Test Report
23-1-0086302T016a-C3

Number of pages:	33	**Date of Report:**	2025-Jun-12
Testing company:	cetecom advanced GmbH Untertuerkheimer Str. 6-10 66117 Saarbruecken GERMANY	**Applicant:**	indurad GmbH
Product: **Model:**	**2D Scanning Radar** **iSDR-H-G5**		
FCC ID:	**2AJRSISDRG5**		
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 selected parameters subject to the test.** The test results relate only to devices specified in this document		

The current version of Test Report 23-1-0086302T016a-C3 replaces the test report 23-1-0086302T016a-C2 dated 2025-Jun-05. The replaced test report is herewith invalid.

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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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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	☐	☐	☒	☐	See note 2, DUT has integral antenna
§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:

1) C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

2) ANSI C63.26-2015, chapter 5.5.1:
"…many contemporary portable transmitters utilize integral antennas, precluding access to an antenna output port from which to perform conducted compliance measurements. For these types of transmitters, all of the data necessary to demonstrate compliance must be measured in a radiated test configuration…"

1.3 Summary of Test Methods

Test standard	Date	Description
FCC – Title 47, Chapter I Subchapter D	--	Part 95, Subpart M, The 76-81GHz Band Radar Service

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
ANSI C63.10-2020	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
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:	cetecom 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**
FCC:	DE0003
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:	--

2.4 Organizational Items

Responsible test manager:	Al-Amin Hossain
Receipt of EUT:	2023-Dec-12
Date(s) of test:	2023-Dec-13 to 2024-Mar-26
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 Deutschland

2.7 Equipment under Test (EUT)

EUT No.*)	Sample No.	Product	Model	Type	SN	HW	SW
EUT 1	23-1-00863S28_C01	2D Scanning Radar	iSDR-H-G5	iSDR-H-G5-DN190	9a1767	G5	E5
EUT 2	23-1-00863S26_C01	2D Scanning Radar	iSDR-H-G5	iSDR-H-G5-DN190**V**	ea7b45	G5	E5
EUT 3	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
--	--	2D Scanning Radar	iSDR-H-G5	iSDR-H-G5-DN190**F**	--	G5	E5
--	--	2D Scanning Radar	iSDR-H-G5	iSDR-H-G5-DN190**VF**	--	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)

AE No.*)	Sample No.	Auxiliary Equipment	Model	SN	HW	SW
AE 1	23-1-00863S17_C01	Laptop	Thinkpad	PF-4QBH1Y	--	--
AE 2	23-1-00863S18_C01	Laptop charger/Adapter	--	--	--	--
AE 3	23-1-00863S19_C01	Ethernet Adapter	A7613	--	--	--
AE 4	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. If the table above does not show any other line than the headline, no AE was used during testing nor was taken into account for evaluation

2.10 Connected cables (CAB)

CAB No.*)	Sample No.	Cable Type	Connectors / Details	Length
CAB 1	23-1-00863S20_C01	Harness	--	N/A
CAB 2	--	LAN	RJ45	N/A
CAB 3	23-1-00863S06_C01	Cable harness	--	N/A

*) CAB short description is used to simplify the identification of the connected cables in this test report. If the table above does not show any other line than the headline, no cable was used during testing nor was taken into account for evaluation

2.11 Software (SW)

SW No.*)	Sample No.	SW Name	Description	SW Status

*) SW short description is used to simplify the identification of the used software in this test report. If the table above does not show any other line than the headline, no SW was used during testing nor was taken into account for evaluation.

2.12 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
Set 1	EUT 1+ AE 1 + AE 2 + AE 3 + CAB 1 + CAB 2	This setup has been used for radiated measurements
Set 2	EUT 2+ AE 1 + AE 2 + AE 3 + CAB 1 + CAB 2	This setup has been used for radiated measurements
Set 3	EUT 3+ AE 4 + CAB 2 + CAB 3	This setup has been used for frequency stability measurements with extreme temperature voltage condition

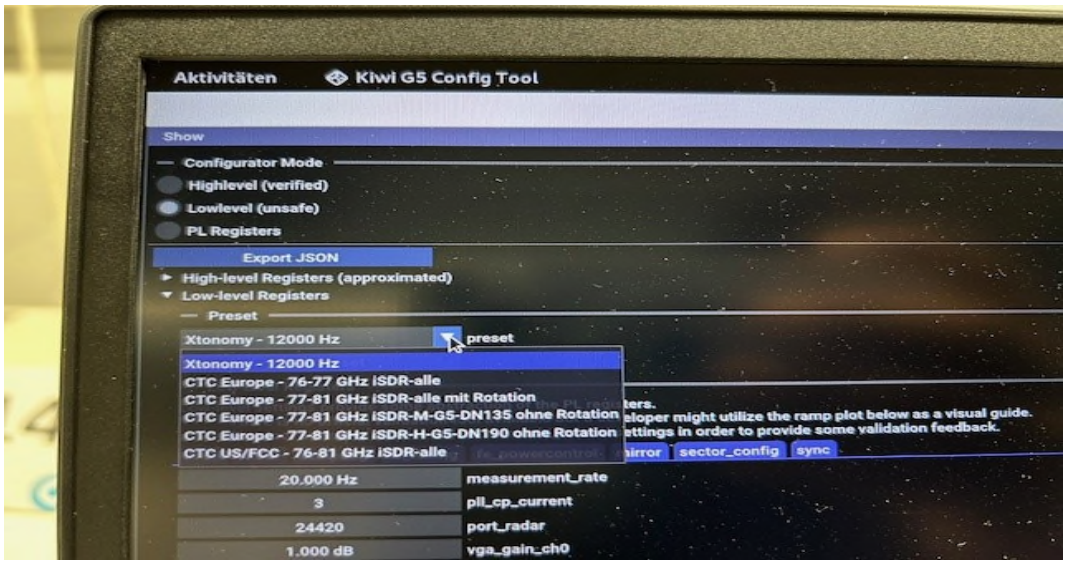
*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

2.13 EUT operation modes

EUT operating mode no.*)	Operating modes	Additional information
op. 1	Normal TXRX ,mode EUT set to Normal mode (76G – 81GHz)	➢ AE 1 + AE 3 + CAB 2 have been used to set the EUT in operation mode ➢ Customer Provided Tool has been used to set the EUT in operation. ➢ For more information regarding Test tool, check below chapter 2.14 ➢ EUT Antenna without Rotation

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

2.14 Test tool information



Note: EUT operating mode set to in different frequency / different mode by the help of customer provided tool.
In this case EUT set to 76 – 81GHz frequency mode.

Note: Customer provided tool to verify RADAR is active and working properly.

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Firmware	☐ normal use	☒ Special version for test execution: see pictures	
Power supply	☐ AC Mains	--	
	☒ DC Mains	24V DC	
	☐ Battery		
Operational conditions	T_{nom} =22 °C	--	--
EUT sample type	**Pre-Production**		
Weight	7.940 kg		
Size [LxWxH]	18.5 cm x 18.5 cm x 36.5 cm		
Interfaces/Ports	Check Annex-3		
For further details refer Applicants Declaration & following technical documents			

3.2 Detailed Technical data of Main EUT as Declared by Applicant

TX Frequency range [MHz]	76 GHz to 81 GHz		
Type of modulation used	FMCW		
Antenna polarization	Vertical (Worst case)		
Modulation method	F3N (FMCW)		
Bandwidth	<4000 MHz		
Coaxial antenna connector available	☒ No connector	☐ Only for testing purpose	☐ Regular use
Antenna Type	☐ Integrated – monopole ☒ External, no RF- connector ☐ External, separate RF-connector		
Antenna Gain (DN190) **Antenna Gain (DN190V)**	39 dBi 34 dBi	☒ Declared by applicant	☐ Measured
For further details refer Applicants Declaration & following technical documents			

Description of Reference Document (supplied by applicant)	Version	Total Pages
2023-11-08_iSDR-H_antenna_description_V1	**V1**	**9**

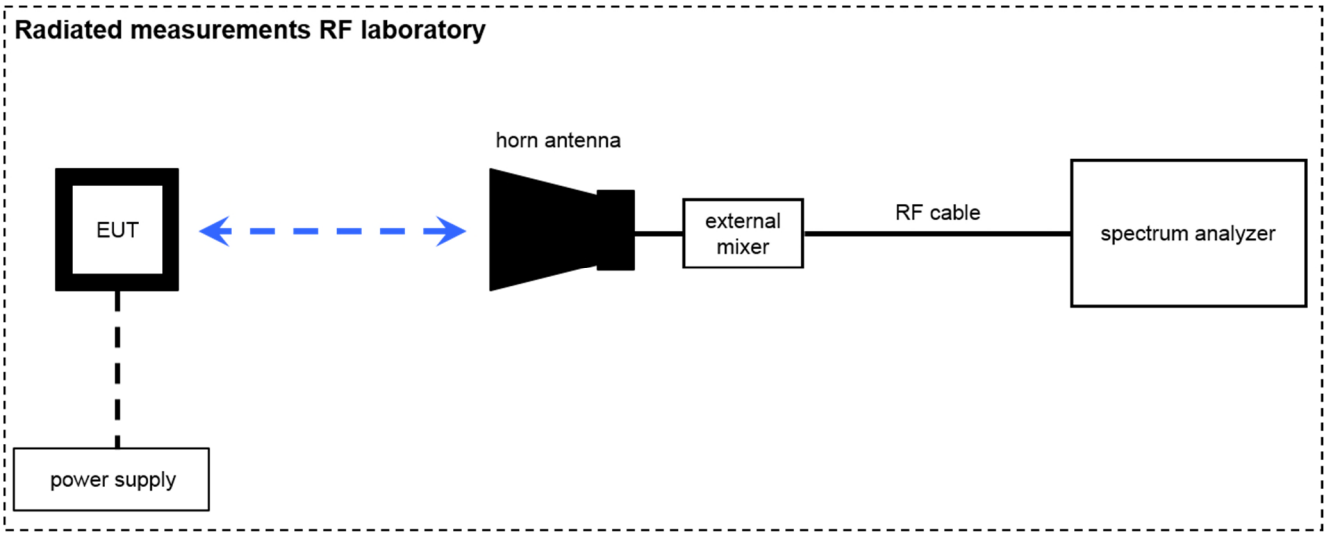
3.3 Modifications on Test sample

Additions/deviations or exclusions	--

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 [dBm] = -65.0 [dBm] + 50.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)
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

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
Channel integration method	Activated

Measurement: Peak Power

Measurement parameter	
Detector:	Pos-Peak
Resolution bandwidth:	50 MHz (Desensitization check necessary)
Video bandwidth:	80 MHz
Trace-Mode:	Max Hold

Note: KDB 653005 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.

4.1.2 Result

Diagram	EUT Setup	Peak detector, max peak search (marker) [dBm]	Peak detector, max peak search (marker frequency) [GHz]	RMS detector, channel power measurement [dBm]	Voltage [V]	Temperature [°C]	Result
D505	1	40.96	76.549	--	24 DC	22	Passed
D509	1	--	--	36.24	24 DC	22	Passed
D705	2	36.14	76.122	--	24 DC	22	Passed
D712	2	--	--	31.56	24 DC	22	Passed

Note-1: for more information and graphical plot see annex **TR23-1-0086302T016a-A1**

Note-2: EUT setup-1 has more Antenna gain than EUT setup-2

Note-3: Maximum Radiated Power has been found with EUT setup-1, therefore all radiated spurious emission measurements are performed with EUT setup-1 as worst case scenario.

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:	80 MHz
Video bandwidth:	80 MHz
Trace-Mode:	Max Hold

4.3.1 Result

Diagram	EUT setup	Low edge [GHz]	High edge [GHz]	Voltage [V]	Temperature [°C]	Occ. bandwidth [GHz]	Result
D507	1	76.093	80.951	24	22	4.86	Passed
D709	2	76.079	80.928	24	22	4.85	Passed

Remark: for more information and graphical plot see annex A1 **TR23-1-0086302T016a-A1**

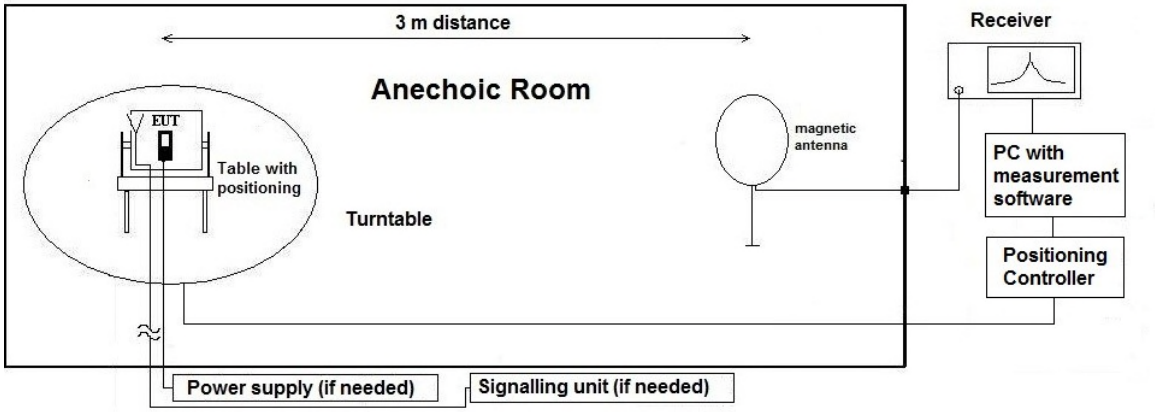
4.4 Radiated field strength emissions below 30 MHz

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

Evaluating the radiated field emissions are done first by an exploratory emission measurement and a final measurement for most critical frequencies determined.

The loop antenna was placed at 1 m height above ground plane and 3 m measurement distance from set-up for investigations. Because of reduced measurement distance, correction data were applied, as stated in chapter "General Limit - Radiated field strength emissions below 30 MHz". The tests are performed in the semi anechoic room recognized by the regulatory commission.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Exploratory, preliminary measurements
The EUT and it's associated accessories are placed on a non-conductive position manipulator (tipping device) of 0.8 m height which is placed on the turntable. By rotating the turntable (step 90°, range 0°to 360°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT), the emission spectrum was recorded.

The loop antenna was moved at least to 2-perpendicular axes (antenna vector in direction of EUT and parallel to EUT) in order to maximize the emissions. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a data reduction table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself either over 3-orthogonal axis (not defined usage position) or 2-orthogonal axis (defined usage position).

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$

$M = L_T - E_C$

AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
E_C = Electrical field – corrected value
E_R = Receiver reading
G_A = Gain of pre-amplifier (if used)
L_T = Limit
M = Margin

All units are dB-units, positive margin means value is below limit.

4.4.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss	Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
19.83	18.9	-70.75	0.18	--	-51.67	-31.83	30 to 3 m correction used according ANSI C63.10-2013

Remark: This calculation is based on an example value at 458 kHz

4.4.3 Correction factors due to reduced meas. distance (f < 30 MHz):

The used correction factors when the measurement distance is reduced compared to regulatory measurement distance, are calculated according Extrapolation formulas valid for EUT's with maximum dimension of 0.625xLambda. Formula 2+3+4 as presented in ANSI C63.10, Chapter 6.4.4 are used for the calculations of proper extrapolation factors

Frequency Range	f [kHz/MHz]	Lambda [m]	Far-Field Point [m]	Distance Limit accord. 15.209 [m]	1st Condition (dmeas < Dnear-field)	2nd Condition (Limit distance bigger dnear-field)	Distance Correction accord. Formula
kHz	9	33333.33	5305.17	300	fullfilled	not fullfilled	-80.00
	10	30000.00	4774.65		fullfilled	not fullfilled	-80.00
	20	15000.00	2387.33		fullfilled	not fullfilled	-80.00
	30	10000.00	1591.55		fullfilled	not fullfilled	-80.00
	40	7500.00	1193.66		fullfilled	not fullfilled	-80.00
	50	6000.00	954.93		fullfilled	not fullfilled	-80.00
	60	5000.00	795.78		fullfilled	not fullfilled	-80.00
	70	4285.71	682.09		fullfilled	not fullfilled	-80.00
	80	3750.00	596.83		fullfilled	not fullfilled	-80.00
	90	3333.33	530.52		fullfilled	not fullfilled	-80.00
	100	3000.00	477.47		fullfilled	not fullfilled	-80.00
	125	2400.00	381.97		fullfilled	not fullfilled	-80.00
	200	1500.00	238.73		fullfilled	fullfilled	-78.02
	300	1000.00	159.16		fullfilled	fullfilled	-74.49
	400	750.00	119.37		fullfilled	fullfilled	-72.00
	490	612.24	97.44		fullfilled	fullfilled	-70.23
	500	600.00	95.49	30	fullfilled	not fullfilled	-40.00
	600	500.00	79.58		fullfilled	not fullfilled	-40.00
	700	428.57	68.21		fullfilled	not fullfilled	-40.00
	800	375.00	59.68		fullfilled	not fullfilled	-40.00
	900	333.33	53.05		fullfilled	not fullfilled	-40.00
MHz	1.00	300.00	47.75		fullfilled	not fullfilled	-40.00
	1.59	188.50	**30.00**		fullfilled	not fullfilled	-40.00
	2.00	150.00	23.87		fullfilled	fullfilled	-38.02
	3.00	100.00	15.92		fullfilled	fullfilled	-34.49
	4.00	75.00	11.94		fullfilled	fullfilled	-32.00
	5.00	60.00	9.55		fullfilled	fullfilled	-30.06
	6.00	50.00	7.96		fullfilled	fullfilled	-28.47
	7.00	42.86	6.82		fullfilled	fullfilled	-27.13
	8.00	37.50	5.97		fullfilled	fullfilled	-25.97
	9.00	33.33	5.31		fullfilled	fullfilled	-24.95
	10.00	30.00	4.77		fullfilled	fullfilled	-24.04
	10.60	28.30	4.50		fullfilled	fullfilled	-23.53
	11.00	27.27	4.34		fullfilled	fullfilled	-23.21
	12.00	25.00	3.98		fullfilled	fullfilled	-22.45
	13.56	22.12	3.52		fullfilled	fullfilled	-21.39
	15.00	20.00	3.18		fullfilled	fullfilled	-20.51
	15.92	18.85	**3.00**		fullfilled	fullfilled	-20.00
	17.00	17.65	2.81		not fullfilled	fullfilled	-20.00
	18.00	16.67	2.65		not fullfilled	fullfilled	-20.00
	20.00	15.00	2.39		not fullfilled	fullfilled	-20.00
	21.00	14.29	2.27		not fullfilled	fullfilled	-20.00
	23.00	13.04	2.08		not fullfilled	fullfilled	-20.00
	25.00	12.00	1.91		not fullfilled	fullfilled	-20.00
	27.00	11.11	1.77		not fullfilled	fullfilled	-20.00
	29.00	10.34	1.65		not fullfilled	fullfilled	-20.00
	30.00	10.00	1.59		not fullfilled	fullfilled	-20.00

4.4.4 Measurement Location

Test site	SAC 3

4.4.5 Limit

Radiated emissions limits (3 meters)					
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/m]	Distance [m]	Detector	RBW [kHz]
0.009 – 0.09	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.09 – 0.11	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Quasi peak	0.2
0.11 – 0.15	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	0.2
0.15 – 0.49	2400 / f [kHz]	67.6 – 20Log(f) (kHz)	300	Pk & Avg	9
0.49 – 1.705	24000 / f [kHz]	87.6 – 20Log(f) (kHz)	30	Quasi peak	9
1.705 - 30	30	29.5	30	Quasi peak	9

*Remark: In Canada same limits apply, just unit reference is different

4.4.6 Result

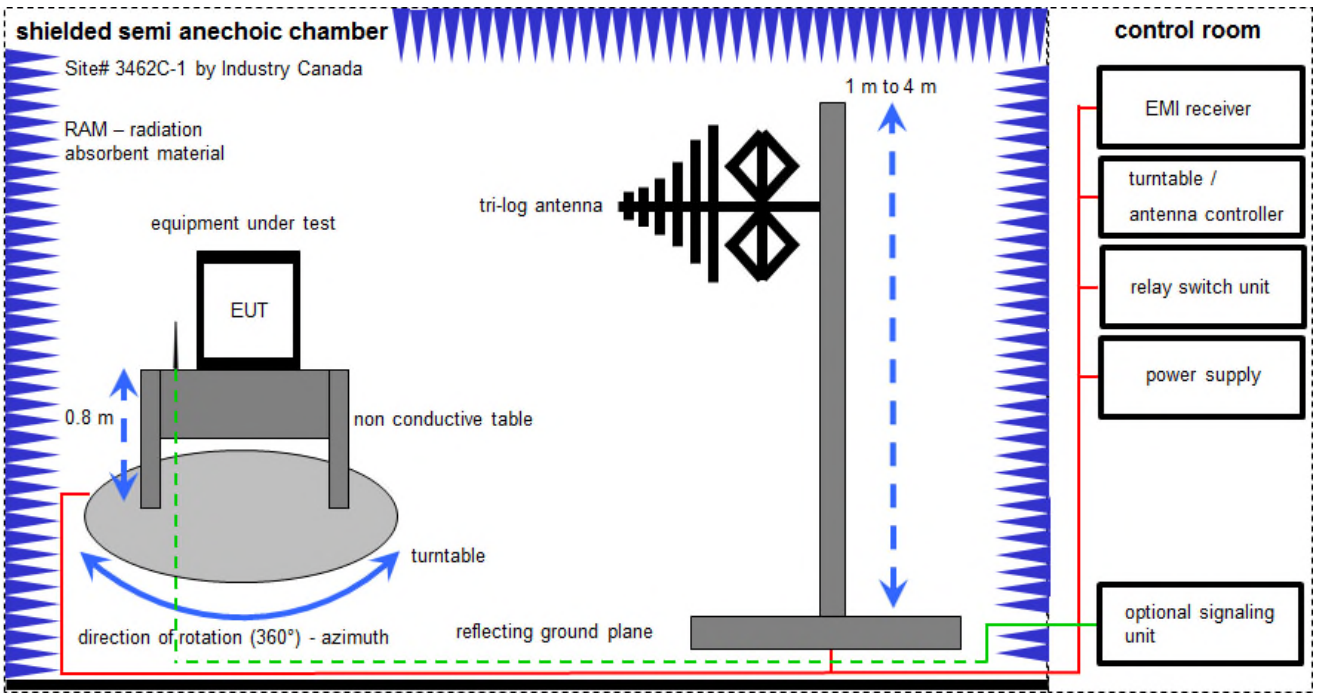
Diagram	Setup	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
D513	1	1	No critical emission found	Passed

Remark: for more information and graphical plot see annex A1 **TR23-1-0086302T016a-A1**

4.5 Radiated field strength emissions 30 MHz – 1000 MHz

4.5.1 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 conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter

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

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

4.5.2 Measurement Location

Test site	Halle F, SB

4.5.3 Limit

Radiated emissions limits (3 meters)				
Frequency Range [MHz]	Limit [µV/m]	Limit [dBµV/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

4.5.4 Result

Diagram	EUT Setup	Operation Mode	Maximum Level [dBµV/m] Frequency Range 30M – 1000 MHz	Result
6513_01_04_L_EC_SB	1	1	34.18dBµV/m@249.987MHz	Passed

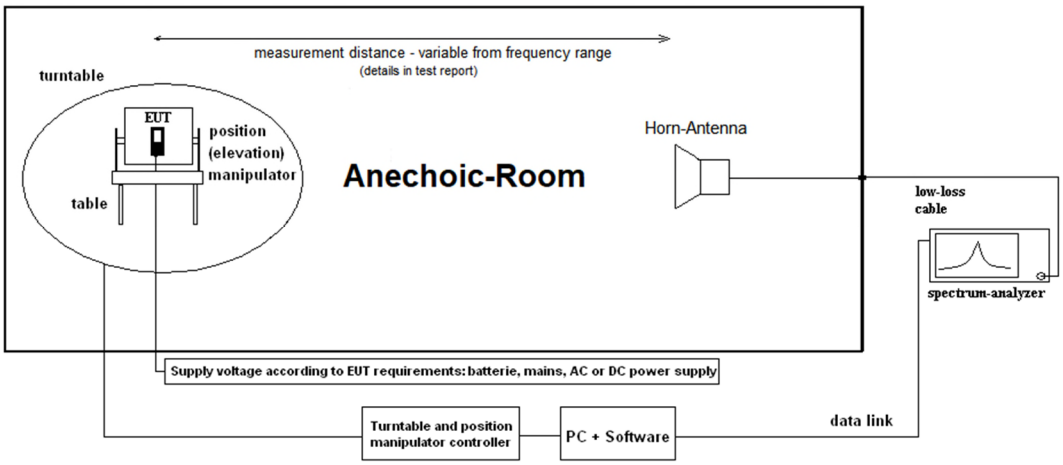
Remark: for more information and graphical plot see annex A1 **TR23-1-0086302T016a-A1**

4.6 Radiated field strength emissions 1 GHz – 50 GHz

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

Evaluating the emissions have to be done first by an exploratory emissions measurement and a final measurement for most critical frequencies. The tests are performed in a CISPR 18-1-4:2010 compliant fully anechoic room (FAR) recognized by the regulatory commission. Horn antennas are used for frequency range 1 GHz to 50 GHz. The EUT is aligned within 3 dB beam width of the measurement antenna with worst case position on the EUT.

Schematic:



Testing method:

The measurement is made according to relevant reference clauses:
(See Tables *Summary of Test Results* and *Summary of Test Methods* on page 5)

Exploratory, preliminary measurements
The EUT and its associated accessories are placed on a non-conductive position manipulator (tipping device) of 1.55 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 15°) and the EUT itself worst case position, the emission spectrum and it's characteristics was recorded with an EMI-receiver and software.
The measurements are performed in horizontal and vertical polarization of the measurement antennas. The results are documented in a diagram. Critical frequencies (low margin to limit) are saved within a table for further investigations. If various operating modes are supported, further investigations are made to find the worst-case of them. Also the interconnection cables and equipment position were varied in order to maximize the emissions.

Final measurement on critical frequencies
Based on the exploratory measurements, the most critical frequencies are re-measured by maintaining the EUT's worst-case operation mode, cable position, etc.

First a frequency zoom around the critical frequency is done to locate the frequency more precisely. After this step, for all identified critical frequencies, the maximum peak was determined.

Following parameters were varied: the turntable angle continuously in the range 0 to 360 degree, the EUT itself worst case position and the height for EUT with large dimensions.

On the determined worst-case position, a final measurement with necessary bandwidth and detector according standard has been carried out.

Formula:

$P_{EIRP} = P_{MEAS} + C_L + FSL - G_A$ (1)

P_{MEAS} = measured power at instrument
M = Margin
L_T = Limit

FSL = Free Space loss = Function(frequency, measurement distance)

$M = L_T - P_{EIRP}$

C_L= cable loss
G_A = Gain of pre-amplifier (if used)

All units are dB-units, positive margin means value is below limit.

4.6.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss + Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
29.37	41.20	--	24.28	16.92	46.3	CableLoss and PreAmp data in one data correction file

Remark: This calculation is based on an example value at 10 GHz

4.6.3 Measurement Location

Test site	120907 - FAC2 - Radiated Emissions

4.6.4 Limit

Frequency Range [MHz]	EIRP [dBm]	Field strength [dBµV/m]	RBW / VBW [kHz]
1000-40000	-21.23/ −41.23	74 (PK) / 54 (AV)	1000 / 3000
40000 – 50000	-1.7	--	1000 / 3000

EIRP limit was calculated according to the equation (38) in ANSI C63.10-2020:
EIRP[dBm] = E[dBµV/m]+ 20log(d [m])−104.77
EIRPlimit = [54 + 20log(3)−104.77] dBm
= [54 + 9.54−104.77] dBm
= -41.23 dBm

4.6.5 Measurement distance

Frequency Range [GHz]	Measurement distance [m]
1 - 15	3
15 - 18	2
18 - 40	1
40 – 50	2

4.6.6 Result

Diagram	Mode	EUT Setup	Frequency [GHz]	Max level [dBm]	Result
D515	1	1	1 – 15	No critical emission found	Passed
D516 D516_01	1	1	15 – 18	No critical emission found	Passed
D517 D517_01	1	1	18 – 40	No critical emission found	Passed
D518	1	1, Ant Ver	40G – 50GHz	≤ -28.91dBm No critical frequency found	Passed
D518_01	1	1, Ant Hor	40G – 50GHz	≤ -37.96dBm No critical frequency found	Passed

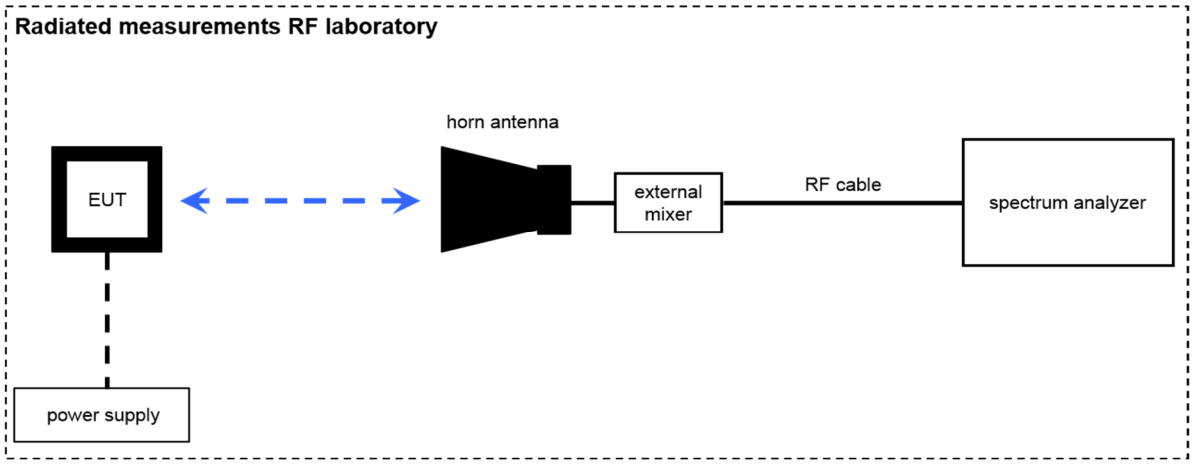
Remark:

- for more information and graphical plot see annex A1 **TR23-1-0086302T016a-A1**
- Only worst case Antenna polarization measurement's results are stated here

4.7 Radiated field strength emissions, above 50 GHz

4.7.1 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)

<u>Example calculation:</u>

OP [dBm] = -65.0 [dBm] + 50.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

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

<u>Testing method:</u>

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

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., Rm = 2D2 / λ), 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]
50-75	0.03072	73.5	0.004078810	0.46
55-75	0.03072	74.5	0.004024060	0.47
55-75	0.03072	75	0.003997233	0.47
75-110	0.020757	76	0.003944640	0.22
75-110	0.020757	78.5	0.003819010	0.23
75-110	0.020757	79.5	0.003770974	0.23
75-110	0.020757	81	0.003701141	0.23
75-110	0.020757	90	0.003331027	0.26
75-110	0.020757	98	0.003059107	0.28
75-110	0.020757	110	0.002725386	0.32
90-140	0.016696	122	0.002457315	0.23
90-140	0.016696	130	0.002306100	0.24
140-220	0.010700	220	0.001362693	0.17
220-325	0.007050	250	0.001199170	0.08

Measurement distance:

Measurement frequency range:	Measurement distance [m]	Boundary for near/far field [m]
50 GHz – 75 GHz	1	0.47
75 GHz – 90 GHz	1	0.26
90GHz – 110 GHz	0.25	0.32
110 GHz – 140 GHz	0.5	0.25
140 GHz – 170 GHz	0.25	0.17
140 GHz – 200 GHz	0.25	0.17
200 GHz – 220 GHz	0.25	0.08
220 GHz – 250 GHz	0.25	0.08

SB:

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_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

4.7.2 Measurement Location

Test site-1	120907 - FAC2 - Radiated Emissions
Test site-2	SYS 13, SB 75G – 90GHz

4.7.3 Limit

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 (µV/m)**	**Measurement distance (m)**
0.009 – 0.490	2400/F[kHz]	300
0.490 – 1.705	24000/F[kHz]	30
1.705 – 30.0	30	30
30 88	100	3
88 – 216	150	3
216 – 960	200	3
960 – 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):

EIRP[dBm] = 10 × log(4 × π × d² × PD[W/m²])

- 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.

4.7.4 Spectrum-Analyzer Settings

Resolution Bandwidth (RBW)	1 MHz
Video Bandwidth (VBW)	Minimum 3 times the resolution bandwidth
Detector	RMS detector.
Trace-Mode:	Maxhold
Sweep time	≥(Span/RBW)*EUT Cycle Time*N (N≥1)

4.7.5 Result

Diagram	EUT Setup	Operation Mode	Frequency Range	Maximum Level [dBm] Frequency Range 40G – 231 GHz	Result
D519	1	1	50G – 75GHz	≤ -38.0dBm No critical frequency found	Passed
D520_02	1	1	75G – 90GHz 76G – 81GHz	≤ -25.0dBm No critical frequency found **Note-4**	Passed
D522	1	1	90G – 110GHz	No critical frequency found Margin ≥ 20dB	Passed
D525	1	1	110G – 140GHz	No critical frequency found Margin ≥ 20dB, note 3	Passed
D526	1	1	140G – 170GHz	No critical frequency found Margin ≥ 20dB	Passed
D527	1	1	170G – 200GHz	No critical frequency found Margin ≥ 20dB	Passed
D528	1	1	200G – 220GHz	No critical frequency found Margin ≥ 20dB	Passed
D529	1	1	220G – 250GHz	No critical frequency found Margin ≥ 20dB	Passed

Note-1: for more information and graphical plot see annex A1, **TR23-1-0086302T016a-A1**
Note-2: Only worst measurement Antenna polarization noted in this Table, for more information check EUT setup picture.
Note-3: Intermodulation product on diagram
Note-4: 76G – 81 GHz, In Band Measurements, check chapter 4.1, 4.3

4.8 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).
- Since the RF part of iLDR and iSDR are identical, therefore frequency stabilty measurements with extreme condition have been performed only with iLDR variant.

Result: Passed

4.9 Equipment lists (location1)

SAC3

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	20341	Digital Multimeter	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottertal	81650455	--	cal	13.05.2024	13.05.2026
3	20482	Filter Matrix	Filter Matrix SAC3	cetecom advanced GmbH / Essen	without	--	cnn	-/-	-/-
4	20574	Biconilog Hybrid Antenna	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH / Heideck	980026L	--	cal	15.06.2022	15.06.2025
5	20620	EMI Test Receiver	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100362	--	cal	15.05.2024	15.05.2025
6	20885	Power Supply EA3632A	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	--	cnn	-/-	-/-
7	25038	Loop Antenna	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH / Memmingen	879824/13	--	cal	04.07.2022	04.07.2025

FAC2

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	Kind of Calibration	Last Calibration	Next Calibration
1	20133	Double-Ridged Waveguide Horn Antenna	Double-Ridged Waveguide Horn Antenna 3115 (Meas 1)	EMCO Elektronik GmbH / Gilching	9012-3629	cal	22.05.2023	22.05.2026
2	20354	DC - Power Supply 40A	DC - Power Supply 40A NGPE 40/40		448	cpu	05.03.2008	-/-
3	20412	Fully Anechoic Chamber	Fully Anechoic Chamber 2	ETS-Lindgren Gmbh / Taufkirchen	without	chk	15.03.2024	15.03.2025
4	20972	Signal- and Spectrum Analyzer	Signal- and Spectrum Analyzer FSW50	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101929	cal	05.01.2024	05.01.2025
5	20811	Horn Antenna	Horn Antenna ASY-SGH-124-SMA	Antenna Systems Solutions S.L / Santander	29F14182337	chk	20.10.2021	07.10.2025
6	20816	SGH Antenna	SGH Antenna SGH-26-WR10	Anteral S.L.	1144	cnn	-/-	-/-
7	20817	Waveguide Rectangular Horn Antenna	Waveguide Rectangular Horn Antenna SAR-2309-22-S2	ERAVANT / Torrance	13254-01	chk	16.10.2024	20.10.2026
8	20836	Amplifier	1-18 GHz Amplifier	Wright Technologies, Inc., Inc. / Roseville	0001	chk	18.10.2024	18.10.2026
9	20912	Low noise Amplifier Module 0.5-4GHz	Low noise Amplifier Module 0.5-4GHz	RF-Lambda Europe GmbH / Rüsselsheim	19041200083	cpu	18.10.2024	18.10.2025
10	20913	Phase Amplitude Stable Cable Assembly	Phase Amplitude Stable Cable Assembly DC-40GHz	RF-Lambda Europe GmbH	AC19040001	cnn	-/-	-/-
11	25457	DRG Horn Antenna	DRG Horn Antenna SAS-574	A.H. Systems, Inc. / Chatsworth	383	cal	28.03.2022	28.03.2025

FAC2

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	Kind of Calibration	Last Calibration	Next Calibration
1	20133	Double-Ridged Waveguide Horn Antenna	Double-Ridged Waveguide Horn Antenna 3115 (Meas 1)	EMCO Elektronik GmbH / Gilching	9012-3629	cal	22.05.2023	22.05.2026
2	20354	DC - Power Supply 40A	DC - Power Supply 40A NGPE 40/40		448	cpu	05.03.2008	-/-
3	20412	Fully Anechoic Chamber	Fully Anechoic Chamber 2	ETS-Lindgren Gmbh / Taufkirchen	without	chk	15.03.2024	15.03.2025
4	20729	Harmonic Mixer	FS-Z140	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101004	cal	16.06.2023	16.06.2026
5	20730	Harmonic Mixer	FS-Z110	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101468	cal	02.06.2023	02.06.2026
6	20731	Harmonic Mixer	FS-Z75	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101022	cal	18.05.2022	18.05.2025
7	20732	Signal- and Spectrum Analyzer	Signal- and Spectrum Analyzer FSW67	Rohde & Schwarz Messgerätebau GmbH / Memmingen	104023	cal	30.07.2024	30.07.2025
8	20733	Harmonic Mixer	Harmonic Mixer FS-Z220	RPG-Radiometer Physics GmbH / Meckenheim	101009	cal	24.05.2024	24.05.2027
9	20734	Harmonic Mixer	Harmonic Mixer FS-Z325	RPG-Radiometer Physics GmbH / Meckenheim	101005	cal	24.05.2024	24.05.2027
10	20765	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 40-60	RPG-Radiometer Physics GmbH / Meckenheim	010001	chk	16.10.2024	16.10.2026
11	20767	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 140-220	RPG-Radiometer Physics GmbH / Meckenheim	010011	chk	09.10.2024	09.10.2026
12	20811	Horn Antenna	Horn Antenna ASY-SGH-124-SMA	Antenna Systems Solutions S.L / Santander	29F14182337	cal	08.10.2024	08.10.2027
13	20813	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 075	RPG-Radiometer Physics GmbH / Meckenheim	10006	chk	16.10.2024	16.10.2026
14	20814	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 140	RPG-Radiometer Physics GmbH / Meckenheim	10008	chk	09.10.2024	09.10.2026
15	20815	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 110	RPG-Radiometer Physics GmbH / Meckenheim	10014	chk	22.03.2024	22.03.2026
16	20817	Waveguide Rectangular Horn Antenna	Waveguide Rectangular Horn Antenna SAR-2309-22-S2	ERAVANT / Torrance	13254-01	chk	16.10.2024	16.10.2026
17	20836	Amplifier	1-18 GHz Amplifier	Wright Technologies, Inc., Inc. / Roseville	0001	chk	18.10.2024	18.10.2026
18	20912	Low noise Amplifier Module 0.5-4GHz	Low noise Amplifier Module 0.5-4GHz	RF-Lambda Europe GmbH / Rüsselsheim	19041200083	cpu	18.10.2024	18.10.2025
19	20913	Phase Amplitude Stable Cable Assembly	Phase Amplitude Stable Cable Assembly DC-40GHz	RF-Lambda Europe GmbH	AC19040001	cnn	-/-	-/-
20	25457	DRG Horn Antenna	DRG Horn Antenna SAS-574	A.H. Systems, Inc. / Chatsworth	383	cal	28.03.2022	28.03.2025

4.10 Equipment lists (location2)

(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	05.12.2024	05.12.2025
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	vlKl!	23.05.2023	31.05.2025

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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	07.12.2023 09.01.2025	09.01.2026
2	n. a.	Power supply	N5767A	Agilent Technologies	US14J1569P	300004851	vlKl!	06.12.2023	31.12.2026
3	n. a.	Std. Gain Horn Antenna 60-90 GHz	COR 60_90	Thomson CSF		300000814	ev	-/-	-/-
4	n. a.	Harmonic Mixer 3-Port, 60-90 GHz	FS-Z90	R&S	101555	300004691	k	21.08.2023 25.07.2024	25.07.2025
5	n. a.	Std. Gain Horn Antenna 73.8-112 GHz	2724-20	Flann	*	300001988	ne	-/-	-/-

Remark: valid for period of measurements

4.10.1 Legend

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

Abbreviation Check Type	Description
cnn	Calibration and verification not necessary
cal	Calibration
calchk	Calibration plus intermediate Verification
chk	Verification
cpu	Verification before usage

5 Results from external laboratory

None	-

6 Opinions and interpretations

None	-

7 List of abbreviations

None	-

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 it contribution to the overall uncertainty according its statistical distribution calculated.

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

9 Versions of test reports (change history)

Version	Applied changes	Date of release
--	➢ Initial release	2025-Feb-14
C1	➢ Annex-5 has been added on page 3, ➢ Partial (Infront of test report) has been removed from front page, ➢ 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-6 has been added on page 3	2025-Jun-05
C3	➢ Annex-5 mentioned on page 13	2025-Jun-12

End Of Test Report