
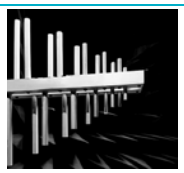
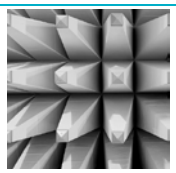

TEST REPORT

Test report no.: 1-4939_22-01-02

Testing laboratory

CTC advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.ctcadvanced.com
e-mail: mail@ctcadvanced.com

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-12076-01-03

Applicant

Brose Fahrzeugteile SE & Co. KG, Bamberg
Berliner Ring 1
96052 Bamberg / GERMANY
Phone: +49 9517474-0
Contact: Bertram Bopp
e-mail: Bertram.Bopp@brose.com
Phone: +49 951 7474 2375

Manufacturer

Brose Fahrzeugteile SE & Co. KG, Bamberg
Berliner Ring 1
96052 Bamberg / GERMANY

Test standard/s

ETSI EN 302 264 V2.1.1	Short Range Devices; Transport and Traffic Telematics (TTT); Short Range Radar equipment operating in the 77 GHz to 81 GHz band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

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

Test Item

Kind of test item:	Automotive FMCW Radarsensor 77-81GHz
Model name:	PMRGEN1
Frequency:	77GHz – 81GHz
Antenna:	Integrated antenna
Power supply:	9.0 – 16.0 V DC by Battery
Temperature range:	-40°C to +70°C

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

Test report authorized:

Thomas Vogler
cn=Thomas Vogler, o=CTC advanced GmbH, ou=VOG-211118, email=thomas.vogler@ctcadvanced.com, c=DE
2023.03.27 15:07:50 +02'00'

Thomas Vogler
Lab Manager
Radio Labs

Test performed:

cn=Stephan Thiel, o=CTC advanced GmbH, ou=THL-220401, email=Stephan.Thiel@ctcadvanced.com, c=DE
2023.03.27 14:45:09 +02'00'

Stephan Thiel
Testing Manager
Radio Labs

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. CTC advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

2.2 Application details

Date of receipt of order:	2022-10-26
Date of receipt of test item:	2022-12-07
Start of test:*	2023-01-24
End of test:*	2020-02-23
Person(s) present during the test:	-/-

*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.

2.3 Test laboratories sub-contracted

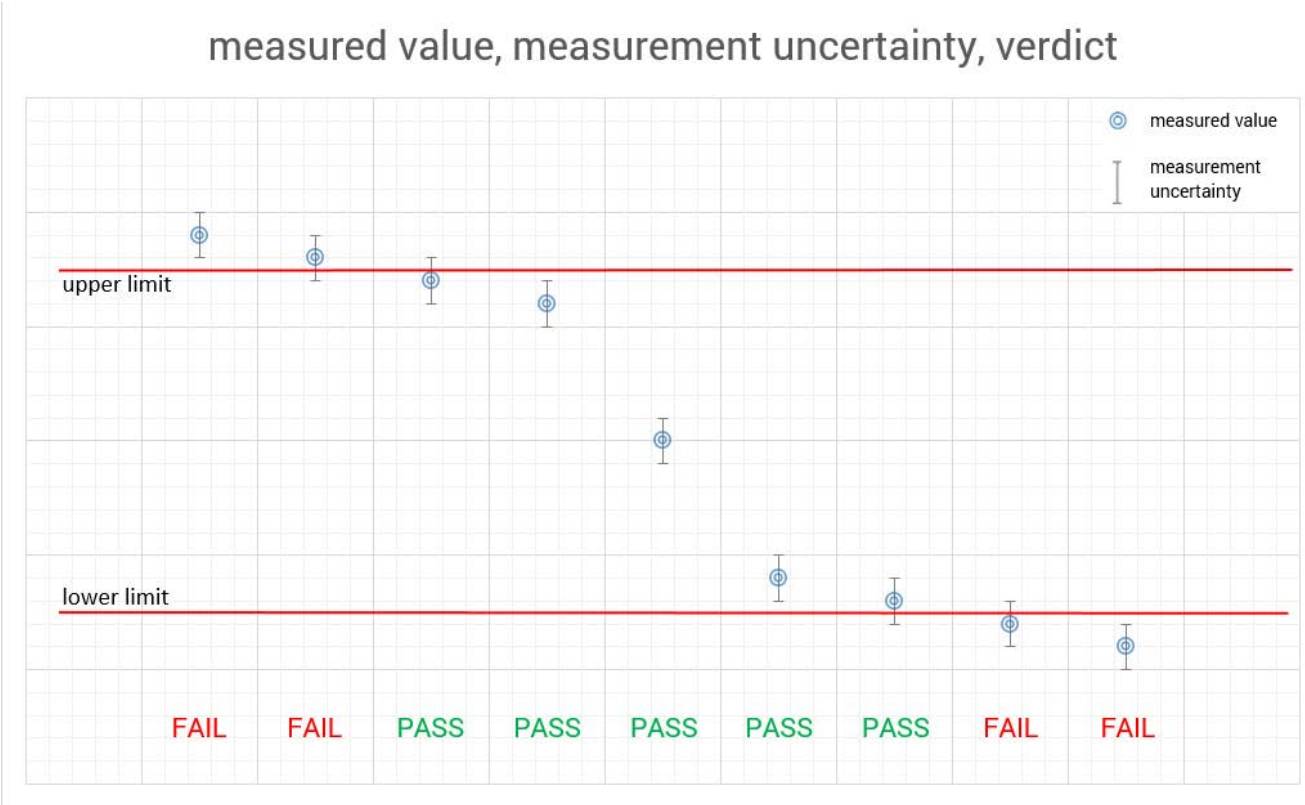
None

3 Test standard/s

Test standard	Date	Description
ETSI EN 302 264 V2.1.1	01.05.2017	Short Range Devices; Transport and Traffic Telematics (TTT); Short Range Radar equipment operating in the 77 GHz to 81 GHz band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
ETSI EN 303 396 V1.1.1	2016-12	Short Range Devices; Measurement Techniques for Automotive and Surveillance Radar Equipment

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 8, 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}	+20 °C during room temperature tests +70 °C during high temperature tests -40 °C during low temperature tests
Relative humidity content	:		40-60 %
Barometric pressure	:		not relevant for this kind of testing
Power supply	:	V_{nom} V_{max} V_{min}	13.5 V DC by Battery 16.0 V 9.0 V

6 Test item

6.1 General description

Kind of test item	:	Automotive FMCW Radarsensor 77-81GHz
Model name:	:	PMRGEN1
S/N serial number	:	EUT1: G28900-100
Hardware status	:	G33375-100
Software status	:	G47455-100
Firmware status	:	B320
Frequency band	:	77GHz – 81GHz
Type of modulation	:	FMCW
Number of modes	:	1
Antenna	:	Integrated antenna
Power supply	:	9.0 – 16.0 V DC by Battery
Temperature range	:	-40°C to +70°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report: 1-4939/22-01-01_AnnexA
1-4939/22-01-01_AnnexB
1-4939/22-01-01_AnnexC

7 Description of the test setup

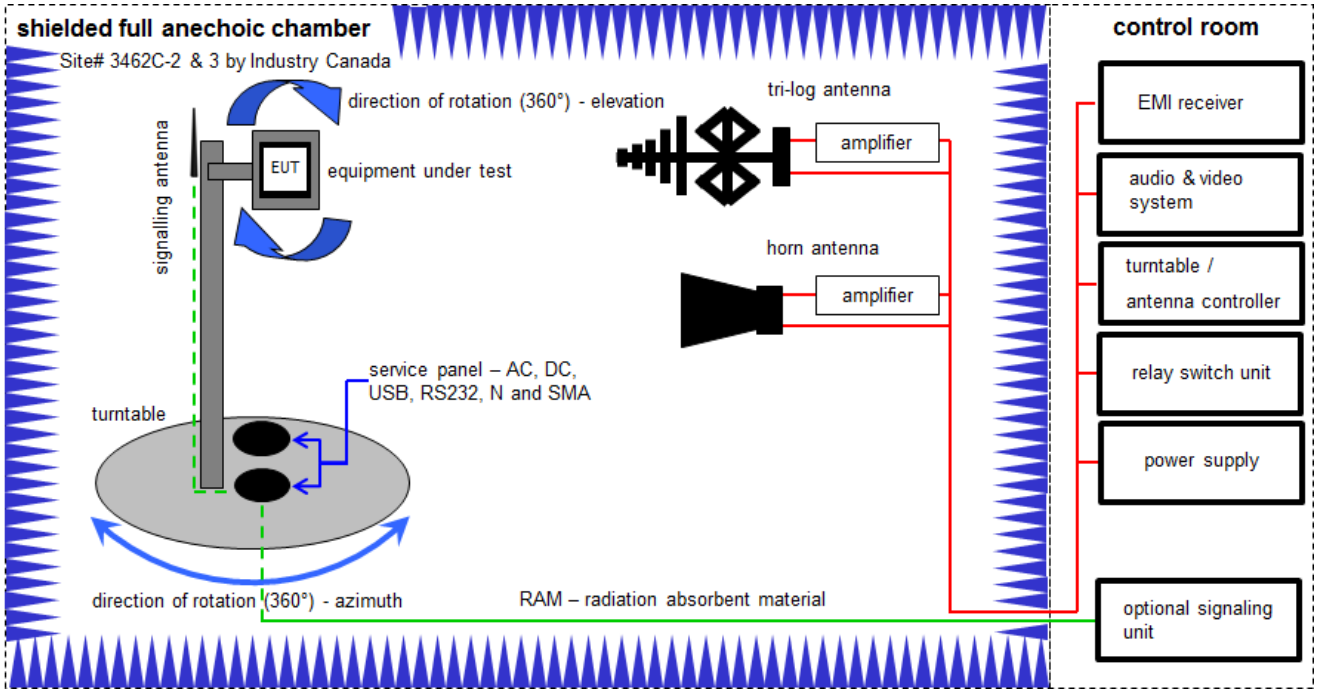
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements 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	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

7.1 Shielded fully anechoic chamber



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

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

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

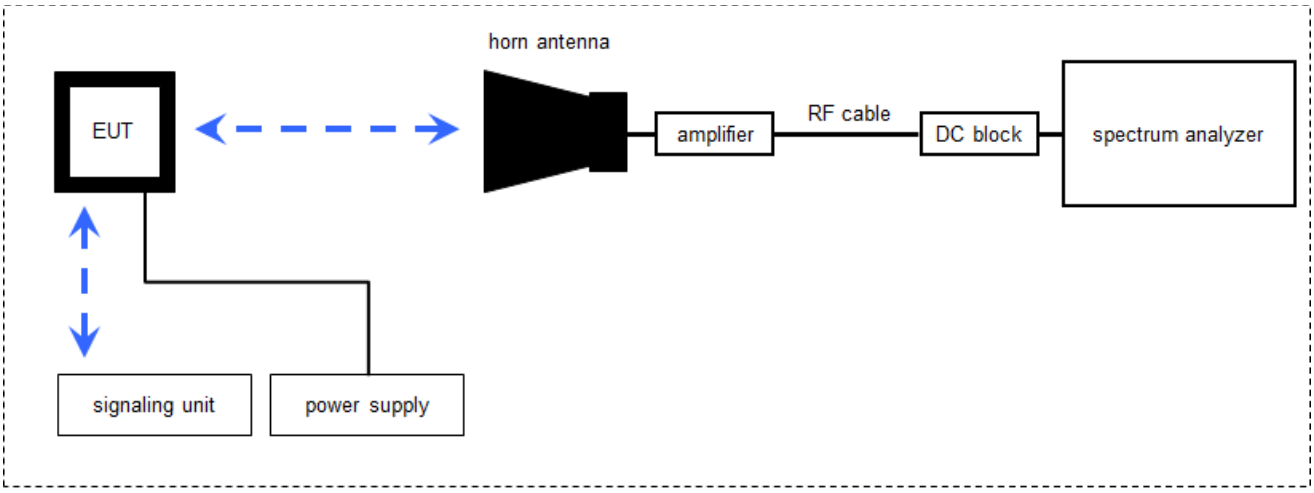
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

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

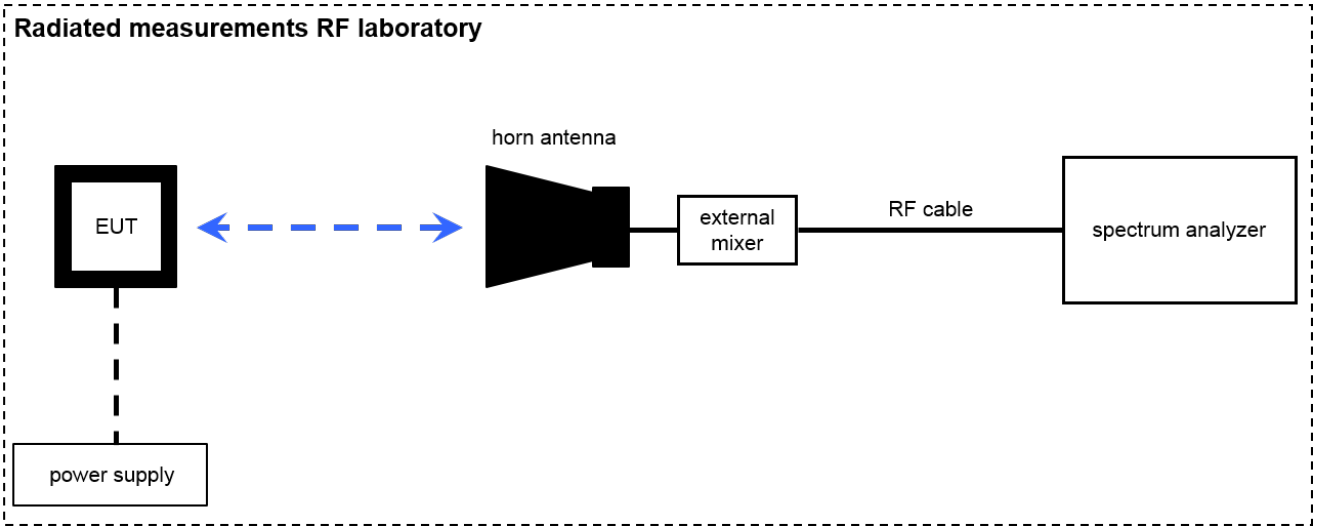
Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vIKI!	09.12.2020	08.12.2023
2	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
4	A037	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vIKI!	11.02.2022	29.02.2024
5	9	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-
6	90	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO/2	8905-2342	300000256	vIKI!	17.06.2021	30.06.2023
7	n. a.	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	07.12.2022	31.12.2023
8	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
9	n. a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
10	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
11	n. a.	NEXIO EMV-Software	BAT EMC V2022.0.22.0	Nexio		300004682	ne	-/-	-/-
12	n. a.	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-
13	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	01029	300005379	vIKI!	18.08.2021	30.08.2023

7.2 Radiated measurements > 18 GHz



7.3 Radiated measurements > 50/85 GHz



Measurement distance: horn antenna e.g. 75 cm

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

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

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

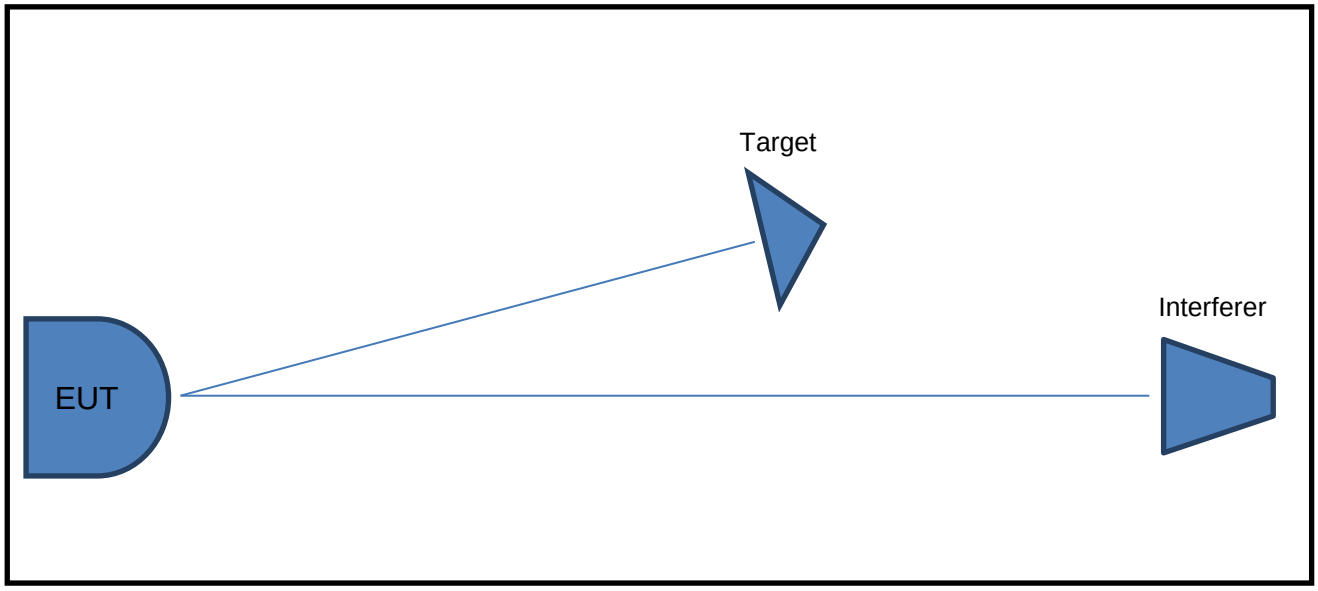
Example calculation:
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

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

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	CR 79	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	7911	300001751	ne	-/-	-/-
2	A029	Std. Gain Horn Antenna 92.3-140 GHz	2824-20	Flann	*	300001993	ne	-/-	-/-
3	A027	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda	01096	300000486	vlKl!	17.01.2022	31.01.2024
4	A036	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814	ev	-/-	-/-
5	n. a.	Harmonic Mixer 3-Port, 110-170 GHz	FS-Z170	Radiometer Physics GmbH	100014	300004156	k	01.07.2022	31.07.2023
6	n. a.	Harmonic Mixer 3-Port, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157	k	21.07.2022	31.07.2023
7	n. a.	Harmonic Mixer 3-Port, 220-325 GHz	SAM-325	Radiometer Physics GmbH	100002	300004158	k	25.07.2022	31.07.2023
8	n. a.	Std. Gain Horn Antenna 33.0-50.1 GHz	2324-20	Flann	57	400000683	ne	-/-	-/-
9	n. a.	Harmonic Mixer 3-Port, 60-90 GHz	FS-Z90	R&S	101555	300004691	k	21.07.2022	31.07.2023
10	n. a.	Broadband LNA 18-50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	09.03.2022	08.03.2024
11	n. a.	Std. Gain Horn Antenna 217-330 GHz	32240-20	Flann	233278	300004960	ne	-/-	-/-
12	n. a.	Signal- and Spectrum Analyzer 2 Hz - 85 GHz	FSW85	Rohde&Schwarz	101333	300005568	k	11.07.2022	31.07.2023
13	n. a.	Harmonic Mixer 3-port, 90-140 GHz	FS-Z140	Rohde & Schwarz	101119	300005581	k	20.07.2022	31.07.2023
14	n. a.	Signal- and Spectrum Analyzer 2 Hz - 50 GHz	FSW50	Rohde&Schwarz	101332	300005935	k	03.01.2023	31.01.2024
15	n. a.	Power Supply	E3632A	Agilent Technologies	MY40001320	400000396	vlKl!	14.12.2021	31.12.2024
16	n. a.	Temperature Test Chamber	T-40/50	CTS GmbH	064023	300003540	ev	09.05.2022	31.05.2024
17	A034	Std. Gain Horn Antenna 145-220 GHz	3024-20	Flann	*	300002001	ne	-/-	-/-

7.4 Receiver in-band, out-of-band and remote-band signals handling



Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Corner Reflector 4.3'	SAJ-043-S1	Sage Millimeter Inc.		300005619	ne	-/-	-/-
2	n. a.	Corner Reflector 2.4'	SAJ-024-S1	Sage Millimeter Inc.		300005619	ne	-/-	-/-
3	3	Synthesized Sweeper 10 MHz - 40 GHz	83640A	HP	3119A00458	300002266	vIKI!	10.12.2021	31.12.2023
4	A025	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne	-/-	-/-
5	A027	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001988	ne	-/-	-/-
6	n. a.	SG Extension Module 75 - 110 GHz	E8257DV10	VDI	US53250033	300005539	ev	-/-	-/-
7	n. a.	SG Extension Module 50 - 75 GHz	E8257DV15	VDI	US54250124	300005541	ev	-/-	-/-

8 Measurement uncertainty

Test case	Uncertainty
Equivalent isotropically radiated power (e.i.r.p.)	Conducted value ± 1 dB Radiated value ± 3 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 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 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	ETSI EN 302 264 V2.1.1	see below	2023-03-27	-/-

Test Specification clause	Test Case	Test conditions	Mode	Pass	Fail	NA	NP	Remark
4.3.1	Operating Frequency Range	Nominal Extreme	NM	☒	☐	☐	☐	
4.3.2	Mean Power spectral density	Nominal Extreme	NM	☒	☐	☐	☐	
4.3.3	Peak Power	Nominal Extreme	NM	☒	☐	☐	☐	
4.3.4 / 4.3.5	Unwanted emissions in the out-of-band domain / spurious domain	Nominal	NM	☒	☐	☐	☐	
4.4.2	Receiver spurious emissions	Nominal	RM	☐	☐	☒	☐	see note
4.4.3	Receiver in-band, out-of-band and remote-band signals handling	Nominal	RM	☒	☐	☐	☐	
4.4.4	Receiver sensitivity	Nominal	RM	☐	☐	☒	☐	see note
4.5.1	Installation requirements	Nominal	NM	☐	☐	☐	☒	see note

Note: NA = Not applicable; NP = Not performed, NM = Normal operation mode, RM = Receive-only mode

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode. Consequently, receiver spurious emission testing applies only when the equipment can work in a receive-only mode or is a receive only device (ETSI EN 303 396 V1.1.1, 6.2.12).
In cases where receivers are used in combination with permanently co-located transmitters the receivers will be tested together with the transmitter in operating mode as part of the transmitter spurious.

Receiver sensitivity is not specified in the present document in order to allow manufacturers the freedom to tailor equipment to specific circumstances.
For instance, equipment covered by the present document may be intended to detect a target at maximum range or may be intended to discriminate features such as size, shape or velocity at shorter range. The level of minimum usable signal would be different in each case (ETSI EN 302 264 V2.1.1, 4.4.4).

Test case 'Installation requirements' need the installation of EUT in a vehicle. This requirement cannot be tested.

10 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

10.1 Operation mode for testing

Test mode: ☒ No test mode available.

☒ Special test software is used.

Description of test modes as declared by customer:

- The operation of the radar sensor can be start and stop by a special software.
- In the operation mode, the radar sensor works in normal mode

10.2 Temperature range for radar operation

The customer declare the following temperature range:

- -40°C to +70°C

11 Measurement results

11.1 Operating Frequency Range

Description: **ETSI EN 303 396 V1.1.1 – clause 6.2.2**

The operating frequency range is the frequency range over which the equipment is transmitting. The occupied frequency range of the equipment is determined by the lowest (f_L) and the highest frequency (f_H) as occupied by the power envelope.

Measurement:

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

Limits: **EN 302 264 - Clause 4.3.1.3**

The upper and lower limits of the operating frequency range shall meet the following conditions:

- $f_H \leq 81$ GHz.
- $f_L \geq 77$ GHz.

Environmental conditions: **EN 302 264 - Clause 4.3.1.4**

Conformance shall be established under normal and extreme test conditions.

Measurement results:

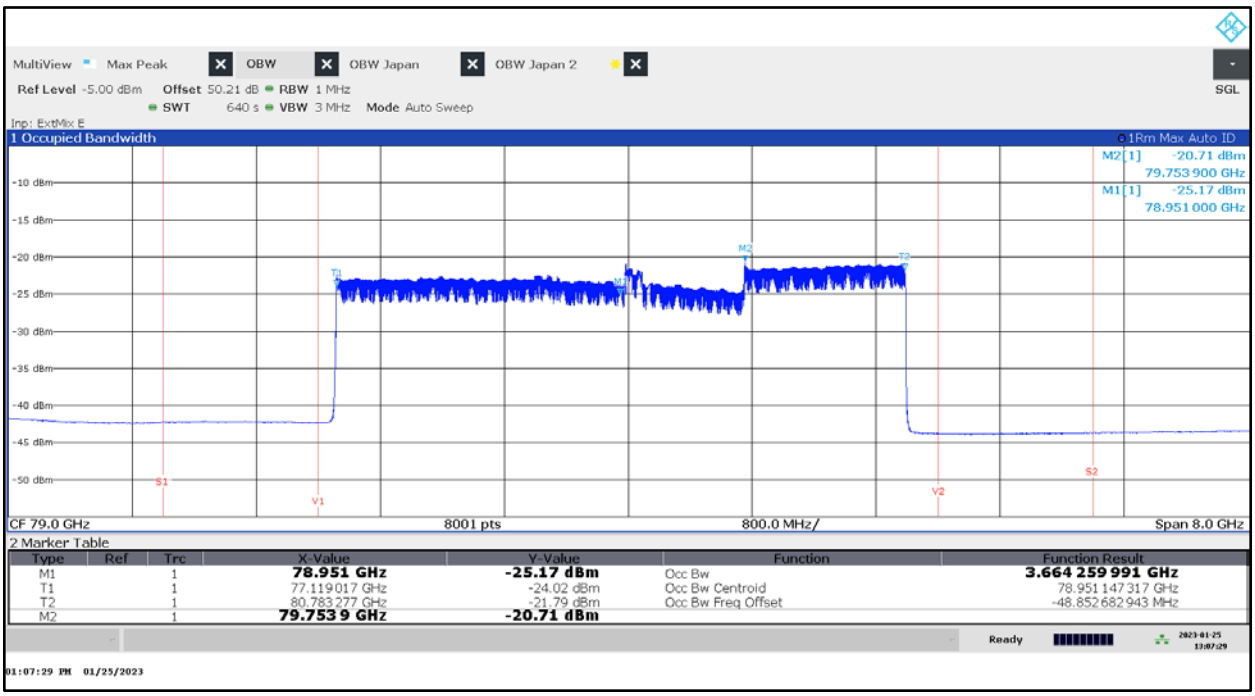
EUT	Mode	Test condition	Operating Frequency Range		
			f_L [GHz]	f_H [GHz]	OBW [GHz]
EUT1	Normal	T_{nom} / $V_{min-max}$	77.119	80.783	3.664
		T_{min} / V_{nom}	77.123	80.785	3.662
		T_{max} / V_{nom}	77.119	80.785	3.666

Note:

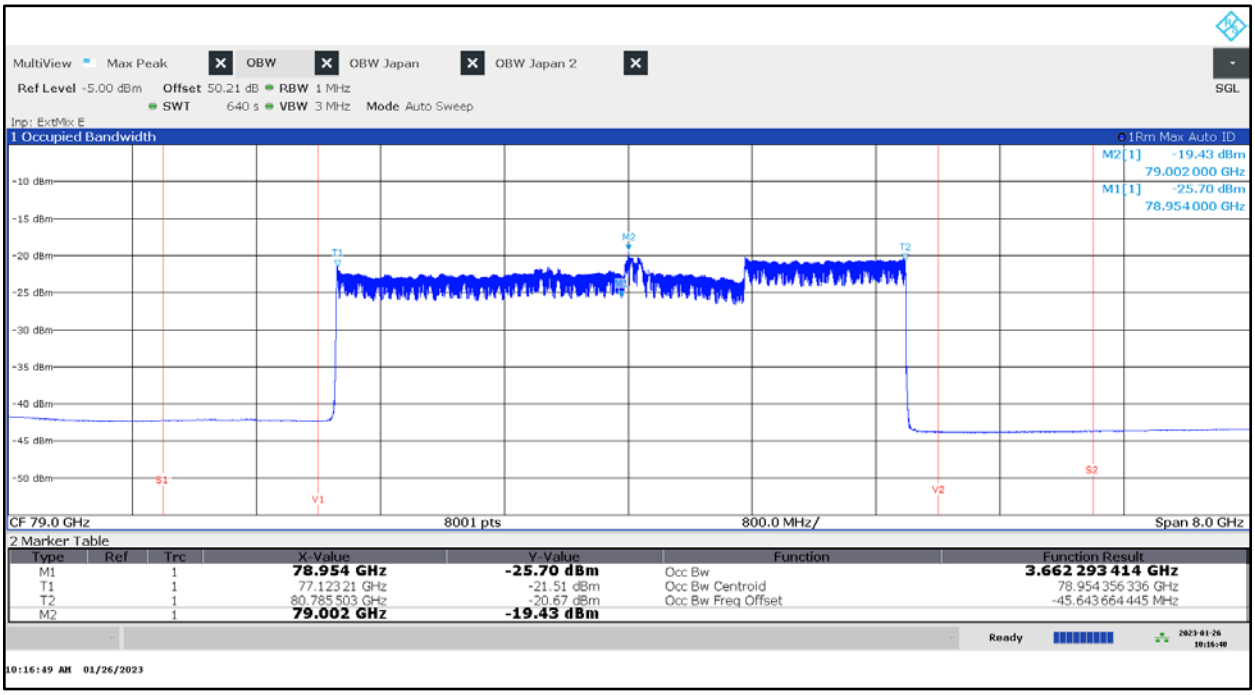
- Voltage variation has no impact
- Vertical Line V1 = 77GHz
- Vertical Line V2 = 81GHz
- Vertical Line S1 & S2 are limits for OBW calculation

Verdict: compliant

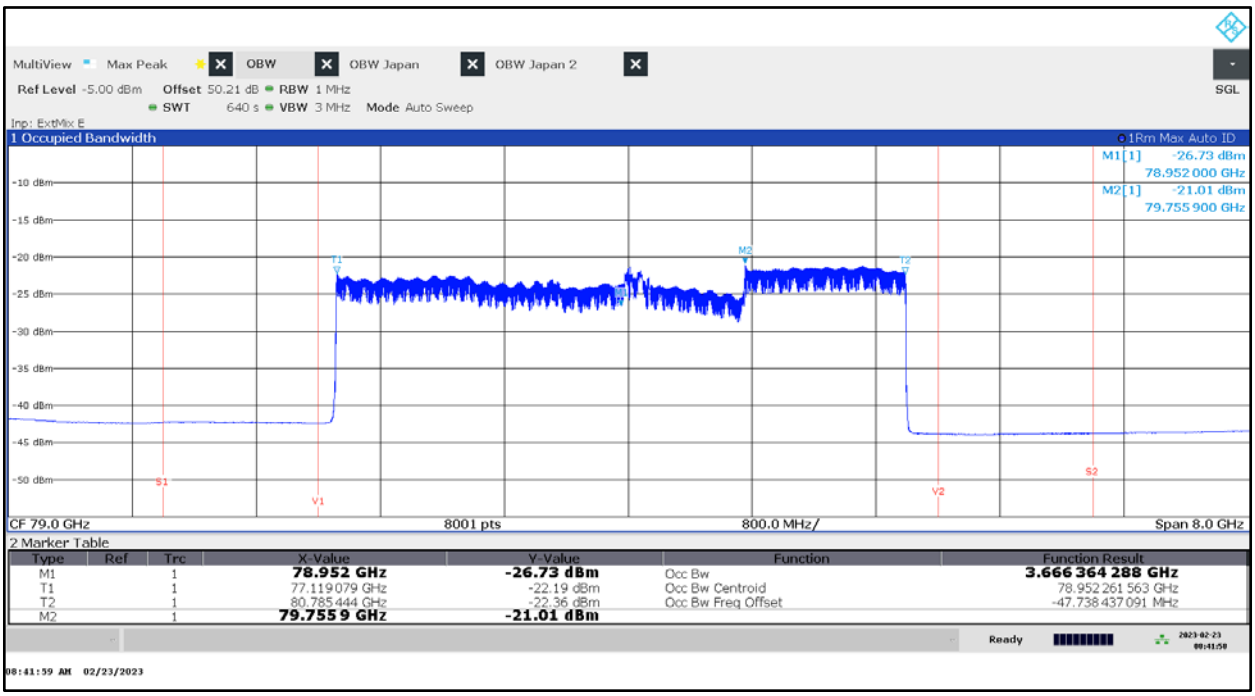
Plot 1: OBW, EUT1, T_{norm} / $V_{min-max}$



Plot 2: OBW, EUT1, T_{min} / V_{norm}



Plot 3: OBW, EUT1, T_{max} / V_{norm}



11.2 Mean Power spectral density

Description: **ETSI EN 303 396 V1.1.1 (2016-12) – clause 6.2.6**

The mean power spectral density (e.i.r.p.) is defined as the emitted power spectral density over a defined bandwidth of the transmitter including antenna gain radiated in the direction of the maximum level under the specified conditions of measurement.

Measurement:

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

Limits mean power spectral density: **EN 302 264 - clause 4.3.2.3**

The mean power shall not be greater than the limits in the table below.

Frequency in GHz	77 GHz to 81 GHz
Maximum radiated average power spectral density (e.i.r.p.) [dBm/MHz] of the EUT	-3 dBm/MHz

Environmental conditions: **EN 302 264 - Clause 4.3.2.4**

Conformance shall be established under normal and extreme test conditions.

Measurement results:

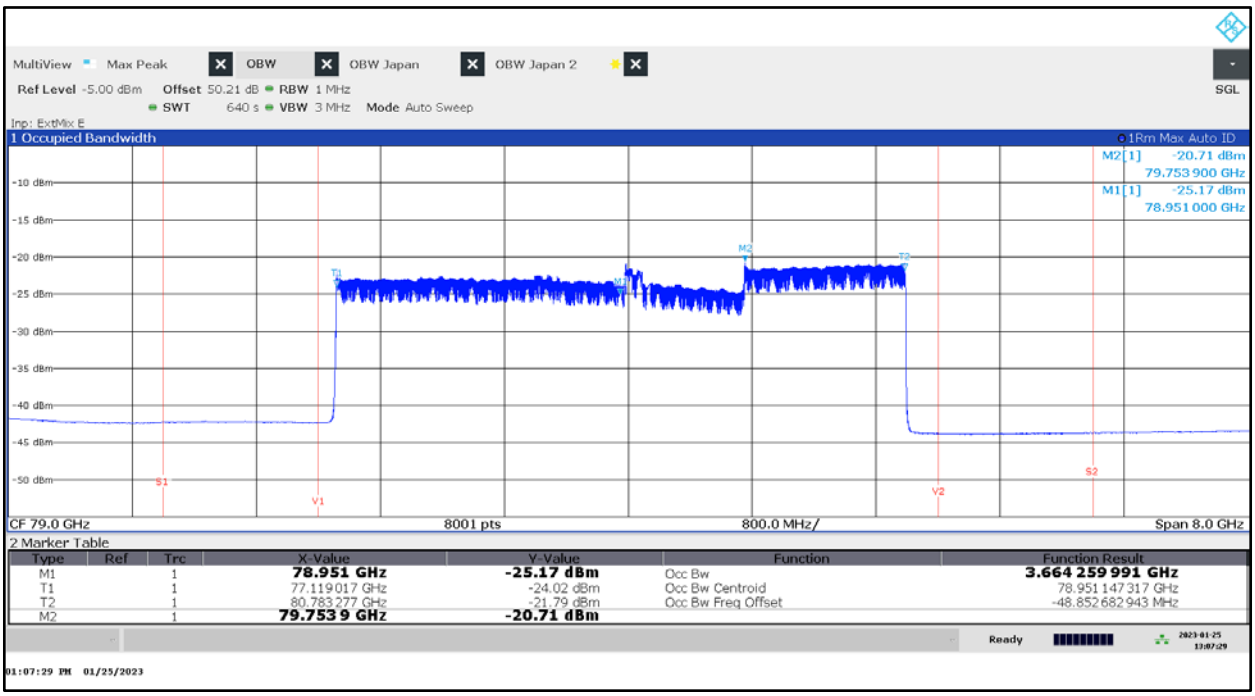
EUT	Mode	Test condition	Radiated Mean Power (eirp) / [dBm/MHz]
EUT1	Normal	T_{nom} / $V_{min-max}$	-20.71
		T_{min} / V_{nom}	-19.43
		T_{max} / V_{nom}	-21.01

Note:

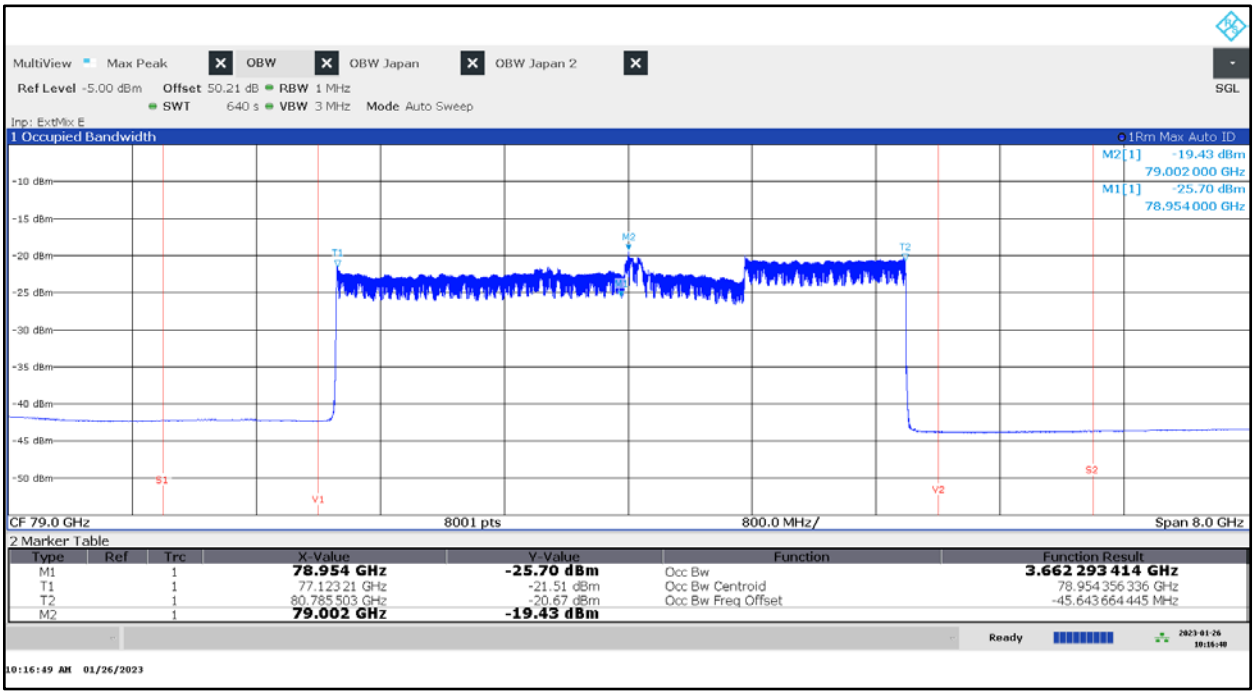
- Voltage variation has no impact
- Vertical Line V1 = 77GHz
- Vertical Line V2 = 81GHz
- Vertical Line S1 & S2 are limits for OBW calculation

Verdict: compliant

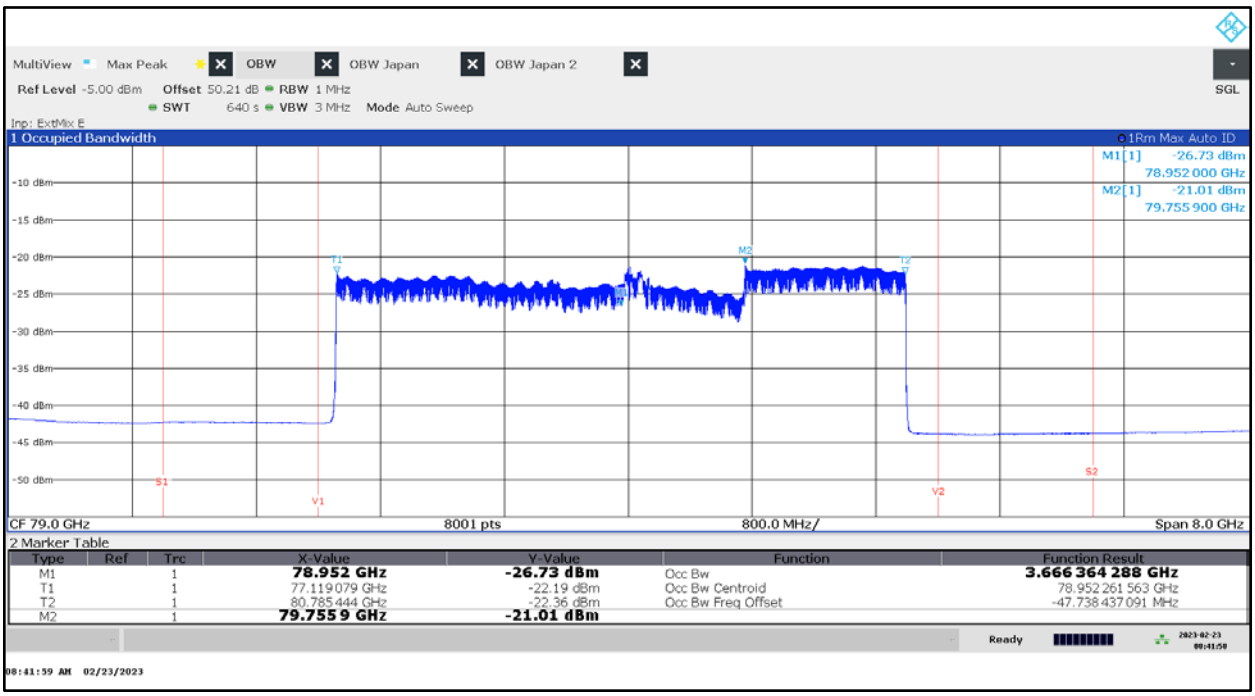
Plot 4: Mean Power spectral density (eirp), EUT1, T_{nom} / $V_{min-max}$



Plot 5: Mean Power spectral density (eirp), EUT1, T_{min} / V_{norm}



Plot 6: Mean Power spectral density (eirp), EUT1, T_{max} / V_{norm}



11.3 Peak Power

Description: **ETSI EN 303 396 V1.1.1 (2016-12) – clause 6.2.4**

The radiated peak power (e.i.r.p.) is the highest instantaneous power radiated by the equipment. It is measured in the permitted range of operating frequencies.

Measurement:

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

Note: **ETSI EN 303 396 V1.1.1 (2016-12) – clause 6.3.3.2**

The RBW has to be increased until a stable peak power reading is obtained.

Limits peak power: **EN 302 264 - clause 4.3.3.3**

The peak power for EUT with fixed beam or scanning antenna shall not be greater than 55 dBm.

Environmental conditions: **EN 302 264 - Clause 4.3.3.4**

Conformance shall be established under normal and extreme test conditions.

Measurement results: Inside the climatic chamber

EUT	Mode	Test condition	Radiated Peak Power (eirp) [dBm]
EUT1	Mid	T_{nom} / $V_{min-max}$	16.32
		T_{min} / V_{nom}	17.45
		T_{max} / V_{nom}	18.27

Note:

- Voltage variation has no impact
- Vertical Line V1 = 76GHz
- Vertical Line V1 = 77GHz
- Vertical Line V1 = 81GHz

Verdict: compliant

Plot 7: Peak Power, EUT1, T_{nom} / $V_{min-max}$

Plot 8: Peak Power, EUT1, T_{min} / V_{nom}

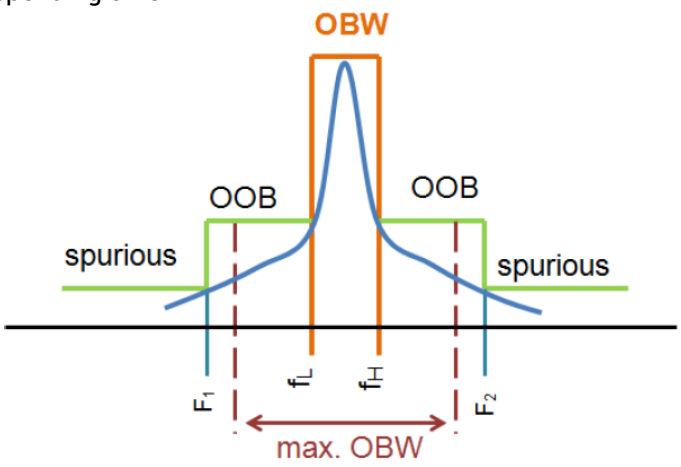
Plot 9: Peak Power, EUT1, T_{max} / V_{nom}

11.4 Unwanted emissions in the out-of-band and spurious domain

Description: **ETSI EN 303 396 V1.1.1 (2016-12) – clause 6.2.11**

OOB emissions are emissions on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.
The measurement results of f_H and f_L under clause 6.3.2 (Operating Frequency Range) will be used to determine the operating BW of the device.
The operating bandwidth (f_H - f_L) will be used to calculated the ranges of OOB and spurious domain.
Spurious emission are emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.
According to CEPT/ERC/Recommendation 74-01, and Recommendation ITU-R SM.329-12, the boundary between the out-of-band and spurious domains is ±250 % of the operating bandwidth (OBW) from the centre frequency of the emission. Out-of-band and spurious emissions are measured as spectral power density under normal operating conditions.

Overview OOB/spurious, depending on OBW:



The borders are calculated as follows:

$$f_C = (f_L + f_H) / 2$$

$$F_1 = f_C - (2.5 \times (f_H - f_L))$$

$$F_2 = f_C + (2.5 \times (f_H - f_L))$$

This calculation taken into account that the border between OOB and spurious may be larger or smaller than the maximum permitted range of operation.

Conformance:
The conformance test suite for unwanted emissions in the out-of-band domain shall be as defined in clause 6.3.10 of ETSI EN 303 396.
The conformance test suite for unwanted emissions in the spurious domain shall be as defined in clause 6.3.10 of ETSI EN 303 396.
Conformance shall be established under normal test conditions defined in clause 4.1 of EN 302 264.

Measurement:

Parameters	
Detector:	Below 1 GHz: Quasi-Peak Above 1 GHz: RMS
Resolution bandwidth:	Below 1 GHz: 100 kHz Above 1 GHz: 1 MHz
Video bandwidth:	Below 1 GHz: 300 kHz Above 1 GHz: 3 MHz
Trace-Mode:	Max Hold

Note: The peak detector is partially used to obtain a worst-case assessment. Final measurements are performed with the detectors mentioned above.

Limits:

Out-of-band domain: **EN 302 264 - clause 4.3.4.3**

The RMS mean power spectral density radiated in the calculated out-of-band domain (between F_1 to f_L and f_H to F_2 band) shall not be greater than the values given in table below.

Frequency [GHz]	RMS mean power spectral density [dBm/MHz]
$F_1 \leq f < f_L$	-30
$f_H < f \leq F_2$	-30

The values f_L and f_H are the results of the operating frequency range conformance test.
The values F_1 and F_2 are calculated as in ETSI EN 303 396, clause 6.2.11.

Spurious domain: **EN 302 264 - clause 4.3.5.3**

The effective radiated power of any radiated spurious emission shall be not greater than the values given in table below:

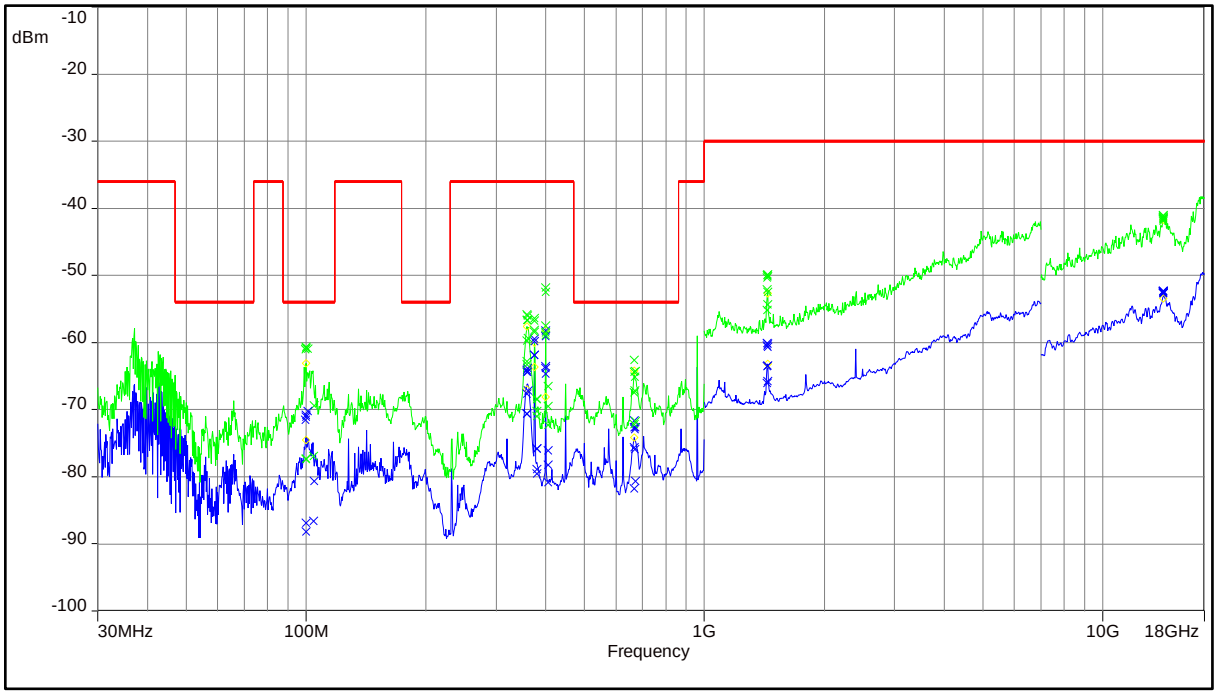
Frequency range [MHz]	Limit for spurious radiation	Detector type
47 to 74	-54 dBm e.r.p.	Quasi-Peak
87.5 to 118	-54 dBm e.r.p.	Quasi-Peak
174 to 230	-54 dBm e.r.p.	Quasi-Peak
230 to 790	-54 dBm e.r.p.	Quasi-Peak
otherwise in band 30 to 1000	-36 dBm e.r.p.	Quasi-Peak
F > 1000 to 300000 (see note)	-30 dBm e.i.r.p.	RMS
NOTE: Measurement is only required up to the 2nd harmonic of the fundamental frequency (as defined in CEPT/ERC/REC 74-01). In this case, the upper frequency limit up to which measurements are performed is 162 GHz.		

Measurement results:

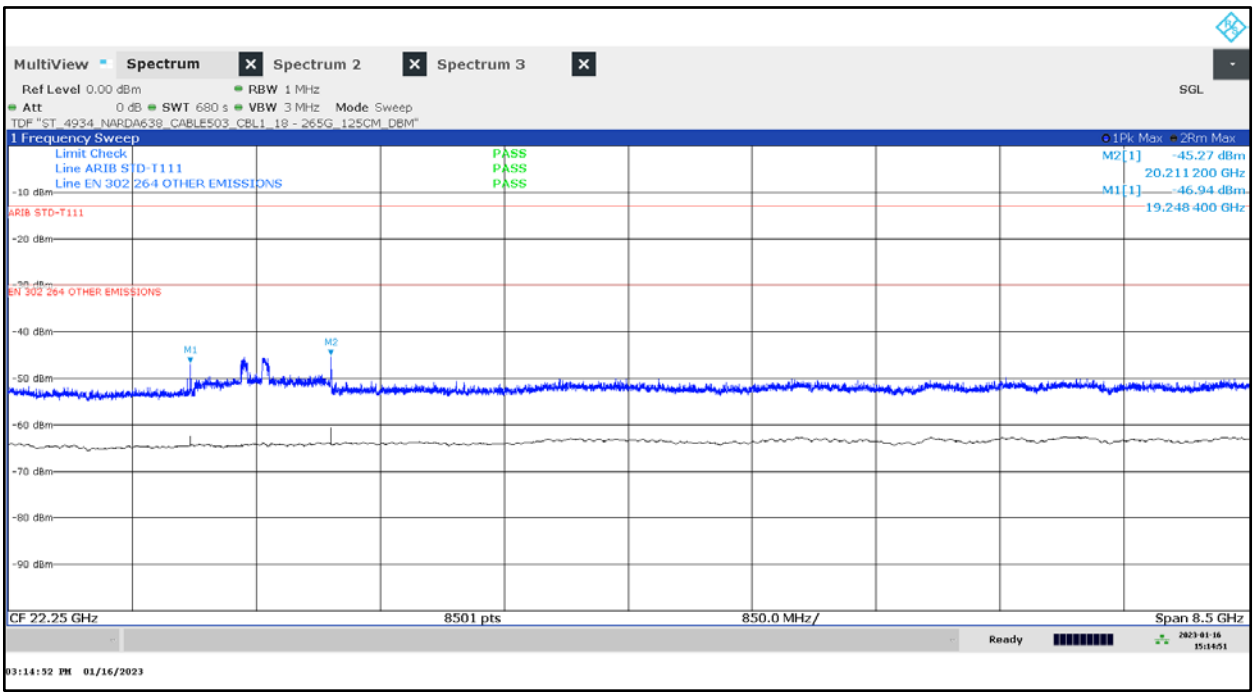
Spurious Emissions				
Frequency [GHz]	Receiver bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
-/-	-/-	-/-	-/-	-/-
No critical spurious emission levels				

Verdict: Compliant

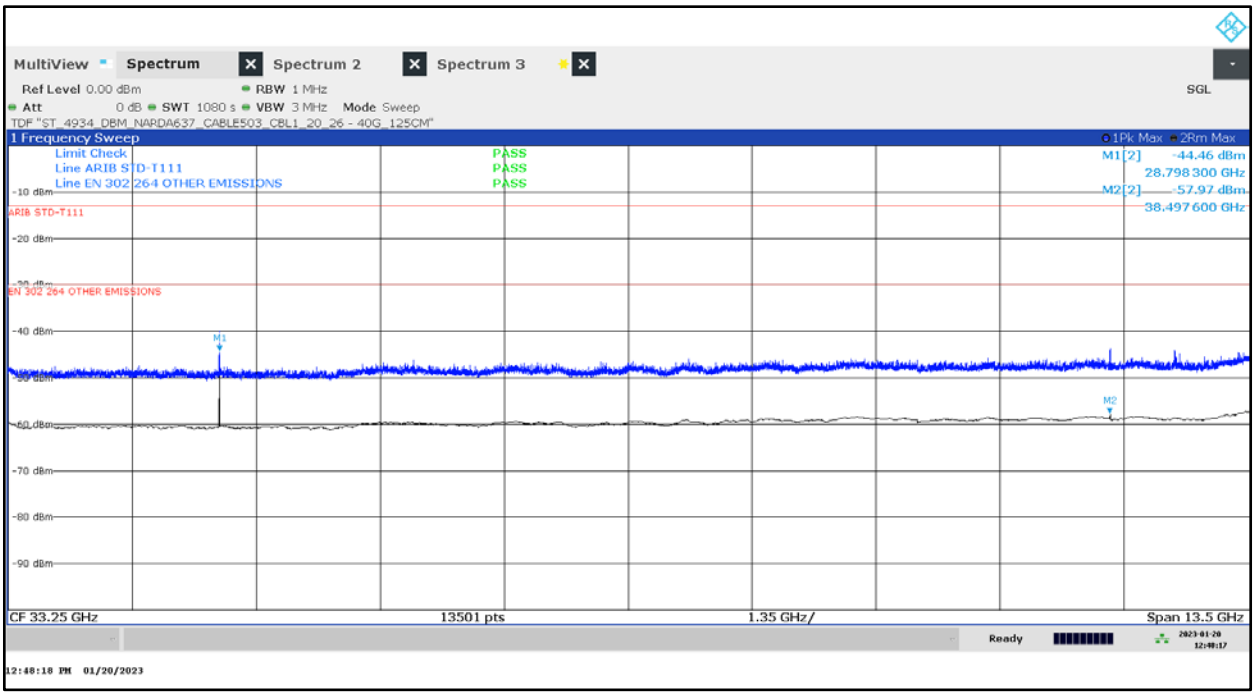
Plot 10: 30 MHz – 18 GHz, EUT1



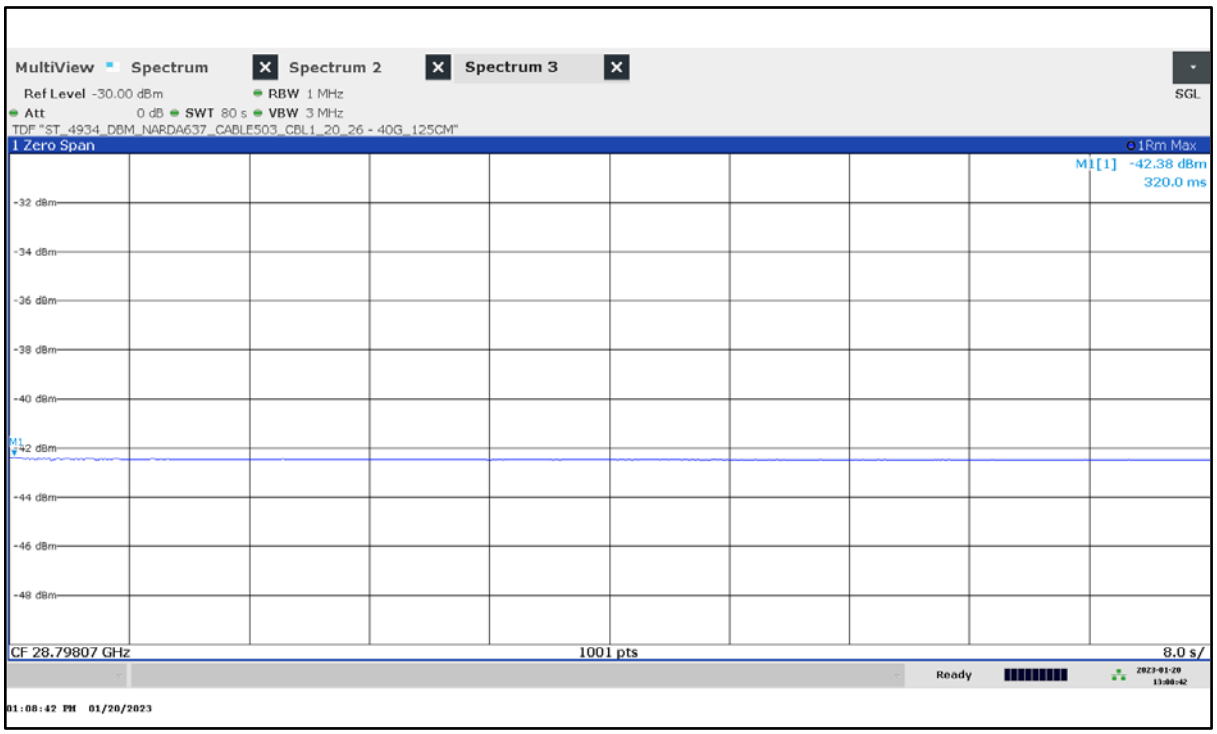
Plot 11: 18 GHz – 26.5 GHz, EUT 1



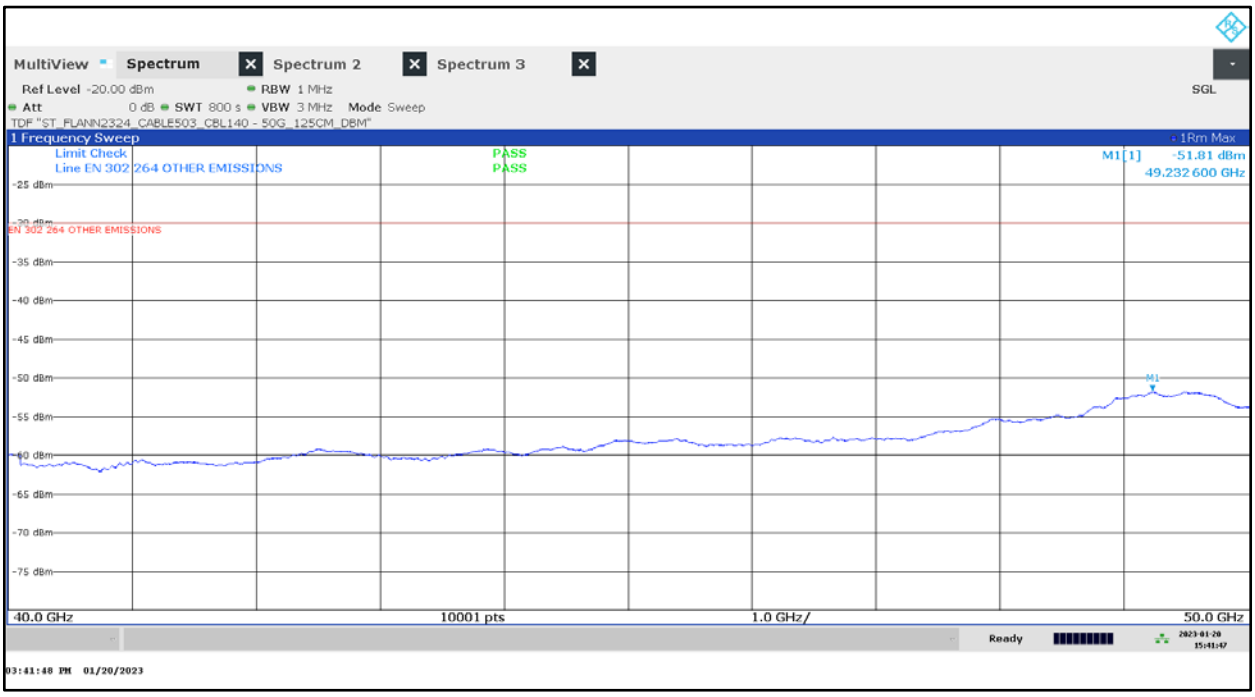
Plot 12: 26.5 GHz – 40 GHz, EUT 1



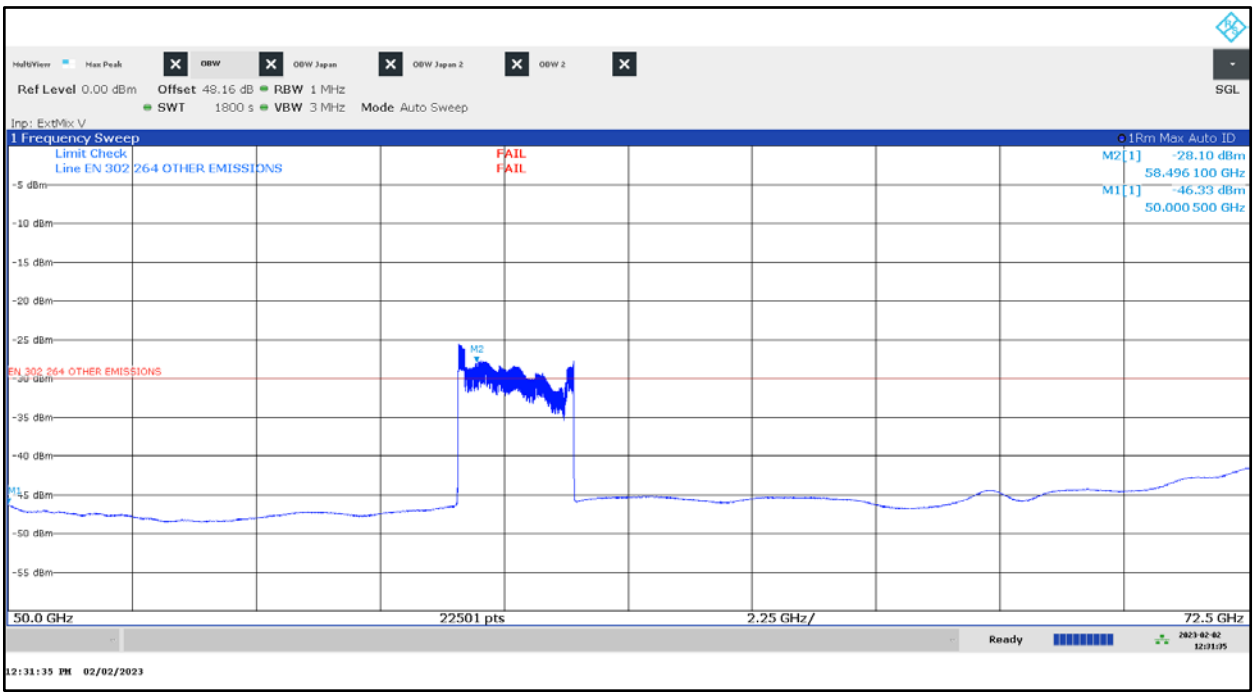
Plot 13: Final measurement at 28.798GHz



Plot 14: 40 GHz – 50GHz, EUT1



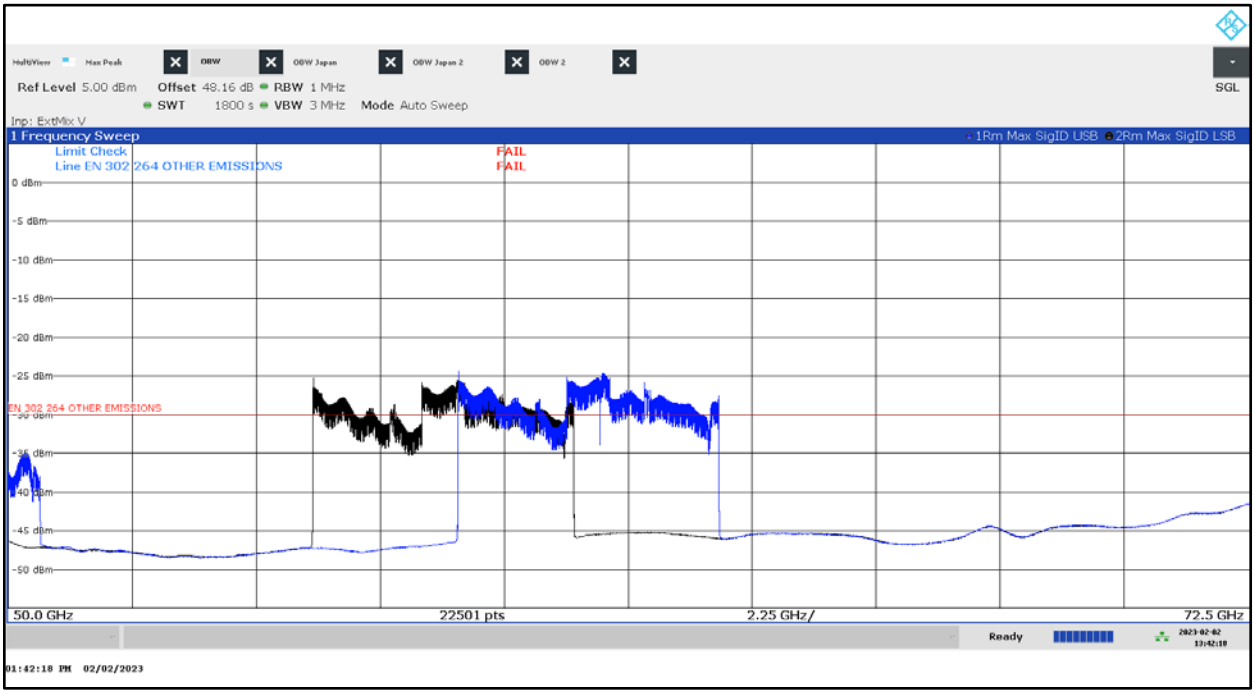
Plot 15: 50 GHz – 72.5 GHz, EUT1 measured with Auto ID



Note:

- In the AutoID mode, the spectrum analyser try to calculate the mixer mirrors out of the spectrum

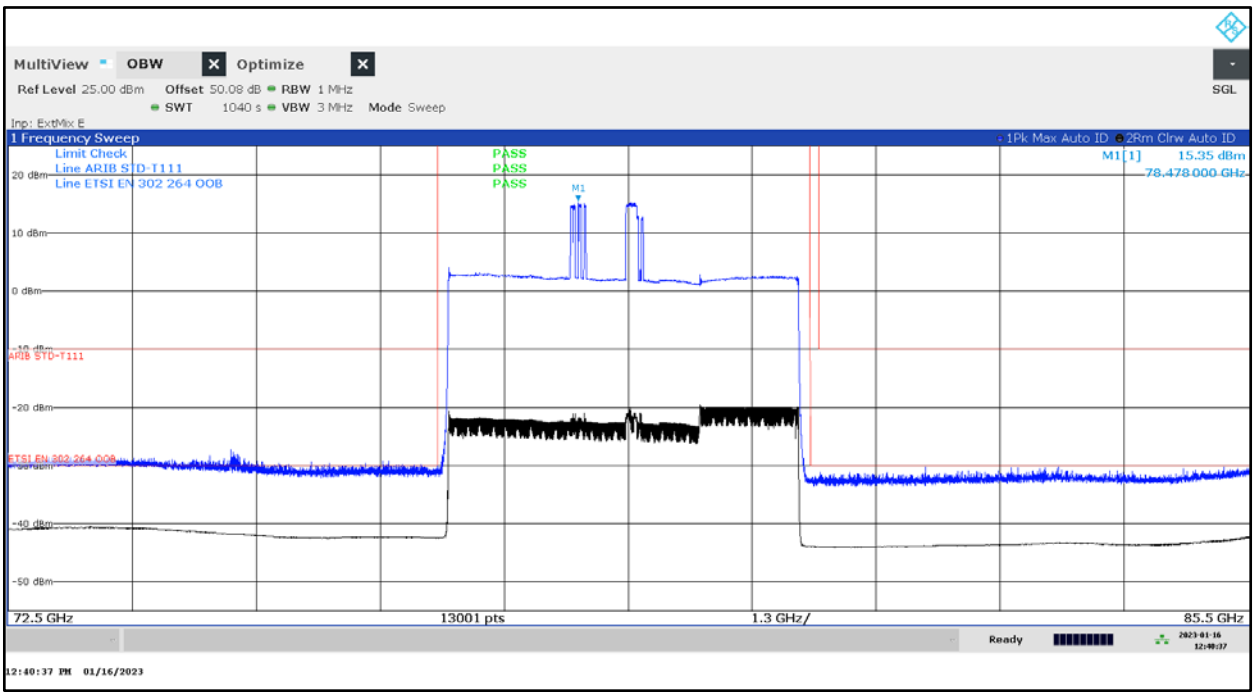
Plot 16: 50 GHz – 72.5 GHz, EUT1 measured with Signal ID



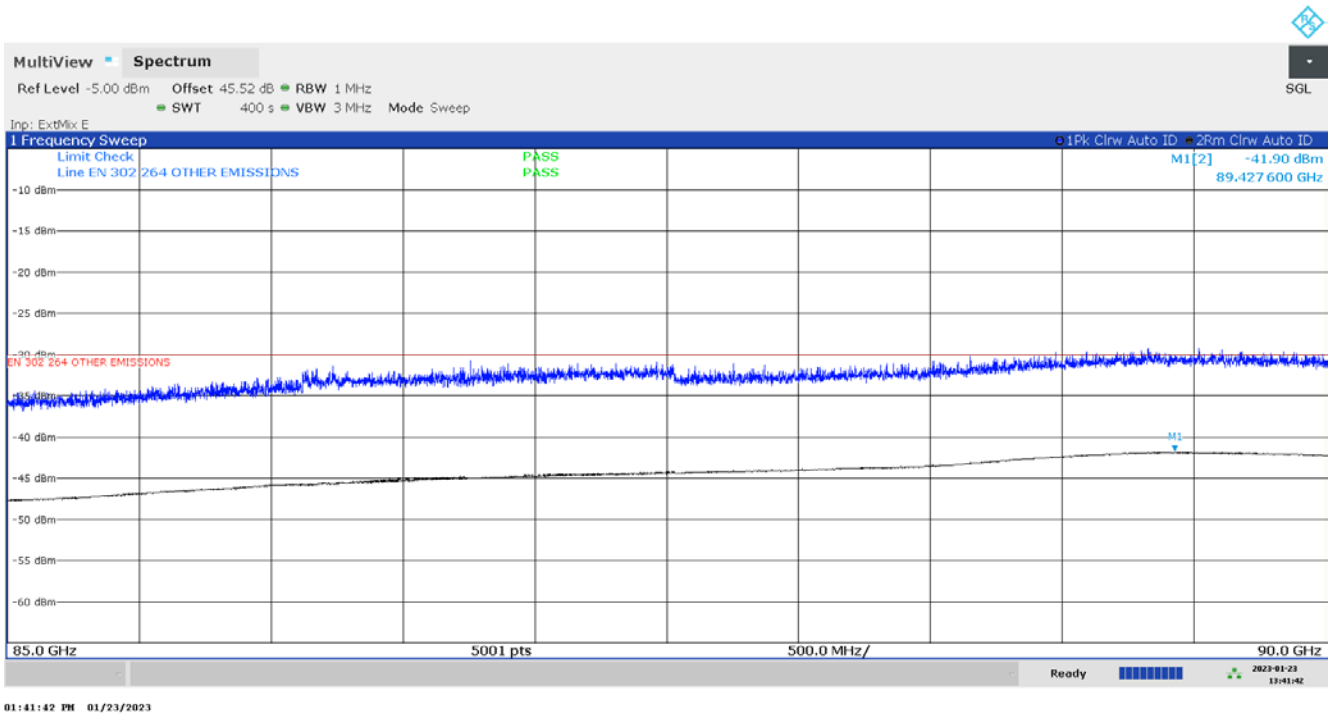
Note:

- In the Signal ID mode, the spectrum analyser displays the upper and the lower sideband
- Plot 16 shows the shift of the upper and the lower sideband and therefore the signal in Plot 15 is not a real signal. The signal is produced by the external mixer.

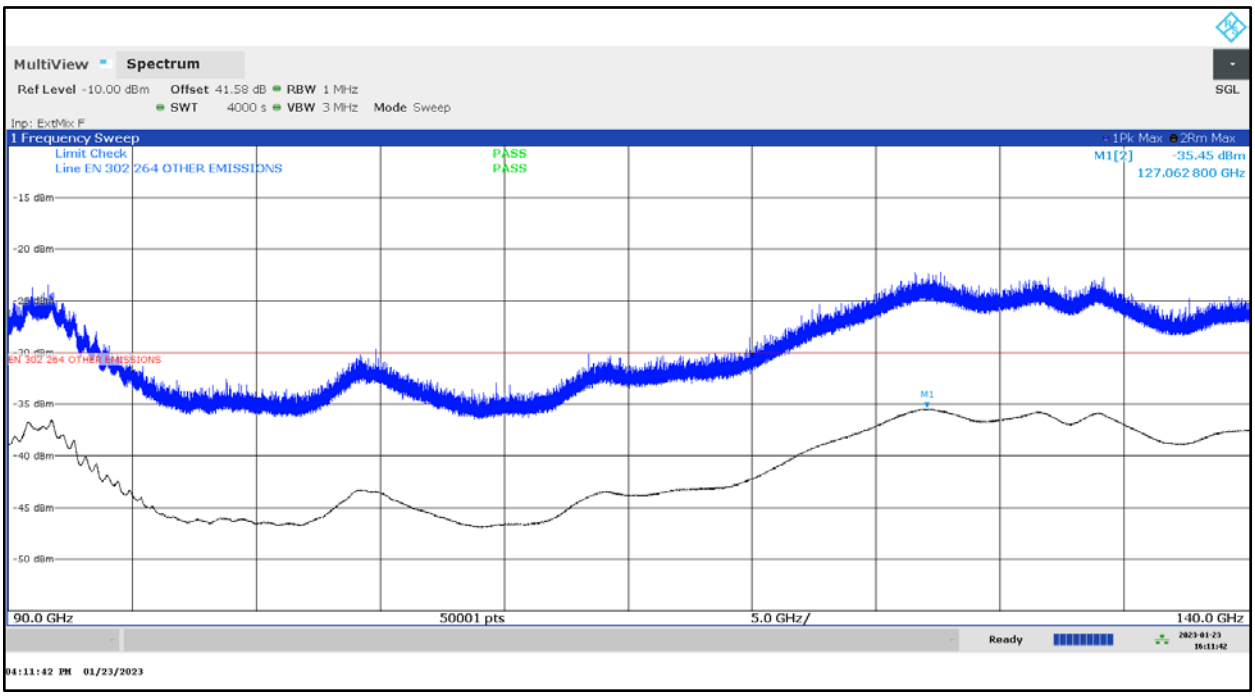
Plot 17: 72.5 GHz – 85.5 GHz, EUT1



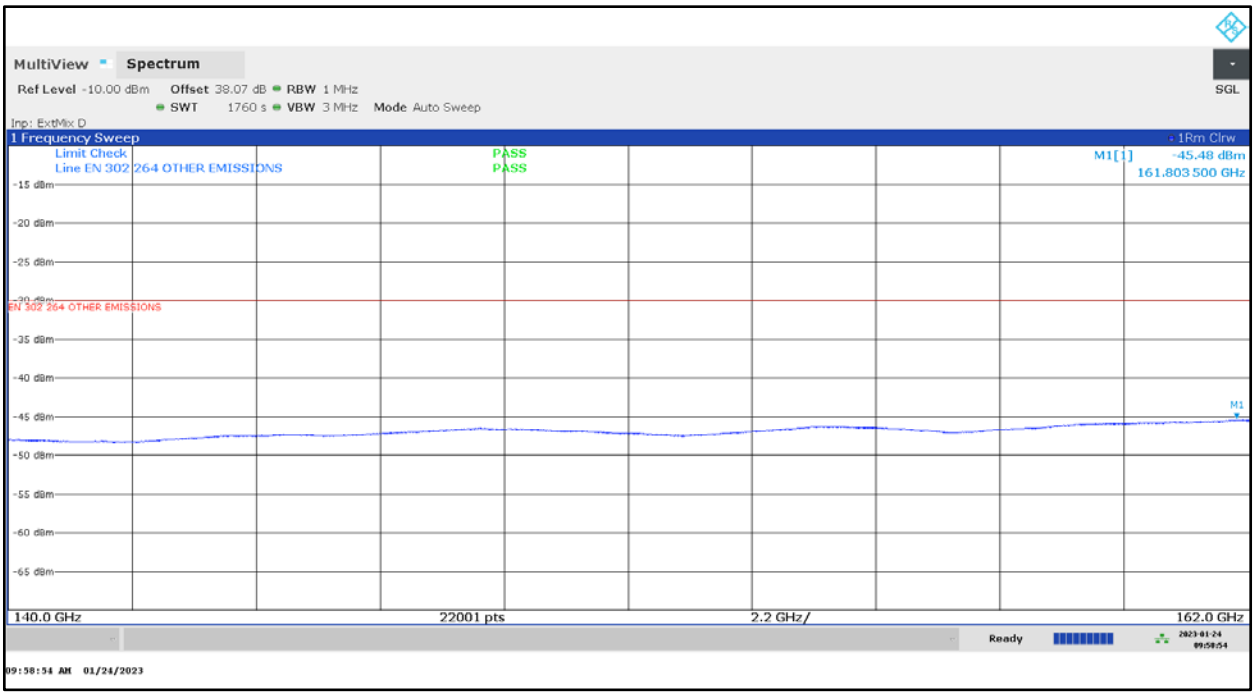
Plot 18: 85 GHz – 90 GHz, EUT1



Plot 19: 90 GHz – 140 GHz, EUT1



Plot 20: 140 GHz – 162 GHz, EUT1



11.5 Receiver in-band, out-of-band and remote-band signals handling

Description: **ETSI EN 303 396 V1.1.1 (2016-12) – clause 6.2.13**

Ability of the receiver to operate as intended when unwanted signals, located respectively in-band, out-of-band and at a remote band, are occurring.

Conformance:
The conformance test suite for receiver in-band, out-of-band and remote-band signals handling shall be as defined in clause 6.3.12 of ETSI EN 303 396.
Conformance shall be established under normal test conditions defined in clause 4.1 of EN 301 091-1.

Limits: **EN 302 264 - clause 4.4.3.3**
The EUT shall achieve the wanted performance criterion in the presence of unwanted signals defined in the table below.
The unwanted signal transmitter shall be able to transmit continuous wave signals at specific frequencies, as described in the table 7 below.

	In-band signal	OOB signal	Remote-band signal
Frequency	Center frequency (f_C) of the EUT modulated signal	$f = f_C \pm F$	$f = f_C \pm 10 \times F$
Signal level field strength at the EUT	55 mV/m	173 mV/m	173 mV/m
Equivalent EIRP at 10m	10 dBm	20 dBm	20 dBm
F: permitted frequency bandwidth (4 GHz)			

Wanted performance criterion: **EN 302 264 - clause 4.2.2**
The wanted performance criterion is that the EUT shall indicate the properties of a given target at a given distance. Since EUT considered here typically are tailored to specific applications, no single wanted performance criterion can be defined here.
Therefore:

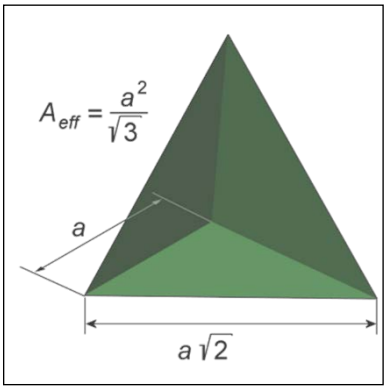
- the relevant properties (e.g. presence, range, relative speed, azimuth angle) shall be declared by the manufacturer;
- the type and RCS of the target and the distance shall be declared by the manufacturer.

Note:
The Radar Cross Section (RCS) is a measure of how detectable an object is with a radar.

$\sigma = 4 \cdot \pi \cdot a^4 / 3 \cdot \lambda^2$

a = Length of the side edges of the three isosceles triangles
λ = wavelength of scanning radar

Example: a = 4.3 cm → σ = ~1 m^2 at 76.5 GHz



Measurement results:

A CW interferer is positioned at a distance of 2.15 m to the EUT. The interfering power is set to 15 dBm EIRP (equivalent to 28 dBm EIRP at 10 m) for in-band, OOB and remote-band interfering tests. The measurement is performed with vertical and horizontal polarization of the interfering antenna.

The interferer has no effect on the performance of the EUT.

Interferer frequency	fc-10 x F		fc-F		fc		fc+F		fc+10 x F	
Polarization	H	V	H	V	H	V	H	V	H	V
Maximum equivalent EIRP at 10 m [dBm]	>20.0	>20.0	>20.0	>20.0	>20.0	>20.0	>20.0	>20.0	>20.0	>20.0

Verdict: Compliant

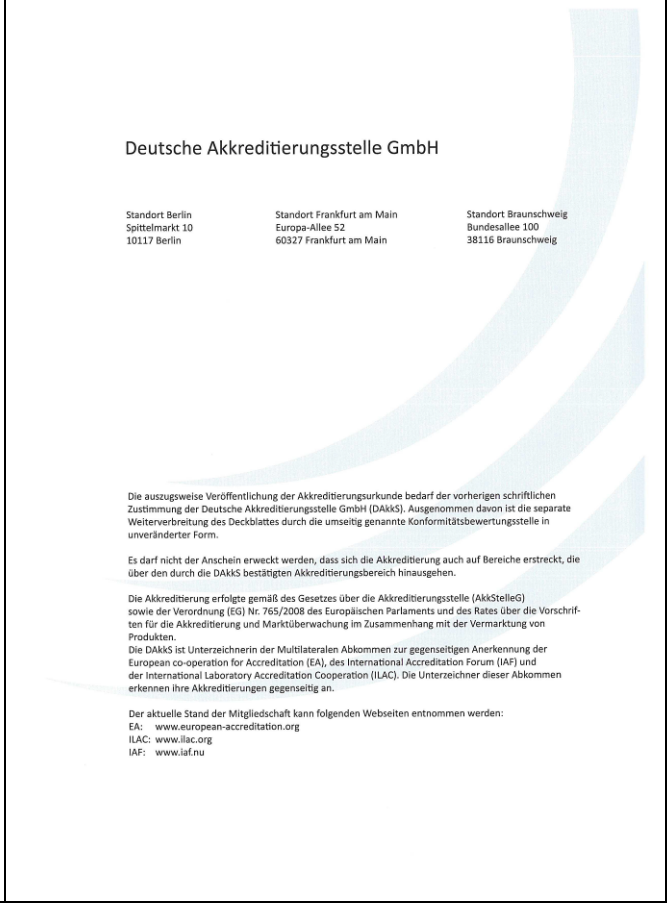
12 Glossary

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

13 Document history

Version	Applied changes	Date of release
V1	Initial Draft release	2023-03-27

14 Accreditation Certificate – D-PL-12076-01-03

first page	last page
	

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

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-03.pdf
or
https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-03_TK.pdf

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