



EMI – TEST REPORT

- Human Exposure -

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. : **T44481-00-05KS**

05. March 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-IREC2

Contents

1	<u>TEST STANDARDS</u>	<u>3</u>
2	<u>EQUIPMENT UNDER TEST</u>	<u>4</u>
2.1	Photo documentation of the EUT – See ATTACHMENT B	4
2.2	Equipment type, category	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	Antennas	5
2.7	Power supply system utilised	5
3	<u>TEST RESULT SUMMARY</u>	<u>6</u>
3.1	Final assessment	6
4	<u>TEST ENVIRONMENT</u>	<u>7</u>
4.1	Address of the test laboratory	7
4.2	Environmental conditions	7
4.3	Statement of the measurement uncertainty	7
5	<u>HUMAN EXPOSURE</u>	<u>8</u>
5.1	Maximum peak conducted output power	8
5.2	Maximum permissible exposure (MPE)	9
5.3	Co-location and Co-transmission	12
5.4	SAR test exclusion considerations	12

ATTACHMENT B as separate supplement

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules and Regulations Part 1, Subpart I - Procedures Implementing the National Environmental Policy Act of 1969

Part 1, Subpart I, Section 1.1310 Radiofrequency radiation exposure limits

Part 1, Subpart 2, Section 2.1091 Radiofrequency radiation exposure evaluation: **mobile devices**.

Part 1, Subpart 2, Section 2.1093 Radiofrequency radiation exposure evaluation: **portable devices**.

OET Bulletin 65, 65A, 65B Edition 97-01, August 1997 – Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

KDB 447498 D01 v06 Mobile and portable devices RF Exposure procedures and equipment authorisation policies, October 23, 2015.

KDB 865664 D01 v01r04 SAR Measurement Requirements for 100 MHz to 6 GHz, August 7, 2015.

ANSI C95.1: 2005 IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

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

FCC ID: 2ALC5-KNX-IREC2

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – See ATTACHMENT B

2.2 Equipment type, category

Fixed UWB device for indoor use

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.

The EUT has two identical UWB modules. Additionally, the EUT has an integrated WLAN and Bluetooth low energy module with integrated antennas. These modules are already certified with the FCC ID (WLAN module): TFB-1004 and FCC ID (BLE module): X8WBT840.

Number of tested samples: 1 sample
Serial number: pre-production sample
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

BLE is working in the frequency range 2400 MHz to 2483.5 MHz

WLAN is working in the frequency range 2400 MHz to 2483.5 MHz and 5180 MHz to 5825 MHz

FCC ID: 2ALC5-KNX-IREC2**2.6 Antennas**

The following antennas shall be used with the EUT:

UWB: mounted antennas with following gain: 4.15 dBi peak

WLAN: integrated antenna with following gain: 1.0 dBi peak (2.4 GHz) / -1.5 dBi peak (5 GHz)

BLE: integrated antenna with following gain: 0.54 dBi peak

2.7 Power supply system utilised

Power supply voltage, V_{nom} : 12 V DC

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.

FCC ID: 2ALC5-KNX-IREC2

3 TEST RESULT SUMMARY

FCC Rule Part	Description	Result
15.247(i)	MPE	passed
KDB 447498	SAR exclusion consideration	not applicable
OET Bulletin 65	Co-location, Co-transmission	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 : 08 October 2018

Checked by:

Tested by:

Klaus Gegenfurtner
Teamleader Radio

Kathrin Schiebl
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

**CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY**

4.2 Environmental conditions

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

Temperature: 15-35 °C

Humidity: 30-60 %

Atmospheric pressure: 86-106 kPa

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor $k = 2$. The true value is located in the corresponding interval with a probability of 95 %. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 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%	± 3.29 dB
EBW and OBW	2400 MHz to 3000 MHz	95%	$\pm 2.5 \times 10^{-7}$
Maximum peak conducted output power	2400 MHz to 3000 MHz	95%	± 0.62 dB
Power spectral density	2400 MHz to 3000 MHz	95%	± 0.62 dB
Conducted Spurious Emissions	9 kHz to 10000 MHz	95%	± 2.15 dB
Conducted Spurious Emissions	10000 MHz to 40000 MHz	95%	± 3.47 dB
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	± 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	± 3.71 dB
Radiated Spurious Emissions	1000 MHz to 10000 MHz	95%	± 2.34 dB
Field strength of the fundamental	100 kHz to 100 MHz	95%	± 3.53 dB

5 HUMAN EXPOSURE

5.1 Maximum peak conducted output power

5.1.1 Test result

UWB 1:

EIRP = rated output power + tune up tolerance + gain = -49 dB/MHz + 3 dB + 4.15 dBi = **-41.85 dBm/MHz**

UWB 2:

EIRP = rated output power + tune up tolerance + gain = -49 dB/MHz + 3 dB + 4.15 dBi = **-41.85 dBm/MHz**

Bluetooth low energy:

The output power of the device is taken from the power measurement in the test report ISL-18LR094FC of the test laboratory International Standards Laboratory.

2480 MHz: EIRP = conducted power + tune up tolerance + gain = 6.21 dBm + 1.0 dB + 0.54 dBi = **7.75 dBm**

WLAN 2.4 GHz:

The output power of the device is taken from the power measurement in the test report TR 316356 E (RFx) of the test laboratory Laird Technologies, Inc.

2412 MHz: EIRP = conducted power + tune up tolerance + gain = 21.50 dBm + 2.0 dB + 1.0 dBi = **24.50 dBm**

WLAN 5 GHz:

The output power of the device is taken from the power measurement in the test report TR 316356 E (RFx) of the test laboratory Laird Technologies, Inc.

5745 MHz: EIRP = conducted power + tune up tolerance + gain = 15.80 dBm + 2.0 dB - 1.5 dBi = **16.3 dBm**

Remarks: As worst case the power values are not averaged over time.

5.2 Maximum permissible exposure (MPE)

5.2.1 Description of the test location

Test location: NONE

5.2.2 Applicable standard

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

Systems operating under the provisions of this section shall be operated in a manner that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

The test methods used comply with ANSI/IEEE C95.1, "IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz".

This test report shows the compliance with the limits for Maximum Permissible Exposure (MPE) specified in FCC Part 1, Section 1.1310 and the criteria to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in FCC Part 1, Section 1.1307(b).

5.2.3 Description of Measurement

The maximum total power input to the antenna has been measured conducted as described in clause 5.3 of this document. Through the Friis transmission formula, the known maximum gain of the antenna and the maximum power, can be calculated the MPE in a defined distance away from the product.

Friis transmission formula:

$$P_d = \frac{P_{out} * G}{4 * \pi * r^2}$$

Where:

P_d = power density (mW/cm²)

P_{out} = output power to antenna (mW)

G = gain of antenna (linear scale)

r = distance between antenna and observation point (cm)

According to FCC Rules 47CFR 2.1093(b) the EUT is not a portable device. The EUT is designed to be used that radiating structures are 20 cm outside of the body of the user. ($r = 20$ cm)

FCC ID: 2ALC5-KNX-IREC2
5.2.4 Test result

UWB 1:

Channel	EIRP	Antgain	EIRP	G	EIRP	S	Limit S_{eq}	Margin	Exposure ratio
No.	(dBm)	(dBi)	(mW)	linear	(W)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
1	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013
2	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013
3	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013
5	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013

UWB 2:

Channel	EIRP	Antgain	EIRP	G	EIRP	S	Limit S_{eq}	Margin	Exposure ratio
No.	(dBm)	(dBi)	(mW)	linear	(W)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
1	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013
2	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013
3	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013
5	-41.9	4.15	0.0000653	2.60	0.000000065	0.000000000013	1.0	-0.9999999999	0.0000000013

BLE:

Channel	max. EIRP	Antgain	EIRP	G	EIRP	S	Limit S_{eq}	Margin	Exposure ratio
No.	(dBm)	(dBi)	(mW)	linear	(W)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
37	7.7	0.5	5.94	1.13	0.0059	0.0012	1.0	-0.9988	0.12
17	7.7	0.5	5.94	1.13	0.0059	0.0012	1.0	-0.9988	0.12
39	7.7	0.5	5.94	1.13	0.0059	0.0012	1.0	-0.9988	0.12

WLAN 2.4 GHz

Channel	EIRP	Antgain	EIRP	G	EIRP	S	Limit S_{eq}	Margin	Exposure ratio
No.	(dBm)	(dBi)	(mW)	linear	(W)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
1	24.5	1.0	281.83	1.26	0.2818	0.0561	1.0	-0.9439	5.61
6	24.5	1.0	281.83	1.26	0.2818	0.0561	1.0	-0.9439	5.61
11	24.5	1.0	281.83	1.26	0.2818	0.0561	1.0	-0.9439	5.61

WLAN 5 GHz

Channel	EIRP	Antgain	EIRP	G	EIRP	S	Limit S_{eq}	Margin	Exposure ratio
No.	(dBm)	(dBi)	(mW)	linear	(W)	(mW/cm ²)	(mW/cm ²)	(mW/cm ²)	(%)
149	16.3	-1.5	42.66	0.71	0.0427	0.0085	1.0	-0.9915	0.85
157	16.3	-1.5	42.66	0.71	0.0427	0.0085	1.0	-0.9915	0.85
165	16.3	-1.5	42.66	0.71	0.0427	0.0085	1.0	-0.9915	0.85

FCC ID: 2ALC5-KNX-IREC2

Limits for maximum permissible exposure (MPE):

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(B) Limits for General Population / Uncontrolled Exposure				
0.3 – 1.34	614	1.63	100	30
1.34 – 30	824/ <i>f</i>	2.19/ <i>f</i>	180/ <i>f</i> ²	30
30 - 300	27.5	0.073	0.2	30
300-1500	---	---	<i>f</i> /1500	30
1500-100000	---	---	1.0	30

f = Frequency in MHz

The requirements are **FULFILLED**.

Remarks:

-

FCC ID: 2ALC5-KNX-IREC2

5.3 Co-location and Co-transmission

Applicable standard:

OET Bulletin 65, Edition 97-01, Section 2: Multiple-transmitter sites and Complex Environments

The FCC's MPE limits vary with frequency. Therefore, in mixed or broadband RF fields where several sources and frequencies are involved, the fraction of the recommended limit (in terms of power density or square of the electric or magnetic field strength) incurred within each frequency interval should be determined, and the sum of all fractional contributions should not exceed 1.0, or 100 % in terms of percentage.

Maximum power density ratio BLE (%)	Maximum power density ratio WLAN 2.4 GHz (%)	Maximum power density ratio WLAN 5 GHz (%)	Maximum power density ratio UWB 1 (%)	Maximum power density ratio UWB 2 (%)	Sum of exposure ratios (%)
0.1183	5.6068	0.8487	0.0000000013	0.0000000013	6.57

The requirements are **FULFILLED**.

Remarks:

-

5.4 SAR test exclusion considerations

Remarks:

Not applicable, because the EUT is a fixed equipment and the distance between the EUT and the user is more than 20 cm.