

## TEST REPORT

Test report no.: 1-1054/20-01-02

### 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](mailto: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

**Baumer Electric AG**

Hummelstr. 17

8501 Frauenfeld / SWITZERLAND

Phone: +41 (0)52 728 14 85

Contact: Matthias Sutter

e-mail: [msutter@baumer.com](mailto:msutter@baumer.com)

Phone: +41 (0)52 728 1594

### Manufacturer

**Baumer Electric AG**

Hummelstr. 17

8501 Frauenfeld / SWITZERLAND

### Test standard/s

FCC - Title 47 CFR  
Part 15

RSS - 210 Issue 10

RSS-GEN

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

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

Radio Standards Specification - Licence-Exempt Radio Apparatus: Category II  
Equipment

General Requirements for Compliance of Radio Apparatus

### Test Item

**Kind of test item:** 122-123 GHz FMCW Radar

**Model name:** R600V

**FCC-ID** PGP-R600V

**IC-ID** 24812-R600V

**Frequency:** 122 GHz – 123 GHz

**Technology tested:** FMCW Radar

**Antenna:** Integrated patch antenna

**Power supply:** 9 V to 32 V DC by external power supply

**Temperature range:** -40°C to +70°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=Thomas Vogler, o=CTC advanced  
GmbH, ou=VOG-161125,  
email=thomas.vogler@ctcadvanced.com,  
c=DE  
2021.02.11 10:58:52 +01'00'

Thomas Vogler  
Lab Manager  
Radio Communications

### Test performed:



cn=Sebastian Janoschka, o=CTC advanced  
GmbH, ou=JKA-190527,  
email=sebastian.janoschka@ctcadvanced.com,  
c=DE  
2021.02.11 10:50:39 +01'00'

Sebastian Janoschka  
Lab Manager  
Radio Communications

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## 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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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:          | 2020-11-16 |
| Date of receipt of test item:      | 2020-10-22 |
| Start of test:*                    | 2020-11-10 |
| End of test:*                      | 2021-02-02 |
| 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         | 12-2019 | Radio Standards Specification - Licence-Exempt Radio Apparatus: Category II Equipment           |
| RSS-GEN                    | 03-2019 | General Requirements for Compliance of Radio Apparatus                                          |

| Guidance         | Version | Description                                                                                                                                                         |
|------------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ANSI C63.4-2017  | -/-     | 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-12076-01-05 | Telecommunication FCC requirements<br><a href="https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf">https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf</a> |  <br><small>Deutsche<br/>Akkreditierungsstelle<br/>D-PL-12076-01-05</small> |

### 4 Test environment

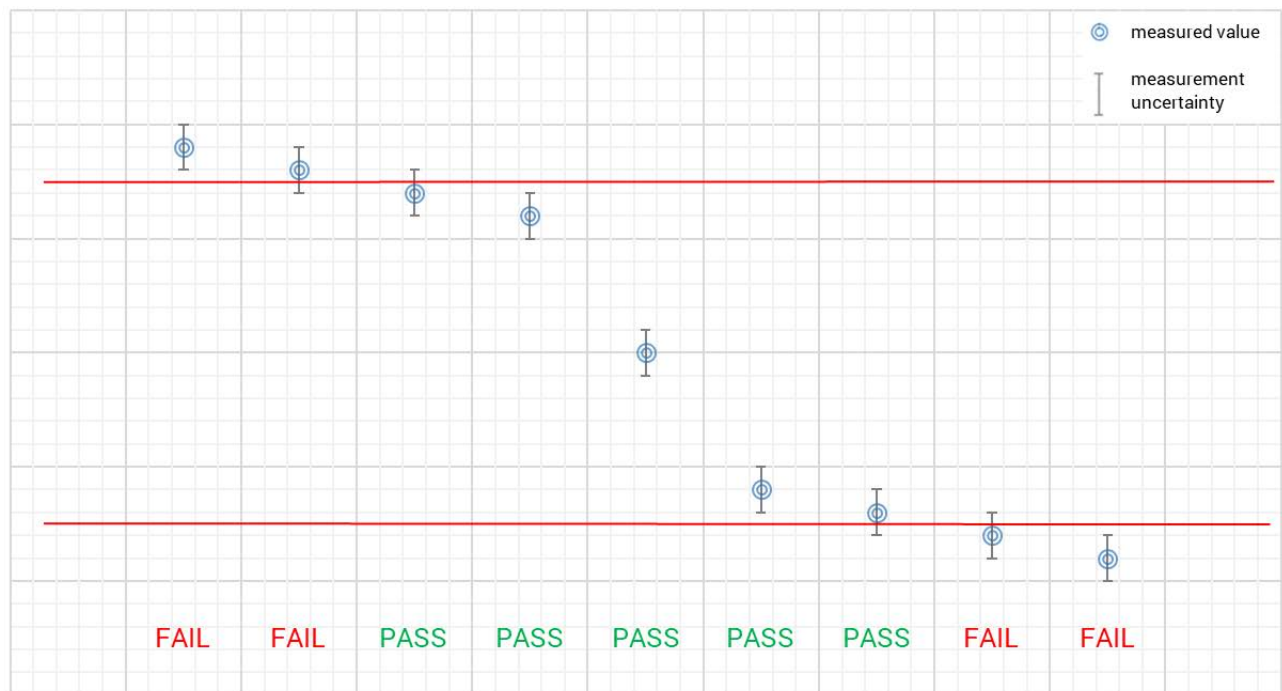
|                           |   |                                                                                                                                                   |
|---------------------------|---|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature               | : | $T_{nom}$ +22 °C during room temperature tests<br>$T_{max}$ +50 °C during high temperature tests<br>$T_{min}$ -20 °C during low temperature tests |
| Relative humidity content | : | 49 %                                                                                                                                              |
| Barometric pressure       | : | 1010 hPa                                                                                                                                          |
| Power supply              | : | $V_{nom}$ 12 V DC<br>$V_{max}$ 32 V DC<br>$V_{min}$ 9 V DC                                                                                        |

## 5 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.

measured value, measurement uncertainty, verdict



## 6 Test item

### 6.1 General description

|                           |   |                                                                                                                                                                |
|---------------------------|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Kind of test item</b>  | : | 122-123 GHz FMCW Radar                                                                                                                                         |
| <b>Model name:</b>        | : | R600V                                                                                                                                                          |
| <b>HMN</b>                | : | n/a                                                                                                                                                            |
| <b>PMN</b>                | : | R600V.DAE0-11188367<br>R600V.DAE0-11209335<br>R600V.DAE0-11228779<br>R600V.DAH5-11205779<br>R600V.DAH5-11221283<br>R600V.RAH5-11225384                         |
| <b>HVIN</b>               | : | 11188367<br>11209335<br>11228779<br>11205779<br>11221283<br>11225384                                                                                           |
| <b>FVIN</b>               | : | R600VMOF_S<br>R600VMSF_S<br>R600VMSF_S<br>R600VSOF_S<br>R600VM8F_S<br>R600VRTF_S                                                                               |
| <b>S/N serial number</b>  | : | M111.10.X-0543-2359<br>0009640 (RF-Chirp stopped, low frequency)<br>0010371 (RF-Chirp stopped, middle frequency)<br>0010019 (RF-Chirp stopped, high frequency) |
| <b>Hardware status</b>    | : | RE00050D / RE.00061 / RE.00009 / PCBA_R714028_SOE-1                                                                                                            |
| <b>Software status</b>    | : | N/A                                                                                                                                                            |
| <b>Firmware status</b>    | : | R600VSOF_S01-03-00                                                                                                                                             |
| <b>Frequency band</b>     | : | 122 GHz – 123 GHz                                                                                                                                              |
| <b>Type of modulation</b> | : | FMCW                                                                                                                                                           |
| <b>Number of channels</b> | : | 1                                                                                                                                                              |
| <b>Antenna</b>            | : | Integrated patch antenna                                                                                                                                       |
| <b>Power supply</b>       | : | 9 V to 32 V DC by external power supply                                                                                                                        |
| <b>Temperature range</b>  | : | -40°C to +70°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:      1-1054/20-01-01\_AnnexA  
                                                                                          1-1054/20-01-01\_AnnexB  
                                                                                          1-1054/20-01-01\_AnnexD

## 7 Sequence of testing

### 7.1 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.

## 7.2 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  $\pm 45^\circ$  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.

### 7.3 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.

## 7.4 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.

## 7.5 Sequence of testing radiated spurious above 50 GHz with external mixers

### Setup

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

### Premeasurement

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

### Final measurement

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

## 8 Description of the test setup

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

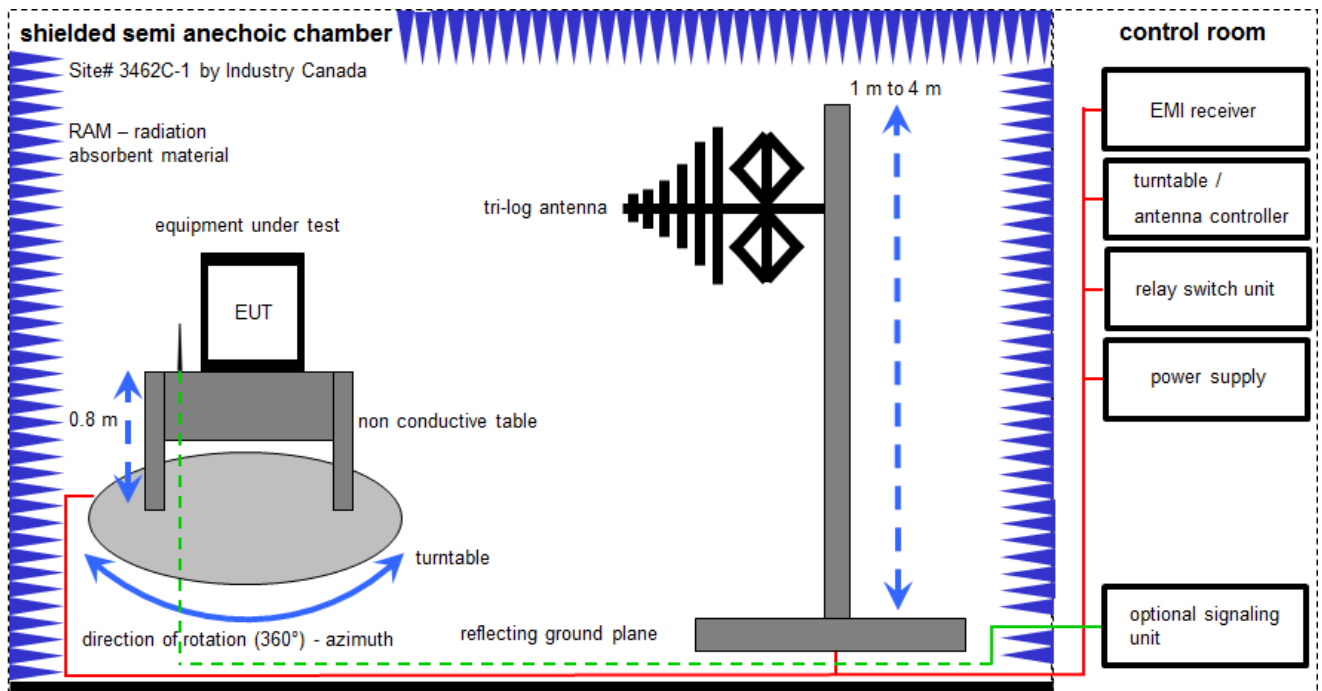
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

### **Agenda:** Kind of Calibration

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

## 8.1 Shielded semi anechoic chamber

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

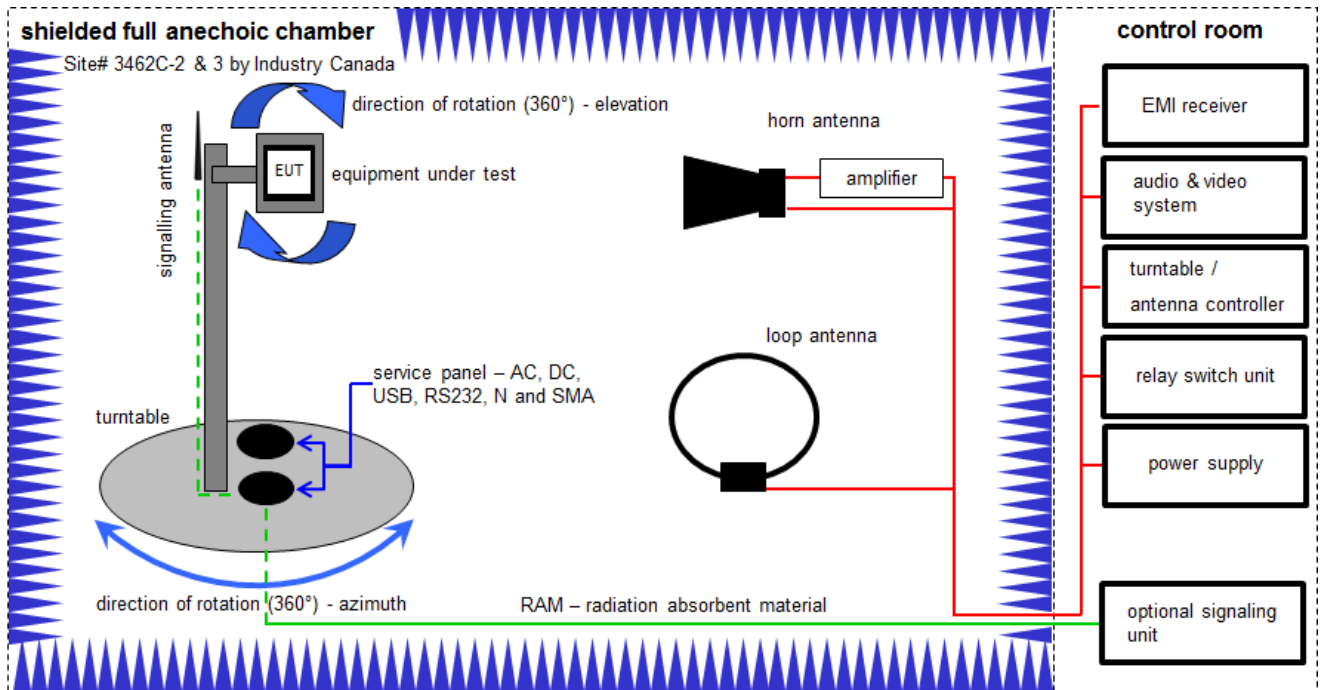


Measurement distance: tri-log antenna 10 meter

### Equipment table:

| No. | Lab / Item | Equipment                                    | Type             | Manufacturer                  | Serial No. | INV. No.  | Kind of Calibration | Last Calibration         | Next Calibration |
|-----|------------|----------------------------------------------|------------------|-------------------------------|------------|-----------|---------------------|--------------------------|------------------|
| 1   | n. a.      | Switch-Unit                                  | 3488A            | HP                            | 2719A14505 | 300000368 | ev                  | -/-                      | -/-              |
| 2   | n. a.      | DC power supply, 60Vdc, 50A, 1200 W          | 6032A            | HP                            | 2920A04466 | 300000580 | ne                  | -/-                      | -/-              |
| 3   | n. a.      | Meßkabine 1                                  | HF-Absorberhalle | MWB AG 300023                 |            | 300000551 | ne                  | -/-                      | -/-              |
| 4   | n. a.      | EMI Test Receiver                            | ESCI 3           | R&S                           | 100083     | 300003312 | k                   | 10.12.2019<br>09.12.2020 | 08.12.2021       |
| 5   | n. a.      | Antenna Tower                                | Model 2175       | ETS-Lindgren                  | 64762      | 300003745 | izw                 | -/-                      | -/-              |
| 6   | n. a.      | Positioning Controller                       | Model 2090       | ETS-Lindgren                  | 64672      | 300003746 | izw                 | -/-                      | -/-              |
| 7   | n. a.      | Turntable Interface-Box                      | Model 105637     | ETS-Lindgren                  | 44583      | 300003747 | izw                 | -/-                      | -/-              |
| 8   | n. a.      | TRILOG Broadband Test-Antenna 30 MHz - 3 GHz | VULB9163         | Schwarzbeck Mess - Elektronik | 295        | 300003787 | vKI!                | 19.02.2019               | 18.02.2021       |
| 10  | n. a.      | Switch-Unit                                  | 3488A            | HP                            | 2719A14505 | 300000368 | ev                  | -/-                      | -/-              |
| 11  | n. a.      | EMI Test Receiver                            | ESR3             | Rohde & Schwarz               | 102587     | 300005771 | k                   | 10.12.2020               | 09.06.2022       |

## 8.2 Radiated measurements 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:

$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V/m]} + (-35.8) \text{ [dB]} + 32.9 \text{ [dB/m]} = 37.1 \text{ [dB}\mu\text{V/m]} (71.61 \mu\text{V/m})$$

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

$$OP \text{ [dBm]} = -39.0 \text{ [dBm]} + 57.0 \text{ [dB]} - 12.0 \text{ [dBi]} + (-36.0) \text{ [dB]} = -30 \text{ [dBm]} (1 \mu\text{W})$$

**Equipment table (Chamber A):**

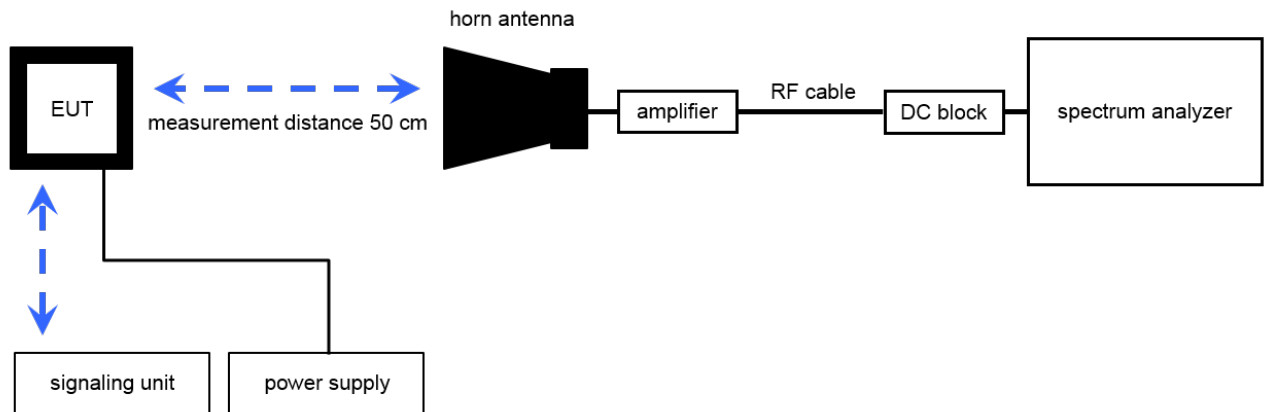
| No. | Lab / Item | Equipment                                      | Type                                  | Manufacturer         | Serial No.      | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|------------------------------------------------|---------------------------------------|----------------------|-----------------|-----------|---------------------|------------------|------------------|
| 1   | n. a.      | Active Loop Antenna 9 kHz to 30 MHz            | 6502                                  | EMCO                 | 2210            | 300001015 | vKI!                | 13.06.2019       | 12.06.2021       |
| 2   | n. a.      | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115                                  | EMCO                 | 9107-3696       | 300001604 | vKI!                | 27.02.2019       | 26.02.2021       |
| 3   | n. a.      | RF-Amplifier                                   | AMF-6F06001800-30-10P-R               | NARDA-MITEQ Inc      | 2011571         | 300005240 | ev                  | -/-              | -/-              |
| 4   | n. a.      | Broadband Amplifier 0.5-18 GHz                 | CBLU5184540                           | CERNEX               | 22050           | 300004482 | ev                  | -/-              | -/-              |
| 5   | n. a.      | Highpass Filter                                | WHK1.1/15G-10SS                       | Wainwright           | 37              | 400000148 | ne                  | -/-              | -/-              |
| 6   | n. a.      | Highpass Filter                                | WHKX7.0/18G-8SS                       | Wainwright           | 18              | 300003789 | ne                  | -/-              | -/-              |
| 7   | n. a.      | EMI Test Receiver 9kHz-26,5GHz                 | ESR26                                 | R&S                  | 101376          | 300005063 | k                   | 09.12.2020       | 08.12.2021       |
| 8   | n. a.      | 4U RF Switch Platform                          | L4491A                                | Agilent Technologies | MY50000032      | 300004510 | ne                  | -/-              | -/-              |
| 9   | n. a.      | Computer                                       | Intel Core i3 3220/3,3 GHz, Prozessor |                      | 2V2403033A54 21 | 300004591 | ne                  | -/-              | -/-              |
| 10  | n. a.      | NEXIO EMV-Software                             | BAT EMC V3.20.0.13                    | EMCO                 |                 | 300004682 | ne                  | -/-              | -/-              |
| 11  | n. a.      | Anechoic chamber                               |                                       | TDK                  |                 | 300003726 | ne                  | -/-              | -/-              |
| 12  | n. a.      | DC power supply, 60Vdc, 50A, 1200 W            | 6032A                                 | HP                   | 2920A04590      | 300001041 | vKI!                | 09.12.2020       | 08.12.2023       |

**Equipment table (Chamber C):**

| No. | Lab / Item | Equipment                                      | Type                                          | Manufacturer         | Serial No. | INV. No.  | Kind of Calibration | Last Calibration         | Next Calibration         |
|-----|------------|------------------------------------------------|-----------------------------------------------|----------------------|------------|-----------|---------------------|--------------------------|--------------------------|
| 1   | n. a.      | DC power supply, 60Vdc, 50A, 1200 W            | 6032A                                         | HP                   | 2818A03450 | 300001040 | vKI!                | 12.12.2017<br>09.12.2020 | 11.12.2020<br>08.12.2023 |
| 2   | n. a.      | Active Loop Antenna 9 kHz to 30 MHz            | 6502                                          | EMCO                 | 2210       | 300001015 | vKI!                | 13.06.2019               | 12.06.2021               |
| 3   | n. a.      | Anechoic chamber                               | FAC 3/5m                                      | MWB / TDK            | 87400/02   | 300000996 | ev                  | -/-                      | -/-                      |
| 4   | n. a.      | Double-Ridged Waveguide Horn Antenna 1-18.0GHz | 3115                                          | EMCO                 | 9107-3697  | 300001605 | vKI!                | 27.12.2019               | 26.02.2021               |
| 5   | n. a.      | Switch / Control Unit                          | 3488A                                         | HP                   | *          | 300000199 | ne                  | -/-                      | -/-                      |
| 6   | n. a.      | Variable isolating transformer                 | MPL IEC625 Bus Variable isolating transformer | Erfi                 | 91350      | 300001155 | ne                  | -/-                      | -/-                      |
| 7   | n. a.      | EMI Test Receiver 20Hz- 26,5GHz                | ESU26                                         | R&S                  | 100037     | 300003555 | k                   | 11.12.2019<br>11.12.2020 | 10.12.2020<br>10.12.2021 |
| 8   | n. a.      | Highpass Filter                                | WHKX7.0/18G-8SS                               | Wainwright           | 19         | 300003790 | ne                  | -/-                      | -/-                      |
| 9   | n. a.      | Broadband Amplifier 0.5-18 GHz                 | CBLU5184540                                   | CERNEX               | 22049      | 300004481 | ev                  | -/-                      | -/-                      |
| 10  | n. a.      | Broadband Amplifier 5-13 GHz                   | CBLU5135235                                   | CERNEX               | 22010      | 300004491 | ev                  | -/-                      | -/-                      |
| 11  | n. a.      | 4U RF Switch Platform                          | L4491A                                        | Agilent Technologies | MY50000037 | 300004509 | ne                  | -/-                      | -/-                      |
| 12  | n. a.      | NEXIO EMV-Software                             | BAT EMC V3.16.0.49                            | EMCO                 |            | 300004682 | ne                  | -/-                      | -/-                      |
| 13  | n. a.      | PC                                             | ExOne                                         | F+W                  |            | 300004703 | ne                  | -/-                      | -/-                      |
| 14  | n. a.      | RF-Amplifier                                   | AMF-6F06001800-30-10P-R                       | NARDA-MITEQ Inc      | 2011572    | 300005241 | ev                  | -/-                      | -/-                      |

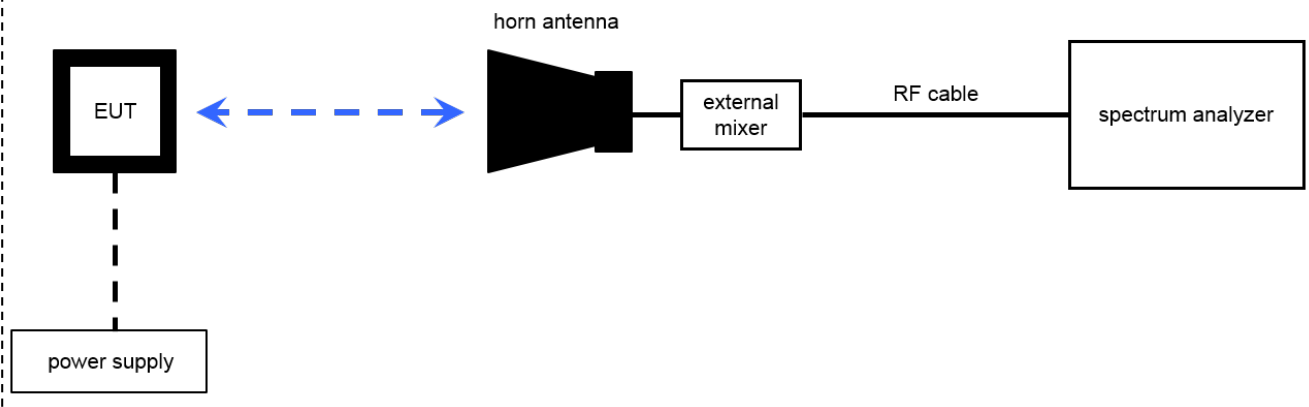
### 8.3 Radiated measurements 18 GHz to 50 GHz in test lab

#### Radiated measurements > 12.75 GHz



### 8.4 Radiated measurements > 50 GHz in test lab

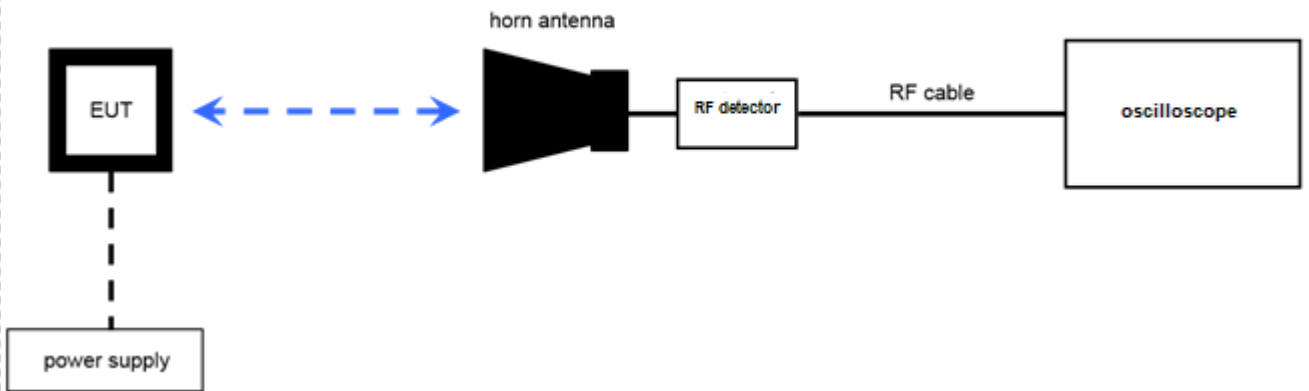
#### Radiated measurements RF laboratory



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

## 8.5 Radiated power measurements using RF detector according to ANSI C63.10-2013

### Radiated measurements RF laboratory



Note: EUT is replaced by reference source for substitution measurement

**Equipment table:**

| No. | Lab / Item | Equipment                                       | Type               | Manufacturer            | Serial No.    | INV. No.  | Kind of Calibration | Last Calibration | Next Calibration |
|-----|------------|-------------------------------------------------|--------------------|-------------------------|---------------|-----------|---------------------|------------------|------------------|
| 1   | n.a.       | Horn Antenna 18,0-40,0 GHz                      | LHAF180            | Microw.Devel            | 39180-103-021 | 300001747 | vKI!                | 18.02.2019       | 17.02.2022       |
| 2   | n. a.      | Std. Gain Horn Antenna 18.0-26.5 GHz            | 638                | Narda                   |               | 300000486 | vKI!                | 21.01.2020       | 20.01.2022       |
| 3   | n. a.      | Std. Gain Horn Antenna 26.5-40.0 GHz            | V637               | Narda                   | 82-16         | 300000510 | vKI!                | 23.01.2020       | 22.01.2022       |
| 4   | n.a.       | Std. Gain Horn Antenna 33.0-50.1 GHz            | 2324-20            | Flann                   | 57            | 400000683 | ne                  | -/-              | -/-              |
| 5   | n. a.      | Std. Gain Horn Antenna 49.9-75.8 GHz            | 2524-20            | Flann                   | *             | 300001983 | ne                  | -/-              | -/-              |
| 6   | n. a.      | Std. Gain Horn Antenna 60-90 GHz                | COR 60_90          | Thomson CSF             |               | 300000814 | ev                  | -/-              | -/-              |
| 7   | n. a.      | Std. Gain Horn Antenna 73.8-112 GHz             | 2724-20            | Flann                   | *             | 300001988 | ne                  | -/-              | -/-              |
| 8   | n.a.       | Std. Gain Horn Antenna 92.3-140 GHz             | 2824-20            | Flann                   |               | 300001993 | ne                  | -/-              | -/-              |
| 9   | n. a.      | Std. Gain Horn Antenna 114-173 GHz              | 2924-20            | Flann                   | *             | 300001999 | ne                  | -/-              | -/-              |
| 10  | n. a.      | Std. Gain Horn Antenna 145-220 GHz              | 3024-20            | Flann                   | *             | 300002000 | ne                  | -/-              | -/-              |
| 11  | n. a.      | Std. Gain Horn Antenna 217-330 GHz              | 32240-20           | Flann                   | 233278        | 300004960 | ne                  | -/-              | -/-              |
| 12  | n. a.      | Standard Gain Horn 325-500 GHz                  | 570240-20 1785-2a  | Flann                   | 273569        | 300006097 | ev                  | 25.05.2020       | 24.05.2022       |
| 13  | n. a.      | Broadband LNA 18-50 GHz                         | CBL18503070PN      | CERNEX                  | 25240         | 300004948 | ev                  | 09.03.2020       | 08.03.2022       |
| 14  | n. a.      | Harmonic Mixer 3-Port, 50-75 GHz                | FS-Z75             | Rohde & Schwarz         | 101578        | 300005788 | k                   | 17.06.2020       | 16.06.2021       |
| 15  | n. a.      | Harmonic Mixer 3-Port, 60-90 GHz                | FS-Z90             | R&S                     | 101555        | 300004691 | k                   | 08.07.2020       | 07.07.2021       |
| 16  | n. a.      | Harmonic Mixer 3-Port, 75-110 GHz               | FS-Z110            | R&S                     | 101411        | 300004959 | k                   | 19.06.2020       | 18.06.2021       |
| 17  | n.a.       | Harmonic Mixer 3-port, 90-140 GHz               | FS-Z140            | Rohde & Schwarz         | 101119        | 300005581 | k                   | 09.07.2020       | 08.07.2021       |
| 18  | n. a.      | Harmonic Mixer 3-Port, 110-170 GHz              | FS-Z170            | Radiometer Physics GmbH | 100014        | 300004156 | k                   | 28.05.2020       | 27.05.2021       |
| 19  | n. a.      | Harmonic Mixer 3-Port, 140-220 GHz              | SAM-220            | Radiometer Physics GmbH | 200001        | 300004157 | k                   | 14.07.2020       | 13.07.2021       |
| 20  | n. a.      | Harmonic Mixer 3-Port, 220-325 GHz              | SAM-325            | Radiometer Physics GmbH | 100002        | 300004158 | k                   | 23.07.2020       | 22.07.2021       |
| 21  | n.a.       | Harmonic Mixer 325-500GHz                       | FS-Z500            | Radiometer Physics GmbH | 101016        | 300006096 | k                   | 25.05.2020       | 24.05.2021       |
| 22  | n. a.      | Spectrum Analyzer 2 Hz - 85 GHz                 | FSW85              | R&S                     | 101333        | 300005568 | k                   | 17.06.2020       | 16.06.2021       |
| 23  | n. a.      | Spectrum Analyzer                               | FSW50              | Rohde & Schwarz         | 101332        | 300005935 | k                   | 26.02.2020       | 25.02.2021       |
| 24  | n.a.       | Std. Gain Horn Antenna 90-140 GHz               | COR 90_140         | Thomson CSF             |               | 300000799 | ev                  | -/-              | -/-              |
| 25  | n.a.       | F-Band Positive Amplitude Detector SG Extension | SFD-903144-08SF-P1 | Sage Millimeter Inc.    | 07354-1       | 300006119 | ev                  | -/-              | -/-              |
| 26  | n.a.       | Module 110 - 170 GHz                            | E8257DV06          | VDI                     | US53250018    | 300005540 | ev                  | -/-              | -/-              |
| 27  | n.a.       | Std. Gain Horn Antenna 114-173 GHz              | 2924-20            | Flann                   | *             | 300001999 | ne                  | -/-              | -/-              |
| 28  | n.a.       | Synthesized Sweeper 10 MHz - 40 GHz             | 83640A             | HP                      | 3119A00458    | 300002266 | vKI!                | 13.12.2019       | 12.12.2021       |
| 29  | n.a.       | 2.5 GHz Digital Phosphor Oscilloscope           | DPO7254            | Tektronix               | B022702       | 300003573 | vKI!                | 07.12.2020       | 06.12.2022       |

**9 Measurement uncertainty**

| Test case                                                          | Uncertainty                                             |
|--------------------------------------------------------------------|---------------------------------------------------------|
| Equivalent isotropically radiated power (e.i.r.p.)                 | Conducted value $\pm 1$ dB<br>Radiated value $\pm 3$ dB |
| Permitted range of operating frequencies                           | $\pm 100$ kHz                                           |
| Conducted unwanted emissions in the spurious domain (up to 18 GHz) | $\pm 1$ dB                                              |
| Radiated unwanted emissions in the spurious domain (up to 18 GHz)  | $\pm 3$ dB                                              |
| Conducted unwanted emissions in the spurious domain (18 to 40 GHz) | $\pm 4$ dB                                              |
| Radiated unwanted emissions in the spurious domain (18 to 40 GHz)  | $\pm 4$ dB                                              |
| Conducted unwanted emissions in the spurious domain (40 to 50 GHz) | $\pm 4.5$ dB                                            |
| Radiated unwanted emissions in the spurious domain (40 to 50 GHz)  | $\pm 4.5$ dB                                            |
| Conducted unwanted emissions in the spurious domain (above 50 GHz) | $\pm 5$ dB                                              |
| Radiated unwanted emissions in the spurious domain (above 50 GHz)  | $\pm 5$ dB                                              |
| DC and low frequency voltages                                      | $\pm 3$ %                                               |
| Temperature                                                        | $\pm 1$ °C                                              |
| Humidity                                                           | $\pm 3$ %                                               |

## 10 Far field consideration for measurements above 18 GHz

### Far field distance calculation:

$$D_{ff} = 2 \times D^2 / \lambda$$

with

$D_{ff}$  Far field distance  
 $D$  Antenna dimension  
 $\lambda$  wavelength

### Spurious emission measurements:

| Antenna frequency range in GHz | Highest measured frequency in GHz | D in cm | $\lambda$ in cm | $D_{ff}$ in cm |
|--------------------------------|-----------------------------------|---------|-----------------|----------------|
| 18-26                          | 26                                | 3.4     | 1.15            | 20.04          |
| 26-40                          | 40                                | 2.2     | 0.75            | 12.91          |
| 40-50                          | 50                                | 2.77    | 0.60            | 25.58          |
| 50-75                          | 75                                | 1.85    | 0.40            | 17.11          |
| 75-110                         | 110                               | 1.24    | 0.27            | 11.28          |
| 90-140                         | 140                               | 1.02    | 0.22            | 9.72           |
| 110-170                        | 170                               | 0.85    | 0.18            | 8.19           |
| 140-220                        | 220                               | 0.68    | 0.14            | 6.78           |
| 220-325                        | 325                               | 0.43    | 0.09            | 4.01           |
| 325-500                        | 500                               | 0.26    | 0.06            | 2.22           |

### In band measurement (OBW):

| Antenna frequency range in GHz | Highest measured frequency in GHz | Antenna dimension in cm | Wavelength in cm | far field distance in cm |
|--------------------------------|-----------------------------------|-------------------------|------------------|--------------------------|
| 90 - 140                       | 123.5                             | 1                       | 0.24             | 8.24                     |

## 11 Measurement results

### 11.1 Summary

|                                     |                                                                                                                          |
|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> | No deviations from the technical specifications were ascertained                                                         |
| <input type="checkbox"/>            | There were deviations from the technical specifications ascertained                                                      |
| <input type="checkbox"/>            | 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    | FCC 47 CFR Part 15<br>IC RSS-210 Issue 10<br>IC RSS-Gen Issue 5 | see below | 2021-02-11 | -/-    |

| Test specification clause                                   | Test case           | Temperature conditions | Power supply       | Pass                                | Fail                     | NA                       | NP                       | Results (max.) |
|-------------------------------------------------------------|---------------------|------------------------|--------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|----------------|
| §15.258 (d)<br>RSS-Gen Issue 5<br>RSS-210 Issue 10          | Occupied bandwidth  | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies       |
| §15.258(b) (1) / (3)<br>RSS-Gen Issue 5<br>RSS-210 Issue 10 | Maximum E.I.R.P.    | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies       |
| §15.258(c)<br>RSS-Gen Issue 5<br>RSS-210 Issue 10           | Spurious Emissions  | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies       |
| §15.258(d)<br>RSS-Gen Issue 5<br>RSS-210 Issue 10           | Frequency stability | Extreme<br>Nominal     | Extreme<br>Nominal | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies       |
| RSS-Gen Issue 5<br>RSS-210 Issue 10                         | Duty cycle          | Nominal                | Nominal            | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | complies       |

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

According to the document "DRS Authorization Letter - Baumer (2020).pdf", ISED is allowing a special authorization for the R600V radar family according to RSS-Gen Issue 5 and RSS-210 Issue 10 requirements.

## 12 Measurement results

### 12.1 Occupied bandwidth (6 dB Bandwidth)

#### Description:

Measurement of the bandwidth of the wanted signal.

#### Measurement:

| Measurement parameter |          |
|-----------------------|----------|
| Detector:             | Pos-Peak |
| Sweep time:           | 10 s     |
| Resolution bandwidth: | 100 kHz  |
| Video bandwidth:      | 300 kHz  |
| Trace-Mode:           | Max Hold |

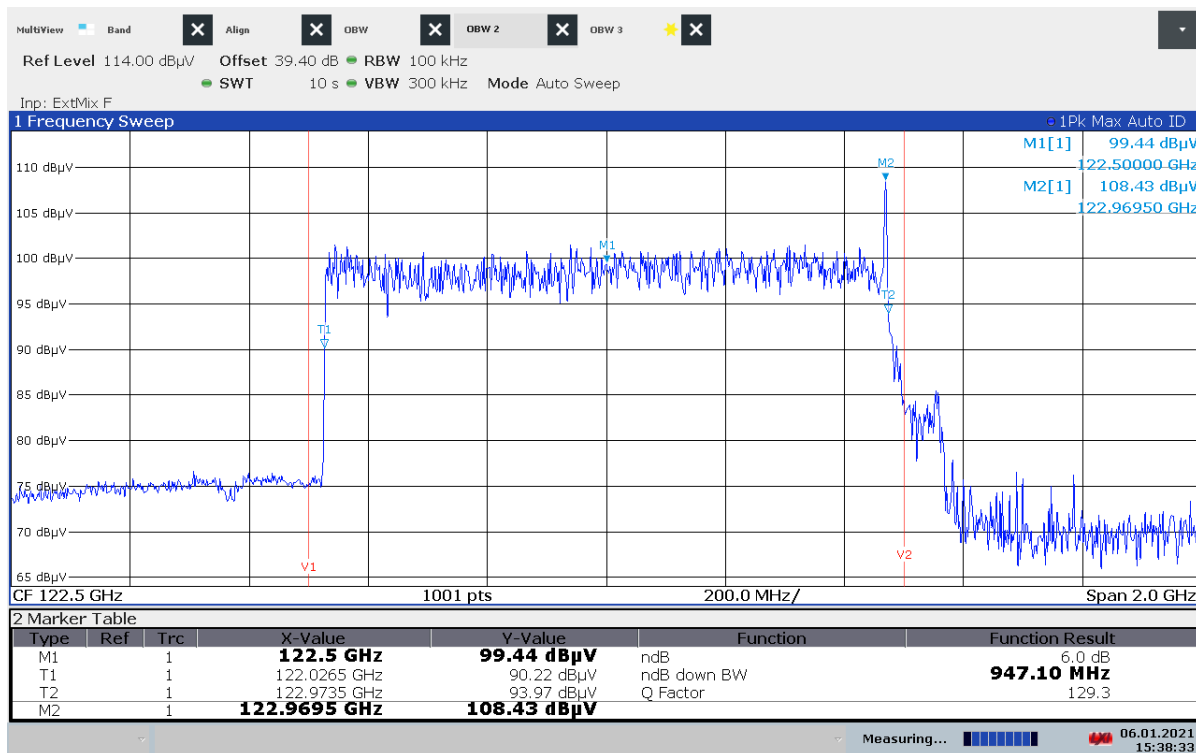
#### Limits:

| FCC                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------|
| CFR Part 15.258                                                                                                                 |
| The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following: |
| Frequency range                                                                                                                 |
| 116 GHz – 123 GHz                                                                                                               |

#### Measurement results:

| Test condition                      | F <sub>L</sub> in GHz | F <sub>H</sub> in GHz | Occupied bandwidth in MHz |
|-------------------------------------|-----------------------|-----------------------|---------------------------|
| T <sub>nom</sub> / V <sub>nom</sub> | 122.0256              | 122.9735              | 947.1                     |
| Measurement uncertainty             | ± span/1000           |                       |                           |

Plot 1: 6 dB OBW, operating frequency band



15:38:33 06.01.2021

## 12.2 Maximum E.I.R.P.

### Description:

Measurement of the maximum radiated e.i.r.p. of the wanted signal.

### Measurement:

| Measurement parameter |                        |
|-----------------------|------------------------|
| Detector:             | Pos-Peak (RF-Detector) |
| Video bandwidth:      | 10 MHz                 |
| Trace-Mode:           | Max Hold               |

### Limits:

**FCC Part 15.258 (b)**

Emission levels within the 116-123 GHz, 174.8-182 GHz, 185-190 GHz and 244-246 GHz bands shall not exceed the following equivalent isotropically radiated power (EIRP) limits as measured during the transmit interval:

The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm.

The peak power shall be measured with a detection bandwidth that encompasses the entire occupied bandwidth within the intended band of operation, e.g., 116-123 GHz, 174.8-182 GHz, 185-190 GHz or 244-246 GHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

### Measurement results:

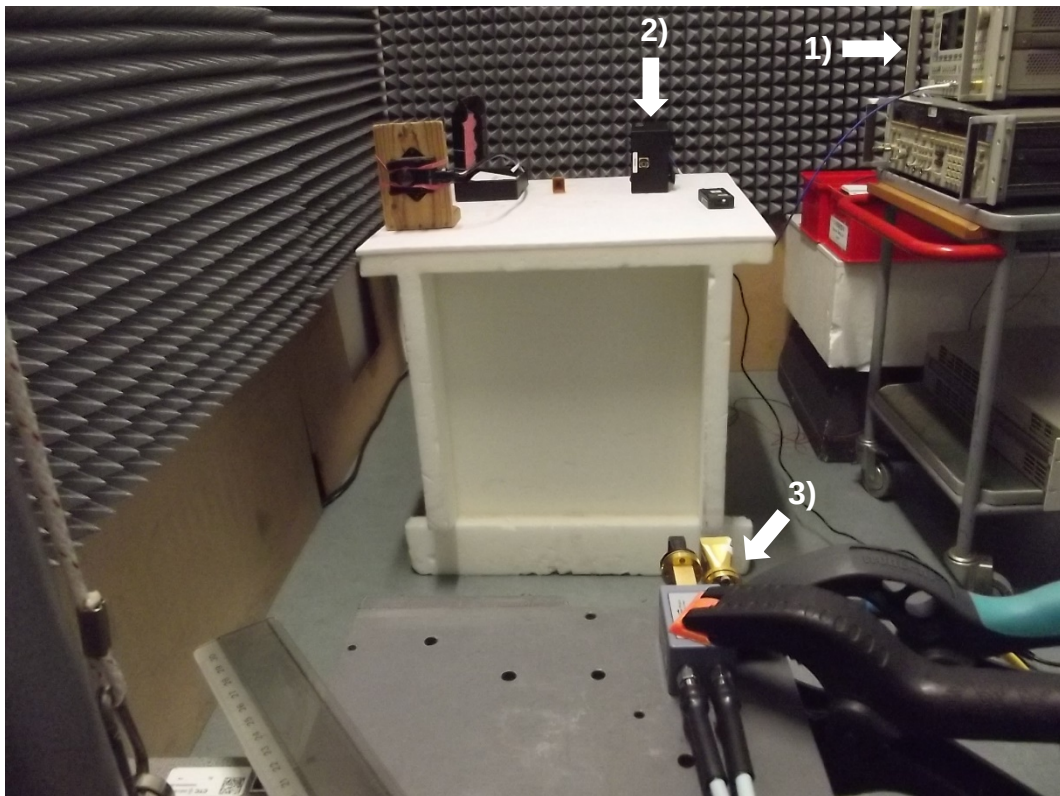
| Test condition          | Max E.I.R.P.<br>10 MHz VBW | Average E.I.R.P.<br>10 MHz VBW |
|-------------------------|----------------------------|--------------------------------|
| $T_{nom} / V_{nom}$     | 17.1 dBm                   | 13.0 dBm                       |
| Measurement uncertainty | $\pm 3$ dB                 |                                |

| Test condition      | Duty cycle |
|---------------------|------------|
| $T_{nom} / V_{nom}$ | 39.2 %     |

Description of the E.I.R.P. measurement by substitution method:

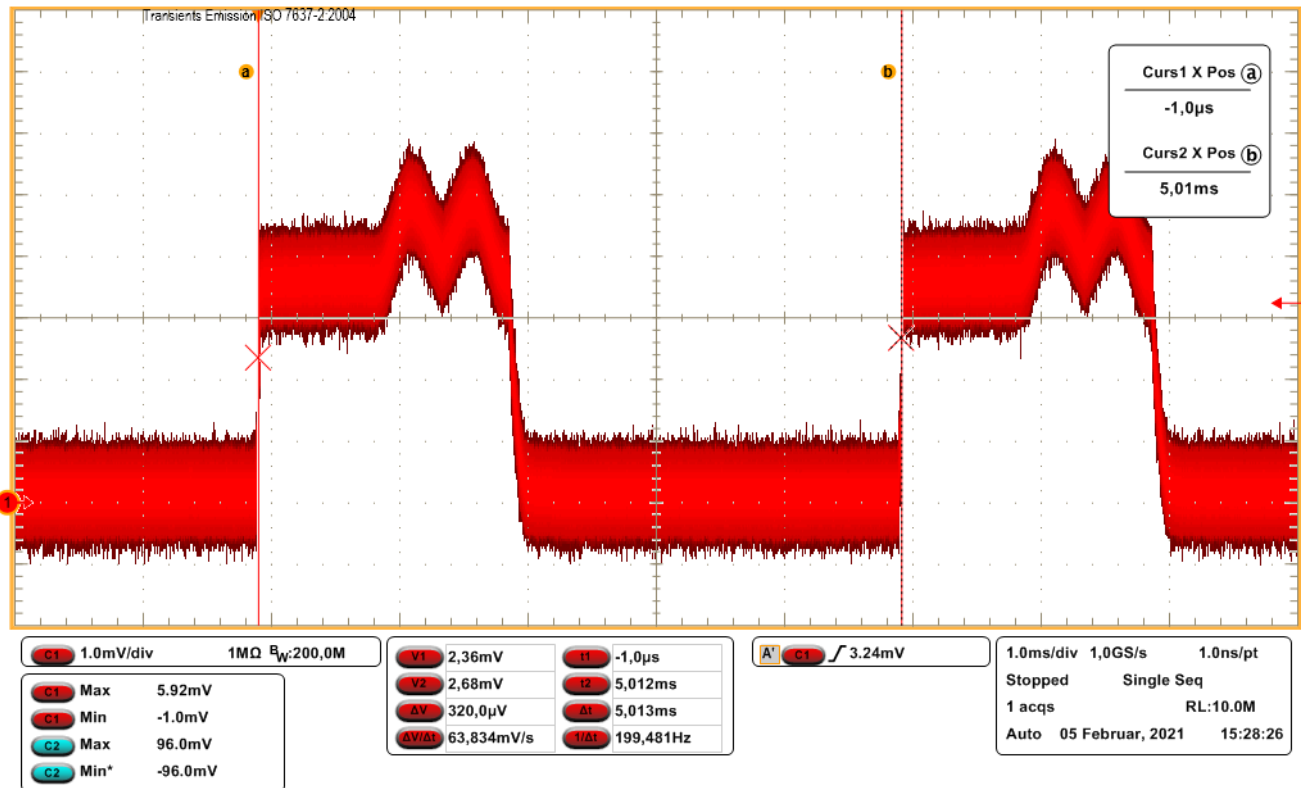
- 1) EUT emission measured with RF-detector:
  - Measurement distance:  $d = 0.26 \text{ m}$
  - Maximum readout value on oscilloscope:  $V = 2.57 \text{ mV}$
- 2) Substitution of EUT by a cw reference source with a frequency of  $f = 122.5 \text{ GHz}$  and a fixed output power of  $P_{\text{ref}} = 28.4 \text{ dBm}$ 
  - Readout value on oscilloscope adjusted by far field attenuation
- 3) Calculation of the Max E.I.R.P. of the EUT:
  - Free space loss:  $\text{FSL}(d) = 20 \times \log(4 \times \pi \times d \times f / c)$ ,  $c$ : speed of light
  - Max E.I.R.P. =  $P_{\text{ref}} - \text{FSL}(0.95 \text{ m}) + \text{FSL}(0.26 \text{ m}) = 17.1 \text{ dBm}$
- 4) Calculation of the Average E.I.R.P. of the EUT:
  - Measured duty cycle of the EUT:  $39.2 \%$
  - Average E.I.R.P. =  $\text{Max E.I.R.P.} + 10 \times \log(0.392) = 13.0 \text{ dBm}$

Setup of the substitution:

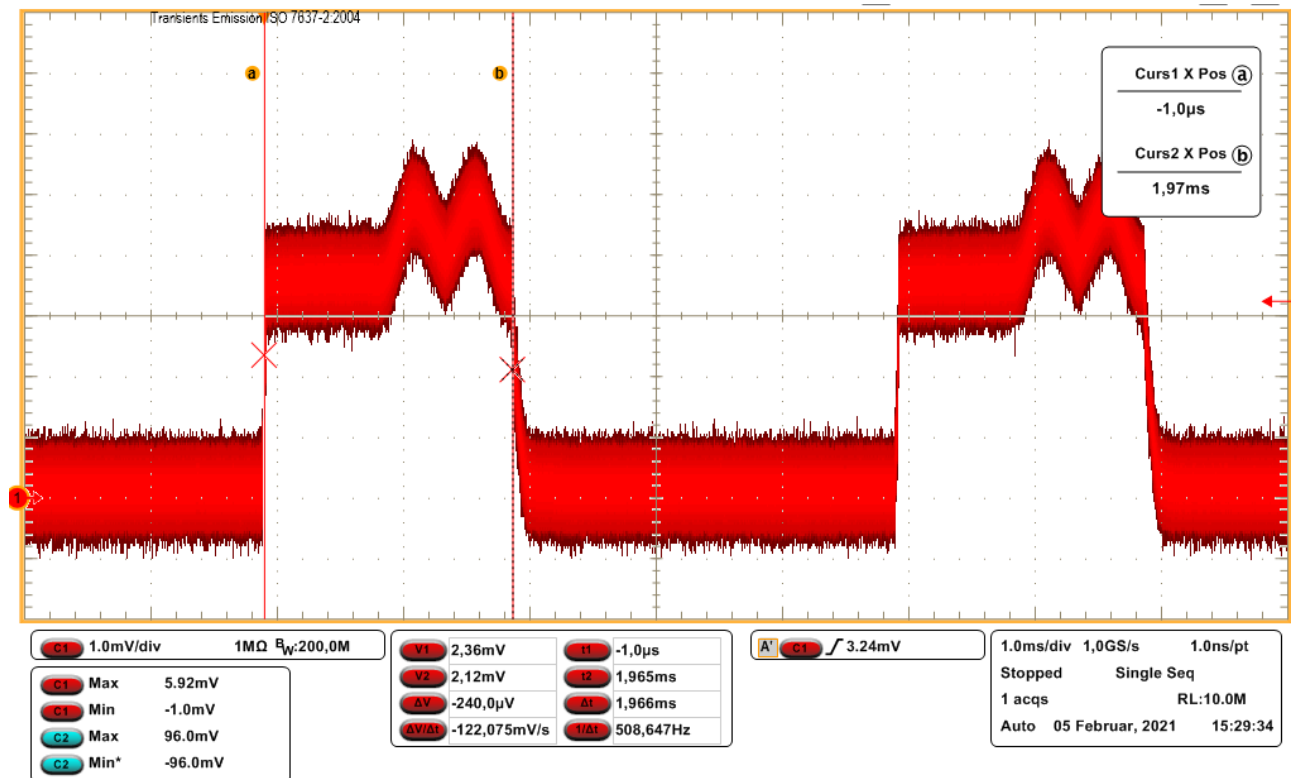


- 1) Synthesized Sweeper 10 MHz - 40 GHz
- 2) SG Extension Module 110 - 170 GHz & Std. Gain Horn Antenna 114-173 GHz
- 3) F-Band Positive Amplitude Detector & Std. Gain Horn Antenna 90-140 GHz

Plot 2: Duty cycle



Plot 3: Duty cycle



## 12.3 Spurious emissions radiated

### Description:

Measurement of the radiated spurious emissions.

### Measurement:

| Measurement parameter |                                        |
|-----------------------|----------------------------------------|
| Detector:             | Quasi Peak / Pos-Peak / RMS            |
| Sweep time:           | Auto                                   |
| Resolution bandwidth: | F < 1 GHz: 100 kHz<br>F > 1 GHz: 1 MHz |
| Video bandwidth:      | Auto                                   |
| Frequency range:      | 30 MHz to 500 GHz                      |
| Trace-Mode:           | Max Hold                               |

### Limits:

**FCC Part 15.258 / RSS-210**

(c) Spurious emissions shall be limited as follows:

- (1) The power density of any emissions outside the band of operation, e.g., 116-123 GHz, 174.8-182 GHz, 185-190 GHz or 244-246 GHz, shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

| FCC / IC                               |                                   |                               |
|----------------------------------------|-----------------------------------|-------------------------------|
| CFR Part 15.209(a) / RSS-210 / RSS-Gen |                                   |                               |
| Radiated emission limits               |                                   |                               |
| Frequency (MHz)                        | Field strength (microvolts/meter) | Measurement distance (meters) |
| 0.009 – 0.490                          | 2400/F(kHz)                       | 300                           |
| 0.490 – 1.705                          | 24000/F(kHz)                      | 30                            |
| 1.705 – 30.0                           | 30                                | 30                            |
| 30 – 88                                | 100                               | 3                             |
| 88 – 216                               | 150                               | 3                             |
| 216 – 960                              | 200                               | 3                             |
| Above 960                              | 500                               | 3                             |

- (3) Between 40 GHz and the highest frequency specified in § 15.33, the level of these emissions shall not exceed 90 pW/cm<sup>2</sup> at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

**Limit conversion:**

**ANSI C63.10-2013 9.6**

Power density at the distance specified by the limit: PD [W/m<sup>2</sup>]

Equivalent isotropically radiated power: EIRP [dBm]

Distance at which the power density limit is specified: d [m]

$$\text{EIRP[dBm]} = 10 \times \log(4 \times \pi \times d^2 \times \text{PD[W/m}^2])$$

According to this formula, an emission limit of PD = 90 pW/cm<sup>2</sup> at a distance of 3 meters corresponds to EIRP = -10 dBm.

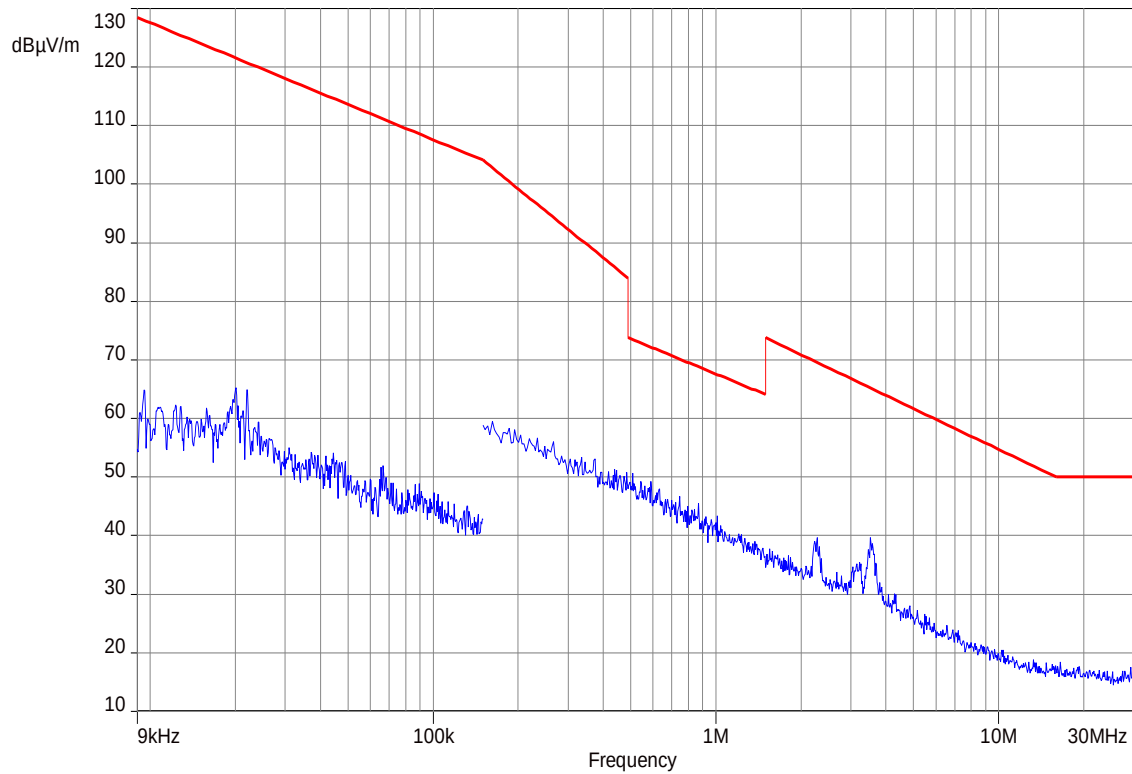
**Measurement results:**

Note:

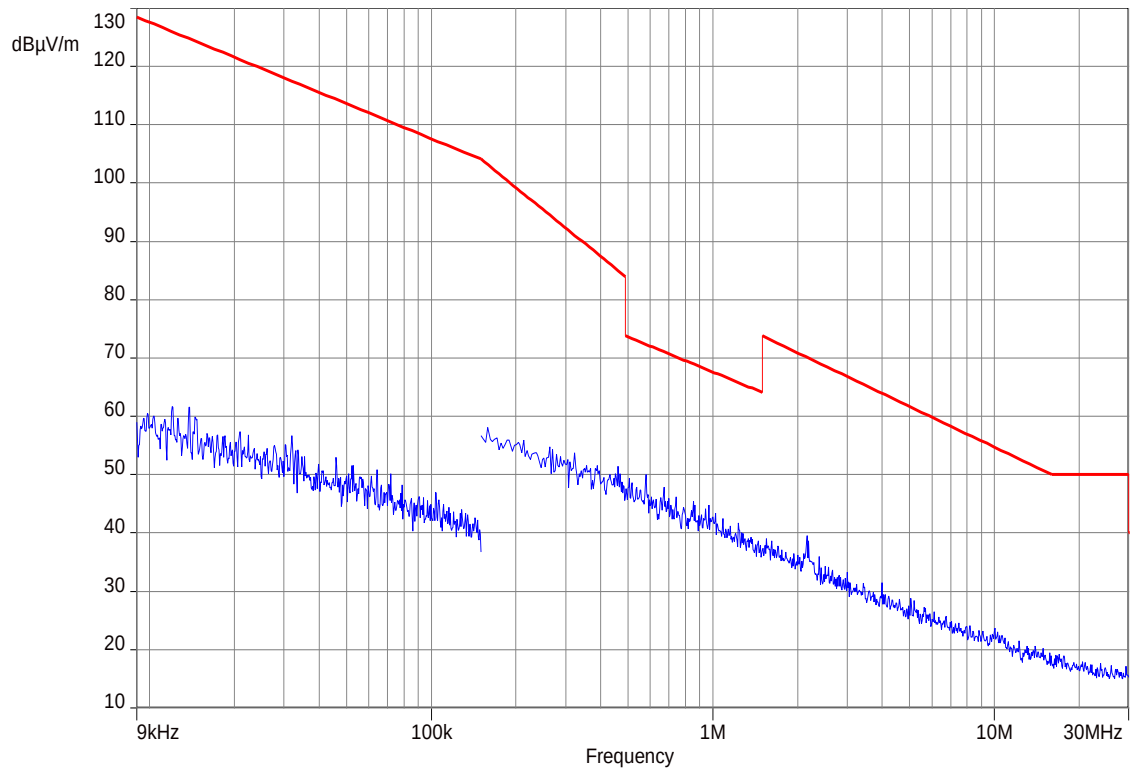
Measurements were performed in normal operation mode (frequency sweep) and in stopped mode (frequency sweep stopped at three positions within the range of operation: near top, near middle, near bottom) in accordance with §15.31(c), (m).

If the results in the cases of the stopped frequency sweep are comparable, only the results with a stop in the middle of the operating frequency range are shown below.

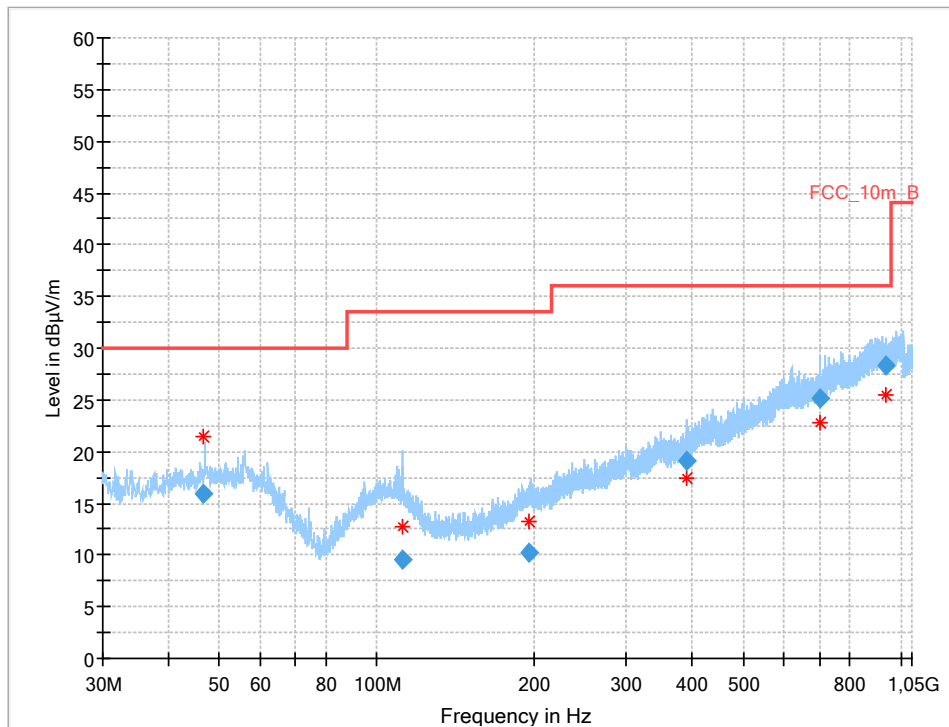
Plot 4: 9 kHz – 30 MHz, normal mode



Plot 5: 9 kHz – 30 MHz, stopped mode (sweep stopped in the middle of the range of operation)



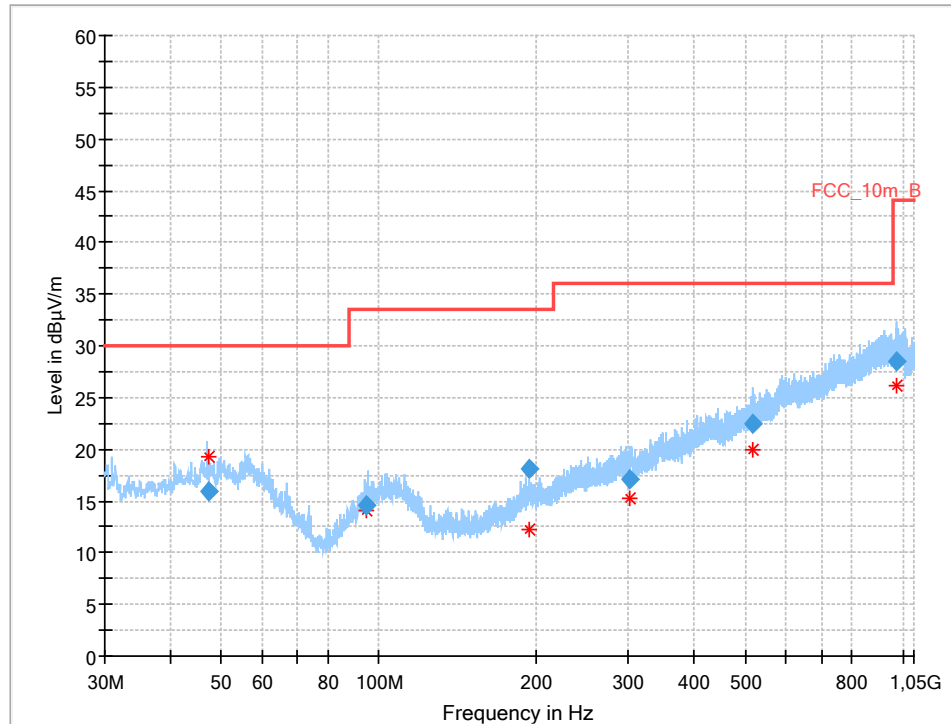
Plot 6: 30 MHz – 1 GHz, normal mode



## 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) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|
| 46.831          | 15.91              | 30.0           | 14.1        | 1000            | 120.0           | 98.0        | V   | 77            | 14           |
| 111.691         | 9.55               | 33.5           | 24.0        | 1000            | 120.0           | 160.0       | H   | 279           | 12           |
| 195.743         | 10.19              | 33.5           | 23.3        | 1000            | 120.0           | 110.0       | V   | 157           | 12           |
| 389.114         | 19.15              | 36.0           | 16.9        | 1000            | 120.0           | 170.0       | H   | -22           | 16           |
| 703.558         | 25.22              | 36.0           | 10.8        | 1000            | 120.0           | 170.0       | H   | 247           | 21           |
| 936.988         | 28.39              | 36.0           | 7.6         | 1000            | 120.0           | 170.0       | H   | 157           | 24           |

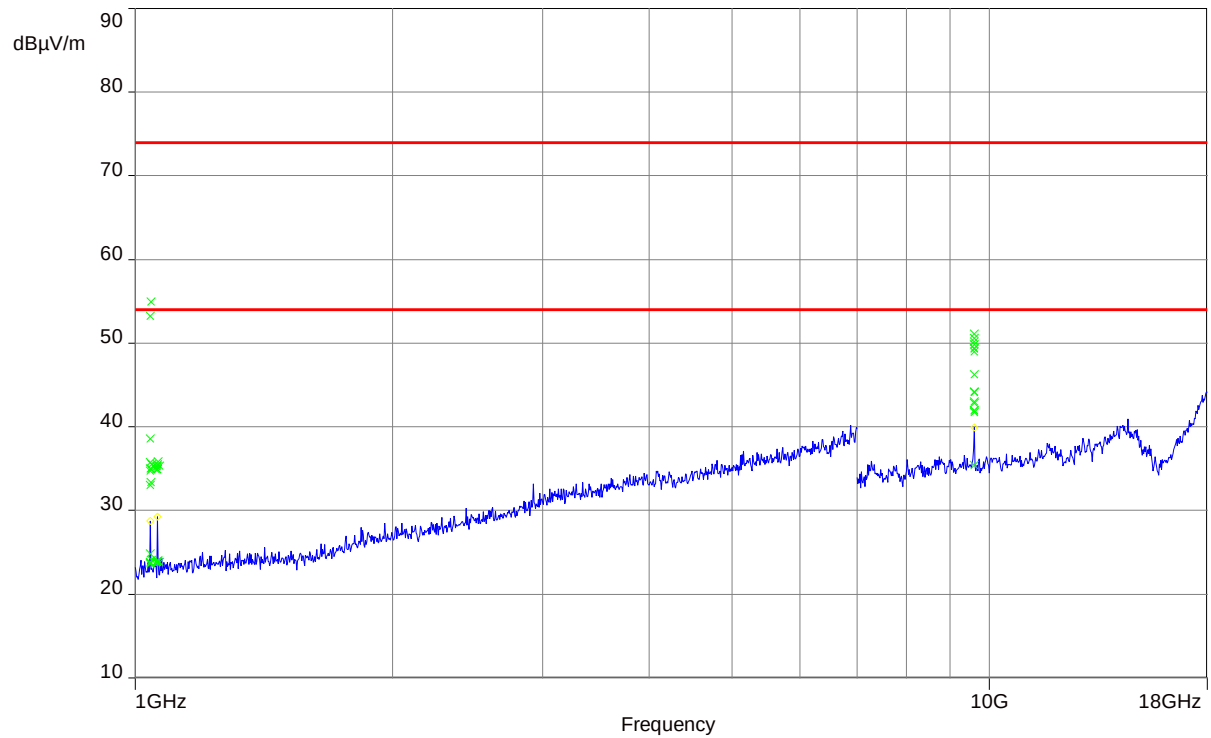
Plot 7: 30 MHz – 1 GHz, stopped mode (sweep stopped in the middle of the range of operation)



### Final\_Result

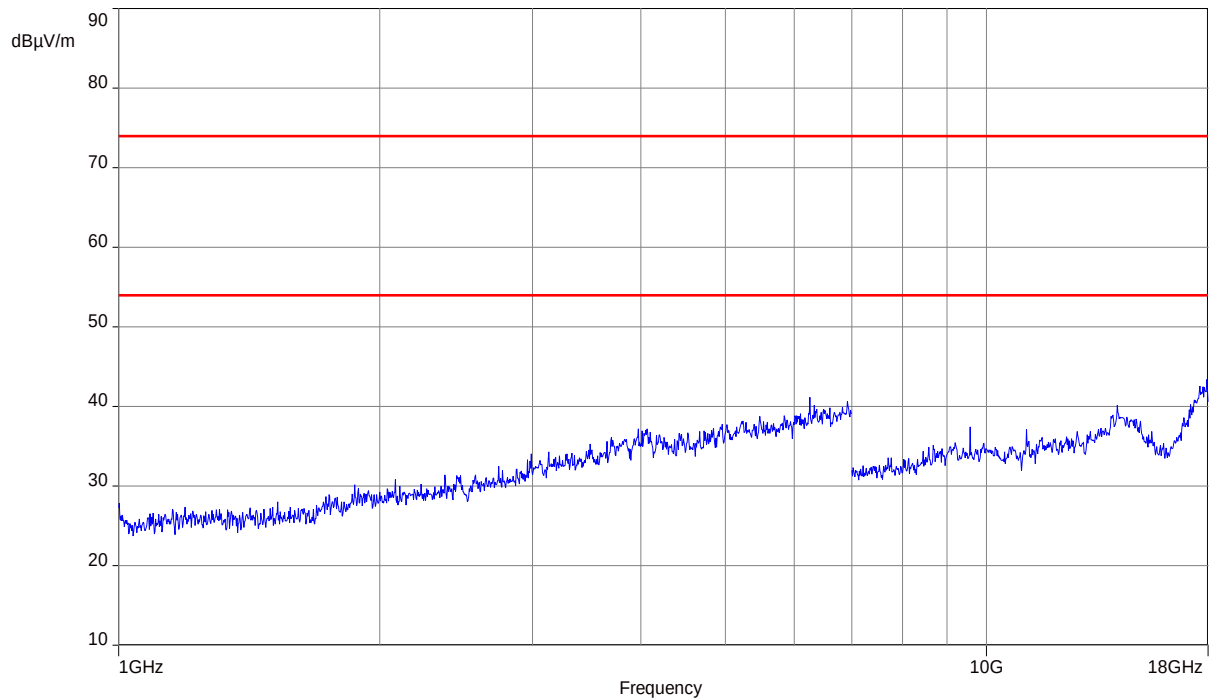
| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|
| 47.529          | 15.91              | 30.0           | 14.1        | 1000            | 120.0           | 170.0       | V   | 282           | 14           |
| 94.997          | 14.65              | 33.5           | 18.9        | 1000            | 120.0           | 142.0       | V   | 112           | 12           |
| 193.652         | 18.06              | 33.5           | 15.4        | 1000            | 120.0           | 121.0       | V   | 112           | 12           |
| 301.403         | 17.06              | 36.0           | 18.9        | 1000            | 120.0           | 131.0       | H   | 202           | 14           |
| 515.771         | 22.49              | 36.0           | 13.5        | 1000            | 120.0           | 170.0       | H   | 157           | 19           |
| 970.380         | 28.50              | 44.0           | 15.5        | 1000            | 120.0           | 159.0       | V   | 93            | 24           |

Plot 8: 1 GHz – 18 GHz, normal mode

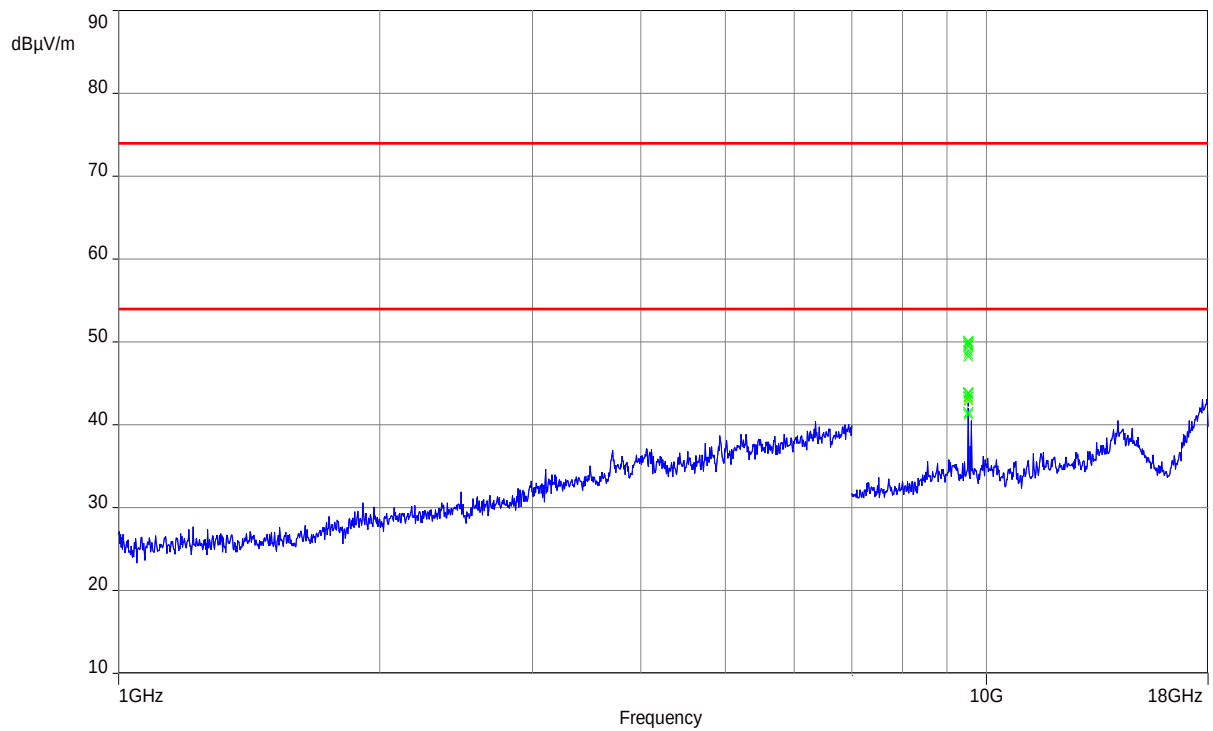


| Frequency (MHz) | Peak (dBμV/m) | Peak Limit (dBμV/m) | Margin (dB) | Average (dBμV/m) | Average Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------|---------------------|-------------|------------------|------------------------|-------------|
| 1042.361        | 54.95         | 74                  | 19.05       | 33.39            | 54                     | 20.61       |
| 1064.420        | 35.84         | 74                  | 38.16       | 23.96            | 54                     | 30.04       |
| 9607.000        | 51.13         | 74                  | 22.87       | 44.24            | 54                     | 9.76        |

Plot 9: 1 GHz – 18 GHz, stopped mode (sweep stopped in the middle of the range of operation)

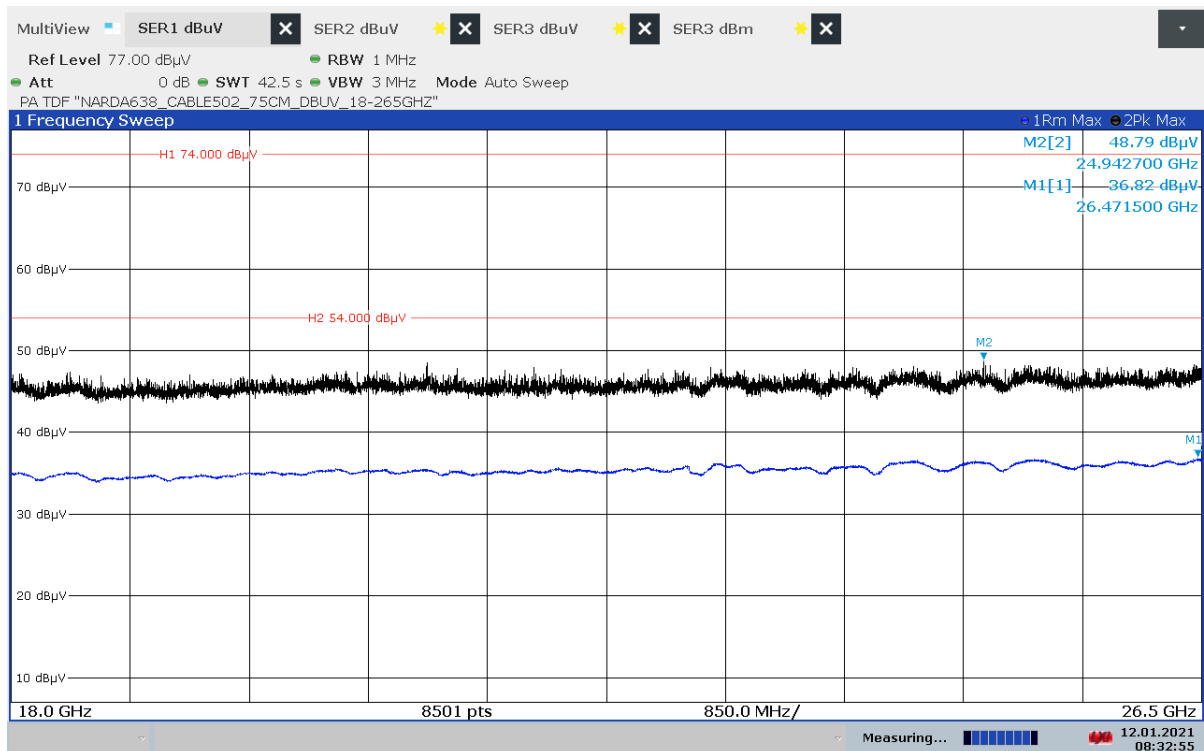


Plot 10: 1 GHz – 18 GHz, stopped mode (sweep stopped near the bottom and near the top of the range of operation)



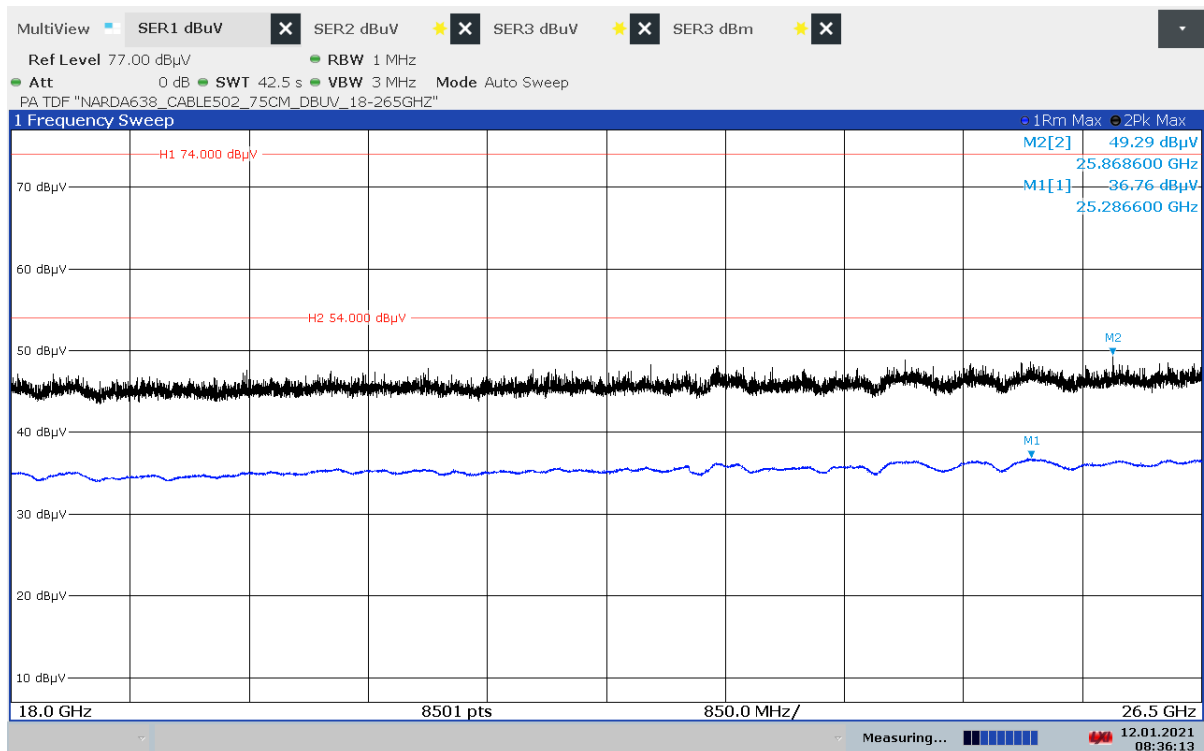
| Frequency (MHz) | Peak (dBμV/m) | Peak Limit (dBμV/m) | Margin (dB) | Average (dBμV/m) | Average Limit (dBμV/m) | Margin (dB) |
|-----------------|---------------|---------------------|-------------|------------------|------------------------|-------------|
| 9533.300        | 50.00         | 74                  | 24.00       | 43.93            | 54                     | 10.07       |
| 9533.472        | 50.07         | 74                  | 23.93       | 43.73            | 54                     | 10.27       |

Plot 11: 18 GHz – 26.5 GHz, normal mode



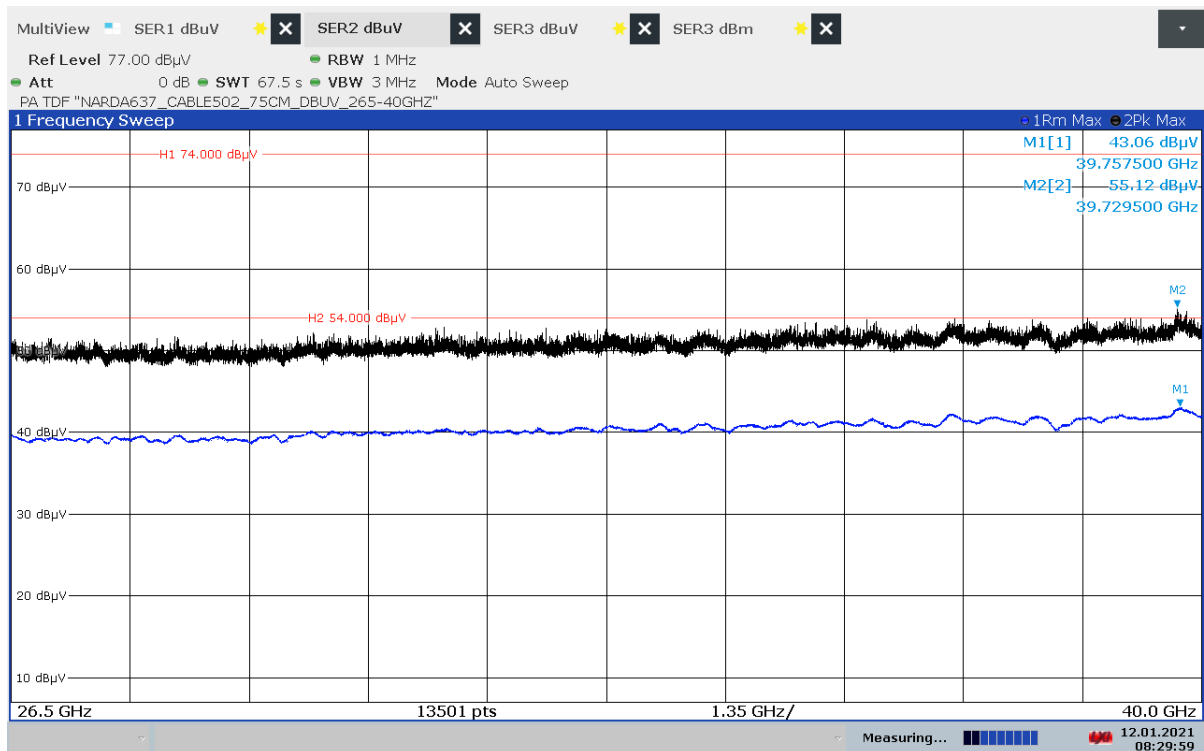
08:32:56 12.01.2021

Plot 12: 18 GHz – 26.5 GHz, stopped mode (sweep stopped in the middle of the range of operation)



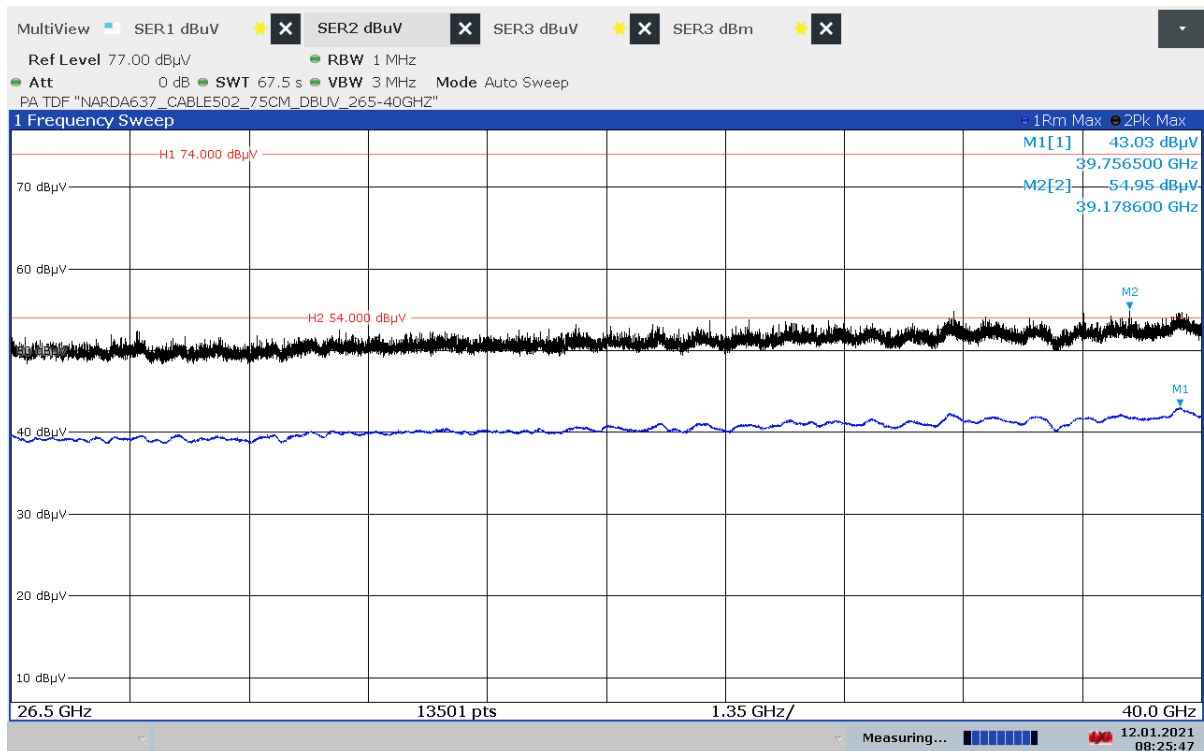
08:36:14 12.01.2021

Plot 13: 26.5 GHz – 40 GHz, normal mode



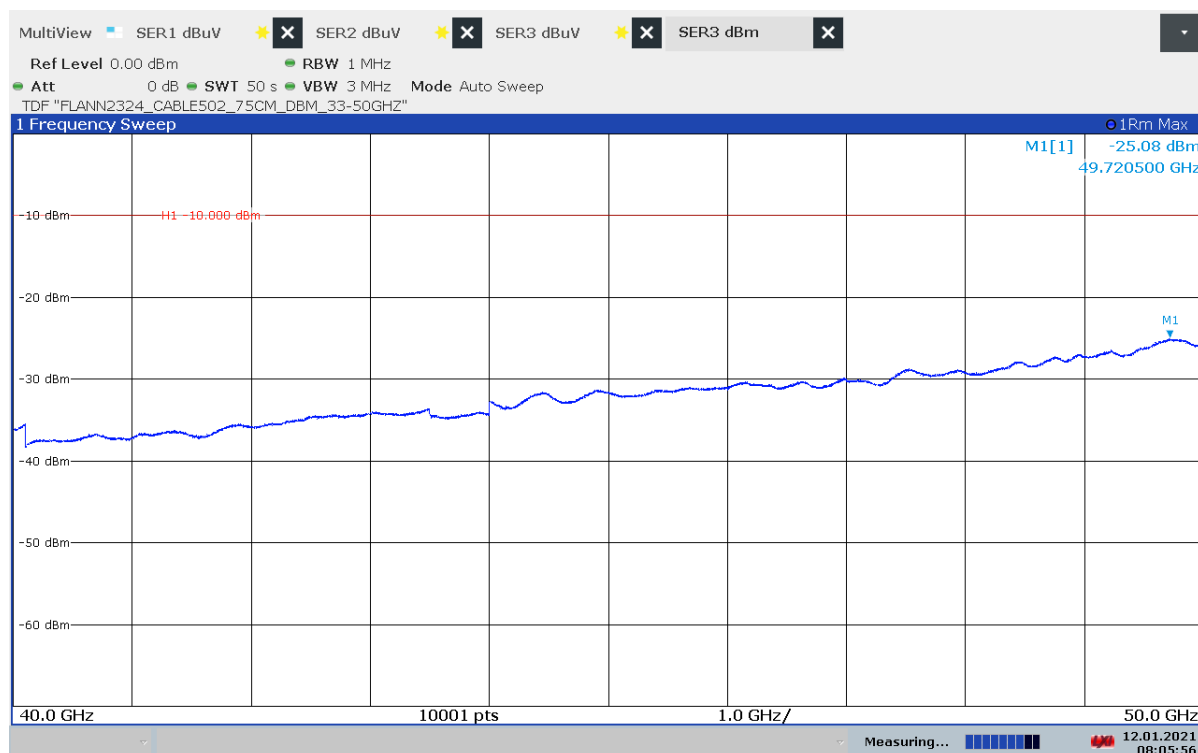
08:30:00 12.01.2021

Plot 14: 26.5 GHz – 40 GHz, stopped mode (sweep stopped in the middle of the range of operation)



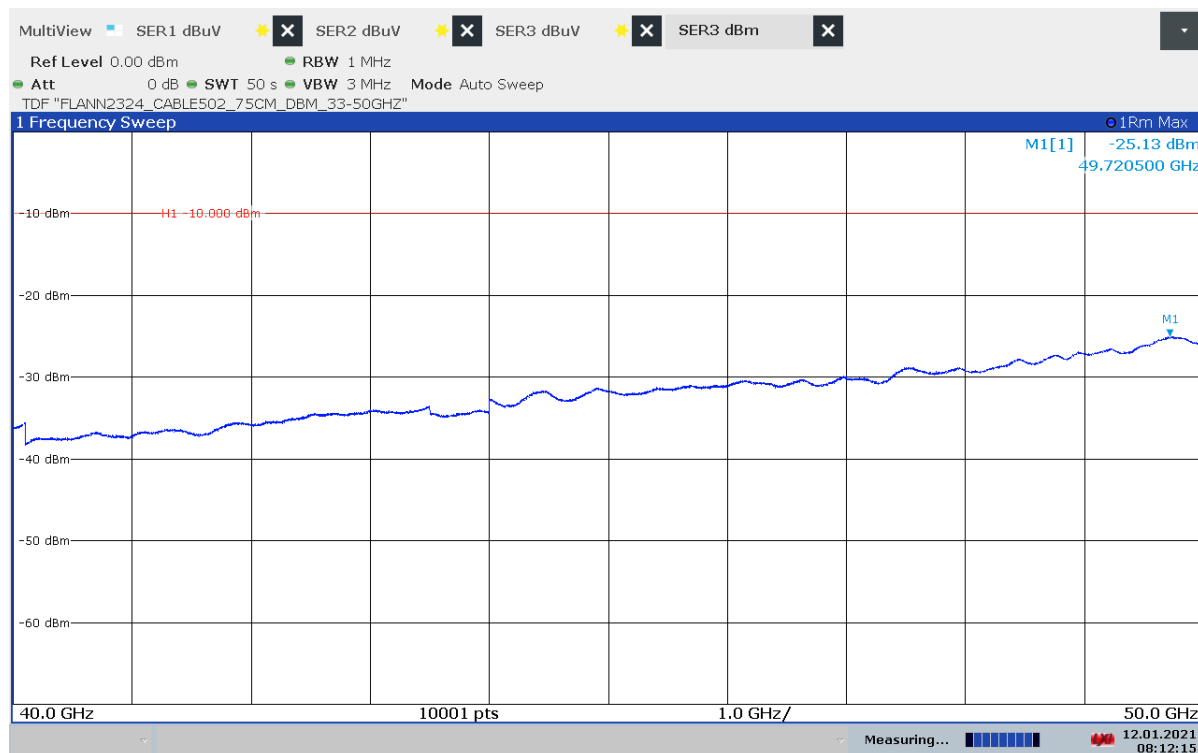
08:25:48 12.01.2021

Plot 15: 40 GHz – 50 GHz, normal mode



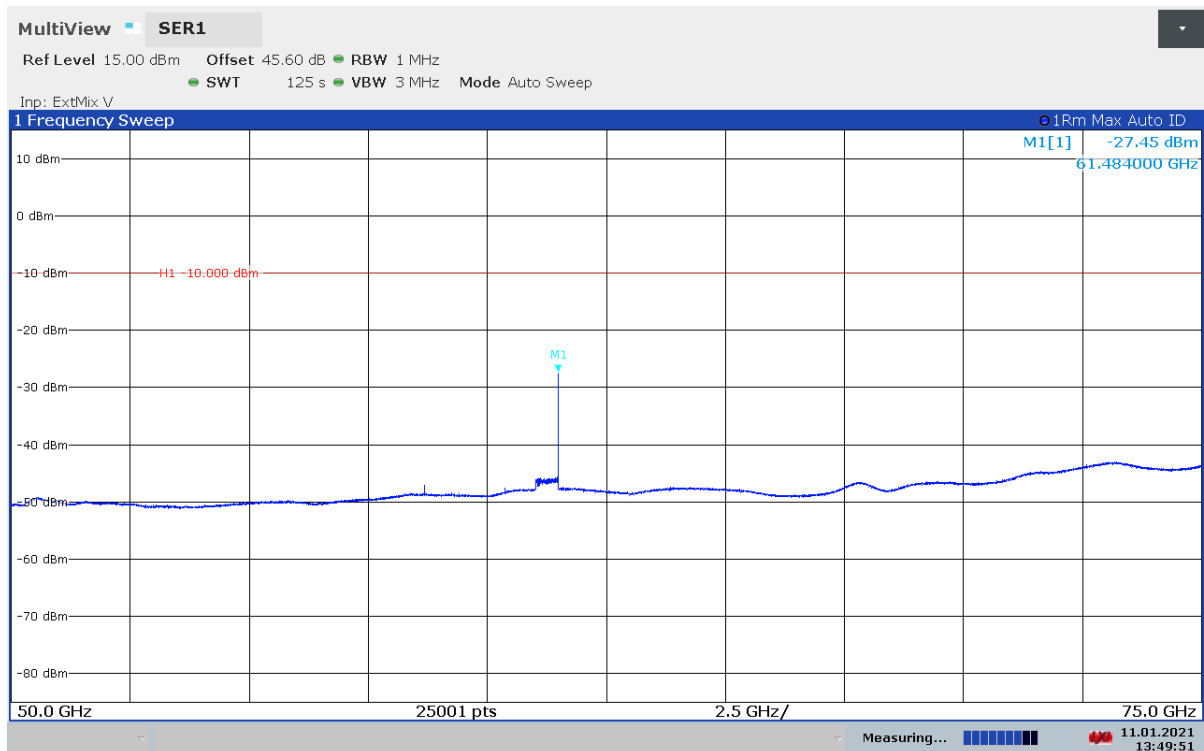
08:05:56 12.01.2021

Plot 16: 40 GHz – 50 GHz, stopped mode (sweep stopped in the middle of the range of operation)



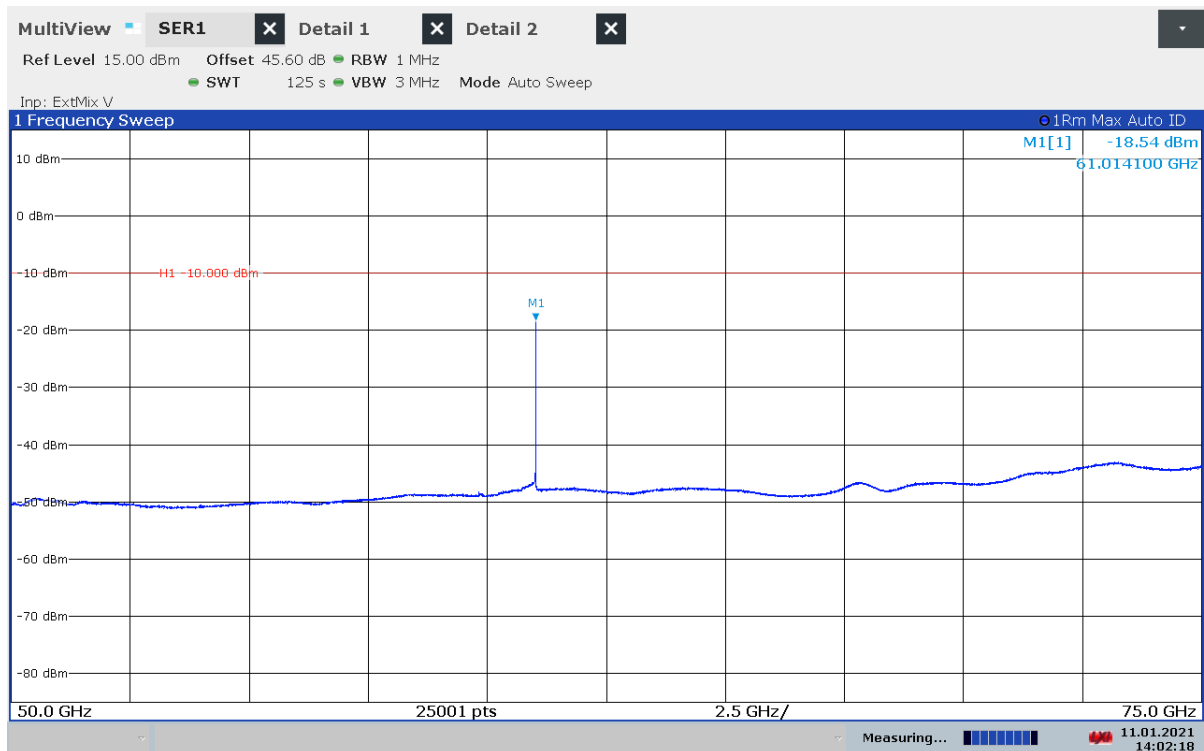
08:12:15 12.01.2021

Plot 17: 50 GHz – 75 GHz, normal mode



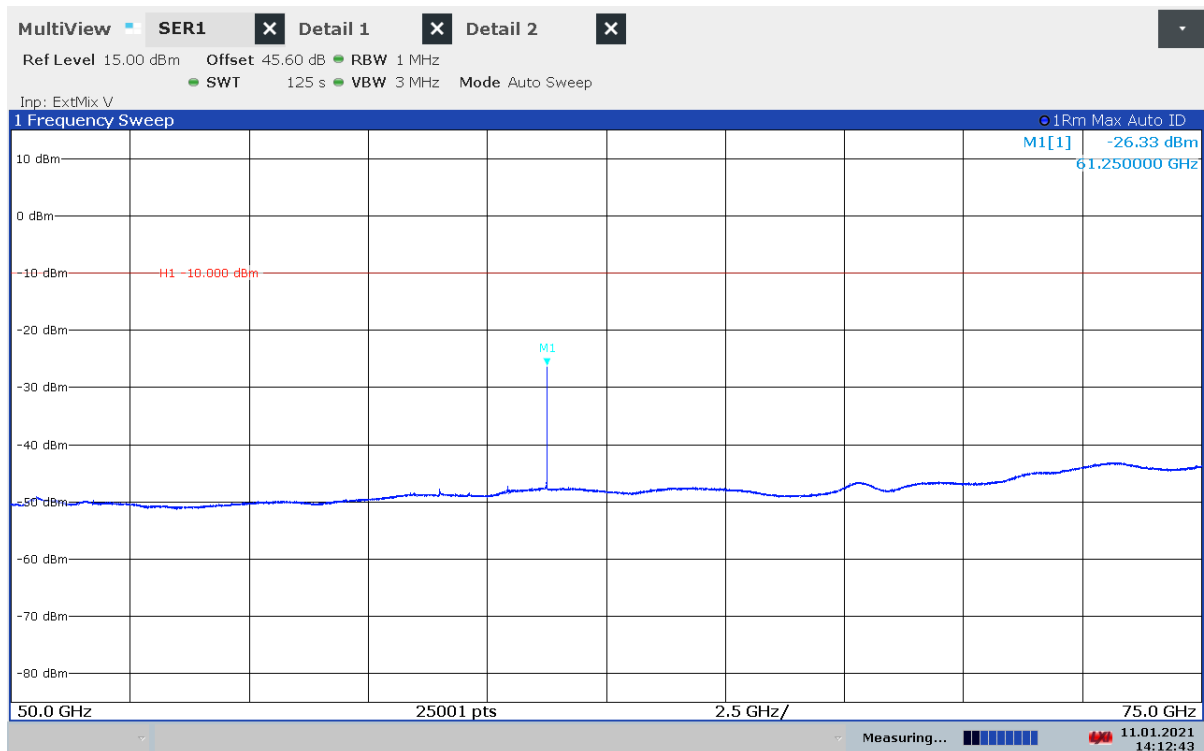
13:49:52 11.01.2021

Plot 18: 50 GHz – 75 GHz, stopped mode (sweep stopped near the bottom of the range of operation)



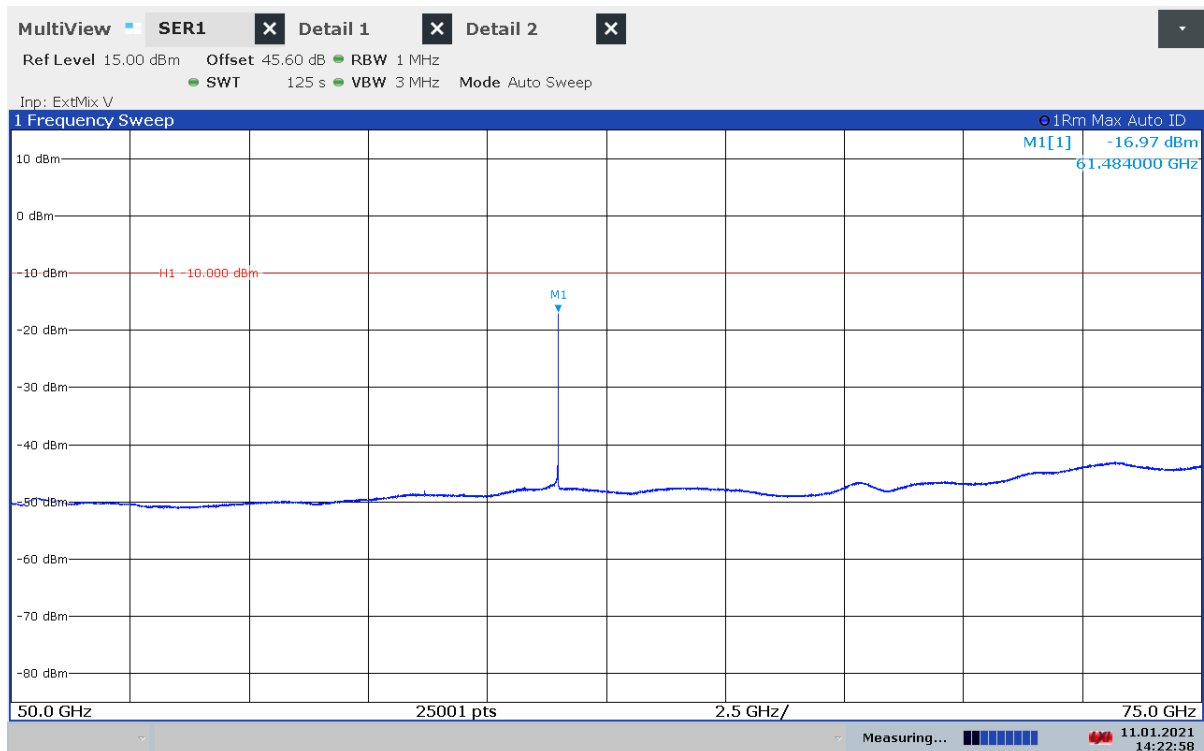
14:02:19 11.01.2021

Plot 19: 50 GHz – 75 GHz, stopped mode (sweep stopped in the middle of the range of operation)



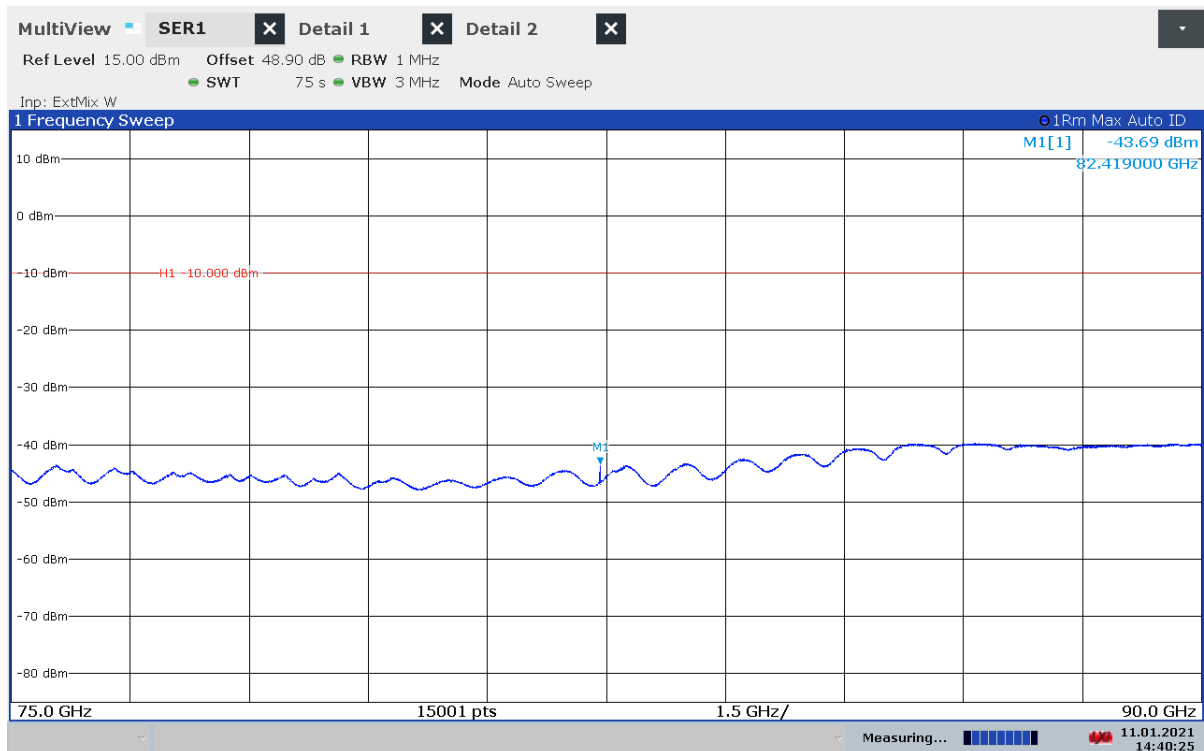
14:12:43 11.01.2021

Plot 20: 50 GHz – 75 GHz, stopped mode (sweep stopped near the top of the range of operation)



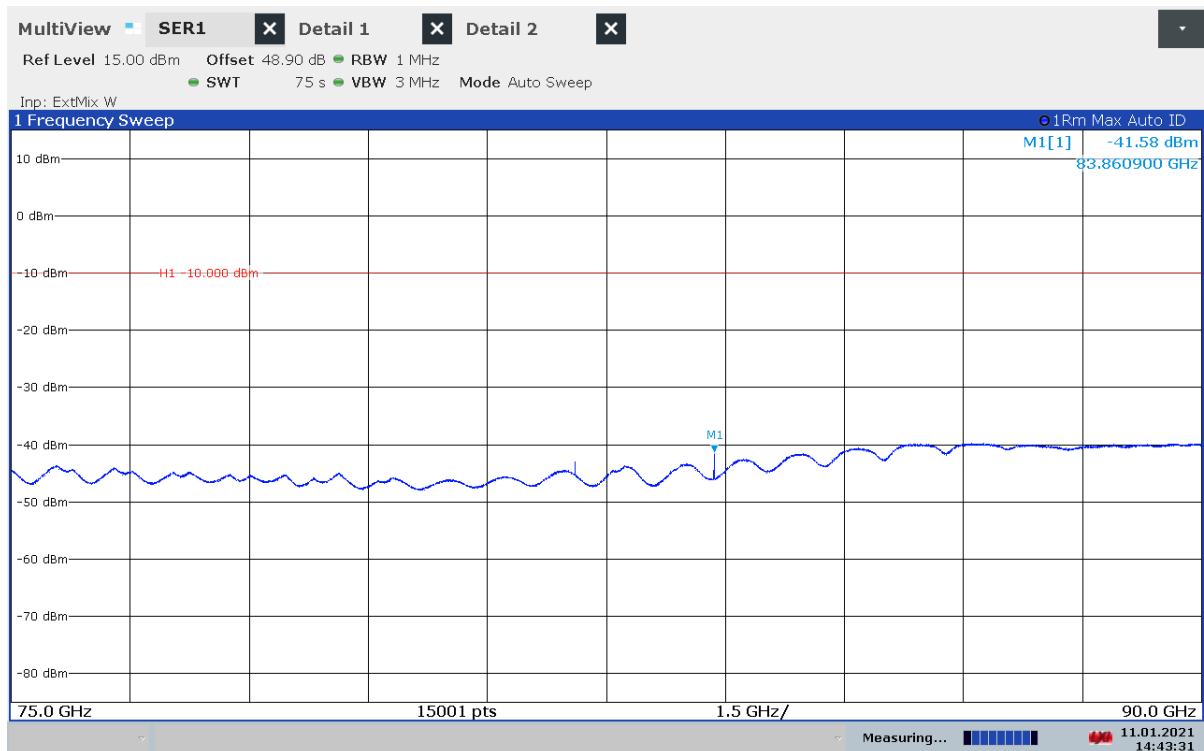
14:22:59 11.01.2021

Plot 21: 75 GHz – 90 GHz, normal mode



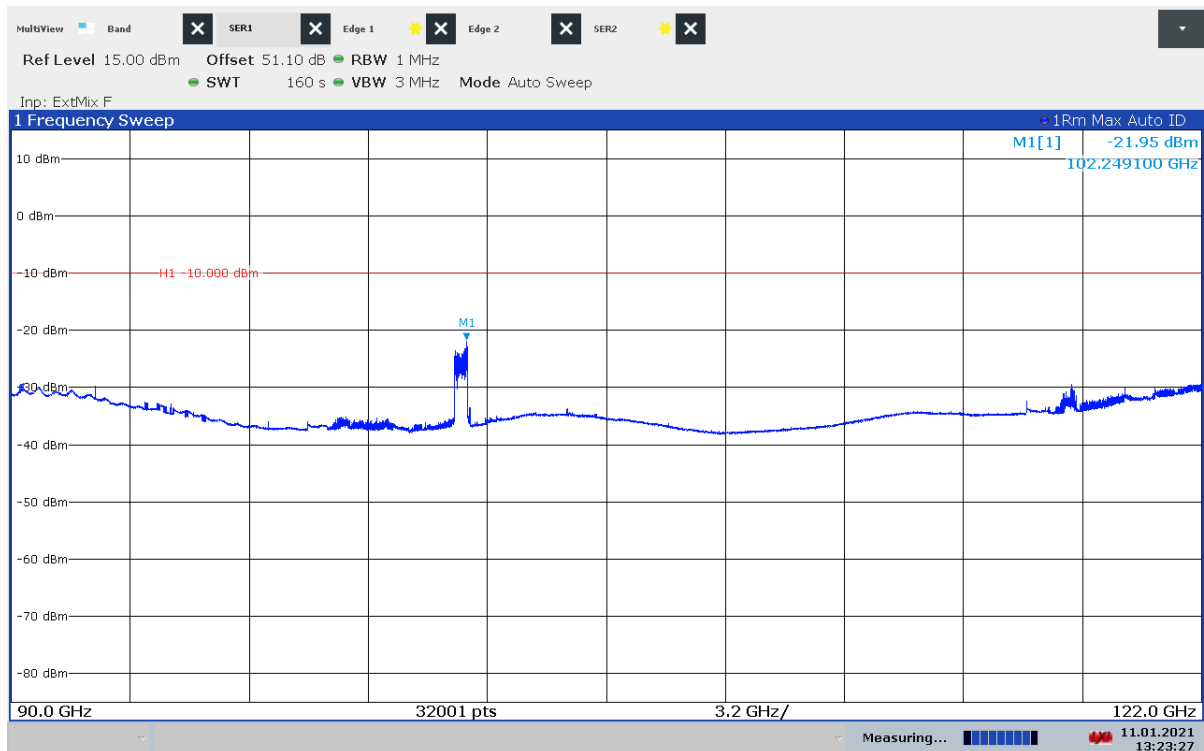
14:40:25 11.01.2021

Plot 22: 75 GHz – 90 GHz, stopped mode (sweep stopped in the middle of the range of operation)



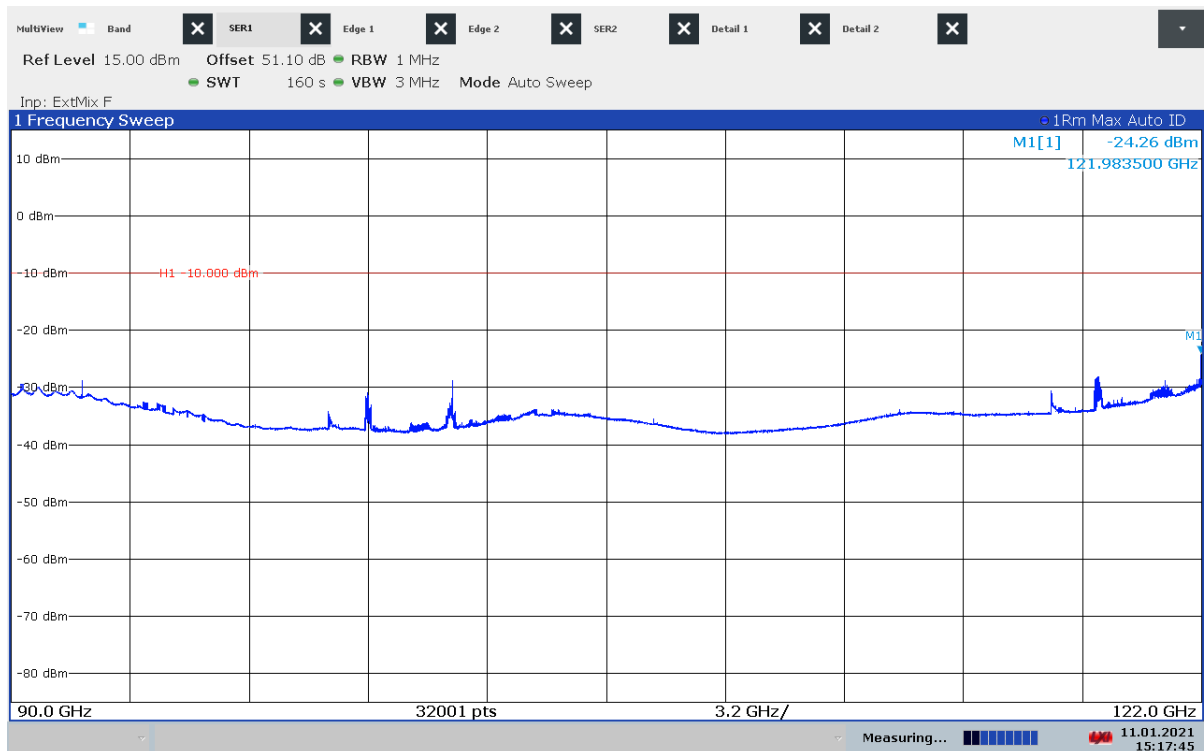
14:43:31 11.01.2021

Plot 23: 90 GHz – 122 GHz, normal mode



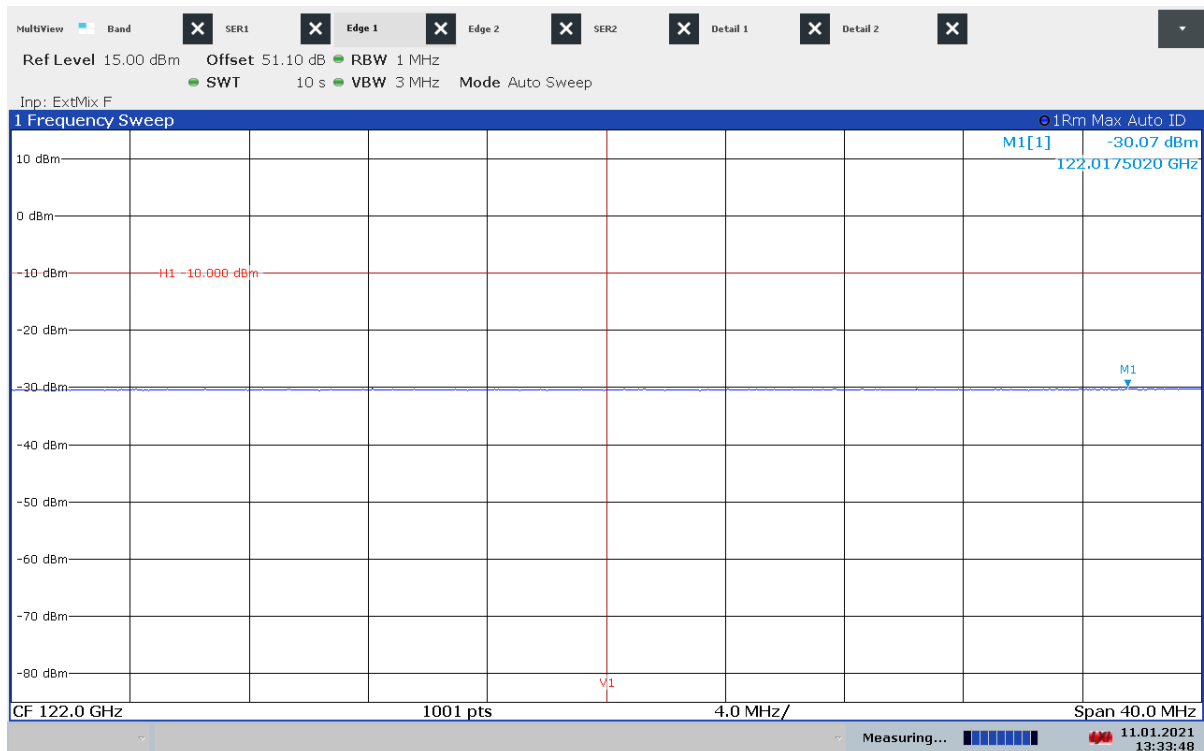
13:23:28 11.01.2021

Plot 24: 90 GHz – 122 GHz, stopped mode (sweep stopped in the middle of the range of operation)



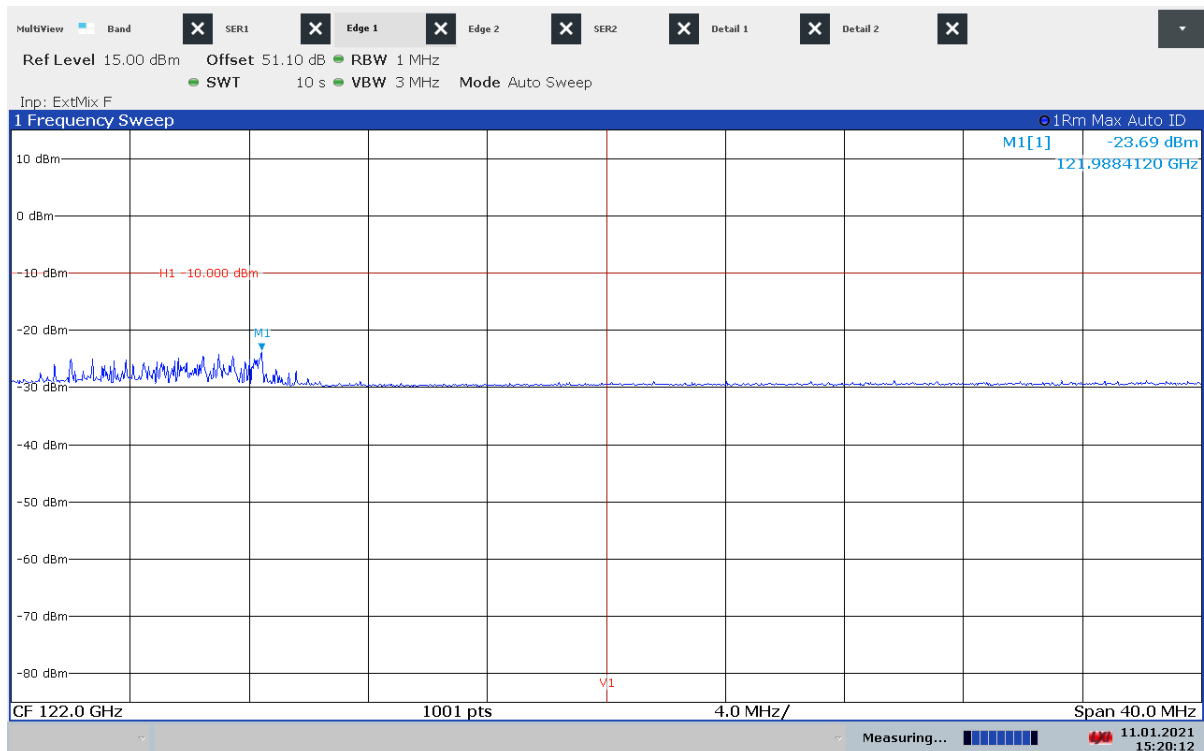
15:17:45 11.01.2021

Plot 25: lower band edge compliance, normal mode



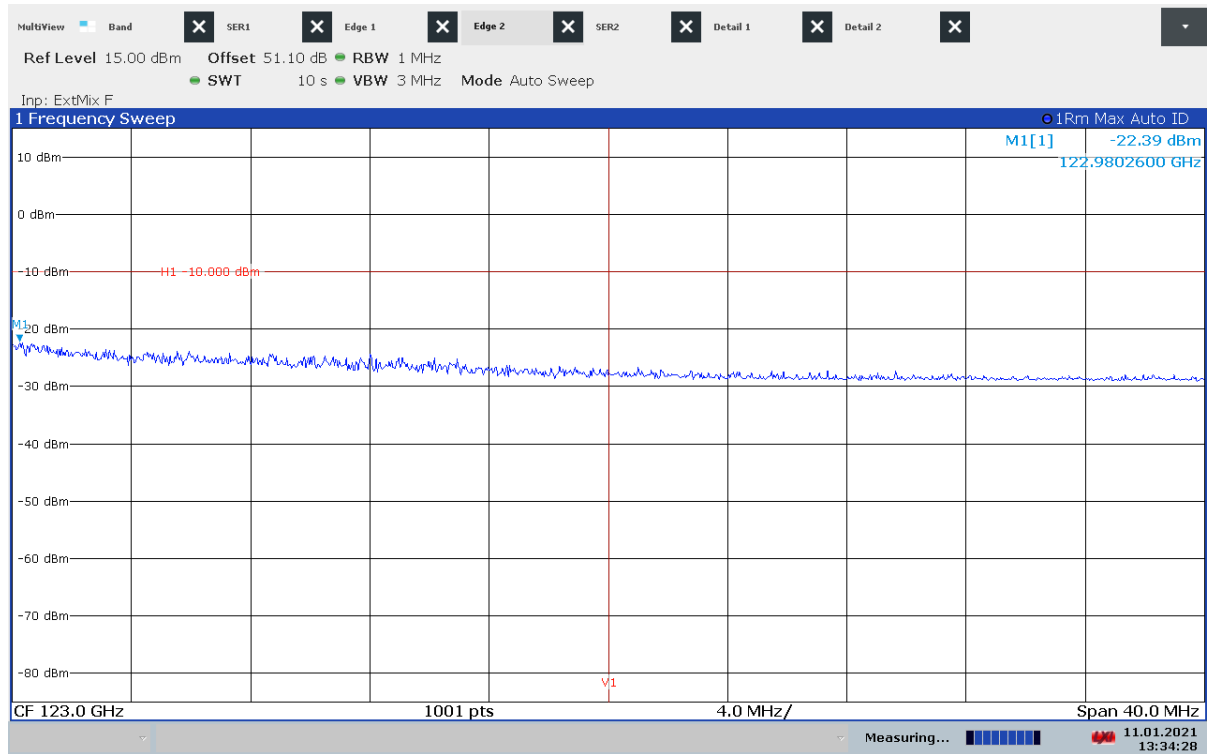
13:33:49 11.01.2021

Plot 26: lower band edge compliance, stopped mode (sweep stopped in the middle of the range of operation)



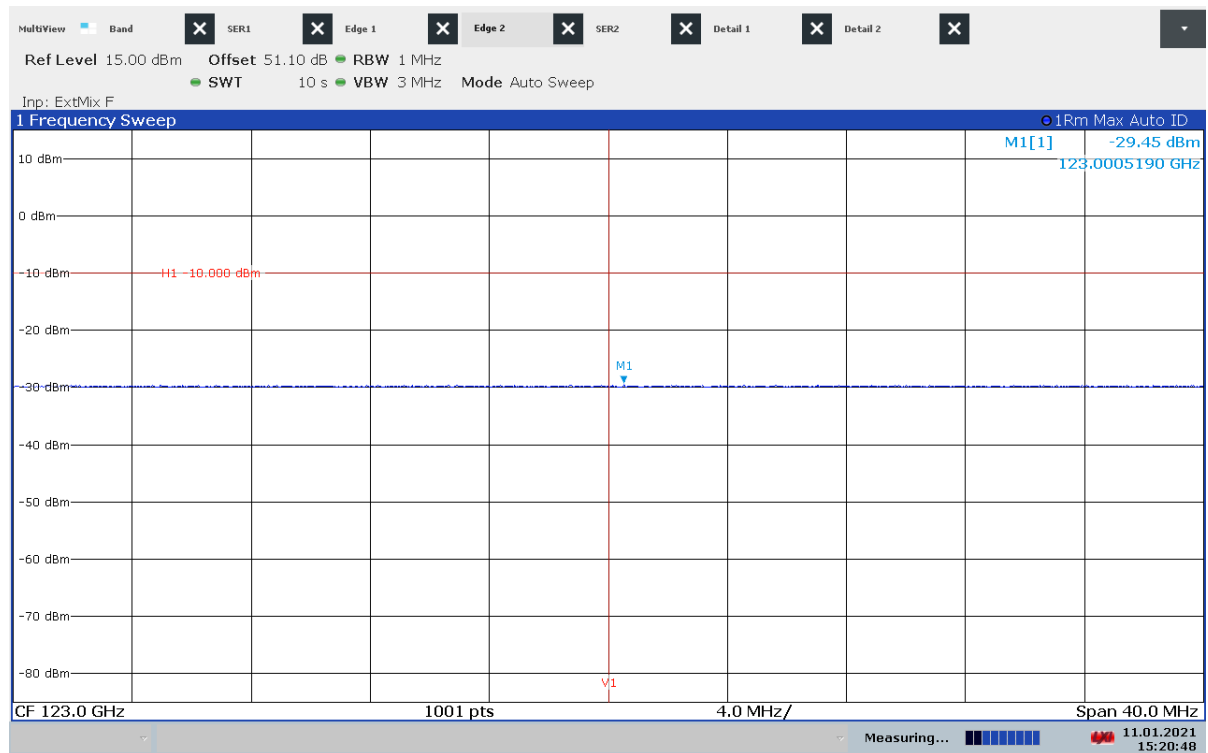
15:20:12 11.01.2021

Plot 27: upper band edge compliance, normal mode



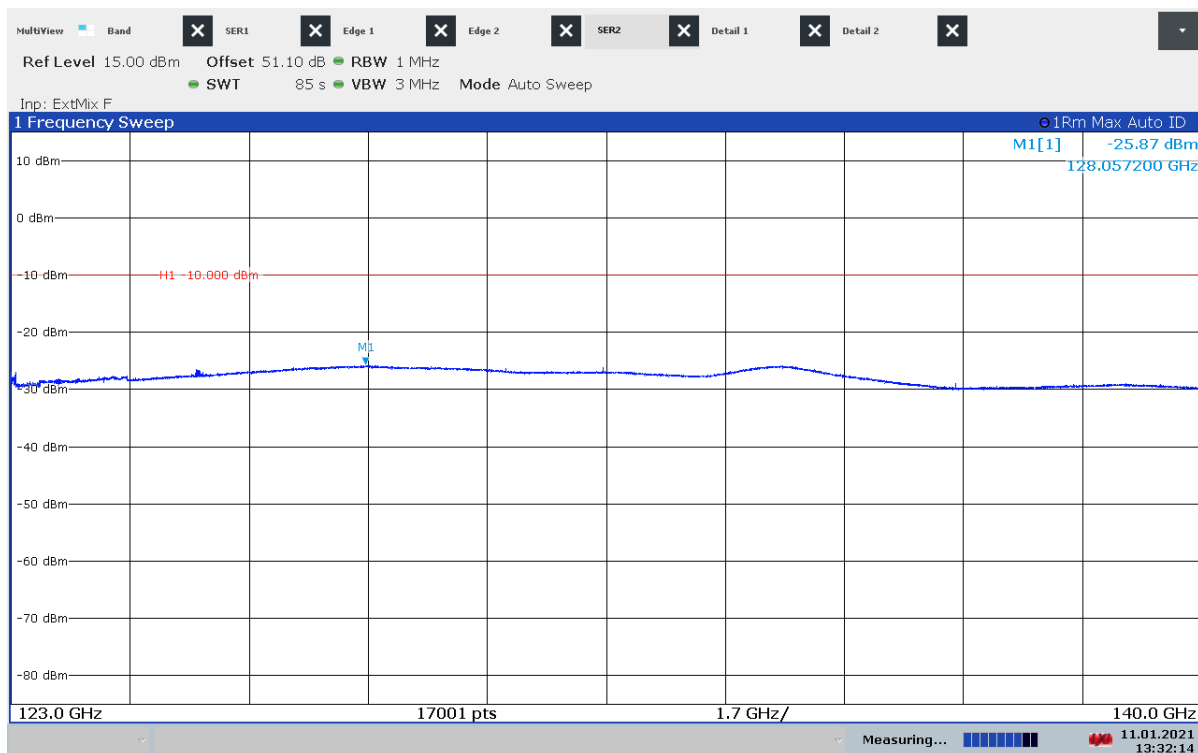
13:34:29 11.01.2021

Plot 28: upper band edge compliance, stopped mode (sweep stopped in the middle of the range of operation)



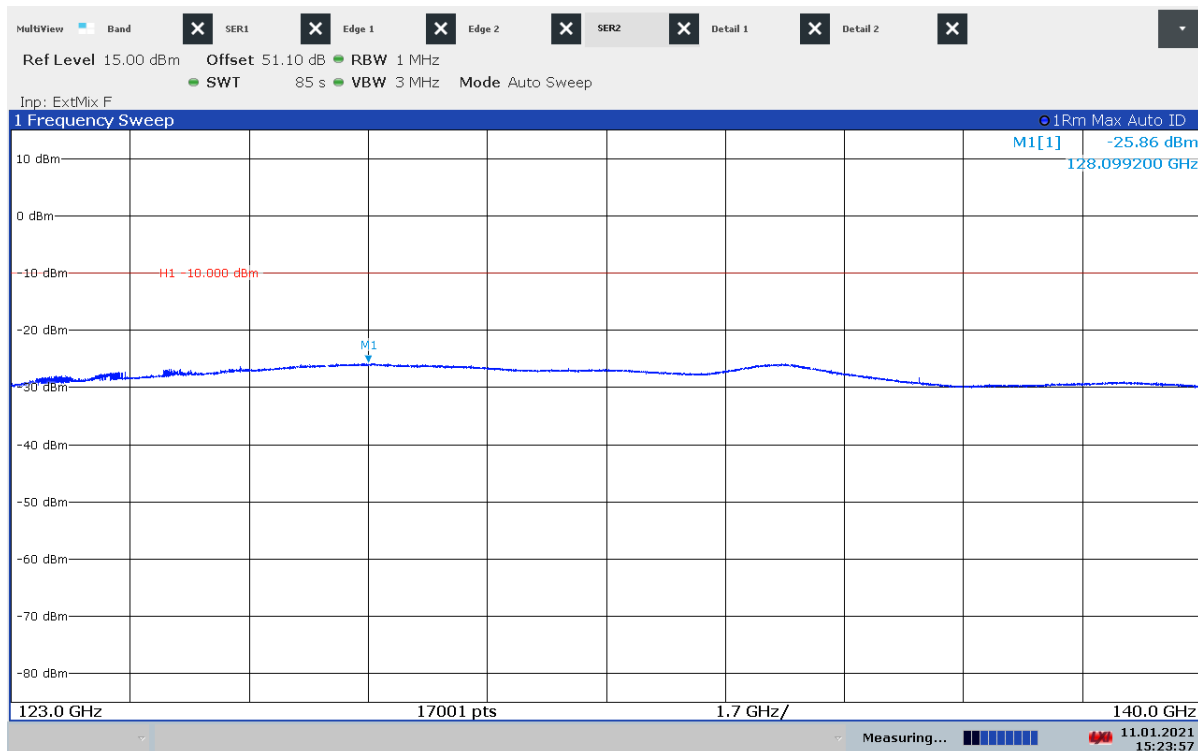
15:20:49 11.01.2021

Plot 29: 123 GHz – 140 GHz, normal mode



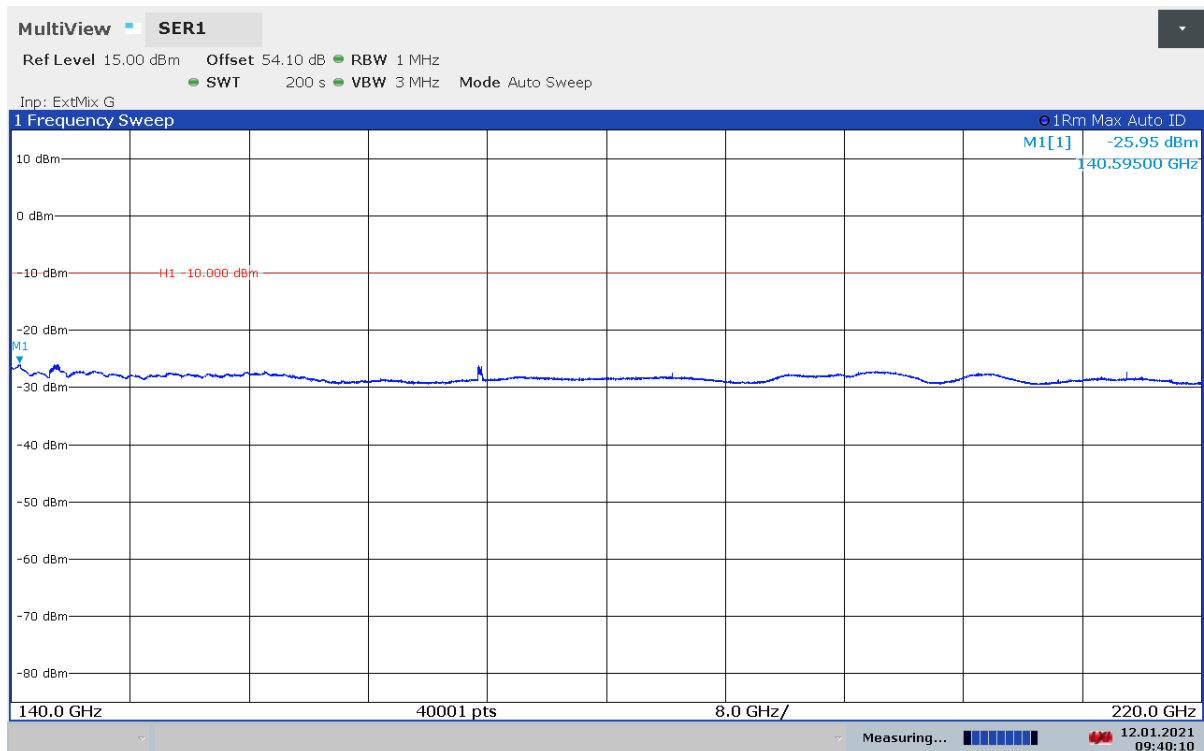
13:32:15 11.01.2021

Plot 30: 123 GHz – 140 GHz, stopped mode (sweep stopped in the middle of the range of operation)



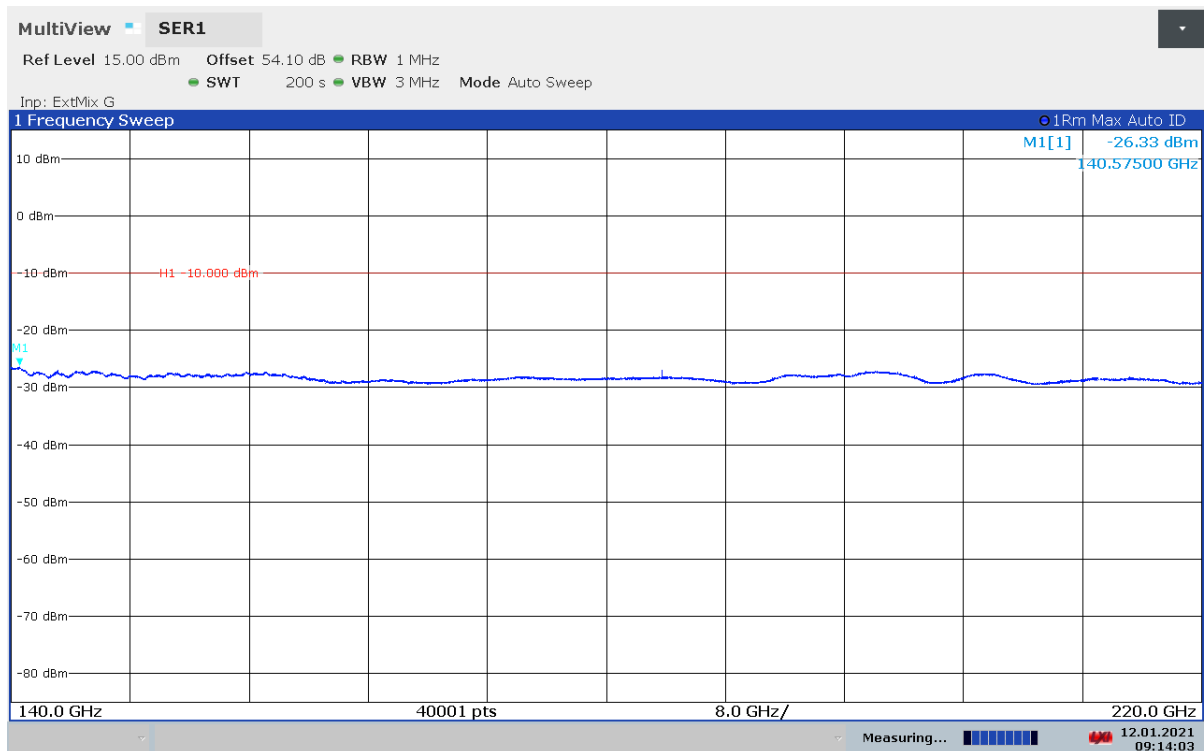
15:23:57 11.01.2021

Plot 31: 140 GHz – 220 GHz, normal mode



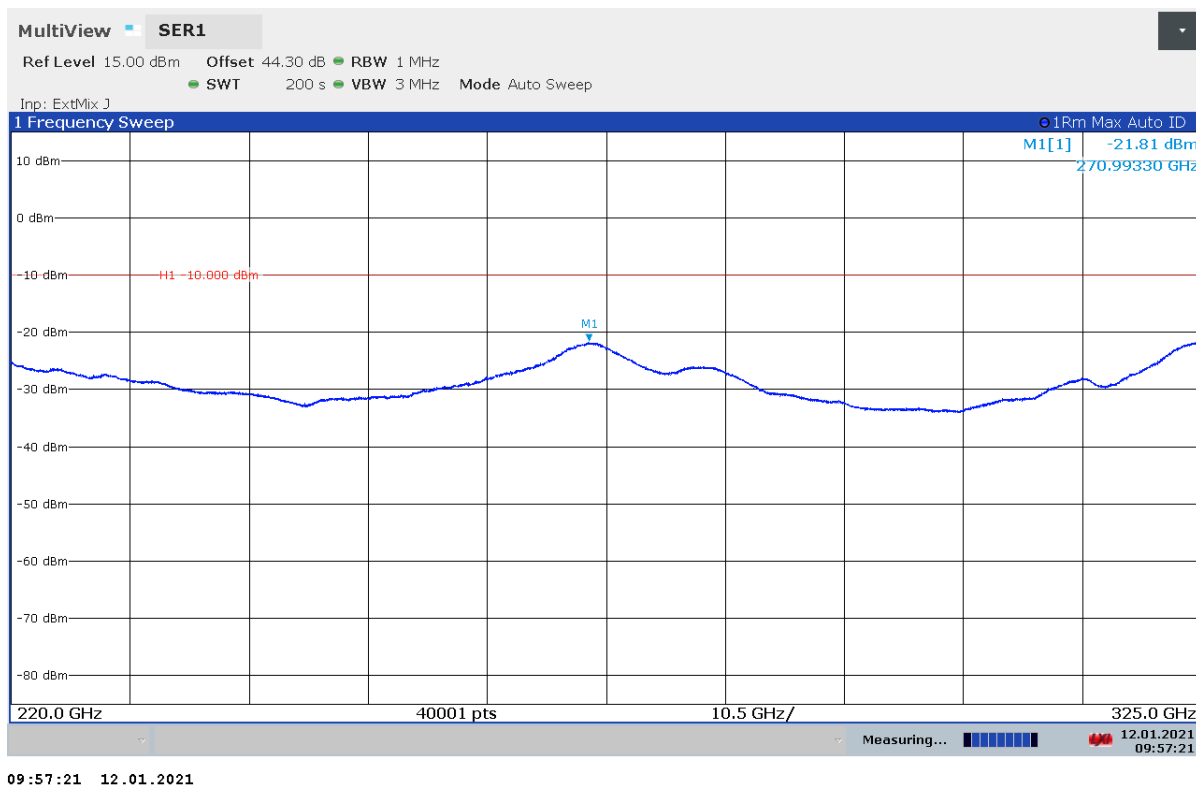
09:40:10 12.01.2021

Plot 32: 140 GHz – 220 GHz, stopped mode (sweep stopped in the middle of the range of operation)

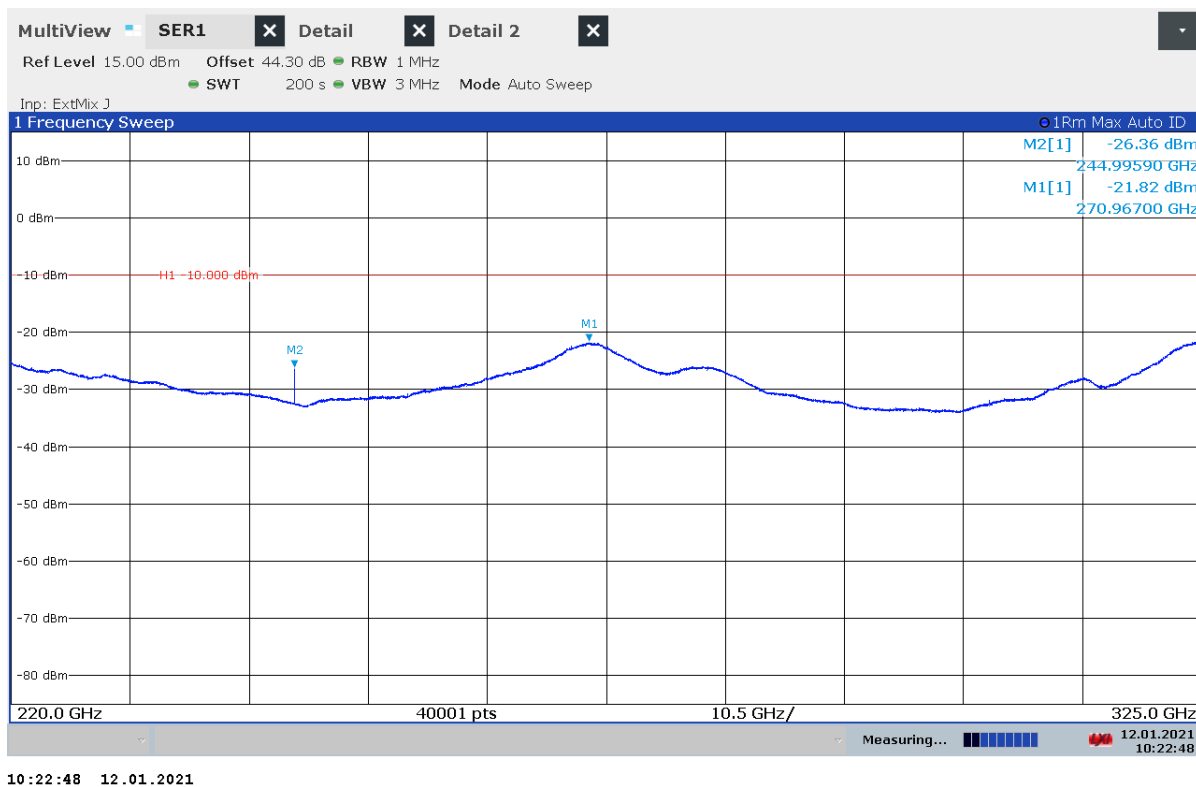


09:14:03 12.01.2021

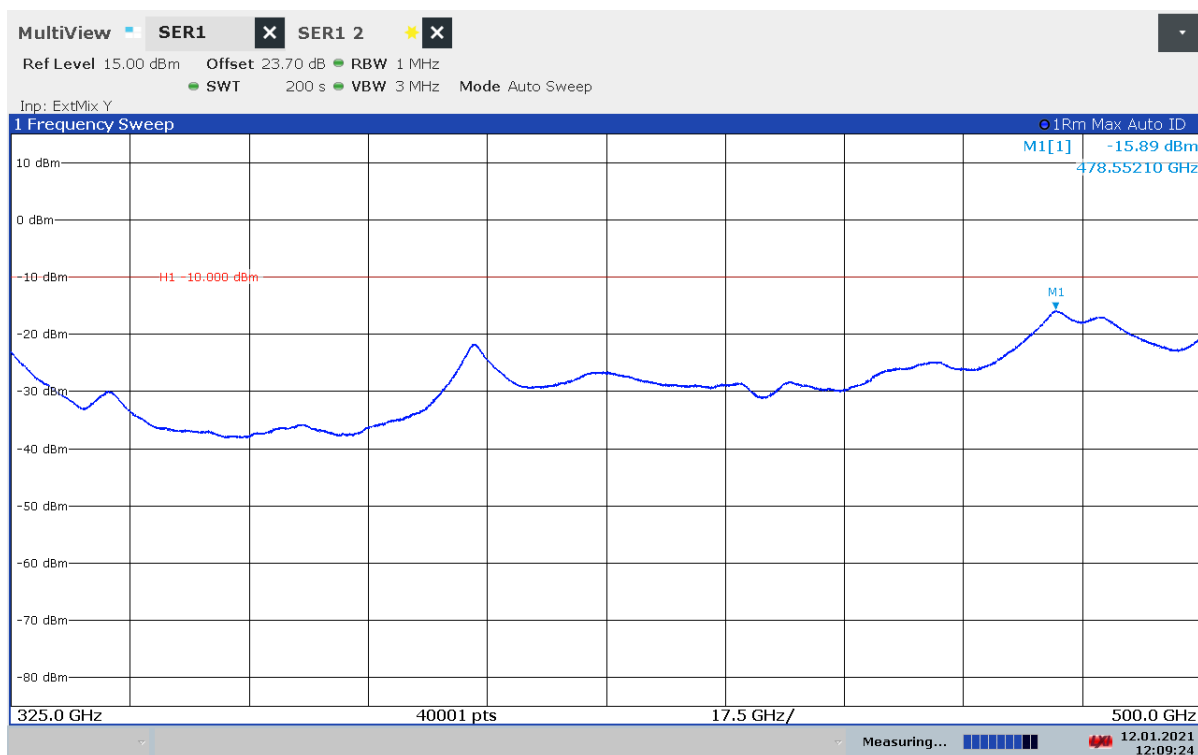
Plot 33: 220 GHz – 325 GHz, normal mode



Plot 34: 220 GHz – 325 GHz, stopped mode (sweep stopped in the middle of the range of operation)

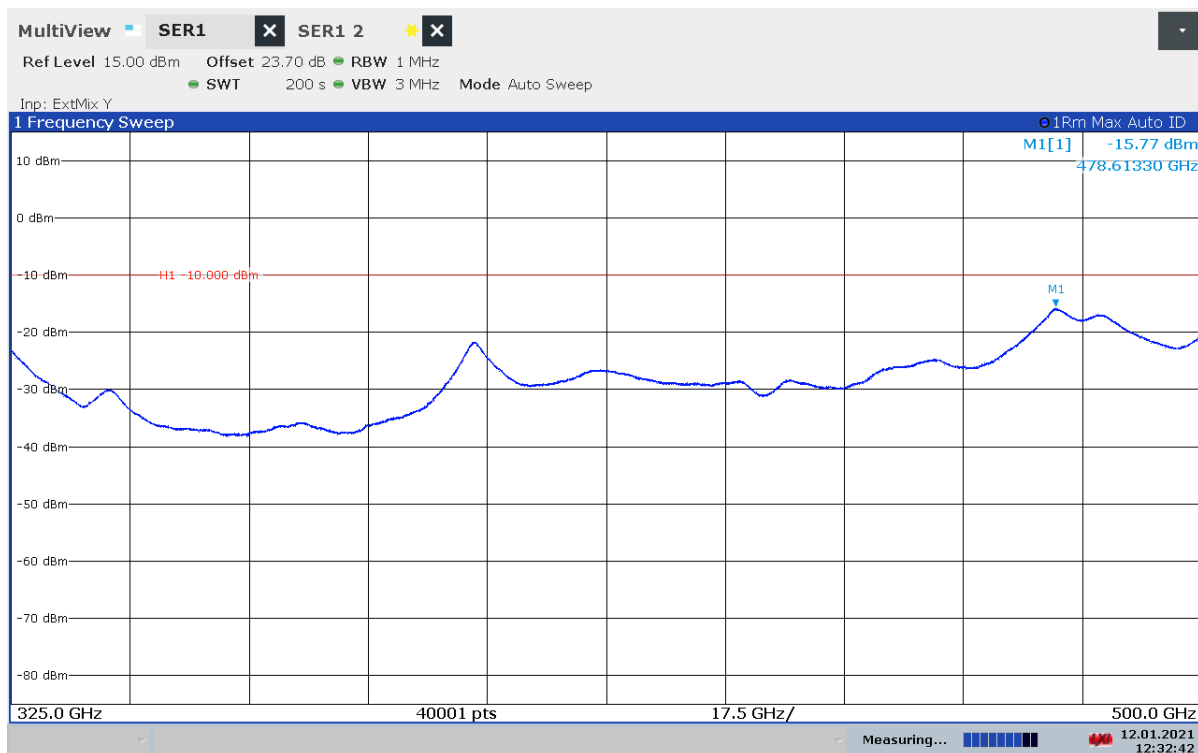


Plot 35: 325 GHz – 500 GHz, normal mode



12:09:24 12.01.2021

Plot 36: 325 GHz – 500 GHz, stopped mode (sweep stopped in the middle of the range of operation)



12:32:43 12.01.2021

## 12.4 Frequency Stability

### Description:

§15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

§15.258 (d) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

### Measurement:

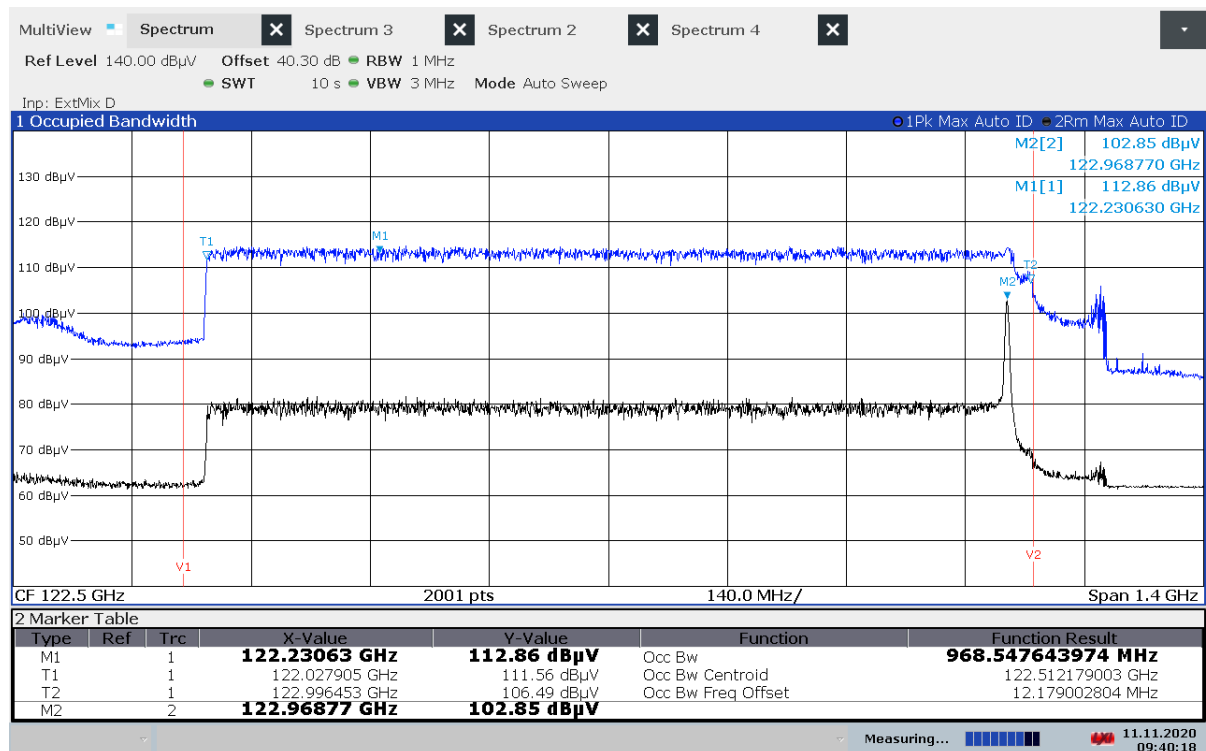
| Measurement parameter |          |
|-----------------------|----------|
| Detector:             | Pos-Peak |
| Sweep time:           | 10 s     |
| Resolution bandwidth: | 1 MHz    |
| Video bandwidth:      | 3 MHz    |
| Span:                 | 1.4 GHz  |
| Trace-Mode:           | Max Hold |

### Limits:

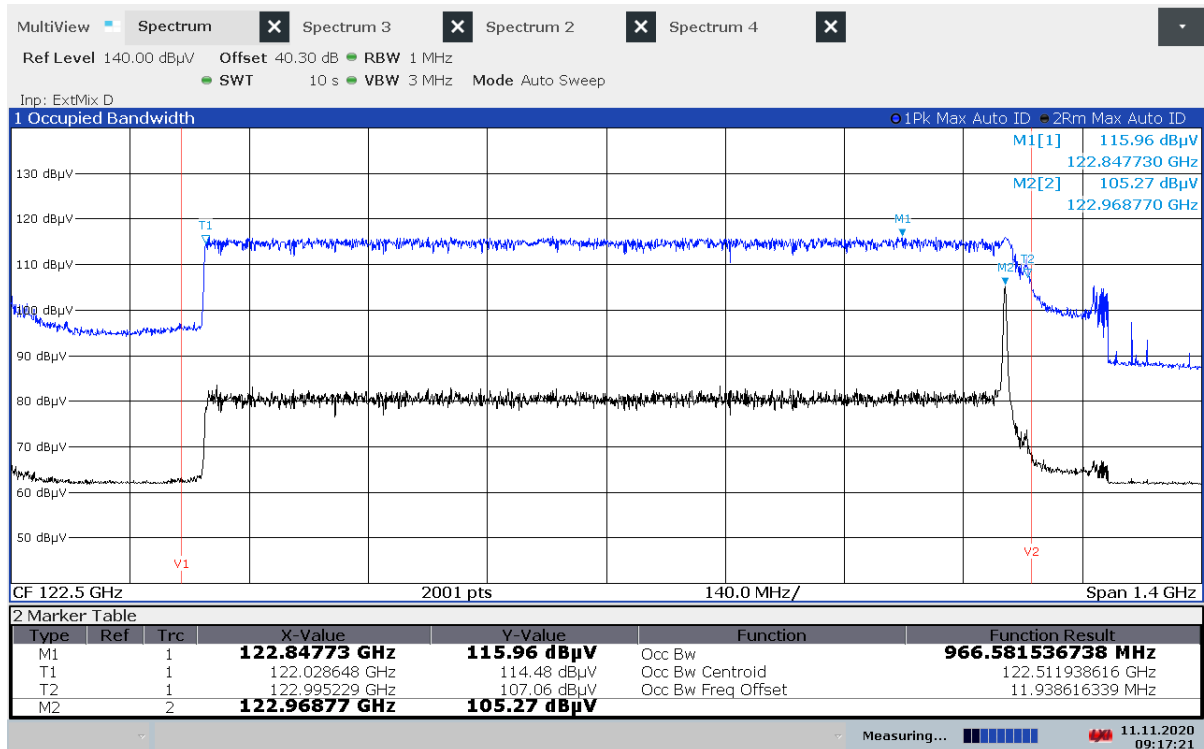
| FCC                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------|
| CFR Part 15.258 (d)                                                                                                             |
| The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following: |
| Frequency range                                                                                                                 |
| 116 GHz – 123 GHz (regulatory)<br>122 – 123 GHz (EUT)                                                                           |

**Measurement Results:**

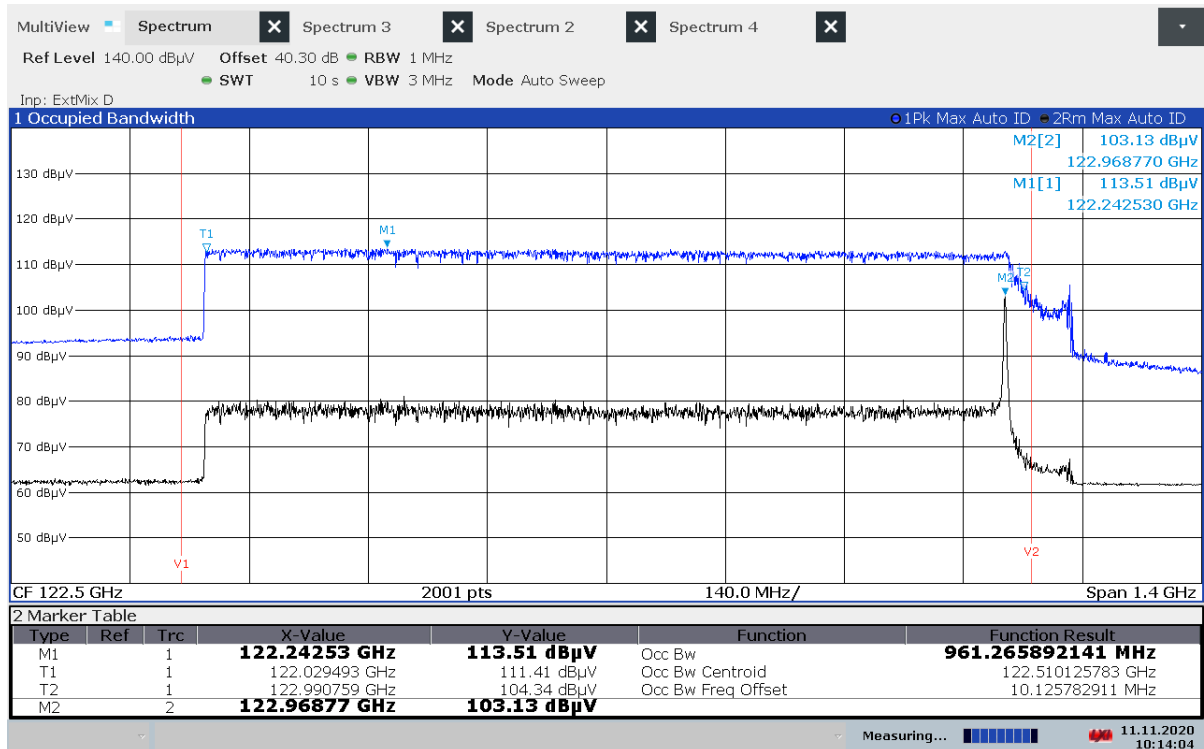
| Test Conditions     | Transmitter Frequency Range [GHz] |            | Occupied Bandwidth [MHz] |
|---------------------|-----------------------------------|------------|--------------------------|
|                     | $F_L$                             | $F_H$      |                          |
| $T_{nom} / V_{nom}$ | 122.027905                        | 122.996453 | 968.548                  |
| $T_{min} / V_{nom}$ | 122.028648                        | 122.995229 | 966.581                  |
| $T_{max} / V_{nom}$ | 122.029493                        | 122.990759 | 961.266                  |
| $T_{nom} / V_{min}$ | 122.028757                        | 122.991494 | 962.737                  |
| $T_{nom} / V_{max}$ | 122.029375                        | 122.990685 | 961.311                  |

Plot 37:  $T_{nom} / V_{nom}$ 

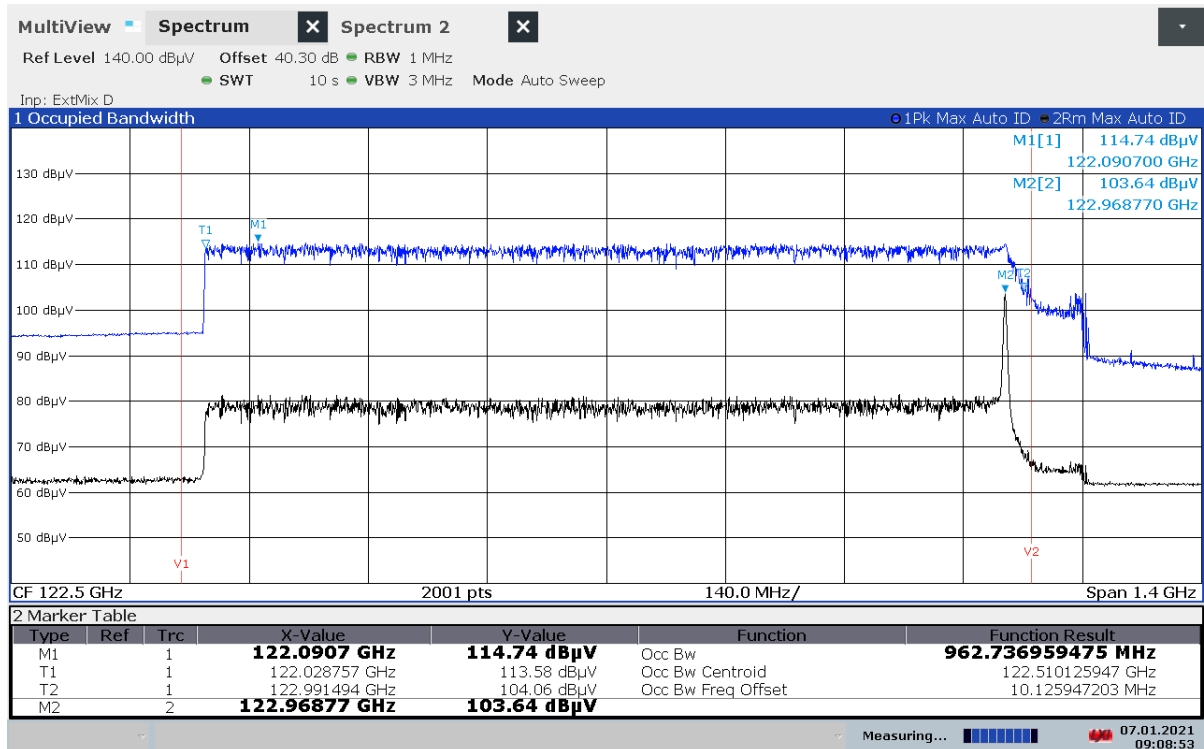
09:40:19 11.11.2020

Plot 38:  $T_{\min} / V_{\text{nom}}$ 

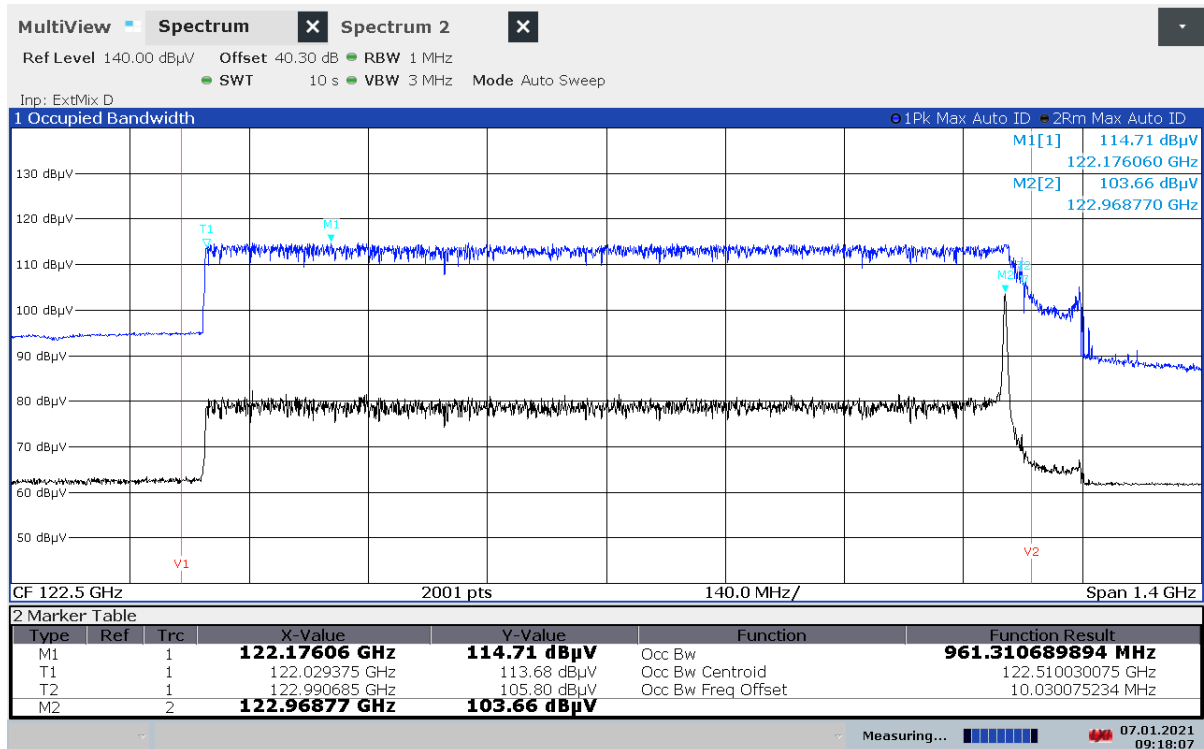
09:17:21 11.11.2020

Plot 39:  $T_{\max} / V_{\text{nom}}$ 

10:14:04 11.11.2020

Plot 40:  $T_{\text{nom}} / V_{\text{min}}$ 

09:08:53 07.01.2021

Plot 41:  $T_{\text{nom}} / V_{\text{max}}$ 

09:18:07 07.01.2021

### 13 Glossary

|                        |                                                    |
|------------------------|----------------------------------------------------|
| <b>EUT</b>             | Equipment under test                               |
| <b>DUT</b>             | Device under test                                  |
| <b>UUT</b>             | Unit under test                                    |
| <b>GUE</b>             | GNSS User Equipment                                |
| <b>ETSI</b>            | European Telecommunications Standards Institute    |
| <b>EN</b>              | European Standard                                  |
| <b>FCC</b>             | Federal Communications Commission                  |
| <b>FCC ID</b>          | Company Identifier at FCC                          |
| <b>IC</b>              | Industry Canada                                    |
| <b>PMN</b>             | Product marketing name                             |
| <b>HMN</b>             | Host marketing name                                |
| <b>HVIN</b>            | Hardware version identification number             |
| <b>FVIN</b>            | Firmware version identification number             |
| <b>EMC</b>             | Electromagnetic Compatibility                      |
| <b>HW</b>              | Hardware                                           |
| <b>SW</b>              | Software                                           |
| <b>Inv. No.</b>        | Inventory number                                   |
| <b>S/N or SN</b>       | Serial number                                      |
| <b>C</b>               | Compliant                                          |
| <b>NC</b>              | Not compliant                                      |
| <b>NA</b>              | Not applicable                                     |
| <b>NP</b>              | Not performed                                      |
| <b>PP</b>              | Positive peak                                      |
| <b>QP</b>              | Quasi peak                                         |
| <b>AVG</b>             | Average                                            |
| <b>OC</b>              | Operating channel                                  |
| <b>OCW</b>             | Operating channel bandwidth                        |
| <b>OBW</b>             | Occupied bandwidth                                 |
| <b>OOB</b>             | Out of band                                        |
| <b>DFS</b>             | Dynamic frequency selection                        |
| <b>CAC</b>             | Channel availability check                         |
| <b>OP</b>              | Occupancy period                                   |
| <b>NOP</b>             | Non occupancy period                               |
| <b>DC</b>              | Duty cycle                                         |
| <b>PER</b>             | Packet error rate                                  |
| <b>CW</b>              | Clean wave                                         |
| <b>MC</b>              | Modulated carrier                                  |
| <b>WLAN</b>            | Wireless local area network                        |
| <b>RLAN</b>            | Radio local area network                           |
| <b>DSSS</b>            | Dynamic sequence spread spectrum                   |
| <b>OFDM</b>            | Orthogonal frequency division multiplexing         |
| <b>FHSS</b>            | Frequency hopping spread spectrum                  |
| <b>GNSS</b>            | Global Navigation Satellite System                 |
| <b>C/N<sub>0</sub></b> | Carrier to noise-density ratio, expressed in dB-Hz |

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

| Version | Applied changes | Date of release |
|---------|-----------------|-----------------|
| -/-     | Initial release | 2021-02-11      |

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

first page

Deutsche Akkreditierungsstelle GmbH

Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV  
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

## Accreditation

The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory

**CTC advanced GmbH**  
Untertürkheimer Straße 6-10, 66117 Saarbrücken

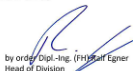
is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields:

**Telecommunication (FCC Requirements)**

The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages.

Registration number of the certificate: **D-PL-12076-01-05**

Frankfurt am Main, 09.06.2020

  
by order/Dipl.-Ing. (FH) Prof. Dr. Egner  
Head of Division

The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.  
<https://www.dakks.de/en/content/accredited-bodies-dakks>  
Date notice issued:

last page

Deutsche Akkreditierungsstelle GmbH

Office Berlin  
Spittelmarkt 10  
10117 Berlin

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

Office Braunschweig  
Bundesallee 100  
38116 Braunschweig

The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.

No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS.

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:  
EA: [www.european-accreditation.org](http://www.european-accreditation.org)  
ILAC: [www.ilac.org](http://www.ilac.org)  
IAF: [www.iaf.eu](http://www.iaf.eu)

<https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf>

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