



# Bundesnetzagentur

# **Test Report**

Test report no.: 21096188-22599-1 Date of issue: 2022-02-18

Test result: The test item - passed - and complies with below listed standards.

### Applicant

Leica Geosystems AG

#### Manufacturer

Leica Geosystems AG

Test Item

60 GHz Radar Module / BLK2FLY

# RF-Spectrum Testing according to:

FCC 47 CFR Part 15 Radio Frequency Devices, Subpart C -§15.255 Operation within the bands 57-71GHz

#### WAIVER

Tested by (name, function, signature) Sebastian Janoschka Lab Manager RF

signature

Approved by (name, function, signature) Andreas Bender Deputy Managing Director

signature

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2022-02-18



Applicant and Test item details				
Applicant	Leica Geosystems AG Heinrich-Wild-Strasse 9435, Heerbrugg, Switzerland Fon: +41 71 245 33 80 Fax: +41 71 245 33 81			
Manufacturer	Leica Geosystems AG Heinrich-Wild-Strasse 9435, Heerbrugg, Switzerland			
Test item description	60 GHz radar modules for object detection and collision avoidance for a drone			
Model/Type reference	60 GHz Radar Module / BLK2FLY			
FCC ID	RFD-BLK2FLY			
Frequency	60 GHz to 64 GHz			
Antenna	serial fed patch antenna			
Power supply	14.0 to 17.0 V DC (nominal: 15.0 V DC)			
Temperature range	-20 °C to +50 °C			

#### **Disclaimer and Notes**

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Within this test report, a ⊠ point / □ comma is used as a decimal separator. If otherwise, a detailed note is added adjected to its use.

IBL-Lab GmbH does not take test samples. The samples used for testing are provided by the applicant.

Decision rule:

Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2 according to ILAC-G8:09/2019



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Annex 3



# 2 GENERAL INFORMATION

2.1 Administrative details				
Testing laboratory	<b>IBL-Lab GmbH</b> Heinrich-Hertz-Allee 7 66386 Sankt Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: <u>www.ib-lenhardt.de</u> E-Mail: info@ib-lenhardt.de			
Accreditation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number:			
	<ul> <li>Electronics</li> <li>Electromagnetic Compatibility</li> <li>Electromagnetic Compatibility and Telecommunication (FCC requirements)</li> <li>Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ISED Company Number Testing Laboratory CAB Identifier</li> <li>Telecommunication (TC)</li> <li>Website DAkkS: <u>https://www.dakks.de/</u></li> <li>The Deutsche Akkreditierungsstelle GmbH (DA the <u>ILAC Mutual Recognition Arrangement</u></li> </ul>	D-PL-21375-01-01 D-PL-21375-01-02 D-PL-21375-01-03 D-PL-21375-01-04 27156 DE0020 D-PL-21375-01-05		
Testing location	<b>IBL-Lab GmbH</b> Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany			
Date of receipt of test samples Start – End of tests	2021-11-02 2021-11-02 – 2022-02-07			

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# 2.2 Possible test case verdicts Test sample meets the requirements P (PASS) Test sample does not meet the requirements F (FAIL) Test case does not apply to the test sample N/A (Not applicable) Test case not performed N/P (Not performed)



#### 2.3 Observations

No additional observations other than the reported observations within this test report have been made.

#### 2.4 Opinions and interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

#### 2.5 Revision History

-0 Initial Version

-1 Revision: editorial changes based on TCB feedback

This test report 21096188-22599-1 replaces the previous test report 21096188-22599-0. Utilisation, publication and control of previous report editions is under responsibility of the applicant.

#### 2.6 Further documents

List of further applicable documents belonging to the present test report: – no additional documents –



# 3 ENVIRONMENTAL & TEST CONDITIONS

#### 3.1 Environmental conditions

Temperature	20°C ± 5°C
Relative humidity	25-75% r.H.
Barometric Pressure	860-1060 mbar
Power supply	230 V AC ± 5%

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#### 3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-20 °C	20 °C	+50 °C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	14.0 V DC	14.8 V DC	17.0 V DC

# 4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
	Radio Frequency Devices, Subpart C -
	§15.255 Operation within the bands 57-71GHz

Reference	Description
ANSI C63.4-2014	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
Request for Waiver (2019-06-28)	Request for Waiver: Leica Geosystems AG requests a waiver of Section 15.255(b) of the Commission's rules to permit the marketing of a 60-64 GHz radar device that will be integrated in commercial Unmanned Aerial Vehicles (UAVs) used for visual capture of the outsides of structures. The radar will help to avoid collisions with stationary obstacles.



# 5 EQUIPMENT UNDER TEST (EUT)

#### 5.1 **Product description**

60 GHz radar modules for object detection and collision avoidance for a drone

#### 5.2 Description of test item

•		
Model name*	60 GHz Radar Module / BLK2FLY	
Serial number*	88088021081900XXE and 88087021081900XXE	
PCB identifier*	N/A	
Hardware status*	Rev. E	
Software status*	V-ACR_IWR-HEX-0502	
	•	

\*: as declared by applicant

#### 5.3 Technical data of test item **Operational frequency band\*** 60 GHz to 64 GHz Type of radio transmission\* modulated carrier Modulation type\* FMCW Number of channels\* 1 Channel bandwidth\* <4 GHz **Channel spacing\*** N/A **Receiver category\*** N/A N/A **Receiver bandwidth\*** Duty cycle\* ~15% Antenna\* serial fed patch antenna Rated RF output power\* <20 dBm 14.0 to 17.0 V DC (nominal: 15.0 V DC) **Power supply\*** -20 °C to +50 °C Temperature range\*

\*: as declared by applicant

#### 5.4 Additional information

Model differences	none
Ancillaries tested with	EUT was integrated in Leica Geosystems AG, Model BLK2FLY, Art.No. 938405
Additional equipment used for testing	Notebook with special test software and battery adapter



# 6 SUMMARY OF TEST RESULTS

#### **Test specification**

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#### FCC 47 CFR Part 15.255

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§15.255(e) / §2.1049	Occupied bandwidth (6dB/12dB bandwidth)	Normal	3762 MHz	Р
§15.255(c)	Radiated EIRP	Normal	-1.09 dBm AVG 13.89 dBm Peak	Р
§15.215(c) / §15.255(f)	Transmitter frequency stability	Normal/Extreme	-/-	Р
§15.255(d) / §15.209(a)	Field strength of emissions (spurious & harmonics)	Normal	< Waver limit	Р

#### Notes

#### 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 may exceed the +20 dBm input power limit of many commercially available mixers. For these reasons a radiated method is preferred.

#### **Comments and observations**

Testing was done according to Waiver (2019-06-28):

Request for Waiver: Leica Geosystems AG requests a waiver of Section 15.255(b) of the Commission's rules to permit the marketing of a 60-64 GHz radar device that will be integrated in commercial Unmanned Aerial Vehicles (UAVs) used for visual capture of the outsides of structures. The radar will help to avoid collisions with stationary obstacles.



# 7 TEST RESULTS

#### 7.1 Occupied bandwidth (§2.1049)

#### Description

§2.1049 Measurements required: Occupied bandwidth.

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 shall be measured.

#### Limits

The radar device's occupied bandwidth (i.e. 99% emission bandwidth) shall be contained in the 57-71GHz frequency band.

FCC §15.255 € (1):

For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

#### Test procedure

ANSI C63.10, 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

- The following procedure shall be used for measuring 99% power bandwidth:
- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

#### Note

Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.10).

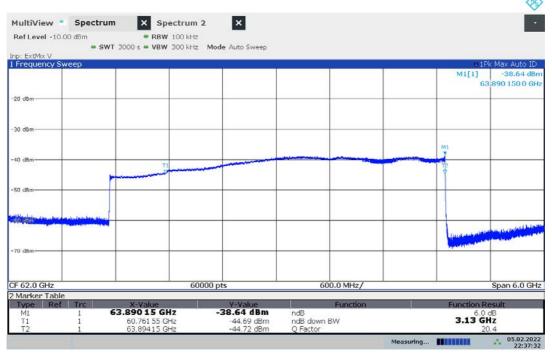
Test setup: 8.4



Test results under normal and extreme test conditions:					
EUT mode	Test conditions	f <sub>L</sub> [GHz]	f <sub>H</sub> [GHz]	99% OBW [GHz]	
Normal operating	Normal - 6dB	60.762	63.894	3.13	
Normal operating	Normal - 10dB	60.134	63.896	3.76	
Normal operating	Normal - 99%	60.147	63.879	3.73	

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#### Plot no. 1: 6 dB bandwidth



22:37:33 05.02.2022

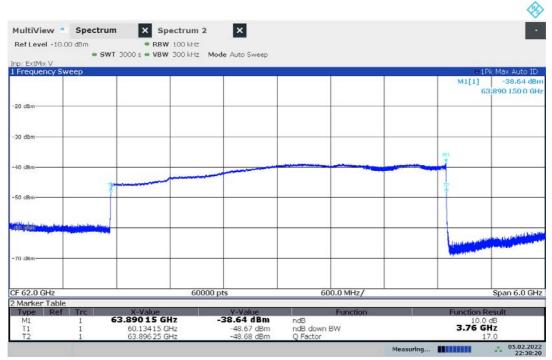
Note: The 6 dB Bandwidth does not cover the full spectrum due to an uneven power spectral density and is therefore deemed insufficient, alternative measurements were made as worst-case considerations:



8

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#### Plot no. 2: 10 dB bandwidth



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#### Plot no. 3: 99 % bandwidth

p: ExtMix V Occupied Bandwidth	0. 0			<del>0</del> 1Pk	Max Auto II
				M1[1]	-37.80 dE
20 dBm				62	108500 G
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			M1	T2	
40 dBm	T1			No. of Concession, Name	
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o den					
r0 dBm					
B0 dBm					
0 d8m					
100 dBm					
LOU UBIN					
		60000 pts	600.0 MHz/		Span 6.0 G
F 62.0 GHz Marker Table					

20:23:03 05.02.2022





#### 7.2 Radiated EIRP

§ 15.255 (c) (4) The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

#### Limits

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

#### Limits of Waiver

Average EIRP: 0 dBm Peak EIRP: 18.7 dBm

#### Test procedure

According to ANSI C63.10, 9.11 Measurement of the fundamental emission using an RF detector and substitution.

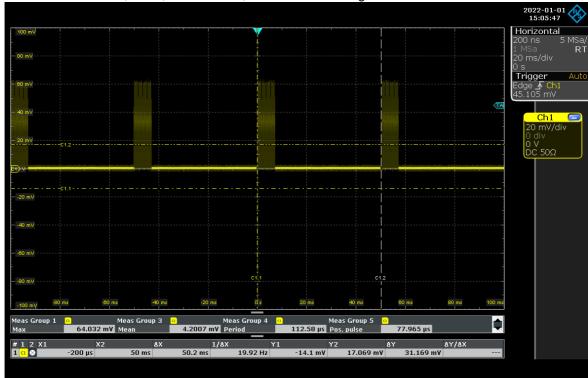
#### Test setup: 8.5

#### Test results:

rectrectation				
EUT mode	Temperature / Voltage	Peak Power	Mean Power	Duty Cycle
Normal operating	T <sub>nom</sub> / V <sub>nom</sub>	13.89 dBm	-1.09 dBm	14 %

# INGENIEURBÜRO LENHARDT

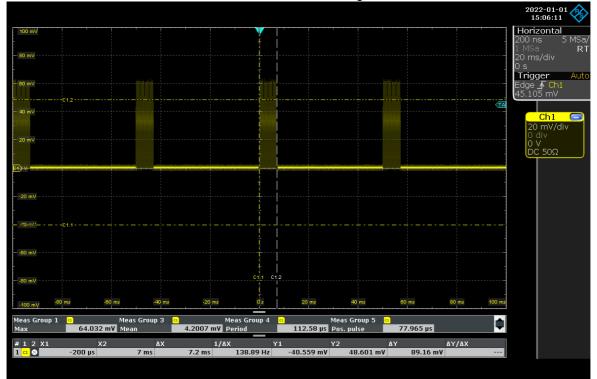
#### TR no.: 21096188-22599-1



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Plot no. 4: Screenshot DSO, Peak, AVG Values, Delta marker timing considerations

Plot no. 5 Screenshot DSO, Peak, AVG Values, Delta marker timing considerations 2





#### 7.3 Frequency stability (§2.1055 & §15.255(f))

#### Description

§2.1055 Measurements required: Frequency stability.

- (a) The frequency stability shall be measured with variation of ambient temperature as follows:
- (1) From −30° to + 50° centigrade for all equipment except that specified in paragraphs (a) (2) and (3) of this section.
- (b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10° centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.
- (d) The frequency stability shall be measured with variation of primary supply voltage as follows:
- (1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.
- (2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.
- (3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

#### Limits

§15.255 Operation within the band 57-71 GHz

(f) Frequency stability. 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.

#### **Test procedure**

ANSI C63.10, 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

- a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.
- b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.
- c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.
- d) Step a) through step c) might require iteration to adjust within the specified range.
- e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
- f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.
- g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.
- h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).

#### Test results / Note

See following plots.



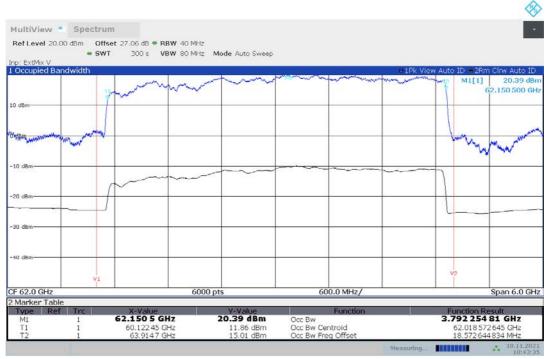
2022-02-18

Test results under no	ormal and extreme tes	t conditions:		
EUT mode	Test conditions	f∟ [GHz]	f <sub>H</sub> [GHz]	99% OBW [MHz]
Normal operating mode	-20 °C	60.122	63.915	3792
Normal operating mode			63.912	3793
Normal operating mode	0°C	60.121	63.910	3790
Normal operating mode	10 °C	60.126	63.910	3784
Normal operating mode	20 °C / V <sub>min</sub>	60.122	63.910	3789
Normal operating mode	20 °C / V <sub>nom</sub>	60.123	63.911	3787
Normal operating mode	20 °C / V <sub>max</sub>	60.121	63.911	3790
Normal operating mode	30 °C	60.121	63.909	3788
Normal operating mode	40 °C	60.125	63.909	3784
Normal operating mode	50 °C	60.125	63.909	3784
Voltage variation				
Input voltage variation	does not affect the tran	nsmitted signal (see p	lots for ambient/norma	al temperature).

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#### Plot no. 6: 99% OBW, Peak detector, -20 °C



10:43:35 10.11.2021

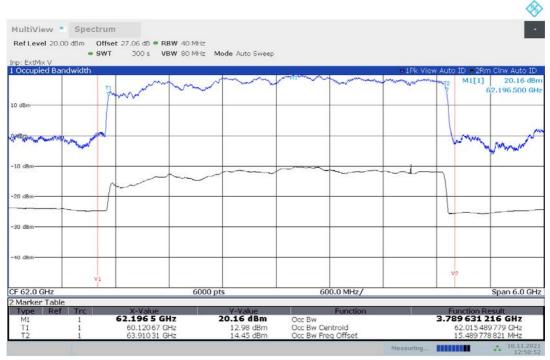
#### Plot no. 7: 99% OBW, Peak detector, -10 °C

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	V1			V2	
62.0 GHz		6000 pts	600.0 MHz/		Span 6.0 G

12:17:28 10.11.2021



#### Plot no. 8: 99% OBW, Peak detector, +0 °C



12:50:53 10.11.2021

#### Plot no. 9: 99% OBW, Peak detector, +10 °C

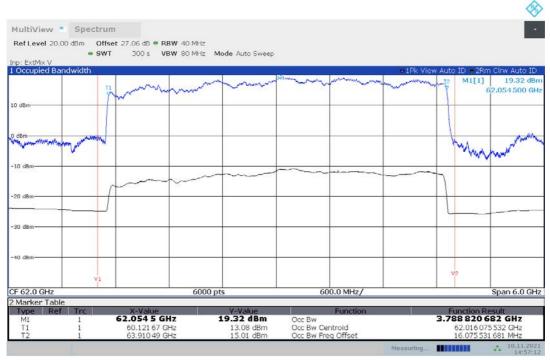
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0 dBm				
	V1			V2
62.0 GHz		6000 pts	600.0 MHz/	Span 6.0 C

13:24:19 10.11.2021



A

Plot no. 10: 99% OBW, Peak detector, +20 °C, Vmin



14:57:12 10.11.2021

Plot no. 11: 99% OBW, Peak detector, +20 °C, Vnom

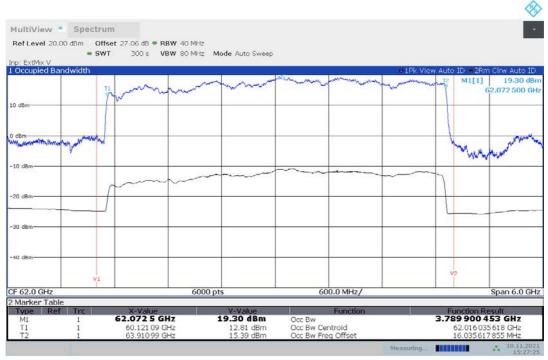
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0 dBm				
0 dBm				
0 dBm				
	V1			N2
62.0 GHz		6000 pts	600.0 MHz/	Span 6.0 G

14:26:59 10.11.2021



A

Plot no. 12: 99% OBW, Peak detector, +20 °C, V<sub>max</sub>



15:27:25 10.11.2021

Plot no. 13: 99% OBW, Peak detector, +30 °C

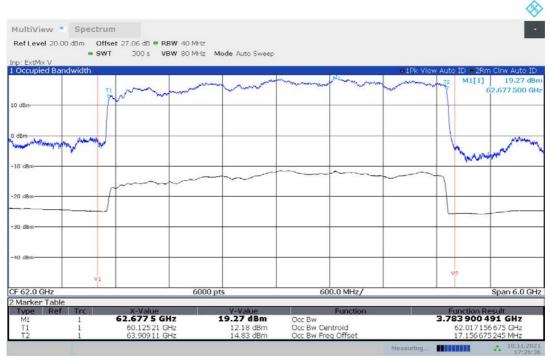
0 1Pk View Auto ID – 2Rm Clav Auto ID MI[1] 19.00 dBi 62.786 500 GF
62.786 500 GH
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Mar and Marine
v2
//Hz/ Span 6.0 Gi
nction Function Result 3.788 159 454 GHz
ic

16:54:10 10.11.2021



A

#### Plot no. 14: 99% OBW, Peak detector, +40 °C



17:26:36 10.11.2021

Plot no. 15: 99% OBW, Peak detector, +50 °C

np: ExtMix V	SWT 300 s V	/BW 80 MHz Mode Auto Swe	ep	
Occupied Bandwidth			man and the and	01Pk View Auto ID = 2Rm Clrw Auto ID T2 M1[1] 19.02 de
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dBm				
and an and the second second second second	pyper			1 mm
0 dBm		5		how have
0 dBm		à		
IO dBm				
0 dBm				
	V1			V2
	V1	6000 pts	600.0 MHz/	Span 6.0 Gi
F 62.0 GHz		0000 pts		

18:29:17 10.11.2021

## 7.4 Field strength of emissions (spurious and harmonics)

#### **Description / Limits**

15.255 (d) (1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

§15.255 (d) (2)

Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.:

Frequency	Field Strength	Measurement distance
0.009 – 0.490 MHz	2400/F[kHz] μV/m	300 m
0.490 – 1.705 MHz	24000/F[kHz] μV/m	30 m
1.705 – 30.0 MHz	30.0 µV/m / 29.5 dBµV/m	30 m
30 – 88 MHz	100 μV/m / 40.0 dBμV/m	3 m
88 – 216 MHz	150 μV/m / 43.5 dBμV/m	3 m
216 – 960 MHz	200 µV/m / 46.0 dBµV/m	3 m
960 – 100 000 MHz	500 μV/m / 54.0 dBμV/m	3 m

15.255 (d) (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm<sup>2</sup> at a distance of 3 meters.

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

#### Limit of Waiver:

30 MHz – 200 GHz: -51.3 dBm

#### Test procedure

§15.31 (c) Except as otherwise indicated in §15.256, for swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported. §15.31 (m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range	Number of frequencies	Location
< 1MHz bandwidth	1	middle
1 – 10 MHz bandwidth	2	1 near bottom and 1 near top
> 10 MHz bandwidth	3	1 near bottom / middle / top

§15.35 (b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g.,see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

§15.35 (c) Unless otherwise specified, e.g., §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application

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for certification or shall be retained in the measurement data file for equipment subject to Supplier's Declaration of Conformity.

#### Calculation of the far field distance (Rayleigh distance):

The aperture dimensions of these horn antennas shall be small enough so that the measurement distance in meters is equal to or greater than the Rayleigh distance (i.e.  $R_m = 2D^2 / \lambda$ ), where *D* is the largest linear dimension (i.e. width or height) of the antenna aperture in m and  $\lambda$  is the free-space wavelength in meters at the frequency of measurement.

Antenna type	Frequency range [GHz]	D [m]	Highest frequency in use [GHz]	Far field distance R <sub>m</sub> [m]
20240-20	18.0 - 26.5	0.0520	26.5	0.478
22240-20	26.5 - 40.0	0.0342	40	0.312
23240-20	33.0 - 50.0	0.0280	50	0.261
24240-20	40.0 - 60.0	0.0230	60	0.212
25240-20	50.0 - 75.0	0.0185	75	0.171
26240-20	60.0 - 90.0	0.0150	90	0.135
27240-20	75.0 – 110	0.0124	110	0.113
28240-20	90.0 - 140	0.0100	140	0.093
29240-20	110 – 170	0.0085	170	0.082
30240-20	140 – 220	0.0068	220	0.068

#### **Used test distances**

Up to 18 GHz:	3.00 m
18 – 40 GHz:	0.50 m
40 – 50 GHz:	0.35 m
50 – 60 GHz:	0.25 m
50 – 75 GHz:	0.5 m
75 – 90 GHz:	0.2 m
90 – 140 GHz:	0.5 m
140 – 200 GHz:	0.1 m
Testcase FreqStal	oility: 6.00 m

#### Test setup: 8.1 - 8.4

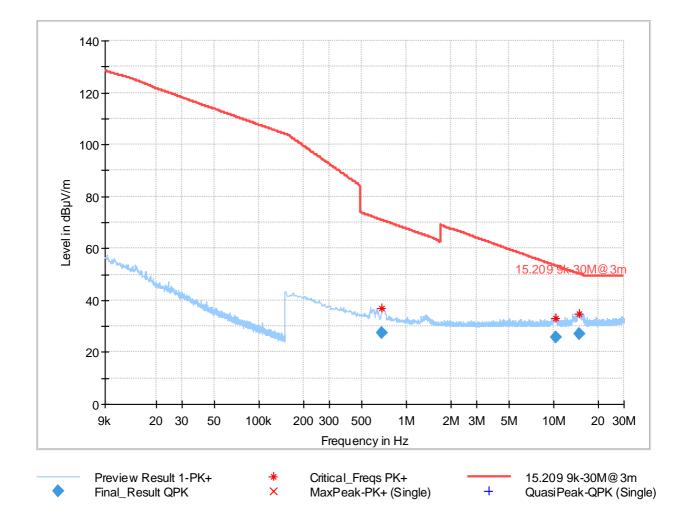
Test distance correction factor of 20dB/decade is already considered in the plots / result table.

#### Test results:

Test lesuits.								
Channel / Mode	Frequency [GHz]	Detector	Test distance [m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]		
	No critical emissions found, please refer to plots.							



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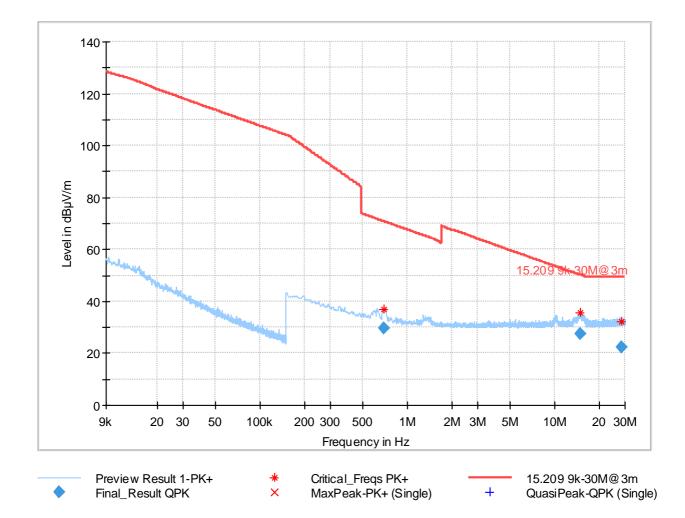




Frequency (MHz)	QuasiPeak (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.681000	27.59	(α <u>Βμ</u> ν/iii) 70.96	43.36	100.0	9.000	н	(deg) 273.0	20.3
10.284000	25.66	53.34	27.68	100.0	9.000	Н	300.0	20.5
14.815500	26.89	50.17	23.28	100.0	9.000	Н	15.0	20.5



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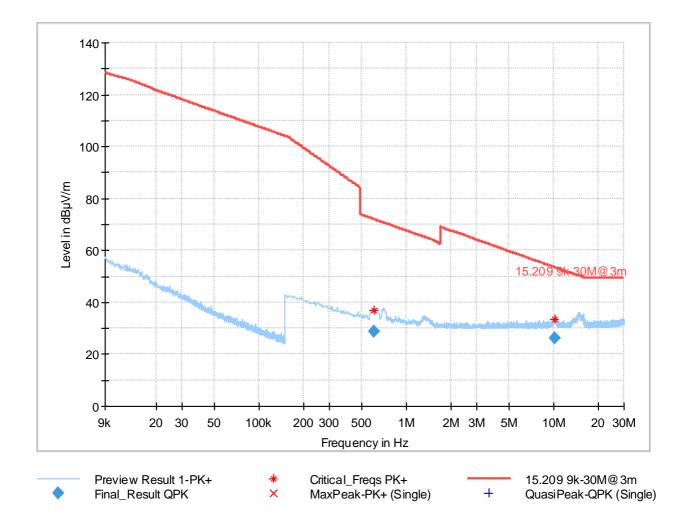




Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.692250	29.76	70.80	41.04	100.0	9.000	Н	288.0	20.3
14.880750	27.58	50.13	22.55	100.0	9.000	н	75.0	20.4
28.554000	22.21	49.54	27.33	100.0	9.000	Н	165.0	20.7



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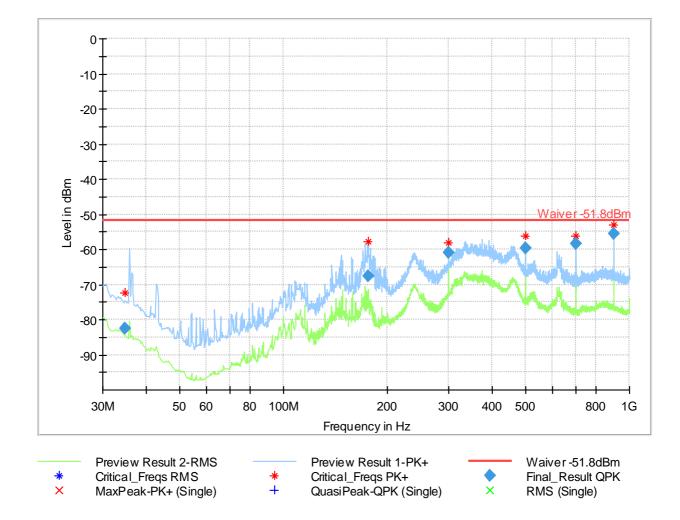


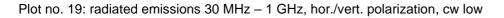


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.604500	28.61	71.98	43.37	100.0	9.000	Н	-24.0	20.4
10.241250	26.39	53.38	26.99	100.0	9.000	н	-24.0	20.5



2022-02-18

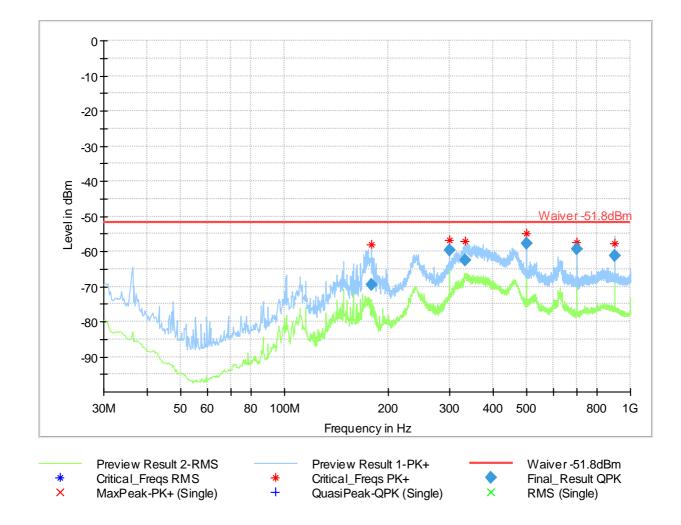


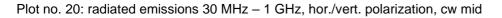


Frequency (MHz)	QuasiPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
34.740000	-82.61	-51.80	30.81	100.0	120.000	150.0	v	32.0
175.652500	-67.69	-51.80	15.89	100.0	120.000	150.0	Н	278.0
299.992500	-61.11	-51.80	9.31	100.0	120.000	150.0	Н	44.0
499.995000	-59.74	-51.80	7.94	100.0	120.000	150.0	Н	261.0
699.997500	-58.32	-51.80	6.52	100.0	120.000	150.0	v	258.0
900.000000	-55.40	-51.80	3.60	100.0	120.000	150.0	v	230.0



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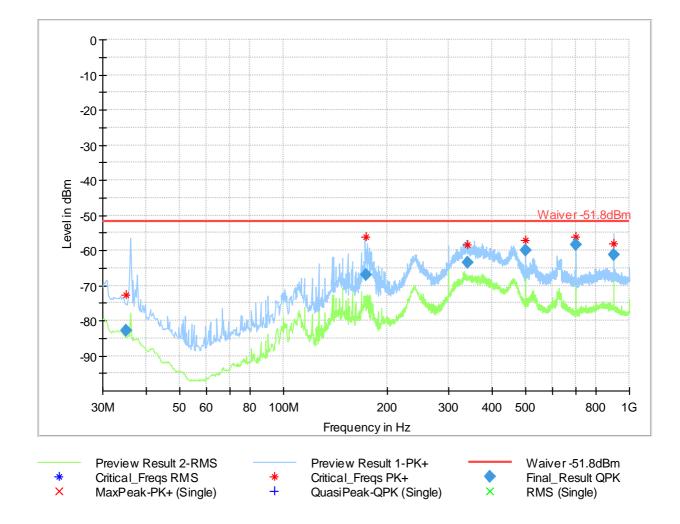


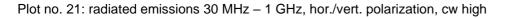


Frequency (MHz)	QuasiPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
177.840000	-69.49	-51.80	17.69	100.0	120.000	150.0	Н	133.0
299.992500	-59.78	-51.80	7.98	100.0	120.000	150.0	н	18.0
332.652500	-62.56	-51.80	10.76	100.0	120.000	150.0	Н	187.0
499.995000	-57.86	-51.80	6.06	100.0	120.000	150.0	v	246.0
699.997500	-59.52	-51.80	7.72	100.0	120.000	150.0	v	-5.0
900.000000	-61.24	-51.80	9.44	100.0	120.000	150.0	v	263.0



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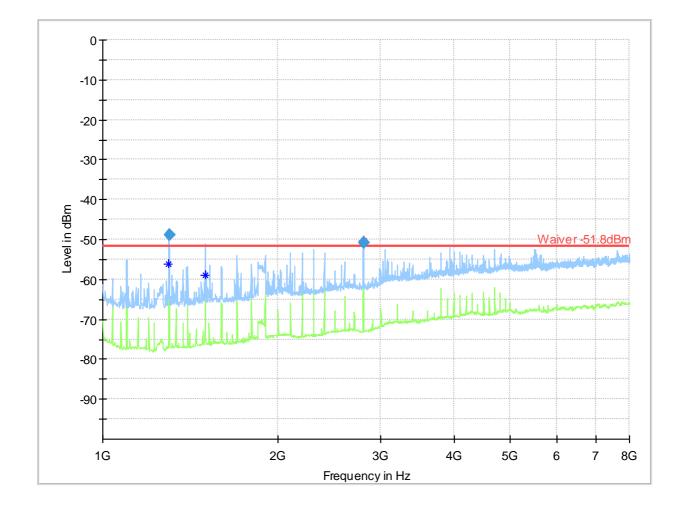


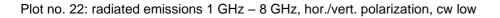


Frequency (MHz)	QuasiPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
34.982500	-82.98	-51.80	31.18	100.0	120.000	150.0	V	50.0
173.155000	-66.98	-51.80	15.18	100.0	120.000	150.0	Н	261.0
339.335000	-63.55	-51.80	11.75	100.0	120.000	150.0	Н	155.0
499.995000	-60.10	-51.80	8.30	100.0	120.000	150.0	н	254.0
699.997500	-58.30	-51.80	6.50	100.0	120.000	150.0	v	257.0
900.000000	-61.33	-51.80	9.53	100.0	120.000	150.0	v	206.0



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# Final\_Result

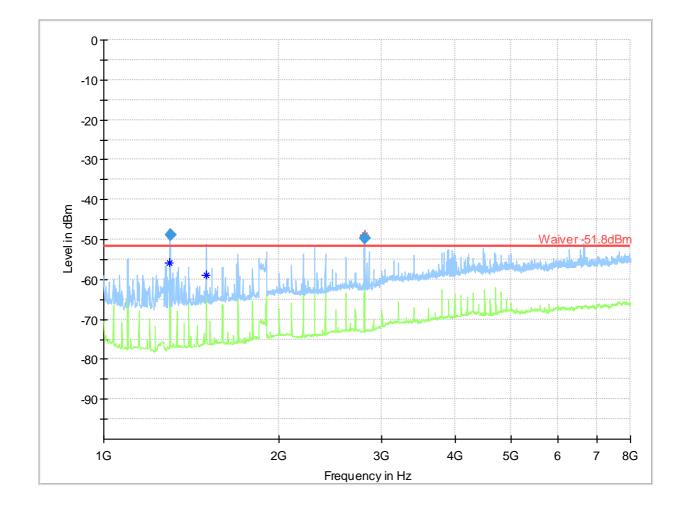
Peak values

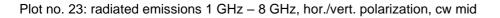
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
1299.750000	-48.75	-31.80	16.95	100.0	1000.000	150.0	٧	30.0	 75.0
2800.500000	-50.81	-31.80	19.01	100.0	1000.000	150.0	Н	-7.0	9.0

Frequency	MaxRMS	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Elevatio
(MHz)	(dBm)	(dBm)	(dB)	(ms)	(kHz)	(cm)		(deg)	n
1299.750000	-56.12	-51.80	4.32	100.0	1000.000	150.0	V	40.0	65.0
1498.750000	-59.07	-51.80	7.27	100.0	1000.000	150.0	Н	40.0	150.0



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# Final\_Result

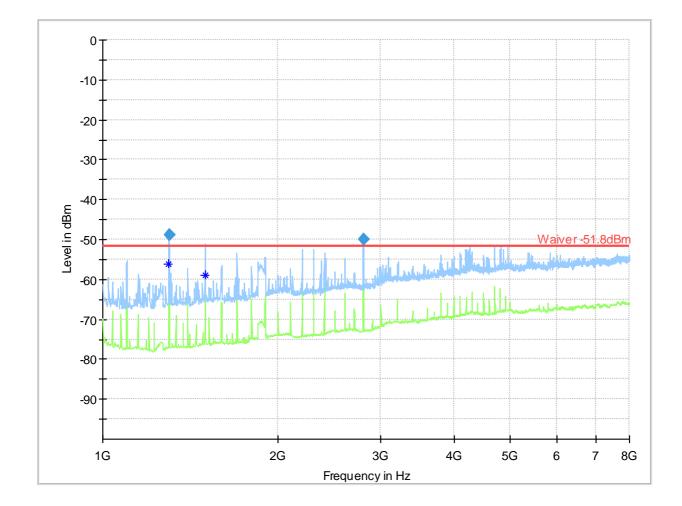
Peak values

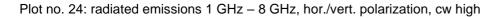
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
1299.750000	-48.94	-31.80	17.14	100.0	1000.000	150.0	V	29.0	75.0
2800.250000	-49.76	-31.80	17.96	100.0	1000.000	150.0	Н	349.0	0.0

Frequency (MHz)	MaxRMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
1299.750000	-55.98	-31.80	4.18	100.0	1000.000	150.0	V	39.0	65.0
1498.750000	-58.99	-31.80	7.19	100.0	1000.000	150.0	V	83.0	150.0



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# Final\_Result

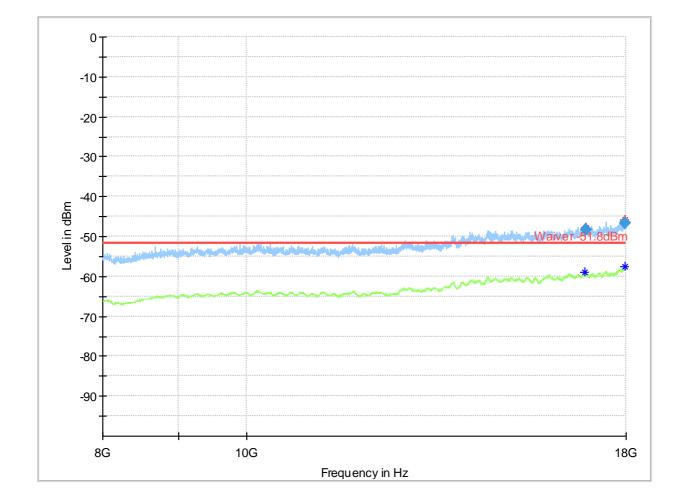
Peak values

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
1299.750000	-48.82	-31.80	17.02	100.0	1000.000	150.0	V	30.0	75.0
2800.500000	-50.07	-31.80	18.27	100.0	1000.000	150.0	Н	345.0	1.0

Frequency (MHz)	MaxRMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
1299.750000	-56.27	-31.80	4.47	100.0	1000.000	150.0	V	35.0	90.0
1498.750000	-59.07	-31.80	7.27	100.0	1000.000	150.0	v	62.0	90.0



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# Final\_Result

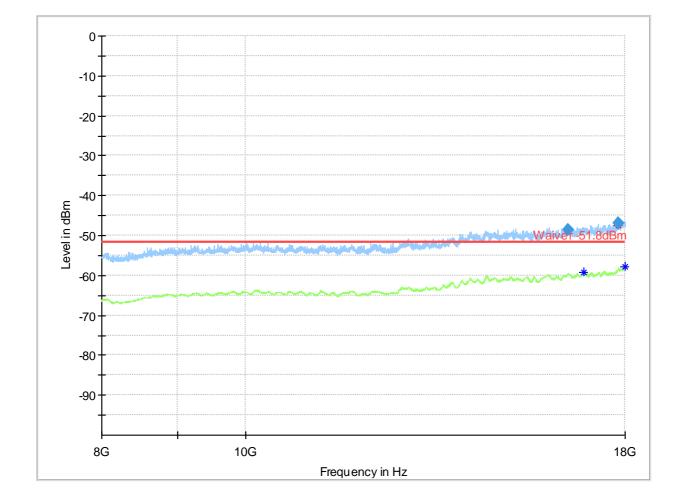
Peak values

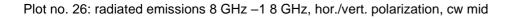
Frequency	MaxPeak	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Elevatio
(MHz)	(dBm)	(dBm)	(dB)	(ms)	(kHz)	(cm)		(deg)	n
16901.500000	-48.43	-31.80	16.63	100.0	1000.000	150.0	Н	11.0	135.0
17984.250000	-46.63	-31.80	14.83	100.0	1000.000	150.0	Н	43.0	126.0

Frequency (MHz)	MaxRMS (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
16898.000000	-59.07	-51.8	7.27	100.0	1000.000	150.0	н	3	0
17984.000000	-57.92	-51.8	6.12	100.0	1000.000	150.0	Н	142	30



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# Final\_Result

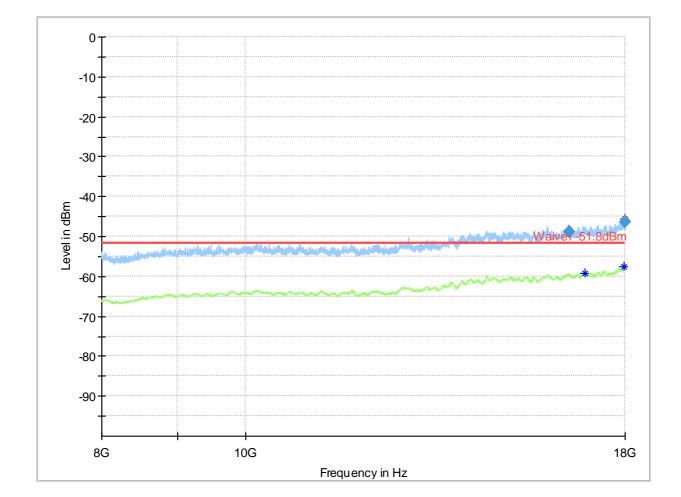
Peak values

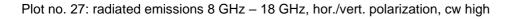
Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
16478.250000	-48.71	-31.80	16.91	100.0	1000.000	150.0	Н	105.0	27.0
17819.000000	-46.88	-31.80	15.08	100.0	1000.000	150.0	V	1.0	-5.0

Frequency	MaxRMS	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Elevatio
(MHz)	(dBm)	(dBm)	(dB)	(ms)	(kHz)	(cm)		(deg)	n
16894.000000	-59.31	-51.8	7.51	100.0	1000.000	150.0	V	274	90
17986.000000	-57.86	-51.8	6.06	100.0	1000.000	150.0	н	257	75



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# Final\_Result

Peak values

Frequency (MHz)	MaxPeak (dBm)	Limit (dBm)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Elevatio n
16498.500000	-48.90	-31.80	17.1	100.0	1000.000	150.0	v	180.0	-15.0
17997.500000	-46.40	-31.80	14.6	100.0	1000.000	150.0	Н	166.0	15.0

Frequency	MaxRMS	Limit	Margin	Meas. Time	Bandwidth	Height	Pol	Azimuth	Elevatio
(MHz)	(dBm)	(dBm)	(dB)	(ms)	(kHz)	(cm)		(deg)	n
16900.000000	-59.09	-51.8	7.29	100.0	1000.000	150.0	v	189	30
17984.000000	-58.15	-51.8	6.35	100.0	1000.000	150.0	v	224	0

# INGENIEURBÜRO LENHARDT

#### TR no.: 21096188-22599-1

#### 2022-02-18

				\$
MultiView Spectrum	K Spectrum 2 X Spectrum 3	🔶 🗙 Spectrum 4 🛛 🗙		-
Ref Level -30.00 dBm Offset	33.80 dB • RBW 1 MHz			
	80 s = VBW 3 MHz Mode Auto Swe	ep		
1 Frequency Sweep	1002.03		O 1Pk N	lax = 2Rm Max
Limit Check	PASS		M2[2]	-61.52 dBn
Line WAIVER FCC	PASS			21.280 100 GH
			M1[1]	-52.97 dBn
-40 dBm				21.280 100 GH
-50 dBm-				
	MI	2		
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-90 dBm				
PO GDM				
				0
CF 22.0 GHz	8001 pts	800.0 MHz/		Span 8.0 GHz
			Measuring	26.01.2022

#### Plot no. 28: radiated emissions 18 GHz – 26.5 GHz, hor./vert. polarization, cw low

10:30:30 26.01.2022

Plot no. 29: radiated emissions 18 GHz - 26.5 GHz, hor./vert. polarization, cw mid

MultiView	Spectrum	× Spectrum	2 X Sp	ectrum 3	×			-
Ref Level -30.0	00 dBm Offset	33.80 dB • RBW 1 MM	iz					
Att		80 s = VBW 3 Mł	iz Mode Auto S	iweep				
PA TDF "CAB_LAB 1 Frequency Sw							O 1Pk M	ax 🖷 2Rm Max
Limit Check			PASS				M2[2]	-61.50 dBm
Line WAIVE	RFCC		PASS					1.280 100 GHz
							M1[1]	
-40 dBm								1.280 100 GHz
-50 dBm-			MI					
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-70 dBm		$\sim$						
-70 GBm								
-80 dBm								
-90 dBm								
CF 22.0 GHz		. 80	01 pts	. 80	0.0 MHz/	5) A		Span 8.0 GHz
						Measuring		26.01.2022

10:03:46 26.01.2022

# INGENIEURBÜRO

#### TR no.: 21096188-22599-1

2022-02-18

	PASS			
FCC	PASS		M4[2	
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			MILI	Contraction of the second s
				21.280 100 6
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Plot no. 30: radiated emissions 18 GHz - 26.5 GHz, hor./vert. polarization, cw high

10:25:30 26.01.2022

Plot no. 31: radiated emissions 26.5 GHz - 40 GHz, hor./vert. polarization, cw low

and the second se			2.200 P				Measuring	CONTRACTOR OF A DECK	26.01.202
33.0 GHz			14000 p	ts	1	1.4 GHz/	-		Span 14.0 GH
5 dBm									
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) dBm		and a second second	West Service	and the second second	1 Lit. brakk day	La mar di di la	Sans Land Land at the last	All and the party of the life	
								52	M2
5 dBm									
0 dBm			-				-		-
									39.534 500 G
5 dBm							-		-60.67 dB
Line WAIVE	ER FCC		P	SS					39.251 500 G
Limit Check	k (		P	SS				M2[1]	
TDF "CAB_LAB Frequency Sw								O 1DL N	lax = 2Rm Ma
Att	0 dB = SW1	T 140 s •	VBW 3 MHz N	lode Auto Swe	ep				
Ref Level -30.0	00 dBm Offs	et 37.20 dB	RBW 1 MHz						-
ultiView *	Spectrum	XS	Spectrum 2	×					
		and the second se		10000					

09:49:18 26.01.2022



8

#### TR no.: 21096188-22599-1

#### 2022-02-18

MultiView 🌯 Spectrum	× Spectrum 2	X Spectrum 3	×		-
Ref Level -30.00 dBm Offset					
Att 0 dB = SWT PA TDF "CAB LAB000163"	140 s = VBW 3 MHz Mode	Auto Sweep			
1 Frequency Sweep	00000			O1Pk Ma	ax = 2Rm Max
Limit Check	PASS			M1[2]	-60.51 dBr
Line WAIVER FCC	PASS			3	9.544 500 GH
-35 dBm				M2[1]	-47.85 dBr
548-7-53888030 ································				3	9.441 500 GH
-40 dBm					
-45 dBm					
+5 GBI				~	M2
-50 dBm		I WAS AT MANY MILE AN	West I	AND A DESCRIPTION OF A DESCRIPTION	terral set on a Mill
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					M1
-60 dBm					MI
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		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			
-60 dBm		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~		
		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			M1
-65 GBm		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	~~~~		
-65 GBm		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		~~~~~	M1
-70 dBm					M1
-05 GBm					M1
-05 GBm					M1
-65 08m	14000 pts		1.4 GHz/		5pan 14.0 GHz

Plot no. 32: radiated emissions 26.5 GHz - 40 GHz, hor./vert. polarization, cw mid

10:12:38 26.01.2022

Plot no. 33: radiated emissions 26.5 GHz - 40 GHz, hor./vert. polarization, cw high

Att 0 dB = S TDF "CAB_LAB000163"	WT 140 s = VBW 3 M	MHz Mode Auto Swee	P				
Frequency Sweep		100000				O1Pk M	ax 🖷 2Rm Max
Limit Check		PASS				M2[1]	-48.47 dB
Line WAIVER FCC		PASS					9.951 500 GI
5 dBm			-		-	M1[2]	-60.53 dB
A. 222 (200 A)						2	9.530 500 GI
0 dBm						-	
1940-19							
5 dBm-			-			·	
					1 Para	here has	and star in last
ST22703							
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rver, neo , new vient, and so							MI
rver, neo , new vient, and so							M1
o dem			v				M1
VER NED LIJAN (1941), A 1941 V GBM							M1
VER HEC LINA I I VIII, BUILL I GBM D GBM VERM							M1
VER HEC LINA I I VIII, BUILL I GBM D GBM VERM				····			M1
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2022-02-18



		-		
MultiView Spectr				
Att 0 dB = SV	fset 38.94 dB = RBW 1 M VT 100 s = VBW 3 M	Hz Hz Mode Auto Sweep		
PA TDF "CAB_LAB000163" 1 Frequency Sweep				NCAN - 1Pk Max  2Rm Max
Limit Check		PASS		M3[2] -64.94 dBm
-10 dBm	R	PASS		49.523 500 GHz
TO GBIN				M1[1] -56.80 dBm
-20 dBm				40.000 000 GHz
-20 UBIN-				
-30 dBm-				
-30 GBIN				
-40 dBm-				D1
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50 dBm				M3
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R _ R _ R _ R				
-80 dBm-				
-90 dBm-				
40.0 GHz	-	10000 pts	1.0 GHz/	50.0 GHz
2 Marker Table		10000 pts	no drizy	5010 GHz
Type Ref Trc	X-Value	Y-Value	Function	Function Result
M1 1	40.0 GHz	-56.80 dBm		
D1 M1 1	8.212 5 GHz	11.44 dB		
M2 2 M3 2	40.066 5 GHz 49.523 5 GHz	-61.86 dBm -64.94 dBm		
1112 2	49.323 3 GHZ	-04.34 UBIII		
			Meas	auring 26.01.2022

12:07:40 26.01.2022

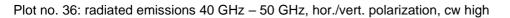
Plot no. 35: radiated emissions 40 GHz - 50 GHz, hor./vert. polarization, cw mid

Type Ref M1 M2		X-Value 40.0 GH 40.066 5 GH		Y-Value 3.79 dBm 3.83 dBm		Function		Function R	esult
0.0 GHz Marker Tabl	e		10000 pt	5	1	.0 GHz/			50.0 Gł
0 dBm									
0 dBm									
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0 dBm	ndahihan péliktipa	denter the daries of	to contra	in the second	COM P	- 15 I			MB
			to a sharehout in the second		Herley as we have a strate				
				1			aness really a star	a constantine la la la constantine de la	have beauty
0 dBm									
0 dBm		-							
0 dBm									
								M2[2]	-63.83 dE
	OOB WAIVER	t	PA						10.000 000 G
Frequency S			PA	19				NCAN = 1Pk M M1[1]	ax e 2Rm Ma -53.79 de
TDF "CAB LA	0 dB = SW1		W 3 MHz Mod	Auto Sweep					
ultiView	•	et 38.94 dB 🖷 RF	SW 1 MHz						
	Spectru								

12:16:41 26.01.2022



2022-02-18



				<
MultiView Spec	trum			
Ref Level -1.06 dBm         0           Att         0 dB = 5	Dffset 38.94 dB ■ RBW 1 MHz SWT 100 s ■ VBW 3 MHz M	ode Auto Sweep		
PA TDF "CAB_LABOOD163"				
1 Frequency Sweep		U P C C		NCAN = 1Pk Max = 2Rm Ma
Limit Check Line TSM OOB WAI		PASS		M3[2] -64.50 d
-10 dBm	/ER	2833		47.833 500 (
				M1[1] -45.55 d
-20 dBm				49.236 500 (
-30 dBm				
-40 dBm				M1
TSM QOB WALVER		الدامين والمراجع	Lan rate - Ober Lord - Billeria la	
			all for the first of the second s	anteres administration for a local design
		1		M3
M2	and the second		and the second s	A service and the service of the ser
1789 A A AMANA		Market Market		
-80 dBm				
-90 dBm				
40.0 GHz	10000	pts	1.0 GHz/	50.0 G
2 Marker Table		1000 Marcine 2010		
Type Ref Trc	X-Value 49.236 5 GHz	Y-Value -45.55 dBm	Function	Function Result
M1 1 M2 2 M3 2	49.236 5 GHZ 40.069 5 GHZ 47.833 5 GHZ	-69.11 dBm -64.50 dBm		
			Meas	suring 26.01.20

12:21:56 26.01.2022

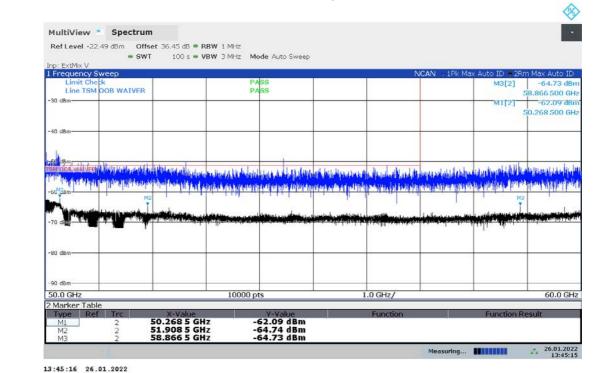
Plot no. 37: radiated emissions 50 GHz - 60 GHz, hor./vert. polarization, cw low

1ultiView	Spectrum								
Ref Level -22		et 36.45 dB 🖷 R							
p: ExtMix V	= SWT	100 s 🗕 V	BW 3 MHz Mo	de Auto Sweep					
Frequency S						N	ICAN = 1Pk Ma	< Auto ID = 2R	um Max Auto ID
Limit Che			PA	SS				M1[2]	-62.82 dB
Line TSM	OOB WAIVER		PA	35					50.050 500 G
30 dBm									
0 dBm									_
D dBm	Internet destant	the distance			10 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -			LLL LLL	Julia Maria
	and other defenses of		all al al al al al all a sea Ald	under service in	فالثافرا والأورار للرواق تامي	And the state of the second	Market 11 Market	phone with the follow	an di kana kana ka
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0 dBm	di la la	L. Ablahbab	II. a difficilities of	e a nahi bi ta dua	of this is the second	a distants beb at	Milmillan and Li.	We and the set	I. alise In.
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	1. <b>100</b> . A.	The second second second	alaise ti sallisikilite a	all all designed and a second	de ser les endsets ent	a tablati da an an an an an an an an	al dud the sheet	alak willing a state	de de la
10 dBm									+
0 dBm									+
0.0 GHz			10000 pt			.0 GHz/			60.0 GI

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2022-02-18



Plot no. 38: radiated emissions 50 GHz - 60 GHz, hor./vert. polarization, cw mid

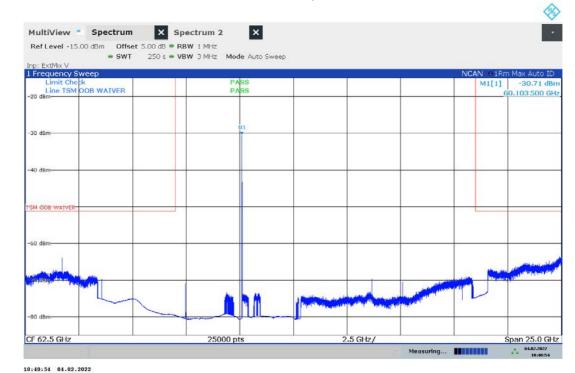
Plot no. 39: radiated emissions 50 GHz - 60 GHz, hor./vert. polarization, cw high

: ExtMix V					
requency Sweep		1000	NC	CAN 🗇 1 Pk Max Auto ID 🖷 🛛	and the second se
Limit Check Line TSM OOB WAIVER		PASS		M3[2]	
		PASS			51.909 500 G
dBm-				M1[2]	
					50.003 500 6
dBm	-				-
Bm					
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100000					
dBm-					
dBm					
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0 GHz		10000 pts	1.0 GHz/		60.0 G
larker Table					

13:40:14 26.01.2022

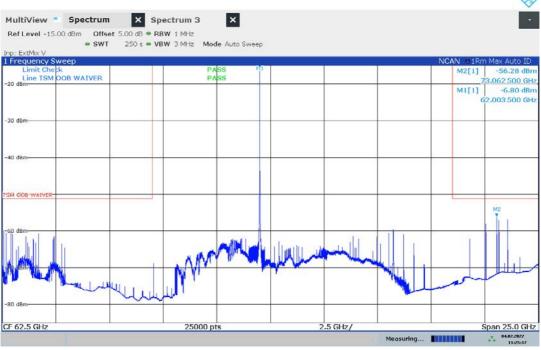


2022-02-18



Plot no. 40: radiated emissions 50 GHz - 75 GHz, hor./vert. polarization, cw low

#### Plot no. 41: radiated emissions 50 GHz - 75 GHz, hor./vert. polarization, cw mid

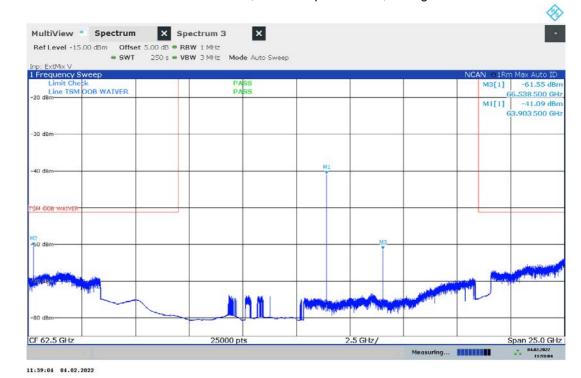


11:25:18 04.02.2022



2

2022-02-18



Plot no. 42: radiated emissions 50 GHz – 75 GHz, hor./vert. polarization, cw high

Plot no. 43: radiated emissions 75 GHz - 90 GHz, hor./vert. polarization, cw low

Ref Level -20.00 dBm Offset	36.10 dB 🖷 RBW 1 MHz		
= SWT	250 s = VBW 3 MHz Mode Auto Sweep		
np: ExtMix E			NOAN DIDE May Arts TO
Frequency Sweep	PASS		NCAN 01Rm Max Auto ID M1[1] -60.26 dBr
Line TSM OOB WAIVER	PASS		89.494 500 GH
30 dBm			
40 dBm			
50 dBm			
SM OOB WAIVER			141
60 dBm-		والتعقيب	
A SALE DESCRIPTION OF THE OWNER OF THE OWNER		i k kan an ing si ki pak al jinan di an ing kan di kan dari kan di k Taka ka di ki palangan dan mangan di kina dan mangan di kan di	a de la companya de l
70° diBiyetinin daharin dahari dah Martin dahari	n <mark>i ni katanligi na harin ni hata da katan kat</mark>	ette seda seda este la seconda de la sec	
80 dBm			
JO OBIN			
E 82 5 GHz	25000 ptr	15 GHz/	Span 15.0 GH
CF 82.5 GHz	25000 pts	1.5 GHz/	Span 15.0 ( uring

15:44:56 04.02.2022



2022-02-18

np: ExtMix E Frequency Swee	en		Mode Auto Sweep	52 		NCAN O	1Rm Max Auto ID
Limit Check	eb.		PASS			M4[	and the second se
Line TSM OOF	B WAIVER		PASS				84.864300 G
						MI	
30 dBm			-		-		83,109 300 0
10000							
40 dBm			-		-		-
50 dBm		-			-		
SM OOB WAIVER							
				141	MM4		M
-60 dBm			-	1	- TT		
				a second second	a state of the same	ويعوينه بمستبطنا ليماله المتالحة مستصب	and an an area destant
and the second second second	متتحلك ومتظلمتين مأتورين وأسلام معقو	and a statement of the	standel and the state	And in the standard of the local	ter ift in a fal iffer to childred	and the second	Manual Incolution in the second
70 dBm	and the second sec	Collected and the	hu da ta				
-80 dBm		-	-	-	-		
F 82.5 GHz		2500	) este	5	1.5 GHz/		Span 15.0 G
		2500	) pts		1.5 GHZ/		span 15.0 G
Marker Table							
	Trc X-Value	LL a	Y-Value -60.31 dBm		Function	Function	n Result
M1 M2	1 83.1093 G 1 84.7737 G		-59.77 dBm				
M2 M3	1 89.6433 G		-59.43 dBm				
M4	1 84.864 3 G		-60.03 dBm				

#### Plot no. 44: radiated emissions 75 GHz - 90 GHz, hor./vert. polarization, cw mid

15:28:01 04.02.2022

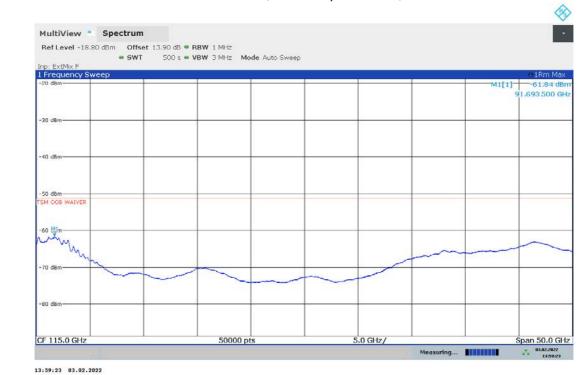
Plot no. 45: radiated emissions 75 GHz - 90 GHz, hor./vert. polarization, cw high

ultiView Spectrum 🗙 S	Spectrum 3 🛛 🗙				
ef Level -17.60 dBm Offset 36.10 dB •					
	VBW 3 MHz Mode Auto Swi	eep			
o: ExtMix E Frequency Sweep	100.000			NCAN 01Rr	n Max Auto IE
Limit Check	PASS			M2[1]	
D dBm Line TSM OOB WAIVER	PASS				7.396 300 G
				M1[1]	and the second second second
					5.641 900 G
					22041 900 0
0 dBm-					
Ren 1959-10. 8					
0 dBm-		8	3	8	
0 dBm-					
and the second			M1	1000	
			Y	M2	
0 dBm					
			a data she alter at a second	and a station	
and the second	I set a set of a set	فالمنصر وبالاعتمام وشراه أتسأله مدد شاد وسريك ويعتف سأت وأحداثه ورحاما	In such that the local	in the second second second	and the second second second
	and the second		Second and the second second	a middle the order or the Andrews	All days
DidBm	transferentieferen edetter i service	The stress of the second second			
A DE LE					
) dBm					
53992225					
82.5 GHz	25000 pts	1.5 GHz/	- 226	· · · · · · · · · · · · · · · · · · ·	Span 15.0 G

15:04:09 04.02.2022



2022-02-18



Plot no. 46: radiated emissions 90 GHz - 140 GHz, hor./vert. polarization, cw low

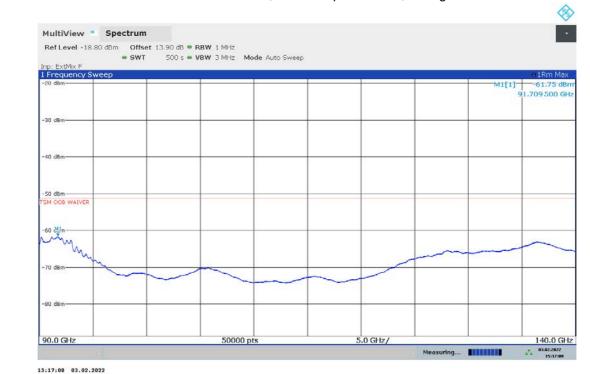
Plot no. 47: radiated emissions 90 GHz - 140 GHz, hor./vert. polarization, cw mid

MultiView Spectrum Ref Level -18.80 dBm Offset 13.90 dB • RBW 1 MHz - SWT 500 s = VBW 3 MHz Mode Auto Sweep Inp: ExtMix F 1 Frequency Sweep 1Rm M -61.73 dBn 91.718 500 GH; M1[1] -30 dBr 40 dB -50 dBm-FSM OOB WAIVER -60 člim -70 dBm -80 dBm 90.0 GHz 50000 pts 5.0 GHz/ 140.0 GHz Measuring... 14:26:2

14:26:29 03.02.2022

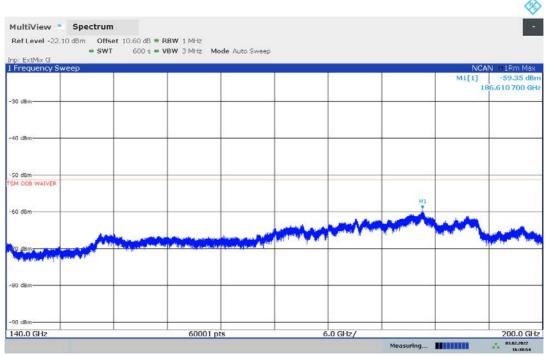


2022-02-18



Plot no. 48: radiated emissions 90 GHz - 140 GHz, hor./vert. polarization, cw high

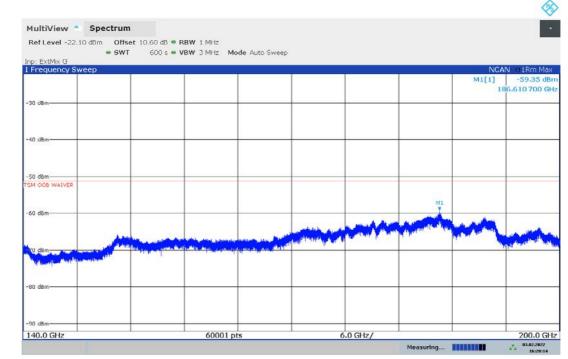
Plot no. 49: radiated emissions 140 GHz – 200 GHz, hor./vert. polarization, cw low



16:30:54 03.02.2022



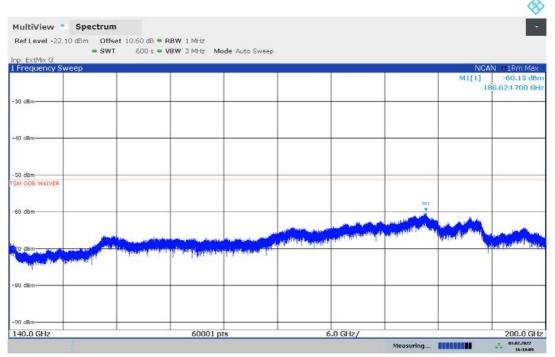
2022-02-18



Plot no. 50: radiated emissions 140 GHz - 200 GHz, hor./vert. polarization, cw mid

16:20:14 03.02.2022

Plot no. 51: radiated emissions 140 GHz - 200 GHz, hor./vert. polarization, cw high



16:10:10 03.02.2022



# 8 Test Setup Description

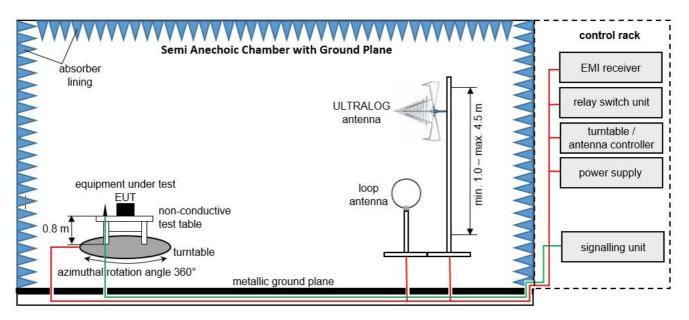
Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements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



## 8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the 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 a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: ULTRALOG antenna 3 m; loop antenna 3 m EMC32 software version: 11.10.00

FS = UR + CL + AF

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

#### Example calculation:

FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)



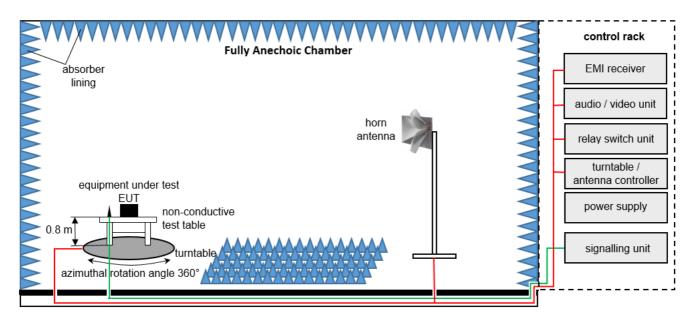
#### List of test equipment used:

No.	Equipment	Manufacturer	Туре	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NE	-
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NE	-
3	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NE	-
4	Compressed Air	Implotex	1-850-30	-	LAB000256	NE	-
5	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	к	$2021-07-01 \rightarrow 12M \rightarrow 2022-07-01$
6	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PRB	LAB000235	СМ	$2020\text{-}08\text{-}24 \rightarrow 36\text{M} \rightarrow 2023\text{-}08\text{-}24$
7	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10		LAB000226	NE	-
8	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NE	-
9	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NE	-
10	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NE	-
11	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NE	-
12	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	NE	-
13	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	NE	-
14	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	К	$2020-04-23 \rightarrow 36M \rightarrow 2023-04-23$
15	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	К	$2020-07-05 \rightarrow 36M \rightarrow 2023-07-05$
16	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	к	$2020-03-25 \rightarrow 36M \rightarrow 2023-03-25$
17	Pre-Amplifier	Schwarzbeck Mess- Elektronik OHG	BBV 9718 C	84	LAB000169	NE	-

2022-02-18



# 8.2 Fully Anechoic Chamber



Measurement distance: horn antenna 3 m EMC32 software version: 11.10.00

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

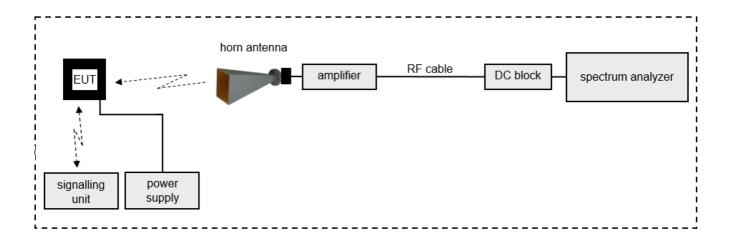
<u>Example calculation:</u> ROP [dBm] = -54.0 [dBm] + 64.0 [dB] - 20.0 [dBi] = -10 [dBm] (100 μW)

#### List of test equipment used:

No.	Equipment	Manufacturer	Туре	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NA	-
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NA	-
3	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NA	-
4	Compressed Air	Implotex	1-850-30	-	LAB000256	NA	-
5	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	К	$2021-07-01 \rightarrow 12M \rightarrow 2022-07-01$
6	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PRB	LAB000235	СМ	$2020\text{-}07\text{-}23 \rightarrow 12\text{M} \rightarrow 2023\text{-}07\text{-}23$
7	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10		LAB000226	NA	-
8	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NA	-
9	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NA	-
10	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NA	-
11	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NA	-
12	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	NA	-
13	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	NA	-
14	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	К	$2020-04-23 \rightarrow 36M \rightarrow 2023-04-23$
15	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	К	$2020-07-05 \rightarrow 36M \rightarrow 2023-07-05$
16	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	к	$2020\text{-}03\text{-}25 \rightarrow 36\text{M} \rightarrow 2023\text{-}03\text{-}25$
17	Amplifier	B&Z Technologies	BZ-08001800- 180855-202020	22105	LAB000297	NA	-
18	Amplifier	B&Z Technologies	BZ-01000900- 111550-202320	24336	LAB000296	NA	-

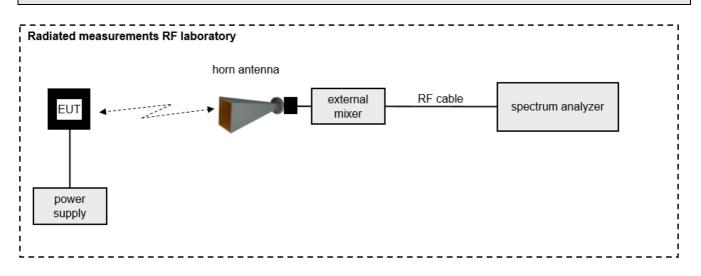


### 8.3 Radiated measurements > 18 GHz



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## 8.4 Radiated measurements > 50 GHz



Measurement distance: Horn antenna e.g. 10 cm @ 170 GHz

ROP = AV + D - PA - G

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

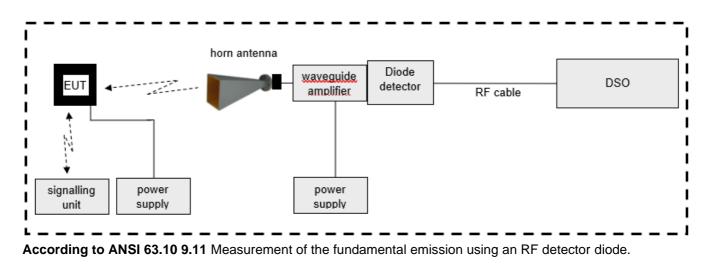
#### Example calculation:

ROP [dBm] = -72.63 [dBm] + 57.05 [dB] - 26.4 [dB] - 20.02 [dBi] = -62 [dBm]

Note: Conversion loss of mixer, as well as above mentioned values (e.g. PA, D, G) are already included in analyzer value, due to corresponding transducer file and given offset. Values in plots are final measurement values.



# 8.5 Radiated measurements > EIRP power





#### 2022-02-18

#### List of test equipment used:

No.	Equipment	Manufacturer	Туре	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Antenna Mast	Schwarzbeck Mess- Elektronik OHG	AM 9104	99	LAB000109	NA	-
2	Spectrum Analyser	Rohde & Schwarz	FSW50	101450	LAB000111	к	$\textbf{2021-07-22} \rightarrow \textbf{12M} \rightarrow \textbf{2022-07-22}$
3	Harmonic Mixer	Rohde & Schwarz	FS-Z075	102015	LAB000112	к	$2021\text{-}03\text{-}31 \rightarrow 12\text{M} \rightarrow 2022\text{-}03\text{-}31$
4	Harmonic Mixer	Rohde & Schwarz	FS-Z090	102020	LAB000113	к	$2021\text{-}03\text{-}31 \rightarrow 12\text{M} \rightarrow 2022\text{-}03\text{-}31$
5	Harmonic Mixer	Rohde & Schwarz	FS-Z110	102000	LAB000114	к	$2021\text{-}04\text{-}07 \rightarrow 12\text{M} \rightarrow 2022\text{-}04\text{-}07$
6	Harmonic Mixer	Rohde & Schwarz	FS-Z140	101144	LAB000115	к	$2021\text{-}05\text{-}19 \to 12 \text{M} \to 2022\text{-}05\text{-}19$
7	Harmonic Mixer	Rohde & Schwarz	FS-Z220	101039	LAB000116	к	$2021\text{-}05\text{-}18 \rightarrow 12\text{M} \rightarrow 2022\text{-}05\text{-}18$
8	Signal Generator	Rohde & Schwarz	SMA100-B-50	103838	LAB000118	К	$\textbf{2021-06-30} \rightarrow \textbf{36M} \rightarrow \textbf{2024-06-30}$
9	Harmonic Mixer	Rohde & Schwarz	FS-Z170	100996	LAB000126	к	$2021-05-18 \rightarrow 12M \rightarrow 2022-05-18$
10	Antenna	Flann Microwave Ltd	20240-20	266403	LAB000128	к	$2020-06-29 \rightarrow 36M \rightarrow 2023-06-29$
11	Antenna	Flann Microwave Ltd	22240-20	270448	LAB000130	к	$2020-06-29 \rightarrow 36M \rightarrow 2023-06-29$
12	Antenna	Flann Microwave Ltd	25240-20	272860	LAB000133	CM	$2020-07-01 \rightarrow 36M \rightarrow 2023-07-01$
13	Antenna	Flann Microwave Ltd	26240-20	273417	LAB000135	CM	$2020-08-01 \rightarrow 36M \rightarrow 2023-08-01$
14	Antenna	Flann Microwave Ltd	27240-20	273367	LAB000137	CM	$2020-08-01 \rightarrow 36M \rightarrow 2023-08-01$
15	Antenna	Flann Microwave Ltd	29240-20	273382	LAB000139	CM	$2020-08-01 \rightarrow 36M \rightarrow 2023-08-01$
15	Antenna	Flann Microwave Ltd	29240-20	273382	LAB000139	CM	$2020-08-01 \rightarrow 36M \rightarrow 2023-08-01$
16	Coaxial Cable	Rosenberger	LU7-022-1000	33	LAB000153	NA	-
17	Coaxial Cable	Rosenberger	LU7-022-1000	34	LAB000154	NA	-
18	Coaxial Cable	Huber & Suhner	ST18/48"	2276454-02	LAB000158	CM	$2021-08-16 \rightarrow 12M \rightarrow 2022-08-16$
19	Coaxial Cable	Huber & Suhner	SF101/1.0m	503990/1	LAB000164	CM	$2021-08-16 \rightarrow 12M \rightarrow 2022-08-16$
20	Digital Oscilloscope	Rohde & Schwarz	RTE1204	300113	LAB000175	к	$2021-06-02 \rightarrow 12M \rightarrow 2022-06-02$
21	Antenna	Flann Microwave Ltd	28240-20	273371	LAB000176	CM	$2021-09-01 \rightarrow 36M \rightarrow 2024-09-01$
22	Antenna	Flann Microwave Ltd	30240-20	273390	LAB000178	CM	$2021-09-01 \rightarrow 36M \rightarrow 2024-09-01$
23	WG-Coax-Adapter	Flann Microwave Ltd	20093-TF30 UBR220	273374	LAB000181	СМ	$2021\text{-}09\text{-}01 \rightarrow 36\text{M} \rightarrow 2024\text{-}09\text{-}01$
24	WG-Coax-Adapter	Flann Microwave Ltd	22093-TF30 UG599/U	273263	LAB000183	СМ	$2021\text{-}09\text{-}01 \rightarrow 36\text{M} \rightarrow 2024\text{-}09\text{-}01$
25	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350255	LAB000189	NA	-
26	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PS 2042-10 B	2878350263	LAB000190	NA	-
27	Multiplier	Rohde & Schwarz	SMZ110	100001	LAB000272	NA	-
28	Spectrum Analyser	Rohde & Schwarz	FSW43	101391	LAB000289	К	$2021-07-02 \rightarrow 12M \rightarrow 2022-07-02$
29	Test table	innco systems GmbH	PT0707-RH light	-	LAB000303	NA	-
30	Harmonic Mixer	Rohde & Schwarz	FS-Z060	101350	LAB000375	К	$2021-07-06 \rightarrow 12M \rightarrow 2022-07-06$
31	Antenna	Flann Microwave Ltd	24240-20	275176	LAB000376	СМ	$2021-09-01 \rightarrow 36M \rightarrow 2024-09-01$
32	Detector Diode	Eravant	SFD-903144-08SF- P1	13795-01	LAB000437	NA	-
33	Pre-Amplifier	Eravant	SBL-9531443565- 0808-E1	13790-01	LAB000439	СМ	$2021\text{-}10\text{-}21 \rightarrow 12\text{M} \rightarrow 2022\text{-}10\text{-}21$
34	Amplifier	Radiometer Physics GmbH	GLNA 140-220-20-6	200145	LAB000440	СМ	$2021-12-06 \rightarrow 12M \rightarrow 2022-12-06$



# 9 Measurement procedures

## 9.1 Radiated spurious emissions from 9 kHz to 30 MHz

#### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
- In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

#### Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- For each turntable step the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

#### **Final measurement**

- Significant emissions found during the pre-scan will be maximized by the EMI-software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated with special 3D adapter set to find maximum level of emissions.
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position and settings of measuring equipment is recorded.

#### **Distance correction (extrapolation)**

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade of distance in the region closer than  $\lambda$  in m divided by  $2\pi$  (i.e.,  $\lambda/2\pi$ ), and at 20 dB/decade of distance beyond that, using the measurement of a single point at the radial angle that produces the maximum emission.

This correction is already included in the limit line of corresponding measurement plots.



# 9.2 Radiated spurious emissions from 30 MHz to 1 GHz

#### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table. In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

#### Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

#### **Final measurement**

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

#### **Distance correction (extrapolation)**

When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission. This correction is already included in the corresponding measurement plots.



# 9.3 Radiated spurious emissions from 1 GHz to 18 GHz

#### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table. In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, ... are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

#### Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

#### **Final measurement**

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

#### **Distance correction (extrapolation)**

When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission. This correction is already included in the corresponding measurement plots.



## 9.4 Radiated spurious emissions above 18 GHz

#### Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- Additional equipment, cables, ... necessary for testing, are positioned like under normal operation.
- EUT is powered on and set into operation.
- Test distance depends on EUT size and test antenna size (farfield conditions shall be met).

#### Pre-scan

- The test antenna is handheld and moved carefully over the EUT to cover the EUT's whole sphere and for different polarizations of the antenna.

#### **Final measurement**

- Significant emissions found during the pre-scan will be maximized, i.e. position and antenna orientation causing the highest emissions with Peak and RMS detector
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C63.4 / C63.10).
- Final plot showing measurement data, levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit is recorded.

#### Note

- In case of measurements with external harmonic mixers (e.g. above 50 GHz) special care is taken to avoid possible overloading of the external mixer's input.
- As external harmonic mixers may generate false images, care is taken to ensure that any emission measured by the spectrum analyzer is indeed radiated from the EUT and not internally generated by the external harmonic mixer. Signal identification feature of spectrum analyzer is used to eliminate/reduce images of the external harmonic mixer.

#### **Distance correction (extrapolation)**

When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission. This correction is already included in the corresponding measurement plots.



# **10 MEASUREMENT UNCERTAINTIES**

Radio frequency	≤ ± 10 ppm			
Radiated emission	≤ ± 6 dB			
Temperature	≤ ± 1 °C			
Humidity	≤±5%			
DC and low frequency voltages	≤ ± 3 %			

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor k = 2. It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.



#### 2022-02-18

# Annex 1 EUT Photographs, external

#### Photo No. 1:



Photo No. 2:

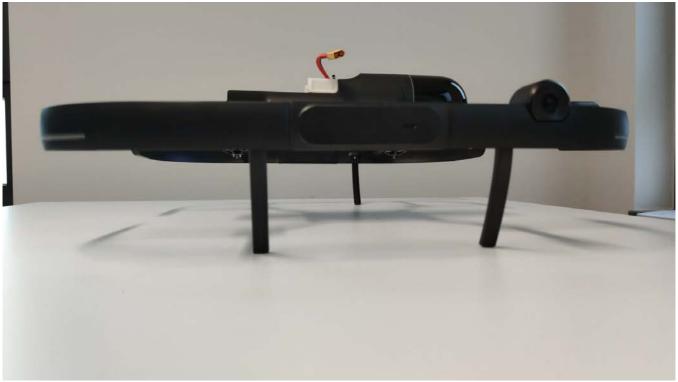




Photo No. 3:



2022-02-18

Photo No. 4:





Photo No. 5:

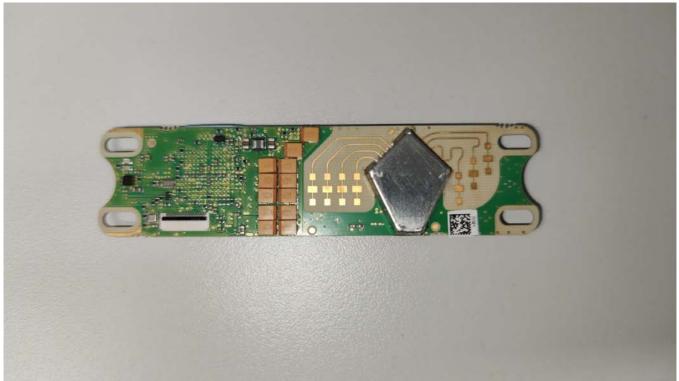


2022-02-18



# Annex 2 EUT Photographs, internal

Photo No. 6:



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#### Photo No. 7:

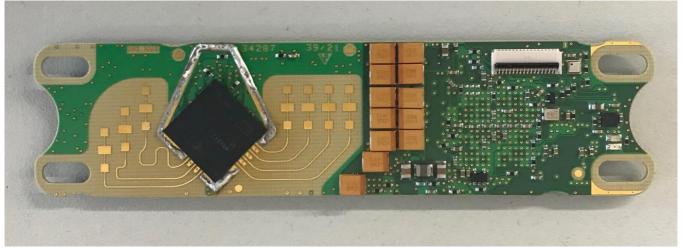
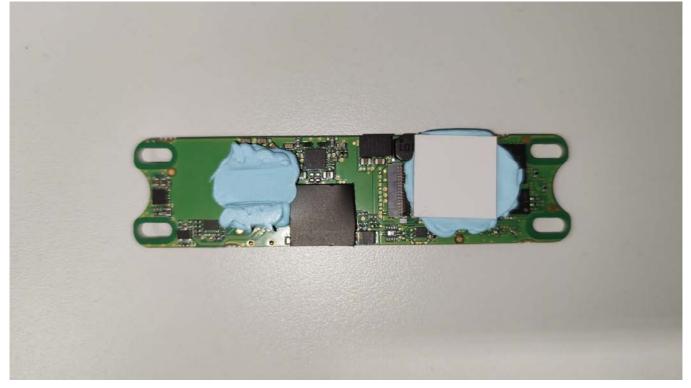


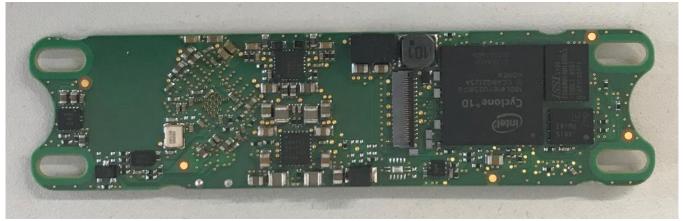


Photo No. 8:



2022-02-18

#### Photo No. 9:





# Annex 3 Test Setup Photographs

Photo No. 10:



Photo No. 11:

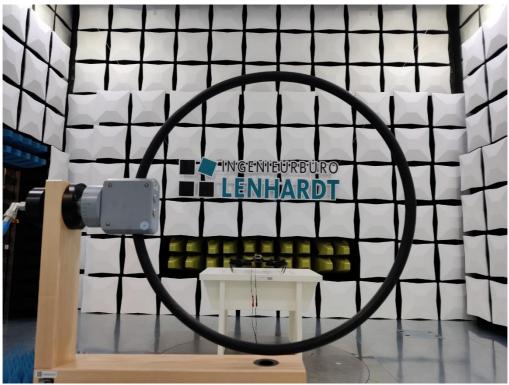






Photo No. 12:

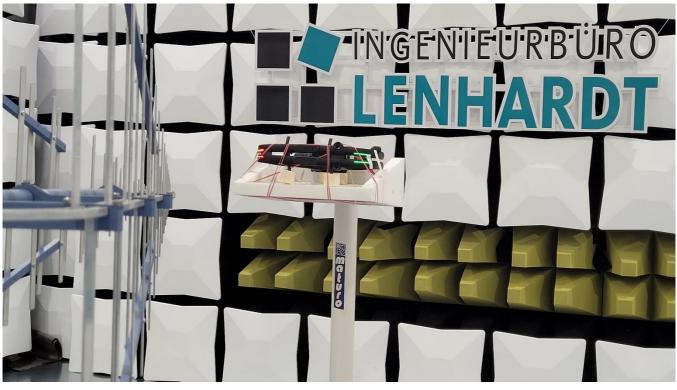
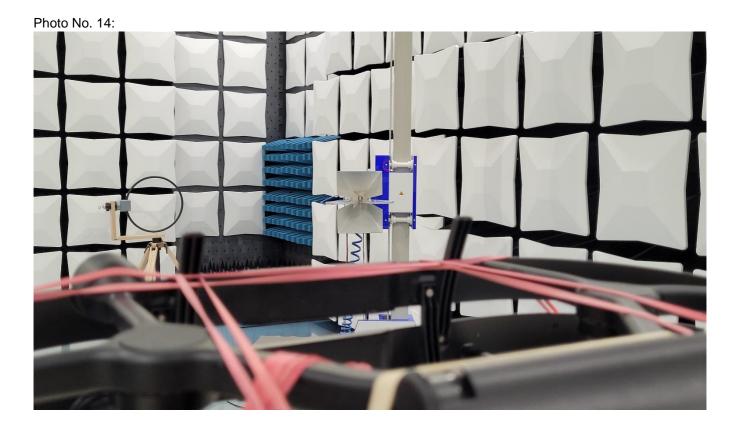


Photo No. 13:







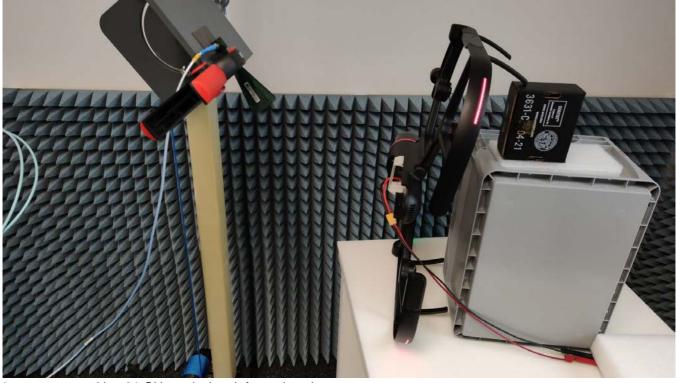


#### Photo No. 15:





Photo No. 16:



2022-02-18

\*worst case position 21 GHz emission. Informative picture

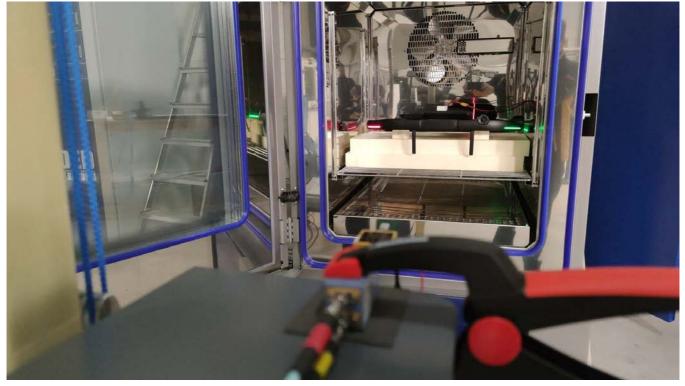
Photo No. 17:







Photo No. 18:



2022-02-18

#### Photo No. 19:





Photo No. 20:



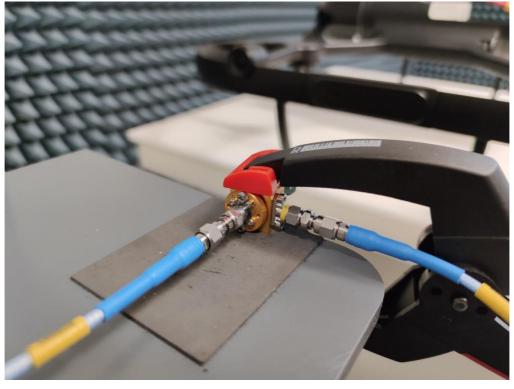
2022-02-18

Photo No. 21:





Photo No. 22:



2022-02-18

Photo No. 23:





# End of Test Report