

TEST REPORT
 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 |  FCC FEDERAL COMMUNICATIONS COMMISSION U.S.A. 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 |
|  WiFi 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 surveillance 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) μ V/m 24000/F(kHz) μ V/m 30 μ V/m | -- | -- | Remark 1.) |
| 7 | RF-Power (ERP/EIRP) radiated | | §2.1046 §22.913(a)(2) | RSS-132: 5.4 SRSP-503: 5.1.3 | < 11.5 Watt (EIRP) (mobile stations) | | | passed |
| 8 | Spurious emissions radiated (30 MHz to... *tenth-times of the fundamental frequency) | | §24.232(c) | RSS-133: 4.1/6.4 SRSP-510: 5.1.2 | < 2 Watt (EIRP) | | | passed |
| 9 | Band-Edge compliance | | §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 |
| 30 | RF Power | | §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 | Antenna terminal | §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 | | §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 |
| 36 | Spurious emissions | | §22.355, table C-1 §24.235 §2.1055(a)(2) | RSS-132: 5.3 RSS-133: 6.3 | < \pm 2.5ppm < \pm 0.1 ppm | | | passed |
| 37 | Band-Edge compliance | | | | | | | |
| 38 | Frequency stability | | | | | | | |

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.



.....
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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) | <input checked="" type="checkbox"/> GSM 850: 824 – 849 MHz (Uplink), 869-894 MHz (Downlink) <input checked="" type="checkbox"/> GSM1900: 1850-1910 MHz (Uplink), 1930-1990 MHz (Downlink) | | |
| Type of modulation | <input checked="" type="checkbox"/> GSM,GPRS: GMSK <input checked="" type="checkbox"/> EGPRS-Mode: 8-PSK | | |
| Number of channels (USA/Canada -bands) | <input checked="" type="checkbox"/> GSM 850: 128 – 251, 125 channels <input checked="" type="checkbox"/> GSM1900: 512 – 810, 300 channels | | |
| Test Channel frequencies | <input checked="" type="checkbox"/> GSM/E-GPRS 850 MHz Band: Channel 128/192/251 <input checked="" type="checkbox"/> GSM/E-GPRS 1900 MHz Band: Channel 512/661/810 | | |
| Emission designator(s) | 245KGXW (GSM850) 250KGXW (EDGE850) 245KG7W (GSM1900) 253KG7W (EDGE 1900) | | |
| Antenna Type | <input checked="" type="checkbox"/> External, separate RF-connector | | |
| Antenna Gain Tx (main) | <input checked="" type="checkbox"/> 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) | <input checked="" type="checkbox"/> 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 | <input checked="" type="checkbox"/> for board over AC/DC adapter (AE2): 120V/60 Hz <input checked="" type="checkbox"/> 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, electrodynamic microphones, etc.? | <input type="checkbox"/> yes <input checked="" type="checkbox"/> no | | |
| EUT sample type | <input type="checkbox"/> Production | <input checked="" type="checkbox"/> Pre-Production | <input type="checkbox"/> Engineering |
| FCC label attached | <input type="checkbox"/> yes | <input checked="" type="checkbox"/> 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: 357520070020 959 | 261A01 | 23.56 |
| EUT B | GSM/W-CDMA Module | SARA-U201 | IMEI: 357520070020 918 | 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 | GSATT150500 1611 | - | - |
| 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

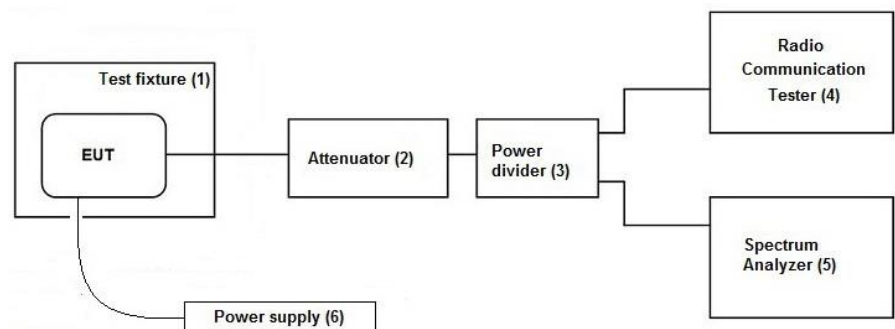
4.1. Test system set-up for conducted measurements at antenna port

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: |
|---|---|---|
| <input checked="" type="checkbox"/> 10 dB Attenuator (#530) | <input checked="" type="checkbox"/> CMU200 Communication Test-Unit for GSM/W-CDMA | See List of equipment under each test case and chapter 8 for calibration info |
| <input checked="" type="checkbox"/> Low loss RF-cables | <input checked="" type="checkbox"/> DC-Power Supply | |
| <input checked="" type="checkbox"/> 6 dB resistive power divider/coupler (#529) | <input checked="" type="checkbox"/> Spectrum-Analyser | |

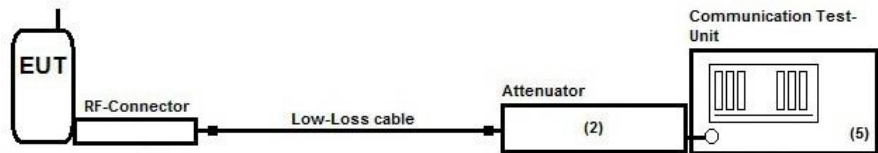
Testing method: ANSI C63.10:2013, KDB 971168 D01 v02r02

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: |
|----------------|---|---|---|
| | <input checked="" type="checkbox"/> 20 dB Attenuator (#613) | <input checked="" type="checkbox"/> CMU200 Communication Test-Unit for GSM/W-CDMA | See List of equipment under each test case and chapter 8 for calibration info |
| | <input checked="" type="checkbox"/> Low loss RF-cables | <input checked="" type="checkbox"/> DC-Power Supply | |

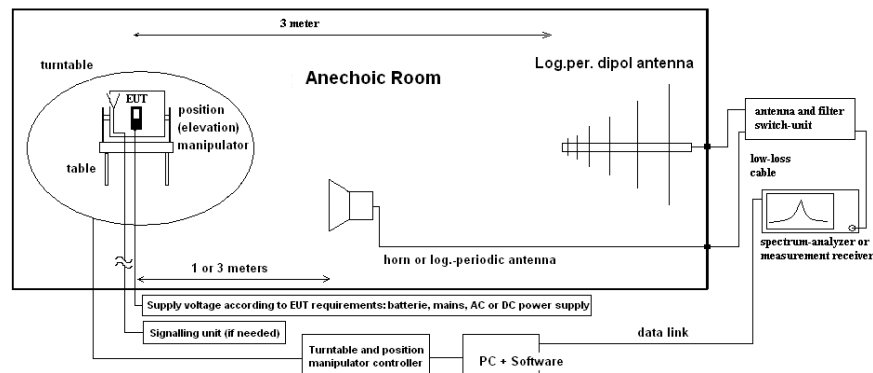
Measurement uncertainty See chapter Measurement Uncertainties (Cel-2)

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 its characteristics was recorded with an EMI-receiver, broadband antenna and software.

The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

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

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

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions.

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

The readings on the spectrum analyzer are corrected with conversion value between field strength and E(I)RP, so the readings shown are equivalent to ERP/EIRP values. Critical measurements near the limit are re-measured with a substitution method accord. ANSI/TIA/EIA 603 C/D

Formula:

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

$$E_{C(E)RP} = E_C - 95.2 \text{ dB}$$

$$M = L_T - E_{C(E)RP}$$

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)

$E_{C(E)RP}$ = 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 | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | | | |
| test site | <input checked="" type="checkbox"/> 347 Radio.lab. 1 | <input type="checkbox"/> Radio.lab. 2 | | | |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 489 ESU 40 | <input type="checkbox"/> 264 FSEK | <input checked="" type="checkbox"/> 620 ESU 26 | |
| signaling | <input type="checkbox"/> 392 MT8820A | <input checked="" type="checkbox"/> 436 CMU | <input type="checkbox"/> 547 CMU | | |
| otherwise | <input type="checkbox"/> 110 USB LWL | | | | |
| DC power | <input type="checkbox"/> 456 EA 3013A | <input checked="" type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 459 EA 2032-50 | <input type="checkbox"/> 268 EA- 3050 | <input type="checkbox"/> 494 AG6632A <input type="checkbox"/> 498 NGPE 40 |
| otherwise | <input type="checkbox"/> 331 HC 4055 | <input checked="" type="checkbox"/> 248 6 dB Att. | <input checked="" type="checkbox"/> 529 Power div. | <input checked="" type="checkbox"/> - cable OTA20 | |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | <input checked="" type="checkbox"/> 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 | <p>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.</p> <p>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)</p> <p>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.</p> | |
| Mobile phone settings | <p>A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200"</p> <p>UE Power should be set to maximum, continuous transmission. DTX or other power saving techniques have been disabled</p> <p>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.</p> | |

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 [dBm] | PAPR-Limit [dB] | Result |
|----------|-----------------|-----|-------------------------|----------------------------|-------------------------------------|------------------------|-----------------|--------|
| | Range | No. | | | | | | |
| 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 [dBm] | PAPR-Limit [dB] | Result |
|------------|-----------------|-----|-------------------------|----------------------------|-------------------------------------|------------------------|-----------------|--------|
| | Range | No. | | | | | | |
| 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 [dBm] | PAPR-Limit [dB] | Result |
|----------|-----------------|-----|-------------------------|----------------------------|-------------------------------------|------------------------|-----------------|--------|
| | Range | No. | | | | | | |
| 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 [dBm] | PAPR-Limit [dB] | Result |
|-------------|-----------------|-----|-------------------------|----------------------------|-------------------------------------|------------------------|-----------------|--------|
| | Range | No. | | | | | | |
| 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 | <input checked="" type="checkbox"/> 347 Radio.lab. 1 | <input type="checkbox"/> Radio.lab. 2 | | | | |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 489 ESU40 | <input type="checkbox"/> 264 FSEK | <input checked="" type="checkbox"/> 620 ESU26 | | |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 436 CMU | <input checked="" type="checkbox"/> 547 CMU | | | |
| DC Power | <input type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 087 EA3013 | <input checked="" type="checkbox"/> 354 NGPE 40 | <input type="checkbox"/> 086 LNG50-10 | | |
| otherwise | <input checked="" type="checkbox"/> 529 6dB divider | <input checked="" type="checkbox"/> 530 10dB Att. | <input type="checkbox"/> 431 Near field | | | |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | | <input checked="" type="checkbox"/> 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 Span RBW VBW Sweep time Sweep mode Detector | Spectrum analyser mode 1 MHz 3 kHz 30 kHz Coupled Repetitive, max-hold Peak | Spectrum analyser mode 1 MHz 3 kHz 30 kHz Coupled Repetitive, max-hold 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 annex 1/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 | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site | <input checked="" type="checkbox"/> 347 Radio.lab. 1 | <input checked="" type="checkbox"/> Radio.lab. 2 | |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK <input checked="" type="checkbox"/> 489 ESU <input type="checkbox"/> 620 ESU26 |
| signaling | <input type="checkbox"/> 017 CMD 65 | <input type="checkbox"/> 323 CMD 55 | <input checked="" type="checkbox"/> 340 CMD 55 |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 436 CMU | <input checked="" type="checkbox"/> 547 CMU |
| power supply | <input checked="" type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 <input type="checkbox"/> 268 EA- 3050 <input type="checkbox"/> 494 AG6632A <input type="checkbox"/> 498 NGPE 40 |
| otherwise | <input checked="" type="checkbox"/> 529 6dB divider | <input checked="" type="checkbox"/> 530 10dB Att. | <input type="checkbox"/> 431 Near field |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | | <input type="checkbox"/> 060 120 V/ 60 Hz via PAS 5000 |

5.3.2. Requirements and limits

| | |
|-------|---|
| FCC | <input checked="" type="checkbox"/> Part 2.1051, Part2.1057(a)(1) <input checked="" type="checkbox"/> Part 22 Subpart H, §22.917(a)(b)(c)(d) <input checked="" type="checkbox"/> Part 24 Subpart E, §24.238(a)(b)(c)(d) |
| IC | <input checked="" type="checkbox"/> RSS-132, Issue 3: 5.5(i)(ii) <input checked="" type="checkbox"/> 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 | <p>“§ 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”</p> <p>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.</p> <p>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)</p> | |
| Spectrum-Analyzer settings | See below tables | |
| EUT settings | <p>A call was established with settings according chapter “Parameter settings on mobile phone and base station CMU200”</p> <p>UE Power should be set to maximum, continuous transmission. DTX or other power saving techniques have been disabled.</p> <p>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.</p> | |

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 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.08_CH128_GPRS_Sweep2 | Low | | 30MHz – 9 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.03_BE_CH128_GPRS | Low | | 823-824 MHz | | Band Edge Compliance | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.09_CH192_GPRS_Sweep1 | Middle | 192 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.10_CH192_GPRS_Sweep2 | Middle | | 30MHz – 9 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.11_CH251_GPRS_Sweep1 | High | 251 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.12_CH251_GPRS_Sweep2 | High | | 30MHz – 9 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.04_BE_CH251_GPRS | High | | 849 – 850 MHz | | Band-Edge compliance | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 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 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.14_Ch128_EGPRS_Sweep2 | Low | | 30MHz – 9 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.05_BE_Ch128_EGPRS | Low | | 823 - 824 MHz | | Band Edge Compliance | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.15_Ch192_EGPRS_Sweep1 | Middle | 192 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.16_Ch192_EGPRS_Sweep2 | Middle | | 30MHz – 9 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.17_Ch251_EGPRS_Sweep1 | High | 251 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.18_Ch251_EGPRS_Sweep2 | High | | 30MHz – 9 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.06_BE_Ch251_EGPRS | High | | 849 – 850 MHz | | Band-Edge compliance | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 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 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.21_RSE_Ch512_GPRS_Sweep2 | Low | | 30MHz – 20 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.10_BE_Ch512_GPRS_PK | Low | | 1849 – 1850 MHz | | Band Edge Compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.22_RSE_Ch661_GPRS_Sweep1 | Middle | 661 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.23_RSE_Ch661_GPRS_Sweep2 | Middle | | 30MHz – 20 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.24_RSE_Ch810_GPRS_Sweep1 | High | 810 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.25_RSE_Ch810_GPRS_Sweep2 | High | | 30MHz – 20 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.11_BE_Ch810_GPRS_PK | High | | 1910 – 1911 MHz | | Band-Edge compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 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 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.27_RSE_Ch512_EGPRS_Sweep 2 | Low | | 30MHz – 20 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.12_BE_Ch512_EGPRS_PK | Low | | 1849 – 1850 MHz | | Band Edge Compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.28_RSE_Ch661_EGPRS_Sweep 1 | Middle | 661 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.29_RSE_Ch661_EGPRS_Sweep 2 | Middle | | 30MHz – 20 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.30_RSE_Ch810_EGPRS_Sweep 1 | High | 810 | 9 kHz – 30 MHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 36.31_RSE_Ch810_EGPRS_Sweep 2 | High | | 30MHz – 20 GHz | | Carrier visible on diagram, not relevant for result | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 37.13_BE_Ch810_EGPRS_PK | High | | 1910 – 1911 MHz | | Band-Edge compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 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 | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site | <input checked="" type="checkbox"/> 347 Radio.lab.1 | <input checked="" type="checkbox"/> Radio.lab.2 | <input type="checkbox"/> <input type="checkbox"/> |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 489 ESU 40 | <input type="checkbox"/> 264 FSEK <input type="checkbox"/> 620 ESU 26 |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 436 CMU | <input checked="" type="checkbox"/> 547 CMU |
| DC power | <input type="checkbox"/> 456 EA 3013A | <input type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 <input type="checkbox"/> 268 EA- 3050 <input type="checkbox"/> 494 AG6632A <input type="checkbox"/> 498 NGPE 40 |
| otherwise | <input checked="" type="checkbox"/> 529 6dB divider | <input checked="" type="checkbox"/> 530 10dB Att. | <input type="checkbox"/> 431 Near field |
| Climatic test chamber | <input checked="" type="checkbox"/> 331 HC 4055 | <input checked="" type="checkbox"/> 627 OPUS 1 | |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | | <input type="checkbox"/> 060 120 V/ 60 Hz via PAS 5000 |

5.4.2. Requirements and limits

| | |
|--------------|--|
| FCC | <input checked="" type="checkbox"/> §2.1055(a)(1) (d) <input checked="" type="checkbox"/> §22.355 <input checked="" type="checkbox"/> §24.235 |
| IC | <input checked="" type="checkbox"/> RSS-Gen, Issue 3 <input checked="" type="checkbox"/> RSS-132: 5.3 <input checked="" type="checkbox"/> RSS-133: 6.3 |
| ANSI | C63.26-2015, Chapter 5.6 |
| Limit | <i>"The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block"</i> |

5.4.3. Test condition and test set-up

| | |
|--------------------|--|
| Test system set-up | <p>Please see chapter "Test system set-up for conducted measurements on antenna port"</p> <p>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.</p> |
| Measurement method | <p>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)</p> <p>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.</p> |
| EUT settings | <p>A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200"</p> <p>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.</p> |

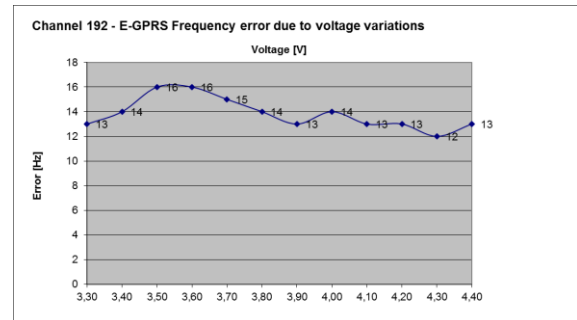
5.4.4. Measurement results

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.

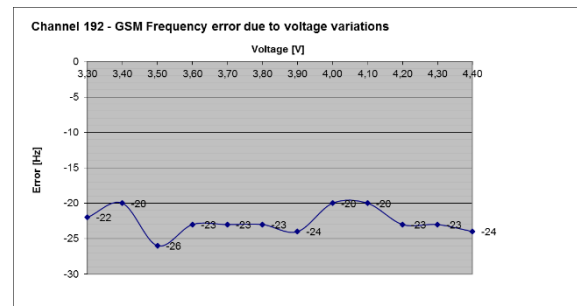
5.4.4.2. GPRS 850 Mode: Op. Mode 1, set-up 2

| Channel 192: GMSK | | | | |
|-------------------|-------------------------|-------------------------|-------|---------|
| Voltage [V] | Nominal Frequency [MHz] | Maximum frequency error | | Verdict |
| | | [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 | |



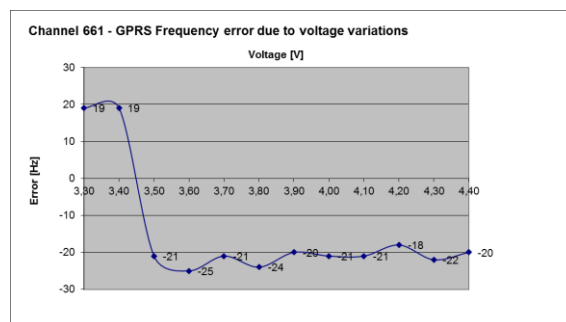
5.4.4.3. E-GPRS 850 Mode: Op. Mode 2, set-up 2

| Channel 192: 8-PSK | | | | |
|--------------------|-------------------------|-------------------------|--------|---------|
| Voltage [V] | Nominal Frequency [MHz] | Maximum frequency error | | Verdict |
| | | [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 | |



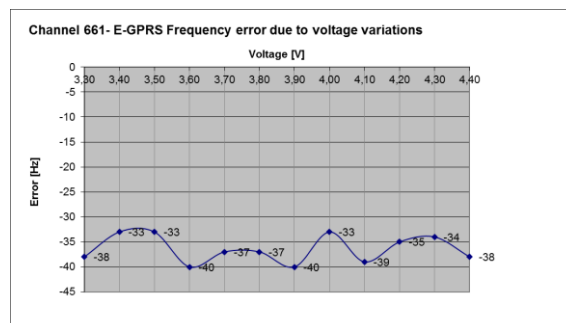
5.4.4.4. GPRS 1900 Mode: Op. Mode 3, set-up 2

| Channel 661: GMSK | | | | |
|-------------------|-------------------------|-------------------------|--------|---------|
| Voltage [V] | Nominal Frequency [MHz] | Maximum frequency error | | Verdict |
| | | [Hz] | [ppm] | |
| 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 [V] | Nominal Frequency [MHz] | Maximum frequency error | | Verdict |
| | | [Hz] | [ppm] | |
| 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 | |

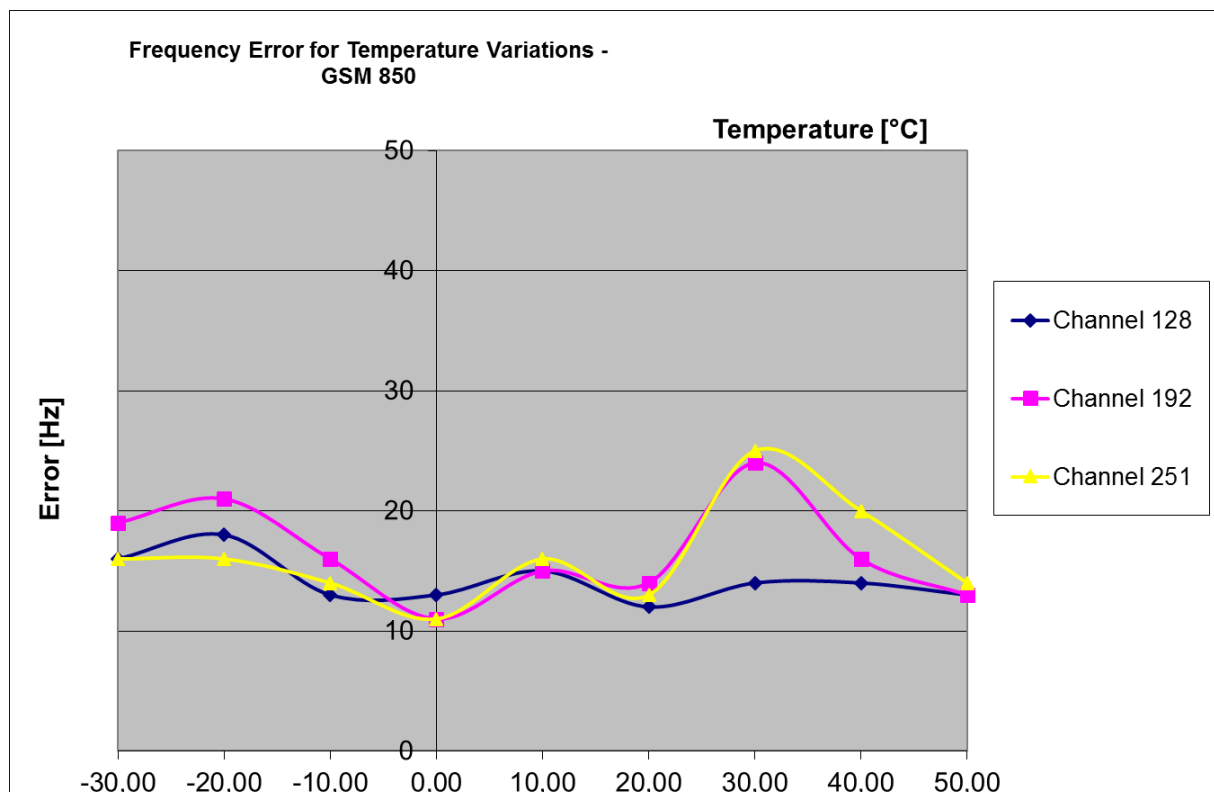


5.4.4.6. Frequency shift of carrier against temperature at constant power supply voltage

- 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.

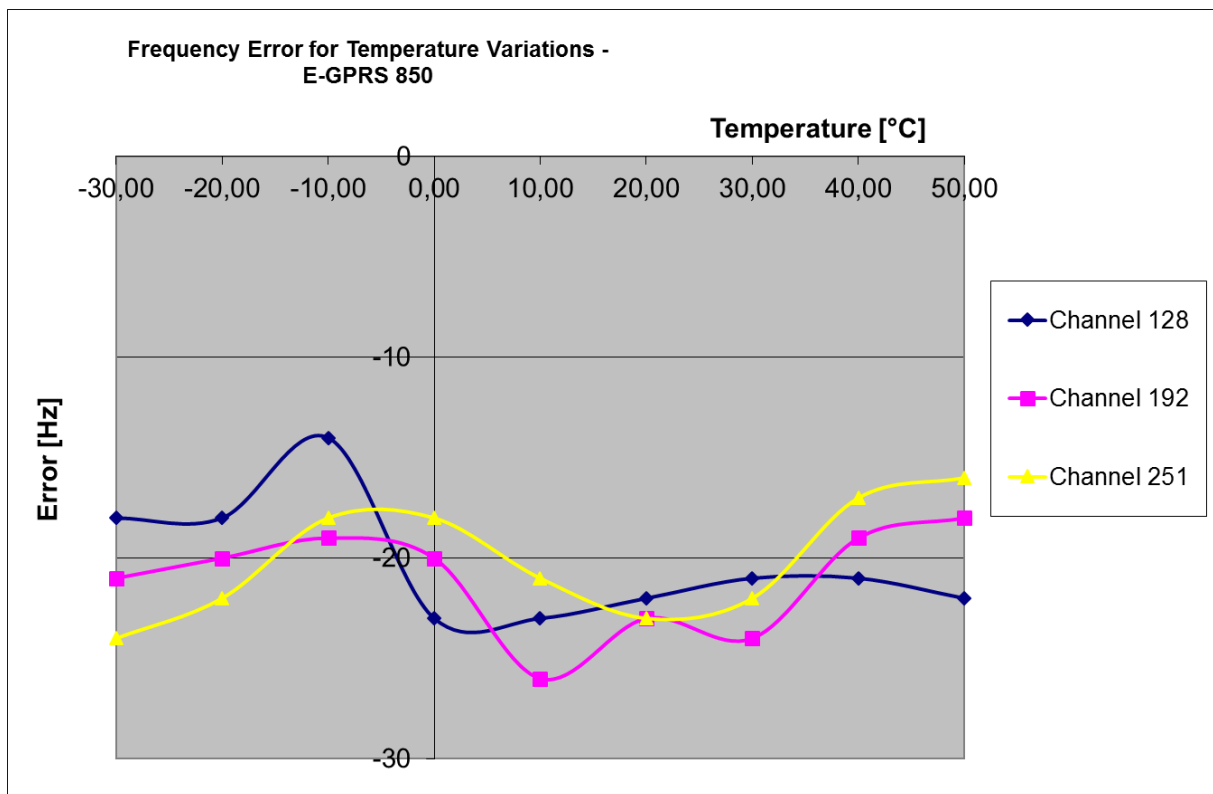
5.4.4.6.1. GPRS 850 Mode: Op. Mode 1, set-up 2

| Temperature | Maximum frequency error | | | | | | Verdict Limit=±0.1 ppm |
|-------------|-------------------------|-------------|-------------|-------------|-------------|-------------|---------------------------|
| | 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 | |



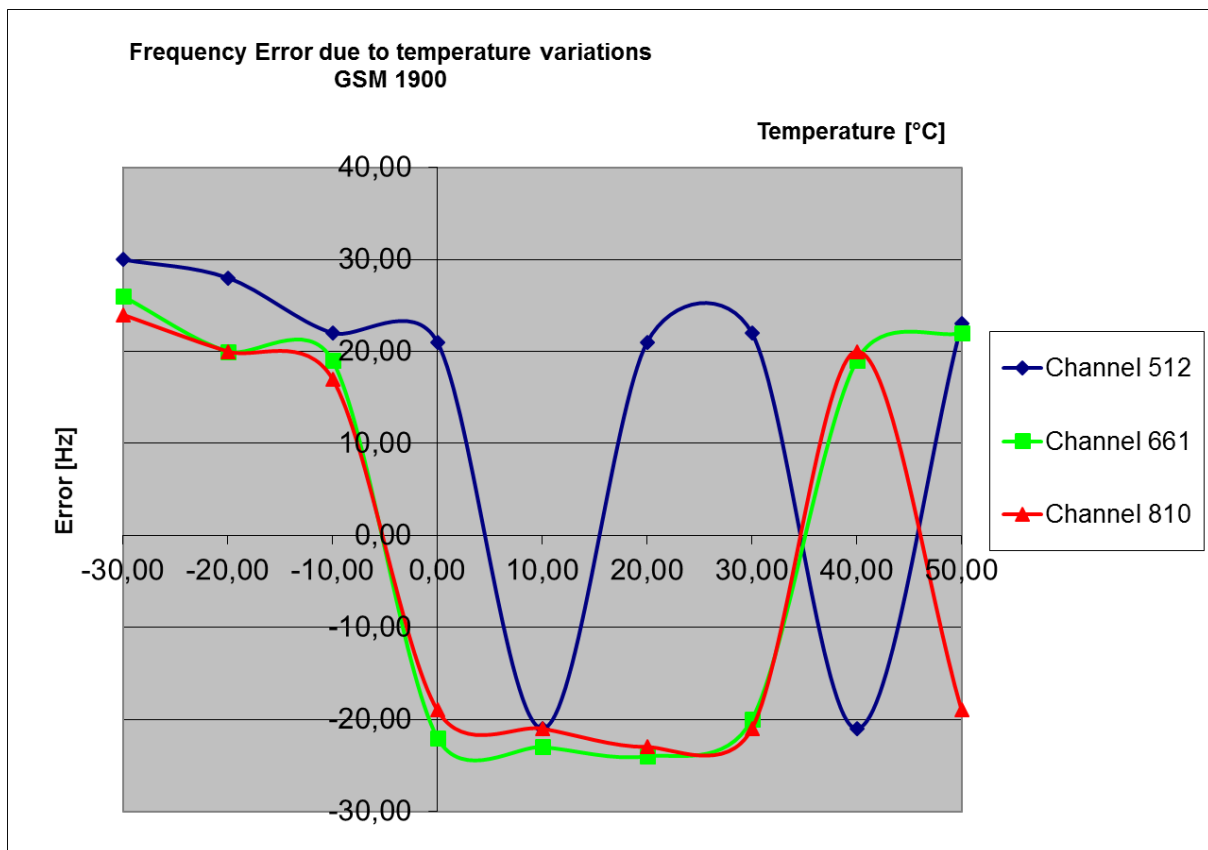
5.4.4.6.2. E-GPRS 850 Mode: Op. Mode 2, set-up 2

| Temperature | Maximum frequency error | | | | | | Verdict Limit=±0.1 ppm |
|-------------|-------------------------|-------------|-------------|-------------|-------------|-------------|---------------------------|
| | 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 | |



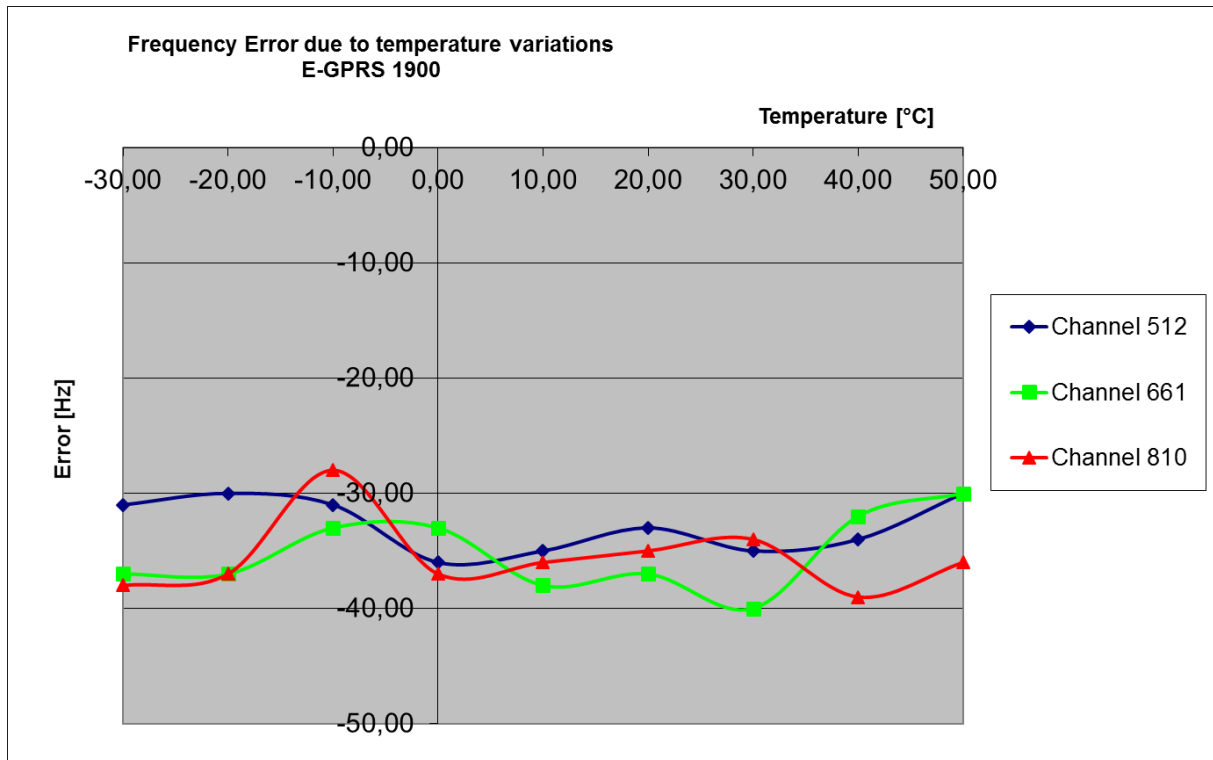
5.4.4.6.3. GPRS 1900 Mode: Op. Mode 3, set-up 2

| Temperature | Maximum frequency error | | | | | | Verdict Limit=±0.1ppm |
|-------------|-------------------------|-------------|-------------|-------------|-------------|-------------|--------------------------|
| | Channel 512 | Channel 661 | Channel 810 | Channel 512 | Channel 661 | Channel 810 | |
| | [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 Limit=±0.1 ppm |
|-------------|-------------------------|-------------|-------------|-------------|-------------|-------------|---------------------------|
| | Channel 512 | Channel 661 | Channel 810 | Channel 512 | Channel 661 | Channel 810 | |
| | [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 | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 487 SAR NSA | <input checked="" type="checkbox"/> 443 FAR |
| receiver | <input type="checkbox"/> 377 ESCS30 | <input type="checkbox"/> 001 ESS | <input type="checkbox"/> 489 ESU 40 |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input checked="" type="checkbox"/> 264 FSEK |
| antenna | <input checked="" type="checkbox"/> 439 HL 562 | <input checked="" type="checkbox"/> 549 HL 025 | <input type="checkbox"/> 302 BBHA9170 |
| signaling | <input type="checkbox"/> 017 CMD 65 | <input type="checkbox"/> 323 CMD 55 | <input type="checkbox"/> 340 CMD 55 |
| power supply | <input checked="" type="checkbox"/> 392 MT8820A | <input checked="" type="checkbox"/> 546 CMU | <input type="checkbox"/> 547 CMU |
| otherwise | <input checked="" type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 |
| line voltage | <input type="checkbox"/> 529 6dB divider | <input type="checkbox"/> 530 6dB Att. | <input type="checkbox"/> 110 USB LWL |
| | <input type="checkbox"/> 230 V 50 Hz via public mains | <input checked="" type="checkbox"/> 060 120 V/ 60 Hz via PAS 5000 | <input type="checkbox"/> 482 Filter Matrix |
| | | | <input type="checkbox"/> 268 EA- 3050 |
| | | | <input type="checkbox"/> 494 AG6632A |
| | | | <input type="checkbox"/> 498 NGPE 40 |
| | | | <input type="checkbox"/> 030 HFH-Z2 |
| | | | <input type="checkbox"/> 477 GPS |

5.5.2. Requirements and limits (Variante RF-Parameter)

| | |
|-------|--|
| FCC | <input checked="" type="checkbox"/> Part 2.1053(a), Part2.1057(a)(1) <input checked="" type="checkbox"/> Part 22 Subpart H, §22.917(a)(b) <input checked="" type="checkbox"/> Part 24 Subpart E, §24.238(a)(b) |
| IC | <input checked="" type="checkbox"/> RSS-132, Issue 3: 5.5(i)(ii) <input checked="" type="checkbox"/> 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): | <input checked="" type="checkbox"/> air link | <input type="checkbox"/> cable connection |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply |
| Equipment set up | <input checked="" type="checkbox"/> table top | <input type="checkbox"/> 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 | <p>“§ 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”</p> <p>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.</p> <p>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</p> | |
| EUT settings | <p>A call was established with settings according chapter “Parameter settings on mobile phone and base station CMU200”</p> <p>The UE and used accessories (if any used) were set to work according their intended use/specification stated as by the applicant</p> <p>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.</p> | |

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 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.03_RSE_R_Ch128_GPRS | Low | | 823 – 824 MHz | | Band Edge Compliance | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 8.05_RSE_R_Ch192_GPRS | Middle | 192 | 30 MHz – 9 GHz | | Carrier on diagram, not relevant for results | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 8.06_RSE_R_Ch251_GPRS | High | 251 | 30 MHz – 9 GHz | | Carrier on diagram, not relevant for results | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.04_RSE_R_Ch251_GPRS | High | | 849 – 850 MHz | | Band-Edge compliance | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 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 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.09_BE_R_Ch512_GPRS | Low | | 1849 – 1850 MHz | | Band Edge Compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 8.14_RSE_R_Ch661_GPRS | Middle | 661 | 30 MHz – 18 GHz | | Carrier on diagram, not relevant for results | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 8.15_RSE_R_Ch810_PRS | High | 810 | 30 MHz – 18 GHz | | Carrier on diagram, not relevant for results | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.10_BE_R_Ch810_GPRS | High | | 1910 – 1911 MHz | | Band-Edge compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 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 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 9.11_BE_R_Ch512_EGPRS | Low | | 1849 – 1850 MHz | | Band Edge Compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | -- | 661 | 30 MHz – 18 GHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| -- | -- | 810 | 30 MHz – 18 GHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 9.12_BE_R_Ch810_EGPRS | High | | 1910 – 1911 MHz | | Band-Edge compliance | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 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 | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | | <input type="checkbox"/> Please see Chapter. 2.2.3 | |
| test site | <input checked="" type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 487 SAR NSA | <input type="checkbox"/> 347 Radio.lab. | <input type="checkbox"/> | <input type="checkbox"/> |
| receiver | <input type="checkbox"/> 377 ESCS30 | <input checked="" type="checkbox"/> 001 ESS | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK | <input type="checkbox"/> | <input type="checkbox"/> |
| antenna | <input type="checkbox"/> 574 BTA-L | <input type="checkbox"/> 133 EMCO3115 | <input type="checkbox"/> 302 BBHA9170 | <input type="checkbox"/> 289 CBL 6141 | <input checked="" type="checkbox"/> 030 HFH-Z2 <input type="checkbox"/> 477 GPS |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 371 CBT32 | <input type="checkbox"/> 547 CMU | <input type="checkbox"/> 594 CMW | |
| otherwise | <input type="checkbox"/> 400 FTC40x15E | <input type="checkbox"/> 401 FTC40x15E | <input type="checkbox"/> 110 USB LWL | <input type="checkbox"/> 482 Filter Matrix | <input type="checkbox"/> 378 RadiSense |
| DC power | <input type="checkbox"/> 456 EA 3013A | <input type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 | <input type="checkbox"/> 268 EA- 3050 | <input type="checkbox"/> 494 AG6632A <input type="checkbox"/> 498 NGPE 40 |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | | <input checked="" type="checkbox"/> 060 120 V 60 Hz via PAS 5000 | | |

5.6.2. Requirements

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

5.6.3. Test condition and test set-up

| | | | |
|---------------------------------------|---|---|--|
| Signal link to test system (if used): | <input checked="" type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input type="checkbox"/> none |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | <input checked="" type="checkbox"/> table top | | <input type="checkbox"/> floor standing |
| Climatic conditions | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| EMI-Receiver or Analyzer Settings | Scan data | <input checked="" type="checkbox"/> 9 – 150 kHz RBW/VBW = 200 Hz Scan step = 80 Hz <input checked="" type="checkbox"/> 150 kHz – 30 MHz RBW/VBW = 9 kHz Scan step = 4 kHz <input type="checkbox"/> other: | |
| | Scan-Mode | <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3dB Spectrum analyser Mode Peak (pre-measurement) and Quasi-PK/Average (final if applicable) | |
| | Detector Mode: Sweep-Time | 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 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 2.23 | Low | 512 | 9 kHz-30 MHz | 1 | 3 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 2.02 | Middle | 192 | 9 kHz-30 MHz | 1 | 1 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 2.24 | Middle | 661 | 9 kHz-30 MHz | 1 | 3 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 2.03 | High | 251 | 9 kHz-30 MHz | 1 | 1 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 2.25 | High | 810 | 9 kHz-30 MHz | 1 | 3 | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | 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 (d _{meas} < D _{near-field}) | 2te Condition (Limit distance bigger d _{near-field}) | Distance Correction accord. Formula |
|-----------------|-------------|------------|---------------------|-----------------------------------|--|--|-------------------------------------|
| kHz | 9,00E+03 | 33333,33 | 5305,17 | 300 | fulfilled | not fulfilled | -80,00 |
| | 1,00E+04 | 30000,00 | 4774,65 | | not fulfilled | -80,00 | |
| | 2,00E+04 | 15000,00 | 2387,33 | | not fulfilled | -80,00 | |
| | 3,00E+04 | 10000,00 | 1591,55 | | not fulfilled | -80,00 | |
| | 4,00E+04 | 7500,00 | 1193,66 | | not fulfilled | -80,00 | |
| | 5,00E+04 | 6000,00 | 954,93 | | not fulfilled | -80,00 | |
| | 6,00E+04 | 5000,00 | 795,78 | | not fulfilled | -80,00 | |
| | 7,00E+04 | 4285,71 | 682,09 | | not fulfilled | -80,00 | |
| | 8,00E+04 | 3750,00 | 596,83 | | not fulfilled | -80,00 | |
| | 9,00E+04 | 3333,33 | 530,52 | | not fulfilled | -80,00 | |
| | 1,00E+05 | 3000,00 | 477,47 | | not fulfilled | -80,00 | |
| | 1,25E+05 | 2400,00 | 381,97 | | not fulfilled | -80,00 | |
| | 2,00E+05 | 1500,00 | 238,73 | | fulfilled | fulfilled | -78,02 |
| | 3,00E+05 | 1000,00 | 159,16 | | fulfilled | fulfilled | -74,49 |
| | 4,00E+05 | 750,00 | 119,37 | | fulfilled | fulfilled | -72,00 |
| | 4,90E+05 | 612,24 | 97,44 | | fulfilled | fulfilled | -70,23 |
| | 5,00E+05 | 600,00 | 95,49 | | fulfilled | not fulfilled | -40,00 |
| | 6,00E+05 | 500,00 | 79,58 | | fulfilled | not fulfilled | -40,00 |
| | 7,00E+05 | 428,57 | 68,21 | | fulfilled | not fulfilled | -40,00 |
| 8,00E+05 | 375,00 | 59,68 | fulfilled | not fulfilled | -40,00 | | |
| 9,00E+05 | 333,33 | 53,05 | fulfilled | not fulfilled | -40,00 | | |
| MHz | 1,00 | 300,00 | 47,75 | 30 | fulfilled | not fulfilled | -40,00 |
| | 1,59 | 188,50 | 30,00 | | fulfilled | not fulfilled | -40,00 |
| | 2,00 | 150,00 | 23,87 | | fulfilled | fulfilled | -38,02 |
| | 3,00 | 100,00 | 15,92 | | fulfilled | fulfilled | -34,49 |
| | 4,00 | 75,00 | 11,94 | | fulfilled | fulfilled | -32,00 |
| | 5,00 | 60,00 | 9,55 | | fulfilled | fulfilled | -30,06 |
| | 6,00 | 50,00 | 7,96 | | fulfilled | fulfilled | -28,47 |
| | 7,00 | 42,86 | 6,82 | | fulfilled | fulfilled | -27,13 |
| | 8,00 | 37,50 | 5,97 | | fulfilled | fulfilled | -25,97 |
| | 9,00 | 33,33 | 5,31 | | fulfilled | fulfilled | -24,95 |
| | 10,00 | 30,00 | 4,77 | | fulfilled | fulfilled | -24,04 |
| | 10,60 | 28,30 | 4,50 | | fulfilled | fulfilled | -23,53 |
| | 11,00 | 27,27 | 4,34 | | fulfilled | fulfilled | -23,21 |
| | 12,00 | 25,00 | 3,98 | | fulfilled | fulfilled | -22,45 |
| | 13,56 | 22,12 | 3,52 | | fulfilled | fulfilled | -21,39 |
| | 15,00 | 20,00 | 3,18 | | fulfilled | fulfilled | -20,51 |
| | 15,92 | 18,85 | 3,00 | | fulfilled | fulfilled | -20,00 |
| | 17,00 | 17,65 | 2,81 | | not fulfilled | fulfilled | -20,00 |
| | 18,00 | 16,67 | 2,65 | | not fulfilled | fulfilled | -20,00 |
| | 20,00 | 15,00 | 2,39 | | not fulfilled | fulfilled | -20,00 |
| | 21,00 | 14,29 | 2,27 | | not fulfilled | fulfilled | -20,00 |
| 23,00 | 13,04 | 2,08 | not fulfilled | fulfilled | -20,00 | | |
| 25,00 | 12,00 | 1,91 | not fulfilled | fulfilled | -20,00 | | |
| 27,00 | 11,11 | 1,77 | not fulfilled | fulfilled | -20,00 | | |
| 29,00 | 10,34 | 1,65 | not fulfilled | fulfilled | -20,00 | | |
| 30,00 | 10,00 | 1,59 | not fulfilled | fulfilled | -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 | 4.0 dB | | | | | | - |
| | | 150 kHz - 30 MHz | 3.6 dB | | | | | | |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz | 4.2 dB | | | | | | E-Field |
| | | 1 GHz - 18 GHz | 5.1 dB | | | | | | |
| 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 | 5.0 dB | | | | | | Magnetic field E-field Substitution |
| | | 30 MHz - 1 GHz | 4.2 dB | | | | | | |
| | | 1 GHz - 20 GHz | 3.17 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 | (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 Measurment. | 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 Measurment. | 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 |
| 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 | dit0307022 | 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) | - | Id | |
| 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 | Wainwrgh | 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 | 201.0999.9302.6.4.1.4 3 | 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 | Amplifier | 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 |
| -- | -- | -- |