

TEST REPORT
No.: 15-1-0017001T41a

According to:
FCC Regulations
Part 15.209
Part 15.247

IC-Regulations
RSS- Gen, Issue 4
RSS-247 Issue 1

for
Peiker acoustic GmbH & Co.KG

ATM-01 R2-US-4GW
FCC-ID: QWY-ATM-R-622
IC: 6588A-ATMR622
PMN: ATM roof version
HVIN: ATM-01 R2-US-4GW







| Laboratory Accreditation and Listings | | | |
|--|--|---|--|
|  Deutsche Akkreditierungsstelle D-PL-12047-01-01 |  FEDERAL COMMUNICATIONS COMMISSION USA MRA US-EU 0003 |  Industry Canada Reg. No.: 3462D-1 Reg. No.: 3462D-2 Reg. No.: 3462D-3 |  Voluntary Controls for Electromagnetic Emissions Reg. No.: R-2666 C-2914, T-1967, G-301 |
|  AUTHORIZED RF LABORATORY |  Authorized Test Lab Lab Code: 20011130-00 | | |
| accredited according to DIN EN ISO/IEC 17025 | | | |
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The listed attachments are an integral part of this report.

1. Summary of test results

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

The 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 WLAN technology and operating frequency range at 2.412 to 2.472 GHz according to IEE 802.11b/g/n. Other implemented wireless technologies were not considered within this test report.

Following test cases have been performed to show compliance with valid Part 15.207/15.209/15.247 of the FCC CFR Title 47 Rules, Edition 4th November 2015 and IC RSS-247 Issue 1/RSS-Gen Issue 4 standards.

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 operating mode | Result |
|--|--|---------------------|---|---|------------|--------------------|----------------------|
| | | FCC Standard | RSS Section | Test Limit | | | |
| TX-Mode | | | | | | | |
| Timing of transmitter (pulsed operation) | Antenna Terminal or enclosure | §15.35 | RSS-Gen, Issue 4 | -- | 3 | 1 | -- |
| 6 dB bandwidth | Antenna terminal (conducted) | §15.247(a)(2) | RSS-247, Chapter 5.2(1) RSS-Gen Issue 4: Chapter 4.6.2 | ≥ 500 kHz for DTS systems | 3 | 1 | passed |
| 99% occupied bandwidth | Antenna terminal (conducted) | 2.1049(h) | RSS-Gen Issue 4: Chapter 6.6 | 99% Power bandwidth | 3 | 1 | for Information only |
| Transmitter Peak output power | Antenna terminal (conducted) | §15.247(b)(3) | RSS-247, Chapter 5.4(4) | 1 Watt Peak | 3 | 1 | passed |
| Transmitter Peak output power radiated | Enclosure + Inter-connecting cables (radiated) | §15.247(b)(4) | RSS-247, Chapter 5.4(4) | < 4 Watt (EIRP) for antenna with directional gain less 6dBi | 1+2 | 1 | passed |
| Out-Of-Band RF- emissions Band-Edge emissions | Antenna terminal (conducted) | §15.247 (d) | RSS-247, Chapter 5.5 | 20 dBc | 3 | 1 | passed |
| Power spectral density | Antenna terminal (conducted) | §15.247(e) | RSS-247, Chapter 5.2(2) | 8dBm in any 3 kHz band | 3 | 1 | passed |

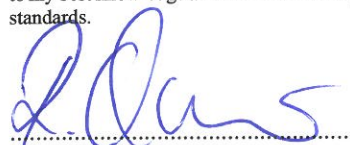
| | | | | | | | |
|---|--|-----------------------------------|--|--|-----|----|----------------|
| General field strength emissions + restricted bands | Enclosure + Inter-connecting cables (radiated) | §15.247 (d) §15.205 §15.209 | RSS-247 Issue 1, Chapter 5.5 RSS-Gen: Issue 4: §8.9 Table 4+5+6 | Emissions in restricted bands must meet the general field-strength radiated limits | 1+2 | 1 | passed |
| AC-Power Lines Conducted Emissions | AC-Power lines | §15.207 | RSS-Gen, Issue 4: Chapter 8.8, Table 3 | FCC §15.107 class B limits §15.207 limits IC: Table 3, Chapter 8.8 | -- | -- | Not applicable |

| 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 | RF-Field Strength Limits: FCC: "general population/uncontrolled" environment Table 1 IC: Table 4 | 1+2 | 1 | See separate test report/evaluation |

Remark: --

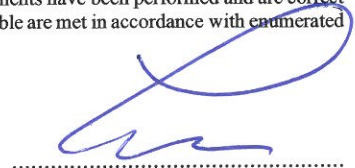
Attestation:

I declare that all measurements were performed by me or under my supervision and that all measurements have been performed and are correct to my best knowledge and belief to Industry Canada standards. All requirements as shown in above table are met in accordance with enumerated standards.



 Dipl.-Ing. Rachid Acharkaoui
 Responsible for test section


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 Dipl.-Ing. C. Lorenz
 Responsible for test report

2. Administrative Data

2.1. Identification of the testing laboratory

| | |
|-------------------------------------|--|
| Company name: | CETECOM GmbH |
| Address: | Im Teelbruch 116 45219 Essen - Kettwig Germany |
| Responsible for testing laboratory: | Dipl.-Ing. Rachid Acharkaoui |
| Deputy: | Dipl.-Ing. Niels Jeß |

2.2. Test location

2.2.1. Test laboratory "CTC"

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

2.3. Organizational items

| | |
|---|---------------------------|
| Responsible for test report and project leader: | Dipl.-Ing. C. Lorenz |
| Receipt of EUT: | 2016-01-06 |
| Date(s) of test: | 2016-01-07- to 2016-04-22 |
| Date of report: | 2016-04-28 |
| ----- | |
| Version of template: | 13.02 |

2.4. Applicant's details

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

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 APPLICANT

| | | | |
|--|--|--|--------------------------------------|
| Frequency range (US/Canada -bands) | <input checked="" type="checkbox"/> 2412 MHz (Channel 1) to 2472 MHz (Channel 13) for 20MHz BW <input type="checkbox"/> 2422 MHz (Channel 3) to 2453 MHz (channel 9) for 40MHz BW | | |
| Type of modulation | See chapter 3.2 | | |
| Number of channels (USA/Canada -bands) | 1 to 13 | | |
| Antenna Type | <input checked="" type="checkbox"/> Integrated <input type="checkbox"/> External, no RF- connector <input type="checkbox"/> External, separate RF-connector | | |
| Antenna Gain | Max. 5 dBi gain according applicants information in 2.4 GHz band | | |
| MAX Field strength (radiated): | 92.70 dB μ V/m@3m distance on nominal 2472 MHz | | |
| Installed options | <input checked="" type="checkbox"/> W-LAN | | |
| Power supply | <input checked="" type="checkbox"/> DC power only: 14.0 Volt | | |
| Special EMI components | -- | | |
| EUT sample type | <input type="checkbox"/> Production | <input checked="" type="checkbox"/> Pre-Production | <input type="checkbox"/> Engineering |
| FCC label attached | <input type="checkbox"/> yes | <input checked="" type="checkbox"/> no | |

3.2. IEEE 802.11 OVERVIEW: MODULATION AND DATA RATES

The modulations and data rates defined for 802.11 b/g/n transmitters are identified in the table below. Also it shows which operational mode is possible for the device under test (EUT) according applicant's information.

| 802.11b-Mode (DSSS System) | | |
|----------------------------|--|------------------|
| Data rate [MBps] | Modulation type | Supported by EUT |
| 1 | DBPSK (Differential binary phase shift keying) | YES |
| 2 | DQPSK (Differential quadrature phase shift keying) | YES |
| 5.5 / 11 | CCK/PBCC (8-chip complementary code keying) | YES |
| 22 | ERP-PBCC (Packet binary convolutional coding) | YES |

| 802.11g-Mode (OFDM system) | | |
|----------------------------|--------------------------------|------------------|
| Brutto data rate [MBps] | Modulation type of subcarriers | Supported by EUT |
| 6 / 9 | BPSK | YES |
| 12 / 18 | QPSK | YES |
| 24 / 36 | 16-QAM | YES |
| 48 / 54 | 64-QAM | YES |

Remark: 52 sub-carriers which can be modulated at different data-rates.

| 802.11n-Mode (OFDM) | | |
|---|--------------------|------------------|
| Brutto data rate [MBps] | Modulation type | Supported by EUT |
| 7.2/14.4/21.7/28.9/43.3/57.8/65/72.2 Mbps | HT20 (MCS0..MCS7) | YEW |
| 14.444/28.889/43.333/57.778/86.667/ 115.556/130/144.444 Mbps | HT20 (MCS8..MCS15) | NO |
| 15/30/45/60/90/120/135/150 Mbps | HT40 (MCS0..MCS7) | YES |
| 30/60/90/120/180/240/270/300 Mbps | HT40 (MCS8..MCS15) | NO |

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

| Short description*) | EUT | Type | S/N serial number | HW hardware status | SW software status |
|---------------------|-----------------------------------|------------------|---|--------------------|--------------------|
| EUT A | Advanced Telecommunication Module | ATM-01 R2-US-4GW | IMEI:3538130 70003073 S/N: 747793 | 113.002.002 | 001.024.047 |
| EUT B | Advanced Telecommunication Module | ATM-01 R2-US-4GW | IMEI:3538130 70003149 S/N: 747694 | 113.002.002 | 001.024.047 |

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

3.4. 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 | Loudspeaker- | KL3/4 -Ohm | -- | -- | -- |
| AE 2 | Microphone | ME39 | -- | -- | -- |
| AE 3 | Antenna TRX mounted on Ground plane | Fender antenna from HIRSCHMANN 920325-102 | -- | - | -- |
| AE 4 | Antenna DRX | bumper telephone antenna from HIRSCHMANN 920337-101 | -- | Length : 30 cm | -- |
| AE 5 | Antenna GPS | Navilock NL-69AT | -- | Length: 3 m | -- |
| AE 6 | Reduced harness | Testing | #1 | See chapter 3.1.1 of Annex 5 | -- |
| AE 7 | RF connection cable | Shielded | -- | Length : One Branch 1: 2.62 m Branch 2 :4 m | |
| AE 8 | Notebook | Dell D2120 | -- | -- | Windows 7 + QUALCOM M Radio control Toolkit (QRCT) |
| AE 9 | FAKRA-SMA Adapter | -- | -- | -- | -- |

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

3.5. EUT set-ups

| EUT set-up no. *) | Combination of EUT and AE | Remarks |
|-------------------|---|--|
| set. 1 | EUT A + AE1 + AE2 + AE3 + AE4 + AE5 + AE6 + AE7 + (AE8) | Radiated test up to 1GHz. AE8 used temporary for connection set-up |
| set. 2 | EUT A + AE1 + AE2 + AE3 + AE4 + AE5 + AE6 + AE7 + (AE8) | Radiated test above 1GHz. AE8 used temporary for connection set-up |
| set. 3 | EUT B + AE6 + AE7 + AE8 + AE9 | Conducted RF measurements |

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

3.6. EUT operating modes

| EUT operating mode no. *) | Description of operating modes | Additional information |
|---------------------------|--------------------------------|---|
| op. 1 | WLAN Continuous TX-Mode | The EUT was put to continuous transmissions mode with help of a special firmware software. The modulation and Bit rate used will be special mentioned in the results. |

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

3.7. Configuration of cables used for testing

| Cable number | Item | Type | S/N serial number | HW hardware status | Cable length |
|--------------|---------------------|------|-------------------|--------------------|--------------|
| Cable 1 | Reduced harness | -- | -- | -- | 1.5 m |
| Cable 2 | RF-connection cable | -- | -- | -- | Max. 4 m |
| Cable 3 | Loudspeaker cable | -- | -- | -- | 2.6 m |
| Cable 4 | GPS cable | -- | -- | -- | 3 m |
| Cable 5 | DC power cable | -- | -- | -- | 2 m |

4. Description of test system set-up's

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

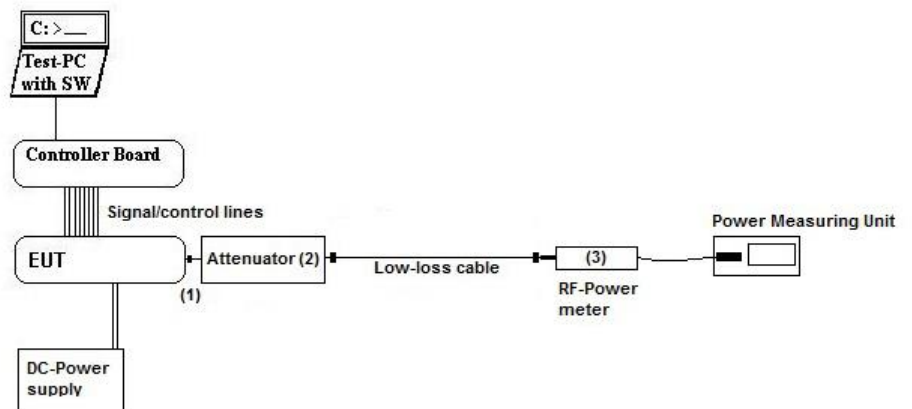
Conducted Set-up W1

W-LAN/Zigbee 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 v03r05

Used Equipment

| Passive Elements | Test Equipment | Remark: |
|--|---|---|
| <input checked="" type="checkbox"/> 20 dB Attenuator | <input checked="" type="checkbox"/> Power Meter | See List of equipment under each test case and chapter 8 for calibration info |
| <input checked="" type="checkbox"/> Low loss RF-cables | <input checked="" type="checkbox"/> DC-Power Supply | |
| | <input checked="" type="checkbox"/> Spectrum-Analyser | |

Measurement uncertainty

See chapter 5.10

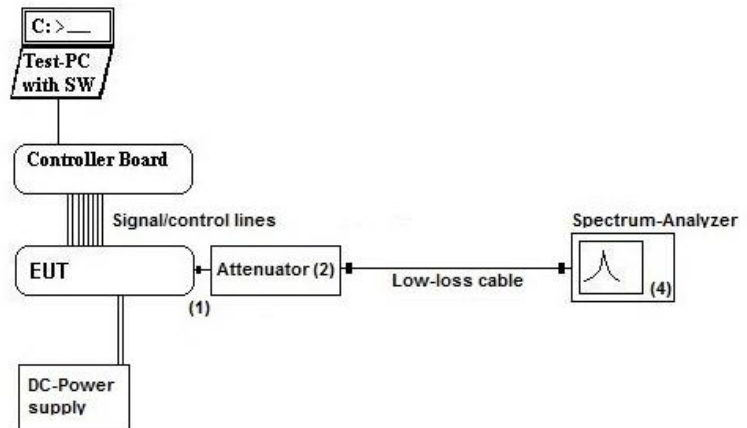
Conducted Set-up W2

W-LAN/Zigbee conducted RF-Setup 2 (W2 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 spectrum-analyzer (4) for RF-conducted 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 of the spectrum-analyzer.

Schematic:



Testing method:

ANSI C63.10:2013, KDB 558074 D01 DTS Meas.Guidance v03r05

Used Equipment

| Passive Elements | Test Equipment | Remark: |
|--|---|---|
| <input checked="" type="checkbox"/> 20 dB Attenuator | <input checked="" type="checkbox"/> Power Meter | See List of equipment under each test case and chapter 8 for calibration info |
| <input checked="" type="checkbox"/> Low loss RF-cables | <input checked="" type="checkbox"/> DC-Power Supply | |
| | <input checked="" type="checkbox"/> Spectrum-Analyser | |

Measurement uncertainty

See chapter 5.10

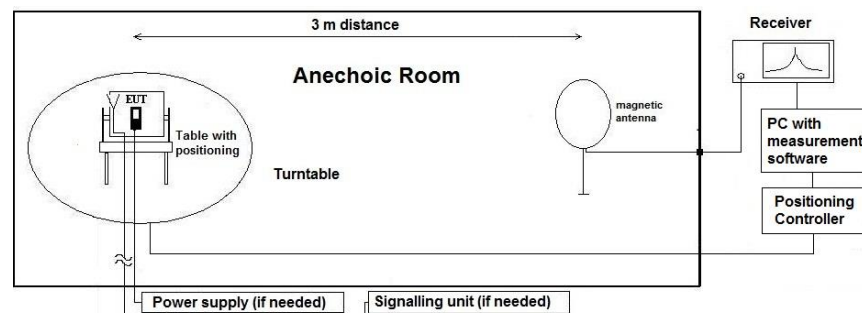
4.2. Test system set-up for radiated magnetic field measurements below 30 MHz

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 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 (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:

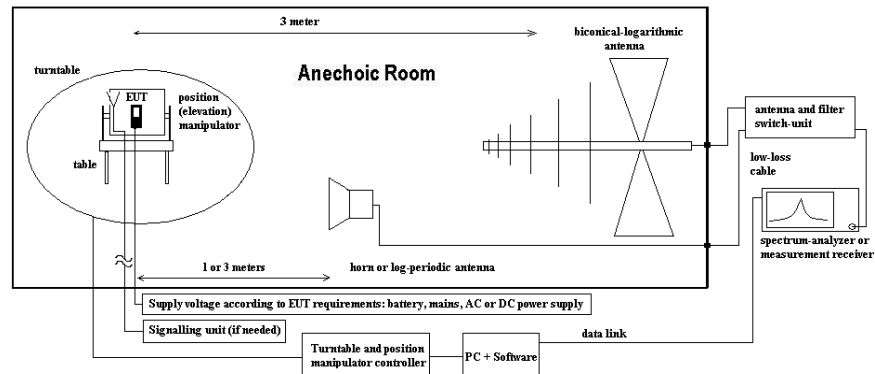
ANSI C63.10:2013, §6.4.4.2 - Equations (2) + (3) + (4)

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 its characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies

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

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

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

- 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

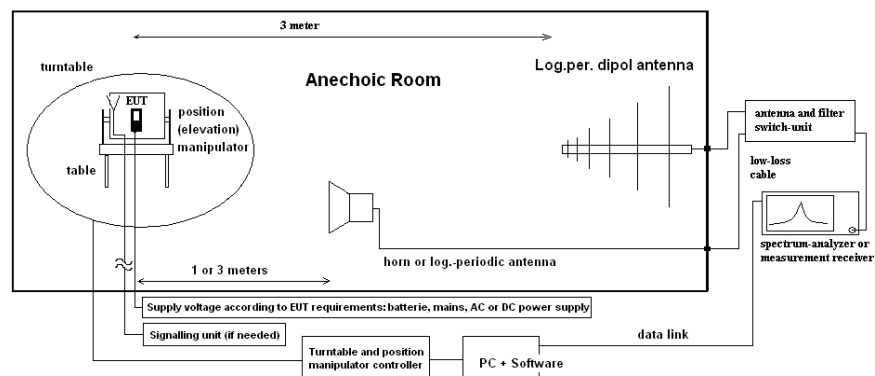
All units are dB-units, positive margin means value is below limit.

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 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 its 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:

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

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

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. 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 | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 348 EMI cond. | <input type="checkbox"/> 443 EMI FAR | <input checked="" type="checkbox"/> 347 Radio.lab. | <input type="checkbox"/> 337 OATS | <input type="checkbox"/> |
| equipment | <input type="checkbox"/> 331 HC 4055 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| spectr. analys. | <input checked="" type="checkbox"/> 683 FSU26 | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| power meter | <input type="checkbox"/> 262 NRV-S | <input type="checkbox"/> 266 NRV-Z31 | <input type="checkbox"/> 265 NRV-Z33 | <input type="checkbox"/> 261 NRV-Z55 | <input type="checkbox"/> 356 NRV-Z1 | <input type="checkbox"/> |
| multimeter | <input type="checkbox"/> 341 Fluke 112 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| DC power | <input type="checkbox"/> 086 LNG50-10 | <input type="checkbox"/> 087 EA3013 | <input type="checkbox"/> 354 NGPE 40 | <input type="checkbox"/> 349 car battery | <input type="checkbox"/> 350 Car battery | <input checked="" type="checkbox"/> 463 HP3245A |
| line voltage | <input checked="" type="checkbox"/> 14 V DC | | | <input type="checkbox"/> 060 120 V 60 Hz via PAS 5000 | | |
| otherwise | <input checked="" type="checkbox"/> 530 Attenuator 10dB | <input checked="" type="checkbox"/> K4 Cable | | | | |

Method of measurement: conducted
 radiated

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 middle channel only. It is assumed that no noticeable changes occur when tested on other channels or climatic conditions. The Duty-Cycle was constant, means without variations. Minimum and maximum modulation index was tested, the duty cycle is to be found therefore between a minimum and maximum values.

Results:

| WLAN-Modes | Marker 1 [BTS ON'] | Marker 2 [BTS ON'] | TX on | TX off | Converted to DC | 10log(1/DC) |
|---------------|--------------------|--------------------|-------------|-------------|-----------------|----------------------------|
| | us | us | us | us | | |
| b-Mode | | | | | | |
| 1MBit | 12279,615000 | 24599,359000 | 12279,61500 | 12319,74400 | 0,49918 | Remark¹⁾ |
| 11MBit | 1287,019000 | 1312,981000 | 1287,01900 | 25,96200 | 0,98023 | 0,08673 |
| g-Mode | | | | | | |
| 6MBit | 2027,564000 | 2057,212000 | 2027,56400 | 29,64800 | 0,9856 | 0,0630 |
| 54MBit | 243,269231 | 276,346154 | 243,26923 | 33,07692 | 0,8803 | 0,5537 |
| n-Mode | | | | | | |
| MCS0 | 1899,038000 | 1933,622000 | 1899,03800 | 34,58400 | 0,9821 | 0,0784 |
| MCS7 | 223,269231 | 255,288462 | 223,26923 | 32,01923 | 0,8746 | 0,5820 |

Remark¹⁾: Measured duty cycle value is lower than the marker uncertainty therefore this measurement can be neglected.

Calculated with following formulas:

| | | | |
|-------------|---|-------------------------|----------------------------------|
| Duty cycle: | $x = \frac{T_{x_{on}}}{T_{x_{on}} + T_{x_{off}}}$ | 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.

5.2. Maximum peak conducted output power

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

| | | | |
|-----------------|--|---|--|
| test location | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> 443 System CTC-FAR-EMI- | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 487 SAR NSA | <input checked="" type="checkbox"/> 347 Radio.lab. |
| receiver | <input type="checkbox"/> 377 ESCS30 | <input type="checkbox"/> 001 ESS | <input type="checkbox"/> 489 ESU 40 |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK |
| antenna | <input type="checkbox"/> 574 BTA-L | <input type="checkbox"/> 133 EMCO3115 | <input type="checkbox"/> 302 BBHA9170 |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 436 CMU | <input type="checkbox"/> 547 CMU |
| otherwise | <input checked="" type="checkbox"/> 266 NRV-Z31 | <input checked="" type="checkbox"/> 600 NRVD | <input type="checkbox"/> 110 USB LWL |
| DC power | <input type="checkbox"/> 456 EA 3013A | <input checked="" type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 459 EA 2032-50 |
| otherwise | <input type="checkbox"/> 331 HC 4055 | <input type="checkbox"/> 248 6 dB Attenuator | <input type="checkbox"/> 529 Power divider |
| | <input checked="" type="checkbox"/> 613 20dB Attenuator | <input type="checkbox"/> K 4 Cable kit | <input checked="" type="checkbox"/> - cable OTA20 |
| line voltage | <input checked="" type="checkbox"/> 14 VDC | <input type="checkbox"/> 060 110 V 60 Hz via PAS 5000 | |

5.2.2. Reference

| | |
|---------------|--|
| FCC | <input checked="" type="checkbox"/> § 15.247(b) (3) + KDB 558074 D01 DTS Meas Guidance v03r05 |
| IC | <input checked="" type="checkbox"/> RSS-247, Chapter 5.4(4) |
| ANSI | <input checked="" type="checkbox"/> ANSI 63.10:2013 |
| Specification | <i>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 signalling 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.</i> |

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 link to test system (if used): | <input type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input checked="" type="checkbox"/> none |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | <input checked="" type="checkbox"/> table top 1.5m height | <input type="checkbox"/> 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. The power was also checked for different data rates, modulation scheme or packet types if applicable.

MEASUREMENT METHOD/ SPECTRUM-ANALYZER SETTINGS:

| | | |
|-----------------------------------|---|---|
| Measurement Method ^{1.)} | §15.247(b) (3) Maximum Peak | 1.) <input type="checkbox"/> PK1-Method (§5.2.1.1): RBW > 6dB-bandwidth of the signal, ANSI 63.10: 2009, chapter 6.10.2.1a |
| | §15.247(b) (3) Maximum Average | 2.) <input type="checkbox"/> PK2-Method (§5.2.1.2): Channel integration method (ANSI 63.10:2009) 3.) <input checked="" type="checkbox"/> PK1-Method (§9.1.2 KDB): Peak Power Meter Method 4.) <input type="checkbox"/> AVG1 - power averaging over EBW + integrated band power measurement 5.) <input type="checkbox"/> AVG2 - trace averaging over EBW + integrated band power measurement 6.) <input type="checkbox"/> RMS power meter method |
| | MIMO | 7.) <input type="checkbox"/> Method as described in Chapter 3.8 was used for measurements on two available RF-Antenna ports. |
| Center Frequency | | Nominal channel frequency |
| Span | | 30% higher than the EBW measured before |
| Resolution Bandwidth (RBW) | | 1MHz |
| Video Bandwidth (VBW) | | 3MHz |
| 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 | | <input checked="" type="checkbox"/> normal <input type="checkbox"/> activated channel integration method with limits set to the EBW of the signal |

Remark 1: guidance 558074 D01 measurement DTS guidance V03r05

5.2.6. RESULTS

APPLICANT'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
- Maximum declared antenna gain [isotropic]: 5 dBi

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

| Max. Peak power (conducted) [dBm] | | | |
|--------------------------------------|-------------------------------|----------------------------------|---------------------------------|
| Set-up no: 3 Op-Mode: 1 | Low channel = 1 (2412 MHz) | Middle channel = 6 (2437 MHz) | High channel = 13 (2472 MHz) |
| Measured Level b-Mode | 1.51 (@1Mbps) | 0.25 (@1Mbps) | -0.26 (@1Mbps) |
| Measured Level g-Mode | 1.87 (@54Mbps) | 1.65 (@54Mbps) | 0.91 (@6Mbps) |
| Measured Level n-Mode @MCS6 | 1.76 (@MCS6) | 1.60 (@MCS6) | 1.19 (@MCS1) |
| Limit | 1 Watt (30dBm) Peak | | |

Remarks:

- 1.) External Path Loss -> set as either as correction factor in spectrum-analyzer or activated as transducer table
- 2.) maximum value among all data rates and modulations, pls. compare separate annex 1 for more details

5.2.6.1. VERDICT: Maximum value of 1.87 dBm Peak (1.53 mW) -> passed

5.3. RF-Parameter - Power Spectral Density

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

| | | | |
|-----------------|--|---|--|
| test location | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 487 SAR NSA | <input type="checkbox"/> 337 OATS |
| receiver | <input type="checkbox"/> 377 ESCS30 | <input type="checkbox"/> 001 ESS | <input type="checkbox"/> 489 ESU |
| spectr. analys. | <input type="checkbox"/> 489 ESU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK |
| power supply | <input checked="" type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 463 |
| | <input checked="" type="checkbox"/> 14 V DC | <input type="checkbox"/> 268 EA- 3050 | |
| otherwise | <input checked="" type="checkbox"/> 530 10dB Attenuator | <input type="checkbox"/> 494 AG6632A | |
| | | <input type="checkbox"/> 498 NGPE 40 | |
| | | <input type="checkbox"/> 060 110 V 60 Hz via PAS 5000 | |
| | | <input checked="" type="checkbox"/> cable K4 | |

5.3.2. REFERENCES: §15.247(e), RSS-247, Chapter 5.2(2)

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.3.3. TEST CONDITION AND MEASUREMENT TEST SET-UP

| | | | |
|--------------------------------------|--|--|--|
| Signal ink to test system (if used): | <input type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input checked="" type="checkbox"/> none |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | <input checked="" type="checkbox"/> table top | <input type="checkbox"/> floor standing | |
| Climatic conditions | Temperature: (22±3°C) | Rel. humidity: (40±20)% | |
| General measurement procedures | Please see chapter "Test system set-up for conducted RF-measurement at antenna Port" (W2 Set-up) | | |

5.3.4. 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.

5.3.5. MEASUREMENT METHOD/ SPECTRUM-ANALYZER SETTINGS

| | | |
|--------------------------------|---|--|
| Measurement Method | <input type="checkbox"/> ANSI 63.10:2009 | <input checked="" type="checkbox"/> PKPSD-Method |
| | | <input type="checkbox"/> AVGPSD Method |
| | <input checked="" type="checkbox"/> guidance 558074 D01 measurement DTS guidance v03r05 | |
| Center Frequency | Nominal channel frequency | |
| Span | 5..30% higher than the EBW measured before | |
| Resolution Bandwidth (RBW) | > 3 kHz (at least 3 times RBW) - pls. see diagram | |
| Video Bandwidth (VBW) | > 10 kHz - pls. see diagram | |
| Sweep time | coupled | |
| Detector | Peak, Max hold mode for method PKPSD or RMS method AVGPSD | |
| Sweep Mode | Repetitive mode, allow trace to stabilize (PKPSD) or single (AVGPSD) | |
| Addition of correction factors | external measuring set-up path-loss | |

Remarks:--

5.3.6. RESULTS

| Set-up no.: 3 Op. Mode: 1 | POWER SPECTRAL DENSITY [dBm/3 kHz] | | |
|------------------------------|---------------------------------------|----------------------------------|---------------------------------|
| | Low channel = 1 (2412 MHz) | Middle channel = 6 (2437 MHz) | High channel = 13 (2472 MHz) |
| Measured Level b-Mode | -11.99 (@1Mbps) | -13.00 (@1Mbps) | -12.65 (@1Mbps) |
| Measured Level g-Mode | -13.97 (@6Mbps) | -13.64 (@54Mbps) | -14.70 (@12Mbps) |
| Measured Level n-Mode | -14.06 (@MCS1) | -14.38 (@MCS6) | -14.98 (@MCS0) |
| Limit | < 8dBm/3 kHz | | |

Remark:

- 1.) Only maximum values among all data rates and modulations are given above. For other data rates please refer diagrams in separate annex A1

5.3.7. VERDICT: PASSED

5.4. RF-Parameter - 6 dB Bandwidth and 99% occupied Bandwidth

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

| | | | | | | |
|----------------------|---|--|---|--|---|--------------------------|
| test site | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 348 EMI cond. | <input type="checkbox"/> 443 EMI FAR | <input checked="" type="checkbox"/> 347 Radio.lab. | <input type="checkbox"/> 337 OATS | <input type="checkbox"/> |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK | <input type="checkbox"/> 489 ESU | <input checked="" type="checkbox"/> 683 FSU26 | <input type="checkbox"/> |
| attenuator | <input checked="" type="checkbox"/> 530 10 dB | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 436 CMU | <input type="checkbox"/> 547 CMU | | | |
| DC power | <input checked="" type="checkbox"/> 463 Power source | <input type="checkbox"/> 087 EA3013 | <input type="checkbox"/> 354 NGPE 40 | <input type="checkbox"/> 086 LNG50-10 | <input type="checkbox"/> | <input type="checkbox"/> |
| Power supply voltage | <input checked="" type="checkbox"/> 14 V DC | | <input type="checkbox"/> 060 110 V 60 Hz via PAS 5000 | | | |
| Others | <input checked="" type="checkbox"/> 530 10dB Attenuator | | <input checked="" type="checkbox"/> cable K5 | | | |

5.4.2. References of occupied and emission bandwidth

§15.247(a)(2), RSS-247, Chapter 5.2(1); RSS-Gen Issue 4: Chapter 4.6.2

(1) *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.*

(2) *DSSS Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.*

5.4.3. Test condition and measurement test set-up

| | | | |
|---------------------------------------|--|--|--|
| Signal link to test system (if used): | <input type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input checked="" type="checkbox"/> none |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | <input checked="" type="checkbox"/> table top | | <input type="checkbox"/> floor standing |
| Climatic conditions | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| General measurement procedures | Please see chapter "Test system set-up for conducted RF-measurement at antenna Port" (W2 Set-up) | | |

5.4.4. 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.

5.4.5. Measurement method:

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.). If applicable the hopping-mode is switched off.

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. The RBW value is readjusted and the measurement repeated until the RBW/EBW ratio is around 1%.

5.4.6. Spectrum-Analyzer settings:

| | |
|----------------------------|--|
| Span | Set as to fully display the emissions + 30% |
| Scale y display | approximate 30dB below the maximum PEAK level |
| Resolution Bandwidth (RBW) | <input type="checkbox"/> ANSI 63.10:2013 Set to initial value approx. 1% to 5% of the emission bandwidth, re-adjust and proof that RBW/EBW is between 1% and 5% <input checked="" type="checkbox"/> KDB558074v03r05 |
| Video Bandwidth (VBW) | Minimum 3 times the resolution bandwidth |
| Sweep time | Auto -coupled |
| Detector | Peak detector |
| Sweep mode | Repetitive Mode, MAX-HOLD, trace stabilization |

5.4.7. Results:

For graphical results pls. see annex 1 to this test report.

6dB BANDWIDTH:

| Set-up no.: 3 Op. Mode: 1 | 6dB BANDWIDTH [MHz] | | |
|---|-------------------------------|----------------------------------|---------------------------------|
| T _{NOM} =21°C, V _{NOM} = 14 V DC | Low channel = 1 (2412 MHz) | Middle channel = 6 (2437 MHz) | High channel = 13 (2472 MHz) |
| Measured Level b-Mode @1Mbps | 10.056089744 | -- | -- |
| Measured Level b-Mode @11Mbps | 10.256410256 | -- | -- |
| Measured Level g-Mode @6Mbps | 15.745192308 | -- | -- |
| Measured Level g-Mode @54Mbps | 16.426282051 | -- | -- |
| Measured Level n-Mode @MCS0 | -- | 17.147435897 | -- |
| Measured Level n-Mode @MCS7 | -- | 17.748397436 | -- |

Remark: 1.) minimum and maximum nominal data rates tested for channel with highest conducted power. The value indicated in above table represents maximum value at that data rate.
2.) Please refer extract of diagrams and results for different modulation types(Data rates) in separate document A1

Additional also the 99% occupied bandwidth were measured for worst-case 6dB bandwidth.

99% OCCUPIED BANDWIDTH:

| Set-up no.: 3 Op. Mode: 1 | 99% Bandwidth [MHz] | | |
|---|-------------------------------|----------------------------------|---------------------------------|
| T _{NOM} =21°C, V _{NOM} = 14 V DC | Low channel = 1 (2412 MHz) | Middle channel = 6 (2437 MHz) | High channel = 13 (2472 MHz) |
| Measured Level b-Mode @1Mbps | 13.568000000 | -- | -- |
| Measured Level b-Mode @11Mbps | 13.440000000 | -- | -- |
| Measured Level g-Mode @6Mbps | 16.408000000 | -- | -- |
| Measured Level g-Mode @54Mbps | 16.384000000 | -- | -- |
| Measured Level n-Mode @MCS0 | -- | 16.440000000 | -- |
| Measured Level n-Mode @MCS7 | -- | 17.656000000 | -- |

Remark: 1.) 99% occupied bandwidth values tested at minimum and maximum data rate on channel with highest conducted power.

VERDICT: DTS system requirements for 6dB-bandwidth according §15.247 (BW > 500kHz) passed

5.5. 20 dBc power specification

5.5.1. TEST LOCATION AND EQUIPMENT (for reference numbers please see chapter 'List of test equipment')

| | | | | | | |
|----------------------|--|---------------------------------------|---|---|--|--------------------------------------|
| test location | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | | <input checked="" type="checkbox"/> 443 System CTC-FAR-EMI- | | <input type="checkbox"/> Please see Chapter. 2.2.3 | |
| test site | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 487 SAR NSA | <input type="checkbox"/> 337 OATS | <input checked="" type="checkbox"/> 347 Radio.lab. | <input type="checkbox"/> | <input type="checkbox"/> |
| receiver | <input type="checkbox"/> 377 ESCS30 | <input type="checkbox"/> 001 ESS | <input type="checkbox"/> 489 ESU | <input checked="" type="checkbox"/> 683 FSU26 | <input type="checkbox"/> | <input type="checkbox"/> |
| spectr. analys. | <input type="checkbox"/> 489 ESU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| DC power supply | <input checked="" type="checkbox"/> 463 HP3245A | <input type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 | <input type="checkbox"/> 268 EA- 3050 | <input type="checkbox"/> 494 AG6632A | <input type="checkbox"/> 498 NGPE 40 |
| Power supply voltage | <input checked="" type="checkbox"/> 14 V DC | | | <input type="checkbox"/> 060 110 V 60 Hz via PAS 5000 | | |
| otherwise | <input checked="" type="checkbox"/> 530 10 dB Attenuator | | | <input checked="" type="checkbox"/> cable K4 | | |

5.5.2. REFERENCE: §15.247, §15.205 / RSS-247, CHAPTER 5.5

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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 the transmitter demonstrates compliance with the peak conducted power limits.

5.5.3. Test condition and measurement test set-up

| | | | |
|---------------------------------------|---|---|--|
| Signal link to test system (if used): | <input type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input checked="" type="checkbox"/> none |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | <input checked="" type="checkbox"/> table top 1.5m height | | <input type="checkbox"/> floor standing |
| Climatic conditions | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| Spectrum-Analyzer settings | Scan frequency range: | <input type="checkbox"/> 1 – 18 GHz <input type="checkbox"/> 18 – 25 GHz <input type="checkbox"/> 18 – 40 GHz <input checked="" type="checkbox"/> other: see diagrams | |
| | Scan-Mode | <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3 dB Spectrum analyser Mode | |
| | Detector | Peak and Average | |
| | RBW/VBW | 100kHz/300kHz | |
| | Mode: | Repetitive-Scan, max-hold | |
| | Scan step | 40kHz | |
| | 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" for general measurements procedures in anechoic chamber. | | |

5.5.4. EUT SETTINGS

For FHHS-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 to applicants instructions.

5.5.5. MEASUREMENT METHOD

According guidance 558074 D01 measurement DTS guidance V03r05: the frequency spectrum was investigated for conducted spurious emissions values lower than 20dB related to the RF-carrier power value. Three carrier frequencies (low/middle/high channel) were used for showing the compliance with this requirement. First a In-Band Reference level measurement of the carrier was performed. The video bandwidth (VBW) was chosen 10 times the resolution bandwidth (RBW). The frequency scan was up to 10 times the highest channel frequency within the operational mode. The spectrum-analyzer was set to MAX-PEAK Detector, MAX-Hold Mode, trace stabilisation mode.

5.5.6. TABLE OF MEASUREMENT RESULTS:

5.5.6.1. Op. Mode: b-Mode,1MBit

| Set-up no.: 3 Op-Mode: 1 | RF-Conducted test: 20 dBc spurious emissions | | | | | |
|-----------------------------|---|-------------|---|-------------|--|-------------|
| Frequency Range | Low channel =1 (2412 MHz) Level Reference (In-Band)= -7.01 dBm Limit=-27.01 dBm | | Middle channel = 6 (2437 MHz) Level Reference (In-Band) = -7.86 dBm Limit= -27.86 dBm | | High channel = 13 (2472 MHz) Level Reference (In-Band)= -8.18 dBm Limit=-28.18 dBm | |
| | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] |
| 150kHz to 30MHz | 8.95 | 38.53 | 16.51 | 37.53 | 28.32 | 36.91 |
| 30MHz to 2.8 GHz | 1250.75 | 37.24 | 1397.24 | 36.26 | 1201.92 | 36.28 |
| | | | | | 1623.63 | 36.02 |
| 2.8 to 25 GHz | 7353.84 | 35.83 | 5966.34 | 35.83 | 15323.07 | 34.59 |
| | 23043.26 | 35.11 | 11943.26 | 35.14 | 18204.80 | 33.73 |
| | -- | -- | 21584.61 | 33.53 | -- | -- |
| Band-Edge | -- | > 39.86 | -- | -- | -- | > 36.82 |

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

5.5.6.2. Op. Mode: g-Mode, Ch 1/ Ch6 : 54MBit / Ch13:6MBit

| Set-up no.: 3 Op-Mode: 1 | RF-Conducted test: 20 dBc spurious emissions | | | | | |
|-----------------------------|--|-------------|---|-------------|---|-------------|
| Frequency Range | Low channel =1 (2412 MHz) Level Reference (In-Band)= -8.83 dBm Limit= -28.83 dBm | | Middle channel = 6 (2437 MHz) Level Reference (In-Band) = -9.22 dBm Limit= -29.22 dBm | | High channel = 13 (2472 MHz) Level Reference (In-Band)= -9.16 dBm Limit= -29.16 dBm | |
| | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] |
| 150kHz to 30MHz | 14.26 | 36.57 | 27.94 | 36.01 | 2.49 | 35.19 |
| 30MHz to 2.8 GHz | 1126.458 | 35.88 | 593.76 | 35.44 | 491.666 | 35.53 |
| | | | 2706.77 | 34.70 | | |
| 2.8 to 25 GHz | 4151.92 | 34.92 | 9025.96 | 34.23 | 11978.84 | 33.95 |
| | 14469.23 | 33.71 | 22260.57 | 32.53 | 24359.61 | 32.77 |
| | 23363.46 | 32.84 | -- | -- | -- | -- |
| Band-Edge | -- | >32.17 | -- | -- | -- | >32.84 |

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

5.5.6.3. Op. Mode: n-Mode, Ch 1/6 MCS6 / Ch13:MCS1

| Set-up no.: 3 Op-Mode: 1 | RF-Conducted test: 20 dBc spurious emissions | | | | | |
|-----------------------------|---|-------------|---|-------------|--|-------------|
| Frequency Range | Low channel =1 (2412 MHz) Level Reference (In-Band) = -8.89 dBm Limit= -28.89 dBm | | Middle channel = 6 (2437 MHz) Level Reference (In-Band) = -9.62 dBm Limit= -29.62 dBm | | High channel = 13 (2472 MHz) Level Reference (In-Band) = -9.47 dBm Limit= -29.47 dBm | |
| | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] | Frequency [MHz] | Value [dBc] |
| 150kHz to 30MHz | 29.61 | 36.64 | 23.68 | 35.48 | 10.57 | 35.67 |
| 30MHz to 2.8 GHz | 608.65 | 35.72 | 2009.83 | 34.36 | 1268.50 | 35.09 |
| | 1184.38 | 35.56 | | | | |
| 2.8 to 25 GHz | 6926.92 | 35.08 | 10377.88 | 32.95 | 15821.15 | 32.65 |
| | 16034.61 | 33.32 | 21620.19 | 31.60 | 22367.30 | 32.39 |
| | 20979.80 | 32.97 | -- | -- | -- | -- |
| Band-Edge | -- | > 33.84 | -- | -- | -- | >32.53 |

Remark: 1.) see diagrams in separate document A1

2.)The limit on the diagrams is 20dB under the reference level measured In-Band for each channel

5.5.7. TEST RESULT: PASSED

5.6. General Limit - Radiated field strength emissions below 30 MHz

5.6.1. Test location and equipment

| | | | |
|-----------------|--|--|--|
| test location | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site | <input checked="" type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 487 SAR NSA | <input type="checkbox"/> 347 Radio.lab. |
| receiver | <input type="checkbox"/> 377 ESCS30 | <input checked="" type="checkbox"/> 001 ESS | <input type="checkbox"/> |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK |
| antenna | <input type="checkbox"/> 574 BTA-L | <input type="checkbox"/> 133 EMCO3115 | <input type="checkbox"/> 302 BBHA9170 |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 371 CBT32 | <input type="checkbox"/> 547 CMU |
| otherwise | <input type="checkbox"/> 400 FTC40x15E | <input type="checkbox"/> 401 FTC40x15E | <input type="checkbox"/> 110 USB LWL |
| DC power | <input type="checkbox"/> 456 EA 3013A | <input checked="" type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 |
| line voltage | <input checked="" type="checkbox"/> 14 V DC | <input type="checkbox"/> 060 120 V 60 Hz | via PAS 5000 |

5.6.2. Requirements

| FCC | Part 15, Subpart C, §15.205 & §15.209 | | | |
|-----------------|---------------------------------------|-----------------------|--------------|---|
| IC | RSS-Gen: Issue 4: §8.9 Table 5 | | | |
| ANSI | C63.10-2013 | | | |
| Frequency [MHz] | Field strength limit | | Distance [m] | Remarks |
| | [µV/m] | [dBµV/m] | | |
| 0.009 – 0.490 | 2400/f (kHz) | 67.6 – 20Log(f) (kHz) | 300 | Correction factor used due to measurement distance of 3 m |
| 0.490 – 1.705 | 24000/f (kHz) | 87.6 – 20Log(f) (kHz) | 30 | Correction factor used due to measurement distance of 3 m |
| 1.705 – 30 | 30 | 29.5 | 30 | Correction factor used due to measurement distance of 3 m |

5.6.3. Test condition and test set-up

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

5.6.4. 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. For more information please see the diagrams.

Table of measurement results:

| Diagram No. | Carrier Channel | | Frequency range | Set-up no. | OP-mode no. | Remark | Used detector | | | Result |
|-------------|-----------------|-----|-----------------|------------|-------------|----------------|-------------------------------------|--------------------------|--------------------------|--------|
| | Range | No. | | | | | PK | AV | QP | |
| 2.01 | Low | 1 | 9 kHz-30 MHz | 1 | 1 | b-Mode,11Mbit | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 2.02 | Middle | 6 | 9 kHz-30 MHz | 1 | 1 | g-Mode, 12Mbit | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |
| 2.03 | High | 13 | 9 kHz-30 MHz | 1 | 1 | n-Mode,MCS0 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | passed |

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

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

5.7.1. Test location and equipment

| | | | |
|-----------------|---|---|--|
| test location | <input checked="" type="checkbox"/> CETECOM Essen (Chapter. 2.2.1) | <input type="checkbox"/> Please see Chapter. 2.2.2 | <input type="checkbox"/> Please see Chapter. 2.2.3 |
| test site | <input checked="" type="checkbox"/> 441 EMI SAR <input checked="" type="checkbox"/> 487 SAR NSA | | |
| receiver | <input type="checkbox"/> 377 ESCS30 <input checked="" type="checkbox"/> 001 ESS | <input type="checkbox"/> 489 ESU 40 | <input type="checkbox"/> 620 ESU 26 |
| spectr. analys. | <input type="checkbox"/> 584 FSU <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK | |
| antenna | <input checked="" type="checkbox"/> 574 BTA-L <input type="checkbox"/> 133 EMCO3115 | <input type="checkbox"/> 302 BBHA9170 | <input type="checkbox"/> 289 CBL 6141 <input type="checkbox"/> 030 HFH-Z2 <input type="checkbox"/> 477 GPS |
| signaling | <input type="checkbox"/> 392 MT8820A <input type="checkbox"/> 371 CBT32 | <input type="checkbox"/> 547 CMU | <input type="checkbox"/> 594 CMW |
| otherwise | <input type="checkbox"/> 400 FTC40x15E <input type="checkbox"/> 401 FTC40x15E | <input type="checkbox"/> 110 USB LWL | <input checked="" type="checkbox"/> 482 Filter Matrix |
| DC power | <input type="checkbox"/> 456 EA 3013A <input checked="" type="checkbox"/> 457 EA 3013A | <input type="checkbox"/> 459 EA 2032-50 | <input type="checkbox"/> 268 EA- 3050 <input type="checkbox"/> 494 AG6632A <input type="checkbox"/> 498 NGPE |
| line voltage | <input checked="" type="checkbox"/> 14 V DC | <input type="checkbox"/> 060 120 V 60 Hz via PAS 5000 | |

5.7.2. Requirements/Limits

| | | | |
|--------------|-----------------|---|---------------------------|
| FCC | | <input type="checkbox"/> Part 15 Subpart B, §15.109, class B <input checked="" type="checkbox"/> Part 15 Subpart C, §15.209 @ frequencies defined in §15.205 | |
| IC | | <input checked="" type="checkbox"/> RSS-Gen., Issue 4, Chapter 8.9, Table 4+6 (licence-exempt radio apparatus) <input type="checkbox"/> RSS-Gen., Issue 4, Chapter 7.1.2, Table 2 (receiver) <input type="checkbox"/> ICES-003, Issue 6, Table 5 (Class B) <input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 5 | |
| ANSI | | <input type="checkbox"/> C63.4-2014 <input checked="" type="checkbox"/> C63.10-2013 | |
| Limit | Frequency [MHz] | Radiated emissions limits, 3 meters | |
| | | QUASI Peak [μ V/m] | QUASI-Peak [dB μ V/m] |
| | 30 - 88 | 100 | 40.0 |
| | 88 - 216 | 150 | 43.5 |
| | 216 - 960 | 200 | 46.0 |
| | above 960 | 500 | 54.0 |

5.7.3. Restricted bands of operation (FCC §15.205/ RSS-Gen, Issue 4 Chapter 8.9, Table 4)

| 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

5.7.4. Test condition and measurement test set-up

| | | | | |
|---------------------------------------|---|---|--|--|
| Signal link to test system (if used): | | <input type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input checked="" type="checkbox"/> none |
| EUT-grounding | | <input type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | | <input checked="" type="checkbox"/> table top 0.8m height | | <input type="checkbox"/> floor standing |
| Climatic conditions | | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| EMI-Receiver (Analyzer) Settings | Scan frequency range: | <input checked="" type="checkbox"/> 30 – 1000 MHz <input type="checkbox"/> other: | | |
| | Scan-Mode | <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 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" | | |

5.7.5. 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 | |
| 3.02 | Low | 1 | 30 MHz – 1 GHz | 1 | 1 | b-Mode, 11Mbit | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | passed |
| 3.03 | Middle | 6 | | 1 | 1 | g-Mode, 12Mbit | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | passed |
| 3.04 | High | 13 | | 1 | 1 | n-Mode, MCS0 | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | passed |

Remark:

5.8. General Limit - Radiated emissions, above 1 GHz

5.8.1. Test location and equipment FAR

| | | | | | | |
|-----------------|---|--|---|---|--|----------------------------------|
| test site | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 348 EMI cond. | <input checked="" type="checkbox"/> 443 EMI FAR | <input type="checkbox"/> 347 Radio.lab. | <input type="checkbox"/> 337 OATS | <input type="checkbox"/> |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK | <input checked="" type="checkbox"/> 489 ESU 40 | <input type="checkbox"/> | <input type="checkbox"/> |
| antenna meas | <input type="checkbox"/> 574 BTA-L | <input type="checkbox"/> 289 CBL 6141 | <input type="checkbox"/> 608 HL 562 | <input checked="" type="checkbox"/> 549 HL025 | <input checked="" type="checkbox"/> 302 BBHA9170 | <input type="checkbox"/> 477 GPS |
| antenna meas | <input type="checkbox"/> 123 HUF-Z2 | <input type="checkbox"/> 132 HUF-Z3 | <input type="checkbox"/> 030 HFH-Z2 | <input checked="" type="checkbox"/> 376 BBHA9120E | <input type="checkbox"/> | <input type="checkbox"/> |
| antenna subst | <input type="checkbox"/> 071 HUF-Z2 | <input type="checkbox"/> 020 EMCO3115 | <input type="checkbox"/> 063 LP 3146 | <input type="checkbox"/> 303 BBHA9170 | <input type="checkbox"/> | <input type="checkbox"/> |
| multimeter | <input type="checkbox"/> 341 Fluke 112 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 371 CBT32 | <input type="checkbox"/> 547 CMU | <input type="checkbox"/> 594 CMW | <input type="checkbox"/> | <input type="checkbox"/> |
| DCpower | <input type="checkbox"/> 086 LNG50-10 | <input checked="" type="checkbox"/> 087 EA3013 | <input type="checkbox"/> 354 NGPE 40 | <input type="checkbox"/> 349 car battery | <input type="checkbox"/> 350 Car battery | <input type="checkbox"/> |
| line voltage | <input checked="" type="checkbox"/> 14 V DC | | <input type="checkbox"/> 060 120 V 60 Hz via PAS 5000 | | | |

5.8.2. Requirements/Limits (CLASS B equipment)

| FCC | <input type="checkbox"/> Part 15 Subpart B, §15.109 class B <input checked="" type="checkbox"/> Part 15 Subpart C, §15.209 for frequencies defined in §15.205 <input type="checkbox"/> Part 15 Subpart C, §15.407(b)(1)(2)(3) 9 | | | |
|---|--|-------------|-------------|----------------------------|
| IC | <input checked="" type="checkbox"/> RSS-Gen., Issue 4, Chapter 8.9, Table 4+6 (transmitter licence exempt) <input type="checkbox"/> RSS-Gen., Issue 4, Chapter 8.9, Table 2 (receiver) <input type="checkbox"/> ICES-003, Issue 6, Chapter 6.2.2, Table 7 (class B) <input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 6 | | | |
| ANSI | <input type="checkbox"/> C63.4-2014 <input checked="" type="checkbox"/> C63.10-2013 | | | |
| | Limits | | | |
| Frequency [MHz] | 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 4, §8.10 - Table 6 | 500 | 54.0 | 5000 | 74.0 dBµV/m |

5.8.3. Test condition and measurement test set-up

| | | | |
|---------------------------------------|--|--|--|
| Signal link to test system (if used): | <input type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input checked="" type="checkbox"/> none |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | <input checked="" type="checkbox"/> table top 1.5m height | | <input type="checkbox"/> floor standing |
| Climatic conditions | Temperature: (22±3°C) | | Rel. humidity: (40±20)% |
| Spectrum-Analyzer settings | Scan frequency range: <input checked="" type="checkbox"/> 1 – 18 GHz <input type="checkbox"/> 18 – 25 GHz <input type="checkbox"/> 18 – 40 GHz <input type="checkbox"/> other: <input checked="" type="checkbox"/> 6 dB EMI-Receiver Mode <input type="checkbox"/> 3 dB Spectrum analyser Mode Peak and Average 1 MHz / 3 MHz Mode: Repetitive-Scan, max-hold 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" | | |

5.8.4. Measurement Results

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

| Diagram no. | Carrier Channel | | Frequency range | Set-up no. | OP-mode no. | Remark | Used detector | | | Result |
|-------------|-----------------|-----|-----------------|------------|-------------|---|-------------------------------------|-------------------------------------|--------------------------|--------|
| | Range | No. | | | | | PK | AV | QP | |
| 4.01 | Low | 1 | 1-18 GHz | 2 | 1 | b-Mode, 11Mbit | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| | | | 18-25GHz | 2 | 1 | Not performed Only conducted measurements no spurious or harmonics except noise level detected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 4.02 | Middle | 6 | 1-18 GHz | 2 | 1 | g-Mode, 12Mbit | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| | | | 18-25GHz | 2 | 1 | Not performed Only conducted measurements no spurious or harmonics except noise level detected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |
| 4.04 | High | 13 | 1-18 GHz | 2 | 1 | n-Mode, MCS2 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | passed |
| | | | 18-25GHz | 2 | 1 | Not performed Only conducted measurements no spurious or harmonics except noise level detected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | -- |

Remark: see diagrams in annex 1 for more details

5.9. RF-Parameter - Radiated Band Edge compliance measurements

5.9.1. Test location and equipment FAR

| | | | | | | |
|-----------------|---|--|---|--|--|----------------------------------|
| test site | <input type="checkbox"/> 441 EMI SAR | <input type="checkbox"/> 348 EMI cond. | <input checked="" type="checkbox"/> 443 EMI FAR | <input type="checkbox"/> 347 Radio.lab. | <input type="checkbox"/> 337 OATS | <input type="checkbox"/> |
| spectr. analys. | <input type="checkbox"/> 584 FSU | <input type="checkbox"/> 120 FSEM | <input type="checkbox"/> 264 FSEK | <input checked="" type="checkbox"/> 489 ESU 40 | <input type="checkbox"/> | <input type="checkbox"/> |
| antenna meas | <input type="checkbox"/> 574 BTA-L | <input type="checkbox"/> 289 CBL 6141 | <input type="checkbox"/> 608 HL 562 | <input checked="" type="checkbox"/> 549 HL025 | <input type="checkbox"/> 302 BBHA9170 | <input type="checkbox"/> 477 GPS |
| antenna meas | <input type="checkbox"/> 123 HUF-Z2 | <input type="checkbox"/> 132 HUF-Z3 | <input type="checkbox"/> 030 HFH-Z2 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| antenna subst | <input type="checkbox"/> 071 HUF-Z2 | <input type="checkbox"/> 020 EMCO3115 | <input type="checkbox"/> 063 LP 3146 | <input type="checkbox"/> 303 BBHA9170 | <input type="checkbox"/> | <input type="checkbox"/> |
| multimeter | <input type="checkbox"/> 341 Fluke 112 | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| signaling | <input type="checkbox"/> 392 MT8820A | <input type="checkbox"/> 371 CBT32 | <input type="checkbox"/> 547 CMU | <input type="checkbox"/> 594 CMW | <input type="checkbox"/> | <input type="checkbox"/> |
| DC power | <input type="checkbox"/> 086 LNG50-10 | <input checked="" type="checkbox"/> 087 EA3013 | <input type="checkbox"/> 354 NGPE 40 | <input type="checkbox"/> 349 car battery | <input type="checkbox"/> 350 Car battery | <input type="checkbox"/> |
| line voltage | <input checked="" type="checkbox"/> 14 V DC | | <input type="checkbox"/> 060 120 V 60 Hz via PAS 5000 | | | |

5.9.2. Requirements/Limits

| | |
|-------------|--|
| FCC | <input type="checkbox"/> Part 15 Subpart B, §15.109 class B <input checked="" type="checkbox"/> Part 15 subpart C, §15.209 @ frequencies defined in §15.205 |
| IC | <input type="checkbox"/> RSS-210, Issue 8, Annex 8 <input checked="" type="checkbox"/> RSS-247, Issue 1, Chapter 5.5; RSS-Gen: Issue 4: §8.9 Table 4+5+6 <input checked="" type="checkbox"/> RSS-Gen: Issue 4: §8.9, Table 4+6 |
| ANSI | <input checked="" type="checkbox"/> C63.10-2013, Chapter 6.10.6 |

5.9.3. Test condition and measurement test set-up

| | | | |
|---------------------------------------|---|---|--|
| Signal link to test system (if used): | <input type="checkbox"/> air link | <input type="checkbox"/> cable connection | <input checked="" type="checkbox"/> none |
| EUT-grounding | <input checked="" type="checkbox"/> none | <input type="checkbox"/> with power supply | <input type="checkbox"/> additional connection |
| Equipment set up | <input checked="" type="checkbox"/> table top 1.5m height | | <input type="checkbox"/> floor standing |
| Climatic conditions | | Temperature: (22±3°C) | Rel. humidity: (40±20)% |
| Spectrum-Analyzer settings | Scan frequency range: | <input type="checkbox"/> 1 – 18 GHz <input type="checkbox"/> 18 – 25 GHz <input type="checkbox"/> 18 – 40 GHz <input checked="" type="checkbox"/> other: see diagrams | |
| | Scan-Mode | <input type="checkbox"/> 6 dB EMI-Receiver Mode <input checked="" type="checkbox"/> 3 dB Spectrum analyser Mode | |
| | Detector | Peak and Average | |
| | RBW/VBW | Left band-edge: 100kHz/300kHz Right band-edge: 1 MHz / 3 MHz | |
| | Mode: | Repetitive-Scan, max-hold | |
| Scan step | 40kHz or 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" for general measurements procedures in anechoic chamber. | | |

5.9.4. 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 4, Chapter 8.10, Table 6 with the general limits of FCC §15.209 or RSS-Gen, Issue 4 Chapter 8.9, Table 4.

5.9.5. EUT settings

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

5.9.6. Results:for non-restricted bands near-by

5.9.6.1. Non-restricted bands near-by - limits according FCC §15.247 and RSS-247, Issue 1, Chapter 5.5

| Diagram 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 | | | | | | |
| 9.01a | 1 | no | 82,93 | 74,47 | 56 | 26,93 | 20 | 6,93 | PASS | b-Mode, 11MBit PWR-VALUE=0 dBm used |
| 9.02a | 1 | no | 82,60 | 73,65 | 57 | 25,6 | 20 | 5,6 | PASS | g-Mode, 12MBit PWR-VALUE=0 dBm used |
| 9.03a | 1 | no | 80,36 | 72,02 | 57,5 | 22,86 | 20 | 2,86 | PASS | n-Mode, MCS2 PWR-VALUE=0 dBm used |

Remark: Refer chapter 5.1 for applicable duty-cycle correction factor for AV value maximum 0.6 dB additional to be considered on n-Mode modulation

5.9.6.2. Restricted bands near-by

(§15.205 with limits accord. FCC §15.209) and (RSS-Gen, Issue4, Chapter 8.10)

| Diagram No. | Channel no. | Restricted band ? | Fundamental Value [dBuV/m] | | Value at Band-Edge [dBuV/m] | | Limits [dBuV/m] | | Margin [dB] | | Verdict | Remark: |
|-------------|-------------|-------------------|----------------------------|---------------|-----------------------------|----------------|-----------------|----------------|-------------|---------|---------|-------------------------------------|
| | | | Peak-Value | Average-Value | Peak -Value | Average -Value | Peak -Value | Average -Value | Peak | Average | | |
| 9.01b | 11 | yes | 91,44 | 84,57 | 57,82 | 46,17 | 74 | 54 | 16,18 | 7,83 | PASS | b-Mode, 11MBit PWR-VALUE=0 dBm used |
| 9.02b | 11 | yes | 92,70 | 82,72 | 65 | 51,5 | 74 | 54 | 9 | 2,5 | PASS | g-Mode, 12MBit PWR-VALUE=0 dBm used |
| 9.03b | 11 | yes | 92,08 | 82,48 | 65 | 52 | 74 | 54 | 9 | 2 | PASS | n-Mode, MCS2 PWR-VALUE=0 dBm used |

Remark: Refer chapter 5.1 for applicable duty-cycle correction factor for AV value maximum 0.6 dB additional to be considered on n-Mode modulation

5.9.7. Verdict: passed

5.10. 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 | 4.0 dB | | | | | | - |
| | | 150 kHz - 30 MHz | 3.6 dB | | | | | | |
| Radiated emissions Enclosure | CISPR 16-2-3 | 30 MHz - 1 GHz | 4.2 dB | | | | | | E-Field |
| | | 1 GHz - 18 GHz | 5.1 dB | | | | | | |
| 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 | 5.0 dB | | | | | | Magnetic field E-field Substitution |
| | | 30 MHz - 1 GHz | 4.2 dB | | | | | | |
| | | 1 GHz - 20 GHz | 3.17 dB | | | | | | |

Table: measurement uncertainties, valid for conducted/radiated measurements

6. Abbreviations used in this report

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

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

| Ref.-No. | Accreditation Certificate | Valid for laboratory area or test site | Accreditation Body |
|---|--|---|---|
| - | D-PL-12047-01-01 | All laboratories and test sites of CETECOM GmbH, Essen | DAkkS, Deutsche Akkreditierungsstelle GmbH |
| 337 487 558 348 348 | (MRA US-EU 0003) | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur. | FCC, Federal Communications Commission Laboratory Division, USA |
| 337 487 550 558 | 3462D-1 3462D-2 3462D-2 3462D-3 | Radiated Measurements 30 MHz to 1 GHz, 3 m / 10 m (OATS) Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Radiated Measurements above 1 GHz, 3 m (FAR) | IC, Industry Canada Certification and Engineering Bureau |
| 487 550 348 348 | R-2666 G-301 C-2914 T-1967 | Radiated Measurements 30 MHz to 1 GHz, 3 m (SAR) Radiated Measurements 1 GHz to 6 GHz, 3 m (SAR) Mains Ports Conducted Interference Measurements Telecommunication Ports Conducted Interference Measur. | VCCI, Voluntary Control Council for Interference by Information Technology Equipment, Japan |
| OATS = Open Area Test Site, SAR = Semi Anechoic Room, FAR = Fully Anechoic Room | | | |

8. Instruments and Ancillary

8.0.1. Test software and firmware of equipment

| Ref.-No. | Equipment | Type | Serial-No. | Version of Firmware or Software during the test |
|----------|---|------------------------|----------------|---|
| 001 | EMI Test Receiver | ESS | 825132/017 | Firm.= 1.21 , OTP=2.0, GRA=2.0 |
| 012 | Signal Generator (EMS-cond.) | SMY 01 | 839069/027 | Firm.= V 2.02 |
| 013 | Power Meter (EMS cond.) | NRVD | 839111/003 | Firm.= V 1.51 |
| 017 | Digital Radiocommunication Tester | CMD 60 M | 844365/014 | Firmware = V 3.52 .22.01.99, DECT = D2.87 13.01.99 |
| 053 | Audio Analyzer | UPA3 | 860612/022 | Firm. V 4.3 |
| 119 | RT Harmonics Analyzer dig. Flickermeter | B10 | G60547 | Firm.= V 3.1DHG |
| 140 | Signal Generator | SMHU | 831314/006 | Firm.= 3.21 |
| 261 | Thermal Power Sensor | NRV-Z55 | 825083/0008 | EPROM-Datum 02.12.04, SE EE 1 B |
| 262 | Power Meter | NRV-S | 825770/0010 | Firm.= 2.6 |
| 263 | Signal Generator | SMP 04 | 826190/0007 | Firm.=3.21 |
| 264 | Spectrum Analyzer | FSEK 30 | 826939/005 | Bios=2.1, Analyzer= 3.20 |
| 295 | Racal Digital Radio Test Set | 6103 | 1572 | UNIT Firmware= 4.04, SW-Main=4.04, SW-BBP=1.04, SW-DSP=1.02, Hardboot=1.02, Softboot=2.02 |
| 298 | Univ. Radio Communication Tester | CMU 200 | 832221/091 | R&S Test Firmware =3.53 /3.54 (current Testsoftw. f. all band used |
| 323 | Digital Radiocommunication Tester | CMD 55 | 825878/0034 | Firm.= 3.52 .22.01.99 |
| 331 | Climatic Test Chamber -40/+80 Grad | HC 4055 | 43146 | TSI 1.53 |
| 335 | CTC-EMS-Conducted | System EMS Conducted | - | EMC 32 V 8.52 |
| 340 | Digital Radiocommunication Tester | CMD 55 | 849709/037 | Firm.= 3.52 .22.01.99 |
| 355 | Power Meter | URV 5 | 891310/027 | Firm.= 1.31 |
| 365 | 10V Insertion Unit 50 Ohm | URV5-Z2 | 100880 | Eprom Data = 31.03.08 |
| 366 | Ultra Compact Simulator | UCS 500 M4 | V0531100594 | Firm. UCS 500=001925/3.06a02, rc=ISMIEC 4.10 |
| 371 | Bluetooth Tester | CBT32 | 100153 | CBT V5.30+ SW-Option K55, K57 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Firm.= 2.30, OTP= 02.01, GRA= 02.36 |
| 378 | Broadband RF Field Monitor | RadiSense III | 03D00013SNO-08 | Firm.= V.03D13 |
| 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 | - | 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 | dit0307022 | V 2.30 |
| 524 | Voltage Drop Simulator | VDS 200 | 0196-16 | Software Nr: 000037 Version V4.20a01 |
| 526 | Burst Generator | EFT 200 A | 0496-06 | Software Nr. 000034 Version V2.32 |
| 527 | Micro Pulse Generator | MPG 200 B | 0496-05 | Software-Nr. 000030 Version V2.43 |
| 528 | Load Dump Simulator | LD 200B | 0496-06 | Software-Nr. 000031 Version V2.35a01 |
| 546 | Univ. Radio Communication Tester | CMU 200 | 106436 | R&S Test Firmware Base=5.14, GSM=5.14 WCDMA=5.14 (current Testsoftw.,f. all band to be used |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | R&S Test Firmware Base=V5.1403 (current Testsoftw., f. all band used, GSM = 5.14 WCDMA: = 5.14 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | 2.82_SP3 |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | R&S Test Firmware Base=5.01, GSM=5.02 WCDMA= not installed, Mainboard= µP1=V.850 |
| 598 | Spectrum Analyzer | FSEM 30 (Reserve) | 831259/013 | Firmware Bios 3.40 , Analyzer 3.40 Sp 2 |
| 620 | EMI Test Receiver | ESU 26 | 100362 | 4.43_SP3 |
| 642 | Wideband Radio Communication Tester | CMW 500 | 126089 | Setup V03.26, Test programm component V03.02.20 |
| 692 | Bluetooth Tester | CBT 32 | 100236 | CBT V 5.40, FW: V.2.41 (FPGA Digital, V. 3.09 FPGA RF) |

8.0.2. Single instruments and test systems

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|----------|---|------------------------------|--------------|------------------------|-------------------------|--------|------------|
| 001 | EMI Test Receiver | ESS | 825132/017 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 005 | AC - LISN (50 Ohm/50µH, test site 1) | ESH2-Z5 | 861741/005 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 007 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 892563/002 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 009 | Power Meter (EMS-radiated) | NRV | 863056/017 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 016 | Line Impedance Simulating Network | Op. 24-D | B6366 | Spitzenberger+Spies | 36 M | - | 31.05.2016 |
| 020 | Horn Antenna 18 GHz (Subst 1) | 3115 | 9107-3699 | EMCO | 36/12 M | - | 31.03.2017 |
| 021 | Loop Antenna (H-Field) | 6502 | 9206-2770 | EMCO | 36 M | - | 30.04.2018 |
| 030 | Loop Antenna (H-field) | HFH-Z2 | 879604/026 | Rohde & Schwarz | 36 M | - | 30.04.2018 |
| 033 | RF-current probe (100kHz-30MHz) | ESH2-Z1 | 879581/18 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 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 | - | 30.04.2018 |
| 100 | passive voltage probe | Probe TK 9416 | without | Schwarzbeck | 36 M | - | 30.04.2018 |
| 110 | USB-LWL-Converter | OLS-1 | - | Ing. Büro Scheiba | - | 4 | |
| 119 | RT Harmonics Analyzer dig. Flickermeter | B10 | G60547 | BOCONSULT | 36 M | - | 31.05.2016 |
| 136 | adjustable dipole antenna (Dipole 1) | 3121C-DB4 | 9105-0697 | EMCO | 36 M | - | 30.04.2018 |
| 140 | Signal Generator | SMHU | 831314/006 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 248 | attenuator | SMA 6dB 2W | - | Radiall | pre-m | 2 | |
| 249 | attenuator | SMA 10dB 10W | - | Radiall | pre-m | 2 | |
| 252 | attenuator | N 6dB 12W | - | Radiall | pre-m | 2 | |
| 256 | attenuator | SMA 3dB 2W | - | Radiall | pre-m | 2 | |
| 257 | hybrid | 4031C | 04491 | Narda | pre-m | 2 | |
| 260 | hybrid coupler | 4032C | 11342 | Narda | pre-m | 2 | |
| 261 | Thermal Power Sensor | NRV-Z55 | 825083/0008 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 262 | Power Meter | NRV-S | 825770/0010 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 263 | Signal Generator | SMP 04 | 826190/0007 | Rohde & Schwarz | 36 M | - | 31.05.2016 |
| 264 | Spectrum Analyzer | FSEK 30 | 826939/005 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 265 | peak power sensor | NRV-Z33, Model 04 | 840414/009 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 266 | Peak Power Sensor | NRV-Z31, Model 04 | 843383/016 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 267 | notch filter GSM 850 | WRCA 800/960-6EEK | 9 | Wainwright GmbH | pre-m | 2 | |
| 270 | termination | 1418 N | BB6935 | Weinschel | pre-m | 2 | |
| 271 | termination | 1418 N | BE6384 | Weinschel | pre-m | 2 | |
| 272 | attenuator (20 dB) 50 W | Model 47 | BF6239 | Weinschel | pre-m | 2 | |
| 273 | attenuator (10 dB) 100 W | Model 48 | BF9229 | Weinschel | pre-m | 2 | |
| 274 | attenuator (10 dB) 50 W | Model 47 (10 dB) 50 W | BG0321 | Weinschel | pre-m | 2 | |
| 275 | DC-Block | Model 7003 (N) | C5129 | Weinschel | pre-m | 2 | |
| 276 | DC-Block | Model 7006 (SMA) | C7061 | Weinschel | pre-m | 2 | |
| 279 | power divider | 1515 (SMA) | LH855 | Weinschel | pre-m | 2 | |
| 298 | Univ. Radio Communication Tester | CMU 200 | 832221/091 | Rohde & Schwarz | pre-m | 3 | |
| 300 | AC LISN (50 Ohm/50µH, 1-phase) | ESH3-Z5 | 892 239/020 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 301 | attenuator (20 dB) 50W, 18GHz | 47-20-33 | AW0272 | Lucas Weinschel | pre-m | 2 | |
| 302 | horn antenna 40 GHz (Meas 1) | BBHA9170 | 155 | Schwarzbeck | 36 M | - | 31.03.2017 |
| 303 | horn antenna 40 GHz (Subst 1) | BBHA9170 | 156 | Schwarzbeck | 36 M | - | 31.03.2017 |
| 331 | Climatic Test Chamber -40/+80 Grad | HC 4055 | 43146 | Heraeus Vötsch | 24 M | - | 30.12.2016 |
| 341 | Digital Multimeter | Fluke 112 | 81650455 | Fluke | 24 M | - | 31.05.2016 |
| 342 | Digital Multimeter | Voltcraft M-4660A | IB 255466 | Voltcraft | 24 M | - | 30.04.2017 |
| 347 | laboratory site | radio lab. | - | - | - | 5 | |
| 348 | laboratory site | EMI conducted | - | - | - | 5 | |
| 354 | DC - Power Supply 40A | NGPE 40/40 | 448 | Rohde & Schwarz | pre-m | 2 | |
| 355 | Power Meter | URV 5 | 891310/027 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 357 | power sensor | NRV-Z1 | 861761/002 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 371 | Bluetooth Tester | CBT32 | 100153 | R&S | 24 M | - | 31.05.2016 |
| 373 | Single-Line V-Network (50 Ohm/5µH) | ESH3-Z6 | 100535 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 377 | EMI Test Receiver | ESCS 30 | 100160 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 389 | Digital Multimeter | Keithley 2000 | 0583926 | Keithley | 24 M | - | 30.04.2017 |
| 392 | Radio Communication Tester | MT8820A | 6K00000788 | Anritsu | 12 M | - | 31.05.2016 |
| 431 | Model 7405 | Near-Field Probe Set | 9305-2457 | EMCO | - | 4 | |
| 436 | Univ. Radio Communication Tester | CMU 200 | 103083 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 439 | UltraLog-Antenna | HL 562 | 100248 | Rohde & Schwarz | 36 M | - | 31.03.2017 |
| 441 | CTC-SAR-EMI Cable Loss | System EMI field (SAR) Cable | - | CETECOM | 12 M | 5 | 31.05.2016 |
| 443 | CTC-FAR-EMI-RSE | System CTC-FAR-EMI-RSE | - | ETS-Lindgren / CETECOM | 12 M | 5 | 30.09.2016 |
| 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 | |

| Ref.-No. | Equipment | Type | Serial-No. | Manufacturer | Interval of calibration | Remark | Cal due |
|----------|---|-----------------------------|----------------------------|-----------------------------|-------------------------|--------|------------|
| 460 | Univ. Radio Communication Tester | CMU 200 | 108901 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 463 | Universal source | HP3245A | 2831A03472 | Agilent | - | 4 | |
| 466 | Digital Multimeter | Fluke 112 | 89210157 | Fluke USA | 24 M | - | 31.05.2016 |
| 467 | Digital Multimeter | Fluke 112 | 89680306 | Fluke USA | 36 M | - | 30.04.2018 |
| 468 | Digital Multimeter | Fluke 112 | 90090455 | Fluke USA | 36 M | - | 30.04.2018 |
| 477 | ReRadiating GPS-System | AS-47 | - | Automotive Cons. Fink | - | 3 | |
| 480 | power meter (Fula) | NRVS | 838392/031 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 482 | filter matrix | Filter matrix SAR 1 | - | CETECOM (Brl) | - | Id | |
| 484 | pre-amplifier 2,5 - 18 GHz | AMF-5D-02501800-25-10P | 1244554 | Miteq | 12 M | - | 30.09.2016 |
| 487 | System CTC NSA-Verification SAR-EMI | System EMI field (SAR) NSA | - | ETS Lindgren / CETECOM | 24 M | - | 31.07.2017 |
| 489 | EMI Test Receiver | ESU40 | 1000-30 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 502 | band reject filter | WRCG 1709/1786-1699/1796- | SN 9 | Wainwright | pre-m | 2 | |
| 503 | band reject filter | WRCG 824/849-814/859- | SN 5 | Wainwright | pre-m | 2 | |
| 517 | relais switch matrix | HF Relais Box Keithley | SE 04 | Keithley | pre-m | 2 | |
| 523 | Digital Multimeter | L4411A | MY46000154 | Agilent | 24 M | - | 30.04.2017 |
| 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 | - | 31.05.2016 |
| 547 | Univ. Radio Communication Tester | CMU 200 | 835390/014 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 548 | Digital-Barometer | GBP 2300 | without | Greisinger GmbH | - | - | |
| 549 | Log.Per-Antenna | HL025 | 1000060 | Rohde & Schwarz | 36 M | - | 31.07.2018 |
| 552 | high pass filter 2,8-18GHz | WHKX 2.8/18G-10SS | 4 | Wainwright | 12 M | 1c | 30.09.2016 |
| 574 | Biconilog Hybrid Antenna | BTA-L | 980026L | Frankonia | 36/12 M | - | 31.05.2016 |
| 584 | Spectrum Analyzer | FSU 8 | 100248 | Rohde & Schwarz | pre-m | - | |
| 594 | Wideband Radio Communication Tester | CMW 500 | 101757 | Rohde & Schwarz | 12 M | - | 31.05.2016 |
| 597 | Univ. Radio Communication Tester | CMU 200 | 100347 | Rohde & Schwarz | 36 M | - | 31.05.2016 |
| 598 | Spectrum Analyzer | FSEM 30 (Reserve) | 831259/013 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 600 | power meter | NRVD (Reserve) | 834501/018 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 601 | medium-sensitivity diode sensor | NRV-Z5 (Reserve) | 8435323/003 | Rohde & Schwarz | 24 M | - | 30.04.2017 |
| 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 | - | 31.05.2016 |
| 617 | Power Splitter/Combiner | ZFSC-2-2-S+ | S F987001108 | Mini Circuits | - | 2 | |
| 618 | Power Splitter/Combiner | 50PD-634 | 600994 | JFW Industries USA | - | 2 | |
| 619 | Power Splitter/Combiner | 50PD-634 | 600995 | JFW Industries, USA | - | 3 | |
| 621 | Step Attenuator 0-139 dB | RSP | 100017 | Rohde & Schwarz | pre-m | 2 | |
| 625 | Generic Test Load USB | Generic Test Load USB | - | CETECOM | - | 2 | |
| 627 | data logger | OPUS 1 | 201.0999.9302.6.4.1.4 3 | G. Lufft GmbH | 24 M | - | 30.04.2017 |
| 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 | - | Reichelt | - | 2 | |
| 640 | HDMI cable 2m rund | HDMI cable 2m rund | - | Reichelt | - | 2 | |
| 641 | HDMI cable with Ethernet | Certified HDMI cable with | - | PureLink | - | 2 | |
| 642 | Wideband Radio Communication Tester | CMW 500 | 126089 | Rohde&Schwarz | 12 M | - | 31.05.2016 |
| 644 | Amplifierer | ZX60-2534M+ | SN865701299 | Mini-Circuits | - | - | |
| 670 | Univ. Radio Communication Tester | CMU 200 | 106833 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 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 | - | 31.05.2016 |
| 686 | Field Analyzer | EHP-200A | 160WX30702 | Narda Safety Test Solutions | 24 M | - | 30.04.2017 |
| 687 | Signal Generator | SMF 100A | 102073 | Rohde&Schwarz | 12 M | - | 31.05.2016 |
| 688 | Pre Amp | JS-18004000-40-8P | 1750117 | Miteq | pre-m | - | |
| 692 | Bluetooth Tester | CBT 32 | 100236 | Rohde & Schwarz | 24 M | - | 31.05.2016 |
| 697 | Power Splitter | ZN4PD-642W-S+ | 165001445 | Mini-Circuits | - | 2 | |

8.0.3. 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 | 2016-04-28 |
| -- | -- | -- |
| -- | -- | -- |