Test report

Customer:

KINEXON Inc.

25 Broadway, Floor 9
New York, NY 10004

RF test report

190123-AU01+W01

KINEXON Inc.

Tag

KNX-T4.1-1.2-2:B

EMV TESTHAUS GmbH

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Accreditation:

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:

EMV TESTHAUS GmbH
Gustav-Hertz-Straße 35
94315 Straubing

The technical accuracy is guaranteed through the quality management of the EMV TESTHAUS GmbH.

Table of contents

List of figures

List of tables

1 Summary of test results

System type: UWB device

47 CFR part and section	*Test*	*Page*	*Result*	*Note(s)*
15.207a)	AC power line conducted emissions 150 kHz to 30 MHz	---	Not applicable	1,2
15.203	Antenna requirement	21	Passed	---
15.517(a)(1)	Signal deactivation	22		
15.503(a)(d) 15.517(b)	UWB bandwidth	26	Passed	---
15.517(d)	Radiated emissions in GPS bands	31	Passed	---
15.517(e)	Peak emissions in a 50 MHz bandwidth	39	Passed	---
15.209 15.517(c)	Radiated emissions	44		---
	9 kHz to 30 MHz	44	Passed	---
	30 MHz to 1 GHz	47	Passed	---
	Emissions from 960 MHz to 40 GHz	50	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.
2 EUT is battery-powered.

Straubing, March 27, 2020

Konrad Graßl
Head of radio department
EMV **TESTHAUS** GmbH

Christian Kiermeier
Technical executive
EMV **TESTHAUS** GmbH

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 remark

The EUT a passive NFC tag and UWB integrated. In this test report only UWB is in consideration.

3.2 General information

Product type:	Tag		
Model name:	KNX-T4.1-1.2-2:B		
Serial number(s):	CH 2: 40776/ CH 3: 40774/ CH 3: 39847/ CH 5: 40777		
Applicant:	KINEXON Inc.		
Manufacturer:	KINEXON GmbH		
Version:	Hardware:	TATS-01-04B	
	Software:	FW 4.27 with automatic signal deactivation (default for board version KNX-T4.1-1.2-2:B)	
Additional modifications:	None		
FCC ID:	2ALC5-KNX-ATI1		
Power supply:	DC supply		
	Nominal voltage:	3 V	
Device type:	☒ Portable	☐ Mobile	☐ Fixed

.

3.3 Radio specifications

System type	UWB device
Application frequency band:	3.1 GHz – 10.6 GHz
Operating frequencies:	3.994 GHz, 4.493 GHz, 6.490 GHz
Number of channels:	3 (channel 2, 3 and 5)
Modulation:	BPM/BPSK (Burst Position Modulation/Binary Phase Shift Keying)
Short description:	The Kinexon System is a Real-Time Location System (RTLS) based on Ultra-Wideband (UWB) technology. Its primary use is for the tracking of people or objects. The system operates using active Tags, a network of Receivers, and a Kinexon Sensor Network Application. The Tag is a small, transceiving device with an integrated antenna. It senses different data (e.g., accelerations, temperature) and transmits the data to the Receivers.
Antenna:	Type: Dielectric chip antenna ACS5200HFAUWB Gain: Peak 4.16 dBi at 6200 MHz Connector: ☐ external ☐ internal ☐ temporary ☒ none (integral antenna)

3.4 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*
EUT			
UWB Tag CH 2	UWB tag	40776	Kinexon
UWB Tag CH 3	UWB tag	40774	Kinexon
UWB Tag CH 3	UWB tag	39847	Kinexon
UWB Tag CH 5	UWB tag	40777	Kinexon
Support equipment			
Power supply	3252.1	E00541	Statron
Anchor	A-07-12	27801	Kinexon
NUC	NUC6i5SYH	---	Intel

Table 1: Devices used for testing

Port	*Classification (see note 1)*	*Cable type*	*Fixed*	*Cable length*		*Note*
				used	*maximum*	
none						

Table 2: Ports of EUT and appropriate cables[1]

Notes:
1 Ports of EUT are classified as “AC power”, “DC power”, “DC power connected to dedicated AC/DC power supply”, “Signal/control” or “Wired network”.
2 The serial port is used for configuration.

[1] As specified by manufacturer.

4.2 Mode of operation

With the ecxeption of the signal deactivation test the EUT is forced by software configuration to transmit on a fixed frequency without any frequency hop or step function. All tests were performed with modulated signal.
Signal deactivation test:
Software is configured to show the normal behavior of the EUT.

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.

Floor-standing devices are placed either directly on the reference ground-plane or on insulating material (see clause 6.3.3 of ANSI C63.4-2014 for more details).

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.

5.2 AC power-line 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 3: 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 3). 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).

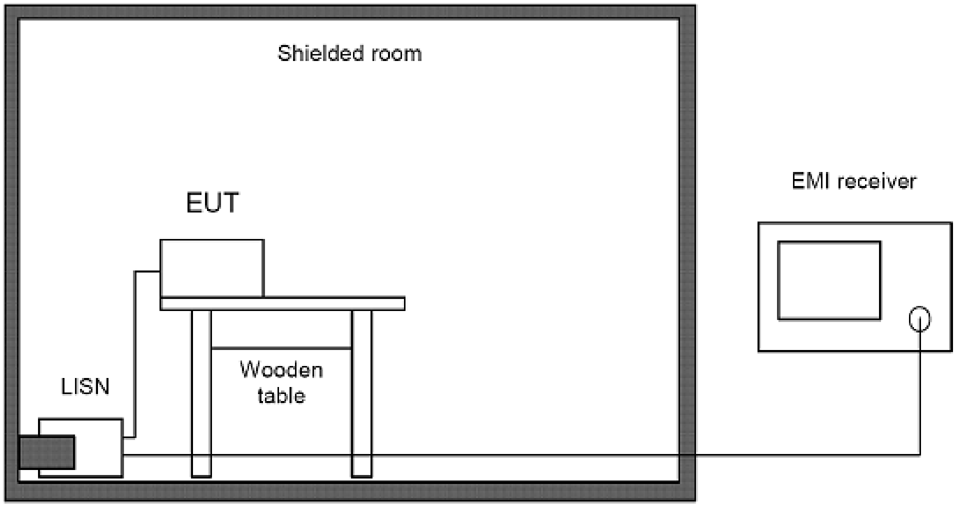


Figure 1: Setup for AC power-line conducted emissions test from 150 kHz to 30 MHz

5.3 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, 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 4: 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 5.

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

Sample calculation:

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

Correction factor = Antenna correction + Cable attenuation

Level = Reading value + Correction factor = 20 dBµV + 19.92 dB/m = 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 5).
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.

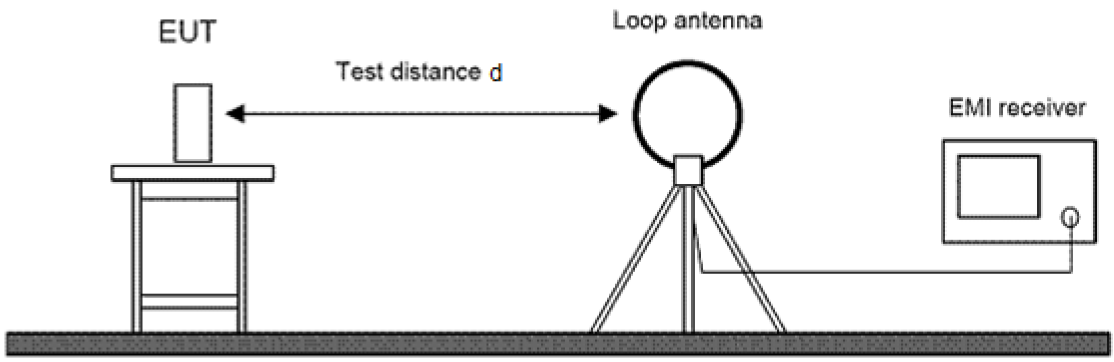


Figure 2: Setup for radiated emissions test below 30 MHz

5.4 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 6.

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

Sample calculation:

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

Correction factor = Antenna correction + Cable attenuation

Level = Reading value + Correction factor = 30 dBµV + 12.77 dB/m = 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 6).
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.

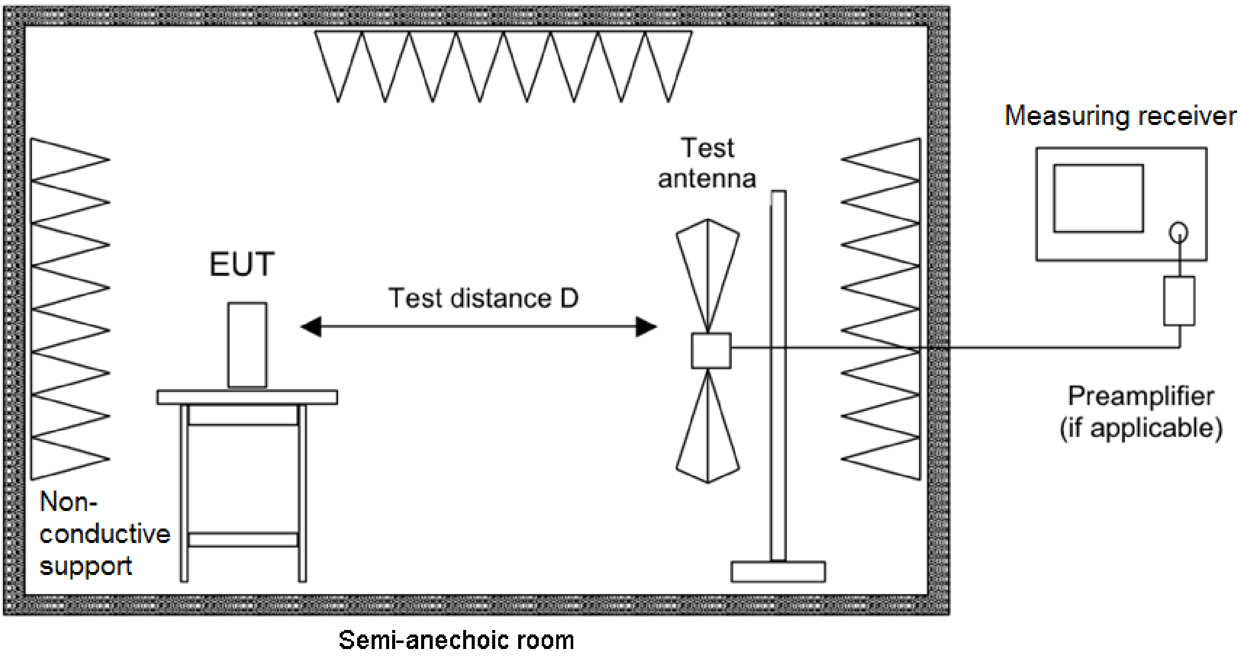


Figure 3: Setup for radiated emissions test from 30 MHz to 1 GHz

5.5 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.

Sample calculation:

Frequency (MHz)	Reading value (dBµV)	Antenna correction (dB/m)	Correction pre-amplifier (dB)	Cable attenuation (dB)	Correction factor (Corr.) (dB/m)	Level (dBµV/m)
2400	50.00	27.76	-34.57	3.51	-3.30	46.70

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

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

5.5.1 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 7.

Frequency (f)	*Resolution bandwidth*	*Video bandwidth*	Sweep time	*Trace detector(s)*	*Trace mode(s)*
f ≥ 1 GHz	1 MHz	3 MHz	AUTO	RMS	Max Hold

Table 7: 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.

5.5.2 Final radiated emissions measurements

Final radiated emissions above 1 GHz are measured in a semi-anechoic chamber (SAC) with RF absorbing material on the floor between measurement antenna and EUT. The measurement distance is shown in the appropriate tests. The emissions of the EUT are recorded with an EMI test receiver.

The horn antenna is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization For UWB the measurement procedure according clause 6.6.5 of ANSI C63.10-2013 is used, specified in clause 6.6.5.4 of ANSI C63.10-2013.

5.6 UWB Bandwidth measurement

The test is performed according the procedure described in clause 10.1 of ANSI C63.10.2013.

6 Test results

This clause gives details about the test results as collected in the summary of test results on page 5.

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 Antenna requirement

Section(s) in 47 CFR Part 15:	Requirement(s): Reference(s):	15.203

Result	☒ Requirement kept	☐ Requirement not kept

6.1.1 Requirement

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§15.211, 15.213, 15.217, 15.219, 15.221, or §15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.Test procedure

6.1.2 Result

Performed by:	Konrad Graßl	Date(s) of test:	April 17, 2019

The EUT has an integrated antenna, therefore the antenna can not be changed by the user.

6.2 Signal deactivation

Section(s) in 47 CFR Part 15: Requirement(s): 15.517(a)(1)

Result[2]: ☒ Test passed ☐ Test not passed

6.2.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☐	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☐	Free space semi-anechoic chamber (FS-SAC)	FS-SAC	EMV **TESTHAUS**	E00100
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☒	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Preamplifier (1 GHz - 18 GHz)	ALS05749	Aldetec	W01007
☐	Preamplifier (1 GHz - 18 GHz)	BBV9718B	Schwarzbeck	W01325
☒	Horn antenna	BBHA 9120D	Schwarzbeck	W00052
☐	Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
☐	Cable set FS-SAC	RF cable(s)	EMCO ELEKTRONIK Huber + Suhner	W00096 E01032

2 For information about measurement uncertainties see page 76.

6.2.2 Limits

According 15.517(a)(1):
Indoor UWB devices, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g., a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.

6.2.3 Test procedure

EUT has an active connection to a UWB anchor. The anchor is connected via LAN to a NUC. In the second step the power supply of the anchor/ the LAN connection are disconnected to show that EUT stops immediately transmissions without companion device. Only during this test the EUT was powered by a power supply (Statron).

6.2.4 Test results

Performed by:	Konrad Graßl	Date(s) of test:	March 16, 2020
Test distance:	☐ 3 m	☐ 1.5 m	☒ 0.15 m

Power supply of anchor disconnected

Explanation:
Marker 1 is set on the red timeline when the power supply of the anchor was disconnected. The emissions of the EUT stop immediately (53.5 ms).

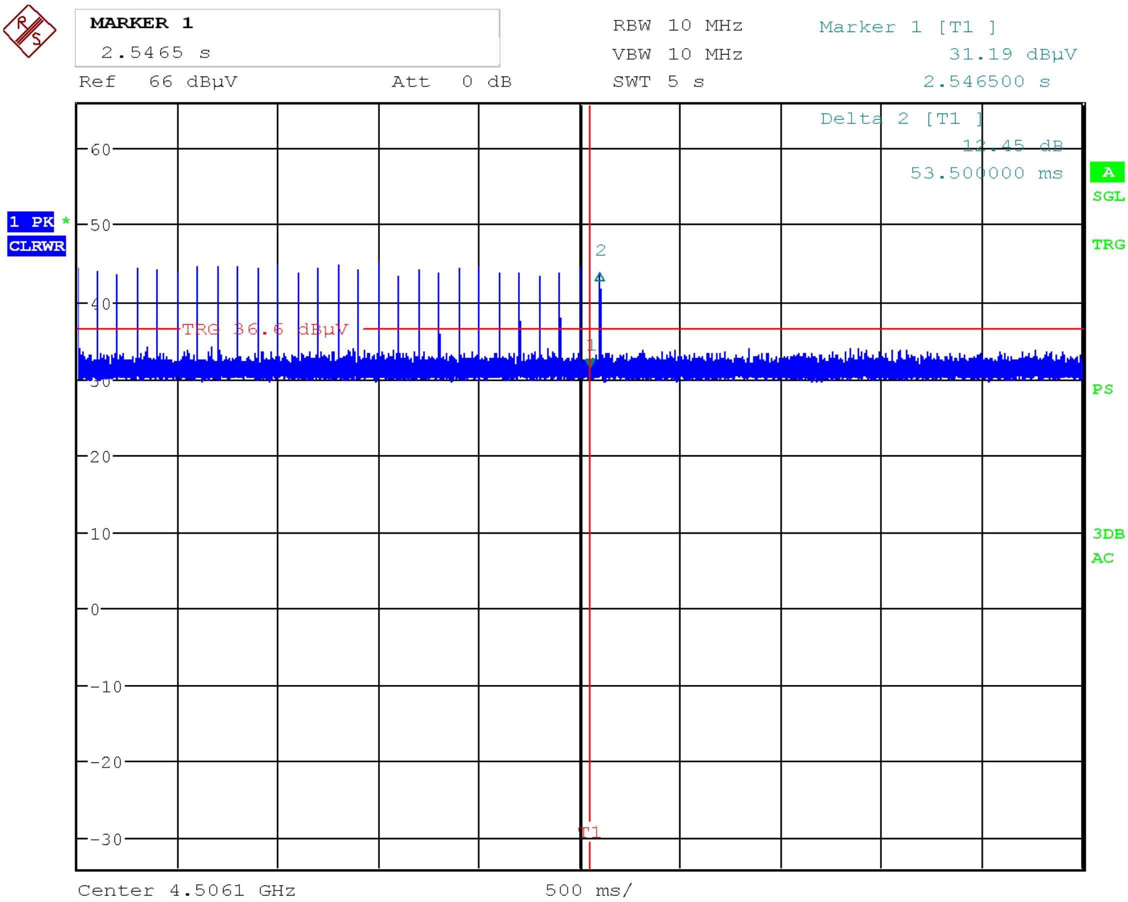


Figure 4: Chart of signal deactivation test on channel 3 – power supply of anchor disconnected

LAN disconnected

Explanation:
Marker 1 is set on the red timeline when LAN was disconnected. The emissions of the EUT stop immediately (1.4 s).

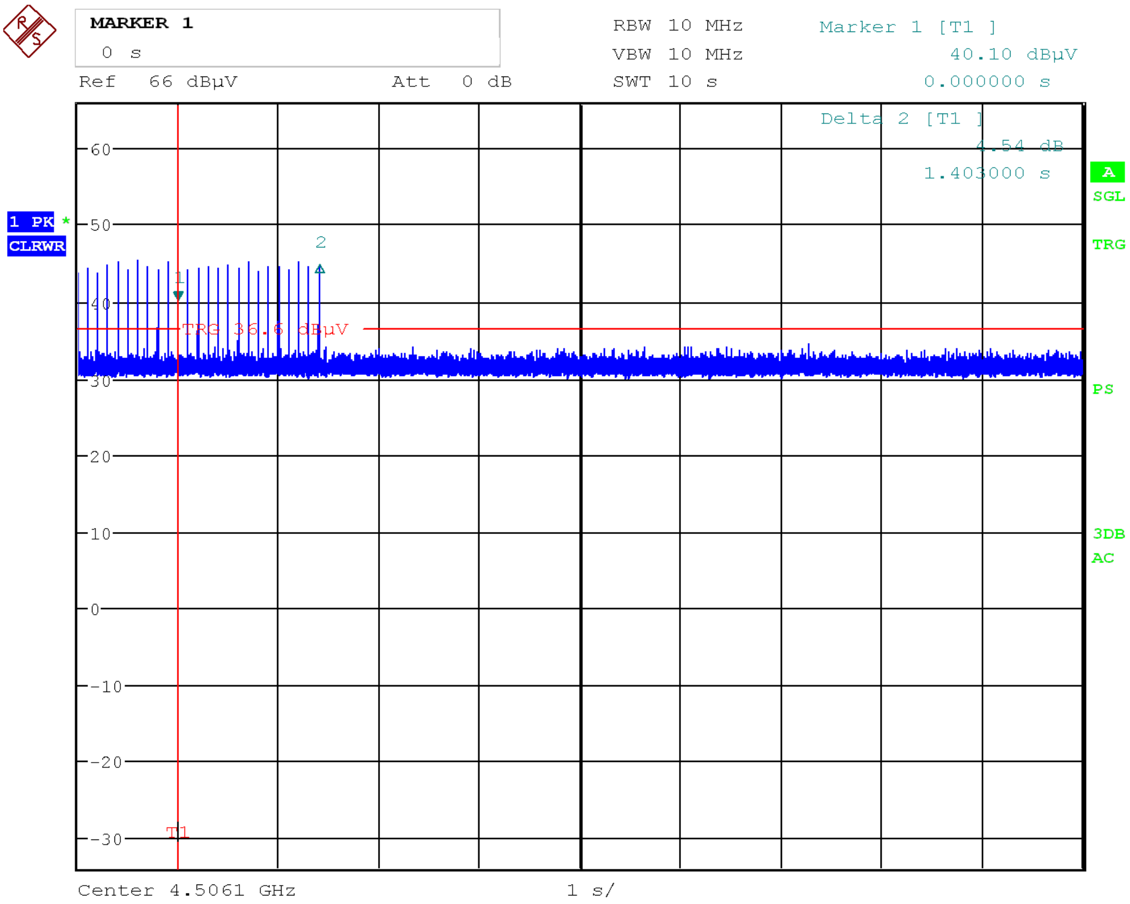


Figure 5: Chart of signal deactivation test on channel 3 – LAN disconnected

6.3 UWB bandwidth

Section(s) in 47 CFR Part 15:	Requirement(s):	15.503(a)(d) 15.517(b)
	Reference(s):	ANSI C63.10, clause 10.1

Result[3]: ☒ Test passed ☐ Test not passed

6.3.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☐	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☒	Free space semi-anechoic chamber (FS-SAC)	FS-SAC	EMV **TESTHAUS**	E00100
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☒	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Preamplifier (1 GHz - 18 GHz)	ALS05749	Aldetec	W01007
☒	Preamplifier (1 GHz - 18 GHz)	BBV9718B	Schwarzbeck	W01325
☒	Horn antenna	BBHA 9120D	Schwarzbeck	W00052
☐	Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
☒	Cable set FS-SAC	RF cable(s)	EMCO ELEKTRONIK Huber + Suhner	W00096 E01032

[3] For information about measurement uncertainties see page 76.

6.3.2 Limits

According 15.517(b):
The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

15.503(a)
UWB bandwidth. For the purpose of this subpart, the UWB 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. The upper boundary is designated fH and the lower boundary is designated fL. The frequency at which the highest radiated emission occurs is designated fM.

15.503(d)
Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

6.3.3 Test procedure

The UWB bandwidth is measured using the test procedure as described in clause 5.6

6.3.4 Test results

Performed by:	Konrad Graßl	Date(s) of test:	March 25, 2019
		Date(s) of test:	April 8, 2019
Test distance:	☐ 3 m	☐ 1.5 m	☒ 0.75 m

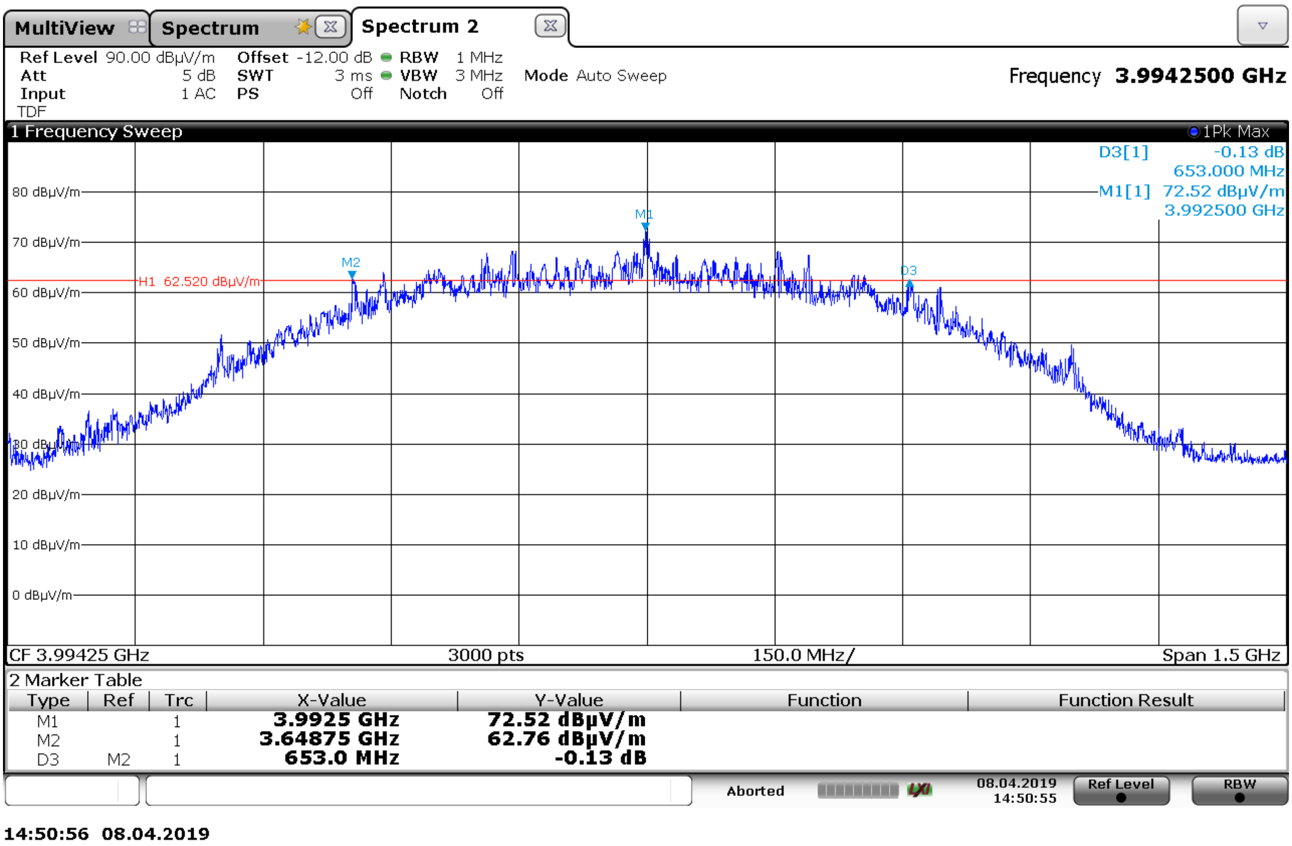
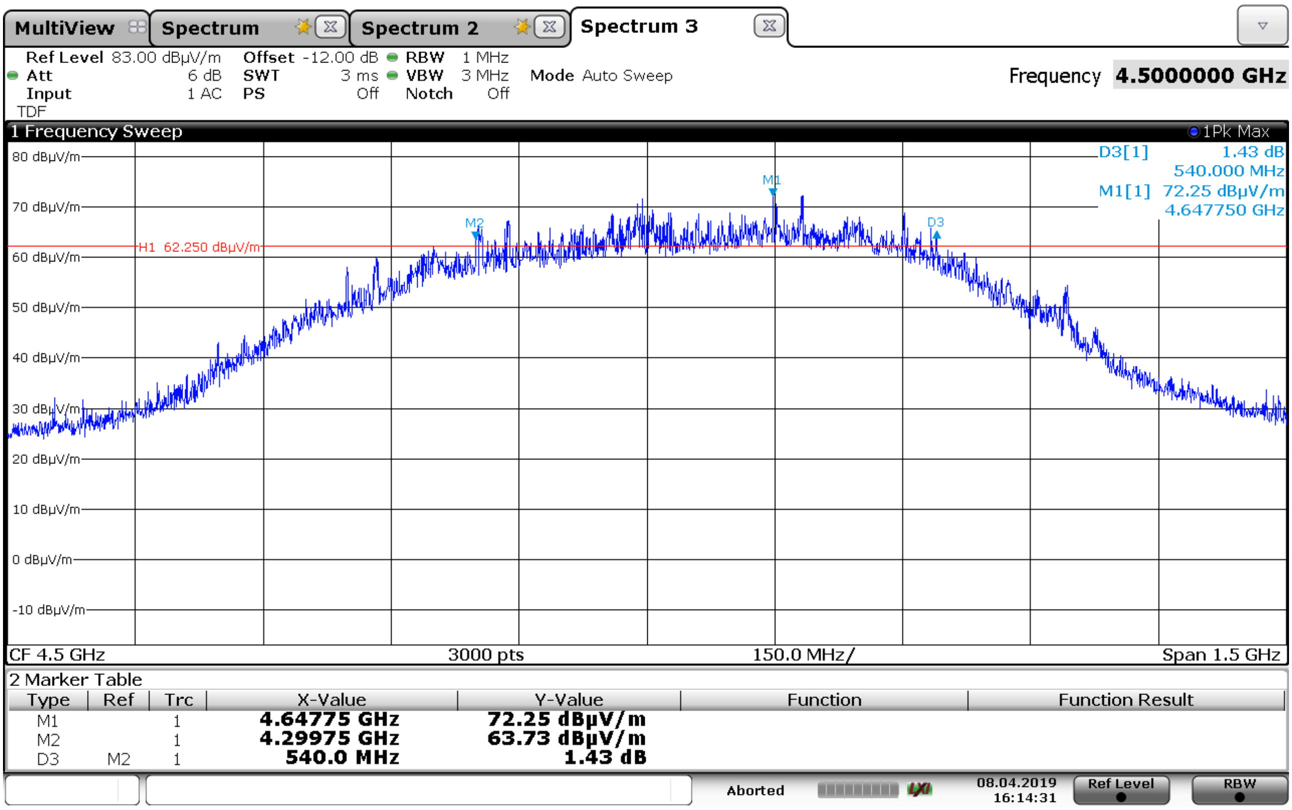


Figure 6: Chart of UWB bandwidth on channel 2



Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	4.64775 GHz	72.25 dBµV/m		
M2		1	4.29975 GHz	63.73 dBµV/m		
D3	M2	1	540.0 MHz	1.43 dB		

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Figure 7: Chart of UWB bandwidth on channel 3

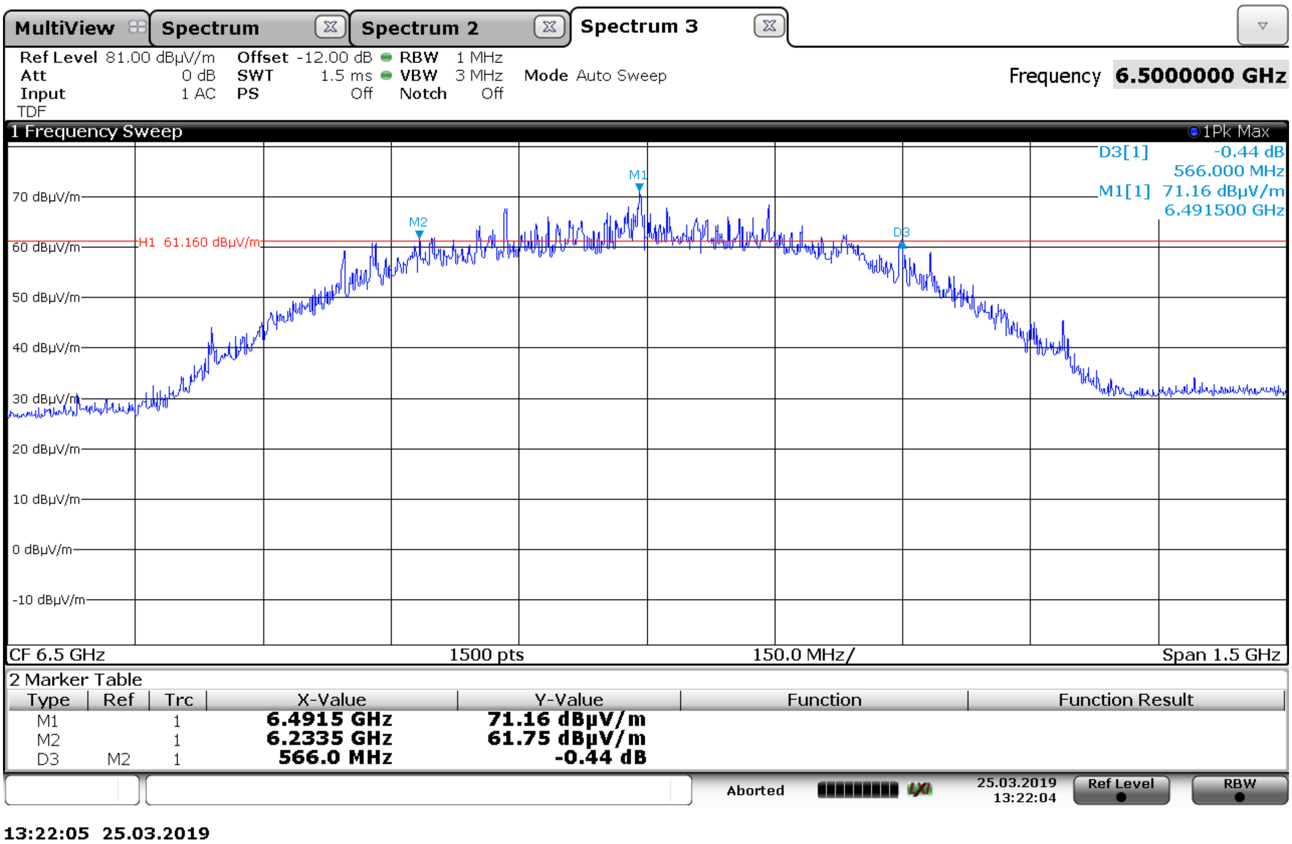

Figure 8: Chart of UWB bandwidth on channel 5

Channel	UWB bandwidth		fL		fH		Result
	Value (MHz)	Limit (MHz)	Frequency (MHz)	Limit (MHz)	Frequency (MHz)	Limit (MHz)	
2	653.0	≥ 500	3648.75	>3100	4301.75	<10600	Passed
3	540.0	≥ 500	4299.75	>3100	4839.75	<10600	Passed
5	566.0	≥ 500	6233.50	>3100	6799.50	<10600	Passed

Table 8: Results of UWB bandwidth

6.4 Radiated emissions in GPS bands

Section(s) in 47 CFR Part 15: Requirement(s): 15.517(d)
Reference(s):

Result[4]: ☒ Test passed ☐ Test not passed

6.4.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☐	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☒	Free space semi-anechoic chamber (FS-SAC)	FS-SAC	EMV **TESTHAUS**	E00100
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☒	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Preamplifier (1 GHz - 18 GHz)	ALS05749	Aldetec	W01007
☒	Preamplifier (1 GHz - 18 GHz)	BBV9718B	Schwarzbeck	W01325
☒	Horn antenna	BBHA 9120D	Schwarzbeck	W00052
☐	Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
☒	Cable set FS-SAC	RF cable(s)	EMCO ELEKTRONIK Huber + Suhner	W00096 E01032

[4] For information about measurement uncertainties see page 48.

6.4.2 Limits

According 15.517(d):
In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency (MHz)	*EIRP (dBm)*	*calculated Fieldstrength at 3 m (dBµV/m)*
1164-1240	-85.3	10
1559-1610	-85.3	10

6.4.3 Test procedure

The radiated emissions in GPS bands are measured using the test procedure as described in clause 5.5.2.

6.4.4 Test results

Performed by:	Konrad Graßl	Date(s) of test:	March 25, 2019
		Date(s) of test:	April 8, 2019
Test distance:	☐ 3 m	☐ 1.5 m	☒ 0.75 m
EUT elevation:	See notes		

RBW	10 kHz
Detector	RMS
Measurement distance	0.75 m

Note: With the reference level offset of -12 dB the measurement is referenced to the calculated limit at 3m.

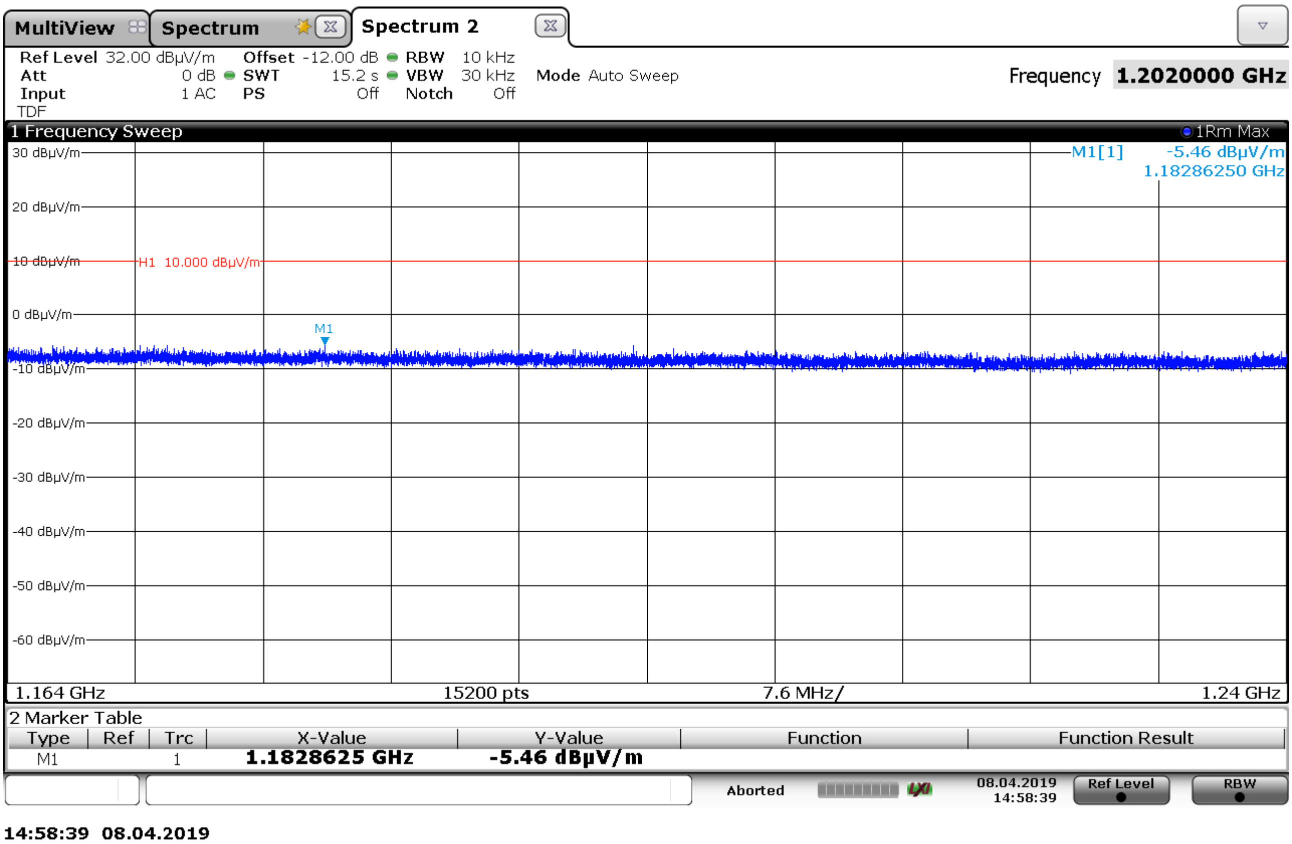

Figure 9: Chart of measurement 1164 MHz to 1240 MHz on channel 2

Note: Worst case elevation: 120 °, measurement antenna horizontal

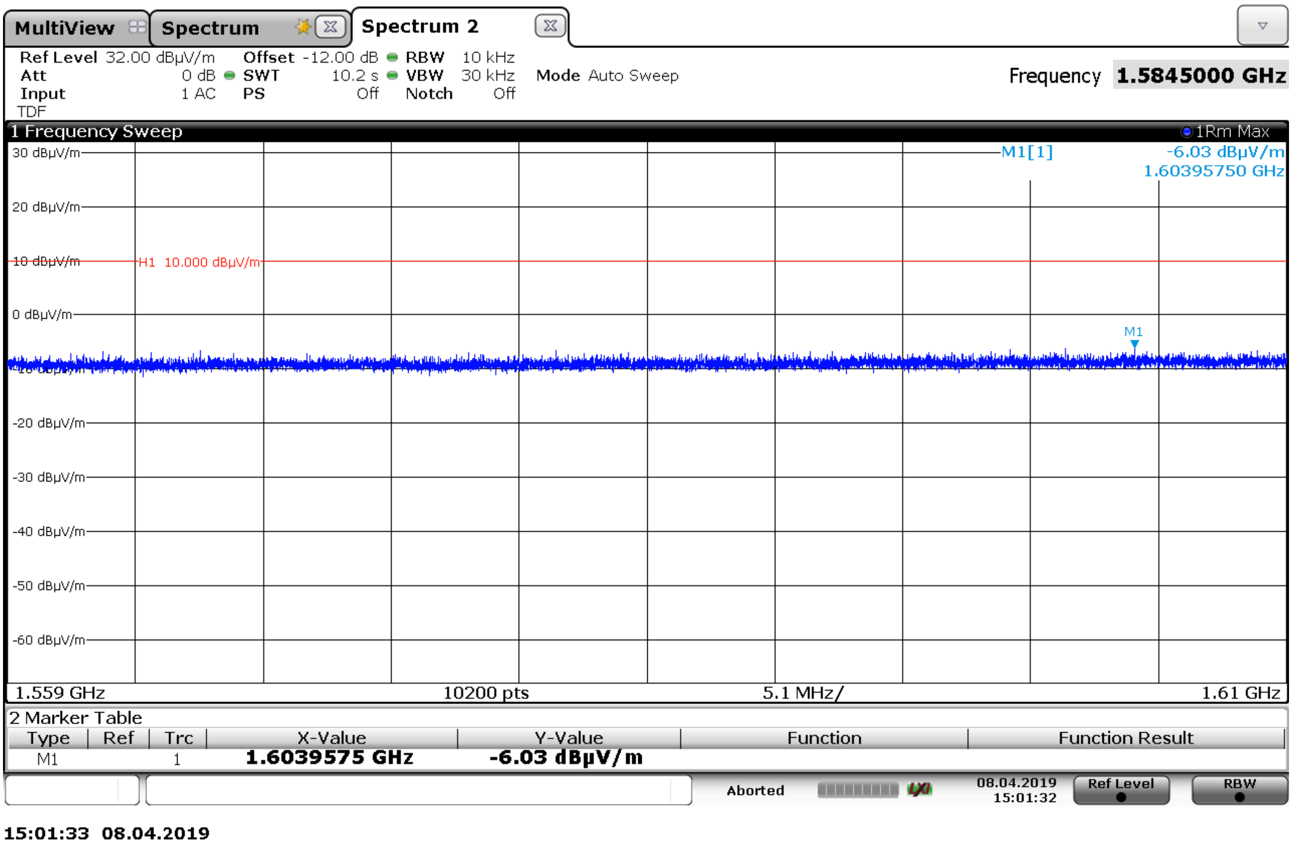

Figure 10: Chart of measurement 1559 MHz to 1610 MHz on channel 2

Note: Worst case elevation: 120 °, measurement antenna horizontal

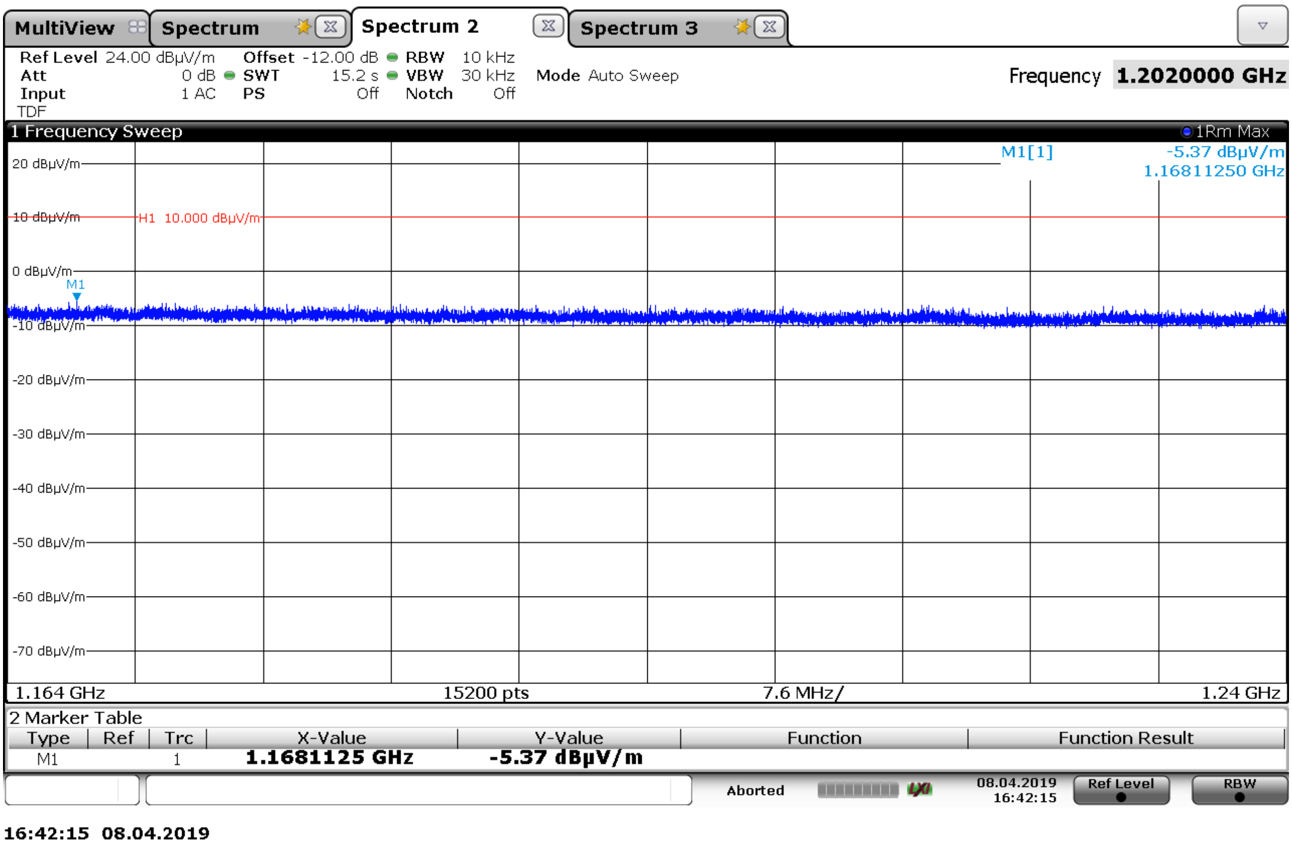

Figure 11: Chart of measurement 1164 MHz to 1240 MHz on channel 3

Note: Worst case elevation: 0 °, measurement antenna horizontal

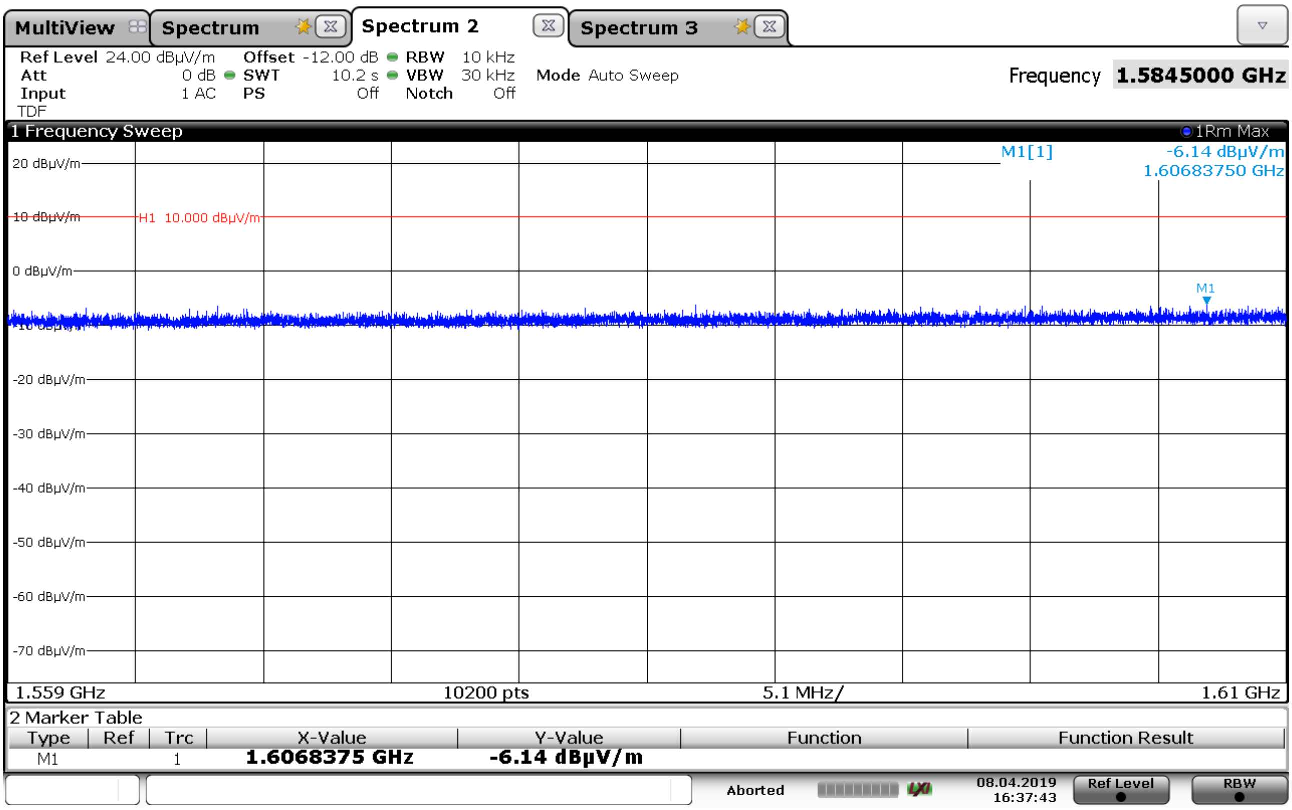

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Figure 12: Chart of measurement 1559 MHz to 1610 MHz on channel 3

Note: Worst case elevation: 0 °, measurement antenna horizontal

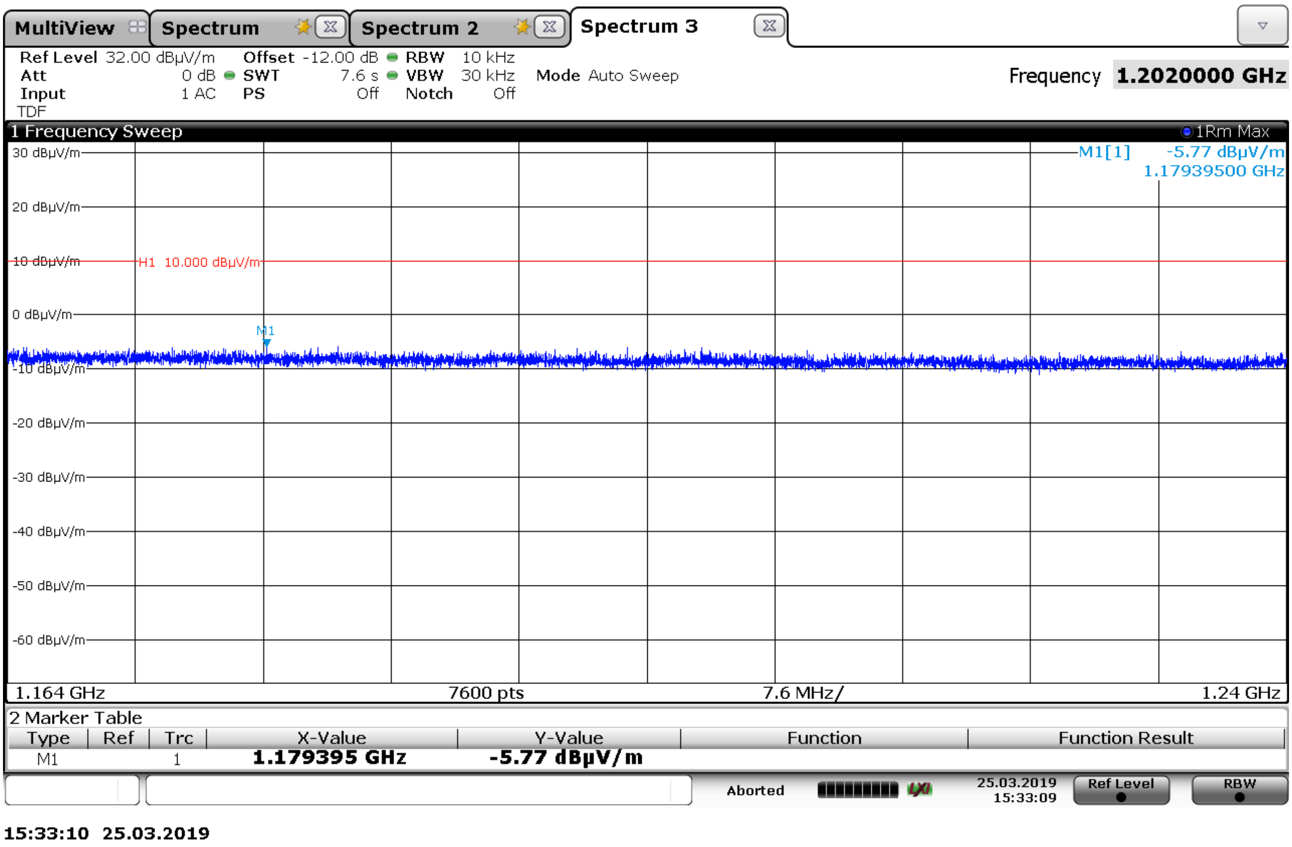

Figure 13: Chart of measurement 1164 MHz to 1240 MHz on channel 5

Note: Worst case elevation: 30 °, measurement antenna horizontal

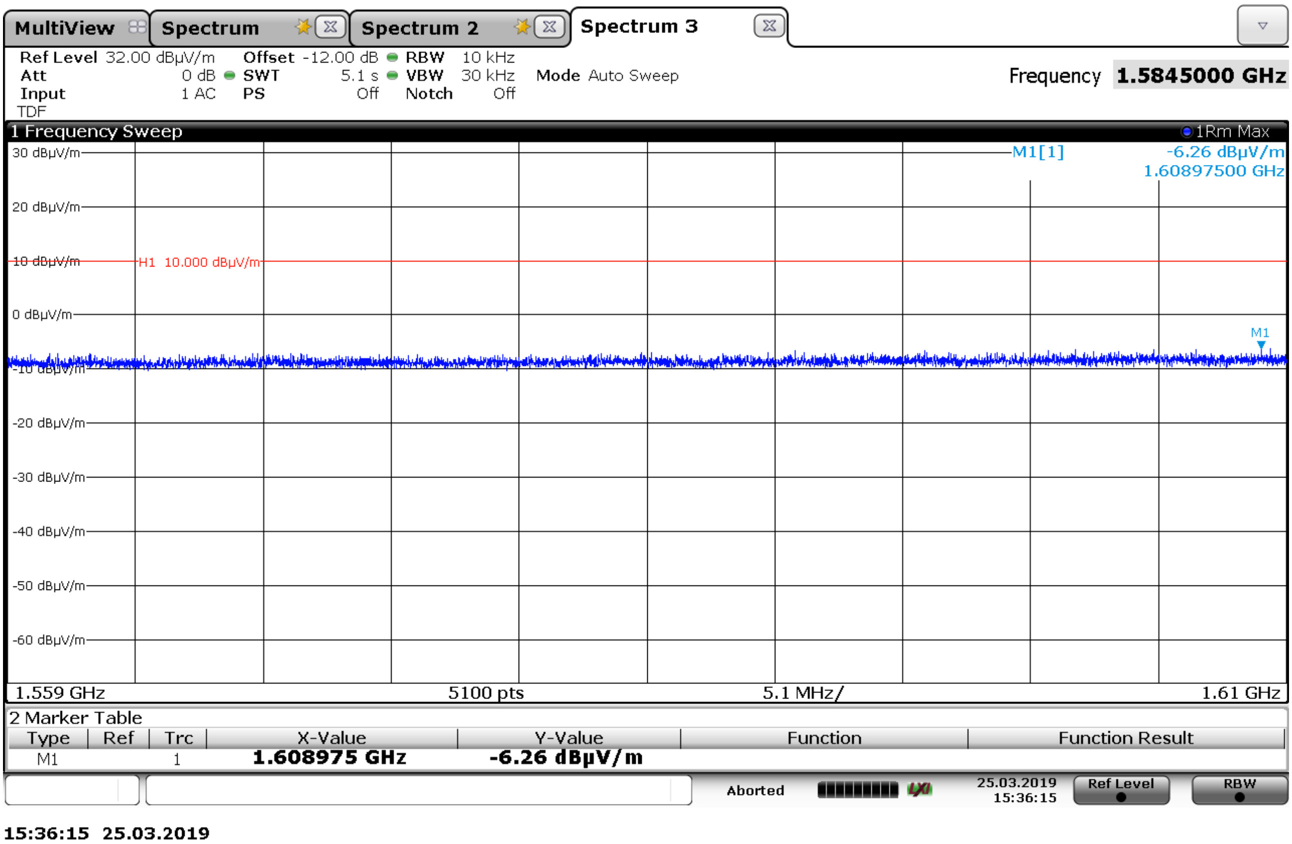

Figure 14: Chart of measurement 1559 MHz to 1610 MHz on channel 5

Note: Worst case elevation: 30 °, measurement antenna horizontal

6.5 Peak emissions in a 50 MHz bandwidth

Section(s) in 47 CFR Part 15:	Requirement(s):	15.517(e)
	Reference(s):	

Result[5]: ☒ Test passed ☐ Test not passed

6.5.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☐	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☒	Free space semi-anechoic chamber (FS-SAC)	FS-SAC	EMV **TESTHAUS**	E00100
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☒	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Preamplifier (1 GHz - 18 GHz)	ALS05749	Aldetec	W01007
☒	Preamplifier (1 GHz - 18 GHz)	BBV9718B	Schwarzbeck	W01325
☒	Horn antenna	BBHA 9120D	Schwarzbeck	W00052
☐	Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
☒	Cable set FS-SAC	RF cable(s)	EMCO ELEKTRONIK Huber + Suhner	W00096 E01032

[5] For information about measurement uncertainties see page 52.

6.5.2 Limits

According 15.517(e):
There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, fM. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521.

Frequency (MHz)	*EIRP (within 50 MHz) (dBm)*	*calculated Fieldstrength at 3 m (dBµV/m)*
3100-10600	0	95.3

According to §15.521(g)
If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed.

6.5.3 Test procedure

The Peak emissions measurements are performed using the test procedure for radiated measurements as described in clause 5.5.

6.5.4 Test results

Performed by:	Konrad Graßl	Date(s) of test:	September 4, 2019
		Date(s) of test:	April 8, 2019
Test distance:	☐ 3 m	☐ 1.5 m	☒ 0.75 m
EUT elevation:	See notes		

RBW 50 MHz
Detector Peak
Measurement distance 0.75 m

Note: With the reference level offset of -12 dB the measurement is referenced to the calculated limit at 3m.

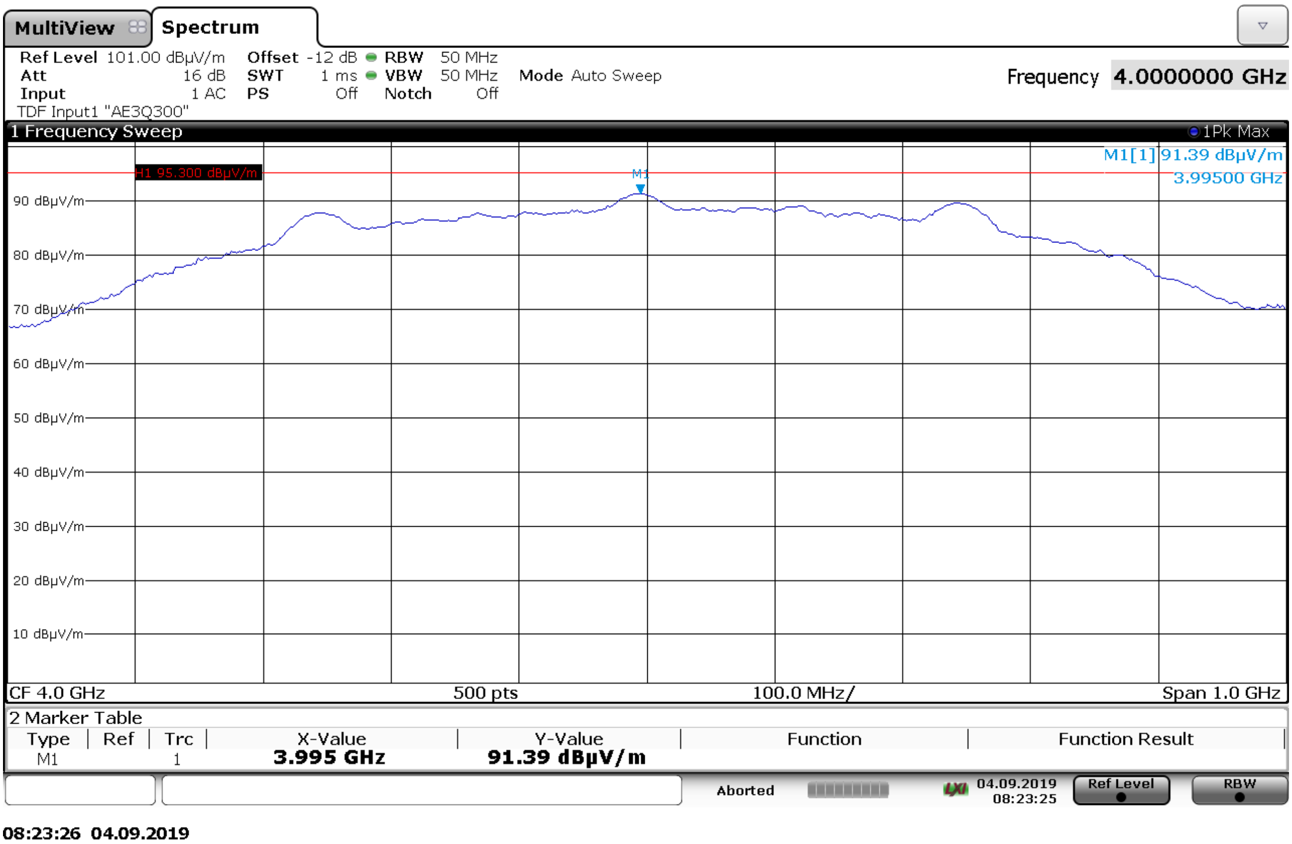

Figure 15: Chart of Peak emission measurement on channel 2

Note: Worst case elevation: 120 °, measurement antenna horizontal

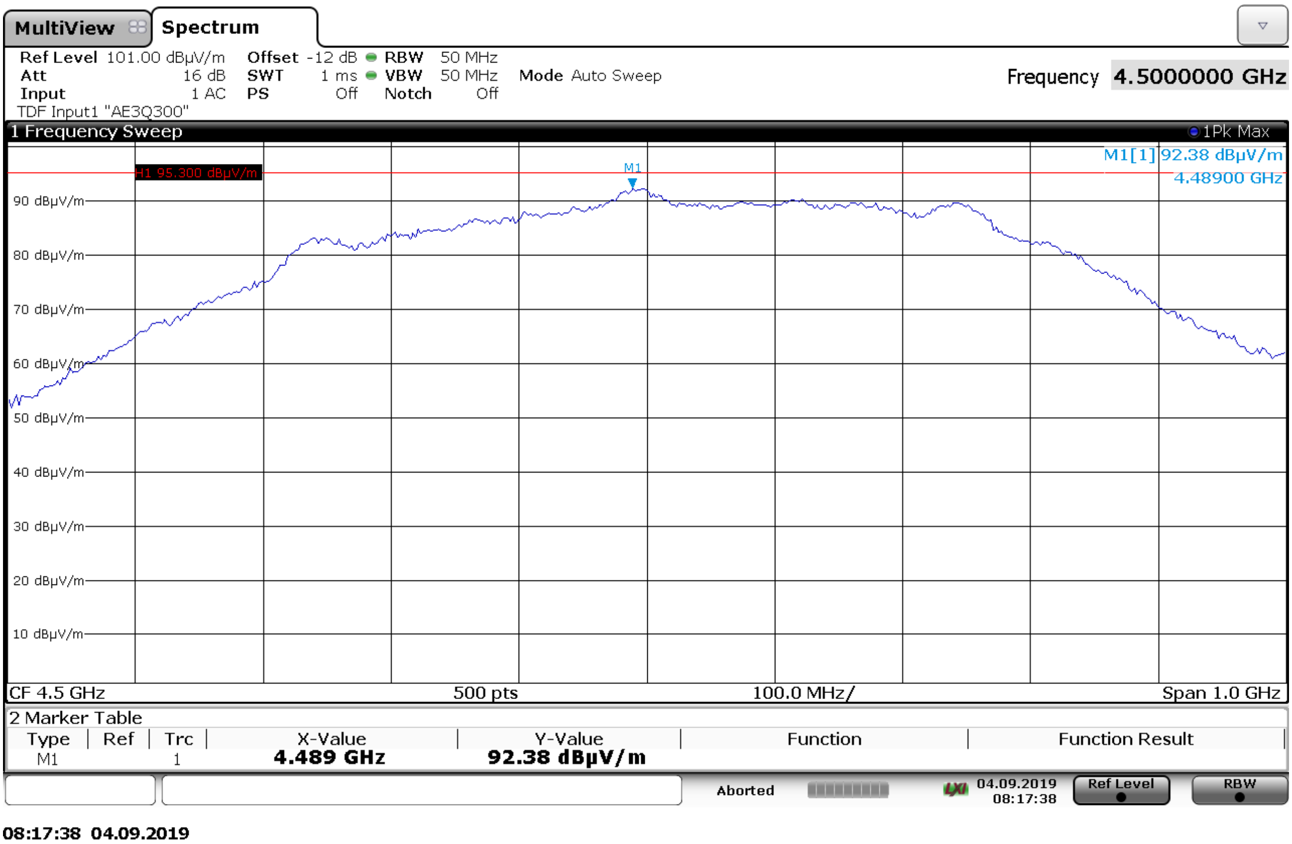

Figure 16: Chart of Peak emission measurement on channel 3

Note: Worst case elevation: 0 º, measurement antenna horizontal

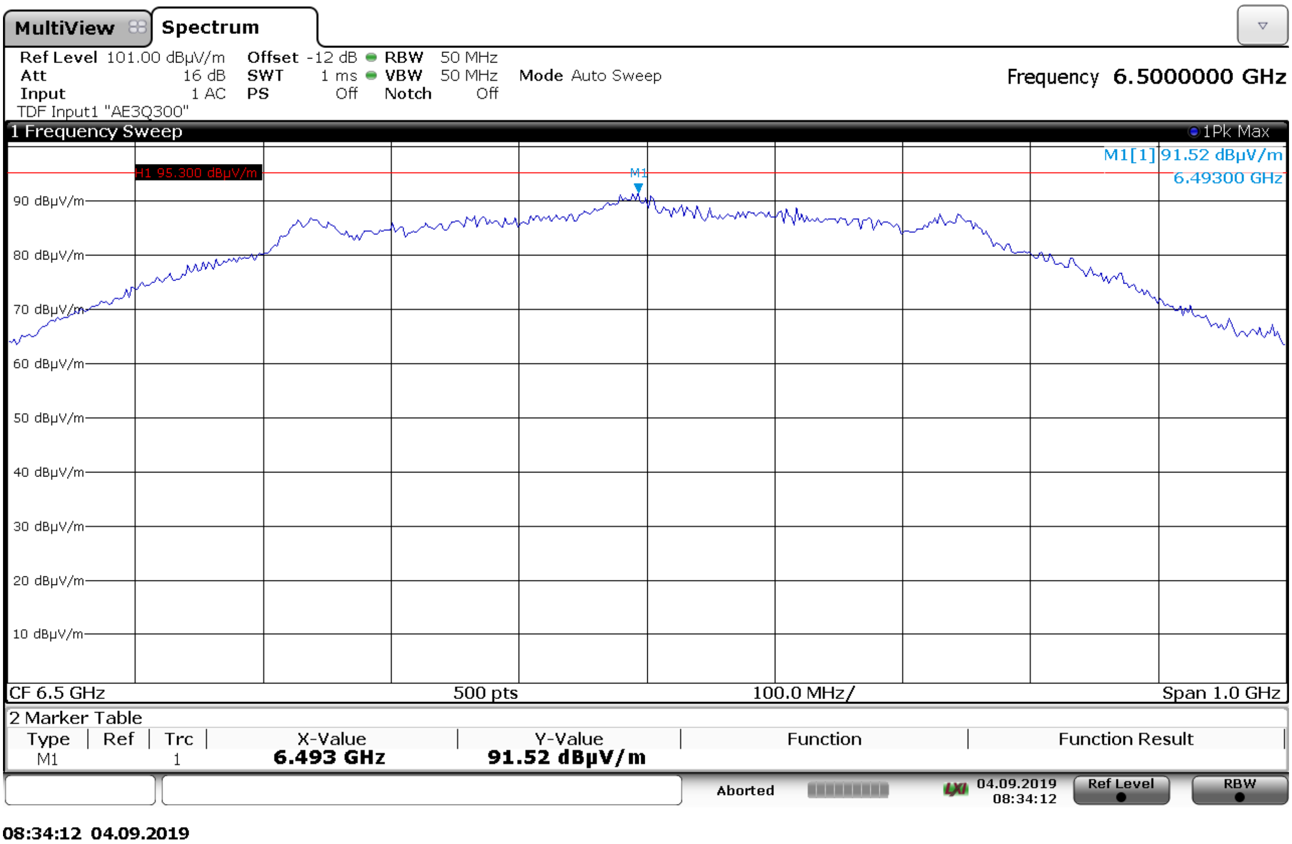

Figure 17: Chart of Peak emission measurement on channel 5

Note: Worst case elevation: 30 °, measurement antenna horizontal

Channel	measured fieldstrength RBW 50 MHz (dBµV/m at 3 m)	Limit RBW 50 MHz (dBµV/m at 3 m)	Margin (dB)	Result
2	91.39	95.30	3.91	passed
3	92.38	95.30	2.92	passed
5	91.52	95.30	3.78	passed

6.6 Radiated emissions 9 kHz to 40 GHz

6.6.1 Emissions below 30 MHz

Section(s) in 47 CFR Part 15:	Requirement(s):	15.209, 15.517(c)
	Reference(s):	

Result[6]:	☒ Test passed	☐ Test not passed

6.6.1.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☒	Compact Diagnostic Chamber (CDC)	VK041.0174	Albatross Projects	E00026
☐	Open area test site (OATS)	---	EMV **TESTHAUS**	E00354
☐	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☒	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Field probe	RF-R 400-1	Langer EMV-Technik	E00270
☒	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
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E00778
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

[6] For information about measurement uncertainties see page 55.

6.6.1.2 Limits

According 15.517(c):
The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency (MHz)	*Field strength (µV/m)*	*(dBµV/m)*	*Measurement distance (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 9: General radiated emission limits up to 30 MHz according to §15.209

6.6.1.3 Test procedure

The emissions below 30 MHz are measured using the test procedure for radiated measurements as described in clause 5.3.

6.6.1.4 Test results

Performed by:	Konrad Graßl	Date(s) of test:	March 28, 2019
Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
Antenna alignment:	☒ in parallel	☐ in line	☐ angle ….. °
EUT position:	☒ Position X	☒ Position Y	☒ Position Z

Frequency range	*Step size*	*IF Bandwidth*	*Detector*		*Measurement Time*		*Preamplifier*
			Prescan	*Final scan*	*Prescan*	*Final scan*	
9 kHz – 150 kHz	70.5 Hz	200 Hz	PK	PK,	2 s	1 s	Off
150 kHz – 30 MHz	7.462 kHz	9 kHz	PK	PK	2 s	1 s	Off

Note: Exploratory measurements are performed in all positions as indicated. However, the figures and result tables within this test report show only the worst case position. Pre- measurements have shown that there is no difference between the channels 2, 3 and 5, therefore representative only channel 2 was tested finally.

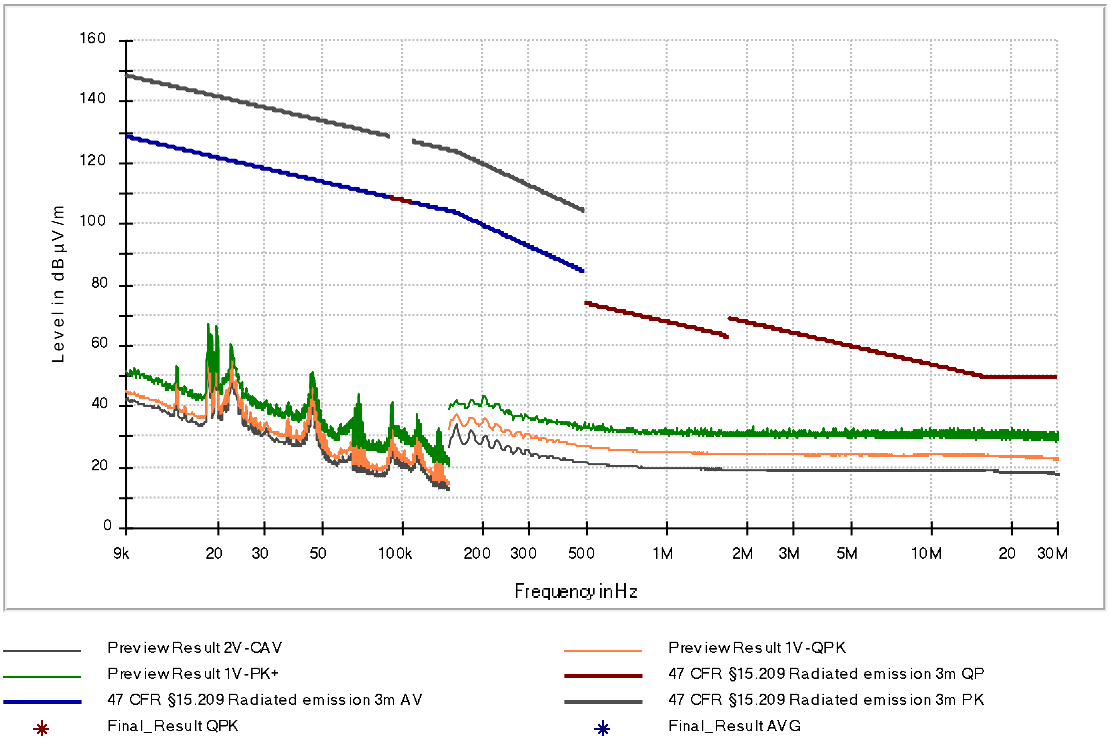

Figure 18: Chart of emissions test below 30 MHz on channel 2 in position X

Note: No assessable values could be detected.

6.6.2 Emissions from 30 MHz to 960 MHz

Section(s) in 47 CFR Part 15: Requirement(s): 15.209, 15.517(c)
Reference(s):

Result[7]: ☒ Test passed ☐ Test not passed

6.6.2.1 Test equipment

	Type	Designation	Manufacturer	Inventory no.
☒	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☐	Free space semi-anechoic chamber (FS-SAC)	FS-SAC	EMV **TESTHAUS**	E00100
☐	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☒	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	TRILOG broadband antenna (CDC)	VULB 9160	Schwarzbeck	E00011
☐	TRILOG broadband antenna (OATS)	VULB 9163	Schwarzbeck	E00013
☒	TRILOG broadband antenna (SAC)	VULB 9162	Schwarzbeck	E00643
☒	Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
☐	Cable set FS-SAC	RF cable(s)	Teledyne Reynolds Huber + Suhner Teledyne Reynolds	E00435 E00307 E00433
☒	Test software	EMC32-EB (V10.35)	Rohde & Schwarz	E00777
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E00778
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

[7] For information about measurement uncertainties see page 54.

6.6.2.2 Limits

According 15.517(c):
The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

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

Table 10: General radiated emission limits ≥ 30 MHz to 960 MHz according to §15.209

6.6.2.3 Test procedure

The emissions from 30 MHz to 1 GHz are measured using the test procedure for radiated measurements as described in clause 5.4.

6.6.2.4 Test results

Performed by:	Konrad Graßl	Date(s) of test:	March 29, 2019
Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
EUT position[8]:	☒ Position X	☐ Position Y	☐ Position Z

Frequency range	*Step size*	*IF Bandwidth*	*Detector*		*Measurement Time*		*Preamplifier*
			Prescan	*Final scan*	*Prescan*	*Final scan*	
30 MHz – 1 GHz	30 kHz	120 kHz	QP	QP	1 s	1 s	20 dB

Note: Exploratory measurements are performed in all positions as indicated. However, the figures and result tables within this test report show only the worst case position. Pre- measurements have shown that there is no difference between the channels 2, 3 and 5, therefore representative only channel 2 was tested finally.

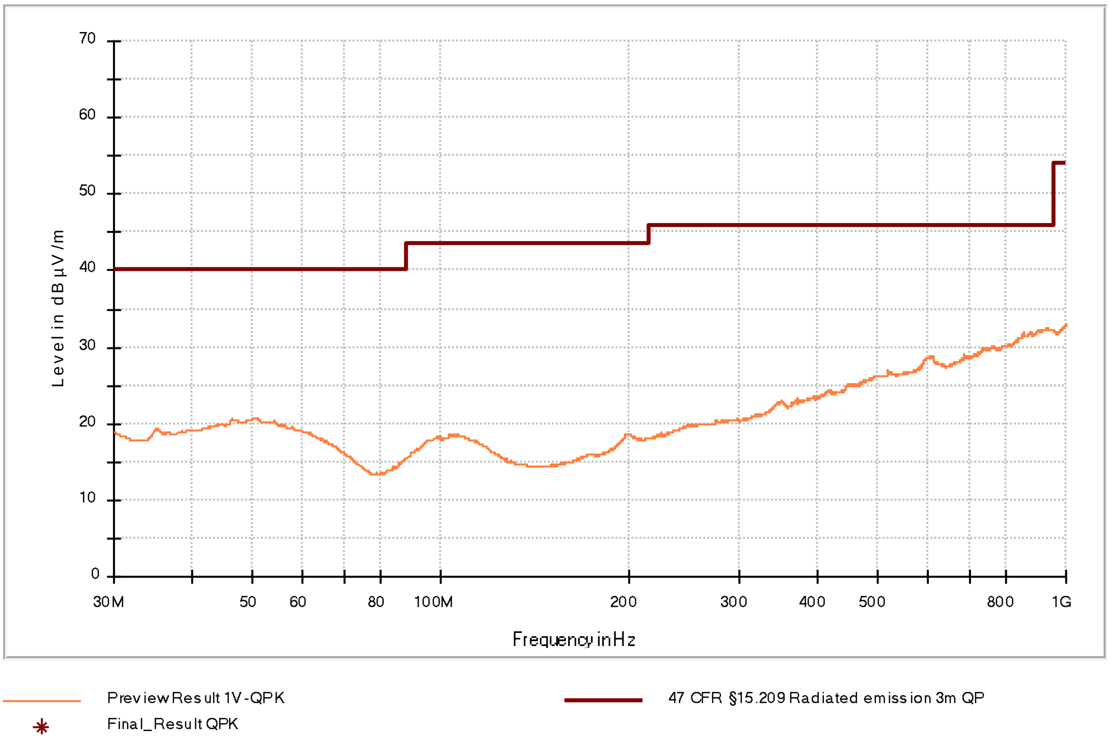

Figure 19: Chart of emissions test from 30 MHz to 1 GHz on channel 2 in position X measurement antenna vertical

Note: No assessable values could be detected.

[8] Exploratory measurements are performed in all positions as indicated. However, the figures and result tables within this test report show the worst case position, only.

6.6.3 Emissions from 960 MHz to 40 GHz

Section(s) in 47 CFR Part 15: Requirement(s): 15.517(c)
Reference(s):

Result[9]: ☒ Test passed ☐ Test not passed

6.6.3.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☐	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☒	Free space semi-anechoic chamber (FS-SAC)	FS-SAC	EMV **TESTHAUS**	E00100
☒	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☒	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Preamplifier (1 GHz - 18 GHz)	ALS05749	Aldetec	W01007
☒	Preamplifier (1 GHz - 18 GHz)	BBV9718B	Schwarzbeck	W01325
☒	Preamplifier (16 GHz - 40 GHz)	BBV9721	Schwarzbeck	W01350
☒	Horn antenna	BBHA 9120D	Schwarzbeck	W00052
☒	Horn antenna	BBHA 9170	Schwarzbeck	W00054
☐	Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
☒	Cable set FS-SAC	RF cable(s)	EMCO ELEKTRONIK Huber + Suhner	W00096 E01032

[9] For information about measurement uncertainties see page 52.

6.6.3.2 Limits

According 15.517(c):
The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz:

Frequency (MHz)	*EIRP (dBm)*	*calculated Fieldstrength at 3 m (dBµV/m)*
960-1610	-75.3	20
1610-1990	-53.3	42
1990-3100	-51.3	44
3100-10600	-41.3	54
Above 10600	-51.3	44

Table 11: Radiated emission limits above 960 MHz to 40 GHz according to §15.517

6.6.3.3 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.

6.6.3.4 Test results

Performed by:	Konrad Graßl	Date(s) of test:	March 25, 2019
		Date(s) of test:	April 8, 2019
Test distance:	960 MHz to 16.5 GHz: 16.5 GHz to 40 GHz :	☐ 1 m ☐ 3 m	☒ 0.75 m ☒ 0.30 m
EUT elevation:	See notes		

Measurement 960 MHz to 16.5 GHz:

RBW	1 MHz
Detector	RMS
Measurement distance	0.75 m

Note: With the reference level offset of -12 dB the measurement is referenced to the calculated limit at 3m.

Measurement 17 GHz to 40 GHz

RBW	1 MHz

Pre-measurement:

Detector	Peak
Measurement distance	0.15 m

Note: With the reference level offset of -26 dB the measurement is referenced to the calculated limit at 3m.

Final measurement:

Detector	RMS
Measurement distance	0.3 m

Note: With the reference level offset of -20 dB the measurement is referenced to the calculated limit at 3m.

Channel 2:

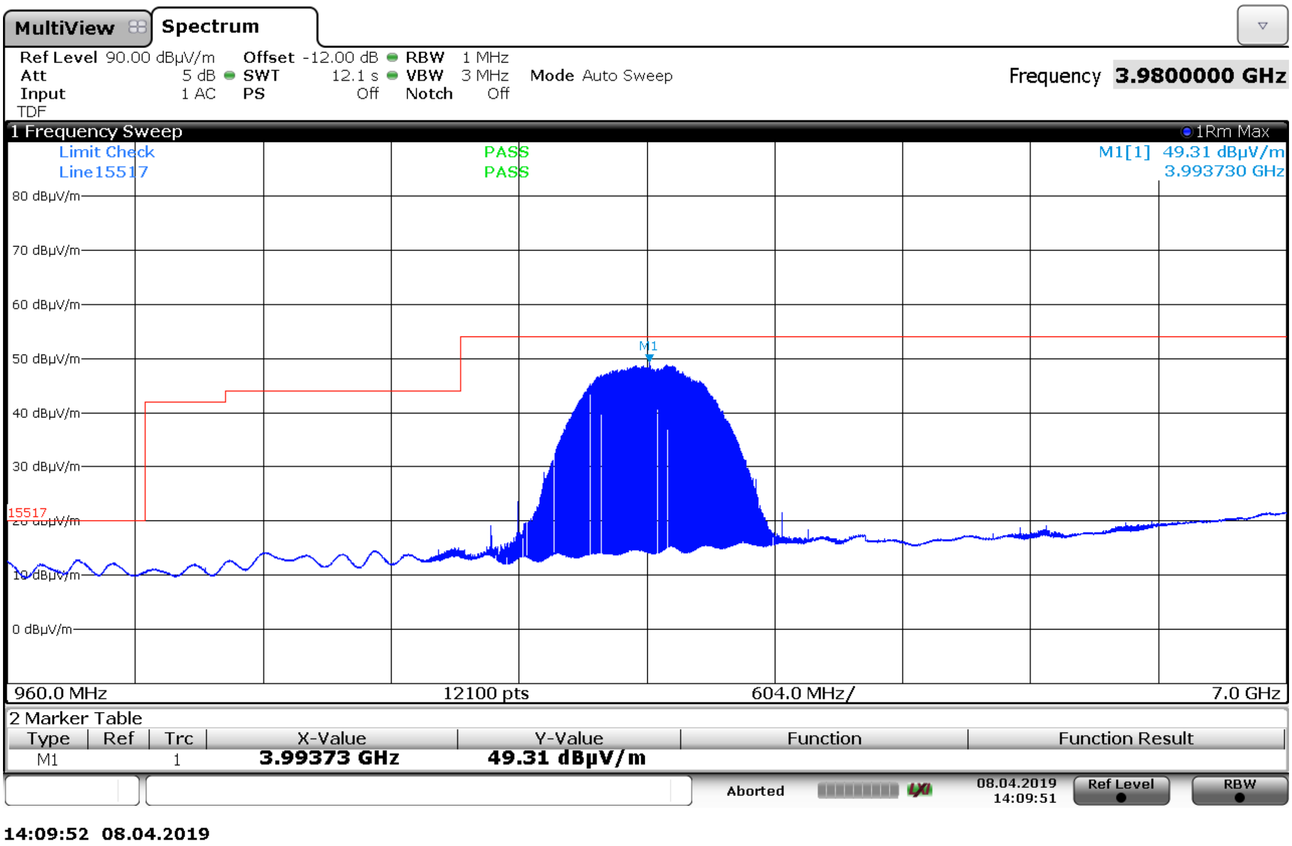

Figure 20: Chart of emissions test from 960 MHz to 7 GHz on channel 2

Note: Worst case elevation: 120 °, measurement antenna horizontal.

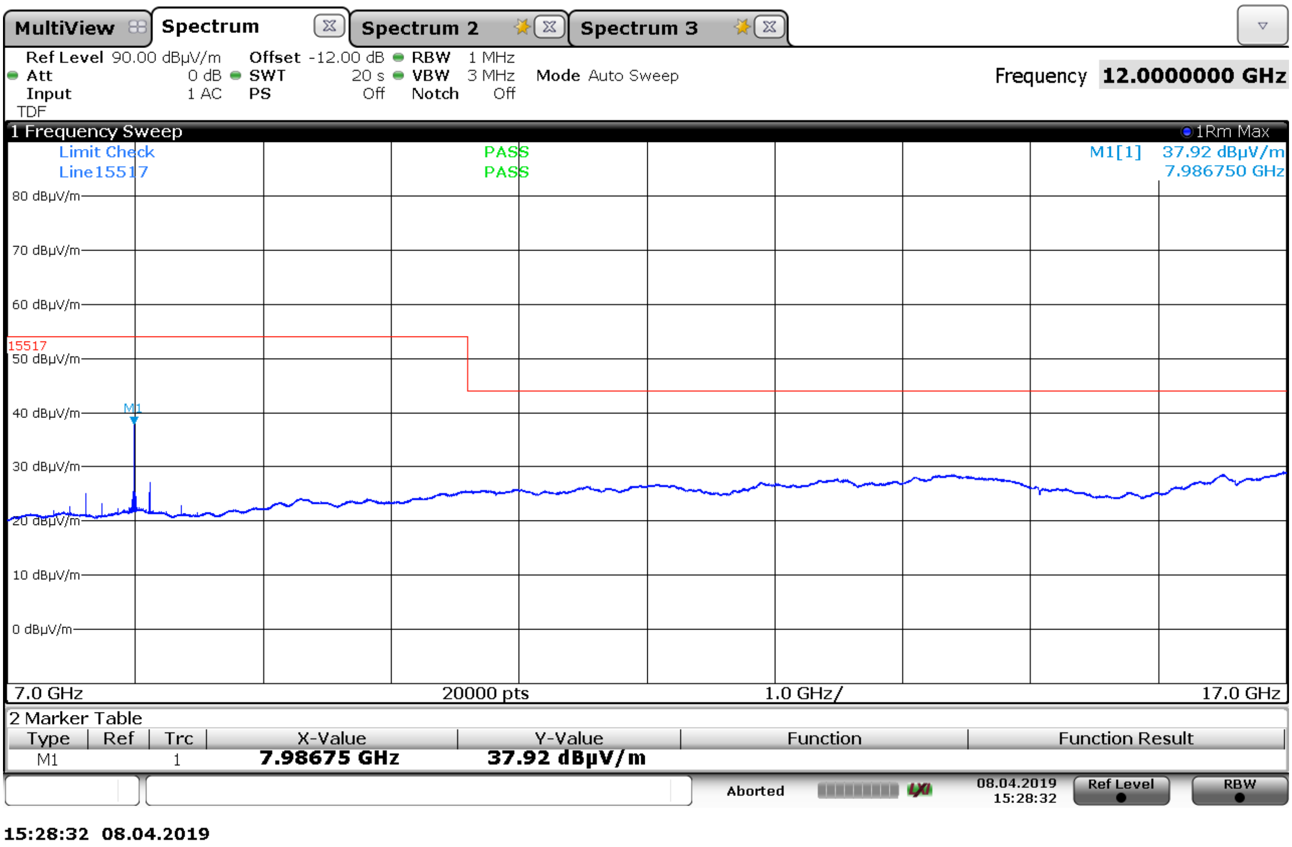

Figure 21: Chart of emissions test from 7 MHz to 17 GHz on channel 2

Note: Worst case elevation: 60 °, measurement antenna horizontal.

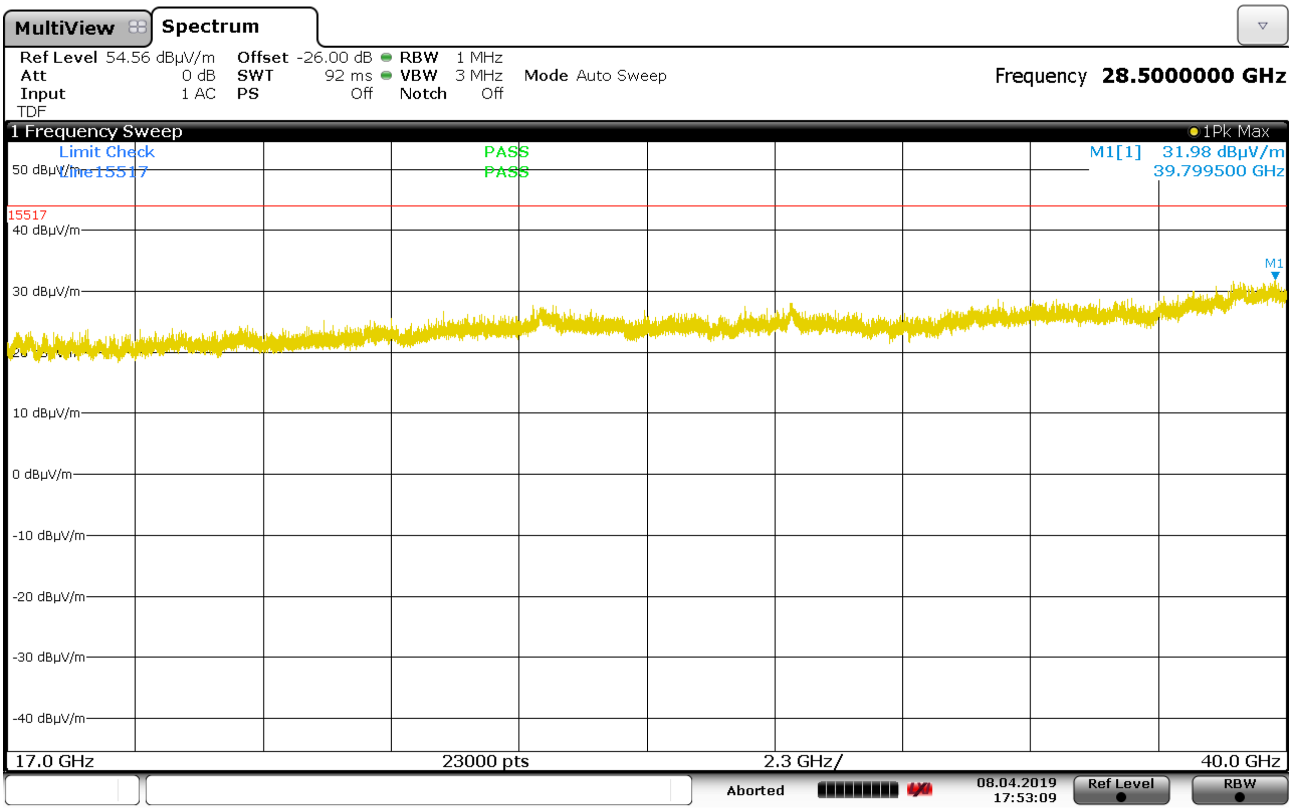

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Table 12: Chart of emissions test from 17 GHz to 40 GHz on channel 2, pre-measurement at measurement distance 15 cm

Note: Pre-measurements have shown that there is no assessable emission of the EUT in this frequency range. Representative the measurement with elevation 0 º, measurement antenna horizontal is shown.

Channel 3:

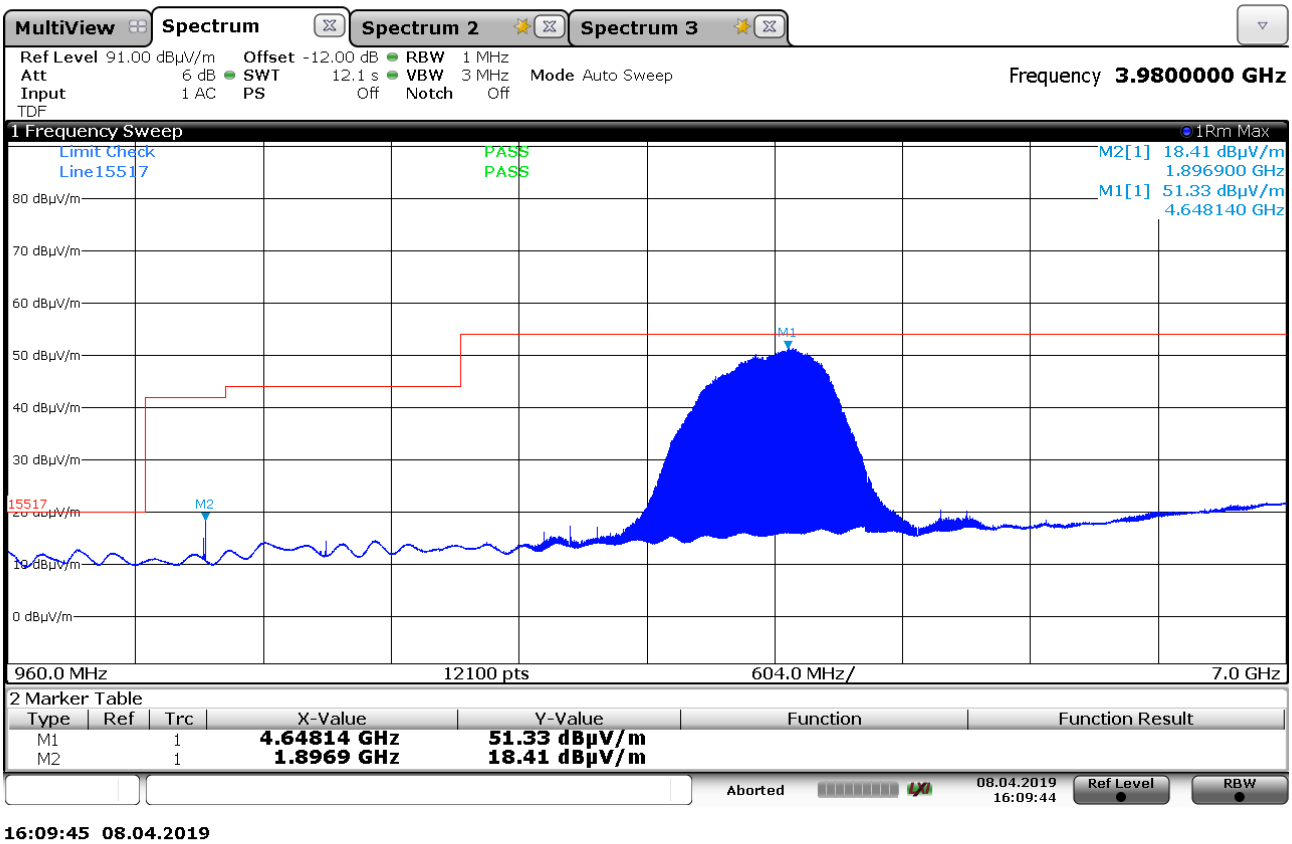

Figure 22: Chart of emissions test from 960 MHz to 7 GHz on channel 3

Note: Worst case elevation: 0 °, measurement antenna horizontal.

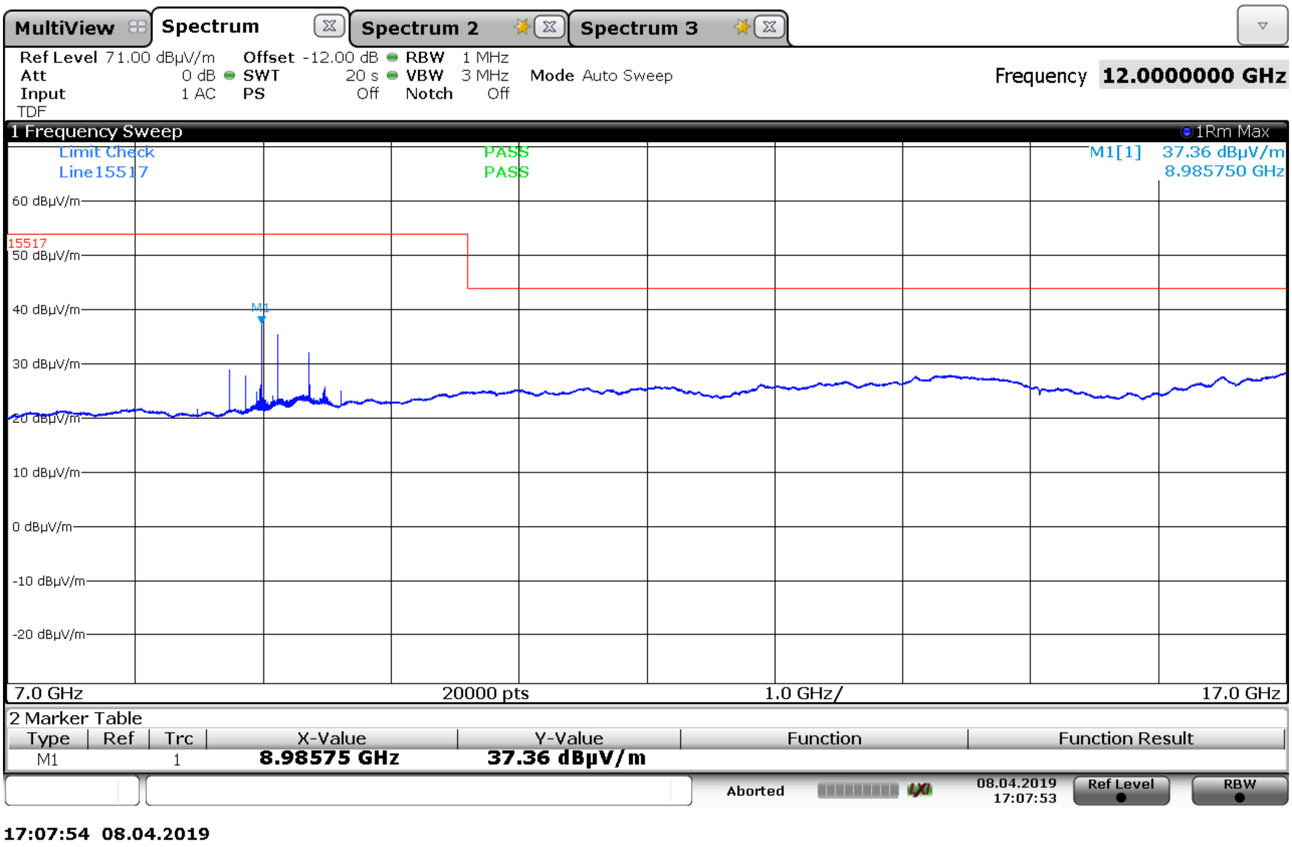

Figure 23: Chart of emissions test from 7 GHz to 17 GHz on channel 3

Note: Worst case elevation: 0 °, measurement antenna horizontal.

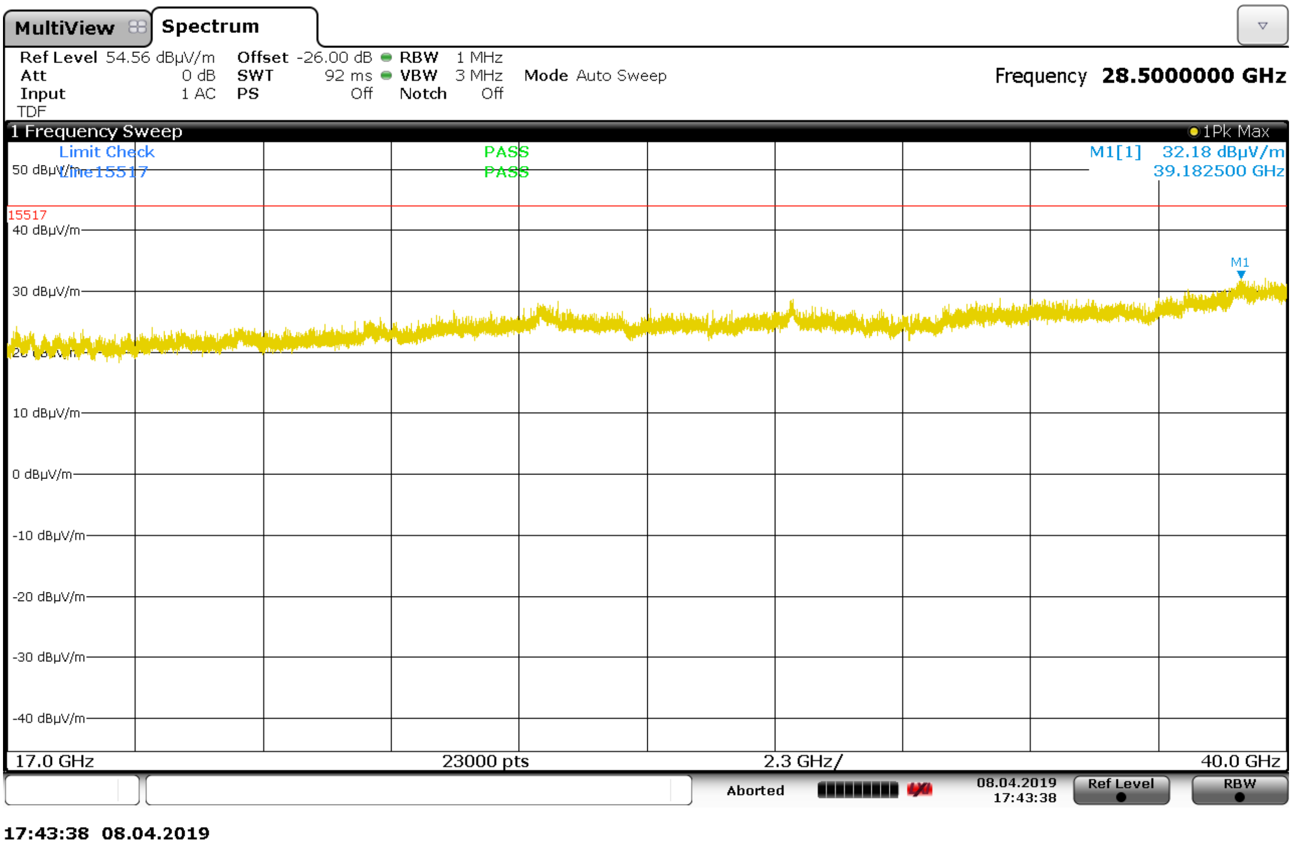

Table 13: Chart of emissions test from 17 GHz to 40 GHz on channel 3

Note: Pre-measurements have shown that there is no assessable emission of the EUT in this frequency range. Representative the measurement with elevation 0 °, measurement antenna horizontal is shown.

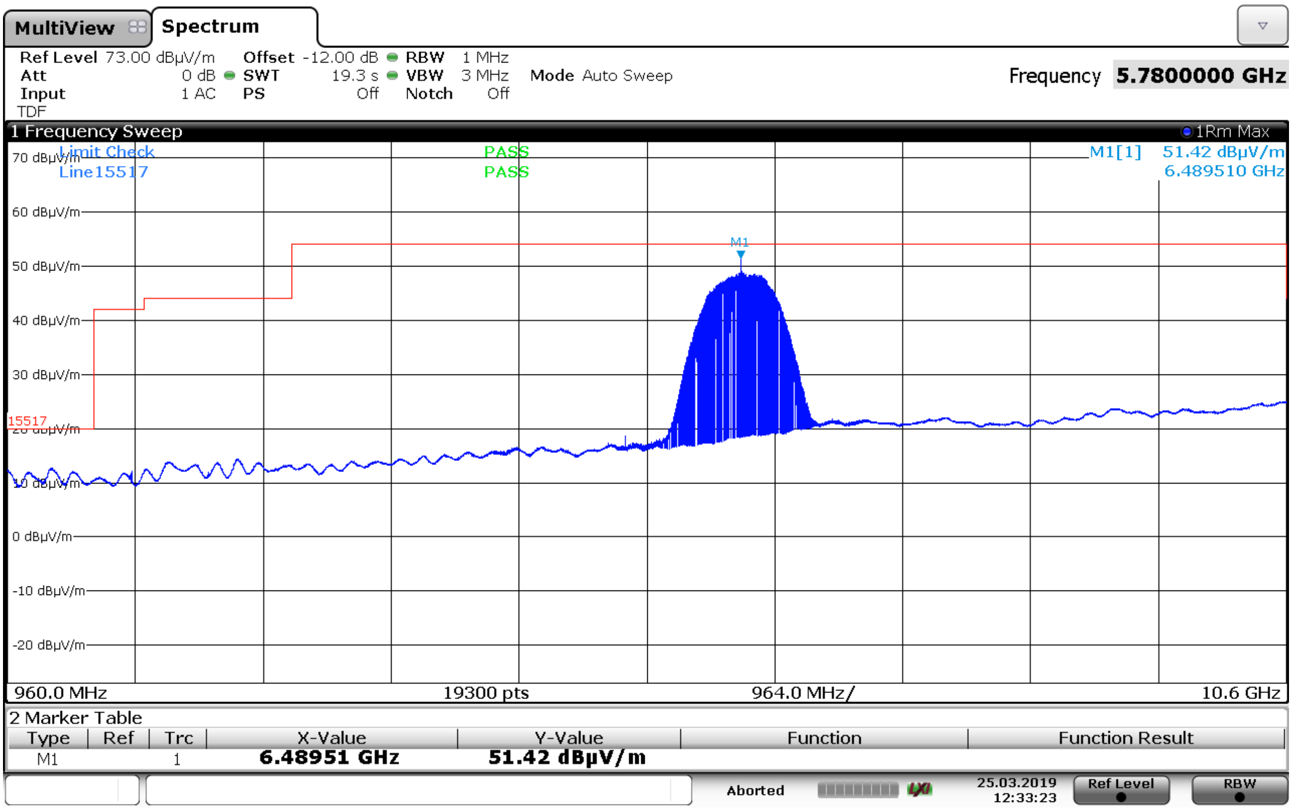

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Figure 24: Chart of emissions test from 960 MHz to 10.6 GHz on channel 5

Note: Worst case elevation: 30 °, measurement antenna horizontal.

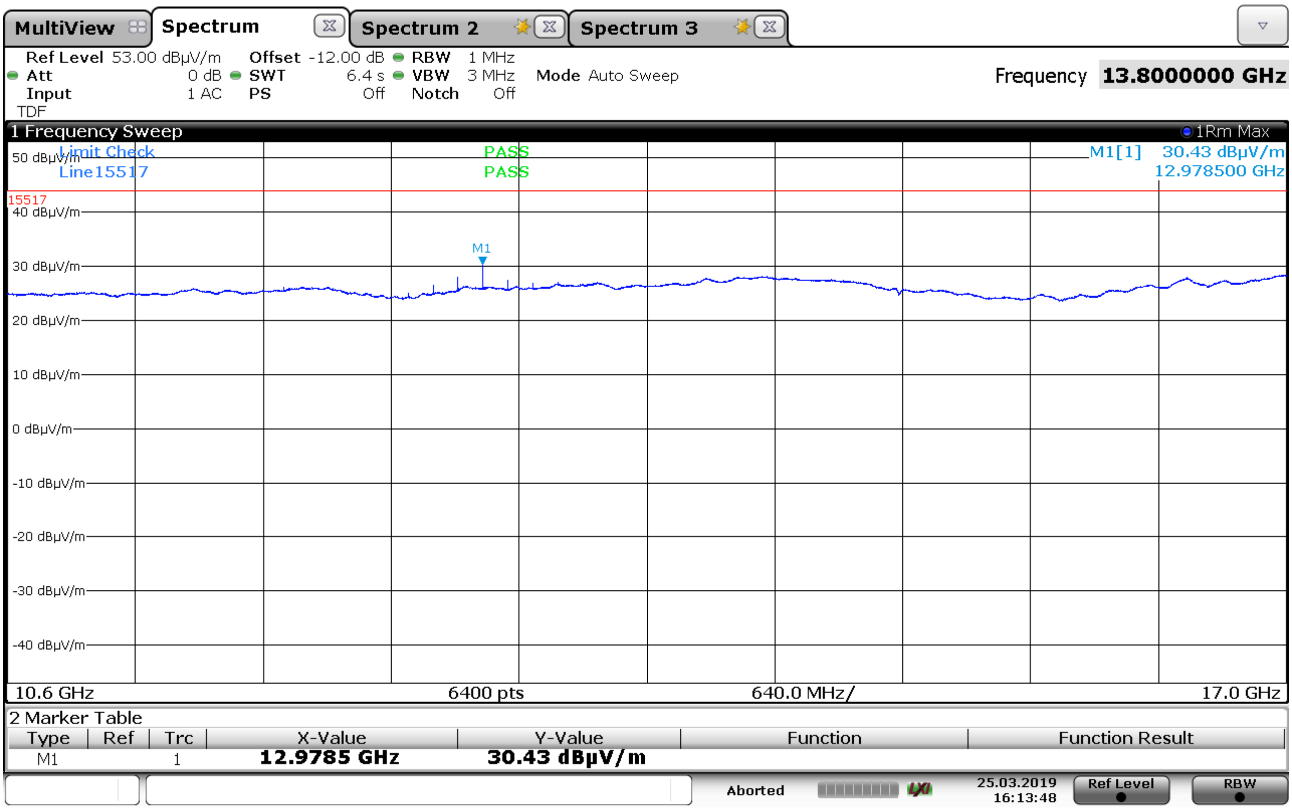

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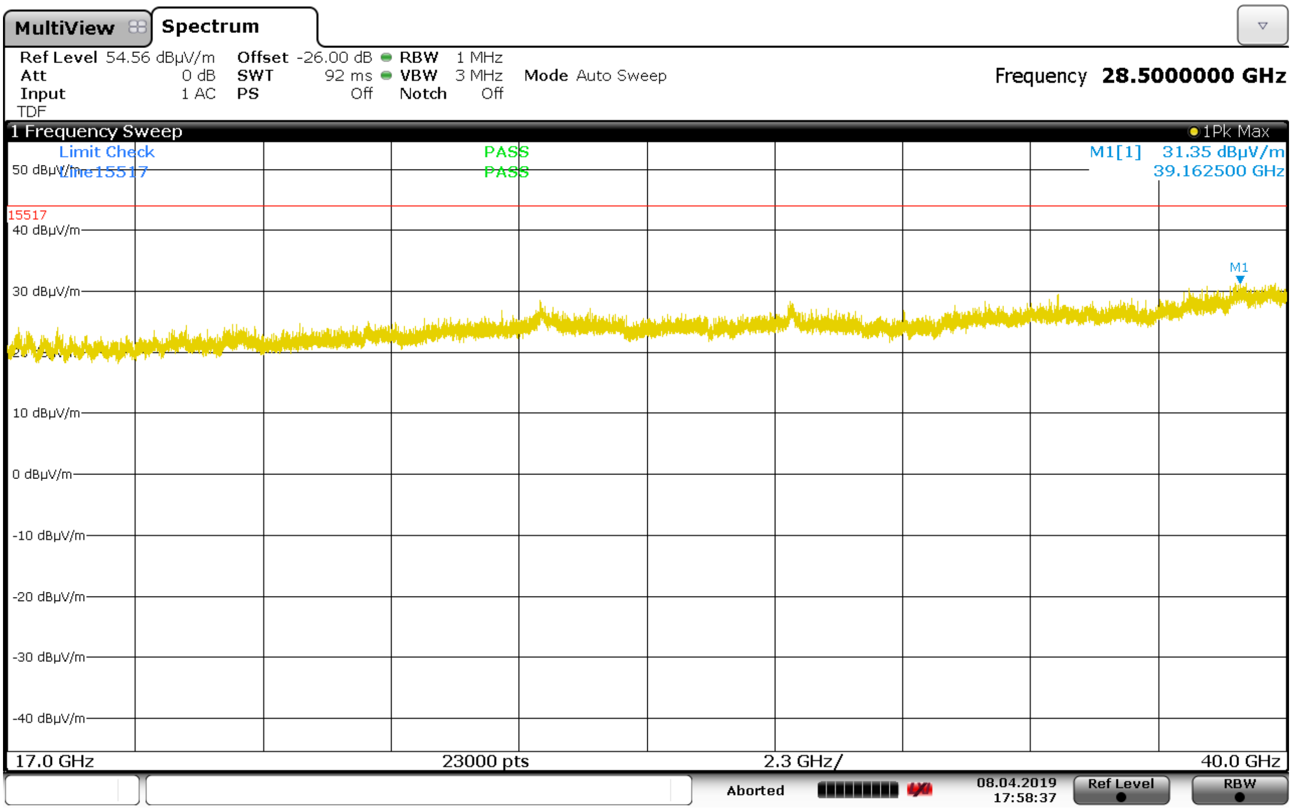
Figure 25: Chart of emissions test from 10.6 GHz to 17 GHz on channel 5

Note: Worst case elevation: 30 º, measurement antenna horizontal.



17:58:37 08.04.2019

Table 14: Chart of emissions test from 17 GHz to 40 GHz on channel 5

Note: Pre-measurements have shown that there is no assessable emission of the EUT in this frequency range. Representative the measurement with elevation 0 °, measurement antenna vertical is shown.

7 Equipment calibration status

Description	*Modell number*	*Serial number*	*Inventory number(s)*	*Last calibration*	*Next calibration*
EMI test receiver	ESW44	101538	E00895	2019-07	2020-07
EMI test receiver	ESU26	100026	W00002	2018-06	2020-06
EMI test receiver	ESR7	101059	E00739	2019-08	2020-08
Preamplifier (1 GHz - 18 GHz)	BBV 9718 B	00032	W01325	2019-09	2020-10
Preamplifier (18 GHz - 40 GHz)	BBV 9721	43	W01350	2019-11	2020-11
Loop antenna	HFH2-Z2	871398/0050	E00060	2018-10	2020-10
TRILOG broadband antenna (SAC3)	VULB 9162	9162-041	E00643	2018-03	2021-03
Horn antenna	BBHA 9120D	9120D-592	W00052	2017-04	2020-04
Horn antenna	BBHA 9170	9170-332	W00054	2017-04	2020-04
Measuring antenna set	---	---	A00088	N/A[3]	
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	2018-03	2021-03
Semi-anechoic chamber (SAC)	SAC3	C62128-A520-A643-x-0006	E00716	2018-03	2021-03
Cable set CDC	RG214/U	---	E00446	2019-04	2020-04
	LCF12-50J	---	E01215	2019-04	2020-04
	LMR400	1718020006	E00920	2020-01	2021-01
	RG214 Hiflex	171802007	E00921	2020-01	2021-01
Cable set anechoic chamber	262-0942-1500	005	E00435	2019-10	2020-10
	SF104EA/2x11PC 35-42/5m	11144/4EA	E00307	2019-12	2020-12
	262-0942-1500	003	E00433	2019-10	2020-10
Cable set of semi-anechoic chamber SAC3	SF104EA/11PC35 /11PC35/10000M M	501347/4EA	E00755	2019-12	2020-12
	SF104E/11PC35/1 1PC35/2000MM	507410/4E	E01033	2019-12	2020-12
	SF104E/11PC35/1 1PC35/2000MM	507411/4E	E01034	2019-09	2020-09

8 Measurement uncertainties

Description	*Uncertainty*	*k=*
AC power line conducted emission	± 4.1 dB	2
Carrier frequency separation Number of hopping frequencies Time of occupancy (dwell time)	± 5.0 %	2
Bandwidth tests	± 2.0 %	
Maximum conducted output power (conducted)	± 1.5 dB	
Power spectral density (conducted)	± 2.9 dB	
Conducted spurious emissions	± 2.9 dB	
Radiated emissions in semi-anechoic chamber		
9 kHz to 30 MHz	± 4.8 dB	2
30 MHz to 300 MHz	± 5.4 dB	2
300MHz to 1 GHz	± 4.7 dB	2
Radiated emissions in semi-anechoic chamber with RF absorbing material on the floor or fully anechoic room		
1 GHz to 40 GHz	± 4.5 dB	2

Comment: 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.

Test related measurement uncertainties have to be taken into consideration when evaluating the test results. All used test instrument as well as the test accessories are calibrated at regular intervals.

9 Revision history

Revision	*Date*	*Issued by*	*Description of modifications*
0	2020-03-27	Konrad Graßl	First edition