

TEST REPORT
No.: 15-1-0017001T37a

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

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

for

peiker acoustic GmbH & Co. KG

ATM-01 R2-US-4GW

FCC-ID: QWY-ATM-R-622

IC: 6588A-ATMR622

PMN: ATM roof version

HVIN: ATM-01 R2-US-4GW







| Laboratory Accreditation and Listings | | | |
|--|--|---|---|
|  Deutsche Akkreditierungsstelle D-PL-12047-01-01 |  FEDERAL COMMUNICATIONS COMMISSION USA 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 |  ctia AuthorizedTM Test Lab Lab Code: 20011130-00 | | |
| accredited according to DIN EN ISO/IEC 17025 | | | |
| CETECOM GmbH Laboratory Radio Communications & Electromagnetic Compatibility Im Teelbruch 116 • 45219 Essen • Germany Registered in Essen, Germany, Reg. No.: HRB Essen 8984 Tel.: + 49 (0) 20 54 / 95 19-954 • Fax: + 49 (0) 20 54 / 95 19-964 E-mail: info@cetecom.com • Internet: www.cetecom.com | | | |

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The listed attachments are an integral part of this report.

1. Summary of test results

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

The 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. Delta tests apply to check for conformance against valid standards due already approved cellular wireless module V1140-101-1 with FCC-ID: QWY-V1140-101-1 and IC 6588A-V11401011.

Following tests have been performed to show compliance with applicable FCC Part 2, Part 22, Subpart H, Part 24, Subpart E (Broadband PCS) and Part 27, Subpart C of the FCC CFR Title 47 Rules, Edition 4th November 2015 and Canada RSS-132 Issue 3, RSS-133 Issue 6, RSS-130 Issue 1 and RSS-Gen Issue 4 standards.

1.1. TX mode, Test overview of FCC and Canada IC (RSS) Standards

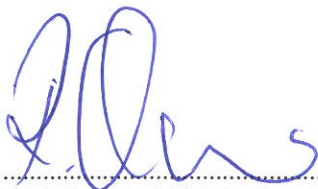
| No. of Diagram group | Test case | Port | References & Limits | | | EUT set-up | EUT op-mode | Result |
|----------------------|---|---|---------------------------------|--|---|------------|-------------|-----------------|
| | | | FCC Standard | RSS Section | Test limit | | | |
| 1 | AC-Power Lines Emissions Conducted (0,15 - 30 MHz) | AC-Power lines (conducted) | §15.207 | RSS-Gen, Issue 4: Chapter 8.8 | §15.207 limits IC: Table 3, Chapter 8.8 | -- | -- | Remark 1.) |
| 2 | General field strength emissions (9 kHz - 30 MHz) | Cabinet + inter-connecting cables (radiated) | §15.209(a) | RSS-Gen, Issue 4: Chapter 8.9, Table 5+6 | 2400/F(kHz) μ V/m 24000/F(kHz) μ V/m 30 μ V/m | -- | -- | Not performed |
| 7 | RF-Power (ERP/EIRP) | | §2.1046 §22.913(a)(2) | RSS-132, Issue 3: Chapter 5.4 SRSP-503: 5.1.3 | < 7 Watt (ERP) | -- | 1 to 10 | Only calculated |
| | | | §24.232(c) | RSS-133, Issue 6 Chapter 4.1/6.4 SRSP-510: 5.1.2 | < 2 Watt (EIRP) | | | |
| | | | §27.50 (d)(4) | RSS-139: Issue 3 Chapter 6.5 SRSP-513: 5.1.2 | < 1 Watt (EIRP) | | | |
| | | | §27.50(c)(10) | RSS-130, Issue 1, Chapter 4.4 | < 3 Watt (ERP) | | | |
| 8 | Spurious emissions | | §2.1053(a) §2.1057 | RSS-Gen., Issue 4 | 43+10log(P) dBc | 1 | 1 to 10 | passed |
| | | | §22.917(a)(b) | RSS-132: Chapter 5.5(i)(ii) | | | | |
| 9 | Band-Edge compliance | | §24.238(a)(b) | RSS-133: Chapter 6.5.1(i)(ii) | 43+10log(P) dBc + Spectrum Mask | 1 | 1 to 10 | passed |
| | | | §27.53(h)(1)(3) (i)(ii)(iii) | RSS-139: Issue 3 Chapter 6.6 (i) (ii) | | | | |
| | | | §27.53(g) | RSS-130: Issue 1 Chapter 4.6.1 | | | | passed |

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

Remarks: 1.) EUT based on already certified cellular module, see original test reports

1.2. Attestation:

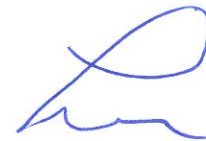
I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All requirements as shown in above table are met in accordance with enumerated standards.



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Responsible for test section



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

2. Administrative Data

2.1. Identification of the testing laboratory

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

2.2. Test location

2.2.1. Test laboratory "CTC"

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

2.3. Organizational items

| | |
|---|--------------------------|
| Responsible for test report and project leader: | Dipl.-Ing. C. Lorenz |
| Receipt of EUT: | 2016-01-06 |
| Date(s) of test: | 2016-01-07 to 2016-04-22 |
| Date of report: | 2016-04-26 |
| ----- | |
| Version of template: | 13.02 |

2.4. Applicant's details

| | |
|-------------------|---|
| Applicant's name: | peiker acoustic GmbH & Co. KG |
| Address: | Max-Planck-Straße 28-32 61381 Friedrichsdorf/TS Germany |
| Contact person: | Mr. Martin Fleckenstein |

2.5. Manufacturer's details

| | |
|----------------------|---------------|
| Manufacturer's name: | see applicant |
| Address: | |

3. Equipment under test (EUT)

3.1. TECHNICAL GSM/GPRS/E-GPRS 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) | See original module's grant: | |
| Antenna Type | <input type="checkbox"/> Integrated (enclosure) <input checked="" type="checkbox"/> External - dedicated, no RF- connector (proprietary) | |
| Antenna Gain Tx (main) | <input checked="" type="checkbox"/> Values taken from data sheet Model no. 34105-US-4G Band 5: 2.8dBi (0.65dBd) Band 2: 1.9dBi | |
| Antenna Gain Dx (diversity) | <input checked="" type="checkbox"/> No information from customer | |
| Measured Output Power [dBm]: Conducted GSM 850 Conducted EDGE850 | 32.7 (PK) 29.6 (PK) | |
| Measured Output Power [dBm]: Radiated GSM 850 Radiated EDGE 850 | External Roof-Antenna | Internal PCB antenna |
| | 30.55 dBm erp 27.45 dBm erp | 31.2 dBm erp 28.1 dBm erp |
| Measured Output Power [dBm]: Conducted GSM 1900 Conducted EDGE 1900 | 30.0 (PK) 29.1 (PK) | |
| Measured Output Power [dBm]: Radiated GSM 1900 Radiated EDGE1900 | External Roof-Antenna | Internal PCB antenna |
| | 26.90 dBm eirp 26.00 dBm eirp | 30.90 dBm eirp 30.0 dBm eirp |

3.2. TECHNICAL W-CDMA DATA OF MAIN EUT DECLARED BY APPLICANT

| | | |
|-----------------------------|--|----------------------|
| TX-frequency range | <input checked="" type="checkbox"/> FDD Band 2: 1852.4–1907.6 MHz (Uplink), 1930-1990 MHz (Downlink) <input checked="" type="checkbox"/> FDD Band 5: 826.4-846.6 MHz (Uplink), 869-894 MHz (Downlink) | |
| Type of modulation | <input checked="" type="checkbox"/> FDD-Mode Release99: QPSK <input checked="" type="checkbox"/> FDD Mode Release 5+6: 16QAM additional | |
| Number of channels | <input checked="" type="checkbox"/> FDD Band 2: UARFCN range 9262 – 9400 – 9538 <input checked="" type="checkbox"/> FDD Band 5: UARFCN range 4132 – 4183 – 4233 | |
| UMTS-HSPA connectivity | <input checked="" type="checkbox"/> Uplink speed: 5.76 Mb/s (category 6) <input type="checkbox"/> Uplink speed: | |
| Emission designator(s) | See original module's grant: | |
| Antenna Type | <input type="checkbox"/> Integrated (enclosure) <input checked="" type="checkbox"/> External - dedicated, no RF- connector (proprietary) | |
| Antenna Gain Tx (main) | <input checked="" type="checkbox"/> Values taken from data sheet Model no. 34105-US-4G Band 5: 2.8dBi (0.65dBd) Band 2: 1.9dBi | |
| Antenna Gain Dx (diversity) | <input checked="" type="checkbox"/> No information from customer | |
| MAX PEAK Output Power: | External Roof-Antenna | Internal PCB antenna |
| Radiated | | |
| FDD-Mode 2 | 21.37 dBm eirp | 25.37 dBm eirp |
| FDD-Mode 5 | 21.58 dBm erp | 22.2 dBm erp |
| MAX PEAK Output Power: | | |
| Conducted | | |
| FDD-Mode 2 | 24.47 (AV) dBm | |
| FDD-Mode 5 | 23.73 (AV) dBm | |

3.3. TECHNICAL LTE DATA OF MAIN EUT DECLARED BY APPLICANT

| | | | |
|---|--|---|---|
| TX-frequency range (E-UTRA operating bands) | LTE Band 2: 1850 - 1910 MHz (Uplink), 1930-1990 MHz (Downlink) LTE Band 4: 1710 - 1755 MHz (Uplink), 2110 - 2155 MHz (Downlink) LTE Band 5: 824 - 849 MHz (Uplink), 869-894 MHz (Downlink) LTE Band 17: 704 - 716 MHz (Uplink), 734 - 746 MHz (Downlink) | | |
| Type of modulation | QPSK, 16-QAM | | |
| Data rates | Cat3, Downlink: max. 100Mbps, Uplink: max. 50Mbps | | |
| Number of channels – Table 5.4.4-1 accord. 3GPP TS36.521-1 | LTE Band 2: UARFCN range 18600 - 19199 LTE Band 4: UARFCN range 19950 - 20399 LTE Band 5: UARFCN range 20400 – 20649 LTE Band 17: UARFCN range 23730 - 23849 | See Note about channels not to be used depending on channel bandwidths | |
| Emission designator(s) (Max. Value across all operating bands) | Channel bandwidth | QPSK Modulation: | 16-QAM Modulation |
| | 1.4 MHz 3 MHz 5 MHz 10 MHz 15 MHz 20 MHz | See original grant of module | See original grant of module |
| Antenna Gain | <input checked="" type="checkbox"/> Values taken from data sheet Model no. 34105-US-4G Band 17: 1.8 dBi (-0.34dBd) Band 5: 2.8dBi (0.65dBd) Band 4: 2.4dBi Band 2: 1.9dBi | | |
| MAX average Output Power: Conducted | LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 17 | Measured: 24.82 (AV) dBm 24.42 (AV) dBm 23.73 (AV) dBm 23.77 (AV) dBm | |
| MAX PEAK Output Power: radiated | LTE-Mode 2 LTE-Mode 4 LTE-Mode 5 LTE-Mode 17 | External Roof-Antenna | Internal PCB antenna |
| | | 21.72 dBm eirp 21.30 dBm eirp 21.57 dBm erp 21.03 dBm erp | 25.72 dBm eirp 25.12 dBm erp 22.18 dBm erp 22.02 dBm erp |
| Installed option | <input checked="" type="checkbox"/> GSM 900 and GSM 1800 Bands (not usable in USA/Canada) <input checked="" type="checkbox"/> W-CDMA Band I and Band VIII (not usable in USA/Canada) <input checked="" type="checkbox"/> GPS/GNSS (not tested within this test report) | | |
| Power supply | <input checked="" type="checkbox"/> DC power only: 14.0 V | | |
| Special EMI components | -- | | |
| Does EUT contain devices susceptible to magnetic fields, e.g. Hall elements, electrostatics 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 | |

3.4. 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 | Advanced Telecommunication Module (ATM) RoofVersion | ATM-01 R2-US-4GW | IMEI: 35381307-000307-3 S/N: 747793512 | 113.002.002 | 001.024.047 |
| EUT B | Advanced Telecommunication Module (ATM) Roof Version | ATM-01 R2-US-4GW | IMEI: 35381307-000349-5 S/N: 744748#518 | 113.002.002 | 001.024.047 |
| EUT C | AutomotiveAntenna Roof-Pod (US-Version) | Model No.: 34105 (US-4G) | #01 | 4G MIMO GPS SDARS US | -- |

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

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

| AE short description *) | Auxiliary Equipment | Type | S/N serial number | HW hardware status | SW software status |
|-------------------------|---------------------|------------|-------------------|---|--------------------|
| AE 1 | Loudspeaker | KL3/4-Ohm | -- | -- | -- |
| AE 2 | Microphone | ME39 | -- | -- | -- |
| AE 3 | Cable harness | Testing | #1 | See chapter 3.1 of Annex 5 | -- |
| AE 4 | RF connection cable | shielded | -- | One branch 2.62m length other branch 4m length | -- |
| AE 5 | Notebook | Dell D2120 | -- | -- | Windows 7 |
| AE 6 | FAKRA-SMA Adapter | -- | -- | -- | -- |

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

3.6. EUT set-ups

| EUT set-up no. *) | Combination of EUT and AE | Remarks |
|-------------------|--|--|
| set. 1 | EUT A + EUT C + AE 1 + AE 2 + AE 3 + AE 4 + AE 5 + AE 6 (+ AE 7) | Radiated measurements. AE 7 used temporary for connection set-up |
| set. 2 | EUT B + AE 5 (+ AE 7) + AE 8 | Conducted RF-measurements. AE 7 used temporary for connection set-up |

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

3.7. GSM/GPRS/E-GPRS 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.

3.8. W-CDMA EUT operating modes

| EUT operating mode no.*) | Description of operating modes | Additional information |
|--------------------------|--------------------------------|---|
| op. 5 | FDD-Band 2 12.2 kbps RMC | A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 21 dBm or 24dBm nominal. The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link according Table E5.1/Table E5.1A as described in 3GPP TS34.121, Annex E. |
| op. 6 | FDD-Band 5 12.2 kbps RMC | A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 21 dBm or 24dBm nominal. The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link according Table E5.1/Table E5.1A as described in 3GPP TS34.121, Annex E. |

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

3.9. EUT LTE operating modes

| EUT operating mode no.*) | Description of operating modes | Additional information |
|--------------------------|--------------------------------|---|
| op. 7 | LTE-Band 2 RMC Mode | A communication link is established between the mobile station (UE) and the test simulator. The transmitter is operated on its maximum rated output power class: 23dBm nominal. The input signal to the receiver is modulated with normal test modulation: QPSK or 16-QAM Modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link. NS_01 Network signalling value was used, no A-MPR was used therefore for this band. |
| op. 8 | LTE-Band 4 RMC Mode | |
| op. 9 | LTE-Band 5 RMC Mode | |
| op. 10 | LTE-Band 17 RMC Mode | |

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

3.10. Configuration of cables used for testing

| Cable number | Item | Type | S/N serial number | HW hardware status | Cable length |
|--------------|---------------------|------|-------------------|--------------------|--------------|
| Cable 1 | Cable harness | - | -- | -- | 2.62m |
| Cable 2 | RF-connection cable | -- | -- | -- | Max. 4m |
| Cable 3 | Loudspeaker cable | -- | -- | -- | 1.5m |
| Cable 4 | GPS cable | -- | -- | -- | 3m |
| Cable 5 | DC-power cable | -- | -- | -- | 2m |

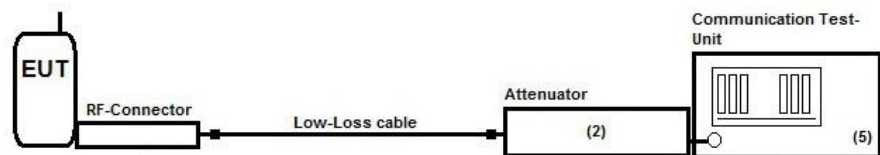
4. Description of test system set-up's

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

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

Tests Specification: Conducted Carrier power, Frequency Error

Schematic: Following test set-up applies 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 | |

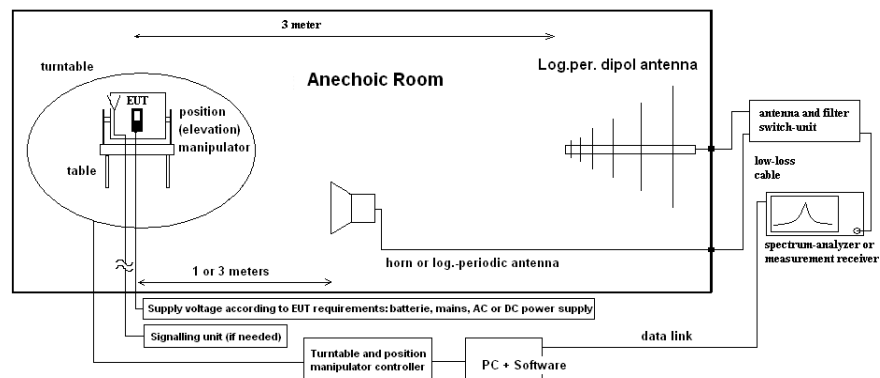
Measurement uncertainty See chapter Measurement Uncertainties (Cel-2)

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:

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

$$E_{CE(I)RP} = E_C - 95.2 \text{ dB}$$

$$M = L_T - E_{CE(I)RP}$$

E_C = Electrical field – corrected value

E_R = Receiver reading

M = Margin

L_T = Limit

AF = Antenna factor

C_L = Cable loss

D_F = Distance correction factor (if used)

G_A = Gain of pre-amplifier (if used)

$E_{CE(I)RP}$ = Electrical field corrected for E(I)RP

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

5. Measurements

5.1. RF-Parameter - RF Peak power output conducted and PAPR-value (GSM/GPRS/E-GPRS Mode)

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 checked="" type="checkbox"/> 489 ESU 40 | <input type="checkbox"/> 264 FSEK | <input 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 type="checkbox"/> 529 Power div. | <input checked="" type="checkbox"/> - cable OTA20 | |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | <input 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 |
| 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)</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 2

| 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. | | | | | | |
| GPRS 850 | Low | 128 | 32.3 | 32.1 | Remark 1 | 38.4 | 13 | Passed |
| | Middle | 192 | 32.7 | 32.5 | | | | |
| | High | 251 | 32.5 | 32.4 | | | | |

Remark: 1.) see original reports of Cellular Module type V1140-101-1

Op. Mode 2, Set-up 2

| 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 | 29.6 | 26.4 | Remark 1 | 38.4 | 13 | Passed |
| | Middle | 192 | 29.6 | 26.4 | | | | |
| | High | 251 | 29.6 | 26.4 | | | | |

Remark: 1.) see original reports of Cellular Module type V1140-101-1

Op. Mode 3, Set-up 2

| 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. | | | | | | |
| GPRS 1900 | Low | 512 | 30.0 | 29.9 | Remark 1 | 38.4 | 13 | Passed |
| | Middle | 661 | 29.9 | 29.8 | | | | |
| | High | 810 | 30.0 | 29.9 | | | | |

Remark: 1.) see original reports of Cellular Module type V1140-101-1

Op. Mode 4, Set-up 2

| 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 | 29.1 | 26.0 | Remark 1 | 33.0 | 13 | Passed |
| | Middle | 661 | 29.1 | 26.0 | | | | |
| | High | 810 | 29.1 | 25.9 | | | | |

Remark: 1.) see original reports of Cellular Module type V1140-101-1

5.2. RF-Parameter - RF Peak power output conducted and PAPR-Value (W-CDMA Mode)

5.2.1. 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 | | |
| test site | <input type="checkbox"/> 347 Radio.lab. 1 | <input checked="" type="checkbox"/> Radio.lab. 2 | | |
| 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 type="checkbox"/> 547 CMU | <input type="checkbox"/> 460 CMU |
| otherwise | <input type="checkbox"/> 400 FTC40x15E | <input type="checkbox"/> 401 FTC40x15E | <input type="checkbox"/> 110 USB LWL | <input type="checkbox"/> 482 Filter Matrix |
| DC power | <input checked="" type="checkbox"/> 611 E3636A | <input type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 459 EA 2032-50 | <input type="checkbox"/> 268 EA- 3050 |
| otherwise | <input type="checkbox"/> 331 HC 4055 | <input type="checkbox"/> 248 6 dB Att. | <input type="checkbox"/> 529 Power div. | <input type="checkbox"/> - cable OTA20 |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | | <input type="checkbox"/> 060 110 V/ 60 Hz via PAS 5000 | |

5.2.2. Requirements and limits

| | |
|---------------|--|
| FCC | <input checked="" type="checkbox"/> §2.1046 <input checked="" type="checkbox"/> §22.913(a)(2) <input checked="" type="checkbox"/> § 24.232(c) <input type="checkbox"/> § 27.50(d)(4) |
| IC | <input checked="" type="checkbox"/> RSS-132, Issue 3: 5.4 + SRSP 503:5.1.3 <input checked="" type="checkbox"/> RSS-133, Issue 6: 4.1/6.4 + SRSP-510:5.1.2 <input type="checkbox"/> RSS-139, Issue 3: 6.5 |
| KDB | 971168 D01 v02r02, October 2014 |
| Limits | Maximum Power Output of the wireless device should be determined while measured radiated E(IRP) <input checked="" type="checkbox"/> Limit FDD Band 5: 7 Watt ERP (38.4 dBm) <input checked="" type="checkbox"/> Limit FDD Band 2: 2 Watt EIRP (33.0 dBm) <input type="checkbox"/> Limit FDD Band 4: 1 Watt EIRP (30.0 dBm) PAPR ≤ 13dB |

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 on antenna port" ANRITSU | |
| 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)</p> | |
| EUT settings | <p>A call was established on highest power transmit conditions in GMSK and RMC99 mode.</p> <p>UE is set TX mode, highest transmit power conditions, DTX, MPR 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> | |

5.2.4. Measurement Results

| FDD Band 2 | | | | | | | | |
|--|----------------------|-------|-----------------|-------|-----------------|-------|-------|--------|
| EUT | Set-up 2, Op. Mode 5 | | | | | | | |
| Test case | Power value [dBm] | | | | | | Limit | Result |
| | UARFCN no. 9262 | | UARFCN no. 9400 | | UARFCN no. 9538 | | | |
| | PK | AV | PK | AV | PK | AV | [dBm] | |
| Release 99 12.2kbps RMC | 27.68 | 24.47 | 27.45 | 24.04 | 26.90 | 24.12 | 33 | Passed |
| Peak-to-Average power ratio on 0.1% probability [dB] | Remark 1 | | | | | | 13 | Passed |

1.) Remark: see original reports of Cellular Module V1140-101-1

| FDD Band 5 | | | | | | | | |
|--|----------------------|-------|-----------------|-------|-----------------|-------|-------|--------|
| EUT | Set-up 2, Op. Mode 6 | | | | | | | |
| Test case | Power value [dBm] | | | | | | Limit | Result |
| | UARFCN no. 4132 | | UARFCN no. 4183 | | UARFCN no. 4233 | | | |
| | PK | AV | PK | AV | PK | AV | [dBm] | |
| Release 99 12.2kbps RMC | 27.11 | 23.56 | 27.04 | 23.39 | 27.37 | 23.73 | 38.4 | Passed |
| Peak-to-Average power ratio on 0.1% probability [dB] | Remark 1 | | | | | | 13 | Passed |

2.) see original reports of Cellular Module with FCC-ID: V1140-101-1

5.3. RF-Parameter - RF Peak power output conducted and PAPR (LTE – Mode)

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 | | | |
| test site | <input type="checkbox"/> 347 Radio.lab. 1 | <input checked="" type="checkbox"/> Radio.lab. 2 | | | |
| 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 type="checkbox"/> 547 CMU | <input checked="" type="checkbox"/> 594 CMW500 | |
| 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"/> 463 HP3245A | <input type="checkbox"/> 459 EA 2032-50 | <input type="checkbox"/> 268 EA- 3050 | <input type="checkbox"/> 494 AG6632A <input checked="" type="checkbox"/> 611 E3632A |
| otherwise | <input type="checkbox"/> 331 HC 4055 | <input type="checkbox"/> 248 6 dB Att. | <input type="checkbox"/> 529 Power div. | <input type="checkbox"/> - cable OTA20 | <input checked="" type="checkbox"/> 530 10 dB Att. |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | | <input type="checkbox"/> 060 110 V/ 60 Hz via PAS 5000 | | |

5.3.2. Requirements and limits

| | |
|--------------|--|
| FCC | §2.1046 |
| IC | RSS-132:5.4 + SRSP 503:5.1.3 for FDD Band 5; RSS-133:4.1/6.4 + SRSP-510:5.1.2 for FDD Band 2 RSS-139, Issue 3: 6.5 , RSS-199: Issue 1, §4.4 + PAR PK-AV ≤ 13 dB |
| Limit | Maximum Power Output of the mobile phone should be determined while measured conducted. |
| | Limit LTE Band 5: 7 Watt ERP (38.4 dBm) |
| | Limit LTE Band 2: 2 Watt EIRP (33.0 dBm) |
| | Limit LTE Band 4: 1 Watt EIRP (30.0 dBm) |
| | Limit LTE Band 17: 3 Watt ERP (34.7dBm) |

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>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 and band. The Peak-to -Average-Ratio is determined by comparing the total peak power to total average power for each measurement.</p> | |
| Mobile phone settings | <p>A call was established with a suitable communication test unit (CMW500). UE is set TX mode, highest transmit power conditions (RMC-mode), power saving techniques have been disabled (MPR-techniques)</p> <p>Tests have been performed in different EUT bandwidth settings and various settings for allocated RBs.</p> <p>The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band within the designated range within the allowed channel bandwidths. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance.</p> | |

5.3.4. Power results

5.3.4.1. LTE Band 2 Results

| LTE Band 2 | | | | | LTE Band 2 | | | |
|------------|-------|-------|--------|-------|------------|-------|--------|-------|
| Signal-BW | QPSK | | 16-QAM | | QPSK | | 16-QAM | |
| | Peak | RMS | Peak | RMS | Peak | RMS | Peak | RMS |
| 1.4 | 29,09 | 24,32 | 29,25 | 23,50 | 29,72 | 24,82 | 30,04 | 24,07 |
| 3 | 29,59 | 24,17 | 29,44 | 23,56 | | | | |
| 5 | 29,50 | 24,19 | 29,29 | 23,68 | | | | |
| 10 | 29,72 | 24,82 | 30,04 | 24,00 | | | | |
| 15 | 29,72 | 24,70 | 29,52 | 24,07 | | | | |
| 20 | 29,45 | 24,69 | 29,62 | 24,05 | | | | |

5.3.4.2. LTE Band 4 Results

| LTE Band 4 | | | | | LTE Band 4 | | | |
|------------|-------|-------|--------|-------|------------|-------|--------|-------|
| Signal-BW | QPSK | | 16-QAM | | QPSK | | 16-QAM | |
| | Peak | RMS | Peak | RMS | Peak | RMS | Peak | RMS |
| 1.4 | 29,66 | 24,20 | 29,76 | 23,79 | 29,74 | 24,42 | 29,88 | 23,80 |
| 3 | 29,52 | 24,42 | 29,60 | 23,73 | | | | |
| 5 | 29,74 | 24,30 | 29,76 | 23,64 | | | | |
| 10 | 29,53 | 24,14 | 29,59 | 23,45 | | | | |
| 15 | 29,72 | 24,27 | 29,73 | 23,79 | | | | |
| 20 | 29,48 | 24,19 | 29,88 | 23,80 | | | | |

5.3.4.3. LTE Band 5 Results

| LTE Band 5 | | | | | LTE Band 5 | | | |
|------------|-------|-------|--------|-------|------------|-------|--------|-------|
| Signal-BW | QPSK | | 16-QAM | | QPSK | | 16-QAM | |
| | Peak | RMS | Peak | RMS | Peak | RMS | Peak | RMS |
| 1.4 | 30,36 | 23,73 | 30,42 | 23,29 | 30,36 | 23,73 | 30,42 | 23,29 |
| 3 | 30,24 | 23,64 | 30,31 | 23,09 | | | | |
| 5 | 29,93 | 23,68 | 30,27 | 23,04 | | | | |
| 10 | 29,93 | 23,54 | 29,92 | 23,15 | | | | |

5.3.4.4. LTE Band 17 Results

| LTE Band 17 | | | | | LTE Band 17 | | | |
|-------------|-------|-------|--------|-------|-------------|-------|--------|-------|
| Signal-BW | QPSK | | 16-QAM | | QPSK | | 16-QAM | |
| | Peak | RMS | Peak | RMS | Peak | RMS | Peak | RMS |
| 5 | 29,98 | 23,59 | 30,12 | 23,23 | 29,98 | 23,77 | 30,12 | 23,23 |
| 10 | 29,95 | 23,77 | 29,96 | 22,99 | | | | |

5.3.5. PAPR results

5.3.5.1. Test condition and test set-up

| | | |
|-----------------------|---|-------------------------|
| Climatic conditions | Temperature: (22±3°C) | Rel. humidity: (40±20)% |
| Test system set-up | Please see chapter "Test system set-up for conducted measurements on antenna port" | |
| Measurement method | <p>The measurements were performed with the integrated power measurement function of the „radio communication tester CMW500 from Rohde&Schwarz company.</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>The CCDF function of the measurement equipment as described in the operating manual was used (default settings). Further details can be found in KDB 971168 D01 v02r02 chapter 5.7.1.</p> | |
| Mobile phone settings | <p>A call was established with a suitable communication test unit (CMW500). UE is set TX mode, highest transmit power conditions (RMC-mode), power saving techniques have been disabled (MPR-techniques)</p> <p>Tests have been performed in different EUT bandwidth settings and various settings for allocated RBs.</p> | |

5.3.5.2. PAPR-results

According KDB 5.7.1 two method are allowed.

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

| LTE Band 2 | | |
|--------------------------|--|-------------------|
| Signal-Bandwidth / [MHz] | Max. PAPR Max. PAPR level with 0.1% probability / [dB] | |
| | QPSK Modulation | 16-QAM Modulation |
| 1.4 | see original reports of Cellular Module of V1140-101-1 | |
| 3.0 | | |
| 5.0 | | |
| 10 | | |
| 15 | | |
| 20 | | |

Remark:--

| LTE Band 4 | | |
|--------------------------|--|-------------------|
| Signal-Bandwidth / [MHz] | Max. PAPR level with 0.1% probability / [dB] | |
| | QPSK Modulation | 16-QAM Modulation |
| 1.4 | see original reports of Cellular Module of V1140-101-1 | |
| 3.0 | | |
| 5.0 | | |
| 10 | | |
| 15 | | |
| 20 | | |

Remark:--

| LTE Band 5 | | |
|--------------------------|--|-------------------|
| Signal-Bandwidth / [MHz] | Max. PAPR level with 0.1% probability / [dB] | |
| | QPSK Modulation | 16-QAM Modulation |
| 1.4 | see original reports of Cellular Module of V1140-101-1 | |
| 3.0 | | |
| 5.0 | | |
| 10 | | |

Remark:--

| LTE Band 17 | | |
|--------------------------|--|-------------------|
| Signal-Bandwidth / [MHz] | Max. PAPR level with 0.1% probability / [dB] | |
| | QPSK Modulation | 16-QAM Modulation |
| 5.0 | see original reports of Cellular Module of V1140-101-1 | |
| 10 | | |

Remark:--

5.3.5.3. Conclusion

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

5.4. RF-Parameter - Radiated out of Band RF emissions and Band Edge (GSM/GPRS/E-GPRS Mode)

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 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 |
| signaling | <input type="checkbox"/> 392 MT8820A | <input checked="" type="checkbox"/> 546 CMU | <input type="checkbox"/> 547 CMU |
| power supply | <input type="checkbox"/> 463 HP3245A | <input checked="" type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 |
| otherwise | <input type="checkbox"/> 529 6dB divider | <input type="checkbox"/> 530 6dB Att. | <input type="checkbox"/> 110 USB LWL |
| 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 (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 |

5.4.3. 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.</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 |

5.4.4. Measurement results

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

5.4.4.1. Band 850 GRPS/GSM

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|-------------|-----------------|-----|-----------------|-------------|--|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.04_Ch128 | Low | 128 | 30 MHz – 12 GHz | GPRS | Carrier on diagram, not relevant for result External antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.09_Ch128 | Low | | 823 – 824 MHz | GPRS | External antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | 192 | -- | -- | -- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.03_Ch251 | High | 251 | 30 MHz – 12 GHz | GPRS | Carrier on diagram, not relevant for result Internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.02_Ch251 | High | | 849 – 850 MHz | GPRS | Internal antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |

Remark: Low and high channels tested, different transmitting EUT antennas used between channels

5.4.4.2. GPRS 1900

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|-------------|-----------------|-----|-------------------|-------------|--|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.13_Ch512 | Low | 512 | 30 MHz – 19.5 GHz | GPRS | Carrier on diagram, not relevant for result External antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.09_Ch512 | Low | | 1849 – 1850 MHz | GPRS | External antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | -- | 30 MHz – 18 GHz | -- | -- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.12_Ch810 | High | 810 | 30 MHz – 20 GHz | GPRS | Carrier on diagram, not relevant for result Internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.08_Ch810 | High | | 1910 – 1911 MHz | GPRS | Internal antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |

Remark: Low and high channels tested, different transmitting EUT antennas used between channels

5.5. RF-Parameter - Radiated out of Band RF emissions and Band Edge (W-CDMA – Mode)

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 |
| signaling | <input type="checkbox"/> 392 MT8820A | <input checked="" type="checkbox"/> 546 CMU | <input type="checkbox"/> 547 CMU |
| power supply | <input type="checkbox"/> 611 E3636A | <input checked="" type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 |
| otherwise | <input type="checkbox"/> 529 6dB divider | <input type="checkbox"/> 530 6dB Att. | <input type="checkbox"/> 110 USB LWL |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | <input type="checkbox"/> 060 110 V/ 60 Hz via PAS 5000 | |

5.5.2. Requirements and limits

| | |
|--------------|---|
| FCC | General: §2.1053(a) , §2.1057(a) <input checked="" type="checkbox"/> FDD Band 5: Part 22: §22.917(a)(b) <input checked="" type="checkbox"/> FDD Band 2: Part 24: §24.238(a)(b) <input type="checkbox"/> FDD Band 4: Part 27: §27.53(h) |
| IC | <input checked="" type="checkbox"/> FDD Band 5: RSS-132, Issue 3: 5.5(i)(ii) <input checked="" type="checkbox"/> FDD Band 2: RSS-133, Issue 6: 6.5.1(i)(ii) <input type="checkbox"/> FDD Band 4: RSS-139, Issue 3: 6.6 (i)(ii) |
| Limit | „the power of emissions shall be attenuated below the transmitter output power (p) by at least 43+10Log(P) dB“ -> Resulting limits for all power levels of the Mobile Phone: -13dBm |

5.5.3. Test condition and test set-up

| | | | |
|--------------------------------|---|--|--|
| link to test system (if used): | <input checked="" type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input type="checkbox"/> |
| 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)% | |
| Test system set-up | Please see chapter “Test system set-up for radiated spurious emission measurements up to 20 GHz” | | |
| Measurement method | The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment. A PEAK detector was used except measurements near the Band-Edge where a AVERAGE detector applied for critical measurements. According chapter 4.2 | | |
| EUT settings | A call was established on highest power transmit conditions in RMC99 mode. The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the wireless device, should be sufficient to demonstrate compliance. | | |

Spectrum-Analyzer settings for FDD band 2

| | Start freq. MHz | Stop freq. MHz | R-BW MHz | V-BW MHz | Sweep time sec. | Att. [dB] | Detector |
|----------------------|-----------------|----------------|----------|----------|-----------------|-----------|----------|
| Sweep 1 (subrange 1) | 30 | 1000 | 1 | 1 | 10 | 10 | MaxH-PK |
| Sweep 1 (subrange 2) | 1000 | 2800 | 1 | 1 | 15 | 0 | MaxH-PK |
| Sweep 1 (subrange 3) | 2800 | 20000 | 1 | 1 | 60 | 10 | MaxH-PK |
| Sweep 2a (Band-Edge) | 1849 | 1850 | 0.05 | 0.5 | 30 | 35 | MaxH-PK |
| Sweep 2b (Band-Edge) | 1849 | 1850 | | | 30 | 35 | MaxH-AV |
| Sweep 3a (Band-Edge) | 1910 | 1911 | | | 30 | 35 | MaxH-PK |
| Sweep 3b (Band-Edge) | 1910 | 1911 | | | 30 | 35 | MaxH-AV |

Spectrum-analyzer settings for FDD Band 5

| | Start freq. MHz | Stop freq. MHz | R-BW MHz | V-BW MHz | Sweep time sec. | Att. | Detector |
|----------------------|-----------------|----------------|----------|----------|-----------------|------|----------|
| Sweep 1 (subrange 1) | 30 | 1000 | 1 | 1 | 10 | 10 | MaxH-PK |
| Sweep 1 (subrange 2) | 1000 | 2800 | 1 | 1 | 15 | 0 | MaxH-PK |
| Sweep 1 (subrange 3) | 2800 | 12000 | 1 | 1 | 160 | 10 | MaxH-PK |
| Sweep 2a (Band-Edge) | 823 | 824 | 0.05 | 0.5 | 30 | 35 | MaxH-PK |
| Sweep 2b (Band-Edge) | 823 | 824 | | | 30 | 35 | MaxH-AV |
| Sweep 3a (Band-Edge) | 850 | 851 | | | 30 | 35 | MaxH-PK |
| Sweep 3b (Band-Edge) | 850 | 851 | | | 30 | 35 | MaxH-AV |

5.5.4. Results

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

5.5.4.1. FDD Band 2

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|-------------|-----------------|------|------------------|-------------|--|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.23_Ch9262 | Low | 9262 | 30 MHz to 20 GHz | 5 | Carrier visible on diagram. Not relevant for results External antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.22_Ch9262 | Low | | 1849 – 1850 MHz | | External antenna used | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | -- | 30 MHz to 18 GHz | | -- | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.22_Ch9538 | High | 9538 | 30 MHz to 20 GHz | | Carrier visible on diagram. Not relevant for results Internal antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.21_Ch9538 | High | | 1910 – 1911 MHz | | Internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |

Remark: Low and high channels tested, different transmitting EUT antennas used between channels

5.5.4.2. FDD Band 5

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|-------------|-----------------|------|-----------------|-------------|--|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.53_Ch4132 | Low | 4132 | 30 MHz to 9 GHz | 6 | Carrier visible on diagram. Not relevant for results External antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.52_Ch4132 | Low | | 823 – 824 MHz | | External antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | -- | -- | | -- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.52_Ch4233 | High | 4233 | 30 MHz to 9 GHz | | Carrier visible on diagram. Not relevant for results Internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.51_Ch4233 | High | | 849 – 850 MHz | | Internal antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |

Remark: Low and high channels tested, different transmitting EUT antennas used between channels

5.6. RF-Parameter - Radiated out of Band RF emissions and Band Edge (LTE - Mode)

5.6.1. 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 EMISAR | <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"/> 608 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"/> 611 E3632A | <input type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 |
| otherwise | <input type="checkbox"/> 529 6dB divider | <input type="checkbox"/> 530 6dB Att. | <input type="checkbox"/> 110 USB LWL |
| line voltage | <input type="checkbox"/> 230 V 50 Hz via public mains | <input checked="" type="checkbox"/> 060 110 V/ 60 Hz via PAS 5000 | |

5.6.2. Requirements and limits

| | |
|--------------|---|
| FCC | <p>General: §2.1053(a) , §2.1057(a)</p> <p><input checked="" type="checkbox"/> LTE Band 5: Part 22: §22.917(a)(b)</p> <p><input checked="" type="checkbox"/> LTE Band 2: Part 24: §24.238(a)(b)</p> <p><input checked="" type="checkbox"/> LTE Band 4: Part 27: §27.53(h) <input checked="" type="checkbox"/> LTE Band 17: Part 27: §27.53(g)</p> |
| IC | <p><input checked="" type="checkbox"/> FDD Band 5: RSS-132, Issue 3: 5.5(i)(ii)</p> <p><input checked="" type="checkbox"/> FDD Band 2: RSS-133, Issue 6: 6.5.1(i)(ii)</p> <p><input checked="" type="checkbox"/> FDD Band 4: RSS-139, Issue 3: 6.6 (i)(ii) <input checked="" type="checkbox"/> FDD Band 17: RSS-130, Issue 1: 4.6.1</p> |
| Limit | <p>„the power of emissions shall be attenuated below the transmitter output power (p) by at least 43+10Log(P) dB“</p> <p>-> Resulting limits for all power levels of the Mobile Phone: -13dBm</p> |

5.6.3. Test condition and test set-up

| | | | |
|--------------------------------|---|--|--|
| link to test system (if used): | <input checked="" type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input type="checkbox"/> |
| 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)% |
| Test system set-up | Please see chapter “Test system set-up for radiated spurious emission measurements up to 20 GHz” | | |
| Spectrum Analyzer Settings | <p>Parameter:</p> <p>Scan Mode</p> <p>RBW</p> <p>VBW</p> <p>Sweep time</p> <p>Sweep mode</p> <p>Detector</p> | <p>Spectrum analyser mode</p> <p>1 MHz</p> <p>10 MHz</p> <p>Coupled (Auto)</p> <p>repetitive</p> <p>Peak</p> | |
| Measurement method | The spectrum was scanned from 9 kHz to the 10th harmonic of the highest frequency generated within the equipment. A PEAK detector was used except measurements near the Band-Edge where a AVERAGE detector applied when results are critical (low margin or limit exceed). Tests have been performed in various settings for the device regarding allocated resource blocks and channels in order to find worst-case configuration. Due to very big amount of possible combinations only certain combinations have been tested. | | |
| Mobile phone settings | A call was established on highest power transmit conditions in RMC mode. MPR was deactivated. | | |
| | The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band within the designated range within the allowed channel bandwidths. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance. | | |

Spectrum-Analyzer settings for LTE band 2

| | Start freq. MHz | Stop freq. MHz | R-BW MHz | V-BW MHz | Sweep time sec. | Att. [dB] | Detector |
|----------------------|-----------------|----------------|----------|----------|-----------------|-----------|----------|
| Sweep 1 (subrange 1) | 30 | 1000 | 1 | 10 | 10 | 10 | MaxH-PK |
| Sweep 1 (subrange 2) | 1000 | 2800 | 1 | 10 | 15 | 0 | MaxH-PK |
| Sweep 1 (subrange 3) | 2800 | 20000 | 1 | 10 | 60 | 10 | MaxH-PK |
| Sweep 2a (Band-Edge) | 1849 | 1850 | 0.2 | 1 | 30 | 35 | MaxH-PK |
| Sweep 2b (Band-Edge) | 1849 | 1850 | | | 30 | 35 | MaxH-AV |
| Sweep 3a (Band-Edge) | 1910 | 1911 | | | 30 | 35 | MaxH-PK |
| Sweep 3b (Band-Edge) | 1910 | 1911 | | | 30 | 35 | MaxH-AV |

Spectrum-analyzer settings for FDD Band 4

| | Start freq. MHz | Stop freq. MHz | R-BW MHz | V-BW MHz | Sweep time sec. | Att. | Detector |
|----------------------|-----------------|----------------|----------|----------|-----------------|------|----------|
| Sweep 1 (subrange 1) | 30 | 1000 | 1 | 10 | 10 | 10 | MaxH-PK |
| Sweep 1 (subrange 2) | 1000 | 2800 | 1 | 10 | 15 | 0 | MaxH-PK |
| Sweep 1 (subrange 3) | 2800 | 18000 | 1 | 10 | 160 | 10 | MaxH-PK |
| Sweep 2a (Band-Edge) | 1709 | 1710 | 0.2 | 1 | 30 | 35 | MaxH-PK |
| Sweep 2b (Band-Edge) | 1709 | 1710 | | | 30 | 35 | MaxH-AV |
| Sweep 3a (Band-Edge) | 1755 | 1756 | | | 30 | 35 | MaxH-PK |
| Sweep 3b (Band-Edge) | 1755 | 1756 | | | 30 | 35 | MaxH-AV |

Spectrum-analyzer settings for LTE Band 5

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

Spectrum-analyzer settings for LTE Band 17

| | Start freq. MHz | Stop freq. MHz | R-BW kHz | V-BW kHz | Sweep time sec. | Att. | Detector |
|----------------------|-----------------|----------------|----------|----------|-----------------|------|-------------------------|
| Sweep 1 (subrange 1) | 30 | 1000 | 100 | 300 | 10 | 10 | MaxH-PK |
| Sweep 1 (subrange 2) | 1000 | 2800 | 100 | 300 | 15 | 0 | MaxH-PK |
| Sweep 1 (subrange 3) | 2800 | 9000 | 100 | 300 | 160 | 10 | MaxH-PK |
| Sweep 2a (Band-Edge) | 703 | 704 | 50 | 300 | 30 | 35 | MaxH-PK, Signal-BW=5MHz |
| Sweep 3a (Band-Edge) | 716 | 717 | 50 | 300 | 30 | 35 | MaxH-PK, Signal-BW=5MHz |

5.6.4. Results

The results are presented below in summary form only. Measurements have been performed with both possible modulations QPSK and 16-QAM. Also the allocated RB's were varied between minimum 1RB and 100%RBs over the LTE-signal bandwidth in order to search for worst-case mode.

For more information please see the diagrams enclosed in annex 1.

5.6.4.1. LTE Band 2

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|-------------------|-----------------|-------|--------------------|-------------|--|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.20_ Ch18607 | Low | 18607 | 30 MHz to 19.5 GHz | 2 | Carrier visible on diagram. Not relevant for results, QPSK modulation external antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.20a_ Ch18607 | Low | 18650 | 1849 – 1850 MHz | 2 | 1RB low QPSK modulation external antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.20b_ Ch18607 | Low | 18650 | 1849 – 1850 MHz | 2 | 1RB low QAM modulation external antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.21a_ Ch18607 | Low | 18650 | 1849 – 1850 MHz | 2 | 6RBs QPSK modulation external antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.21b_ Ch18607 | Low | 18650 | 1849 – 1850 MHz | 2 | 6RBs QAM modulation external antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | 18900 | -- | -- | -- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.22 | High | 19193 | 30 MHz to 19.5 GHz | 2 | Carrier visible on diagram. Not relevant for results, QPSK modulation Internal antenna used | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.23a_ Ch19193 | High | 19607 | 1910 – 1911 MHz | 2 | 1RB low QPSK modulation internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.23b_ Ch19193 | High | 19150 | 1910 – 1911 MHz | 2 | 1RB low QAM modulation internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.22a Ch19193 | High | 19607 | 1910 – 1911 MHz | 2 | 6RBs QPSK modulation internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.22b_ Ch19193 | High | 19150 | 1910 – 1911 MHz | 2 | 6RBs QAM modulation internal antenna used | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |

Remark1: A signal bandwidth of 1.4MHz was chosen for the tests

5.6.4.2. LTE Band 4

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|------------------|-----------------|-------|------------------|-------------|--|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.40 Ch19957 | Low | 19957 | 30 MHz to 18 GHz | 8 | Carrier visible on diagram. Not relevant for results QPSK modulation External antenna | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.40a Ch19957 | | 19957 | 1709 - 1710 MHz | 8 | 1RB low, QPSK modulation External antenna Worst/Case value: see diagram | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.40b Ch19957 | | | 1709 - 1710 MHz | 8 | 1RB low, 16-QAM modulation External antenna Worst/Case value: see diagram | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.41a Ch19957 | | | 1709 - 1710 MHz | 8 | 6RBs, QPSK modulation, External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.41b Ch19957 | | | 1709 - 1710 MHz | 8 | 6RBs, QAM modulation, External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | 20175 | -- | --9 | -- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.42_ Ch20393 | High | 20393 | 30 MHz to 18 GHz | 8 | Carrier visible on diagram. Not relevant for results QPSK modulation Internal antenna | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.42a Ch20393 | | 20393 | 1709 - 1710 MHz | 8 | 1RB high, QPSK modulation Internal antenna Worst/Case value: see diagram | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.42b Ch20393 | | | 1709 - 1710 MHz | 8 | 1RB high, 16-QAM modulation Internal antenna Worst/Case value: see diagram | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.43a Ch20393 | | | 1709 - 1710 MHz | 8 | 6RBs, QPSK modulation, Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.43b Ch20393 | | | 1709 - 1710 MHz | 8 | 6RBs, QAM modulation, Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |

Remark1: A signal bandwidth of 1.4MHz was chosen for the tests

5.6.4.3. LTE Band 5

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|-------------------|-----------------|-------|-----------------|-------------|--|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.50 Ch20407 | Low | 20407 | 30 MHz to 9 GHz | 9 | Carrier visible on diagram. Not relevant for results QPSK modulation External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.500a Ch20407 | Low | 20407 | 823 – 824 MHz | 9 | 1RB low, QPSK modulation External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.500b Ch20407 | Low | 20407 | 823 – 824 MHz | 9 | 1RB low 16-QAM modulation External antenna | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.501a Ch20407 | Low | 20407 | 823 – 824 MHz | 9 | 6RBs, QPSK Modulation External antenna | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.501b Ch20407 | Low | 20407 | 823 – 824 MHz | 9 | 6RBS, QAM modulation External antenna | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | 20525 | -- | -- | -- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.52 Ch20643 | High | 20643 | 30 MHz to 9 GHz | 9 | Carrier visible on diagram. Not relevant for results QPSK modulation Internal antenna | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.50a Ch20643 | High | 20643 | 849 - 850 MHz | 9 | 1RB high, QPSK modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.50b Ch20643 | High | 20643 | 849 - 850 MHz | 9 | 1RB high 16-QAM modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.503a Ch20643 | High | 20643 | 849 - 850 MHz | 9 | 6RBs, QPSK Modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.503b Ch20643 | High | 20643 | 849 - 850 MHz | 9 | 6RBS, QAM modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |

Remark: A LTE signal bandwidth of 1.4MHz was chosen for the tests

5.6.4.4. LTE Band 17

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|-------------|-----------------|-------|-----------------|-------------|--|-------------------------------------|--------------------------|--------------------------|--------|
| | Range | No. | | | | PK | AV | QP | |
| 8.171 | Low | 23737 | 30 MHz to 9 GHz | 10 | Carrier visible on diagram. Not relevant for results QPSK modulation External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1701a | Low | 23755 | 703 - 704 MHz | 10 | Band Edge Compliance 1RB low, QPSK modulation External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1701b | Low | 23755 | 703 - 704 MHz | 10 | Band Edge Compliance 1RB low, 16-QAM modulation, External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1702a | Low | 23755 | 703 - 704 MHz | 10 | Band Edge Compliance 25RBs, QPSK modulation External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1702b | Low | 23755 | 703 - 704 MHz | 10 | Band Edge Compliance 25RBs, 16-QAM modulation, External antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| -- | Middle | 23790 | -- | -- | -- | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 8.173 | High | 23843 | 30 MHz to 9 GHz | 10 | Carrier visible on diagram. Not relevant for results Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1704a | High | 23825 | 716 – 717 MHz | 10 | Band Edge Compliance 1RB high, QPSK modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1704b | High | 23825 | 716 – 717 MHz | 10 | Band Edge Compliance 1RB high, 16-QAM modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1705a | High | 23825 | 716 – 717 MHz | 10 | Band Edge Compliance 25RBs, QPSK modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 9.1705b | High | 23825 | 716 – 717 MHz | 10 | Band Edge Compliance 25RBs, 16-QAM modulation Internal antenna | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |

Remark: A LTE signal bandwidth of 5MHz was chosen for the tests

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

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

8.0.1. Test software and firmware of equipment

| Ref.-No. | Equipment | Type | Serial-No. | Version of Firmware or Software during the test |
|----------|---|------------------------|----------------|--|
| 001 | EMI Test Receiver | ESS | 825132/017 | Firm.= 1.21 , OTP=2.0, GRA=2.0 |
| 012 | Signal Generator (EMS-cond.) | SMY 01 | 839069/027 | Firm.= V 2.02 |
| 013 | Power Meter (EMS cond.) | NRVD | 839111/003 | Firm.= V 1.51 |
| 017 | Digital Radiocommunication Tester | CMD 60 M | 844365/014 | Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99 |
| 053 | Audio Analyzer | UPA3 | 860612/022 | Firm. V 4.3 |
| 119 | RT Harmonics Analyzer dig. Flickermeter | B10 | G60547 | Firm.= V 3.1DHG |
| 140 | Signal Generator | SMHU | 831314/006 | Firm.= 3.21 |
| 261 | Thermal Power Sensor | NRV-Z55 | 825083/0008 | EPROM-Datum 02.12.04, SE EE 1 B |
| 262 | Power Meter | NRV-S | 825770/0010 | Firm.= 2.6 |
| 263 | Signal Generator | SMP 04 | 826190/0007 | Firm.=3.21 |
| 264 | Spectrum Analyzer | FSEK 30 | 826939/005 | Bios=2.1, Analyzer= 3.20 |
| 295 | Racal Digital Radio Test Set | 6103 | 1572 | UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02 |
| 298 | Univ. Radio Communication Tester | CMU 200 | 832221/091 | R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used |
| 323 | Digital Radiocommunication Tester | CMD 55 | 825878/0034 | Firm.= 3.52 .22.01.99 |
| 331 | Climatic Test Chamber -40/+80 Grad | HC 4055 | 43146 | TSI 1.53 |
| 335 | CTC-EMS-Conducted | System EMS Conducted | - | EMC 32 V 8.52 |
| 340 | Digital Radiocommunication Tester | CMD 55 | 849709/037 | Firm.= 3.52 .22.01.99 |
| 355 | Power Meter | URV 5 | 891310/027 | Firm.= 1.31 |
| 365 | 10V Insertion Unit 50 Ohm | URV5-Z2 | 100880 | Eprom Data = 31.03.08 |
| 366 | Ultra Compact Simulator | UCS 500 M4 | V0531100594 | Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10 |
| 371 | Bluetooth Tester | CBT32 | 100153 | CBT V5.30+ SW-Option K55, K57 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Firm.= 2.30, OTP= 02.01, GRA= 02.36 |
| 378 | Broadband RF Field Monitor | RadiSense III | 03D00013SNO-08 | Firm.= V.03D13 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Firm. = A13 (Mainboard) A02 (Display) 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 |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | |
| 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 | - | 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 |
| 692 | Bluetooth Tester | CBT 32 | 100236 | CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF) |

8.0.2. Single instruments and test systems

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|----------|---|------------------------------|--------------|------------------------|-------------------------|--------|------------|
| 001 | EMI Test Receiver | ESS | 825132/017 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 005 | AC - LISN (50 Ohm/50µH, test site 1) | ESH2-Z5 | 861741/005 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 007 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 892563/002 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 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 | - | 31.05.2016 |
| 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 | |
| 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 | - | 31.05.2016 |
| 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 | - | 31.05.2016 |
| 248 | attenuator | SMA 6dB 2W | - | Radiall | pre-m | 2 | |
| 249 | attenuator | SMA 10dB 10W | - | Radiall | pre-m | 2 | |
| 252 | attenuator | N 6dB 12W | - | Radiall | pre-m | 2 | |
| 256 | attenuator | SMA 3dB 2W | - | Radiall | pre-m | 2 | |
| 257 | hybrid | 4031C | 04491 | Narda | pre-m | 2 | |
| 260 | hybrid coupler | 4032C | 11342 | Narda | pre-m | 2 | |
| 261 | Thermal Power Sensor | NRV-Z55 | 825083/0008 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 262 | Power Meter | NRV-S | 825770/0010 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 263 | Signal Generator | SMP 04 | 826190/0007 | Rohde & Schwarz | 36 M | - | 31.05.2016 |
| 264 | Spectrum Analyzer | FSEK 30 | 826939/005 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 265 | peak power sensor | NRV-Z33, Model 04 | 840414/009 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 266 | Peak Power Sensor | NRV-Z31, Model 04 | 843383/016 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 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 | |
| 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 | - | 31.05.2016 |
| 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 | 24 M | - | 30.12.2016 |
| 341 | Digital Multimeter | Fluke 112 | 81650455 | Fluke | 24 M | - | 31.05.2016 |
| 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 | - | 31.05.2016 |
| 357 | power sensor | NRV-Z1 | 861761/002 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 371 | Bluetooth Tester | CBT32 | 100153 | R&S | 24 M | - | 31.05.2016 |
| 373 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 100535 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Keithley | 24 M | - | 30.04.2017 |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Anritsu | 12 M | - | 31.05.2016 |
| 431 | Model 7405 | Near-Field Probe Set | 9305-2457 | EMCO | - | 4 | |
| 436 | Univ. Radio Communication Tester | CMU 200 | 103083 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 439 | UltraLog-Antenna | HL 562 | 100248 | Rohde & Schwarz | 36 M | - | 31.03.2017 |
| 441 | CTC-SAR-EMI Cable Loss | System EMI field (SAR) Cable | - | CETECOM | 12 M | 5 | 30.01.2016 |
| 443 | CTC-FAR-EMI-RSE | System CTC-FAR-EMI-RSE | - | ETS-Lindgren / CETECOM | 12 M | 5 | 30.09.2016 |
| 454 | Oscilloscope | HM 205-3 | 9210 P 29661 | Hameg | - | 4 | |
| 456 | DC-Power supply 0-5 A | EA 3013 S | 207810 | Elektro Automatik | pre-m | 2 | |
| 459 | DC -Power supply 0-5 A , 0-32 V | EA-PS 2032-50 | 910722 | Elektro Automatik | pre-m | 2 | |
| 460 | Univ. Radio Communication Tester | CMU 200 | 108901 | Rohde & Schwarz | 12 M | - | 31.05.2016 |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|----------|---|-----------------------------|----------------------------|-----------------------------|-------------------------|--------|------------|
| 463 | Universal source | HP3245A | 2831A03472 | Agilent | - | 4 | |
| 466 | Digital Multimeter | Fluke 112 | 89210157 | Fluke USA | 24 M | - | 31.05.2016 |
| 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) | - | ld | |
| 484 | pre-amplifier 2,5 - 18 GHz | AMF-5D-02501800-25-10P | 1244554 | Miteq | 12 M | - | 30.09.2016 |
| 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 | - | 31.05.2016 |
| 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 | |
| 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 | - | 31.05.2016 |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 548 | Digital-Barometer | GBP 2300 | without | Greisinger GmbH | - | - | |
| 549 | Log.Per-Antenna | HL025 | 1000060 | Rohde & Schwarz | 36 M | - | 31.07.2018 |
| 552 | high pass filter 2,8-18GHz | WHKX 2.8/18G-10SS | 4 | Wainwright | 12 M | 1c | 30.09.2016 |
| 574 | Biconilog Hybrid Antenna | BTA-L | 980026L | Frankonia | 36/12 M | - | 31.05.2016 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | Rohde & Schwarz | pre-m | - | |
| 594 | Wideband Radio Communication Tester | CMW 500 | 101757 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | Rohde & Schwarz | 36 M | - | 31.05.2016 |
| 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 | - | 31.05.2016 |
| 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 | |
| 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 | |
| 642 | Wideband Radio Communication Tester | CMW 500 | 126089 | Rohde&Schwarz | 12 M | - | 31.05.2016 |
| 644 | Amplifierer | ZX60-2534M+ | SN865701299 | Mini-Circuits | - | - | |
| 670 | Univ. Radio Communication Tester | CMU 200 | 106833 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 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 | - | 31.05.2016 |
| 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 | - | 31.05.2016 |
| 688 | Pre Amp | JS-18004000-40-8P | 1750117 | Miteq | pre-m | - | |
| 692 | Bluetooth Tester | CBT 32 | 100236 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 697 | Power Splitter | ZN4PD-642W-S+ | 165001445 | Mini-Circuits | - | 2 | |

8.0.3. 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 | 2016-04-26 |
| -- | -- | -- |
| -- | -- | -- |