element

Radio Radio Radio Radio Radio Radio Radio Radio Radio Radio Radio Radio

Applicant:

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Test report no.:

200903-AU01+W01

for:

OTT-JAKOB Spanntechnik GmbH
Force gauge
PowerCheck 2

according to:

15.249

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12155-01-04

Note:

1 Element Materials Technology Straubing GmbH is the legal successor of EMV Testhaus GmbH. Therefore, until the ongoing procedure for renaming the conformity assessment body applied for at German Accreditation Body DAkkS is completed, the certificates and appropriate annexes of EMV Testhaus GmbH are referred to.

Accreditation:

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12155-01-04

FCC test firm accreditation expiration date: 2021-05-30
MRA US-EU, FCC designation number: DE0010
FCC registration number: 97268
BnetzA-CAB-02/21-02/5 Valid until 2023-11-26

Location of Testing:

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The technical accuracy is guaranteed through the quality management of Element Materials Technology Straubing GmbH.

Table of contents

List of figures

List of tables

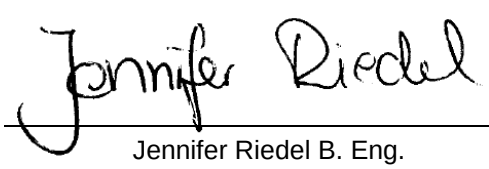
1 Summary of test results

47 CFR part and section	*Test*	*Page*	*Result*	*Note(s)*
15.207(a)	AC powerline conducted emissions	---	Not applicable	1
15.215(c)	20 dB bandwidth	23	Passed	---
15.249(e)	Correction for pulse operation (duty cycle)	26	Recorded	---
15.249(a)	Field strength of fundamental wave	23	Passed	---
15.249(d)	Spurious radiated emissions below 30 MHz	33	Passed	---
15.249(d)	Spurious radiated emissions from 30 MHz to 1 GHz	36	Passed	---
15.249(d)	Spurious radiated emissions above 1 GHz	39	Passed	---

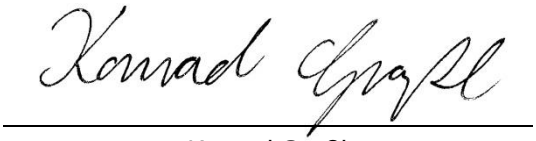
Notes (for information about EUT see clause 3):

1 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, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

Straubing, March 22, 2021



Jennifer Riedel B. Eng.
Radio Test Engineer



Konrad Graßl
Department Manager Radio

2 Referenced publications

Publication	*Title*
CFR 47 Part 2 October 2019	Code of Federal Regulations, Title 47 (Telecommunication), Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)
CFR 47 Part 15 October 2019	Code of Federal Regulations, Title 47 (Telecommunication), Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.10 June 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3 Equipment under test (EUT)

All Information in this clause is declared by customer.

3.1 General information

Product type:	Force gauge		
Model name:	PowerCheck 2		
Serial number(s):	837461		
Manufacturer:	OTT-JAKOB Spanntechnik GmbH		
Version:	Hardware:	Version B	
	Software:	Version E	
Short description:	EUT is a force gauge that transmits the measurement results to a receiver in the frequency band from 2407 MHz to 2458 MHz.		
Additional modifications:	None		
FCC ID:	2AXLG-OJ2501		
Power supply:	Battery supply		
	Nominal voltage:	3 V	
Device type:	☐ Portable	☐ Mobile	☒ Fixed

3.2 Radio specifications

System type:	RF Transmitter
Frequency range:	2400-2483.5 MHz
Operating frequencies:	2407 MHz to 2458 MHz
Channel spacing:	200 kHz
Number of RF channels:	255
Modulation type(s):	GFSK
Antenna type(s):	2.4 GHz SMD antenna
Antenna gain(s):	2.1 dBi (maximum)

Channel	*Frequency (MHz)*
Low	2407
Middle	2413.4
High	2458

Table 1: Tested channel(s)

3.3 Photo documentation

For external photos of the EUT see annex B, for internal ones see annex C.
Photos taken during testing including EUT positions can be found in annex A.

4 Test configuration and mode of operation

4.1 Test configuration

Device	*Type designation*	*Serial or inventory no.*	*Manufacturer*
Force gauge	PowerCheck 2	837461	OTT-JAKOB Spanntechnik GmbH

Table 2: EUT used for testing

Device	*Type designation*	*Serial or inventory no.*	*Manufacturer*
Laptop	Lifebook A531	E001053	FUJITSU
Power supply for laptop	AC adapter	E001053	FUJITSU

Table 3: Support equipment used for testing

Port	*Classification*
USB	Signal/control

Table 4: Ports of EUT and appropriate cables

4.2 Mode of operation

The EUT was connected to the laptop via USB. The appropriate channel was set via software “PuTTY”. After disconnecting the EUT from the laptop, the “manual” button was pressed until the display on the EUT was off. By pressing the “clear/off” button the EUT was set to continuously transmitting on the selected frequency.

5 Test procedures

5.1 General specifications

5.1.1 Test setups

Tabletop devices are placed on a non-conductive table with a height of 0.8 m. In case of AC power-line conducted emissions test, the rear of the EUT is located 40 cm to the vertical wall of the RF-shielded (screened) room which is used as vertical conducting plane. For radiated emission measurements above 1 GHz, tabletop devices are placed at a height of 1.5 m above the floor using a support made of styrene placed on top of the non-conductive table.

All other surfaces of tabletop or floor-standing EUTs are at least 80 cm from any other grounded conducting surface. This includes the case or cases of one or more LISNs when performing an AC power-line conducted emissions test.

Radiated emission measurements of equipment that can be used in multiple orientations (e.g. portable or handheld devices) are performed with the EUT in each of three orthogonal axis positions.

5.1.2 Conversion to conducted test results

If test procedures described herein are based on the use of an antenna-port conducted test configuration, but the EUT cannot provide such a configuration (e.g., portable or handheld devices with integral antenna), radiated tests are performed for demonstrating compliance to the conducted requirements.

If a radiated test configuration has to be used, then the measured power or field strength levels are converted to equivalent conducted power levels for comparison to the applicable limit. For this purpose, at first the radiated field strength or power levels are converted to EIRP as described in annex G of ANSI C63.10 and KDB Publication 412172, document D01. The equivalent conducted power is then determined by subtracting the EUT transmit antenna gain from the EIRP (assuming logarithmic representation).

For devices utilizing multiple antenna technologies, KDB Publication 662911 applies.

5.2 Antenna-port conducted measurements

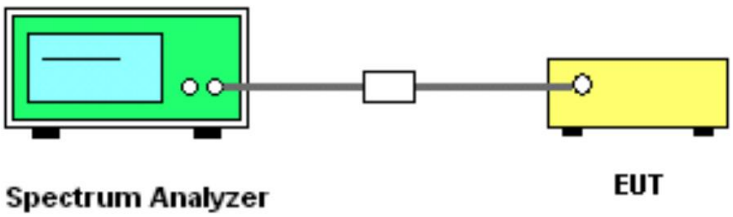


Figure 1: Setup for antenna-port conducted measurements

The RF signal of the EUT is measured conducted at the antenna port. In case of no permanent antenna connector available, a temporary antenna connector should be supplied by the manufacturer. The specific insertion loss of the signal path, which is matched to 50 Ohm, is determined. The test receiver is set to analyzer mode with pre-selector activated. The measurement readings on the test receiver are corrected by the signal path loss.

For frequency hopping systems (FHSS) and digital transmission systems (DTS) the settings as specified by KDB Publication 558074, document D01, are used.

If a radiated test configuration has to be used, conversion to conducted test results is performed according to clause 5.1.2.

5.3 AC powerline conducted emissions

AC power-line conducted emissions are measured according to clause 6.2 of ANSI C63.10 over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network. The tests are performed in a shielded room.

If the EUT normally receives power from another device that in turn connects to the public utility ac power lines, measurements are made on that device with the EUT in operation to demonstrate that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required.
For direct current (dc) powered devices where the ac power adapter is not supplied with the device, an “off-the-shelf” unmodified ac power adapter is used. If the device is supposed to be installed in a host (e.g., the device is a module or PC card), then it is tested in a typical compliant host.

Frequency (f)	*Measurement receiver bandwidth*	*Step size*	*Detector type*		
			Prescan	*Prescan with FFT*	*Final scan*
150 kHz ≤ f < 30 MHz	9 kHz	≤ 4.5 kHz	Peak, Average	Quasi-peak, Average	Quasi-peak, Average

Table 5: Bandwidth and detector type for AC power-line conducted emissions test

The AC power-line conducted emissions test is performed in the following steps:
a) The EUT is arranged as tabletop or floor-standing equipment, as applicable, and connected to a line impedance stabilization network (LISN) with 50 µH / 50 Ω. If required, a second LISN of the same type and terminated by 50 Ω is used for peripheral devices. The EUT is switched on.
b) The measurement equipment is connected to the LISN for the EUT and set-up according to the specifications of the test (see table 5). At the LISN, the neutral line is selected to be tested.

c) The prescan is performed with both detectors activated at the same time. If the test receiver is capable of FFT analysis, it is used for prescan, but not for final scan.
d) When the prescan is completed, maximum levels with less margin than 10 dB or exceeding the limit are determined and collected in a list.
e) With the first frequency of the list selected, a frequency zoom over a range of ten times of the measurement receiver bandwidth around this frequency is performed. If the EUT has no significant drift in frequency, the frequency zoom can be skipped.
f) For final scan, the emission level is measured and the maximum is recorded.
g) Steps e) to f) are repeated for all other frequencies in the list. At least the six highest EUT emissions relative to the limit have to be recorded.
h) Steps c) to g) are repeated for all current-carrying conductors of all of the power cords of EUT, i.e. all phase and (if used) neutral line(s).

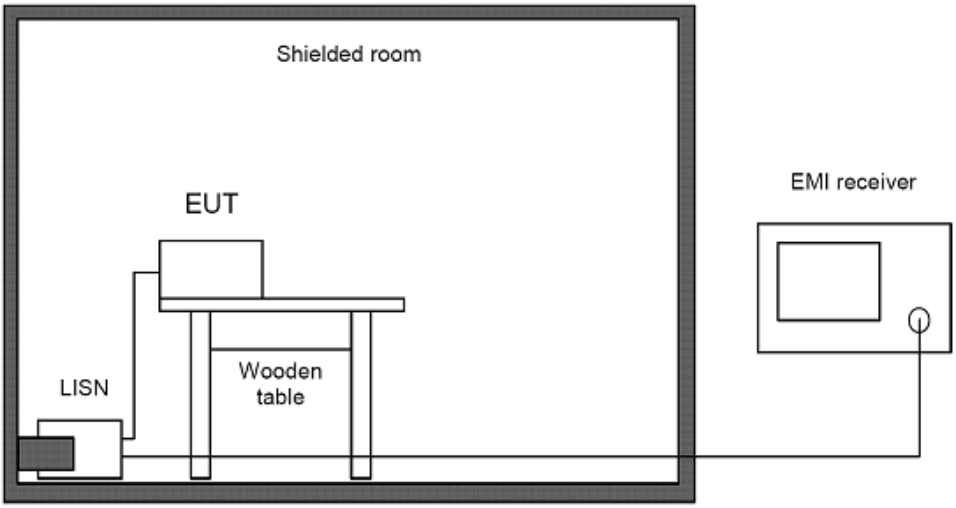


Figure 2: Setup for AC power-line conducted emissions test from 150 kHz to 30 MHz

Phase	*Frequency (MHz)*	*Reading value (dBµV)*	*AMN correction (dB)*	*Cable attenuation + 10 dB attenuator (dB)*	*Correction factor (Corr.) (dB)*	*Level (dBµV/m)*
L 1	10	10	0.6	10.9	11.5	21.5
N	10	10	1.0	10.9	11.9	21.9

Table 6: Sample calculation

Correction factor = Artifical mains network correction + Cable attenuation + 10 dB

Level = Reading value + Correction factor = 10 dBµV + 11.5 dB = 21.5 dBµV

Prescans are performed with all detectors activated at the same time. If the test receiver is capable of FFT analysis, it is used for prescans, but not for final scans. If no limit is specified for certain detectors, final scan measurement with these detectors may be omitted.

5.4 Radiated emissions below 30 MHz

Radiated emissions below 30 MHz are measured according to clause 6.4 of ANSI C63.10 using an inductive shielded loop antenna. As this antenna measures the magnetic field only, its antenna factors are converted to electric field strength values assuming a free space impedance of 377 Ω as described in clause 4.3.1 of ANSI C63.10. This results in an additional correction of 51.53 dB.

According to clause 6.4.3 of ANSI C63.10, at frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements. In this case, the results are extrapolated to the specified distance by using a recalculation factor determined according to one of the methods described in clause 6.4.4 of ANSI C63.10, provided that the maximum dimension of the device is equal to or less than 0.625 times the wavelength at the frequency being measured. As the minimum wavelength is 10 meters corresponding to the maximum frequency of 30 MHz, this requirement is fulfilled if the maximum dimension of the device is equal to or less than 6.25 meters.

Unless otherwise stated, the recalculation factor is determined according to clause 6.4.4.2 “Extrapolation from the measurement of a single point” of ANSI C63.10:

$d_{near\ field}$ = 47.77 / f_{MHz}, or
f_{MHz} = 47.77 / $d_{near\ field}$

The frequency f_{MHz} at which the near field distance is equal to the limit and/or test distance is important for selection of the right formula to determine the recalculation factor:

f_{MHz}(300 m) ≈ 0.159 MHz
f_{MHz}(30 m) ≈ 1.592 MHz
f_{MHz}(3 m) ≈ 15.923 MHz

Based on the test distances for the general radiated emission limits as specified in §15.209 of 47 CFR Part 15 or RSS-Gen, the following formulas are used to determine the recalculation factor:

Frequency (f)	d_{limit}	$d_{measure}$	*Formula for recalculation factor*
9 kHz ≤ f ≤ 159 kHz 490 kHz < f ≤ 1.592 MHz	300 m 30 m	3 m	$-40 \log(d_{limit} / d_{measure})$
159 kHz < f ≤ 490 kHz 1.592 MHz < f ≤ 15.923 MHz	300 m 30 m	3 m	$-40 \log(d_{near\ field} / d_{measure}) - 20 \log(d_{limit} / d_{near\ field})$
f > 15.923 MHz	30 m	3 m	$-20 \log(d_{limit} / d_{measure})$

Table 7: Recalculation factors for extrapolation

Prescans for radiated measurements below 30 MHz are performed in a fully anechoic room (called “CDC”). The measurement distance is 3 meters. The emissions of the EUT are recorded with an EMI test receiver configured as described in table 8.

Frequency (f)	*Measurement receiver bandwidth*	*Step size*	*Detector type*		
			Prescan	*Prescan with FFT*	*Final scan*
9 kHz ≤ f < 150 kHz	200 Hz	≤ 100 Hz	Peak, Average	Peak Quasi-peak, Average	Peak Quasi-peak, Average
150 kHz ≤ f < 30 MHz	9 kHz	≤ 4.5 kHz	Peak, Average	Peak Quasi-peak, Average	Peak Quasi-peak, Average

Table 8: Bandwidth and detector type for radiated emissions test below 30 MHz

Frequency (MHz)	*Reading value (dBµV)*	*Antenna correction (dB/m)*	*Cable attenuation (dB)*	*Correction factor (Corr.) (dB)*	*Level (dBµV/m)*
10	20.00	19.59	0.33	19.92	39.92

Table 9: Sample calculation

Correction factor = Antenna correction + Cable attenuation

Level = Reading value + Correction factor = 20 dBµV + 19.92 dB = 39.92 dBµV/m

Prescans are performed with all detectors activated at the same time. If the test receiver is capable of FFT analysis, it is used for prescans, but not for final scans. If no limit is specified for certain detectors, final scan measurement with these detectors may be omitted.

The radiated emissions test below 30 MHz is performed in the following steps:

a) The loop antenna is positioned with its plane perpendicular to the ground with the lowest height of the antenna 1 m above the ground.
b) The EUT is placed in its standard position on a turntable capable of rotation through 360° in the horizontal plane and arranged as tabletop or floor-standing equipment, as applicable. The EUT is switched on.
c) The measurement equipment is connected to the loop antenna and set-up according to the specifications of the test (see table 8).
d) The EUT is turned to a position likely to get the maximum and the test antenna is rotated to detect the maximum of the fundamental in this EUT position.
e) Then the EUT is rotated in a horizontal plane through 360° in steps of 45°. Starting at 0°, at each table position the spectrum for the full frequency range is recorded. If the emission at a certain frequency is higher than the levels already recorded, the current table position is noted as the maximum position.
f) After the last prescan, the significant maximum emissions and their table positions are determined and collected in a list.
g) With the test receiver set to the first frequency of the list, the EUT is rotated by ±45° around the table position found during prescans while measuring the emission level continuously. For final scan, the worst-case table position is set and the maximum emission level is recorded.
h) Step g) is repeated for all other frequencies in the list.
i) Finally, for frequencies with critical emissions the loop antenna is rotated again to find the maximum of emission. At least, frequency and level of the six highest emissions relative to the limit have to be recorded. However, emissions more than 20 dB below the limit do not need to be reported.

If the EUT may be used in various positions, steps a) to i) are repeated in two other orthogonal positions. If the EUT may be used in one position only, steps a) to i) are repeated in one orthogonal position.

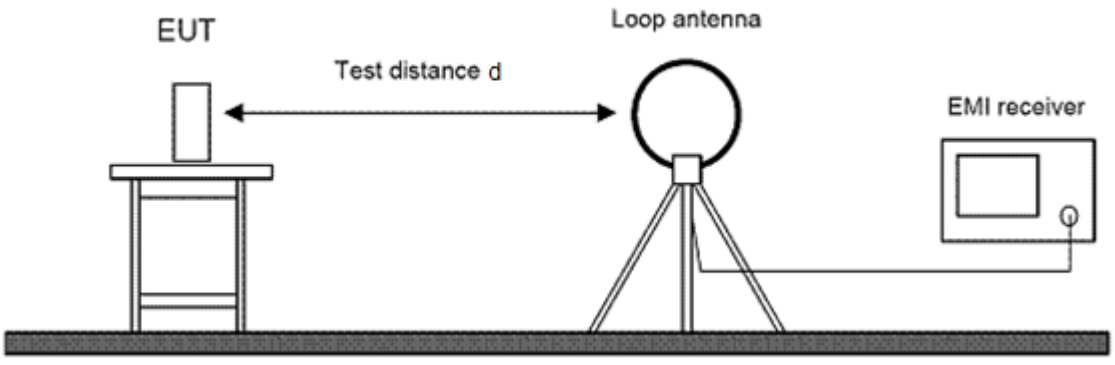


Figure 3: Setup for radiated emissions test below 30 MHz

5.5 Radiated emissions from 30 MHz to 1 GHz

Radiated emissions in the frequency range 30 MHz to 1 GHz are measured according to clause 6.5 of ANSI C63.10 using a semi-anechoic chamber (SAC) with a ground plane on the floor. The measurement distance is 3 meters. The emissions of the EUT are recorded with an EMI test receiver configured as described in table 10.

Frequency (f)	*Measurement receiver bandwidth*	*Step size*	*Detector type*		
			Prescan	*Prescan with FFT*	*Final scan*
30 MHz ≤ f ≤ 1 GHz	120 kHz	≤ 60 kHz	Peak	Quasi-peak	Quasi-peak

Table 10: Bandwidth and detector type for radiated emissions test from 30 MHz to 1 GHz

Frequency (MHz)	*Reading value (dBµV)*	*Antenna correction (dB/m)*	*Cable attenuation (dB)*	*Correction factor (Corr.) (dB)*	*Level (dBµV/m)*
100	30.00	11.71	1.06	12.77	42.77

Table 11: Sample calculation

Correction factor = Antenna correction + Cable attenuation

Level = Reading value + Correction factor = 30 dBµV + 12.77 dB = 42.77 dBµV/m

The measurement antenna is a combination of a biconical antenna and a logarithmic-periodic dipole array antenna. It is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization and in a height between 1 m and 4 m above the ground plane.

If the test receiver is capable of FFT analysis, it is used for prescans, but not for final scans.

The radiated emissions test from 30 MHz to 1 GHz is performed in the following steps:

a) The measurement antenna is oriented initially for vertical polarization.
b) The EUT is placed in its standard position on a turntable capable of rotation through 360° in the horizontal plane and arranged as tabletop or floor-standing equipment, as applicable. The EUT is switched on.
c) The measurement equipment is connected to the measurement antenna and set-up according to the specifications of the test (see table 10).
d) The table position is set to 0°.
e) The antenna height is set to 1 m.
f) The spectrum for the full frequency range is recorded. If the emission at a certain frequency is higher than the levels already recorded, the polarization and height of the measurement antenna as well as the current table position are noted as the maximum position.
g) The antenna height is increased to 4 m in steps of 50 cm. At each height, step f) is repeated.
h) The polarization of the measurement antenna is changed to horizontal.
i) The antenna height is decreased from 4 m to 1 m in steps of 50 cm. At each height, step f) is repeated.
j) The EUT is rotated in a horizontal plane through 360° in steps of 60°. At each table position, steps e) to i) are repeated.
k) After the last prescan, the significant maximum emissions with their polarizations and heights of the measurement antenna as well as their table positions are determined and collected in a list.
l) With the test receiver set to the first frequency of the list, the measurement antenna is set to the polarization and height and the table is moved to the position as determined during prescans.
m) The antenna is moved by ±50 cm around this height and the EUT is rotated by ±60° around this table position while measuring the emission level continuously.
n) For final scan, the worst-case positions of antenna and table are set and the maximum emission level is recorded.
o) Steps l) to n) are repeated for all other frequencies in the list. At least, frequency and level of the six highest emissions relative to the limit have to be recorded. However, emissions more than 20 dB below the limit do not need to be reported.

If the EUT may be used in various positions, steps a) to o) are repeated in two other orthogonal positions.

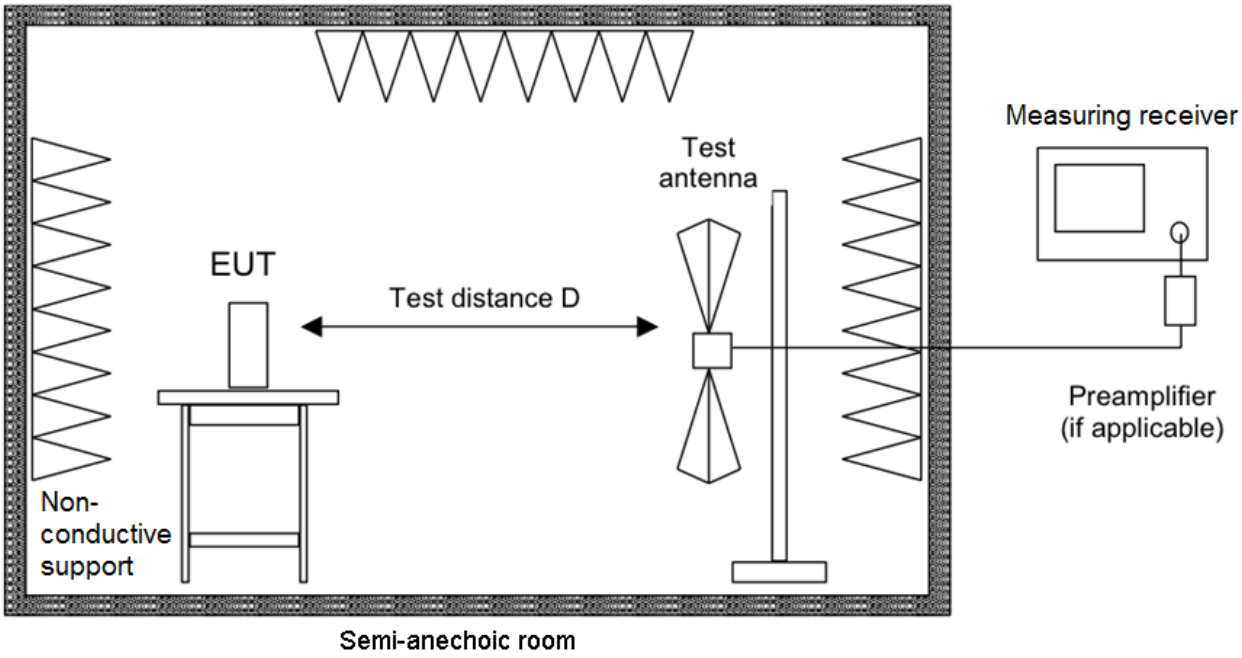


Figure 4: Setup for radiated emissions test from 30 MHz to 1 GHz

5.6 Radiated emissions above 1 GHz

Radiated emissions above 1 GHz are measured according to clause 6.6 of ANSI C63.10 by conducting exploratory and final radiated emission tests. According to clause 6.6.4.1 of ANSI C63.10, measurements may be performed at a distance closer than that specified in the requirements. However, an attempt shall be made to avoid making final measurements in the near field of both the measurement antenna and the EUT.

For measurement of radiated emissions above 1 GHz, horn antennas are used.

Test chamber	*Frequency (MHz)*	*Reading value (dBµV)*	*Antenna correction (dB/m)*	*Correction pre-amplifier (dB)*	*Cable attenuation (dB)*	*Correction factor (Corr.) (dB)*	*Level (dBµV/m)*
SAC3	2400	50.00	27.76	-47.91	5.24	-14.92	35.08
FS-SAC	2400	50.00	27.76	-34.57	3.51	-3.30	46.70

Table 12: Sample calculation

Correction factor = Antenna correction + Correction pre-amplifier + Cable attenuation

SAC3:
Level = Reading value + Correction factor = 50.00 dBµV - 14.92 dB/m = 35.08 dBµV/m

FS-SAC:
Level = Reading value + Correction factor = 50.00 dBµV - 3.30 dB/m = 46.70 dBµV/m

5.6.1 Exploratory radiated emissions measurements

Exploratory radiated emissions above 1 GHz are measured in a semi-anechoic chamber with RF absorbing material on the floor or a fully anechoic room. They are performed by moving the receiving antenna over all sides of the EUT at a closer distance (e.g. 0.5 or 1 m) while observing the display of the test receiver to find the emissions to be re-tested during final radiated emission measurements.

According to clause 5.3.3 of ANSI C63.10, when performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements). To simplify testing and documentation, the limits are increased accordingly instead of decreasing the results.

The emissions of the EUT are displayed and recorded with an EMI test receiver operating in the spectrum analyzer mode using the settings as described in table 13.

Frequency (f)	*Resolution bandwidth*	*Video bandwidth*	Sweep time	*Trace detector(s)*	*Trace mode(s)*	*Test*
f ≥ 1 GHz	1 MHz	3 MHz	AUTO	Max Peak, Average	Clear Write	Searching
					Max Hold	Recording

Table 13: Bandwidth and trace settings for exploratory radiated emissions test above 1 GHz

If during exploratory radiated emissions measurements no levels to be re-tested are found, the final radiated emissions measurement may be omitted. In this case, the chart of the exploratory radiated emissions measurements has to be reported.

5.6.2 Final radiated emissions measurements

Final radiated emissions above 1 GHz are measured in the semi-anechoic chamber (SAC3) or Free space semi-anechoic chamber (FS-SAC) with RF absorbing material on the floor between measurement antenna and EUT. The measurement distance is 3 meters in the semi-anechoic chamber (SAC3) or 1.5 m in the Free space semi-anechoic chamber (FS-SAC). The emissions of the EUT are recorded with an EMI test receiver configured as described in table 14.

Frequency (f)	*Measurement receiver bandwidth*	*Step size*	*Detector type*	
			Prescan	*Final scan*
f ≥ 1 GHz	1 MHz	≤ 500 kHz	Peak, Average	Peak, Average

Table 14: Bandwidth and detector type for final radiated emissions test above 1 GHz

Prescans are performed with both detectors activated at the same time. If the test receiver is capable of FFT analysis, it is used for prescans, but not for final scans.

The horn antenna is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization and to be moved in a scan height range between 1 m and the scan height upper range defined in clause 6.6.3.3 of ANSI C63.10. When the EUT is manipulated through three different orientations, the scan height upper range for the measurement antenna is limited to 2.5 m above the ground plane.or 0.5 m above the top of the EUT, whichever is higher. Otherwise, the scan height upper range is 4 m above the ground plane.
To keep the emission signal within the illumination area of the 3 dB beamwidth of the measurement antenna, the automatic tilt function of the antenna support device is used to point the antenna at an angle toward the source of the emission.

The final radiated emissions test above 1 GHz is performed in the following steps:

a) The measurement antenna is oriented initially for vertical polarization.
b) The EUT is placed in its standard position on a turntable capable of rotation through 360° in the horizontal plane and arranged as tabletop or floor-standing equipment, as applicable. The EUT is switched on.
c) The measurement equipment is connected to the measurement antenna and set-up according to the specifications of the test (see table 14).
d) The table position is set to 0°.
e) The antenna height is set to 1 m.
f) The spectrum for the full frequency range is recorded. If the emission at a certain frequency is higher than the levels already recorded, the polarization and height of the measurement antenna as well as the current table position are noted as the maximum position.
    g) The antenna height is increased to the scan height upper range in steps of 50 cm. At each height, step f) is repeated.
h) The polarization of the measurement antenna is changed to horizontal.
i) The antenna height is decreased from the scan height upper range to 1 m in steps of 50 cm. At each height, step f) is repeated.
j) The EUT is rotated in a horizontal plane through 360° in steps of 30°. At each table position, steps e) to i) are repeated.
k) After the last prescan, the significant maximum emissions with their polarizations and heights of the measurement antenna as well as their table positions are determined and collected in a list.
l) With the test receiver set to the first frequency of the list, the measurement antenna is set to the polarization and height and the table is moved to the position as determined during prescans.
m) The antenna is moved by ±50 cm around this height and the EUT is rotated by ±30° around this table position while measuring the emission level continuously.
n) For final scan, the worst-case positions of antenna and table are set and the maximum emission level is recorded.
o) Steps l) to n) are repeated for all other frequencies in the list. At least, frequency and level of the six highest emissions relative to the limit have to be recorded. However, emissions more than 20 dB below the limit do not need to be reported.

If the EUT may be used in various positions, steps a) to o) are repeated in two other orthogonal positions.

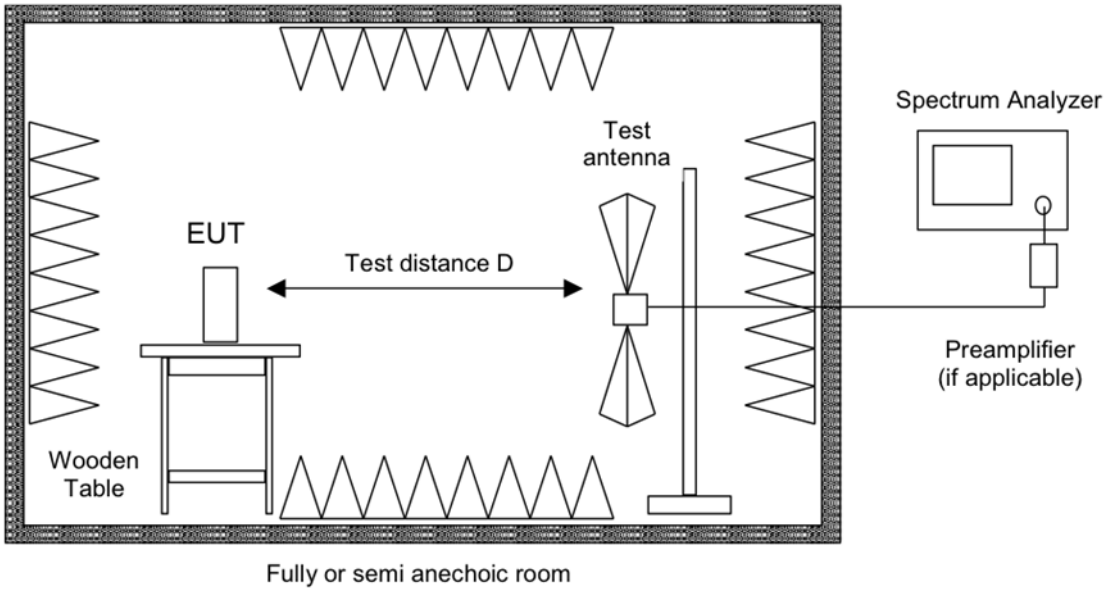


Figure 5: Setup for radiated emissions test above 1 GHz

5.7 Bandwidth measurements

In case of antenna-port conducted tests as described in clause 5.2 cannot be performed, according to section 3.0 of KDB 558074 D01, results of radiated tests are used for demonstrating compliance to the conducted emission requirements. For details about conversion see clause 5.1.2

5.7.1 99 % occupied bandwidth

According to section 6.7 of RSS-Gen, the occupied bandwidth (OBW) is defined as the 99 % emission bandwidth.

The span of the spectrum analyzer is set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
The resolution bandwidth is in the range of 1 % to 5 % of the occupied bandwidth and the video bandwidth is not smaller than three times the resolution bandwidth. Video averaging is not permitted.
If possible, the detector of the spectrum analyzer is set to “Sample”. However, if the device is not transmitting continuously, a peak, or peak hold is used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement).

To measure the 99 % emission bandwidth, the OBW function of the test receiver is used with the power bandwidth set to 99 %. This function indicates the lowest frequency (starting from the left side of the span) and the highest frequency (starting from the right side of the span) where 0.5% of the total sum is reached. The difference between the two frequencies is the 99 % occupied bandwidth.

5.7.2 20 dB bandwidth

The 20 dB bandwidth test method refers to section 6.9.2 of ANSI C63.10 and shall be as follows:

Spectrum analyzer settings:
Spectrum analyzer center frequency = nominal EUT channel center frequency
Span = between two times and five times the OBW
IF filter bandwidth (3 dB RBW) = between 1 % to 5 % of the OBW
VBW ≥ 3 x RBW
Detector function = peak
Trace mode = max hold
Reference level: more than 10·log(OBW/RBW) dB above peak of spectral envelope

Measure the maximum width of the emission that is constrained by the frequencies associated with the two markers (upper and lower frequencies) that are at or slightly below the 20 dB down amplitude relative to the maximum level measured in the fundamental emission.
If possible, use the automatic bandwidth measurement capability of the spectrum analyzer using the X dB bandwidth mode with X set to 20 dB. Submit this plot(s).
The 20 dB bandwidth is the frequency difference between the two markers.

6 Test results

This clause gives details about the test results as collected in the summary of test results on page 6.

For information about measurement uncertainties see page 49.

The climatic conditions are recorded during the tests. It is ensured that the climatic conditions are within the following ranges:

Ambient temperature	*Ambient humidity*	*Ambient pressure*
15°C to 35°C	30 % to 75 %	86 kPa to 106 kPa

6.1 20 dB bandwidth

Section(s) in 47 CFR Part 15:	Requirement(s): Reference(s)	15.215(c) ANSI C63.10, clause 6.9	

Performed by:	Jennifer Riedel B. Eng.	Date(s) of test:	March 17, 2021
Result:	☒ Test passed	☐ Test not passed	

6.1.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Free space semi-anechoic chamber (FS-SAC)	FS-SAC	ELEMENT STRAUBING	E00100
EMI test receiver	ESU 26	Rohde & Schwarz	W00002
Horn antenna	BBHA 9120D	Schwarzbeck	W00053

6.1.2 Limits

According to §15.215(c):
Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the frequency band designated in the rule section under which the equipment is operated.

6.1.3 Test procedure

The 20 dB bandwidth is measured using the test procedure as described in clause 5.7.2.

6.1.4 Test results

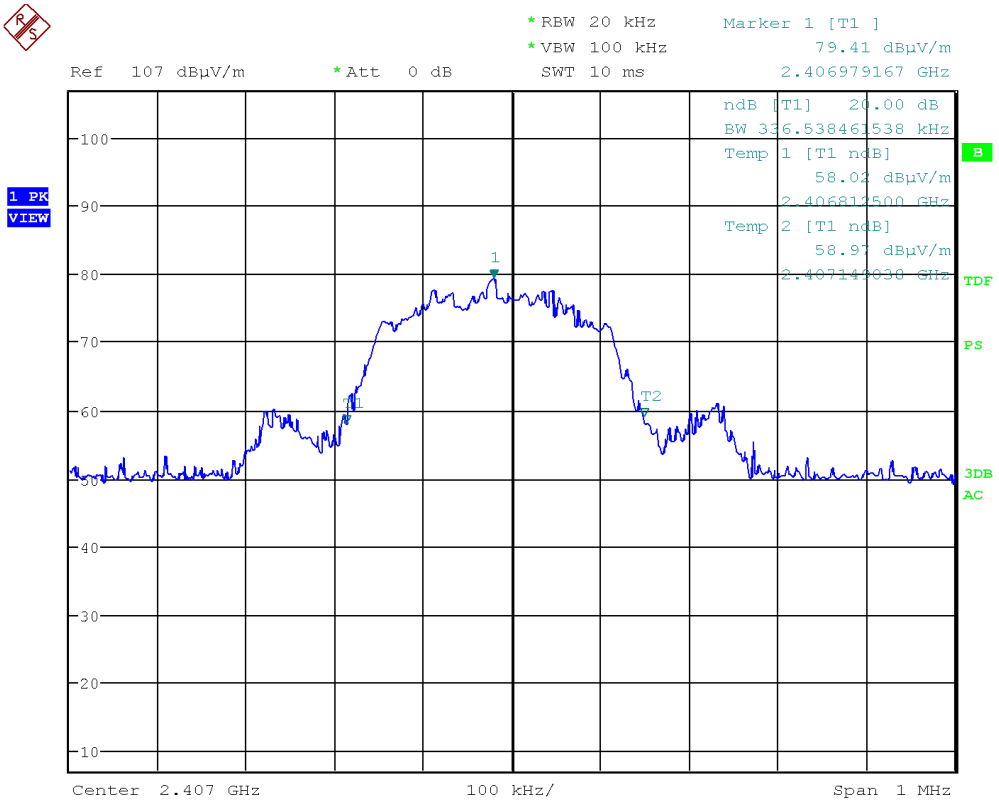


Figure 6: Chart of 20 dB bandwidth test on lowest channel

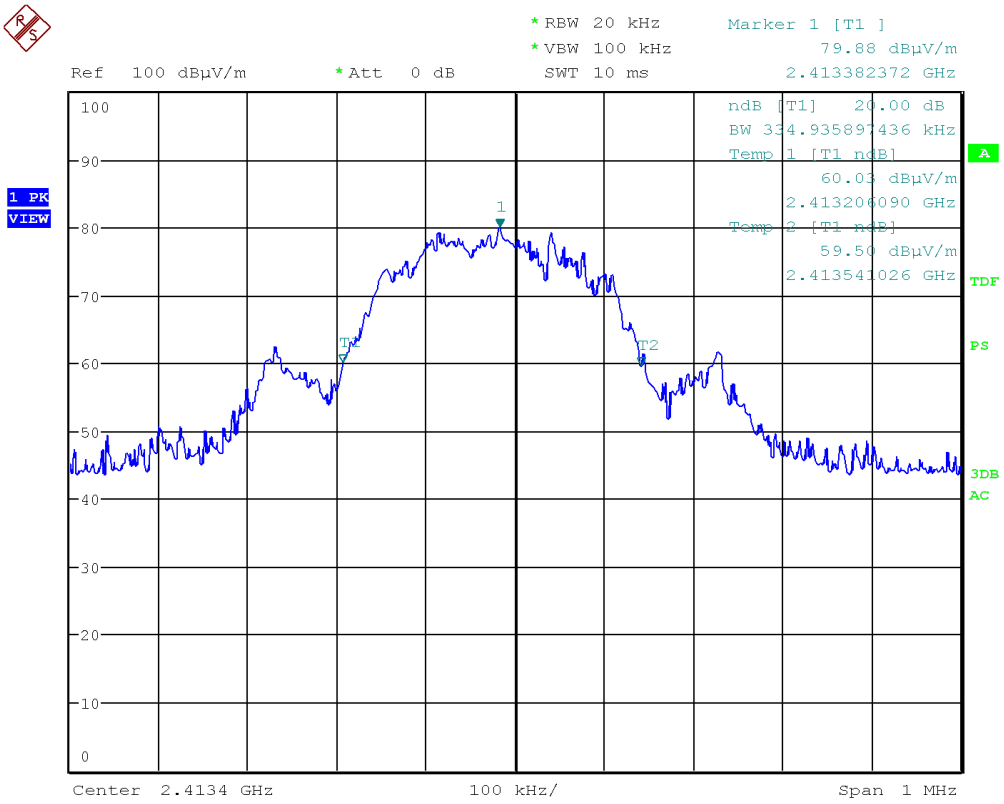


Figure 7: Chart of 20 dB bandwidth test on middle channel

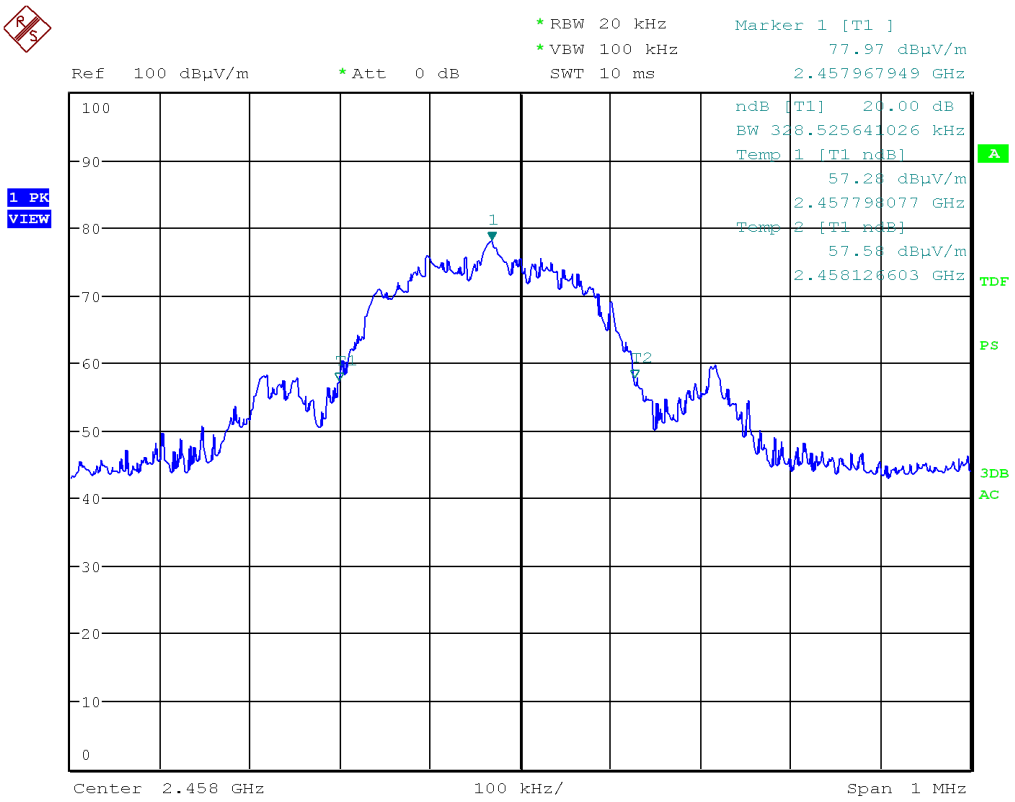


Figure 8: Chart of 20 dB bandwidth test on highest channel

Channel	*20 dB bandwidth (kHz)*	*Lower frequency of bandwidth (MHz)*	*Lower frequency of designated band (MHz)*	*Upper frequency of bandwidth (MHz)*	*Upper frequency of designated band (MHz)*	*Result*
low	336.538	2406.813	2400.000	2407.149	2483.500	Passed
middle	334.936	2413.206	2400.000	2413.541	2483.500	Passed
high	328.526	2457.798	2400.000	2458.127	2483.500	Passed

Table 15: Final results of 20 dB bandwidth

6.2 Correction for pulse operation (duty cycle)

Section(s) in 47 CFR Part 15: Requirement(s): 15.249(e)
Reference(s) ANSI C63.10, clause 7.5

Performed by:	Jennifer Riedel B. Eng.	Date(s) of test:	March 17, 2021
Result:	☒ Test passed	☐ Test not passed	

6.2.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Free space semi-anechoic chamber (FS-SAC)	FS-SAC	ELEMENT STRAUBING	E00100
EMI test receiver	ESU 26	Rohde & Schwarz	W00002
Horn antenna	BBHA 9120D	Schwarzbeck	W00053
Cable set FS-SAC	RF cable(s)	Teledyne Reynolds Huber + Suhner Teledyne Reynolds	E00435 E00307 E00433

6.2.2 Requirement

According to 15.249(e):
As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in Table 17 are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

According to §15.35(b):
Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g., see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

6.2.3 Test procedure

According to §15.35(c):
When the radiated emissions limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined form the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

The duty cycle is measured using the transmitting of one data packet.
The duty cycle factor (dB) is calculated applying the following formula:

$$KE = 20\lg\frac{tiB * p}{\mathrm{Tw}}$$

K_E	pulse operation correction factor	(dB)
t_{iw}	pulse duration for one complete pulse track	(ms)
t_{ib}	pulse duration for one pulse	(ms)
T_w	a period of the pulse track	(ms)
P	number of pulses in one train	(ms)

6.2.4 Test results

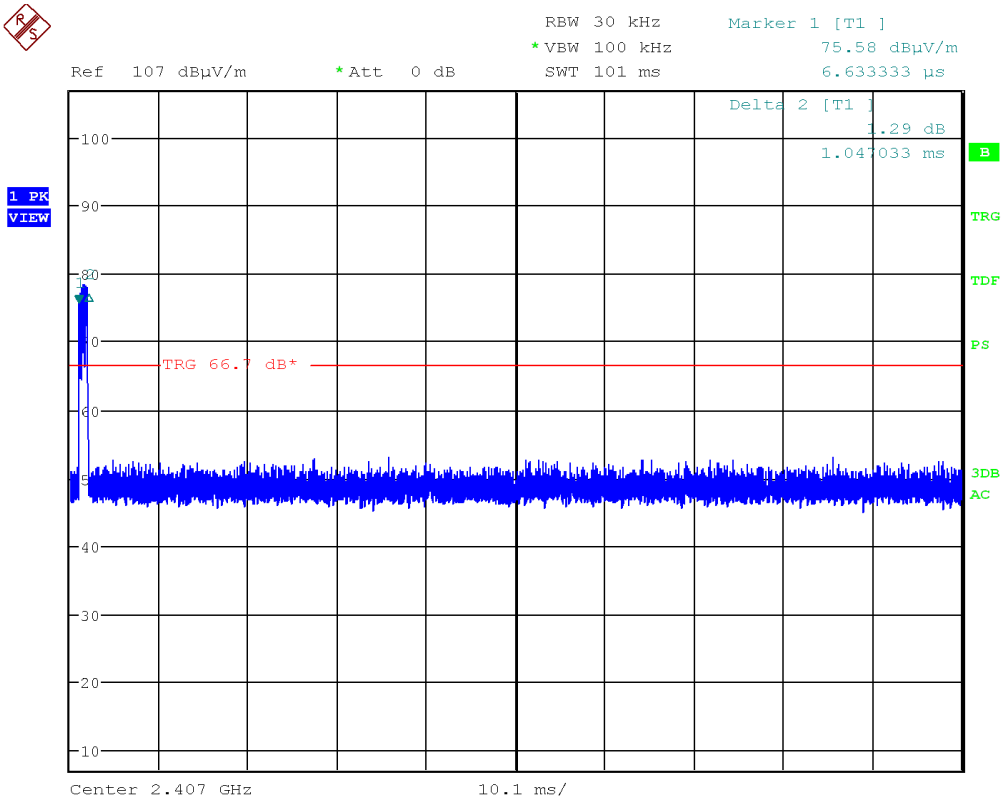


Figure 9: Detailed view of signal in 100 ms (Trigger-offset -1 ms) on lowest channel

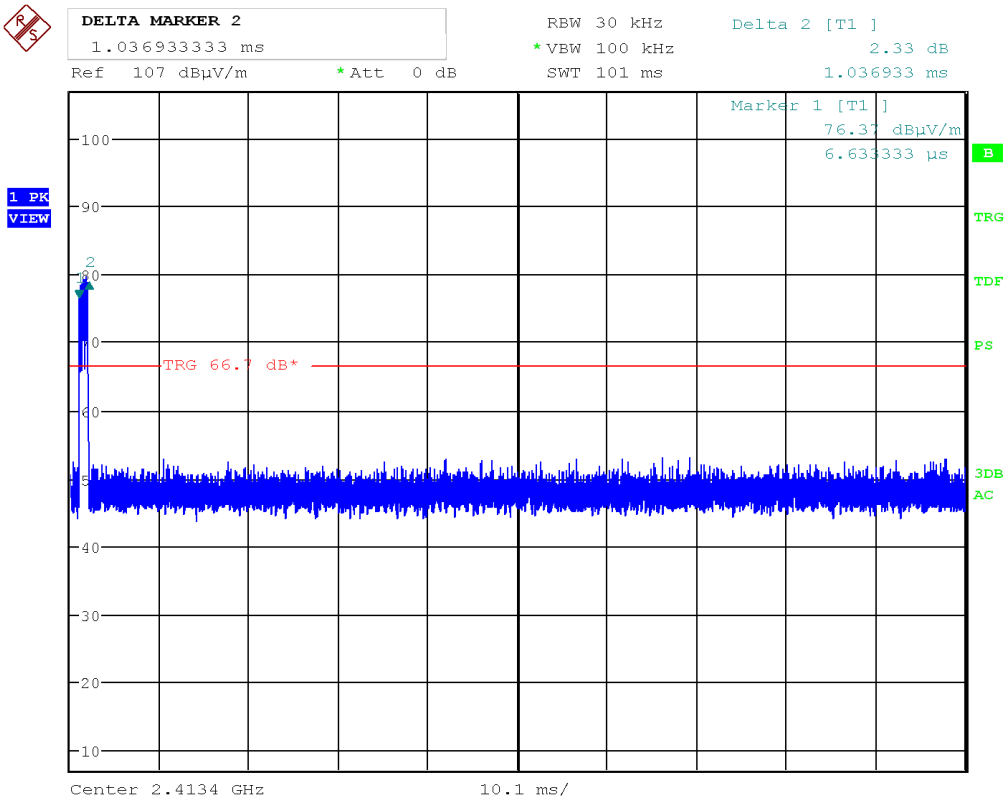


Figure 10: Detailed view of signal in 100 ms (Trigger-offset -1 ms) on middle channel

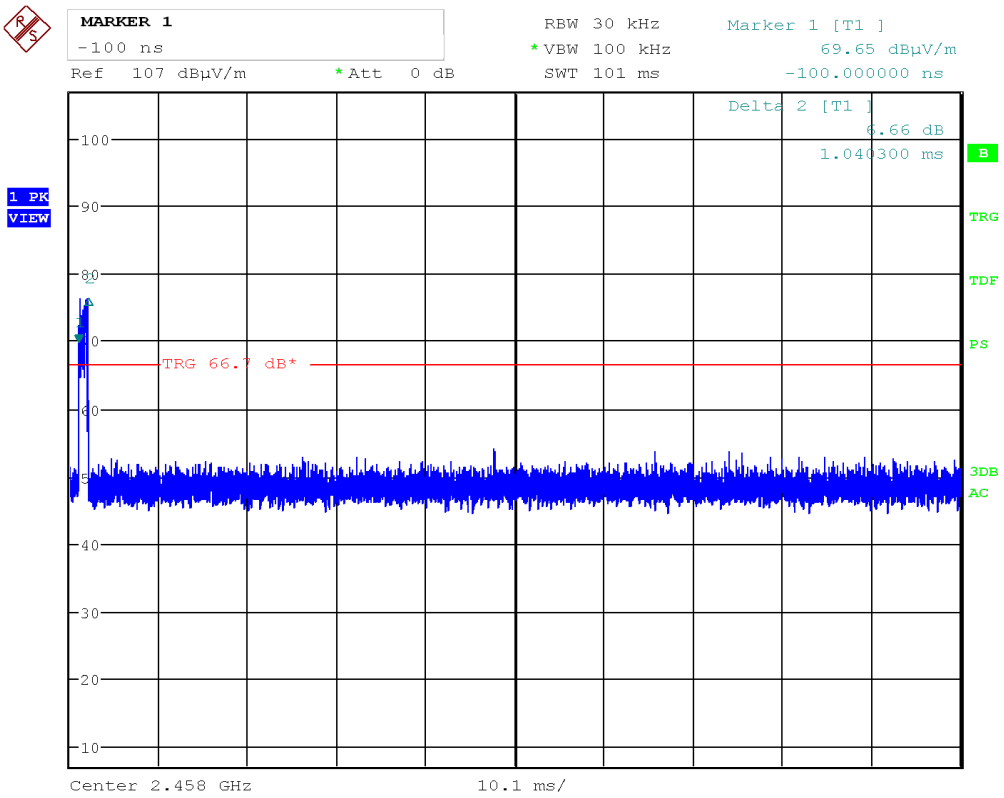


Figure 11: Detailed view of signal in 100 ms (Trigger-offset -1 ms) on highest channel

Channel	*Duration of one burst ti_B (ms)*	*Number of bursts p*	*Whole duration time T_W (ms)*	*Duty cycle factor KE (dB)*	*Result*
low	1.047	1	100	-39.6	Recorded
middle	1.037	1	100	-39.7	Recorded
high	1.040	1	100	-39.7	Recorded

Table 16: Final results of duty cycle factor

The duty cycle factor KE is calculated with the following formula:

$$KE = 20lg\frac{ti_B \cdot p}{T_W}$$

6.3 Field strength of fundamental wave

Section(s) in 47 CFR Part 15:	Requirement(s): Reference(s)	15.249(a) ANSI C63.10, clause 6.5	

Performed by:	Jennifer Riedel B. Eng.	Date(s) of test:	March 10, 2021
Result:	☒ Test passed	☐ Test not passed	

6.3.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Free space semi-anechoic chamber (FS-SAC)	FS-SAC	ELEMENT STRAUBING	E00100
EMI test receiver	ESU 26	Rohde & Schwarz	W00002
Horn antenna	BBHA 9120D	Schwarzbeck	W00053
Cable set FS-SAC	RF cable(s)	Teledyne Reynolds Huber + Suhner Teledyne Reynolds	E00435 E00307 E00433

6.3.2 Limits

According to 15.249(a):
The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Frequency (MHz)	*Field strength (mV/m)*	*Field strength (dBµV/m)*	*Measurement distance d (m)*
902-928	50	94	3
2400-2483.5	50	94	3
5725-5875	50	94	3
24000-24250	250	108	3

Table 17: Limits for field strength according to 15.249(a)

According to 15.249(e):
As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

6.3.3 Test procedure

The field strength of fundamental wave is measured using the test procedure as described in clause 5.6.

6.3.4 Test results

Test distance:	☐ 3 m	☐ 10 m	☒ 1.5 m
Polarisation:	☒ horizontal	☒ vertical	
EUT position:	☒ Position X	☒ Position Y	☐ Position Z

Note(s):
1 Premeasurements were performed to declare the worst case which is documented below.

Channel	*Level PK (dBµV/m)*	*Limit PK (dBµV/m)*	*Margin PK (dB)*	*Duty cycle factor (dB)*	*Level AV (dBµV/m)*	*Limit AV (dBµV/m)*	*Margin AV (dB)*	*Result*
low	83.61	114.00	30.39	-39.6	44.01	94.00	49.99	Passed
middle	81.99	114.00	32.01	-39.7	42.29	94.00	51.71	Passed
high	77.52	114.00	36.48	-39.7	37.82	94.00	56.18	Passed

Table 18: Test result of field strength of fundamental wave, EUT position X, antenna polarization horizontal

6.4 Spurious radiated emissions below 30 MHz

Section(s) in 47 CFR Part 15:	Requirement(s):	15.249(b)	
	Reference(s)	ANSI C63.10, clause 6.4	

Performed by:	Jennifer Riedel B. Eng.	Date(s) of test:	March 15, 2021
Result:	☒ Test passed	☐ Test not passed	

6.4.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Compact Diagnostic Chamber (CDC)	VK041.0174	Albatross Projects	E00026
EMI test receiver	ESW 44	Rohde & Schwarz	E00895
Loop antenna	HFH2-Z2	Rohde & Schwarz	E00060
Cable set CDC	RF cable(s)	Huber + Suhner AME HF-Technik AME HF-Technik Stabo	E00446 E00920 E00921 E01215
Test software	EMC32-EB (V10.35)	Rohde & Schwarz	E00777

6.4.2 Limits

According to §15.249(d):
Emissions radiated outside the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Frequency	*Field strength*		*Measurement distance*
(MHz)	*(µV/m)*	*(dBµV/m)*	*(m)*
0.009 – 0.490	2400/F(kHz) (266.67 – 4.90)	48.52 – 13.80	300
0.490 – 1.705	24000/F(kHz) (48.98 – 14.08)	33.80 – 22.97	30
1.705 – 30	30	29.54	30

Table 19: General radiated emission limits up to 30 MHz according to §15.209

6.4.3 Test procedure

The emissions below 30 MHz are measured using the test procedure for radiated measurements as described in clause 5.4.

6.4.4 Test results

Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
Antenna alignment:	☒ in parallel	☒ in line	☐ angle ….. °
EUT position:	☒ Position X	☒ Position Y	☐ Position Z

Note(s):
1 Premeasurements were performed to declare the worst case which is documented below.
2 No assessable emissions could be detected.
3 Premeasurements have shown that there are no differences between the tested channels below 30 MHz, so the final measurement was only performed on middle channel.
4 The radiated emission limits according to § 15.209 are applied.

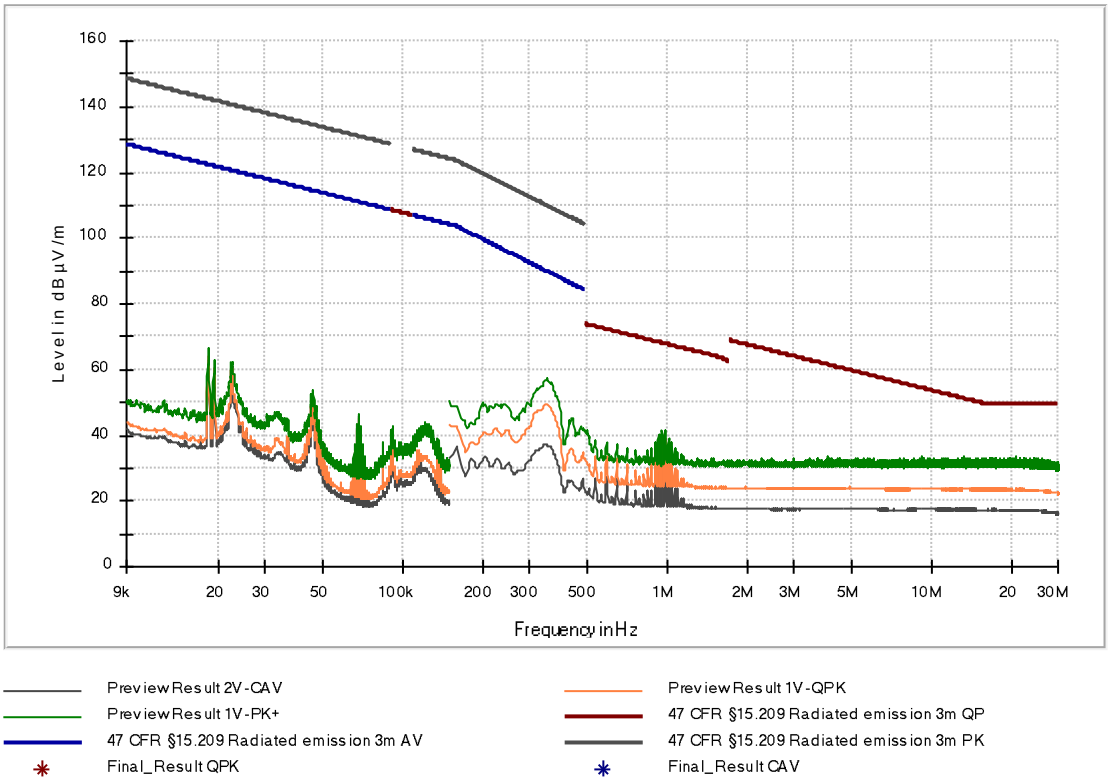


Figure 12: Chart of spurious radiated emission test below 30 MHz on middle channel, EUT position X, antenna parallel to the EUT

6.5 Spurious radiated emissions from 30 MHz to 1 GHz

Section(s) in 47 CFR Part 15:	Requirement(s):	15.249(d)	
	Reference(s)	ANSI C63.10, clause 6.5	

Performed by:	Jennifer Riedel B. Eng.	Date(s) of test:	March 11, 2021
Result:	☒ Test passed	☐ Test not passed	

6.5.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
EMI test receiver	ESR 7	Rohde & Schwarz	E00739
TRILOG broadband antenna (SAC)	VULB 9162	Schwarzbeck	E00643
Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

6.5.2 Limits

According to §15.249(d):
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Frequency	*Field strength*		*Measurement distance*
(MHz)	*(µV/m)*	*(dBµV/m)*	*(m)*
30 – 88	100	40.00	3
88 – 216	150	43.52	3
216 - 960	200	46.02	3
Above 960	500	53.98	3

Table 20: General radiated emission limits ≥ 30 MHz according to §15.209

6.5.3 Test procedure

The emissions from 30 MHz to 1 GHz are measured using the test procedure for radiated measurements as described in clause 5.5.

6.5.4 Test results

Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
Polarisation:	☒ horizontal	☒ vertical	
EUT position:	☒ Position X	☒ Position Y	☒ Position Z

Note(s):
1 Premeasurements were performed to declare the worst case which is documented below.
2 Premeasurements have shown that there are no differences between the tested channels from 30 MHz to 1 GHz, so the final measurement was only performed on lowest channel.
3 The radiated emission limits according to § 15.209 are applied.

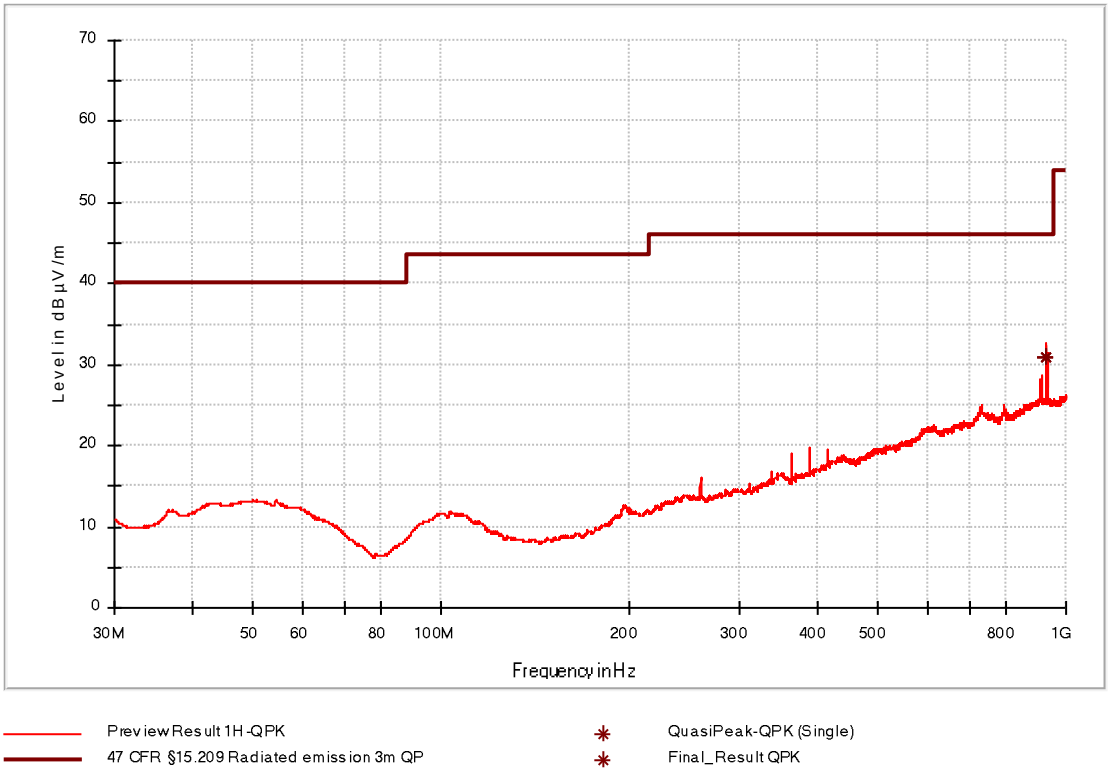


Figure 13: Chart of spurious radiated emission test 30 MHz - 1 GHz on lowest channel, EUT position X, antenna polarization horizontal

Frequency (MHz)	*QuasiPK (dBµV/m)*	*Limit (dBµV/m)*	*Margin (dB)*	*Height (cm)*	*Pol.*	*Azimuth (deg)*	*Corr. (dB/m)*	*Result*
929.910000	30.84	46.00	15.16	184.0	H	120.0	25.7	Passed

Table 21: Results of emissions test from 30 MHz to 1 GHz on lowest channel, EUT position X, antenna polarization horizontal

6.6 Spurious radiated emissions above 1 GHz

Section(s) in 47 CFR Part 15:	Requirement(s): Reference(s)	15.249(a)(d) ANSI C63.10, clause 6.6	

Performed by:	Jennifer Riedel B. Eng.	Date(s) of test:	March 10, 2021
Result:	☒ Test passed	☐ Test not passed	

6.6.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Free space semi-anechoic chamber (FS-SAC)	FS-SAC	ELEMENT STRAUBING	E00100
EMI test receiver	ESU 26	Rohde & Schwarz	W00002
Preamplifier (0.5 GHz – 18 GHz)	BBV 9718	Schwarzbeck	W01325
Preamplifier (18 GHz – 40 GHz)	BBV 9721	Schwarzbeck	W01350
Notch filter	FSM-2450-85	Miteq	W00092
Highpass filter	WHKX10-5850-6500-18000-40SS	Wainwright Instruments	W00699
Horn antenna	BBHA 9120D	Schwarzbeck	W00053
Horn antenna	BBHA 9170	Schwarzbeck	W00055
Cable set FS-SAC	RF cable(s)	Teledyne Reynolds Huber + Suhner Teledyne Reynolds	E00435 E00307 E00433

6.6.2 Limits

According to §15.249(a):
The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	*Field strength of harmonics*		*Measurement distance*
(MHz)	*(µV/m)*	*(dBµV/m)*	*(m)*
900-928	500	54	3
2400-2483.5	500	54	3
5725-5875	500	54	3
24000-24250	2500	68	3

Table 22: Radiated emission limits according to §15.249(a)

According to §15.249(d):
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Frequency	*Field strength*		*Measurement distance*
(MHz)	*(µV/m)*	*(dBµV/m)*	*(m)*
Above 960	500	53.98	3

Table 23: General radiated emission limits ≥ 960 MHz according to §15.209

6.6.3 Test procedure

The emissions from 1 GHz to 10th harmonics are measured using the test procedure for radiated measurements as described in clause 5.6.

6.6.4 Test results

Test distance:	☐ 3 m	☐ 10 m	☒ 1.50 m
Polarization:	☒ horizontal	☒ vertical	
EUT position:	☒ Position X	☒ Position Y	☒ Position Z

Note(s):

1 Premeasurements were performed to declare the worst case which is documented below.

2 The measurements from 1 GHz to 17 GHz were made at a measurement distance of 1.5 m. However, the limit lines for these tests were referenced to the limit lines at a measurement distance of 3 m (Offset – 6 dB).The exploratory measurements from 17 GHz to 25 GHz were made at a measurement distance of 0.5 m. However, the limit lines for these tests were referenced to the limit lines at a measurement distance of 3 m (Offset – 15.6 dB).Premeasurements were performed in all three positions and antenna polarizations. However, the figures within this test report show only the worst case position and antenna polarization. The table results were the final measurements of the emissions detected in the premeasurements which are shown in this test report.

5 The radiated emission limits according to § 15.209 were applied.

6 According to note 1 of ANSI C63.10-2013 clause 6.6.4.3: Where limits are specified by regulations for both average and peak detection, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

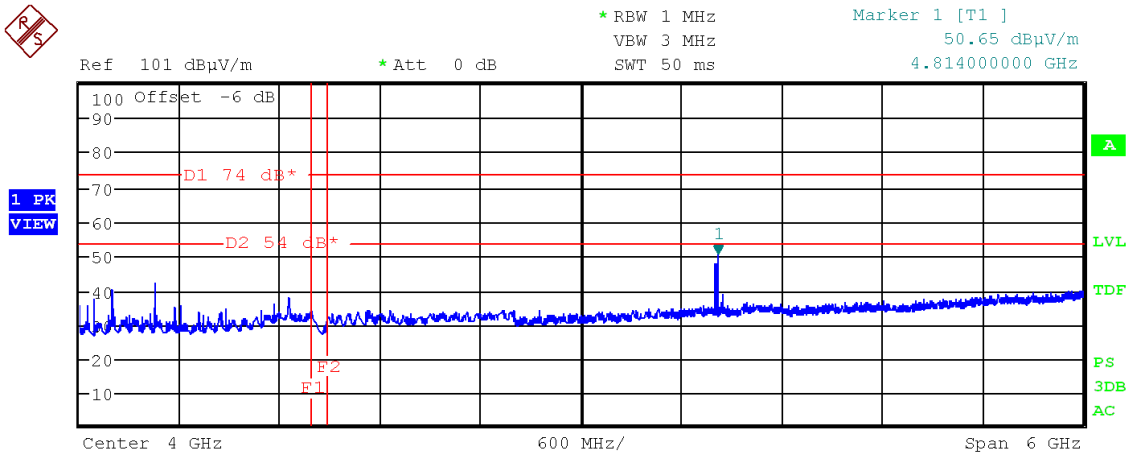


Figure 14: Chart of spurious radiated emission final test from 1 GHz to 7 GHz on lowest channel, EUT position X, antenna polarization vertical

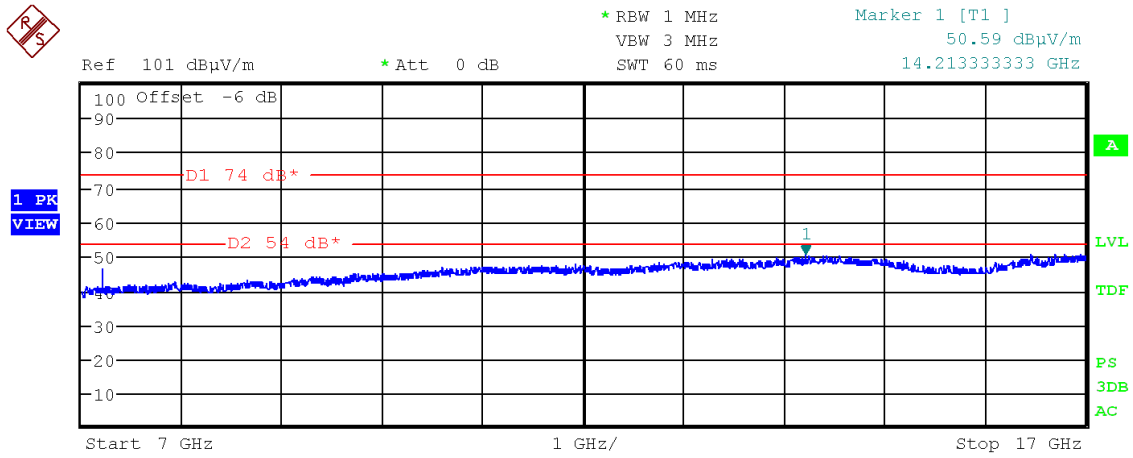


Figure 15: Chart of spurious radiated emission final test from 7 GHz to 17 GHz on lowest channel, EUT position X, antenna polarization vertical

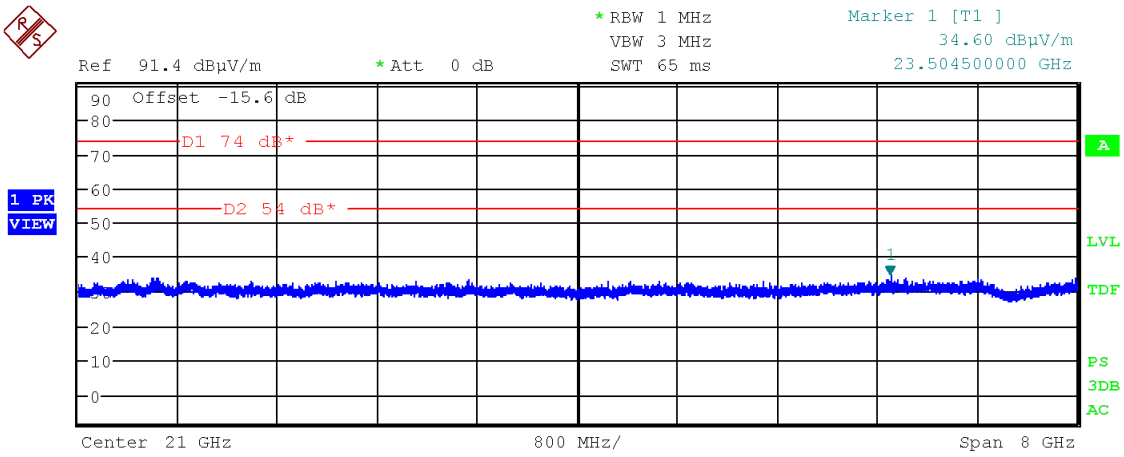


Figure 16: Chart of exploratory measurement from 17 GHz to 25 GHz on lowest channel, measurement distance of 0.5 m

Frequency (MHz)	*EUT Pos.*	*Level (dBµV/m)*	*Detec-tor*	*Limit (dBµV/m)*	*Margin (dB)*	*Height (cm)*	*Pol.*	*Azimuth (deg)*	*Corr. (dB/m)*	*Result*
4814.160	X	53.58	PK	74.00	20.42	200.0	V	320.0	0.9	Passed
7220.696	X	52.62	PK	74.00	21.38	200.0	V	320.0	8.2	Passed

Table 24: Test result of spurious radiated emissions wave above 1 GHz on lowest channel

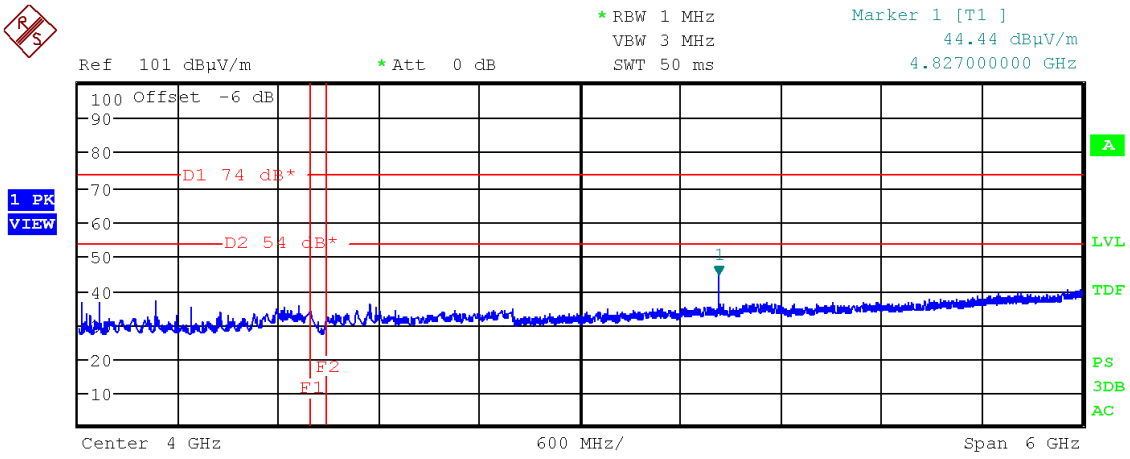


Figure 17: Chart of spurious radiated emission final test from 1 GHz to 7 GHz on middle channel, EUT position X, antenna polarization vertical

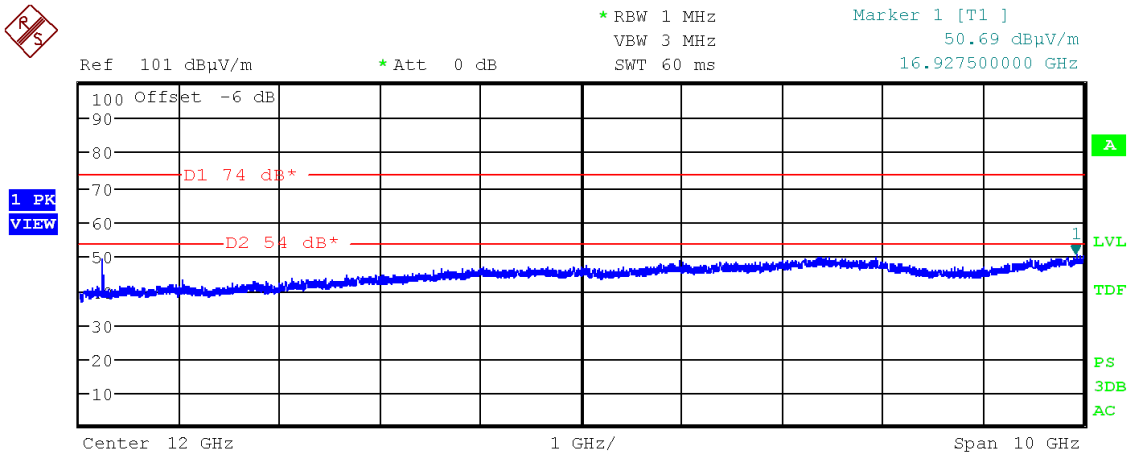


Figure 18: Chart of spurious radiated emission final test from 7 GHz to 17 GHz on middle channel, EUT position X, antenna polarization vertical

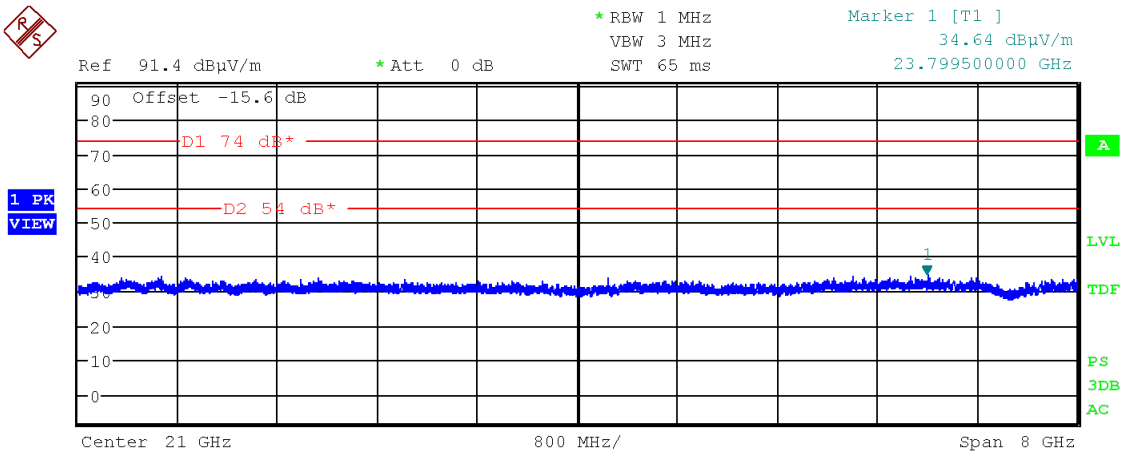


Figure 19: Chart of exploratory measurement from 17 GHz to 25 GHz on middle channel, measurement distance of 0.5 m

Frequency (MHz)	*EUT Pos.*	*Level (dBµV/m)*	*Detec-tor*	*Limit (dBµV/m)*	*Margin (dB)*	*Height (cm)*	*Pol.*	*Azimuth (deg)*	*Corr. (dB/m)*	*Result*
4826.644	X	54.88	PK	74.00	19.12	100.0	V	330.0	1.1	Passed
4826.644	X	50.95	AV	54.00	3.05	100.0	V	330.0	1.1	Passed
7239.647	X	52.89	PK	74.00	21.11	250.0	V	315.0	8.5	Passed

Table 25: Test result of spurious radiated emissions wave above 1 GHz on middle channel

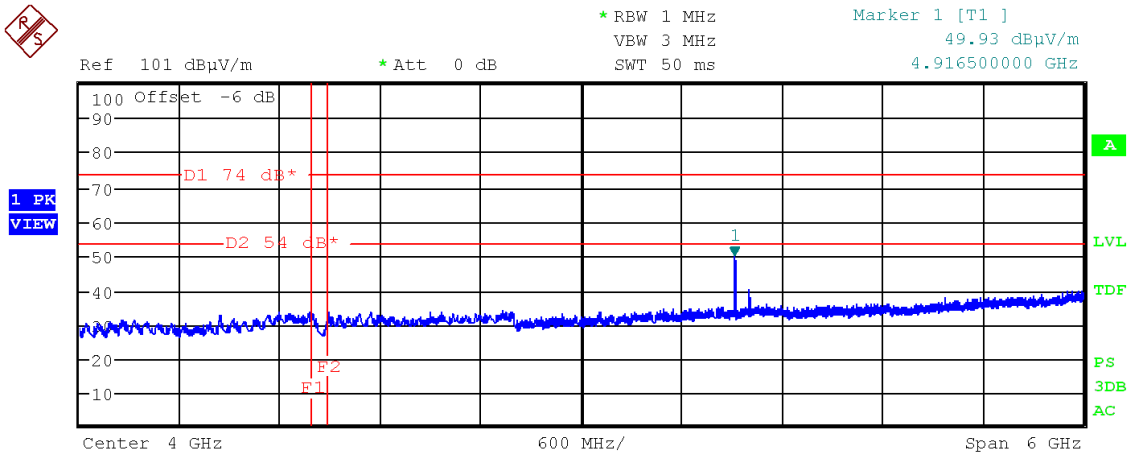


Figure 20: Chart of spurious radiated emission final test from 1 GHz to 7 GHz on highest channel, EUT position X, antenna polarization vertical

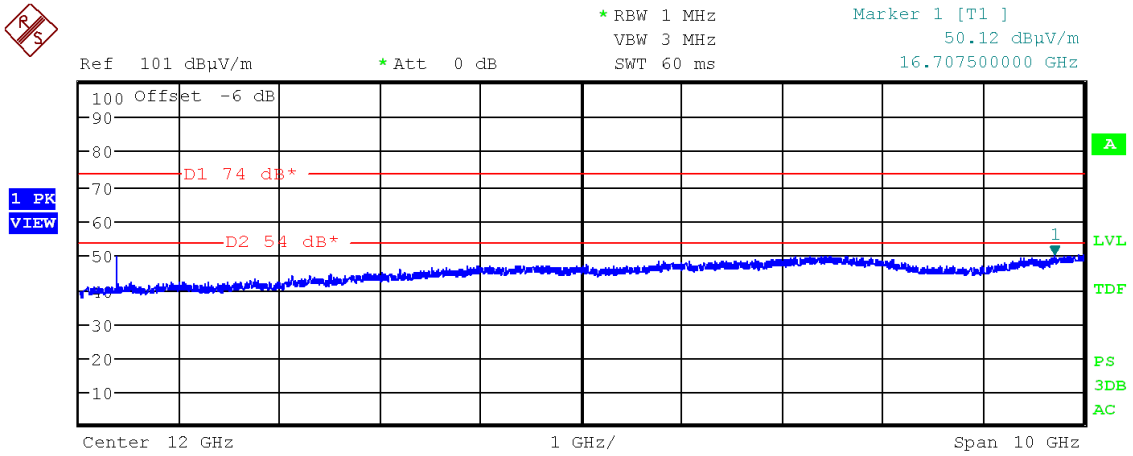


Figure 21: Chart of spurious radiated emission final test from 7 GHz to 17 GHz on highest channel, EUT position X, antenna polarization vertical

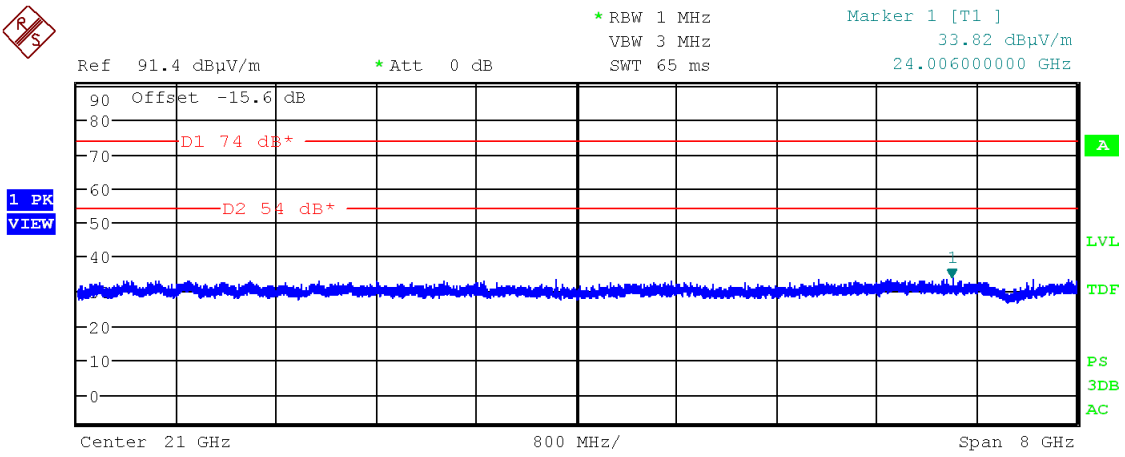


Figure 22: Chart of exploratory measurement from 17 GHz to 25 GHz on highest channel, measurement distance of 0.5 m

Frequency (MHz)	*EUT Pos.*	*Level (dBµV/m)*	*Detec-tor*	*Limit (dBµV/m)*	*Margin (dB)*	*Height (cm)*	*Pol.*	*Azimuth (deg)*	*Corr. (dB/m)*	*Result*
4915.920	X	54.57	PK	74.00	19.43	200.0	V	326.0	1.2	Passed
4915.920	X	50.09	AV	54.00	3.91	200.0	V	326.0	1.2	Passed
7373.705	X	53.25	PK	74.00	20.75	250.0	V	315.0	8.8	Passed

Table 26: Test result of spurious radiated emissions wave above 1 GHz on highest channel

7 Equipment calibration status

Description	*Modell number*	*Serial number*	*Inventory number(s)*	*Last calibration*	*Next calibration*
EMI test receiver	ESW44	101538	E00895	2020-08	2022-08
EMI test receiver	ESU26	100026	W00002	2020-06	2022-06
EMI test receiver	ESR7	101059	E00739	2019-08	2021-08
EMI test receiver	ESCI3	100328	E00552	2020-10	2022-10
EMI test receiver	ESCI3	100013	E00001	2020-05	2022-05
Preamplifier (1 GHz - 18 GHz)	BBV 9718 B	00032	W01325	2020-09	2021-10
Preamplifier (18 GHz - 40 GHz)	BBV 9721	43	W01350	2020-11	2021-11
Preamplifier (1 GHz - 18 GHz)	ALS05749	001	W01007	2021-01	2022-01
Loop antenna	HFH2-Z2	871398/0050	E00060	2020-10	2022-10
LISN	ESH2-Z5	881362/037	E00004	Note 1	
LISN	ESH2-Z5	893406/009	E00005	2020-10	2022-10
Field probe	RF-R 400-1	02-2030	E00270	Note 2	
TRILOG broadband antenna (SAC3)	VULB 9162	9162-041	E00643	2021-03	2024-03
Horn antenna	BBHA 9120D	9120D-592	W00053	2020-04	2023-04
Horn antenna	BBHA 9170	9170-332	W00055	2020-04	2023-04
Shielded room	P92007	B 83117 C 1109 T 211	E00107	N/A	
Compact diagnostic chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	N/A	
Semi-anechoic chamber (SAC) with floor absorbers	FS-SAC	---	E00100	2021-03	2024-03
Semi-anechoic chamber (SAC)	SAC3	C62128-A520-A643-x-0006	E00716	2021-03	2024-03
Cable set CDC	RG214/U	---	E00446	2020-04	2021-04
	LCF12-50J	---	E01215	2020-04	2021-04
	LMR400	1718020006	E00920	2021-01	2022-01
	RG214 Hiflex	171802007	E00921	2021-01	2022-01
Cable set anechoic chamber	262-0942-1500	005	E00435	2020-10	2021-10
	SF104EA/2x11PC35-42/5m	11144/4EA	E00307	2020-12	2021-12
	262-0942-1500	003	E00433	2020-10	2021-10
Cable set of semi-anechoic chamber SAC3	SF104EA/11PC35/11PC35/10000MM	501347/4EA	E00755	2020-12	2021-12
	SF104E/11PC35/11PC35/2000MM	507410/4E	E01035	2020-12	2021-12
	SF104E/11PC35/11PC35/2000MM	507411/4E	E01034	2020-09	2021-09

Note(s)
1. Only used for decoupling of support equipment.
2. Only used for relative measurements.

8 Measurement uncertainties

Description	*Uncertainty*	U_{Limit}	*Note(s)*	*k=*
AC power line conducted emission	± 3.0 dB	± 3.4 dB	2b), 3b)	2
Bandwidth tests	± 2.0 %	± 5 %	2a), 3a)	2
Radiated emissions				
from 9 kHz to 30 MHz	± 3.8 dB	± 4.0 dB	2b), 3b)	2
from 30 MHz to 1 GHz	± 6.1 dB	± 6.3 dB	2b), 3b)	2
from 1 GHz to 6 GHz	± 4.6 dB	± 5.2 dB	2b), 3b)	2
from 6 GHz to 18 GHz	± 5.0 dB	± 5.5 dB	2b), 3b)	2
from 18 GHz to 26.5 GHz	± 5.4 dB	± 6.0 dB	2b), 3c)	2
from 26.5 GHz to 40 GHz	± 6.2 dB	± 6.5 dB	2b), 3c)	2

Note(s):

1 The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. For a confidence level of 95 % the coverage factor k is 2.

2 The values of the measurement uncertainty as listed above are calculated according to
   a) ETSI TR 100 028-1 V1.4.1 and ETSI TR 100 028-2 V1.4.1
   b) CISPR 16-4-2:2011-06 + A1:2014-02 + A2:2018-08

3 The limits for the measurement uncertainty as listed above are
   a) derived from ETSI EN 300 328 V2.1.1
   b) equal to U_{CISPR} taken from CISPR 16-4-2:2011-06 + A1:2014-02 + A2:2018-08
   c) defined by the test laboratory

4 Simple acceptance is applied as the decision rule while keeping the specified limits (U_{Limit}) for the expanded measurement uncertainty (i.e. Test Uncertainty Ratio TUR ≥ 1:1). That means, compliance is based on the recorded level by the lab irrespective of the expanded measurement uncertainty value but with a limitation to it.

5 All used test instruments as well as the test accessories are calibrated at regular intervals.

9 Revision history

Revision	*Date*	*Issued by*	*Description of modifications*
0	2021-03-22	Jennifer Riedel B. Eng.	First edition

Template: RF_15.249_RSS-210_V1.2