# P A R T I A L  T E S T  R E P O R T
# No.: 19-1-0107603T01a-C1

According to:
**Title 47 CFR, Chapter I**
**FCC Regulations, Subchapter A**
**Subpart C:**
§15.247 (DTS)

**ISED-Regulations**
RSS-Gen, Issue 5
RSS 247 Issue 2
(DTS)

for

## Continental Advanced Antenna GmbH

## DDA02
## BT-Transceiver

**FCC ID: 2ACC7DDA02**
**ISED: 11980A-DDA02**

| Laboratory Accreditation and Listings |
|---|
| Accredited EMC-Test Laboratory |
| accredited according to DIN EN ISO/IEC 17025 |


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# 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) supports radiofrequency technologies with Bluetooth LE technology and operating frequency range at 2.402 to 2.480 GHz. Other implemented wireless technologies were not considered within this test report.

Following test cases have been performed to show compliance with valid standards as mentioned in table below:

## 1.1. Tests measurement overview according of US CFR Title 47, Subpart 15C and Canada RSS-Standards:

| Test cases | Port | References & Limits | | | EUT set-up | EUT opera-ting mode | Result |
|---|---|---|---|---|---|---|---|
| | | FCC Standard | RSS Section | Test Limit | | | |
| TX-Mode | | | | | | | |
| Timing of transmitter (pulsed operation) | Antenna Terminal or enclosure | §15.35 | RSS-Gen, Issue 5 | -- | 1 | 1 | -- |
| Duty Cycle | Antenna terminal (conducted) | -- | -- | -- | -- | -- | *1) |
| 6 dB bandwidth | Antenna terminal (conducted) | §15.247(a)(2) | RSS-247, Chapter 5.2(a)<br><br>RSS-Gen Issue 5: Chapter 4.6.2 | ≥ 500 kHz for DTS systems | -- | -- | *1) |
| 99% occupied bandwidth | Antenna terminal (conducted) | 2.1049(h) | RSS-Gen Issue 5: Chapter 6.6 | 99% Power bandwidth | -- | -- | *1) |
| Transmitter Peak output power | Antenna terminal (conducted) | §15.247(b)(3) | RSS-247, Chapter 5.4(d) | 1 Watt Peak | -- | -- | *1) |
| Transmitter Peak output power radiated | Enclosure + Inter-connecting cables (radiated) | §15.247(b)(4) | RSS-247, Chapter 5.4(d | < 4 Watt (EIRP) for antenna with directional gain less 6dBi | -- | -- | Not tested |
| Out-Of-Band RF- emissions<br><br>Band-Edge emissions | Antenna terminal (conducted) | §15.247 (d) | RSS-247, Chapter 5.5 | 20 dBc | 1 | 1 | *1) |
| Power spectral density | Antenna terminal (conducted) | §15.247(e) | RSS-247, Chapter 5.2(b) | 8dBm in any 3 kHz band | -- | -- | *1) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| General field strength emissions + restricted bands | Enclosure + Inter-connecting cables (radiated) | §15.247 (d) §15.205 §15.209 | RSS-247 Issue 2, Chapter 3.3<br><br>RSS-Gen: Issue 5: §8.9 Table 5+6+7 | 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 | -- | -- | Not tested |
| RX Mode | | | | | | | |
| RECEIVER<br><br>Radiated emissions | Enclosure + Inter-connecting cables (radiated) | §15.109 §15.33 §15.35 | RSS-Gen, Issue 5: Chapter 7.1.2 | FCC 15.109 class B limits<br><br>ISED-limits: Table 2 | -- | -- | *2) |

Remark:
*1) for further details see separate Test Report: CETECOM_TR19-1-0107601T08a-C1 issued on 2019-12-03
*2) for further details see separate Test Report: CETECOM_TR19-1-0107601T09a-C1 issued on 2019-11-21

➔ **FCC ID: 2ACC7DDAECE02; ISED: 11980A-DDAECE02**

| RF-Exposure Evaluation (separation distance user to RF-radiating element greater 20cm) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test cases** | **Port** | **References & Limits** | | | **EUT set-up** | **EUT operating mode** | **Result** |
| | | **FCC Standard** | **RSS Section** | **Test Limit** | | | |
| Radio frequency radiation exposure requirements | Cabinet + Inter-connecting cables (radiated) | §1.1310(b) §2.1091 §2.1093 | RSS-102 Issue 5 | **SAR-Limits FCC:** 1.1310(b) **ISED:** Table 3 | -- | -- | not applicable *3) |
| | | | | **RF-Field Strength Limits: FCC:** "general population/ uncontrolled" environment Table 1 **ISED:** Table 4 | -- | -- | See separate test report/ evaluation |

Remark:
*3) for further details see separate documents: **FCC_MPE_short_report_19-1-0107601T10a_C1** for FCC and **ISED_RF_exposure_Exemption_Letter_19-1-0107601T10b_C1** for ISED

The current version of the Test Report **CETECOM_TR19-1-0107603T01a-C1** replaces the Test Report **CETECOM_TR19-1-0107603T01a** dated 2020-01-21. The replaced test report is herewith invalid.

## 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.

Digital signiert von: Christian Lorenz
Datum: 2020.02.03 13:03:22 +01'00'

Digital signiert von: M.Sc. Patrick Marzotko
Name: CN = M.Sc. Patrick Marzotko email = patrick.marzotko@cetecom.com C = DE O = Cetecom GmbH OU = RC/ EMC
Datum: 2020.02.03 12:55:53 +01'00'

| | |
|---|---|
| Dipl.-Ing. Ch. Lorenz | M.Sc. P. Marzotko |
| Responsible for test section | 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: | Volker Wittmann |
| Deputy: | Dipl.-Ing. Ninovic Perez |

## 2.2. Test location

### 2.2.1. Test laboratory "CTC"

| | |
|---|---|
| Company name: | see chapter 2.1. Identification of the testing laboratory |

## 2.3. Organizational items

| | |
|---|---|
| Responsible for test report: | B.Sc Mohamed Ahmed |
| Project leader: | M.Sc. Patrick Marzotko |
| Receipt of EUT: | 2019-08-13 |
| Date(s) of test: | 2019-08-12 – 2019-12-18 |
| Date of report: | 2020-02-03 |
| Version of template: 13.02 | |

## 2.4. Applicant's details

| | |
|---|---|
| Applicant's name: | Continental Advanced Antenna GmbH |
| Address: | Römerring 1<br>31137 Hildesheim<br>Germany |
| Contact person: | Mr. Timo Wetteborn |

## 2.5. Manufacturer's details

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

# 3. Equipment under test (EUT)

## 3.1. TECHNICAL DATA OF MAIN EUT DECLARED BY

| | | | |
|---|---|---|---|
| Frequency range (US/Canada -bands) | ☒ 2402 MHz (Channel 1 = 01) to 2480 MHz (Channel 39) for 1 MHz BW | | |
| Type of modulation | GFSK | | |
| Number of channels (USA/Canada -bands) | 40 ( 3 advertising channels (1/20/39), 37 channels are in hopping mode (0 to 39 with nominal channel frequency = 2402 MHz + 2*k) with k: 0 to 39 | | |
| Channel spacing | 2 MHz | | |
| Antenna Type | ☒ Integrated<br>☐ External, no RF- connector<br>☐ External, separate RF-connector | | |
| Antenna Gain | Max. 6 dBi gain according applicants information in 2.4 GHz band | | |
| MAX Field strength (radiated): | 96.631 dBµV/m@3m distance | | |
| Occupied Bandwidth | 1.025 MHz | | |
| 6dB Emission Bandwidth | 701.298 kHz | | |
| Other Installed options | ☒ GNSS (LNA) only supplied with 5V DC<br>☒ SDARS only supplied with 5V DC | | |
| Power supply | | | |
| Additional Power Supply | ☒ yes: 5V DC for GNSS (LNA) and SDARS ☐ no | | |
| Special EMI components | -- | | |
| EUT sample type | ☐ Production | ☒ Pre-Production | ☐ Engineering |
| FCC label attached | ☒ yes | ☐ no | |
| ISED Certification Number attached | ☒ yes | ☐ no | |

Remark: please refer to document “System description DDA02_V3”

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

| Short descrip-tion*) | EUT | Type | S/N serial number | HW hardware status | SW software status |
|---|---|---|---|---|---|
| EUT A S08 | DDA02 | BT-Transceiver | 52512491 | 01S | BT-Stack: 01.03.05 |

*) 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 | CAN to USB converter | CAN Transceiver | IPEH-002022-214006 | -- | -- |
| AE 2 | Power Supply Cable Set | -- | -- | -- | -- |
| AE 3 | Dell Laptop CTC462012 | Latitude E6420 | JS5WDS1 | Intel Core i5 | Windows 7 |

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

## 3.4. EUT set-ups

| EUT set-up no.*) | Combination of EUT and AE | Remarks |
|---|---|---|
| set. 1 | EUT A + AE 1** + AE 2 + AE 3** | Radiated measurement set-up |

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.
**) AE 1 and AE 3 were placed outside the test chamber during tests

## 3.5. EUT operating modes

| EUT operating mode no.*) | Description of operating modes | Additional information |
|---|---|---|
| op. 1 | Continuous TX-Mode | The EUT was put to continuous transmissions mode with help of a special software named **'UDS_communication'**. |

*) EUT operating mode no. is used to simplify the test report.

## 3.6. Test Settings

| Modulation | Packettype | Frame length | TX-Power |
|---|---|---|---|
| GFSK | PRBS9 | 32 | 31 |

## 3.7. Worst Case Selection

- ➔ Worst case selection is based on 19-1-0107601T08-C1 issued on 2019-12-03
  **FCCID: 2ACC7DDAECE02**
  **ISED ID: 11980A-DDAECE02**
- ➔ in this case the mid channel was used for testing.

## 3.8. Test Software

| SW name | Version | Date | Storage |
|---|---|---|---|
| UDS_communication | r62 | - | Saved on AE3 |

Remarks: Settings were set according to customer specification document “System description DDA02_V3”.

## 3.9. Configuration of cables used for testing

| No. of cables | Item | Type | S/N serial number | HW hardware status | Cable length |
|---|---|---|---|---|---|
| 1. | Power Supply Cable | - | - | - | 2m |

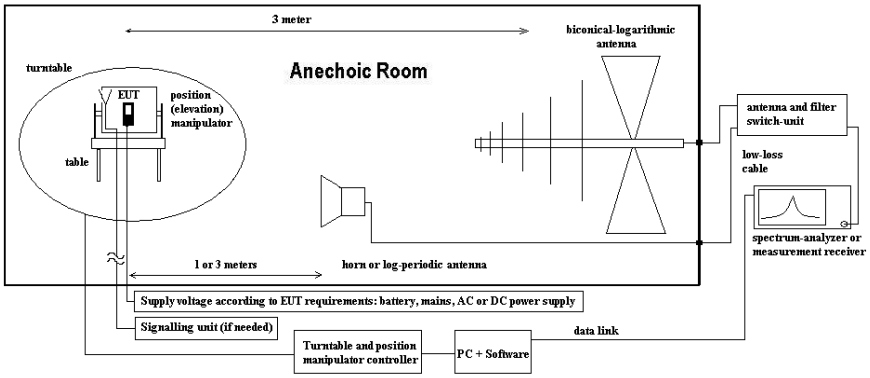
# 4. Description of test system set-up's

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

**Specification:** ANSI C63.4-2014 chapter 8.2.3, 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

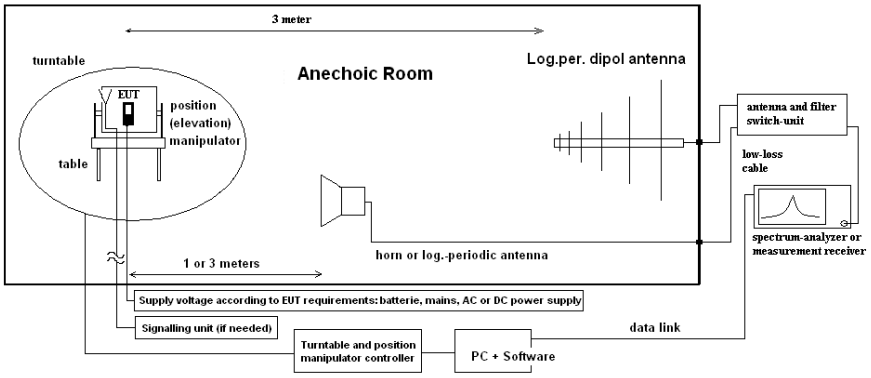
All units are dB-units, positive margin means value is below limit.

## 4.2. 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 16-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 18 GHz and 2 meter above 18 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz. Horn antennas are used for frequency range 1 GHz to 40 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with three orthogonal axis measurements on the EUT.

**Schematic:**




**Testing method:**

**Exploratory, preliminary measurements**
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 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. Measurements

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

### 5.1.1. 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 |
| signalling | ☐ 392 MT8820A | ☐ 371 CBT32 | ☐ 547 CMU | ☐ 594 CMW | | |
| otherwise | ☐ 400 FTC40x15E | ☐ 401 FTC40x15E | ☐ 110 USB LWL | ☒ 482 Filter Matrix | | |
| multimeter | ☒ 341 Fluke 112 | | | | | |
| DC power | ☐ 456 EA 3013A | ☒ 612 E3632A | ☐ 459 EA 2032-50 | ☐ 268 EA- 3050 | ☐ 494 AG6632A | ☐ 498 NGPE |
| line voltage | ☐ 230 V 50 Hz via public mains | | ☒ 12 V DC | | | |

### 5.1.2. Requirements/Limits

| | | | |
|---|---|---|---|
| **FCC** | | ☐ Part 15 Subpart B, §15.109, class B<br>☒ Part 15 Subpart C, §15.209 @ frequencies defined in §15.205 | |
| **ISED (IC)** | | ☒ RSS-Gen., Issue 5, Chapter 8.9, Table 5+6+7 (licence-exempt radio apparatus) | |
| **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 |

### 5.1.3. Restricted bands of operation (FCC §15.205/ RSS-Gen, Issue 5, Chapter 8.10, Table 7)

| MHz | MHz | GHz |
|---|---|---|
| 0.090-0.110 | 156.7-156.9 | 9.0-9.2 |
| 0.495-0.505 | 162.0125-167.17 | 9.3-9.5 |
| 2.1735-2.1905 | 167.72-173.2 | 10.6-12.7 |
| 3.020-3.026 (Canada only) | 240-285 | 13.25-13.4 |
| 4.125-4.128 | 322-335.4 | 14.47-14.5 |
| 4.17725 - 4.17775 | 399.9-410 | 15.35-16.2 |
| 4.20725-4.20775 | 608-614 | 17.7-21.4 |
| 5.677 - 5.683 (Canada only) | 960-1240 | 22.01-23.12 |
| 6.215-6.218 | 1300-1427 | 23.6-24.0 |
| 6.26775-6.26825 | 960-1427 (only Canada) | 31.2-31.8 |
| 6.31175-6.31225 | 1435-1626.5 | 36.43-36.5 |
| 8.291-8.294 | 1645.5-1646.5 | Above 38.6 |
| 8.362-8.366 | 1660-1710 | -- |
| 8.37625-8.38675 | 1718.8-1722.2 | -- |
| 8.41425-8.41475 | 2200-2300 | -- |
| 12.29-12.293 | 2310-2390 | -- |
| 12.51975-12.52025 | 2483.5-2500 | -- |
| 12.57675-12.57725 | 2690-2900 | -- |
| 13.36-13.41 | 2655-2900 (only Canada) | -- |
| 16.42-16.423 | 3260-3267 | -- |
| 16.69475-16.69525 | 3332-3339 | -- |
| 16.80425-16.80475 | 3345.8-3358 | -- |
| 25.5-25.67 | 3500-4400 (only Canada) | -- |
| 37.5-38.25 | 3600-4400 | -- |
| 73-74.6 | 4500-5150 | -- |
| 74.8-75.2 | 5350-5460 | -- |
| 108-121.94 | 7250-7750 | -- |
| 123-138 | 8025-8500 | -- |
| 108-138 (only Canada) | -- | -- |
| 149.9-150.05 | -- | -- |
| 156.52475-156.52525 | -- | -- |
| Remark: only spurious emissions are allowed within these frequency bands not exceeding the limits per §15.209/RSS-Gen. | | |

### 5.1.4. 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" | | |

### 5.1.5. MEASUREMENT RESULTS

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 | |
| 3.01 | Low | 0 | 30 MHz – 1 GHz | 1 | 1 | EUT laying position | ☒ | ☐ | ☒ | passed |
| 3.01 | Low | | | | | EUT standing position | ☒ | ☐ | ☒ | passed |

Remark: for further details please see annex 1

## 5.2. General Limit – Radiated field strength emissions, above 1 GHz

### 5.2.1. 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 | ☒ 714 FSW | |
| antenna meas | ☐574 BTA-L | ☐289 CBL 6141 | ☐608 HL 562 | ☒549 HL025 | ☒ 302 BBHA9170 | |
| antenna subst | ☐071 HUF-Z2 | ☐020 EMCO3115 | ☐063 LP 3146 | | ☐ 303 BBHA9170 | |
| signalling | ☐392 MT8820A | ☐371 CBT32 | ☐547 CMU200 | ☐594 CMW | | |
| multimeter | ☒341 Fluke 112 | | | | | |
| DC power | ☐086 LNG50-10 | ☐087 EA3013 | ☒354 NGPE 40 | ☐349 car battery | ☐ 350 Car battery | ☐ |
| line voltage | ☐ 230 V 50 Hz via public mains | | ☒ 12 V DC | | | |

### 5.2.2. Requirements/Limits

| | | | | |
|---|---|---|---|---|
| **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 Subpart C, §15.407(b)(1)(2)(3)(4) | | | |
| **ISED** | ☒ RSS-Gen., Issue 5, Chapter 8.9, Table 5+6+7 (transmitter licence exempt) | | | |
| **ANSI** | ☐ C63.4-2014<br>☒ C63.10-2013 | | | |
| Frequency [MHz] | Limits | | | |
| | AV [µV/m] | AV [dBµV/m] | Peak [µV/m] | Peak [dBµV/m] |
| above 1 GHz for frequencies as defined in §15.205 or RSS-Gen | 500 | 54.0 | 5000 | 74.0 |

### 5.2.3. 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 – 26 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" | | |

### 5.2.4. Measurement Results

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

| Dia-gram 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.01 | Mid | 20 | 1-18GHz | 1 | 1 | EUT laying/standing position | ☒ | ☒ | ☐ | passed |
| 4.01 | Mid | | 18-26GHz | | | | ☒ | ☒ | ☐ | passed |

Remark: see diagrams in annex 1 for more details

## 5.3. Radiated Band-Edge compliance, field strength measurements accord. §15.205

### 5.3.1. 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 | ☐371 CBT32 | ☐298 CMU 200 | ☐ | ☐ | | |
| DCpower | ☐086 LNG50-10 | ☐087 EA3013 | ☒354 NGPE 40 | ☐349 car battery | ☐350 Car battery | ☐ |
| line voltage | ☐ 230 V 50 Hz via public mains | | ☒ 12 V DC | | | |

### 5.3.2. Requirements/Limits

| | | | | |
|---|---|---|---|---|
| **FCC** | ☐ Part 15 Subpart B, §15.109 class B<br>☒ Part 15 Subpart C, §15.209 @ frequencies defined in §15.205 | | | |
| **ISED** | ☒ RSS-Gen: Issue 5: §8.9 Table 5 + §8.10 Table 7 | | | |
| **ANSI** | ☐ C63.4-2009<br>☒ C63.10-2013 | | | |
| Frequency [MHz] | Right Band-Edge Limits beginning on 2483.5MHz@3 meters | | | |
| | AV [µV/m] | AV [dBµV/m] | Peak [µV/m] | Peak [dBµV/m] |
| above 1 GHz | 500 | 54.0 | 5000 | 74.0 |

### 5.3.3. MEASUREMENT METHOD FOR BAND-EDGE:

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

For critical results a Marker-Delta marker method was used for showing compliance to restricted bands according §15.205. The method is according ANSI 63.10:2013 "Marker-Delta method", §6.9.3. 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 §15.205 with the general limits of §15.209.

### 5.3.4. RESULTS – LEFT BAND-EDGE

| Diagramm no. | Channel no. | Restricted band ? | Fundamental Value [dBuV/m] | | Peak-Value at Band-Edge [dBuV/m] | Difference [dB] | Limit [dBc] | Margin [dB] | Verdict | Remark: |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak-Value | Average-Value | | | | | | |
| 9.01 | 1 | no | 98.31 | 89.44 | 50.62 | 47.69 | 20 | 27.69 | PASS | BT-LE - PRBS9 |

Remarks Diagram no.: 9.01

### 5.3.5. RESULTS – RIGHT BAND-EDGE

| Diagramm no. | Channel no. | Restricted band ? | Fundamental Value [dBuV/m] | | Value at Band-Edge [dBuV/m] | | Limits [dBuV/m] | | Duty-Cycle Correction for AV-detector | Margin [dB] | | Verdict | Remark: |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Peak-Value | Average-Value | Peak -Value | Average -Value | Peak -Value | Average -Value | [dB] | Peak | Average | | |
| 9.02 | 11 | yes | 97.84 | 94.61 | 59.50 | 46.49 | 74 | 54 | 2.50017 | 14.50 | 5.01 | PASS | BT-LE - PRBS9 |

Remarks: Diagram no.: 9.02

➔ Duty cycle correction factor was derived from Testreport 19-1-0107601T08a-C1 issue date **2019-12-03 (FCCID: 2ACC7DDAECE02; ISED ID: 11980A-DDAECE02)**

### 5.3.6. VERDICT: PASS

## 5.4. Measurement uncertainties

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

Following table shows expectable uncertainties for each measurement type performed.

| RF-Measurement | Reference | Frequency range | Calculated uncertainty based on a confidence level of 95% | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| Conducted emissions ($U_{CISPR}$) | CISPR 16-2-1 | 9 kHz - 150 kHz<br>150 kHz - 30 MHz | 4.0 dB<br>3.6 dB | | | | | | - |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz<br>1 GHz - 18 GHz | 4.2 dB<br>5.1 dB | | | | | | E-Field |
| Disturbance power | CISPR 16-2-2 | 30 MHz - 300 MHz | - | | | | | | - |
| Power Output radiated | - | 30 MHz - 4 GHz | 3.17 dB | | | | | | Substitution method |
| Power Output conducted | - | Set-up No. | Cel-C1 | Cel-C2 | BT1 | W1 | W2 | -- | |
| | | 9 kHz - 12.75 GHz | N/A | 0.60 | 0.7 | 0.25 | N/A | -- | - |
| | | 12.75 - 26.5GHz | N/A | 0.82 | -- | N/A | N/A | -- | |
| Conducted emissions on RF-port | - | 9 kHz - 2.8 GHz | 0.70 | N/A | 0.70 | N/A | 0.69 | -- | N/A - not applicable |
| | | 2.8 GHz - 12.75GHz | 1.48 | N/A | 1.51 | N/A | 1.43 | -- | |
| | | 12.75 GHz - 18GHz | 1.81 | N/A | 1.83 | N/A | 1.77 | -- | |
| | | 18 GHz - 26.5GHz | 1.83 | N/A | 1.85 | N/A | 1.79 | -- | |
| Power density | - | 1 – 2.8GHz | 1.40 dB | | | | | | -- |
| Occupied bandwidth | - | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | Frequency error |
| | | | 1.0 dB | | | | | | Power |
| Emission bandwidth | -<br>- | 9 kHz - 4 GHz | 0.1272 ppm (Delta Marker) | | | | | | Frequency error |
| | | | See above: 0.70 dB | | | | | | Power |
| Frequency stability | - | 9 kHz - 20 GHz | 0.0636 ppm | | | | | | - |
| Radiated emissions Enclosure | - | 150 kHz - 30 MHz<br>30 MHz - 1 GHz<br>1 GHz - 20 GHz | 5.0 dB<br>4.2 dB<br>3.17 dB | | | | | | Magnetic field<br>E-field<br>Substitution |

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

# 6. Abbreviations used in this report

| The abbreviations | |
|---|---|
| ANSI | American National Standards Institute |
| AV , AVG, CAV | Average detector |
| EIRP | Equivalent isotropic 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, Documents from Industry Canada |
| Rx | Receiver |
| TCH | Traffic channel |
| Tx | Transmitter |
| QP | Quasi peak detector |
| VBW | Video bandwidth |
| ERP | Effective radiated power |

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

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

# 8. Instruments and Ancillary

## 8.1. Used equiment "CTC"

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

### 8.1.1. Test software and firmware of equipment

| Ref.-No. | Equipment | Type | Serial-No. | Version of Firmware or Software during the test |
|---|---|---|---|---|
| 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 |
| 119 | RT Harmonics Analyzer dig. Flickermeter | B10 | G60547 | Firm.= V 3.1DHG |
| 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 |
| 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 |
| 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= |
| 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 |
| 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) |
| 693 | Test System | TS8997 | -- | SW: EMC32/WMS32 version 10.50.00<br>HW: OSP120 Base unit (S/N=106833) ;<br>FSU26 (Ref. Nr. 683) ;<br>SMU 200 (Ref. Nr. 689) ;<br>SMF 100A (Ref. Nr. 687) |
| 699 | Audio Analyzer | UPL16 | 833494/005 | 3.06 |
| | | | | |

### 8.1.2. Single instruments and test systems

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|---|---|---|---|---|---|---|---|
| 005 | AC - LISN (50 Ohm/50µH, test site 1) | ESH2-Z5 | 861741/005 | Rohde & Schwarz | 12 M | - | 23.05.2020 |
| 007 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 892563/002 | Rohde & Schwarz | 12 M | - | 23.05.2020 |
| 009 | Power Meter (EMS-radiated) | NRV | 863056/017 | Rohde & Schwarz | 24 M | - | 23.05.2021 |
| 016 | Line Impedance Simulating Network | Op. 24-D | B6366 | Spitzenberger+Spies | 36 M | - | 22.05.2022 |
| 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 |
| 033 | RF-current probe (100kHz-30MHz) | ESH2-Z1 | 879581/18 | Rohde & Schwarz | 24 M | - | 23.05.2021 |
| 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 | - | 22.05.2022 |
| 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 | - | 30.05.2020 |
| 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 | |
| 287 | pre-amplifier 25MHz - 4GHz | AMF-2D-100M4G-35-10P | 379418 | Miteq | 12 M | 1c | 16.11.2020 |
| 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 | - | 22.05.2020 |
| 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 | - | 10.01.2021 |
| 341 | Digital Multimeter | Fluke 112 | 81650455 | Fluke | 24 M | - | 30.05.2020 |
| 342 | Digital Multimeter | Voltcraft M-4660A | IB 255466 | Voltcraft | 24 M | - | 23.05.2021 |
| 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 | - | 21.05.2021 |
| 373 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 100535 | Rohde & Schwarz | 12 M | - | 22.05.2020 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Rohde & Schwarz | 12 M | - | 22.05.2020 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Keithley | pre-m | - | |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Anritsu | 12 M | - | 01.07.2020 |
| 396 | Thermo/Hygrometer | Thermo/Hygrometer | - | Conrad | 24 M | - | 09.01.2021 |
| 431 | Model 7405 | Near-Field Probe Set | 9305-2457 | EMCO | - | 4 | |
| 436 | Univ. Radio Communication Tester | CMU 200 | 103083 | Rohde & Schwarz | 12 M | - | 25.05.2020 |
| 439 | UltraLog-Antenna | HL 562 | 100248 | Rohde & Schwarz | 36 M | - | 10.03.2020 |
| 441 | CTC-SAR-EMI Cable Loss | System EMI field (SAR) Cable | - | CETECOM | 12 M | 5 | 05.06.2017 |
| 443 | CTC-FAR-EMI-RSE | System CTC-FAR-EMI-RSE | - | ETS-Lindgren / CETECOM | 12 M | 5 | 16.11.2020 |
| 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 | - | 30.05.2020 |
| 463 | Universal source | HP3245A | 2831A03472 | Agilent | - | 4 | |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|---|---|---|---|---|---|---|---|
| 466 | Digital Multimeter | Fluke 112 | 89210157 | Fluke USA | 24 M | - | 30.05.2020 |
| 467 | Digital Multimeter | Fluke 112 | 89680306 | Fluke USA | 36 M | - | 30.05.2021 |
| 468 | Digital Multimeter | Fluke 112 | 90090455 | Fluke USA | 36 M | - | 30.04.2021 |
| 477 | ReRadiating GPS-System | AS-47 | - | Automotive Cons. Fink | - | 3 | |
| 480 | power meter (Fula) | NRVS | 838392/031 | Rohde & Schwarz | 24 M | - | 30.05.2021 |
| 482 | filter matrix | Filter matrix SAR 1 | - | CETECOM (Brl) | - | 1d | |
| 484 | pre-amplifier 2,5 - 18 GHz | AMF-5D-02501800-25-10P | 1244554 | Miteq | 12 M | - | 16.11.2020 |
| 487 | System CTC NSA-Verification SAR-EMI | System EMI field (SAR) NSA | - | ETS Lindgren / CETECOM | 24 M | - | 16.04.2021 |
| 489 | EMI Test Receiver | ESU40 | 1000-30 | Rohde & Schwarz | 12 M | - | 30.06.2020 |
| 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 | - | 23.05.2021 |
| 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 | |
| 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 | - | 30.10.2021 |
| 552 | high pass filter 2,8-18GHz | WHKX 2.8/18G-10SS | 4 | Wainwright | 12 M | 1c | 16.11.2020 |
| 557 | System CTC-OTA-2 | R&S TS8991 | - | Rohde & Schwarz | 12 M | 5 | 24.01.2020 |
| 574 | Biconilog Hybrid Antenna | BTA-L | 980026L | Frankonia | 36/12 M | - | 03.05.2022 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | Rohde & Schwarz | pre-m | - | |
| 594 | Wideband Radio Communication Tester | CMW 500 | 101757 | Rohde & Schwarz | 12 M | - | 26.06.2020 |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | Rohde & Schwarz | pre-m | - | |
| 600 | power meter | NRVD (Reserve) | 834501/018 | Rohde & Schwarz | 24 M | - | 30.05.2021 |
| 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 | - | 30.05.2020 |
| 621 | Step Attenuator 0-139 dB | RSP | 100017 | Rohde & Schwarz | pre-m | 2 | |
| 625 | Generic Test Load USB | Generic Test Load USB | - | CETECOM | - | 2 | |
| 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 | |
| 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 | - | 30.05.2020 |
| 687 | Signal Generator | SMF 100A | 102073 | Rohde&Schwarz | 12 M | - | 30.05.2020 |
| 688 | Pre Amp | JS-18004000-40-8P | 1750117 | Miteq | pre-m | - | |
| 690 | Spectrum Analyzer | FSU | 100302/026 | Rohde&Schwarz | 24 M | - | 30.05.2021 |
| 691 | OSP120 Base Unit | OSP120 | 106833 | Rohde & Schwarz | 12 M | - | 30.05.2020 |
| 692 | Bluetooth Tester | CBT 32 | 100236 | Rohde & Schwarz | 36 M | - | 29.05.2020 |
| 697 | Power Splitter | ZN4PD-642W-S+ | 165001445 | Mini-Circuits | - | 2 | |
| 701 | CMW500 wide. Radio Comm. | CMW500 | 158150 | Rohde & Schwarz | 24 M | - | 30.07.2020 |
| 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 | 24 M | - | 05.07.2021 |
| 714 | Signal Analyzer 67GHz | FSW67 | 104023 | Rohde & Schwarz | 24 M | - | 04.07.2021 |
| 715 | Harmonic Mixer, 140 GHz - 220GHz | FS-Z220 | 101009 | RPG Radiometer Physics | 36 M | - | 03.08.2020 |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|---|---|---|---|---|---|---|---|
| 716 | Harmonic Mixer 220 GHz to 325 GHZ | FS-Z325 | 101005 | RPG Radiometer Physics | 36 M | - | 13.02.2020 |
| 764 | Spectrum Analyzer | FSU 26 | 200152 | Rohde & Schwarz | 12 M | - | 30.07.2020 |
| 748 | Pickett-Potter Horn Antenna | FH-PP 4060 | 010001 | Radiometer Physiscs | 36 M | - | |
| 750 | Pickett-Potter Horn Antenna | FH-PP 220 | 010011 | Radiometer Physics | 36 M | - | |
| 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 | - | - | |
| 757 | WIDEBAND RADIO COMMUNICATION | CMW500 | 163673 | Rohde&Schwarz | 12 M | - | 30.05.2020 |
| 758 | Signal Generator | SMU 200A | 100754 | Rohde & Schwarz | 24 M | - | 11.10.2020 |
| 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 | - | 30.05.2020 |
| 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 | 24 M | - | 30.05.2020 |
| 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 |
| 790 | Horn Antenna | ASY-SGH-124-SMA | 29F14182337 | Antenna System Solutions | 36 M | - | 08.10.2021 |
| 791 | Pickett-Potter Horn Antenna | FH-PP-325 | 10024 | Radiometer Physics | 36 M | - | |
| 792 | Pickett-Potter Horn Antenna | FH-PP 075 | 10006 | Radiometer Physics | 36 M | - | |
| 793 | Pickett-Potter Horn Antenna | FH-PP 140 | 10008 | Radiometer Physics | 36 M | - | |
| 794 | Pickett-Potter Horn Antenna | FH-PP 110 | 10014 | Radiometer Physics | 36 M | - | |
| 795 | SGH Antenna | SGH-26-WR10 | 1144 | Anteral S.L. | 36 M | - | |
| 798 | WR-22 Rectangular Gain Horn | SAR-2309-22-S2 | 13254-01 | SAGE Millimeter, Inc. | 36 M | - | |
| 799 | Transceiver | optoLAN-Gb | 18-014746 | mk messtechnik | pre-m | - | |
| 801 | Spectrum Analyzer | FSP 13 | 100960 | Rohde & Schwarz | 24 M | - | 14.01.2021 |
| 802 | Exposure Level Tester | ELT-400 | O-0026 | NARDA Safety Solutions | 24 M | - | 30.01.2021 |
| 803 | Probe | ELT probe 3cm² | O-0026 | Narda Safety Test Solution | 24 M | - | 30.01.2021 |
| 805 | Thermo-Hygrometer | Web-Thermo-Hygrometer | 02749814 | W&T | 24 M | - | |
| 806 | AC2600 Smart Wifi Router | Netgear Nighthawk x4S | 5K5188590067B | Netgear | - | - | |
| 807 | Direct Coupler | Direct Coupler C-05020-10 | 511 | ET Industries | - | - | |
| 808 | Diode Power Sensor | NRV-Z1 | 829894/001 | Rohde & Schwarz | 24 M | - | 24.05.2021 |
| 809 | Standard gain Horn Antenna | WR-159 Horn Antenna | - | Pasternack Enterprises Inc. | - | - | |
| | | | | | | | |

| 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 | 2020-01-21 |
| C1 | FCC ID changed and report references in ToC changed | 2020-02-03 |

# END OF TEST REPORT