



# RF - TEST REPORT

- FCC Part 15.247, RSS-247 -

**Type / Model Name** : KINEXON Mesh Anchor / A040001

**Product Description** : Anchor for UWB localization system

**Applicant** : KINEXON Inc.

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

CHICAGO, IL 60606, USA

**Manufacturer** : KINEXON GmbH

**Address** : Schellingstr. 35

80799 MÜNCHEN, GERMANY

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

**POSITIVE**

**Test Report No. :** 80185270-05 Rev\_2

25. April 2024

Date of issue



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

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ATTACHMENT A as separate supplement

# 1 TEST STANDARDS

The tests were performed according to following standards:

## **FCC Rules and Regulations Part 15, Subpart A - General (October 2023)**

Part 15, Subpart A, Section 15.31	Measurement standards
Part 15, Subpart A, Section 15.33	Frequency range of radiated measurements
Part 15, Subpart A, Section 15.35	Measurement detector functions and bandwidths

## **FCC Rules and Regulations Part 15, Subpart C - Intentional Radiators (October 2023)**

Part 15, Subpart C, Section 15.203	Antenna requirement
Part 15, Subpart C, Section 15.204 modifications	External radio frequency power amplifiers and antenna
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 15.247	Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices
KDB 558074 D01 v05r02	Guidance for compliance measurements on DTS; FHSS and hybrid system devices operating under Section 15.247 of the FCC rules, April 2, 2019.

## **ISED Canada Rules and Regulations**

RSS-Gen, Issue 5 + Amendment 1 + 2	General Requirements for Compliance of Radio Apparatus
RSS-247, Issue 3	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE- LAN) Devices
ANSI C63.10: 2013	Testing Unlicensed Wireless Devices

FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## 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 General remarks

None.

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

### 2.5 Equipment type

BLE device

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

The KINEXON Mesh system is a real-time location system (RTLS) designed to provide precise tracking and asset management solutions. It leverages the combined capabilities of Ultra-Wideband (UWB) technology and Bluetooth Low Energy (BLE) Mesh.

Number of tested samples:	6 (3 radiated, 3 conducted)
EUT 1 Serial number:	#210 (BLE CH37 radiated)
EUT 2 Serial number:	#218 (BLE CH17 radiated)
EUT 3 Serial number:	#216 (BLE CH39 radiated)
EUT 4 Serial number:	#215 (BLE CH37 conducted)
EUT 5 Serial number:	#225 (BLE CH17 conducted)
EUT 6 Serial number:	#221 (BLE CH39 conducted)

## FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

### 2.7 Variants of the EUT

There are no variants.

### 2.8 Operation frequency and channel plan

The operating frequency is 2400 MHz to 2483.5 MHz.

Channel plan:

Channel	Frequency	Channel	Frequency
37	2402	18	2442
0	2404	19	2444
1	2406	20	2446
2	2408	21	2448
3	2410	22	2450
4	2412	23	2452
5	2414	24	2454
6	2416	25	2456
7	2418	26	2458
8	2420	27	2460
9	2422	28	2462
10	2424	29	2464
38	2426	30	2466
11	2428	31	2468
12	2430	32	2470
13	2432	33	2472
14	2434	34	2474
15	2436	35	2476
16	2438	36	2478
17	2440	39	2480

Note: the marked frequencies are determined for final testing.

### 2.9 Transmit operating modes

The EUT uses GFSK modulation and may provide following data rates:

- 1000 kbps

(kbps = *kilobits per second*)

### 2.10 Antenna

The following antennas shall be used with the EUT:

Number	Characteristic	Model number	Plug	f-range (GHz)	Gain (dBi)
1	Omni	PCB antenna, MIFA	None	2.4 – 2.5	1.6

### 2.11 Power supply system utilised

Power supply voltage,  $V_{nom}$  : 5.0 V DC (USB)

Power supply voltage (alternative) : 3.6 V DC (internal battery)

All tests were carried out with a supply voltage of 5.0 V DC.

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## 2.12 Peripheral devices and interface cables

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

- USB cable \_\_\_\_\_ Model : \_\_\_\_\_ Commercially available \_\_\_\_\_
- USB power adapter \_\_\_\_\_ Samsung EP-TA 200 \_\_\_\_\_

## 2.13 Determination of worst-case conditions for final measurement

Preliminary tests are performed in all three orthogonal axes of the EUT to locate at which position and at what setting of the EUT produce the maximum of the emissions. For the further measurement the EUT is set in X position.

The tests are carried out in the following frequency band:

**2400 MHz – 2483.5 MHz**

For the final test the following channels and test modes are selected:

Wireless system	Available channel	Tested channels	Power setting	Modulation	Modulation type	Data rate
802.15.1	0 - 39	37, 17, 39	P2	DSSS	GFSK	1000 kbps

### 2.13.1 Test jig

No test jig is used.

### 2.13.2 Test software

The EUT was set with test modulation to transmit data during the tests with a maximum duty cycle (x) from an internal packet generator.

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### 3 TEST RESULT SUMMARY

FCC Rule Part	RSS Rule Part	Description	Result
15.207(a)	RSS-Gen, 8.8	AC power line conducted emissions	passed
15.247(a)(2)	RSS-247, 6.2.4(1)	-6 dB EBW	passed
15.247(b)(3)	RSS-247, 6.2.4(1)	Maximum peak conducted output power	passed
15.247(d)	RSS-247, 6.2.4(2)	Out-of-band emission, radiated	passed
15.247(d)	RSS-Gen, 8.9	Emissions in restricted bands	passed
15.247(e)	RSS-247, 6.2.4(1)	PSD	passed
15.35(c)	RSS-Gen, 6.10	Pulsed operation	passed
15.203	RSS-Gen, 6.6	Antenna requirement	passed
-	RSS-Gen, 6.11	Transmitter frequency stability	passed
-	RSS-Gen, 6.6	99 % Bandwidth	passed

The mentioned new RSS Rule Parts in the above table are related to:

RSS-Gen, Issue 5 + Amendment 1 + Amendment 2, March 2019

RSS-247, Issue 3, August 2023

#### 3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80185270-05	0	07 March 2024	Initial test report
80185270-05	1	18 April 2024	section 2.12: adding USB power adapter. section 3: RSS-247 standard changed to issue 3. section 4.5.3.2.4: table height changed to 1.5 m. section 5.1.5: USB power adapter mentioned in remarks. section 5.2.7: OBW plots corrected. section 5.4.5: limit and test results corrected. section 5.4.6: PSD plots corrected. section 5.5.5: radiated emissions < 30 MHz and DC correction added.
80185270-05	2	25 April 2024	section 2.6: description changed

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

FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

### 3.2 Final assessment

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

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

Testing commenced on : 26 January 2024

Testing concluded on : 21 February 2024

Checked by:

Tested by:

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

p. p. \_\_\_\_\_  
Christopher Thaller  
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 on basis of the ETSI Technical Report TR 100 028 Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1 and Part 2. The results are documented in the quality system acc. to DIN EN ISO/IEC 17025. 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%	$\pm 3.29$ 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%	$\pm 3.53$ dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	$\pm 3.71$ dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	$\pm 2.34$ dB
Peak conducted output power	902 MHz to 928 MHz	95%	$\pm 0.35$ dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	$\pm 2.15$ dB

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## 4.4 Conformity Decision Rule

The applied conformity decision rule is based on ILAC G8:09/2019 clause 4.2.1 Binary Statement for Simple Acceptance Rule ( $w = 0$ ).

Details can be found in the procedure CSA\_B\_V50\_29.

## 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".

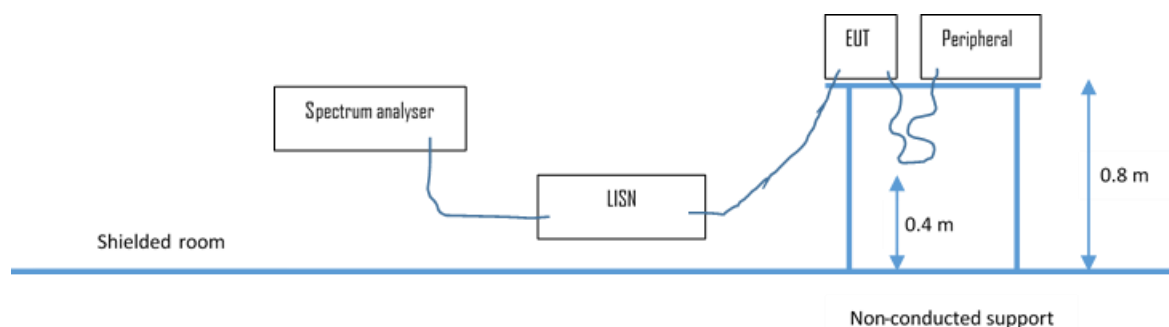
#### 4.5.2.1 Justification

The equipment under test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions.

### 4.5.3 Details of test procedures

#### 4.5.3.1 Conducted emission

Test setup according ANSI C63.10



The final level, expressed in dB $\mu$ V, is arrived at by taking the reading directly from the Spectrum analyser. This level is compared to the limit.

To convert between dB $\mu$ V and  $\mu$ V, the following conversions apply:

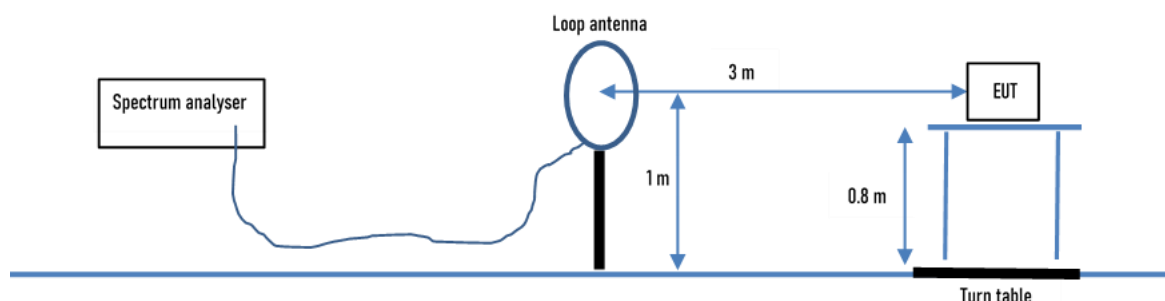
$$\text{dB}\mu\text{V} = 20(\log \mu\text{V})$$

$$\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$$

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection and a Line Impedance Stabilization Network (LISN) with 50  $\Omega$  / 50  $\mu$ H (CISPR 16) characteristics. The receiver is protected by means of an impedance matched pulse limiter connected directly to the RF input. Table top equipment is placed on a non-conducting table 80 centimetres above the floor and is positioned 40 centimetres from the vertical ground plane (wall) of the screen room. If the minimum limit margin appears to be less than 20 dB with a peak mode measurement, the emission is re-measured using a tuned receiver with quasi-peak and average detection and recorded on the data sheets.

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**
**4.5.3.2 Radiated emission**
**4.5.3.2.1 OATS1 test site (9 kHz - 30 MHz):**

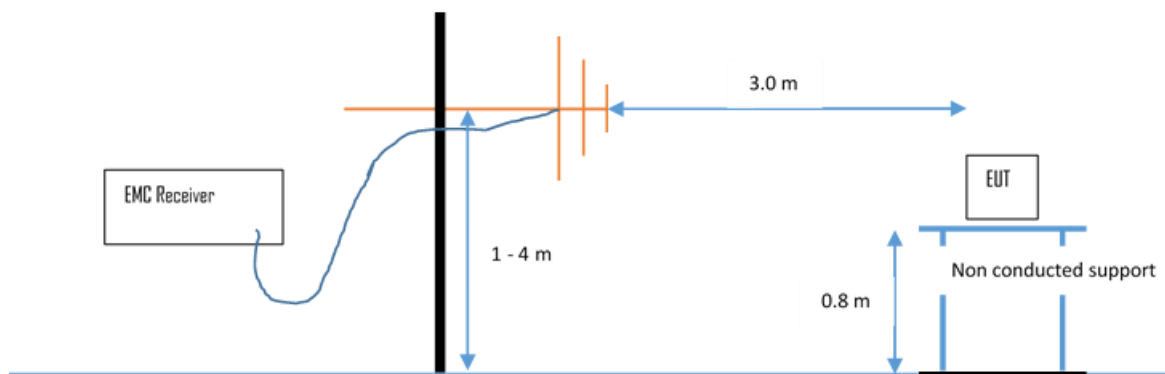
Test setup according ANSI C63.10



Emissions from the EUT are measured in the frequency range of 9 MHz to 30 MHz using a tuned receiver and a calibrated loop antenna. Table top equipment is placed on a 1.0 X 1.5 m non-conducting table 80 centimetres above the ground plane. Cables to simulators/testers (if used in this test) are routed through the centre 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 along the site axis and the EUT is rotated 360 degrees.

**4.5.3.2.2 OATS1 test site (30 MHz - 1 GHz):**

Test setup according ANSI C63.10.



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. Cables to simulators/testers (if used in this test) are routed through the centre of the table and to a screened room located outside the test area. 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 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

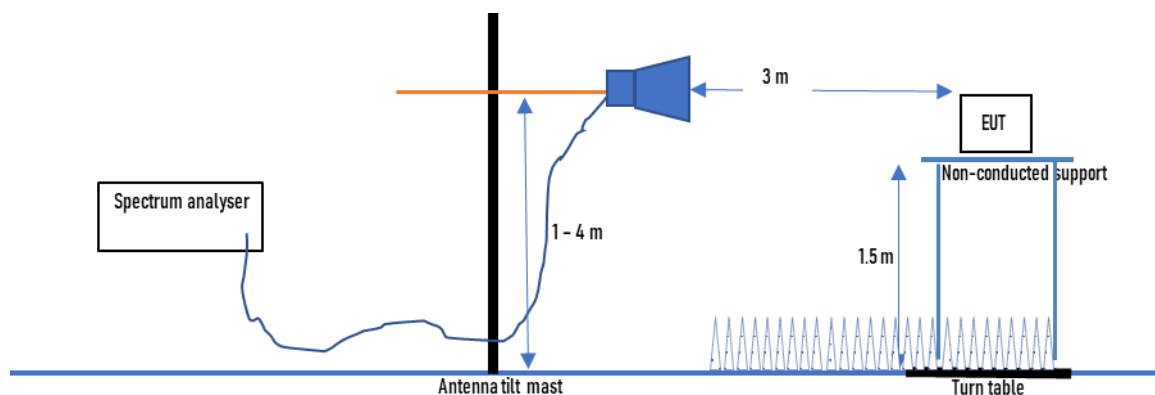
Example:

Frequency (MHz)	Level (dB $\mu$ V)	+	Factor (dB)	=	Level (dB $\mu$ V/m)	-	Limit (dB $\mu$ V/m)	=	Delta (dB)
719.0	75.0	+	32.6	=	107.6	-	110.0	=	-2.4

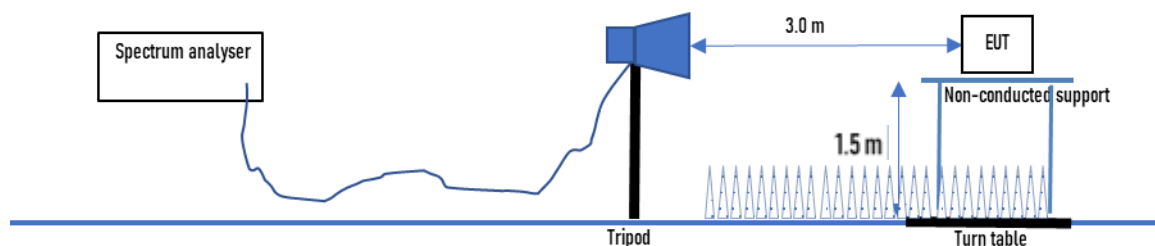
FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

**4.5.3.2.3 Anechoic chamber 1 (1000 MHz – 18000 MHz)**

Test setup according ANSI C63.10.



Radiated emissions from the EUT are measured in the frequency range 1 GHz up to 18 GHz 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 non-conducting table, 1.5 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the centre, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements.

**4.5.3.2.4 Anechoic chamber 1 (18 GHz – 40 GHz)**

Emissions from the EUT are measured in the frequency range 18 GHz up to 40 GHz 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 non-conducting table, 0.8 metre above the ground plane. The turntable is fully covered with the appropriate absorber (Type VHP-12). Any controlling device is positioned such that it does not significantly influence the measurement results. Interconnecting cables that hang closer than 40 cm to the ground plane are folded back and forth in the centre, forming a bundle 30 cm to 40 cm long. Measurements are made in three orientations of the EUT and the horizontal and vertical polarization planes of measurement antenna in a fully anechoic room. The measurement antenna is adjusted and the EUT orientated to permit the measurement of the maximum emission from the EUT. The conditions determined as worst-case will then be used for the final measurements. Where appropriate, the test distance may be reduced in order to detect emissions under better uncertainty. The limit is adopted.

FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## 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



#### 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.

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1****5.1.5 Test result**

Frequency range: 0.15 MHz - 30 MHz

Min. limit margin -18.2 dB at 29.805 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**.

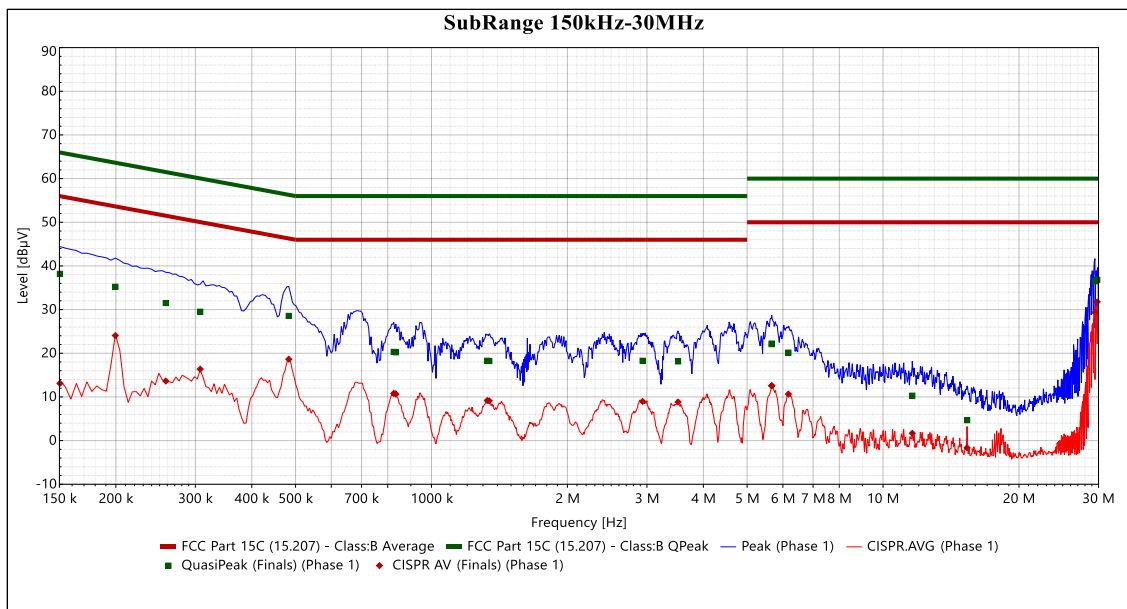
**Remarks:** For detailed test result please see the following test protocols

The AC power adapter from section 2.12 is used for measurements.

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**
**5.1.6 Test protocol**

Test point L1  
Operation mode: Transmission at 2.4 GHz

Result: passed

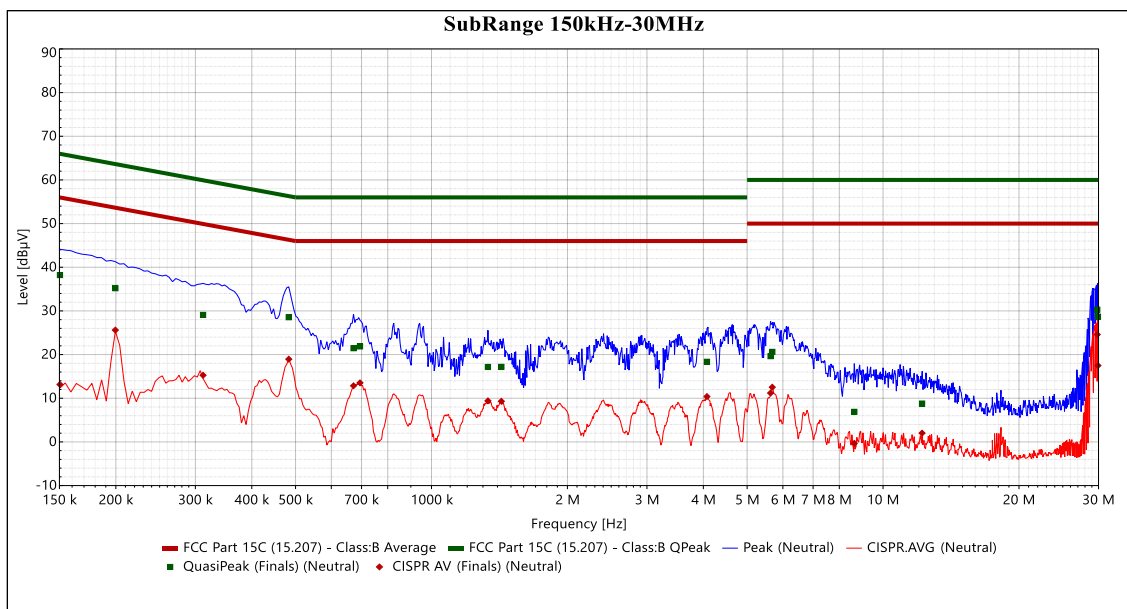


Frequency (MHz)	QuasiPeak (dBμV)	QP Margin (dB)	QP Limit (dBμV)	CISPR AV (dBμV)	CISPR AV Margin (dB)	AV Limit (dBμV)
0.150	38.193	-27.807	66	13.105	-42.895	56
0.200	35.234	-28.398	63.631	24.057	-29.574	53.631
0.258	31.492	-30.004	61.496	13.644	-37.851	51.496
0.308	29.531	-30.506	60.038	16.373	-33.665	50.038
0.483	28.571	-27.716	56.287	18.643	-27.645	46.287
0.825	20.333	-35.667	56	10.812	-35.188	46
834 k	20.223	-35.777	56	10.643	-35.357	46
1.329	18.304	-37.696	56	9.189	-36.811	46
1.343	18.213	-37.787	56	9.098	-36.902	46
2.936	18.294	-37.706	56	8.957	-37.043	46
3.516	18.133	-37.867	56	8.827	-37.173	46
5.667	22.094	-37.906	60	12.53	-37.47	50
5.671	22.222	-37.778	60	12.597	-37.403	50
6.171	20.155	-39.845	60	10.66	-39.34	50
11.607	10.303	-49.697	60	1.684	-48.316	50
15.351	4.67	-55.33	60	-1.652	-51.652	50
29.463	36.48	-23.52	60	29.362	-20.638	50
29.805	36.817	-23.183	60	31.762	-18.238	50

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**

Test point N  
Operation mode: Transmission at 2.4 GHz

Result: passed



Frequency (MHz)	QuasiPeak (dBμV)	QP Margin (dB)	QP Limit (dBμV)	CISPR AV (dBμV)	CISPR AV Margin (dB)	AV Limit (dBμV)
0.150	38.208	-27.792	66	13.155	-42.845	56
0.22	35.19	-28.442	63.631	25.608	-28.024	53.631
0.312	29.094	-30.824	59.917	15.263	-34.654	49.917
0.483	28.552	-27.735	56.287	18.948	-27.339	46.287
0.672	21.45	-34.55	56	12.847	-33.153	46
0.695	21.857	-34.143	56	13.529	-32.471	46
1.334	17.181	-38.819	56	9.409	-36.591	46
1.428	17.198	-38.802	56	9.306	-36.694	46
4.074	18.36	-37.64	56	10.387	-35.613	46
5.636	19.626	-40.374	60	11.193	-38.807	50
5.685	20.628	-39.372	60	12.536	-37.464	50
8.637	6.899	-53.101	60	-0.345	-50.345	50
12.201	8.79	-51.21	60	2.012	-47.988	50
29.810	30.283	-29.717	60	24.577	-25.423	50
29.913	28.698	-31.302	60	17.495	-32.505	50



**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**

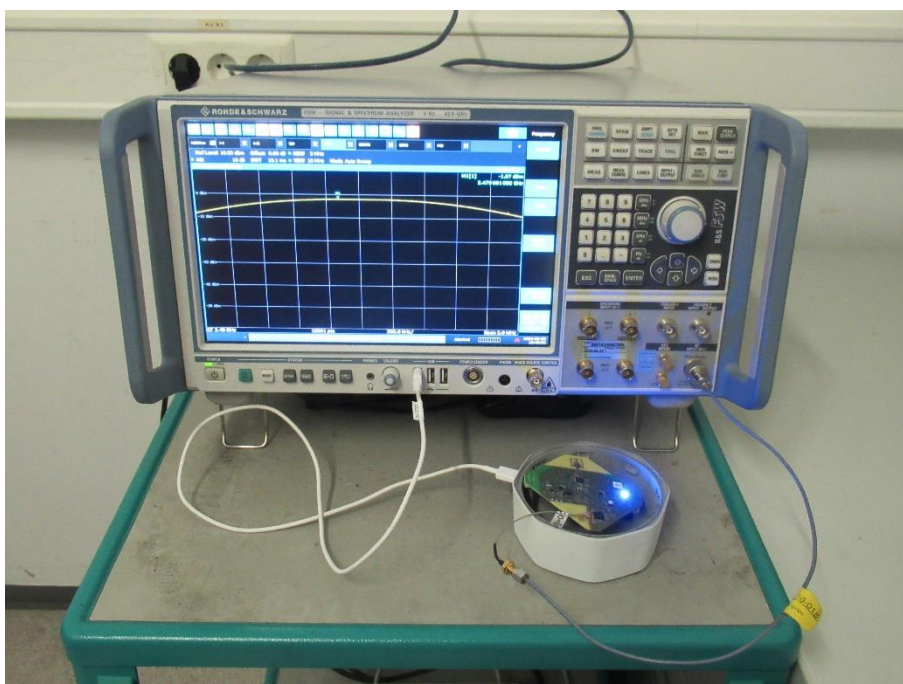
## 5.2 EBW and OBW

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

### 5.2.1 Description of the test location

Test location:                      Shielded Room S6

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



### 5.2.3 Applicable standard

According to FCC Part 15, Section 15.247(a)(2):

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 – 2483.5 MHz and 5725 – 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

### 5.2.4 Description of Measurement

The bandwidth was measured at an amplitude level reduced from the reference level of a modulated channel by a ratio of -6 dB. The reference level is the level of the highest signal amplitude observed at the transmitter at either the fundamental frequency or the first order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. An alternative is to use the bandwidth measurement of the analyser.

Spectrum analyser settings for EBW:

RBW: 100 kHz,    VBW: 300 kHz,    Detector: Max peak,    Span: 3 MHz;

Spectrum analyser settings for OBW:

RBW: 1-5% OBW, VBW: 3 RBW,    Detector: Max peak,    Span: 3 MHz;

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1****5.2.5 Test result**

EBW 6 dB:

Channel	Centre frequency (MHz)	6 dB bandwidth (kHz)	Minimum limit (MHz)
37	2402	688.4	0.5
38	2426	691.9	0.5
39	2480	695.3	0.5

The requirements are **FULFILLED**.**Remarks:** For detailed test result please see the following test protocols

# FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## 5.2.6 Test protocols EBW

### Channel 37 (2402 MHz)



### Channel 17 (2440 MHz)



### Channel 39 (2480 MHz)



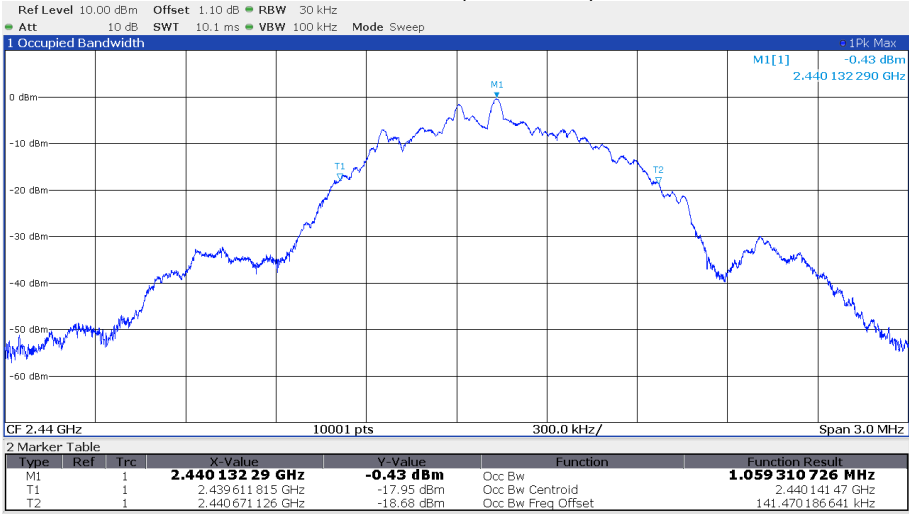
FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

5.2.7 Test protocols OBW

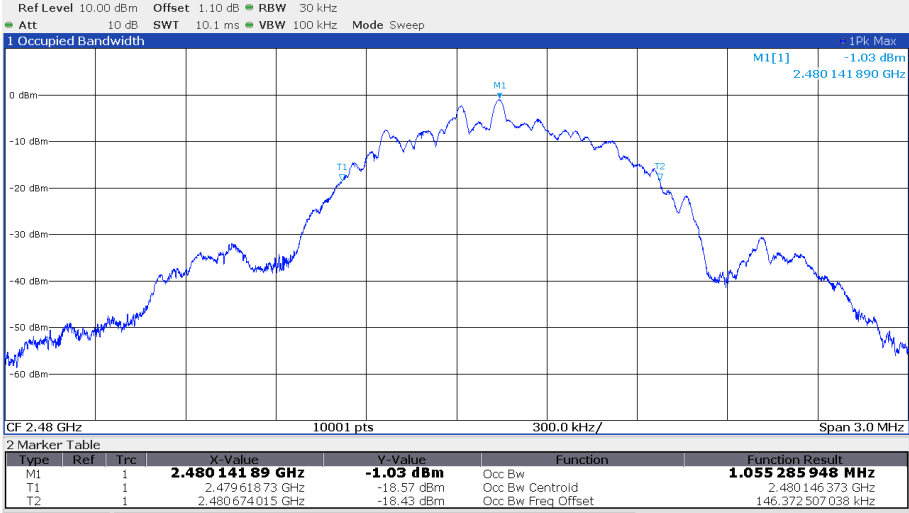
Channel 37 (2402 MHz)



Channel 17 (2440 MHz)



Channel 39 (2480 MHz)



**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**

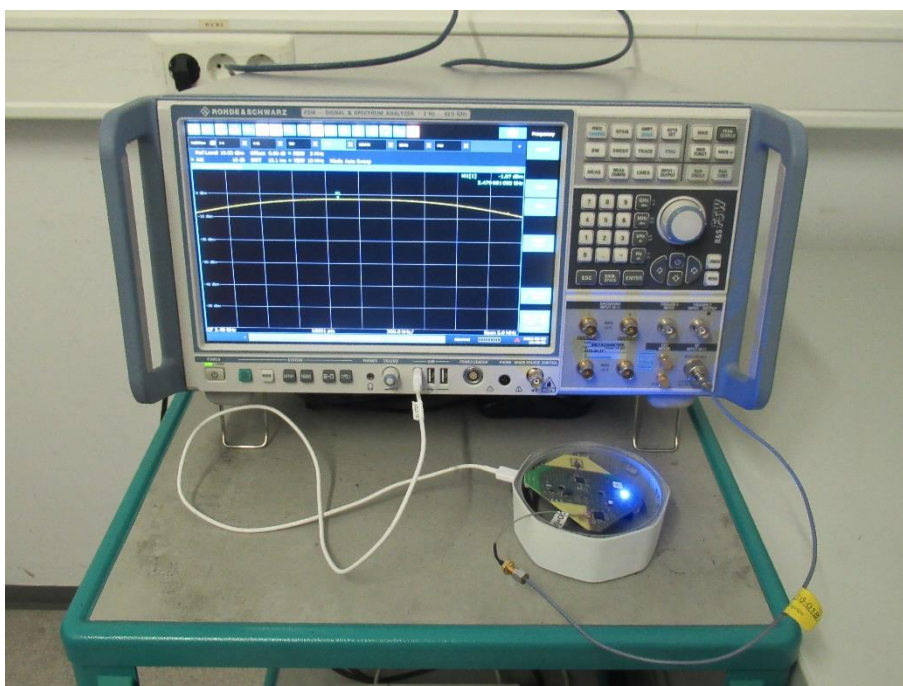
### 5.3 Maximum peak output power

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

#### 5.3.1 Description of the test location

Test location:                    Shielded Room S6

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



#### 5.3.3 Applicable standard

According to FCC Part 15, Section 15.247(b)(3):

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

#### 5.3.4 Description of Measurement

The maximum peak radiated output power is measured using a spectrum analyser following the procedure set out in ANSI C63.10, item 11.9.2.2. The EUT is set in TX continuous mode while measuring. The radiated measurement was performed in terms of fieldstrength. Therefore, the formula set out in ANSI C63.10, item 9.5 (Equation 22) is changed into the following term:

$$E = \text{EIRP} - (20 \cdot \log_{10}(3)) + 104.7$$

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**
**5.3.5 Test result**

802.15.1, 1000 kbps, TX		Test results conducted				
		P (dBm)	Antenna Gain (dBi)	EIRP (dBm)	EIRP Limit (dBm)	Margin (dB)
Lowest frequency: CH37						
$T_{nom}$	$V_{nom}$	6.5	1.6	8.1	36.0	-27.9
Middle frequency: CH17						
$T_{nom}$	$V_{nom}$	7.1	1.6	8.7	36.0	-27.3
Highest frequency: CH39						
$T_{nom}$	$V_{nom}$	6.5	1.6	8.1	36.0	-27.9

Peak Power Limit according to FCC Part 15, Section 15.247(b)(3):

Frequency (MHz)	Peak Power Limit	
	(dBm)	(W)
902-928	36	4.0
<b>2400-2483.5</b>	<b>36</b>	<b>4.0</b>
5725-5850	36	4.0

The requirements are **FULFILLED**.

**Remarks:** None.



FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

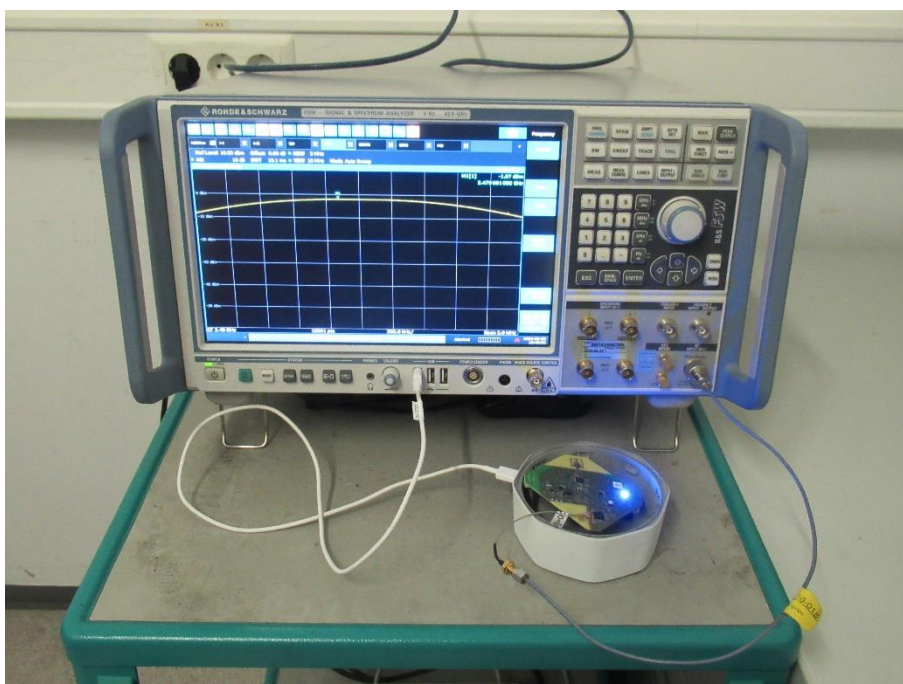
## 5.4 Power spectral density

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

### 5.4.1 Description of the test location

Test location:                      Shielded Room S6

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



### 5.4.3 Applicable standard

According to FCC Part 15, Section 15.247(e):

For digitally modulated systems, the power spectral density radiated from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the radiated output power shall be used to determine the power spectral density.

### 5.4.4 Description of Measurement

The measurement is performed using the procedure set out in 11.10 of ANSI C63.10. The power measurement was done as peak power measurement. Therefore, the PKPSD is measured. The max peak was located and with the spectrum analyser and a marker set to peak.

Spectrum analyser settings:

RBW: 3 kHz, VBW: 10 kHz, Detector: Peak, Sweep time: Auto

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1****5.4.5 Test result**

CH	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)	Margin (dB)
37	-12.3	8.0	-20.3
17	-13.3	8.0	-21.3
39	-14.3	8.0	-22.3

Power spectral density limit according to FCC Part 15, Section 15.247(e):

Frequency (MHz)	Power spectral density limit (EIRP)
	(dBm/3 kHz)
2400 - 2483.5	8

The requirements are **FULFILLED**.

**Remarks:** For detailed test result please see the following test protocols

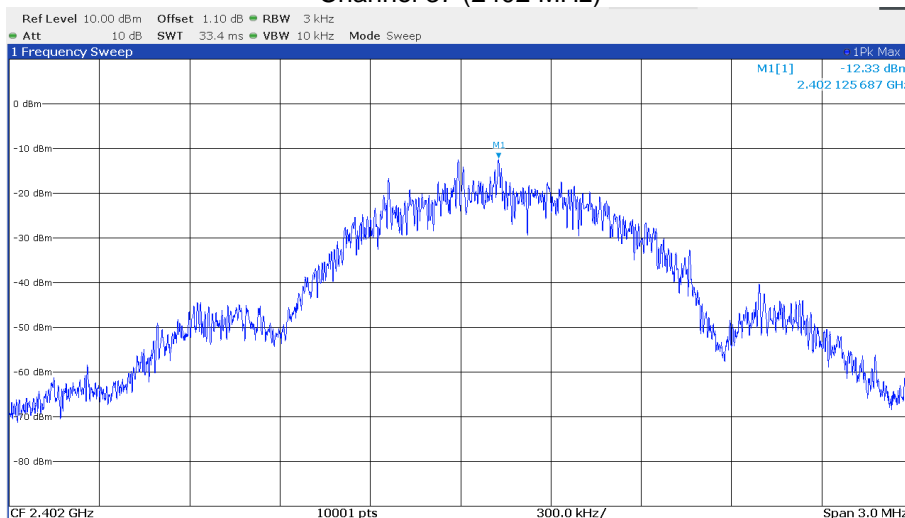
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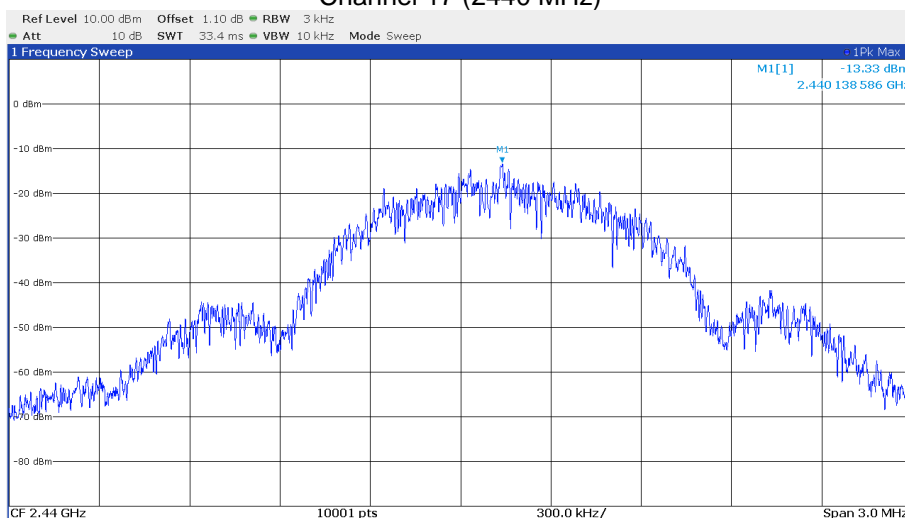
# FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## 5.4.6 Test protocols

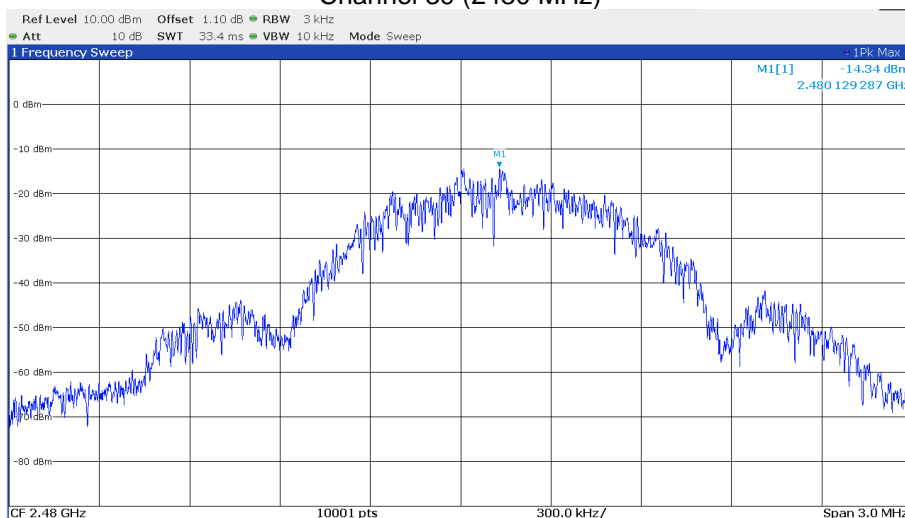
Channel 37 (2402 MHz)



Channel 17 (2440 MHz)



Channel 39 (2480 MHz)



FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## 5.5 Unwanted emissions, radiated

For test instruments and accessories used see section 6 Part **SER1**, **SER 2**, **SER 3**.

### 5.5.1 Description of the test location

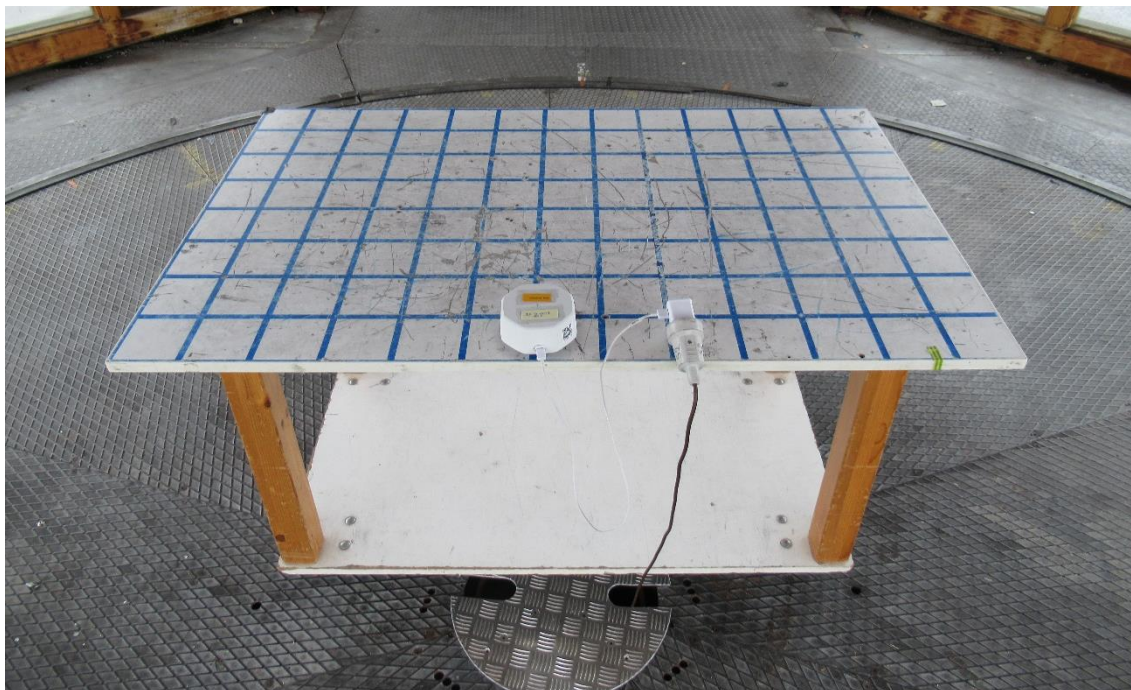
Test location: OATS 1  
Test location: Anechoic chamber 1  
Test distance: 3 m

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

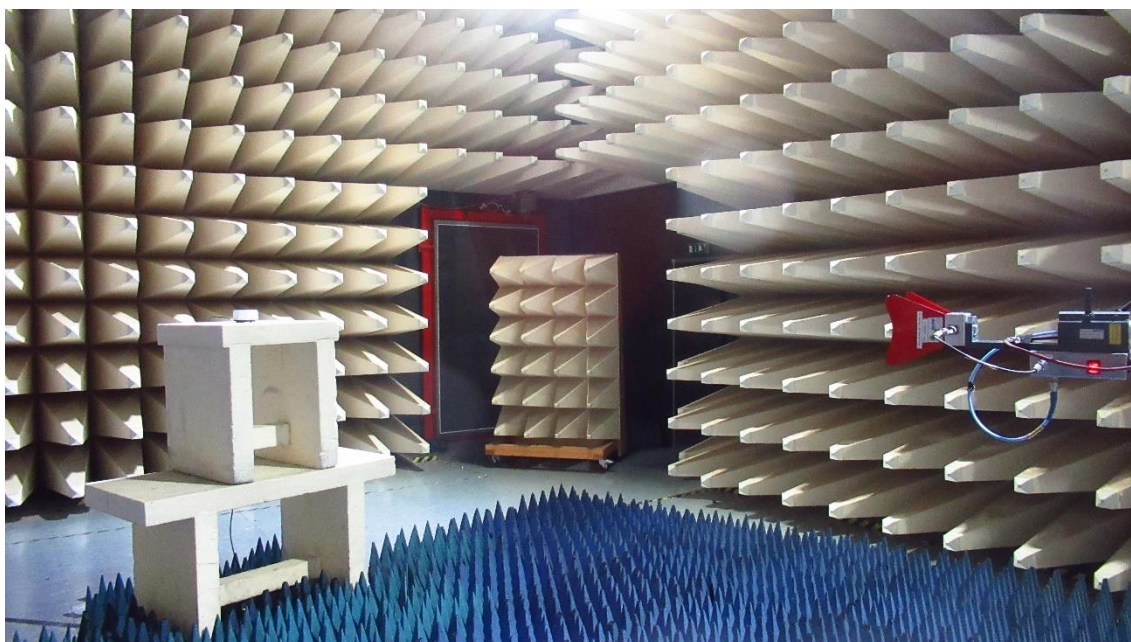
OATS1



FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

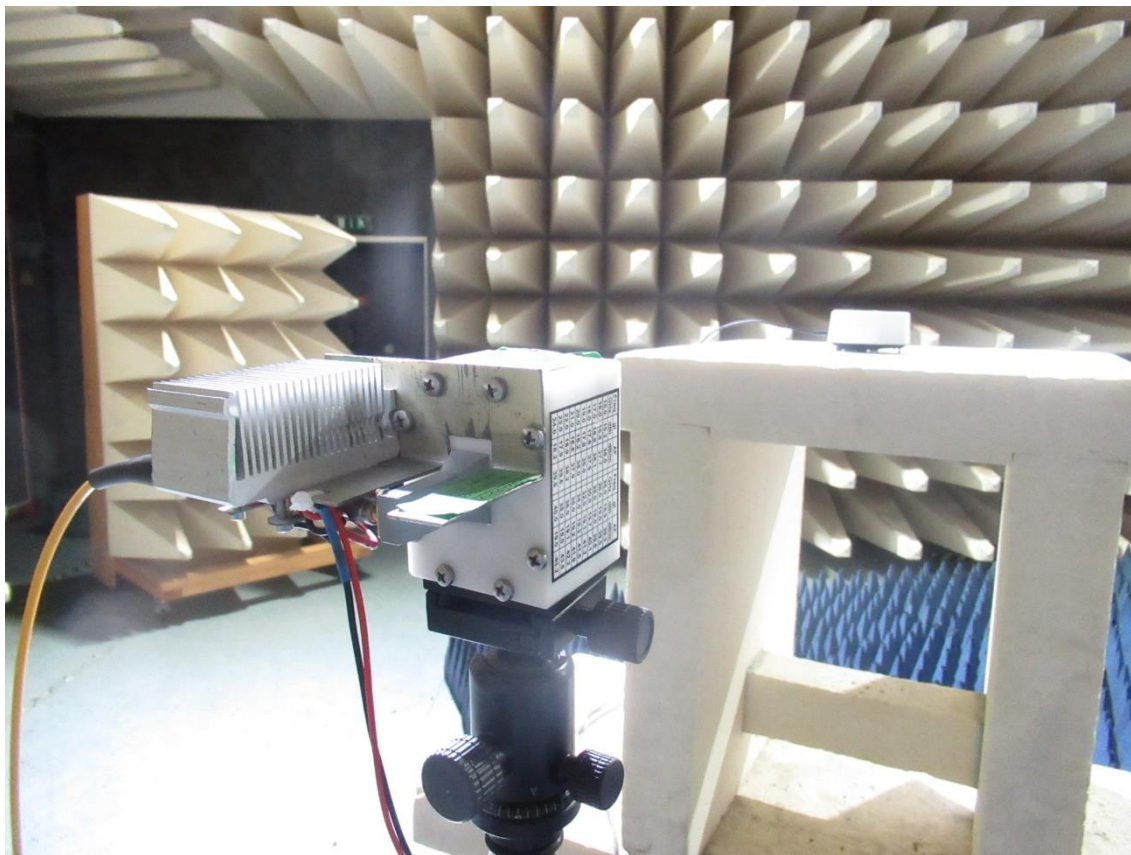


A1:





**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**



### 5.5.3 Applicable standard

According to FCC Part 15, Section 15.247(d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

According to RSS-247 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

## FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

### 5.5.4 Description of Measurement

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

The radiated power of the spurious emission from the EUT is measured in a test setup following the procedures set out in ANSI C63.10. If the emission level of the EUT in peak mode complies with the average limit is 20 dB lower, then testing will be stopped and peak values of the EUT will be reported, otherwise the emission will be measured in average mode again and reported.

The restricted bands are measured radiated. The span of the spectrum analyser is set wide enough to capture the restricted band and measure the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation. The restricted bands are measured falling emissions into it and the nearest restricted band are checked for emissions also the restricted band for the harmonics of the carrier.

Measurements are performed in following order:

1) Measurement of emissions according to General Limit specified in section 15.209(a):

Test receiver settings for SER2:

30MHz-1GHz      RBW: 120 MHz      Detector: Quasi peak      Meas. Time: 1 s,

Spectrum analyser settings for SER3:

1GHz-26GHz      RBW: 1 MHz      Detector: Max. peak      Trace: Max. hold      Sweep: Auto

2) If emissions outside the Restricted Bands are above General Limit additional measurements of emissions according to Spurious Emissions Limit specified in section 15.247(d) are performed:

Spectrum analyser settings:

RBW: 100 kHz      VBW: 300 kHz      Detector: Max. peak      Trace: Max. hold      Sweep: Auto

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**
**5.5.5 Test result**
**f < 1000 MHz**
**FCC**

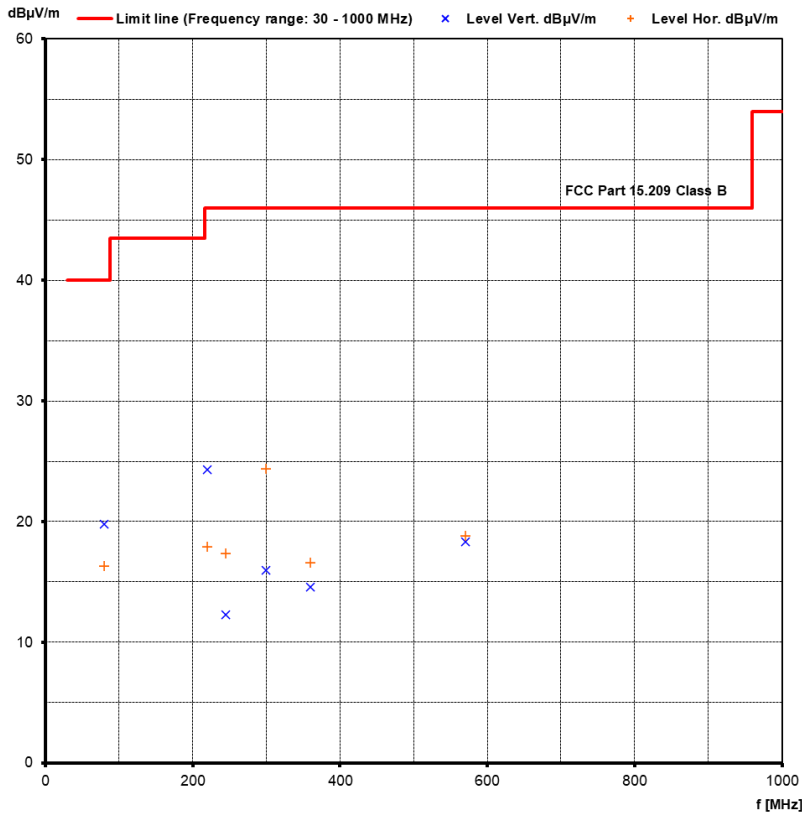
f (MHz)	Level QP@3m (dBμV)	Ant. factor (dB/m)	Field strength QP@3m dB(μV/m)	Distance corr. 3m to 30/300m (dB)	Corrected level QP@30/300m dB(μV/m)	Limit QP dB(μV/m)
0.010	26.8	20.0	46.8	-80.0	-33.2	47.6
0.080	9.8	20.0	29.8	-80.0	-50.2	29.5
0.200	26.9	20.0	46.9	-80.0	-33.1	21.6
2.500	8.5	20.0	28.5	-40.0	-11.5	29.5
14.000	9.0	20.0	29.0	-40.0	-11.0	29.5
24.000	18.7	20.0	38.7	-40.0	-1.3	29.5

**ISED**

f (MHz)	Level QP@3m (dBμA)	Ant. factor (dB/m)	Field strength QP@3m dB(μA/m)	Distance corr. 3m to 30/300m (dB)	Corrected level QP@30/300m dB(μA/m)	Limit QP dB(μA/m)
0.010	26.8	20.0	-4.7	-80.0	-84.7	16.1
0.080	9.8	20.0	-21.7	-80.0	-101.7	-2.0
0.200	26.9	20.0	-4.6	-80.0	-84.6	-9.9
2.500	8.5	20.0	-23.0	-40.0	-63.0	-22.0
14.000	9.0	20.0	-22.5	-40.0	-62.5	-22.0
24.000	18.7	20.0	-32.8	-40.0	-72.8	-22.0

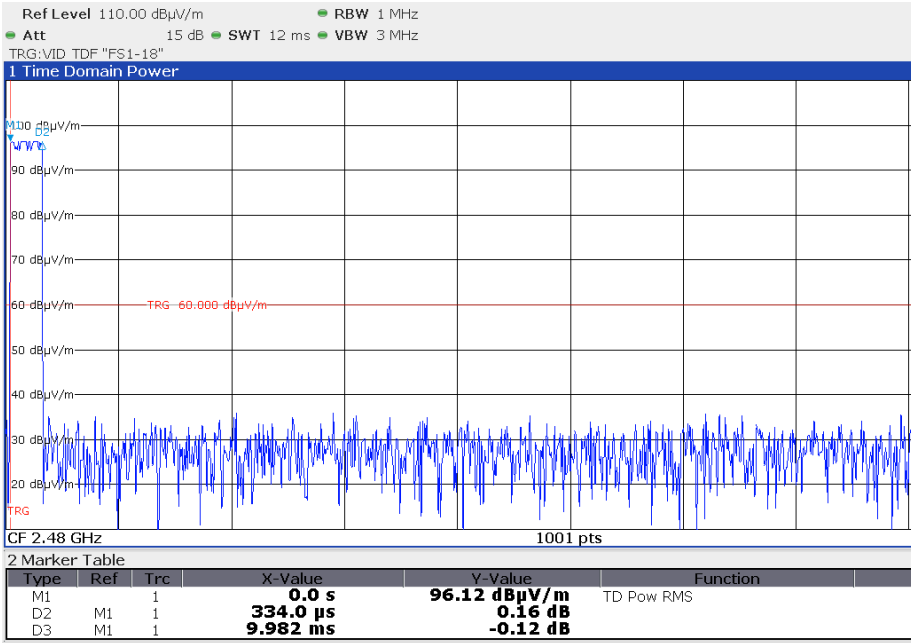
Frequency (MHz)	Reading Vert. (dBμV)	Reading Hor. (dBμV)	Correct. Vert. (dB)	Correct. Hor. (dB)	Level Vert. (dBμV/m)	Level Hor. (dBμV/m)	Limit (dBμV/m)	Dlimit (dB)
80.00	5.6	1.8	14.2	14.5	19.8	16.3	40.0	-20.2
220.00	6.6	0.5	17.7	17.4	24.3	17.9	46.0	-21.7
245.00	-6.3	-1.1	18.6	18.5	12.3	17.4	46.0	-28.6
300.00	-4.2	3.6	20.2	20.8	16.0	24.4	46.0	-21.6
360.00	-7.5	-5.9	22.1	22.5	14.6	16.6	46.0	-29.4
570.00	-9.2	-9.0	27.6	27.9	18.4	18.9	46.0	-27.1

FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1



f > 1000 MHz

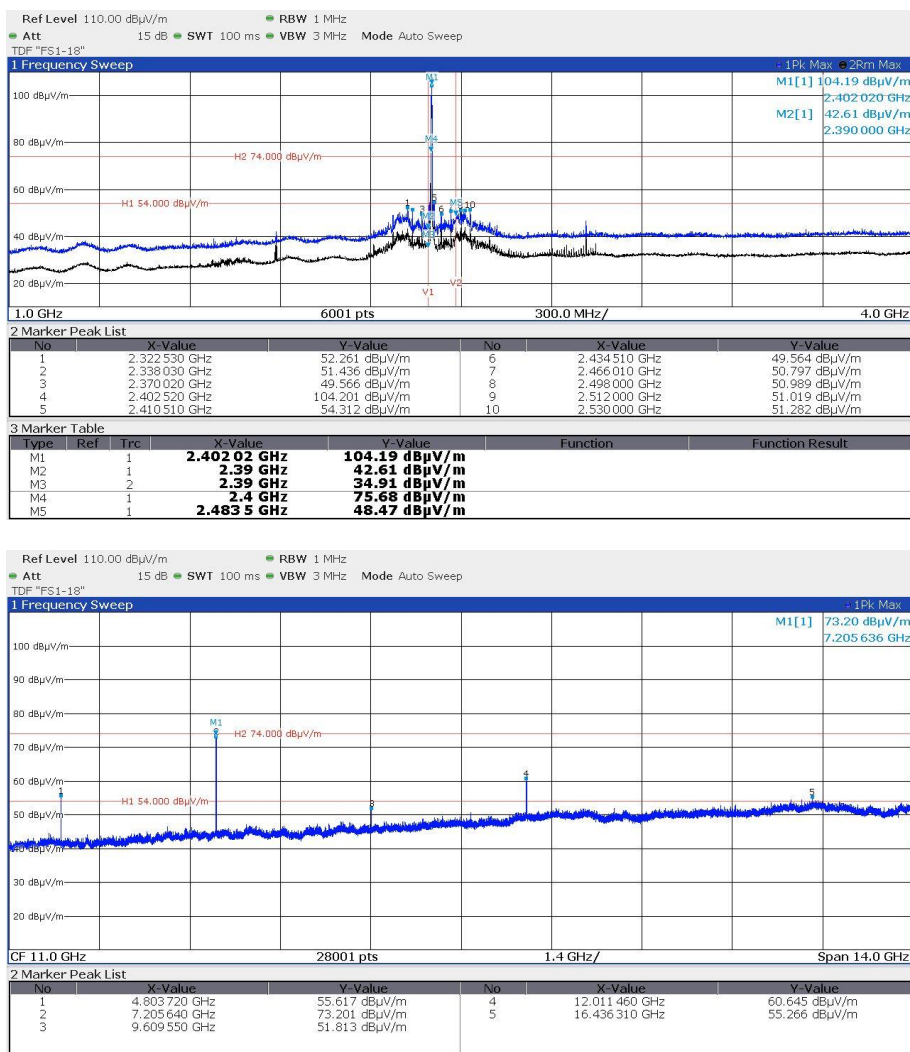
Duty Cycle of the EUT



According to procedures for duty cycle correction, the factor can be calculated as  $\delta(\text{dB}) = 20\log(\Delta)$ . The duty cycle is equal for all used frequencies with  $T_{\text{ON}} = 334\mu\text{s}$  and  $T_{\text{OFF}} = 9.982\text{ ms}$ , therefore all peak values can be corrected with a factor  $\delta(\text{dB}) = -29.5\text{ dB}$ .

# FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## Channel 37 (2402 MHz)

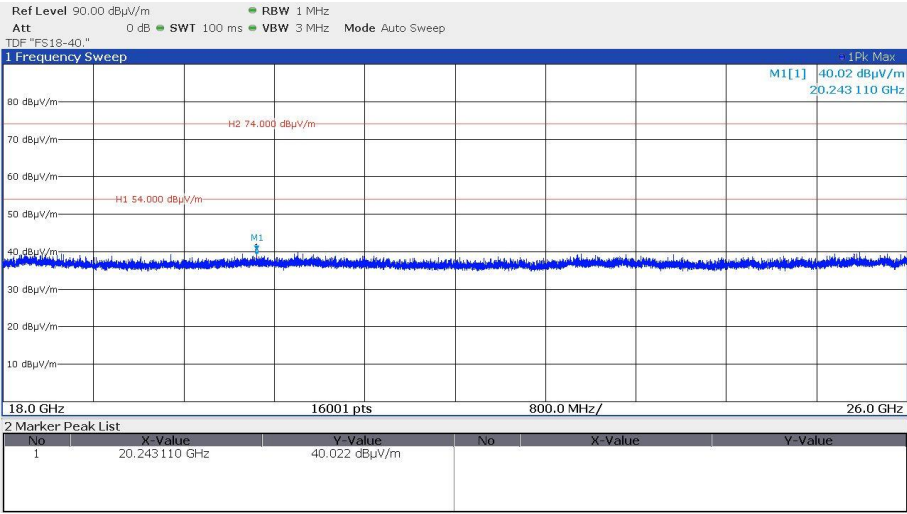


Applying Duty cycle correction of peaks over average limit:

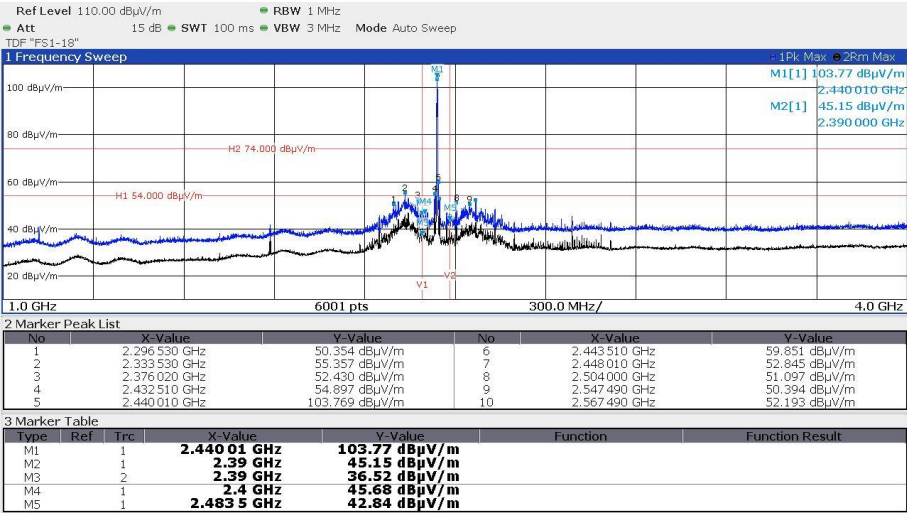
MP (#)	f (GHz)	Peak (dBμV/m)	DC corr. (dB)	AV (dBμV/m)	AV Limit (dBμV/m)	Margin (dB)
1	4.80372	55.6	-29.5	26.1	54.0	-27.9
2	7.20564	73.2	-29.5	43.7	54.0	-10.3
4	12.01146	60.6	-29.5	31.1	54.0	-22.9
5	16.43631	55.3	-29.5	25.8	54.0	-28.2



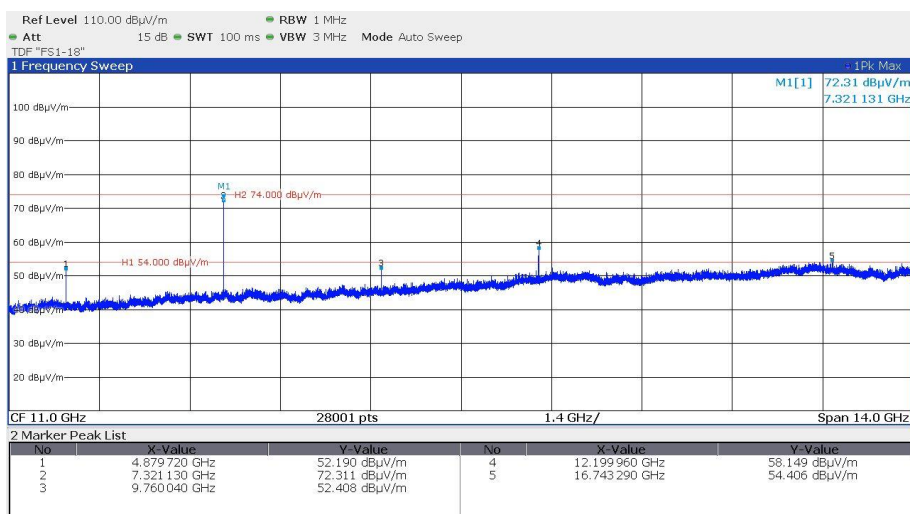
FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1



Channel 17 (2440 MHz)

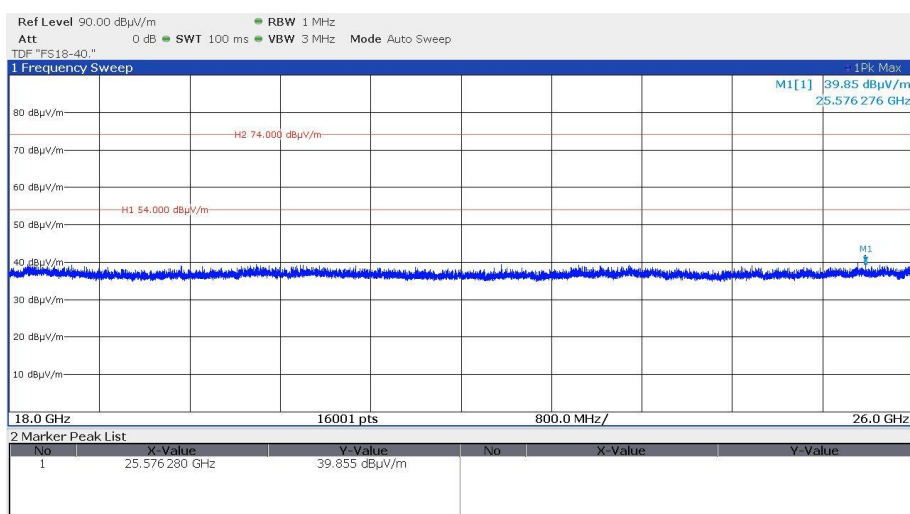


**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**



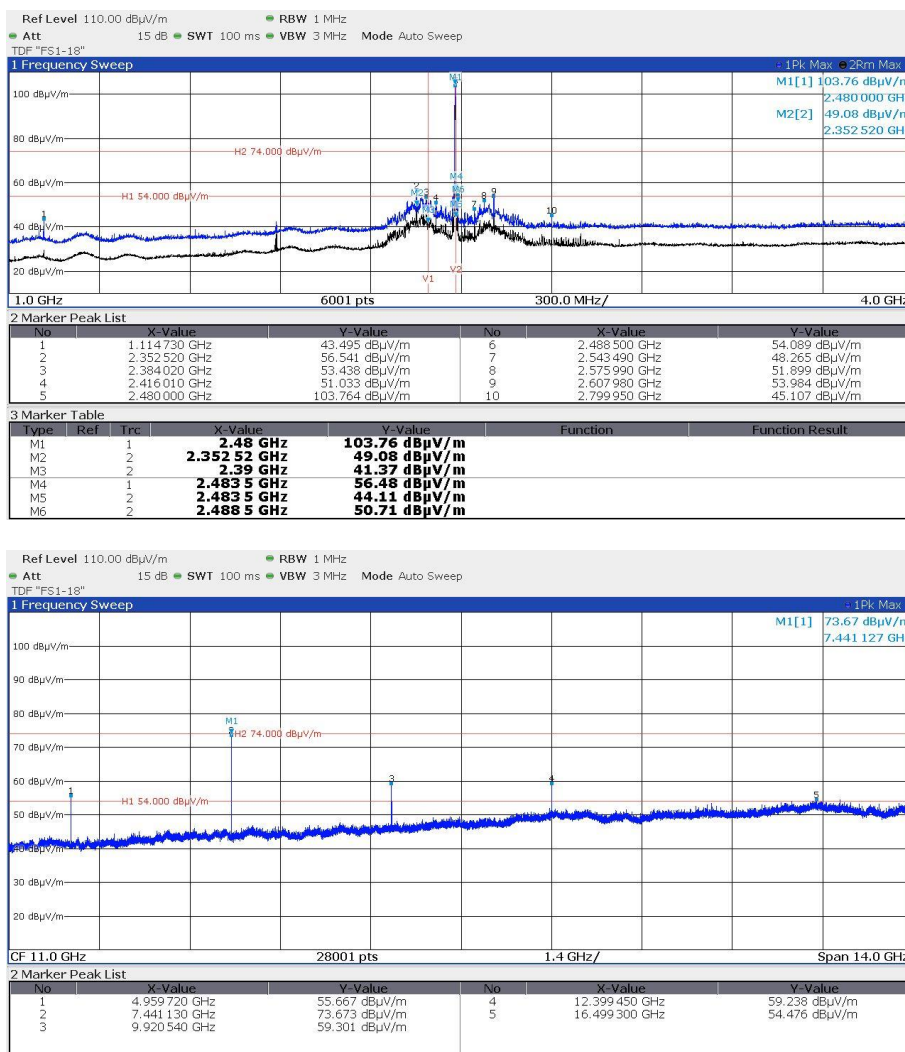
Applying Duty cycle correction of peaks over average limit:

MP (#)	f (GHz)	Peak (dBμV/m)	DC corr. (dB)	AV (dBμV/m)	AV Limit (dBμV/m)	Margin (dB)
2	7.32113	72.3	-29.5	42.8	54.0	11.2
4	12.19996	58.1	-29.5	28.6	54.0	-25.4
5	16.74329	54.4	-29.5	24.9	54.0	-29.1



## FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## Channel 39 (2480 MHz)

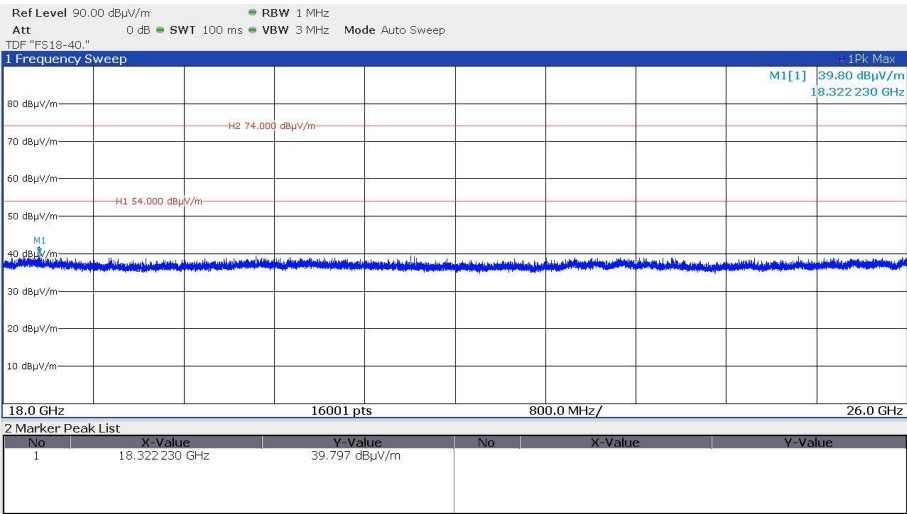


Applying Duty cycle correction of peaks over average limit:

MP (#)	f (GHz)	Peak (dBμV/m)	DC corr. (dB)	AV (dBμV/m)	AV Limit (dBμV/m)	Margin (dB)
1	4.95972	55.7	-29.5	26.2	54.0	-27.8
2	7.44113	73.7	-29.5	44.2	54.0	-9.8
3	9.92054	59.3	-29.5	29.8	54.0	-24.2
4	12.39945	59.2	-29.5	29.7	54.0	-24.3
5	16.4993	54.5	-29.5	25.0	54.0	-29.0



FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1



**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**

Radiated limits according to FCC Part 15 Section 15.209(a) for spurious emissions which fall in restricted bands:

Frequency (MHz)	Field strength of spurious emissions		Measurement distance (metres)
	( $\mu\text{V/m}$ )	dB( $\mu\text{V/m}$ )	
0.009-0.490	2400/F (kHz)		300
0.490-1.705	24000/F (kHz)		30
1.705-30	30	29.5	30
30-88	100	40	3
88-216	150	43.5	3
216-960	200	46	3
Above 960	500	54	3

Radiated limits according to RSS-Gen, 8.9 for spurious emissions which fall in restricted bands:

Frequency (MHz)	RSS-Gen Limits ( $\mu\text{A/m}$ )	Measurement distance (m)
0.009 - -0.49	63.7/f(kHz)	300
0.49 – 1.705	63.7/f(kHz)	30
1.705 – 30.0	0.08	30

Frequency (MHz)	RSS-Gen Limits ( $\mu\text{V/m}$ )	Measurement distance (m)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

Limit according to FCC Part 15, Section 15.247(d) for emissions falling not in restricted bands:

Frequency (MHz)	Spurious emission limit
Below 1000	20 dB below the highest level of the desired power
Above 1000	20 dB below the highest level of the desired power

Attenuation below the general limits specified in Section 15.209(a) is not required.

Limit according to RSS-247, 5.5 for emissions falling not in restricted bands:

Frequency (MHz)	Spurious emission limit
Below 1000	20 dB below the highest level of the desired power
Above 1000	20 dB below the highest level of the desired power

Attenuation below the general limits specified in RSS-Gen is not required.

**FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1**
**Restricted bands of operation:**

The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.69475 – 16.69525	608 – 614	5.35 – 5.46
2.1735 – 2.1905	16.80425 – 16.80475	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2483.5 – 2500	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	2690 – 2900	22.01 – 23.12
8.41425 – 8.41475	162.0125 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 – 3339	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3345.8 – 3358	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4	3600 – 4400	Above 38.6

**RSS-Gen, Table 6 – Restricted Frequency Bands**

MHz	MHz	MHz	GHz
0.090 - 0.110	12.57675 - 12.57725	399.9 - 410	7.250 - 7.750
0.495 - 0.505	13.36 - 13.41	608 - 614	8.025 – 8.500
2.1735 - 2.1905	16.42 - 16.423	960 - 1427	9.0 - 9.2
3.020 - 3.026	16.69475 - 16.69525	1435 - 1626.5	9.3 - 9.5
4.125 - 4.128	16.80425 - 16.80475	1645.5 - 1646.5	10.6 - 12.7
4.17725 - 4.17775	25.5 - 25.67	1660 - 1710	13.25 - 13.4
4.20725 - 4.20775	37.5 - 38.25	1718.8 - 1722.2	14.47 - 14.5
5.677 - 5.683	73 - 74.6	2200 - 2300	15.35 - 16.2
6.215 - 6.218	74.8 - 75.2	2310 - 2390	17.7 - 21.4
6.26775 - 6.26825	108 – 138	2483.5 - 2500	22.01 - 23.12
6.31175 - 6.31225	149.9 - 150.05	2655 - 2900	23.6 - 24.0
8.291 - 8.294	156.52475 - 156.52525	3260 – 3267	31.2 - 31.8
8.362 - 8.366	156.7 - 156.9	3332 - 3339	36.43 - 36.5
8.37625 - 8.38675	162.0125 - 167.17	3345.8 - 3358	Above 38.6
8.41425 - 8.41475	167.72 - 173.2	3500 - 4400	
12.29 - 12.293	240 – 285	4500 - 5150	
12.51975 - 12.52025	322 - 335.4	5350 - 5460	

The requirements are **FULFILLED**.

**Remarks:** The measurement was performed up to the 10<sup>th</sup> harmonic.

FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## 5.6 Antenna application

### 5.6.1 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.

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

Remarks: None.

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FCC ID: 2ALC5-KNX-AM1 IC: 25557-KNXAM1

## 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 2023.0.8.0	01-02/68-13-001				
	ESCI	02-02/03-15-001	03/07/2024	03/07/2023		
	ESH 2 - Z 5	02-02/20-05-004	13/10/2025	13/10/2022	17/04/2024	17/04/2023
	N-4000-BNC	02-02/50-05-138				
	ESH 3 - Z 2	02-02/50-05-155	09/11/2025	09/11/2022	06/08/2024	06/02/2024
MB	FSW43	02-02/11-15-001	04/05/2024	04/05/2023		
	minibend KR-16	02-02/50-16-016				
SER 1	ESCI	02-02/03-05-004	05/10/2024	05/10/2023		
	HFH 2 - Z 2	02-02/24-05-020	01/06/2025	01/06/2022	05/09/2024	05/09/2023
	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 2	ESVS 30	02-02/03-05-006	27/07/2024	27/07/2023		
	VULB 9168	02-02/24-05-005	20/04/2024	20/04/2023	03/05/2024	03/05/2023
	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	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	12/07/2024	12/07/2023		
	BBHA 9170	02-02/24-05-013	21/03/2026	21/03/2023	21/03/2024	21/03/2023
	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 2023.0.8.0	02-02/68-13-001				