

TEST REPORT
No.: 6-0491-14-14-2c

According to:
FCC Regulations
Part 2.1091

IC-Regulations
RSS-102, Issue 4

for

peiker acustic GmbH & Co. KG

GSM/W-CDMA Module V1140-103
and
ATM-01 R1-ECE-3G, ATM-01 R1-RoW-3G
or ATM-01 R1-BR-3G

FCC-ID: QWY-V1140-103
IC-ID: 6588A-V1140103 , PMN: LTE-NAD , HVIN: V1140-103







| Laboratory Accreditation and Listings | | | |
|--|--|--|--|
|  DAkKS Deutsche Akkreditierungsstelle D-PL-12047-01-01 |  FEDERAL COMMUNICATIONS COMMISSION FC USA Reg. No.: 736496 MRA US-EU 0003 |  Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3 |  Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2666 C-2914, T-1967, G-301 |
|  WiFi ALLIANCE AUTHORIZED RF LABORATORY |  CTIA Authorized Test Lab LAB CODE 20011130-00 | | |
| accredited according to DIN EN ISO/IEC 17025 | | | |
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Annex 1: External EUT photographs – separate document TR6-0491-14-14-2c-A1

4

The listed attachments are an integral part of this report.

1. Summary of test results

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

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies. The presented RF Data-Module can be build inside host applications and extends their capability by wireless GSM and W-CDMA technology. Data transmissions application is possible field application.

In order to verify the compliance with applicable rules, a representative configuration consisting of representative auxiliary equipment was chosen. Embedded in this configuration, Module can be tested. Please refer to set-up description and photos of test reports and annexes for more details.

Following tests have been performed to show compliance with applicable FCC Part 2.1091 and FCC Part 1.1310 of the FCC CFR 47 Rules and Canadian RSS-102 Issue 4 regulations.

1.1. TX mode, tests overview FCC Part 2.1091 and Canada IC Standards (RSS)

| No. of Diag. group | Test Cases | Port | References & Limits | | | EUT set-up | EUT op-mode | Result |
|--------------------|---|------------------------------|--------------------------|---------------------------------|---|------------|-------------|--------------------|
| | | | FCC Standard | RSS Section | Test limits | | | |
| -- | RF Power (conducted) | Antenna terminal (conducted) | §2.1046 | -- | N/A | - | 1 to 10 | passed Remark 1 |
| -- | RF Power (radiated) | Cabinet | §2.1046 §22.913(a)(2) | RSS-132: 4.4 SRSP-503: 5.1.3 | < 7 Watt ERP | -- | 1 to 10 | passed Remark 1 |
| | | | §24.232(c) | RSS-133:6.4 SRSP-510: 5.1.2 | < 2Watt (EIRP) | | | |
| | | | §27.50(c)(10) | -- | < 3 Watt (ERP) | | | |
| | | | §27.50(d) | RSS-139:6.4 | < 1 Watt (EIRP) | | | |
| -- | Radio frequency Exposure Evaluation (MPE) | Cabinet | §1.1310 §2.1091 | RSS-102, Issue 4 | FCC: §1.1310 Table 1, Limits for General Population IC: Chapter 4.2 RF-Limits | -- | 1 to 10 | passed |

Remark: 1.) See separate test reports TR6-0315-13-1-8a/b/c and corresponding annexes.

This MPE report does not take into consideration a possible collocation with other transmitter (ex. BT, Wi-Fi).

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.

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

.....
M. Nunier
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: | M. Nunier |
| Receipt of EUT: | 2013-06-10 |
| Date(s) of test: | 2013-06-10 to 2013-07-04 |
| Date of report: | 2015-03-19 |
| ----- | |
| Version of template: | 13.01 |

2.4. Applicant's details

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

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 DESCRIPTION OF MAIN EUT

GSM characteristics:

| | | | |
|--|---|--|--------------------------------------|
| Main function | GSM/GPRS/E-GPRS/W-CDMA Wireless Module | | |
| Type | V1140-103 | | |
| GSM Frequency range (US/Canada -bands) | GSM 850: 824 – 849 MHz (Uplink), 869-894 MHz (Downlink) GSM1900: 1850-1910 MHz (Uplink), 1930-1990 MHz (Downlink) | | |
| Type of modulation | GSM,GPRS, GMSK EGPRS-Mode: 8-PSK | | |
| Number of channels (USA/Canada -bands) | GSM 850: 128 – 251, 125 channels GSM1900: 512 – 810, 300 channels | | |
| Test Channel frequencies | GSM/E-GPRS 850 MHz Band: Channel 128/192/251 GSM/E-GPRS 1900 MHz Band: Channel 512/661/810 | | |
| Emission designator(s) | 247KGXW (GSM850) 245KG7W (EDGE850) 245KGXW (GSM1900) 245KG7W (EDGE 1900) | | |
| Antenna Type | <input type="checkbox"/> Integrated <input type="checkbox"/> External, no RF- connector <input checked="" type="checkbox"/> External, separate RF-connector | | |
| Antenna Gain (declared by applicant) | <input type="checkbox"/> conducted: not declared by applicant <input checked="" type="checkbox"/> radiated: not declared by the applicant | | |
| Measured Output Power [dBm]: Conducted GSM 850 Conducted EDGE850 | Peak 33,0dBm / AV 32,7dBm Peak 30,1dBm / AV 26,9dBm | | |
| Measured Output Power [dBm]:: Radiated GSM 850 Radiated EDGE 850 | Peak 31,0dBm Peak 23,0dBm | | |
| Measured Output Power [dBm]:: Conducted GSM 1900 Conducted EDGE 1900 | Peak 29,9dBm / AV 29,6dBm Peak 29,1dBm / AV 25,8dBm | | |
| Measured Output Power [dBm]:: Radiated GSM 1900 Radiated EDGE1900 | Peak 31,7dBm Peak 29,8dBm | | |
| FCC-ID | QWY-V1140-103 | | |
| IC | 6588A-V1140103 | | |
| Installed options | <input checked="" type="checkbox"/> W-CDMA Band I and Band VIII (not usable in USA/Canada) | | |
| Power supply | <input checked="" type="checkbox"/> possibility one: over AC/DC adapter: 12 V DC <input checked="" type="checkbox"/> possibility two: DC powered only by laboratory power supply with 3.8 Volt | | |
| Special EMI components | -- | | |
| Voltage | <input checked="" type="checkbox"/> nominal 3.8 V DC | | |
| 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 | | |

W-CDMA characteristics:

| | | | |
|-------------------------------------|---|--|--------------------------------------|
| Main function | GSM/GPRS/E-GPRS/W-CDMA Wireless Module | | |
| Type | V1140-103 | | |
| TX-frequency range | FDD Band 2: 1852.4–1907.6 MHz (Uplink), 1930-1990 MHz (Downlink) FDD Band 5: 826.4-846.6 MHz (Uplink), 869-894 MHz (Downlink) | | |
| Type of modulation | FDD-Mode Release99: QPSK FDD Mode Release 5+6: 16QAM additional | | |
| Number of channels | FDD Band 2: UARFCN range 9262 – 9400 – 9538 FDD Band 5: UARFCN range 4132 – 4183 – 4233 | | |
| UMTS-HSPA connectivity | no information available | | |
| Emission designator(s) | Band II: 4M17F9W Band V: 4M17F9W | | |
| Antenna Type | <input type="checkbox"/> Integrated <input type="checkbox"/> External, no RF- connector <input checked="" type="checkbox"/> External, separate RF-connector | | |
| Antenna Gain | <input type="checkbox"/> conducted: not declared by applicant <input checked="" type="checkbox"/> radiated: not declared by the applicant | | |
| MAX PEAK Output Power: Radiated | FDD-Mode 2 | (PK) 30,8dBm | |
| | FDD-Mode 5 | (PK) 26,6dBm | |
| MAX PEAK Output Power: Conducted | FDD-Mode 2 | (PK) 27,0dBm | |
| | FDD-Mode 5 | (PK) 27,4dBm | |
| FCC-ID | QWY-V1140-103 | | |
| IC | 6588°-V1140103 | | |
| Installed option | <input checked="" type="checkbox"/> GSM 900 and GSM 1800 Bands (not usable in USA/Canada) | | |
| Power supply | <input checked="" type="checkbox"/> possibility one: over AC/DC adapter: 12 V DC <input checked="" type="checkbox"/> possibility two: DC powered only by laboratory power supply with 3.8 Volt | | |
| Special EMI components | -- | | |
| EUT sample type | <input type="checkbox"/> Production | <input checked="" type="checkbox"/> Pre-Production | <input type="checkbox"/> Engineering |
| FCC label attached | <input type="checkbox"/> yes <input checked="" type="checkbox"/> no | | |

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

| Short description*) | EUT | Type | S/N serial number | HW hardware status | SW software status |
|---------------------|-------------------|-----------|---------------------|--------------------|--------------------------|
| EUT A | GSM/W-CDMA Module | V1140-103 | WC#418 V1140-103 | V1140-103_Ver. 3 | M9615A-CETWTAZM-50110010 |
| EUT B | | -- | EU 64159 | -- | -- |

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

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

| AE short description *) | Auxiliary Equipment | Type | S/N serial number | HW hardware status | SW software status |
|-------------------------|---------------------|---------------------|-------------------|--------------------------|--------------------|
| AE 1 | Evaluation Board | LTE-NAD LP1307-1 | 218 UL94V-0 | -- | -- |
| AE 2 | Microphone | KL1/B | -- | -- | -- |
| AE 3 | Loudspeaker | -- | 9263744 | -- | -- |
| AE 4 | USB cable | High Speed 2.0 | -- | -- | -- |
| AE 5 | AC/DC Adapter | Fairway | WN20U-12A | Output: 12 V DC 1.25A | -- |
| AE 6 | Notebook | Dell D2120 | -- | -- | Windows 7 |
| AE 7 | Host device | ATM-01 R1-ECE-3G | -- | -- | -- |
| AE 8 | Host device | ATM-01 R1-RoW-3G | -- | -- | -- |
| AE 9 | Host device | ATM-01 R1-BR-3G | -- | -- | -- |

*) 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 +EUT B + AE 1 +AE 2 +AE 3 +AE 4 +AE5 +AE 6 | Setup for radiated tests, results not used within this report. Pls. see comment on chapter 4.1.4 |
| set. 2 | EUT A + AE 1 +AE 2 +AE 3 +AE 4 +AE5 +AE 6 | Setup for conducted tests, results not used within this report. Pls. see comment on chapter 4.1.4. |
| set. 3 | EUT A + AE 7 | Used for MPE re-evaluation report |
| set. 4 | EUT A + AE 8 | Used for MPE re-evaluation report |
| set. 5 | EUT A + AE 9 | Used for MPE re-evaluation report |

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

3.5. EUT operating modes

| EUT operating mode no. *) | Description of operating modes | Additional information |
|---------------------------|---|--|
| op. 1 | GPRS 850 TCH mode TCH=128/192/251 | A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 33 dBm (power class 4; power control level 5). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (33dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link. |
| op. 2 | EGPRS 850 TCH mode TCH=128/192/251 | A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 33 dBm (power class 4; power control level 5). USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8PSK modulation, slot 3 active, uplink gamma: 6 (27dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link. |
| op. 3 | GPRS 1900 TCH mode TCH=512/661/810 | A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 30 dBm (power class 1; power control level 0). USF_Duty CYCLE set to 100%, coding scheme CS-1 for GMSK modulation, slot 3 active, uplink gamma: 3 (30dBm). The input signal to the receiver is modulated with normal test modulation. The wanted RF input signal level to the receiver of the mobile station is set to a level to provide a stable communication link |
| op. 4 | EGPRS 1900 TCH mode PCL=0 (max. power) TCH=512/661/810 | A communication link is established between the mobile station and the test simulator. The transmitter is operated at its maximum rated output power: 30 dBm (power class 1; power control level 0). USF_Duty CYCLE set to 100%, coding scheme MCS-5 for 8-PSK modulation, slot 3 active, uplink gamma: 5 (26dBm). 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. 5 | FDD Mode 2 RMC99-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: 24dBm. |
| op. 6 | FDD Mode 5 RMC99-Mode | 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.

4. Measurements

4.1. Radio Frequency Exposure Evaluation §2.1091

4.1.1. Test location and equipment (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 |
| For Evaluation instruments are not needed. Results are determined by calculation. | | | |

4.1.2. Requirements

| | |
|--------------------|---|
| FCC: §1.1310 | <i>The criteria used for the evaluation of human exposure to radio frequency radiation is table 1 according FCC §1.1310 and table chapter 4.2 of RSS-102 standard and it is subject for evaluation of the RF exposure prior to equipment authorization. As the mobile equipment is authorized under Part 22 (Subpart H) and Part 24 of the FCC Rules, it is subject for evaluation of the RF exposure prior to equipment authorization.</i> |
| FCC § 2.1091 | <i>Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation." For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits given in Table 1 of Appendix A.</i> |
| IC RSS-102 Issue 4 | <i>"...sets out the requirements and measurement techniques used to evaluate radio frequency (RF) exposure compliance of radiocommunication apparatus designed to be used within the vicinity of the human body"</i> |

| Table 1: LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) | | | | |
|---|-------------------------------|-------------------------------|-----------------------|--------------------------|
| Frequency range [MHz] | Electric field strength [V/m] | Magnetic field strength [A/m] | Powe density [mW/cm²] | Averaging time [minutes] |
| 30 - 300 | 61.4 | 0.163 | 1.0 | 6 |
| 300 - 1500 | - | - | f/300 | 6 |
| 1500 - 100,000 | - | - | 5 | 6 |
| (B) Limits for General Population / Uncontrolled Exposure | | | | |
| 0.3 – 1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34 – 30 | 824/f | 2.19/f | *(180/f²) | 30 |
| 30 - 300 | 27.5 | 0.073 | 0.2 | 30 |
| 300 - 1500 | - | - | f/1500 | 30 |
| 1500 – 100,0 | - | - | 1.0 | 30 |

For given power density limit at a single frequency (accord. Table 1 Limits) the maximum antenna gain can be calculated.

The used equation to predict the power density in the far-field of one single radiating antenna can be made by following equation:

$$S = \frac{EIRP}{4\pi R^2} = \frac{P * G}{4\pi R^2}$$

$$G_{NUMERIC} = \frac{S * 4\pi R^2}{P}$$

4.1.3. General Limits:

FCC:

| | |
|-----------------------|--|
| FCC: §1.1307 | <i>Cellular Radiotelephone Service (subpart H of part 22) Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP)</i> |
| FCC §1.1307 | <i>Personal Communications Services (part 24) Broadband PCS (subpart E): non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP)</i> |
| FCC §1.1310 | <i>LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) Table 1(B) Limits for General Population/Uncontrolled Exposure 300–1500 MHz: $f/1500$ mW/cm² 1500–100,000 MHz: 1.0 mW/cm²</i> |
| FCC §2.1091 | <i>Subject to routine evaluation is required when the device operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.</i> |
| FCC §24.232 | <i>(a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT. b) Mobile/portable stations are limited to 2 watts e.i.r.p. peak power, ...</i> |
| FCC §22.913 | <i>(a) Maximum ERP. The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.</i> |
| FCC §27.50 (C)(10) | <i>(10) Portable stations (hand-held devices) are limited to 3 watts ERP; and</i> |
| FCC §27.50(d) | <i>(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP.</i> |

4.1.4. Measurement method

Valid for GSM/GPRS/EDGE mode:

- The power was tested on 3 frequencies (lowest/middle/highest) within each operable bands and the results compared to applicant's declared power values (tune-up info).
- Average burst power (slot power) and peak were measured (see separate report for GSM/GPRS/E-GPRS technology)
- Only one uplink slot (1 TX) was measured. 4 TX slots are maximum possible for this device and calculated as worst-case
- A duty-cycle correction factor of $10 \cdot \log_{10}$ (max. number of possible active slots / 8 slots) were applied

Please find in the following tables the calculations based on applicants tune-up information for the power values. Also the maximum admissible allowed antenna gain is calculated which is not exceeding the MPE limit for fixed and mobile operations.

Valid for W-CDMA Mode:

- The power was checked on 3 frequencies (lowest/middle/highest) within each operable FDD-band (see separate report for W-CDMA technology) and the results compared to applicant's declared power values (tune-up info). A RMS detector was used.
- No duty-cycle correction factor is applicable

Please find in the following tables the calculations based on applicants tune-up information (document *Tune-Up Information for Peiker 2G/3G LTE-NAD V1140-103 / V1140-105* Rev. 1.0, dated 2013-11-20) for the power values. Also the maximum admissible allowed antenna gain is calculated which is not exceeding the MPE limit for fixed and mobile operations.

4.2. Results for fixed and mobile operations

4.2.1. Results for lower operational band: GSM850 and FDD Band 5

4.2.1.1. MPE results

For MPE calculations the PCB path loss is considered according provided information by the applicant. Path loss value is 2.8 dB for the external antenna path.

| Operating Mode | Frequency on channel (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer | Maximum output power (declared+ Tune-up) (dBm) | Duty cycle | Declared Maximum conducted output power [W] | Equivalent conducted output power (maximum conducted output power) |
|------------------------------|----------------------------|---|--|--|------------|---|--|
| GSM/GPRS (PK) | 824.2 | 32.50 | 1.50 | 34.00 | 50% | 2.5119 | 1255.94 |
| | 837 | 32.50 | | 34.00 | | 2.5119 | 1255.94 |
| | 848.8 | 32.50 | | 34.00 | | 2.5119 | 1255.94 |
| GSM/GPRS (Avg. Burst Power) | 824.2 | 32.50 | 1.50 | 34.00 | 50% | 2.5119 | 1255.94 |
| | 837 | 32.50 | | 34.00 | | 2.5119 | 1255.94 |
| | 848.8 | 32.50 | | 34.00 | | 2.5119 | 1255.94 |
| EDGE (PK) | 824.2 | 26.50 | 2.50 | 29.00 | 50% | 0.7943 | 397.16 |
| | 837 | 26.50 | | 29.00 | | 0.7943 | 397.16 |
| | 848.8 | 26.50 | | 29.00 | | 0.7943 | 397.16 |
| EDGE (Avg. Burst Power) | 824.2 | 26.50 | 2.50 | 29.00 | 50% | 0.7943 | 397.16 |
| | 837 | 26.50 | | 29.00 | | 0.7943 | 397.16 |
| | 848.8 | 26.50 | | 29.00 | | 0.7943 | 397.16 |
| WCDMA FDD Band 5 (RMS-Value) | 826.4 | 23.00 | 2.00 | 25.00 | 100% | 0.3162 | 316.23 |
| | 836.4 | 23.00 | | 25.00 | | 0.3162 | 316.23 |
| | 846.6 | 23.00 | | 25.00 | | 0.3162 | 316.23 |

| Maximum calculated MPE value: | | |
|-------------------------------|-------|-----------------------|
| MPE-Limit: | 0.471 | [mW/cm ²] |
| Highest MPE value: | 0.131 | [mW/cm ²] |
| Margin to limit | 0.340 | [mW/cm ²] |

Remark: based on 0dBd antenna gain and additional path loss of 2.8dB

Canadian RSS-102 standard requires the RF-exposure value in W/m² unit., therefore the value determined in mW/cm² unit, should be multiplied by 10 to have the required unit.

4.2.1.2. Max. antenna gain calculations

| | | |
|--|--|--|
| Maximum antenna gain considerations for fixed/mobile operations for complying with limits: | | |
|--|--|--|

| | | |
|----------------|--|---------|
| POUT | Maximum power delivery at RF-Pad from Module incl. Duty cycle [mW]: (Avg. Burst Power or RMS) | 1255.94 |
| Atten-Pad | Attenuation - Path Loss NAD to ext. Ant. (MIMO 1) [dB] (information from applicant) | -2.8 |
| PANT | Resulting delivered Power at antenna input [mW] | 659.13 |
| R | Safety distance [cm]: | 20.00 |
| S | MPE limit acc. §1.1310 and RSS-102 for uncontrolled exposure [mW/cm ²]: (FCC use mW/cm ² & IC use W/m ²) | 0.55 |
| G ₁ | Maximum Antenna gain to comply with MPE limit [dBi]: | 6.22 |

(For G₁ the lowest measured channel to reach minimum ant. Gain selected)

| | | |
|--|--|------|
| ERP power limit according to §2.1091 [W]: (Avg. Burst Power or RMS) | | 1.50 |
| G ₂ | Max. Antenna gain to comply with limit incl. Duty cycle [dBi]: | 5.72 |

(For G₂ select the max. Avg. Burst Power or RMS value incl. Duty cycle)

| | | |
|---|---|------|
| ERP power limit according to §22.913 [W ERP]: | | 7.00 |
| G ₃ | Max. Antenna gain to comply with limit [dBi]: | 9.35 |

(For G₃ select the max. Average burst power value **excluding** Duty cycle)

| | | |
|----------------------|--|------|
| G 850MHz-Band | Min (G₁, G₂, G₃) [dBi] | 5.72 |
|----------------------|--|------|

| | | |
|----------------------------|--|------|
| Summarized results: | The max. ant. gain for mobile operation at 850 MHz band to comply with MPE and ERP limits incl. External path loss for shown application shall not exceed [dBd]: | 3.57 |
|----------------------------|--|------|

4.2.2. Results for upper operational band: GSM1900 and FDD 2

4.2.2.1. MPE results

For MPE calculations the PCB path loss is considered according provided information by the applicant. Path loss value is 5.0 dB for the external antenna path.

| Operation Mode | Frequency on channel (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer (dB) | Declared maximum output power (Measured+ Tune-up) (dBm) | Duty cycle | Declared Maximum conducted output power (W) | Equivalent conducted output power (maximum conducted output power x duty cycle) (mW) |
|-------------------------------|----------------------------|---|---|---|------------|---|--|
| GSM/GPRS (PK-Burst value) | 1850.2 | 29.5 | 1.50 | 31.00 | 50% | 1.259 | 629 |
| | 1880.0 | 29.5 | | 31.00 | | 1.259 | 629 |
| | 1909.8 | 29.5 | | 31.00 | | 1.259 | 629 |
| GSM/GPRS (AV Burst Power) | 1850.2 | 29.5 | 1.50 | 31.00 | 50% | 1.259 | 629 |
| | 1880.0 | 29.5 | | 31.00 | | 1.259 | 629 |
| | 1909.8 | 29.5 | | 31.00 | | 1.259 | 629 |
| EDGE (PK-Burst value) | 1850.2 | 25.5 | 2.50 | 28.00 | 50% | 0.631 | 315 |
| | 1880.0 | 25.5 | | 28.00 | | 0.631 | 315 |
| | 1909.8 | 25.5 | | 28.00 | | 0.631 | 315 |
| EDGE (AV Burst Power) | 1850.2 | 25.5 | 2.50 | 28.00 | 50% | 0.631 | 315 |
| | 1880.0 | 25.5 | | 28.00 | | 0.631 | 315 |
| | 1909.8 | 25.5 | | 28.00 | | 0.631 | 315 |
| W-CDMA FDD Band 2 (RMS-Value) | 1852.4 | 23.0 | 2.00 | 25.00 | 100% | 0.316 | 316 |
| | 1880.0 | 23.0 | | 25.00 | | 0.316 | 316 |
| | 1907.6 | 23.0 | | 25.00 | | 0.316 | 316 |

| | | |
|--------------------------------------|-------|------------|
| Maximum calculated MPE value: | | |
| MPE-Limit: | 1 | [mW/cm ^2] |
| Highest MPE value: | 0.040 | [mW/cm ^2] |
| Margin to limit | 0.960 | [mW/cm ^2] |

Remark: based on 0dBi antenna gain and additional path loss of 5.0dB

Canadian RSS-102 standard requires the RF-exposure value in W/m² unit., therefore the value determined in mW/cm² unit, should be multiplied by 10 to have the required unit.

4.2.2.2. Max. antenna gain calculations

| | | |
|---|--|--|
| Maximum antenna gain considerations for fixed/mobile operations for complying with limits: | | |
|---|--|--|

| | | |
|-----------|--|--------------|
| P_{OUT} | Maximum power delivery at RF-Pad from Module incl. Duty cycle (mW): (Avg. Burst Power or RMS) | 629 |
| Atten-Pad | Attenuation - Path Loss NAD to ext. Ant. (MIMO 1) [dB] (information from applicant) | -5.0 |
| P_{ANT} | Resulting delivered Power at antenna input [mW] | 199 |
| R | Safety distance [cm] | 20 |
| S | MPE limit acc. §1.1310 and RSS-102 for uncontrolled exposure (mW/cm ²): (FCC use mW/cm ² & IC use W/m ²) | 1.00 |
| G_1 | Maximum Antenna gain to comply with MPE limit (dBi): | 14.02 |

(For G1 the lowest measured channel to reach minimum ant. Gain selected)

| | | |
|--|---|--------------|
| ERP power limit according to §2.1091 [W]: (Avg. Burst Power or RMS) | | 3.00 |
| G_2 | Max. Antenna gain to comply with this limit incl. Duty cycle (dBi): | 13.93 |

(For G2 select the max. Avg. Burst Power or RMS value incl. Duty cycle)

| | | |
|--|--|-------------|
| EIRP power limit according to §24.232 [W]: | | 2.00 |
| G_3 | Max. Antenna gain to comply with this limit (dBi): | 7.01 |

(For G3 select the max. Average burst power value **excluding** Duty cycle)

| | | |
|--------------------|-------------------------------|-------------|
| $G_{1900MHz-Band}$ | Min (G1, G2, G3) (dBi) | 7.01 |
|--------------------|-------------------------------|-------------|

| | | |
|----------------------------|--|-------------|
| Summarized results: | The max. ant. gain for mobile operation at 1900 MHz band to comply with MPE and EIRP limits incl. External path loss for shown application shall not exceed (dBi): | 7.01 |
|----------------------------|--|-------------|

4.3. Conclusion for maximum admissible antenna gain including PCB loss

| | |
|--|---------------------|
| Max. Gain in Lower operational band (850MHz) | 3.57 dBd (5.72 dBi) |
| Max. Gain in Higher operational band (1900MHz) | 7.01 dBi |

Remark: calculations does not include other may be nearby situated second transmitters (Co-location)

4.4. 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 | Frequency range | Calculated uncertainty based on a confidence level of 95% | Remarks: |
|--|-------------------|---|---------------------|
| Power Output conducted | 9 kHz .. 20 GHz | 1.0 dB | -- |
| Power Output radiated | 30 MHz .. 4 GHz | 3.17 dB | Substitution method |
| Conducted emissions on antenna ports | 9 kHz .. 20 GHz | 1.0 dB | -- |
| Radiated emissions enclosure | 150 kHz .. 30 MHz | 5.0 dB | Magnetic field |
| | 30 MHz .. 1 GHz | 4.2 dB | E-Field |
| | 1 GHz .. 20 GHz | 3.17 dB | Substitution method |
| Occupied bandwidth | 9 kHz .. 4 GHz | 0.1272 ppm (Delta Marker) | Frequency error |
| | | 1.0 dB | Power |
| Emission bandwidth | 9 kHz .. 4 GHz | 0.1272 ppm (Delta Marker) | Frequency error |
| | | 1.0 dB | Power |
| Frequency stability | 9 kHz .. 20 GHz | 0.0636 ppm | -- |
| Conducted emissions on AC-mains port (U _{CISPR}) | 9 kHz .. 150 kHz | 4.0 dB | -- |
| | 150 kHz .. 30 MHz | 3.6 dB | -- |

Table: measurement uncertainties, valid for conducted/radiated measurements

5. 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 |

6. Accreditation details of CETECOM’s laboratories and test sites

| Ref.-No. | Accreditation Certificate | Valid for laboratory area or test site | Accreditation Body |
|---------------------------------|--|---|---|
| - | D-PL-12047-01-01 | All laboratories and test sites of CETECOM GmbH, Essen | DAkkS, Deutsche Akkreditierungsstelle GmbH |
| 337 487 558 348 348 | 736496 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur. | FCC, Federal Communications Commission Laboratory Division, USA (MRA US-EU 0003) |
| 337 487 550 558 | 3462D-1 3462D-2 3462D-2 3462D-3 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) | IC, Industry Canada Certification and Engineering Bureau |
| 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 Measur. | VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan |

OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room

7. Versions of test reports (change history)

| Version | Applied changes | Date of release |
|---------|-----------------|-----------------|
| -- | Initial release | 2015-03-19 |
| -- | -- | -- |
| -- | -- | -- |

8. Instruments and Ancillary

8.1. Used equipment “CTC”

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

8.1.1. Test software and firmware of equipment

| Ref.-No. | Equipment | Type | Serial-No. | Version of Firmware or Software during the test |
|----------|---|------------------------|----------------|---|
| 001 | EMI Test Receiver | ESS | 825132/017 | Firm.= 1.21 , OTP=2.0, GRA=2.0 |
| 012 | Signal Generator (EMS-cond.) | SMY 01 | 839069/027 | Firm.= V 2.02 |
| 013 | Power Meter (EMS cond.) | NRVD | 839111/003 | Firm.= V 1.51 |
| 017 | Digital Radiocommunication Tester | CMD 60 M | 844365/014 | Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99 |
| 053 | Audio Analyzer | UPA3 | 860612/022 | Firm. V 4.3 |
| 119 | RT Harmonics Analyzer dig. Flickermeter | B10 | G60547 | Firm.= V 3.1DHG |
| 140 | Signal Generator | SMHU | 831314/006 | Firm.= 3.21 |
| 261 | Thermal Power Sensor | NRV-Z55 | 825083/0008 | EPROM-Datum 02.12.04, SE EE 1 B |
| 262 | Power Meter | NRV-S | 825770/0010 | Firm.= 2.6 |
| 263 | Signal Generator | SMP 04 | 826190/0007 | Firm.=3.21 |
| 264 | Spectrum Analyzer | FSEK 30 | 826939/005 | Bios=2.1, Analyzer= 3.20 |
| 295 | Racal Digital Radio Test Set | 6103 | 1572 | UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02 |
| 298 | Univ. Radio Communication Tester | CMU 200 | 832221/091 | R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used |
| 323 | Digital Radiocommunication Tester | CMD 55 | 825878/0034 | Firm.= 3.52 .22.01.99 |
| 331 | Climatic Test Chamber -40/+80 Grad | HC 4055 | 43146 | TSI 1.53 |
| 335 | CTC-EMS-Conducted | System EMS Conducted | - | EMC 32 V 8.52 |
| 340 | Digital Radiocommunication Tester | CMD 55 | 849709/037 | Firm.= 3.52 .22.01.99 |
| 355 | Power Meter | URV 5 | 891310/027 | Firm.= 1.31 |
| 365 | 10V Insertion Unit 50 Ohm | URV5-Z2 | 100880 | Eprom Data = 31.03.08 |
| 366 | Ultra Compact Simulator | UCS 500 M4 | V0531100594 | Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10 |
| 371 | Bluetooth Tester | CBT32 | 100153 | CBT V5.30+ SW-Option K55, K57 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Firm.= 2.30, OTP= 02.01, GRA= 02.36 |
| 378 | Broadband RF Field Monitor | RadiSense III | 03D00013SNO-08 | Firm.= V.03D13 |
| 383 | Signal Generator | SME 03 | 842 828 /034 | Firm.= 4.61 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Firm. = A13 (Mainboard) A02 (Display) |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Firm.= 4.50 #005, IPL=4.01#001,OS=4.02#001, GSM=4.41#013, W-CDMA= 4.54#004, scenario= 4.52#002 |
| 436 | Univ. Radio Communication Tester | CMU 200 | 103083 | R&S Test Firmware Base=5.14, Mess-Software= GSM:5.14 WCDMA:5.14 (current Testsoftw. F. all band |
| 441 | CTC-SAR-EMI Cable Loss | System EMI field (SAR) | - | EMC 32 Version 8.52 |
| 442 | CTC-SAR-EMS | System EMS field (SAR) | - | EMC 32 Version 8.40 |
| 443 | CTC-FAR-EMI-RSE | System CTC-FAR-EMI-RSE | - | Spuri 7.2.5 or EMC 32 Ver. 8.53 |
| 444 | CTC-FAR-EMS field | System-EMS-Field (FAR) | - | EMC 32 Version 8.40 |
| 460 | Univ. Radio Communication Tester | CMU 200 | 108901 | R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used, |
| 489 | EMI Test Receiver | ESU40 | 1000-30 | Firmware=4.43 SP3, Bios=V5.1-16-3, Spec. =01.00 |
| 491 | ESD Simulator dito | ESD dito | dito307022 | V 2.30 |
| 524 | Voltage Drop Simulator | VDS 200 | 0196-16 | Software Nr. 000037 Version V4.20a01 |
| 526 | Burst Generator | EFT 200 A | 0496-06 | Software Nr. 000034 Version V2.32 |
| 527 | Micro Pulse Generator | MPG 200 B | 0496-05 | Software-Nr. 000030 Version V2.43 |
| 528 | Load Dump Simulator | LD 200B | 0496-06 | Software-Nr. 000031 Version V2.35a01 |
| 546 | Univ. Radio Communication Tester | CMU 200 | 106436 | R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | 2.82_SP3 |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µPI=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) |

8.1.2. Single instruments and test systems

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|----------|---|-------------------------------|-----------------|------------------------|-------------------------|--------|------------|
| 001 | EMI Test Receiver | ESS | 825132/017 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 005 | AC - LISN (50 Ohm/50µH, test site 1) | ESH2-Z5 | 861741/005 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 007 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 892563/002 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 009 | Power Meter (EMS-radiated) | NRV | 863056/017 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 016 | Line Impedance Simulating Network | Op. 24-D | B6366 | Spitzenberger+Spies | 36 M | - | 31.03.2016 |
| 020 | Horn Antenna 18 GHz (Subst 1) | 3115 | 9107-3699 | EMCO | 36/12 M | - | 31.03.2014 |
| 021 | Loop Antenna (H-Field) | 6502 | 9206-2770 | EMCO | 36 M | - | 31.03.2015 |
| 030 | Loop Antenna (H-field) | HFH-Z2 | 879604/026 | Rohde & Schwarz | 36 M | - | 31.03.2015 |
| 033 | RF-current probe (100kHz-30MHz) | ESH2-Z1 | 879581/18 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 057 | relay-switch-unit (EMS system) | RSU | 494440/002 | Rohde & Schwarz | pre-m | 1a | |
| 060 | power amplifier (DC-2kHz) | PAS 5000 | B6363 | Spitzenberger+Spies | - | 3 | |
| 066 | notch filter (WCDMA; FDD1) | WRCT 1900/2200-5/40-10EEK | 5 | Wainwright GmbH | 12 M | 1g | 30.06.2014 |
| 086 | DC - power supply, 0 -10 A | LNG 50-10 | - | Heinzinger Electronic | pre-m | 2 | |
| 087 | DC - power supply, 0 -5 A | EA-3013 S | - | Elektro Automatik | pre-m | 2 | |
| 090 | Helmholtz coil: 2x10 coils in series | Helmholtz coil: 2x10 coils in | - | RWTÜV | 12 M | 4 | 31.03.2015 |
| 091 | USB-LWL-Converter | OLS-1 | 007/2006 | Ing. Büro Scheiba | - | 4 | |
| 099 | passive voltage probe | ESH2-Z3 | 299.7810.52 | Rohde & Schwarz | 36 M | - | 31.03.2015 |
| 100 | passive voltage probe | Probe TK 9416 | without | Schwarzbeck | 36 M | - | 31.03.2015 |
| 110 | USB-LWL-Converter | OLS-1 | - | Ing. Büro Scheiba | - | 4 | |
| 119 | RT Harmonics Analyzer dig. Flickermeter | B10 | G60547 | BOCONSULT | 36 M | - | 31.03.2016 |
| 134 | horn antenna 18 GHz (Subst 2) | 3115 | 9005-3414 | EMCO | pre-m | - | 31.03.2014 |
| 136 | adjustable dipole antenna (Dipole 1) | 3121C-DB4 | 9105-0697 | EMCO | 36 M | - | 31.03.2015 |
| 140 | Signal Generator | SMHU | 831314/006 | Rohde & Schwarz | 24 M | - | 31.03.2016 |
| 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 | - | 31.03.2016 |
| 262 | Power Meter | NRV-S | 825770/0010 | Rohde & Schwarz | 24 M | - | 31.03.2016 |
| 263 | Signal Generator | SMP 04 | 826190/0007 | Rohde & Schwarz | 36 M | - | 31.03.2016 |
| 264 | Spectrum Analyzer | FSEK 30 | 826939/005 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 265 | peak power sensor | NRV-Z33, Model 04 | 840414/009 | Rohde & Schwarz | 24 M | - | 31.03.2014 |
| 266 | Peak Power Sensor | NRV-Z31, Model 04 | 843383/016 | Rohde & Schwarz | 24 M | - | 31.03.2016 |
| 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 | |
| 287 | pre-amplifier 25MHz - 4GHz | AMF-2D-100M4G-35-10P | 379418 | Miteq | 12 M | 1c | 30.06.2014 |
| 291 | high pass filter GSM 850/900 | WHJ 2200-4EE | 14 | Wainwright GmbH | 12 M | 1c | 30.06.2014 |
| 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 | - | 31.03.2015 |
| 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 | - | 30.11.2014 |
| 341 | Digital Multimeter | Fluke 112 | 81650455 | Fluke | 24 M | - | 31.03.2016 |
| 342 | Digital Multimeter | Voltcraft M-4660A | IB 255466 | Voltcraft | 24 M | - | 31.03.2015 |
| 347 | laboratory site | radio lab. | - | - | - | 5 | |
| 348 | laboratory site | EMI conducted | - | - | - | 5 | |
| 354 | DC - Power Supply 40A | NGPE 40/40 | 448 | Rohde & Schwarz | pre-m | 2 | |
| 355 | Power Meter | URV 5 | 891310/027 | Rohde & Schwarz | 24 M | - | 31.03.2016 |
| 356 | power sensor | NRV-Z1 | 882322/014 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 357 | power sensor | NRV-Z1 | 861761/002 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 371 | Bluetooth Tester | CBT32 | 100153 | R&S | 24 M | - | 31.03.2016 |
| 373 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 100535 | Rohde & Schwarz | 24 M | - | 31.03.2016 |
| 376 | Horn Antenna 6 GHz | BBHA9120 E | BBHA 9120 E 179 | Schwarzbeck | 12 M | - | 31.03.2015 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Keithley | 24 M | - | 31.03.2015 |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Anritsu | 12 M | - | 31.03.2015 |
| 431 | Model 7405 | Near-Field Probe Set | 9305-2457 | EMCO | - | 4 | |
| 436 | Univ. Radio Communication Tester | CMU 200 | 103083 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 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 | 31.10.2014 |
| 443 | CTC-FAR-EMI-RSE | System CTC-FAR-EMI-RSE | - | ETS-Lindgren / CETECOM | 12 M | 5 | 15.07.2014 |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|----------|---|-----------------------------|----------------------------|-----------------------------|-------------------------|--------|------------|
| 448 | notch filter WCDMA_FDD II | WRCT 1850.0/2170.0-5/40- | 5 | Wainwright Instruments GmbH | 12 M | 1c | 30.06.2014 |
| 449 | notch filter WCDMA FDD V | WRCT 824.0/894.0-5/40-8SSK | 1 | Wainwright | 12 M | 1c | 30.06.2014 |
| 454 | Oscilloscope | HM 205-3 | 9210 P 29661 | Hameg | - | 4 | |
| 456 | DC-Power supply 0-5 A | EA 3013 S | 207810 | Elektro Automatik | pre-m | 2 | |
| 459 | DC -Power supply 0-5 A , 0-32 V | EA-PS 2032-50 | 910722 | Elektro Automatik | pre-m | 2 | |
| 460 | Univ. Radio Communication Tester | CMU 200 | 108901 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 463 | Universal source | HP3245A | 2831A03472 | Agilent | - | 4 | |
| 466 | Digital Multimeter | Fluke 112 | 89210157 | Fluke USA | 24 M | - | 31.03.2016 |
| 467 | Digital Multimeter | Fluke 112 | 89680306 | Fluke USA | 36 M | - | 31.03.2015 |
| 468 | Digital Multimeter | Fluke 112 | 90090455 | Fluke USA | 36 M | - | 31.03.2015 |
| 477 | ReRadiating GPS-System | AS-47 | - | Automotive Cons. Fink | - | 3 | |
| 480 | power meter (Fula) | NRVS | 838392/031 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 482 | filter matrix | Filter matrix SAR 1 | - | CETECOM (Brl) | - | 1d | |
| 484 | pre-amplifier 2,5 - 18 GHz | AMF-5D-02501800-25-10P | 1244554 | Miteq | 12 M | - | 30.06.2014 |
| 487 | System CTC NSA-Verification SAR-EMI | System EMI field (SAR) NSA | - | ETS Lindgren / CETECOM | 24 M | - | 30.06.2015 |
| 489 | EMI Test Receiver | ESU40 | 1000-30 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 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 | Wainwright | 12 M | 1c | 30.06.2014 |
| 517 | relais switch matrix | HF Relais Box Keithley | SE 04 | Keithley | pre-m | 2 | |
| 523 | Digital Multimeter | L4411A | MY46000154 | Agilent | 24 M | - | 31.03.2015 |
| 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 | - | 12.02.2015 |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | Rohde & Schwarz | 12 M | - | 31.03.2014 |
| 548 | Digital-Barometer | GBP 2300 | without | Greisinger GmbH | 36 M | - | 30.06.2015 |
| 549 | Log-Per-Antenna | HL025 | 1000060 | Rohde & Schwarz | 36/12 M | - | 31.03.2015 |
| 552 | high pass filter 2,8-18GHz | WHKX 2.8/18G-10SS | 4 | Wainwright | 12 M | 1c | 30.06.2014 |
| 558 | System CTC FAR S-VSWR | System CTC FAR S-VSWR | - | CTC | 24 M | - | 31.07.2015 |
| 574 | Biconilog Hybrid Antenna | BTA-L | 980026L | Frankonia | 36/12 M | - | 31.03.2016 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | Rohde & Schwarz | pre-m | - | |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | Rohde & Schwarz | 36 M | - | 31.03.2016 |
| 598 | Spectrum Analyzer | FSEM 30 (Reserve) | 831259/013 | Rohde & Schwarz | 24 M | - | 13.01.2015 |
| 600 | power meter | NRVD (Reserve) | 834501/018 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 601 | medium-sensitivity diode sensor | NRV-Z5 (Reserve) | 8435323/003 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 602 | peak power sensor | NRV-Z32 (Reserve) | 835080 | Rohde & Schwarz | 24 M | - | 31.03.2015 |
| 611 | DC power supply | E3632A | KR 75305854 | Agilent | pre-m | 2 | |
| 612 | DC power supply | E3632A | MY 40001321 | Agilent | pre-m | 2 | |
| 613 | Attenuator | R416120000 20dB 10W | Lot. 9828 | Radiall | pre-m | 2 | |
| 616 | Digitalmultimeter | Fluke 177 | 88900339 | Fluke | 24 M | - | 31.03.2016 |
| 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 | |
| 620 | EMI Test Receiver | ESU 26 | 100362 | Rohde-Schwarz | 12 M | - | 31.03.2015 |
| 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. Luft GmbH | 24 M | - | 30.05.2014 |
| 634 | Spectrum Analyzer | FSM (HF-Unit) | 826188/010 | Rohde & Schwarz | pre-m | 2 | |
| 636 | Thermal Imaging camera | Ti32 | Ti32-12060213 | Fluke Corporation | 24 M | - | 31.07.2014 |
| 637 | High Speed HDMI with Ethernet 1m | HDMI cable with Ethernet 1m | - | KogiLink | - | 2 | |
| 638 | HDMI Kabel with Ethernet 1,5 m flach | HDMI cable with Ethernet | - | Reichelt | - | 2 | |
| 640 | HDMI cable 2m rund | HDMI cable 2m rund | - | Reichelt | - | 2 | |
| 641 | HDMI cable with Ethernet | Certified HDMI cable with | - | PureLink | - | 2 | |
| 642 | Wideband Radio Communication Tester | CMW 500 | 126089 | Rohde&Schwarz | 12 M | - | 31.03.2015 |
| 644 | Amplifierer | ZX60-2534M+ | SN865701299 | Mini-Circuits | - | - | |
| 670 | Univ. Radio Communication Tester | CMU 200 | 106833 | Rohde & Schwarz | 12 M | - | 31.03.2014 |
| 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 | - | 26.11.2014 |
| 686 | Field Analyzer | EHP-200A | 160WX30702 | Narda Safety Test Solutions | 24 M | - | 18.07.2015 |
| 687 | Signal Generator | SMF 100A | 102073 | Rohde&Schwarz | 12 M | - | 27.11.2014 |
| 688 | Pre Amp | JS-18004000-40-8P | 1750117 | Miteq | pre-m | - | |
| 692 | Bluetooth Tester | CBT 32 | 100236 | Rohde & Schwarz | 12 M | - | 31.03.2015 |
| 693 | TS8997 | CTC-Radio Lab 1_TS8997 | - | Rohde&Schwarz | 12 M | 5 | 30.11.2014 |

8.1.3. Legend

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

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

8.1.4. 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 |