

TEST REPORT

No.: 17-1-0172601T26a

According to:
FCC Regulations
Part 1.1310
Part 2.1091

IC-Regulations
RSS-102, Issue 5

for

Robert Bosch Tool Corporation

GPS 25-4

With integrated SARA-R410M LTE Cat-M1 Module

FCC ID: TXTGPS25-4
ISED: 909H-GPS254

Laboratory Accreditation



accredited according to DIN EN ISO/IEC 17025

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The listed attachments are an integral part of this report.

1. Summary of test results

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

The Equipment Under Test (in this report, hereinafter referred as EUT) supports radiofrequency technologies and use an already approved cellular module SARA-R410M.

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.

1.1. Summary of tests results

| RF-Exposure Evaluation (separation distance user to RF-radiating element greater 20cm) | | | | | | | | |
|--|---------|-------------------------------|---|------------------|-------------------|------------|--------------|--------|
| Test cases | Port | References & Limits | | | | EUT set-up | EUT op. mode | Result |
| | | FCC Standard | Test Limit | RSS Standard | Test Limit | | | |
| Radio frequency radiation exposure Requirements | Cabinet | §1.1310 §2.1091 §2.1093 | RF-Field Strength Limits: FCC: "general population/uncontrolled" environment | RSS-102, Issue 5 | Chapter 4 Table 4 | 1 | 1 to 4 | Pass |

Remark: Calculations based on Datasheet delivered by applicant

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. Niels Jeß
Responsible for test section

.....
B.Eng. Martin 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. 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: | B.Eng. Martin Nunier |
| Receipt of EUT: | -- |
| Date(s) of test: | -- |
| Date of report: | 2019-06-25 |

2.4. Applicant's details

| | |
|-------------------|--|
| Applicant's name: | Robert Bosch Tool Corporation |
| Address: | 1800 W, Central Road Mount Prospect IL, 60056 USA Germany |
| Contact person: | Mr. Gerard Pasciak |

| | |
|------------------|--|
| Customer's name: | Rosenberger Hochfrequenztechnik GmbH & Co.KG |
| Address: | Hauptstr.1 83413 Fridolfing Germany |
| Contact person: | Mr. Matthias Rappl |

2.5. Manufacturer's details

| | |
|----------------------|-------------------------------|
| Manufacturer's name: | Robert Bosch Power Tools GmbH |
| Address: | 70538 Stuttgart Germany |
| Contact person: | Mr. Thomas Moser |

3. Equipment under test (EUT)

3.1. Technical data of MAIN EUT (LTE-technology) declared by applicant

| | | | |
|--|---|---|--------------------------------------|
| TX-frequency range (E-UTRA operating bands) | <input checked="" type="checkbox"/> LTE Band 2: 1850 - 1910 MHz (Uplink), 1930-1990 MHz (Downlink) <input checked="" type="checkbox"/> LTE Band 4: 1710 - 1755 MHz (Uplink), 2110 - 2155 MHz (Downlink) <input checked="" type="checkbox"/> LTE Band 5: 824 - 849 MHz (Uplink), 869-894 MHz (Downlink) <input checked="" type="checkbox"/> LTE Band 12: 699 - 716 MHz (Uplink), 729 - 746 MHz (Downlink) | | |
| Type of modulation | QPSK, 16-QAM | | |
| Data rates | Cat3, Downlink: max. 100Mbps, Uplink: max. 50Mbps | | |
| Number of channels – Table 5.4.4-1 accord. 3GPP TS36.521-1 (See Note in 3GPP-Standard about channels not to be used depending on channel bandwidths) | <input checked="" type="checkbox"/> LTE Band 2: UARFCN range 18600 - 19199 <input checked="" type="checkbox"/> LTE Band 4: UARFCN range 19950 - 20399 <input checked="" type="checkbox"/> LTE Band 5: UARFCN range 20400 - 20649 <input checked="" type="checkbox"/> LTE Band 12: UARFCN range 23010 - 23179 | | |
| Emission designator(s) | Nominal Channel bandwidth | QPSK Modulation: | 16-QAM Modulation |
| | 1.4 MHz | See initial certification of the module: https://apps.fcc.gov/eas/GetApplicationAttachment.html?id=3764932 | |
| Antenna Type | <input checked="" type="checkbox"/> Integrated <input type="checkbox"/> External, no RF- connector <input type="checkbox"/> External, separate RF-connector | | |
| Antenna Gain Tx | Please refer to annex 1. | | |
| Installed option | <input type="checkbox"/> GSM 900 and GSM 1800 Bands (not usable in USA) <input type="checkbox"/> W-CDMA Band II, IV, V (not tested within this test report) <input checked="" type="checkbox"/> GPS (not tested within this test report) | | |
| Power supply | <input checked="" type="checkbox"/> over AC/DC adapter: 120V/60 Hz | | |
| Special EMI components | -- | | |
| EUT sample type | <input type="checkbox"/> Production | <input checked="" type="checkbox"/> Pre-Production | <input type="checkbox"/> Engineering |
| FCC/ISED label attached | <input type="checkbox"/> yes | <input checked="" type="checkbox"/> no | |

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

| Short description*) | EUT | Type | S/N serial number | HW hardware status | SW software status |
|---------------------|---------|---------------------|---------------------------------|--------------------|------------------------------------|
| EUT A S03 | GPS25-4 | Retrofit Tracker US | IMEI-No: 352753090098 185 | PCB-R2802 #200 | Doberman- Retrofit-US- 1.0.0 |

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

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

| AE short description *) | Auxiliary Equipment | Type | S/N serial number | HW hardware status | SW software status |
|-------------------------|---------------------|------|-------------------|--------------------|--------------------|
| AE 1 | -- | -- | -- | -- | -- |

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

3.6. EUT set-ups

| EUT set-up no. *) | Combination of EUT and AE | Remarks |
|-------------------|---------------------------|------------------------------|
| set. 1 | EUT A | only theoretical calculation |

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

3.7. EUT operating modes

| EUT operating mode no. *) | Description of operating modes | Additional information |
|---------------------------|--------------------------------|------------------------------|
| op. 1 | LTE-Band 2 eMTC Auto Mode | Only theoretical calculation |
| op. 2 | LTE-Band 4 eMTC Auto Mode | |
| op. 3 | LTE-Band 5 eMTC Auto Mode | |
| op. 4 | LTE-Band 12 eMTC Auto Mode | |

*) 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 based on applicants delivered Tune-Up procedure. | | |

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> |

4.1.2.1. Valid for FCC

| Table 1: LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) | | | | |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency range [MHz] | Electric field strength [V/m] | Magnetic field strength [A/m] | Power density [mW/cm ²] | 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/f ²) | 30 |
| 30 - 300 | 27.5 | 0.073 | 0.2 | 30 |
| 300 - 1500 | - | - | f/1500 | 30 |
| 1500 - 100,0 | - | - | 1.0 | 30 |

f=frequency in MHz

*Plane-wave equivalent power density

NOTE1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. These limits apply to amateur station licensees and members of their immediate household as discussed in the text.

NOTE2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. As discussed in the text, these limits apply to neighbours living near amateur radio stations.

4.1.3 General Limits:

| | |
|--------------------|---|
| FCC: §1.1307 | 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) |
| FCC §1.1307 | 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) |
| FCC §1.1310 | LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) Table 1(B) Limits for General Population/Uncontrolled Exposure 300–1500 MHz: $f/1500 \text{ mW/cm}^2$ 1500–100,000 MHz: 1.0 mW/cm^2 |
| FCC §2.1091 | 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. |
| FCC §24.232 | (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, ... |
| FCC §22.913 | (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. |
| FCC §27.50 (C)(10) | (10) Portable stations (hand-held devices) are limited to 3 watts ERP; and |
| FCC §27.50(d) | (4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP. |
| KDBs | No. 447498 D01 v06 |

4.2. Requirements and limits for RSS Standard

| | |
|------------------|---|
| RSS-102, Issue 5 | 2.5 Exemption Limits for Routine Evaluation All transmitters are exempt from routine SAR and RF exposure evaluations provided that they comply with the requirements of <u>sections 2.5.1 or 2.5.2</u> . If the equipment under test (EUT) meets the requirements of sections 2.5.1 or 2.5.2, applicants are only required to submit a properly signed declaration of compliance (see Annex C). The information contained in the RF exposure technical brief may be limited to the value(s) of the maximum output power, the information that demonstrates how the maximum output power of the transmitter was derived and the rationale for the separation distances applied (see <u>Table 1</u>), which must be based on the most conservative exposure condition for the applicable module or host platform test procedure requirements. |
| | 2.5.2 Exemption Limits for Routine Evaluation — RF Exposure Evaluation RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows: <ul style="list-style-type: none"> below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance); at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz; at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance); at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz; at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance). <p>In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.</p> |
| | 2.6 User Manual Requirements The applicant is responsible for providing proper instructions to the user of the radio device, and any usage restrictions, including limits of exposure durations. The user manual shall provide installation and operation instructions, as well as any special usage conditions (e.g. proper accessory required, including the proper orientation of the device in the accessory, maximum antenna gain in the case of detachable antenna), in order to ensure compliance with SAR and/or RF field strength limits. For instance, compliance distance shall be clearly stated in the user manual. |
| | The user manual of devices intended for controlled use shall also include information relating to the operating characteristics of the device; the operating instructions to ensure compliance with SAR and/or RF field strength limits; information on the installation and operation of accessories to ensure compliance with SAR and/or RF field strength limits; and contact information where the user can obtain Canadian information on RF exposure and compliance. Other related information may also be included. |

4.3. MPE Calculation method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

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

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator

R=distance to the centre of radiation of the antenna

4.4. Evaluation Method

4.4.1. Standalone

Valid for LTE Mode:

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

Please find in the following tables **the calculations based on applicants information.**

The calculation based on a separation distance of 20 centimetres between radiating structures and the body of the user or nearby persons.

4.5. Results for fixed and mobile operations

4.5.1. Results for FCC Standard

4.5.1.1. Results for lower operational band: LTE Band 5 and LTE Band 12

| Operating Mode | Frequency on channel (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer (dB) | Declared Antenna Gain (dBi) | Calculated maximum EIRP (declared+ Tune-up+ antenna Gain) (dBm) | Duty cycle (%) | Calculated Maximum EIRP (W) | Equivalent EIRP (maximum EIRP x duty cycle) (mW) | MPE Limit accord. Table 1 (mW/cm ²) | MPE-Value (mW/cm ²) | Margin to limit: (mW/cm ²) | Fraction for Co-Location calculations | Max. Fraction-Value within Frequency-Band |
|---------------------------------------|-------------------------------|--|--|--------------------------------|--|-------------------|--------------------------------|---|--|------------------------------------|---|---------------------------------------|---|
| LTE Band 5 (QPSK, #RB=1, RMS-Value) | 824.0 | 23.0 | 1.0 | -7.0 | 17.0 | 100% | 0.050 | 50 | 0.549 | 0.010 | 0.539 | 0.018 | 0.020 |
| | 836.5 | 23.0 | 1.0 | -6.5 | 17.5 | | 0.056 | 56 | 0.558 | 0.011 | 0.546 | 0.020 | |
| | 849.0 | 23.0 | 1.0 | -6.8 | 17.2 | | 0.052 | 52 | 0.566 | 0.010 | 0.556 | 0.018 | |
| LTE Band 5 (16QAM, #RB=1, RMS-Value) | 824.0 | 23.0 | 1.0 | -7.0 | 17.0 | 100% | 0.050 | 50 | 0.549 | 0.010 | 0.539 | 0.018 | 0.020 |
| | 836.5 | 23.0 | 1.0 | -6.5 | 17.5 | | 0.056 | 56 | 0.558 | 0.011 | 0.546 | 0.020 | |
| | 849.0 | 23.0 | 1.0 | -6.8 | 17.2 | | 0.052 | 52 | 0.566 | 0.010 | 0.556 | 0.018 | |
| LTE Band 12 (QPSK, #RB=1, RMS-Value) | 699.0 | 23.0 | 1.0 | -6.6 | 17.4 | 100% | 0.055 | 55 | 0.466 | 0.011 | 0.455 | 0.023 | 0.029 |
| | 707.5 | 23.0 | 1.0 | -6.0 | 18.0 | | 0.063 | 63 | 0.472 | 0.013 | 0.459 | 0.027 | |
| | 716.0 | 23.0 | 1.0 | -5.6 | 18.4 | | 0.069 | 69 | 0.477 | 0.014 | 0.464 | 0.029 | |
| LTE Band 12 (16QAM, #RB=1, RMS-Value) | 699.0 | 23.0 | 1.0 | -6.6 | 17.4 | 100% | 0.055 | 55 | 0.466 | 0.011 | 0.455 | 0.023 | 0.029 |
| | 707.5 | 23.0 | 1.0 | -6.0 | 18.0 | | 0.063 | 63 | 0.472 | 0.013 | 0.459 | 0.027 | |
| | 716.0 | 23.0 | 1.0 | -5.6 | 18.4 | | 0.069 | 69 | 0.477 | 0.014 | 0.464 | 0.029 | |

| Maximum calculated MPE value: | | |
|---|----------|-----------------------|
| Lowest MPE-Limit in Frequency-Band: | 0.466000 | [mW/cm ²] |
| Highest MPE value in frequency-band: | 0.013764 | [mW/cm ²] |
| Lowest margin to limit in frequency band: | 0.455067 | [mW/cm ²] |

4.5.2.1 Results for upper operational band: LTE Band 4

| Operating Mode | Frequency on channel (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer (dB) | Declared Antenna Gain (dBi) | Calculated maximum EIRP (declared+ Tune-up+ antenna Gain) (dBm) | Duty cycle (%) | Declared Maximum EIRP (W) | Equivalent EIRP (maximum EIRP x duty cycle) (mW) | MPE Limit accord. Table 1 (mW/cm ²) | MPE-Value (mW/cm ²) | Margin to limit: (mW/cm ²) | Fraction for Co-Location calculations | Max. Fraction-Value within Frequency-Band |
|-------------------------------------|-------------------------------|--|--|--------------------------------|--|-------------------|------------------------------|---|--|------------------------------------|---|---------------------------------------|---|
| LTE Band 4 (QPSK, #1RB, RMS-Value) | 1710.0 | 23.0 | 1.0 | 0.5 | 24.5 | 100% | 0.282 | 282 | 1.000 | 0.056 | 0.944 | 0.056 | 0.060 |
| | 1732.5 | 23.0 | 1.0 | 0.8 | 24.8 | | 0.302 | 302 | 1.000 | 0.060 | 0.940 | 0.060 | |
| | 1755.0 | 23.0 | 1.0 | -0.5 | 23.5 | | 0.224 | 224 | 1.000 | 0.045 | 0.955 | 0.045 | |
| LTE Band 4 (16QAM, #1RB, RMS-Value) | 1710.0 | 23.0 | 1.0 | 0.5 | 24.5 | 100% | 0.282 | 282 | 1.000 | 0.056 | 0.944 | 0.056 | 0.060 |
| | 1732.5 | 23.0 | 1.0 | 0.8 | 24.8 | | 0.302 | 302 | 1.000 | 0.060 | 0.940 | 0.060 | |
| | 1755.0 | 23.0 | 1.0 | -0.5 | 23.5 | | 0.224 | 224 | 1.000 | 0.045 | 0.955 | 0.045 | |

| Maximum calculated MPE value: | | |
|---|----------|-----------------------|
| Lowest MPE-Limit in frequency-band: | 1.000000 | [mW/cm ²] |
| Highest MPE value in frequency-band: | 0.060080 | [mW/cm ²] |
| Lowest margin to limit in frequency-band: | 0.939920 | [mW/cm ²] |

4.5.3.1. Results for upper operational band: LTE Band 2

| Operation Mode | Frequency on channel (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer (dB) | Antenna Gain (dBi) | Declared maximum ERP (Measured+ Tune-up+ Antenna Gain) (dBm) | Duty cycle (%) | Declared Maximum ERP (W) | Equivalent ERP (maximum ERP x duty cycle) (mW) | MPE Limit accord. Table 1 (mW/cm ²) | MPE-Value (mW/cm ²) | Margin to limit: (W/m ²) | Fraction for Co-Location calculations | Max. Fraction-Value within Frequency-Band |
|-------------------------------------|-------------------------------|--|--|-----------------------|---|-------------------|-----------------------------|---|--|------------------------------------|---|---------------------------------------|---|
| LTE Band 2 (QPSK, #1RB, RMS-Value) | 1850.0 | 23.0 | 1.0 | 0.8 | 24.8 | 100% | 0.302 | 302 | 1.000 | 0.060 | 0.940 | 0.060 | 0.060 |
| | 1880.0 | 23.0 | 1.0 | 0.3 | 24.3 | | 0.269 | 269 | 1.000 | 0.054 | 0.946 | 0.054 | |
| | 1910.0 | 23.0 | 1.0 | 0.6 | 24.6 | | 0.288 | 288 | 1.000 | 0.057 | 0.943 | 0.057 | |
| LTE Band 2 (16QAM, #1RB, RMS-Value) | 1850.0 | 23.0 | 1.0 | 0.8 | 24.8 | 100% | 0.302 | 302 | 1.000 | 0.060 | 0.940 | 0.060 | 0.060 |
| | 1880.0 | 23.0 | 1.0 | 0.3 | 24.3 | | 0.269 | 269 | 1.000 | 0.054 | 0.946 | 0.054 | |
| | 1910.0 | 23.0 | 1.0 | 0.6 | 24.6 | | 0.288 | 288 | 1.000 | 0.057 | 0.943 | 0.057 | |

| Maximum calculated MPE value: | | |
|--------------------------------------|----------|-----------------------|
| Lowest MPE-Limit in frequency-band: | 1.000000 | [mW/cm ²] |
| Highest MPE value in frequency-band: | 0.060080 | [mW/cm ²] |
| Margin to limit in frequency-band: | 0.939920 | [mW/cm ²] |

4.5.6. Co-location assessment (scenario)

No Multiple band or Dual Band Mode on radio equipment -> no assessment

4.6.1. Results for RSS Standard

4.6.1.1. Results for lower operational band: LTE Band 5 and LTE Band 12 and FDD Band 5

| Operating Mode | Channel frequency (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer's tune-up info (dB) | Declared Antenna Gain (dBi) | Calculated maximum EIRP (declared+ Tune-up+ antenna Gain) (dBm) | Duty-Cycle (%) | Calculated Maximum EIRP (W) | Equivalent EIRP (maximum EIRP x duty cycle) (mW) | MPE Limit accord. Table 4 (EIRP-Limit) (W/m ²) | MPE-Value (EIRP referred) (W/m ²) | Margin to limit: (W/m ²) | Fraction for Co-location calculations | Maximum Fraction Value within Frequency band |
|--|----------------------------|--|---|--------------------------------|--|-------------------|--------------------------------|---|---|--|---|---------------------------------------|--|
| LTE Band 5 (QPSK, #RB=1, RMS-Value) | 824.0 | 23.0 | 1.0 | -7.0 | 17.0 | 100% | 0.050 | 0.050 | 2.576 | 0.100 | 2.476 | 0.039 | 0.043 |
| | 836.5 | 23.0 | 1.0 | -6.5 | 17.5 | 100% | 0.056 | 0.056 | 2.602 | 0.112 | 2.490 | 0.043 | |
| | 849.0 | 23.0 | 1.0 | -6.8 | 17.2 | 100% | 0.052 | 0.052 | 2.629 | 0.104 | 2.524 | 0.040 | |
| LTE Band 5 (16QAM, #RB=1, RMS-Value) | 824.0 | 23.0 | 1.0 | -7.0 | 17.0 | 100% | 0.050 | 0.050 | 2.576 | 0.100 | 2.476 | 0.039 | |
| | 836.5 | 23.0 | 1.0 | -6.5 | 17.5 | 100% | 0.056 | 0.056 | 2.602 | 0.112 | 2.490 | 0.043 | |
| | 849.0 | 23.0 | 1.0 | -6.8 | 17.2 | 100% | 0.052 | 0.052 | 2.629 | 0.104 | 2.524 | 0.040 | |
| LTE Band 12 (QPSK, #RB=1, RMS-Value) | 699.0 | 23.0 | 1.0 | -6.6 | 17.4 | 100% | 0.055 | 0.055 | 2.302 | 0.109 | 2.192 | 0.047 | 0.059 |
| | 707.5 | 23.0 | 1.0 | -6.0 | 18.0 | 100% | 0.063 | 0.063 | 2.321 | 0.126 | 2.195 | 0.054 | |
| | 716.0 | 23.0 | 1.0 | -5.6 | 18.4 | 100% | 0.069 | 0.069 | 2.340 | 0.138 | 2.202 | 0.059 | |
| LTE Band 12 (16QAM, #RB=1, RMS-Value) | 699.0 | 23.0 | 1.0 | -6.6 | 17.4 | 100% | 0.055 | 0.055 | 2.302 | 0.109 | 2.192 | 0.047 | |
| | 707.5 | 23.0 | 1.0 | -6.0 | 18.0 | 100% | 0.063 | 0.063 | 2.321 | 0.126 | 2.195 | 0.054 | |
| | 716.0 | 23.0 | 1.0 | -5.6 | 18.4 | 100% | 0.069 | 0.069 | 2.340 | 0.138 | 2.202 | 0.059 | |

| Maximum calculated MPE value: | | |
|---|----------|---------------------|
| Lowest MPE-Limit within frequency-band: | 2.301713 | [W/m ²] |
| Highest MPE value within frequency-band: | 0.137635 | [W/m ²] |
| Lowest margin to limit within frequency-band: | 2.192385 | [W/m ²] |

4.6.2.1 Results for upper operational band: FDD Band 4 and LTE Band 4

| Operating Mode | Channel frequency (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer's tune-up info (dB) | Declared Antenna Gain (dBi) | Calculated maximum EIRP (declared+ Tune-up+ antenna Gain) (dBm) | Calculated Maximum EIRP (W) | Duty-Cycle (%) | Equivalent EIRP (maximum EIRP x duty cycle) (W) | MPE Limit accord. Table 4 (W/m ²) | MPE-Value (W/m ²) | Margin to Limit (W/m ²) | Fraction for Co-location calculations | Maximum Fraction Value within Frequency band |
|---------------------------------------|----------------------------|--|---|--------------------------------|--|--------------------------------|-------------------|--|--|----------------------------------|--|---------------------------------------|--|
| LTE Band 4 (QPSK, #1RB RMS-Value) | 1710.0 | 23.0 | 1.0 | 0.5 | 24.5 | 0.282 | 100% | 0.282 | 4.242 | 0.561 | 3.681 | 0.132 | 0.140 |
| | 1732.5 | 23.0 | 1.0 | 0.8 | 24.8 | 0.302 | | 0.302 | 4.280 | 0.601 | 3.679 | 0.140 | |
| | 1755.0 | 23.0 | 1.0 | -0.5 | 23.5 | 0.224 | | 0.224 | 4.318 | 0.445 | 3.873 | 0.103 | |
| LTE Band 4 (16QAM, #1RB RMS-Value) | 1710.0 | 23.0 | 1.0 | 0.5 | 24.5 | 0.282 | 100% | 0.282 | 4.242 | 0.561 | 3.681 | 0.132 | |
| | 1732.5 | 23.0 | 1.0 | 0.8 | 24.8 | 0.302 | | 0.302 | 4.280 | 0.601 | 3.679 | 0.140 | |
| | 1755.0 | 23.0 | 1.0 | -0.5 | 23.5 | 0.224 | | 0.224 | 4.318 | 0.445 | 3.873 | 0.103 | |

| Maximum calculated MPE value: | | |
|---|----------|----------------------|
| Lowest MPE-Limit within frequency-band: | 4.241945 | [W/cm ²] |
| Highest MPE value within frequency-band: | 0.600800 | [W/cm ²] |
| Lowest margin to limit within frequency-band: | 3.679210 | [W/cm ²] |

4.6.3.1. Results for upper operational band: FDD Band 2 and LTE Band 2

| Operating Mode | Frequency on channel (MHz) | Declared maximum conducted output power (dBm) | Max. positive tolerance according manufacturer's tune-up info (dB) | Declared Antenna Gain (dBi) | Calculated maximum EIRP (Measured+ Tune-up+ Antenna Gain) (dBm) | Duty-Cycle (%) | Calculated Maximum ERP (W) | Equivalent ERP (maximum ERP x duty cycle) (W) | MPE Limit accord. Table 4 (W/m ²) | MPE-Value (W/m ²) | Margin to Limit (W/m ²) | Fraction for Co-location calculations | Maximum Fraction Value within Frequency band |
|-------------------------------------|-------------------------------|--|---|--------------------------------|--|-------------------|-------------------------------|--|--|----------------------------------|--|---------------------------------------|--|
| LTE Band 2 (QPSK, #1RB, RMS-Value) | 1850.0 | 23.0 | 1.0 | 0.8 | 24.8 | 100% | 0.302 | 0.302 | 4.476 | 0.601 | 3.876 | 0.134 | 0.134 |
| | 1880.0 | 23.0 | 1.0 | 0.3 | 24.3 | | 0.269 | 0.269 | 4.526 | 0.535 | 3.990 | 0.118 | |
| | 1910.0 | 23.0 | 1.0 | 0.6 | 24.6 | | 0.288 | 0.288 | 4.575 | 0.574 | 4.001 | 0.125 | |
| LTE Band 2 (16QAM, #1RB, RMS-Value) | 1850.0 | 23.0 | 1.0 | 0.8 | 24.8 | 100% | 0.302 | 0.302 | 4.476 | 0.601 | 3.876 | 0.134 | |
| | 1880.0 | 23.0 | 1.0 | 0.3 | 24.3 | | 0.269 | 0.269 | 4.526 | 0.535 | 3.990 | 0.118 | |
| | 1910.0 | 23.0 | 1.0 | 0.6 | 24.6 | | 0.288 | 0.288 | 4.575 | 0.574 | 4.001 | 0.125 | |

| Maximum calculated MPE value: | | |
|---|----------|---------------------|
| Lowest MPE-Limit within frequency-band: | 4.476315 | [W/m ²] |
| Highest MPE value within frequency-band: | 0.600800 | [W/m ²] |
| Lowest margin to limit within frequency-band: | 3.875515 | [W/m ²] |

4.6.6. Co-location assessment (scenario)

No Multiple band or Dual Band Mode on radio equipment -> no assessment

5. 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 to its 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 150 kHz - 30 MHz | 4.0 dB 3.6 dB | | | | | | | - |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz 1 GHz - 18 GHz | 4.2 dB 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 | -- | -- | -- | | - | |
| | | 12.75 - 26.5GHz | N/A | 0.82 | -- | -- | -- | | | |
| Conducted emissions on RF-port | - | 9 kHz - 2.8 GHz | 0.70 | N/A | -- | -- | -- | | N/A - not applicable | |
| | | 2.8 GHz - 12.75GHz | 1.48 | N/A | -- | -- | -- | | | |
| | | 12.75 GHz - 18GHz | 1.81 | N/A | -- | -- | -- | | | |
| | | 18 GHz - 26.5GHz | 1.83 | N/A | -- | -- | -- | | | |
| Occupied bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | | Frequency error |
| | | | 1.0 dB | | | | | | | Power |
| Emission bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | | Frequency error |
| | - | | See above: 0.70 dB | | | | | | | Power |
| Frequency stability | - | 9 kHz - 20 GHz | 0.0636 ppm | | | | | | | - |
| Radiated emissions Enclosure | - | 150 kHz - 30 MHz | 5.0 dB | | | | | | | Magnetic field E-field Substitution |
| | | 30 MHz - 1 GHz | 4.2 dB | | | | | | | |
| | | 1 GHz - 20 GHz | 3.17 dB | | | | | | | |

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Abbreviations used in this report

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

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

| Ref.-No. | Accreditation Certificate | Valid for laboratory area or test site | Accreditation Body |
|---------------------------------|--|---|---|
| - | D-PL-12047-01-01 | All laboratories and test sites of CETECOM GmbH, Essen | DAkkS, Deutsche Akkreditierungsstelle GmbH |
| 337 487 558 348 348 | MRA US-EU 0003 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measurem. | FCC, Federal Communications Commission Laboratory Division, USA |
| 337 487 550 558 | 3462D-1 3462D-2 3462D-2 3462D-3 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) | IC, Industry Canada Certification and Engineering Bureau |
| 487 550 348 348 | R-2666 G-301 C-2914 T-1967 | Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference 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. Versions of test reports (change history)

| Version | Applied changes | Date of release |
|---------|-----------------|-----------------|
| -- | Initial release | 2019-06-25 |
| -- | -- | -- |

END OF TEST REPORT