

PARTIAL TEST REPORT

Test report no.: 1-6927-23-01-03_TR1-R01

Testing laboratory

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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

Acconeer AB
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211 77 Malmö / SWEDEN
Phone: +46 10 218 92 00
Contact: Mikael Rosenhed
e-mail: mikael.rosenhed@acconeer.com

Manufacturer

Acconeer AB
Västra Varvsgatan 19
211 77 Malmö / SWEDEN

Test standard/s

FCC - Title 47 CFR Part 15	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
Canada – RSS-210 Issue 11	License –exempt Radio Apparatus: Category I equipment Annex J: Devices operating in the band 57-71 GHz

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

Test Item

Kind of test item:	**IoT module**
Model name:	**XM126**
FCC ID:	2AQ6KXM002
IC:	24388-XM002
Frequency:	57 GHz to 64 GHz
Technology tested:	Pulsed RADAR 60GHz
Antenna:	Integrated antenna
Power supply:	3V DC
Temperature range:	21.5°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:

Thomas Vogler
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Thomas Vogler
Lab Manager
Radio Labs

Test performed:

Christian Lorenz
Lab Manager
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1 Table of contents

2 General information

2.1 Notes and disclaimer

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2.2 Application details

Date of receipt of order:	2023-10-20
Date of receipt of test item:	2023-11-27
Start of test:*	2024-05-16
End of test:*	2024-06-21
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 Test laboratories sub-contracted

None

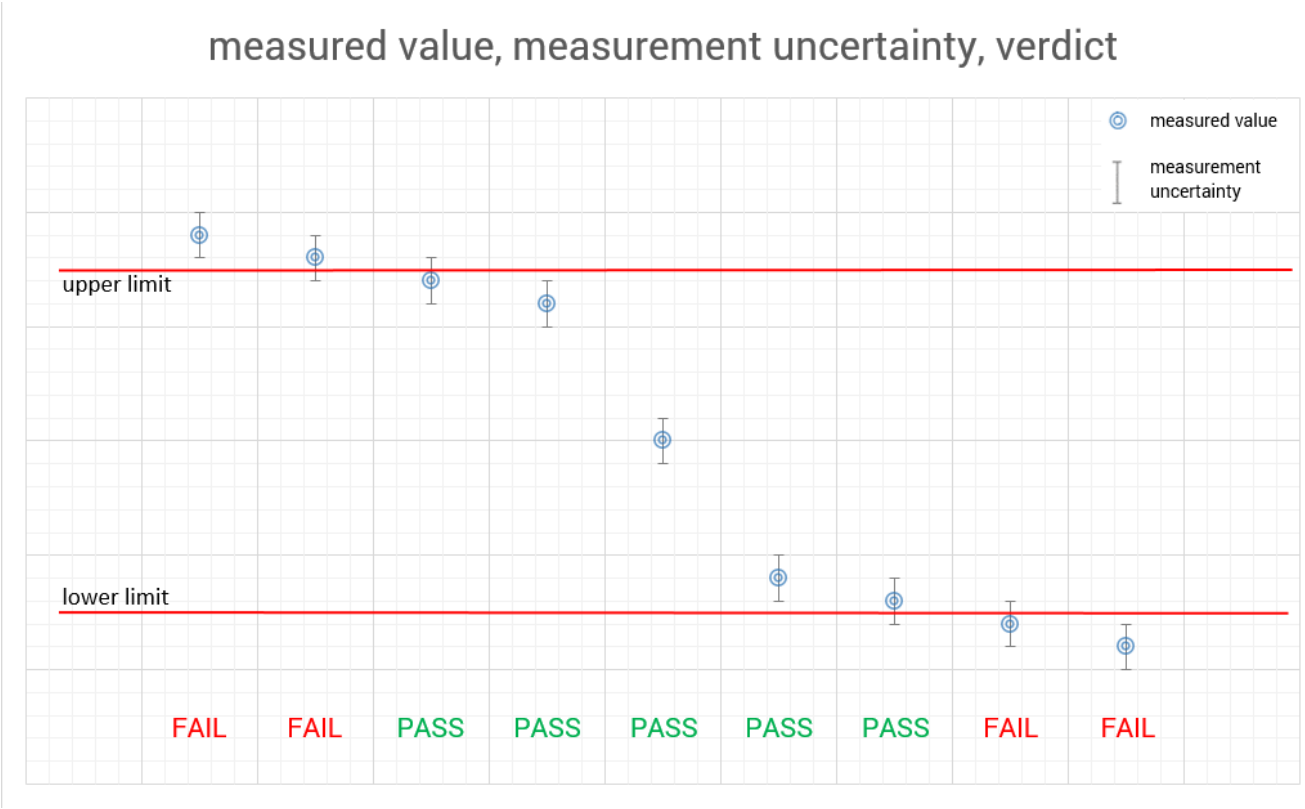
3 Test standard/s, references and accreditations

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	June25, 2024	Canada – RSS-210 Issue 11 License –exempt Radio Apparatus: Category I equipment Annex J: Devices operating in the band 57-71 GHz

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}	+21.5 °C during room temperature tests -/- °C during high temperature tests -/- °C during low temperature tests
Relative humidity content	:		58 %
Barometric pressure	:		990 hPa to 1010 hPa
Power supply	:	V_{nom} V_{max} V_{min}	3 V DC Li battery cell 123 -/- V -/- V

6 Test item

6.1 General description Main-EUT

Kind of test item	:	IoT module
Model name	:	XM126
HMN	:	--
PMN	:	*XM126*
HVIN	:	*XM126*
FVIN	:	N/A
S/N serial number	:	7A05455ADEF90AEC
Power setting		N/A
Hardware status	:	R1B
Software status	:	V1.4.0
Firmware status	:	V1.4.0
Frequency band	:	57 GHz to 64 GHz
Type of radio transmission Use of frequency spectrum	: :	Pulsed FDS
Type of modulation	:	Pulse Modulation
Number of channels	:	1
Antenna	:	Integrated antenna
Power supply	:	3 V DC Li battery cell 123 over AE1
Temperature range	:	21.5°C to 22.3°C

6.2 General description Accessories (AE's)

Kind of test item	:	AE1: Board for module
Model name	:	XM 122/ XM126 certification PCB PB47 v1.0
S/N serial number	:	3154509A-Y15
Power supply	:	3 V DC Li battery cell 123

6.3 Additional information

The content of the following annexes are 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:

- 1-6927-23-1-03_TR1-A101-R01 (External photographs of EUT)
- 1-6927-23-1-03 _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:

- 1-6927-23-1-03 _TR1-A201-R01

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).

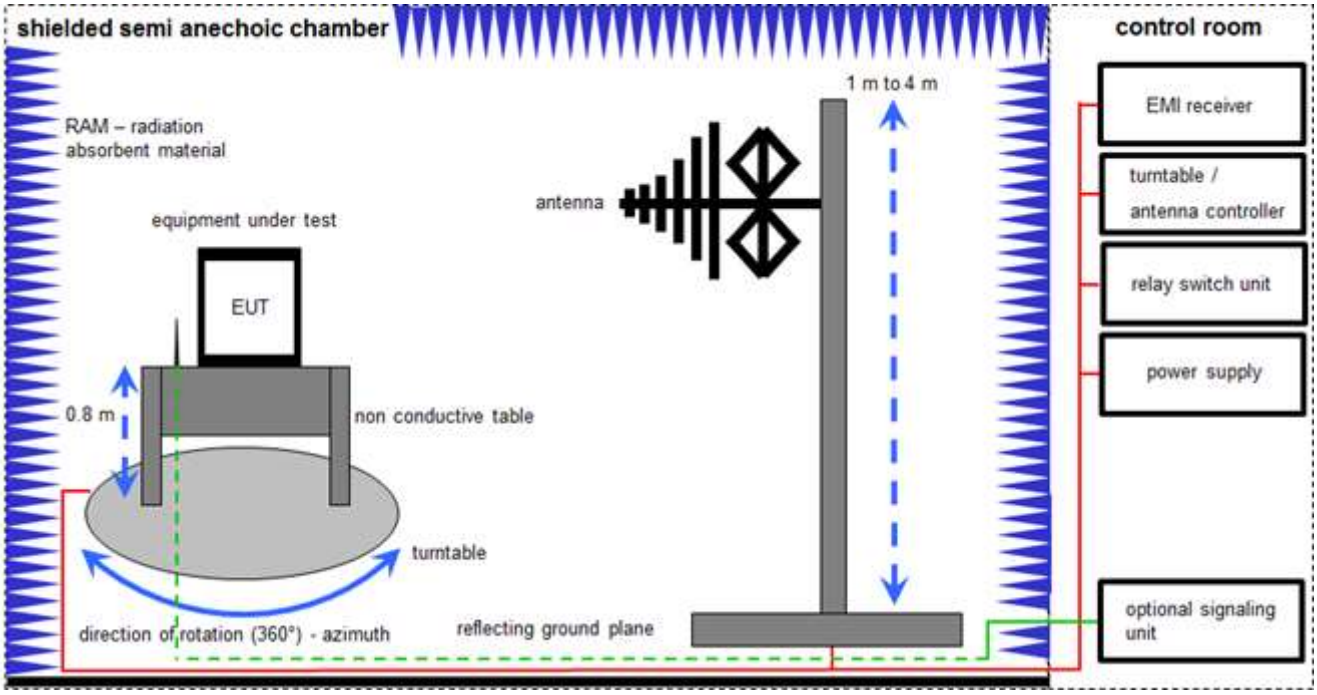
In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

Agenda: Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	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

7.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers (Reg#3462D). The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: 3 meter

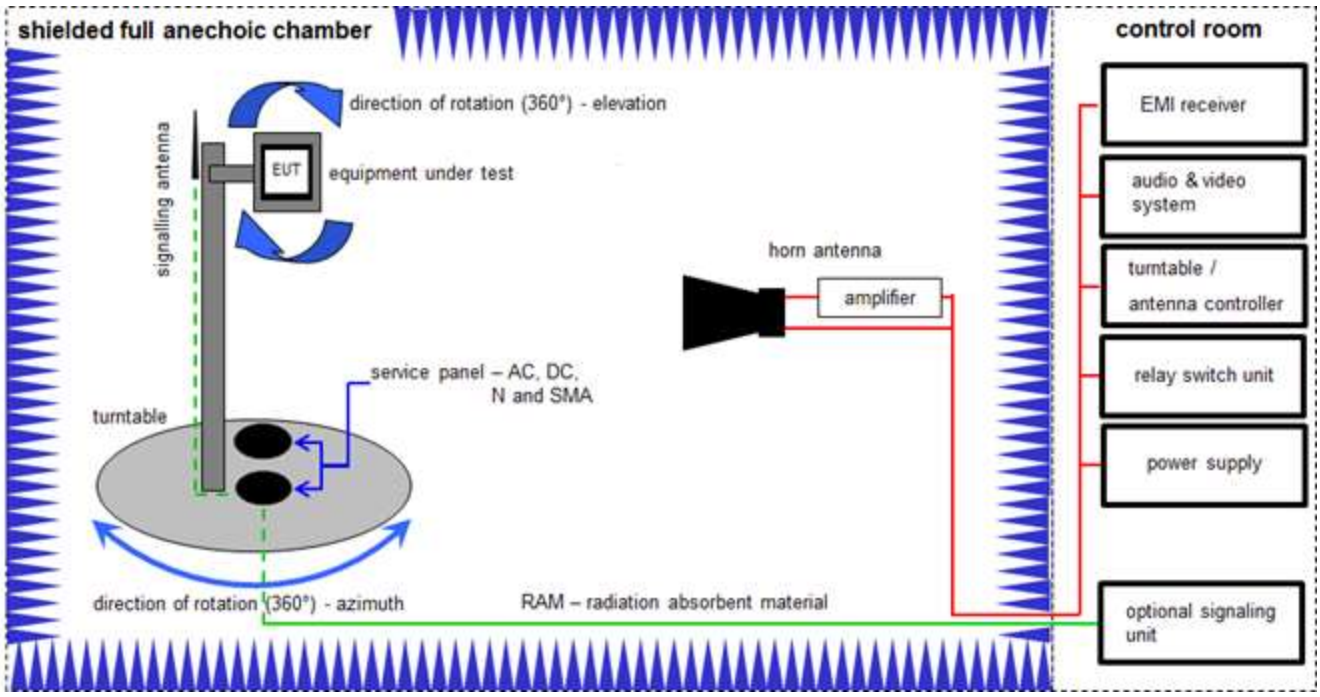
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	120901	Semi Anechoic Chamber	Semi Anechoic Chamber SAC3	ETS-Lindgren Gmbh / Taufkirchen	without		cnn	27.07.2021	27.07.2024
2	20482	filter matrix	filter matrix Filter matrix SAR 1	cetecom advanced GmbH / Essen	without		ev	-/-	-/-
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	25038	Loop Antenna	Loop Antenna HFH2-Z2	Rohde & Schwarz Messgerätebau GmbH / Memmingen	879824/13		cal	04.07.2022	04.07.2024

7.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter

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

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

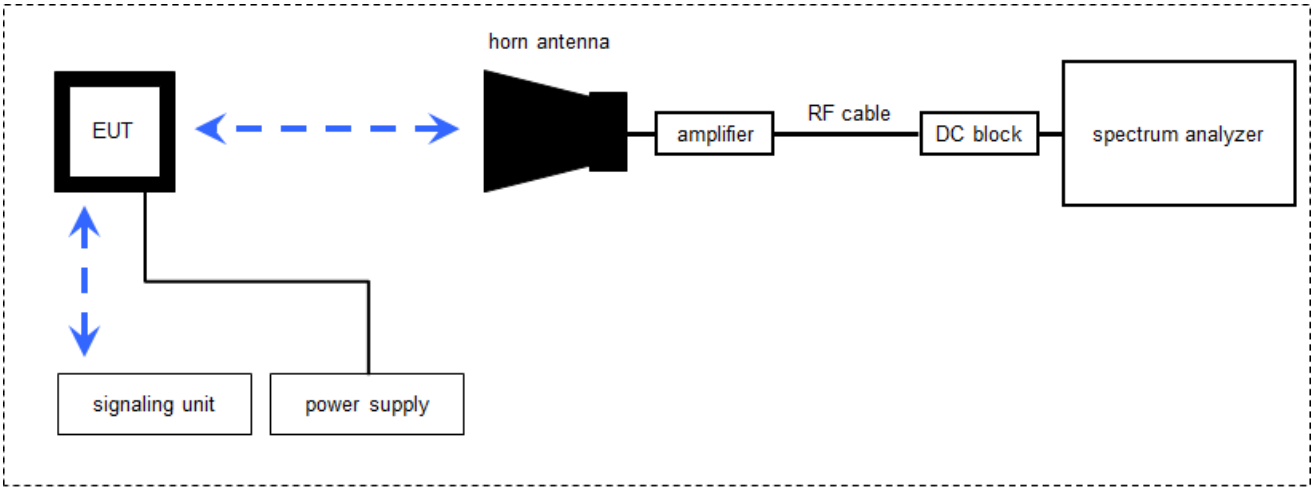
OP = AV + D - G + CA
(OP-radiated output power; AV-analyzer value; D-free field attenuation of measurement distance; G-antenna gain+amplifier gain; CA-loss signal path)

Example calculation:
OP [dBm] = -65.0 [dBm] + 50 [dB] - 20 [dBi] + 5 [dB] = -30 [dBm] (1 µW)

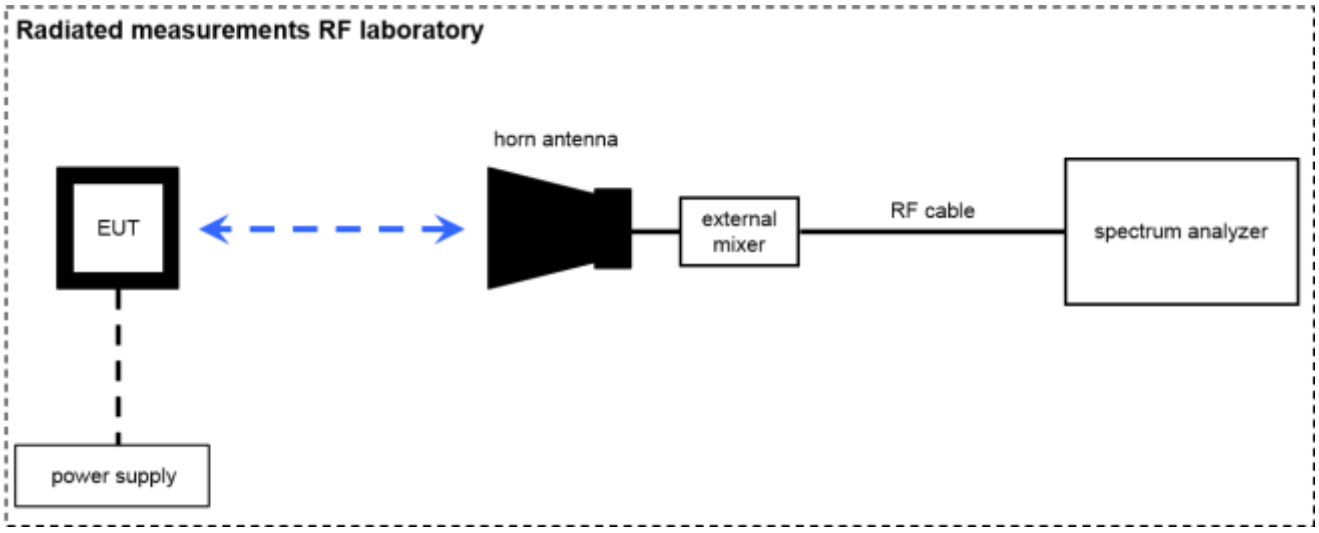
Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	20133	Horn Antenna	Horn Antenna 3115 (Meas 1)	EMCO Elektronik GmbH / Gilching	9012-3629		cal	22.05.2023	22.05.2026
2	120907	Fully Anechoic Chamber	Fully Anechoic Chamber 2	ETS-Lindgren Gmbh / Taufkirchen	without		chk	14.03.2024	13.03.2025
3	20729	Harmonic Mixer	FS-Z140	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101004		cal	16.06.2023	16.06.2026
4	20730	Harmonic Mixer	FS-Z110	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101468		cal	02.06.2023	02.06.2026
5	20731	Harmonic Mixer	FS-Z75	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101022		cal	18.05.2022	18.05.2025
6	20732	Signal- and Spectrum Analyzer	Signal- and Spectrum Analyzer FSW67	Rohde & Schwarz Messgerätebau GmbH / Memmingen	104023		cal	26.05.2023	25.08.2024
7	20733	Harmonic Mixer	Harmonic Mixer FS-Z220	RPG-Radiometer Physics GmbH / Meckenheim	101009		cal	24.05.2024	24.05.2027
8	20767	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 140-220	RPG-Radiometer Physics GmbH / Meckenheim	010011		chk	20.10.2023	20.10.2024
9	20811	Horn Antenna	Horn Antenna ASY-SGH-124-SMA	Antenna Systems Solutions S.L	29F14182337		cal	20.10.2021	20.10.2024
10	20813	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 075	RPG-Radiometer Physics GmbH / Meckenheim	10006		chk	20.10.2023	20.10.2024
11	20814	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 140	RPG-Radiometer Physics GmbH / Meckenheim	10008		chk	20.10.2023	20.10.2024
12	20815	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 110	RPG-Radiometer Physics GmbH / Meckenheim	10014		chk	20.10.2023	20.10.2024
13	20765	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 40-60	RPG-Radiometer Physics GmbH / Meckenheim	010001		chk	20.10.2023	20.10.2024
14	20877	JS42-08001800-16-8P	JS42-08001800-16-8P Verstärker	Miteq Inc.	2079991 / 2079992		chk	27.02.2023	27.08.2024
15	20913	Phase Amplitude Stable Cable Assembly	Phase Amplitude Stable Cable Assembly DC-40GHz	RF-Lambda Europe GmbH	AC19040001		cnn	-/-	-/-
16	25457	DRG Horn Antenna	DRG Horn Antenna SAS-574	A.H. Systems, Inc. / Chatsworth	383	P/N: 2581	cal	28.03.2022	28.03.2025

7.3 Radiated measurements > 18 GHz



7.4 Radiated measurements > 50/85 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)

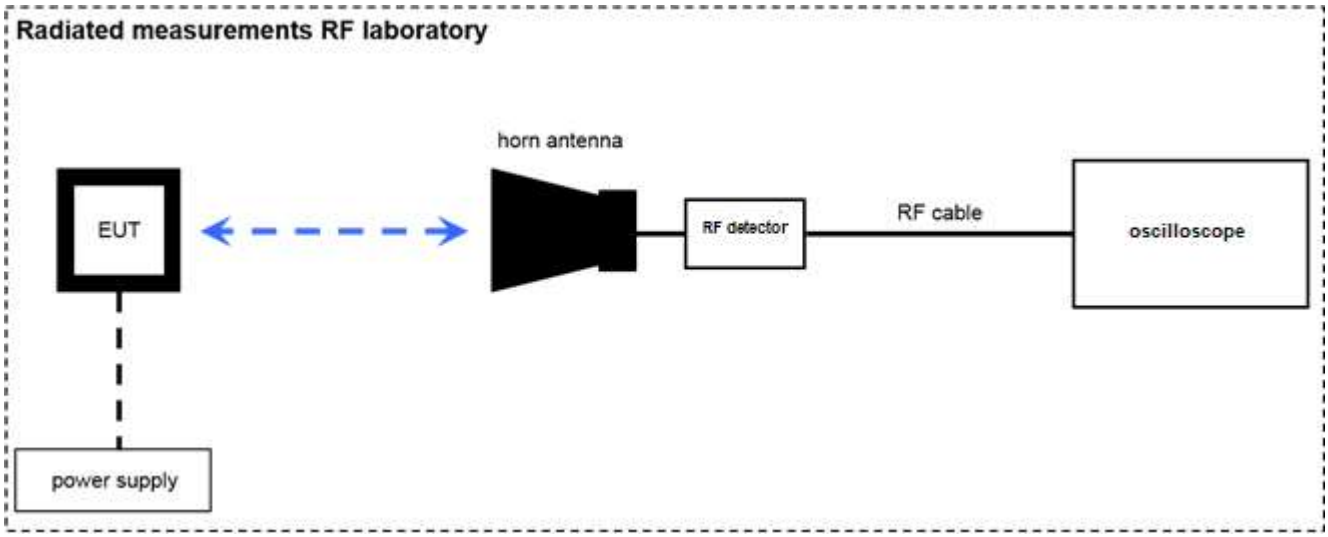
Example calculation:
OP [dBm] = -59.0 [dBm] + 44.0 [dB] - 20.0 [dBi] + 5.0 [dB] = -30 [dBm] (1 µW)

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

Equipment table:

No.	ID-Number	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	20972	Signal- and Spectrum Analyzer	Signal- and Spectrum Analyzer FSW50	Rohde & Schwarz Messgerätebau GmbH / Memmingen	101929		cal	05.01.2024	05.01.2025
2	20733	Harmonic Mixer	Harmonic Mixer FS-Z220	RPG-Radiometer Physics GmbH / Meckenheim	101009		cal	24.05.2024	24.05.2027
3	20767	Pickett-Potter Horn Antenna	Pickett-Potter Horn Antenna FH-PP 140-220	RPG-Radiometer Physics GmbH / Meckenheim	010011		chk	20.10.2023	20.10.2024

7.5 Radiated power measurements using RF detector according to ANSI C63.10-2013



Note: EUT is replaced by reference source for substitution measurement

Measurement distance: horn antenna e.g. 50 cm

Equipment table:

No.	Lab / Item	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	n. a.	Low Noise Amplifier, Waveguide, 50-75 GHz	AFB-V30LN-02	Ducommun Incorporated	1026151-01	300005899	ev	-/-	-/-
2	n. a.	Oscilloscope	DPO5054	Tektronix	C010174	300004169	k	05.12.2023	31.12.2025
3	n. a.	Power supply	N5767A	Agilent Technologies	US14J1569P	300004851	vIKI!	06.12.2023	31.12.2026
4	n. a.	SG Extension Module 50 - 75 GHz	E8257DV15	VDI	US54250124	300005541	ev	-/-	-/-
5	n. a.	Std. Gain Horn Antenna 49.9-75.8 GHz	2524-20	Flann	*	300001983	ne	-/-	-/-
6	n. a.	Std. Gain Horn Antenna 50-75 GHz	COR 50_75	Thomson CSF		300000813	ev	-/-	-/-
7	n. a.	Synthesized Sweeper 10 MHz - 40 GHz	83640A	HP	3119A00458	300002266	vIKI!	05.12.2023	31.12.2025
8	n. a.	V-Band Positive Amplitude Detector	SFD-503753-15SF-P1	Sage Millimeter Inc.	07353-1	300006118	ev	-/-	-/-
9	n. a.	WG Rotary Attenuator	25110 UG-385/U-AC	Flann Microwave	266740	300005798	ev	-/-	-/-

8 Sequence of testing

8.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

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, it is placed on a table with 0.8 m height.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into normal operation mode.

Pre-measurement*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

Final-measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the pre-measurement and the limit is stored.

8.2 Sequence of testing radiated spurious 30 MHz to 1 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 table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- 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 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

Pre-measurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak 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 maximize the peaks by changing turntable position ± 45° and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, 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.

8.3 Sequence of testing radiated spurious 1 GHz to 18 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.

Pre-measurement

- 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.

8.4 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. 0.5 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 63.4).
- 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.

8.5 Sequence of testing radiated spurious above 50 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.

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 63.4).
- 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 pre-measurement and the limit is stored.

9 Measurement uncertainty

Test case	Uncertainty
Equivalent isotropically radiated power (e.i.r.p.)	Conducted value ± 1 dB Radiated value ± 3 dB
Permitted range of operating frequencies	± 100 kHz
Conducted unwanted emissions in the spurious domain (up to 18 GHz)	± 1 dB
Radiated unwanted emissions in the spurious domain (up to 18 GHz)	± 3 dB
Conducted unwanted emissions in the spurious domain (18 to 40 GHz)	± 4 dB
Radiated unwanted emissions in the spurious domain (18 to 40 GHz)	± 4 dB
Conducted unwanted emissions in the spurious domain (40 to 50 GHz)	± 4.5 dB
Radiated unwanted emissions in the spurious domain (40 to 50 GHz)	± 4.5 dB
Conducted unwanted emissions in the spurious domain (above 50 GHz)	± 5 dB
Radiated unwanted emissions in the spurious domain (above 50 GHz)	± 5 dB
DC and low frequency voltages	± 3 %
Temperature	± 1 °C
Humidity	± 3 %

1 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:

Antenna frequency range in GHz	Highest measured frequency in GHz	D in cm	λ in cm	D_{ff} in cm
18 - 26.5	26.5	3.4	1.13	20.44
26.5 - 40	40	2.2	0.75	12.91
40 - 50	50	2.77	0.60	25.58
50 - 75	75	1.85	0.40	17.11
75 - 110	110	1.24	0.27	11.28
90 - 140	140	1.02	0.22	9.72
110 - 170	170	0.85	0.18	8.19
140 - 220	220	0.68	0.14	6.78
220 - 325	325	0.43	0.09	4.01
325 - 500	500	0.26	0.06	2.25

In band measurement (OBW)

Antenna frequency range in GHz	Highest measured frequency in GHz	Antenna dimension in cm	Wavelength in cm	Far Field distance in cm
50-75	67	1.85	0.47	14.6

2 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	see below	2024-08-28	-/-

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

Note: NA = Not applicable; NP = Not performed

TC identifier	Description	verdict	date	Remark
RF-Testing	RSS-210, Issue 11	see below	2024-06-25	-/-

Test specification clause	Test case	Temperature conditions	Power supply	Pass	Fail	NA	NP	Remark
J3.2 (c)(iv)	Occupied bandwidth & Frequency stability	Nominal Extreme	Nominal Extreme	☒	☐	☐	☐	complies
J3.2 (c)(i) (c)(ii)	Radiated power (EIRP)	Nominal	Nominal	☒	☐	☐	☐	complies
J3.2	Peak transmitter conducted output power	Nominal	Nominal	☐	☐	☒	☐	complies
J3.2 (c)(i)	Time domain requirements	Nominal	Nominal	☒	☐	☐	☐	complies
J.4	Spurious emissions radiated	Nominal	Nominal	☒	☐	☐	☐	complies
RSS-Gen, Issue 5 §8.8	Conducted emissions < 30 MHz (AC power line)	Nominal	Nominal	☐	☐	☒	☐	complies

Note: NA = Not applicable; NP = Not performed

3 Additional comments

Reference documents: --

Special test descriptions: None

Configuration descriptions: *XM126_certification_-_User_guidelines_v1.2.pdf*

4 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))
  - ☐ Unmanned aircraft (47 CFR 15.255(b)(3))
  - ☐ 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)).

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 57 – 71 GHz (47 CFR 15.255 / 47 CFR 15.255(c))
- ☐ Operating within band 59.3 – 71.0 GHz (47 CFR 15.255(b)(2)(iii))
- ☐ Operating within band 60 – 64 GHz (47 CFR 15.255(b)(3))
- ☒ Operating within band 57 – 64 GHz (47 CFR 15.255(c)(3) / 47 CFR 15.255(c)(2)(iii))
- ☐ Operating within band 57 – 71 GHz (47 CFR 15.255(c)(2))
- ☐ Operating within band 57.0 – 59.4 GHz (47 CFR 15.255(c)(2)(i))
- ☐ Operating within band 57.0 – 61.56 GHz (47 CFR 15.255(c)(2)(ii))
- ☐ Operating within band 61.0 – 61.5 GHz (47 CFR 15.255(c)(2)(v))

Note: See results in chapter 5.1

Selection of applicable rule parts:

Applicable rule parts and limits depend on the basic information of the DUT (see chapter 4).
The comparison of the basic information of the DUT with the rule parts lead to the following conclusions:

Rule Part	Applicable? Yes	Applicable? 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 -analyser. The centre 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 5.6), 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.	☐	☐

5 Measurement results

5.1 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 4

Designated frequency band of 47 CFR 15.215
57 GHz – 71 GHz

Bandwidth to be measured		
Applicable	**Rule part**	**Bandwidth**
☐	15.215(c)	20 dB bandwidth
☒	15.255(c)(3)	10 dB bandwidth
☐	15.255(e)(2)	6 dB emission bandwidth

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).

Measurement:

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

Measurement procedures:

- Bandwidth: ANSI C63.10-2013 6.9 / 9.3
- Frequency stability: ANSI C63.10-2013 6.8 / 9.4

Measurement results:

10 dB bandwidth at normal conditions:

EUT	Mode	Test condition	f_L [GHz]	f_H [GHz]	Bandwidth [MHz]
1	1	T_{nom} / V_{nom}	60.2123	60.8836	671.30

Frequency stability:

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: 10 dB bandwidth

Test condition	Frequency f_L [GHz]	Frequency f_H [GHz]	Bandwidth [MHz]
T_{min} / V_{nom}	--	--	--
-20 °C / V_{nom}	--	--	--
-10 °C / V_{nom}	--	--	--
0 °C / V_{nom}	--	--	--
10 °C / V_{nom}	--	--	--
20 °C / V_{nom}	60.2123	60.8836	671.30
20 °C / V_{min}	--	--	--
20 °C / V_{max}	--	--	--
30 °C / V_{nom}	--	--	--
40 °C / V_{nom}	--	--	--
50 °C / V_{nom}	--	--	--
T_{max} / V_{nom}	--	--	--

Note:

- Detailed measurement results: see measurement annex 201
- Delta test scope for this device, only tests at nominal conditions performed

Verdict: Compliant

5.2 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 4

Applicable limits for radiated power (EIRP)			
Applicable	**Rule part**	**Limit average EIRP**	**Limit peak EIRP**
☐	15.255(c)(1)(i)	40 dBm (see note 1)	43 dBm
☐	15.255(c)(1)(ii)	(see note 1 & 2.1)	(see note 1 & 2.2)
☐	15.255(c)(2)	none	10 dBm
☐	15.255(c)(2)(i)	none	20 dBm (indoor) 30 dBm (outdoor)
☐	15.255(c)(2)(ii)	none	3 dBm (general) 20 dBm (+ off-time requirement)
☐	15.255(c)(2)(iii)(A)	none	14 dBm (+ off-time requirement)
☐	15.255(c)(2)(iii)(B)	none	20 dBm (+ off-time requirement)
☐	15.255(c)(2)(v)	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) (see note 1)	13 dBm (outside 61-61.5 GHz)
☒	15.255(c)(3)	AV: 13 dBm (+ 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:
   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.

Measurements:

Spectrum analyzer:

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

Measurement results AV EIRP within band 61.5-64GHz:

EUT	Test condition	(1) Ch-PWR Channel IN-BAND [dBm]	(2) Ch-PWR Channel 61.5-64GHz [dBm]	(3) = (1)-(2) Difference [dB]	(4) AV EIRP Detector measurement [dBm]	(5) = (4)-(3) Resulting AV-EIRP within band 61.5-64GHz [dBm]	Limit average EIRP [dBm]
1	T_{nom} / V_{nom}	-6.92 (TID002)	-26.23 (TID003)	19.31	-2.35	-21.66	5 dBm /0.3µs

Note:
- Detailed measurement results: see measurement annex A201

Verdict: Compliant

RF detector:

Measurement parameter	
Detector:	Pos-Peak (RF-Detector)
Video bandwidth:	≥ 10 MHz

Measurement procedures:
- Fundamental emission using an RF detector: ANSI C63.10-2013 9.11

Measurement results EIRP:

EUT	Mode	Test condition	Peak E.I.R.P. (substituted)	Limit peak E.I.R.P	Average E.I.R.P (With Duty-Cycle)	Limit average EIRP
1	1	T_{nom} / V_{nom}	12 dBm	33 dBm	-2.35 dBm	13 dBm

Note:
- Detailed measurement results: see measurement annex A201
- Max. duty cycle used for average calculation: -14.36dB (10*log10(3.66%)) < 20dB

Verdict: Compliant

RF detector: Description of the E.I.R.P. measurement by substitution method

1) EUT emission measured with RF-detector:
   - Measurement distance: d_{EUT}
   - Maximum readout value on oscilloscope: $V_{max,EUT}$

2) Substitution of EUT by a CW reference source with a frequency of f_{REF} and a fixed output power of P_{REF}
   - Positioning of the cw reference source at distance: d_{EUT}
   - Adjustment of the readout value on oscilloscope to V_{max} via the variable attenuator of the source: $V_{max,CW} = V_{max,EUT}$

3) Measurement of the conducted output power $P_{cond,CW}$ of the CW reference source (without horn antenna) using the power meter

4) Calculation of the Peak E.I.R.P. of the EUT taking into account the gain of the substitution antenna G_{CW}:
   - $P_{Peak\ E.I.R.P.} = P_{cond,CW} + G_{CW}$

Measurement step	Measurement parameter		EUT Mode			
			1+2	--	--	--
1	d_{EUT}	[m]	0.5	-/-	-/-	-/-
	$V_{max,EUT}$	[mV]	11.28	-/-	-/-	-/-
2	f_{REF}	[GHz]	60.579	-/-	-/-	-/-
3	$P_{cond,CW}$ + G_{CW}	[dBm]	40.5	-/-	-/-	-/-
4	Attenuation Rotary attenuator	[dBi]	28.5	-/-	-/-	-/-
	$P_{Peak\ E.I.R.P.}$	[dBm]	**12.0**	-/-	-/-	-/-
	$P_{AV\ EIRP}$ with duty-cycle (Note 3)	[dBm]	**-2.35**			

Notes:

1. for more results and graphical plot, pls. see annex A201, chapter 1.6
2. for set-up photographs, see pls. annex A103
3. Duty-Cycle max. of 3.66% or -14.36dB used for calculation

5.3 Peak transmitter conducted output power

Description:

Measurement or calculation of the transmitter conducted output power.

Limits and provisions:

Selection of applicable rule parts: see 4

Applicable limits for peak transmitter conducted output power		
Applicable	**Rule part**	**Limit peak transmitter conducted output power**
☐	15.255(c)(2)	-10 dBm
☐	15.255(e)(1)	500 mW
☐	15.255(e)(2)	500 mW * (emission bandwidth/100 MHz)
☒		none

5.4 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 4

Applicable time domain requirements		
Applicable	**Rule part**	**Time domain requirement**
☐	15.255(b)(3)	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)(i)	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)	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)	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)	maximum pulse duration of 6 ns; transmit duty cycle shall not exceed 10% during any 0.3 µs time window
☐		none

Note:

- Continous 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 (RF-Detector)
Video bandwidth:	Video bandwidth: 10MHz minimum at 50Ohm

Measurement results:

EUT	Mode	Test condition	Maximum pulse duration		Maximum transmit duty cycle during any 0.3 µs time window	
			Measured value	Limit	Measured value	Limit
1	1	T_{nom} / V_{nom}	1.826 ns	6 ns	5 Pulses * 1.826ns=9.13ns =3.04 % (Plot TID005 +TID007)	10 %
1	2	T_{nom} / V_{nom}	2.2ns	6 ns	5Pulses*2.2ns=11.0ns =3.66% (Plot TID008+TID009)	10 %

Verdict: Compliant

Remark: for more information and graphical plot see annex A201, chapter 1.6

5.5 Spurious emissions radiated

Description:

Measurement of the radiated spurious emissions.

Limits and provisions:

Selection of applicable rule parts: see 4

47CFR Part 15.209(a)		
Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
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
Above 960	500	3
47 CFR 15.255(d)		
Frequency (GHz)	Power density [pW/cm2]	Equivalent isotropically radiated power: EIRP [dBm]
Below 40	See §15.209	
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)		
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.		

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 = 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

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

Result: 9 kHz – 30 MHz

Diagram	Channel	Mode	Maximum Level [dBµV/m] Frequency Range 0.009 – 30 MHz	Result
TID030a	1	RADAR-on	24.20	Passed
TID030b	1	RADAR-on	12.29	Passed

Remark: for more information and graphical plots, see annex A201

Result: 30 MHz – 1GHz

Diagram	Set-up	Mode	Maximum Level [dBµV/m] Frequency Range 30 – 1000 MHz	Result
TID018	1	RADAR-on	≤ 40 (noise level)	Passed
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Remark: for more information and graphical plots, see annex A201

Result: 1GHz – 12.4 GHz

Diagram	Set-up	Mode	Maximum Level [dBµV/m] Frequency Range 1 – 12.4 GHz	Result
TID019	1	RADAR-on	PK: ≤ 60.0 (Noise level)	Passed
			AV: ≤ 47.0 (Noise level)	Passed

Remark: for more information and graphical plots, see annex A201

Result: 12.4 GHz – 18 GHz

Diagram	Set-up	Mode	Maximum Level [dBµV/m] Frequency Range 12.4 - 18 GHz	Result
TID020a_AntH	1	RADAR on	PK: ≤ 54.0 (Noise level) AV: ≤ 42.0 (Noise level)	Passed
TID020b_AntV	1	Radar-on	PK: ≤ 54.0 (Noise level) AV: ≤ 42.0 (Noise level)	Passed

Remark: for more information and graphical plots, see annex A201

Result: 18 GHz – 40 GHz

Diagram	Set-up	Mode	Maximum Level [dBµV/m] Frequency Range 18 – 40 GHz	Result
TID021b_AntV EUT_laying	1	Radar-on	PK: ≤ 62.0 (Noise level) AV: ≤ 49.0 (Noise level)	Passed
TID021b_AntV EUT_standing	1	Radar-on	PK: ≤ 62.0 (Noise level) AV: ≤ 49.0 (Noise level)	Passed

Remark: for more information and graphical plots, see annex A201

Verdict: Compliant

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

Result: 40 -50 GHz

Diagram	Mode	Frequency [GHz]	Max level [dBm]	Limit [dBm]	Result
TID022a	Radar-on	49.755	-20.82 (PK)	-10.0	Passed
TID022b	Radar-on	49.665	-21.0 (PK)	-10.0	Passed

Remark: for more information and graphical plots, see annex A201

Result: 50 GHz – 75 GHz

Diagram	Mode	Frequency [GHz]	Max level [dBm]	Limit [dBm]	Result
TID023a	Radar-on	--	-24 (PK)	-10.0	Passed
TID023b	Radar-on	--	-24 (PK)	-10.0	Passed

Remark: for more information and graphical plots, see annex A201

Result: 75 GHz – 110 GHz

Diagram	Mode	Frequency [GHz]	Max level [dBm]	Limit [dBm]	Result
TID027a	Radar-on	104.29	-25.24 (PK)	-10.0	Passed
TID027b	Radar-on	104.352	-25.46 (PK)	-10.0	Passed

Remark: for more information and graphical plots, see annex A201

Result: 110 GHz – 140 GHz

Diagram	Mode	Frequency [GHz]	Max level [dBm]	Limit [dBm]	Result
TID028a	Radar-on	128.439	-17.20 (PK)	-10.0	Passed
TID027b	Radar-on	128.42	-17.11 (PK)	-10.0	Passed

Remark: for more information and graphical plots, see annex A201

Result: 140 GHz – 220 GHz

Diagram	Mode	Frequency [GHz]	Max level [dBm]	Limit [dBm]	Result
TID029a	Radar-on	154.378 140.009	-15.43 (PK) -27.12 (AV)	-10.0	Passed
TID029b	Radar-on	194.085 140.01	-15.24 (PK) -27.04 (AV)	-10.0	Passed
TID029b_01	Radar-on	194.146	-28.25 (AV)	-10.0	Passed
TID029b_02	Radar-on	194.3	-28.15 (AV)	-10.0	Passed

Remark: for more information and graphical plots, see annex A201

5.6 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 4

47 CFR 15.207(a)		
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:

The device only employs not chargeable battery power for operation (as declared by manufacturer).

Verdict: test not applicable

6 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

7 Document history

Version	Applied changes	Date of release
-/-	Initial release	2024-08-28

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