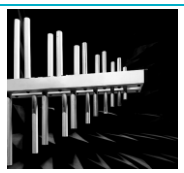
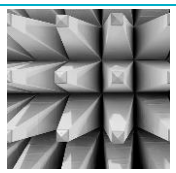

cetecom advanced

TEST REPORT

Test report no.: 1-9898-25-01-03_TR1-R01

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-00

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: +49 2353 709 0
Contact: Markus Teubner
e-mail: markus.teubner@turck.com

Manufacturer

Hans Turck GmbH & Co. KG
Witzlebenstraße 7
45472 Mülheim an der Ruhr / 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:	**Radar Displacement Sensor**
Model name:	**DR7.5WE-M30E-IOL8X2-H1141**
FCC ID:	**YQ7-DR75WEM30E**
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:

M. Walla

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Meheza Walla
Lab Manager
Radio Labs

Test performed:

Thomas Vogler

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Thomas Vogler
Lab Manager
Radio Labs

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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. 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:	2025-04-14
Date of receipt of test item:	2025-04-25
Start of test:*	2025-04-25
End of test:*	2025-05-08
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 66117 Saarbruecken Germany	☐	Im Teelbruch 116 45219 Essen Germany

2.4 Test laboratories sub-contracted

None

2.5 Laboratory listings and recognitions

	Saarbruecken	Essen
FCC	DE0002	DE0003
ISED	DE0001 3462C	DE0001 3462D

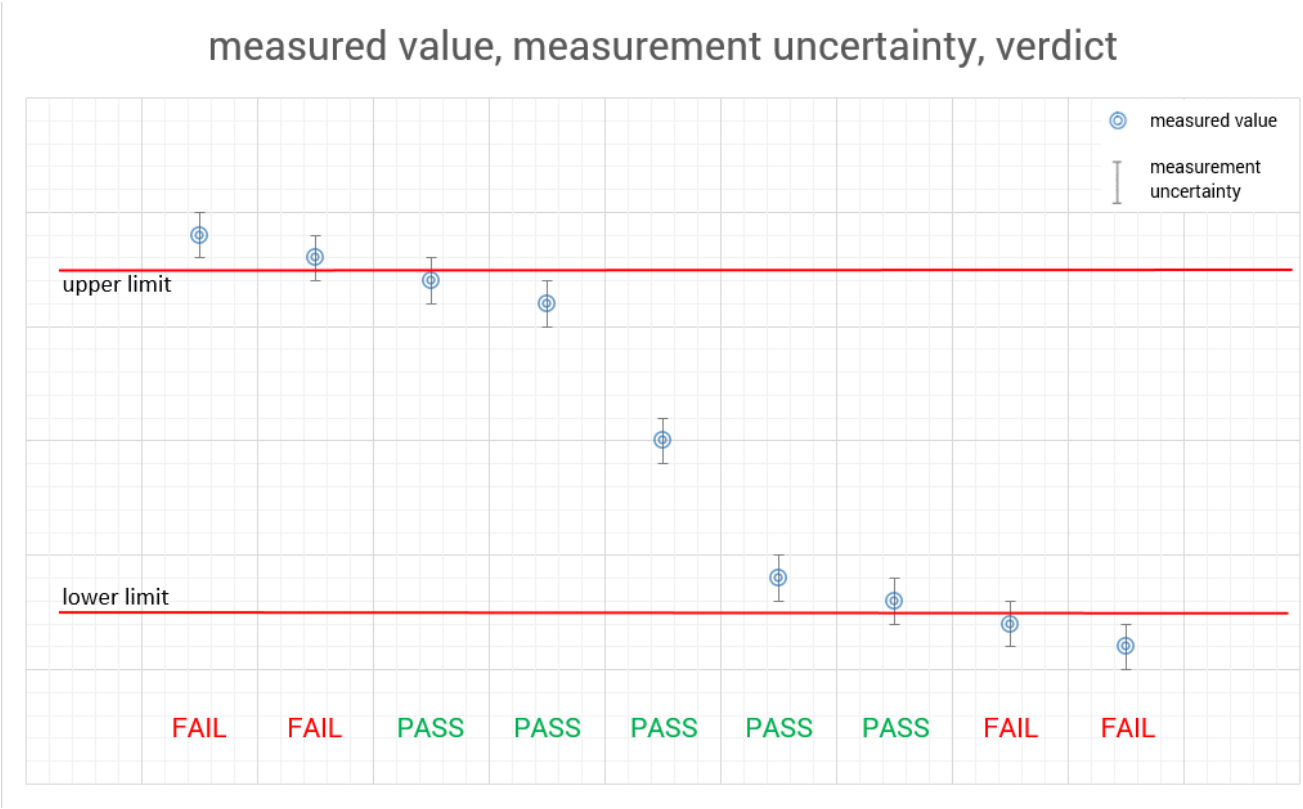
3 Test standard/s, references and accreditations

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} T_{max} T_{min}	+22 °C during room temperature tests +50 °C during high temperature tests -20 °C during low temperature tests
Relative humidity content	:		50 %
Barometric pressure	:		990 hPa to 1010 hPa
Power supply	:	V_{nom} V_{max} V_{min}	24 V DC by external power supply 27.6 V DC by external power supply (1.15 * V_{nom}) 20.4 V DC by external power supply (0.85 * V_{nom})

6 Test item

6.1 General description

Kind of test item	:	Radar Displacement Sensor
Model name:	:	DR7.5WE-M30E-IOL8X2-H1141
S/N serial number	:	100030150
Hardware status	:	7534/1
Firmware status	:	4.1.0.3
Frequency band	:	122 GHz – 123 GHz
Type of modulation	:	FMCW
Number of modes	:	1
Antenna	:	Integrated antenna with dielectric lens
Power supply	:	24 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:

- 1-9898-25-01-03_TR1-A101-R01 (External photographs of EUT)
- 1-9898-25-01-03_TR1-A102-R01 (Internal photographs of EUT)
- 1-9898-25-01-03_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:

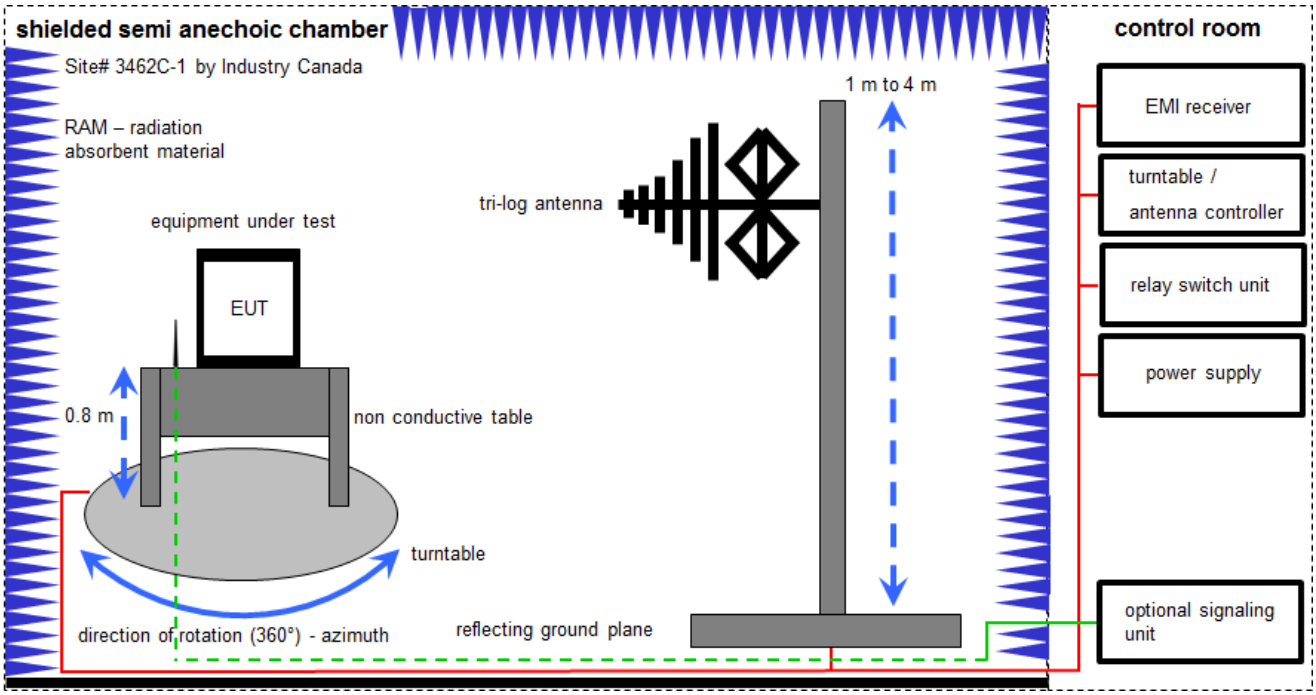
- 1-9898-25-01-03_TR1-A201-R01

Additional declarations (manufacturer's declarations, declarations of conformity, etc.):

- none

6.3 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

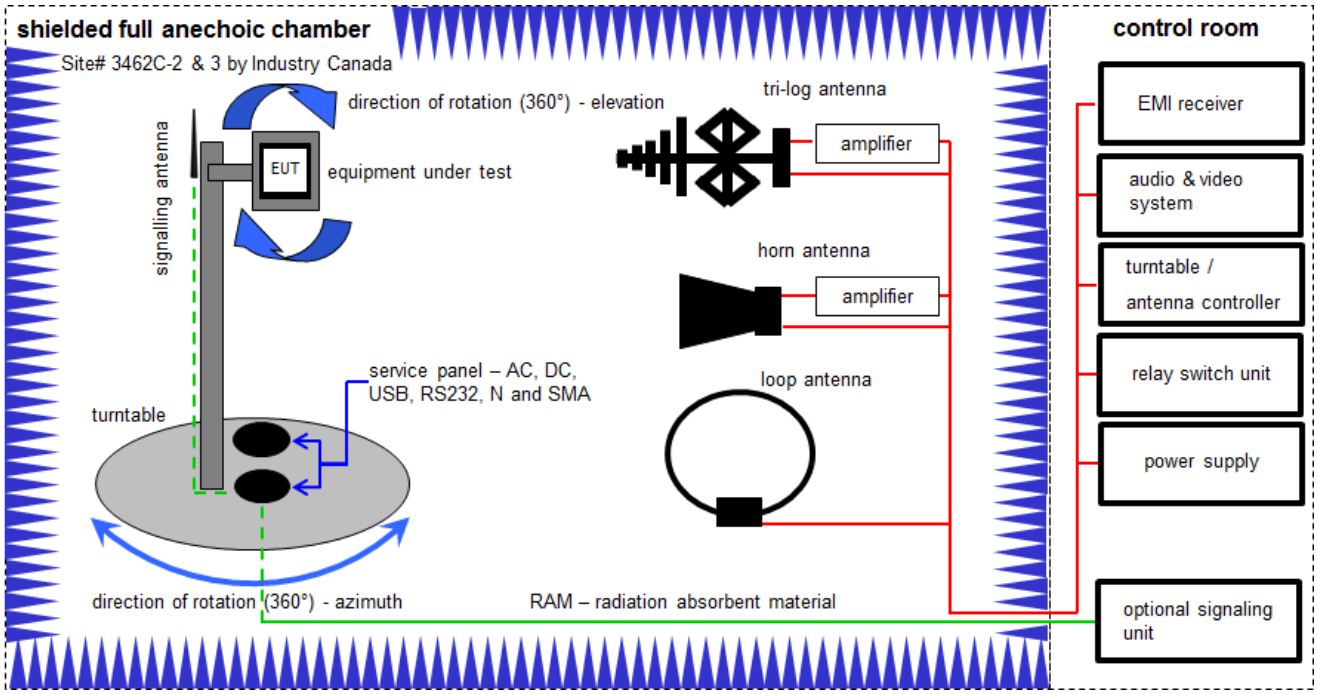
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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.	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	Semi anechoic chamber	Semi anechoic chamber 3000023	MWB AG	*	300000551	cnn	-/-	-/-
3	Turntable	Turntable 2089-4.0	EMCO Elektronik GmbH / Gilching	*	300004394	cnn	-/-	-/-
4	Switch-Unit	Switch-Unit 3488A	Hewlett Packard	2719A14505	300000368	cpu	-/-	-/-
6	Antenna Tower	Antenna Tower 2175	ETS-Lindgren Gmbh / Taufkirchen	64762	300003745	cnn	-/-	-/-
7	Positioning Controller	Positioning Controller 2090	ETS-Lindgren Gmbh / Taufkirchen	64672	300003746	cnn	-/-	-/-
10	EMI Test Receiver	EMI Test Receiver ESR3	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102587	300005771	cal	05.12.2024	05.12.2025
11	TRILOG Broadband Antenna	TRILOG Broadband Antenna VULB9163	Schwarzbeck Mess-Elektronik OHG / Schönau	295	300003787	cal	23.05.2023	23.05.2025

6.4 Shielded fully anechoic chamber



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

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

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

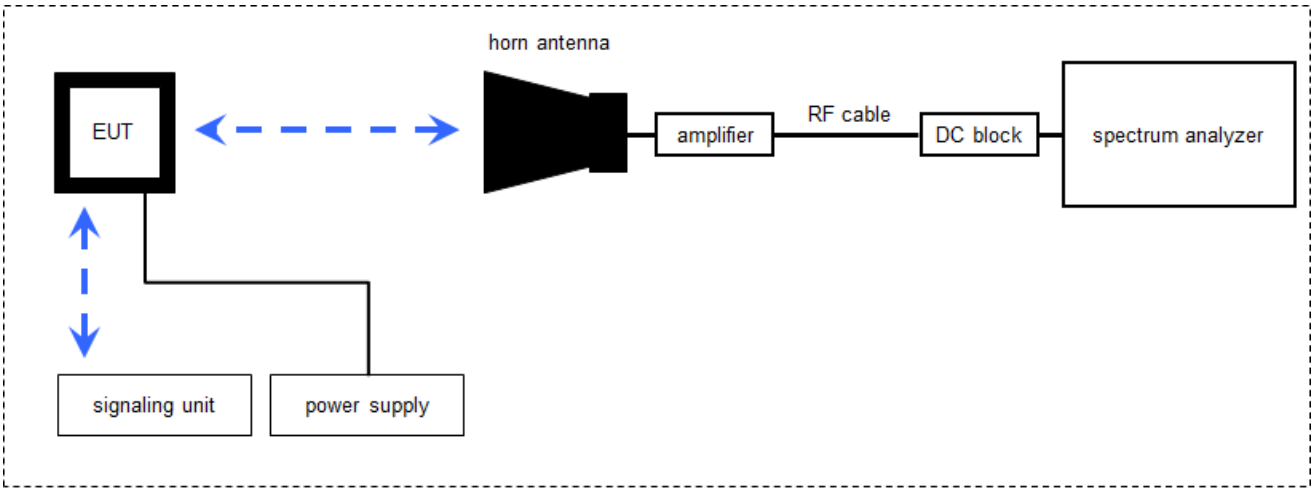
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

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

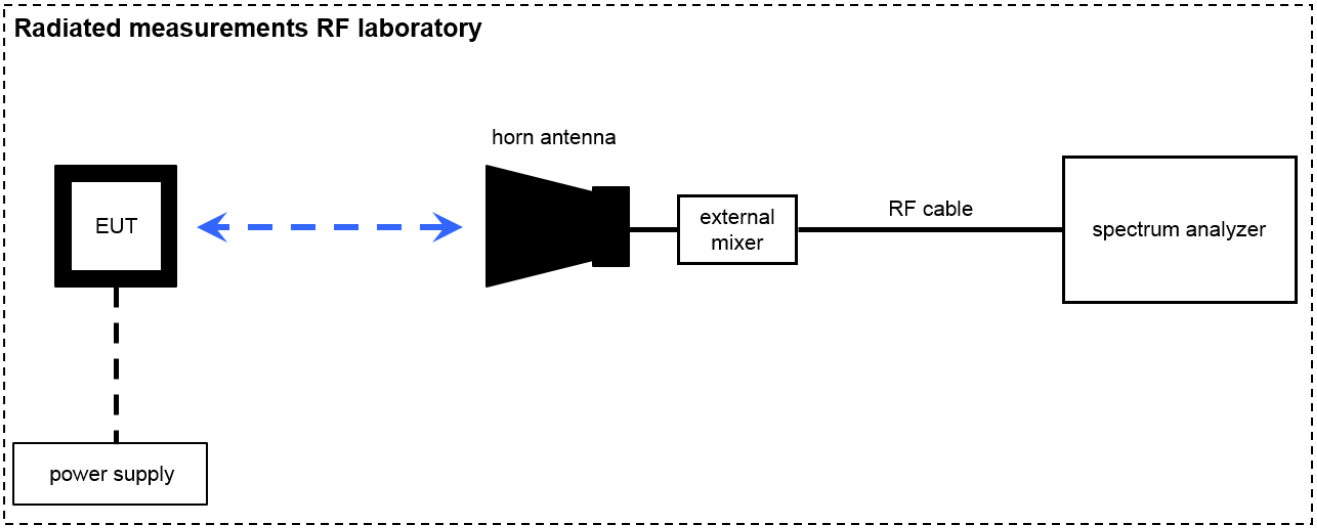
Equipment table:

No.	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	Double-Ridged Waveguide Horn Antenna	Double-Ridged Waveguide Horn Antenna 3115	EMCO Elektronik GmbH / Gilching	8812-3089	300000307	cal	09.07.2024	09.07.2026
2	Anechoic chamber	Anechoic chamber FAC 3/5m	MWB / TDK	87400/02	300000996	cpu	-/-	-/-
3	Switch / Control Unit	Switch / Control Unit 3488A	Hewlett Packard	*	300000199	cnn	-/-	-/-
4	Highpass Filter	Highpass Filter WHKX7.0/18G-8SS	Wainwright Instruments GmbH / Andechs	19	300003790	cnn	-/-	-/-
5	Broadband Amplifier 0.5-18 GHz	Broadband Amplifier 0.5-18 GHz CBLU5184540	CERNEX	22049	300004481	cpu	-/-	-/-
6	4U RF Switch Platform	4U RF Switch Platform L4491A	Agilent Technologies Deutschland GmbH / Böblingen	MY50000037	300004509	cnn	-/-	-/-
7	NEXIO EMV-Software	NEXIO EMV-Software BAT EMC V2022.0.32.0	Nexio	*	300004682	cnn	-/-	-/-
8	RF-Amplifier	RF-Amplifier AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	cpu	-/-	-/-
9	Active Loop Antenna	Active Loop Antenna 6502	EMCO Elektronik GmbH / Gilching	8905-2342	300000256	cal	19.07.2023	31.07.2025
10	EMI Test Receiver	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100037	300003555	cal	10.12.2024	10.12.2025
11	TRILOG Broadband Antenna	TRILOG Broadband Antenna VULB9163	Schwarzbeck Mess-Elektronik OHG / Schönau	318	300003696	cal	31.01.2024	31.01.2026

6.5 Radiated measurements > 18 GHz



6.6 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)

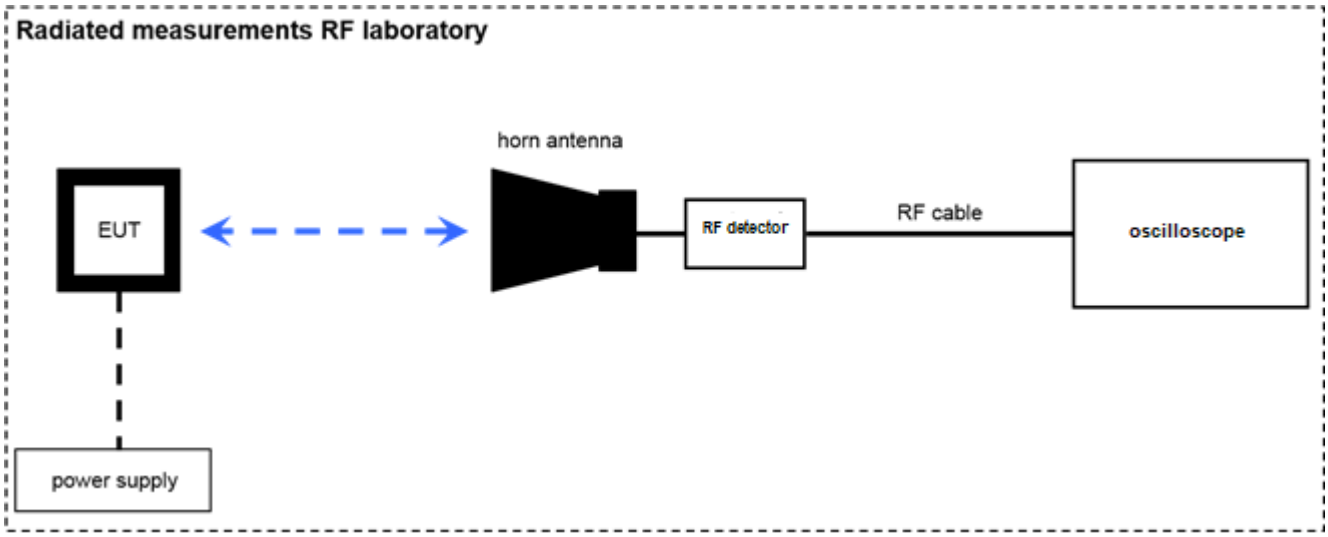
Example calculation:
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

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

Equipment table:

No.	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	Temperature Test Chamber	Temperature Test Chamber T-40/50	CTS Clima Temperatur Systeme GmbH / Hechingen	064023	300003540	calchk	11.07.2024	11.07.2026
2	Power Supply	Power Supply E3632A	Agilent Technologies Deutschland GmbH / Böblingen	MY40001320	400000396	cal	04.12.2024	04.12.2027
3	Signal- and Spectrum Analyzer 2 Hz - 85 GHz	Signal- and Spectrum Analyzer 2 Hz - 85 GHz FSW85	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101333	300005568	cal	27.09.2024	27.09.2025
4	Signal- and Spectrum Analyzer 2 Hz - 50 GHz	Signal- and Spectrum Analyzer 2 Hz - 50 GHz FSW50	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101332	300005935	cal	09.01.2025	09.01.2026
5	Signal- and Spectrum Analyzer 2 Hz - 50 GHz	Signal- and Spectrum Analyzer 2 Hz - 50 GHz FSW50	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101560	300006179	cal	27.12.2024	27.12.2025
6	Std. Gain Horn Antenna 49.9-75.8 GHz	Std. Gain Horn Antenna 49.9-75.8 GHz 2524-20	Flann	*	300001983	cnn	-/-	-/-
7	Std. Gain Horn Antenna 114-173 GHz	Std. Gain Horn Antenna 114-173 GHz 2924-20	Flann	*	300001999	cnn	-/-	-/-
8	Std. Gain Horn Antenna 145-220 GHz	Std. Gain Horn Antenna 145-220 GHz 3024-20	Flann	*	300002000	cnn	-/-	-/-
9	Std. Gain Horn Antenna 60-90 GHz	Std. Gain Horn Antenna 60-90 GHz COR 60_90	Thomson CSF	*	300000814	cpu	-/-	-/-
10	Harmonic Mixer 3-Port, 110-170 GHz	Harmonic Mixer 3-Port, 110-170 GHz FS-Z170	Radiometer Physics GmbH	100014	300004156	cal	15.07.2024	15.07.2025
11	Harmonic Mixer 3-Port, 140-220 GHz	Harmonic Mixer 3-Port, 140-220 GHz SAM-220	Radiometer Physics GmbH	200001	300004157	cal	01.08.2024	01.08.2025
12	Harmonic Mixer 3-Port, 220-325 GHz	Harmonic Mixer 3-Port, 220-325 GHz SAM-325	Radiometer Physics GmbH	100002	300004158	cal	31.07.2024	31.07.2025
13	Std. Gain Horn Antenna 33.0-50.1 GHz	Std. Gain Horn Antenna 33.0-50.1 GHz 2324-20	Flann	57	400000683	cnn	-/-	-/-
14	Harmonic Mixer 3-Port, 60-90 GHz	Harmonic Mixer 3-Port, 60-90 GHz FS-Z90	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101555	300004691	cal	25.07.2024	25.07.2025
15	Std. Gain Horn Antenna 217-330 GHz	Std. Gain Horn Antenna 217-330 GHz 32240-20	Flann	233278	300004960	cnn	-/-	-/-
16	Harmonic Mixer 3-Port, 75-110 GHz	Harmonic Mixer 3-Port, 75-110 GHz FS-Z110	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101411	300004959	cal	30.08.2024	30.08.2025
17	Harmonic Mixer 3-port, 90-140 GHz	Harmonic Mixer 3-port, 90-140 GHz FS-Z140	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101119	300005581	cal	01.08.2024	01.08.2025
18	Harmonic Mixer 3-Port, 50-75 GHz	Harmonic Mixer 3-Port, 50-75 GHz FS-Z75	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101578	300005788	cal	10.07.2024	10.07.2025
19	Harmonic Mixer 3-Port, 325-500GHz	Harmonic Mixer 3-Port, 325-500GHz FS-Z500	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101016	300006096	cal	16.07.2024	16.07.2025
20	Std. Gain Horn Antenna 73.8-112 GHz	Std. Gain Horn Antenna 73.8-112 GHz 2724-20	Flann	*	300001988	cnn	-/-	-/-
21	Std. Gain Horn Antenna 92.3-140 GHz	Std. Gain Horn Antenna 92.3-140 GHz 2824-20	Flann	*	300001993	cnn	-/-	-/-
22	Standard Gain Horn 325-500 GHz	Standard Gain Horn 325-500 GHz 570240-20 1785-2a	Flann Microwave	273569	300006097	cpu	-/-	-/-
23	Horn Antenna 18,0-40,0 GHz	Horn Antenna 18,0-40,0 GHz LHAF180	Microw.Devel	39180-103-021	300001747	cal	24.01.2024	31.01.2026
24	Low Noise Amplifier, Broadband 18-50 GHz	Low Noise Amplifier, Broadband 18-50 GHz BZT-18005000-550835-SL2525-SL	B&Z Technologies	27887-27889	300006363	cpu	-/-	-/-

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



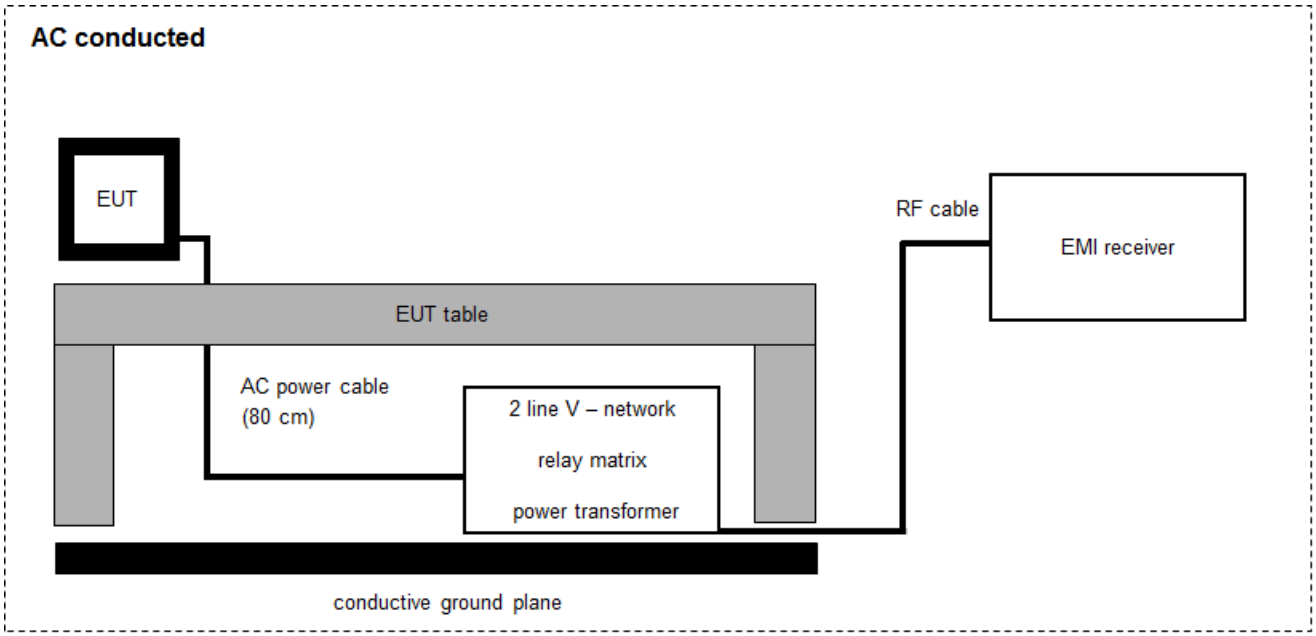
Note: EUT is replaced by reference source for substitution measurement

Measurement distance: horn antenna e.g. 50 cm

Equipment table:

No.	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	Oscilloscope	Oscilloscope DPO5054	Tektronix UK Ltd. / Berkshire	C010174	300004169	cal	05.12.2023	05.12.2025
2	Signal Generator 100 kHz - 40 GHz	Signal Generator 100 kHz - 40 GHz SMB100A	Rohde & Schwarz Messgerätebau GmbH / Memmingen	183320	300006330	cal	07.01.2025	07.01.2028
3	Std. Gain Horn Antenna 114-173 GHz	Std. Gain Horn Antenna 114-173 GHz 2924-20	Flann	*	300001999	cnn	-/-	-/-
4	SG Extension Module 110 - 170 GHz	SG Extension Module 110 - 170 GHz E8257DV06	VDI	US53250018	300005540	cpu	-/-	-/-
5	Std. Gain Horn Antenna 90-140 GHz	Std. Gain Horn Antenna 90-140 GHz COR 90_140	Thomson CSF	*	300000799	cpu	-/-	-/-
6	F-Band Positive Amplitude Detector	F-Band Positive Amplitude Detector SFD-903144-08SF-P1	Sage Millimeter Inc.	07354-1	300006119	cpu	-/-	-/-
7	Waveguide Amplifier 90-140 GHz	Waveguide Amplifier 90-140 GHz VDI-WR8.0AMP	VDI	01.01.2013	300006234	cpu	-/-	-/-

6.8 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.	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	EMI Test Receiver	EMI Test Receiver ESR3	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102981	300006318	cal	03.12.2024	03.12.2025
2	Analyzer-Impedence-System	Analyzer-Impedence-System AIS16/1	MEC Import: Spitzenberger + Spies GmbH & Co. KG	UO2076 07/0 1023	400001751	cal	19.10.2023	31.10.2025
3	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
4	Hochpass 150 kHz	Hochpass 150 kHz EZ-25	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100010	300003798	cpu	-/-	-/-

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 ± 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.

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.

7.6 Sequence of testing efficient use of spectrum

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- The EUT positioned at a distance of approx. 0.5m to the horn antenna used for the measurement.
- The associated receiver is positioned between the EUT the horn antenna to assure that the received signal level of the associated receiver at the spectrum analyzer is higher than the level of the EUT.

Measurement:

- Switch on EUT and associated receiver and wait until the connection is established.
- Start Analyzer sweep in Zerospan with a sweep time of 15 s.
- Switch of the associated receiver.
- When switching of the associated receiver, a drop in the received signal level at the spectrum analyzer can be observed. → position marker 1
- Position marker two at the point where the transmission of the EUT stops.
- Measure time difference between marker 1 and marker 2.

8 Measurement uncertainty

Test case	Uncertainty
Equivalent isotropically radiated power (e.i.r.p.)	Conducted value ± 1 dB 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 %

9 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
λ wavelength

Spurious emission measurements:

Antenna frequency range in GHz	Highest measured frequency in GHz	D in cm	λ in cm	D_{ff} in cm
18 - 26.5	26.5	3.4	1.13	20.44
26.5 - 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	2.25

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	1.02	0.24	8.57

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. 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	2025-06-26	-/-

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:

- None

Special test descriptions:

- None

Configuration descriptions:

- None

Test devices (EUT):

- EUT1: The normal operation mode (intended use) is used.
- EUT2/3/4: The below described Stop-Modes are used.

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

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: 99% bandwidth	
Detector:	Pos-Peak
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Trace-Mode:	Max Hold

Measurement parameter: 6 dB bandwidth	
Detector:	Pos-Peak
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Trace-Mode:	Max Hold

Measurement results:

99% bandwidth at normal conditions:

EUT	Mode	Test condition	f_L [GHz]	f_H [GHz]	Bandwidth [MHz]
1	1	T_{nom} / V_{nom}	122.020 110	122.955 161	935.051

6 dB bandwidth at normal conditions:

EUT	Mode	Test condition	f_L [GHz]	f_H [GHz]	Bandwidth [MHz]
1	1	T_{nom} / V_{nom}	122.017 710	122.960 500	942.790

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: 99% bandwidth

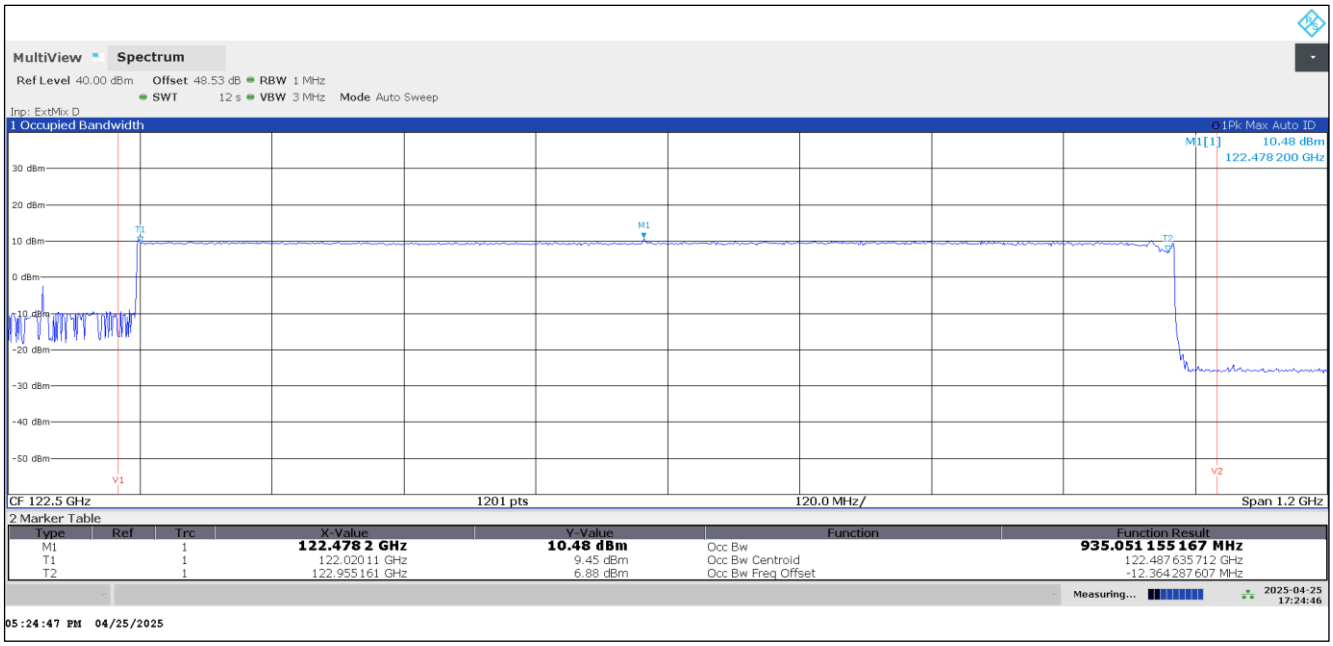
Test condition	Frequency f_L [GHz]	Frequency f_H [GHz]	Bandwidth [MHz]
-20 °C / V_{nom}	122.017	122.955	938.76
-10 °C / V_{nom}	122.017	122.955	937.11
0 °C / V_{nom}	122.018	122.954	936.12
10 °C / V_{nom}	122.018	122.955	936.23
20 °C / V_{nom}	122.018	122.954	935.94
20 °C / V_{min}	122.019	122.955	936.57
20 °C / V_{max}	122.019	122.955	936.74
30 °C / V_{nom}	122.019	122.954	935.19
40 °C / V_{nom}	122.019	122.955	935.21
50 °C / V_{nom}	122.020	122.955	935.08

Note:

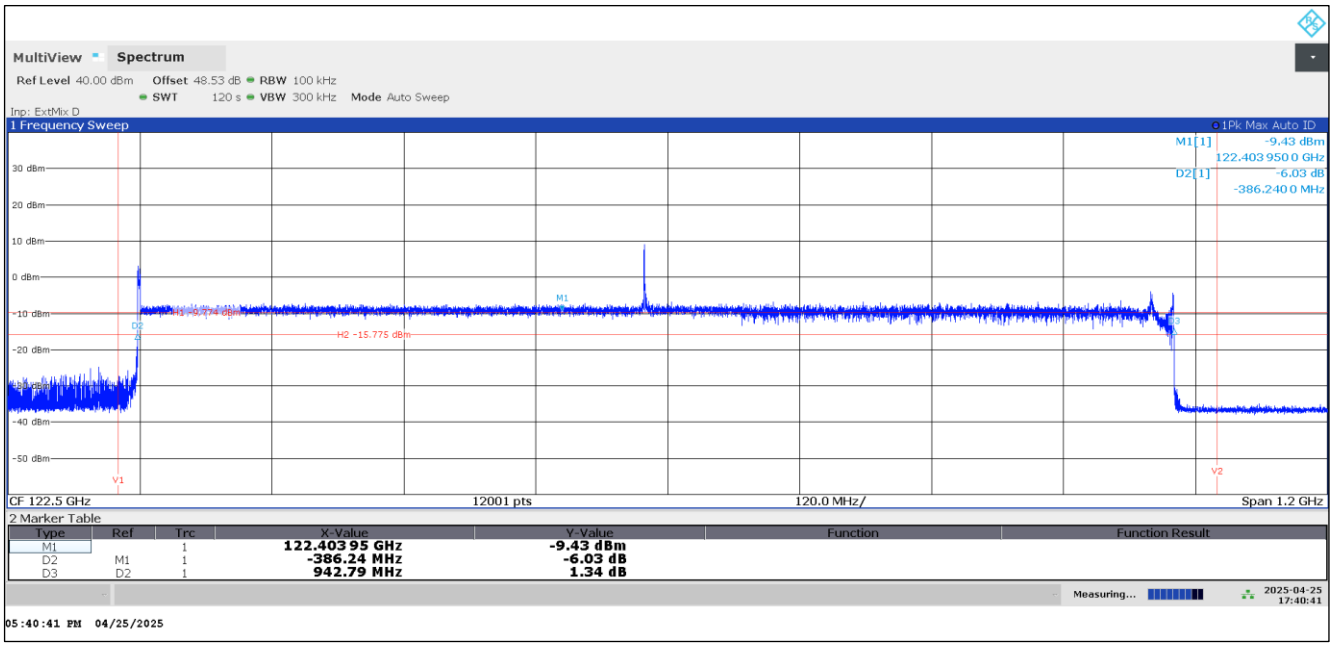
- Detailed measurement results: see measurement report 1-9898-25-01-03_TR1-A201-R01

Verdict: Compliant

Plot 1: EUT 1, Normal mode, 99% bandwidth



Plot 2: EUT 1, Normal mode, 6 dB bandwidth (RBW = 100 kHz)



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	1	T_{nom} / V_{nom}	7.43	43.0	-3.93	40.0

Verdict: Compliant

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

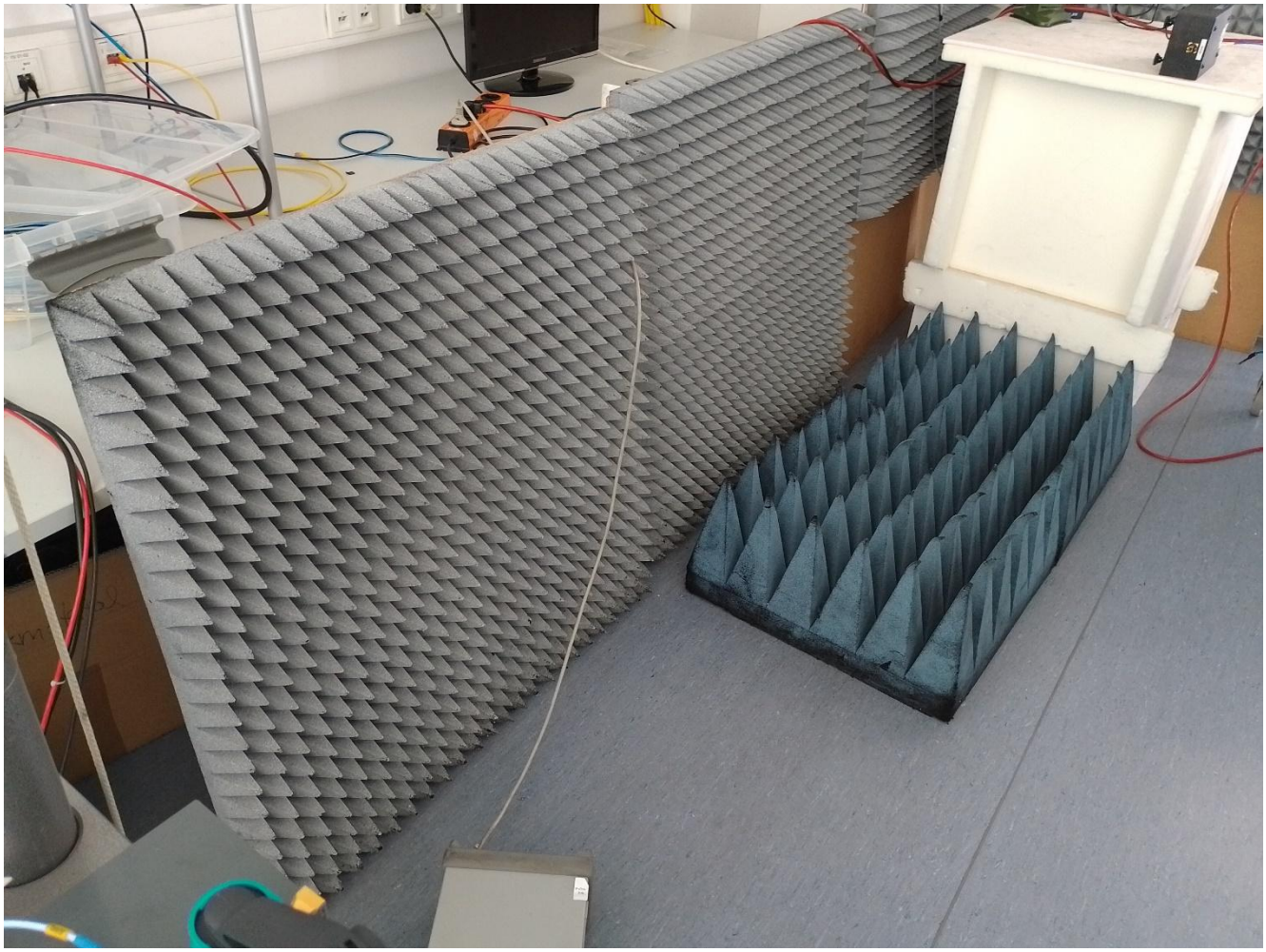
1) EUT emission measured with RF-detector:
   - Measurement distance: d_{EUT}
   - Maximum readout value on oscilloscope: V_{max}
   - Average (during the transmit interval) readout value on oscilloscope: $V_{average}$

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)	Measurement distance d_{EUT}	[m]	0.25
	Maximum readout value V_{max}	[mV]	2.46
	Average readout value $V_{average}$	[mV]	0.51
2)	Output power P_{REF}	[dBm]	27
	Frequency f_{REF}	[GHz]	122.5
	Measurement distance $d_{REF,max}$	[m]	2.38
	Measured duty cycle of EUT	[%]	7.32
3)	Max E.I.R.P.	[dBm]	7.43
	Average E.I.R.P.	[dBm]	-3.93

Setup of the substitution:

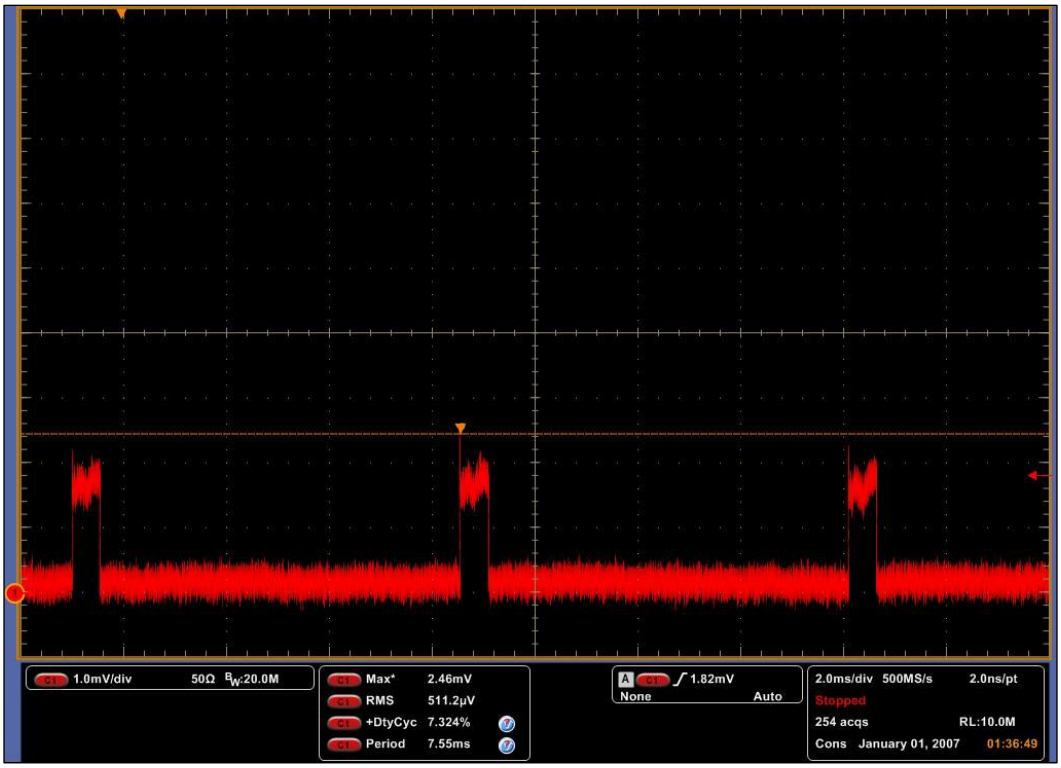


1) Synthesized Sweeper 10 MHz - 40 GHz

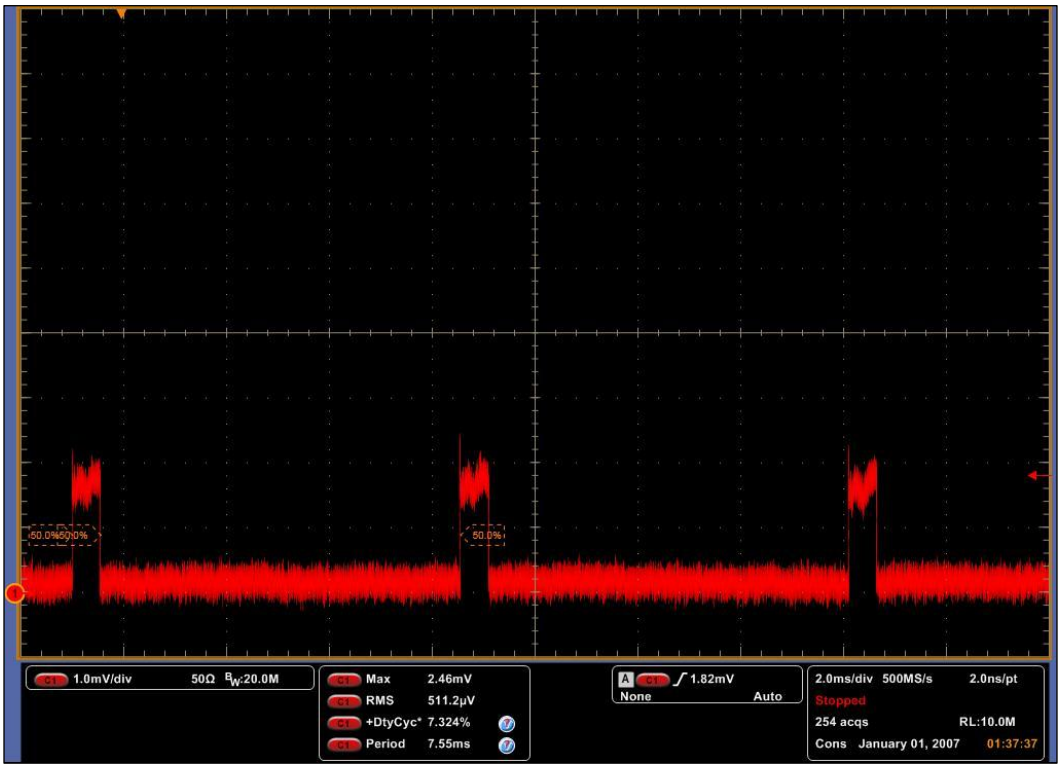
2) SG Extension Module 110 - 170 GHz & Std. Gain Horn Antenna 114-173 GHz

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

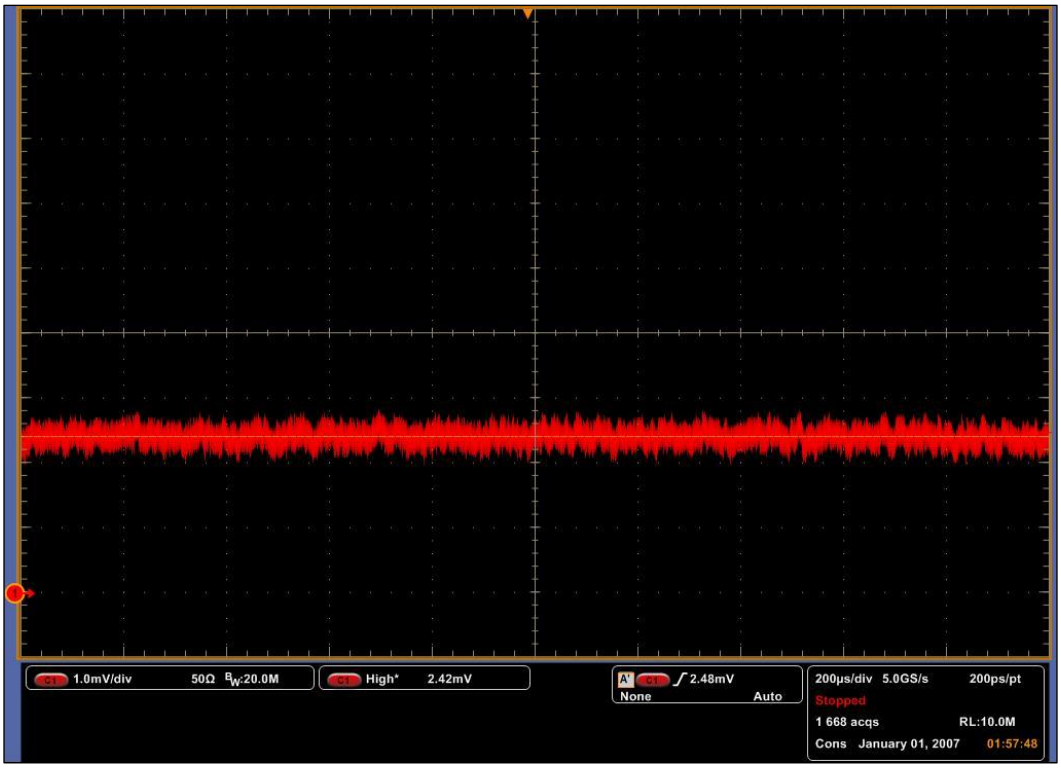
Plot 3: EUT Emission measured with RF Detector, EUT, Peak



Plot 4: EUT Emission measured with RF Detector, EUT, Duty Cycle



Plot 5: EUT Emission measured with reference source



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 × log(4 × π × d² × 1000 × PD[W/m²])

- 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 F > 1 GHz: 1 MHz
Video bandwidth:	F < 1 GHz: 300 kHz 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:

Frequency [GHz]	Detector	Bandwidth [MHz]	Level	Limit	Margin [dB]
61.239	RMS	1	-39.23	-10	29.23
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]
61.00948	RMS	1	-27.43	-10	17.43
183.028	RMS	1	-28.34	-10	18.34
Please refer to the following plots for more information on the level of spurious emissions					

Stop mode, middle frequency:

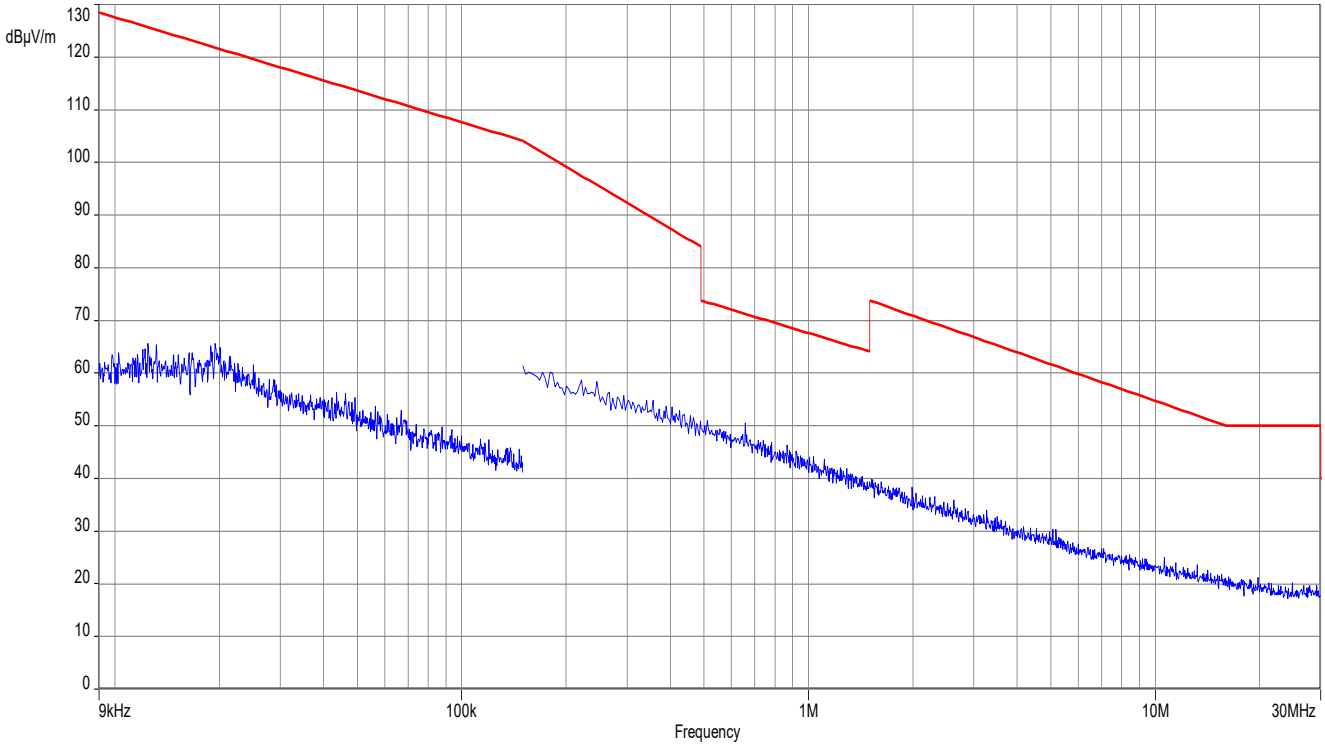
Frequency [GHz]	Detector	Bandwidth [MHz]	Level	Limit	Margin [dB]
61.239	RMS	1	-27.03	-10	17.03
183.717	RMS	1	-26.79	-10	16.79
Please refer to the following plots for more information on the level of spurious emissions					

Stop mode, high frequency:

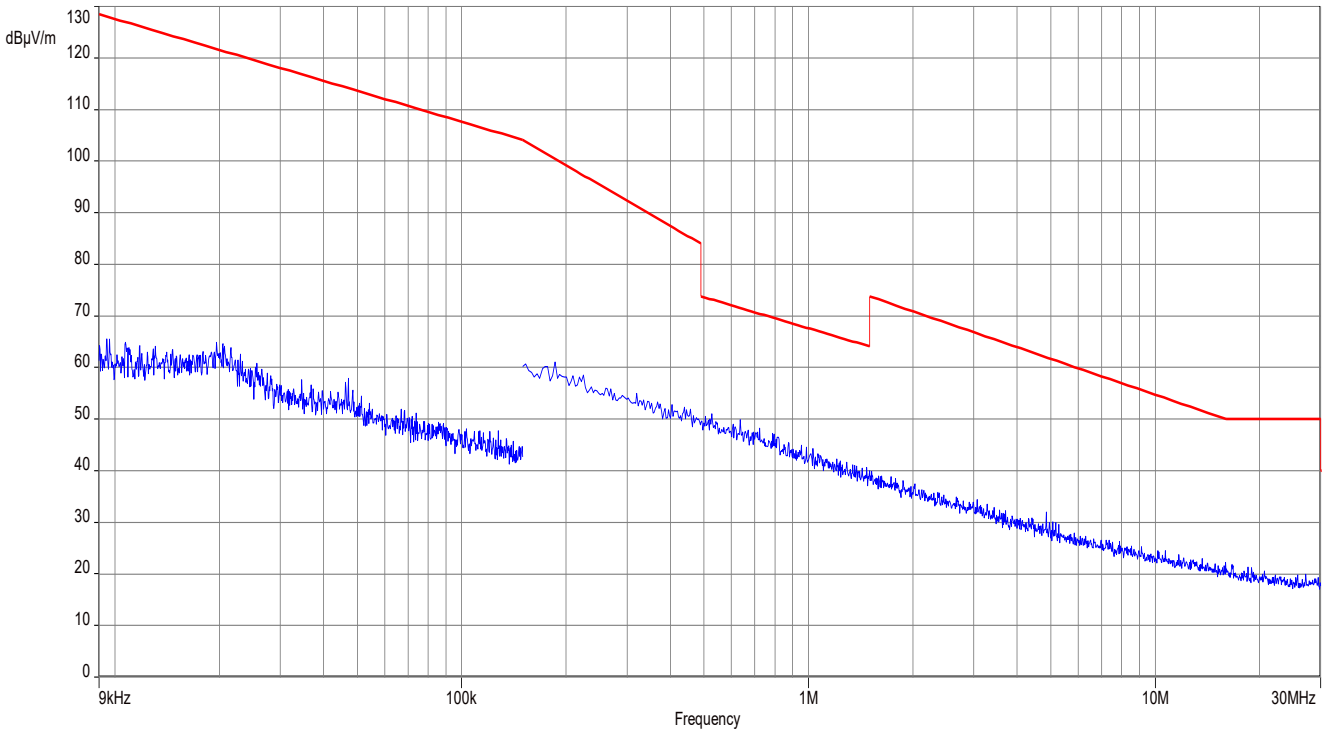
Frequency [GHz]	Detector	Bandwidth [MHz]	Level	Limit	Margin [dB]
61.470	RMS	1	-28.73	-10	18.73
184.409	RMS	1	-24.62	-10	14.62
Please refer to the following plots for more information on the level of spurious emissions					

Verdict: Compliant

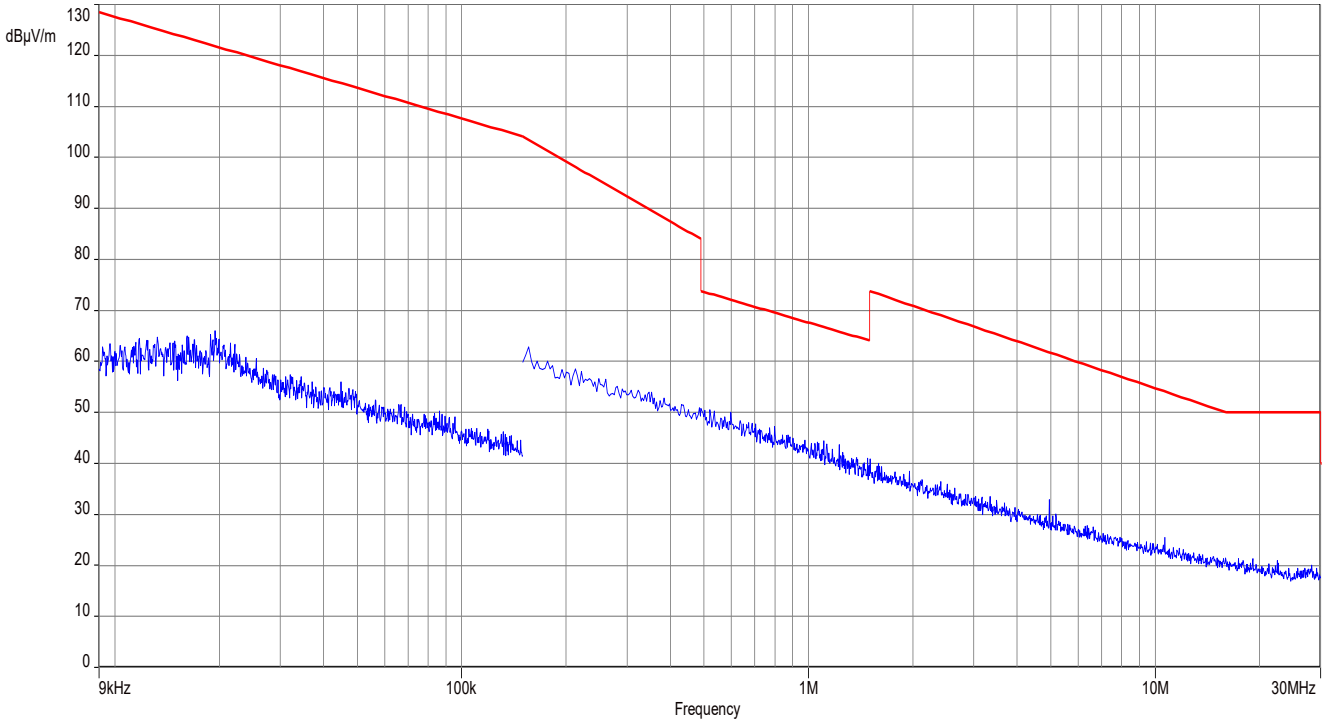
Plot 6: 9 kHz – 30 MHz, normal operation mode



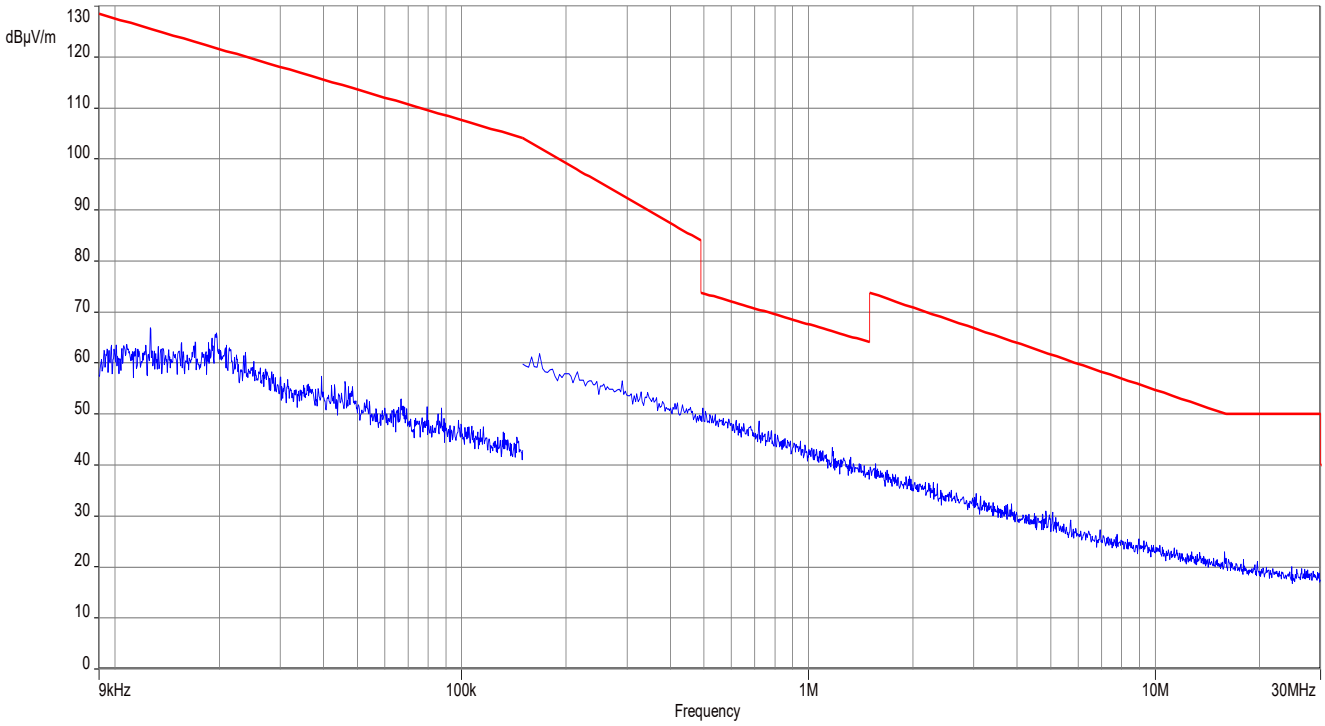
Plot 7: 9 kHz – 30 MHz, stop mode, low frequency



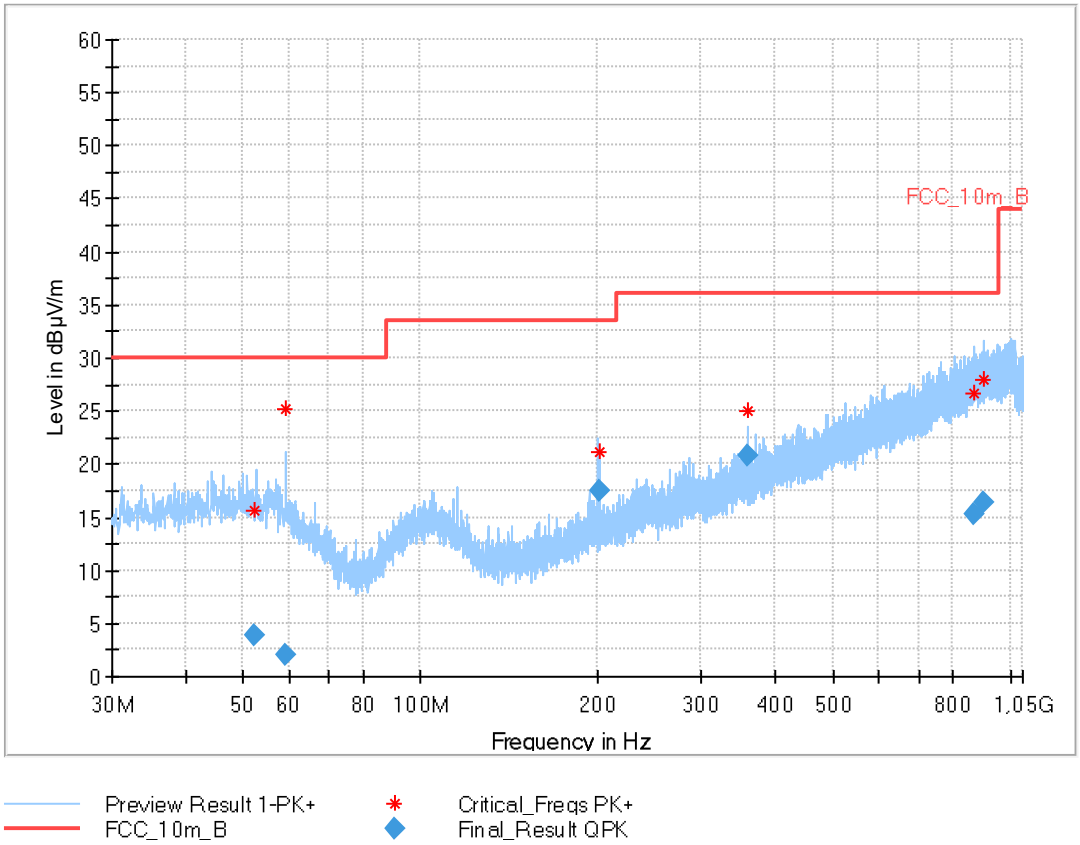
Plot 8: 9 kHz – 30 MHz, stop mode, middle frequency



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



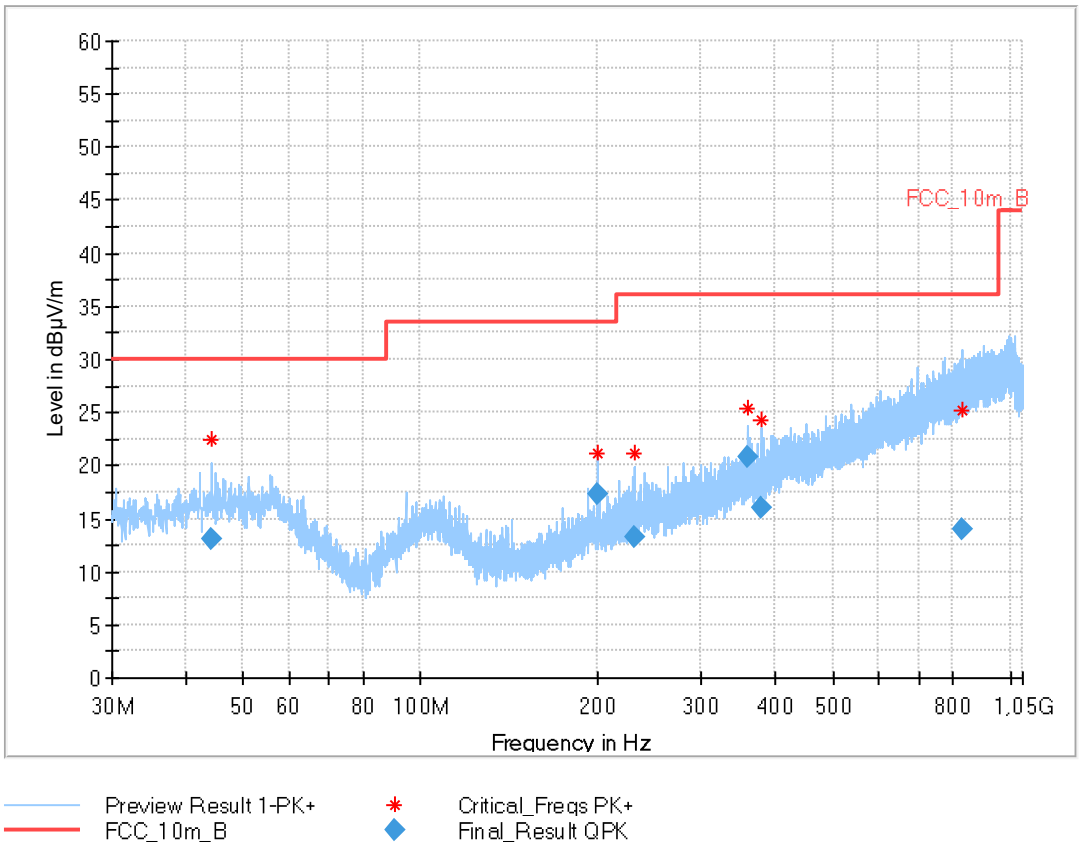
Plot 10: 30 MHz – 1GHz, normal operation mode



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)
52.278	3.94	30.0	26.1	1000	120.0	195.0	H	217	15
59.298	2.06	30.0	27.9	1000	120.0	195.0	H	29	14
200.578	17.54	33.5	16.0	1000	120.0	98.0	V	307	12
359.418	20.79	36.0	15.2	1000	120.0	105.0	V	87	17
869.944	15.22	36.0	20.8	1000	120.0	185.0	V	-23	25
903.968	16.45	36.0	19.6	1000	120.0	132.0	H	284	25

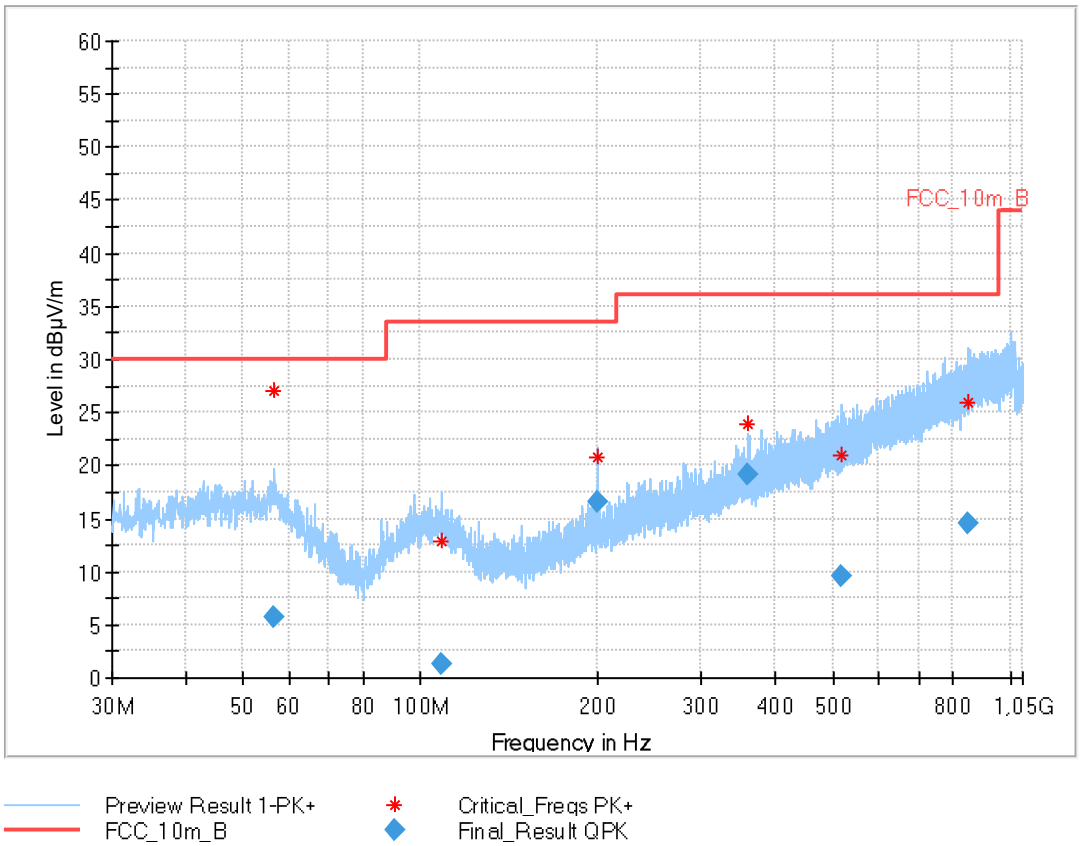
Plot 11: 30 MHz – 1GHz, stop mode, low frequency



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)
44.246	13.00	30.0	17.0	1000	120.0	174.0	V	168	15
200.002	17.28	33.5	16.2	1000	120.0	102.0	V	307	12
230.821	13.34	36.0	22.7	1000	120.0	121.0	V	-28	14
359.432	20.78	36.0	15.2	1000	120.0	98.0	V	53	17
379.877	15.99	36.0	20.0	1000	120.0	104.0	V	288	17
828.686	13.95	36.0	22.1	1000	120.0	105.0	H	235	24

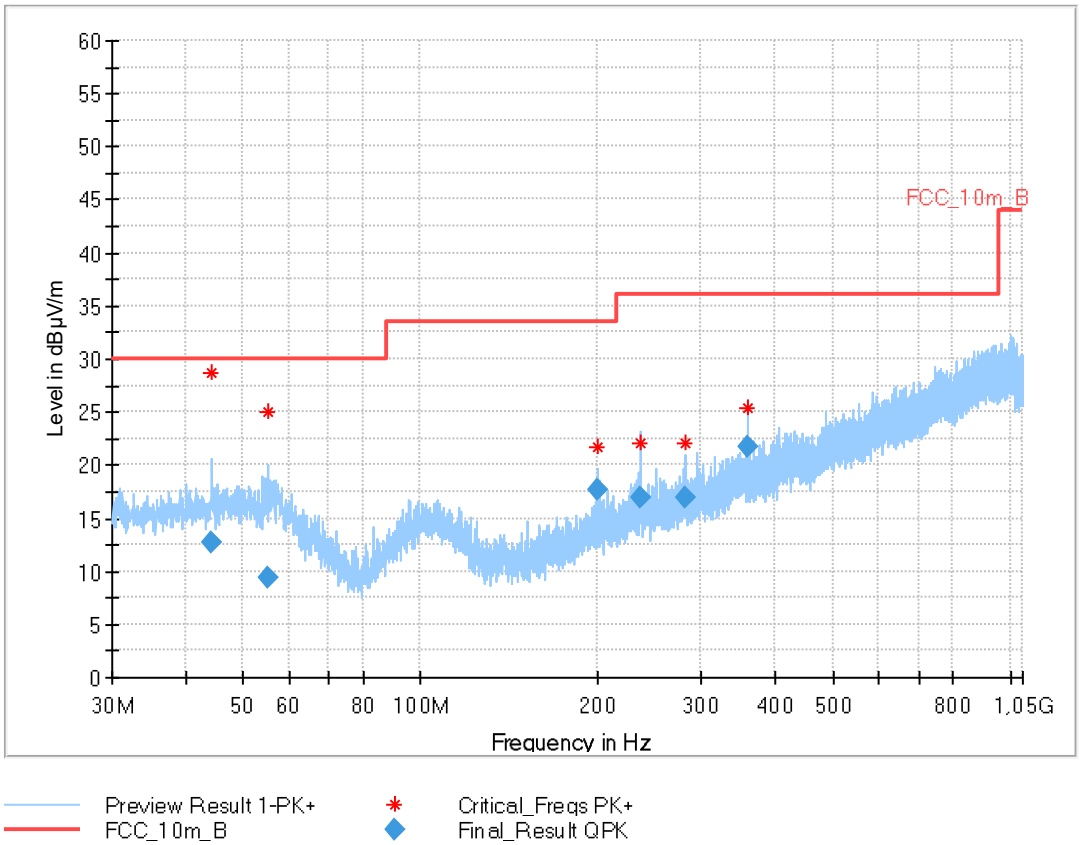
Plot 12: 30 MHz – 1GHz, stop mode, middle frequency



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)
56.246	5.73	30.0	24.3	1000	120.0	195.0	V	145	16
108.830	1.32	33.5	32.2	1000	120.0	195.0	H	266	13
200.006	16.58	33.5	16.9	1000	120.0	107.0	V	11	12
359.988	19.23	36.0	16.8	1000	120.0	102.0	V	118	17
516.969	9.48	36.0	26.5	1000	120.0	195.0	V	217	20
849.310	14.61	36.0	21.4	1000	120.0	170.0	H	168	24

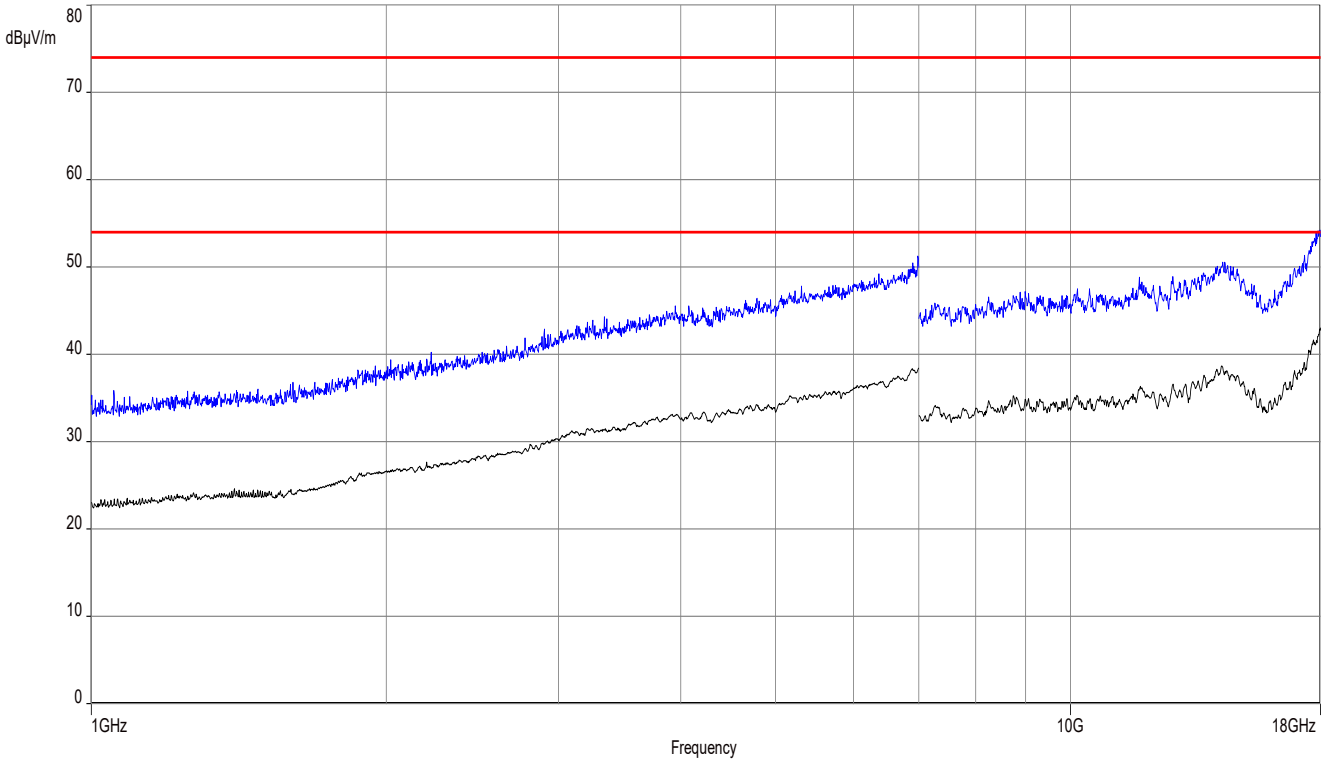
Plot 13: 30 MHz – 1GHz, stop mode, high frequency



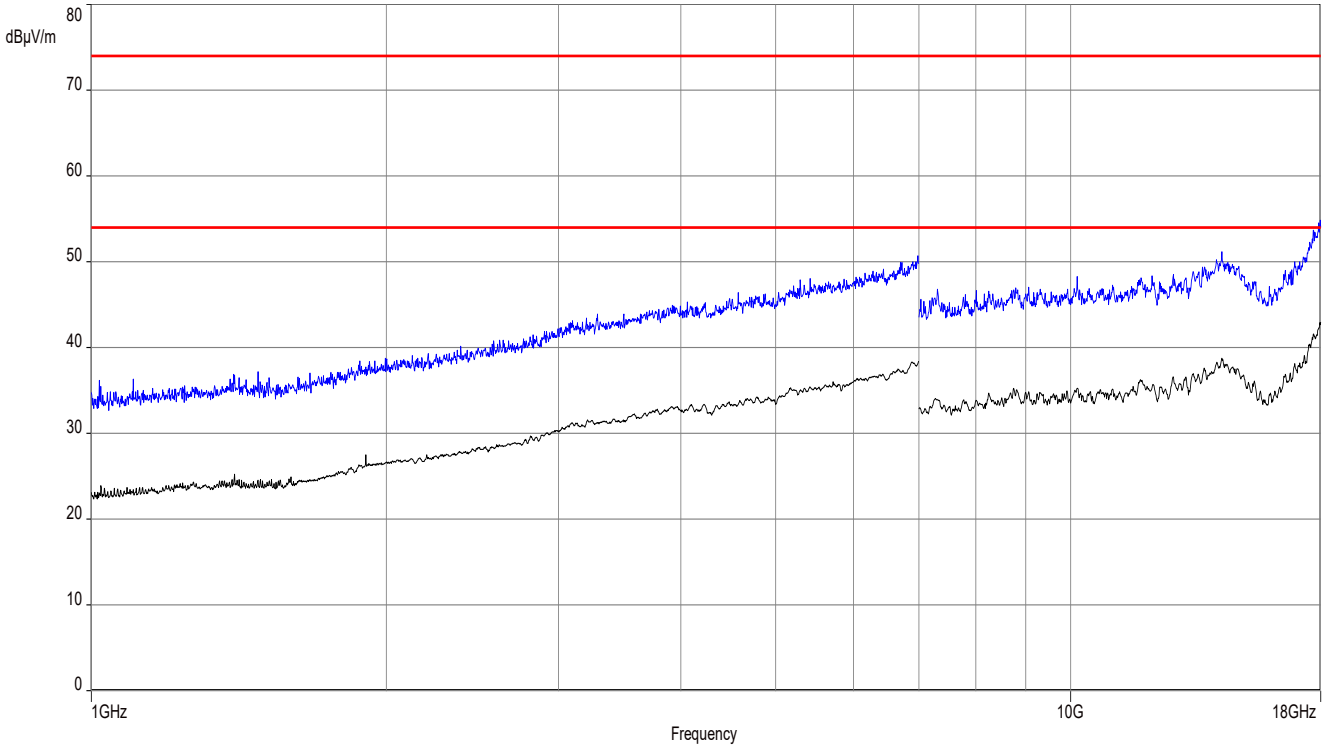
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
44.216	12.74	30.0	17.3	1000	120.0	195.0	V	58	15
55.320	9.40	30.0	20.6	1000	120.0	195.0	V	58	15
200.000	17.65	33.5	15.9	1000	120.0	102.0	V	97	12
235.980	16.85	36.0	19.2	1000	120.0	101.0	V	67	14
280.567	17.01	36.0	19.0	1000	120.0	98.0	V	-5	15
360.015	21.71	36.0	14.3	1000	120.0	98.0	V	111	17

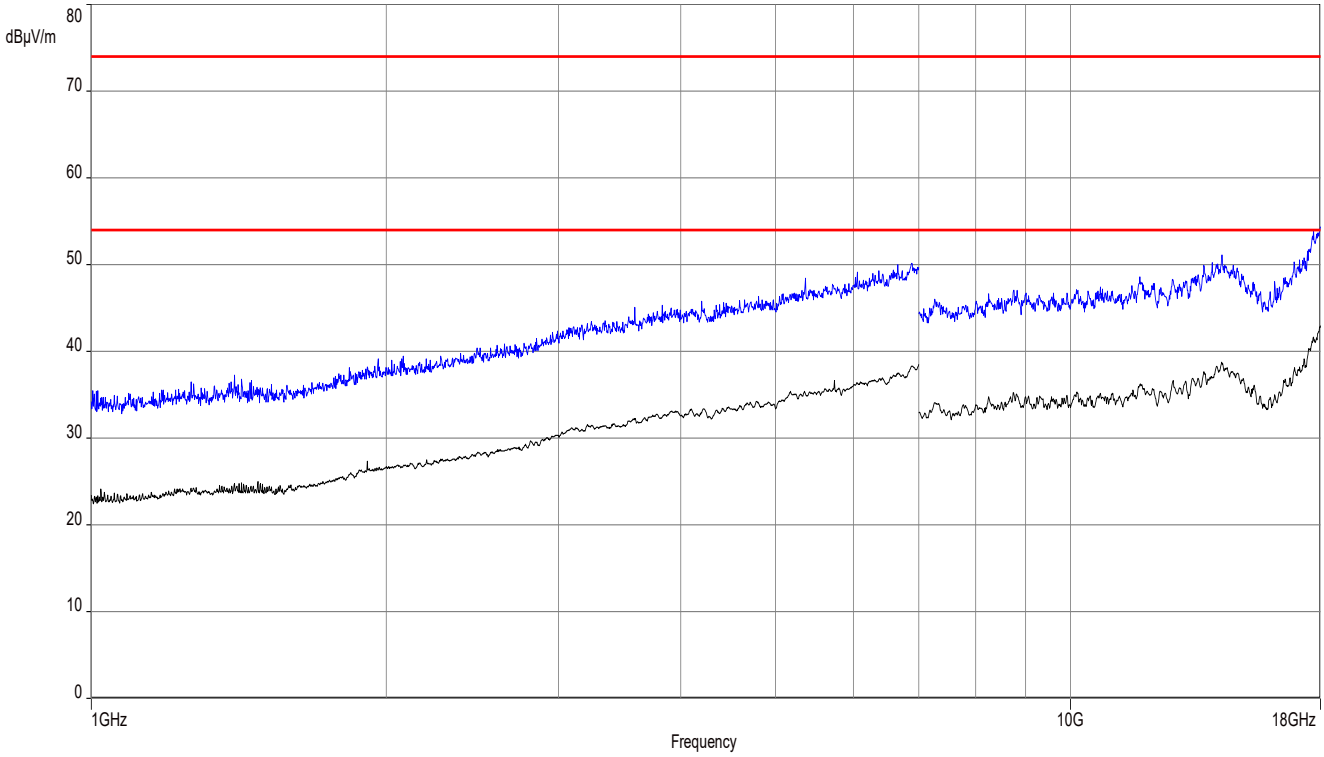
Plot 14: 1GHz – 18 GHz, normal operation mode



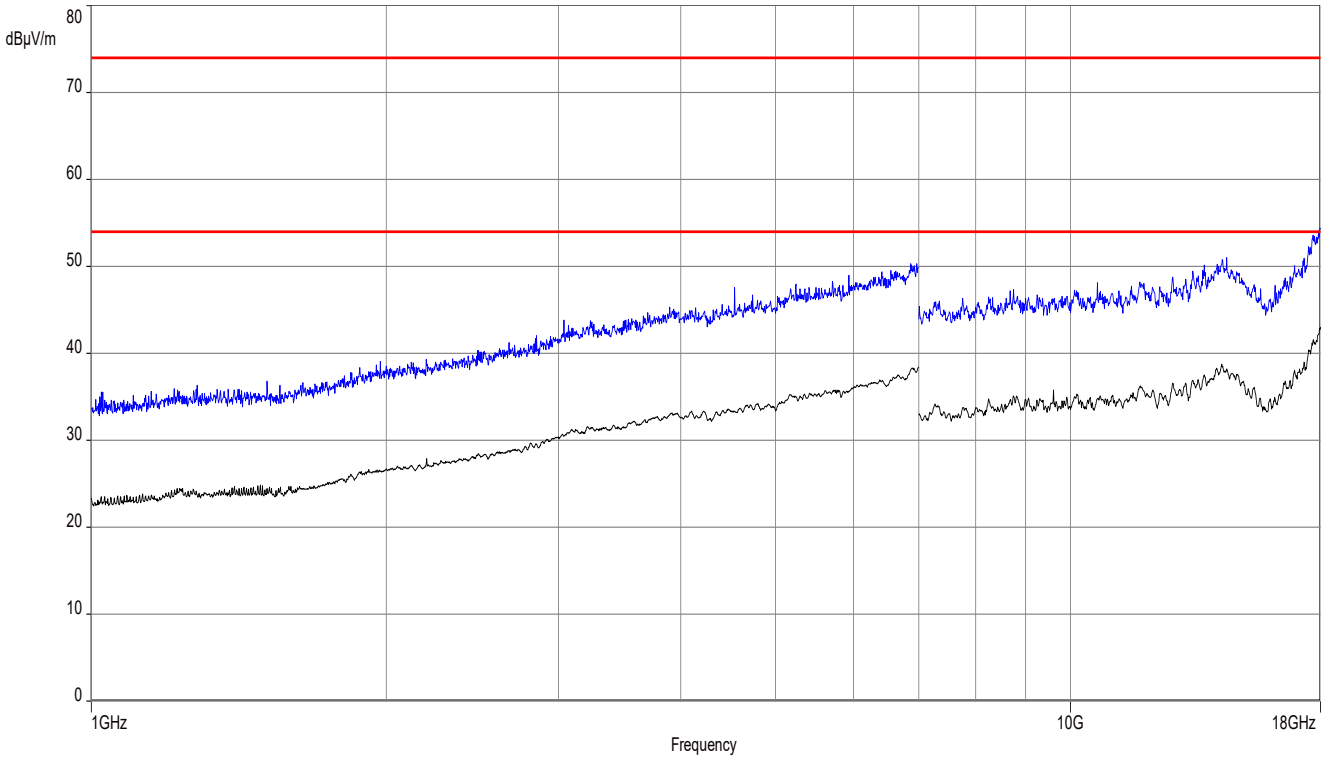
Plot 15: 1GHz – 18 GHz, stop mode, low frequency



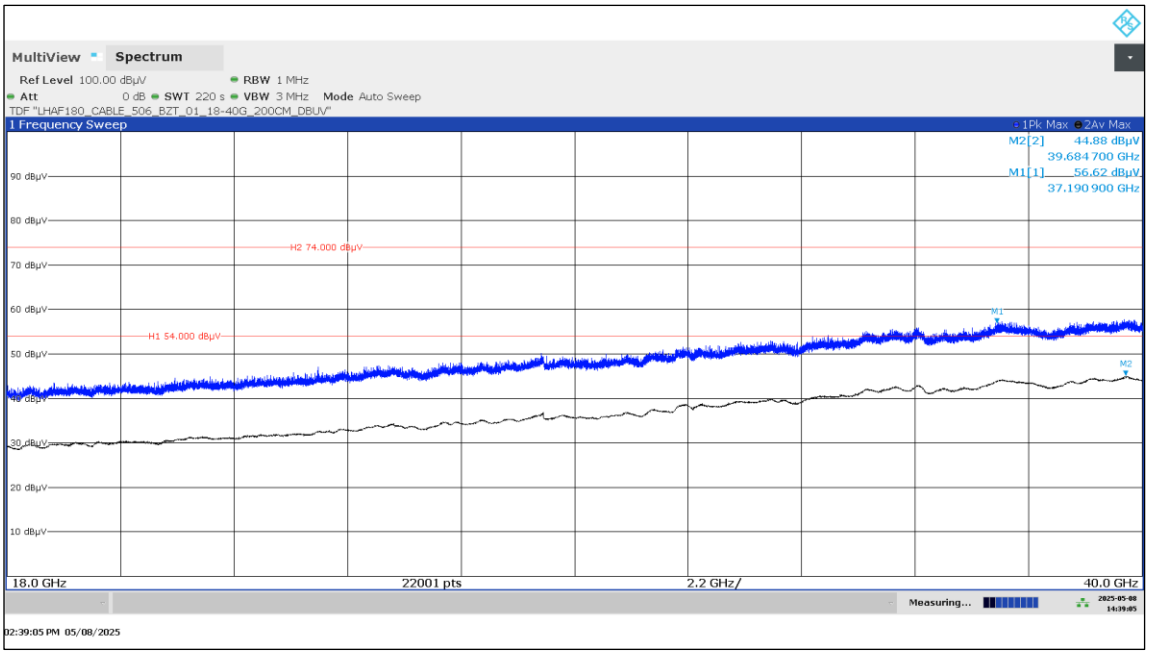
Plot 16: 1GHz – 18 GHz, stop mode, middle frequency



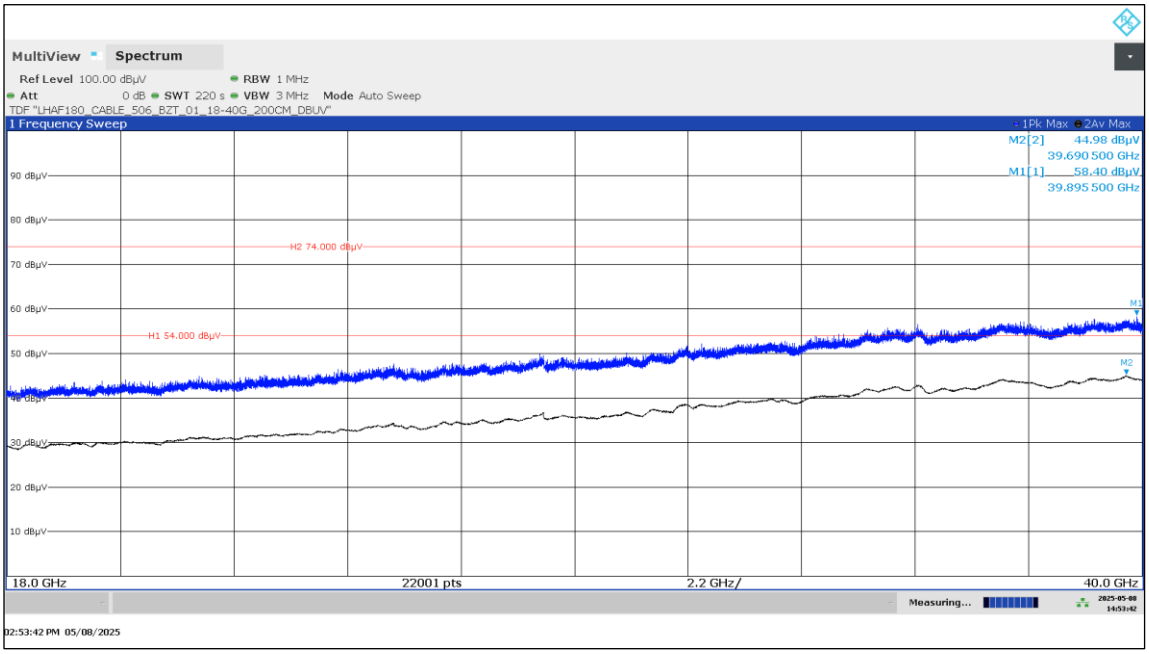
Plot 17: 1GHz – 18 GHz, stop mode, high frequency



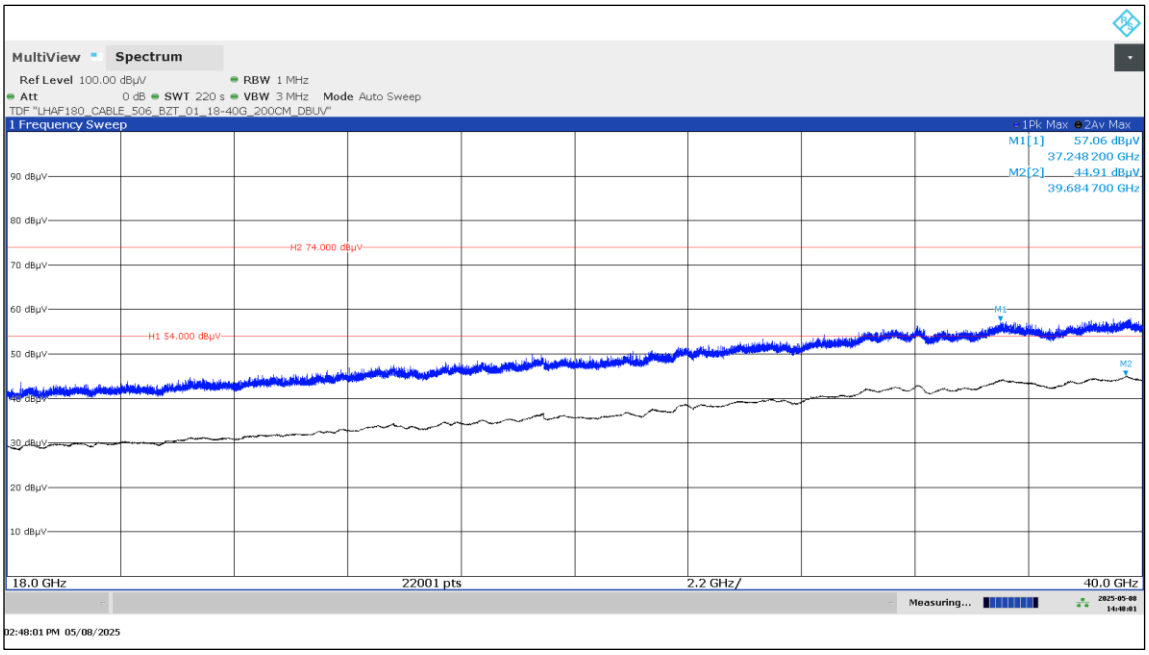
Plot 18: 18 GHz – 40 GHz, normal operation mode



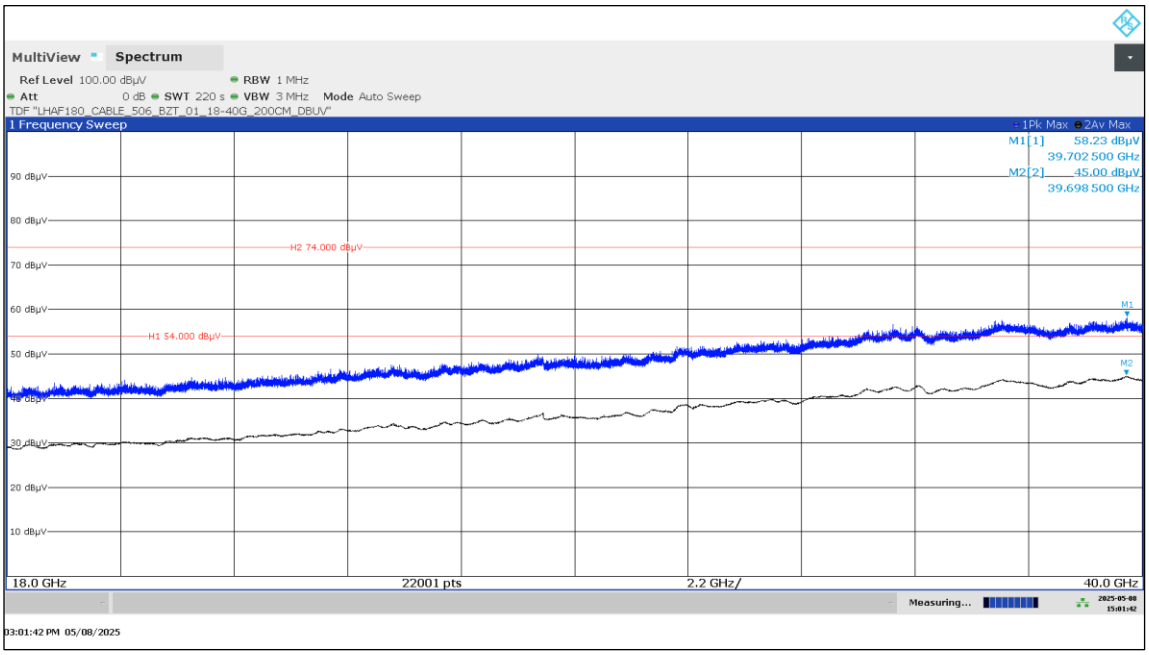
Plot 19: 18 GHz – 40 GHz, stop mode, low frequency



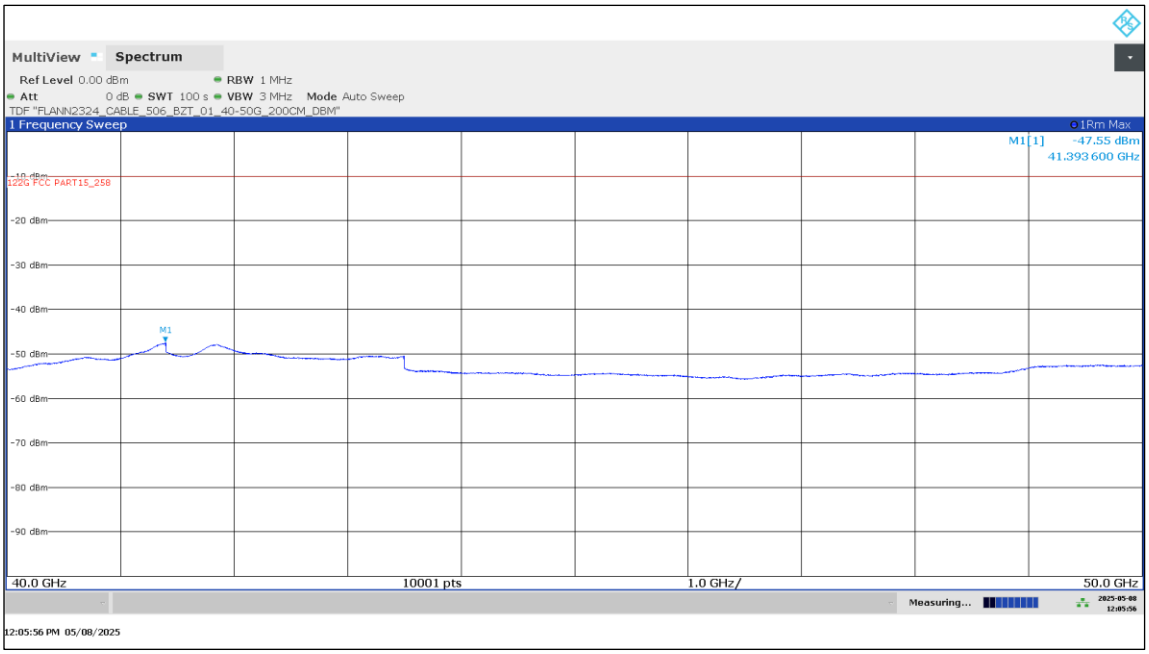
Plot 20: 18 GHz – 40 GHz, stop mode, middle frequency



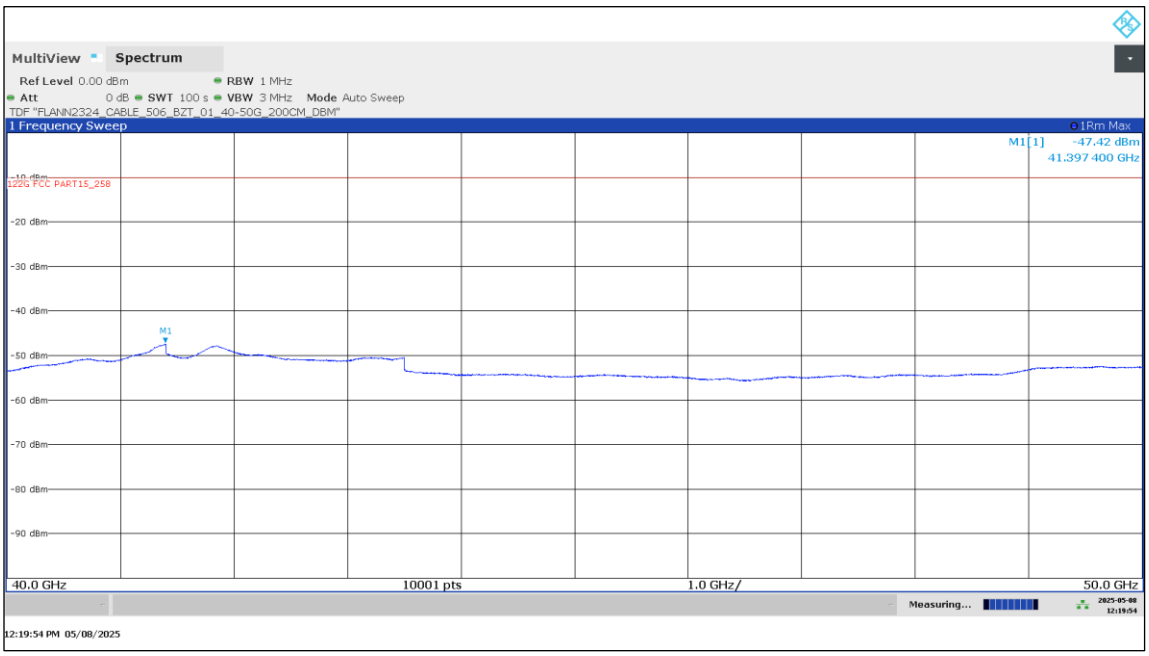
Plot 21: 18 GHz – 40 GHz, stop mode, high frequency



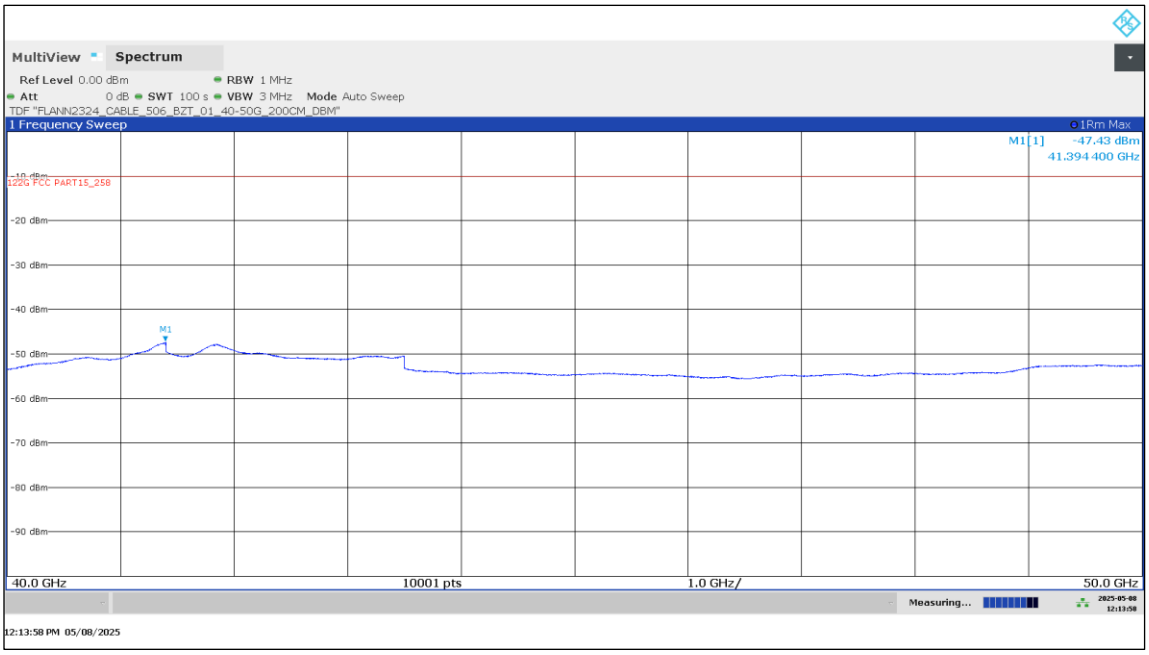
Plot 22: 40 GHz – 50 GHz, normal operation mode



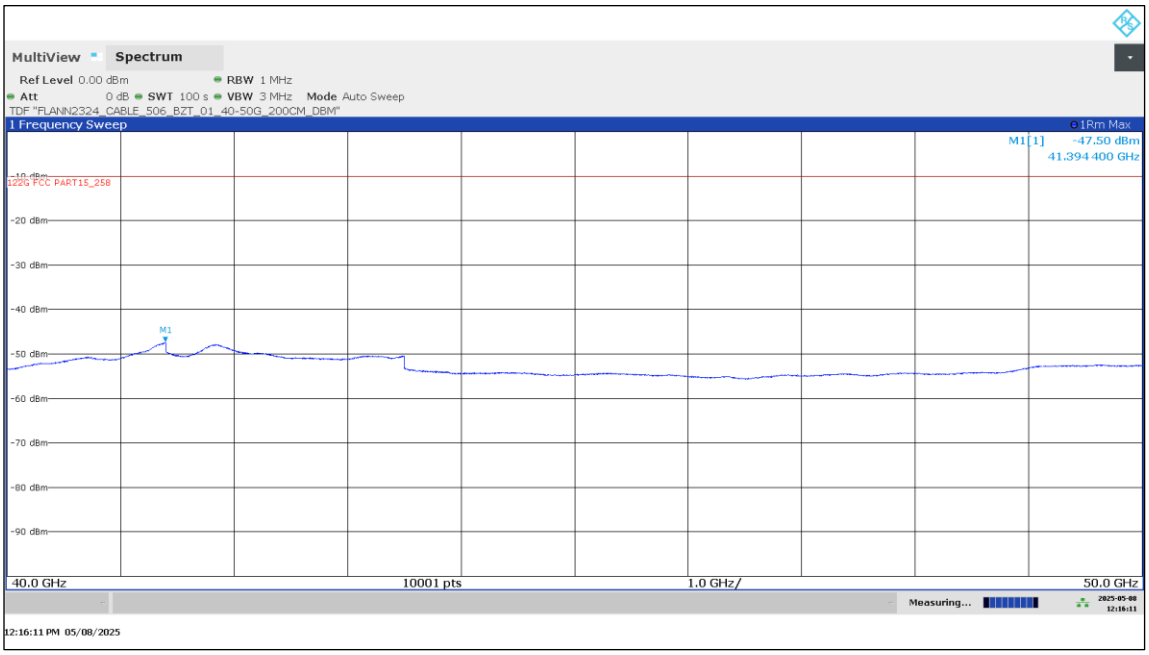
Plot 23: 40 GHz – 50 GHz, stop mode, low frequency



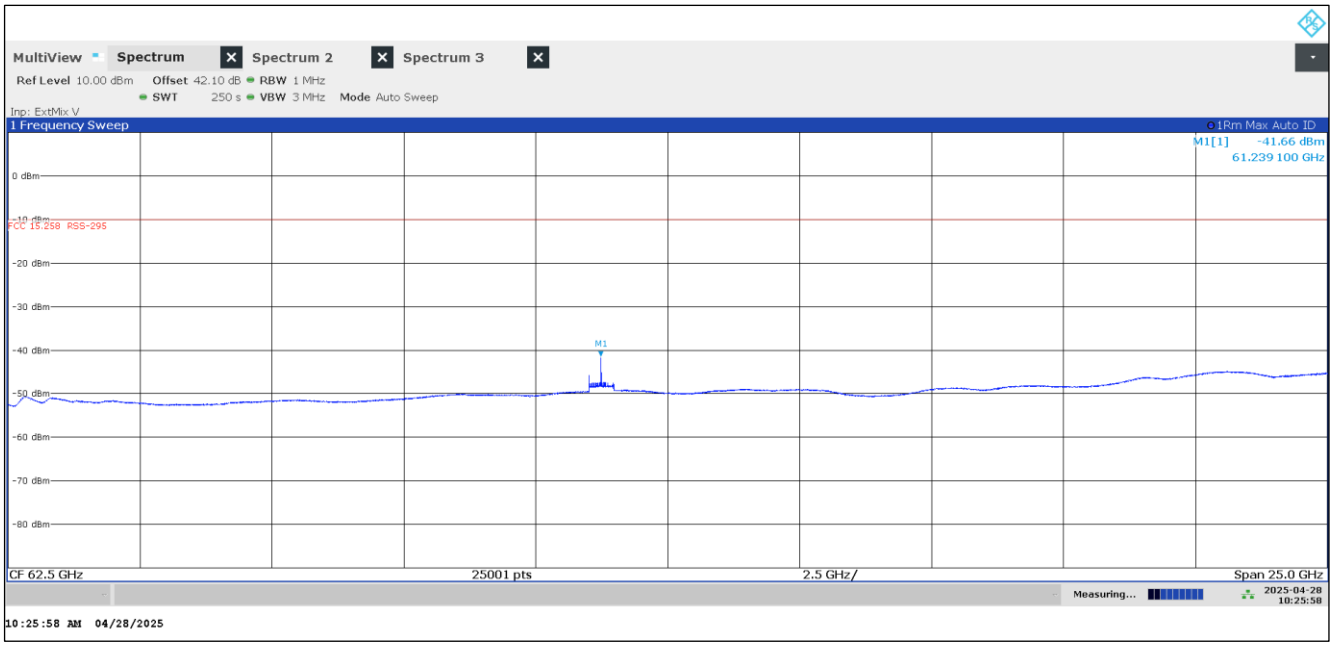
Plot 24: 40 GHz – 50 GHz, stop mode, middle frequency



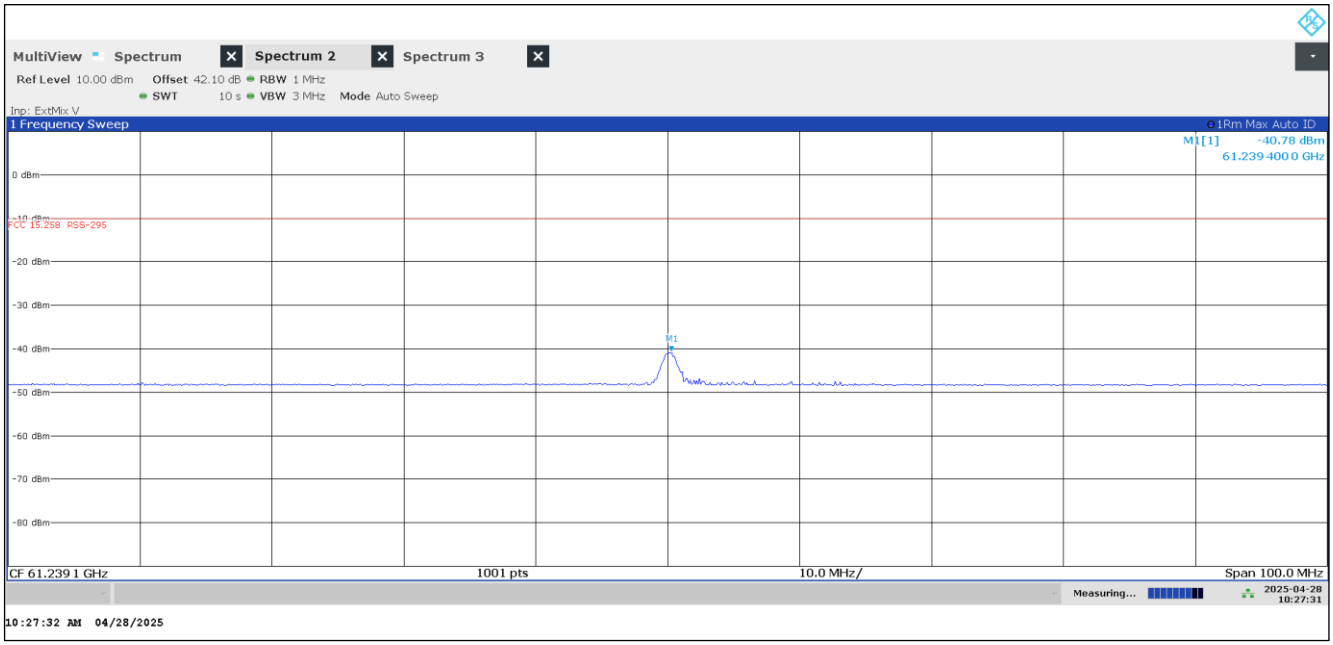
Plot 25: 40 GHz – 50 GHz, stop mode, high frequency



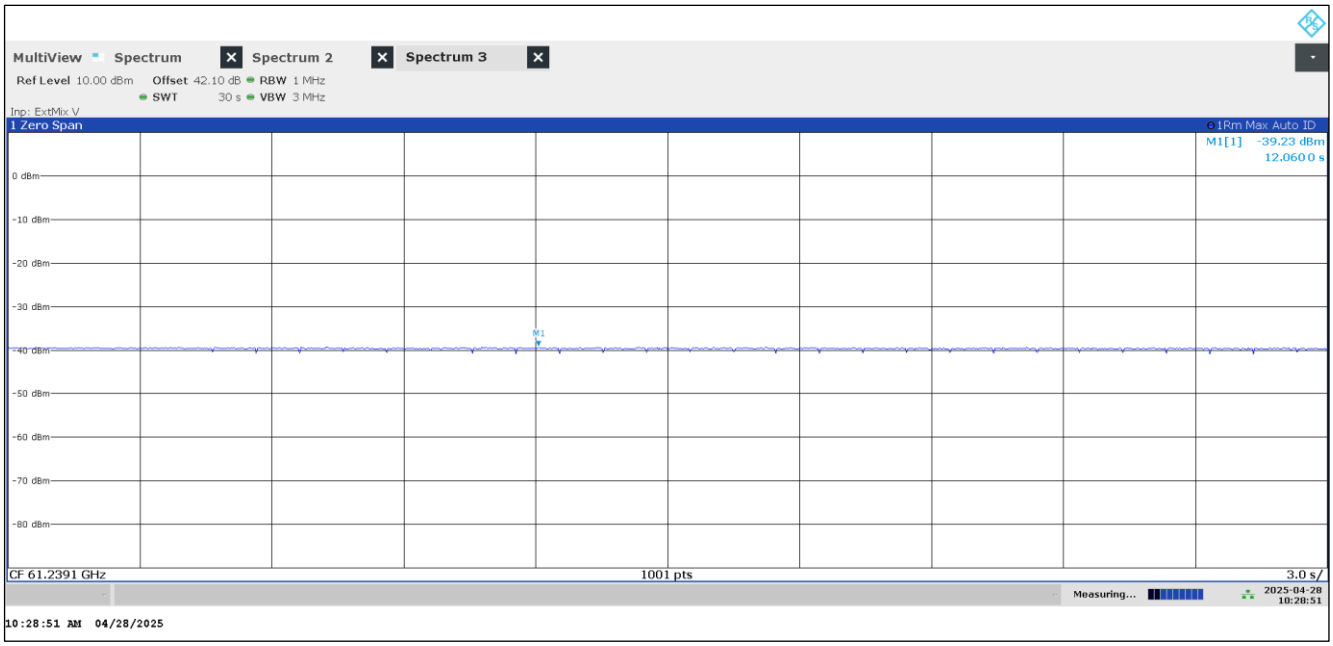
Plot 26: 50 GHz – 75 GHz, normal operation mode



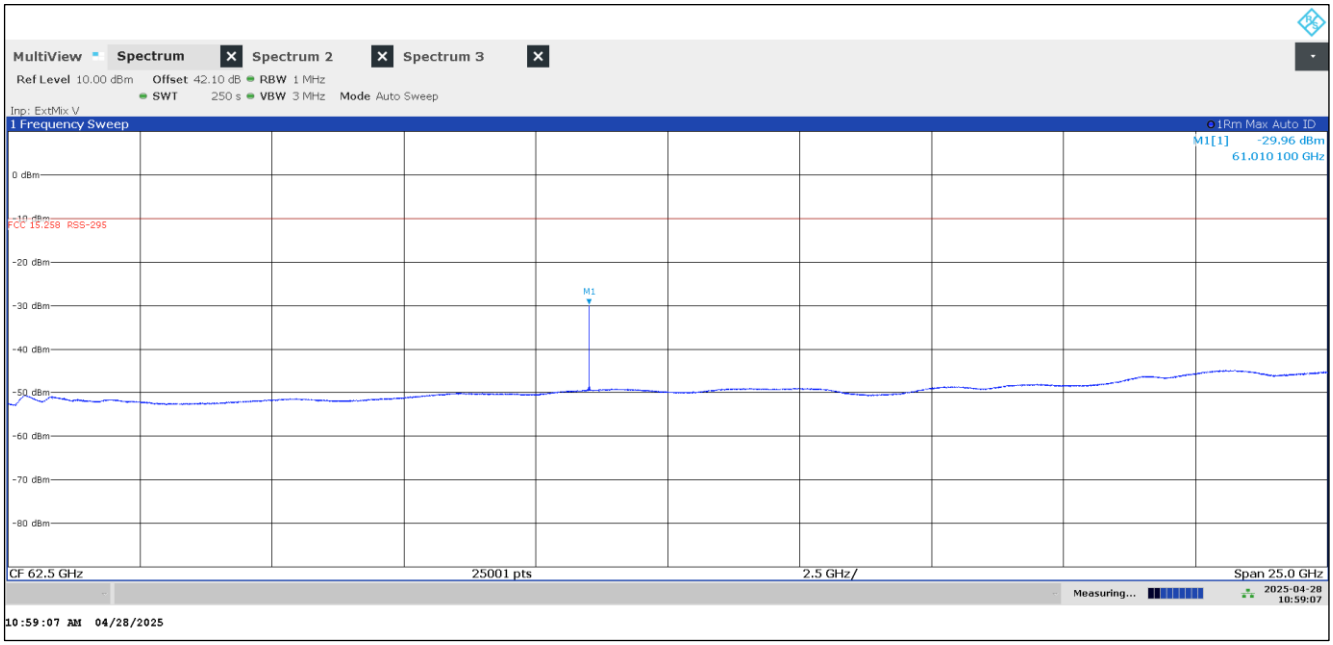
Plot 27: 50 GHz – 75 GHz, normal operation mode, 10 MHz span



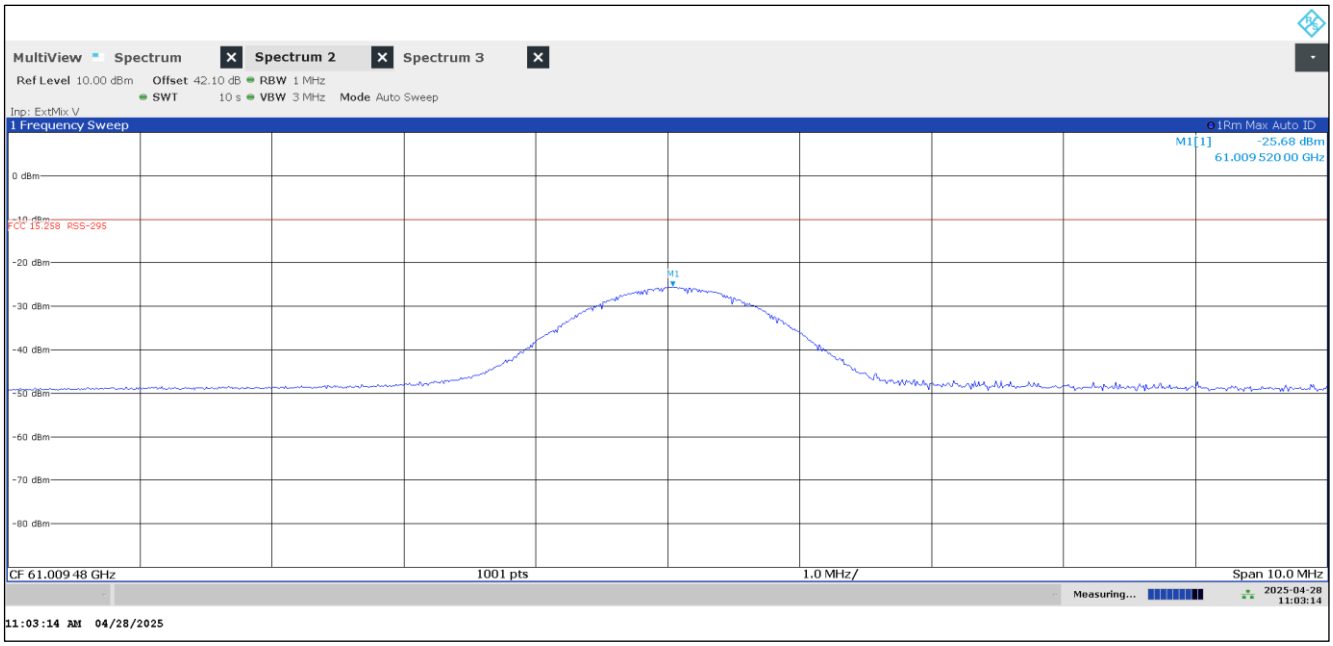
Plot 28: 50 GHz – 75 GHz, normal operation mode, zero span



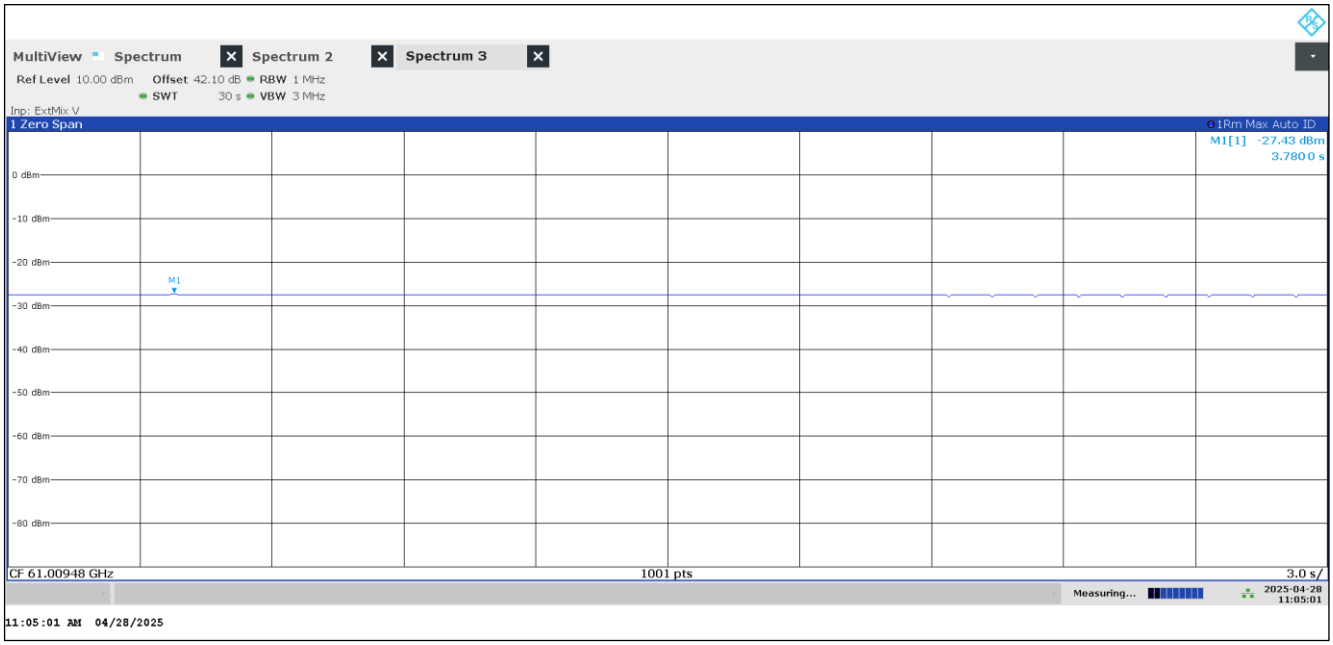
Plot 29: 50 GHz – 75 GHz, stop mode, low frequency



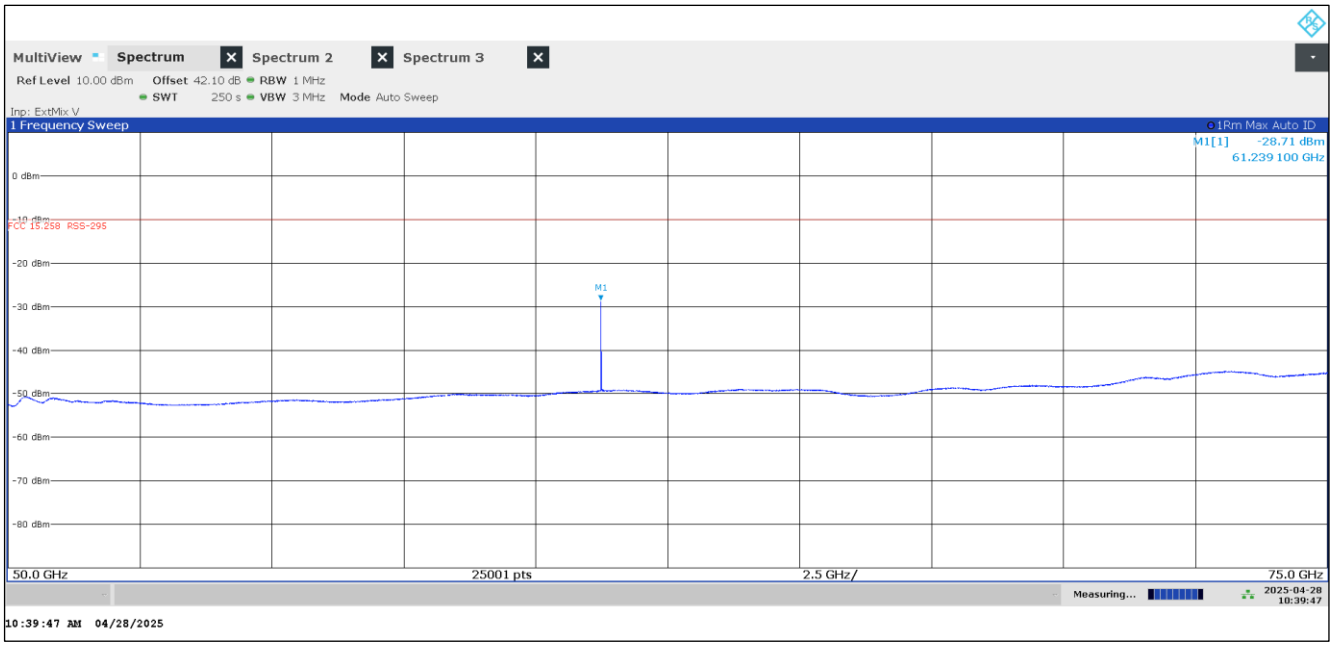
Plot 30: 50 GHz – 75 GHz, stop mode, low frequency, 10 MHz span



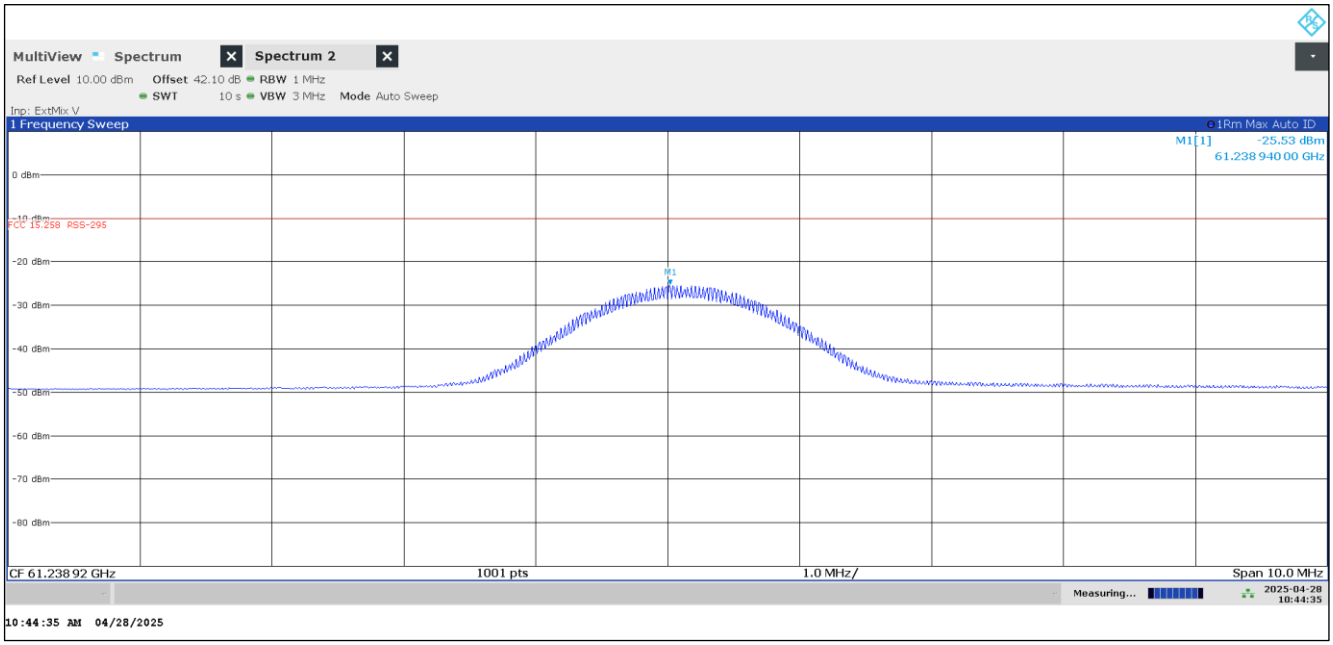
Plot 31: 50 GHz – 75 GHz, stop mode, low frequency, zero span



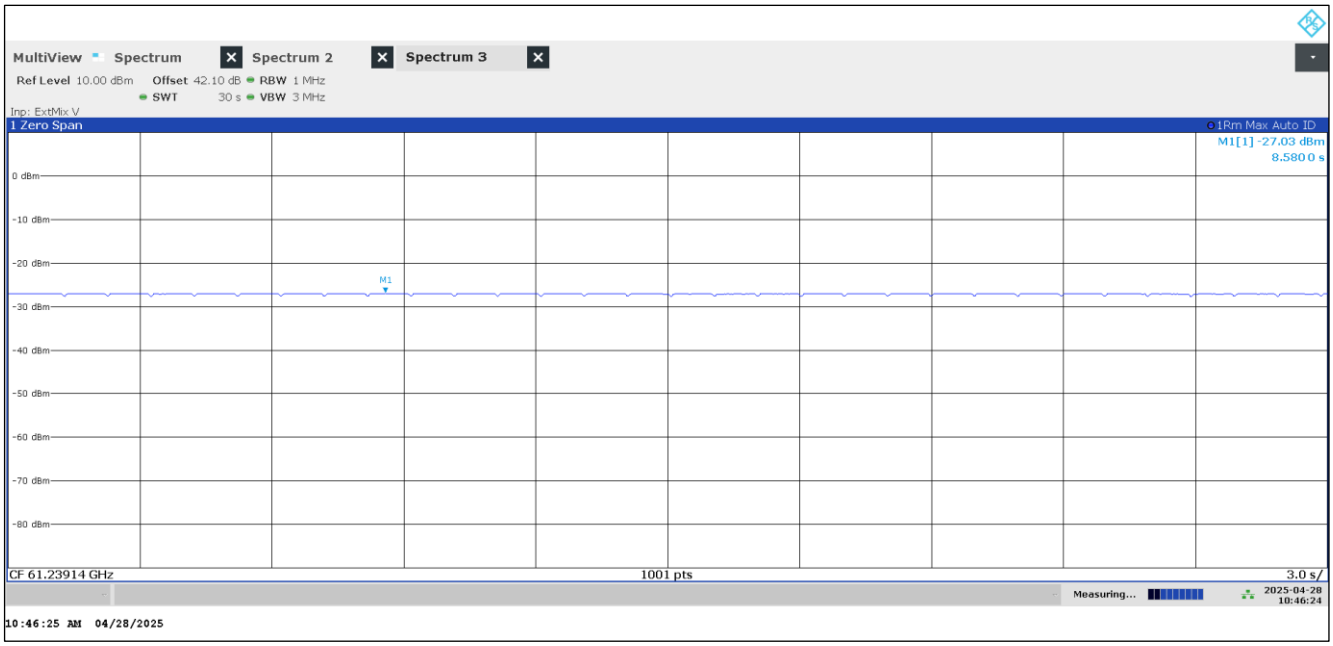
Plot 32: 50 GHz – 75 GHz, stop mode, middle frequency



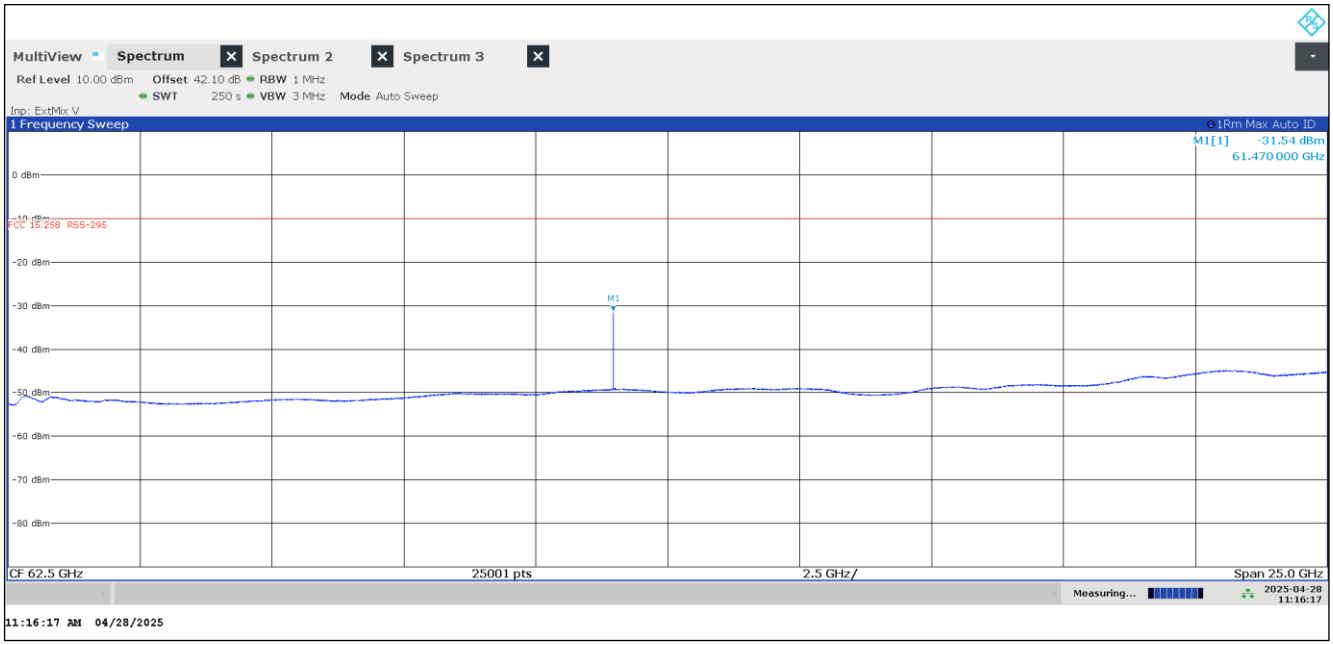
Plot 33: 50 GHz – 75 GHz, stop mode, middle frequency, 10 MHz span



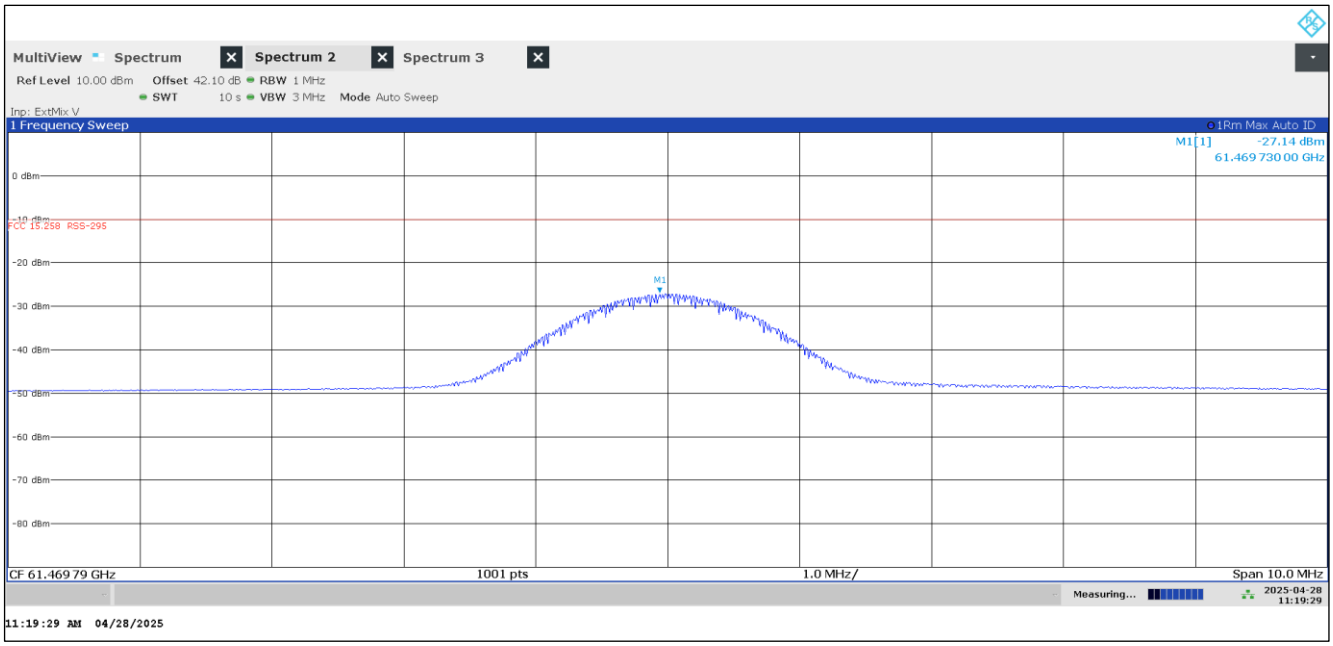
Plot 34: 50 GHz – 75 GHz, stop mode, middle frequency, zero span



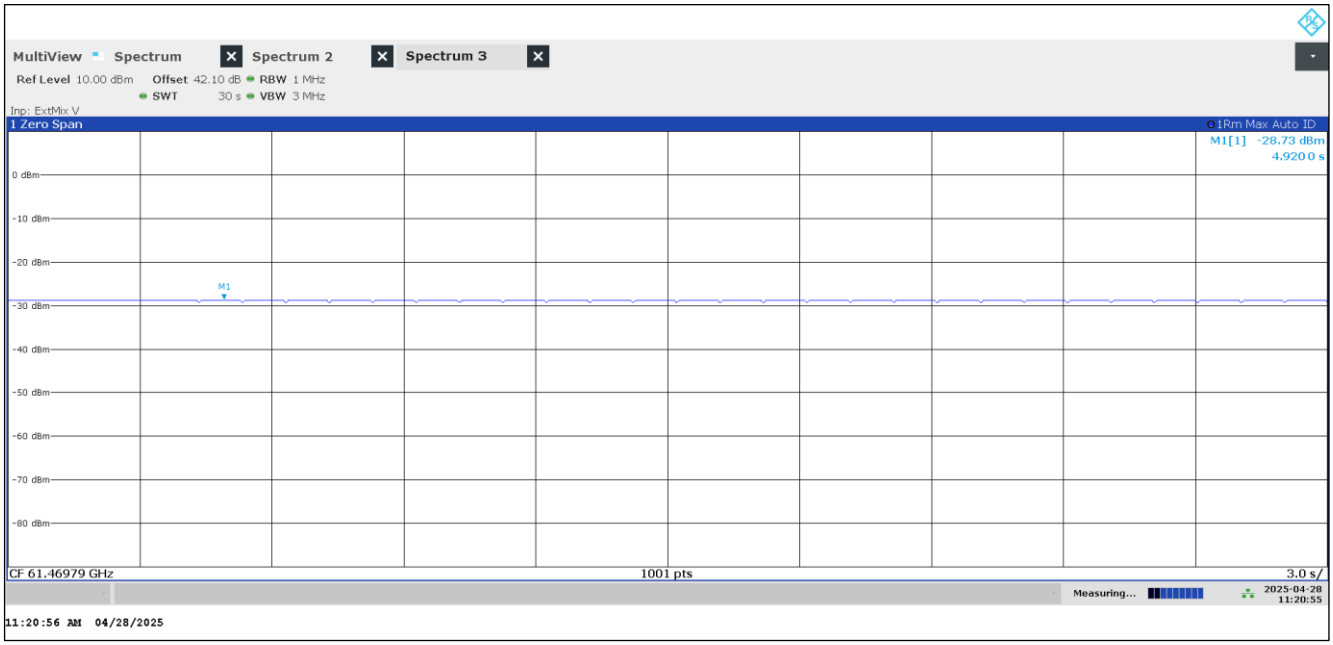
Plot 35: 50 GHz – 75 GHz, stop mode, high frequency



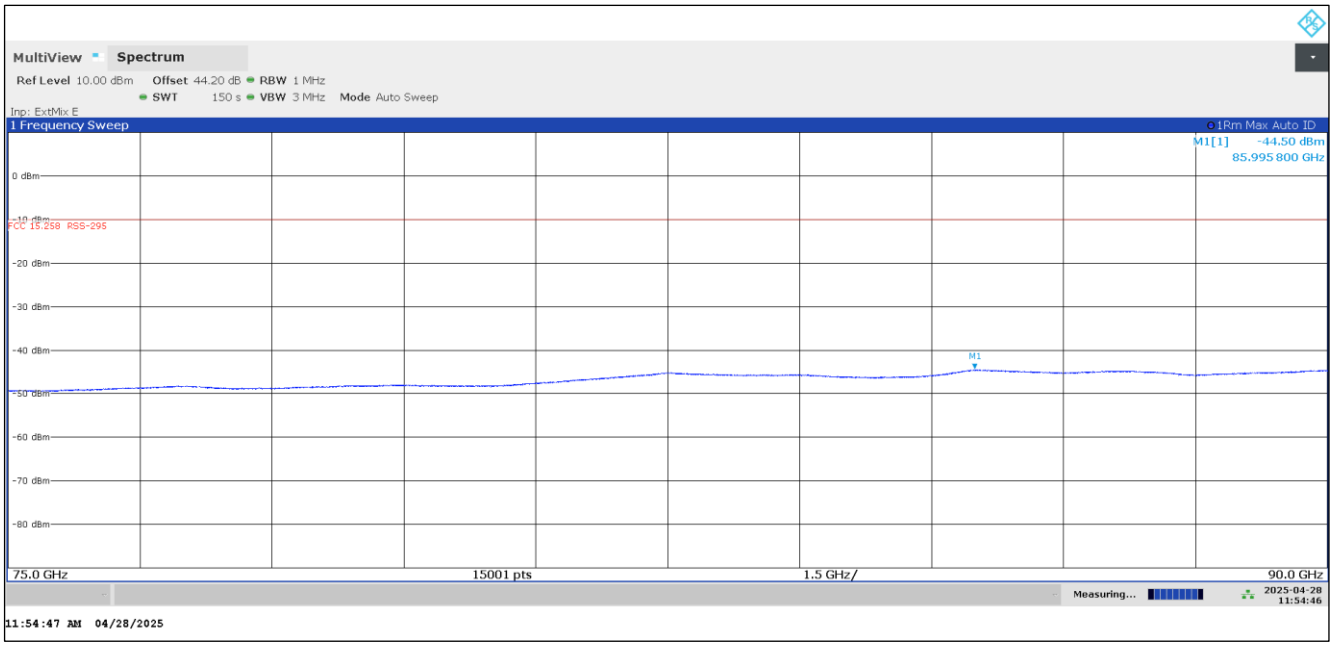
Plot 36: 50 GHz – 75 GHz, stop mode, high frequency, 10 MHz span



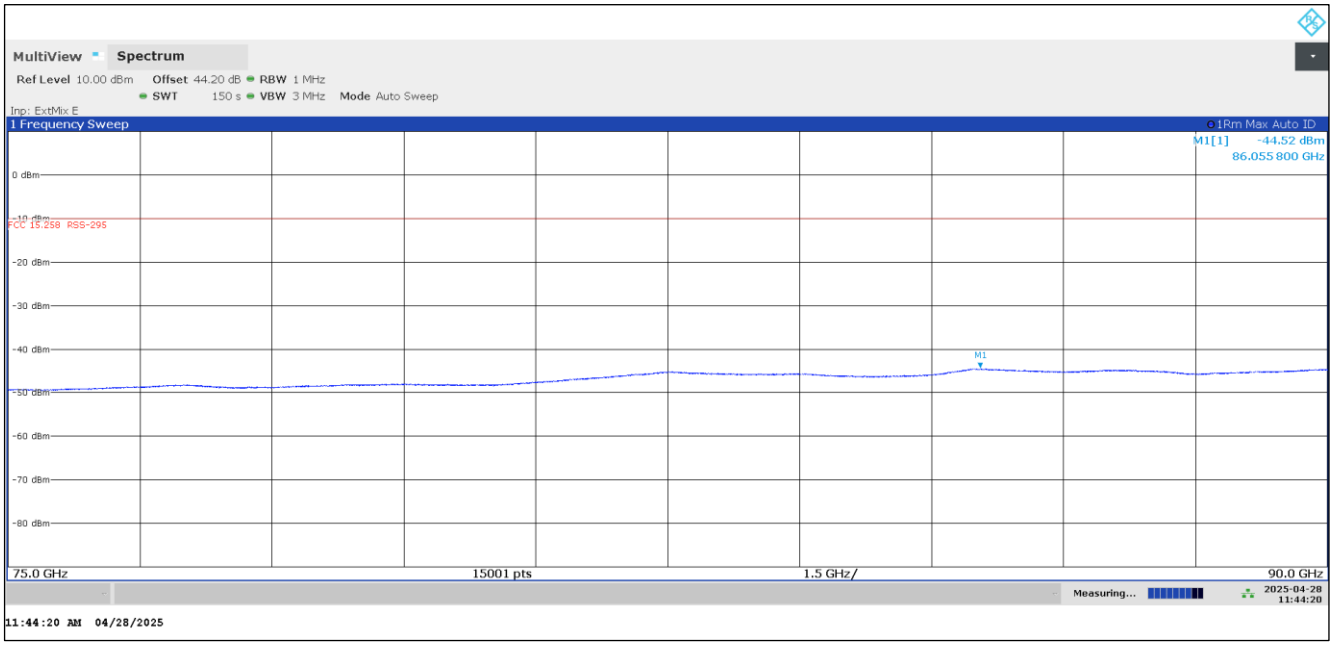
Plot 37: 50 GHz – 75 GHz, stop mode, high frequency, zero span



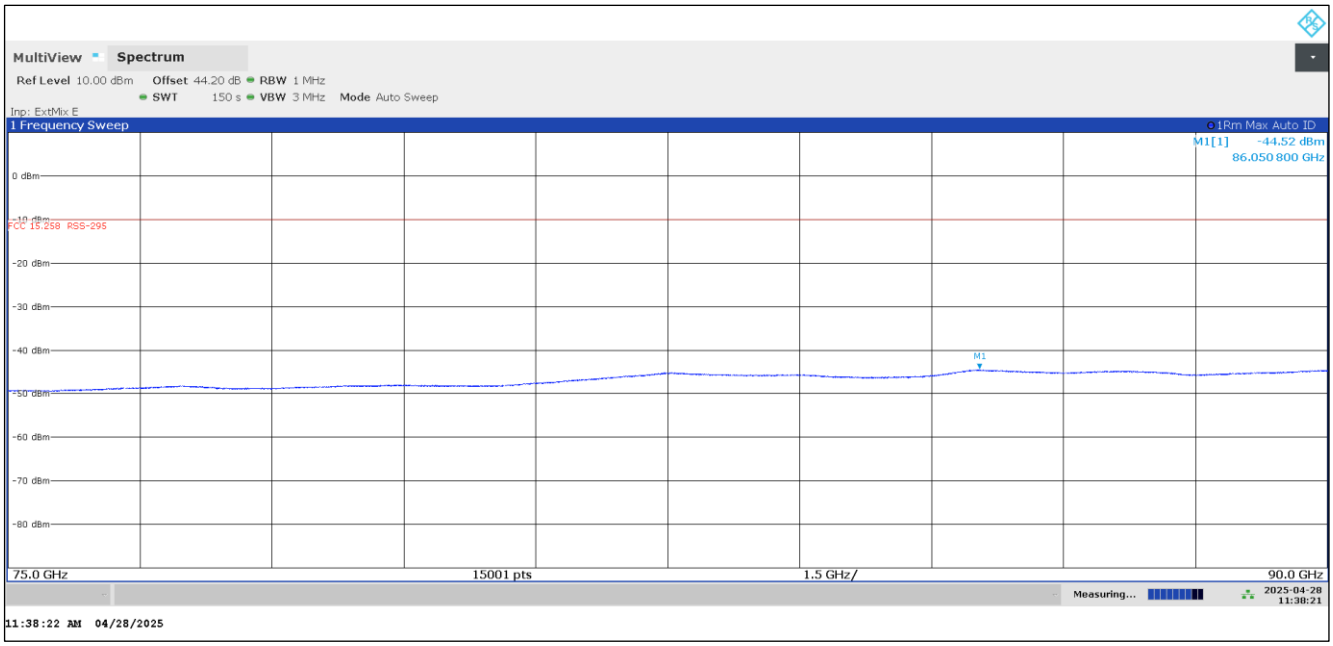
Plot 38: 75 GHz – 90 GHz, normal operation mode



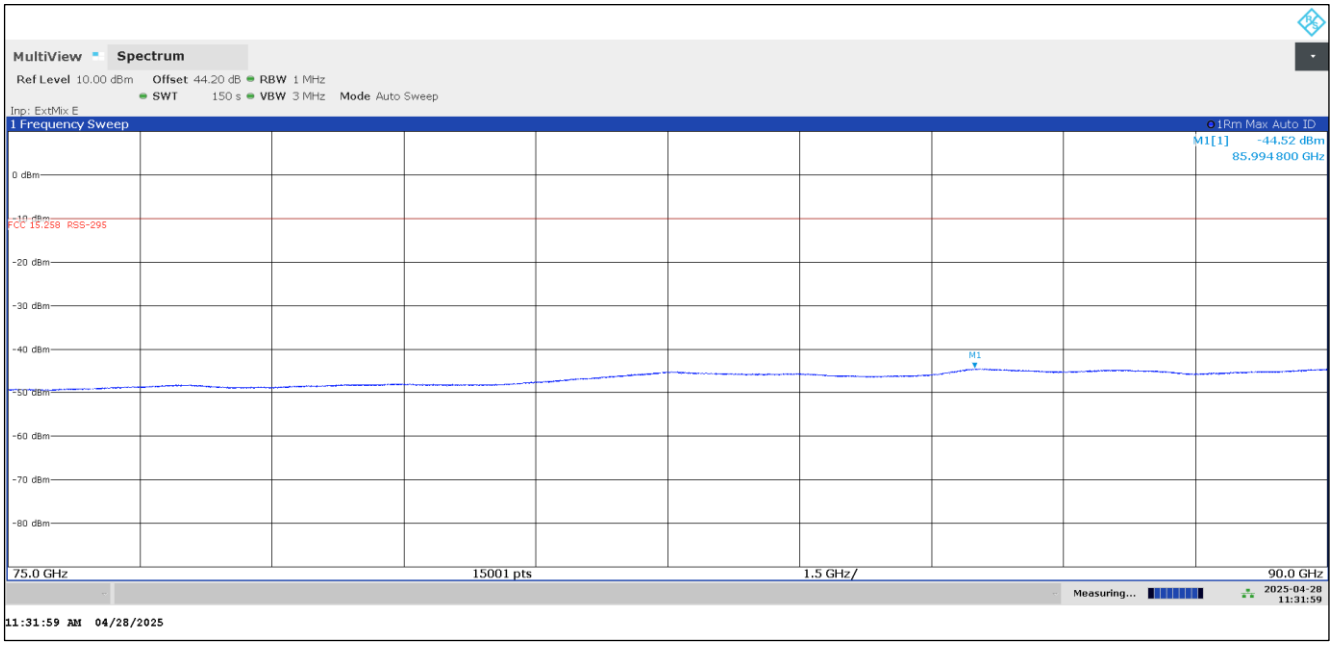
Plot 39: 75 GHz – 90 GHz, stop mode, low frequency



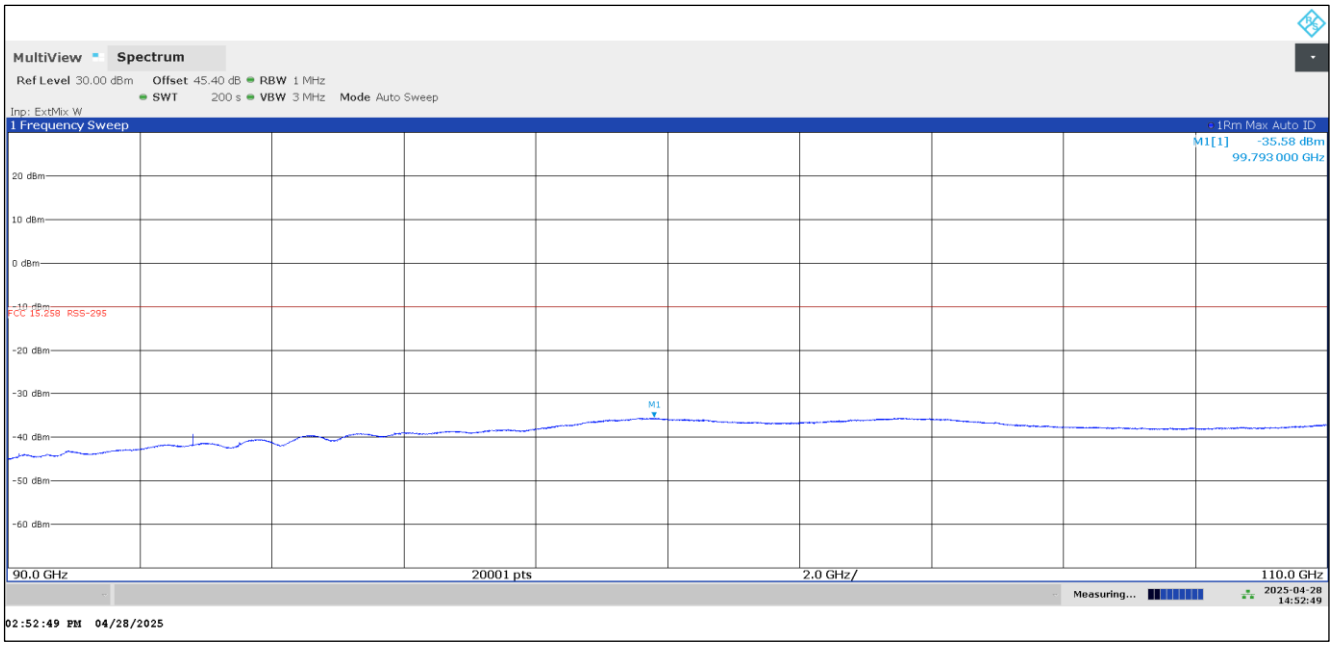
Plot 40: 75 GHz – 90 GHz, stop mode, middle frequency



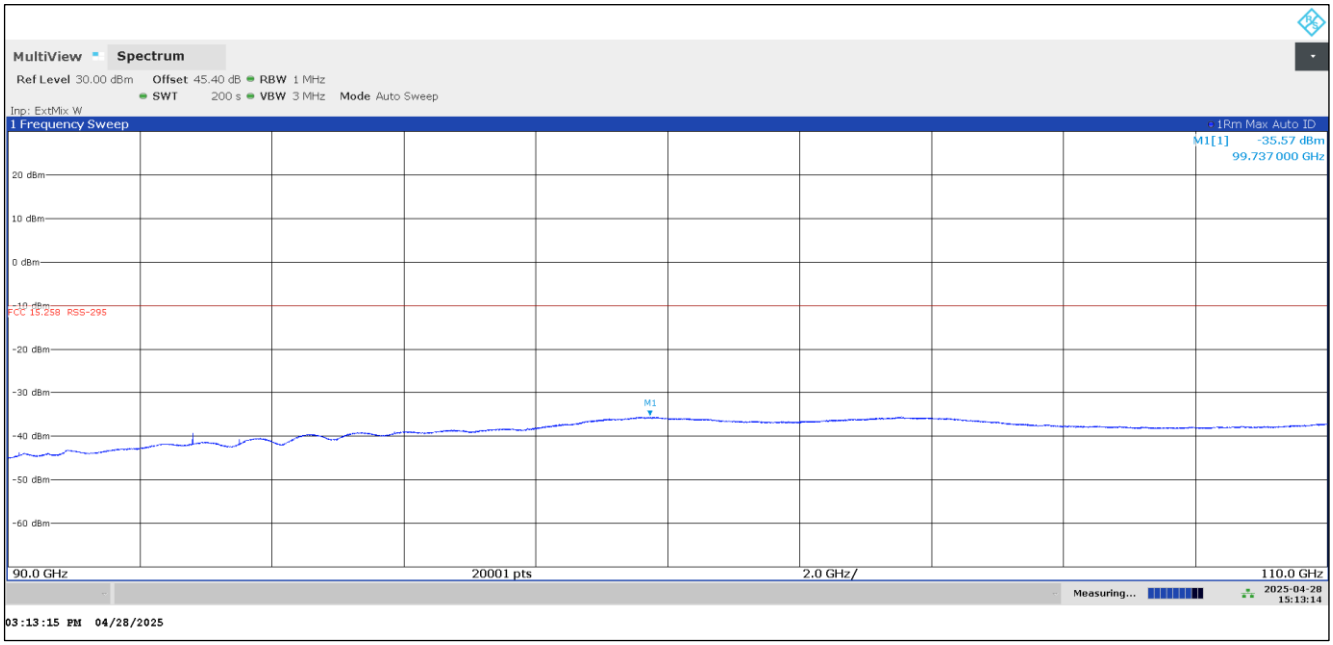
Plot 41: 75 GHz – 90 GHz, stop mode, high frequency



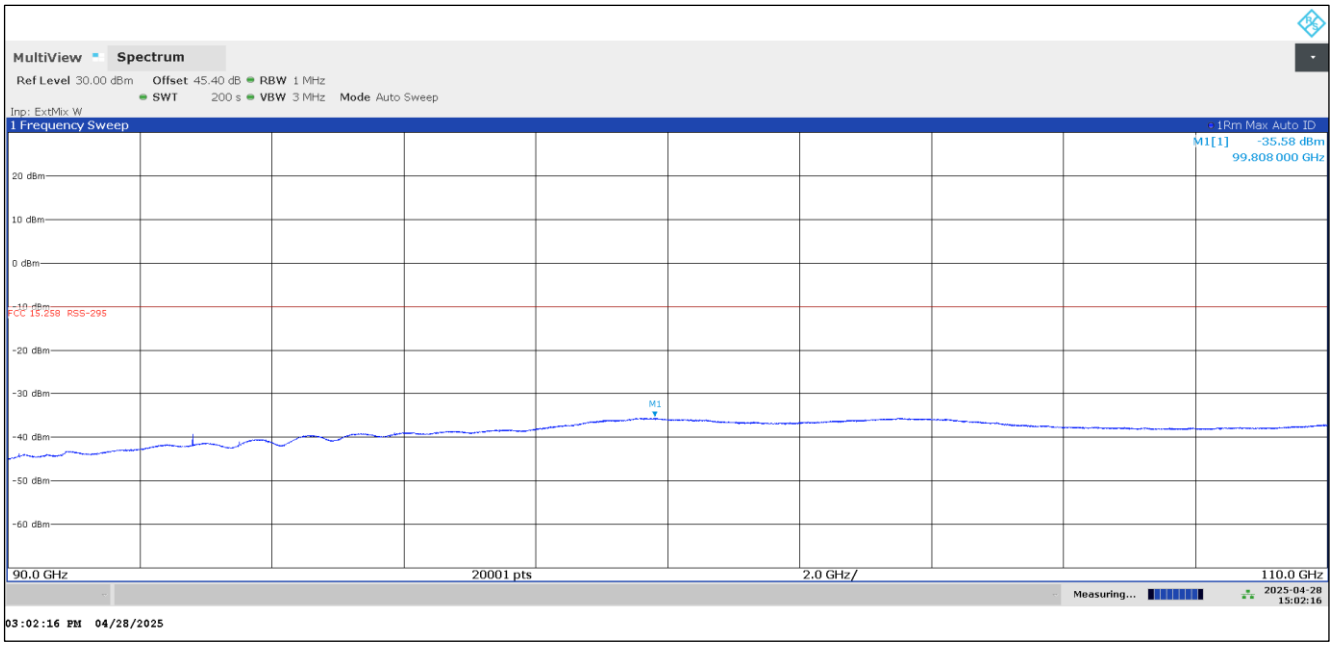
Plot 42: 90 GHz – 110 GHz, normal operation mode



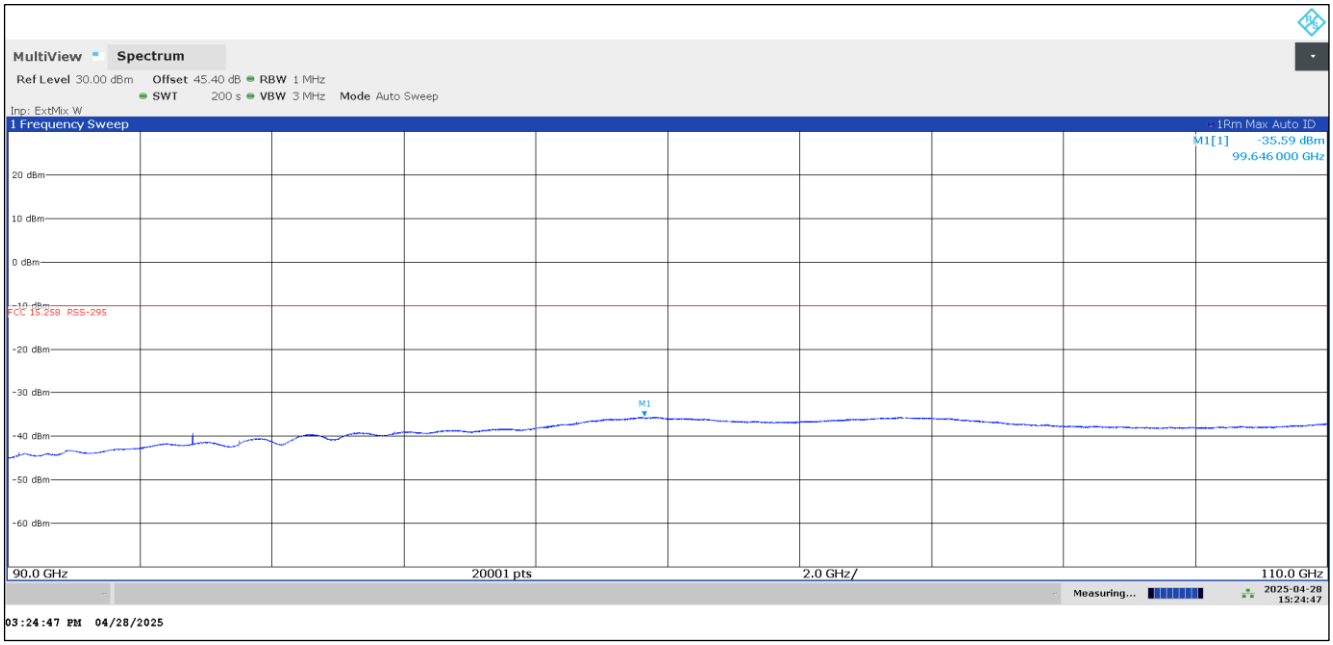
Plot 43: 90 GHz – 110 GHz, stop mode, low frequency



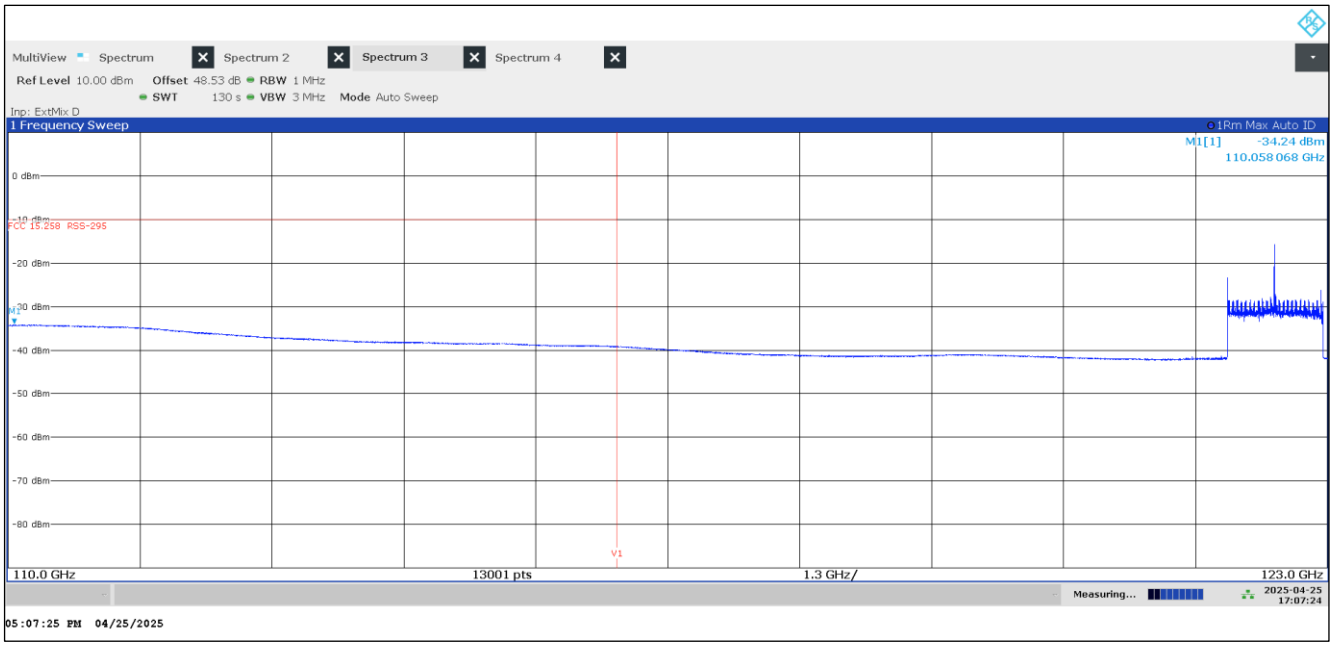
Plot 44: 90 GHz – 110 GHz, stop mode, middle frequency



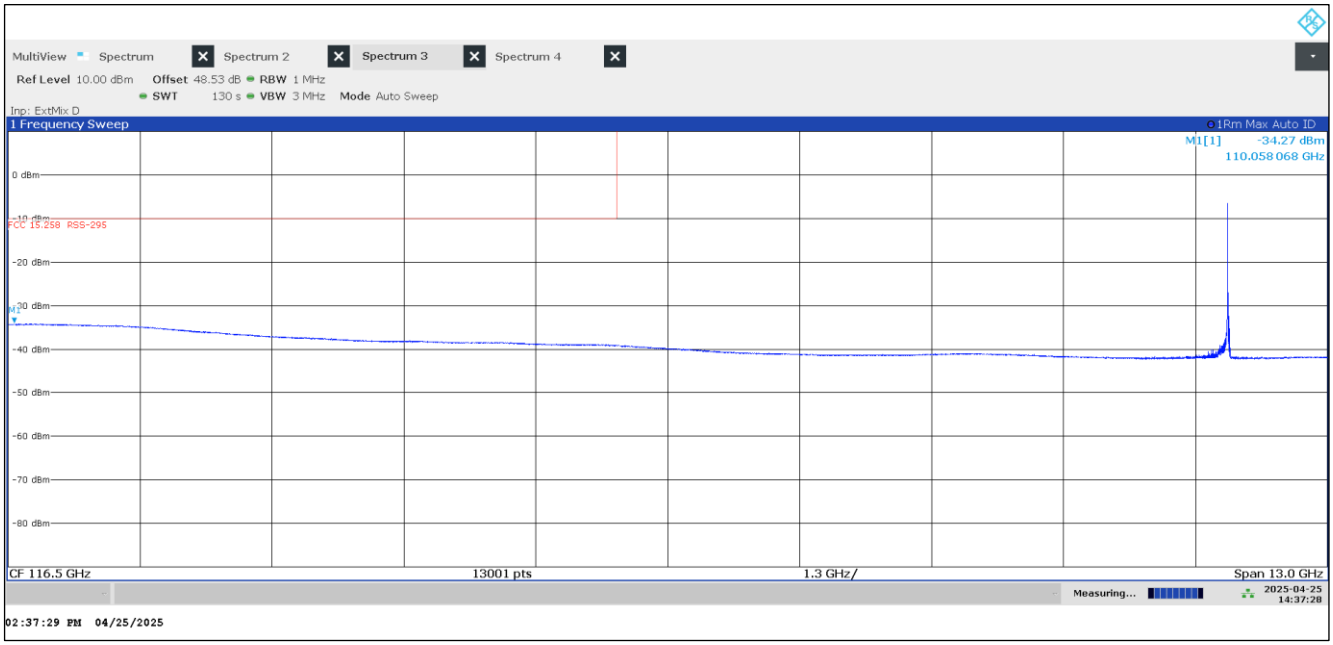
Plot 45: 90 GHz – 110 GHz, stop mode, high frequency



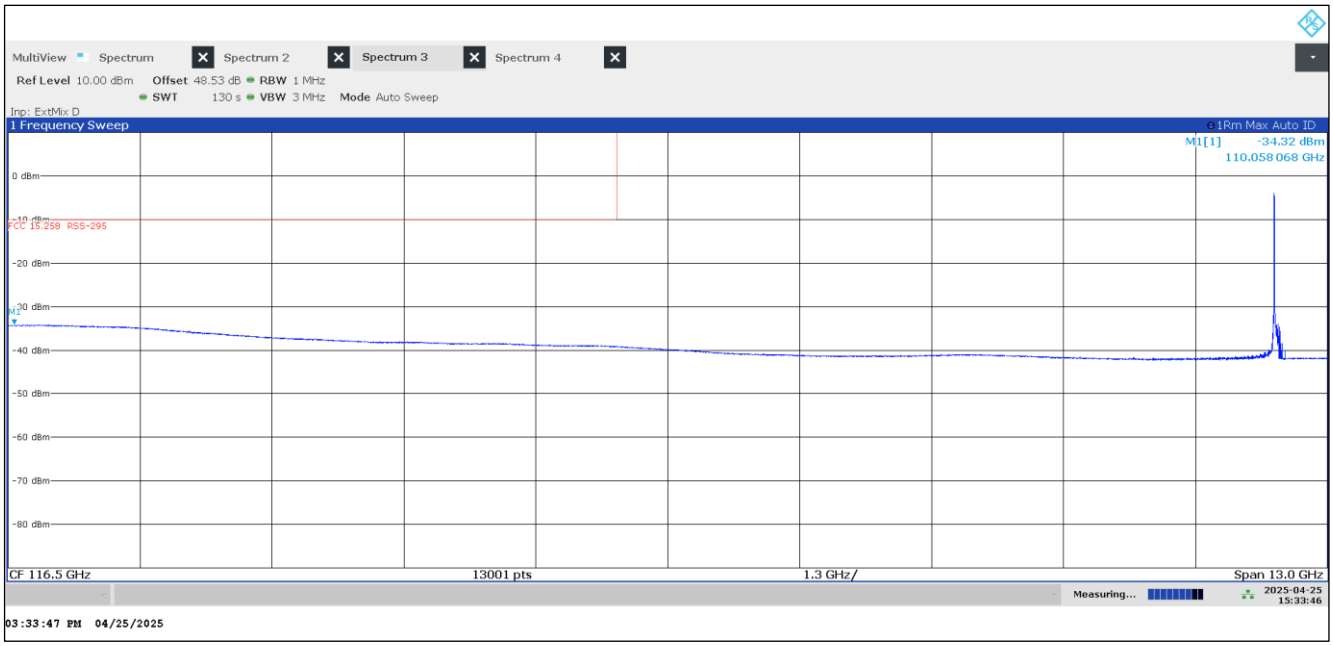
Plot 46: 110 GHz – 123 GHz, normal operation mode (in-band wanted signal visible on plot)



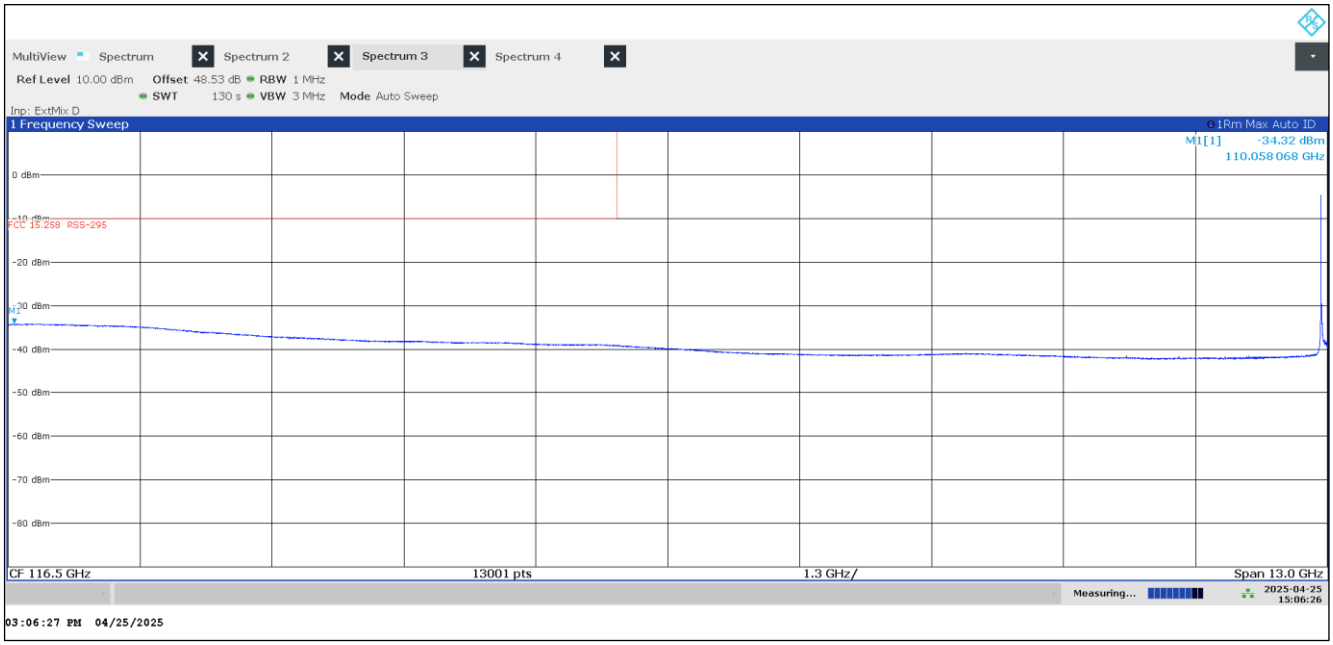
Plot 47: 110 GHz – 123 GHz, stop mode, low frequency (in-band wanted signal visible on plot)



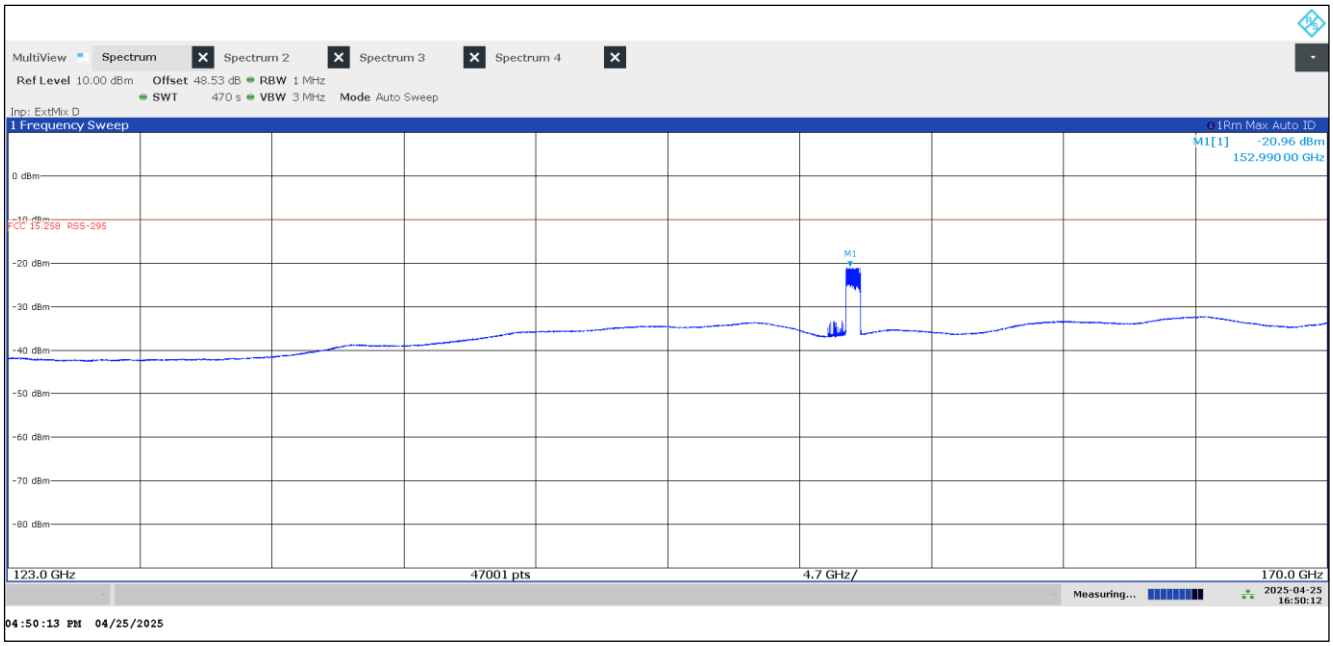
Plot 48: 110 GHz – 123 GHz, stop mode, middle frequency (in-band wanted signal visible on plot)



Plot 49: 110 GHz – 123 GHz, stop mode, high frequency (in-band wanted signal visible on plot)

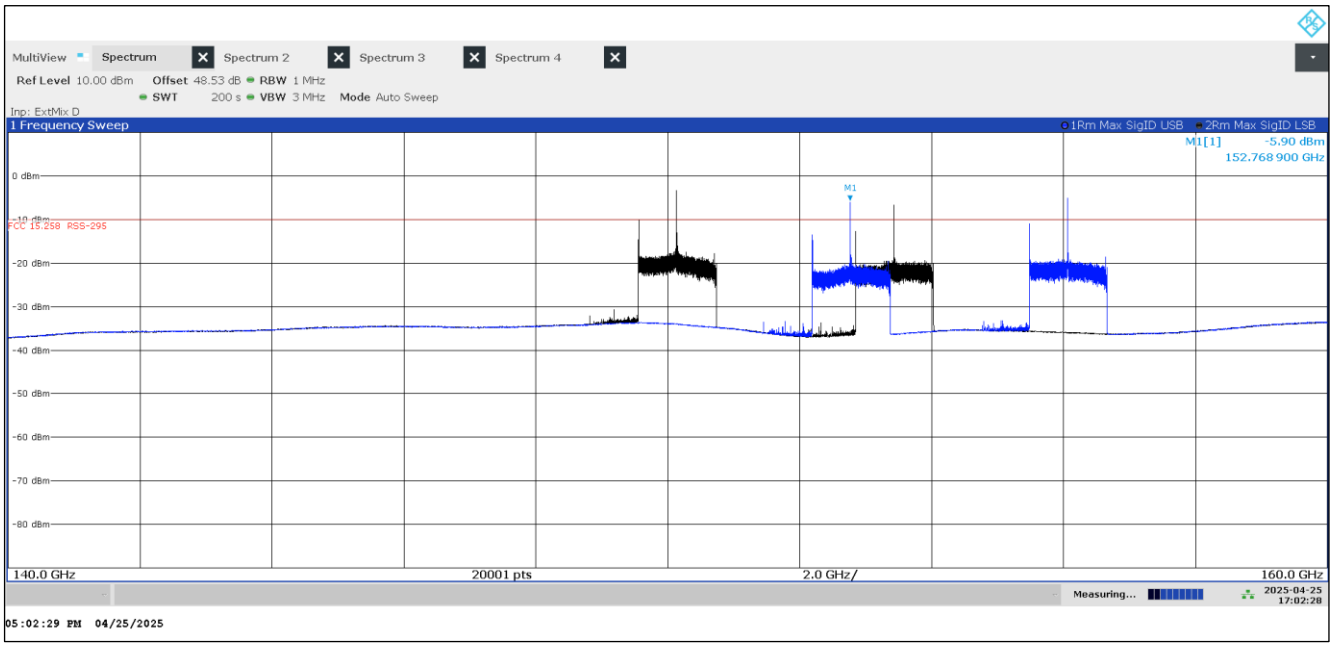


Plot 50: 123 GHz – 170 GHz, normal operation mode



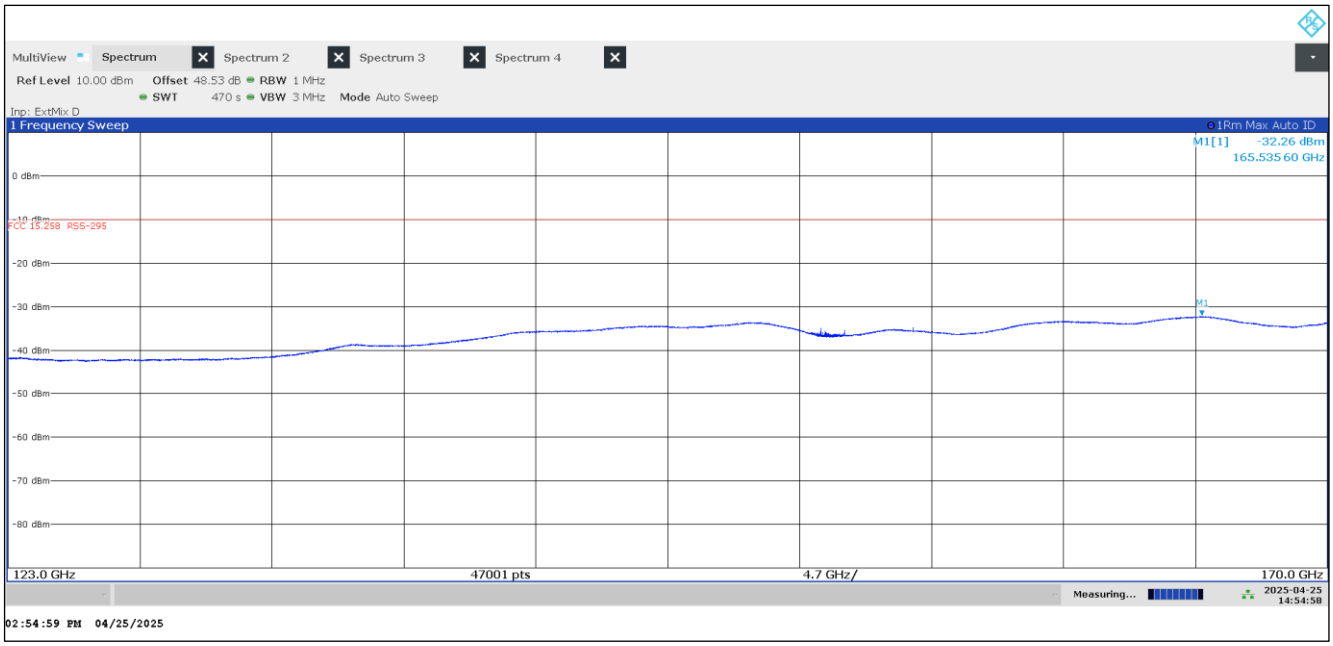
Note: Mixer products visible on plot

Plot 51: 123 GHz – 170 GHz, normal operation mode



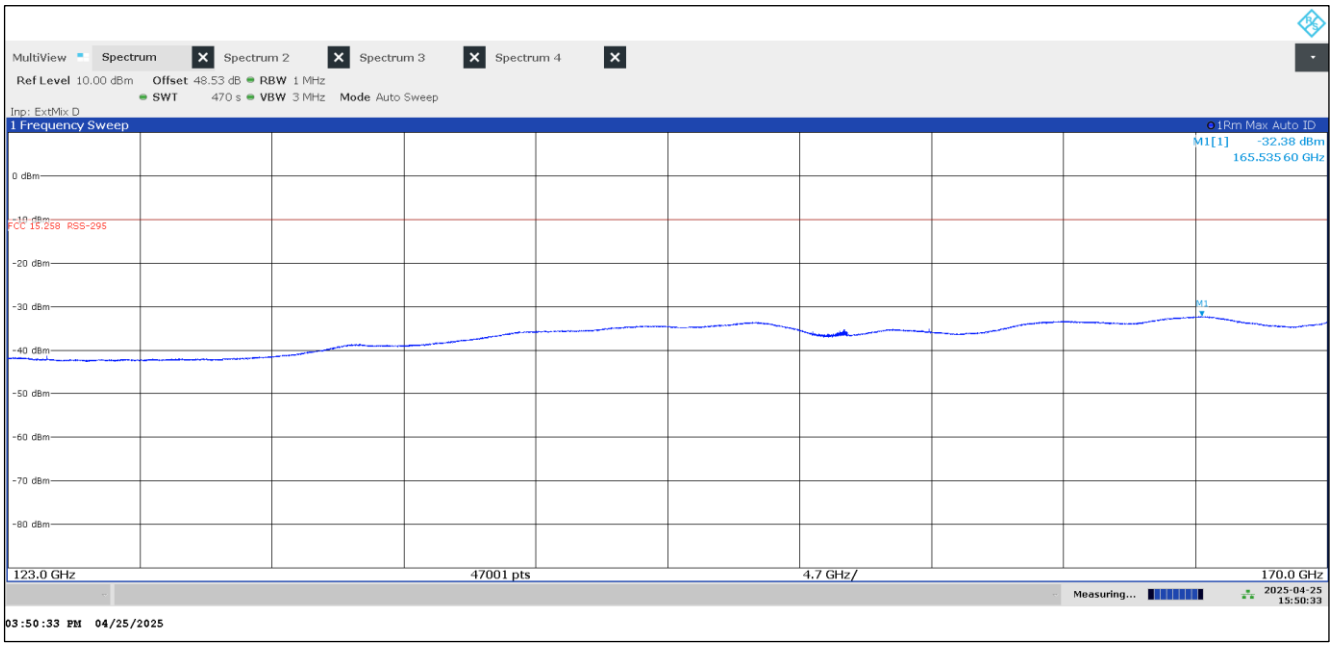
Mixer products – check with Signal ID function

Plot 52: 123 GHz – 170 GHz, stop mode, low frequency



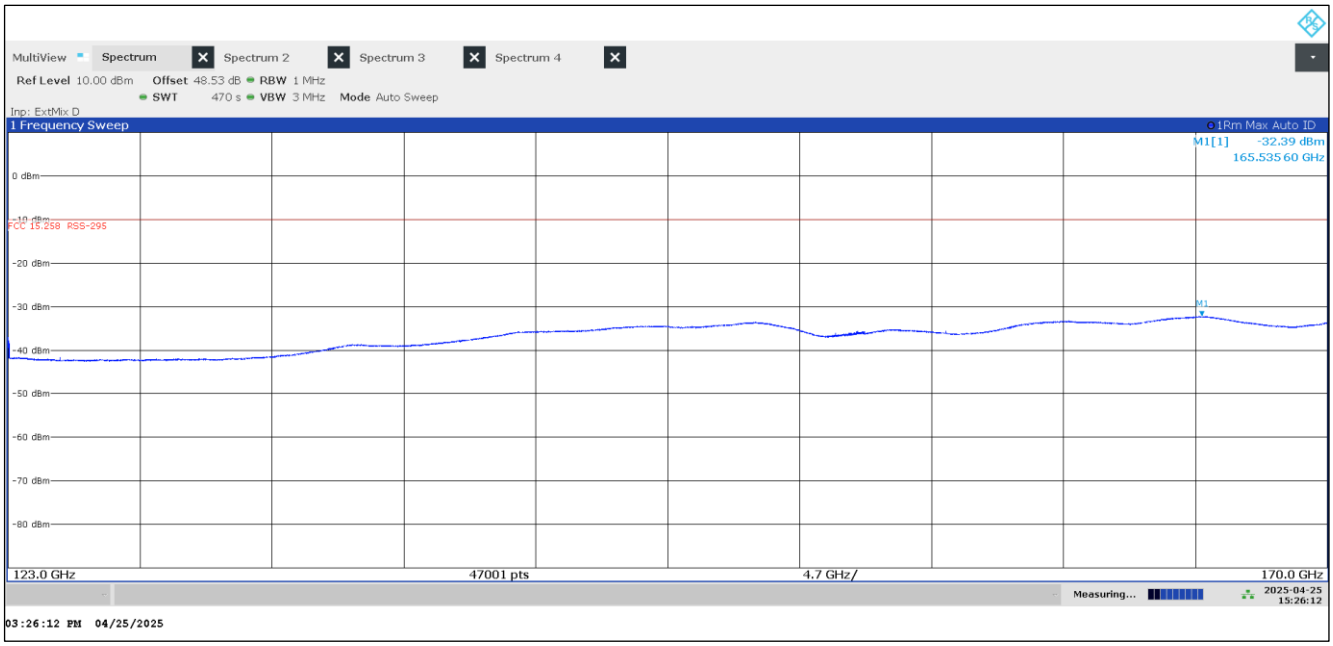
Note: Mixer products visible on plot

Plot 53: 123 GHz – 170 GHz, stop mode, middle frequency



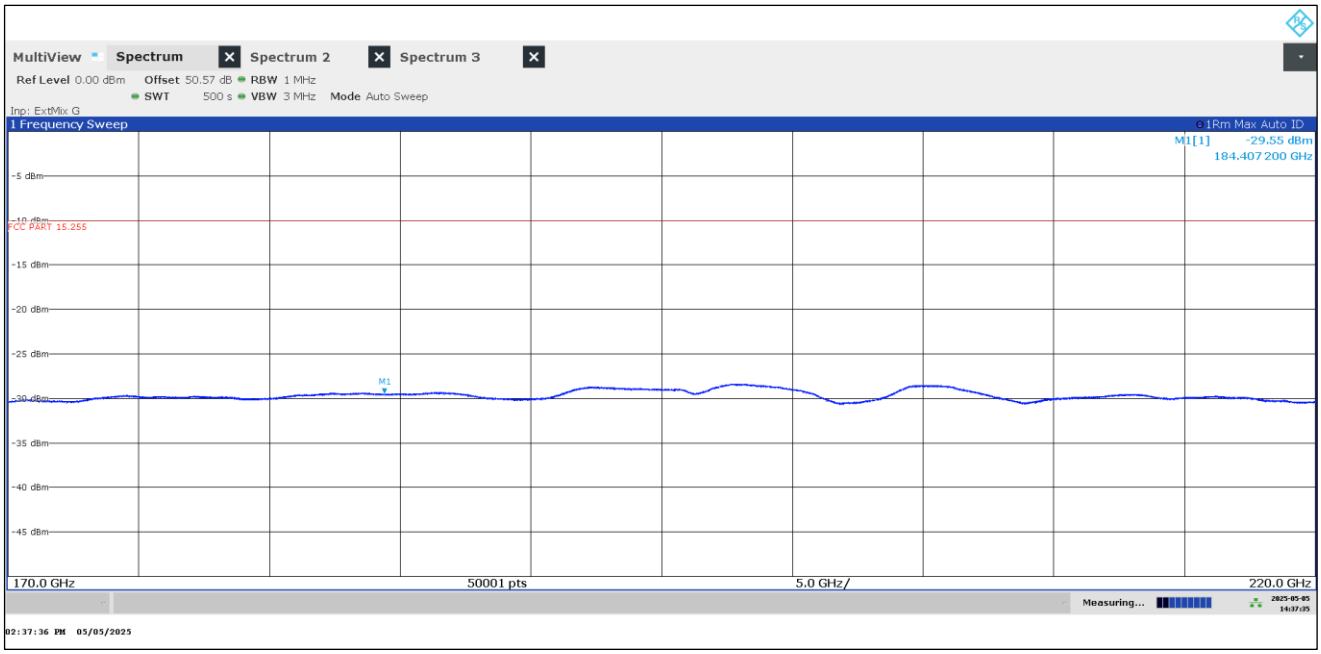
Note: Mixer products visible on plot

Plot 54: 123 GHz – 170 GHz, stop mode, high frequency

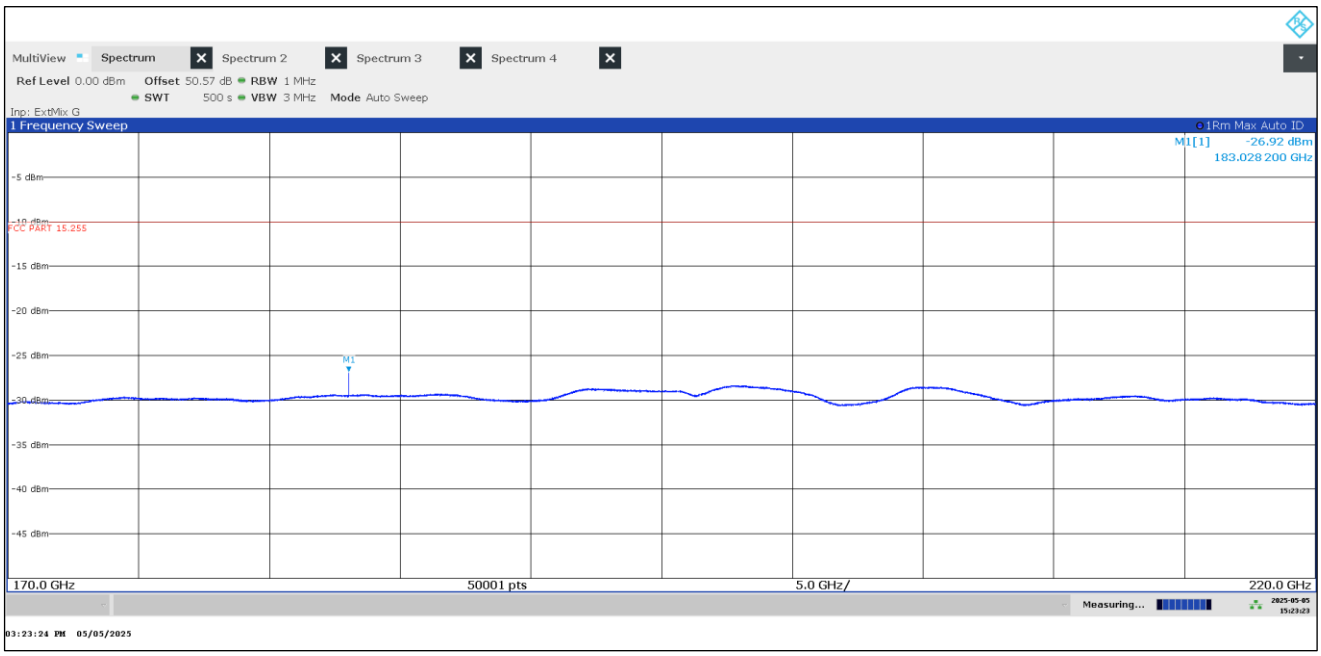


Note: Mixer products visible on plot

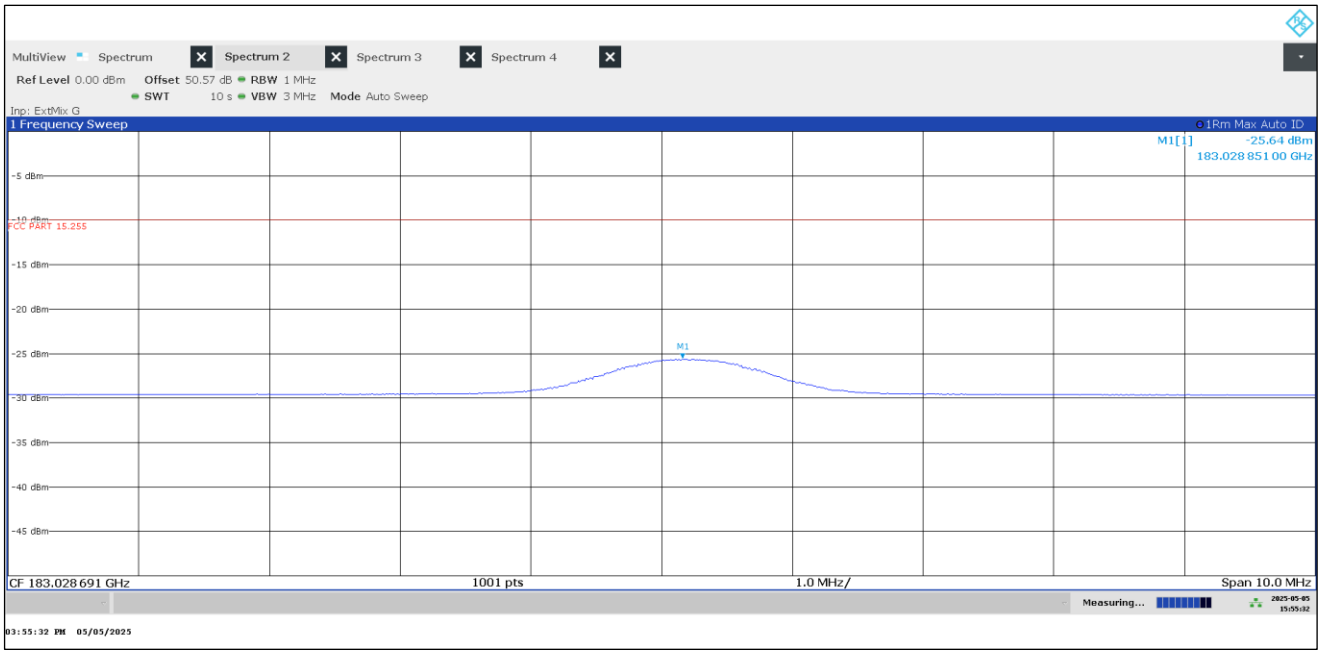
Plot 55: 170 GHz – 220 GHz, normal operation mode



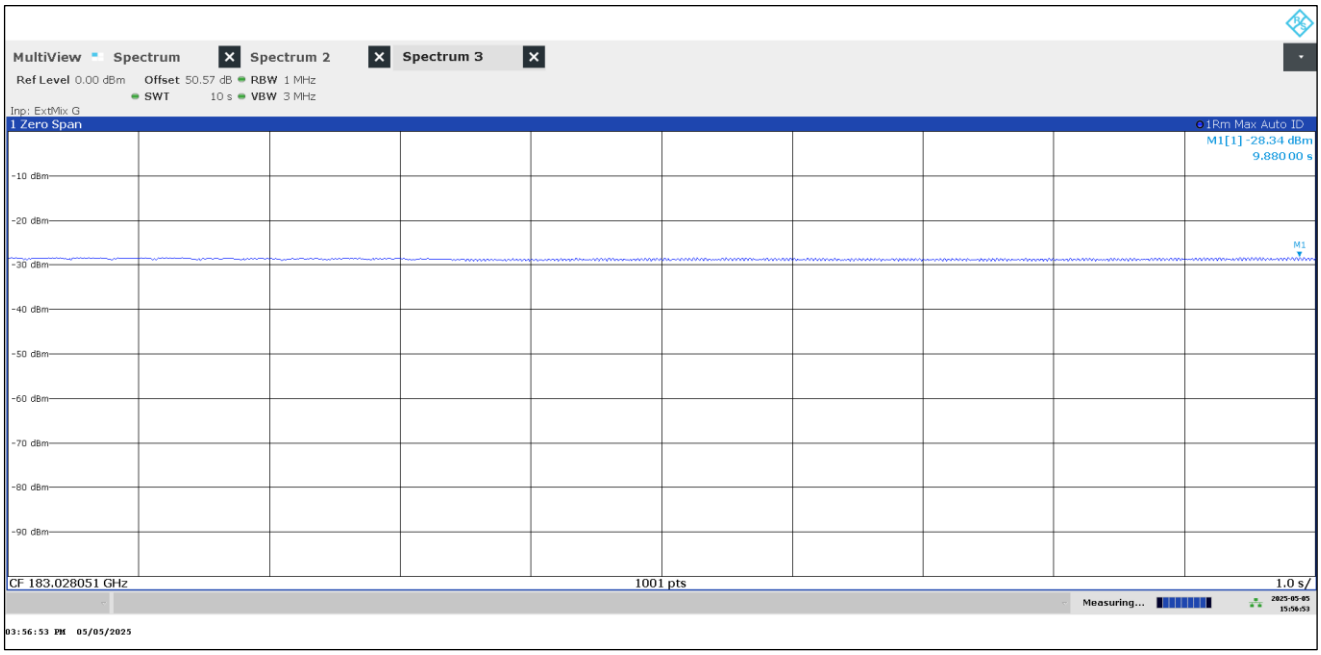
Plot 56: 170 GHz – 220 GHz, stop mode, low frequency



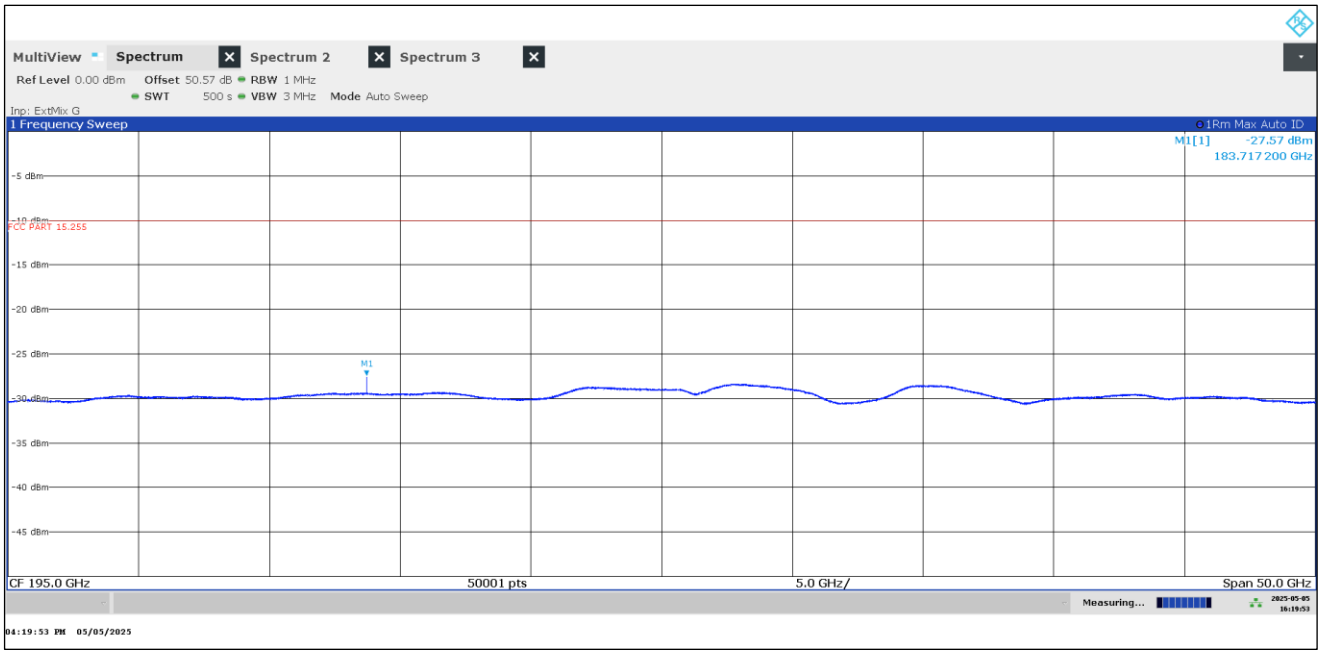
Plot 57: 170 GHz – 220 GHz, stop mode, low frequency, 10 MHz



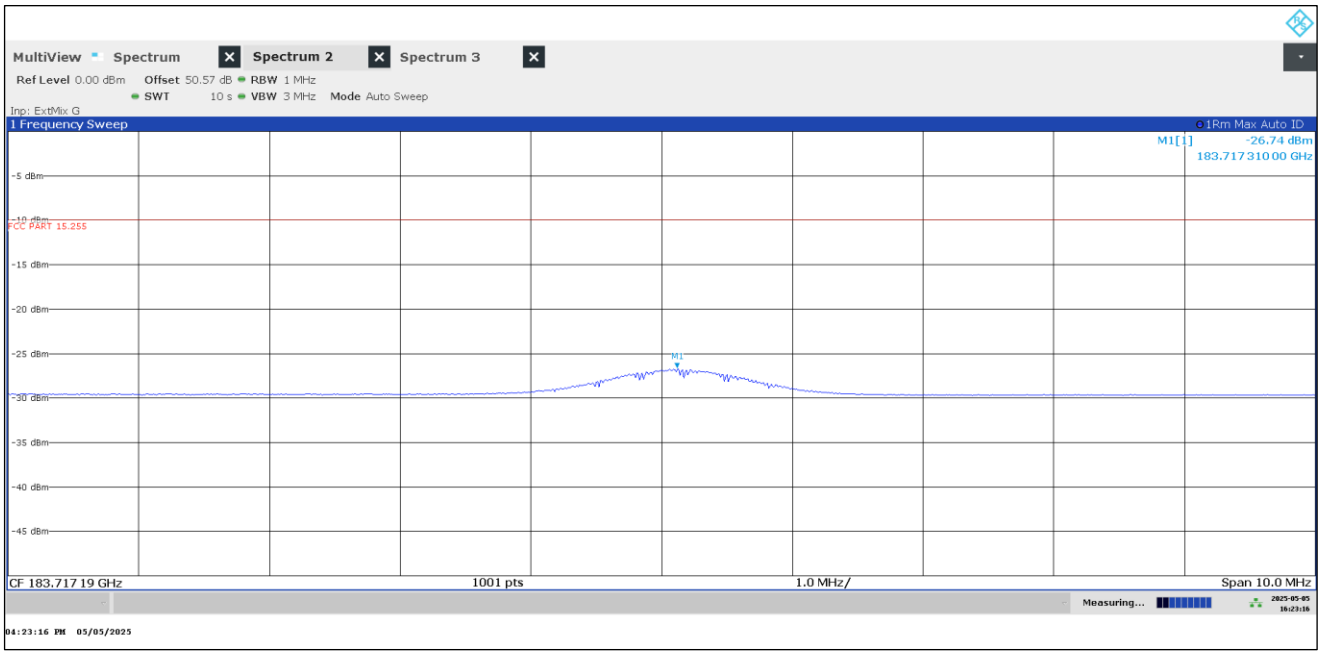
Plot 58: 170 GHz – 220 GHz, stop mode, low frequency, zero span



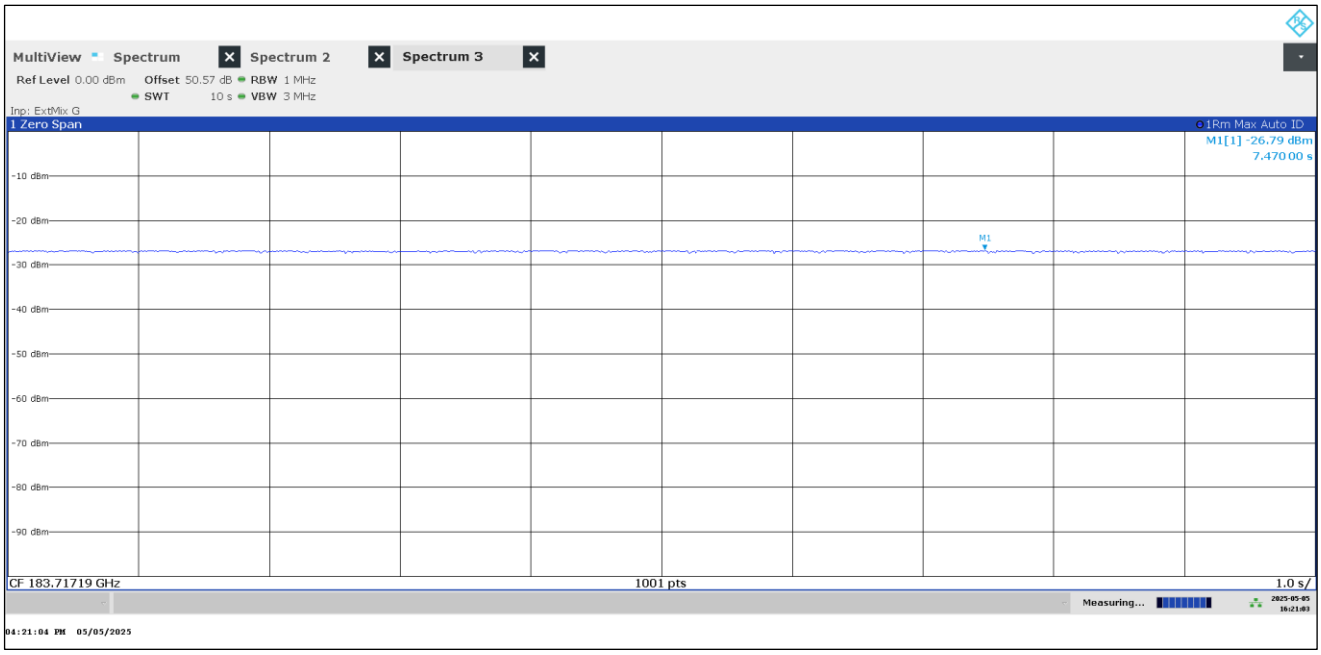
Plot 59: 140 GHz – 220 GHz, stop mode, middle frequency



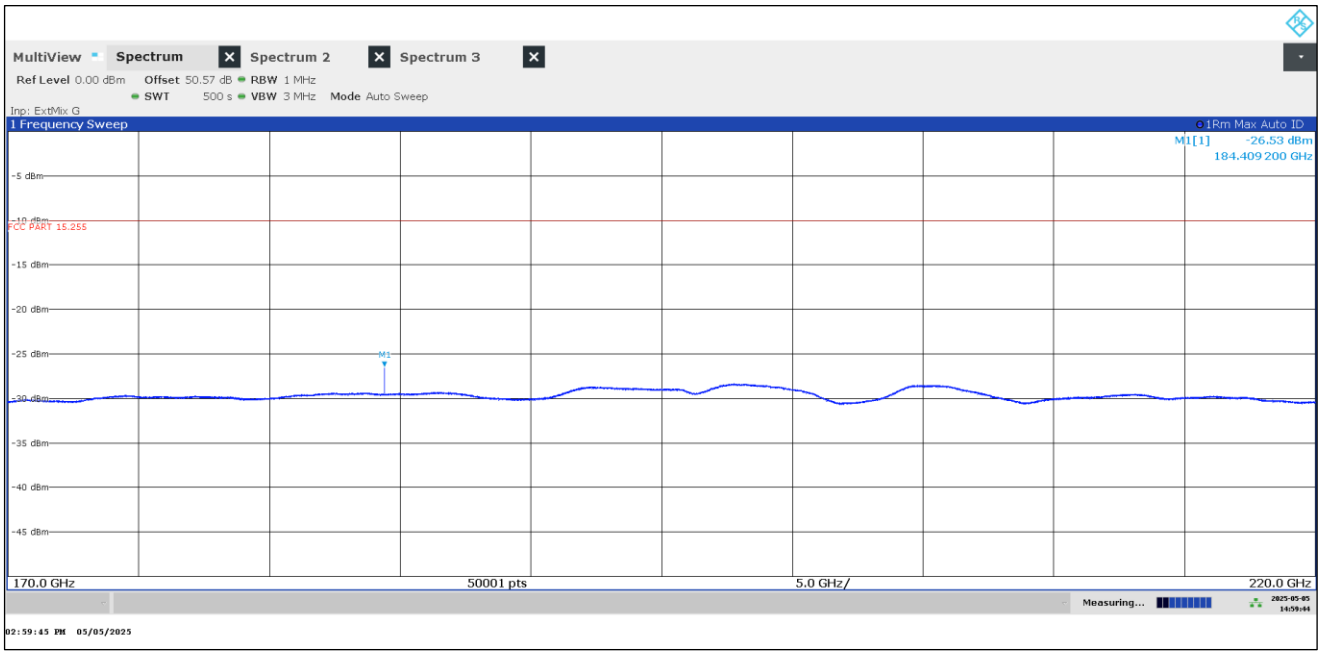
Plot 60: 140 GHz – 220 GHz, stop mode, middle frequency, 10 MHz



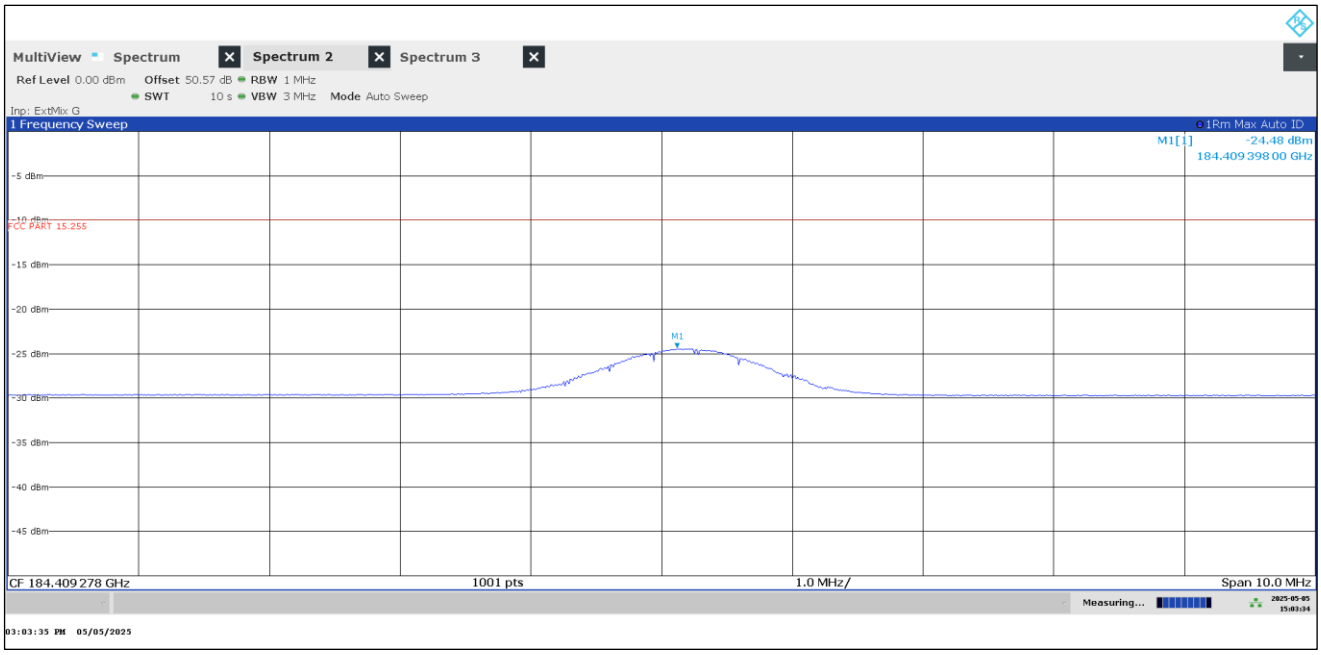
Plot 61: 140 GHz – 220 GHz, stop mode, middle frequency, zero span



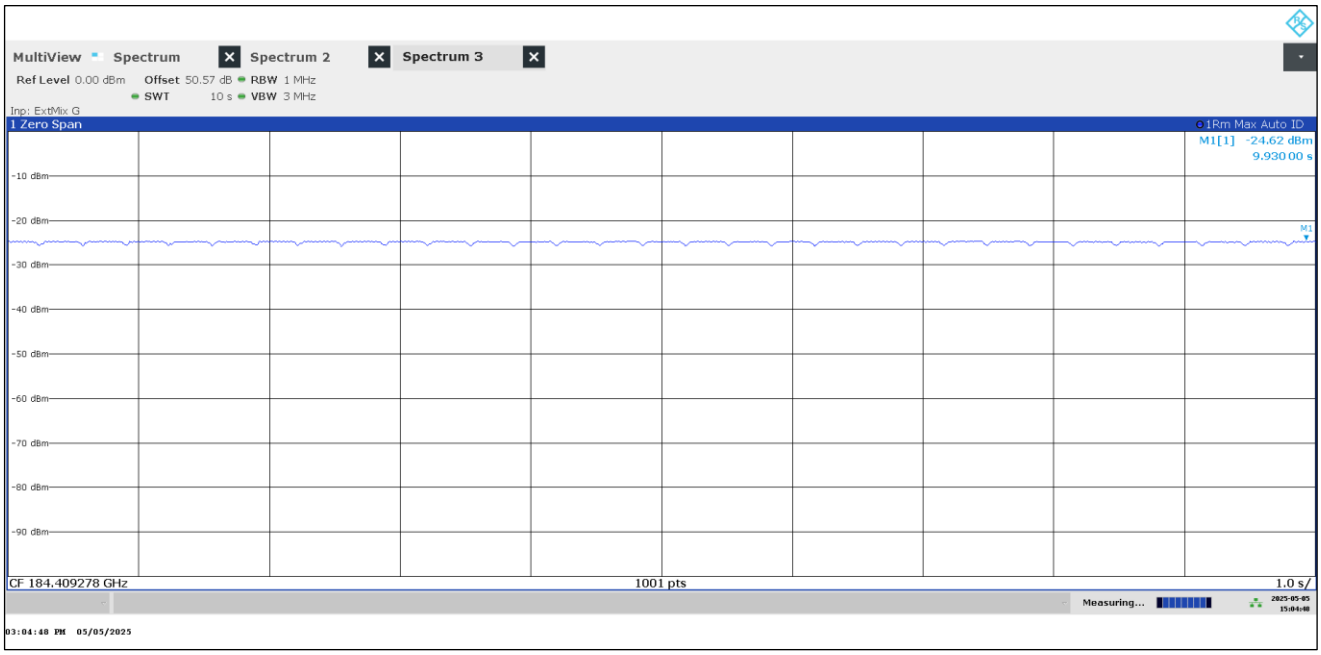
Plot 62: 140 GHz – 220 GHz, stop mode, high frequency



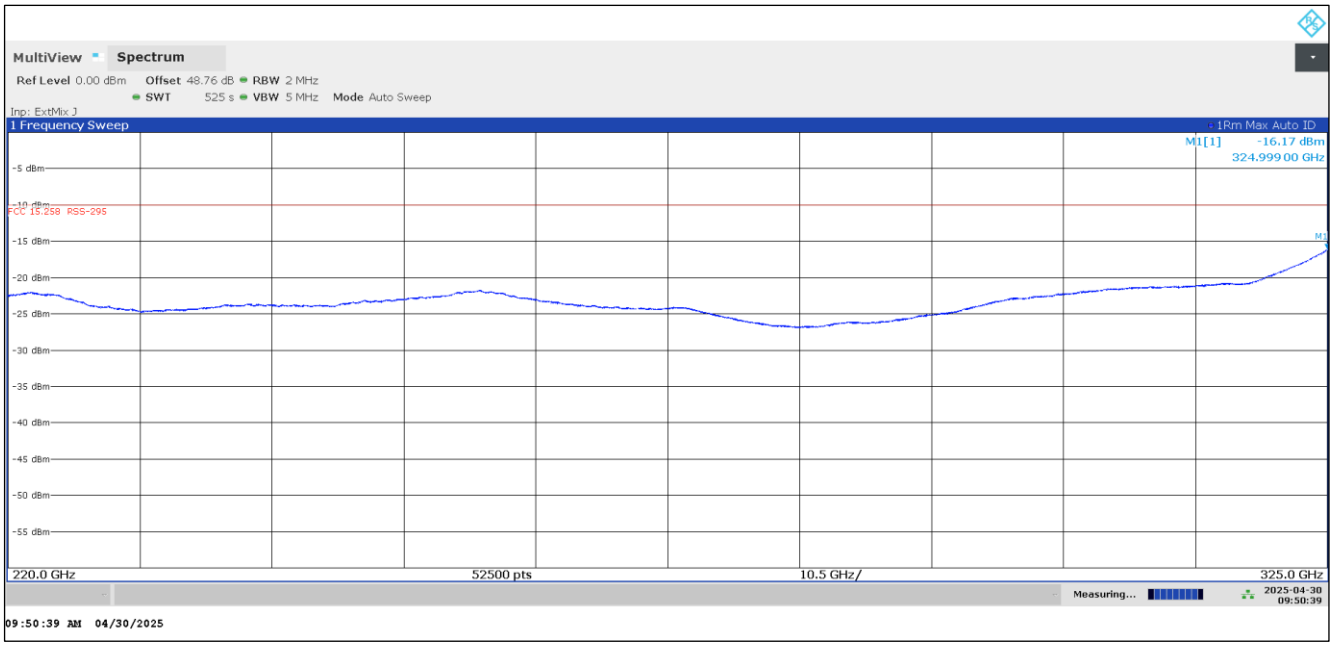
Plot 63: 140 GHz – 220 GHz, stop mode, high frequency, 10 MHz



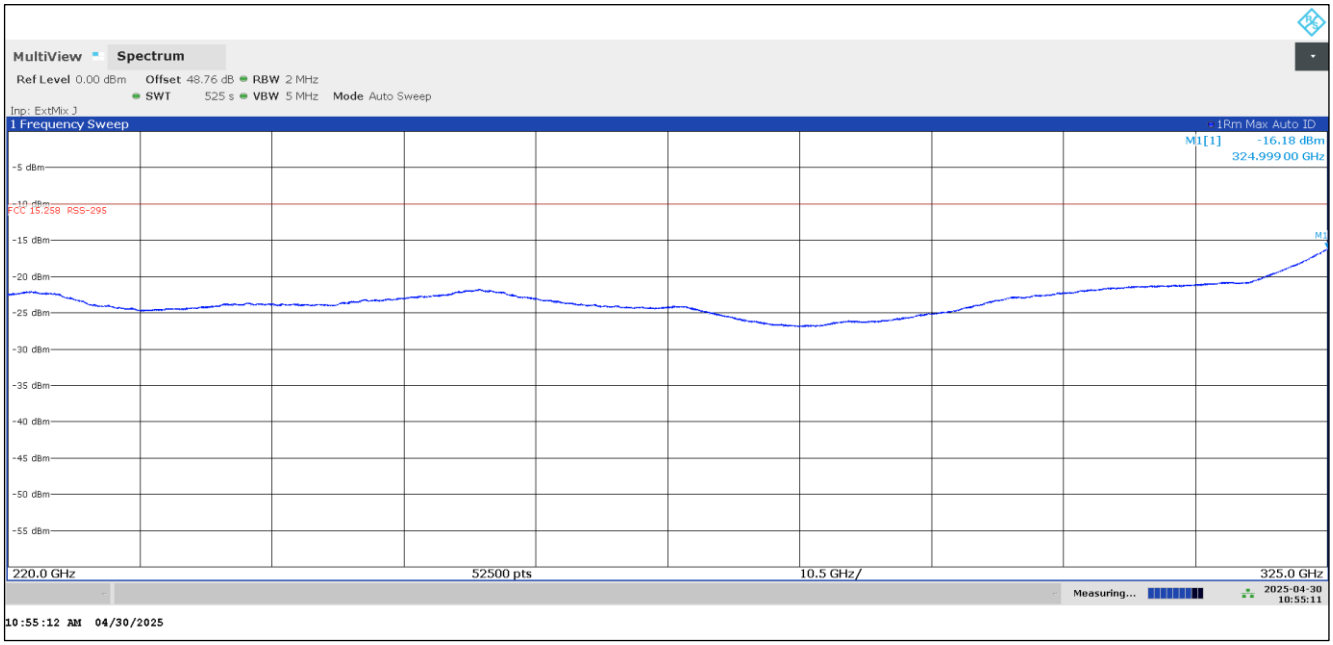
Plot 64: 140 GHz – 220 GHz, stop mode, high frequency, zero span



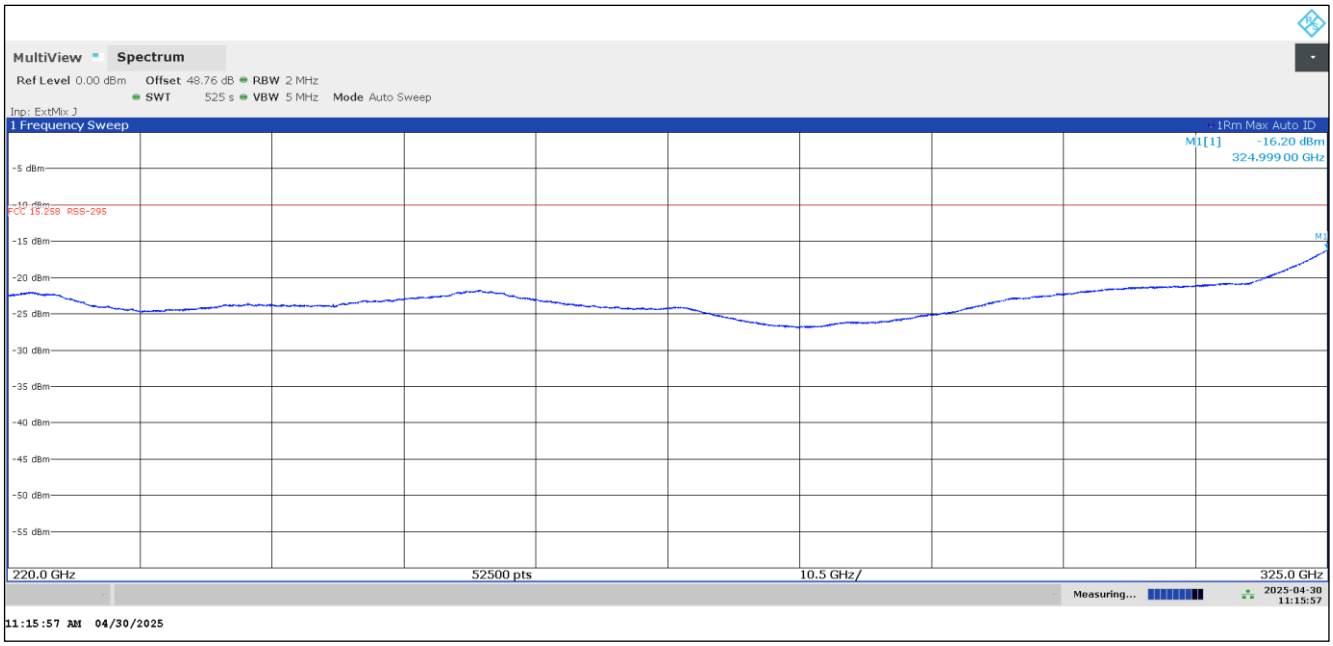
Plot 65: 220 GHz – 325 GHz, normal operation mode



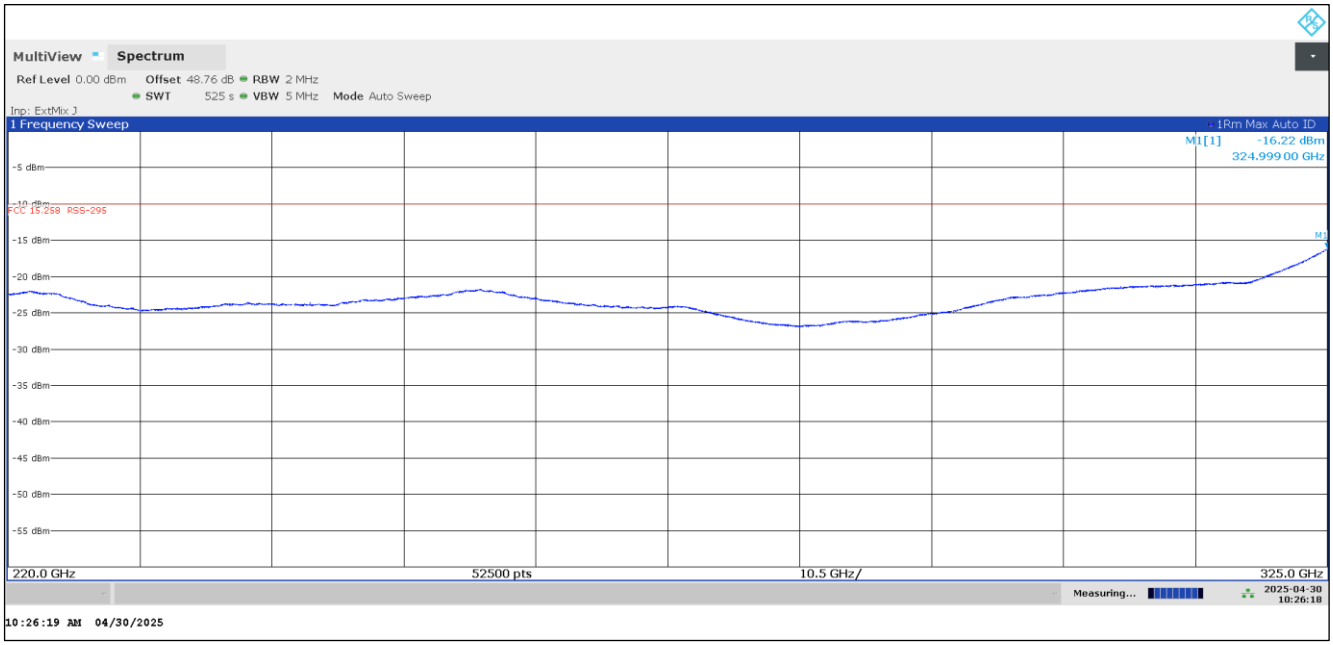
Plot 66: 220 GHz – 325 GHz, stop mode, low frequency



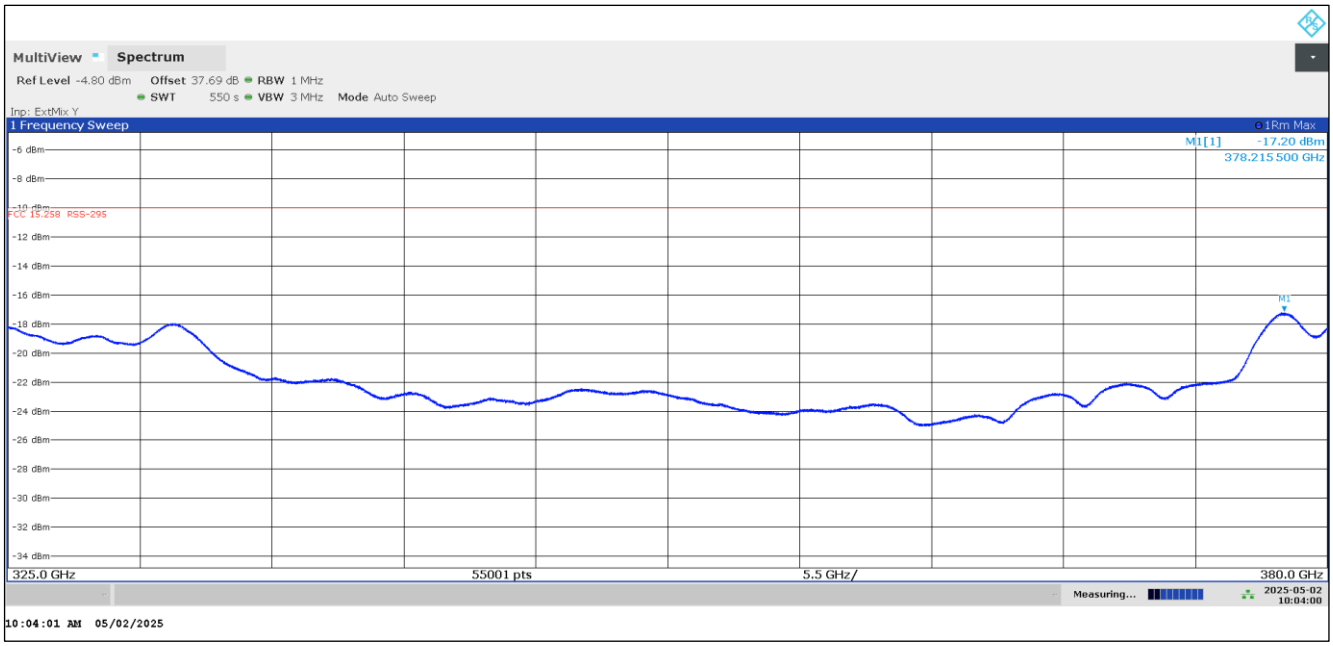
Plot 67: 220 GHz – 325 GHz, stop mode, middle frequency



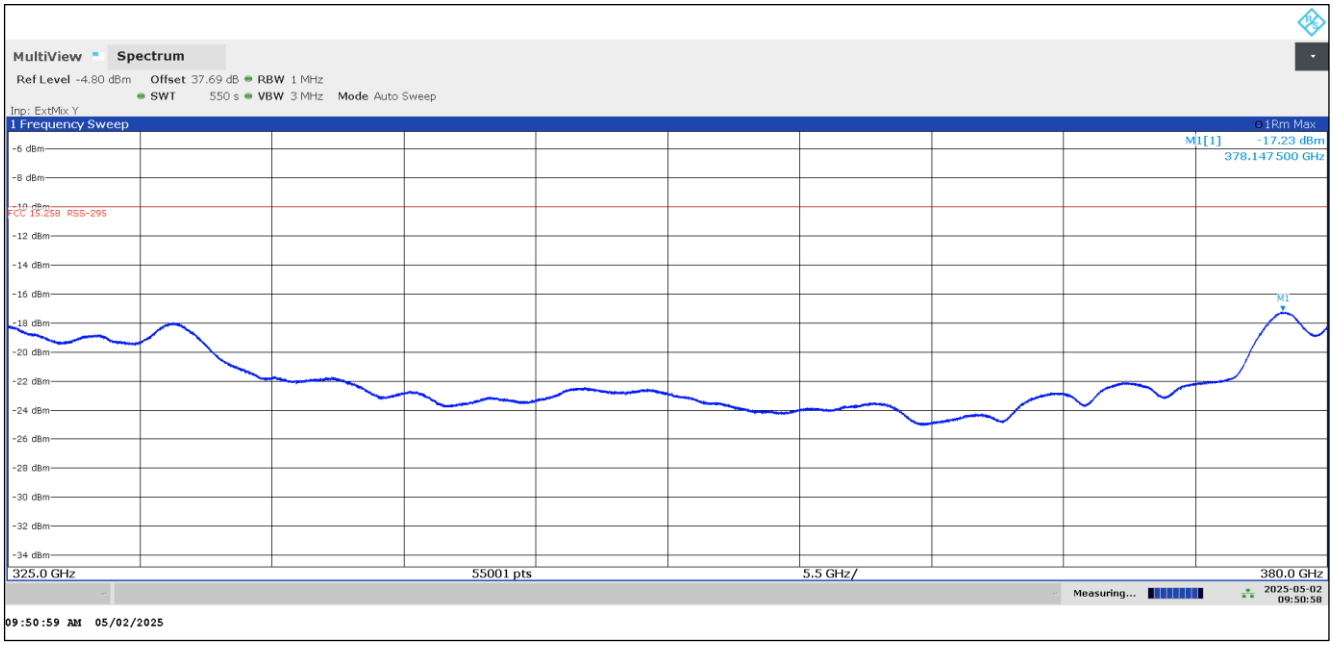
Plot 68: 220 GHz – 325 GHz, stop mode, high frequency



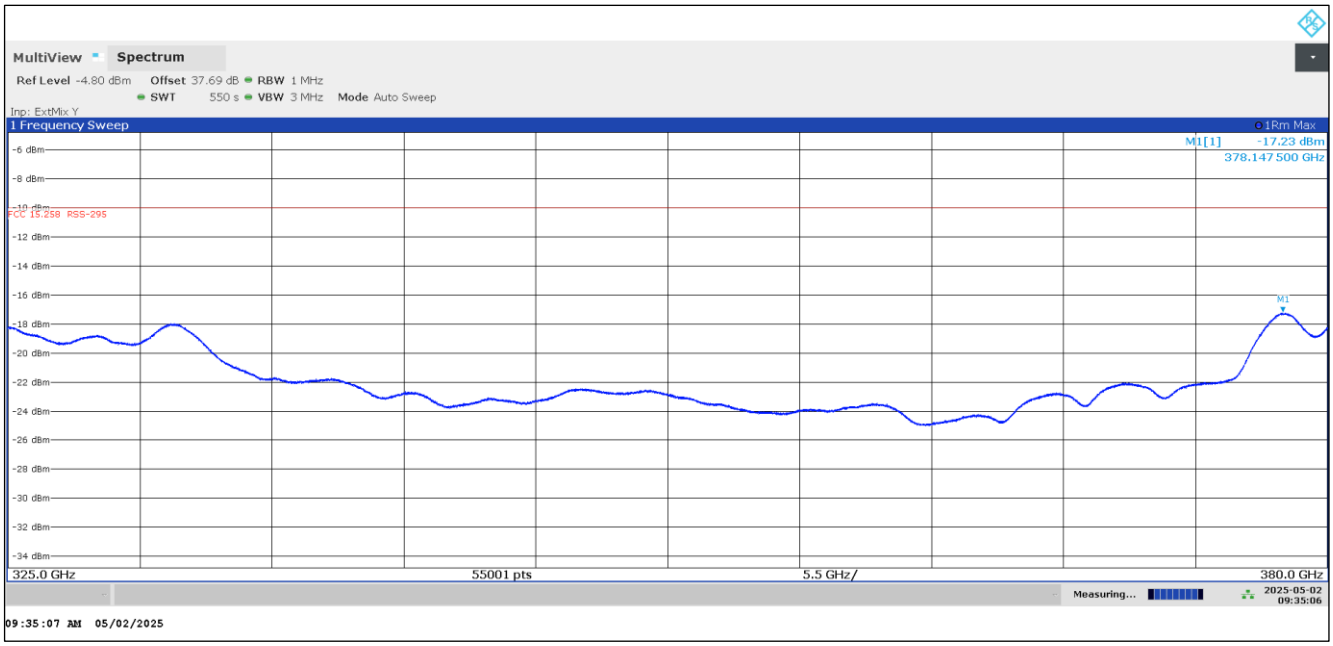
Plot 69: 325 GHz – 380 GHz, normal operation mode



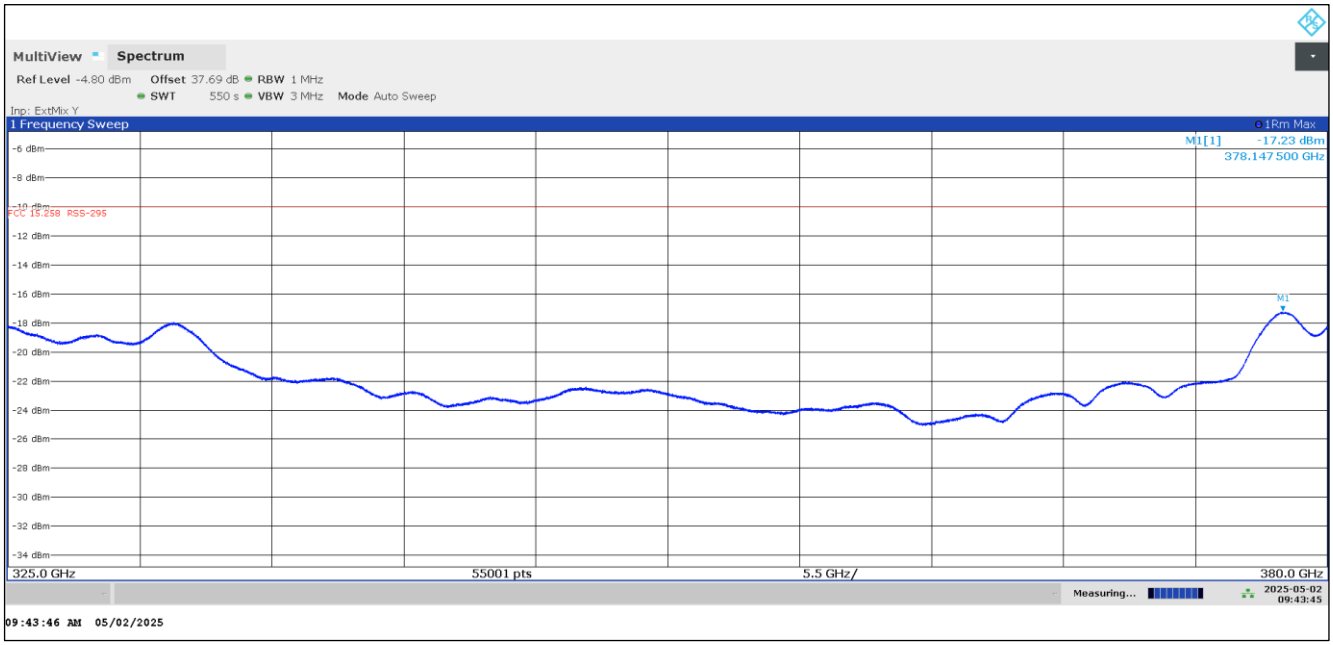
Plot 70: 325 GHz – 380 GHz, stop mode, low frequency



Plot 71: 325 GHz – 380GHz, stop mode, middle frequency



Plot 72: 325 GHz – 380 GHz, stop mode, high frequency



13.4 Conducted emissions < 30 MHz (AC power line)

Description:

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

Limits and provisions:

47 CFR 15.207(a)		
Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

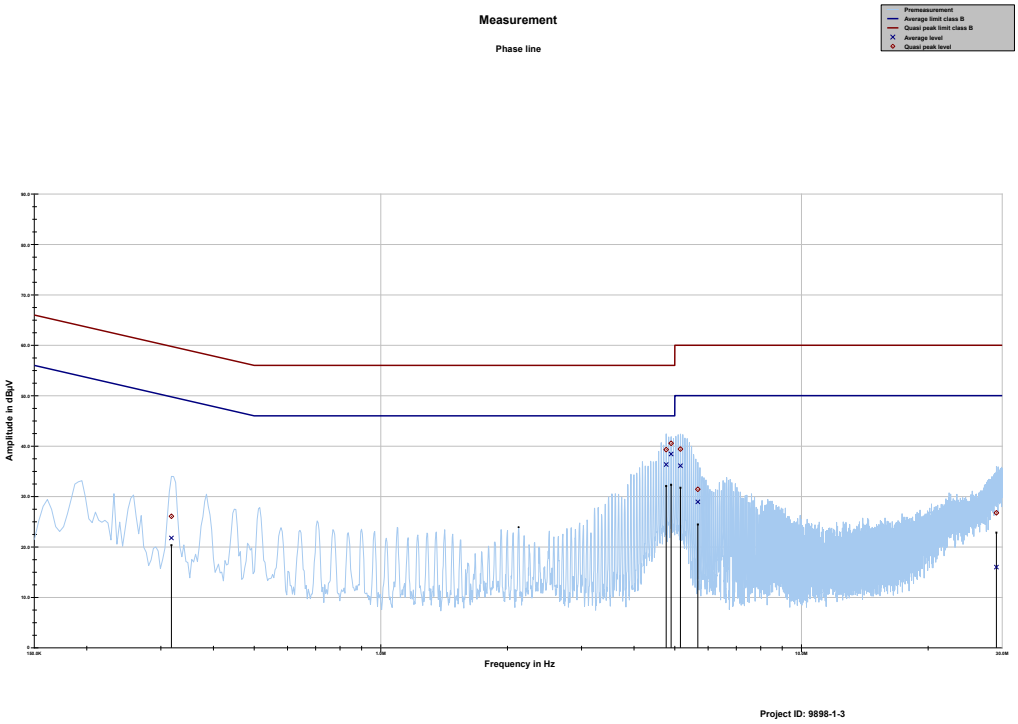
* Decreases with the logarithm of the frequency

Measurement:

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

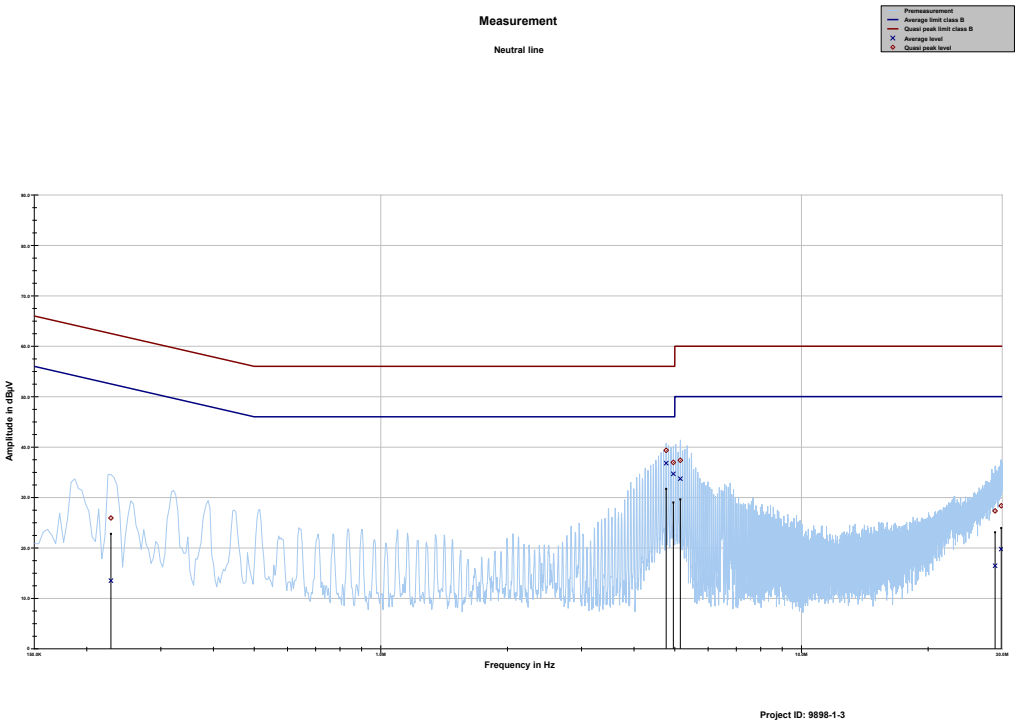
Measurement results:

Plot 73: Phase line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.317906	26.08	33.68	59.761	21.78	29.42	51.203
4.769287	39.29	16.71	56.000	36.34	9.66	46.000
4.899881	40.56	15.44	56.000	38.43	7.57	46.000
5.157337	39.41	20.59	60.000	36.11	13.89	50.000
5.672250	31.43	28.57	60.000	28.94	21.06	50.000
29.078381	26.76	33.24	60.000	16.00	34.00	50.000

Plot 74: Neutral line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.228356	25.94	36.57	62.509	13.51	40.25	53.761
4.769287	39.34	16.66	56.000	36.80	9.20	46.000
4.959581	36.95	19.05	56.000	34.69	11.31	46.000
5.153606	37.37	22.63	60.000	33.73	16.27	50.000
28.865700	27.34	32.66	60.000	16.46	33.54	50.000
29.854481	28.34	31.66	60.000	19.76	30.24	50.000

Verdict: Compliant

14 Glossary

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

15 Document history

Version	Applied changes	Date of release
-/-	Initial release – DRAFT	2025-05-30
-/-	Initial release	2025-06-26

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