
	Limit LTE Band 12: 3 Watt ERP/5W EIRP (34.77 dBm ERP/ 37dBm EIRP)

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			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]				
5 MHz	18625	1852,5	1RB low	28,404	22,2382	6,1654	28,67	21,404	7,2657	22,482	21,791	22,8	23,86
			1RB high	28,634	22,4823	6,1513	29,014	21,638	7,3768				
			50%RB mid	28,336	21,5307	6,8054	29,004	21,791	7,2125				
			100%RB	29,205	21,5048	7,6999	28,763	20,401	8,3622				
	18900	1880	1RB low	28,753	22,6885	6,0646	28,978	21,953	7,0249	22,689	22,051		
			1RB high	28,755	22,4949	6,2604	29,102	21,854	7,248				
			50%RB mid	28,215	21,7774	6,4374	29,031	22,051	6,9805				
			100%RB	28,599	21,7474	6,8517	28,645	20,65	7,9953				
	19175	1907,5	1RB low	28,289	22,8007	5,4881	27,739	21,822	5,9172	22,801	21,822		
			1RB high	27,716	21,3312	6,3852	26,9	20,464	6,4362				
			50%RB mid	27,773	21,2942	6,4786	28,067	21,577	6,4905				
			100%RB	27,741	21,251	6,4903	27,8	20,407	7,3929				
10 MHz	18650	1855	1RB low	27,794	22,0713	5,723	27,798	20,877	6,9214	22,42	22,903	22,9	
			1RB high	28,356	22,4203	5,9356	28,527	21,491	7,0364				
			50%RB mid	28,658	21,6975	6,9606	28,61	20,644	7,9653				
			100%RB	28,82	21,4748	7,345	26,682	22,903	3,7797				
	18900	1880	1RB low	28,269	22,3971	5,8718	28,276	21,678	6,5982	22,397	22,498		
			1RB high	28,127	21,9318	6,1949	28,39	21,154	7,2365				
			50%RB mid	28,569	21,7053	6,864	28,686	20,71	7,9758				
			100%RB	28,862	21,4786	7,3838	26,14	22,498	3,6426				
	19150	1905	1RB low	27,742	22,014	5,7281	28,143	21,201	6,9423	22,014	21,795		
			1RB high	26,501	20,8109	5,6905	27,397	20,123	7,2735				
			50%RB mid	27,832	21,4703	6,362	27,91	20,606	7,3033				
			100%RB	28,489	21,181	7,3084	25,979	21,795	4,1836				
15 MHz	18675	1857,5	1RB low	27,803	22,0239	5,7792	28,009	21,176	6,8338	22,596	23,046	23,05	
			1RB high	28,296	22,5958	5,7	28,555	21,852	6,703				
			50%RB mid	28,863	22,2335	6,6296	29,504	22,519	6,9844				
			100%RB	28,729	21,8524	6,8764	26,849	23,046	3,8036				
	18900	1880	1RB low	28,408	22,7572	5,6506	28,449	21,81	6,6396	22,757	22,491		
			1RB high	28,097	21,9681	6,1284	28,649	20,913	7,7354				
			50%RB mid	28,774	22,114	6,6598	29,039	22,353	6,6864				
			100%RB	28,827	21,7261	7,1011	26,231	22,491	3,74				
	19125	1902,5	1RB low	28,469	21,831	6,6379	28,696	20,954	7,7418	22,219	22,483		
			1RB high	27,225	21,0756	6,1494	27,448	20,513	6,935				
			50%RB mid	28,467	22,2185	6,2482	28,747	22,483	6,2643				
			100%RB	28,366	21,6475	6,7185	29,01	21,55	7,46				
20 MHz	18700	1860	1RB low	28,477	23,1704	5,307	28,327	22,304	6,023	23,776	23,858	23,86	
			1RB high	28,808	23,7758	5,032	28,813	22,96	5,8534				
			50%RB mid	29,143	22,0697	7,0737	28,962	22,127	6,8358				
			100%RB	29,386	22,0996	7,2867	27,575	23,858	3,7172				
	18900	1880	1RB low	28,938	23,8166	5,1216	28,789	23,162	5,6272	23,817	23,683		
			1RB high	28,849	22,9582	5,8905	28,416	22,211	6,205				
			50%RB mid	28,799	21,7449	7,0539	29,196	21,88	7,316				
			100%RB	29,026	21,8545	7,1713	27,37	23,683	3,6872				
	19100	1900	1RB low	28,946	22,7781	6,168	28,365	22,079	6,2861	22,778	22,838		
			1RB high	27,316	22,0309	5,2854	27,485	21,536	5,9484				
			50%RB mid	28,507	21,6409	6,866	28,727	21,746	6,9806				
			100%RB	28,774	21,5942	7,1798	26,945	22,838	4,1068				

Remark: Marked cells shows maximum values for 1RB and 100% RBs and on which PAPR measurements have been performed

Max-Values for different signal bandwidths:

LTE Band 2				
Signal-BW	QPSK		16-QAM	
	Peak	RMS	Peak	RMS
5	29,20	22,80	29,10	22,05
10	28,86	22,42	28,69	22,90
15	28,86	22,76	29,50	23,05
20	29,39	23,82	29,20	23,86

Max-Values for Modulation:

LTE Band 2			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
29,39	23,82	29,50	23,86

5.1.4.2. LTE Band 4 Results

LTE-Band 4				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]				
5 MHz	19975	1712,5	1RB low	27,819	23,305	4,5135	27,79	22,356	5,4343	23,305	22,5	23,31	23,86
			1RB high	27,989	22,6014	5,388	28,037	21,743	6,2933				
			50%RB mid	28,2	23,2	5	28,2	22,5	5,7				
			100%RB	28,153	22,0125	6,1402	27,914	21,101	6,8132				
	20175	1732,5	1RB low	27,133	21,857	5,2761	27,494	21,038	6,4556	22,54	21,93		
			1RB high	27,165	22,3383	4,8267	27,335	21,482	5,8534				
			50%RB mid	27,95	22,54	5,41	28,5	21,93	6,57				
			100%RB	27,409	21,2145	6,1943	27,148	20,16	6,9875				
	20375	1752,5	1RB low	28,156	22,8143	5,3413	27,787	21,842	5,945	23,008	23,02		
			1RB high	28,409	23,0079	5,4006	28,076	22,043	6,0323				
			50%RB mid	28,43	22,11	6,32	28,22	23,02	5,2				
			100%RB	28,314	21,9406	6,3736	28,111	20,976	7,135				
10 MHz	20000	1715	1RB low	27,562	22,7441	4,8177	27,508	22,019	5,4891	22,744	22,664	22,74	
			1RB high	27,208	21,3735	5,8342	27,433	20,698	6,7347				
			50%RB mid	27,66	21,82	5,84	27,9	20,8	7,1				
			100%RB	27,794	21,4533	6,3406	25,969	22,664	3,3048				
	20175	1732,5	1RB low	26,957	21,2301	5,7273	26,977	20,582	6,3953	21,988	21,892		
			1RB high	27,005	21,9879	5,0171	26,938	20,983	5,9546				
			50%RB mid	27,3	21,24	6,06	27,159	20,2	6,9585				
			100%RB	27,281	20,9059	6,3753	25,184	21,892	3,292				
	20350	1750	1RB low	27,719	22,4491	5,2694	27,571	21,605	5,9656	22,449	22,361		
			1RB high	28,348	22,3403	6,0081	28,093	21,427	6,6662				
			50%RB mid	27,96	22,43	5,53	28,02	21,89	6,13				
			100%RB	28,044	21,635	6,4088	25,722	22,361	3,3608				
15 MHz	20025	1717,5	1RB low	27,244	22,709	4,5352	27,475	21,872	5,6031	22,709	22,841	22,84	
			1RB high	26,641	21,395	5,2458	27,28	20,571	6,7085				
			50%RB mid	28,76	21,71	7,05	28,67	21,7	6,97				
			100%RB	28,079	21,5037	6,5751	25,997	22,841	3,1563				
	20175	1732,5	1RB low	27,101	21,3501	5,7507	27,958	22,397	5,5608	22,442	22,397		
			1RB high	27,126	22,4421	4,6836	27,3	21,777	5,5234				
			50%RB mid	27,93	21,803	6,127	27,996	22,086	5,91				
			100%RB	27,743	21,4422	6,3003	27,833	21,968	5,8654				
	20325	1747,5	1RB low	27,137	22,6658	4,4711	27,351	21,803	5,5485	22,666	22,548		
			1RB high	27,708	22,4151	5,2932	28,092	21,661	6,4314				
			50%RB mid	28,44	22,45	5,99	28,672	22,548	6,124				
			100%RB	28,34	22,1561	6,1836	25,741	22,513	3,2285				
20 MHz	20050	1720	1RB low	27,703	23,7188	3,9845	27,656	23,14	4,5165	23,719	23,861	23,86	
			1RB high	27,514	22,7521	4,7617	27,875	22,169	5,7059				
			50%RB mid	28,41	21,21	7,2	29,18	21,155	8,025				
			100%RB	28,408	21,5174	6,8902	27,003	23,861	3,1419				
	20175	1732,5	1RB low	27,967	22,4249	5,5416	27,725	21,834	5,8903	22,858	23,288		
			1RB high	27,692	22,8576	4,8347	27,692	22,858	4,8347				
			50%RB mid	28,004	21,42	6,584	27,897	21,418	6,479				
			100%RB	28,154	21,5328	6,6212	26,518	23,288	3,2306				
	20300	1745	1RB low	27,362	23,204	4,158	27,568	22,747	4,8217	23,623	23,127		
			1RB high	28,582	23,6233	4,9586	28,485	23,127	5,358				
			50%RB mid	28,03	22,22	5,81	28,254	22,24	6,014				
			100%RB	28,376	22,2686	6,1076	26,365	23,127	3,2377				

Remark: Marked cells shows maximum values for 1RB and 100% RBs and on which PAPR measurements have been performed

Max-Values for different signal bandwidths:

LTE Band 4				
Signal-BW	QPSK		16-QAM	
	Peak	RMS	Peak	RMS
5	28,43	23,31	28,50	23,02
10	28,35	22,74	28,09	22,66
15	28,76	22,71	28,67	22,84
20	28,58	23,72	29,18	23,86

Max-Values for Modulation:

LTE Band 4			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
28,76	23,72	29,18	23,86

5.1.4.3. LTE Band 12 Results

LTE-Band 12				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]				
5 MHz	23035	701,5	1RB low	28,024	23,364	4,660	28,237	22,439	5,797	23,36	22,44	23,36	23,44
			1RB high	27,711	22,639	5,072	28,001	21,806	6,194				
			50%RB mid	28,388	21,585	6,803	29,042	20,515	8,527				
			100%RB	27,459	21,698	5,761	28,357	20,746	7,611				
	23095	707,5	1RB low	28,080	22,540	5,540	28,213	21,616	6,597	23,22	22,43		
			1RB high	28,546	23,217	5,329	28,765	22,429	6,336				
			50%RB mid	28,857	21,769	7,088	29,297	20,833	8,464				
			100%RB	28,875	21,764	7,111	29,470	20,850	8,620				
	23155	713,5	1RB low	28,546	23,182	5,364	28,098	22,344	5,754	23,18	22,34		
			1RB high	28,012	22,488	5,525	27,503	21,640	5,863				
			50%RB mid	28,266	21,597	6,669	28,517	20,719	7,798				
			100%RB	28,714	21,681	7,033	28,884	20,740	8,144				
10 MHz	23060	704	1RB low	27,947	22,824	5,123	27,945	21,802	6,143	22,82	23,44	23,44	
			1RB high	28,294	22,727	5,567	28,293	21,665	6,628				
			50%RB mid	28,747	21,380	7,367	28,260	20,383	7,877				
			100%RB	28,366	21,555	6,811	26,818	23,435	3,382				
	23095	707,5	1RB low	27,841	22,196	5,645	28,436	21,230	7,206	22,76	23,18		
			1RB high	28,103	22,765	5,338	28,107	21,711	6,397				
			50%RB mid	29,083	21,752	7,331	28,727	20,808	7,919				
			100%RB	28,819	21,706	7,113	26,553	23,176	3,378				
	23130	711	1RB low	28,594	22,407	6,187	28,758	21,814	6,944	22,41	22,78		
			1RB high	27,924	22,038	5,886	26,715	20,613	6,103				
			50%RB mid	28,913	22,015	6,898	29,104	21,045	8,059				
			100%RB	28,988	21,813	7,175	26,247	22,785	3,462				

Remark: Marked cells shows maximum values for 1RB and 100% RBs and on which PAPR measurements have been performed

Max-Values for different signal bandwidths:

LTE Band 12				
Signal-BW	QPSK		16-QAM	
	Peak	RMS	Peak	RMS
5	28,88	23,36	29,47	22,44
10	29,08	22,82	29,10	23,44

Max-Values for Modulation:

LTE Band 12			
QPSK		16-QAM	
Peak	RMS	Peak	RMS
29,08	23,36	29,47	23,44

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]			
	QPSK Modulation		16-QAM Modulation	
Signal-Bandwidth / [MHz]	1RB	50% or 100% RBs	1RB or 50% RB	100% RBs
1.4	N/A		N/A	
3.0	N/A		N/A	
5.0	**12.234**	6.094	6.797 (50% RB)	6.516 (100%RB)
10	8.813	6.938	**8.438**	6.938
15	8.391	7.594	6.938	6.891
20	8.391	7.547	8.438	7.219

Remark: pls. see annex 1 for graphical plots
For each possible LTE signal-bandwidth on each maximum rms-value a value was recorded
two modulation schemes have been investigated: QPSK and 16-QAM
Values have been recorded for 1RB and a maximized RB value (50% or 100%)

LTE Band 4				
	Max. PAPR level with 0.1% probability / [dB]			
	QPSK Modulation		16-QAM Modulation	
Signal-Bandwidth / [MHz]	1RB	50% or 100% RBs	1RB if not other statement	50% or 100% RBs
1.4	N/A		N/A	
3.0	N/A		N/A	
5.0	**12.094**	6.141	6.188 (50%RB)	6.703 (100%RB)
10	8.859	7.125	**8.906**	6.516
15	8.391	7.594	7.125 (50%RB)	7.359 (100%RB)
20	8.906	7.594	8.203	8.109

Remark: pls. see annex 1 for graphical plots

LTE Band 12				
	Max. PAPR level with 0.1% probability / [dB]			
	QPSK Modulation		16-QAM Modulation	
Signal-Bandwidth / [MHz]	1RB	50% or 100% RBs	1RB if not other statement	50% or 100% RBs
1.4	N/A		N/A	
3.0	N/A		N/A	
5.0	**11.156**	6.094	**11.766**	6.469
10	8.203	6.984	8.953	6.891

Remark: pls. see annex 1 for graphical plots

5.1.5.3. Conclusion

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

5.2. RF-Parameter - Occupied bandwidth and emission bandwidth

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

test site	☐ 347 Radio.lab. 1	☒ Radio.lab. 2				
spectr. analys.	☐ 584 FSU8	☐ 489 ESU	☒ 620 ESU26	☐ 264 FSEK		
attenuator	☒ 530 10 dB	☐	☐			
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU	☒ 594 CMW500		
DC Power	☒ 611 E3632A	☐ 087 EA3013	☐ 354 NGPE 40	☐ 086 LNG50-10	☒ 611 E3632A	
otherwise	☒ 529 6dB divider					
line voltage	☐ 230 V 50 Hz via public mains		☐ 060 110 V/ 60 Hz via PAS 5000			

5.2.2. Requirements and Limits

FCC	CFR47, §2.202(a), §2.1049, §24.238(b), 27.53(h)(3), §27.53(m)(6)	„the **occupied bandwidth** is the frequency bandwidth, such that, below it lower and above it upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated"
IC	RSS-Gen, Issue 4: §6.6	
ANSI	C63.26-2015	

5.2.3. Test condition and test set-up

Climatic conditions		Temperature: (22±3°C)	Rel. humidity: (40±20)%
Test system set-up		Please see chapter "Test system set-up for conducted measurements at antenna port"	
Spectrum Analyzer Settings	Parameter	Occupied bandwidth:	Emission bandwidth
	Scan Mode	Spectrum analyser mode	Spectrum analyser mode
	Span	1.8MHz/4MHz/6MHz /12MHz/17MHz/22MHz	2MHz/4MHz/7MHz /12MHz/17MHz/22MHz
	RBW	30kHz/50kHz/100kHz/	30kHz/50kHz/100kHz/
	VBW	500kHz/1MHz/	300 kHz/500kHz/1MHz/
	Sweep time	Coupled (Auto)	Coupled (Auto)
	Sweep mode	Repetitive, max-hold	Repetitive, max-hold
	Detector	Peak	Peak
Measurement method		The used spectrum analyzer FSE or ESU from Rohde & Schwarz contains an integrated function to calculate the occupied bandwidth automatically. From left and right display margin, the upper and lower frequency points where the accumulated power becomes 0.5% of the total power, are calculated. Subtracting the previous determined two frequency points, yields the occupied bandwidth.	Bandwidth defined between 2 markers with are 26dBc compared to highest In-Band Peak Emission.
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. All RBs as possible per EUT signal bandwidth have been allocated. The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.	

5.2.4. Results

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

Operational Band	Modulation	Signal bandwidth [MHz]	Channel no.		Occupied bandwidth		26 dB Bandwidth	
			Range	Channel no.	Diagram no.	Value [MHz]	Diagram no.	Value [MHz]
Band 2	QPSK	5	Low	18625	35.206	4.500	34.206	5.508
			Mid	18900	--	--	34.207	5.484
			High	19175	35.208	**4.500**	34.208	**5.544**
		10	low	18650	35.209	8.961	34.209	10.656
			Mid	18900	35.210	**9.000**	34.210	**10.752**
			High	19150	35.211	8.980	34.211	10.680
		15	Low	18675	35.212	**13.430**	34.212	**15.130**
			Mid	18900	--	--	34.213	15.130
			High	19125	35.214	13.376	34.214	14.892
		20	Low	18700	35.215	17.910	34.215	19.800
			Mid	18900	35.216	17.908	34.216	**19.888**
			High	19100	35.217	**17.910**	34.217	19.800

1.) see diagrams in annex 1

Band 2	16-QAM	5	low	18625	35.224	4.500	34.224	5.568
			mid	18900	--	--	34.225	5.556
			high	19175	35.226	**4.500**	34.226	**5.580**
		10 remark 2	low	18650	35.227	4.961	34.227	6.048
			mid	18900	--	--	34.228	6.168
			high	19150	35.229	**5.048**	34.229	**6.192**
		15 remark 2	low	18675	35.230	4.985	34.230	6.216
			Mid	18900	35.231	4.896	34.231	**6.240**
			High	19125	35.232	**5.008**	34.232	5.952
		20 remark 2	low	18700	35.233	**5.048**	34.233	**6.408**
			Mid	18900	--	--	34.234	6.312
			High	19100	35.235	5.008	34.235	6.240

Remark:

1.) see diagrams in annex 1

2.) For 16-QAM maximum 27RBs could be activated in regard to category 1 device (3GPP 36.101, Annex 2.1.3) They have been positioned near left band-edge for low channels or near right band-edge for high channels.

5.2.4.2. LTE Band 4: Op. Mode 2, Set-up 1

Operational Band	Modulation	Signal bandwidth [MHz]	Channel no.		Occupied bandwidth		26 dB Bandwidth	
			Range	Channel no.	Diagram no.	Value [MHz]	Diagram no.	Value [MHz]
Band 4	QPSK	5	Low	19975	35.407	4.490	34.407	5.496
			Mid	20175	--	--	34.408	5.436
			High	20375	35.409	4.500	34.409	**5.568**
		10	low	20000	35.410	**8.980**	34.410	10.800
			Mid	20175	--		34.411	10.848
			High	20350	35.412	8.976	34.412	**10.848**
		15	Low	20025	35.413	13.430	34.413	**15.470**
			Mid	20175	--		34.414	15.402
			High	20325	35.415	13.403	34.415	15.164
		20	Low	20050	35.416	17.952	34.416	**19.888**
			Mid	20175	--		34.417	19.844
			High	20300	35.418	17.910	34.418	19.756

3.) see diagrams in annex 1

Operational Band	Modulation	Signal bandwidth [MHz]	Channel no.		Occupied bandwidth		26 dB Bandwidth	
			Range	Channel no.	Diagram no.	Value [MHz]	Diagram no.	Value [MHz]
Band 4	16-QAM	5	Low	19975	35.425	4.490	34.425	5.556
			Mid	20175	--		34.426	5.436
			High	20375	35.427	**4.512**	34.427	5.604
		10 remark 2	low	20000	35.428	4.980	34.428	6.000
			Mid	20175	--		34.429	6.000
			High	20350	35.430	5.088	34.430	6.072
		15 remark 2	Low	20025	35.431	5.048	34.431	6.096
			Mid	20175	35.432	4.872	34.432	6.120
			High	20325	35.433	5.088	34.433	5.976
		20 remark 2	Low	20050	35.434	5.006	34.434	6.264
			Mid	20175	35.435	4.872	34.435	6.432
			High	20300	35.436	**5.112**	34.436	6.192

Remark:

1.) see diagrams in annex 1

2.) For 16-QAM maximum 27RBs could be activated in regard to category 1 device (3GPP 36.101, Annex 2.1.3) They have been positioned near left band-edge for low channels or near right band-edge for high channels.

5.2.4.3. LTE Band 12: Op. Mode 3, Set-up 1

Operational Band	Modulation	Signal bandwidth [MHz]	Channel no.		99%-Occupied bandwidth		26 dB Emission Bandwidth	
			Range	Channel no.	Diagram no.	Value [MHz]	Diagram no.	Value [MHz]
Band 12	QPSK	5	Low	23035	35.121	4.524	34.121	5.580
			Mid	23095	--	--	34.122	5.388
			High	23155	--	--	34.123	5.448
		10	low	23060	--	--	34.124	10.248
			Mid	23095	--	--	34.125	10.272
			High	23130	35.126	8.952	34.126	10.368
	16-QAM	5	Low	23035	--	--	34.127	5.184
			Mid	23095	--	--	34.128	5.496
			High	23155	35.129	4.512	34.129	5.592
		10	low	23060	35.1210	4.896	34.1210	6.528
			Mid	23095	--	--	34.1211	6.240
			High	23130	--	--	34.1212	6.312

Remarks:

1.) see diagrams in annex 1, only maximum of 26dBc EBW was tested

2.) For 16-QAM maximum 27RBs could be activated in regard to category 1 device (3GPP 36.101, Annex 2.1.3)

5.3. RF-Parameter - Conducted 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	☐ 347 Radio.lab. 1	☒ Radio.lab. 2				
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK	☒ 620 ESU26		
signaling	☐ 017 CMD 65	☐ 323 CMD 55	☐ 340 CMD 55			
signaling	☐ 392 MT8820A	☐ 436 CMU	☒ 594 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 10dB Att.	☐ 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: §2.1051, §2.1057(2) ☐ 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“

5.3.3. Test condition and test set-up

Climatic conditions	Temperature: (22±3°C)	Rel. humidity: (40±20)%
Test system set-up	Please see chapter “Test system set-up for conducted measurements on antenna port”	
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 block-edge where a AVERAGE detector applied. 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)	
Spectrum-Analyzer settings	See below tables	
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 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. The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.	

Spectrum-Analyzer settings for LTE Band 2

	Start freq. MHz	Stop freq. MHz	R-BW kHz	V-BW MHz	Sweep time sec.	Att. [dB]	Detector
Sweep 1 (subrange 1)	0.009	0.150	0.0001	--[1.)]	10	25	MaxH-PK
Sweep 1 (subrange 2)	0.150	1	0.009	--[1.)]	10	25	MaxH-PK
Sweep 1 (subrange 3)	1	30	0.1	--[1.)]	5	25	MaxH-PK
Sweep 2 (subrange 1)	30	19500	1	--[1.)]	>60	35	MaxH-PK
Sweep 3a (Block-Edge)	1849	1850	20[2.)] to 200	--[1.)]	30	35	MaxH-PK
Sweep 3b (Block-Edge)	1849	1850		--[1.)]	30	35	MaxH-AV
Sweep 4a (Block-Edge)	1910	1911		--[1.)]	30	35	MaxH-PK
Sweep 4b (Block-Edge)	1910	1911		--[1.)]	30	35	MaxH-AV

Remark:
1.) EMI 6dB receiver mode used
2.) according rules approx. 1% of emission bandwidth depending of chosen signal bandwidth; this was choosen according power max values as worst-case

Spectrum-Analyzer Settings LTE Band 4

	Start freq. MHz	Stop freq. MHz	R-BW kHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	0.009	0.150	0.0001	--[1.)]	10	25	MaxH-PK
Sweep 1 (subrange 2)	0.150	1	0.009	--[1.)]	10	25	MaxH-PK
Sweep 1 (subrange 3)	1	30	0.1	--[1.)]	5	25	MaxH-PK
Sweep 2 (subrange 1)	30	18000	1	--[1.)]	>60	35	MaxH-PK
Sweep 3a (Block-Edge)	1709	1710	20[2.)] to 200	--[1.)]	30	35	MaxH-PK
Sweep 3b (Block-Edge)	1709	1710		--[1.)]	30	35	MaxH-AV
Sweep 4a (Block-Edge)	1755	1756		--[1.)]	30	35	MaxH-PK
Sweep 4b (Block-Edge)	1755	1756		--[1.)]	30	35	MaxH-AV

Remark:
1.) EMI 6dB receiver mode used
2.) according rules approx. 1% of emission bandwidth depending of chosen signal bandwidth, this was choosen according power max values as worst-case

Spectrum-Analyzer Settings LTE Band 12

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	0.009	0.150	0.0001	--[1.)]	10	25	MaxH-PK
Sweep 1 (subrange 2)	0.150	1	0.009	--[1.)]	10	25	MaxH-PK
Sweep 1 (subrange 3)	1	30	0.1	--[1.)]	5	25	MaxH-PK
Sweep 2 (subrange 1)	30	9000	1	--[1.)]	>60	35	MaxH-PK
Sweep 3a (Block-Edge)	697	698	50[2.)] to 100	--[1.)]	30	35	MaxH-PK
Sweep 3b (Block-Edge)	697	698		--[1.)]	30	35	MaxH-AV
Sweep 4a (Block-Edge)	716	717		--[1.)]	30	35	MaxH-PK
Sweep 4b (Block-Edge)	716	717		--[1.)]	30	35	MaxH-AV

Remark:
1.) EMI 6dB receiver mode used
2.) according rules approx. 1% of emission bandwidth depending of chosen signal bandwidth, this was choosen according power max values as worst-case

5.3.4. Results

The results are presented below in summary form only. For more information please see diagrams enclosed in annex 4.

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

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	[dBm]
36.13	Low	18700	9kHz to 30MHz	1	16-QAM-Modulation	☒	☐	☐	passed
36.14	Low	18700	9kHz to 30MHz		QPSK-Modulation	☒	☐	☐	passed
36.15	Low	18700	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results 16-QAM-modulation	☒	☐	☐	passed
36.16	Low	18700	30 MHz to 19.GHz		Carrier visible on diagram, not relevant for results QPSK-modulation	☒	☐	☐	passed
37.17	Band-Edge low	18625	1849 – 1850 MHz	1	Band Edge Compliance QPSK-modulation	☐	☒	☐	-13.23 Passed (low margin to limit of -13dBm)
37.18		18625	1849 – 1850 MHz		Band Edge Compliance 16-QAM-modulation	☐	☒	☐	-13.13 Passed (low margin to limit of -13dBm)
37.19		18625	1849 – 1850 MHz		Band Edge Compliance 16-QAM-modulation	☐	☒	☐	passed
37.20		18625	1849 – 850 MHz		Band Edge Compliance QPSK modulation	☐	☒	☐	passed
36.17	Middle	18900	9kHz to 30MHz	1	16-QAM-modulation	☒	☐	☐	passed
36.18	Middle	18900	9kHz to 30MHz		QPSK-Modulation	☒	☐	☐	Passed (low margin to limit of -13dBm)
36.19	Middle	18900	30 MHz to 19.5MHz		Carrier visible on diagram, not relevant for results 16-QAM-modulation	☒	☐	☐	passed
36.20	Middle	18900	30 MHz to 19.5MHz		Carrier visible on diagram, not relevant for results QPSK-modulation	☒	☐	☐	passed
36.21	High	19175	9kHz to 30MHz	1	QPSK-modulation	☒	☐	☐	passed
36.22		19175	9kHz to 30MHz		16-QAM-modulation	☒	☐	☐	passed
36.23		19175	30 MHz to 19.5GHz		QPSK-modulation	☒	☐	☐	passed
36.24		19175	30 MHz to 19.5GHz		16-QAM-modulation	☒	☐	☐	passed

37.21	Band-Edge high	19185	1910 – 1911 MHz	1	Band-Edge compliance QPSK Modulation	☐	☒	☐	Passed
37.22		19185	1910 – 1911 MHz		Band-Edge compliance QAM Modulation	☐	☒	☐	passed
37.23		19185	1910 – 1911 MHz		Band-Edge compliance QAM Modulation	☐	☒	☐	passed
37.23		19185	1910 – 1911 MHz		Band-Edge compliance QPSK Modulation	☐	☒	☐	passed

Remark:

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

Dia-gram no.	Carrier Channel Range	Carrier Channel No.	Frequency range	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result
36.01	Low	19975	9kHz to 30MHz	2	QPSK modulation	☒	☐	☐	passed
36.02	Low	19975	9kHz to 30MHz		16-QAM modulation	☒	☐	☐	passed
36.03	Low	19975	30 MHz to 18GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.04	Low	19975	30 MHz to 18GHz		Carrier visible on diagram, not relevant for results 16-QAM modulation	☒	☐	☐	passed
37.01	Band-Edge low	19975	1709 -1710 MHz	2	Band Edge Compliance QPSK modulation	☐	☒	☐	Passed
37.02		19975	1709 -1710 MHz		Band Edge Compliance 16-QAM modulation	☐	☒	☐	passed
37.03		19975	1709 -1710 MHz		Band Edge Compliance QPSK modulation	☐	☒	☐	passed
37.04		19975	1709 -1710 MHz		Band Edge Compliance 16-QAM modulation	☐	☒	☐	passed
36.05	Middle	20175	9kHz to 30MHz	2	QPSK modulation	☒	☐	☐	passed
36.06	Middle	20175	9kHz to 30MHz		16-QAM modulation	☒	☐	☐	passed
36.07	Middle	20175	30 MHz to 18GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.08	Middle	20175	30 MHz to 18GHz		Carrier visible on diagram, not relevant for results 16-QAM modulation	☒	☐	☐	passed
36.09	High	20300	9kHz to 30MHz	2	QPSK modulation	☒	☐	☐	passed
36.10	High	20300	30 MHz to 18GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.11	High	20230	9kHz to 30MHz		16-QAM modulation	☒	☐	☐	passed
36.12	High	20230	30 MHz to 19.5MHz		Carrier visible on diagram, not relevant for results 16-QAM modulation	☒	☐	☐	passed

37.05	Band-Edge high	20375	1755 - 1756 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
37.07		20375	1755 - 1756 MHz		Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
37.06		20375	1709 -1710 MHz		Band Edge Compliance QPSK modulation	☐	☒	☐	passed
37.08		20375	1709 -1710 MHz		Band Edge Compliance 16-QAM modulation	☐	☒	☐	passed

Remark:

5.3.4.3. LTE Band 12: Op. Mode 3, Set-up 2

Dia-gram no.	Carrier Channel Range	Carrier Channel No.	Frequency range	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result [dBm]
36.25	Low	23035	9kHz to 30MHz	3	QPSK modulation	☒	☐	☐	passed
36.26	Low	23035	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.27	Low	23035	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.28	Low	23035	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed
37.09	Band-Edge Low	23025	697 - 698 MHz	3	Band Edge Compliance 16-QAM modulation	☐	☒	☐	-13.29 Passed (low margin to limit of -13dBm)
37.10		23025	697 - 698 MHz		Band Edge Compliance QPSK modulation	☐	☒	☐	pa Passed (low margin to limit of -13dBm)
37.11		23025	697 - 698 MHz		Band Edge Compliance QPSK modulation	☐	☒	☐	passed
37.12		23025	697 - 698 MHz		Band Edge Compliance QAM modulation	☐	☒	☐	Passed
36.29	Middle	23095	9kHz to 30MHz	3	QPSK modulation	☒	☐	☐	Passed
36.30	Middle	23095	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.31	Middle	23095	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.32	Middle	23095	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed
36.33	High	23130	9kHz to 30MHz	3	QPSK modulation	☒	☐	☐	passed
36.34	High	23130	9kHz to 30MHz		QAM modulation	☒	☐	☐	passed
36.35	High	23130	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.36	High	23130	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed
37.13	Band-Edge High	23155	716 - 717 MHz	3	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
37.14		23155	716 - 717 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed
37.15		23155	716 - 717 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed
37.16		23155	716 - 717 MHz		Band-Edge compliance QPSK modulation	☐	☒	☐	passed

Remark:

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

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ 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			

5.4.2. 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

5.4.3. 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 12

	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)	697	698	50	300	30	35	MaxH-PK, Signal-BW=5MHz
Sweep 2b (Band-Edge)	697	698	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

5.4.4. Results

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

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

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.22	High	19175	30 MHz to 19.5 GHz	1	Carrier visible on diagram. Not relevant for results QPSK modulation	☒	☐	☐	passed
8.23	Low	18700	30 MHz to 19.5 GHz	1	Carrier visible on diagram. Not relevant for results 16-QAM modulation	☒	☐	☐	passed
8.24	Middle	18900	30 MHz to 19.5 GHz	1	Carrier visible on diagram. Not relevant for results 16-QAM modulation	☒	☐	☐	passed
9.24a	Band-Edge low	18625	1849 – 1850 MHz	1	Band-Edge compliance QPSK modulation	☒	☒	☐	passed
9.25a		18625	1849 – 1850 MHz	1	Band-Edge compliance 16-QAM modulation	☒	☒	☐	passed
9.26		18625	1849 – 1850 MHz	1	Band-Edge compliance QPSK modulation	☒	☒	☐	passed
9.27		18625	1849 – 1850 MHz	1	Band-Edge compliance 16-QAM modulation	☒	☒	☐	passed
9.28	Band-Edge high	19175	1910 – 1911 MHz	1	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.29		19175	1910 – 1911 MHz	1	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.30		19175	1910 – 1911 MHz	1	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.31		19175	1910 – 1911 MHz	1	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

Remark1:

5.4.4.2. LTE Band 4: Op. Mode 2, Set-up 1

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.40	Low	19975	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation	☒	☐	☐	passed
8.42a 8.42b	High	20300	30MHz – 2.8GHz 2.8GHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation	☒	☐	☐	passed
8.44	Mid	20175	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results 16-QAM modulation	☒	☐	☐	passed

9.44	Band-edge low	19975	1709 – 1710 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	Passed
9.45		19975	1709 – 1710 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.46		19975	1709 – 1710 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.47		19975	1709 – 1710 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.48	Band-edge high	20375	1755 – 1756 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.49		20375	1755 – 1756 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.50		20375	1755 – 1756 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.51		20375	1755 – 1756 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

Remark1:

5.4.4.3. LTE Band 12: Op. Mode 3, Set-up 1

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.120	Low	23035	30 MHz to 9 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation	☒	☐	☐	passed
8.121	Middle	23095	30 MHz to 9 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation	☒	☐	☐	passed
8.122	High	23155	30 MHz to 9 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation	☒	☐	☐	passed

9.01	Band-Edge low	23035	697 – 698 MHz	2	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	Passed
9.02		23035	697 – 698 MHz	2	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed
9.03		23035	697 – 698 MHz	2	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	passed
9.04		23035	697 – 698 MHz	2	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed

9.05	Band-Edge high	23155	716 – 717 MHz	2	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	Passed
9.06		23155	716 – 717 MHz	2	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed
9.07		23155	716 – 717 MHz	2	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	passed
9.08		23155	716 – 717 MHz	2	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed

Remark1:

5.5. RF-Parameter - Frequency stability on temperature and voltage variations

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 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	☐ 594 CMW500	
DC power	☐ 611 E3632A	☐ 457 EA 3013A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☒ 529 6dB divider	☒ 530 10dB Att.	☐ 431 Near field			
Climatic test chamber	☒ 331 HC 4055	☒ VT 4002	☒ 627 OPUS 1			
line voltage	☐ 230 V 50 Hz via public mains		☐ 060 110 V/ 60 Hz via PAS 5000			

5.5.2. Requirements and limits

FCC	§2.1055(a)(1) , §24.235, §27.54
IC	RSS-133: 6.3 RSS-139, Issue 3: 6.4RSS-130, Issue 1: §4.3
Limit	*"The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block"*

5.5.3. Test condition and test set-up

Test system set-up	Please see chapter "Test system set-up for conducted measurements on antenna port" In order to maintain the voltage constant over the time period of the tests, a dummy battery was connected to a laboratory power supply. The power supply voltage was controlled on the input of the power supply terminals of the EUT.
Measurement method	The RF Channel spacing is 100 kHz according LTE-Spec, with a guard band depending of the TX signal bandwidth. Details can be found in standard 3GPP36.521. The aim of the EUT is to function under all extreme conditions within authorized sub-bands in regard to temperature and voltage variations. The frequency deviation was recorded with base station's build in capability. (CMW500) for both modulations possible: QPSK and 16-QAM As the standard requires that the fundamental emissions stays within the authorized band, a limit of ±0.1ppm is considered low enough to ensure this. However the standard required a more relaxed limit of ±2.5ppm
Mobile phone settings	UE is set TX mode, highest transmit power conditions (RMC-mode), power saving techniques have been disabled Tests have been done in RMC operating mode ,maximum power at lowest per bandwidth allowed TX signal bandwidth: 1.4MHz or 5MHz. Both modulations have been tested: QPSK and 16-QAM.

5.5.3.1. Frequency shift of carrier against a voltage range at constant nominal temperature of 20° Celsius

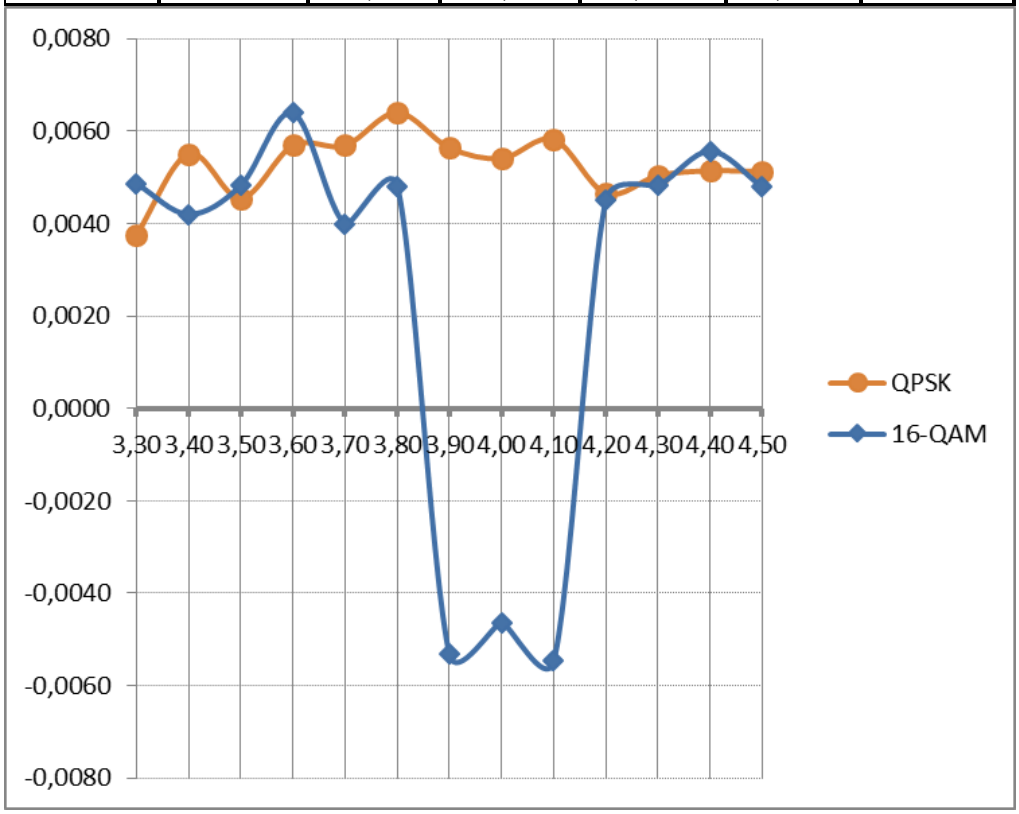
1.) determine the carrier frequency for the lowest and highest channel at room temperature and nominal voltage [20°C]
2.) The voltage was reduced in 0.1 Volt steps to the lower end point, where the mobile phone stops working. (this shall be specified by the manufacturer) Record the carrier frequency shift within 2 minutes after powering on the mobile phone, to prevent for self heating effects.
3.) The voltage was increased in 0.1 Volt steps to the upper declared voltage of the battery. Record the carrier frequency shift within 2 minutes after powering on the mobile phone, to prevent for self heating effects.

5.5.4. Measurement Results:

5.5.4.1. LTE Band 2: Maximum frequency Error during connection state

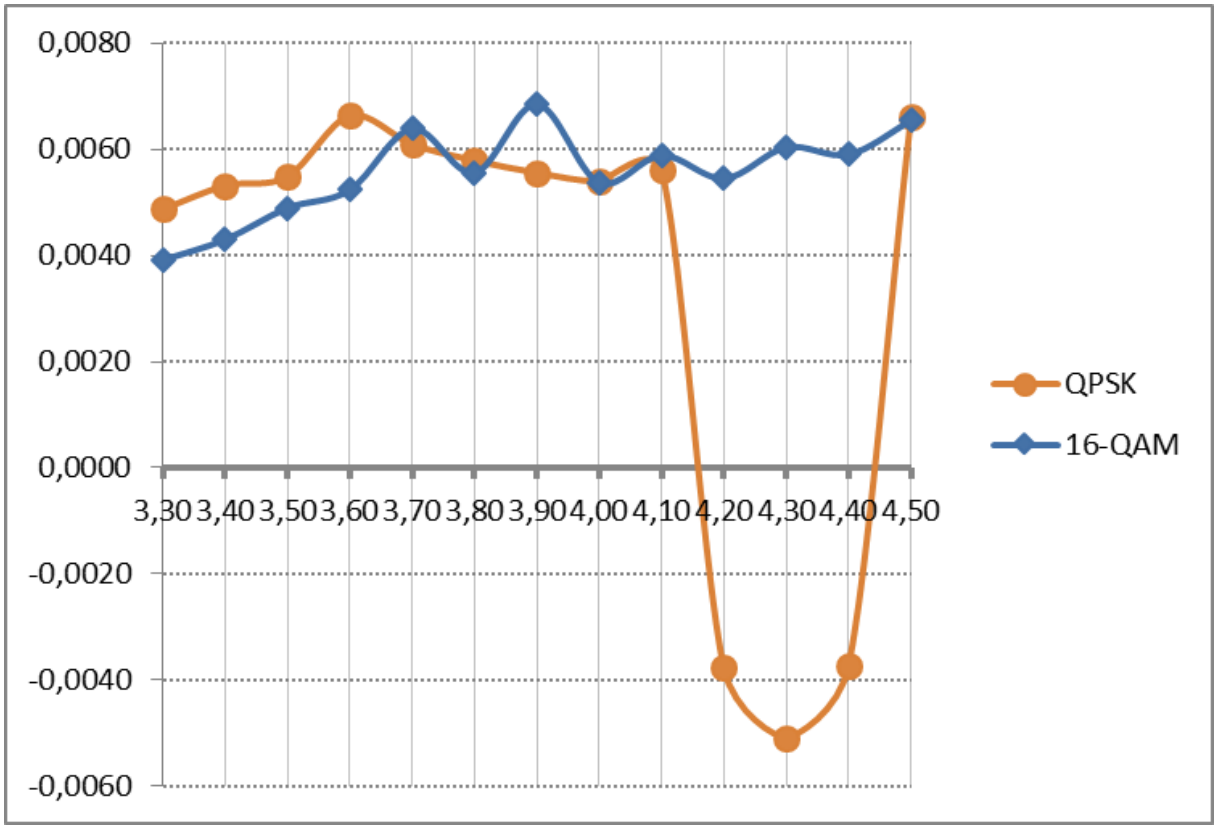
LTE Band 2 /Channel 18900/ BW=5 MHz/Full RBs

Voltage	Nominal Frequency	Frequency error [Hz]		Maximum Frequency error		Verdict
		QPSK Modulation	16-QAM	QPSK	16-QAM	
[V]	[MHz]	[Hz]	[Hz]	[ppm]	[ppm]	Limit=0.1ppm
3,30		7,07	9,14	0,0038	0,0049	
3,40		10,36	7,90	0,0055	0,0042	
3,50		8,55	9,08	0,0045	0,0048	
3,60		10,70	12,02	0,0057	0,0064	
3,70		10,70	7,51	0,0057	0,0040	
3,80		12,04	9,04	0,0064	0,0048	
3,90	1,8800E+09	10,60	-10,01	0,0056	-0,0053	passed
4,00		10,17	-8,70	0,0054	-0,0046	
4,10		10,94	-10,27	0,0058	-0,0055	
4,20		8,75	8,48	0,0047	0,0045	
4,30		9,47	9,07	0,0050	0,0048	
4,40		9,67	10,47	0,0051	0,0056	
4,50		9,63	9,01	0,0051	0,0048	



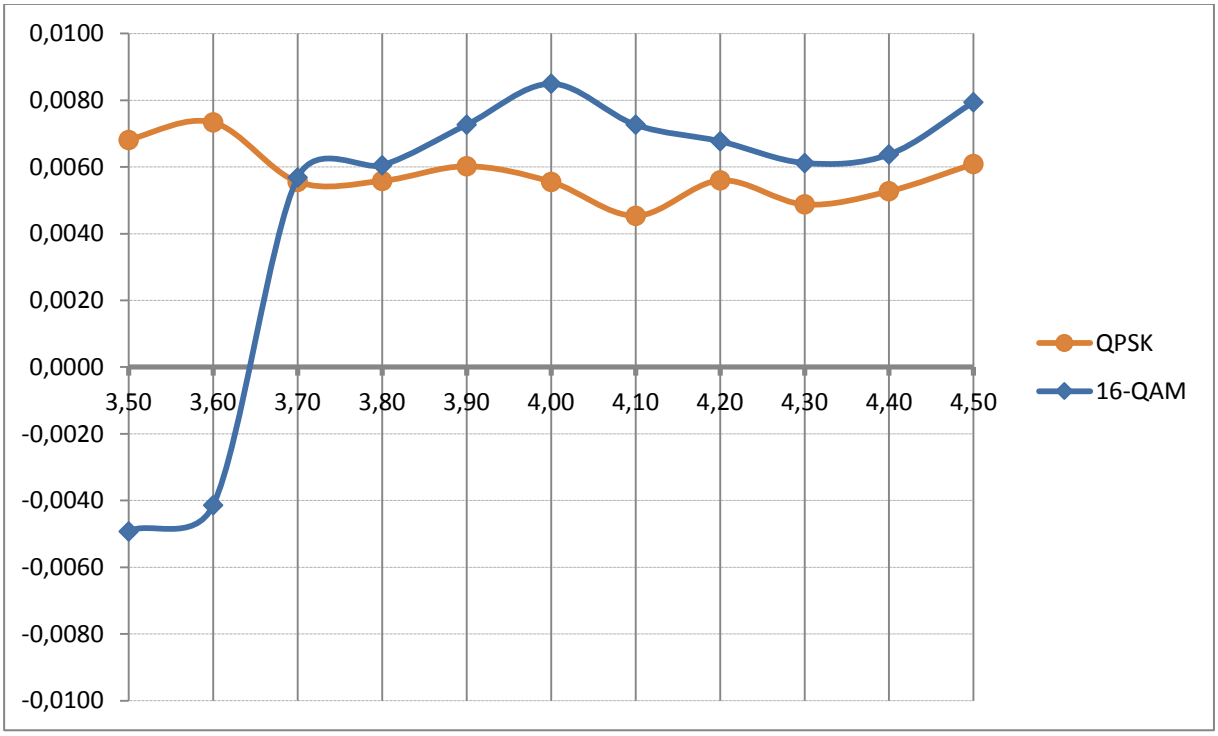
5.5.4.2. LTE Band 4

LTE Band 4 /Channel 20175/ BW= 5MHz/Full RBs						
Voltage	Nominal Frequency	Frequency error [Hz]		Maximum Frequency error		Verdict
		QPSK Modulation	16-QAM	QPSK	16-QAM	
[V]	[MHz]	[Hz]	[Hz]	[ppm]	[ppm]	Limit=0.1ppm
3,30	1,7325E+09	8,44	6,78	0,0049	0,0039	passed
3,40		9,21	7,45	0,0053	0,0043	
3,50		9,51	8,48	0,0055	0,0049	
3,60		11,49	9,07	0,0066	0,0052	
3,70		10,56	11,07	0,0061	0,0064	
3,80		10,03	9,63	0,0058	0,0056	
3,90		9,63	11,87	0,0056	0,0069	
4,00		9,36	9,31	0,0054	0,0054	
4,10		9,71	10,2	0,0056	0,0059	
4,20		-6,54	9,44	-0,0038	0,0054	
4,30		-8,81	10,46	-0,0051	0,0060	
4,40		-6,45	10,23	-0,0037	0,0059	
4,50		11,46	11,33	0,0066	0,0065	



5.5.4.3. LTE Band 12

LTE Band 12 /Channel 23095/ BW=5MHz/Full RBs						
Voltage	Nominal Frequency	Frequency error [Hz]		Maximum Frequency error		Verdict
		QPSK Modulation [Hz]	16-QAM	QPSK	16-QAM	
[V]	[MHz]		[Hz]	[ppm]	[ppm]	Limit=0.1ppm
3,30	7,0750E+08	4,49	-4,96	0,0063	-0,0070	passed
3,40		4,22	-5,18	0,0060	-0,0073	
3,50		4,82	-3,49	0,0068	-0,0049	
3,60		5,19	-2,93	0,0073	-0,0041	
3,70		3,93	4,02	0,0056	0,0057	
3,80		3,95	4,28	0,0056	0,0060	
3,90		4,26	5,14	0,0060	0,0073	
4,00		3,93	6,01	0,0056	0,0085	
4,10		3,21	5,14	0,0045	0,0073	
4,20		3,96	4,79	0,0056	0,0068	
4,30		3,45	4,33	0,0049	0,0061	
4,40		3,73	4,51	0,0053	0,0064	
4,50		4,31	5,62	0,0061	0,0079	

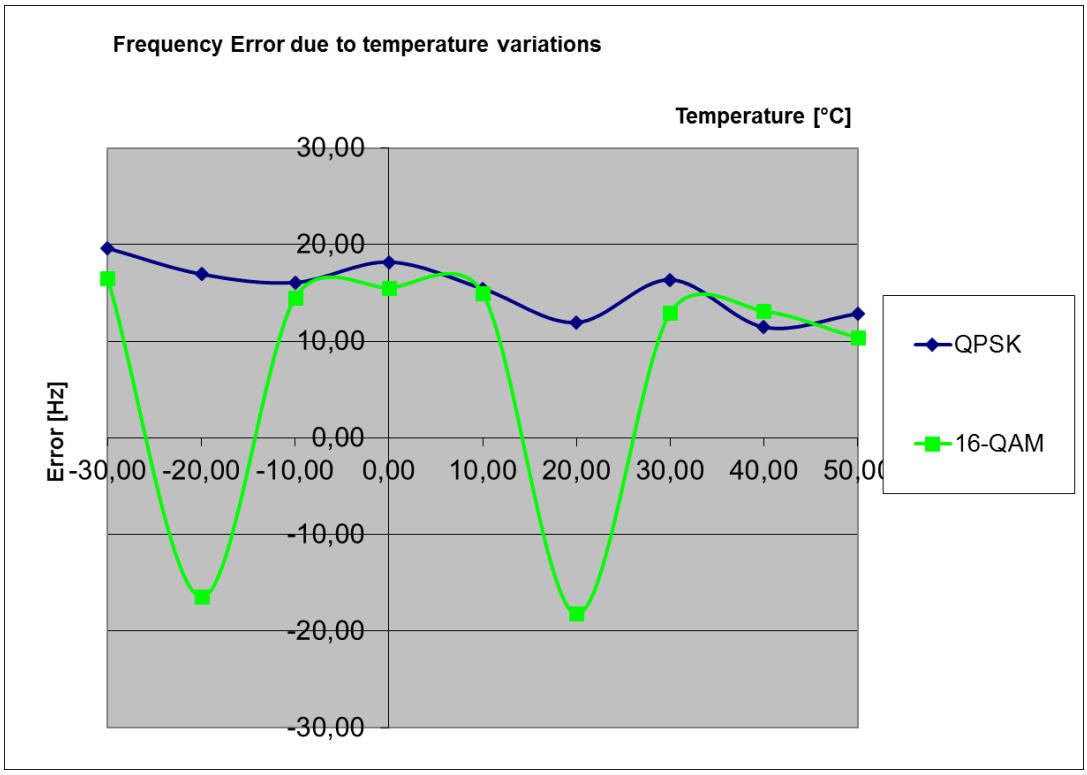


5.5.4.4. Frequency shift of carrier against temperature at constant power supply voltage

1.) determine the carrier frequency for the lowest, middle and highest channel at room temperature and nominal voltage [20°C]
2.) expose the mobile station to –30°C, wait sufficient time to have constant temperature.
3.) Perform the carrier frequencies measurements in 10°C increments from –30°C to +60°C. For about half hour at the specified temperature the mobile was powered-off. After powering-on, the measurements were made within 2 minute for the channel lower channel, in order to prevent self-warming of the mobile.

5.5.4.5. LTE Band 2: Maximum frequency Error during connection state

	Maximum frequency error				
	Channel 18900/ BW=5 MHz				
Temperature	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Verdict Limit=±0.1ppm
-30	**19,63**	**16,48**	0,010	0,009	Passed
-20	16,94	-16,45	0,009	-0,009	
-10	16,08	14,51	0,009	0,008	
0	18,2	15,52	0,010	0,008	
10	15,44	14,95	0,008	0,008	
20	11,94	**-18,21**	0,006	-0,010	
30	16,37	12,92	0,009	0,007	
40	**11,46**	13,12	0,006	0,007	
50	12,85	10,36	0,007	0,006	



5.5.4.6. LTE Band 2: Canada requierement regarding emission/occupied bandwith

Measurement Method:
With results of chapter 5.5.4.5 (frequency error) and of chapter 5.2.4.1 (occupied bandwidth) a calculations should show that the emissions bandwidth remains within authorized bands. Negative frequency error shifts the carrier (T1 and T2 points) more closer to the left band-edge (1850MHz), positive frequency error shifts the carrier (T1 and T2 points) more closer to the right band-edge (1910MHz).
Following table shows the results calculated with above presumptions:

from occupied bandwidth diagramms point (T1)

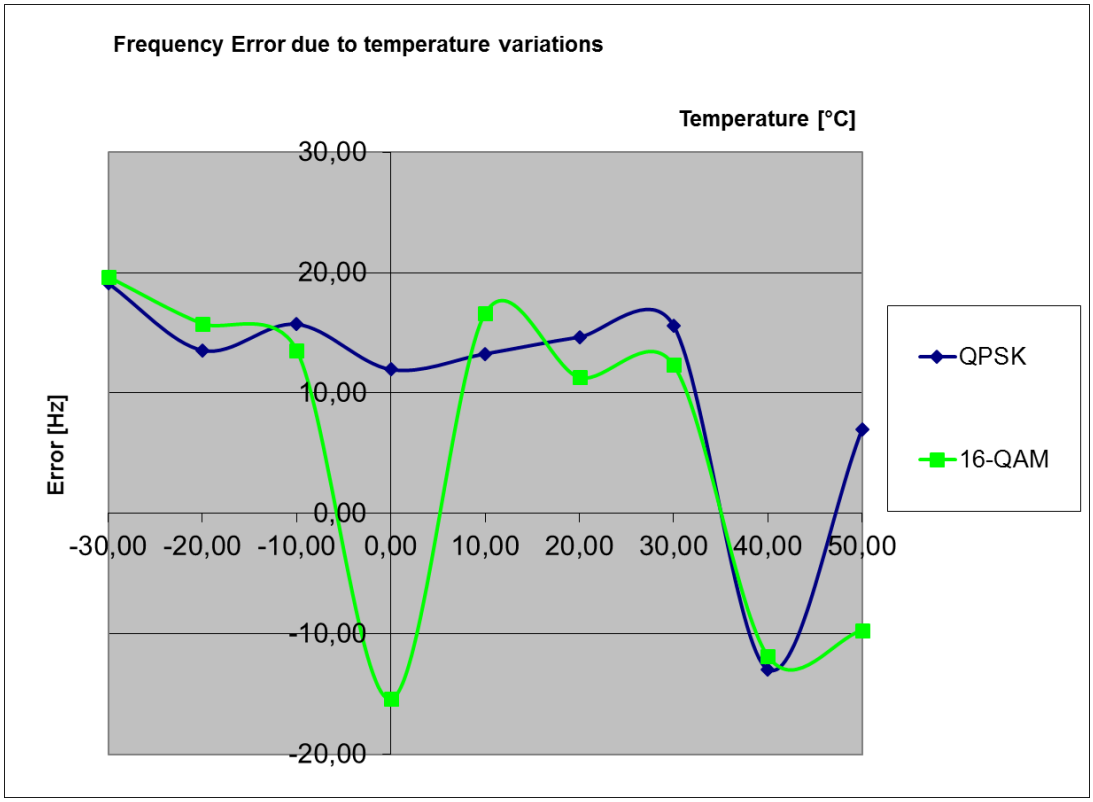
Modulation -Scheme	LTE Signal Bandwidth [MHz]	**FL [MHz]**	Low Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency of Maximum Deviation during climatic tests [MHz]	**Margin to Low-Band-Edge including climatic conditions** [MHz]	Verdict
QPSK	5	1850,25	1850	0,25	-0,00001821	0,24998179	pass
	10	1850,519231		0,519231	-0,00001821	0,51921279	pass
	15	1850,802		0,802	-0,00001821	0,80198179	pass
	20	1851,044872		1,044872	-0,00001821	1,04485379	pass
16-QAM	5	1850,25	1850	0,25	0,00001146	0,25001146	pass
	10	1850,480769		0,480769	0,00001146	0,48078046	pass
	15	1850,716346		0,716346	0,00001146	0,71635746	pass
	20	1850,945513		0,945513	0,00001146	0,94552446	pass

from occupied bandwidth diagramms point (T2)

Modulation -Scheme	LTE Signal Bandwidth [MHz]	**FH [MHz]**	High Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency of Maximum Deviation during climatic tests [MHz]	**Margin to Low-Band-Edge including climatic conditions**	Verdict
QPSK	5	1909,744	1910	0,256	0,00001963	0,25598037	pass
	10	1909,461538		0,538462	0,00001963	0,53844237	pass
	15	1909,147436		0,852564	0,00001963	0,85254437	pass
	20	1908,955128		1,044872	0,00001963	1,04485237	pass
16-QAM	5	1909,744	1910	0,256	0,00001648	0,25598352	pass
	10	1909,52724400		0,472756	0,00001648	0,47273952	pass
	15	1909,286859		0,713141	0,00001648	0,71312452	pass
	20	1909,046474		0,953526	0,00001648	0,95350952	pass

5.5.4.7. LTE Band 4

Temperature	Maximum frequency error Channel 20175/ BW= 5MHz QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Verdict Limit=±0.1ppm
-30	**19,11**	**19,66**	0,011	0,011	Passed
-20	13,55	15,76	0,008	0,009	
-10	15,72	13,56	0,009	0,008	
0	11,96	**-15,42**	0,007	-0,009	
10	13,26	16,61	0,008	0,010	
20	14,65	11,29	0,008	0,007	
30	15,59	12,33	0,009	0,007	
40	**-12,95**	-11,84	-0,007	-0,007	
50	7,01	-9,7	0,004	-0,006	



5.5.4.8. LTE Band 4: Canada requierement regarding emission/occupied bandwith

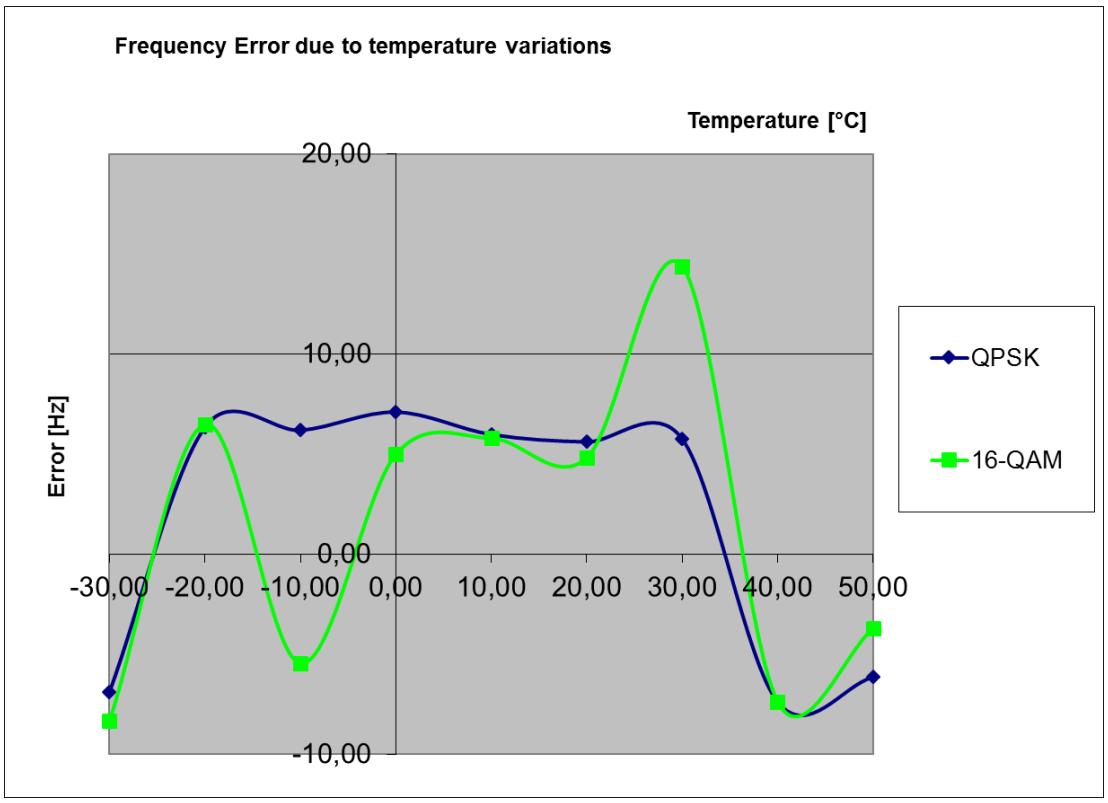
Measurement Method:
With results of chapter 5.5.4.7 (frequency error) and of chapter 5.2.4.2 (occupied bandwidth) a calculations should show that the emissions bandwidth remains within authorized bands. Negative frequency error shifts the carrier (T1 and T2 points) more closer to the left band-edge (1710MHz), positive frequency error shifts the carrier (T1 and T2 points) more closer to the right band-edge (1755MHz).
Following table shows the results calculated with above presumptions:

	from occupied bandwidth diagramms point						
Modulation -Scheme	LTE Signal Bandwidth [MHz]	**FL [MHz]**	Low Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency of Maximum Deviation during climatic tests [MHz]	**Margin to Low-Band-Edge including climatic conditions [MHz]**	Verdict
QPSK	5	1710,259615	1710	0,259615	-0,00001295	0,25960205	pass
	10	1710,5		0,5	-0,00001295	0,49998705	pass
	15	1710,802		0,802	-0,00001295	0,80198705	pass
	20	1711,024		1,024	-0,00001295	1,02398705	pass
16-QAM	5	1710,25	1710	0,25	-0,00001542	0,24998458	pass
	10	1710,461538		0,461538	-0,00001542	0,46152258	pass
	15	1710,689103		0,689103	-0,00001542	0,68908758	pass
	20	1710,939103		0,939103	-0,00001542	0,93908758	pass

	from occupied bandwidth diagramms point						
Modulation -Scheme	LTE Signal Bandwidth [MHz]	**FH [MHz]**	High Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency of Maximum Deviation during climatic tests [MHz]	Margin to Low-Band-Edge including climatic conditions [MHz]	Verdict
QPSK	5	1754,744	1755	0,256	0,00001911	0,25598089	pass
	10	1754,488		0,512	0,00001911	0,51198089	pass
	15	1754,17		0,83	0,00001911	0,82998089	pass
	20	1753,955		1,045	0,00001911	1,04498089	pass
16-QAM	5	1754,756	1755	0,244	0,00001966	0,24398034	pass
	10	1754,527244		0,472756	0,00001966	0,47273634	pass
	15	1754,270833		0,729167	0,00001966	0,72914734	pass
	20	1754,080897		0,919103	0,00001966	0,91908334	pass

5.5.4.9. LTE Band 12

Temperature	Maximum frequency error Channel 23095/ BW=5MHz QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Verdict Limit=±0.1ppm
-30	-6,88	**-8,33**	-0,010	-0,012	Passed
-20	6,35	6,49	0,009	0,009	
-10	6,19	-5,45	0,009	-0,008	
0	**7,1**	4,99	0,010	0,007	
10	5,98	5,79	0,008	0,008	
20	5,61	4,82	0,008	0,007	
30	5,76	**14,39**	0,008	0,020	
40	**-7,38**	-7,37	-0,010	-0,010	
50	-6,14	-3,72	-0,009	-0,005	



5.5.4.10. LTE Band 12: Canada requierement regarding emission/occupied bandwith

Measurement Method:
With results of chapter 5.5.4.9 (frequency error) and spectrum mask diagrams (see annex 1) a calculations should show that the points FH and FL remain within authorized band. Negative frequency error shifts the carrier (F_L point) more closer to the left band-edge (698MHz), positive frequency error shifts the carrier (F_H) more closer to the right band-edge (716MHz).

Following table shows the results calculated with above presumptions:

Modulation -Scheme	LTE Signal Bandwidth [MHz]	**from spectrum diagram F_L [MHz]**	Low Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency of Maximum Deviation during climatic tests [MHz]	**Margin to Low-Band-Edge including climatic conditions [MHz]**	Verdict
QPSK	5	699,201923077	698	1,201923077	-0,00000738	1,20191570	pass
	10	699,384615385		1,384615385	-0,00000738	1,38460800	pass
16-QAM	5	699,192307692	698	1,192307692	-0,00000833	1,19229936	pass
	10	699,384615385		1,384615385	-0,00000833	1,38460705	pass

Modulation -Scheme	LTE Signal Bandwidth [MHz]	**from spectrum diagram F_H [MHz]**	High Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency of Maximum Deviation during climatic tests [MHz]	Margin to Low-Band-Edge including climatic conditions [MHz]	Verdict
QPSK	5	715,807692308	716	0,192307692	0,00000710	0,19230059	pass
	10	715,615384615		0,384615385	0,00000710	0,38460828	pass
16-QAM	5	715,807692308	716	0,192307692	0,00001439	0,19229330	pass
	10	715,615384615		0,384615385	0,00001439	0,38460099	pass

5.6. General Limit - Conducted emissions on AC-Power lines

5.6.1. 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	☐ 333 EMI field	☒ 348 EMI cond.				
receiver	☐ 001 ESS	☒ 377 ESCS 30	☐ 489 ESU 40	☐ 620 ESU 26		
LISN	☒ 005 ESH2-Z5	☐ 007 ESH3-Z6	☐ 300 ESH3-Z5 & 50Ω used for AE		☐ no LISN for AE	
signaling	☐ 392 MT8820A	☐ 436 CMU	☐ 547 CMU	☐ 594 CMW		
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V 60 Hz via PAS 5000			

5.6.2. Requirements

FCC		Part 15, Subpart B, §15.207	
IC		RSS-Gen Issue 4, Chapter 8.8, Table 3	
ANSI		C63.10-2013	
Limit	Frequency [MHz]	QUASI-Peak [dBµV]	AVERAGE [dBµV]
	0.15 – 0.5	66 to 56*	56 to 46*
	0.5 – 5	56	46
	5 – 30	60	50
Remark: * decreases with the logarithm of the frequency			

5.6.3. 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 (40 cm distance to reference ground plane (wall)		☐ floor standing EUT stands isolated on reference ground plane (floor)
Climatic conditions		Temperature: (22±3°C)		Rel. humidity: (40±20)%
EMI-Receiver or Analyzer settings	Scan data	☐ 9 – 150 kHz, RBW = 200 Hz, Step = 61 Hz ☒ 150 kHz – 30 MHz RBW = 9 kHz, Step = 4 kHz ☐ other:		
	Scan-Mode Pre-measurement Final measurement	6 dB EMI-Receiver Mode Peak detector, Repetitive-Scan, max-hold, sweep-time 50 µs per frequency point Average & Quasi-peak detector at critical frequencies		
General measurement procedures		Please see chapter "Test system set-up for AC power line conducted emissions measurements"		

5.6.4. Measurement results

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

EUT set-up no.:			set-up 2		
Diagram No.	EUT operating mode no. or commend	Used Detector	Power line	Additional (scan-) information or remarks	Result
1.01	EUT operating mode 2	☒ Peak (pre-scan) ☒ AV (final) ☒ QP (final)	L1/ N	LTE Band 4: Tested on channel 20175, SignaBW:5MHz, 25RBs	passed
1.02	EUT operating mode 1	☒ Peak (pre-scan) ☒ AV (final) ☒ QP (final)	L1/ N	LTE Band 2: Tested on channel 18900, SignaBW:5MHz, 25RBs	passed
1.03	EUT operating mode 3	☒ Peak (pre-scan) ☒ AV (final) ☒ QP (final)	L1/ N	LTE Band 12: Tested on channel 23095, SignaBW:5MHz, 25RBs	passed

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

5.7.1. 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			

5.7.2. 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

5.7.3. 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"		

5.7.4. Measurement Results LTE FDD Band 2:

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 Range	Carrier Channel No.	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector PK	Used detector AV	Used detector QP	Result
2.01	High	19175	9 kHz-30 MHz		1	LTE Band 2 QPSK modulation	☒	☐	☐	passed
2.02	Middle	18900	9 kHz-30 MHz		1	LTE Band 2 16-QAM modulation	☒	☐	☐	passed
2.03	Low	18700	9 kHz-30 MHz		1	LTE Band 2 16-QAM modulation	☒	☐	☐	passed

5.7.5. Measurement Results LTE FDD Band 4:

Table of measurement results:

Diagram No.	Carrier Channel		Set-up no.	OP-mode no.	Remark	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
2.01	High	19175	9 kHz-30 MHz		1	LTE Band 2 QPSK modulation	☒	☐	☐	passed
2.05	High	20300	9 kHz-30 MHz		2	LTE Band 4 QPSK modulation	☒	☐	☐	Passed
2.06	Middle	19975	9 kHz-30 MHz		2	LTE Band 4 QPSK modulation	☒	☐	☐	passed
2.07	Low	20175	9 kHz-30 MHz		2	LTE Band 4 16-QAM modulation	☒	☐	☐	passed

5.7.6. Measurement Results LTE FDD Band 12:

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	
2.08	Low	23035	9 kHz-30 MHz		2	LTE Band 12 QPSK modulation	☒	☐	☐	Passed
2.09	Middle	23095	9 kHz-30 MHz		2	LTE Band 12 QPSK modulation	☒	☐	☐	passed
2.10	High	23155	9 kHz-30 MHz		2	LTE Band 12 QPSK modulation	☒	☐	☐	passed

5.7.7. 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

5.8. Measurement uncertainties

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

Following table shows expectable uncertainties for each measurement type performed.

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

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Abbreviations used in this report

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

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

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

8. Instruments and Ancillary

8.1. Used equiment "CTC"

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

8.1.1. 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
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)

8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	EMI Test Receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	30.05.2017
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	30.05.2017
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	30.05.2017
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	30.04.2017
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	30.05.2019
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2017
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	30.04.2018
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	30.04.2018
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	30.04.2017
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1g	30.06.2016
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
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	
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	30.06.2017
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2017
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	12 M	-	30.05.2017
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	36 M	-	31.03.2017
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2017
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	Pre-m	2	
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	30.05.2018
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	30.04.2017
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
355	Power Meter	URV 5	891310/027	Rohde & Schwarz	24 M	-	30.05.2018
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	30.04.2017
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	-	30.05.2017
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	30.05.2017
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	30.04.2017
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	30.05.2017
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	30.04.2017
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	31.03.2017
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.06.2017
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	30.06.2017
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2017
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	

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
459	DC -Power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
460	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	30.04.2017
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	30.05.2018
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	36 M	-	30.04.2018
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	36 M	-	30.04.2018
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	30.04.2017
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	30.06.2017
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	31.07.2017
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	30.05.2017
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	-	30.04.2017
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	30.05.2017
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
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.06.2017
557	System CTC-OTA-2	R&S TS8991	-	Rohde & Schwarz	12 M	5	30.09.2016
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	19.04.2017
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	31.03.2019
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
594	Wideband Radio Communication Tester	CMW 500	101757	Rohde & Schwarz	12 M	-	30.04.2017
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	pre-m	-	
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	30.04.2017
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	30.04.2017
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	30.04.2017
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
616	Digitalmultimeter	Fluke 177	88900339	Fluke	24 M	-	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	-	30.05.2017
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
627	data logger	OPUS 1	201.0999.9302.6.4.1.43	G. Lufft GmbH	24 M	-	30.04.2017
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	KogiLink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
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	-	30.05.2017
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	30.04.2017
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	30.05.2017
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	12 M	-	30.05.2017
692	Bluetooth Tester	CBT 32	100236	Rohde & Schwarz	36 M	-	31.03.2017
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	

8.1.3. Legend

Note / remarks		Calibrated during system calibration:
	1a	System CTC-SAR-EMS (Ref.-No. 442)
	1b	System-CTC-EMS-Conducted (Ref.-No. 335)
	1c	System CTC-FAR-EMI-RSE (Ref.-No . 443)
	1d	System CTC-SAR-EMI (Ref.-No . 441)
	1e	System CTC-OATS (EMI radiated) (Ref.-No. 337)
	1 f	System CTC-CTIA-OTA (Ref.-No . 420)
	1 g	System CTC-FAR-EMS (Ref.-No . 444)
	2	Calibration or equipment check immediately before measurement
	3	Regulatory maintained equipment for functional check or support purpose
	4	Ancillary equipment without calibration e.g. mechanical equipment or monitoring equipment
	5	Test System

Interval of calibration	12 M	12 month
	24 M	24 month
	36 M	36 month
	24/12 M	Calibration every 24 months, between this every 12 months internal validation
	36/12 M	Calibration every 36 months, between this every 12 months internal validation
	Pre-m	Check before starting the measurement
	-	Without calibration

9. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2017-01-11
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