

Test Report

23-1-0086301T004a-C2

Number of pages: 32 **Date of Report:** 2025-Jun-12

Testing company: cetecom advanced GmbH
Untertuerkheimer Str. 6-10
66117 Saarbruecken
GERMANY **Applicant:** indurad GmbH

Product: 1D Radar
Model: iLDR-M-G5

FCC ID: 2AJRSILDRG5

Testing has been carried out in accordance with: **FCC Regulations**
Title 47 CFR, Chapter I, Subchapter D, Part 95
Subpart M
The 76-81 GHz Band Radar Service
§ 95.3367 76-81 GHz Band Radar Service radiated power limits
§ 95.3379 76-81 GHz Band Radar Service unwanted emissions limits

Tested Technology: Radar (76G – 81GHz)

Test Results: ☒ **The EUT complies with the requirements in respect of all parameters subject to the test.**
The test results relate only to devices specified in this document

The current version of Test Report 23-1-0086301T004a-C2 replaces the test report 23-1-0086301T004a-C1, dated 2025-Jun-04. The replaced test report is herewith invalid.

Signatures:

Christian Lorenz	Al-Amin Hossain
Lab Manager	Lab Manager
Authorization of test report	Responsible of test report

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The listed attachments are separate documents.			

1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. cetecom advanced 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.

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Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

1.2 Summary of Test Results

The EUT integrates a Radar transmitter. Other implemented wireless technologies were not considered within this test report.

Test specification clause	Test case	Temperature conditions	Power source voltages	Pass	Fail	NA	NP	Remark
§2.1046 §95.3367 (a) / (b)	Radiated power	Nominal	Nominal	☒	☐	☐	☐	complies
§2.1047	Modulation characteristics	-/-	-/-	☒	☐	☐	☒	See Annex 5
§2.1049	Occupied bandwidth (99% bandwidth)	Nominal	Nominal	☒	☐	☐	☐	complies
§2.1051	Spurious emissions at antenna terminals	Nominal	Nominal	☒	☐	☐	☐	complies
§2.1053 §95.3379 (a)(1) §95.3379 (a)(2) §95.3379 (a)(3)	Unwanted emissions (radiated spurious)	Nominal	Nominal	☒	☐	☐	☐	complies
§2.1055 §95.3379 (b)	Frequency stability	Nominal and Extreme	Nominal and Extreme	☒	☐	☐	☐	complies

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

See FCC's Millimeter Wave Test Procedures:

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

Decision Rule: cetecom advanced GmbH follows [ILAC G8:2019 chapter 4.2.1 \(Simple Acceptance Rule\)](#).

1.3 Summary of Test Methods

Guidance	Version	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 C63.26-2015	-/-	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
76-81 GHz Radars KDB	v01r02	653005 D01 76-81 GHz Radars v01r02: EQUIPMENT AUTHORIZATION GUIDANCE FOR 76-81 GHz RADAR DEVICES

2 Administrative Data

2.1 Identification of the Testing Laboratory

Company name:	cetekom advanced GmbH		
Address:	Untertuerkheimer Str. 6-10 66117 Saarbruecken Germany		
Responsible for testing laboratory:	Dipl.-Ing. (FH) Andreas Luckenbill M.Sc.		
Accreditation scope:	DAkkS Webpage: FCC ISED		
Lab company recognition no.:	Location Essen-Laboratory DE0003		Location SB Laboratory DE0002
Test location 1:	Im Teelbruch 116; 45219 Essen		
Test location 2:	Untertuerkheimer Str. 6-10; 66117 Saarbruecken		

2.2 General limits for environmental conditions

Temperature:	22±2 °C
Relative. humidity:	45±15% rH

2.3 Test Laboratories sub-contracted

Company name:	--
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2.4 Organizational Items

Responsible test manager:	Al-Amin Hossain
Receipt of EUT:	2023-Aug-01
Date(s) of test:	2023-Aug-01 to 2024-Jan-30
Version of template:	24.0101

2.5 Applicant's details

Applicant's name:	indurad GmbH
Address:	Belvederealle 5 52070 Aachen North Rhine-Westphalia Germany
Contact Person:	Matthias Rabel
Contact Person's Email:	matthias.rabel@indurad.com

2.6 Manufacturer's details

Manufacturer's name:	indurad GmbH
Address:	Belvederealle 5 52070 Aachen Germany

2.7 EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	PMT Sample No.	Product	Model	Type	S/N	HW status	SW status
EUT 1	23-1-00863S03_C01	1D Radar	iLDR-M-G5	iLDR-M-G5-DN100	--	G5	E5

*) EUT short description is used to simplify the identification of the EUT in this test report.

2.8 Untested Variant (VAR)

VAR No. *)	Sample No.	Product	Model	Type	SN	HW	SW
--	--	1D Radar	iLDR-M-G5	iLDR-M-G5-DN50	--	G5	E5
--	--	1D Radar	iLDR-M-G5	iLDR-M-G5-DN80	--	G5	E5

*) The listed additional untested model variant(s) (VAR) is/are not object of evaluation of compliance. For further information please see Annex 5: Declaration of applicant of model differences.

If the table above does not show any other line than the headline, no untested variants are available.

2.9 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

Short description*)	PMT Sample No.	Auxiliary Equipment	Type	S/N	HW status	SW status
AE 1	23-1-00863S09_C01	Laptop	ThinkPad	heineken 77-81GHz	-	run iDat solution

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

2.10 Connected cables

Short description*)	PMT Sample No.	Cable type	Connectors	Length
CAB 01	23-1-00863S06_C01	Cable harness	--	N/A
CAB 02	--	LAN Cable	--	N/A

*) CAB short description is used to simplify the identification of the connected cables in this test report.

2.11 Software

Short description*)	PMT Sample No.	Software	Type	S/N	HW status	SW status
-	-	-	-	-	-	-

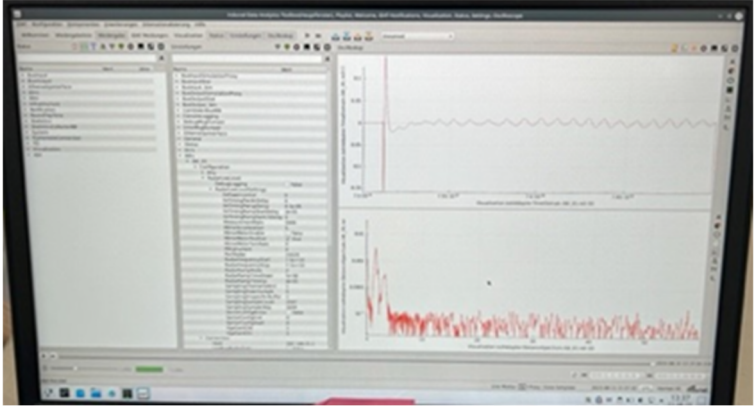
*) SW short description is used to simplify the identification of the used software in this test report.

2.12 EUT set-ups

set-up no. *)	Combination of EUT and AE	Description
Set. 1	EUT 1 + AE 1 + CAB 1 + CAB 2	This setup has been used for all radiated measurements

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

2.13 EUT operation modes

EUT operating mode no. *)	Operating modes	Additional information
op. 1	EUT set to Normal mode(76G to 81GHz), RADAR is Active, EUT in Transmit and Receive mode	➤ AE 1 + CAB 2 have been used to set the EUT in operation mode ➤ Customer provided tool has been used to set the EUT in operation 

*) EUT operating mode no. is used to simplify the test report.

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product name	1D Radar		
Kind of product	iLDR-M-G5		
Firmware	☐ for normal use		☒ Special version for test execution
Power supply	☐ AC Mains	-	
	☒ DC Mains	24 V DC via banana Connector	
	☐ Battery	--	
Operational conditions	T _{nom} = 20 °C	T _{min} = -40 °C	T _{max} = +70 °C
	V _{nom} = 24 V	V _{min} = 10 V	V _{max} = 35 V
EUT sample type	Pre-Production		
Weight	3.3 kg		
Size [LxWxH]	100 x 100 x 215 mm		
Interfaces	Gbit Ethernet (requires indurad RadarProcessingUnit)		
For further details refer Applicants Declaration & following technical documents			
Refer section 3.2			

3.2 Detailed Technical data of Main EUT as Declared by Applicant

TX Frequency range	76 GHz to 81 GHz		
Type of modulation used	FMCW		
Antenna polarization	Vertical (Worst-case)		
Bandwidth	< 5000 MHz		
Emission classification	F3N (FMCW)		
Coaxial antenna connector available	☒ No connector	☐ Only for testing purpose	☐ Regular use
Antenna Type	☐ Integrated – microstrip patch array		
	☒ External, no RF- connector		
	☐ External, separate RF-connector		
Single TX antenna gain	31 dBi	☒ Declared by applicant	☐ Measured
Total effective gain of 3 TX antenna	--	☐ Declared by applicant	☐ Measured
For further details refer Applicants Declaration & following technical documents			
Description of Reference Document (supplied by applicant)		Version	Total Pages
2023-05_indurad_LinearDynamicRadar-Premium_iLDR-M_Data-Sheet_en_V01.02jsg		V01.04	2
2023-08-03_iLDR_iSDR-G5-platform_CTC_V1mrl		CTC Version 1	7

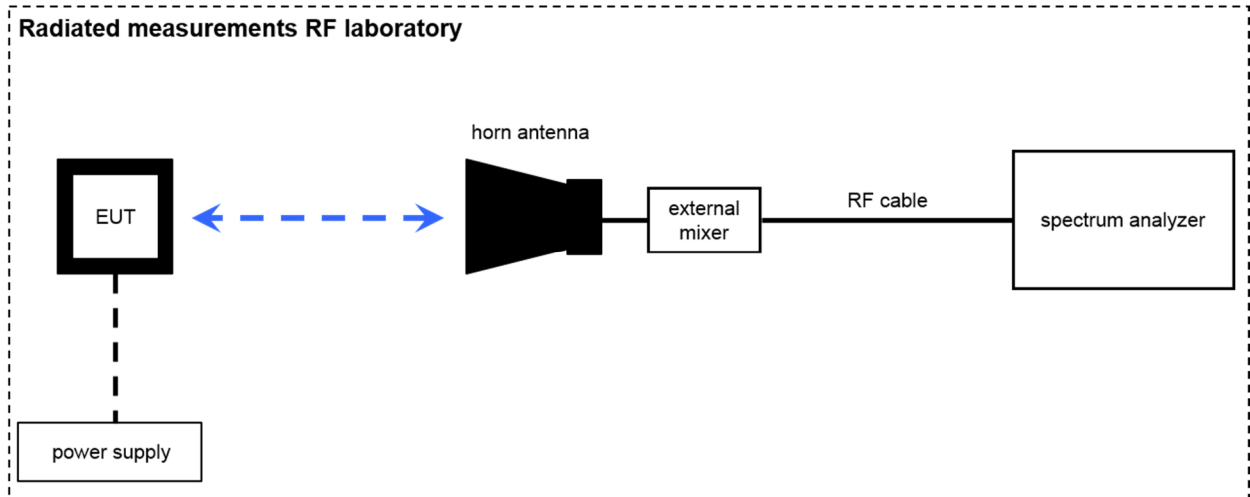
3.3 Modifications on Test sample

Additions/deviations or exclusions	--
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4 Measurements

4.1 The maximum peak power EIRP / peak EIRP spectral density. The maximum power EIRP/ average EIRP.

Schematic:



$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance;

G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

$$OP \text{ [dBm]} = -65.0 \text{ [dBm]} + 50.0 \text{ [dB]} - 20.0 \text{ [dBi]} + 5.0 \text{ [dB]} = -30 \text{ [dBm]} (1 \mu\text{W})$$

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

Testing method:

All the measurements are done according to standards and rules listed in subsection 5.1.2. The measured power is EIRP*.

The EUT is ON and set to default mode: FMCW modulation. EUT is tested under nominal condition.

For the maximum peak power EIRP / peak EIRP spectral density test function Signal-ID is activated to exclude ghost signals (product of the mixer).

*EIRP: Equivalent Isotropic Radiated Power

4.1.1 Measurement Location

Test site	120907 - FAC2 - Radiated Emissions
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4.1.2 Limit

Average [dBm]	Peak [dBm]
50	55

Description:

§95.3367:

The fundamental radiated emission limits within the 76-81 GHz band are expressed in terms of Equivalent Isotropically Radiated Power (EIRP) and are as shown below.

Limits:

FCC §95.3367 (a) (b)

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

Measurement: Average Power

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

Measurement: Peak Power

Measurement parameter	
Detector:	Pos-Peak
Resolution bandwidth:	10 MHz
Video bandwidth:	28 MHz
Trace-Mode:	Max Hold

Note: KDB 653005 D01 v01r02 / §4.(c)(1)

Peak power measurements of swept frequency radar implementations (e.g., high sweep rate FMCW) may require a desensitization correction factor to be applied to the measurement results.

Consequence:

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

4.1.3 Result

Mode	Peak detector, max peak search (marker) [dBm]	max peak search (marker frequency) [GHz]	RMS detector, channel power measurement [dBm]	Voltage [V]	Temperature [°C]	Result
Normal mode	37.51	76.423	22.90	24 DC	22	Passed

Remark: for more information and graphical plot see annex, TR23-1-0086301T004a-A6

4.2 Modulation characteristics

Description:

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

KDB 653005 D01 76-81 GHz Radars v01r02, section 3 (g)

Concerning the Section 2.1047 modulation characteristics requirement, the following information should be provided:

- 1) Pulsed radar: pulse width and pulse repetition frequency (if PRF is variable, then report maximum and minimum values).
- 2) Non-pulsed radar (e.g., FMCW): modulation type (i.e., sawtooth, sinusoid, triangle, or square wave) and sweep characteristics (sweep bandwidth, sweep rate, sweep time).

For this measurement, please check customer provided document in Annex 5.

4.3 Occupied bandwidth

Description:

§2.1049 The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

Limits:

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

Measurement:

Parameters	
Detector:	Pos-Peak
Resolution bandwidth:	10 MHz
Video bandwidth:	28 MHz
Trace-Mode:	Max Hold

Results:

EUT	Temperature [°C]	Voltage [V]	f_L in GHz	f_H in GHz	Occupied Bandwidth (99%) in GHz
EUT 1	20(Tnom)	24(Vnom)	76.0528	80.9191	4.8663

Remark: for more information and graphical plot see annex TR23-1-0086301T004a-A6 (Page 7-8)

EUT	Temperature [°C]	Voltage [V]	f_L in GHz	f_H in GHz	20dB Occupied Bandwidth in GHz
EUT 1	20(Tnom)	24(Vnom)	76.02900	80.97100	4.94200

Remark: for more information and graphical plot see annex TR23-1-0086301T004a-A6 (Page 10-11)

4.4 Field strength of emissions (band edge)

Testing method:

For low and high band edge see “Field strength of emission (radiated spurious)” in the corresponding frequency range.

4.4.1 Measurement Location

Test site	120907 - FAC2 - Radiated Emissions
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Description:

Investigation of the emission limits at the band edge.

Limits:

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

Frequency Range [GHz]	Measurement distance	Power Density
40 – 76 and 81 – 200	3.0 m	600 pW/cm ² → -1.7 dBm

FCC §95.3367 (a) (b)

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

Measurement:

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

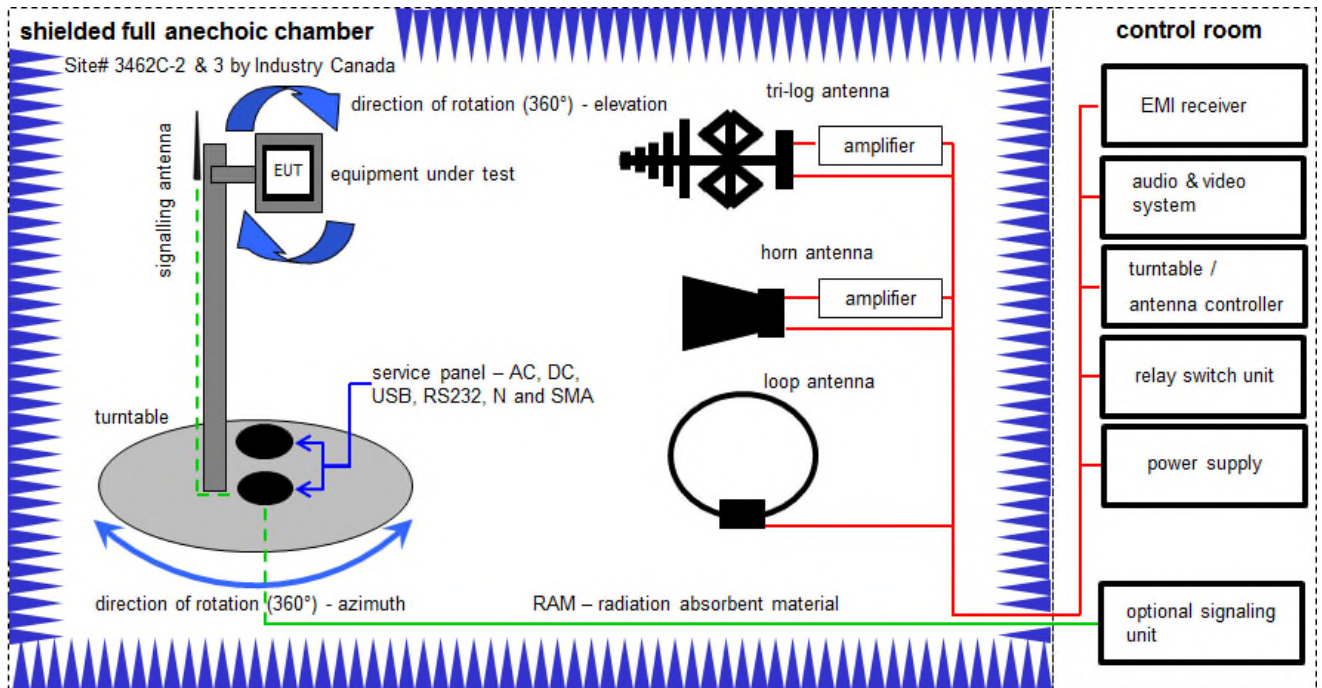
4.4.2 Result

- Remark: for more information and graphical plot see annex, **TR23-1-0086301T004a-A1**
- Overview about results are included in chapter 4.8

4.5 Radiated field strength emissions below 30 MHz

4.5.1 Description of the general test setup and methodology, see below example:

Schematic:



Measurement distance: tri-log antenna 3 meter and horn antenna 3 meter; loop antenna 3 meter.

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:

$$FS [dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$$

$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance;

G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

$$OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 \mu W)$$

FCC §95.3379

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

(1) Radiated emissions below 40 GHz shall not exceed the field strength as shown in the following emissions table.

FCC		
CFR Part 95.3379 (a) (1) / CFR Part 95.3379 (a) (3)		
Radiated unwanted emissions		
Frequency (MHz)	Field Strength ($\mu\text{V/m}$)	Measurement distance (m)
0.009 – 0.490	$2400/F[\text{kHz}]$	300
0.490 – 1.705	$24000/F[\text{kHz}]$	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 1000	200	3
1000 – 18 000	500	3
18 000 – 40 000	500	3

(i) In the emissions table in paragraph (a)(1) of this section, the tighter limit applies at the band edges.

(ii) The limits in the table in paragraph (a)(1) of this section are based on the frequency of the unwanted emissions and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(iii) The emissions limits shown in the table in paragraph (a)(1) of this section are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9.0-90.0 kHz, 110.0-490.0 kHz, and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector with a 1 MHz RBW

(2) The power density of radiated emissions outside the 76-81 GHz band above 40.0 GHz shall not exceed the following, based on measurements employing an average detector with a 1 MHz RBW:

(i) For radiated emissions outside the 76-81 GHz band between 40 GHz and 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 600 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure.

(ii) For radiated emissions above 200 GHz from field disturbance sensors and radar systems operating in the 76-81 GHz band: 1000 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure.

Frequency Range (GHz)	Power Density	EIRP
40 – 200	600 pW/cm ² @ 3m	-1.7 dBm
200 – 243	1000 pW/cm ² @ 3m	+0.5 dBm

(3) For field disturbance sensors and radar systems operating in the 76-81 GHz band, the spectrum shall be investigated up to 231.0 GHz.

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

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

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

According to this formula, an emission limit of PD = 600 pW/cm² at a distance of d = 3 m corresponds to an equivalent isotropically radiated power of EIRP = -1.7 dBm.

Measurement:

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

4.5.2 Measurement Location

Test site	Halle C, SB
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4.5.3 Result

Diagram	Operation Mode	Maximum Level [dBμV/m] Frequency Range 0.009 – 30 MHz	Result
2-01_B	1	No critical frequency found	Passed

Remark: for more information and graphical plot see annex A1 **TR23-1-0086301T004a-A1**

Equipment table (Chamber C):

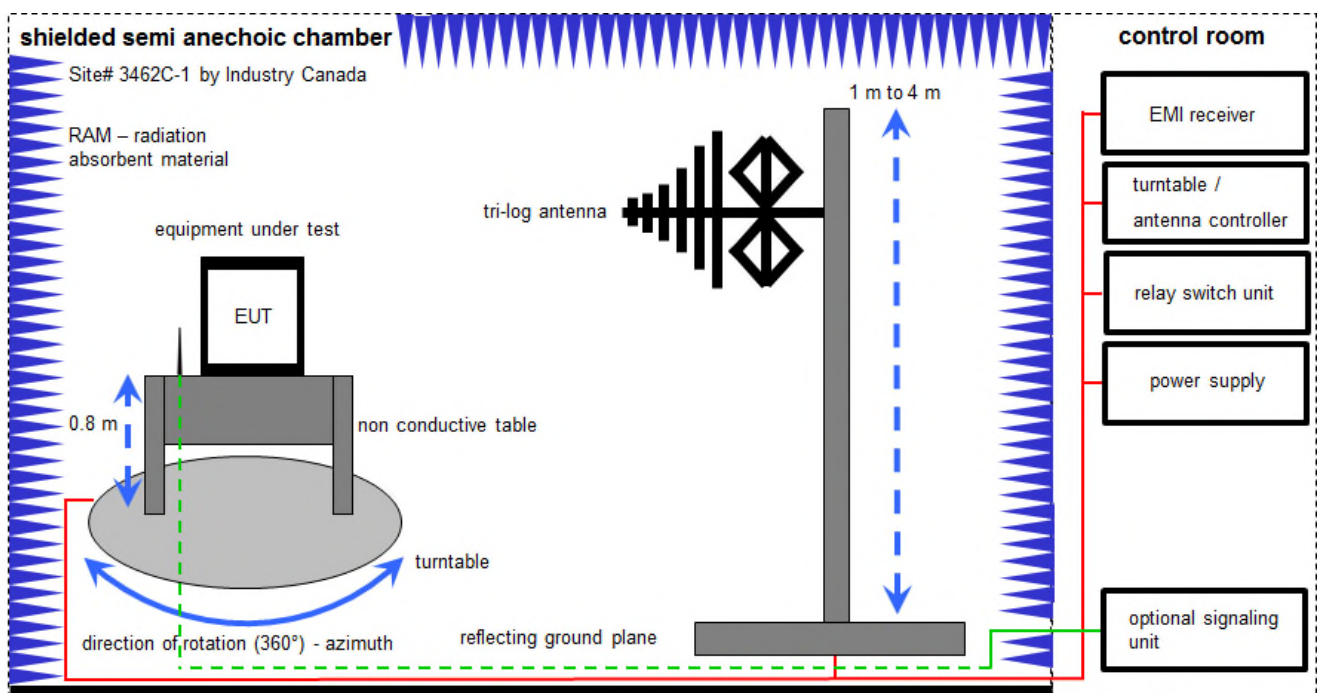
No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A,B,C	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vKI!	09.12.2020	08.12.2023
2	A,B,C	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	A,B,C	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
4	A,B,C	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	Erfi	91350	300001155	ne	-/-	-/-
5	A,B,C	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2023	31.12.2024
6	A,B,C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
7	A,B,C	NEXIO EMV-Software	BAT EMC V2022.0.32.0	EMCO		300004682	ne	-/-	-/-
8	A,B,C	PC	ExOne	F+W		300004703	ne	-/-	-/-
9	B,C	MXG Microwave Analog Signal Generator	NS183A	Agilent Technologies	MY47420220	300003813	vKI!	07.12.2022	31.12.2025
10	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
11	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
12	B	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-
13	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vKI!	11.02.2022	29.02.2024
14	C	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vKI!	31.01.2024	30.01.2026
15	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	8905-2342	300000256	vKI!	17.06.2021 19.07.2023	30.06.2023 31.07.2025

Remark: valid for period of measurements

4.6 Radiated field strength emissions 30 MHz – 1000 MHz

4.6.1 Description of the general test setup and methodology, see below example:

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



Measurement distance: tri-log antenna 10 meter

$$FS = UR + CL + AF$$

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

Example calculation:

$$FS [dB\mu V/m] = 12.35 [dB\mu V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB\mu V/m] (35.69 \mu V/m)$$

4.6.2 Measurement Location

Test site	Halle F, SB
-----------	-------------

4.6.3 Limit

Radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [$\mu\text{V}/\text{m}$]	Limit [$\text{dB}\mu\text{V}/\text{m}$]	Detector	RBW / VBW [kHz]
30 - 88	100	40.0	Quasi peak	100 / 300
88 - 216	150	43.5	Quasi peak	100 / 300
216 - 960	200	46.0	Quasi peak	100 / 300
960 - 1000	500	54.0	Quasi peak	100 / 300

4.6.4 Result

Diagram	Operation Mode	Maximum Level [$\text{dB}\mu\text{V}/\text{m}$] Frequency Range 30M – 1000 MHz	Result
3.01	1	32.62dB $\mu\text{V}/\text{m}$ @724.106MHz	Passed

Remark: for more information and graphical plot see annex A1 **TR23-1-0086301T004a-A1**

Equipment table (Chamber F):

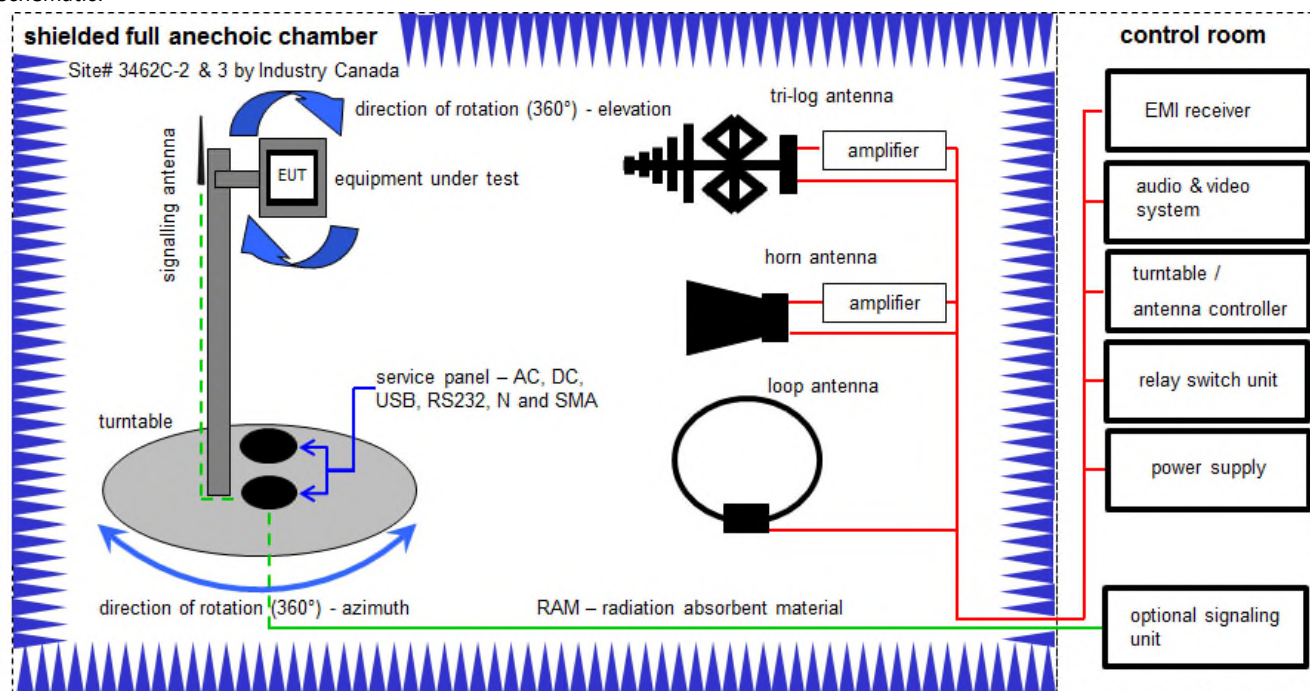
No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	n. a.	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2920A04466	300000580	ne	-/-	-/-
3	n. a.	Semi anechoic chamber	300023	MWB AG	-/-	300000551	ne	-/-	-/-
4	n. a.	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
5	n. a.	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
6	n. a.	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
7	n. a.	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	09.12.2022 06.12.2023	31.12.2023 31.12.2024
8	n. a.	PC	TecLine	F+W	-/-	300004388	ne	-/-	-/-
9	n. a.	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	295	300003787	vKI!	12.04.2021 23.05.2023	30.04.2023 31.05.2025

Remark: valid for period of measurements

4.7 Radiated field strength emissions 1GHz – 18 GHz

4.7.1 Description of the general test setup and methodology, see below example:

Schematic:



Measurement distance: tri-log antenna 3 meter and horn antenna 3 meter; loop antenna 3 meter.

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:

$$FS [dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$$

$$OP = AV + D - G + CA$$

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

Example calculation:

$$OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 \mu W)$$

4.7.2 Measurement Location

Test site	Halle C, SB
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4.7.3 Measurement distance

Frequency Range [GHz]	Measurement distance [m]
1 - 8	3
8 - 18	3

4.7.4 Result

Diagram	Operation Mode	Frequency Range	Maximum Level [dBμV/m] Frequency Range 1G – 40 GHz	Result
D127_B	1	1G – 18GHz	Max Peak: 53dBuV/m @ 12500GHz, 47.7 dBuV/m @ 12500GHz	Passed

Remark: for more information and graphical plot see annex A1 **TR23-1-0086301T004a-A1**

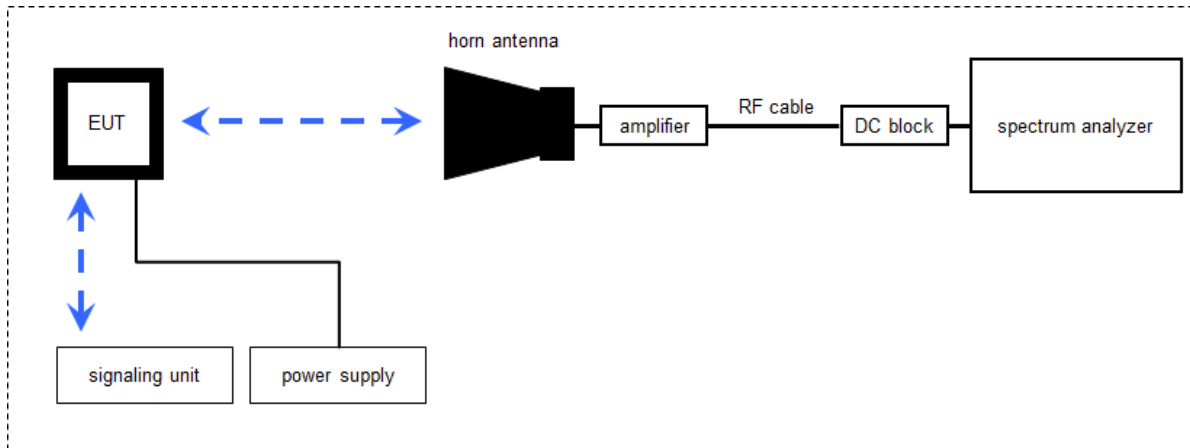
Equipment table (Chamber C):

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A,B,C	DC power supply, 60Vdc, 50A, 1200 W	6032A	HP	2818A03450	300001040	vKI!	09.12.2020	08.12.2023
2	A,B,C	Anechoic chamber	FAC 3/5m	MWB / TDK	87400/02	300000996	ev	-/-	-/-
3	A,B,C	Switch / Control Unit	3488A	HP	*	300000199	ne	-/-	-/-
4	A,B,C	Variable isolating transformer	MPL IEC625 Bus Variable isolating transformer	ErFi	91350	300001155	ne	-/-	-/-
5	A,B,C	EMI Test Receiver 20Hz- 26,5GHz	ESU26	R&S	100037	300003555	k	11.12.2023	31.12.2024
6	A,B,C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000037	300004509	ne	-/-	-/-
7	A,B,C	NEXIO EMV-Software	BAT EMC V2022.0.32.0	EMCO		300004682	ne	-/-	-/-
8	A,B,C	PC	ExOne	F+W		300004703	ne	-/-	-/-
9	B,C	MXG Microwave Analog Signal Generator	NS183A	Agilent Technologies	MY47420220	300003813	vKI!	07.12.2022	31.12.2025
10	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	19	300003790	ne	-/-	-/-
11	B	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22049	300004481	ev	-/-	-/-
12	B	RF-Amplifier	AMF-6F06001800-30-10P-R	NARDA-MITEQ Inc	2011572	300005241	ev	-/-	-/-
13	B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3089	300000307	vKI!	11.02.2022	29.02.2024
14	C	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess - Elektronik	318	300003696	vKI!	31.01.2024	30.01.2026
15	A	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	8905-2342	300000256	vKI!	17.06.2021 19.07.2023	30.06.2023 31.07.2025

Remark: valid for period of measurements

4.8 Radiated field strength emissions, above 18 GHz

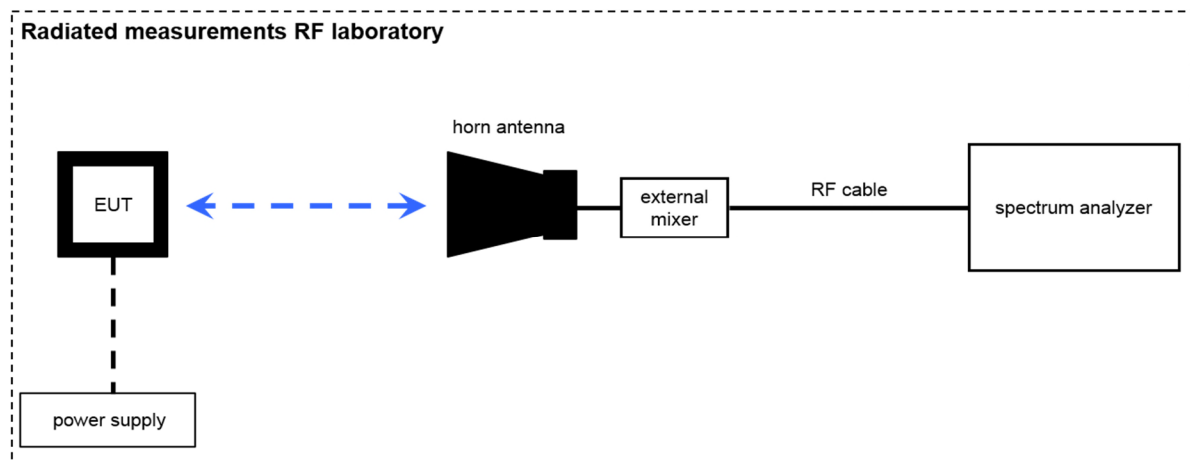
Schematic:



4.9 Radiated field strength emissions, above 50/85 GHz

4.9.1 Description of the general test setup and methodology, see below example:

Schematic:



$$OP = AV + D - G + CA$$

(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance;

G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:

$$OP [dBm] = -65.0 [dBm] + 50.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 \mu W)$$

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

Testing method:

All the measurements are done according to standards and rules listed in subsection 5.1.2. The measured power is EIRP*.

The EUT is ON and set to default mode: FMCW modulation. EUT is tested under nominal condition.

For the maximum peak power EIRP / peak EIRP spectral density test function Signal-ID is activated to exclude ghost signals (product of the mixer).

*EIRP: Equivalent Isotropic Radiated Power

4.9.2 Measurement Location

Test site	SYS 13 + SYS 14, SB 18G – 162GHz
	FAC 2, ESS 162G – 243GHz

Equipment table :

ID	Description	Manufacturer	SerNo	CheckType	Last Check	Interval	Next Check
	120907 - FAC2 - Radiated Emissions			chk			
20005	AC - LISN 50 Ohm/50µH ESH2-Z5	Rohde & Schwarz Messgerätebau GmbH / Memmingen	861741/005	cal	chk: 2023-Feb-21 cal: 2023-May-25	chk: 12M cal: 12M	chk: 2024-Feb-21 cal: 2024-May-25
20133	Horn Antenna 3115 (Meas 1)	EMCO Elektronik GmbH / Gilching	9012-3629	cal	cal: 2023-May-22	cal: 36M	cal: 2026-May-22
20302	Horn Antenna BBHA9170 (Meas 1)	Schwarzbeck Mess-Elektronik OHG / Schönaun	155	cpu	chk: 2020-Apr-15	chk: 12M	
20303	Horn Antenna BBHA9170 (Subst 1)	Schwarzbeck Mess-Elektronik OHG	156	cpu		chk: 12M	
20354	DC - Power Supply 40A NGPE 40/40		448	cpu			
20729	FS-Z140	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101004	cal	cal: 2023-Jun-16	cal: 36M	cal: 2026-Jun-16
20730	FS-Z110	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101468	cal	cal: 2023-Jun-02	cal: 36M	cal: 2026-Jun-02
20731	FS-Z75	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101022	cal	cal: 2022-May-18	cal: 36M	cal: 2025-May-18
20732	Signal- and Spectrum Analyzer FSW67	Rohde & Schwarz Messgerätebau GmbH / Memmingen	104023	cal	cal: 2023-May-25	cal: 12M	cal: 2024-May-25
20733	Harmonic Mixer FS-Z220	RPG-Radiometer Physics GmbH	101009	cal	cal: 2021-May-27	cal: 36M	cal: 2024-May-27
20734	Harmonic Mixer FS-Z325	RPG-Radiometer Physics GmbH / Meckenheim	101005	cal	cal: 2021-May-27	cal: 36M	cal: 2024-May-27
20765	Pickett-Potter Horn Antenna FH-PP 40-60	RPG-Radiometer Physics GmbH / Meckenheim	010001	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20767	Pickett-Potter Horn Antenna FH-PP 140-220	RPG-Radiometer Physics GmbH / Meckenheim	010011	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20811	Horn Antenna ASY-SGH-124-SMA	Antenna Systems Solutions S.L	29F14182337	cal	cal: 2021-Oct-20	cal: 36M	cal: 2024-Oct-20
20812	Pickett-Potter Horn Antenna FH-PP-325	RPG-Radiometer Physics GmbH / Meckenheim	10024	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20813	Pickett-Potter Horn Antenna FH-PP 075	RPG-Radiometer Physics GmbH / Meckenheim	10006	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20814	Pickett-Potter Horn Antenna FH-PP 140	RPG-Radiometer Physics GmbH / Meckenheim	10008	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20815	Pickett-Potter Horn Antenna FH-PP 110	RPG-Radiometer Physics GmbH / Meckenheim	10014	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20
20817	Waveguide Rectangular Horn Antenna SAR-2309-22-S2	ERAVANT / Torrance	13254-01	chk	chk: 2023-Oct-20	chk: 12M	chk: 2024-Oct-20

Remark: valid for period of measurements

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Spectrum Analyzer	FSW50	Rohde & Schwarz	101332	300005935	k	20.01.2022 07.12.2023	31.01.2023 31.12.2024
2	n. a.	Spectrum Analyzer 2 Hz - 85 GHz	FSW85	R&S	101333	300005568	k	11.07.2022 02.08.2023	31.07.2023 31.08.2024
3	n. a.	Temperature Test Chamber	T-40/50	CTS GmbH	064023	300003540	ev	09.05.2022	08.05.2024
4	n. a.	DC Power Supply, 60V, 10A	6038A	HP	2848A07027	300001174	vKI!	08.12.2020	07.12.2023
5	n. a.	Power supply	N5767A	Agilent Technologies	US14J1569P	300004851	vKI!	08.12.2020	31.12.2023
6	n. a.	Broadband LNA 18-50 GHz	CBL18503070PN	CERNEX	25240	300004948	ev	09.03.2022	08.03.2024
7	n. a.	Horn Antenna 18,0-40,0 GHz	LHAF180	Microw.Devel	39180-103-021	300001747	vKI!	17.01.2022 24.01.2024	31.01.2024 31.01.2026
8	n. a.	Std. Gain Horn Antenna 18.0-26.5 GHz	638	Narda		300000486	vKI!	17.01.2022	31.01.2024
9	n. a.	Std. Gain Horn Antenna 26.5-40.0 GHz	V637	Narda	82-16	300000510	vKI!	17.01.2022	31.01.2024

10	n. a.	Std. Gain Horn Antenna 33.0-50.1 GHz	2324-20	Flann	57	400000683	ne	-/-	-/-
11	n. a.	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne	-/-	-/-
12	n. a.	Harmonic Mixer 3- Port, 50-75 GHz	FS-Z75	Rohde & Schwarz	101578	300005788	k	07.07.2022 19.07.2023	31.07.2024
13	n. a.	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814	ev	-/-	-/-
14	n. a.	Harmonic Mixer 3- Port, 60-90 GHz	FS-Z90	R&S	101555	300004691	k	21.07.2022 25.08.2023	31.07.2023 31.08.2024
15	n. a.	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001988	ne	-/-	-/-
16	n. a.	Harmonic Mixer 3- Port, 75-110 GHz	FS-Z110	R&S	101411	300004959	k	07.07.2022 17.07.2023	31.07.2023 31.07.2024
17	n.a.	Std. Gain Horn Antenna 92.3-140 GHz	2824-20	Flann		300001993	ne	-/-	-/-
18	n.a.	Harmonic Mixer 3- port, 90-140 GHz	FS-Z140	Rohde & Schwarz	101119	300005581	k	20.07.2022 03.08.2023	31.07.2023 31.08.2024
19	n. a.	Std. Gain Horn Antenna 114-173 GHz	2924-20	Flann	*	300001999	ne	-/-	-/-
20	n. a.	Harmonic Mixer 3- Port, 110-170 GHz	FS-Z170	Radiometer Physics GmbH	100014	300004156	k	01.07.2022 21.07.2023	31.07.2023 31.07.2024
21	n. a.	Std. Gain Horn Antenna 145-220 GHz	3024-20	Flann	*	300002000	ne	-/-	-/-
22	n. a.	Harmonic Mixer 3- Port, 140-220 GHz	SAM-220	Radiometer Physics GmbH	200001	300004157	k	21.07.2022 01.08.2023	31.07.2023 31.08.2024

Remark: valid for period of measurements

Calculation of the boundary near/far field:

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

Antenna range [GHz]	D [m]	Highest frequency in the measurement [GHz]	Lowest wavelength λ in the measurement [m]	Boundary for near/far field [m]
162-220	0.01070	220	0.001362693	0.17
220-243	0.00705	243	0.001297803	0.08

Transducer factor TF

Mixer: 50 - 75 GHz (FS-Z75, S/N 101578)			
Distance [m]	Frequency [GHz]	TF [dB] (for power)	TF [dB] (for field strength)
0,10	50-75	/	/
0,15	50-75	/	/
0,25	50-75	36,12	24,36
0,50	50-75	42,14	30,38
0,75	50-75	45,66	33,90
1,00	50-75	48,16	36,40
1,50	50-75	51,68	39,92
2,00	50-75	54,18	42,42
2,50	50-75	56,12	44,36
3,00	50-75	57,71	45,94
Far field distance of antenna (@ max. frequency):			17.2 cm
Mixer: 75-110 GHz (FS-Z110, S/N 101411)			
Distance [m]	Frequency [GHz]	TF [dB] (for power)	TF [dB] (for field strength)
0,10	75-110	/	/
0,15	75-110	34,95	23,19
0,25	75-110	39,39	27,63
0,50	75-110	45,41	33,65
0,75	75-110	48,93	37,17
1,00	75-110	51,43	39,67
1,50	75-110	54,95	43,19
2,00	75-110	57,45	45,69
2,50	75-110	59,39	47,63
3,00	75-110	60,97	49,21
Far field distance of antenna (@ max. frequency):			11.3 cm
Mixer: 110-170 GHz (FS-Z170, S/N 100014)			
Distance [m]	Frequency [GHz]	TF [dB] (for power)	TF [dB] (for field strength)
0,10	110-170	34,55	22,79
0,15	110-170	38,07	26,31
0,25	110-170	42,51	30,75
0,50	110-170	48,53	36,77
0,75	110-170	52,05	40,29
1,00	110-170	54,55	42,76
1,50	110-170	58,07	46,31
2,00	110-170	60,57	48,81
2,50	110-170	62,51	50,75
3,00	110-170	64,09	52,33
Far field distance of antenna (@ max. frequency):			8.2 cm

Mixer: 60 - 90 GHz (FS-Z90, S/N 101555, ThomsonCOR6090)			
Distance [m]	Frequency [GHz]	TF [dB] (for power)	TF [dB] (for field strength)
0,15	60 70 80 90	/	/
0,25	60 70 80 90	/	/
0,50	60 70 80 90	41,78 42,93 44,19 45,52	30,02 31,17 32,43 33,76
0,75	60 70 80 90	45,30 46,45 47,71 49,05	33,54 34,69 35,95 37,28
1,00	60 70 80 90	47,80 48,95 50,21 51,55	36,04 37,19 38,45 39,78
1,50	60 70 80 90	51,33 52,47 53,73 55,07	39,56 40,71 41,97 43,30
2,00	60 70 80 90	53,82 54,97 56,23 57,57	42,06 43,21 44,47 45,80
2,50	60 70 80 90	55,76 56,91 58,17 59,50	44,00 45,15 46,41 47,74
3,00	60 70 80 90	57,35 58,49 59,75 61,09	45,58 46,73 48,00 49,32
Far field distance of antenna (@ max. frequency):			44.5 cm

Measurement distance_SYS13_SYS14_SB:

Measurement frequency range:	Measurement distance [m]	Boundary for near/far field [m]
76 GHz – 81 GHz	1.50	0.445
81 GHz – 85 GHz	0.50	0.445
85 GHz – 90 GHz	0.50	0.113
90 GHz – 110 GHz	0.50	0.113
110 GHz – 115 GHz	0.25	0.082
115 GHz – 162 GHz	0.50	0.082

Measurement distance_FAC2_ESS:

Measurement frequency range:	Measurement distance [m]	Boundary for near/far field [m]
162 GHz – 220 GHz	1	0.17
220 GHz – 243 GHz	0.5	0.08

4.9.3 Limit

FCC Frequency [GHz]	FCC EIRP [dBm]	ISED Frequency [GHz]	ISED EIRP [dBm]
40 - 200	600 pW/cm ² ~ -1.7	40 - 162	-30
200 - 243	1000 pW/cm ² ~ 0.5	73.5 - 76	0
Limit conversion (pW/cm ² to dBm):	$P[\text{dBm}] = 10 \cdot \log(4 \cdot \pi \cdot d^2 \cdot P[\text{W/m}^2])$ d- distance of the limit defined in W/m². Here: 3 m. 600 pW/cm²: $P[\text{dBW}] = 10 \cdot \log(4 \cdot \pi \cdot (3\text{m})^2 \cdot 6 \cdot 10^{-6} \text{W/m}^2)$ 600 pW/cm²: $P[\text{dBW}] = -31.7 \text{ dBW}$ $P[\text{dBm}] = P[\text{dBW}] + 30$ 600 pW/cm²: $P[\text{dBm}] = -31.7 \text{ dBW} + 30$ 600 pW/cm²: $P[\text{dBm}] = -1.7 \text{ dBm}$ 1000 pW/cm²: $P[\text{dBW}] = 10 \cdot \log(4 \cdot \pi \cdot (3\text{m})^2 \cdot 1 \cdot 10^{-5} \text{W/m}^2)$ 1000 pW/cm²: $P[\text{dBW}] = -29.5 \text{ dBW}$ $P[\text{dBm}] = P[\text{dBW}] + 30$ 1000 pW/cm²: $P[\text{dBm}] = -29.5 \text{ dBW} + 30$ 1000 pW/cm²: $P[\text{dBm}] = +0.5 \text{ dBm}$		

4.9.4 Spectrum-Analyzer Settings

Resolution Bandwidth (RBW)	1 MHz
Video Bandwidth (VBW)	Minimum 3 times the resolution bandwidth
Detector	RMS detector.
Trace-Mode:	Maxhold

4.9.5 Result

Diagram	Operation Mode	Frequency Range	Maximum Level [dBm] Frequency Range 40G – 231 GHz	Result
D129_01	1	18G – 26.5GHz	No critical frequency found	Passed
D129_02	1	26.5G – 40GHz	No critical frequency found	Passed
D131	1	40G – 50GHz	No critical frequency found	Passed
D132	1	50G – 76GHz	No critical frequency found	Passed
--	--	76G – 81GHz	Note-2	--
D134_01	1	81G – 85GHz	No critical frequency found	Passed
D135	1	85G – 90GHz	-39.17dBm@87.498GHz	Passed
D137	1	90G – 110GHz	No critical frequency found	Passed
D139	1	110G – 115GHz	No critical frequency found	Passed
D141	1	115G – 162GHz	No critical frequency found	Passed
D143_01	1	162G – 200GHz	No critical frequency found	Passed
D143_02	1	200G – 220GHz	No critical frequency found	Passed
D145	1	220G – 243GHz	No critical frequency found	Passed

Note-1: for more information and graphical plot see annex **TR23-1-0086301T004a-A1**

Note-2: 76G – 81GHz, In Band Measurements, check chapter 4.1, 4.3.

Note-3: Only worst measurement antenna polarization noted in this table, for other results see annex A1

4.10 Frequency stability

Description:

§95.3379 (b) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Limits:

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

Measurement:

Parameters	
Detector:	Pos-Peak
Resolution bandwidth:	10 MHz
Video bandwidth:	28 MHz
Trace-Mode:	Max Hold

Measurement results 99% Occupied Bandwidth:

Test condition	Frequency f_L [MHz]	Frequency f_H [MHz]	Bandwidth [MHz]
-20 °C / V_{nom}	76044.25	80906.91	4862.6
-10 °C / V_{nom}	76045.90	80904.89	4858.9
0 °C / V_{nom}	76047.94	80910.75	4862.8
10 °C / V_{nom}	76049.03	80914.84	4865.8
20 °C / V_{nom}	See chapter 4.3 results		
20 °C / V_{min}	76050.86	80917.07	4866.2
20 °C / V_{max}	76051.06	80917.26	4866.1
30 °C / V_{nom}	76049.01	80908.46	4859.4
40 °C / V_{nom}	76050.22	80909.85	4859.6
50 °C / V_{nom}	76050.27	80914.91	4864.6

Note:

- The EUT is measured in the temperature range from -20°C to 50°C specified by §95.3379 (b).

Result: Passed

4.10.1 Calibration legend

Note / remarks	Interval of calibration & Verification
12M	12 months
24M	24 months
36M	36 months
10Y	10 Years

Abbreviation Check Type	Description
K (cal)	calibration / calibrated
Ne (cnn)	not required (k, ev, izw, zw not required)
Ev (chk)	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
cpu	Verification before usage
*)	next calibration ordered / currently in progress

5 Results from external laboratory

None	-
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6 Opinions and interpretations

None	-
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7 List of abbreviations

None	-
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8 Measurement Uncertainty valid for conducted/radiated measurements

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and its contribution to the overall uncertainty according its statistical distribution calculated.

Measurement Uncertainty Location Essen

Issue No.	Measurement type	References	Frequency range of measurement		Calculated Uncertainty based on confidence level of 95,54%	Remarks
			Start [MHz]	Stop [MHz]		
1	Magnetic field strength	EN/FCC/ISED/JP	0,009	30	4,86	Magnetic loop antenna, Pre-amp on
2	RF-Output power (eirp) Unwanted emissions (eirp) [dB]	EN,FCC/ISED, JP	30	100	4,57	without Pre-Amp
			30	100	4,91	with PreAmp
			100	1000	4,02	without Pre-Amp
			100	1000	4,26	with PreAmp
			1000	18000	4,36	without Pre-Amp
			1000	18000	5,23	with PreAmp
			18000	33000	4,92	Schwarzbeck BBHA9170 (#20302) Antenna set-up non-mixer set-up)
			33000	50000	4,17	Set-up for Q-Band (WR-22), non-mixer set-up
			40000	60000	4,69	Set-up U-Band (WR-19), non-mixer set-up
			50000	75000	4,06	External Mixer set-up V-Band (WR-15)
			75000	110000	4,17	External Mixer set-up W-Band (WR-6)
			90000	140000	5,49	External Mixer set-up F-Band (WR-8)
			140000	225000	6,22	External Mixer set-up G-Band (WR-5)
			225000	325000	7,04	External Mixer set-up (WR-3)
			325000	500000	8,84	External Mixer set-up (WR-2.2)
3	Radiated Blocking [dB]	EN	1000	18000	2,85	Typical set-up with microwave generator and antenna, value for 7GHz calculated
			18000	33000	4,66	Typical set-up with microwave generator and antenna
			33000	50000	3,48	WR-22 set-up
			50000	75000	3,73	WR-15 set-up
			75000	110000	4,26	WR-6 set-up
4	Frequency Error UWB/FMCW [kHz]	EN, FCC,JP, ISED	116000	123000	279,87	Calculated for 123GHz carrier (FMCW)
			40000	77000	276,19	calculated for 77 GHz (FMCW) carrier
			6000	7000	33,92	calculated for 6.5GHz UWB Ch.5
	Frequency error [Hz]		11	14	20,76	calculated for 13.56MHz carrier
6	Conducted emissions AC-mains	EN/FCC/ISED	0,009	30	3,57	general EMI-measurements on AC/DC ports

Measurement Uncertainty Location Saarbrücken

Test case	Uncertainty
Equivalent isotropically radiated power (e.i.r.p.)	Conducted value ± 1 dB Radiated value ± 3 dB
Permitted range of operating frequencies	± 100 kHz
Conducted unwanted emissions in the spurious domain (up to 18 GHz)	± 1 dB
Radiated unwanted emissions in the spurious domain (up to 18 GHz)	± 3 dB
Conducted unwanted emissions in the spurious domain (18 to 40 GHz)	± 4 dB
Radiated unwanted emissions in the spurious domain (18 to 40 GHz)	± 4 dB
Conducted unwanted emissions in the spurious domain (40 to 50 GHz)	$\pm 4,5$ dB
Radiated unwanted emissions in the spurious domain (40 to 50 GHz)	$\pm 4,5$ dB
Conducted unwanted emissions in the spurious domain (above 50 GHz)	± 5 dB
Radiated unwanted emissions in the spurious domain (above 50 GHz)	± 5 dB
DC and low frequency voltages	± 3 %
Temperature	± 1 °C
Humidity	± 3 %

9 Versions of test reports (change history)

Version	Applied changes	Date of release
--	➤ Initial release	2025-Jan-17
C1	➤ Annex-5 has been added on page 3, ➤ Summary of test result for modulation characteristics on page 5 has been updated, ➤ Chapter 2.8 (untested variant) has been updated.	2025-Jun-04
C2	➤ Annex 5 mentioned on page 12, ANSI C63.10 deleted, Antenna gain	2025-Jun-12
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End Of Test Report