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Bundesnetzagentu

TEST REPORT

Test report no.: 1-0599/20-08-02

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-HIRES55
Frequency:	76 – 81 GHz
Antenna:	Integrated patch antenna
Power supply:	10 V to 16 V DC
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:

p.o.

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: 2021-05-12 Date of receipt of test item: 2021-06-14 Start of test:* 2021-06-15 End of test:* 2021-06-29 -/-

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					
	-/-	American National Standard of Procedures for Compliance Testing					
ANSI 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						

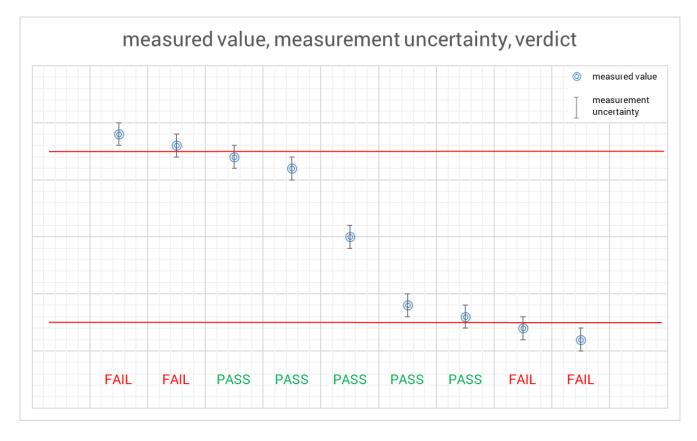
Accreditation	Description	
D-PL-12076-01-05	Telecommunication FCC requirements https://www.dakks.de/as/ast/d/D-PL-12076-01-05.pdf	DAKKS Deutsche Akkreditierungsstelle D-PL-12076-01-05



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

Temperature : T _{nom} T _{max} T _{min}		T _{max}	 +22 °C during room temperature tests +50 °C during high temperature tests -20 °C during low temperature tests
Relative humidity content	:		47 %
Barometric pressure	:		1019 hpa
Power supply : V _{nom} V _{max} V _{min}		V _{max}	 12 V DC by external power supply 16 V 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		SN1106-M1
of N Schar Hamber	•	SN1107-M1
Hardware status	:	6455v3
Software status	:	15.1.0
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:

1-0599/20-08-01_AnnexA 1-0599/20-08-01_AnnexB 1-0599/20-08-01_AnnexD

Tests were performed on 2 modulations, mode2_4262, mode2_4672.

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: Mode2_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).

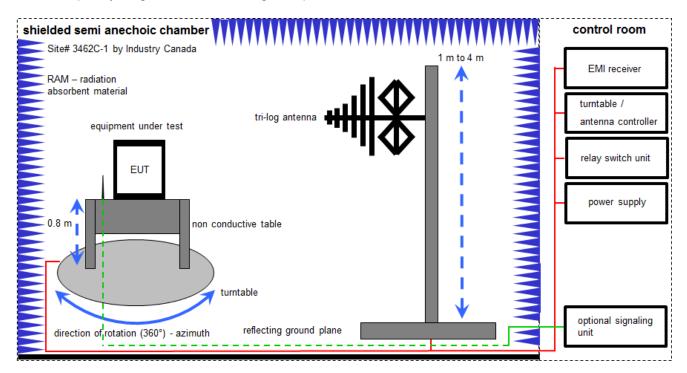
k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical
			maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: 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)

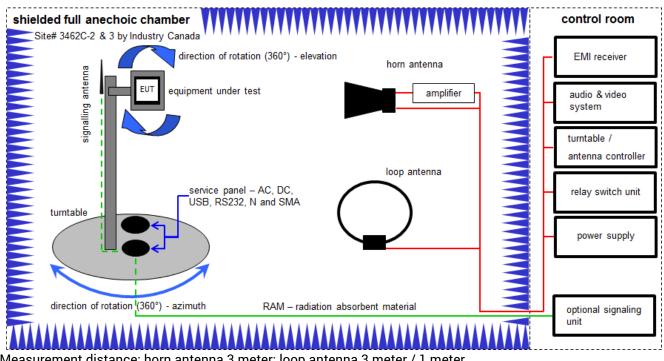
<u>Example calculation</u>: FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)



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)

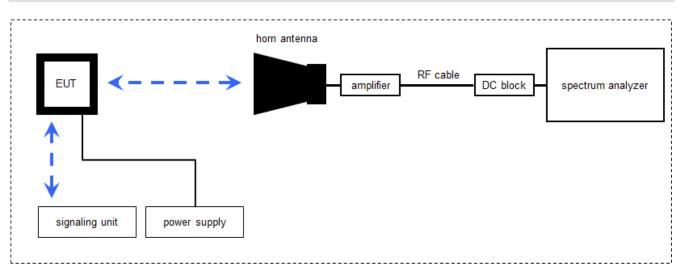
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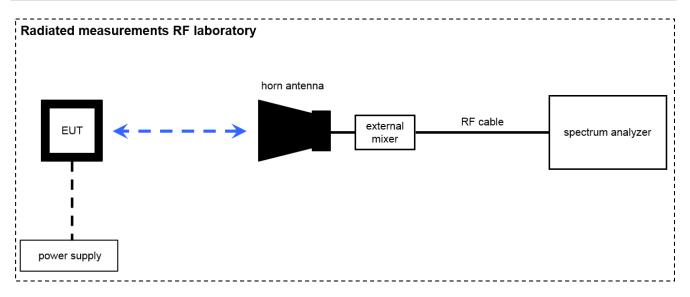


No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vlKl!	09.12.2020	08.12.2023
2	n. a.	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vlKl!	13.06.2019	12.06.2022
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	vlKl!	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	vlKI!	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
15	n. a.	Harmonic Mixer 3- Port, 60-90 GHz	FS-Z90	R&S	101555	300004691	k	08.07.2020	07.07.2021
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, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157	k	14.07.2020	13.07.2021
19	n. a.	Harmonic Mixer 3- Port, 220-325 GHz	SAM-325	Radiometer Physics GmbH	100002	300004158	k	23.07.2020	22.07.2021
20	n. a.	Spectrum Analyzer 2 Hz - 50 GHz	FSW50	R&S	101332	300005935	k	05.03.2021	04.03.2022



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 _{ff} 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

\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.

CTC I advanced

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	47 CFR Part 95 Subpart M	see below	2021-07-22	-/-

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					-/-
§2.1047	Modulation characteristics	-/-	-/-	X				-/-
§2.1049	Occupied bandwidth (99% bandwidth)	Nominal	Nominal	\boxtimes				-/-
§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	X				-/-

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>

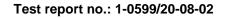
FCC §95.3367 (a) (b)

CTC I advanced

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

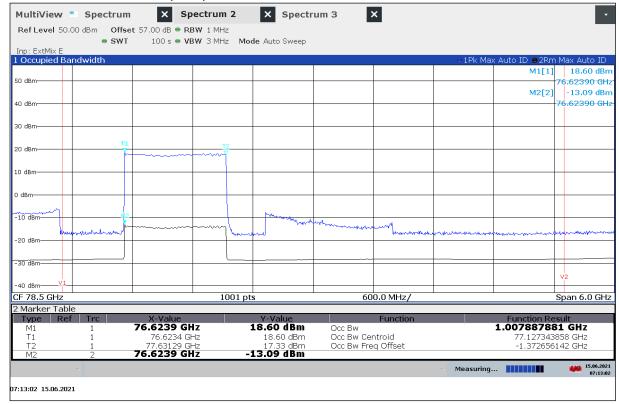
Measurement results:

Mode	Test conditions	Radiated peak power (eirp) [dBm]	Channel power [dBm]	Power spectral density [dBm/MHz]	
Mode2_4262	T _{nom} / V _{nom}	18.60	16.14	-13.09	
Mode2_4672	T _{nom} / V _{nom}	18.15	16.13	-13.62	





Plot 1: Mode2_4262- Radiated peak power, PSD



Plot 2: Mode5´2_4672- Radiated peak power, PSD

MultiView Spectru			um 3 ×		•
	set 57.00 dB 🗢 RBW 1 MH:				
 SW Inp: ExtMix E 	T 100 s 🗢 VBW 3 MH:	z Mode Auto Sweep			
1 Occupied Bandwidth				●1Pk Max Auto ID (Rm Max Auto ID
				N	11[1] 18.15 dBm
50 dBm					77.46900 GH
				N	12[2] -13.62 dBm
40 dBm					77.46900 GH
30 dBm					
	M1 T	27			
10 dBm					
0 dBm					
-10 dBm	M2-	Manage and	-tha b		
a some man	-hh	No. and the second second	Manusconder Municipality	manufacture de mar a service an	a marine marked on
-20 dBm					
-30 dBm	,				
					V2
-40 dBm					
CF 78.5 GHz	1	001 pts	600.0 MHz/		Span 6.0 GHz
2 Marker Table					
Type Ref Trc	X-Value	Y-Value	Function		on Result
M1 1	77.469 GHz 76.62443 GHz	18.15 dBm 17.30 dBm	Occ Bw Occ Bw Centroid		38979 GHz
T1 1 T2 1	76.62443 GHz 77.63052 GHz	17.30 dBm 17.27 dBm	Occ Bw Centrold Occ Bw Freg Offset		27473544 GHz 72526456 GHz
M2 2	77.469 GHz	-13.62 dBm		1.57	2020400 012
▽				🗸 Measuring	15.06.2021 07:05:14
7:05:15 15.06.2021					

Test	report	no.:	1-0599/	20-08-02
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Plot 3: Mode2_4262 - Mean power

MultiView 📑 Spectrum	× Spectrum	2 × Spect	rum 3 🔹	×			•
Ref Level 50.00 dBm Offset		_		-			_
SWT Inp: ExtMix E	100 s 🗢 VBW 3 MHz	Mode Auto Sweep					
1 ACLR						0 1Rm 0	Irw Auto ID
50 dBm							
		Т	*1				
40 dBm							
30 dBm							
20 dBm							
			'		I		
10 dBm							
0 dBm							
-10 dBm							
-20 dBm							
-30 dBm							
							V2
-40 dBm							
CF 78.5 GHz	10	01 pts		0.0 MHz/		S	pan 6.0 GHz
2 Result Summary			ne				
Channel Tx1 (Ref)	Bandwidth 5.000 GHz	Offset		Power 16.14 dBm			
Tx Total	5,000 0112			16.14 dBm			
~					Measuring		400 15.06.2021 07:18:57
							07:18:57
07:18:57 15.06.2021							

Plot 4: Mode2_4672 - Mean power

MultiView	Spectrum	× Spe	ectrum 2	× Spect	rum 3	×			•
Ref Level 50	0.00 dBm Offset SWT		WIMHz WI3MHz Moo	de Auto Curren					_
Inp: ExtMix E	- 3111	100 S 🖶 VB		ie Auto Sweep					
1 ACLR								O1Rm	n Clrw Auto ID
50 dBm									
				-	F#1				
40 dBm									
30 dBm									
20 dBm									
10 dBm									
0 dBm									
-10 dBm									
	~								
-20 dBm									
20 0011									
-30 dBm									
									V2
-40 dBm									
CF 78.5 GHz			1001 pts			00.0 MHz/			Span 6.0 GHz
2 Result Sum Chanr		Bandwidth		Offset	one	Power			_
Tx1 (R	ef)	5.000 GHz		Unset		16.13 dBm			
Tx Tot	tal					16.13 dBm			
	~						Measuring		15.06.2021 07:08:56
07:08:56 15.06.20	21								



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 2_4262	Mode 2_4672
Duty Cycle %	10.9	12.0
Timing RF on (ms)	10.9	12.0
Timing RF off (ms)	89.1	88.0
Power	Constant during RF on	Constant during RF on
Steepness of Ramps (GHz/s)	12207.0	12207.0
Calibration	N/A	N/A
Antenna Beam Steering (Tx)	No	No
Characteristic	Linear FMCW	Linear FMCW
Sweep Bandwidth (GHz)	1	1
Sweep Rate (kHz)	11.7	10.7
Sweep Time (us)	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)

CTC I advanced

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

Measurement results:

Mode	Operating Frequency Range				
	f⊾ [GHz]	fн [GHz]	OBW [MHz]		
Mode2_4262	76.623 400	77.631 290	1008		
Mode2_4672	76.624 430	77.630 520	1006		

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			

<u>Limits:</u>

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

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

<u>Limits:</u>

Frequency rangef(lowest) > 76.0 GHzf(highest) < 81.0 GHz</th>

Measurement results:

See plots below.in Chapter 12.5, Plot 15.



FCC §95.3379 (b)

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

FCC							
CFR Pa	art 95.3379 (a) (1) / CFR Part 95.3379	9 (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	30	30					
30 88	30.0	10					
88 – 216	88 - 216 33.5						
216 - 960	36.0	10					
960 - 40 000	54.0	3					

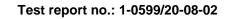
<u>Limits:</u>

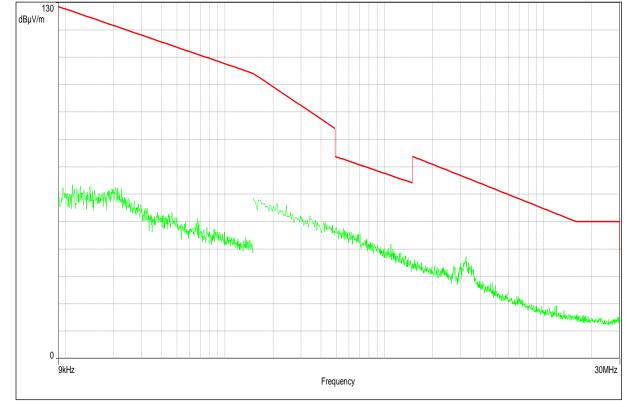
FCC §95.3379 (a) (2) (i) + (ii)

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

Measurement results:

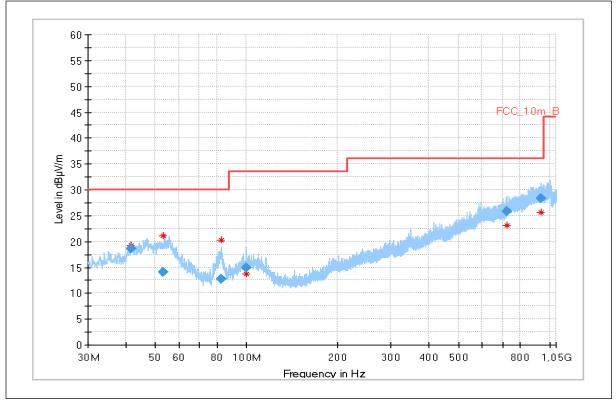
Frequency	Detector	Bandwidth	Level [dBµV]	Distance [m]	Limit [dBµV]	Margin [dB]
38.6 GHz	AVG	1 MHz	37.7	1	54.0	16.3



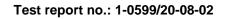


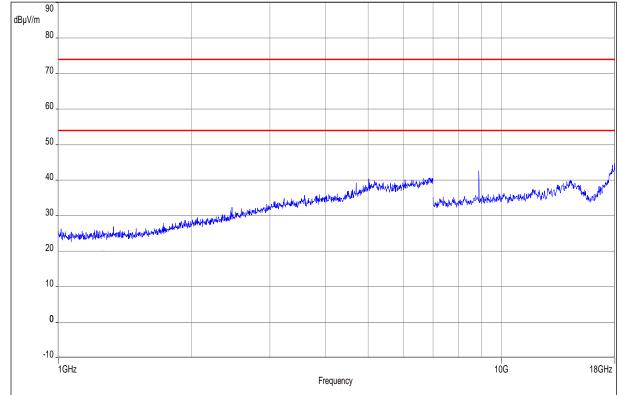
Plot 5: 9 kHz - 30 MHz, Magnetic antenna, (Valid for specified Modes)

Plot 6: 30 MHz - 1 GHz, vertical / horizontal polarization, (Valid for specified Modes)

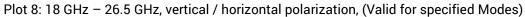


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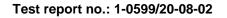


Plot 7: 1 GHz - 18 GHz, vertical / horizontal polarization, (Valid for specified Modes)

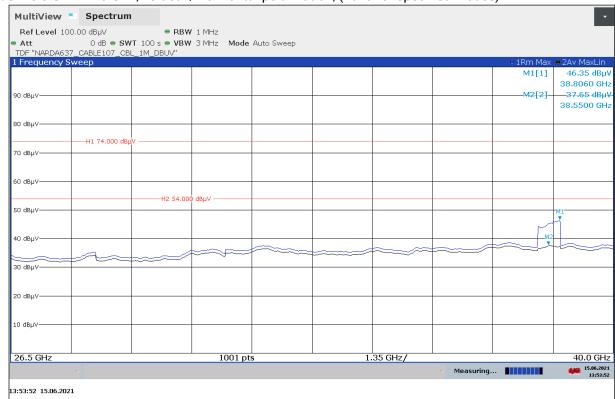


Att	0 dB 👄 SWT 1	00 s 👄 VBW	3 MHz Moo	le Auto Sweep				
	CABLE107_CBL_1	M_DBUV"					- 15 - 11	
Frequency Swe	еер						-	a e 2Av MaxLin
							M1[1]	
0 dBµV								25.46830 GH 30.40 dBL
							M2[2]	25,46830 GF
o dout								25,46830 G
0 dBµV								
	—Н1 74.000 dBµV —						 	
0 dBµV								
0 dBµV								
			10.11					
0 dBµV		H2 54.000	авhл —					
о авру								
0 dBµ∨							-	-
							Mž	
о dвµv								
0 dBµV								
o dop i								
0 dBµV								
18.0 GHz			1001	nts	85	0.0 MHz/		26.5 GH
Marker Table			1001	515		010 111127		2010 01
Type Ref	Trc	X-Value		Y-Value		Function	Function R	esult
M1	1 25.	.4683 GHz		31.44 dBµV		- anodori	- aneuonno	Jour
M2	2 25.	4683 GHz		30.40 dBµV				

CTC I advanced







Plot 9: 26.5 GHz - 40 GHz, vertical / horizontal polarization, (Valid for specified Modes)

Plot 10: 40 GHz - 60 GHz, vertical / horizontal polarization, (Valid for specified Modes)

MultiView	Spectrum								
		et 37.25 dB 🖷 R							
Att 1 Frequency Sw		100 s 🖷 V	BW 3 MHz Mo	de Auto Sweep					●1Rm Max
I Hequency 34	YCCP							M1[1] -33.39 dBm
									41.8480 GHz
20 dBm									
10 dBm									
0 dBm									
FCC95M_40-231GHZ									
-10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
					\sim				
-50 dBm									
00 00									
60 d0m									
-60 dBm									
40.0 GHz			1001 pt:	S	2	.0 GHz/	I		60.0 GHz
							Measuring.		15.06.2021 13:10:08
12:10:00 15 06 0001									
13:10:09 15.06.2021									

Test report no.	: 1-0599/20-08-02
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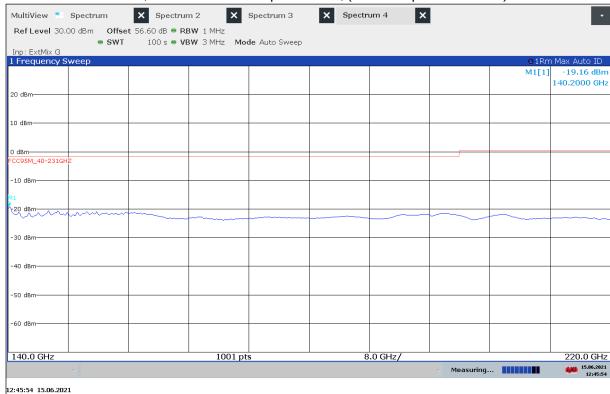


MultiView 📑 Spectrum	X Spectrum 2 X	Spectrum 3	× Spectr	um 4 🗙			
Ref Level 50.00 dBm Offs SWT Inp: ExtMix E		ode Auto Sweep					
1 Frequency Sweep						o1Rn	n Max Auto ID
40 dBm							
i0 dBm							
0 dBm							
0 dBm							
o usin							
Cd95M_40-231GHZ							
10 dBm							
20 dBm							
-30 dBm	<u></u>	<u> </u>					
-40 dBm							
40 ubiii							
60.0 GHz	1001 p	ts	3	.0 GHz/			90.0 GH
	1001 p			/	Measuring.		15.06.202
							07:29:09
7:29:10 15.06.2021							

Plot 11: 60 GHz - 90 GHz, vertical / horizontal polarization, (Valid for specified Modes)

Plot 12: 90 GHz – 140 GHz, vertical / horizontal polarization, (Valid for specified Modes)

MultiView 📒	Spectrum	× Spectrur	n 2 🗙	Spectrum 3	× Spectr	um 4 🗙			•
Ref Level 30.	00 dBm Offset	t 53.60 dB 🖷 RE	3W 1 MHz						_
	● SWT	100 s 👄 VE	W 3 MHz Mod	le Auto Sweep					
Inp: ExtMix F									
1 Frequency S	weep	[01Rm M1[1]	Max Auto ID -20.06 dBm
								MILI	90.1250 GHz
20 dBm									
10 dBm									
0 dBm									
FCC95M_40-231GH	IZ								
-10 dBm									
M1 -20 dBm									
MM	M							\sim	
-30 dBm									
-40 dBm									
-50 dBm									
-60 dBm									
90.0 GHz	1		1001 pt	3		5.0 GHz/			140.0 GHz
2010 0112	~		1001 pt.	,			• Measuring.		15.06.2021 13:03:54
13:03:54 15.06.202	21								



Plot 13: 140 GHz - 220 GHz, vertical / horizontal polarization, (Valid for specified Modes)

Plot 14: 220 GHz - 231 GHz, vertical / horizontal polarization, (Valid for specified Modes)

MultiView 📒	Spectrum	× Spectrun	n 2 🗙	Spectrum 3	× Spectr	um 4 🗙			•
Ref Level 30.0	00 dBm Offse						•		_
Inp: ExtMix J	● SWT	100 s 🖷 VB	WY 3 MHz Mo	de Auto Sweep					
1 Frequency S	weep								n Max Auto ID
								M1[1]	-14.50 dBm 220.0050 GHz
20 dBm									
10 dBm									
FCC95M_40-231GH	z								
10 dBm									
-20 dBm									
-30 dBm									
-40 dBm									
-50 dBm									
-60 dBm									
220 0 CH=			1001		<u> </u>	1.6457			221.0.611-
220.0 GHz	v		1001 pt	.5	1	.1 GHz/	Measuring.		231.0 GHz 15.06.2021 12:54:05
12:54:05 15.06.202	:1								

CTC I advanced

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.

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

Measurement results:

Mode2_4262 (Worst Case)

Measurement results:

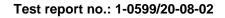
Temperature variation

Mode	Temperature in °C	f∟in GHz	f _H in GHz	Bandwidth [MHz]
	-20 °C / V _{nom}	76.624 220	77.630 670	1006
	-10 °C / V _{nom}	76.624 070	77.631 310	1007
	0 °C / V _{nom}	76.624 010	77.631 110	1007
Mode2_4262	10 °C / V _{nom}	76.623 410	77.631 460	1008
(Worst case)	20 °C / V _{min-max}	76.623 400	77.631 290	1008
	30 °C / V _{nom}	76.623 920	77.631 810	1008
	40 °C / V _{nom}	76.623 770	77.632 140	1008
	50 °C / V _{min-max}	76.623 070	77.631 090	1008

Voltage variation

Voltage variation of rated input voltage	f⊾in GHz	f _H in GHz				
< 85 % of U	Voltage variation does not affect the radiated signal					
> 115 % of U						





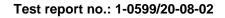


Plot 15: OBW, -20 °C / Vnom

MultiView	Spectrum	× Spectru	n 2 X	Spectrum 3	× Spectru	um 4 🗙			•
		t 57.00 dB • RE					•		_
	● SWT			lode Auto Sweep					
Inp: ExtMix E 1 Occupied Ba	an du ui dtha						o t Dk Mo	x Auto ID ⊜2Rn	Mov Auto TD
T Occupied Ba	anuwiuun						U IPK Ma	M1[1]	19.15 dBm
50 dBm									76.62390 GHz
								M2[2]	-12.84 dBm
40 dBm									76.64790 GHz
30 dBm									
	m1		T2						
20 dBm	ľ ř		~~~~~~						
10 dBm									
0 dBm									
-18.dBm1	M	2		- two					
hun	mannerander	+	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	much many men	Mannaman	mmunit	mulikowan	mulant	mound
-20 dBm									
-30 dBm									
									V2
-40 dBm V1 CF 78.5 GHz			1001	nte	60	0.0 MHz/			Span 6.0 GHz
2 Marker Tabl	le		1001	513	00				opan olo anz
Type Ref		X-Value		Y-Value		Function		Function Re	
M1 T1	1	76.6239 GH 76.62422 GH		19.15 dBm 19.15 dBm	Occ Bw Occ Bw Ce	ntroid		1.00645128 77.127448	
T2	1	77.63067 Gł	z	18.07 dBm	Occ Bw Fre			-1.372551	
M2	2	76.6479 GH	IZ	-12.84 dBm			Measuring		15.06.2021
							maasuning.		09:42:17
09:42:17 15.06.202	21								

Plot 16: OBW, -10 °C / Vnom

MultiView Spectrum		× Spectrum 3	X Spectrum 4	
Ref Level 50.00 dBm	Offset 57.00 dB • RBW 1	MHz		-
	SWT 100 s • VBW 3	MHz Mode Auto Sweep		
Inp: ExtMix E 1 Occupied Bandwidth				⊙1Pk Max Auto ID ⊜2Rm Max Auto ID
				M1[1] 18.76 dB
50 dBm				76.62390 GH
				M2[2] -13.17 dB
40 dBm				76.62390 GH
30 dBm				
20 dBm	mi	T2		
20 0011	hannen	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
10 dBm				
0 dBm				
~10~dBm~~~~	N2	promision a		
mannen		marken - m	have a second and the second	wardy and a second a
-20 dBm				
-30 dBm				
-40 dBm				V2
CF 78.5 GHz		1001 pts	600.0 MHz/	Span 6.0 GH
2 Marker Table			<i>`</i>	
Type Ref Trc	X-Value	Y-Value	Function	Function Result
M1 1 T1 1	76.6239 GHz 76.62407 GHz	18.76 dBm 18.76 dBm	Occ Bw Occ Bw Centroid	1.007244969 GHz 77.12768901 GHz
T2 1	77.63131 GHz	18.35 dBm	Occ Bw Freq Offset	-1.37231099 GHz
M2 2	76.6239 GHz	-13.17 dBm		
				Measuring Measuring
39:08:51 15.06.2021				
9:08:21 12:00:2021				



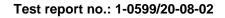


Plot 17: OBW, 0 °C / Vnom

MultiView Spectrum	X Spectrum 2	× Spectrum 3	X Spectrum 4	<	•
	Diffset 57.00 dB • RBW 1 MH		X opectium 4		
● S					
Inp: ExtMix E					
1 Occupied Bandwidth				0 1Pk Max Auto ID ●2R M1[1	1 1
50 dBm				wit[i	76.72580 GHz
				M2[2	
40 dBm					77.46900 GHz
30 dBm					
20 dBm	T1 M1 ·	T2			
	hummer	Ť			
10 dBm					
0 dBm					
-10 dBm1	M2	have			
	h) J	manamenterstandurcher		
-20 dBm	<i>w</i> ~ <i>v</i>	Mourand	" Withhan	mm. Multipular management	m when we want the second
-30 dBm					
V1					V2
-40 dBm CF 78.5 GHz	1	.001 pts	600.0 MHz/		Span 6.0 GHz
2 Marker Table	1	.001 pt3	00010 1411127		Span olo anz
Type Ref Trc	X-Value	Y-Value	Function	Function R	
M1 1 T1 1	76.7258 GHz 76.62401 GHz	18.52 dBm 18.29 dBm	Occ Bw Occ Bw Centroid	1.0071024	55 GHZ
T2 1	77.63111 GHz	17.53 dBm	Occ Bw Freq Offset		86605 GHz
M2 2	77.469 GHz	-13.39 dBm			
~				🗸 Measuring	15.06.2021 08:55:48
08:55:48 15.06.2021					

Plot 18: OBW, 10 °C / Vnom

MultiView = Spectru	m X Spectrum 2	× Spectrum 3	X Spectrum 4 X		•
Ref Level 50.00 dBm	Offset 57.00 dB = RBW 1 M	tz			
	● SWT 100 s ● VBW 3 MH	Iz Mode Auto Sweep			
Inp: ExtMix E					
1 Occupied Bandwidth	1			01Pk Max Auto ID ⊜2Rm Ma	
					18.30 dBm
50 dBm					52390 GHz
					13.82 dBm
40 dBm				77.	46900 GHz
30 dBm					
20 dBm	1 V	T2			
	http://www.http://wwww	Ϋ́Ι Ι			
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manumun	When	human	and and the second second	which answer when not have an and the second when the	which where
-20 dBm-					
-30 dBm					
				v2	
-40 dBm					
CF 78.5 GHz		1001 pts	600.0 MHz/	Spa	in 6.0 GHz
2 Marker Table					
Type Ref Trc	X-Value	Y-Value	Function	Function Result	
M1 1	76.6239 GHz	18.30 dBm	Occ Bw	1.0080491 (
T1 1 T2 1	76.62341 GHz 77.63146 GHz	18.30 dBm 17.15 dBm	Occ Bw Centroid Occ Bw Freg Offset	77.127432011 -1.372567989	
M2 2	77.469 GHz	-13.82 dBm	OLL BW Fred Offset	-1.372567989	GHZ
 				Measuring	4/15.06.2021 08:39:36
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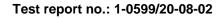


Plot 19: OBW, 20 °C / Vmin-max

MultiView - Spectr	um × Spectru	m 2 × Spectr	um 3 🗙	
	0ffset 57.00 dB ● RBW 1 M		_	-
 S Inp: ExtMix E 	SWT 100 s ● VBW 3 M	Hz Mode Auto Sweep		
1 Occupied Bandwidth				● 1Pk Max Auto ID ● 2Rm Max Auto ID
				M1[1] 18.60 dBr
50 dBm				76.62390 GH
				M2[2] -13.09 dBr
40 dBm				76.62390 GH
30 dBm				
20 dBm	T1	<u>T2</u>		
	h	1 I		
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o ubiii				
-10 dBm	M2	home is		
-10 dBm	han -	mongrand	Mundamm	
Municipality	~	timent	mannahas	and a second and the
-20 dBm-				
-30 dBm				
				v2
-40 dBm				
CF 78.5 GHz	· · ·	1001 pts	600.0 MHz/	Span 6.0 GH
2 Marker Table				
Type Ref Trc	X-Value	Y-Value	Function	Function Result
M1 1 T1 1	76.6239 GHz 76.6234 GHz	18.60 dBm 18.60 dBm	Occ Bw Occ Bw Centroid	1.007887881 GHz 77.127343858 GHz
T2 1	77.63129 GHz	17.33 dBm	Occ Bw Freg Offset	-1.372656142 GHz
M2 2	76.6239 GHz	-13.09 dBm	Sto Divined Shadt	1.37 20301-12 0112
v				 Measuring Measuring
				0,100
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Plot 20: OBW, 30 °C / Vnom

MultiView =	Spectrum	× Spectrur	n 2 🗙	Spectrum 3	× Spectru	um 4 🗙			
Ref Level 50.0	0 dBm Offset	t 57.00 dB 🖷 RB	W 1 MHz				-		_
	● SWT	100 s 👄 VB	W 3 MHz Mo	de Auto Sweep					
Inp: ExtMix E	1.1.1.1							TD - 00	
1 Occupied Ban	idwidth						отрк мах	Auto ID	1 1
50 dBm								MILI	77.63090 GHz
								M2[2]	
40 dBm									77.63090 GHz
30 dBm									
20 dBm	<u>T1</u>		TT2.						
10 dBm									
0 dBm									
monung									
-10 dBm				here	manna	angely			
bul	medinanti and			Ind		manymo	unamint		and mar marken
-20 dBm									
-30 dBm									
-40 dBm									V2
CF 78.5 GHz			1001 pt	i s	60	0.0 MHz/			Span 6.0 GHz
2 Marker Table			1001 pt			sto frinzy			opan oro driz
Type Ref	Trc	X-Value		Y-Value		Function		Function Re	
M1	1	77.6309 GH		18.19 dBm	Occ Bw		1	L.00789492	
T1 T2	1	76.62392 GH 77.63181 GH		17.15 dBm 18.19 dBm	Occ Bw Cer Occ Bw Fre			77.1278	
M2	2	77.6309 GH	Z -	13.58 dBm	000 04 116	y onset		1.5721.	
	v						✓ Measuring		15.06.2021 07:48:09
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07:48:10 15.06.2021									





Plot 21: OBW, 40 °C / Vnom

MultiView Spectrum	X Spectrum 2 X	Spectrum 3	× Spectru	ım 4 🗙			•
Ref Level 50.00 dBm Offs	et 57.00 dB = RBW 1 MHz			_	•		
• SW1	T 100 s ● VBW 3 MHz	Mode Auto Sweep					
Inp: ExtMix E 1 Occupied Bandwidth					o 1 Pk Max	Auto ID ⊜2Rm	Max Auto ID
						M1[1]	17.70 dBm
50 dBm							77.46900 GHz
						M2[2]	-14.04 dBm 76.64790 GHz
40 dBm							-76.64790 GHz
30 dBm							
20 dBm	1 <u>M1 T2</u>						
10 dBm-							
0 dBm							
-10 dBm	12	mann	Margan Marken				
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-20 dBm							
-30 dBm							
							V2
-40 dBm							
CF 78.5 GHz	1001	pts	60	0.0 MHz/			Span 6.0 GHz
2 Marker Table Type Ref Trc	X-Value	Y-Value		Function		Function Re	eult
M1 1	77.469 GHz	17.70 dBm	Occ Bw		1	.00837405	4 GHz
T1 1 T2 1	76.62377 GHz 77.63214 GHz	16.98 dBm 17.25 dBm	Occ Bw Cer Occ Bw Fre			77.127956	
M2 2	76.6479 GHz	-14.04 dBm	Sce Dwitte	9 011302		1.572045	27 0112
∇					Measuring		4966.2021 08:05:16
08:05:17 15.06.2021							

Plot 22: OBW, 50 °C / Vmin-max

MultiView 🔳 Spectrum 🗙	Spectrum 2 X Spec	trum 3 🗙 Spectru	ım 4 🗙	•
Ref Level 50.00 dBm Offset 57	7.00 dB 🖷 RBW 1 MHz	_		_
● SWT	100 s 🖷 VBW 3 MHz 🛛 Mode Au	ito Sweep		
Inp: ExtMix E 1 Occupied Bandwidth			o 1 Pk Ma	ax Auto ID 😑 2Rm Max Auto ID
			OTKIN	M1[1] 17.49 dBm
50 dBm				77,46900 GHz
				M2[2] -14.19 dBm
40 dBm				76.64790 GHz
30 dBm				
	M1			
20 dBm				
10 dBm-				
0 dBm				
-10 dBm		man man man man man	moun	
and the second s	hand mentioned			
-20 dBm				
-30 dBm				
-30 uBm				
-40 dBm				V2
CF 78.5 GHz	1001 pts	60	0.0 MHz/	Span 6.0 GHz
2 Marker Table	1001 pt3	00		Spair 0.0 Griz
Type Ref Trc		Value	Function	Function Result
		9 dBm Occ Bw		1.008016926 GHz
	76.62307 GHz 16 77.63109 GHz 15	5.77 dBm Occ Bw Cer 5.92 dBm Occ Bw Fre		77.127079905 GHz -1.372920095 GHz
M2 2 76	.6479 GHz -14.1	.9 dBm	eq Onset	-1.372920095 GH2
~			Measuring	15.06.2021
				08:17:09
08:17:09 15.06.2021				



13 Glossary

EUT	Equipment under test
	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 ₀	Carrier to noise-density ratio, expressed in dB-Hz

14 Document history

Version	Applied changes	Date of release
-/-	Initial release - DRAFT	2021-06-30
-/-	Minor changes	2021-07-22

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

first page	last page		
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	Office Berlin Office Frankfurt am Main Office Braunschweig Spittelmarkt 10 Europa-Allee 52 Bundesallee 100 10117 Berlin 60327 Frankfurt am Main 38116 Braunschweig		
Accreditation			
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:			
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	The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAKKS). Exempted is the unchanged form of separate disseminations of the cover sheat by the conformity assessment body mentioned overleat. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attacted by DAKS.		
The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-DL. It comprises the cover sheet, the reverse side of the cover sheet and the following annew with a total of 05 pages.	The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette In, 2625) and the Begulation (EC) No 765/2008 of the European Parliament and of the Council of <i>J</i> July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of <i>J</i> July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European Co-operation for Accreditation (E.G.), Iternational Accreditation Forum (IR) and International Laboratory Accreditation Cooperation (ILAG). The signatories to these agreements recognise each other's accreditations.		
Registration number of the certificate: D-PL-12076-01-05 Frankfurt am Main, 09.06.2020 Frankfurt	The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.ilac.org ILAF: www.iat.nu		
The confliction together with its annex reflects the status at the time of the date of issue. The current status of the scope of accordition can be found in the database of accordited badies of Deutsche Akkreditierungsstelle GmbH. http://www.dakk.sdofer/content/accordited-badies-dakks			

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