# T E S T  R E P O R T
# No.: 16-1-0219301T10a

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

**ISED-Regulations**
RSS-132 Issue 3, RSS-133 Issue 6,
RSS-Gen Issue 4

for

## ACTIA Nordic

## TEM4G  Telematics Module
## + Antenna 31409875

FCC-ID: 2AGKKTEM4G
ISED: 20839-TEM4G
PMN: TEM4G
HVIN: TEM4G
FVIN: 13

| Laboratory Accreditation and Listings | | |
|---|---|---|
| DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01<br>Accredited EMC-Test Laboratory | Industry Canada<br>Reg. No.: 3462D-1<br>Reg. No.: 3462D-2<br>Reg. No.: 3462D-3 | Voluntary Controls for Electromagnetic Emissions<br>Reg. No.:<br>R-20013, C-20009,<br>T-20006, G-20013 |
| Wi Fi ALLIANCE AUTHORIZED RF LABORATORY | ctia Authorized Test Lab Lab Code: 20011130-00 | FCC COMMUNICATIONS COMMISSION USA<br>MRA US-EU 0003 |
| accredited according to DIN EN ISO/IEC 17025 | | |


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Laboratory Accreditation and Listings

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**Total pages**



The listed attachments are an integral part of this report.

# 1. Summary of test results

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

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

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies and use an already approved cellular module with FCC-ID: QIPALS3-USR3 and ISED ID: 20839-TEM4G. This test report shows results for GPRS and (E)GPRS technologies only. Other implemented wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2, Part 22, Subpart H, Part 24, Subpart E (Broadband PCS) of the FCC CFR Title 47 Rules, Edition 4th November 2016 and Canada RSS-132 Issue 3, RSS-133 Issue 6 and RSS-Gen Issue 4 standards.

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

| No. of Diagram group | Test Cases | Port | References & Limits | | | EUT set-up | EUT op-mode | Result |
|---|---|---|---|---|---|---|---|---|
| | | | FCC Standard | RSS Section | Test limit | | | |
| 1 | Emissions AC-Power lines conducted (0,15 to 30 MHz) | AC-Power lines | §15.207 | RSS-Gen, Issue 4: Chapter 8.8 | §15.207 limits<br><br>IC: Table 3, Chapter 8.8 | -- | -- | Remark 3.) |
| 2 | General field strength emissions radiated - (9 kHz to 30 MHz) | Enclosure + Inter-connecting cables (radiated) | §15.209(a) | RSS-Gen, Issue 4: Chapter 8.9, Table 5 | 2400/F(kHz) µV/m<br>24000/F(kHz) µV/m<br>30 µV/m | 2 | 1+2+3+4 | Passed |
| 7 | RF-Power (ERP/EIRP)<br><br>radiated | | §2.1046<br>§22.913(a)(2)<br><br>§24.232(c) | RSS-132: 5.4<br>SRSP-503: 5.1.3<br><br>RSS-133: 4.1/6.4<br>SRSP-510: 5.1.2 | < 11.5 Watt (EIRP) (mobile stations)<br><br>< 2 Watt (EIRP) | -- | -- | Passed (Calculated with declared antenna gain) |
| 8 | Spurious emissions radiated (30 MHz to… *tenth-times of the fundamental frequency) | | §2.1053(a)<br>§2.1057<br>§22.917(a)(b)<br>§24.238(a)(b) | RSS-132: 5.5(i)(ii)<br><br>RSS-133: 6.5.1(i)(ii) | Required attenuation below P(dBW): 43+10log(P) dBc | 2 | 1+2+3+4 | passed |
| 9 | Band-Edge compliance | | | | | 2 | 1+2+3+4 | passed |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 30 | RF Power | Antenna terminal | §2.1046 | RSS-132: 5.4<br>SRSP-503: 5.1.3<br><br>RSS-133: 4.1/6.4<br>SRSP-510: 5.1.2 | < 11.5 Watt (EIRP) (mobile stations)<br><br>< 2 Watt (EIRP) | 1 | 2+4+5+6 | Remark 1 |
| 34 | 26dB Emission bandwidth | | §2.202<br>§2.1049(h)<br>§22.917(a)<br>§24.238(a) | RSS-Gen, Issue 4: Chapter 6.6 | 99% Power | -- | -- | |
| 35 | 99% Occupied bandwidth | | | | | | | |
| 36 | Spurious emissions | | §2.1051<br>§2.1057<br>§22.917(a)(b)<br>§24.238(a)(b) | RSS-132: 5.5(i)(ii)<br><br>RSS-133: 6.5.1(i)(ii) | Required attenuation below P(dBW): 43+10log(P) dBc | -- | -- | |
| 37 | Band-Edge compliance | | | | | | | |
| 38 | Frequency stability | | §22.355, table C-1<br>§24.235<br>§2.1055(a)(2) | RSS-132: 5.3<br><br>RSS-133: 6.3 | < ±2.5ppm<br><br><±0.1 ppm | -- | -- | |

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

| No. of Diagram group | Test case | Port | References & Limits | | | EUT set-up | EUT op-mode | Result |
|---|---|---|---|---|---|---|---|---|
| | | | FCC Standard | RSS Section | Test limit | | | |
| 1 | AC-Power Lines<br><br>conducted Emissions | AC-Power lines | §15.107<br>§15.207 | RSS-Gen, Issue4: Chapter 8.8 | FCC §15.107 class B limits<br>§15.207 limits<br><br>RSS-Gen: Table 3 | -- | -- | Remark 3 |
| 3 | Receiver<br><br>radiated emissions | Cabinet + Interconnecting cables | §15.109<br>§15.33<br>§15.35 | RSS-132, Issue 3: 6.6<br>RSS-Gen, Issue 4: 5.3<br>RSS 133, Issue 6: 6.6 | FCC 15.109 class B limits<br><br>RSS-Gen: Chapter 5.3+Chapter 7.1.2 | -- | -- | Passed<br><br>Remark 2 |

Remark:
1.) See RF-modules initial test report
2.) See separate test report no. CETECOM_TR16_1_0219301T10b for measurements according Part 15, Subpart B
3.) not applicable since car-environment

## 1.3. Attestation:

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

Digital unterschrieben von Niels Jeß
Datum: 2017.08.03 17:53:20 +02'00'

.....
Dipl.-Ing. Niels Jeß
Responsible for test section

Christian Lorenz
2017.08.03 10:35:11 +02'00'

.....
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<br>45219 Essen - Kettwig<br>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: | 2017-03-20 |
| Date(s) of test: | 2017-03-20 to 2017-06-29 |
| Date of report: | 2017-08-02 |
| Version of template: 13.02 | |

## 2.4. Applicant's details

| | |
|---|---|
| Applicant's name: | ACTIA Nordic |
| Address: | Hammarbacken 4A<br>19149 Sollentuna<br>Sweden |
| Contact person: | Mr. Salah Alazawi |

## 2.5. Manufacturer's details

| | |
|---|---|
| Manufacturer's name: | please see Applicant's details |
| Address: | please see Applicant's details |

# 3. Equipment under test (EUT)

## 3.1. TECHNICAL DATA OF MAIN EUT DECLARED BY APPLICANT

| | |
|---|---|
| GSM Frequency range<br>(US/Canada -bands) | ☒ GSM 850: 824 – 849 MHz (Uplink), 869-894 MHz (Downlink)<br>☒ GSM1900: 1850-1910 MHz (Uplink), 1930-1990 MHz (Downlink) |
| Type of modulation | ☒ GSM,GPRS, GMSK<br>☒ E-GPRS-Mode: 8-PSK |
| Number of channels<br>(USA/Canada -bands) | ☒ GSM 850: 128 – 251, 125 channels<br>☒ GSM1900: 512 – 810, 300 channels |
| Test Channel frequencies | ☒ GSM/E-GPRS 850 MHz Band: Channel 128/(192)/251<br>☒ GSM/E-GPRS 1900 MHz Band: Channel 512/(661)/810 |
| Emission designator(s) | From original report:<br>https://apps.fcc.gov/oetcf/eas/reports/ViewExhibitReport.cfm?mode=Exhibits&RequestTimeout=500&calledFromFrame=N&application_id=N1R4OGyLaKCotehafTuv1g%3D%3D&fcc_id=QIPALS3-USR3 |
| Antenna Type | ☒ Integrated (enclosure): Internal antenna set-up<br>☐ External - dedicated, no RF- connector<br>☒ External, separate RF-connector: External antenna set-up |
| Antenna Gain TX<br>(main external) | ☒ Values:<br>850 MHz Band: 0.4dBd (2.55dBi)<br>1900 MHz Band: 4.89 dBi |
| Antenna Gain TX<br>(secondary-backup antenna) | Accord. Document: *ACUII-05 / ACUII-06 Backup Antenna Specification Rev.1.0*<br>850MHz Band: -5.05dBd<br>1900MHz Band: 2.5dBi |
| Antenna Gain Dx (diversity) | ☐ Not applicable<br>☐ Value: xyz (Data sheet xyz)<br>☒ No information from customer |

| | | | |
|---|---|---|---|
| Measured Output Power [dBm]:<br>Conducted GSM 850<br>Conducted EDGE850 | 31.2dBm<br>25.2dBm | | |
| ERP Output Power [dBm]:<br>Radiated GSM 850<br>Radiated EDGE 850 | External Antenna:<br>31.2 dBm+0.4 dBd=31.6 dBm ERP<br>25.2 dBm+0.4 dBd=25.6 dBm ERP | Internal (Backup) antenna:<br>31.2dBm-5.05 dBd=26.15 dBm ERP<br>25.2dBm-5.05 dBd=20.15 dBm ERP | |
| Measured Output Power [dBm]:<br>Conducted GSM 1900<br>Conducted EDGE 1900 | 27.1dBm<br>23.2dBm | | |
| EIRP Output Power [dBm]:<br>Radiated GSM 1900<br>Radiated EDGE1900 | External Antenna:<br>27.1dBm+4.89dBi=31.99 dBm EIRP<br>23.2dBm+4.89dBi=28.09 dBm EIRP | Internal (Backup) antenna:<br>27.1dBm+2.5dBi=29.6 dBm EIRP<br>23.2dBm+2.5dBi=25.7 dBm EIRP | |
| Installed options | ☒ GSM 900 and GSM 1800 Bands (not usable in USA/Canada) (not tested within this test report)<br>☒ W-CDMA Band I and Band VIII (not usable in USA/Canada) (not tested within this test report)<br>☒ W-LAN wireless technologies (not tested within this test report)<br>☒ GPS (not tested within this test report) | | |
| Power supply | ☒ DC power only: 12Volt DC (car environment) | | |
| Special EMI components | -- | | |
| Does EUT contain devices susceptible to magnetic fields, e.g. Hall elements, electrodynamics microphones, etc.? | ☐ yes<br>☒ no | | |
| EUT sample type | ☐ Production | ☒ Pre-Production | ☐ Engineering |
| FCC label attached | ☒ yes (on module) | ☐ no | |

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

| Short descrip-tion*) | EUT | Type | S/N serial number | HW hardware status | SW software status |
|---|---|---|---|---|---|
| EUT A | TEM4G | Telematics Module | 20071090027 | H1 | 13 |
| EUT B | TEM4G | Telematics Module | 20071090026 | H1 | 13 |
| EUT C | External Antenna | 31409875 | #1 | -- | -- |

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

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

| AE short descrip-tion *) | Auxiliary Equipment | Type | S/N serial number | HW hardware status | SW software status |
|---|---|---|---|---|---|
| AE 1 | Main harness with power supply cables | For TEM4G | 1007-141-06 | Rev A1.1 | -- |
| AE 2 | External SIM card holder | For TEM4G | -- | -- | -- |
| AE 3 | Button Unit/Microphone | 30710477 | -- | -- | -- |
| AE 4 | USB Termination | -- | -- | -- | -- |

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

## 3.4. EUT set-ups

| EUT set-up no.*) | Combination of EUT and AE | Remarks |
|---|---|---|
| set. 1 | EUT A + AE 1+ AE 2 + AE 2 + AE 4 | Conducted measurement set-up |
| set. 2 | EUT B + EUT C + AE 1+ AE 2 + AE 2 + AE 4 | Radiated Set-up (main TX external-antenna activated) |
| set. 3 | EUT B + EUT C + AE 1+ AE 2 + AE 2 + AE 4 | Radiated Set-up (Backup antenna activated) |

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

## 3.5. Configuration of cables used for testing

| Cable number | Item | Type | S/N serial number | HW hardware status | Cable length |
|---|---|---|---|---|---|
| Cable 1 | Cable harness | For TEM4G | 1007-141-06 | Rev A1.1 | - |

## 3.6. EUT operating modes

| EUT operating mode no.*) | Description of operating modes | Additional information |
|---|---|---|
| op. 1 | GSM 850-Voice<br><br>Traffic channels<br>=<br>128/251 | 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).<br>The input signal to the receiver is modulated with normal test modulation.<br>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 | GPRS 850<br>Data<br>Traffic channels<br>=<br>128/251 | 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).<br>The input signal to the receiver is modulated with normal test modulation.<br>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 | GSM1900-Voice<br><br>Traffic channels<br>=<br>512/810 | 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).<br>The input signal to the receiver is modulated with normal test modulation.<br>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 | GPRS 1900<br>Data<br>Traffic channels<br>=<br>512/810 | 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).<br>The input signal to the receiver is modulated with normal test modulation.<br>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. 5 | E-GPRS 850<br>Data<br>Traffic channels<br>=<br>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).<br>The input signal to the receiver is modulated with normal test modulation.<br>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. 6 | E-GPRS 1900<br>Data<br>traffic channels<br>=<br>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).<br>The input signal to the receiver is modulated with normal test modulation.<br>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.

## 3.7. Parameter Settings on mobile phone and base station CMU200

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

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

**Settings for CMU (general)**

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

Additional settings on the base stations CMU200 for frequency stability measurements

# 4. Description of test system set-up's

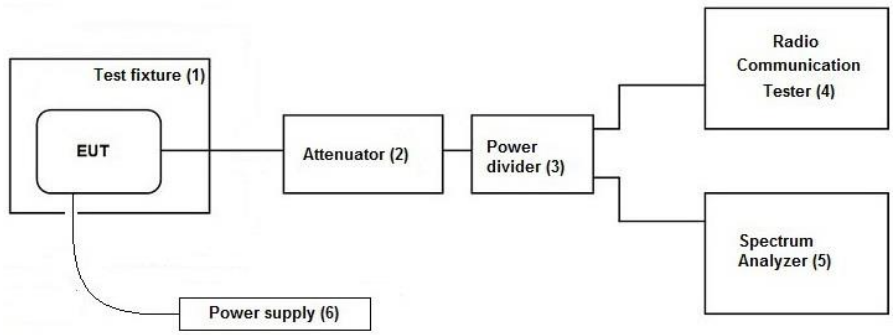
## 4.1. Test system set-up for conducted measurements on antenna port

**Cellular Conducted RF-Setup 1 (Cel-1 Set-up)**

**Tests Specification:** Conducted spurious emissions, Emission Bandwidth

**General Description:** The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) before it is 0° divided by a power divider (3). One of the RF-signal path is connected to the test unit communication tester (4), other RF-path is connected to the spectrum – analyzer (5) for specific RF-measurements. The specific attenuation losses for both signal paths/branches are determined prior to the measurement within a set-up calibration. These are then taken into account by correcting the measurement readings on the spectrum-analyzer.

**Schematic:**




**Used Equipment:**

| Passive Elements | Test Equipment | Remark: |
|---|---|---|
| ☒ 10 dB Attenuator (#530) | ☒ CMU200 Communication Test-Unit for GSM/W-CDMA | See List of equipment under each test case and chapter 8 for calibration info |
| ☒ Low loss RF-cables | ☒ DC-Power Supply | |
| ☒ 6 dB resistive power divider/coupler (#529) | ☒ Spectrum-Analyser | |

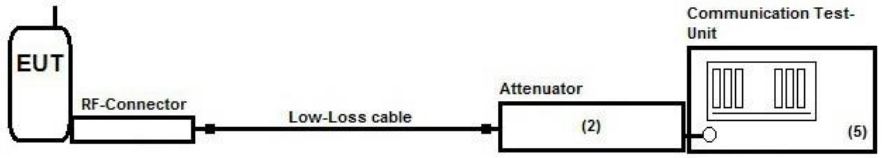
**Testing method:** ANSI C63.10:2013, KDB 971168 D01 v02r02

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

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

**Tests Specification:** Conducted Carrier power, Frequency Error

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




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

**Used Equipment**

| Passive Elements | Test Equipment | Remark: |
|---|---|---|
| ☒ 20 dB Attenuator (#613) | ☒ CMU200Communication Test-Unit for GSM/W-CDMA | See List of equipment under each test case and chapter 8 for calibration info |
| ☒ Low loss RF-cables | ☒ DC-Power Supply | |

**Measurement uncertainty** See chapter Measurement Uncertainties (Cel-2)

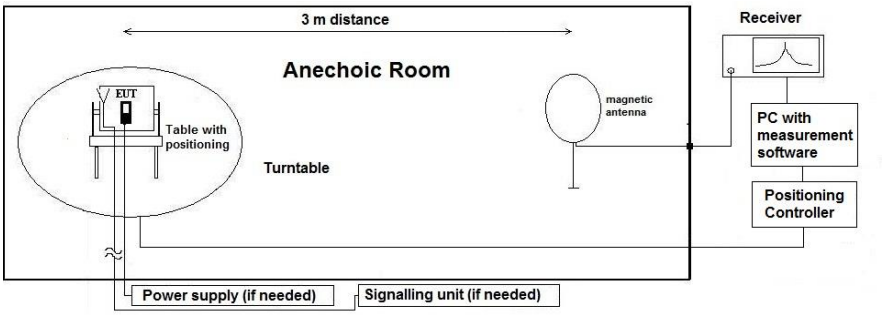
## 4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

**Specification:** ANSI C63.4-2014 §5.3, §8.2.1, §8.3.1.1+§8.3.2.1 , ANSI C63.10-2013 chapter 6.4 (§6.4.4.2)

**General Description:** Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

**Schematic:**




**Testing method:**

**Exploratory, preliminary measurement**
The EUT and it's associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0°to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded. The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

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

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

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

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

**Formula:**

$E_C = E_R + AF + C_L + D_F - G_A$

$M = L_T - E_C$

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

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

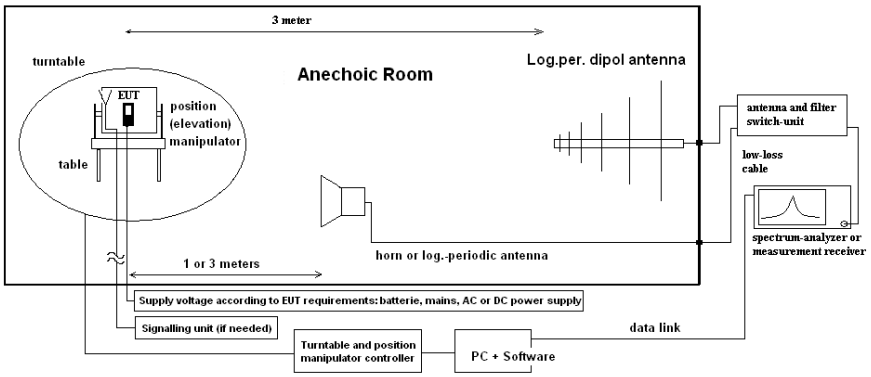
**Distance correction:** Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

## 4.3. Test system set-up for radiated spurious emission measurements

**Specification:** ANSI C63.4-2014 chapter 8.3, ANSI C63.10-2013 chapter 6.6.3.3 & 6.6.4, ANSI C63.26-2015, Chapter 4.6.3.3

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

**Schematic:**




**Testing method:**

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

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

**Formula:**

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

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

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

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

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

# 5. Measurements

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

### 5.1.1. Test location and equipments

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ Please see Chapter. 2.2.2 | | | |
| test site | ☒ 347 Radio.lab. 1 | ☐ Radio.lab. 2 | | | | |
| spectr. analys. | ☐ 584 FSU | ☒ 489 ESU 40 | ☐ 264 FSEK | ☐ 620 ESU 26 | | |
| signaling | ☐ 392 MT8820A | ☒ 436 CMU | ☐ 547 CMU | | | |
| otherwise | ☐ 110 USB LWL | | | | | |
| DC power | ☐ 456 EA 3013A | ☒ 463 HP3245A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 498 NGPE 40 |
| otherwise | ☐ 331 HC 4055 | ☒ 530 10 dB Att. | ☒ 529 Power div. | ☒ - cable OTA20 | | |
| line voltage | ☐ 230 V 50 Hz via public mains | | ☐ 060 120 V/ 60 Hz via PAS 5000 | | | |

### 5.1.2. Requirements and limits

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

### 5.1.3. Test condition and test set-up

| | | |
|---|---|---|
| Climatic conditions | Temperature: (22±3°C) | Rel. humidity: (40±20)% |
| Test system set-up | Please see chapter "Test system set-up for conducted measurements on antenna port" | |
| Measurement method | The measurements were performed with the integrated power measurement function of the „radio communication tester CMU200 from Rohde & Schwarz company. In this way spectrum-analyzers instrument limitations can be avoided or minimized. Instead, CMU manufacturers declared measurement error can be considered for this measurement.<br><br>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)<br><br>Peak and Average Values have been recorded for each channel on test set-up Cel-2. The Peak-to - Average-Power Ratio is determined on test set-up Cel-1 with corresponding settings. (see plots). The guideline in ANSIC63.26-2016 is taken into account. | |
| Mobile phone settings | A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200"<br><br>UE Power should be set to maximum, continuous transmission. DTX or other power saving techniques have been disabled<br><br>The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the mobile phone, should be sufficient to demonstrate compliance. | |

### 5.1.4. Measurement results

**Op. Mode 2, Set-up 1**

| Op. Mode | Carrier Channel | | Peak Output Power [dBm] | Average Output Power [dBm] | PAPR-Ratio on 0.1% probability [dB] | Peak power Limit | PAPR-Limit | Result |
|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | [dBm] | [dB] | |
| GSM 850 | Low | 128 | 31.2 | 31.1 | 0.33 | 38.4 | 13 | Passed |
| | Middle | 192 | 31.2 | 31.1 | 0.33 | | | |
| | High | 251 | 31.3 | 31.2 | 0.35 | | | |

**Remark:** --

**Op. Mode 5, Set-up 1**

| Op. Mode | Carrier Channel | | Peak Output Power [dBm] | Average Output Power [dBm] | PAPR-Ratio on 0.1% probability [dB] | Peak power Limit | PAPR-Limit | Result |
|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | [dBm] | [dB] | |
| E-GPRS 850 | Low | 128 | 28.0 | 24.8 | 3.47 | 38.4 | 13 | Passed |
| | Middle | 192 | 28.2 | 25.0 | 3.55 | | | |
| | High | 251 | 28.4 | 25.2 | 3.52 | | | |

**Remark:** --

**Op. Mode 4, Set-up 1**

| Op. Mode | Carrier Channel | | Peak Output Power [dBm] | Average Output Power [dBm] | PAPR-Ratio on 0.1% probability [dB] | Peak power Limit | PAPR-Limit | Result |
|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | [dBm] | [dB] | |
| GSM 1900 | Low | 512 | 27.3 | 27.1 | 0.34 | 38.4 | 13 | Passed |
| | Middle | 661 | 27.0 | 26.9 | 0.34 | | | |
| | High | 810 | 27.0 | 26.8 | 0.32 | | | |

**Remark:** --

**Op. Mode 6, Set-up 1**

| Op. Mode | Carrier Channel | | Peak Output Power [dBm] | Average Output Power [dBm] | PAPR-Ratio on 0.1% probability [dB] | Peak power Limit | PAPR-Limit | Result |
|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | [dBm] | [dB] | |
| E-GPRS 1900 | Low | 512 | 26.5 | 23.2 | 3.3 | 33.0 | 13 | Passed |
| | Middle | 661 | 25.2 | 23.0 | 3.2 | | | |
| | High | 810 | 26.1 | 22.9 | 3.25 | | | |

**Remark:** --

## 5.2. General Limit - Radiated field strength emissions below 30 MHz

### 5.2.1. Test location and equipment

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ Please see Chapter. 2.2.2 | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☒ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 347 Radio.lab. | | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☒ 001 ESS | ☐ | ☐ | ☐ | ☐ |
| spectr. analys. | ☐ 584 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ | ☐ | ☐ |
| antenna | ☐ 574 BTA-L | ☐ 133 EMCO3115 | ☐ 302 BBHA9170 | ☐ 289 CBL 6141 | ☒ 030 HFH-Z2 | ☐ 477 GPS |
| signaling | ☐ 392 MT8820A | ☐ 371 CBT32 | ☐ 547 CMU | ☐ 594 CMW | | |
| otherwise | ☐ 400 FTC40x15E | ☐ 401 FTC40x15E | ☐ 110 USB LWL | ☐ 482 Filter Matrix | ☐ 378 RadiSense | |
| DC power | ☒ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 498 NGPE 40 |
| line voltage | ☒ 12V DC | | ☐ 060 120 V 60 Hz via PAS 5000 | | | |

### 5.2.2. Requirements

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

### 5.2.3. Test condition and test set-up

| | | | | |
|---|---|---|---|---|
| Signal link to test system (if used): | | ☒ air link | ☐ cable connection | ☐ none |
| EUT-grounding | | ☒ none | ☐ with power supply | ☐ additional connection |
| Equipment set up | | ☒ table top | | ☐ floor standing |
| Climatic conditions | | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| EMI-Receiver or Analyzer Settings | Scan data | ☒ 9 – 150 kHz RBW/VBW = 200 Hz Scan step = 80 Hz<br>☒ 150 kHz – 30 MHz RBW/VBW = 9 kHz Scan step = 4 kHz<br>☐ other: | | |
| | Scan-Mode<br>Detector<br>Mode:<br>Sweep-Time | ☒ 6 dB EMI-Receiver Mode ☐ 3dB Spectrum analyser Mode<br>Peak (pre-measurement) and Quasi-PK/Average (final if applicable)<br>Repetitive-Scan, max-hold<br>Coupled – calibrated display if continuous signal otherwise adapted to EUT's individual transmission duty-cycle | | |
| General measurement procedures | | Please see chapter "Test system set-up radiated magnetic field measurements below 30 MHz" | | |

### 5.2.4. Measurement Results

The results are presented below in summary form only. For more information please consult the diagrams included in annex 1.

The EUT is put on operation on middle channel only. If critical peaks are found (Margin <10 dB) the lowest and highest channels will be performed too.For more information please see the diagrams.

Table of measurement results:

| Diagram No. | Carrier Channel | | Frequency range | Set-up no. | OP-mode no. | Remark | Used detector | | | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | | PK | AV | QP | |
| 2.01 | Low | 128 | 9 kHz-30 MHz | 3 | 1 | Internal antenna EUT standing | ☒ | ☐ | ☐ | passed |
| 2.03 | Low | 512 | 9 kHz-30 MHz | 3 | 3 | Internal antenna EUT standing | ☒ | ☐ | ☐ | passed |
| 2.02 | High | 251 | 9 kHz-30 MHz | 2 | 1 | External Antenna EUT standing | ☒ | ☐ | ☐ | passed |
| 2.04 | High | 810 | 9 kHz-30 MHz | 2 | 4 | External Antenna EUT standing | ☒ | ☐ | ☐ | passed |

Remarks: no critical frequencies within noise-level found

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

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

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

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

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

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ Please see Chapter. 2.2.2 | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☒ 443 FAR | ☐ 347 Radio.lab.1 | ☐ Radio.lab.2 | |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☐ 489 ESU 40 | ☐ 620 ESU 26 | | |
| spectr. analys. | ☐ 584 FSU | ☐ 120 FSEM | ☒ 264 FSEK | | | |
| antenna | ☒ 439 HL 562 | ☒ 549 HL 025 | ☐ 302 BBHA9170 | ☐ 289 CBL 6141 | ☐ 030 HFH-Z2 | ☐ 477 GPS |
| signaling | ☐ 017 CMD 65 | ☐ 323 CMD 55 | ☐ 340 CMD 55 | | | |
| signaling | ☐ 392 MT8820A | ☒ 546 CMU | ☐ 547 CMU | | | |
| power supply | ☒ 463 HP3245A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 498 NGPE 40 |
| otherwise | ☐ 529 6dB divider | ☐ 530 6dB Att. | ☐ 110 USB LWL | ☐ 482 Filter Matrix | ☐ 431 Near field | |
| line voltage | ☒ 12V DC | | ☐ 060 120 V/ 60 Hz via PAS 5000 | | | |

### 5.3.2. Requirements and limits (Variante RF-Parameter)

| | |
|---|---|
| FCC | ☒ Part 2.1053(a), Part2.1057(a)(1)<br>☒ Part 22 Subpart H, §22.917(a)(b)<br>☒ Part 24 Subpart E, §24.238(a)(b) |
| IC | ☒ RSS-132, Issue 3: 5.5(i)(ii)<br>☒ RSS-133, Issue 6: 6.5.1(i)(ii) |
| Limit | **§22.917(a) & §24.238(a):**<br>"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"<br>**Limit:** -13dBm for all Power Control Levels of the cellular equipment |

### 5.3.3. Test condition and test set-up

| | | | |
|---|---|---|---|
| link to test system (if used): | ☒ air link | ☐ cable connection | |
| EUT-grounding | ☒ none | ☐ with power supply | ☐ additional connection |
| Equipment set up | ☒ table top | | ☐ floor standing |
| Climatic conditions | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| Test system set-up | Please see chapter "Test system set-up for radiated spurious emission measurements up to 20 GHz" | | |
| Measurement method | *"§ 2.1057 Frequency spectrum to be investigated. (a) In all of the measurements set forth in § 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz"*<br><br>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.<br><br>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. | | |
| EUT settings | A call was established with settings according chapter "Parameter settings on mobile phone and base station CMU200"<br><br>The UE and used accessories (if any used) were set to work according their intended use/specification stated as by the applicant<br><br>The measurements were made at the low, middle and high carrier frequencies of each of the supported operating band. Choosing three TX-carrier frequencies of the wireless device, should be sufficient to demonstrate compliance. | | |

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

| Sweep no. | Start freq. MHz | Stop freq. MHz | R-BW MHz | V-BW MHz | Sweep time sec. | Att. [dB] | Detector |
|---|---|---|---|---|---|---|---|
| Sweep 1 (subrange 1) | 30 | 1000 | 0.1 | 0.3 | 10 | 10 | MaxH-PK |
| Sweep 2 (subrange 2) | 1000 | 2800 | 0.1 | 0.3 | 15 | 10 | MaxH-PK |
| Sweep 3 (subrange 3) | 2800 | 9000 | 0.1 | 0.3 | 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 | 3 | 10 | 10 | MaxH-PK |
| Sweep 2 (subrange 2) | 1000 | 2800 | 1 | 3 | 15 | 10 | MaxH-PK |
| Sweep 3 (subrange 3) | 2800 | 18000 | 1 | 3 | 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 |

### 5.3.4. Measurement results

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

#### 5.3.4.1. GSM 850: Set-up 2+3

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|---|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | PK | AV | QP | |
| 8.01_RSE_R_Ch128_Internal_ Voice_GSM_laying<br>8.01b_RSE_R_Ch128_Internal_ Voice_GSM_standing | Low | 128 | 30 MHz – 1 GHz | 1 Voice | Carrier on diagram, not relevant for results -> Internal antenna used | ☒ | ☐ | ☐ | passed |
| 8.01c_RSE_R_Ch128_GSM_ 1G-12G | | | 1 – 12 GHz | | Standing/laying Internal antenna used | ☒ | ☐ | ☐ | passed |
| 9.01_BE_R_Ch128_Internal_ Voice_Laying<br>9.01b_BE_R_Ch128_Internal_ Voice_Standing | | | 823 – 824 MHz | | Band Edge Compliance Internal antenna used | ☒ | ☒ | ☐ | passed |
| 9.03_BE_R_Ch128_ExtAnt_ GPRS_Laying<br>9.03b_BE_R_Ch128_ExtAnt_ GPRS_Standing | Low | 128 | 823 – 824 MHz | 2 GPRS | Band Edge Compliance<br>External antenna used | ☒ | ☒ | ☐ | passed |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8.06_RSE_R_Ch251_External_GPRS_30M_1G_Laying<br>8.06b_RSE_R_Ch251_External_GPRS_30M_1G_Standing | High | 251 | 30 MHz – 1 GHz | 2 | Carrier on diagram, not relevant for results<br>External antenna used | ☒ | ☐ | ☐ | passed |
| 8.06b_RSE_R_Ch251_GPRS_1G-12G | | | 1 to 12GHz | | Standing/laying<br>External antenna used | ☒ | ☐ | ☐ | passed |
| 9.02_BE_R_Ch251_IntAnt_GSM_VOICE_Laying<br><br>9.02b_BE_R_Ch251_IntAnt_GSM_VOICE_Standing | High | 251 | 849 – 850 MHz | 1 | Band-Edge compliance<br>Internal antenna used | ☒ | ☐ | ☐ | passed |
| 9.04_BE_R_Ch251_External_GPRS_Laying<br><br>9.04b_BE_R_Ch251_External_GPRS_Standing | High | | | 2 | Band-Edge compliance<br>External antenna used | ☒ | ☐ | ☐ | passed |

Remark:--

### 5.3.4.2. GPRS 1900: Set-up 2/3

| Diagram no. | Carrier Channel | | Frequency range | OP-mode no. | Remark | Used detector | | | Result |
|---|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | PK | AV | QP | |
| 8.10a_RSE_R_Ch512_GSM_Standing | Low | 512 | 30 MHz – 19.5 GHz | 4 | Carrier on diagram, not relevant for results<br>Internal antenna used | ☒ | ☐ | ☐ | passed |
| 9.07_BE_R_Ch512_Internal_Voice_Standing<br><br>9.07b_BE_R_Ch512_Internal_Voice_Laying | Low | 512 | 1849 – 1850 MHz | 3 | Band Edge Compliance<br>Internal antenna used | ☒ | ☐ | ☐ | passed |
| 9.09_BE_R_Ch512_ExtAnt_GPRS_Standing<br><br>9.09b_BE_R_Ch512_ExtAnt_GPRS_Laying | | | | 4 | Band Edge Compliance<br>External antenna used | ☒ | ☐ | ☐ | passed |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8.15_RSE_R_Ch810_External_GPRS_Laying<br><br>8.15_RSE_R_Ch810_External_GPRS_Standing | High | 810 | 30 MHz – 1 GHz | 4 | Carrier on diagram, not relevant for results<br>External antenna used | ☒ | ☐ | ☐ | passed |
| 8.15_RSE_R_Ch810_GPRS_1G-18G | High | | 1GHz – 18 GHz | | Standing/ Laying | ☒ | ☐ | ☐ | passed |
| 9.08_BE_R_Ch810_Internal_Voice_Standing<br><br>9.08b_BE_R_Ch810_Internal_Voice_Laying | High | 810 | 1910 – 1911 MHz | 3 | Band-Edge compliance<br>Internal antenna used | ☒ | ☐ | ☐ | passed |
| 9.10_BE_R_Ch810_ExtAnt_GPRS_Standing<br><br>9.10b_BE_R_Ch810_ExtAnt_GPRS_Laying | High | | | 4 | Band-Edge compliance<br>External antenna used | ☒ | ☐ | ☐ | passed |

Remark:--

## 5.4. 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<br>150 kHz - 30 MHz | 4.0 dB<br>3.6 dB | | | | | | - |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz<br>1 GHz - 18 GHz | 4.2 dB<br>5.1 dB | | | | | | E-Field |
| Disturbance power | CISPR 16-2-2 | 30 MHz - 300 MHz | - | | | | | | - |
| Power Output radiated | - | 30 MHz - 4 GHz | 3.17 dB | | | | | | Substitution method |
| Power Output conducted | - | Set-up No. | Cel-C1 | Cel-C2 | BT1 | W1 | W2 | -- | |
| | | 9 kHz - 12.75 GHz | N/A | 0.60 | 0.7 | 0.25 | N/A | -- | - |
| | | 12.75 - 26.5GHz | N/A | 0.82 | -- | N/A | N/A | -- | |
| Conducted emissions on RF-port | - | 9 kHz - 2.8 GHz | 0.70 | N/A | 0.70 | N/A | 0.69 | -- | N/A - not applicable |
| | | 2.8 GHz - 12.75GHz | 1.48 | N/A | 1.51 | N/A | 1.43 | -- | |
| | | 12.75 GHz - 18GHz | 1.81 | N/A | 1.83 | N/A | 1.77 | -- | |
| | | 18 GHz - 26.5GHz | 1.83 | N/A | 1.85 | N/A | 1.79 | -- | |
| Power density | - | 1 – 2.8GHz | 1.40 dB | | | | | | -- |
| Occupied bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | Frequency error |
| | | | 1.0 dB | | | | | | Power |
| Emission bandwidth | -<br>- | 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<br>30 MHz - 1 GHz<br>1 GHz - 20 GHz | 5.0 dB<br>4.2 dB<br>3.17 dB | | | | | | Magnetic field<br>E-field<br>Substitution |

**Table: measurement uncertainties, valid for conducted/radiated measurements**

# 6. Abbreviations used in this report

| The abbreviations | |
|---|---|
| ANSI | American National Standards Institute |
| AV , AVG, CAV | Average detector |
| EIRP | Equivalent isotropically radiated power, determined within a separate measurement |
| EGPRS | Enhanced General Packet Radio Service |
| EUT | Equipment Under Test |
| FCC | Federal Communications Commission, USA |
| IC | Industry Canada |
| n.a. | not applicable |
| Op-Mode | Operating mode of the equipment |
| PK | Peak |
| RBW | resolution bandwidth |
| RF | Radio frequency |
| RSS | Radio Standards Specification, Dokuments from Industry Canada |
| Rx | Receiver |
| TCH | Traffic channel |
| Tx | Transmitter |
| QP | Quasi peak detector |
| VBW | Video bandwidth |
| ERP | Effective radiated power |

# 7. Accreditation details of CETECOM's laboratories and test sites

| Ref.-No. | Accreditation Certificate | Valid for laboratory area or test site | Accreditation Body |
|---|---|---|---|
| - | D-PL-12047-01-01 | All laboratories and test sites of CETECOM GmbH, Essen | DAkkS, Deutsche Akkreditierungsstelle GmbH |
| 337<br>487<br>558<br>348<br>348 | (MRA US-EU 0003) | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS)<br>Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR)<br>Radiated Measurements above 1 GHz, 3 m (FAR)<br>Mains Ports Conducted Interference Measurements<br>Telecommunication Ports Conducted Interference Measurem. | FCC, Federal Communications Commission<br>Laboratory Division, USA |
| 337<br>487<br>550<br>558 | 3462D-1<br>3462D-2<br>3462D-2<br>3462D-3 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS)<br>Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR)<br>Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR)<br>Radiated Measurements above 1 GHz, 3 m (FAR) | IC, Industry Canada Certification and Engineering Bureau |
| 487<br>550<br>348<br>348 | R- 4452<br>G- 20013<br>C- 20009<br>T- 20006 | Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR)<br>Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR)<br>Mains Ports Conducted Interference Measurements<br>Telecommunication Ports Conducted Interference Measurem. | VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan |
| OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room | | | |

# 8. Instruments and Ancillary

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 |
| 295 | Racal Digital Radio Test Set | 6103 | 1572 | UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02 |
| 298 | Univ. Radio Communication Tester | CMU 200 | 832221/091 | R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used |
| 323 | Digital Radiocommunication Tester | CMD 55 | 825878/0034 | Firm.= 3.52 .22.01.99 |
| 335 | CTC-EMS-Conducted | System EMS Conducted | - | EMC 32 V 8.52 |
| 340 | Digital Radiocommunication Tester | CMD 55 | 849709/037 | Firm.= 3.52 .22.01.99 |
| 355 | Power Meter | URV 5 | 891310/027 | Firm.= 1.31 |
| 365 | 10V Insertion Unit 50 Ohm | URV5-Z2 | 100880 | Eprom Data = 31.03.08 |
| 366 | Ultra Compact Simulator | UCS 500 M4 | V0531100594 | Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10 |
| 371 | Bluetooth Tester | CBT32 | 100153 | CBT V5,30+ SW-Option K55, K57 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Firm.= 2.30, OTP= 02.01, GRA= 02.36 |
| 378 | Broadband RF Field Monitor | RadiSense III | 03D00013SNO-08 | Firm.= V.03D13 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Firm. = A13 (Mainboard) A02 (Display) |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario= 4.52#002 |
| 436 | Univ. Radio Communication Tester | CMU 200 | 103083 | R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band |
| 441 | CTC-SAR-EMI Cable Loss | System EMI field (SAR) | - | EMC 32 Version 8.52 |
| 442 | CTC-SAR-EMS | System EMS field (SAR) | - | EMC 32 Version 8.40 |
| 443 | CTC-FAR-EMI-RSE | System CTC-FAR-EMI-RSE | - | Spuri 7.2.5 or EMC 32 Ver. 9.15.00 |
| 444 | CTC-FAR-EMS field | System-EMS-Field (FAR) | - | EMC 32 Version 9.15.00 |
| 460 | Univ. Radio Communication Tester | CMU 200 | 108901 | R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used, |
| 489 | EMI Test Receiver | ESU40 | 1000-30 | Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00 |
| 491 | ESD Simulator dito | ESD dito | dito307022 | V 2.30 |
| 524 | Voltage Drop Simulator | VDS 200 | 0196-16 | Software Nr: 000037 Version V4.20a01 |
| 526 | Burst Generator | EFT 200 A | 0496-06 | Software Nr. 000034 Version V2.32 |
| 527 | Micro Pulse Generator | MPG 200 B | 0496-05 | Software-Nr. 000030 Version V2.43 |
| 528 | Load Dump Simulator | LD 200B | 0496-06 | Software-Nr. 000031 Version V2.35a01 |
| 546 | Univ. Radio Communication Tester | CMU 200 | 106436 | R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | 2.82_SP3 |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850 |
| 598 | Spectrum Analyzer | FSEM 30 (Reserve) | 831259/013 | Firmware Bios 3.40 , Analyzer 3.40 Sp 2 |
| 607 | Signal Generator | SMR 20 | 832033/011 | V1.25 |
| 620 | EMI Test Receiver | ESU 26 | 100362 | 4.43_SP3 |
| 642 | Wideband Radio Communication Tester | CMW 500 | 126089 | Setup V03.26, Test programm component V03.02.20 |
| 670 | Univ. Radio Communication Tester | CMU 200 | 106833 | µP1 =V8.50, Firmware = V.20 |
| 689 | Vector Signal Generator | SMU200 | 100970 | 02.20.360.142 |
| 692 | Bluetooth Tester | CBT 32 | 100236 | CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF) |
| | | | | |

## 8.0.2. 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 | - | 16.05.2018 |
| 005 | AC - LISN (50 Ohm/50µH, test site 1) | ESH2-Z5 | 861741/005 | Rohde & Schwarz | 12 M | - | 15.05.2018 |
| 007 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 892563/002 | Rohde & Schwarz | 12 M | - | 17.05.2018 |
| 009 | Power Meter (EMS-radiated) | NRV | 863056/017 | Rohde & Schwarz | 24 M | - | 15.05.2019 |
| 016 | Line Impedance Simulating Network | Op. 24-D | B6366 | Spitzenberger+Spies | 36 M | - | 30.05.2019 |
| 020 | Horn Antenna 18 GHz (Subst 1) | 3115 | 9107-3699 | EMCO | 36/12 M | - | 31.07.2017 |
| 021 | Loop Antenna (H-Field) | 6502 | 9206-2770 | EMCO | 36 M | - | 30.04.2018 |
| 030 | Loop Antenna (H-field) | HFH-Z2 | 879604/026 | Rohde & Schwarz | 36 M | - | 30.04.2018 |
| 033 | RF-current probe (100kHz-30MHz) | ESH2-Z1 | 879581/18 | Rohde & Schwarz | 24 M | - | 15.05.2019 |
| 057 | relay-switch-unit (EMS system) | RSU | 494440/002 | Rohde & Schwarz | pre-m | 1a | |
| 060 | power amplifier (DC-2kHz) | PAS 5000 | B6363 | Spitzenberger+Spies | - | 3 | |
| 086 | DC - power supply, 0 -10 A | LNG 50-10 | - | Heinzinger Electronic | pre-m | 2 | |
| 087 | DC - power supply, 0 -5 A | EA-3013 S | - | Elektro Automatik | pre-m | 2 | |
| 091 | USB-LWL-Converter | OLS-1 | 007/2006 | Ing. Büro Scheiba | - | 4 | |
| 099 | passive voltage probe | ESH2-Z3 | 299.7810.52 | Rohde & Schwarz | 36 M | - | 30.04.2018 |
| 100 | passive voltage probe | Probe TK 9416 | without | Schwarzbeck | 36 M | - | 30.04.2018 |
| 110 | USB-LWL-Converter | OLS-1 | - | Ing. Büro Scheiba | - | 4 | |
| 119 | RT Harmonics Analyzer dig. Flickermeter | B10 | G60547 | BOCONSULT | 36 M | - | 30.05.2019 |
| 133 | horn antenna 18 GHz (Meas 1) | 3115 | 9012-3629 | EMCO | 36 M | 1c | 10.03.2020 |
| 134 | horn antenna 18 GHz (Subst 2) | 3115 | 9005-3414 | EMCO | 36 M | - | 10.03.2020 |
| 136 | adjustable dipole antenna (Dipole 1) | 3121C-DB4 | 9105-0697 | EMCO | 36 M | - | 30.04.2018 |
| 140 | Signal Generator | SMHU | 831314/006 | Rohde & Schwarz | 24 M | - | 30.05.2018 |
| 248 | attenuator | SMA 6dB 2W | - | Radiall | pre-m | 2 | |
| 249 | attenuator | SMA 10dB 10W | - | Radiall | pre-m | 2 | |
| 252 | attenuator | N 6dB 12W | - | Radiall | pre-m | 2 | |
| 256 | attenuator | SMA 3dB 2W | - | Radiall | pre-m | 2 | |
| 257 | hybrid | 4031C | 04491 | Narda | pre-m | 2 | |
| 260 | hybrid coupler | 4032C | 11342 | Narda | pre-m | 2 | |
| 261 | Thermal Power Sensor | NRV-Z55 | 825083/0008 | Rohde & Schwarz | 24 M | - | 30.05.2018 |
| 262 | Power Meter | NRV-S | 825770/0010 | Rohde & Schwarz | 24 M | - | 30.05.2018 |
| 263 | Signal Generator | SMP 04 | 826190/0007 | Rohde & Schwarz | 36 M | - | 30.05.2019 |
| 265 | peak power sensor | NRV-Z33, Model 04 | 840414/009 | Rohde & Schwarz | 24 M | - | 30.05.2018 |
| 266 | Peak Power Sensor | NRV-Z31, Model 04 | 843383/016 | Rohde & Schwarz | 24 M | - | 30.05.2018 |
| 267 | notch filter GSM 850 | WRCA 800/960-6EEK | 9 | 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 | - | 17.05.2018 |
| 301 | attenuator (20 dB) 50W, 18GHz | 47-20-33 | AW0272 | Lucas Weinschel | pre-m | 2 | |
| 302 | horn antenna 40 GHz (Meas 1) | BBHA9170 | 155 | Schwarzbeck | 36 M | - | 14.03.2020 |
| 303 | horn antenna 40 GHz (Subst 1) | BBHA9170 | 156 | Schwarzbeck | 36 M | - | 20.03.2020 |
| 331 | Climatic Test Chamber -40/+180 Grad | HC 4055 | 43146 | Heraeus Vötsch | 24 M | - | 30.10.2018 |
| 341 | Digital Multimeter | Fluke 112 | 81650455 | Fluke | 24 M | - | 30.05.2018 |
| 342 | Digital Multimeter | Voltcraft M-4660A | IB 255466 | Voltcraft | 24 M | - | 17.05.2019 |
| 347 | laboratory site | radio lab. | - | - | - | 5 | |
| 348 | laboratory site | EMI conducted | - | - | - | 5 | |
| 354 | DC - Power Supply 40A | NGPE 40/40 | 448 | Rohde & Schwarz | pre-m | 2 | |
| 355 | Power Meter | URV 5 | 891310/027 | Rohde & Schwarz | 24 M | - | 30.05.2018 |
| 357 | power sensor | NRV-Z1 | 861761/002 | Rohde & Schwarz | 24 M | - | 24.05.2019 |
| 371 | Bluetooth Tester | CBT32 | 100153 | R&S | 36 M | - | 30.05.2019 |
| 373 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 100535 | Rohde & Schwarz | 12 M | - | 17.05.2018 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Rohde & Schwarz | 12 M | - | 15.05.2018 |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Anritsu | 12 M | - | 18.05.2018 |
| 405 | Thermo-/Hygrometer | OPUS 10 THI | 126.0604.0003.3.3.3.22 | LUFFT Mess u. Regeltechnik | 24 M | - | 30.03.2019 |
| 431 | Model 7405 | Near-Field Probe Set | 9305-2457 | EMCO | - | 4 | |
| 436 | Univ. Radio Communication Tester | CMU 200 | 103083 | Rohde & Schwarz | 12 M | - | 24.05.2018 |
| 439 | UltraLog-Antenna | HL 562 | 100248 | Rohde & Schwarz | 36 M | - | 10.03.2020 |
| 443 | CTC-FAR-EMI-RSE | System CTC-FAR-EMI-RSE | - | ETS-Lindgren / CETECOM | 12 M | 5 | 30.09.2017 |
| 463 | Universal source | HP3245A | 2831A03472 | Agilent | - | 4 | |
| 466 | Digital Multimeter | Fluke 112 | 89210157 | Fluke USA | 24 M | - | 30.05.2018 |
| 467 | Digital Multimeter | Fluke 112 | 89680306 | Fluke USA | 36 M | - | 30.04.2018 |
| 468 | Digital Multimeter | Fluke 112 | 90090455 | Fluke USA | 36 M | - | 30.04.2018 |
| 477 | ReRadiating GPS-System | AS-47 | - | Automotive Cons. Fink | - | 3 | |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|---|---|---|---|---|---|---|---|
| 480 | power meter (Fula) | NRVS | 838392/031 | Rohde & Schwarz | 24 M | - | 16.05.2019 |
| 482 | filter matrix | Filter matrix SAR 1 | - | CETECOM (Brl) | - | 1d | |
| 484 | pre-amplifier 2,5 - 18 GHz | AMF-5D-02501800-25-10P | 1244554 | Miteq | 12 M | - | 30.07.2017 |
| 487 | System CTC NSA-Verification SAR-EMI | System EMI field (SAR) NSA | - | ETS Lindgren / CETECOM | 24 M | - | 31.07.2017 |
| 489 | EMI Test Receiver | ESU40 | 1000-30 | Rohde & Schwarz | 12 M | - | 18.05.2019 |
| 502 | band reject filter | WRCG 1709/1786-1699/1796- | SN 9 | Wainwright | pre-m | 2 | |
| 503 | band reject filter | WRCG 824/849-814/859- | SN 5 | Wainwright | pre-m | 2 | |
| 512 | notch filter GSM 850 | WRCA 800/960-02/40-6EEK | SN 24 | Wainwrght | 12 M | 1c | 30.06.2017 |
| 517 | relais switch matrix | HF Relais Box Keithley | SE 04 | Keithley | pre-m | 2 | |
| 523 | Digital Multimeter | L4411A | MY46000154 | Agilent | 24 M | - | 18.05.2019 |
| 529 | 6 dB Broadband resistive power divider | Model 1515 | LH 855 | Weinschel | pre-m | 2 | |
| 530 | 10 dB Broadband resistive power divider | R 416110000 | LOT 9828 | - | pre-m | 2 | |
| 546 | Univ. Radio Communication Tester | CMU 200 | 106436 | R&S | 12 M | - | 30.03.2018 |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | Rohde & Schwarz | 12 M | - | 30.04.2017 |
| 549 | Log.Per-Antenna | HL025 | 1000060 | Rohde & Schwarz | 36/12 M | - | 31.07.2018 |
| 550 | System CTC S-VSWR Verification SAR-EMI | System EMI Field SAR S-VSWR | - | ETS Lindgren/CETECOM | 24 M | - | 31.07.2017 |
| 552 | high pass filter 2,8-18GHz | WHKX 2.8/18G-10SS | 4 | Wainwright | 12 M | 1c | 30.06.2017 |
| 557 | System CTC-OTA-2 | R&S TS8991 | - | Rohde & Schwarz | 12 M | 5 | 30.09.2016 |
| 558 | System CTC FAR S-VSWR | System CTC FAR S-VSWR | - | CTC | 24 M | - | 31.07.2017 |
| 574 | Biconilog Hybrid Antenna | BTA-L | 980026L | Frankonia | 36/12 M | - | 31.03.2019 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | Rohde & Schwarz | pre-m | - | |
| 594 | Wideband Radio Communication Tester | CMW 500 | 101757 | Rohde & Schwarz | 12 M | - | 30.04.2017 |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | Rohde & Schwarz | pre-m | - | |
| 598 | Spectrum Analyzer | FSEM 30 | 831259/013 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 600 | power meter | NRVD (Reserve) | 834501/018 | Rohde & Schwarz | 24 M | - | 17.05.2019 |
| 601 | medium-sensitivity diode sensor | NRV-Z5 (Reserve) | 8435323/003 | Rohde & Schwarz | 24 M | - | 15.05.2019 |
| 602 | peak power sensor | NRV-Z32 (Reserve) | 835080 | Rohde & Schwarz | 24 M | - | |
| 611 | DC power supply | E3632A | KR 75305854 | Agilent | pre-m | 2 | |
| 612 | DC power supply | E3632A | MY 40001321 | Agilent | pre-m | 2 | |
| 613 | Attenuator | R416120000 20dB 10W | Lot. 9828 | Radiall | pre-m | 2 | |
| 616 | Digitalmultimeter | Fluke 177 | 88900339 | Fluke | 24 M | - | 30.05.2018 |
| 617 | Power Splitter/Combiner | ZFSC-2-2-S+ | S F987001108 | Mini Circuits | - | 2 | |
| 618 | Power Splitter/Combiner | 50PD-634 | 600994 | JFW Industries USA | - | 2 | |
| 619 | Power Splitter/Combiner | 50PD-634 | 600995 | JFW Industries, USA | - | 3 | |
| 620 | EMI Test Receiver | ESU 26 | 100362 | Rohde-Schwarz | 12 M | - | 16.05.2018 |
| 621 | Step Attenuator 0-139 dB | RSP | 100017 | Rohde & Schwarz | pre-m | 2 | |
| 625 | Generic Test Load USB | Generic Test Load USB | - | CETECOM | - | 2 | |
| 627 | data logger | OPUS 1 | 201.0999.9302.6.4.1.43 | G. Lufft GmbH | 24 M | - | 30.03.2019 |
| 634 | Spectrum Analyzer | FSM (HF-Unit) | 826188/010 | Rohde & Schwarz | pre-m | 2 | |
| 637 | High Speed HDMI with Ethernet 1m | HDMI cable with Ethernet 1m | - | KogiLink | - | 2 | |
| 638 | HDMI Kabel with Ethernet 1,5 m flach | HDMI cable with Ethernet | - | Reichelt | - | 2 | |
| 640 | HDMI cable 2m rund | HDMI cable 2m rund | - | Reichelt | - | 2 | |
| 641 | HDMI cable with Ethernet | Certified HDMI cable with | - | PureLink | - | 2 | |
| 642 | Wideband Radio Communication Tester | CMW 500 | 126089 | Rohde&Schwarz | 12 M | - | 24.05.2018 |
| 644 | Amplifierer | ZX60-2534M+ | SN865701299 | Mini-Circuits | - | - | |
| 670 | Univ. Radio Communication Tester | CMU 200 | 106833 | Rohde & Schwarz | 24 M | - | 30.05.2018 |
| 671 | DC-power supply 0-5 A | EA-3013S | - | Elektro Automatik | pre-m | 2 | |
| 678 | Power Meter | NRP | 101638 | Rohde&Schwarz | pre-m | - | |
| 683 | Spectrum Analyzer | FSU 26 | 200571 | Rohde & Schwarz | 12 M | - | 17.05.2018 |
| 686 | Field Analyzer | EHP-200A | 160WX30702 | Narda Safety Test Solutions | 24 M | - | 29.03.2019 |
| 687 | Signal Generator | SMF 100A | 102073 | Rohde&Schwarz | 12 M | - | 17.05.2018 |
| 688 | Pre Amp | JS-18004000-40-8P | 1750117 | Miteq | pre-m | - | |
| 690 | Spectrum Analyzer | FSU | 100302/026 | Rohde&Schwarz | 12 M | - | 16.05.2018 |
| 691 | OSP120 Base Unit | OSP120 | 101183 | Rohde & Schwarz | 12 M | - | 22.05.2018 |
| 692 | Bluetooth Tester | CBT 32 | 100236 | Rohde & Schwarz | 36 M | - | 29.05.2020 |
| 693 | TS8997 | CTC-Radio Lab 1_TS8997 | - | Rohde&Schwarz | 12 M | 5 | 06.06.2017 |
| 697 | Power Splitter | ZN4PD-642W-S+ | 165001445 | Mini-Circuits | - | 2 | |
| 703 | INNCO Antennen Mast | MA 4010-KT080-XPET-ZSS3 | MA4170-KT100-XPET- | INNCO | pre-m | - | |
| 704 | INNCON Controller | CO 3000-4port | CO3000/933/38410516/L | INNCO Systems GmBh | pre-m | - | |
| 711 | Harmonic Mixer 90 GHz - 140GHz | RPG FS-Z140 | 101004 | RPG | 12 M | - | 22.02.2018 |
| 712 | Harmonic Mixer 75 GHz - 110GHz | FS-Z110 | 101468 | Rohde & Schwarz | 12 M | - | 22.02.2018 |
| 713 | Harmonic Mixer, 50 GHz - 75GHz | FS-Z75 | 101022 | Rohde & Schwarz | 12 M | - | 22.05.2018 |
| 714 | Signal Analyzer 67GHz | FSW67 | 104023 | Rohde & Schwarz | 24 M | - | 03.03.2019 |
| 715 | Harmonic Mixer, 140 GHz - 220GHz | FS-Z220 | 101009 | RPG Radiometer Physics | 12 M | - | 03.08.2018 |
| 716 | Harmonic Mixer 220 GHz to 325 GHZ | FS-Z325 | 101005 | RPG Radiometer Physics | 12 M | - | 13.02.2018 |
| 747 | Spectrum Analyzer | FSU 26 | 200152 | Rohde & Schwarz | 12 M | - | 18.05.2018 |
| 748 | Pickett-Potter Horn Antenna | FH-PP 4060 | 010001 | Radiometer Physiscs | - | - | |
| 749 | Pickett-potter Horn Antenna | FH-PP 60-90 | 010003 | Radiometer Physics | - | - | |
| 750 | Pickett-Potter Horn Antenna | FH-PP 140-220 | 010011 | Radiometer Physics | - | - | |

### 8.0.3. 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 | 2017-08-02 |