	CTC I advanced member of RWTÜV group
Bundesnetzagentur TEST R	EPORT
BNetzA-CAB-02/21-102 Test report no.: 1	-0079/20-03-02-A
Testing laboratory	Applicant
CTC advanced GmbH Untertuerkheimer Strasse 6 – 10 66117 Saarbruecken / Germany Phone: + 49 681 5 98 - 0 Fax: + 49 681 5 98 - 9075 Internet: https://www.ctcadvanced.com e-mail: mail@ctcadvanced.com	Hans Turck GmbH & Co. KG Witzlebenstr. 7 45472 Mülheim an der Ruhr / GERMANY Phone: Contact: Matthias Linde e-mail: <u>matthias.linde@turck.com</u> Phone: +49 2353 709-6198
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.	Manufacturer Hans Turck GmbH & Co. KG Witzlebenstr. 7 45472 Mülheim an der Ruhr / GERMANY
Test starFCC - Title 47 CFRFCC - Title 47 of the Code of IPart 15Part 15 - Radio frequency dev	Federal Regulations; Chapter I;

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

	Test Item	
Kind of test item:	122-123 GHz FMCW Radar	
Model name:	EUT 1: G1 (1 inch thread): LRS510-10-69-Ll2UPN8-H1141 EUT 2: G3/4 (3/4 inch thread): LRS510-10-51-Ll2UPN8-H1141	
FCC-ID	YQ7-LRS-510-10	
Frequency:	122 GHz – 123 GHz	
Technology tested:	FMCW Radar	
Antenna:	Integrated antenna	
Power supply:	24 V DC	
Temperature range:	-20°C to +55°C	

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

## Test report authorized:

Sebastian Janoschka Lab Manager Radio Communications & EMC

## **Test performed:**

Thomas Vogler Lab Manager Radio Communications & EMC



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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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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.

#### This test report replaces the test report with the number 1-0079/20-03-02 and dated 2021-04-22.

#### 2.2 Application details

Date of receipt of order:	2020-10-09
Date of receipt of test item:	2020-10-29
Start of test:	2020-11-02
End of test:	2021-04-19
Person(s) present during the test:	

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

#### 2.3 Test laboratories sub-contracted

None

## 3 Test standard/s, references and accreditations

Test standard	Date	Description		
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices		
Guidance	Version	Description		
ANSI C63.4-2017	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz		
ANSI C63.10-2013	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices		
ANSI C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services		

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

## 4 Test environment

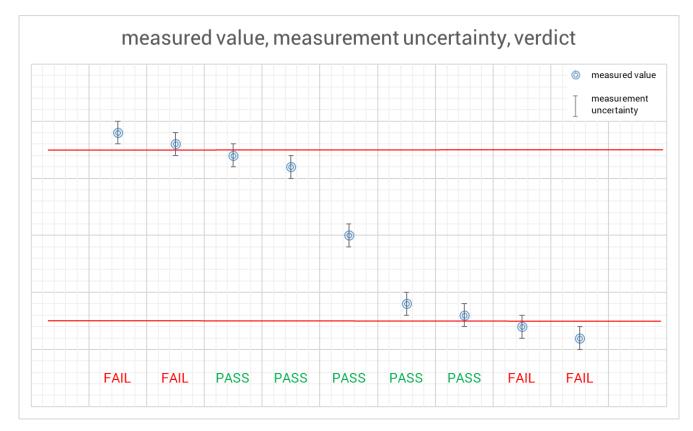
Temperature	:	T <sub>nom</sub> T <sub>max</sub> T <sub>min</sub>	<ul> <li>+22 °C during room temperature tests</li> <li>+55 °C during high temperature tests</li> <li>-20 °C during low temperature tests</li> </ul>		
Relative humidity content	••		49 %		
Barometric pressure	:		1008 hpa		
Power supply	:	$V_{\text{nom}}$	24 V DC		



#### 5 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.





## 6 Test item

## 6.1 General description

Kind of test item	:	122-123 GHz FMCW Radar
Model name:	:	EUT 1: G1 (1 inch thread): LRS510-10-69-LI2UPN8-H1141 EUT 2: G3/4 (3/4 inch thread): LRS510-10-51-LI2UPN8-H1141
S/N serial number	:	n.a.
Hardware status	:	1
Software status	:	1
Firmware status	:	n.a.
Frequency band	:	122 GHz – 123 GHz
Type of modulation	:	FMCW
Number of channels	:	1
Antenna	:	Integrated antenna
Power supply	-	24 V DC
Temperature range	:	-20°C to +55°C

## 6.2 Additional information

Test setup and EUT photos are included in test report:

1-0079/20-03-01\_AnnexA 1-0079/20-03-01\_AnnexB 1-0079/20-03-01\_AnnexC



### 7 Sequence of testing

### 7.1 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.



### 7.2 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.



### 7.3 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.

### 7.4 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.

### 7.5 Sequence of testing radiated spurious above 50 GHz with external mixers

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate for far field (e.g. 0.25 m).
- The EUT is set into operation.

#### Premeasurement

- The test antenna with external mixer is handheld and moved carefully over the EUT to cover the EUT's whole sphere and different polarizations of the antenna.
- Caution is taken to reduce the possible overloading of the external mixer.

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- As external mixers may generate false images care is taken to ensure that any emission measured by the spectrum analyzer does indeed originate in the EUT. Signal identification feature of spectrum analyzer is used to eliminate false mixer images (i.e., it is not the fundamental emission or a harmonic falling precisely at the measured frequency).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.



#### 8 Description of the test setup

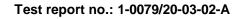
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

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

Agenda: Kind of Calibration

- k calibration / calibrated
- ne not required (k, ev, izw, zw not required)
- ev periodic self verification
- Ve long-term stability recognized
- vlkl! Attention: extended calibration interval
- NK! Attention: not calibrated

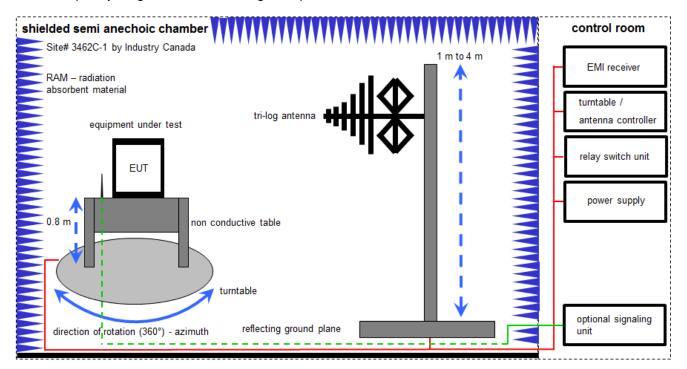
- EK limited calibration
- zw cyclical maintenance (external cyclical maintenance)
- izw internal cyclical maintenance
- g blocked for accredited testing
- \*) next calibration ordered / currently in progress





### 8.1 Shielded semi anechoic chamber

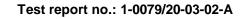
The radiated measurements are performed in vertical and horizontal plane in the frequency range from 9 kHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are confirmed with 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.



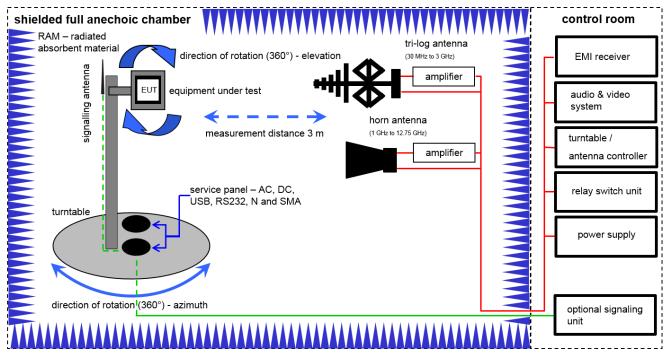
Measurement distance: tri-log antenna 10 meter

#### 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	318	300003696	viKi!	04.09.2019	03.09.2021
9	n. a.	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
10	n. a.	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	10.12.2020	09.06.2022





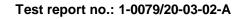


## Equipment table (Chamber C):

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	viKi!	09.12.2020	08.12.2023
2	n. a.	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	viKi!	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	viKi!	14.01.2020	13.01.2022
5	n. a.	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	9709-5289	300000213	viKi!	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	-/-	-/-

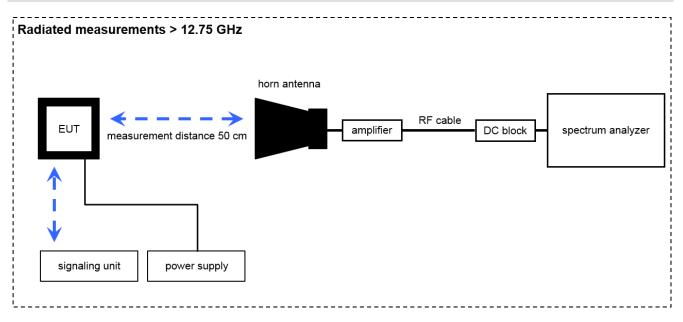
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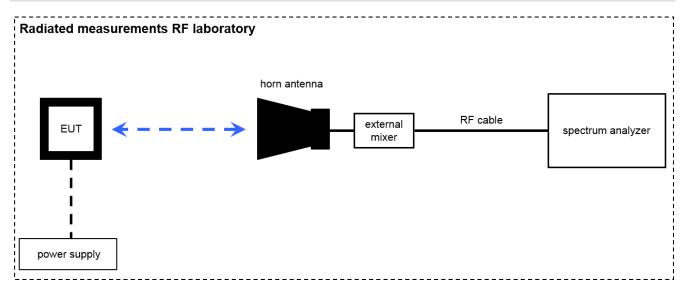




#### 8.3 Radiated measurements 18 GHz to 50 GHz in test lab



#### 8.4 Radiated measurements > 50 GHz in test lab

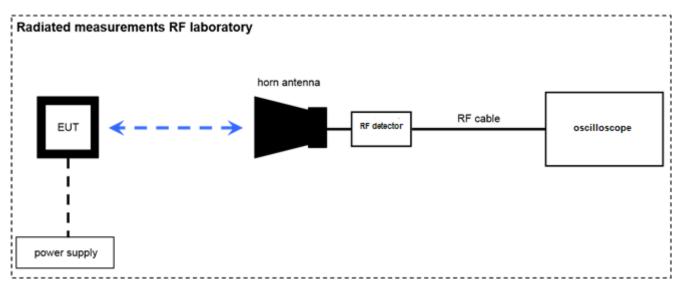


Note: conversion loss of mixer is already included in analyzer value.



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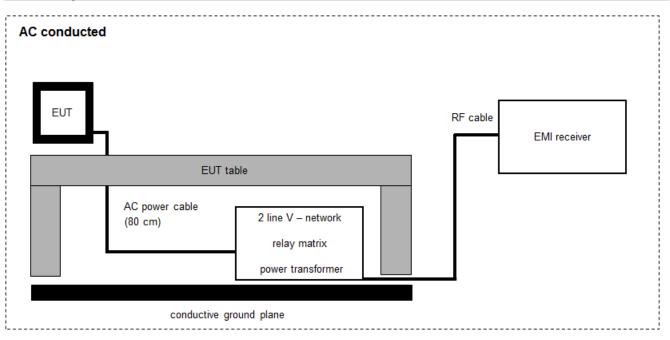
Note: EUT is replaced by reference source for substitution measurement



## 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	viKI!	18.02.2019	17.02.2022
2	n. a.	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda		300000486	viKi!	21.01.2020	20.01.2022
3	n. a.	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	viKi!	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	ne	-/-	-/-
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	Flann	273569	300006097	ne	-/-	-/-
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
23	n. a.	Spectrum Analyzer	FSW50	Rohde & Schwarz	101332	300005935	k	26.02.2020	25.02.2021
24	n.a.	Std. Gain Horn Antenna 90-140 GHz	COR 90_140	Thomson CSF		300000799	ev	-/-	-/-
25	n.a.	F-Band Positive Amplitude Detector	SFD-903144-08SF- P1	Sage Millimeter Inc.	07354-1	300006119	ev	-/-	-/-
26	n.a.	SG Extension Module 110 - 170 GHz	E8257DV06	VDI	US53250018	300005540	ev	-/-	-/-
27	n.a.	Std. Gain Horn Antenna 114-173 GHz	2924-20	Flann	*	300001999	ne	-/-	-/-
28	n.a.	Synthesized Sweeper 10 MHz - 40 GHz	83640A	HP	3119A00458	300002266	viKi!	13.12.2019	12.12.2021
29	n.a.	2.5 GHz Digital Phosphor Oscilloscope	DP07254	Tektronix	B022702	300003573	viKi!	07.12.2020	06.12.2022

## 8.6 AC power-line conducted emissions



#### FS = UR + CF + VC

(FS-field strength; UR-voltage at the receiver; CR-loss of the cable and filter; VC-correction factor of the ISN)

#### Example calculation:

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

#### Equipment table:

No.	Lab / Item	Equipment	Туре	Manufacturer	Serial No.	INV. No.	Kind of Calibration		Next Calibration
1	-/-	Two-line V-Network (LISN) 9 kHz to 30 MHz	ESH3-Z5	R&S	892475/017	300002209	viKI!	11.12.2019	10.12.2021
2	-/-	RF-Filter-section	85420E	HP	3427A00162	300002214	NK!	-/-	-/-
3	-/-	EMI Test Receiver	ESCI 3	R&S	100083	300003312	k	09.12.2020	08.12.2021
4	-/-	Hochpass 150 kHz	EZ-25	R&S	100010	300003798	ev	-/-	-/-



# 9 Measurement uncertainty

Measurement uncertainty						
Test case	Uncertainty					
Spectrum bandwidth	span/1000					
Output power	± 3 dB					
Spurious emissions radiated below 30 MHz	± 3 dB					
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB					
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB					
Spurious emissions radiated above 12.75 GHz	± 4.5 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

- D<sub>ff</sub> Far field distance
- D Antenna dimension
- $\lambda$  wavelength

### 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	9.46
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	4.11
325-500	500	0.26	0.06	2.29

## In band measurement (EIRP, OBW):

	Highest measured frequency in GHz	Antenna dimension in cm	Wavelength in cm	far field distance in cm	
110 - 170	123	1	0.24	8.33	



## 11 Measurement results

# 11.1 Summary

No deviations from the technical specifications were ascertained
There were deviations from the technical specifications ascertained
This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC 47 CFR Part 15 / IC RSS-210	see below	2021-05-18	-/-

Test specification clause	Test case	Temperature conditions	Power supply	Pass	Fail	NA	NP	Results (max.)
§15.215	Occupied bandwidth	Nominal	Nominal	$\boxtimes$				complies
§15.258(b) (1) / (3)	Maximum E.I.R.P.	Nominal	Nominal	$\boxtimes$				complies
§15.258(c)	Spurious Emissions	Nominal	Nominal	$\boxtimes$				complies
§15.255(d)	Frequency stability	Extreme Nominal	Extreme Nominal	$\boxtimes$				complies

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



## 12 Measurement results

## 12.1 Occupied bandwidth (20 dB Bandwidth)

### **Description:**

Measurement of the Bandwidth of the wanted signal.

#### Measurement:

Measurement parameter				
Detector:	Pos-Peak			
Sweep time:	1 s			
Resolution bandwidth:	1 MHz			
Video bandwidth:	3 MHz			
Span:	See plot			
Trace-Mode:	Max Hold			

### Limits:

FCC
CFR Part 15.258
The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following:
Frequency range
116 GHz – 123 GHz

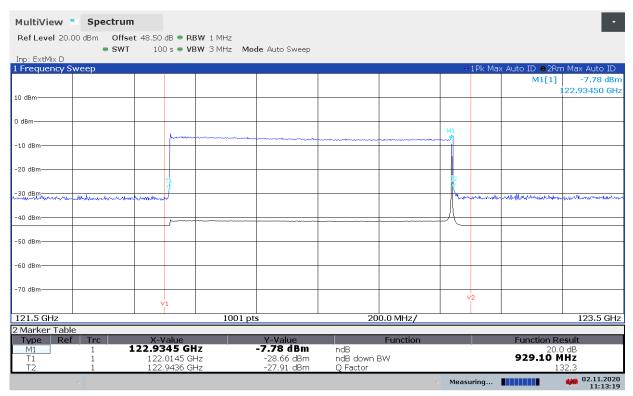
### Measurement results:

Test condition T <sub>nom</sub> / V <sub>nom</sub>	F∟ in GHz	F <sub>H</sub> in GHz	Occupied bandwidth in MHz
20 dB OBW (1" version)	122.014 500	122.944 600	929.10
26 dB OBW (1" version)	122.009 500	122.952 500	943.10
20 dB OBW (3/4" version)	122.014 500	122.944 600	929.10
26 dB OBW (3/4" version)	122.009 500	122.952 500	943.10
Measurement uncertainty		± span/1000	1

### Result: The measurement is passed.



Plot 1: 20 dB OBW, 1 inch version, operating frequency band



11:13:19 02.11.2020

#### Plot 2: 26 dB OBW, 1 inch version, complete band

MultiView	- Spectru	m × Spectrum 2	×			
Ref Level 20	.00 dBm Offs SW	set 48.50 dB ● RBW 1 MHz T 100 s ● VBW 3 MHz	Mode Auto Sween			
Inp: ExtMix D		10000 0000 0000	Mode Add offeep			
1 Frequency	Sweep					k Max ⊜2Rm Max
					M1[	
10 dBm						122,93760 GH
0 dBm						
-10 dBm						
10 00.00						
-20 dBm					7	7
20 0011						
~30 48m ~~~						
-30 dBm	and the second	marked and a second and a second s	where the work was a second where the second s	and an an and an and and	a Marine and man	and how how how
-40_dBm—						
-50 dBm						
-60 dBm						
-70 dBm						
v1						V2
115.5 GHz		100	01 pts	800.0 MHz/		123.5 GHz
2 Marker Tab	le	100	лры	00010 MIL127		125.5 GHz
Type Re		X-Value	Y-Value	Function	Functio	n Result
M1	1	122.9376 GHz	8.90 dBm	ndB		26.0 dB
T1	1	122.0095 GHz	-19.68 dBm	ndB down BW	943.1	
T2	1	122.9525 GHz	-19.31 dBm	Q Factor		130.4
					v Measuring	05.11.2020 13:34:01

13:34:01 05.11.2020





MultiView	- Spectr	um 🗙 Specti	um 2	×					
Ref Level 20	0.00 dBm Of	ffset 48.50 dB • RBW :	MHz	-					
Inp: ExtMix D	● S¥	WT 100 s • VBW 3	3 MHz Mode Au	uto Sweep					
1 Frequency	Sweep							o 1Pk M	lax ⊜2Rm Max
								M1[1]	7.91 dBm
		M1							122.01850 GH
10 dBm							that I		
0 dBm									
-10 dBm							<u> </u>		
		Ý							
-20 dBm									
-30 dBm								her which the way	
	- manar W man	way have been been been been been been been be							
-40 dBm									
-50 dBm									
-30 ubm									
-60 dBm									
									1
-70 dBm							¥2		
		V1							
121.5 GHz			1001 pts	I	20	0.0 MHz/			123.5 GHz
2 Marker Tal	le		•			· ·			
Type Re		X-Value		Value		Function		Function R	esult
M1	1	122.0185 GHz		€1 dBm	ndB			20.	0 dB
T1 T2	1	122.0145 GHz		4.82 dBm	ndB down I	3W		929.10	
12	1	122.9436 GHz	-1.	3.64 dBm	Q Factor				31.3
							Measuring		05.11.2020 14:23:02

14:23:02 05.11.2020

## Plot 4: 26 dB OBW, 3/4 inch version, complete band

MultiView	- Spectru	m X Spectr	um 2 🗙				•
Ref Level 20		set 48.50 dB ● RBW 1					
Inp: ExtMix D	● SW	T 100 s • VBW 3	MHz Mode Auto Sweep	1			
1 Frequency S	Sweep					o 1Pk Max	●2Rm Max
					M1[	-	8.29 dBm 2,9 <u>3</u> 660 GHz
10 dBm							
0 dBm							
-10 dBm							
-20 dBm							T2 7
-							1
-30 dBm		and the contraction of the second	and a second and a s	and a second the second and the second s	minternation		
40_dBm <b></b>							-l
-50 dBm							
-60 dBm							
-70 dBm							
V1							V2
115.5 GHz			1001 pts	800.0 MHz/	,		123.5 GHz
2 Marker Tab							
<b>Type Re</b> M1 T1 T2	f Trc 1 1 1	X-Value <b>122.9366 GHz</b> 122.0095 GHz 122.9525 GHz	Y-Value 8.29 dBm -17.86 dBm -19.22 dBm	ndB down BW	n	Function Res 26.0 c <b>943.10 MH</b> 130	iB Iz
12	~	122.7323 012	19.22 dbm	Q racio	Measuring		05.11.2020 15:28:18

15:28:18 05.11.2020



## 12.2 Maximum E.I.R.P.

#### **Description:**

Measurement of the maximum radiated e.i.r.p. of the wanted signal.

#### Measurement:

Measurement parameter					
Detector:	Pos-Peak (RF-Detector)				
Video bandwidth:	10 MHz				
Trace-Mode:	Max Hold				

### Limits:

#### FCC Part 15.258 (b)

Emission levels within the 116-123 GHz, 174.8-182 GHz, 185-190 GHz and 244-246 GHz bands shall not exceed the following equivalent isotropically radiated power (EIRP) limits as measured during the transmit interval:

The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm.

The peak power shall be measured with a detection bandwidth that encompasses the entire occupied bandwidth within the intended band of operation, e.g., 116-123 GHz, 174.8-182 GHz, 185-190 GHz or 244-246 GHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

#### Measurement results:

Test condition	Max E.I.R.P. 10 MHz VBW	Average E.I.R.P. 10 MHz VBW			
T <sub>nom</sub> / V <sub>nom</sub>	7.7 dBm	7.6 dBm			
Measurement uncertainty	± 3 dB				

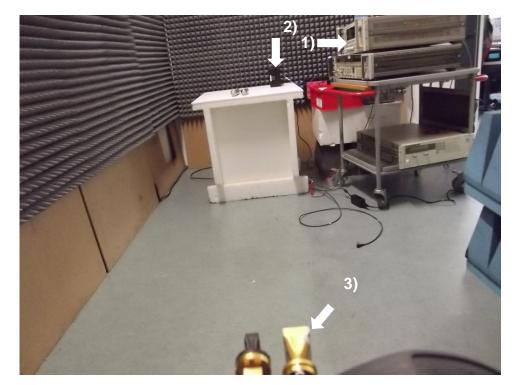
Test condition	Duty cycle
Tnom / Vnom	0.98



#### Description of the E.I.R.P. measurement by substitution method:

- 1) EUT emission measured with RF-detector:
  - Measurement distance: d = 0.26 m
  - Maximum readout value on oscilloscope: V = 0.5 mV
- 2) Substitution of EUT by a CW reference source with a frequency of f = 122 GHz and a fixed output power of  $P_{ref} = 28.4 \text{ dBm}$ 
  - Readout value on oscilloscope adjusted by far field attenuation, 0.5 mV found at 2.8m distance
- 3) Calculation of the Max E.I.R.P. of the EUT:
  - Free space loss: FSL(d) = 20 × log(4×π×d×f/c), c: speed of light
  - Max E.I.R.P. = P<sub>ref</sub> FSL(2.8 m) + FSL (0.26 m) = 7.7 dBm
- 4) Calculation of the Average E.I.R.P. of the EUT:
  - Measured duty cycle of the EUT: 98 %
  - Average E.I.R.P. = Max E.I.R.P. + 10 × log(0.98) = 7.6 dBm

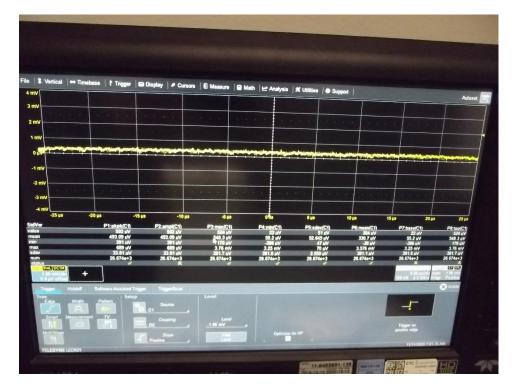
#### Setup of the substitution:



- 1) Synthesized Sweeper 10 MHz 40 GHz
- 2) SG Extension Module 110 170 GHz & Std. Gain Horn Antenna 114-173 GHz
- 3) F-Band Positive Amplitude Detector & Std. Gain Horn Antenna 90-140 GHz



### Oscilloscope measurement:





### 12.3 Spurious emissions radiated

#### **Description:**

Measurement of the radiated spurious emissions.

#### Measurement:

Measurement parameter							
Detector: Quasi Peak / Pos-Peak / RMS							
Sweep time:	Auto						
Resolution bandwidth:	F < 1 GHz: 100 kHz F > 1 GHz: 1 MHz						
Video bandwidth:	Auto						
Frequency range:	30 MHz to 500 GHz						
Trace-Mode:	Max Hold						

#### Limits:

#### FCC Part 15.258 / RSS-210

(c) Spurious emissions shall be limited as follows:

(1) The power density of any emissions outside the band of operation, e.g., 116-123 GHz, 174.8-182 GHz, 185-190 GHz or 244-246 GHz, shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

	FCC / IC									
	CFR Part 15.209(a) / RSS-210 / RSS-Gen									
	Radiated emission limits									
Frequency (MHz)	Frequency (MHz)         Field strength (microvolts/meter)         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	100	3								
88 – 216	150	3								
216 – 960	200	3								
Above 960	500	3								

(3) Between 40 GHz and the highest frequency specified in § 15.33, the level of these emissions shall not exceed 90 pW/cm<sup>2</sup> at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.



#### Limit conversion:

ANSI C63.10-2013 9.6

Power density at the distance specified by the limit: PD [W/m<sup>2</sup>] Equivalent isotropically radiated power: EIRP [dBm] Distance at which the power density limit is specified: d [m]

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

According to this formula, an emission limit of PD = 90 pW/cm<sup>2</sup> at a distance of 3 meters corresponds to EIRP = -10 dBm.

#### Measurement results:

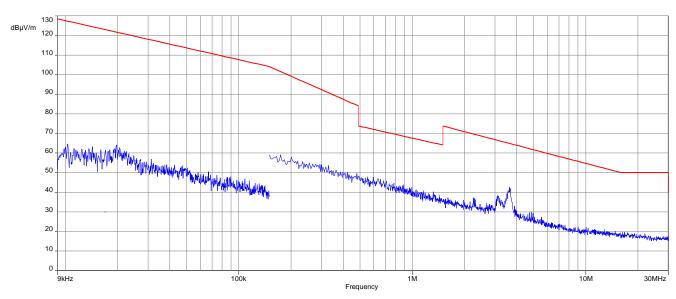
Note:

Measurements were performed in normal operation mode (frequency sweep) and in stopped mode (frequency sweep stopped at three positions within the range of operation: near top, near middle, near bottom) in accordance with 15.31(c), (m).

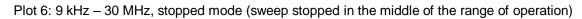
If the results in the cases of the stopped frequency sweep are comparable, only the results with a stop in the middle of the operating frequency range are shown below.

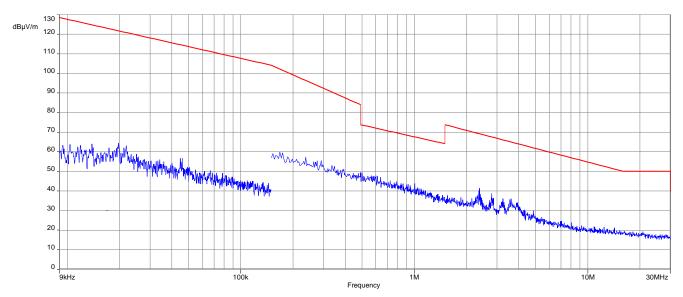


## 12.3.1 Spurious emissions radiated (1" version)

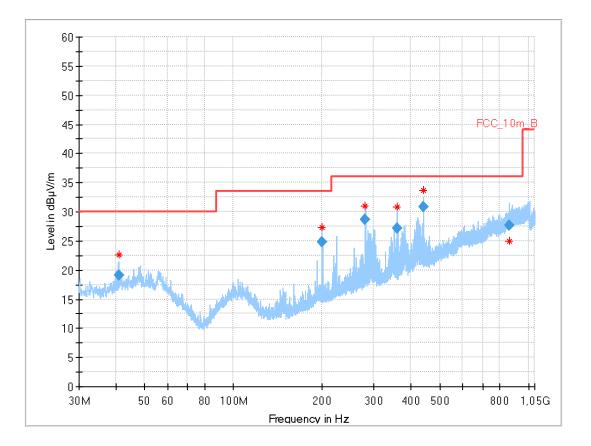


Plot 5: 9 kHz - 30 MHz, normal mode





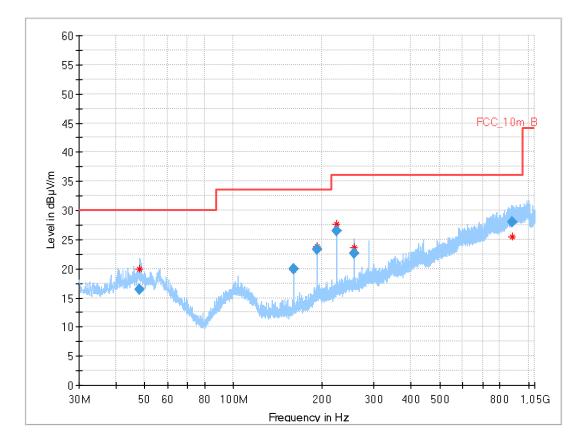
Plot 7: 30 MHz – 1 GHz, normal mode

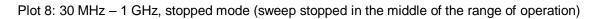


# Final\_Result

Frequency (MHz)	QuasiPe ak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m )
40.865	19.09	30.0	10.9	1000	120.0	118.0	V	112	14
200.006	24.74	33.5	8.8	1000	120.0	170.0	V	67	11
280.000	28.66	36.0	7.3	1000	120.0	109.0	V	-7	14
359.121	27.22	36.0	8.8	1000	120.0	98.0	V	164	16
440.006	30.92	36.0	5.1	1000	120.0	98.0	V	159	17
859.808	27.62	36.0	8.4	1000	120.0	132.0	V	247	23

CTC I advanced



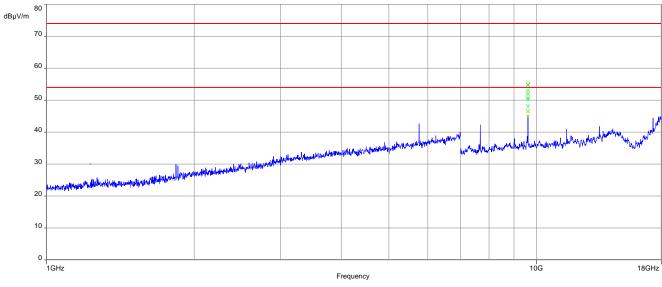


# Final\_Result

Frequency (MHz)	QuasiPe ak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m )
48.276	16.41	30.0	13.6	1000	120.0	102.0	V	16	14
160.130	19.93	33.5	13.6	1000	120.0	102.0	V	67	9
192.147	23.36	33.5	10.1	1000	120.0	170.0	V	95	11
224.193	26.54	36.0	9.5	1000	120.0	107.0	V	22	12
256.221	22.62	36.0	13.4	1000	120.0	101.0	V	157	13
879.275	28.04	36.0	8.0	1000	120.0	170.0	Н	67	23

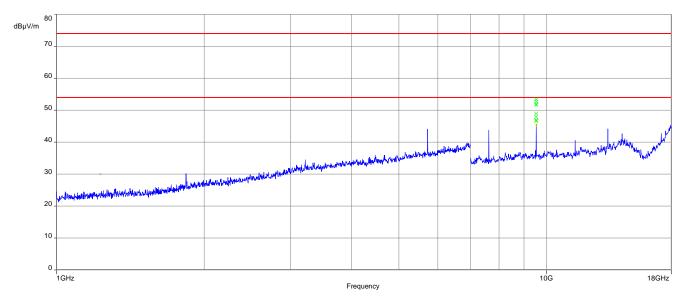
CTC I advanced

Plot 9: 1 GHz - 18 GHz, normal mode



Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9604.800	54.82	74	19.18	50.56	54	

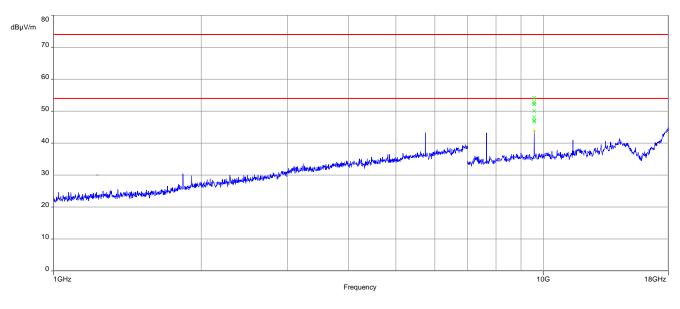




Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9532.200	52.65	74	17.35	47.89	54	6.11

80]

CTC | advanced

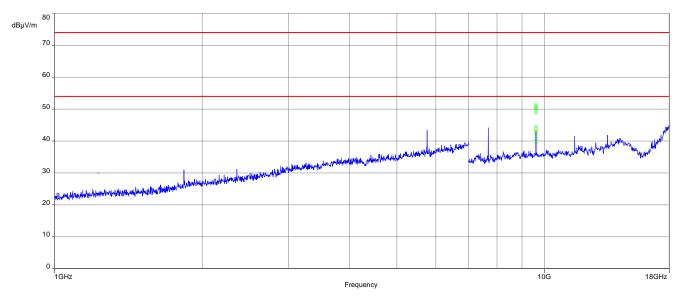


CTC I advanced

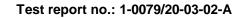
Plot 11: 1 GHz – 18 GHz, stopped mode (sweep stopped in the middle of the range of operation)

Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9568.500	52.25	74	21.75	46.79	54	

Plot 12: 1 GHz – 18 GHz, stopped mode (sweep stopped near the top of the range of operation)



Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9603.7	50.05	74	23.95	41.59	54	12.41





 $\mathbf{\Delta}$ 

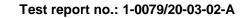
### Plot 13: 18 GHz - 40 GHz, normal mode

IltiView 🗧 Spee	trum 🗙	Spectrum 2	<mark>.</mark> ★ ★					
ef Level 77.00 dBµV	• R	BW 1 MHz	_					
		BW 3 MHz Mode	Auto Sweep					
TDF "LHAF180_CABLE: requency Sweep	502_0_5M_DBUV"						●1Pk Max	e OAu Mevi
							M2[2	
BμV H1 74.	000 dBµV		-				MZLZ	21.0060
							М1[1	38.85
βμν								20,9840
ВµV			-					
ВµV								
вµ∨								
	H2 8	4.000 dBµV						السديمة
BµV							1 March March	mamely the
						and the Mayor Mon	Marran .	
BUV					highly have a			
			1 month	Marin Marine Vince				
	1 march	northalleland	Mr. Warne					
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вич								
Bho-						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		
					T '			
BμV			from the second se					
м2 вримание ма	m	//~~~~						
Bharrow			1	1	1			
ВµV								
		1001						10.0
0 GHz		1001 p	ts		2.2 GHz/			40.0
						Measuring		+ 08.04.1 11:0

Plot 14: 18 GHz – 40 GHz, stopped mode (sweep stopped in the middle of the range of operation)

MultiView	Spectrum	× Spe	ectrum 2	<mark>∗</mark> ×					•
Ref Level 77.0	00 dBµV	RBW	1 MHz						
<ul> <li>Att</li> </ul>		100 s 🖷 VBW 🗄	3 MHz Mode A	Auto Sweep					
PA TDF "LHAF180		5M_DBUV"							
1 Frequency Sv	veep							1	2Av MaxLin
75 dBµV		v						M1[1	45.17 dBμV
	111 1 1000 000							MOLO	28.720 0 GHz
70 dBµV								M2[2	31.55 dBµV 28.720 0 GHz
									28.7200 GHZ
65 dBµV									
60 dBµV									
00 000									
55 dBµV		H2 54.000	dBµV						1.
									MAL MANNAM
50 dBµV							1 0. I. MA	a photomorray and	N N YW
55 dBµV 50 dBµV 45 dBµV 40 dBµV 10 dBµV 35 dBµV				M1		uenter Monter	Mr. My Waller	, id.	
45 dBµV				1 Andrews	warmy where the strate	Magne I			
			In white how here	M MM MANNE MANNE					
40 dBµV	Mr. M. March Apression	Here have by the same	Vev, w.						mm
Mar Marina								m	$\sim \sim$
35 dBµV						. ~~		<u> </u>	
				M2		~~~~~	· ·		
30 dBµV					~~~~				
			~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	00-					
125\dBjiv~~~~~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	0-0/0+0							
20 MphA									
20 dBµV									
18.0 GHz			1001 pt		2	2.2 GHz/			40.0 GHz
10.0 012			1001 pt	3					
	~						Measuring		08.04.2021 10:55:20

10:55:20 08.04.2021





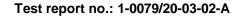
### Plot 15: 40 GHz - 50 GHz, normal mode

ultiView	Spectrum	× Spe	ectrum 2	<mark>∗</mark> ×					
Ref Level 77.00	dBµV	RBW							
Att	0 dB • SWT 10								
	CABLE502_0_5M	_DBUV","FLAN	IN2324_CABLE	502_50CM_DBUV	_33-50GHZ"				
requency Swe	ер							• 1Pk Max M1[1]	• 2Av Maxl 52.22 d
dBµV	-H1 74.000 dBuV							MILI	49.925 00
								M2[2]	
dBµV								WZ[Z]	49,965.00
									45150000
dBµV									
dBµV									
звµv									
		H2 54.000	i dBµV−−−−						
dBµV					. A. muldhampak	Jul another and	Mushermont	m which we	Marphyshellow
monthe with	hundermarkan	when the more	m Mr. Marin M. M	www.Man.Man.	Mariake of Karl	a.v	"		
звµ∨									
∃Вµ∨							~ ~	$h \sim$	
	~~~~	~ ~	$\sim \sim$	~~~~				0	
івру	<u> </u>	~~~							
dBµV									
dBµV									
				1					
dBuV									
oopv									
.0 GHz			1001 p	s	1	LO GHz/	1	1	50.0
							Measuring		* 08.04. 11:3

Plot 16: 40 GHz – 50 GHz, stopped mode (sweep stopped in the middle of the range of operation)

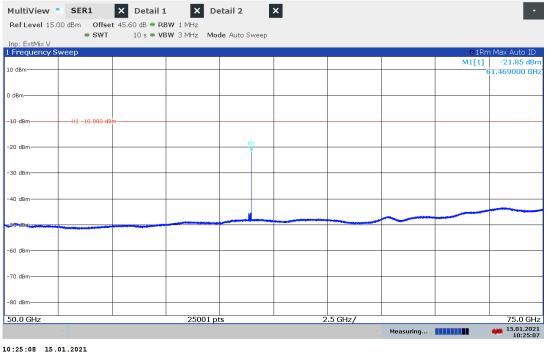
MultiView	Spectrum	× Sp	ectrum 2	<mark>∻</mark> ×					•
Ref Level 77.00	) dBµV	RBW	1 MHz						
Att	0 dB 🖷 SWT	100 s 👄 VBW		uto Sweep					
PA TDF "LHAF180		5M_DBUV","FLAM	NN2324_CABLE5	02_50CM_DBUV	_33-50GHZ"				
1 Frequency Sw	еер					1			● 2Av MaxLin
75 dBµV	—H1 74.000 dBµ							M2[2]	
	—ні 74.000 авр	v							48.666 00 GHz
70 dBµV								M1[1]	
									48.656 00 GHz
65 dBµV									
60 dBµV									
00 dBp+									
55 dBµV		H2 54.000	dBµV					M1	
				. 1	I an abada a		where when we	Marmunangen	moundlimber
SO dBUV	My with my popula	Un Municum W	W Mary Mar Mary Mary	- affall Margaret Margaret	ded the second state of the second	MAD SHOW NO W		MMunimur	
an of a mollo									
45 dBµV									
								M2	
40 dBµV									~~~~
				~~~~	$\sim$		$\sim \sim \sim$		
35 dBµV	$\sim\sim\sim$	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~							
30 dBµV									
25 dBµV									
25 0001									
20 dBµV									
40.0 GHz			1001 pt	5	1	.0 GHz/	1	1	50.0 GHz
						,	Measuring		08.04.2021 11:51:29
							measuring		11:51:29

11:51:30 08.04.2021

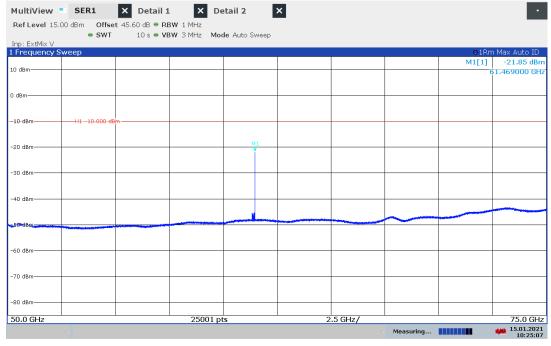




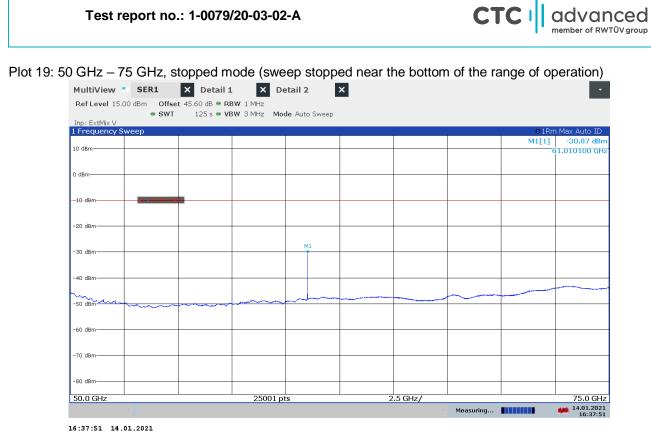
#### Plot 17: 50 GHz – 75 GHz, normal mode







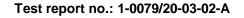


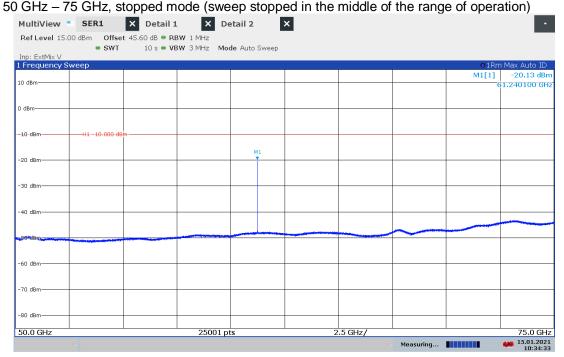


Plot 20: 50 GHz – 75 GHz, stopped mode (sweep stopped near the bottom of the range of operation)

Ref Level 1	5.00 dBm Offset 45.60 df SWT 10	B	de Auto Swoon					
Inp: ExtMix V			ue Auto Sweep					
. Frequency				1		1		n Max Auto ID
10 dBm							M1[1]	-18.54 dBn
U UBM								1.009100 GH
I dBm								
10-dBm	H1 -10.000 d8m							
			M1					
20 dBm								
30 dBm								
40 dBm								
40 UBM								
50•dBm								
-60 dBm								
70 dBm								
80 dBm								
50.0 GHz		25001 p	ts		2.5 GHz/	-		75.0 GHz

10:30:27 15.01.2021





Plot 21: 50 GHz – 75 GHz, stopped mode (sweep stopped in the middle of the range of operation)

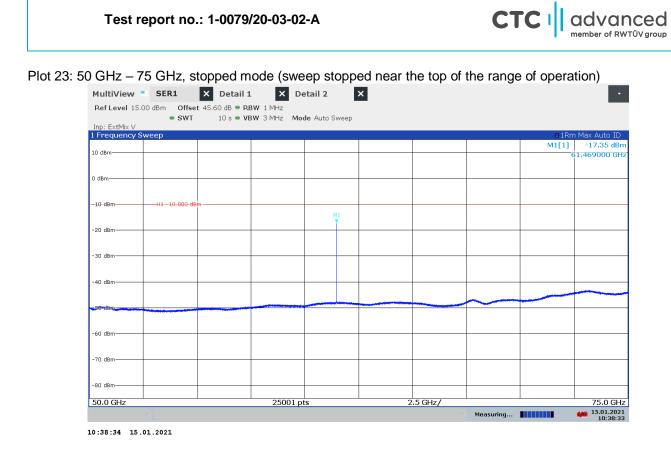
10:34:33 15.01.2021

Plot 22: 50 GHz – 75 GHz, stopped mode (sweep stopped in the middle of the range of operation)

	• SWT 10 s	• VBW 3 MHz Mo	de Auto Sweep					
np: ExtMix V Frequency Sweep							O 1 Pr	n Max Auto ID
Trequency owcep							M1[1]	-19.07 dBr
0 dBm								61.239510 GH
dBm								
10-dBm H1 -	10.000 dBm							
			M1					
20 dBm			T I					
30 dBm								
40 dBm								
50 dBm								
50 dBm								
JU UBIII								
70. JD								
70 dBm								
30 dBm								
F 61.25 GHz	I	1001 pt	s	50	).0 MHz/	1	Sp	ban 500.0 MH

10:33:44 15.01.2021

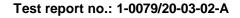
CTC I advanced



Plot 24: 50 GHz – 75 GHz, stopped mode (sweep stopped near the top of the range of operation)

		pped mode (			ne top or	the range	e or opera	tion)
MultiView	SER1 ×	Detail 1 🗙	Detail 2	×				
Ref Level 15.0		5.60 dB 🗢 RBW 1 MHz						
Inp: ExtMix V	● SWT	10 s 🗢 VBW 3 MHz	Mode Auto Sweep					
I Frequency S	weep						O 1 Rn	n Max Auto ID
10 dBm							M1[1]	-17.26 dBm
to uBm								1.469280 GHz
) dBm								
-10-dBm	H1 -10.000 dBm -							
								M1 T
-20 dBm								
-30 dBm								
-40 dBm								
-50 dBm								
-60 dBm								
-70 dBm								
-80 dBm								
								500.0141
CF 61.25 GHz		10	01 pts	50	0.0 MHz/			an 500.0 MHz
						Measuring		15.01.2021 10:39:11

10:39:11 15.01.2021

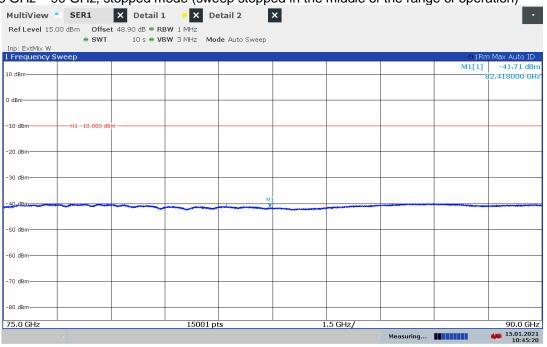




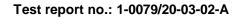
### Plot 25: 75 GHz – 90 GHz, normal mode

MultiView 📑	SER1	× Detail	1 🔸 🗙 De	tail 2	×				•
Ref Level 15.0									
Inp: ExtMix W	● SWT	10 s 🖷 V	/BW 3 MHz Mod	le Auto Sweep					
Frequency Sv	/eep				1				n Max Auto ID
.0 dBm								M1[1]	-41.90 dB
O GBII									82.418000 GF
) dBm									
10-dBm	H1 -10.000 dB	m							
20 dBm									
30 dBm								+	
40.dBm				M					
-50 dBm									
-60 dBm									
oo ubm									
70 dBm									
-80 dBm									
75.0 GHz			15001 pt	s		1.5 GHz/			90.0 GH
	v		20001 pt	-			Measuring		15.01.202 10:49:1

Plot 26: 75 GHz – 90 GHz, stopped mode (sweep stopped in the middle of the range of operation)

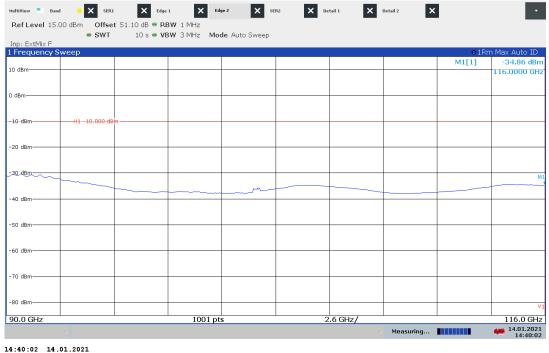


10:45:21 15.01.2021

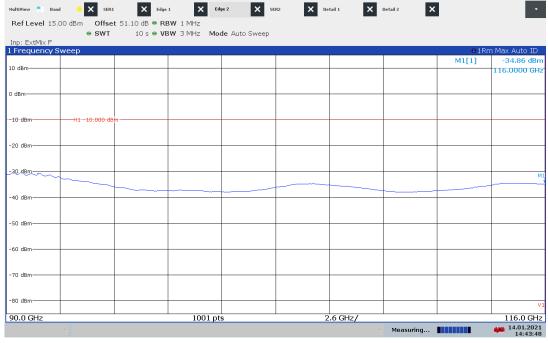




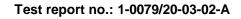
#### Plot 27: 90 GHz – 116 GHz, normal mode



Plot 28: 90 GHz - 116 GHz, stopped mode (sweep stopped near the bottom of the range of operation)

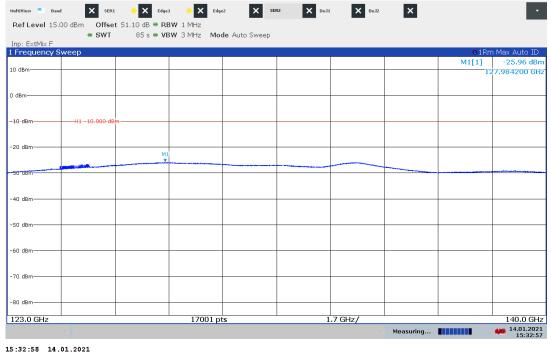


14:43:48 14.01.2021





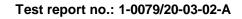
#### Plot 29: 123 GHz – 140 GHz, normal mode



Plot 30: 123 GHz - 140 GHz, stopped mode (sweep stopped near the top of the range of operation)

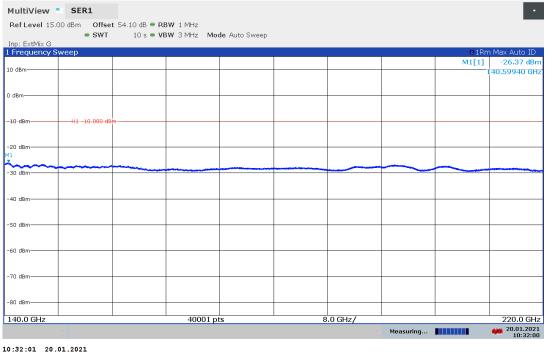
MultiView 🌅 Band 🗙 SER1 🔆 🗙 Edge1 🔶 🗙 Edge2 X SER2 X De.l1 X De.l2 X RefLevel 15.00 dBm Offset 51.10 dB • RBW 1 MHz ● SWT 85 s 🖷 VBW 3 MHz 🛛 Mode Auto Sweep Inp: ExtMix F 1 Frequency Sweep 01R M1[1] dB 10 dBm-.984200 GH 0 dBm--10 dBm H1 -10.000 ( -20 dBm-M: 30 dBm--40 dBm--50 dBm· -60 dBm--70 dBm--80 dBm-140.0 GHz 123.0 GHz 17001 pts 1.7 GHz/ Measuring... 14.01.2021 15:54:07

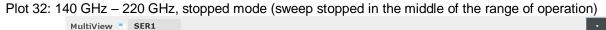
15:54:07 14.01.2021





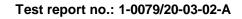
### Plot 31: 140 GHz - 220 GHz, normal mode



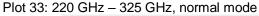


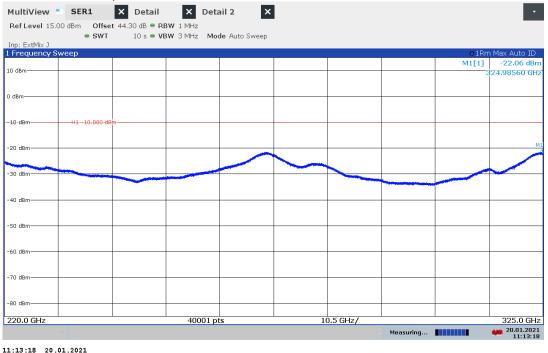
Inp: ExtMix G					O 1 Rn	n Max Auto ID
					M1[1]	-24.32 dB
.0 dBm					1	183.71990 GF
I dBm						
10 dBm	H1 -10.000 dBm					
20 dBm			M1			
-30 dBm						
SU UDIT						
-40 dBm						
-50 dBm					L	
-60 dBm						
-70 dBm						
80 dBm						
						220.0 GH

10:37:43 20.01.2021

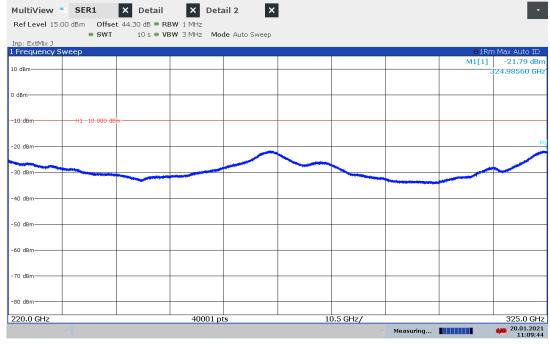








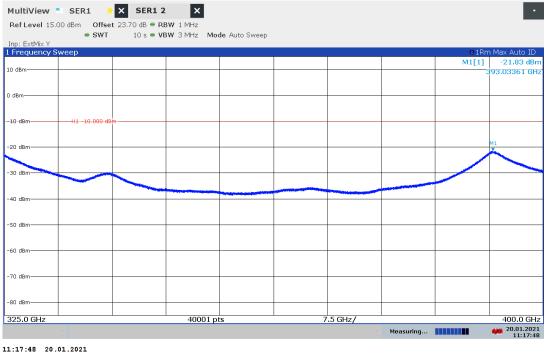
Plot 34: 220 GHz - 325 GHz, stopped mode (sweep stopped in the middle of the range of operation)



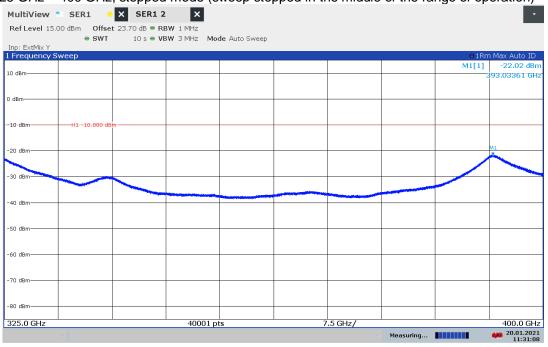
11:09:44 20.01.2021



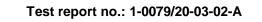
# Plot 35: 325 GHz - 400 GHz, normal mode



Plot 36: 325 GHz – 400 GHz, stopped mode (sweep stopped in the middle of the range of operation)

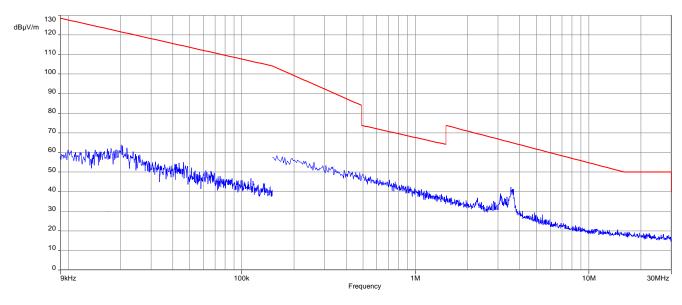


11:31:08 20.01.2021

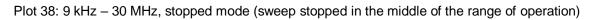


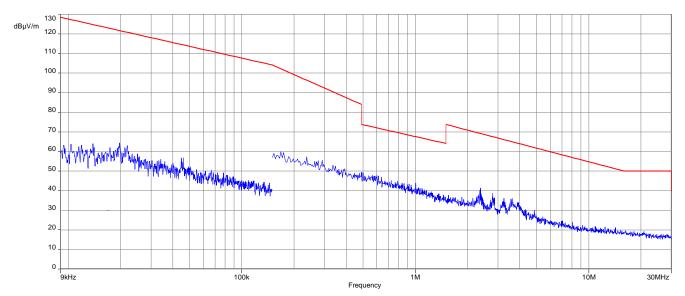


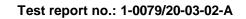
# 12.3.2 Spurious emissions radiated (3/4" version)



Plot 37: 9 kHz - 30 MHz, normal mode

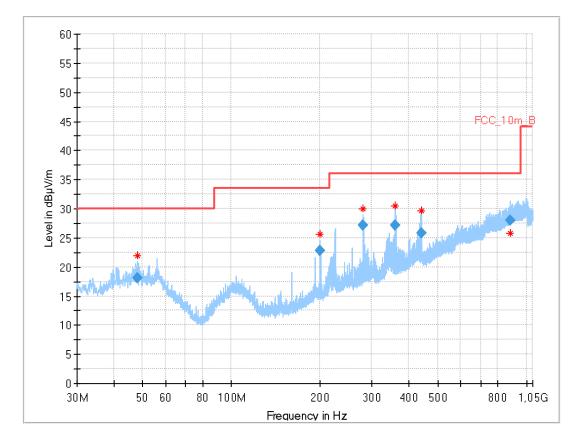








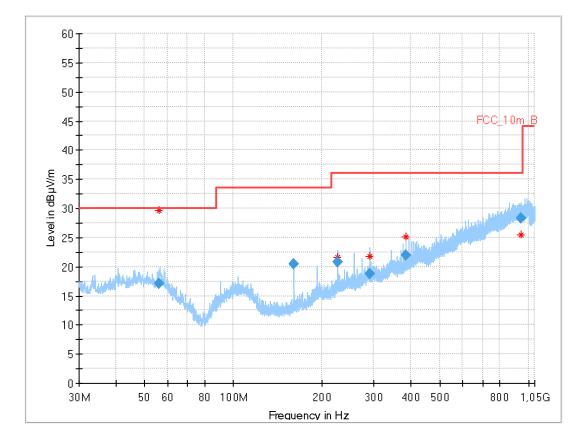
Plot 39: 30 MHz - 1 GHz, normal mode



# Final\_Result

Frequency (MHz)	QuasiPe ak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m )
48.075	18.03	30.0	12.0	1000	120.0	114.0	V	80	14
200.012	22.82	33.5	10.7	1000	120.0	170.0	V	-18	11
280.001	27.11	36.0	8.9	1000	120.0	123.0	V	-22	14
359.154	27.07	36.0	8.9	1000	120.0	106.0	v	165	16
440.865	25.89	36.0	10.1	1000	120.0	98.0	V	247	17
879.067	27.99	36.0	8.0	1000	120.0	140.0	Н	67	23

# Test report no.: 1-0079/20-03-02-A

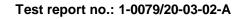


# Plot 40: 30 MHz - 1 GHz, stopped mode (sweep stopped in the middle of the range of operation)

# Final\_Result

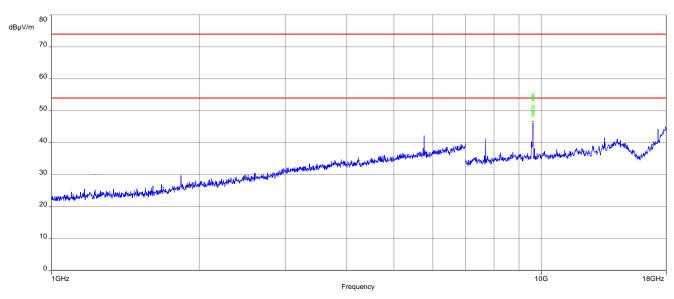
Frequency (MHz)	QuasiPe ak (dBµV/m	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimut h (deg)	Corr. (dB/m )
55.958	17.04	30.0	13.0	1000	120.0	114.0	V	184	15
160.617	20.44	33.5	13.1	1000	120.0	98.0	V	180	9
224.885	20.84	36.0	15.2	1000	120.0	110.0	V	-22	12
289.112	18.71	36.0	17.3	1000	120.0	105.0	V	67	14
385.494	21.97	36.0	14.0	1000	120.0	101.0	V	157	16
944.694	28.39	36.0	7.6	1000	120.0	170.0	Н	247	24

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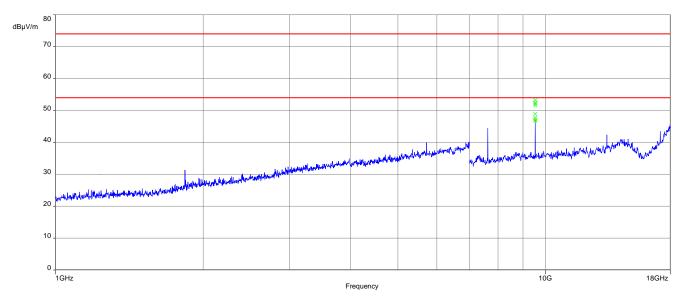


Plot 41: 1 GHz - 18 GHz, normal mode

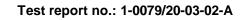


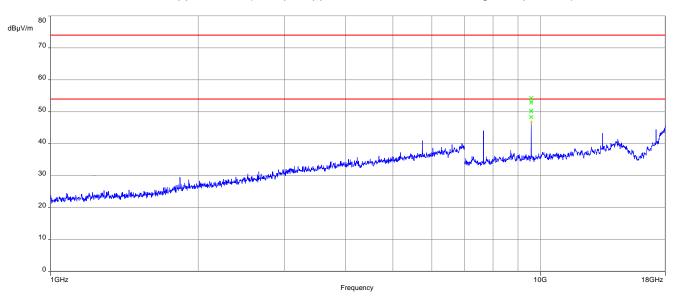
Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9604.800	54.12	74	19.88	49.44	54	4.56

Plot 42: 1 GHz – 18 GHz, stopped mode (sweep stopped near the bottom of the range of operation)



Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9532.200	52.1	74	21.9	47.1	54	6.9





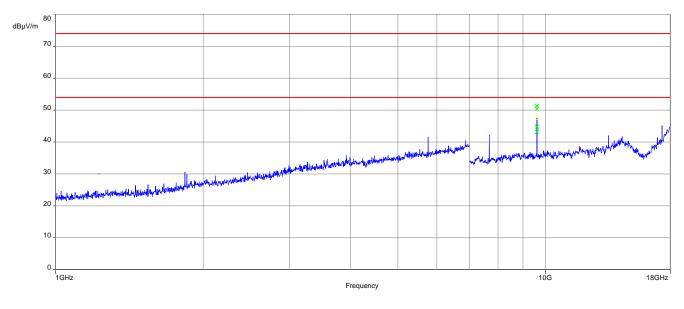
CTC

advanced member of RWTÜV group

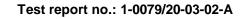
Plot 43: 1 GHz – 18 GHz, stopped mode (sweep stopped in the middle of the range of operation)

Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9568.500	54.31	74	19.69	50.11	54	3.89

Plot 44: 1 GHz – 18 GHz, stopped mode (sweep stopped near the top of the range of operation)



Frequency	Peak	Peak Limit	Margin	Average	Average Limit	Margin
(MHz)	(dBµV/m)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV/m)	(dB)
9603.7	51.14	74	22.86	44.67	54	





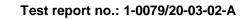
# Plot 45: 18 GHz - 40 GHz, normal mode

ultiView 📑	Spectrum	X Spe	ctrum 2	××					
Ref Level 77.00	-	• RBW 1							
tt	0 dB = SWT 10			Auto Sween					
	_CABLE502_0_5M_			. aco o noop					
equency Sw	еер			1	T	1		o1Pk Max	
Bµ∨———	-H1 74.000 dBµV							M2[2	26,42
	111 / 4.000 dbpv								21.0060
вµ∨								M1[1	39.13 20.9840
									20,9840
вµ∨									
вµ∨									
вич									
		H2 54.000	dBµV						
BuV								men mours	my have me
							wa my my my my	Walding	
BUV					mund	WWWWWWWWWWWWWW	4. 4 · ·		
	M1 MD Anton Mark			in white months	Marchan March				
BUV	MI	unton	an management	dovernin .					
munulun	W.W.W.W. Construction of the second	AUT 18 1						~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	$\sim\sim\sim$
вµν							~~~~	· ~~	
6µ*							V-V-0		
BµV					~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~				
	M2		~~~~~	hw.					
IBBY CANA	M2	www							
вро									
BµV									
0 GHz			1001 p	ts	2	.2 GHz/			40.0
							Measuring		• 08.04.

Plot 46: 18 GHz – 40 GHz, stopped mode (sweep stopped in the middle of the range of operation)

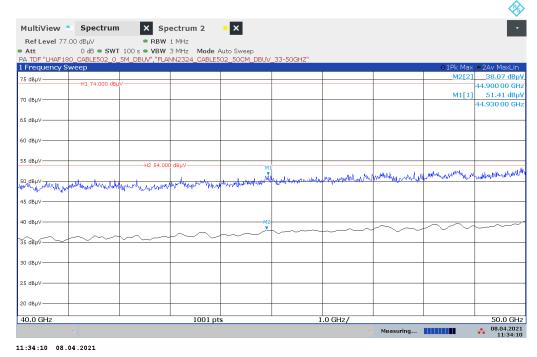
MultiView	Spectrum	🔸 🗙 Spe	ectrum 2	<mark>∗</mark> ×					•
Ref Level 77.	00 dBµV	• RBW :	l MHz						SGL
Att	0 dB 🖷 SWT	100 s 👄 VBW 3	8 MHz Mode /	Auto Sweep					
PA TDF "LHAF18		5M_DBUV"							
1 Frequency Sy	weep							1	● 2Av MaxLin
75 dBµ∨		/						M2[2]	27.02 dBµV 19.137 0 GHz
								M1[1]	38.80 dBµV
70 dBµ∨									19,137 0 GHz
65 dBµ∨									
60 dBµ∨									
55 dBµ∨		H2 54.000	dBuV-						
									1. maker maker
55 dbµv 50 dbµv 45 dbµv 40 dbµv <sup>M1</sup> 40 dbµv <sup>M1</sup> 35 dbµv							L. L. M.K. MARK	AL Many march	w.Con.M.
						de un marin	wwwwwww	***	
45 dBµ∨				A JAMA	Alver and Alman Alver	www			
			14 Marshallan	My way way way of	w dee				. ^
40 dBµ√	when a rate Marine	town the Marine	No You					~~~~	$\sim \sim \sim \sim \sim \sim$
an many many	- 10 P						1 mm	~~~ ·	
35 dBµ∨							~ / -		
				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~~				
30 dBµV		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~^~~~~~	~~~-					
antion	m	~~~~							
25 dBµV —									
20 dBµV									
18.0 GHz			1001 pt	[		2.2 GHz/			40.0 GHz
10.0 GH2			1001 pt	5					
	~					~	Ready		10:31:14

10:31:14 08.04.2021





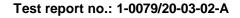
# Plot 47: 40 GHz - 50 GHz, normal mode



Plot 48: 40 GHz - 50 GHz, stopped mode (sweep stopped in the middle of the range of operation)

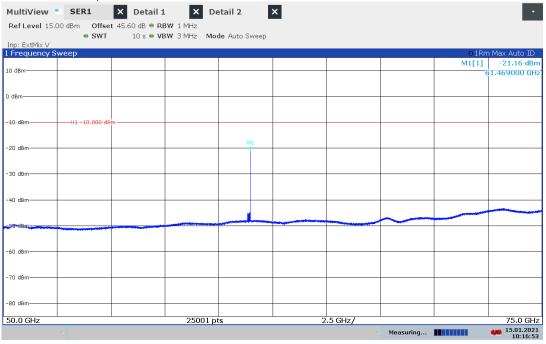
dBµ∨									
dBµV		H2 54.000	dBuV				MI		
							that was	watered warnes in	1 marshing
10.00				1	and the superstand here the	and and the lot	Mulherman	and the work way	horadariante
dBµV	the states of	when I have	White All Month	wand wand work	www.wyway.www.	as an approximation	an white the stand of the stand of the	the second the second	Marken and a second
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dBµV									
·									
							M2		
dBµV							M2		
							×~~	$\sim$	
					$\sim \sim \sim$	$ \sim \sim$	$r \sim \sim$		-
	$\sim \sim \sim \sim \sim$	~~~	$\sim \sim$	$\sim$	-				
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inus I				1					
IBμV —									
				1	1			1	
				1	1			1	
BµV —									
	I			1	1			1	
I				1	1			1	
I				1	1			1	
I				1	1	1	1	1	
BμV									
phy									
				1	1	1	1	1	
I				1	1			1	
0 GHz			1001 p	ts	1	.0 GHz/			50.0 G
0.0112	-		1001 p						• 08.04.20 12:09

12:09:10 08.04.2021





# Plot 49: 50 GHz – 75 GHz, normal mode

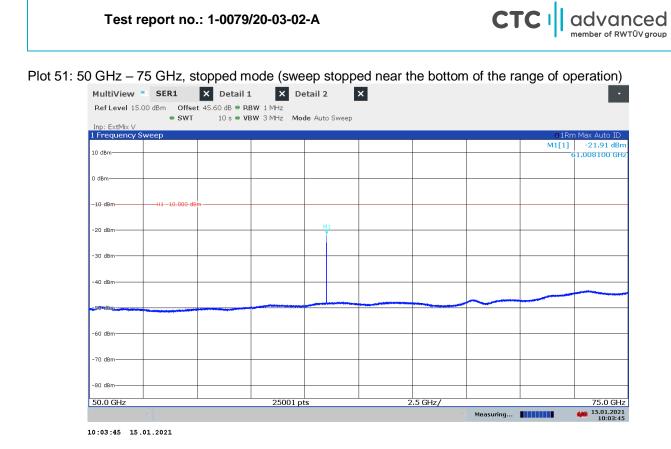


10:16:53 15.01.2021

### Plot 50: 50 GHz - 75 GHz, normal mode

Frequency Swe	еер		1			1			n Max Auto IE
) dBm								M1[1]	-20.77 dE
									11.408780 0
-									
dBm									
LO-dBm	-H1 -10.000 dBm	ì							
20 dBm									M1
30 dBm									
10 dBm									
50 dBm					······		·····		annan C
i0 dBm									
70 dBm			-					+	
				1	1	1	1	1	1

10:20:00 15.01.2021

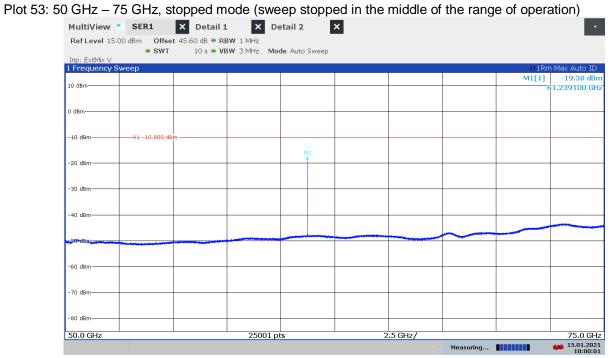


Plot 52: 50 GHz – 75 GHz, stopped mode (sweep stopped near the bottom of the range of operation)

MultiView		× Detail 1		etail 2	×				-
Ref Level 15.00		45.60 dB ● RB 10 s ● VB		de Auto Sweep					
Inp: ExtMix V									
Frequency Sw	/eep								n Max Auto ID
LO dBm								M1[1]	-21,21 dBr 51.008240 GH
) dBm									
10-dBm									
20 dBm									
30 dBm									
40 dBm									
50 dBm									
60 dBm									
70 dBm									
80 dBm									
F 61.25 GHz			1001 pt	ts	50	0.0 MHz/		Sp	oan 500.0 MH
							Measuring		15.01.202 10:07:08

10:07:08 15.01.2021





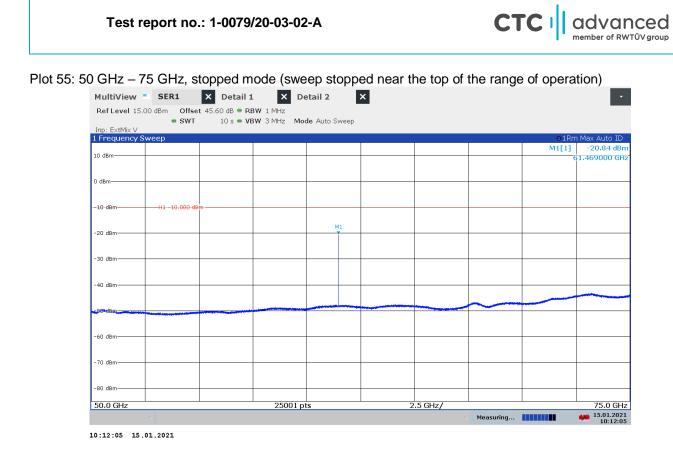


Plot 54: 50 GHz – 75 GHz, stopped mode (sweep stopped in the middle of the range of operation)

		B●RBW 1 MHz s●VBW 3 MHz Mod	le Auto Sweep				
Inp: ExtMix V Frequency Swee	n.					01Rn	n Max Auto ID
Trequency office	·P					M1[1]	-18.87 dBr
0 dBm							1.238510 GF
dBm							
10-dBm	H1 -10.000 dBm						
			M1				
20 dBm			MI T				
eo abin							
30 dBm							
40 dBm							
			Л				
50 dBm							
50 dBm							
70 dBm							
30 dBm							
o abili							
F 61.25 GHz		1001 pts	6	50	0.0 MHz/	Sp	an 500.0 MH

10:00:48 15.01.2021

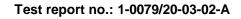
CTC I advanced



Plot 56: 50 GHz – 75 GHz, stopped mode (sweep stopped near the top of the range of operation)

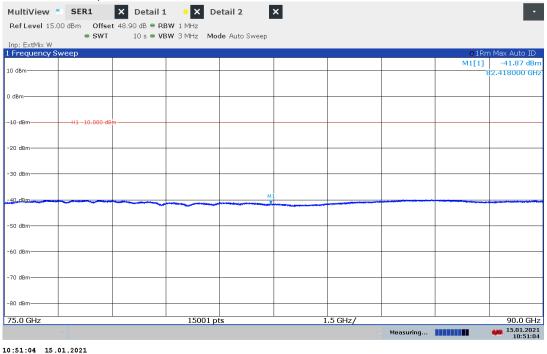
MultiView	SER1	X Detail :	L X De	etail 2	×				-
Ref Level 15.0	00 dBm Offset								
Inp: ExtMix V	● SWT	10 s 👄 VE	W 3 MHz Mo	de Auto Sweep					
Frequency S	weep						1		n Max Auto ID
10 dBm								M1[1]	-21.34 dBr 61.469780 GH
I dBm									
, abiii									
10-dBm	H1 -10.000 dB	n							
-20 dBm									M1
30 dBm									
40 dBm									
50 dBm									
SO UBIII									
60 dBm									
70 dBm									
80 dBm									
CF 61.25 GHz	_		1001 pt	s	5	0.0 MHz/		S	0an 500.0 MH 15.01.202: 09:56:24

09:56:24 15.01.2021





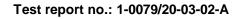
## Plot 57: 75 GHz – 90 GHz, normal mode



Plot 58: 75 GHz – 90 GHz, stopped mode (sweep stopped in the middle of the range of operation)

Inp: ExtMix W	• SWT 10 s	• VBW 3 MHz M	oue Auto Sweep			
Frequency Sweep						m Max Auto II
0 dBm					M1[1]	-41.67 df 82.418000 G
) dBm				 	 	
10-dBm H1 -	10.000 dBm					
	10.000 0011					
20 dBm						1
30 dBm						
10. dBm			MI	 	 	
50 dBm						
50 dBm						
70 dBm					 	
30 dBm						
oo ubiii						

10:55:01 15.01.2021

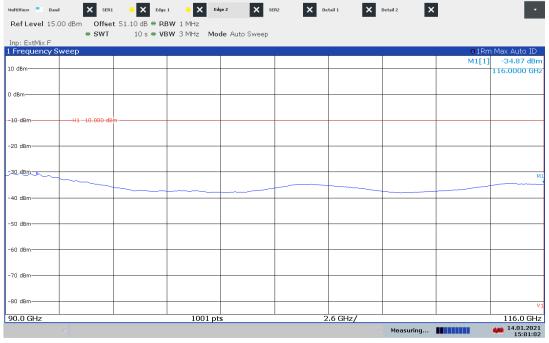




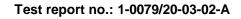
### Plot 59: 90 GHz – 116 GHz, normal mode

fulti¥iew 📕 Band 🛛 🔆 🗙 SER1	1 🔆 🗙 Edge 1 🕂 🗙 Edg	e 2 🗙 SER2	X Detail 1 X	Detail 2	¢	•
Ref Level 15.00 dBm Offse	t 51.10 dB 🗢 RBW 1 MHz				-	_
inp: ExtMix F	10 s 🗢 VBW 3 MHz Mod	le Auto Sweep				
Frequency Sweep					O1Rn	n Max Auto ID
					M1[1]	
.0 dBm						116.0000 GF
) dBm						
-10-dBm H1 -10.000 dB	3m					
20 dBm						
30 dBm						
		m				
40 dBm						
50 dBm						
-60 dBm						
70 dBm						
80 dBm						
90.0 GHz	1001 pts	ŝ	2.6 GHz/			116.0 GH
Ŷ				Measuring		14:52:1
:52:16 14.01.2021						

Plot 60: 90 GHz - 116 GHz, stopped mode (sweep stopped near the bottom of the range of operation)

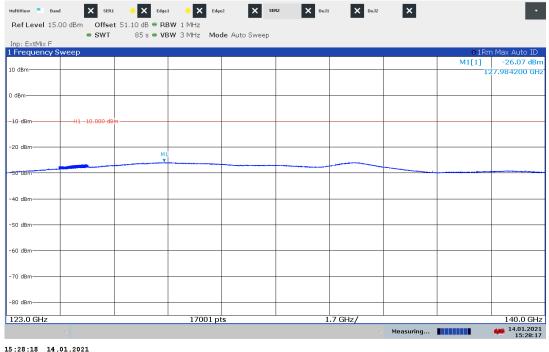


15:01:02 14.01.2021

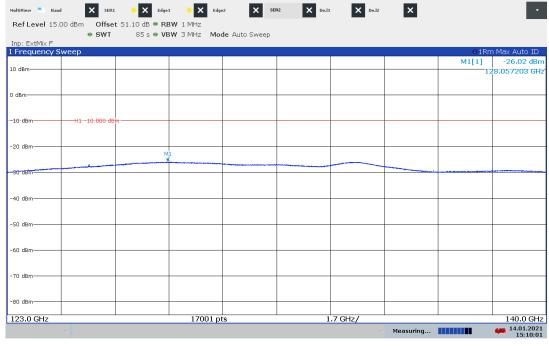




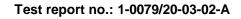
#### Plot 61: 123 GHz – 140 GHz, normal mode



Plot 62: 123 GHz – 140 GHz, stopped mode (sweep stopped near the top of the range of operation)

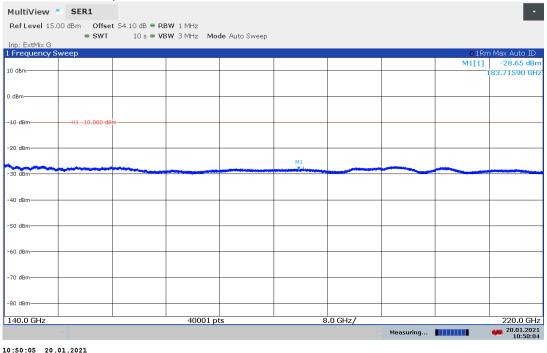


15:10:01 14.01.2021

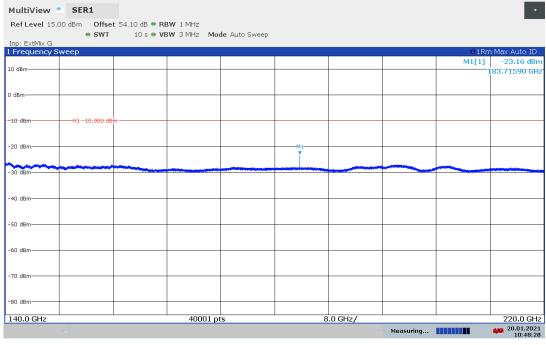




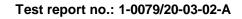
#### Plot 63: 140 GHz - 220 GHz, normal mode



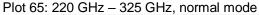
Plot 64: 140 GHz – 220 GHz, stopped mode (sweep stopped in the middle of the range of operation)

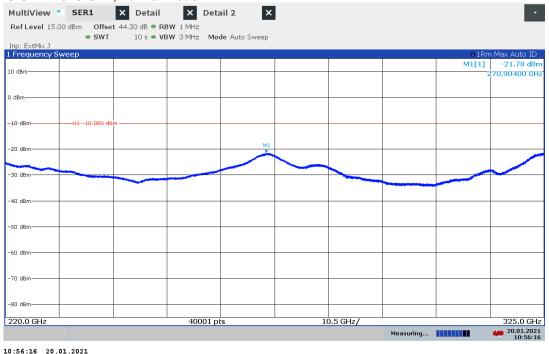


10:48:29 20.01.2021

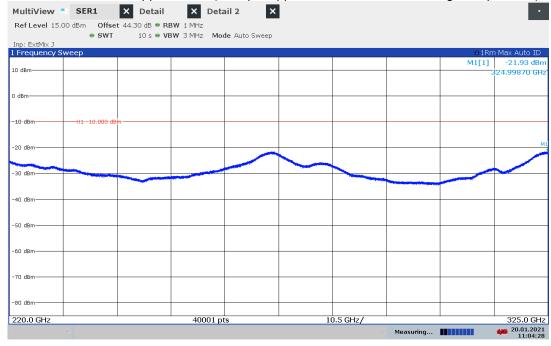








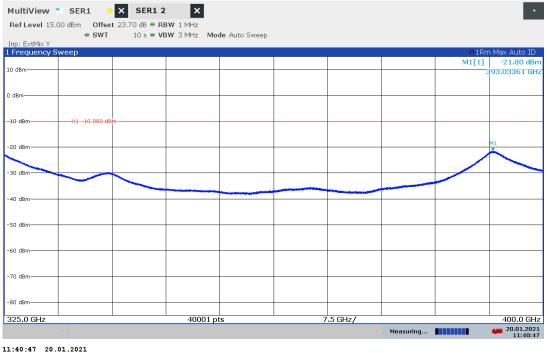
Plot 66: 220 GHz - 325 GHz, stopped mode (sweep stopped in the middle of the range of operation)



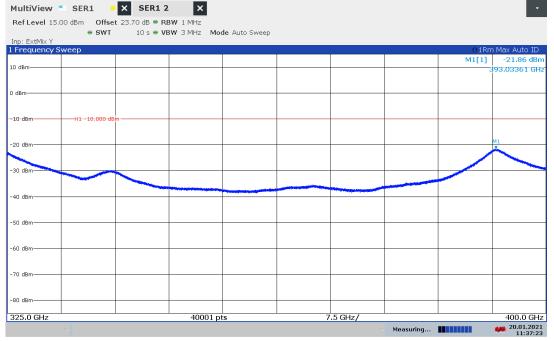
11:04:29 20.01.2021



# Plot 67: 325 GHz - 400 GHz, normal mode



Plot 68: 325 GHz – 400 GHz, stopped mode (sweep stopped in the middle of the range of operation)



11:37:23 20.01.2021



# **12.4 Frequency Stability**

#### **Description:**

§15.215(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

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.

#### Measurement:

 $f_C$  is the point in the radiation where the power is at maximum. The frequency points where the power falls 10 dB below the  $f_C$  level and above  $f_C$  level are designated as  $f_L$  and  $f_H$  respectively. The operating frequency range (i.e. the frequency band of operation) is defined as  $f_H - f_L$ .

Measuremei	nt parameter
Detector:	Peak
Sweep time:	100 s
Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Span:	2 GHz
Trace-Mode:	Max Hold
Temperature:	-20 °C / +50 °C
Voltage:	20.4 V / 24 V / 27.6 V

#### Limits:

FCC							
CFR Part 15.258 (d)							
The occupied bandwidth from intentional radiators operated within the specified frequency band shall comply with the following:							
Frequency range							
116 GHz – 123 GHz (regulatory) 122 – 123 GHz (EUT)							



# Measurement Results:

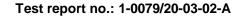
# a) 1" version

Test Conditions		equency Range Hz]	Occupied Bandwidth [MHz]
	fL	f <sub>H</sub>	נואורזצן
-20 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
-10 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
0 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
10 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
20 °C / V <sub>min</sub>	122.014 500	122.9436	929.10
20 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
20 °C / V <sub>max</sub>	122.014 500	122.9436	929.10
30 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
40 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
50 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10
55 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10

# b) 3/4" version

Test Conditions		Transmitter Frequency Range [GHz]				
	fL	f <sub>H</sub>	[MHz]			
-20 °C / V <sub>nom</sub>	122.014 500	122.9456	931.10			
-10 °C / V <sub>nom</sub>	122.014 500	122.9456	931.10			
0 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10			
10 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10			
20 °C / V <sub>min</sub>	122.014 500	122.9436	929.10			
20 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10			
20 °C / V <sub>max</sub>	122.014 500	122.9436	929.10			
30 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10			
40 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10			
50 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10			
55 °C / V <sub>nom</sub>	122.014 500	122.9436	929.10			

# Result: The measurement is passed.





Plot 69: Occupied Bandwidth of 1" version at -20 °C / Vnom

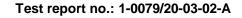
MultiView	Spectru	ım 🗙 Spectr	um 2 🗙			•
Ref Level 20		set 48.50 dB 🖷 RBW 1				
	● SW	T 100 s 🖷 VBW 3	3 MHz Mode Auto Sweep			
Inp: ExtMix D 1 Frequency	Sween					o1Pk Max ●2Rm Max
Trequency	Энсер					M1[1] 8.87 dBn
					M1	122.93760 GH
10 dBm					7	
0 dBm						
-10 dBm					2	
		<u>1</u>			7	
-20 dBm		Υ				
-20 ubiii-						
-30 dBm	Amerikanser	momental providence			herean	a warmer and the and the and the second and the second sec
-40 dBm						
-50 dBm						
-60 dBm						
oo abiii						
-70 dBm					V2	
		Ý1			i i i	
121.5 GHz			1001 pts	200.0 MHz/		123.5 GHz
2 Marker Tat	ole					
Type Re		X-Value	Y-Value	Function		Function Result
M1	1	122.9376 GHz	8.87 dBm	ndB		20.0 dB
T1	1	122.0145 GHz	-16.91 dBm	ndB down BW		929.10 MHz
T2	1	122.9436 GHz	-13.12 dBm	Q Factor		132.3
					Measuring	<b>06.11.2020</b>

17:10:48 06.11.2020

### Plot 70: Occupied Bandwidth of 1" version at +55 °C / V<sub>nom</sub>

MultiView	- Spectru	m × Spectrum 2	×			•
Ref Level 20	.00 dBm Offs	set 48.50 dB • RBW 1 MHz				_
	● S₩	T 100 s 🖷 VBW 3 MHz	Mode Auto Sweep			
Inp: ExtMix D 1 Frequency S	Bwoon					o1Pk Max ⊜2Rm Max
	sweep					M1[1] 4.34 dBn
						122.93760 GH
10 dBm					M1	122.93760 GH
					Y.	
0 dBm		have a second se		and the second s	~~~	
-10 dBm						
-10 UBM		T.			12	
		\4			l l	
-20 dBm						
-30.dBm	alventure man	mumpan			Mulmon	warmanger Mar Mary Mary marker warmen
-40 dBm						
	+					
-50 dBm						
oo abiii						
co dou						
-60 dBm						
-70 dBm					V2	
		V1			v2	
121.5 GHz	1	100	1 pts	200.0 MHz/		123.5 GHz
2 Marker Tab	le	100	1 pto	20010 11112/		12010 GH
Type Re		X-Value	Y-Value	Function		Function Result
M1	1	122.9376 GHz	4.34 dBm	ndB		20.0 dB
Τ1	1	122.0145 GHz	-18.60 dBm	ndB down BW		929.10 MHz
T2	1	122.9436 GHz	-15.29 dBm	Q Factor		132.3
					<ul> <li>Measuring</li> </ul>	<b>06.11.2020</b>

14:26:26 06.11.2020





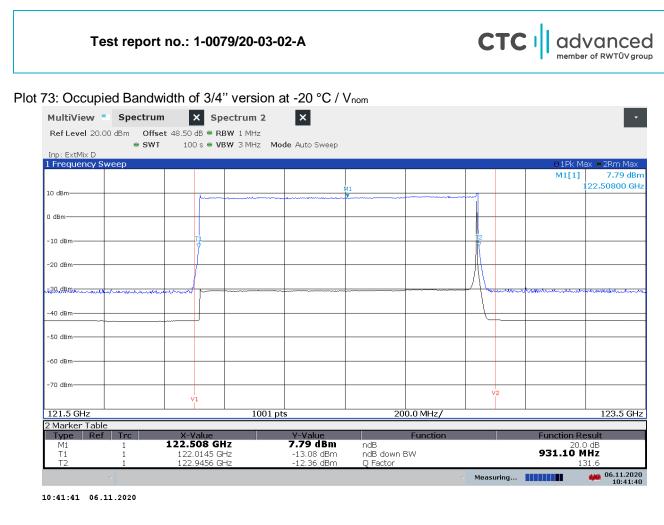
14:00:30 06.11.2020

## Plot 72: Occupied Bandwidth of 1" version at 20 °C / V<sub>max</sub>

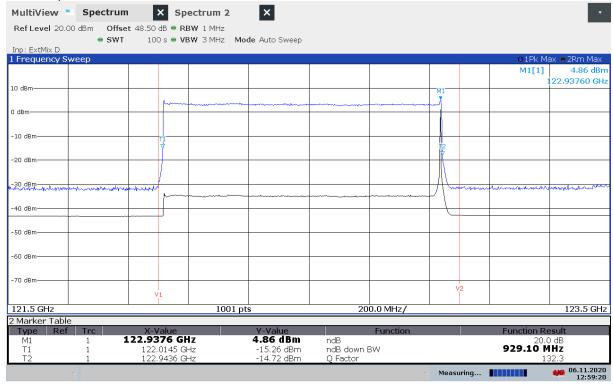
MultiView	- Spectrui	m 🗙 Spe	ctrum 2	×					
Ref Level 20	.00 dBm Offs	et 48.50 dB = RB							_
	● S₩1	100 s 🖷 VB	WI 3 MHz Mod	le Auto Sweep					
Inp: ExtMix D 1 Frequency	Cuucan							o t D k I	Max ⊜2Rm Max
1 Frequency	Sweep							M1[1]	
								MILI	122.93760 GH
10 dBm							M1-		122.93760 GH
		l.					<u>1</u>		
0 dBm									
o ubili									
							12		
-10 dBm									
		먗							
-20 dBm		1							
		/							
-30 dBm	mantennotoria	ad a sha di						and and also have a series	Munnunnham
and a second	and the second second second	providence					+		
-40 dBm									
10 dbm		<b>↓</b> ↓ ↓						~	
-50 dBm									
-60 dBm									
-70 dBm									
		V1					V2		
		VI							
121.5 GHz			1001 pts	6	20	0.0 MHz/			123.5 GHz
2 Marker Tab									
Type Re		X-Value		Y-Value		Function		Function F	
M1	1	122.9376 GH		6.11 dBm	ndB	2141		000 10	.0 dB
T1 T2	1	122.0145 GH 122.9436 GH		-19.23 dBm -10.08 dBm	ndB down I Q Factor	SVV		929.10	<b>МПZ</b> 132.3
	1	122.9430 GH	۷	10.00 UDIT	QTACCO				
							Measuring		06.11.2020

14:06:17 06.11.2020

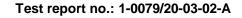
CTC I advanced

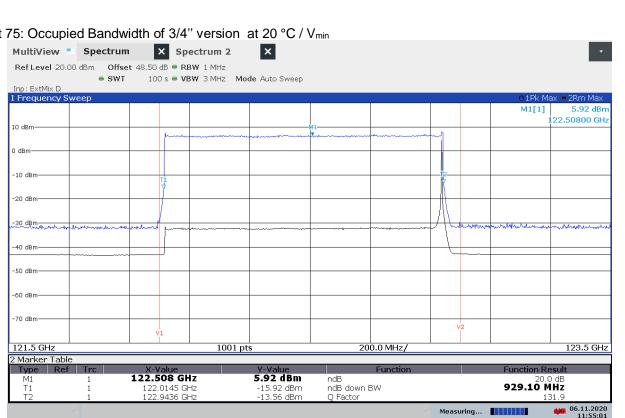


Plot 74: Occupied Bandwidth of 3/4" version at +55  $^\circ\text{C}$  /  $V_{\text{nom}}$ 



12:59:20 06.11.2020





### Plot 75: Occupied Bandwidth of 3/4" version at 20 °C / Vmin

11:55:01 06.11.2020

# Plot 76: Occupied Bandwidth of 3/4" version at 20 °C / Vmax

MultiView	- Specti	rum 🗙 Spectrun	12 ×			•
Ref Level 20		Hfset 48.50 dB ● RBW 1 MH				
Inp: ExtMix D	• S	WT 100 s • VBW 3 MH	Hz Mode Auto Sweep			
1 Frequency	Sweep					o1Pk Max e2Rm Max
						M1[1] 7.80 dBn
10 dBm					M1	122.93760 GH
10 dBm		harmon	and the second			
0.40						
0 dBm						
-10 dBm		т			1	
		₹			A A	
-20 dBm						
		( )				
-30 dBm	was have not	many provident			- Mahrum	month have a marked to a set
-40 dBm						
-50 dBm						
-60 dBm						
-70 dBm						
		V1			V2	
121.5 GHz			1001 pts	200.0 MHz/		123.5 GHz
2 Marker Tat	le		1001 pt3	20010 1411 127		125.5 012
Type Re		X-Value	Y-Value	Function		Function Result
M1	1	122.9376 GHz	7.80 dBm	ndB		20.0 dB
T1 T2	1	122.0145 GHz	-17.35 dBm	ndB down BW		929.10 MHz
12	1	122.9436 GHz	-13.97 dBm	Q Factor		132.3
					Measuring	<b>06.11.2020</b>

11:58:01 06.11.2020

CTC I advanced



# 13 Conducted spurious emissions < 30 MHz

# **Description:**

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. Both power lines, phase and neutral line, are measured. Found peaks are re-measured with average and quasi peak detection to show compliance to the limits.

### Measurement:

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

# Limits:

FCC			IC			
CFR Part 15.207(a)		RSS-Gen 8.8				
Conducted Spurious Emissions < 30 MHz						
Frequency (MHz)	Quasi-Pea	κ (dBμV/m)	Average (dBµV/m)			
0.15 – 0.5	79 to 69* (Class A) 66 to 56* (Class B)		79 to 69* (Class A) 56 to 46* (Class B)			
0.5 – 5	73 (Cl 56 (Cl		63 (Class A) 46 (Class B)			
5 - 30.0	73 (Cl 60 (Cl		63 (Class A) 50 (Class B)			

\*Decreases with the logarithm of the frequency

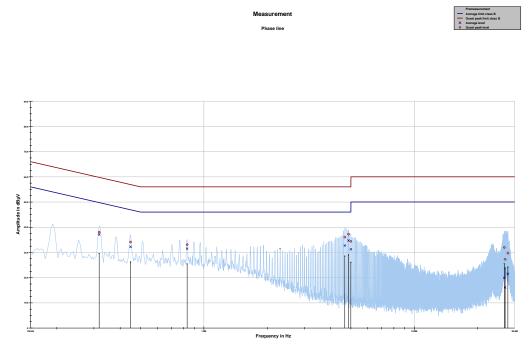
#### **Measurement results:**

See plots below.

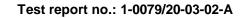
# Test report no.: 1-0079/20-03-02-A



# Plot 77: Phase line 1" version

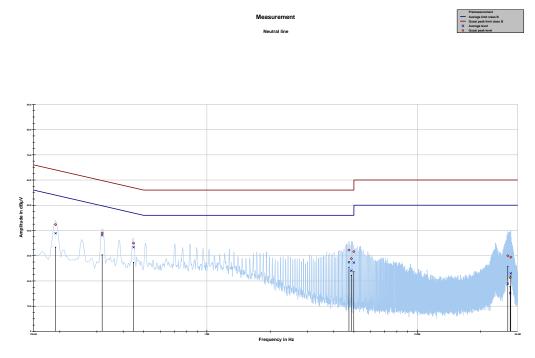


Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.317906	38.04	21.72	59.761	37.08	14.12	51.203
0.448500	34.13	22.77	56.903	32.23	15.24	47.471
0.832819	33.07	22.93	56.000	31.51	14.49	46.000
4.676006	36.07	19.93	56.000	32.71	13.29	46.000
4.870031	37.25	18.75	56.000	34.73	11.27	46.000
4.996894	34.40	21.60	56.000	31.25	14.75	46.000
26.787394	31.99	28.01	60.000	19.92	30.08	50.000
27.041119	27.28	32.72	60.000	16.09	33.91	50.000
27.876919	29.72	30.28	60.000	21.50	28.50	50.000





# Plot 78: Neutral line 1" version

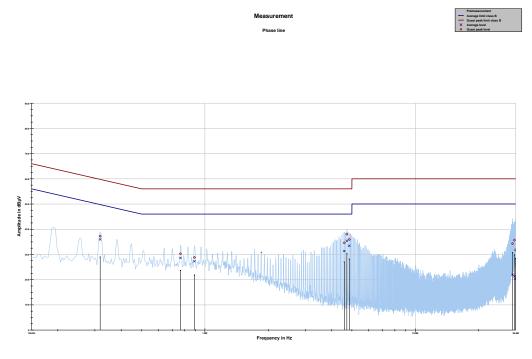


Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.191044	42.31	21.68	63.991	38.87	15.95	54.827
0.317906	38.98	20.78	59.761	38.09	13.11	51.203
0.448500	34.96	21.94	56.903	33.35	14.12	47.471
4.735706	32.25	23.75	56.000	27.41	18.59	46.000
4.862569	28.82	27.18	56.000	24.05	21.95	46.000
4.993163	31.62	24.38	56.000	27.27	18.73	46.000
26.951569	29.96	30.04	60.000	18.91	31.09	50.000
27.653044	21.29	38.71	60.000	15.14	34.86	50.000
27.843338	29.42	30.58	60.000	22.97	27.03	50.000

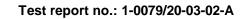
# Test report no.: 1-0079/20-03-02-A



# Plot 79: Phase line 3/4" version

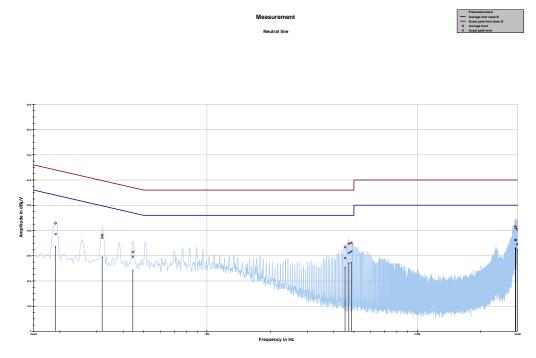


Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.317906	37.25	22.52	59.761	35.96	15.24	51.203
0.765656	30.28	25.72	56.000	28.61	17.39	46.000
0.892519	28.82	27.18	56.000	27.30	18.70	46.000
4.601381	34.59	21.41	56.000	31.31	14.69	46.000
4.731975	38.05	17.95	56.000	35.42	10.58	46.000
4.858837	35.94	20.06	56.000	33.43	12.57	46.000
29.029875	34.25	25.75	60.000	22.01	27.99	50.000
29.608219	35.69	24.31	60.000	21.34	28.66	50.000
29.988806	31.77	28.23	60.000	20.30	29.70	50.000





# Plot 80: Neutral line <sup>3</sup>/<sub>4</sub>" version



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.191044	42.84	21.15	63.991	38.52	16.31	54.827
0.317906	38.21	21.55	59.761	37.17	14.03	51.203
0.444769	31.45	25.52	56.972	29.65	17.93	47.578
4.537950	33.39	22.61	56.000	29.08	16.92	46.000
4.731975	34.77	21.23	56.000	31.10	14.90	46.000
4.858837	35.05	20.95	56.000	31.61	14.39	46.000
29.279869	41.61	18.39	60.000	36.14	13.86	50.000
29.406731	41.11	18.89	60.000	36.26	13.74	50.000
29.854481	40.41	19.59	60.000	34.51	15.49	50.000



#### 14 Glossary

EUT	Equipment under teet
DUT	Equipment under test
	Device under test Unit under test
UUT	
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
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N <sub>0</sub>	Carrier to noise-density ratio, expressed in dB-Hz



# 15 Document history

Version	Applied changes	Date of release
	Final version	2021-04-22
-A	FCC-ID corrected	2021-05-18

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

first page	last page
Every	Office Berlin       Office Frankfurt am Main       Office Braunschweig         Spittelmarkt 10       Office Frankfurt am Main       Office Braunschweig         10117 Berlin       G0327 Frankfurt am Main       Bundesallee 100         38116 Braunschweig
The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number 0-Pt-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages. Registration number of the certificate: D-PL-12076-01-05 Frankfurt arm Main, 09.06.2020 The certificate inset of the status at the time of the date of issue. The current status of the scope of accreditation can be joond in the database of accredited badies of distribute Akkedbierungsstelle GmbAt. http://www.akk.adu/content/foccredited-badies_disks	The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkrediterungsstelle GmbH (DAkkS). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkkS. The accreditation attested by DAkkS. The accreditation attested by DAkkS. The accreditation attested by DAkkS. In the Accreditation attested by DAkkS. The accreditation attested by DAkkS. In the Accreditation (IC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation attested approach. DS(S) and the Regulation (IC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation attracting and produces (Diffical Journal of the European Unit D2 at 51 July 2008, p. 30). DAkkS is a conditioned of the European Unit D2 at 51 July 2009, p. 30). DAkkS is a conditioned (IC) No 765/2008 of the European Parliament at a diffication (IC), lotentational Accreditation forum (ICP) ind International Liboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations. The up-to-date state of membership can be retrieved from the following websites: EA: www.european-accreditation.org ILAC: www.european-accreditation.org ILAC: www.iaf.nu

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

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