
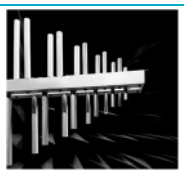
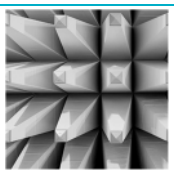

TEST REPORT

Test report no.: 23-1-0145601T010_TR1-R02

Testing laboratory

cetecom advanced GmbH
Untertuerkheimer Strasse 6 – 10
66117 Saarbruecken / Germany
Phone: + 49 681 5 98 - 0
Fax: + 49 681 5 98 - 9075
Internet: https://www.cetecomadvanced.com
e-mail: mail@cetecomadvanced.com

Accredited Testing Laboratory:
The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAkkS).
The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate with the registration number: D-PL-12047-01-00.
ISED Testing Laboratory Recognized Listing Number: DE0001
FCC designation number: DE0002

Applicant

Brose Fahrzeugteile SE & Co. KG, Bamberg
Berliner Ring 1
96052 Bamberg / GERMANY
Phone: +49 9517474-0
Contact: Mr. Bertram Bopp
e-mail: bertram.bopp@brose.com

Manufacturer

Brose Fahrzeugteile SE & Co. KG, Bamberg
Berliner Ring 1
96052 Bamberg / GERMANY

Test standard/s

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

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

Test Item

Kind of test item:	**Periphery Monitoring Radar (PMR)**
Model name:	**PMRGEN2**
FCC ID:	2AHV8-G67498
IC:	--
Frequency:	77-81 GHz
Technology tested:	FMCW Radar
Antenna:	Integrated antenna
Power supply:	8V to 16 V DC
Temperature range:	-40°C to +85°C

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

Test report authorized:

Christian Lorenz
CN = Christian Lorenz email = christian.lorenz@cetecomadvanced.com C = DE O = cetecom advanced GmbH OU = RC8G
2025.02.19 16:05:39 +01'00'

Christian Lorenz
Lab Manager
Radio Communications

Test performed:

Al-Amin Hossain
CN = Al-Amin Hossain email = al-amin.hossain@cetecomadvanced.com C = DE O = cetecom advanced GmbH OU = Radio Labs
2025.02.20 07:01:51 +01'00'

Al-Amin Hossain
Lab Manager
Radio Communications

1 Table of contents

2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. cetecom advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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In no case this test report can be considered as a Letter of Approval.

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.

2.2 Application details

Date of receipt of order:	2024-08-13
Date of receipt of test item:	2024-08-13
Start of test:*	2024-08-28
End of test:*	2024-12-19
Person(s) present during the test:	-/-

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

2.3 Involved test locations

	Saarbruecken lab		Essen lab
☐	Untertuerkheimer Str. 6-10 66117 Saarbruecken Germany	☒	Im Teelbruch 116 45219 Essen Germany

2.4 Test laboratories sub-contracted

None

2.5 Laboratory listings and recognitions

	Saarbruecken	Essen
FCC	DE0002	DE0003
ISED	DE0001 3462C	DE0001 3462D

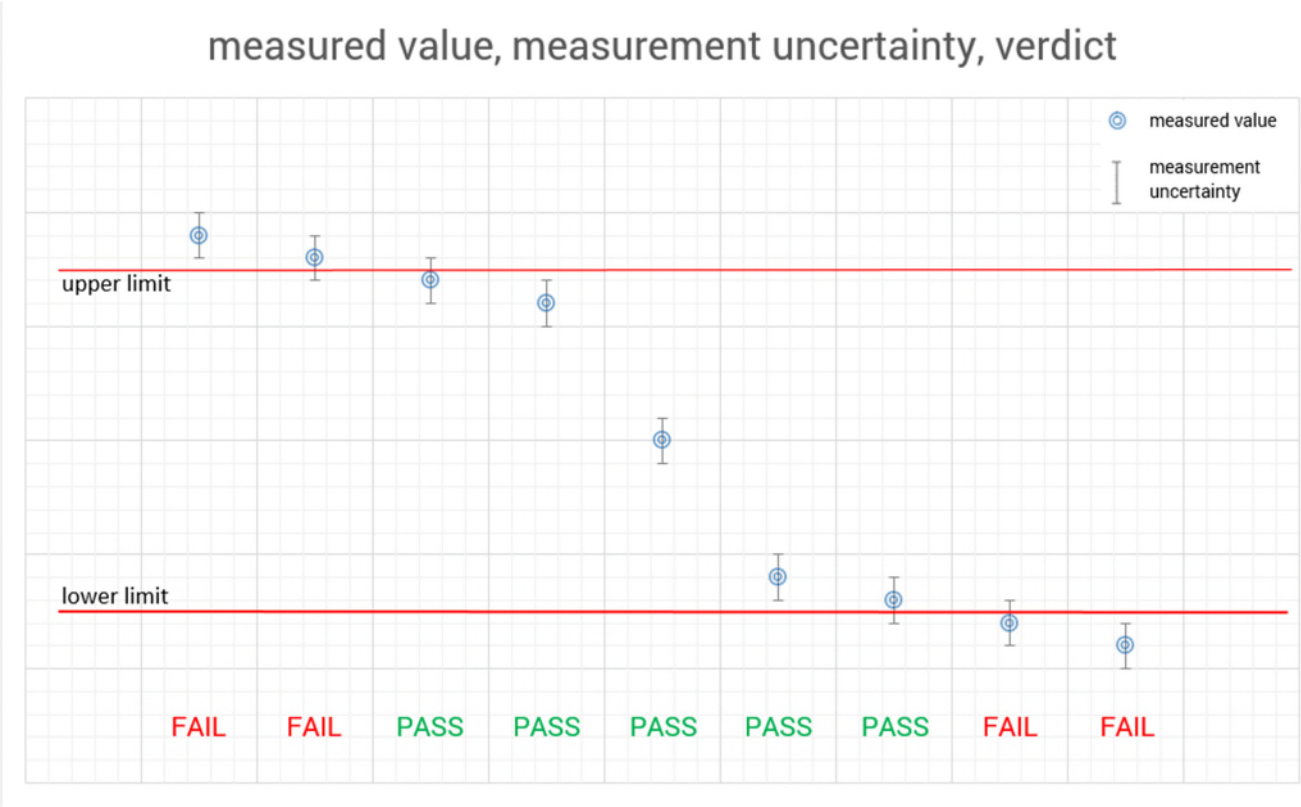
3 Test standard/s, references and accreditations

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

4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3.
The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong.



5 Test environment

Temperature	:	T_{nom} T_{max} T_{min}	+21 °C during room temperature tests -20 °C during high temperature tests +50 °C during low temperature tests
Relative humidity content	:		49 %
Barometric pressure	:		990 hPa to 1010 hPa
Power supply	:	V_{nom} V_{max} V_{min}	12.0 V DC 13.8 V DC (115% V_{NOM}) 10.2 V DC (85% V_{NOM})

6 Test item

6.1 General description

Kind of test item	:	Periphery Monitoring Radar (PMR)
Model name	:	PMRGEN2
S/N serial number EUT1	:	23-1-01456S19
S/N serial number EUT2	:	23-1-01456S28 (with microwave absorber)
Power setting		N/A
Hardware status	:	Rev1. G67498-101 (for sample 23-1-01456S19) Rev2. G67498-101 (for sample 23-1-01456S28)
Software status	:	0x0820
Firmware status	:	G72089
Accessories for testing (used together with main EUT)		1.) Notebook HP Elitebook, S/N: 23-1-01456S14 with software VECTOR Vers. 11.0.96 (SP4) 2.) Vector VN1611 LAN/CAN interface, S/N: 23-1-01456S12 3.) DC to CAN adapter cable
Frequency band	:	77-81GHz
Type of radio transmission Use of frequency spectrum	: :	FMCW
Type of modulation	:	Linear Sweep
Number of channels/ modes	:	1
Antenna	:	Integrated antenna
Power supply	:	8V to 16 V DC
Temperature range	:	-40°C to +85°C

6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

FCC Test setup and EUT photos are included in test report:

- 23-1-0145601T010_TR1-A101-R01 (External photographs of EUT)
- none (Internal photographs of EUT) – to be supplied by applicant
- 23-1-0145601T010_TR1-A103-R01 (Test set-up photographs)
- Note: The referenced photos show EUT delivered by the customer in this project, not necessarily the exact one used for the specific tests. EUT identification shown in the photos may differ.

Additional measurement reports:

- 23-1-0145601T010_TR1-A201-R01 (Climatic tests: frequency error)
- 23-1-0145601T010_TR1-A202-R01 (In-Band Measurements + Emission measurements)

Additional declarations (manufacturer's declarations, declarations of conformity, etc.):

- “Manual Switch cable certification.pdf”, Status 17July 2024
- “CertificationManual.docx”, Version 01.Aug.2024

7 Description of the test setup

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

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

Agenda: Kind of Calibration

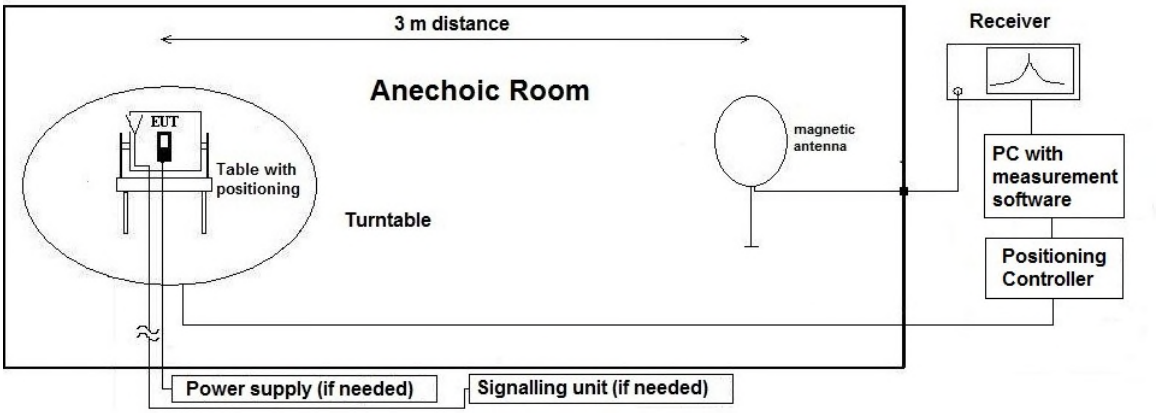
k/cal	calibration / calibrated	EK	limited calibration
Ne/cnn	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
Ev/chk	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlkl!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress
cpu	check prior usage		

7.1 Shielded semi-anechoic chamber

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 9.2.1. 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.

7.1.1 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 C63.10-2020

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

7.1.2 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

7.1.3 Measurement Location

Test site	SAC 3

Equipment table:

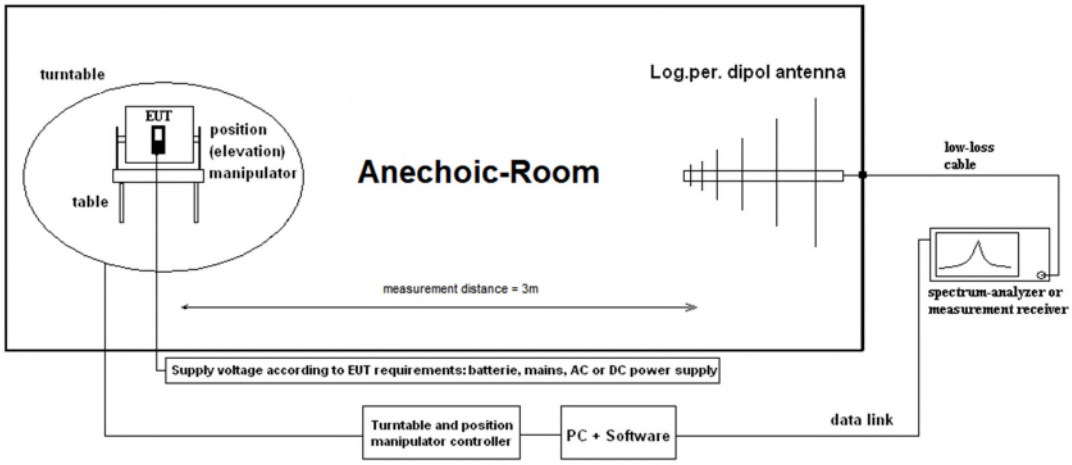
No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	20341	Digital Multimeter	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottertal	81650455	--	cal	13.05.2024	13.05.2026
3	20482	Filter Matrix	Filter Matrix SAC3	cetecom advanced 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

7.2 Radiated field strength emissions 30 MHz – 1000 MHz (Chamber: SAC 3)

7.2.1 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 16-1-4:2010 compliant Semi anechoic Chamber (SAC) recognized by the regulatory commission. The measurement distance was set to 3 meter for frequencies up to 1 GHz. A logarithmic periodic antenna is used for the frequency range 30 MHz to 1 GHz.

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 0.8 m height which is placed on the turntable. By rotating the turntable (range 0° to 360°, step 90°) and the EUT itself either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna and software.

Measurement antenna: horizontal and vertical, heights: 1,0 m and 1,82 m as worst-case determined by an exploratory emission measurements. 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. either on 10m OATS or 3m semi-anechoic room.
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). The measurement antenna height between 1 m and 4 m.

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

Formula:

$E_C = E_R + AF + C_L + D_F - G_A$ (1)

$M = L_T - E_C$ (2)

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.

7.2.2 Sample calculation

Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss	Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
32.7	22.25	--	3.1	--	25.35	58.05	--

Remark: This calculation is based on an example value at 800.4 MHz

7.2.3 Measurement Location

Test site	SAC 3

Equipment table:

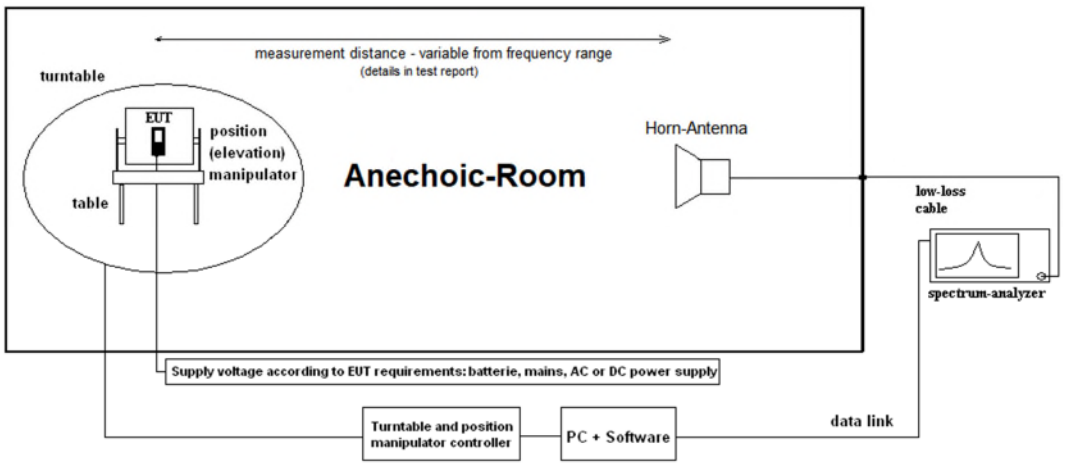
No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	Kind of Calibration	Last Calibration	Next Calibration
1	20341	Digital Multimeter	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottertal	81650455	cal	13.05.2024	13.05.2026
2	20442	Semi Anechoic Chamber	Semi Anechoic Chamber SAC3	ETS-Lindgren Gmbh / Taufkirchen	without	cnn	24.10.2024	24.10.2025
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	-/-	-/-

7.3 Shielded fully anechoic chamber (1 GHz – 40 GHz / Chamber: FAC 2)

7.3.1 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. The measurement distance was set to 3 meter for frequencies up to 12.4 GHz and 2 meter up to 18 GHz. Horn antennas are used for frequency range 1 GHz to 65 GHz.

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 either on 3-orthogonal axis (portable equipment) or 2-orthogonal axis (defined operational position of EUT) the emission spectrum and it's characteristics was recorded with an EMI-receiver, broadband antenna 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 over 3-orthogonal axis and the height for EUT with large dimensions or three axis scan for portable/small equipment.

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.

7.3.2 Sample calculation

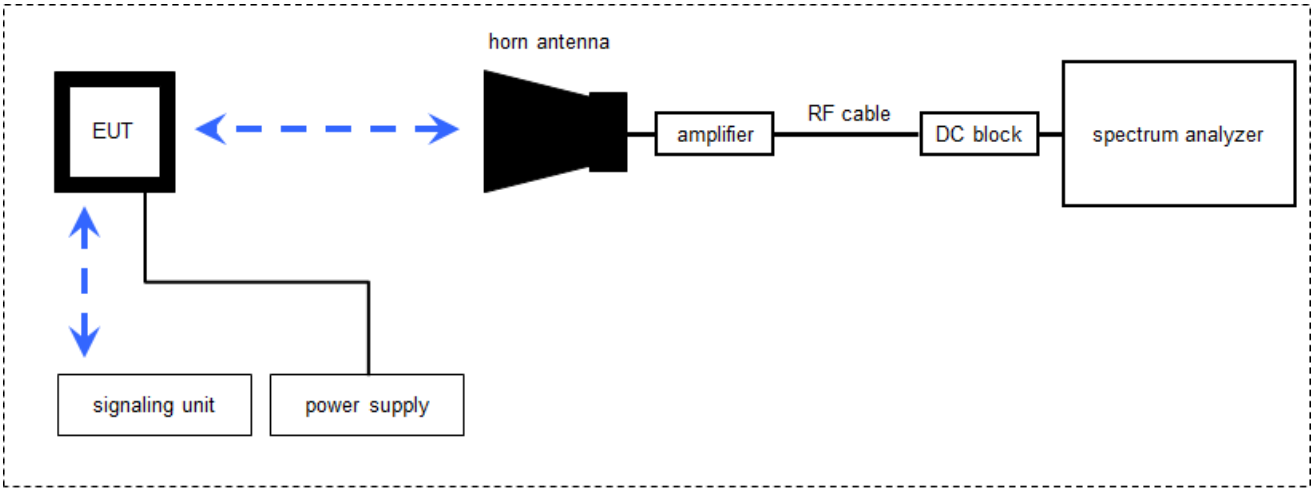
Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss + Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
29.37	41.20	--	24.28	16.92	46.3	CableLoss and PreAmp data in one data correction file

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

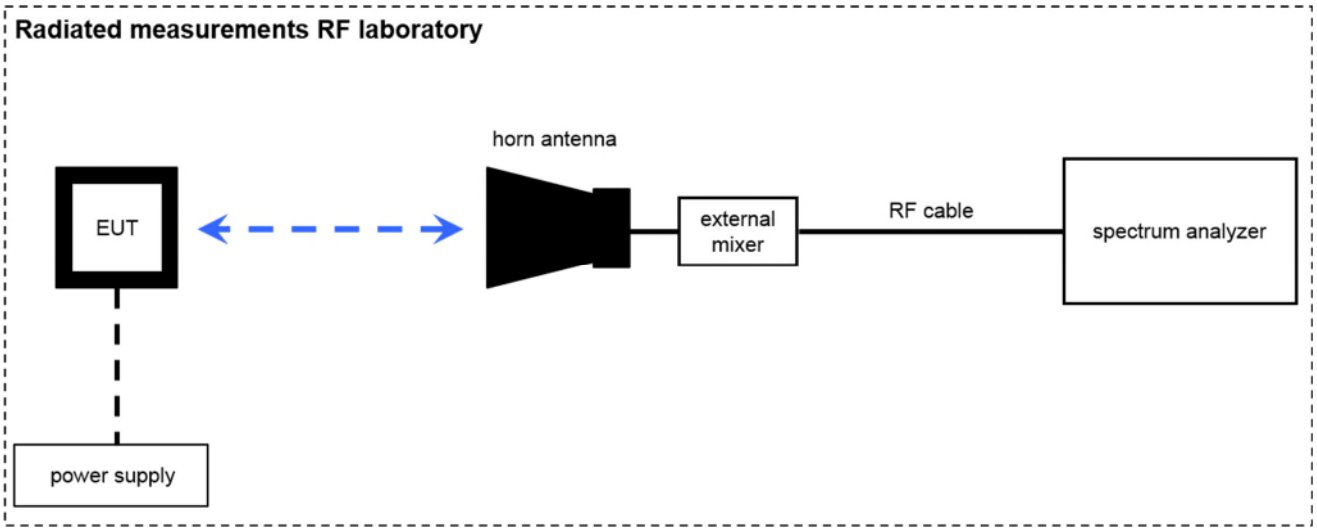
7.3.3 Equipment table

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

7.4 Radiated measurements > 40 GHz



7.5 Radiated measurements > 65/85 GHz



Measurement distance: horn antenna e.g. 75 cm

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss signal path & distance correction; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-60.1) [dB] + 36.74 [dB/m] = 16.64 [dBµV/m] (6.79 µV/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] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

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

Equipment table:

FCC/ISED

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

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

Setup
Note: Check Chapter 7.1

Pre-measurement*
Note: Check Chapter 7.1

Final measurement
Note: Check Chapter 7.1

*)Note: The sequence will be repeated two times with different EUT orientations.

8.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup
Note: Check Chapter 7.2

Pre-measurement
Note: Check Chapter 7.2

Final measurement
Note: Check Chapter 7.2

8.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup
Note: Check Chapter 7.3

Pre-measurement
Note: Check Chapter 7.3

Final measurement
Note: Check Chapter 7.3

8.4 Sequence of testing radiated spurious 1 GHz to 40 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the pre-measurement with marked maximum final results and the limit is stored.

8.5 Sequence of testing radiated spurious above 40 GHz, up to 65GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 0.5 m).
- The EUT is set into operation.

Premeasurement

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

Final measurement

- The final measurement is performed at the position and antenna orientation causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement and the limit is stored.

8.6 Sequence of testing radiated spurious above 65 GHz with external mixers

Setup

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

Premeasurement

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

Final measurement

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

9 Measurement uncertainty

Issue No.	Measurement type	References	Frequency range of measurement Start [MHz]	Frequency range of measurement Stop [MHz]	Calculated Uncertainty based on confidence level of 95.54%	Remarks
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

10 Far field consideration for measurements above 18 GHz

Far field distance calculation:

$D_{ff} = 2 \times D^2/\lambda$

with
D_{ff} Far field distance
D Antenna dimension
λ wavelength

Spurious emission measurements:

Spurious emission measurements: OOB and Spurious area					
Antenna frequency range in GHz f_{START} f_{STOP}	Highest measured frequency in GHz	D in m	λ in m	D_{ff} in m	D_{MEAS} in m
18 40	40	0,045	0,0075	0,54	1,0
U-BAND					
40 50	50	0,0384	0,006	0,49	1,5
V-BAND					
50 75	75	0,03072	0,004	0,47	1.0
75 90	90	0,03072	0,003333333	0,57	1.0
W-BAND					
75 90	90	0,020757	0,003333333	0,25	0,25
F-BAND					
90 140	140	0,016696	0,002142857	0,25	0,25
G-BAND					
140 220	220	0,01066	0,001363636	0,17	0,17
J-Band					
220 243	243	0,00705	0,001234568	0,08051805	0,25

In band measurement (OBW):

IN-BAND measurements. OBW, Power					
Antenna frequency range in GHz f_{START} f_{STOP}	**Highest measured frequency in GHz**	**D in m**	**λ in m**	**D_{ff} in m**	**D_{MEAS} in m**
W-BAND					
76 82	82	0,020757	0,003658537	0,24	1,00

11 Summary of measurement results

11.1 Summary

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

TC Identifier	Description	Verdict	Date	Remark
RF-Testing	47 CFR Part 95 Subpart M	see below	2025-02-19	-/-

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	-/-	-/-	☐	☐	☐	☒	Declaration of applicant
§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…"

11.2 Additional comments

Reference documents: None

Special test descriptions: None

Configuration descriptions: None

12 Measurement results

12.1 Radiated power

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:	50 MHz
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.

Measurement results:

EUT	Mode	Test condition	Radiated peak power (eirp)	Radiated Mean Power (eirp)
1	NM	T_{nom} / V_{nom}	16.52 dBm (TID007)	11.97dBm (TID010)

Verdict: **Complies**

12.2 Modulation characteristics

Description:

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

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).

Information from manufacturer on modulation characteristics:

Modulation Type	FMCW: sawtooth (non pulsed radar)
Modulation characteristics:	
Sweep bandwidth	3750MHz
Sweep rate	40ms
Sweep time	57.5us

12.3 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.*

RSS-251 chapter 7.2:
The radar device's occupied bandwidth (i.e. 99% emission bandwidth) shall be contained in the 76-81GHz frequency band.

Limits:

FCC	IC
FCC §95.3379 (b)	RSS-251 chapter 7.2:
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:	1 MHz
Video bandwidth:	3 MHz
Trace-Mode:	Max Hold

Results Voltage range at Tnom:

EUT	TEST CONDITIONS	f_L in GHz	f_H in GHz	Occupied Bandwidth (99%) in MHz	Plot
EUT 1	T_{nom} / V_{nom}	77126.6	80770.8	3644.2	A201 Page 2/3

Verdict: **Complies**

12.4 Band edge compliance

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

Measurement results:

- Results are part of chapter 12.5

Verdict: **Complies**

12.5 Unwanted emissions (radiated spurious)

Description:

Measurement of the radiated unwanted emissions.

Limits:

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 – 231	1000 pW/cm2 @ 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.

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

Measurement results (9kHz < f < 30MHz):

Frequency [MHz]	Detector	Bandwidth [kHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
18.41	PK	1/10	≤ 19.173	29.52	>10
	AV	1/10	--	--	--
15.30	PK	1/10	≤ 17.53	29.52	>10
	AV	1/10	--	--	--
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID010a and TID010b in annex A202/Chapter 1.4.1

Measurement results (30MHz < f < 1GHz):

Frequency [MHz]	Detector	Bandwidth [kHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
266.67	QP	120	≤ 37.75	46.0	8.25
	AV	--	–	--	--
266.68	QK	120	≤ 37.96	46.0	8.04
	AV	--	–	--	--
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID011a and TID011b in annex A202/Chapter 1.4.2

Measurement results (1GHz < f < 12.4GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
--	PK	1	≤ 57.31	74	16.69
	AV	1	≤ 47.28	54	6.72
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID012 in annex A202/Chapter 1.4.3

Measurement results (12.4GHz < f < 18GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
--	PK	1	≤ 52.07	74	21.93
	AV	1	≤ 41.09	54	12.90
--	PK	1	≤ 52.16	74	21.84
	AV	1	≤ 39.36	54	14.64
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID013a (Ant-H) and TID013b (Ant-V) in annex A202/Chapter 1.4.4

Measurement results (18GHz < f < 40GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
28.7994	PK	1	≤ 60.54	74	13.46
	AV	1	≤ 51.44	54	2.56
28.7944	PK	1	≤ 58.92	74	15.07
	AV	1	≤ 46.93	54	7.07
Please refer to the following plots for more information on the level of spurious emissions					

See diagrams:

- TID202a / TID201a_02 and TID201a_03 (Ant-H) in annex A202
- TID202b / TID202b_01/ TID202b_02/ TID202b_02_01 and TID202b_02_02 (Ant-V) in annex A202
- Measurements on Sample S28

Measurement results (40GHz < f < 50GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	≤ -40.08	-1.7 dBm	> 20
--	RMS	1	≤ -40.03	-1.7 dBm	> 20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID015a (Ant-H) and TID015b (Ant-V) in annex A202/Chapter 1.4.6

Measurement results (50GHz < f < 65GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
61.901	RMS	1	-44.15	-1.7	> 20
63.737	RMS	1	-32.10	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID016a(Ant-H) and TID016b (Ant-V) in annex A202/Chapter 1.4.7

Measurement results (65GHz < f < 75GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	-46.72	-1.7	>20
--	RMS	1	≤ -48.0	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID017a (Ant-H) and TID017b (Ant-V) in annex A202/Chapter 1.4.8

Measurement results (75GHz < f < 90GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	≤ -36.0	-1.7	>20
--	RMS	1	≤ -38.0	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagrams:

- TID018 (Ant-H) and TID019 (Ant-V) in annex A202/Chapter 1.4.9
- Carrier on diagram, does not count for final verdict.

Measurement results (90GHz < f < 110GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	≤ -28.75	-1.7	>20
--	RMS	1	≤ -40.30	-1.7	>20
--	RMS	1	≤ -38.79	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram:

- TID021a (Ant-H) and TID022 (Ant-V) in annex A202/Chapter 1.4.10
- Intermodulation signal which “moves” to lower frequencies with second LO (shifted by -2.65GHz)
- TID022_02 shows reduced intermodulation signal if a W-Band high-pass filter with fc frequency of 82GHz was used.

Measurement results (110GHz < f < 120GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -38.27	-1.7	>20
--	PK/RMS	1	≤ -42.63	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID023 (Ant-H) and TID024 (Ant-V) in annex A202/Chapter 1.4.11

Measurement results (120GHz < f < 140GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -16.62	-1.7	14.92
--	PK/RMS	1	≤ -33.73	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID025 (Ant-H) and TID026 (Ant-V) in annex A202/Chapter 1.4.12

Measurement results (140GHz < f < 150GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -36.06	-1.7	>20
--	PK/RMS	1	≤ -36.05	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID027 (Ant-H) and TID028 (Ant-V) in annex A202/Chapter 1.4.13

Measurement results (150GHz < f < 160GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -37.01	-1.7	>20
--	PK/RMS	1	≤ -37.04	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID029(Ant-H) and TID030 (Ant-V) in annex A202/Chapter 1.4.14

Measurement results (160GHz < f < 170GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -36.64	-1.7	>20
--	PK/RMS	1	≤ -36.66	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID031 (Ant-H) and TID032 (Ant-V) in annex A202/Chapter 1.4.15

Measurement results (170GHz < f < 200GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -25.98	-1.7	>20
--	PK/RMS	1	≤ -35.37	-1.7	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID033 (Ant-H) and TID034 (Ant-V) in annex A202/Chapter 1.4.16

Measurement results (200GHz < f < 220GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -37.97	0.5	>20
--	PK/RMS	1	≤ -37.98	0.5	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID035 (Ant-H) and TID036 (Ant-V) in annex A202/Chapter 1.4.17

Measurement results (220GHz < f < 243GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -22.10	0.5	>20
--	PK/RMS	1	≤ -22.11	0.5	>20
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID037 (Ant-H) and TID038 (Ant-V) in annex A202/Chapter 1.4.18

Verdict: Complies

12.6 Frequency stability

Description:

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

Limits:

FCC	IC
FCC §95.3379 (b)	RSS-251 chapter 7.2:
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:	1 MHz
Video bandwidth:	3 MHz
Trace-Mode:	Max Hold

Measurement results:

Results Voltage range at Tnom: 10.2V/12V/13.8V

EUT	TEST CONDITIONS	f_L in GHz	f_H in GHz	Occupied Bandwidth (99%) in MHz	Plot
EUT 1	T_{nom} / V_{nom}	77126.6	80770.8	3644.2	A201 Page 2/3
	T_{nom} / V_{min}	77126.9	80769.9	3642.9	A201 Page 4
	T_{nom} / V_{max}	77126.8	80770.3	3643.4	A201 Page 5

Results for Vnom and temperature range: -20° to +50°

EUT	TEST CONDITIONS	f_L in GHz	f_H in GHz	Occupied Bandwidth (99%) in MHz	Plot
EUT 1	T_{-20deg}/ V_{nom}	77127.9	80774.5	3646.6	A201 Page 6
	T_{-10deg} / V_{nom}	77127.2	80772.9	3645.6	A201 Page 7
	T_{0deg} / V_{nom}	77127.4	80771.5	3644.1	A201 Page 8
	T_{+10deg} / V_{nom}	77126.9	80769.8	3642.8	A201 Page 9
	T_{+20deg} / V_{nom}	**77126.6**	**80770.8**	**3644.2**	A201 Page 2/3
	T_{+30deg} / V_{nom}	77126.1	80769.6	3643.5	A201 Page 11
	T_{+40deg} / V_{nom}	77126.1	80769.3	3643.1	A201 Page 12
	T_{+50deg} / V_{nom}	77126.9	80769.5	3642.6	A201 Page 13

Note:

- The EUT is tested in the temperature range from -20°C to 50°C specified by §95.3379 (b) and RSS Gen 6.11.
- If the operating temperature range of the device specified by the manufacturer exceeds the test temperature range (-20°C to +50°C), the customer is responsible for ensuring the frequency stability and proper functioning of the device within the extended operating temperature range.

Verdict: Complies

13 Glossary

EUT	Equipment under test
DUT	Device under test
UUT	Unit under test
GUE	GNSS User Equipment
ETSI	European Telecommunications Standards Institute
EN	European Standard
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
IC	Industry Canada
PMN	Product marketing name
HMN	Host marketing name
HVIN	Hardware version identification number
FVIN	Firmware version identification number
EMC	Electromagnetic Compatibility
HW	Hardware
SW	Software
Inv. No.	Inventory number
S/N or SN	Serial number
C	Compliant
NC	Not compliant
NA	Not applicable
NP	Not performed
PP	Positive peak
QP	Quasi peak
AVG	Average
OC	Operating channel
OCW	Operating channel bandwidth
OBW	Occupied bandwidth
OOB	Out of band
DFS	Dynamic frequency selection
CAC	Channel availability check
OP	Occupancy period
NOP	Non occupancy period
DC	Duty cycle
PER	Packet error rate
CW	Clean wave
MC	Modulated carrier
WLAN	Wireless local area network
RLAN	Radio local area network
DSSS	Dynamic sequence spread spectrum
OFDM	Orthogonal frequency division multiplexing
FHSS	Frequency hopping spread spectrum
GNSS	Global Navigation Satellite System
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz

14 Document history

Version	Applied changes	Date of release
R01	Initial release	2025-02-06
R02	Added correct value and frequency range at page 40/41. R01 test report is not valid anymore and substituted herewith.	2025-02-19

################################## END OF TEST REPORT ##################################