
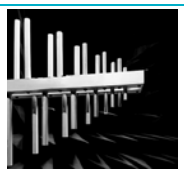
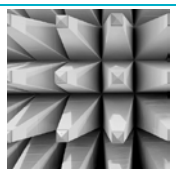

CTC advanced
member of RWTÜV group

Bundesnetzagentur

BNetzA-CAB-02/21-102

# TEST REPORT

**Test report no.: 1-1330/20-01-15-A**

## 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


**Leica Camera AG**
Am Leitz-Park 5
35578 Wetzlar / GERMANY
Phone: +49(0)6441-2080-0
Contact: Peter Schober
e-mail: peter.schober@leica-camera.com


## Manufacturer

**Leica Camera AG**
Am Leitz-Park 5
35578 Wetzlar / GERMANY

## 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 - 247 Issue 2 | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices |

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

## Test Item

| | |
|---|---|
| **Kind of test item:** | **Digital Camera** |
| **Model name:** | **2416** |
| **FCC ID:** | **N5A2416** |
| **IC:** | **11245A-2416** |
| Frequency: | 5725 MHz - 5850 MHz |
| Technology tested: | WLAN |
| Antenna: | Integrated PCB antenna via cable |
| Power supply: | 7.4 V DC by rechargeable Li-Polymer battery |
| Temperature range: | 0°C to +40°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=Marco Bertolino, o=CTC advanced GmbH, ou=BTL-291121, email=marco.bertolino@ctcadvanced.com, c=DE
2021.12.03 11:11:36 +01'00'

Marco Bertolino
Lab Manager
Radio Communications

## Test performed:

cn=Andreas Luckenbill, o=CTC advanced GmbH, ou=LUC-180217, email=andreas.luckenbill@ctcadvanced.com, c=DE
2021.12.03 12:48:42 +01'00'

Andreas Luckenbill
Head of Department
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.

**This test report replaces the test report with the number 1-1330/20-01-15 and dated 2021-07-23.**

## 2.2 Application details

| | |
|---|---|
| Date of receipt of order: | 2021-04-22 |
| Date of receipt of test item: | 2021-05-03 |
| Start of test:* | 2021-05-03 |
| End of test:* | 2021-07-21 |
| 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

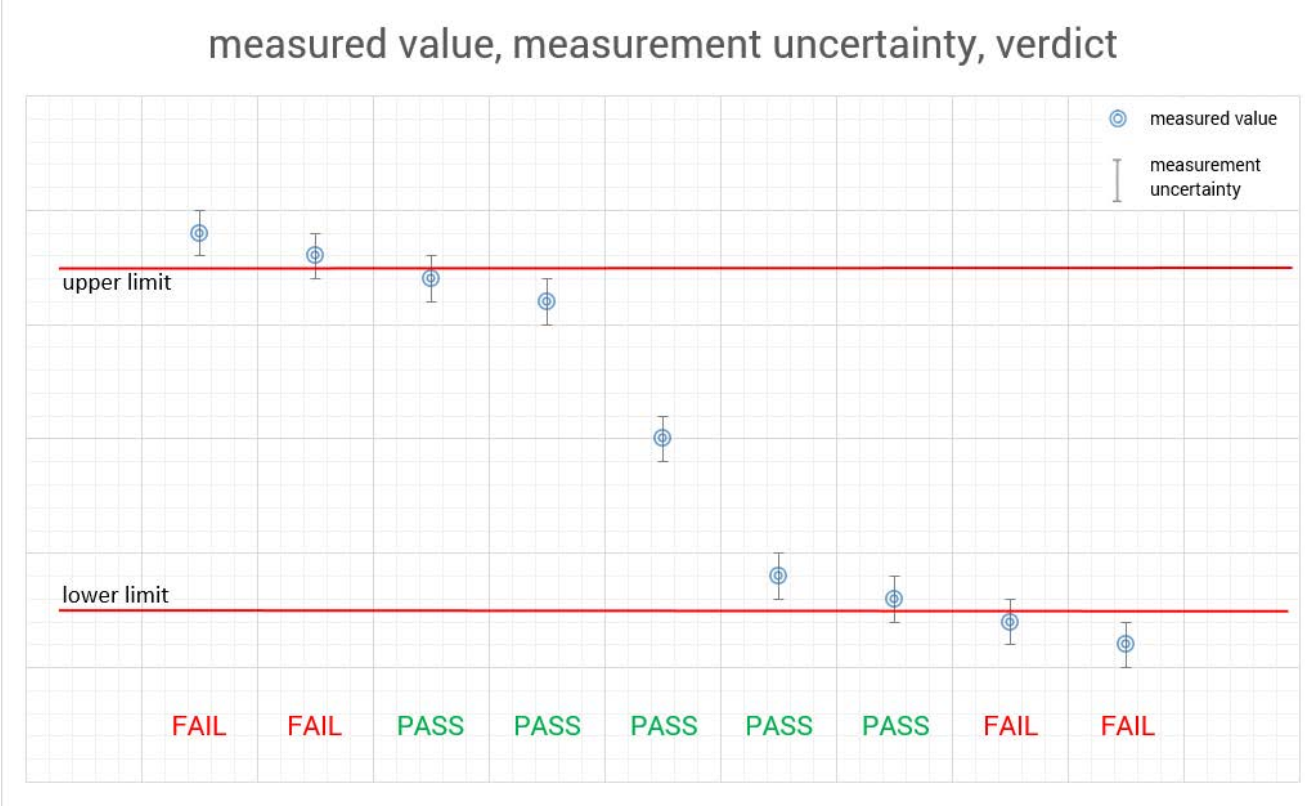
| Test standard | Date | Description |
|---|---|---|
| FCC - Title 47 CFR Part 15 | -/- | FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices |
| RSS - 247 Issue 2 | February 2017 | Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices |
| 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 |
|---|---|---|
| KDB 789033 D02 | v02r01 | Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - Part 15, Subpart E |
| 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 |

## 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>$T_{min}$ | +24 °C during room temperature tests<br>No tests under extreme conditions required.<br>No tests under extreme conditions required. |
| Relative humidity content | : | | 44 % |
| Barometric pressure | : | | 1015 hpa |
| Power supply | : | $V_{nom}$<br>$V_{max}$<br>$V_{min}$ | 7.4 V DC by rechargeable Li-Polymer battery<br>No tests under extreme conditions required.<br>No tests under extreme conditions required. |

# 6 Test item

## 6.1 General description

| | | |
|---|---|---|
| Kind of test item | : | Digital Camera |
| Model name | : | 2416 |
| HMN | : | -/- |
| PMN | : | 2416 |
| HVIN | : | 2416 |
| FVIN | : | -/- |
| S/N serial number | : | Rad. 5587083<br>Cond. 5587007 |
| Hardware status | : | Prototype |
| Software status | : | -/- |
| Firmware status | : | 0.21.18.4 |
| Frequency band | : | 5725 MHz to 5850 MHz |
| Type of radio transmission<br>Use of frequency spectrum | :<br>: | OFDM |
| Type of modulation | : | (D)BPSK, (D)QPSK, 16 – QAM, 64 – QAM |
| Number of channels | : | 5 channels with 20 MHz and 2 channels with 40 MHz |
| Antenna | : | Integrated PCB antenna via cable |
| Power supply | : | 7.4 V DC by rechargeable Li-Polymer battery |
| Temperature range | : | 0°C to +40°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: 1-1330/20-01-01_AnnexA
1-1330/20-01-01_AnnexB
1-1330/20-01-01_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).

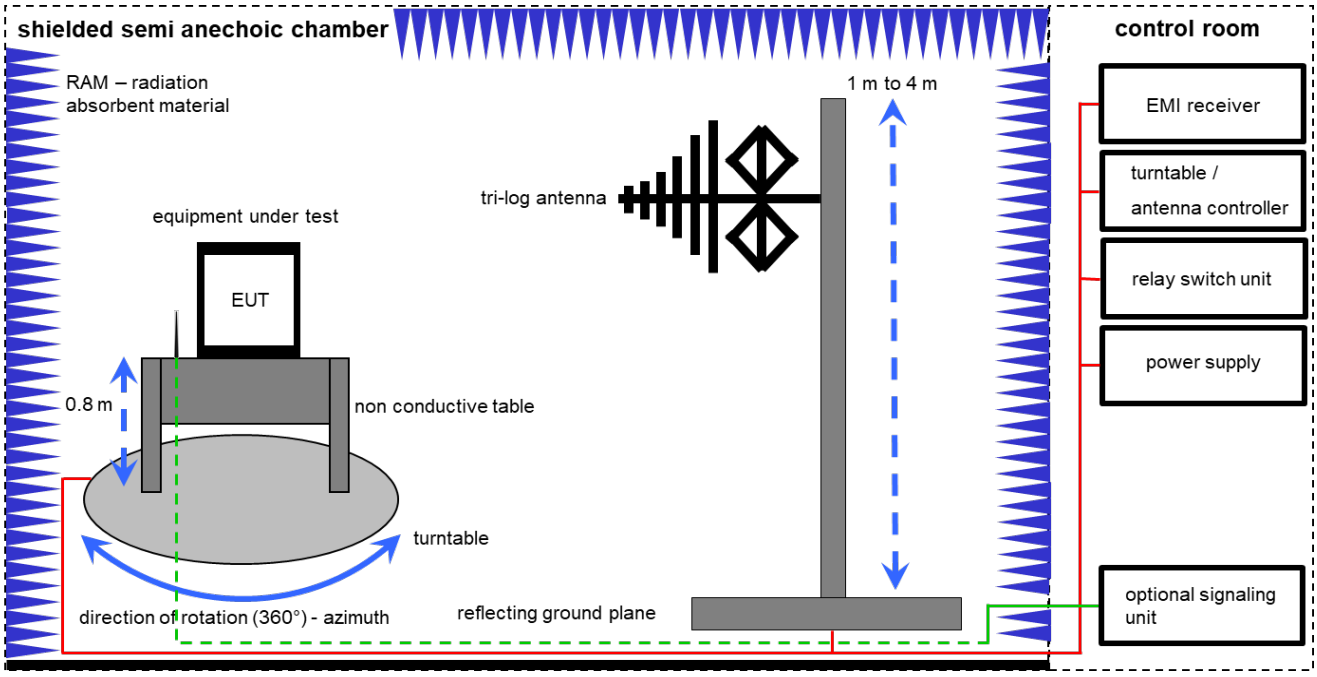
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

**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

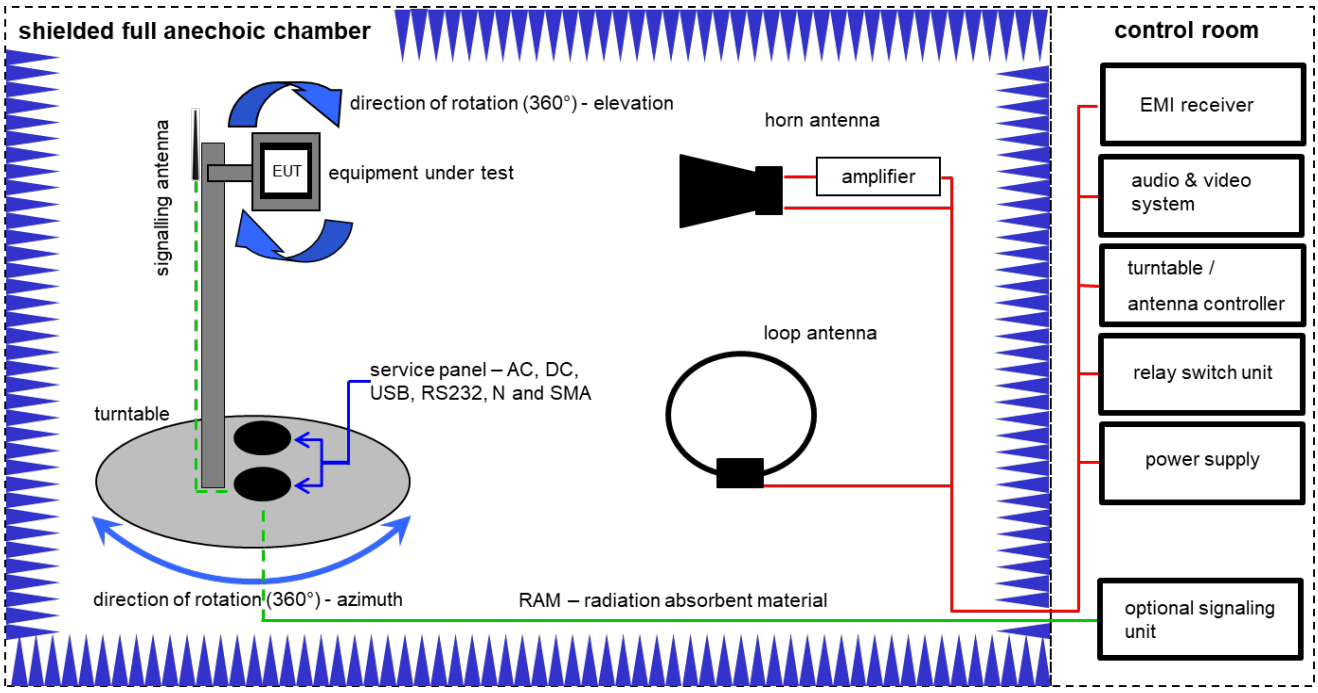
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

*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 | Antenna Tower | Model 2175 | ETS-Lindgren | 64762 | 300003745 | izw | -/- | -/- |
| 4 | A | Positioning Controller | Model 2090 | ETS-Lindgren | 64672 | 300003746 | izw | -/- | -/- |
| 5 | A | Turntable Interface-Box | Model 105637 | ETS-Lindgren | 44583 | 300003747 | izw | -/- | -/- |
| 6 | A | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163 | Schwarzbeck Mess - Elektronik | 318 | 300003696 | vlKl! | 04.09.2019 | 03.09.2021 |
| 7 | A | Turntable | 2089-4.0 | EMCO | -/- | 300004394 | ne | -/- | -/- |
| 8 | A | PC | TecLine | F+W | -/- | 300004388 | ne | -/- | -/- |
| 9 | A | EMI Test Receiver | ESR3 | Rohde & Schwarz | 102587 | 300005771 | k | 10.12.2020 | 09.06.2022 |

## 7.2 Shielded fully anechoic chamber




Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

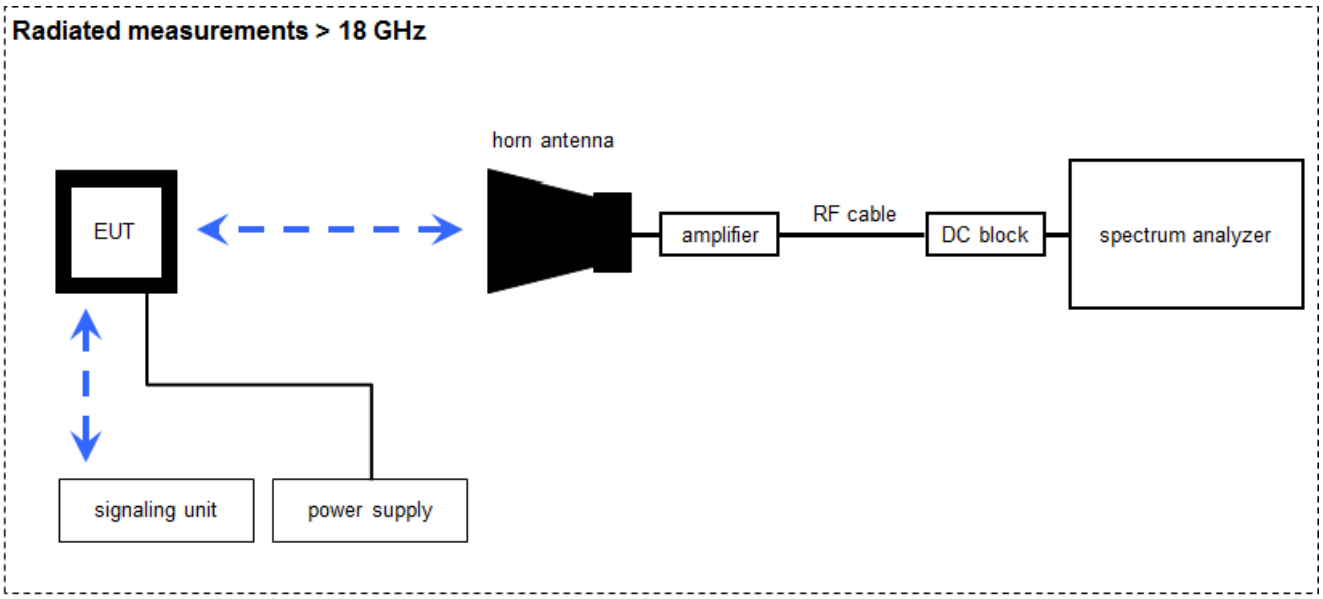
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

*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 | C | Active Loop Antenna 9 kHz to 30 MHz | 6502 | EMCO | 2210 | 300001015 | vlKl! | 13.06.2019 | 12.06.2021 |
| 2 | A, B, C | Anechoic chamber | FAC 3/5m | MWB / TDK | 87400/02 | 300000996 | ev | -/- | -/- |
| 3 | A, B | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115 | EMCO | 9107-3697 | 300001605 | vlKl! | 12.03.2021 | 11.03.2023 |
| 4 | A, B, C | Switch / Control Unit | 3488A | HP | * | 300000199 | ne | -/- | -/- |
| 5 | B | Band Reject filter | WRCG2400/2483-2375/2505-50/10SS | Wainwright | 11 | 300003351 | ev | -/- | -/- |
| 6 | A, B, C | EMI Test Receiver 20Hz- 26,5GHz | ESU26 | R&S | 100037 | 300003555 | k | 11.12.2020 | 10.12.2021 |
| 7 | B | Highpass Filter | WHK1.1/15G-10SS | Wainwright | 3 | 300003255 | ev | -/- | -/- |
| 8 | B | Highpass Filter | WHKX7.0/18G-8SS | Wainwright | 19 | 300003790 | ne | -/- | -/- |
| 9 | B | Broadband Amplifier 0.5-18 GHz | CBLU5184540 | CERNEX | 22049 | 300004481 | ev | -/- | -/- |
| 10 | A, B, C | 4U RF Switch Platform | L4491A | Agilent Technologies | MY50000037 | 300004509 | ne | -/- | -/- |
| 11 | A, B, C | NEXIO EMV-Software | BAT EMC V3.20.0.17 | EMCO | -/- | 300004682 | ne | -/- | -/- |
| 12 | A, B, C | PC | ExOne | F+W | -/- | 300004703 | ne | -/- | -/- |
| 13 | B | RF-Amplifier | AMF-6F06001800-30-10P-R | NARDA-MITEQ Inc | 2011572 | 300005241 | ev | -/- | -/- |

## 7.3 Radiated measurements > 18 GHz




Measurement distance: horn antenna 50 cm

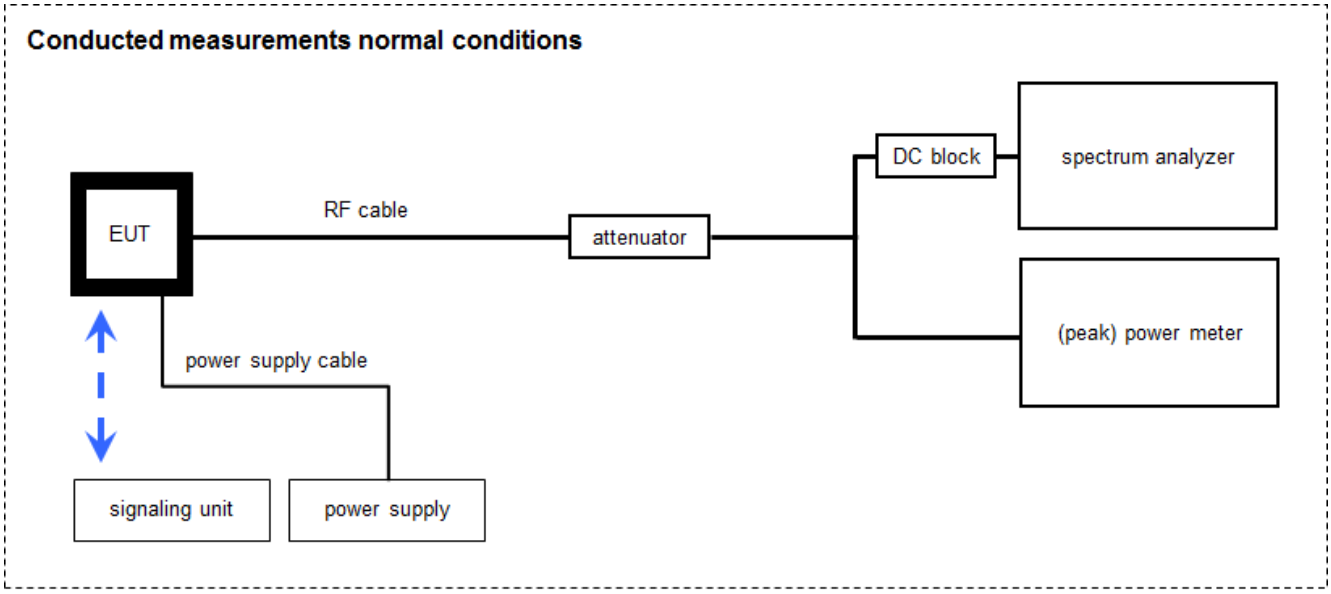
FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

*Example calculation:*
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/m)

**Equipment table:**

| No. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | Microwave System Amplifier, 0.5-26.5 GHz | 83017A | HP | 00419 | 300002268 | ev | -/- | -/- |
| 2 | A | Std. Gain Horn Antenna 18.0-26.5 GHz | 638 | Narda | 01096 | 300000486 | vlKl! | 21.01.2020 | 20.01.2022 |
| 3 | A | Signal Analyzer 40 GHz | FSV40 | Rohde & Schwarz | 101042 | 300004517 | k | 07.12.2020 | 06.12.2021 |
| 4 | A | RF-Cable | ST18/SMAm/SMAm /48 | Huber & Suhner | Batch no. 600918 | 400001182 | ev | -/- | -/- |
| 5 | A | DC-Blocker 0.1-40 GHz | 8141A | Inmet | -/- | 400001185 | ev | -/- | -/- |
| 6 | A | Std. Gain Horn Antenna 26.5-40.0 GHz | V637 | Narda | 82-16 | 300000510 | vlKl! | 23.01.2020 | 22.01.2022 |
| 7 | A | Broadband Low Noise Amplifier 18-50 GHz | CBL18503070-XX | CERNEX | 19338 | 300004273 | ev | -/- | -/- |

## 7.4 Conducted measurements with peak power meter & spectrum analyzer




WLAN tester version: 1.1.13; LabView2015

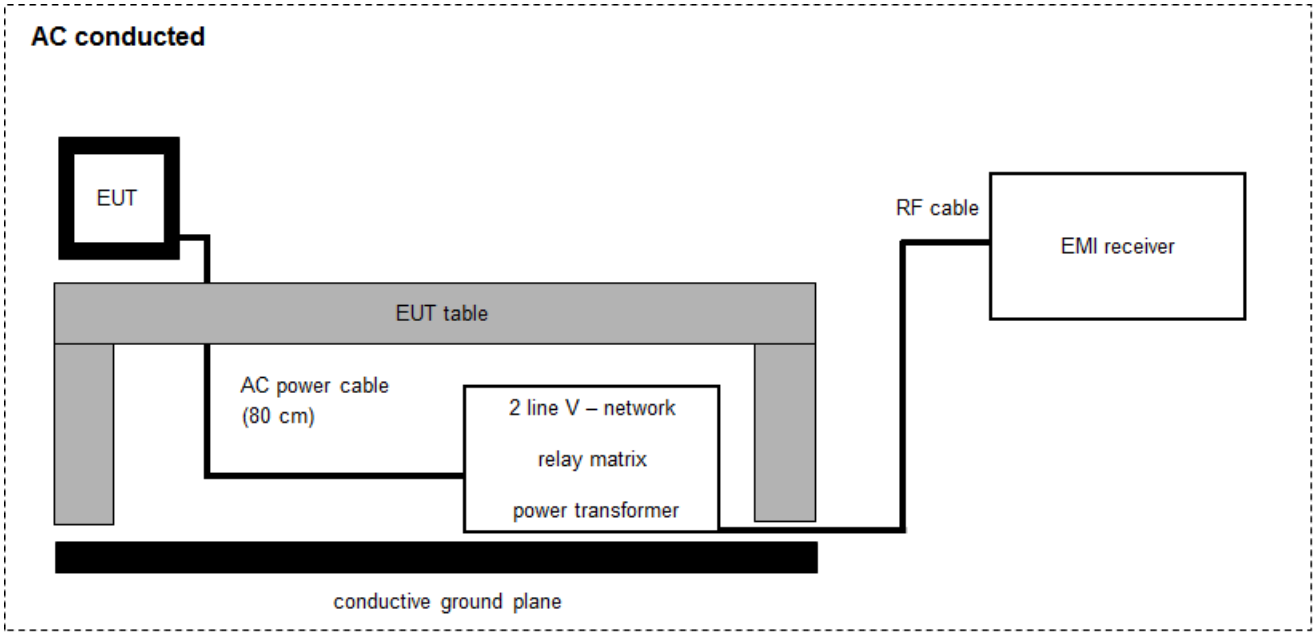
OP = AV + CA
(OP-output power; AV-analyzer value; CA-loss signal path)

*Example calculation:*
OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

**Equipment table:**

| No. | Setup | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | Signal Analyzer 40 GHz | FSV40 | Rohde & Schwarz | 101042 | 300004517 | k | 07.12.2020 | 06.12.2021 |
| 2 | A | DC-Blocker 0.1-40 GHz | 8141A | Inmet | -/- | 400001185 | ev | -/- | -/- |
| 3 | A | RF-Cable | ST18/SMAm/SMAm /60 | Huber & Suhner | Batch no. 606844 | 400001181 | ev | -/- | -/- |
| 4 | A | Coax Attenuator 10 dB 2W 0-40 GHz | MCL BW-K10-2W44+ | Mini Circuits | -/- | 400001186 | ev | -/- | -/- |
| 5 | A | Synchron Power Meter | SPM-4 | CTC | 1 | 300005580 | ev | -/- | -/- |
| 6 | A | Tester Software RadioStar (C.BER2 for BT Conformance) | Version 1.0.0.X | CTC advanced GmbH | 0001 | 400001380 | ne | -/- | -/- |

## 7.5 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! | 11.12.2019 | 10.12.2021 |
| 2 | A | RF-Filter-section | 85420E | HP | 3427A00162 | 300002214 | NK! | -/- | -/- |
| 3 | A | EMI Test Receiver | ESCI 3 | R&S | 100083 | 300003312 | k | 09.12.2020 | 08.12.2021 |
| 4 | A | Hochpass 150 kHz | EZ-25 | R&S | 100010 | 300003798 | ev | -/- | -/- |
| 5 | A | PC | TecLine | F+W | -/- | 300003532 | ne | -/- | -/- |

# 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 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.

## 8.4 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 Measurement uncertainty

| Measurement uncertainty | | |
|---|---|---|
| **Test case** | **Uncertainty** | |
| Antenna gain | ± 3 dB | |
| Power spectral density | ± 1.56 dB | |
| DTS bandwidth | ± 100 kHz (depends on the used RBW) | |
| Occupied bandwidth | ± 100 kHz (depends on the used RBW) | |
| Maximum output power conducted | ± 1.56 dB | |
| Detailed spurious emissions @ the band edge - conducted | ± 1.56 dB | |
| Band edge compliance radiated | ± 3 dB | |
| Spurious emissions conducted | > 3.6 GHz | ± 1.56 dB |
| | > 7 GHz | ± 1.56 dB |
| | > 18 GHz | ± 2.31 dB |
| | ≥ 40 GHz | ± 2.97 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 | |

## 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 | CFR Title 47 Part 15<br>RSS 247, Issue 2 | See table | 2021-12-03 | -/- |

| Test specification clause | Test case | C | NC | NA | NP | Remark |
|---|---|---|---|---|---|---|
| -/- | Output power verification (cond.) | -/- | | | | Declared |
| -/- | Antenna gain | -/- | | | | Declared |
| U-NII Part 15 | Duty cycle | -/- | | | | -/- |
| §15.407(a)<br>RSS - 247 (6.2.x.1) | Maximum output power<br>(conducted & radiated) | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.407(a)<br>RSS - 247 (6.2.x.1) | Power spectral density | ☒ | ☐ | ☐ | ☐ | -/- |
| RSS - 247 (6.2.4.1) | Spectrum bandwidth<br>6dB bandwidth | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.407(a)<br>RSS - 247 (6.2.x.2) | Spectrum bandwidth<br>26dB bandwidth | ☒ | ☐ | ☐ | ☐ | -/- |
| RSS Gen clause<br>6.6 | Spectrum bandwidth<br>99% bandwidth | -/- | | | | -/- |
| §15.205<br>RSS - 247 (6.2.x.2) | Band edge compliance radiated | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.407(b)<br>RSS - 247 (6.2.x.2) | TX spurious emissions radiated | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.109<br>RSS-Gen | RX spurious emissions radiated | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.209(a)<br>RSS-Gen | Spurious emissions radiated<br>< 30 MHz | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.107(a)<br>§15.207 | Spurious emissions conducted<br>emissions< 30 MHz | ☒ | ☐ | ☐ | ☐ | -/- |
| §15.407<br>RSS - 247 (6.3) | DFS | -/- | | | | -/- |

Notes:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C: | Compliant | NC: | Not compliant | NA: | Not applicable | NP: | Not performed |

## 11 Additional comments

Reference documents: CU20010-1 - Dual-band WiFi - Leica PS_Rev03.pdf (antenna gain)
CU20010-1 Appendix to Product Specification - RF Performance Summary.pdf

Co-applicable documents: 1-1330_21-01-15_log1_conducted.pdf

Special test descriptions: None

Configuration descriptions: None

EUT selection:

☐ Only one device available

☐ Devices selected by the customer

☒ Devices selected by the laboratory (Randomly)

Provided channels:

Channels with 20 MHz channel bandwidth:

| U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency | | | | | |
|---|---|---|---|---|---|
| channel | **149** | 153 | **157** | 161 | **165** |
| $f_c$ / MHz | **5745** | 5765 | **5785** | 5805 | **5825** |

Channels with 40 MHz channel bandwidth:

| U-NII-3 (5725 MHz to 5850 MHz) channel number & center frequency | | |
|---|---|---|
| channel | **151** | **159** |
| $f_c$ / MHz | **5755** | **5795** |

Note: The channels used for the tests were marked in bold in the list.

Test mode:

☐ No test mode available.
Iperf is used to transmit data to a companion device

☒ 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)

☐ Operating mode 2 (multiple antennas, no beamforming)
- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously but without beamforming.

☐ Operating mode 3 (multiple antennas, with beamforming)
- Equipment operating in this mode contains a smart antenna system using two or more transmit/receive chains simultaneously with beamforming.
  In addition to the antenna assembly gain (G), the beamforming gain (Y) may have to be taken into account when performing the measurements.

# 12 Measurement results

## 12.1 Identify worst case data rate

Measurement:

All modes of the module will be measured with an average power meter to identify the maximum transmission power on mid channel. In the case that only one or two channels are available, only these will be measured.

In further tests only the identified worst case modulation scheme or bandwidth will be measured.

Measurement parameters:

| Measurement parameter | |
|---|---|
| Detector: | Peak |
| Sweep time: | Auto |
| Resolution bandwidth: | 3 MHz |
| Video bandwidth: | 3 MHz |
| Trace mode: | Max hold |
| Used test setup: | See chapter 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Results:

| OFDM – mode | Modulation scheme / bandwidth | | | | | |
|---|---|---|---|---|---|---|
| | U-NII-1 & U-NII-2A | | U-NII-2C | | U-NII-3 | |
| | lowest channel | highest channel | lowest channel | highest channel | lowest channel | highest channel |
| a – mode | Band not provided! | | Band not provided! | | 6Mbit/s | 6Mbit/s |
| n/ac HT20 – mode | | | | | MCS0 | MCS0 |
| n/ac HT40 – mode | | | | | MCS0 | MCS0 |

## 12.2 Antenna gain

Limits:

| Antenna Gain |
|---|
| 6 dBi / > 6 dBi output power and power density reduction required |

Declaration of the antenna gain:

| U-NII-3 (5725 MHz to 5850 MHz) | Antenna gain | | |
|---|---|---|---|
| | Lowest channel | Middle channel | Highest channel |
| Gain / dBi (calculated or declared) | 3.4 | | |

## 12.3 Duty cycle

Description:

The duty cycle is necessary to compute the maximum power during an actual transmission. The shown plots and values are to show an example of the measurement procedure. The real value is measured direct during the power measurement or power density measurement. The correction value is shown in each plot of these measurements.

Measurement:

| Measurement parameter | |
|---|---|
| According to: KDB789033 D02, B. | |
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>FCC Part 15.407 Max Output Power and PSD |
| Used test setup: | See chapter 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Results:

Duty cycle and correction factor:

| OFDM – mode<br>(low channel) | Calculation method | |
|---|---|---|
| | $T_{on}$ ($D2_{plot}$) * 100 / $T_{complete}$ ($D3_{plot}$) = duty cycle<br>10 * log(duty cycle) = correction factor | |
| | Duty cycle (min – worst case) | Correction factor (max – worst case) |
| a – mode | 23.5 | 6.29 |
| n/ac HT20 – mode | 31.0 | 5.09 |
| n/ac HT40 – mode | 80.0 | 0.97 |
| The measurement was performed for each channel and bandwidth variation.<br>See file: 1-1330_20-01-15_Log1_conducted.pdf | | |

## 12.4 Maximum output power

### 12.4.1 Maximum output power according to FCC requirements

Description:

Measurement of the maximum output power conducted

Measurement:

| Measurement parameter | |
|---|---|
| According to: KDB789033 D02, E.2.e. | |
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>FCC Part 15.407 Max Output Power and PSD |
| Used test setup: | See chapter 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| Radiated output power | Conducted output power for mobile equipment |
|---|---|
| Conducted power + 6 dBi antenna gain | 250mW 5.150-5.250 GHz<br>The lesser one of<br>250mW or 11 dBm + 10 log Bandwidth 5.250-5.350 GHz<br>250mW or 11 dBm + 10 log Bandwidth 5.470-5.725 GHz<br>(where Bandwidth is the 26dB Bandwidth [MHz])<br>1W 5.725-5.85 GHz |

**Results:**

| a | Maximum output power conducted [dBm] | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 19.29 | 13.94 | 13.02 |

| n/ac HT20 | Maximum output power conducted [dBm] | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 17.51 | 13.86 | 13.12 |

| n/ac HT40 | Maximum output power conducted [dBm] | |
|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | |
| | Lowest channel | Highest channel |
| | 13.64 | 13.71 |

### 12.4.2 Maximum output power according to ISED requirements

Description:

Measurement of the maximum output power conduced + radiated

Measurement:

| Measurement parameter | |
|---|---|
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>ISED Max Output Power and PSD |
| Used test setup: | See chapter 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| Radiated output power | Conducted output power for mobile equipment |
|---|---|
| The lesser one of<br>200 mW or 10 dBm + 10 log Bandwidth 5.150-5.250 GHz<br>1 W or 17 dBm + 10 log Bandwidth 5.250-5.350 GHz<br>1 W or 17 dBm + 10 log Bandwidth 5.470-5.725 GHz<br>(where Bandwidth is the 99% Bandwidth [MHz])<br>Conducted power + 6dBi antenna gain 5.725-5.825 GHz | The lesser one of<br><br>250mW or 11 dBm + 10 log Bandwidth 5.250-5.350 GHz<br>250mW or 11 dBm + 10 log Bandwidth 5.470-5.725 GHz<br>(where Bandwidth is the 99% Bandwidth [MHz])<br>1W 5.725-5.825 GHz |

**Results:**

| | | | |
|---|---|---|---|
| a | Maximum output power [dBm] | | |
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | Conducted | | |
| | 14.20 | 14.57 | 13.46 |
| | Radiated (calculated – see chapter antenna gain) | | |
| | 17.60 | 17.97 | 16.86 |

| | | | |
|---|---|---|---|
| n/ac HT20 | Maximum output power [dBm] | | |
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | Conducted | | |
| | 16.99 | 14.25 | 13.17 |
| | Radiated (calculated – see chapter antenna gain) | | |
| | 20.39 | 17.65 | 16.57 |

| | | |
|---|---|---|
| n/ac HT40 | Maximum output power [dBm] | |
| | U-NII-3 (5725 MHz to 5850 MHz) | |
| | Lowest channel | Highest channel |
| | Conducted | |
| | 12.92 | 13.56 |
| | Radiated (calculated – see chapter antenna gain) | |
| | 16.32 | 16.96 |

## 12.5 Power spectral density

### 12.5.1 Power spectral density according to FCC requirements

Description:

Measurement of the power spectral density of a digital modulated system. The measurement is repeated at the lowest, middle and highest channel.

Measurement:

| Measurement parameter | |
|---|---|
| According to: KDB789033 D02, F. | |
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>FCC Part 15.407 Max Output Power and PSD |
| Used test setup: | See chapter 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| Power Spectral Density |
|---|
| power spectral density conducted ≤ 30 dBm in any 500 kHz band (band 5725 – 5850 MHz) |

Results:

| | Power spectral density (dBm/1MHz or dBm/500kHz) | | |
|---|---|---|---|
| a | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 6.20 | -0.20 | -1.21 |

| | Power spectral density (dBm/1MHz or dBm/500kHz) | | |
|---|---|---|---|
| n/ac HT20 | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 3.53 | -0.45 | -1.25 |

| | Power spectral density (dBm/1MHz or dBm/500kHz) | |
|---|---|---|
| n/ac HT40 | U-NII-3 (5725 MHz to 5850 MHz) | |
| | Lowest channel | Highest channel |
| | -3.58 | -3.42 |

### 12.5.2 Power spectral density according to ISED requirements

Description:

Measurement of the power spectral density of a digital modulated system. The measurement is repeated at the lowest, middle and highest channel.

Measurement:

| Measurement parameter | |
|---|---|
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>ISED Max Output Power and PSD |
| Used test setup: | See chapter 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| Power Spectral Density |
|---|
| power spectral density conducted ≤ 30 dBm in any 500 kHz band (band 5725 – 5850 MHz) |

Results:

| | Power spectral density (dBm/1MHz or dBm/500kHz) | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| a | Lowest channel | Middle channel | Highest channel |
| | 0.11 | 0.45 | -0.68 |

| | Power spectral density (dBm/1MHz or dBm/500kHz) | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| n/ac HT20 | Lowest channel | Middle channel | Highest channel |
| | 2.97 | -0.04 | -1.06 |

| | Power spectral density (dBm/1MHz or dBm/500kHz) | |
|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | |
| n/ac HT40 | Lowest channel | Highest channel |
| | -4.36 | -3.48 |

## 12.6 Minimum emission bandwidth for the band 5.725-5.85 GHz

Description:

Measurement of the 6 dB bandwidth of the modulated signal.

Measurement:

| Measurement parameter | |
|---|---|
| According to: KDB789033 D02, C.2. | |
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>FCC Part 15.407 & ISED Minimum Emission BW |
| Used test setup: | See chapter 7.5 – A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| FCC | ISED |
|---|---|
| The minimum 6 dB bandwidth shall be at least 500 kHz. | |

Results:

| a | 6 dB emission bandwidth (MHz) | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 15.15 | 15.15 | 15.15 |

| n/ac HT20 | 6 dB emission bandwidth (MHz) | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 15.15 | 15.15 | 15.15 |

| n/ac HT40 | 6 dB emission bandwidth (MHz) | |
|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | |
| | Lowest channel | Highest channel |
| | 35.10 | 35.00 |

## 12.7 Spectrum bandwidth / 26 dB bandwidth

Description:

Measurement of the 26 dB bandwidth of the modulated signal.

Measurement:

| Measurement parameter | |
|---|---|
| According to: KDB789033 D02, C.1. | |
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>FCC Part 15.407 & ISED Bandwidths |
| Used test setup: | see chapter 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| Spectrum Bandwidth – 26 dB Bandwidth |
|---|
| **IC:** Any unwanted emissions that fall into the band 5250-5350 MHz shall be attenuated below the channel power by at least 26 dB, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth (i.e. 99% bandwidth), above 5250 MHz. The 26 dB bandwidth may fall into the 5250-5350 MHz band; however, if the occupied bandwidth also falls within the 5250-5350 MHz band, the transmission is considered as intentional and the devices shall comply with all requirements in the band 5250-5350 MHz including implementing dynamic frequency selection (DFS) and TPC, on the portion of the emission that resides in the 5250-5350 MHz band.<br><br>**FCC:** Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating with any part of its 26 dB emission bandwidth in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. |

Results:

| | | | |
|---|---|---|---|
| a | 26 dB bandwidth (MHz) | | |
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 24.40 | 32.44 | 30.92 |
| | Lowest frequency | | Highest frequency |
| | 5732.520 | | 5841.520 |

| | | | |
|---|---|---|---|
| n/ac HT20 | 26 dB bandwidth (MHz) | | |
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 35.16 | 33.84 | 26.88 |
| | Lowest frequency | | Highest frequency |
| | 5726.520 | | 5839.520 |

| | | |
|---|---|---|
| n/ac HT40 | 26 dB bandwidth (MHz) | |
| | U-NII-3 (5725 MHz to 5850 MHz) | |
| | Lowest channel | Highest channel |
| | 48.48 | 44.16 |
| | Lowest frequency | Highest frequency |
| | 5730.440 | 5816.040 |

## 12.8 Occupied bandwidth / 99% emission bandwidth

Description:

Measurement of the 99% bandwidth of the modulated signal acc. RSS-GEN.

Measurement:

| Measurement parameter | |
|---|---|
| External result file(s) | 1-1330_20-01-15_Log1_conducted.pdf<br>FCC Part 15.407 & ISED Bandwidths |
| Test setup: | See sub clause 7.4 – A |
| Measurement uncertainty: | See chapter 9 |

Usage:

| -/- | ISED |
|---|---|
| OBW is necessary for Emission Designator | |

**Results:**

| a | 99% bandwidth (kHz) | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 18282 | 18032 | 17732 |

| n/ac HT20 | 99% bandwidth (kHz) | | |
|---|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | | |
| | Lowest channel | Middle channel | Highest channel |
| | 20130 | 18581 | 17732 |

| n/ac HT40 | 99% bandwidth (kHz) | |
|---|---|---|
| | U-NII-3 (5725 MHz to 5850 MHz) | |
| | Lowest channel | Highest channel |
| | 37562 | 35964 |

## 12.9 Spurious emissions radiated below 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The limits are re-calculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

Measurement:

| Measurement parameter | |
|---|---|
| Detector: | Peak / Quasi Peak |
| Sweep time: | Auto |
| Video bandwidth: | F < 150 kHz: 200 Hz<br>F > 150 kHz: 9 kHz |
| Resolution 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 sub clause 7.2 – C |
| Measurement uncertainty: | See chapter 9 |

Limits:

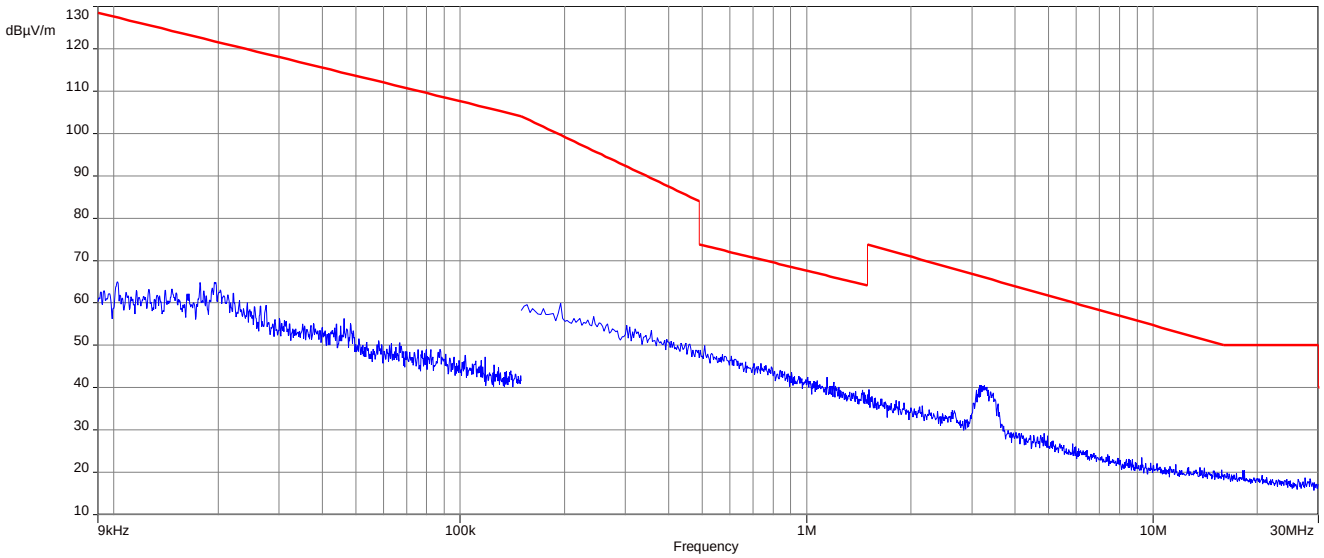
| Spurious Emissions Radiated < 30 MHz | | |
|---|---|---|
| Frequency (MHz) | Field Strength (dBµV/m) | Measurement distance |
| 0.009 – 0.490 | 2400/F(kHz) | 300 |
| 0.490 – 1.705 | 24000/F(kHz) | 30 |
| 1.705 – 30.0 | 30 | 30 |

Results:

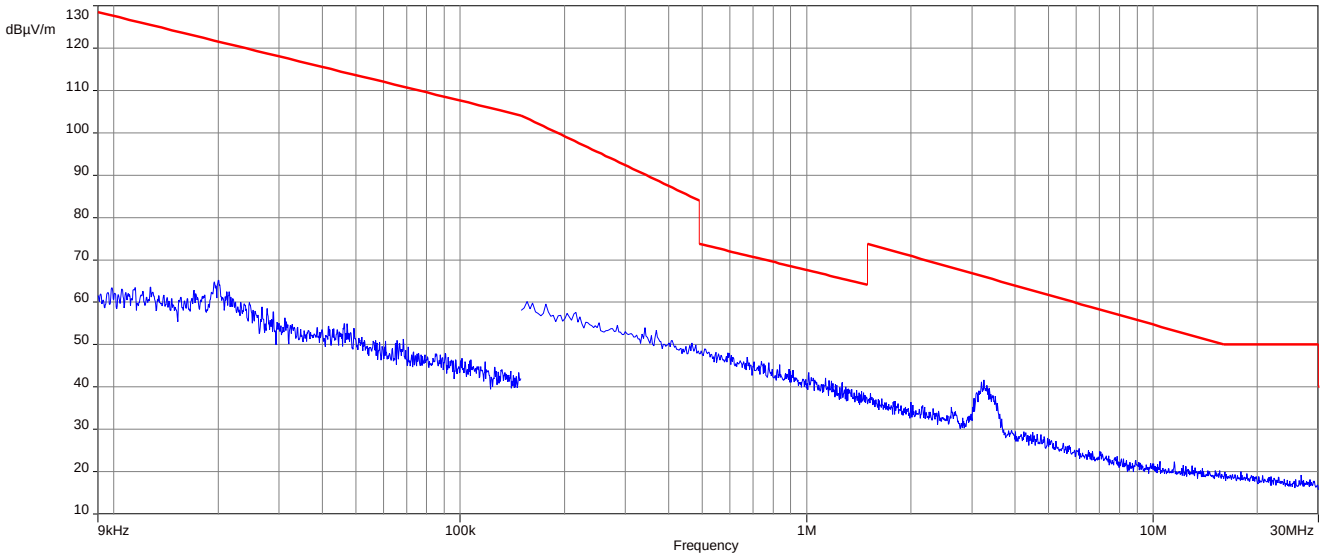
| Spurious Emissions Radiated < 30 MHz [dBµV/m] | | |
|---|---|---|
| F [MHz] | Detector | Level [dBµV/m] |
| All detected emissions are more than 20 dB below the limit. | | |
| | | |
| | | |

**Plots:** 20 MHz channel bandwidth

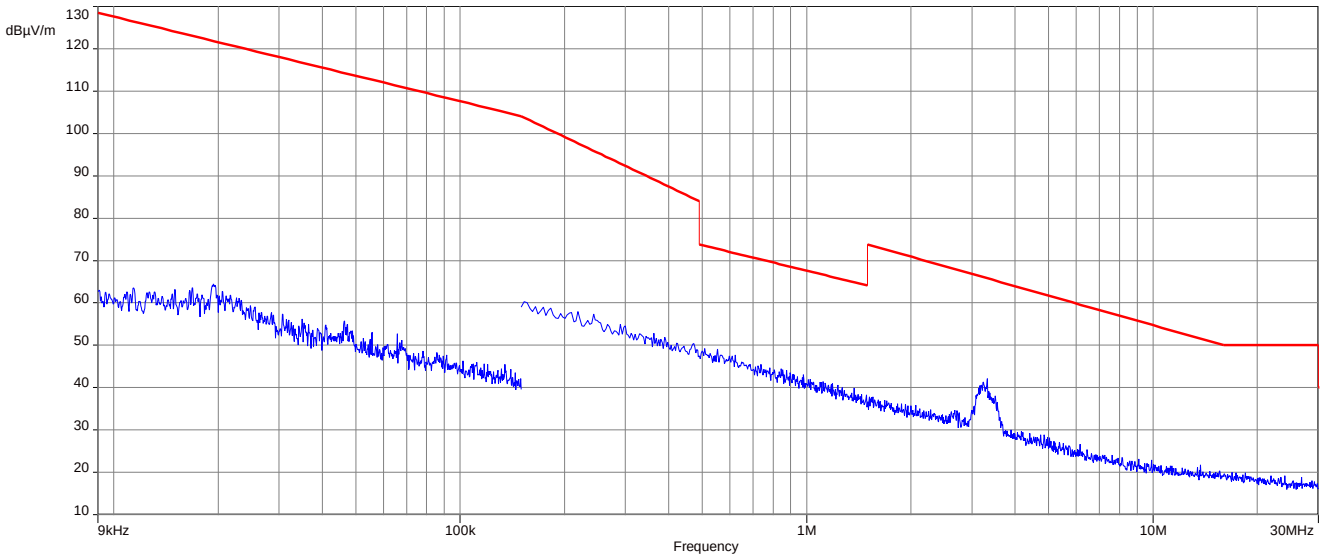
**Plot 1:** 9 kHz to 30 MHz, U-NII-3; lowest channel




**Plot 2:** 9 kHz to 30 MHz, U-NII-3; middle channel

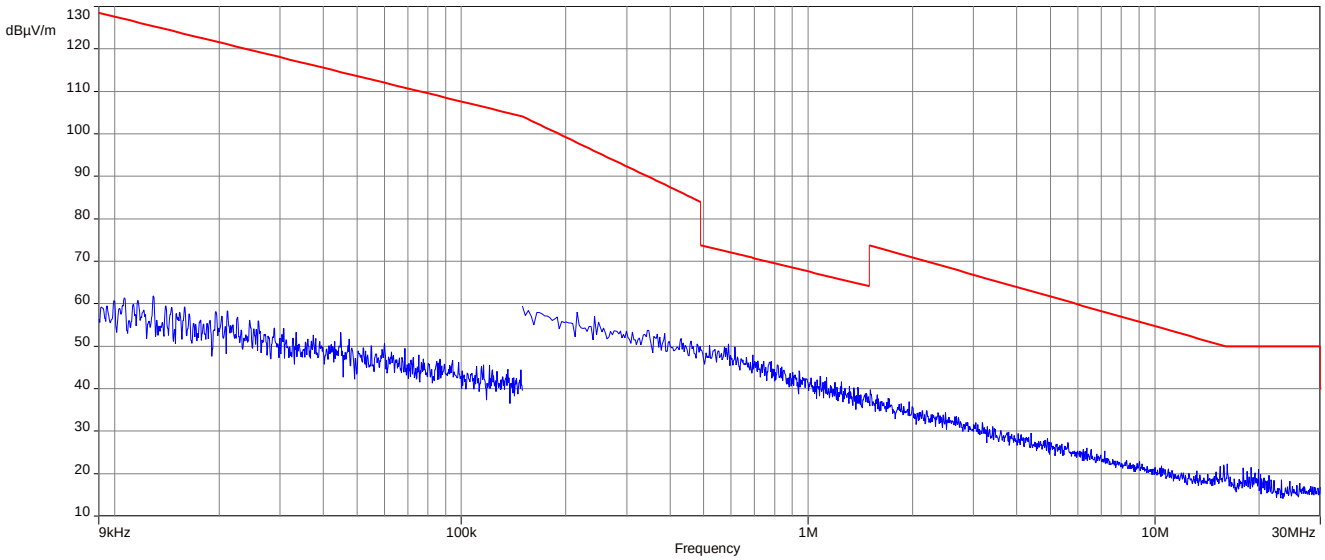


**Plot 3:** 9 kHz to 30 MHz, U-NII-3; highest channel

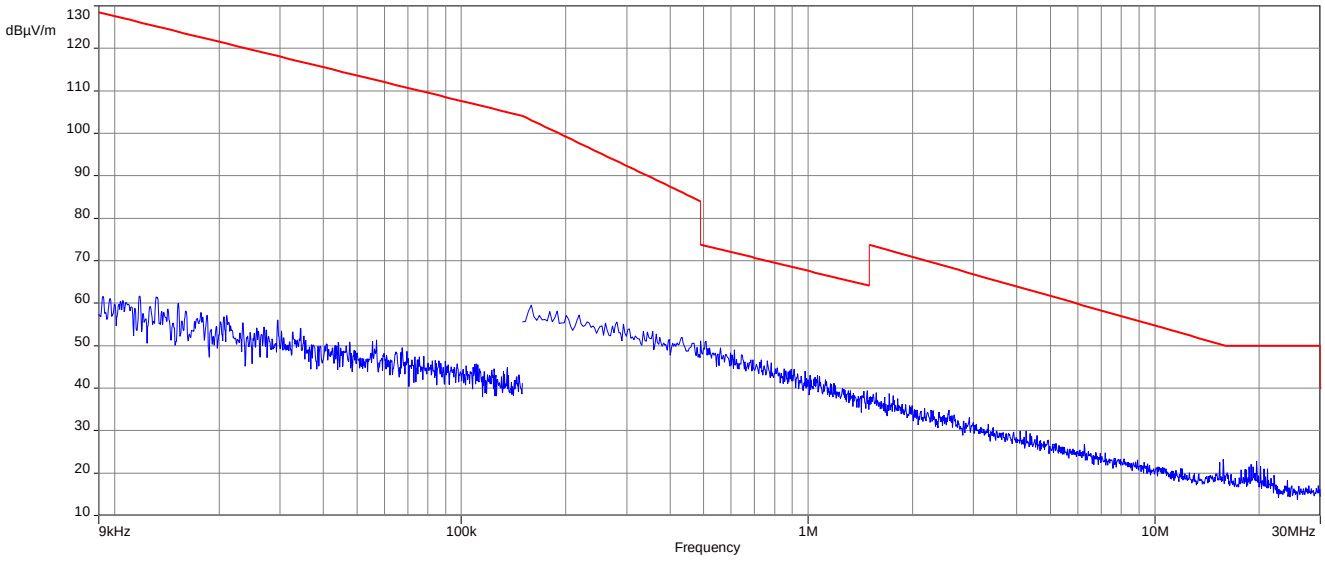


**Plots:** 40 MHz channel bandwidth

**Plot 1:** 9 kHz to 30 MHz, U-NII-3; lowest channel




**Plot 2:** 9 kHz to 30 MHz, U-NII-3; highest channel



## 12.10 Spurious emissions radiated 30 MHz to 1 GHz

Description:

Measurement of the radiated spurious emissions and cabinet radiations below 1 GHz.

Measurement:

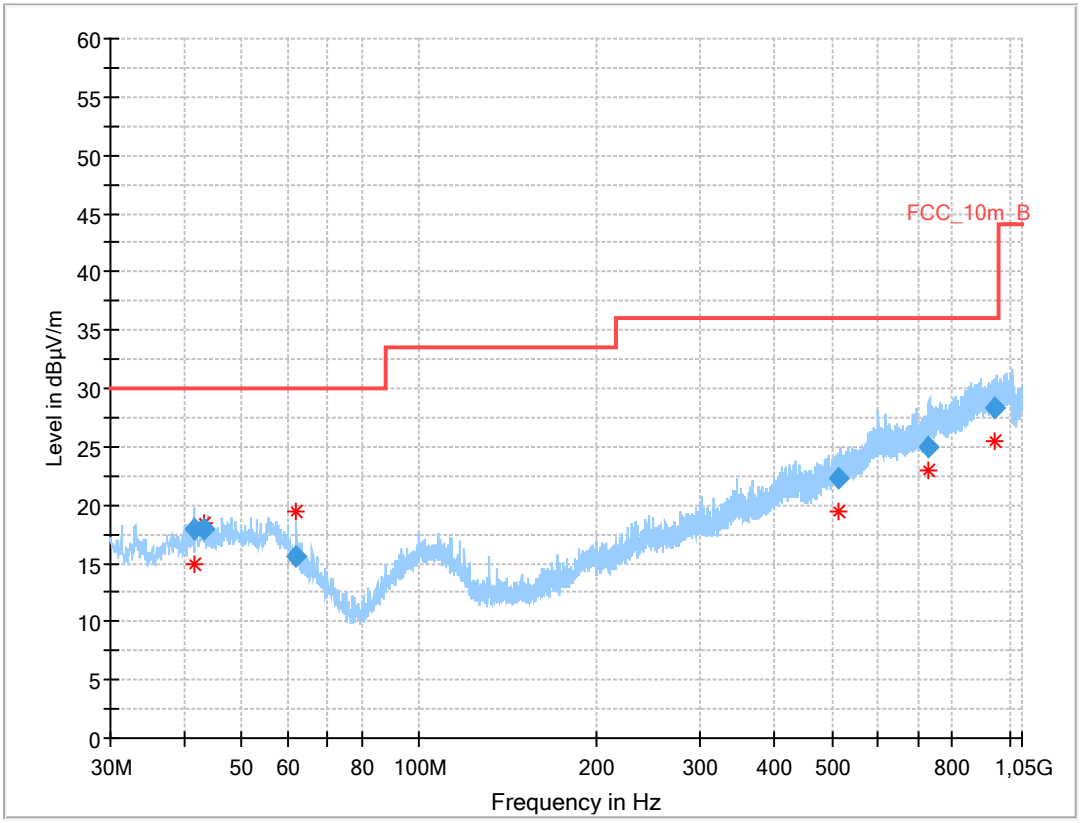
| Measurement parameter | |
|---|---|
| Detector: | Quasi Peak |
| Sweep time: | Auto |
| Resolution bandwidth: | 120 kHz |
| Video bandwidth: | 500 kHz |
| Span: | 30 MHz to 1 GHz |
| Test setup: | See sub clause 7.1 – A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| TX Spurious Emissions Radiated | | |
|---|---|---|
| §15.209 / RSS-247 | | |
| Frequency (MHz) | Field Strength (dBµV/m) | Measurement distance |
| 30 - 88 | 30.0 | 10 |
| 88 – 216 | 33.5 | 10 |
| 216 – 960 | 36.0 | 10 |
| Above 960 | 54.0 | 3 |
| §15.407 | | |
| Outside the restricted bands! | -27 dBm / MHz | |

**Plots:** 20 MHz channel bandwidth

**Plot 1:** 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-3; valid for all channels

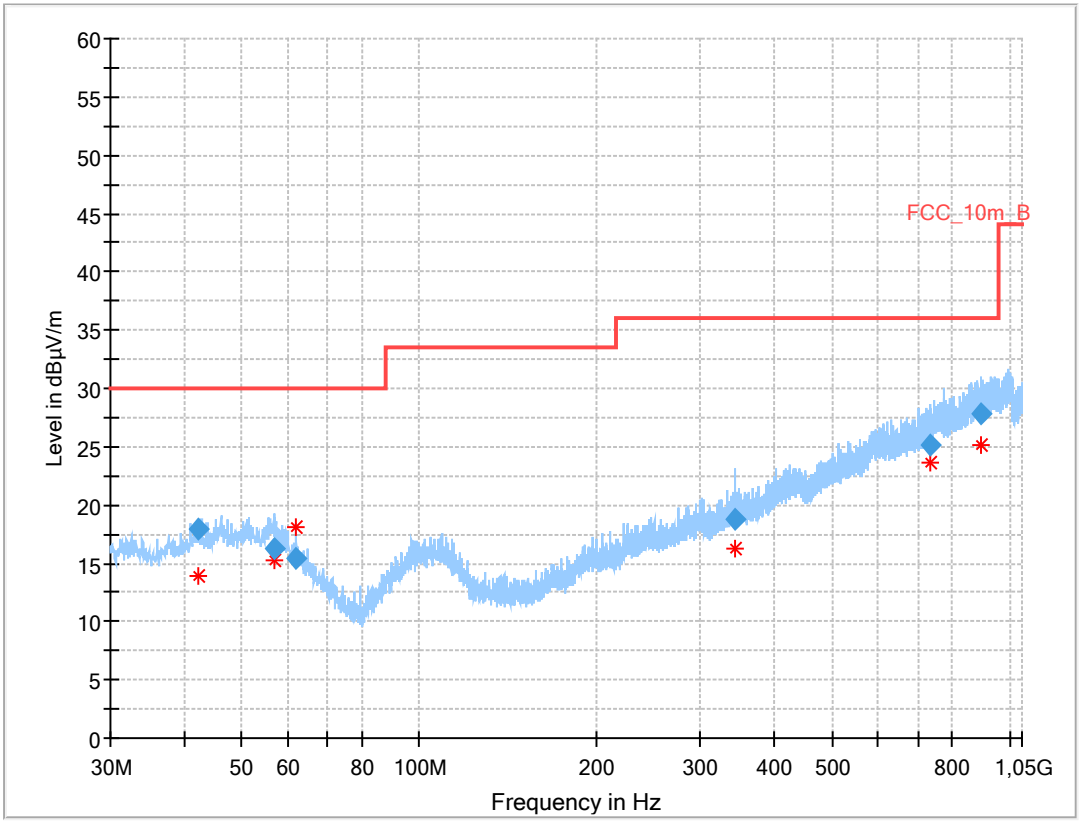



**Results:**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 41.764 | 17.86 | 30.0 | 12.1 | 1000 | 120.0 | 126.0 | H | 67 | 14 |
| 43.364 | 17.99 | 30.0 | 12.0 | 1000 | 120.0 | 162.0 | V | 268 | 14 |
| 62.006 | 15.66 | 30.0 | 14.3 | 1000 | 120.0 | 102.0 | V | 106 | 12 |
| 511.856 | 22.31 | 36.0 | 13.7 | 1000 | 120.0 | 170.0 | H | 101 | 19 |
| 730.901 | 25.02 | 36.0 | 11.0 | 1000 | 120.0 | 150.0 | V | 202 | 21 |
| 947.406 | 28.32 | 36.0 | 7.7 | 1000 | 120.0 | 170.0 | H | 22 | 24 |

**Plots:** 40 MHz channel bandwidth

**Plot 1:** 30 MHz to 1 GHz; vertical & horizontal polarization; U-NII-3; valid for all channels




**Results:**

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 42.251 | 17.92 | 30.0 | 12.1 | 1000 | 120.0 | 170.0 | V | -21 | 14 |
| 56.986 | 16.31 | 30.0 | 13.7 | 1000 | 120.0 | 170.0 | V | -22 | 15 |
| 61.991 | 15.50 | 30.0 | 14.5 | 1000 | 120.0 | 102.0 | V | 247 | 12 |
| 342.605 | 18.72 | 36.0 | 17.3 | 1000 | 120.0 | 106.0 | V | 88 | 16 |
| 735.966 | 25.22 | 36.0 | 10.8 | 1000 | 120.0 | 120.0 | H | 67 | 22 |
| 893.760 | 27.80 | 36.0 | 8.2 | 1000 | 120.0 | 155.0 | V | 67 | 24 |

## 12.11 Spurious emissions radiated 1 GHz to 40 GHz

Description:

Measurement of the radiated spurious emissions and cabinet radiations from 1 GHz to 40 GHz.

Measurement:

| Measurement parameter | |
|---|---|
| Detector: | Quasi Peak below 1 GHz<br>(alternative Peak)<br>Peak above 1 GHz / RMS |
| Sweep time: | Auto |
| Resolution bandwidth: | 1 MHz |
| Video bandwidth: | 3 MHz |
| Span: | 1 GHz to 40 GHz |
| Trace mode: | Max Hold / Average with 100 counts + 20 log (1 / X)<br>for duty cycle lower than 100 % |
| Test setup: | See sub clause 7.2 – B (1 GHz – 18 GHz)<br>See sub clause 7.3 – A (18 GHz – 40 GHz) |
| Measurement uncertainty: | See chapter 9 |

Limits:

| TX Spurious Emissions Radiated | | |
|---|---|---|
| §15.209 / RSS-247 | | |
| Frequency (MHz) | Field Strength (dBµV/m) | Measurement distance |
| Above 960 | 54.0 | 3 |
| §15.407 | | |
| Outside the restricted bands! | -27 dBm / MHz | |

**Results:** 20 MHz channel bandwidth

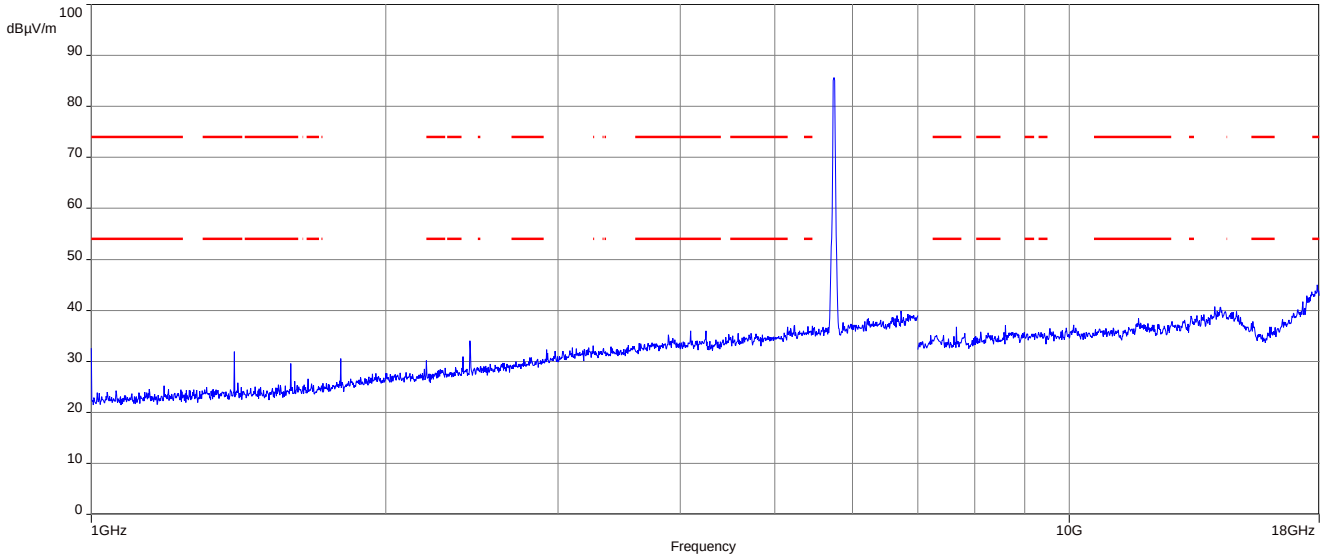
| TX Spurious Emissions Radiated [dBµV/m] / dBm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| U-NII-3 (5725 MHz to 5850 MHz) | | | | | | | | |
| Lowest channel | | | Middle channel | | | Highest channel | | |
| F [MHz] | Detector | Level [dBµV/m] | F [MHz] | Detector | Level [dBµV/m] | F [MHz] | Detector | Level [dBµV/m] |
| All detected peak emissions are below the average limit. | | | All detected peak emissions are below the average limit. | | | All detected peak emissions are below the average limit. | | |
| -/- | Peak | -/- | -/- | Peak | -/- | -/- | Peak | -/- |
| | AVG | -/- | | AVG | -/- | | AVG | -/- |
| For emissions above 18 GHz please take look at the plots. | | | For emissions above 18 GHz please take look at the plots. | | | For emissions above 18 GHz please take look at the plots. | | |

**Results:** 40 MHz channel bandwidth

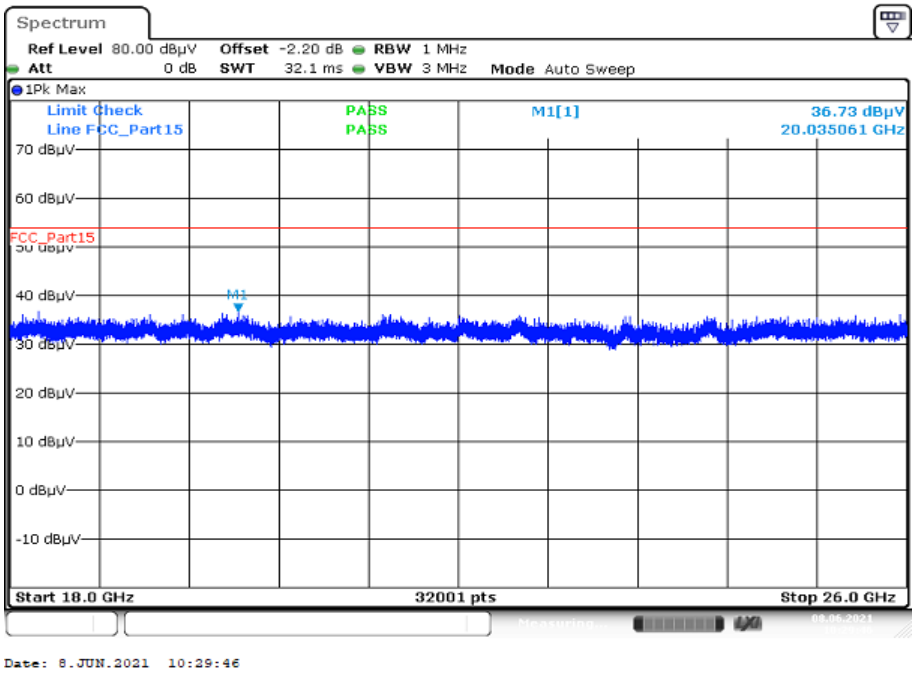
| TX Spurious Emissions Radiated [dBµV/m] / dBm | | | | | |
|---|---|---|---|---|---|
| U-NII-3 (5725 MHz to 5850 MHz) | | | | | |
| Lowest channel | | | | Highest channel | |
| F [MHz] | Detector | Level [dBµV/m] | | F [MHz] | Detector | Level [dBµV/m] |
| All detected peak emissions are below the average limit. | | | | All detected peak emissions are below the average limit. | | |
| -/- | Peak | -/- | | -/- | Peak | -/- |
| | AVG | -/- | | | AVG | -/- |
| For emissions above 18 GHz please take look at the plots. | | | | For emissions above 18 GHz please take look at the plots. | | |

**Plots:** 20 MHz channel bandwidth

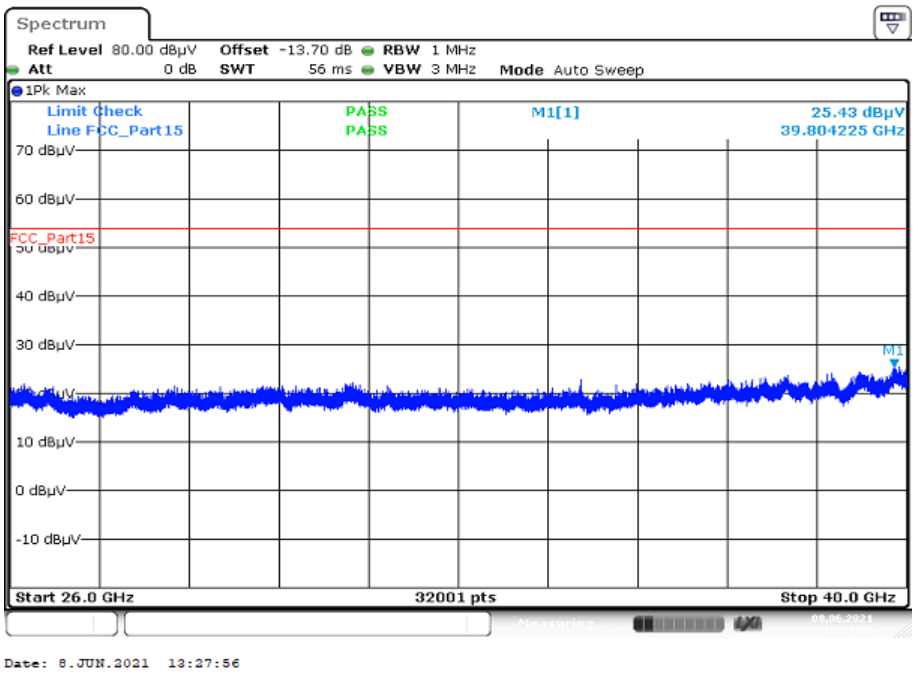
**Plot 1:** 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



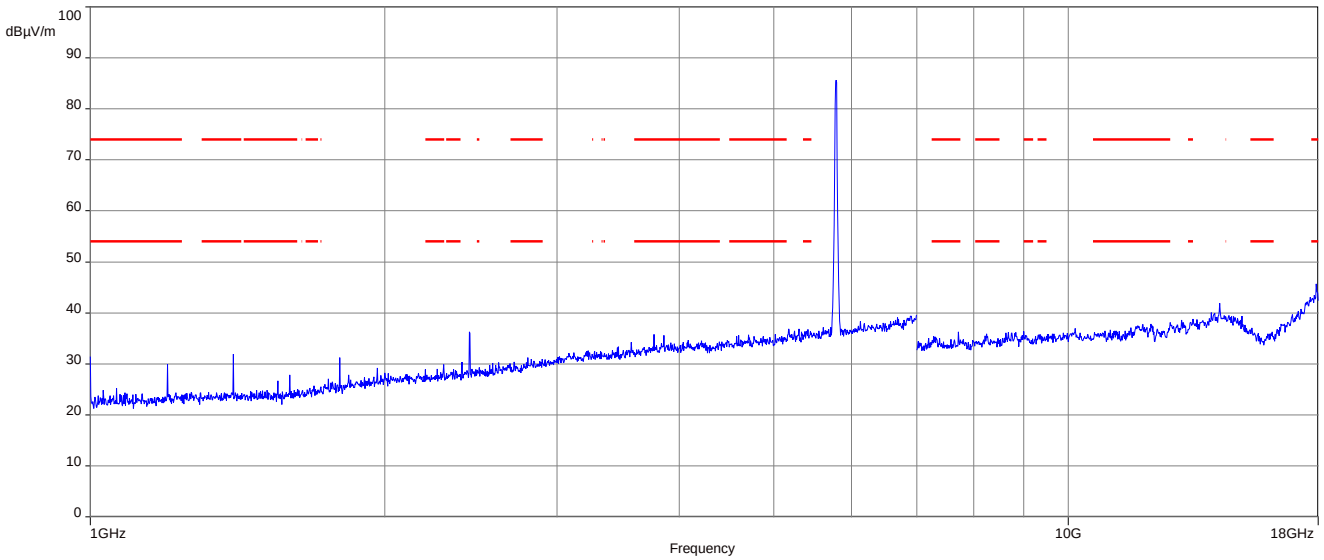

**Plot 2:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



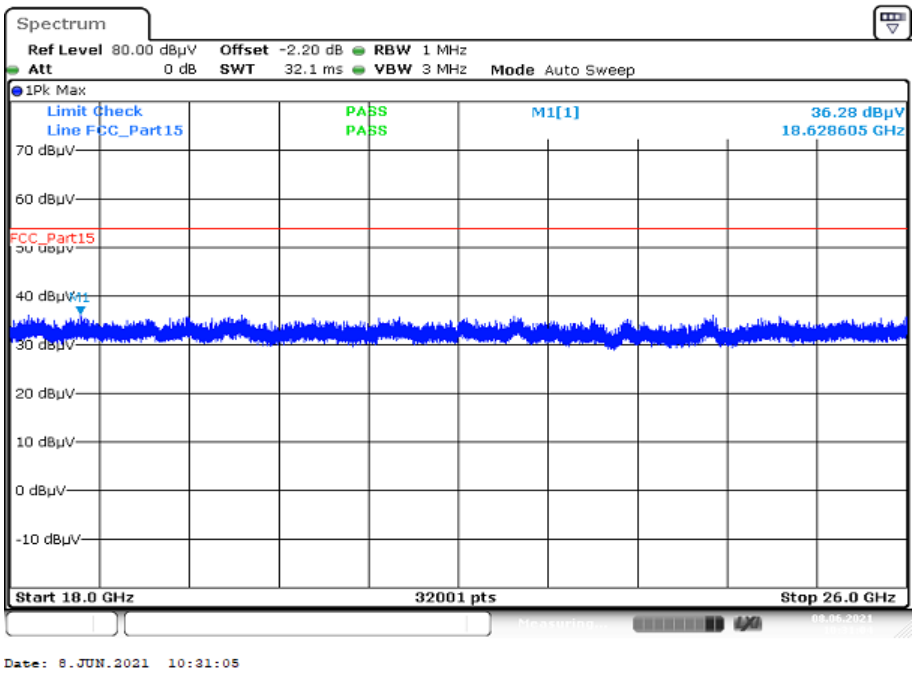
**Plot 3:** 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



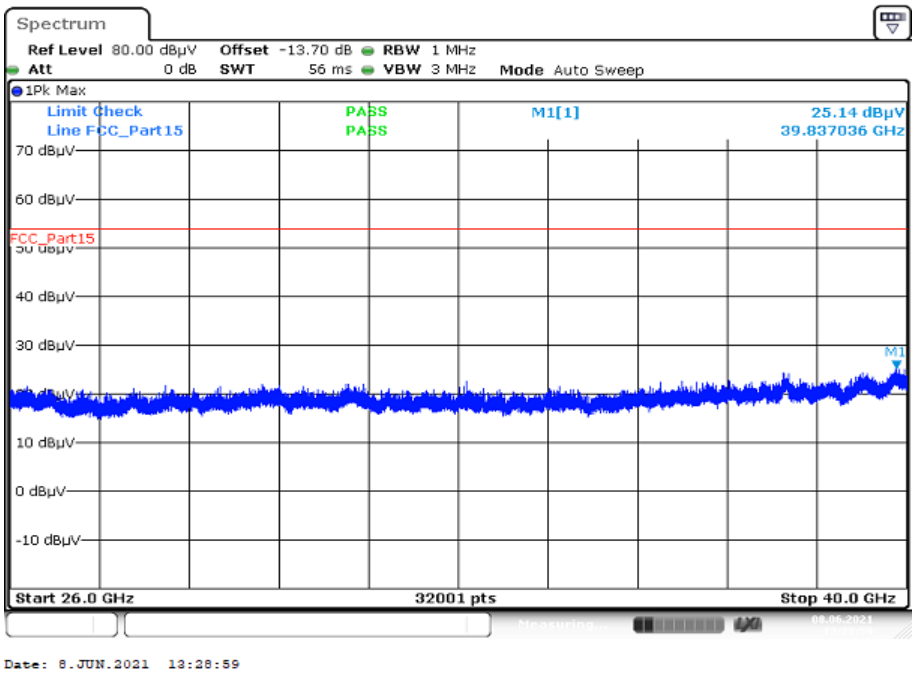

**Plot 4:** 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; middle channel



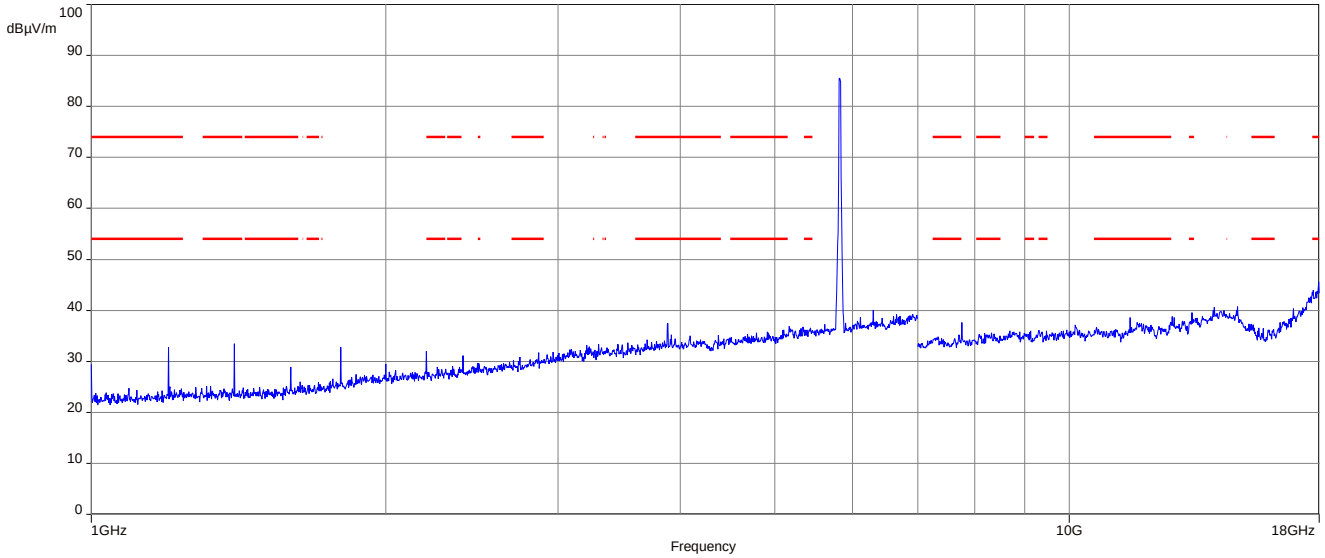
**Plot 5:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; middle channel



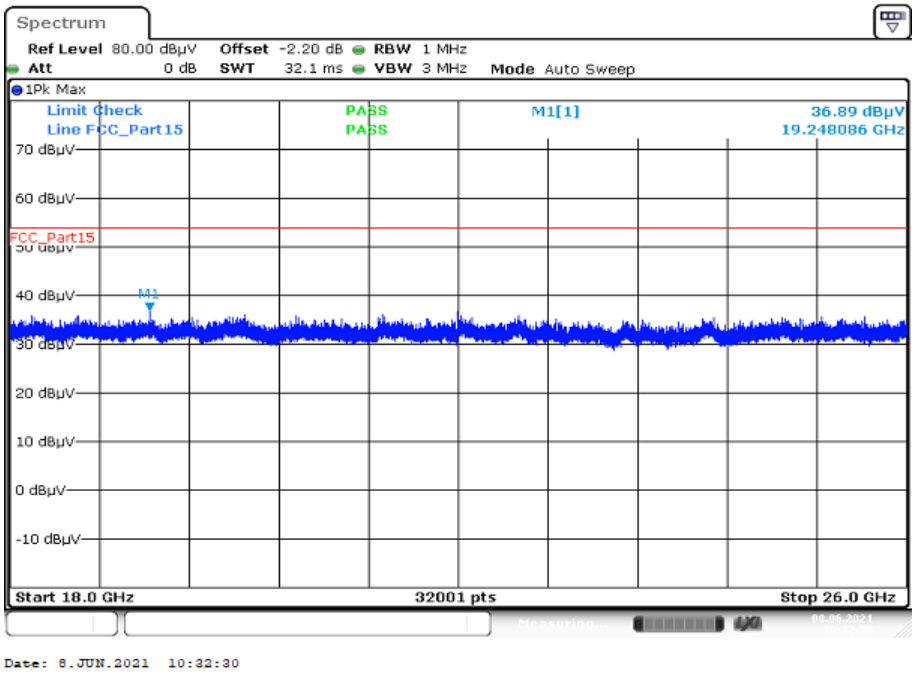

**Plot 6:** 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; middle channel



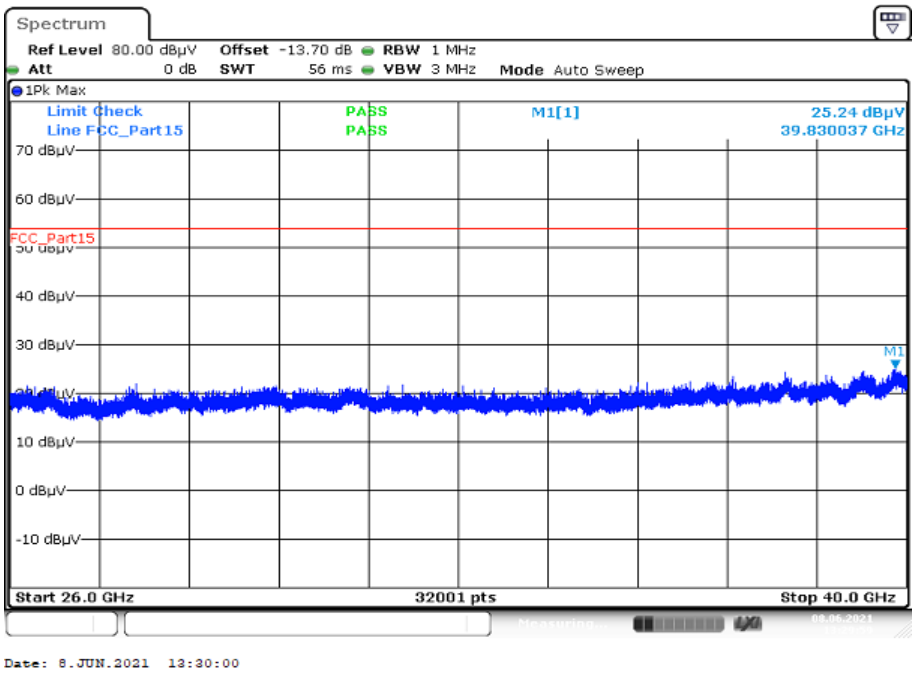
**Plot 7:** 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; highest channel




**Plot 8:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; highest channel

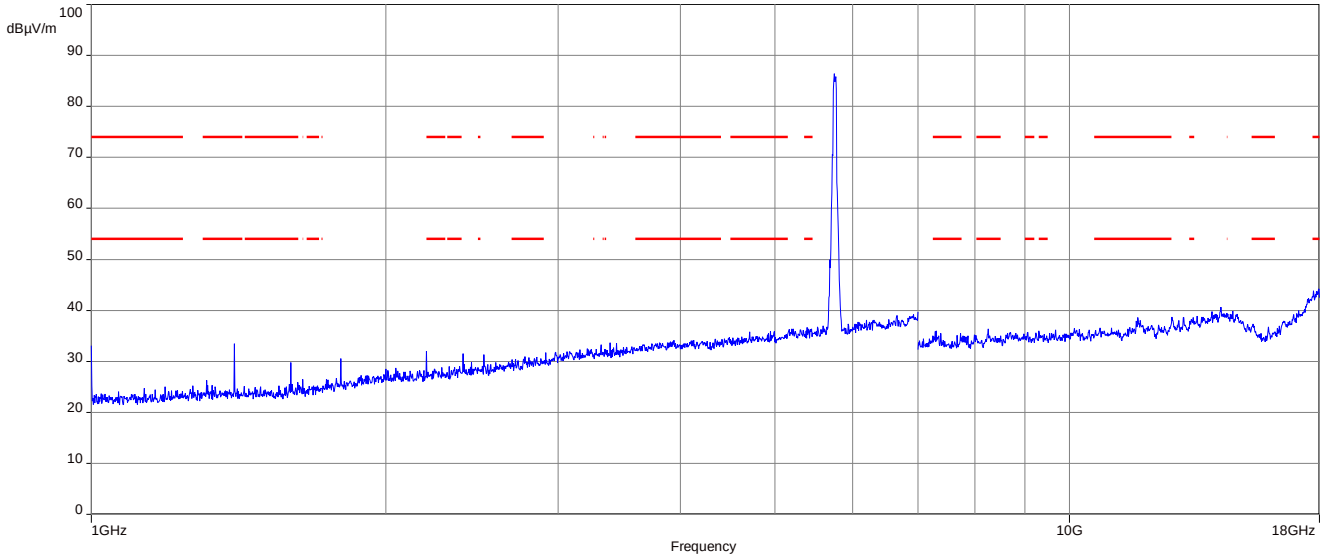


**Plot 9:** 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; highest channel

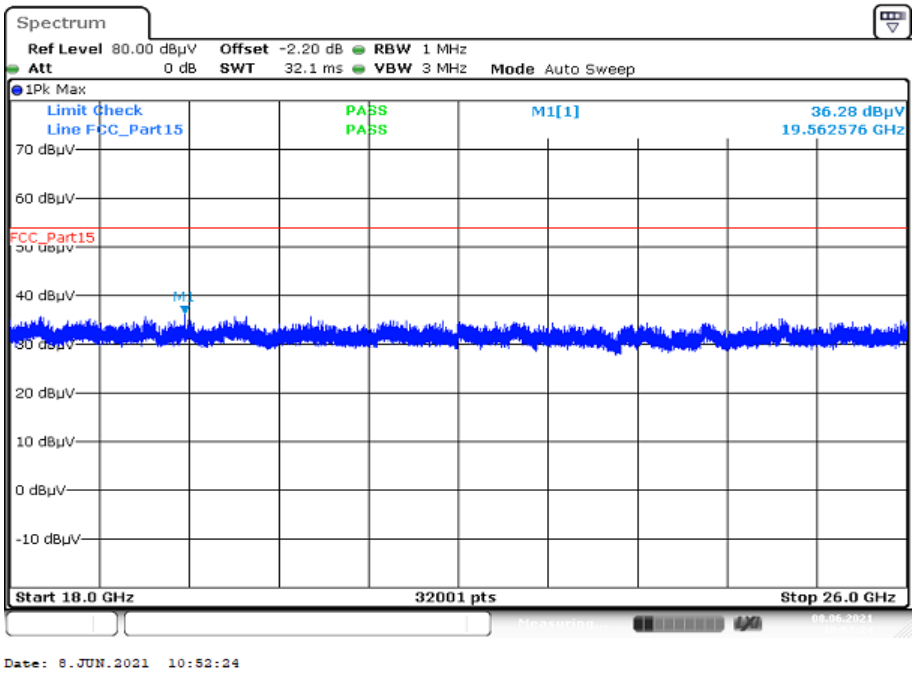


**Plots:** 40 MHz channel bandwidth

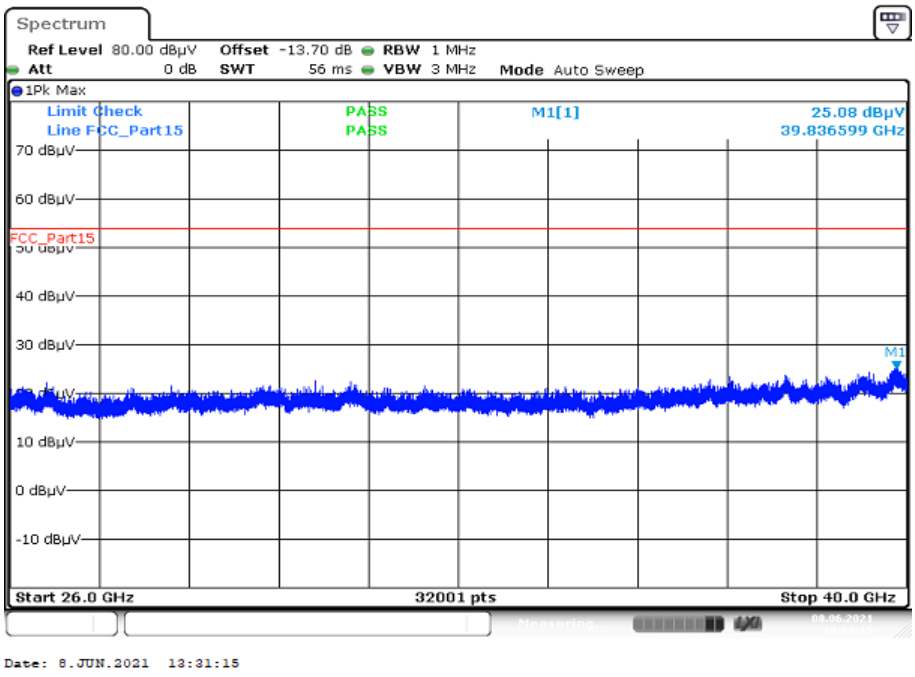
**Plot 1:** 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



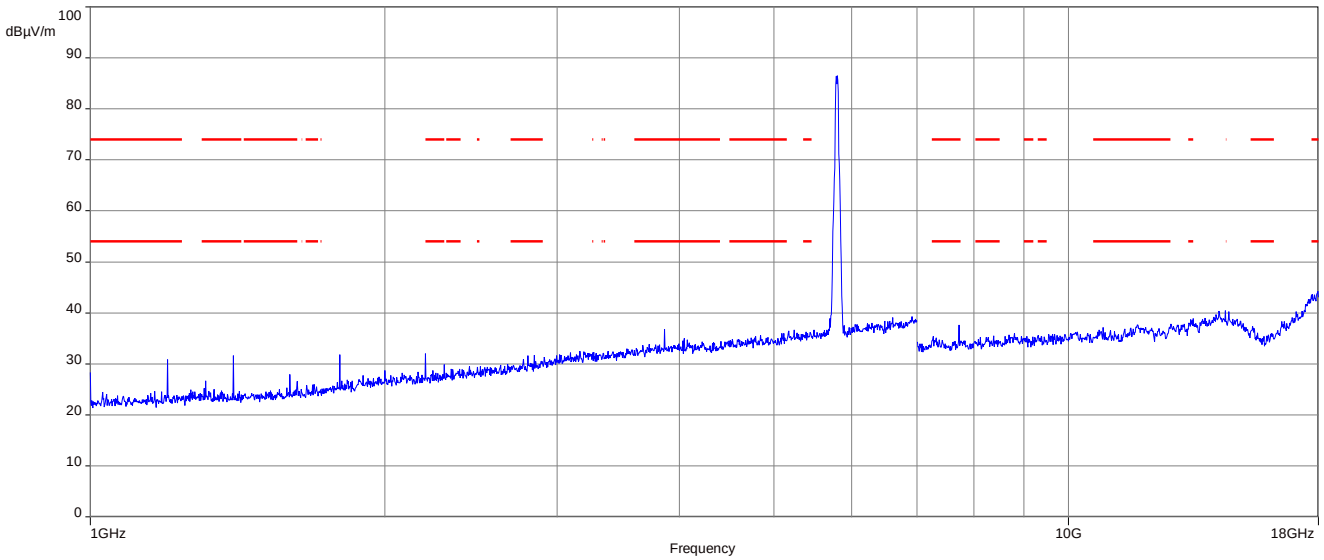

**Plot 2:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



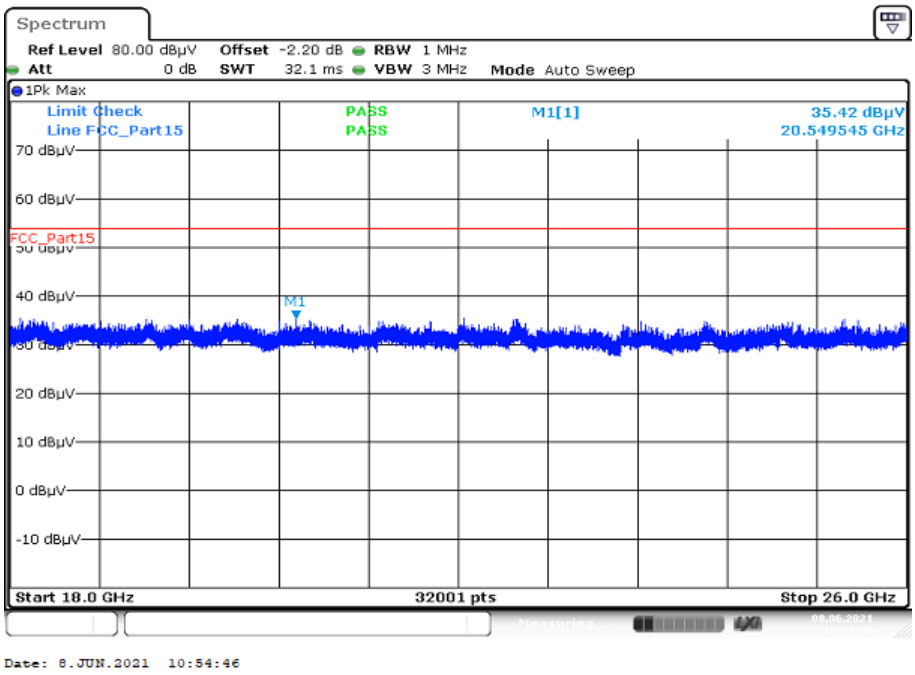
**Plot 3:** 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; lowest channel



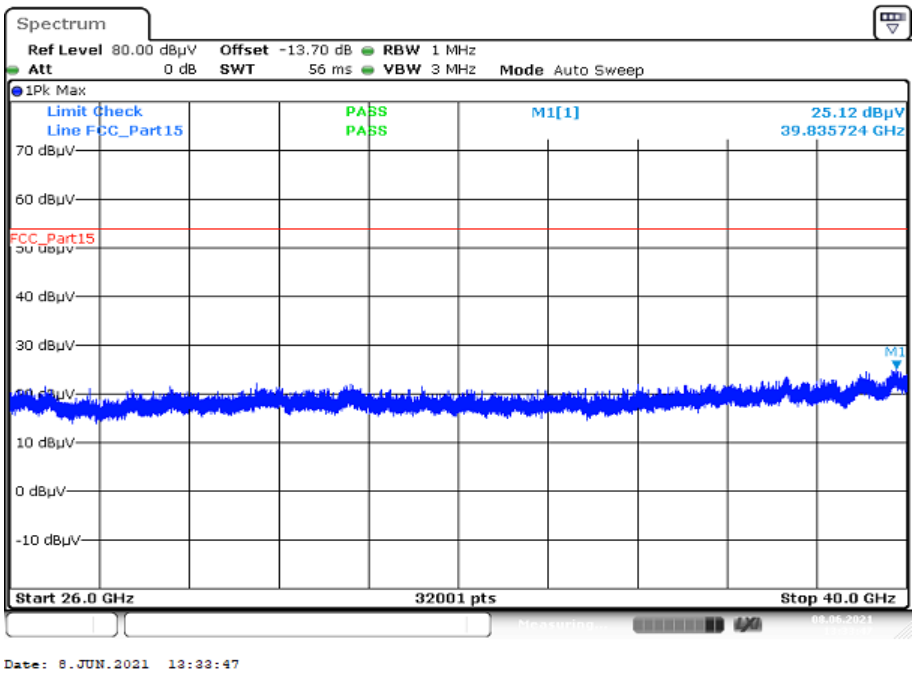

**Plot 4:** 1 GHz to 18 GHz; vertical & horizontal polarization; U-NII-3; highest channel



**Plot 5:** 18 GHz to 26 GHz; vertical & horizontal polarization; U-NII-3; highest channel




**Plot 6:** 26 GHz to 40 GHz; vertical & horizontal polarization; U-NII-3; highest channel



## 12.12 Spurious emissions conducted < 30 MHz

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The EUT is set to middle channel. If critical peaks are found the lowest channel and the highest channel will be measured too. 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:

| Measurement parameter | |
|---|---|
| Detector: | Peak - Quasi Peak / Average |
| Sweep time: | Auto |
| Video bandwidth: | 9 kHz |
| Resolution bandwidth: | 100 kHz |
| Span: | 150 kHz to 30 MHz |
| Trace mode: | Max Hold |
| Test setup: | See sub clause 7.5 setup A |
| Measurement uncertainty: | See chapter 9 |

Limits:

| Spurious Emissions Conducted < 30 MHz | | |
|---|---|---|
| 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 |

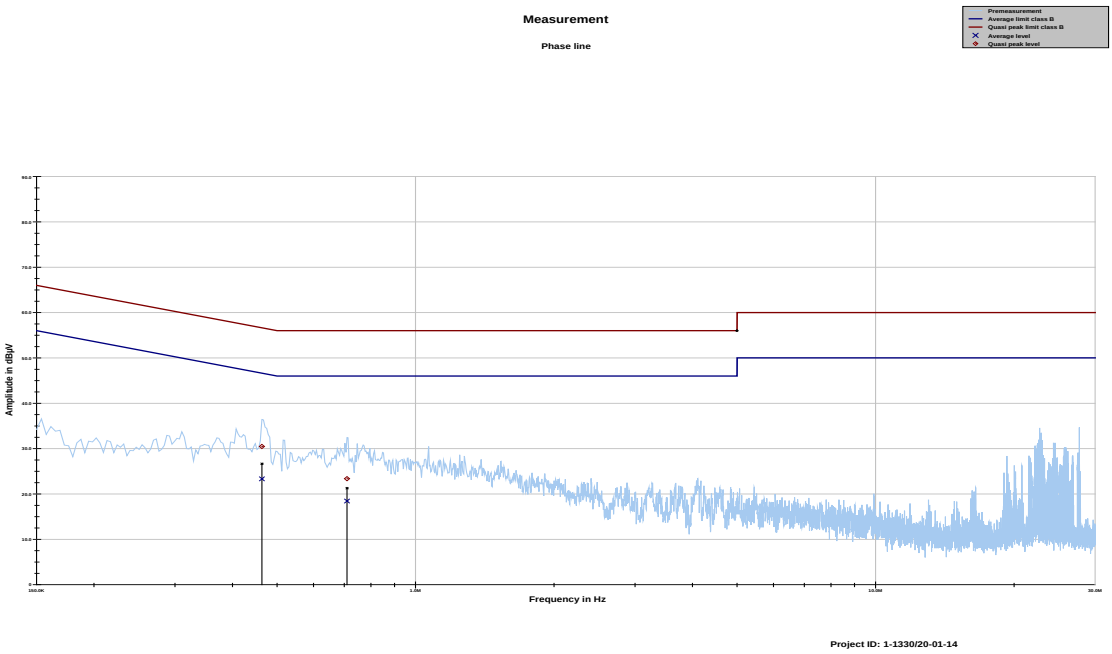
*Decreases with the logarithm of the frequency

Results:

| Spurious Emissions Conducted < 30 MHz [dBµV/m] | | |
|---|---|---|
| F [MHz] | Detector | Level [dBµV/m] |
| All detected emissions are more than 20 dB below the limit. | | |
| | | |

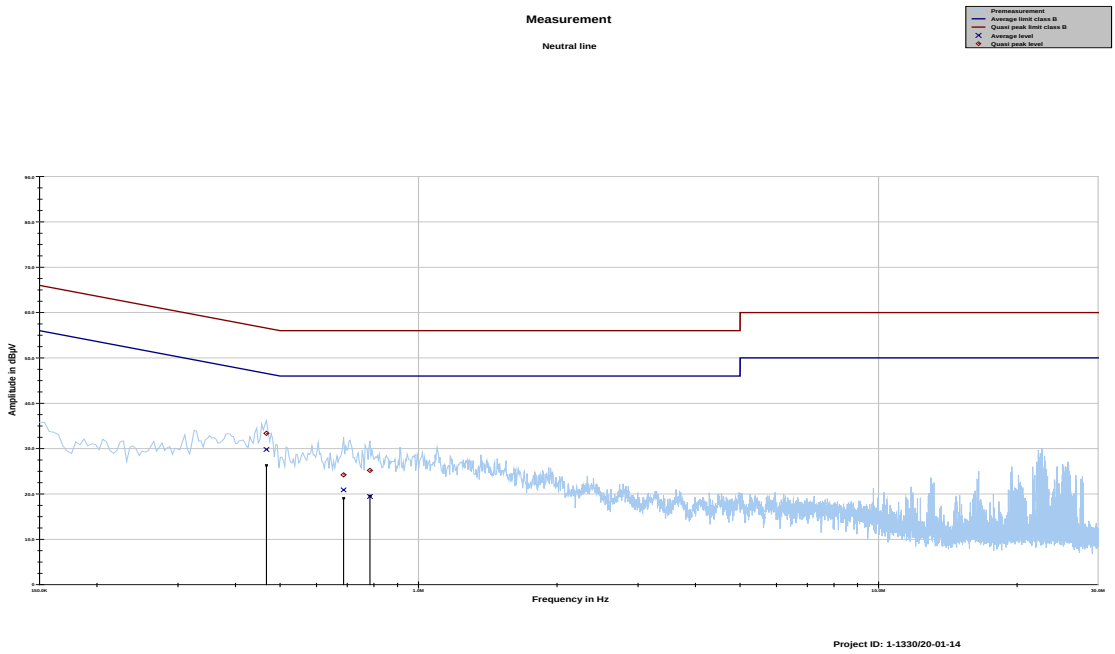
**Plots:**

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




| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin average | Limit AV |
|---|---|---|---|---|---|---|
| MHz | dBµV | dB | dBµV | dBµV | dB | dBµV |
| **0.463425** | 30.48 | 26.16 | 56.631 | 23.32 | 23.72 | 47.045 |
| **0.709688** | 23.36 | 32.64 | 56.000 | 18.44 | 27.56 | 46.000 |

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




| Frequency | Quasi peak level | Margin quasi peak | Limit QP | Average level | Margin Average | Limit AV |
|---|---|---|---|---|---|---|
| MHz | dBµV | dB | dBµV | dBµV | dB | dBµV |
| **0.467156** | 33.37 | 23.20 | 56.564 | 29.80 | 17.14 | 46.938 |
| **0.687300** | 24.21 | 31.79 | 56.000 | 20.89 | 25.11 | 46.000 |
| **0.784312** | 25.19 | 30.81 | 56.000 | 19.44 | 26.56 | 46.000 |

## 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 | 2021-07-23 |
| A | 80 MHz mode results removed | 2021-12-03 |

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

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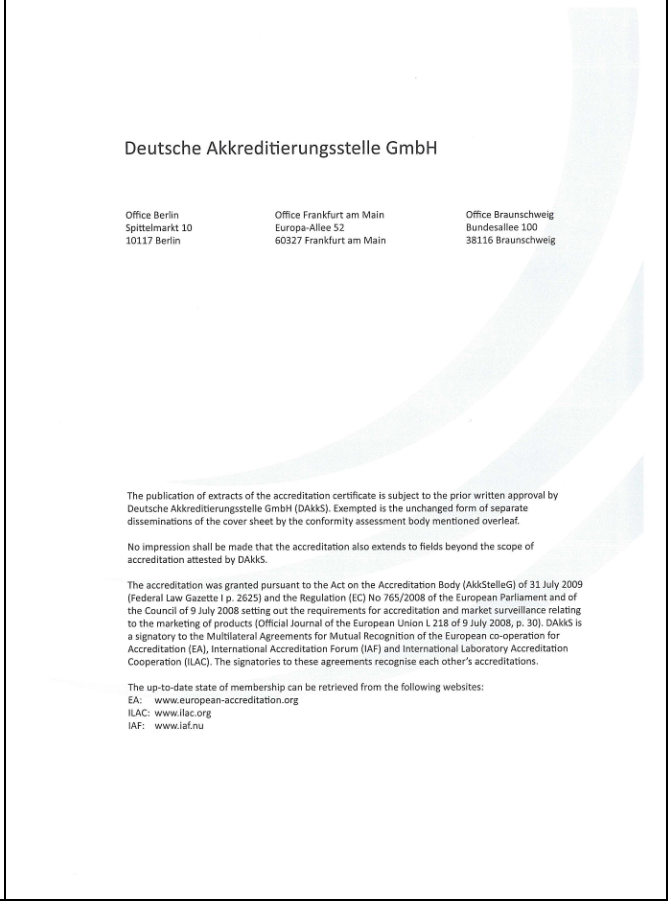
|  |  |





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

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

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

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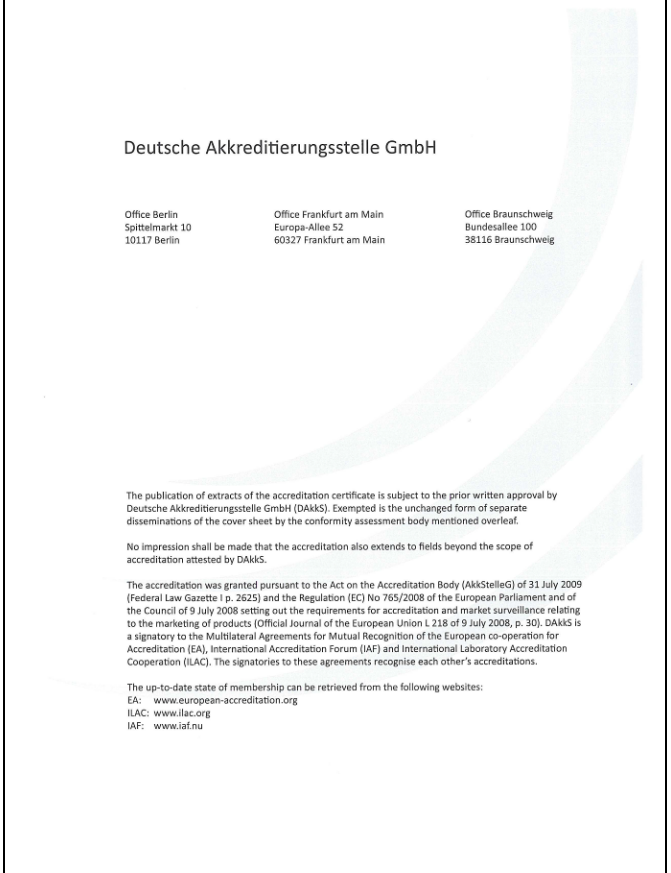
|---|---|
|  |  |





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