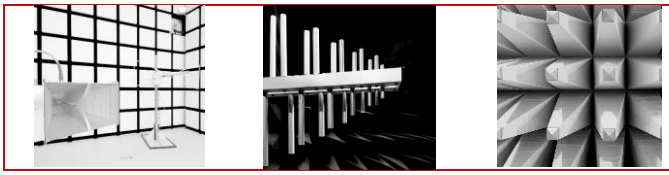


CETECOM™

CETECOM ICT Services
consulting - testing - certification

# TEST REPORT

**Test report no.: 1-8891/14-01-07-A**

DAkkS Deutsche Akkreditierungsstelle D-PL-12076-01-01

## Testing laboratory


**CETECOM ICT Services GmbH**
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: http://www.cetecom.com
e-mail: ict@cetecom.com


**Accredited Testing Laboratory:**
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2005) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12076-01-01

## Applicant


**KROHNE Messtechnik GmbH**
Ludwig-Krohne-Str. 5
47058 Duisburg / GERMANY
Phone: +49 234 588 80-152
Fax: +49 234 588 80-101
Contact: Ouzounis Charalambos
e-mail: c.ouzounis@krohne.com
Phone: +49 234 588 80-152


## Manufacturer

**KROHNE SAS**
2 allee des Ors – BP98
26103 Romans / FRANCE

## Test standard/s

| | |
|---|---|
| 47 CFR Part 15 | Title 47 of the Code of Federal Regulations; Chapter I; Part 15 – Radio frequency devices |

For further applied test standards please refer to section 3 of this test report.

## Test Item

| | |
|---|---|
| **Kind of test item:** | **Tank level probing radar** |
| **Model name:** | **OPTIWAVE 7400-80C** |
| **FCC ID:** | **Q6BFMCW80G74T** |
| Frequency: | 78 GHz – 82 GHz |
| Antenna: | dielectric lens antenna |
| Power Supply: | 14 – 36 V DC |
| Temperature Range: | -40 °C to +80 °C |

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

**Test report authorized:**

M. Walla

Digital unterschrieben von Meheza Walla
DN: cn=Meheza Walla, o=CETECOM ICT Services GmbH, ou=WAL-151005, email=Meheza.Walla@cetecom.com, c=DE
Datum: 2016.06.09 15:46:27 +02'00'

Meheza Walla
Lab Manager
Radio Communications & EMC

**Test performed:**

Geraldy Karsten

DN: cn=Karsten Geraldy, o=CETECOM ICT Services GmbH, ou=GER-151201, email=karsten.geraldy@cetecom.com, c=DE
Datum: 2016.06.09 15:45:30 +02'00'

Karsten Geraldy
Lab Manager
Radio Communications & EMC

# 1 Table of contents


1 Table of contents ..... 2

2 General information ..... 3

2.1 Notes and disclaimer ..... 3
2.2 Application details ..... 3

3 Test standard/s and guideline/s ..... 3

4 Test laboratories sub-contracted ..... 3

5 Test environment ..... 4

6 Test item ..... 4

6.1 General Description ..... 4
6.2 Additional information ..... 4

7 Description of the test setup ..... 5

7.1 Shielded semi anechoic chamber ..... 6
7.2 Shielded fully anechoic chamber ..... 7
7.3 Radiated measurements > 18 GHz ..... 8
7.4 Radiated measurements > 50 GHz ..... 8
7.5 Conducted measurements in test lab ..... 9
7.6 AC conducted ..... 10

8 Measurement uncertainty ..... 10

9 Sequence of testing ..... 11

9.1 Sequence of testing radiated spurious 9 kHz to 30 MHz ..... 11
9.2 Sequence of testing radiated spurious 30 MHz to 1 GHz ..... 12
9.3 Sequence of testing radiated spurious 1 GHz to 18 GHz ..... 13
9.4 Sequence of testing radiated spurious above 18 GHz ..... 14
9.5 Sequence of testing radiated spurious above 50.0 GHz with external mixers ..... 15

10 Summary of measurement results ..... 16

11 Test results ..... 17

11.1 Unwanted emissions limit (transmitter) ..... 17
11.2 Unwanted emission limits (receiver) ..... 25
11.3 Conducted limits ..... 26

12 Document history ..... 28

13 Further information ..... 28

14 Accreditation Certificate ..... 29

# 2 General information

## 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM ICT Services GmbH.
The testing service provided by CETECOM ICT Services GmbH has been rendered under the current "General Terms and Conditions for CETECOM ICT Services GmbH".
CETECOM ICT Services GmbH will not be liable for any loss or damage resulting from false, inaccurate, inappropriate or incomplete product information provided by the customer.
Under no circumstances does the CETECOM ICT Services GmbH test report include any endorsement or warranty regarding the functionality, quality or performance of any other product or service provided.
Under no circumstances does the CETECOM ICT Services GmbH test report include or imply any product or service warranties from CETECOM ICT Services GmbH, including, without limitation, any implied warranties of merchantability, fitness for purpose, or non-infringement, all of which are expressly disclaimed by CETECOM ICT Services GmbH.
All rights and remedies regarding vendor’s products and services for which CETECOM ICT Services GmbH has prepared this test report shall be provided by the party offering such products or services and not by CETECOM ICT Services GmbH.
In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

## 2.2 Application details

| | |
|---|---|
| Date of receipt of order: | 2014-11-26 |
| Date of receipt of test item: | 2015-01-12 |
| Start of test: | 2015-01-12 |
| End of test: | 2015-01-16 |
| Person(s) present during the test: | -/- |

# 3 Test standard/s and guideline/s

| Test standard | Date | Test standard description |
|---|---|---|
| 47 CFR Part 15 | 2014-10 | Title 47 of the Code of Federal Regulations; Chapter I; Part 15 – Radio frequency devices |

# 4 Test laboratories sub-contracted

None

# 5 Test environment

| | | |
|---|---|---|
| Temperature: | $T_{nom}$ | +22 °C during room temperature tests |
| | $T_{max}$ | +50 °C |
| | $T_{min}$ | -20 °C |
| Relative humidity content: | | 45 % |
| Barometric pressure: | | not relevant for this kind of testing |
| Power supply: | $V_{nom}$ | 24.0 V DC |
| | $V_{max}$ | 36.0 V DC |
| | $V_{min}$ | 14.0 V DC |

# 6 Test item

## 6.1 General Description

| | | |
|---|---|---|
| Kind of test item | : | Tank level probing radar |
| Type identification | : | OPTIWAVE 7400-80C |
| PMN | : | Optiwave X400-80 Series |
| HVIN | : | 80G-TLPR-C |
| FVIN | : | -/- |
| HMN | : | -/- |
| S/N serial number | : | 1 (radiated sample) / 2 (conducted sample) |
| HW hardware status | : | HW hardware status sensor: 4002581601 b-mod<br>HW hardware status converter: 4002260701 c-mod |
| SW software status | : | Cetecom_RadioTesting_80GHz_Jan2015_Final_PV Rev. 11087 |
| Frequency band | : | 78 GHz – 82 GHz |
| Type of modulation | : | FMCW |
| Number of channels | : | 1 |
| Antenna | : | dielectric lens antenna |
| Power supply | : | 14 – 36 V DC, < 30 mA |
| Temperature range | : | -40 °C to +85 °C |

**Note:**
Following antennas are used as TLPR application:

| Antenna | Maximum gain | Maximum 3 dB beam width | Maximum side lobe level > 60 deg |
|---|---|---|---|
| 40 mm convex lens | 26.1 | 8.0 | -12.6 dBi |
| 25 mm convex lens | 22.1 | 10.7 | -17.0 dBi |

## 6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.
Test setup- and EUT-photos are included in test report: 1-8891/14-01-03_AnnexA
1-8891/14-01-03_AnnexB
1-8891/14-01-03_AnnexD

## 7 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

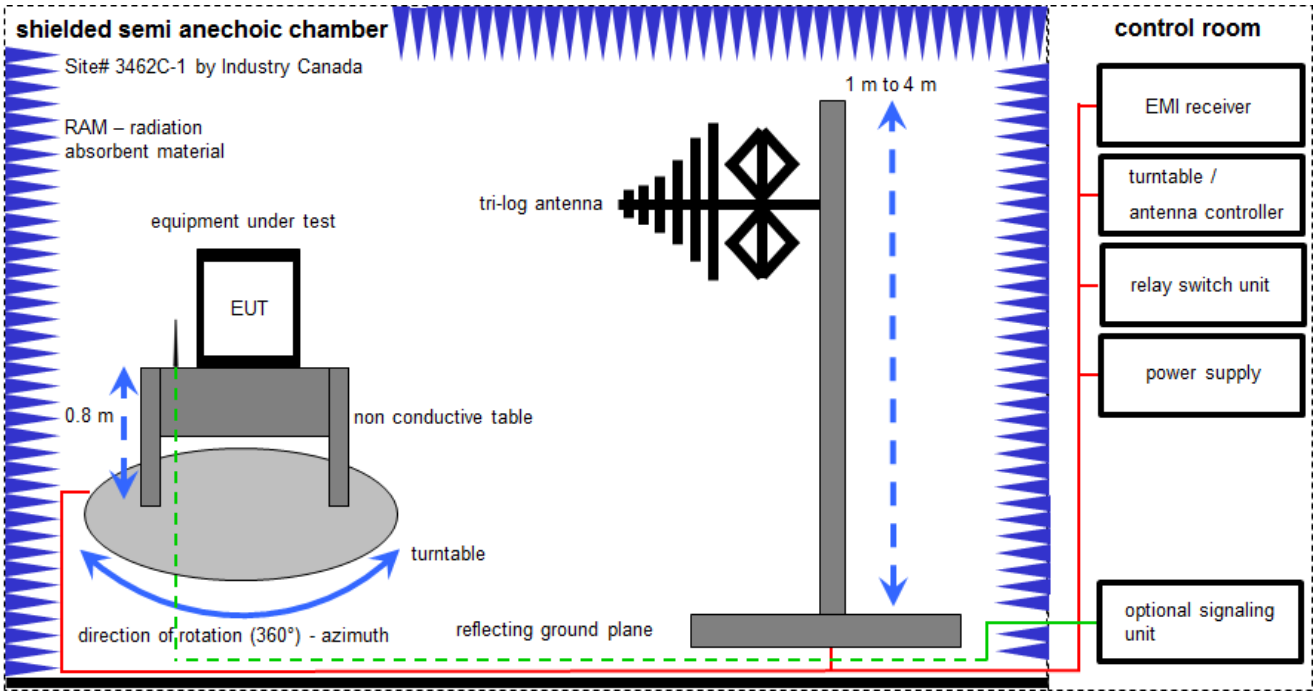
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

**Agenda:** Kind of Calibration

| | | | |
|---|---|---|---|
| k | calibration / calibrated | EK | limited calibration |
| ne | not required (k, ev, izw, zw not required) | zw | cyclical maintenance (external cyclical maintenance) |
| ev | periodic self verification | izw | internal cyclical maintenance |
| Ve | long-term stability recognized | g | blocked for accredited testing |
| vlkl! | Attention: extended calibration interval | | |
| NK! | Attention: not calibrated | *) | next calibration ordered / currently in progress |

## 7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



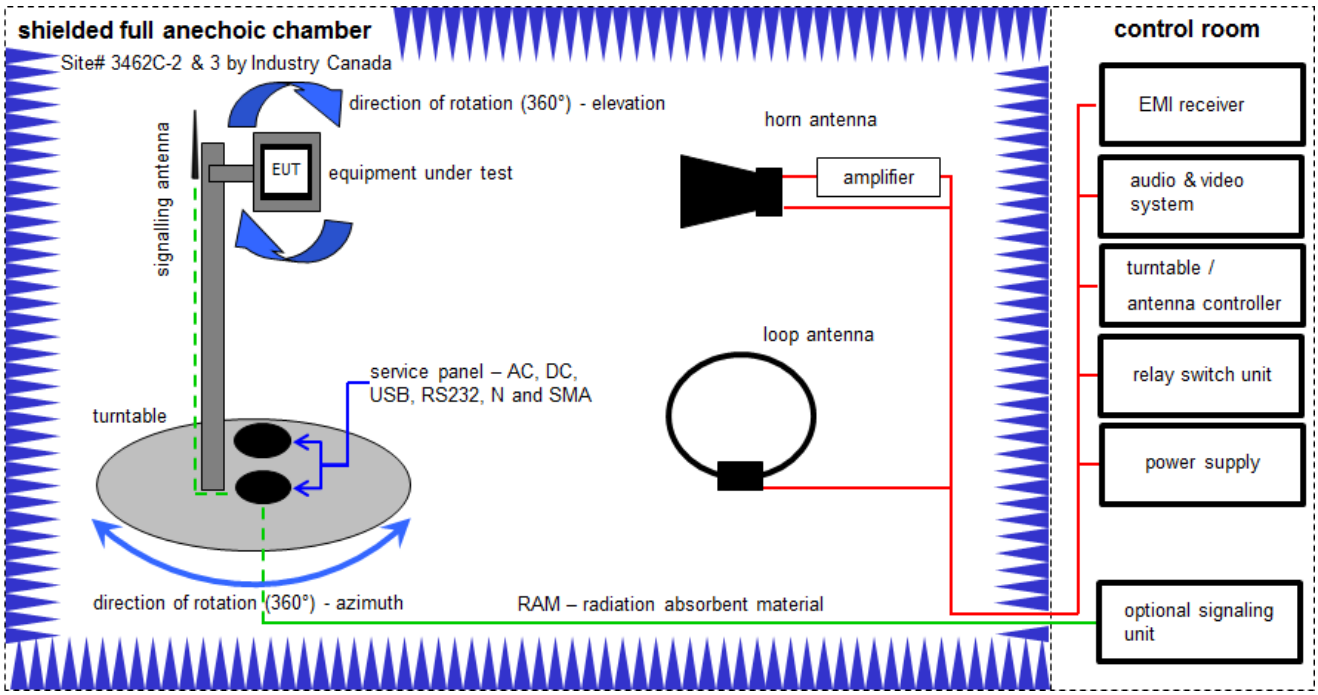

FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

*Example calculation:*
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

**Equipment table:**

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 45 | Switch-Unit | 3488A | HP | 2719A14505 | 300000368 | ev | | |
| 2 | 50 | DC power supply, 60Vdc, 50A, 1200 W | 6032A | HP | 2920A04466 | 300000580 | ne | | |
| 3 | n. a. | EMI Test Receiver | ESCI 3 | R&S | 100083 | 300003312 | k | 26.01.2014 | 26.01.2015 |
| 4 | n. a. | Amplifier | JS42-00502650-28-5A | MITEQ | 1084532 | 300003379 | ev | | |
| 5 | n. a. | Antenna Tower | Model 2175 | ETS-Lindgren | 64762 | 300003745 | izw | | |
| 6 | n. a. | Positioning Controller | Model 2090 | ETS-Lindgren | 64672 | 300003746 | izw | | |
| 7 | n. a. | Turntable Interface-Box | Model 105637 | ETS-Lindgren | 44583 | 300003747 | izw | | |
| 8 | n. a. | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck | 295 | 300003787 | k | 22.04.2014 | 22.04.2015 |
| 9 | n. a. | Spectrum-Analyzer | FSU26 | R&S | 200809 | 300003874 | k | 26.01.2014 | 26.01.2015 |

## 7.2 Shielded fully anechoic chamber



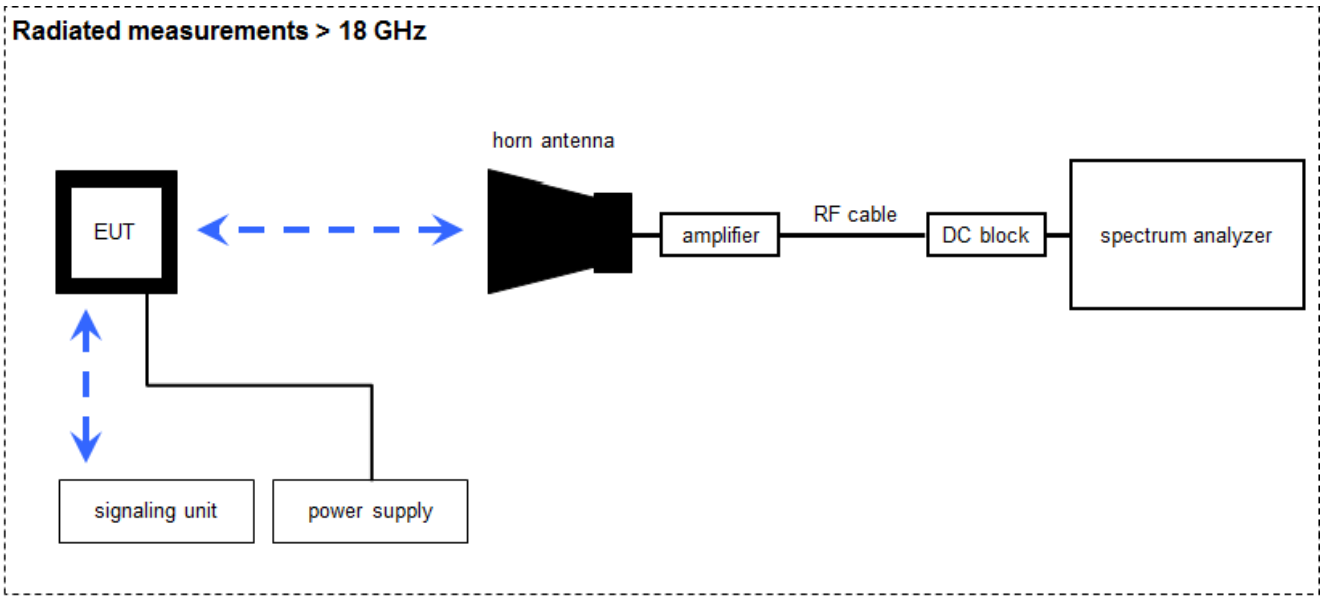

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

*Example calculation:*
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

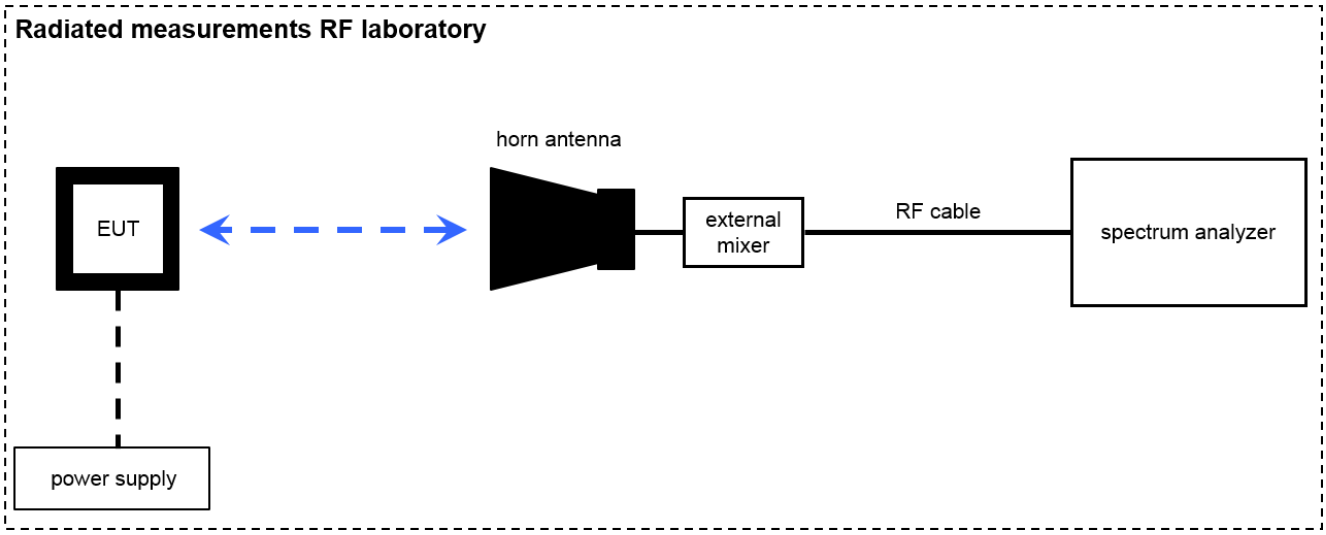
**Equipment table:**

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n. a. | DC power supply, 60Vdc, 50A, 1200 W | 6032A | HP | 2818A03450 | 300001040 | Ve | 20.01.2014 | 20.01.2015 |
| 2 | n. a. | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115 | EMCO | 8812-3088 | 300001032 | vIKI! | 08.05.2013 | 08.05.2015 |
| 3 | n. a. | Anechoic chamber | FAC 3/5m | MWB / TDK | 87400/02 | 300000996 | ev | | |
| 4 | n. a. | Switch / Control Unit | 3488A | HP | * | 300000199 | ne | | |
| 5 | 9 | Isolating Transformer | MPL IEC625 Bus Regeltrenntravo | Erfi | 91350 | 300001155 | ne | | |
| 6 | 90 | Active Loop Antenna 10 kHz to 30 MHz | 6502 | Kontron Psychotech | 8905-2342 | 300000256 | k | 24.06.2014 | 24.06.2015 |
| 7 | n. a. | Amplifier | js42-00502650-28-5a | Parzich GMBH | 928979 | 300003143 | ne | | |
| 8 | n. a. | Band Reject filter | WRCG1855/1910-1835/1925-40/8SS | Wainwright | 7 | 300003350 | ev | | |
| 9 | n. a. | Band Reject filter | WRCG2400/2483-2375/2505-50/10SS | Wainwright | 11 | 300003351 | ev | | |
| 10 | n. a. | Highpass Filter | WHKX7.0/18G-8SS | Wainwright | 18 | 300003789 | ne | | |
| 11 | n. a. | MXE EMI Receiver 20 Hz to 26,5 GHz | N9038A | Agilent Technologies | MY51210197 | 300004405 | k | 06.03.2014 | 06.03.2015 |
| 12 | n. a. | 4U RF Switch Platform | L4491A | Agilent Technologies | MY50000037 | 300004509 | ne | | |

## 7.3 Radiated measurements > 18 GHz




## 7.4 Radiated measurements > 50 GHz

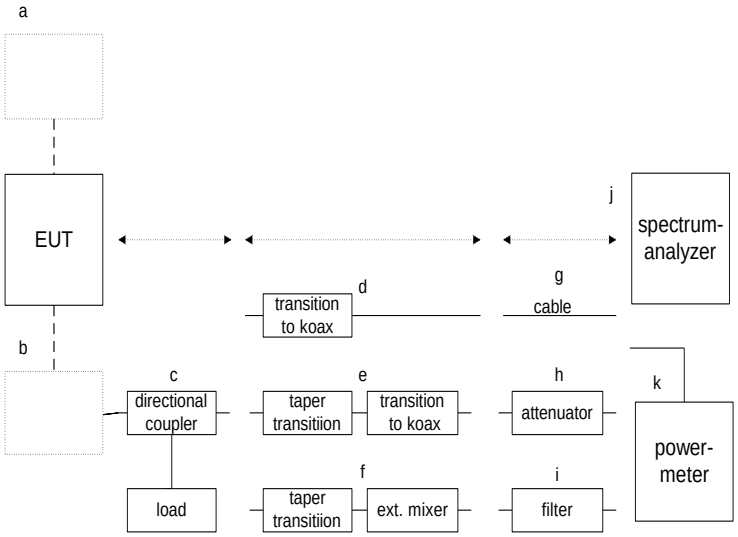



OP = AV + D - G
(OP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

*Example calculation:*
OP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 µW)

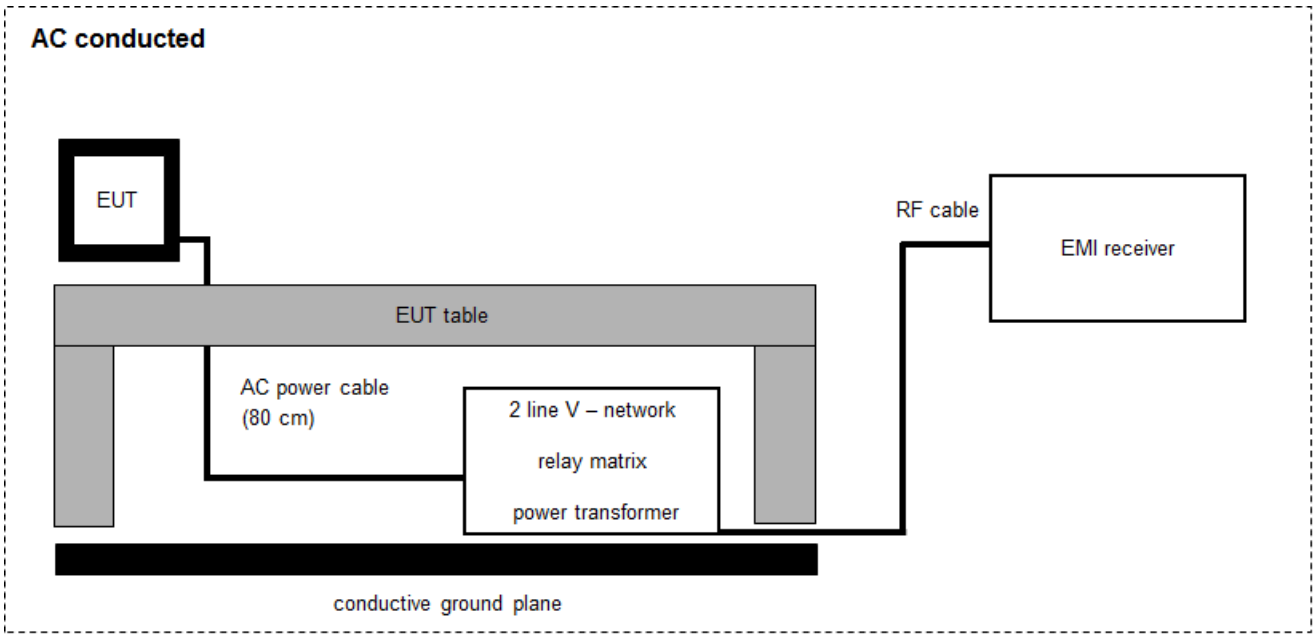
Note: conversion loss of mixer is already included in analyzer value.

## 7.5 Conducted measurements in test lab




| No. | Lab / Item | Equipment | Type | Manufact. | Serial No. | INV. No Cetecom | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | CR 79 | Std. Gain Horn Antenna 26.5-40.0 GHz | V637 | Narda | 7911 | 300001751 | ne | | |
| 2 | 11b | Microwave System Amplifier, 0.5-26.5 GHz | 83017A | HP | 00419 | 300002268 | ev | | |
| 3 | A023 | Std. Gain Horn Antenna 39.3-59.7 GHz | 2424-20 | Flann | 75 | 300001979 | ne | | |
| 4 | A025 | Std. Gain Horn Antenna 49.9-75.8 GHz | 2524-20 | Flann | * | 300001983 | ne | | |
| 5 | A028 | Std. Gain Horn Antenna 73.8-112 GHz | 2724-20 | Flann | * | 300001991 | ne | | |
| 6 | A032 | Std. Gain Horn Antenna 114-173 GHz | 2924-20 | Flann | * | 300001999 | ne | | |
| 7 | A033 | Std. Gain Horn Antenna 145-220 GHz | 3024-20 | Flann | * | 300002000 | ne | | |
| 8 | A026 | Std. Gain Horn Antenna 12.4 to 18.0 GHz | 639 | Narda | 8402 | 300000787 | k | 22.07.2013 | 22.07.2015 |
| 9 | A029 | Std. Gain Horn Antenna 18.0 to 26.5 GHz | 638 | Narda | 8205 | 300002442 | k | 19.07.2013 | 19.07.2015 |
| 10 | A029 | Power Supply | LA30/5GA | Zentro | 2046 | 300000711 | NK! | | |
| 11 | A029 | Spectrum Analyzer 20 Hz - 50 GHz | FSU50 | R&S | 200012 | 300003443 | Ve | 02.10.2014 | 02.10.2016 |
| 12 | A029 | Harmonic mixer 50 - 75 GHz for spectrum analyzers | FS-Z75 | R&S | 100099 | 300003949 | k | 06.03.2014 | 06.03.2016 |
| 13 | A029 | Spectrum Analyzer Mixer 2-Port, 75-110 GHz | SAM-110-7 | Radiometer Physics GmbH | 002 | 300004155 | k | 31.01.2014 | 31.01.2016 |
| 14 | A029 | Spectrum Analyzer Mixer 3-Port, 110-170 GHz | SAM-170 | Radiometer Physics GmbH | 100014 | 300004156 | k | 12.02.2014 | 12.02.2016 |
| 15 | A029 | Spectrum Analyzer Mixer 3-Port, 170-220 GHz | SAM-220 | Radiometer Physics GmbH | 200001 | 300004157 | k | 30.01.2014 | 30.01.2016 |
| 16 | A029 | Broadband Low Noise Amplifier 18-50 GHz | CBL18503070-XX | CERNEX | 19338 | 300004273 | ne | | |
| 17 | A029 | Harmonic mixer 60 - 90 GHz | FS-Z90 | R&S | 101555 | 300004691 | k | 21.10.2013 | 27.02.2016 |

## 7.6 AC conducted




FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

*Example calculation:*
FS [dBµV/m] = 37.62 [dBµV/m] + 9.90 [dB] + 0.23 [dB] = 47.75 [dBµV/m] (244.06 µV/m)

**Equipment table:**

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No Cetecom | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n. a. | Netznachbildung | ESH3-Z5 | R&S | 892475/017 | 300002209 | k | 17.06.2014 | 17.06.2016 |
| 2 | 68 | EMI-Receiver | 8542E | HP | 3617A00170 | 300000568 | k | 28.01.2014 | 28.01.2015 |
| 3 | n. a. | Analyzer-Reference-System (Harmonics and Flicker) | ARS 16/1 | SPS | A3509 07/0 0205 | 300003314 | Ve | 11.02.2014 | 11.02.2016 |

# 8 Measurement uncertainty

| Measurement uncertainty | |
|---|---|
| **Test case** | **Uncertainty** |
| Spectrum bandwidth | span/1000 |
| Conducted output power | ± 3 dB |
| Spurious emissions radiated below 30 MHz | ± 3 dB |
| Spurious emissions radiated 30 MHz to 1 GHz | ± 3 dB |
| Spurious emissions radiated 1 GHz to 12.75 GHz | ± 3.7 dB |
| Spurious emissions radiated above 12.75 GHz | ± 4.5 dB |
| Spurious emissions conducted below 30 MHz (AC conducted) | ± 2.6 dB |

# 9 Sequence of testing

## 9.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

**Setup**

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

**Premeasurement**

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1.5 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

**Final measurement**

- Identified emissions during the premeasurement are maximized by the software by rotating the turntable from 0° to 360°. In case of the 2-axis positioner is used the elevation axis is also rotated from 0° to 360°.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

## 9.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

**Setup**

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

**Premeasurement**

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

**Final measurement**

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 9.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

**Setup**

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

**Premeasurement**

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

**Final measurement**

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 9.4 Sequence of testing radiated spurious above 18 GHz

**Setup**

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

**Premeasurement**

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.

**Final measurement**

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

## 9.5 Sequence of testing radiated spurious above 50.0 GHz with external mixers

**Setup**

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate for far field (e.g. 0.25 m).
- The EUT is set into operation.

**Premeasurement**

- The test antenna with external mixer is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.
- Caution is taken to reduce the possible overloading of the external mixer.

**Final measurement**

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- As external mixers may generate false images care is taken to ensure that any emission measured by the spectrum analyzer does indeed originate in the EUT. Signal identification feature of spectrum analyzer is used to eliminate false mixer images (i.e., it is not the fundamental emission or a harmonic falling precisely at the measured frequency).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

## 10 Summary of measurement results

| | |
|---|---|
| ☒ | No deviations from the technical specifications were ascertained |
| ☐ | There were deviations from the technical specifications ascertained |
| ☐ | This test report is only a partial test report.<br>The content and verdict of the performed test cases are listed below. |

| TC identifier | Description | verdict | date | Remark |
|---|---|---|---|---|
| RF-Testing | 47 CFR Part 15 | see below | 2016-06-09 | -/- |

| Test Specification Clause | Test Case | Temperature Conditions | Power Source Voltages | Pass | Fail | NA | NP | Results |
|---|---|---|---|---|---|---|---|---|
| §15.209 | Radiated emissions limits, general requirements | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| | | | | | | | | |
| §15.109 | Radiated emissions limits | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| | | | | | | | | |
| §15.107/207 | Conducted limits | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| | | | | | | | | |

**Note:**
NA = Not applicable; NP = Not performed

# 11 Test results

## 11.1 Unwanted emissions limit (transmitter)

**Description:**

§15.209
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table below.

**Measurement parameters:**

Resolution bandwidth: 100 kHz / 1 MHz
Video bandwidth: ≥ resolution bandwidth
Detector: Quasi Peak / Average (RMS)
Trace: Max hold

**Limits:**

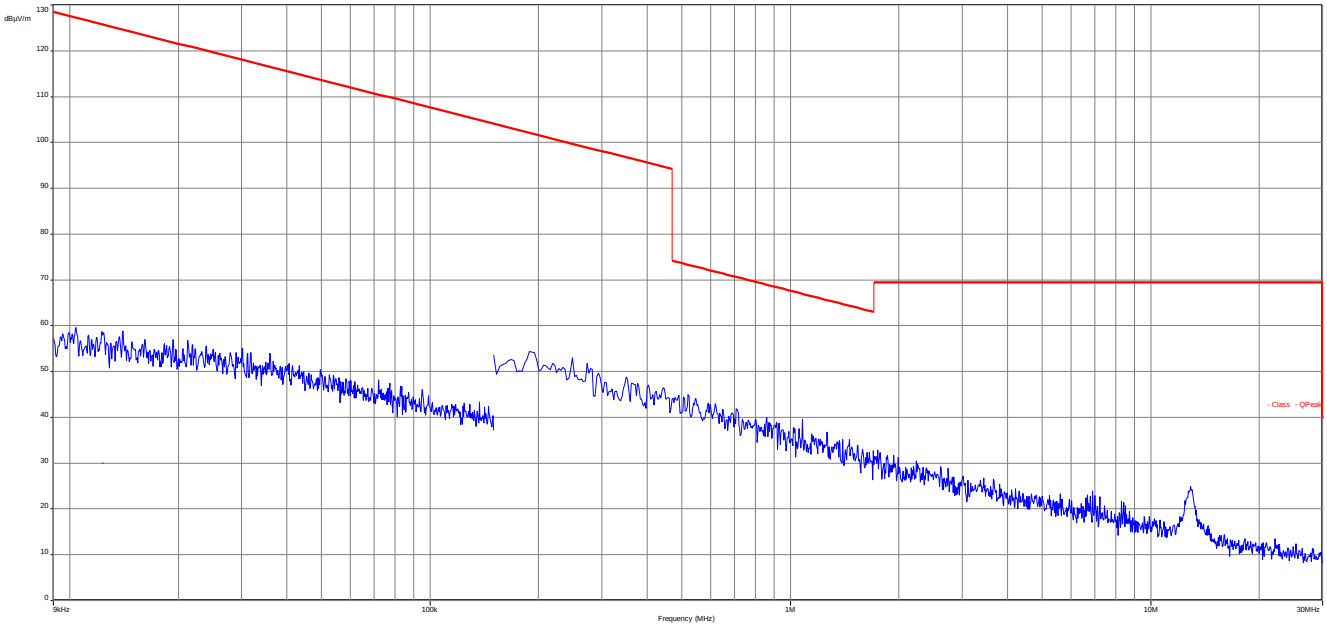
| FCC §15.209 | | |
|---|---|---|
| Field strength of the harmonics and spurious. | | |
| **Frequency (MHz)** | **Field strength (µV/m)** | **Measurement distance (m)** |
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30 | 30 (29.5 dBµV/m) | 30 |
| 30 – 88 | 100 (40 dBµV/m) | 3 |
| 88 – 216 | 150 (43.5 dBµV/m) | 3 |
| 216 – 960 | 200 (46 dBµV/m) | 3 |
| >960 | 500 (54 dBµV/m) | 3 |

**Results:**

| Spurious emission level (dBm) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| -/- | | | -/- | | | -/- | | |
| Frequency [GHz] | BW [kHz] | Level [dBm] | Frequency [GHz] | BW [kHz] | Level [dBm] | Frequency [GHz] | BW [kHz] | Level [dBm] |
| see plots | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

**Verdict:** **Complies**

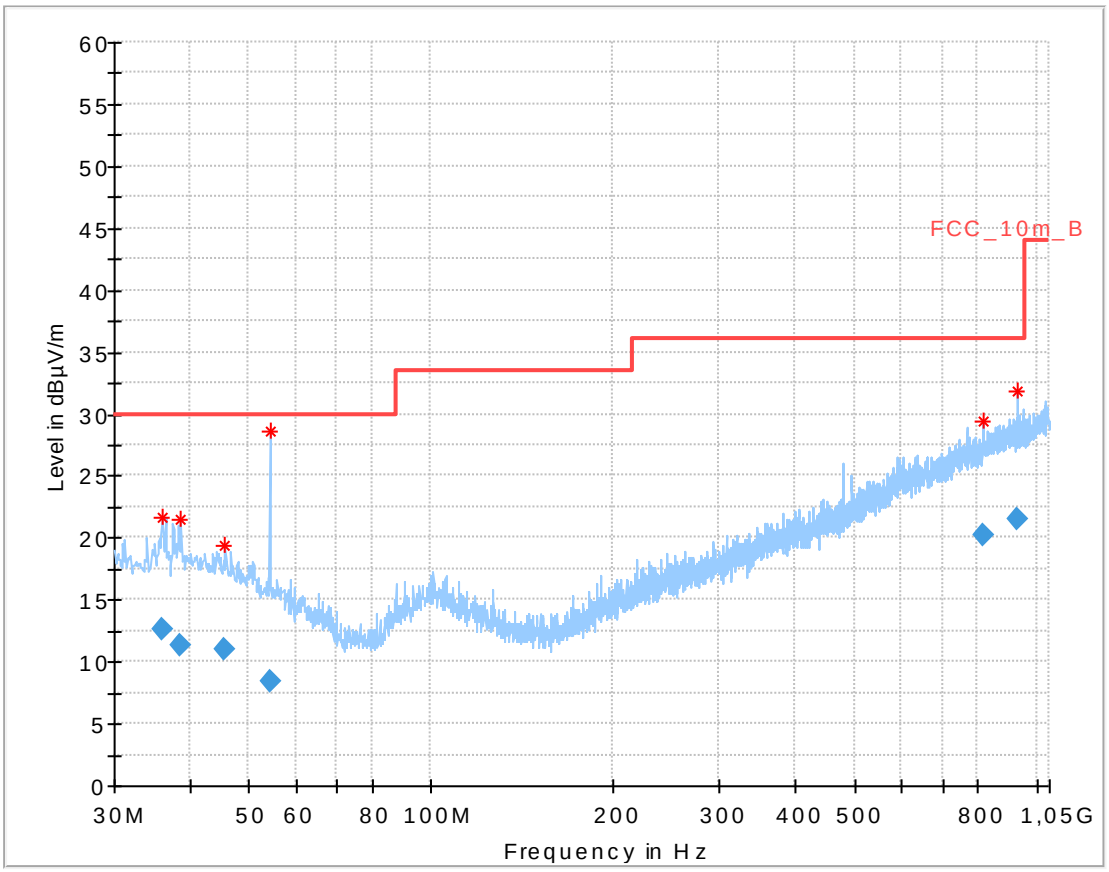
Plot 1: 9 kHz – 30 MHz, special test mode, frequency sweep stopped at $f_{low}/f_{mid}/f_{high}$



Plot 2: 30 MHz – 1000 MHz, special test mode, frequency sweep stopped at $f_{low}/f_{mid}/f_{high}$

**Common Information**

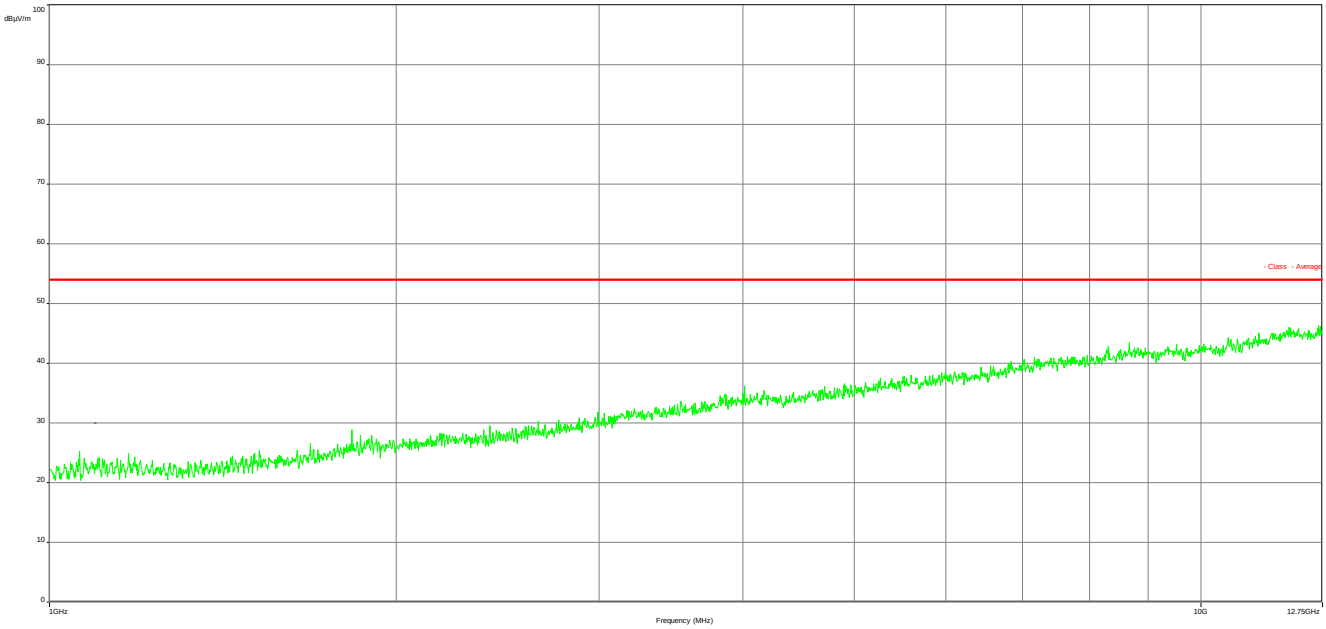
| | |
|---|---|
| EUT: | Optiwave 7400-80 |
| Serial number: | no 3 |
| Test description: | FCC part 15 class B @ 10 m |
| Operating condition: | TX low/mid/high |
| Operator name: | Hennemann |
| Comment: | DC 24 V |



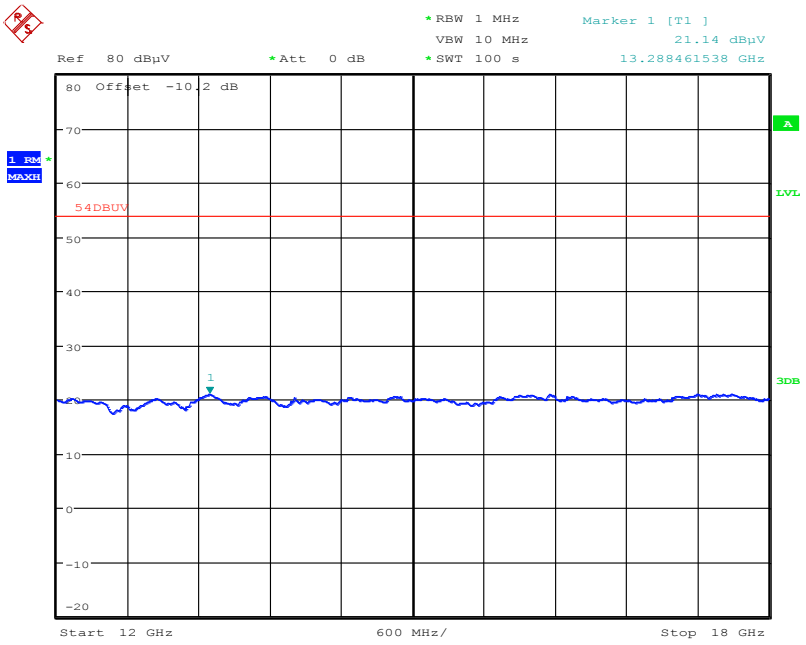

**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 36.014100 | 12.59 | 30.00 | 17.41 | 1000.0 | 120.000 | 272.0 | V | 8 | 13.8 |
| 38.665050 | 11.26 | 30.00 | 18.74 | 1000.0 | 120.000 | 273.0 | V | 7 | 14.0 |
| 45.466650 | 10.93 | 30.00 | 19.07 | 1000.0 | 120.000 | 271.0 | H | 266 | 13.7 |
| 54.520950 | 8.47 | 30.00 | 21.53 | 1000.0 | 120.000 | 274.0 | V | 282 | 11.9 |
| 816.635550 | 20.18 | 36.00 | 15.82 | 1000.0 | 120.000 | 100.0 | V | 53 | 23.0 |
| 927.661650 | 21.45 | 36.00 | 14.55 | 1000.0 | 120.000 | 100.0 | V | 5 | 24.2 |

Plot 3: 1 GHz – 12.75 GHz, special test mode, frequency sweep stopped at $f_{low}/f_{mid}/f_{high}$

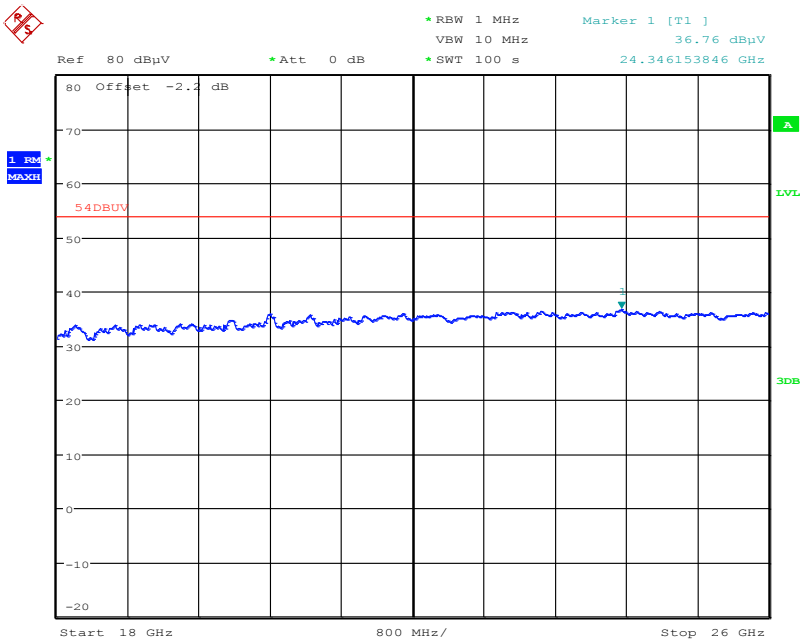



Plot 4: 12 GHz – 18 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$



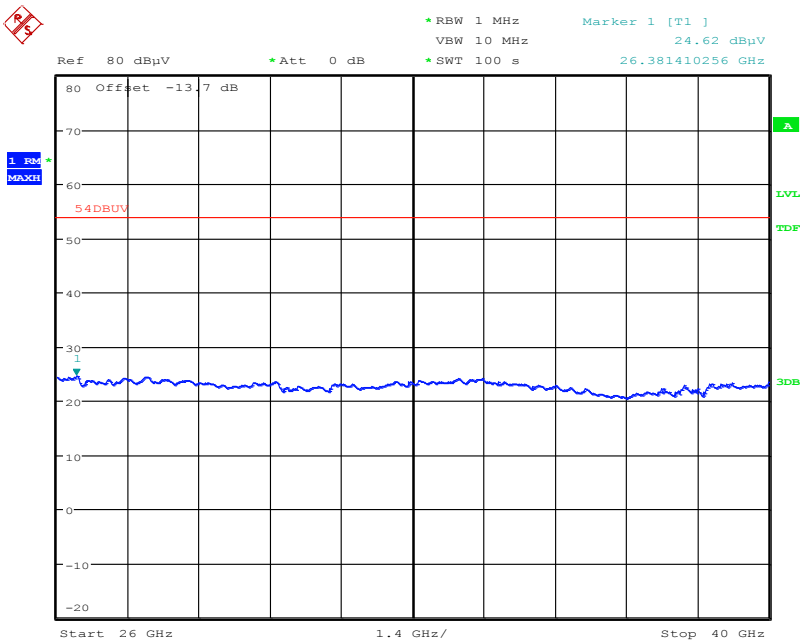

Date: 13.JAN.2015 15:17:31

Plot 5: 18 GHz – 26 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$



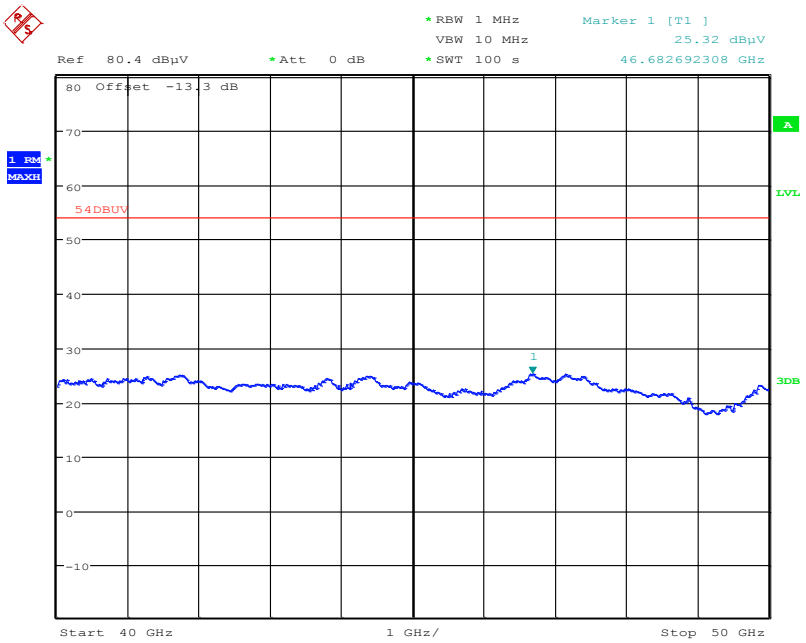

Date: 13.JAN.2015 15:28:10

Plot 6: 26 GHz – 40 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$



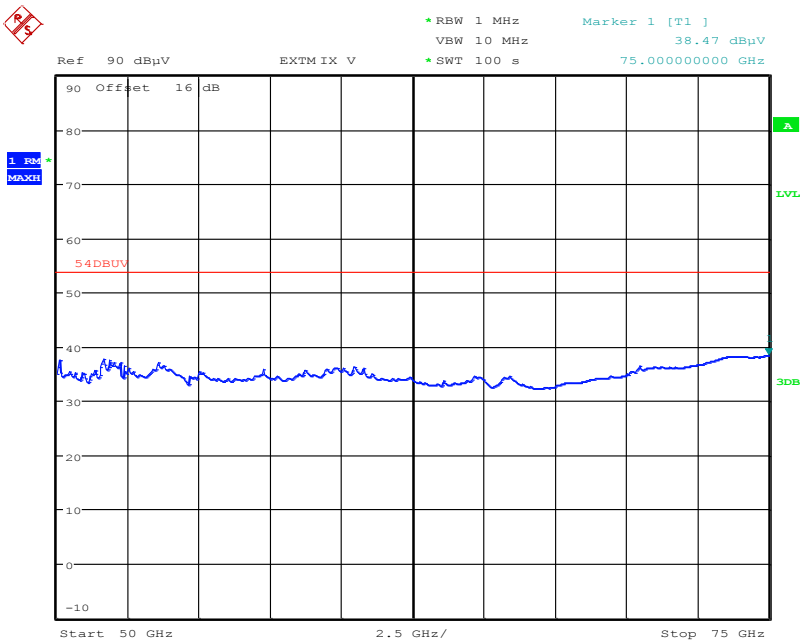

Date: 13.JAN.2015 15:48:40

Plot 7: 40 GHz – 50 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$



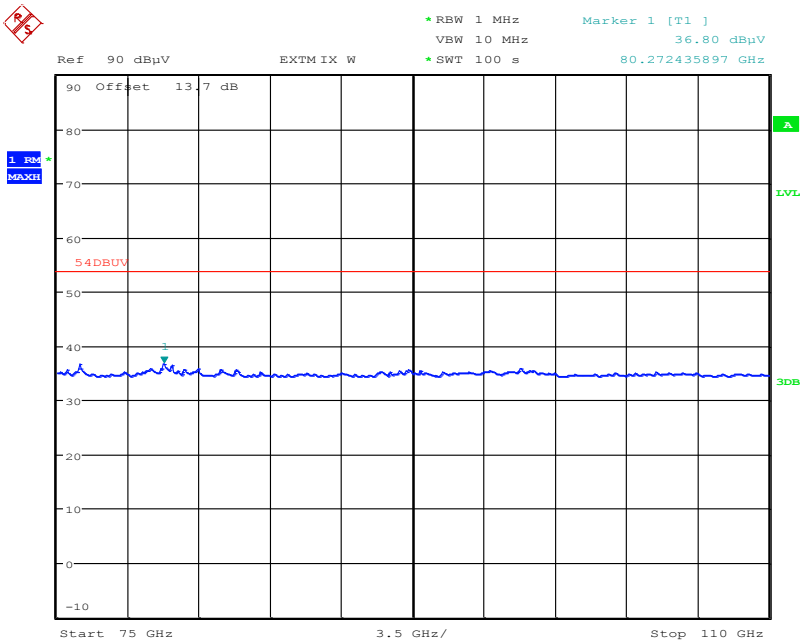

Date: 13.JAN.2015 15:55:13

Plot 8: 50 GHz – 75 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$



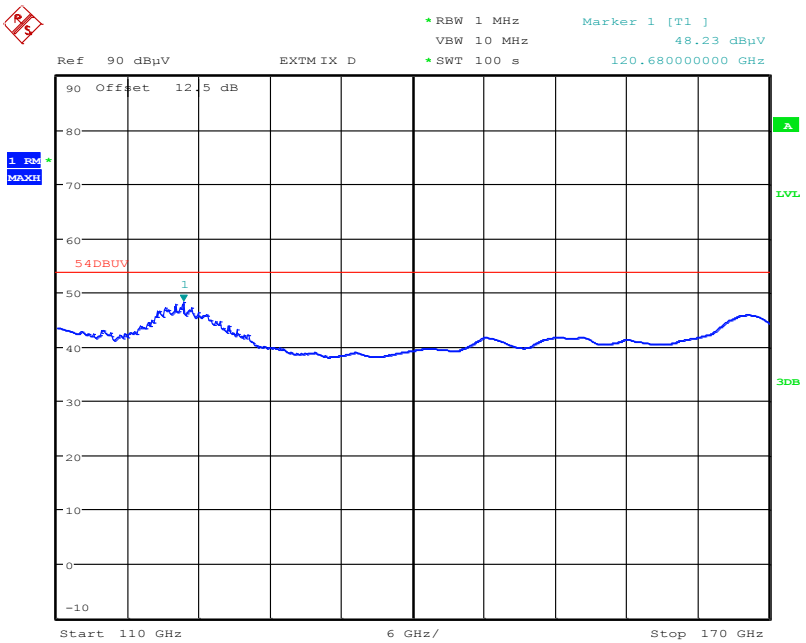

Date: 14.JAN.2015 17:00:34

Plot 9: 75 GHz – 110 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$



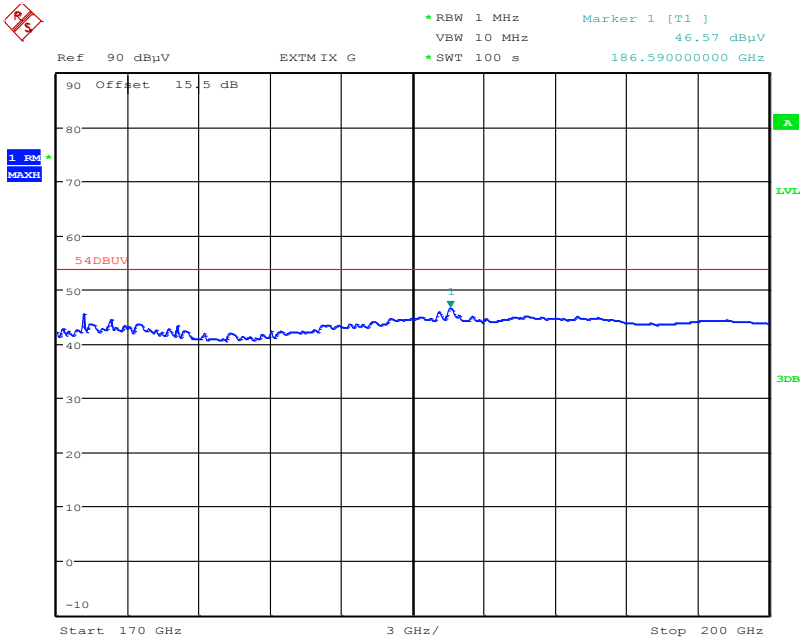

Date: 14.JAN.2015 17:08:15

Plot 10: 110 GHz – 170 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$




Date: 14.JAN.2015 18:14:38

Plot 11: 170 GHz – 200 GHz, special test mode, $f_{low}/f_{mid}/f_{high}$




Date: 14.JAN.2015 18:19:24

## 11.2 Unwanted emission limits (receiver)

**Description:**

§15.109
(a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values shown in table below.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Quasi Peak / Average (RMS) |
| Sweep time: | Auto |
| Resolution bandwidth: | 100 kHz / 1 MHz |
| Video bandwidth: | > RBW |
| Trace-Mode: | Max-Hold |

**Limits:**

| FCC §15.109 | | |
|---|---|---|
| Field strength of the harmonics and spurious. | | |
| **Frequency (MHz)** | **Field strength (µV/m)** | **Measurement distance (m)** |
| 30 – 88 | 100 (40 dBµV/m) | 3 |
| 88 – 216 | 150 (43.5 dBµV/m) | 3 |
| 216 – 960 | 200 (46 dBµV/m) | 3 |
| >960 | 500 (54 dBµV/m) | 3 |

**Results:**

See 11.1 Unwanted emissions limit (transmitter).

**Verdict:** **Complies**

## 11.3 Conducted limits

**Description:**

§15.107
(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

§15.207
(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak - Quasi Peak / Average |
| Sweep time: | Auto |
| Resolution bandwidth: | F < 150 kHz: 200 Hz<br>F > 150 kHz: 9 kHz |
| Video bandwidth: | F < 150 kHz: 1 kHz<br>F > 150 kHz: 100 kHz |
| Span: | 9 kHz to 30 MHz |
| Trace-Mode: | Max Hold |

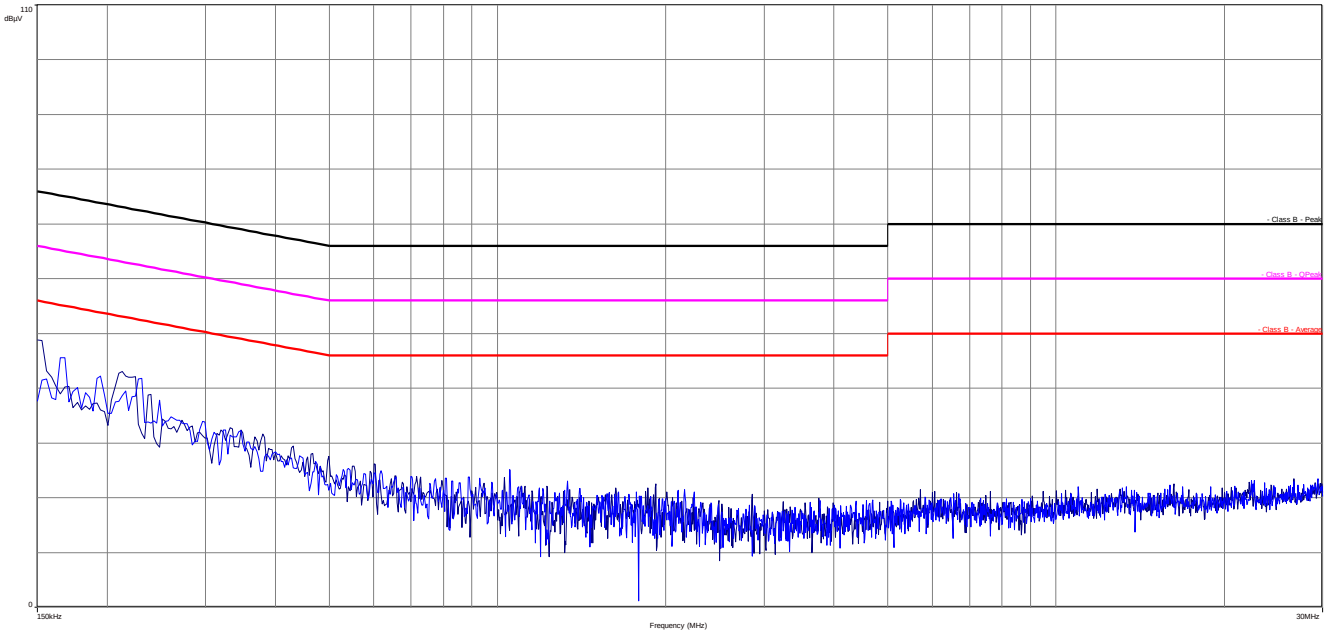
**Limits:**

| FCC §15.107 / §15.207 | | |
|---|---|---|
| **Conducted limits** | | |
| **Frequency of Emission (MHz)** | **Conducted Limit (dBµV)** | |
| | Quasi-peak | Average |
| 0.15 – 0.5 | 66 to 56 * | 56 to 46 * |
| 0.5 – 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |

*Decreases with the logarithm of the frequency

**Verdict:** **Complies**

Plot 12: Phase & Neutral



## 12 Document history

| Version | Applied changes | Date of release |
|---|---|---|
| | Initial release | 2016-05-24 |
| -A | plot no. 9 replaced, description of test procedure | 2016-06-09 |

## 13 Further information

**Glossary**

AVG - Average
DUT - Device under test
EMC - Electromagnetic Compatibility
EN - European Standard
EUT - Equipment under test
ETSI - European Telecommunications Standard Institute
FCC - Federal Communication Commission
FCC ID - Company Identifier at FCC
HW - Hardware
IC - Industry Canada
Inv. No. - Inventory number
N/A - Not applicable
PP - Positive peak
QP - Quasi peak
S/N - Serial number
SW - Software

## 14 Accreditation Certificate

Front side of certificate

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

**Beliehene gemäß § 8 Absatz 1 AkkStelleG i.V.m. § 1 Absatz 1 AkkStelleGBV**
Unterzeichnerin der Multilateralen Abkommen
von EA, ILAC und IAF zur gegenseitigen Anerkennung

**Akkreditierung**

Die Deutsche Akkreditierungsstelle GmbH bestätigt hiermit, dass das Prüflaboratorium

**CETECOM ICT Services GmbH**
**Untertürkheimer Straße 6-10, 66117 Saarbrücken**

die Kompetenz nach DIN EN ISO/IEC 17025:2005 besitzt, Prüfungen in folgenden Bereichen durchzuführen:

**Funk**
**Mobilfunk (GSM / DCS) + OTA**
**Elektromagnetische Verträglichkeit (EMV)**
**Produktsicherheit**
**SAR / EMF**
**Umwelt**
**Smart Card Technology**
**Bluetooth***
**Automotive**
**Wi-Fi-Services**
**Kanadische Anforderungen**
**US-Anforderungen**
**Akustik**
**Near Field Communication (NFC )**

Die Akkreditierungsurkunde gilt nur in Verbindung mit dem Bescheid vom 04.05.2016 mit der Akkreditierungsnummer D-PL-12076-01 und ist gültig bis 17.01.2018. Sie besteht aus diesem Deckblatt, der Rückseite des Deckblatts und der folgenden Anlage mit insgesamt 63 Seiten.

Registrierungsnummer der Urkunde: **D-PL-12076-01-01**

Frankfurt, 04.05.2016

Im Auftrag Dipl.-Ing. (FH) Ralf Egner
Abteilungsleiter

Siehe Hinweise auf der Rückseite

Back side of certificate

Deutsche Akkreditierungsstelle GmbH

Standort Berlin
Spittelmarkt 10
10117 Berlin

Standort Frankfurt am Main
Europa-Allee 52
60327 Frankfurt am Main

Standort Braunschweig
Bundesallee 100
38116 Braunschweig

Die auszugsweise Veröffentlichung der Akkreditierungsurkunde bedarf der vorherigen schriftlichen Zustimmung der Deutsche Akkreditierungsstelle GmbH (DAkkS). Ausgenommen davon ist die separate Weiterverbreitung des Deckblattes durch die umseitig genannte Konformitätsbewertungsstelle in unveränderter Form.

Es darf nicht der Anschein erweckt werden, dass sich die Akkreditierung auch auf Bereiche erstreckt, die über den durch die DAkkS bestätigten Akkreditierungsbereich hinausgehen.

Die Akkreditierung erfolgte gemäß des Gesetzes über die Akkreditierungsstelle (AkkStelleG) vom 31. Juli 2009 (BGBl. I S. 2625) sowie der Verordnung (EG) Nr. 765/2008 des Europäischen Parlaments und des Rates vom 9. Juli 2008 über die Vorschriften für die Akkreditierung und Marktüberwachung im Zusammenhang mit der Vermarktung von Produkten (Abl. L 218 vom 9. Juli 2008, S. 30).
Die DAkkS ist Unterzeichnerin der Multilateralen Abkommen zur gegenseitigen Anerkennung der European co-operation for Accreditation (EA), des International Accreditation Forum (IAF) und der International Laboratory Accreditation Cooperation (ILAC). Die Unterzeichner dieser Abkommen erkennen ihre Akkreditierungen gegenseitig an.

Der aktuelle Stand der Mitgliedschaft kann folgenden Webseiten entnommen werden:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

**Note:**
**The current certificate including annex can be received from CETECOM ICT Services GmbH on request.**