T E S T R E P O R T
No.: 16-1-0019501T07a

According to:
FCC Regulations
Part 22, Part 24, Part 15C

IC-Regulations
RSS-132 Issue 3, RSS-133 Issue 6,
RSS-Gen Issue 4

for

u-Blox AG

GSM/W-CDMA Module SARA-U201

FCC-ID: XPY1CGM5NNN
IC: 8595A-1CGM5NNN
PMN: SARA-U201
HVIN: SARA-U201

Laboratory Accreditation and Listings			
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	MRA US-EU 0003	Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3	Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2666 C-2914, T-1967, G-301
Wi Fi ALLIANCE AUTHORIZED RF LABORATORY	ctia Authorized™ Test Lab Lab Code: 20011130-00		
accredited according to DIN EN ISO/IEC 17025			

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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. Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveilance tests.

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. This test report shows results for GPRS and (E)GPRS technologies only. Other implemented wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2, Part 22, Subpart H, Part 24, Subpart E (Broadband PCS) and Part 15, Subpart C of the FCC CFR Title 47 Rules, Edition 4th November 2015 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 Cases	Port	References & Limits			EUT set-up	EUT op-mode	Result
			FCC Standard	RSS Section	Test limit			
1	Emissions AC-Power lines conducted (0,15 to 30 MHz)	AC-Power lines	§15.207	RSS-Gen, Issue 4: Chapter 8.8	§15.207 limits IC: Table 3, Chapter 8.8	--	--	Remark 1.)
2	General field strength emissions radiated - (9 kHz to 30 MHz)	Enclosure + Inter-connecting cables (radiated)	§15.209(a)	RSS-Gen, Issue 4: Chapter 8.9, Table 5	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	--	--	Remark 1.)
7	RF-Power (ERP/EIRP) radiated		§2.1046 §22.913(a)(2) §24.232(c)	RSS-132: 5.4 SRSP-503: 5.1.3 RSS-133: 4.1/6.4 SRSP-510: 5.1.2	< 11.5 Watt (EIRP) (mobile stations) < 2 Watt (EIRP)			passed
8	Spurious emissions radiated (30 MHz to… *tenth-times of the fundamental frequency)		§2.1053(a) §2.1057 §22.917(a)(b) §24.238(a)(b)	RSS-132: 5.5(i)(ii) RSS-133: 6.5.1(i)(ii)	Required attenuation below P(dBW): 43+10log(P) dBc			passed
9	Band-Edge compliance							passed
30	RF Power	Antenna terminal	§2.1046	RSS-132: 5.4 SRSP-503: 5.1.3 RSS-133: 4.1/6.4 SRSP-510: 5.1.2	< 11.5 Watt (EIRP) (mobile stations) < 2 Watt (EIRP)			passed
34	26dB Emission bandwidth		§2.202 §2.1049(h) §22.917(a) §24.238(a)	RSS-Gen, Issue 4: Chapter 6.6	99% Power			passed
35	99% Occupied bandwidth							
36	Spurious emissions		§2.1051 §2.1057 §22.917(a)(b) §24.238(a)(b)	RSS-132: 5.5(i)(ii) RSS-133: 6.5.1(i)(ii)	Required attenuation below P(dBW): 43+10log(P) dBc			passed
37	Band-Edge compliance							
38	Frequency stability		§22.355, table C-1 §24.235 §2.1055(a)(2)	RSS-132: 5.3 RSS-133: 6.3	< ±2.5ppm <±0.1 ppm			passed

Remarks: 1.) see separate test report for tests according FCC Part 15B and FCC Part15C

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	--	--	Passed 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 1

Remark: 1.) See separate test report 16-1-0088301T01a 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.

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

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

2. Administrative Data

2.1. Identification of the testing laboratory

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

2.2. Test location

2.2.1. Test laboratory "CTC"

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

2.3. Organizational items

Responsible for test report and project leader:	Dipl.-Ing. C. Lorenz
Receipt of EUT:	2016-06-06
Date(s) of test:	2016-06-07 to 2016-06-20
Date of report:	2016-06-28
Version of template: 13.02	

2.4. Applicant's details

Applicant's name:	u-Blox AG
Address:	Zürcherstr. 68 8800 Thalwil Switzerland
Contact person:	Mr. Marco Barchitta

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

GSM Frequency range (US/Canada -bands)	☒ GSM 850: 824 – 849 MHz (Uplink), 869-894 MHz (Downlink) ☒ GSM1900: 1850-1910 MHz (Uplink), 1930-1990 MHz (Downlink)		
Type of modulation	☒ GSM,GPRS: GMSK ☒ EGPRS-Mode: 8-PSK		
Number of channels (USA/Canada -bands)	☒ GSM 850: 128 – 251, 125 channels ☒ GSM1900: 512 – 810, 300 channels		
Test Channel frequencies	☒ GSM/E-GPRS 850 MHz Band: Channel 128/192/251 ☒ GSM/E-GPRS 1900 MHz Band: Channel 512/661/810		
Emission designator(s)	245KGXW (GSM850) 250KGXW (EDGE850) 245KG7W (GSM1900) 253KG7W (EDGE 1900)		
Antenna Type	☒ External, separate RF-connector		
Antenna Gain Tx (main)	☒ Value from Data sheet GSA.8827.A.101111 Phoenix for 1m cable length 850MHz Band: -0.44dBd (1.71 dBi) 1900MHz Band: 2.32dBi		
Antenna Gain Dx (diversity)	☒ Not applicable		
Measured Output Power [dBm]: Conducted GSM 850 Conducted EDGE850	 32.6 30.0		
Calculated Output Power [dBm]:: Radiated GSM 850 Radiated EDGE 850	**Calculated with antenna details for 1m cable length:** 32.6 – 0.44dBd = 32.16 dBm ERP 30.0 - 0.44dBd = 29.56 dBm ERP		
Measured Output Power [dBm]:: Conducted GSM 1900 Conducted EDGE 1900	 29.8 26.2		
Measured Output Power [dBm]:: Radiated GSM 1900 Radiated EDGE1900	 29.8 dBm + 2.32dBi = 32.12 dBm EIRP 26.2 dBm + 2.32dBi = 25.52 dBm EIRP		
Installed options			
Power supply	☒ for board over AC/DC adapter (AE2): 120V/60 Hz ☒ DC power only: 3.8 Volt nominal / Range 3.3 to 4.4Volt		
Special EMI components	--		
Does EUT contain devices susceptible to magnetic fields, e.g. Hall elements, electrodynamics microphones, etc.?	☐ yes ☒ no		
EUT sample type	☐ Production	☒ Pre-Production	☐ Engineering
FCC label attached	☐ yes	☒ no	

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/W-CDMA Module	SARA-U201	IMEI: 357520070020959	261A01	23.56
EUT B	GSM/W-CDMA Module	SARA-U201	IMEI: 357520070020918	261A01	23.56
EUT C	-	-	-	-	-

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

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

AE short description *)	Auxiliary Equipment	Type	S/N serial number	HW hardware status	SW software status
AE 1	AC/DC power adapter	UUX-324-1215	F04-0026561	-	-
AE 2	Evaluation Test Board	EVB-WL3	BS090514	-	-
AE 3	Headset	HDC-5	-	-	-
AE 4	Cellular antenna	Taoglas GSA.8827.A.101111 phoenix	GSATT1505001611	-	-
AE 5	USB cable	Mini-USB to USB A	--	1.5m	--
AE 6	Dell Latitude Notebook	D2120	Ctc062011	--	Win 7 + Putty program

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

3.4. EUT set-ups

EUT set-up no.*)	Combination of EUT and AE	Remarks
set. 1	EUT A + AE 1 + AE 2+ AE 3+ AE 4 + AE 5 + AE 6	AE 6 used temporary for AT commands
set. 2	EUT B + AE 1 + AE 2+ AE 3+ AE 4 + AE 5 + AE 6	Conducted RF-tests performed except power conducted measurements, AE 6 used temporary for AT commands

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

3.5. EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
op. 1	GPRS 850 Data Traffic channels = 128/192/251	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 33 dBm (power class 4; power control level 5). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (33 dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
op. 2	E-GPRS 850 Data Traffic channels = 128/192/251	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 33 dBm (power class 4; power control level 5). USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8PSK modulation, slot 3 active, uplink gamma: 6 (27dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.
op. 3	GPRS 1900 Data Traffic channels = 512/661/810	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 30 dBm (power class 1; power control level 0). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (30 dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link
op. 4	E-GPRS 1900 Data traffic channels = 512/661/810	A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 30 dBm (power class 1; power control level 0). USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8-PSK modulation, slot 3 active, uplink gamma: 5 (26 dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link.

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

3.6. Parameter Settings on mobile phone and base station CMU200

Following settings apply to the MS during the measurements in **GSM/(E)GPRS**-Mode only:

Parameter	Traffic Mode	Idle Mode
Traffic Channels mobile station (EUT)	GSM 850: TCH_{MS}= 128/ 192 /251 GSM 1900: TCH_{MS} = 512 / 661 / 810	--
maximum power level (PCL)	GSM 850: PCL = 5 (2 Watt) GSM 1900: PCL = 0 (1 Watt)	--
Modulation	GSM/GPRS: GMSK-Modulation Scheme EDGE: 8-PSK Modulation Scheme	--
DTX	off	--
Bitstream	PRBS 2E9-1 (pseudo-random-sequence) – CCITT 0.153	
Timeslot(s) no. activated in Uplink	3	
Hopping	off	
Timeslot (slot mode)	GPRS/E-GPRS-Mode: single	
MS slot class	Class 12	
Maximum data transmission rate, single time slot	GSM: 9,6 kbit/s Slot GPRS: 17,6 kbit/s Slot EDGE: 59,2 kBit/s Slot	
Speech transcoding (Traffic Mode)	Full rate Version 1	
Speed rate	130 Kb/s	
Mode	BCCH and TCH	
BCCH – base station (CMU,CMD)	GSM 850: 182 GSM 1900: 651	
TCH – base station (CMD, CMU)	auto	
Power level TCH – base station (used timeslot level)	- 70 dBm	
Power level BCCH – base station (control channel level)	- 80 dBm	
External attenuation RF/AF-Input/Output	Accord. calibration prior to measurements	
Mobile Country Code	310	310
Domain	CS	
BS_AG_BLKS_RES	Not applicable	0
Paging reorganisation		Off (0)
Signalling channel		SDCCH
Location Update		Auto
Cell access		Disabled (barred)

Settings for CMU (general)

Repetition	Continuous	
Stop condition	None	
Display mode	Max./Min	
Statistic Count	1000 Bursts	
Decoder	Standard	

Additional settings on the base stations CMU200 for frequency stability measurements

3.7. Configuration of cables used for testing

Cable number	Item	Type	S/N serial number	HW hardware status	Cable length
Cable 1	USB cable	Mini-USB to USB A	-	1.5m	-

4. Description of test system set-up's

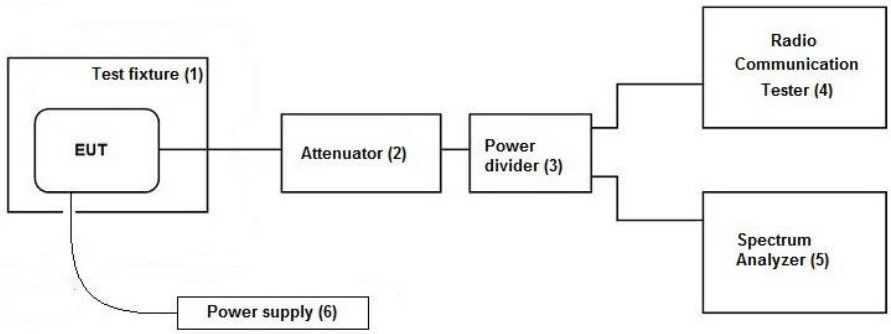
4.1. Test system set-up for conducted measurements at antenna port

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)	☒ CMU200 Communication Test-Unit for GSM/W-CDMA	See List of equipment under each test case and chapter 8 for calibration info
☒ Low loss RF-cables	☒ DC-Power Supply	
☒ 6 dB resistive power divider/coupler (#529)	☒ Spectrum-Analyser	

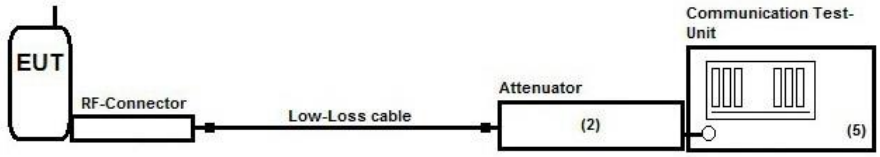
Testing method: ANSI C63.10:2013, KDB 971168 D01 v02r02

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

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

Tests Specification: Conducted Carrier power, Frequency Error

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



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

Used Equipment	Passive Elements	Test Equipment	Remark:
	☒ 20 dB Attenuator (#613) ☒ Low loss RF-cables	☒ CMU200 Communication Test-Unit for GSM/W-CDMA ☒ DC-Power Supply	See List of equipment under each test case and chapter 8 for calibration info

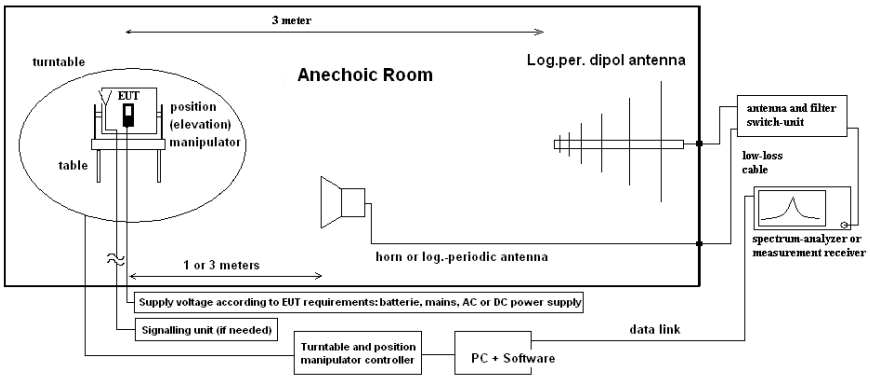
Measurement uncertainty See chapter Measurement Uncertainties (Cel-2)

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

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

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

Schematic:



Testing method:

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

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

Formula:

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

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

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

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

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

5. Measurements

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

5.1.1. Test location and equipments

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			
otherwise	☐ 110 USB LWL					
DC power	☐ 456 EA 3013A	☒ 463 HP3245A	☐ 459 EA 2032-50	☐ 268 EA- 3050	☐ 494 AG6632A	☐ 498 NGPE 40
otherwise	☐ 331 HC 4055	☒ 248 6 dB Att.	☒ 529 Power div.	☒ - cable OTA20		
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V/ 60 Hz via PAS 5000			

5.1.2. Requirements and limits

FCC	§2.1046(a)
IC	RSS-132 : 5.4 + SRSP 503 :5.1.3 for GSM 850 RSS-133 4.1/6.4 + SRSP-510 :5.1.2 for GSM 1900
ANSI	C63.26-2015, Chapter 5.2
Limit	Maximum conducted output power of the transmitter should be determined while measured on RF output terminal.
	Limit GSM850: 7 Watt (38.4 dBm)
	Limit GSM1900: 2 Watt (33.0 dBm)
	PAPR≤13 dB

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 CMU200 from Rohde&Schwarz company. In this way spectrum-analyzers instrument limitations can be avoided or minimized. Instead, CMU manufacturers declared measurement error can be considered for this measurement. The attenuation (insertion loss) at the RF Inputs/Outputs of CMU 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 on test set-up Cel-1. The Peak-to -Average-Power Ratio is determined by devices integrated CCDF capability with corresponding settings. (see annex 1 plots) The guideline in ANSIC63.26-2016 is taken into account.	
Mobile phone settings	A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200" UE Power should be set to maximum, continuous transmission. DTX or other power saving techniques have been disabled 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.	

5.1.4. Measurement results

Op. Mode 1, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
GSM 850	Low	128	32.7	32.5	0.34	38.4	13	Passed
	Middle	192	32.8	32.6	0.34			
	High	251	32.7	32.6	0.32			

Remark: --

Op. Mode 2, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
E-GPRS 850	Low	128	29.9	27.2	3.37	38.4	13	Passed
	Middle	192	30.0	27.3	3.30			
	High	251	30.0	27.3	3.49			

Remark: --

Op. Mode 3, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
GSM 1900	Low	512	29.9	29.8	0.26	38.4	13	Passed
	Middle	661	29.9	29.7	0.26			
	High	810	29.9	29.8	0.27			

Remark: --

Op. Mode 4, Set-up 1

Op. Mode	Carrier Channel		Peak Output Power [dBm]	Average Output Power [dBm]	PAPR-Ratio on 0.1% probability [dB]	Peak power Limit	PAPR-Limit	Result
	Range	No.				[dBm]	[dB]	
E-GPRS 1900	Low	512	29.0	26.1	3.55	33.0	13	Passed
	Middle	661	29.0	26.1	3.38			
	High	810	29.0	26.2	3.18			

Remark: --

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 FSU	☐ 489 ESU40	☐ 264 FSEK	☒ 620 ESU26		
signaling	☐ 392 MT8820A	☐ 436 CMU	☒ 547 CMU			
DC Power	☐ 463 HP3245A	☐ 087 EA3013	☒ 354 NGPE 40	☐ 086 LNG50-10		
otherwise	☒ 529 6dB divider	☒ 530 10dB Att.	☐ 431 Near field			
line voltage	☐ 230 V 50 Hz via public mains		☒ 060 120 V/ 60 Hz via PAS 5000			

5.2.2. Requirements and Limits

FCC	§2.202(a), §2.1049(h), §22.917(b), §24.238(b)	„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, Chapter 5.4	

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 MHz	1 MHz
	RBW	3 kHz	3 kHz
	VBW	30 kHz	30 kHz
	Sweep time	Coupled	Coupled
	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.
EUT settings		Provisions with the requirements is based on the fact, that GSM modulation scheme is GMSK Modulation for GSM equipment with a maximum data transmission rate of 17,6 kBit/s per Slot. Provisions with the requirements is based on the fact, that EDGE modulation scheme is 8-PSK Modulation for EDGE equipment with a maximum data transmission rate of 69,2 kBit/s per Slot. A call was established with settings according chapter “Parameter settings on wireless device and base station CMU200”	

5.2.4. Measurement results

Operating mode/band Set-up	Carrier Channel		Occupied 99% bandwidth [kHz]	26 dBc Emission bandwidth [kHz]
	Range	No.		
Set-up 2, Op-Mode 1				
GSM 850	Low	128	241.987179487	314.102564103
	Middle	192	243.589743590	318.910256410
	High	251	245.192307692	315.705128205
Set-up 2, Op-Mode 2				
E-GPRS 850	Low	128	250.0	**323.717948718**
	Middle	192	250.0	322.115384615
	High	251	248.397435897	**323.717948718**
Set-up 2, Op-Mode 3				
GSM 1900	Low	512	243.58974359	312.5
	Middle	661	243.58974359	312.5
	High	810	**245.192307692**	**317.307692307**
Set-up 2, Op-Mode 4				
E-GPRS 1900	Low	512	250.0	**325.32051282**
	Middle	661	**253.205128205**	315.705128205
	High	810	243.8397435897	317.307692307

Remarks: see annex1/diagrams

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	☒ 489 ESU	☐ 620 ESU26	
signaling	☐ 017 CMD 65	☐ 323 CMD 55	☐ 340 CMD 55			
signaling	☐ 392 MT8820A	☐ 436 CMU	☒ 547 CMU			
power supply	☒ 463 HP3245A	☐ 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		☐ 060 120 V/ 60 Hz via PAS 5000			

5.3.2. Requirements and limits

FCC	☒ Part 2.1051, Part2.1057(a)(1) ☒ Part 22 Subpart H, §22.917(a)(b)(c)(d) ☒ Part 24 Subpart E, §24.238(a)(b)(c)(d)
IC	☒ RSS-132, Issue 3: 5.5(i)(ii) ☒ RSS-133, Issue 6: 6.5.1(i)(ii)
ANSI	C63.26-2015, Chapter 5.7
Limit	**§22.917(a) & §24.238(a):** "The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB" Resulting Limit of-13dBm for all Power Control Levels of the cellular equipment

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	*"§ 2.1057 Frequency spectrum to be investigated. (a) In all of the measurements set forth in § 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz"* The spectrum was scanned from 9 kHz (depend on the equipment, s. §2.1057) to the 10th harmonic of the highest frequency generated within the equipment. A PEAK detector was used except measurements near the block-edge where also a AVERAGE detector can be applied. A suitable artificial antenna or RF-connector is provided by the applicant in order to perform the conducted measurements. Any data provided with the artificial antenna or connector, have been taken in account in order to correct the measurement data. (typical 0.3dB for attenuation of antenna connector)	
Spectrum-Analyzer settings	See below tables	
EUT settings	A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200" UE Power should be set to maximum, continuous transmission. DTX or other power saving techniques have been disabled. 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 wireless device, should be sufficient to demonstrate compliance.	

5.3.4. Spectrum-Analyzer settings for GSM/GPRS/E-GPRS 850

Sweep No.	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att. [dB]	Detector
Sweep 1 (subrange 1)	0.009	1	0.001	0.01	10	25	PK or RMS
Sweep 1 (subrange 2)	1	30	0.1	1	5	25	PK or RMS
Sweep 2 (subrange 1)	30	820	1	10	10	35	PK or RMS
Sweep 2 (subrange 2)	820	1000	1	10	2	45	PK or RMS
Sweep 2 (subrange 3)	1000	9000	1	10	100	35	PK or RMS
Sweep 3a (Band-Edge)	823	824	0.003	0.01	70	35	PK or RMS
Sweep 4a (Band-Edge)	849	850	0.003	0.01	70	35	PK or RMS

5.3.5. Spectrum-Analyzer Settings GSM/GPRS/E-GPRS 1900

	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	0.009	1	0.001	0.01	10	25	PK or RMS
Sweep 1 (subrange 2)	1	30	0.1	1	5	25	PK or RMS
Sweep 2 (subrange 1)	30	1000	1	10	100	35	PK or RMS
Sweep 2 (subrange 2)	1000	2500	1	10	15	35	PK or RMS
Sweep 2 (subrange 3)	2500	19500	1	10	150	35	PK or RMS
Sweep 3a (Band-Edge)	1849	1850	0.003	0.01	70	35	PK or RMS
Sweep 4a (Band-Edge)	1910	1911	0.003	0.01	70	35	PK or RMS

5.3.6. Results

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

5.3.7. GPRS 850: Set-up 2

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.07_CH128_GPRS_Sweep1	Low	128	9 kHz – 30 MHz	1	--	☒	☐	☐	passed
36.08_CH128_GPRS_Sweep2	Low		30MHz – 9 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.03_BE_CH128_GPRS	Low		823-824 MHz		Band Edge Compliance	☐	☒	☐	passed
36.09_CH192_GPRS_Sweep1	Middle	192	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.10_CH192_GPRS_Sweep2	Middle		30MHz – 9 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
36.11_CH251_GPRS_Sweep1	High	251	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.12_CH251_GPRS_Sweep2	High		30MHz – 9 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.04_BE_CH251_GPRS	High		849 – 850 MHz		Band-Edge compliance	☐	☒	☐	passed

Remark:--

5.3.8. E-GPRS 850: Set-up 2

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.13_Ch128_EGPRS_Sweep1	Low	128	9 kHz – 30 MHz	2	--	☒	☐	☐	passed
36.14_Ch128_EGPRS_Sweep2	Low		30MHz – 9 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.05_BE_Ch128_EGPRS	Low		823 - 824 MHz		Band Edge Compliance	☐	☒	☐	passed
36.15_Ch192_EGPRS_Sweep1	Middle	192	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.16_Ch192_EGPRS_Sweep2	Middle		30MHz – 9 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
36.17_Ch251_EGPRS_Sweep1	High	251	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.18_Ch251_EGPRS_Sweep2	High		30MHz – 9 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.06_BE_Ch251_EGPRS	High		849 – 850 MHz		Band-Edge compliance	☐	☒	☐	passed

Remark:--

5.3.9. GPRS 1900: Set-up 2

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.20_RSE_Ch512_GPRS_Sweep1	Low	512	9 kHz – 30 MHz	3	--	☒	☐	☐	passed
36.21_RSE_Ch512_GPRS_Sweep2	Low		30MHz – 20 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.10_BE_Ch512_GPRS_PK	Low		1849 – 1850 MHz		Band Edge Compliance	☒	☐	☐	passed
36.22_RSE_Ch661_GPRS_Sweep1	Middle	661	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.23_RSE_Ch661_GPRS_Sweep2	Middle		30MHz – 20 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
36.24_RSE_Ch810_GPRS_Sweep1	High	810	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.25_RSE_Ch810_GPRS_Sweep2	High		30MHz – 20 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.11_BE_Ch810_GPRS_PK	High		1910 – 1911 MHz		Band-Edge compliance	☒	☐	☐	passed

Remark: --

5.3.10. E-GPRS 1900: Set-up 2

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
36.26_RSE_Ch512_EGPRS_Sweep 1	Low	512	9 kHz – 30 MHz	4	--	☒	☐	☐	passed
36.27_RSE_Ch512_EGPRS_Sweep 2	Low		30MHz – 20 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.12_BE_Ch512_EGPRS_PK	Low		1849 – 1850 MHz		Band Edge Compliance	☒	☐	☐	passed
36.28_RSE_Ch661_EGPRS_Sweep 1	Middle	661	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.29_RSE_Ch661_EGPRS_Sweep 2	Middle		30MHz – 20 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
36.30_RSE_Ch810_EGPRS_Sweep 1	High	810	9 kHz – 30 MHz		--	☒	☐	☐	passed
36.31_RSE_Ch810_EGPRS_Sweep 2	High		30MHz – 20 GHz		Carrier visible on diagram, not relevant for result	☒	☐	☐	passed
37.13_BE_Ch810_EGPRS_PK	High		1910 – 1911 MHz		Band-Edge compliance	☒	☐	☐	passed

Remark: --

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

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	☒ 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			
DC power	☐ 456 EA 3013A	☐ 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	☒ 627 OPUS 1				
line voltage	☐ 230 V 50 Hz via public mains		☐ 060 120 V/ 60 Hz via PAS 5000			

5.4.2. Requirements and limits

FCC	☒ §2.1055(a)(1) (d) ☒ §22.355 ☒ §24.235
IC	☒ RSS-Gen, Issue 3 ☒ RSS-132: 5.3 ☒ RSS-133: 6.3
ANSI	C63.26-2015, Chapter 5.6
Limit	*"The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block"*

5.4.3. 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 under operating conditions.
Measurement method	The GSM RF Channel spacing is 200 kHz according GSM-Spec, with a guard band of 200 kHz of each band of the sub-bands. The purpose 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. (CMU) 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.
EUT settings	A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200" 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 wireless device , should be sufficient to demonstrate compliance.

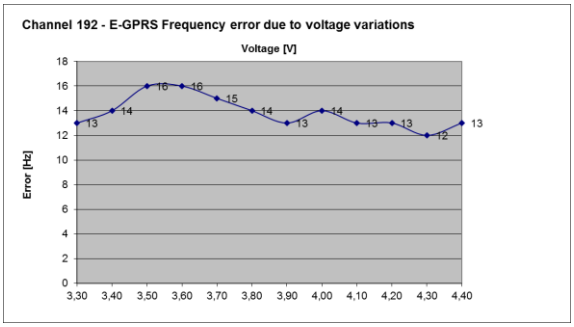
5.4.4. Measurement results

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

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

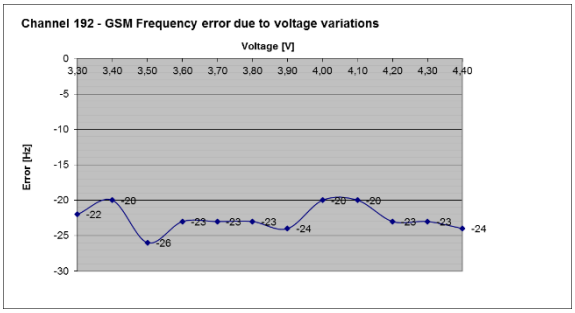
5.4.4.2. GPRS 850 Mode: Op. Mode 1, set-up 2

Channel 192: GMSK				
Voltage [V]	Nominal Frequency [MHz]	Maximum frequency error		Verdict Limit=+/-0.1ppm
		[Hz]	[ppm]	
3,3	8,37E+08	13	0,016	passed
3,4		14	0,017	
3,5		16	0,019	
3,6		16	0,019	
3,7		15	0,018	
3,8		14	0,017	
3,9		13	0,016	
4,0		14	0,017	
4,1		13	0,016	
4,2		13	0,016	
4,3		12	0,014	
4,4		13	0,016	



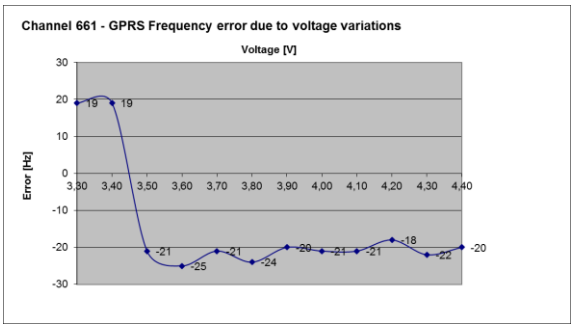
5.4.4.3. E-GPRS 850 Mode: Op. Mode 2, set-up 2

Channel 192: 8-PSK				
Voltage [V]	Nominal Frequency [MHz]	Maximum frequency error		Verdict Limit= +/-0.1ppm
		[Hz]	[ppm]	
3,3	8,37E+08	-22	-0,026	passed
3,4		-20	-0,024	
3,5		-26	-0,031	
3,6		-23	-0,027	
3,7		-23	-0,027	
3,8		-23	-0,027	
3,9		-24	-0,029	
4,0		-20	-0,024	
4,1		-20	-0,024	
4,2		-23	-0,027	
4,3		-23	-0,027	
4,4		-24	-0,029	



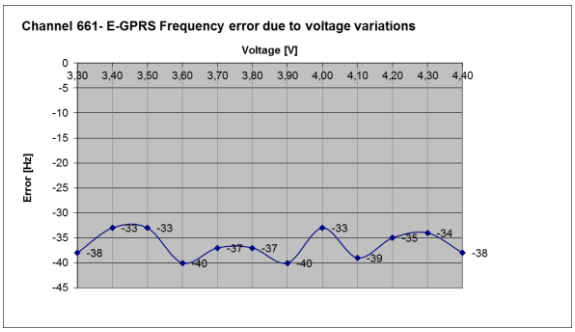
5.4.4.4. GPRS 1900 Mode: Op. Mode 3, set-up 2

Channel 661: GMSK				
Voltage	Nominal Frequency	Maximum frequency error		Verdict
[V]	[MHz]	[Hz]	[ppm]	Limit= +/-0.1ppm
3,3	1,88E+09	19	0,010	passed
3,4		19	0,010	
3,5		-21	-0,011	
3,6		-25	-0,013	
3,7		-21	-0,011	
3,8		-24	-0,013	
3,9		-20	-0,011	
4,0		-21	-0,011	
4,1		-21	-0,011	
4,2		-18	-0,010	
4,3		-22	-0,012	
4,4		-20	-0,011	



5.4.4.5. E-GPRS 1900 Mode: Op. Mode 4, set-up 2

Channel 661: 8-PSK				
Voltage	Nominal Frequency	Maximum frequency error		Verdict
[V]	[MHz]	[Hz]	[ppm]	Limit= +/-0.1ppm
3,3	1,88E+09	-38	-0,020	passed
3,4		-33	-0,018	
3,5		-33	-0,018	
3,6		-40	-0,021	
3,7		-37	-0,020	
3,8		-37	-0,020	
3,9		-40	-0,021	
4,0		-33	-0,018	
4,1		-39	-0,021	
4,2		-35	-0,019	
4,3		-34	-0,018	
4,4		-38	-0,020	

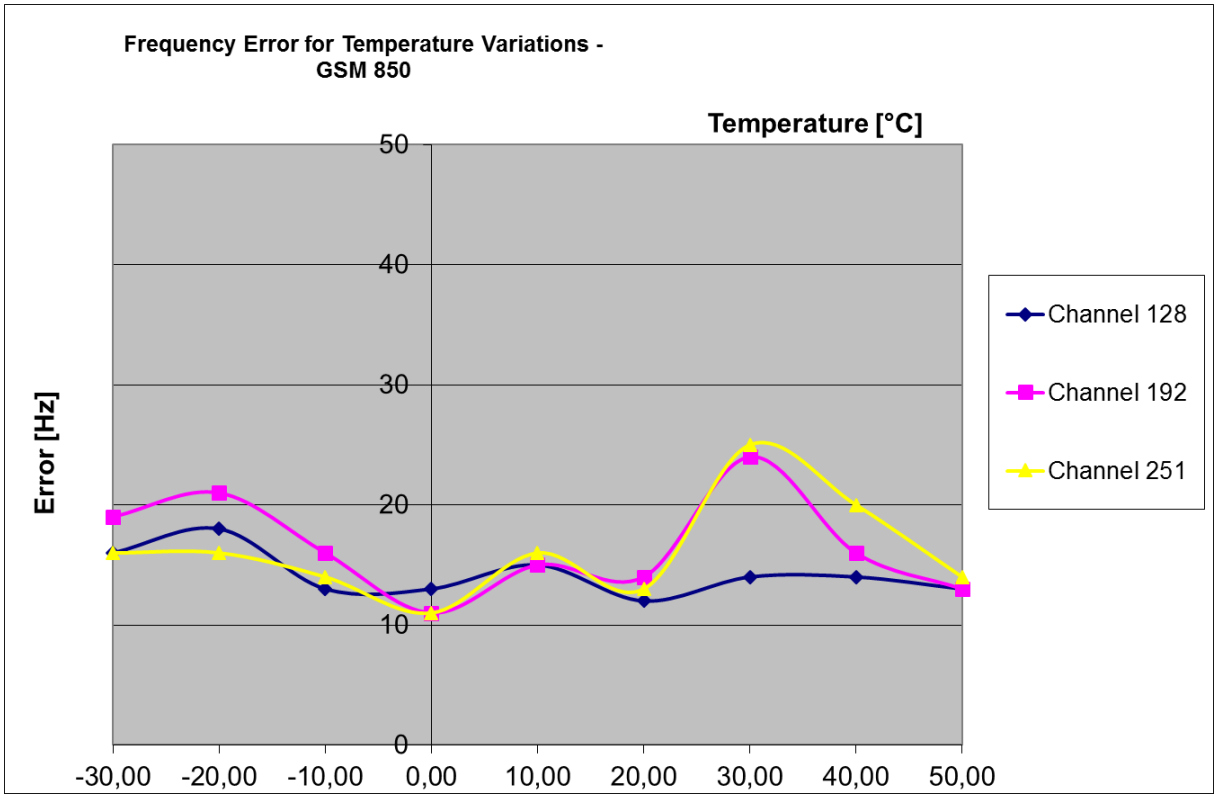


5.4.4.6. Frequency shift of carrier against temperature at constant power supply voltage

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 –30°C to +60°C. For about half hour at the specified temperature the mobile was powered-off. After powering-on, the measurements were made within 2 minute for the channel lower channel, in order to prevent self-warming of the mobile.

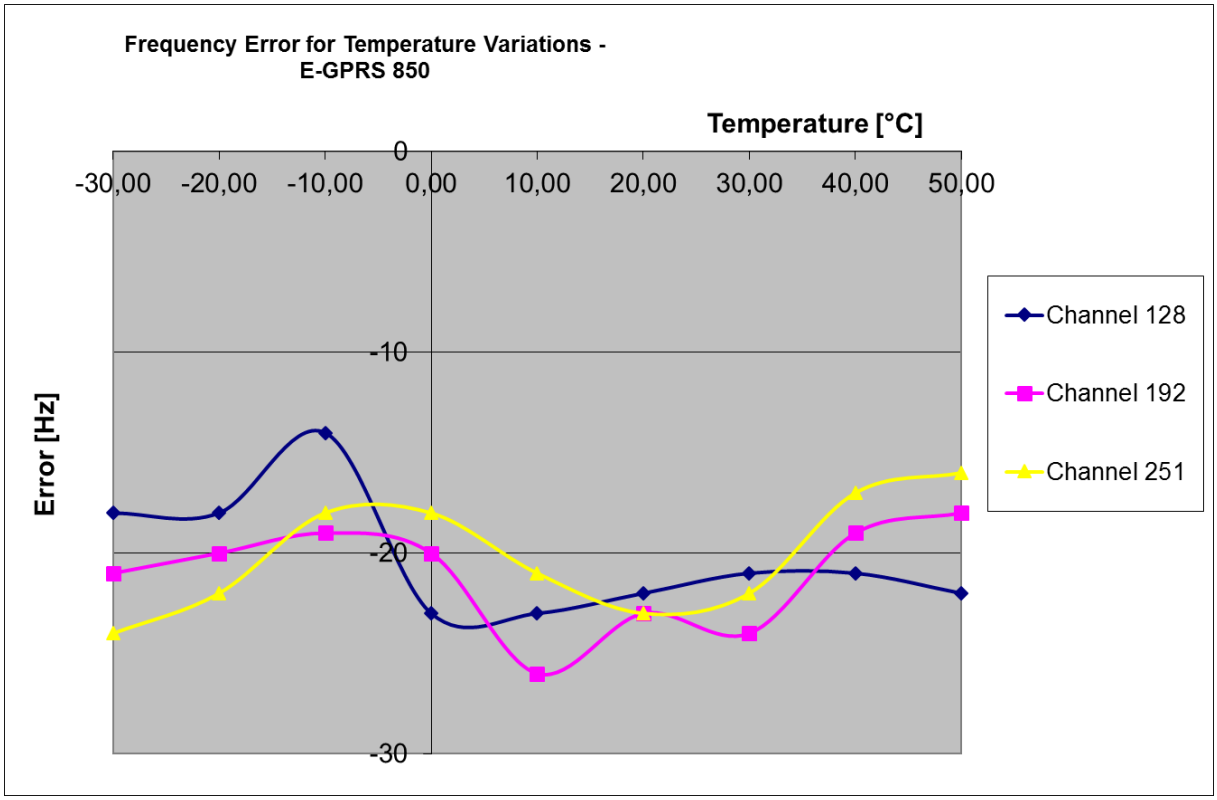
5.4.4.6.1. GPRS 850 Mode: Op. Mode 1, set-up 2

Temperature	Maximum frequency error						Verdict Limit=±0.1ppm
	Channel 128	Channel 192	Channel 251	Channel 128	Channel 192	Channel 251	
	[Hz]			[ppm]			
-30	16	19	16	0,019	0,023	0,019	Passed
-20	18	21	16	0,022	0,025	0,019	
-10	13	16	14	0,016	0,019	0,016	
0	13	11	11	0,016	0,013	0,013	
10	15	15	16	0,018	0,018	0,019	
20	12	14	13	0,015	0,017	0,015	
30	14	24	25	0,017	0,029	0,029	
40	14	16	20	0,017	0,019	0,024	
50	13	13	14	0,016	0,016	0,016	



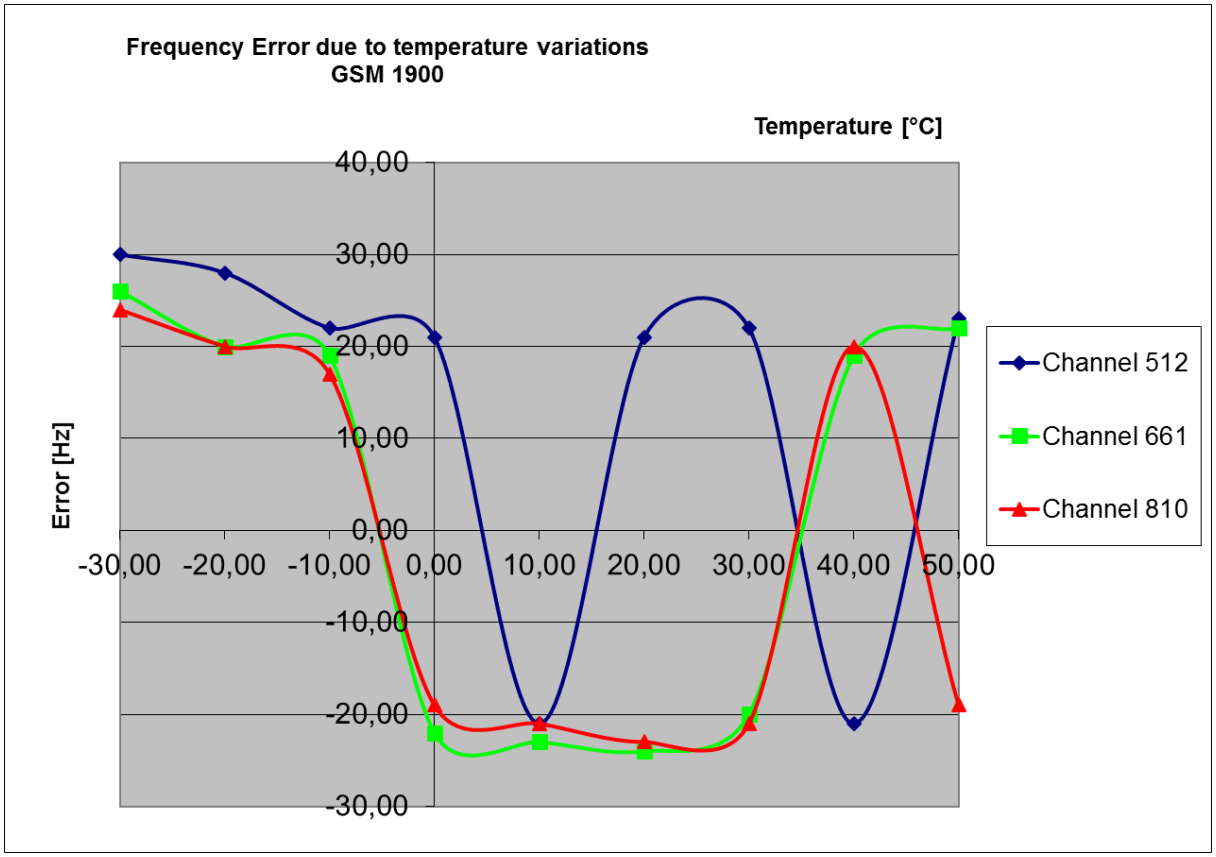
5.4.4.6.2. E-GPRS 850 Mode: Op. Mode 2, set-up 2

Temperature	Maximum frequency error						Verdict Limit=±0.1ppm
	Channel 128	Channel 192	Channel 251	Channel 128	Channel 192	Channel 251	
	[Hz]			[ppm]			
-30	-18	-21	-24	-0,022	-0,025	-0,028	Passed
-20	-18	-20	-22	-0,022	-0,024	-0,026	
-10	-14	-19	-18	-0,017	-0,023	-0,021	
0	-23	-20	-18	-0,028	-0,024	-0,021	
10	-23	-26	-21	-0,028	-0,031	-0,025	
20	-22	-23	-23	-0,027	-0,027	-0,027	
30	-21	-24	-22	-0,025	-0,029	-0,026	
40	-21	-19	-17	-0,025	-0,023	-0,020	
50	-22	-18	-16	-0,027	-0,022	-0,019	



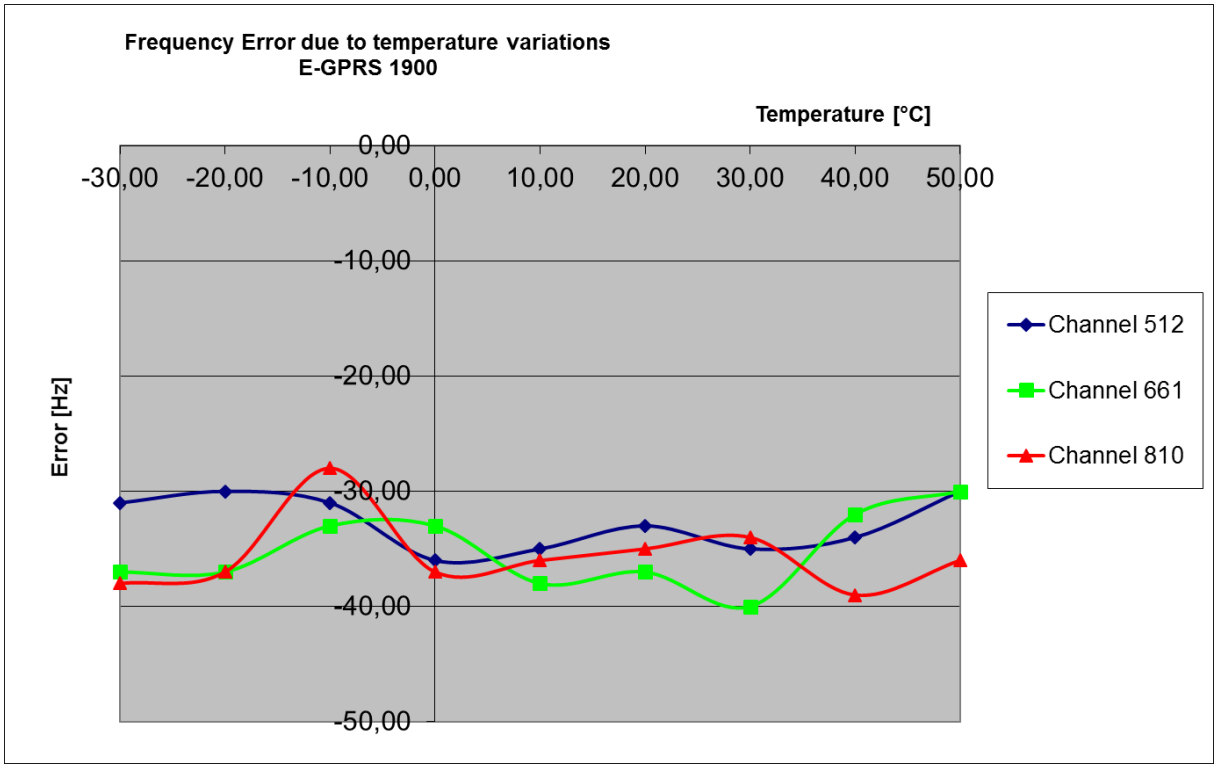
5.4.4.6.3. GPRS 1900 Mode: Op. Mode 3, set-up 2

Temperature	Maximum frequency error						Verdict
	Channel 512	Channel 661	Channel 810	Channel 512	Channel 661	Channel 810	Limit=±0.1ppm
	[Hz]			[ppm]			
-30	30	26	24	0,016	0,014	0,013	Passed
-20	28	20	20	0,015	0,011	0,010	
-10	22	19	17	0,012	0,010	0,009	
0	21	-22	-19	0,011	-0,012	-0,010	
10	-21	-23	-21	-0,011	-0,012	-0,011	
20	21	-24	-23	0,011	-0,013	-0,012	
30	22	-20	-21	0,012	-0,011	-0,011	
40	-21	19	20	-0,011	0,010	0,010	
50	23	22	-19	0,012	0,012	-0,010	



5.4.4.6.4. E-GPRS 1900 Mode: Op. Mode 4, set-up 2

Temperature	Maximum frequency error						Verdict
	Channel 512	Channel 661	Channel 810	Channel 512	Channel 661	Channel 810	Limit=±0.1ppm
	[Hz]			[ppm]			
-30	-31	-37	-38	-0,017	-0,020	-0,020	Passed
-20	-30	-37	-37	-0,016	-0,020	-0,019	
-10	-31	-33	-28	-0,017	-0,018	-0,015	
0	-36	-33	-37	-0,019	-0,018	-0,019	
10	-35	-38	-36	-0,019	-0,020	-0,019	
20	-33	-37	-35	-0,018	-0,020	-0,018	
30	-35	-40	-34	-0,019	-0,021	-0,018	
40	-34	-32	-39	-0,018	-0,017	-0,020	
50	-30	-30	-36	-0,016	-0,016	-0,019	



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

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	☐ 441 EMI SAR	☐ 487 SAR NSA	☒ 443 FAR	☐ 347 Radio.lab.1	☐ Radio.lab.2	
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ 620 ESU 26		
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☒ 264 FSEK			
antenna	☒ 439 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			
power supply	☒ 463 HP3245A	☐ 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		☒ 060 120 V/ 60 Hz via PAS 5000			

5.5.2. Requirements and limits (Variante RF-Parameter)

FCC	☒ Part 2.1053(a), Part2.1057(a)(1) ☒ Part 22 Subpart H, §22.917(a)(b) ☒ Part 24 Subpart E, §24.238(a)(b)
IC	☒ RSS-132, Issue 3: 5.5(i)(ii) ☒ RSS-133, Issue 6: 6.5.1(i)(ii)
Limit	**§22.917(a) & §24.238(a):** "The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB" **Limit:** -13dBm for all Power Control Levels of the cellular equipment

5.5.3. 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"		
Measurement method	*"§ 2.1057 Frequency spectrum to be investigated. (a) In all of the measurements set forth in § 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz"* The spectrum was scanned from 9 kHz (depend on the equipment, s. §2.1057) 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. According chapter "Test system set-up for electric field measurement in the range 30-1000MHz and 1 to 40GHz" and additionally: the readings on the spectrum analyzer are corrected with annually performed chamber path calibration values 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 and ANSI C63.26-2015		
EUT settings	A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200" The UE and used accessories (if any used) were set to work according their intended use/specification stated as by the applicant 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 wireless device, should be sufficient to demonstrate compliance.		

Spectrum-Analyzer settings for GSM/GPRS/E-GPRS 850 Mode

Sweep no.	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	1	10	10	MaxH-PK
Sweep 2 (subrange 2)	1000	2800	1	1	15	10	MaxH-PK
Sweep 3 (subrange 3)	2800	9000	1	1	60	10	MaxH-PK
Sweep 4a (Band-Edge)	823	824	0.003	0.01	30	10	MaxH-PK
Sweep 4b (Band-Edge)	849	850	0.003	0.01	30	10	MaxH-PK

Spectrum-analyzer settings for GSM/GPRS/E-GPRS 1900 Mode

Sweep no.	Start freq. MHz	Stop freq. MHz	R-BW MHz	V-BW MHz	Sweep time sec.	Att.	Detector
Sweep 1 (subrange 1)	30	1000	1	1	10	10	MaxH-PK
Sweep 2 (subrange 2)	1000	2800	1	1	15	10	MaxH-PK
Sweep 3 (subrange 3)	2800	20000	1	1	160	10	MaxH-PK
Sweep 4a (Band-Edge)	1849	1850	0.003	0.01	30	10	MaxH-PK
Sweep 4b (Band-Edge)	1910	1911	0.003	0.01	30	10	MaxH-AV

5.5.4. Measurement results

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

5.5.4.1. GPRS 850: Set-up 1

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.04_RSE_R_Ch128_GPRS	Low	128	30 MHz – 9 GHz	1	Carrier on diagram, not relevant for results	☒	☐	☐	passed
9.03_RSE_R_Ch128_GPRS	Low		823 – 824 MHz		Band Edge Compliance	☒	☒	☐	passed
8.05_RSE_R_Ch192_GPRS	Middle	192	30 MHz – 9 GHz		Carrier on diagram, not relevant for results	☒	☐	☐	passed
8.06_RSE_R_Ch251_GPRS	High	251	30 MHz – 9 GHz		Carrier on diagram, not relevant for results	☒	☐	☐	passed
9.04_RSE_R_Ch251_GPRS	High		849 – 850 MHz		Band-Edge compliance	☒	☒	☐	passed

Remark:--

5.5.4.2. GPRS 1900: Set-up 1

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
8.13_RSE_R_Ch512_GPRS	Low	512	30 MHz – 18 GHz	3	Carrier on diagram, not relevant for results	☒	☐	☐	passed
9.09_BE_R_Ch512_GPRS	Low		1849 – 1850 MHz		Band Edge Compliance	☒	☐	☐	passed
8.14_RSE_R_Ch661_GPRS	Middle	661	30 MHz – 18 GHz		Carrier on diagram, not relevant for results	☒	☐	☐	passed
8.15_RSE_R_Ch810_PRS	High	810	30 MHz – 18 GHz		Carrier on diagram, not relevant for results	☒	☐	☐	passed
9.10_BE_R_Ch810_GPRS	High		1910 – 1911 MHz		Band-Edge compliance	☒	☐	☐	passed

Remark:--

5.5.4.3. E-GPRS 1900: Set-up 1

Diagram no.	Carrier Channel		Frequency range	OP-mode no.	Remark	Used detector			Result
	Range	No.				PK	AV	QP	
--	--	512	30 MHz –18 GHz	4	--	☒	☐	☐	--
9.11_BE_R_Ch512_EGPRS	Low		1849 – 1850 MHz		Band Edge Compliance	☒	☐	☐	passed
--	--	661	30 MHz – 18 GHz		--	☒	☐	☐	--
--	--	810	30 MHz – 18 GHz		--	☒	☐	☐	--
9.12_BE_R_Ch810_EGPRS	High		1910 – 1911 MHz		Band-Edge compliance	☒	☐	☐	passed

Remark: due critical results in GRPS1900 Mode also tests in E-GPRS 1900MHz mode

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 [µV/m]	[dBµV/m]	Distance [m]	Remarks
0.009 – 0.490	2400/f (kHz)	67.6 – 20Log(f) (kHz)	300	Correction factor used due to measurement distance of 3 m
0.490 – 1.705	24000/f (kHz)	87.6 – 20Log(f) (kHz)	30	Correction factor used due to measurement distance of 3 m
1.705 – 30	30	29.5	30	Correction factor used due to measurement distance of 3 m

5.6.3. 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

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	
2.01	Low	128	9 kHz-30 MHz	1	1	--	☒	☐	☐	passed
2.23	Low	512	9 kHz-30 MHz	1	3	--	☒	☐	☐	passed
2.02	Middle	192	9 kHz-30 MHz	1	1	--	☒	☐	☐	passed
2.24	Middle	661	9 kHz-30 MHz	1	3	--	☒	☐	☐	passed
2.03	High	251	9 kHz-30 MHz	1	1	--	☒	☐	☐	passed
2.25	High	810	9 kHz-30 MHz	1	3	--	☒	☐	☐	passed

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

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

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

5.7. 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-1 3462D-2 3462D-2 3462D-3	Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR)	IC, Industry Canada Certification and Engineering Bureau
487 550 348 348	R-2666 G-301 C-2914 T-1967	Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem.	VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan
OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room			

8. Instruments and Ancillary

8.1. Used equiment "CTC"

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

8.1.1. Test software and firmware of equipment

Ref.-No.	Equipment	Type	Serial-No.	Version of Firmware or Software during the test
001	EMI Test Receiver	ESS	825132/017	Firm.= 1.21 , OTP=2.0, GRA=2.0
012	Signal Generator (EMS-cond.)	SMY 01	839069/027	Firm.= V 2.02
013	Power Meter (EMS cond.)	NRVD	839111/003	Firm.= V 1.51
017	Digital Radiocommunication Tester	CMD 60 M	844365/014	Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99
053	Audio Analyzer	UPA3	860612/022	Firm. V 4.3
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	Firm.= V 3.1DHG
140	Signal Generator	SMHU	831314/006	Firm.= 3.21
261	Thermal Power Sensor	NRV-Z55	825083/0008	EPROM-Datum 02.12.04, SE EE 1 B
262	Power Meter	NRV-S	825770/0010	Firm.= 2.6
263	Signal Generator	SMP 04	826190/0007	Firm.=3.21
295	Racal Digital Radio Test Set	6103	1572	UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02
298	Univ. Radio Communication Tester	CMU 200	832221/091	R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used
323	Digital Radiocommunication Tester	CMD 55	825878/0034	Firm.= 3.52 .22.01.99
335	CTC-EMS-Conducted	System EMS Conducted	-	EMC 32 V 8.52
340	Digital Radiocommunication Tester	CMD 55	849709/037	Firm.= 3.52 .22.01.99
355	Power Meter	URV 5	891310/027	Firm.= 1.31
365	10V Insertion Unit 50 Ohm	URV5-Z2	100880	Eprom Data = 31.03.08
366	Ultra Compact Simulator	UCS 500 M4	V0531100594	Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10
371	Bluetooth Tester	CBT32	100153	CBT V5,30+ SW-Option K55, K57
377	EMI Test Receiver	ESCS 30	100160	Firm.= 2.30, OTP= 02.01, GRA= 02.36
378	Broadband RF Field Monitor	RadiSense III	03D00013SNO-08	Firm.= V.03D13
389	Digital Multimeter	Keithley 2000	0583926	Firm. = A13 (Mainboard) A02 (Display)
392	Radio Communication Tester	MT8820A	6K00000788	Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario= 4.52#002
436	Univ. Radio Communication Tester	CMU 200	103083	R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR)	-	EMC 32 Version 8.52
442	CTC-SAR-EMS	System EMS field (SAR)	-	EMC 32 Version 8.40
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	Spuri 7.2.5 or EMC 32 Ver. 9.15.00
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 9.15.00
460	Univ. Radio Communication Tester	CMU 200	108901	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used,
489	EMI Test Receiver	ESU40	1000-30	Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00
491	ESD Simulator dito	ESD dito	dito307022	V 2.30
524	Voltage Drop Simulator	VDS 200	0196-16	Software Nr: 000037 Version V4.20a01
526	Burst Generator	EFT 200 A	0496-06	Software Nr. 000034 Version V2.32
527	Micro Pulse Generator	MPG 200 B	0496-05	Software-Nr. 000030 Version V2.43
528	Load Dump Simulator	LD 200B	0496-06	Software-Nr. 000031 Version V2.35a01
546	Univ. Radio Communication Tester	CMU 200	106436	R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used
547	Univ. Radio Communication Tester	CMU 200	835390/014	R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14
584	Spectrum Analyzer	FSU 8	100248	2.82_SP3
597	Univ. Radio Communication Tester	CMU 200	100347	R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Firmware Bios 3.40 , Analyzer 3.40 Sp 2
620	EMI Test Receiver	ESU 26	100362	4.43_SP3
642	Wideband Radio Communication Tester	CMW 500	126089	Setup V03.26, Test programm component V03.02.20
670	Univ. Radio Communication Tester	CMU 200	106833	µP1 =V8.50, Firmware = V.20
689	Vector Signal Generator	SMU200	100970	02.20.360.142
692	Bluetooth Tester	CBT 32	100236	CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF)

8.1.2. Single instruments and test systems

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
001	EMI Test Receiver	ESS	825132/017	Rohde & Schwarz	12 M	-	30.05.2017
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	12 M	-	30.05.2017
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	12 M	-	30.05.2017
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	30.04.2017
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	30.05.2019
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2017
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	30.04.2018
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	30.04.2018
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	30.04.2017
057	relay-switch-unit (EMS system)	RSU	494440/002	Rohde & Schwarz	pre-m	1a	
060	power amplifier (DC-2kHz)	PAS 5000	B6363	Spitzenberger+Spies	-	3	
066	notch filter (WCDMA; FDD1)	WRCT 1900/2200-5/40-10EEK	5	Wainwright GmbH	12 M	1g	30.06.2016
086	DC - power supply, 0 -10 A	LNG 50-10	-	Heinzinger Electronic	pre-m	2	
087	DC - power supply, 0 -5 A	EA-3013 S	-	Elektro Automatik	pre-m	2	
091	USB-LWL-Converter	OLS-1	007/2006	Ing. Büro Scheiba	-	4	
099	passive voltage probe	ESH2-Z3	299.7810.52	Rohde & Schwarz	36 M	-	30.04.2018
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	30.04.2018
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	30.05.2019
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	36 M	-	30.04.2018
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	30.05.2018
248	attenuator	SMA 6dB 2W	-	Radiall	pre-m	2	
249	attenuator	SMA 10dB 10W	-	Radiall	pre-m	2	
252	attenuator	N 6dB 12W	-	Radiall	pre-m	2	
256	attenuator	SMA 3dB 2W	-	Radiall	pre-m	2	
257	hybrid	4031C	04491	Narda	pre-m	2	
260	hybrid coupler	4032C	11342	Narda	pre-m	2	
261	Thermal Power Sensor	NRV-Z55	825083/0008	Rohde & Schwarz	24 M	-	30.05.2018
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	30.05.2018
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	30.05.2019
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	30.05.2018
266	Peak Power Sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	30.05.2018
267	notch filter GSM 850	WRCA 800/960-6EEK	9	Wainwright GmbH	pre-m	2	
270	termination	1418 N	BB6935	Weinschel	pre-m	2	
271	termination	1418 N	BE6384	Weinschel	pre-m	2	
272	attenuator (20 dB) 50 W	Model 47	BF6239	Weinschel	pre-m	2	
273	attenuator (10 dB) 100 W	Model 48	BF9229	Weinschel	pre-m	2	
274	attenuator (10 dB) 50 W	Model 47 (10 dB) 50 W	BG0321	Weinschel	pre-m	2	
275	DC-Block	Model 7003 (N)	C5129	Weinschel	pre-m	2	
276	DC-Block	Model 7006 (SMA)	C7061	Weinschel	pre-m	2	
279	power divider	1515 (SMA)	LH855	Weinschel	pre-m	2	
287	pre-amplifier 25MHz - 4GHz	AMF-2D-100M4G-35-10P	379418	Miteq	12 M	1c	30.06.2017
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2017
298	Univ. Radio Communication Tester	CMU 200	832221/091	Rohde & Schwarz	pre-m	3	
300	AC LISN (50 Ohm/50µH, 1-phase)	ESH3-Z5	892 239/020	Rohde & Schwarz	12 M	-	30.05.2017
301	attenuator (20 dB) 50W, 18GHz	47-20-33	AW0272	Lucas Weinschel	pre-m	2	
302	horn antenna 40 GHz (Meas 1)	BBHA9170	155	Schwarzbeck	36 M	-	31.03.2017
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2017
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	Pre-m	2	
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	30.05.2018
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	30.04.2017
347	laboratory site	radio lab.	-	-	-	5	
348	laboratory site	EMI conducted	-	-	-	5	
354	DC - Power Supply 40A	NGPE 40/40	448	Rohde & Schwarz	pre-m	2	
355	Power Meter	URV 5	891310/027	Rohde & Schwarz	24 M	-	30.05.2018
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	30.04.2017
371	Bluetooth Tester	CBT32	100153	R&S	36 M	-	30.05.2019
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	12 M	-	30.05.2017
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	30.05.2017
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	30.04.2017
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	30.05.2017
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	30.04.2017
439	UltraLog-Antenna	HL 562	100248	Rohde & Schwarz	36 M	-	31.03.2017
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.06.2017
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	30.06.2017
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2017

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
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	-	30.04.2017
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	30.05.2018
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	36 M	-	30.04.2018
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	36 M	-	30.04.2018
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	30.04.2017
482	filter matrix	Filter matrix SAR 1	-	CETECOM (Brl)	-	1d	
484	pre-amplifier 2,5 - 18 GHz	AMF-5D-02501800-25-10P	1244554	Miteq	12 M	-	30.06.2017
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	31.07.2017
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	30.05.2017
502	band reject filter	WRCG 1709/1786-1699/1796-	SN 9	Wainwright	pre-m	2	
503	band reject filter	WRCG 824/849-814/859-	SN 5	Wainwright	pre-m	2	
512	notch filter GSM 850	WRCA 800/960-02/40-6EEK	SN 24	Wainwrght	12 M	1c	30.06.2017
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	30.04.2017
529	6 dB Broadband resistive power divider	Model 1515	LH 855	Weinschel	pre-m	2	
530	10 dB Broadband resistive power divider	R 416110000	LOT 9828	-	pre-m	2	
546	Univ. Radio Communication Tester	CMU 200	106436	R&S	12 M	-	30.05.2017
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	30.04.2017
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.07.2018
550	System CTC S-VSWR Verification SAR-EMI	System EMI Field SAR S-VSWR	-	ETS Lindgren/CETECOM	24 M	-	31.07.2017
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.06.2017
557	System CTC-OTA-2	R&S TS8991	-	Rohde & Schwarz	12 M	5	30.09.2016
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	19.04.2017
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	31.03.2019
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	pre-m	-	
594	Wideband Radio Communication Tester	CMW 500	101757	Rohde & Schwarz	12 M	-	30.04.2017
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	pre-m	-	
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	30.04.2017
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	30.04.2017
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	30.04.2017
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	
611	DC power supply	E3632A	KR 75305854	Agilent	pre-m	2	
612	DC power supply	E3632A	MY 40001321	Agilent	pre-m	2	
613	Attenuator	R416120000 20dB 10W	Lot. 9828	Radiall	pre-m	2	
616	Digitalmultimeter	Fluke 177	88900339	Fluke	24 M	-	30.05.2018
617	Power Splitter/Combiner	ZFSC-2-2-S+	S F987001108	Mini Circuits	-	2	
618	Power Splitter/Combiner	50PD-634	600994	JFW Industries USA	-	2	
619	Power Splitter/Combiner	50PD-634	600995	JFW Industries, USA	-	3	
620	EMI Test Receiver	ESU 26	100362	Rohde-Schwarz	12 M	-	30.05.2017
621	Step Attenuator 0-139 dB	RSP	100017	Rohde & Schwarz	pre-m	2	
625	Generic Test Load USB	Generic Test Load USB	-	CETECOM	-	2	
627	data logger	OPUS 1	201.0999.9302.6.4.1.43	G. Lufft GmbH	24 M	-	30.04.2017
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
637	High Speed HDMI with Ethernet 1m	HDMI cable with Ethernet 1m	-	KogiLink	-	2	
638	HDMI Kabel with Ethernet 1,5 m flach	HDMI cable with Ethernet	-	Reichelt	-	2	
640	HDMI cable 2m rund	HDMI cable 2m rund	-	Reichelt	-	2	
641	HDMI cable with Ethernet	Certified HDMI cable with	-	PureLink	-	2	
644	Amplifierer	ZX60-2534M+	SN865701299	Mini-Circuits	-	-	
670	Univ. Radio Communication Tester	CMU 200	106833	Rohde & Schwarz	24 M	-	30.05.2018
671	DC-power supply 0-5 A	EA-3013S	-	Elektro Automatik	pre-m	2	
678	Power Meter	NRP	101638	Rohde&Schwarz	pre-m	-	
683	Spectrum Analyzer	FSU 26	200571	Rohde & Schwarz	12 M	-	30.05.2017
686	Field Analyzer	EHP-200A	160WX30702	Narda Safety Test Solutions	24 M	-	30.04.2017
687	Signal Generator	SMF 100A	102073	Rohde&Schwarz	12 M	-	30.05.2017
688	Pre Amp	JS-18004000-40-8P	1750117	Miteq	pre-m	-	
690	Spectrum Analyzer	FSU	100302/026	Rohde&Schwarz	12 M	-	30.05.2017
692	Bluetooth Tester	CBT 32	100236	Rohde & Schwarz	36 M	-	31.03.2017
697	Power Splitter	ZN4PD-642W-S+	165001445	Mini-Circuits	-	2	

8.1.3. Legend

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

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

9. Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2016-06-28
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