T E S T   R E P O R T
No.: 16-1-0050601T40a

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

ISED-Regulations
RSS-132 Issue 3, RSS-133 Issue 6,
RSS-139 Issue 2, RSS-Gen Issue 4
RSS-130 Issue 1, RSS-199 Issue 3

for

peiker acustic GmbH & Co. KG

GSM/ WCDMA/ LTE Telematics US Module
V1231-0

FCC-ID: QWY-V1231-0
ISED ID: 6588A-V12310
PMN: V1231-0
HVIN: V1231-0

Laboratory Accreditation and Listings		
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01 Accredited EMC-Test Laboratory	Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	VCI Voluntary Controls for Electromagnetic Emissions Reg. No.: R-20013, C-20009, T-20006, G-20013
WiFi ALLIANCE AUTHORIZED RF LABORATORY	ctia Authorized™ Test Lab Lab Code: 20011130-00	FC MRA US-EU 0003
accredited according to DIN EN ISO/IEC 17025		
CETECOM GmbH Laboratory Radio Communications & Electromagnetic Compatibility Im Teelbruch 116 • 45219 Essen • Germany Registered in Essen, Germany, Reg. No.: HRB Essen 8984 Tel.: + 49 (0) 20 54 / 95 19-954 • Fax: + 49 (0) 20 54 / 95 19-964 E-mail: info@cetecom.com • Internet: www.cetecom.com		
Laboratory Accreditation and Listings		

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Total pages

The listed attachments are an integral part of this report.

1. Summary of test results

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

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

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. This test report shows results for LTE 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)	§15.207	RSS-Gen, Issue 4: Chapter 8.8	§15.207 limits ISED: Table 3, Chapter 8.8	--	--	Remark 1.)
2	General field strength emissions (9 kHz - 30 MHz)	Cabinet + inter-connecting cables (radiated)	§15.209(a)	RSS-Gen, Issue 4: Chapter 8.9, Table 5+6	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	2	1+2+3 +4+5	passed
7	RF-Power (ERP/EIRP)	Cabinet + inter-connecting cables (radiated)	§2.1046 §22.913(a)(2)	RSS-132, Issue 3: Chapter 5.4 SRSP-503: 5.1.3	< 7 Watt (ERP)	2	1+2+3 +4+5	Calculated passed
			§24.232(c)	RSS-133, Issue 6 Chapter 4.1/6.4 SRSP-510: 5.1.2	< 2 Watt (EIRP)			
			§27.50 (d)(4)	RSS-139: Issue 3 Chapter 6.5 SRSP-513: 5.1.2	< 1 Watt (EIRP)			
			§27.50(c)(10)	RSS-130, Issue 1, Chapter 4.4	< 3 Watt (ERP)			
			§27.50(h)(2)	RSS-199, Issue 3, Chapter 4.4	< 2 Watt (EIRP)			
8	Spurious emissions		§2.1053(a) §2.1057	RSS-Gen., Issue 4	43+10log(P) dBc	2	1+2+3 +4+5	passed
			§22.917(a)(b)	RSS-132: Chapter 5.5(i)(ii)				
9	Band-Edge compliance		§24.238(a)(b)	RSS-133: Chapter 6.5.1(i)(ii)	43+10log(P) dBc	2	1+2+3 +4+5	passed
			§27.53(h)(1)(3) (i)(ii)(iii)	RSS-139: Issue 3 Chapter 6.6 (i) (ii)				
			§27.53(g)	RSS-130: Issue 1 Chapter 4.6.1				
			§27.53(m)(4)	RSS-199, Issue 3, Chapter 4.5				

30	RF Power			§2.1046	--	N/A	1	1+2+3 +4+5	passed
34	26dB Emission bandwidth			§2.1049(h)	RSS-Gen, Issue 4, Chapter 6.6	26dBc Emissions BW 99% Power	1	1+2+3 +4+5	passed
35	99% Occupied bandwidth								
36	Spurious emissions	Antenna terminal (conducted)		§2.1051 §2.1057 §22.917(a)(b) §24.238(a)(b) §27.53	RSS-132, Issue 3: 5.5(i)(ii) RSS-133, Issue 6: 6.5.1(i)(ii) RSS-139, Issue 3 Chapt. 6.6 (i) (ii) RSS-130, Issue 1 Chapt. 4.6.1 Chapt. 4.6.2 RSS-199, Issue 3, Chapter 4.5	43+10log(P) dBc	1	1+2+3 +4+5	passed
37	Band-Edge compliance								passed
38	Frequency stability			§22.355, table C-1 §24.235 §2.1055(a)(2) §27.54	RSS-132, Issue 3: Chapter 5.3 RSS-133, Issue 6: Chapter 6.3 RSS-130, Issue 1: Chapter 4.3 RSS-139, Issue 3, Chapter 6.4 RSS-199, Issue 3, Chapter 4.3	< ±2.5ppm	3	1+2+3 +4+5	passed Remark 3.)

Remarks: 1.) not applicable since car environment
        2.) calculated with declared antenna gain
        3.) Tests only performed across extreme voltage range for information: limited approval
           OEM integrators should consult grant and applicants recommendations on power supply design rules.

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

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

Remark:

1.) EUT intended for car environment only
2.) See separate test report CETECOM_TR16_1_0050601T43a for measurements according Part 15, Subpart B.
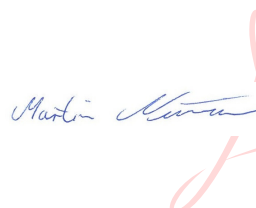
1.3. Attestation:

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

Digital unterschrieben von Rachid Acharkaoui
DN: cn=Rachid Acharkaoui, o=CETECOM GmbH, ou=RC&EMC, email=rachid.acharkaoui@cetecom.com, c=DE
Datum: 2017.09.20 12:23:22 +02'00'

Digitally signed by Martin Nunier
Date: 2017.09.19 14:29:15 +02'00'

....

Dipl.-Ing. Rachid Acharkaoui   M. Nunier
Responsible for test section   Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

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

2.2. Test location
2.2.1. Test laboratory "CTC"

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

2.3. Organizational items

Project leader:	Dipl.-Ing. Mario Schmidt-Mecklenbrauck
Responsible for test report:	M. Nunier
Receipt of EUT:	2017-01-18
Date(s) of test:	2017-01-20 to 2017-07-14
Date of report:	2017-08-29

Version of template: 13.02	

2.4. Applicant's details

Applicant's name:	peiker acustic GmbH & Co. KG
Address:	Max-Planck-Straße 28-32
	61381 Friedrichsdorf/Ts.
	Germany
Contact person:	Philippe Seguret

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	GSM/ WCDMA/ LTE Telematics US Module	
Type	V1231-0	
TX-frequency range (E-UTRA operating bands)	LTE Band 2: 1850 - 1910 MHz (Uplink), 1930-1990 MHz (Downlink) LTE Band 4: 1710 - 1755 MHz (Uplink), 2110 - 2155 MHz (Downlink) LTE Band 5: 824 - 849 MHz (Uplink), 869-894 MHz (Downlink) LTE Band 7: 2500-2570 MHz (Uplink), 2620-2690 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 5: UARFCN range 20400 - 20649 LTE Band 7: UARFCN range 20750 - 21449 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:
	1.4 MHz	1M09G7D	1M09W7D
	3 MHz	2M70G7D	2M70W7D
	5 MHz	4M50G7D	4M50W7D
	10 MHz	9M00G7D	9M00W7D
	15 MHz	13M5G7D	13M4W7D
	20 MHz	17M9G7D	17M9W7D

Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector: main TX + secondary RX connector
Antenna Gain Tx (main)	☐ Not applicable ☒ from data sheet "BMW_Multibandantenna_Max Gain Tel GNSS_en" 699MHz – 716MHz: 8.3dBi 824MHz – 849MHz: 7.8dBi 1710MHz – 1755MHz: 7.3dBi 1850MHz – 1910MHz: 8.9dBi 2500MHz – 2570MHz: 6.8dBi ☐ No information from customer
Path Losses	☒ from data sheet "TEL1_NAD_to_TEL1_TRUNK_table" LTE B2: 5.55dB LTE B4: 5.10dB LTE B5: 2.96dB LTE B7: 6.61dB LTE B12: 2.57dB

MAX AV Output Power[dBm]: Conducted LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 7 LTE-Mode 12	QPSK 23.91 24.05 23.73 22.46 22.97	
EIRP[dBm]: LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 7 LTE-Mode 12	(max peak output power + antenna gain – path losses) QPSK 23.91dBm + 8.9dBi – 5.55dB=27.26dBm 24.05dBm + 7.3dBi – 5.10dB=26.25dBm 23.73dBm + 7.8dBi – 2.96dB=28.57dBm 22.46dBm + 6.8dBi – 5.10dB=24.16dBm 22.97dBm + 8.3dBi – 2.57dB=28.70dBm	
ERP[dBm]: LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 7 LTE-Mode 12	(Peak EIRP – 2.15) 27.26dBm – 2.15= 25.11dBm 26.25dBm – 2.15= 24.09dBm 28.57dBm – 2.15= 26.42dBm 24.16dBm – 2.15= 22.01dBm 28.70dBm – 2.15= 26.55dBm	
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) ☒ GPS (not tested within this test report)	
Power supply	☒ 12VDC	
Special EMI components	--	
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

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

Short description*)	EUT	Type	S/N serial number	HW hardware status	SW software status
EUT A	GSM/ WCDMA/ LTE Telematics US Module	V1231-0	00440258004 0446	V1231-0_Ver.1	MPSS.TH.2.0. 2-00256
EUT B	Kathrein Cellular/GNSS antenna	Model No: 9396828-02	50110256	--	--
EUT C	Kathrein Cellular antenna	Model No: 9396827-02	50110255	--	--
EUT D	GSM/WCDMA/LTE Telematics US Module	V1231-0	00440258004 0248	V1231-0_Ver.1	MPSS.TH.2.0. 2.c4-00018

*) 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	Loudspeaker	KL3 / 4-Ohm	-	-	-
AE 2	Microphone	ME 39	-	-	-
AE 3	DC cable	--	--	--	--
AE 4	Dell Laptop Computer	DELL Latitude D610	EMC#3	Pentium IV Centrino	Windows XP Professional

*) 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 3	RF-Conducted Measurement set-up
set. 2	EUT A + EUT 2 + EUT 3+ AE 1 + AE 2 + AE 3	RF-radiated measurement set-up
set. 3	EUT D + AE3	Frequency stability measurement set-up

*) 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. NS_01 Network signaling value was used, no A-MPR was used therefore for this band.
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. NS_01 Network signaling value was used, no A-MPR was used therefore for this band.
3	LTE-Band 5 RMC Mode	A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM Modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link. NS_01 Network signaling value was used, no A-MPR was used therefore for this band.
4	LTE-Band 7 RMC Mode	A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM Modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link. NS_01 Network signaling value was used, no A-MPR was used therefore for this band.
5	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. NS_01 Network signaling value was used, no A-MPR was used therefore for this band.

*) 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	DC line	--	--	--	<3m
Cable 2	Microphone line	--	--	--	<3m
Cable 3	Speaker line	--	--	--	<3m
Cable 4	GPS antenna cable	--	--	--	<3m
Cable 5	Antenna cable TRX	--	--	--	<3m
Cable 6	Antenna cable DRX	--	--	--	<3m

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:
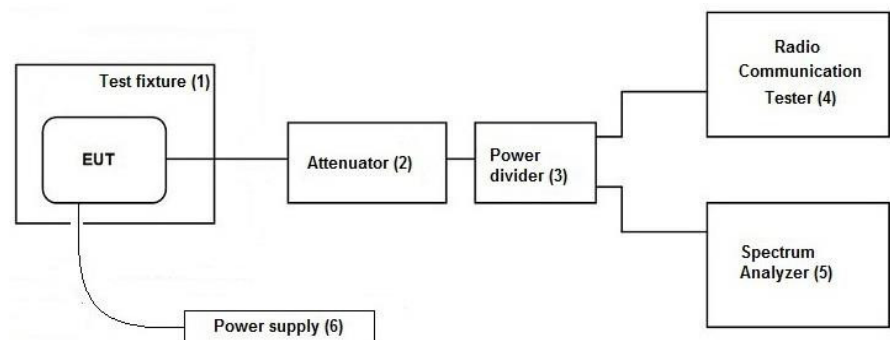
Used Equipment:

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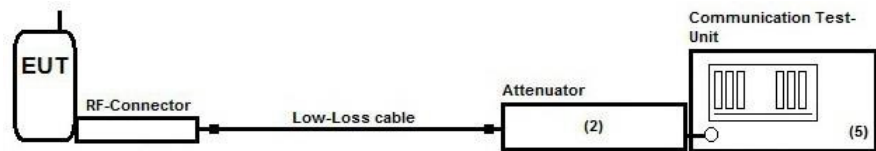
Testing method: ANSI C63.10:2013, KDB 971168 D01 v02r02

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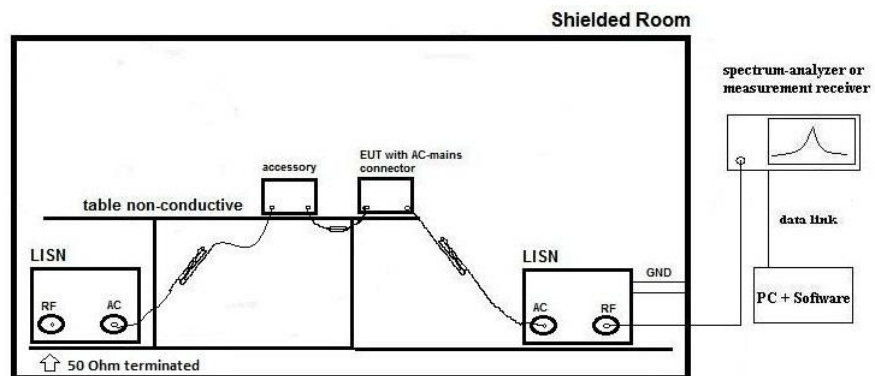
Only schematic view, we refer to figure 6, 7 and 8 of ANSI C63.4-2009 for more details.

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:
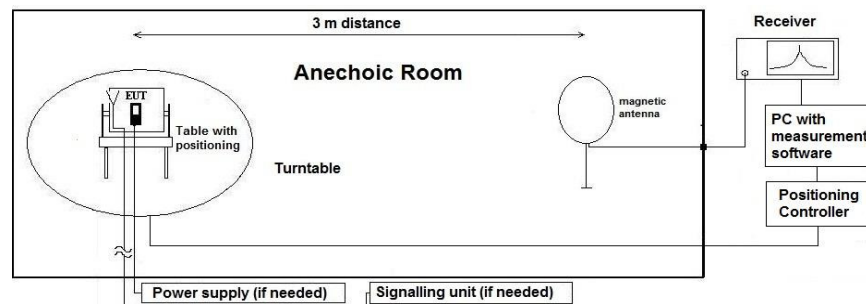
Testing method:

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:
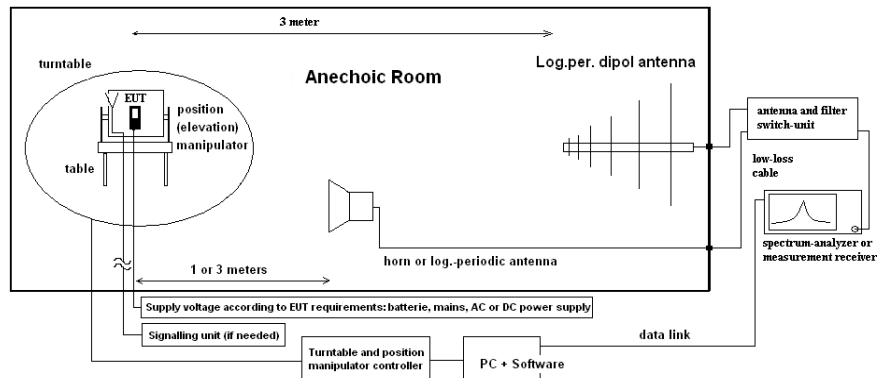
Testing method:

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:

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

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

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

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

5.1.3. Test condition and test set-up

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

5.1.4. Power results

5.1.4.1. LTE Band 2 Results

LTE-Band 2				QPSK-Modulation			16-QAM-Modulation						
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	max. modulation QPSK	max. modulation 16QAM	max. bandwidth	absolute max. value channels/bandwidths
1.4 MHz	18607	1850,7	1RB low	27,38	22,88	4,5024	27,484	22,205	5,2792	23,039	22,286		
			1RB high	27,54	22,89	4,6526	27,519	22,074	5,4451				
			50%RB mid	27,57	23,04	4,5304	27,546	22,286	5,2591				
			100%RB	27,94	21,88	6,0583	27,633	20,939	6,6946				
	18900	1880	1RB low	27,48	22,5	4,9749	27,511	22,011	5,5001	22,583	22,011	23,0386	
			1RB high	27,43	22,55	4,8822	27,508	21,846	5,6626				
			50%RB mid	27,57	22,58	4,9819	27,514	21,951	5,5634				
			100%RB	27,94	21,46	6,4832	27,575	20,601	6,9738				
	19193	1909,3	1RB low	26,81	22,17	4,6381	26,848	21,498	5,3506	22,296	21,546		
			1RB high	26,54	22,19	4,3484	26,66	21,546	5,1141				
			50%RB mid	26,66	22,3	4,3682	26,821	21,373	5,4477				
			100%RB	26,9	21,08	5,82	26,757	20,352	6,4056				
3 MHz	18615	1851,5	1RB low	27,22	23,05	4,1716	27,212	22,31	4,9016	23,052	22,376		
			1RB high	27,27	22,96	4,3141	27,449	22,376	5,0722				
			50%RB mid	26,6	21,94	4,6632	27,192	22,084	5,1077				
			100%RB	27,48	21,85	5,624	27,278	20,998	6,2802				
	18900	1880	1RB low	27,26	22,64	4,6163	27,409	22,022	5,3866	22,642	22,022	23,0516	
			1RB high	27,14	22,44	4,7001	27,277	21,873	5,4046				
			50%RB mid	26,36	21,49	4,8722	27,251	21,905	5,3465				
			100%RB	27,53	21,51	6,0178	27,482	20,655	6,8272				
	19185	1908,5	1RB low	26,64	22,36	4,277	26,709	21,793	4,9159	22,364	21,793		
			1RB high	26,35	22,28	4,0732	26,384	21,45	4,9344				
			50%RB mid	25,86	21,13	4,735	26,536	21,423	5,1128				
			100%RB	26,69	21,2	5,492	27,126	20,299	6,8268				
5 MHz	18625	1852,5	1RB low	27,48	23,25	4,2306	27,471	22,748	4,7229	23,25	22,748		23,911
			1RB high	27,35	23,03	4,3169	27,365	22,353	5,0115				
			50%RB mid	27,12	21,99	5,1355	27,366	22,119	5,2471				
			100%RB	27,43	21,93	5,5007	27,897	21	6,897				
	18900	1880	1RB low	27,64	23,24	4,4004	27,524	22,14	5,3845	23,237	22,14	23,2472	
			1RB high	27,17	22,6	4,5685	27,185	22,002	5,1826				
			50%RB mid	26,85	21,45	5,4043	27,253	21,668	5,5844				
			100%RB	27,16	21,53	5,6234	27,447	20,575	6,8717				
	19175	1907,5	1RB low	26,87	22,58	4,2971	27,029	21,995	5,0342	22,577	21,995		
			1RB high	26,36	22,24	4,1141	26,469	21,734	4,7355				
			50%RB mid	26,3	21,12	5,1789	26,601	21,314	5,2864				
			100%RB	26,69	21,11	5,5774	27	20,206	6,7936				
10 MHz	18650	1855	1RB low	27,76	23,61	4,1447	27,816	23,062	4,754	23,61	23,06		
			1RB high	27,67	23,36	4,3095	27,744	22,775	4,9694				
			50%RB mid	27,09	22,05	5,042	26,944	21,218	5,7262				
			100%RB	28,17	22,17	5,9964	27,589	21,112	6,477				
	18900	1880	1RB low	27,55	23,08	4,4664	27,711	22,344	5,3664	23,082	22,344	23,61	
			1RB high	27,03	22,48	4,5447	27,132	21,977	5,1558				
			50%RB mid	26,81	21,59	5,2233	26,295	20,599	5,6954				
			100%RB	28,11	21,62	6,4853	27,4	20,695	6,7048				
	19150	1905	1RB low	27,02	22,85	4,1713	27,052	22,431	4,6209	22,85	22,431		
			1RB high	26,46	22,36	4,0974	26,426	21,711	4,7146				
			50%RB mid	26,2	21,37	4,8335	25,929	20,321	5,6076				
			100%RB	27,28	21,42	5,8634	27,627	20,331	7,2961				
15 MHz	18675	1857,5	1RB low	27,83	23,35	4,4812	27,892	22,75	5,1419	23,544	22,895		
			1RB high	28,19	23,54	4,641	28,047	22,895	5,1525				
			50%RB mid	27,5	22,22	5,2824	27,84	22,314	5,526				
			100%RB	28,24	22,28	5,9603	28,317	21,386	6,9306				
	18900	1880	1RB low	27,33	22,96	4,3724	27,356	22,577	4,779	22,959	22,577	23,5443	
			1RB high	27,07	22,56	4,5067	27,261	22,386	4,875				
			50%RB mid	26,63	21,5	5,1226	27,261	21,689	5,572				
			100%RB	28,11	21,63	6,4839	27,768	20,704	7,0637				
	19125	1902,5	1RB low	26,8	22,59	4,2044	26,983	22,143	4,8397	22,594	22,143		
			1RB high	26,58	22,56	4,0138	26,498	22,066	4,4321				
			50%RB mid	26,32	21,25	5,0669	26,618	21,324	5,2934				
			100%RB	27,65	21,32	6,3288	27,239	20,336	6,9033				
20 MHz	18700	1860	1RB low	28,06	23,45	4,6081	28,146	22,961	5,1852	23,91	22,961		
			1RB high	28,32	23,91	4,4052	28,222	22,944	5,2773				
			50%RB mid	27,52	22,35	5,1727	27,862	22,333	5,529				
			100%RB	28,61	22,49	6,1245	28,003	21,525	6,4779				
	18900	1880	1RB low	27,61	23,47	4,1392	27,422	22,567	4,8547	23,467	22,567	23,91	
			1RB high	27,12	22,8	4,3198	27,288	22,322	4,9669				
			50%RB mid	26,61	21,56	5,0542	27,155	21,639	5,5152				
			100%RB	27,91	21,69	6,2193	27,949	20,716	7,2326				
	19100	1900	1RB low	27	22,71	4,2919	27,016	22,031	4,9848	22,711	22,253		
			1RB high	26,63	22,62	4,0071	26,728	22,253	4,475				
			50%RB mid	26,23	21,29	4,9471	26,675	21,365	5,3095				
			100%RB	27,73	21,52	6,215	27,364	20,676	6,6889				

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:

Signal-BW		QPSK		16-QAM	
		Peak	**RMS**	**Peak**	**RMS**
1.4		27,94	23,04	27,63	22,29
3		27,53	23,05	27,48	22,38
5		27,64	23,25	27,90	22,75
10		28,17	23,61	27,82	23,06
15		28,24	23,54	28,32	22,89
20		28,61	23,91	28,22	22,96

Table header: LTE Band 2

Max-Values for Modulation:

QPSK		16-QAM	
Peak	**RMS**	**Peak**	**RMS**
28,61	23,91	28,32	23,06

Table header: LTE Band 2

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]				
1.4 MHz	19957	1710,7	1RB low	27,23	22,61	4,6187	27,247	22,112	5,1341	22,734	22,112		
			1RB high	27,34	22,73	4,6053	27,441	22,012	5,4289				
			50%RB mid	27,43	22,71	4,7203	27,443	22,089	5,3533				
			100%RB	27,69	21,55	6,1334	27,406	20,693	6,7136				
	20175	1732,5	1RB low	27,66	23,09	4,5668	27,556	22,462	5,0942	23,094	22,462	23,5082	
			1RB high	27,59	22,98	4,6122	27,544	22,266	5,278				
			50%RB mid	27,7	23,09	4,6084	27,624	22,174	5,4497				
			100%RB	27,78	21,99	5,7882	27,637	21,104	6,5336				
	20393	1754,3	1RB low	27,89	23,45	4,4465	27,968	22,754	5,2134	23,508	22,76		
			1RB high	27,94	23,46	4,4749	28,061	22,746	5,3144				
			50%RB mid	27,98	23,51	4,4696	27,902	22,76	5,1427				
			100%RB	28,17	22,38	5,7907	27,728	21,363	6,3653				
3 MHz	19965	1711,5	1RB low	27,25	22,94	4,311	27,21	22,286	4,924	22,941	22,286		
			1RB high	27,04	22,67	4,3698	26,941	22,139	4,8012				
			50%RB mid	26,48	21,95	4,5298	26,945	21,865	5,0796				
			100%RB	27,46	21,8	5,6632	27,201	20,817	6,3841				
	20175	1732,5	1RB low	27,43	23,13	4,3013	27,367	22,491	4,8762	23,132	22,675	23,5508	
			1RB high	27,46	23,01	4,4524	27,512	22,675	4,8371				
			50%RB mid	26,65	22,08	4,5717	27,324	22,277	5,047				
			100%RB	27,63	21,96	5,6637	27,709	21,139	6,5704				
	20385	1753,5	1RB low	27,74	23,55	4,1854	27,816	23,142	4,6733	23,551	23,142		
			1RB high	27,66	23,44	4,2265	27,622	22,949	4,6734				
			50%RB mid	26,94	22,5	4,4424	27,677	22,763	4,9137				
			100%RB	28,25	22,46	5,7962	27,825	21,548	6,2774				
5 MHz	19975	1712,5	1RB low	27,37	23,03	4,3433	27,335	22,379	4,9558	23,028	22,379		
			1RB high	27,2	22,78	4,424	27,189	22,161	5,0283				
			50%RB mid	26,83	21,66	5,1731	27,199	21,948	5,2514				
			100%RB	27,76	21,72	6,0394	27,781	20,842	6,9388				
	20175	1732,5	1RB low	27,47	23,26	4,2111	27,478	22,447	5,0315	23,263	22,466	23,6414	
			1RB high	27,35	23,06	4,2896	27,434	22,466	4,9681				
			50%RB mid	27,1	22,09	5,0028	27,409	22,331	5,0784				
			100%RB	27,43	21,96	5,4711	27,882	21,198	6,6846				
	20375	1752,5	1RB low	27,89	23,64	4,2519	27,887	23,016	4,8711	23,641	23,016		24,046
			1RB high	27,64	23,56	4,0849	27,7	22,807	4,8931				
			50%RB mid	27,46	22,5	4,9524	27,747	22,725	5,0218				
			100%RB	28,24	22,48	5,7579	28,45	21,546	6,9033				
10 MHz	20000	1715	1RB low	27,43	22,98	4,4498	27,481	22,482	4,999	23,01	22,521		
			1RB high	27,5	23,01	4,4868	27,495	22,521	4,9734				
			50%RB mid	26,73	21,67	5,0616	26,571	20,865	5,7062				
			100%RB	27,43	21,72	5,7161	27,831	20,664	7,1671				
	20175	1732,5	1RB low	27,4	23,21	4,1905	27,378	22,659	4,7188	23,49	23,067	24,05	
			1RB high	27,75	23,49	4,2616	27,8	23,067	4,7328				
			50%RB mid	26,92	21,99	4,9343	26,589	21,148	5,441				
			100%RB	28,22	22,03	6,1821	27,771	21,152	6,6184				
	20350	1750	1RB low	28,19	24,05	4,1459	27,994	23,053	4,9415	24,05	23,405		
			1RB high	27,91	23,97	3,9436	27,998	23,405	4,5934				
			50%RB mid	27,36	22,50	4,8531	26,902	21,541	5,3615				
			100%RB	28,54	22,44	6,0994	28,302	21,457	6,8451				
15 MHz	20025	1717,5	1RB low	27,96	23,48	4,4785	27,921	22,928	4,9939	23,483	22,928		
			1RB high	27,56	23,01	4,5563	27,611	22,306	5,3046				
			50%RB mid	27,23	22,12	5,1071	27,657	22,296	5,3613				
			100%RB	28,41	22,02	6,3878	27,996	21,092	6,9042				
	20175	1732,5	1RB low	27,39	23,23	4,1674	27,372	22,61	4,7619	23,227	22,61	23,954	
			1RB high	27,39	23,07	4,3211	27,536	22,576	4,9597				
			50%RB mid	27,14	22,21	4,9314	27,607	22,418	5,1886				
			100%RB	28,43	22,15	6,2789	28,163	21,175	6,9877				
	20325	1747,5	1RB low	28,11	23,95	4,1566	27,614	22,785	4,8289	23,954	23,246		
			1RB high	27,81	23,72	4,081	27,86	23,246	4,6142				
			50%RB mid	27,46	22,64	4,8191	27,905	22,731	5,1743				
			100%RB	28,4	22,52	5,8856	28,275	21,504	6,7705				
20 MHz	20050	1720	1RB low	28,13	23,53	4,6035	28,329	23,095	5,2341	23,53	23,095		
			1RB high	27,72	22,97	4,7512	27,657	22,455	5,2018				
			50%RB mid	27,41	22,17	5,2423	27,933	22,215	5,7185				
			100%RB	28,18	22,02	6,1646	28,09	21,093	6,997				
	20175	1732,5	1RB low	27,37	23,19	4,1798	27,383	22,797	4,5855	23,254	22,797	23,8254	
			1RB high	27,51	23,25	4,2561	27,547	22,723	4,8237				
			50%RB mid	27,07	22,2	4,8729	27,554	22,365	5,1895				
			100%RB	28,5	22,19	6,3174	27,948	21,254	6,694				
	20300	1745	1RB low	27,54	23,36	4,183	27,566	22,635	4,9315	23,825	23,181		
			1RB high	27,84	23,83	4,0152	27,945	23,181	4,7636				
			50%RB mid	27,38	22,57	4,8123	27,945	22,788	5,1569				
			100%RB	28,62	22,45	6,1711	28,334	21,642	6,6916				

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:

Signal-BW		QPSK		16-QAM	
		Peak	RMS	Peak	RMS
1.4		28,17	23,51	28,06	22,76
3		28,25	23,55	27,83	23,14
5		28,24	23,64	28,45	23,02
10		28,54	24,05	28,30	23,40
15		28,43	23,95	28,27	23,25
20		28,62	23,83	28,33	23,18

(Table heading: **LTE Band 4**)

Max-Values for Modulation:

QPSK		16-QAM	
Peak	RMS	Peak	RMS
28,62	24,05	28,45	23,40

(Table heading: **LTE Band 4**)

5.1.4.3. LTE Band 5 Results

LTE-Band 5				QPSK-Modulation			16-QAM-Modulation			max. modulation QPSK	max. modulation 16-QAM	max. channel	absolute max. value
channel bandwidth	ARFCN ch. no.	ARFCN-Frequency [MHz]	Resource block allocation	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]	Peak detektor [dBm]	RMS detektor [dBm]	PAR Faktor [dB]				
1.4 MHz	20407	824.7	1RB low	27,38	23,11	4,2764	27,176	22,425	4,7508	23,18	22,42		
			1RB high	27,46	23,18	4,2756	27,328	22,342	4,9858				
			50%RB mid	27,61	23,06	4,5482	27,572	22,289	5,2836				
			100%RB	28,04	21,91	6,131	27,823	20,95	6,8731				
	20525	836.5	1RB low	27,95	23,1	4,8485	27,972	22,469	5,503	23,38	22,56	23,38	
			1RB high	27,97	23,22	4,756	27,974	22,538	5,4361				
			50%RB mid	28,40	23,38	5,0204	28,33	22,564	5,7662				
			100%RB	28,12	22,36	5,7586	28,212	21,465	6,7473				
	20643	848.3	1RB low	28,01	23,33	4,6781	28,042	23,015	5,0273	23,37	23,05		
			1RB high	28,07	23,37	4,6928	28,101	22,721	5,3804				
			50%RB mid	28,23	23,29	4,9409	28,53	23,047	5,4825				
			100%RB	28,69	22,52	6,1702	28,185	21,594	6,5908				
3 MHz	20415	825.5	1RB low	27,36	23,24	4,1118	27,457	22,565	4,8922	23,24	22,57		
			1RB high	27,59	23,21	4,3722	27,445	22,522	4,9229				
			50%RB mid	26,8	22,11	4,6951	27,47	22,414	5,0556				
			100%RB	27,75	22,16	5,5916	27,441	21,099	6,3418				
	20525	836.5	1RB low	28,23	23,65	4,5814	28,05	22,549	5,5008	23,65	22,86	23,65	
			1RB high	27,98	23,52	4,4657	27,983	22,811	5,1719				
			50%RB mid	27,43	22,48	4,9436	28,115	22,865	5,25				
			100%RB	28,44	22,35	6,0885	28,453	21,272	7,1807				
	20635	847.5	1RB low	27,65	23,29	4,3633	27,934	22,922	5,012	23,31	23,15		
			1RB high	27,79	23,31	4,4815	28,267	23,153	5,1142				
			50%RB mid	27,56	22,75	4,8097	28,151	22,929	5,2224				
			100%RB	28,49	22,77	5,7155	28,071	21,672	6,3996				23,73
5 MHz	20425	826.5	1RB low	27,63	23,62	4,0096	27,553	22,644	4,9095	23,65	22,91		
			1RB high	28,03	23,65	4,3843	27,779	22,908	4,8705				
			50%RB mid	27,31	22,03	5,2769	27,798	22,555	5,2435				
			100%RB	27,66	22,09	5,5704	28,275	21,171	7,1042				
	20525	836.5	1RB low	28,28	23,73	4,5584	28,133	22,769	5,3643	23,73	22,93	23,73	
			1RB high	27,88	23,40	4,4834	28,042	22,927	5,1144				
			50%RB mid	27,64	22,22	5,4286	28,253	22,61	5,6428				
			100%RB	27,99	22,13	5,8671	28,601	21,266	7,3354				
	20625	846.5	1RB low	27,57	23,29	4,2732	27,757	22,831	4,9258	23,36	23,63		
			1RB high	27,81	23,36	4,4454	28,454	23,629	4,8253				
			50%RB mid	27,89	22,61	5,2779	28,204	22,876	5,3281				
			100%RB	29,18	22,69	6,4892	28,584	21,808	6,7764				
10 MHz	20450	829	1RB low	27,36	22,98	4,3813	27,432	22,411	5,0201	23,09	22,82		
			1RB high	27,94	23,09	4,8492	27,926	22,817	5,1092				
			50%RB mid	27,73	22,34	5,3887	27,185	21,41	5,7744				
			100%RB	28,16	22,04	6,1217	28,513	21,073	7,4398				
	20525	836.5	1RB low	27,83	23,18	4,6559	27,691	22,44	5,2514	23,36	22,72	23,36	
			1RB high	27,66	23,36	4,2982	27,642	22,723	4,9192				
			50%RB mid	27,6	22,17	5,4284	27,287	21,404	5,8823				
			100%RB	28,57	22,16	6,4115	28,521	21,12	7,4011				
	20600	844	1RB low	27,62	23,29	4,336	27,71	22,751	4,9592	23,29	22,75		
			1RB high	27,65	23,26	4,3941	27,787	22,641	5,1462				
			50%RB mid	27,48	22,46	5,0211	27,064	21,405	5,6592				
			100%RB	28,69	22,32	6,3694	28,095	21,29	6,8054				

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:

Signal-BW		QPSK		16-QAM	
		Peak	**RMS**	**Peak**	**RMS**
1.4		28,69	23,38	28,53	23,05
3		28,49	23,65	28,45	23,15
5		29,18	23,73	28,60	23,63
10		28,69	23,36	28,52	22,82

Table title: LTE Band 5

Max-Values for Modulation:

QPSK		16-QAM	
Peak	**RMS**	**Peak**	**RMS**
29,18	23,73	28,60	23,63

Table title: LTE Band 5

5.1.4.4. LTE Band 7 Results

LTE-Band 7				QPSK-Modulation			16-QAM-Modulation			max. modulation	max. modulation	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	20775		1RB low	26,14	22,08	4,0567	26,16	21,329	4,8311	22,082			
			1RB high	26	21,83	4,1749	25,923	21,15	4,7733				
			50%RB mid	25,64	20,7	4,9463	25,887	20,933	4,9538				
			100%RB	26,49	20,73	5,7591	26,245	19,86	6,3844				
	21100		1RB low	26,13	21,67	4,4642	26,234	21,008	5,226	21,666	22,082	22,08	
			1RB high	25,81	21,44	4,3617	25,82	20,843	4,9775				
			50%RB mid	25,51	20,38	5,1355	25,888	20,481	5,4066				
			100%RB	26,49	20,3	6,1863	26,631	19,447	7,1842				
	21425		1RB low	26,33	21,78	4,5577	26,245	21,035	5,2107	21,776			
			1RB high	25,94	21,49	4,455	25,873	20,923	4,9496				
			50%RB mid	25,8	20,47	5,3378	26,199	20,74	5,4598				
			100%RB	26,82	20,41	6,4121	26,73	19,527	7,2034				
10 MHz	20800		1RB low	26,61	22,46	4,1511	26,645	21,813	4,8326	22,463			
			1RB high	26,65	22,19	4,4564	26,778	21,941	4,8373				
			50%RB mid	25,65	20,82	4,8244	25,341	19,946	5,3958				
			100%RB	26,75	21	5,7439	26,335	20,055	6,2807				
	21000		1RB low	26,54	22,02	4,5179	26,452	21,22	5,2326	22,024	22,463	22,46	
			1RB high	26,08	21,81	4,2719	26,186	21,419	4,7668				
			50%RB mid	25,44	20,42	5,0193	24,998	19,481	5,5162				
			100%RB	26,76	20,6	6,1657	26,399	19,666	6,733				
	21400	2565MHz	1RB low	26,31	21,86	4,4518	26,263	21,269	4,9938	21,86			
			1RB high	26,2	21,8	4,3946	26,243	21,361	4,8817				22,46
			50%RB mid	25,7	20,55	5,1445	25,256	19,585	5,6714				
			100%RB	26,97	20,66	6,3036	26,656	19,784	6,8722				
15 MHz	20825		1RB low	26,69	22,34	4,3467	26,331	21,734	4,5966	22,345			
			1RB high	26,73	22,01	4,7253	26,874	21,534	5,3397				
			50%RB mid	25,7	20,78	4,9184	26,473	21,154	5,319				
			100%RB	27,07	20,91	6,1596	26,853	20,04	6,8123				
	21100		1RB low	26,42	21,98	4,4435	26,564	21,663	4,9011	21,979	22,34	22,34	
			1RB high	26,25	21,74	4,5106	26,33	21,242	5,0886				
			50%RB mid	25,56	20,54	5,0201	26,119	20,638	5,4818				
			100%RB	27,16	20,57	6,5977	26,846	19,633	7,2128				
	21375		1RB low	25,91	21,52	4,3873	25,874	20,881	4,9929	21,52			
			1RB high	25,86	21,52	4,3433	25,831	20,933	4,898				
			50%RB mid	25,46	20,33	5,1235	26,154	20,596	5,5578				
			100%RB	26,99	20,46	6,5296	26,416	19,404	7,0118				
20 MHz	20850		1RB low	26,77	22,46	4,3119	26,626	21,542	5,0844	22,455			
			1RB high	26,84	21,97	4,8719	27,014	21,54	5,4746				
			50%RB mid	26	20,84	5,162	26,575	20,951	5,6245				
			100%RB	27,18	20,91	6,2688	27,153	19,926	7,2278				
	21100		1RB low	26,36	21,94	4,4212	26,563	21,756	4,8069	21,938	22,455	22,46	
			1RB high	26,21	21,82	4,3863	26,246	21,055	5,1903				
			50%RB mid	25,59	20,52	5,0737	26,184	20,574	5,6101				
			100%RB	26,86	20,62	6,2402	26,944	19,653	7,2917				
	21300		1RB low	25,9	21,67	4,2221	25,855	21,196	4,6596	21,674			
			1RB high	26	21,64	4,3591	26,028	20,778	5,25				
			50%RB mid	25,25	20,37	4,8788	26,06	20,544	5,5158				
			100%RB	26,64	20,45	6,1911	26,338	19,455	6,8828				

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 7					
Signal-BW		**QPSK**		**16-QAM**	
		Peak	**RMS**	**Peak**	**RMS**
5		26,82	22,08	26,73	21,33
10		26,97	22,46	26,78	21,94
15		27,16	22,34	26,87	21,73
20		27,18	22,46	27,15	21,76

Max-Values for Modulation:

LTE Band 7 / [mW]			
QPSK		**16-QAM**	
Peak	**RMS**	**Peak**	**RMS**
27,18	22,46	27,15	21,94

5.1.4.5. 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]				
1.4 MHz	23017	699.7	1 RB low	27,50	22,50	5,00	27,59	22,23	5,37	22,81	22,23		
			1 RB high	27,55	22,71	4,84	27,61	22,10	5,51				
			50%RB mid	27,71	22,81	4,90	27,80	22,23	5,57				
			100%RB	28,19	21,76	6,42	27,84	20,80	7,04				
	23095	707.5	1 RB low	27,44	22,66	4,78	27,57	21,89	5,68	22,77	21,89	22,85	
			1 RB high	27,43	22,62	4,82	27,61	21,54	6,07				
			50%RB mid	27,75	22,77	4,99	27,94	21,45	6,49				
			100%RB	28,00	21,48	6,53	28,11	20,34	7,76				
	23173	715.3	1 RB low	27,53	22,85	4,68	27,76	21,04	6,72	22,85	22,02		
			1 RB high	27,48	22,53	4,95	27,53	22,02	5,51				
			50%RB mid	27,65	22,45	5,19	27,65	21,72	5,93				
			100%RB	27,90	21,58	6,32	27,30	20,27	7,03				
3 MHz	23025	700.5	1 RB low	27,38	22,84	4,54	27,57	22,22	5,35	22,97	22,36		
			1 RB high	27,52	22,97	4,54	27,69	22,36	5,33				
			50% RB mid	26,80	21,93	4,88	27,07	21,14	5,93				
			100% RB	28,04	21,89	6,14	27,94	21,05	6,89				
	23095	707.5	1 RB low	27,44	22,75	4,70	27,55	21,52	6,03	22,75	21,70	22,97	
			1 RB high	27,31	22,70	4,61	27,41	21,70	5,71				
			50% RB mid	26,82	21,67	5,15	26,80	20,97	5,83				
			100% RB	27,92	21,62	6,30	27,42	20,62	6,80				
	23165	714.5	1 RB low	27,31	22,59	4,72	27,38	21,80	5,58	22,82	21,80		23,21
			1 RB high	27,24	22,82	4,42	27,28	21,55	5,73				
			50% RB mid	26,72	21,73	5,00	26,84	20,82	6,02				
			100% RB	27,58	21,64	5,93	28,01	20,70	7,31				
5 MHz	23035	701.5	1 RB low	27,47	22,89	4,58	27,53	22,25	5,28	23,21	22,26		
			1 RB high	27,73	23,21	4,52	27,86	22,26	5,61				
			50% RB mid	27,24	21,86	5,37	27,65	21,74	5,91				
			100% RB	27,99	21,88	6,10	28,11	20,74	7,37				
	23095	707.5	1 RB low	27,50	22,71	4,79	27,55	21,66	5,88	22,71	22,19	23,21	
			1 RB high	27,35	22,60	4,76	27,49	21,53	5,96				
			50% RB mid	27,07	21,75	5,32	27,65	22,19	5,46				
			100% RB	27,43	21,64	5,79	28,10	20,50	7,60				
	23155	713.5	1 RB low	27,37	22,74	4,63	27,46	21,78	5,67	22,74	22,07		
			1 RB high	27,31	22,64	4,67	27,40	22,07	5,34				
			50% RB mid	27,06	21,65	5,40	27,80	21,65	6,15				
			100% RB	27,58	21,61	5,97	28,54	20,88	7,66				
10 MHz	23060	704	1 RB low	27,71	23,06	4,64	27,73	22,56	5,17	23,06	22,56		
			1 RB high	27,74	22,97	4,77	27,81	21,90	5,91				
			50% RB mid	27,43	21,82	5,61	27,37	20,96	6,41				
			100% RB	28,08	21,93	6,15	28,36	21,04	7,32				
	23095	707,5	1 RB low	27,50	22,85	4,65	27,65	22,54	5,11	22,85	22,54	23,06	
			1 RB high	27,40	22,75	4,66	27,40	21,90	5,49				
			50% RB mid	27,07	21,73	5,34	27,07	20,83	6,24				
			100% RB	28,33	21,87	6,46	28,30	20,66	7,63				
	23130	711	1 RB low	27,33	22,73	4,60	27,45	21,65	5,79	22,81	21,98		
			1 RB high	27,26	22,81	4,46	27,30	21,98	5,32				
			50% RB mid	27,13	21,72	5,41	27,10	20,62	6,48				
			100% RB	27,86	21,92	5,94	27,57	20,67	6,90				

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 / [mW]					
Signal-BW		**QPSK**		**16-QAM**	
		Peak	**RMS**	**Peak**	**RMS**
1.4		27,1627	22,3449	26,8739	21,734
3		27,1781	22,4554	27,1533	21,7562
5		28,1855	22,8094	27,8376	22,2263
10		28,0373	22,97	28,1053	22,36

Max-Values for Modulation:

LTE Band 12 / [mW]			
QPSK		**16-QAM**	
Peak	**RMS**	**Peak**	**RMS**
28,19	22,97	28,11	22,36

5.1.5. PAPR results

5.1.5.1. Test condition and test set-up

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

5.1.5.2. PAPR-results

According KDB 5.7.1 two method are allowed.

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

LTE Band 2		
	Max. PAPR Max. PAPR level with 0.1% probability / [dB]	
Signal-Bandwidth / [MHz]	QPSK Modulation	16-QAM Modulation
1.4	5.40	5.98
3.0	5.23	5.65
5.0	5.19	5.00
10	5.31	6.06
15	4.79	6.02
20	5.31	6.48

Remark: pls. see annex 1 for graphical plots

LTE Band 4		
	Max. PAPR level with 0.1% probability / [dB]	
Signal-Bandwidth / [MHz]	QPSK Modulation	16-QAM Modulation
1.4	5.13	5.92
3.0	4.81	5.85
5.0	4.94	5.85
10	5.10	6.06
15	4.67	5.92
20	4.98	6.42

Remark: pls. see annex 1 for graphical plots

LTE Band 5		
	Max. PAPR level with 0.1% probability / [dB]	
Signal-Bandwidth / [MHz]	QPSK Modulation	16-QAM Modulation
1.4	5.42	6.02
3.0	5.44	6.27
5.0	5.25	4.79
10	5.29	6.10

Remark: pls. see annex 1 for graphical plots

LTE Band 7		
	Max. PAPR level with 0.1% probability / [dB]	
Signal-Bandwidth / [MHz]	QPSK Modulation	16-QAM Modulation
5	5.23	5.98
10	5.25	5.90
15	4.58	5.71
20	4.98	6.25

Remark: pls. see annex 1 for graphical plots

LTE Band 12 (max PAR Factor)		
	Max. PAPR level with 0.1% probability / [dB]	
Signal-Bandwidth / [MHz]	QPSK Modulation	16-QAM Modulation
1.4	5.94	6.38
3.0	5.44	6.42
5.0	5.44	6.56
10	5.33	6.25

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

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
Test are performed at 100% resource blocks allocation as per bandwidth

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 2	QPSK	1.4	Low	18607	35.200	1.087	34.200	1.245
			Mid	18900	35.201	1.090	34.201	1.274
			High	19193	35.202	1.090	34.202	1.249
		3	Low	18615	35.203	2.704	34.203	3.024
			Mid	18900	35.204	2.704	34.204	3.016
			High	19185	35.205	2.700	34.205	3.016
		5	Low	18625	35.206	4.470	34.206	4.944
			Mid	18900	35.207	4.476	34.207	4.932
			High	19175	35.208	4.476	34.208	4.92
		10	low	18650	35.209	8.940	34.209	9.696
			Mid	18900	35.210	8.952	34.210	9.744
			High	19150	35.211	8.940	34.211	9.696
		15	Low	18675	35.212	13.379	34.212	14.430
			Mid	18900	35.213	13.413	34.213	14.400
			High	19125	35.214	13.464	34.214	14.470
		20	Low	18700	35.215	17.820	34.215	18.960
			Mid	18900	35.216	17.886	34.216	19.000
			High	19100	35.217	17.908	34.217	19.050

Operational Band	Modulation	Signal bandwidth [MHz]	Channel no.		99%-Occupied bandwidth		26 dB Emission Bandwidth	
Band 2	16-QAM	1.4	low	18607	35.218	1.090	34.218	1.231
			mid	18900	35.219	1.094	34.219	1.267
			high	19193	35.220	1.089	34.220	1.267
		3	low	18615	35.221	2.700	34.221	3.020
			mid	18900	35.222	2.708	34.222	2.99
			high	19185	35.223	2.712	34.223	3.024
		5	low	18625	35.224	4.476	34.224	4.908
			mid	18900	35.225	4.482	34.225	4.908
			high	19175	35.226	4.480	34.226	4.896
		10	low	18650	35.227	8.940	34.227	9.672
			mid	18900	35.228	8.950	34.228	9.728
			high	19150	35.229	8.952	34.229	9.720
		15	low	18675	35.230	13.396	34.230	14.430
			Mid	18900	35.231	13.413	34.231	14.400
			High	19125	35.232	13.430	34.232	14.430
		20	low	18700	35.233	17.820	34.233	19.008
			Mid	18900	35.234	17.908	34.234	19.056
			High	19100	35.235	17.886	34.235	19.056

Remark:

1.) see diagrams in annex 1

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

Test are performed at 100% resource blocks allocation as per bandwidth

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 4	QPSK	1.4	Low	19957	35.401	1.087	34.401	1.234
			Mid	20175	35.402	1.085	34.402	1.238
			High	20393	35.403	1.087	34.403	1.242
		3	Low	19965	35.404	2.704	34.404	3.008
			Mid	20175	35.405	2.700	34.405	2.992
			High	20385	35.406	2.704	34.406	3.016
		5	Low	19975	35.407	4.488	34.407	4.908
			Mid	20175	35.408	4.476	34.408	4.896
			High	20375	35.409	4.476	34.409	4.884
		10	low	20000	35.410	8.940	34.410	9.72
			Mid	20175	35.411	8.940	34.411	9.696
			High	20350	35.412	8.928	34.412	9.744
		15	Low	20025	35.413	13.396	34.413	14.4
			Mid	20175	35.414	13.43	34.414	14.4
			High	20325	35.415	13.396	34.415	14.364
		20	Low	20050	35.416	17.842	34.416	18.96
			Mid	20175	35.417	17.842	34.417	19.008
			High	20300	35.418	17.86	34.418	19.15

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 4	16-QAM	1.4	Low	19957	35.419	1.085	34.419	1.234
			Mid	20175	35.420	1.090	34.420	1.242
			High	20393	35.421	1.087	34.421	1.245
		3	Low	19965	35.422	2.704	34.422	3.008
			Mid	20175	35.423	2.696	34.423	3.0
			High	20385	35.424	2.704	34.424	3.016
		5	Low	19975	35.425	4.47	34.425	4.92
			Mid	20175	35.426	4.476	34.426	4.896
			High	20375	35.427	4.476	34.427	4.908
		10	low	20000	35.428	8.95	34.428	9.696
			Mid	20175	35.429	8.940	34.429	9.672
			High	20350	35.430	8.940	34.430	9.696
		15	Low	20025	35.431	13.43	34.431	14.4
			Mid	20175	35.432	13.396	34.432	14.328
			High	20325	35.433	13.396	34.433	14.4
		20	Low	20050	35.434	17.842	34.434	19.05
			Mid	20175	35.435	17.864	34.435	19.05
			High	20300	35.436	17.860	34.436	19.10

Remark:

1.) see diagrams in annex 1

5.2.4.3. LTE Band 5: Op. Mode 3, Set-up 1

Test are performed at 100% resource blocks allocation as per bandwidth

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 5	QPSK	1.4	Low	20407	35.501	1.085	34.501	1.227
			Mid	20525	35.502	1.087	34.502	1.227
			High	20643	35.503	1.081	34.503	1.234
		3	Low	20415	35.504	2.704	34.504	3.00
			Mid	20525	35.505	2.700	34.505	3.00
			High	20635	35.506	2.704	34.506	3.016
		5	Low	20425	35.507	4.482	34.507	4.908
			Mid	20525	35.508	4.476	34.508	4.908
			High	20625	35.509	4.482	34.509	4.908
		10	low	20450	35.510	8.940	34.510	9.696
			Mid	20525	35.511	8.940	34.511	9.648
			High	20600	35.512	8.952	34.512	9.696

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 5	16-QAM	1.4	Low	20407	35.513	10.087	34.513	1.231
			Mid	20525	35.514	1.083	34.514	1.2348
			High	20643	35.515	1.087	34.515	1.2348
		3	Low	20415	35.516	2.704	34.516	3.00
			Mid	20525	35.517	2.704	34.517	2.992
			High	20635	35.518	2.704	34.518	3.016
		5	Low	20425	35.519	4.482	34.519	4.896
			Mid	20525	35.520	4.476	34.520	4.92
			High	20625	35.521	4.482	34.521	4.908
		10	low	20450	35.522	8.952	34.522	9.744
			Mid	20525	35.523	8.940	34.523	9.672
			High	20600	35.524	8.952	34.524	9.696

Remarks:

1.) see diagrams in annex 1

5.2.4.4. LTE Band 7: Op. Mode 4, Set-up 1

Test are performed at 100% resource blocks allocation as per bandwidth

Operational Band	Modulation	Signal bandwidth [MHz]	Channel no.		99%-Occupied bandwidth		26 dB Emission Bandwidth	
			Range	Channel no. (Frequenz [MHz])	Diagram no.	Value [MHz]	Diagram no.	Value [MHz]
Band 7	QPSK	5	Low	Ch20775 (2502.5)	35.701	4.476	34.701	4.908
			Mid	Ch21100 (2535)	35.702	4.482	34.702	4.92
			High	Ch21425 (2567.5)	35.703	4.482	34.703	4.908
		10	Low	Ch20800 (2505)	35.704	8.928	34.704	9.672
			Mid	Ch21100 (2535)	35.705	8.940	34.705	9.744
			High	Ch21400 (2565)	35.706	8.940	34.706	9.72
		15	Low	Ch20825 2507.5	35.707	13.396	34.707	14.45
			Mid	Ch21100 (2535)	35.708	13.379	34.708	14.45
			High	Ch21375 2562.5	35.709	13.413	34.709	14.41
		20	low	Ch20850 2510	35.710	17.886	34.710	19.008
			Mid	Ch21100 (2535)	35.711	17.842	34.711	18.964
			High	Ch21350 2560	35.712	17.886	34.712	19.228

Operational Band	Modulation	Signal bandwidth [MHz]	Channel no.		99%-Occupied bandwidth		26 dB Emission Bandwidth	
			Range	Channel no. (Frequenz [MHz])	Diagram no.	Value [MHz]	Diagram no.	Value [MHz]
Band 7	16-QAM	5	Low	Ch20775 (2502.5)	35.713	4.476	34.713	4.884
			Mid	Ch21100 (2535)	35.714	4.476	34.714	4.896
			High	Ch21425 (2567.5)	35.715	4.470	34.715	4.908
		10	Low	Ch20800 (2505)	35.716	8.940	34.716	9.696
			Mid	Ch21100 (2535)	35.717	8.940	34.717	9.672
			High	Ch21400 (2565)	35.718	8.940	34.718	9.744
		15	Low	Ch20825 2507.5	35.719	13.396	34.719	14.38
			Mid	Ch21100 (2535)	35.720	13.396	34.720	14.41
			High	Ch21375 2562.5	35.721	13.430	34.721	14.45
		20	low	Ch20850 2510	35.722	17.864	34.722	19.09
			Mid	Ch21100 (2535)	35.523	17.842	34.723	19.052
			High	Ch21350 2560	35.524	17.886	34.724	19.18

Remark:
   1.) see diagrams in annex 1

5.2.4.5. LTE Band 12: Op. Mode 5, Set-up 1

Test are performed at 100% resource blocks allocation as per bandwidth:

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	1.4	Low	23017	35.121	1.083	34.121	1.222
			Mid	23095	35.122	1.083	34.122	1.229
			High	23173	35.123	1.083	34.123	1.218
		3.0	low	23025	35.124	2.704	34.124	2.992
			Mid	23095	35.125	2.708	34.125	2.992
			High	23165	35.126	2.700	34.126	2.984
	16-QAM	1.4	Low	23017	35.127	1.087	34.127	1.218
			Mid	23095	35.128	1.085	34.128	1.229
			High	23173	35.129	1.085	34.129	1.229
		3.0	low	23025	35.130	2.704	34.130	2.976
			Mid	23095	35.131	2.704	34.131	2.998
			High	23165	35.132	2.700	34.132	2.998
	QPSK	5	Low	23035	35.133	4.476	34.133	4.848
			Mid	23095	35.134	4.482	34.134	4.872
			High	23155	35.135	4.482	34.135	4.878
		10	low	23060	35.136	8.940	34.136	9.684
			Mid	23095	35.137	8.952	34.137	9.624
			High	23130	35.138	8.952	34.138	9.648
	16-QAM	5	Low	23035	35.139	4.482	34.139	4.908
			Mid	23095	35.140	4.482	34.140	4.824
			High	23155	35.141	4.476	34.141	4.890
		10	low	23060	35.142	8.952	34.142	9.642
			Mid	23095	35.143	8.940	34.143	9.636
			High	23130	35.144	8.940	34.144	9.624

Remark:

1.) see diagrams in annex 1

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 7: Part 27: §27.53(m)(4)(6) ⊠ 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)
ISED	⊠ LTE Band 5: RSS-132, Issue 3: 5.5(i)(ii) ⊠ LTE Band 2: RSS-133, Issue 6: 6.5.1(i)(ii) ⊠ LTE Band 4: RSS-139, Issue 3: 6.6 (i)(ii) ⊠ LTE Band 7: RSS-199, Issue 3: 4.5 ⊠ LTE Band 12: RSS-130, Issue 1: 4.6.1 ☐ LTE Band 13: RSS-130, Issue 1: 4.6.2(a)(i)(ii) + 4.6.2(b)☐ LTE 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	**OOB-Emissions:** 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) **Band-Edge Emissions:** An integrated BW method was used for high band-edge compliance measurements in addition to the conventional sweep-method if necessary. Details for measurement parameters can be found on the diagrams in annex 1. The integrated function of the measurement receiver was used with corresponding suitable settings.	
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 3b (Block-Edge)	1849	1850	20[2)] to 200	--[1)]	30	35	MaxH-AV
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 chosen 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 3b (Block-Edge)	1709	1710	20[2)] to 200	--[1)]	30	35	MaxH-AV
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 chosen according power max values as worst-case

Spectrum-Analyzer Settings LTE Band 5

	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	9000	1	--[1)]	>60	35	MaxH-PK
Sweep 3a (Block-Edge)	823	824	20[2)] to 100	--[1)]	30	35	MaxH-PK
Sweep 3b (Block-Edge)	823	824		--[1)]	30	35	MaxH-AV
Sweep 4a (Block-Edge)	850	851		--[1)]	30	35	MaxH-PK
Sweep 4b (Block-Edge)	850	851		--[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

Spectrum-Analyzer Settings LTE Band 7

	Start freq. MHz	Stop freq. MHz	R-BW kHz	V-BW MHz	Sweep time sec.	Att. [dB]	Detector
Sweep 1	0.009	0.150	0.0001	--[1]	10	25	MaxH-PK
Sweep 1	0.150	1	0.009	--[1]	10	25	MaxH-PK
Sweep 1	1	30	0.1	--[1]	5	25	MaxH-PK
Sweep 2	30	19500	1	--[1]	>60	35	MaxH-PK
Sweep 3a (Band-Edge)	Min. 2480	2500	50kHz to 200kHz [1]	500kHz to 2MHz	30	35	MaxH-AV
Sweep 3b (Band-Edge)	2570	Max. 2600	50MHz to 200kHz [1]		30	35	MaxH-AV

Remark:

1.) EMI 6dB receiver mode used

2.) Sweep-Method: according rules approx. 1% of emission bandwidth depending of chosen signal bandwidth

3.) Integrated BW Method used, results integrated to 1MHz reference bandwidth. See other settings on diagrams

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 chosen 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 1.

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

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.20a	Low	18700	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.20b	Low	18650	9kHz to 30MHz		16QAM-Modulation	☒	☐	☐	passed
36.21a	Low	18700	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.21b	Low	18650	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results 16QAM-Modulation	☒	☐	☐	passed
36.22a	Middle	18900	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.22b	Middle	18900	9kHz to 30MHz	1	16QAM-Modulation	☒	☐	☐	passed
36.23a	Middle	18900	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.23b	Middle	18900	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed
36.24a	High		9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.24b	High	19150	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results 16QAM modulation	☒	☐	☐	passed
36.25a	High	19150	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.25b	High	19150	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed

Band-Edge low

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. [*1.)]	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.201a 37.202a 37.203a 37.204a 37.205a 37.206a 37.207a 37.208a 37.209a 37.210a 37.211a 37.212a	Low	18607 (1850.7MHz) 18615 (1851.5MHz) 18625 (1852.5MHz)	1849 – 1850 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
37.201b 37.202b 37.203b 37.204b 37.205b 37.206b 37.207b 37.208b 37.209b 37.210b 37.211b 37.212b	Low	18650 (1855.0MHz) 18675 (1857.5MHz) 18700 (1860.0MHz)	1849 – 1850 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

Band-Edge High

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. [*1.)]	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.213a 37.214a 37.215a 37.216a 37.217a 37.218a 37.219a 37.220a 37.221a 37.222a 37.223a 37.224a	High	19193 (1909.3MHz) 19185 (1908.5MHz) 19175 (1907.5MHz)	1910 – 1911 MHz		Band-Edge compliance QPSK modulation	☐	☒	☐	passed
37.213b 37.214b 37.215b 37.216b 37.217b 37.218b 37.219b 37.220b 37.221b 37.222b 37.223b 37.224b	High	19150 (1905.0MHz) 19125 (1905.5MHz) 19100 (1900.0MHz)	1910 – 1911 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

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

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.40a	Low	20050	9kHz to 30MHz	2	QPSK modulation	☒	☐	☐	passed
36.40b	Low	20050	9kHz to 30MHz		16QAM-Modulation	☒	☐	☐	passed
36.41a	Low	20050	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.41b	Low	20050	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results 16QAM-Modulation	☒	☐	☐	passed
36.42a	Middle	20175	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.42b	Middle	20175	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.43a	Middle	20175	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.43b	Middle	20175	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed
36.44a	High	20350	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.44b	High	20350	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.45a	High	20350	30 MHz to 19.5GHz		QPSK modulation, Carrier visible on diagram, not relevant for results	☒	☐	☐	passed
36.45b	High	20350	30 MHz to 19.5GHz		QAM modulation Carrier visible on diagram, not relevant for results	☒	☐	☐	passed

Remark: Please see test measurement diagrams in annex 1

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. *1.)	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.401a 37.402a 37.403a 37.404a 37.405a 37.406a 37.407a 37.408a 37.409a 37.410a 37.411a 37.412a	Low	19957 (1710.7MHz) 19965 (1711.5MHz) 19975 (1712.5MHz)	1709 – 1710 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
37.401b 37.402b 37.403b 37.404b 37.405b 37.406b 37.407b 37.408b 37.409b 37.410b 37.411b 37.412b	Low	20000 (1715.0MHz) 20025 (1717.5MHz) 20050 (1720.0MHz)	1709 – 1710 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. *1.)	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.413a 37.414a 37.415a 37.416a 37.417a 37.418a 37.419a 37.420a 37.421a 37.422a 37.423a 37.424a	High	20393 (1754.3MHz) 20385 (1753.5MHz) 20375 (1752.5MHz)	1755 – 1756 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
37.413b 37.414b 37.415b 37.416b 37.417b 37.418b 37.419b 37.420b 37.421b 37.422b 37.423b 37.424b	High	20350 (1750.0MHz) 20325 (1747.5MHz) 20300 (1745.0MHz)	1755 – 1756 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

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

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.50a	Low	20425	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.50b	Low	20425	9kHz to 30MHz		16QAM-Modulation	☒	☐	☐	passed
36.51a	Low	20425	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.51b	Low	20425	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results 16QAM-Modulation	☒	☐	☐	passed
36.52a	Middle	20525	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.52b	Middle	20525	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.53a	Middle	20525	30 MHz to 9GHz	3	Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.53b	Middle	20525	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed
36.54a	High	20643	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.54b	High	20643	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.55a	High	20643	30 MHz to 9GHz		QPSK modulation, Carrier visible on diagram, not relevant for results	☒	☐	☐	passed
36.55b	High	20643	30 MHz to 9GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed

Remark: Please see test measurement diagrams in annex 1

Band-Edge Low

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. [*1.)]	Remark	Used detector			Result
	Rang	No.				PK	AV	QP	
37.501a 37.502a 37.503a 37.504a 37.505a 37.507a 37.508a 37.509a	Low	20407 (824.7MHz) 20415 (825.5MHz)	823 – 824 MHz	3	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
37.501b 37.502b 37.503b 37.504b 37.505b 37.507b 37.508b 37.509b	Low	20425 (826.5MHz) 20450 (829.0MHz)	823 – 824 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

Band-Edge High

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. [*1.)]	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.510a 37.511a 37.512a 37.513a 37.514a 37.515a 37.516a 37.517a	High	20643 (848.3MHz) 20635 (847.5MHz)	849 – 850 MHz	3	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
37.510b 37.511b 37.512b 37.513b 37.514b 37.515b 37.516b 37.517b	High	20625 (846.5MHz) 20600 (844.0MHz)	849 – 850 MHz		Band-Edge compliance QAM modulation	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

5.3.4.4. LTE Band 7: Op. Mode 4, Set-up 2

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.720a	Low	20850	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.726b	Low	20850	9kHz to 30MHz		16QAM-Modulation	☒	☐	☐	passed
36.721a	Low	20850	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QPSK modulation 5.0024GHz=-26.31dBm	☒	☐	☐	passed
36.727b	Low	20850	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results 16QAM-Modulation 5.002GHz=-26.53dBm	☒	☐	☐	passed
36.722a	Middle	21100	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.728b	Middle	21100	9kHz to 30MHz		16QAM-Modulation	☒	☐	☐	passed
36.723a	Middle	21100	30 MHz to 19.5GHz	4	Carrier visible on diagram, not relevant for results QPSK modulation 5.0612GHz=-25.42dBm	☒	☐	☐	passed
36.729b	Middle	21100	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QAM modulation 5.0612GHz=-25.42dBm	☒	☐	☐	passed
36.724a	High	21400	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.730b	High	21400	30 MHz to 19.5GHz		QPSK modulation	☒	☐	☐	passed
36.725a	High	21400	30 MHz to 19.5GHz		QAM modulation, Carrier visible on diagram, not relevant for results 5.1212GHz=-26.95dBm	☒	☐	☐	passed
36.731b	High	21400	30 MHz to 19.5GHz		Carrier visible on diagram, not relevant for results QAM modulation 5.121GHz=-26.64dBm	☒	☐	☐	passed

Remark: Please see test measurement diagrams in annex 1

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no.[*1.)]	Remark	Used detector			Result
	Rang	No.				PK	AV	QP	
37.701 37.702 37.705 37.706 37.709 37.710 37.713 37.714	Low	20775 (2502.5MHz) 20800 (2505.0MHz)	2486 - 2500 MHz	4	Band-Edge compliance QPSK modulation type	☐	☒	☐	passed
37.703 37.704 37.707 37.708 37.711 37.712 37.715 37.716	Low	20825 (2507.5MHz) 20850 (2510.0MHz)	2486 - 2500 MHz		Band-Edge compliance, 16-QAM modulation type	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no.[*1.)]	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.717 37.718 37.721 37.722 37.725 37.726 37.729 37.730	High QPSK	21425 (2567.5MHz) 21400 (2565.0MHz)	2570 -2576 MHz		Band-Edge compliance Method: An integrated bandwidth method combined with classical sweep method was used for the measurements.	☐	☒	☐	passed
37.719 37.720 37.723 37.724 37.727 37.728 37.731 37.732	High 16-QAM	21375 (2562.5MHz) 21350 (2560.0MHz)	2570 -2576 MHz		Pls. consult TX-channel value for first 1MHz near band-edge as well as Adjacent/alternate channels on the UPPER-column for the results for frequencies far from high band-edge.	☐	☒	☐	passed

Remark:
  1. Please see test measurement diagrams in annex 1
  2. High Band-Edge defined as the frequency area directly above LTE-Band 7 range (2570MHz) F2 line in diagram.

5.3.4.5. LTE Band 12: Op. Mode 5, Set-up 2

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.40a	Low	23035	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.40b	Low	23035	9kHz to 30MHz		16QAM-Modulation	☒	☐	☐	passed
36.41a	Low	23035	30 MHz to 8GHz		Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.41b	Low	23035	30 MHz to 8GHz		Carrier visible on diagram, not relevant for results 16QAM-Modulation	☒	☐	☐	passed
36.42a	Middle	23095	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.42b	Middle	23095	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.43a	Middle	23095	30 MHz to 8GHz	5	Carrier visible on diagram, not relevant for results QPSK modulation	☒	☐	☐	passed
36.43b	Middle	23095	30 MHz to 8GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed
36.44a	High	23173	9kHz to 30MHz		QPSK modulation	☒	☐	☐	passed
36.44b	High	23173	9kHz to 30MHz		16QAM modulation	☒	☐	☐	passed
36.45a	High	23173	30 MHz to 8GHz		QPSK modulation Carrier visible on diagram, not relevant for results	☒	☐	☐	passed
36.45b	High	23173	30 MHz to 8GHz		Carrier visible on diagram, not relevant for results QAM modulation	☒	☐	☐	passed

Remark: Please see test measurement diagrams in annex 1

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. [*1.)]	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.1201a 37.1202a 37.1203a 37.1204a 37.1205a 37.1206a 37.1207a 37.1208a	Low	23017 (699.7MHz) 23025 (700.5MHz)	697 – 698 MHz	5	Band-Edge compliance QPSK modulation-edge.	☐	☒	☐	passed
37.1201b 37.1202b 37.1203b 37.1204b 37.1205b 37.1206b 37.1207b 37.1208b	Low	23035 (701.5MHz) 23060 (704.0MHz)	697 – 698 MHz		Band-Edge compliance QAM modulation-edge.	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

Dia-gram no.	Carrier Channel		Measured frequency range	OP-mode no. [*1.)]	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
37.1208a 37.1209a 37.1210a 37.1212a 37.1213a 37.1214a 37.1215a 37.1216a	High	23173 (715.3MHz) 23165 (714.5MHz)	716-717 MHz	5	Band-Edge compliance QPSK modulation above1MHz from channel-edge.	☐	☒	☐	passed
37.1208b 37.1209b 37.1210b 37.1212b 37.1213b 37.1214b 37.1215b 37.1216b	High	23155 (713.5MHz) 23130 (711.0MHz)	716-717 MHz		Band-Edge compliance QAM modulation above1MHz from channel-edge.	☐	☒	☐	passed

Remark: Please see test measurement diagrams in annex 1

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 7: Part 27: §27.53(m)(4) ☐ 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 7: RSS-199, Issue 3: 4.5 ☐ 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 analyzer mode 100kHz or 1 MHz 1MHz or 10 MHz Coupled (Auto) repetitive LTE Band 2/4/5/12 Peak Max-Hold LTE Band 7: RMS detector		
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 resource blocks and channels in order to find worst-case configuration. Due to very big amount of possible combinations only certain combinations have been tested.		
Mobile phone settings		A call was established on highest power transmit conditions in RMC mode. MPR was deactivated. The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band within the designated range within the allowed channel bandwidths. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.		

Spectrum-Analyzer settings for LTE band 2

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

Spectrum-analyzer settings for FDD Band 4

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

Spectrum-analyzer settings for LTE Band 5

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

Spectrum-analyzer settings for LTE Band 7

	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)			0.05	0.5	30	35	MaxH-PK
Sweep 2b (Band-Edge)			0.05	0.5	30	35	MaxH-AV
Sweep 3a (Band-Edge)			0.05	0.5	30	35	MaxH-PK
Sweep 3b (Band-Edge)			0.05	0.5	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	
8.20	Low	18700	30 MHz to 19.5 GHz	1	Carrier visible on diagram. Not relevant for results QPSK modulation Laying and standing position	☒	☐	☐	passed
8.21	Middle	18900	30 MHz to 19.5 GHz	1	Carrier visible on diagram. Not relevant for results QPSK modulation Laying and standing position	☒	☐	☐	passed
8.22	High	19150	30 MHz to 19.5 GHz	1	Carrier visible on diagram. Not relevant for results QPSK modulation Laying and standing position	☒	☐	☐	passed

9.40a		18700	1849 – 1850 MHz	1	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.40b	Band-Edge low	18700	1849 – 1850 MHz	1	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.41a		18700	1849 – 1850 MHz	1	Band-Edge compliance QPSK modulation Laying and standing position	☐	☒	☐	passed
9.41b		18700	1849 – 1850 MHz	1	Band-Edge compliance 16-QAM modulation Laying and standing position	☐	☒	☐	passed

9.42a		19150	1910 – 1911 MHz	1	Band-Edge compliance QPSK modulation Laying and standing position	☐	☒	☐	Passed
9.42b	Band-Edge high	19150	1910 – 1911 MHz	1	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.43a		19150	1910 – 1911 MHz	1	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.43b		19150	1910 – 1911 MHz	1	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

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 8.40b	Low	20050	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation Laying and standing position	☒	☐	☐	passed
8.41 8.41b	Middle	20175	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation Laying and standing position	☒	☐	☐	passed
8.42 8.42b	High	20350	30 MHz to 18 GHz	2	Carrier visible on diagram. Not relevant for results QPSK modulation Laying and standing position	☒	☐	☐	passed

Dia-gram no.	Range	No.	Frequency range	OP-mode no.	Remark	PK	AV	QP	Result
9.48a		20050	1709 – 1710 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.48b	Band-edge low	20050	1709 – 1710 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.49a		20050	1709 – 1710 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.49a		20050	1709 – 1710 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

Dia-gram no.	Range	No.	Frequency range	OP-mode no.	Remark	PK	AV	QP	Result
9.41a		20350	1755 – 1756 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.41b	Band-edge high	20350	1755 – 1756 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.42a		20350	1755 – 1756 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.42b		20350	1755 – 1756 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

5.4.4.3. LTE Band 5: 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	
8.50a 8.50b	Low	20425	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation EUT laying/ EUT standing	☒	☐	☐	passed
8.51a 8.51b	Middle	20525	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results QPSK modulation	☒	☐	☐	passed
8.52a 8.52b	High	20643	30 MHz to 9 GHz	3	Carrier visible on diagram. Not relevant for results 16-QAM modulation	☒	☐	☐	passed

Dia-gram no.	Range	No.	Frequency range	OP-mode no.	Remark	PK	AV	QP	Result
9.508b		20425	823 – 824 MHz	3	Band-Edge compliance 16-QAM modulation	☐	☒	☐	Passed
9.508a	Band-edge low	20425	823 – 824 MHz	3	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.510a		20425	823 – 824 MHz	3	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.510b		20425	823 – 824 MHz	3	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

Dia-gram no.	Range	No.	Frequency range	OP-mode no.	Remark	PK	AV	QP	Result
9.502a		20643	849 – 850 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.502b	Band-edge high	20643	849 – 850 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.503a		20643	849 – 850 MHz	2	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.503b		20643	849 – 850 MHz	2	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

5.4.4.4. LTE Band 7: Op. Mode 4, Set-up 1

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.53a 8.53aa 8.54b	Low	20850	30MHz – 2.8GHz 2.8GHz to 18 GHz	4	Carrier visible on diagram. Not relevant for results QPSK modulation EUT laying/ EUT standing	☒	☐	☐	passed
8.54 8.54a 8.54aa 8.54b 8.54b b	Middle	21100	30MHz – 2.8GHz 2.8GHz to 18 GHz	4	Carrier visible on diagram. Not relevant for results QPSK modulation EUT laying/ EUT standing	☒	☐	☐	passed
8.55a 8.55aa 8.55b	High	21400	30MHz – 2.8GHz 2.8GHz to 18 GHz	4	Carrier visible on diagram. Not relevant for results 16-QAM modulation	☒	☐	☐	passed

9.701	Band-edge low 5 MHz	20775	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.702		20775	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.703		20775	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.704		20775	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.705	Band-edge low 10 MHz	20800	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.706		20800	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.707		20800	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.708		20800	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.709		20825	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.710	Band-edge low 15MHz	20825	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.711		20825	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.712		20825	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.713		20850	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.714	Band-edge low 20MHz	20850	2486 – 2500 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.715		20850	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.716		20850	2486 – 2500 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.717		21425	2572-2592 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.718	Band-edge high 5MHz	21425	2572-2592 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.719		21425	2572-2592 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.720		21425	2572-2592 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.721		21400	2570-2590 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.722	Band-edge high 10MHz	21400	2570-2590 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.723		21400	2570-2590 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.724		21400	2570-2590 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.725	Band-edge high 15MHz	21375	2570-2590 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.726		21375	2570-2590 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.727		21375	2570-2590 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.728		21375	2570-2590 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

9.729	Band-edge high 20MHz	21350	2570-2590 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	Passed
9.730		21350	2570-2590 MHz	4	Band-Edge compliance QPSK modulation	☐	☒	☐	passed
9.731		21350	2570-2590 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed
9.732		21350	2570-2590 MHz	4	Band-Edge compliance 16-QAM modulation	☐	☒	☐	passed

5.4.4.5. LTE Band 12: Op. Mode 5, Set-up 1

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.53	Low	23035	30 MHz to 9 GHz	5	Carrier visible on diagram. Not relevant for results QPSK modulation Standing and laying position of EUT	☒	☐	☐	passed
8.54	Middle	23095	30 MHz to 9 GHz	5	Carrier visible on diagram. Not relevant for results QPSK modulation Standing and laying position of EUT	☒	☐	☐	passed
8.56a 8.56b	High	23173	30 MHz to 9 GHz	5	Carrier visible on diagram. Not relevant for results QPSK modulation Standing and laying position of EUT	☒	☐	☐	passed

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
9.55b		23035	697 – 698 MHz	5	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	Passed
9.55a	Band-Edge low	23035	697 – 698 MHz	5	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed
9.56b		23035	697 – 698 MHz	5	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	passed
9.56a		23035	697 – 698 MHz	5	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed

Dia-gram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
9.57b		23173	716 – 717 MHz	5	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	Passed
9.57a	Band-Edge high	23173	716 – 717 MHz	5	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed
9.58b		23173	716 – 717 MHz	5	Band-Edge compliance QPSK modulation Remark 1	☒	☒	☐	passed
9.58a		23173	716 – 717 MHz	5	Band-Edge compliance QAM modulation Remark 1	☒	☒	☐	passed

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
ISED	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

Tests only performed across extreme voltage range for information: limited approval
OEM integrators should consult grant and applicants recommendations on power supply design rules.

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				Verdict
	Channel 18625/ BW=5 MHz				
Voltage(V)	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,90	7,0238	8,0109	0,004	0,004	Pass
4,0	5,064	7,1526	0,003	0,004	
4,1	6,8092	5,6505	0,004	0,003	

	Maximum frequency error				Verdict
	Channel 18900/ BW=5 MHz				
Voltage(V)	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	7,7105	8,0538	0,004	0,004	Pass
4,0	7,0095	5,4789	0,004	0,003	
4,1	6,1798	-4,0054	0,003	-0,002	

	Maximum frequency error				Verdict
	Channel 19175/ BW=5 MHz				
Voltage(V)	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	-7,8249	-4,6778	-0,004	-0,002	Pass
4,0	-6,4087	-5,6648	-0,003	-0,003	
4,1	-7,8964	-5,579	-0,004	-0,003	

5.5.4.2. LTE Band 4

Voltage(V)	Maximum frequency error				Verdict
	Channel 19975/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	5,7507	5,2643	0,003	0,003	Pass
4,0	6,9523	5,6076	0,004	0,003	
4,1	2,9612	6,4087	0,002	0,004	

Voltage(V)	Maximum frequency error				Verdict
	Channel 20175/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	4,1628	9,656	0,002	0,006	Pass
4,0	5,1498	7,1955	0,003	0,004	
4,1	-5,3358	4,9782	-0,003	0,003	

Voltage(V)	Maximum frequency error				Verdict
	Channel 20375/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	-5,1928	-7,7677	-0,003	-0,004	Pass
4,0	-5,4359	-5,8079	-0,003	-0,003	
4,1	-5,4597	-4,6778	-0,003	-0,003	

5.5.4.3. LTE Band 5

| Voltage(V) | Maximum frequency error | | | | Verdict |
| | Channel 20425/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	-3,5906	-4,878	-0,004	-0,006	Pass
4,0	-3,0184	-4,7064	-0,004	-0,006	
4,1	-2,3174	-3,7336	-0,003	-0,005	

| Voltage(V) | Maximum frequency error | | | | Verdict |
| | Channel 20525/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	-2,6321	-3,0899	-0,003	-0,004	Pass
4,0	-2,1172	-5,4789	-0,003	-0,007	
4,1	-2,2316	2,346	-0,003	0,003	

| Voltage(V) | Maximum frequency error | | | | Verdict |
| | Channel 20625/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	-4,3488	-2,4891	-0,005	-0,003	Pass
4,0	-1,8883	1,6737	-0,002	0,002	
4,1	-2,0885	3,233	-0,002	0,004	

5.5.4.4. LTE Band 7

	Maximum frequency error				
	Channel 20775/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	**Verdict**
Voltage(V)					Limit=±0.1ppm
3,91	10,2568	4,5061	0,004	0,002	
4,0	5,4216	6,3801	0,002	0,003	Pass
4,1	10,0851	7,0667	0,004	0,003	

	Maximum frequency error				
	Channel 21100/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	**Verdict**
Voltage(V)					Limit=±0.1ppm
3,91	-7,1526	-6,7091	-0,003	-0,003	
4,0	-9,9993	-5,1212	-0,004	-0,002	Pass
4,1	-10,3283	-5,1212	-0,004	-0,002	

	Maximum frequency error				
	Channel 21425/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	**Verdict**
Voltage(V)					Limit=±0.1ppm
3,91	-4,7207	6,8665	-0,002	0,003	
4,0	-6,423	-5,4646	-0,003	-0,002	Pass
4,1	-5,0783	5,064	-0,002	0,002	

5.5.4.5. LTE Band 12

| Voltage(V) | Maximum frequency error | | | | Verdict |
| | Channel 23035/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	-1,9045	-1,7023	-0,003	-0,002	
4,0	3,2187	-1,8883	0,005	-0,003	Pass
4,1	-3,7479	-2,0027	-0,005	-0,003	

| Voltage(V) | Maximum frequency error | | | | Verdict |
| | Channel23095/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	3,8624	-3,4761	0,005	-0,005	
4,0	3,1042	2,2173	0,004	0,003	Pass
4,1	2,2888	-2,2602	0,003	-0,003	

| Voltage(V) | Maximum frequency error | | | | Verdict |
| | Channel23155/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
3,91	-3,3234	-3,5334	-0,005	-0,005	
4,0	1,6737	2,0599	0,002	0,003	Pass
4,1	-2,6178	-2,2173	-0,004	-0,003	

5.5.4.6. 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 –40°C to +80°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.

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

| Temperature | Maximum frequency error | | | | Verdict |
| | Channel 18625/ BW=5 MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	10,6573	10,8147	0,006	0,006	
-30	11,8303	11,7314	0,006	0,006	
-20	10,6716	11,2152	0,006	0,006	
-10	11,1151	11,4727	0,006	0,006	
0	9,9277	10,8862	0,005	0,006	
10	12,8317	11,9734	0,007	0,006	
20	10,7718	11,5728	0,006	0,006	Pass
30	9,8276	10,457	0,005	0,006	
40	10,8004	10,4713	0,006	0,006	
50	13,4039	11,5871	0,007	0,006	
60	22,4876	11,4727	0,012	0,006	
70	8,1396	9,6846	0,004	0,005	
80	9,9421	11,4441	0,005	0,006	

MAX:	22,4876	11,9734
MIN:	8,1396	9,6846

Frequency Error due to temperature variations
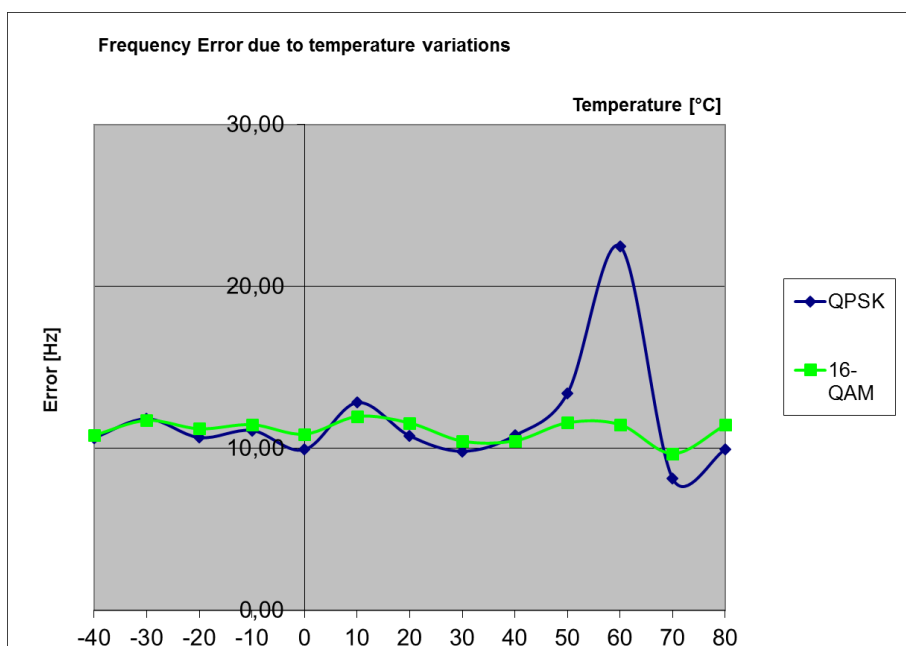
Temperature	Maximum frequency error				Verdict
	Channel 18900/ BW=5 MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	-10,6001	17,0803	-0,006	0,009	
-30	11,5585	10,0708	0,006	0,005	
-20	9,1696	10,6573	0,005	0,006	
-10	9,1839	10,6287	0,005	0,006	
0	9,4271	10,4856	0,005	0,006	
10	11,158	10,9148	0,006	0,006	
20	8,0109	7,8678	0,004	0,004	Pass
30	9,0265	8,626	0,005	0,005	
40	9,7132	8,4543	0,005	0,004	
50	9,3842	11,3726	0,005	0,006	
60	10,1423	9,3842	0,005	0,005	
70	11,3726	12,3024	0,006	0,007	
80	9,9993	6,7949	0,005	0,004	

MAX:	11,5585	17,0803
MIN:	-10,6001	6,7949

Frequency Error due to temperature variations
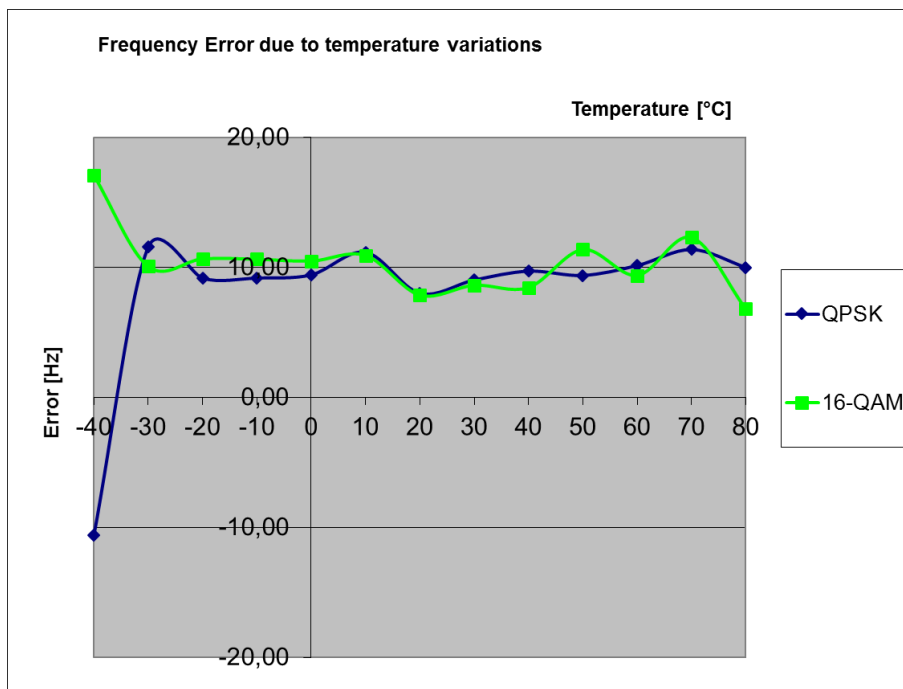
| Temperature | Maximum frequency error | | | | Verdict |
| | Channel 19175/ BW=5 MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	-12,4168	-11,0435	-0,007	-0,006	
-30	7,6103	-7,2813	0,004	-0,004	
-20	-7,7534	7,0953	-0,004	0,004	
-10	-8,2254	-6,9094	-0,004	-0,004	
0	-7,3099	-5,765	-0,004	-0,003	
10	-7,6389	-7,4959	-0,004	-0,004	
20	-9,3412	-10,5429	-0,005	-0,006	Pass
30	-9,2125	-10,8433	-0,005	-0,006	
40	-9,6273	-8,9407	-0,005	-0,005	
50	-8,3399	-10,8147	-0,004	-0,006	
60	-7,925	-7,6389	-0,004	-0,004	
70	-9,0837	-9,4843	-0,005	-0,005	
80	-9,8133	-9,5844	-0,005	-0,005	

MAX:	7,6103	7,0953
MIN:	-12,4168	-11,0435

Frequency Error due to temperature variations
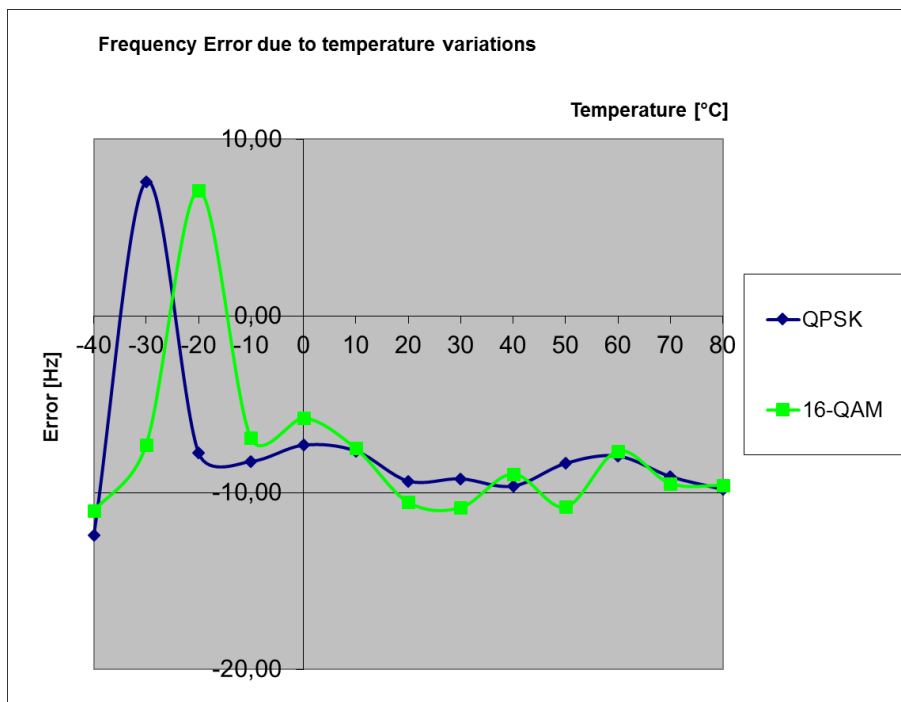
5.5.4.8. LTE Band 2: Canada requirement regarding emission/occupied bandwidth

Measurement Method:
With results of chapter 5.5.4.7 (frequency error) and of chapter 5.2 (occupied bandwidth) a calculations should show that the emissions bandwidth remains within authorized bands. Negative frequency error shifts the carrier (T1 point) more closer to the left band-edge (1850MHz), positive frequency error shifts the carrier (T2 point) more closer to the right band-edge (1910MHz).
Following table shows the results calculated with above presumptions:

Low channel = 18625		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 Worst-Case Deviation during climatic tests [MHz]	Margin to Low-Band-Edge including climatic conditions [MHz]	Verdict
QPSK	5	1850,268	1850	0,268	0,00000814	0,26800814	pass
16-QAM	5	1850,268	1850	0,268	0,00000968	0,26800968	pass

High channel = 19175		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 Worst-Case Deviation during climatic tests [MHz]	Margin to Low-Band-Edge including climatic conditions [MHz]	Verdict
QPSK	5	1909,744	1910	0,256	0,00000761	0,25599239	pass
16-QAM	5	1909,744	1910	0,256	0,00000710	0,25599290	pass

5.5.4.9. LTE Band 4

Temperature	Maximum frequency error				Verdict
	Channel 19975/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	8,812	10,1852	0,005	0,006	
-30	10,7431	10,0422	0,006	0,006	
-20	11,2152	10,9863	0,007	0,006	
-10	8,7976	11,2152	0,005	0,007	
0	11,0722	10,1137	0,006	0,006	
10	9,6703	11,158	0,006	0,007	
20	8,4543	9,3985	0,005	0,005	Pass
30	6,4945	8,1253	0,004	0,005	
40	11,2295	9,2268	0,007	0,005	
50	12,0735	9,9707	0,007	0,006	
60	11,4727	19,7125	0,007	0,012	
70	10,3283	10,1709	0,006	0,006	
80	10,9863	9,0265	0,006	0,005	

MAX:	12,0735	19,7125
MIN:	6,4945	8,1253
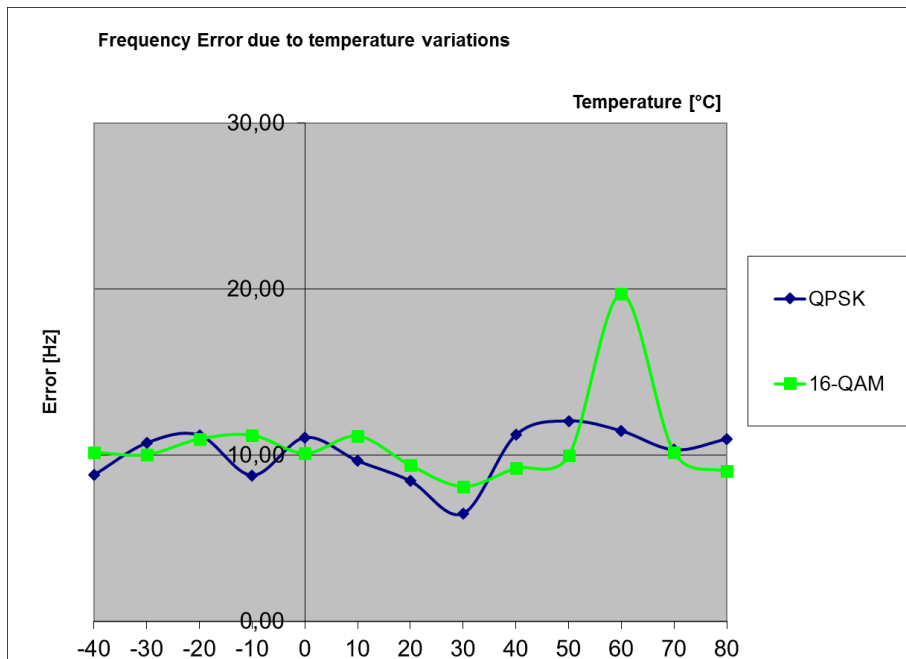
Frequency Error due to temperature variations

| Temperature | Maximum frequency error | | | | Verdict |
| | Channel 20175/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	16,2649	8,6117	0,009	0,005	
-30	8,9264	8,3971	0,005	0,005	
-20	9,3269	10,6716	0,005	0,006	
-10	11,0149	7,6532	0,006	0,004	
0	7,0238	8,1968	0,004	0,005	
10	8,3685	9,1124	0,005	0,005	
20	8,4543	8,9264	0,005	0,005	Pass
30	8,2684	8,9121	0,005	0,005	
40	9,1982	9,5272	0,005	0,005	
50	10,2997	9,8419	0,006	0,006	
60	9,7418	14,4196	0,006	0,008	
70	10,5143	8,7833	0,006	0,005	
80	9,5272	20,6709	0,005	0,012	

MAX:	16,2649	20,6709
MIN:	7,0238	7,6532
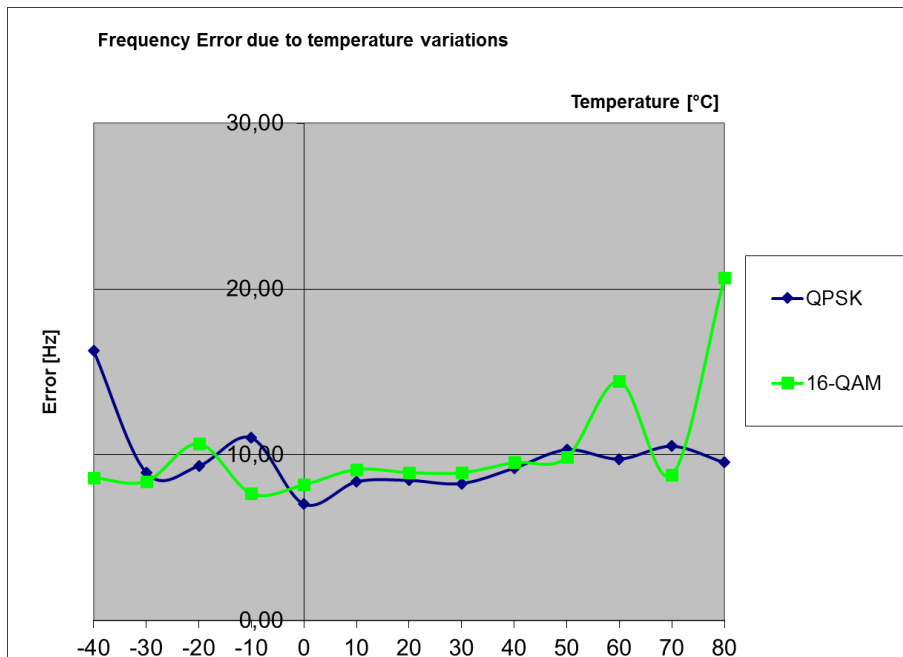
Frequency Error due to temperature variations

Temperature	Maximum frequency error				Verdict
	Channel 20375/ BW= 5MHz				Limit=±0.1ppm
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	
-40	-10,0136	-9,141	-0,006	-0,005	
-30	-6,609	8,4686	-0,004	0,005	
-20	-6,2513	-6,8378	-0,004	-0,004	
-10	6,7949	-7,1526	0,004	-0,004	
0	5,722	-5,8079	0,003	-0,003	
10	-6,094	6,4802	-0,003	0,004	
20	-8,1253	-7,4673	-0,005	-0,004	Pass
30	-7,6103	-7,9536	-0,004	-0,005	
40	-7,8535	-6,8235	-0,004	-0,004	
50	-7,6246	-8,2541	-0,004	-0,005	
60	-9,3555	-8,955	-0,005	-0,005	
70	-7,6675	-8,4686	-0,004	-0,005	
80	7,8821	-8,0538	0,004	-0,005	

MAX:	7,8821	8,4686
MIN:	-10,0136	-9,141

Frequency Error due to temperature variations
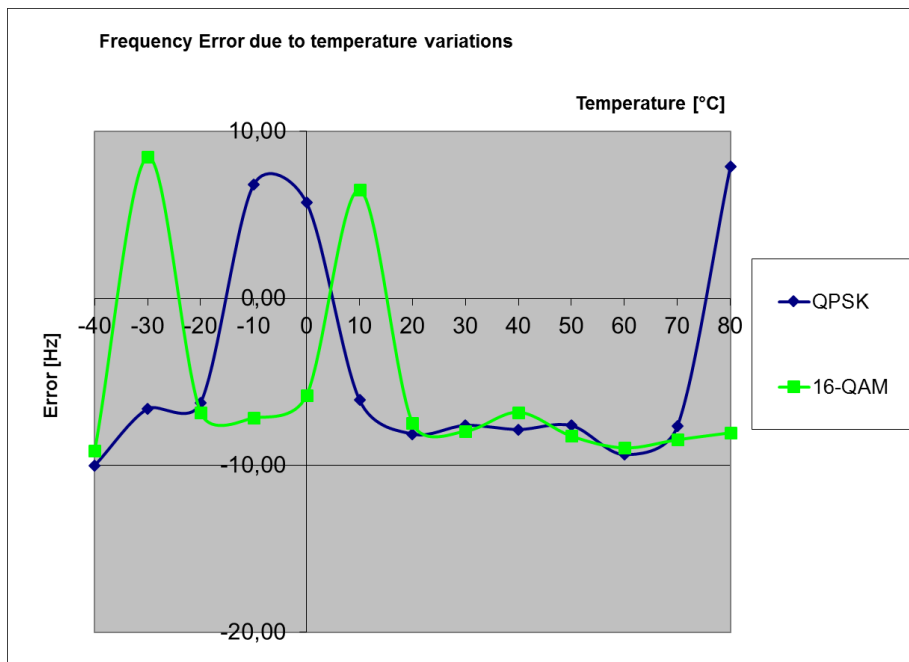
5.5.4.10. LTE Band 4: Canada requirement regarding emission/occupied bandwidth

Measurement Method:
With results of chapter 5.5.4.9 (frequency error) and of chapter 5.2 (occupied bandwidth) a calculations should show that the emissions bandwidth remains within authorized bands. Negative frequency error shifts the carrier (T1 point) more closer to the left band-edge (1710MHz), positive frequency error shifts the carrier (T2 point) more closer to the right band-edge (1755MHz).
Following table shows the results calculated with above presumptions:

Low channel = 19975		**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	1710,256	1710	0,256	0,00000649	0,25600649	pass
16-QAM	5	1710,268	1710	0,268	0,00000813	0,26800813	pass

High channel = 20375		**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 [MHz]	Verdict
QPSK	5	1754,738	1755	0,262	0,00000788	0,26199212	pass
16-QAM	5	1754,738	1755	0,262	0,00000847	0,26199153	pass

5.5.4.11. LTE Band 5

| Temperature | Maximum frequency error | | | | Verdict |
| | Channel 20425/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	-5,1069	-4,22	-0,006	-0,005	
-30	-3,1757	-3,8195	-0,004	-0,005	
-20	-3,9482	-2,8896	-0,005	-0,003	
-10	-3,5477	-3,2473	-0,004	-0,004	
0	-3,6621	-4,1056	-0,004	-0,005	
10	-3,7193	-3,4904	-0,005	-0,004	
20	-3,8624	-4,0483	-0,005	-0,005	Pass
30	-4,8208	-4,1342	-0,006	-0,005	
40	-4,9353	-5,1355	-0,006	-0,006	
50	-3,9196	-4,9782	-0,005	-0,006	
60	-4,7922	-5,0068	-0,006	-0,006	
70	-4,5919	-5,6791	-0,006	-0,007	
80	-4,2343	-4,1485	-0,005	-0,005	

MAX:	-3,1757	-2,8896
MIN:	-5,1069	-5,6791
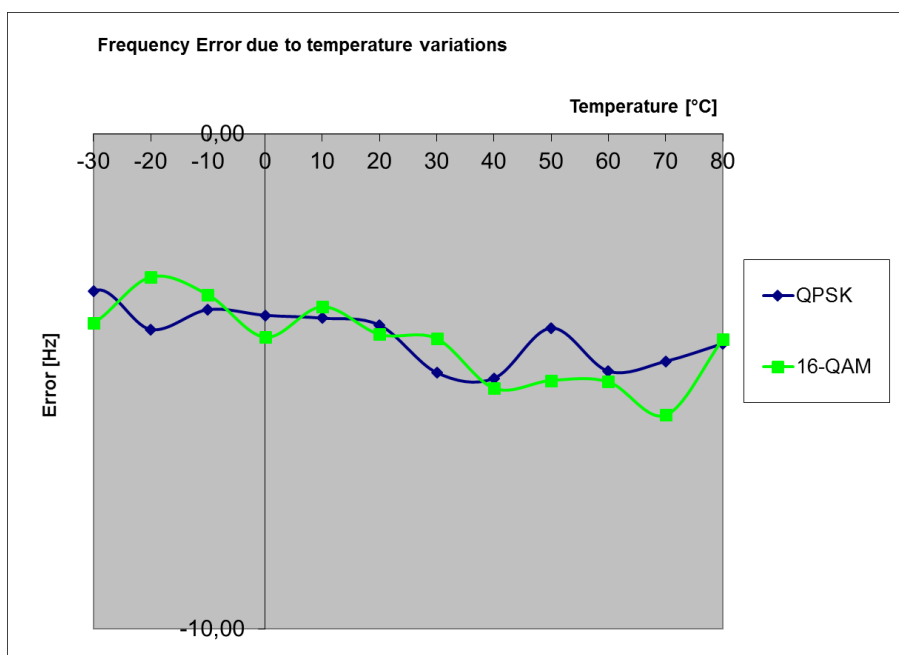
| Temperature | Maximum frequency error | | | | Verdict |
| | Channel 20525/ BW= 5MHz | | | | Limit=±0.1ppm |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	
-40	-3,6192	-4,1199	-0,004	-0,005	
-30	3,1185	3,2043	0,004	0,004	
-20	3,0041	4,3345	0,004	0,005	
-10	-4,2915	-3,3331	-0,005	-0,004	
0	2,3174	3,8195	0,003	0,005	
10	-3,2473	3,4904	-0,004	0,004	Pass
20	-3,4475	-3,9482	-0,004	-0,005	
30	-3,3617	-3,4332	-0,004	-0,004	
40	3,9911	-3,6478	0,005	-0,004	
50	-3,4904	-3,1185	-0,004	-0,004	
60	-4,7922	-3,4332	-0,006	-0,004	
70	-4,406	-3,6478	-0,005	-0,004	
80	-4,3345	-3,7622	-0,005	-0,004	

MAX:	3,9911	4,3345
MIN:	-4,7922	-4,1199
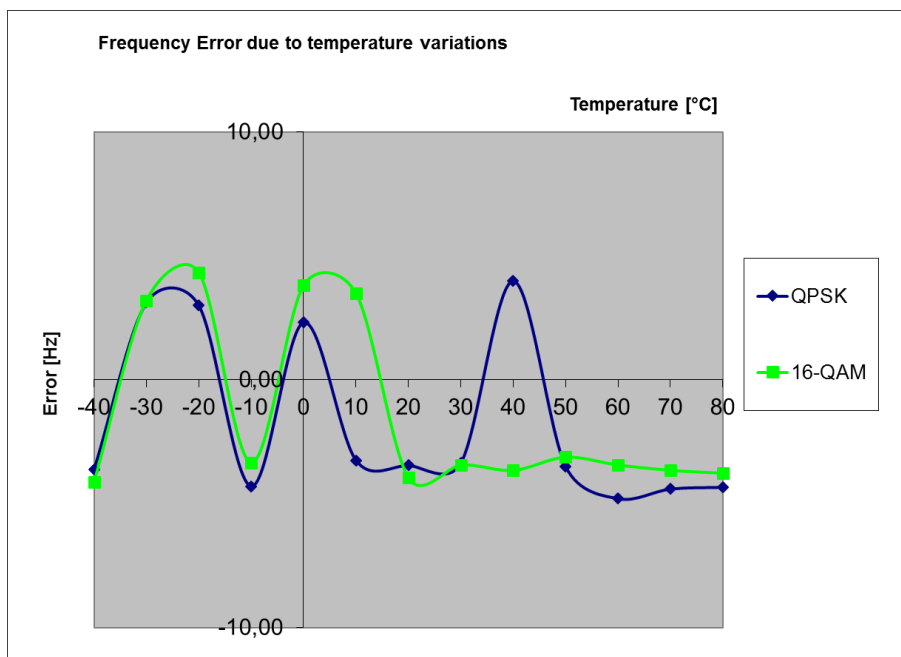
	Maximum frequency error				Verdict
	Channel 20625/ BW= 5MHz				
Temperature	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	3,3045	-3,376	0,004	-0,004	
-30	2,9755	4,8208	0,004	0,006	
-20	4,1485	3,891	0,005	0,005	
-10	3,5048	2,5749	0,004	0,003	
0	-3,4618	3,8052	-0,004	0,004	
10	3,233	3,6621	0,004	0,004	
20	-3,2473	-3,3474	-0,004	-0,004	Pass
30	-3,5763	-2,6464	-0,004	-0,003	
40	-3,3617	-3,4904	-0,004	-0,004	
50	-2,9755	-3,3331	-0,004	-0,004	
60	-3,6764	-2,9898	-0,004	-0,004	
70	-3,0756	-4,1771	-0,004	-0,005	
80	-3,1757	-4,6921	-0,004	-0,006	

MAX:	4,1485	4,8208
MIN:	-3,6764	-4,6921

Frequency Error due to temperature variations
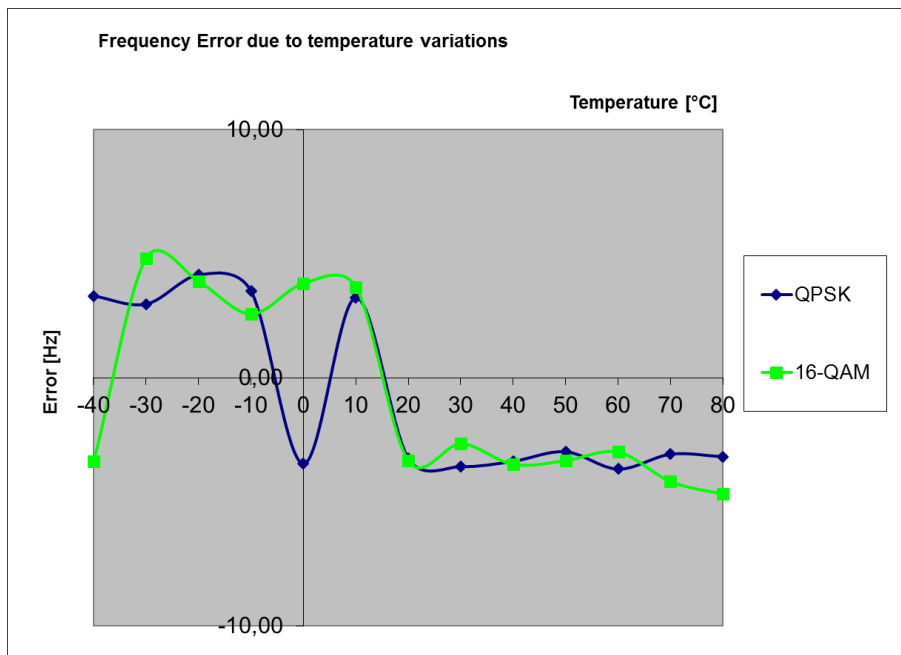
5.5.4.11.1. Band 5: Canada requirement regarding emission/occupied bandwidth

Measurement Method:
With results of chapter 5.5.4.11 (frequency error) and of chapter 5.2. (occupied bandwidth) a calculation should show that the occupied/emissions bandwidth remains within the authorized band. Negative frequency error shifts the carrier (T1 point) more closer to the left band-edge (824MHz), positive frequency error shifts the carrier (T2 point) more closer to the right band-edge (849MHz). Following table shows the results calculated with above presumptions:

Low channel = 20425	from occupied bandwidth diagrams point (T1)

Modulation-Scheme	**FL** **[MHz]**	Low Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency Deviation during climatic tests [MHz]	**Margin to Low-Band-Edge including climatic conditions** [MHz]	Verdict
QPSK	824,256	824	0,256	-0,00000511	0,25599489	pass
16-QAM	824,256	824	0,256	-0,00000568	0,25599432	pass

High channel = 20625	from occupied bandwidth diagrams point (T2)

Modulation-Scheme	**FH** **[MHz]**	High Band-Edge [MHz]	Margin to band-Edge except Frequency Error [MHz]	Frequency of Deviation during climatic tests [MHz]	**Margin to Low-Band-Edge including climatic conditions** **[MHz]**	Verdict
QPSK	848,7380	849	0,262000000	0,00000415	0,26199585	pass
16-QAM	848,7440	849	0,256000000	0,00000482	0,25599518	pass

5.5.4.12. LTE Band 7

Temperature	Maximum frequency error				Verdict
	Channel 20775/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	13,9904	14,5483	0,006	0,006	
-30	11,7302	13,1178	0,005	0,005	
-20	13,6614	12,7888	0,005	0,005	
-10	15,3637	14,4339	0,006	0,006	
0	16,6941	14,9775	0,007	0,006	
10	14,9059	12,7459	0,006	0,005	
20	16,1362	11,7159	0,006	0,005	Pass
30	15,049	13,2322	0,006	0,005	
40	12,9032	12,6171	0,005	0,005	
50	11,7445	11,344	0,005	0,005	
60	13,4897	12,0163	0,005	0,005	
70	12,1737	11,4155	0,005	0,005	
80	12,3596	13,8044	0,005	0,006	

MAX:	16,6941	14,9775
MIN:	11,7302	11,344
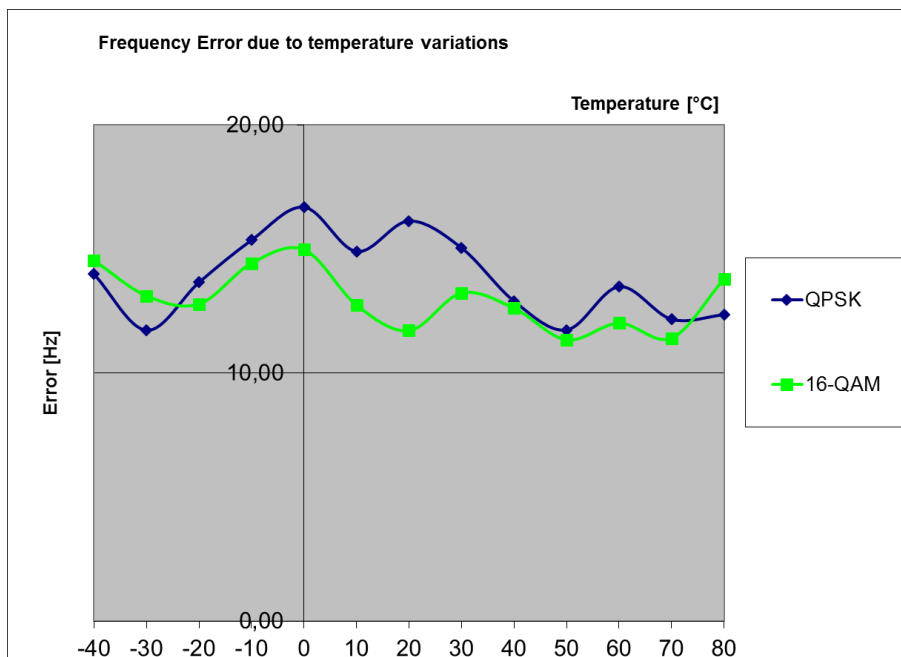
Frequency Error due to temperature variations

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Temperature	Maximum frequency error				Verdict
	Channel 21100/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	-16,9802	-13,3896	-0,007	-0,005	
-30	-26,5503	-10,3426	-0,010	-0,004	
-20	-9,5701	-9,5129	-0,004	-0,004	
-10	9,0551	-10,7002	0,004	-0,004	
0	9,9993	12,4025	0,004	0,005	
10	-9,5987	-9,0265	-0,004	-0,004	
20	9,656	-10,829	0,004	-0,004	Pass
30	7,9393	-9,8276	0,003	-0,004	
40	14,348	-10,6716	0,006	-0,004	
50	9,0837	-10,457	0,004	-0,004	
60	-10,0279	-10,4284	-0,004	-0,004	
70	-10,5143	-10,2139	-0,004	-0,004	
80	11,5299	-10,5	0,005	-0,004	

MAX:	14,348	12,4025
MIN:	-26,5503	-13,3896
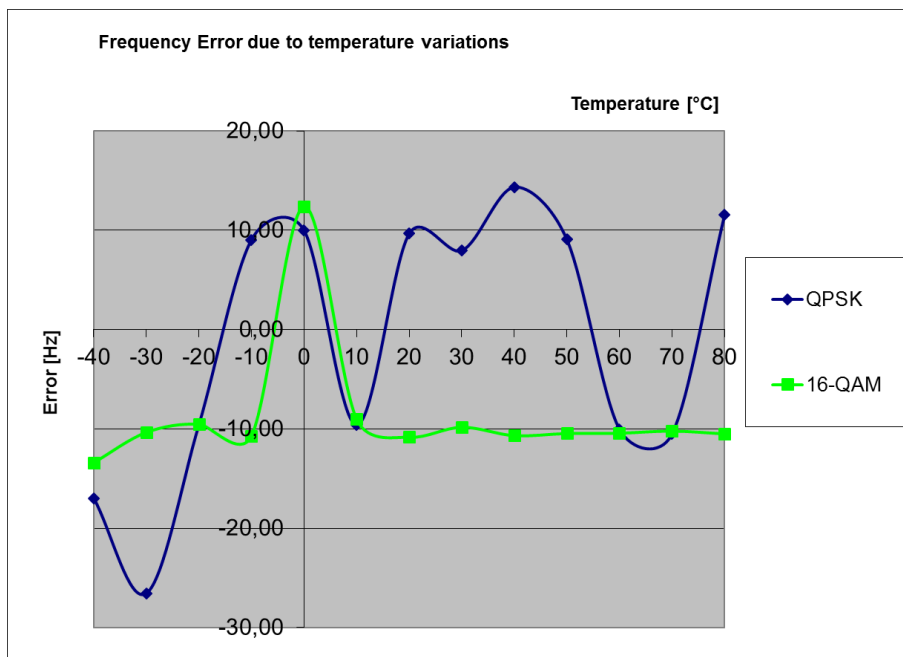
Frequency Error due to temperature variations

| Temperature | Maximum frequency error | | | | Verdict |
| | Channel 21425/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	13,1035	11,7159	0,005	0,005	
-30	11,9734	10,7431	0,005	0,004	
-20	11,1151	11,9448	0,004	0,005	
-10	13,5326	12,4025	0,005	0,005	
0	13,2179	10,6859	0,005	0,004	
10	10,829	10,128	0,004	0,004	
20	10,9148	10,1423	0,004	0,004	Pass
30	11,7302	9,6416	0,005	0,004	
40	10,3712	10,8576	0,004	0,004	
50	10,2711	9,0981	0,004	0,004	
60	11,9162	12,4741	0,005	0,005	
70	12,1737	12,846	0,005	0,005	
80	12,4884	8,7404	0,005	0,003	

MAX:	13,5326	12,846
MIN:	10,2711	8,7404

Frequency Error due to temperature variations

5.5.4.13. LTE Band 12

	Maximum frequency error				Verdict
	Channel 23035/ BW= 5MHz				
Temperature	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	-2,7323	-3,6192	-0,004	-0,005	
-30	2,9469	3,0184	0,004	0,004	
-20	2,9182	3,1328	0,004	0,004	
-10	2,5606	4,2486	0,004	0,006	
0	2,3746	2,9755	0,003	0,004	
10	3,7909	-3,6335	0,005	-0,005	
20	-3,705	-4,034	-0,005	-0,006	Pass
30	-3,8338	-3,0327	-0,005	-0,004	
40	-2,9325	-2,6178	-0,004	-0,004	
50	-3,4332	-2,7752	-0,005	-0,004	
60	-3,891	-3,8338	-0,006	-0,005	
70	-3,6478	-3,891	-0,005	-0,006	
80	-3,5763	-3,9339	-0,005	-0,006	

MAX:	3,7909	4,2486
MIN:	-3,891	-4,034
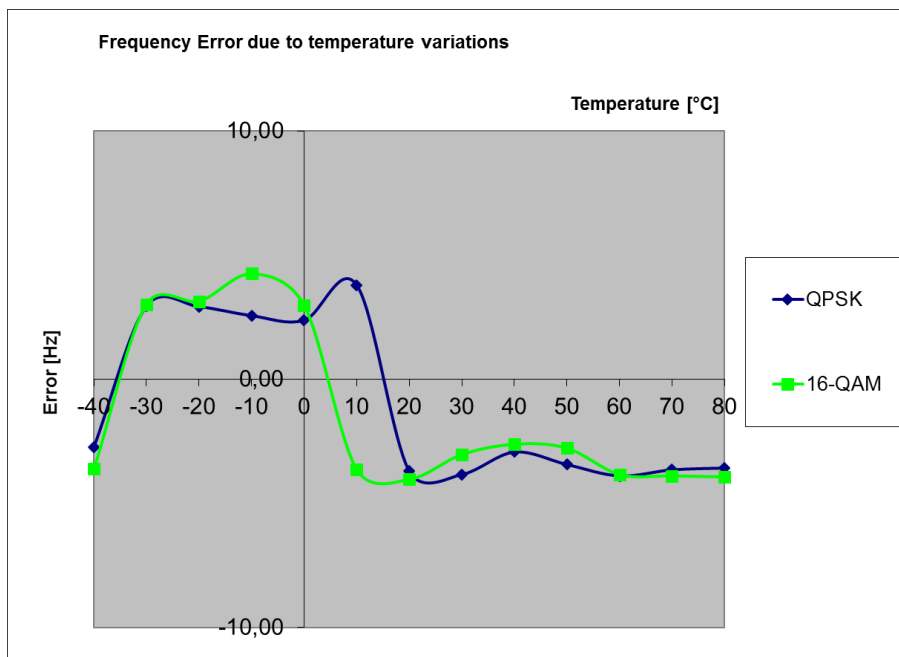
Temperature	Maximum frequency error				Verdict
	Channel 23095/ BW= 5MHz				
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	-3,7765	-2,9612	-0,005	-0,004	
-30	3,5477	-2,7037	0,005	-0,004	
-20	2,2459	-3,0756	0,003	-0,004	
-10	-2,5606	2,8324	-0,004	0,004	
0	3,2473	3,8195	0,005	0,005	
10	3,705	-3,2902	0,005	-0,005	
20	-2,4748	-2,9755	-0,003	-0,004	Pass
30	-2,6751	-3,9911	-0,004	-0,006	
40	-3,562	-3,0613	-0,005	-0,004	
50	-3,3188	-3,7479	-0,005	-0,005	
60	-4,8065	-4,5061	-0,007	-0,006	
70	-3,9911	-3,5763	-0,006	-0,005	
80	-3,3188	3,7909	-0,005	0,005	

MAX:	3,705	3,8195
MIN:	-4,8065	-4,5061
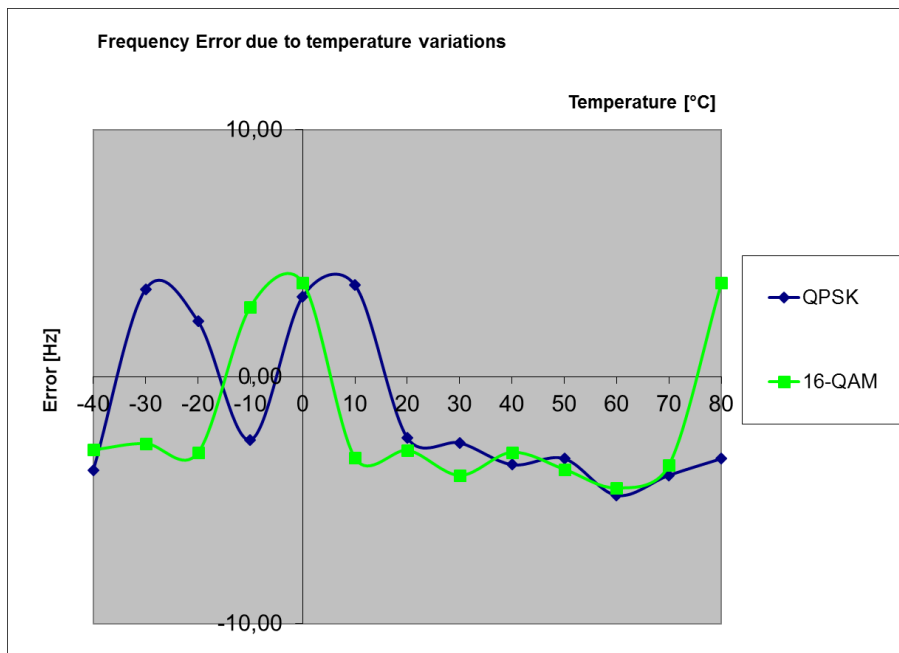
Frequency Error due to temperature variations

| Temperature | Maximum frequency error | | | | Verdict |
| | Channel 23155/ BW= 5MHz | | | | |
	QPSK Modulation [Hz]	16-QAM Modulation [Hz]	QPSK Modulation [ppm]	16-QAM Modulation [ppm]	Limit=±0.1ppm
-40	-3,19	-4,0627	-0,004	-0,006	
-30	2,9469	3,6049	0,004	0,005	
-20	-2,8896	3,4475	-0,004	0,005	
-10	3,2043	3,5048	0,004	0,005	
0	2,2459	2,4605	0,003	0,003	
10	2,1458	2,9325	0,003	0,004	
20	-3,0899	-3,2473	-0,004	-0,005	Pass
30	-2,6035	-3,1757	-0,004	-0,004	
40	-3,2759	-3,6192	-0,005	-0,005	
50	-2,7037	-3,4761	-0,004	-0,005	
60	-3,2473	-3,0041	-0,005	-0,004	
70	-3,2759	-3,5906	-0,005	-0,005	
80	-4,034	-3,7765	-0,006	-0,005	

MAX:	3,2043	3,6049
MIN:	-4,034	-4,0627

Frequency Error due to temperature variations
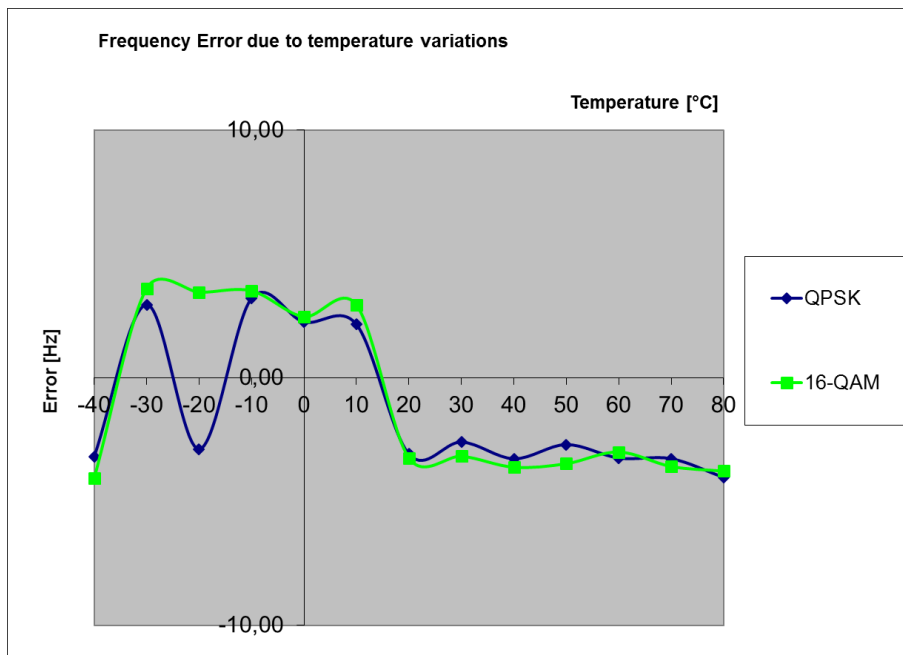
5.5.4.14. LTE Band 12: Canada requirement regarding emission/occupied bandwidth

Measurement Method:
With results of chapter 5.5.4.13 (frequency error) and of chapter 5.2. (occupied bandwidth) a calculations should show that the points Marker1 and Marker2 remain within authorized band. Negative frequency error shifts the carrier (F_1 point) more closer to the left band-edge (698MHz), positive frequency error shifts the carrier (F_2) more closer to the right band-edge (716MHz).

Following table shows the results calculated with above presumptions:

Low Band-Edge Calculations

Modulation-Scheme	LTE Signal Bandwidth [MHz]	Channel no.	from spectrum diagram Marker1 [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	1.4	23017	699,074038462	698	1,074038462	-0,000003891	1,0740345710	pass
	3.0	23025	699,000000000		1,000000000	-0,000003891	0,9999961090	pass
	5.0	23035	699,033653846		1,033653846	-0,000003891	1,0336499550	pass
	10	23060	699,088942308		1,088942308	-0,000003891	1,0889384170	pass
16-QAM	1.4	23017	699,080769231	698	1,080769231	-0,000004034	1,080765197	pass
	3.0	23025	699,007211538		1,007211538	-0,000004034	1,007207504	pass
	5.0	23035	699,045673077		1,045673077	-0,000004034	1,045669043	pass
	10	23060	699,112980769		1,112980769	-0,000004034	1,112976735	pass

High Band-Edge calculations

Modulation-Scheme	LTE Signal Bandwidth [MHz]	Channel no.	from spectrum diagram Marker2 [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	1.4	23173	715,922596154	716	0,077403846	0,000003204	0,077400642	pass
	3.0	23165	715,985576923		0,014423077	0,000003204	0,014419873	pass
	5.0	23155	715,963942308		0,036057692	0,000003204	0,036054488	pass
	10	23130	715,875000000		0,125000000	0,000003204	0,124996796	pass
16-QAM	1.4	23173	715,922596154	716	0,077403846	0,0000036049	0,077400241	pass
	3.0	23165	715,985576923		0,014423077	0,0000036049	0,014419472	pass
	5.0	23155	715,951923077		0,048076923	0,0000036049	0,048073318	pass
	10	23130	715,855769231		0,144230769	0,0000036049	0,144227164	pass

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

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	☒ 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			

5.6.2. 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		Distance [m]	Remarks
	[µV/m]	[dBµV/m]		
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

5.6.3. 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		☐ 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"		

5.6.4. 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		Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
	Range	No.					PK	AV	QP	
2.20	Low	18700	9 kHz-30 MHz	RAD1	1	LTE Band 2 QPSK modulation EUT standing	☒	☐	☐	passed
2.20a						LTE Band 2 QPSK modulation EUT laying	☒	☐	☐	passed
2.21	Middle	18900	9 kHz-30 MHz	RAD1	1	LTE Band 2 QPSK modulation EUT standing	☒	☐	☐	passed
2.21a						LTE Band 2 QPSK modulation EUT laying	☒	☐	☐	passed
2.22	High	19150	9 kHz-30 MHz	RAD1	1	LTE Band 2 QPSK modulation EUT standing	☒	☐	☐	passed
2.22a						LTE Band 2 QPSK modulation EUT laying	☒	☐	☐	passed

5.6.5. Measurement Results LTE FDD Band 4:

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	
2.40	Low	20050	9 kHz-30 MHz	RAD1	2	LTE Band 4 QPSK modulation EUT standing	☒	☐	☐	passed
2.40b	Low	20050	9 kHz-30 MHz	RAD1	2	LTE Band 4 QPSK modulation EUT Laying	☒	☐	☐	passed
2.41	Middle	20175	9 kHz-30 MHz		2	LTE Band 4 QPSK modulation EUT standing	☒	☐	☐	passed
2.41b	Middle	20175	9 kHz-30 MHz		2	LTE Band 4 QPSK modulation EUT standing	☒	☐	☐	passed
2.42	High	20350	9 kHz-30 MHz	RAD1	2	LTE Band 4 QPSK modulation EUT standing	☒	☐	☐	passed
2.42a	High	20350	9 kHz-30 MHz	RAD1	2	LTE Band 4 QPSK modulation EUT Laying	☒	☐	☐	passed

5.6.6. Measurement Results LTE FDD Band 5:

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	
2.50a	Low	20425	9 kHz-30 MHz	RAD1	3	LTE Band 5 QPSK modulation EUT laying	☒	☐	☐	passed
2.50b	Low	20425	9 kHz-30 MHz	RAD1	3	LTE Band 5 QPSK modulation EUT standing	☒	☐	☐	passed
2.51a	Middle	20525	9 kHz-30 MHz	RAD1	3	LTE Band 5 QPSK modulation EUT laying	☒	☐	☐	passed
2.51b	Middle	20525	9 kHz-30 MHz	RAD1	3	LTE Band 5 QPSK modulation EUT standing	☒	☐	☐	passed
2.52a	High	20643	9 kHz-30 MHz	RAD1	3	LTE Band 5 QPSK modulation EUT laying	☒	☐	☐	passed
2.52b	High	20643	9 kHz-30 MHz	RAD1	3	LTE Band 5 QPSK modulation EUT standing	☒	☐	☐	passed

5.6.7. Measurement Results LTE FDD Band 7:

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	
2.56a	Low	20850	9 kHz-30 MHz	RAD1	4	LTE Band 7 QPSK modulation EUT laying	☒	☐	☐	passed
2.56b	Low	20850	9 kHz-30 MHz	RAD1	4	LTE Band 7 QPSK modulation EUT standing	☒	☐	☐	passed
2.57a	Middle	21100	9 kHz-30 MHz	RAD1	4	LTE Band 7 QPSK modulation EUT laying	☒	☐	☐	passed
2.57b	Middle	21100	9 kHz-30 MHz	RAD1	4	LTE Band 7 QPSK modulation EUT standing	☒	☐	☐	passed
2.58a	High	21300	9 kHz-30 MHz	RAD1	4	LTE Band 7 QPSK modulation EUT laying	☒	☐	☐	passed
2.58b	High	21300	9 kHz-30 MHz	RAD1	4	LTE Band 7 QPSK modulation EUT standing	☒	☐	☐	passed

5.6.8. 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	
2.53a	Low	23035	9 kHz-30 MHz	RAD1	5	LTE Band 12 QPSK modulation EUT laying	☒	☐	☐	Passed
2.53b	Low	23035	9 kHz-30 MHz	RAD1	5	LTE Band 12 QPSK modulation EUT standing	☒	☐	☐	Passed
2.54a	Middle	23095	9 kHz-30 MHz	RAD1	5	LTE Band 12 QPSK modulation EUT laying	☒	☐	☐	passed
2.54b	Middle	23095	9 kHz-30 MHz	RAD1	5	LTE Band 12 QPSK modulation EUT standing	☒	☐	☐	passed
2.55a	High	23173	9 kHz-30 MHz	RAD1	5	LTE Band 12 QPSK modulation EUT laying	☒	☐	☐	passed
2.55b	High	23173	9 kHz-30 MHz	RAD1	5	LTE Band 12 QPSK modulation EUT standing	☒	☐	☐	passed

5.6.9. 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 ($d_{meas} < D_{near-field}$)	2'te Condition (Limit distance bigger $d_{near-field}$)	Distance Correction accord. Formula
kHz	9,00E+03	33333,33	5305,17		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	300	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		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	30	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

5.7. 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	-	16.05.2018
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	15.05.2018
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	17.05.2018
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	15.05.2019
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	30.05.2019
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.07.2017
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	-	15.05.2019
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainright GmbH	12 M	1g	30.06.2017
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	30.04.2018
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	30.04.2018
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	30.05.2019
133	horn antenna 18 GHz (Meas 1)	3115	9012-3629	EMCO	36 M	1c	10.03.2020
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	36 M	-	10.03.2020
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	36 M	-	30.04.2018
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	30.05.2018
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
261	Thermal Power Sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24 M	-	30.05.2018
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	30.05.2018
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	30.05.2019
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	30.05.2018
266	Peak Power Sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	30.05.2018
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainright 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	Wainright 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	-	17.05.2018
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	36 M	-	14.03.2020
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	20.03.2020
331	Climatic Test Chamber -40/+180 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	30.10.2018
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	30.05.2018
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	17.05.2019
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
355	Power Meter	URV 5	891310/027	Rohde & Schwarz	24 M	-	30.05.2018
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	24.05.2019
371	Bluetooth Tester	CBT32	100153	R&S	36 M	-	30.05.2019
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	12 M	-	17.05.2018
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	15.05.2018
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	31.12.2017
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	18.05.2018
405	Thermo-/Hygrometer	OPUS 10 THI	126.0604.0003.3.3.3.2 2	LUFFT Mess u. Regeltechnik	24 M	-	30.03.2019
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	24.05.2018
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	10.03.2020

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	CETECOM	12 M	5	31.12.2017
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	31.12.2017
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	31.12.2017
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	31.12.2017
454	Oscilloscope	HM 205-3	9210 P 29661	Hameg	-	4	
456	DC-Power supply 0-5 A	EA 3013 S	207810	Elektro Automatik	pre-m	2	
459	DC -Power supply 0-5 A , 0-32 V	EA-PS 2032-50	910722	Elektro Automatik	pre-m	2	
460	Univ. Radio Communication Tester	CMU 200	108901	Rohde & Schwarz	12 M	-	16.06.2018
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	-	16.05.2019
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	-	30.07.2017
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	31.03.2019
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	18.05.2019
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwrght	12 M	1c	31.12.2017
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	18.05.2019
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	30.03.2018
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	05.07.2018
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	-	30.03.2019
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainright	12 M	1c	31.12.2017
557	System CTC-OTA-2	R&S TS8991	-	Rohde & Schwarz	12 M	5	31.12.2017
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	08.08.2019
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	-	
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	17.05.2019
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	15.05.2019
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
616	Digitalmultimeter	Fluke 177	88900339	Fluke	24 M	-	30.05.2018
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	16.05.2018
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
627	data logger	OPUS 1	201.0999.9302.6.4.1.43	G. Lufft GmbH	24 M	-	30.03.2019
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	KogiLink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
642	Wideband Radio Communication Tester	CMW 500	126089	Rohde&Schwarz	12 M	-	24.05.2018
644	Amplifierer	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	24 M	-	30.05.2018
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	
678	Power Meter	NRP	101638	Rohde&Schwarz	pre-m	-	
683	Spectrum Analyzer	FSU 26	200571	Rohde & Schwarz	12 M	-	17.05.2018

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	29.03.2019
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	17.05.2018
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	12 M	-	16.05.2018
691	OSP120 Base Unit	OSP120	101183	Rohde & Schwarz	12 M	-	22.05.2018
692	Bluetooth Tester	CBT 32	100236	Rohde & Schwarz	36 M	-	29.05.2020
693	TS8997	CTC-Radio Lab 1_TS8997	-	Rohde&Schwarz	12 M	5	31.12.2017
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	
701	CMW500 wide. Radio Comm.	CMW500	158150	Rohde & Schwarz	12 M	-	31.12.2017
703	INNCO Antennen Mast	MA 4010-KT080-XPET-ZSS3	MA4170-KT100-XPET-	INNCO	pre-m	-	
704	INNCON Controller	CO 3000-4port	CO3000/933/38410516/L	INNCO Systems GmBh	pre-m	-	
711	Harmonic Mixer 90 GHz - 140GHz	RPG FS-Z140	101004	RPG	12 M	-	22.02.2018
712	Harmonic Mixer 75 GHz - 110GHz	FS-Z110	101468	Rohde & Schwarz	12 M	-	22.02.2018
713	Harmonic Mixer, 50 GHz - 75GHz	FS-Z75	101022	Rohde & Schwarz	12 M	-	22.05.2018
714	Signal Analyzer 67GHz	FSW67	104023	Rohde & Schwarz	24 M	-	03.03.2019
715	Harmonic Mixer, 140 GHz - 220GHz	FS-Z220	101009	RPG Radiometer Physics	12 M	-	03.08.2018
716	Harmonic Mixer 220 GHz to 325 GHZ	FS-Z325	101005	RPG Radiometer Physics	12 M	-	13.02.2018
747	Spectrum Analyzer	FSU 26	200152	Rohde & Schwarz	12 M	-	18.05.2018
748	Pickett-Potter Horn Antenna	FH-PP 4060	010001	Radiometer Physiscs	-	-	
749	Pickett-potter Horn Antenna	FH-PP 60-90	010003	Radiometer Physics	-	-	
750	Pickett-Potter Horn Antenna	FH-PP 140-220	010011	Radiometer Physics	-	-	

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	2017-08-29
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