
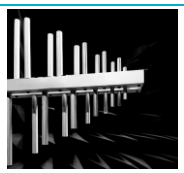
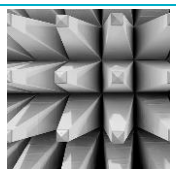

# TEST REPORT

**Test report no.: 1-8972-24-01-02_TR1-R01**

## Testing laboratory


**cetecom advanced GmbH**
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.cetecomadvanced.com
e-mail: mail@cetecomadvanced.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 with the registration number:
D-PL-12047-01-00.
ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

## Applicant


**Werner Turck GmbH & Co. KG**
Goethestr. 7
58553 Halver / GERMANY
Phone:
Contact: Markus Teubner
e-mail: markus.teubner@turck.com


## Manufacturer

**Werner Turck GmbH & Co. KG**
Goethestr. 7
58553 Halver / 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 |

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

## Test Item

| | |
|---|---|
| **Kind of test item:** | **122-123 GHz FMCW Radar** |
| **Model name:** | **Radar Level Sensor** |
| **FCC ID:** | **YQ7LRS-510-10** |
| Frequency: | 122 GHz to 123 GHz |
| Antenna: | Integrated antenna |
| Power supply: | 18 V to 33 V DC by external power supply |
| Temperature range: | -25°C to 65°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:

Thomas Vogler

cn=Thomas Vogler, o=cetecom advanced GmbH, ou=VOG-230609, email=thomas.vogler@cetecomadvanced.com, c=DE
2025.07.18 12:32:29 +02'00'

Thomas Vogler
Lab Manager
Radio Labs

## Test performed:

cn=Stephan Thiel, o=cetecom advanced GmbH, ou=THL-230601, email=Stephan.Thiel@cetecomadvanced.com, c=DE
2025.07.18 10:50:13 +02'00'

Stephan Thiel
Testing Manager
Radio Labs

# 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. cetecom advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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In no case this test report can be considered as a Letter of Approval.

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

## 2.2 Application details

| | |
|---|---|
| Date of receipt of order: | 2024-12-12 |
| Date of receipt of test item: | 2024-11-27 |
| Start of test:* | 2024-12-04 |
| End of test:* | 2025-01-27 |
| 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 Involved test locations

| | Saarbruecken lab | | Essen lab |
|---|---|---|---|
| ☒ | Untertuerkheimer Str. 6-10<br>66117 Saarbruecken<br>Germany | ☐ | Im Teelbruch 116<br>45219 Essen<br>Germany |

## 2.4 Test laboratories sub-contracted

None

## 2.5 Laboratory listings and recognitions

| | Saarbruecken | Essen |
|---|---|---|
| **FCC** | DE0002 | DE0003 |
| **ISED** | DE0001 3462C | DE0001 3462D |

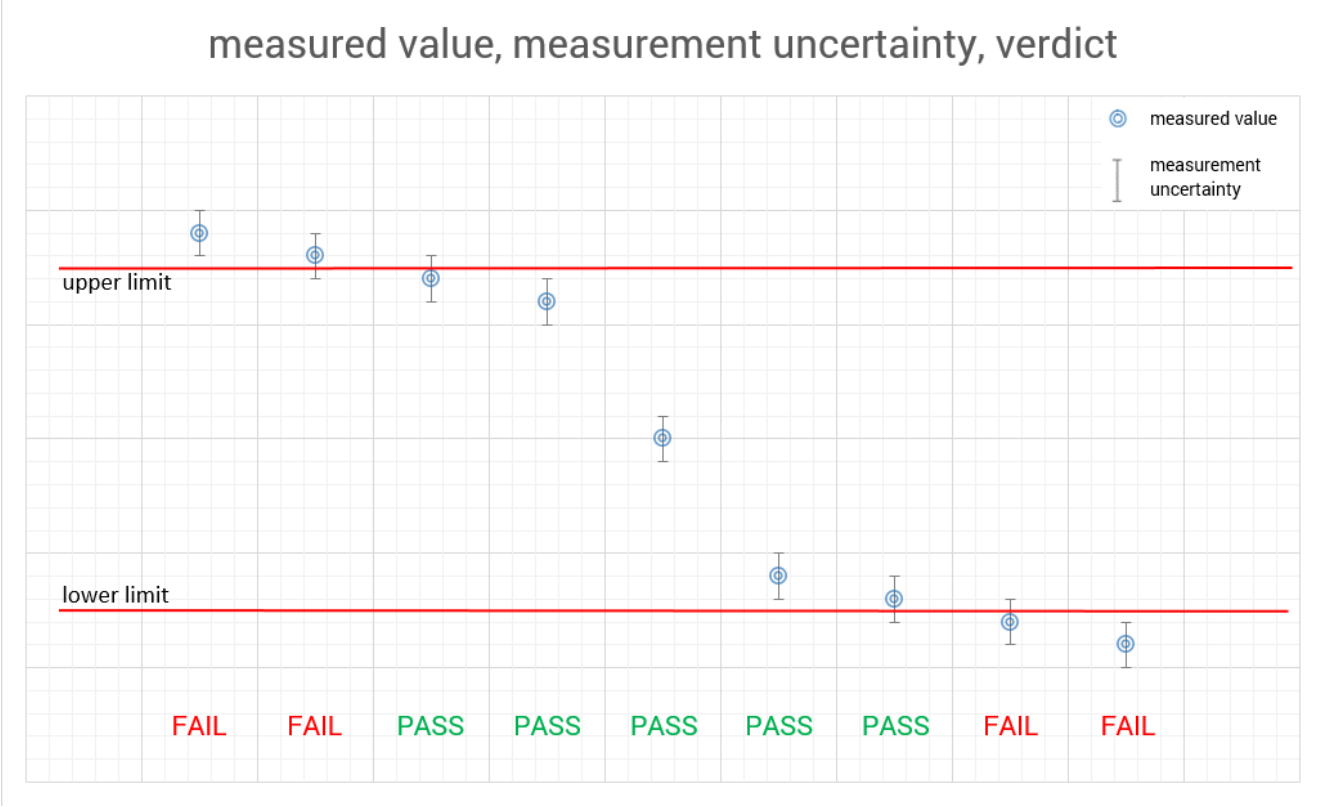
# 3 Test standard/s, references and accreditations

| 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 |

| Guidance | Version | Description |
|---|---|---|
| ANSI C63.4-2014 | -/- | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ANSI C63.10-2020 | -/- | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |

## 4 Reporting statements of conformity – decision rule

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



# 5 Test environment

| | | | |
|---|---|---|---|
| Temperature | : | $T_{nom}$<br>$T_{max}$<br>$T_{min}$ | +22 °C during room temperature tests<br>+50 °C during high temperature tests<br>-20 °C during low temperature tests |
| Relative humidity content | : | | 49 % |
| Barometric pressure | : | | 990 hPa to 1010 hPa |
| Power supply | : | $V_{nom}$<br>$V_{max}$<br>$V_{min}$ | 24.0 V DC by external power supply<br>27.6 V<br>20.4 V |

# 6 Test item

## 6.1 General description

| | | |
|---|---|---|
| Kind of test item | : | 122-123 GHz FMCW Radar |
| Model name | : | Radar Level Sensor |
| S/N serial number | : | EUT 1: LRS510-10-69-LI2UPN8-H1141<br>EUT 2: LRS510-10-51-LI2UPN8-H1141 |
| Hardware status | : | Frontend: LP 7534/1, SL 12927081, Revision 8001212958<br>LP 7549/3, SL 12137201, Revision 8000882908<br>Backend: SL 22083301, Revision 8000928213 for variants -2UPN8-<br>SL 22083401, Revision 8000928213 for variants -LI2UPN8- |
| Software status | : | n.a. |
| Firmware status | : | Frontend: 3.0.0.4<br>Backend: 1.15.1.0 |
| Frequency band | : | 122 GHz to 123 GHz |
| Type of modulation | : | FMCW |
| Number of modes | : | 1 |
| Antenna | : | Integrated antenna |
| Power supply | : | 18 V to 33 V DC by external power supply |
| Temperature range | : | -25°C to 65°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:

- 1-8972-24-01-01_TR1-A101-R01 (External photographs of EUT)
- 1-8972-24-01-01_TR1-A102-R01 (Internal photographs of EUT)
- 1-8972-24-01-01_TR1-A103-R01 (Test set-up photographs)
- Note: The referenced photos show EUT delivered by the customer in this project, not necessarily the exact one used for the specific tests. EUT identification shown in the photos may differ.

Additional measurement reports:

- 1-8972-24-01-02_TR1-A201-R1
- 1-8972-24-01-02_TR1-A203-R1

# 7 Description of the test setup

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

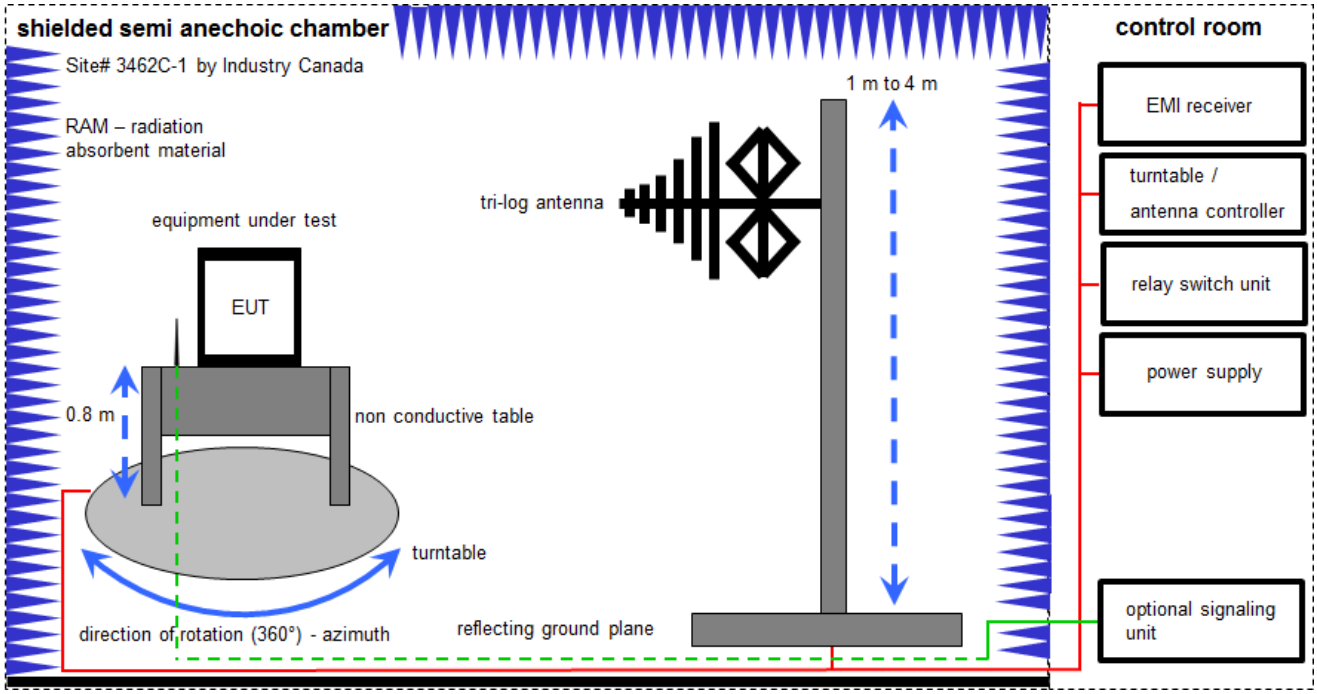
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

**Agenda:** Kind of Calibration

| | | | |
|---|---|---|---|
| k/cal | calibration / calibrated | EK | limited calibration |
| Ne/cnn | not required (k, ev, izw, zw not required) | zw | cyclical maintenance (external cyclical maintenance) |
| Ev/chk | 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 |
| cpu | check prior usage | | |

## 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; loop antenna 10 meter

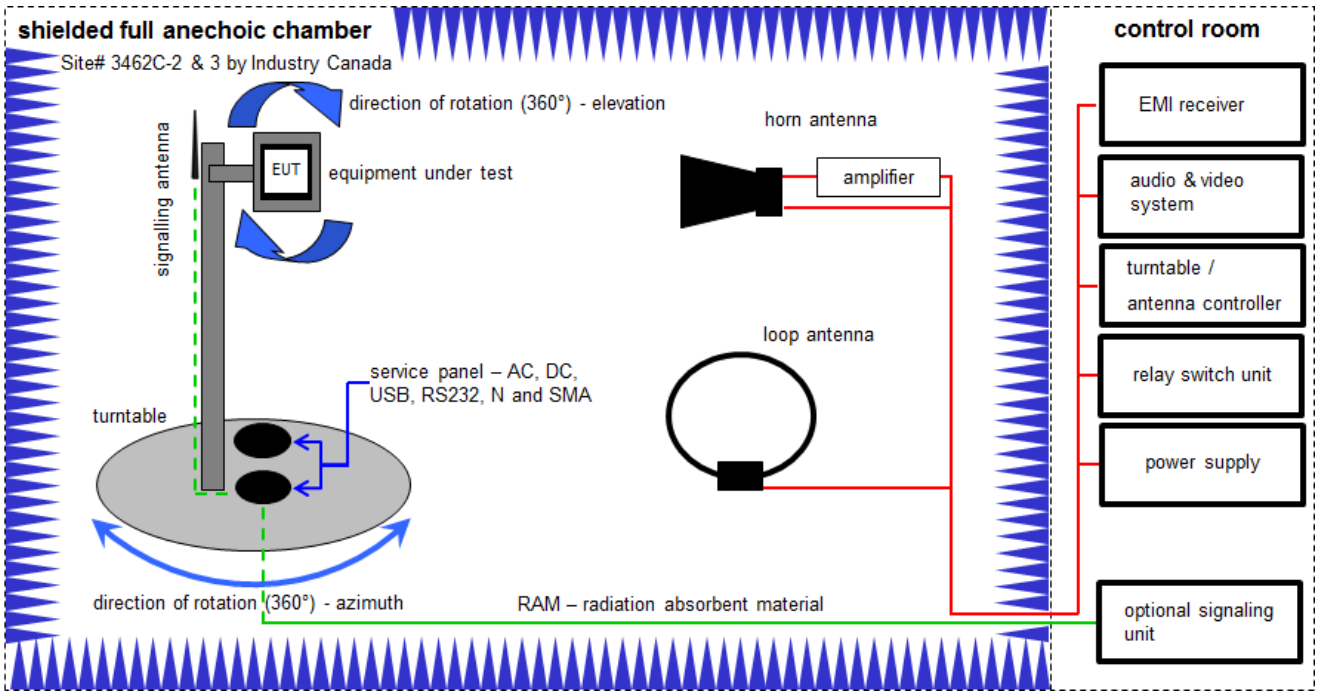
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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

## Equipment table:

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n.a. | Switch-Unit | Switch-Unit 3488A | Hewlett Packard | 2719A14505 | 300000368 | cpu | -/- | -/- |
| 2 | n.a. | Power Supply | Power Supply 6032A | Hewlett Packard | 2920A04466 | 300000580 | cnn | -/- | -/- |
| 3 | n.a. | Antenna Tower | Antenna Tower 2175 | ETS-Lindgren Gmbh / Taufkirchen | 64762 | 300003745 | cnn | -/- | -/- |
| 4 | n.a. | Positioning Controller | Positioning Controller 2090 | ETS-Lindgren Gmbh / Taufkirchen | 64672 | 300003746 | cnn | -/- | -/- |
| 5 | n.a. | Spectrum-Analyzer | Spectrum-Analyzer FSU26 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 200809 | 300003874 | cal | 04.12.2024 | 04.12.2025 |
| 6 | n.a. | TRILOG Broadband Antenna | TRILOG Broadband Antenna VULB9163 | Schwarzbeck Mess-Elektronik OHG / Schönau | 1029 | 300005379 -0000 | cal | 25.09.2023 | 30.09.2025 |
| 7 | n.a. | EMI Test Receiver | EMI Test Receiver ESR3 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 102587 | 300005771 | cal | 05.12.2024 | 05.12.2025 |

## 7.2 Shielded fully anechoic chamber




Measurement distance: tri-log antenna 3 meter and horn antenna 3 meter

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

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

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 [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

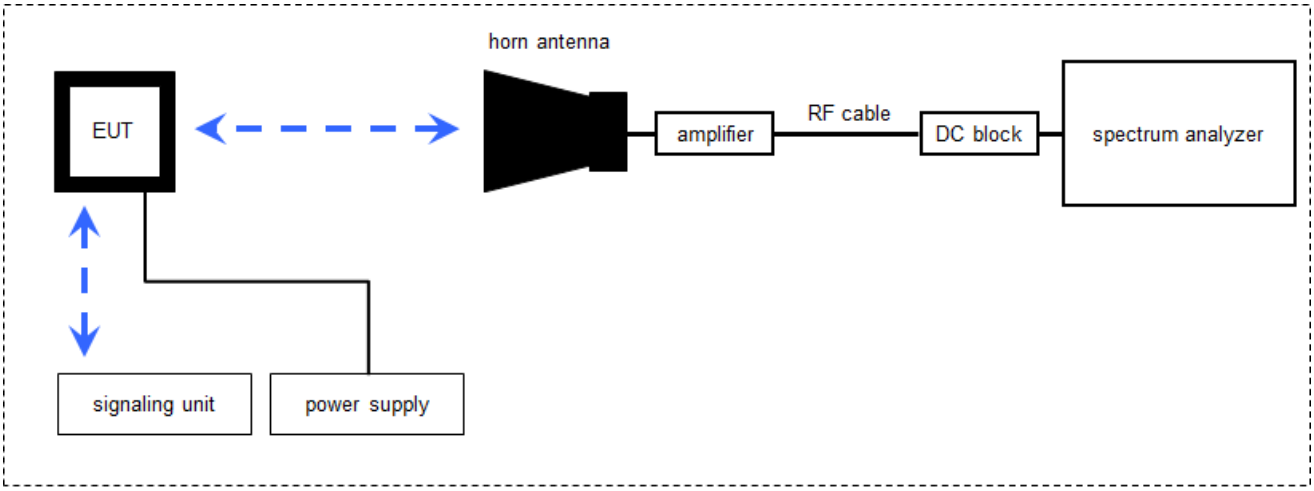
## Equipment table:

| 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 | DC power supply, 60Vdc, 50A, 1200 W 6032A | Hewlett Packard | 2818A03450 | 300001040 -0000 | cal | 05.12.2023 | 05.12.2026 |
| 2 | n.a. | Double-Ridged Waveguide Horn Antenna | Double-Ridged Waveguide Horn Antenna 3115 | EMCO Elektronik GmbH / Gilching | 8812-3088 | 300001032 | cal | 10.10.2023 | 31.10.2025 |
| 3 | n.a. | Anechoic chamber | Anechoic chamber FAC 3/5m | MEC Import: MWB / TDK | 87400/02 | 300000996 -0000 | cpu | -/- | -/- |
| 4 | n.a. | Switch / Control Unit | Switch / Control Unit 3488A | Hewlett Packard | * | 300000199 -0000 | cnn | -/- | -/- |
| 5 | n.a. | Highpass Filter | Highpass Filter WHKX7.0/18G-8SS | Wainwright Instruments GmbH / Andechs | 19 | 300003790 -0000 | cnn | -/- | -/- |
| 6 | n.a. | Broadband Amplifier 0.5-18 GHz | Broadband Amplifier 0.5-18 GHz CBLU5184540 | MEC Import: CERNEX | 22049 | 300004481 -0000 | cpu | -/- | -/- |
| 7 | n.a. | 4U RF Switch Platform | 4U RF Switch Platform L4491A | Agilent Technologies Deutschland GmbH / Böblingen | MY50000037 | 300004509 -0000 | cnn | -/- | -/- |
| 8 | n.a. | NEXIO EMV-Software | NEXIO EMV-Software BAT EMC V2022.0.32.0 | MEC Import: Nexio | | 300004682 -0000 | cnn | -/- | -/- |
| 9 | n.a. | Active Loop Antenna | Active Loop Antenna 6502 | EMCO Elektronik GmbH / Gilching | 2210 | 300001015 | cal | 02.08.2023 | 02.08.2025 |
| 10 | n.a. | EMI Test Receiver 20Hz- 26,5GHz | EMI Test Receiver 20Hz- 26,5GHz ESU26 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 100037 | 300003555 -0000 | cal | 10.12.2024 | 10.12.2025 |
| 11 | n.a. | TRILOG Broadband Antenna | TRILOG Broadband Antenna VULB9163 | Schwarzbeck Mess-Elektronik OHG / Schönau | 318 | 300003696 | cal | 31.01.2024 | 31.01.2026 |

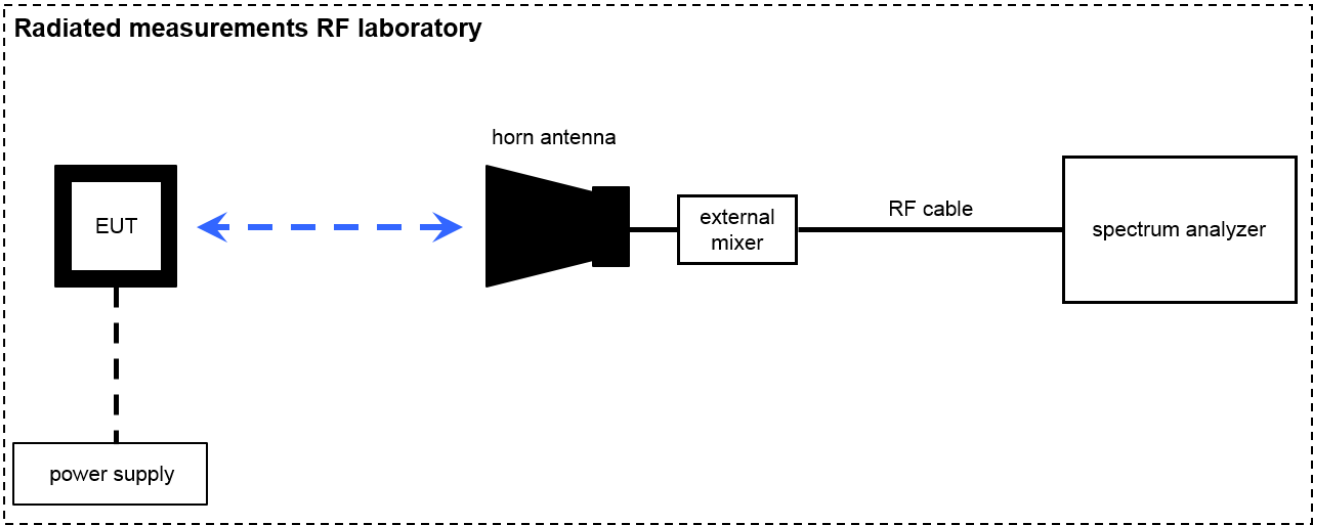
## Equipment table (OTA):

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n.a. | Power supply GPIB dc power supply, 0-50 Vdc, 0-2 A | Power supply GPIB dc power supply, 0-50 Vdc, 0-2 A 6633A | Hewlett Packard | 2851A01222 | 300001530 -0000 | cal | 15.12.2022 | 31.12.2025 |
| 2 | n.a. | CTIA-Chamber | CTIA-Chamber CTIA-Chamber AMS 8500 | MEC Import: ETS-Lindgren Finnland | | 300003327 -0000 | cnn | -/- | -/- |
| 3 | n.a. | CTIA-Chamber - Positioning Equipment | CTIA-Chamber - Positioning Equipment CTIA-Chamber - Positioning Equipment | EMCO Elektronik GmbH / Gilching | | 300003328 -0000 | cpu | -/- | -/- |
| 4 | n.a. | Signal- and Spectrumanalyzer | Signal- and Spectrumanalyzer FSW50 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101928 | 140607335 -0000 | cal | 17.01.2024 | 17.01.2025 |

## 7.3 Radiated measurements > 18 GHz




## 7.4 Radiated measurements > 50/85 GHz




Measurement distance: horn antenna e.g. 75 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)

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)

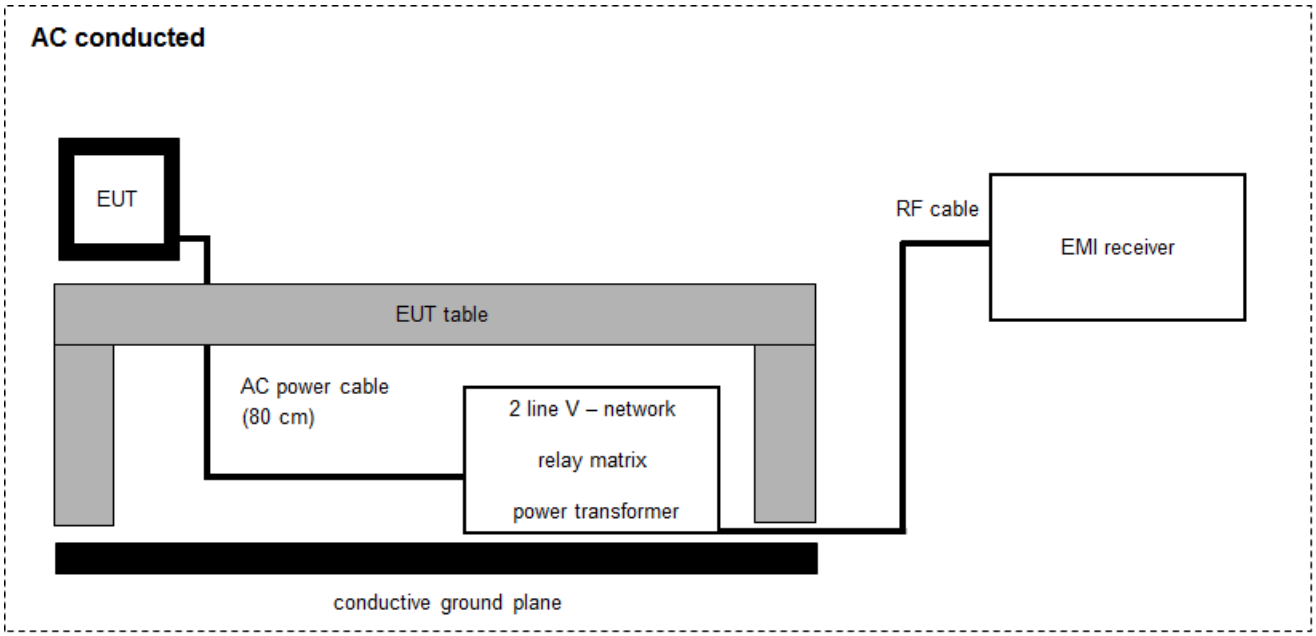
*Example calculation:*
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

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

## Equipment table:

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n.a. | Temperature Test Chamber | Temperature Test Chamber T-40/50 | CTS Clima Temperatur Systeme GmbH / Hechingen | 064023 | 300003540 -0000 | calchk | 11.07.2024 | 11.07.2026 |
| 2 | n.a. | Signal- and Spectrum Analyzer 2 Hz - 50 GHz | Signal- and Spectrum Analyzer 2 Hz - 50 GHz FSW50 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101560 | 300006179 -0000 | cal | 27.12.2024 | 27.12.2025 |
| 3 | n.a. | Broadband LNA 18-50 GHz | Broadband LNA 18-50 GHz CBL18503070PN | MEC Import: CERNEX | 25240 | 300004948 -0000 | chk | 22.04.2024 | 22.04.2026 |
| 4 | n.a. | Std. Gain Horn Antenna 49.9-75.8 GHz | Std. Gain Horn Antenna 49.9-75.8 GHz 2524-20 | MEC Import: Flann | * | 300001983 -0000 | cnn | -/- | -/- |
| 5 | n.a. | Std. Gain Horn Antenna 114-173 GHz | Std. Gain Horn Antenna 114-173 GHz 2924-20 | MEC Import: Flann | * | 300001999 -0000 | cnn | -/- | -/- |
| 6 | n.a. | Std. Gain Horn Antenna 145-220 GHz | Std. Gain Horn Antenna 145-220 GHz 3024-20 | MEC Import: Flann | * | 300002000 -0000 | cnn | -/- | -/- |
| 7 | n.a. | Harmonic Mixer 3-Port, 110-170 GHz | Harmonic Mixer 3-Port, 110-170 GHz FS-Z170 | MEC Import: Radiometer Physics GmbH | 100014 | 300004156 -0000 | cal | 15.07.2024 | 15.07.2025 |
| 8 | n.a. | Harmonic Mixer 3-Port, 140-220 GHz | Harmonic Mixer 3-Port, 140-220 GHz SAM-220 | MEC Import: Radiometer Physics GmbH | 200001 | 300004157 -0000 | cal | 01.08.2024 | 01.08.2025 |
| 9 | n.a. | Harmonic Mixer 3-Port, 220-325 GHz | Harmonic Mixer 3-Port, 220-325 GHz SAM-325 | MEC Import: Radiometer Physics GmbH | 100002 | 300004158 -0000 | cal | 31.07.2024 | 31.07.2025 |
| 10 | n.a. | Std. Gain Horn Antenna 33.0-50.1 GHz | Std. Gain Horn Antenna 33.0-50.1 GHz 2324-20 | MEC Import: Flann | 57 | 400000683 -0000 | cnn | -/- | -/- |
| 11 | n.a. | Std. Gain Horn Antenna 217-330 GHz | Std. Gain Horn Antenna 217-330 GHz 32240-20 | MEC Import: Flann | 233278 | 300004960 -0000 | cnn | -/- | -/- |
| 12 | n.a. | Harmonic Mixer 3-Port, 75-110 GHz | Harmonic Mixer 3-Port, 75-110 GHz FS-Z110 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101411 | 300004959 -0000 | cal | 30.08.2024 | 30.08.2025 |
| 13 | n.a. | Harmonic Mixer 3-port, 90-140 GHz | Harmonic Mixer 3-port, 90-140 GHz FS-Z140 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101119 | 300005581 -0000 | cal | 01.08.2024 | 01.08.2025 |
| 14 | n.a. | Harmonic Mixer 3-Port, 50-75 GHz | Harmonic Mixer 3-Port, 50-75 GHz FS-Z75 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101578 | 300005788 -0000 | cal | 10.07.2024 | 10.07.2025 |
| 15 | n.a. | Harmonic Mixer 3-Port, 325-500GHz | Harmonic Mixer 3-Port, 325-500GHz FS-Z500 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 101016 | 300006096 -0000 | cal | 16.07.2024 | 16.07.2025 |
| 16 | n.a. | Std. Gain Horn Antenna 73.8-112 GHz | Std. Gain Horn Antenna 73.8-112 GHz 2724-20 | MEC Import: Flann | * | 300001988 -0000 | cnn | -/- | -/- |
| 17 | n.a. | Std. Gain Horn Antenna 92.3-140 GHz | Std. Gain Horn Antenna 92.3-140 GHz 2824-20 | MEC Import: Flann | * | 300001993 -0000 | cnn | -/- | -/- |
| 18 | n.a. | Standard Gain Horn 325-500 GHz | Standard Gain Horn 325-500 GHz 570240-20 1785-2a | MEC Import: Flann Microwave | 273569 | 300006097 -0000 | cpu | -/- | -/- |
| 19 | n.a. | Horn Antenna 18,0-40,0 GHz | Horn Antenna 18,0-40,0 GHz LHAF180 | MEC Import: Microw.Devel | 39180-103-021 | 300001747 -0000 | cal | 24.01.2024 | 31.01.2026 |
| 20 | n.a. | Power supply | Power supply N5767A | Agilent Technologies Deutschland GmbH / Böblingen | US14J1569P | 300004851 -0000 | cal | 06.12.2023 | 31.12.2026 |

## 7.5 AC conducted



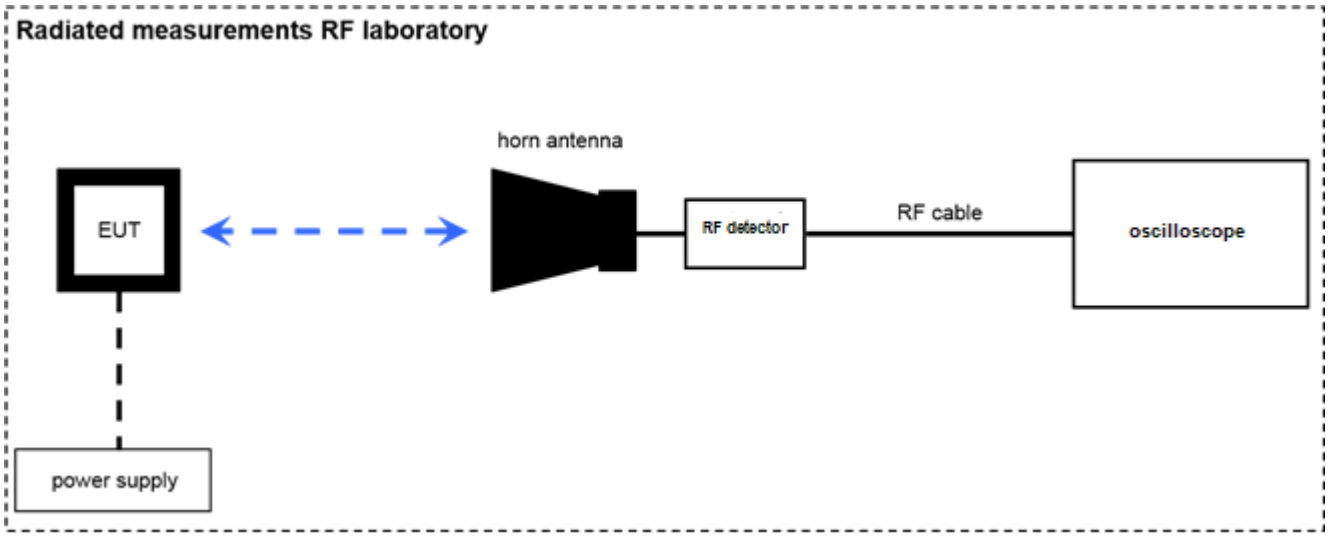

FS = UR + CF + VC
(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

*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. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n.a. | EMI Test Receiver | EMI Test Receiver ESR3 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 102981 | 300006318 | cal | 03.12.2024 | 03.12.2025 |
| 2 | n.a. | Two-Line V-Network (LISN) | Two-Line V-Network (LISN) ESH3-Z5 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 892475/017 | 300002209 | cal | 12.12.2023 | 31.12.2025 |
| 3 | n.a. | Artificial Mains Network | Artificial Mains Network ESH2-Z5 | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 892602/0024 | 300000587 | cal | 11.12.2024 | 11.12.2026 |

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




Note: EUT is replaced by reference source for substitution measurement

Measurement distance: horn antenna e.g. 50 cm

**Equipment table:**

| No. | Lab / Item | Equipment | Type | Manufacturer | Serial No. | INV. No. | Kind of Calibration | Last Calibration | Next Calibration |
|---|---|---|---|---|---|---|---|---|---|
| 1 | n.a. | Oscilloscope | Oscilloscope DPO5054 | Tektronix UK Ltd. / Berkshire | C010174 | 300004169 -0000 | cal | 05.12.2023 | 05.12.2025 |
| 2 | n.a. | Signal Generator 100 kHz - 40 GHz | Signal Generator 100 kHz - 40 GHz SMB100A | Rohde & Schwarz Messgerätebau GmbH / Memmingen | 183320 | 300006330 -0000 | cal | 07.01.2025 | 07.01.2028 |
| 3 | n.a. | Std. Gain Horn Antenna 114-173 GHz | Std. Gain Horn Antenna 114-173 GHz 2924-20 | MEC Import: Flann | * | 300001999 -0000 | cnn | -/- | -/- |
| 4 | n.a. | SG Extension Module 110 - 170 GHz | SG Extension Module 110 - 170 GHz E8257DV06 | MEC Import: VDI | US53250018 | 300005540 -0000 | cpu | -/- | -/- |
| 5 | n.a. | F-Band Positive Amplitude Detector | F-Band Positive Amplitude Detector SFD-903144-08SF-P1 | MEC Import: Sage Millimeter Inc. | 07354-1 | 300006119 -0000 | cpu | -/- | -/- |
| 6 | n.a. | Waveguide Amplifier 90-140 GHz | Waveguide Amplifier 90-140 GHz VDI-WR8.0AMP | MEC Import: VDI | 01.01.2013 | 300006234 -0000 | cpu | -/- | -/- |

# 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.

## 8.5 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.

# 9 Measurement uncertainty

| Test case | Uncertainty |
|---|---|
| Equivalent isotropically radiated power (e.i.r.p.) | Conducted value ± 1 dB<br>Radiated value ± 3.5 dB |
| Permitted range of operating frequencies | ± 100 kHz |
| Conducted unwanted emissions in the spurious domain (up to 18 GHz) | ± 1 dB |
| Radiated unwanted emissions in the spurious domain (up to 18 GHz) | ± 3.5 dB |
| Conducted unwanted emissions in the spurious domain (18 to 40 GHz) | ± 4 dB |
| Radiated unwanted emissions in the spurious domain (18 to 40 GHz) | ± 4 dB |
| Conducted unwanted emissions in the spurious domain (40 to 50 GHz) | ± 4.5 dB |
| Radiated unwanted emissions in the spurious domain (40 to 50 GHz) | ± 4.5 dB |
| Conducted unwanted emissions in the spurious domain (above 50 GHz) | ± 5 dB |
| Radiated unwanted emissions in the spurious domain (above 50 GHz) | ± 5 dB |
| DC and low frequency voltages | ± 3 % |
| Temperature | ± 1 °C |
| Humidity | ± 3 % |

## 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 | FCC 47 CFR Part 15 (dated 2020-08-24) | see below | 2025-07-18 | -/- |

| Test specification clause | Test case | Temperature conditions | Power supply | Pass | Fail | NA | NP | Remark |
|---|---|---|---|---|---|---|---|---|
| §15.258 (b)(4), §15.258 (d) | Occupied bandwidth & Emission bandwidth & Frequency stability | Nominal Extreme | Nominal Extreme | ☒ | ☐ | ☐ | ☐ | complies |
| §15.258 (b) | Maximum E.I.R.P. / Transmitter output power | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| §15.258 (c) | Spurious Emissions / Transmitter unwanted emissions | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |
| §15.207 | Conducted emissions < 30 MHz (AC power line) | Nominal | Nominal | ☒ | ☐ | ☐ | ☐ | complies |

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

## 11 Basic information of the DUT

**Basic information of the DUT as declared by the customer:**

General information: see chapter 6 Test item

Equipment class:

- ☐ Fixed point-to-point transmitters located outdoors
- ☐ Transmitters with an emission bandwidth of less than 100 MHz
- ☒ Else

Note: Operation on board an aircraft or a satellite is prohibited. (§15.258 (d))

## 12 Additional comments

**Reference documents:**

- EUT 1: edb_100012722_gbr_en.pdf
- EUT 2: edb_100012729_gbr_en.pdf

**Special test descriptions:**

- None

**Configuration descriptions:**

- None

**Test devices EUT 1:**

- EUT1: 1 normal operation mode sample (intended use).
- EUT1: 3 below described Stop-Modes samples are used.
- EUT1: For information see Plot 1.
- Information: No dedicated software is needed. Each sample is preconfigured by the customer

**Test devices EUT 2:**

- EUT2: 1 normal operation mode sample (intended use).
- EUT2: 3 below described Stop-Modes samples are used.
- EUT2: For information see Plot 2.
- Information: No dedicated software is needed. Each sample is preconfigured by the customer

**Associated equipment (AE):**

- None

**Normal operation modes (NM):**

| Abbreviation | Name | Features |
|---|---|---|
| NM | Normal mode | Normal FMCW mode with a duty cycle of 100% |
| SM | Stop Mode | Stop Mode, frequency sweep is stoped |

**Additional test modes:**

☐ No test modes available

☐ Special test modes/special software (see description below)

☒ Stop-Modes (see description below)

**Stop-Modes:**
In addition to the normal operation mode, Stop-Modes are used in accordance with CFR 47 Part §15.31 (c) & (m), in which the frequency sweep is stopped at the following positions in the range of operation:

- Stop-Mode, low frequency: 122.02 GHz
- Stop-Mode, middle frequency: 122.48 GHz
- Stop-Mode, high frequency: 122.94 GHz

**Software provided by the manufacturer:**

- No software is provided by the manufacturer

**Plot 1: EUT 1**


Note:

- One device for normal mode and the other 3 devices for stop mode

**Plot 2: EUT 2**


Note:

- One device for normal mode and the other 3 devices for stop mode

# 13 Measurement results

## 13.1 Occupied bandwidth & emission bandwidth & frequency stability

**Description:**

Measurement of the bandwidth and the frequency stability of the wanted signal (fundamental emission) under temperature and supply voltage variations.

**Limits and provisions:**

| Designated frequency band |
|---|
| 116 GHz – 123 GHz |

**§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: 6 dB bandwidth** | |
|---|---|
| Detector: | Pos-Peak |
| Resolution bandwidth: | 100 kHz |
| Video bandwidth: | 300 kHz |
| Trace-Mode: | Max Hold |

**Measurement results:**

**6 dB bandwidth at normal conditions:**

| EUT | Mode | Test condition | $f_L$ [GHz] | $f_H$ [GHz] | Bandwidth [MHz] |
|---|---|---|---|---|---|
| 1 | NM | $T_{nom}$ / $V_{nom}$ | 122.020 | 122.942 | 921.8 |
| 2 | NM | $T_{nom}$ / $V_{nom}$ | 122.019 | 122.941 | 921.8 |

**Frequency stability (15.258(d):**

Mode for frequency stability tests: Normal mode (Mode with the widest bandwidth, ANSI C63.10-2020 5.6.2.2)

Bandwidth measurement for frequency stability tests: 6 dB bandwidth

EUT 1:

| Test condition | Frequency $f_L$ [GHz] | Frequency $f_H$ [GHz] | Bandwidth [MHz] |
|---|---|---|---|
| -20 °C / $V_{nom}$ | 122.021 | 122.943 | 921.9 |
| -10 °C / $V_{nom}$ | 122.021 | 122.943 | 921.8 |
| 0 °C / $V_{nom}$ | 122.021 | 122.943 | 921.8 |
| 10 °C / $V_{nom}$ | 122.021 | 122.942 | 921.5 |
| 20 °C / $V_{nom}$ | 122.020 | 122.942 | 921.8 |
| 20 °C / $V_{min}$ | 122.020 | 122.942 | 921.7 |
| 20 °C / $V_{max}$ | 122.020 | 122.942 | 921.6 |
| 30 °C / $V_{nom}$ | 122.020 | 122.941 | 921.5 |
| 40 °C / $V_{nom}$ | 122.019 | 122.941 | 921.8 |
| 50 °C / $V_{nom}$ | 122.019 | 122.941 | 921.5 |

Note:

- Detailed measurement results: see measurement report 1-8972-24-01-02_TR1-A201-R1

EUT 2:

| Test condition | Frequency $f_L$ [GHz] | Frequency $f_H$ [GHz] | Bandwidth [MHz] |
|---|---|---|---|
| -20 °C / $V_{nom}$ | 122.017 | 122.938 | 921.7 |
| -10 °C / $V_{nom}$ | 122.017 | 122.938 | 921.8 |
| 0 °C / $V_{nom}$ | 122.017 | 122.939 | 921.8 |
| 10 °C / $V_{nom}$ | 122.018 | 122.940 | 921.8 |
| 20 °C / $V_{nom}$ | 122.019 | 122.941 | 921.8 |
| 20 °C / $V_{min}$ | 122.019 | 122.940 | 921.5 |
| 20 °C / $V_{max}$ | 122.019 | 122.941 | 921.7 |
| 30 °C / $V_{nom}$ | 122.019 | 122.941 | 921.8 |
| 40 °C / $V_{nom}$ | 122.020 | 122.942 | 921.8 |
| 50 °C / $V_{nom}$ | 122.022 | 122.942 | 921.4 |

Note:

- Detailed measurement results: see measurement report 1-8972-24-01-02_TR1-A203-R1

**Verdict: Compliant**

## 13.2 Maximum E.I.R.P. / Transmitter output power

**Description:**

Measurement of the maximum radiated E.I.R.P. of the wanted signal.

**Limits and provisions:**

**§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:

(1) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(2) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The provisions in this paragraph (b)(2) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (b)(1) of this section.

(3) 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.

(4) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak radiated power to the product of the maximum permissible radiated power (in milliwatts) times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph (b)(4), emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Pos-Peak (RF-Detector) |
| Video bandwidth: | 10 MHz |

Measurement procedures:
Fundamental emission using an RF detector: ANSI C63.10-2020 9.8

**Measurement results:**

| EUT | Mode | Test condition | Peak E.I.R.P. [dBm] | Applicable Limit Peak E.I.R.P. [dBm] | Average E.I.R.P. [dBm] | Applicable Limit Average E.I.R.P. [dBm] |
|---|---|---|---|---|---|---|
| 1 | NM | $T_{nom}$ / $V_{nom}$ | 11.8 | 43 | 11.0 | 40 |
| 2 | NM | $T_{nom}$ / $V_{nom}$ | 11.6 | 43 | 10.9 | 40 |

**Verdict: Compliant**

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

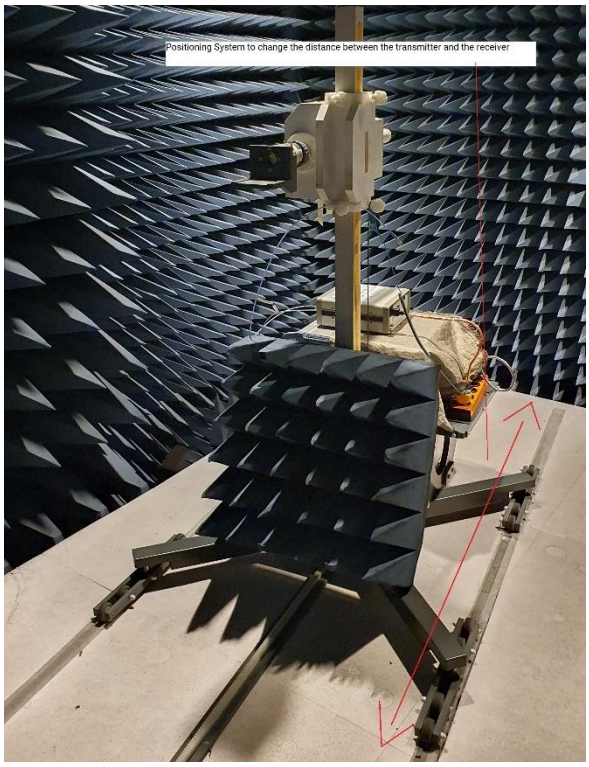
1) EUT emission measured with RF-detector:
   - Measurement distance: $d_{EUT}$
   - Maximum readout value on oscilloscope: $V_{max}$
   - Average (during the transmit interval) readout value on oscilloscope: $V_{average}$

2) Substitution of EUT by a cw reference source with a frequency of $f_{REF}$ and a fixed output power of $P_{REF}$
   - Readout value on oscilloscope adjusted to $V_{max}$ and $V_{average}$ by far field attenuation
   - Determination of measurement distance $d_{REF,max}$ and $d_{REF,average}$

3) Calculation of the Max E.I.R.P. of the EUT:
   - Free space loss: $FSL(d) = 20 \times \log(4 \times \pi \times d \times f / c)$, c: speed of light
   - Max E.I.R.P. = $P_{REF} - FSL(d_{REF,max}) + FSL(d_{EUT})$
   - Average E.I.R.P. = $P_{REF} - FSL(d_{REF,average}) + FSL(d_{EUT})$

| Measurement step | Measurement parameter | Unit | EUT | |
|---|---|---|---|---|
| | | | 1 | 2 |
| 1) | Measurement distance $d_{EUT}$ | [m] | 0.3 | 0.3 |
| | Maximum readout value $V_{max}$ | [mV] | 5.3 | 5.1 |
| | Average readout value $V_{average}$ | [mV] | 4.3 | 4.1 |
| 2) | Output power $P_{REF}$ | [dBm] | 27 | 27 |
| | Frequency $f_{REF}$ | [GHz] | 122.5 | 122.5 |
| | Measurement distance $d_{REF,max}$ | [m] | 1.73 | 1.76 |
| | Measurement distance $d_{REF,average}$ | [m] | 1.9 | 1.9 |
| 3) | Max E.I.R.P. | [dBm] | 11.8 | 11.6 |
| | Average E.I.R.P. | [dBm] | 11.0 | 10.9 |

**Setup of the substitution:**

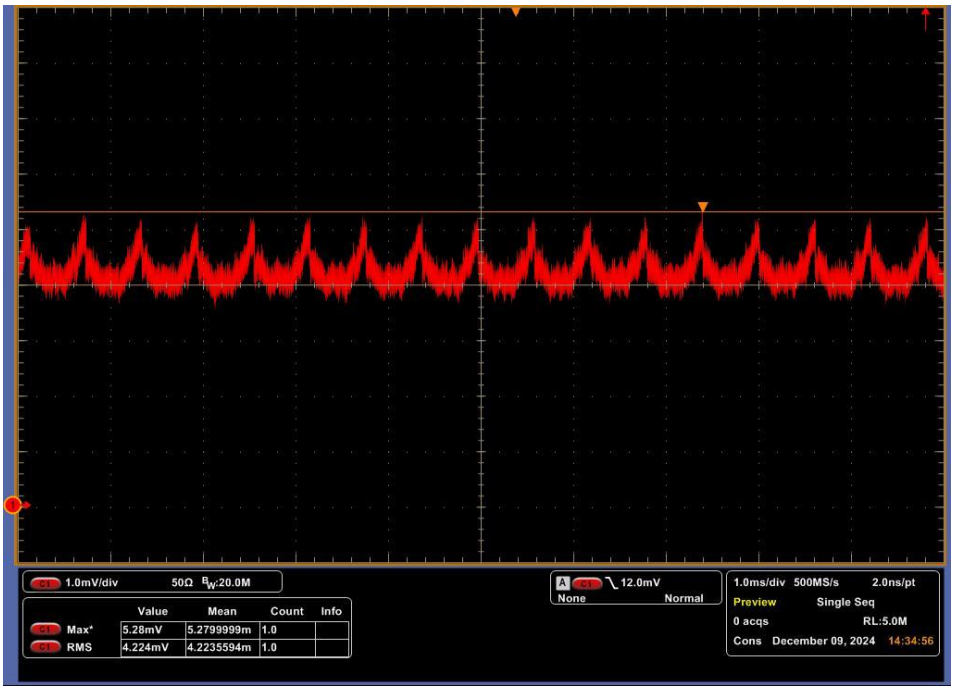




1) Synthesized Sweeper 10 MHz - 40 GHz

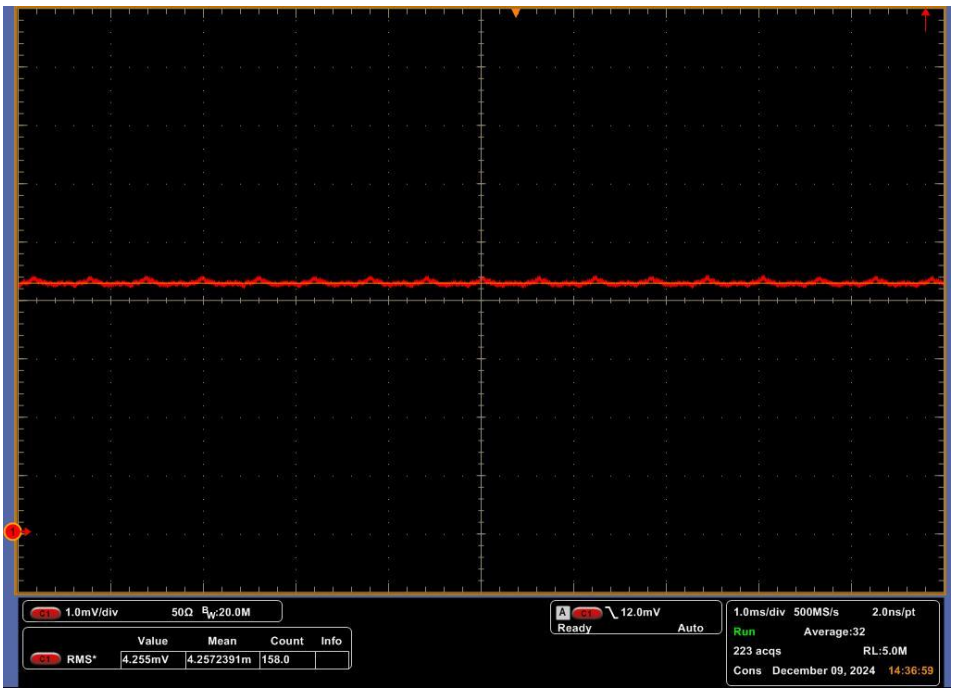
2) SG Extension Module 110 - 170 GHz & Std. Gain Horn Antenna 114-173 GHz

3) F-Band Positive Amplitude Detector & Waveguide Amplifier & Std. Gain Horn Antenna 90-140 GHz

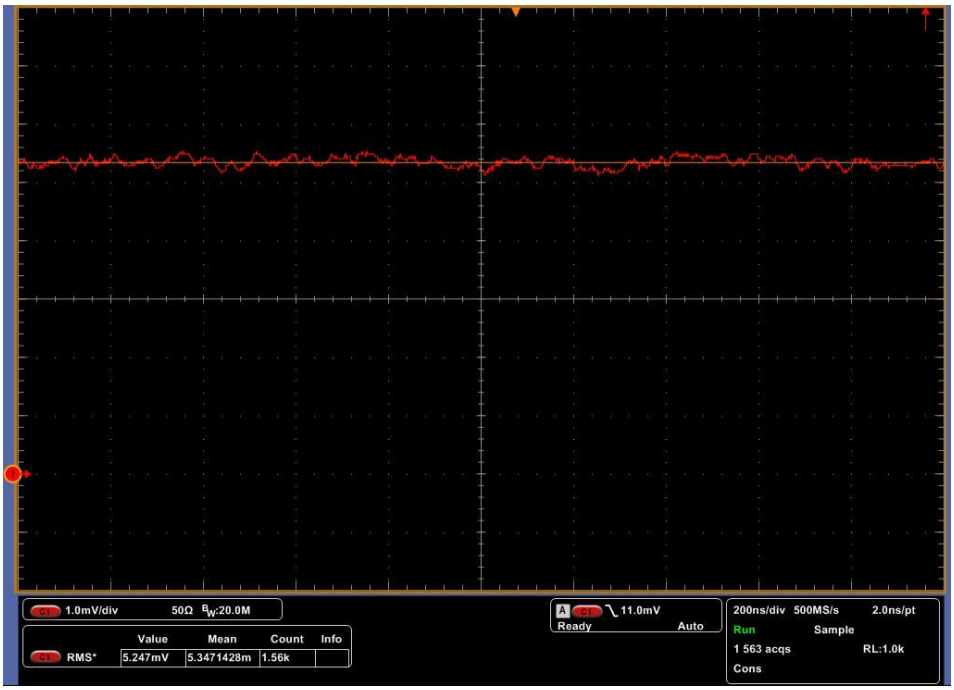
**Plot 3: EUT 1: Peak on 30 cm**



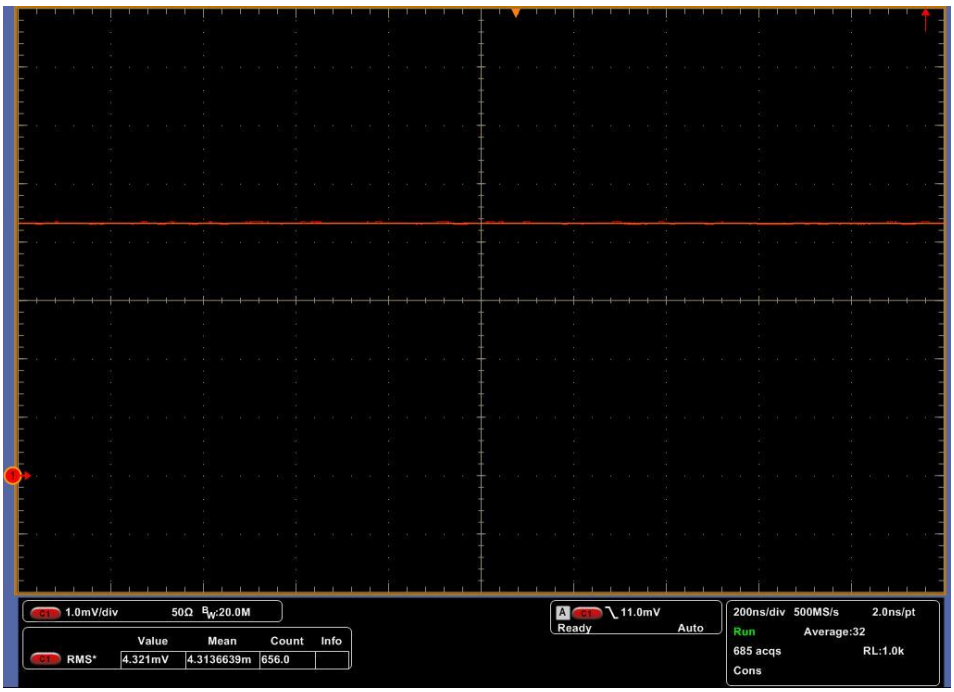

**Plot 4: EUT 1: Average on 30 cm**



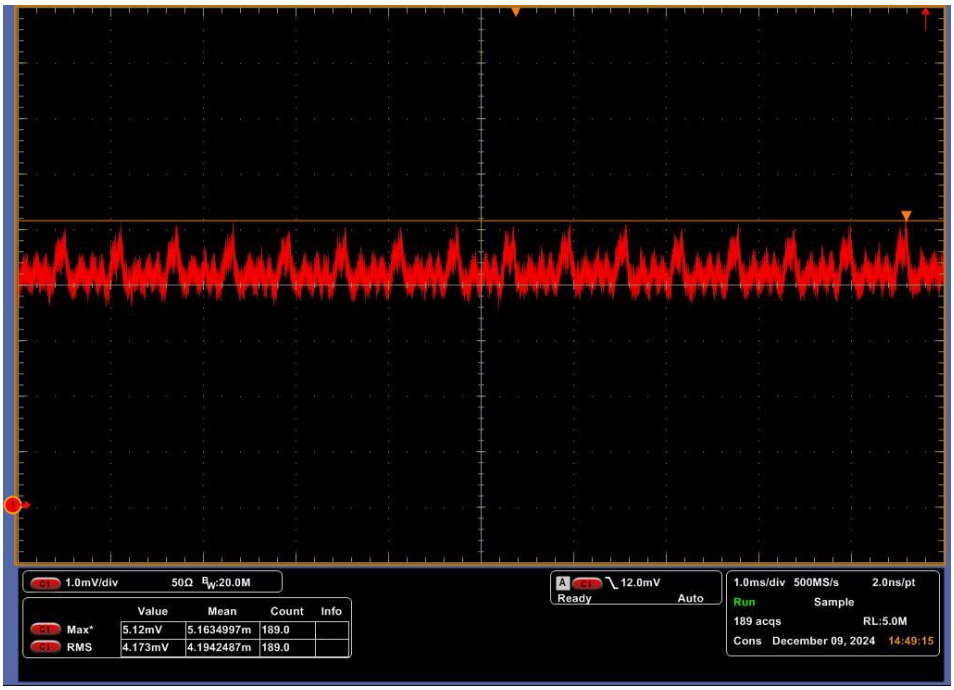
**Plot 5: CW for peak on 1.73 m**



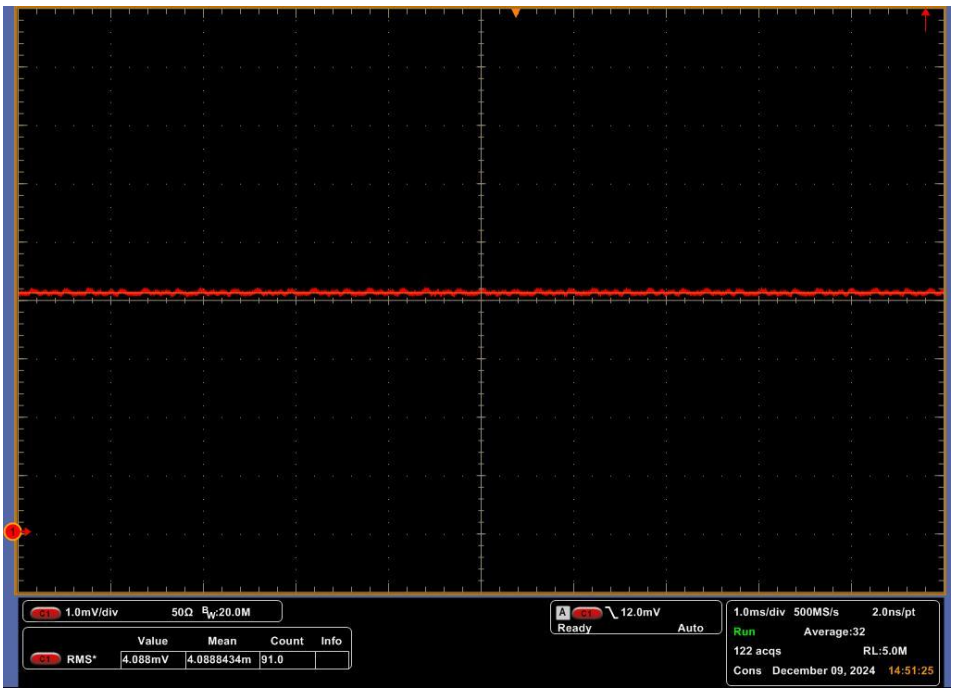

**Plot 6: CW for average on 1.9 m**



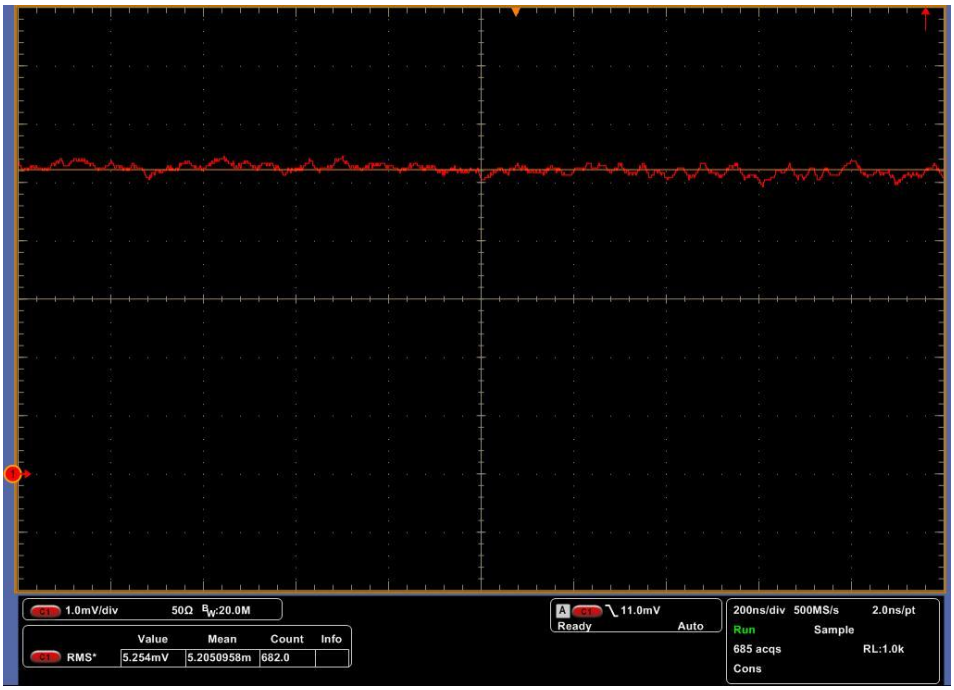
**Plot 7: EUT 2: Peak on 30 cm**



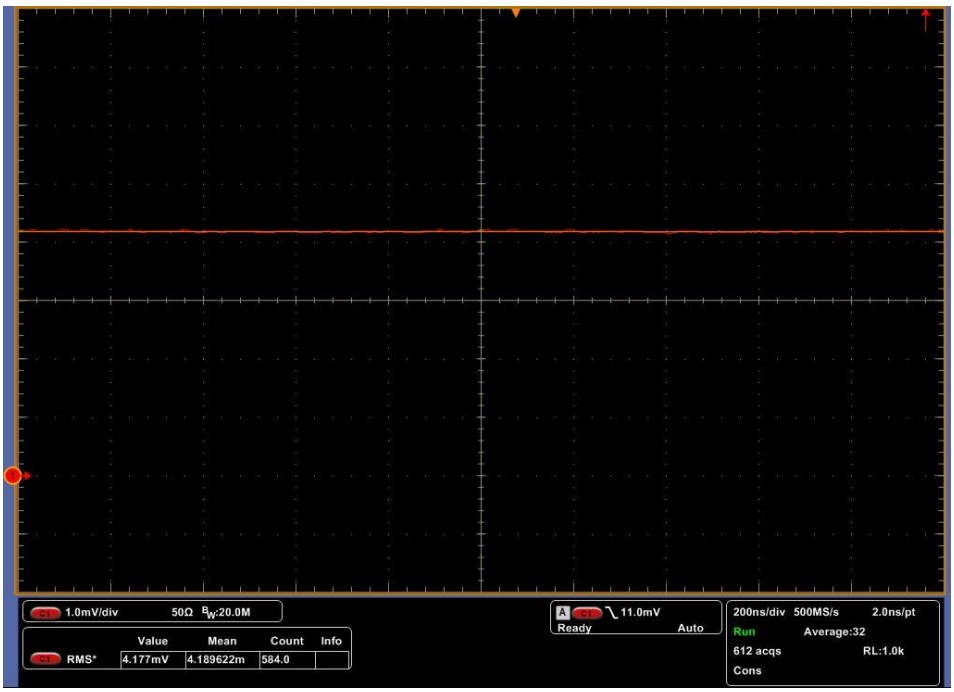

**Plot 8: EUT 2: Average on 30 cm**



**Plot 9: CW for peak on 1.76 m**




**Plot 10: CW for average on 1.91 m**



## 13.3 Spurious emissions radiated / Transmitter unwanted emissions

**Description:**

Measurement of the radiated spurious emissions / transmitter unwanted emissions.

**Limits and provisions:**

**§15.258 (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.

(3) Between 40 GHz and the highest frequency specified in § 15.33, the level of these emissions shall not exceed 90 pW/cm$^2$ at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

**FCC Part 15.33 (a)**
For an intentional radiator, the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(4) If the intentional radiator operates at or above 95 GHz: To the third harmonic of the highest fundamental frequency or to 750 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.

| §15.209(a) | | |
|---|---|---|
| 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 |
| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
| 30 – 88 | 100 | 3 |
| 88 – 216 | 150 | 3 |
| 216 – 960 | 200 | 3 |
| Above 960 | 500 | 3 |

**Limit conversion (ANSI C63.10-2020 9.2.3):**

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

- Power density at the distance specified by the limit: PD [W/m²]
- Equivalent isotropically radiated power: EIRP [dBm]
- Distance at which the power density limit is specified: d [m]

According to this formula, an emission limit of PD = 90 pW/cm² at a distance of d = 3 m corresponds to an equivalent isotropically radiated power of EIRP = -10 dBm.

**Measurement:**

| Measurement parameter | |
|---|---|
| Detector: | Quasi Peak / Pos-Peak / linear-AV / RMS |
| Resolution bandwidth: | F < 1 GHz: 100 kHz<br>F > 1 GHz: 1 MHz |
| Video bandwidth: | F < 1 GHz: 300 kHz<br>F > 1 GHz: 3 MHz |
| Trace-Mode: | Max Hold |

**Measurement results:**

Note:
(1) Measurements were performed in normal operation mode (frequency sweep) and in stop 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).

Normal operation mode:EUT 1

| Frequency [GHz] | Detector | Bandwidth [MHz] | Level | Limit | Margin [dB] |
|---|---|---|---|---|---|
| 0.359 | QP | 0.12 | 33.9 dBuV/m | 36.0 dBuV/m | 2.1 |
| Please refer to the following plots for more information on the level of spurious emissions | | | | | |

Normal operation mode:EUT 2

| Frequency [GHz] | Detector | Bandwidth [MHz] | Level | Limit | Margin [dB] |
|---|---|---|---|---|---|
| 0.359 | QP | 0.12 | 35.3 dBuV/m | 36.0 dBuV/m | 0.7 |
| Please refer to the following plots for more information on the level of spurious emissions | | | | | |

Stop mode, low frequency:

| Frequency [GHz] | Detector | Bandwidth [MHz] | Level | Limit | Margin [dB] |
|---|---|---|---|---|---|
| -/- | -/- | 1 | -/- | -/- | -/- |
| Please refer to the following plots for more information on the level of spurious emissions | | | | | |

Stop mode, middle frequency:

| Frequency [GHz] | Detector | Bandwidth [MHz] | Level | Limit | Margin [dB] |
|---|---|---|---|---|---|
| -/- | -/- | 1 | -/- | -/- | -/- |
| Please refer to the following plots for more information on the level of spurious emissions | | | | | |

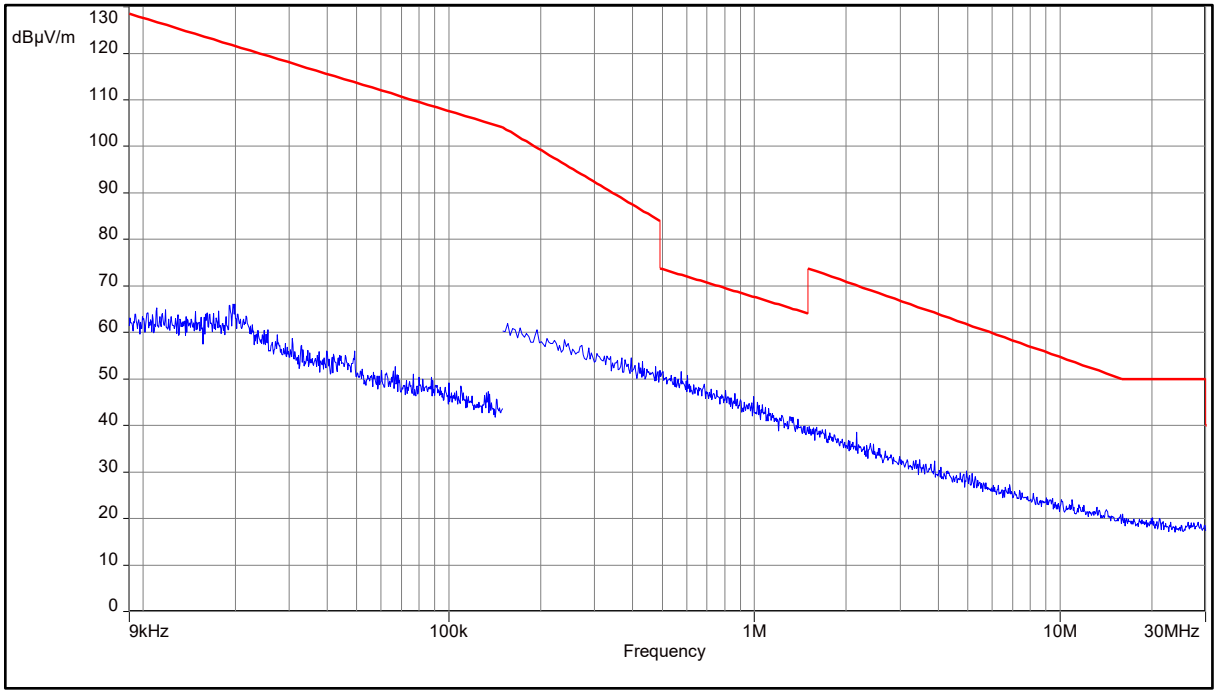
Stop mode, high frequency:

| Frequency [GHz] | Detector | Bandwidth [MHz] | Level | Limit | Margin [dB] |
|---|---|---|---|---|---|
| -/- | -/- | 1 | -/- | -/- | -/- |
| Please refer to the following plots for more information on the level of spurious emissions | | | | | |

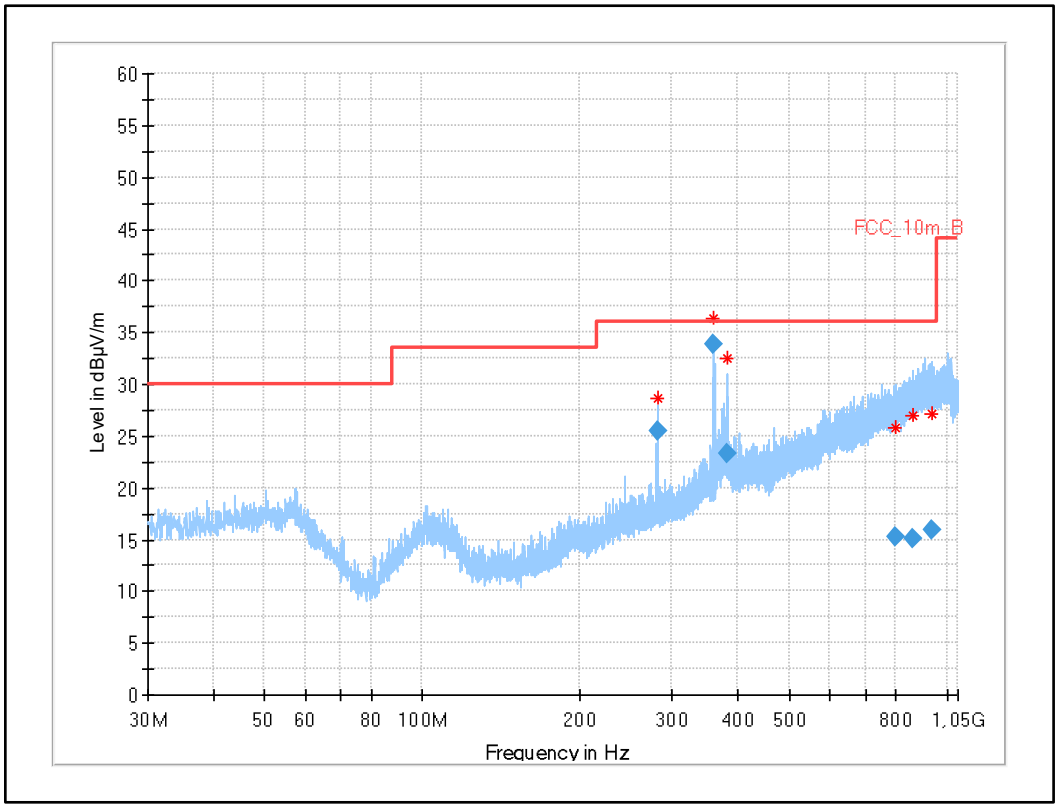
**Verdict: Compliant**

### 13.3.1 EUT 1 normal mode

**Plot 11: 9 kHz – 30 MHz, normal operation mode**

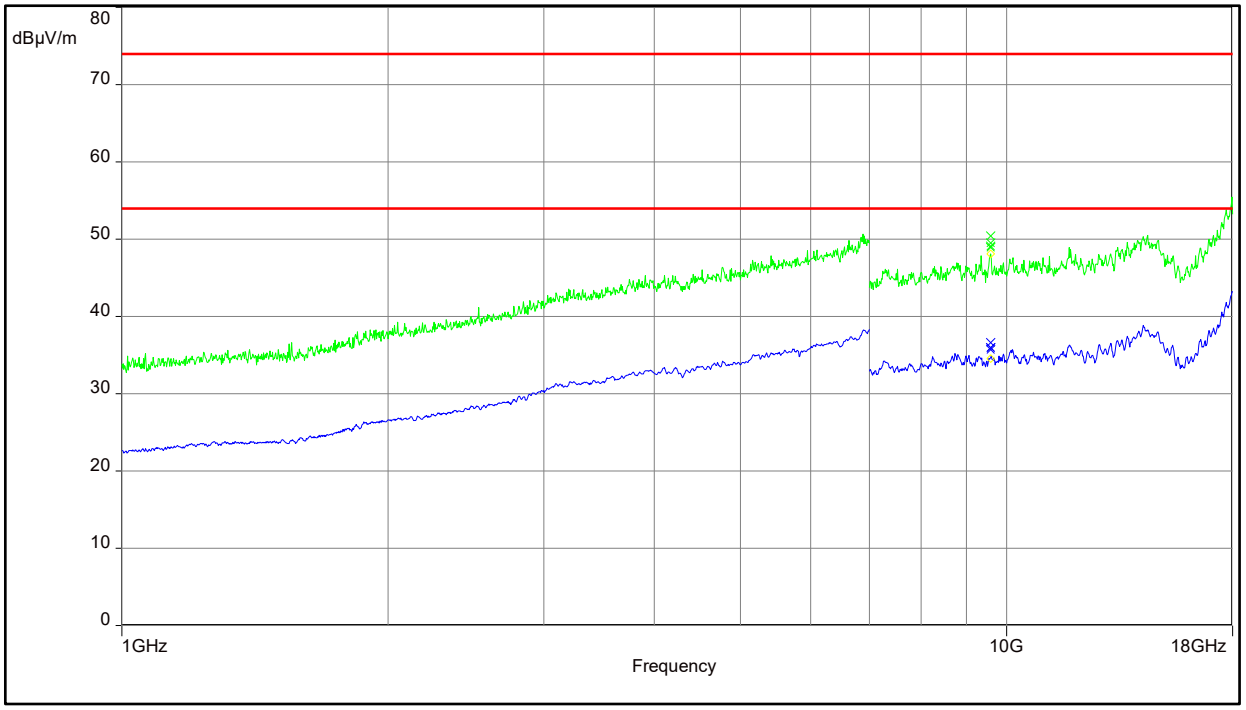


**Plot 12: 30 MHz – 1GHz, normal operation mode**

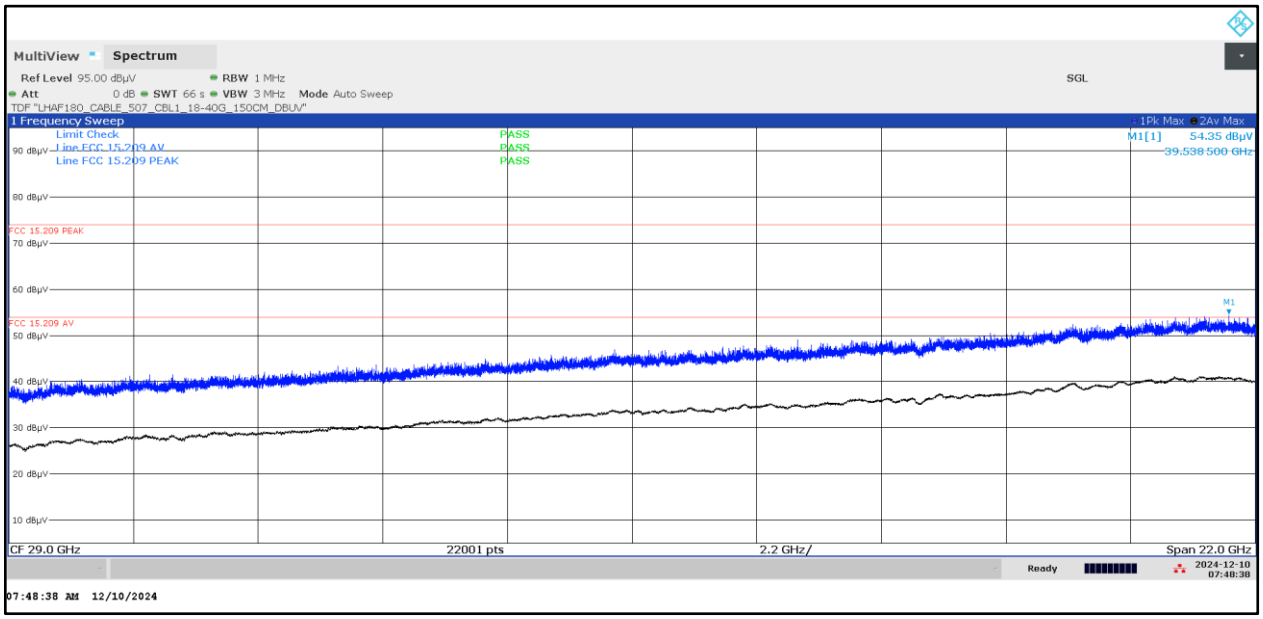



| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 280.848 | 25.43 | 36.0 | 10.6 | 1000 | 120.0 | 320.0 | V | 131 | 15 |
| 359.996 | 33.91 | 36.0 | 2.1 | 1000 | 120.0 | 234.0 | H | 100 | 17 |
| 381.922 | 23.35 | 36.0 | 12.7 | 1000 | 120.0 | 291.0 | V | 109 | 17 |
| 795.783 | 15.23 | 36.0 | 20.8 | 1000 | 120.0 | 400.0 | V | 87 | 24 |
| 863.414 | 15.05 | 36.0 | 21.0 | 1000 | 120.0 | 292.0 | H | 106 | 25 |
| 936.343 | 15.91 | 36.0 | 20.1 | 1000 | 120.0 | 200.0 | V | 283 | 25 |

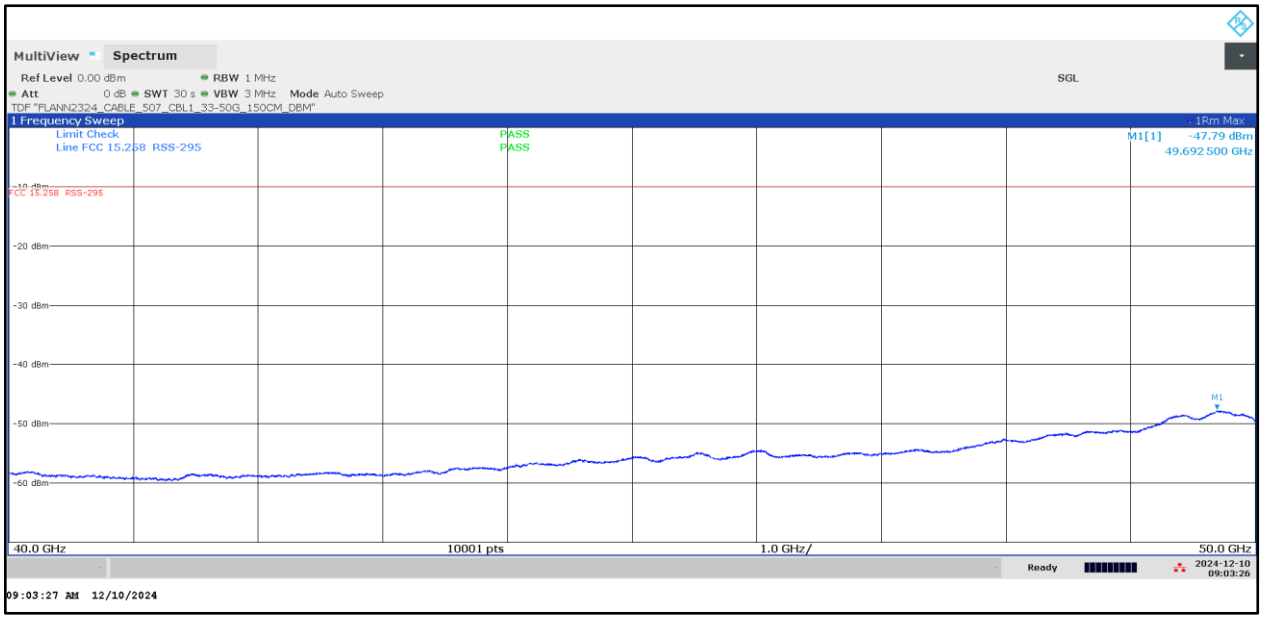
**Plot 13: 1GHz – 18 GHz, normal operation mode**



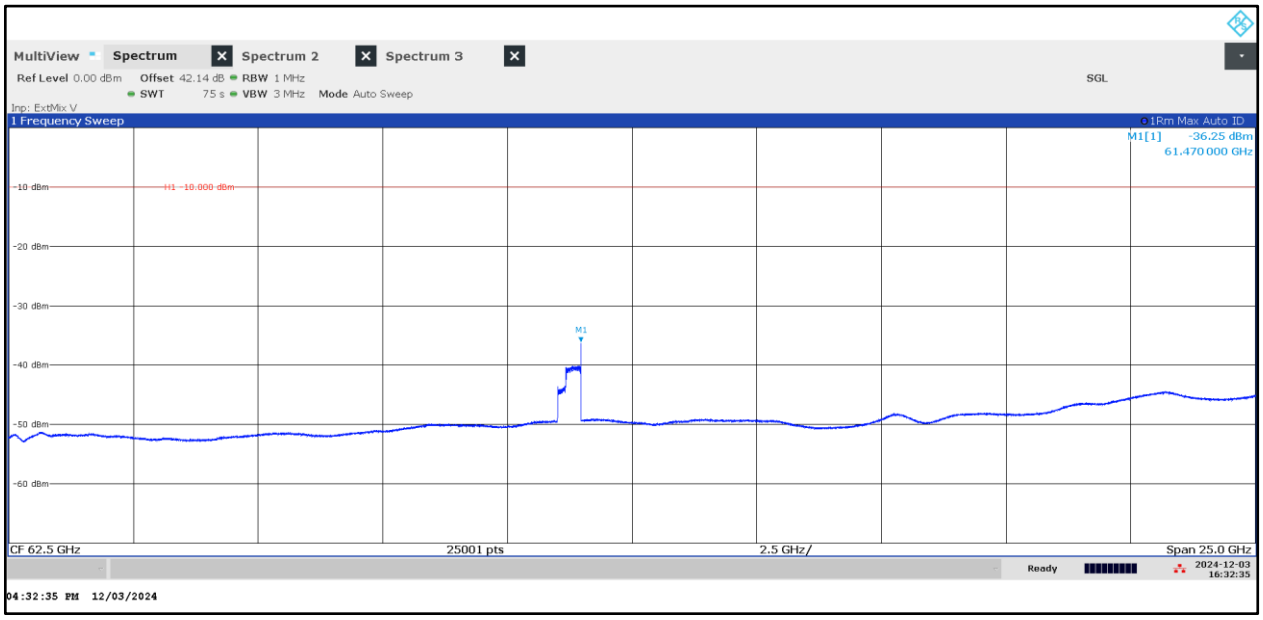

**Plot 14: 18 GHz – 40 GHz, normal operation mode**



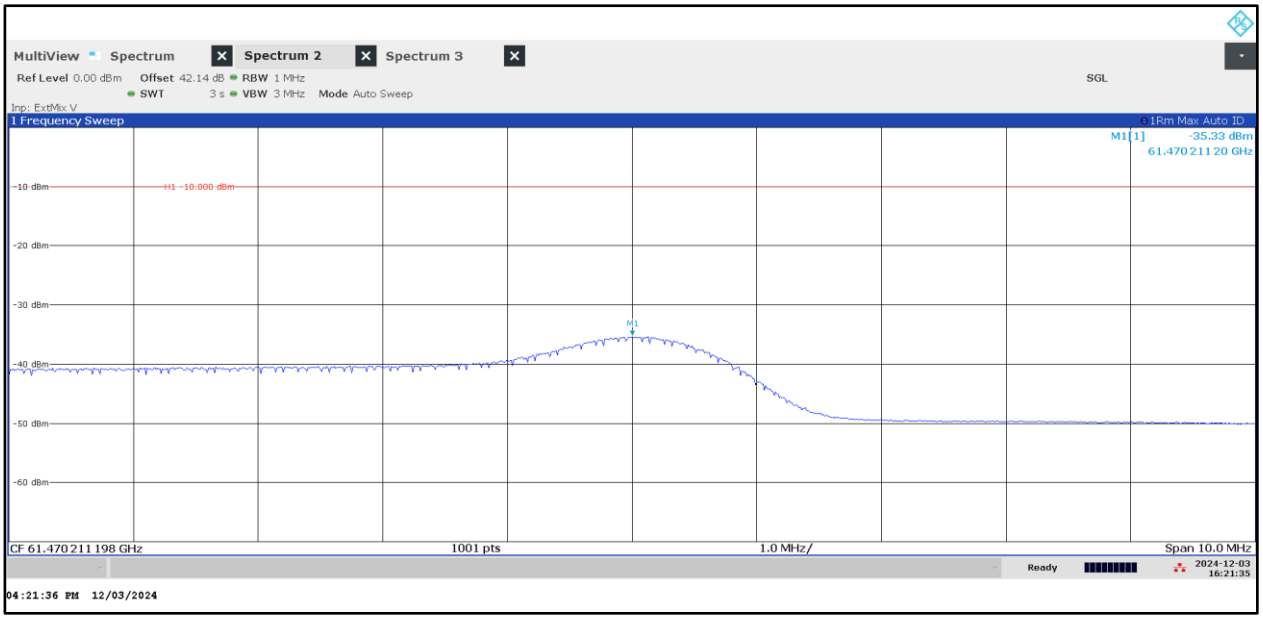
**Plot 15: 40 GHz – 50 GHz, normal operation mode**



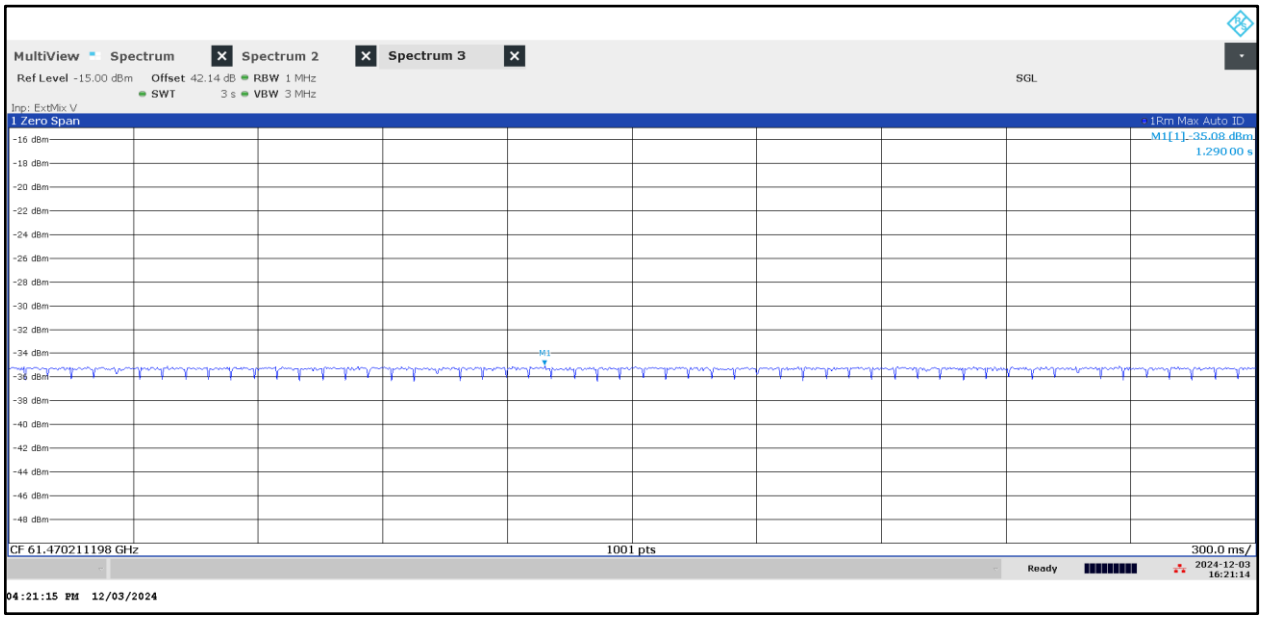

**Plot 16: 50 GHz – 75 GHz, normal operation mode**



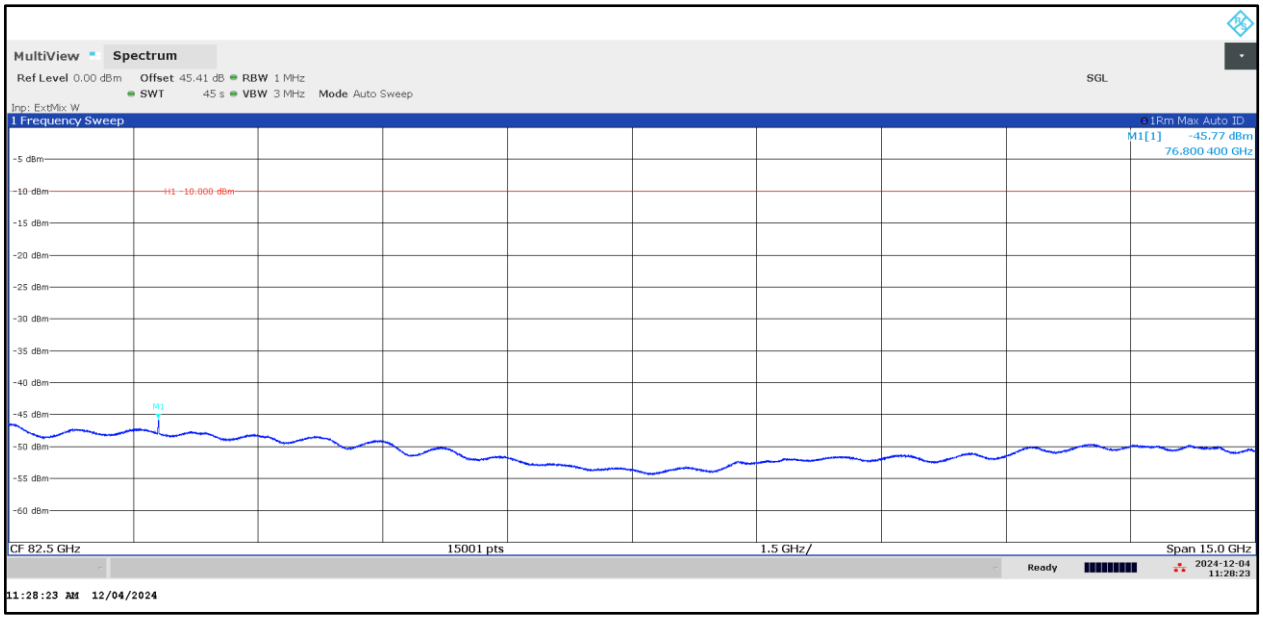
**Plot 17: 61 GHz, normal operation mode 10 MHz span**



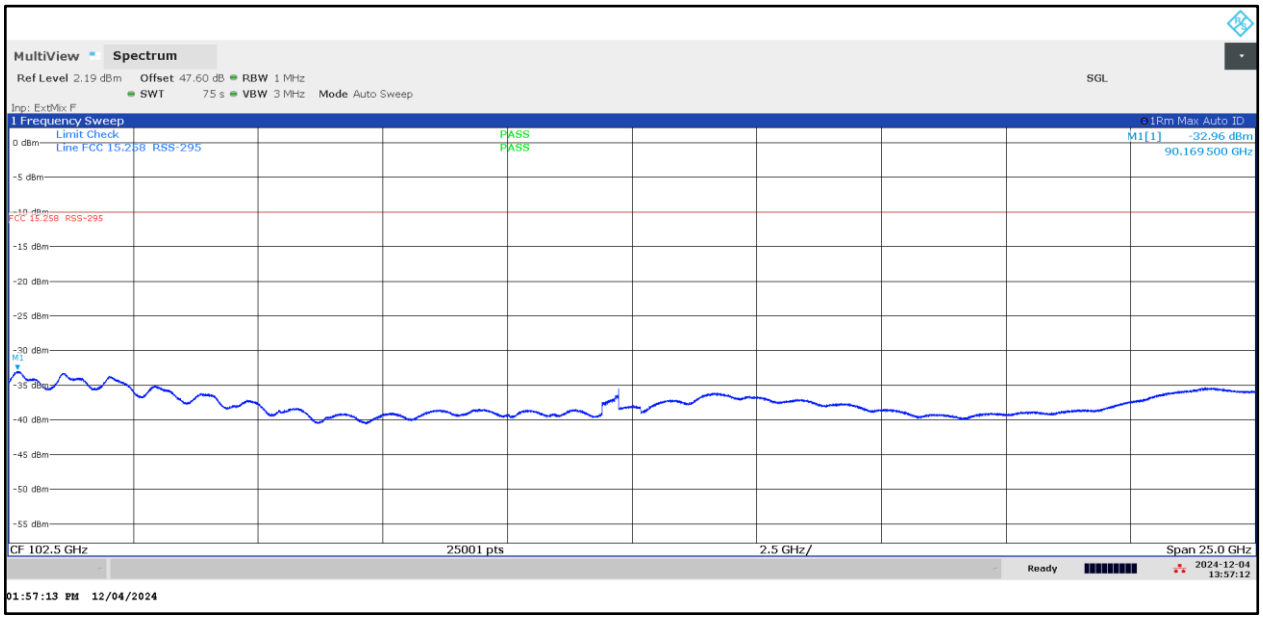

**Plot 18: 61 GHz, normal operation mode zero span**



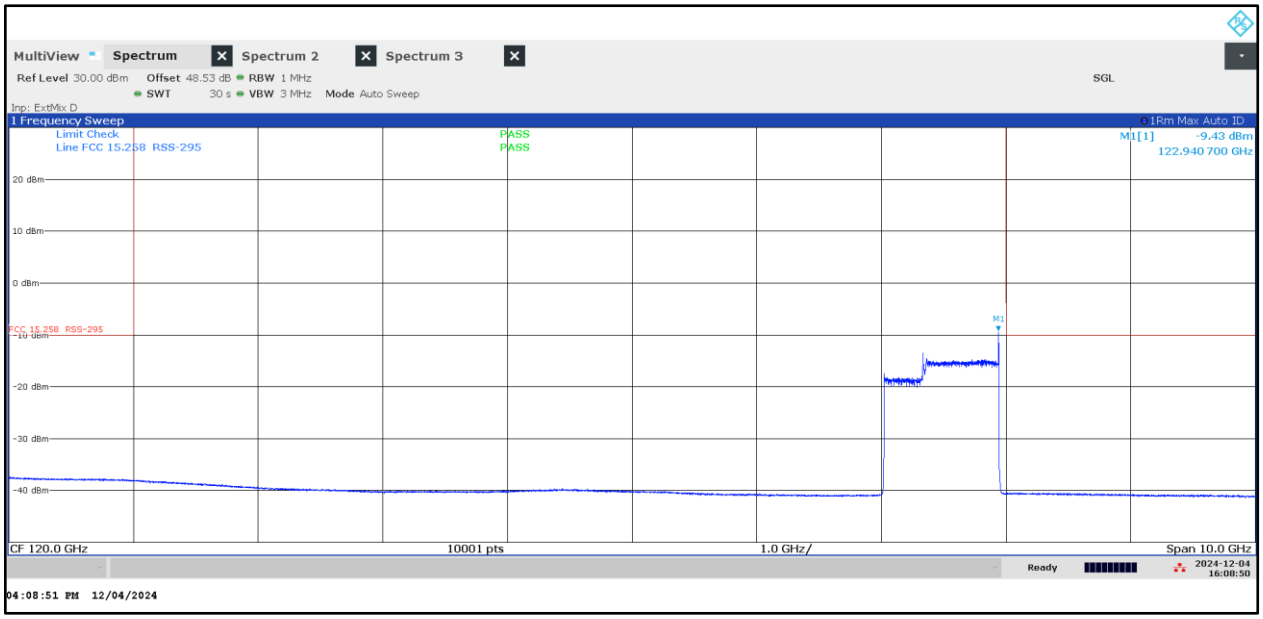
**Plot 19: 75 GHz – 90 GHz, normal operation mode**



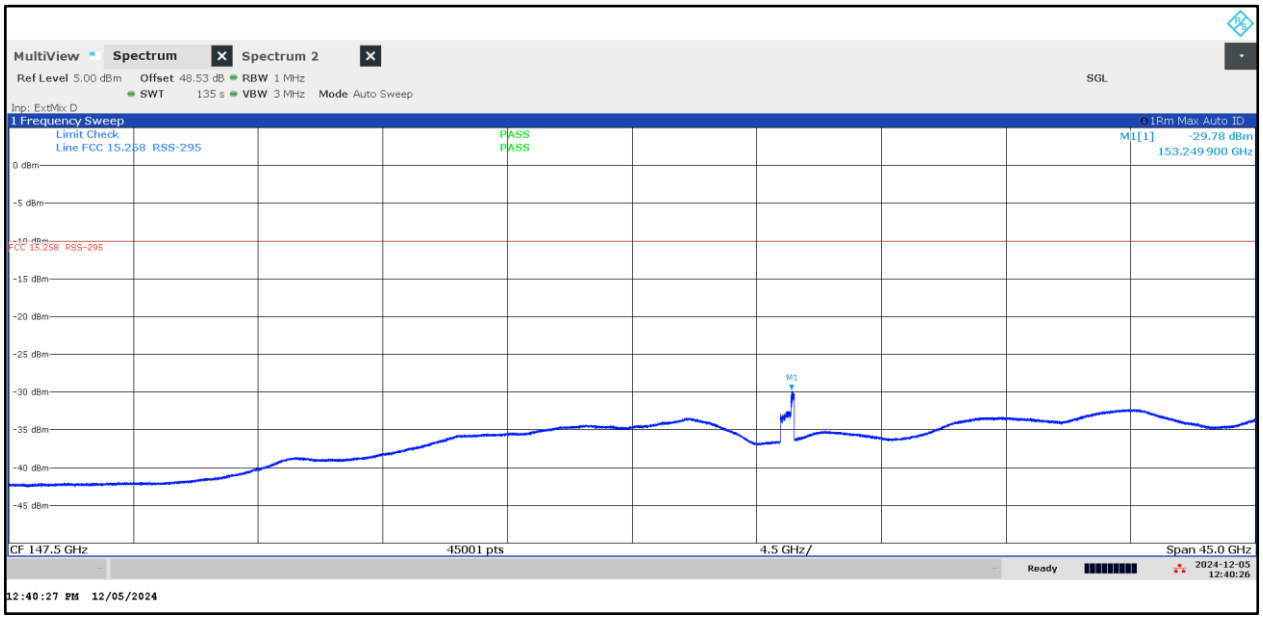

**Plot 20: 90 GHz – 115 GHz, normal operation mode**



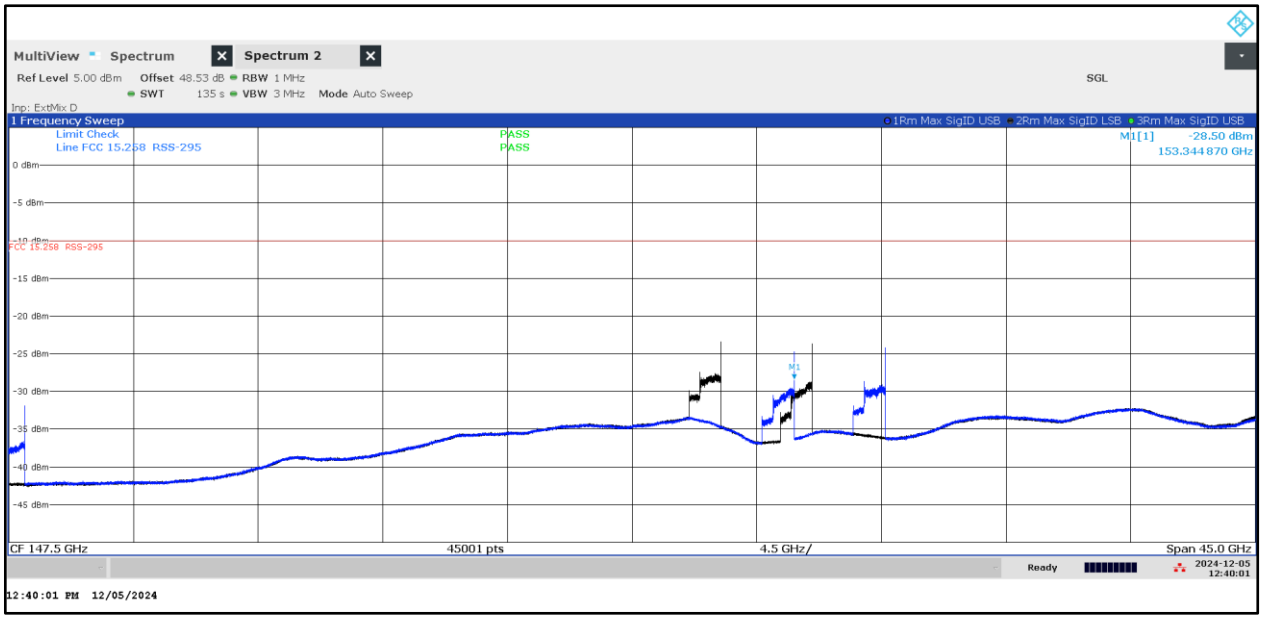
**Plot 21: 115 GHz – 125 GHz, normal operation mode**




**Plot 22: 125 GHz – 170 GHz, normal operation mode**



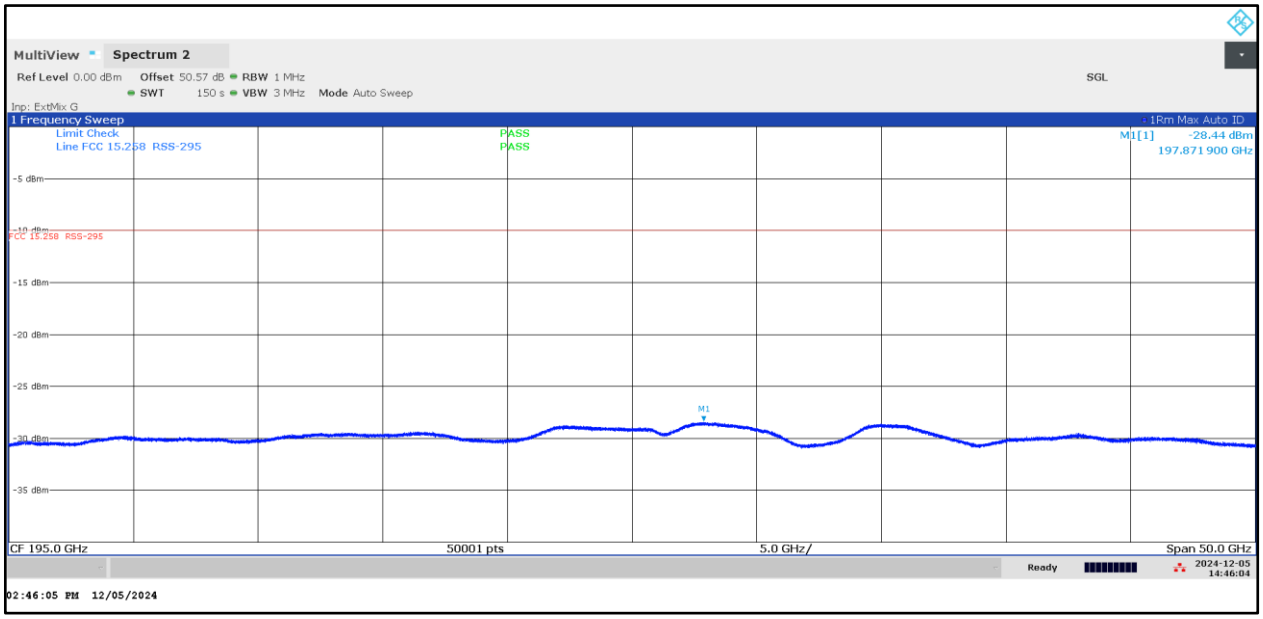
**Plot 23: 125 GHz – 170 GHz, normal operation mode with Signal ID**



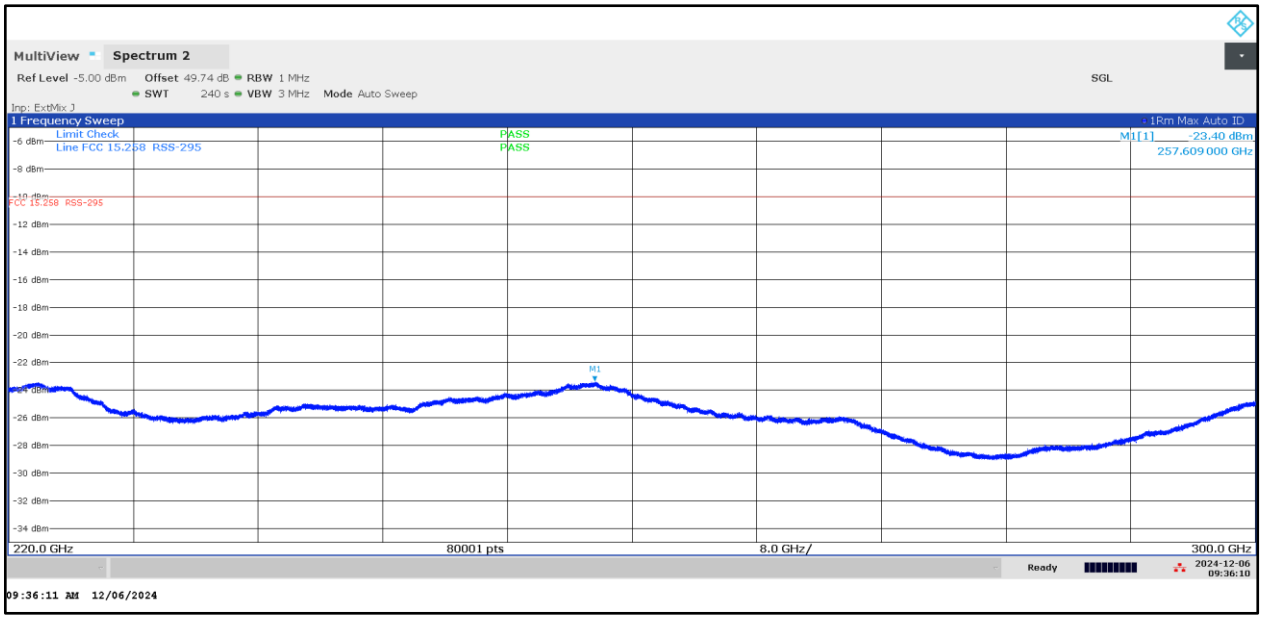

Note:

- The analysis shows that the signal is produced by the mixer and not by the EUT

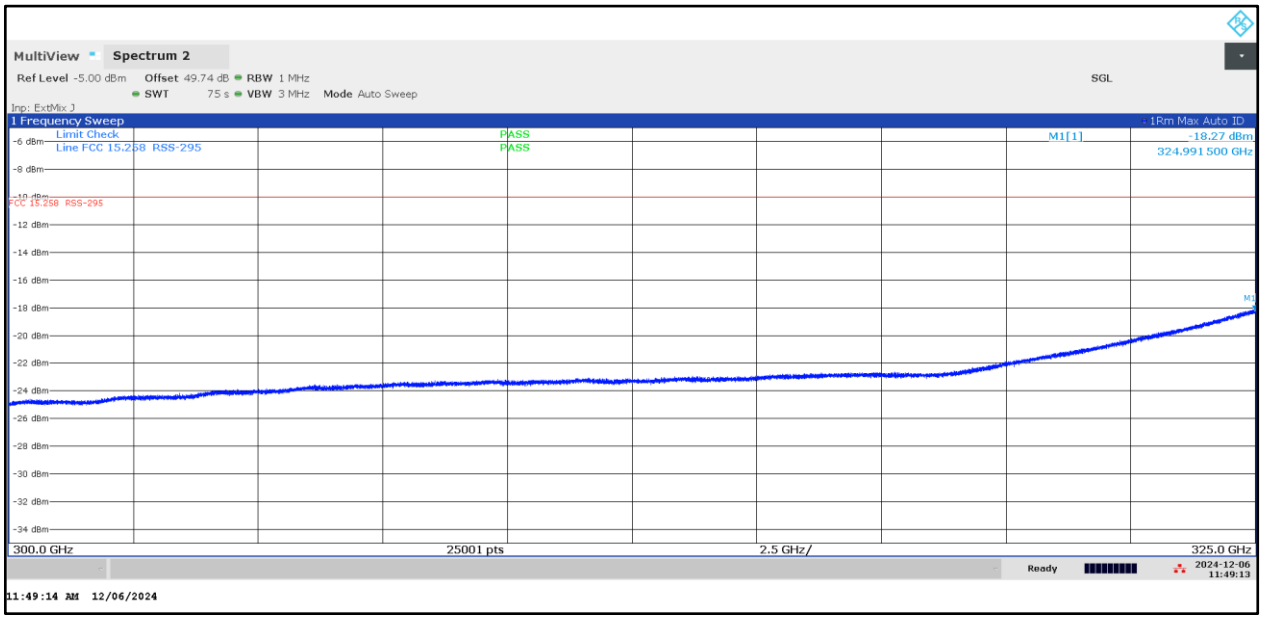
**Plot 24: 170 GHz – 220 GHz, normal operation mode**



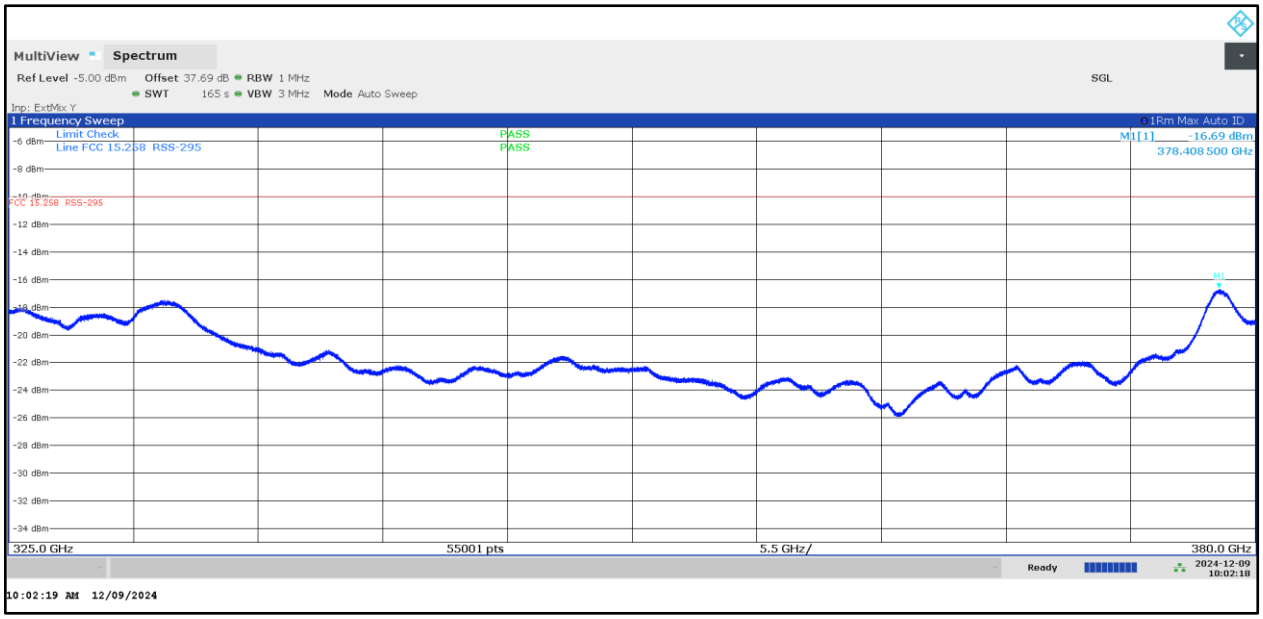
**Plot 25: 220 GHz – 300 GHz, normal operation mode**




**Plot 26: 300 GHz – 325 GHz, normal operation mode**

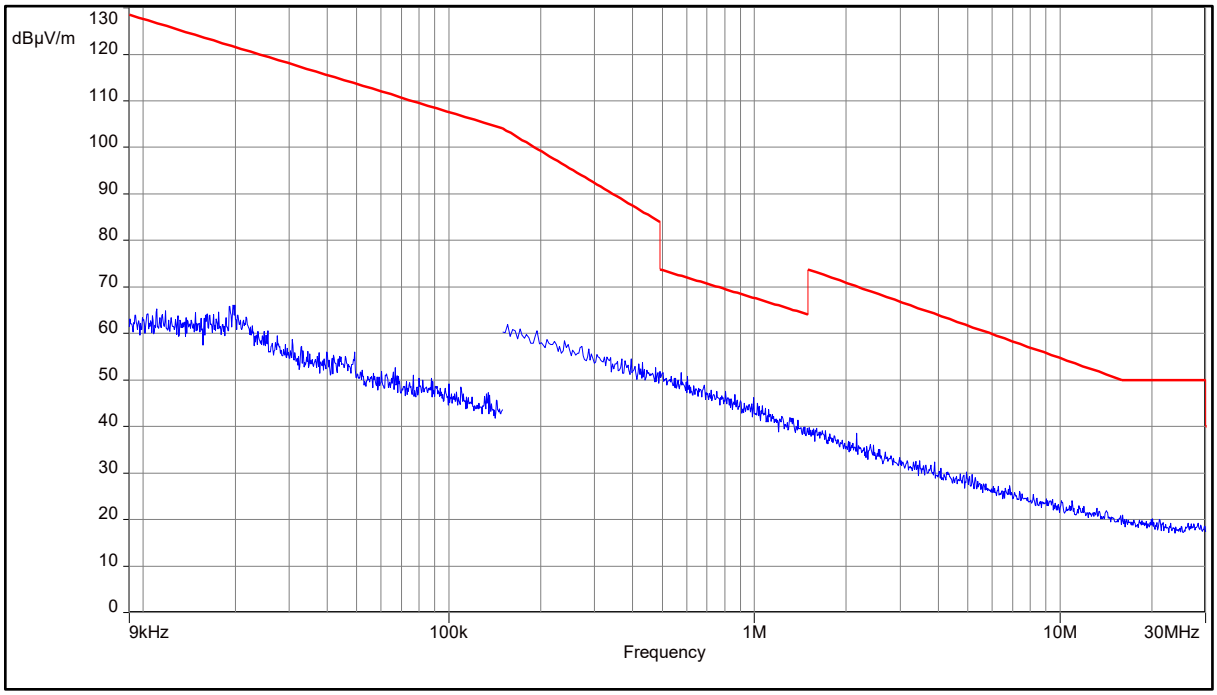


**Plot 27: 325 GHz – 380 GHz, normal operation mode**

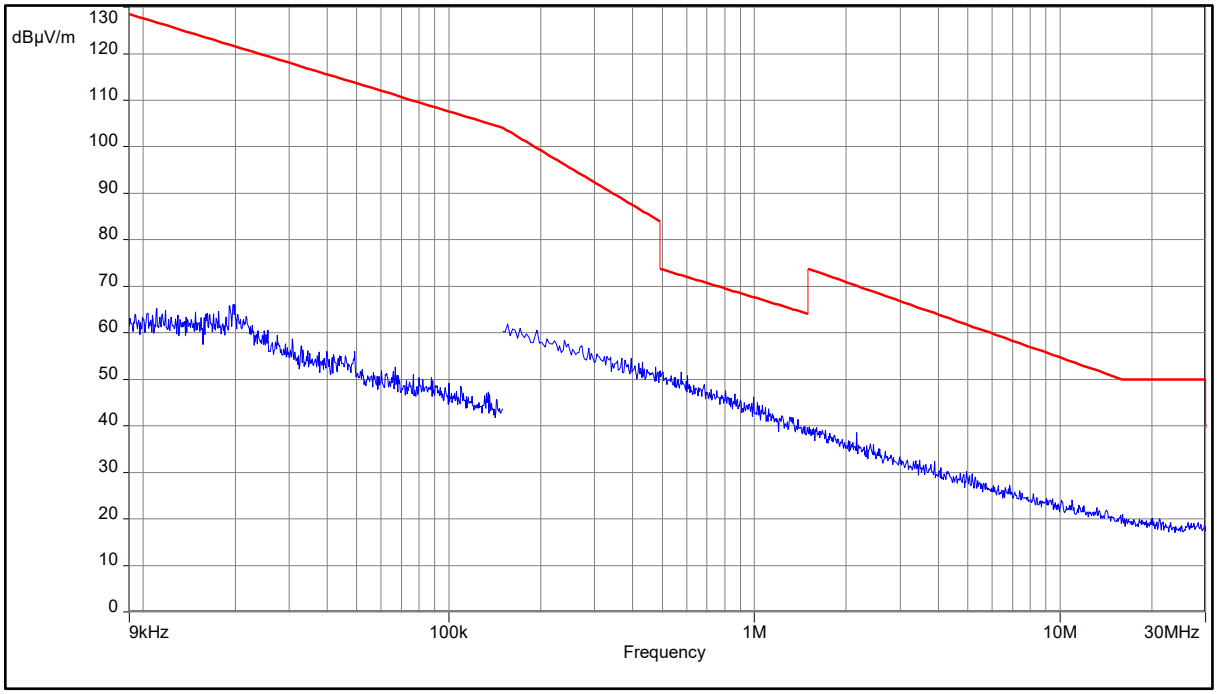


### 13.3.2 EUT 1 stop mode

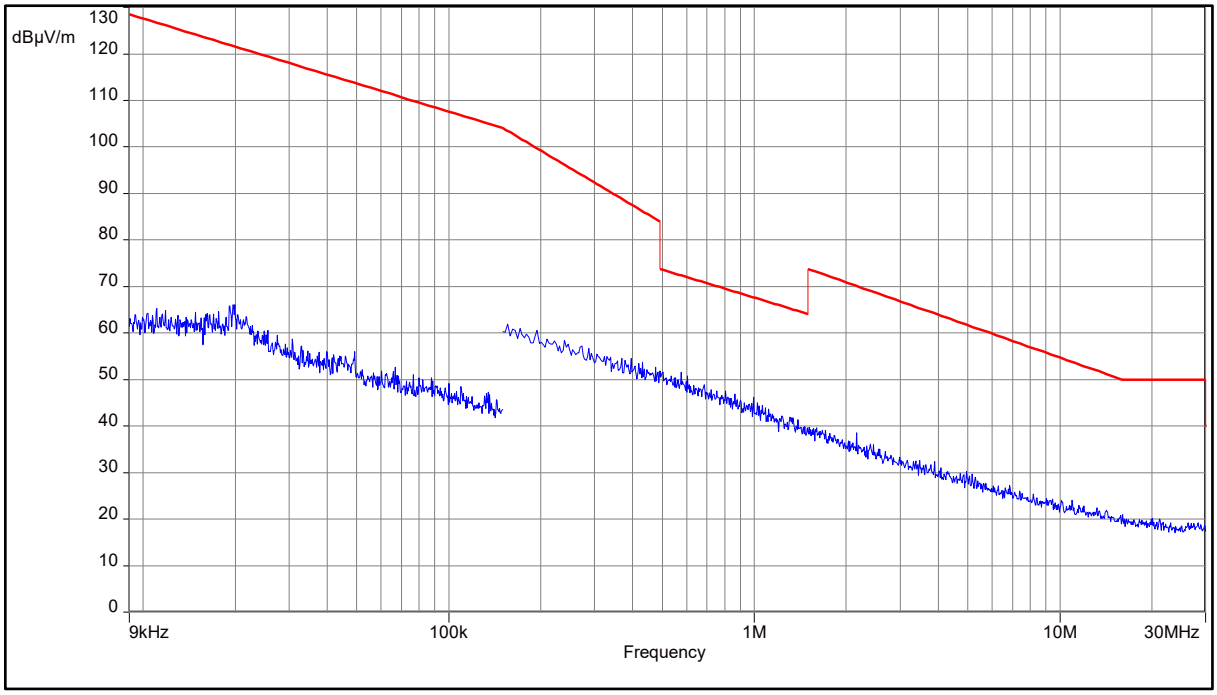
**Plot 28: 9 kHz – 30 MHz, stop mode, low frequency**



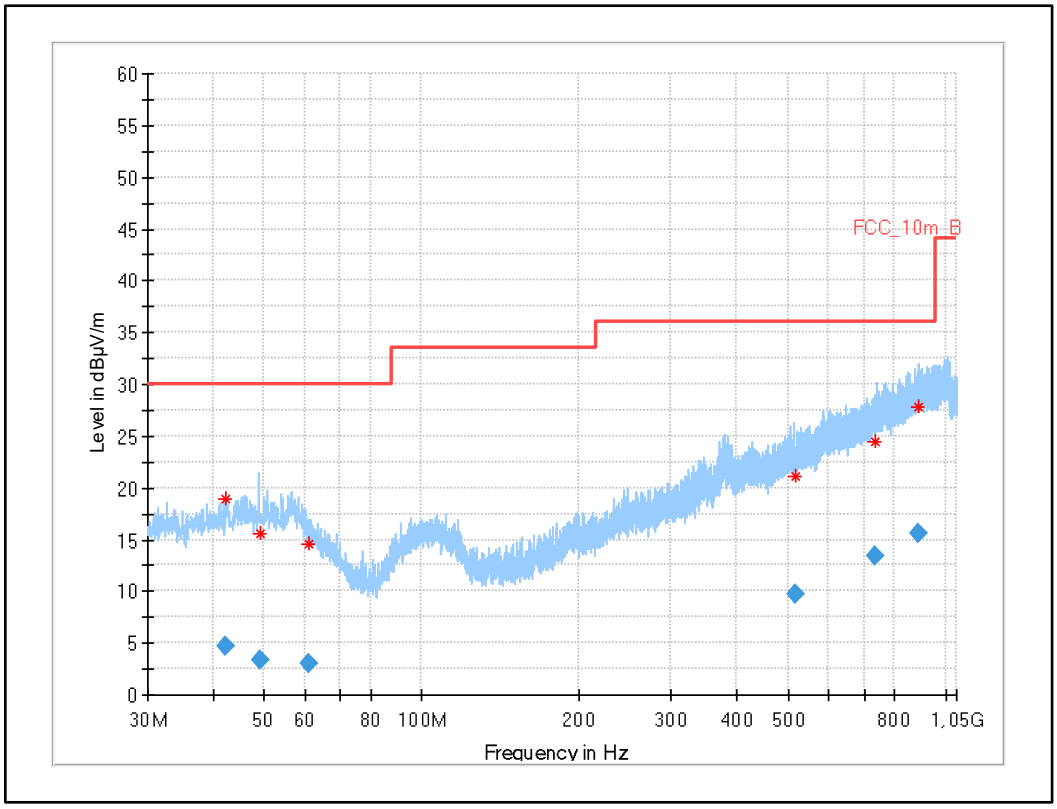

**Plot 29: 9 kHz – 30 MHz, stop mode, middle frequency**



**Plot 30: 9 kHz – 30 MHz, stop mode, high frequency**

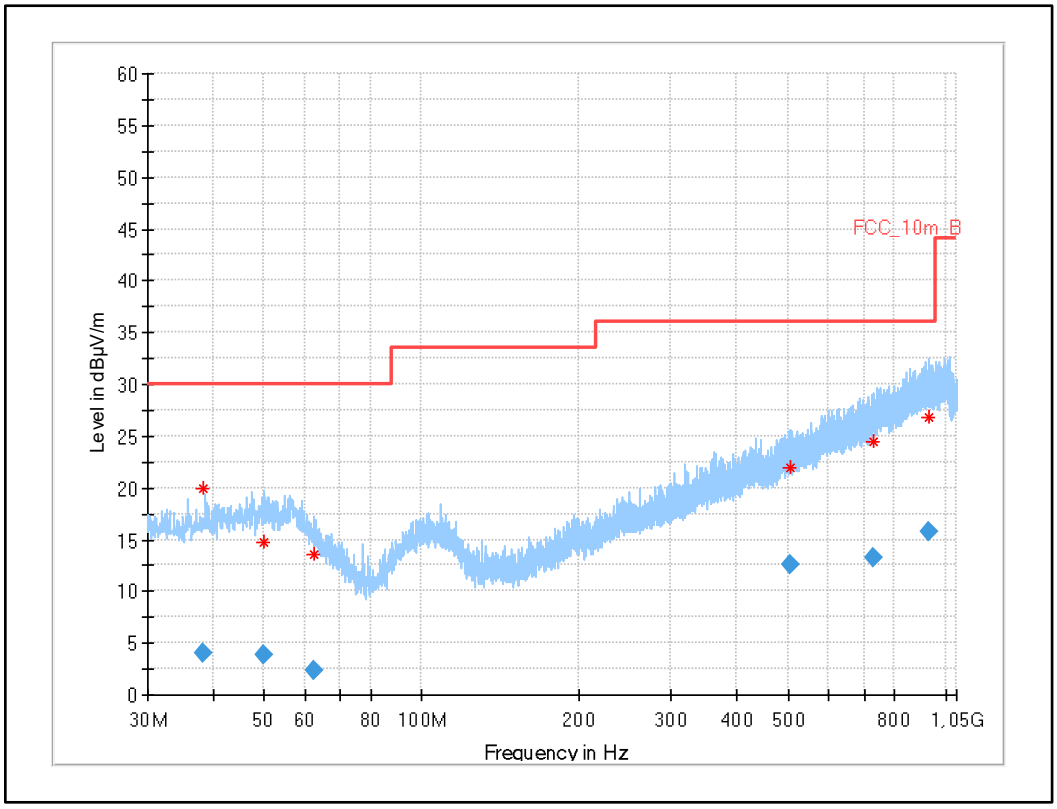


**Plot 31: 30 MHz – 1GHz, stop mode, low frequency**



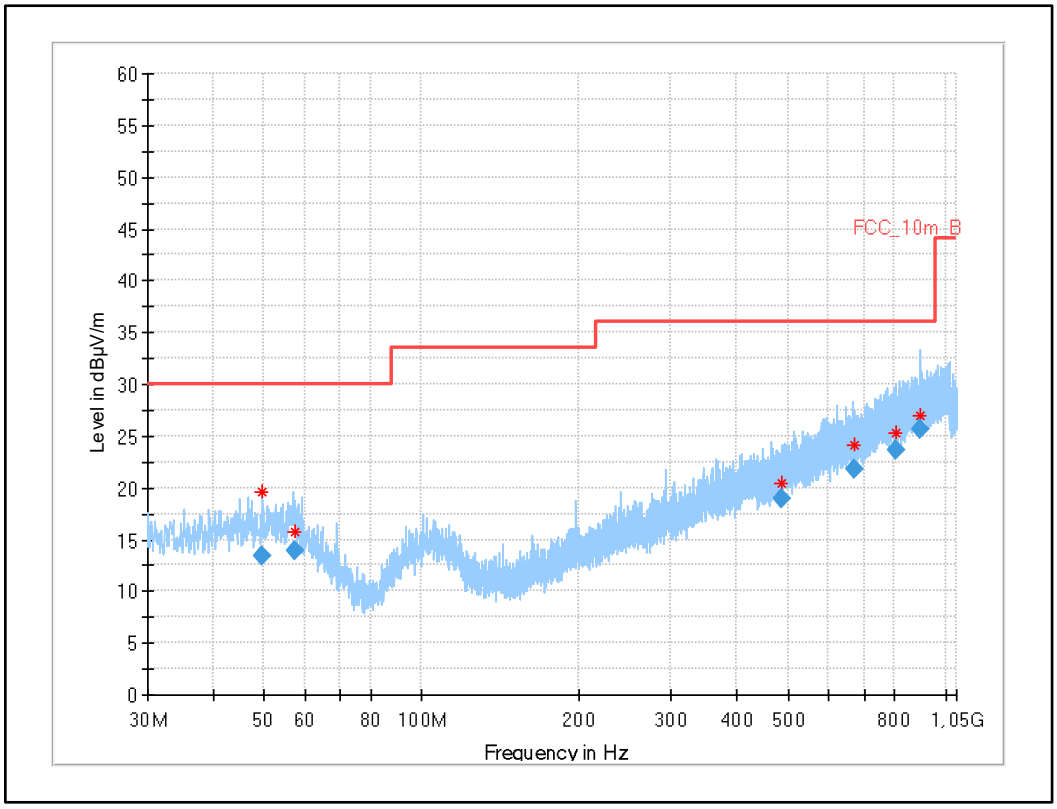

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 42.336 | 4.68 | 30.0 | 25.3 | 1000 | 120.0 | 183.0 | V | 275 | 15 |
| 49.386 | 3.27 | 30.0 | 26.7 | 1000 | 120.0 | 338.0 | V | 115 | 15 |
| 61.012 | 3.08 | 30.0 | 26.9 | 1000 | 120.0 | 121.0 | V | 41 | 13 |
| 515.544 | 9.77 | 36.0 | 26.2 | 1000 | 120.0 | 400.0 | V | -26 | 20 |
| 733.471 | 13.37 | 36.0 | 22.6 | 1000 | 120.0 | 340.0 | H | 36 | 23 |
| 887.000 | 15.61 | 36.0 | 20.4 | 1000 | 120.0 | 200.0 | V | 84 | 25 |

**Plot 32: 30 MHz – 1GHz, stop mode, middle frequency**



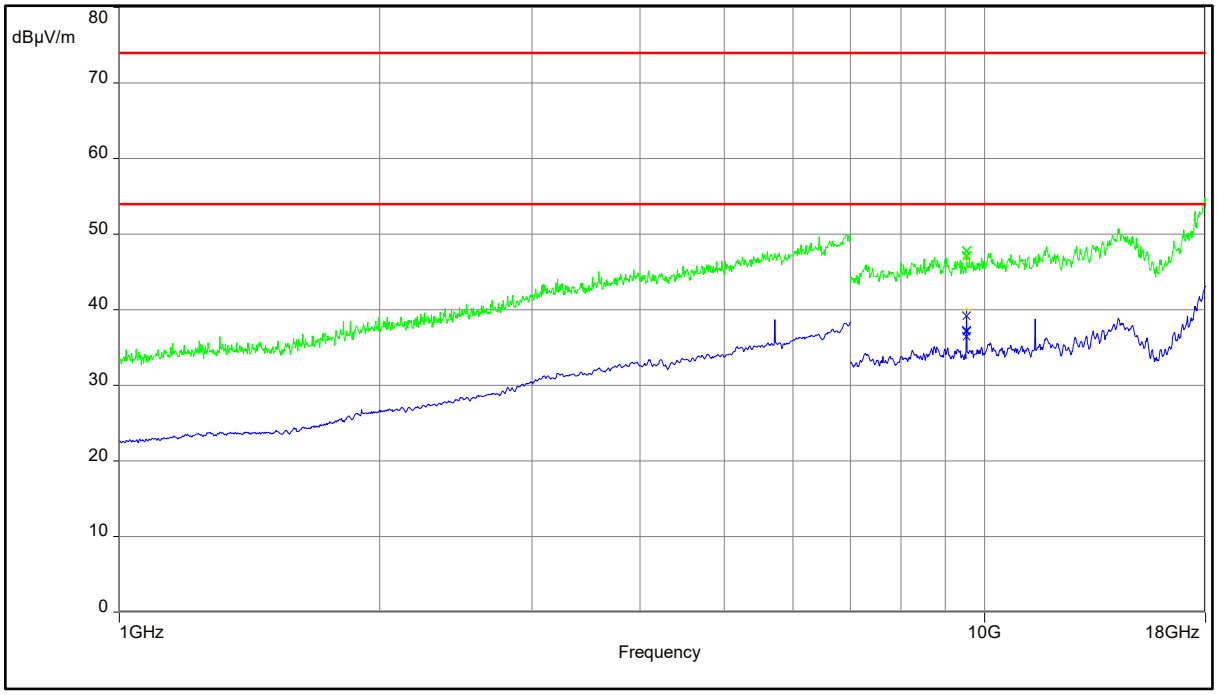

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 38.165 | 3.97 | 30.0 | 26.0 | 1000 | 120.0 | 322.0 | H | 233 | 14 |
| 50.048 | 3.85 | 30.0 | 26.2 | 1000 | 120.0 | 280.0 | H | 57 | 15 |
| 62.222 | 2.28 | 30.0 | 27.7 | 1000 | 120.0 | 330.0 | V | 261 | 13 |
| 504.032 | 12.62 | 36.0 | 23.4 | 1000 | 120.0 | 216.0 | H | 245 | 20 |
| 728.330 | 13.19 | 36.0 | 22.8 | 1000 | 120.0 | 224.0 | V | 57 | 23 |
| 928.406 | 15.77 | 36.0 | 20.2 | 1000 | 120.0 | 200.0 | V | 271 | 25 |

**Plot 33: 30 MHz – 1GHz, stop mode, high frequency**

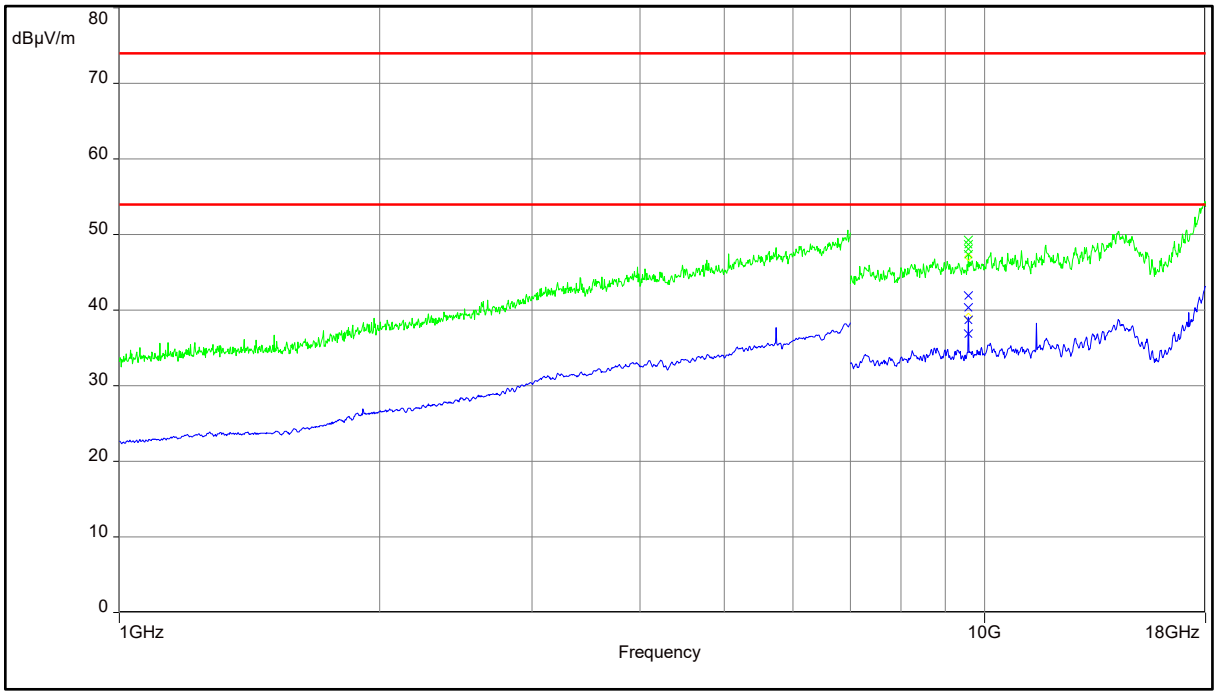



| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 49.516 | 13.39 | 30.0 | 16.6 | 1000 | 120.0 | 134.0 | V | -24 | 15 |
| 57.231 | 13.84 | 30.0 | 16.2 | 1000 | 120.0 | 195.0 | H | 7 | 15 |
| 487.201 | 19.01 | 36.0 | 17.0 | 1000 | 120.0 | 195.0 | V | -30 | 19 |
| 670.190 | 21.73 | 36.0 | 14.3 | 1000 | 120.0 | 195.0 | H | 260 | 22 |
| 803.075 | 23.62 | 36.0 | 12.4 | 1000 | 120.0 | 195.0 | H | 166 | 24 |
| 898.205 | 25.57 | 36.0 | 10.4 | 1000 | 120.0 | 195.0 | V | 276 | 25 |

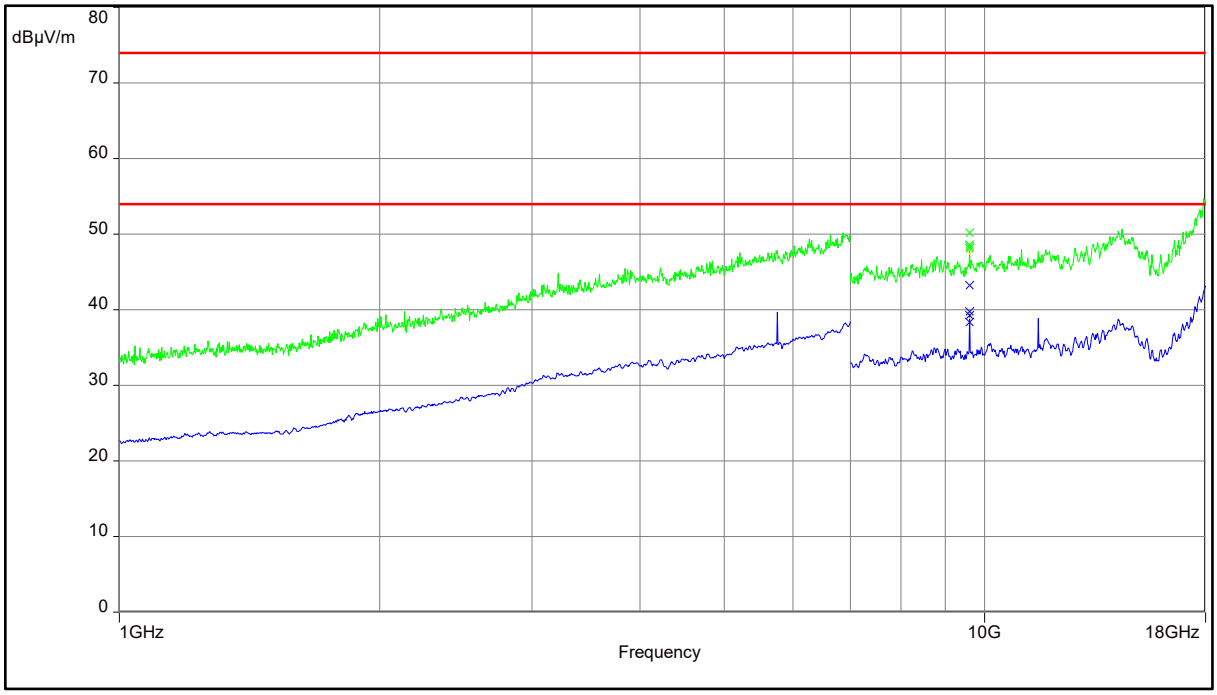
**Plot 34: 1GHz – 18 GHz, stop mode, low frequency**



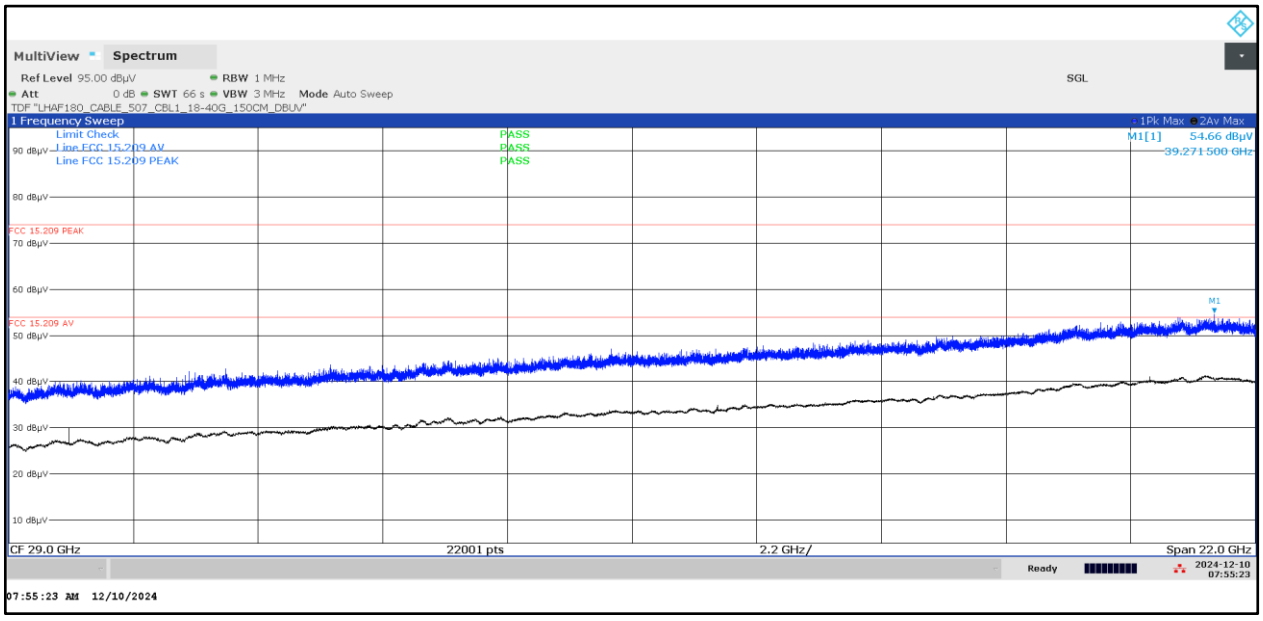

**Plot 35: 1GHz – 18 GHz, stop mode, middle frequency**



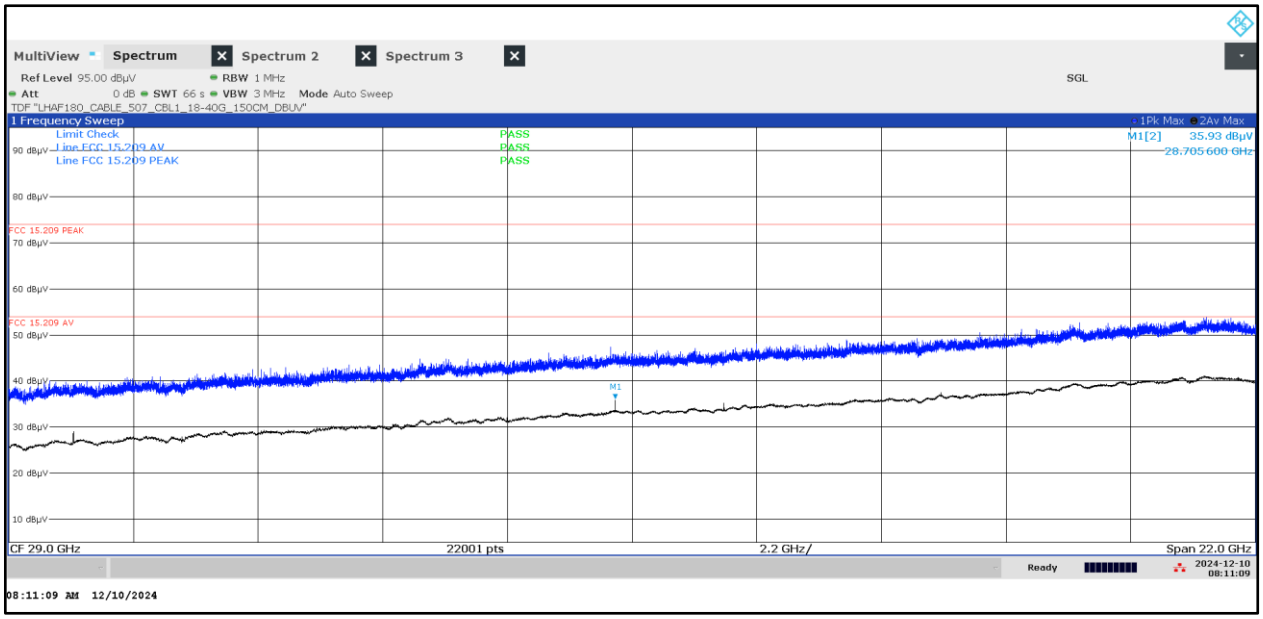
**Plot 36: 1GHz – 18 GHz, stop mode, high frequency**



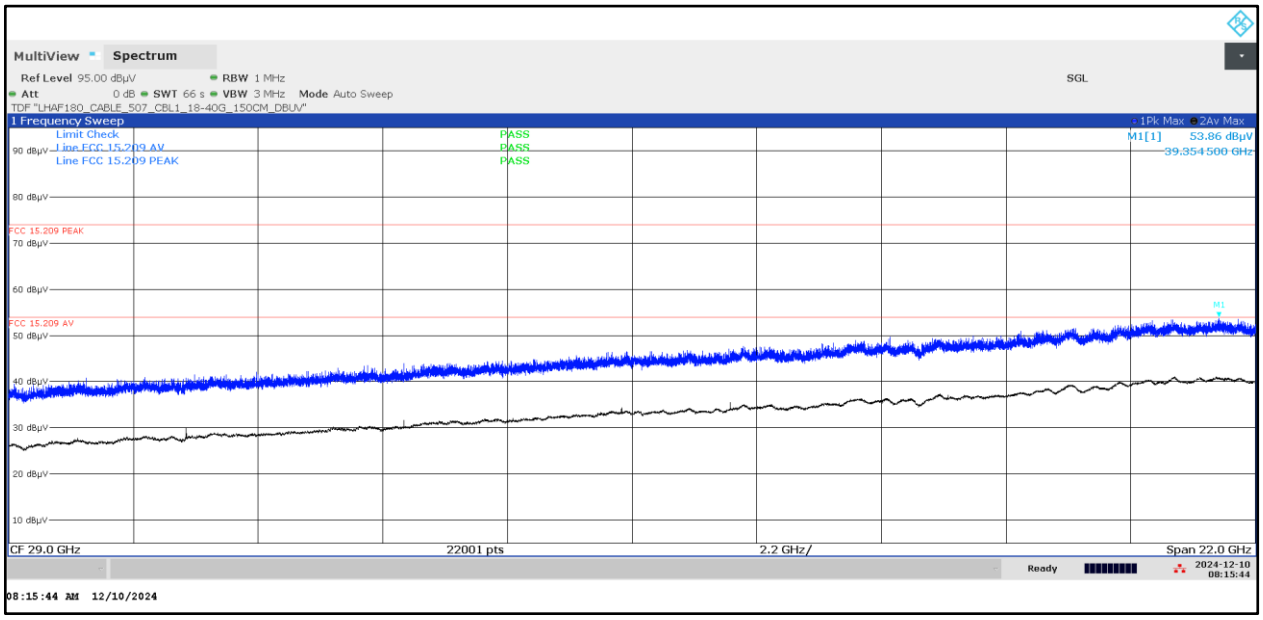

**Plot 37: 18 GHz – 40 GHz, stop mode, low frequency**



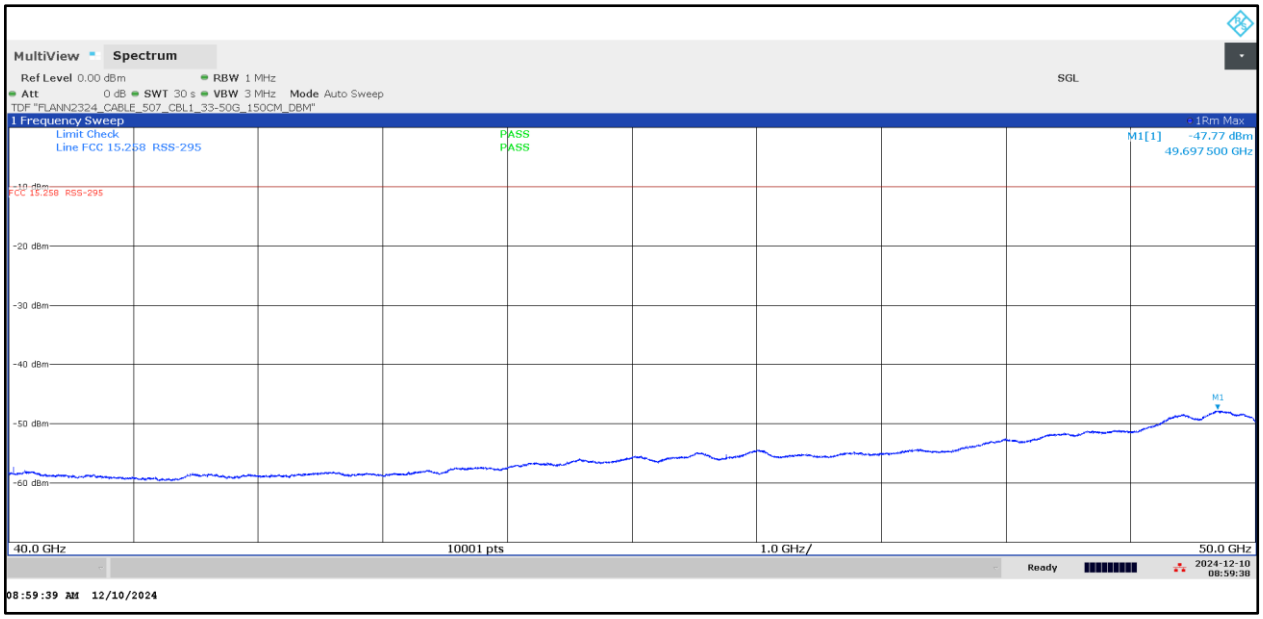
**Plot 38: 18 GHz – 40 GHz, stop mode, middle frequency**



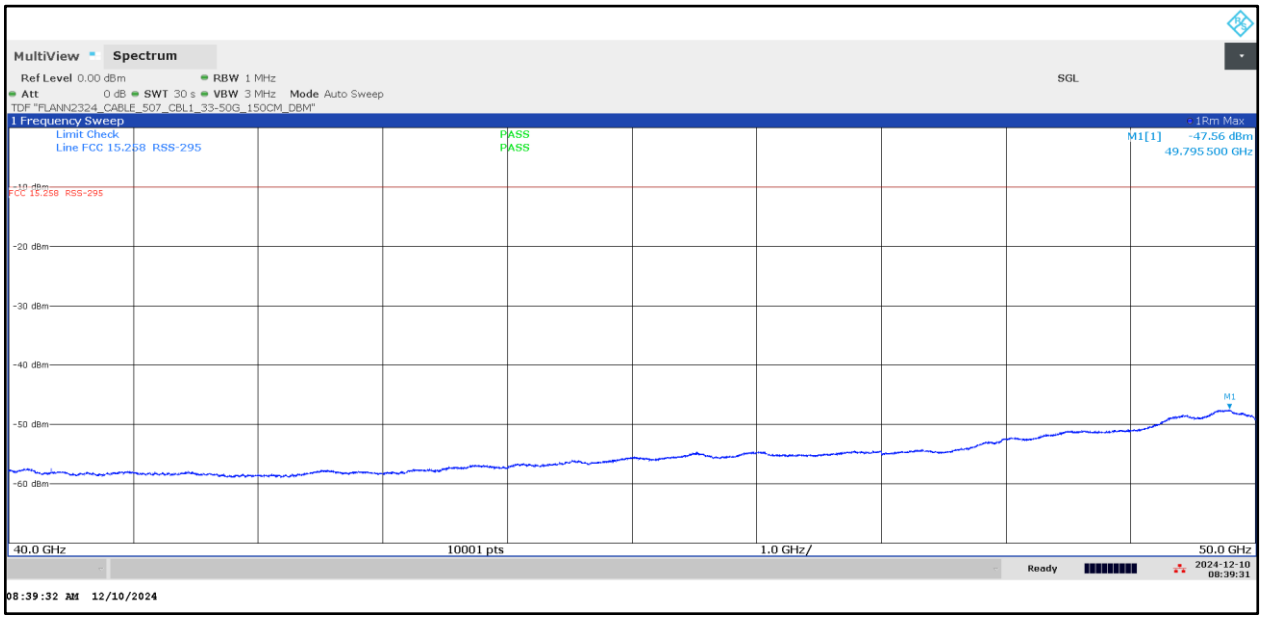

**Plot 39: 18 GHz – 40 GHz, stop mode, high frequency**



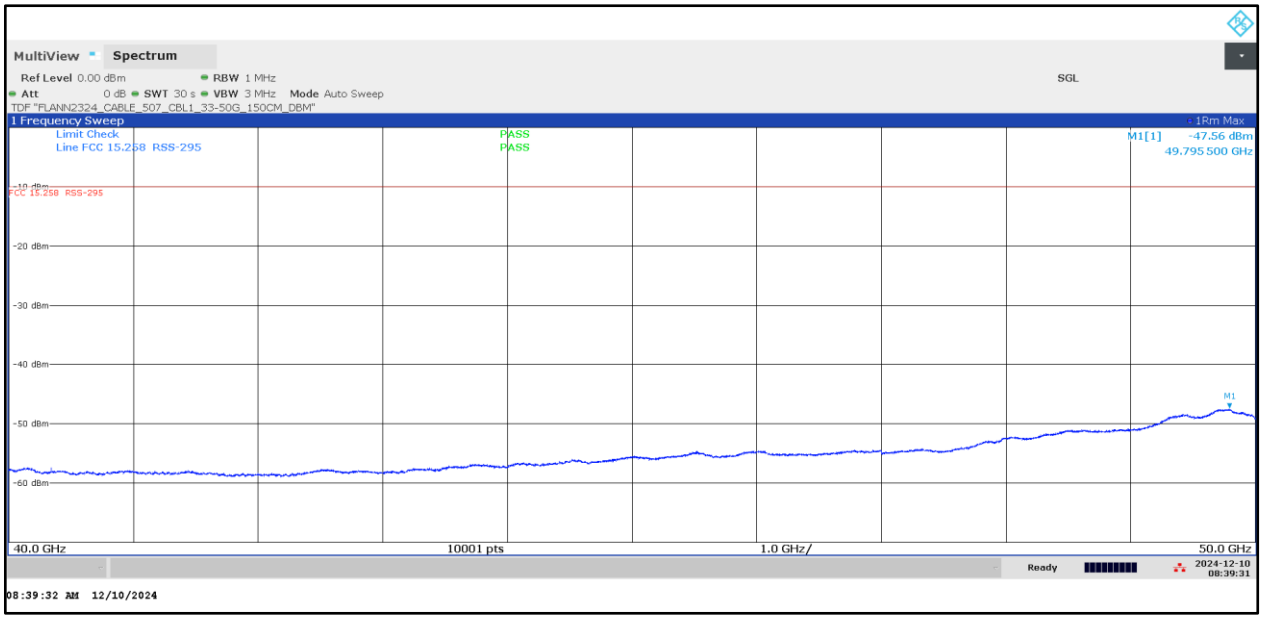
**Plot 40: 40GHz – 50 GHz, stop mode, low frequency**



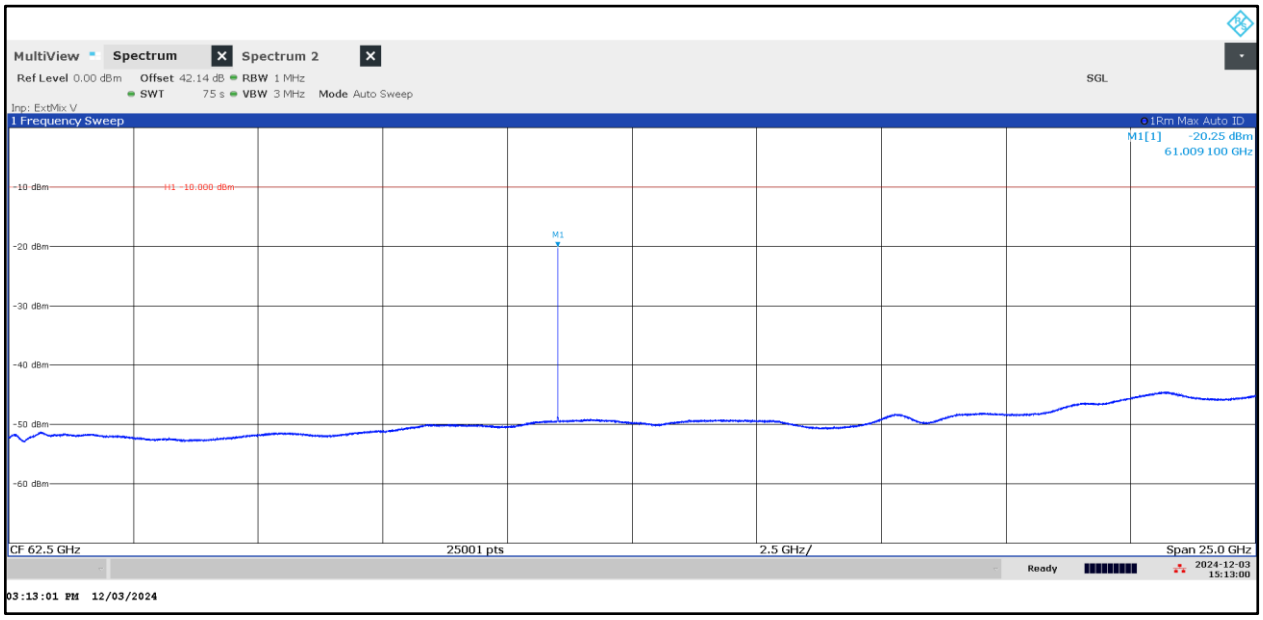

**Plot 41: 40 GHz – 50 GHz, stop mode, middle frequency**



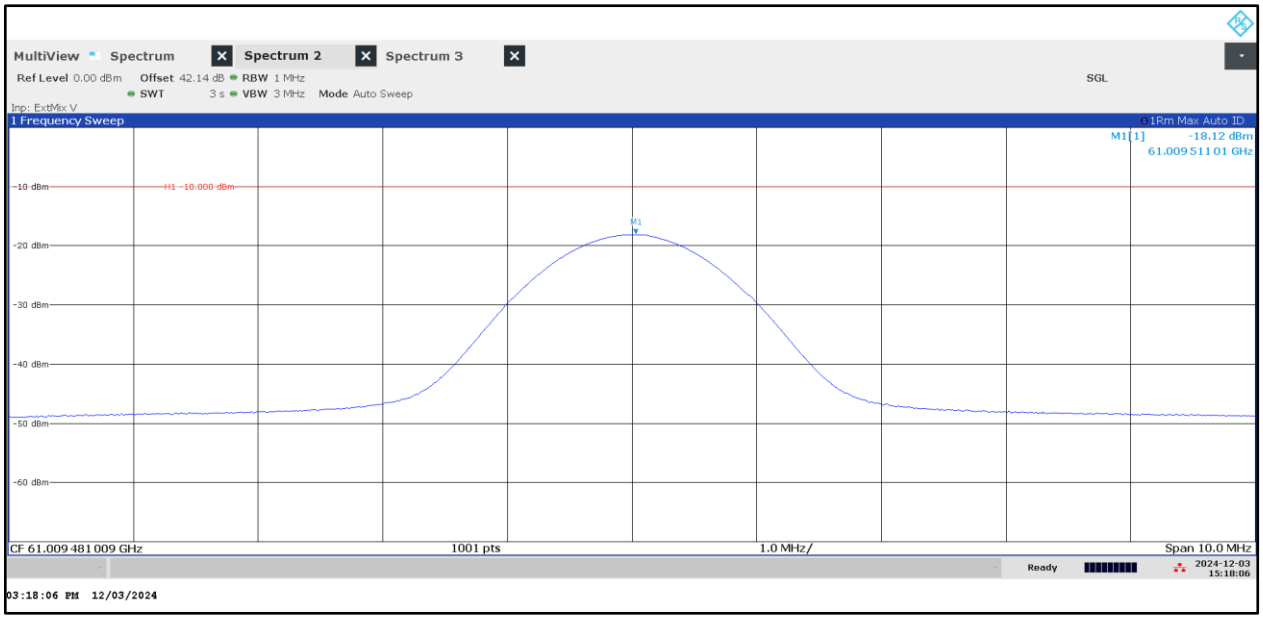
**Plot 42: 40 GHz – 50 GHz, stop mode, high frequency**



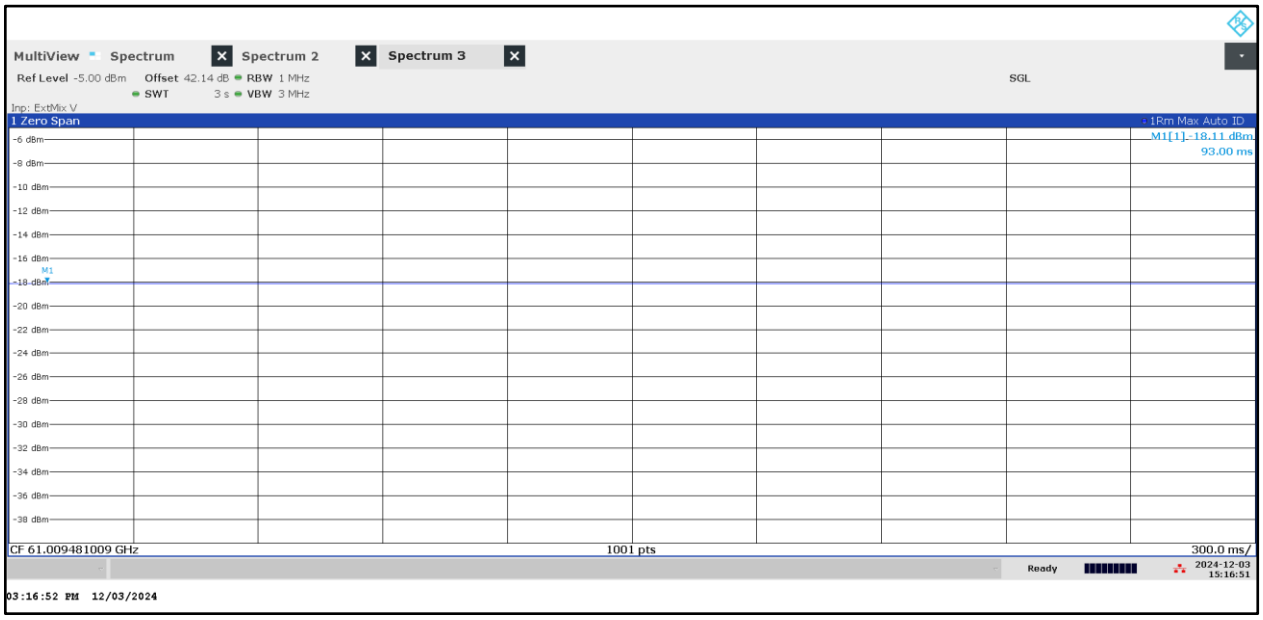

**Plot 43: 50 GHz – 75 GHz, stop mode, low frequency**



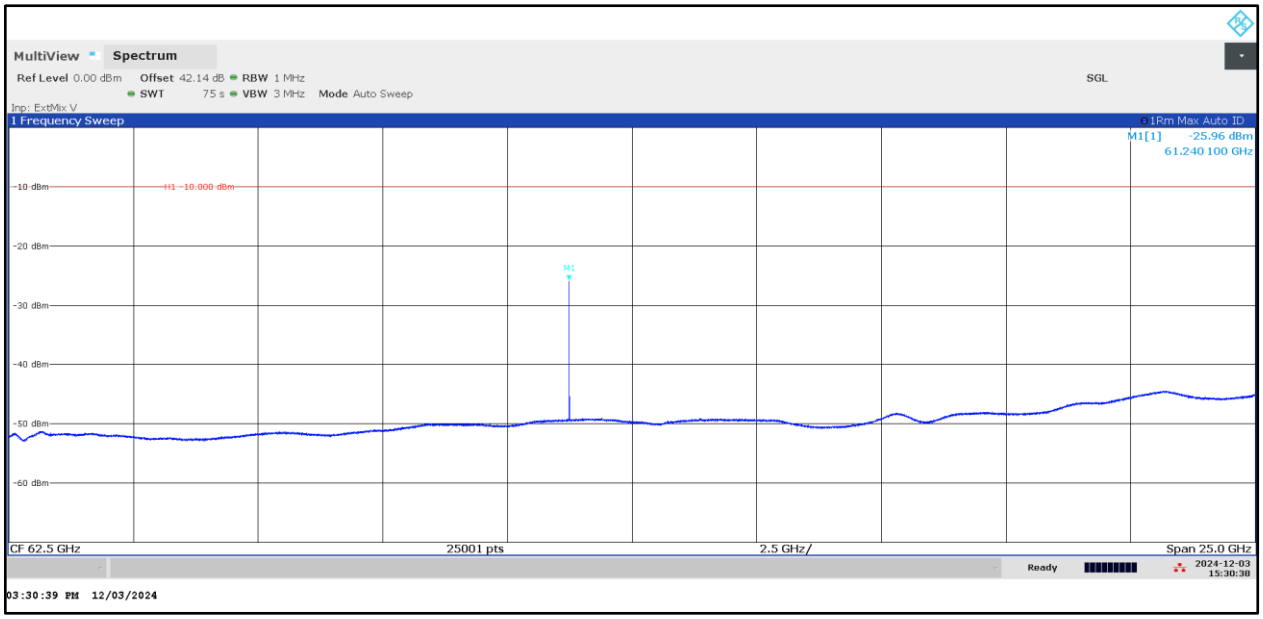
**Plot 44: 61 GHz, stop mode, low frequency with 10 MHz span**



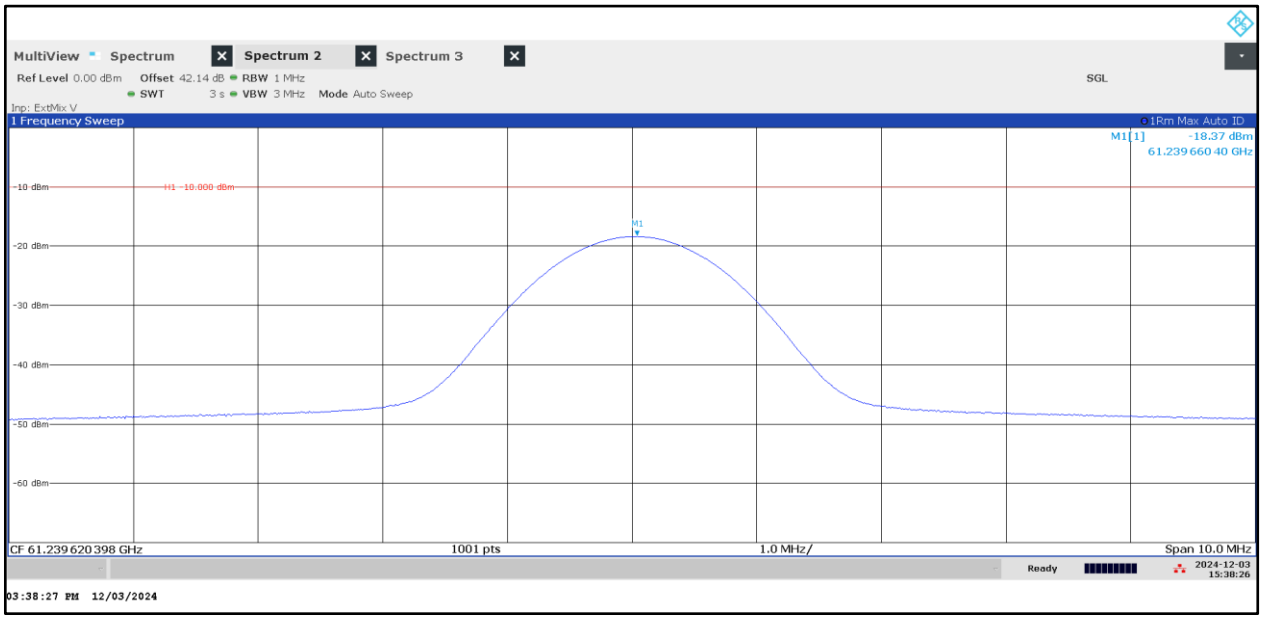

**Plot 45: 61 GHz, stop mode, low frequency with zero span**



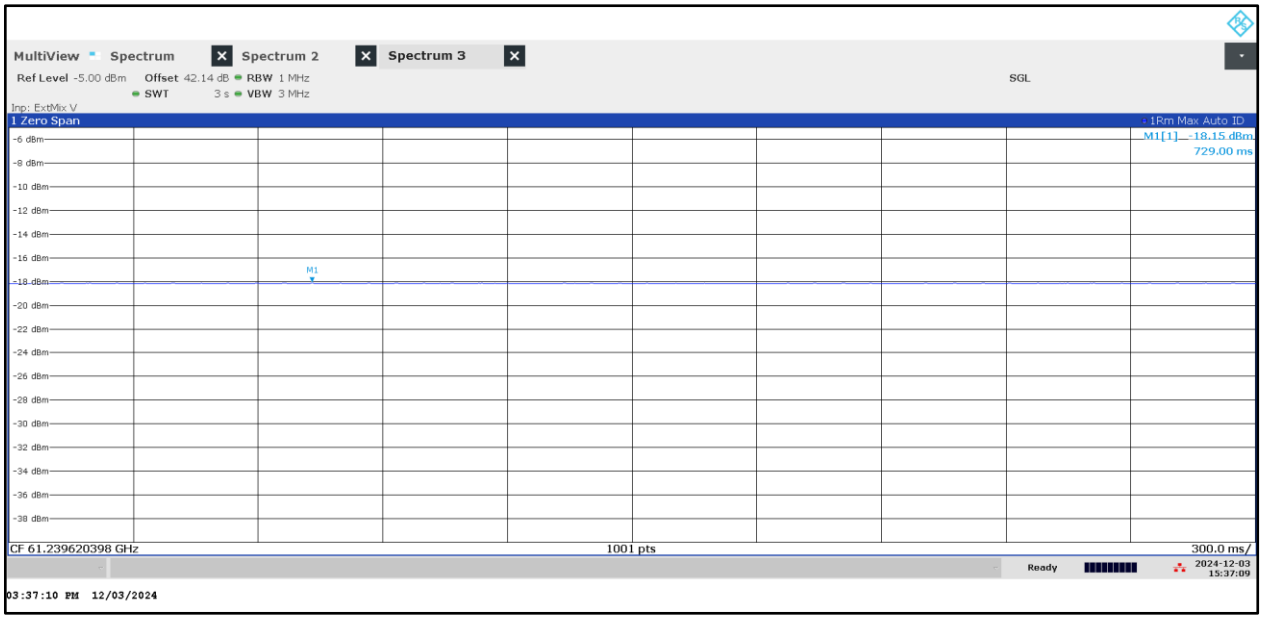
**Plot 46: 50 GHz – 75 GHz, stop mode, middle frequency**



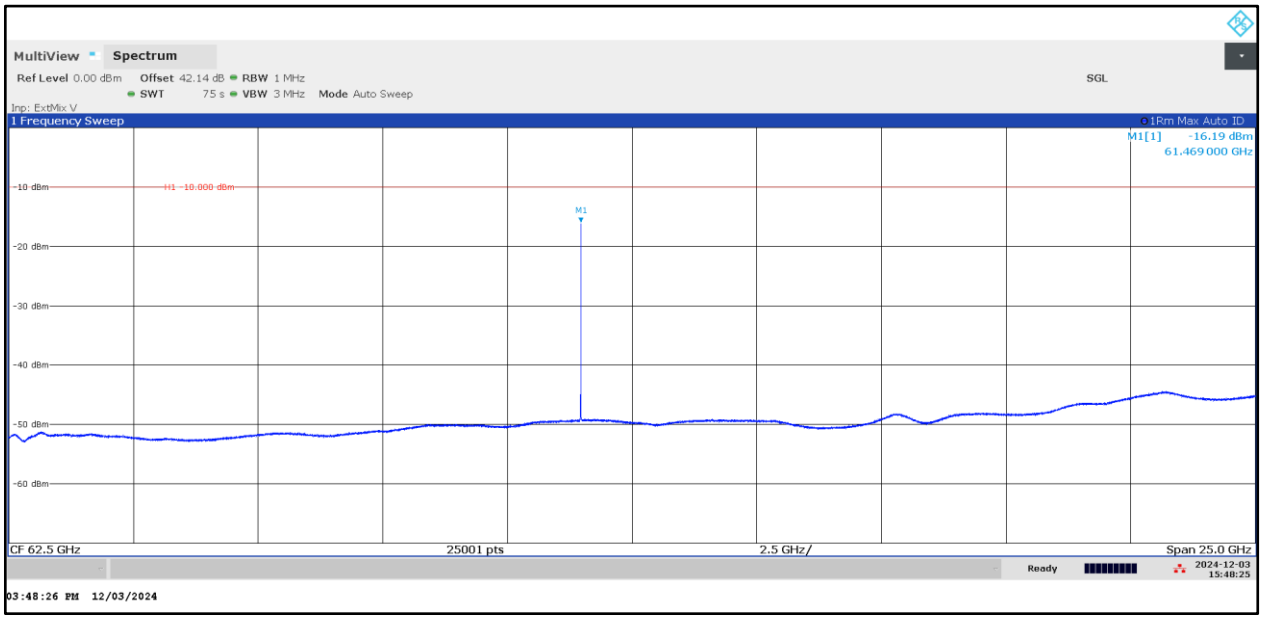

**Plot 47: 61 GHz, stop mode, middle frequency with 10 MHz span**



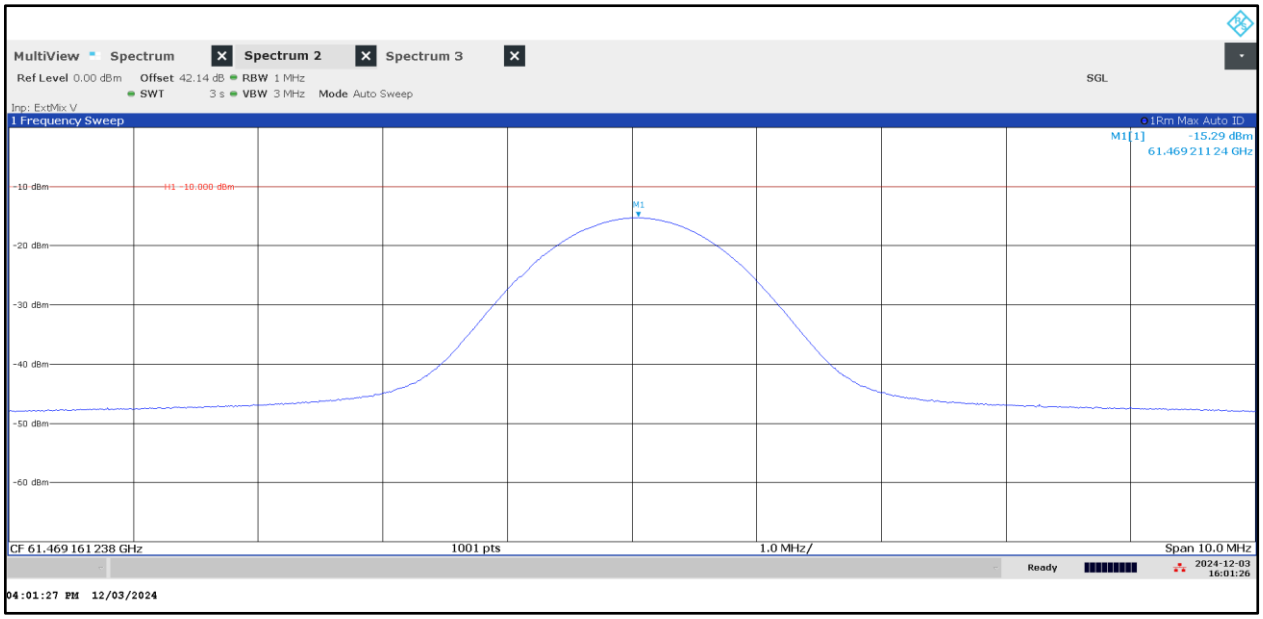
**Plot 48: 61 GHz, stop mode, middle frequency with zero span**



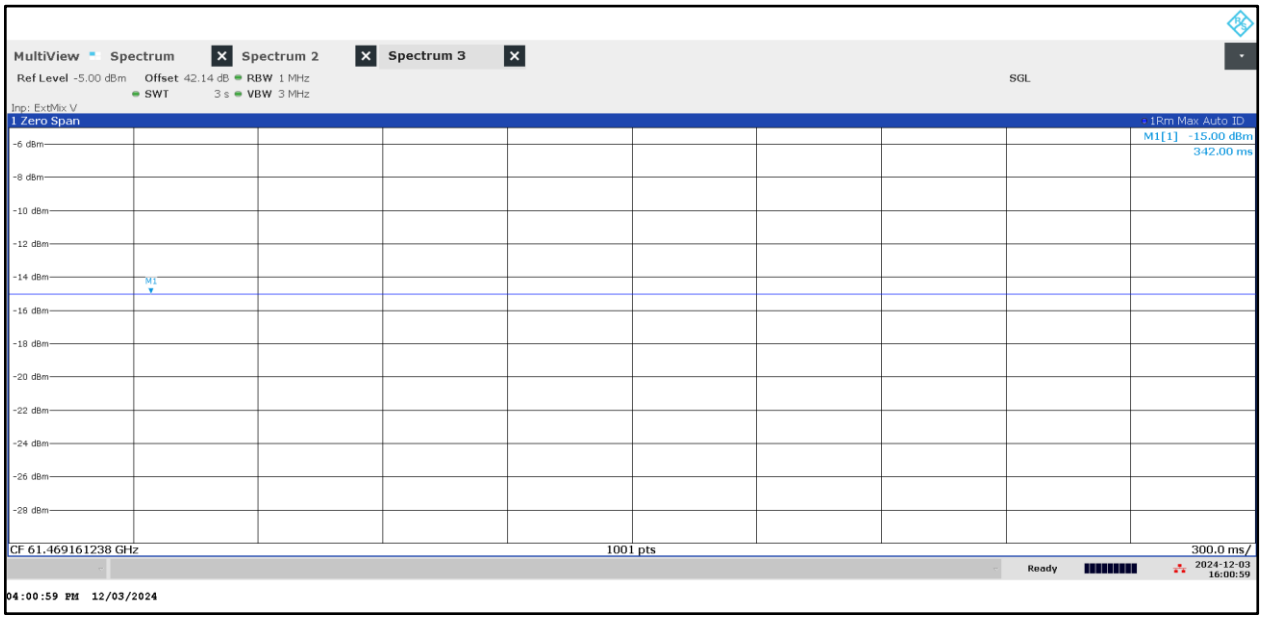

**Plot 49: 50 GHz – 75 GHz, stop mode, high frequency**



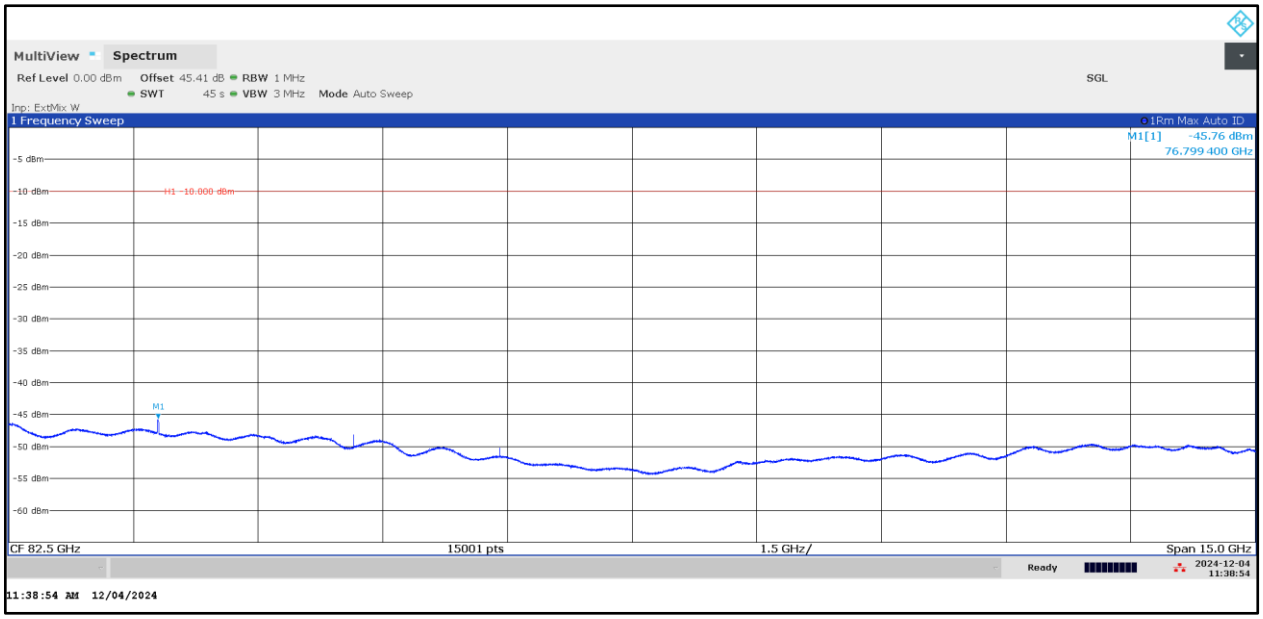
**Plot 50: 61 GHz, stop mode, high frequency with 10 MHz span**



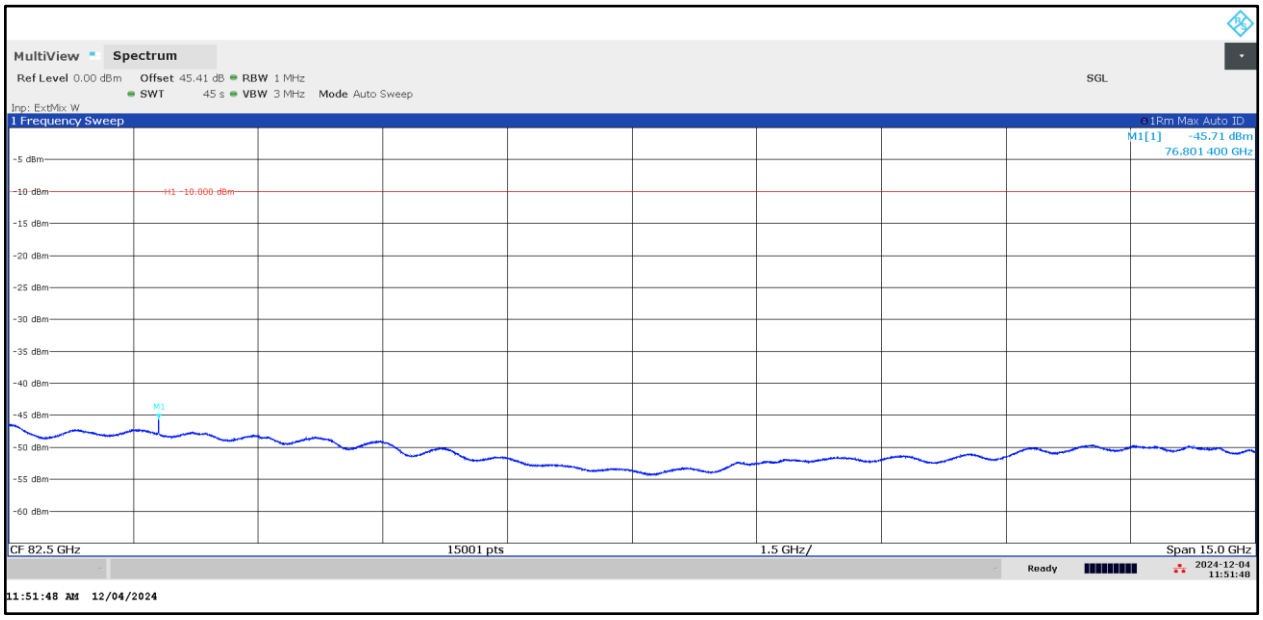

**Plot 51: 61 GHz, stop mode, high frequency with zero span**



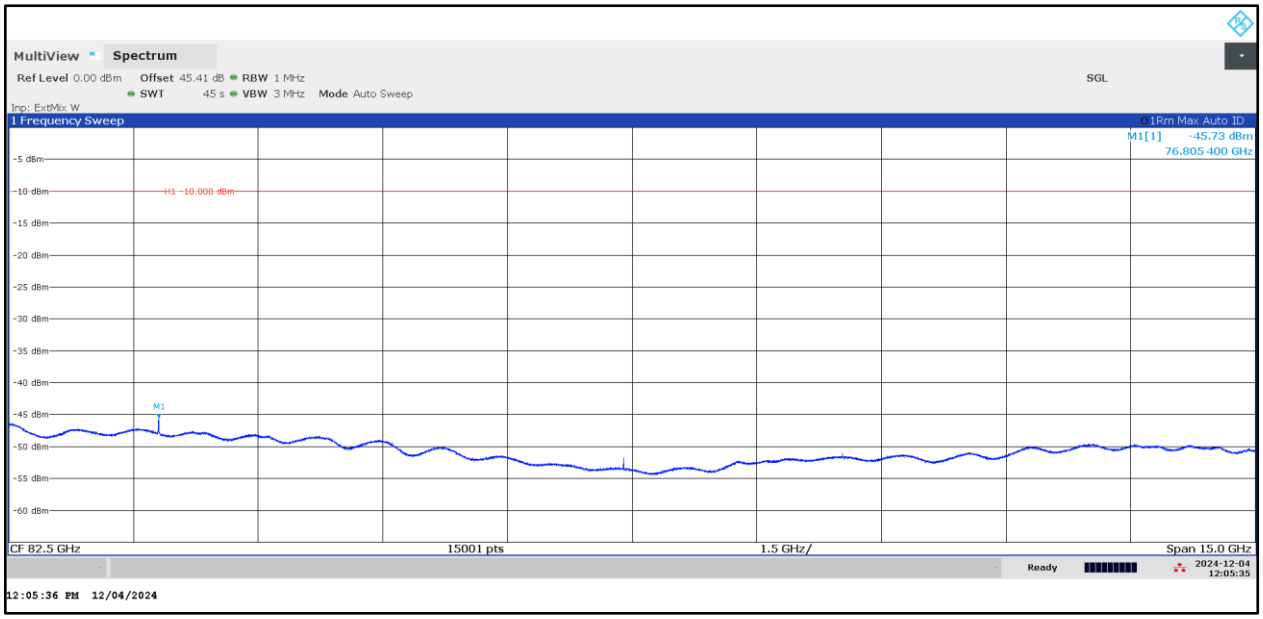
**Plot 52: 75 GHz – 90 GHz, stop mode, low frequency**



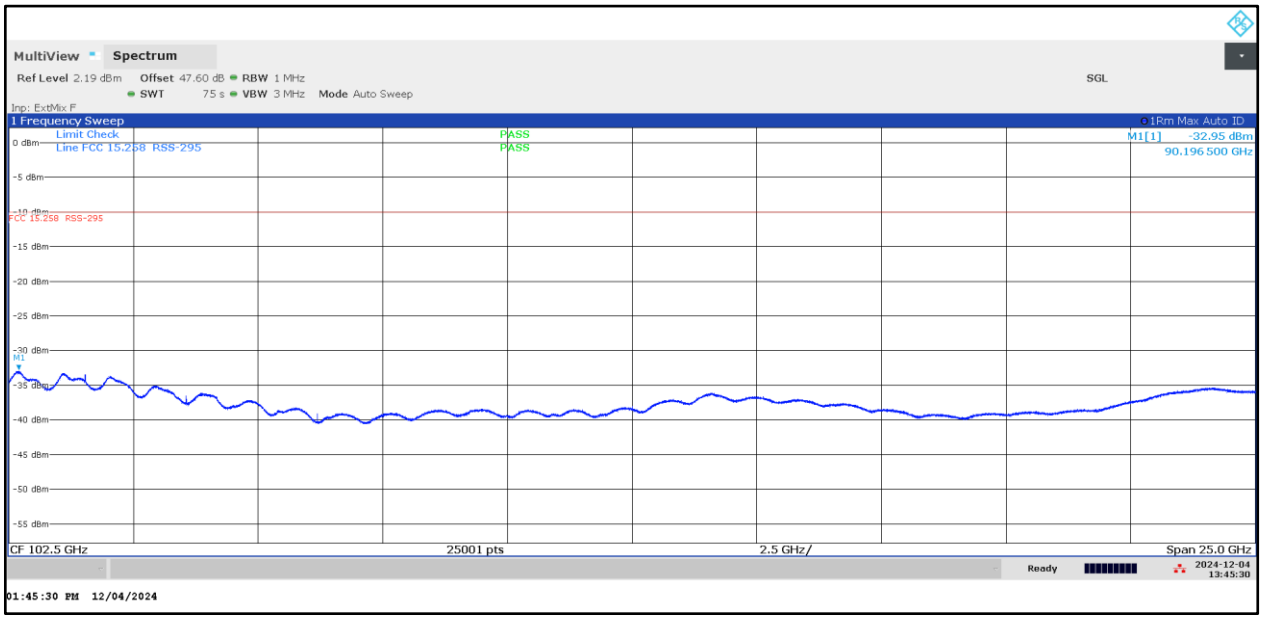

**Plot 53: 75 GHz – 90 GHz, stop mode, middle frequency**



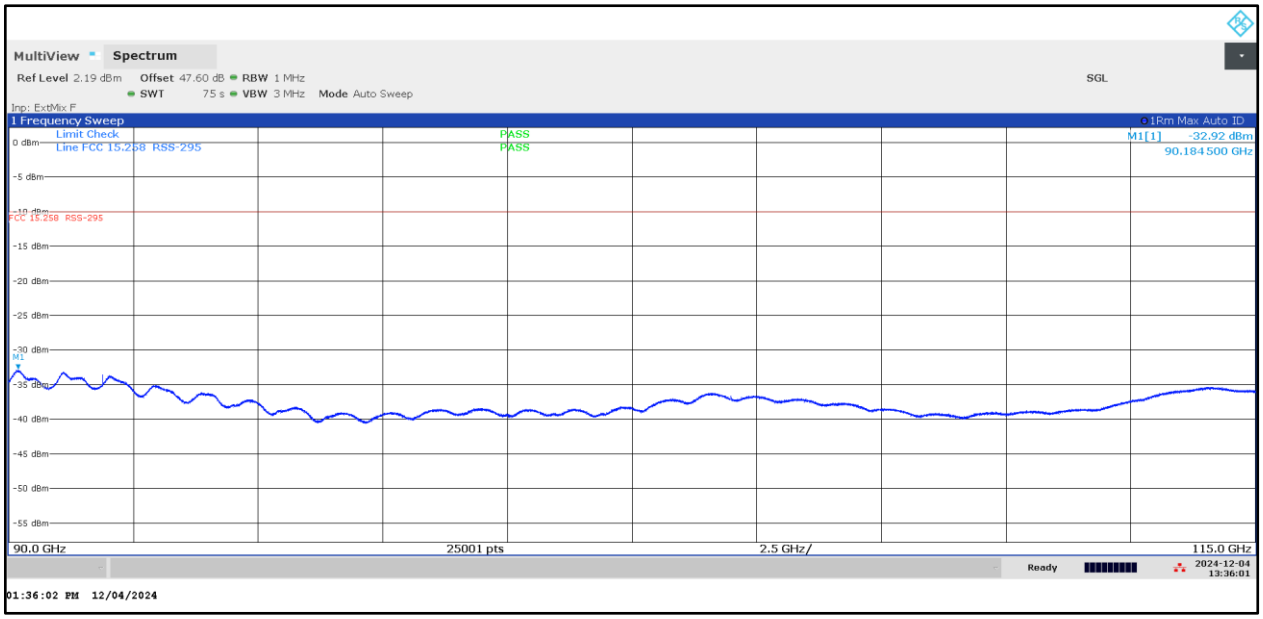
**Plot 54: 75 GHz – 90 GHz, stop mode, high frequency**



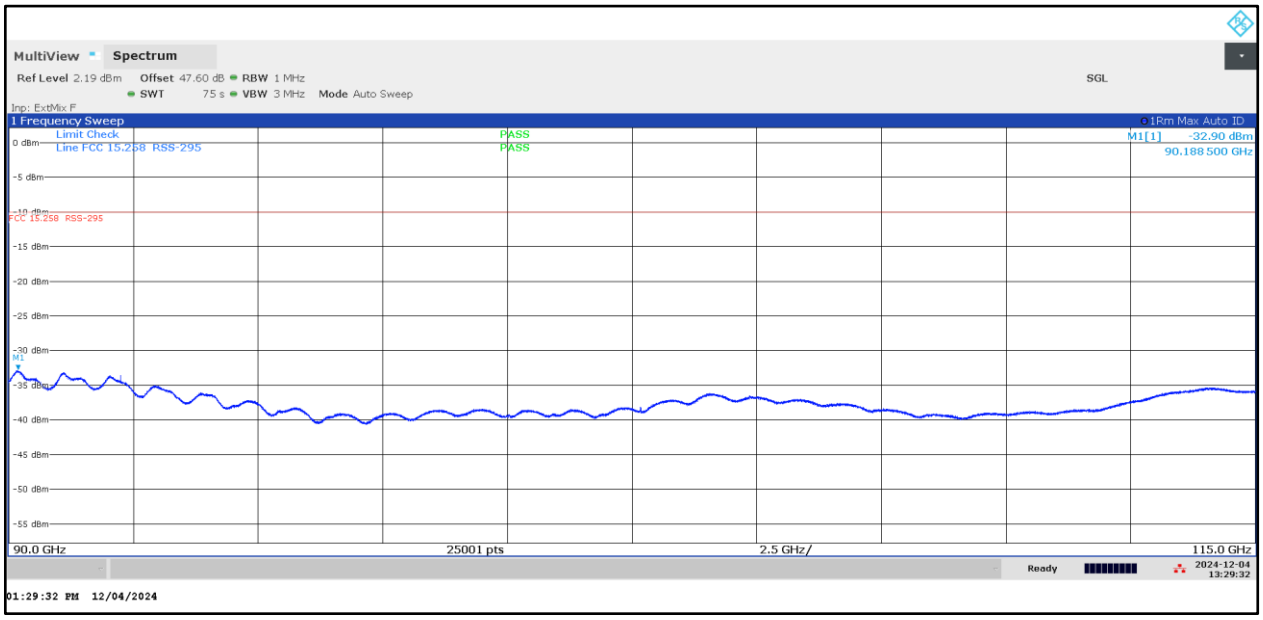

**Plot 55: 90 GHz – 115 GHz, stop mode, low frequency**



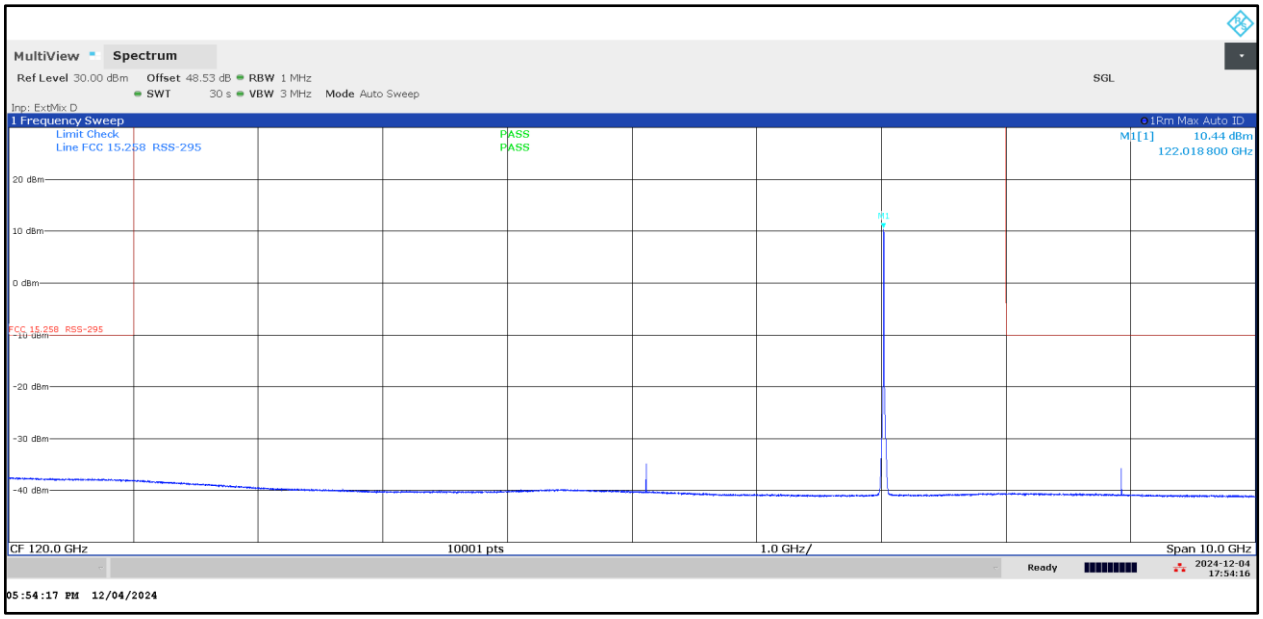
**Plot 56: 90 GHz – 115 GHz, stop mode, middle frequency**



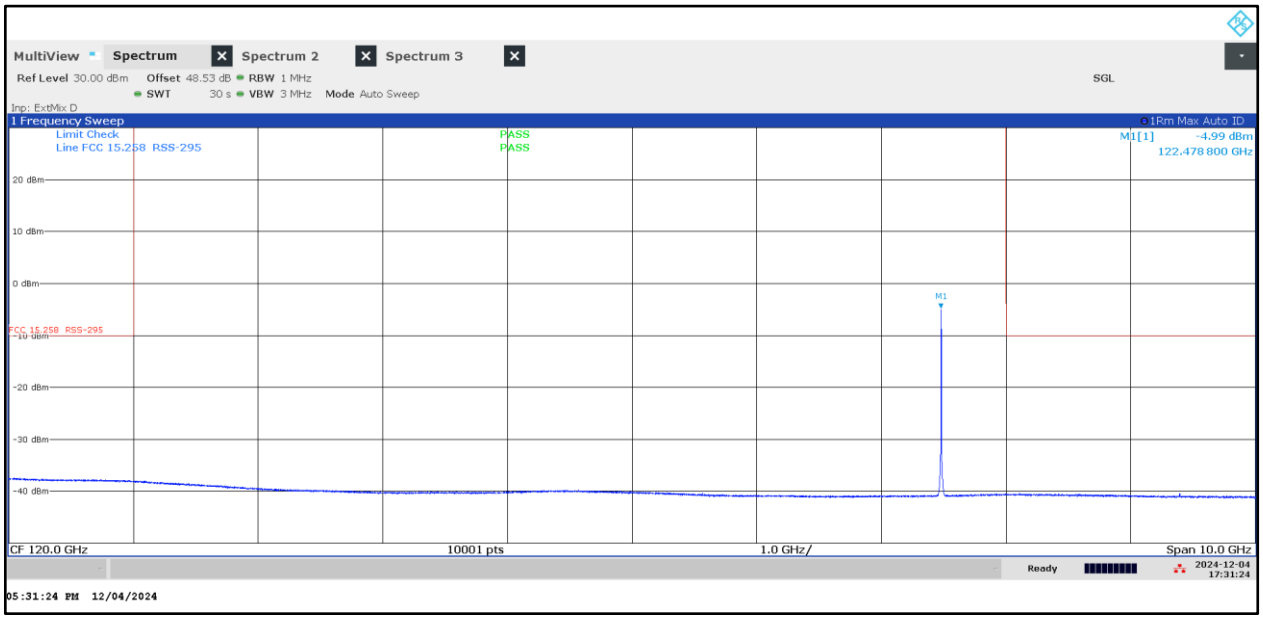

**Plot 57: 90 GHz – 115 GHz; stop mode, high frequency**



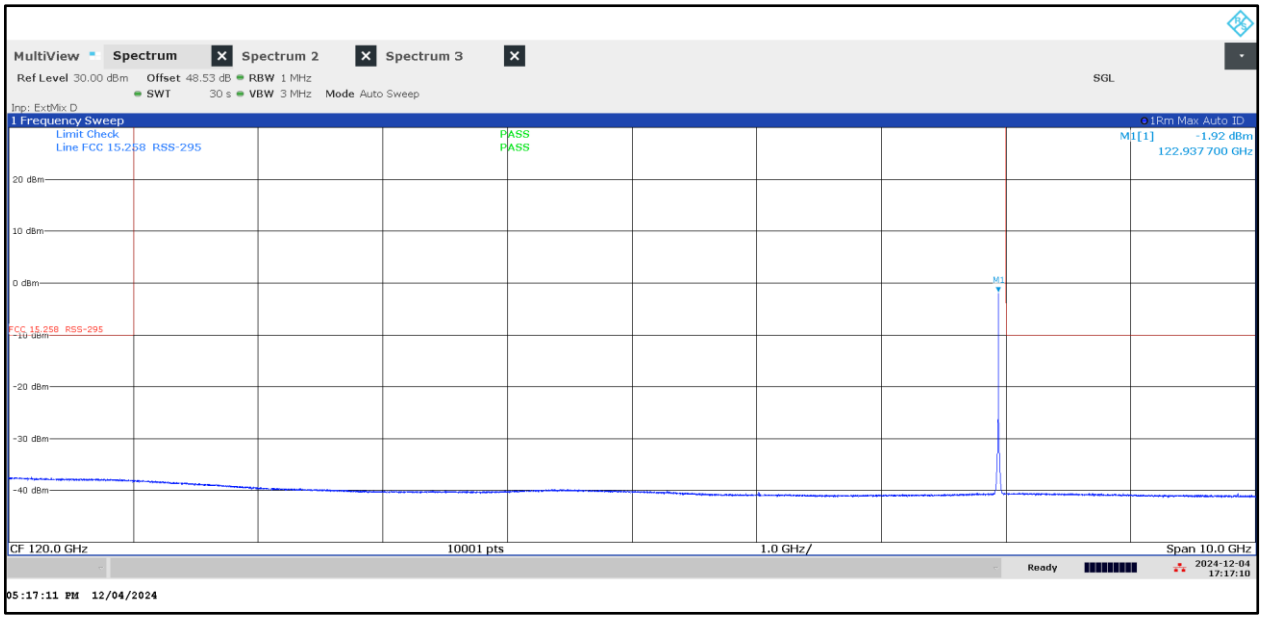
**Plot 58: 115 GHz – 125 GHz, stop mode, low frequency**



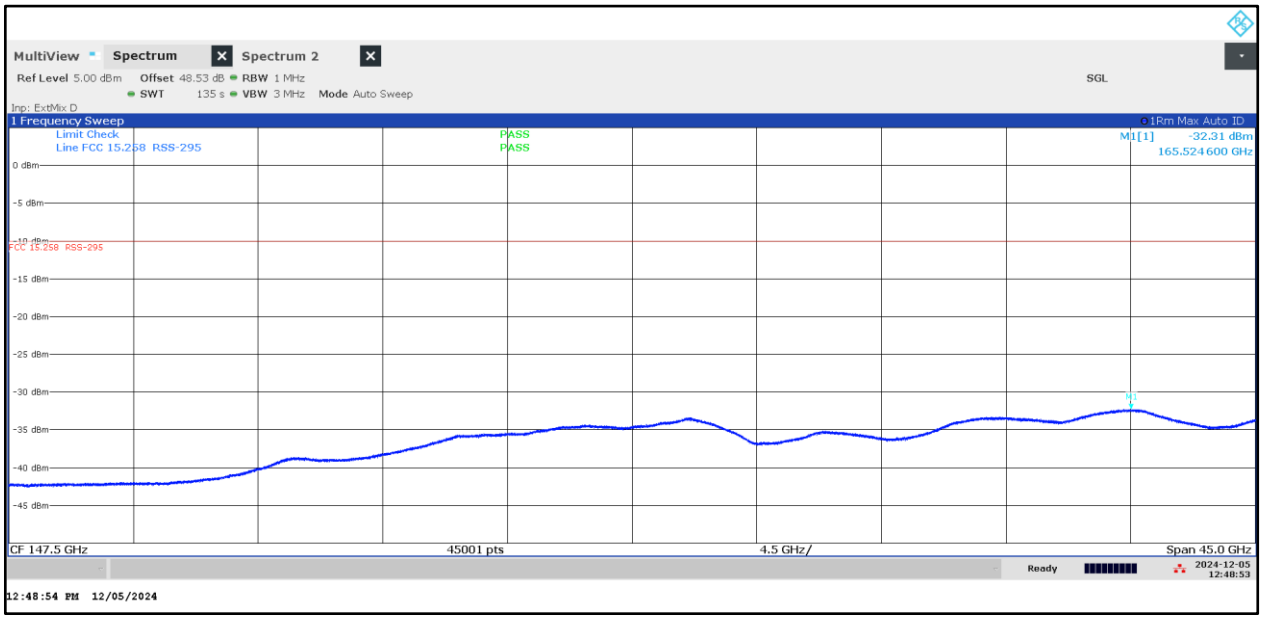

**Plot 59: 115 GHz – 125 GHz, stop mode, middle frequency**



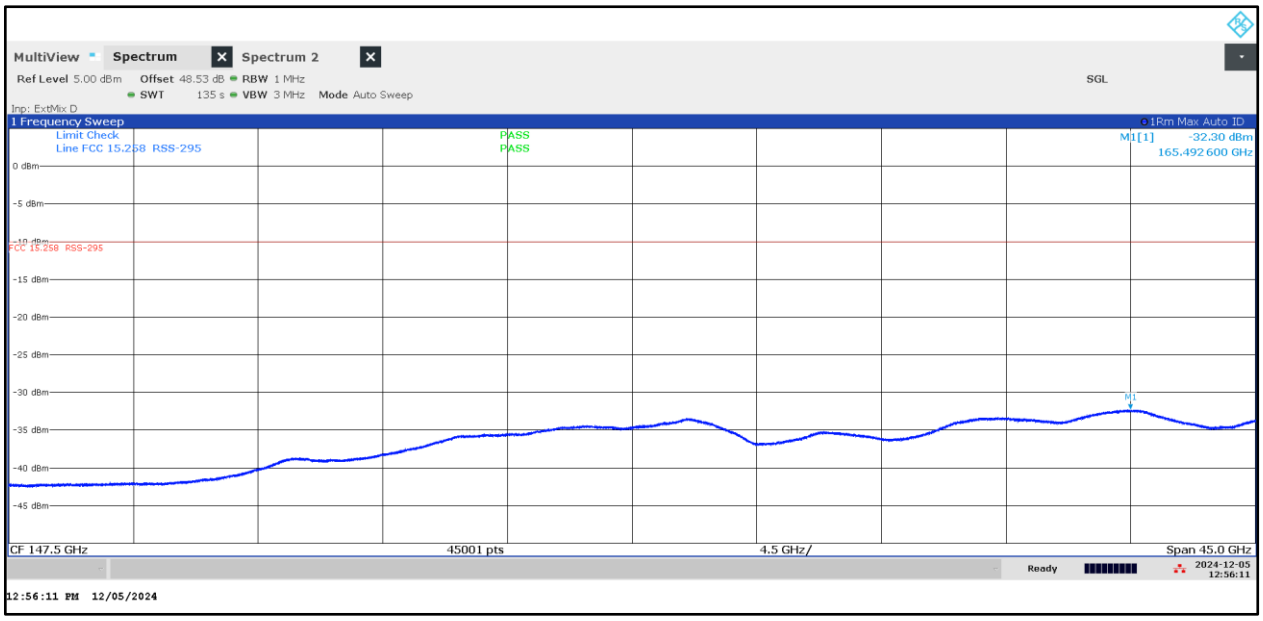
**Plot 60: 115 GHz – 125 GHz, stop mode, high frequency**



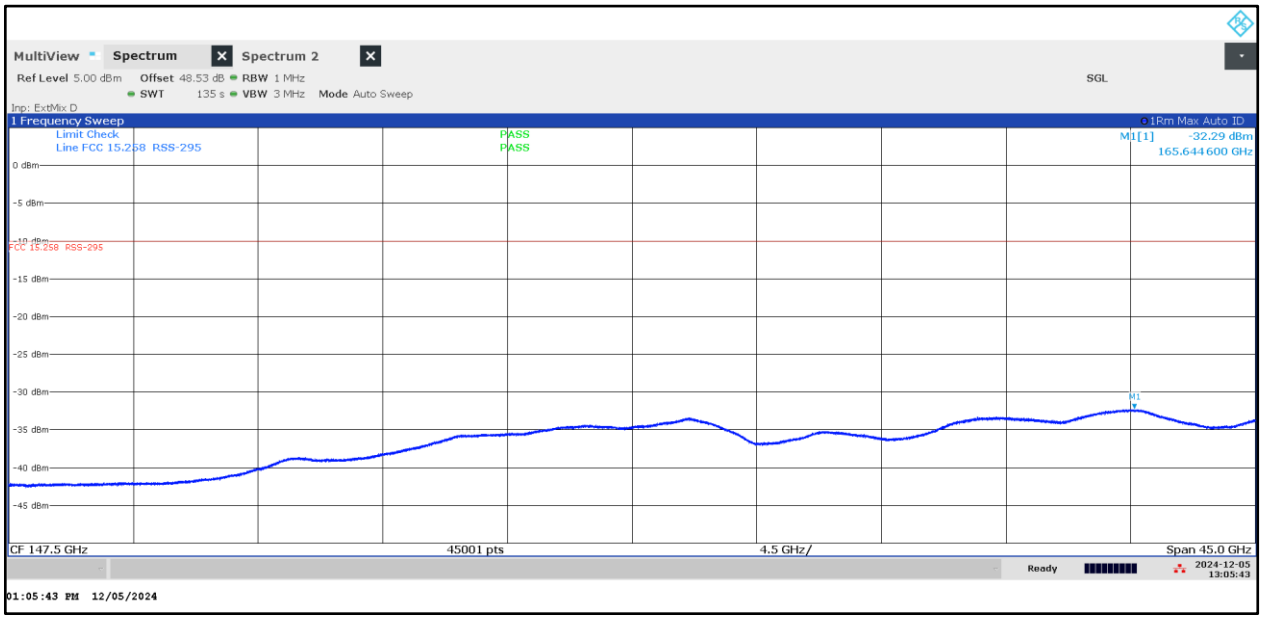

**Plot 61: 125 GHz – 170 GHz, stop mode, low frequency**



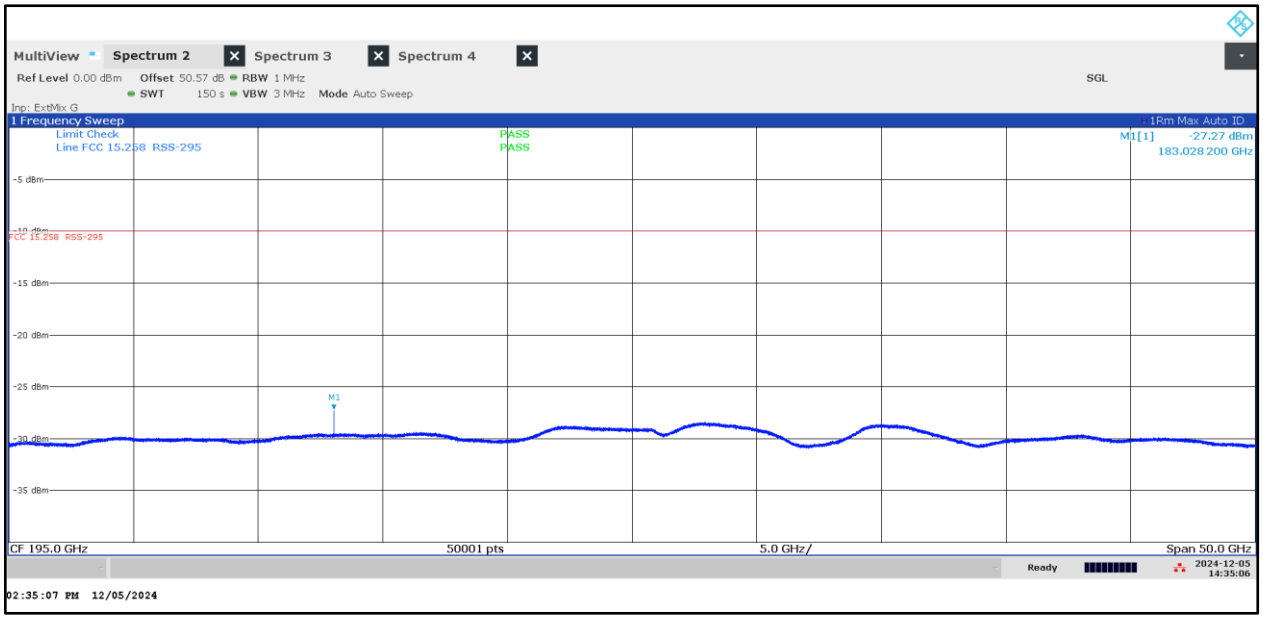
**Plot 62: 125 GHz – 170 GHz, stop mode, middle frequency**



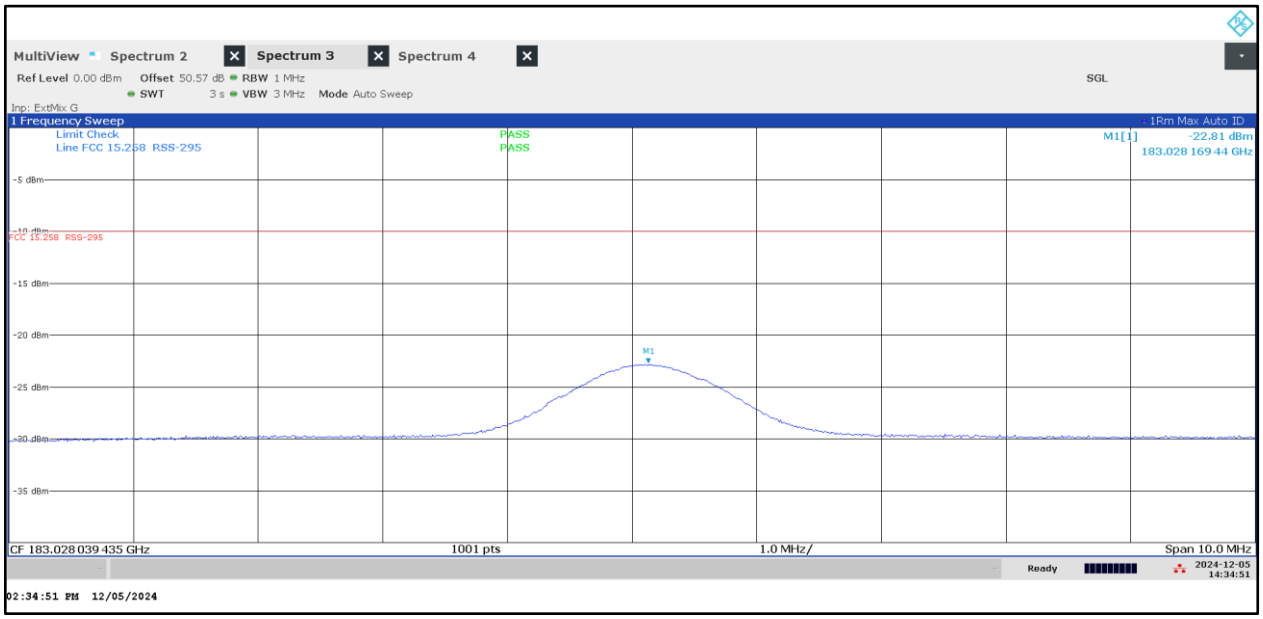

**Plot 63: 125 GHz – 170 GHz, stop mode, high frequency**



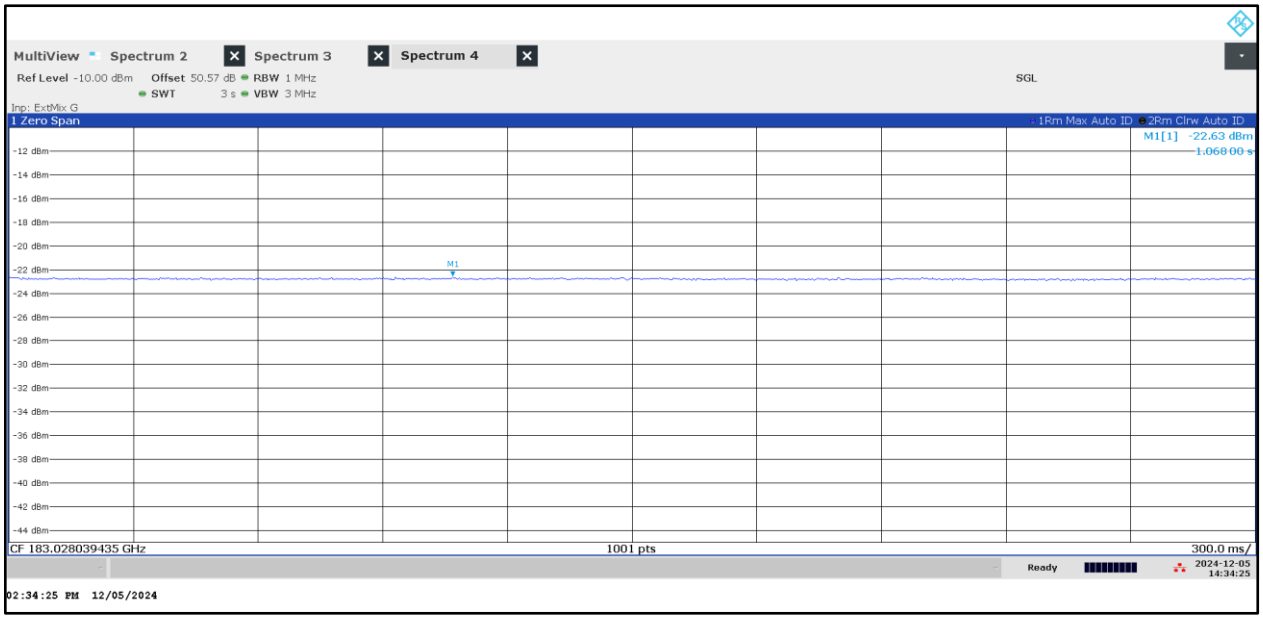
**Plot 64: 170 GHz – 220 GHz, stop mode, low frequency**



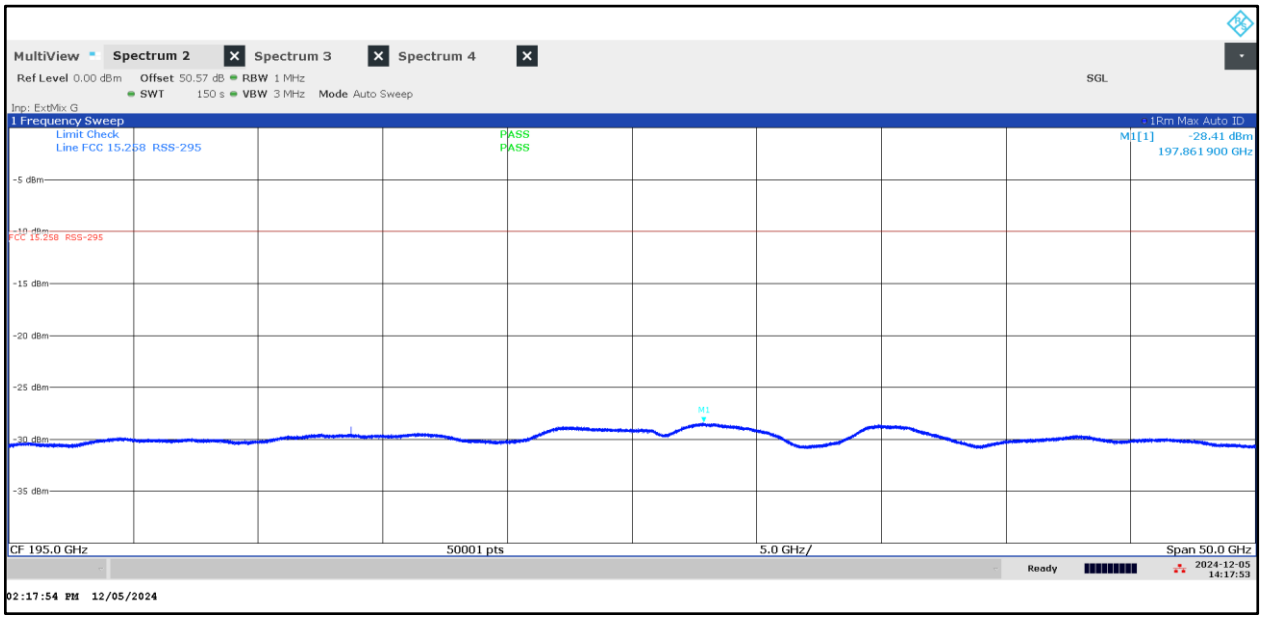

**Plot 65: Spurious at183 GHz with 10MHz span, stop mode, low frequency**



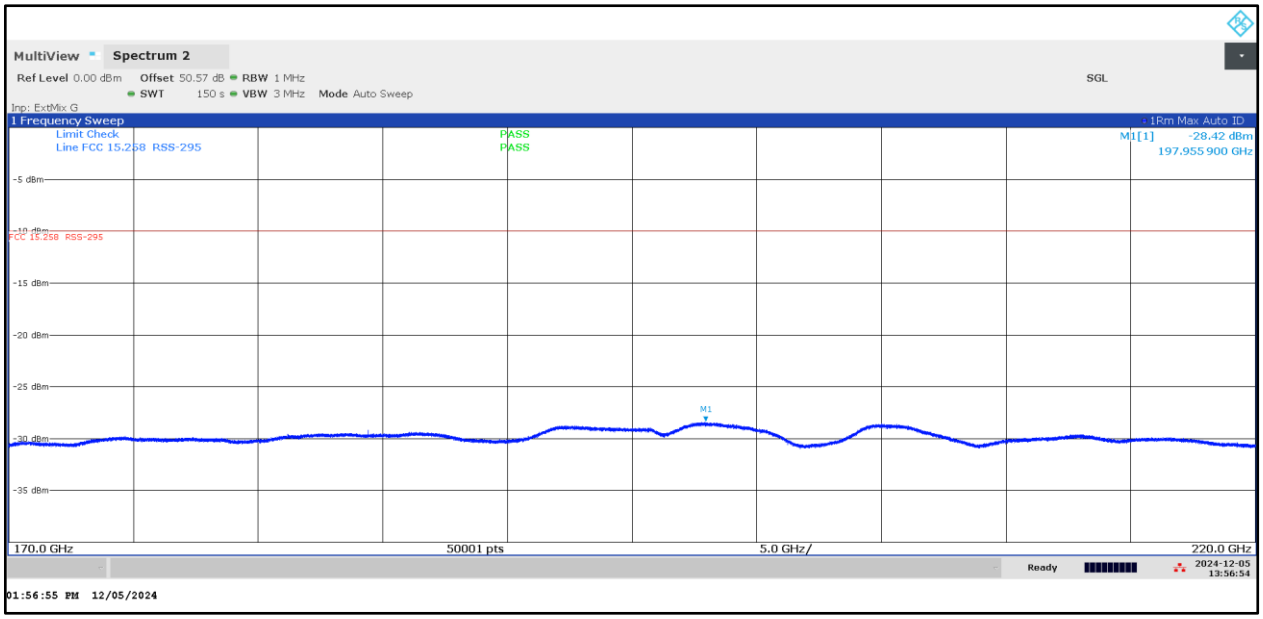
**Plot 66: Spurious at183 GHz with zero span, stop mode, low frequency**



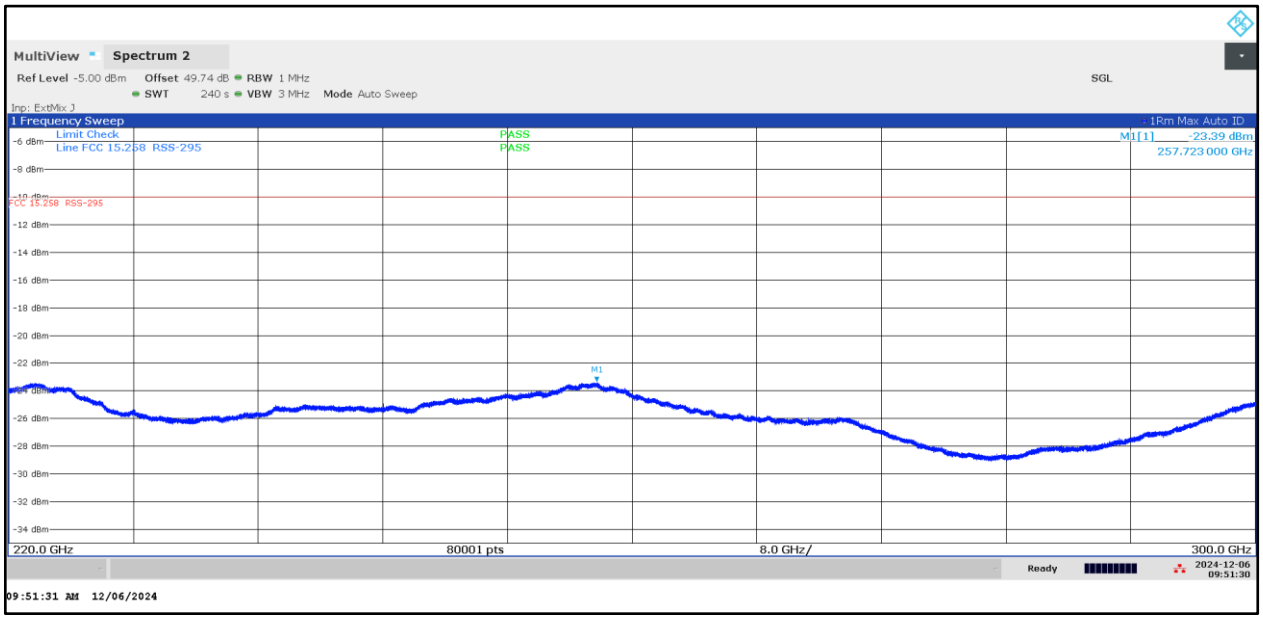

**Plot 67: 170 GHz – 220 GHz, stop mode, middle frequency**



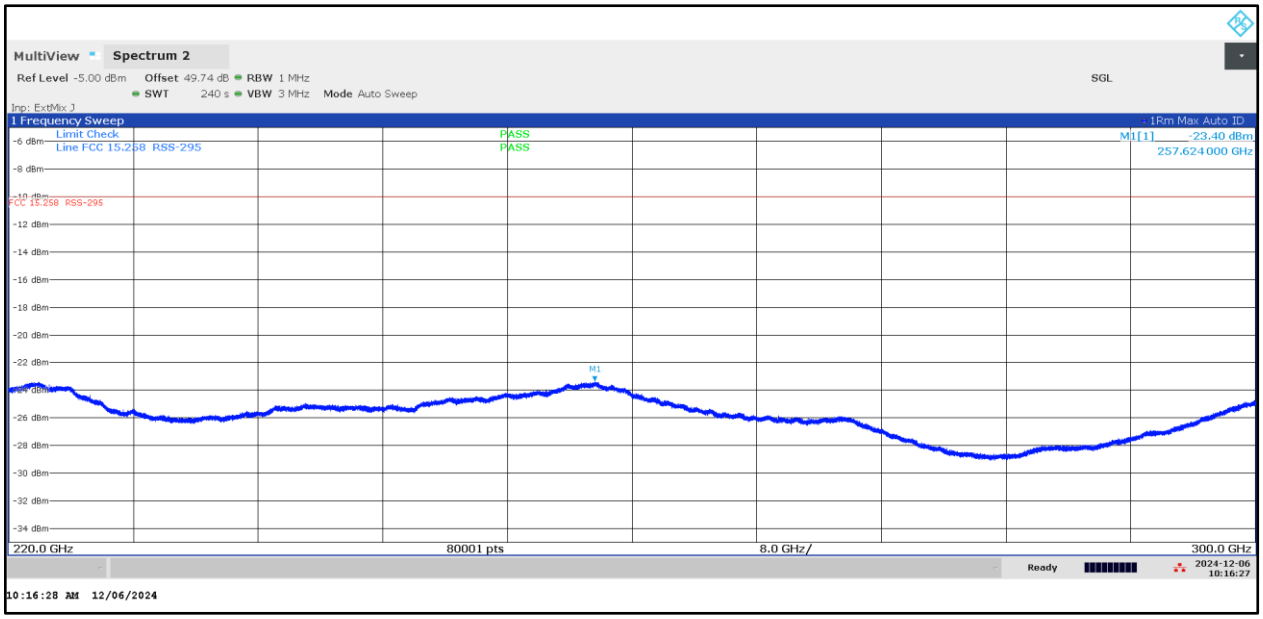
**Plot 68: 170 GHz – 220 GHz, stop mode, high frequency**




**Plot 69: 220 GHz – 300 GHz, stop mode, low frequency**



**Plot 70: 220 GHz – 300 GHz, stop mode, middle frequency**




**Plot 71: 220 GHz – 300 GHz, stop mode, high frequency**