T E S T R E P O R T
No.: 6-0171-12-5-2a_C1

According to:
FCC Regulations
Part §15.209, Part 22 & Part 24

IC-Regulations
RSS-132 Issue 2, RSS-133 Issue 5 & RSS-Gen Issue 3

for

CARLO GAVAZZI CONTROLS SPA

UNIVERSAL MOBILE MODEM FOR DATA COMMUNICATION
VMU-WAUMM2X

FCC ID: SNJUMMNAD
IC: 7118D-UMMNAD

Laboratory Accreditation and Listings			
DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01	Reg. No.: 736496 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-2665, 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			

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

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The listed attachments are an integral part of this report.

1. Summary of test results

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

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. This test report shows results for GSM and W-CDMA 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 and Part 24, Subpart E (Broadband PCS) of the FCC CFR 47 Rules (10-1-12 Edition) and Canada RSS-132 Issue 2, RSS-133 Issue 5 and RSS-Gen Issue 3 standards.

1.1. TX mode, tests overview according FCC and Canadian 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 3: Chapter 7.2.4	§15.207 limits IC: Table 4, Chapter 7.2.4	--	--	Remark 1.)
2	General field strength emissions radiated - (9 kHz to 30 MHz)	Cabinet + inter-connecting cables (radiated)	§15.209(a)	RSS-Gen, Issue 3: Chapter 4.11 Chapter 7.2.5, Table 5+6	2400/F(kHz) µV/m 24000/F(kHz) µV/m 30 µV/m	3+4	1+3+ 5+6	passed
7	RF-Power (ERP/EIRP) radiated		§2.1046 §22.913(a)(2) §24.232(c)	RSS-132: 4.4 SRSP-503: 5.1.3 RSS-133:4.1/6.4 SRSP-510: 5.1.2	< 7 Watt (ERP) < 2 Watt (EIRP)	1+2	1+2+3+ 4+5+6	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: 4.5.1 & 4.5.2 RSS-133: 6.5.1(a)(b)	43+10log(P) dBc	1+2	2+4+ 5+6	passed
9	Band-Edge compliance					1+2	1+2+3+ 4+5+6+ 7+8	passed
30	RF Power	Antenna terminal	§2.1046	--	N/A	5	1+2+3+ 4+5+6	passed
34	26dB Emission bandwidth		§2.202 §2.1049 §22.917(a) §24.238(a)	RSS-Gen:4.6.1	99% Power	5	1+2+3+ 4+5+6+ 7+8	passed
35	99% Occupied bandwidth							
36	Spurious emissions		§2.1051 §2.1057 §22.917(a)(b) §24.238(a)(b)	RSS-132: 4.5.1 RSS-133: 6.5.1(a)(b)	43+10log(P) dBc	5	1+2+3+ 4+5+6+ 7+8	passed
37	Band-Edge compliance							
38	Frequency stability		§22.355, table C-1 §24.235 §2.1055(a)(2)	RSS-132: 4.3 RSS-133: 6.3	< ±2.5ppm <±0.1 ppm	5	1+2+3+ 4+5+6	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 3: Chapter 7.2.4	FCC §15.107 class B limits §15.207 limits IC: Table 4, Chapter 7.2.4	--	--	Remark 1
3	Receiver radiated emissions	Cabinet + Interconnecting cables	§15.109 §15.33 §15.35	RSS-132, Issue 2: 4.6 RSS-Gen, Issue 3: 6.1 RSS 133, Issue 5: 6.6	FCC 15.109 class B limits IC-limits: Table 1, Chapter 6	--	--	Remark 1

Remark: 1.) See separate test report TR6-0171-12-5-2b for measurements according Part 15, Subpart B and C.

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.

The current version of the Test Report 6-0171-12-5-2a_C1 dated 2013-05-14 replaces the Test Report 6-0171-12-5-2a dated 2012-12-20. The replaced Test Report is herewith invalid.
Correction: FCC ID

.....
Dipl.-Ing. Ch. Lorenz
Responsible for test section

CETECOM GmbH
Im Teelbruch 116
45219 Essen
Tel.: + 49 (0) 20 54 / 95 19 - 0
Fax: + 49 (0) 20 54 / 95 19 - 397

.....
Dipl.-Ing. B. Taslica
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. W. Richter
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. B. Taslica
Receipt of EUT:	2012-12-05
Date(s) of test:	December -2012
Date of report:	2013-05-14
Version of template: 12.11	

2.4. Applicant's details

Applicant's name:	CARLO GAVAZZI CONTROLS SPA
Address:	Via Safforze, 8 32100 Belluno ITALIA
Contact person:	Mr. Alberto Mambrini

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	GPRS/EGPRS/UMTS Mobile Modem for Data Communication
Type	VMU-WAUMM2X
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) FDD Band 2: 1852.4–1907.6 MHz (Uplink), 1930-1990 MHz (Downlink) FDD Band 5: 826.4-846.6 MHz (Uplink), 869-894 MHz (Downlink)
Type of modulation	GSM, GPRS, GMSK EGPRS-Mode: 8-PSK FDD-Mode Release99: QPSK FDD Mode Release 5+6: DL 16 QAM, UL QPSK/BPSK additionally
Number of channels (USA/Canada -bands)	GSM 850: 128 – 251, 125 channels GSM1900: 512 – 810, 300 channels FDD Band 2: UARFCN range 9262 – 9400 – 9538 FDD Band 5: UARFCN range 4132 – 4183 – 4233
Test Channel frequencies	Channel 128: 824.2 MHz Channel 192: 837 MHz Channel 251: 848.8 MHz
Emission designator(s)	247KGXW (GPRS850) 248KGXW (EDGE850) 247KG7W (GPRS1900) 245KG7W (EDGE 1900) 4M08F9D (FDD 2, RMC & HSUPA) 4M07F9D (FDD 5, RMC & HSUPA)
Antenna Type	☐ Integrated ☐ External, no RF- connector ☒ External, separate RF-connector
Antenna Gain (declared by applicant)	☒ radiated: <0 dBi gain at GSM 850 / FDD 5/ PCS 1900 / FDD 2 (Planar Pentaband Mount Antenna) ☒ radiated: Max. 1 dBi gain at GSM 850 / FDD 5 Max. 2.0 dBi gain at GSM 1900 / FDD 2 (Stubby Pentaband Antenna)
Max. Output Power (radiated):	
GSM 850	21.8 dBm (PK) with Planar Antenna
EDGE 850	24.8 dBm (PK) with Planar Antenna
GSM 1900	30.0 dBm (PK) with Planar Antenna
EDGE 1900	31.8 dBm (PK) with Planar Antenna
GSM 850	15.1 dBm (PK) with Stubby Antenna
EDGE 850	16.5 dBm (PK) with Stubby Antenna
GSM 1900	27.7 dBm (PK) with Stubby Antenna
EDGE 1900	29.3 dBm (PK) with Stubby Antenna

Max. Output Power (conducted): GSM 850 EDGE 850 GSM 1900 EDGE 1900	 30.75 dBm (PK) / 30.58 dBm (AV) 27.58 dBm (PK) / 24.57 dBm (AV) 30.19 dBm (PK) / 30.02 dBm (AV) 28.98 dBm (PK) / 25.80 dBm (AV)		
Max. Output Power (radiated): FDD-II RMC99 FDD-V RMC99 FDD-II RMC99 FDD-V RMC99	 29.8 dBm (PK) with Planar Antenna 26.3 dBm (PK) with Planar Antenna 29.7 dBm (PK) with Stubby Antenna 16.6 dBm (PK) with Stubby Antenna		
Max. Output Power (conducted): FDD-II RMC99 FDD-V RMC99	 23.06 dBm (RMS) / 26.00 (PK) 22.33 dBm (RMS) / 25.50 (PK)		
FCC-ID	SNJUMMNAD		
IC	7118D-UMMNAD		
Installed options	☒ none		
Power supply	☒ DC power only: 24 Volt		
Special EMI components	--		
Voltage	☒ nominal 24 V DC	☒ min 15 V DC	☒ max 24 V DC
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	UNIVERSAL MOBILE MODEM FOR DATA COMMUNICATION	VMU-WAUMM2X**)	355323-04-001514-8	V1.0	-
EUT B	UNIVERSAL MOBILE MODEM FOR DATA COMMUNICATION	VMU-WAUMM2X**)	355323-04-001543-7	V1.0	-

*) EUT short description is used to simplify the identification of the EUT in this test report.
**) Integrated certified RF Module from TELIT (FCC ID: RI7HE863NA and IC: 5131A-HE863NA)

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	Planar Antenna	Pentaband GSM-UMTS Mount from Dynaflex 505_2507805	-	-	-
AE 2	Stubby Antenna-	Pentaband EU/US GSM/WCDMA from PULSE Model W911	--	--	-
AE 3	Serial communication bus cable	8 Pins socket / USB plug	-	-	-

*) 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 3	Used only for radiated tests
Set. 2	EUT A + AE 2 + AE 3	Used only for radiated tests
Set. 3	EUT B + AE 1 + AE 3	Used only for radiated tests
Set. 4	EUT B + AE 2 + AE 3	Used only for radiated tests
Set. 5	EUT A	Used only for conducted tests

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.
**) Power supply cables at EUT A/B for nominal and extreme voltage (± 20 % of 15 -24 V DC according applicant's information) used.

3.5. EUT operating modes

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

FDD modes

op. 5	FDD-Mode 2 12.2 kbps RMC	A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 24dBm. The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link according Table E5.1/Table E5.1A as described in 3GPP TS34.121, Annex E.
op. 6	FDD-Mode 5 12.2 kbps RMC	
op. 7	FDD Mode 2 HSUPA	In addition to normal FDD-Mode, the UE was set to operate in HSDPA and HSUPA Mode too. Chosen settings: 12.2kbps RMC + HSPA 34.108 This setting was chosen for all release 6 mobile equipment.
op. 8	FDD Mode 5 HSUPA	

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) in Uplink	3	
Hopping	off	
Timeslot (slot mode)	GSM-Mode: single GPRS-Mode: maximum allowed uplink slots no. according MS class	
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	PS	
BS_AG_BLKS_RES	Not applicable	0
Paging reorganisation		Off (0)
Signalling channel		SDCCH
Location Update		Auto
Cell access		Disabled (barred)

Following settings apply to the UE (EUT) during the measurements in **FDD-Mode** only:

Parameter	Traffic Mode	Idle Mode
UARFCN UE Uplink (EUT) (according TS34.108)	FDD 2 = 9262/ 9400/ 9538 FDD 5 = 4132/ 4182/ 4233	--
UARFCN Node B (downlink) (according TS34.108)	FDD 2 = 9663/ 9800/ 9937 FDD 5 = 4358/ 4040/ 4457	
UE power class	Class 3 (+24dBm) nominal	
HSDPA UE category/ HSUPA category	8/6	
Maximum power	FDD 2/5 12.2kbps RMC -> all TPC bits up ("1") HSDPA-mode = accord. in 3GPP TS34.108 HSUPA mode = accord. in 3GPP TS34.108	--
Modulation	12.2kbps RMC-mode: (UL) QPSK-Modulation Scheme HSDPA/HSUPA= (UL) BPSK/QPSK, (DL) 16 QAM Modulation Scheme is applicable	--
Compression mode	Off	--
Bitstream	PRBS 2E9-1 (pseudo-random-sequence) – CCITT 0.153	
Maximum data transmission rate:	GSM: 17,6 kbps Slot EDGE: 59,2 kbps Slot FDD: QPSK 5,76 Mbps (UL) 16 QAM 14,4 Mbps (DL)	
Node B Downlink physical channels settings	According Table E.5.1/E.5.1A in 3GPP TS34.121	
External attenuation RF/AF-Input/Output	Accord. Set-up calibration prior to measurements	

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	Serial communication bus cable	8 Pins/ USB plug (< 3m)	-	-	-

4. Description of test system set-up's

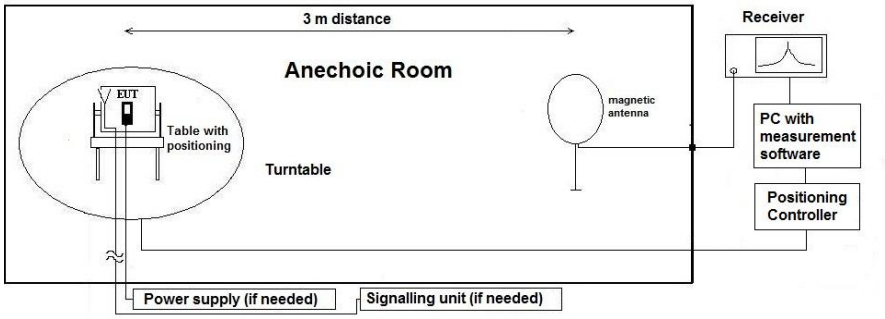
4.1. Test system set-up for radiated magnetic field measurements below 30 MHz

Specification: ANSI C63.4-2009 chapter 8.2.1, ANSI C63.10-2009 chapter 6.4

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.

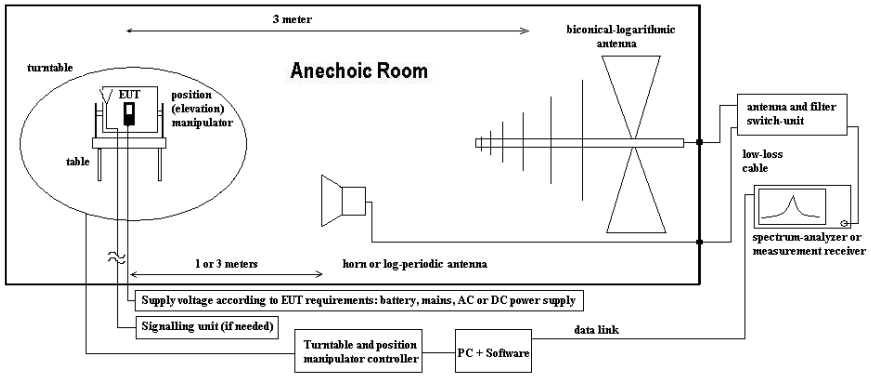
Distance correction: Reference for applied correction (extrapolating) factors:
IEEC Transaction EMC, Vol. 47, No. 3 , Aug. 2005, Journal Paper
"*Extrapolating Near-field emissions of low frequency loop transmitters".*

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

Specification: ANSI C63.4-2009 chapter 8, ANSI C63.10-2009 chapter 6.6

General Description: Evaluating the field 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 16-4 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 20 GHz and 1 meter above 20 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 20 GHz. The antennas are set to fixed antenna height of 1.55 m and the EUT aligned within 3 dB cone of radiation pattern.

Schematic:



Testing method:

Exploratory, preliminary measurements
The EUT and it's associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 45°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) 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 either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height is fixed to 1.55 m.
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 be**tween field strength and E(I)RP**. Critical measurements near the limit are re-measured with a substitution method accord. ANSI/TIA/EIA 603.

Formula:

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

$Ec_{E(I)RP} = Ec - 95.2\ dB|_{3m}$

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

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 forE(I)RP

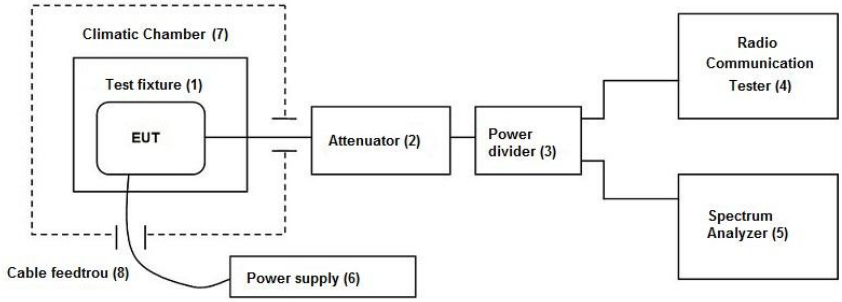
4.3. Test system set-up for conducted measurements at antenna port

Specification: ANSI C63.10-2009

General Description: The EUT‘s RF-signal is coupled out by a suitable antenna coupling connector directly or via test fixture (1). The signal is first attenuated (2) before it is 0° divided by a power divider (3). One of the signal path is connected to the radio communication tester (4), other branch is connected to the spectrum analyzer (5). The specific attenuation losses for all 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.

For measurements in the climatic chamber, the same equipment and cables are used. The EUT and test fixture are arranged in a climate chamber. The cables are routed through special openings. No additional connectors are needed.

Schematic:



Testing method: According to ANSI C63.10-2009 for each individual test, see details in each chapter.

5. Measurements

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

5.1.1. 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	☐ 436 CMU	☐ 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		☒ 24 V DC			

5.1.2. Requirements

FCC	Part 15, Subpart C, §15.205 & §15.209			
IC	RSS-Gen., Issue 3			
ANSI	C63.10-2009			
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

5.1.3. Test condition and test set-up

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"		

5.1.4. Measurement Results

The results are presented below in summary form only. For more information please see the diagrams.
Due to uncritical measurements (only noise floor) measurements have been performed alternate different channels of G850, PCS1900, FDD II and FDD V Mode.

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	
02.01	Low	128	9 kHz-30 MHz	3	2	--	☒	☐	☒	passed
02.04	Low	9262	9 kHz-30 MHz	4	5	--	☒	☐	☒	passed
02.07	Low	192	9 kHz-30 MHz	4	2	--	☒	☐	☐	passed
02.10	Low	512	9 kHz-30 MHz	3	4	--	☒	☐	☐	passed
02.02	Middle	192	9 kHz-30 MHz	3	2	--	☒	☐	☒	passed
02.05	Middle	9400	9 kHz-30 MHz	4	5	--	☒	☐	☐	passed
02.08	Middle	661	9 kHz-30 MHz	4	4	--	☒	☐	☐	passed
02.11	Middle	4182	9 kHz-30 MHz	3	6	--	☒	☐	☐	passed
02.03	High	251	9 kHz-30 MHz	3	2	--	☒	☐	☒	passed
02.06	High	9538	9 kHz-30 MHz	4	5	--	☒	☐	☐	passed
02.09	High	4233	9 kHz-30 MHz	4	6	--	☒	☐	☐	passed
02.12	High	9538	9 kHz-30 MHz	3	5	--	☒	☐	☐	passed

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

The used correction factors when the measurement distance is reduced, are taken from IEEC Transaction EMC, Vol 47, No.3, Aug. 2005, Journal Paper *"EXTRAPOLATING NEAR-FIELD EMISSIONS OF LOW-FREQUENCY LOOP TRANSMITTERS"*.

Used Transducer factors (f < 30 MHz)					
1	2	3	4	5	6
					=2+3+4+5
Frequency	Antenna factor	Corection factor		Cable loss	Transducer factor
		300m to 3m	30m to 3m		
kHz	dB µV/m	dB	dB	dB	dB µV/m
9,0	20,0	-116,7		0,0	-96,7
10,6	20,0	-116,7		0,0	-96,7
12,6	20,0	-116,7		0,0	-96,7
14,8	20,0	-116,7		0,0	-96,7
17,5	20,0	-116,6		0,0	-96,6
20,7	20,0	-116,6		0,0	-96,6
24,4	20,0	-116,6		0,0	-96,6
28,9	20,0	-116,6		0,0	-96,6
34,1	20,0	-116,5		0,0	-96,5
40,3	20,0	-116,4		0,0	-96,4
47,6	20,0	-116,3		0,0	-96,3
56,2	20,0	-116,2		0,0	-96,2
66,4	20,0	-116,0		0,0	-96,0
78,4	20,0	-115,8		0,0	-95,8
92,7	20,0	-115,4		0,0	-95,4
109,4	20,0	-115,0		0,0	-95,0
129,3	20,0	-114,5		0,0	-94,5
152,7	20,0	-113,9		0,0	-93,9
180,4	20,0	-113,1		0,0	-93,1
213,1	20,0	-112,2		0,0	-92,2
251,7	20,0	-111,3		0,0	-91,3
297,3	20,0	-108,3		0,0	-88,3
351,2	20,0	-105,2		0,0	-85,2
414,8	20,0	-102,1		0,0	-82,1
490,0	20,0	-99,1		0,0	-79,1
490,0	20,0		-56,4	0,1	-36,3
582,0	20,0		-56,2	0,1	-36,1
690,0	20,0		-56,0	0,2	-35,8
820,0	20,0		-55,7	0,2	-35,5
973,0	20,0		-55,4	0,2	-35,2
1.155,0	20,0		-54,9	0,3	-34,6
1.371,0	20,0		-54,4	0,3	-34,1
1.627,0	20,0		-53,7	0,3	-33,4
1.931,0	20,0		-52,9	0,4	-32,5
2.292,0	20,0		-52,0	0,4	-31,6
2.721,0	20,0		-49,8	0,5	-29,3
3.230,0	20,0		-46,6	0,5	-26,1
3.834,0	20,0		-43,3	0,6	-22,7
4.551,0	20,0		-40,1	0,6	-19,5
5.402,0	20,0		-36,8	0,7	-16,1
6.412,0	20,0		-33,5	0,7	-12,8
7.612,0	20,0		-30,3	0,8	-9,5
9.035,0	20,0		-27,0	0,8	-6,2
10.725,0	20,0		-23,9	0,9	-3,0
12.730,0	20,0		-21,2	0,9	-0,3
15.111,0	20,0		-19,3	1,0	1,7
17.937,0	20,0		-18,4	1,0	2,6
21.292,0	20,0		-18,2	1,1	2,9
25.274,0	20,0		-18,3	1,1	2,8
30.000,0	20,0		-18,4	1,2	2,8

5.2. RF-Parameter - RF Peak power output radiated

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 347 Radio.lab.	☒ 443 FAR	☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ 620 ESU 26	☐	☐
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☒ 264 FSEK	☐	☐	☐
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☒ 608 HL 562	☒ 549 HL025	☐ 477 GPS
signaling	☐ 392 MT8820A	☐ 436 CMU	☒ 546 CMU			
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	☐ 498 NGPE 40
otherwise	☐ 331 HC 4055	☐ 248 6 dB Att.	☐ 529 Power divider	☐ - cable OTA20		
line voltage	☐ 230 V 50 Hz via public mains		☒ 24 V DC			

5.2.2. Requirements

FCC	§2.1046 (radiated), §22.913(a)(2), § 24.232(c)
IC	RSS-132:4.4 + SRSP 503:5.1.3 for GSM 850; RSS-133:4.1/6.4 + SRSP-510:5.1.2 for GSM 1900
Limit	Maximum Power Output of the mobile phone should be determined while measured radiated E(I)RP.
	Limit GSM850 / FDD 5: 7 Watt
	Limit GSM1900 / FDD 2: 2 Watt

5.2.3. Test condition and measurement test set-up

link to test system (if used):	☒ air link	☐ cable connection	☐
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%

5.2.3.1. Test method

1. The measurements were made at the upper, middle and lower carrier traffic frequencies of the operating band. Choosing three TX-carrier frequencies of the mobile phone within each operable GSM band, should be sufficient to demonstrate compliance.
2. 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.
3. 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.
4. PK and Average Values have been recorded for each channel and band.

The measurements were made at the upper, center, and lower carrier traffic frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.

The measurements were performed by using the **substitution method** (ANSI/TIA/EIA 603) with a spectrum-analyzer. This method can be described like follows:

1. choosing of suitable spectrum-analyzer settings for performing the measurements. This settings of the spectrum analyzer must be maintained for both stages of the measurements: EUT emission measurements and also for measurements of the substituted level.

Parameter	Setting for GSM measurements	Settings for UTRA/FDD measurements
$RBW\|_{3dB}$	3 MHz	10 MHz
VBW	10 MHz	10 MHz
Span	20 MHz	50 MHz
Detector Mode	Positive max-hold	Positive max-hold
Average	off	off
Sweep Time	coupled	coupled

2. The maximum level of the peak power was recorded, while the emissions were maximized by rotating the EUT in three orthogonal axes, which was situated on a non-conductive turntable of 1.55 m height ($P_{MEAS,1}$). This was performed for both measuring antenna polarisations (vertical/horizontal), the maximum of both values is used for further measurements and final substitution ($P_{MEAS,\ 1,\ MAX}$).
3. As the maximum emission is recorded, the EUT is replaced by a frequency dependant suitable antenna, which is connected to a RF-signal generator, which is transmitting on the determined worst-case frequency as determined in step 2.
4. The RF-signal level of the signal generator is adjusted as long the same worst-case level determined first step is measured at the spectrum analyzer ($P_{SMHU}=P_{MEAS,1,\ MAX}$)
5. Than the RF-signal cable is disconnected from the antenna and connected to a power-level meter. The level is determined ($P_{MEAS,2}$).
6. The final result is calculated by adding the ERP/EIRP gain of the antenna which substitutes the EUT. $P_{EUT,SUBST} = P_{MEAS,2} + G_{ANTENNA}$

5.2.4. Measurement Results

General remarks:1.) PAR (PEAK-AVERAGE-RATIO) ≤ 13 dB (Please refer chapter 5.5 chapter)

5.2.4.1. GSM 850 results (radiated)

Set-up 1 & op. modes 1 & 2		Peak Output Power (dBm)			Limit	Result
		PK	AV			
GSM 850	Channel 128/ 824.2 MHz	17.3	1.)	ERP-Value	38.45 dBm	passed
	Channel 192/ 837.0 MHz	**21.8**				
	Channel 251/ 848.8 MHz	21.3				
E-GPRS 850	Channel 128/ 824.2 MHz	20.9	1.)	ERP-Value		passed
	Channel 192/ 837.0 MHz	**24.8**				
	Channel 251/ 848.8 MHz	23.3				
Set-up 2 & op. modes 1 & 2		Peak Output Power (dBm)			Limit	Result
		PK	AV			
GSM 850	Channel 128/ 824.2 MHz	6.4	1.)	ERP-Value	38.45 dBm	passed
	Channel 192/ 837.0 MHz	13.3				
	Channel 251/ 848.8 MHz	**15.1**				
E-GPRS 850	Channel 128/ 824.2 MHz	13.7	1.)	ERP-Value		passed
	Channel 192/ 837.0 MHz	15.6				
	Channel 251/ 848.8 MHz	**16.5**				

5.2.4.2. GSM 1900 results (radiated)

Set-up 1 & op. modes 3 & 4		Peak Output Power (dBm)			Limit	Result
		PK	AV			
GSM 1900	Channel 512/ 1850.2 MHz	29.8	1.)	EIRP-Value	33.00 dBm	passed
	Channel 661/ 1880.0 MHz	29.6				
	Channel 810/ 1909.8 MHz	**30.0**				
E-GPRS 1900	Channel 512/ 1850.2 MHz	**31.8**	1.)	EIRP-Value		passed
	Channel 661/ 1880.0 MHz	31.7				
	Channel 810/ 1909.8 MHz	30.2				
Set-up 2 & op. modes 3 & 4		Peak Output Power (dBm)			Limit	Result
		PK	AV			
GSM 1900	Channel 512/ 1850.2 MHz	26.6	1.)	EIRP-Value	33.00 dBm	passed
	Channel 661/ 1880.0 MHz	27.3				
	Channel 810/ 1909.8 MHz	**27.7**				
E-GPRS 1900	Channel 512/ 1850.2 MHz	28.5	1.)	EIRP-Value		passed
	Channel 661/ 1880.0 MHz	**29.3**				
	Channel 810/ 1909.8 MHz	27.6				

5.2.4.2.1. FDD2 (radiated)

Set-up 1 / op. modes 5					
Test case	U-ARFCN no.	Power[dBm] PK		Limit	Result
Release 99, 12.2kbps RMC	9262	29.6	EIRP-Value	33.00 dBm	Passed
	9400	28.9			
	9538	**29.8**			
Set-up 2 / op. modes 5					
Test case	U-ARFCN no.	Power[dBm] PK		Limit	Result
Release 99, 12.2kbps RMC	9262	29.6	EIRP-Value	33.00 dBm	Passed
	9400	28.9			
	9538	**29.7**			

5.2.4.2.2. FDD 5 (radiated)

Set-up 1 / op. modes 6					
Test case	U-ARFCN no.	Power[dBm] PK		Limit	Result
Release 99, 12.2kbps RMC	4132	14.9	ERP-Value	38.45 dBm	Passed
	4183	**26.3**			
	4233	25.4			
Set-up 2 / op. modes 6					
Test case	U-ARFCN no.	Power[dBm] PK		Limit	Result
Release 99, 12.2kbps RMC	4132	16.6	ERP-Value	38.45 dBm	Passed
	4183	16.3			
	4233	**17.4**			

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

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☒ 443 FAR	☐ 347 Radio.lab.		
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	☐ 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		☒ 24 V DC			

5.3.2. Requirements

FCC	§2.1053(a)-radiated, §2.1057, §22.917(a)(b); §24.238(a)(b)
IC	RSS-132: 4.5.1 & 4.5.2, RSS-133: 6.5.1(a)(b)
Limit	-13 dBm

5.3.3. Test condition and measurement 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 measurement"		
Measurement method	The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment. A PEAK detector was used except measurements near the block-edge where a AVERAGE detector applied. Below described settings for spectrum-analyzer applies.		
Mobile phone 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 mobile phone, should be sufficient to demonstrate compliance.		

5.3.3.1. Spectrum-Analyzer settings for GSM/GPRS/E-GPRS 850 Mode/ FDD V Mode

	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 (Block-Edge)	823	824	0.003(GSM)	0.01	30	10	MaxH-PK
Sweep 4b (Block-Edge)	849	850	0.03 (FDD)	0.1	30	10	MaxH-PK

5.3.3.2. Spectrum-analyzer settings for GSM/GPRS/E-GPRS 1900 Mode/ FDD II Mode

	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(GSM)	0.01	30	10	MaxH-PK
Sweep 4b (Band-Edge)	1910	1911	0.03 (FDD)	0.1	30	10	MaxH-PK

Due to not available exact 1% RBW of the measurement equipment, the lower available RBW was used for these measurements.
An additional correction factor of 10 Log (RBW1/ RBW2) to the result was added to RBW1 is the narrower measurement resolution bandwidth (used RBW) and RBW2 is either the 1% emissions bandwidth or 1 MHz.

Formula: Band-Edge compliance correction factor for FDD bands -> 10log(50kHz/30kHz) to be used=2.22dB

5.3.4. Results radiated

Generally only measured level will be notify here which has a margin to limit below 3 dB otherwise see the results at annex 4.

Due to uncritical measurements of GSM and EDGE modes selected only the highest ERP and EIRP values of the below-mentioned tables.

Planar antenna:

5.3.4.1. G850

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.07_RSE_R_Ch128_EDGE	Low	30 – 9000 MHz	1	2	Uplink carrier of GSM band on diagrams	☒	☐	☐	passed
8.08_RSE_R_Ch192_EDGE	Middle					☒	☐	☐	passed
8.09_RSE_R_Ch251_EDGE	High					☒	☐	☐	passed
9.24 & 9.25 _BE_GPRS	Low & High	823-824/ 849-850			Band Edge Compliance	☒	☐	☐	passed
9.26 & 9.27 _BE_EDGE	Low & High					☒	☐	☐	passed

5.3.4.2. PCS 1900

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.10_RSE_R_Ch512_EDGE	Low	30 MHz – 19 GHz	1	4	Uplink carrier of GSM band on diagrams	☒	☐	☐	passed
8.11_RSE_R_Ch661_EDGE	Middle					☒	☐	☐	passed
8.12_RSE_R_Ch810_EDGE	High					☒	☐	☐	passed
9.20 & 9.21 _BE_GPRS	Low & High	1849 – 1850 MHz/ 1910 – 1911 MHz			Band Edge Compliance: -no. 9.20 margin 1 dB	☒	☐	☐	passed
9.22 & 9.22 _BE_EDGE	Low & High				-no. 9.21 margin 0.4 dB	☒	☐	☐	passed

5.3.4.3. FDD II

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.01_FDDII_ RSE_RMC	Low	30 MHz – 19 GHz	1	5	Uplink carrier of FDD band on diagrams	☒	☐	☐	passed
8.02_FDDII_ RSE_RMC	Middle					☒	☐	☐	passed
8.03_FDDII_ RSE_RMC	High					☒	☐	☐	passed
9.01_BE_L_ RMC	Low	1849 – 1850 MHz/ 1910– 1911 MHz			Band Edge Compliance Calculated level: -18.00 + 2.22= -15.78 dBm	☒	☐	☐	passed
9.02 _BE_H_ RMC	High				Band Edge Compliance Calculated level: -25.66 + 2.22= -23.44	☒	☐	☐	passed
9.62_BE_L_ HSUPA	Low			7	Band Edge Compliance Calculated level: -27.4 + 2.22= -25.18	☒	☐	☐	passed
9.63_BE_H_ HSUPA	High				Band Edge Compliance Calculated level: -20.0 + 2.22= -17.78	☒	☐	☐	passed

Remark: Band-Edge compliance incl. formula

5.3.4.4. FDD V

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.50_RSE_R_ Ch4132_RMC	Low	30 MHz – 9 GHz	1	6	Uplink carrier of FDD band on diagrams	☒	☐	☐	passed
8.51_RSE_R_ Ch4183_RMC	Middle					☒	☐	☐	passed
8.52_RSE_R_ Ch4233_RMC	High					☒	☐	☐	passed
9.50_BE_L_ RMC	Low	823-824 MHz/ 849-850 MHz			Band Edge Compliance Calculated level: -28.9 + 2.22= -26.68	☒	☐	☐	passed
9.51 _BE_H_ RMC	High				Band Edge Compliance Calculated level: -21.5 + 2.22= -19.28	☒	☐	☐	passed
9.60_BE_L_ HSUPA	Low			8	Band Edge Compliance Calculated level: -29.4 + 2.22= -27.18	☒	☐	☐	passed
9.61_BE_H_ HSUPA	High				Band Edge Compliance Calculated level: -21.2 + 2.22= -18.98	☒	☐	☐	passed

Remark: Band-Edge compliance incl. formula

Stubby antenna:

5.3.4.5. G850

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.04_RSE_R_ Ch128_EDGE	Low	30 – 9000 MHz	2	2	Uplink carrier of GSM band on diagrams	☒	☐	☐	passed
8.05_RSE_R_ Ch251_EDGE	Middle					☒	☐	☐	passed
8.05_RSE_R_ Ch251_EDGE	High					☒	☐	☐	passed
9.03 & 9.04 _BE_GPRS	Low & High	823-824/ 849-850			Band Edge Compliance	☒	☐	☐	passed
9.05 & 9.06 _BE_EDGE	Low & High					☒	☐	☐	passed

5.3.4.6. PCS 1900

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.16_RSE_R_ Ch512_ EDGE	Low	30 MHz – 19 GHz	2	4	Uplink carrier of GSM band on diagrams	☒	☐	☐	passed
8.17_RSE_R_ Ch661_ EDGE	Middle					☒	☐	☐	passed
8.18_RSE_R_ Ch810_ EDGE	High					☒	☐	☐	passed
9.09 & 9.10 _BE_GPRS	Low & High	1849 – 1850 MHz/ 1910 – 1911 MHz			Band Edge Compliance	☒	☐	☐	passed
9.11 & 9.12 _BE_EDGE	Low & High					☒	☐	☐	passed

5.3.4.7. FDD II

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.56_FDDII_ RSE_RMC	Low	30 MHz – 19 GHz	2	5	Uplink carrier of FDD band on diagrams	☒	☐	☐	passed
8.57_FDDII_ RSE_RMC	Middle					☒	☐	☐	passed
8.58_FDDII_ RSE_RMC	High					☒	☐	☐	passed
9.54_BE_L_ RMC	Low	1849 – 1850 MHz/ 1910– 1911 MHz			Band Edge Compliance Calculated level: -15.40 + 2.22= -13.18 dBm	☒	☐	☐	passed
9.55 _BE_H_ RMC	High				Band Edge Compliance Calculated level: -16.80 + 2.22= -14.58	☒	☐	☐	passed
9.56_BE_L_ HSUPA	Low			7	Band Edge Compliance Calculated level: -17.0 + 2.22= -14.78	☒	☐	☐	passed
9.57_BE_H_ HSUPA	High				Band Edge Compliance Calculated level: -18.2 + 2.22= -15.98	☒	☐	☐	passed

Remark: Band-Edge compliance incl. formula

5.3.4.8. FDD V

Diagram no.	Carrier Channel	Frequency range	Set-up no.	OP-mode no.	Remark	Used detector			Result
						PK	AV	QP	
8.53_RSE_R _Ch4132_ RMC	Low	30 MHz – 9 GHz	2	6	Uplink carrier of FDD band on diagrams	☒	☐	☐	passed
8.54_RSE_R _Ch4183_ RMC	Middle					☒	☐	☐	passed
8.55_RSE_R _Ch4233_ RMC	High					☒	☐	☐	passed
9.52_BE_L_ RMC	Low	823-824 MHz/ 849-850 MHz			Band Edge Compliance Calculated level: -42.3 + 2.22= -40.08	☒	☐	☐	passed
9.53 _BE_H_ RMC	High				Band Edge Compliance Calculated level: -37.2 + 2.22= -34.98	☒	☐	☐	passed
9.58_BE_L_ HSUPA	Low			8	Band Edge Compliance Calculated level: -36.5 + 2.22= -34.28	☒	☐	☐	passed
9.59_BE_H_ HSUPA	High				Band Edge Compliance Calculated level: - 30.8 + 2.22= -28.58	☒	☐	☐	passed

Remark: Band-Edge compliance incl. formula

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

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☐ 337 OATS	☒ 347 Radio.lab.	☒ 443 FAR	
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU			
spectr. analys.	☐ 584 FSU	☐ 120 FSEM	☐ 264 FSEK			
antenna	☐ 574 BTA-L	☐ 133 EMCO3115	☐ 302 BBHA9170	☒ 608 CBL 6141	☒ 549 HL025	☐ 477 GPS
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	☒ 426 6dB divider	☒ 530 10dB Att.	☐ 110 USB LWL	☐ 482 Filter Matrix	☐ 431 Near field	
line voltage	☐ 230 V 50 Hz via public mains		☒ 24 V DC			

5.4.2. Requirements

FCC	§2.1051-conducted, §2.1057(a)(1), §22.917(a)(b), §24.238(a)(b)
IC	RSS-132: 4.5.1.1, RSS-133: 6.5.1(a)(b)
Limit	„the power of emissions shall be attenuated below the transmitter output power (p) by at least least 43+10Log(P) dB“

5.4.3. Test condition and measurement test set-up

link to test system (if used):	☒ air link	☐ cable connection	☐
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%

5.4.3.1. Frequency range

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.

“The specification that all emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range of the mobile phone (1 to 0.001 W) to a constant limit of -13 dBm.”

“§ 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”

5.4.3.2. Description of Set-up

- see conducted set-up in chapter 4.3

5.4.3.3. Settings on Mobile Phone

The measurements were made at the upper, middle, and lower carrier frequencies of the operating band. Choosing three representative TX-carrier frequencies of the mobile phone within each operable GSM band, should be sufficient to demonstrate compliance with the emissions limits outside and adjacent to the frequency blocks.

A call was established with settings according chapter 3.6

5.4.3.4. Settings of Spectrum-Analyser

Frequency range	RBW (resolution bandwidth)	VBW (video bandwidth)
BAND-EDGE compliance: 1 MHz immediately adjacent to the frequency blocks	1% from applicants stated/measured emission bandwidth	3..10 times the RBW
More than 1 MHz outside and adjacent the frequency blocks	1 kHz or 100 kHz to measurement frequencies up to 1 MHz 1 MHz for measurement frequency range 1 MHz to maximum 10-times TX-frequency	3..10 times the RBW

Settings for G850 Mode

	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	MaxH-PK
Sweep 1 (subrange 2)	1	30	0.1	1	5	25	MaxH-PK
Sweep 2 (subrange 1)	30	1000	1	1	10	35	MaxH-PK
Sweep 2 (subrange 2)	1000	2500	1	1	15	35	MaxH-PK
Sweep 2 (subrange 3)	2500	9000	1	1	60	35	MaxH-PK
Sweep 3a (Block-Edge)	823	824	0.003	0.01	30	35	MaxH-PK
Sweep 3b (Block-Edge)	823	824	0.003	0.01	30	35	MaxH-AV
Sweep 4a (Block-Edge)	850	851	0.003	0.01	30	35	MaxH-PK
Sweep 4b (Block-Edge)	850	851	0.003	0.01	30	35	MaxH-AV

Settings for PCS1900 Mode

	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	MaxH-PK
Sweep 1 (subrange 2)	1	30	0.1	1	5	25	MaxH-PK
Sweep 2 (subrange 1)	30	1000	1	1	10	35	MaxH-PK
Sweep 2 (subrange 2)	1000	2500	1	1	15	35	MaxH-PK
Sweep 2 (subrange 3)	2500	19500	1	1	160	35	MaxH-PK
Sweep 3a (Block-Edge)	1849	1850	0.003	0.01	30	35	MaxH-PK
Sweep 3b (Block-Edge)	1849	1850	0.003	0.01	30	35	MaxH-AV
Sweep 4a (Block-Edge)	1910	1911	0.003	0.01	30	35	MaxH-PK
Sweep 4b (Block-Edge)	1910	1911	0.003	0.01	30	35	MaxH-AV

Settings for FDD II/ FDD V bands are equal except subrange 3 and Block-Edge

	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	MaxH-PK
Sweep 1 (subrange 2)	1	30	0.1	1	5	25	MaxH-PK
Sweep 2 (subrange 1)	30	1000	0.1	1	10	35	MaxH-PK
Sweep 2 (subrange 2)	1000	2500	1	1	15	35	MaxH-PK
Sweep 2 (FDD V) (subrange 3)	2500	9000	1	1	60	35	MaxH-PK
Sweep 2 (FDD II) (subrange 3)	2500	19500	1	1	160	35	MaxH-PK
Sweep 3a (FDD V) (Block-Edge)	823	824	0.03	0.1	30	35	MaxH-PK
Sweep 3b (FDD V) (Block-Edge)	823	824	0.03	0.1	30	35	MaxH-AV
Sweep 4a (FDD V) (Block-Edge)	850	851	0.03	0.1	30	35	MaxH-PK
Sweep 4b (FDD V) (Block-Edge)	850	851	0.03	0.1	30	35	MaxH-AV
Sweep 3a (FDD II) (Block-Edge)	1849	1850	0.03	0.1	30	35	MaxH-PK
Sweep 3b (FDD II) (Block-Edge)	1849	1850	0.03	0.1	30	35	MaxH-AV
Sweep 4a (FDD II) (Block-Edge)	1910	1911	0.03	0.1	30	35	MaxH-PK
Sweep 4b (FDD II) (Block-Edge)	1910	1911	0.03	0.1	30	35	MaxH-AV

Remarks: Due to not available exact 1% RBW of the meas.equipment, the lower available RBW was used.

An an additional correction factor of 10 Log (RBW1/ RBW2) to the result was added.
RBW1 is the narrower measurement resolution bandwidth (used RBW) and RBW2 is either the 1% emissions bandwidth or 1 MHz **(KDB890810).**

Formula: Block-Edge compliance correction factor for FDD bands

10log(50 kHz/30 KHz) to be used= 2.22 dB

5.4.4. Results conducted

5.4.4.1. GPRS TCH 850: Op. Mode 1, Set-up 5

Transmitting frequencies: TX = 824.2 MHz, 837 MHz & 848.8 MHz							
Sweep no.	Diagram number	Frequency of emission [MHz]	Worst-Peak level [dBm]	Frequency of worst-peak level [MHz]	Result [dBm]	Limit [dBm]	Result
Sweep 1	36.01, 36.03, 36.05	0.009 to 30	--	--	<-49	-13	passed
Sweep 2[1)]	36.02, 36.04, 36.06	30 to 9000	--	--	<-24		passed
Sweep 3&4[2.)]	37.01 / 37.02	823-824/ 849-850	-18.6	--	--		passed

Remark: see diagrams in Annex A4 for more details

5.4.4.2. EDGE TCH 850: Op. Mode 2, Set-up 5

Transmitting frequencies: TX = 824.2 MHz, 837 MHz & 848.8 MHz							
Sweep no.	Diagram number	Frequency of emission [MHz]	Worst-Peak level [dBm]	Frequency of worst-peak level [MHz]	Result [dBm]	Limit [dBm]	Result
Sweep 1	36.07, 36.09, 36.11	0.009 to 30	--	--	<-52	-13	passed
Sweep 2[1)]	36.08, 36.10, 36.12	30 to 19500	--	--	<-24		passed
Sweep 3&4 [2.)]	37.03 / 37.04	823-824/ 849-850	-18.6	--	--		passed

Remark: see diagrams in Annex A4 for more details

5.4.4.3. GPRS 1900 Mode: Op. Mode 3, Set-up 5

Transmitting frequencies: TX = 1850,2 MHz, 1880,0 MHz & 1908,8 MHz							
Sweep no.	Diagram number	Frequency of emission [MHz]	Worst-Peak level [dBm]	Frequency of worst-peak level [MHz]	Result [dBm]	Limit [dBm]	Result
Sweep 1	36.20, 36.22, 36.24	0.009 to 30	--	--	<-49	-13	passed
Sweep 2 [1)]	36.21, 36.23, 36.25	30 to 19500	--	--	<-21		passed
Sweep3& 4 [2.)]	37.10 / 37.11	1849-1850/ 1910-1911	-17.8	--	--		passed

Remark: see diagrams in Annex A4 for more details

General remarks:

1.) Carrier visible

2.) Band-Edge compliance

5.4.4.4. EDGE 1900 Mode: Op. Mode 4, Set-up 5

Transmitting frequencies: TX = 1850,2 MHz, 1880,0 MHz & 1908,8 MHz							
Sweep no.	Diagram number	Frequency of emission [MHz]	Worst-Peak level [dBm]	Frequency of worst-peak level [MHz]	Result [dBm]	Limit [dBm]	Result
Sweep 1	36.26, 36.28, 36.30	0.009 to 30	--	--	<-50	-13	passed
Sweep 2 [1)]	36.27, 36.29, 36.31	30 to 19500	--	--	<-21		passed
Sweep3& 4 [2.)]	37.12 / 37.13	1849-1850/ 1910-1911	<-17.4	--	--		passed

Remark: see diagrams in Annex A4 for more details

1.) Carrier visible

2.) Band-Edge compliance

5.4.4.5. TCH FDD V Mode: Op. Mode 5 & 6, Set-up 5

Transmitting frequencies: TX = 828 MHz, 837.4 MHz & 845.2 MHz							
Sweep no.	Diagram number	Frequency of emission [MHz]	Worst-Peak level [dBm]	Frequency of worst-peak level [MHz]	Result [dBm]	Limit [dBm]	Result
Sweep 1	36.40, 36.42, 36.44	0.009 to 30	-30.98	0.380	--	-13	passed
Sweep 2[1)]	36.41, 36.43, 36.45	30 to 9000	-34.5	2483.2	--		passed
Sweep 3&4[2.)]	37.40 / 37.41	823-824/ 849-850	-18.0 + 2.22= -15.78 (RMC)	849.13	--		passed
	37.42/ 37.43		-20.1 + 2.22= -17.88 (HSUPA)	849.84	--		passed

Remark: see diagrams in Annex A4 for more details

5.4.4.6. TCH FDD II Mode: Op. Mode 6, Set-up 5

Transmitting frequencies: TX = 1851.4 MHz, 1878.4 MHz & 1906.6 MHz							
Sweep no.	Diagram number	Frequency of emission [MHz]	Worst-Peak level [dBm]	Frequency of worst-peak level [MHz]	Result [dBm]	Limit [dBm]	Result
Sweep 1	36.60, 36.62, 36.64	0.009 to 30	-30.69	0.380	--	-13	passed
Sweep 2[1)]	36.61, 36.63, 36.65	30 to 9000	--	--	<-31		passed
Sweep 3&4[2.)]	37.60 / 37.61	1849-1850/ 1910-1911	-15.71 + 2.22= -13.49 (RMC)	1849.9	--		passed
	37.60 / 37.61		-16.45 + 2.22= -14.23 (HSUPA)	1849.9	--		

Remark: see diagrams in Annex A4 for more details

General remarks for FDD Mode:

1.) Carrier visible

2.) Band-Edge compliance included formula

5.5. RF-Parameter - RF Peak power output conducted

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☒ 347 Radio.lab.		☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☐ 489 ESU 40	☐ 620 ESU 26	☐	☐
signaling	☐ 392 MT8820A	☒ 436 CMU	☐ 547 CMU			
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		☒ 24 V DC			

5.5.2. Requirements

FCC	§2.1046 (conducted)
IC	RSS-132:4.4 + SRSP 503:5.1.3 for GSM 850; RSS-133:4.1/6.4 + SRSP-510:5.1.2 for GSM 1900
Limit	Maximum Power Output of the mobile phone should be determined while measured conducted E(I)RP.
	Limit GSM850: 7 Watt
	Limit GSM1900: 2 Watt

5.5.3.Test condition and measurement test set-up

link to test system (if used):	☐ air link	☒ cable connection	☐
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%

- see conducted measurement set-up, description in chapter 4.3
- 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 (0.3dB for attenuation).

5.5.4. Measurement Results

	ARFCN	Frequency (MHz)	Burst Power (dBm)	Limit (dBm)	Result
power_GSM_850_average	128	824.2	31.97	38.45	Passed
	192	837.0	32.04		Passed
	251	848.8	32.02		Passed
power_GSM_850_peak	128	824.2	32.16		Passed
	192	837.0	32.21		Passed
	251	848.8	32.17		Passed
power_EGPRS_850_average	128	824.2	26.43		Passed
	192	837.0	26.53		Passed
	251	848.8	26.51		Passed
power_EGPRS_850_peak	128	824.2	29.30		Passed
	192	837.0	29.48		Passed
	251	848.8	29.44		Passed
power_GSM_1900_average	512	1850.2	28.93	33.00	Passed
	661	1880.0	28.78		Passed
	810	1909.8	28.73		Passed
power_GSM_1900_peak	512	1850.2	29.15		Passed
	661	1880.0	29.01		Passed
	810	1909.8	28.92		Passed
power_EGPRS_1900_average	512	1850.2	25.26		Passed
	661	1880.0	25.17		Passed
	810	1909.8	25.06		Passed
power_EGPRS_1900_peak	512	1850.2	28.24		Passed
	661	1880.0	28.11		Passed
	810	1909.8	27.97		Passed

	U-ARFCN	Frequency (MHz)	RMC99 Power RMS (dBm)	Limit (dBm)	Result
power_FDD_2	9262	1852.4	22.36	33.00	Passed
	9400	1880.0	22.17		Passed
	9538	1907.6	22.28		Passed
power_FDD_5	4132	826.4	22.45	38.45	Passed
	4182	836.4	22.41		Passed
	4233	846.6	22.34		Passed

5.6. RF-Parameter - Occupied bandwidth and emission bandwidth

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

test site	☐ 441 EMI SAR	☐ 348 EMI cond.	☐ 443 EMI FAR	☒ 347 Radio.lab.	☐ 337 OATS	☐
spectr. analys.	☐ 584 FSU	☒ 489 ESU	☐ 264 FSEK		☐	☐
attenuator	☒ 530 10 dB	☒ 463 6dB Power divider	☐	☐	☐	☐
signaling	☐ 392 MT8820A	☐ 436 CMU	☒ 547 CMU			
DCpower	☐ 463 Power divider	☐ 087 EA3013	☒ 354 NGPE 40	☐ 086 LNG50-10	☐	☐
line voltage	☐ 230 V 50 Hz via public mains		☒ 24 V DC			

5.6.2.Test condition and measurement test set-up

link to test system (if used):	☐ air link	☒ cable connection	☐
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%

5.6.3. References of occupied and emission bandwidth

FCC	*§2.202, §2.1049, §22.917(b), §24.238(b)*
IC	*RSS-Gen, Issue 3:§ 4.6.1 & §4.6.3*
ANSI	*C63.10-2009*
Requirement	„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"

5.6.4. Test Set-up

- see conducted measurement set-up described in 4.3

5.6.5. Mobile phone settings

- a call was established with settings according chapter 3.6

5.6.6. Measurement procedure

Following settings were chosen on the spectrum analyzer							
Measurement	**Center Frequency**	**Span**	**RBW**	**VBW**	**Sweep Time**	**Sweep Mode**	**Detector**
26 dB BW	Nominal Carrier frequency	1 MHz (GSM)/ 5.5 MHz (FDD)	3 kHz (GSM) / 50 kHz (FDD)	30 kHz (GSM)/ 500 kHz (FDD)	coupled	Repetitive, max-hold	PK
99% OBW	Nominal Carrier frequency	1 MHz (GSM)/ 5.5 MHz (FDD)	3 kHz (GSM) / 50 kHz (FDD)	30 kHz (GSM)/ 500 kHz (FDD)	coupled	Single	RMS

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.

Also the 26dB emission bandwidth was measured, defined as a bandwidth between 2 markers with are 26dBc compared to highest In-Band Peak Emission.

5.6.7. Results

Set-up 5, Op-Mode 1

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
GPRS 850	Channel 128/ 824.2 MHz	245.19	**314.10**
	Channel 192/ 837.0 MHz	**246.79**	299.68
	Channel 251/ 848.8 MHz	243.58	309.29

Set-up 5, Op-Mode 2

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
EGPRS 850	Channel 128/ 824.2 MHz	245.19	**312.5**
	Channel 192/ 837.0 MHz	**248.40**	310.8
	Channel 251/ 848.8 MHz	245.19	302.9

Set-up 5, Op-Mode 3

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
GPRS 1900	Channel 512/ 1850.2 MHz	243.58	312.5
	Channel 661/ 1880.0 MHz	241.98	**315.7**
	Channel 810/ 1909.8 MHz	**246.79**	306.08

Set-up 5, Op-Mode 4

Channel/ Frequency (MHz)		Occupied 99% bandwidth [kHz]	Emission bandwidth [kHz]
EGPRS 1900	Channel 512/ 1850.2 MHz	241.98	309.29
	Channel 661/ 1880.0 MHz	**245.19**	309.29
	Channel 810/ 1909.8 MHz	243.58	**310.89**

Set-up 5, Op-Mode 5

Channel/ Frequency (MHz)		Occupied 99% bandwidth [MHz]	Emission bandwidth [MHz]
RMC FDD II	Channel 128/ 824.2 MHz	**4.080**	4.636
	Channel 192/ 837.0 MHz	4.072	**4.653**
	Channel 251/ 848.8 MHz	4.072	4.636

Set-up 5, Op-Mode 7

Channel/ Frequency (MHz)		Occupied 99% bandwidth [MHz]	Emission bandwidth [MHz]
HSUPA FDD II	Channel 128/ 824.2 MHz	**4.080**	**4.653**
	Channel 192/ 837.0 MHz	4.072	**4.653**
	Channel 251/ 848.8 MHz	4.072	4.627

Set-up 5, Op-Mode 6

Channel/ Frequency (MHz)		Occupied 99% bandwidth [MHz]	Emission bandwidth [MHz]
RMC FDD V	Channel 512/ 1850.2 MHz	4.063	4.592
	Channel 661/ 1880.0 MHz	4.063	**4.618**
	Channel 810/ 1909.8 MHz	**4.072**	**4.618**

Set-up 5, Op-Mode 8

Channel/ Frequency (MHz)		Occupied 99% bandwidth [MHz]	Emission bandwidth [MHz]
HSUPA FDD V	Channel 512/ 1850.2 MHz	4.063	4.574
	Channel 661/ 1880.0 MHz	4.063	4.600
	Channel 810/ 1909.8 MHz	**4.072**	**4.609**

General Remarks: Please see at annex A4 the plots
Final Verdict: Passed

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

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

test location	☒ CETECOM Essen (Chapter. 2.2.1)		☐ Please see Chapter. 2.2.2		☐ Please see Chapter. 2.2.3	
test site	☐ 441 EMI SAR	☐ 487 SAR NSA	☒ 347 Radio.lab.		☐	☐
receiver	☐ 377 ESCS30	☐ 001 ESS	☒ 489 ESU 40	☐ 620 ESU 26	☐	☐
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	☐ 436 CMU	☒ 547 CMU			
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
Climatic test chamber	☒ 331 HC 4055					
line voltage area	☐ 230 V 50 Hz via public mains		☒ 12.0 – 28.8 V DC [$\pm$ 20% $of\ Vmin = 12\ V\ and\ Vmax = 24\ V$]			

5.7.2. Requirements

FCC	§2.1055(a)(1), §22.355, §24.235
IC	RSS-132: 4.3, RSS-133: 6.3
Limit	*"The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block"*

5.7.3. Test condition and measurement test set-up

link to test system (if used):	☐ air link	☒ cable connection	☐
Climatic conditions	Temperature: (22±3°C)		Rel. humidity: (40±20)%

5.7.3.1. Test Set-up

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. A conducted measurement test set-up like described in chapter 4.3 was used.

5.7.3.2. Mobile phone settings

The measurements were made at the lowest, middle and highest carrier frequencies of the operating bands.

5.7.3.3. Test method

The aim of the EUT is to function under all extreme conditions within authorized sub-bands in regard to temperature and voltage variations. 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.

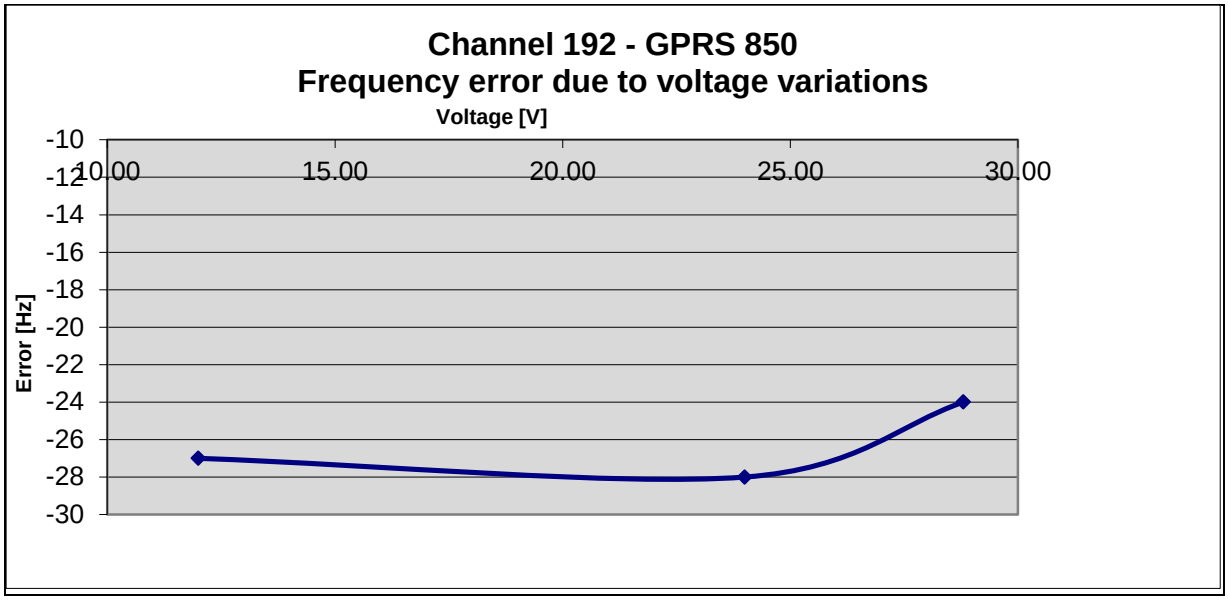
5.7.3.4. Frequency shift of carrier against a voltage range at constant nominal temperature of 20° Celsius

1.) Determine the carrier frequency for the middle 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.

5.7.4. Measurement Results:

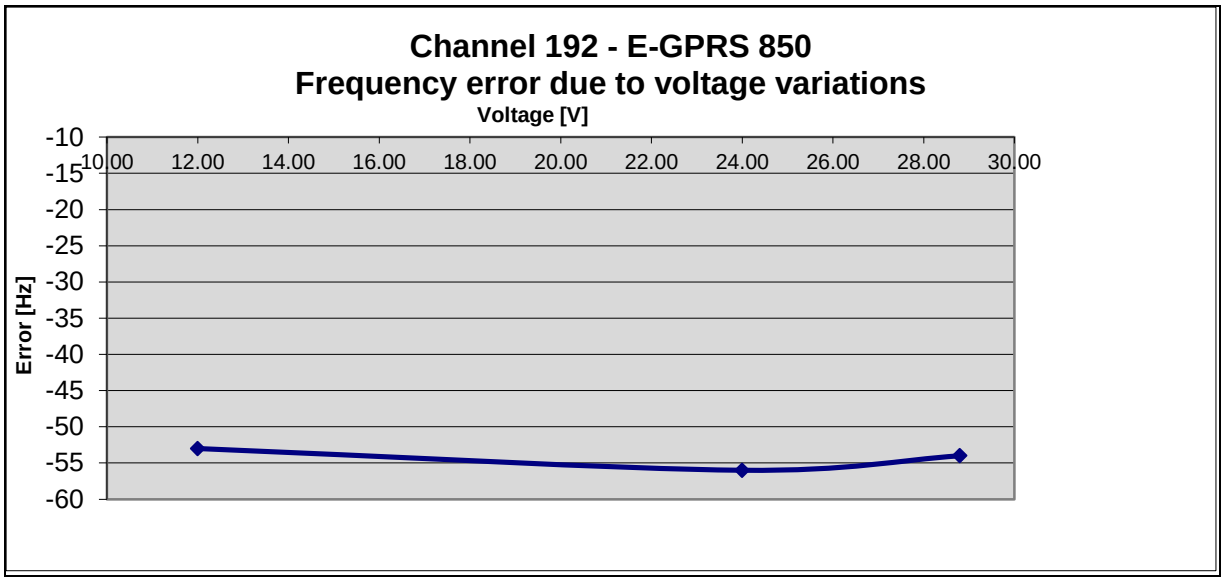
5.7.4.1. GPRS 850 Mode: Op. Mode 1, set-up 5

Voltage [V]	Nominal Frequency [MHz]	Maximum frequency error [Hz]	[ppm]	Verdict Limit=±0.1ppm
28.80	837000000	-24	-0.029	Passed
24.00		-28	-0.033	
12.00		-27	-0.032	



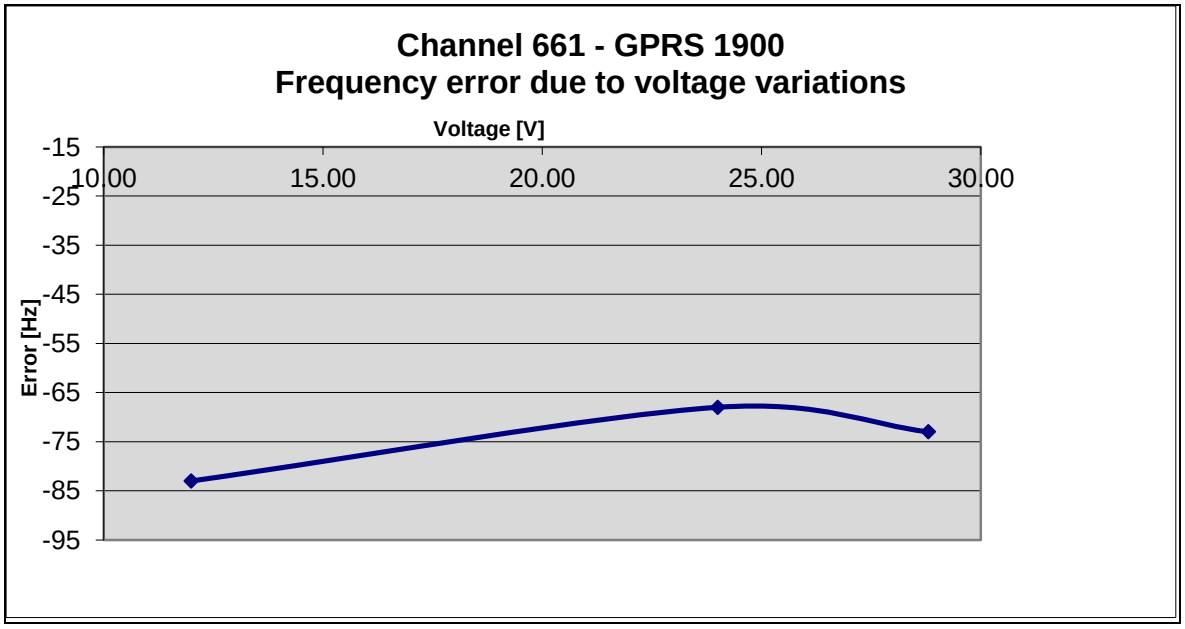
5.7.4.2. EDGE 850 Mode: Op. Mode 2, set-up 5

Voltage [V]	Nominal Frequency [MHz]	Maximum frequency error [Hz]	[ppm]	Verdict Limit=±0.1ppm
28.80	837000000	-54	-0.065	Passed
24.00		-56	-0.067	
12.00		-53	-0.063	



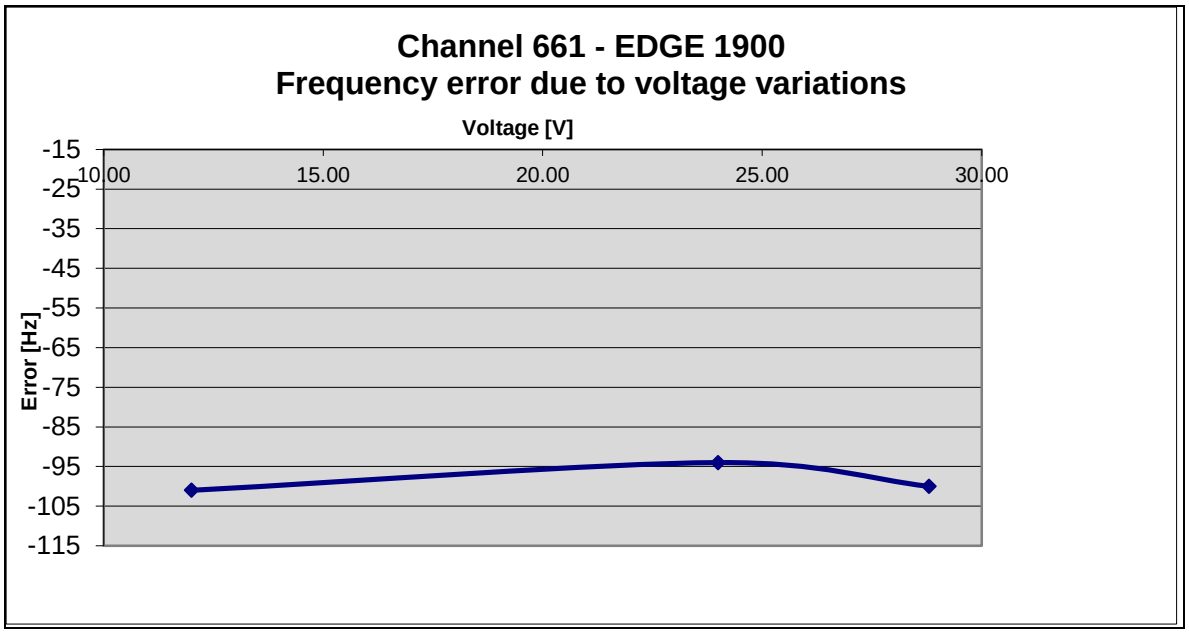
5.7.4.3. GPRS 1900 Mode: Op. Mode 5, set-up 5

Voltage [V]	Nominal Frequency [Hz]	Maximum frequency error		Verdict Limit=±0.1ppm
		[Hz]	[ppm]	
28.80	1880000000	-73	-0.039	Passed
24.00		-68	-0.036	
12.00		-83	-0.044	



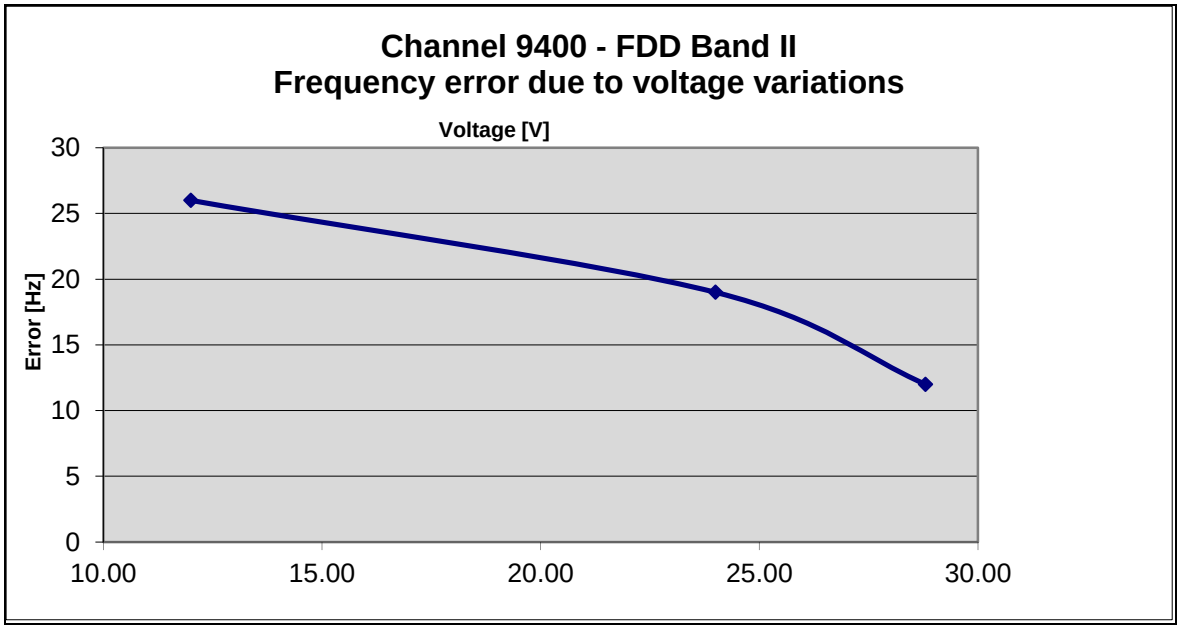
5.7.4.4. EDGE 1900 Mode: Op. Mode 4, set-up 5

Voltage [V]	Nominal Frequency [Hz]	Maximum frequency error		Verdict Limit=±0.1ppm
		[Hz]	[ppm]	
28.80	1880000000	-100	-0.053	Passed
24.00		-94	-0.050	
12.00		-101	-0.054	



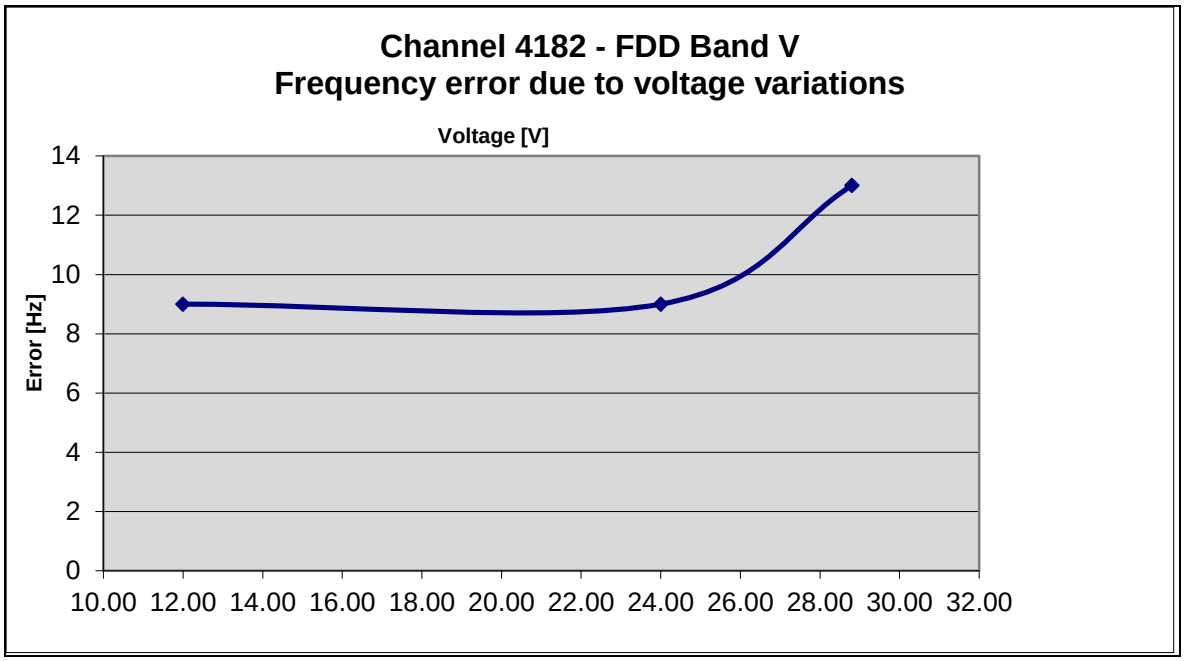
5.7.4.5. FDD II Mode: Op. Mode 5, set-up 5

Voltage [V]	Nominal Frequency [Hz]	Maximum frequency error [Hz]	[ppm]	Verdict Limit=±0.1ppm
28.80	1880000000	12	0.006	Passed
24.00		19	0.010	
12.00		26	0.014	



5.7.4.5.1. FDD V Mode: Op. Mode 6, set-up 5

Voltage [V]	Nominal Frequency [Hz]	Maximum frequency error [Hz]	[ppm]	Verdict Limit=±0.1ppm
28.80	836600000	13	0.016	Passed
24.00		9	0.011	
12.00		9	0.011	

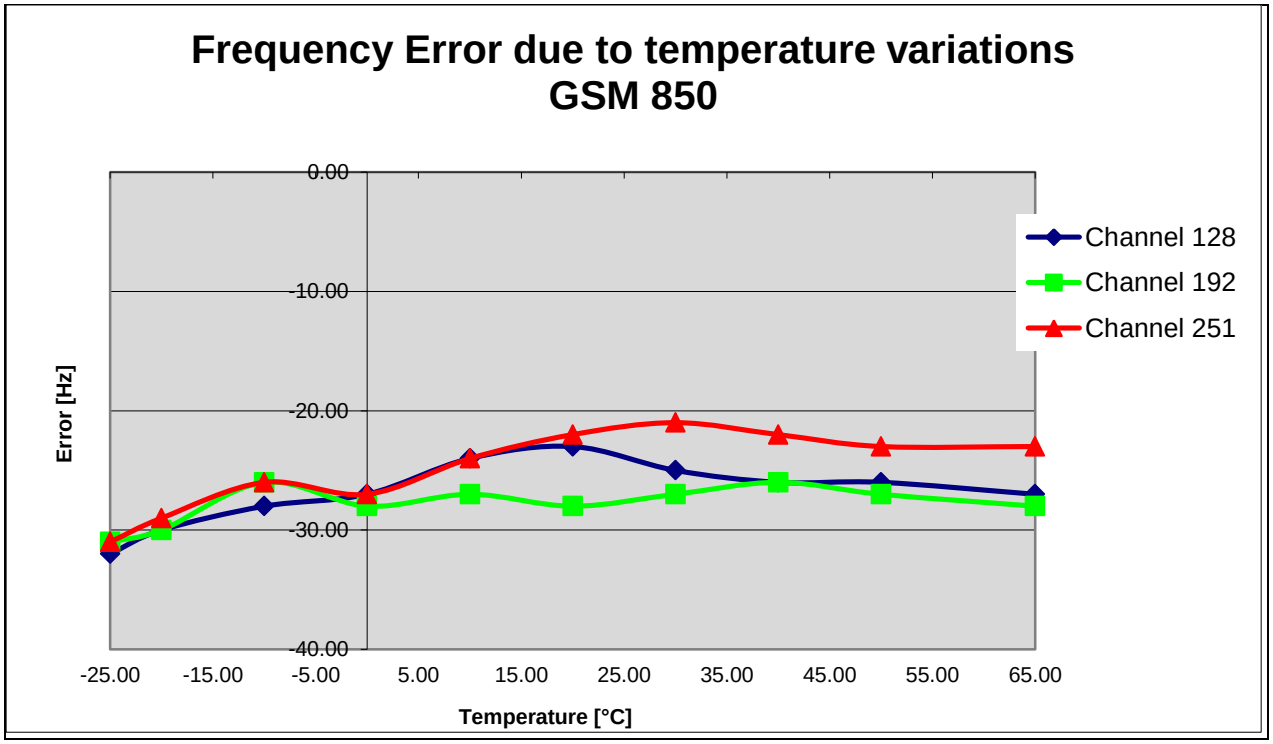

Channel 4182 - FDD Band V
Frequency error due to voltage variations
Voltage [V]
Error [Hz]
14
12
10
8
6
4
2
0
10.00
12.00
14.00
16.00
18.00
20.00
22.00
24.00
26.00
28.00
30.00
32.00

5.7.4.6. 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 –25°C, wait sufficient time to have constant temperature.*
3.) *Perform the carrier frequencies measurements in 10°C increments from –25°C to +65°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.*

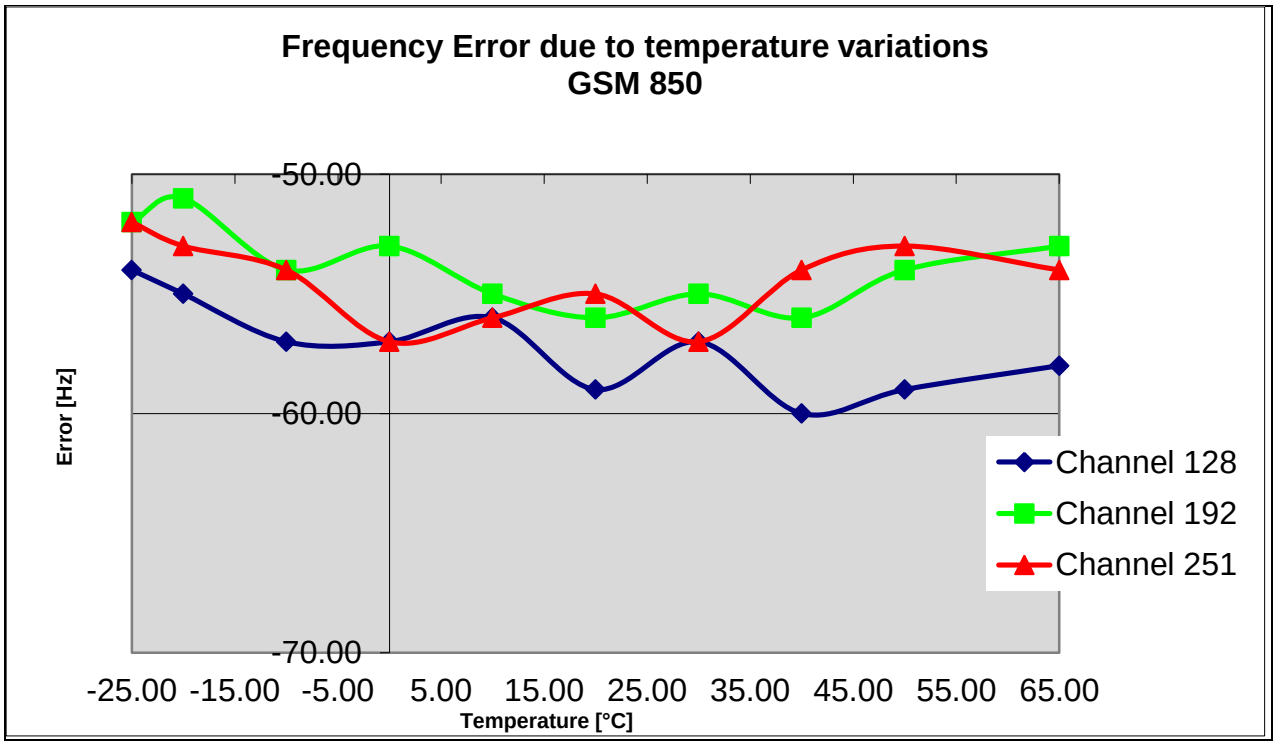
5.7.4.7. GPRS G850 Mode: Op. Mode 1, set-up 5

	Maximum frequency error						Result
	Channel 128	Channel 192	Channel 251	Channel 128	Channel 192	Channel 251	
Temperature	[Hz]			[ppm]			Limit=±0.1ppm
-25	-32	-31	-31	-0.039	-0.037	-0.037	
-20	-30	-30	-29	-0.036	-0.036	-0.034	
-10	-28	-26	-26	-0.034	-0.031	-0.031	
0	-27	-28	-27	-0.033	-0.033	-0.032	
10	-24	-27	-24	-0.029	-0.032	-0.028	passed
20	-23	-28	-22	-0.028	-0.028	-0.026	
30	-25	-27	-21	-0.030	-0.032	-0.025	
40	-26	-26	-22	-0.032	-0.031	-0.026	
50	-26	-27	-23	-0.032	-0.032	-0.027	
65	-27	-28	-23	-0.033	-0.033	-0.027	



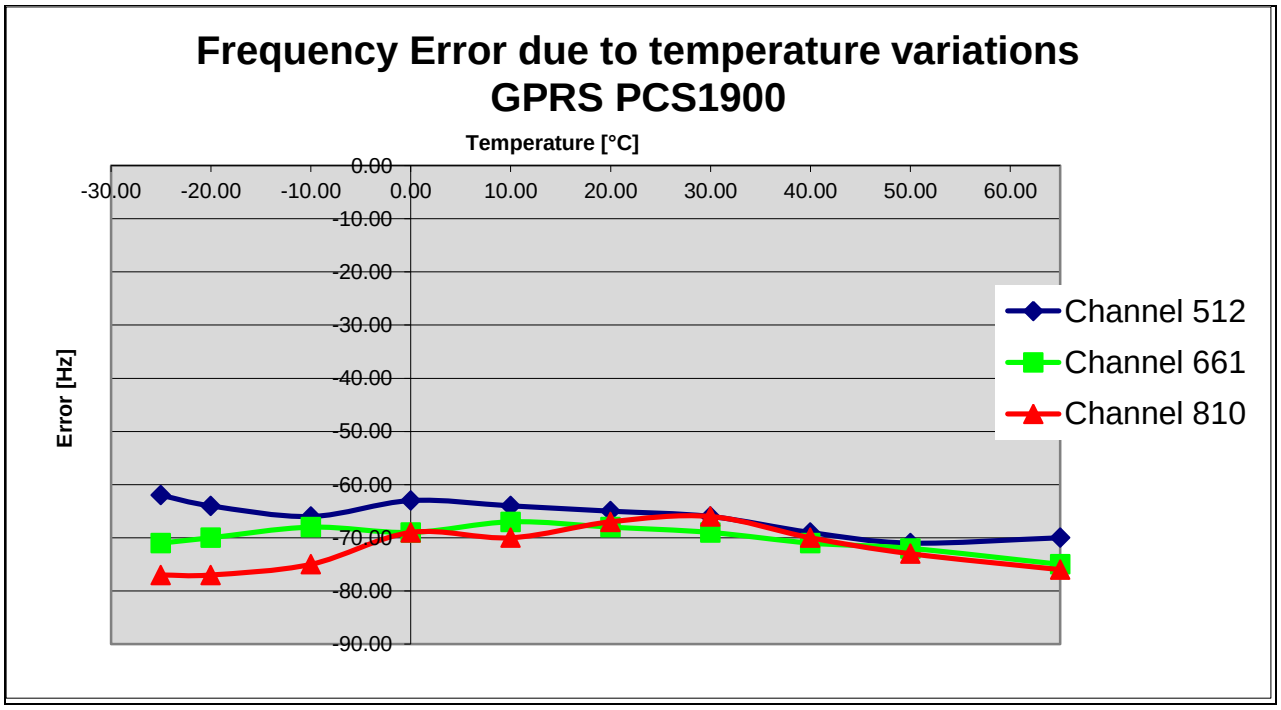
5.7.4.8. EDGE **G850 Mode: Op. Mode** 2**, set-up 5**

	Maximum frequency error						Result
	Channel 128	Channel 192	Channel 251	Channel 128	Channel 192	Channel 251	
Temperature	[Hz]			[ppm]			Limit=±0.1ppm
-25	-54	-52	-52	-0.066	-0.062	-0.061	
-20	-55	-51	-53	-0.067	-0.061	-0.062	
-10	-57	-54	-54	-0.069	-0.065	-0.064	
0	-57	-53	-57	-0.069	-0.063	-0.067	
10	-56	-55	-56	-0.068	-0.066	-0.066	
20	-59	-56	-55	-0.072	-0.072	-0.065	passed
30	-57	-55	-57	-0.069	-0.066	-0.067	
40	-60	-56	-54	-0.073	-0.067	-0.064	
50	-59	-54	-53	-0.072	-0.065	-0.062	
65	-58	-53	-54	-0.070	-0.063	-0.064	



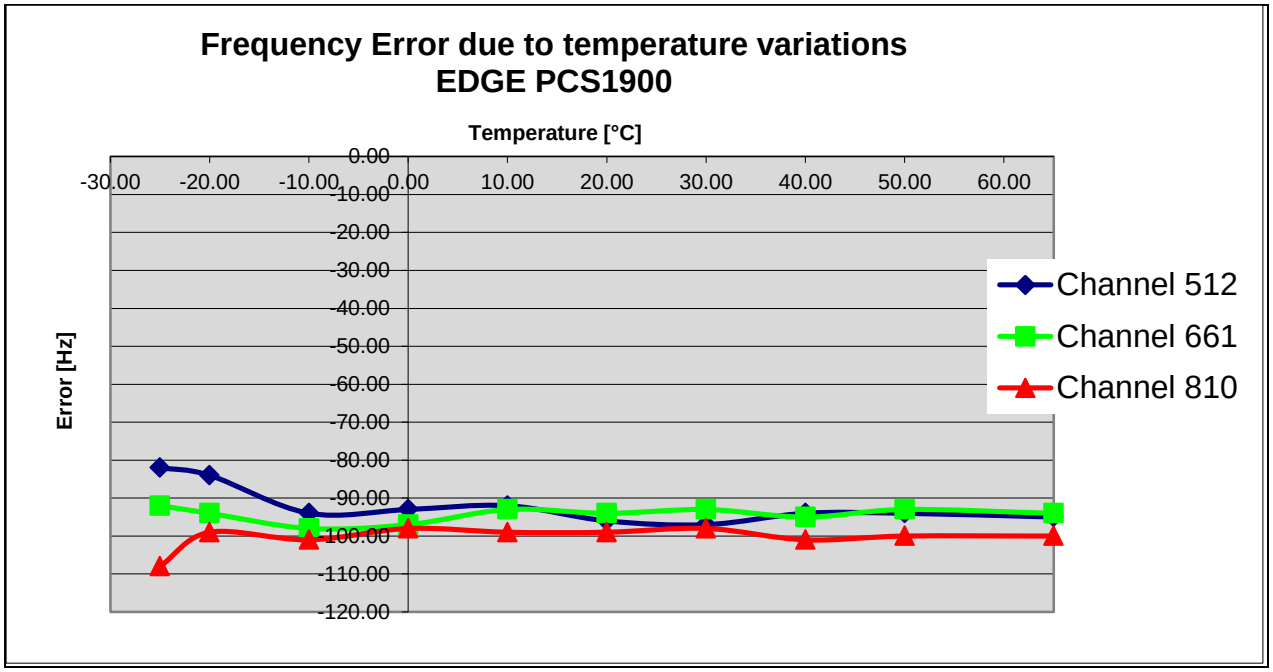
5.7.4.9. GPRS PCS1900 Mode: Op. Mode 3, set-up 5

	Maximum frequency error						Result
Temperature	Channel 512	Channel 661	Channel 810	Channel 512	Channel 661	Channel 810	Limit=±0.1ppm
	[Hz]			[ppm]			
-25	-62	-71	-77	-0.034	-0.038	-0.040	
-20	-64	-70	-77	-0.035	-0.037	-0.040	
-10	-66	-68	-75	-0.036	-0.036	-0.039	
0	-63	-69	-69	-0.034	-0.037	-0.036	
10	-64	-67	-70	-0.035	-0.036	-0.037	
20	-65	-68	-67	-0.035	-0.036	-0.035	passed
30	-66	-69	-66	-0.036	-0.037	-0.035	
40	-69	-71	-70	-0.037	-0.038	-0.037	
50	-71	-72	-73	-0.038	-0.038	-0.038	
65	-70	-75	-76	-0.038	-0.040	-0.040	



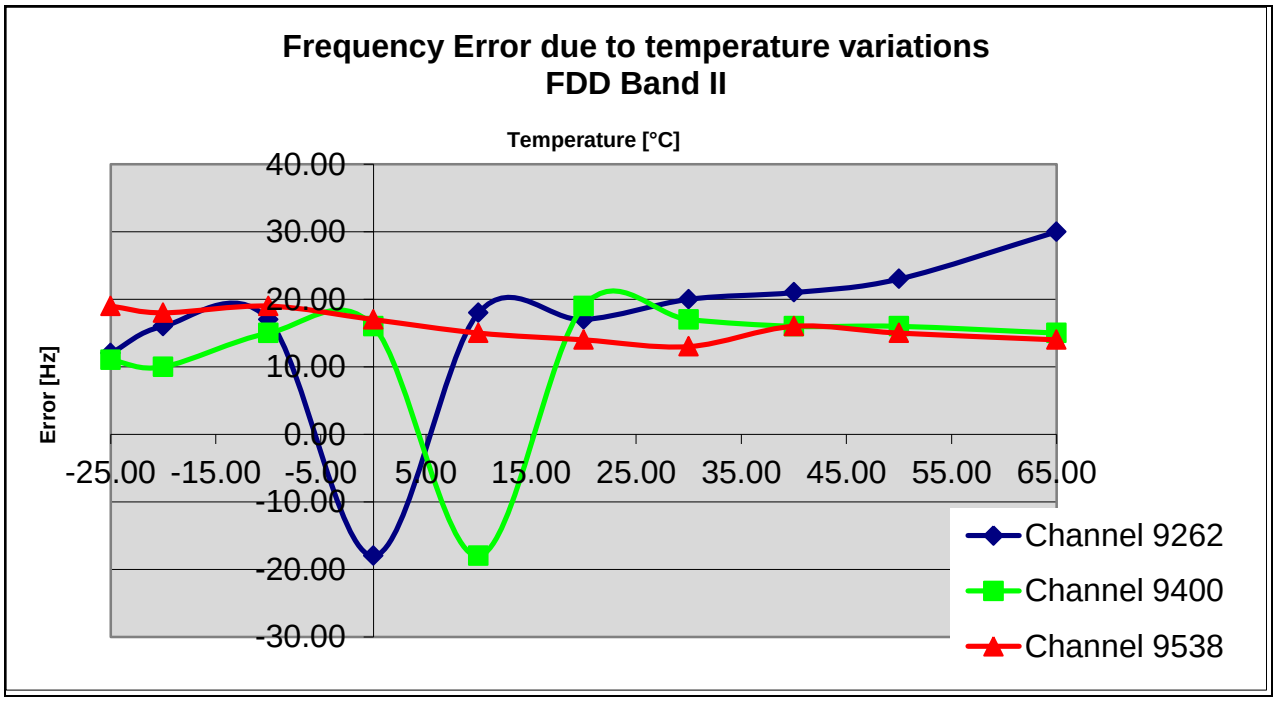
5.7.4.10. EDGE PCS1900 Mode: Op. Mode 4, set-up 5

	Maximum frequency error						Result
Temperature	Channel 512 [Hz]	Channel 661 [Hz]	Channel 810 [Hz]	Channel 512 [ppm]	Channel 661 [ppm]	Channel 810 [ppm]	Limit=±0.1ppm
-25	-82	-92	-108	-0.044	-0.049	-0.057	
-20	-84	-94	-99	-0.045	-0.050	-0.052	
-10	-94	-98	-101	-0.051	-0.052	-0.053	
0	-93	-97	-98	-0.050	-0.052	-0.051	
10	-92	-93	-99	-0.050	-0.049	-0.052	
20	-96	-94	-99	-0.052	-0.050	-0.052	passed
30	-97	-93	-98	-0.052	-0.049	-0.051	
40	-94	-95	-101	-0.051	-0.051	-0.053	
50	-94	-93	-100	-0.051	-0.049	-0.052	
65	-95	-94	-100	-0.051	-0.050	-0.052	



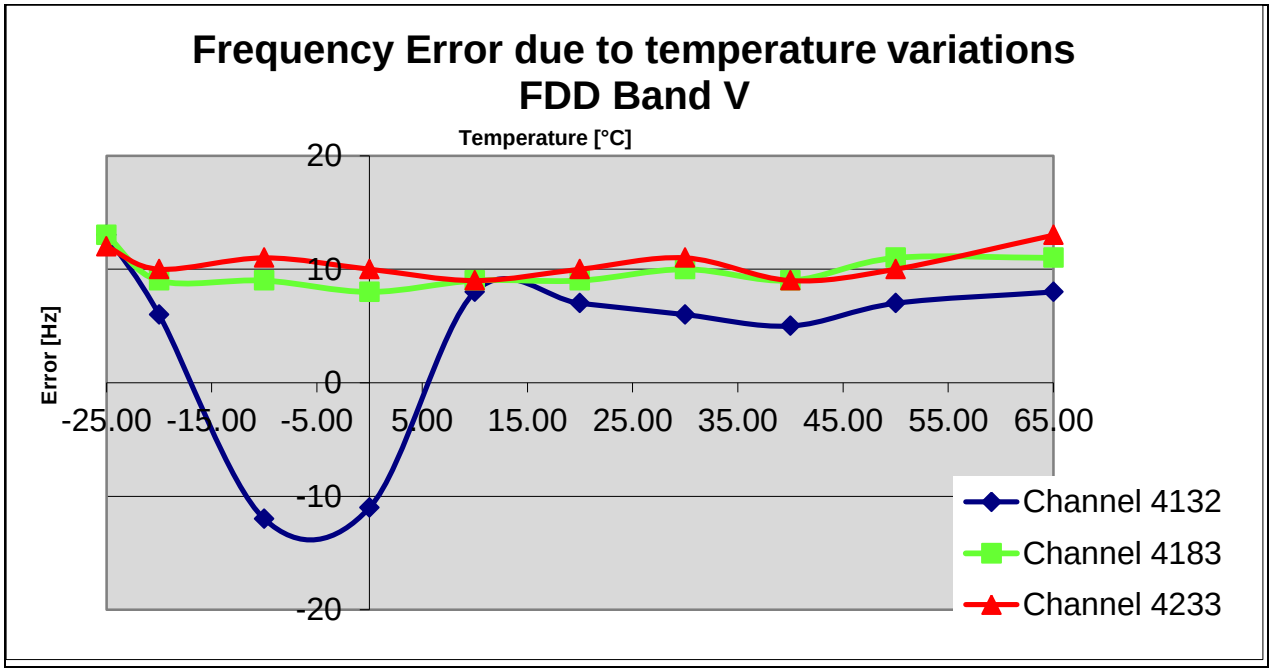
5.7.4.11. FDD II Mode: Op. Mode 5, set-up 5

	Maximum frequency error						Result
	Channel 9262	Channel 9400	Channel 9538	Channel 9262	Channel 9400	Channel 9538	
Temperature	[Hz]			[ppm]			Limit=±0.1ppm
-25	12	11	19	0.006	0.006	0.010	
-20	16	10	18	0.009	0.005	0.009	
-10	17	15	19	0.009	0.008	0.010	
0	-18	16	17	-0.010	0.009	0.009	
10	18	-18	15	0.010	-0.010	0.008	
20	17	19	14	0.009	0.010	0.007	passed
30	20	17	13	0.011	0.009	0.007	
40	21	16	16	0.011	0.009	0.008	
50	23	16	15	0.012	0.009	0.008	
65	30	15	14	0.016	0.008	0.007	



5.7.4.12. FDD V Mode: Op. Mode 6, set-up 5

	Maximum frequency error						Result
	Channel 4132	Channel 4182	Channel 4233	Channel 4132	Channel 4182	Channel 4233	
Temperature	[Hz]			[ppm]			Limit=±0.1ppm
-25	13	13	12	0.016	0.016	0.014	passed
-20	6	9	10	0.007	0.011	0.012	
-10	-12	9	11	-0.015	0.011	0.013	
0	-11	8	10	-0.013	0.010	0.012	
10	8	9	9	0.010	0.011	0.011	
20	7	9	10	0.008	0.011	0.012	
30	6	10	11	0.007	0.012	0.013	
40	5	9	9	0.006	0.011	0.011	
50	7	11	10	0.008	0.013	0.012	
65	8	11	13	0.010	0.013	0.015	



5.8. Measurement uncertainties

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

Following table shows expectable uncertainties for each measurement type performed.

RF-Measurement	Frequency range	Calculated uncertainty based on a confidence level of 95%	Remarks:
Power Output conducted	9 kHz .. 20 GHz	1.0 dB	--
Power Output radiated	30 MHz .. 4 GHz	3.17 dB	Substitution method
Conducted emissions on antenna ports	9 kHz .. 20 GHz	1.0 dB	--
Radiated emissions enclosure	150 kHz .. 30 MHz	5.0 dB	Magnetic field
	30 MHz .. 1 GHz	4.2 dB	E-Field
	1 GHz .. 20 GHz	3.17 dB	Substitution method
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
		1.0 dB	Power
Frequency stability	9 kHz .. 20 GHz	0.0636 ppm	--
Conducted emissions on AC-mains port (U_{CISPR})	9 kHz .. 150 kHz	4.0 dB	--
	150 kHz .. 30 MHz	3.6 dB	

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	736496	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 (MRA US-EU 0003)
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
337 487 550 348 348	R-2665 R-2666 G-301 C-2914 T-1967	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) 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 equipment "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
264	Spectrum Analyzer	FSEK 30	826939/005	Bios=2.1, Analyzer= 3.20
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
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	TSI 1.53
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
383	Signal Generator	SME 03	842 828 /034	Firm.= 4.61
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. 8.53
444	CTC-FAR-EMS field	System-EMS-Field (FAR)	-	EMC 32 Version 8.40
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
594	Wideband Radio Communication Tester	CMW500	101757	Firmware Base=2.0.20.9, LTE=2.0.20.8. CDMA= 2.0.10
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	??????????

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	-	31.03.2013
005	AC - LISN (50 Ohm/50µH, test site 1)	ESH2-Z5	861741/005	Rohde & Schwarz	24/12 M	-	31.03.2014
007	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	892563/002	Rohde & Schwarz	24/12 M	-	31.03.2014
009	Power Meter (EMS-radiated)	NRV	863056/017	Rohde & Schwarz	24 M	-	31.03.2013
016	Line Impedance Simulating Network	Op. 24-D	B6366	Spitzenberger+Spies	36 M	-	31.03.2013
020	Horn Antenna 18 GHz (Subst 1)	3115	9107-3699	EMCO	36/12 M	-	31.03.2013
021	Loop Antenna (H-Field)	6502	9206-2770	EMCO	36 M	-	31.03.2015
030	Loop Antenna (H-field)	HFH-Z2	879604/026	Rohde & Schwarz	36 M	-	31.03.2015
033	RF-current probe (100kHz-30MHz)	ESH2-Z1	879581/18	Rohde & Schwarz	24 M	-	31.03.2013
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	30.06.2013
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	
090	Helmholtz coil: 2x10 coils in series	-	-	RWTÜV	-	4	
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	-	31.03.2015
100	passive voltage probe	Probe TK 9416	without	Schwarzbeck	36 M	-	31.03.2015
110	USB-LWL-Converter	OLS-1	-	Ing. Büro Scheiba	-	4	
119	RT Harmonics Analyzer dig. Flickermeter	B10	G60547	BOCONSULT	36 M	-	31.03.2013
134	horn antenna 18 GHz (Subst 2)	3115	9005-3414	EMCO	12 M	-	31.03.2014
136	adjustable dipole antenna (Dipole 1)	3121C-DB4	9105-0697	EMCO	36 M	-	31.03.2015
140	Signal Generator	SMHU	831314/006	Rohde & Schwarz	24 M	-	31.03.2014
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	-	31.03.2014
262	Power Meter	NRV-S	825770/0010	Rohde & Schwarz	24 M	-	31.03.2014
263	Signal Generator	SMP 04	826190/0007	Rohde & Schwarz	36 M	-	31.03.2013
264	Spectrum Analyzer	FSEK 30	826939/005	Rohde & Schwarz	12 M	-	31.03.2013
265	peak power sensor	NRV-Z33, Model 04	840414/009	Rohde & Schwarz	24 M	-	31.03.2014
266	peak power sensor	NRV-Z31, Model 04	843383/016	Rohde & Schwarz	24 M	-	31.03.2014
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	30.06.2013
291	high pass filter GSM 850/900	WHJ 2200-4EE	14	Wainwright GmbH	12 M	1c	30.06.2013
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	24/12 M	-	31.03.2014
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	-	31.03.2014
303	horn antenna 40 GHz (Subst 1)	BBHA9170	156	Schwarzbeck	36 M	-	31.03.2014
331	Climatic Test Chamber -40/+80 Grad	HC 4055	43146	Heraeus Vötsch	24 M	-	30.11.2013
341	Digital Multimeter	Fluke 112	81650455	Fluke	24 M	-	31.03.2014
342	Digital Multimeter	Voltcraft M-4660A	IB 255466	Voltcraft	24 M	-	31.03.2013
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	-	31.03.2014
356	power sensor	NRV-Z1	882322/014	Rohde & Schwarz	24 M	-	31.03.2013
357	power sensor	NRV-Z1	861761/002	Rohde & Schwarz	24 M	-	31.03.2013
371	Bluetooth Tester	CBT32	100153	R&S	12 M	-	31.03.2013
373	Single-Line V-Network (50 Ohm/5µH)	ESH3-Z6	100535	Rohde & Schwarz	24/12 M	-	31.03.2014
376	Horn Antenna 6 GHz	BBHA9120 E	BBHA 9120 E 179	Schwarzbeck	12 M	-	31.03.2013
377	EMI Test Receiver	ESCS 30	100160	Rohde & Schwarz	12 M	-	31.03.2013
389	Digital Multimeter	Keithley 2000	0583926	Keithley	24 M	-	31.03.2013
392	Radio Communication Tester	MT8820A	6K00000788	Anritsu	12 M	-	31.03.2013
431	Model 7405	Near-Field Probe Set	9305-2457	EMCO	-	4	
436	Univ. Radio Communication Tester	CMU 200	103083	Rohde & Schwarz	12 M	-	31.03.2013
441	CTC-SAR-EMI Cable Loss	System EMI field (SAR) Cable	-	CETECOM	12 M	5	31.10.2013

Ref.-No.	Equipment	Type	Serial-No.	Manufacturer	Interval of calibration	Remark	Cal due
443	CTC-FAR-EMI-RSE	System CTC-FAR-EMI-RSE	-	ETS-Lindgren / CETECOM	12 M	5	30.06.2013
448	notch filter WCDMA_FDD II	WRCT 1850.0/2170.0-5/40-	5	Wainwright Instruments GmbH	12 M	1c	30.06.2013
449	notch filter WCDMA FDD V	WRCT 824.0/894.0-5/40-8SSK	1	Wainwright	12 M	1c	30.06.2013
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	-	31.03.2013
463	Universal source	HP3245A	2831A03472	Agilent	-	4	
466	Digital Multimeter	Fluke 112	89210157	Fluke USA	24 M	-	31.03.2014
467	Digital Multimeter	Fluke 112	89680306	Fluke USA	24 M	-	31.03.2014
468	Digital Multimeter	Fluke 112	90090455	Fluke USA	24 M	-	31.03.2014
477	ReRadiating GPS-System	AS-47	-	Automotive Cons. Fink	-	3	
480	power meter (Fula)	NRVS	838392/031	Rohde & Schwarz	24 M	-	31.03.2013
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	-	30.06.2013
487	System CTC NSA-Verification SAR-EMI	System EMI field (SAR) NSA	-	ETS Lindgren / CETECOM	24 M	-	30.09.2013
489	EMI Test Receiver	ESU40	1000-30	Rohde & Schwarz	12 M	-	31.03.2013
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	30.06.2013
517	relais switch matrix	HF Relais Box Keithley	SE 04	Keithley	pre-m	2	
523	Digital Multimeter	L4411A	MY46000154	Agilent	24 M	-	31.03.2013
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	-	31.03.2013
547	Univ. Radio Communication Tester	CMU 200	835390/014	Rohde & Schwarz	12 M	-	31.03.2013
548	Digital-Barometer	GBP 2300	without	Greisinger GmbH	36 M	-	30.06.2015
549	Log.Per-Antenna	HL025	1000060	Rohde & Schwarz	36/12 M	-	31.03.2015
552	high pass filter 2,8-18GHz	WHKX 2.8/18G-10SS	4	Wainwright	12 M	1c	30.06.2013
558	System CTC FAR S-VSWR	System CTC FAR S-VSWR	-	CTC	24 M	-	31.07.2013
574	Biconilog Hybrid Antenna	BTA-L	980026L	Frankonia	36/12 M	-	30.03.2013
584	Spectrum Analyzer	FSU 8	100248	Rohde & Schwarz	12 M	-	31.03.2013
594	Wideband Radio Communication Tester	CMW500	101757	Rohde & Schwarz	24 M	-	31.03.2014
597	Univ. Radio Communication Tester	CMU 200	100347	Rohde & Schwarz	12 M	-	31.03.2013
598	Spectrum Analyzer	FSEM 30 (Reserve)	831259/013	Rohde & Schwarz	24 M	-	13.01.2013
600	power meter	NRVD (Reserve)	834501/018	Rohde & Schwarz	24 M	-	31.03.2013
601	medium-sensitivity diode sensor	NRV-Z5 (Reserve)	8435323/003	Rohde & Schwarz	24 M	-	12.01.2013
602	peak power sensor	NRV-Z32 (Reserve)	835080	Rohde & Schwarz	24 M	-	12.01.2013
608	UltraLog-Antenna	HL 562	830547/009	Rohde & Schwarz	36/12 M	-	31.03.2014
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	-	31.03.2014
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	-	01.01.2014
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	-	30.05.2014
634	Spectrum Analyzer	FSM (HF-Unit)	826188/010	Rohde & Schwarz	pre-m	2	
635	DFS Testbox	DFS Testbox	2012 V01	CETECOM SHA	-	-	
636	Wärmebildkamera	Ti32	Ti32-12060213, Tele	Fluke Corporation	24 M	-	31.07.2014
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	24 M	-	31.03.2014

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