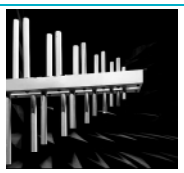
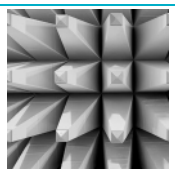

cetecom advanced

TEST REPORT

Test report no.: 23-1-0012601T007_TR1-R03

DAkkS Deutsche Akkreditierungsstelle D-PL-12047-01-00

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

Rosenberger Hochfrequenztechnik GmbH & Co. KG
Hauptstraße 1
83413 Fridolfing / GERMANY
Phone: --
Contact: Mr. Simon Huber
e-mail: simon.huber@rosenberger.de

Manufacturer

Rosenberger Hochfrequenztechnik GmbH & Co. KG
Hauptstraße 1
83413 Fridolfing / GERMANY

Test standard/s

FCC - Title 47 CFR Part 15, Subpart C, §15.255	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 210 Issue 11 Annex J	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

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

Test Item

Kind of test item:	RoProxCon Hybrid Transmitter
Model name:	MI1C804-901-01
FCC ID:	2BG4VRPCH-
IC:	33058-RPCH
Frequency:	57 – 64 GHz
Technology tested:	RADAR Device
Antenna:	Integrated antenna
Power supply:	24V DC
Temperature range:	-20°C to +50°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
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Christian Lorenz
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Radio Communications

Test performed:

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Al-Amin Hossain
Lab manager
Radio Communications

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2 General information

2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. 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.
The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of cetecom advanced GmbH.
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All rights and remedies regarding vendor's products and services for which cetecom advanced GmbH has prepared this test report shall be provided by the party offering such products or services and not by cetecom advanced GmbH.
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:	2024-07-26
Date of receipt of test item:	2024-07-10
Start of test:*	2024-07-24
End of test:*	2024-08-20
Person(s) present during the test:	none-

*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

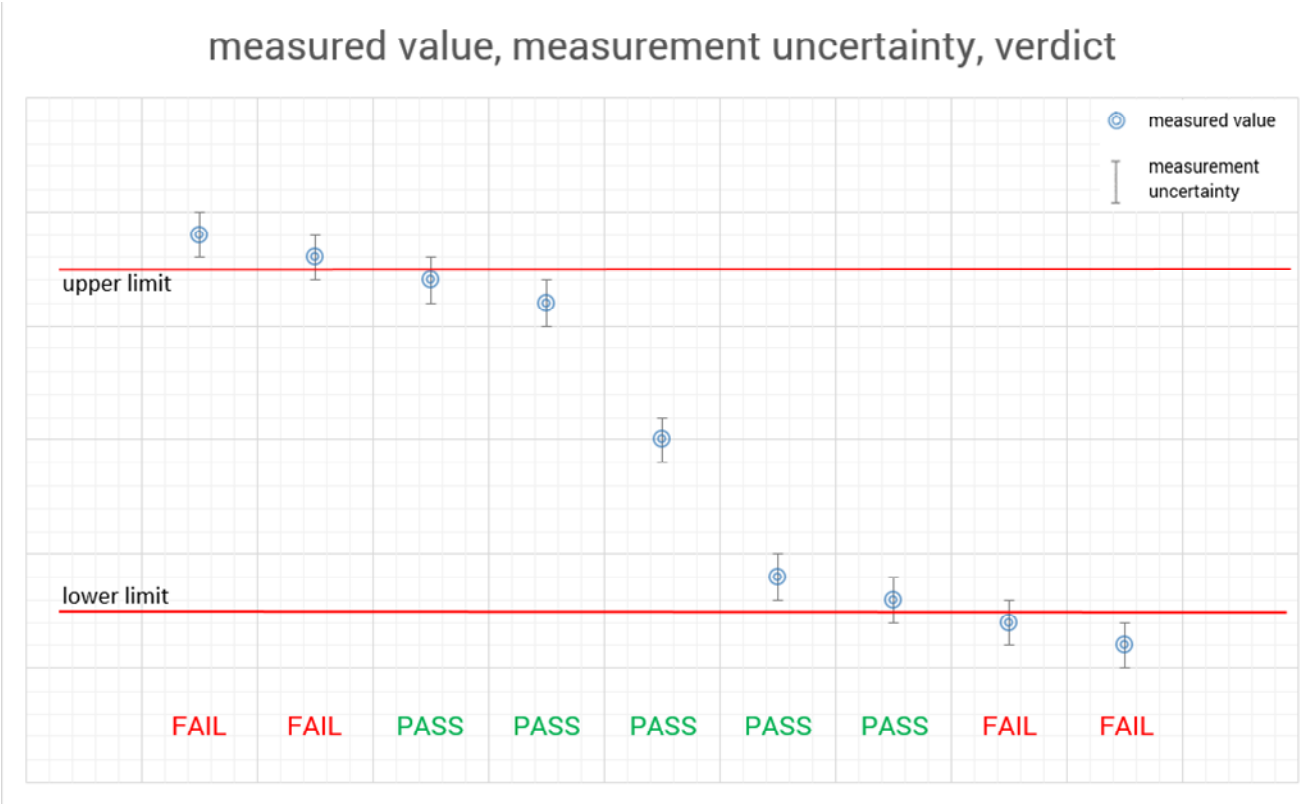
3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15		FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 210 Issue 11	25.06.2024	Spectrum Management and Telecommunications Radio Standards Specification - Licence-Exempt Radio Apparatus: Category I Equipment

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 C63.10-2020	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
57-71 GHz (60 GHz) frequency band	V01	364244 D01 Meas 15.255 Radars v01: RADAR DEVICES CERTIFYING UNDER THE PROVISIONS OF §15.255

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}	+22°C during room temperature tests +50°C during high temperature tests -20°C during low temperature tests
Relative humidity content :		49 %
Barometric pressure :		990 hPa to 1010 hPa
Power supply :	V_{nom} V_{max} V_{min}	24.0 V DC 27.6 V DC (115% of V_{nom}) 20.4 V DC (85% of V_{nom})

6 Test item

6.1 General description DUT

Kind of test item EUT :	RoProxCon Hybrid Transmitter
Model name EUT :	MI1C804-901-01
HMN :	--
PMN :	RoProxCon Hybrid
HVIN :	MIC804-901-01
FVIN :	--
S/N serial number :	23-1-00126S05_C01
Power setting	--
Hardware status :	200
Software status :	1.0
Firmware status :	1,0
Frequency band :	57 – 64 GHz
Type of radio transmission : Use of frequency spectrum :	modulated carrier
Type of modulation :	2-ASK
Number of channels :	1
Antenna :	Integrated antenna See separate document about antenna gain. 3.3dBi to 4.9dBi over frequency band, see chapter 6.2 for referenced applicants document
Power supply :	20.4 V to 27.6 V DC (according applicants information)
Temperature range :	-20°C to +50°C (according applicants information)
Other items:	Untested variant: Model/Type: MI1C804-901-02 with HVIN: MI1C804-901-02 (for further information see annex 301)

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.

Test setup and EUT photos are included in test report:

- 23-1-0012601T007_TR1-A101-R01 (External photographs of EUT)
- 23-1-0012601T007_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:

- 23-1-0012601T007_TR1-A201-R01 (Extreme voltage & climatic tests)
- 23-1-0012601T007_TR1-A202-R01 (nominal condition measurements)

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

- 23-1-0012601T007_TR1-A301-R02 (declaration of similarity)
- *Rosenberger Specification Certification.pdf* (5 Pages / Version 1.0- Draft)
- *RoProxcon_Hybrid_Zertifizierung_Spec.pdf* – general data
- *Antenna data*: *Specification_RoProxCon_Hybrid_Antenna_V0101.pdf*

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

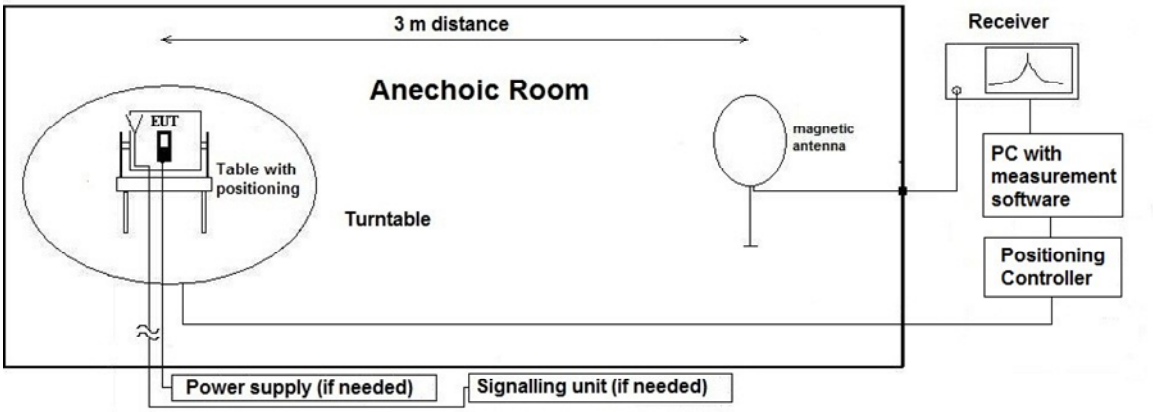
K (cal)	calibration / calibrated	EK	limited calibration
Ne (cnn)	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
Ev (chk)	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing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

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

7.1.4 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

7.1.5 Result

Note: For more information Check Chapter 12.5

7.1.6 Equipment table

Equipment table:

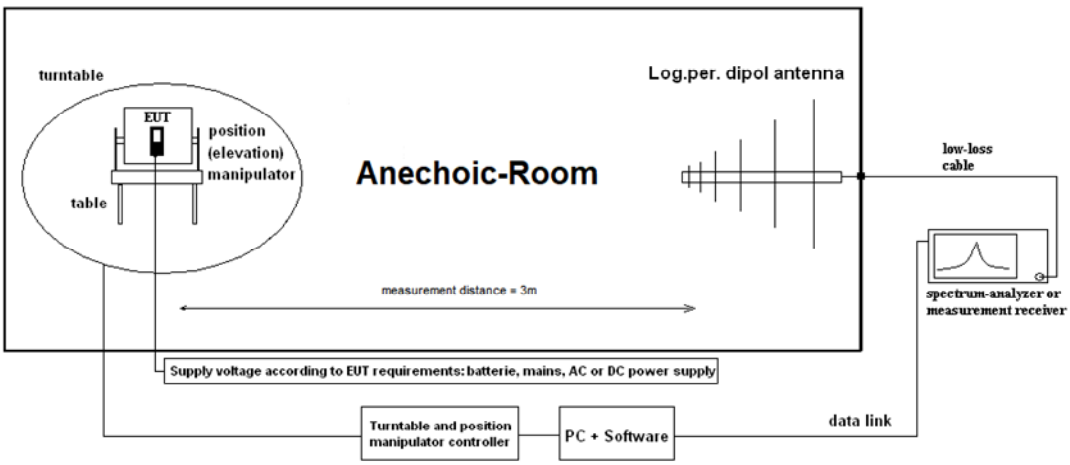
No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	20341	Digital Multimeter	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottertal	81650455	--	cal	13.05.2024	13.05.2026
2	20482	Filter Matrix	Filter Matrix SAC3	cetecom advanced GmbH / Essen	without	--	cnn	-/-	-/-
3	20574	Biconilog Hybrid Antenna	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH / Heideck	980026L	--	cal	15.06.2022	15.06.2025
4	20620	EMI Test Receiver	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100362	--	cal	15.05.2024	15.05.2025
5	20885	Power Supply EA3632A	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	--	cnn	-/-	-/-
6	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

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

7.2.4 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

7.2.5 Result

Note: For more information Check Chapter 12.5

7.2.6 Equipment table:

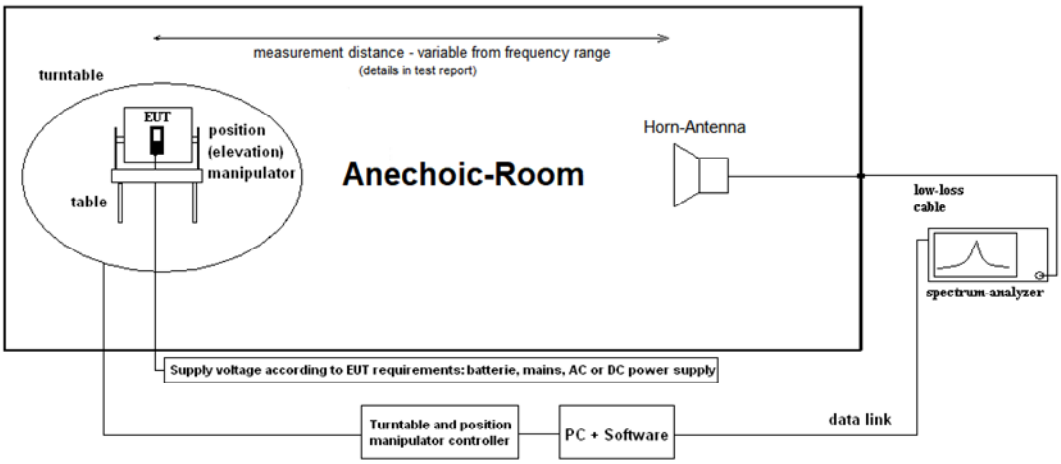
No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	Kind of Calibration	Last Calibration	Next Calibration
1	20341	Digital Multimeter	Digital Multimeter Fluke 112	Fluke Deutschland GmbH / Glottertal	81650455	cal	13.05.2024	13.05.2026
2	20482	Filter Matrix	Filter Matrix SAC3	cetecom advanced GmbH / Essen	without	cnn	-/-	-/-
3	20574	Biconilog Hybrid Antenna	Biconilog Hybrid Antenna BTA-L	Frankonia GmbH / Heideck	980026L	cal	15.06.2022	15.06.2025
4	20620	EMI Test Receiver	EMI Test Receiver ESU26	Rohde & Schwarz Messgerätebau GmbH / Memmingen	100362	cal	15.05.2024	15.05.2025
5	20885	Power Supply EA3632A	Power Supply EA3632A	Agilent Technologies Deutschland GmbH	75305850	cnn	-/-	-/-

7.3 Shielded fully anechoic chamber (1 GHz – 18 GHz)

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

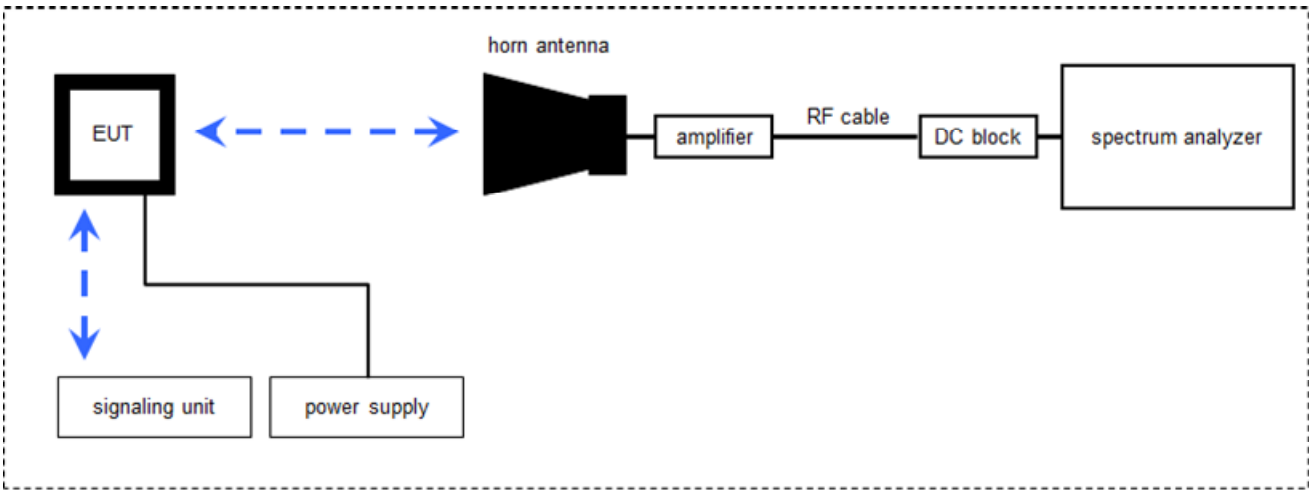
Raw-Value [dBuV/m]	Antenna factor	Distance Correction [dB]	Cable Loss + Preamplifier	Resulting correction value [dB]	Final result [dBuV/m]	Remarks
29.37	41.20	--	24.28	16.92	46.3	CableLoss and PreAmp data in one data correction file

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

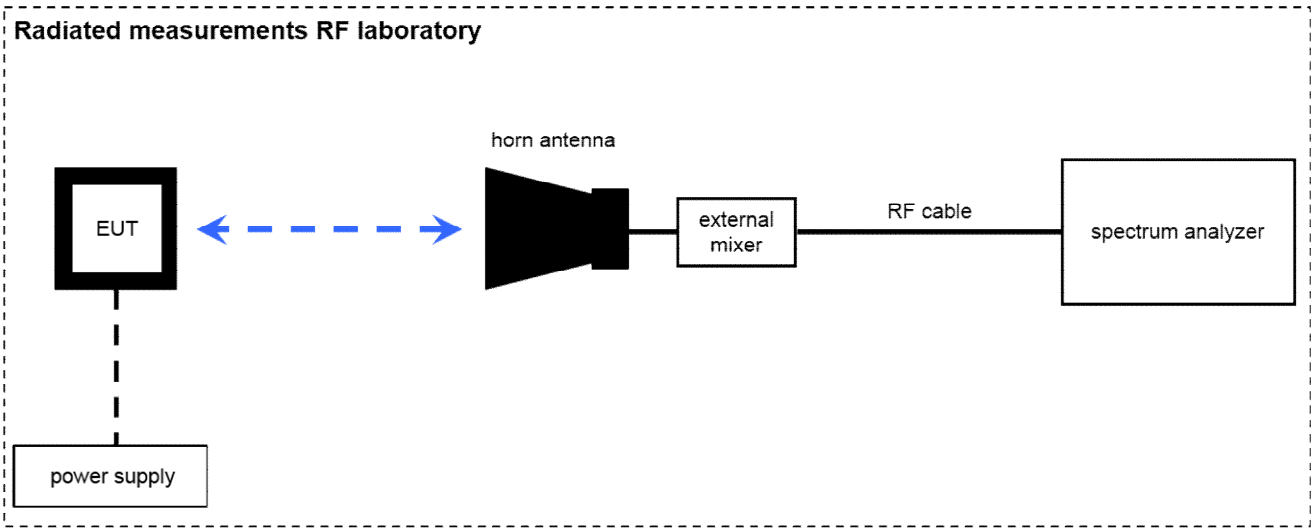
7.3.3 Equipment table

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	20972	Signal- and Spectrum Analyzer	Signal- and Spectrum Analyzer FSW50	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101929	cal	05.01.2024	05.01.2025
4	20811	Horn Antenna	Horn Antenna ASY-SGH-124-SMA	Antenna Systems Solutions S.L / Santander	29F14182337	chk	20.10.2021	07.10.2025
5	20816	SGH Antenna	SGH Antenna SGH-26-WR10	Anteral S.L.	1144	cnn	-/-	-/-
6	20817	Waveguide Rectangular Horn Antenna	Waveguide Rectangular Horn Antenna SAR-2309-22-S2	ERAVANT / Torrance	13254-01	chk	16.10.2024	20.10.2026
7	20836	Amplifier	1-18 GHz Amplifier	Wright Technologies, Inc., Inc. / Roseville	0001	chk	18.10.2024	18.10.2026
8	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
9	20913	Phase Amplitude Stable Cable Assembly	Phase Amplitude Stable Cable Assembly DC-40GHz	RF-Lambda Europe GmbH	AC19040001	cnn	-/-	-/-
10	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 > 18 GHz



7.5 Radiated measurements > 50(67) 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.

7.5.1 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	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

Premeasurement*
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

Premeasurement
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

Premeasurement
Note: Check Chapter 7.3

Final measurement
Note: Check Chapter 7.3

8.4 Sequence of testing radiated spurious above 18 GHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet.
- The measurement distance is as appropriate (e.g. 1.5m/1 m).
- The EUT is set into operation.

Pre-measurement

- 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 63.10).
- 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.

8.5 Sequence of testing radiated spurious above 50/67 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 measurement conditions (e.g. 0.25 m). See details on diagrams.
- The EUT is set into operation.

Pre-measurement

- 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 63.10).
- 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 pre-measurement and the limit is stored.

9 Measurement uncertainty (Location Essen)

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

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

10.1 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 – 67	62	0,03072	0,004477612	0,42	0,5
67 – 75	75	0,03072	0,004	0,47	1.0
W-BAND					
75 – 85	90	0,020757	0,003529412	0,24	1.0
85 – 95	90	0,020757	0,003157895	0,27	1.0
95 – 105	90	0,020757	0,002857143	0,30	1.0
105 – 110	90	0,020757	0,002727273	0,32	1.0
F-BAND					
110 – 130	110	0,016696	0,002307692	0,24	0,25
130 – 140	120	0,016696	0,002142857	0,25	0,25
G-BAND					
140 – 170	150	0,01066	0,001764706	0,13	0,25

10.2 In band measurement (OBW/PSD/Power):

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
V-BAND					
57 64	79,5	0,03072	0,0046875	0,40	0,5

11 Summary of measurement results

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

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC 47 CFR Part 15 (dated 2023-08-23) ISED RSS-210 J (Issue 11), RSS-Gen (Issue 5)	see below	2025-07-23	-/-

Test specification clause	Test case	Temperature conditions	Power supply	Pass	Fail	NA	NP	Remark
47 CFR 15.215(b) & (c), 47 CFR 15.255(f) RSS-210 J.2 & J.3, RSS-210 J.6	**Occupied bandwidth & Frequency stability**	Nominal Extreme	Nominal Extreme	☒	☐	☐	☐	complies
47 CFR 15.255(b)(3) & (c) RSS-210 J.3	**Radiated power (EIRP)**	Nominal	Nominal	☒	☐	☐	☐	complies
47 CFR 15.255(c)(2) 47 CFR 15.255(e) RSS-210 J.3.2 & J.3.3	**Peak transmitter conducted output power**	Nominal	Nominal	☒	☐	☐	☐	complies
47 CFR 15.255(b)(3), 47 CFR 15.255(c) RSS-210 J.3.2	**Time domain requirements**	Nominal	Nominal	☐	☐	☒	☐	--
47 CFR 15.255(d) RSS-210 J.4	**Spurious emissions radiated**	Nominal	Nominal	☒	☐	☐	☐	complies
47 CFR 15.207 RSS-Gen 8.8	**Conducted emissions < 30 MHz (AC power line)**	Nominal	Nominal	☒	☐	☐	☐	complies

Note: NA = Not applicable; NP = Not performed

12 Additional comments

Reference documents: *Antenna data*: *Specification_RoProxCon_Hybrid_Antenna_V0101.pdf*

Special test descriptions: None

Configuration descriptions: None

13 Basic information of the DUT & selection of applicable rule parts

Basic information of the DUT:

General: see chapter "X Test item"

Operation condition:

☐ Operation on aircraft (47 CFR 15.255(b) / RSS-210 J.2)

☐ Unmanned aircraft (47 CFR 15.255(b)(3)) / Unmanned air vehicles (UAVs) (RSS-210 J.2)

☐ Not unmanned aircraft

☒ No operation on aircraft

Note: Operation under the provisions of this section is not permitted for equipment used on satellites (47 CFR 15.255(a)).

Note: The devices certified under this annex J are not permitted to be used on satellites (RSS-210 J.2).

Kind of DUT:

☒ Devices other than field disturbance sensors and other than fixed point-to-point transmitters located outdoors

☐ Fixed point-to-point transmitters located outdoors

☐ Field disturbance sensors/radars

☐ Pulsed field disturbance sensors/radars

☐ Other than pulsed field disturbance sensors/radars

Frequency band:

☐ Operating within band 59.3 – 71.0 GHz (47 CFR 15.255(b)(2)(iii)) (RSS-210 J.2(b)(iv))

☐ Operating within band 60 – 64 GHz (47 CFR 15.255(b)(3)) (RSS-210 J.2(d)(i))

☒ Operating within band 57 – 71 GHz (47 CFR 15.255(c)(1) / (c)(2)) (RSS-210 J.3.2 / J.3.3)

☐ Operating within band 57.0 – 59.4 GHz (47 CFR 15.255(c)(2)(i)) (RSS-210 J.3.2(b)(i))

☐ Operating within band 57.0 – 61.56 GHz (47 CFR 15.255(c)(2)(ii)) (RSS-210 J.3.2(b)(ii))

☐ Operating within band 57 – 64 GHz (47 CFR 15.255(c)(2)(iii) / (c)(3)) (RSS-210 J.3.2(b)(iii) / J.3.2(c))

☐ Operating within band 61.0 – 61.5 GHz (47 CFR 15.255(c)(2)(v)) (RSS-210 J.3.2(a))

Note: See results in chapter 14.1

Selection of applicable rule parts:

Applicable rule parts and limits depend on the basic information of the DUT (see chapter 13).
The comparison of the basic information of the DUT with the rule parts lead to the following conclusions:

Rule Part	Applicable?	
	Yes	No
47 CFR 15.255:		
(a) **General:** Operation under the provisions of this section is not permitted for equipment used on **satellites**.	☒	
(b) **Operation on aircraft:** Operation on aircraft is permitted under the following conditions:	☐	☐
(1) When the aircraft is on the ground.	☐	☐
(2) While airborne, only in closed exclusive on-board communication networks within the aircraft, with the following exceptions:	☐	☐
(i) Equipment shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure.	☐	☐
(ii) Except as permitted in paragraph (b)(3) of this section, equipment shall not be used on aircraft where there is little attenuation of RF signals by the body/fuselage of the aircraft.	☐	☐
(iii) **Field disturbance sensor/radar** devices may only operate in the frequency band **59.3–71.0 GHz** while installed in passengers' personal portable electronic equipment (e.g., smartphones, tablets) and shall comply with paragraph (b)(2)(i) of this section, and relevant requirements of paragraphs (c)(2) through (c)(4) of this section.	☐	☐
(3) **Field disturbance sensors/radar** devices deployed on **unmanned aircraft** may operate within the frequency band **60–64 GHz**, provided that the transmitter not exceed 20 dBm peak EIRP. The sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds. Operation shall be limited to a maximum of 121.92 meters (400 feet) above ground level.	☐	☐
(c) **Radiated power limits:** Within the **57–71 GHz band**, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):	☒	
(1) **Devices other than field disturbance sensors** shall comply with one of the following power limits, as measured during the transmit interval:	☐	☐
(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or	☒	☐
(ii) For **fixed point-to-point transmitters located outdoors**, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.	☐	☐
(A) The provisions in this paragraph (c) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (c)(1)(i) of this section.	☐	☐
(B) The provisions of § 15.204(c)(2) and (4) that permit the use of different antennas of the same type and of equal or less directional gain do not apply to intentional radiator systems operating under this provision. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the system will be marketed and operated. Compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level. The responsible party, as defined in § 2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.	☐	☐

(2) **Field disturbance sensors/radars** shall not exceed −10 dBm peak conducted output power and 10 dBm peak EIRP except that field disturbance sensors/radars that limit their operation to all or part of the specified frequency band may operate without being subject to a transmitter conducted output power limit if they operate in compliance with paragraph (b)(3) of this section or with one or more of the provisions below:	☐	☒
(i) **57.0–59.4 GHz**: the peak EIRP level shall not exceed 20 dBm for **indoor operation** or 30 dBm for **outdoor operation**;	☐	☐
(ii) **57.0–61.56 GHz**: the peak EIRP shall not exceed 3 dBm except that the peak EIRP shall not exceed 20 dBm if the sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds;	☐	☐
(iii) **57.0–64.0 GHz:**	☐	☐
(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;	☐	☐
(B) The peak EIRP shall not exceed 20 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds when operated outdoors:	☐	☐
(1) As part of a **temporary or permanently fixed application**; or	☐	☐
(2) When being used in **vehicular applications to perform specific tasks of moving something or someone, except for in-cabin applications**;	☐	☐
(iv) A **field disturbance sensor** may operate in any of the modes in the above sub-sections so long as the device operates in only one mode at any time and does so for at least 33 milliseconds before switching to another mode.	☐	☐
(v) **61.0–61.5 GHz:** For **field disturbance sensors/radars** that occupy 500 MHz bandwidth or less that are contained wholly **within the frequency band 61.0–61.5 GHz**, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission **outside of the 61.0–61.5 GHz band**, measured during the transmit interval, but still within the 57–71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.	☐	☐
(3) For **pulsed field disturbance sensors/radars** operating in the 57–64 GHz band that have a maximum pulse duration of 6 ns, the average EIRP shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3 µs time window. In addition, the average integrated EIRP within the frequency band **61.5–64.0 GHz** shall not exceed 5 dBm in any 0.3 µs time window. Peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the equipment under test. The radar bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna	☐	☒
(4) The provisions in § 15.35(b) and (c) that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under paragraphs (c)(2) and (3) of this section.	☐	☐
(d) Limits on spurious emissions:	☒	
(1) The power density of any emissions outside the 57–71 GHz band shall consist solely of spurious emissions.	☒	
(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.	☒	
(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.	☒	
(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.	☒	
(e) Limits on transmitter conducted output power.	☒	☐

(1) Except as specified in paragraph (e)(2) of this section, the peak transmitter conducted output power of **devices other than field disturbance sensors/radars** shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.	☐	☒
(2) **Devices other than field disturbance sensors/radars** with an emission bandwidth of less than 100 megahertz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 megahertz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kilohertz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).	☒	☐
(f) Frequency stability: Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.	☒	
(g) Radio frequency radiation exposure: Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.	☒	
(h) Group installation: Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.	☐	
(i) Compliance measurement: Measurement procedures that have been found to be acceptable to the Commission in accordance with § 2.947 of this chapter may be used to demonstrate compliance.	☒	
(1) For purposes of demonstrating compliance with this section, corrections to the transmitter conducted output power may be made due to the antenna and circuit loss.	☒	
(2) Compliance measurements of **frequency-agile field disturbance sensors/radars** shall be performed with any related frequency sweep, step, or hop function activated.	☐	☒
47 CFR 15.215		
(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the **20 dB bandwidth of the emission**, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.	☒	

47 CFR 15.209	☒	
47 CFR 15.207		
(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the table of this paragraph (see chapter 14.6), as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.	☒	
(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which **only employ battery power** for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtainig their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.	☐	☒

Rule Part KANADA only	Applicable? Yes	Applicable? No
RSS-210 J: NOTWENDIG nur für KANADA	☒	
J.2 Restrictions: The devices certified under this annex are not permitted to be used on **satellites**.	☒	
Devices used on **aircraft** are permitted under the following conditions:	☐	☐
(a) Except as allowed in J.2(b), devices are only to be used when the aircraft is on the ground.	☐	☐
(b) Devices used **in-flight** are subject to the following restrictions:	☐	☐
(i) they shall be used within closed, exclusive on-board, communication networks within the aircraft	☐	☐
(ii) they shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure	☐	☐
(iii) they shall not be used on aircraft equipped with a body/fuselage that provides little or no RF attenuation except when installed on unmanned air vehicles (UAVs) and complying with J.2(d)	☐	☐
(iv) devices operating in the **59.3-71.0 GHz** band shall not be used except if they meet all of the following conditions: (1) they are FDS (2) they are installed within personal portable electronic devices (3) they comply with the relevant requirements in J.3.2(a), J.3.2(b) and J.3.2(c)	☐	☐
(c) Devices' user manuals shall include text indicating restrictions shown in J.2(a) and J.2(b).	☐	☐
(d) FDS devices deployed on **UAVs** shall comply with all of the following conditions: (i) they operate in the **60-64 GHz band** (ii) the UAVs limit their altitude operation to the regulations established by Transport Canada (e.g. altitudes below 122 metres above ground) (iii) they comply with J.3.2(d)	☐	☐
J.3 Emission limits within the band 57-71 GHz This section specifies the emission limits inside the allocated band.	☒	
J.3.1 General Within the band 57-71 GHz, the power of any emissions shall be measured during the transmission interval and shall comply with the limits in this section. For the purpose of this annex, the terms "average e.i.r.p." and "peak e.i.r.p." refer to e.i.r.p. with transmitter output power measured in terms of average value or peak value, respectively.	☒	
J.3.2 Emission limits for FDS **FDS** devices operating in the 57-71 GHz band shall not exceed –10 dBm peak transmitter conducted output power and 10 dBm peak e.i.r.p. The following exceptions apply:	☐	☐
(a) FDS devices that occupy a **bandwidth of 500 MHz or less** and where this bandwidth is contained wholly within the frequency band **61.0-61.5 GHz** shall comply with the following limits: the equipment shall not exceed 40 dBm average e.i.r.p. and 43 dBm peak e.i.r.p. in the 61.0-61.5 GHz band. In addition, the average and peak e.i.r.p. of any emission outside of the band 61.0-61.5 GHz, but still within the band 57-71 GHz, shall not exceed 10 dBm average e.i.r.p. and 13 dBm peak e.i.r.p.	☐	☐
(b) FDS devices may operate in any mode as indicated in J.3.2(b)(i) and J.3.2(b)(ii), as long as they operate in only one of these modes for at least 33 ms before switching to another mode.	☐	☐
(i) FDS devices operating in the **57.0-59.4 GHz** band shall comply with one of the following limits, depending on the operating condition of the device:	☐	☐
(1) the peak e.i.r.p. shall not exceed 20 dBm for **indoor usage** (devices operating and situated in or designed to be used in, or carried within the interior of a building)	☐	☐

(2) the peak e.i.r.p. for **outdoor usage** (devices operating, situated in, designed to be used in, or carried in open air) shall not exceed 30 dBm	☐	☐
(ii) FDS devices operating in the **57.0-61.56 GHz** band shall have the peak e.i.r.p. not exceeding 3 dBm or, if the sum of continuous transmitter off-times of at least 2 ms equals at least 16.5 ms within any contiguous interval of 33 ms, the peak e.i.r.p. shall not exceed 20 dBm.	☐	☐
(iii) FDS operating in the **57.0-64.0 GHz** band shall comply with one of the following limits, depending on the operating condition of the device:	☐	☐
(1) the peak e.i.r.p. shall not exceed **14 dBm** and the sum of continuous transmitter off-times of at least 2 ms shall equal at least 25.5 ms within any contiguous interval of 33 ms	☐	☐
(2) for devices employed for **outdoor operation** (temporary or permanently fixed application) or vehicular uses (excluding in-cabin applications and operations), the peak e.i.r.p. shall not exceed **20 dBm** and the sum of continuous transmitter off-times of at least 2 ms shall equal at least 16.5 ms within any contiguous interval of 33 ms	☐	☐
(c) For **pulsed FDS** devices operating in the 57-64 GHz band that have a maximum pulse duration of 6 ns:	☐	☐
(i) the average e.i.r.p. shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3 µs time window	☐	☐
(ii) the average integrated e.i.r.p. within the 61.5-64.0 GHz band shall not exceed 5 dBm in any 0.3 µs time window	☐	☐
(iii) peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the device	☐	☐
(iv) the bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna	☐	☐
(v) For FDS devices **installed on UAVs**, their peak e.i.r.p. shall not exceed 20 dBm and the sum of continuous transmitter off-times of at least 2 ms shall equal at least 16.5 ms within any contiguous interval of 33 ms. See also J.2(d).	☐	☐
J.3.3 Emission limits for devices other than FDS Following are the conditions for devices other than FDS:	☒	☐
(a) Except when J.3.3(b) applies, the average e.i.r.p. of any emission shall not exceed 40 dBm and the peak e.i.r.p. of any emission shall not exceed 43 dBm.	☒	☐
(b) For **fixed point-to-point equipment located outdoors**:	☐	☐
(i) The average e.i.r.p. of any emission shall not exceed 82 dBm minus 2 dB for every dB the antenna gain is less than 51 dBi. The peak e.i.r.p. of any emission shall not exceed 85 dBm minus 2 dB for every dB the antenna gain is less than 51 dBi.	☐	☐
(ii) The provisions for reducing the transmit power based on the antenna gain, as per J.3.3(b)(i), shall not require that the power levels be reduced below the limits specified in J.3.3(a).	☐	☐
(iii) Compliance testing shall be performed using the highest gain and the lowest gain antennas with which the equipment is certified. Further, this equipment shall not be marketed and operated with antennas other than those listed in the certification application with which the equipment is certified.	☐	☐
(c) Except as specified in J.3.3(d), the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the e.i.r.p. limits specified in J.3.3(a) and J.3.3(b).	☐	☐
(d) For devices with an **emission bandwidth less than 100 MHz**, the peak transmitter conducted output power (PTCOP) shall be less than or equal to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purpose of J.3.3(d), emission bandwidth is the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density is 6 dB below the maximum radiated power spectral density in the band, as measured	☒	☐

with a 100 kHz resolution bandwidth. The centre frequency shall be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).		
J.4 Spurious emissions Any emissions outside the band 57-71 GHz shall consist solely of spurious emissions and shall not exceed: (a) the fundamental emission levels (b) the general field strength limits specified in RSS-Gen, General Requirements for Compliance of Radio Apparatus, for emissions below 40 GHz (c) the general field strength limits specified in RSS-Gen, General Requirements for Compliance of Radio Apparatus, for emissions below 40 GHz	☒	
J.5 Measurement requirements Following are the measurement requirements for emissions:	☒	
(a) Emissions shall be measured up to 200 GHz.	☒	
(b) **Conducted measurement** for emissions above 40 GHz are permitted provided the antenna characteristics can be determined accurately.	☐	☐
(c) Compliance measurements of **frequency-agile FDS** shall be performed with any related frequency sweep, step, or hop function activated.	☐	☐
(d) Corrections to the **transmitter conducted output power** may be considered due to the antenna and cabling loss.	☐	☐
(e) The provisions of RSS-Gen requiring the application of a peak limit that is 20 dB above the average limit shall not apply to devices subject to **J.3.2(a) and J.3.2(b).**	☐	☐
(a) The provisions of RSS-Gen requiring averaging over a time interval of 0.1 seconds shall not apply to devices subject to **J.3.2(a), J.3.2(b) and J.3.2(c).**	☐	☐
J.6 Transmitter frequency stability Fundamental emissions shall be contained within the frequency bands specified in this annex during all conditions of operation when tested at the temperature and voltage variations specified for the frequency stability measurement in RSS-Gen.	☒	
J.7 Group installations Any transmitter that is certified under this annex may be mounted in a group installation for simultaneous operation with one or more certified transmitters, without any additional equipment authorization. However, no transmitter operating under the provisions of this annex shall be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.	☐	
RSS-Gen	☒	
6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB bandwidth The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs. […]	☒	
8.8 AC power-line conducted emissions limits Unless stated otherwise in the applicable RSS, **for radio apparatus that are designed to be connected to the public utility AC power network**, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 µH / 50 Ω line impedance stabilization network. […]	☒	
8.9 Transmitter emission limits	☒	

14 Measurement results

14.1 Occupied bandwidth & emission bandwidth & frequency stability

Description:

Measurement of the bandwidth and the frequency stability of the wanted signal (fundamental emission) under temperature and supply voltage variations.

Limits and provisions:

Selection of applicable rule parts: see 13

Bandwidth & Applicable limits of designated frequency band			
Applicable	**Rule part**	**Method of bandwidth measurement**	**Limit of designated frequency band**
☐	15.255(b)(2)(iii) RSS-210 J.3.2(b)(iv)	20 dB bandwidth or 99% bandwidth 99% bandwidth	59.3 - 71.0 GHz
☐	15.255(b)(3) RSS-210 J.2(d)(i)	20 dB bandwidth or 99% bandwidth 99% bandwidth	60 - 64 GHz
☒	15.255(c)(1)(i) RSS-210 J.3.3(a)	20 dB bandwidth or 99% bandwidth 99% bandwidth	57 - 71 GHz
☐	15.255(c)(1)(ii) RSS-210 J.3.3(b)	20 dB bandwidth or 99% bandwidth 99% bandwidth	57 - 71 GHz
☐	15.255(c)(2) RSS-210 J.3.2	20 dB bandwidth or 99% bandwidth 99% bandwidth	57 - 71 GHz
☐	15.255(c)(2)(i) RSS-210 J.3.2(b)(i)	20 dB bandwidth or 99% bandwidth 99% bandwidth	57.0 - 59.4 GHz
☐	15.255(c)(2)(ii) RSS-210 J.3.2(b)(ii)	20 dB bandwidth or 99% bandwidth 99% bandwidth	57.0 - 61.56 GHz
☐	15.255(c)(2)(iii) RSS-210 J.3.2(b)(iii)	20 dB bandwidth or 99% bandwidth 99% bandwidth	57.0 - 64.0 GHz
☐	15.255(c)(2)(v) RSS-210 J.3.2(a)	20 dB bandwidth or 99% bandwidth 99% bandwidth	61.0 - 61.5 GHz
☐	15.255(c)(3) RSS-210 J.3.2(c)	10 dB bandwidth	57 - 64 GHz
☒	15.255(e)(2) RSS-210 J.3.3(d)	6 dB emission bandwidth (EBW_{6dB})	None (required for calculation in chapter 14.3)

Note:

- Definition of 6dB emission bandwidth (15.255(e)(2)): the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kilohertz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).
- Definition of 6dB emission bandwidth (RSS-210 J.3.3(d)): the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density is 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency shall be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

Measurement:

Measurement parameter	
Detector:	Pos-Peak
Resolution bandwidth:	50 MHz
Video bandwidth:	80 MHz
Trace-Mode:	Max Hold

Measurement procedures:

- Bandwidth: ANSI C63.10-2020 6.9 / 9.3 / 9.4
- Frequency stability: ANSI C63.10-2020 6.8 / 9.5

Measurement results:

6 dB emission bandwidth at normal conditions:

EUT	Mode	Test condition	f_L [GHz]	f_H [GHz]	Bandwidth [MHz]
1	1	T_{nom} / V_{nom}	60.641519	61.922519	1.281

Diagram TID034_01, Annex 202

20 dB bandwidth at normal conditions:

EUT	Mode	Test condition	f_L [MHz]	f_H [MHz]	Bandwidth [MHz]
1	1	T_{nom} / V_{nom}	58743.0	62523.0	3780

Diagrams in annex 201

99% bandwidth at normal conditions:

EUT	Mode	Test condition	f_L [MHz]	f_H [MHz]	Bandwidth [MHz]
1	1	T_{nom} / V_{nom}	58103.504	63705.9567	5602.453

Diagrams in annex 201

Frequency stability (15.255(f)):

Mode for frequency stability tests: 1 (Mode with the widest bandwidth, ANSI C63.10-2020 5.6.2.2)

Bandwidth measurement for frequency stability tests: **20 dB bandwidth**

Test condition	Frequency f_L [MHz]	Frequency f_H [MHz]	Bandwidth [MHz]
T_{min} : -20 °C / V_{nom}	58743.0	61501.0	2758.0
-10 °C / V_{nom}	58743.0	61501.0	2758.0
0 °C / V_{nom}	58743.0	61508.0	2765.0
10 °C / V_{nom}	58743.0	62523.0	3780.0
20 °C / V_{nom}	58743.0	62523.0	3780.0
20 °C / V_{min}	58743.0	62523.0	3780.0
20 °C / V_{max}	58743.0	62523.0	3780.0
30 °C / V_{nom}	58743.0	62523.0	3780.0
40 °C / V_{nom}	58743.0	62523.0	3780.0
T_{max} : 50 °C / V_{nom}	58743.0	61522.0	2779.0

Note:
- Detailed measurement results: see measurement report 23-1-0012601T007_TR1-A201-R01
- 85% and 115% percent from 24V nominal voltage performed

Frequency stability (RSS-210 J.6):

Mode for frequency stability tests: 1 (Mode with the widest bandwidth, ANSI C63.10-2020 5.6.2.2)

Bandwidth measurement for frequency stability tests: **99% bandwidth**

Test condition	Frequency f_L [MHz]	Frequency f_H [MHz]	Bandwidth [MHz]
T_{min} : -20 °C / V_{nom}	58139.827	63680.247	5540.4
-10 °C / V_{nom}	58137.397	63669.765	5532.3
0 °C / V_{nom}	58124.723	63668.704	5543.9
10 °C / V_{nom}	58112.791	63691.571	5578.7
T_{nom} 20 °C / V_{nom}	**58103.504**	**63705.956**	**5602.5**
20 °C / V_{min}	58101.983	63707.174	5605.1
20 °C / V_{max}	58096.612	63705.853	5609.2
30 °C / V_{nom}	58048.776	63709.996	5661.2
40 °C / V_{nom}	57997.781	63713.604	5715.8
T_{max} : 50 °C / V_{nom}	57875.249	63705.966	5830.7

Note:
- Detailed measurement results: see measurement report 23-1-0012601T007_TR1-A201-R01
- 85% and 115% percent from 24V nominal voltage performed

Verdict: Compliant

14.2 Radiated power (EIRP)

Description:

Measurement of the maximum radiated E.I.R.P. of the wanted signal.

Limits and provisions:

Selection of applicable rule parts: see 13

Applicable limits of radiated power (EIRP)			
Applicable	**Rule part**	**Limit average EIRP**	**Limit peak EIRP**
☐	15.255(b)(3) RSS-210 J.3.2(a)	none	20 dBm
☒	15.255(c)(1)(i) RSS-210 J.3.3(a)	40 dBm (see note 1)	43 dBm
☐	15.255(c)(1)(ii) RSS-210 J.3.3(b)	Calculation depending on EUT antenna gain (see note 1, 2.1 & 2.3)	Depending on EUT antenna gain (see note 1, 2.2 & 2.3)
☐	15.255(c)(2) RSS-210 J.3.2	none	10 dBm
☐	15.255(c)(2)(i) RSS-210 J.3.2(b)(i)	none	20 dBm (indoor) 30 dBm (outdoor)
☐	15.255(c)(2)(ii) RSS-210 J.3.2(b)(ii)	none	3 dBm (general) 20 dBm (+ off-time requirement)
☐	15.255(c)(2)(iii)(A) RSS-210 J.3.2(b)(iii)(1)	none	14 dBm (+ off-time requirement)
☐	15.255(c)(2)(iii)(B) RSS-210 J.3.2(b)(iii)(2)	none	20 dBm (+ off-time requirement)
☐	15.255(c)(2)(v) RSS-210 J.3.2(a)	40 dBm (within 61-61.5 GHz) (see note 1)	43 dBm (within 61.0-61.5 GHz)
		10 dBm (outside 61-61.5 GHz, but within 57-71GHz) (see note 1)	13 dBm (outside 61-61.5 GHz, but within 57-71GHz)
☐	15.255(c)(3) RSS-210 J.3.2(c)	13 dBm (average EIRP during any 0.3 µs time window) (+ time domain requirement)	applicable average limit + 20 dB
		5 dBm (average integrated EIRP within 61.5–64.0 GHz in any 0.3 µs time window)	

Note:
1. Measured during the transmit interval
2. Calculation depending on EUT antenna gain:
   2.1. The average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.
   2.2. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.
   2.3. Reducing the transmit power based on the antenna gain shall not require that the power levels be reduced below the limits specified in 15.255(c)(1)(i)/J.3.3(a).

Measurement:

Spectrum analyzer:

Measurement parameter	
Detector:	Pos-Peak for peak power / RMS for average power
Resolution bandwidth:	50 MHz Peak / 1MHz for average power
Video bandwidth:	80 MHz Peak / 3MHz
Trace-Mode:	Max Hold

Measurement procedures:
1. Peak power: a RBW > 6dB EBW of signal chosen
2. Average power: channel power function activated for average power measurements

Measurement results:

EUT	Mode	Test condition	Peak E.I.R.P.	Limit Peak E.I.R.P	Average E.I.R.P	Limit Average EIRP
1	1	T_{nom} / V_{nom}	-1.88 dBm (AntV)	43 dBm	-0.52 dBm (AntV)	40 dBm

Note:
- Detailed measurement results: see measurement report 23-1-0012601T007_TR1-A202-R01
- Diagrams TID032 and TID041 for maximum determined values among 2 investigated polarisations of measurement antenna.

Verdict: Compliant

14.3 Peak transmitter conducted output power

Description:

Measurement or calculation of the transmitter conducted output power.

Limits and provisions:

Selection of applicable rule parts: see 13

Applicable limits of peak transmitter conducted output power		
Applicable	**Rule part**	**Limit peak transmitter conducted output power**
☐	15.255(c)(2) RSS-210 J.3.2	-10 dBm
☐	15.255(e)(1) RSS-210 J.3.3(c)	500 mW
☒	15.255(e)(2) RSS-210 J.3.3(d)	500 mW * (EBW_{6dB}/100 MHz)
☐	other	none

Note:
- EBW_{6dB} (6 dB emission bandwidth): see chapter 14.1: result of 1.281 MHz

Results:

EUT	Mode	Test condition	Peak E.I.R.P.	Gain of EUT antenna G_{EUT}	Peak transmitter conducted output power	Limit Peak transmitter conducted output power
1	1	T_{nom} / V_{nom}	-1.88 dBm	4.4 dBi	-6.28 dBm	6.405 mW (8.06 dBm)

Note:
- Peak transmitter conducted output power = Peak E.I.R.P – Gain of EUT antenna G_{EUT}
- Peak EIRP: see chapter 14.2 (Diagram TID032)
- Gain of EUT antenna:
  - Declaration by customer based on own measurements: 3.3dBi (57GHz) to 4.9dBi (64GHz). For max. peak value frequency of approx.. 60.6GHz, 4.4dBi according diagram is used. (see document mentioned in chapter 12)

Verdict: Compliant

14.4 Time domain requirements: Continuous transmitter off-times & transmit duty cycle

Description:

Measurement of the time domain parameter.

Limits and provisions:

Selection of applicable rule parts: see 13

Applicable time domain requirements		
Applicable	**Rule part**	**Time domain requirement**
☐	15.255(b)(3) RSS- 210 J.3.2(d)	sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds
☐	15.255(c)(2)(ii) RSS- 210 J.3.2(b)(ii)	Peak EIRP ≤ 3 dBm: none
		Peak EIRP ≤ 20 dBm: sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds
☐	15.255(c)(2)(iii)(A) RSS- 210 J.3.2(b)(iii)(1)	sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds
☐	15.255(c)(2)(iii)(B) RSS- 210 J.3.2(b)(iii)(2)	sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds
☐	15.255(c)(3) RSS- 210 J.3.2(c)	maximum pulse duration of 6 ns; transmit duty cycle shall not exceed 10% during any 0.3 µs time window
☒	other	none

Note:

- Continuous transmitter off-times:
  Off-times are only taken into account if they are larger than the specified minimum value (e.g. 2 ms). Off-times smaller than the specified minimum value are not considered when checking the specified limit (e.g. "at least 25.5 ms within any contiguous interval of 33 ms").

Measurement:

Measurement parameter	
Detector:	Pos-Peak
RBW bandwidth: 1MHz	Video bandwidth: 3MHz

Measurement results:

EUT	Mode	Test condition	Maximum Duy-Cycle	
1	1	T_{nom} / V_{nom}	Measured value	Limit
			100% DC	none

TID103, Annex 201

Verdict: Compliant (no limit)

14.5 Spurious emissions radiated

Description:

Measurement of the radiated spurious emissions.

Limits and provisions:

Selection of applicable rule parts: see 13

47CFR Part 15.209(a) RSS-Gen 8.9		
Frequency (MHz)	Field strength (microvolts/meter) Magnetic field strength (H-Field) (µA/m)	Measurement distance (meters)
0.009 – 0.490	2400/F(kHz) 6.37/F (F in kHz)	300
0.490 – 1.705	24000/F(kHz) 63.7/F (F in kHz)	30
1.705 – 30.0	30 0.08	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3
47 CFR 15.255(d) RSS-210 J.4		
Frequency (GHz)	Power density [pW/cm2]	Equivalent isotropically radiated power: EIRP [dBm]
Below 40	See §15.209 See RSS-Gen 8.9	-/-
40 - 200	90 @ distance of 3 m	-10
The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.		
The levels of the spurious emissions shall not exceed the level of the fundamental emission.		
47 CFR 15.255(i)(2) RSS-210 J.5(c)		
Compliance measurements of frequency-agile field disturbance sensors/radars shall be performed with any related frequency sweep, step, or hop function activated.		
47 CFR 15.33(a)(3)		
If the intentional radiator operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise elsewhere in the rules.		
RSS-210 J.5(a)		
Emissions shall be measured up to 200 GHz.		

Limit conversion (ANSI C63.10-2020 9.2.3):

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 = 90 pW/cm² at a distance of d = 3 m corresponds to an equivalent isotropically radiated power of EIRP = -10 dBm.

Measurement:

Measurement parameter	
Detector:	Quasi Peak / Pos-Peak / 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

14.5.1 Measurement results: §15.255(d)(2) and reference to §15.209

Measurement results (f<30MHz):

Frequency	Detector	Bandwidth [kHz]	Level	Limit	Margin [dB]
--	PK	10	≤ 20 dBuV/m	29.54	9.54
7.89 MHz	PK	10	13.83	29.54	15.76
Please refer to the following plots for more information on the level of spurious emissions					

Remark: see diagram TID017a and TID017b in annex A202

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

Frequency [GHz]	Detector	Bandwidth [kHz]	Level	Limit	Margin [dB]
--	PK	100	≤ 40 dBuV/m	-/-	-/-
--	PK	100	≤ 40 dBuV/m	-/-	-/-
Please refer to the following plots for more information on the level of spurious emissions					

Remark:
1.) see diagram TID018a and TID018b in annex A202

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

Frequency [GHz]	Detector	Bandwidth [MHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
--	PK	1	≤ 60.39	74	13.61
	AV	1	≤ 47.25	54	6.75
--	PK	1	≤ 60.24	74	13.76
	AV	1	≤ 47.26	54	6.74
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID026a (Ant-H) and TID026b (AntV) in annex A202

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

Frequency [GHz]	Detector	Bandwidth [MHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
--	PK	1	≤ 58.82	74	15.18
	AV	1	≤ 45.61	54	8.39
--	PK	1	≤ 59.06	74	14.93
	AV	1	≤ 45.43	54	8.57
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID023a (Ant-H) and TID023b (Ant-V) in annex A202

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

Frequency [GHz]	Detector	Bandwidth [MHz]	Level dBuV/m	Limit dBuV/m	Margin [dB]
20.215	PK	1	≤ 57.03	74	16.97
	AV	1	≤ 45.12	54	8.88
20.215	PK	1	≤ 59.31	74	14.68
	AV	1	≤ 52.30	54	1.70
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID016a / TID016a_01/ TID016a_02 (Ant-H) and TID016b / TID016b_01/ TID016b_03 (Ant-V) in annex A202

14.5.2 Measurement results: §15.255(d)(3)

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

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
40.429	RMS	1	-47.39	-10 dBm	37.39
--	RMS	1	≤ -42.70	-10 dBm	32.70
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID014a_01 / TID014a_02(Ant-H) and TID014b_01 (Ant-V) in annex A202

Measurement results (50GHz < f < 67GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
56.89	RMS	1	-38.95	-10	28.95
56.89	RMS	1	-36.65	-10	26.65
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID044_02 (Ant-V) and TID045_02 (Ant-H) in annex A202

Measurement results (67GHz < f < 75GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
68.74	RMS	1	-40.33	-10	30.33
--	RMS	1	≤ -41.64	-10	31.64
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID046 (Ant-V) and TID047(Ant-H) in annex A202

Measurement results (75GHz < f < 85GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	≤ -42.0	-10	32.0
--	RMS	1	≤ -35.00	-10	25.0
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID013a_01 (Ant-H) and TID013b (Ant-V) in annex A202

Measurement results (85GHz < f < 95GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	≤ -39.0	-10	29.0
--	--	--	--	--	--
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID013a_02 (Ant-H) and TID013b (Ant-V) in annex A202

Measurement results (95GHz < f < 105GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	≤ -34.64	-10	24.64
--	RMS	1	≤ -35.0	-10	25.0
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID013a_03 (Ant-H) and TID013b (Ant-V) in annex A202

Measurement results (105GHz < f < 110GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	RMS	1	≤ -36.40	-10	26.40
--	--	--	--	--	--
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID013a_04 (Ant-H) and TID013b (Ant-V) in annex A202

Measurement results (110GHz < f < 130GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -34.88	-10	24.88
--	PK/RMS	1	≤ -34.95	-10	24.95
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID019a (Ant-H) and TID019b (Ant-V) in annex A202

Measurement results (130GHz < f < 140GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -36.69	-10	26.69
--	PK/RMS	1	≤ -36.63	-10	26.63
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID020a (Ant-H) and TID020b (Ant-V) in annex A202

Measurement results (140GHz < f < 170GHz):

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -28.88	-10	18.88
--	PK/RMS	1	≤ -28.79	-10	18.79
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID021a (Ant-H) and TID021b (Ant-V) in annex A202

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

Frequency [GHz]	Detector	Bandwidth [MHz]	Level [dBm]	Limit [dBm]	Margin [dB]
--	PK/RMS	1	≤ -28.56	-10	18.56
--	PK/RMS	1	≤ -28.52	-10	18.52
Please refer to the following plots for more information on the level of spurious emissions					

See diagram TID022a (Ant-H) and TID022b (Ant-V) in annex A202

Verdict: Compliant

14.6 Conducted emissions < 30 MHz (AC power line)

Description:

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

Limits and provisions:

Selection of applicable rule parts: see 13

47 CFR 15.207(a) RSS-Gen 8.8		
Frequency of emission (MHz)	**Conducted limit (dBµV)**	
	Quasi-peak	**Average**
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency

Measurement:

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

Measurement results:

See annex 202, chapter 1.17 for results under diagram 1.01.

Verdict: Compliant

15 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

16 Document history

Version	Applied changes	Date of release
R01-D2	Initial release	2024-12-19
R02	HVIN corrected. R01-D2 Version of the test report is not valid anymore. New annex 301-R02 referenced.	2025-06-13
R03	Frequency range (57 – 64 GHz) has been updated at page 1 and page 7 (chapter 6.1) Previous Report R02 is not valid anymore.	2025-07-23

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