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. : T44481-00-06KS	03. June 2019 Date of issue

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

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FCC ID: 2ALC5-KNX-HREC2

Contents

ATTACHMENT B as separate supplement

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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

2 EQUIPMENT UNDER TEST

2.1 Photo documentation of the EUT – See ATTACHMENT B

2.2 Equipment type, category

Portable UWB device for indoor an doutdoor 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

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 EUT can be powered over Ethernet.

3 TEST RESULT SUMMARY

FCC Rule Part	Description	Result
15.247(i)	MPE	not applicable
KDB 447498	SAR exclusion consideration	passed
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:

Klaus Gegenfurtner
I confirm the correctness and integrity of this document.
2019.06.04 08:17:42 +02'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

Franz-Xaver Schrettenbrunner
I am the author of this document
2019.06.03 08:36:36 +02'00'

Franz-Xaver Schrettenbrunner
Radio Team

4 TEST ENVIRONMENT

4.1 Address of the test laboratory

CSA Group Bayern GmbH
Ohmstrasse 1-4
94342 STRASSKIRCHEN
GERMANY

4.2 Environmental conditions

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

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

4.3 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. It is noted that the expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2. The true value is located in the corresponding interval with a probability of 95 % The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4-2 / 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)

Remarks: Not applicable. Because the separation distance is below 20 cm. Therefore, a SAR test exclusion consideration was made.

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.

The requirements are **FULFILLED.**

Remarks: Not applicable. Because the separation distance is below 20 cm. Therefore, a SAR test exclusion consideration for simultaneous transmission was made.

5.4 SAR test exclusion considerations

5.4.1 Applicable standard

According to RF exposure guidance:
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.

5.4.2 Determination of the standalone SAR test exclusion threshold

For UWB:

The minimum separation distance results from the application of the EUT which is handled by hand. This distance is assumed to ≤ **70 mm** from antenna to the hand of the user.

The formula under 4.3.1 b) 2) for 100 MHz to 6 GHz and test separation distances > 50 mm for standalone equipment is used to determine the threshold level:
{[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW

The max conducted average power is according to the equipment (UWB module):

Rated output power:	0.000025	mW	-49.0	dBm
Tune-up tolerance:	3.00	dB		
Maximum output power:	-46.0	dBm	0.000025	mW
Antenna gain max:	4.15	dBi		
Maximum EIRP:	-41.9	dBm	0.00007	mW
Minimum distance r:	70.0	mm		

Channel frequency (MHz)	Rated power (mW)	Threshold level 70 mm (mW)	Margin
3494.4	0.0000251	438.0	-437.99997
3993.6	0.0000251	438.0	-437.99997
4492.8	0.0000251	438.0	-437.99997

Conclusion: The Threshold level is much lower than the limit, SAR measurement is not necessary.

FCC ID: 2ALC5-KNX-HREC2

For BLE:

The minimum separation distance results from the application of the EUT which is handled by hand. This distance is assumed to ≥ **70 mm** from antenna to the hand of the user.

The formula under 4.3.1 b) 2) for 100 MHz to 6 GHz and test separation distances > 50 mm for standalone equipment is used to determine the threshold level:
{[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW

The max conducted average power is according the equipment (BLE module):

Rated output power:	4.2 mW	6.2 dBm
Tune-up tolerance:	1.00 dB	
Maximum output power:	7.2 dBm	5.3 mW
Antenna gain max:	0.54 dBi	
Maximum EIRP:	7.8 dBm	6.0 mW
Minimum distance r:	70.0 mm	

Channel frequency (MHz)	Rated power (mW)	Threshold level 70 mm (mW)	Margin
2402	5.3	438.0	-432.7
2440	5.3	438.0	-432.7
2480	5.3	438.0	-432.7

Conclusion: The Threshold level is much lower than the limit, SAR measurement is not necessary.

FCC ID: 2ALC5-KNX-HREC2

For WLAN 2.4 GHz:

The minimum separation distance results from the application of the EUT which is handled by hand. This distance is assumed to ≥ **70 mm** from antenna to the hand of the user.

The formula under 4.3.1 b) 2) for 100 MHz to 6 GHz and test separation distances > 50 mm for standalone equipment is used to determine the threshold level:
{[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW

The max conducted average power is according the equipment (WLAN module):

Rated output power:	141.3 mW	21.5 dBm
Tune-up tolerance:	2.00 dB	
Maximum output power:	23.5 dBm	223.9 mW
Antenna gain max:	1.0 dBi	
Maximum EIRP:	24.5 dBm	281.8 mW
Minimum distance r:	70.0 mm	

Channel frequency (MHz)	Rated power (mW)	Threshold level 70 mm (mW)	Margin
2412	223.9	438.0	-214.1
2440	223.9	438.0	-214.1
2472	223.9	438.0	-214.1

Conclusion: The Threshold level is much lower than the limit, SAR measurement is not necessary.

FCC ID: 2ALC5-KNX-HREC2

For WLAN 5 GHz:

The minimum separation distance results from the application of the EUT which is handled by hand. This distance is assumed to ≥ **70 mm** from antenna to the hand of the user.

The formula under 4.3.1 b) 2) for 100 MHz to 6 GHz and test separation distances > 50 mm for standalone equipment is used to determine the threshold level:
{[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW

The max conducted average power is according the equipment (WLAN module):

Rated output power:	38.0 mW	15.8 dBm
Tune-up tolerance:	2.00 dB	
Maximum output power:	17.8 dBm	60.3 mW
Antenna gain max:	-1.5 dBi	
Maximum EIRP:	16.3 dBm	42.7 mW
Minimum distance r:	70.0 mm	

Channel frequency (MHz)	Rated power (mW)	Threshold level 70 mm (mW)	Margin
5745	60.3	355.0	-294.7
5785	60.3	355.0	-294.7
5825	60.3	355.0	-294.7

Conclusion: The Threshold level is much lower than the limit, SAR measurement is not necessary.

Remarks: The manufacturer declares a minimum distance of 7 cm as use case as the device will be mounted on a tripod.

5.4.3 Determination of the SAR test exclusion threshold for simultaneous transmission

When all modules are active the ratios of the transmitters are summed and have to be < 1.

Transmitter	Rated output power (mW)	Threshold at 70 mm (mW)	Ratio
BLE	224	438	0.51
WLAN 2.4 GHz	5	438	0.01
WLAN 5 GHz	60	355	0.16

Level BLE module + level WLAN 2.4 GHz module

0.01 +0.51 = 0.52 < 1

Level BLE module + level WLAN 5 GHz module

0.01 + 0.17 = 0.18 < 1

Conclusion: The Threshold level is lower than the limit, SAR measurement is not necessary. All modules can be co-located without exceeding SAR limits.

The requirements are **FULFILLED.**

Remarks: The ratio of the UWB transmitter is not included as the value it too low and therefore not significant.