

TEST REPORT

Test report no.: 1-9686-25-02-02_TR3-R01



Testing laboratory

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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

IDS GeoRadar s.r.l.

Via Augusto Righi 6, 6A,8

56121 PISA (PI) / ITALY

Phone:

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Manufacturer

IDS GeoRadar s.r.l.

Via Augusto Righi 6, 6A,8

56121 PISA (PI) / ITALY

Test standard/s

FCC - Title 47 CFR Part 95 FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 95 - Personal Radio Services

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

Test Item

Kind of test item: Fixed Interferometric Radar System at 76-77 GHz

Model name: HYDRA2

FCC ID: UFW-HYDRA2

Frequency band: 76.5 GHz band: 76 GHz – 77 GHz

Technology tested: FMCW radar

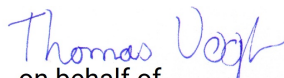
Antenna: Integrated antenna

Power supply: 22.6 V to 26.4 V DC, by external power supply or battery

Temperature range: -20°C to 55°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.

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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:	2025-10-15
Date of receipt of test item:	2025-11-14
Start of test:*	2025-11-17
Test item send to customer:	2025-12-10
Test item received from customer:	2026-03-09
End of test:*	2026-03-13
Person(s) present during the test:	Mr. Simoni Marco (Periode: 2025-11-17 – 2025-11-21)

*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 95	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 95 - Personal Radio Services

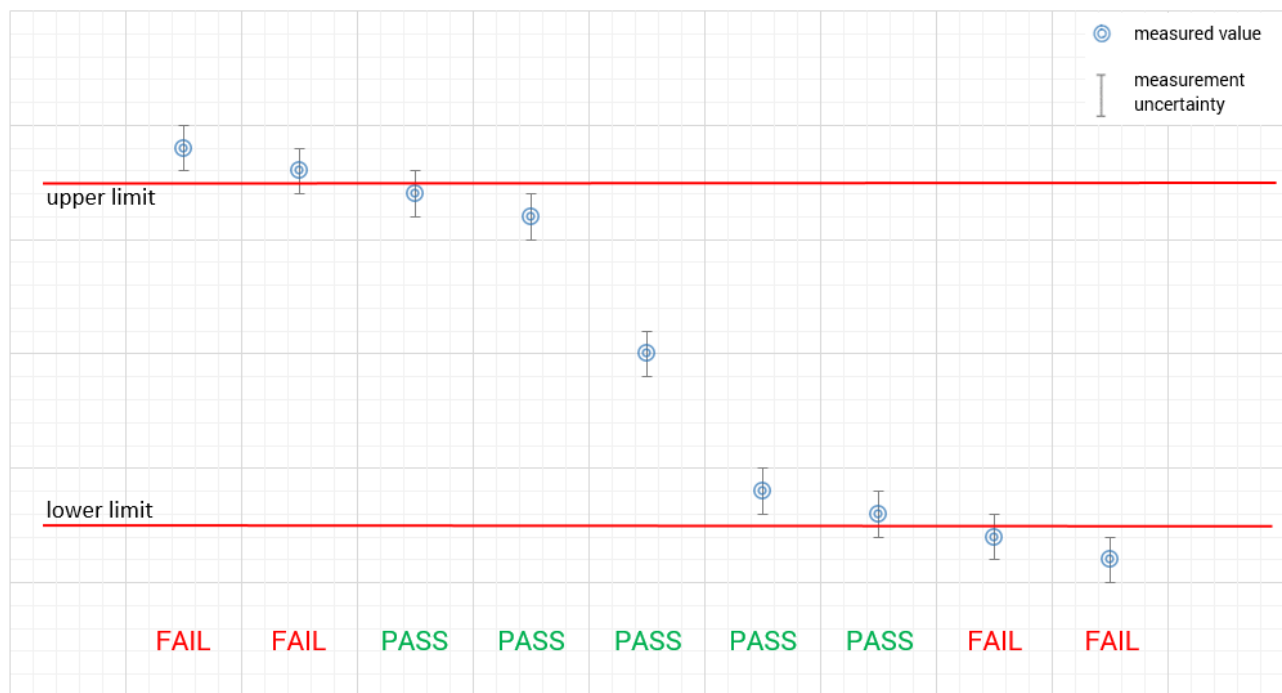
Guidance	Version	Description
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
76-81 GHz Radars KDB	v01r02	653005 D01 76-81 GHz Radars v01r02: EQUIPMENT AUTHORIZATION GUIDANCE FOR 76-81 GHz RADAR DEVICES

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.

measured value, measurement uncertainty, verdict



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	:		49 %
Barometric pressure	:		990 hPa to 1010 hPa
Power supply	:	V _{nom} V _{max} V _{min}	24.0 V DC by external power supply 26.4 V 22.6 V

6 Test item

6.1 General description

Kind of test item	:	Fixed Interferometric Radar System at 76-77 GHz
Model name	:	HYDRA2
S/N serial number	:	Test Period 1 EUT 1: 003 Test Period 2 EUT 1: 001
Power setting	:	0 dB Attenuation (configured in SW)
Hardware status	:	Test Period 1: Rev A Test Period 2: Rev C
Software status	:	Test Period 1: 0.0.31 Test Period 2: 0.0.35
Firmware status	:	FW (Digital) Test Period 1 & 2: 1.37 FW (FR) Test Period 1 & 2: 1.14
Frequency band	:	76.5 GHz band: 76 GHz – 77 GHz
Type of radio transmission	:	Modulated carrier
Use of frequency spectrum	:	
Type of modulation	:	FMCW
Number of modes	:	76.5 GHz band: 3 modes
Antenna	:	Integrated antenna
Power supply	:	22.6 V to 26.4 V DC, by external power supply or battery
Temperature range	:	-20°C to 55°C

Note:

- First test period: 2025-11-17 up to 2025-12-10
- Second test period: 2026-03-09 up to 2026-03-13

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:

- 1-9686-25-01-03_TR1-A101-R01 (External photographs of EUT)
- 1-9686-25-01-03_TR1-A102-R01 (Internal photographs of EUT)
- 1-9686-25-02-02_TR1-A103-R02 (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:

- 1-9686-25-02-02_TR1-A201-R01
- 1-9686-25-02-02_TR1-A202-R01
- 1-9686-25-02-02_TR1-A203-R01
- 1-9686-25-02-02_TR1-A204-R02
- 1-9686-25-02-02_TR1-A205-R01
- 1-9686-25-02-02_TR1-A206-R01

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

- 1-9686-25-01-03_TR1-A301-R01

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).

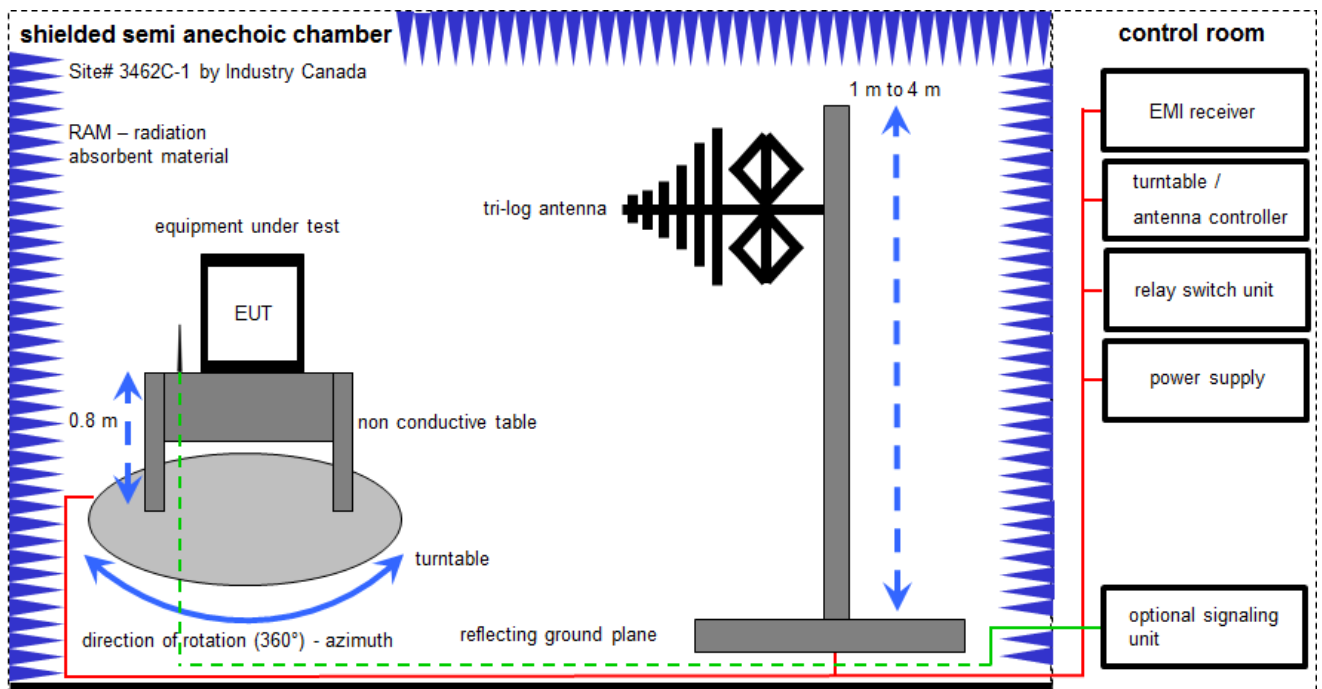
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

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
vkl!	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;

$$FS = UR + CL + AF$$

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

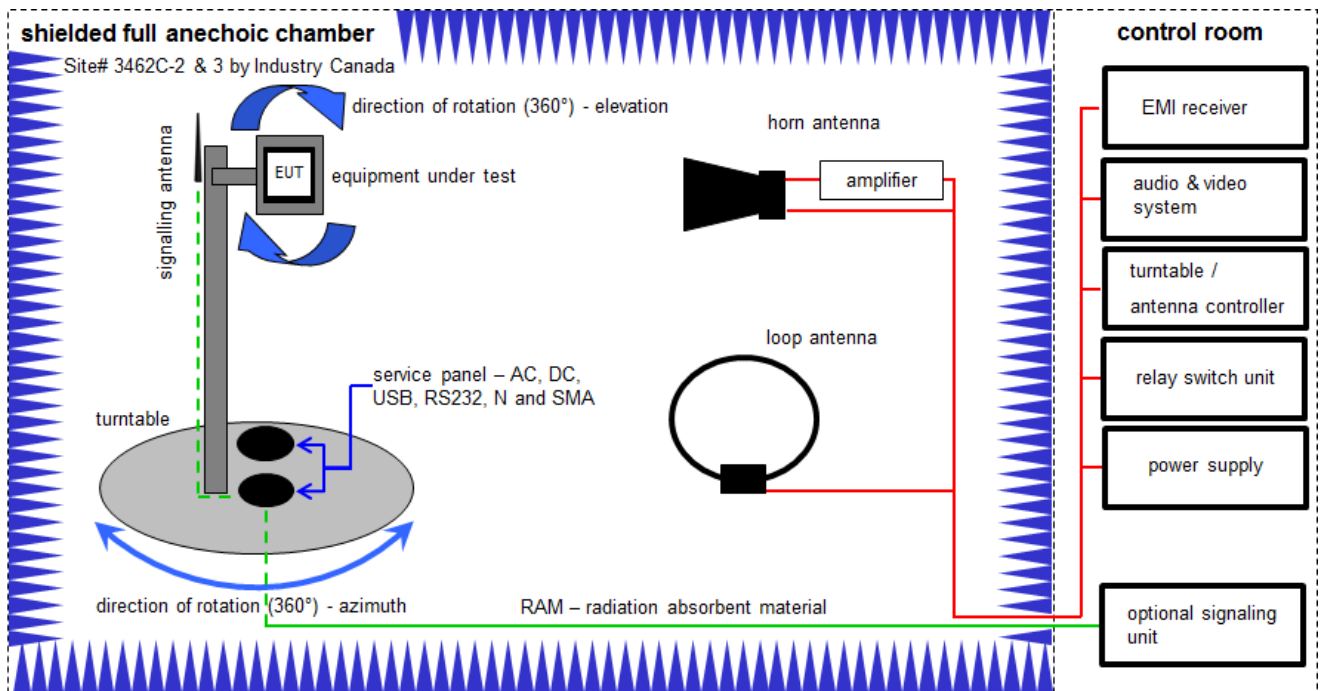
Example calculation:

$$FS \text{ [dB}\mu\text{V/m]} = 12.35 \text{ [dB}\mu\text{V]} + 1.90 \text{ [dB]} + 16.80 \text{ [dB/m]} = 31.05 \text{ [dB}\mu\text{V/m]} \text{ (35.69 } \mu\text{V/m) @ distance}$$

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n.a.	Semi anechoic chamber	3000023	MWB AG		300000551-0000	cnn	-/-	-/-
2	n.a.	TRILOG Broadband Antenna	VULB9163	Schwarzbeck Mess-Elektronik OHG / Schönau	371	300003854-0000	cal	11.07.2024	11.07.2026
3	n.a.	Switch-Unit	3488A	Hewlett Packard	2719A14505	300000368	cpu	-/-	-/-
4	n.a.	Power Supply	6032A	Hewlett Packard	2920A04466	300000580	cnn	-/-	-/-
5	n.a.	Antenna Tower	2175	ETS-Lindgren GmbH / Taufkirchen	64762	300003745	cnn	-/-	-/-
6	n.a.	Positioning Controller	2090	ETS-Lindgren GmbH / Taufkirchen	64672	300003746	cnn	-/-	-/-
7	n.a.	EMI Test Receiver	ESR3 9kHz-3.6GHz	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102587	300005771	cal	05.12.2024 08.12.2025	31.12.2026

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:

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

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

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

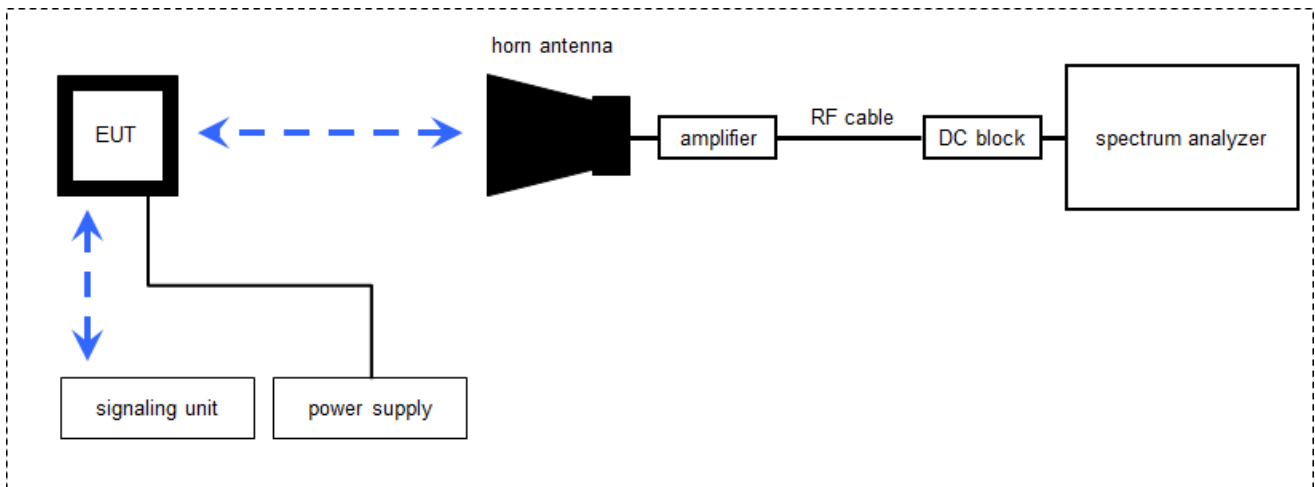
Example calculation:

$$OP \text{ [dBm]} = -65.0 \text{ [dBm]} + 50 \text{ [dB]} - 20 \text{ [dBi]} + 5 \text{ [dB]} = -30 \text{ [dBm]} \text{ (1 } \mu\text{W)}$$

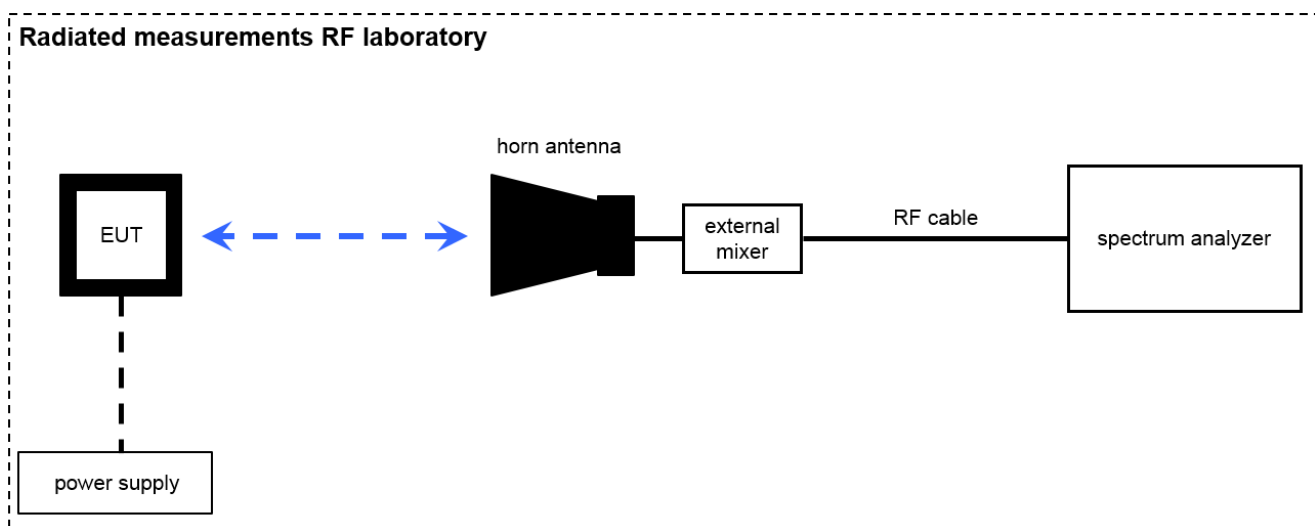
Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n.a.	EMI Test Receiver	ESR26 9kHz-26.5GHz	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101376	300005063-0000	cal	06.12.2024 12.02.2026	28.02.2027
2	n.a.	Double-Ridged Waveguide Horn Antenna	3115	EMCO Elektronik GmbH / Gilching	8812-3089	300000307	cal	09.07.2024	09.07.2026
3	n.a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright Instruments GmbH / Andechs	18	300003789-0000	cpu	-/-	-/-
4	n.a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22050	300004482-0000	cpu	-/-	-/-
5	n.a.	4U RF Switch Platform	L4491A	Agilent Technologies Deutschland GmbH / Böblingen	MY50000032	300004510-0000	cnn	-/-	-/-
6	n.a.	NEXIO EMV-Software	BAT EMC V2022.0.32.0	Nexio		300004682-0000	cnn	-/-	-/-
7	n.a.	Anechoic chamber	Anechoic chamber	TDK		300003726-0000	cnn	-/-	-/-
8	n.a.	Power Supply	HMP2020	Rohde & Schwarz Messgerätebau GmbH / Memmingen	120626	300006408-0000	cal	02.05.2023	31.05.2026
9	n.a.	Active Loop Antenna	6502	EMCO Elektronik GmbH / Gilching	2210	300001015	cal	07.07.2025	07.07.2027

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:

$$FS \text{ [dB}\mu\text{V/m]} = 40.0 \text{ [dB}\mu\text{V]} + (-60.1) \text{ [dB]} + 36.74 \text{ [dB/m]} = 16.64 \text{ [dB}\mu\text{V/m]} \text{ (6.79 } \mu\text{V/m) @ distance}$$

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

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

Example calculation:

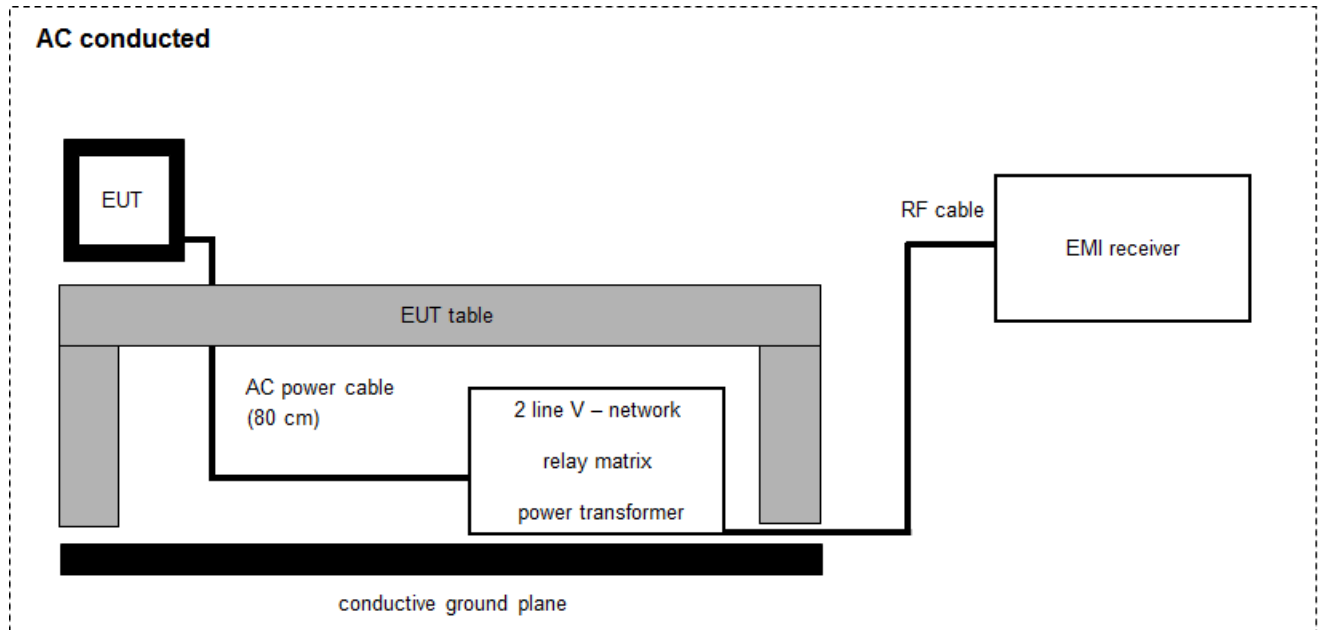
$$OP \text{ [dBm]} = -59.0 \text{ [dBm]} + 44.0 \text{ [dB]} - 20.0 \text{ [dBi]} + 5.0 \text{ [dB]} = -30 \text{ [dBm]} \text{ (1 } \mu\text{W)}$$

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	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	FSW50	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101332	300005935 -0000	cal	09.01.2025 28.01.2026	31.01.2027
3	n.a.	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983 -0000	cnn	-/-	-/-
4	n.a.	Std. Gain Horn Antenna 114-173 GHz	2924-20	Flann	*	300001999 -0000	cnn	-/-	-/-
5	n.a.	Std. Gain Horn Antenna 145-220 GHz	3024-20	Flann	*	300002000 -0000	cnn	-/-	-/-
6	n.a.	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814 -0000	cpu	-/-	-/-
7	n.a.	Harmonic Mixer 3- Port, 110-170 GHz	FS-Z170	Radiometer Physics GmbH	100014	300004156 -0000	cal	15.07.2025	15.07.2026
8	n.a.	Harmonic Mixer 3- Port, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157 -0000	cal	06.08.2025	06.08.2026
9	n.a.	Harmonic Mixer 3- Port, 220-325 GHz	SAM-325	Radiometer Physics GmbH	100002	300004158 -0000	cal	11.07.2025	11.07.2026
10	n.a.	Std. Gain Horn Antenna 33.0-50.1 GHz	2324-20	Flann	57	400000683 -0000	cnn	-/-	-/-
11	n.a.	Harmonic Mixer 3- Port, 60-90 GHz	FS-Z90	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101555	300004691 -0000	cal	01.09.2025	01.09.2026
12	n.a.	Std. Gain Horn Antenna 217-330 GHz	32240-20	Flann	233278	300004960 -0000	cnn	-/-	-/-
13	n.a.	Harmonic Mixer 3- Port, 75-110 GHz	FS-Z110	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101411	300004959 -0000	cal	01.09.2025	01.09.2026
14	n.a.	Harmonic Mixer 3- port, 90-140 GHz	FS-Z140	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101119	300005581 -0000	cal	06.08.2025	06.08.2026
15	n.a.	Harmonic Mixer 3- Port, 50-75 GHz	FS-Z75	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101578	300005788 -0000	cal	11.03.2025	31.03.2026
16	n.a.	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001988 -0000	cnn	-/-	-/-
17	n.a.	Std. Gain Horn Antenna 92.3-140 GHz	2824-20	Flann	*	300001993 -0000	cnn	-/-	-/-
18	n.a.	Horn Antenna 18,0- 40,0 GHz	LHAF180	Microw.Devel	39180-103-021	300001747 -0000	cal	24.01.2024 16.01.2026	31.01.2028
19	n.a.	Power supply	N5767A	Agilent Technologies Deutschland GmbH / Böblingen	US14J1569P	300004851 -0000	cal	06.12.2023	31.12.2026
20	n.a.	Low Noise Amplifier, Broadband 18-50 GHz	BZT-18005000- 550835-SL2525-SL	B&Z Technologies	27888-27890	300006364 -0000	cpu	-/-	-/-

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:

$$FS [dB\mu V/m] = 37.62 [dB\mu V] + 9.90 [dB] + 0.23 [dB] = 47.75 [dB\mu V/m] (244.06 \mu V/m) @ distance$$

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	ESR3 9kHz-3.6GHz	Rohde & Schwarz Messgerätebau GmbH / Memmingen	102981	300006318	cal	03.12.2024 05.12.2025	31.12.2026
2	n.a.	Analyzer- Impedence-System	AIS16/1	Spitzenberger + Spies GmbH & Co. KG	UO2076 07/0 1023	400001751 -0000	cal	19.10.2023 09.12.2025	31.12.2027
3	n.a.	Two-Line V-Network (LISN)	ESH3-Z5	Rohde & Schwarz Messgerätebau GmbH / Memmingen	892475/017	300002209	cal	12.12.2023 09.12.2025	31.12.2027
4	n.a.	Power Supply	6032A	Hewlett Packard	2920A04466	300000580	cnn	-/-	-/-
5	n.a.	Hochpass 150 kHz	150 kHz EZ-25	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100010	300003798 -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 $\pm 45^\circ$ and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

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 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

10.1 Summary

☒	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	47 CFR Part 95 Subpart M	see below	2025-11-28	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	Pass	Fail	NA	NP	Remark
§2.1046 §95.3367	Radiated power	Nominal	Nominal	☒	☐	☐	☐	complies
§2.1047	Modulation characteristics	-/-	-/-	☒	☐	☐	☐	complies
§2.1049 §2.1055 §95.3379 (b)	Occupied bandwidth / Frequency stability (99% bandwidth)	Nominal Extreme	Nominal Extreme	☒	☐	☐	☐	complies
§2.1051	Spurious emissions at antenna terminals	Nominal	Nominal	☐	☐	☒	☐	see note 3, DUT has integral/internal antenna
§2.1053 §95.3379 (a)	Unwanted emissions (radiated spurious)	Nominal	Nominal	☒	☐	☐	☐	complies
§15.207	Conducted emissions < 30 MHz (AC power line)	Nominal	Nominal	☒	☐	☐	☐	see note 2 complies

Note:

- 1) NA = Not applicable; NP = Not performed
- 2) Part 15.207 is not part of the examination according to Part 95M. However, the FCC must grant permission for the product certification to be waived. As the device can also be operated on the mains electricity supply, this test was added.
- 3) ANSI C63.26-2015 5.5.1:
 "...many contemporary portable transmitters utilize integral antennas, precluding access to an antenna output port from which to perform conducted compliance measurements. For these types of transmitters, all of the data necessary to demonstrate compliance must be measured in a radiated test configuration..."

11 Additional comments

Reference documents:

- None

Special test descriptions:

- None

Configuration descriptions:

- None

Test devices (EUT):

- EUT1: The normal operation mode (intended use) is used.

Associated equipment (AE):

- AE1: Laptop for configuration

Normal operation modes (NM):

Abbreviation	Name	Features
NM_1	Mode 1	800 MHz bandwidth
NM_2	Mode 2	400 MHz bandwidth
NM_3	Mode 3	200 MHz bandwidth

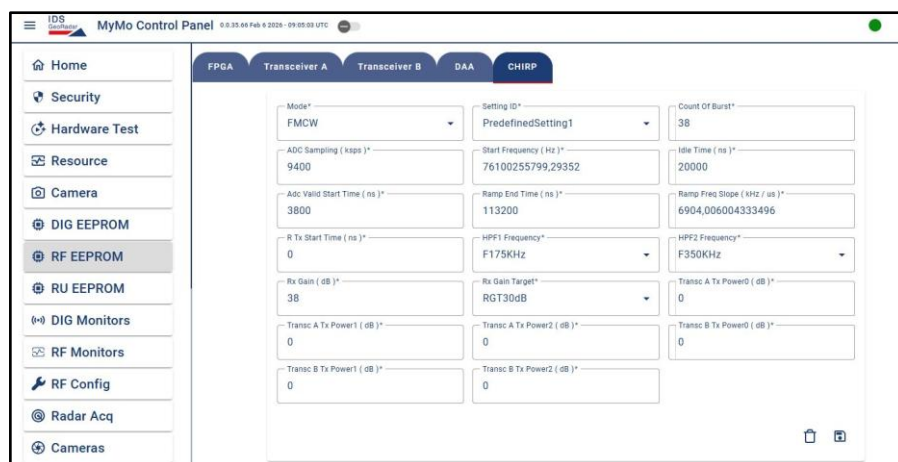
Additional test modes: ☒ No test modes available

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

Software provided by the manufacturer:

- The EUT can be configured via Ethernet.
- The user can configure the different modes via the device's web interface.

Plot 1: Configuration example of Mode 1 within the software



Information from customer:

Short description of changes between period 1 and period 2

- Added shield around the antenna housing
- Added ferrites

Info from Lab:

- After EUT 1 returns from customer, an In-Band validation was performed.
- Result: The In-Band emissions are similar to the emissions in period 1

12 Measurement results

12.1 Radiated power

Description:

§95.3367

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as shown below.

Limits and provisions:

FCC §95.3367 (a) (b)

Frequency	Limit (eirp)
76.0 - 81.0 GHz	50 dBm (Average)
76.0 - 81.0 GHz	55 dBm/MHz (PEAK)

Measurement:

Measurement parameter: Average Power	
Detector:	RMS
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Trace-Mode:	Max Hold

Measurement parameter: Peak Power	
Detector:	Pos-Peak
Resolution bandwidth:	50 MHz
Video bandwidth:	80 MHz
Trace-Mode:	Max Hold

Note: KDB 653005 4.(c)(1)

“Peak power measurements of swept frequency radar implementations (e.g., high sweep rate FMCW) may require a desensitization correction factor to be applied to the measurement results.”

→ Peak power measurements are therefore performed using an optimized (usually larger) resolution bandwidth to mitigate issues with desensitization.

Measurement results:

EUT	Mode	Test condition	Radiated Peak Power (EIRP)	Radiated Mean Power (EIRP)
1	1	$T_{\text{nom}} / V_{\text{nom}}$	26.99	23.22
1	2	$T_{\text{nom}} / V_{\text{nom}}$	27.21	23.25
1	3	$T_{\text{nom}} / V_{\text{nom}}$	27.29	23.25

Note:

- Measured in Period 1
- Detailed measurement results: see the following measurement report:
 - 1-9686-25-02-02_TR1-A201-R01
 - 1-9686-25-02-02_TR1-A202-R01
 - 1-9686-25-02-02_TR1-A203-R01

Verdict: Compliant

12.2 Modulation characteristics

Description:

§2.1047 (d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

KDB 653005 D01 76-81 GHz Radars v01r02, section 3 (g)

Concerning the Section 2.1047 modulation characteristics requirement, the following information should be provided:

- 1) Pulsed radar: pulse width and pulse repetition frequency (if PRF is variable, then report maximum and minimum values).
- 2) Non-pulsed radar (e.g., FMCW): modulation type (i.e., sawtooth, sinusoid, triangle, or square wave) and sweep characteristics (sweep bandwidth, sweep rate, sweep time).

Information from manufacturer on modulation characteristics:

Plot 2: Modulation characteristics provided by customer

	Profile ID 1	Profile ID 2	Profile ID 3
Frequency slope (MHz/ μ s)	6.904	3.476	1.738
f_{start} (MHz)	76100	76300	76400
f_{stop} (MHz)	76881.5328	76693.4832	76596.7416
Idle time (μ s)	20	20	20
Ramp end time (μ s)	113.2	113.2	113.2
TX Start time (μ s)	0	0	0
Inter-burst blanking time (μ s)	450.8	450.8	450.8
Burst time (ms)	1.25	1.25	1.25
PS blanking time (ms)	2.5	2.5	2.5
Frame time (ms)	50	50	50

Node:

- More details can be found: 1-9686-25-01-03_TR1-A301-R01

12.3 Occupied bandwidth / Frequency stability

Description:

§2.1049 The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

§95.3379 (b) 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.

Limits and provisions:

FCC
FCC §2.1049/ §95.3379 (b)
The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply during all conditions of operation with the following:
Frequency range
76 GHz – 81 GHz

Measurement:

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

Measurement results: All modes under normal conditions

EUT	Mode	Test Conditions	f_L in GHz	f_H in GHz	Occupied Bandwidth (99%) in MHz
1	1	T_{nom} / V_{nom}	76.097	76.877	779
1	2	T_{nom} / V_{nom}	76.299	76.691	392
1	3	T_{nom} / V_{nom}	76.399	76.595	196

Note:

- Measured in Period 1
- Detailed measurement results: see the following measurement report:
 - 1-9686-25-02-02_TR1-A201-R01
 - 1-9686-25-02-02_TR1-A202-R01
 - 1-9686-25-02-02_TR1-A203-R01

Measurement results: Mode 1 under extreme conditions

EUT	Mode	Test Conditions	f_L in MHz	f_H in MHz	Occupied Bandwidth (99%) in MHz
1	1	-20 °C / V_{nom}	76100.32	76878.13	777.81
1	1	-10 °C / V_{nom}	76100.79	76878.34	777.55
1	1	0 °C / V_{nom}	76100.14	76878.02	777.88
1	1	10 °C / V_{nom}	76098.86	76877.20	778.34
1	1	T_{nom} / V_{min}	76094.67	76877.19	782.52
1	1	T_{nom} / V_{nom}	76094.70	76877.18	782.48
1	1	T_{nom} / V_{max}	76094.68	76877.11	782.43
1	1	30 °C / V_{nom}	76087.80	76877.56	789.76
1	1	40 °C / V_{nom}	76036.73	76876.73	840.00
1	1	50 °C / V_{nom}	76010.68	76868.11	857.43

Note:

- Measured in Period 2
- The EUT is tested in the temperature range from -20°C to 50°C specified by §95.3379 (b) and RSS Gen 6.11.
- If the operating temperature range of the device specified by the manufacturer exceeds the test temperature range (-20°C to +50°C), the customer is responsible for ensuring the frequency stability and proper functioning of the device within the extended operating temperature range.
- Detailed measurement results: see measurement report 1-9686-25-02-02_TR1-A204-R02

Verdict: Compliant

12.4 Unwanted emissions (radiated spurious)

Description:

Measurement of the radiated unwanted emissions.

Limits and provisions:

FCC §95.3379

(a) The power density of any emissions outside the 76-81 GHz band shall consist solely of spurious emissions and shall not exceed the following:

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

FCC		
CFR Part 95.3379 (a) (1) / CFR Part 95.3379 (a) (3)		
Radiated unwanted emissions		
Frequency (MHz)	Field Strength (µV/m)	Measurement distance (m)
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30	30
30 - 88	100	3
88 – 216	150	3
216 – 960	200	3
960 – 40 000	500	3

- (i) In the emissions table in paragraph (a)(1) of this section, the tighter limit applies at the band edges.
 - (ii) The limits in the table in paragraph (a)(1) of this section are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
 - (iii) The emissions limits shown in the table in paragraph (a)(1) of this section are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW
- (2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:
- (i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure.

- (ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure.

Frequency Range (GHz)	Power Density	EIRP
40 – 200	600 pW/cm ² @ 3m	-1.7 dBm
200 – 231	1000 pW/cm ² @ 3m	+0.5 dBm

- (3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

Note: KDB 653005 4. (e)

Unwanted emissions shall be examined from the lowest radio frequency signal generated by the EUT, without going below 9 kHz, up to at least 231 GHz (preferably 243 GHz)

Limit conversion (ANSI C63.10-2013 9.6):

$$\text{EIRP[dBm]} = 10 \times \log(4 \times \pi \times d^2 \times 1000 \times \text{PD[W/m}^2])$$

- 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 = 600 pW/cm² at a distance of d = 3 m corresponds to an equivalent isotropically radiated power of EIRP = -1.7 dBm.

Measurement results:

Mode 1:

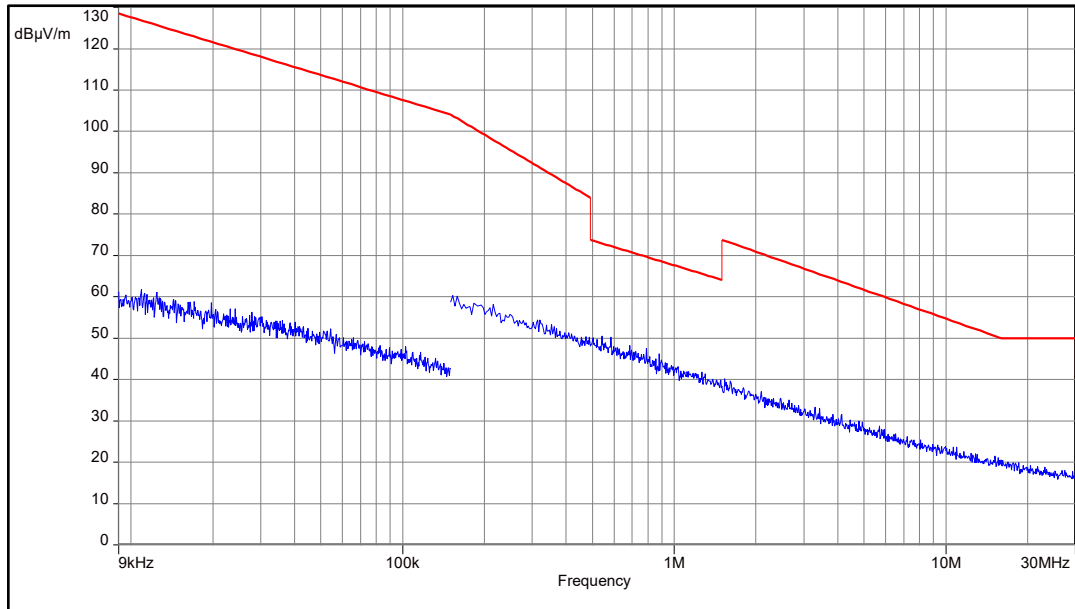
Frequency	Detector	Bandwidth [MHz]	Level	Limit	Margin [dB]
Please refer to the following plots for more information on the level of spurious emissions					

Note:

- Measurements are performed in the worst-case configuration of the device in terms of unwanted emissions.
- All three modes show roughly the same output power.
- In this case, mode 1 is the worst case, as it has the largest occupied bandwidth of all three modes.

Verdict: Compliant

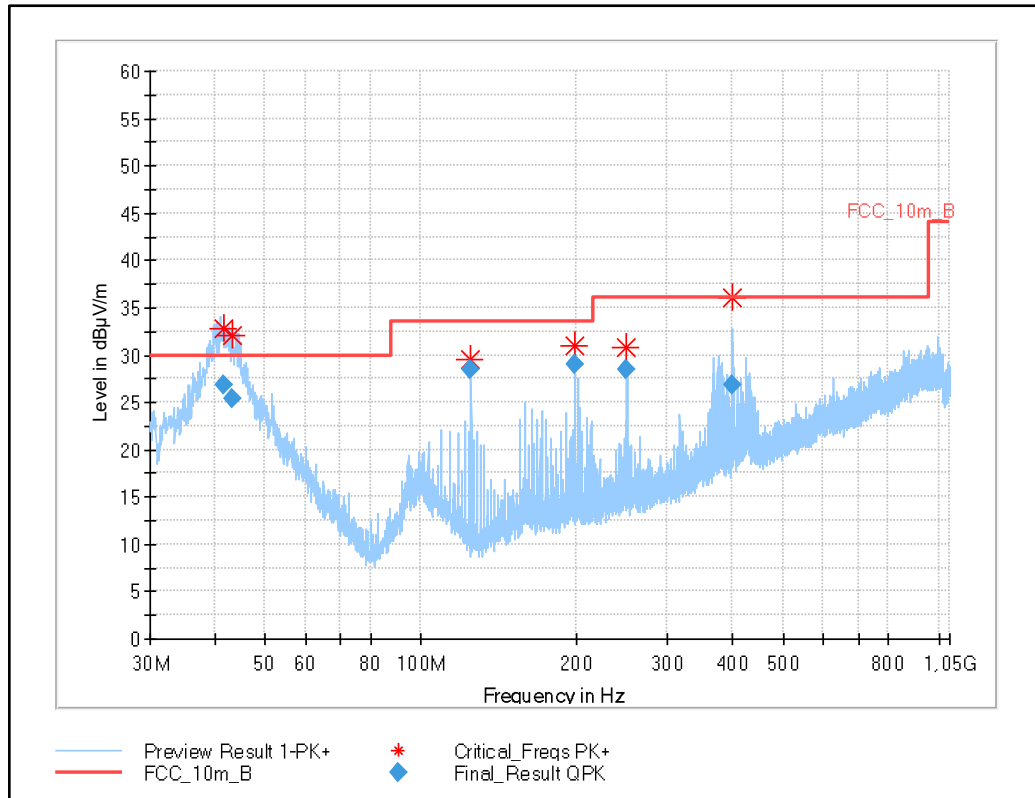
Plot 3: 9 kHz – 30 MHz, EUT 1, Mode 1



Note:

- Measured in Period 1

Plot 4: 30 MHz – 1 GHz, EUT 1, Mode 1

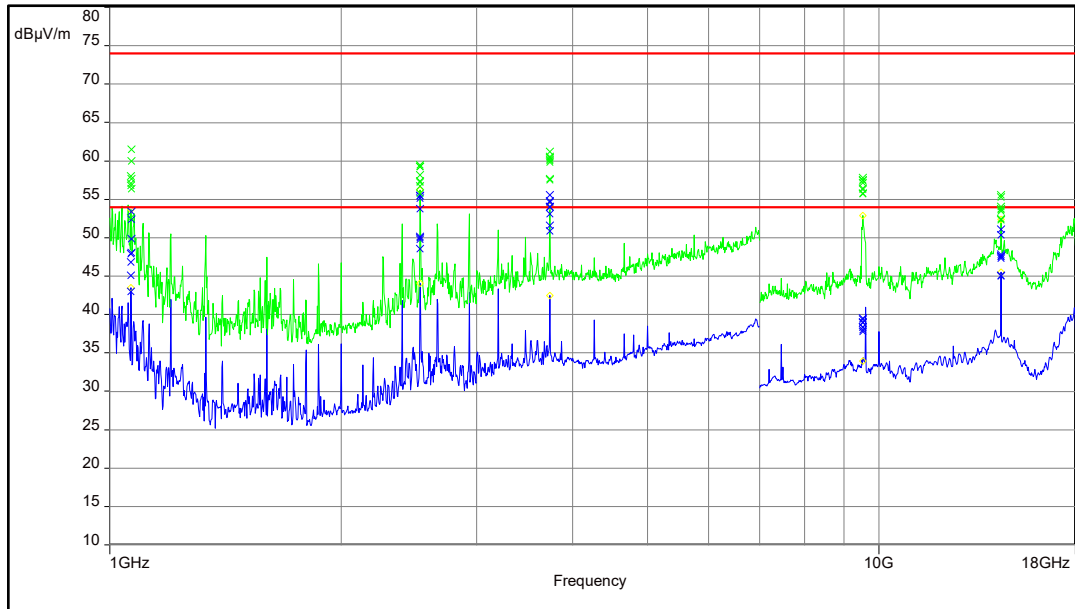


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
41.586	26.74	30.0	3.3	1000	120.0	100.0	V	111	14
43.389	25.32	30.0	4.7	1000	120.0	200.0	V	90	14
125.000	28.51	33.5	5.0	1000	120.0	151.0	V	4	10
198.485	29.08	33.5	4.4	1000	120.0	100.0	V	24	12
249.991	28.38	36.0	7.6	1000	120.0	100.0	V	34	14
399.993	26.89	36.0	9.1	1000	120.0	103.0	V	278	18

Note:

- Measured in Period 2

Plot 5: 1 GHz – 18 GHz, EUT 1, Mode 1



Note 1:

- The plot shows a prescan with worst-case settings. The final measurements with final settings are shown below.
- Green: Peak
- Blue: Average

Note 2:

- Final measurement for 2.5 GHz: 33.6 dBuV/m
- Result: pass
- See report: 1-9686-25-02-02_TR1-A205-R01

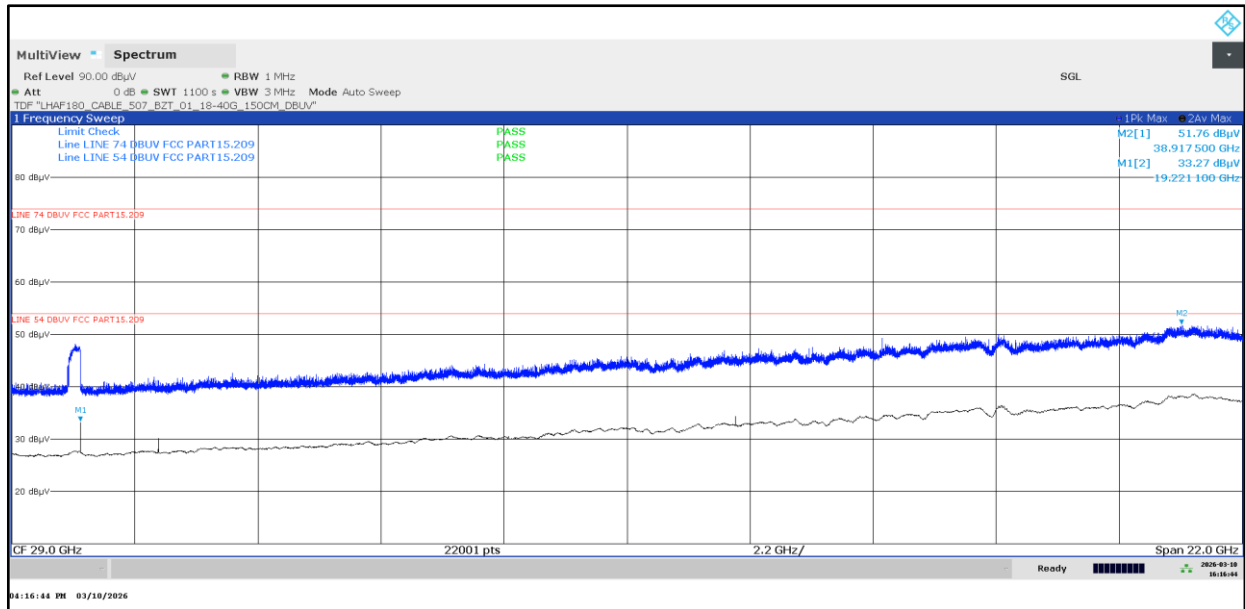
Note 3:

- Final measurement for 3.7 GHz: 45.7 dBuV/m
- Result: pass
- See report: 1-9686-25-02-02_TR1-A206-R01

Note 4:

- Measured in Period 1

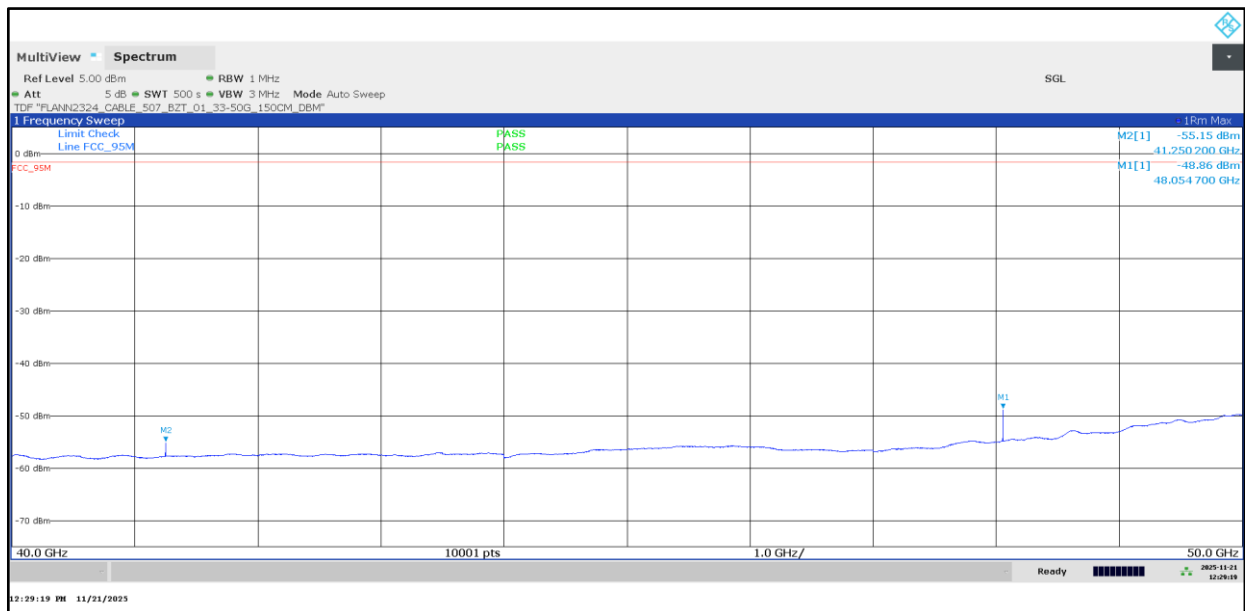
Plot 6: 18 GHz – 40 GHz, EUT 1, Mode 1



Note:

- Measured in Period 2

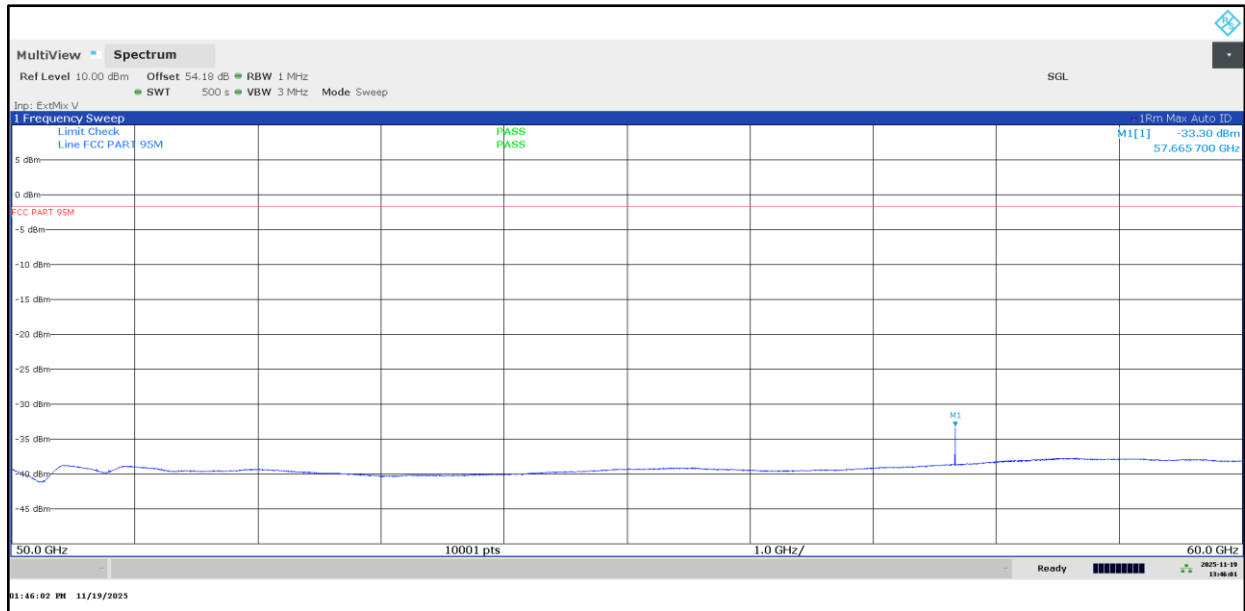
Plot 7: 40 GHz – 50 GHz, EUT 1, Mode 1



Note:

- Measured in Period 1

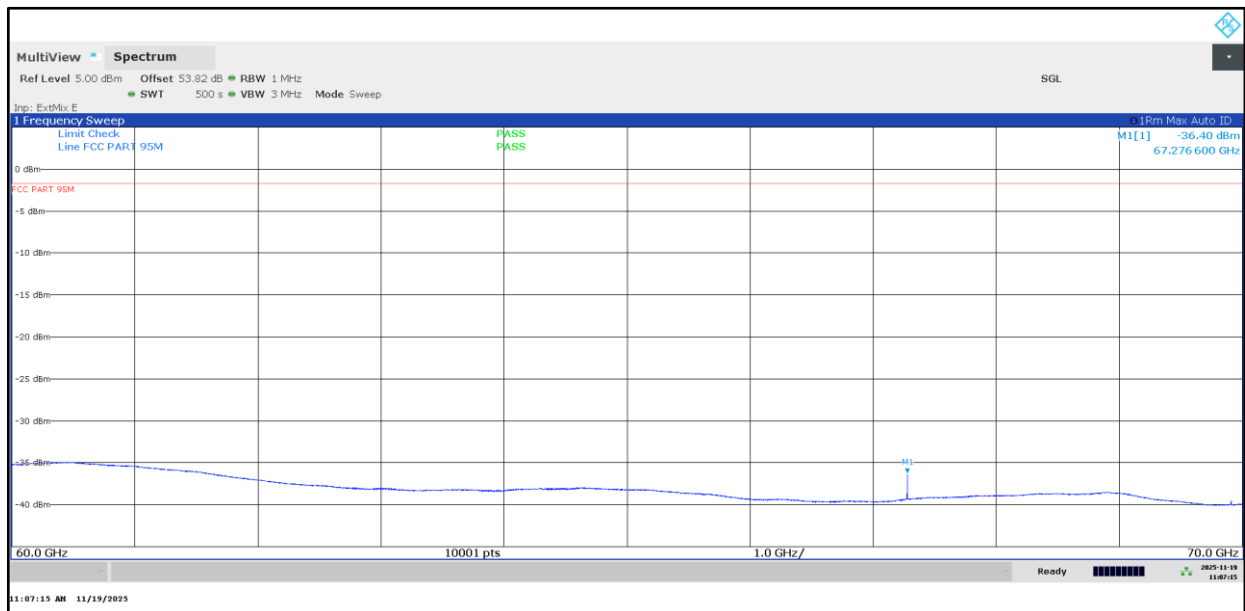
Plot 8: 50 GHz – 60 GHz, EUT 1, Mode 1



Note:

- Measured in Period 1

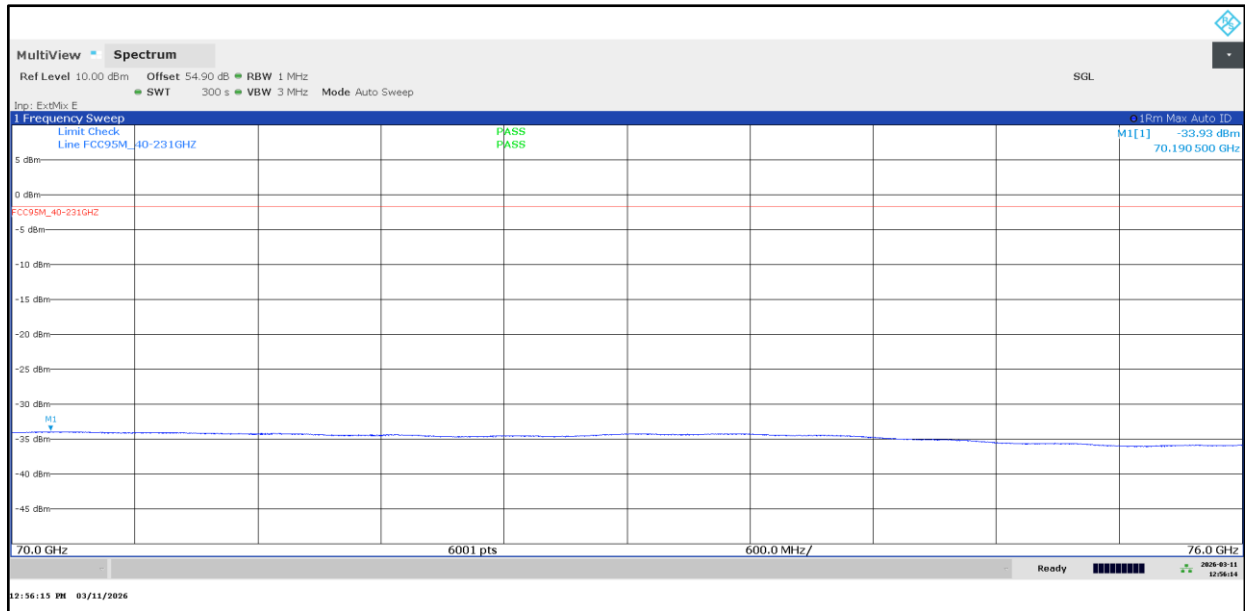
Plot 9: 60 GHz – 70 GHz, EUT 1, Mode 1



Note:

- Measured in Period 1

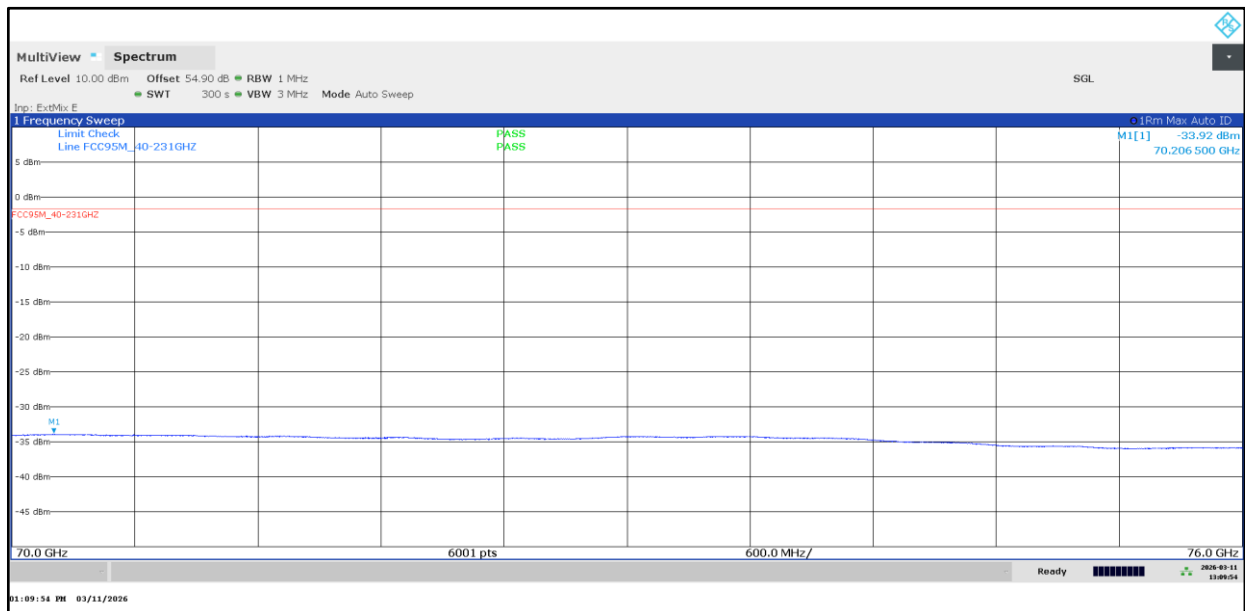
Plot 10: 70 GHz – 76 GHz, EUT 1, OOB emission Mode 1



Note:

- Measured in Period 1

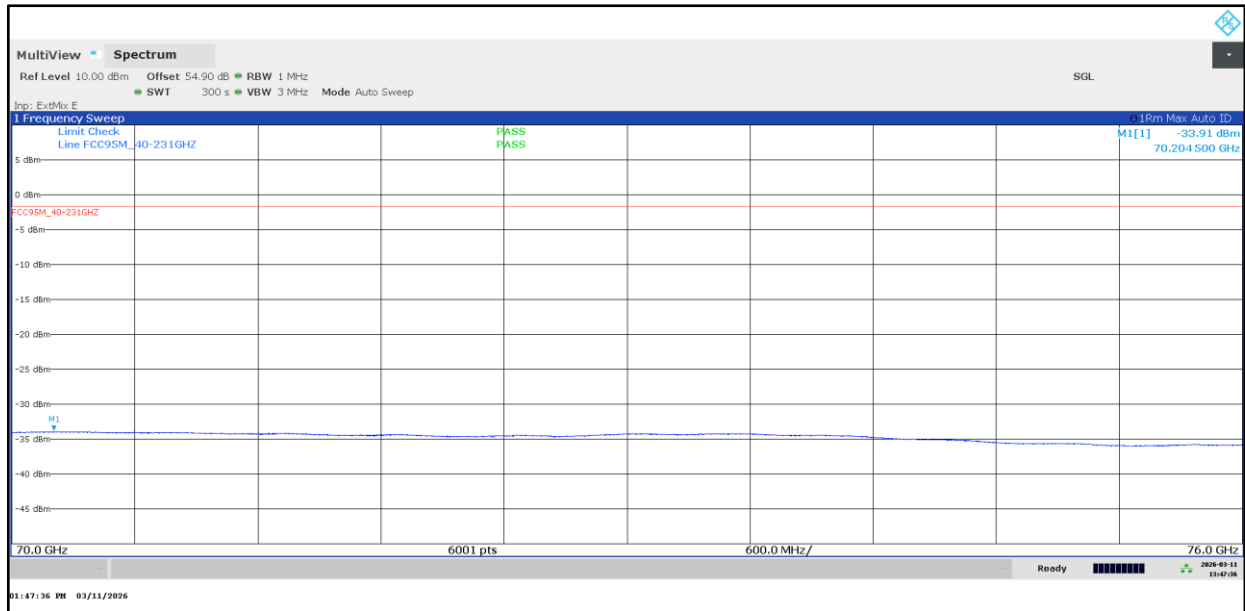
Plot 11: 70 GHz – 76 GHz, EUT 1, OOB emission Mode 2



Note:

- Measured in Period 1

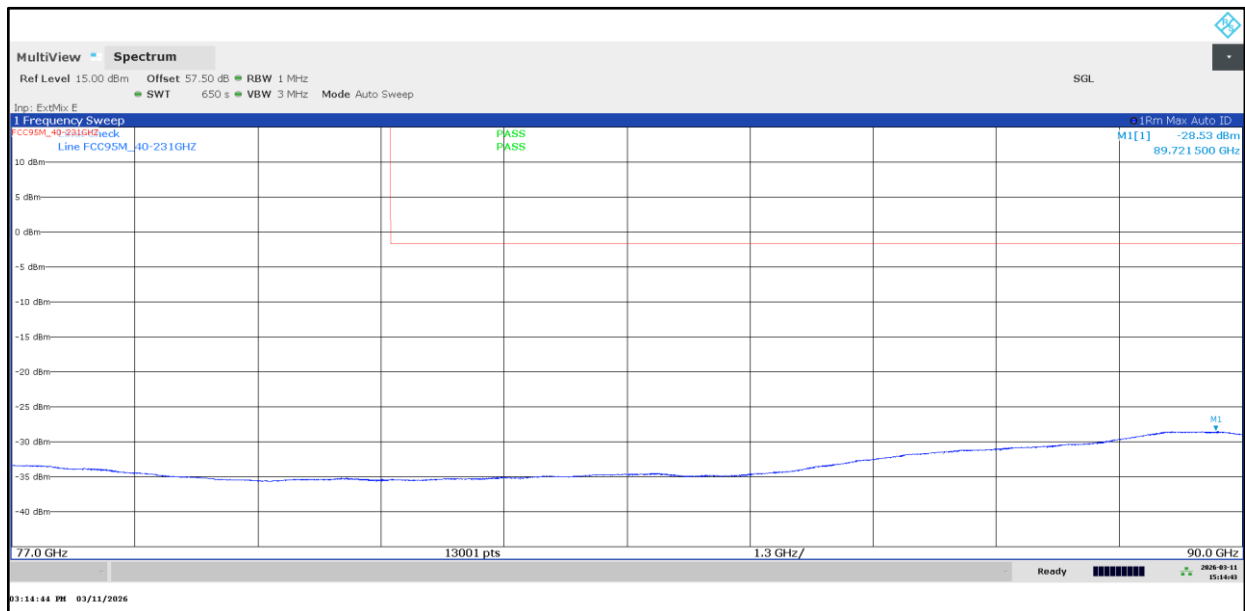
Plot 12: 70 GHz – 76 GHz, EUT 1, OOB emission Mode 3



Note:

- Measured in Period 1

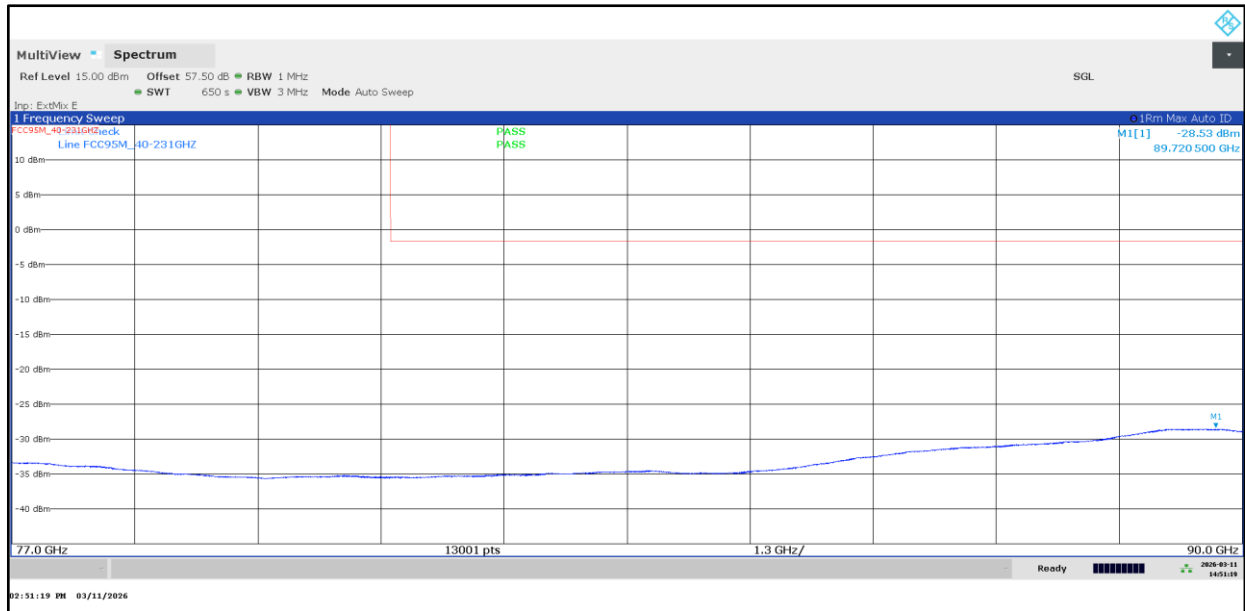
Plot 13: 77 GHz – 90 GHz, EUT 1, OOB emission Mode 1



Note:

- Measured in Period 1

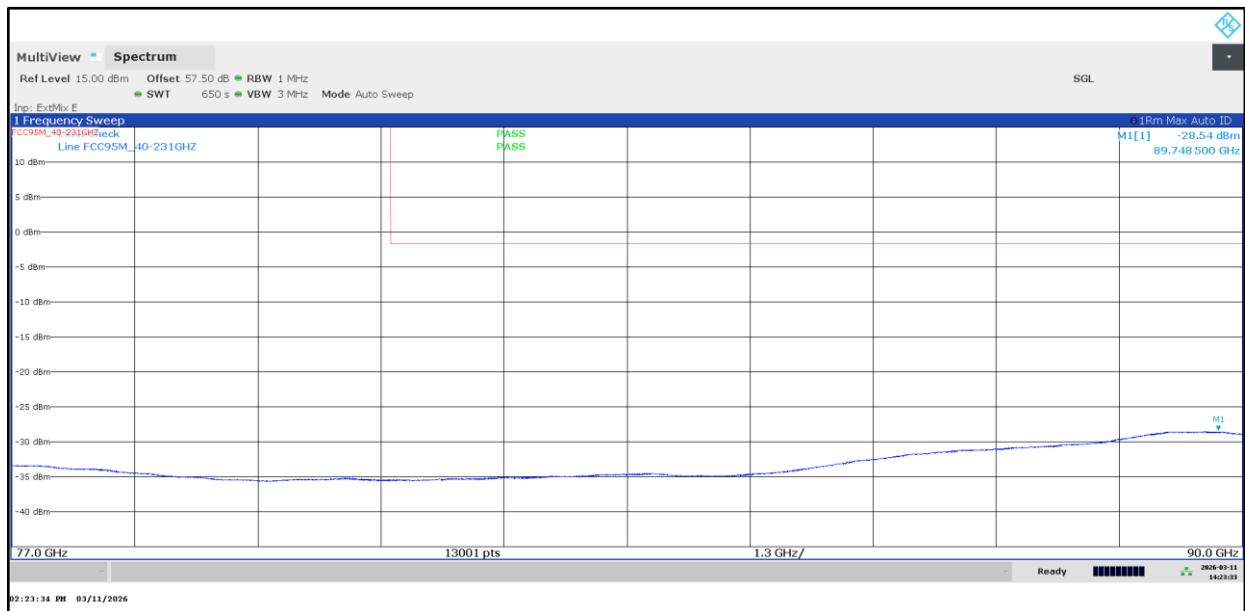
Plot 14: 77 GHz – 90 GHz, EUT 1, OOB emission Mode 2



Note:

- Measured in Period 1

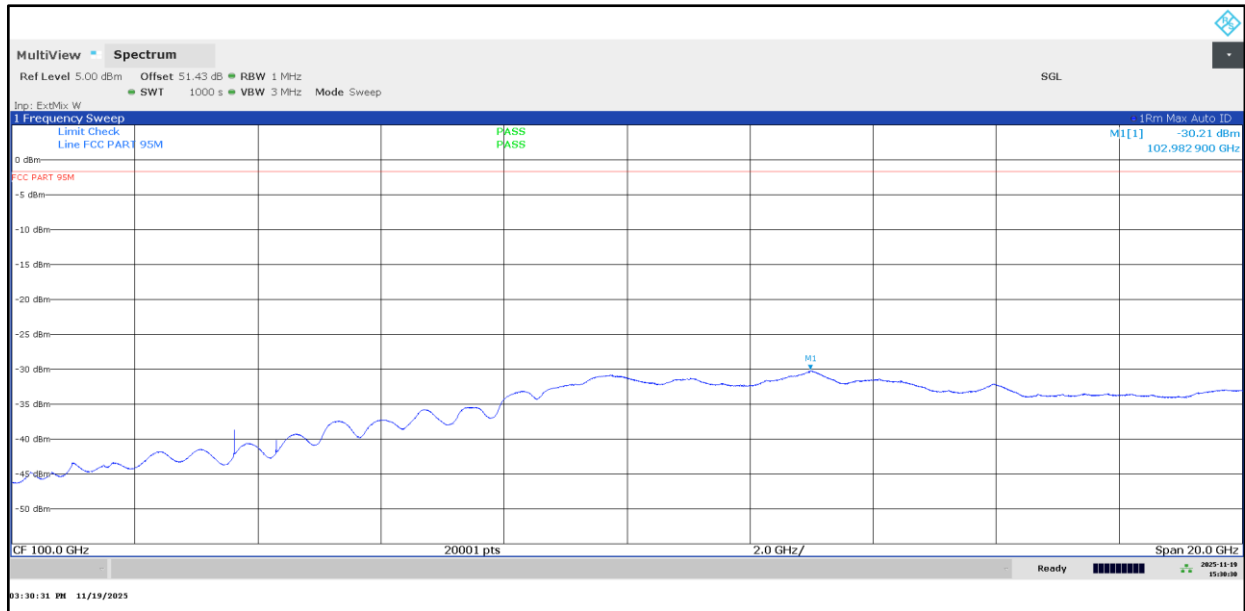
Plot 15: 77 GHz – 90 GHz, EUT 1, OOB emission Mode 3



Note:

- Measured in Period 1

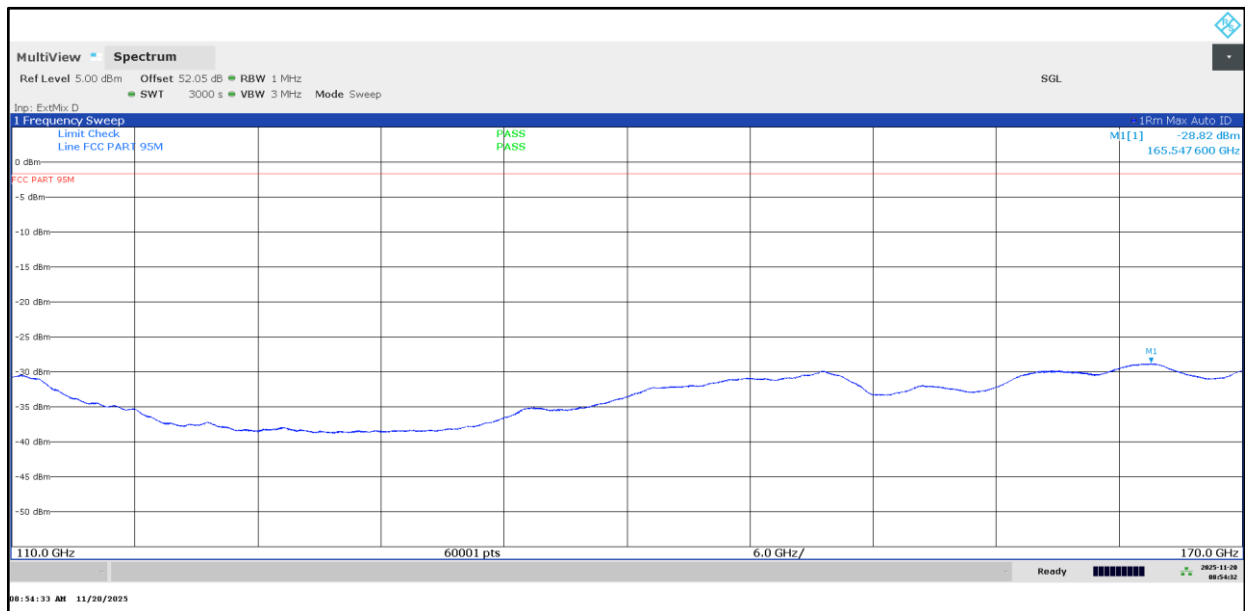
Plot 16: 90 GHz – 110 GHz, EUT 1, Mode 1



Note:

- Measured in Period 1

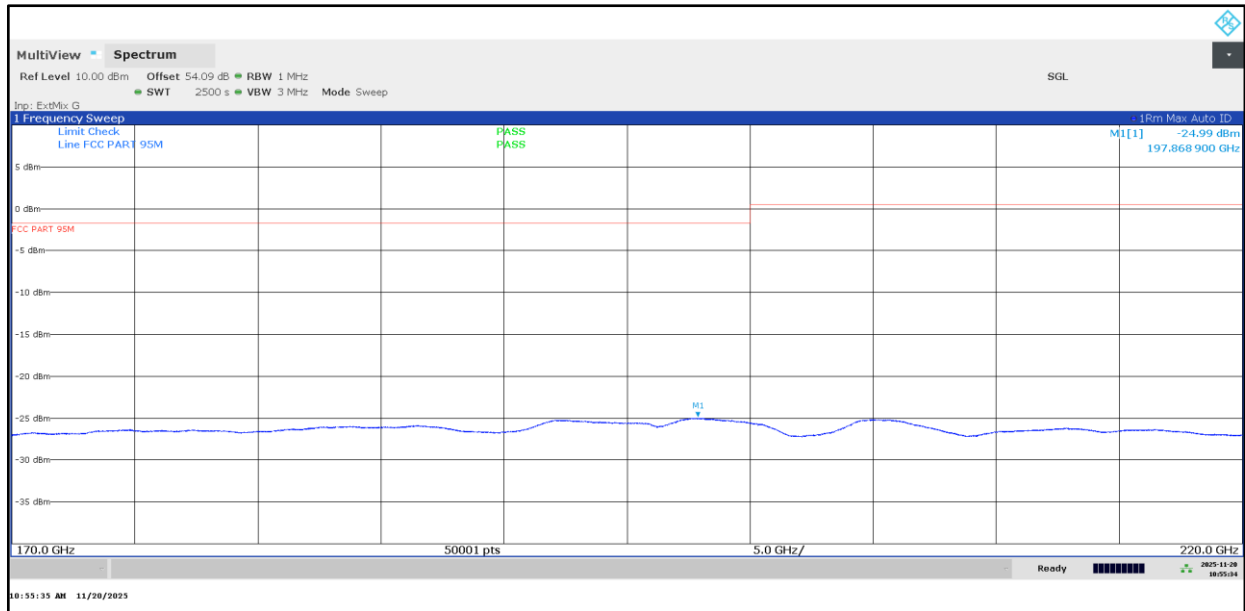
Plot 17: 110 GHz – 170 GHz, EUT 1, Mode 1



Note:

- Measured in Period 1

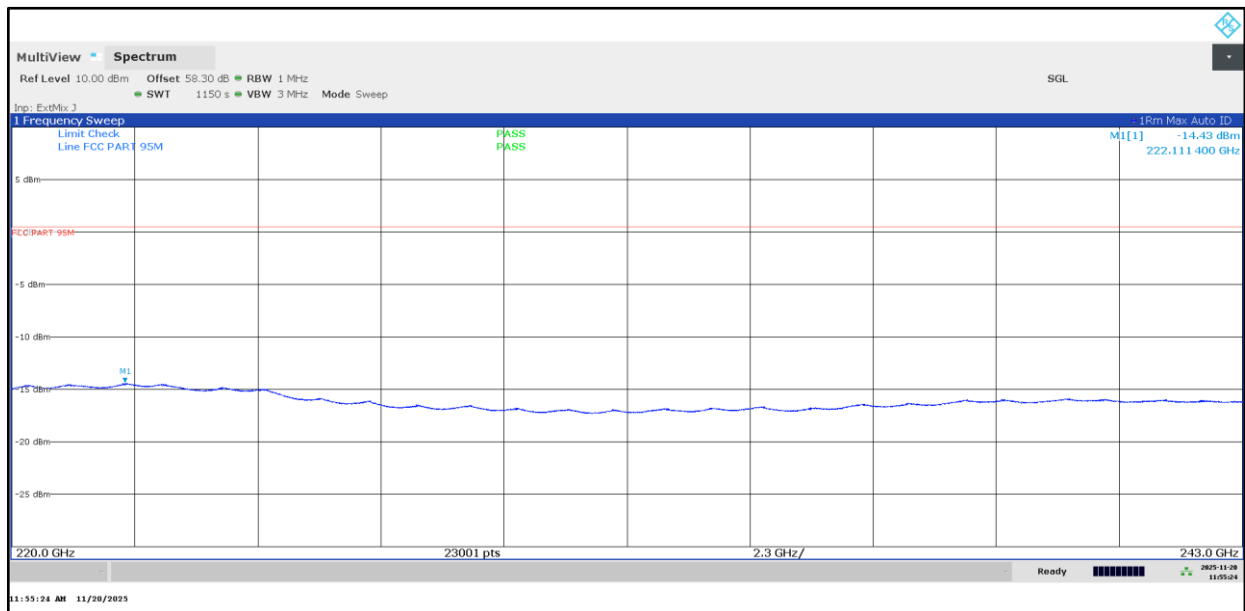
Plot 18: 170 GHz – 220 GHz, EUT 1, Mode 1



Note:

- Measured in Period 1

Plot 19: 220 GHz – 243GHz, EUT 1, Mode 1



Note:

- Measured in Period 1

12.5 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.

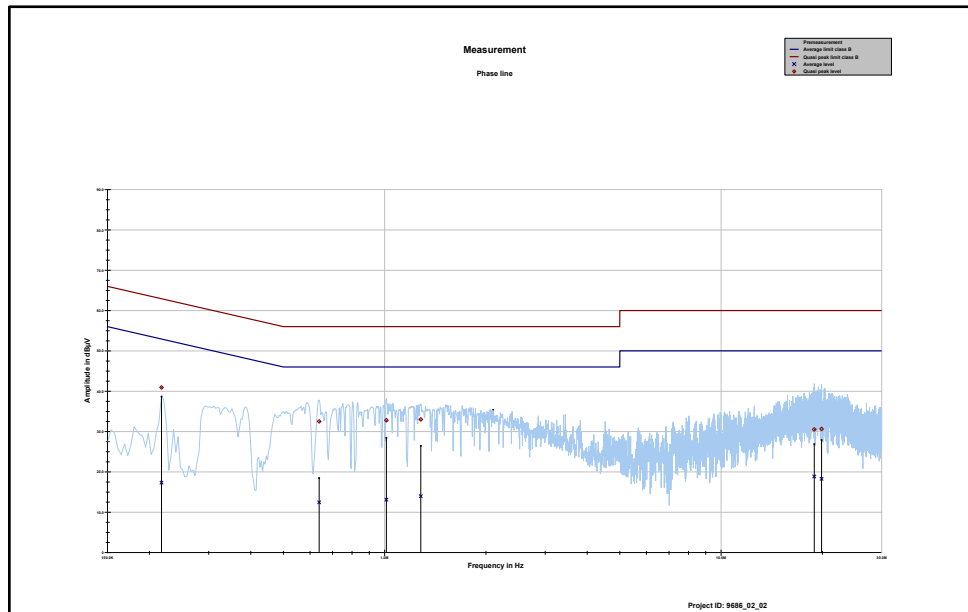
Limits and provisions:

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:

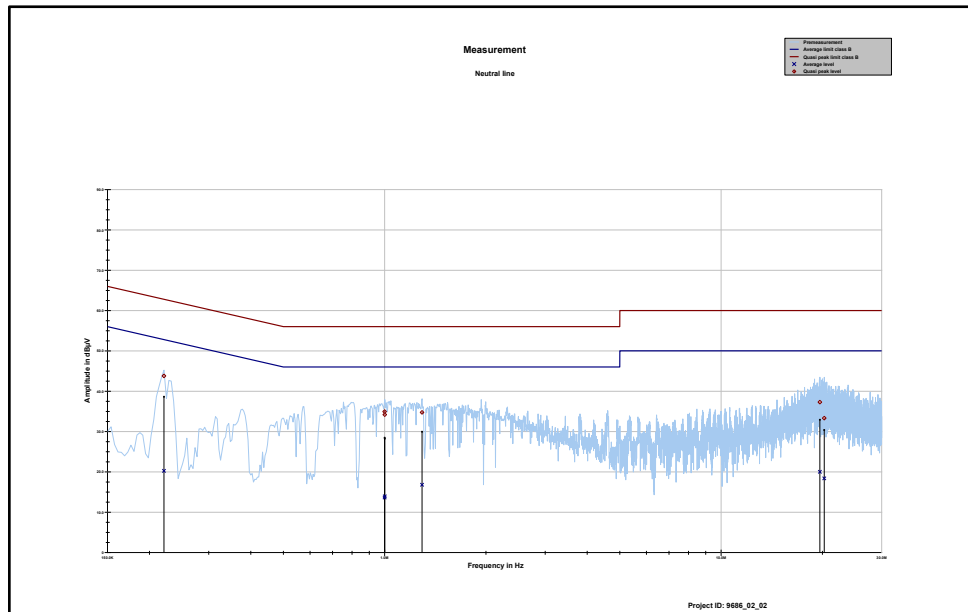
Parameter	
Detector:	Peak - Quasi Peak / Average
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold

Measurement results:**Plot 20:** Phase line: AC 120V / 60Hz

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBμV	dB	dBμV	dBμV	dB	dBμV
0.217163	40.91	22.02	62.927	17.32	36.76	54.081
0.638794	32.51	23.49	56.000	12.44	33.56	46.000
1.011919	32.78	23.22	56.000	13.07	32.93	46.000
1.280569	33.00	23.00	56.000	13.94	32.06	46.000
18.921919	30.51	29.49	60.000	18.85	31.15	50.000
19.892044	30.62	29.38	60.000	18.27	31.73	50.000

Note:

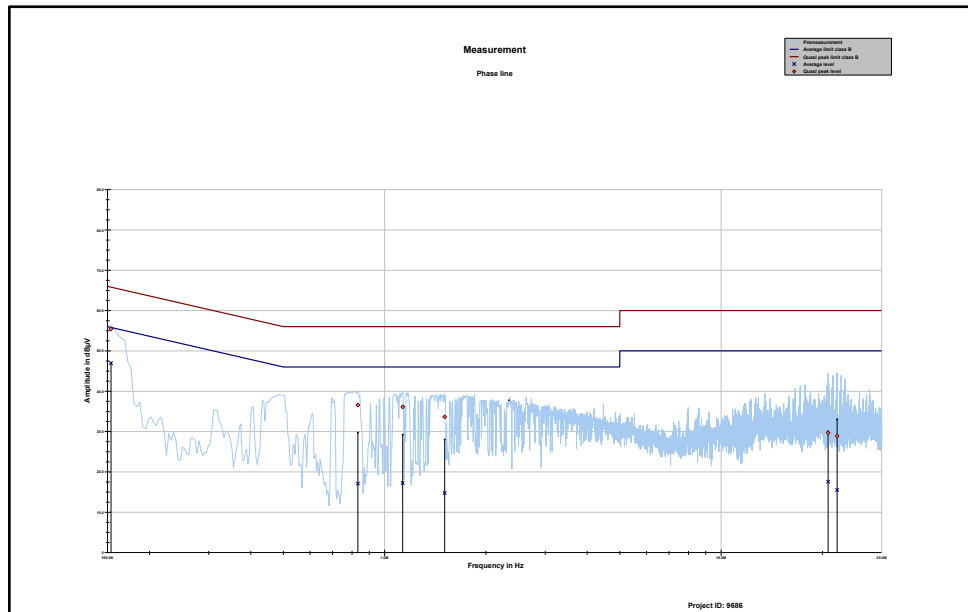
- Measured in Period 1

Plot 21: Neutral line: AC 120V / 60Hz

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBμV	dB	dBμV	dBμV	dB	dBμV
0.220894	43.78	19.00	62.785	20.24	33.73	53.974
1.000000	34.95	21.05	56.000	13.62	32.38	46.000
1.000725	34.18	21.82	56.000	13.92	32.08	46.000
1.291762	34.74	21.26	56.000	16.80	29.20	46.000
19.660706	37.27	22.73	60.000	20.01	29.99	50.000
20.257706	33.32	26.68	60.000	18.37	31.63	50.000

Note:

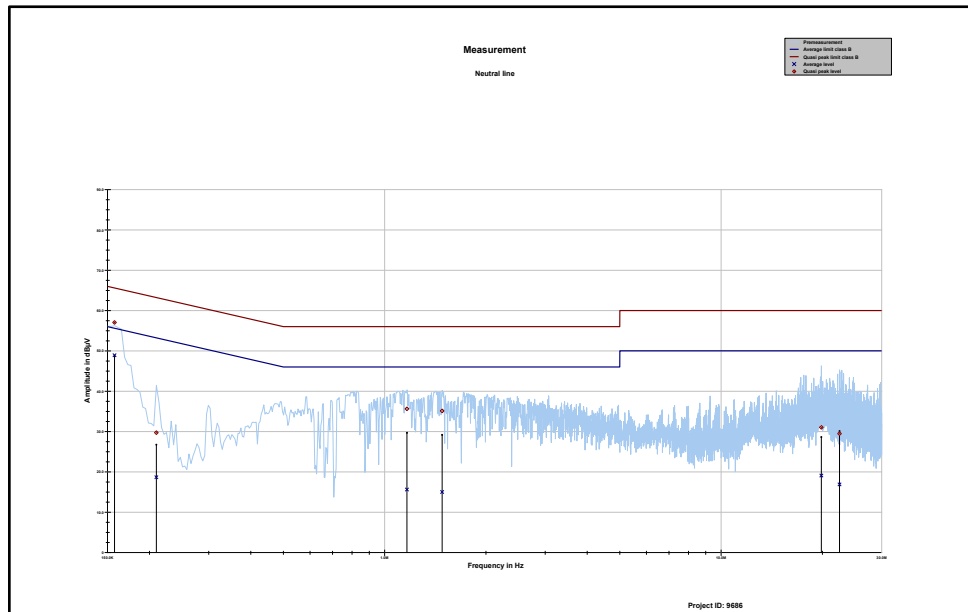
- Measured in Period 1

Plot 22: Phase line: AC 240V / 50Hz

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBμV	dB	dBμV	dBμV	dB	dBμV
0.153731	55.43	10.36	65.796	46.95	8.94	55.893
0.832819	36.56	19.44	56.000	17.08	28.92	46.000
1.131319	36.13	19.87	56.000	17.22	28.78	46.000
1.508175	33.63	22.37	56.000	14.74	31.26	46.000
20.802469	29.72	30.28	60.000	17.54	32.46	50.000
22.123331	28.89	31.11	60.000	15.48	34.52	50.000

Note:

- Measured in Period 1

Plot 23: Neutral line: AC 240V / 50Hz

Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBμV	dB	dBμV	dBμV	dB	dBμV
0.157463	57.04	8.56	65.597	48.91	6.88	55.787
0.209700	29.71	33.51	63.217	18.65	35.65	54.294
1.164900	35.63	20.37	56.000	15.61	30.39	46.000
1.482056	35.11	20.89	56.000	15.00	31.00	46.000
19.858463	31.02	28.98	60.000	19.07	30.93	50.000
22.492725	29.47	30.53	60.000	16.88	33.12	50.000

Note:

- Measured in Period 1

Verdict: Compliant

13 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	Combination of Grantee Code and Equipment Product Code
ISED	Innovation, Science and Economic Development 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	Continuous 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/N₀	Carrier to noise-density ratio, expressed in dB-Hz

14 Document history

Version	Applied changes	Date of release
TR3-R01	Initial release	2026-06-19

END OF TEST REPORT