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Test report no.:

230524-AU01+W03

for:

Elatec GmbH
RFID reader / writer module
TWN4 Palon Compact S M LF HF

according to:

47 CFR Part 2
RSS-102

Accreditation:

FCC test firm accreditation expiration date: 2024-05-17
MRA US-EU, FCC designation number: DE0010
Test firm registration number: 997268
FCC Registration Number (FRN): 0032245045
BNetzA-CAB-02/21-02/7 Valid until 2028-11-26

Recognized until 2025-03-16 by the
Department of Innovation, Science and Economic Development Canada (ISED)
as a recognized testing laboratory
CAB identifier: DE0011
Company number: 3472A

Location of Testing:

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The technical accuracy is guaranteed through the quality management of
Element Materials Technology Straubing GmbH.

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1 Summary of test results

1.1 FCC standard

<i>FCC standard</i>	<i>Requirement</i>	<i>Result</i>	<i>Page</i>
47 CFR Part Part 1, § 1.1310(e)(1)	Maximum permissible exposure, except WPT, measurement	Passed	9
47 CFR Part Part 1, § 1.1310(e)(1)	Maximum permissible exposure, except WPT, calculation	Passed	13

1.2 IC standard

<i>IC standard</i>	<i>Requirement</i>	<i>Result</i>	<i>Page</i>
RSS-102 Issue 5, section 2.5.2	Evaluation for separation distance > 20 cm, except 3 kHz – 10 MHz	Passed	15

Straubing, April 17, 2024



Tested by
Konrad Graßl
Department Manager Radio



Approved by
Christian Kiermeier
Reviewer

2 Test regulations

2.1 FCC standards

<i>Standard</i>	<i>Title</i>
IEEE C95.3-2002 (R2008) Approved December 11, 2002 Reaffirmed June 12, 2008	IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz–300 GHz
Part 1, Subpart I, Section 1.1310 October 2023	Radiofrequency radiation exposure limits
ANSI C63.10 June, 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

2.2 IC standards

<i>Standard</i>	<i>Title</i>
RSS-102 Issue 5 (March 19, 2015) Amendment 1 (February 2, 2021)	Spectrum Management and Telecommunications Radio Standards Specification Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)
SPR-002 Issue 2 (October 2022)	Spectrum Management and Telecommunications Supplementary Procedure Supplementary Procedure for Assessing Compliance with RSS-102 Nerve Stimulation Exposure Limits
Safety Code 6 (2015)	Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz
IEEE C95.3-2002 (R2008) Approved December 11, 2002 Reaffirmed June 12, 2008	IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to Such Fields, 100 kHz–300 GHz

3 Equipment under Test

3.1 General information

Product type:	RFID reader / writer module		
Model name:	TWN4 Palon Compact S M LF HF		
Serial number(s):	Prototype		
Applicant:	Elatec GmbH		
Manufacturer:	Elatec GmbH		
Hardware version:	PRODA		
Software version:	TWN4_xKx472_CONT200_PalonPort_MODE06_13.56MHz.bix TWN4_xKx472_CONT200_PalonPort_MODE04_125kHz.bix		
Short description:	EUT is a RFID reader / writer module operating at the frequencies 125 kHz and 13.56 MHz.		
Additional modifications:	None		
FCC ID:	WP5TWN4F25		
IC registration number:	7948A-TWN4F25		
Power supply:	DC supply		
	Nominal voltage:	5.00 V	
	Minimum voltage:	4.25 V	
	Maximum voltage:	5.75 V	
Temperature range:	-25 °C to +85 °C (customer defined)		
Device type:	<input type="checkbox"/> Portable	<input checked="" type="checkbox"/> Mobile	<input type="checkbox"/> Fixed

3.2 Radio specifications

Radio technology 1:

System type:	RFID Reader		
Application frequency band:	n/a		
Operating frequencies:	125 kHz		
Number of RF channels	1		
Highest internal frequency:	120 MHz		
Modulation	ASK		
Antenna:	Type:	Wired loop antenna	
	Connector:	<input type="checkbox"/> external	<input type="checkbox"/> internal
		<input type="checkbox"/> temporary	<input checked="" type="checkbox"/> none (integral antenna)

Radio technology 2:

System type:	RFID Reader		
Application frequency band:	13.110 MHz – 14.010 MHz		
Operating frequencies:	13.56 MHz		
Number of RF channels	1		
Highest internal frequency:	120 MHz		
Modulation	ASK		
Antenna:	Type:	PCB loop antenna	
	Connector:	<input type="checkbox"/> external	<input type="checkbox"/> internal
		<input type="checkbox"/> temporary	<input checked="" type="checkbox"/> none (integral antenna)

3.3 Human exposure specifications

Separation distance:	> 20 cm
Evaluated against exposure limits:	General public use
Simultaneous transmissions:	no

3.4 Photographs of EUT

See Annex B of test report 230524-AU01+W01 of test laboratory Element Materials Technology Straubing GmbH.

4 Test results

This clause gives details about the test results as collected in the summary of test results on page 4.

The climatic conditions are recorded during the tests. It is ensured that the climatic conditions are within the following ranges:

<i>Ambient temperature</i>	<i>Ambient humidity</i>	<i>Ambient pressure</i>
15°C to 35°C	30 % to 75 %	86 kPa to 106 kPa

4.1 FCC

4.1.1 Maximum permissible exposure, except WPT, measurement

Requirement: Part 1, § 1.1310(e)(1)

Performed by: Konrad Graßl Date of test: April 16, 2024

Result: Limits kept Limits not kept

4.1.1.1 Test configuration

<i>Device</i>	<i>Type designation</i>	<i>Serial or inventory no.</i>	<i>Manufacturer</i>
RFID reader / writer module	TWN4 Palon Compact S M LF HF	Prototype	Elatec GmbH

Table 1: EUT used for testing

<i>Device</i>	<i>Type designation</i>	<i>Serial or inventory no.</i>	<i>Manufacturer</i>
RFID-tag	125 kHz	---	Elatec GmbH
Laptop	Lifebook A531	E001053	FUJITSU
Power supply for laptop	AC adapter	E001053	FUJITSU

Table 2: Support equipment used for testing

4.1.1.2 Mode of operation

- The EUT was in continuous interrogation mode at 125 kHz.
- The device was powered by a laptop via USB.

4.1.1.3 Test equipment

Type	Designation	Manufacturer	Inventory no.
Exposure level tester with magnetic field probe 100 cm ²	ELT-400 with BN 2300/90.10	Narda Safety Test Solutions GmbH	E00276
Broadband field meter	NBM-550	Narda Safety Test Solutions GmbH	E00900
Electric field probe	EF0691	Narda Safety Test Solutions GmbH	E00902

4.1.1.4 Test setup



Picture 1: Setup of magnetic field test at a measurement distance of 20 cm, without RFID tag



Picture 2: Setup of electric field test at a measurement distance of 20 cm, without RFID tag

4.1.1.5 Requirements and limits maximum permissible exposure

According to the TCB Workshop on April 27, 2022:
Regarding the frequency range from 100 kHz to 300 kHz the limit for the frequency 300 kHz in table 1 to § 1.1310(e)(1) is applicable: $E = 614 \text{ V/m}$ and $H = 1.63 \text{ A/m}$

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
0.3-3.0	614	1.63	(100)(see note 1)	<30

Table 3: Table 1 to § 1.1310(e)(1), limits for general population/ uncontrolled exposure

Note:

1. Plane-wave equivalent power density

4.1.1.6 Test procedure

The RF exposure test is performed by the direct measurement method using a Broadband probe.

To find the worst case emissions, the field probe is moved over all sides of the EUT at the separation distance of 20 cm, while observing the display of the field meter. At the worst case position, the final value is measured and recorded.

The test distance is measured from the center of the probe(s) to the edge of the device.

4.1.1.7 Results

Radio technology 1:

Application: RFID
 Operation frequency: 125 kHz

Information related to Exposure:

Separation distance: 20 cm
 Exposure: general public

Note(s):

- 1 Averaging time over 6 minutes was applied.
- 2 Worst case: without RFID tag
- 3 Separation distance to the edge of the EUT: 20 cm

<i>Type of measurement</i>	<i>Operation frequency (kHz)</i>	<i>Measured average value</i>	<i>Limit</i>	<i>Ratio of limit</i>	<i>Result</i>
E-Field	125	0.36 V/m	614.00 V/m	0.001	Passed
H-Field	125	0.44 A/m	1.63 A/m	0.27	Passed

Table 4: Test results for electric, magnetic and electromagnetic fields

4.1.2 Maximum permissible exposure, except WPT, calculation

Requirement: Part 1, § 1.1310(e)(1)

Reference:

Performed by:	Konrad Graßl	Date of test:	April 16, 2024
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Result:	<input checked="" type="checkbox"/> Limits kept	<input type="checkbox"/> Limits not kept
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4.1.2.1 Requirements and limits maximum permissible exposure

According to §1.1310(e)(1):

Table 1 to § 1.1310(e)(1) sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

<i>Frequency range (MHz)</i>	<i>Electric field strength (V/m)</i>	<i>Magnetic field strength (A/m)</i>	<i>Power density (mW/cm²)</i>	<i>Averaging time (minutes)</i>
1.34-30	824/f	2.19/f	180/f ² (see note 2)	<30

Table 5: Table 1 to §1.1310(e)(1) Limits for Maximum Permissible Exposure (MPE) for General Population/Uncontrolled Exposure

Notes:

1. F = frequency in MHz
2. Plane-wave equivalent power density

4.1.2.2 Results

Radio technology 2:

The following data are based on applicants document: Test report 230524-AU01+W01 of the test laboratory Element Materials Technology Straubing GmbH

Operation frequency: 13.56 MHz
 Field strength:: 40.2 dB μ V/m at 30 m

Information related to Exposure:

Tune-up tolerance (according to the manufacturer): 0 dB
 Separation distance: 20 cm
 Exposure: general public
 Power averaging over time: not applied

<i>Operation frequency (MHz)</i>	<i>EIRP + tune-up tolerance (dBm)</i>	<i>Power density (mW/cm²)</i>	<i>Limit (mW/cm²)</i>	<i>Ratio of limit</i>	<i>Result</i>
13.56	-35.0	0.0000001	0.9789334	6.42654E-08	Passed

Table 6: Result of evaluation of compliance

EIRP is calculated using the formula of ANSI C63.10-2013 clause 9.5:

$$\text{EIRP} = E + 20\log(d) - 104.7$$

Where: EIRP = equivalent isotropically radiated power in dBm
 E = electric field strength in dB μ V/m
 d = measurement distance in meters (m)

Relationship between ERP and EIRP

According to clause G.4 of ANSI C63.10-2013: ERP = EIRP – 2.15 dB

4.2 Canada

4.2.1 Evaluation for separation distance > 20 cm, except 3 kHz – 10 MHz

Requirement: RSS-102 Issue 5, section 2.5.2

Reference: n/a

Performed by:	Konrad Graßl	Date of test:	April 16, 2024
Result:	<input checked="" type="checkbox"/> Limits kept	<input type="checkbox"/> Limits not kept	

4.2.1.1 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

According to RSS 102 Clause 2.5.2:

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

4.2.1.2 Results

Radio technology 2:

The following data are based on applicants document: Test report 230524-AU01+W01 of the test laboratory Element Materials Technology Straubing GmbH

Operation frequency: 13.56 MHz
 Field strength:: 40.2 dB μ V/m at 30 m

Information related to Exposure:

Tune-up tolerance (according to the manufacturer): 0 dB
 Separation distance: 20 cm
 Exposure: general public
 Power averaging over time: not applied

<i>Channel Frequency (MHz)</i>	<i>EIRP + tuneup tolerance (dBm)</i>	<i>EIRP (W)</i>	<i>EIRP limit (W)</i>	<i>Ratio of limit</i>	<i>Result</i>
13.56	-35.0	0.0000003	1.0000000	0.0000003	Passed

Table 7: Result of exemption for routine evaluation of RF exposure

EIRP is calculated using the formula of ANSI C63.10-2013 clause 9.5:

$$EIRP = E + 20\log(d) - 104.7$$

Where: EIRP = equivalent isotropically radiated power in dBm
 E = electric field strength in dB μ V/m
 d = measurement distance in meters (m)

5 Equipment calibration status

<i>Description</i>	<i>Modell number(s)</i>	<i>Serial number(s)</i>	<i>Inventory number(s)</i>	<i>Last calibration</i>	<i>Next calibration</i>
Exposure level tester with magnetic field probe 100 cm ²	ELT-400 with BN 2300/90.10	B-0087 B-0102	E00276	2024-03	2026-03
Broadband field meter with magnetic field probe	NBM-550 with HF3061	H-0015 D-0595	E00900 E00901	2023-09	2025-09
Broadband field meter with electric field probe	NBM-550 with EF0691	H-0015 H-0318	E00900 E00902	2023-09	2025-09

6 Measurement uncertainty

Test	Frequency range	Equipment used	Expanded uncertainty	U_{Limit}	$k=$
Magnetic field	1 Hz – 10 kHz	ELT 400 + probe	$\pm 28.147 \%$	+58.% / -37 %	2
Magnetic field	10 kHz – 400 kHz	ELT 400 + probe	$\pm 28.147 \%$	+41.% / -30 %	2
H-field	300 kHz – 800 kHz	NBM 550 + HF3061	$\pm 25.602 \%$	+41.% / -30 %	2
H-field	800 kHz – 1 MHz	NBM 550 + HF3061	$\pm 25.245 \%$	+41.% / -30 %	2
H-field	1 MHz – 30 MHz	NBM 550 + HF3061	$\pm 25.245 \%$	+41.% / -30 %	2
E-field	100 kHz – 1 MHz	NBM 550 + EF0691	$\pm 28.467 \%$	+41.% / -30 %	2
E-field	1 MHz – 30 MHz	NBM 550 + EF0691	$\pm 27.324 \%$	+41.% / -30 %	2
E-field	30 MHz – 1 GHz	NBM 550 + EF0691	$\pm 27.324 \%$	+100.% / -50 %	2
E-field	1 GHz – 4 GHz	NBM 550 + EF0691	$\pm 30.244 \%$	+100.% / -50 %	2
E-field	4 GHz – 6 GHz	NBM 550 + EF0691	$\pm 32.150 \%$	+100.% / -50 %	2
Contact current	0 Hz – 110 MHz	EZ 17	+41.25 % / -29.21.%	+100.% / -50 %	2

Note(s):

- 1 The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k . For a confidence level of 95 % the coverage factor k is 2.
- 2 The values of the measurement uncertainty as listed above are calculated according to
 - a) ETSI TR 100 028-1 V1.4.1 and ETSI TR 100 028-2 V1.4.1
 - b) CISPR 16-4-2:2011-06 + A1:2014-02 + A2:2018-08
- 3 The limits for the measurement uncertainty as listed above are
 - a) derived from ETSI EN 300 328 V2.1.1
 - b) equal to U_{CISPR} taken from CISPR 16-4-2:2011-06 + A1:2014-02 + A2:2018-08
 - c) defined by the test laboratory
- 4 Simple acceptance is applied as the decision rule while keeping the specified limits (U_{Limit}) for the expanded measurement uncertainty (i.e. Test Uncertainty Ratio $TUR \geq 1:1$). That means, compliance is based on the recorded level by the lab irrespective of the expanded measurement uncertainty value but with a limitation to it. For details on simple acceptance and the level of risk (such as false accept, false reject and false statistical assumptions) associated with this decision rule see ISO/IEC Guide 98-4:2012 and ILAC G8:09/2019 "Guidelines on Decision Rules and Statements of Conformity" ("Binary Statement for Simple Acceptance Rule" according to clause 4.2.1).
- 5 All used test instruments as well as the test accessories are calibrated at regular intervals.

7 Revision history

<i>Revision</i>	<i>Date</i>	<i>Issued by</i>	<i>Description of modifications</i>
0	2024-04-17	Konrad Graßl	First edition

Template: RF_FCC_IC_Human Exposure_V1.8