Test Report
20-1-0194901T14a

D-PL-12047-01-01
D-PL-12047-01-03
D-PL-12047-01-04

Number of pages:	15	**Date of Report:**	2021-Dec-06
Testing company:	CETECOM GmbH Im Teelbruch 116 45219 Essen Germany Tel. + 49 (0) 20 54 / 95 19-0 Fax: + 49 (0) 20 54 / 95 19-150	**Applicant:**	Eliko Tehnoloogia Arenduskeskus OÜ
Product: **Model:**	**Positioning device** **ELIKO ANCHOR**		
FCC ID:	2AF2I-ANCHOR Contains FCC ID: 2AC7Z-ESPWROOM32D		
Testing has been carried out in accordance with:	**FCC Regulations** Part 1.1310 Part 2.1091 Deviations, modifications or clarifications (if any) to above mentioned documents are written in each section under "Test method and limit".		
Tested Technology:	WLAN, UWB		
Test Results:	☒ **The EUT complies with the requirements in respect of all parameters subject to the test.** The test results relate only to devices specified in this document		

Signatures:

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Testing Expert

Authorization of test report | Responsible of test report

Table of Contents

Table of Annex			
Annex No.	**Contents**	**Reference Description**	**Total Pages**
Annex 1	External photographs of EUT	**CETECOM_TR20_1_0194901T14a_A1**	3
Annex 2	Tune up and Antenna gain Information	**MPE Information Requirements-v1**	1
The listed attachments are separate documents.			

1 General information

1.1 Disclaimer and Notes

The test results of this test report relate exclusively to the test item specified in this test report as specified in chapter 2.7. CETECOM does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.
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Also we refer on special conditions which the applicant should fulfill according §2.927 to §2.948, special focus regarding modification of the equipment and availability of sample equipment for market surveillance tests.

1.2 Summary of Test Results

The test results apply exclusively to the test samples as presented in this Report. The CETECOM GmbH does not assume responsibility for any conclusions and generalizations taken in conjunction with other specimens or samples of the type of the item presented to tests.

The presented Equipment Under Test (in this report, hereinafter referred as EUT) integrates follwing RF Transceiver:

RF Transceiver	WLAN
	UWB

Other implemented wireless technologies were not considered within this test report.

Following tests have been performed to show compliance with applicable FCC Part 2.1091 and FCC Part 1.1310 of the FCC CFR 47 Rules.

RF-Exposure Evaluation (separation distance user to RF-radiating element greater 20cm)						
Test cases	**Port**	**References & Limits**		**EUT set-up**	**EUT op. mode**	**Result**
		FCC Standard	Test Limit			
Radio frequency radiation exposure Requirements	Cabinet	§1.1310 §2.1091	RF-Field Strength Limits: FCC: “general population/ uncontrolled” environment	1	1 to 5	PASSED

Remark: Calculations based on Datasheet delivered by applicant

PASSED	The EUT complies with the essential requirements in the standard.
FAILED	The EUT does not comply with the essential requirements in the standard.
NP	The test was not performed by the CETECOM Laboratory.
NT	Not tested
N/A	Not applicable

2 Administrative Data

2.1 Identification of the Testing Laboratory

Company name:	CETECOM GmbH
Address:	Im Teelbruch 116 45219 Essen - Kettwig Germany
Responsible for testing laboratory:	Ninovic Perez
Accreditation scope:	DAkkS Webpage
Test location:	CETECOM GmbH; Im Teelbruch 116; 45219 Essen - Kettwig

2.2 General limits for environmental conditions

Temperature:	22±2 °C
Relative. humidity:	45±15% rH

2.3 Test Laboratories sub-contracted

Company name:	--

2.4 Organizational Items

Responsible test manager:	B.Eng. Martin Nunier
Receipt of EUT:	08.04.2021
Date(s) of test:	--
Version of template:	21.1

2.5 Applicant's details

Applicant's name:	Eliko Tehnoloogia Arenduskeskus OÜ
Address:	Aiandi 13/1 12918 Tallinn Estonia
Contact Person:	Inderk Ruiso
Contact Person's Email:	info@eliko.ee

2.6 Manufacturer's details

Manufacturer's name:	same as the Applicant
Address:	same as the Applicant

2.7 EUT: Type, S/N etc. and short descriptions used in this test report

Short description*)	PMT Sample No.	Product	Model	Type	S/N	HW status	SW status
EUT 01	20-1-01949S45_C02	Positioning device	ELIKO ANCHOR	standard	0009D4	4.9	3.1.0

*) EUT short description is used to simplify the identification of the EUT in this test report.

2.8 Auxiliary Equipment (AE): Type, S/N etc. and short descriptions

Short description*)	PMT Sample No.	Auxiliary Equipment	Type	S/N	HW status	SW status
	--	--	-	--	--	--

*) AE short description is used to simplify the identification of the auxiliary equipment in this test report.

2.9 Connected cables

Short description*)	PMT Sample No.	Cable type	Connectors	Length
	--	--	--	--

*) CAB short description is used to simplify the identification of the connected cables in this test report.

2.10 Software

Short description*)	PMT Sample No.	Software	Type	S/N	HW status	SW status
	--	--	--	--	--	--

*) SW short description is used to simplify the identification of the used software in this test report.

2.11 EUT set-ups

set-up no.*)	Combination of EUT and AE	Description
SET 01	EUT 01	Used for theoretical calculation

*) EUT set-up no. is used to simplify the identification of the EUT set-up in this test report.

2.12 EUT operation modes

EUT operating mode no.*)	Operating modes	Additional information
op. 1	WLAN 2.4 GHz 802.11b	Only theoretical calculation
op. 2	WLAN 2.4 GHz 802.11g	Only theoretical calculation
op. 3	WLAN 2.4 GHz 802.11n HT 20	Only theoretical calculation
op. 4	WLAN 2.4 GHz 802.11n HT 40	Only theoretical calculation
op. 5	UWB	Only theoretical calculation

*) EUT operating mode no. is used to simplify the test report.

3 Equipment under test (EUT)

3.1 General Data of Main EUT as Declared by Applicant

Product	Positioning device
Model	ELIKO ANCHOR
Type	standard
Radio access technology	WLAN, UWB
For further details refer Applicants Declaration and technical documents	

3.2 Detailed Technical data of Main EUT as Declared by Applicant

Frequency Band	WLAN 2.4 GHz, UWB 3328 MHz - 4659.2 MHz
Antenna Type(s)	Integrated antenna
Antenna Gain(s)	Please refer to Annex 2
FCC label attached	No
For further details refer Applicants Declaration and technical documents	

4 Measurements

4.1 Radio Frequency Exposure Evaluation §2.1091

4.1.1 Test location and equipment (for reference numbers please see chapter 'List of test equipment')

Test location	See Chapter 2.1
Equipment	For Evaluation instruments are not needed. Results are determined by calculation based on applicants delivered Tune-Up procedure.

4.1.2 Requirements

FCC: §1.1310	The criteria used for the evaluation of human exposure to radio frequency radiation is table 1 according FCC §1.1310 and table chapter 4.2 of RSS-102 standard and it is subject for evaluation of the RF exposure prior to equipment authorization. As the mobile equipment is authorized under Part 22 (Subpart H) and Part 24 of the FCC Rules, it is subject for evaluation of the RF exposure prior to equipment authorization.
FCC § 2.1091	Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, ''Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation.'' For purposes of these requirements mobile devices are defined by the FCC as transmitters designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between radiating structures and the body of the user or nearby persons. These devices are normally evaluated for exposure potential with relation to the MPE limits given in Table 1 of Appendix A.

4.1.2.1 Valid for FCC

Table 1: LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)				
Frequency range [MHz)	Electric field strength [V/m]	Magnetic field strength [A/m]	Power density [mW/cm²]	Averaging time [minutes]
30 - 300	61.4	0.163	1.0	6
300 - 1500	-		f/300	6
1500 – 100.000	-		5	6
(B) Limits for General Population / Uncontrolled Exposure				
0.3 – 1.34	614	1.63	*(100)	30
1.34 – 30	824/f	2.19/f	*(180/f²)	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f/1500	30
1500 – 100.000	-	-	1.0	30

f= frequency in MHz

*Plane-wave equivalent power density

NOTE1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. These limits apply to amateur station licensees and members of their immediate household as discussed in the text.

NOTE2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. As discussed in the text, these limits apply to neighbors living near amateur radio stations.

4.1.3 General Limits:

FCC: §1.1307	Cellular Radiotelephone Service (subpart H of part 22) Non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 1000 W ERP (1640 W EIRP)
FCC §1.1307	Personal Communications Services (part 24) Broadband PCS (subpart E): non-building-mounted antennas: height above ground level to lowest point of antenna < 10 m and total power of all channels > 2000 W ERP (3280 W EIRP)
FCC §1.1310	LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) Table 1(B) Limits for General Population/Uncontrolled Exposure 300–1500 MHz: f/1500 mW/cm² 1500–100.000 MHz: 1.0 mW/cm²
FCC §2.1091	Subject to routine evaluation is required when the device operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more.
FCC §24.232	(a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT. b) Mobile/portable stations are limited to 2 watts e.i.r.p. peak power, …
FCC §22.913	(a) Maximum ERP. The effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts. The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.
FCC §27.50 (C)(10)	(10) Portable stations (hand-held devices) are limited to 3 watts ERP; and
FCC §27.50(d)	(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band are limited to 1 watt EIRP.
KDBs	No. 447498 D01 v06

4.2 MPE Calculation method

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{EIRP}{4\pi R^2} = \frac{P * G}{4\pi R^2}$$

$$G_{NUMERIC} = \frac{S * 4\pi R^2}{P}$$

Where:

S= power density
P= power input to antenna
G= power gain of the antenna in the direction of interest relative to an isotropic radiator
R= distance to the center of radiation of the antenna

4.3 Evaluation Method

Please find in the following tables **the calculations based on applicants information**

4.4 Results for fixed and mobile operations

4.4.1 Results for FCC Standard

4.4.1.1 Results for WLAN

Operation Mode	Frequency on channel (MHz)	Declared maximum conducted output power (dBm)	Max. positive tolerance according manufacturer (dB)	Declared Antenna Gain (dBi)	Ext. Path Loss to antenna (external cables) (dB)	Calculated maximum EIRP (declared + Tune-up + antenna Gain - Path Loss) (dBm)	Duty cycle (%)	Calculated Maximum EIRP (W)	Equivalent EIRP (maximum EIRP x duty cycle) (mW)	MPE Limit accord. Table 1 (mW/cm^2)	MPE-Value (mW/cm^2)	Margin to limit: (mW/cm^2)	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
WLAN 2.4 GHz 802.11b	2412.0	13.1	1.5	3.7	0.0	18.3	100%	0.0676	67.6	1.0000	0.0135	0.9865	0.013450	0.0134502
	2442.0	12.5	1.5	3.7	0.0	17.7		0.0589	58.9	1.0000	0.0117	0.9883	0.011715	
	2472.0	12.9	1.5	3.7	0.0	18.1		0.0646	64.6	1.0000	0.0128	0.9872	0.012845	
WLAN 2.4 GHz 802.11g	2412.0	14.3	1.5	3.7	0.0	19.5	100%	0.0891	89.1	1.0000	0.0177	0.9823	0.017731	0.0177309
	2442.0	13.3	1.5	3.7	0.0	18.5		0.0708	70.8	1.0000	0.0141	0.9859	0.014084	
	2472.0	13.2	1.5	3.7	0.0	18.4		0.0692	69.2	1.0000	0.0138	0.9862	0.013764	
WLAN 2.4 GHz 802.11n HT 20	2412.0	14.1	1.0	3.7	0.0	18.8	100%	0.0759	75.9	1.0000	0.0151	0.9849	0.015091	0.0150914
	2442.0	13.4	1.0	3.7	0.0	18.1		0.0646	64.6	1.0000	0.0128	0.9872	0.012845	
	2472.0	13.2	1.0	3.7	0.0	17.9		0.0617	61.7	1.0000	0.0123	0.9877	0.012267	
WLAN 2.4 GHz 802.11n HT 40	2422.0	13.9	1.0	3.7	0.0	18.6	100%	0.0724	72.4	1.0000	0.0144	0.9856	0.014412	0.0144122
	2442.0	13.6	1.0	3.7	0.0	18.3		0.0676	67.6	1.0000	0.0135	0.9865	0.013450	
	2462.0	13.3	1.0	3.7	0.0	18.0		0.0631	63.1	1.0000	0.0126	0.9874	0.012552	

Remark: Calculation based on declared minimum seperation distance of 20 cm.

4.4.1.2 Results for UWB

Operation Mode	Frequency on channel (MHz)	Declared maximum conducted output power (dBm)	Max. positive tolerance according manufacturer (dB)	Declared Antenna Gain (dBi)	Ext. Path Loss to antenna (external cables) (dB)	Calculated maximum EIRP (declared + Tune-up + antenna Gain - Path Loss) (dBm)	Duty cycle (%)	Calculated Maximum EIRP (W)	Equivalent EIRP (maximum EIRP x duty cycle) (mW)	MPE Limit accord. Table 1 (mW/cm^2)	MPE-Value (mW/cm^2)	Margin to limit: (mW/cm^2)	Fraction for Co-Location calculations	Max. Fraction-Value within Frequency-Band
UWB	3993.6	-20.3	2.0	4.1	0.0	-14.2	100%	0.000038	0.038	1.000000	0.000008	0.999992	0.000008	0.0000076

Remark: Calculation based on declared minimum seperation distance of 20 cm.

4.4.1.3 Assesment of Co-Location

	Ratio of MPE-Value/Limit	UWB
		0.000008
WLAN 2.4 GHz 802.11b	0.013450	0.013458
WLAN 2.4 GHz 802.11g	0.017731	0.017738
WLAN 2.4 GHz 802.11n HT 20	0.015091	0.015099
WLAN 2.4 GHz 802.11n HT 40	0.014412	0.014420
Maximum-Value		0.017738

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

5 Abbreviations used in this report

The abbreviations	
ANSI	American National Standards Institute
AV , AVG, CAV	Average detector
EIRP	Equivalent isotropically radiated power, determined within a separate measurement
EGPRS	Enhanced General Packet Radio Service
ERP	Effective radiated power
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
ISED	Innovation, Science and Economic Development Canada
IC	Industry Canada
n.a.	not applicable
Op-Mode	Operating mode of the equipment
PK	Peak
RBW	resolution bandwidth
RF	Radio frequency
RSS	Radio Standards Specification, Documents from Industry Canada
Rx	Receiver
TCH	Traffic channel
Tx	Transmitter
QP	Quasi peak detector
VBW	Video bandwidth

6 Measurement Uncertainty valid for conducted/radiated measurements

The reported uncertainties are calculated based on the standard uncertainty multiplied with the appropriate coverage factor **k**, such that a confidence level of approximately 95% is achieved. For uncertainty determination, each component used in the concrete measurement set-up was taken in account and it contribution to the overall uncertainty according its statistical distribution calculated.

RF-Measurement	Reference	Frequency range	Calculated uncertainty based on a confidence level of 95%						Remarks
Conducted emissions (U_{CISPR})	-	9 kHz - 150 kHz 150 kHz - 30 MHz	4.0 dB 3.6 dB						-
Power Output radiated	-	30 MHz - 4 GHz	3.17 dB						Substitution method
Power Output conducted	-	Set-up No.	Cel-C1	Cel-C2	BT1	W1	W2	--	
		9 kHz - 12.75 GHz	N/A	0.60	0.7	0.25	N/A	--	-
		12.75 GHz - 26.5 GHz	N/A	0.82	--	N/A	N/A	--	
Conducted emissions on RF-port	-	9 kHz - 2.8 GHz	0.70	N/A	0.70	N/A	0.69	--	N/A - not applicable
		2.8 GHz - 12.75 GHz	1.48	N/A	1.51	N/A	1.43	--	
		12.75 GHz – 18 GHz	1.81	N/A	1.83	N/A	1.77	--	
		18 GHz - 26.5 GHz	1.83	N/A	1.85	N/A	1.79	--	
Occupied bandwidth	-	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			1.0 dB						Power
Emission bandwidth	- -	9 kHz - 4 GHz	0.1272 ppm (Delta Marker)						Frequency error
			See above: 0.70 dB						Power
Frequency stability	-	9 kHz - 20 GHz	0.0636 ppm						-
Radiated emissions Enclosure	-	150 kHz - 30 MHz	5.01dB						Magnetic field strength
		30 MHz - 1 GHz 1 GHz - 18 GHz 18-26.5 GHz	5.83 dB 4.91 dB 5.06 dB						Electrical Field strength

7 Versions of test reports (change history)

Version	Applied changes	Date of release
--	Initial release	2021-Dec-06
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End Of Test Report