









Bundesnetzagentu

# **TEST REPORT**

Test report no.: 1-0599/20-06-02

## **Testing laboratory**

#### **CTC advanced GmbH**

BNetzA-CAB-02/21-102

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#### Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS) The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

## Applicant

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## Manufacturer

ASTYX GmbH Caroline-Herschel-Str. 2 85521 Ottobrunn / GERMANY

## Test standard/s

CFR 47 Part 95. The 76-81 GHz Band Radar Service Subpart M CFR 47 Part 2, Frequency allocations and radio treaty matters; general rules and regulations Subpart J

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

## **Test Item**

Kind of test item: 77GHz Radar for Autonomous Drive Applications Model name: HiRes 6455 FCC ID: 2ASKB-HIRES55V3P1 Frequency: 76 – 81 GHz Antenna: Integrated patch antenna 10 V to 16 V DC Power supply: Temperature range: -20°C to +50°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
Lab Manager
Radio Communications

## Test performed:

Meheza Walla Lab Manager **Radio Communications** 



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#### 2 General information

#### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. 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: 2021-03-21 Date of receipt of test item: 2021-04-19 Start of test:\* 2021-04-22 End of test:\* 2021-05-04 -/-

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
CFR 47 Part 95, Subpart M	-/-	The 76-81 GHz Band Radar Service
CFR 47 Part 2, Subpart J	-/-	Frequency allocations and radio treaty matters; general rules and
		regulations

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		
ANGL 062 10 2012	1	American National Standard of Procedures for Compliance Testing		
AINSI C63.10-2013	-/-	of Unlicensed Wireless Devices		
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of		
		Transmitters Used in Licensed Radio Services		
KDB 653005 D01	v01r01	Equipment Authorization Guidance for 76-81 GHz Radar Devices		
	2019-04			

Accreditation	Description	
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05.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

		$T_{nom}$	+22 °C during room temperature tests
Temperature	:	T <sub>max</sub>	+50 °C during high temperature tests
		$T_{min}$	-20 °C during low temperature tests
Relative humidity content	:		47 %
Barometric pressure	:		1019 hpa
		$V_{nom}$	12 V DC by external power supply
Power supply	:	V <sub>max</sub>	16 V
		$V_{min}$	10 V



## 6 Test item

## 6.1 General description

Kind of test item	:	77GHz Radar for Autonomous Drive Applications
Model name	:	HiRes 6455
S/N serial number	:	1106-M1
Hardware status	:	6455v3.1
Software status	:	13.1.0
Frequency band	:	76 – 81 GHz
Type of modulation	:	FMCW
Number of channels	:	1
Antenna	:	Integrated patch antenna
Power supply	:	10 V to 16 V DC
Temperature range	:	-20°C to +50°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:

1-0599/20-06-01\_AnnexA 1-0599/20-06-01\_AnnexB 1-0599/20-06-01\_AnnexD

Tests were performed on 3 modulations, mode5\_5784, mode5\_5169 and mode5\_4262.

The channel power, the positive peak power, the occupied bandwidth (OBW) and the spurious emissions were measured on all modulations at  $T_{nom}$  /  $V_{nom}$ .

Tests under extreme test conditions were done according to ANSI 63.10 as worst case mode for given tests:

Frequency Stability: mode5\_4262



## 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).

k	calibration / calibrated		EK	limited calibration
ne	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

#### Agenda: Kind of Calibration



## 7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter

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

<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	n. a.	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	n.a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	n. a.	Meßkabine 1	HF-Absorberhalle	MWB AG 300023		300000551	ne	-/-	-/-
4	n. a.	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	09.12.2020	08.12.2021
5	n. a.	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
6	n. a.	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
7	n.a.	Turntable Interface- Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
8	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	295	300003787	vlKl!	04.09.2019	03.09.2021
9	n. a.	Switch-Unit	3488A	HP	2719A14505	30000368	ev	-/-	-/-
10	n. a.	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	10.12.2020	09.06.2022

#### 7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 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  $[dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$ 

## 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)

## Example calculation:

OP [dBm] = -39.0 [dBm] + 57.0 [dB] - 12.0 [dBi] + (-36.0) [dB] = -30 [dBm] (1 μW)

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## 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	vlKI!	09.12.2020	08.12.2023
2	n. a.	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	13.06.2019	12.06.2021
3	n. a.	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
4	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	371	300003854	vlKl!	14.01.2020	13.01.2022
5	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5289	300000213	vlKl!	14.07.2020	13.07.2022
6	n. a.	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
7	n. a.	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-
8	n. a.	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2020	10.12.2021
9	n. a.	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
10	n. a.	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
11	n. a.	Broadband Amplifier 5-13 GHz	CBLU5135235	CERNEX	22010	300004491	ev	-/-	-/-
12	n. a.	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
13	n. a.	NEXIO EMV- Software	BAT EMC V3.16.0.49	EMCO		300004682	ne	-/-	-/-
14	n. a.	PC	ExOne	F+W		300004703	ne	-/-	-/-
15	n. a.	RF-Amplifier	AMF-6F06001800- 30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-

## 7.3 Radiated measurements > 18 GHz



## 7.4 Radiated measurements > 50/85 GHz



#### OP = AV + D - G

(OP-rad. output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain)

<u>Example calculation:</u> OP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 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	n.a.	Horn Antenna 18,0- 40,0 GHz	LHAF180	Microw.Devel	39180-103-021	300001747	vlKI!	18.02.2019	17.02.2022
2	n. a.	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda		300000486	vlKI!	21.01.2020	20.01.2022
3	n. a.	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	vlKli	23.01.2020	22.01.2022
4	n.a.	Std. Gain Horn Antenna 33.0-50.1 GHz	2324-20	Flann	57	400000683	ne	-/-	-/-
5	n. a.	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne	-/-	-/-
6	n. a.	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814	ev	-/-	-/-
7	n. a.	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001988	ne	-/-	-/-
8	n.a.	Std. Gain Horn Antenna 92.3-140 GHz	2824-20	Flann		300001993	ne	-/-	-/-
9	n. a.	Std. Gain Horn Antenna 114-173 GHz	2924-20	Flann	*	300001999	ne	-/-	-/-
10	n. a.	Std. Gain Horn Antenna 145-220 GHz	3024-20	Flann	*	300002000	ne	-/-	-/-
11	n. a.	Std. Gain Horn Antenna 217-330 GHz	32240-20	Flann	233278	300004960	ne	-/-	-/-
12	n. a.	Standard Gain Horn 325-500 GHz	570240-20 1785-2a	Flann	273569	300006097	ev	25.05.2020	24.05.2022
13	n. a.	Broadband LNA 18-50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	09.03.2020	08.03.2022
14	n. a.	Harmonic Mixer 3- Port, 50-75 GHz	FS-Z75	Rohde & Schwarz	101578	300005788	k	17.06.2020	16.06.2021
15	n. a.	Harmonic Mixer 3- Port, 60-90 GHz	FS-Z90	R&S	101555	300004691	k	08.07.2020	07.07.2021
16	n. a.	Harmonic Mixer 3- Port, 75-110 GHz	FS-Z110	R&S	101411	300004959	k	19.06.2020	18.06.2021
17	n.a.	Harmonic Mixer 3- port, 90-140 GHz	FS-Z140	Rohde & Schwarz	101119	300005581	k	09.07.2020	08.07.2021
18	n. a.	Harmonic Mixer 3- Port, 110-170 GHz	FS-Z170	Radiometer Physics GmbH	100014	300004156	k	28.05.2020	27.05.2021
19	n. a.	Harmonic Mixer 3- Port, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157	k	14.07.2020	13.07.2021
20	n. a.	Harmonic Mixer 3- Port, 220-325 GHz	SAM-325	Radiometer Physics GmbH	100002	300004158	k	23.07.2020	22.07.2021
21	n.a.	Harmonic Mixer 325-500GHz	FS-Z500	Radiometer Physics GmbH	101016	300006096	k	25.05.2020	24.05.2021
22	n. a.	Spectrum Analyzer 2 Hz - 85 GHz	FSW85	R&S	101333	300005568	k	17.06.2020	16.06.2021



## 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 50/85 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.



#### **Measurement uncertainty** 9

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 Far field consideration for measurements above 18 GHz

## Far field distance calculation:

 $D_{ff} = 2 \times D^2 / \lambda$ 

with

- Far field distance Dff
- D Antenna dimension
- wavelength λ

## Spurious emission measurements:

Antenna frequency range in GHz	Highest measured frequency in GHz	D in cm	λ in cm	D <sub>ff</sub> in cm
18-26	26	3.4	1.15	20.04
26-40	40	2.2	0.75	12.91
40-50	50	2.77	0.60	25.58
50-75	75	1.85	0.40	17.11
75-110	110	1.24	0.27	11.28
90-140	140	1.02	0.22	9.72
110-170	170	0.85	0.18	8.19
140-220	220	0.68	0.14	6.78
220-325	325	0.43	0.09	4.01
325-500	500	0.26	0.06	2.22

## 11 Summary of measurement results

$\square$	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.

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TC Identifier Description		Verdict	Date	Remark
RF-Testing	47 CFR Part 95 Subpart M	see below	2021-05-20	-/-

Test specification clause	Test case	Temperature conditions	Power source voltages	с	NC	NA	NP	Results (max.)
§2.1046 §95.3367 (a) / (b)	Radiated power	Nominal	Nominal	$\boxtimes$				-/-
§2.1047	Modulation characteristics	-/-	-/-	X				-/-
§2.1049	Occupied bandwidth (99% bandwidth)	Nominal	Nominal	X				-/-
§2.1051	Spurious emissions at antenna terminals	Nominal	Nominal			X		see note
§2.1053 §95.3379 (a)(1) §95.3379 (a)(2) §95.3379 (a)(3)	Field strength of emissions (radiated spurious)	Nominal	Nominal					-/-
§2.1055 §95.3379 (b)	Frequency stability	Nominal Extreme	Nominal Extreme	$\boxtimes$				-/-

**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.



## 12.1 Radiated power

## **Description:**

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.

#### Measurement:

Parameters			
Detector:	Pos-Peak / RMS		
Sweep time:	100s		
Resolution bandwidth:	1 MHz		
Video bandwidth:	3 MHz		
Trace-Mode:	Max Hold / Clear Write		

## <u>Limits:</u>

## FCC §95.3367 (a) (b)

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Frequency	Measurement distance	EIRP
76.0 - 81.0 GHz	3.0 m	88 µW/cm <sup>2</sup> → 50 dBm (Average) 279 µW/cm <sup>2</sup> → 55 dBm (PEAK)

#### Measurement results:

Mode	Test conditions	Radiated peak power (eirp) [dBm]	Channel power [dBm]	Power spectral density [dBm/MHz]
mode5_5784	T <sub>nom</sub> / V <sub>nom</sub>	14.79	13.85	-17.30
mode5_5169	T <sub>nom</sub> / V <sub>nom</sub>	14.95	14.00	-17.43
mode5_4262	T <sub>nom</sub> / V <sub>nom</sub>	15.02	14.09	-17.30

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## Plot 1: mode5\_5784- Radiated peak power, PSD

IltiView Spe	ctrum X Spectrum	2 X Spectru	um 3 X			
fLevel 50.00 dBm	Offset 57.00 dB • RBW 1 MH SWT 100 s • VBW 3 MH	lz Iz Mode Auto Sweep				
ExtMix E coupled Bandwidth				0 1 Dk M	av Auto ID 😑 2R	m May Aut
ccupica banawiaan				O TI K III	M1[1	1 14.79
						76.3846
IBm-					M2[2	] -17.30
						76.1119
Bm						
ism	T1 MI		70			
D.u.	Kuntun	mmmm	AV			
Bm-						
-m						
in minutes						
Martin	m2		hanny			
d9m	Imm		an on the man programme	manual Margaret	moutureman	mannen
abiii		·····	m			
dBm				-		
abiii						
dBm						
						V2
	V I					
/8.0 GHz		1001 pts	700.0 MHz/			Span 7.0
arker Table	V Value	V Value	Eupation		Eurotian E	ocult
уре кен Птс M1 1	76.384 6 GHz	14.79 dBm	Occ Bw		2.018 302	2 648 GH
T1 1	76.10338 GHz	14.07 dBm	Occ Bw Centroid		77.112	534713 GH
T2 1	78.12169 GHz	10.95 dBm	Occ Bw Freq Offset		-887.465	286 817 MH
M2 2	76.1119 GHZ	-17.3V aBM				
				Measuring		22.04

Plot 2: mode5\_5169- Radiated peak power, PSD

1ultiView	Spectrun	n 🗙 Spectrum	2 X Spectru	um 3 🗙		
Ref Level 50.	00 dBm Offse	t 57.00 dB ● RBW 1 MH	łz.	_		_
np: ExtMix E	● SWT	100 s ● VBW 3 MH	Iz Mode Auto Sweep			
Occupied Ba	ndwidth				o 1Pk Max A	uto ID 😑 2Rm Max Auto ID
						M1[1] 14.95 dB
0 dBm						76.391 60 GI
o dom						M2[2] -17.43 dB
o dom						76.11890 GF
o upm						
U dBm		T1 M1		70		
		min	mmm	λ <u>Σ</u>		
D dBm			Vican			
I dBm						
10 dBm	munnar			Maria I.		
maent		V		many mython with	thrown many and	
20 dBm		- monther	man	M	· · · · · · · · · · · · · · · · · · ·	and show when a start water the
30 dBm						
40 dBm						
		V1				V2
			001 ptp	300 0 MHz (		Enon 7.0 Cl
	0		.001 pts	700.0 MH2/		span 7.0 GF
Type Po	e Tro	V-Value	V-Value	Eupetion		Eupction Result
M1	1	76.391 6 GHz	14.95 dBm	Occ Bw		2.018 079 33 GHz
Τ1	î	76.1036 GHz	14.43 dBm	Occ Bw Centroid		77.112.639.905 GHz
T2	1	78.121 68 GHz	11.42 dBm	Occ Bw Freq Offset		-887.360 095 224 MHz
M2	2	76.1189 GHz	-17.43 dBm			
					- Measuring	22.04.202
						18:44:4

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## Plot 3: mode5\_4262 - Radiated peak power, PSD

		_	_			~
MultiView 📒 Sp	pectrum × Spect	rum 2 × Spec	trum 3 🗙 🗙			•
Ref Level 50.00 dBm	Offset 57.00 dB • RBW	1 MHz				
np: ExtMix E	• 5WT 100 S • VBW	5 MHZ Mode Auto Swee				
Occupied Bandwid	lth			●1Pk Ma	ax Auto ID 😑 2Rm	n Max Auto ID
					M1[1]	15.02 dB
0 dBm					M2[2]	- 17 30 dB
					malal	76.38460 GF
0 dBm						
o ubm			T2			
0 dBm	Annound A	mmm	-mr.			
dBm						
10 dBm	Man Man		tur.			
and	min		Mun marin	mound mark have	anna alananna	in march
20 dBm		www.	~~~			
30 dBm						
So ubiii						
40 dBm						
	V1					V2
E 78.0 GHz		1001 pts		7/		Span 7.0 GH
Marker Table				<i>.</i>		,
Type Ref Tr	c X-Value	Y-Value	Functi	ion	Function Re	sult
M1 1 T1 1	76.384 6 GHZ	15.02 dBm 13.00 dBm	Occ Bw Occ Bw Centroid		2.017489 771132	581 GHZ
T2 1	78.121 98 GHz	11.47 dBm	n Occ Bw Freq Offset	t	-886.76495	54 685 MHz
M2 2	76.384 6 GHz	-17.30 dBm				
				Measuring		22.04.202 18:52:4
-52-43 22 04 20	01					
.52.45 22.04.20	<u> </u>					

## Plot 4: mode5\_5784 – Mean power

Ref Level 50.00 dB       Offset 57.00 dB       RBW 1 MHz 100 s       VBW 3 MHz Mode Auto Sweep       O1         ACLR       O1       O1       O1         40 dBm       T31       O1         30 dBm       O1       O1       O1         10 dBm       O1       O1       O1         20 dBm       O1       O1       O1       O1         30 dBm       O1       O1       O1       O1         20 dBm       O1       O1       O1       O1         30 dBm       O1       O1       O1       O1         30 dBm       O1       O1       O1       O1       O1         31 (Ref)       Sum 2       O10       D1       D1       D1	
Gene Level SUUd da B KBW 1 MHZ         SWT         100 s P VBW 3 MHz         Mode Auto Sweep           p: ExtMix E         01           ACLR         01           d8m         101         101           0         08m         101           0         101         101           78.5 GHz         1001         101           Chanel         Bandwidth         Offset         Power           Ty (Per)         5.000 GHz         13.85 dBm	
ExtMix E     O I       ACLR     O I       dBm     T31       dBm        T41 (Ref)	
ACLR     O1       dBm     Ts1       dBm     Ts1       dBm     Image: State Stat	
dBm     T1     Image: Chanel     T001 pts     600.0 MHz/       Chanel     Bandwidth     Offset     Power       Tx1 (Ref)     5.000 GHz     13.85 dBm	m Clrw Aut
JBm     Image: Sector of the sec	
IBm     Imm     Imm <td></td>	
IBM I I I I I I I I I I I I I I I I I I	
IBM I I I I I I I I I I I I I I I I I I	
IBm I I I I I I I I I I I I I I I I I I	
Bm     Image: Chanel     Bandwidth     Offset     Power       Tx1 (Ref)     5.000 GHz     13.85 dBm	
Bm     Im     <	
dBm dBm dBm v1 z8.5 GHz chanel Chanel Bandwidth Offset Chanel Chanel Chanel Chanel S.000 GHz Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chanel Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan Chan	
dBm     dBm     dBm     dBm       v1     dBm     dBm     dBm       78.5 GHz     1001 pts     600.0 MHz/       esult Summary     None       Channel     Bandwidth     Offset       Txt (Ref)     5.000 GHz     13.85 dBm	
dBm dBm dBm dBm dBm dBm v1 z8.5 GHz that the set of the se	
dBm	
dBm dBm dBm v1 dBm v1 z8.5 GHz table table tabl	
dBm	
dBm         dBm <td></td>	
dBm         dI         Image: Channel         Bandwidth         Offset         Power           TA1 (Ref)         5.000 GHz         13.85 dBm         13.85 dBm	
dBm dBm v1 v1 v1 v1 v1 v1 v1 v1 v1 v1	
dBm v1 dBm v1 dBm dBm dBm dBm v1 dBm	
dBm         v1         1001 pts         600.0 MHz/           78.5 GHz         1001 pts         600.0 MHz/           esult Summary         None           Channel         Bandwidth         Offset         Power           Txt (Ref)         5.000 GHz         13.85 dBm	
V1         1001 pts         600.0 MHz/           result Summary         None           Channel         Bandwidth         Offset         Power           Tx1 (Ref)         5.000 GHz         13.85 dBm           Tu Table         13.85 dBm	
78.5 GHz         1001 pts         600.0 MHz/           esult Summary         None           Channel         Bandwidth         Offset         Power           Tx1 (Ref)         5.000 GHz         13.85 dBm           Total         13.85 dBm         13.85 dBm	V2
State         State         State           esult Summary         None           Channel         Bandwidth         Offset         Power           Tx1 (Ref)         5.000 GHz         13.85 dBm           Total         13.85 dBm	Span 6.(
Channel         Bandwidth         Offset         Power           Tx1 (Ref)         5.000 GHz         13.85 dBm           Tx1 Fabre         13.85 dBm	oparrore
Tx1 (Ref) 5.000 GHz 13.85 dBm	
	05.5
✓ Measuring	18:

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<u>^</u>

## Plot 5: mode5\_5169 - Mean power

IultiView = Spect	rum X Spec	trum 2	× Spectru	m 3	×			
p: ExtMix E ACLR	SWT 100 s • VBW	3 MHz Mode	Auto Sweep				o 1Rn	n Clrw Auto i
l dBm								
1 dBm			T*1					
1 dBm								
l dBm								
dem								
0 d9m								
	m							
0 dBm			~					
0 dBm								
V1								V2
78.5 GHz		1001 pts		60	0.0 MHz/			Span 6.0
Channel Tx1 (Ref) Tx Total	Bandwidth 5.000 GHz		Offset	e	Power 14.00 dBm 14.00 dBm			
~					~	Measuring		+ 22.04. 18:4

## Plot 6: mode5\_4262 – Mean power

								<b></b>
MultiView = Spect	rum 🗙 Spe	ctrum 2	× Spect	um 3	×			•
Ref Level 50.00 dBm	Offset 57.00 dB • RBV	V 1 MHz			_			
Inn: ExtMix E	SWT 100 s • VBV	VI3 MHz Mo	de Auto Sweep					
1 ACLR			_				o 1 Rr	n Clrw Auto ID
40 dBm								
				s1				
30 dBm							-	
20 dBm							-	+ +
10 dBm								
0 d0m								
U UBIII								
-10 dBm								1
-20 dBm	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
-30 dBm								
-40 dBm								1/2
V1								
CF 78.5 GHz		1001 pt	S	60	0.0 MHz/			Span 6.0 GHz
2 Result Summary			No	ne				
Tx1 (Ref)	5.000 GHz	ľ	Uffset		14.09 dBm			
Tx Total	2.500 GHz				14.09 dBm			
						Measuring		22.04.2021
B-56-30 00 04 0001								10.00
8:56:30 22.04.2021								



## **12.2 Modulation characteristics**

#### **Description:**

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

## Comments from manufacturer on modulation characteristics according to KDB:

Parameter	Mode 5_5784	Mode 5_5169	Mode 5_4262
Duty Cycle %	14.8	13.2	10.9
Timing RF on (ms)	14.8	13.2	10.9
Timing RF off (ms)	85.2	86.8	89.1
Power	Constant during RF on	Constant during RF on	Constant during RF on
Steepness of Ramps (GHz/s)	24414.1	24414.1	24414.1
Calibration	N/A	N/A	N/A
Antenna Beam Steering (Tx)	No	No	No
Characteristic	Linear FMCW	Linear FMCW	Linear FMCW
Sweep Bandwidth (GHz)	2	2	2
Sweep Rate (kHz)	8.6	9.7	11.7
Sweep Time (us)	83.3	83.3	83.3



#### **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.

#### Measurement:

Parameters		
Detector:	Pos-Peak	
Sweep time:	100s	
Resolution bandwidth:	1 MHz	
Video bandwidth:	3 MHz	
Trace-Mode:	Max Hold	
Measurement uncertainty	Span/1000	

## Limits:

## FCC §95.3379 (b)

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|--|

#### Measurement results:

Mode	o	perating Frequency Rang	je
	f⊾ [GHz]	fн [GHz]	OBW [GHz]
mode5_5784	76.103 380	78.121 690	2.018
mode5_5169	76.103 600	78.121 680	2.018
mode5_4262	76.104 490	78.121 980	2.017

Note: for corresponding plots refer to chapter 12.1



#### **Description:**

Investigation of the emission limits at the band edge.

#### Measurement:

Parameters		
Detector:	RMS	
Sweep time:	100 s	
Resolution bandwidth:	1 MHz	
Video bandwidth:	3 MHz	
Trace-Mode:	Max Hold	

## Limits:

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

FCC §95.3379 (b)

Frequency Range [GHz]	Measurement distance	Power Density
40 - 200	3.0 m	600 pW/cm² → -1.7 dBm

## <u>Limits:</u>

# Frequency range f(lowest) > 76.0 GHz f(highest) < 81.0 GHz

#### Measurement results:

See plots below.in Chapter 12.5, Plot 17, 18, 19.



# 12.5 Field strength of spurious emissions

### **Description:**

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

#### Limits:

FCC §95.3379

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FCC				
CFR Pa	art 95.3379 (a) (1) / CFR Part 95.3379	) (a) (3)		
Radiated Spurious Emissions				
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.				
Frequency [MHz]         Field Strength [dBµV/m]         Measurement distance				
0.009 - 0.490	2400/F[kHz]	300		
0.490 - 1.705	24000/F[kHz]	30		
1.705 – 30.0	1.705 – 30.0 30			
30 88	<b>30 88 30.0 10</b>			
88 – 216	33.5	10		
216 - 960	216 - 960 36.0 10			
960 - 40 000	54.0	3		

## <u>Limits:</u>

## FCC §95.3379 (a) (2) (i) + (ii)

Frequency Range [GHz]	Measurement distance	Power Density
40 - 200	3.0 m	600 pW/cm <sup>2</sup> → -1.7 dBm
200 – 231	3.0 m	1000 pW/cm <sup>2</sup> → +0.5 dBm

## Measurement results:

Frequency	Detector	Bandwidth	Level [dBµV]	Distance [m]	Limit [dBµV]	Margin [dB]
38.6 GHz	AVG	1 MHz	32.5	0.5	54.0	21.5





Plot 7: 9 kHz - 30 MHz, Magnetic antenna, (Valid for specified Modes)

Plot 8: 30 MHz - 1 GHz, vertical / horizontal polarization, (Valid for specified Modes)



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Plot 9: 1 GHz - 18 GHz, vertical / horizontal polarization, (Valid for specified Modes)

Plot 10: 18 GHz - 26.5 GHz, vertical / horizontal polarization, (Valid for specified Modes)

MultiView	Spectrum	× Sp	ectrum 2	<mark>∗</mark> ×					-
Ref Level 100	.00 dBµV	RBW	1 MHz						
🖷 Att	0 dB 😑 SW	T 100 s 👄 VBW	3 MHz Mode	Auto Sweep					
TDF "NARDA638	_CABLE502_CBL	1_18-26_5G_0	_5M_DBUV"						
1 Frequency Sv	veep					1		O1Rm Max	●2Av MaxLin
								M1[1]	24.25 dBµV
									25.34090 GHz
90 dBµV								M2[2]	<u>—23,20 dBµV</u>
									25.34090 GHz
80 dBµV									
	U1 74 000 db.								
	— нт 74.000 авр	v							
70 авру									
60. dBuV									
		H2 54.000	) dBµV ———						
50 dBµV									
40 dBµ∨									
00 JD 11									
30 gBhA								M1	
				h					
20 dBuV	~~~~~~			h			~~~~~~		
10 dBµV									
18.0 GHz			1001 pt	S	85	0.0 MHz/			26.5 GHz
	~						Measuring.		23.04.2021 12:22:18
12:22:18 23.04.2021									

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RefLevel 100.0 Att	00 dBuV								· · · · · · · · · · · · · · · · · · ·
Att		RBW	1 MHz						
	0 dB 😑 SWT	100 s 👄 VBW	3 MHz Mode	Auto Sweep					
DF "NARDA637_	CABLE502_CBL1	1_26_5-40G_0_	_5M_DBUV"					o 1 Pm May	● 24 v MayLin
in requeries 344	cep							M1E1	1 49.22 dBu
									38.6990 GH
0 dBµV								M2[2	]—32.25 dBµ
									38.6990 GH
0 dBuV									
o do da	—H1 74.000 dBµV								
7 gBhA									
∂ dBµV									
		H2 54.000	dBµV						
0 dBµV									×
								~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	
0 dBµV									
								( ,	42
									ř
	-	~~~~~	~~~~~						
		~							
Э dBµV									
) dBµV									
26 5 GHz			1001 pt	<u> </u>	1	35 GHz/			40.0 GHz
			1001 pt	~	1		Measuring		23.04.2021
							susuning.		12:06:07

## Plot 11: 26.5 GHz – 40 GHz, vertical / horizontal polarization, (Valid for specified Modes)

Plot 12: 38 GHz, vertical / horizontal polarization, (mode5\_5784)

MultiView	Spectrum	× Sp	ectrum 2	×				•
Ref Level 10	0.00 dBµV	RBW	1 MHz					
Att	0 dB 🖷 SW1	T 100 s 👄 VBW	3 MHz Mode	Auto Sweep				
TDF "NARDA63	7_CABLE502_CBL	.1_26_5-40G_0	_5M_DBUV"					
1 Frequency S	weep			1	1		01Rm Max	2Av MaxLin
							M1[1]	49.55 dBµ\
							MOLO	38.69990 GHz
90 dBµV							WIZLZ	
								38.61800 GHz
80 dBuV								
	H1 74.000 dBµ	/						
70 dBµV								
eo deuv								
00 ubµv								
		H2 54.000	) dBµV ———		M1			
50 dBµV					V.			
		h				-1		
		p						
40 dBµV								
					M2			
-30 dBu∀								
20 dBµV								
10 dBuV								
10 0004								
CE 38 6 GHz			1001 pt	c	20			Spap 2.0 CHz
GF 3010 GHZ	~		1001 pt	.3	20	Measuring		23.04.2021
						nousunign		12:08:25
12:08:25 23.04.202	1							



MultiView	Spectrum	× Spe	ctrum 2	×					-
Ref Level 100	).00 dBµV	RBW	1 MHz						
🕨 Att	0 dB 🖷 SW	T 100 s 👄 VBW	3 MHz Mode	Auto Sweep					
TDF "NARDA637	_CABLE502_CBL	.1_26_5-40G_0_	5M_DBUV"						
I Frequency SV	жеер							O IRM Max	● ZAV MaxLin
								MILI	49.15 dBµ
								MOLOI	38.69990 GH
90 аврv								MZ[Z]	29 61200 CH
									38.01200 GH.
80 dBµV									
	——H1 74.000 dBµ	/							
70 dBµ∨									
60 dвµV									
		H2 54.000	dBµV ───		M1				
50 dBµ∨									
		r							
40. dBuV									
10 0001									
					MI2 V				
30-dBµ∀ <del></del>									
20. dav.									
20 0601									
10 dBµV									
CF 38.6 GHz			1001 p	S		200.0 MHz/			Span 2.0 GHz
							<ul> <li>Measuring</li> </ul>	g <b>III ( ) ( )</b>	<b>400</b> 23.04.2021
									12:10:17

## Plot 13: 38 GHz, vertical / horizontal polarization, (mode5\_5169)

Plot 14: 38 GHz, vertical / horizontal polarization, (mode5\_4262)

	•		•		,				
MultiView	Spectrum	× Sp	ectrum 2	×					•
Ref Level 10	0.00 dBµV	■ RBW	/ 1 MHz						
Att	0 dB 🖷 SW	T 100 s 👄 VBW	3 MHz Mode	Auto Sweep					
TDF "NARDA63	7_CABLE502_CBL	1_26_5-40G_0	_5M_DBUV"						
1 Frequency S	weep							• 1Rm Max	●2Av MaxLin
								M1[1]	48.39 dBµV
									38.69990 GHz
90 dBµ∨								M2[2]	—31,77 dBµV
									38.61200 GHz
80 dBµV									
	——H1 74.000 dBµ	v							
70 dBµV									
60 dBµ∨									
so do di		H2 54.00	n aeha		M1				
su авµv									
40 dBµV									
					MO				
					V				
-30-dBuV							C		
20 dBµV									
TO GRHA									
CF 38.6 GHz			1001 pt	is is a second s	20	0.0 MHz/			Span 2.0 GHz
L	~						<ul> <li>Measuring.</li> </ul>		23.04.2021 12:12:29
12:12:29 23.04.202	1								

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MultiView	Spectrum	1							•
Ref Level 30	.00 dBm Offse	et 37.25 dB 🖷 F	<b>BW</b> 1 MHz						
Att	0 dB 🖷 SWT	100 s 😑 🗸	BW 3 MHz Mo	de Auto Sweep					
1 Frequency S	weep								o 1Rm Max
								M1[1	] -33.35 dBn 41.8480 GH
20 dBm									
10 dBm									
0 dBm									
FCC95M_40-231GH	Z								
-10 dBm									
-20 dBm									
-30 dBm									
									~
-40 dBm					$\frown$				
-50 dBm									
-60 dBm									
40.0 GHz	_		1001 pt	S	2	.0 GHz/	Manaurina		60.0 GHz
	v						Measuring	•••	11:20:48

## Plot 15: 40 GHz – 60 GHz, vertical / horizontal polarization, (Valid for specified Modes)

## Plot 16: 60 GHz - 90 GHz, vertical / horizontal polarization, (mode5\_5784)

						_			<u></u>
MultiView 📑	Spectrum	× Sp	ectrum 2	× Spectr	um 3	×			-
Ref Level 50.00	dBm Offse	t 57.00 dB 🖷 RE	3W 1 MHz						
Ion : ExtMix E	● SWT	100 s 👄 VE	SW 3 MHz Mo	de Auto Sweep					
1 Frequency Sw	reep							o 1 Rrr	n Max Auto ID
								M1[1	] -20.89 dBm
									60.010 0 GHz
40 dBm									
30 dBm									
20 dBm									
10 dBm									l
FCC95M_40-231GHZ-									l
-10 dBm									
M1 r-20 dBm					man				
	~					1			
-30 dBm						L			
-40 d8m									<u> </u>
-40 0000-									
60.0 GHz			1001 p	ts		3.0 GHz/			90.0 GHz
~							Measuring		23.04.2021 08:38:04
08:38:04 23 04	4 2021								
20.00.01 20.04									

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<u>
</u>

Plot	17: 60 GHz – 90 GHz, vertical ,	/ horizontal	polarization,	(mode5_5169)

MultiView 📑	Spectrum	× Sp	ectrum 2	× Spect	rum 3	3 3	×			
Ref Level 50.00	dBm Offset !	57.00 dB 🗢 RE	W 1 MHz				-			_
	● SWT	100 s 🖷 VB	WI3 MHz Mo	ode Auto Sweep						
np: extimix e I Frequency Sw	еер								o 1Rm	ı Max Auto ID
									M1[1	] -20.90 dBr
										60.005 0 GH
40 dBm										
										I
30 dBm										
										I
20 dBm										
										I
LO dBm										
										I
005M 40-231CHZ										
					'					
10 40										I
-TO OBM										
1						(mm),				I
-20 dBm						- ward	1			
				+		J				
-30 dBm										
										I
-40 dBm										
										I
60.0.CHz			1001 0	te			0.6Hz/			00.0.04
00.0 GHZ			1001 p	13		3	.0 0H2/	Monguring		90.0 GHz
· · · · · · · · · · · · · · · · · · ·							V	measuring		08:33:18

Plot 18: 60 GHz – 90 GHz, vertical / horizontal polarization, (mode5\_4262)

									Sector 1
MultiView	Spectrum	× sp	ectrum 2	× Spect	rum 3	×			•
Ref Level 50.0	0 dBm Offset	t 57.00 dB • R	BW 1 MHz BW 3 MHz M	de Auto Sween					
np: ExtMix E	- 341	100 5 🔍 🕯		de Auto Sweep				010	m Max Auto TD
Trequency 3	weep							M1[	11 -20.89 dBn
									60.015 0 GH
40 dBm									
30 dBm									
20 dBm									
LO dBm									
COM 40 001CU	7								
CCB0M_40 20101	-				+				
10 d0m									
10 0BIII									
1					purp and				
-20 dBm						Ч			
	$\sim$			+	+				
-30 dBm									1
-40 dBm									1
60.0 GHz			1001 p	ts	1	3.0 GHz/	1		⊥ 90.0 GHz
	~						- Measuring		23.04.2021
									00.27.31





MultiView Spectrum	× Spectrum 2	× Spectrum 3	×			
Ref Level 30.00 dBm Offset !	53.60 dB • RBW 1 MHz	-	_			_
● SWT	100 s 🗢 VBW 3 MHz 🛛 Mod	<b>je</b> Auto Sweep				
ip: ExtMix F Frequency Sweep					o 1Rr	n Max Auto I
					M1[1]	-19.29 di
0 dBm						
) dBm						
dBm C95M_40-231GHZ						
.0 dBm						
20 dBm				M1		
• . M					h	$\leftarrow$
O dBm						-
-0 dBm					+	
50 dBm						
i0 dBm						
0.0 GHz		s	5.0 GHz/			140.0
				Measuring		23.04.2

## Plot 19: 90 GHz - 140 GHz, vertical / horizontal polarization, (Valid for specified Modes)

Plot 20: 140 GHz - 220 GHz, vertical / horizontal polarization, (Valid for specified Modes)

							~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
MultiView	Spectrum	× Spectrum 2	× Spectrum	з 🗙			•
Ref Level 30.0	OdBm Offset S	56.60 dB • RBW 1 MHz		_			
np: ExtMix G	• SWI	100 s 🖷 VBW 3 MHz I	Mode Auto Sweep				
. Frequency Sv	veep					0	1Rm Max Auto ID
						M1[1]	-22.57 dBr 197.822.0 GH
20 dBm							
.0 dBm							
) dBm CC95M 40-231GHZ							
10 dBm							
20 dBm					M1		
20 0011							
-30 dBm							
-40 dBm							
50 dBm							
60 dBm							
140.0 GHz		1001	pts	8.0 GHz/			220.0 GH
					Measuring		23.04.202
							00.00.1

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MultiView	- Spectrur	n 🗙 Sp	ectrum 2	× Spec	trum 3	×			
Ref Level 3	0.00 dBm Offs	et 54.78 dB 🖷 R	BW 1 MHz			_			_
Inn Exthering 7	● SWT	100 s 👄 V	BW 3 MHz Mo	ode Auto Sweep	c				
I Frequency	Sweep							Θ	1Rm Max Auto ID
								M1[1]	-17.57 dBn 221.280 0 GH
20 dBm									
10 dBm									
CC95M_40-231	SHZ								
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm									
-60 dBm									
220.0 GHz			1001 p	ts		1.1 GHz/			
	~						Measuring		23.04.2021

## Plot 21: 220 GHz – 231 GHz, vertical / horizontal polarization, (Valid for specified Modes)

# 12.6 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.

#### FCC §95.3379 (b) Limits: f(lowest) > 76.0 GHz Frequency range f(highest) < 81.0 GHz

#### Measurement results:

#### mode5\_4262 (Worst Case)

#### **Measurement results:**

#### **Temperature variation**

Mode	Temperature in °C	f∟in GHz	f <sub>H</sub> in GHz	Bandwidth [GHz]
	-20 °C / V <sub>nom</sub>	76.111 160	78.121 380	2.010
	-10 °C / V <sub>nom</sub>	76.110 740	78.120 970	2.010
	0 °C / V <sub>nom</sub>	76.104 230	78.120 940	2.017
mode5_4262	10 °C / V <sub>nom</sub>	76.107 900	78.121 990	2.014
(Worst case)	20 °C / V <sub>min-max</sub>	76.1104 490	78.121 980	2.017
	30 °C / V <sub>nom</sub>	76.108 900	78.122 780	2.014
	40 °C / V <sub>nom</sub>	76.103 860	78.121 380	2.017
	50 °C / Vmin-max	76.104 070	78.120 140	2.016

#### Voltage variation

Voltage variation of rated input voltage	f∟in GHz	f <sub>H</sub> in GHz			
< 85 % of U	Valtara variation daga n	act offect the redicted signal			
> 115 % of U	voltage variation does n	of affect the radiated signal			







Plot 22: OBW, -20 °C / Vnom

Inp: ExtMix E	0.001 10030 000		·P					
l Occupied Bandwi	idth				o 1 Pk Ma	× Auto ID ● 2Rm M1[1]	1 Max	Auto 1
50 dBm							76.2	37 80
						M2[2]	-1	6.78
40 dBm							76.2:	<del>37 80</del>
30 dBm								
20 dBm	M1							
	× ······	mon .	T2					
l0 dBm			which we wanted	-				
) dBm								
10 dBm								
unal	M2		Whenderman	I see a dear anon	ummun .			
20 dBm		······	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	and and denter the second	- YANKA	- mar - mar - the territority	mm	-marken
30 dBm								
40 dBm	V1						V2	2
F 78.0 GHz		1001 pts	70	0.0 MHz/			Spar	n 7.0
Marker Table								
Type Ref T	Trc X-Value	Y-Value	Oce Bui	Function		Function Re	sult	GH-
T1	1 76.11116 GHz	14.76 dBr	n Occ Bw Ce	entroid		77.116 2	7361,	4 GH:
T2	1 78.121 38 GHz	11.95 dBr	n Occ Bw Fre	eq Offset		-883.72638	36 409	9 MHz

## Plot 23: OBW, -10 °C / Vnom

MultiView	Spectrum	X Spe	ctrum 2	X Spect	um 3	X				
Ref Level 50.00	dBm Offset • SWT	57.00 dB • RB' 100 s • VB'	N/1 MHz N/3 MHz Mod	ode Auto Sweep						
ínp: ExtMix E										
l Occupied Banc	dwidth						o1Pk Ma>	k Auto ID 😐 2Rm	n Max Au	uto ID
								M1[1]	15.2	25 dBm
50 dBm									76.181	80 GH2
								M2[2]	-17.0	01 dBm
40 dBm									76.181	80 GH
30 dBm										
20 dBm		T1M1								
		- Vinnen	man	-	T2					
10 dBm		+	000		my		_			
0 dBm										
-10 dBm	way was a second	and								
10 doment	man	M2			manner		1			
		, rtinning	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	manna.		where the war	mar why why warm	emporante	moun	manhana
-20 uBm					**					
-30 dBm										
		V1							V2	
-40 dBm										
3F 78.0 GHz			1001 p	ts	70	00.0 MHz/			Span 7	.0 GHz
2 Marker Table										
Type Ref	Trc	X-Value		Y-Value		Function		Function Re	esult	
M1 T1	1 4	76.181 8 GH	2	14.02 dBm	Occ Bw	etroid		2.010 234 4	472 GI	
T2	1	78 120 97 GH	2 7	11.59 dBm	OCC BW En	en Offset		-884 147 50	94124 M	n iz 1Hz
M2	2	76.181 8 GH	z ·	17.01 dBm	000 000 110	oq onset		00-1.1-47-01	- 12-11	
							Moncuring		• 23.0	04.2021
~							measuring		•• 0	7:29:47

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Plot 24: OBW, 0 °C / Vnom

				M2[2]	76.1 <mark>8180</mark> -17.13
				M2[2]	-17.13
					76.18180
ти					
- Finning	m	T2			
		ww.			
and I have been a second					
M2		manune.	1		
		" When the most	Margary and a construction of the contraction of th	hand have been a second and have a second and	moun
					V2
10	001 pts	700.0 N	1Hz/		Spap 7 0
			1001 pts 700.0 N		

## Plot 25: OBW, 10 °C / Vnom

MultiView	Spectrum	× Spectrum 2	× Spectro	um 3 X			-
Ref Level 50.00	dBm Offset 57.	00 dB • RBW 1 MHz	_	_			
	● SWT	100 s 👄 VBW 3 MHz	Mode Auto Sweep				
np: ExtMix E Occupied Bap	dwidth				o 1 Pk M	lax Auto ID   e 28r	n Max Auto ID
occupied ball						M1[1]	15.34 dB
i0 dBm							76.230 80 GI
						M2[2]	-16.97 dB
-0 dBm							76.18180 G
0 dBm							
0 dBm		MI					
	T.	1 mm	mmm,	T2			
0 dBm			m	~~			
d D uu							
J dBm							
10 dBm	ma ferd						
menn	- marken	M2		man growing and water the server	monunded		
20 dBm			www.	and the second s		monnonman	roamh - polerage a
30 dBm						-	
40 d8m	V1						V2
E 78.0 GHz		100	1 pts	700.0 MHz/			Span 7.0 GH
Marker Table							
Type Ref	Trc >	(-Value	Y-Value	Function		Function R	esult
M1 T1	1 /6.	2506 GHZ 76.1079 GHz	11.39 dBm	Occ Bw Occ Bw Centroid		2.014 093	074 GHZ 46 472 GHz
T2	1 78	8.121 99 GHz	11.37 dBm	Occ Bw Freq Offset		-885.0535	27 533 MHz
M2	2 <b>76.</b>	1818 GHZ	-16.97 dBm		_		- 22.04.202
		Instru	nent warming up		<ul> <li>Measuring</li> </ul>		23.04.202

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## Plot 26: OBW, 20 °C / Vmin-max

np: ExtMix E Occupied Bandwid	th	MHZ Mode Auto Sweep		o 1Pk Ma	x Auto ID. ⊜2Rm	n Max Auto
					M1[1]	15.02
10 dBm						76.38460
					M2[2]	-17.30
30 dBm						76.38460
0 dBm	T1 M1					
	* minn	ummin.	T2			
0 dBm		···· ····	<u>~</u>		+	
dBm-						
10 dBm						
mith	M2		hand when a second more	manana .		
20 dBm	provingen	······································			som abbet when	- Imalensia
30 dBm						
40 dBm						V2
	Vi					
= 78.0 GHz		1001 pts	700.0 MHz/			Span 7.0
Marker Table	Y Value	V Valua	Eupstion		Eurotion De	ocult
M1 1	76.384 6 GHz	15.02 dBm	Occ Bw		2.017 489	581 GHz
T1 1	76.10449 GHz	13.00 dBm	Occ Bw Centroid		77.11323	35 045 GH
T2 1	78.121 98 GHz	11.47 dBm	Occ Bw Freq Offset		-886.76495	54.685 MHz

## Plot 27: OBW, 30 °C / Vnom

MultiView	Spectrum	X Sr	pectrum 2	× Spect	um 3	×			
Ref Level 50.00	dBm Offset	57.00 dB • R	BW 1 MHz BW 3 MHz M	nde Auto Sween		-			
Inp: ExtMix E	- 0111	1000-	bu onne na	and hate entrop					
1 Occupied Band	dwidth						●1Pk Ma	ax Auto ID 😑 2Rr	n Max Auto
								M1[1]	14.72 c
									76.17480
40 dBm								M2[2]	-17.48 c
									76.17480
30 dBm									
20 dBm		T-01							
		Vimm			T2				
10 dBm			mount	min	n f				
o dour									
U dBm									
		~							
-10 dBm	Man marine	M			tun.				
mound		M2			mm	mound announce	mannumen		
-20 dBm		- promo		-	~		and the second sec	a spanner and and a	manner
-30 dBm									
-40 dBm									
-40 ubiii									V2
		V1							
CF 78.0 GHz		1	1001 p	ots		700.0 MHz/	1		Span 7.0 C
2 Marker Table									· ·
Type Ref	Trc	X-Value		Y-Value		Function		Function R	esult
M1	1 7	76.1748 G	Hz	14.72 dBm	Occ Bw			2.01388	163 GHz
Τ1	1	76.10890	GHz	14.06 dBm	Occ Bw	Centroid		77.115	837 39 GHz
T2	1	78.122.78 (	GHz	12.14 dBm	Occ Bw	Freq Offset		-884.1626	10 446 MHz
M2	2	/6.1748G	HZ ·	-17.48 abm					
							- Measuring		22.04.2
									19:09

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Plot 28: OBW, 40 °C / Vnom

p: ExtMix E	andwidth	1000 - 100 -						o t Dk Ma		o Ma	v Aut
Occupied D									M1[1]	i Ma	14.83
0 dBm										76.3	38460
5 dbm									M2[2]	-	17.52
) dBm					-					76.2	384.60
) dBm		T1 M1			-					<u> </u>	-
		× mm	m	m		2					
dBm				· ~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m						-
dD ma											
ubm											
0 dBm	marken a	June									
Uneral where		M2				manufina	deal a granter	monumente			
0 dBm		min	www.www.	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m	F	of a Anne-Mon	marken	sime when we	unn	ana kana kana kana kana kana kana kana
					Ιļ						
0 dBm					† `						
U dBm										X	12
		V1									
78.0 GHz			1001 pts			70	0.0 MHz/			Spa	an 7.0
Marker Tab	ole	V-Value		V-Value	_		Euroction		Eurotion Pa	a cult	-
M1	1	76.384 6 GHz	1	4.83 dBm		Occ Bw	Tunction		2.017 525	164	i GH
T1	1	76.10386 GHz		13.50 dBm		Occ Bw Cer	ntroid		77.1126	5190	02 GH
T2	1	78.121 38 GHz		10.71 dBm		Occ Bw Fre	q Offset		-887.380.98	30 23	38 MH

## Plot 29: OBW, 50 °C / Vmin-max

											- 📀
MultiView	Spectrum	× Sp	ectrum 2	× Spect	run	13 >	×				-
Ref Level 50.00	dBm Offset	57.00 dB • RE	3W 1 MHz			_	-				
Inp: ExtMix E	= 5WI	100 s 🖶 VE	SWY 3 MIHZ IVIC	ode Auto Sweep							
1 Occupied Band	dwidth							⊖1Pk Ma	ax Auto ID 😐 2Rn	h Max	< Auto ID
									M1[1]	1	14.30 dBm
40.40.4										76.3	35 70 GHz
40 dBm									M2[2]	- 1	17.94 dBm
00 d0m										76.5	17 50 GHz
30 dBm											
20 dBm		T1 M1									
		Junim	mm	mm.	T	2					
10 dBm					w						
0 dBm											
		and									
-10 dBm	manner	r			-						
monent		M2				mannon	- alleren and margh	moundaries			
-20 dBm			masan		h~	1.	- obtained	*** WALLA	e destruction to the second	mm	mandan
-30 dBm					-	<u> </u>			_		
-40 dBm					-						
	· · · · · · · · · · · · · · · · · · ·	/								V:	2
05 70 0 011		T	1001			70					7.0.011
CF 78.0 GHZ			1001 p	LS	_	/0	U.U MHZ/			spa	n 7.0 GHz
2 Marker Table	Tro	V Volue	_	V Voluo			Eurotion		Eurotion D	noul+	_
M1	1 <b>7</b>	6.3357 GF	1z	14.30 dBm		Occ Bw	Function		2.016 073	.suit 063	GHz
T1	i	76.10407 G	Hz	12.78 dBm		Occ Bw Cer	ntroid		77.1121	05 69	4 GHz
T2	1	78.12014 G	Hz	9.40 dBm		Occ Bw Fre	q Offset		-887.8943	05 90	5 MHz
M2	2 7	6.5175 GH	1z -	-17.94 dBm	_						
~								Measuring		*	22.04.2021
											20.01.42
20:01:42 22.04	4.2021										



#### 13 Glossary

EUT	Equipment under test					
DUT	Device under test					
UUT	Unit under test					
GUE	GNSS User Equipment					
ETSI	European Telecommunications Standards Institute					
EN	European Standard					
FCC	Federal Communications Commission					
FCC ID	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					
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					
WLAN	Wireless local area network					
MC	Modulated carrier					
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 <sub>0</sub>	Carrier to noise-density ratio, expressed in dB-Hz					

## 14 Document history

Version	Applied changes	Date of release				
-/-	Initial release - DRAFT	2021-05-04				
-/-	Minor changes	2021-05-20				

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

first page	last page
Deutsche Akkreditierungsstelle Deutsche Akkreditierungsstelle GmbH	Deutsche Akkreditierungsstelle GmbH
Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Acccreditation	Office Berlin Office Frankfurt am Main Office Braunschweig Spittelmarkt 10 Europa-Allee 52 Bundesallee 100 10117 Berlin 60327 Frankfurt am Main 38116 Braunschweig
The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields: Telecommunication (FCC Requirements)	
	The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkrediterungstelle GmbH (DAKS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleat. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAKS. The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Enders) Law Gottent 10, 2025) and the Beneditation (20) App SC/2008 Othe European Parliament and of .
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	The Caucil of July 2006 setting used the requirements for accordiation and market surveilance relating to the marketing of products (Official Journal of the European Infont 212 of 9 July 2006, p. 30). DAMA's is a signatory to the Multilateral Agreements for Multiland Recognition of the European co-peration for Accreditation (EA), International Accreditation Forum (IAF) and International Libboratory Accreditation Cooperation (UAC). The signatories to these agreements recognise sea Abdr's accreditations. The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org IAC: www.iaf.uu IAF: www.aif.nu
Frankfurt am Main, 09.06.2020 by order Dis-Ing, Trivit and Egner Head of Division The confictate together with its once refress the status at the time of the date of issue. The current status of the scope of accretification can be found in the database of accredited badies of Devtsche Akhrediterwagsstatie Canbit. https://www.doks.do/en/content/accredited-badies-dokis	

Note: The current certificate annex is published on the website (link see below) of the Accreditation Body DAkkS or may be received by CTC advanced GmbH on request

#### https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf