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Applicant:

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Test report no.:

210568-AU01+W03

for:

Elatec GmbH

RFID reader / writer module

TWN4 MultiTech LEGIC M

according to:

RSS-102

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12155-01-04

ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-12155-01-03

Accreditation:

FCC test firm accreditation expiration date: 2021-05-30
MRA US-EU, FCC designation number: DE0010
FCC registration number: 97268
BnetzA-CAB-02/21-02/5 Valid until 2023-11-26

Recognized until 2023-03-16 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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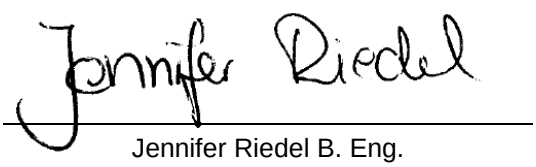
Straubing, November 16, 2021



Jennifer Riedel B. Eng.
Radio Test Engineer

Konrad Graßl
Department Manager Radio

2 Test regulations

Standard	*Title*
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 1 (September 2016)	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
ANSI C63.10 June 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

3 Equipment under test (EUT)

3.1 General information

Product type:	RFID reader / writer module	
Model Name:	TWN4 MultiTech LEGIC M	
HVIN:	EL20212	
Manufacturer:	Elatec GmbH	
Serial number:	2021253905	
Version:	Hardware:	C
	Software:	B1.06/CKB1.64/STD1.07
Short description:	The EUT is a RFID reader / writer module operating at the frequencies 125 kHz and 13.56 MHz.	
FCC ID:	WP5TWN4F19	
IC certification number:	7948A-TWN4F19	
Technology:	RFID	
Operating frequency 1:	125 kHz	
Antenna types:	Loop antenna	
	☐ detachable	☒ not detachable
Operating frequency 2:	13.56 MHz	
Antenna types:	Loop antenna	
	☐ detachable	☒ not detachable
Power supply:	DC supply Nominal voltage: 5 V	
Exposure tier:	☒	Head
	☒	Body
	☐	Limbs
	☐	other
	☐	See appropriate results
Separation distance:	☒	≤ 20 cm
	☐	> 20 cm
	☐	See appropriate results
Evaluated against exposure limits:	☒	General public use
	☐	Controlled use

3.2 Photographs of EUT

See Annex C of test report 210568-AU01+W01 of test laboratory Element Materials Technology Straubing GmbH.

4 Test results

This clause gives details about the test results as collected on page 5.

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

Ambient temperature	*Ambient humidity*	*Ambient pressure*
15°C to 35°C	30 % to 75 %	86 kPa to 106 kPa

4.1 Canada

4.1.1 Frequency range 3 kHz up to 10 MHz

Requirement: RSS-102 Issue 5, section 2.5.1

Basic standard: SPR-002
IEEE C95.3

Performed by:	Jennifer Riedel B. Eng.	Date of test:	October 12, 2021
Result (Note 1):	☒ Test passed	☐ Test not passed	

Note(s):
1. For information about measurement uncertainties see page 19.

4.1.1.1 Test configuration

Device	*Type designation*	*Serial or inventory no.*	*Manufacturer*
RFID reader / writer module	TWN4 MultiTech LEGIC M	2021253905	Elatec GmbH

Table 1: EUT used for testing

Device	*Type designation*	*Serial or inventory no.*	*Manufacturer*
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 DC supplied and continuously reading the tag at 125 kHz.

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 0 cm

Picture 2: Setup of electric field test at a measurement distance of 0 cm

4.1.1.5 Limits

According to note 5 in section 2.5.1 of RSS-102:
Transmitters operating between 3 kHz and 10 MHz, meeting the exemption from routine SAR evaluation, shall demonstrate compliance to the instantaneous limits in section 4 of RSS-102. Therefore, these limits apply irrespective of the separation distance between the user or bystanders and the device.

The exposure limits in section 4 of RSS-102 are adopted from Health Canada's Safety Code 6.

According to section 2.1 of Safety Code 6:
Limits for internal electric field strength are intended to prevent the occurrence of nerve stimulation (NS). At frequencies between 3 kHz and 10 MHz, basic restrictions for internal electric field strength in excitable tissues as shown in table 1 of Safety Code 6 (i.e. table 2 of RSS-102) shall not be exceeded. For conditions where the determination of internal electric field strength is not possible or practical (e.g. by measurement or modelling), external unperturbed field strength assessment shall be carried out and the reference levels outlined in section 2.2 of Safety Code 6 shall be respected.

For transmitters operating between 3 kHz and 10 MHz, the requirements of table 4 and table 6 in section 4 of RSS-102 apply which are adopted from table 3 and table 4 of Safety Code 6, section 2.2:

Electric Field Strength Reference Levels				
Frequency Range (MHz)	*Reference Level Basis*	*Reference Level (E_{RL}), (V/m, RMS)*		*Reference Period*
		Uncontrolled Environment	*Controlled Environment*	
0.003 – 10	NS	83	170	Instantaneous (Note 1)

Table 3: Electric field strength reference levels

Magnetic Field Strength Reference Levels				
Frequency Range (MHz)	*Reference Level Basis*	*Reference Level (H_{RL}), (A/m, RMS)*		*Reference Period (minutes)*
		Uncontrolled Environment	*Controlled Environment*	
0.003 – 10	NS	90	180	Instantaneous (Note 1)

Table 4: Magnetic field strength reference levels

Notes:

1 At no point in time shall the RMS values for electric- and magnetic-fields exceed the reference levels with an instantaneous reference period in table 3 and table 4. In the case of RF fields with amplitude modulation, the RMS value during the maximum of the modulation envelope shall be compared to the reference level.

According to section 6.5 of SPR-002:
The basic restrictions are based on internal induced electric field or SAR. The relationship between the induced field and that of the exposure area is proportional; thus, in cases where the limbs are the primary point of exposure, the induced field would be less than that induced in the trunk of the human body.

When assessing compliance at the compliance distance, where limb exposure is the primary exposed condition, the following table may be used for relaxation of the RSS-102 nerve stimulation reference levels.

Exposure condition	*Relaxation factor*
Whole Body / Torso / Head	1.0
Leg	1.5
Arm	2.5
Hand / foot	5.0

Table 5: Limb exposure limit relaxation

A second exposure evaluation must be taken at the distance at which the trunk of the body would rest in relation to the device under test.

4.1.1.6 Test procedure

The RF exposure test is performed by the direct measurement method using a Broadband probe as described in clause 6.6.1.1 of the supplementary procedure SPR-002.

To find the worst case emissions, the field probe is moved over all sides of the EUT at the separation distances as noted in clause 4.1.1.7 while observing the display of the field meter. At the worst case position, the final value is measured and recorded.

According to section 3.2 of RSS-102, RF exposure evaluation of devices shall be made in accordance with the latest version of IEEE C95.3. Definition 3.95 in clause 3 of IEEE C95.3 specifies the separation distance applied to the measurement of electric and magnetic fields as the “distance between a source and the nearest point on the probe sensing elements”.

4.1.1.7 Test results

RF technology 1:

Application:	RFID
Operation frequency range:	125 kHz
Antenna model	Loop antenna
Antenna connector:	none
Antenna type:	internal
	not detachable
Environment:	Uncontrolled
Primary exposure condition:	Whole Body

Note(s):
1. Premeasurements were performed to determine the worst case which is documented below.
2. The worst case emission occurred without tag.

Frequency (kHz)	*Measured value (V/m)*	*Relaxation factor*	*Limit (V/m)*	*Fraction of limit (%)*	*Result*
125.000	10.63	1.0	83	12.81	Passed

Table 6: Electrical field strength at a distance of 0 cm, nerve stimulation of the body

Frequency (kHz)	*Measured value (A/m)*	*Relaxation factor*	*Limit (A/m)*	*Fraction of limit (%)*	*Result*
125.000	2.74	1.0	90	3.04	Passed

Table 7: Magnetic field strength at a distance of 0 cm, nerve stimulation of the body

4.1.2 SAR test exclusion, except 3 kHz – 10 MHz

Requirement: RSS-102 Issue 5, section 2.5.1

Reference: n/a

Performed by:	Jennifer Riedel B. Eng.	Date of test:	October 20, 2021
Result:	☒ Limits kept	☐ Limits not kept	

4.1.2.1 Exemption Limits for Routine Evaluation – SAR Evaluation

According RSS 102 clause 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.

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	177 mW	195 mW	213 mW
835	80 mW	92 mW	105 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.

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in Table 1 are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in Table 1, linear interpolation shall be applied for the applicable separation distance. For test separation distance less than 5 mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.
For medical implants devices, the exemption limit for routine evaluation is set at 1 mW. The output power of a medical implants device is defined as the higher of the conducted or e.i.r.p to determine whether the device is exempt from the SAR evaluation.

4.1.2.2 Results

RF technology 2:

The following data are based on applicants document: Test report 210568-AU01+W02 of the test laboratory Element Materials Technology Straubing GmbH

Application:	RFID
Operating frequency:	13.56 MHz
Antenna model	Loop antenna
Antenna connector:	none
Antenna type:	internal
	not detachable
Maximum E-field:	44.40 dBµV/m at 30 m

Information related to Exposure:

Tune-up tolerance (according to the manufacturer):	2 dB
Separation distance:	< 5 mm
Exposure tier:	general public
Power averaging over time:	not applied

Separation distance (mm)	*Channel frequency (MHz)*	*EIRP + tolerance (dBm)*	*EIRP + tolerance (mW)*	*Exemption Limit (mW)*	*Ratio of limit*	*Result*
< 5	13.56	-28.76	0.001	71.0	0.00001	passed

Table 8: Result of SAR test exclusion, exposure to the head and body

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

EIRP = E + 20log(d) - 104.7

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

5 Equipment calibration status

Description	Modell number(s)	Serial number(s)	Inventory number(s)	Last calibration	Next calibration
Exposure level tester with magnetic field probe 100 cm^2	ELT-400 with BN 2300/90.10	B-0087 B-0102	E00276	2020-11	2022-11
Broadband field meter with magnetic field probe	NBM-550 with HF3061	H-0015 D-0595	E00900 E00901	2021-03	2023-03
Broadband field meter with electric field probe	NBM-550 with EF0691	H-0015 H-0318	E00900 E00902	2021-03	2023-03

6 Measurement uncertainty

Test	*Frequency range*	*Equipment used*	*Expanded uncertainty*	U_{Limit}	*k=*
Magnetic field	1 Hz – 10 kHz	ELT 400 + probe	± 28.147 %	+58.% / -37 %	2
Magnetic field	10 kHz – 400 kHz	ELT 400 + probe	± 28.147 %	+41.% / -30 %	2
H-field	300 kHz – 800 kHz	NBM 550 + HF3061	± 25.602 %	+41.% / -30 %	2
H-field	800 kHz – 1 MHz	NBM 550 + HF3061	± 25.245 %	+41.% / -30 %	2
H-field	1 MHz – 30 MHz	NBM 550 + HF3061	± 25.245 %	+41.% / -30 %	2
E-field	100 kHz – 1 MHz	NBM 550 + EF0691	± 28.467 %	+41.% / -30 %	2
E-field	1 MHz – 30 MHz	NBM 550 + EF0691	± 27.324 %	+41.% / -30 %	2
E-field	30 MHz – 1 GHz	NBM 550 + EF0691	± 27.324 %	+100.% / -50 %	2
E-field	1 GHz – 4 GHz	NBM 550 + EF0691	± 30.244 %	+100.% / -50 %	2
E-field	4 GHz – 6 GHz	NBM 550 + EF0691	± 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 equal to or lower than the required ones stated in table 3 of EN 62369-1 2009 and listed as (U_{Limit}) in the table above.
3. Simple acceptance is applied as the decision rule while keeping the specified limits (U_{ETSI}) for the expanded measurement uncertainty (i.e. Test Uncertainty Ratio TUR ≥ 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.
4. All used test instrument as well as the test accessories are calibrated at regular intervals.

7 Revision history

Revision	*Date*	*Issued by*	*Description of modifications*
0	2021-11-16	Jennifer Riedel B. Eng.	First edition

Template: RF_FCC_IC_Human Exposure_V1.3