
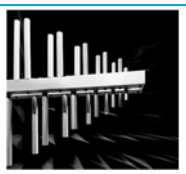


cetecom advanced

Bundesnetzagentur

BNetzA-CAB-02/21-102

# TEST REPORT

**Test report no.: 1-5071_22-01-05**

## Testing laboratory

**CTC advanced GmbH**
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

**Accredited Testing Laboratory:**
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS)
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

## Applicant

**Building 36 Technologies LLC**
150 A Street, Suite 104
02494-0249 Needham) / UNITED STADES
Phone: 781-474-0500
Contact: Daniel Goodman
e-mail: dan@building36.com

## Manufacturer

**MEC electronics Entwicklung und Produktion GmbH**
Dresdner Straße 45
1200 Vienna (Wien) / AUSTRIA
Contact: Helmut Kraus
e-mail: helmut.kraus@mec.at

## Test standard/s

| | |
|---|---|
| FCC - Title 47 CFR Part 15 | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices |
| RSS - 210 Issue 10 | Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment |

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

## Test Item

| | |
|---|---|
| **Kind of test item:** | **Display** |
| **Model name:** | **ADC-T40-HQ** |
| **FCC ID:** | **2AC3T-B36T40HQRA** |
| **ISED certification number:** | **12323A-B36T40HQRA** |
| Frequency band: | 902 MHz – 928 MHz |
| Technology tested: | Zwave |
| Antenna: | Integrated antenna |
| Power supply: | 4.5 V to 5.5 V DC by external power supply |
| Temperature range: | +5°C to +35°C |

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.

## Test report authorized:

cn=Christoph Schneider, o=CTC advanced GmbH, ou=SND-211129, email=christoph.schneider@ctcadvanced.com, c=DE
2023.03.09 14:17:08 +01'00'

Christoph Schneider
Lab Manager
Radio Communications

## Test performed:

cn=Tobias Wittenmeier, o=CTC advanced GmbH, ou=WIT-220519, email=tobias.wittenmeier@ctcadvanced.com, c=DE
2023.03.09 13:58:57 +01'00'

Tobias Wittenmeier
Testing Manager
Radio Communications

# 1 Table of contents

# 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. CTC advanced 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.
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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: | 2022-12-07 |
| Date of receipt of test item: | 2023-01-13 |
| Start of test:* | 2023-01-13 |
| End of test:* | 2023-01-20 |
| Person(s) present during the test: | -/- |

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

## 2.3 Test laboratories sub-contracted

None

## 3 Test standard/s, references and accreditations

| Test standard | Date | Description |
|---|---|---|
| FCC - Title 47 CFR Part 15 | | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices |
| RSS - 210 Issue 10 | December 2019 | Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment |
| RSS - Gen Issue 5 incl. Amendment 1 & 2 | February 2021 | Spectrum Management and Telecommunications Radio Standards Specification<br>- General Requirements for Compliance of Radio Apparatus |

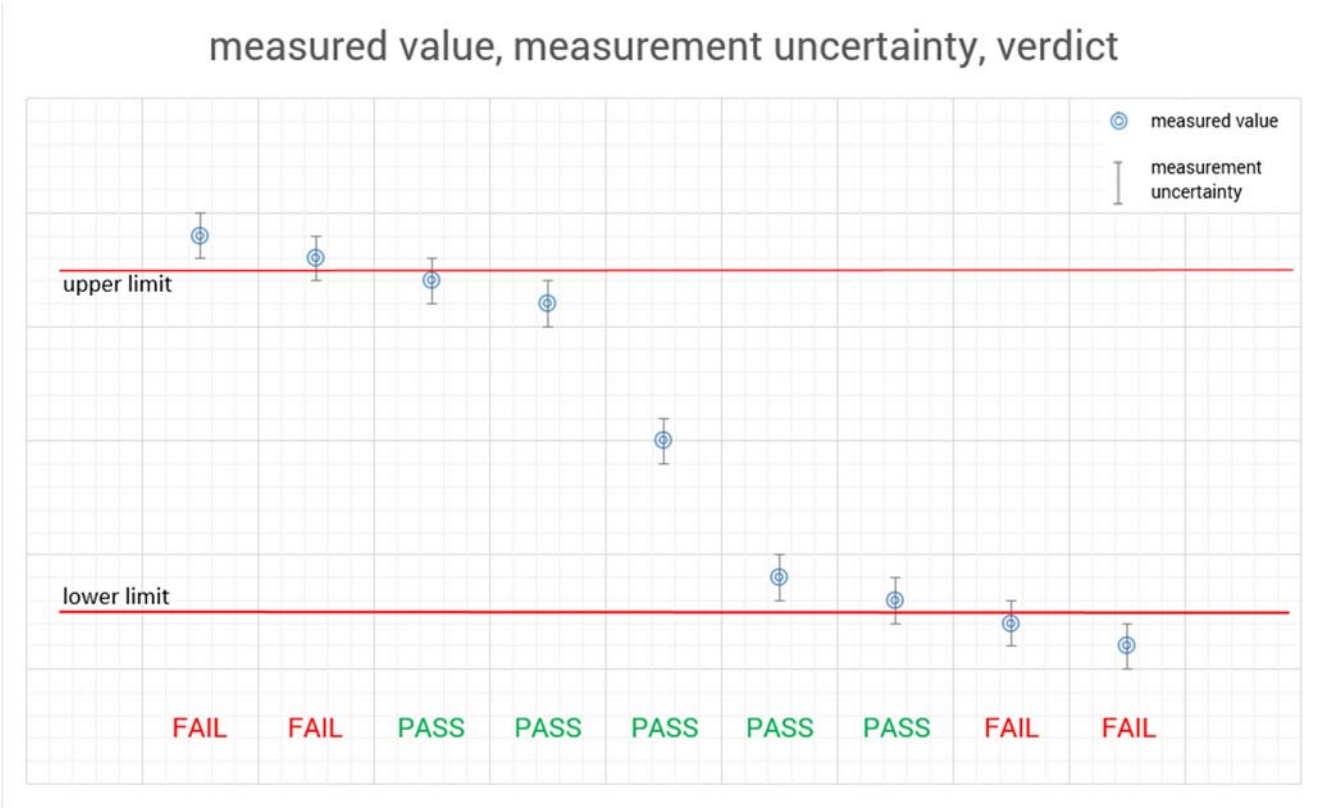
| Guidance | Version | Description |
|---|---|---|
| ANSI C63.4-2014 | -/- | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI C63.10-2013 | -/- | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |

| Accreditation | Description |
|---|---|
| D-PL-12076-01-04 | Telecommunication and EMC Canada<br>https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf |
| D-PL-12076-01-05 | Telecommunication FCC requirements<br>https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf |

ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

## 4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



# 5 Test environment

| | | | |
|---|---|---|---|
| Temperature | : | $T_{nom}$<br>$T_{max}$<br>$T_{min}$ | +22 °C during room temperature tests<br>+35 °C during high temperature tests<br>+5 °C during low temperature tests |
| Relative humidity content | : | | 55 % |
| Barometric pressure | : | | 1021 hpa |
| Power supply | : | $V_{nom}$<br>$V_{max}$<br>$V_{min}$ | 5.0 V DC by external power supply<br>5.5 V<br>4.5 V |

*No tests under extreme conditions required.

# 6 Test item

## 6.1 General description

| | | |
|---|---|---|
| Kind of test item | : | Display |
| Model name | : | ADC-T40-HQ |
| HMN | : | -/- |
| PMN | : | ADC-T40-HQ-AT; ADC-T40-HQ-VZ; ADC-T40-HQ-VZ; ADC-T40-HQ-VZ-W |
| HVIN | : | B36-T40-HQ-Z-A |
| FVIN | : | -/- |
| S/N serial number | : | 015770000326877 |
| Hardware status | : | ADC-T40-HQ LTE |
| Software status | : | v1.0 |
| Firmware status | : | -/- |
| Frequency band | : | 902 MHz – 928 MHz |
| Type of radio transmission<br>Use of frequency spectrum | :<br>: | DSSS |
| Type of modulation | : | OQPSK |
| Number of channels | : | 3 |
| Antenna | : | Integrated antenna |
| Power supply | : | 4.5 V to 5.5 V DC by external power supply |
| Temperature range | : | +5°C to +35°C |

## 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: 1-5071/22-01-01_AnnexA
1-5071/22-01-01_AnnexB
1-5071/22-01-01_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).

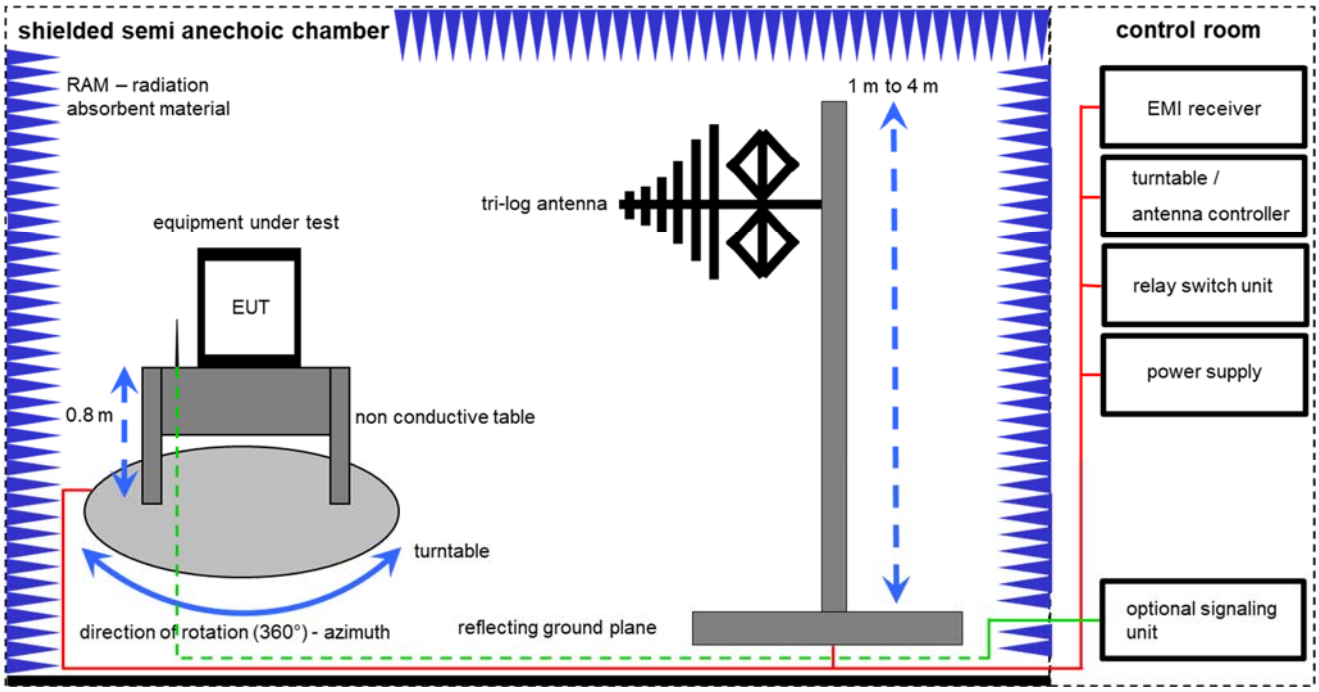
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

**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 30 MHz 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 conform to 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.




Measurement distance: tri-log antenna 10 meter
EMC32 software version: 10.59.00

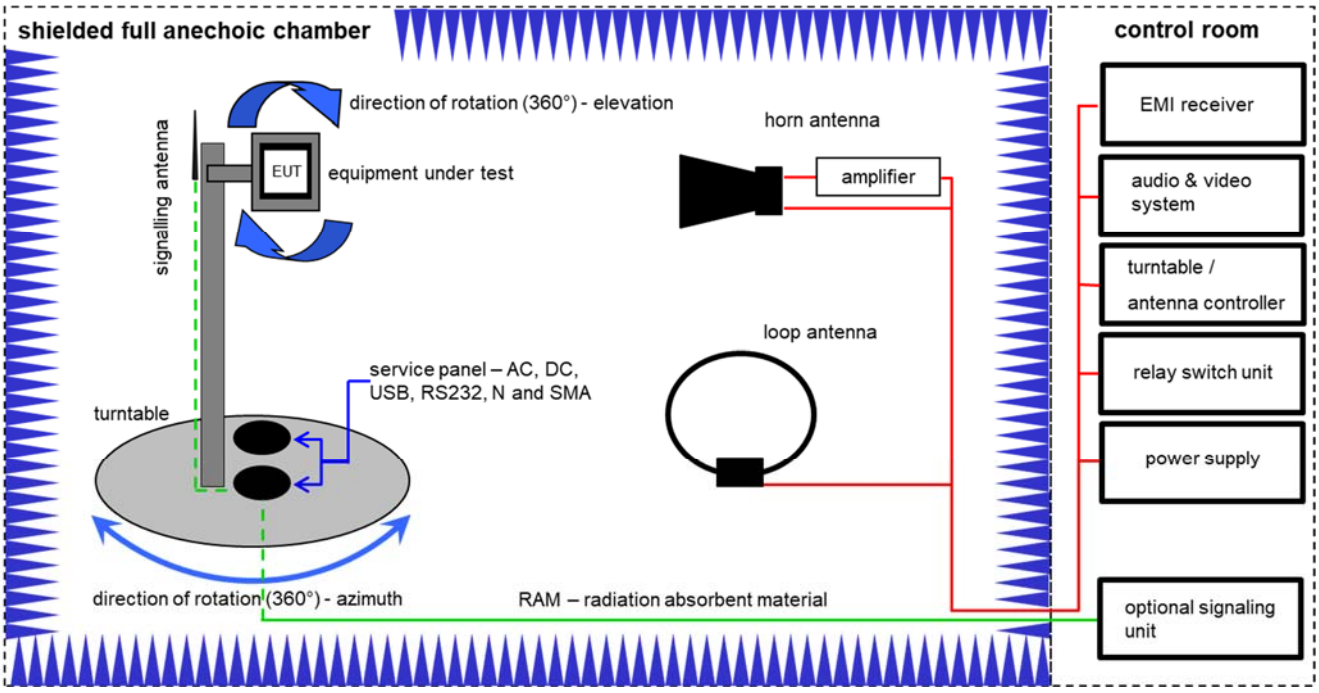
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

*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. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | Switch-Unit | 3488A | HP | 2719A14505 | 300000368 | ev | -/- | -/- |
| 2 | A | Semi anechoic chamber | 3000023 | MWB AG | -/- | 300000551 | ne | -/- | -/- |
| 3 | A | Analyzer-Reference-System (Harmonics and Flicker) | ARS 16/1 | SPS | A3509 07/0 0205 | 300003314 | vlKl! | 29.12.2021 | 31.12.2023 |
| 4 | A | Antenna Tower | Model 2175 | ETS-Lindgren | 64762 | 300003745 | izw | -/- | -/- |
| 5 | A | Positioning Controller | Model 2090 | ETS-Lindgren | 64672 | 300003746 | izw | -/- | -/- |
| 6 | A | Turntable Interface-Box | Model 105637 | ETS-Lindgren | 44583 | 300003747 | izw | -/- | -/- |
| 7 | A | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck Mess - Elektronik | 318 | 300003696 | vlKl! | 30.09.2021 | 29.09.2023 |
| 8 | A | Spectrum-Analyzer | FSU26 | R&S | 200809 | 300003874 | k | 09.12.2022 | 31.12.2023 |
| 9 | A | Turntable | 2089-4.0 | EMCO | -/- | 300004394 | ne | -/- | -/- |
| 10 | A | PC | TecLine | F+W | -/- | 300004388 | ne | -/- | -/- |
| 11 | A | EMI Test Receiver | ESR3 | Rohde & Schwarz | 102587 | 300005771 | k | 09.12.2022 | 31.12.2023 |

## 7.2 Shielded fully anechoic chamber




Measurement distance: horn antenna 3 meter; loop antenna 3 meter

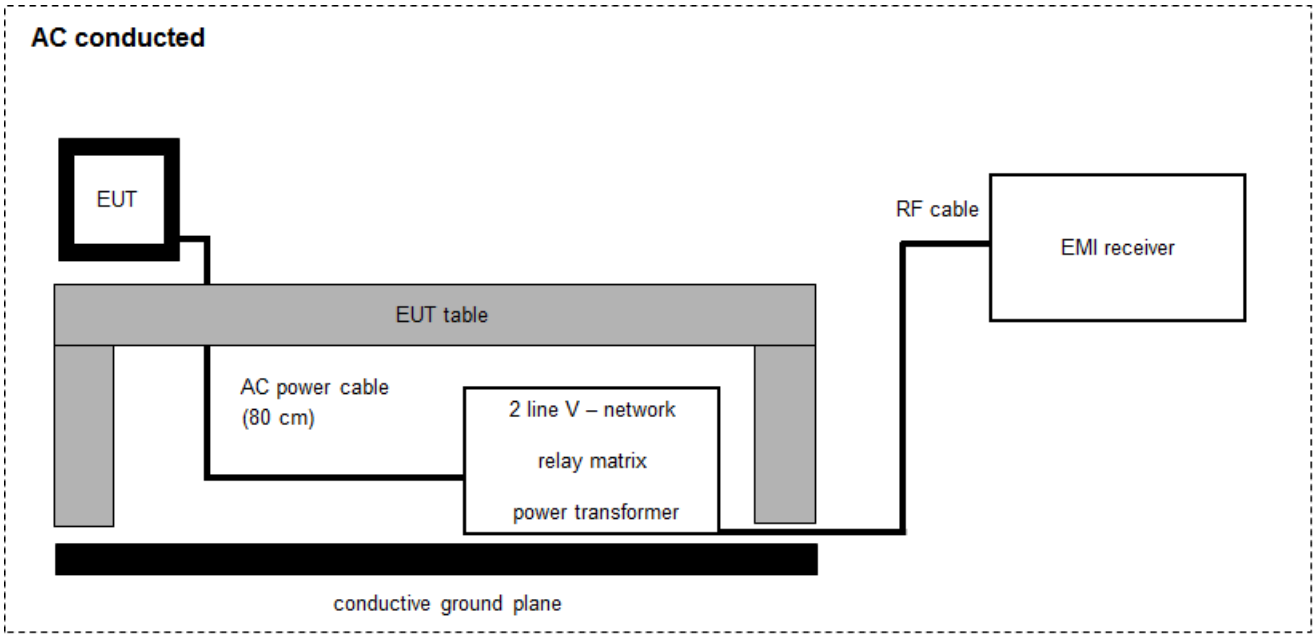
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

*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. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | Active Loop Antenna 9 kHz to 30 MHz | 6502 | EMCO | 2210 | 300001015 | vlKl! | 01.07.2021 | 31.07.2023 |
| 2 | B | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115 | EMCO | 9107-3696 | 300001604 | vlKl! | 12.03.2021 | 11.03.2023 |
| 3 | B | Highpass Filter | WHK1.1/15G-10SS | Wainwright | 37 | 400000148 | ne | -/- | -/- |
| 4 | B | Highpass Filter | WHKX7.0/18G-8SS | Wainwright | 18 | 300003789 | ne | -/- | -/- |
| 5 | B | Broadband Amplifier 0.5-18 GHz | CBLU5184540 | CERNEX | 22051 | 300004483 | ev | -/- | -/- |
| 6 | A,B | 4U RF Switch Platform | L4491A | Agilent Technologies | MY50000032 | 300004510 | ne | -/- | -/- |
| 7 | A,B | Computer | Intel Core i3 3220/3,3 GHz, Prozessor | | 2V2403033A54 21 | 300004591 | ne | -/- | -/- |
| 8 | A,B | Anechoic chamber | | TDK | | 300003726 | ne | -/- | -/- |
| 9 | A,B | EMI Test Receiver 9kHz-26,5GHz | ESR26 | Rohde & Schwarz | 101376 | 300005063 | k | 13.12.2022 | 31.12.2023 |

## 7.3 AC conducted



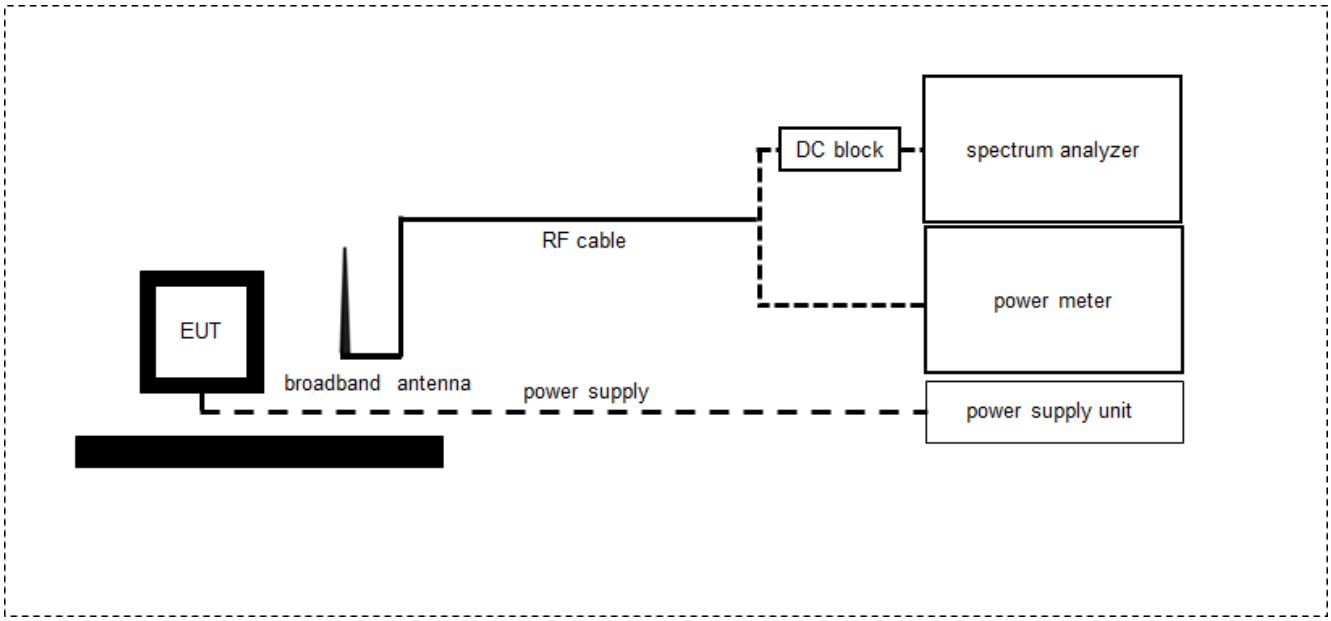

FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

*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. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | Two-line V-Network (LISN) 9 kHz to 30 MHz | ESH3-Z5 | Rohde & Schwarz | 892475/017 | 300002209 | vIKI! | 14.12.2021 | 31.12.2023 |
| 2 | A | RF-Filter-section | 85420E | HP | 3427A00162 | 300002214 | NK! | -/- | -/- |
| 3 | A | EMI Test Receiver | ESCI 3 | R&S | 100083 | 300003312 | g | -/- | -/- |
| 4 | A | Analyzer-Reference-System (Harmonics and Flicker) | ARS 16/1 | SPS | A3509 07/0 0205 | 300003314 | vIKI! | 29.12.2021 | 31.12.2023 |
| 5 | A | Hochpass 150 kHz | EZ-25 | R&S | 100010 | 300003798 | ev | -/- | -/- |
| 6 | A | PC | TecLine | F+W | | 300003532 | ne | -/- | -/- |

## 7.4 Test setup for normalized measurement configurations




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. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | Loop Antenna | | ZEG TS Steinfurt | | 400001208 | ev | -/- | -/- |
| 2 | A | RF Cable BNC | RG58 | Huber & Suhner | | 400001209 | ev | -/- | -/- |
| 3 | A | Signal analyzer | FSV30 | Rohde&Schwarz | 104365 | 300005923 | k | 13.12.2022 | 31.12.2023 |

# 8 Sequence of testing

## 8.1 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, it is placed on a table with 0.8 m height.
- 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 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 pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- 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.

*)Note: The sequence will be repeated three times with different EUT orientations.

## 8.2 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.

## 8.3 Sequence of testing radiated spurious 1 GHz to 12.75 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 Measurement uncertainty

| Measurement uncertainty | |
|---|---|
| **Test case** | **Uncertainty** |
| Occupied bandwidth | ± 100 kHz (depends on the used RBW) |
| 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 |

## 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<br>RSS 210 Issue 10<br>RSS Gen Issue 5 | See table! | 2023-03-09 | -/- |

| Test specification clause | Test case | Temperature conditions | Power source voltages | C | NC | NA | NP | Remark |
|---|---|---|---|---|---|---|---|---|
| §15.249(a)<br>RSS 210 B.10 | Field strength of emissions (wanted signal) | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | -/- |
| RSS Gen | Occupied bandwidth (99% bandwidth) | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.209(a) / §15.249(b)(1)(2)(3)<br>RSS Gen<br>RSS 210 B.10 | Field strength of emissions (spurious) | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.207(a)<br>RSS Gen | Conducted emissions < 30 MHz | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | -/- |

**Note:** C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

## 11 Additional comments

Reference documents: None

Special test descriptions: Tested frequencies

| | |
|---|---|
| Channel 0 | 916.00 MHz |
| Channel 1 | 908.42 MHz |
| Channel high | 908.40 MHz |

All conversions due to different measurement distances have been calculated according ANSI C63.10:

$$FS_{limit} = FS_{max} - 20\log\left(\frac{d_{limit}}{d_{measure}}\right)$$

→ Example: -10.46 dB from 10 m to 3 m

Configuration descriptions: None

Test mode:

☐ No test mode available.
Iperf was used to ping another device with the largest support packet size

☒ Special software is used.
EUT is transmitting pseudo random data by itself

Antennas and transmit operating modes:

☒ Operating mode 1 (single antenna)

- *Equipment with 1 antenna,*
- *Equipment with 2 diversity antennas operating in switched diversity mode by which at any moment in time only 1 antenna is used,*
- *Smart antenna system with 2 or more transmit/receive chains, but operating in a mode where only 1 transmit/receive chain is used)*

# 12 Measurement results

## 12.1 Field strength of emissions (wanted signal)

**Description:**

Measurement of the maximum radiated field strength of the wanted signal.
Measurement performed according to ANSI C63.10, chapter 6.5

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak / Quasi peak |
| Resolution bandwidth: | 100 kHz |
| Video bandwidth: | 300 kHz |
| Trace mode: | Max. hold |

**Limits:**

| FCC / ISED | | | |
|---|---|---|---|
| The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following: | | | |
| Frequency | Field Strength of fundamental | | Measurement distance |
| | peak | quasi peak | |
| 902 MHz – 928 MHz | 500 mV/m (114 dBµV/m) | 50 mV/m (94 dBµV/m) | 3 m |

**Result:**

| Test condition | Frequency | Maximum field strength @ 3 m | |
|---|---|---|---|
| | | field strength peak | field strength quasi peak |
| $T_{nom}$ / $V_{nom}$ | 916.00 MHz | 90.6 dBµV/m | 90.4 dBµV/m |
| | 908.42 MHz | 92.9 dBµV/m | 92.3 dBµV/m |
| | 908.40 MHz | 93.8 dBµV/m | 93.2 dBµV/m |

## 12.2 Occupied bandwidth (99% bandwidth)

**Description:**

Measurement of the 99% bandwidth of the wanted signal.
Measurement performed according to ANSI C63.10, chapter 6.9

**Measurement:**

| Measurement parameters | |
|---|---|
| Detector: | Peak |
| Resolution bandwidth: | 1 % – 5 % of the occupied bandwidth |
| Video bandwidth: | ≥ 3x RBW |
| Trace mode: | Max hold |
| Analyzer function: | 99 % power function |
| Used equipment: | See chapter 7.4A |
| Measurement uncertainty: | See chapter 9 |

**Results:**

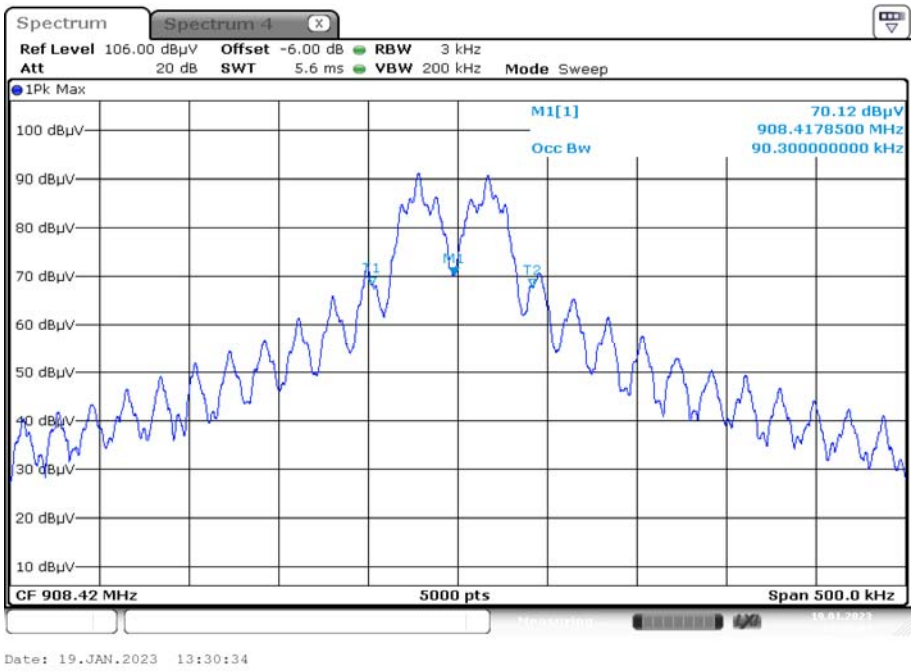
| Occupied bandwidth | |
|---|---|
| Frequency | Occupied bandwidth |
| 916.00 MHz | 113.9 kHz |
| 908.42 MHz | 89.7 kHz |
| 908.40 MHz | 90.3 kHz |

**Plots:**

Plot 1: 916.00 MHz


Plot 2: 908.42 MHz

Plot 3: 908.40 MHz



## 12.3 Spurious emissions radiated below 30 MHz

**Description:**

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.
Measurement performed according to ANSI C63.10, chapter 6.4

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak / Quasi Peak |
| 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 |
| Test setup: | See chapter 7.2A |
| Measurement uncertainty | See chapter 9 |

**Limits:**

| FCC | | |
|---|---|---|
| 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 |

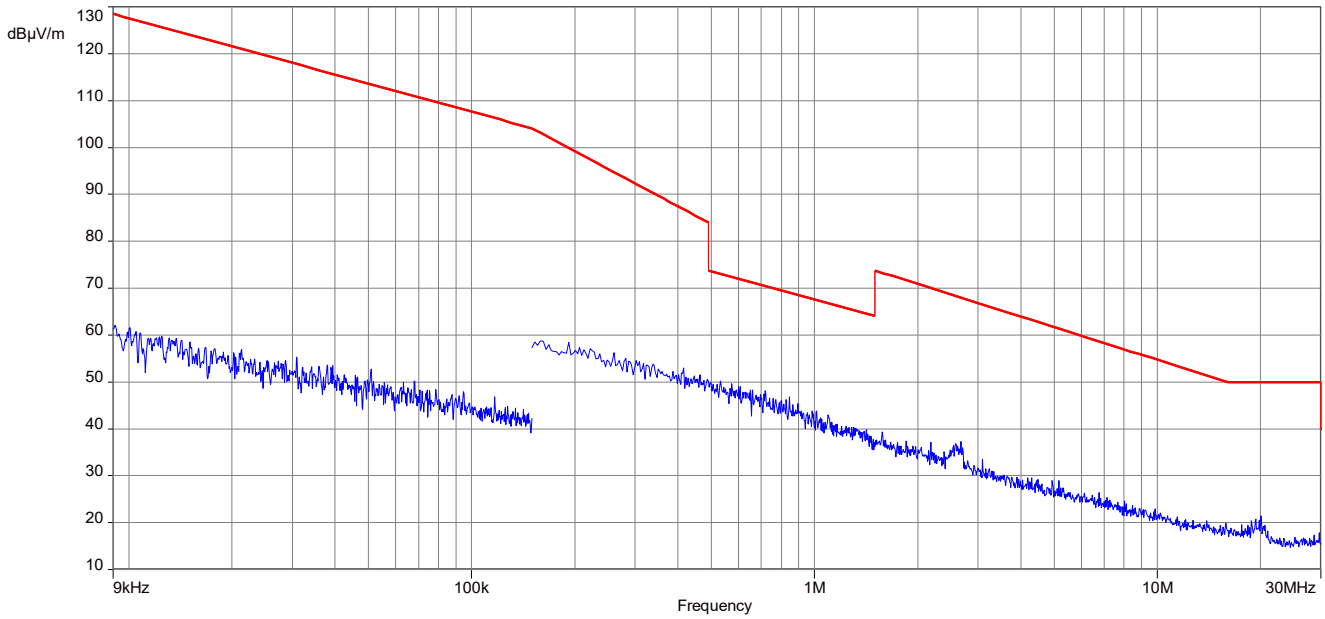
| IC | | |
|---|---|---|
| Frequency (MHz) | Field strength (dBµA/m) | Measurement distance (m) |
| 0.009 – 0.490 | 2400/(F/kHz) | 300 |
| 0.490 – 1.705 | 24000/(F/kHz) | 30 |
| 1.705 – 30 | 0.08 (18.06 dBµA/m) | 30 |

**Results:**

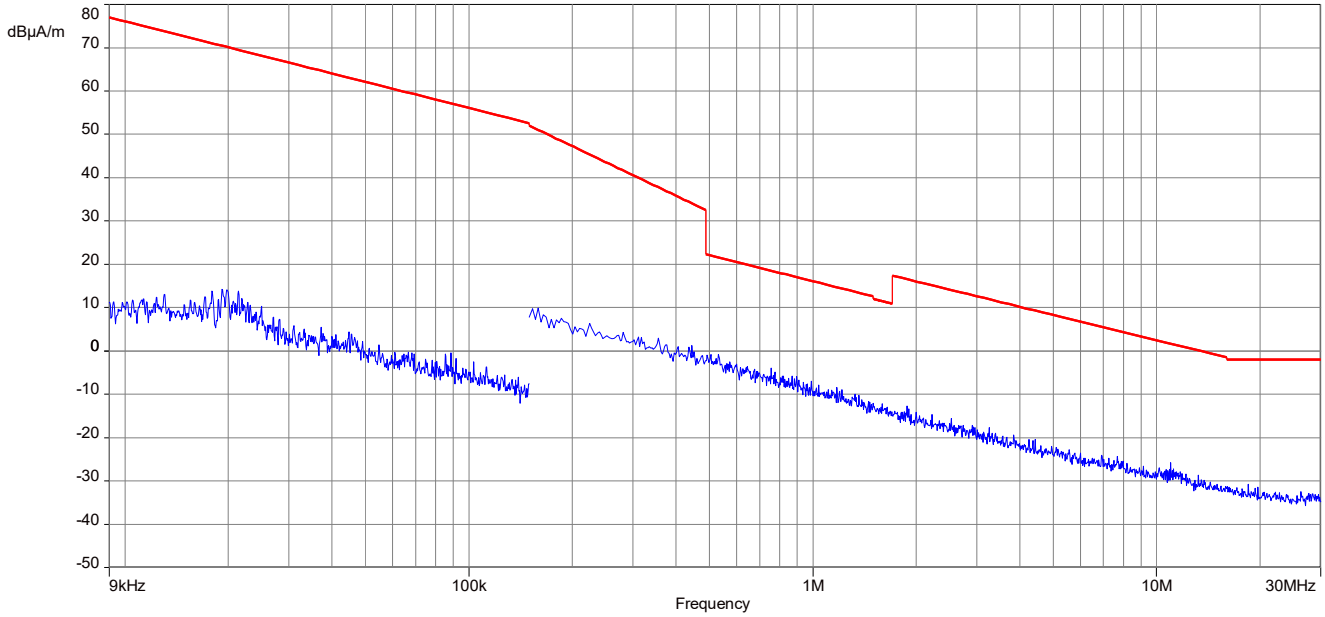
No emissions detected.

## Plots:

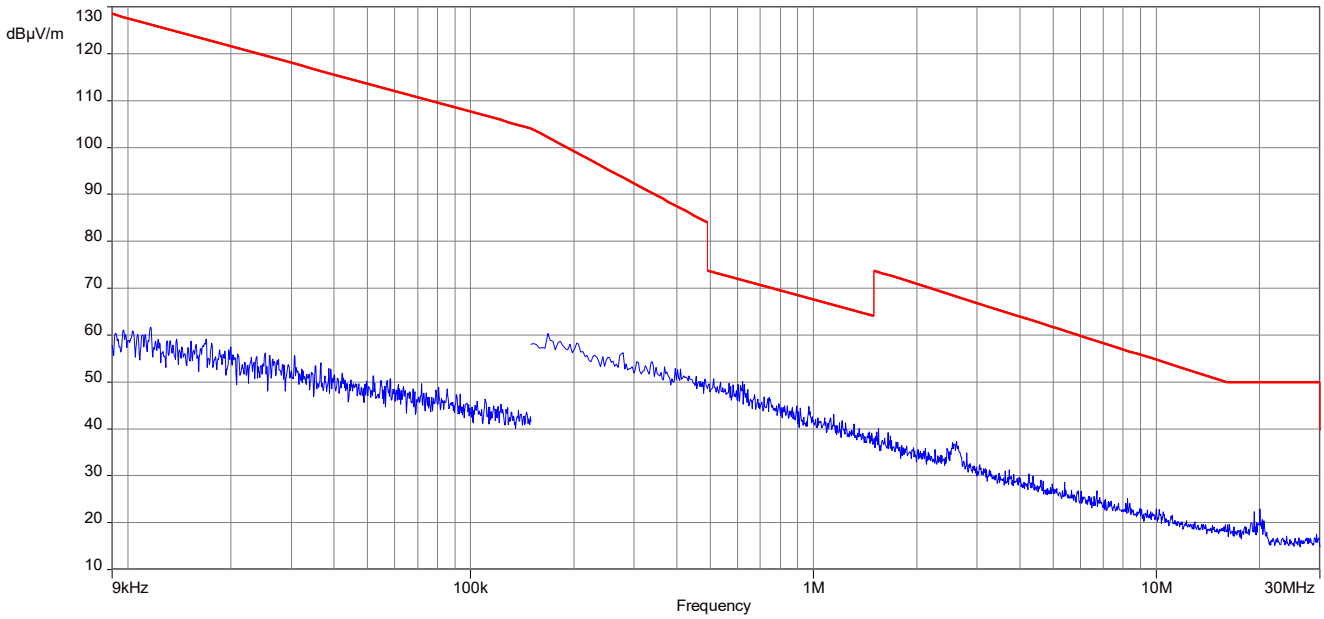
**Plot 1:** 9 kHz to 30 MHz, 916.00 MHz FCC



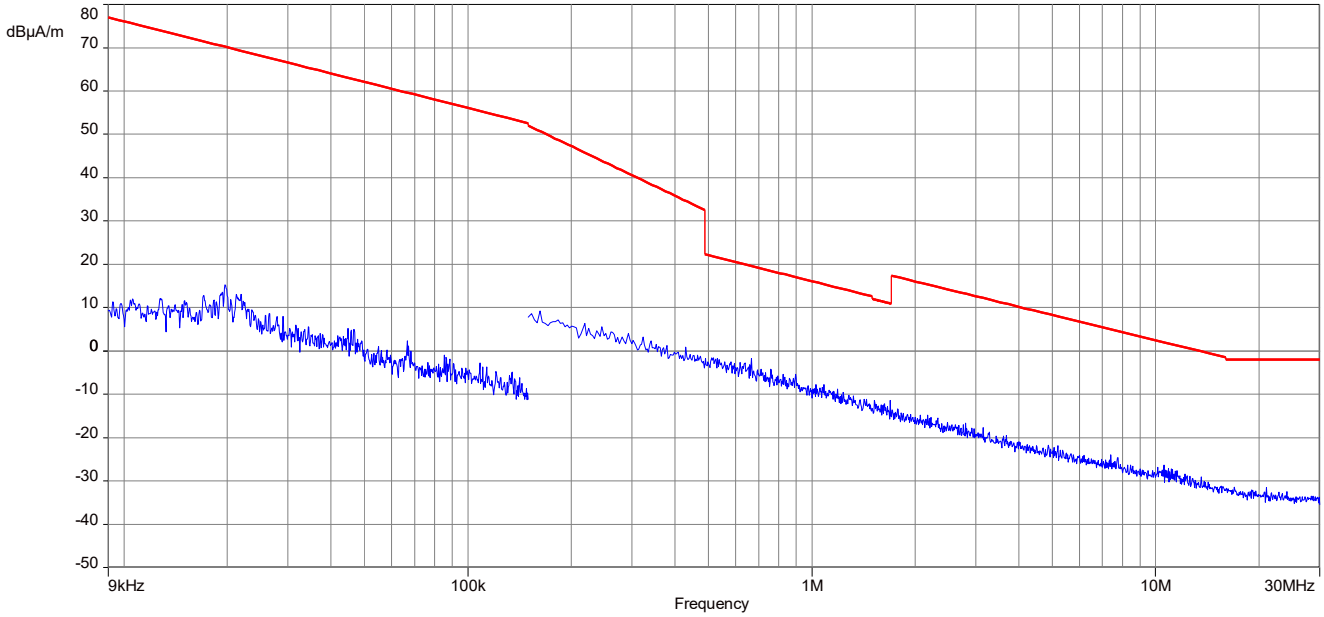

**Plot 2:** 9 kHz to 30 MHz, 916.00 MHz IC



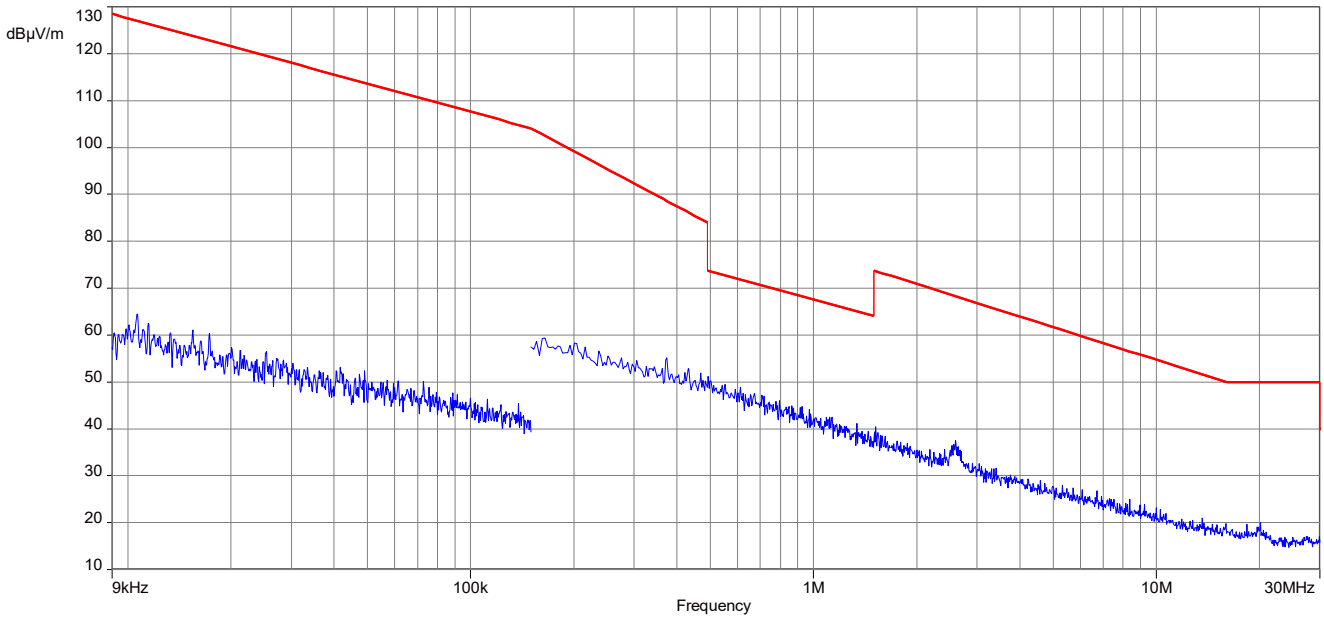
**Plot 3:** 9 kHz to 30 MHz, 908.42 MHz FCC



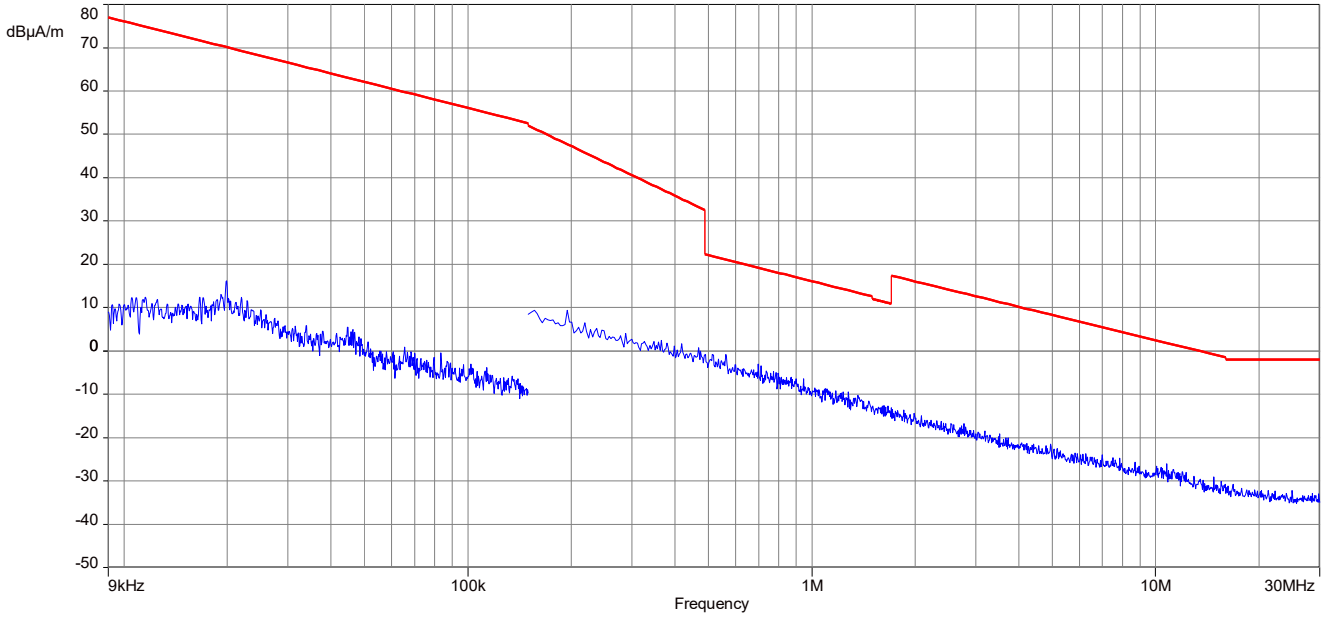

**Plot 4:** 9 kHz to 30 MHz, 908.42 MHz IC



**Plot 5:** 9 kHz to 30 MHz, 908.40 MHz FCC




**Plot 6:** 9 kHz to 30 MHz, 908.40 MHz IC



## 12.4 Spurious emissions radiated 30 MHz to 1 GHz

**Description:**

Measurement of the radiated spurious emissions and cabinet radiations below 1 GHz.
Measurement performed according to ANSI C63.10, chapter 6.5

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak / Quasi Peak |
| Sweep time: | Auto |
| Resolution bandwidth: | 120 kHz |
| Video bandwidth: | 3 x RBW |
| Span: | 30 MHz to 1 GHz |
| Trace mode: | Max Hold |
| Test setup: | See chapter 7.1A |
| Measurement uncertainty | See chapter 9 |

**Limits:**

| FCC | | ISED |
|---|---|---|
| Part 15.249 (a): field strength of harmonics | | |
| 902 MHz – 928 MHz | Quasi Peak | 500 µV/m @ 3 m (54 dBµV/m) |
| | Peak | 5 mV/m @ 3 m (74 dBµV/m) |
| Part 15.249 (d): Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation. | | |

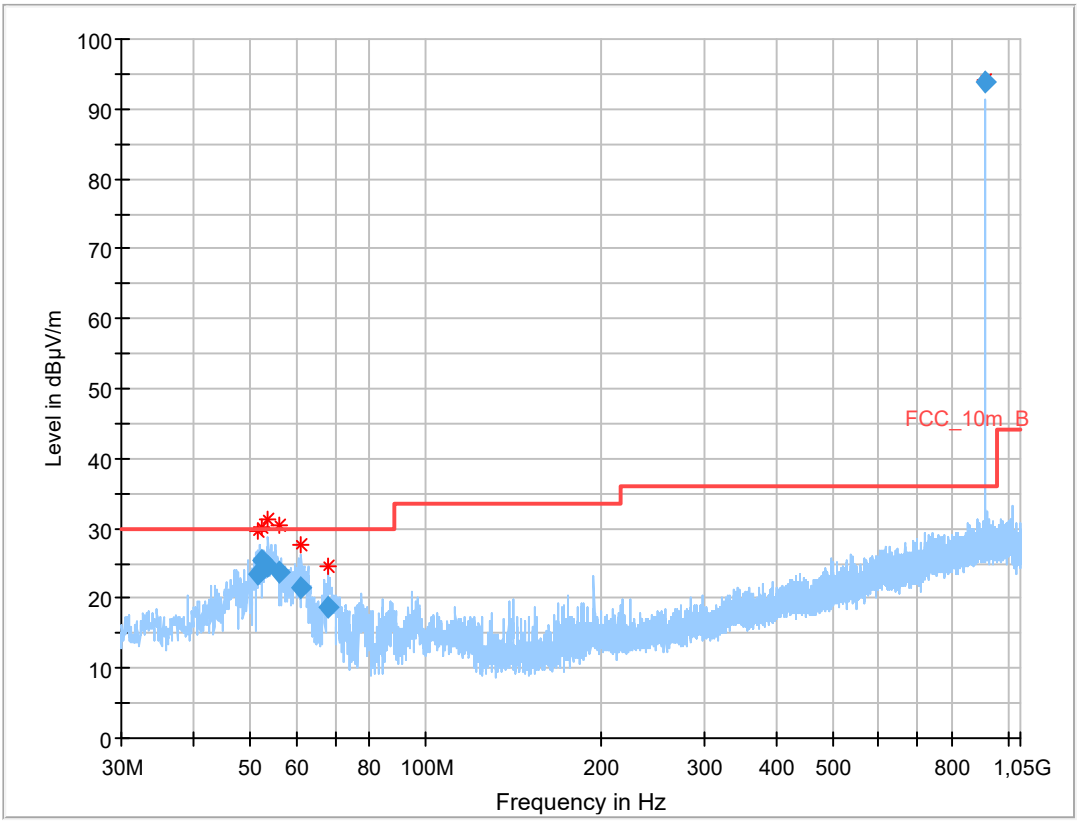
| Limit according Part 15.209 (a): | | | |
|---|---|---|---|
| Frequency /MHz | Field Strength / (dBµV/m) | | Measurement distance |
| | Peak | Quasi Peak | |
| 30 - 88 | 50.0 | 30.0 | 10 m |
| 88 – 216 | 54.5 | 33.5 | 10 m |
| 216 – 960 | 56.0 | 36.0 | 10 m |

**Result:**

See result table below the plots.

**Plot:**

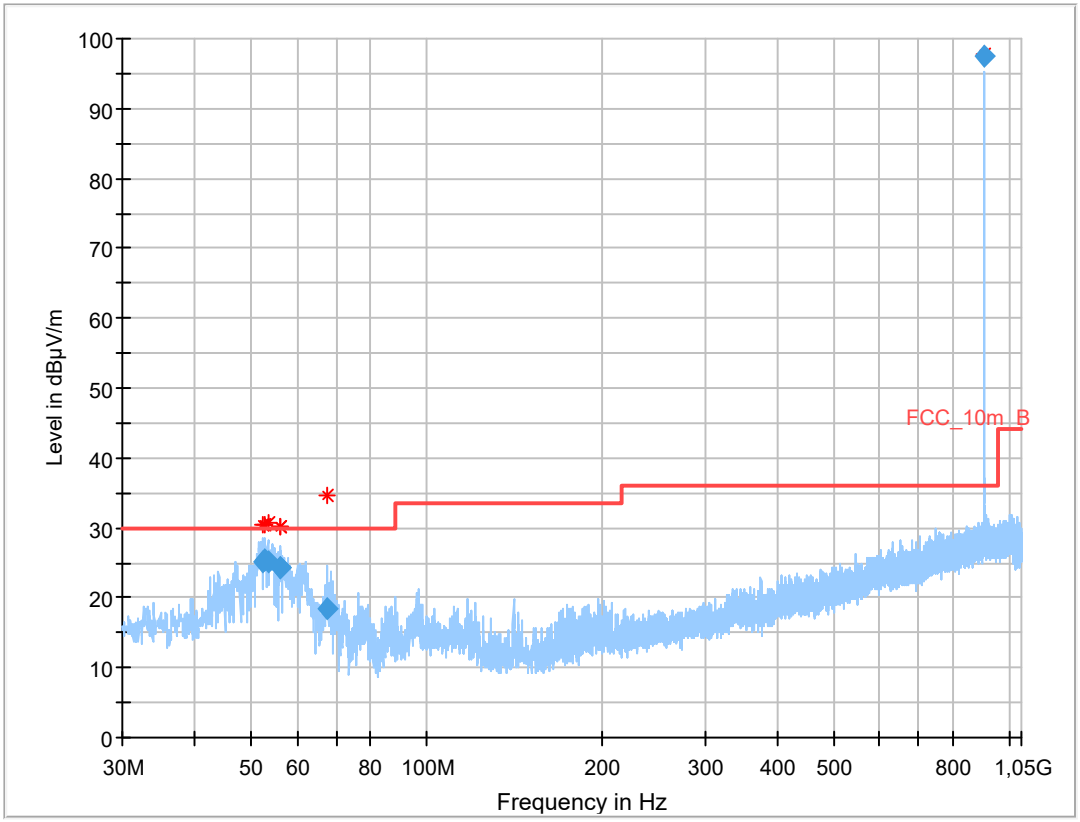
**Plot 1:** 30 MHz to 1 GHz, vertical & horizontal polarization, 916.00 MHz




**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 51.287 | 23.54 | 30.0 | 6.5 | 1000 | 120.0 | 195.0 | V | 113 | 15 |
| 52.285 | 25.38 | 30.0 | 4.6 | 1000 | 120.0 | 107.0 | V | 69 | 15 |
| 53.569 | 24.49 | 30.0 | 5.5 | 1000 | 120.0 | 195.0 | V | 111 | 15 |
| 56.011 | 23.79 | 30.0 | 6.2 | 1000 | 120.0 | 195.0 | V | 240 | 16 |
| 60.884 | 21.64 | 30.0 | 8.4 | 1000 | 120.0 | 195.0 | V | 217 | 14 |
| 67.988 | 18.62 | 30.0 | 11.4 | 1000 | 120.0 | 195.0 | V | 4 | 10 |

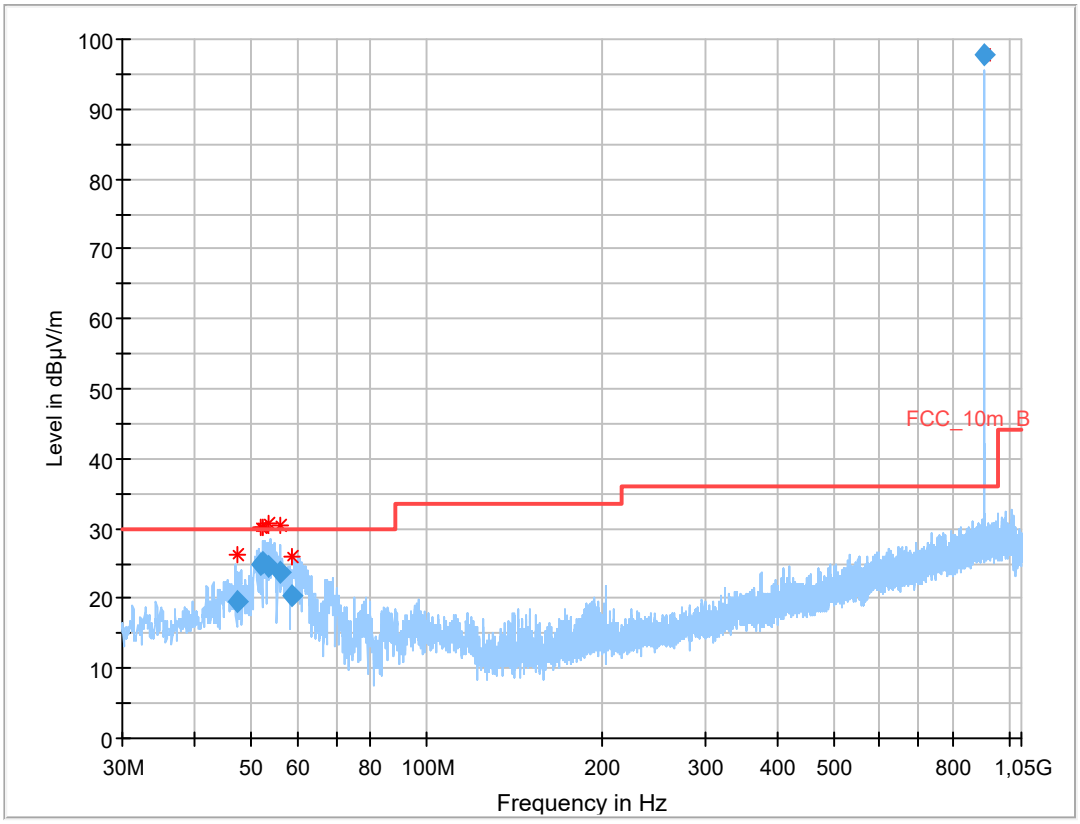
**Plot 2:** 30 MHz to 1 GHz, vertical & horizontal polarization, 908.42 MHz




**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 52.268 | 25.20 | 30.0 | 4.8 | 1000 | 120.0 | 139.0 | V | -34 | 15 |
| 52.533 | 25.53 | 30.0 | 4.5 | 1000 | 120.0 | 167.0 | V | 104 | 15 |
| 53.424 | 25.12 | 30.0 | 4.9 | 1000 | 120.0 | 102.0 | V | 3 | 15 |
| 55.892 | 24.22 | 30.0 | 5.8 | 1000 | 120.0 | 195.0 | V | 100 | 16 |
| 56.011 | 24.28 | 30.0 | 5.7 | 1000 | 120.0 | 123.0 | V | 236 | 16 |
| 67.489 | 18.44 | 30.0 | 11.6 | 1000 | 120.0 | 195.0 | V | -4 | 10 |

**Plot 3:** 30 MHz to 1 GHz, vertical & horizontal polarization, 908.40 MHz




**Final_Result**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 47.276 | 19.56 | 30.0 | 10.4 | 1000 | 120.0 | 195.0 | V | 235 | 16 |
| 51.923 | 24.84 | 30.0 | 5.2 | 1000 | 120.0 | 195.0 | V | -6 | 15 |
| 52.183 | 25.11 | 30.0 | 4.9 | 1000 | 120.0 | 195.0 | V | 114 | 15 |
| 53.487 | 24.59 | 30.0 | 5.4 | 1000 | 120.0 | 195.0 | V | 4 | 15 |
| 56.130 | 23.68 | 30.0 | 6.3 | 1000 | 120.0 | 171.0 | V | 196 | 16 |
| 58.797 | 20.36 | 30.0 | 9.6 | 1000 | 120.0 | 176.0 | V | 25 | 15 |

## 12.5 Spurious emissions radiated above 1 GHz

**Description:**

Measurement of the radiated spurious emissions above 1 GHz in transmit mode
Measurement performed according to ANSI C63.10, chapter 6.6

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Peak / AVG |
| Sweep time: | Auto |
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Span: | 1 GHz to 12.75 GHz |
| Trace mode: | Max Hold |
| Test setup: | See chapter 7.2B |
| Measurement uncertainty | See chapter 9 |

**Limits:**

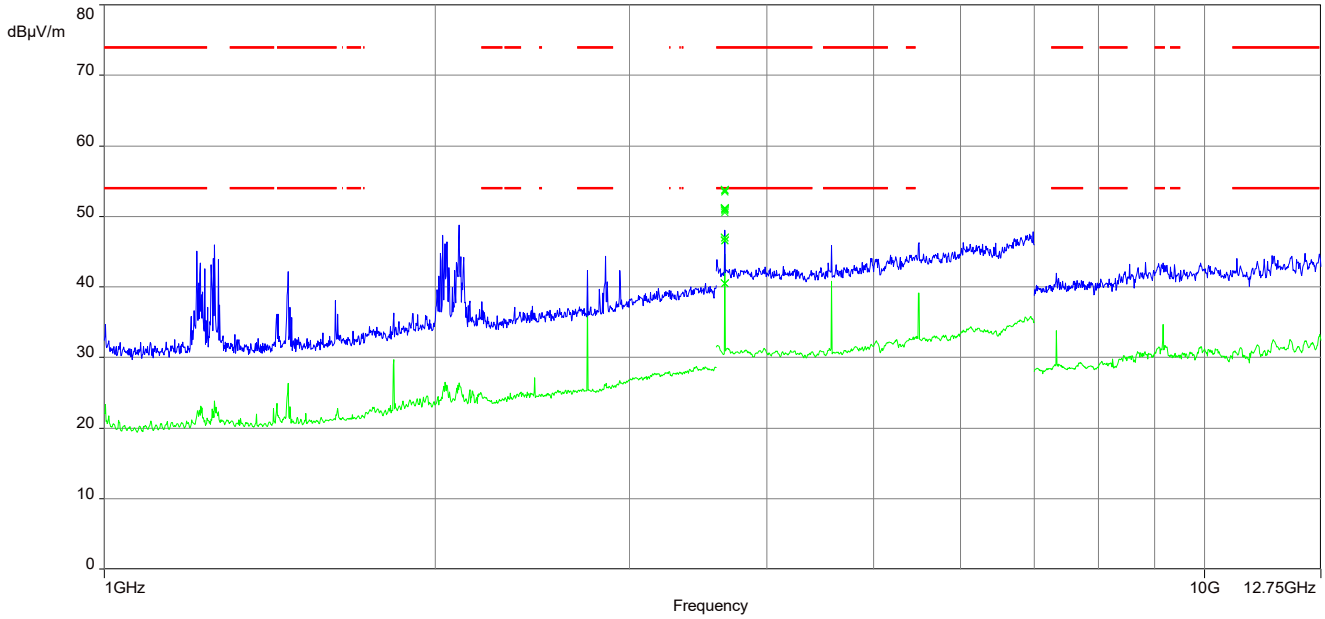
| FCC | | | ISED |
|---|---|---|---|
| Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation. | | | |
| Frequency | Field Strength | | Measurement distance |
| | Peak | AVG | |
| Above 960 MHz | 74 dBµV/m | 54 dBµV/m | 3 m |

**Results:**

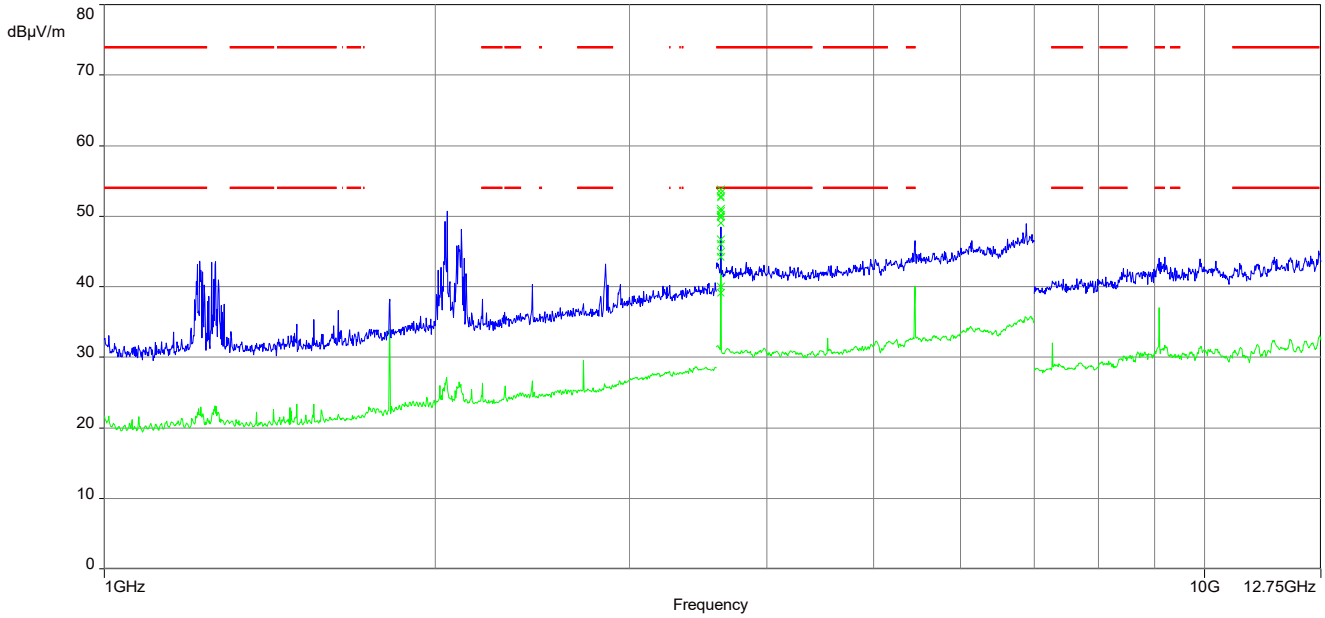
| TX Spurious Emissions Radiated | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 916.00 MHz | | | 908.42 MHz | | | 908.40 MHz | | |
| F / MHz | Detector | Level / dBµV/m | F / MHz | Detector | Level / dBµV/m | F / MHz | Detector | Level / dBµV/m |
| 3663.9 | Peak | 53.7 | 3633.5 | Peak | 53.8 | 3633.6 | Peak | 53.6 |
| | AVG | 51.1 | | AVG | 51.2 | | AVG | 50.8 |
| -/- | Peak | -/- | -/- | Peak | -/- | 5450.6 | Peak | 48.8 |
| | AVG | -/- | | AVG | -/- | | AVG | 47.9 |

**Plots:**

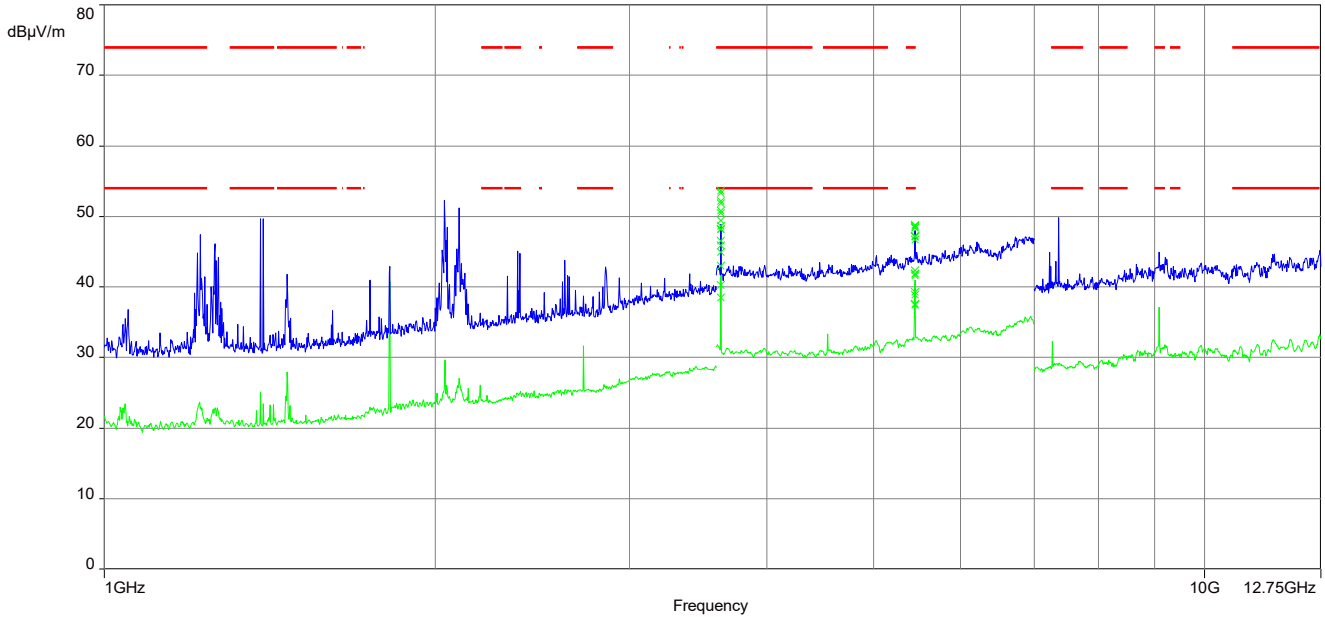
**Plot 1:** 1 GHz to 10 GHz, vertical & horizontal polarization, 916.00 MHz




**Plot 2:** 1 GHz to 10 GHz, vertical & horizontal polarization, 908.42 MHz



**Plot 3:** 1 GHz to 10 GHz, vertical & horizontal polarization, 908.40 MHz



## 12.6 Spurious emissions conducted below 30 MHz (AC conducted)

**Description:**

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. Both power lines, phase and neutral line, are measured. Found peaks are re-measured with average and quasi peak detection to show compliance to the limits.
Measurement performed according to ANSI C63.10, chapter 6.2

**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 |
| Test setup | See chapter 7.3 A |
| Measurement uncertainty | See chapter 9 |

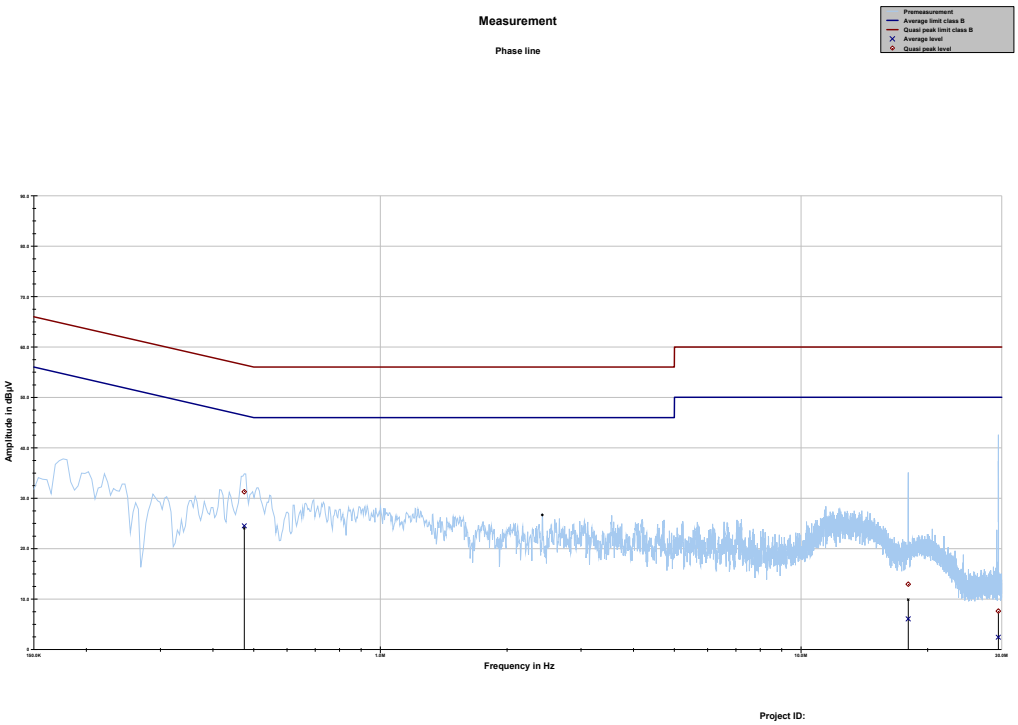
**Limits:**

| FCC | | ISED |
|---|---|---|
| Frequency / MHz | Quasi-Peak / (dBµV / m) | Average / (dBµV / m) |
| 0.15 – 0.5 | 66 to 56* | 56 to 46* |
| 0.5 – 5 | 56 | 46 |
| 5 – 30.0 | 60 | 50 |

*Decreases with the logarithm of the frequency

## Plots:

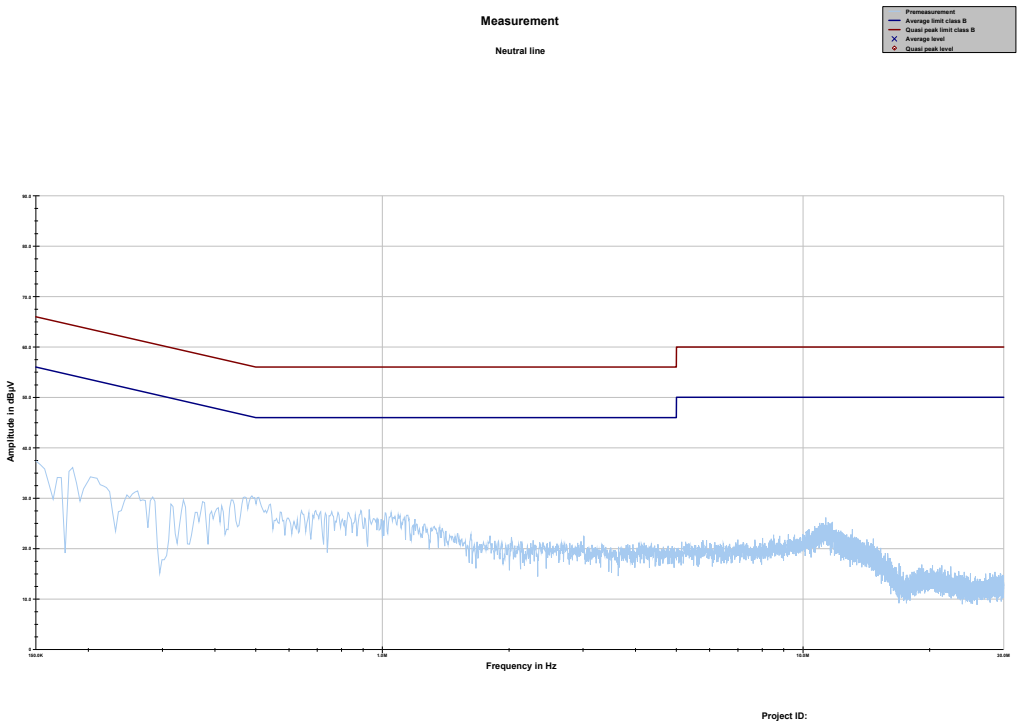
**Plot 1:** 150 kHz to 30 MHz, phase line




## Final_Result

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|---|---|---|---|---|---|---|
| MHz | dBµV | dB | dBµV | dBµV | dB | dBµV |
| | | | | | | |
| **0.474619** | 31.28 | 25.15 | 56.433 | 24.53 | 22.20 | 46.725 |
| **17.981644** | 12.95 | 47.05 | 60.000 | 6.06 | 43.94 | 50.000 |
| **29.447775** | 7.61 | 52.39 | 60.000 | 2.43 | 47.57 | 50.000 |

**Plot 2:** 150 kHz to 30 MHz, neutral line




## Final_Result

| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|---|---|---|---|---|---|---|
| MHz | dBµV | dB | dBµV | dBµV | dB | dBµV |
| | No emissions detected. | | | | | |

## 13 Observations

No observations except those reported with the single test cases have been made.

## 14 Glossary

| | |
|---|---|
| **EUT** | Equipment under test |
| **DUT** | Device under test |
| **UUT** | Unit under test |
| **GUE** | GNSS User Equipment |
| **ETSI** | European Telecommunications Standards Institute |
| **EN** | European Standard |
| **FCC** | Federal Communications Commission |
| **FCC ID** | Company Identifier at FCC |
| **IC** | Industry Canada |
| **PMN** | Product marketing name |
| **HMN** | Host marketing name |
| **HVIN** | Hardware version identification number |
| **FVIN** | Firmware version identification number |
| **EMC** | Electromagnetic Compatibility |
| **HW** | Hardware |
| **SW** | Software |
| **Inv. No.** | Inventory number |
| **S/N or SN** | Serial number |
| **C** | Compliant |
| **NC** | Not compliant |
| **NA** | Not applicable |
| **NP** | Not performed |
| **PP** | Positive peak |
| **QP** | Quasi peak |
| **AVG** | Average |
| **OC** | Operating channel |
| **OCW** | Operating channel bandwidth |
| **OBW** | Occupied bandwidth |
| **OOB** | Out of band |
| **DFS** | Dynamic frequency selection |
| **CAC** | Channel availability check |
| **OP** | Occupancy period |
| **NOP** | Non occupancy period |
| **DC** | Duty cycle |
| **PER** | Packet error rate |
| **CW** | Clean wave |
| **MC** | Modulated carrier |
| **WLAN** | Wireless local area network |
| **RLAN** | Radio local area network |
| **DSSS** | Dynamic sequence spread spectrum |
| **OFDM** | Orthogonal frequency division multiplexing |
| **FHSS** | Frequency hopping spread spectrum |
| **GNSS** | Global Navigation Satellite System |
| **$C/N_0$** | Carrier to noise-density ratio, expressed in dB-Hz |

## 15 Document history

| Version | Applied changes | Date of release |
|---|---|---|
| -/- | Initial release | 2023-03-09 |

## 16 Accreditation Certificate – D-PL-12076-01-04

| first page | last page |
|---|---|
|  |  |





**Note: The current certificate annex is published on the websites (link see below).**

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdf

or
https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04_Canada_TCEMC.pdf

## 17 Accreditation Certificate – D-PL-12076-01-05

| first page | last page |
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**Note: The current certificate annex is published on the websites (link see below).**

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf

or

https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

################################## END OF TEST REPORT ##################################