



# EMI – TEST REPORT

- FCC Part 15.519 -

**Type / Model Name** : KNX-A1.8

**Product Description** : UWB Anchor

**Applicant** : Kinexon Sports & Media Inc.

**Address** : 22 west 38th

New York, NY 10018

**Manufacturer** : Kinexon GmbH

**Address** : Schellingstraße 35

80799 München

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

**POSITIVE**

**Test Report No. :** **T44481-00-04KS**

03. June 2019

Date of issue



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

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.

FCC ID: 2ALC5-KNX-HREC2

# Contents

<b>1</b>	<b><u>TEST STANDARDS</u></b>	<b>3</b>
<b>2</b>	<b><u>EQUIPMENT UNDER TEST</u></b>	<b>4</b>
2.1	Photo documentation of the EUT – Detailed photos see ATTACHMENT B	4
2.2	Equipment type	4
2.3	Short description of the equipment under test (EUT)	4
2.4	Variants of the EUT	4
2.5	Operation frequency and channel plan	4
2.6	Transmit operating modes	4
2.7	Antennas	5
2.8	Power supply system utilised	5
2.9	Peripheral devices and interface cables	5
2.10	Determination of worst case conditions for final measurement	5
<b>3</b>	<b><u>TEST RESULT SUMMARY</u></b>	<b>6</b>
3.1	Final assessment	6
<b>4</b>	<b><u>TEST ENVIRONMENT</u></b>	<b>7</b>
4.1	Address of the test laboratory	7
4.2	Environmental conditions	7
4.3	Statement of the measurement uncertainty	8
4.1	Measurement protocol for FCC and ISED	9
<b>5</b>	<b><u>TEST CONDITIONS AND RESULTS</u></b>	<b>11</b>
5.1	AC power line conducted emissions	11
5.2	UWB Bandwidth	16
5.3	Radiated Emissions 9 kHz to 40 GHz	20
5.4	Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz	40
5.5	Peak Power radiated	50
5.6	Signal deactivation	54
5.7	Antenna application	56
<b>6</b>	<b><u>USED TEST EQUIPMENT AND ACCESSORIES</u></b>	<b>57</b>

# 1 TEST STANDARDS

The tests were performed according to following standards:

## FCC Rules and Regulations Part 15, Subpart A - General (October 2018)

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 (October 2018)

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

## FCC Rules and Regulations Part 15, Subpart F – Ultra Wideband Operation (October 2018)

Part 15, Subpart F, Section 15.503	Definitions
Part 15, Subpart F, Section 15.505	Cross reference
Part 15, Subpart F, Section 15.519	Technical requirements for hand held UWB systems
Part 15, Subpart F, Section 15.521	Technical requirements applicable to all UWB devices

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

## **2 EQUIPMENT UNDER TEST**

### **2.1 Photo documentation of the EUT – Detailed photos see ATTACHMENT B**

### **2.2 Equipment type**

**Portable UWB device**

### **2.3 Short description of the equipment under test (EUT)**

The technology is used in sports as well as industrial environments.

Kinexon Anchors communicate with each other and nearby Tags to obtain information on the Tag positions.

Additionally, the EUT has an integrated WLAN and Bluetooth low energy module with integrated antennas.

Number of tested samples: 3 samples  
Serial number: pre-production samples  
Firmware version: 4.15.0

#### **EUT configuration:**

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

### **2.4 Variants of the EUT**

None.

### **2.5 Operation frequency and channel plan**

The operating frequency band is 3100 MHz to 10600 MHz.

Channel plan:

Channel 1: 3494.4 MHz

Channel 2: 3993.6 MHz

Channel 3: 4492.8 MHz

Channel 5: 6489.6 MHz

### **2.6 Transmit operating modes**

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

Data rate: 6.8 Mbit/s

## 2.7 Antennas

The following antenna shall be used with the EUT:

Mounted antenna with following gain: 4.15 dBi peak

## 2.8 Power supply system utilised

Power supply voltage,  $V_{nom}$  12 V AC

**Note:** The EUT has a DC socket which can be powered with 12 V to 24 V DC. The measurements were performed with a power adapter from the shelf (ETSA120330UD). Additionally, the conducted emissions measurement was performed with a PoE switch from Cisco.

Additionally, the EUT can be powered over Ethernet. A PoE switch from Cisco was used.

## 2.9 Peripheral devices and interface cables

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

- |                  |                                 |
|------------------|---------------------------------|
| - Laptop         | Model : Fujitsu E780            |
| - Computer       | Model : Intel NUC Kit NUC6i5SYH |
| - Network switch | Model : Netgear ProSafe GS105   |

## 2.10 Determination of worst case conditions for final measurement

Measurements are made in all three orthogonal axes.

### 2.10.1 Test jig

None

### 2.10.2 Test software

None

**FCC ID: 2ALC5-KNX-HREC2**

### **3 TEST RESULT SUMMARY**

UWB device using digital modulation:

Operating in the 3100 MHz – 10600 MHz:

FCC Rule Part	Description	Result
15.207(a)	AC power line conducted emissions	passed
15.519(b)	UWB Bandwidth	passed
15.209(a) 15.519(c)	Radiated Emissions 9 kHz to 40 GHz	passed
15.519(d)	Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz	passed
15.519(e)	Peak Power radiated	passed
15.519(a)	Signal deactivation	passed

#### **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 : 24 August 2018

Testing concluded on : 29 May 2019

Checked by:

Tested by:

\_\_\_\_\_  
Klaus Gegenfurtner  
Teamleader Radio

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

FCC ID: 2ALC5-KNX-HREC2

## 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

**FCC ID: 2ALC5-KNX-HREC2**
**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 / 11.2003 „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 power line conducted emissions	0.15 MHz to 30 MHz	95%	$\pm 3.29$ dB
EBW and OBW	2400 MHz to 30000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Output power ERP, radiated	1000 MHz to 7000 MHz	95%	$\pm 2.71$ dB
Field strength of the fundamental	1000 MHz to 7000 MHz	95%	$\pm 2.71$ dB
Power spectral density	2400 MHz to 3000 MHz	95%	$\pm 0.62$ dB
Spurious Emissions, conducted	9 kHz to 10000 MHz	95%	$\pm 2.15$ dB
Spurious Emissions, conducted	10000 MHz to 40000 MHz	95%	$\pm 3.47$ dB
Spurious Emissions, radiated	9 kHz to 30 MHz	95%	$\pm 3.53$ dB
Spurious Emissions, radiated	30 MHz to 1000 MHz	95%	$\pm 4.44$ dB
Spurious Emissions, radiated	1000 MHz to 30000 MHz	95%	$\pm 2.34$ dB
Spurious Emissions, radiated	30000 MHz to 40000 MHz	95%	$\pm 5.13$ dB



## FCC ID: 2ALC5-KNX-HREC2

### 4.1 Measurement protocol for FCC and ISCED

#### 4.1.1 General information

The Open Area test site is a listed Open Site under the Canadian Test-Sites File-No:

**IC 3009A-1**

The Anechoic chamber is a listed test site under the Canadian Test-Sites File-No:

**IC 3009A-2**

#### 4.1.2 General Standard information

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

##### 4.1.2.1 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.

##### 4.1.2.2 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 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 (dBµV)	+	Factor (dB)	=	Level (dBµV/m)	-	Limit (dBµV/m)	=	
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

**FCC ID: 2ALC5-KNX-HREC2****4.1.2.3 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.

FCC ID: 2ALC5-KNX-HREC2

## 5 TEST CONDITIONS AND RESULTS

### 5.1 AC power line conducted emissions

For test instruments and accessories used see section 6 Part A 4.

#### 5.1.1 Description of the test location

Test location:                Shielded Room S2

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



**FCC ID: 2ALC5-KNX-HREC2**
**5.1.3 Applicable standard**

According to FCC Part 15, Section 15.207(a):

Except as shown in paragraphs (b) and (c) of this Section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the given limits.

**5.1.4 Description of Measurement**

The measurements are performed following the procedures set out in ANSI C63.10 described under item 4.4.3. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

**5.1.5 Test result**

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin 4.84 dB at 0.15 MHz

Limit according to FCC Part 15, Section 15.207(a):

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

\* Decreases with the logarithm of the frequency

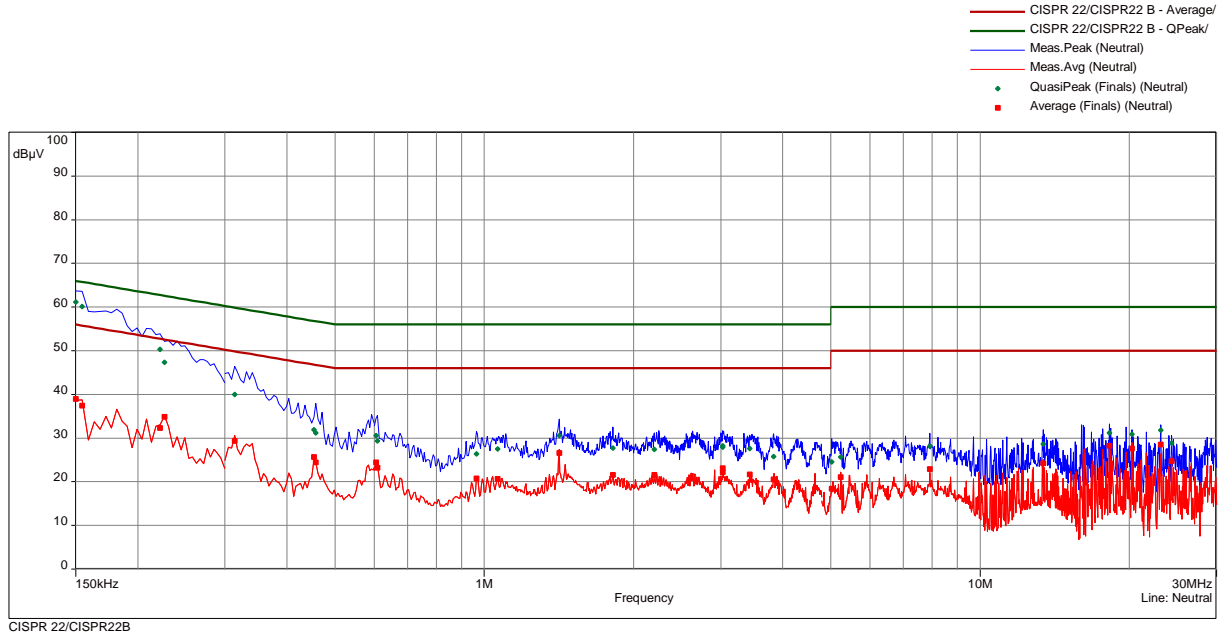
The requirements are **FULFILLED**.

**Remarks:** For detailed test result please refer to following test protocols. This test was performed with the sample 36123 and with the samples 36101 & 36099 as companion device.

**FCC ID: 2ALC5-KNX-HREC2**
**5.1.6 Test protocol**

Powered with power adapter ETSA 120330UD

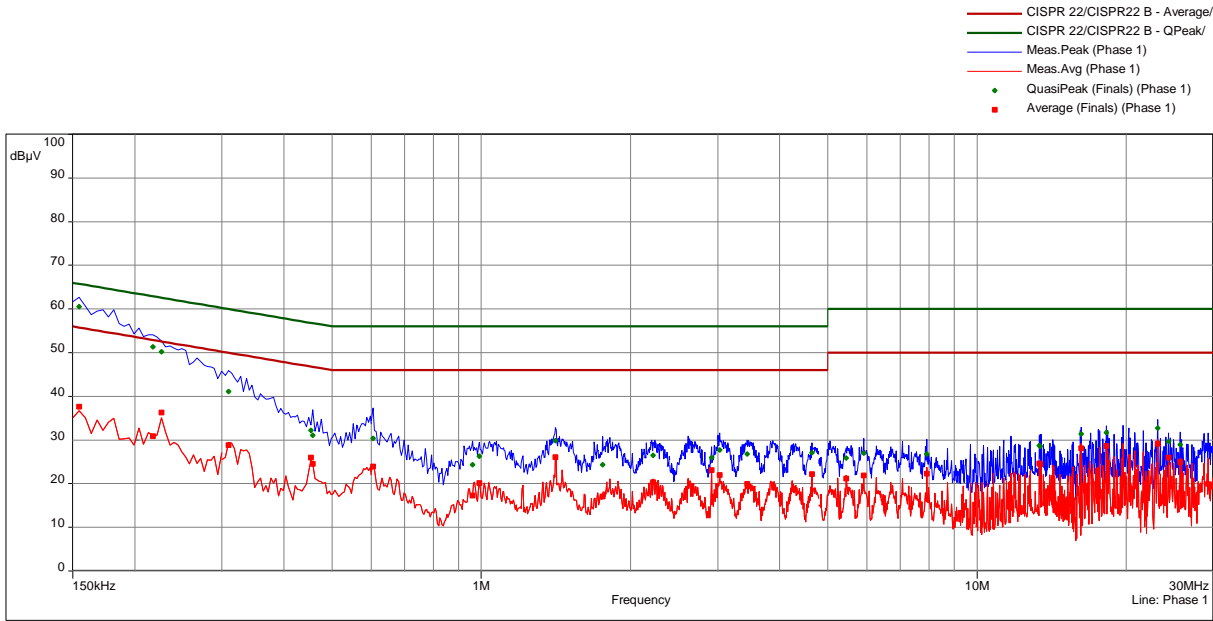
Worst case: WLAN, Bluetooth and UWB active



CISPR 22/CISPR22B

freq	QP	margin	limit	AV	margin	limit	line	corr
MHz	dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.15	61.16	4.84	66.00	38.93	17.07	56.00	Neutral	10.07
0.1545	60.11	5.64	65.75	37.38	18.37	55.75	Neutral	10.08
0.222	50.31	12.43	62.74	32.29	20.46	52.74	Neutral	10.11
0.2265	47.37	15.20	62.58	34.90	17.67	52.58	Neutral	10.11
0.3135	39.99	19.89	59.88	29.36	20.52	49.88	Neutral	10.12
0.453	31.91	24.91	56.82	25.63	21.19	46.82	Neutral	10.14
0.4575	31.16	25.57	56.74	24.40	22.33	46.74	Neutral	10.14
0.6045	30.61	25.39	56.00	24.47	21.53	46.00	Neutral	10.16
0.609	29.34	26.66	56.00	23.26	22.74	46.00	Neutral	10.16
0.9645	26.41	29.59	56.00	20.77	25.23	46.00	Neutral	10.18
1.0635	27.51	28.49	56.00	20.68	25.32	46.00	Neutral	10.20
1.416	30.61	25.39	56.00	26.63	19.37	46.00	Neutral	10.25
1.8165	27.69	28.31	56.00	21.63	24.37	46.00	Neutral	10.26
2.2035	27.39	28.61	56.00	21.59	24.41	46.00	Neutral	10.28
3.0255	27.88	28.12	56.00	22.22	23.78	46.00	Neutral	10.34
3.03	28.25	27.75	56.00	23.08	22.92	46.00	Neutral	10.34
3.435	27.64	28.36	56.00	21.66	24.34	46.00	Neutral	10.35
3.8355	25.79	30.21	56.00	20.52	25.48	46.00	Neutral	10.38
5.025	24.58	35.42	60.00	18.37	31.63	50.00	Neutral	10.45
5.2365	25.69	34.31	60.00	21.02	28.98	50.00	Neutral	10.46
7.923	28.08	31.92	60.00	22.95	27.05	50.00	Neutral	10.61
13.4205	28.62	31.38	60.00	24.27	25.73	50.00	Neutral	10.90
18.2445	31.24	28.76	60.00	28.24	21.76	50.00	Neutral	11.17
20.2575	30.86	29.14	60.00	27.61	22.39	50.00	Neutral	11.25
23.1285	31.86	28.14	60.00	28.49	21.51	50.00	Neutral	11.27
24.348	28.86	31.14	60.00	24.80	25.20	50.00	Neutral	11.27

FCC ID: 2ALC5-KNX-HREC2



CISPR 22/CISPR22B

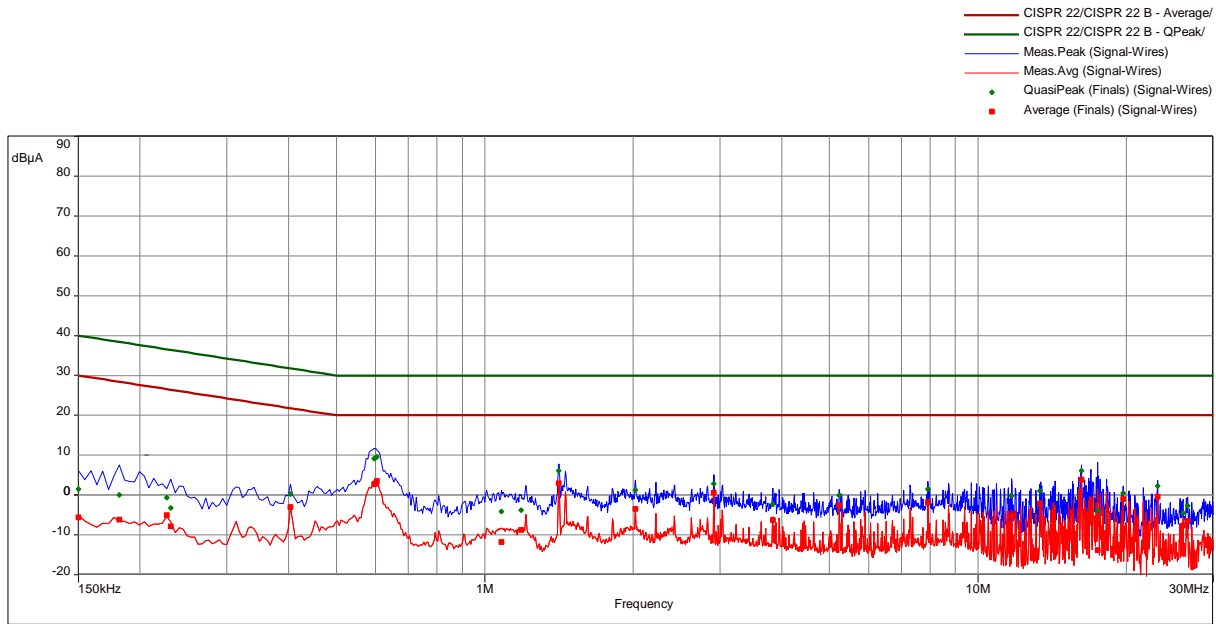
freq	QP	margin	limit	AV	margin	limit	line	corr
MHz	dB(μV)	dB	dB	dB(μV)	dB	dB		dB
0.1545	60.57	5.19	65.75	37.65	18.10	55.75	Phase 1	10.08
0.2175	51.30	11.61	62.91	30.89	22.02	52.91	Phase 1	10.09
0.2265	50.25	12.33	62.58	36.30	16.28	52.58	Phase 1	10.10
0.309	41.11	18.89	60.00	28.87	21.13	50.00	Phase 1	10.12
0.453	32.18	24.64	56.82	26.01	20.81	46.82	Phase 1	10.14
0.4575	31.12	25.62	56.74	24.52	22.22	46.74	Phase 1	10.14
0.6045	30.36	25.64	56.00	23.95	22.05	46.00	Phase 1	10.16
0.96	24.35	31.65	56.00	17.26	28.74	46.00	Phase 1	10.18
0.9915	26.33	29.67	56.00	20.18	25.82	46.00	Phase 1	10.19
1.4115	29.90	26.10	56.00	26.08	19.92	46.00	Phase 1	10.25
1.758	24.30	31.70	56.00	17.05	28.95	46.00	Phase 1	10.27
2.2215	26.46	29.54	56.00	20.39	25.61	46.00	Phase 1	10.29
2.913	26.00	30.00	56.00	23.13	22.87	46.00	Phase 1	10.34
3.0255	27.75	28.25	56.00	21.94	24.06	46.00	Phase 1	10.35
3.4395	26.81	29.19	56.00	19.95	26.05	46.00	Phase 1	10.35
4.6455	27.07	28.93	56.00	22.17	23.83	46.00	Phase 1	10.44
5.4525	25.93	34.07	60.00	21.19	28.81	50.00	Phase 1	10.49
5.907	27.03	32.97	60.00	21.91	28.09	50.00	Phase 1	10.52
7.923	26.75	33.25	60.00	22.25	27.75	50.00	Phase 1	10.65
13.3575	28.70	31.30	60.00	24.66	25.34	50.00	Phase 1	11.04
13.4205	28.51	31.49	60.00	24.44	25.56	50.00	Phase 1	11.05
16.2285	31.42	28.58	60.00	28.12	21.88	50.00	Phase 1	11.25
18.2445	31.70	28.30	60.00	28.65	21.35	50.00	Phase 1	11.37
23.1285	32.70	27.30	60.00	29.12	20.88	50.00	Phase 1	11.61
24.348	29.64	30.36	60.00	25.96	24.04	50.00	Phase 1	11.66
25.6935	28.99	31.01	60.00	24.97	25.03	50.00	Phase 1	11.69



**FCC ID: 2ALC5-KNX-HREC2**

Power over Ethernet switch

Worst case: WLAN, Bluetooth and UWB active



CISPR 22/CISPR 22B

freq MHz	QP dB(μA)	margin dB	limit dB	AV dB(μA)	margin dB	limit dB	corr dB
0.15	1.51	38.49	40.00	-5.54	35.54	30.00	2.88
0.1815	0.07	38.35	38.42	-6.17	34.58	28.42	1.33
0.2265	-0.66	37.24	36.58	-4.98	31.56	26.58	-0.24
0.231	-3.28	39.70	36.41	-7.86	34.28	26.41	-0.36
0.4035	0.22	31.56	31.78	-3.06	24.84	21.78	-4.15
0.597	9.18	20.82	30.00	2.77	17.23	20.00	-6.32
0.6	9.35	20.65	30.00	2.99	17.01	20.00	-6.34
0.6045	9.57	20.43	30.00	3.53	16.47	20.00	-6.36
1.0815	-4.14	34.14	30.00	-11.76	31.76	20.00	-8.48
1.185	-3.74	33.74	30.00	-8.72	28.72	20.00	-8.58
1.4115	6.05	23.95	30.00	2.92	17.08	20.00	-8.79
2.019	1.21	28.79	30.00	-3.46	23.46	20.00	-9.37
2.913	2.86	27.14	30.00	0.55	19.45	20.00	-9.38
3.8355	-2.30	32.30	30.00	-6.28	26.28	20.00	-9.44
5.2365	-0.14	30.14	30.00	-2.52	22.52	20.00	-9.48
7.923	1.47	28.53	30.00	-1.73	21.73	20.00	-9.40
11.7105	-0.14	30.14	30.00	-5.12	25.12	20.00	-9.35
13.3575	1.09	28.91	30.00	-2.06	22.06	20.00	-9.33
16.2285	6.12	23.88	30.00	3.82	16.18	20.00	-9.32
17.4975	-3.91	33.91	30.00	-13.82	33.82	20.00	-9.32
19.7085	0.51	29.49	30.00	-0.95	20.95	20.00	-9.34
23.1285	2.30	27.70	30.00	-0.38	20.38	20.00	-9.24
26.076	-4.46	34.46	30.00	-7.67	27.67	20.00	-9.17
26.607	-2.66	32.66	30.00	-6.49	26.49	20.00	-9.16

## 5.2 UWB Bandwidth

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

### 5.2.1 Description of the test location

Test location:                      Shielded room 6

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



### 5.2.3 Applicable standard

According to FCC Part 15, Section 15.519(b):

The UWB bandwidth of a UWB system operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.

According to FCC Part 15, Section 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.

### 5.2.4 Description of Measurement

The measurement was performed conducted with the sample with a SMA connector.

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



**FCC ID: 2ALC5-KNX-HREC2**
**5.2.5 Test result**

channel	lowest frequency $f_L$ (MHz)	highest frequency $f_H$ (MHz)	permitted frequency range (GHz)	UWB bandwidth (MHz)	required UWB bandwidth (MHz)	result
1	3232.78	3806.33	3.1 to 10.6	573.55	> 500	passed
2	3680.04	4310.78	3.1 to 10.6	630.74	> 500	passed
3	4215.29	4808.34	3.1 to 10.6	593.05	> 500	passed
5	6176.67	6803.97	3.1 to 10.6	627.30	> 500	passed

The requirements are **FULFILLED**.

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

This test was performed with the sample 36158.

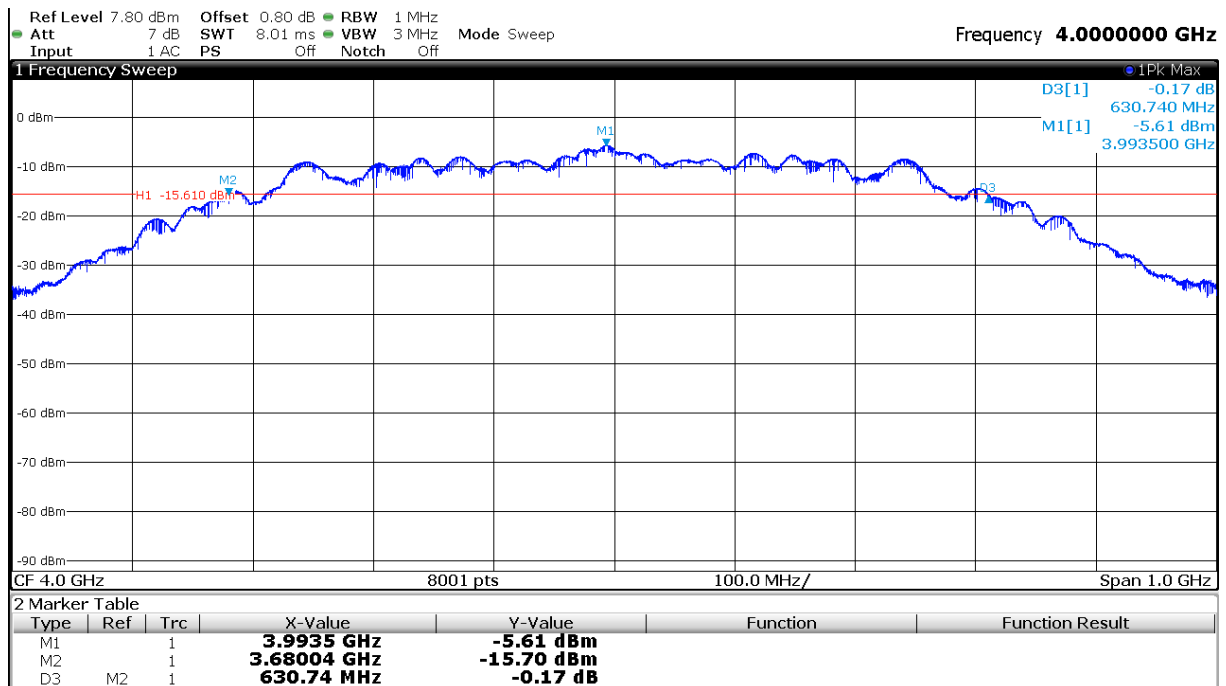
FCC ID: 2ALC5-KNX-HREC2

## 5.2.6 Test protocols

### Channel 1:

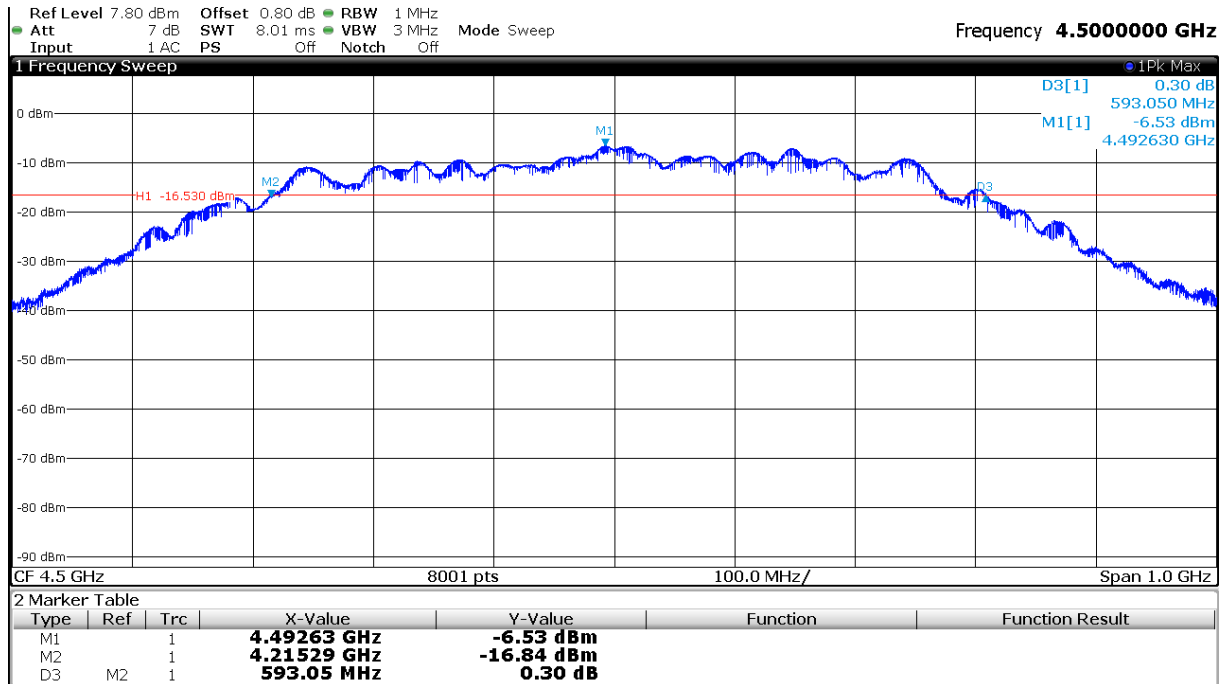


### Channel 2:

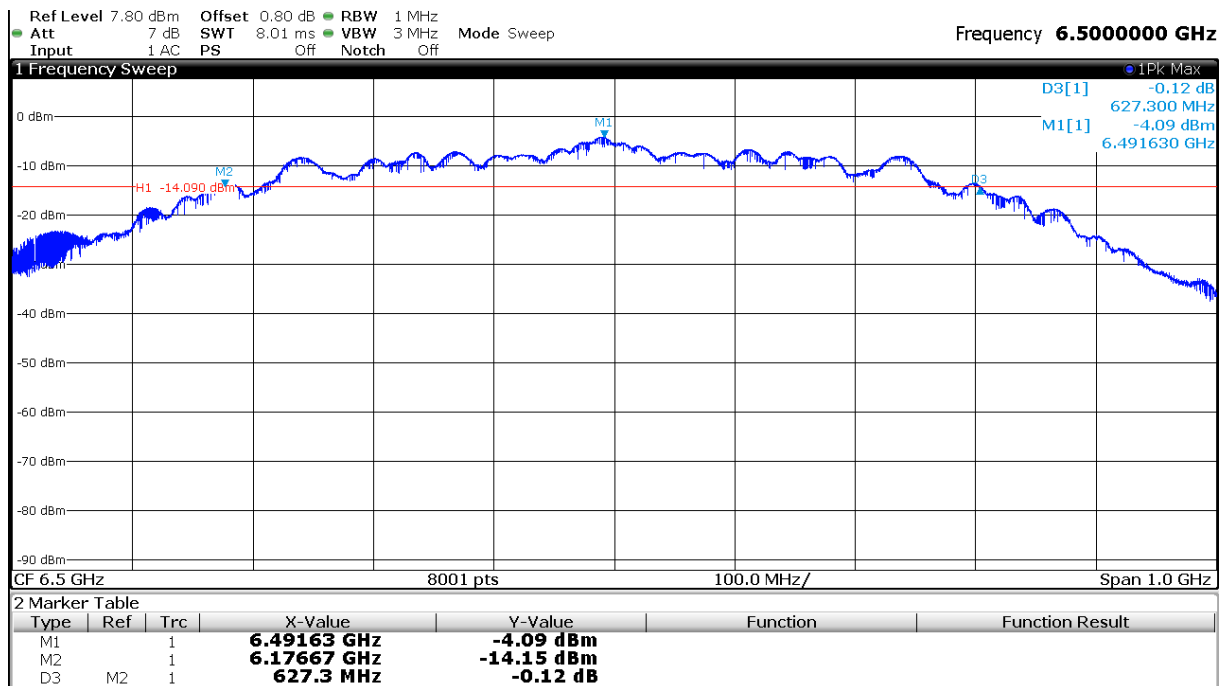


## FCC ID: 2ALC5-KNX-HREC2

### Channel 3:



### Channel 5:



**FCC ID: 2ALC5-KNX-HREC2****5.3 Radiated Emissions 9 kHz to 40 GHz**

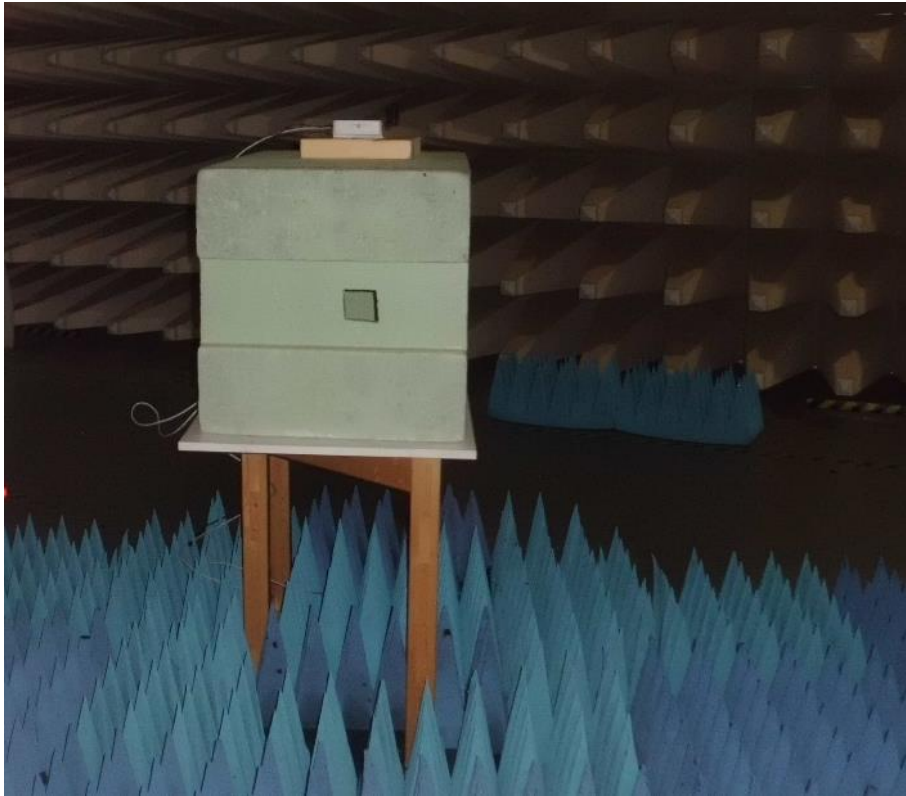
For test instruments and accessories used see section 6 Part **SER 2**, **SER3**.

**5.3.1 Description of the test location**

Test location: OATS 1  
Test location: Anechoic chamber 1

**5.3.2 Photo documentation of the test set-up**

## FCC ID: 2ALC5-KNX-HREC2



### 5.3.3 Applicable standard

According to FCC Part 15, Section 15.519(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.

### 5.3.4 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

**FCC ID: 2ALC5-KNX-HREC2**
**5.3.5 Test result**
**Measurement 9 kHz to 30 MHz:**

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

**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)
41.62	15.9		13.8		29.7		40.0	-10.3
45.05	17.4		14.2		31.6		40.0	-8.4
48.47	21.2	7.8	14.2	13.1	35.4	20.9	40.0	-4.6
66.03	17.6		13.4		31.0		40.0	-9.0
70.37	18.0		13.1		31.1		40.0	-8.9
74.77	18.9		11.8		30.7		40.0	-9.3

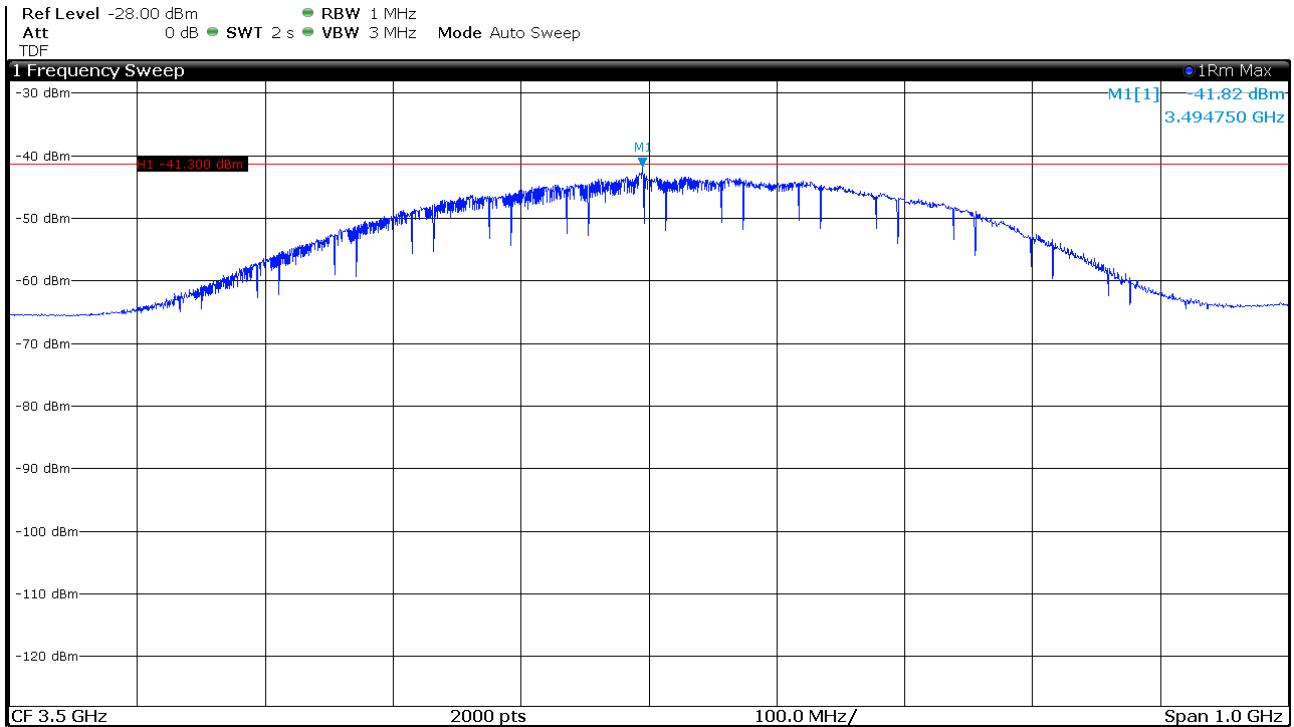
Note: Pre-measurements have shown, there is no difference of the emissions between the different channels.

## FCC ID: 2ALC5-KNX-HREC2

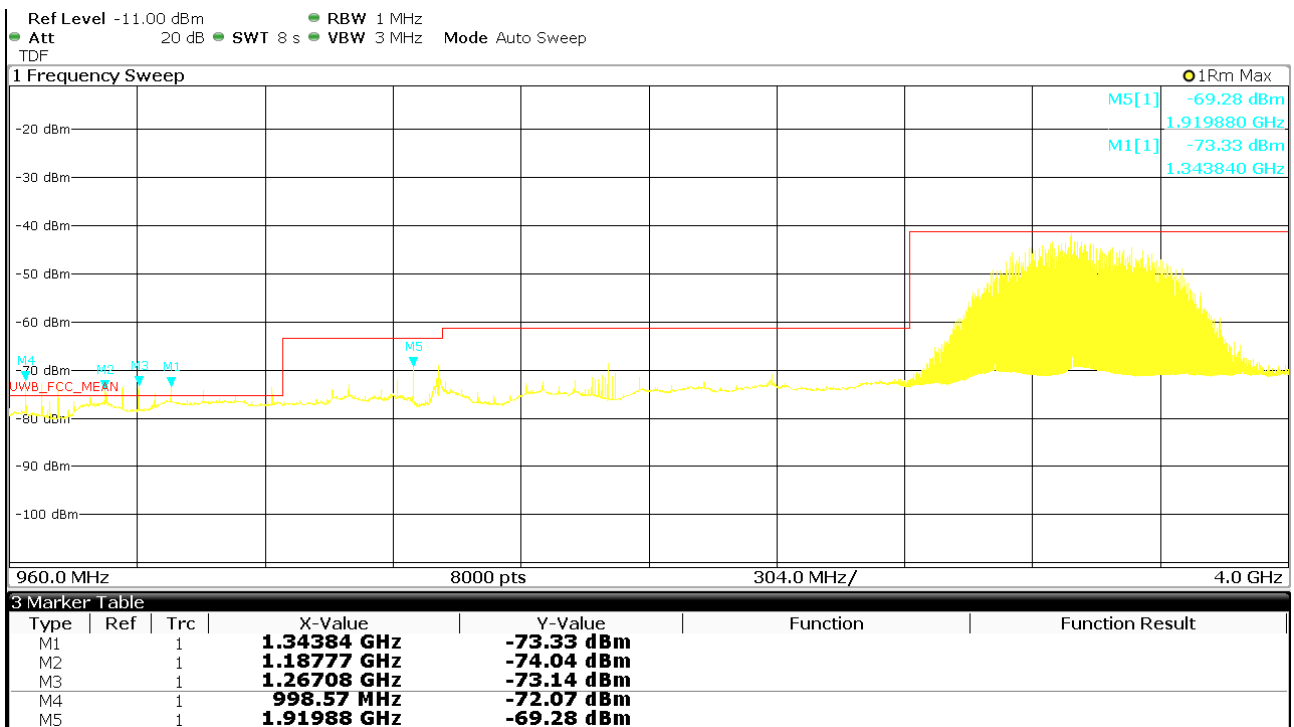
### Measurement 960 MHz to 40 GHz:

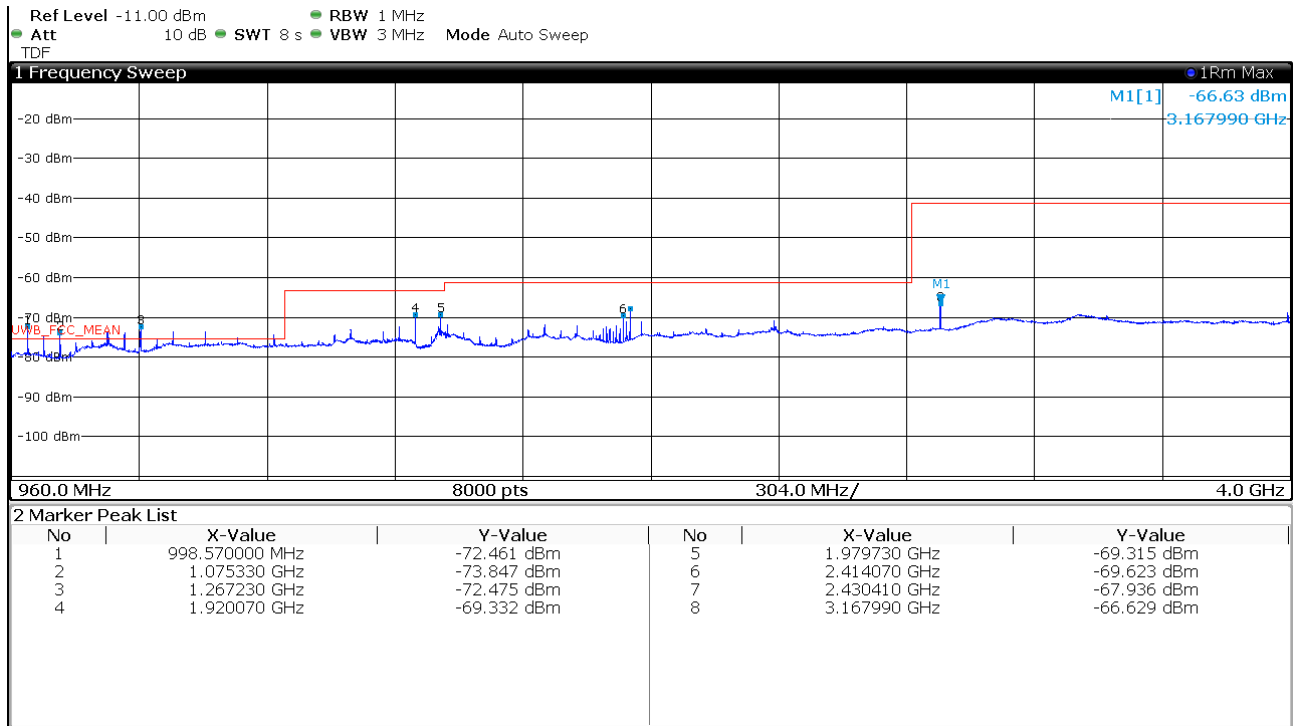
#### Channel 1:

#### Mean power:

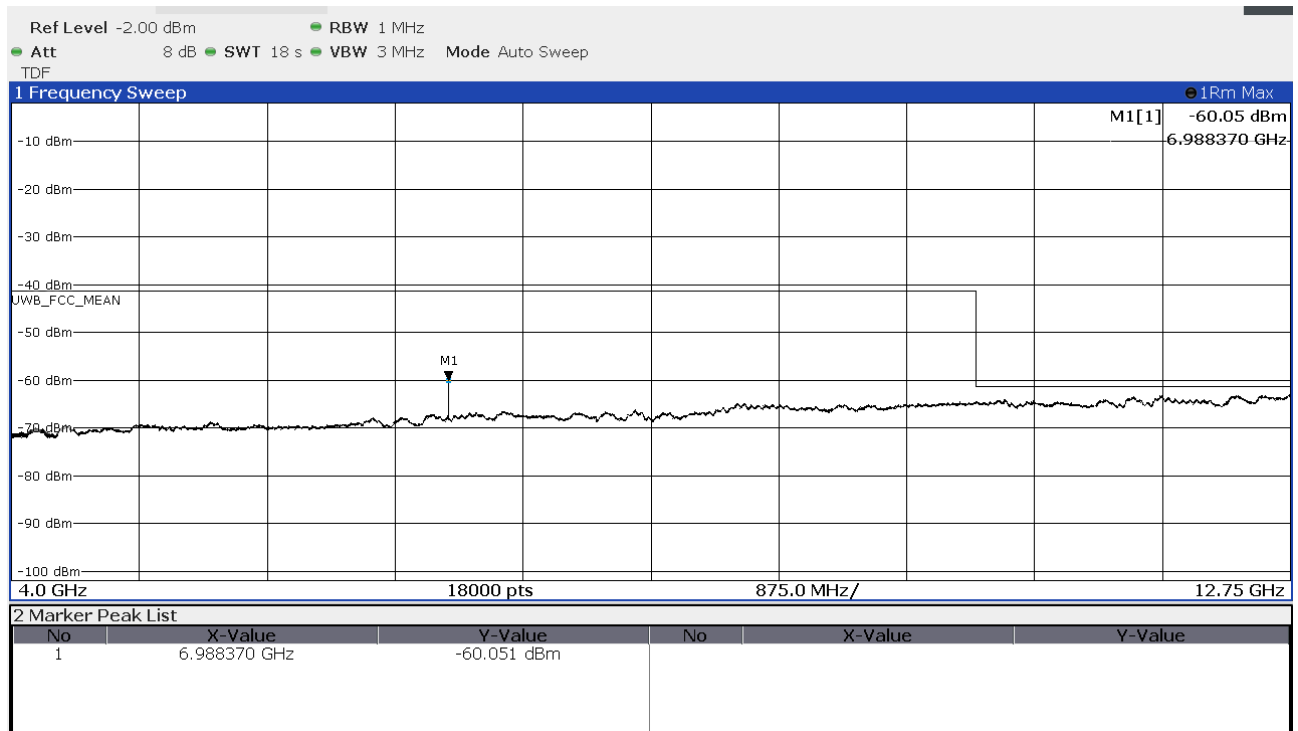


### 960 MHz to 4 GHz



**FCC ID: 2ALC5-KNX-HREC2**
**960 MHz to 4 GHz UWB off**


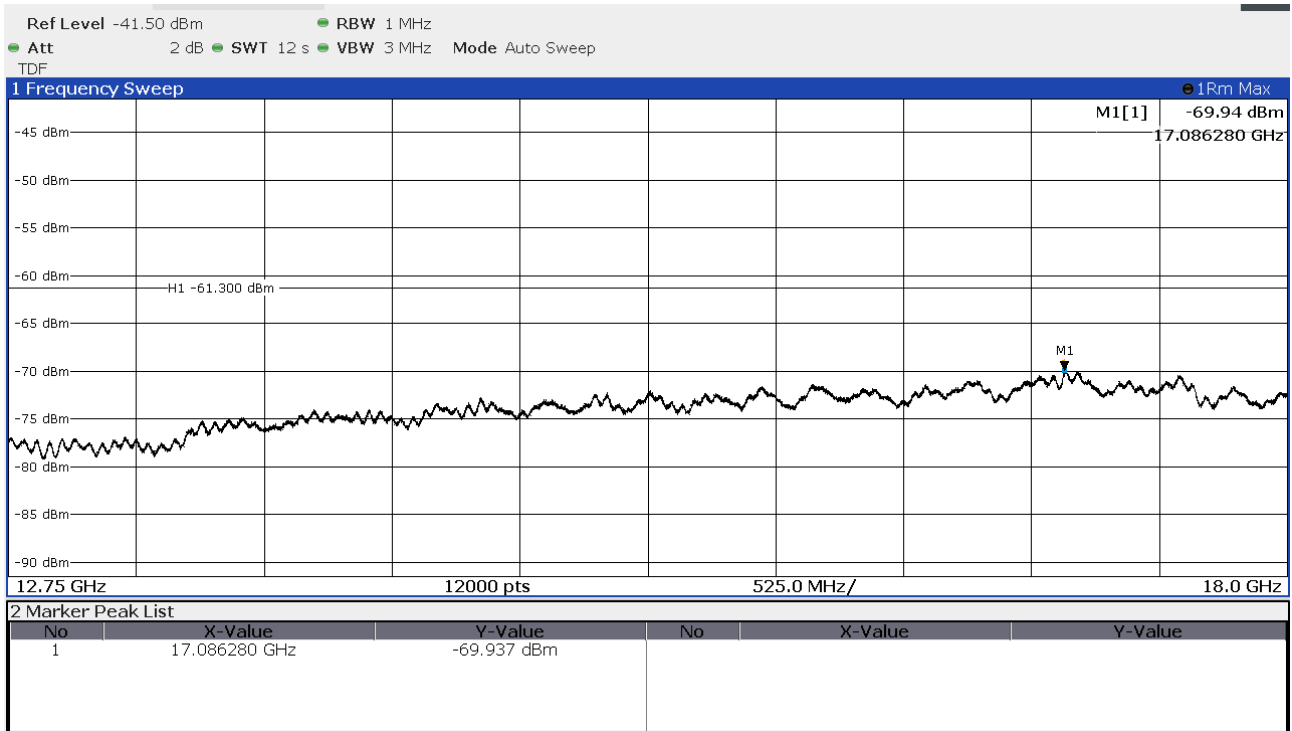
Note: The values above the limit line are not belonging to the UWB technology. These values are considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

**4 GHz to 12.75 GHz**


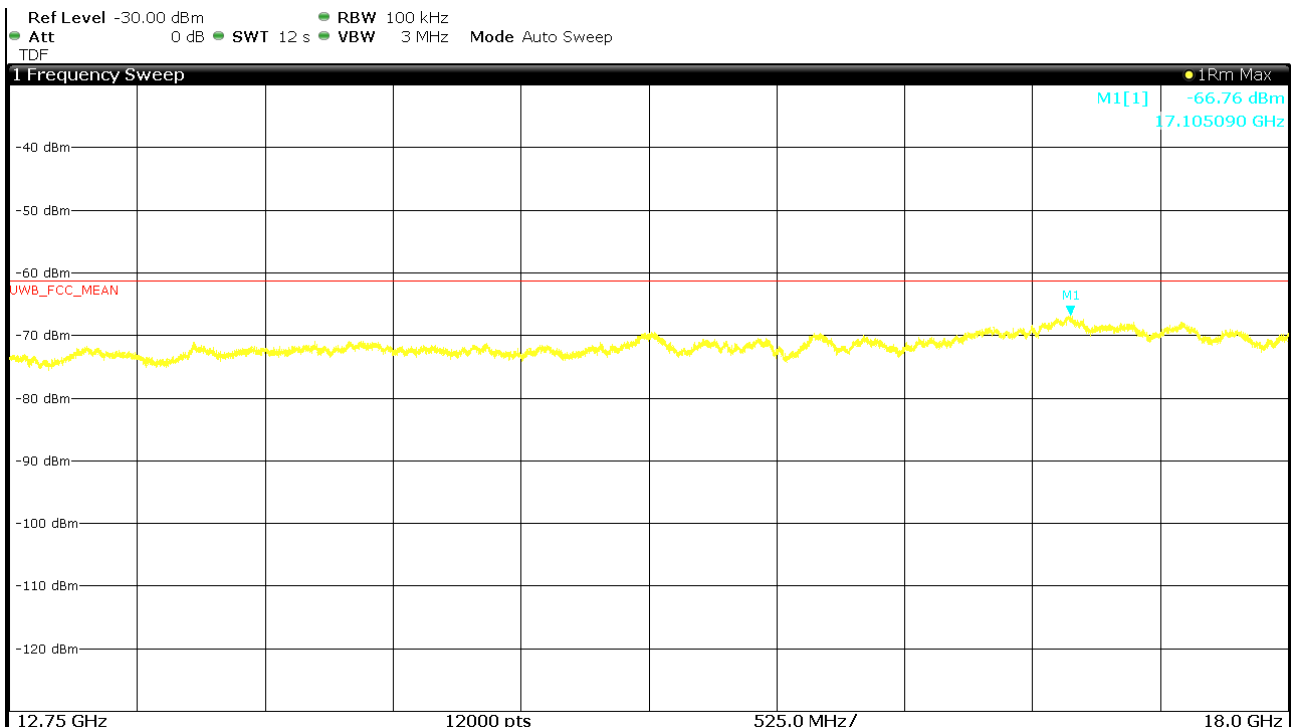


## FCC ID: 2ALC5-KNX-HREC2

12.75 GHz to 18 GHz at 1 m



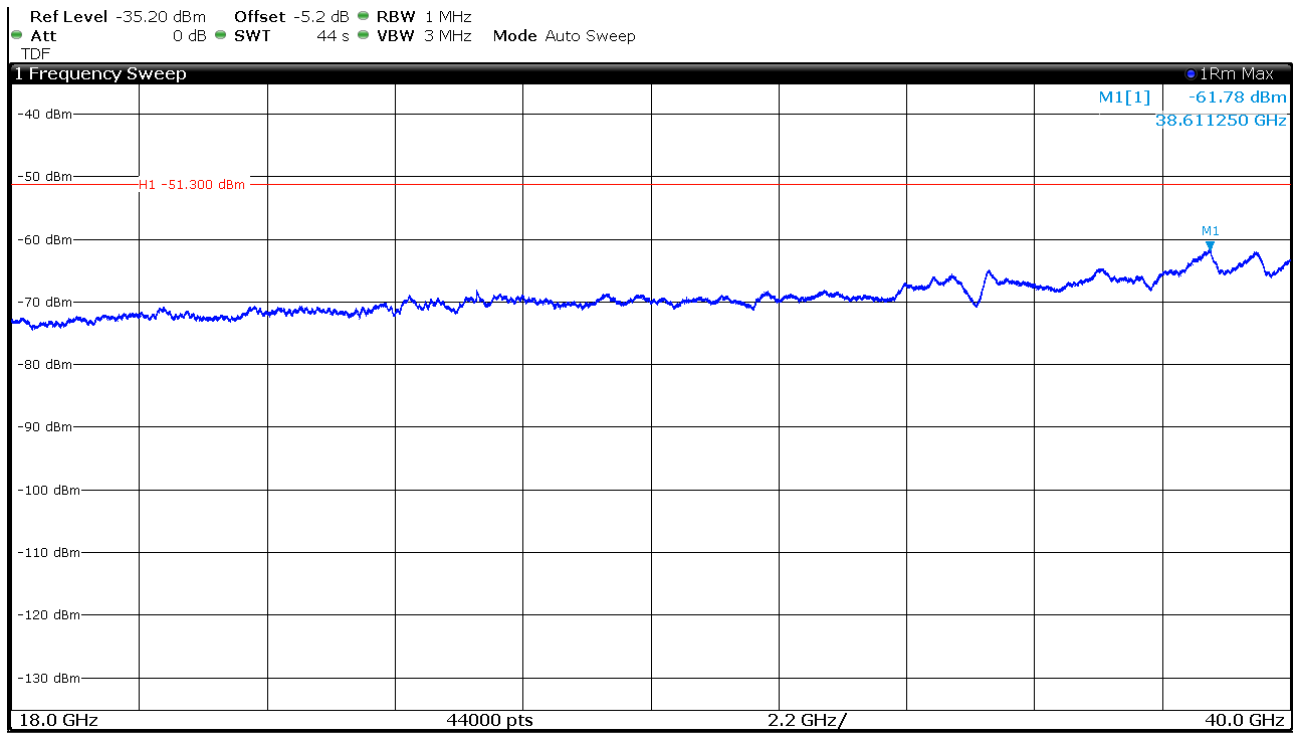
12.75 GHz to 18 GHz with a RBW of 100 kHz at 3 m



Note: the measurement has also been performed with a resolution bandwidth of 100 kHz to reduce the noise floor and to show that there are no emissions of the device.

FCC ID: 2ALC5-KNX-HREC2

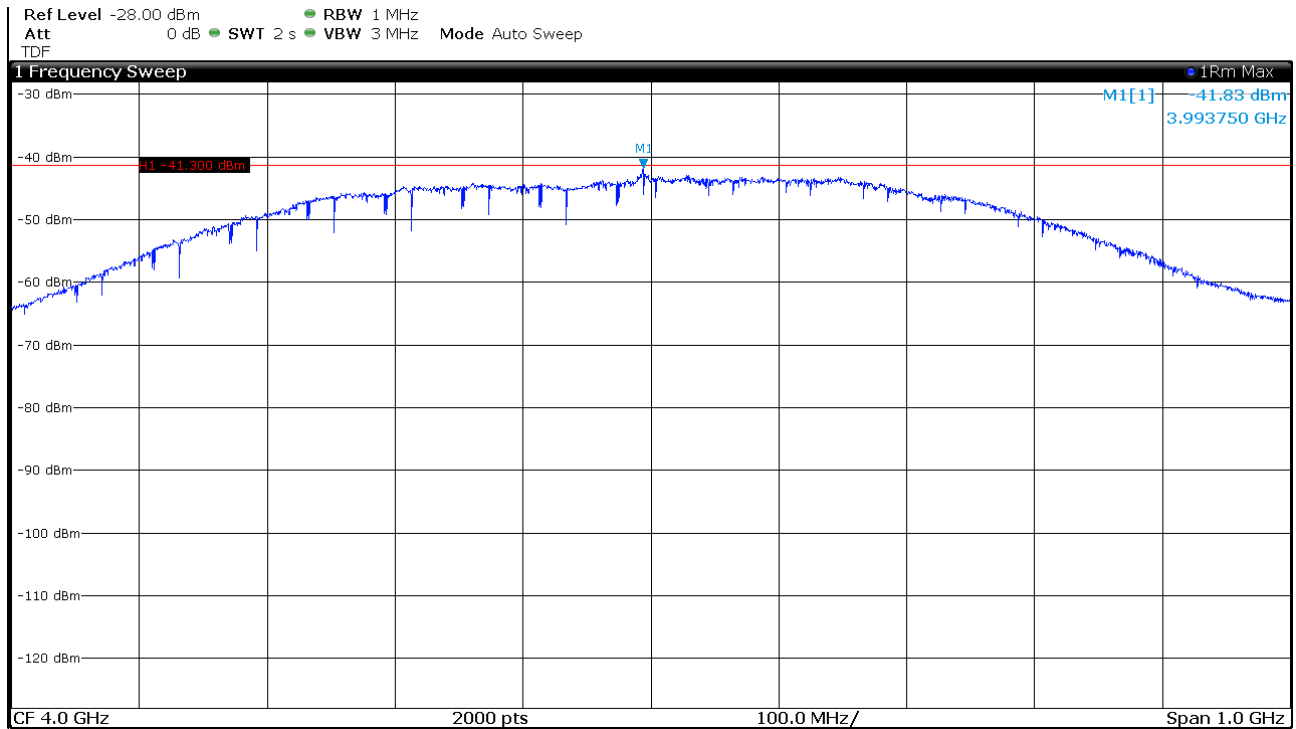
18 GHz to 40 GHz at 30 cm



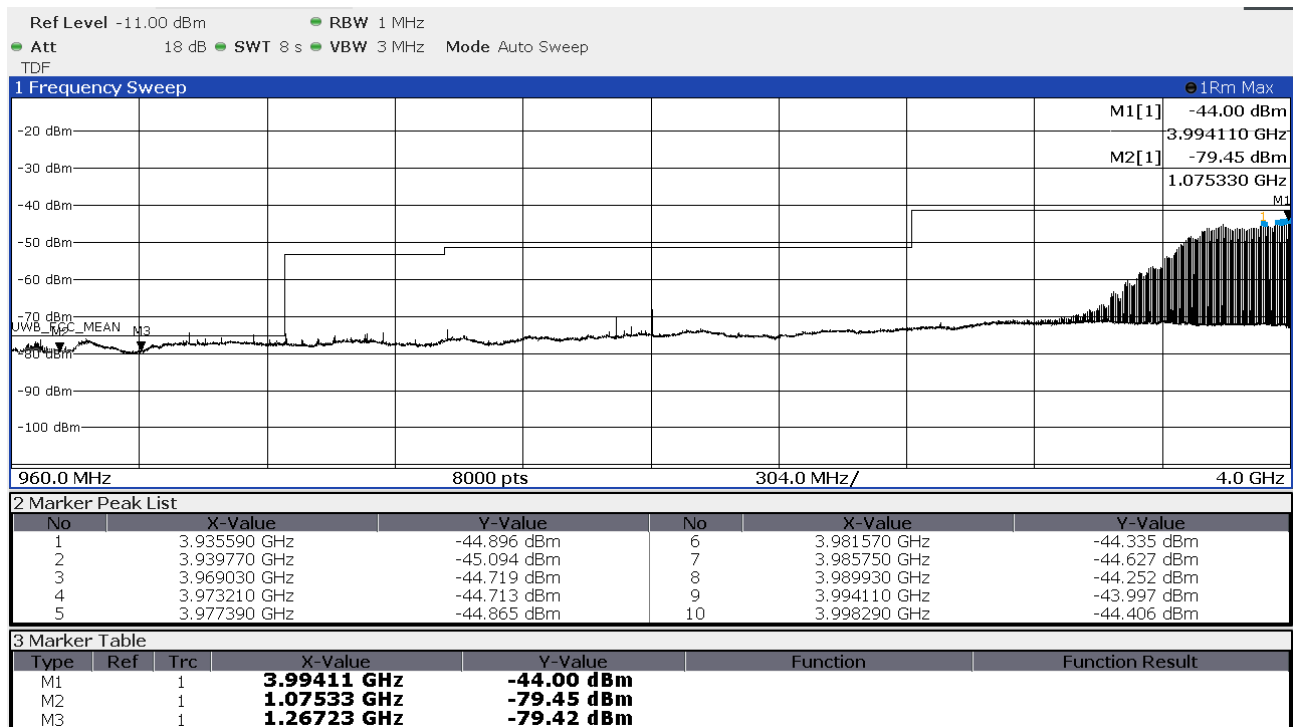
## FCC ID: 2ALC5-KNX-HREC2

### Channel 2:

Mean power:

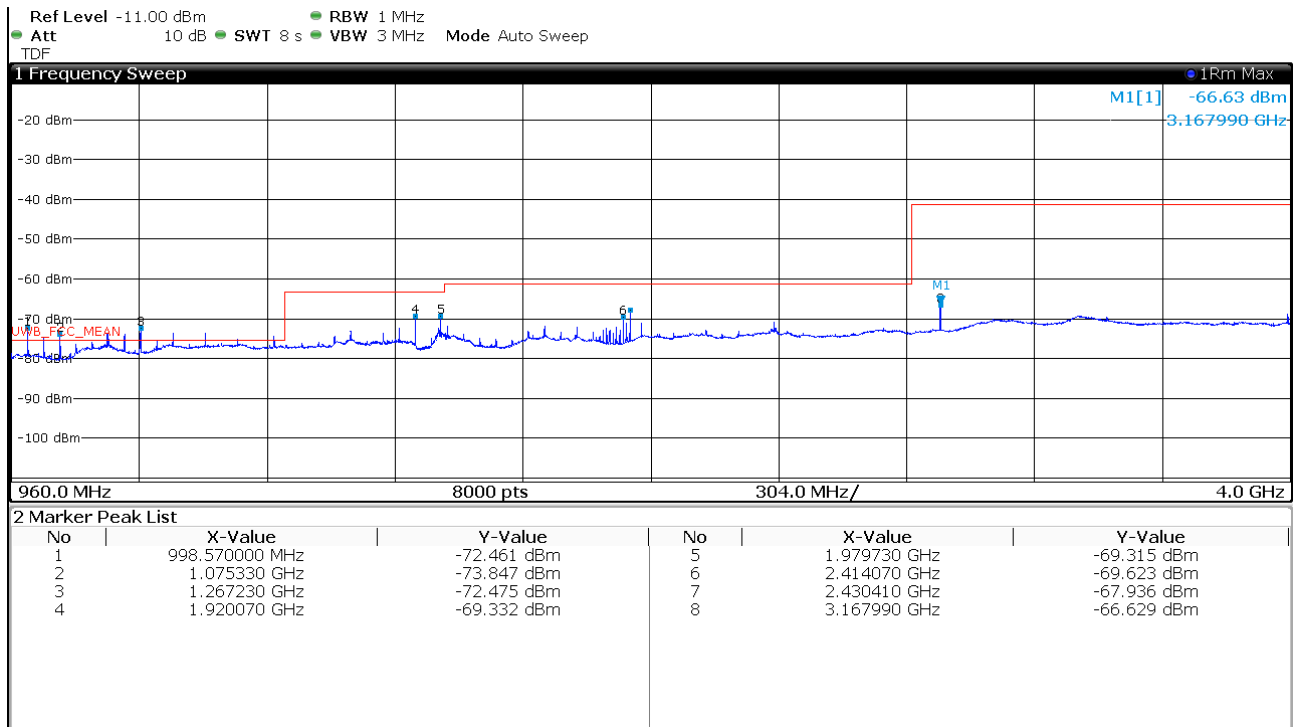


### 960 MHz to 4 GHz



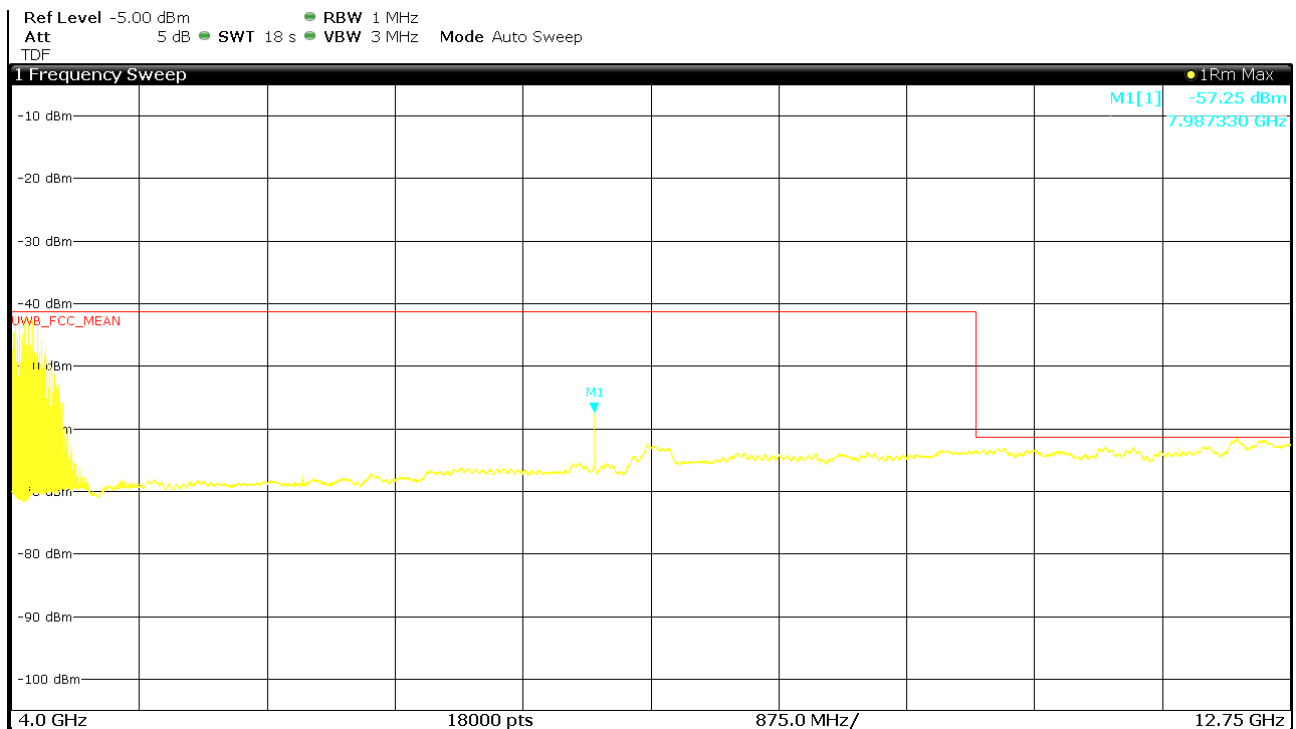
**FCC ID: 2ALC5-KNX-HREC2**

960 MHz to 4 GHz UWB off



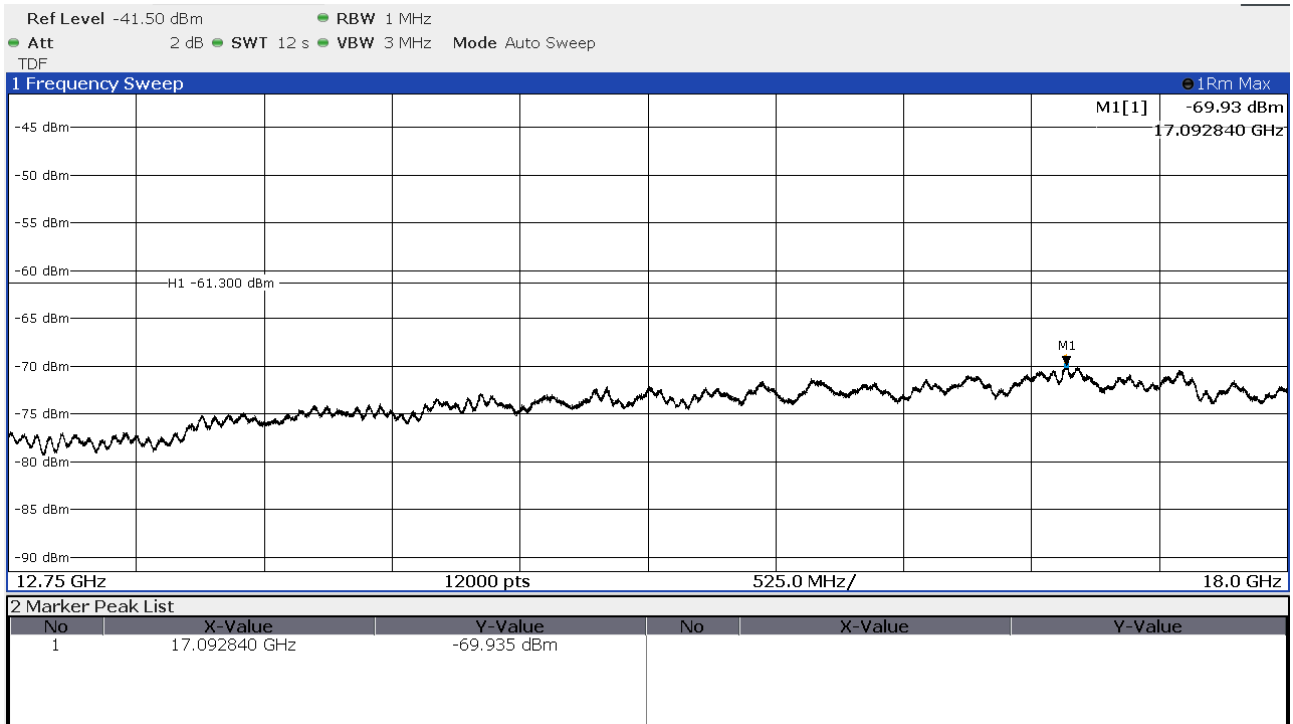
Note: The values above the limit line are not belonging to the UWB technology. These values are considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

4 GHz to 12.75 GHz

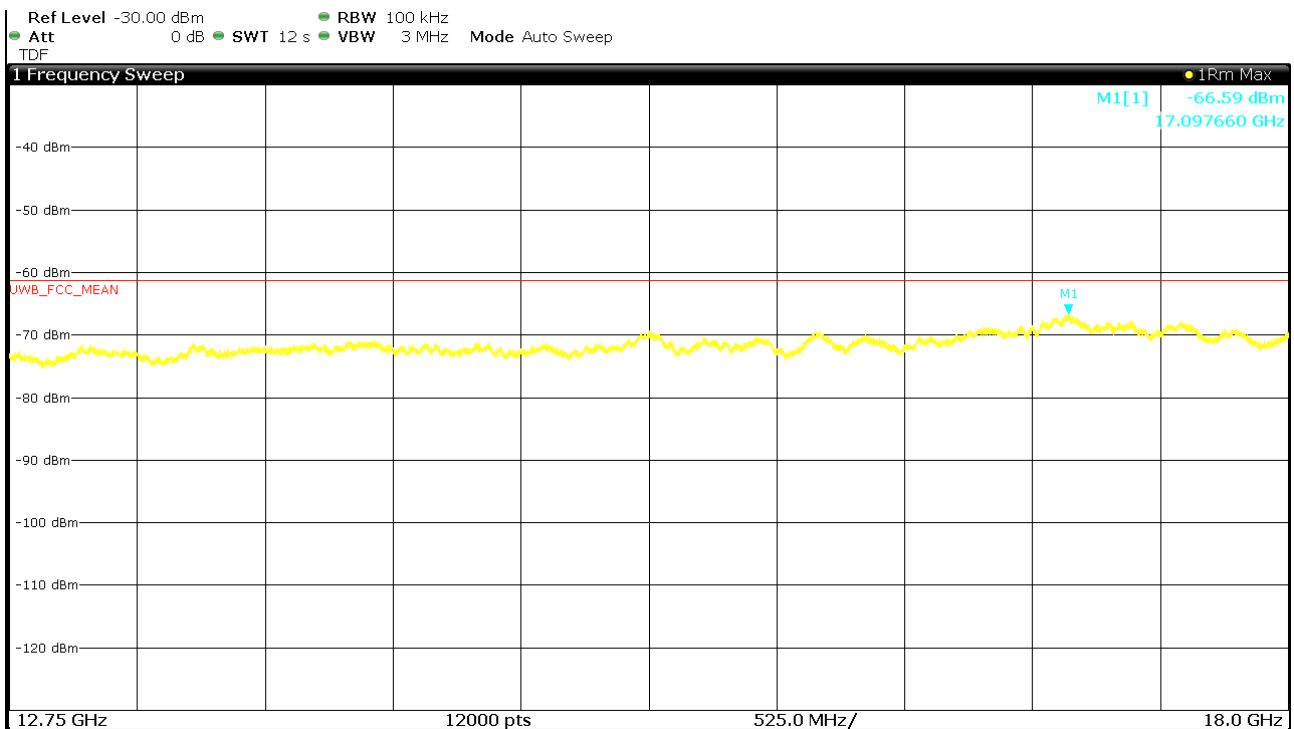


## FCC ID: 2ALC5-KNX-HREC2

12.75 GHz to 18 GHz at 1 m



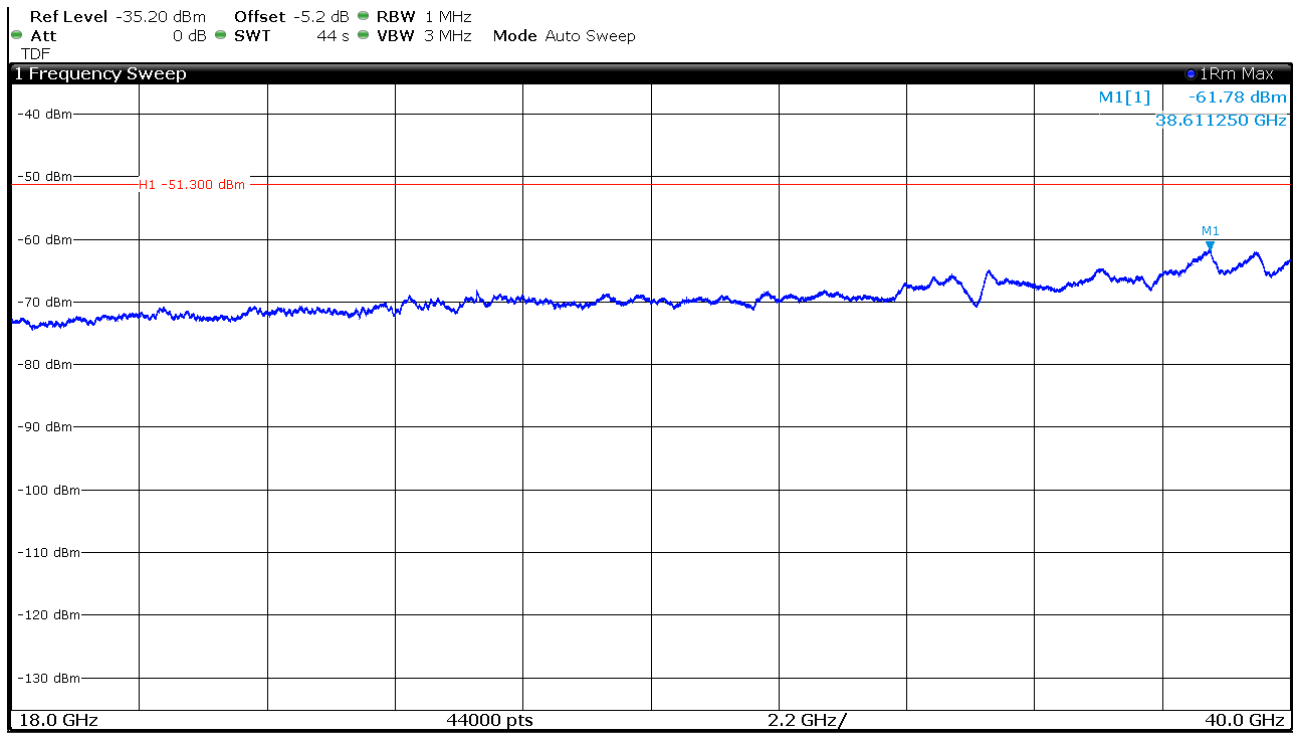
12.75 GHz to 18 GHz with a RBW of 100 kHz at 3 m



Note: the measurement has also been performed with a resolution bandwidth of 100 kHz to reduce the noise floor and to show that there are no emissions of the device.

FCC ID: 2ALC5-KNX-HREC2

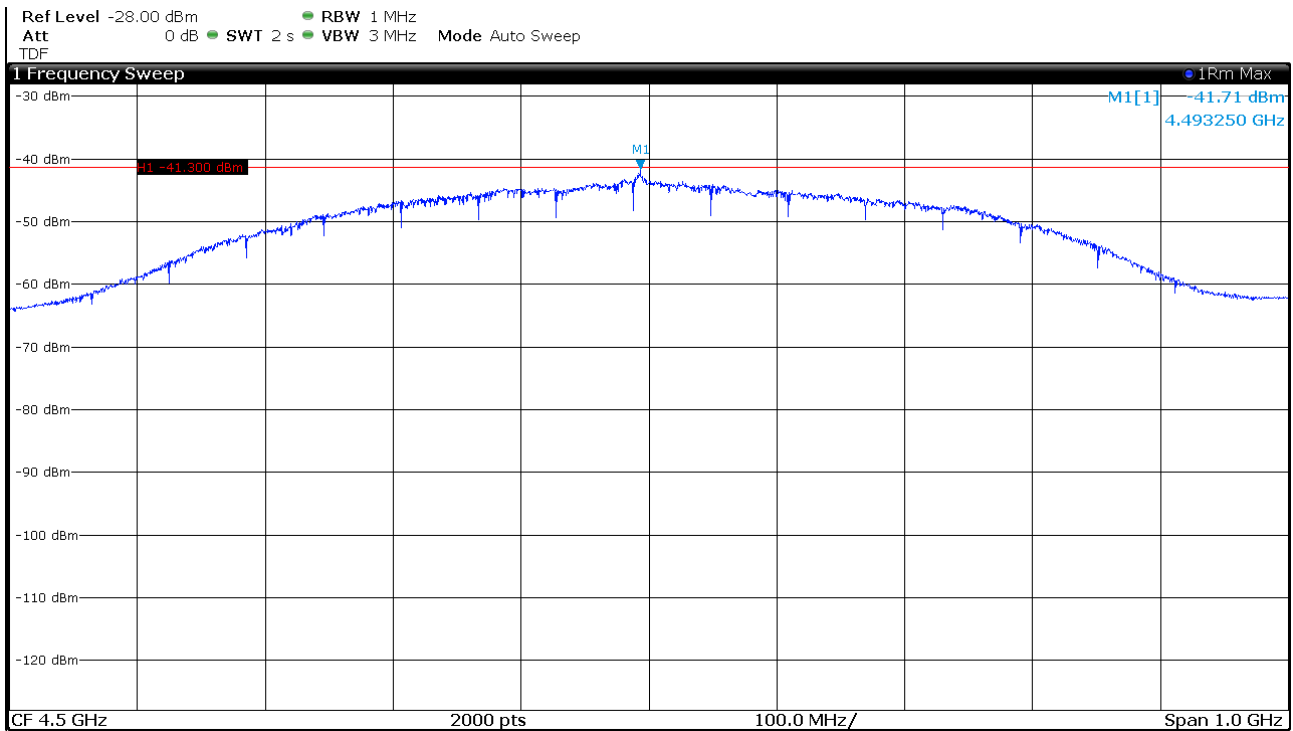
18 GHz to 40 GHz at 30 cm



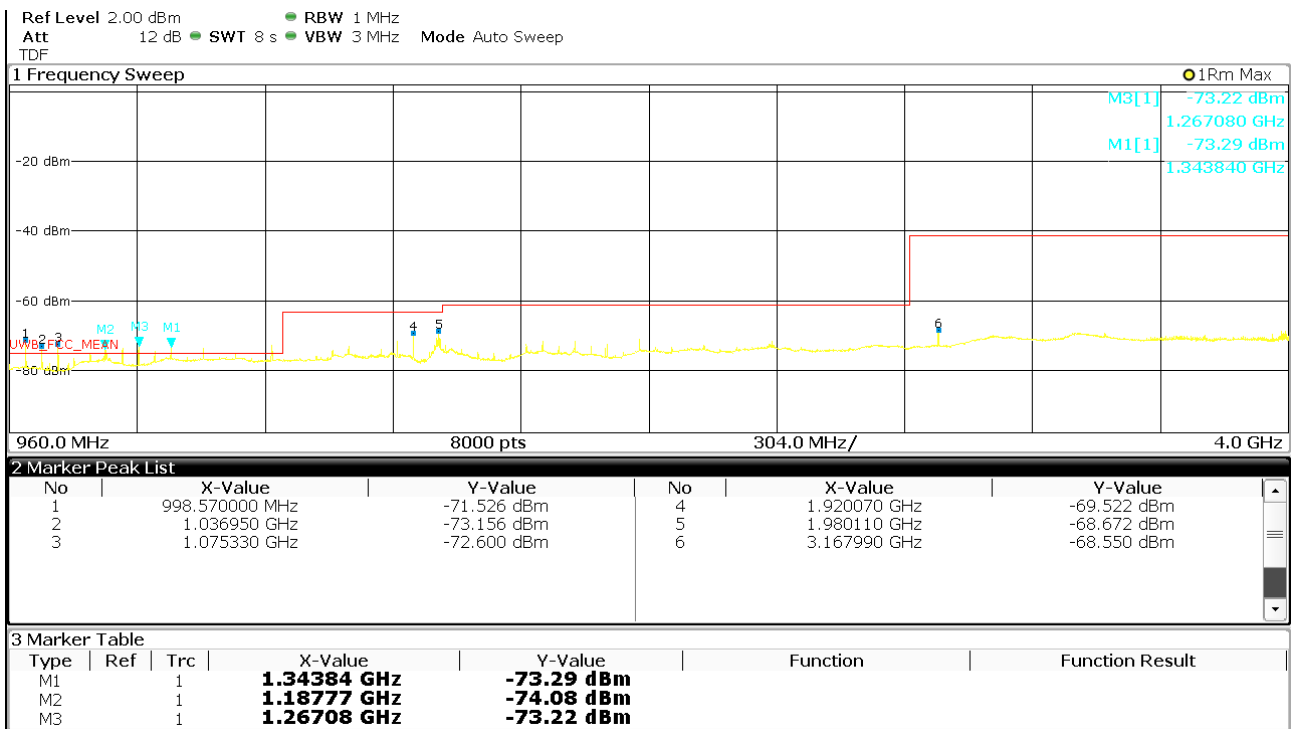
## FCC ID: 2ALC5-KNX-HREC2

### Channel 3:

Mean power:

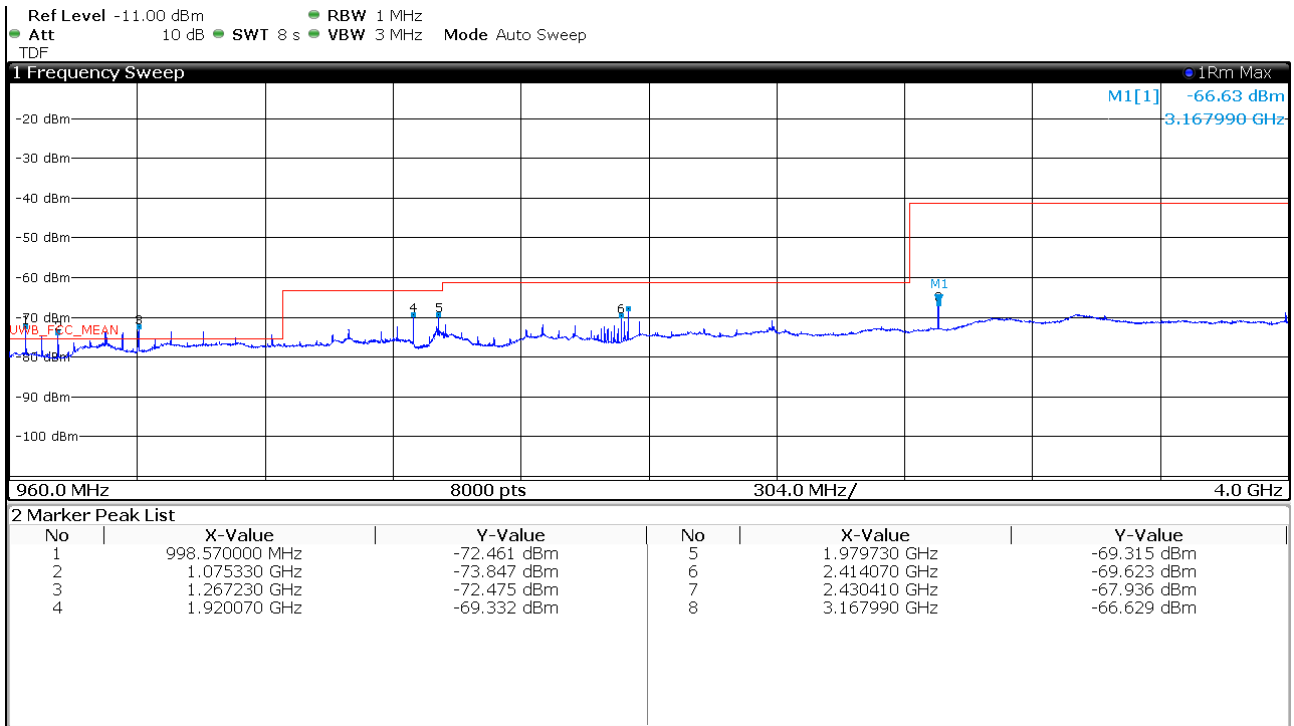


### 960 MHz to 4 GHz



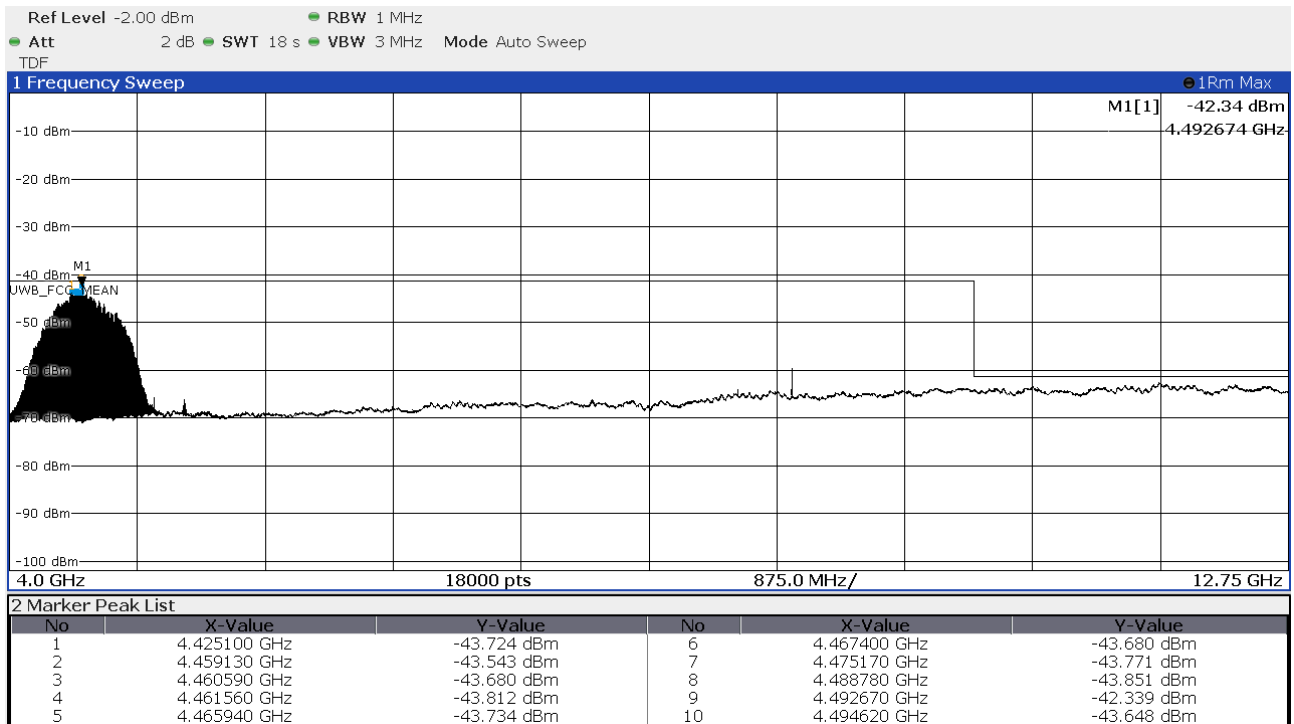
**FCC ID: 2ALC5-KNX-HREC2**

960 MHz to 4 GHz UWB off



Note: The values above the limit line are not belonging to the UWB technology. These values are considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

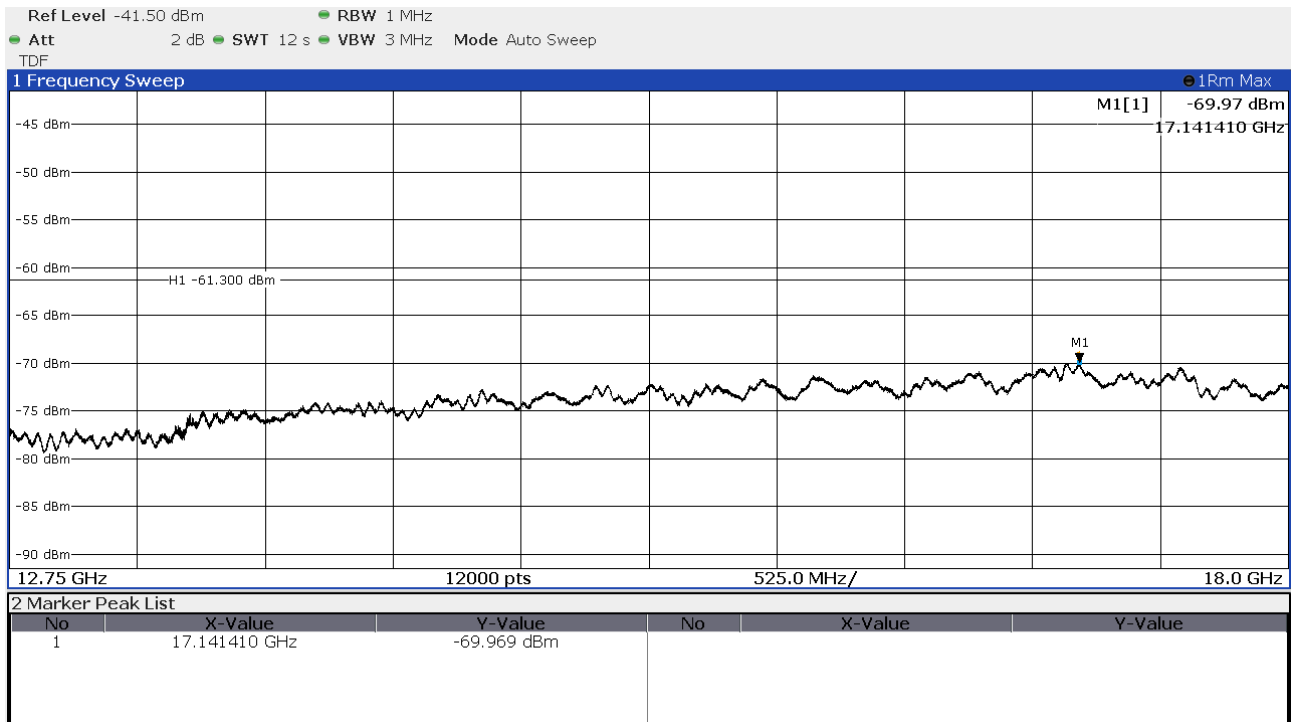
4 GHz to 12.75 GHz



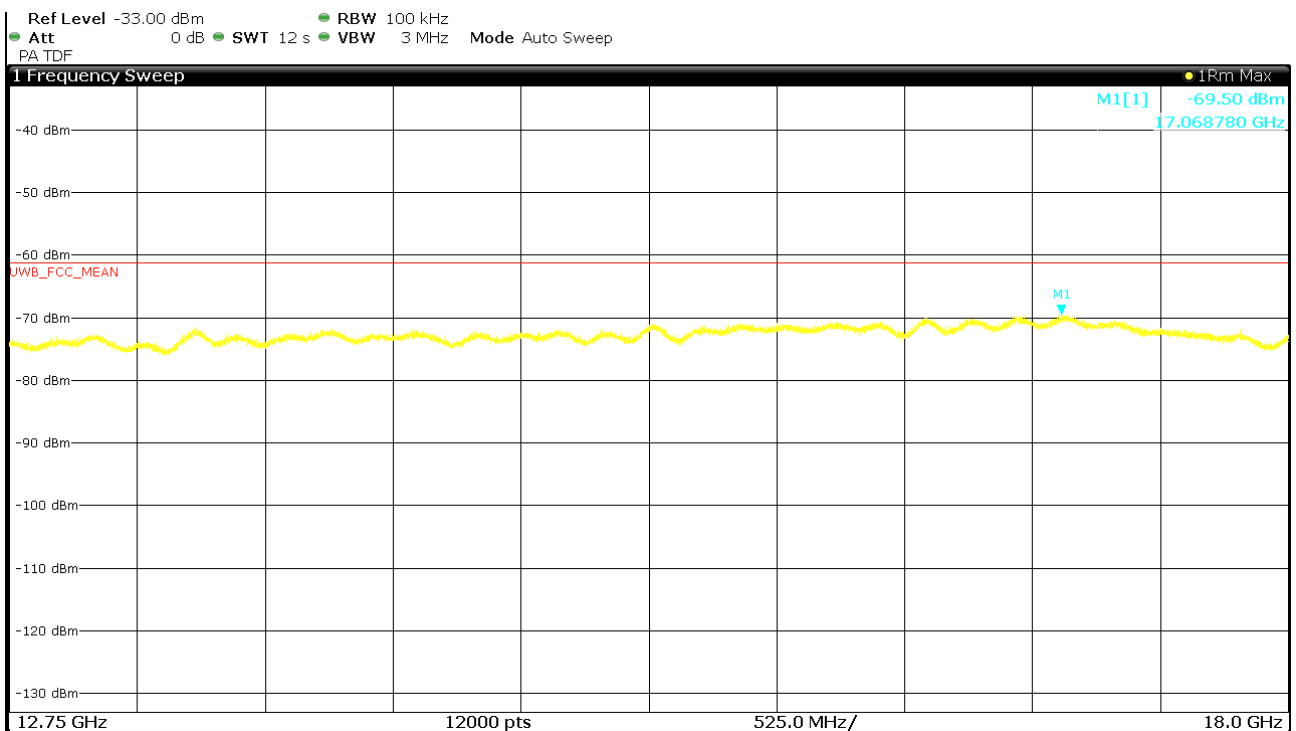


## FCC ID: 2ALC5-KNX-HREC2

12.75 GHz to 18 GHz at 1m



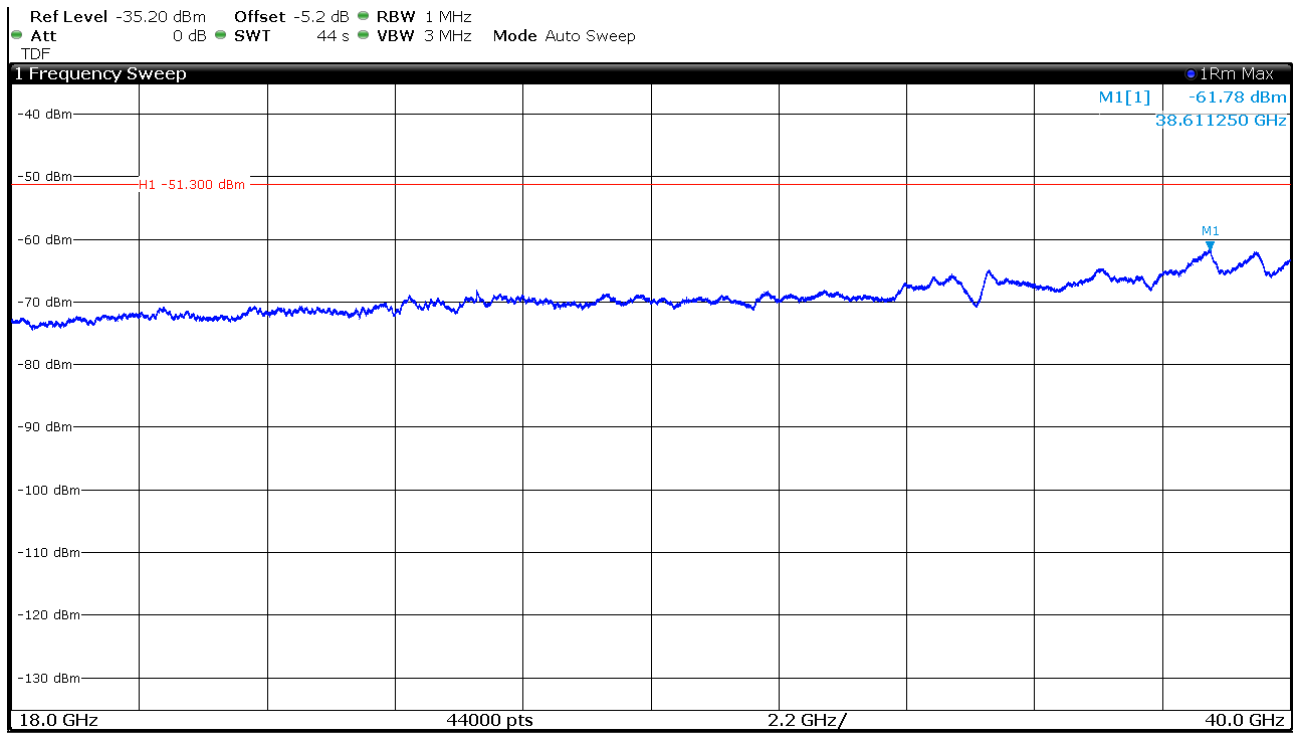
12.75 GHz to 18 GHz with a RBW of 100 kHz at 3 m



Note: the measurement has also been performed with a resolution bandwidth of 100 kHz to reduce the noise floor and to show that there are no emissions of the device.

FCC ID: 2ALC5-KNX-HREC2

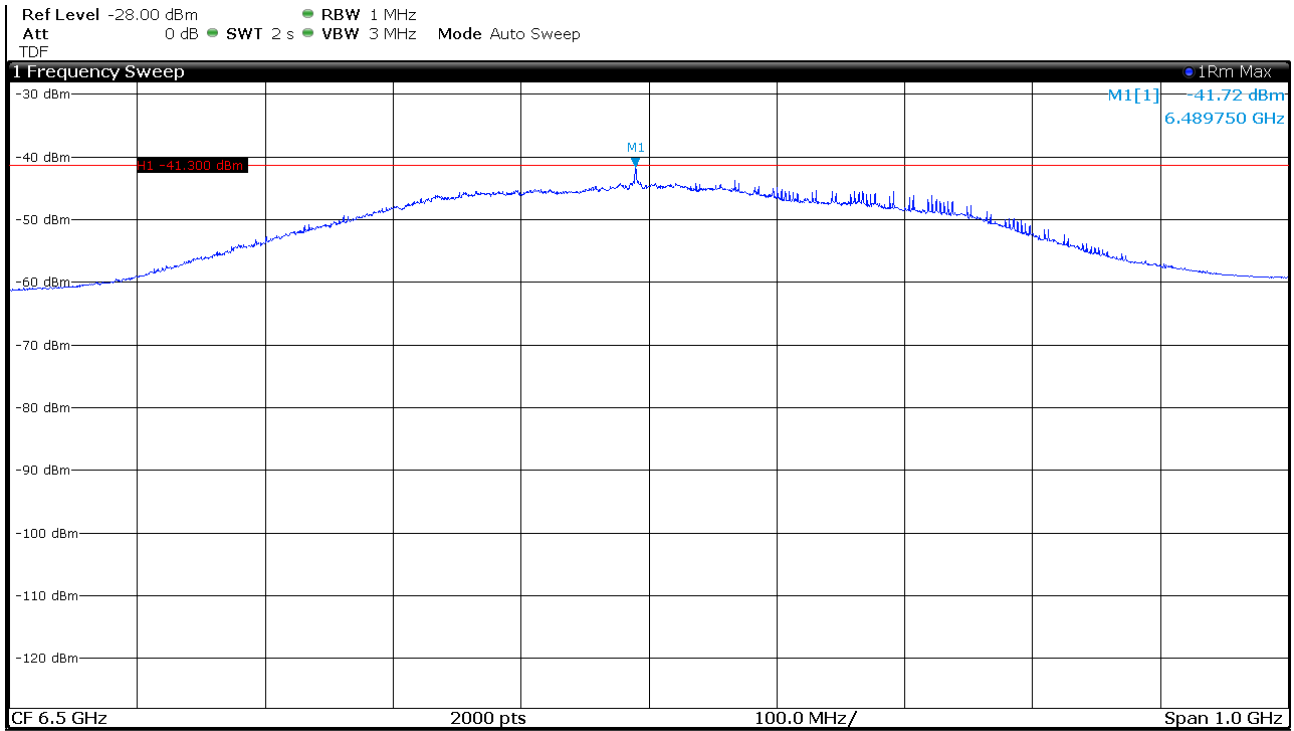
18 GHz to 40 GHz at 30 cm



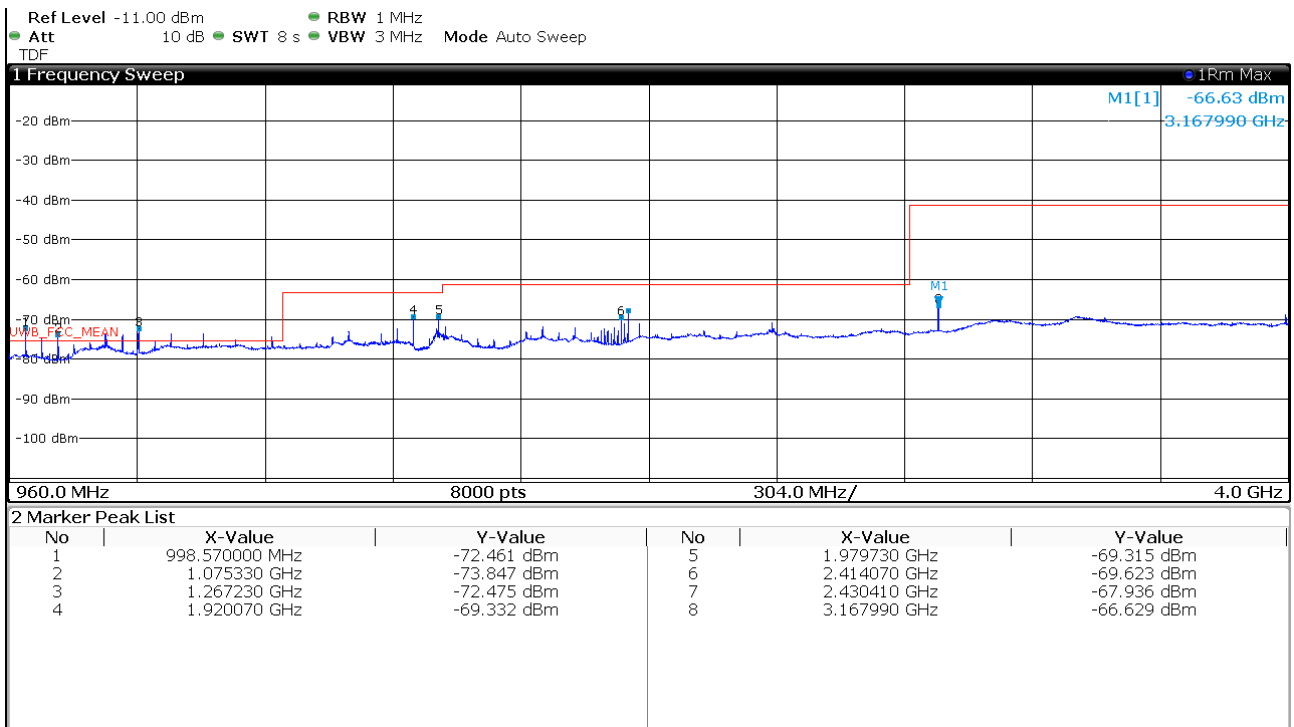
## FCC ID: 2ALC5-KNX-HREC2

### Channel 5:

Mean power:

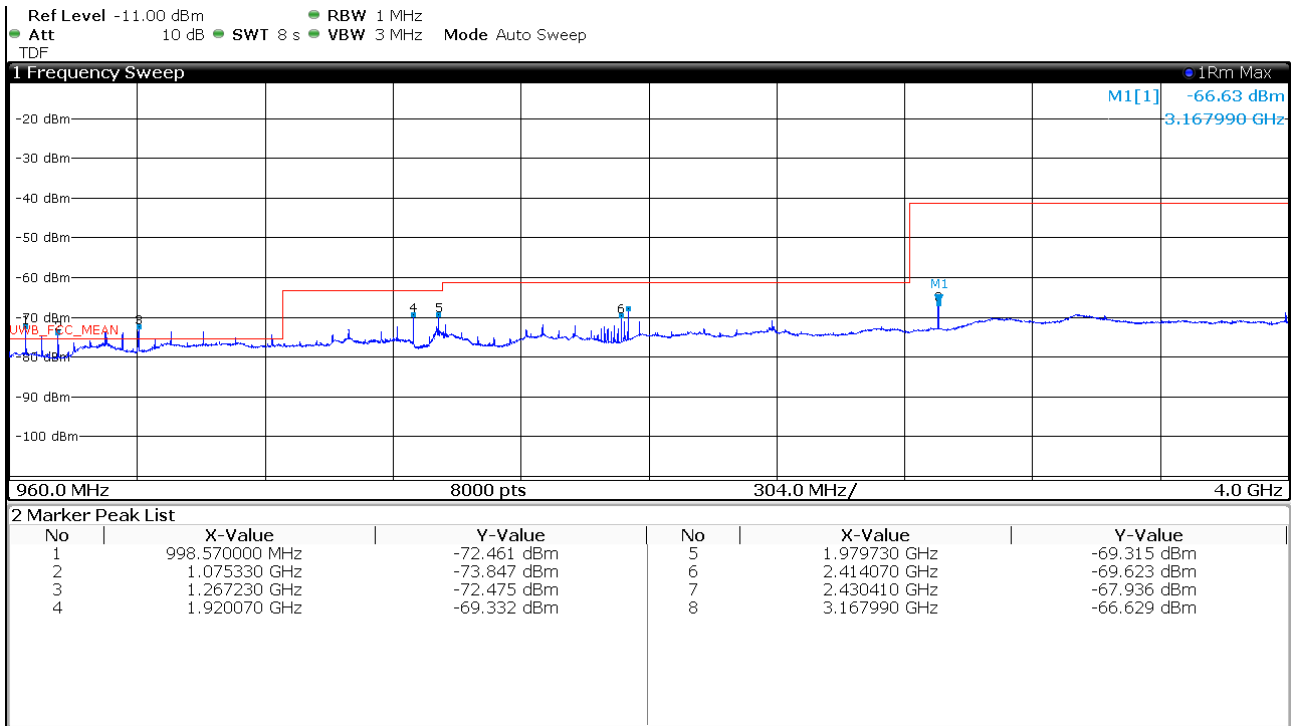


### 960 MHz to 4 GHz



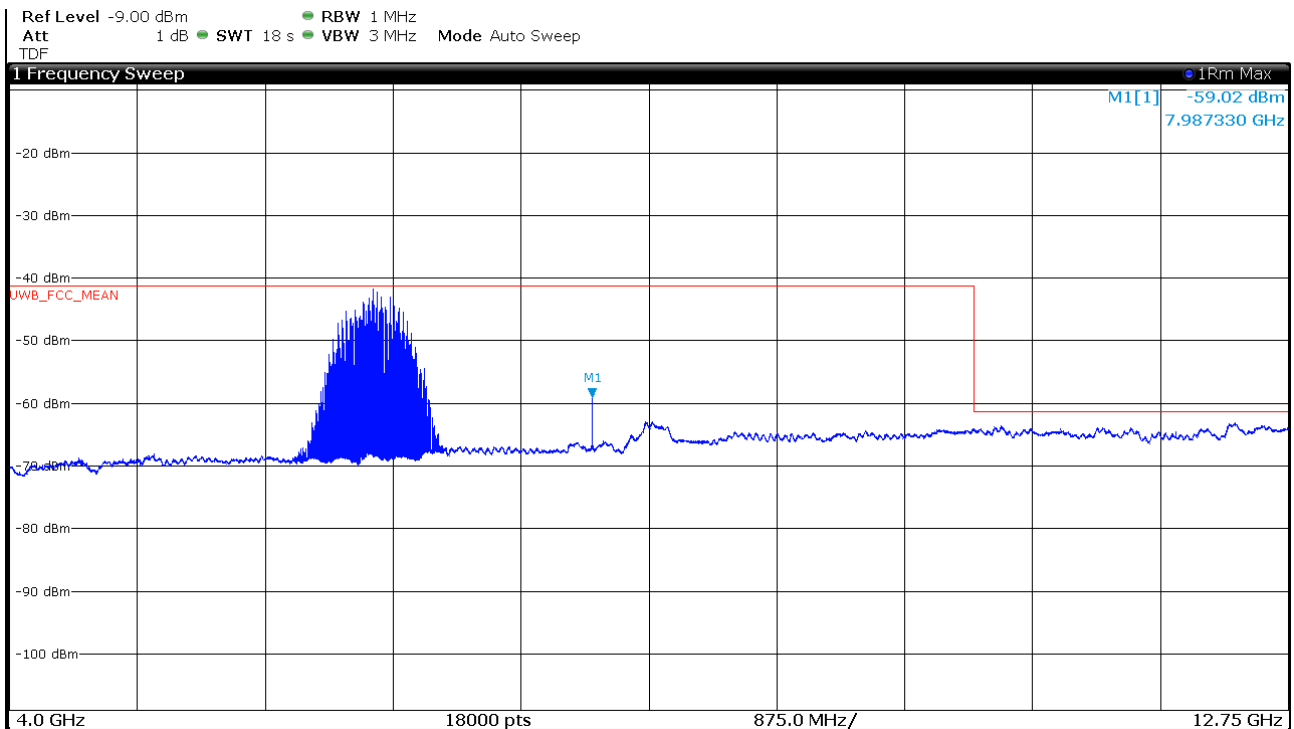
**FCC ID: 2ALC5-KNX-HREC2**

960 MHz to 4 GHz UWB off



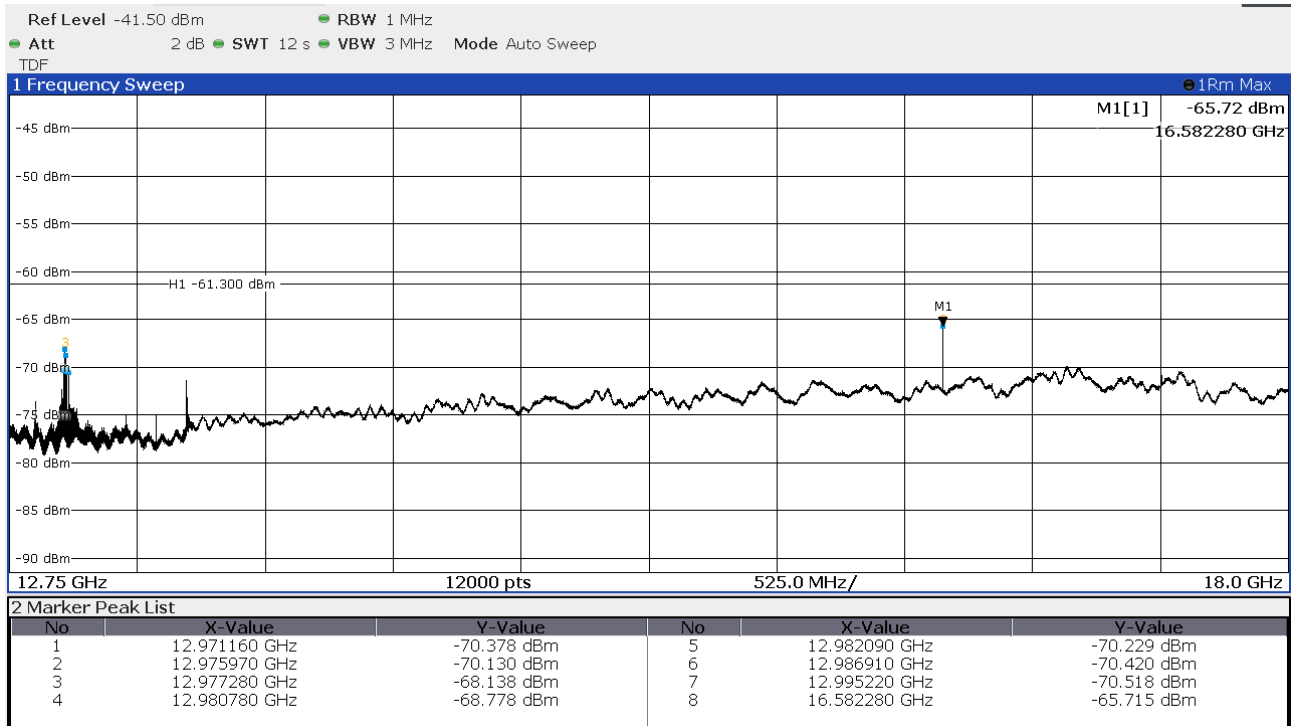
Note: The values above the limit line are not belonging to the UWB technology. These values are considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

4 GHz to 12.75 GHz

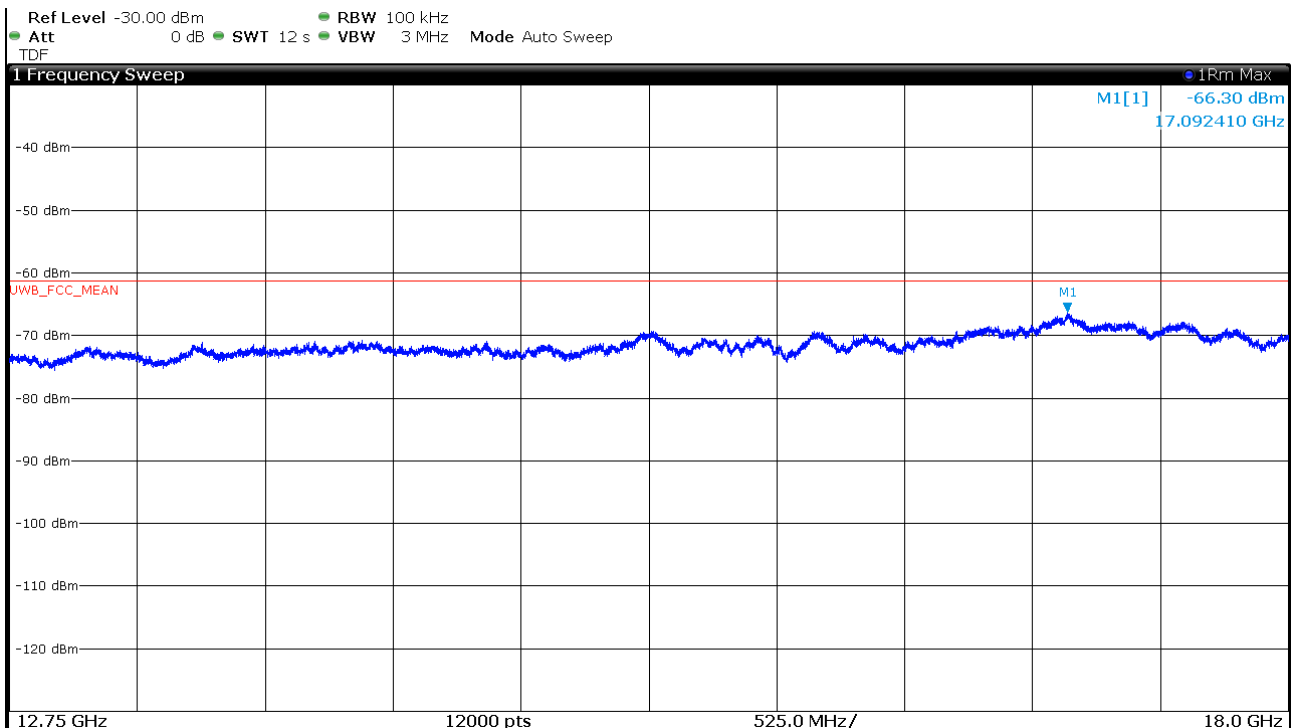


## FCC ID: 2ALC5-KNX-HREC2

12.75 GHz to 18 GHz at 1 m



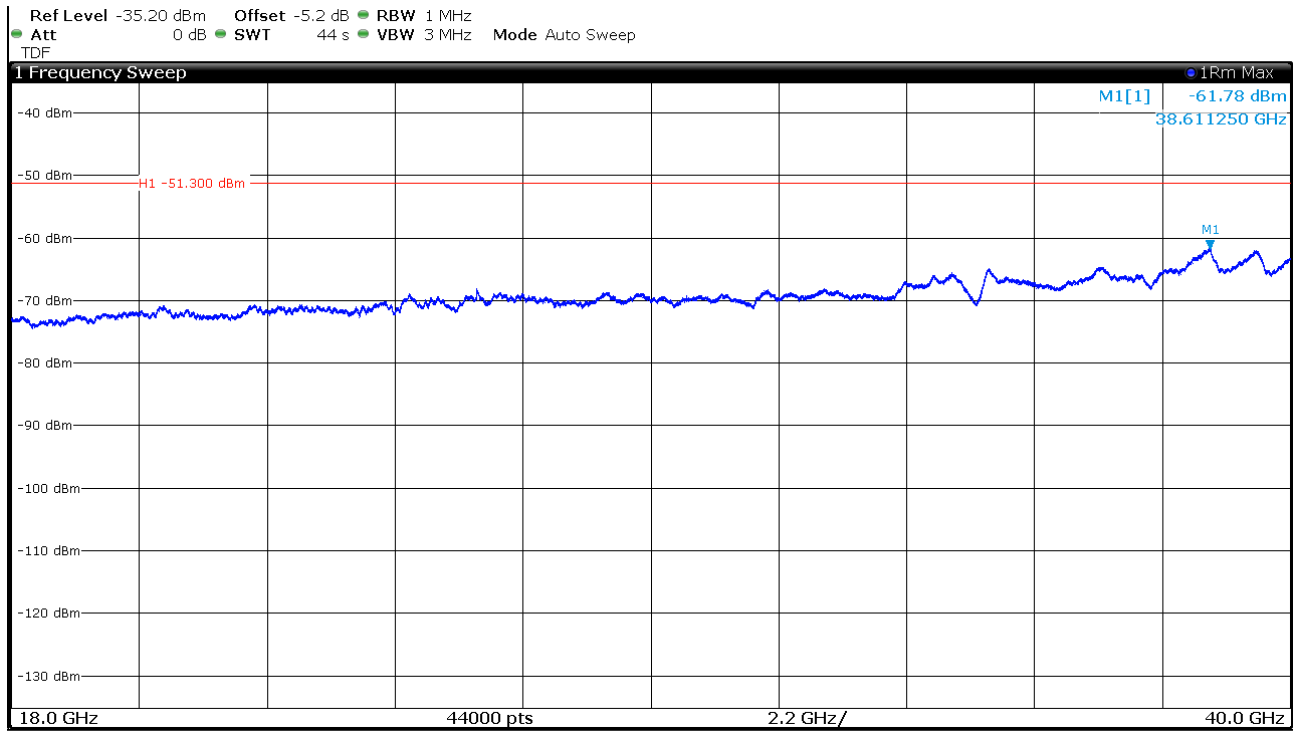
12.75 GHz to 18 GHz with a RBW of 100 kHz at 3 m



Note: the measurement has also been performed with a resolution bandwidth of 100 kHz to reduce the noise floor and to show that there are no emissions of the device.

FCC ID: 2ALC5-KNX-HREC2

18 GHz to 40 GHz at 30 cm



**FCC ID: 2ALC5-KNX-HREC2**
**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 §15.519(c) 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
3100-10600	-41.3
Above 10600	-61.3

The requirements are **FULFILLED**.

**Remarks:** This test was performed with the sample 36158.

## FCC ID: 2ALC5-KNX-HREC2

### 5.4 Radiated Emissions at 1164-1240 MHz and 1559-1610 MHz

For test instruments and accessories used see section 6 Part **SER 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 15.519(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.

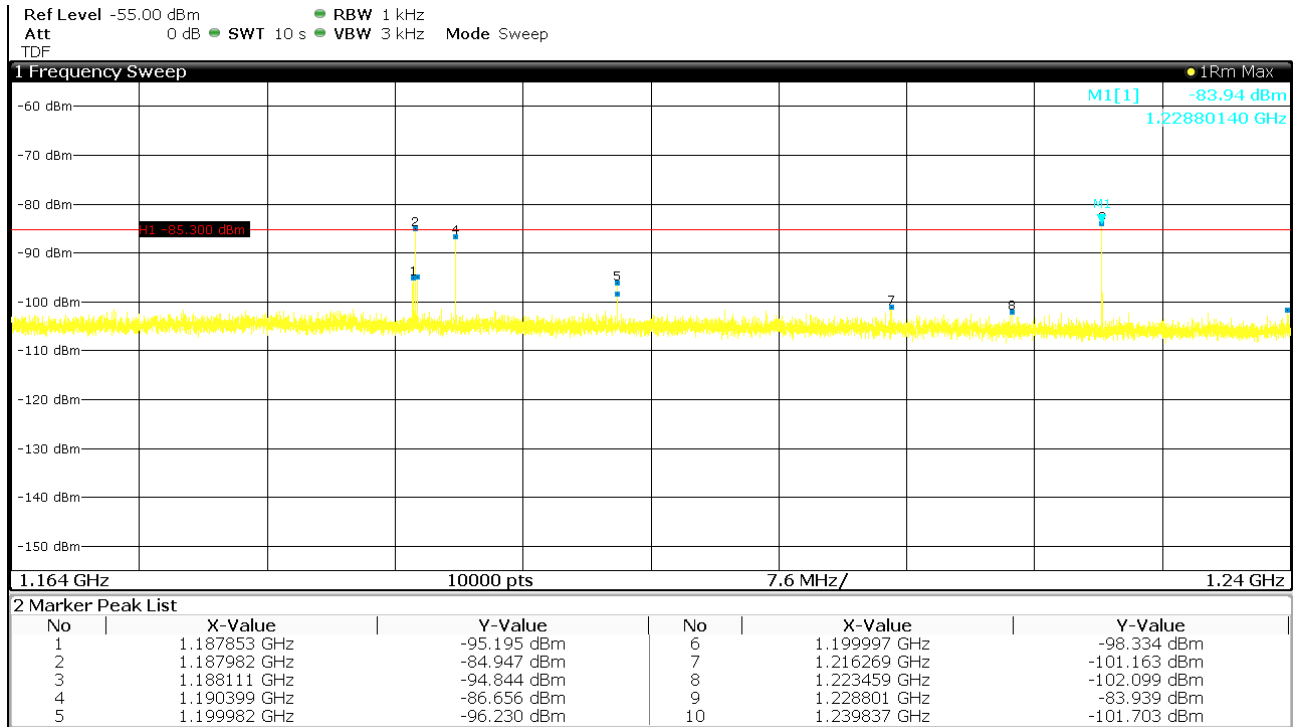
#### 5.4.4 Analyser settings

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

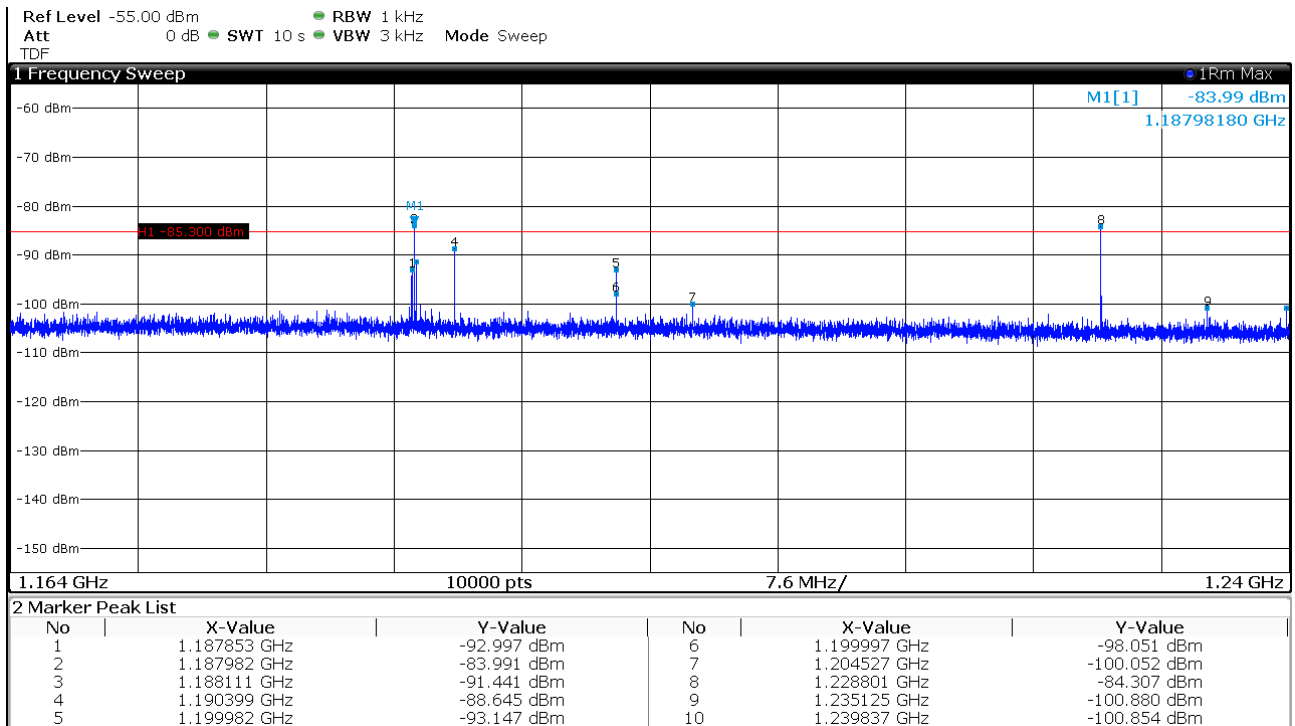


**FCC ID: 2ALC5-KNX-HREC2**
**5.4.5 Test result**
**Channel 1:**

1164 MHz to 1240 MHz



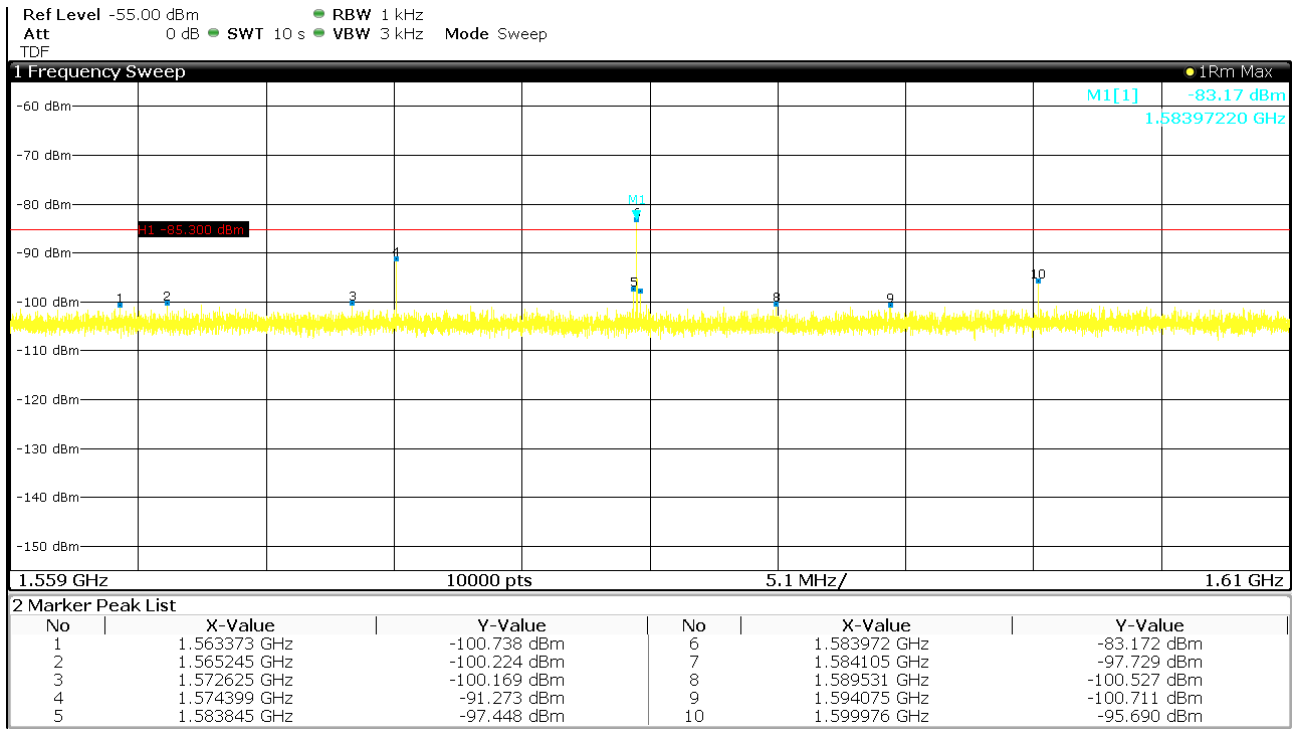
1164 MHz to 1240 MHz UWB off



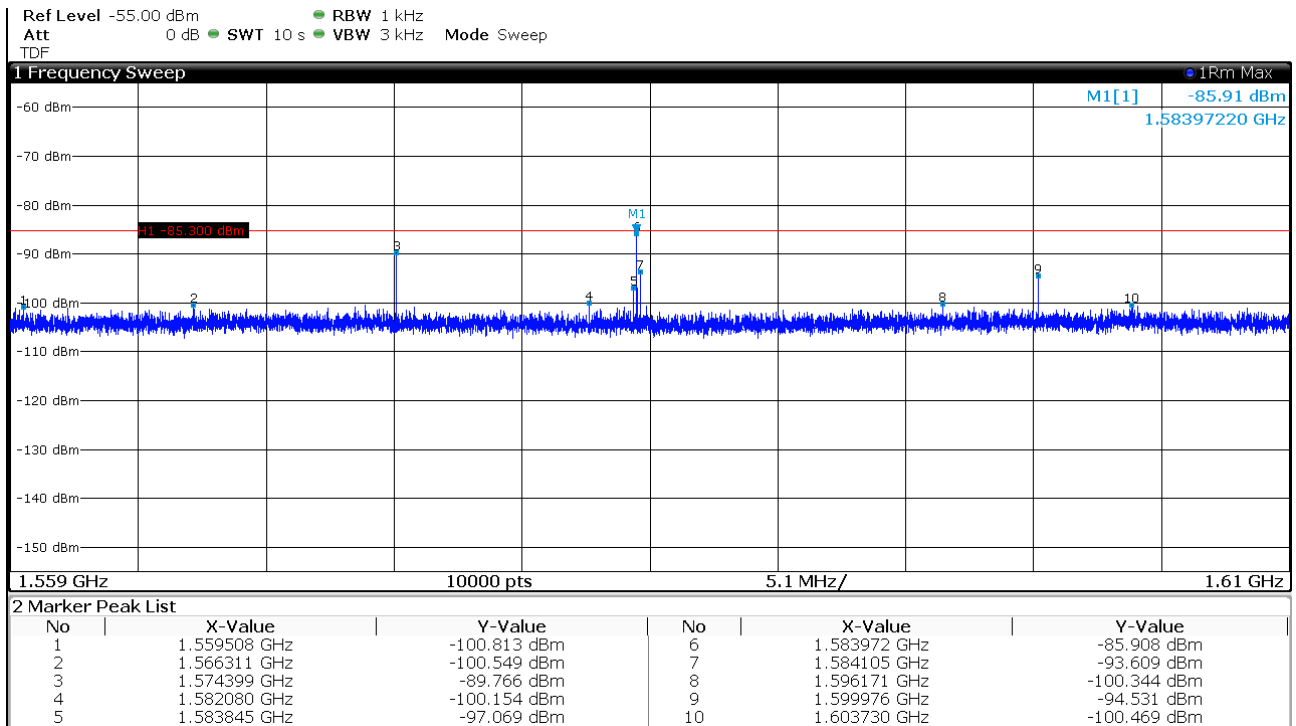
Note: The value above the limit line is not belonging to the UWB technology. This value is considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

**FCC ID: 2ALC5-KNX-HREC2**

1559 MHz to 1610 MHz



1559 MHz to 1610 MHz UWB off

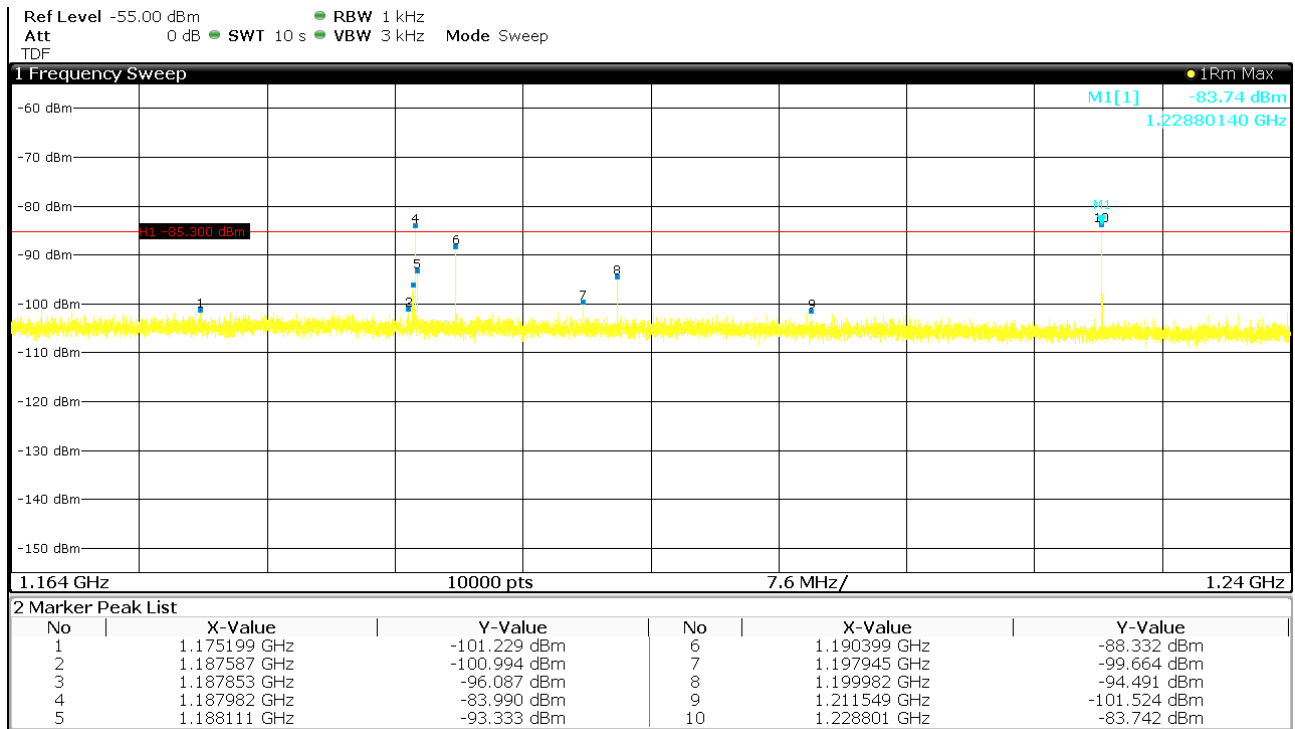


Note: The value above the limit line is not belonging to the UWB technology. This value is considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

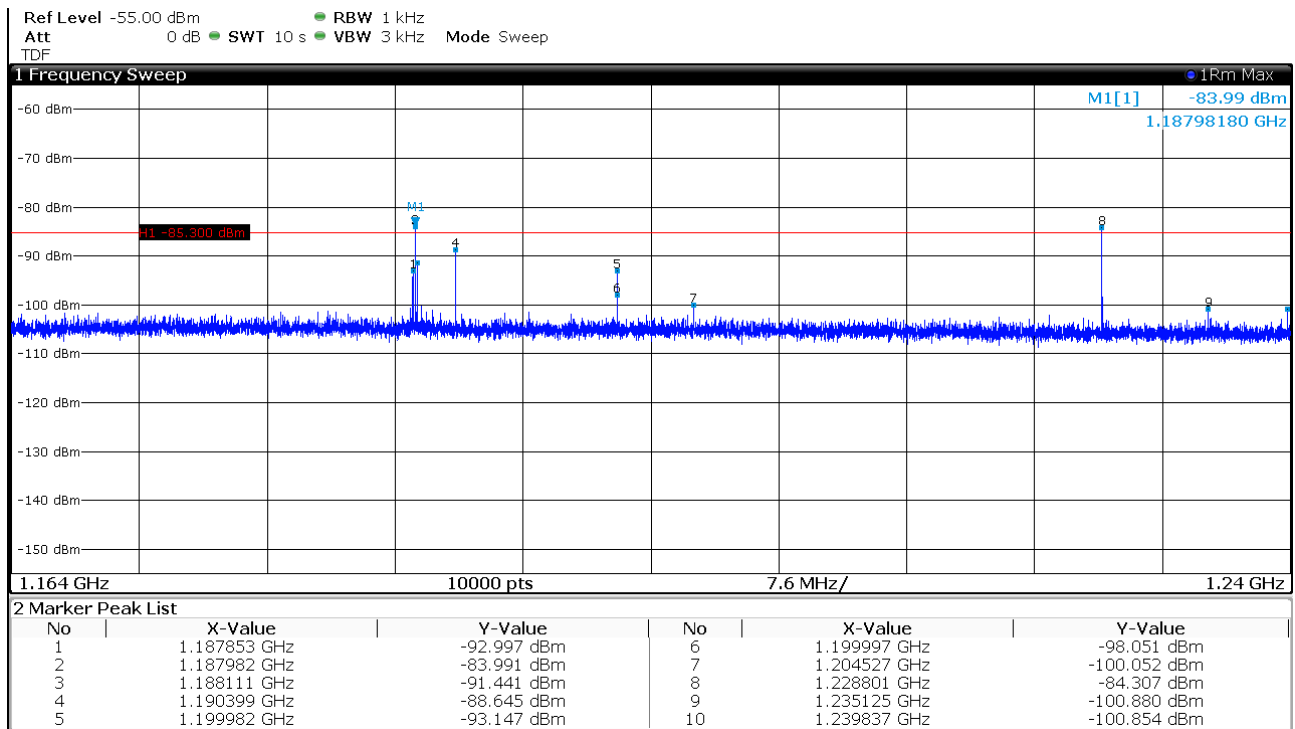
FCC ID: 2ALC5-KNX-HREC2

Channel 2:

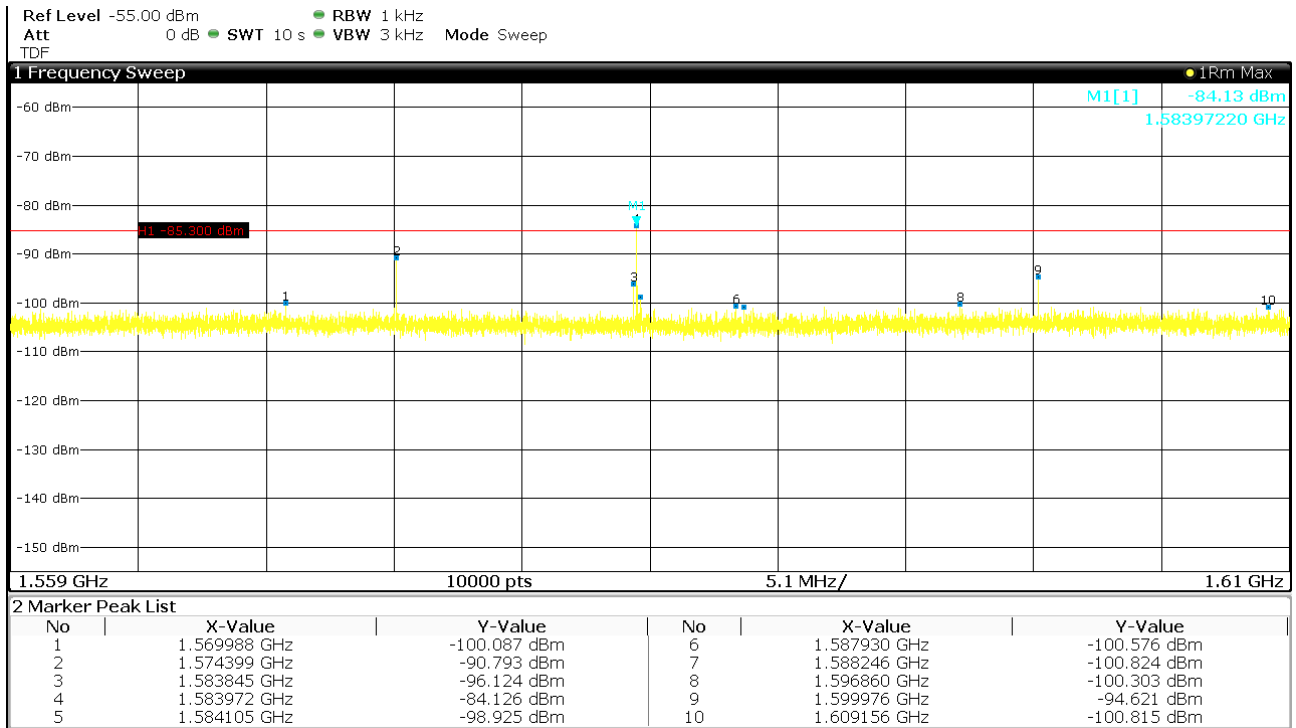
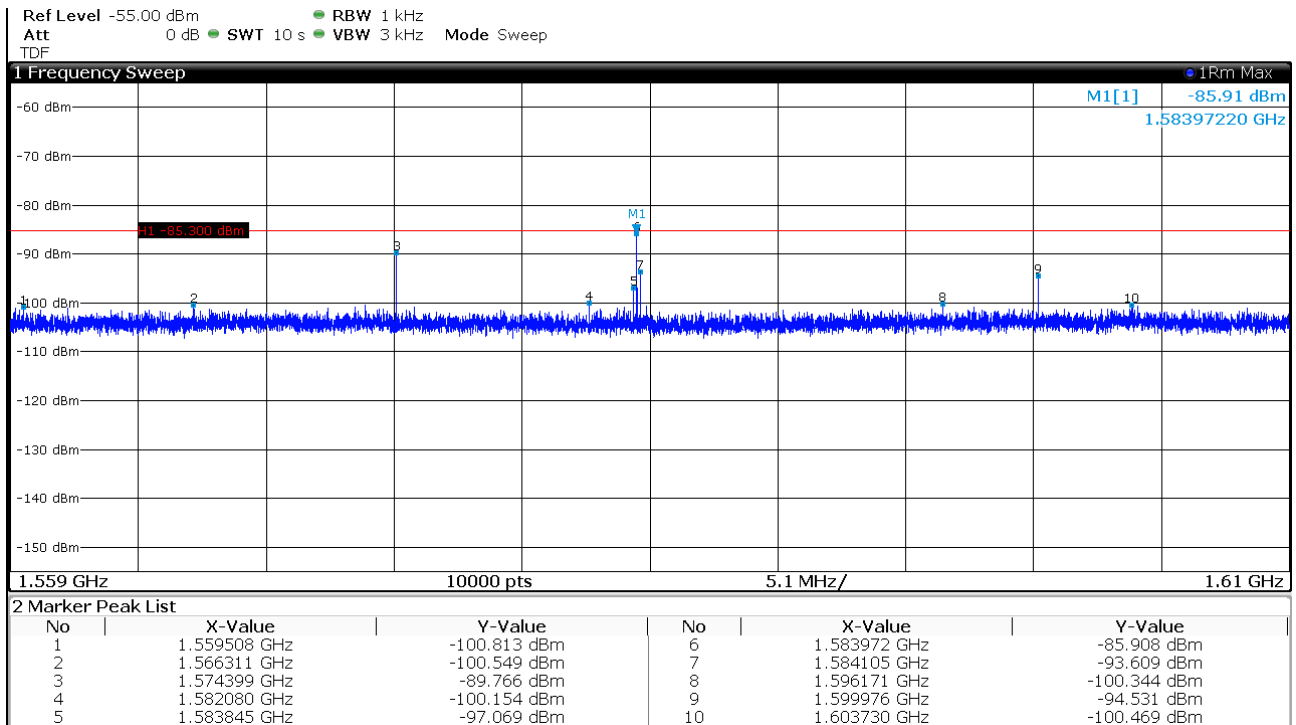
1164 MHz to 1240 MHz



1164 MHz to 1240 MHz UWB off



Note: The value above the limit line is not belonging to the UWB technology. This value is considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

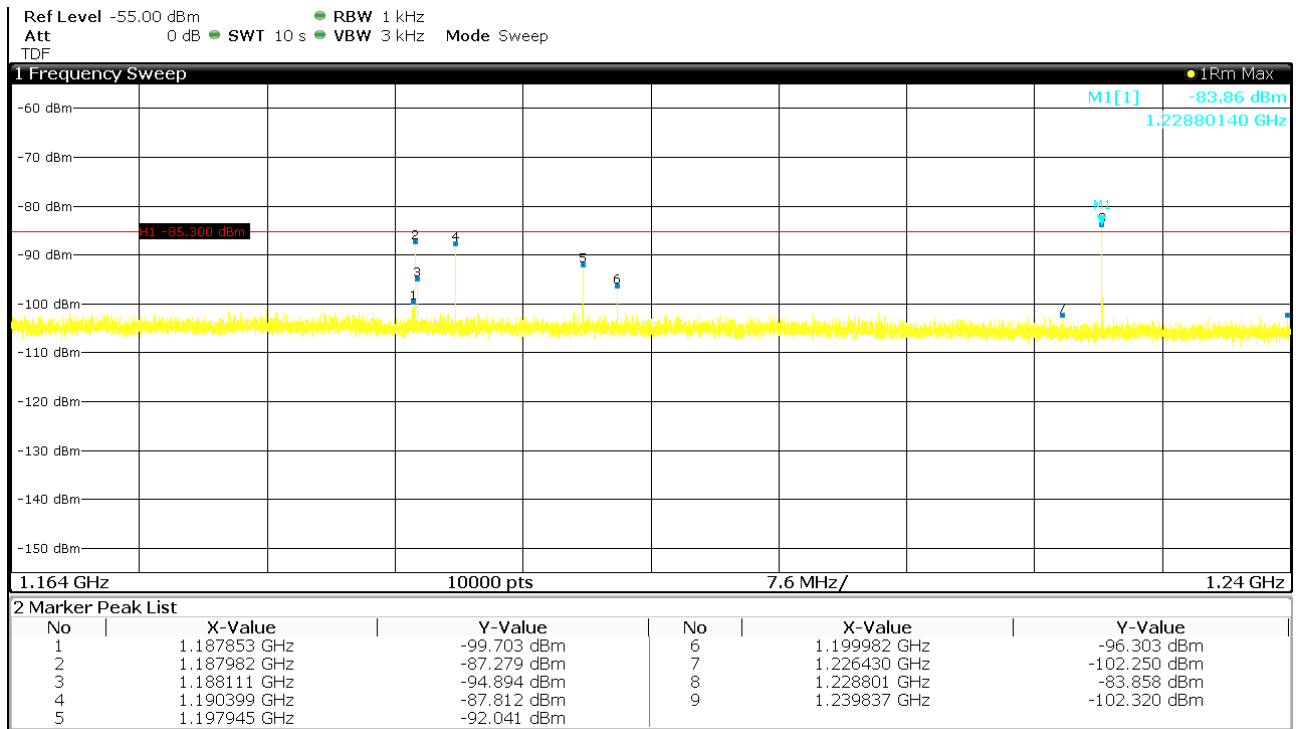
**FCC ID: 2ALC5-KNX-HREC2**
**1559 MHz to 1610 MHz**

**1559 MHz to 1610 MHz UWB off**


Note: The value above the limit line is not belonging to the UWB technology. This value is considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

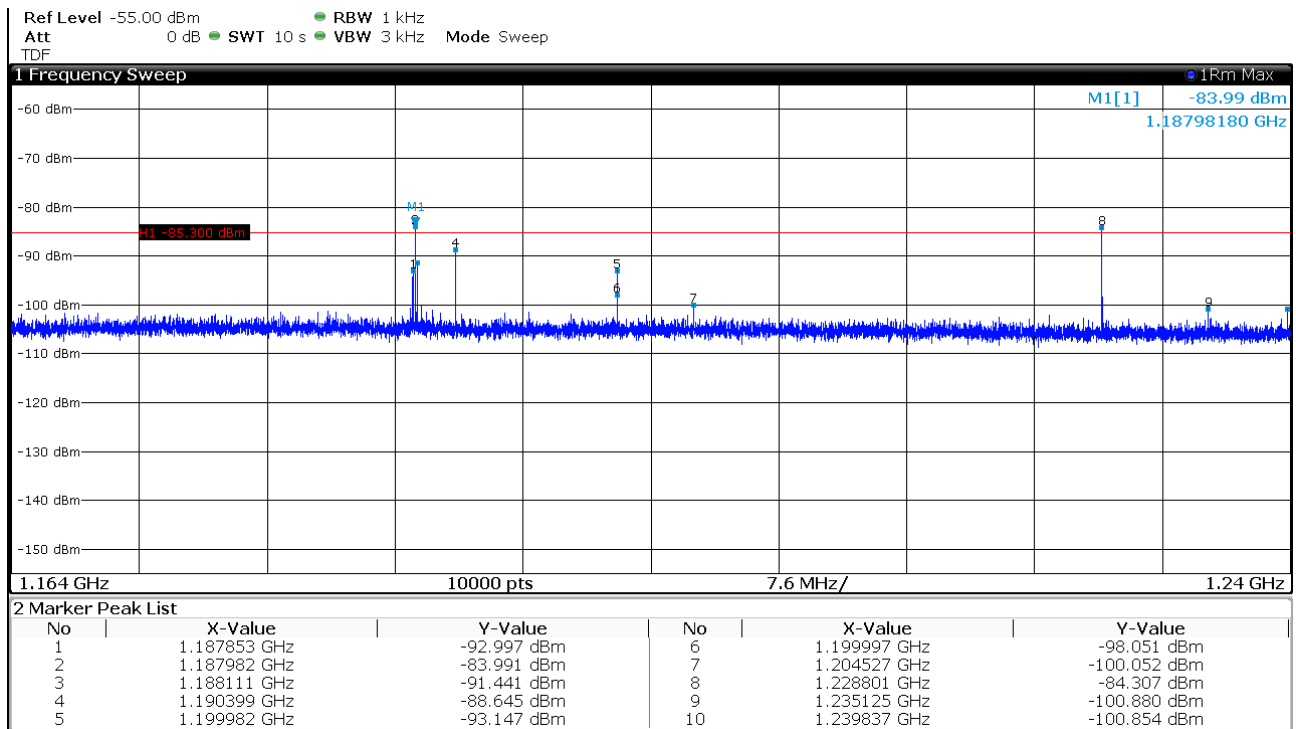
FCC ID: 2ALC5-KNX-HREC2

Channel 3:

1164 MHz to 1240 MHz



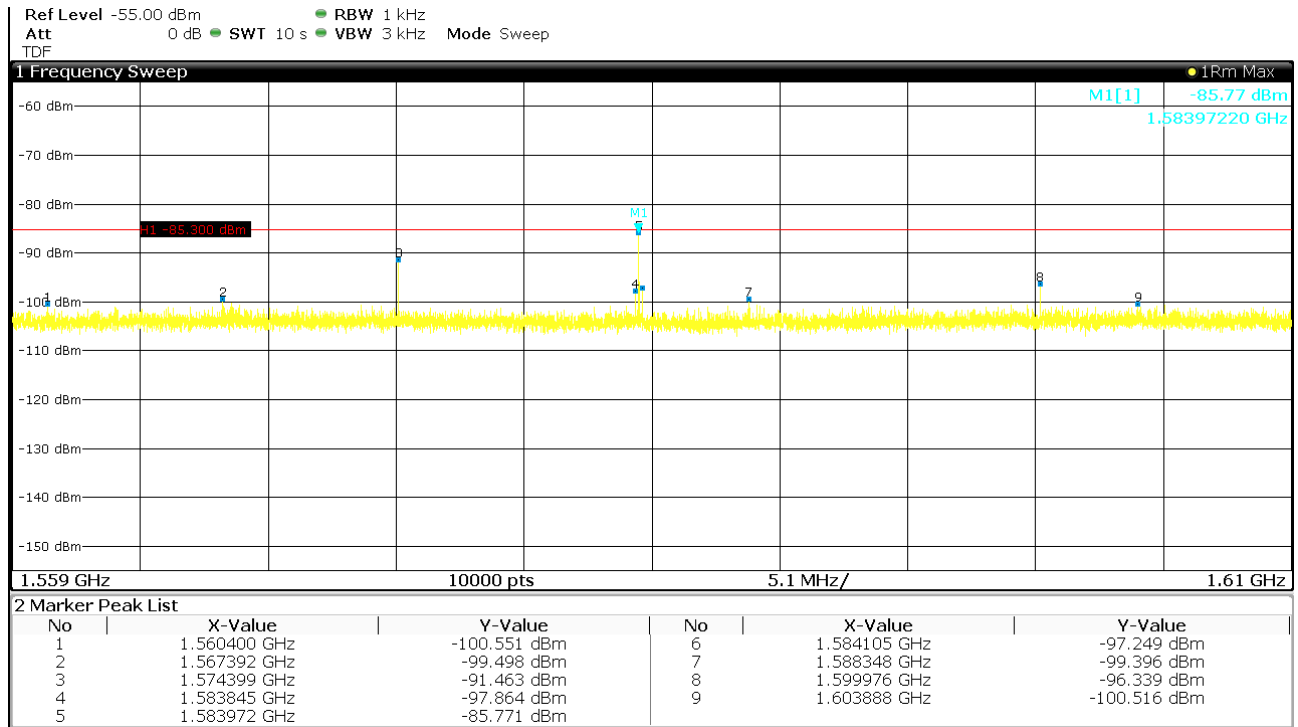
1164 MHz to 1240 MHz UWB off



Note: The value above the limit line is not belonging to the UWB technology. This value is considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

## FCC ID: 2ALC5-KNX-HREC2

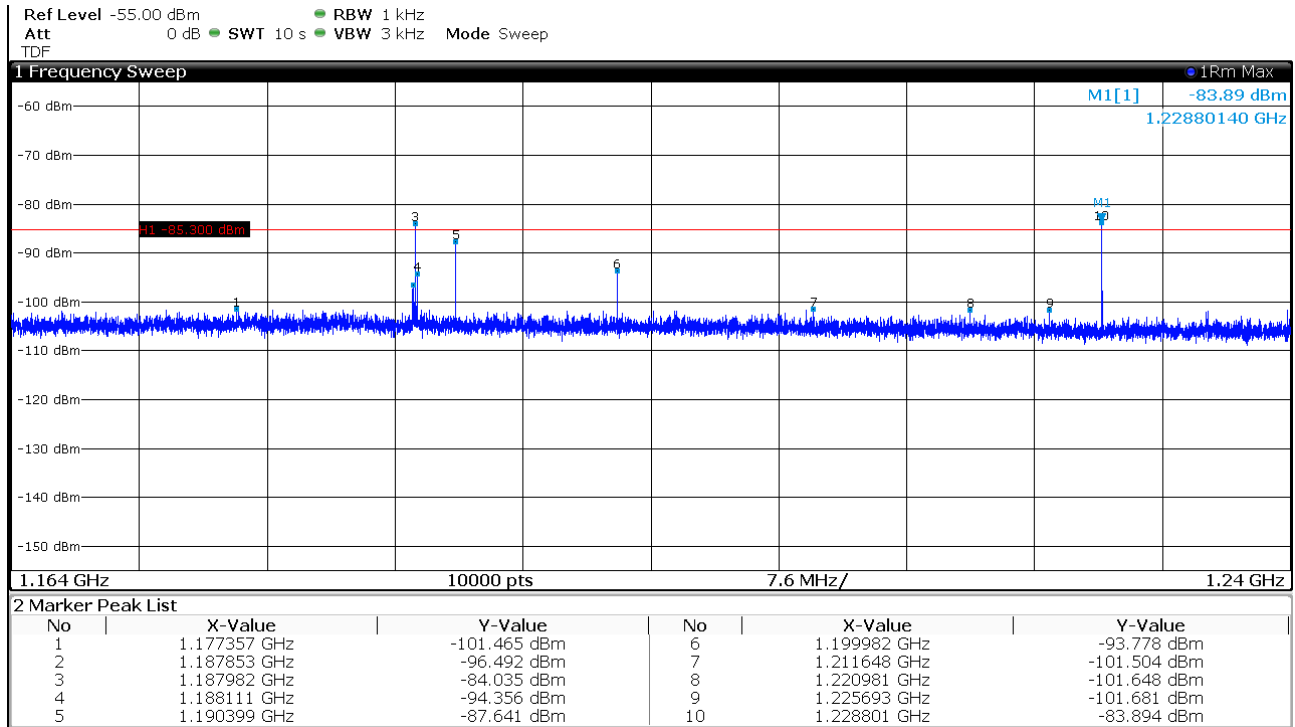
1559 MHz to 1610 MHz



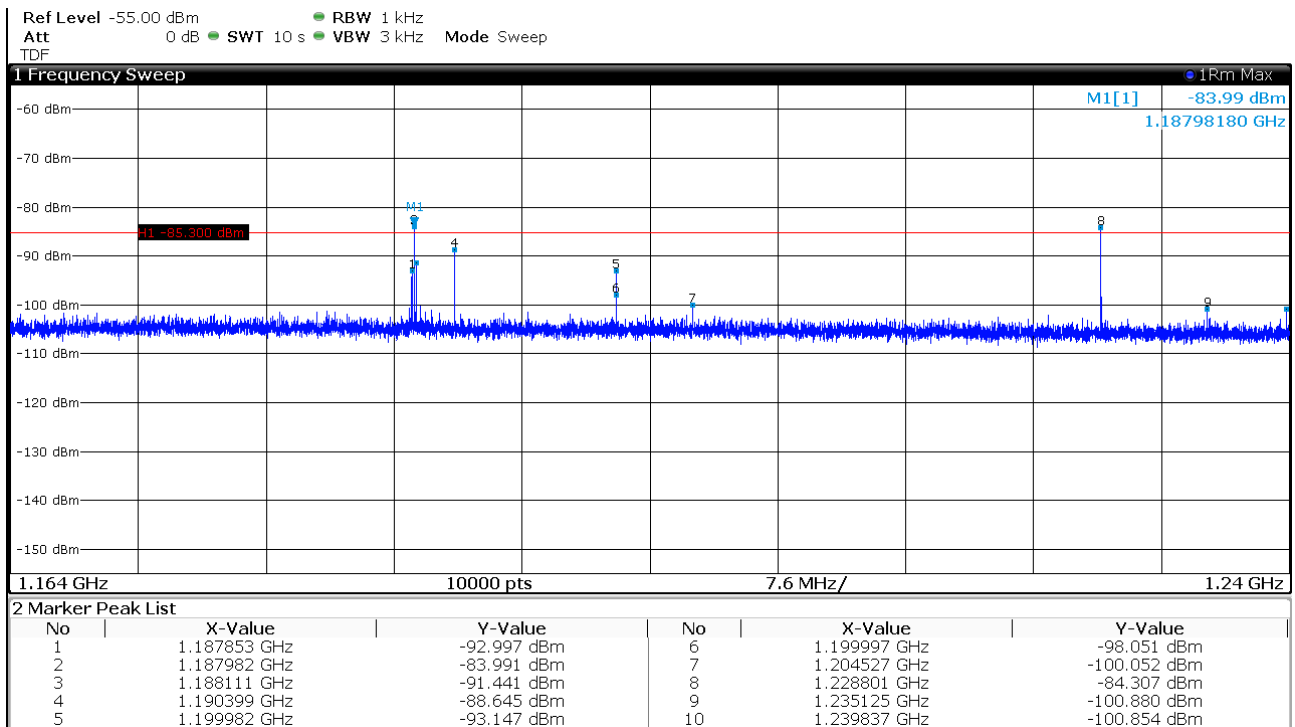
FCC ID: 2ALC5-KNX-HREC2

Channel 5:

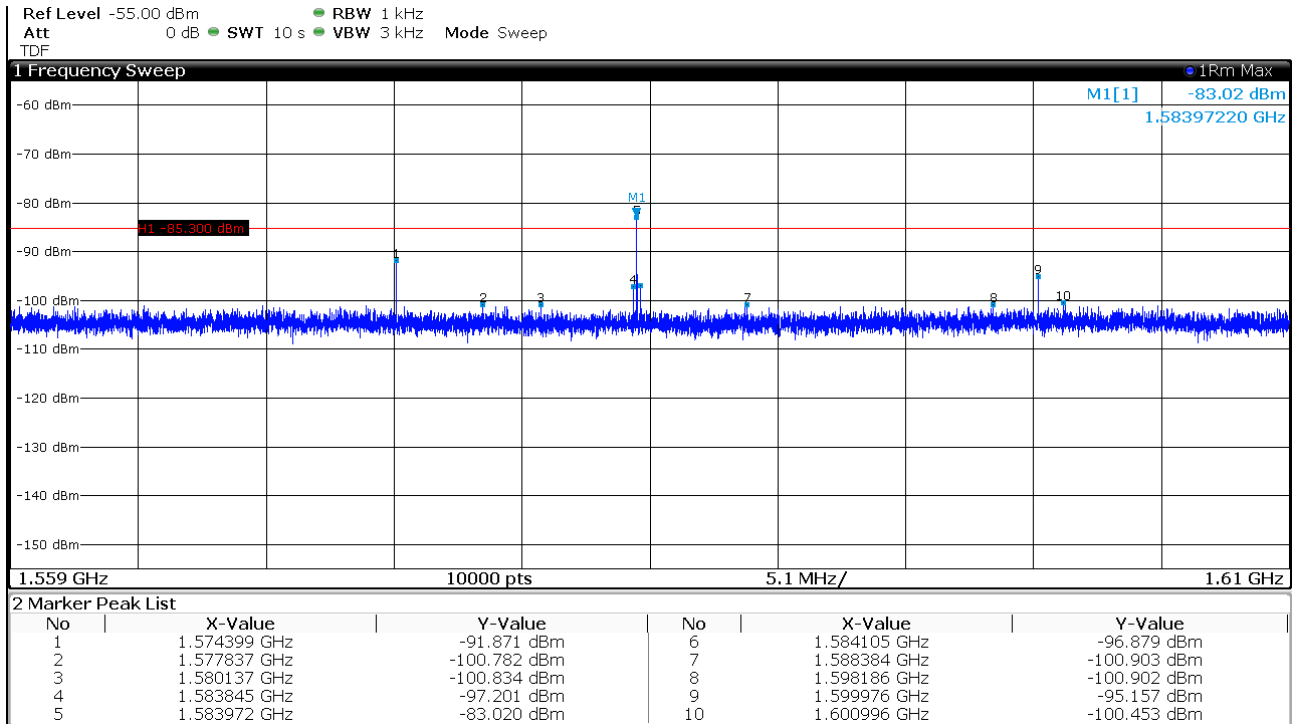
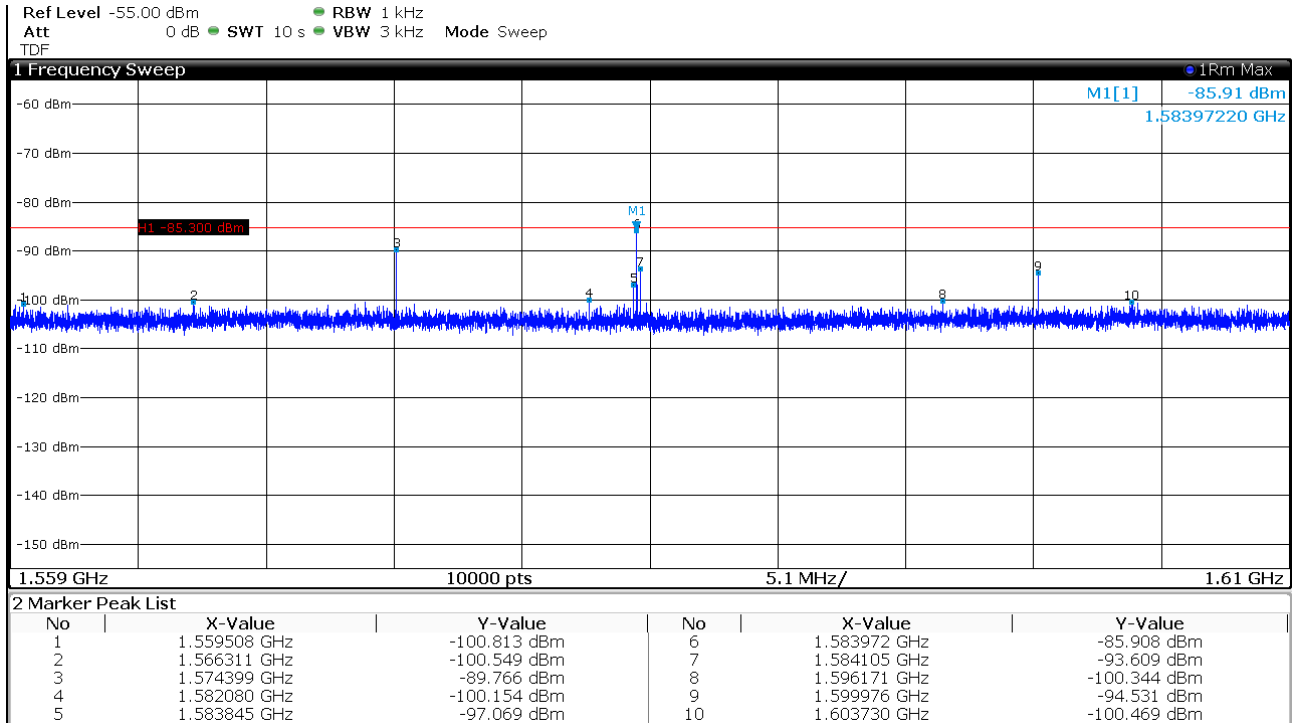
1164 MHz to 1240 MHz



1164 MHz to 1240 MHz UWB off



Note: The value above the limit line is not belonging to the UWB technology. This value is considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.

**FCC ID: 2ALC5-KNX-HREC2**
**1559 MHz to 1610 MHz**

**1559 MHz to 1610 MHz UWB off**


Note: The value above the limit line is not belonging to the UWB technology. This value is considered in the test report T44481-00-07KS of the test laboratory CSA Group Bayern GmbH.



**FCC ID: 2ALC5-KNX-HREC2**

Limit according §15.519(c) in the frequency

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

The requirements are **FULFILLED**.

**Remarks:** This test was performed with the sample 36158.

\_\_\_\_\_

**FCC ID: 2ALC5-KNX-HREC2****5.5 Peak Power radiated**

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

**5.5.1 Description of the test location**

Test location: Anechoic chamber 1

**5.5.2 Photo documentation of the test set-up****5.5.3 Applicable standard**

According to FCC Part 15, Section 15.519(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,  $f_m$ . 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.

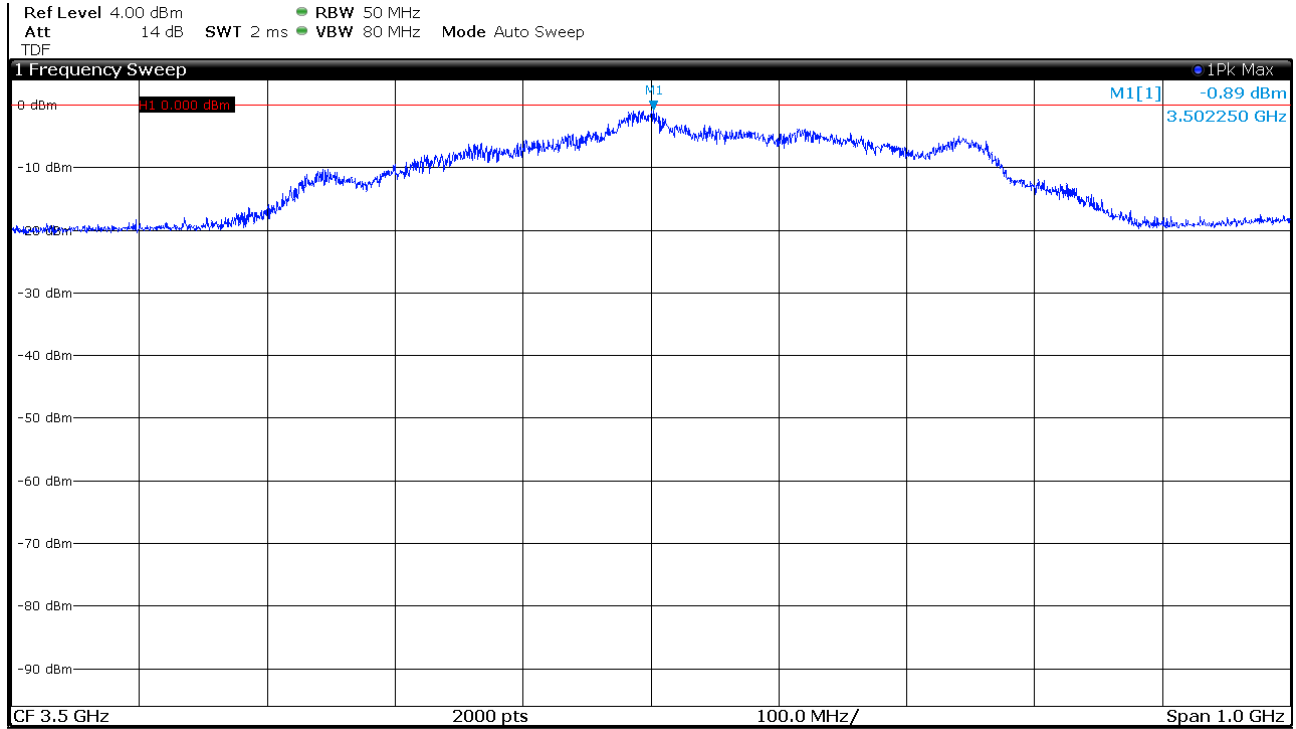
**5.5.4 Analyser settings**

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

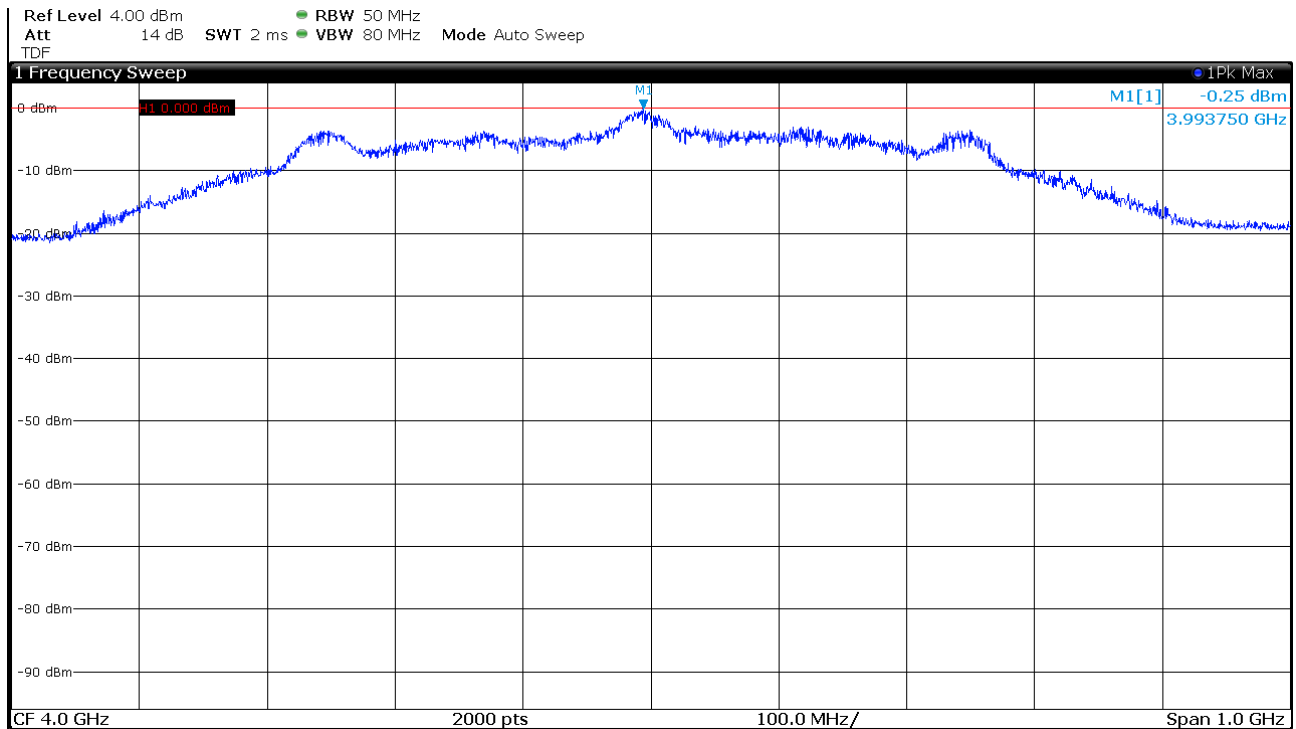
## FCC ID: 2ALC5-KNX-HREC2

### 5.5.5 Test result

#### Channel 1:

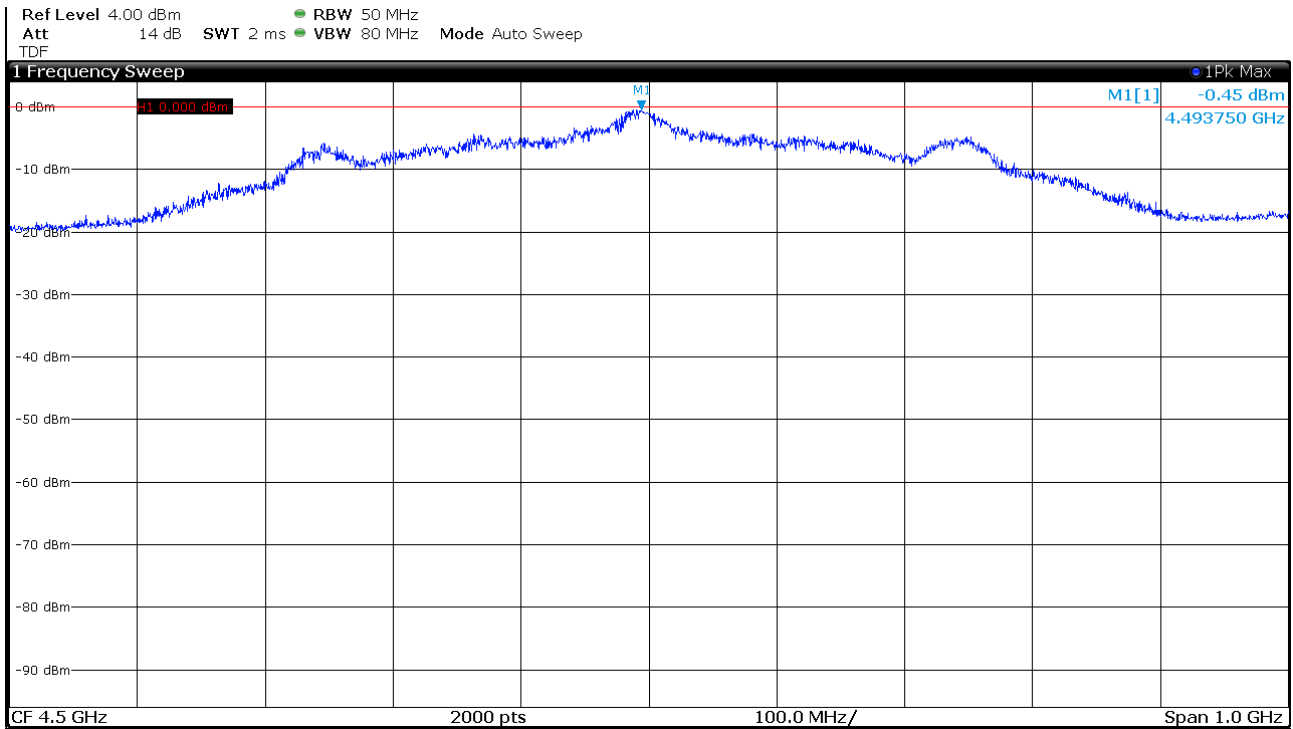


#### Channel 2:

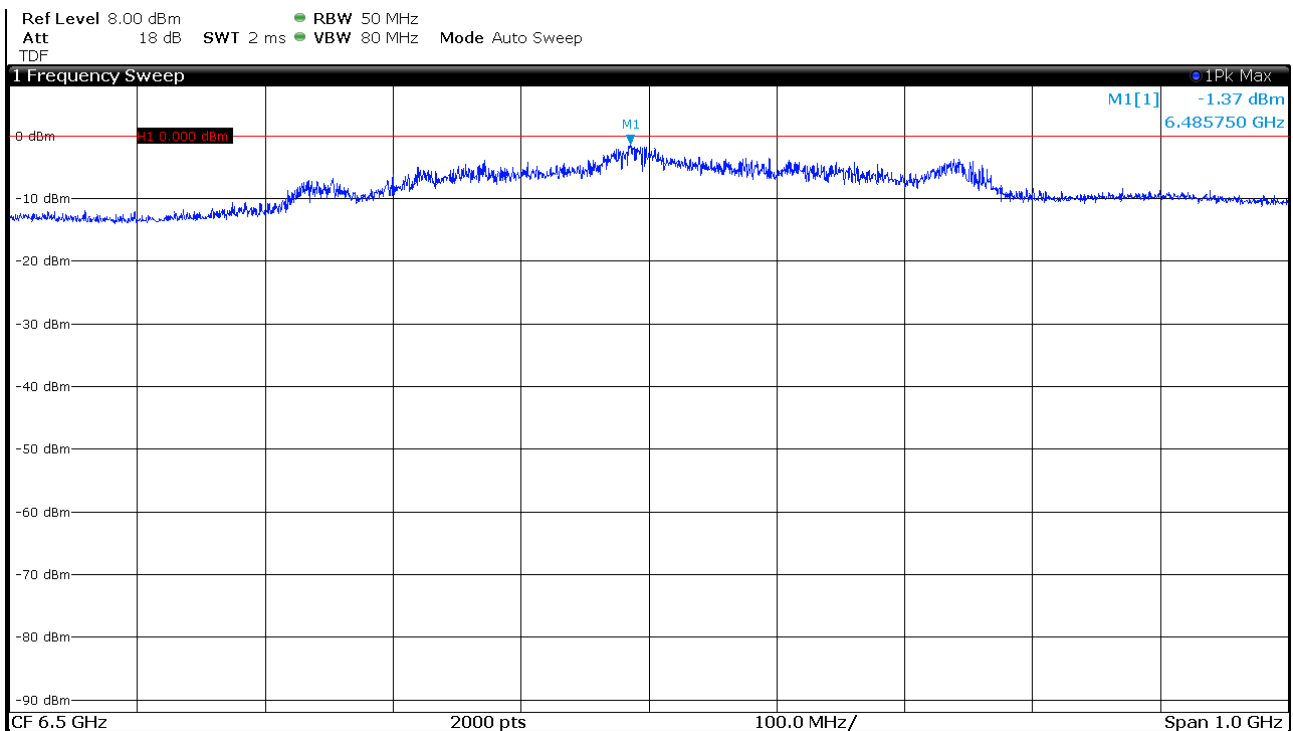


FCC ID: 2ALC5-KNX-HREC2

Channel 3:



Channel 5:



**FCC ID: 2ALC5-KNX-HREC2**

Limit according to FCC Part 15, Section 15.519(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,  $f_m$ . 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.

The requirements are **FULFILLED**.

**Remarks:** This test was performed with the sample 36158.

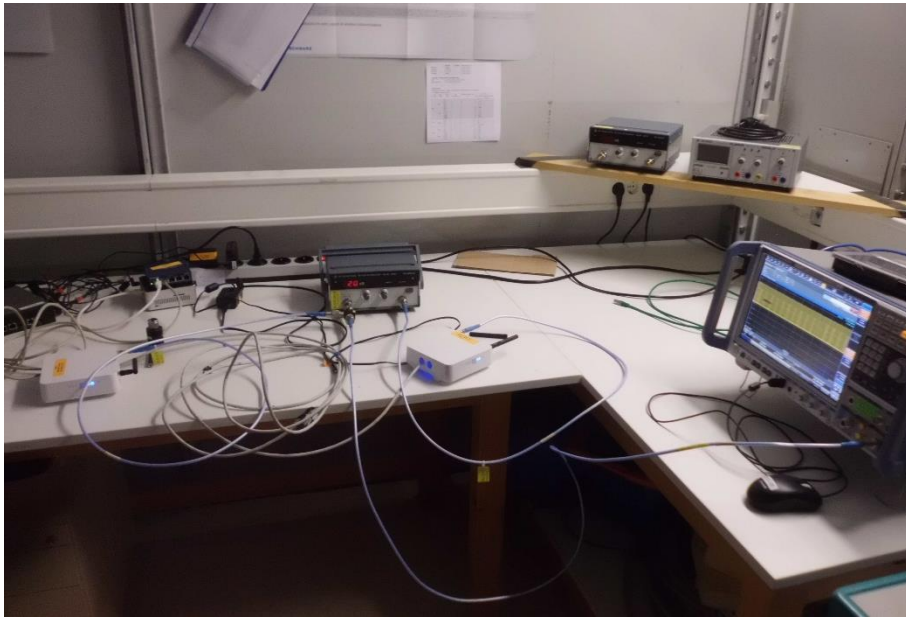
---

**FCC ID: 2ALC5-KNX-HREC2****5.6 Signal deactivation**

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

**5.6.1 Description of the test location**

Test location:                      Shielded room 6

**5.6.2 Photo documentation of the test set-up****5.6.3 Applicable standard**

According to FCC Part 15, Section 15.519(a)(1):

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

**5.6.4 Description of Measurement**

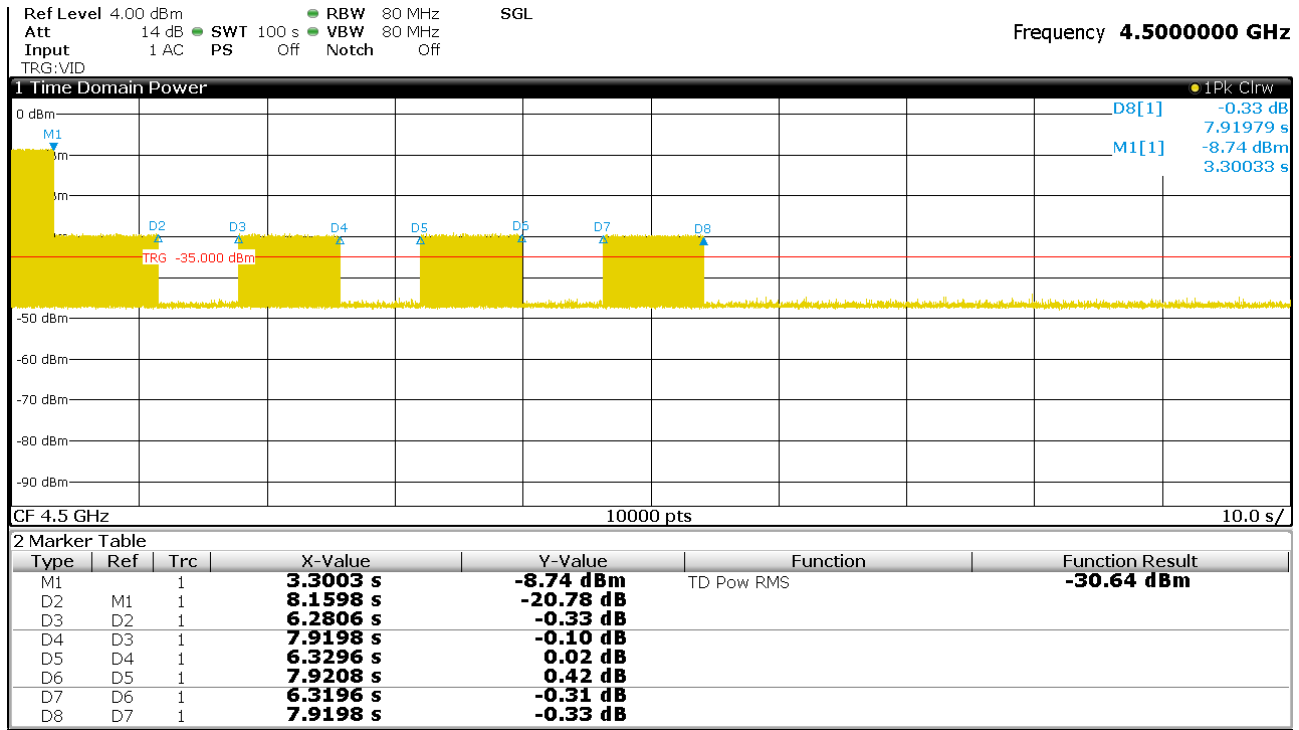
The measurement was performed conducted.

Spectrum analyser settings:

RBW: 80 MHz,      VBW: 80 MHz,      Detector: peak,      zero span

**FCC ID: 2ALC5-KNX-HREC2**
**5.6.5 Test result**

Anchor communicates with another anchor (companion device)



**Note:** The higher emissions are belonging to the companion device, the lower emissions are the transmissions of the EUT.

**Explanation:**

At the time M1 the companion device was powered off. After 8.2 s the EUT stopped transmissions and after 6.3 s retried to get a connection to a companion device. The EUT made two additional attempts to get a connection, then all transmissions stopped.

Limit according to FCC Part 15, Section 15.519(a)(1):

A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.

The requirements are **FULFILLED**.

**Remarks:** This test was performed with the sample 36164.

**FCC ID: 2ALC5-KNX-HREC2****5.7 Antenna application****5.7.1 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 two mounted antennas, Reverse Polarity SMA connectors are used.

The supplied antenna meets the requirements of part 15.203 and 15.204.

**Remarks:**

-



**FCC ID: 2ALC5-KNX-HREC2**

## 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.
A 4	BAT-EMC 3.18.0.17	01-02/68-13-001				
	ESCI	02-02/03-15-001	11/06/2019	11/06/2018		
	ESH 2 - Z 5	02-02/20-05-004	25/10/2019	25/10/2017	30/10/2018	30/04/2018
	NNLK 8121	02-02/20-06-001			20/02/2019	20/08/2018
	EZ-17_20 Hz-100 MHz	02-02/22-08-005	26/06/2019	26/06/2018		
	N-4000-BNC	02-02/50-05-138				
	N-1500-N	02-02/50-05-140				
	F-203I-DCN-32 mm	02-02/50-05-145				
	ESH 3 - Z 2	02-02/50-05-155	18/11/2019	18/11/2016	07/11/2018	07/05/2018
	6430	02-02/50-13-014				
	ISN	02-02/50-14-021			29/08/2019	29/08/2018
CPR 3	FSW43	02-02/11-15-001	19/03/2019	19/03/2018		
	BBHA 9120 E 251	02-02/24-05-006	07/05/2019	07/05/2018	23/01/2019	23/07/2018
	WBH2-18NHG	02-02/24-08-002	07/05/2019	07/05/2018	23/01/2019	23/07/2018
	SR104/11SMA/11N/2000MM	02-02/50-15-002				
DC	ESW26	02-02/03-17-002	08/12/2018	08/12/2017		
	6011	02-02/50-05-079				
	DPSP	02-02/50-05-176				
	SF104/11SMA/11N/1500MM	02-02/50-13-016				
	SF104/11SMA/11N/1500MM	02-02/50-13-017				
	KK-SF104-11SMA-11N-2M	02-02/50-14-002				
MB	FSW43	02-02/11-15-001	19/03/2019	19/03/2018		
	BBHA 9120 E 251	02-02/24-05-006	07/05/2019	07/05/2018	23/01/2019	23/07/2018
	WBH2-18NHG	02-02/24-08-002	07/05/2019	07/05/2018	23/01/2019	23/07/2018
	SR104/11SMA/11N/2000MM	02-02/50-15-002				
SER 2	ESVS 30	02-02/03-05-006	06/06/2019	06/06/2018		
	VULB 9168	02-02/24-05-005	18/04/2019	18/04/2018		
	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				
SER 3	FSW43	02-02/11-15-001	19/03/2019	19/03/2018		
	JS4-18004000-30-5A	02-02/17-05-017				
	AFS5-12001800-18-10P-6	02-02/17-06-002				
	AFS4-01000400-10-10P-4	02-02/17-13-002				
	AMF-4F-04001200-15-10P	02-02/17-13-003				
	BBHA 9120 E 251	02-02/24-05-006	07/05/2019	07/05/2018	23/01/2019	23/07/2018
	BBHA 9170	02-02/24-05-014	12/06/2021	12/06/2018	12/06/2019	12/06/2018
	WBH2-18NHG	02-02/24-08-002	07/05/2019	07/05/2018	23/01/2019	23/07/2018
	Sucoflex N-2000-SMA	02-02/50-05-075				
	KMS102-1 m	02-02/50-11-014				
	KMS102-0.2 m	02-02/50-11-016				
	KMS102-0.2 m	02-02/50-11-020				
	SF104/11N/11N/1500MM	02-02/50-13-015				
	SF104/11SMA/11N/2000MM	02-02/50-15-003				
	SF104/11SMA/11N/2000MM	02-02/50-15-004				