EMI – TEST REPORT

- FCC Part 15.250, RSS-210 -

Type / Model Name	:	KINEXON SafeTag KNX-T1.8-5
Product Description	:	Tracking System
Applicant	:	KINEXON Inc.
Address	:	25 Broadway Floor 9
		NEW YORK, NY 10004, USA
Manufacturer	:	KINEXON GmbH
Address	:	Schellingstraße 35
		80799 MÜNCHEN, GERMANY

Test Result according to the standards listed in clause 1 test standards:	**POSITIVE**

Test Report No. : T46535-00-01SK	11. August 2020 Date of issue

Deutsche Akkreditierungsstelle
D-PL-12030-01-01
D-PL-12030-01-02

CSA Group Bayern GmbH
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FCC ID: 2ALC5-KNX-STAG1 **IC:** 25557-KNXSTAG1

Contents

ATTACHMENT A as separate supplement

FCC ID: 2ALC5-KNX-STAG1 **IC:** 25557-KNXSTAG1

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 15, Subpart A - General (September 2019)

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements

FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (September 2019)

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204	External radio frequency power amplifiers and antenna modifications
Part 15, Subpart C, Section 15.205	Restricted bands of operation
Part 15, Subpart C, Section 15.207	Conducted limits
Part 15, Subpart C, Section 15.209	Radiated emission limits, general requirements
Part 15, Subpart C, Section 15.250	Operation of wideband systems within the band 5925-7250 MHz
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
ETSI TR 100 028 V1.3.1: 2001-03	Electromagnetic Compatibility and Radio Spectrum Matters (ERM); Uncertainties in the Measurement of Mobile Radio Equipment Characteristics—Part 1 and Part 2
KDB 393764 D01 v02 (January 29, 2018)	Ultra-Wideband (UWB) Devices – Frequently Asked Questions

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2 EQUIPMENT UNDER TEST

2.1 General remarks

This test report replaces the test report T46535-00-00SK.

2.2 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.3 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

2.4 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

2.5 Equipment type

Portable UWB Device

2.6 Short description of the equipment under test (EUT)

The product emits UWB signals which can be used to measure the time-of-flight to determine the distance between two or more tags and alert the user in case the distance falls below a configurable level. Also, this tag can be used as part of a real-time location system (RTLS) to determine its absolute position.

Number of tested samples: 1
Serial number: 67319
Firmware version: 4.29.0

EUT configuration:
(The CDF filled by the applicant can be viewed at the test laboratory.)

2.7 Variants of the EUT

There are no variants. The EUT does contain a USB interface which is contacted by two of the pins at the bottom of the housing and connected to the charging station.

2.8 Operation frequency and channel plan

The operating frequency band is 5925 MHz to 7250 MHz.

Channel plan:

Channel number	f_c (MHz)
Channel 5	6489.6

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2.9 Transmit operating modes

Modulation: variable pulse position modulation (PPM) in combination with binary phase shift keying (BPSK).

Data rate: 6.8 Mbit/s

2.10 Antenna

The EUT has only an integrated PCB antenna, no temporary connector and no external antenna to be connected.

2.11 Power supply system utilised

Power supply voltage, V_{nom} : 3.7 V/DC

2.12 Peripheral devices and interface cables

The following peripheral devices and interface cables are connected during the measurements:

- None Model : -
- _____ Model : _____

2.13 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes with horizontal and vertical antenna positions to determine the worst case condition.

2.13.1 Test jig

No test jig is used.

2.13.2 Test software

No test software was used. The EUT is in a continuous transmission mode.

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3 TEST RESULT SUMMARY

UWB device using digital modulation:

Operating in the 5925 MHz - 7250 MHz band:

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	not applicable
15.250(b)	RSS-210, Annex K, K2	UWB Bandwidth	passed
15.209(a) 15.250(c)	RSS-Gen, 8.9 RSS-210, Annex K, K3(a)	Radiated Emissions 9 kHz to 40 GHz	passed
15.250(d)	RSS-210, Annex K, K3(b)	Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz	passed
15.250(d)	RSS-210, Annex K, K3(c)	Peak Power radiated	passed
15.203	RSS-Gen, 6.6	Antenna requirement	passed

Note: AC power line conducted emissions not applicable because EUT has no AC mains connection.

The mentioned RSS Rule Parts in the above table are related to:
RSS-Gen, Issue 5, March 2019
RSS-210, Issue 10, December 2019

3.1 Final assessment

The equipment under test fulfills the EMI requirements cited in clause 1 test standards.

Date of receipt of test sample : acc. to storage records

Testing commenced on : 18 June 2020

Testing concluded on : 03 August 2020

Checked by:

Klaus Gegenfurtner
2020.08.11 12:39:40
+02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Sabine Kugler
2020.08.11
10:26:37
+02'00'

Sabine Kugler
Radio Team

FCC ID: 2ALC5-KNX-STAG1 **IC:** 25557-KNXSTAG1

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	15-35 °C
Humidity:	30-60 %
Atmospheric pressure:	86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 2011 + A1 / 2014 „Uncertainties, statistics and limit modelling – Uncertainty in EMC measurements“ and is documented in the quality system acc. to DIN EN ISO/IEC 17025. For all measurements shown in this report, the measurement uncertainty of the test laboratory, CSA Group Bayern GmbH, is below the measurement uncertainty as defined by CISPR. Therefore, no special measures must be taken into consideration with regard to the limits according to CISPR. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	± 3.29 dB
20 dB Bandwidth	Center frequency of EUT	95%	$\pm 2.5 \times 10^{-7}$
99% Occupied Bandwidth	Center frequency of EUT	95%	$\pm 2.5 \times 10^{-7}$
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Peak conducted output power	902 MHz to 928 MHz	95%	± 0.35 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB

4.4 Conformity Decision Rule

The conformity decision rule is based on the ILAC G8 published at the time of reporting.

4.5 Measurement protocol for FCC and ISED

4.5.1 General information

CSA Group Bayern GmbH is recognized as wireless testing laboratory under the CAB identifier:

FCC: DE 0011
ISED: DE0009

4.5.2 General Standard information

The test methods used comply with ANSI C63.10 - "Testing Unlicensed Wireless Devices".

4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral using the appropriate impedance characteristic or left unterminated. Where appropriate, cables are manually manipulated with respect to each other thus obtaining maximum disturbances from the unit.

4.5.2.2 Radiated emission (electrical field 30 MHz - 1 GHz)

Spurious emissions from the EUT are measured in the frequency range of 30 MHz to 1000 MHz using a tuned receiver and appropriate broadband linearly polarised antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is established in accordance with ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so that they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. The antenna is positioned 3, 10 or 30 metres horizontally from the EUT and is repeated vertically. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 metres and the EUT is rotated 360 degrees.
The final level in dBµV/m is calculated by taking the reading from the EMI receiver (Level dBµV) and adding the correction factors and cable loss factor (dB). The FCC or CISPR limit is subtracted from this result in order to provide the limit margin listed in the measurement protocol.

The resolution bandwidth setting:
30 MHz – 1000 MHz: RBW: 120 kHz

Example:

Frequency (MHz)	Level (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	CISPR Limit (dBµV/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

4.5.2.3 Radiated emission (electrical field 1 GHz - 40 GHz)

Radiated emissions from the EUT are measured in the frequency range 1 GHz up to the maximum frequency as specified in 47 CFR Part 15, Subpart A, Section 15.33, using a spectrum analyser and appropriate linearly polarized antennas. Table top equipment is placed on a 1.0 X 1.5 metre non-conducting table, 1.5 metre above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. The setup of the equipment under test is following set out in ANSI C63.10. The interface cables that are closer than 40 centimetres to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimetres from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screened room located outside the test area. Measurements are made in both the horizontal and vertical polarization planes in a fully anechoic room using a spectrum analyzer set to max peak detector function and a resolution 1 MHz and video bandwidth 3 MHz for peak measurement. The conditions determined as worst case will then be used for the final measurements. When the EUT is larger than the beam width of the measuring antenna it will be moved over the surface for the four sides of the equipment. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty and are calculated at the specified test distance.

The peak EIRP limit on the peak level of the emission according to FCC Part 15 Subpart C §15.250:
For RBW = 50 MHz: $20 * \log_{10}(RBW/50)$ dBm = 0 dBm

The test setup is prepared with the EUT at the desired EUT-antenna separation.
The turntable is rotated 360° until the test receiver displays the maximum level at the observed frequency.
The antenna height is then adjusted from 1 m to 4 m maximizing the measured value.
The turntable is re-adjusted to re-affirm the maximum emission value which is then recorded.
This procedure is repeated for all frequencies of interest.

5 TEST CONDITIONS AND RESULTS

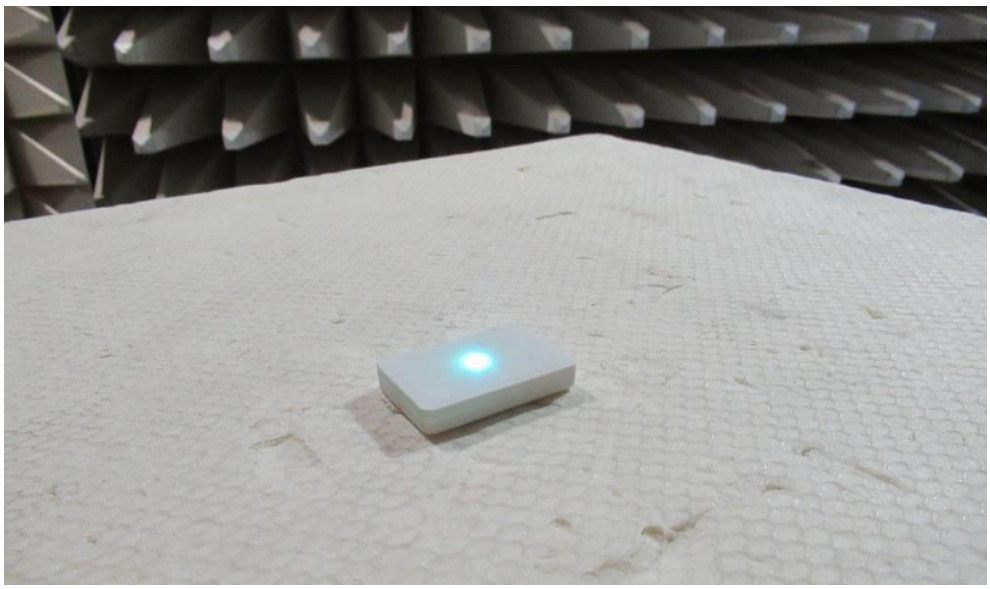
5.1 UWB Bandwidth

For test instruments and accessories used see section 6 Part **CPR 3**.

5.1.1 Description of the test location

Test location: Anechoic chamber 1

5.1.2 Photo documentation of the test set-up



5.1.3 Applicable standard

According to FCC Part 15, Section 15.250(a):
The −10 dB bandwidth of a device operating under the provisions of this section must be contained within the 5925-7250 MHz band under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

According to FCC Part 15, Section 15.250(b):
The −10 dB bandwidth of the fundamental emission shall be at least 50 MHz. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the −10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency following the provisions of §15.31(m)

5.1.4 Description of Measurement

The measurement was performed radiated at a distance of 1 m. The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -10 dB.

Spectrum analyser settings:
RBW: 1 MHz, VBW: 3 MHz, Detector: Peak

5.1.5 Test result

lowest frequency f_L (MHz)	highest frequency f_H (MHz)	permitted frequency range (GHz)	UWB bandwidth (MHz)	required UWB bandwidth (MHz)	result
6239.4	6738.25	5.925 – 7.250	498.85	> 50	passed
				< 500	passed

Limit according to FCC Part 15, Section 15.250(b):
The −10 dB bandwidth of the fundamental emission shall be at least 50 MHz.

Limit according to RSS-210 Annex K, K.2(b):
The 10 dB bandwidth of the device shall be at least 50 MHz and less than 500 MHz.

The requirements are **FULFILLED.**

Remarks: For detailed test results please refer to the following test protocol.

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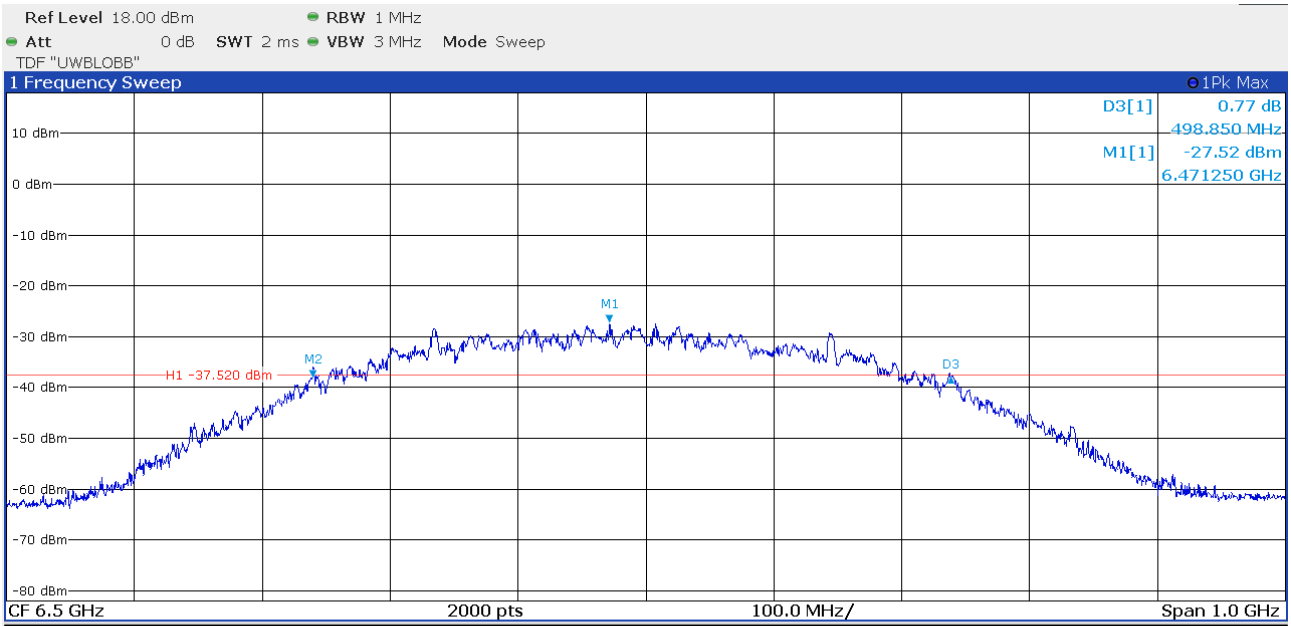
5.1.6 Test protocol EBW

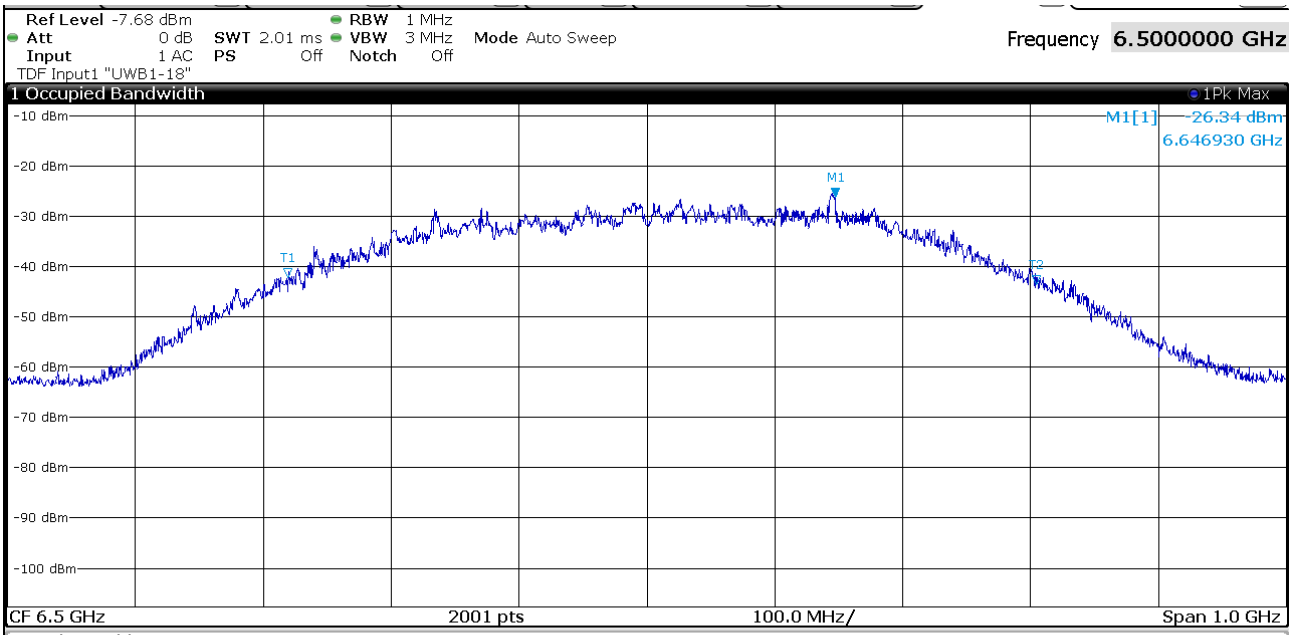
-10dB bandwidth



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**6.47125 GHz**	**-27.52 dBm**		
M2		1	**6.2394 GHz**	**-38.25 dBm**		
D3	M2	1	**498.85 MHz**	**0.77 dB**		

99% bandwidth



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**6.64693 GHz**	**-26.34 dBm**	Occ Bw	**584.923616655 MHz**
T1		1	6.219519 GHz	-42.25 dBm	Occ Bw Centroid	6.51198093 GHz
T2		1	6.804443 GHz	-43.55 dBm	Occ Bw Freq Offset	11.980929514 MHz

5.2 Radiated Emissions 9 kHz to 40 GHz

For test instruments and accessories used see section 6 Part **SER 2** and **SER 3**.

5.2.1 Description of the test location

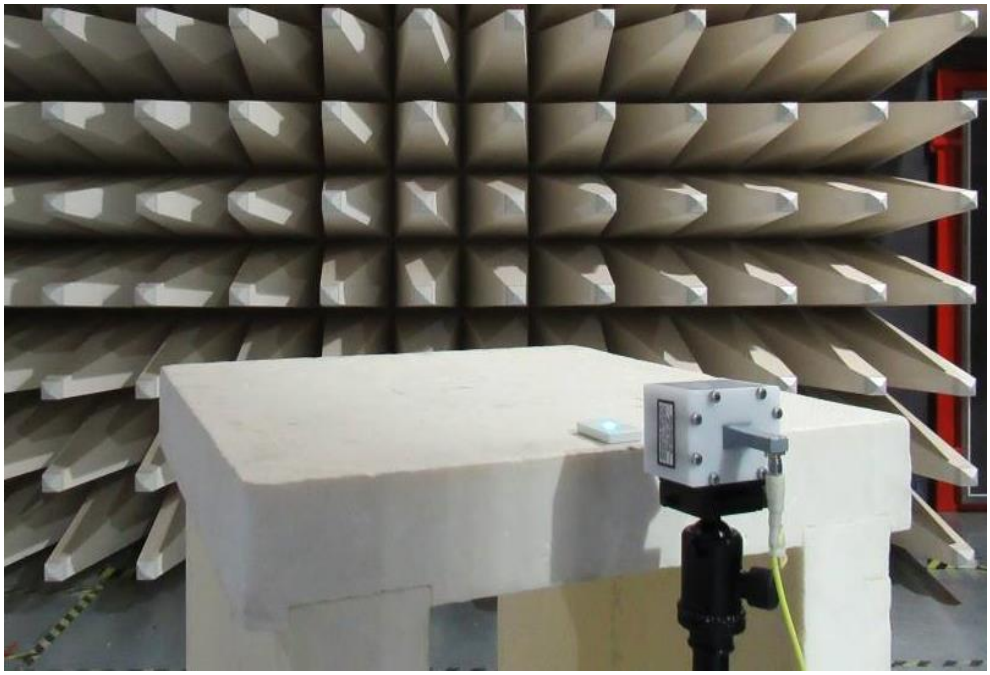
Test location: OATS 1
Test location: Anechoic chamber 1

5.2.2 Photo documentation of the test set-up

30 MHz – 960 MHz:

960 MHz – 18 GHz:

18 GHz – 40 GHz:



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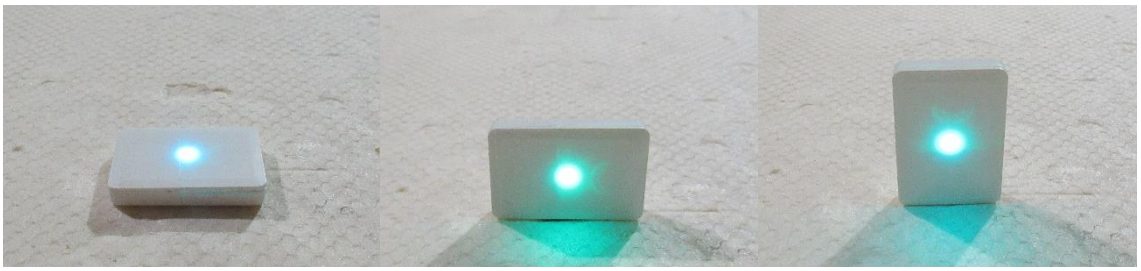

5.2.3 Applicable standard

According to FCC Part 15, Section 15.250(d):
Radiated emissions at or below 960 MHz 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 RMS average limits based on measurements using a 1 MHz resolution bandwidth.

5.2.4 Analyser settings

9 kHz – 150 kHz	RBW: 200 Hz			
150 kHz - 30 MHz	RBW: 9 kHz			
30 MHz – 960 MHz	RBW: 120 kHz	Detector: QP		
960 MHz – 40 GHz	RBW: 1 MHz	VBW: 3 MHz	Detector: RMS	Sweeptime: 1ms per MHz

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5.2.5 Test result

5.2.5.1 Measurement 9 kHz to 30 MHz

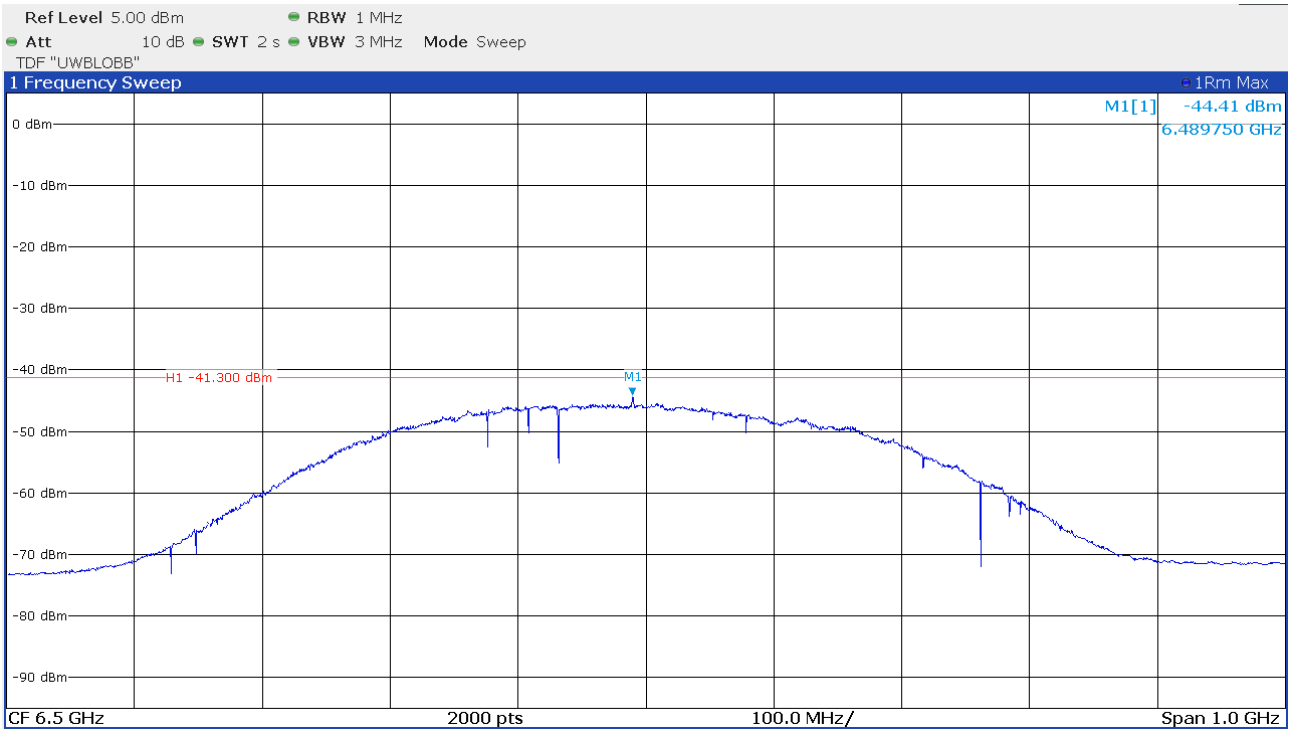
Note: Pre-measurements have shown, there are no detectable emissions in this frequency range.

5.2.5.2 Measurement 30 MHz to 960 MHz

Frequency (MHz)	Reading Vert. (dBµV)	Reading Hor. (dBµV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBµV/m)	Level Hor. (dBµV/m)	Limit (dBµV/m)	Dlimit (dB)
36.30	5.0	-3.1	12.6	13.7	17.6	10.6	40.0	-22.4
109.90	0.4	-3.1	12.5	11.6	12.9	8.5	43.5	-30.6
197.90	3.1	1.0	13.3	12.7	16.4	13.7	43.5	-27.1
304.80	-3.0	-1.4	16.5	16.9	13.5	15.5	46.0	-30.5
442.50	-3.5	-3.5	20.5	20.7	17.0	17.2	46.0	-28.8
604.70	-3.5	-3.4	24.2	24.6	20.7	21.2	46.0	-24.8
730.10	-3.0	-3.2	26.0	26.5	23.0	23.3	46.0	-22.7
841.00	-2.5	-2.6	27.7	28.3	25.2	25.7	46.0	-20.3

5.2.5.3 Measurement 960 MHz to 40 GHz

Mean Power



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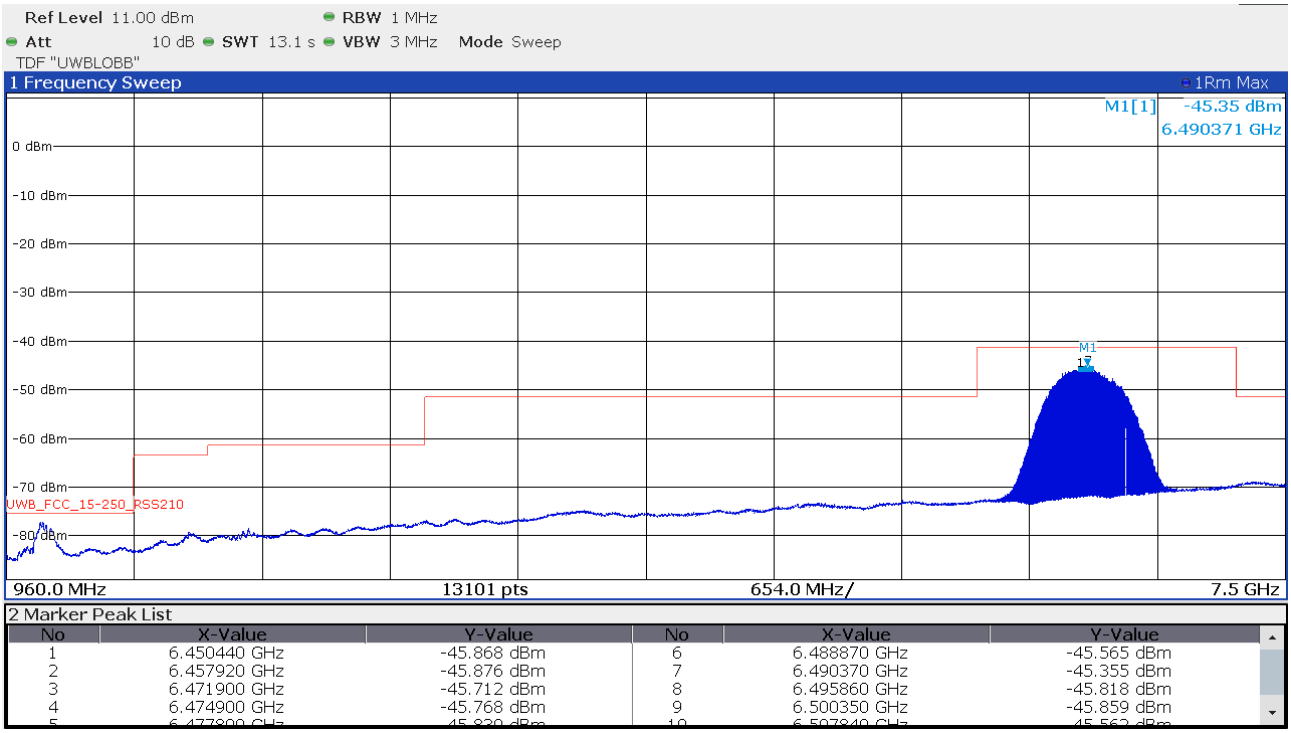
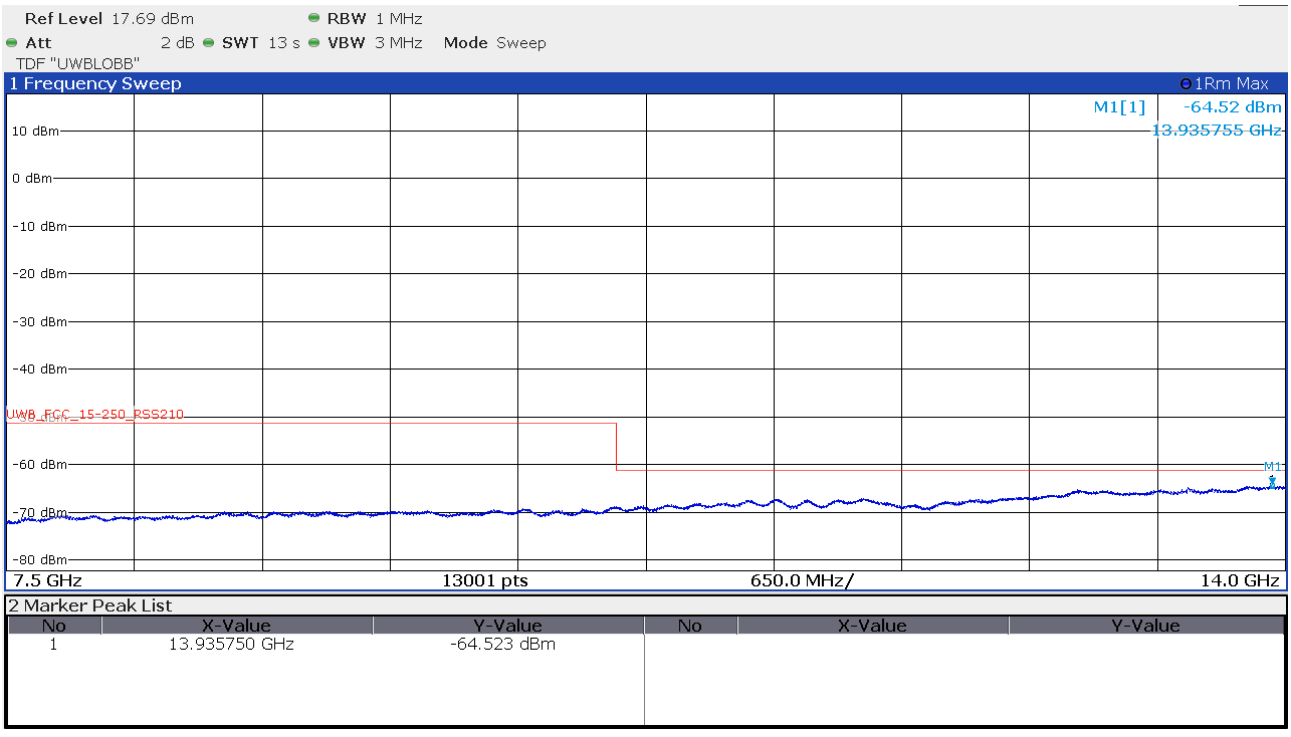
960 MHz to 18 GHz:





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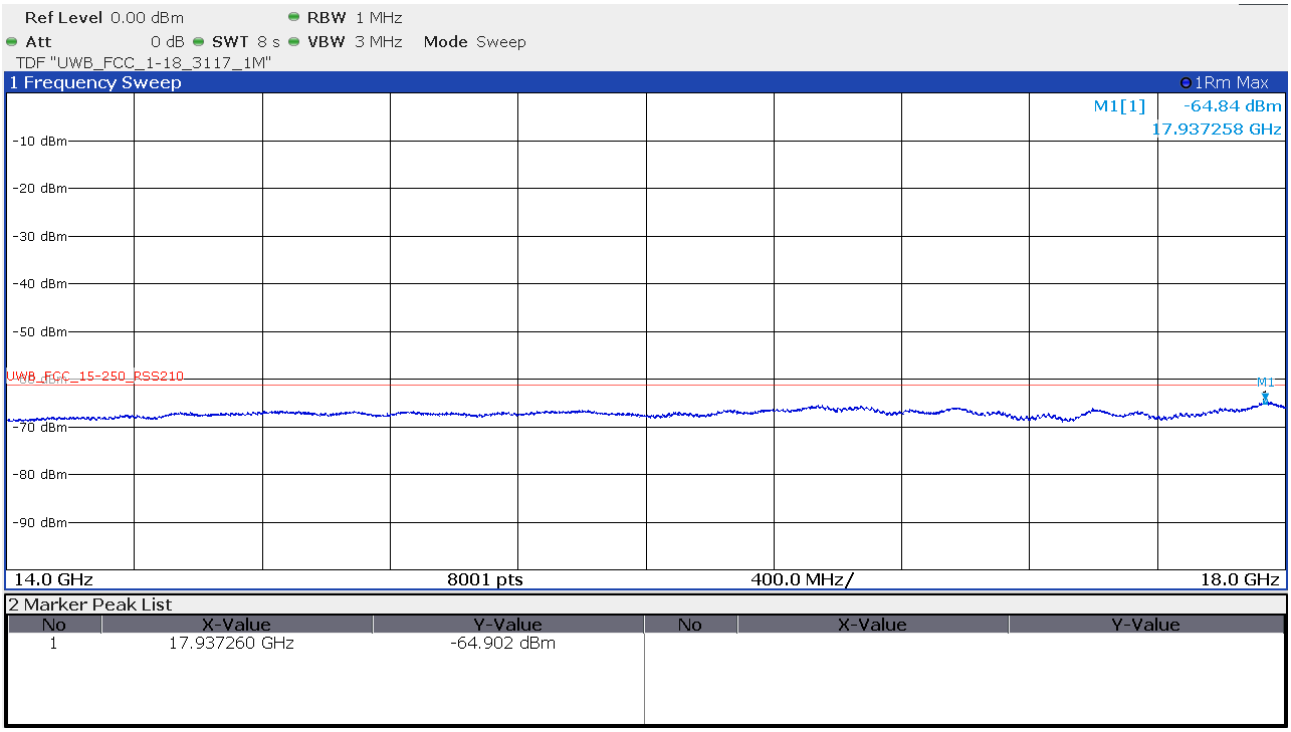
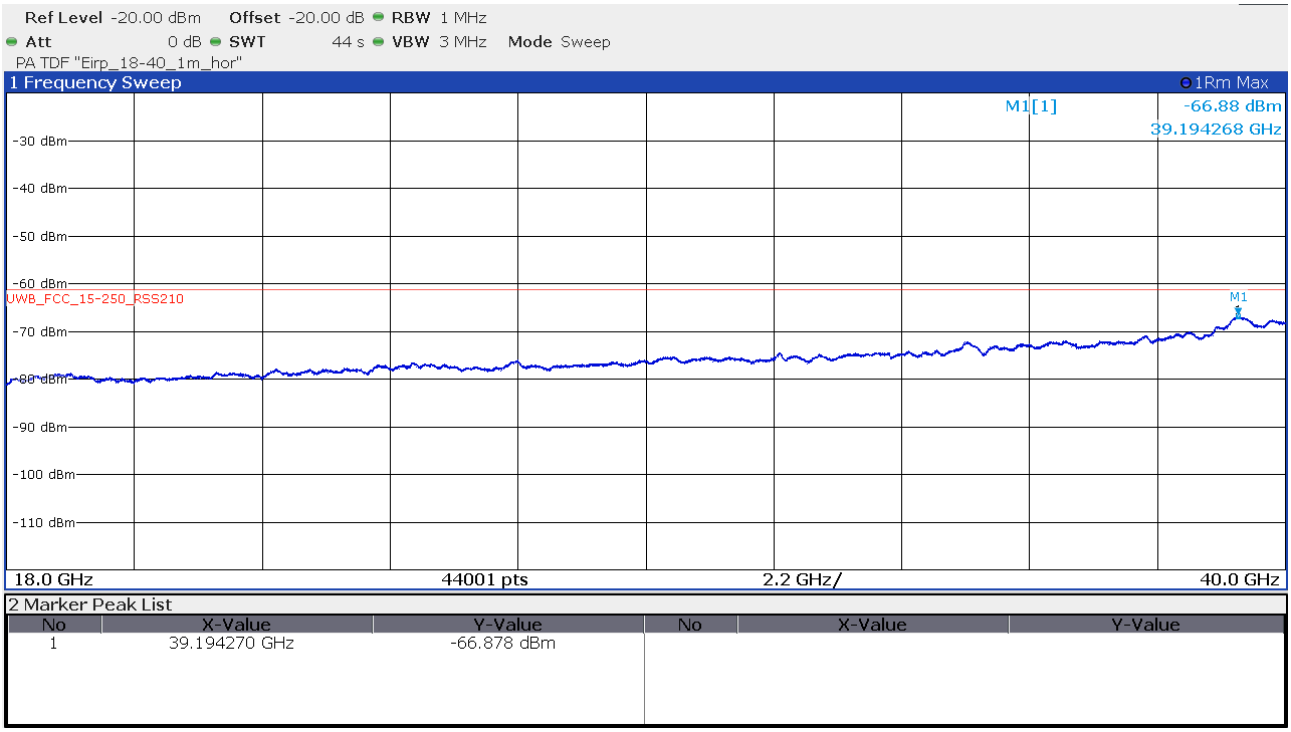


18 GHz to 40 GHz at 10 cm distance:



Note: The measurement distance for the frequency range 18 GHz to 40 GHz was changed from 1 m to 10 cm. Therefore an offset of 20 dB/decade was added (according to §15.31(f)(1)).

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Limits:

Limit according §15.209(a) in the frequency range 9 kHz 960 MHz:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100**	3
88-216	150**	3
216-960	200**	3
Above 960	500	3

Limit according §15.250(d)(1) in the frequency range 960 MHz to 40 GHz:

Frequency in MHz	EIRP in dBm
960-1610	−75.3
1610-1990	−63.3
1990-3100	−61.3
3100-5925	-51.3
5925-7250	-41.3
7250-10600	−51.3
Above 10600	−61.3

Limit according RSS-210 K.3(a) in the frequency range 960 MHz to 40 GHz:

Frequency in MHz	EIRP in dBm
960-1610	−75.3
1610-1990	−63.3
1990-3100	−61.3
3100-5925	-51.3
5925-7250	-41.3
7250-10600	−51.3
Above 10600	−61.3

The requirements are **FULFILLED.**

Remarks: None.

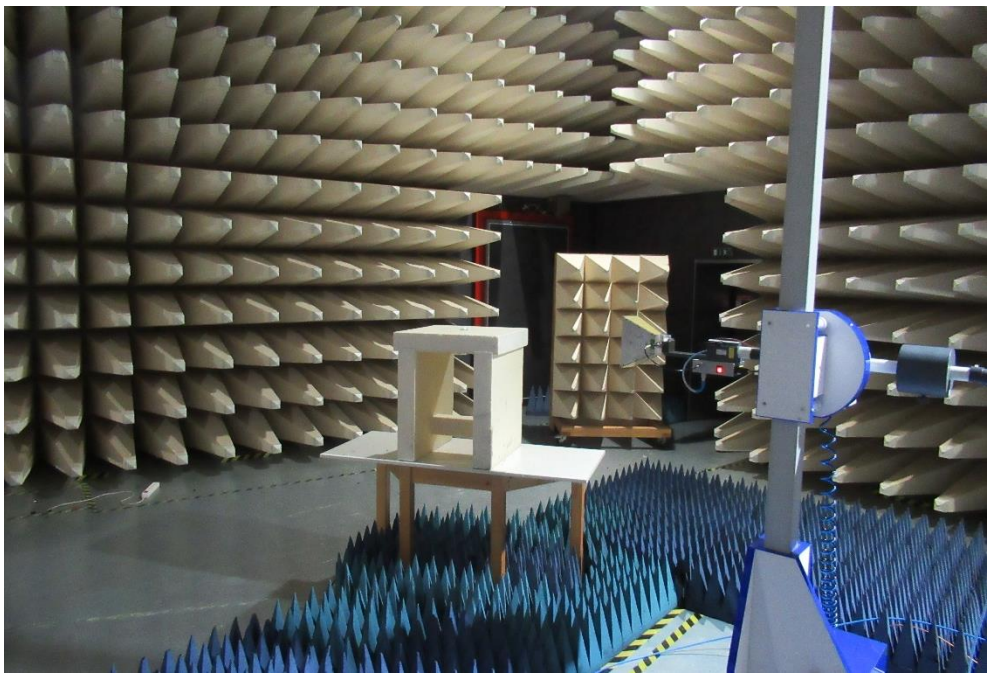
5.3 Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz

For test instruments and accessories used see section 6 Part **SER 3**.

5.3.1 Description of the test location

Test location: Anechoic chamber 1

5.3.2 Photo documentation of the test set-up



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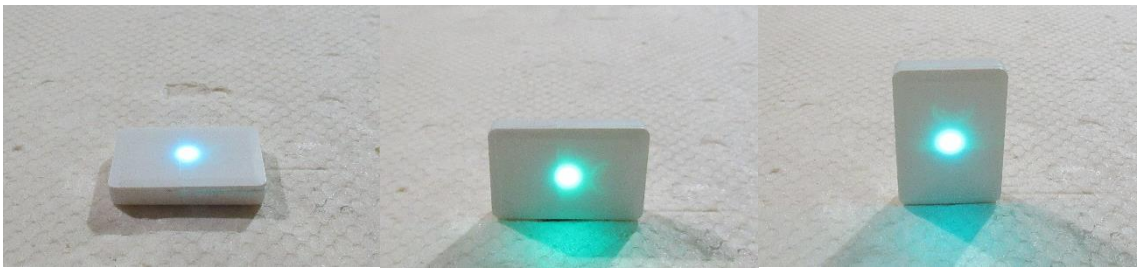

5.3.3 Applicable standard

According to FCC Part 15, Section 15.250(d):
In addition to the radiated emission limits specified in the table in paragraph (d)(1) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz

5.3.4 Analyser settings

RBW: 1 kHz, VBW: 3 kHz, Detector: RMS, Sweep time: 1 ms/1kHz,

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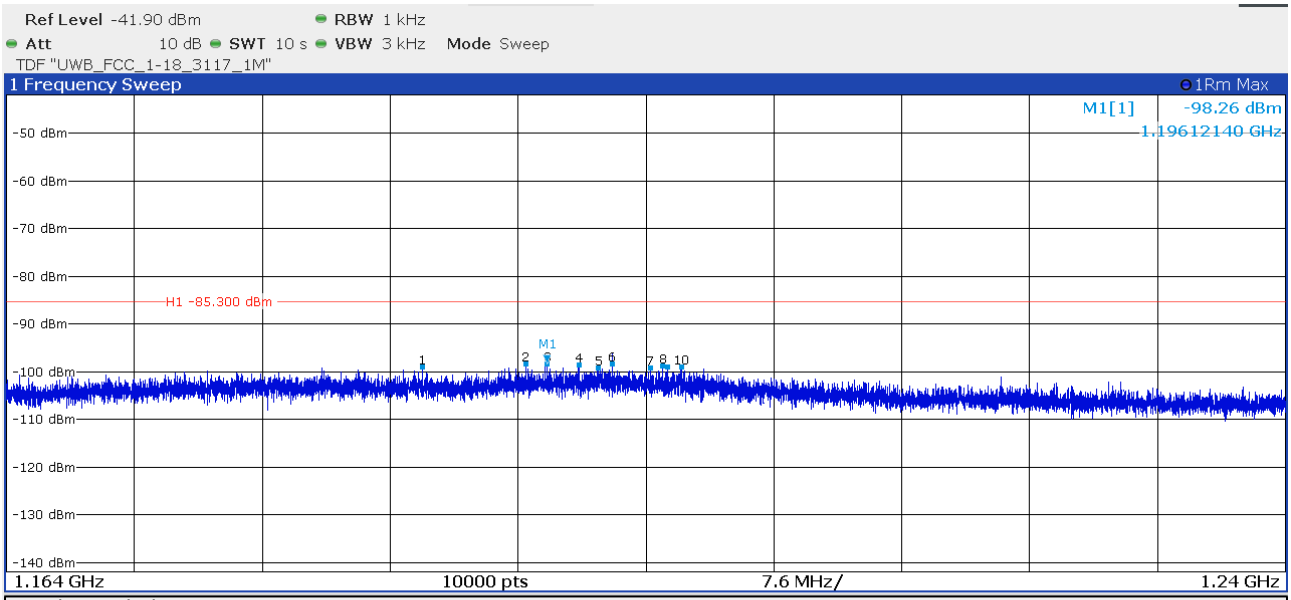
5.3.5 Test result

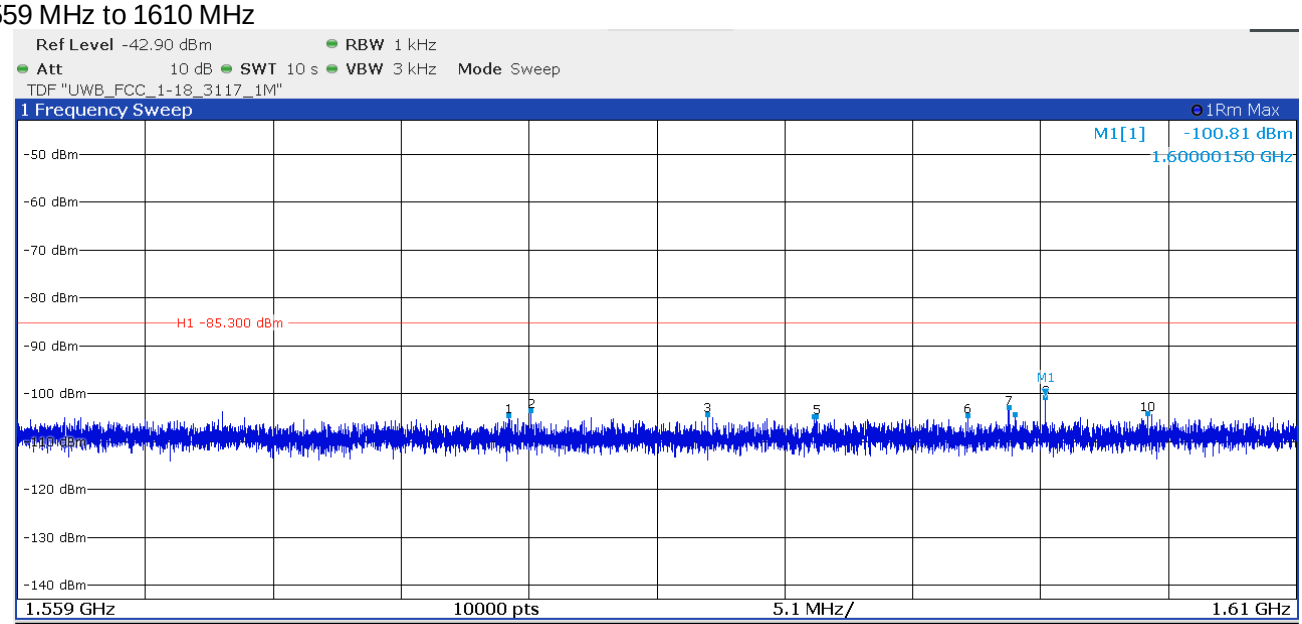
1164 MHz to 1240 MHz



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.188719 GHz	-99.028 dBm	6	1.199997 GHz	-98.381 dBm
2	1.194860 GHz	-98.379 dBm	7	1.202262 GHz	-99.087 dBm
3	1.196121 GHz	-98.256 dBm	8	1.202992 GHz	-98.807 dBm
4	1.198014 GHz	-98.427 dBm	9	1.203296 GHz	-98.987 dBm
5	1.199192 GHz	-99.094 dBm	10	1.204139 GHz	-98.866 dBm

1559 MHz to 1610 MHz



2 Marker Peak List

No	X-Value	Y-Value	No	X-Value	Y-Value
1	1.578592 GHz	-104.561 dBm	6	1.596896 GHz	-104.557 dBm
2	1.579474 GHz	-103.585 dBm	7	1.598523 GHz	-102.921 dBm
3	1.586517 GHz	-104.370 dBm	8	1.598793 GHz	-104.274 dBm
4	1.590765 GHz	-104.831 dBm	9	1.600002 GHz	-100.810 dBm
5	1.590862 GHz	-104.793 dBm	10	1.604071 GHz	-104.250 dBm

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Limit according §15.250(d)(2):

Frequency in MHz	EIRP in dBm
1164-1240	−85.3
1559-1610	−85.3

The requirements are **FULFILLED.**

Remarks: None.

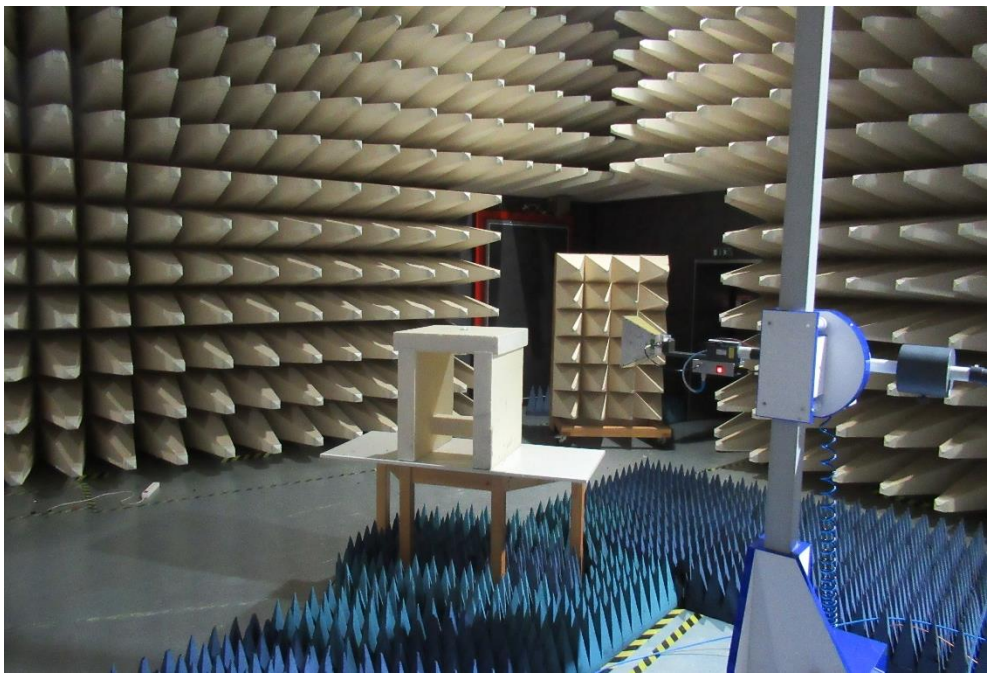
5.4 Peak Power radiated

For test instruments and accessories used see section 6 Part **CPR 3**.

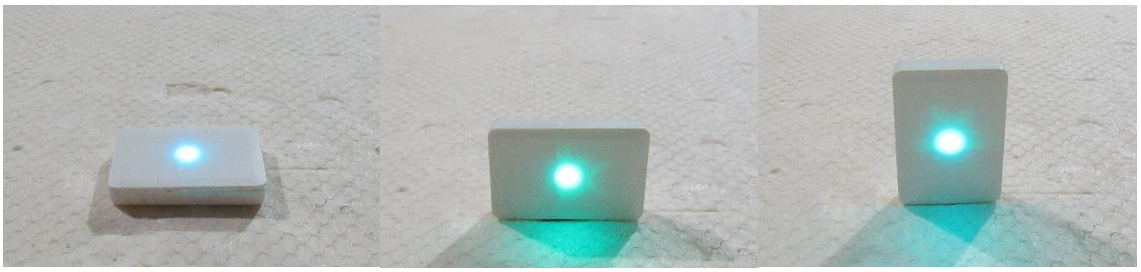
5.4.1 Description of the test location

Test location: Anechoic chamber 1

5.4.2 Photo documentation of the test set-up



X Y Z



5.4.3 Applicable standard

According to FCC Part 15, Section 15.250(d)(3):
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, f_M. 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.

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5.4.4 Analyser settings

RBW: 50 MHz, VBW: 80 MHz, Detector: Peak, Trace Mode: Max hold

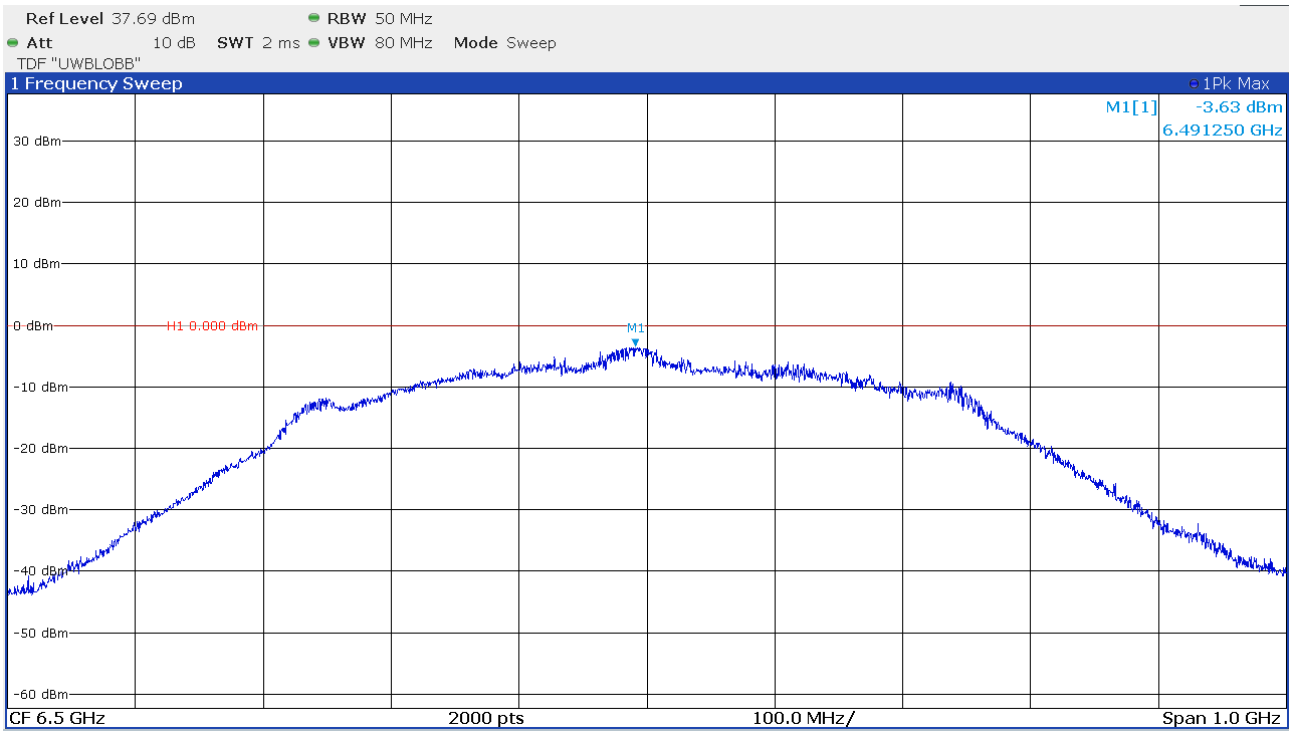
Since the RBW is set greater than 3 MHz the following information is required:

Detailed Description of the test procedure
The EUT was placed on a 1.50 m high pedestal. The measuring system containing of a horn antenna and a pre-amplifyer was placed at a distance of 1 m from the EUT. All measurements were performed in a semi-anechoic chamber. In order to determine the worst case orientation, the EUT was set in all 3 orthogonal axes, where in each orientation the EUT was rotated 360° and high scans up to 4 m were performed.

Instrumentation employed in the testing
Please see section 6 part CPR 3 of this test report.

Calibration of the test setup
Please see the calibration certificates in section 8 of this test report.
For the determination of the measurement data please see ANSI C63.10-2013 chapter 10.3.8 and 10.3.9.

5.4.5 Test result



Min. limit margin: -3.63 dB at 6491.25 MHz

The requirements are **FULFILLED.**

Remarks: None.

5.5 Antenna application

5.5.1 Applicable standard

According to FCC Part 15C, Section 15.203:
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 that broken antennas can be replaced by the user, but the use of a standard antenna jack is prohibited.

The EUT has an integrated antenna. No other antenna can be used with the device.

All supplied antennas meet the requirements of part 15.203 and 15.204.

Remarks: None

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6 USED TEST EQUIPMENT AND ACCESSORIES

All test instruments used are calibrated and verified regularly. The calibration history is available on request.

Test ID	Model Type	Kind of Equipment	Manufacturer	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 3	ESW26	EMI Test Receiver	Rohde & Schwarz München	02-02/03-17-002	16/01/2021	16/01/2020		
	FSW43	Spectrum Analyser	Rohde & Schwarz München	02-02/11-15-001	02/04/2021	02/04/2020		
	AMF-6D-01002000-22-10P	RF Amplifier	MITEQ, Inc.	02-02/17-15-004				
	3117	Horn Antenna 1 - 18 GH	EMCO Elektronik GmbH	02-02/24-05-009	18/06/2021	18/06/2020		
	LOBB 18	Horn Antenna 1 - 18 GH	TÜV Slowakai	02-02/24-05-026	27/02/2021	27/02/2020		
	18N-20	Coax Attenuator 20dB	Tactron Elektronik	02-02/50-17-003				
	NMS111-GL200SC01-NMS	RF Cable	GigaLane Co., Ltd.	02-02/50-17-012				
	BAM 4.5-P	Antenna Mast	maturo GmbH	02-02/50-17-024				
	NCD	Controller for Antenna M	maturo GmbH	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	RF Cable	Huber + Suhner	02-02/50-18-016				
	BAT-EMC 3.19.1.24	Nexio Software	EMCO Elektronik GmbH	02-02/68-13-001				
SER 2	ESVS 30	EMI Test Receiver	Rohde & Schwarz München	02-02/03-05-006	15/07/2021	15/07/2020		
	VULB 9168	Trilog Broadband Antenn	Schwarzbeck Mess-Elektron	02-02/24-05-005	19/09/2020	19/07/2019		
	NW-2000-NB	RF Cable	Huber + Suhner	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	RF Cable 20m	Huber + Suhner	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	RF Cable 33 m	Huber + Suhner AG	02-02/50-15-028				
SER 3	FSW43	Spectrum Analyser	Rohde & Schwarz München	02-02/11-15-001	02/04/2021	02/04/2020		
	AMF-6D-01002000-22-10P	RF Amplifier	MITEQ, Inc.	02-02/17-15-004				
	3117	Horn Antenna 1 - 18 GH	EMCO Elektronik GmbH	02-02/24-05-009	18/06/2021	18/06/2020		
	BBHA 9170	SHF-EHF Horn Antenna	Schwarzbeck Mess-Elektron	02-02/24-05-014	12/06/2021	12/06/2018	14/01/2021	14/01/2020
	LOBB 18	Horn Antenna 1 - 18 GH	TÜV Slowakai	02-02/24-05-026	27/02/2021	27/02/2020		
	KMS102-1 m	RF Cable	Tactron Elektronik	02-02/50-11-014				
	18N-20	Coax Attenuator 20dB	Tactron Elektronik	02-02/50-17-003				
	NMS111-GL200SC01-NMS	RF Cable	GigaLane Co., Ltd.	02-02/50-17-012				
	BAM 4.5-P	Antenna Mast	maturo GmbH	02-02/50-17-024				
	NCD	Controller for Antenna M	maturo GmbH	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	RF Cable	Huber + Suhner	02-02/50-18-016				
	BAT-EMC 3.19.1.24	Nexio Software	EMCO Elektronik GmbH	02-02/68-13-001				

FCC ID: 2ALC5-KNX-STAG1 **IC:** 25557-KNXSTAG1

7 DETAILED MEASUREMENT UNCERTAINTY

7.1 Overview

Measurement instrumentation uncertainty shall be taken into account when determining compliance or non-compliance with a disturbance limit.
The measurement instrumentation uncertainty for a test laboratory shall be evaluated. The standard uncertainty $u(x_i)$ in decibels and the sensitivity coefficient c_i shall be evaluated for the estimate x_i of each quantity. The combined standard uncertainty $u_c(y)$ of the estimate y of the measurand shall be calculated as

$$u_c(y) = \sqrt{\sum_i c_i^2 \; u^2(x_i)}$$

The expanded measurement instrumentation uncertainty U_{lab} for a test laboratory shall be calculated as $U_{lab} = 2\, u_c(y)$

$$U_{lab} = 2\, u_c(y)$$

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cispr} in the table below, then:
- compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

If U_{lab} is greater than U_{cispr} in the table below, then:
- compliance is deemed to occur if no measured disturbance, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit.
- non-compliance is deemed to occur if any measured disturbance, increased by ($U_{lab} - U_{cispr}$), exceeds the disturbance limit.

7.2 Definitions and symbols

X_i	Input quantity
x_i	estimate of X_i
$u(x_i)$	standard uncertainty of x_i
c_i	sensitivity coefficient
$u_c(y)$	(combined) standard uncertainty of y
Y	result of a measurement, (the estimate of the measured), corrected for all recognised significant systematic effects
U	expanded uncertainty of y

7.3 Measurement uncertainty

Measurement	U_{lab} [dB]
Conducted disturbance	+ 2.53 / - 2.77
Radiated disturbance (electric field) - 10 m test distance - 3 m test distance - Frequency range: 30 MHz – 200 MHz	 + 3.16 / - 3.22 + 3.16 / - 3.22
Radiated disturbance (electric field) - 10 m test distance - 3 m test distance - Frequency range: 200 MHz – 1000 MHz	 + 4.51 / - 4.51 + 4.51 / - 4.51
Radiated disturbance (electric field) - 3 m test distance - Frequency range: 1 GHz – 30 GHz	 + 5.07 / -3.70

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8 CALIBRATION DATA

Verification Data of Anechoic Chamber 1:

Form

Verification Protocol – SiteVSWR A1

Description:	Order Nr.:
SER3 – A1	☒ 02-02/30-11-001

Literature
CISPR 16-1-4, Edition 3.2, 2017: Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-4: Radio disturbance and immunity measuring apparatus - Ancillary equipment - Radiated disturbances.

Remarks:

This verification protocol describes the site validation as defined in CISPR 16-1-4.

Due to the fact that the QM system describes verification and calibration only,

it was not renamed in "Validation Protocol"

Tested by:	Approved by:
O. Hauser Oliver Hauser 2020.01.14 21:17:54 +01'00'	S. Murray Seamus Murray 2020.01.15 09:50:28 +01'00'
Date: 14.01.2020	Date: 15.01.2020

CSA Group Bayern GmbH
Ohmstraße 1-4
D-94342 Strasskirchen
Telefon: +49 9424 9481-0

Erstellt von: Oliver Hauser

Seite 1 von 11

FCC ID: 2ALC5-KNX-STAG1 **IC:** 25557-KNXSTAG1

Calibration Certificate of FSW43 02-02/11-15-001

ROHDE&SCHWARZ

akkreditiert durch die / *accredited by the*

Deutsche Akkreditierungsstelle GmbH

als Kalibrierlaboratorium im / *as calibration laboratory in the*

Deutschen Kalibrierdienst DKD

	547380
Kalibrierzeichen *Calibration mark*	D-K-15195-01-01
	2020-04

Kalibrierschein
Calibration certificate

Gegenstand *Object*	**FSW43 SPECTRUM ANALYZER 43GHZ**
Hersteller *Manufacturer*	**ROHDE & SCHWARZ**
Typ *Type*	**FSW43**
Fabrikat/Serien-Nr. *Serial number*	**103792**
Auftraggeber *Customer*	**CSA Group Bayern GmbH** **Ohmstraße 1-4** **94342 Straßkirchen** **DE**
Auftragsnummer *Order No.*	**265/20, 02-02/11-15-001**
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	**3 Certificate** **18 Outgoing Results** **18 Incoming Results**
Datum der Kalibrierung *Date of calibration*	**2020-04-02**

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der Genehmigung sowohl der Deutschen Akkreditierungsstelle GmbH als auch des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit.
This calibration certificate may not be reproduced other than in full except with the permission of both the Deutsche Akkreditierungsstelle GmbH and the issuing laboratory. Calibration certificates without signature are not valid.

Datum der Ausstellung *Date of issue*	Freigabe des Kalibrierscheins durch *Approval of the calibration certificate by*	
2020-04-03	Dr. Gerhard Rösel Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Daniel Gust Bearbeiter *Person in charge*

FCC ID: 2ALC5-KNX-STAG1 **IC:** 25557-KNXSTAG1

Calibration Certificate of Antenna LOBB 18 02-02/24-05-026:

CSA Internal

SEIBERSDORF LABORATORIES

Kalibrierstelle für Antennen und Feldsonden
Calibration Body for Antennas and Field Probes

Akkreditiert durch / *accredited by*
AKKREDITIERUNG AUSTRIA

Kalibrierschein nach ISO/IEC 17025
Calibration Certificate according to ISO/IEC 17025

Kalibrierzeichen
Calibration mark

EH-A276/20
0612
26.02.2020

Gegenstand *Object*	Horn Antenna
Hersteller & Typ *Manufacturer & Type*	TÜV Slowakai LOBB 18
Herstellernummer *Serial number*	AH0401001/10QN622008D
Auftraggeber *Customer*	CSA Group Bayern GmbH Ohmstrasse 1-4 94342 Strasskirchen Deutschland
Auftragsnummer *Order Nr.*	L.L7.00059.0.0-A-7574_1 Ext. Ord. No.: 05/20
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	1 - 4
Datum der Kalibrierung *Date of calibration*	26.02.2020

Akkreditierung Austria ist Vollmitglied bei der International Laboratory Accreditation Cooperation ILAC und Unterzeichner der MRAs für die Bereiche „Testing, Calibration and Inspection".

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Datum *Date*	Zeichnungsberechtigter *Authorized person*	Bearbeiter *Person responsible*
26.02.2020	Patrick Preiner	Markus Vaclav

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Regional court Wiener Neustadt | Company no: 319187v | DVR no: 4000728 | VAT: ATU64767504 | Tax no: 192/8571 | Certified according to ISO 9001:2008
Bank details: Erste Bank der Österreichischen Sparkassen AG | Sort Code 20111 | Account no 291-140-360/00| IBAN AT112011129114036000 | BIC GIBAATWW