



# EMI - TEST REPORT

- FCC Part 15.250, RSS-210 -

**Type / Model Name** : KNX-T6.1-1 / X-Tag

**Product Description** : Tracking Tag

**Applicant** : Kinexon Inc.

**Address** : 200 S Wacker Drive, Suite 3100

CHICAGO, IL 60606, 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. :** **80089170-03 Rev1**

10. February 2022

Date of issue



Deutsche  
Akkreditierungsstelle  
D-PL-12030-01-03  
D-PL-12030-01-04



FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1

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ATTACHMENT A separate supplement

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.



## 1 TEST STANDARDS

The tests were performed according to following standards:

## FCC Rules and Regulations Part 15, Subpart A - General (September 2020)

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 2020)

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



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## 2 EQUIPMENT UNDER TEST

### 2.1 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.

### 2.2 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.

### 2.3 Photo documentation of the EUT – Detailed photos see ATTACHMENT A

### 2.4 Equipment type

Portable UWB Device

### 2.5 Short description of the equipment under test (EUT)

The KINEXON tracking tag facilitates tracking of objects in conjunction with a KINEXON RTLS system (Real Time Locating System).

Number of tested samples: 1  
Serial number: 255029  
UWB driver version: 5.0

### 2.6 Variants of the EUT

There are no variants of the EUT.

### 2.7 Operation frequency and channel plan

The operating frequency band is 5925 MHz to 7250 MHz.

Channel plan:

Channel number	f <sub>c</sub> (MHz)
Channel 5	6489.6

### 2.8 Transmit operating modes

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

Data rate: 6.8 Mbit/s



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## 2.9 Antenna

Number	Characteristic	Model number	Plug	f-range (GHz)	Gain at 6.5 GHz (dBi)
1	Omni	Decawave WB001	None, PCB	3.5 – 7.0	3.7

## 2.10 Power supply system utilised

Power supply voltage : 3.0 V DC (internal battery)

## 2.11 Peripheral devices and interface cables

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

- --- Model : ---

## 2.12 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.

### 2.12.1 Test jig

No test jig is used.

### 2.12.2 Test software

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

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.



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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 Revision history of test report**

Test report No	Rev.	Issue Date	Changes
80089170-03	0	18 November 2021	Initial test report
80089170-03	1	10 February 2022	Update of clause 6

The test report with the highest revision number replaces the previous test reports.



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### 3.2 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 : 22 July 2021

Testing concluded on : 26 July 2021

Checked by:

Tested by:

\_\_\_\_\_  
Jürgen Pessinger  
Radio Team

\_\_\_\_\_  
Franz-Xaver Schrettenbrunner  
Radio Team



## 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%	$\pm 3.29 \text{ dB}$
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%	$\pm 3.53 \text{ dB}$
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	$\pm 3.71 \text{ dB}$
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	$\pm 2.34 \text{ dB}$
Peak conducted output power	902 MHz to 928 MHz	95%	$\pm 0.35 \text{ dB}$
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	$\pm 2.15 \text{ dB}$

### 4.4 Conformity Decision Rule

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



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## 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 dB $\mu$ V/m is calculated by taking the reading from the EMI receiver (Level dB $\mu$ V) 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 Delta (MHz)	Level (dB $\mu$ V)	+	Factor (dB)	=	Level (dB $\mu$ V/m)	-	CISPR Limit (dB $\mu$ V/m)	=	(dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4



**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1****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 test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.



## 5 TEST CONDITIONS AND RESULTS

### 5.1 UWB Bandwidth

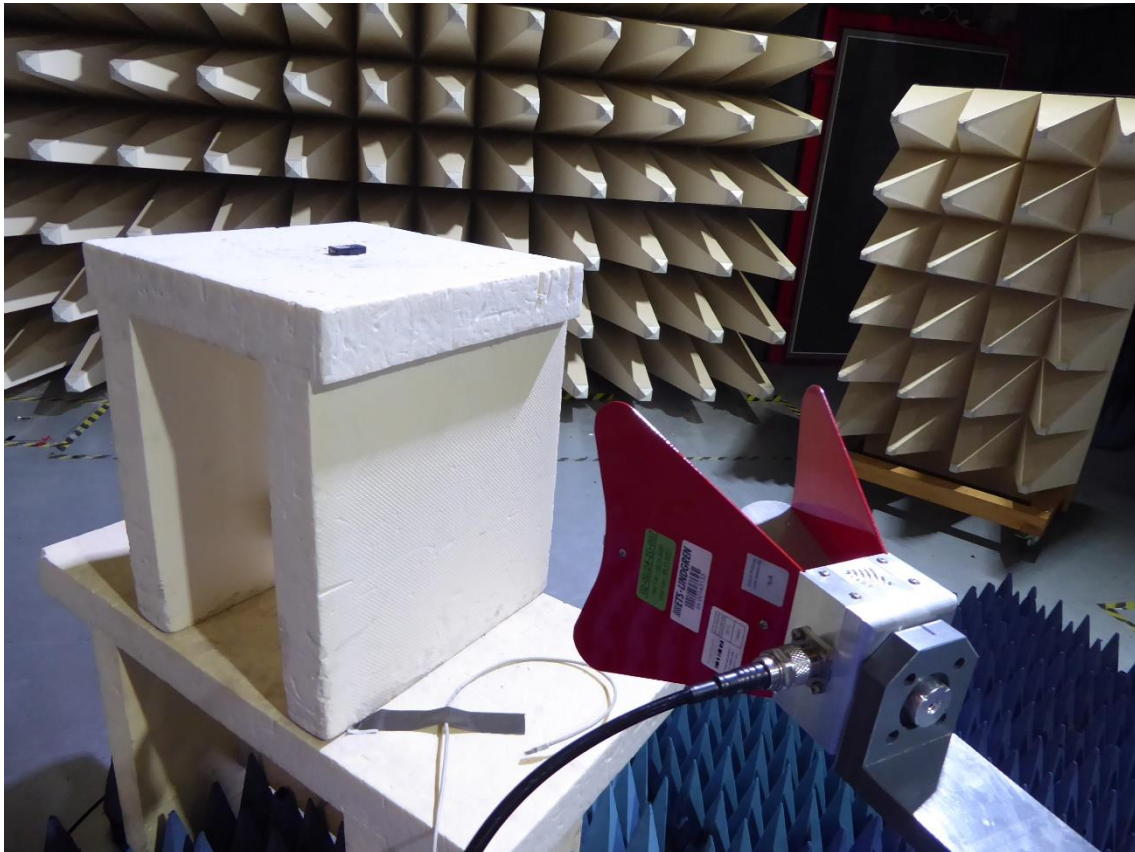
For test instruments and accessories used see section 6 Part **CPR 3**.

#### 5.1.1 Description of the test location

Test location:                   Anechoic chamber 1 (EBW)  
                                      Shielded Room S6 (OBW 99%)

#### 5.1.2 Photo documentation of the test set-up

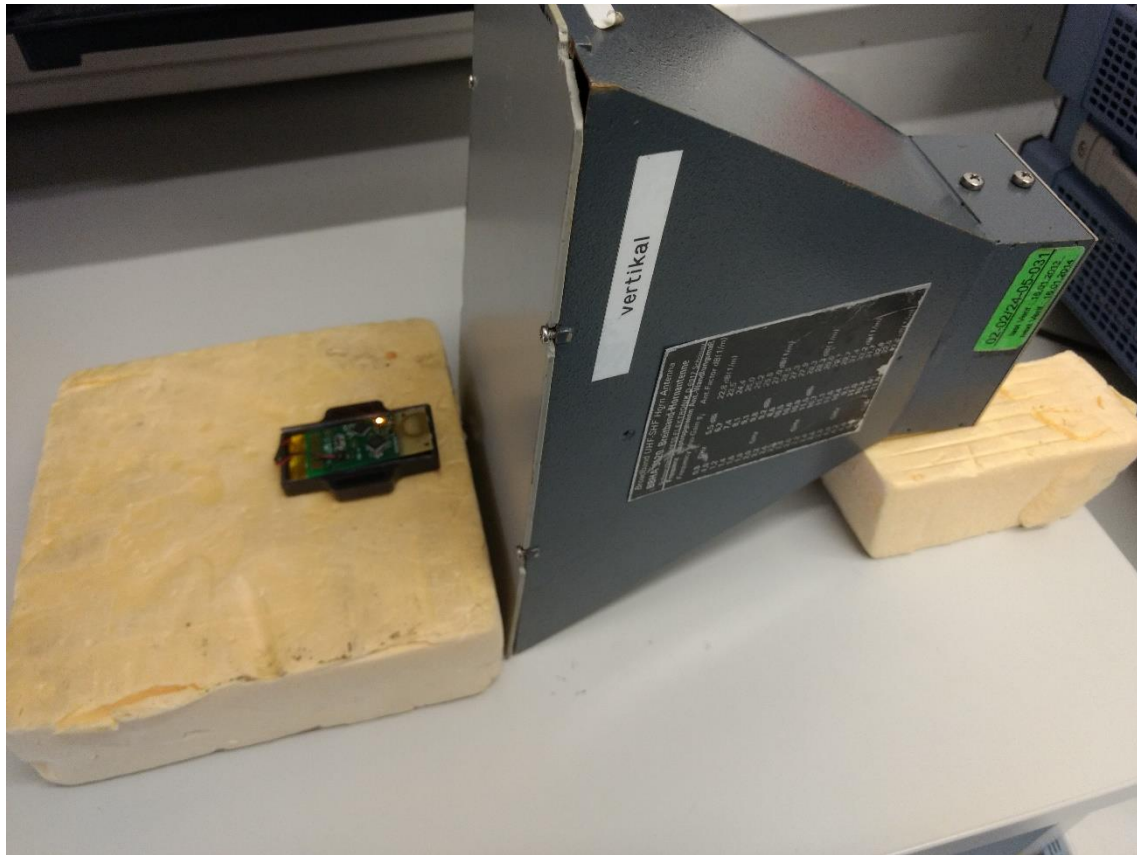
EBW measurements





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OBW 99% measurements



### 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



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**5.1.5 Test result**

channel	lowest frequency $f_L$ (MHz)	highest frequency $f_H$ (MHz)	permitted frequency range (MHz)	UWB bandwidth (MHz)	required UWB bandwidth (MHz)	result
5	6295.90	6682.56	5925-7250	386.66	> 50	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**.

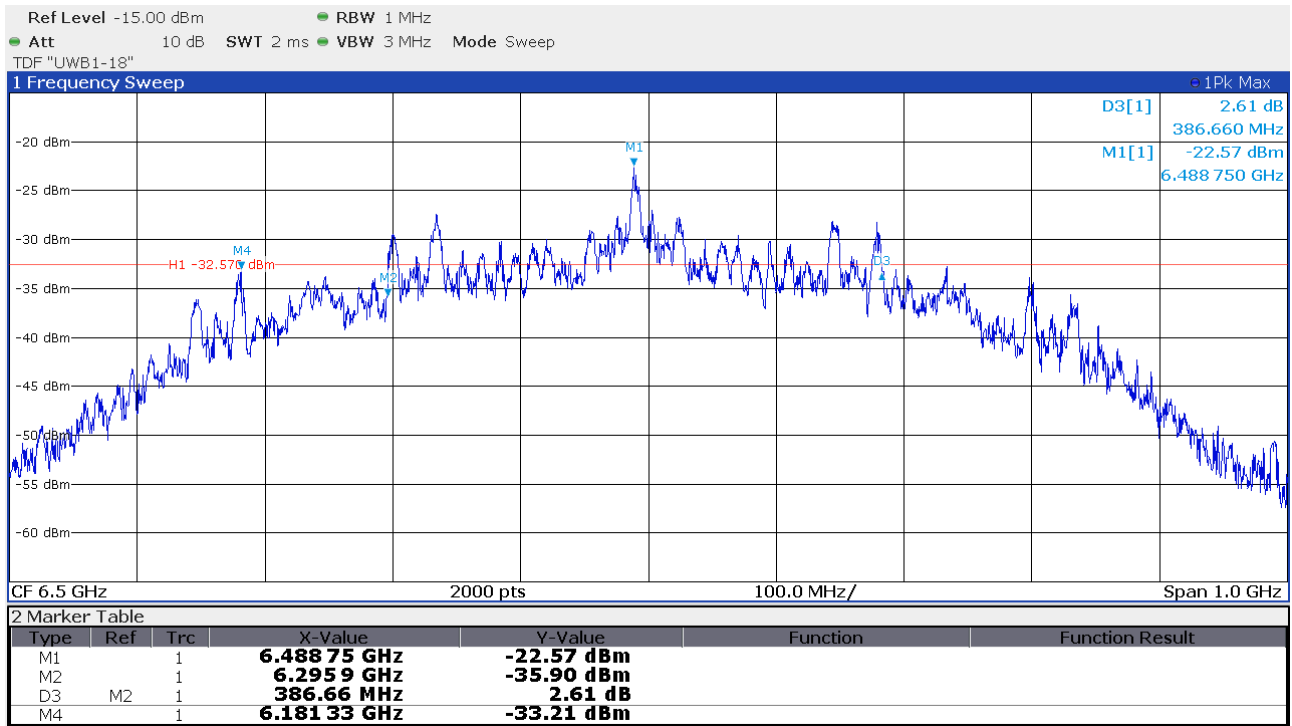
**Remarks:** For detailed test results please refer to following test protocols.



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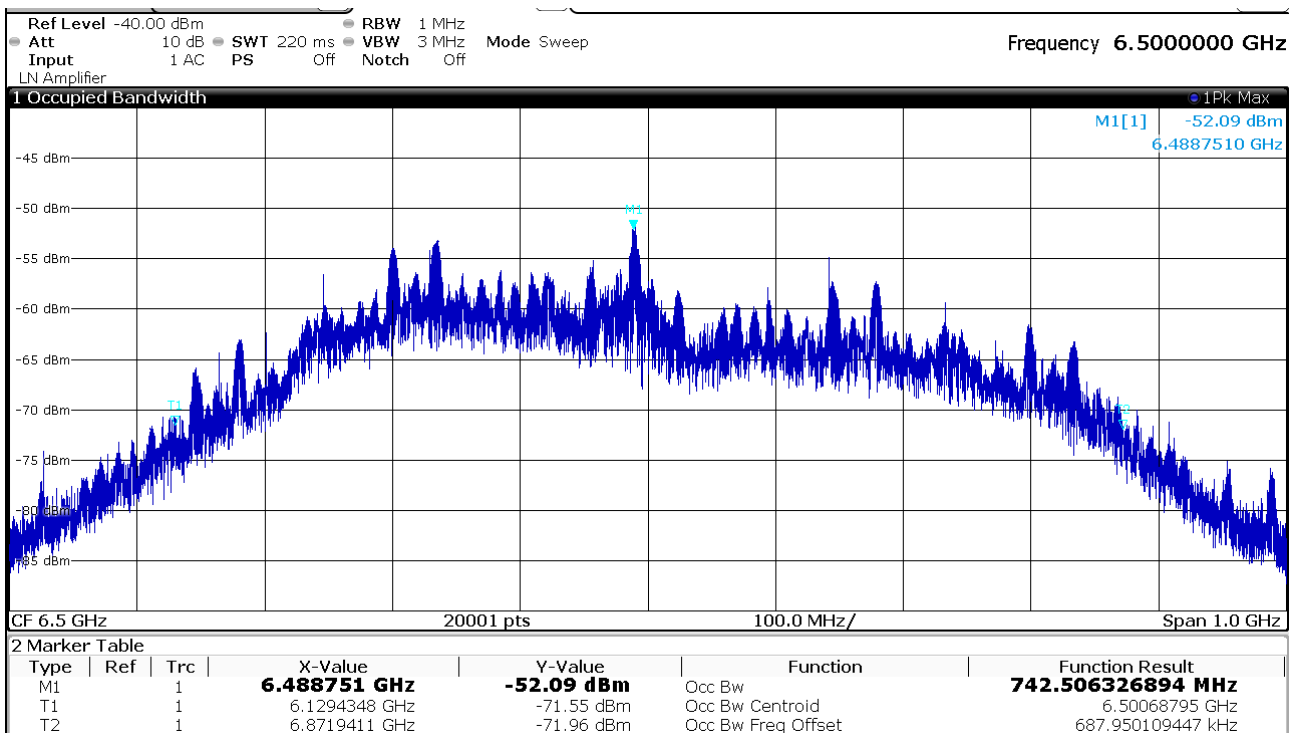
### 5.1.6 Test protocols EBW

#### Channel 5



### 5.1.7 Test protocols OBW 99%

#### Channel 5



Note: The dBm scale is not normalised.



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## 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

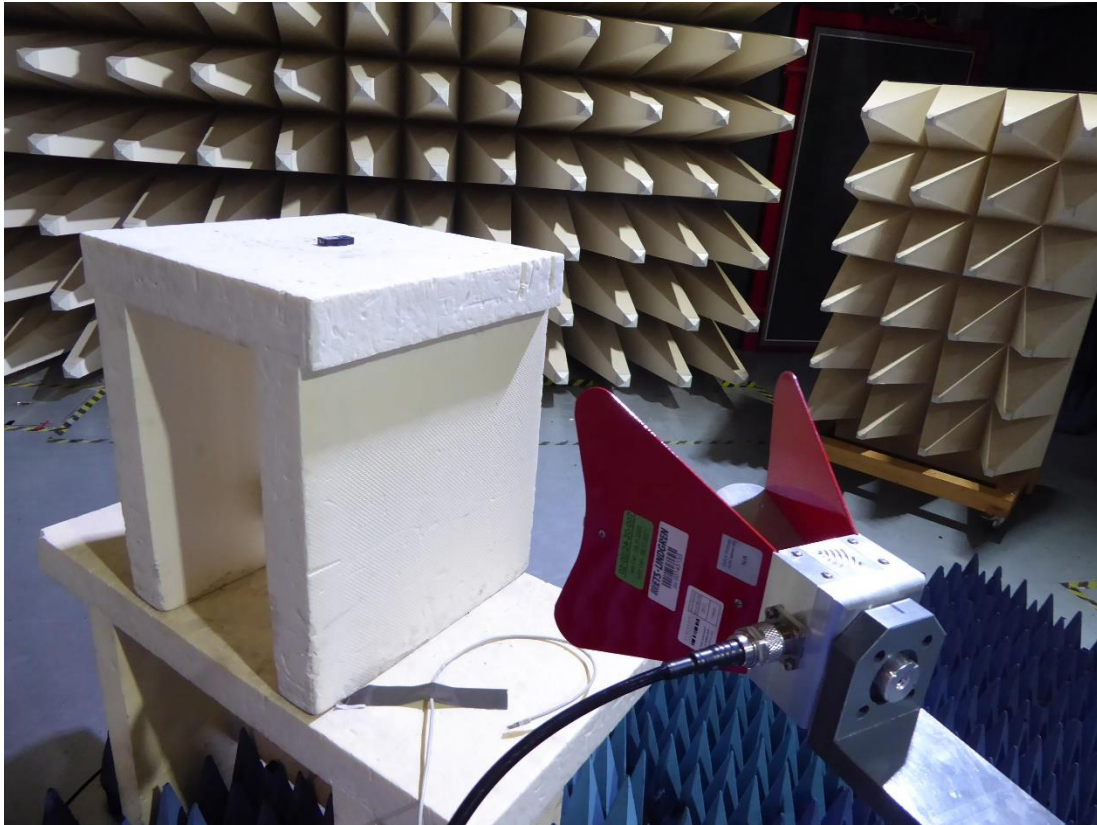


The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.

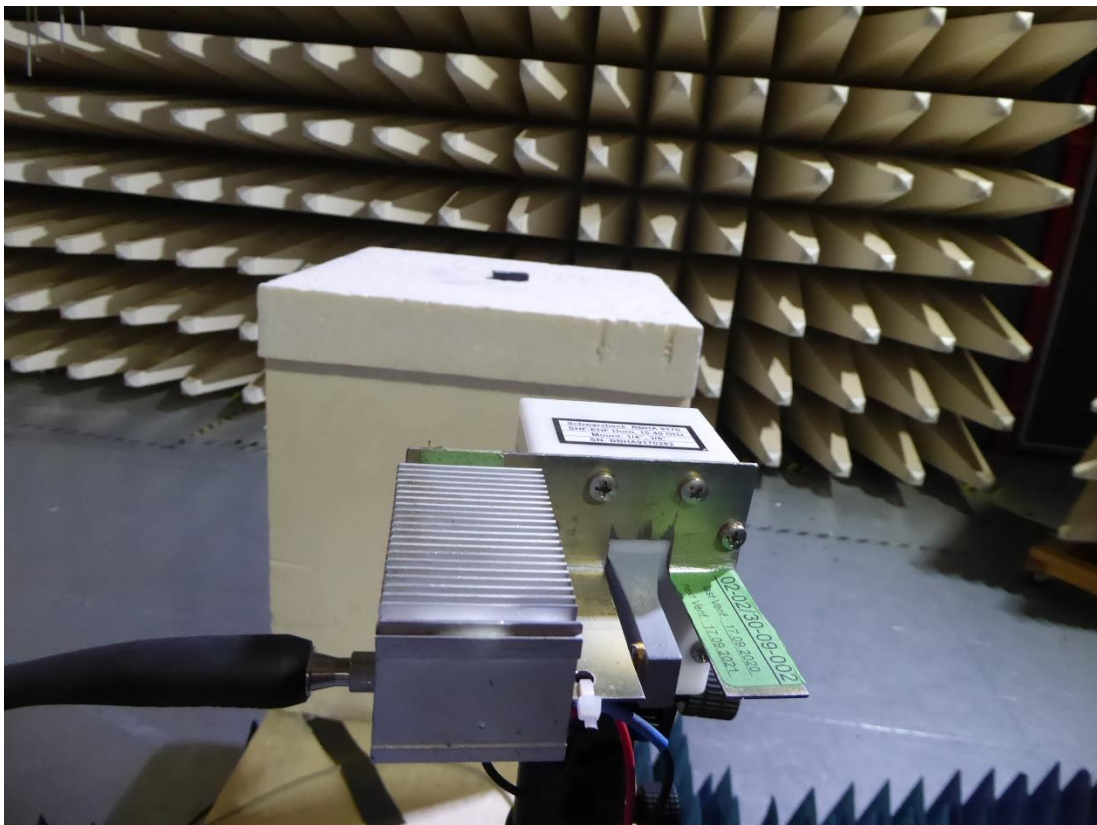


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960 MHz - 18000 MHz



18000 MHz – 40000 MHz





**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**
**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	Sweep time: 1ms per MHz	

**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)
39.00	5.9	0.2	14.5	13.3	20.4	13.5	40.0	-19.6
150.00	0.4	-0.1	13.9	14.8	14.3	14.7	43.5	-28.8
300.00	-1.2	3.5	16.9	16.5	15.7	20.0	46.0	-26.0
450.00	-2.7	-1.7	21.2	20.9	18.5	19.2	46.0	-26.8
600.00	-3.0	-2.4	25.5	25.3	22.5	22.9	46.0	-23.1
750.00	-2.7	-2.8	28.3	27.7	25.6	24.9	46.0	-20.4

**Note:** No emissions from the EUT detectable between 30 MHz and 960 MHz, all measured values represent the noise level of the test site.

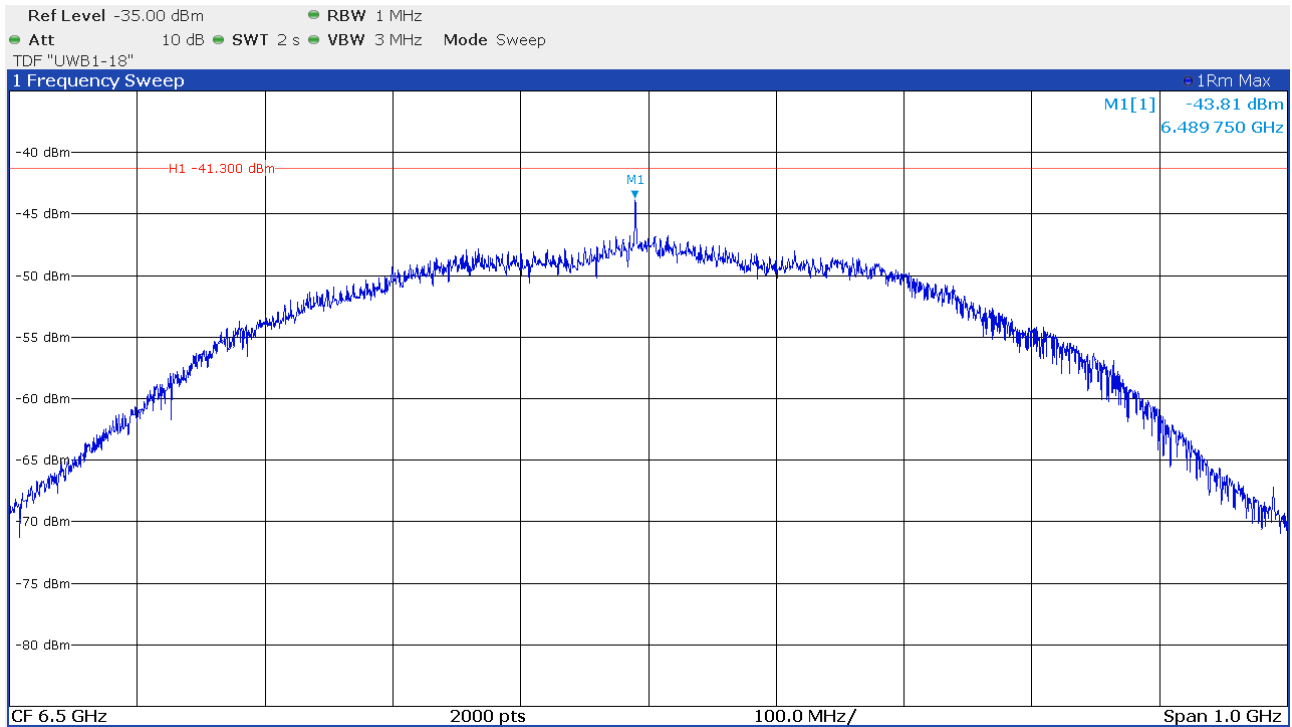


**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**

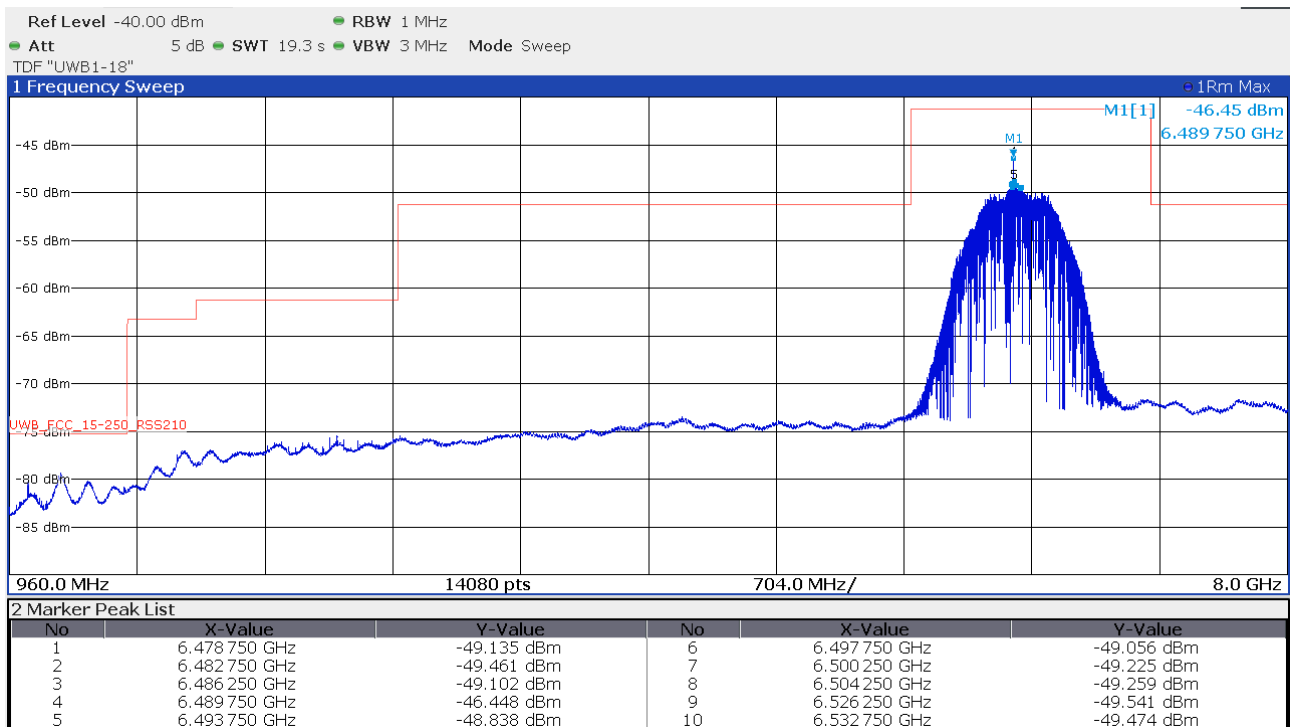
### 5.2.5.3 Measurement 960 MHz to 40 GHz

#### Channel 5

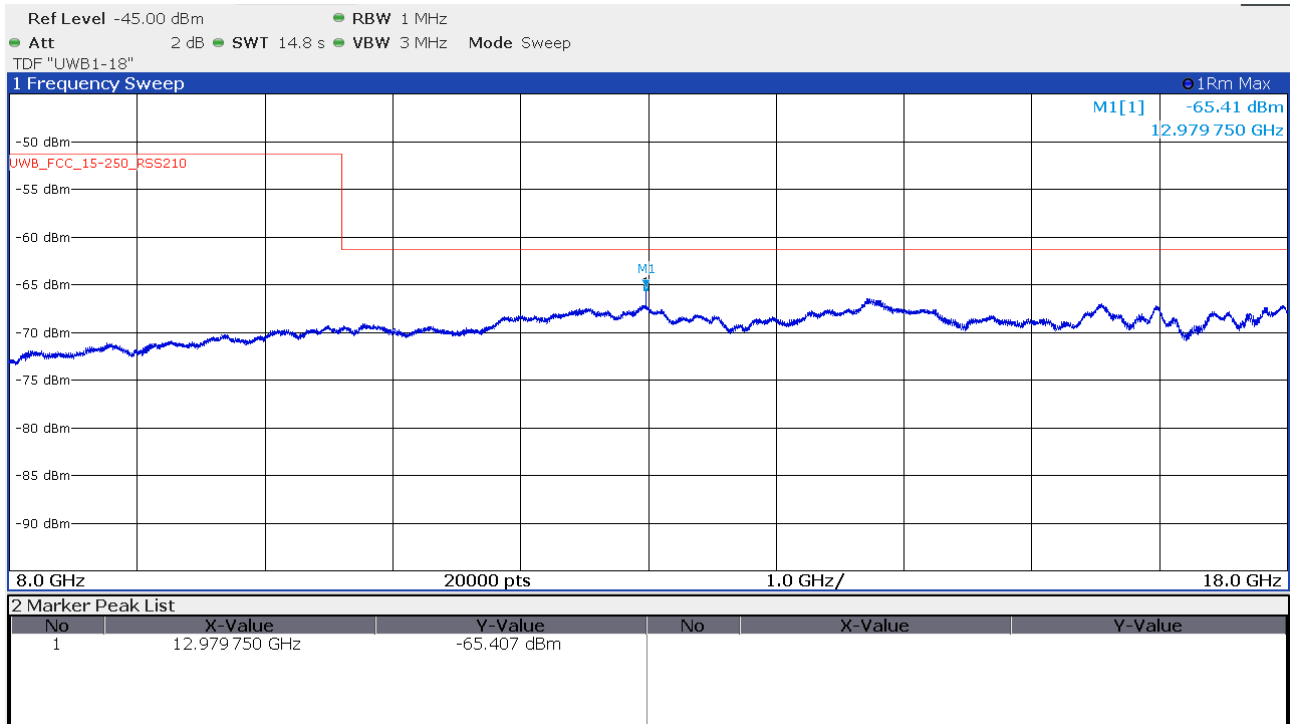
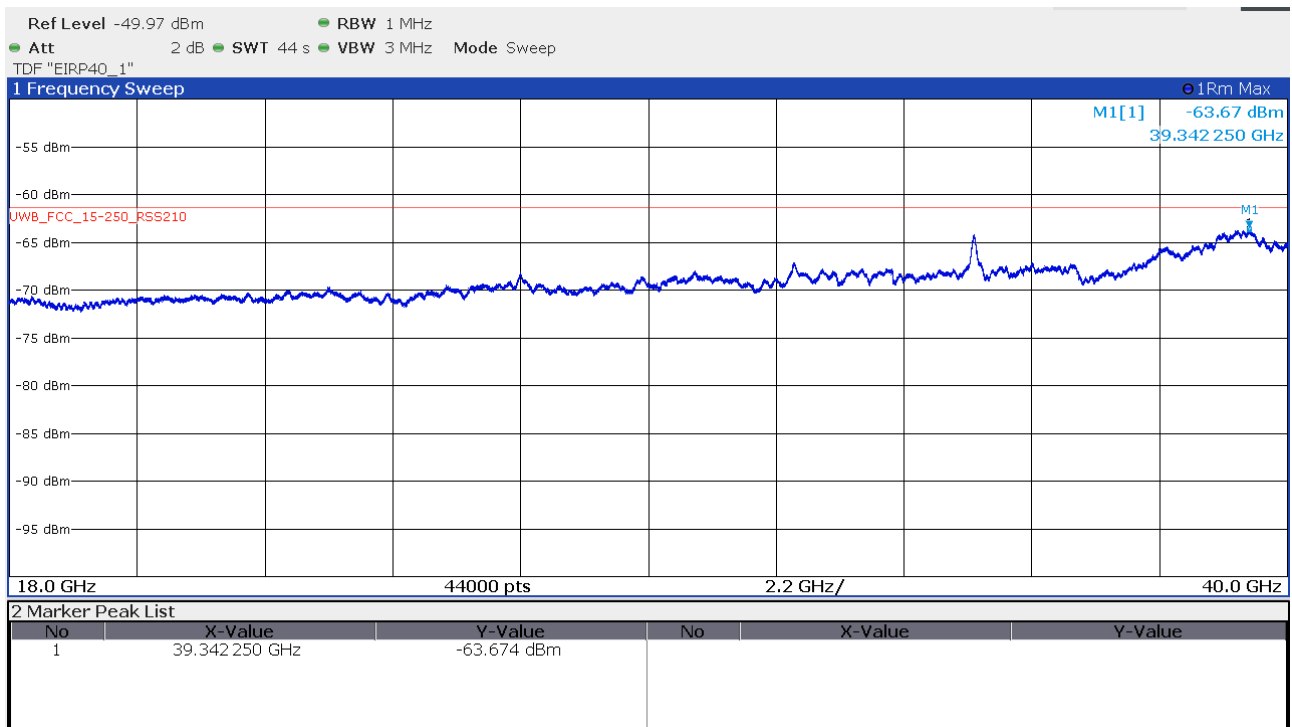
#### Mean Power



#### 960 MHz to 18 GHz





**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**

**18 GHz to 40 GHz**




**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**

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.



**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**

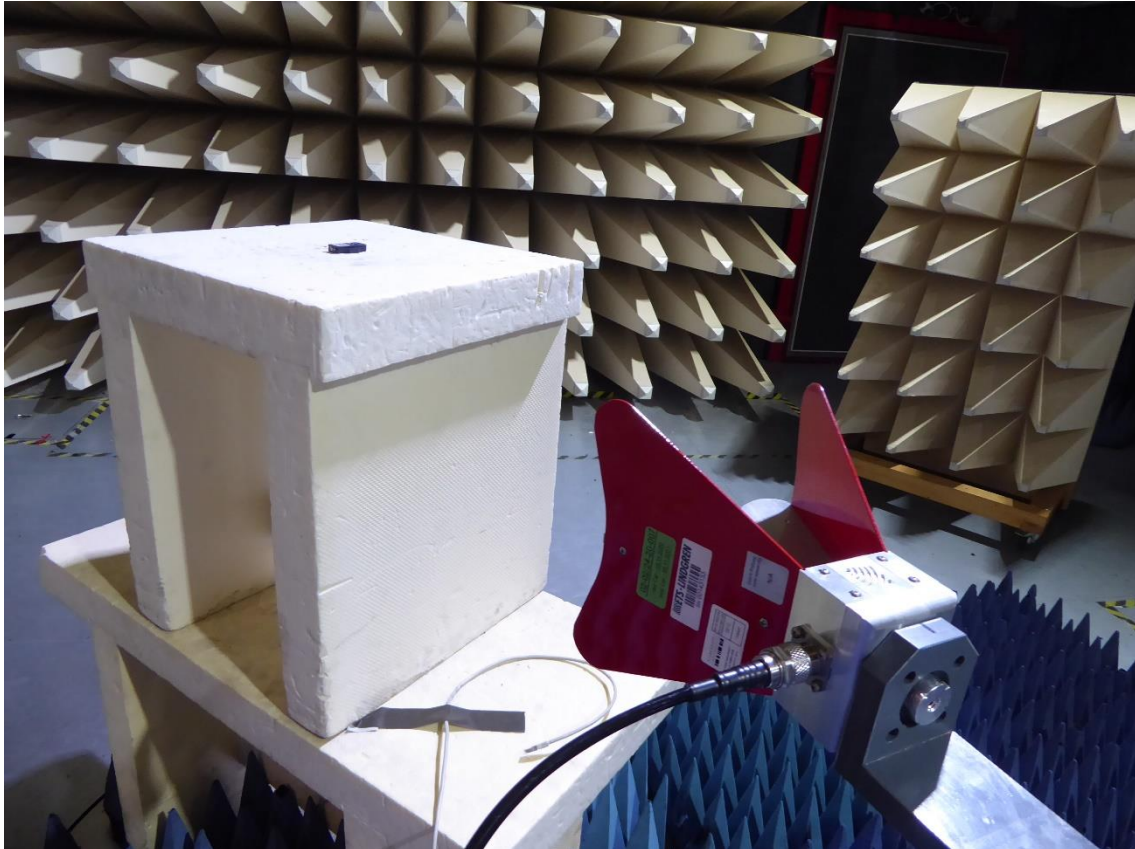
### **5.3 Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz**

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**





**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**
**5.3.3 Applicable standard**

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

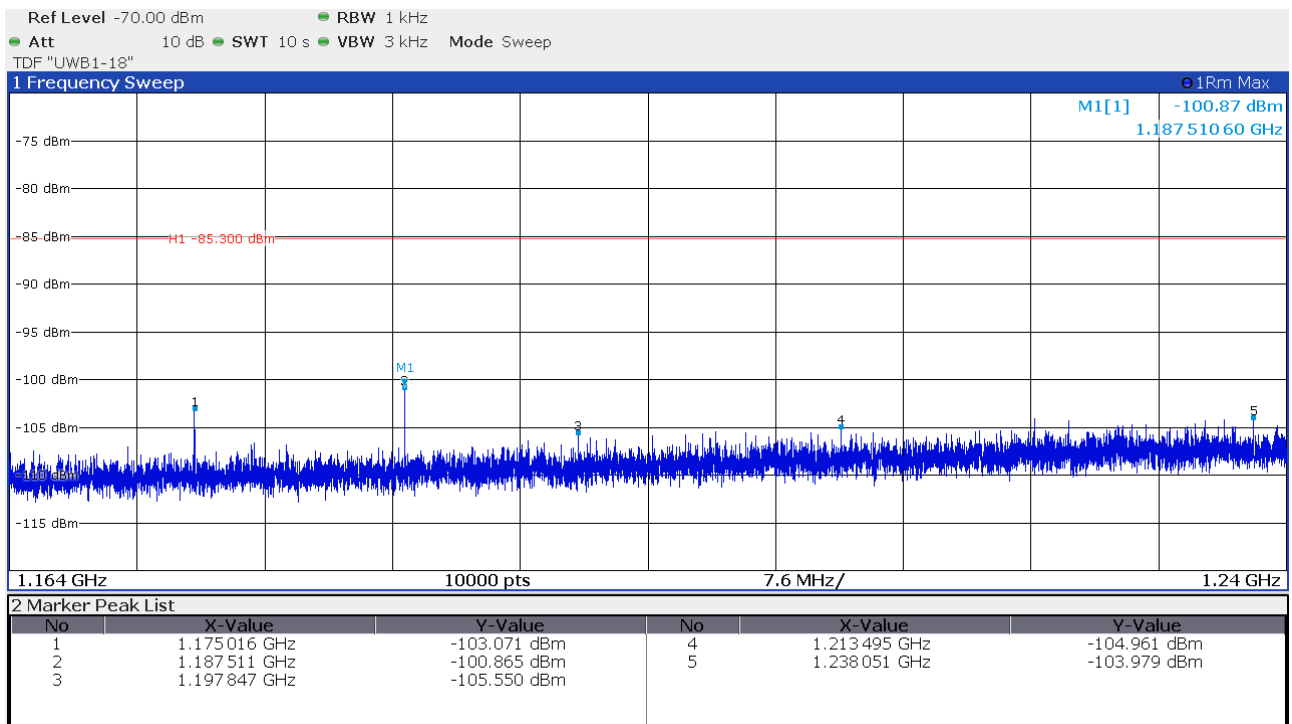
In addition to the radiated emission limits specified in the table in paragraph (d)(1) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz

**5.3.4 Analyser settings**

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

**5.3.5 Test result**
**Channel 5 horizontal**

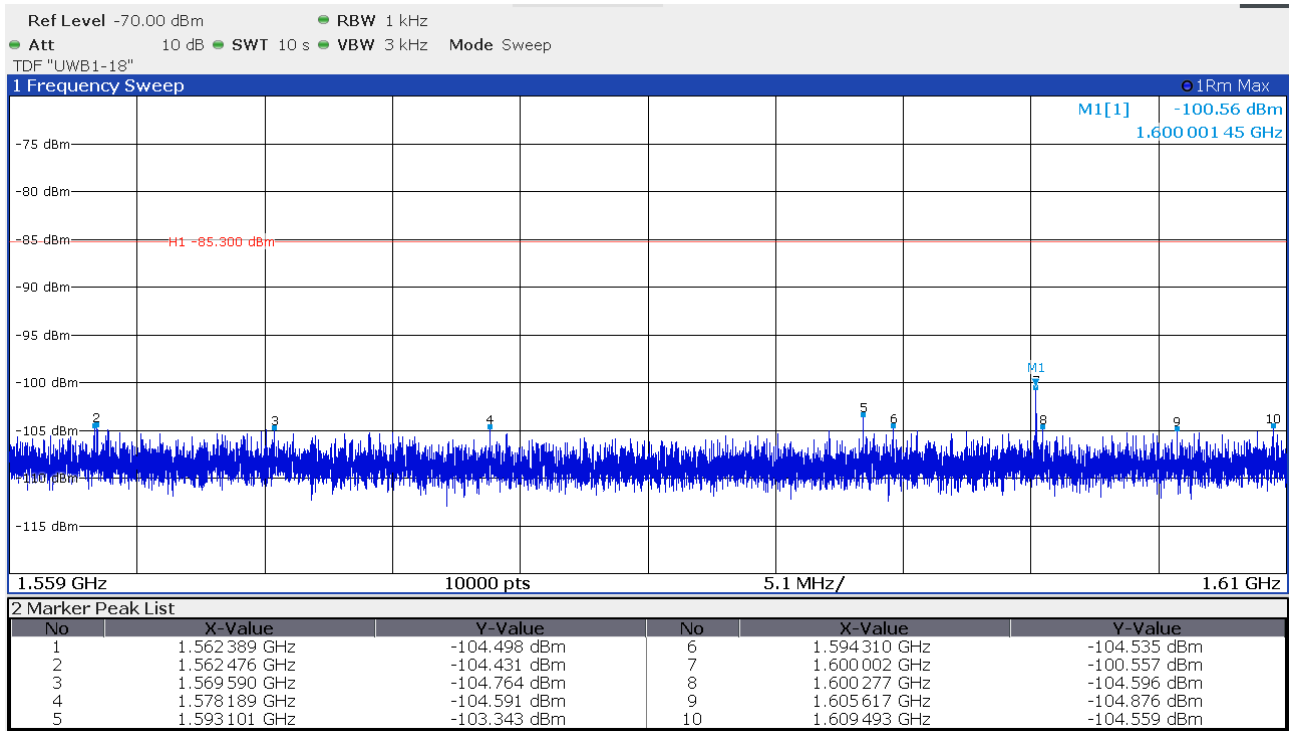
1164 MHz to 1240 MHz



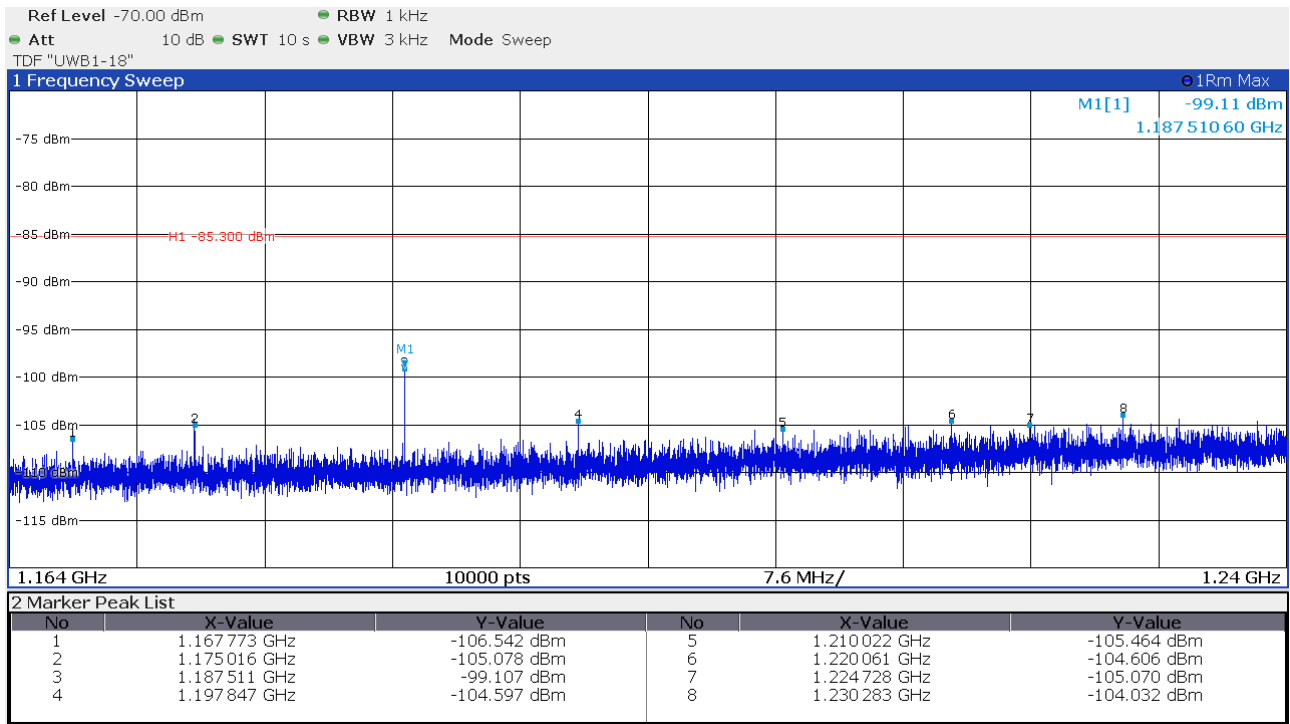


**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**

1559 MHz to 1610 MHz


**Channel 5 vertical**

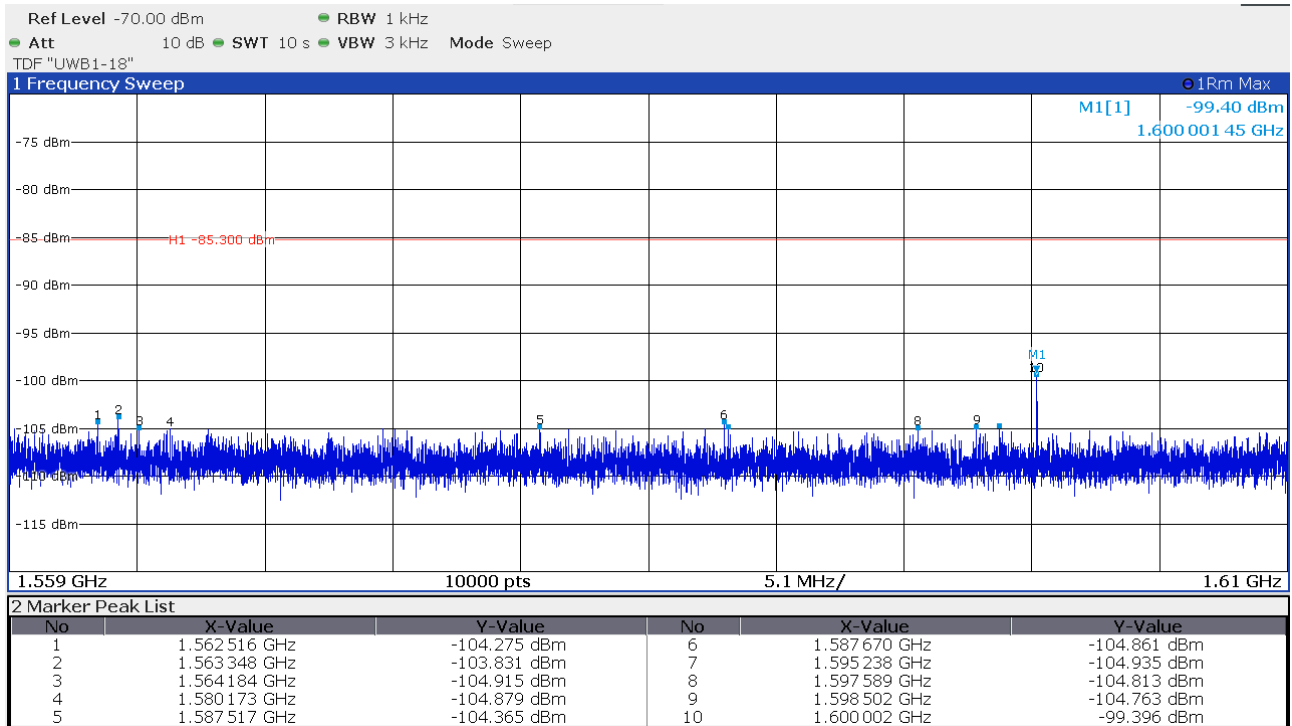
1164 MHz to 1240 MHz





**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**

1559 MHz to 1610 MHz



Limit according §15.250(d) in the frequency

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

The requirements are **FULFILLED**.

**Remarks:** None.

\_\_\_\_\_

\_\_\_\_\_



FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1

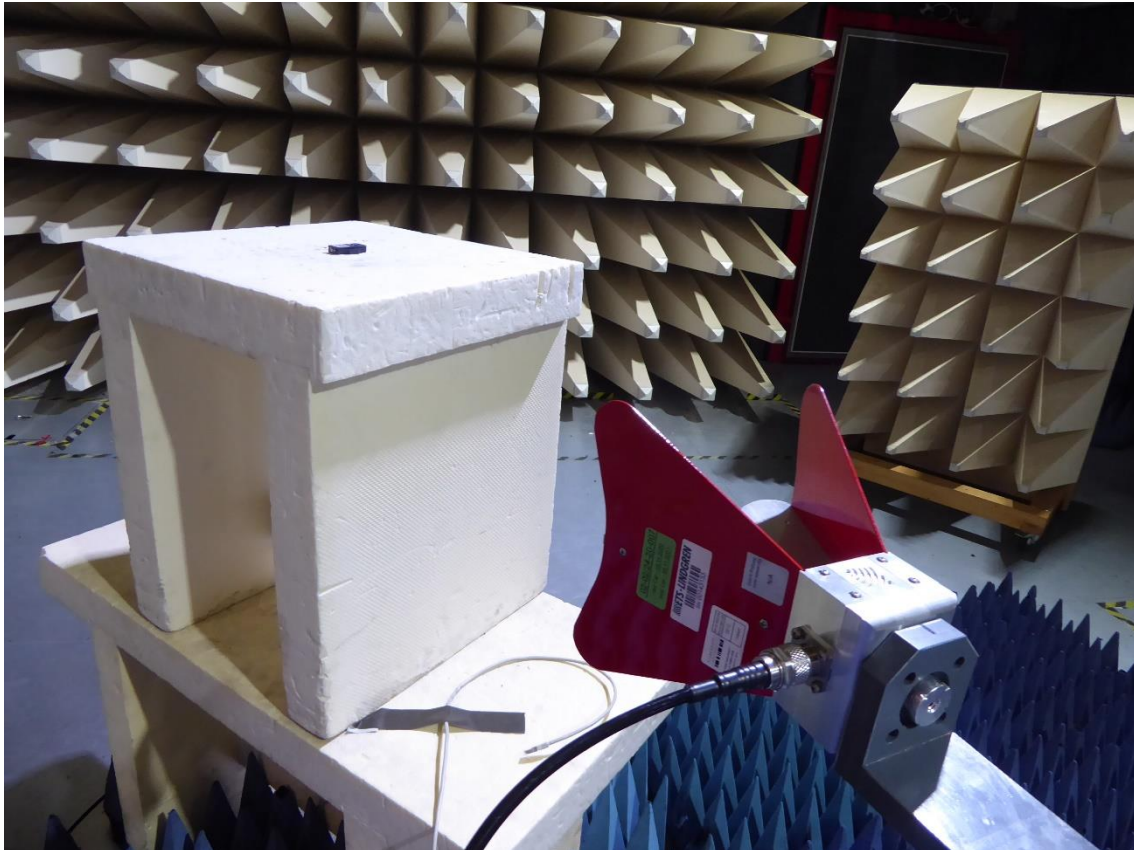
## 5.4 Peak Power radiated

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



### 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.

### 5.4.4 Analyser settings

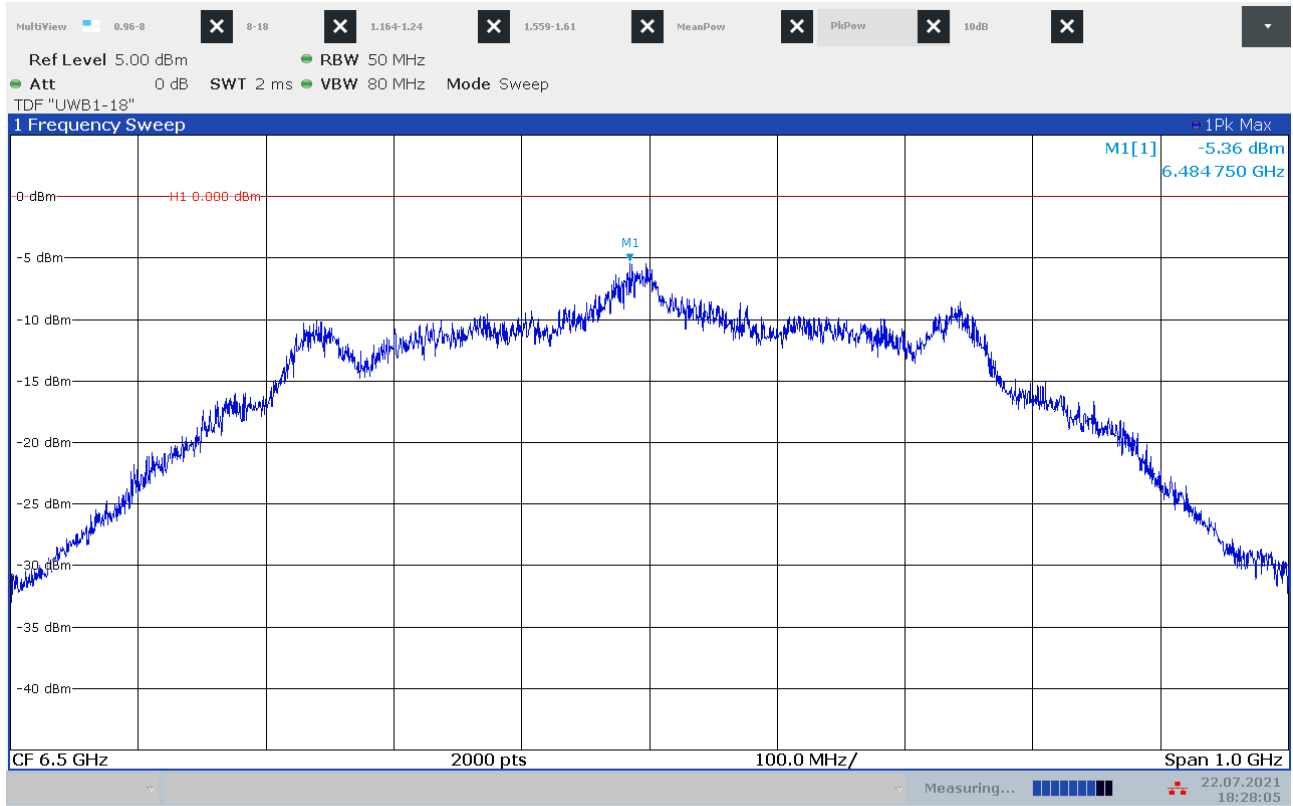
RBW: 50 MHz, VBW: 80 MHz, Detector: Peak, Trace Mode: Max hold



FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1

## 5.4.5 Test result

### Channel 5



18:28:05 22.07.2021

Min. limit margin: -5.36 dB at 6.48475 GHz

The requirements are **FULFILLED**.

Remarks: None.



FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1

## 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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**FCC ID: 2ALC5-KNX-XTAG1 IC: 25557-KNXXTAG1**

## 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	Equipment No.	Next Calib.	Last Calib.	Next Verif.	Last Verif.
CPR 3	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	3117	02-02/24-05-009	28/06/2022	28/06/2021		
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	BAT-EMC 3.21.0.24	02-02/68-13-001				
SER 2	ESVS 30	02-02/03-05-006	09/07/2022	09/07/2021		
	VULB 9168	02-02/24-05-005	20/12/2022	20/12/2021	07/07/2022	07/07/2021
	NW-2000-NB	02-02/50-05-113				
	KK-EF393/U-16N-21N20 m	02-02/50-12-018				
	KK-SD_7/8-2X21N-33,0M	02-02/50-15-028				
	50F-003 N 3 dB	02-02/50-21-010				
SER 3	FSW43	02-02/11-15-001	06/04/2022	06/04/2021		
	AMF-6D-01002000-22-10P	02-02/17-15-004				
	LNA-40-18004000-33-5P	02-02/17-20-002				
	3117	02-02/24-05-009	28/06/2022	28/06/2021		
	BBHA 9170	02-02/24-05-013	19/05/2023	19/05/2020	04/02/2022	04/02/2021
	BAM 4.5-P	02-02/50-17-024				
	NCD	02-02/50-17-025				
	KK-SF106-2X11N-6,5M	02-02/50-18-016				
	KMS116-GL140SE-KMS116-	02-02/50-20-026				
	BAT-EMC 3.21.0.24	02-02/68-13-001				

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test results without the written permission of the test laboratory.