

procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

Test standard/s

96052 Bamberg / GERMANY

FCC - Title 47 CFR Part 95FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 95 - Personal
Radio ServicesRSS - 251 Issue 2Spectrum Management and Telecommunications Radio Standards
Specification - Vehicular Radar and Airport Fixed or Mobile Radar in the 76-81
GHz Frequency Band

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						
FCC ID:	2AHV8- PMRG33375						
IC:	29958- PMRG33375						
Frequency:	77GHz – 81GHz						
Antenna:	Integrated antenna						
Power supply:	9 V to 16 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:

Test performed:

Stephan Thiel Testing Manager Radio Labs

Thomas Vogler Lab Manager Radio Labs

Test report no.: 1-4939_22-01-03



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General information 2

Notes and disclaimer 2.1

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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2.2 Application details

Date of receipt of order:	2022-10-26
Date of receipt of test item:	2022-11-07
Start of test:*	2023-01-24
End of test:*	2020-02-23
Person(s) present during the test:	-/-

Person(s) present during the test:

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

2.3 Test laboratories sub-contracted

None



3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 95	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 95 - Personal Radio Services
RSS - 251 Issue 2	July 2018	Spectrum Management and Telecommunications Radio Standards Specification - Vehicular Radar and Airport Fixed or Mobile Radar in the 76-81 GHz Frequency Band
RSS - Gen Issue 5 incl. Amendment 1 & 2	February 2021	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

Guidance	Version	Description
		American National Standard for Methods of Measurement of
ANSI C63.4-2014	-/-	Radio-Noise Emissions from Low-Voltage Electrical and
		Electronic Equipment in the Range of 9 kHz to 40 GHz
ANCI 062 10 2012	-/-	American National Standard of Procedures for Compliance
ANSI C63.10-2013	-/-	Testing of Unlicensed Wireless Devices
76-81 GHz Radars KDB	v01r02	653005 D01 76-81 GHz Radars v01r02: EQUIPMENT
		AUTHORIZATION GUIDANCE FOR 76-81 GHz RADAR DEVICES

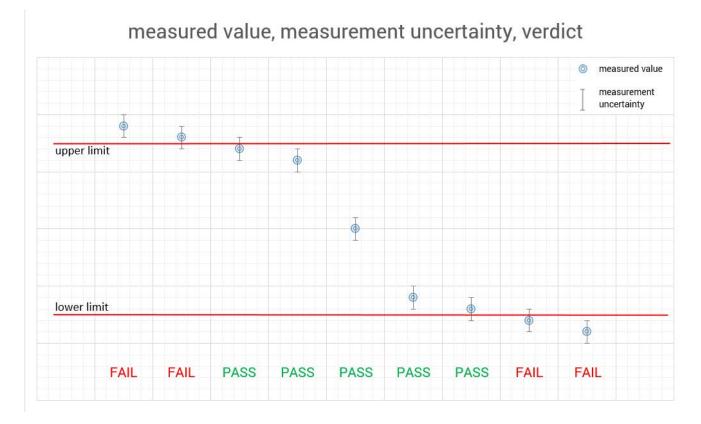
Accreditation	Description	
D-PL-12076-01-04	Telecommunication and EMC Canada https://www.dakks.de/files/data/as/pdf/D-PL-12076- 01-04e.pdf	DAKKS Deutsche Akkreditierungsstelle D-PL-12076-01-04
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/files/data/as/pdf/D-PL-12076- 01-05e.pdf	DAKKS Deutsche Akkreditierungsstelle D-PL-12076-01-05



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}	+20 °C during room temperature tests
		T _{max}	+70°C during high temperature tests
		Tmin	-40°C during low temperature tests
Relative humidity content	:		40-60 %
Barometric pressure	:		not relevant for this kind of testing
		V _{nom}	13.5 V DC by Battery
Power supply	:	V _{max}	16 V
		V_{min}	9 V

6 Test item

6.1 General description

:	Automotive FMCW Radarsensor 77-81GHz
:	PMRGEN1
:	PMRGEN1
:	G33375
:	EUT1: G28900-100
:	G33375-100
:	G47455-100
•	B320
:	77GHz – 81GHz
:	FMCW
:	1
:	Integrated antenna
:	9 V to 16 V DC by Battery
:	-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_AnnexD



7 Description of the test setup

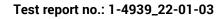
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements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

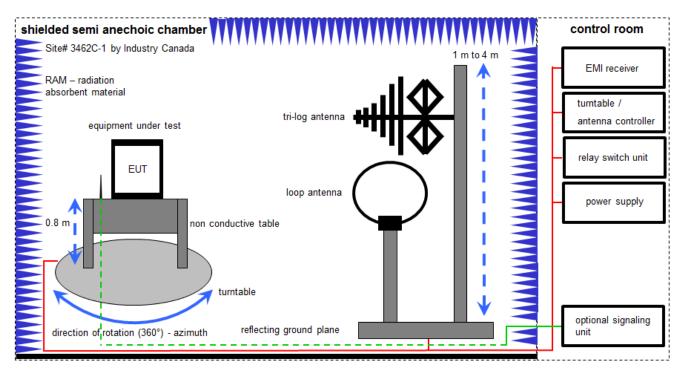
- EK limited calibration
- zw cyclical maintenance (external cyclical maintenance)
- izw internal cyclical maintenance
- g blocked for accredited testing
- *) next calibration ordered / currently in progress





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 specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. 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 EMC32 software version: 10.59.00

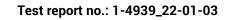
FS = UR + CL + AF (FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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

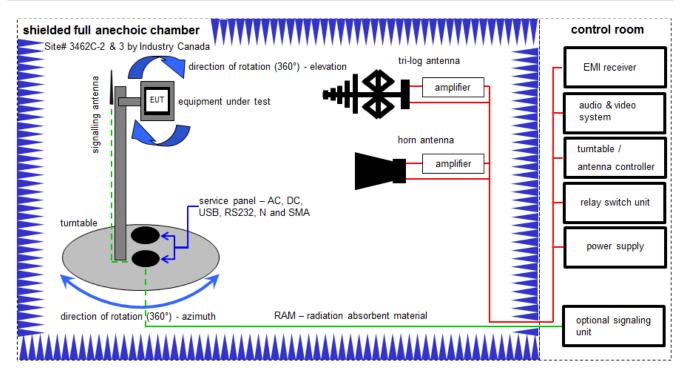


Equipment table:

No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	19	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9107-3697	300001605	vIKI!	12.03.2021	11.03.2023
2	45	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
3	50	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
4	n. a.	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	n. a.	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	n.a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	01029	300005379	vIKI!	18.08.2021	30.08.2023
7	n. a.	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	09.12.2022	31.12.2023



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)

<u>Example calculation</u>: FS $[dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 <math>\mu$ V/m)

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

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

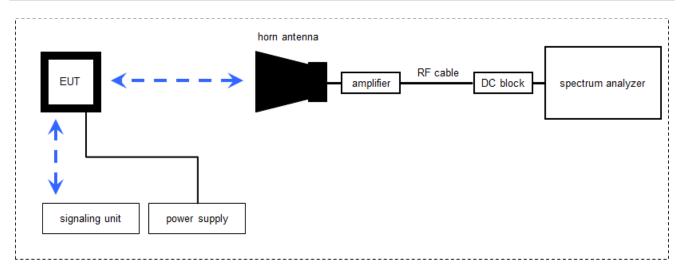


Equipment table:

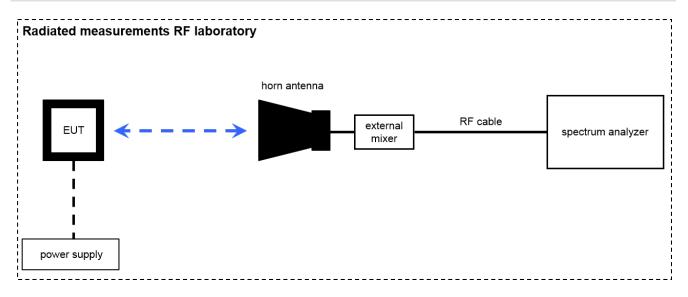
No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vlKl!	09.12.2020	08.12.2023
2	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	n. a.	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	318	300003696	vIKI!	30.09.2021	29.09.2023



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)

<u>Example calculation</u>: FS $[dB\mu V/m] = 40.0 [dB\mu V/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dB\mu V/m] (6.79 <math>\mu$ V/m)

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

<u>Example calculation:</u> 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	Туре	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	-/-	-/-



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.

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.



8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

- 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.

- 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.

- 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 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 %



10 Summary of measurement results

10.1 Summary

\boxtimes	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	2023-03-27	-/-
RF-Testing	RSS – 251 Issue 2	see below	2023-03-27	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	Pass	Fail	NA	NP	Remark
§2.1046 §95.3367 (a) / (b) RSS-251 chapter 8 RSS-251 chapter 9	Radiated power	Nominal	Nominal	X				complies
§2.1047 RSS-251 chapter 6	Modulation characteristics	-/-	-/-	\boxtimes				complies
§2.1049 RSS-251 chapter 7	Occupied bandwidth (99% bandwidth)	Nominal	Nominal	\boxtimes				complies
§2.1051	Spurious emissions at antenna terminals	Nominal	Nominal	\boxtimes				complies
§2.1053 §95.3379 (a)(1) §95.3379 (a)(2) §95.3379 (a)(3) RSS-251 chapter 10 RSS-Gen chapter 6.13 / 8.9	Unwanted emissions (radiated spurious)	Nominal	Nominal					complies
§2.1055 §95.3379 (b) RSS-251 chapter 11 RSS-Gen chapter 6.11 / 8.11	Frequency stability	Nominal and Extreme	Nominal and Extreme					complies

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

See FCC's Millimeter Wave Test Procedures:

I. A radiated method of measurements in order to demonstrate compliance with the various regulatory requirements has been chosen in consideration of test equipment availability and the limitations of many external harmonic mixers. A conducted method of measurement could be employed if EUT and mixer waveguides both are accessible and of the same type (WG number) and if waveguide sections and transitions can be found. Another potential problem is that the peak power output of devices operating under Sections 15.253 and 15.255 may exceed the +20 dBm input power limit of many commercially available mixers. For these reasons a radiated method is preferred.

Test report no.: 1-4939_22-01-03



10.2 Additional comments

Reference documents:	None	
Special test descriptions:	None	
Configuration descriptions:	None	
10.3 Operation mode for	testing]
Test mode:	\boxtimes	No test mode available.
	\boxtimes	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



11 Measurement results

11.1 Radiated power

Description:

<u>§95.3367:</u>

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.

RSS-251 chapter 8.1:

The average e.i.r.p. measurement shall be performed using a power averaging detector with a 1 MHz resolution bandwidth (RBW). The power shall be integrated over the occupied bandwidth.

RSS-251 chapter 9.1:

The peak e.i.r.p. measurement shall be performed by sweeping the transmitted occupied bandwidth with a positive peak power detector, using a peak hold display mode, and a 1 MHz resolution bandwidth. The power integration is not to be used in performing this measurement.

<u>Limits:</u>

FCC §95.3367 (a) (b)/ RSS-251 (5.2.2)

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

Measurement: Average Power

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

Measurement: Peak Power

Measurement parameter			
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.

Consequence:

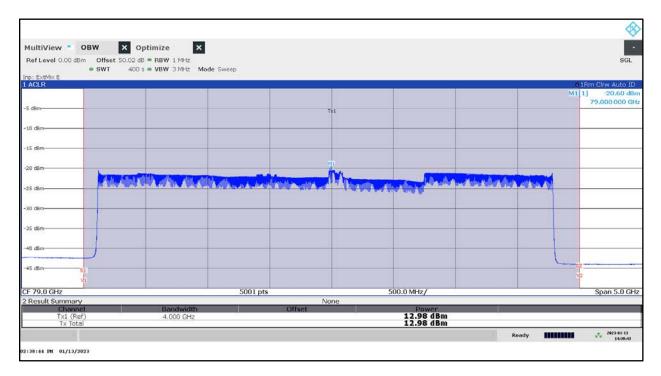
Worst case measurement, the peak power measurement is performed with a greater resolution bandwidth to solve the problem with the desensitization.

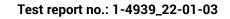
Measurement results:

EUT	Mode	Test condition	Radiated peak power (eirp) [dBm/MHz]	Radiated Mean Power (eirp) [dBm]
1	Normal	T _{nom} / V _{nom}	17.95	12.98

Verdict: Complies

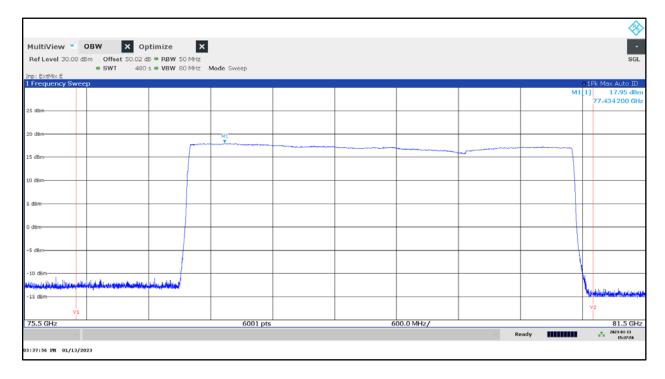
Plot 1: Channel power







Plot 2: Peak power





11.2 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.

RSS-251 chapter 6:

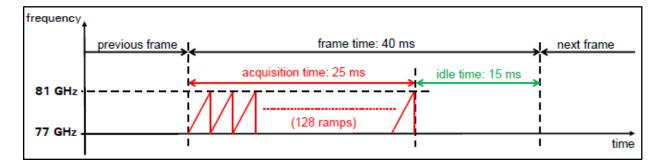
In addition to the reporting requirements of RSS-Gen, the following information shall be provided, as per the applicable modulation type:

- Pulsed radar: pulse width and pulse repetition frequency (PRF). If the PRF is variable, the maximum and minimum values shall be reported.
- Non-pulsed radar (e.g. frequency modulated continuous wave (FMCW)): modulation type (i.e. sawtooth, sinusoid, triangle, or square wave) and sweep characteristics (sweep bandwidth, sweep rate, sweep time).

Comments from manufacturer on modulation characteristics according to KDB 653005 3.(g):

Modulation Type	sawtooth
Modulation characteristics:	
Sweep Bandwidth	See Plot 3
Sweep rate	See Plot 3
Sweep time	See Plot 3

Plot 3: provided by customer





11.3 Occupied bandwidth

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.

RSS-251 chapter 7.2:

The radar device's occupied bandwidth (i.e. 99% emission bandwidth) shall be contained in the 76-81GHz frequency band.

<u>Limits:</u>

FCC	IC			
FCC §95.3379 (b)	RSS-251 chapter 7.2:			
The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following:				
Frequency range				
76 GHz – 81 GHz				

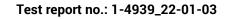
Measurement:

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

Results:

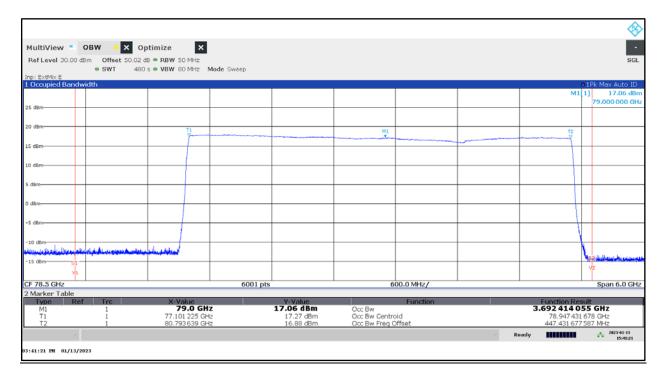
EUT	TEST CONDITIONS	f∟ in GHz	f _H in GHz	Occupied Bandwidth (99%) in MHz	Plot
EUT 1	T _{nom} / V _{nom}	77.101	80.794	3.692	Plot 4

Verdict: Complies





Plot 4: 99% Bandwidth



11.4 Band edge compliance

Description:

Investigation of the emission limits at the band edge.

Limits:

FCC §95.3379 (a) (2) (i) + (ii) / ANSI C63.10-2013 / 6.10

Frequency Range [GHz] Measurement distance		Power Density		
40 – 76 and 81 – 200	3.0 m	$600 \text{ pW/cm}^2 \rightarrow -1.7 \text{ dBm}$		

Limits:

RSS-251 (10.2)

Frequency Range [GHz]	Power Density
40 – 76 and 81 – 162	-30 dBm/MHz (e.i.r.p)

Limits:

FCC §95.3367 (a) (b)/ RSS-251 (5.2.2)

Frequency Range [GHz]	Power Density
76 - 81	50 dBm/MHz (e.i.r.p)

Measurement:

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

Measurement results:

• Results are part of chapter Fehler! Verweisquelle konnte nicht gefunden werden.

Verdict: Complies





11.5 Unwanted emissions

Description:

Measurement of the radiated unwanted emissions.

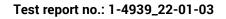
<u>Limits:</u>

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	0.490 – 1.705 24000/F[kHz]						
1.705 – 30.0	1.705 – 30.0 30						
30 88	100	3					
88 – 216	88 - 216 150						
216 - 960	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	$1000 \text{ pW/cm}^2 @ 3\text{m}$	+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.

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

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

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

According to this formula, an emission limit of PD = 600 pW/cm^2 at a distance of d = 3 m corresponds to an equivalent isotropically radiated power of EIRP = -1.7 dBm.



RSS-251 10

10.1 In addition to the requirements specified in RSS-Gen and the method of measurement of ANSI C63.10, the spectrum shall be investigated up to 162 GHz.

10.2

The radar device's unwanted emissions outside the 76-81 GHz frequency band shall comply with the limits in table below.

RSS						
RSS-251 chapter 10.2 Table 1						
	Radiated unwanted emissions					
Emission frequency range	Limit	Applicable detector				
Below 40 GHz	RSS-Gen general field strength limits for licence-exempt radio apparatus	RSS-Gen requirements				
40-162 GHz * -30 dBm/MHz (e.i.r.p.) RMS detector						
Note: * For radar devices that operat	e solely in the 76-77 GHz band (i.e. the occupied	d bandwidth is entirely				

* For radar devices that operate solely in the 76-77 GHz band (i.e. the occupied bandwidth is entirely contained in the 76-77 GHz band), an unwanted emissions limit of 0 dBm/MHz shall apply for the unwanted emission that fall in the 73.5-76 GHz band. Outside of the 73.5-76 GHz band, the unwanted emission limits prescribed in table above shall apply.



RSS-Gen 8.9

Except where otherwise indicated in the applicable RSS, radiated emissions shall comply with the field strength limits shown in the tables below. Additionally, the level of any transmitter unwanted emission shall not exceed the level of the transmitter's fundamental emission.

RSS								
RSS-Gen chapter 8.9 Table 5/6								
	Radiated emissions							
General field str	ength limits at frequencies above 30	MHz						
Frequency (MHz)	Field strengt	h (μV/m)						
30 88	30 88 100 μV/m							
88 – 216 150 μV/m								
216 - 960	216 – 960 200 μV/m							
960 - 40 000	500 μV	/m						
General field str	ength limits at frequencies below 30	MHz						
Frequency	Magnetic field strength (H-Field) (µA/m)	Measurement distance (m)						
9 - 490 kHz ^{Note 1}	6.37/F (F in kHz)	300						
490 - 1705 kHz 63.7/F (F in kHz) 30								
1.705 - 30 MHz 0.08 30								
Note 1: The emission limits for the ranges 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector.								

Measurement:

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



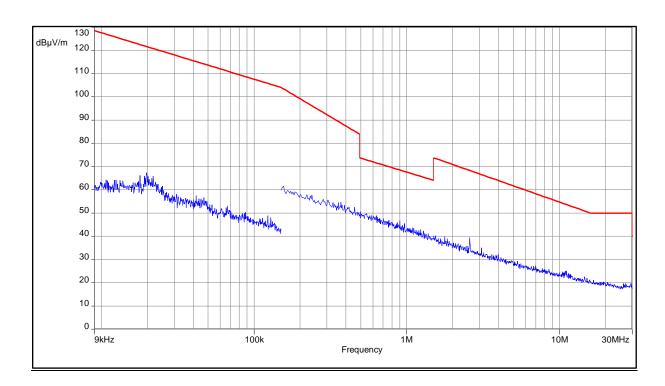
Measurement results:

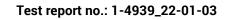
Frequency [GHz]	Detector	Bandwidth [MHz]	Level	Limit	Margin [dB]	
28.798	LinAV	1	52.6 [dBuV]	54.0 [dBuV]	1.4	

For emissions below 1 GHz, please refer to plot Plot 5 to Plot 6.

Verdict: Complies

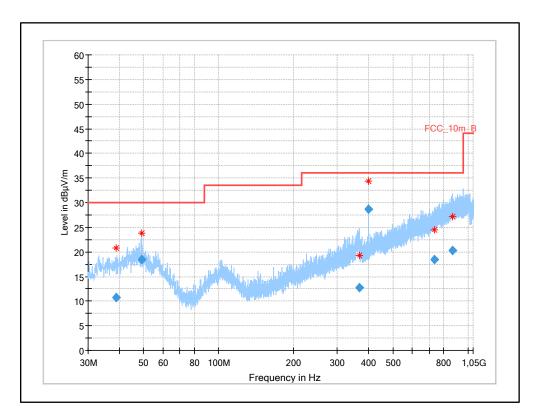
Plot 5: Spurious Emission 9kHz - 30 MHz



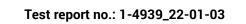




Plot 6: Spurious Emission 30 MHz - 1 GHz

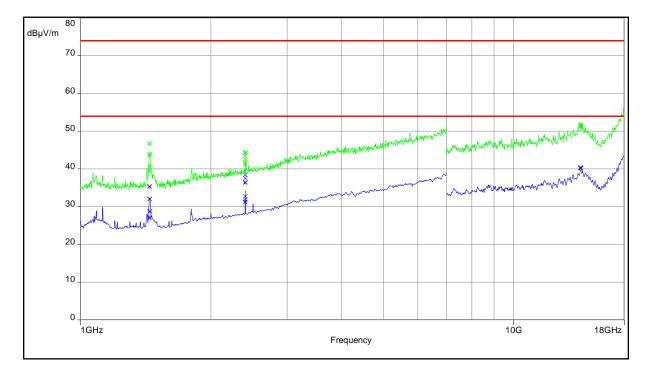


Frequency (MHz)	QuasiPea k (dBuV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
38.719	10.65	30.0	19.4	1000	120.0	119.0	V	135	15
49.055	18.47	30.0	11.5	1000	120.0	123.0	v	97	16
366.056	12.71	36.0	23.3	1000	120.0	104.0	V	90	17
400.023	28.66	36.0	7.3	1000	120.0	266.0	V	104	18
734.463	18.39	36.0	17.6	1000	120.0	112.0	V	225	23
870.319	20.36	36.0	15.6	1000	120.0	400.0	Н	270	25

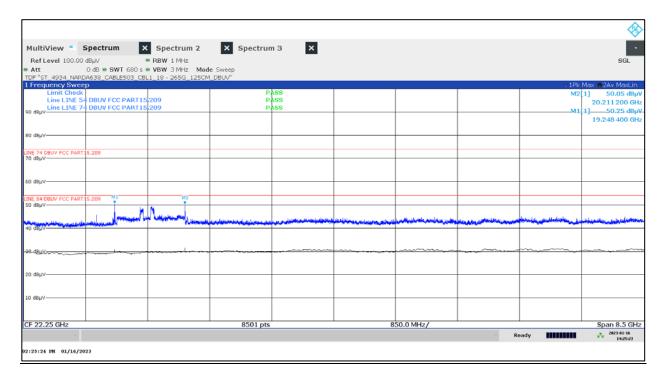




Plot 7: Spurious Emission 1 GHz - 18 GHz



Plot 8: Spurious Emission 18 GHz - 26.5 GHz



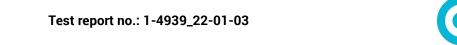


Plot 9: Spurious Emission 19.248 GHz

									Sector 1
MultiView	Spectrum 🛛	Spectrum 2	🔸 🗙 Spectru	m 3 🗙					•
Ref Level 60.00		RBW 1 MHz	_					:	SGL
	0 dB = SWT 80 s = 1 DA638 CABLE503 CB	VBW 3 MHz L1_18 - 265G_125CM	DBUN"						
1 Zero Span	0///00_0/062000_00	<u></u>						01Pk	Max
									M2[2] 31.40 dBµV
									60,4800 s
55 dBµV									M1[1] 51.61 dBµV
ss uspv									35.1200 s
				M1					
so delay								1 A	1 . de la
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45 dBuV									
40 dBµV									
35 dBµV									
							M2		
30 dBµV					\$\$\$\$\$\$\$	-			preserved by
25 dBµV									
CF 19.2484 GHz				100	1 pts				8.0 s/
								eady	. 2023-01-16
									14:40:10
02:40:10 PM 01/16/2	023								

Plot 10: Spurious Emission 20.2112 GHz

									
MultiView	Spectrum ×	Spectrum 2	× Spectrur	n 3 🗙					•
Ref Level 60.00 Att	dBµV • I 0 dB • SWT 80 s • 1	RBW 1 MHz VBW 3 MHz						:	GL
TDF "ST_4934_NAR	DA638_CABLE503_CB		_DBUV"						
1 Zero Span								0 1 Pk	Max ●2Av MaxLin M2[2] 31.82 dBµV
									8.0000 s
									M1[1] 50.08 dBµV
55 dBμV									8.000 0 s
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SU GBDV									
45 dBµV									
40 dBµ∨									
35 dBµV									
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30 dBµV-	ก่าวของสถานการจาก								
25 dBµV									
CF 20.2112 GHz	I			100	pts	1			8.0 s/
Ready # 329415									
02:47:51 PM 01/16/2	1003								
02:47:51 PH 01/16/5	023								





Plot 11: Spurious Emission 26.5 GHz - 40 GHz

Multi	/iew =	Spectrum	× Spectrum 2	× Spectrum	з Х					•
RefL	evel 100.00	dBµV	RBW 1 MHz							SGL
🖷 Att		0 dB 🖷 SWT 1080	s 🖶 VBW 3 MHz Mo	de Sweep						
			503_CBL1_20_26 - 40	G_125CM"						
1 Frequ	Jency Swee	ер								Max 2Av MaxLin
	Limit Check		E 000		SS SS				M2	[1] 51.35 dBμV
	Line LINE 7	4 DBUV FCC PART1 4 DBUV FCC PART1	15,209		55 55					38,497 600 GHz
90 dBµV-	Line Line 5	OBOV FCC PARTS	15:209	P	55				M1	[1]55.30 dBμV
										28.798 300 GHz
80 dBµV-										
LINE 74 D 70 dBuV	BUV FCC PART	15.209								
10 06p+-										
60 dBuV-										
		M1								
LINE 54 D	BUV FCC PART	15,209							M2-	
50 dBµV-								a state a state sets	and the second	and the second
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0.001				10001 010			,		eady	. 2023-01-20
										14:07:45
02:03:46	PH 01/20/2	023								

Plot 12: Spurious Emission 28.798 GHz

									
MultiView	Spectrum	× Spectrum 2	× Spectrum	13 X					•
Ref Level 64.0		RBW 1 MHz						:	SGL
 Att TDF "ST_4934_DE 	0 dB SWT 80 s	VBW 3 MHz 503_CBL1_20_26 - 400	G_125CM"						
1 Zero Span								0 1 Pk	Max @2Av MaxLin
									M1[1] 56.13 dBµV
62 d8µ∨									12.2400 s M2[2]-52.61 dBµV
os uppv									42.1600 s
60 dBµV									
58 dBµV									
	M1								
56 dBµV			the second state		• • • • • • • • • •	and the state			1.4.1.1.1.1.1.
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54 dBµV									
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52 06pV									
50 dBµ∨									
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46 dBµ∨									
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CF 28.79807 GH	z			100	pts				8.0 s/
r							e Ri	eady	14:09:53
02:09:53 PH 01/20	/2023								



Plot 13: Spurious Emission 40 GHz - 50 GHz

MultiView	Spectrum	X Spectrum 2	× Spectrum	з Х					•
Ref Level 0.00	dBm	 RBW 1 MHz 	_	_					SGL
		s . VBW 3 MHz Mode S	weep						
		L140 - 50G_125CM_DBM"							
1 Frequency Sw Limit Che	-1-		PÅ			1			Pk Max ⊜2Rm Max
FCC PART 95M ARI	STD-T111		PA					M2	[2] -51.57 dBm 49.235 600 GHz
Line FCC	PART 95M		PA						49.235 600 GHz [1] -38.99 dBm
Line RSS	251		PA	SS				NIT.	49,547 500 GHz
-10 dBm									491347 300 0Hz
ARIB STD-T111									
-20 dBm-									
R55-251									
-40 dBm									MI
-40 000								المتنافق فالمتعاد والمحمد والمعاد	
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- and the state of the state of the	يشامعه وسيريا العلمان								M2
50 40 m									
750 d9m									
-60_d8m	~~~~~								
40.0 GHz			10001 pts			1.0 GHz/			50.0 GHz
1010 0/16			20001 pts				17 R	eady	2023-01-20
03:17:02 PM 01/20	/2023								

Plot 14: Spurious Emission 50 GHz - 72.5 GHz measured with Auto ID

MultiView 📮 Max Peak	Х ОВW 💥	X 00W Japan	X ODW Japan 2	X 00W 2	×				
Ref Level 5.00 dBm									SGL
		• VBW 3 MHz Mo	de Auto Sweep						000
Inp: ExtMix V									10 11 1 10
1 Frequency Sweep Limit Check)		.	AIL					1Rm Max Auto ID
Line FCC PAR	T 95M			ASS				M2	 -28.10 dBm 58.496 100 GHz
0 dBm Line RSS-251	L			AIL				MI	46.33 dBm
FCC PART 95M								1914	50.000 500 GHz
-S dBm									00100000000
									1
-10 dBm									
10 000									1
-15 dBm-									
20 0011									
-20 dBm									
-20 dbm									
									1
-25 dBm-			M2						
PSS-251			<u>L</u> ```						1
RSS-251 			distant and a second						
				100					
-35 dBm-									l
-40 dBm-									
44-5 dBm									
-50 dBm-									
F0.0.011-			00501						70 5 011-
50.0 GHz			22501 pt			2.25 GHz/			72.5 GHz
							e Ri	eady	2023-02-02 12:34:49
12:34:49 PM 02/02/202									
AR. 52145 ER 52/02/202									

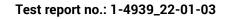


Plot 15: Spurious Emission 50 GHz - 72.5 GHz measured with Signal ID

NiView 🐂 Max Peak 🗙 08	W X 00W Japan	ODW Japan 2	X 00W 2	ĸ				
Ref Level 5.00 dBm Offset 48				-				S
e SWT	1800 s • VBW 3 MHz Mod	e Auto Sweep						
Frequency Sweep						0 1 Rr	m Max SigID USB 😑 2	Rm Max SigID L!
Limit Check		F	AIL					
Line FCC PART 95M dBm Line RSS-251								
PART 95M			AIL					
dBm								
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dBm								
) dBm								
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).0 GHz		22501 pts			2.25 GHz/	1		72.5
							teady	2923-02-0

Note:

- In the Signal ID mode, the spectrum analyser displays the upper and the lower sideband
- Plot 15 shows the shift of the upper and the lower sideband and therefore the signal in Plot 14 is not a real signal. The signal is produced by the external mixer.



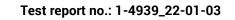


Plot 16: Out of Band Emission between 72.5 GHz and 85.5 GHz

							4
MultiView 🗧 OBW 🔸 🗙 Optimize							
Ref Level 10.00 dBm Offset 50.08 dB = RBW = SWT 1040 s = VBW							se
np: ExtMix E . Frequency Sweep					_	_	e 2Rm Clrw Auto I
Limit Check		PASS					1[2] -19.54 d
Line FCC PART 95M dBm Line RSS-251		PASS		1			79.753 900 0
dBm Line Roo-201		PASS					
				1			
dBm		1					
C PART 95M				1			
5 dBm		+ +					
				1			
10 dBm-							-
				1			
-15 dBm							-
			M1	1			
20 dBm-		line line	4)				
	1.1.1	der te her de beinderte		1 101 11			
25 dBm		THURSDAY THE PARTY OF THE PARTY	HANNA H				
55-251 30-08m			,				
30-08m							
			,				
-35 dBm							-
			,				
40 dBm							-
-45 dBm							
				1			
72.5 GHz	13001 p	ots		1.3 GHz/			85.5 0
						Ready	2023-01-16

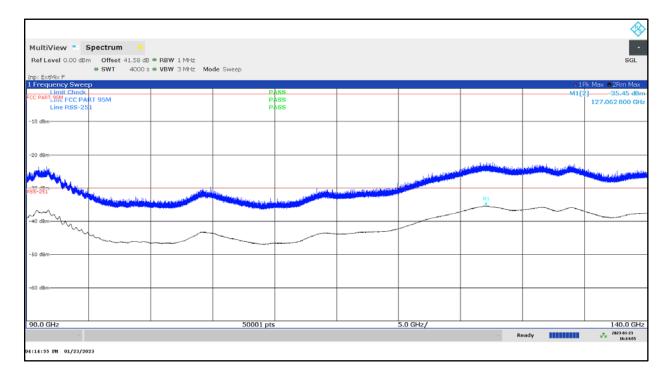
Plot 17: Spurious Emission 85 GHz - 90 GHz

									
MultiView = S	Spectrum 🔸								
Ref Level 0.00 dBn	 Offset 45.52 dB 	 RBW 1 MHz 							SGL
	• SWT 400 s	• VBW 3 MHz Mo	de Sweep						
Inp: ExtMix E 1 Frequency Swee	D							1Pk Clrw Auto ID 😐	2Rm Clrw Auto ID
Limit Check				ASS				M1	
FCC PARTL95M FCC PAI -5 dBm-Line RSS-25	RT 95M			ASS					89,427600 GHz
-5 dBm-time Nee-kee	*			100					
-10 dBm-									
10 000									
-15 dBm-									
-20 d8m-									
-25 d8m-									
									_
RSS-251			consideration.	للقو ويبار راقو الوابين و	والمتعار والمتعاورة	an more test care of billing or	المتحققة المراجعة المراجع المراجع	No ale fright a dealt with parent	And the second second second
and the second state and	أوأنيان وماتلا ويريير انترجين	يتارينيا الياليوانية اليانية والمارية المارية المارية المارية المارية المارية المارية المارية المارية المارية ا	a na ana ana ana ana ana ana ana ana an	A Landa of the State of the Sta	and the state of the second	an fill the for interval and the second she			
And the second second second second	States and a state of the state								
-40 dBm-								M1	
								Ť	
-45 dBm									
-50 d8m									
-55 dBm-									
85.0 GHz			5001 pts		5	00.0 MHz/	1	1	90.0 GHz
							e Ri	eady	2023-01-23
01:47:07 PH 01/23/20	23								



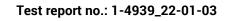


Plot 18: Spurious Emission 90 GHz - 140 GHz



Plot 19: Spurious Emission 140 GHz - 170 GHz

								
MultiView =	Spectrum							
Ref Level 0.00 dBr	m Offset 38.07 dB							SGL
Inp: ExtMix D	• SWT 2400 s	VBW 3 MHz Mo	de Auto Sweep					
1 Frequency Swee	p				 			01Rm Max
Limit Check FCC PART_95M RSS-25			P	ASS			M1[1	
	1		P	ASS				169.996 500 GHz
-5 dBm								
-10 d8m-								
10 0000								
-15 d8m-								
-20 d8m-								
-25 dBm-								
R55-251 -30 dbm								
-35 dBm-								
-35 000								M1
-40 d8m								
-45 dBm					 			
-50 d8m-								
-55 dBm-					 			
140.0 GHz			30001 pts		3.0 GHz/			170.0 GHz
						e Ri	ady	2023-01-24
								1011011
10:48:13 AM 01/24/20	23							





Plot 20: Spurious Emission 170 GHz - 220 GHz

									
MultiView •	Spectrum								
	m Offset 40.11 dB	• RBW 1 MHz							SGL
		• VBW 3 MHz Mo	de Auto Sweep						
Inp: ExtMix G 1 Frequency Swee	'n								0 1Rm Max
Limit Check			P	ASS				M1[3	
Line FCC PA	RT 95M			ASS					197.963 900 GHz
0 dBm-Line RSS-24	<u>i</u>		P	\ss					
FCC PART 95M									
-5 dBm-									
-10 d8m-									
-15 dBm-									
-20 dBm									
-25 dBm-									
066-051									
RSS-251 									
-35 dBm-									
					Mi				
-40 dBm									
45.40.00									
-45 d8m									
50.000									
-50 dBm-									
170.0 GHz			50001 pts			5.0 GHz/			220.0 GHz
ev.							e Re	ady	2023-01-24 10:09:01
01:09:31 PM 01/24/20	323								

Plot 21: Spurious Emission 220 GHz - 250 GHz

								
MultiView =	Spectrum							-
Ref Level 5.00 dBr	m Offset 48.76 dB							SGL
Inp: ExtMix J		VBW 3 MHz Mo	de Auto Sweep					
Inp: ExtMix J 1 Frequency Swee	:p							01Rm Max
Limit Check			P	ASS ASS			M1[]] -24.46 dBm
Line FCC PA	RT 95M		P.	ASS				222.566 400 GHz
FCC/PART 95M								
-5 dBm-								
-10 dBm-								
-15 d8m-								
-20 d8m					 			
M1								
~25 d8m		-						
-30 d8m								
-35 d8m-								
-40 dBm								
220.0 GHz			30001 pts	5	 3.0 GHz/			250.0 GHz
						e Re	ady	2023-01-24 14:15:51
								14:15:51
02:15:52 PM 01/24/20	23							



11.6 Frequency stability

Description:

§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.

RSS-251 chapter 11.1:

The radar device's occupied bandwidth (i.e. 99% emission bandwidth) shall be maintained within the 76-81 GHz frequency band while subjected to all conditions of operation specified in RSS-Gen.

<u>Limits:</u>

FCC	IC				
FCC §95.3379 (b)	RSS-251 chapter 7.2:				
The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following:					
Frequen	cy range				
76 GHz -	- 81 GHz				

Measurement:

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

Measurement results:

Test condition	Frequency f⊾ [GHz]	Frequency f _H [GHz]	Bandwidth [GHz]
-40 °C / V _{nom}	77.105	80.818	3.713
-20 °C / V _{nom}	77.102	80.819	3.717
-10 °C / V _{nom}	77.100	80.819	3.718
0 °C / V _{nom}	77.100	80.815	3.715
10 °C / V _{nom}	77.099	80.816	3.717
20 °C / V _{nom}	77.097	80.817	3.720
20 °C / V _{min}	77.096	80.814	3.717
20 °C / V _{max}	77.098	80.817	3.720
30 °C / V _{nom}	77.099	80.816	3.717
40 °C / V _{nom}	77.099	80.816	3.717
50 °C / V _{nom}	77.099	80.816	3.716
70 °C / V _{nom}	77.099	80.813	3.713



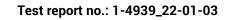
Note:

- Vertical Line V1 = 76 GHz
- Vertical Line V2 = 77 GHz
- Vertical Line V3 = 81 GHz

Verdict: Complies

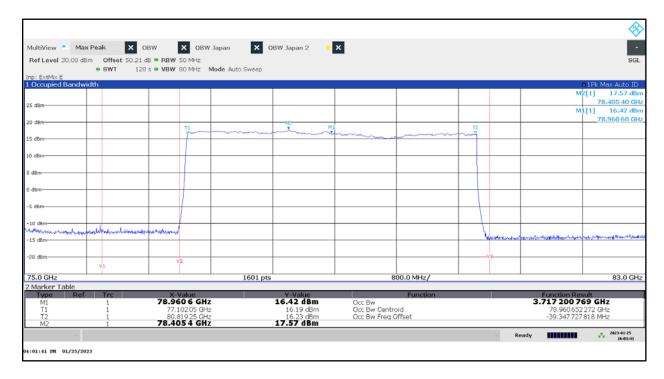
Plot 22: -40 °C / Vnom

MultiView Max	x Peak X OBW	X OBW J	anan X C	BW Japan 2	×					· ·
			apan	Jow Japan 2	^					
Ref Level 30.00 db	3m Offset 50.21 dB SWT 128 s	VBW S0 MHz M	ada Auto Cursos							SGL
Inp: ExtMix E	• 5WI 128 5	VBW SUMPZ M	ode Auto Sweep							
1 Occupied Bandw	ridth									• 1Pk Max Auto ID
									м	2[1] 19.73 dBm
25 dBm							-	_		77.670 80 GHz
			M2						M	1[1] 17.67 dBm 78.961 00 GHz
20 dBm		N N	min-	M		~~~~				70.90100 012
15 dBm		~ ~		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~	\square			
10 dBm-								_		
							1 1			
5 dBm										
0 dBm										
0 OBIN										
-5 dBm							+	_		
							1 1			
-10 dBm	a ha daladada						<u> </u>			
-15 dBm	englisher substations	policity a marked						human	March March March March	and the second
-15 dbm										
-20 dBm-								-v3		
	V1	V2								
CF 79.0 GHz			1601 pts		8	00.0 MHz/	1			Span 8.0 GHz
2 Marker Table										
Type Ref	Trc	X-Value		Y-Value		Function			Function Re	sult
M1 T1	1	78.961 GHz 77.10485 GHz		17.67 dBm 17.90 dBm	Occ Bw Occ Bw Centro	. I di			3.712 929 6 78.961 31	
T2	1	80.81778 GHz		17.67 dBm	Occ Bw Centro Occ Bw Freq (-38.688160	1021 MHz
M2	1	77.6708 GHz		19.73 dBm						
								e Re	ady	2023-02-23
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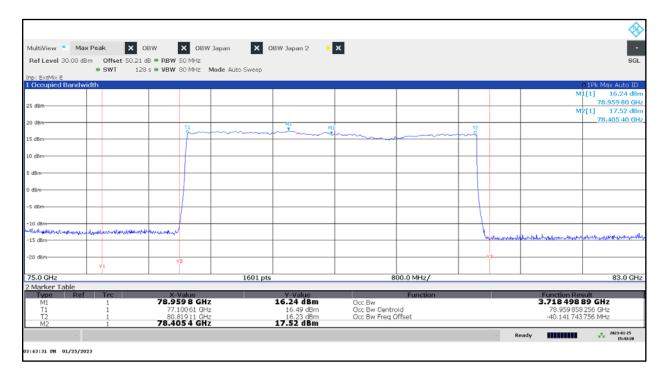


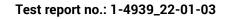


Plot 23: -20 °C / Vnom



Plot 24: -10 °C / Vnom





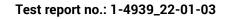


Plot 25: 0 °C / V_{nom}



Plot 26: 10 °C / Vnom



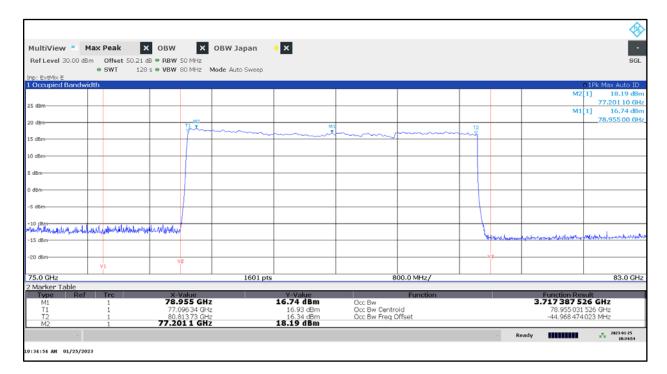


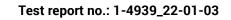


Plot 27: 20 °C / Vnom



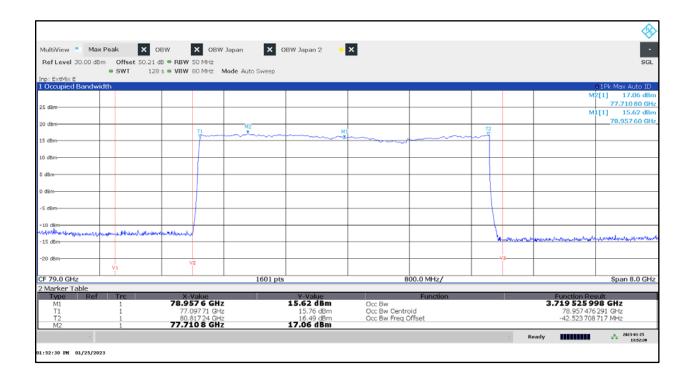
Plot 28: 20 °C / Vmin



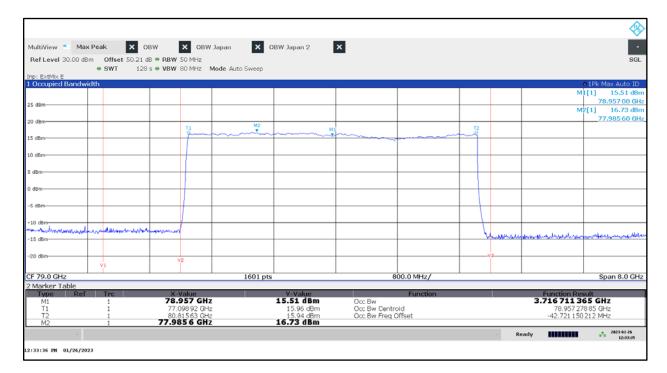


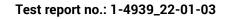


Plot 29: 20 °C / V_{max}



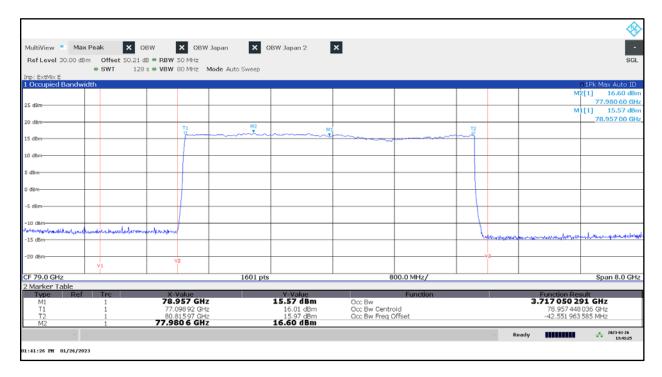
Plot 30: 30 °C / V_{nom}



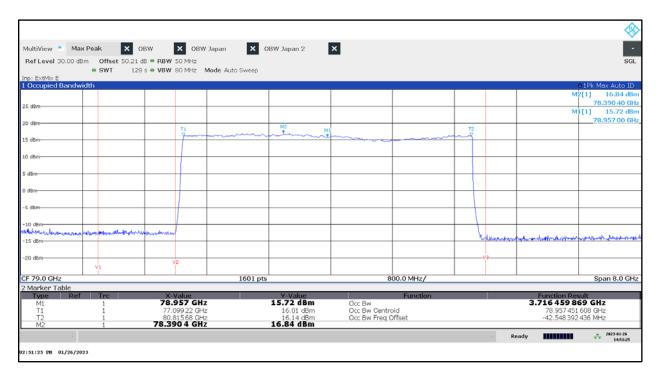


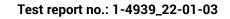


Plot 31: 40 °C / Vnom



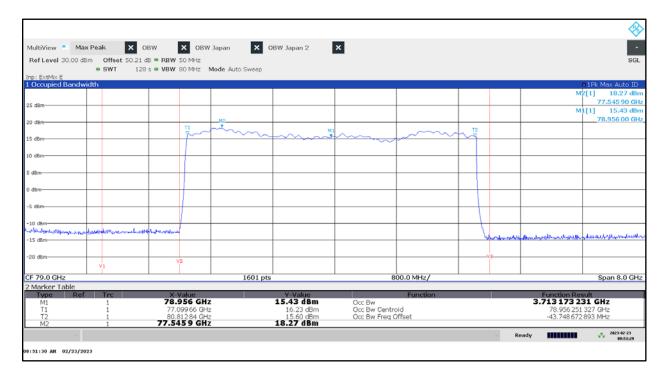
Plot 32: 50 °C / V_{nom}







Plot 33: -70 °C / Vnom





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
	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
С	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
00	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

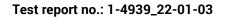
Version	Applied changes	Date of release
-/-	Initial release	2023-03-27

14 Accreditation Certificate – D-PL-12076-01-04

first page	last page				
Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBU Bignatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition 1 AkkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Accoreditation Entrusted extendition of the subsection 1 AkkStelleG in connection with Section 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Entrusted extendition of the subsection 1 akkStelleG in connection with Section 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Entrusted extendition of the State Section 1 akkStelleG in connection with Section 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Entrusted extendition 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Extendition 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Extendition 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Extendition 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Extendition 1 akkStelleGBU Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Extendition 1 akkStelleGBU Extendition 1 akkStelle	Deutsche Akkreditierungsstelle GmbH Office Berlin Spittelmarkt 10 10117 Berlin Office Frankfort am Main Office Braunschweig Bundesallie 100 33116 Braunschweig				
Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards The accreditation cartificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-RL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 07 pages. Registration number of the certificate: D-PL-12076-01-04 Frankfurt am Main, 09.06.2020 The cardificate together with its annex reflects the status of the time of the date of house. The current status of the scope of accreditation can be doned in the database of described bolies of the scheck Alkrediterungatelie Conder. http://www.ddks.ul/en/content/foccredited-bolies-doks	The publication of extracts of the accorditation certificate is subject to the prior written approval by Deutsche Akkreditisrungsstelle GmbH (DAkks). Exampted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overlead. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkds. The accreditation as granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Luk Gazette J. a.2523) and the Regulation (EC) No 755/2008 of the furposen Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation anyket surveillance relating to the marketing of products (Difical Journal of the European Lucion 128 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Reception of the European Loco, p. 300, DAkkS is a signatory to the Multilateral Agreements for Mutual Reception of the European Loco, operation for Accreditation (EA), Intermissional Accreditation accreditation and the 's accreditations. The up-to-date state of membership can be retrieved from the following websites: EA: woweuropean-accreditation.org UAC: wow.lac.org UAC: wow.				

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

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdf or https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-04_Canada_TCEMC.pdf





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

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Every	Office Berlin Spittelmark 10 10117 Berlin Office Frankfurt am Main Europa-Net S2 60327 Frankfurt am Main Office Braunschweig Bundesaller 100 38116 Braunschweig			
The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages. Registration number of the certificate: D-PL-12076-01-05 Frankfurt am Main, 09.06.2020 The certificate bagefor with 16 ansex reflects the status at the time of the date of case. The current status of the score of acccedition case bages at the status at the time of the date of case. The current status of the score of acccedition case bages and the status at the time of the date of case. The current status of the score of acccedition case bages address badies address	The publication of extracts of the accorditation certificate is subject to the prior written approval by Devische Adkrediterungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overlead. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS. The accreditation attested by DAkkS. The accreditation attested by DAkkS. The accreditation attested by DAkkS. Signal and the accuracitation of the Council of 9 July 2008 setting out the requirements for accreditation and arket surveillance relating to the marketing of products (DfGtal Journal of the European Into 128 d 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (E), No Testingatories (DfGtal Journal Formul (AF) and Intermational Laboratory Accreditation Cooperation (LAC). The signatories to these agreements recognise each other's accreditations. The up-to-date state of membership can be retrieved from the following websites: EA: www.iatc.org MAF; www.iatc.org MAF; www.iatc.org			

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

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf or https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf