RF – TEST REPORT

- Human Exposure -

Type / Model Name	:	KINEXON Mesh Tag / T07001
Product Description	:	Tracking-Tag for an UWB localization system
Applicant	:	Kinexon Inc.
Address	:	200 S Wacker Drive, Suite 3100
		CHICAGO, IL 60606, USA
Manufacturer	:	Kinexon GmbH
Address	:	Schellingstraße 35
		80799 MÜNCHEN, GERMANY

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

Test Report No. : 80183169-07 Rev0	15. December 2023 Date of issue

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

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FCC ID: 2ALC5-KNX-TM1 IC: 25557-KNXTM1

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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**.
KDB 447498 D04	RF Exposure procedures and equipment authorisation policies for mobile and portable devices, November 29, 2021.
RSS-102 Issue 5, March 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication apparatus (All Frequnecy Bands)
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 Information provided by the Client

Please note, we do not take any responsibility for information provided by the client or his representative which may have an influence on the validity of the test results.

2.2 Sampling

The customer is responsible for the choice of sample. Sample configuration, start-up and operation is carried out by the customer or according his/her instructions.

2.3 Photo documentation of the EUT – See ATTACHMENT A

2.4 Equipment type, category

UWB device, BLE device, portable equipment.

2.5 Short description of the equipment under test (EUT)

The KINEXON Mesh system is a sophisticated real-time location system (RTLS) designed to provide precise tracking and asset management solutions. Tags are small devices equipped with UWB, BLE, and accelerometer functionalities. Devices affixed to assets that emit UWB beacons.

Number of tested samples: 1
Serial number: pre-production sample #16 (UWB worst case transmission with 1 Hz repetition rate)
pre-production sample #17 (BLE worst case transmission with 1 Hz repetition rate)
Firmware version: V0.1.0

2.6 Variants of the EUT

According to the manufacturer, there are two variants.

KNX-no.	Description	Comment
KNX-T7.1-1.1-1	Mesh Tag with accelerometer WSEN-ITDS	1:1 replacement for LIS2DE12, other supplier
KNX-T7.1-2.1-1	Mesh Tag with accelerometer LIS2DE12	1:1 replacement for WSEN-ITDS, other supplier

2.7 Operation frequency and channel plan

The operating frequencies are 2400 MHz to 2483.5 MHz and 3100 MHz to 10600 MHz.

Channel plan UWB (FCC)

Channel number	f_c (MHz)
Channel 3	4492.8
Channel 5	6489.6

Channel plan UWB (IC)

Channel number	f_c (MHz)
Channel 5	6489.6

Channel plan BLE

Channel	Frequency (MHz)	Channel	Frequency (MHz)
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

2.8 Transmit operating modes

UWB

Variable pulse position modulation (PPM) in combination with BPSK modulation at 6.8 Mbps data rate.

BLE

802.15.1 standard with GFSK modulation at 1 Mbps data rate.

2.9 Antennas

UWB

Number	Characteristic	Model number	Plug	f-range (GHz)	Gain (dBi)
1	Omni	PCB antenna WB001	None	3.5 – 7.0	4.0 at 4.0 GHz 3.7 at 6.5 GHz

BLE

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

2.10 Power supply system utilised

Power supply voltage, V_{nom} : 3.0 V DC

FCC ID: 2ALC5-KNX-TM1 **IC: 25557-KNXTM1**

3 TEST RESULT SUMMARY

FCC Rule Part	RSS Rule Part	Description	Result
KDB 447498, 7.1	RSS 102, 2.5.2	MPE	not applicable
KDB 447498, 4.3.1	RSS 102, 2.5.1	SAR exclusion consideration	passed
KDB 447498, 7.2	RSS102, 3.2	Co-location, Co-transmission	passed

The mentioned RSS Rule Parts in the above table are related to:
RSS 102, Issue 5, March 2015

3.1 Revision history of test report

Test report No	Rev.	Issue Date	Changes
80183169-07	0	15 December 2023	Initial test report

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

3.2 Final assessment

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

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

Testing commenced on : 18 September 2023

Testing concluded on : 18 September 2023

Checked by:

Klaus Gegenfurtner
I confirm the correctness and integrity of this document
2023.12.15 12:36:30 +01'00'

Klaus Gegenfurtner
Teamleader Radio

Tested by:

I am the author of this document
2023.12.15 09:48:13 +01'00'

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 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.

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.

5 HUMAN EXPOSURE

5.1 SAR test exclusion considerations

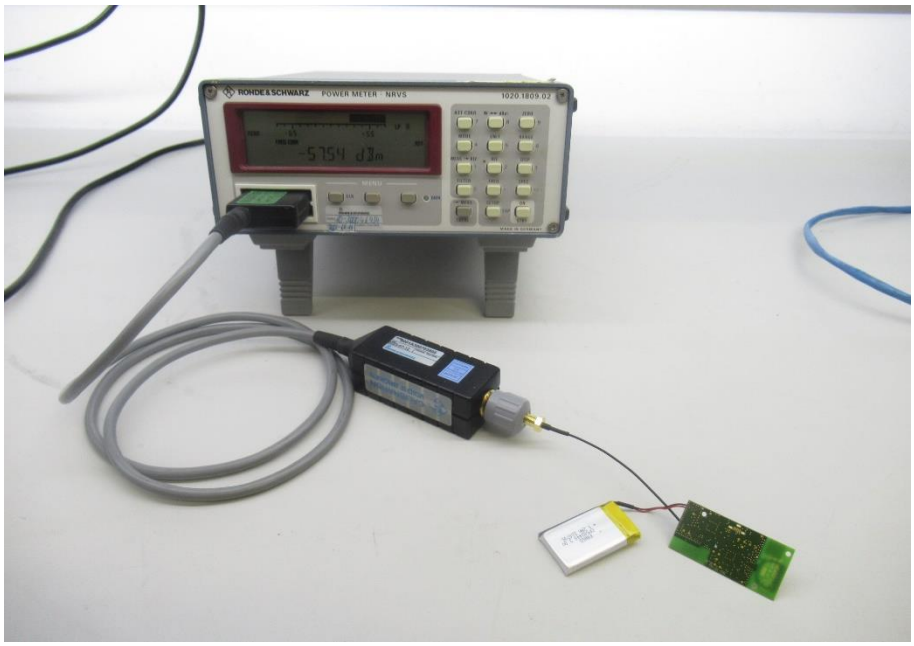
For test instruments and accessories used see section 6 Part **HE**.

5.1.1 Description of the test location

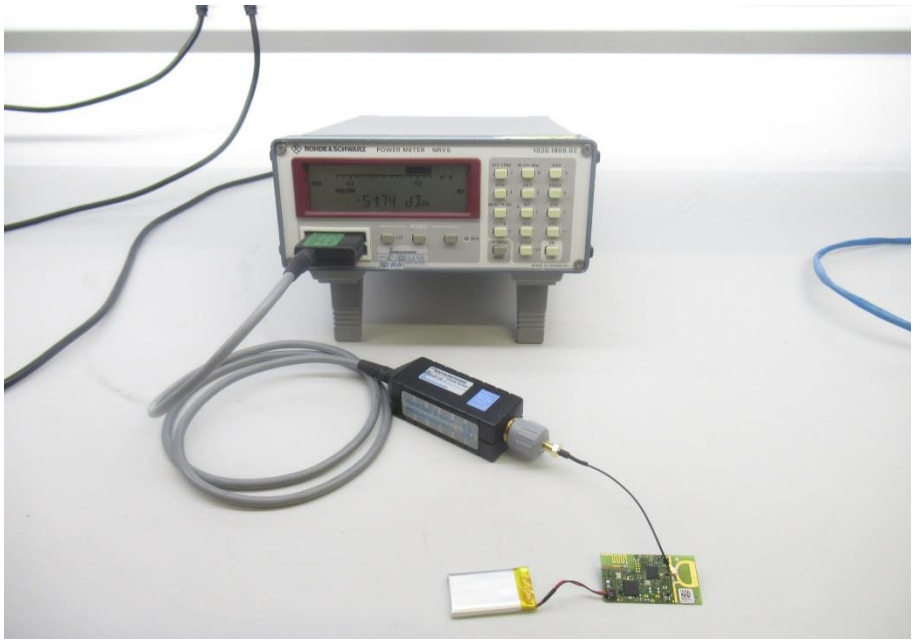
Test location: Shielded Room S6

5.1.2 Photo documentation of the test set-up

BLE



UWB



5.1.3 Applicable standard

According to KDB 447498 clause 2.2.1:
As discussed in § 1.1307(b)(3)(ii)(A), the 1-mW exemption intended for single transmitters may be also applied to simultaneous transmission conditions, within the same host device, according one of the following criteria:

a) When maximum available power each individual transmitting antenna within the same time averaging period is ≤ 1 mW, and the nearest parts of the antenna structures of the simultaneously operating transmitters are separated by at least 2 cm.
b) When the aggregate maximum available power of all transmitting antennas is ≤ 1 mW in the same time-averaging period.

This exemption may not be combined with any other exemption.

5.1.4 Determination of RF exposure exemption for simultaneous transmission

The conducted emissions of both UWB and BLE are measured with a power meter.

UWB	P_c = -51.7 dBm	P_c = 6.76 nW
	G = 4.0 dBi	
	EIRP = -47.7 dBm	**EIRP = 16.98 nW**
BLE	P_c = -57.5 dBm	P_c = 1.78 nW
	G = 1.6 dBi	
	EIRP = -55.9	**EIRP = 2.57 nW**

The total sum of all radiated emissions is 16.98 nW + 2.57 nW = **19.55** nW

The EUT qualifies for 1 mW exemption for simultaneous transmission.

The requirements are **FULFILLED.**

Remarks: None.

5.2 Exemption limits for routine evaluation - SAR evaluation

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

5.2.1 Applicable standard

According to RSS-102, item 2.5.1:
SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance 4, 5

Frequency (MHz)	**Exemption Limits (mW)**				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	**4 mW**	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	**1 mW**	6 mW	15 mW	27 mW	41 mW

Frequency (MHz)	**Exemption Limits (mW)**				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤ 300	223 mW	254 mW	284 mW	315 mW	345 mW
450	141 mW	159 mW	88 mW	195 mW	213 mW
835	80 mW	92 mW	177 mW	117 mW	130 mW
1900	99 mW	153 mW	225 mW	316 mW	431 mW
2450	83 mW	123 mW	173 mW	235 mW	309 mW
3500	86 mW	124 mW	170 mW	225 mW	290 mW
5800	56 mW	71 mW	85 mW	97 mW	106 mW

4 The exemption limits in Table 1 are based on measurements and simulations of half-wave dipole antennas at separation distances of 5 mm to 25 mm from a flat phantom, providing a SAR value of approximately 0.4 W/kg for 1 g of tissue. For low frequencies (300 MHz to 835 MHz), the exemption limits are derived from a linear fit. For high frequencies (1900 MHz and above), the exemption limits are derived from a third order polynomial fit.
5 Transmitters operating between 0.003-10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in Section 4.

5.2.2 Cunclusion according to RSS-102.

The conducted emissions of both UWB and BLE are measured with a power meter.

UWB	P_c = -51.7 dBm	P_c = 6.76 nW
	G = 4.0 dBi	
	EIRP = -47.7 dBm	**EIRP = 16.98 nW**
BLE	P_c = -57.5 dBm	P_c = 1.78 nW
	G = 1.6 dBi	
	EIRP = -55.9	**EIRP = 2.57 nW**

The total sum of all radiated emissions is 16.98 nW + 2.57 nW = **19.55** nW

The requirements are **FULFILLED.**

Remarks: _____

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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.
HE	NRVS	02-02/07-06-003				
	NRV-Z15	02-02/07-07-001	12/07/2024	12/07/2023		