# T E S T  R E P O R T
# No.: 18-1-0048201T03a-C2

According to:
**FCC Regulations**
Part 15.205
Part 15.209
Part 15.247

**ISED-Regulations**
RSS-Gen, Issue 5
RSS-247, Issue 2

for

## Robert Bosch Car Multimedia GmbH

## AIVISBX0
## Navigationsystem with WLAN and Bluetooth

**FCC ID: YBN-AIVISBX0**
**ISED: 9595A-AIVISBX0**

| Laboratory Accreditation and Listings |
|---|
| ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-01 D-PL-12047-01-03 D-PL-12047-01-04<br>Accredited EMC-Test Laboratory |
| Wi Fi ALLIANCE AUTHORIZED RF LABORATORY \| ctia Authorized™ Test Lab Lab Code: 20011130-00 |
| accredited according to DIN EN ISO/IEC 17025 |
| **CETECOM GmbH**<br>Laboratory Radio Communications & 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 |
| Laboratory Accreditation and Listings |

# Table of contents



| Table of Annex | | | |
|---|---|---|---|
| **Annex No.** | **Contents** | **Reference Description** | **Total Pages** |
| **Annex 1** | Test results | **CETECOM_TR18-1-0048201T03a-A1** | 67 |
| **Annex 2** | External photographs of EUT | **CETECOM_TR18-1-0048201T02a-A2** | 8 |
| **Annex 4** | Test set-up photographs | **CETECOM_TR18-1-0048201T02a-A3** | 8 |
| 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. 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 presented Equipment Under Test (in this report, hereinafter referred as EUT) integrates a Bluetooth©EDR transmitter Other implemented wireless technologies are not considered within this test report.

Following test cases have been performed to show compliance with valid Part 15.209/15.247 of the FCC CFR Title 47 Rules, Edition 2017 and ISED RSS-247 Issue 2/RSS-Gen Issue 5 standards.

## 1.1. Tests overview of US CFR (FCC) and Canada ISED (RSS) Standards

| Test cases | Port | References and Limits | | | EUT set-up | EUT op. mode | Result |
|---|---|---|---|---|---|---|---|
| | | FCC Standard | RSS Section | Test limit | | | |
| TX-Mode | | | | | | | |
| 20 dB bandwidth | Antenna terminal (conducted) | §15.247 (a)(1) | RSS-247, Issue 2: 5.1 (a) | At least 25 kHz or 2/3 of 20 dB bandwith | 2 | 1 | Passed |
| Channel carrier frequency separation | | | RSS-247, Issue 2: 5.1 (b) | | 2 | 2 | |
| 99% occupied bandwidth | Antenna terminal (conducted) | 2.1049(h) | RSS-Gen, Issue 5: Chapter 6.6 | 99% Power bandwidth | 2 | 1 | Passed |
| Channel use, average channel use, input band-width and synchronization between signals | -- | §15.247 (a)(1) | RSS-247, Issue 2: 5.1 (d) | See specification | 2 | 2 | Passed |
| Channel average Occupancy time and number of channels | Antenna terminal (conducted) | §15.247 (a)(1) (iii) | RSS-247, Issue 2: 5.1 (d) | 0.4 seconds | 2 | 2 | Passed |
| Transmitter Peak output power | Antenna terminal (conducted) | §15.247 (b)(1) | RSS-247, Issue 2: 5.1 (b) | < 125 mW | 2 | 1 | Passed |
| Transmitter frequency stability | Antenna terminal (conducted) | -- | RSS-Gen Issue 5, Chapter 8.11 | Operation within designated operational band | 2 | 1 | Passed |
| Transmitter Peak output power radiated | Enclosure (radiated) | §15.247 (b)(4) | RSS-247, Issue 2: 5.1 (b) | < 125 mW (EIRP) for antenna with directional gain less 6 dBi | -- | -- | Passed (calculated) |
| Out-Of-Band RF- emissions<br><br>Band-Edge emissions | Antenna terminal (conducted) | §15.247 (d) | RSS-247, Issue 2, Chapter 5.5 | 20 dBc and Emissions in restricted bands must meet the general field strength radiated limits | 1 | 1 + 2 | Passed |
| General field strength emissions + restricted bands | Enclosure + Interconnecting cables (radiated) | §15.247 (d) §15.205 §15.209 | RSS-247, Issue 2, Chapter 5.5<br><br>RSS-Gen: Issue 5: §8.9 Table 4+5+6 | Emissions in restricted bands must meet the general field-strength radiated limits | 1 | 1 | Passed |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AC-Power Lines<br><br>Conducted Emissions | AC-Power lines | §15.207 | RSS-Gen, Issue 5: Chapter 8.8 Table 3 | FCC §15.107 class B limits §15.207 limits<br><br>ISED: Table 3, Chapter 8.8 | -- | -- | NA |

Remark

## 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.

The current version of the Test Report CETECOM_TR18-1-0048201T03a-C2 replaces the Test Report CETECOM_TR18-1-0048201T03a-C1 dated 2011-12-11. The replaced test report is herewith invalid.

Digital unterschrieben von B.Sc. Mohamed Ahmed
DN: cn=B.Sc. Mohamed Ahmed, o=Cetecom GmbH, ou=RC/EMC, email=mohamed.ahmed@cetecom.com, c=DE
Datum: 2019.02.20 13:54:17 +01'00'

..... .....

Dipl.-Ing. Niels Jeß
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. 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:<br>project leader: | B.Sc. Mohamed Ahmed<br>Dipl.-Ing N. Perez |
| Receipt of EUT: | 2018-08-20 |
| Date(s) of test: | 2018-08-22 - 2018-11-29 |
| Date of report: | 2019-02-20 |

## 2.4. Applicant's details

| | |
|---|---|
| Applicant's name: | Robert Bosch Car Multimedia GmbH |
| Address: | Robert-Bosch_Straße 200<br>31139 Hildesheim<br>Germany |
| Contact person: | Mr. Salvatore Miraglia |

## 2.5. Manufacturer's details

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

# 3. Equipment under test (EUT)

## 3.1. Technical data of main EUT declared by applicant

| | | | |
|---|---|---|---|
| Model Nr. | AIVISBX0 | | |
| Type | Navigationsystem with WLAN and Bluetooth | | |
| FCC ID | YBN-AIVISBX0 | | |
| ISED | 9595A-AIVISBX0 | | |
| Frequency range (US/Canada -bands) | ☒ 2402 MHz (Channel 1 or 37) to 2480 MHz (Channel 39) | | |
| Type of modulation | GFSK | | |
| Number of channels (USA/Canada -bands) | 1 - 79 | | |
| Antenna Type | ☒ Integrated<br>☐ External, no RF- connector<br>☐ External, separate RF-connector | | |
| Antenna Model | PCB Antenna | | |
| Antenna Gain | -0.38dBi | | |
| Peak Power<br>CH 1 conducted<br>Ch39 conducted<br>Ch79 conducted | RMS power measured<br>-2,5dBm<br>-3,5dBm<br>-2,5dBm | | |
| EIRP Power (calculated)<br>CH 1 radiated<br>Ch39 radiated<br>Ch79 radiated | EIRP power (calculated)<br>-2.5dBm – 0.38dBi = -1.78dBm<br>-3.5dBm – 0.38 dBi = -2.38dBm<br>-2.5dBm – 0.38dBi = -1.78dBm | | |
| Installed options | ☒ 802.11 a/n/ac (not tested within this report)<br>☒ 802.11 b/g/n (not tested within this report)<br>☒ Bluetooth LE (not tested within this report)<br>☒ Bluetooth EDR | | |
| Power supply | ☐ DC power Range: 2.3 V to 3.3 V (as specified by applicant)<br>☒ 13.5V DC | | |
| Special EMI components | -- | | |
| Does EUT contain devices susceptible to magnetic fields, e.g. Hall elements, electrodynamics microphones, etc.? | ☐ yes<br>☒ no | | |
| EUT sample type | ☐ Production | ☒ Pre-Production | ☐ Engineering |
| FCC label attached | ☐ yes | ☒ no | |

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

| Short description*) | EUT | Type | S/N serial number | HW hardware status | SW software status | PMT Reference |
|---|---|---|---|---|---|---|
| EUT A | AIVISBX0 | Navigationsystem with WLAN and Bluetooth | 0005000 | C-Sample | 1003 | S06 |
| EUT B | AIVISBX0 | Navigationsystem with WLAN and Bluetooth | 0005044 | C-Sample | 1003 | S05 |

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

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

| AE short description *) | Auxiliary Equipment | Type | S/N serial number | HW hardware status | SW software status |
|---|---|---|---|---|---|
| AE 1 | USB-cable (Dongle) | 0,38m | S7291GC000379 | Version-D1 | -- |
| AE 2 | Power Supply Cable | -- | -- | -- | -- |
| AE 3 | Notebook | Lenovo X200S | LVZT1DG | -- | -- |

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

## 3.4. EUT set-ups

| EUT set-up no.*) | Combination of EUT and AE | Remarks |
|---|---|---|
| set. 1 | EUT A + AE 1 + AE 2 | Used for radiated measurements. |
| set. 2 | EUT B + AE 1 + AE 2 | Used for conducted measurements. |

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

## 3.5. EUT operating modes

| EUT operating mode no.*1) | Description of operating modes | Additional information |
|---|---|---|
| op. 1 | Bluetooth BDR/EDR Modes*<br><br>TX-Fixed Channel (Modulated) | The EUT was put to **Fixed Channel (Modulated) Continuous transmissions mode**<br><br>*Other supported wireless technologies were put in idle mode using special test software *2) |
| op. 2 | Bluetooth BDR/EDR Modes*<br><br>Normal operating mode | The EUT was put into **normal hopping mode**.<br><br>*Other supported wireless technologies were put in idle mode using special test software *2) |

*1) EUT operating mode no. is used to simplify the test report.
*2) Please refer to document Instructions_RadioTypeApproval_9_6_2017 “Instructions for setting Operating Modes of WLAN, BT and BT-LE for Radio Type Approval.”
*3) The BT power level for type approval is set to 0dBm.

### 3.5.1. Test tool information

Labtool version: 2.0.0.75
Labtool date: Mar 18 2015 (15:56:06)

For BT the following commands were used in Labtool:

80 // reset
114 2 //PowerClass2
116 1 // PowerLevel Automatic off
16 0 0 // PowerLevel 0dBm BDR
12 x // x for BT channel
225 1 15 2 -1 Y //
Duty Cycle Mode on, DH5, Payploadpattern PN9, max. possible PayloadLength,
Y for Fixed channel (0) and Hopping ON(1)

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

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

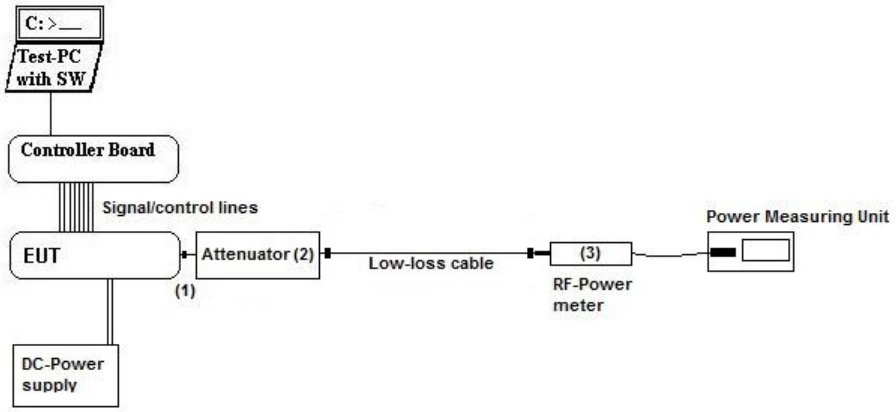
**Conducted Set-up W1**

**Bluetooth Low Energy conducted RF-Setup 1 (W1 Set-up)**

**General description:**

The EUT's RF-signal is coupled out by a suitable antenna coupling connector (1). The signal is first attenuated (2) then connected to the power meter (3) for conducted power measurements. The specific attenuation loss is determined prior to the measurement within a set-up attenuation measurement. These are then taken into account by correcting the measurement readings.

**Schematic:**




**Testing method:** ANSI C63.10:2013, KDB 558074 D01 DTS Meas.Guidance v04

**Used Equipment**

| Passive Elements | Test Equipment | Remark: |
|---|---|---|
| ☒ 20 dB Attenuator | ☒ Power Meter | See List of equipment under each test case and chapter 8 for calibration info |
| ☒ Low loss RF-cables | ☒ DC-Power Supply | |
| ☒ | ☒ Spectrum-Analyser | |

**Measurement uncertainty** See chapter 8

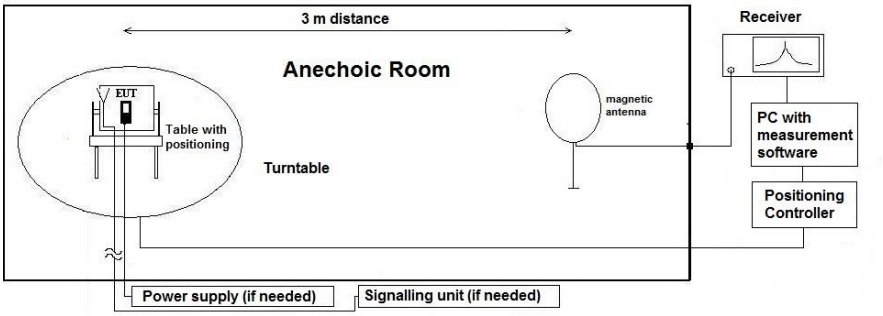
## 4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

**Specification:** ANSI C63.10-2013 chapter 6.4 (§6.4.4.2)

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

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

**Schematic:**




**Testing method:**

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

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

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

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

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

**Formula:**

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

$M = L_T - E_C$

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

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

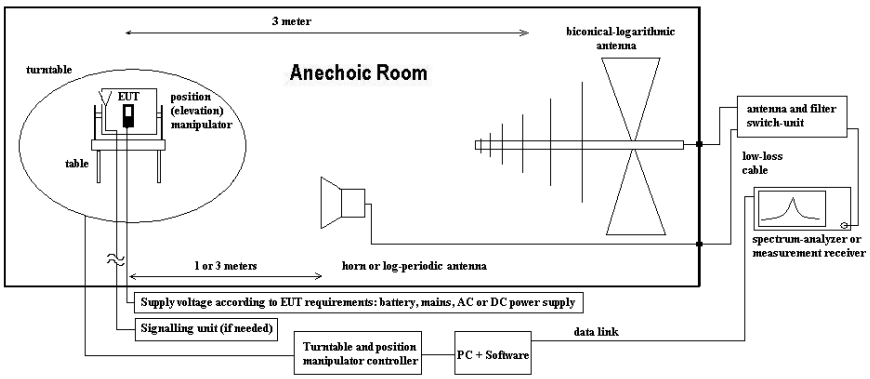
**Distance correction:** Reference for applied correction (extrapolating) factors due to reduced measurement distance:
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

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

**Specification:** ANSI C63.4-2014 chapter 8.2.3, 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 it's 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. either on 10m OATS or 3m semi-anechoic room.

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:**

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

$M = L_T - E_C$ (2)

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

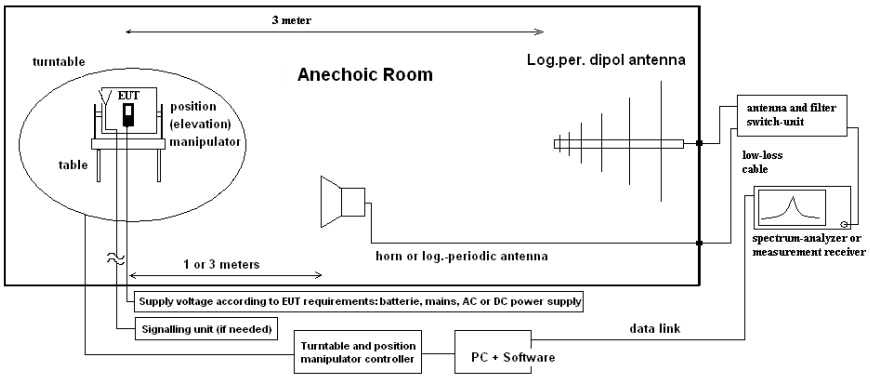
All units are dB-units, positive margin means value is below limit.

## 4.4. Test system set-up for radiated electric field measurement above 1 GHz

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

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

**Schematic:**




**Testing method:**

**Exploratory, preliminary measurements**
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

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

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined. Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself over 3-orthogonal axis and the height for EUT with large dimensions.

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

**Formula:**

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

$M = L_T - E_C$ (2)

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

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

# 5. Measurement results

## 5.1. RF-Parameter Duty-Cycle

### 5.1.1. Test location and equipment

(for reference numbers please see chapter 'List of test equipment')

| Ambient Climatic conditions | | | Temperature: (22±2)°C | Rel. humidity: (45±15)% | | |
|---|---|---|---|---|---|---|
| test site | ☐ 441 EMI SAR | ☐ 348 EMI cond. | ☐ 443 EMI FAR | ☐ 347 Radio.lab. | ☐ 337 OATS | ☒ TS 8997 |
| equipment | ☐ 331 HC 4055 | ☐ | ☐ | ☐ | ☐ | ☐ |
| spectr. analys. | ☐ 683 FSU26 | ☐ 120 FSEM | ☐ 264 FSEK | ☐ | ☐ | ☐ |
| power meter | ☐ 262 NRV-S | ☐ 266 NRV-Z31 | ☐ 265 NRV-Z33 | ☐ 261 NRV-Z55 | ☐ 356 NRV-Z1 | ☐ |
| multimeter | ☐ 341 Fluke 112 | ☐ | ☐ | ☐ | ☐ | ☐ |
| DC power | ☐ 086 LNG50-10 | ☒ 087 EA3013 | ☐ 354 NGPE 40 | ☐ 349 car battery | ☐ 350 Car battery | ☐ 463 HP3245A |
| Supply Voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5V DC | | | |
| otherwise | ☐ 530 Attenuator 10dB | ☒ K4 Cable | | | | |

### 5.1.2. Reference

| | |
|---|---|
| **ANSI** | ☒ ANSI 63.10:2013 |

### 5.1.3. EUT settings:

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

A special firmware program is used for test purposes. In opposite to normal operating mode a higher duty-cycle is set in order to facilitate the measurements. This is maximized at the extent possible.

The necessary duty-cycle correction factor is determined on nominal conditions on one channel in each operable frequency-band. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions. The Duty-Cycle was constant, means without variations.

### 5.1.4. Measurement method:

Method of measurement: ☒ conducted
☐ radiated

Calculated with following formulas:

| | | | |
|---|---|---|---|
| Duty cycle: | $x = \frac{Tx_{on}}{Tx_{on} + Tx_{off}}$ | Duty cycle factor [dB]: | $10\log\left(\frac{1}{x}\right)$ |

☒ The results were corrected in order to evaluate for worst-case result each time when average values are necessary for example average radiated emissions or similar
☐ No correction necessary: Duty-Cycle > 98%

### 5.1.5. RESULTS

| Modulation | DUT Frequency (MHz) | DutyCycle (%) | DutyCycle (dB) | DutyCycle (dB) |
|---|---|---|---|---|
| DH1 | 2402 | 31.276 | 31,28 | 5,05 |
| | 2441 | 31.212 | 31,21 | 5,06 |
| | 2480 | 31.224 | 31,22 | 5,06 |
| DH3 | 2402 | 65.865 | 65,87 | 1,81 |
| | 2441 | 65.919 | 65,92 | 1,81 |
| | 2480 | 65.876 | 65,88 | 1,81 |
| DH5 | 2402 | 77.221 | 77,22 | 1,12 |
| | 2441 | 77.185 | 77,19 | 1,12 |
| | 2480 | 77.202 | 77,20 | 1,12 |
| 2DH1 | 2402 | 31.501 | 31,50 | 5,02 |
| | 2441 | 31.475 | 31,48 | 5,02 |
| | 2480 | 31.566 | 31,57 | 5,01 |
| 2DH3 | 2402 | 66.077 | 66,08 | 1,80 |
| | 2441 | 65.815 | 65,82 | 1,82 |
| | 2480 | 65.870 | 65,87 | 1,81 |
| 2DH5 | 2402 | 77.161 | 77,16 | 1,13 |
| | 2441 | 77.425 | 77,43 | 1,11 |
| | 2480 | 77.157 | 77,16 | 1,13 |
| 3DH1 | 2402 | 32.298 | 32,30 | 4,91 |
| | 2441 | 31.459 | 31,46 | 5,02 |
| | 2480 | 31.407 | 31,41 | 5,03 |
| 3DH3 | 2402 | 65.720 | 65,72 | 1,82 |
| | 2441 | 65.708 | 65,71 | 1,82 |
| | 2480 | 65.711 | 65,71 | 1,82 |
| 3DH5 | 2402 | 77.168 | 77,17 | 1,13 |
| | 2441 | 77.160 | 77,16 | 1,13 |
| | 2480 | 77.286 | 77,29 | 1,12 |

## 5.2. RF-Parameter Maximum peak conducted output power

**5.2.1. Test location and equipment** (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 347 Radio.lab. | ☒ TS 8997 | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☐ 489 ESU 40 | ☐ | ☐ | ☐ |
| spectr. analys. | ☐ 584 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ 489 ESU 40 | ☐ | ☐ |
| antenna | ☐ 574 BTA-L | ☐ 133 EMCO3115 | ☐ 302 BBHA9170 | ☐ 289 CBL 6141 | ☐ 030 HFH-Z2 | ☐ 477 GPS |
| signaling | ☐ 392 MT8820A | ☐ 436 CMU | ☐ 547 CMU | | | |
| otherwise | ☐ 266 NRV-Z31 | ☐ 600 NRVD | ☐ 110 USB LWL | ☐ 482 Filter Matrix | ☐ 378 RadiSense | ☒ 693 TS8997 |
| DC power | ☐ 671 EA-3013S | ☐ 463 HP3245A | ☒ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 498 NGPE 40 |
| otherwise | ☐ 331 HC 4055 | ☐ 248 6 dB Attenuator | ☐ 529 Power divider | ☐ - cable OTA20 | | |
| | ☒ 530 10dB Attenuator | | ☐ K 4 Cable kit | | | |
| Supply Voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5V DC | | | |

**5.2.2. Reference**

| | |
|---|---|
| **FCC** | ☒ §15.247(b) (3) + KDB 558074 D01 DTS Meas Guidance v04 |
| **ISED** | ☒ RSS-247, Chapter 5.4(4) |
| **ANSI** | ☒ ANSI 63.10:2013 |
| **Specification** | *For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.* |

**5.2.3. EUT settings:**

The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

**5.2.4. Test condition and measurement test set-up**

| | | | |
|---|---|---|---|
| Signal ink to test system (if used): | ☐ air link | ☐ cable connection | ☒ none |
| EUT-grounding | ☒ none | ☐ with power supply | ☐ additional connection |
| Equipment set up | ☒ table top 1.5m height | | ☐ floor standing |
| Climatic conditions | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| General measurement procedures | Please see chapter “Test system set-up for conducted RF-measurement at antenna Port” (W1 Set-up) | | |

### 5.2.5. Measurement method and analyzer settings:

The measurement was performed in non-hopping transmission mode with the carrier set to lowest/middle and highest channel.

**MEASUREMENT METHOD/ SPECTRUM-ANALYZER SETTINGS:**

| | | |
|---|---|---|
| Measurement Method 1.) | §15.247(b) (3) Maximum Peak | 1.) ☒ 7.8.5 ANSI63:10:2013, Maximum peak conducted output power (RBW > 20dB-bandwidth of the signal)<br>2.) ☐ 9.1.3. PKPM1 Peak reading power meter (broadband PK meter) |
| | §15.247(b) (3) Maximum Average | 3.) ☐ AVGSA-1 / AVGSA-1 alternative (duty-cycle > 98%)<br>4.) ☐ AVGSA-2 / AVGSA-2 alternative (duty-cycle < 98%, constant)<br>5.) ☐ AVGSA-3 / AVGSA-3 alternative (duty-cycle < 98%, not constant)<br>6.) ☐ AVPM(duty-cycle < 98% (constant)<br>7.) ☐ AVPM-G (duty-cycle < 98% (constant) |
| | MIMO | 8.) ☐ Summarization of values from two antenna ports |
| Center Frequency | | Nominal channel frequency |
| Span | | 30% higher than the EBW measured before |
| Resolution Bandwidth (RBW) | | 2MHz |
| Video Bandwidth (VBW) | | 10MHz |
| Sweep time | | coupled |
| Detector | | Peak, Max hold mode for method PK1/PK2 or RMS and trace average for method AVG1/AVG2 |
| Sweep Mode | | Repetitive mode, allow trace to stabilize |
| Analyzer-Mode | | ☒ normal<br>☐ activated channel integration method with limits set to the EBW of the signal |

Remark 1: guidance 558074 D01 measurement DTS guidance v04 or ANSI 63.10:2013

### 5.2.6. RESULTS

**APLICANT'S DECLARED ANTENNA CHARACTERISTICS:**

☒ Directional Gain < 6 dBi (measured: difference between measured conducted and radiated eirp. power)
☐ Directional Gain > 6 dBi (measured / applicant's declaration) -> conducted power reduction necessary

The antenna gain was measured at 3 different frequencies.
-0.38dBi

Different modulation types and data rates were tested in order to find the maximum conducted output power. **Enclosed are only the maximum values for each modulation format**, pls. compare separate document A1 for all results.

| Modulation | DUT Frequency (MHz) | Peak Power (dbm) | Antenna Gain (dBi) | EIRP (dBm) |
|---|---|---|---|---|
| **DH5** | 2402 | **-2.5** | -0.61 | -3.11 |
| | 2441 | **-3.5** | -0.38 | -3.88 |
| | 2480 | **-2.5** | -0.63 | -3.13 |
| **2DH5** | 2402 | **-3.6** | -0.61 | -4.21 |
| | 2441 | **-4.3** | -0.38 | -4.68 |
| | 2480 | **-3.2** | -0.63 | -3.83 |
| **3DH5** | 2402 | **-3.3** | -0.61 | -3.91 |
| | 2441 | **-4** | -0.38 | -4.38 |
| | 2480 | **-2.8** | -0.63 | -3.43 |

Remark: External Path Loss -> set as correction factor in spectrum-analyzer.

### 5.2.7. Conducted Peak Output Power Verdict: Pass

## 5.3. RF-Parameter – Frequency Stability

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

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 337 OATS | ☒ 347 Radio.lab. | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☒ 489 ESU 40 | ☐ 620 ESU 26 | ☐ | ☐ |
| otherwise | ☐ 600 NRVD | ☐ 357 NRV-Z1 | ☐ 693 TS8997 | | | |
| spectr. analys. | ☐ 683 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ 714 FSW 67 | ☐ | ☐ |
| power supply | ☐ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 354 NGPE 40 |
| otherwise | ☒ 613 20 dB Attenuator | ☐ 248 6 dB Attenuator | ☐ 529 Power divider | ☐ - cable OTA20 | ☐ 530 10dB Atten | ☐ K5 Cable |
| Supply voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13,5 V DC | | | |

**5.3.2. Requirements:**

| | |
|---|---|
| **ISED** | ☒ RSS-Gen, Issue5 , Chapter 6.11 |
| **Remark** | Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage. |

**5.3.3. EUT settings**

For FHSS-systems hopping mode was switched-off so fixed two different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.

**5.3.4. Measurement method**

1. The First Measurement was done at Normal Temperature +20°C and ±15% of the supply voltage.
2. The Second Measurement was done at 3 different Temperatures -20°C (-4°F), +20°C (+68°F) and +50°C (+122°F), and the nominal supply Voltage

3. Also the 99% emission bandwidth was measured. Two markers are placed on frequency points such that left to lower f-marker and right to higher f-marker only 1% of the TX-power is contained. Between the markers, 99% of the power is laying.

**5.3.5. Spectrum-Analyzer Settings**

| | |
|---|---|
| Span | Set as to fully display the emissions and approximate 20dB below the PEAK level |
| Resolution Bandwidth (RBW) | Set to approx. 1% …3% of the emission width |
| Video Bandwidth (VBW) | 3 times the resolution bandwidth |
| Sweep time | Coupled and low enough to have no gaps within power envelope |
| Detector | Sample (if bin width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector) |
| Sweep mode | Repetitive Mode, Max hold |

### 5.3.6. Tmin – Vnom

| Modulation | Channel | 99% OBW | Tnom - Vnom | | Vnom -Tnom | |
|---|---|---|---|---|---|---|
| | | | left Bandedge | right Bandedge | left Bandedge | right Bandedge |
| | MHZ | in MHZ | in HZ | in HZ | in HZ | in HZ |
| DH5 | 2402 | 0.970298 | 2401504950 | 2402475248 | 2401545455 | 2402493506 |
| | 2441 | 0.950496 | 2440504950 | 2441455446 | 2440545455 | 2441493506 |
| | 2481 | 0.970298 | 2479504950 | 2480475280 | 2479545455 | 2480493506 |
| verdict | | | | | Pass | |
| 2-DH5 | 2402 | 1.20792 | 2401326733 | 2402534653 | 2401415584 | 2402623377 |
| | 2441 | 1.20792 | 2440326733 | 2441534653 | 2440415584 | 2441623377 |
| | 2481 | | 2479326733 | 2480534653 | 2479415584 | 2480623377 |
| verdict | | | | | Pass | |
| 3-DH5 | 2402 | 1.227722 | 2401326733 | 2402554455 | 2401402597 | 2402623377 |
| | 2441 | 1.227722 | 2440326733 | 2441554455 | 2440402597 | 2441623377 |
| | 2481 | 1.227722 | 2479326733 | 2480554455 | 2479402597 | 2480636364 |
| verdict | | | | | Pass | |

### 5.3.7. Tmax – Vnom

| Modulation | Channel | 99% OBW | Tnom - Vnom | | Tmax - Vnom | |
|---|---|---|---|---|---|---|
| | | | left Bandedge | right Bandedge | left Bandedge | right Bandedge |
| | | in MHZ | in HZ | in HZ | in HZ | in HZ |
| DH5 | 2402 | 0.970298 | 2401504950 | 2402475248 | 2401506494 | 2402454545 |
| | 2441 | 0.950496 | 2440504950 | 2441455446 | 2440506494 | 2441454545 |
| | 2481 | 0.970298 | 2479504950 | 2480475280 | 2479506494 | 2480454545 |
| verdict | | | | | Pass | |
| 2-DH5 | 2402 | 1.20792 | 2401326733 | 2402534653 | 2401376623 | 2402584416 |
| | 2441 | 1.20792 | 2440326733 | 2441534653 | 2440376623 | 2441584416 |
| | 2481 | | 2479326733 | 2480534653 | 2479376623 | 2480584416 |
| verdict | | | | | Pass | |
| 3-DH5 | 2402 | 1.227722 | 2401326733 | 2402554455 | 2401363636 | 2402597403 |
| | 2441 | 1.227722 | 2440326733 | 2441554455 | 2440363636 | 2441597403 |
| | 2481 | 1.227722 | 2479326733 | 2480554455 | 2479363636 | 2480597403 |
| verdict | | | | | Pass | |

### 5.3.8. Tnom – Vmin

| Modulation | Channel | 99% OBW | Tnom - Vnom | | Tnom - Vmin | |
|---|---|---|---|---|---|---|
| | | | left Bandedge | right Bandedge | left Bandedge | right Bandedge |
| | | in MHZ | in HZ | in HZ | | |
| DH5 | 2402 | 0.970298 | 2401504950 | 2402475248 | 2401506494 | 2402454545 |
| | 2441 | 0.950496 | 2440504950 | 2441455446 | 2440506494 | 2441467532 |
| | 2481 | 0.970298 | 2479504950 | 2480475280 | 2479506494 | 2480467532 |
| verdict | | | | | Pass | |
| 2-DH5 | 2402 | 1.20792 | 2401326733 | 2402534653 | 2401376623 | 2402584416 |
| | 2441 | 1.20792 | 2440326733 | 2441534653 | 2440376623 | 2441597403 |
| | 2481 | | 2479326733 | 2480534653 | 2479376623 | 2480597403 |
| verdict | | | | | Pass | |
| 3-DH5 | 2402 | 1.227722 | 2401326733 | 2402554455 | 2401363636 | 2402597403 |
| | 2441 | 1.227722 | 2440326733 | 2441554455 | 2440363636 | 2441597403 |
| | 2481 | 1.227722 | 2479326733 | 2480554455 | 2479363636 | 2480597403 |
| verdict | | | | | Pass | |

### 5.3.9. Tnom – Vmax

| Modulation | Channel | 99% OBW | Tnom - Vnom | | Tnom - Vmax | |
|---|---|---|---|---|---|---|
| | | | left Bandedge | right Bandedge | left Bandedge | right Bandedge |
| | | in MHZ | in HZ | in HZ | | |
| DH5 | 2402 | 0.970298 | 2401504950 | 2402475248 | 2401506494 | 2402454545 |
| | 2441 | 0.950496 | 2440504950 | 2441455446 | 2440506494 | 2441454545 |
| | 2481 | 0.970298 | 2479504950 | 2480475280 | 2479506494 | 2480454545 |
| verdict | | | | | Pass | |
| 2-DH5 | 2402 | 1.20792 | 2401326733 | 2402534653 | 2.401.376.623 | 2.402.584.416 |
| | 2441 | 1.20792 | 2440326733 | 2441534653 | 2.440.376.623 | 2.441.584.416 |
| | 2481 | | 2479326733 | 2480534653 | 2.479.376.623 | 2.480.584.416 |
| verdict | | | | | Pass | |
| 3-DH5 | 2402 | 1.227722 | 2401326733 | 2402554455 | 2401363636 | 2402584416 |
| | 2441 | 1.227722 | 2440326733 | 2441554455 | 2440363636 | 2441597403 |
| | 2481 | 1.227722 | 2479326733 | 2480554455 | 2479363636 | 2480597403 |
| verdict | | | | | Pass | |

### 5.3.10. Frequency Stability Verdict: pass

## 5.4. RF-Parameter – 99% Occupied Bandwidth

**5.4.1.Test location and equipment** (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 337 OATS | ☒ 347 Radio.lab. | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☐ 489 ESU 40 | ☐ 620 ESU 26 | ☐ | ☐ |
| otherwise | ☐ 600 NRVD | ☐ 357 NRV-Z1 | ☒ 693 TS8997 | | | |
| spectr. analys. | ☒ 683 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ 714 FSW 67 | ☐ | ☐ |
| power supply | ☐ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 354 NGPE 40 |
| otherwise | ☒ 613 20 dB Attenuator | ☐ 248 6 dB Attenuator | ☐ 529 Power divider | ☐ - cable OTA20 | ☐ 530 10dB Atten | ☐ K5 Cable |
| Supply voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5 V DC | | | |

**5.4.2. Requirements:**

| | |
|---|---|
| **FCC** | ☒ 2.1049(h)<br>☒ FCC 2.202 for information |
| **ISED** | ☒ RSS-Gen, Issue5 , Chapter 6.7 |
| **Remark** | The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission<br><br>When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured. |

**5.4.3. EUT settings**

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

**5.4.4. Measurement method**

The measurement was performed with the RBW set to 30kHz. The span was set to cover the complete carrier. Three carrier frequencies (low/middle/high) were used for showing the compliance with this requirement. A 99% OBW measurement function was used to measure the bandwidth compared 99% of the highest In-Band power. The operating modes have been varied (e.g. data rate, modulation scheme, etc.). The hopping-mode is switched off.

**5.4.5. Spectrum-Analyzer Settings**

| | |
|---|---|
| Span | Set as to fully display the emissions and approximate 20dB below the PEAK level |
| Resolution Bandwidth (RBW) | Set to approx. 1% …3% of the emission width |
| Video Bandwidth (VBW) | 3 times the resolution bandwidth |
| Sweep time | Coupled and low enough to have no gaps within power envelope |
| Detector | Sample (if bin width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector) |
| Sweep mode | Repetitive Mode, Max hold |

**5.4.6. 99% Occupied Bandwidth Results:**

| 99% Occupied Bandwidth Measurements | | | |
|---|---|---|---|
| **Temperature :+21 °C** | **Voltage Supply 13.5 V DC** | **Setup: 2** | **Op. Mode: 1** |
| **Frequency Hopping OFF** | | | |
| **Channel** | **Frequency** | **99% Occupied Bandwidth Measurements** | **Plot No.** |
| **[Number]** | **[MHz]** | **[MHz]** | |
| DH5 | 2402 | **0.970298** | |
| DH5 | 2441 | 0.950496 | |
| DH5 | 2480 | 0.970298 | |
| 2DH5 | 2402 | **1.20792** | |
| 2DH5 | 2441 | 1.20792 | |
| 2DH5 | 2480 | 1.20792 | |
| 3DH5 | 2402 | **1.227722** | |
| 3DH5 | 2441 | 1.227722 | |
| 3DH5 | 2480 | 1.227722 | |
| Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0048601T03a-A1** | | | |

**5.4.7. 99% Occupied Bandwidth Verdict: For Information only**

## 5.5. RF-Parameter - 20 dB Bandwith

**5.5.1.Test location and equipment** (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 337 OATS | ☒ 347 Radio.lab. | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☐ 489 ESU 40 | ☐ 620 ESU 26 | ☐ | ☐ |
| otherwise | ☐ 600 NRVD | ☐ 357 NRV-Z1 | ☐ 693 TS8997 | | | |
| spectr. analys. | ☒ 683 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ 714 FSW 67 | ☐ | ☐ |
| power supply | ☐ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 354 NGPE 40 |
| otherwise | ☒ 613 20 dB Attenuator | ☐ 248 6 dB Attenuator | ☐ 529 Power divider | ☐ - cable OTA20 | ☐ 530 10dB Atten | ☐ K5 Cable |
| Supply voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5 V DC | | | |

**5.5.2. Requirements:**

| | |
|---|---|
| **FCC** | ☒ §15.247 (a) (1) |
| **ISED** | ☒ RSS-247, Issue 2, Chapter 5.1,a |
| **Remark** | The bandwidth of a frequency hopping channel is the 20 dB emission bandwidth, measured with the hopping stopped. |

**5.5.3. EUT settings**

For FHSS-systems hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

**5.5.4. Measurement method**

The measurement was performed with the RBW set to 3kHz. The span was set to cover the complete carrier. Three carrier frequencies (low/middle/high) were used for showing the compliance with this requirement. A DELTA Marker method was set to measure the bandwidth compared to the highest In-Band power. The operating modes have been varied (e.g. data rate, modulation scheme, etc.). The hopping-mode is switched off.

**5.5.5. Spectrum-Analyzer Settings**

| | |
|---|---|
| Span | Set as to fully display the emissions and approximate 20dB below the PEAK level |
| Resolution Bandwidth (RBW) | Set to approx. 1% …3% of the emission width |
| Video Bandwidth (VBW) | 3 times the resolution bandwidth |
| Sweep time | Coupled and low enough to have no gaps within power envelope |
| Detector | Sample (if bin width: Span/no. of frequency points SA < 0.5*RBW SA otherwise Peak detector) |
| Sweep mode | Repetitive Mode, Max hold |

### 5.5.6. 20 dB Bandwidth Results:

| 20 dB Emission Bandwidth Measurements | | | |
|---|---|---|---|
| **Temperature :+21 °C** | **Voltage Supply 13.5 V DC** | **Setup: 2** | **Op. Mode: 1** |
| **Frequency Hopping OFF** | | | |
| **Channel** | **Frequency** | **20 dB Emission Bandwidth Measurements** | **Plot No.** |
| **[Number]** | **[MHz]** | **[kHz]** | Remark 1 |
| DH5 | 2402 | 1.128712 | |
| DH5 | 2441 | 1.148514 | |
| DH5 | 2480 | 1.148514 | |
| 2DH5 | 2402 | 1.425742 | |
| 2DH5 | 2441 | 1.425742 | |
| 2DH5 | 2480 | 1.425742 | |
| 3DH5 | 2402 | 1.425742 | |
| 3DH5 | 2441 | 1.425742 | |
| 3DH5 | 2480 | 1.425742 | |
| Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0048601T03a-A1** | | | |

### 5.5.7. 20 dB Bandwidth Verdict: Pass

## 5.6. RF-Parameter - Channel Carrier Frequency Separation for FHSS-systems

**5.6.1.Test location and equipment** (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 337 OATS | ☒ 347 Radio.lab. | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☐ 489 ESU 40 | ☐ 620 ESU 26 | ☐ | ☐ |
| otherwise | ☐ 600 NRVD | ☐ 357 NRV-Z1 | ☒ 693 TS8997 | | | |
| spectr. analys. | ☒ 683 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☒ 714 FSW 67 | ☐ | ☐ |
| power supply | ☐ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 354 NGPE 40 |
| otherwise | ☐ 613 20 dB Attenuator | ☐ 248 6 dB Attenuator | ☐ 529 Power divider | ☐ - cable OTA20 | ☐ 530 10dB Atten | ☐ K5 Cable |
| Supply voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5 V DC | | | |

**5.6.2. Requirements:**

| | |
|---|---|
| **FCC** | ☒ §15.247 (a) (1) |
| **ISED** | ☒ RSS-247, Issue 2, Chapter 5.1,b |
| **Remark** | Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.<br><br>The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.. |

**5.6.3. EUT settings**

For FHSS-systems hopping mode was switched-on so that adjacent Frequency Hopping channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

**5.6.4. Measurement method**

The measurement to prove this requirement was performed with a low RBW of 100kHz, peak detector and trace Hold-Max function in order to resolve each frequency carrier separately.

The span of the frequency analyzer was set to cover the carrier investigated as well as its neighbour channels. A frequency DELTA Marker method was set to measure the frequency separation between the channels.

### 5.6.5. Channel Carrier Frequency Separation Results:

| Channel Carrier Frequency Separation Measurements | | | |
|---|---|---|---|
| **Temperature :+21 °C** | **Voltage Supply 13 V DC - 3 V DC** | **Setup: 2** | **Op. Mode: 2** |
| **Frequency Hopping ON** | | | |
| **Neighboring Channels** | **Carrier Frequency Separation** | **Minimum CFS** | **Plot No.** |
| **[Number]** | **[MHz]** | **[kHz]** | |
| Low channel | 1.010 | **25** | Remark 1 |
| Mid Channel | 1.010 | **25** | |
| High Channel | 1.010 | **25** | |
| **Hopping Channel Carrier Frequencies Separation Limits- FCC 15.247** | | **25 kHz** | |
| **Hopping Channel Carrier Frequencies Separation Limits - RSS-247, Issue 2** | | | |
| Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0048601T03a-A1** | | | |

### 5.6.6. Hopping Channel Carrier Frequencies Separation Verdict: Pass

## 5.7. RF-Parameter – Number of Hopping Channels for FHSS-systems

**5.7.1.Test location and equipment** (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 337 OATS | ☒ 347 Radio.lab. | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☐ 489 ESU 40 | ☐ 620 ESU 26 | ☐ | ☐ |
| otherwise | ☐ 600 NRVD | ☐ 357 NRV-Z1 | ☒ 693 TS8997 | | | |
| spectr. analys. | ☒ 683 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☒ 714 FSW 67 | ☐ | ☐ |
| power supply | ☐ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 354 NGPE 40 |
| otherwise | ☐ 613 20 dB Attenuator | ☐ 248 6 dB Attenuator | ☐ 529 Power divider | ☐ - cable OTA20 | ☐ 530 10dB Atten | ☐ K5 Cable |
| Supply voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5 V DC | | | |

**5.7.2. Requirements:**

| | |
|---|---|
| **FCC** | ☒ §15.247 (a) (1) (iii) |
| **ISED** | ☒ RSS-247, Issue 2, Chapter 5.1,d |
| **Remark** | Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.<br>Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used. |

**5.7.3. EUT settings**

For FHSS-systems hopping mode was switched-on so that adjacent Frequency Hopping channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

**5.7.4. Measurement method**

The measurement to prove this requirement was performed with a low RBW of 100kHz, peak detector and trace Hold-Max function in order to resolve each frequency carrier separately.

The span of the frequency analyzer was set to cover the Hopping channels in two parts namely 2.4 GHz Lower spectrum and 2.4 GHz Upper spectrum. On extreme right & left channels Markers were set to indicate the corresponding channel frequency.

**5.7.5. Number of Hopping Channels Results:**

| **Number of Hopping Channels Measurements** | | | |
|---|---|---|---|
| **Temperature :+21 °C** | **13.5 VDC** | **Setup: 2** | **Op. Mode: 2** |
| **Frequency Hopping ON** | | **Total Channels** 2.4 GHz Spectrum | **Plot No.** |
| | | **[Number]** | Remark 1 |
| | | **79** | |
| **Minimum Number of Hopping Channels Limits- FCC 15.247** | | **15** | |
| **Minimum Number of Hopping Channels Limits - RSS-247, Issue 2** | | | |
| Remark 1: For further details please refer → Annex 1: Test results - **CETECOM_TR18-1-0048601T03a-A1** | | | |

**5.7.6. Minimum Number of Hopping Channels Verdict: Pass**

## 5.8. RF-Parameter – Average Time of Occupancy for FHSS systems

**5.8.1.Test location and equipment** (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 337 OATS | ☒ 347 Radio.lab. | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☐ 489 ESU 40 | ☐ 620 ESU 26 | ☐ | ☐ |
| otherwise | ☐ 600 NRVD | ☐ 357 NRV-Z1 | ☐ 693 TS8997 | | | |
| spectr. analys. | ☒ 683 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ 714 FSW 67 | ☐ | ☐ |
| power supply | ☐ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 354 NGPE 40 |
| otherwise | ☐ 613 20 dB Attenuator | ☐ 248 6 dB Attenuator | ☐ 529 Power divider | ☐ - cable OTA20 | ☒ 530 10dB Atten | ☐ K5 Cable |
| Supply voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5 V DC(AE5) | | | |

**5.8.2. Requirements:**

| | |
|---|---|
| **FCC** | ☒ §15.247 (a) (1) (iii) |
| **ISED** | ☒ RSS-247, Issue 2, Chapter 5.1,d |
| **Remark** | The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. |

**5.8.3. EUT settings**

For FHSS-systems hopping mode was switched-on so that occupancy time of Frequency Hopping channels could be measured. The EUT was instructed to send with maximum power (if adjustable) according applicants instructions. Different modulation characteristics have been checked, e.g. data rates which EUT can operate.

**5.8.4. Measurement method:**

The measurement was performed with a spectrum analyzer set to ZERO span. The device was set to work within the defined specification with frequency Hopping Mode ON. The spectrum-analyzer was set the MAX-Hold positive peak detector mode. The sweep time set as long as necessary to capture the full signal burst per hopping channel. The burst on-period is captured by setting appropriate markers in the rising and falling edges.

**5.8.5. Average occupancy time calculations:**

Formula for calculating the dwell time (pseudo-hopping sequence over all channels assumed):

$$\text{Average Dwell Time} = Timeslot\ length \cdot \frac{Hop\ rate}{number\ of\ hopping\ channels} \cdot time\ period$$

The EUT employs Proprietary 2.4 GHz RF Transceiver Frequency Hopping system with total 79 channels. The maximum staying time of 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. = 0.4 seconds X 79 = 31,6 Seconds.

**That means the average time of occupancy on any channel shall not be greater than 0.4 seconds within 240 seconds.**

### 5.8.6. Average occupancy time Results:

| Average Occupancy Time Measurements | | | | | |
|---|---|---|---|---|---|
| **Temperature :+21 °C** | | **Voltage Supply 13.5 V DC** | | **Setup: 2** | **Op. Mode: 2** |
| **Modulation :** | | | **Frequency Hopping ON** | | |
| **Data Rate** | **Channel** | **Single Transmission Time** | **Number of Transmissions in 31.6 Seconds** | **Average Occupancy Time in 31.6 Seconds** | |
| **[Kbps]** | **[Number]** | **[milliseconds]** | **[Number]** | **[milliseconds]** | |
| DH1 | 39 | 0.383013 | 640 | 245.128 | |
| DH3 | | 1.637821 | 213 | 348.856 | |
| DH5 | | 2.879808 | 128 | 368.615 | |
| **Average Occupancy Time Limits- FCC 15.247** | | | | **≤ 400 milliseconds** | |
| | | | | | |
| For further details please refer → Annex 1: | | | | | |

### 5.8.7. Average Occupancy Time Verdict: Pass

## 5.9. RF-Parameter – Out-of-Band 20 dBc Conducted Emissions for FHSS systems

**5.9.1.Test location and equipment** (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ 443 System CTC-FAR-EMI- | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☐ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 337 OATS | ☒ 347 Radio.lab. | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☐ 001 ESS | ☒ 683 FSU 26 | ☐ 714 FSW67 | ☐ | ☐ |
| spectr. analys. | ☐ 489 ESU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ | ☐ | ☐ |
| power supply | ☐ 456 EA 3013A | ☐ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☒ 354 NGPE 40 |
| otherwise | ☒ 530 10dB Attenuator | ☒ RTK161 | ☐ Directional Coupler 1539R-10 | | | |
| Supply voltage | ☒ 24 V DC | | | | | |

**5.9.2. Requirements:**

| | |
|---|---|
| **FCC** | ☒ §15.247 (d) |
| **Remark** | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating. the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. based on either an RF conducted or a radiated measurement. provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval. as permitted under FCC15.247 paragraph (b)(3) / RSS-247section 5.4(d). the attenuation required shall be 30 dB instead of 20 dB |

**5.9.3. EUT settings**

Fixed Channel Mode:
For FHSS-systems Hopping mode was switched-off so fixed three different channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked. e.g. data rates which EUT can operate.

Hopping Mode:
For FHSS-systems Hopping mode was switched- ON so emissions from hopping channels could be measured.
The EUT was instructed to send with maximum power (if adjustable) according applicants instructions.
Different modulation characteristics have been checked. e.g. data rates which EUT can operate.

**5.9.4. Measurement Method:**

The measurements were performed with the RBW set to 100kHz & maximum carrier level was indicated with MAX-Hold positive peak detector using markers. Then a frequency line was set 20 dB below this measured maximum carrier level.

Then using RBW 100 kHz & spectrum analyzer span from 150 kHz to 25 GHz in three steps spurious emissions were measured with MAX-Hold positive peak detector.

The sweep time set as long as necessary to capture the full signal burst per hopping channel. The burst on-period is captured by setting appropriate markers in the rising and falling edges.

### 5.9.5. Results: Hopping mode off

| Set-up no.: 2<br>Op-Mode: 1 | RF-Conducted test: 20 dBc spurious emissions | | | | | |
|---|---|---|---|---|---|---|
| Frequency Range | **Modulation 8-DPSK**<br>Low channel =0<br>(2402 MHz)<br>Level Reference<br>(In-Band)= 2 dBm – 10 dB (Offset )<br>Limit= -18 dBm – 10 dB (Offset ) | | **Modulation Pi/4-QPSK**<br>Middle channel = 39<br>(2441 MHz)<br>Level Reference<br>(In-Band) = 5.65dBm – 10 dB (Offset )<br>Limit = -14.45 dBm – 10 dB (Offset ) | | **Modulation GFSK**<br>High channel = 78<br>(2480 MHz)<br>Level Reference<br>(In-Band) = 2.27 dBm – 10 dB (Offset )<br>Limit= -17.73 dBm – 10 dB (Offset ) | |
| | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] |
| 150kHz to 30 MHz | 1.0515 | > 35 | 1.204 | > 35 | 1.123 | > 35 |
| 30MHz to 2.8 GHz | -- | > 35 | -- | > 35 | -- | > 35 |
| 2.8 to 25 GHz | 25 327.20 | > 35 | 24 761.12 | > 35 | 23 768 .16 | > 35 |
| Band-Edge (no hopping) | -- | | | | | |

**Remark 1**: see diagrams in separate document A1
The limit on the diagrams is 20dB under the reference level measured In-Band for each channel

**Remark 2:** Plots are 10dB less, 10dB offset was used.

### 5.9.6. Results: Hopping mode on

| Set-up no.: 2<br>Op-Mode: 2 | RF-Conducted test: 20 dBc spurious emissions | | | | | |
|---|---|---|---|---|---|---|
| Frequency Range | **Modulation GFSK**<br>Level Reference<br>(In-Band) = 5.18 dBm – 10 dB (Offset )<br>Limit = -14.82 dBm – 10 dB (Offset ) | | **Modulation Pi/4-QPSK**<br>Level Reference<br>(In-Band) = 2.34 dBm – 10 dB (Offset )<br>Limit= -17.66 dBm – 10 dB (Offset ) | | **Modulation 8-DPSK**<br>Level Reference<br>(In-Band)= 2.26 dBm – 10 dB (Offset )<br>Limit= -17.74 dBm – 10 dB (Offset ) | |
| | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] |
| 150kHz to 30 MHz | 1.25445 | > 35 | -- | > 40 | -- | > 40 |
| 30MHz to 2.8 GHz | -- | > 35 | -- | > 40 | -- | > 40 |
| 2.8 to 25 GHz | 24 761.12 | > 35 | -- | > 40 | -- | > 40 |
| Band-Edge (hopping) | -- | > 40 | -- | > 40 | -- | > 40 |

**Remark 1**: see diagrams in separate document A1
The limit on the diagrams is 20dB under the reference level measured In-Band for each channel
Only worst case from non-hopping Modulation was measured

**Remark 2:** Plots are 10dB less, 10dB offset was used.

### 5.9.7. Out-of-Band 20 dBc Conducted Emissions Verdict: Pass

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

### 5.10.1. Test location and equipment

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ Please see Chapter. 2.2.2 | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☒ 441 EMI SAR | ☐ 487 SAR NSA | ☐ 347 Radio.lab. | | ☐ | ☐ |
| receiver | ☐ 377 ESCS30 | ☒ 001 ESS | ☐ | ☐ | ☐ | ☐ |
| spectr. analys. | ☐ 584 FSU | ☐ 120 FSEM | ☐ 264 FSEK | ☐ | ☐ | ☐ |
| antenna | ☐ 574 BTA-L | ☐ 133 EMCO3115 | ☐ 302 BBHA9170 | ☐ 289 CBL 6141 | ☐ 021 EMCO 6502 | ☐ 477 GPS |
| signaling | ☐ 392 MT8820A | ☐ 371 CBT32 | ☐ 547 CMU | ☐ 594 CMW | | |
| otherwise | ☐ 400 FTC40x15E | ☐ 401 FTC40x15E | ☐ 110 USB LWL | ☐ 482 Filter Matrix | ☐ 378 RadiSense | |
| DC power | ☐ 671 EA-3013S | ☐ 457 EA 3013A | ☒ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 498 NGPE 40 |
| Supply Voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5V DC | | | |

### 5.10.2. Requirements

| | | | | |
|---|---|---|---|---|
| **FCC** | Part 15, Subpart C, §15.205 & §15.209 | | | |
| **ISED** | RSS-Gen: Issue 5: §8.9 Table 5 RSS-247, Issue 2, | | | |
| **ANSI** | C63.10-2013 | | | |
| Frequency [MHz] | Field strength limit [µV/m] | [dBµV/m] | Distance [m] | Remarks |
| 0.009 – 0.490 | 2400/f (kHz) | 67.6 – 20Log(f) (kHz) | 300 | Correction factor used due to measurement distance of 3 m |
| 0.490 – 1.705 | 24000/f (kHz) | 87.6 – 20Log(f) (kHz) | 30 | Correction factor used due to measurement distance of 3 m |
| 1.705 – 30 | 30 | 29.5 | 30 | Correction factor used due to measurement distance of 3 m |

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

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

### 5.10.4. Measurement Results

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

The EUT is put on operation on middle channel only. If critical peaks are found (Margin <10 dB) the lowest and highest channels will be performed too.
Table of measurement results:

| Diagram No. | Carrier Channel Range | Carrier Channel No. | Frequency range | Set-up no. | OP-mode no. | Remark | Used detector PK | Used detector AV | Used detector QP | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.02a | Low | 0 | 9 kHz - 30 MHz | 1 | 1 | BT-BDR-GFSK-1Mbps EUT laying | ☒ | ☐ | ☐ | Pass |
| 2.02b | Low | 0 | 9 kHz - 30 MHz | 1 | 1 | BT-BDR-GFSK-1Mbps EUT standing | ☒ | ☐ | ☐ | Pass |

Remark: see diagrams in Annex A1 →TR18-1-0048201T03a-A1 for more details

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

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

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

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

### 5.11.1. Test location and equipment

| | | | | | | |
|---|---|---|---|---|---|---|
| test location | ☒ CETECOM Essen (Chapter. 2.2.1) | | ☐ Please see Chapter. 2.2.2 | | ☐ Please see Chapter. 2.2.3 | |
| test site | ☒ 441 EMI SAR | ☒ 487 SAR NSA | | | | |
| receiver | ☐ 377 ESCS30 | ☒ 001 ESS | ☐ 489 ESU 40 | ☐ 620 ESU 26 | | |
| spectr. analys. | ☐ 584 FSU | ☐ 120 FSEM | ☐ 264 FSEK | | | |
| antenna | ☒ 574 BTA-L | ☐ 133 EMCO3115 | ☐ 302 BBHA9170 | ☐ 289 CBL 6141 | ☐ 030 HFH-Z2 | ☐ 477 GPS |
| signaling | ☐ 392 MT8820A | ☐ 371 CBT32 | ☐ 547 CMU | ☐ 594 CMW | | |
| otherwise | ☐ 400 FTC40x15E | ☐ 401 FTC40x15E | ☐ 110 USB LWL | ☒ 482 Filter Matrix | | |
| DC power | ☐ 456 EA 3013A | ☒ 457 EA 3013A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 498 NGPE |
| Supply Voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5 V DC | | | |

### 5.11.2. Requirements/Limits

| | | | |
|---|---|---|---|
| **FCC** | | ☐ Part 15 Subpart B. §15.109. class B<br>☒ Part 15 Subpart C. §15.209 @ frequencies defined in §15.205<br>☒ Part 15.247 (d) | |
| **ISED** | | ☒ RSS-Gen.. Issue 5. Chapter 8.9. Table 5+7 (licence-exempt radio apparatus)<br>☐ RSS-Gen.. Issue 5. Chapter 7.1.2. Table 3 (receiver)<br>☐ ICES-003. Issue 6. Table 5 (Class B)<br>☒ RSS-247. Issue 2. Chapter 5 | |
| **ANSI** | | ☐ C63.4-2014<br>☒ 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 |

### 5.11.3. Restricted bands of operation (FCC §15.205)

| MHz | MHz | MHz | GHz |
|---|---|---|---|
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| 0.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.20725-4.20775 | 37.5-38.25 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 73-74.6 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 74.8-75.2 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 108-121.94 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 123-138 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 149.9-150.05 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.52475-156.52525 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 156.7-156.9 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 162.0125-167.17 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 167.72-173.2 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 240-285 | 3600-4400 | -- |
| 13.36-13.41 | 322-335.4 | -- | -- |
| Remark: only spurious emissions are allowed within these frequency bands not exceeding the limits per §15.209 | | | |

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

| | | | | |
|---|---|---|---|---|
| Signal link to test system (if used): | | ☐ air link | ☐ cable connection | ☒ none |
| EUT-grounding | | ☒ none | ☐ with power supply | ☐ additional connection |
| Equipment set up | | ☒ table top 0.8m height | | ☐ floor standing |
| Climatic conditions | | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| EMI-Receiver (Analyzer) Settings | Scan frequency range: | ☒ 30 – 1000 MHz ☐ other: | | |
| | Scan-Mode | ☒ 6 dB EMI-Receiver Mode ☐ 3 dB spectrum analyser mode | | |
| | Detector | Peak / Quasi-peak | | |
| | RBW/VBW | 100 kHz/300 kHz | | |
| | Mode: | Repetitive-Scan, max-hold | | |
| | Scan step | 80 kHz | | |
| | 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" | | |

### 5.11.5. MEASUREMENT RESULTS

#### 5.11.5.1. Measurement Results 30MGHz to 1GHz

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

Table of measurement results:

| Dia-gram no. | Carrier Channel | | Frequency range | Set-up no. | OP-mode no. | Remark | Used detector | | | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | | PK | AV | QP | |
| 3.01a | High | 78 | 30 MHz – 1 GHz | 1 | 1 | BT-EDR-2Mbps EUT laying | ☒ | ☐ | ☐ | Pass |
| 3.01b | High | 78 | 30 MHz – 1 GHz | 1 | 1 | BT-EDR-2Mbps EUT standing | ☒ | ☐ | ☐ | Pass |
| 3.02a | Low | 0 | 30 MHz – 1 GHz | 1 | 1 | BT-EDR-3Mbps EUT laying | ☒ | ☐ | ☐ | Pass |
| 3.02b | Low | 0 | 30 MHz – 1 GHz | 1 | 1 | BT-EDR-3Mbps EUT standing | ☒ | ☐ | ☐ | Pass |
| 3.03a | Low | 39 | 30 MHz – 1 GHz | 1 | 1 | BT-BDR-1Mbps EUT laying | ☒ | ☐ | ☐ | Pass |
| 3.03b | Low | 39 | 30 MHz – 1 GHz | 1 | 1 | BT-BDR-1Mbps EUT standing | ☒ | ☐ | ☐ | Pass |

Remark: see diagrams in Annex A1 →TR18-1-0048201T03a-A1 for more details

## 5.12. General Limit - Radiated emissions, above 1 GHz

### 5.12.1. Test location and equipment FAR

| | | | | | | |
|---|---|---|---|---|---|---|
| test site | ☐441 EMI SAR | ☐348 EMI cond. | ☒443 EMI FAR | ☐347 Radio.lab. | ☐337 OATS | ☐ |
| spectr. analys. | ☐584 FSU | ☐120 FSEM | ☐264 FSEK | ☒489 ESU 40 | ☐ | ☐ |
| antenna meas | ☐574 BTA-L | ☐289 CBL 6141 | ☒608 HL 562 | ☒549 HL025 | ☒302 BBHA9170 | ☐477 GPS |
| antenna meas | ☐123 HUF-Z2 | ☐132 HUF-Z3 | ☐030 HFH-Z2 | ☐376 BBHA9120E | | ☐ |
| antenna subst | ☐071 HUF-Z2 | ☐020 EMCO3115 | ☐063 LP 3146 | ☐303 BBHA9170 | ☐ | ☐ |
| multimeter | ☐341 Fluke 112 | ☐ | ☐ | ☐ | ☐ | ☐ |
| signaling | ☐392 MT8820A | ☐371 CBT32 | ☐547 CMU | ☐594 CMW | | |
| DC power | ☐086 LNG50-10 | ☒087 EA3013 | ☐354 NGPE 40 | ☐349 car battery | ☐350 Car battery | ☐ |
| Supply Voltage | ☐ 230 V 50 Hz via public mains | | ☒ 313.5 V DC | | | |

### 5.12.2. Requirements/Limits (CLASS B equipment)

| | | | | |
|---|---|---|---|---|
| **FCC** | ☐ Part 15 Subpart B. §15.109 class B<br>☒ Part 15 Subpart C. §15.209 for frequencies defined in §15.205<br>☒ Part 15.247 (d) | | | |
| **ISED** | ☒ RSS-Gen.. Issue 5. Chapter 8.9. Table 5+7 (transmitter licence excempt)<br>☐ RSS-Gen.. Issue 5. Chapter 8.9. Table 3 (receiver)<br>☐ ICES-003. Issue 6. Chapter 6.2.2. Table 7 (class B)<br>☒ RSS-247. Issue 2. Chapter 5 | | | |
| **ANSI** | ☐ C63.4-2014<br>☒ C63.10-2013 | | | |
| Frequency [MHz] | Limits | | | |
| | AV [µV/m] | AV [dBµV/m] | Peak [µV/m] | Peak [dBµV/m] or [dBm/MHz] |
| above 1 GHz for frequencies as defined in §15.205 or RSS-Gen.. Issue 5. §8.10 - Table 5 | 500 | 54.0 | 5000 | 74.0 dBµV/m |

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

| | | | | |
|---|---|---|---|---|
| Signal link to test system (if used): | | ☐ air link | ☐ cable connection | ☒ none |
| EUT-grounding | | ☒ none | ☐ with power supply | ☐ additional connection |
| Equipment set up | | ☒ table top 1.5m height | | ☐ floor standing |
| Climatic conditions | | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| Spectrum-Analyzer settings | Scan frequency range: | ☒ 1 – 18 GHz ☒18 – 25 GHz ☐ 18 – 40 GHz ☐ other: | | |
| | Scan-Mode | ☒ 6 dB EMI-Receiver Mode ☐ 3 dB Spectrum analyser Mode | | |
| | Detector | Peak and Average | | |
| | RBW/VBW | 1 MHz / 3 MHz | | |
| | Mode: | Repetitive-Scan, max-hold | | |
| | Scan step | 400 kHz | | |
| | Sweep-Time | Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle | | |
| General measurement procedures | | Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz" | | |

### 5.12.4. Measurement Results

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

#### 5.12.4.1. Measurement Results for frequency range 1 GHz to 18 GHz

| Dia-gram no. | Carrier Channel | | Frequency range | Set-up no. | OP-mode no. | Remark | Used detector | | | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | | PK | AV | QP | |
| 4.01a | High | 78 | 1 GHz – 18 GHz | 1 | 1 | BT-EDR-2Mbps | ☒ | ☒ | ☐ | Pass |
| 4.02a | Low | 0 | 1 GHz – 18 GHz | 1 | 1 | BT-EDR-3Mbps | ☒ | ☒ | ☐ | Pass |
| 4.03a | Low | 39 | 1 GHz – 18 GHz | 1 | 1 | BT-BDR-1Mbps | ☒ | ☒ | ☐ | Pass |

Remark: see diagrams in Annex A1

#### 5.12.4.2. Measurement Results for frequency range 18 GHz to 26.5 GHz

| Dia-gram no. | Carrier Channel | | Frequency range | Set-up no. | OP-mode no. | Remark | Used detector | | | Result |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range | No. | | | | | PK | AV | QP | |
| 4.01b | High | 78 | 18 GHz – 26.5 GHz | 1 | 1 | BT-EDR-2Mbps | ☒ | ☒ | ☐ | Pass |
| 4.02b | Low | 0 | 18 GHz – 26.5 GHz | 1 | 1 | BT-EDR-3Mbps | ☒ | ☒ | ☐ | Pass |
| 4.03b | Low | 39 | 18 GHz – 26.5 GHz | 1 | 1 | BT-BDR-1Mbps | ☒ | ☒ | ☐ | Pass |

Remark: see diagrams in Annex A1

## 5.13. RF-Parameter - Radiated Band Edge compliance measurements

### 5.13.1. Test location and equipment FAR

| | | | | | | |
|---|---|---|---|---|---|---|
| test site | ☐441 EMI SAR | ☐348 EMI cond. | ☒443 EMI FAR | ☐347 Radio.lab. | ☐337 OATS | ☐ |
| spectr. analys. | ☐584 FSU | ☐120 FSEM | ☒264 FSEK | ☐489 ESU 40 | ☐ | ☐ |
| antenna meas | ☐574 BTA-L | ☐289 CBL 6141 | ☐608 HL 562 | ☒549 HL025 | ☐302 BBHA9170 | ☐477 GPS |
| antenna meas | ☐123 HUF-Z2 | ☐132 HUF-Z3 | ☐030 HFH-Z2 | ☐ | ☐ | ☐ |
| antenna subst | ☐071 HUF-Z2 | ☐020 EMCO3115 | ☐063 LP 3146 | ☐303 BBHA9170 | ☐ | ☐ |
| multimeter | ☐341 Fluke 112 | ☐ | ☐ | ☐ | ☐ | ☐ |
| signaling | ☐392 MT8820A | ☐371 CBT32 | ☐547 CMU | ☐594 CMW | | |
| DC power | ☐086 LNG50-10 | ☒087 EA3013 | ☐354 NGPE 40 | ☐349 car battery | ☐350 Car battery | ☐ |
| Supply Voltage | ☐ 230 V 50 Hz via public mains | | ☒ 13.5 V DC | | | |

### 5.13.2. Requirements/Limits

| | |
|---|---|
| **FCC** | ☐ Part 15 Subpart B. §15.109 class B<br>☒ Part 15 subpart C. §15.209 @ frequencies defined in §15.205<br>☒ Part 15.247 (d) |
| **ISED** | ☒ RSS-247. Issue 2. Chapter 5<br>☒ RSS-Gen: Issue 5. Chapter 8.9. Table 5+7 |
| **ANSI** | ☐ C63.4-2009 ☐ C63.4-2014 ☐ C63.10-2009 ☒ C63.10-2013. Chapter 6.10.6 |

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

| | | | | |
|---|---|---|---|---|
| Signal ink to test system (if used): | | ☐ air link | ☐ cable connection | ☒ none |
| EUT-grounding | | ☒ none | ☐ with power supply | ☐ additional connection |
| Equipment set up | | ☒ table top 1.5m height | | ☐ floor standing |
| Climatic conditions | | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| Spectrum-Analyzer settings | Scan frequency range:<br>Scan-Mode<br>Detector<br>RBW/VBW<br><br>Mode:<br>Scan step<br>Sweep-Time | ☐ 1 – 18 GHz ☐ 18 – 25 GHz ☐ 18 – 40 GHz ☒ other: see diagrams<br>☐ 6 dB EMI-Receiver Mode ☒ 3 dB Spectrum analyser Mode<br>Peak and Average<br>Left band-edge: 100kHz/300kHz<br>Right band-edge: 1 MHz / 3 MHz<br>Repetitive-Scan, max-hold<br>40kHz or 400 kHz<br>Coupled – calibrated display if CW signal otherwise adapted to EUT's individual duty-cycle | | |
| General measurement procedures | | Please see chapter "Test system set-up for radiated electric field measurements above 1 GHz" for general measurements procedures in anechoic chamber. | | |

### 5.13.4. Measurement Method

For uncritical results where a measurement resolution bandwidth of 1MHz can clearly show the compliance without influencing the results, a field strength measurement was performed to show compliance.

For critical results a Marker-Delta marker method was used for showing compliance to restricted bands. The method is according ANSI C63.10:2013, Chapter 6.10.6 "Marker-Delta method",. The method consists of three independent steps:

**1. Step:** Prior to the measurement the fundamental radiated In-Band field strength was performed. The determined value is used as reference value.

**2. Step**: Second step consist of finding the relative attenuation between the fundamental emission and the maximum local out-of-band emission (within 2 MHz range around the band edge either on the band-edge directly or some modulation product if the level is greater than that on the band-edge) when measured with lower resolution bandwidth.

**3. Step:** The delta value recorded in step 2 will be subtracted from value recorded in step 1. thus giving the required field strength at the band-edge. This value must fulfil the requirements for radiated spurious emissions in restricted bands in FCC §15.205 or RSS-Gen. Issue 5. Chapter 8.10. Table 7 with the general limits of FCC §15.209 or RSS-Gen. Issue 5 Chapter 8.9. Table 5.

### 5.13.5. EUT settings

The EUT was instructed to send with maximum power (if adjustable) according to applicants instructions.

### 5.13.6. Results: for non-restricted bands near-by

### 5.13.6.1. Non-restricted bands near-by - limits according FCC §15.247

| Diagramm no. | Channel no. | Restricted band ? | Fundamental Value | | Peak-Value at Band-Edge | Difference [dB] | Limit [dBc] | Margin [dB] | Verdict | Remark: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak-Value | Average-Value | | | | | | |
| 9.01a | 0 | no | 90,717 | 80,909 | 50,17 | 40,547 | 20 | 20,547 | PASS | PWR-VALUE=0dBm 2-DH5 |
| 9.02a | 0 | no | 90,717 | 80,909 | 50,17 | 40,547 | 20 | 20,547 | PASS | PWR-VALUE=0dBm DH5 |
| 9.03a | 0 | no | 103,021 | 97,361 | 49,951 | 53,07 | 20 | 33,07 | PASS | PWR-VALUE=0dBm 3-DH5 |
| 9.04a | 0 | no | 101,748 | 100,907 | 50,249 | 51,499 | 20 | 31,499 | PASS | PWR-VALUE=0dBm Hopping ON |

### 5.13.6.2. Restricted bands near-by §15.205 with limits accord. FCC §15.209/RSS-Gen.

| Diagramm no. | Channel no. | Restricted band ? | Fundamental Value | | Value at Band-Edge | | Limits | | Duty-Cycle | Margin | | Verdict | Remark: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak-Value | Average-Value | Peak -Value | Average -Value | Peak -Value | Average -Value | [dB] | Peak | Average | | |
| 9.01b | 78 | yes | 88,635 | 85,494 | 57,86 | 45,899 | 74 | 54 | 5,06 | 16,14 | 3,041 | PASS | PWR-VALUE=0dBm 2-DH5 |
| 9.02b | 78 | yes | 88,468 | 84,83 | 57,2 | 45,5 | 74 | 54 | 5,06 | 16,8 | 3,44 | PASS | PWR-VALUE=0dBm DH5 |
| 9.03b | 78 | yes | 101,417 | 100,33 | 57,404 | 46,562 | 74 | 54 | 5,06 | 16,596 | 2,378 | PASS | PWR-VALUE=0dBm 3-DH5 |
| 9.04b | 78 | yes | 101,423 | 99,979 | 58,5 | 46,765 | 74 | 54 | 5,06 | 15,5 | 2,175 | PASS | PWR-VALUE=0dBm Hopping ON |

## 5.14. Measurement uncertainties

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved.
For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it's contribution to the overall uncertainty according it's statistical distribution calculated.

Following table shows expectable uncertainties for each measurement type performed.

| RF-Measurement | Reference | Frequency range | Calculated uncertainty based on a confidence level of 95% | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Conducted emissions ($U_{CISPR}$) | CISPR 16-2-1 | 9 kHz - 150 kHz<br>150 kHz - 30 MHz | 4.0 dB<br>3.6 dB | | | | | | - |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz<br>1 GHz - 18 GHz | 4.2 dB<br>5.1 dB | | | | | | E-Field |
| Disturbance power | CISPR 16-2-2 | 30 MHz - 300 MHz | - | | | | | | - |
| | | | | | | | | | |
| Power Output radiated | - | 30 MHz - 4 GHz | 3.17 dB | | | | | | Substitution method |
| Power Output conducted | - | Set-up No. | Cel-C1 | Cel-C2 | BT1 | W1 | W2 | -- | |
| | | 9 kHz - 12.75 GHz | N/A | 0.60 | 0.7 | 0.25 | N/A | -- | - |
| | | 12.75 - 26.5GHz | N/A | 0.82 | -- | N/A | N/A | -- | |
| Conducted emissions on RF-port | - | 9 kHz - 2.8 GHz | 0.70 | N/A | 0.70 | N/A | 0.69 | -- | N/A - not applicable |
| | | 2.8 GHz - 12.75GHz | 1.48 | N/A | 1.51 | N/A | 1.43 | -- | |
| | | 12.75 GHz - 18GHz | 1.81 | N/A | 1.83 | N/A | 1.77 | -- | |
| | | 18 GHz - 26.5GHz | 1.83 | N/A | 1.85 | N/A | 1.79 | -- | |
| 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<br>30 MHz - 1 GHz<br>1 GHz - 20 GHz | 5.0 dB<br>4.2 dB<br>3.17 dB | | | | | | Magnetic field<br>E-field<br>Substitution |

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

# 6. Abbreviations used in this report

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

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

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

# 8. Instruments and Ancillary

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

## 8.1. 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 | 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) |
| | | | | |

## 8.2. Single instruments and test systems

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|---|---|---|---|---|---|---|---|
| 001 | EMI Test Receiver | ESS | 825132/017 | Rohde & Schwarz | 12 M | - | 16.05.2019 |
| 005 | AC - LISN (50 Ohm/50µH, test site 1) | ESH2-Z5 | 861741/005 | Rohde & Schwarz | 12 M | - | 16.05.2019 |
| 007 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 892563/002 | Rohde & Schwarz | 12 M | - | 16.05.2019 |
| 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 | - | 31.07.2021 |
| 021 | Loop Antenna (H-Field) | 6502 | 9206-2770 | EMCO | 36 M | - | 30.05.2021 |
| 030 | Loop Antenna (H-field) | HFH-Z2 | 879604/026 | Rohde & Schwarz | 36 M | - | 30.04.2018 |
| 033 | RF-current probe (100kHz-30MHz) | ESH2-Z1 | 879581/18 | Rohde & Schwarz | 24 M | - | 15.05.2019 |
| 057 | relay-switch-unit (EMS system) | RSU | 494440/002 | Rohde & Schwarz | pre-m | 1a | |
| 060 | power amplifier (DC-2kHz) | PAS 5000 | B6363 | Spitzenberger+Spies | - | 3 | |
| 086 | DC - power supply, 0 -10 A | LNG 50-10 | - | Heinzinger Electronic | pre-m | 2 | |
| 087 | DC - power supply, 0 -5 A | EA-3013 S | - | Elektro Automatik | pre-m | 2 | |
| 091 | USB-LWL-Converter | OLS-1 | 007/2006 | Ing. Büro Scheiba | - | 4 | |
| 099 | passive voltage probe | ESH2-Z3 | 299.7810.52 | Rohde & Schwarz | 36 M | - | 30.05.2021 |
| 100 | passive voltage probe | Probe TK 9416 | without | Schwarzbeck | 36 M | - | 30.05.2021 |
| 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 |
| 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 | - | 30.05.2020 |
| 262 | Power Meter | NRV-S | 825770/0010 | Rohde & Schwarz | 24 M | - | 30.05.2019 |
| 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 | - | 30.05.2020 |
| 266 | Peak Power Sensor | NRV-Z31, Model 04 | 843383/016 | Rohde & Schwarz | 24 M | - | 30.05.2020 |
| 267 | notch filter GSM 850 | WRCA 800/960-6EEK | 9 | Wainwright GmbH | pre-m | 2 | |
| 270 | termination | 1418 N | BB6935 | Weinschel | pre-m | 2 | |
| 271 | termination | 1418 N | BE6384 | Weinschel | pre-m | 2 | |
| 272 | attenuator (20 dB) 50 W | Model 47 | BF6239 | Weinschel | pre-m | 2 | |
| 273 | attenuator (10 dB) 100 W | Model 48 | BF9229 | Weinschel | pre-m | 2 | |
| 274 | attenuator (10 dB) 50 W | Model 47 (10 dB) 50 W | BG0321 | Weinschel | pre-m | 2 | |
| 275 | DC-Block | Model 7003 (N) | C5129 | Weinschel | pre-m | 2 | |
| 276 | DC-Block | Model 7006 (SMA) | C7061 | Weinschel | pre-m | 2 | |
| 279 | power divider | 1515 (SMA) | LH855 | Weinschel | pre-m | 2 | |
| 298 | Univ. Radio Communication Tester | CMU 200 | 832221/091 | Rohde & Schwarz | pre-m | 3 | |
| 300 | AC LISN (50 Ohm/50µH, 1-phase) | ESH3-Z5 | 892 239/020 | Rohde & Schwarz | 12 M | - | 17.05.2019 |
| 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 | - | 30.05.2020 |
| 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 | |
| 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 | - | 17.05.2019 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Rohde & Schwarz | 12 M | - | 30.05.2019 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Keithley | pre-m | - | |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Anritsu | 12 M | - | 30.06.2019 |
| 405 | Thermo-/Hygrometer | OPUS 10 THI | 126.0604.0003.3.3.3.22 | LUFFT Mess u. Regeltechnik GmbH | 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 | - | 06.03.2019 |
| 439 | UltraLog-Antenna | HL 562 | 100248 | Rohde & Schwarz | 36 M | - | 10.03.2020 |
| 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 | - | 30.05.2019 |
| 463 | Universal source | HP3245A | 2831A03472 | Agilent | - | 4 | |
| 466 | Digital Multimeter | Fluke 112 | 89210157 | Fluke USA | 24 M | - | 30.05.2020 |
| 467 | Digital Multimeter | Fluke 112 | 89680306 | Fluke USA | 36 M | - | 30.05.2019 |
| 468 | Digital Multimeter | Fluke 112 | 90090455 | Fluke USA | 36 M | - | 30.04.2021 |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|---|---|---|---|---|---|---|---|
| 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 (Brl) | - | 1d | |
| 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 | - | 30.06.2019 |
| 502 | band reject filter | WRCG 1709/1786-1699/1796- | SN 9 | Wainwright | pre-m | 2 | |
| 503 | band reject filter | WRCG 824/849-814/859-60/10SS | SN 5 | Wainwright | pre-m | 2 | |
| 517 | relais switch matrix | HF Relais Box Keithley System | 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 | - | 30.07.2019 |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | Rohde & Schwarz | 12 M | - | 30.07.2019 |
| 549 | Log.Per-Antenna | HL025 | 1000060 | Rohde & Schwarz | 36/12 M | - | 31.07.2021 |
| 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 | 30.06.2017 |
| 557 | System CTC-OTA-2 | R&S TS8991 | - | Rohde & Schwarz | 12 M | 5 | 30.09.2016 |
| 558 | System CTC FAR S-VSWR | System CTC FAR S-VSWR | - | CTC | 24 M | - | 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 | - | 30.05.2019 |
| 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 | - | 30.05.2020 |
| 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 | - | 30.05.2019 |
| 621 | Step Attenuator 0-139 dB | RSP | 100017 | Rohde & Schwarz | pre-m | 2 | |
| 625 | Generic Test Load USB | Generic Test Load USB | - | CETECOM | - | 2 | |
| 627 | data logger | OPUS 1 | 201.0999.9302.6.4.1.43 | G. Lufft GmbH | 24 M | - | 30.03.2019 |
| 634 | Spectrum Analyzer | FSM (HF-Unit) | 826188/010 | Rohde & Schwarz | pre-m | 2 | |
| 637 | High Speed HDMI with Ethernet 1m | HDMI cable with Ethernet 1m | - | KogiLink | - | 2 | |
| 638 | HDMI Kabel with Ethernet 1,5 m flach | HDMI cable with Ethernet 1,5m | - | 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 | 24 M | - | 24.05.2019 |
| 644 | Amplifierer | ZX60-2534M+ | SN865701299 | Mini-Circuits | - | - | |
| 670 | Univ. Radio Communication Tester | CMU 200 | 106833 | Rohde & Schwarz | 24 M | - | 30.05.2020 |
| 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 | - | 30.05.2019 |
| 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 | - | 30.05.2019 |
| 688 | Pre Amp | JS-18004000-40-8P | 1750117 | Miteq | pre-m | - | |
| 690 | Spectrum Analyzer | FSU | 100302/026 | Rohde&Schwarz | 24 M | - | 16.05.2019 |
| 691 | OSP120 Base Unit | OSP120 | 106833 | Rohde & Schwarz | 12 M | - | 30.05.2019 |
| 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 | 30.01.2018 |
| 697 | Power Splitter | ZN4PD-642W-S+ | 165001445 | Mini-Circuits | - | 2 | |
| 701 | CMW500 wide. Radio Comm. | CMW500 | 158150 | Rohde & Schwarz | 12 M | - | 30.07.2019 |
| 703 | INNCO Antennen Mast | MA 4010-KT080-XPET-ZSS3 | MA4170-KT100-XPET-ZSS3 | INNCO | pre-m | - | |
| 704 | INNCON Controller | CO 3000-4port | CO3000/933/38410516/L | INNCO Systems GmBh | pre-m | - | |
| 711 | Harmonic Mixer 90 GHz - 140GHz | RPG FS-Z140 | 101004 | RPG | 36 M | - | 22.02.2020 |
| 712 | Harmonic Mixer 75 GHz - 110GHz | FS-Z110 | 101468 | Rohde & Schwarz | 36 M | - | 22.02.2020 |
| 713 | Harmonic Mixer, 50 GHz - 75GHz | FS-Z75 | 101022 | Rohde & Schwarz | 36 M | - | 22.05.2020 |
| 714 | Signal Analyzer 67GHz | FSW67 | 104023 | Rohde & Schwarz | 24 M | - | 28.02.2020 |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|---|---|---|---|---|---|---|---|
| 715 | Harmonic Mixer, 140 GHz - 220GHz | FS-Z220 | 101009 | RPG Radiometer Physics | 36 M | - | 03.08.2020 |
| 716 | Harmonic Mixer 220 GHz to 325 GHZ | FS-Z325 | 101005 | RPG Radiometer Physics | 36 M | - | 13.02.2020 |
| 747 | Spectrum Analyzer | FSU 26 | 200152 | Rohde & Schwarz | 12 M | - | 30.05.2019 |
| 748 | Pickett-Potter Horn Antenna | FH-PP 4060 | 010001 | Radiometer Physiscs | 36 M | - | |
| 749 | Pickett-potter Horn Antenna | FH-PP 60-90 | 010003 | Radiometer Physics | - | - | |
| 750 | Pickett-Potter Horn Antenna | FH-PP 140-220 | 010011 | Radiometer Physics | - | - | |
| 751 | Digital Optical System | optoCAN-FD Transceiver | 17-010416 | mk-messtechnik GmbH | - | - | |
| 752 | Digital Optical System | optoCAN-FD Transceiver | 17-010083 | mk-messtechnik GmbH | - | - | |
| 753 | Digital Optical System | optoCAN-FD Transceiver | 17-010084 | mk-messtechnik GmbH | - | - | |
| 754 | Digital Optical System | optoCAN-FD Transceiver | 17-010415 | mk-messtechnik GmbH | - | - | |
| 755 | Digital Optical System | optoLAN-100-MAX Transceiver | 17-010795 | mk-messtechnik GmbH | - | - | |
| 758 | Signal Generator | SMU 200A | 100754 | Rohde & Schwarz | 24 M | - | 11.10.2019 |
| 780 | Spectrum Analyzer | FSH3 | 101726 | Rohde & Schwarz | 24 M | - | 19.07.2019 |
| 781 | Power Supply | PS 2042-10 B | 2815450369 | Elektro-Automatik GmbH &Co.KG | - | - | |
| 782 | Power Supply | PS 2042-10 B | 2815450348 | lektro-Automatik GmbH &Co.KG | - | - | |
| 783 | Spectrum Analyzer | FSU 26 | 100414 | Rohde & Schwarz | 12 M | - | 30.05.2019 |
| 784 | Power Supply | NGSM 32/10 | 00196 | Rohde & Schwarz | 12 M | - | |
| 785 | RSP | RF Step Attenuator 0…139.9dB | 860712/012 | Rohde & Schwarz | 12 M | - | |
| 786 | SAR Probe | ES3DV3 | 3340 | Speag | 36 M | - | 14.02.2021 |
| 787 | OSP | OSP B157WX | 101264 | Rohde & Schwarz | 12 M | - | 30.05.2019 |
| 788 | Precision Omnidirectional Dipole | POD 618 | 6182558/Q | Seibersdorf Labaratories | 36 M | - | 30.06.2021 |
| 789 | Precision Omnidirectional Dipole | POD 16 | 162496/Q | Seibersdorf Laboratories | 36 M | - | 30.06.2021 |

## 8.3. Legend

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

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

## 9. Versions of test reports (change history)

| Version | Applied changes | Date of release |
|---|---|---|
| -- | Initial release | 2018-12-10 |
| C1 | SW version and date added, chapter 99% OBW typos corrected | 2018-12-11 |
| C2 | Accreditation details updated | 2019-02-20 |

# END OF TEST REPORT