

# TEST REPORT

No.: 17-1-0277701T09a

According to:  
**FCC Regulations**  
Part 15.225

for

WITTE Nejdek, spol. s r.o.

BMW G3x NFC  
Outer door handle NFC module  
**FCC-ID: 2APBZ030816**

| Laboratory Accreditation and Listings                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                       |                                                                                                                                                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <br>Deutsche<br>Akkreditierungsstelle<br>D-PL-12047-01-01<br><br>Accredited EMC-Test Laboratory                                                                                                                                                         | <br>Industry Canada<br>Reg. No.: 3462D-1<br>Reg. No.: 3462D-2<br>Reg. No.: 3462D-3 | <br>Voluntary Controls for Electromagnetic<br>Emissions<br><br>Reg. No.:<br>R-20013, C-20009,<br>T-20006, G-20013 |
|  <b>AUTHORIZED<br/>RF LABORATORY</b>                                                                                                                                                                                                                    |  <b>Authorized™<br/>Test Lab</b><br>Lab Code: 20011130-00                          | <br>FEDERAL COMMUNICATIONS COMMISSION<br>USA<br>MRA US-EU 0003                                                    |
| accredited according to DIN EN ISO/IEC 17025                                                                                                                                                                                                                                                                                               |                                                                                                                                                                       |                                                                                                                                                                                                        |
| <p><b>CETECOM GmbH</b><br/>Laboratory Radio Communications &amp; Electromagnetic Compatibility<br/>Im Teelbruch 116 • 45219 Essen • Germany<br/>Registered in Essen, Germany, Reg. No.: HRB Essen 8984<br/>Tel.: + 49 (0) 20 54 / 95 19-954 • Fax: + 49 (0) 20 54 / 95 19-964<br/>E-mail: info@cetecom.com • Internet: www.cetecom.com</p> |                                                                                                                                                                       |                                                                                                                                                                                                        |
| Laboratory Accreditation and Listings                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                       |                                                                                                                                                                                                        |

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| The listed attachments are an integral part of this report. |                             |                                     |             |

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) is a digital device with support of radiofrequency technologies including NFC. A typical operation mode was set-up as described in chapter 3.4 according applicants instructions.

Following tests have been performed to show compliance with applicable FCC Part 15, Subpart B (Unintentional Radiators) of the CFR 47 Rules, Edition 2017 standard.

### 1.1. TEST OVERVIEW FCC 15.225

| TX-Mode                                                                  |                                              |                                    |                                                                                                                                                                                                                  |            |                    |                      |
|--------------------------------------------------------------------------|----------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|--------------------|----------------------|
| TEST CASES                                                               | PORT                                         | REFERENCES & LIMITS                |                                                                                                                                                                                                                  | EUT set-up | EUT operating mode | Result               |
|                                                                          |                                              | FCC Standard                       | Test limit                                                                                                                                                                                                       |            |                    |                      |
| Radiated field strength in 30m measurement distance) & emission mask     | Cabinet                                      | §2.1046<br>§15.225(a)(b)<br>(c)(d) | 84dBµV/m<br>13.553-13.567 MHz<br><br>50.5dBµV/m<br>13.410-13.553 MHz<br>13.567-13.710 MHz<br><br>40.5 dBµV/m<br>1.110-13.410 MHz<br>13.710-14.010 MHz<br><br>29.5dBµV/m<br>outside the band<br>13.110-14.010 MHz | 1          | 1                  | passed               |
| 99% Occupied bandwidth                                                   | Antenna coupling (radiated)                  | §2.202(a)<br>§2.1049               | 99% Power                                                                                                                                                                                                        | 1          | 1                  | For information only |
| General field strength emissions (radiated - (9 kHz to 30 MHz)           | Cabinet + inter-connecting cables (radiated) | §15.209(a)                         | 2400/F(kHz) µV/m<br>24000/F(kHz) µV/m<br>30 µV/m                                                                                                                                                                 | 1          | 1                  | passed               |
| General field strength emissions + restricted bands (30 MHz to 1000 MHz) | Cabinet + inter-connecting cables (radiated) | §15.209                            | Emissions in restricted bands must meet the general field-strength radiated limits                                                                                                                               | 1          | 1                  | passed               |

|                     |                          |                       |                    |    |    |                              |
|---------------------|--------------------------|-----------------------|--------------------|----|----|------------------------------|
| Frequency stability | Antenna port (conducted) | §2.1055<br>§15.225(e) | ±100ppm            | 1  | 1  | Not performed <sup>3.)</sup> |
| Conducted Emissions | AC-Power lines           | §15.207               | FCC §15.207 limits | -- | -- | Not applicable               |
|                     |                          |                       | ISED: Table 4      | -- | -- | Remark 2                     |

Remark 2: EUT intended for car environment only

## 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

.....  
B.Sc. Mohamed Ahmed  
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: | B.Sc. Mohamed Ahmed  |
| project leader:              | Dipl.-Ing. C. Lorenz |
| Receipt of EUT:              | 2017-07-14           |
| Date(s) of test:             | 2017-07-31           |
| Date of report:              | 2018-04-05           |
| -----                        |                      |
| Version of template:         | 13.02                |

### 2.4. Applicant's details

|                   |                                    |
|-------------------|------------------------------------|
| Applicant's name: | WITTE Nejdek, spol. s r.o.         |
| Address:          | Rooseveltova, 1299<br>36221 Nejdek |
| Contact person:   | Mr. Thomas Ritzer                  |

### 2.5. Manufacturer's details

|                      |                                                      |
|----------------------|------------------------------------------------------|
| Manufacturer's name: | please see Applicant's details                       |
| Address:             | please see Applicant's details                       |
| Contact person:      | Mr. Tomas Ritzer<br>tomas.ritzer@witte-automotive.cz |

### 3. Equipment under test (EUT)

#### 3.1. 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               | BMW G3x NFC | Outer door handle NFC module | 1174721532450832  | 17/23/00           | 17/24/03           |

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

#### 3.2. 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                    | BMW G3x Smart Access Digital Key | NFC tag                  | --                    | Testkarte #20      | --                 |
| AE 2                    | Main Cable Harness               | DC power + VGA connector | --                    | --                 | --                 |
| AE 3                    | Vector box                       | LIN                      | 007129-005782         | --                 | --                 |
| AE 4                    | Lenovo Laptop                    | L470 20JU-000S           | IMEI: 014582005933438 | --                 | --                 |

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

#### 3.3. EUT set-ups

| EUT set-up no. *) | Combination of EUT and AE     | Remarks               |
|-------------------|-------------------------------|-----------------------|
| set. 1            | EUT A + AE1 + AE2 + AE3 + AE4 | Radiated Measurements |

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

#### 3.4. EUT operating modes

| EUT operating mode no. *) | Description of operating modes | Additional information                   |
|---------------------------|--------------------------------|------------------------------------------|
| op. 1                     | TX Mode                        | Continuously Data communication with tag |

\*) EUT operating mode no. is used to simplify the 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      | Power Line Wireless Charger | Micro USB | --                | --                 | <3m          |
| Cable 2      | Main cable harness          | --        | --                | --                 | --           |

### 3.6. Additional declaration and description of EUT

(Applicant's declaration, ☐ = not selected, ☒ = selected)

|                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                      |                                                                                                                                                 |                                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Set. 2                                                                                                                                                                                                                                                                                                                                                 | <input checked="" type="checkbox"/> table-top<br><input type="checkbox"/> floor-standing<br><input type="checkbox"/> wall-mounted<br><input type="checkbox"/> not defined                                                            | typical use<br><input type="checkbox"/> portable use<br><input checked="" type="checkbox"/> fixed use<br><input type="checkbox"/> vehicular use |                                                                        |
| Place of use                                                                                                                                                                                                                                                                                                                                           | <input checked="" type="checkbox"/> Residential, commercial and light industry<br><input type="checkbox"/> Industrial environment<br><input type="checkbox"/> vehicular use                                                          |                                                                                                                                                 |                                                                        |
| Highest internal frequency generated by EUT and required upper frequency of radiated disturbance measurement                                                                                                                                                                                                                                           | <input checked="" type="checkbox"/> less than 108 MHz      -> up to 1 GHz<br><input type="checkbox"/> between 108 MHz and 500 MHz      -> up to 2 GHz<br><input type="checkbox"/> between 500 MHz and 1 GHz      -> up to 5 or 6 GHz |                                                                                                                                                 |                                                                        |
| typical operating cycle of EUT                                                                                                                                                                                                                                                                                                                         | <input type="checkbox"/> < 0,5 sec. <input checked="" type="checkbox"/> 1 sec:                                                                                                                                                       |                                                                                                                                                 |                                                                        |
| <b>Power line:</b><br><input type="checkbox"/> AC <input type="checkbox"/> 120V, <input type="checkbox"/> 230V, <input type="checkbox"/> 400V<br><input type="checkbox"/> PE, <input checked="" type="checkbox"/> N, <input checked="" type="checkbox"/> L1, <input type="checkbox"/> L2 <input type="checkbox"/> L3<br><input type="checkbox"/> 50 Hz | EUT-grounding:<br><input checked="" type="checkbox"/> none<br><input type="checkbox"/> with power supply<br><input type="checkbox"/> additional:                                                                                     |                                                                                                                                                 |                                                                        |
| <input checked="" type="checkbox"/> DC <input checked="" type="checkbox"/> 12 V <input type="checkbox"/>                                                                                                                                                                                                                                               | (in case of deviation during tests the single details are described on chapter 4)                                                                                                                                                    |                                                                                                                                                 |                                                                        |
| <b>Other Ports</b> (description of interconnecting cables)<br>Description                                                                                                                                                                                                                                                                              | possible total cable length                                                                                                                                                                                                          | shielding                                                                                                                                       | connected during test                                                  |
| Power line (USB)                                                                                                                                                                                                                                                                                                                                       | <input checked="" type="checkbox"/> < 3m <input type="checkbox"/> > 3m<br><input type="checkbox"/> : other                                                                                                                           | <input type="checkbox"/> screened<br><input checked="" type="checkbox"/> unscreened                                                             | <input checked="" type="checkbox"/> yes<br><input type="checkbox"/> no |
| Does EUT contain devices susceptible to magnetic fields, e.g. Hall elements, electrodynamics microphones, etc.?                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                      |                                                                                                                                                 | <input type="checkbox"/> yes<br><input checked="" type="checkbox"/> no |
| Is mounting position / usual operating position defined?                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                      |                                                                                                                                                 | <input checked="" type="checkbox"/> yes<br><input type="checkbox"/> no |

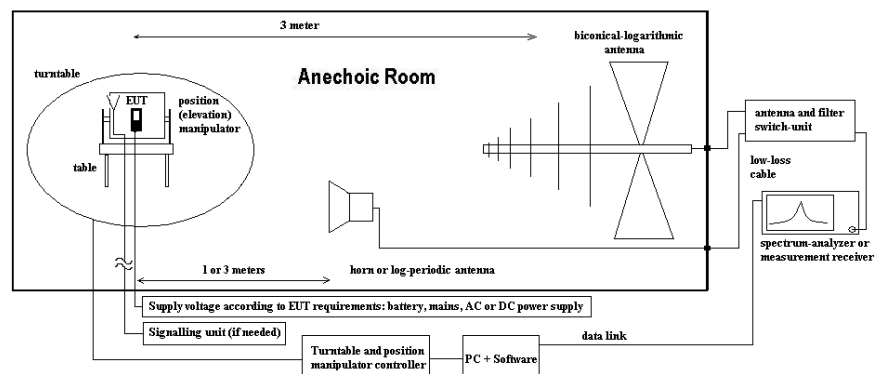
## 4. Description of test system set-up's

### 4.1. Test system set-up for radiated electric field measurement 30 MHz to 1 GHz

**Specification:** ANSI C63.4-2014 chapter 8, ANSI C63.10-2013 chapter 6.5

**General Description:** Evaluating the field 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 NSA-compliant semi anechoic room (SAR) recognized by the regulatory commissions.

**Schematic:**



**Testing method:**

#### Exploratory, preliminary measurements

The EUT and its 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 (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. 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 either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position). The measurement antenna height between 1 m and 4 m.

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

**Formula:**

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

$$M = L_T - E_C \quad (2)$$

AF = Antenna factor

C<sub>L</sub> = Cable loss

D<sub>F</sub> = Distance correction factor (if used)

E<sub>C</sub> = Electrical field – corrected value

E<sub>R</sub> = Receiver reading

G<sub>A</sub> = Gain of pre-amplifier (if used)

L<sub>T</sub> = Limit

M = Margin

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



## 5. Measurements

### 5.1. Radiated field strength emission mask at 13.110-14.010MHz

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 |
| test site       | <input checked="" type="checkbox"/> 441 EMI SAR                    | <input type="checkbox"/> 487 SAR NSA               | <input type="checkbox"/> 337 OATS                  |
| receiver        | <input type="checkbox"/> 377 ESCS30                                | <input checked="" type="checkbox"/> 001 ESS        | <input type="checkbox"/> 347 Radio.lab.            |
| spectr. analys. | <input type="checkbox"/> 120 FSEM                                  | <input type="checkbox"/> 264 FSEK                  | <input type="checkbox"/> 289 CBL 6141              |
| antenna         | <input type="checkbox"/> 048 EMCO3143                              | <input type="checkbox"/> 133 EMCO3115              | <input checked="" type="checkbox"/> 030 HFH-Z2     |
| power supply    | <input type="checkbox"/> 456 EA 3013A                              | <input type="checkbox"/> 457 EA 3013A              | <input type="checkbox"/> 494 AG6632A               |
| otherwise       | <input type="checkbox"/> 400 FTC40x15E                             | <input type="checkbox"/> 401 FTC40x15E             | <input type="checkbox"/> 498 NGPE 40               |
|                 | <input type="checkbox"/> 110 USB LWL                               | <input type="checkbox"/> 482 Filter Matrix         | <input type="checkbox"/> 477 GPS                   |

### STANDARDS AND LIMITS: CFR 47, §15.225(a)(b)(c)(d)

| Frequency [MHz]                 | Field strength [µV/m] | Field strength [dBuV/m] | Measurement distance [meters] | Remarks                                                  |
|---------------------------------|-----------------------|-------------------------|-------------------------------|----------------------------------------------------------|
| 13.553 -13.567 (allocated band) | 15.848                | 84.00                   | 30                            | Correction factor used due to measurement distance of 3m |
| 13.410-13.710                   | 334                   | 50.47                   | 30                            |                                                          |
| 13.110-14.010                   | 106                   | 40.50                   | 30                            |                                                          |
| Outside band 13.110-14.010      | 30                    | 29.5                    | 30                            |                                                          |

### TEST CONDITION AND MEASUREMENT TEST SET-UP

|                                  |                                                                                                                                                                                                                                                                          |                                            |                                                |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------|
| link to test system (if used):   | <input type="checkbox"/> air link                                                                                                                                                                                                                                        | <input type="checkbox"/> cable connection  | <input checked="" type="checkbox"/> none       |
| EUT-grounding                    | <input checked="" type="checkbox"/> none                                                                                                                                                                                                                                 | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up                 | <input checked="" type="checkbox"/> table top                                                                                                                                                                                                                            | <input type="checkbox"/> floor standing    |                                                |
| Climatic conditions              | Temperature: (22±3°C)                                                                                                                                                                                                                                                    |                                            | Rel. humidity: (40±20)%                        |
| EMI-Receiver (Analyzer) Settings | Span/Range: 9kHz to 150kHz; 150 kHz to 30 MHz<br>RBW/VBW: 200Hz/auto; 10 kHz/ auto (ANSI63.10/CISPR#16)<br>Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements<br>Quasi-Peak, for final measurement on critical frequencies (f<1GHz) |                                            |                                                |

### GENERAL MEASUREMENT PROCEDURES:

The measurement test set-up and test procedure are in accordance with the provisions described in ANSI 63.10: 2009

The **Equipment under Test** (EUT) was set-up to defined operating mode and installed (connected) to accessory equipment according the general description of use given by the applicant.

The measurement loop antenna was situated in 3m distance to the EUT. Between EUT and measurement antenna absorbers are covering the GND-Plane. With these absorbers the chamber fulfills CIPR16-1-4 site VSWR-criteria. Radiated magnetic emission measurements were made with the antenna situated in 1 meter height. 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 EUT itself either over 3-orthogonal axes (no defined usage position) or 2-orthogonal axis (defined usage position) by the position manipulator.

According the standard the compliance should be checked in 30m measurement distance. Therefore a additional extrapolation factor was used in order to normalize the measurement data. The frequency dependent extrapolation factor used for this reduced measurement distance, can be found in the chapter **xxx**.

### MEASUREMENT RESULTS: CARRIER FIELD STRENGTH (EMISSION MASK)

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                                  |        |
| 2.01-2.02   | nominal         | --  | 12 - 15 MHz     | 1          | 1           | --     | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | passed |

**VERDICT:** Limits according §15.225(a)(b)(c) - passed

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

### 5.2.1. Test location and equipment

|                 |                                                                    |                                                                  |                                                    |
|-----------------|--------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------|
| test location   | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2               | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site       | <input checked="" type="checkbox"/> 441 EMI SAR                    | <input type="checkbox"/> 487 SAR NSA                             | <input type="checkbox"/> 347 Radio.lab.            |
| receiver        | <input type="checkbox"/> 377 ESCS30                                | <input checked="" type="checkbox"/> 001 ESS                      | <input type="checkbox"/>                           |
| spectr. analys. | <input type="checkbox"/> 584 FSU                                   | <input type="checkbox"/> 120 FSEM                                | <input type="checkbox"/> 264 FSEK                  |
| antenna         | <input type="checkbox"/> 574 BTA-L                                 | <input type="checkbox"/> 133 EMCO3115                            | <input type="checkbox"/> 302 BBHA9170              |
| signaling       | <input type="checkbox"/> 392 MT8820A                               | <input type="checkbox"/> 371 CBT32                               | <input type="checkbox"/> 547 CMU                   |
| otherwise       | <input type="checkbox"/> 400 FTC40x15E                             | <input type="checkbox"/> 401 FTC40x15E                           | <input type="checkbox"/> 110 USB LWL               |
| DC power        | <input type="checkbox"/> 456 EA 3013A                              | <input type="checkbox"/> 457 EA 3013A                            | <input type="checkbox"/> 459 EA 2032-50            |
| line voltage    | <input type="checkbox"/> 230 V 50 Hz via public mains              | <input checked="" type="checkbox"/> 060 120 V 60 Hz via PAS 5000 | <input type="checkbox"/> 289 CBL 6141              |
|                 |                                                                    |                                                                  | <input checked="" type="checkbox"/> 030 HFH-Z2     |
|                 |                                                                    |                                                                  | <input type="checkbox"/> 477 GPS                   |
|                 |                                                                    |                                                                  | <input type="checkbox"/> 594 CMW                   |
|                 |                                                                    |                                                                  | <input type="checkbox"/> 482 Filter Matrix         |
|                 |                                                                    |                                                                  | <input type="checkbox"/> 378 RadiSense             |
|                 |                                                                    |                                                                  | <input type="checkbox"/> 494 AG6632A               |
|                 |                                                                    |                                                                  | <input type="checkbox"/> 498 NGPE 40               |

### 5.2.2. Requirements

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

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

|                                       |                |                                                                                                                                                                                                                                     |                                            |                                                |
|---------------------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------|
| Signal link to test system (if used): |                | <input type="checkbox"/> air link                                                                                                                                                                                                   | <input type="checkbox"/> cable connection  | <input checked="" type="checkbox"/> none       |
| EUT-grounding                         |                | <input checked="" type="checkbox"/> none                                                                                                                                                                                            | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up                      |                | <input checked="" type="checkbox"/> table top                                                                                                                                                                                       |                                            | <input type="checkbox"/> floor standing        |
| Climatic conditions                   |                | Temperature: (22±3°C)                                                                                                                                                                                                               |                                            | Rel. humidity: (40±20)%                        |
| EMI-Receiver or Analyzer Settings     | Scan data      | <input checked="" type="checkbox"/> 9 – 150 kHz      RBW/VBW = 200 Hz      Scan step = 80 Hz<br><input checked="" type="checkbox"/> 150 kHz – 30 MHz      RBW/VBW = 9 kHz      Scan step = 4 kHz<br><input type="checkbox"/> other: |                                            |                                                |
|                                       | Scan-Mode      | <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3dB Spectrum analyser Mode                                                                                                                      |                                            |                                                |
|                                       | Detector Mode: | Peak (pre-measurement) and Quasi-PK/Average (final if applicable)                                                                                                                                                                   |                                            |                                                |
|                                       | Sweep-Time     | 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 see diagrams.

The EUT is put on operation on nominal channel with on modulation mode.

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                                  |        |
| 2.03-2.04   | Nominal         |     | 9 kHz-30 MHz    | 1          | 1           | Carrier visible on diagram, not relevant for results | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | passed |

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

### 5.3. General Limit - Radiated field strength emissions, 30 MHz - 1 GHz

#### 5.3.1. Test location and equipment

|                 |                                                                    |                                                                  |                                                       |
|-----------------|--------------------------------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------|
| test location   | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2               | <input type="checkbox"/> Please see Chapter. 2.2.3    |
| test site       | <input checked="" type="checkbox"/> 441 EMI SAR                    | <input checked="" type="checkbox"/> 487 SAR NSA                  |                                                       |
| receiver        | <input type="checkbox"/> 377 ESCS30                                | <input checked="" type="checkbox"/> 001 ESS                      | <input type="checkbox"/> 489 ESU 40                   |
| spectr. analys. | <input type="checkbox"/> 584 FSU                                   | <input type="checkbox"/> 120 FSEM                                | <input type="checkbox"/> 264 FSEK                     |
| antenna         | <input checked="" type="checkbox"/> 574 BTA-L                      | <input type="checkbox"/> 133 EMCO3115                            | <input type="checkbox"/> 302 BBHA9170                 |
| signaling       | <input type="checkbox"/> 392 MT8820A                               | <input type="checkbox"/> 371 CBT32                               | <input type="checkbox"/> 547 CMU                      |
| otherwise       | <input type="checkbox"/> 400 FTC40x15E                             | <input type="checkbox"/> 401 FTC40x15E                           | <input checked="" type="checkbox"/> 482 Filter Matrix |
| DC power        | <input checked="" type="checkbox"/> 456 EA 3013A                   | <input type="checkbox"/> 457 EA 3013A                            | <input type="checkbox"/> 459 EA 2032-50               |
| line voltage    | <input type="checkbox"/> 230 V 50 Hz via public mains              | <input checked="" type="checkbox"/> 060 120 V 60 Hz via PAS 5000 | <input type="checkbox"/> 268 EA- 3050                 |
|                 |                                                                    | <input type="checkbox"/> 494 AG6632A                             | <input type="checkbox"/> 498 NGPE                     |

#### 5.3.2. Requirements/Limits

|       |                 |                                                                                                                                                                 |                     |
|-------|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| FCC   |                 | <input type="checkbox"/> Part 15 Subpart B, §15.109, class B<br><input checked="" type="checkbox"/> Part 15 Subpart C, §15.209 @ frequencies defined in §15.205 |                     |
| ANSI  |                 | <input type="checkbox"/> C63.4-2014<br><input checked="" type="checkbox"/> C63.10-2013                                                                          |                     |
| Limit | Frequency [MHz] | Radiated emissions limits, 3 meters                                                                                                                             |                     |
|       |                 | QUASI Peak [µV/m]                                                                                                                                               | QUASI-Peak [dBµV/m] |
|       | 30 - 88         | 100                                                                                                                                                             | 40.0                |
|       | 88 - 216        | 150                                                                                                                                                             | 43.5                |
|       | 216 - 960       | 200                                                                                                                                                             | 46.0                |
|       | above 960       | 500                                                                                                                                                             | 54.0                |

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

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                            |                                                |
|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------|
| Signal link to test system (if used): | <input type="checkbox"/> air link                                                                                                                                                                                                                                                                                                                                                                                                                                             | <input type="checkbox"/> cable connection  | <input checked="" type="checkbox"/> none       |
| EUT-grounding                         | <input type="checkbox"/> none                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up                      | <input checked="" type="checkbox"/> table top 0.8m height                                                                                                                                                                                                                                                                                                                                                                                                                     | <input type="checkbox"/> floor standing    |                                                |
| Climatic conditions                   | Temperature: (22±3°C) Rel. humidity: (40±20)%                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                            |                                                |
| EMI-Receiver (Analyzer) Settings      | Scan frequency range: <input checked="" type="checkbox"/> 30 – 1000 MHz <input type="checkbox"/> other:<br>Scan-Mode: <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3 dB spectrum analyser mode<br>Detector: Peak / Quasi-peak<br>RBW/VBW: 100 kHz/300 kHz<br>Mode: Repetitive-Scan, max-hold<br>Scan step: 80 kHz<br>Sweep-Time: Coupled – calibrated display if continuous tx-signal otherwise adapted to EUT's individual duty-cycle |                                            |                                                |
| General measurement procedures        | Please see chapter "Test system set-up for electric field measurement in the range 30 MHz to 1 GHz"                                                                                                                                                                                                                                                                                                                                                                           |                                            |                                                |

#### 5.3.4. MEASUREMENT RESULTS

The results are presented below in summary form only. For more information please see diagrams.

Table of measurement results:

| Dia-gram no. | Frequency range | Set-up no. | OP-mode no. | Remark          | Used detector                       |                                     |                                     | Result |
|--------------|-----------------|------------|-------------|-----------------|-------------------------------------|-------------------------------------|-------------------------------------|--------|
|              |                 |            |             |                 | PK                                  | AV                                  | QP                                  |        |
| 3.01-3.02    | 30 MHz – 1 GHz  | Set. 1     | Op. 1       | Nominal channel | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | passed |

Remark: --

## 5.4. Frequency error(tolerance)

**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 |
| test site       | <input checked="" type="checkbox"/> 441 EMI SAR                    | <input type="checkbox"/> 487 SAR NSA               | <input type="checkbox"/> 337 OATS                  |
| receiver        | <input type="checkbox"/> 377 ESCS30                                | <input type="checkbox"/> 001 ESS                   | <input type="checkbox"/> 347 Radio.lab.            |
| spectr. analys. | <input type="checkbox"/> 489 ESU40                                 | <input checked="" type="checkbox"/> 584 FSU8       | <input type="checkbox"/> 431 Model 7405            |
| antenna         | <input type="checkbox"/> 048 EMCO3143                              | <input type="checkbox"/> 133 EMCO3115              | <input type="checkbox"/> 302 BBHA9170              |
| signaling       | <input type="checkbox"/> 298 CMU                                   | <input type="checkbox"/> 460 CMU                   | <input type="checkbox"/> 289 CBL 6141              |
| power supply    | <input type="checkbox"/> 456 EA 3013A                              | <input type="checkbox"/> 457 EA 3013A              | <input type="checkbox"/> 268 EA- 3050              |
| otherwise       | <input type="checkbox"/> 400 FTC40x15E                             | <input type="checkbox"/> 401 FTC40x15E             | <input type="checkbox"/> 482 Filter Matrix         |

### Standards and Limits: CFR 47, §15.225, ANSI 63.10: 2013

| Frequency [MHz] | Frequency tolerance [%] | [ppm] | [Hz]    | Remarks |
|-----------------|-------------------------|-------|---------|---------|
| 13.553 -13.567  | ±0.01                   | ±100  | ±1356.7 |         |

### Test condition and measurement test set-up

|                                  |                                                                                                                                                                                                    |                                            |                                                                                                                               |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|
| link to test system (if used):   | <input type="checkbox"/> air link                                                                                                                                                                  | <input type="checkbox"/> cable connection  | <input checked="" type="checkbox"/> none                                                                                      |
| EUT-grounding                    | <input checked="" type="checkbox"/> none                                                                                                                                                           | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection: between potential equalisation connector (EUT) and GND with a lab wire 1,2 m) |
| Equipment set up                 | <input checked="" type="checkbox"/> table top                                                                                                                                                      | <input type="checkbox"/> floor standing    |                                                                                                                               |
| Climatic conditions              | Temperature: (22±3°C)                                                                                                                                                                              |                                            | Rel. humidity: (40±20)%                                                                                                       |
| EMI-Receiver (Analyzer) Settings | Span/Range: 9kHz to 150kHz; 150 kHz to 30 MHz<br>RBW/VBW: 200Hz/auto; 10 kHz/ auto (ANSI63.10/CISPR#16)<br>Detector/ Mode: PEAK, TRACE max-hold mode, repetitive scan for exploratory measurements |                                            |                                                                                                                               |

## REFERENCES

FCC: §15.225(e)

## TEST SET-UP

A sniffer antenna acts like a coupling antenna for measuring the fundamental frequency. This is placed at about 20cm away from the equipment. Also connecting cables at the equipment are avoided on the extent possible in order not to degrade the resonance frequency of the equipment and integral antenna.

## EQUIPMENT SETTINGS

The measurements is made on nominal carrier frequency within operational band.

## TEST METHOD

If the equipment is capable of producing an un-modulated carrier then a trace with max-hold function was recorded. The maximum peak within the span was found, then the frequency deviation was recorded with the build-in frequency counter within the spectrum-analyzer. The maximum resolution was chosen on the settings.

The frequency deviation was recorded at switching on point of the equipment and on 2 minutes, 5minutes and 10 minutes after at in accordance with ANSI 63.10: 2013, Chapter 6.8

All measurements data are enclosed in annex measurements. Here only maximum frequency error is reported.

#### 5.4.1. Frequency shift of carrier against voltage range at constant nominal temperature of 20° Celsius

- 1.) determine the carrier frequency for the lowest and highest channel at room temperature and nominal voltage [20°C] after a long run of the device equipment (EUT). This frequency is taken as reference for all other measured frequencies.
- 2.) loaded batteries with specified voltage are prepared and used in the equipment specified range of the battery and equipment declared voltage.

#### Results

##### Set.up 1 / Op. Mode 1

| Voltage<br>[V] | Nominal frequency<br>[MHz] | Maximum Frequency error |             |       | Verdict<br>Limit 100 ppm |
|----------------|----------------------------|-------------------------|-------------|-------|--------------------------|
|                |                            | [Hz]                    | %           | [ppm] |                          |
| 10.2 (Minimum) | 13.5608167                 | 1.7                     | 1.25361E-05 | 0.13  | Passed                   |
| 12 (Nominal)   |                            | -                       | -           | -     |                          |
| 13.8 (Maximum) |                            | 0.70                    | 5.16193E-06 | 0.052 |                          |

Remark: --

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

- 1.) Use a full loaded battery for tests according this chapter
- 2.) determine the carrier frequency at room temperature and nominal voltage [20°C] after a long run of the device equipment (EUT). This frequency is taken as reference for all other measured frequencies.
- 3.) Perform the carrier frequencies measurements in 10°C increments from 50°C down to -20°C as required by the standards. The stabilization period was about 1 hour after thermal reach of the required temperature.

#### Results

##### Set. Up. 1 / Op. Mode 1

| Temperature<br>[°C] | Nominal frequency<br>[MHz] | Maximum Frequency Error |        |                        | Verdict |
|---------------------|----------------------------|-------------------------|--------|------------------------|---------|
|                     |                            | [Hz]                    | ppm    | LIMIT                  |         |
| -40                 | 13.56                      | 227.1000000             | 16.75  | ±100<br>ppm<br>(±0.1%) | Passed  |
| -20                 |                            | 254.2000000             | 18.75  |                        |         |
| -10                 |                            | 232.1000000             | 17.12  |                        |         |
| 0                   |                            | 228.9000000             | 16.88  |                        |         |
| +10                 |                            | 62.3000000              | 4.59   |                        |         |
| +30                 |                            | -40.9000000             | -3.02  |                        |         |
| +40                 |                            | -89.8000000             | -6.62  |                        |         |
| +50                 |                            | -118.7000000            | -8.75  |                        |         |
| +85                 |                            | -138.2000000            | -10.19 |                        |         |

Remark:--

**VERDICT:** Limits according §15.225(a)(b)(c) - passed

## 5.5. 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 <sub>CISPR</sub> ) | 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                        | -            | 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      |
|                                           |              | 30 MHz - 1 GHz                      | 4.2 dB                                                    |        |      |      |      |    |                      | E-field             |
|                                           |              | 1 GHz - 20 GHz                      | 3.17 dB                                                   |        |      |      |      |    |                      | 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 Measur. | FCC, Federal Communications Commission<br>Laboratory Division, USA                          |
| 337<br>487<br>550<br>558                                                        | --<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-2666<br>G-301<br>C-2914<br>T-1967 | 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 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 |                                     |                                                                                                                                                                                                                                                                           |                                                                                             |



## 8. Instruments and Ancillary

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

### 8.1. 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)                                          |

### 8.1.1. 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      |            |
| 066      | notch filter (WCDMA; FDD1)              | WRCT 1900/2200-5/40-10EEK | 5                       | Wainwright GmbH            | 12 M                    | 1g     | 30.06.2017 |
| 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      |            |
| 287      | pre-amplifier 25MHz - 4GHz              | AMF-2D-100M4G-35-10P      | 379418                  | Miteq                      | 12 M                    | 1c     | 30.06.2017 |
| 291      | high pass filter GSM 850/900            | WHJ 2200-4EE              | 14                      | Wainwright GmbH            | 12 M                    | 1c     | 30.06.2017 |
| 298      | Univ. Radio Communication Tester        | CMU 200                   | 832221/091              | Rohde & Schwarz            | pre-m                   | 3      |            |
| 300      | AC LISN (50 Ohm/50µH, 1-phase)          | ESH3-Z5                   | 892 239/020             | Rohde & Schwarz            | 12 M                    | -      | 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 |
| 389      | Digital Multimeter                      | Keithley 2000             | 0583926                 | Keithley                   | 24 M                    | -      | 31.12.2017 |
| 392      | Radio Communication Tester              | MT8820A                   | 6K00000788              | Anritsu                    | 12 M                    | -      | 18.05.2018 |
| 405      | Thermo-Hygrometer                       | OPUS 10 THI               | 126.0604.0003.3.3.3.2 2 | 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 |

| Ref.-No. | Equipment                               | Type                         | Serial-No.              | Manufacturer                | Interval of calibration | Remark | Cal due    |
|----------|-----------------------------------------|------------------------------|-------------------------|-----------------------------|-------------------------|--------|------------|
| 441      | CTC-SAR-EMI Cable Loss                  | System EMI field (SAR) Cable | -                       | CETECOM                     | 12 M                    | 5      | 31.12.2017 |
| 443      | CTC-FAR-EMI-RSE                         | System CTC-FAR-EMI-RSE       | -                       | ETS-Lindgren / CETECOM      | 12 M                    | 5      | 31.12.2017 |
| 448      | notch filter WCDMA_FDD II               | WRCT 1850.0/2170.0-5/40-     | 5                       | Wainwright Instruments GmbH | 12 M                    | 1c     | 31.12.2017 |
| 449      | notch filter WCDMA FDD V                | WRCT 824.0/894.0-5/40-8SSK   | 1                       | Wainwright                  | 12 M                    | 1c     | 31.12.2017 |
| 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                    | -      | 16.06.2018 |
| 463      | Universal source                        | HP3245A                      | 2831A03472              | Agilent                     | -                       | 4      |            |
| 466      | Digital Multimeter                      | Fluke 112                    | 89210157                | Fluke USA                   | 24 M                    | -      | 30.05.2018 |
| 467      | Digital Multimeter                      | Fluke 112                    | 89680306                | Fluke USA                   | 36 M                    | -      | 30.04.2018 |
| 468      | Digital Multimeter                      | Fluke 112                    | 90090455                | Fluke USA                   | 36 M                    | -      | 30.04.2018 |
| 477      | ReRadiating GPS-System                  | AS-47                        | -                       | Automotive Cons. Fink       | -                       | 3      |            |
| 480      | power meter (Fula)                      | NRVS                         | 838392/031              | Rohde & Schwarz             | 24 M                    | -      | 16.05.2019 |
| 482      | filter matrix                           | Filter matrix SAR 1          | -                       | CETECOM (BrI)               | -                       | 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                    | -      | 31.03.2019 |
| 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                   | Wainwrgh                    | 12 M                    | 1c     | 31.12.2017 |
| 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                    | -      | 05.07.2018 |
| 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                    | -      | 30.03.2019 |
| 552      | high pass filter 2,8-18GHz              | WHKX 2.8/18G-10SS            | 4                       | Wainwright                  | 12 M                    | 1c     | 31.12.2017 |
| 557      | System CTC-OTA-2                        | R&S TS8991                   | -                       | Rohde & Schwarz             | 12 M                    | 5      | 31.12.2017 |
| 558      | System CTC FAR S-VSWR                   | System CTC FAR S-VSWR        | -                       | CTC                         | 24 M                    | -      | 08.08.2019 |
| 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                   | -      |            |
| 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                       | 201.0999.9302.6.4.1.4 3 | 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  | -                       | KogitLink                   | -                       | 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 |

| Ref.-No. | Equipment                         | Type                    | Serial-No.             | Manufacturer                | Interval of calibration | Remark | Cal due    |
|----------|-----------------------------------|-------------------------|------------------------|-----------------------------|-------------------------|--------|------------|
| 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      | 31.12.2017 |
| 697      | Power Splitter                    | ZN4PD-642W-S+           | 165001445              | Mini-Circuits               | -                       | 2      |            |
| 701      | CMW500 wide. Radio Comm.          | CMW500                  | 158150                 | Rohde & Schwarz             | 12 M                    | -      | 31.12.2017 |
| 703      | INNCO Antennen Mast               | MA 4010-KT080-XPET-ZSS3 | MA4170-KT100-XPET-     | INNCO                       | pre-m                   | -      |            |
| 704      | INNCON Controller                 | CO 3000-4port           | CO3000/933/3841051 6/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 Physics          | -                       | -      |            |
| 749      | Pickett-potter Horn Antenna       | FH-PP 60-90             | 010003                 | Radiometer Physics          | -                       | -      |            |
| 750      | Pickett-Potter Horn Antenna       | FH-PP 140-220           | 010011                 | Radiometer Physics          | -                       | -      |            |

### 8.1.2. 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 | 2018-04-05      |