

Applicant:

Elatec GmbH
Zeppelinstraße 1
82178 Puchheim
Tel.: +49 89 5529961-0

Test report no.:

210716-AU01+W06

for:

Elatec GmbH
RFID reader / writer module
TWN4 MultiTech Nano LEGIC 42 M

according to:

Part 2

RSS-102



Deutsche
Akkreditierungsstelle
D-PL-12155-01-04



Deutsche
Akkreditierungsstelle
D-PL-12155-01-03

Accreditation:



FCC test firm accreditation expiration date: 2023-04-06
MRA US-EU, FCC designation number: DE0010
Test firm registration number: 997268
FCC Registration Number (FRN): 0032245045
BnetzA-CAB-02/21-02/6 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:

Element Materials Technology Straubing GmbH
Tel.: +49 9421 56868-0
Fax: +49 9421 56868-100
Email: info.straubing@element.com
Gustav-Hertz-Straße 35
94315 Straubing, Germany

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

Table of contents

| | | |
|-----|-----------------------------------|----|
| 1 | Summary of test results | 4 |
| 2 | Test regulations | 5 |
| 3 | Equipment under test (EUT) | 6 |
| 3.1 | General information..... | 6 |
| 3.2 | Photographs of EUT..... | 6 |
| 4 | Test results | 7 |
| 4.1 | Canada..... | 8 |
| 5 | Equipment calibration status..... | 16 |
| 6 | Measurement uncertainty | 17 |
| 7 | Revision history..... | 18 |

List of pictures

| | | |
|------------|--|----|
| Picture 1: | Setup of magnetic field test at a measurement distance of 0 cm | 9 |
| Picture 2: | Setup of electric field test at a measurement distance of 0 cm | 10 |

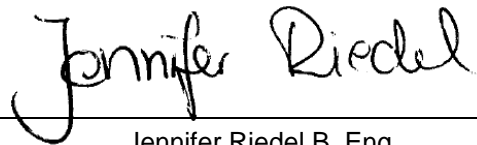
List of tables

| | | |
|-----------|---|----|
| Table 1: | EUT used for testing | 8 |
| Table 2: | Support equipment used for testing | 8 |
| Table 3: | Electric field strength reference levels..... | 11 |
| Table 4: | Magnetic field strength reference levels..... | 11 |
| Table 5: | Limb exposure limit relaxation | 12 |
| Table 6: | Electrical field strength at a distance of 0 cm, nerve stimulation of the body, USB | 13 |
| Table 7: | Electrical field strength at a distance of 0 cm, nerve stimulation of the body, RS232 | 13 |
| Table 8: | Magnetic field strength at a distance of 0 cm, nerve stimulation of the body, USB | 13 |
| Table 9: | Magnetic field strength at a distance of 0 cm, nerve stimulation of the body, RS232 | 13 |
| Table 10: | Result of SAR test exclusion, exposure to the head and body | 15 |

1 Summary of test results

| <i>IC standard</i> | <i>Requirement</i> | <i>Page</i> | <i>Result</i> | <i>Note(s)</i> |
|--------------------------------|---|-------------|---------------|----------------|
| RSS-102 Issue 5, section 2.5.1 | Frequency range 3 kHz up to 10 MHz | 8 | Passed | --- |
| RSS-102 Issue 5, section 2.5.1 | SAR test exclusion, except 3 kHz – 10 MHz | 14 | Passed | --- |

Straubing, February 10, 2022



Jennifer Riedel B. Eng.
Radio Test Engineer



Konrad Graßl
Department Manager Radio

2 Test regulations

| <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 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 |
| Notice 2016-DRS001 September 20, 2016 Updated July 2020 | Applicability of Latest FCC RF Exposure KDB Procedures and Other Procedures |
| KDB 447498 D01 v06 | Mobile and portable devices RF Exposure procedures and equipment authorisation policies, October 23, 2015. |
| 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 |
| KDB 680106 D01 May 31, 2013 (published by the Federal Communications Commission FCC) | RF Exposure Considerations for Low Power Consumer Wireless Power Transfer Applications |
| OET Bulletin 65, 65A, 65B Edition 97-01, August 1997 | Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields |

3 Equipment under test (EUT)

3.1 General information

| | | | |
|------------------------------------|--|--|--|
| Product type: | RFID reader / writer module | | |
| Model Name: | TWN4 MultiTech Nano LEGIC 42 M | | |
| Manufacturer: | Elatec GmbH | | |
| Serial number: | N/A | | |
| Version: | Hardware: | B | |
| | Software: | TWN4-B1.08-NKB3.22-CONT1.11 | |
| Short description: | EUT is a RFID reader / writer module operating at the frequencies 125 kHz and 13.56 MHz. | | |
| FCC ID: | WP5TWN4F20 | | |
| IC certification number: | 7948A-TWN4F20 | | |
| RF technology 1: | | | |
| Operating frequency: | 125 kHz | | |
| Technology: | RFID | | |
| Antenna types: | Loop antenna | | |
| | <input type="checkbox"/> detachable | <input checked="" type="checkbox"/> not detachable | |
| RF technology 2: | | | |
| Operating frequency: | 13.56 MHz | | |
| Technology: | RFID | | |
| Antenna types: | Loop antenna | | |
| | <input type="checkbox"/> detachable | <input checked="" type="checkbox"/> not detachable | |
| Power supply: | DC supply via USB or RS232 Nominal voltage: 5 V | | |
| Exposure tier: | <input checked="" type="checkbox"/> | Head | |
| | <input checked="" type="checkbox"/> | Body | |
| | <input type="checkbox"/> | Limbs | |
| | <input type="checkbox"/> | other | |
| | <input type="checkbox"/> | See appropriate results | |
| Separation distance: | <input checked="" type="checkbox"/> | ≤ 20 cm | |
| | <input type="checkbox"/> | > 20 cm | |
| | <input type="checkbox"/> | See appropriate results | |
| Evaluated against exposure limits: | <input checked="" type="checkbox"/> | General public use | |
| | <input type="checkbox"/> | Controlled use | |

3.2 Photographs of EUT

See Annex B of test report 210716-AU01+W04 of test laboratory Element Materials Technology Straubing GmbH.

4 Test results

This clause gives details about the test results as collected 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 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: January 12, 2022

Result (Note 1): Test passed Test not passed

Note(s):

- For information about measurement uncertainties see page 17.

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 MultiTech Nano LEGIC 42 M | N/A | 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 |
| Power supply for RS232 | AC adapter | NLD300050W1U3 | Shenzhen Nalin Elec. Tech. Co., Ltd. |
| 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 continuously searching for the tag at 125 kHz.

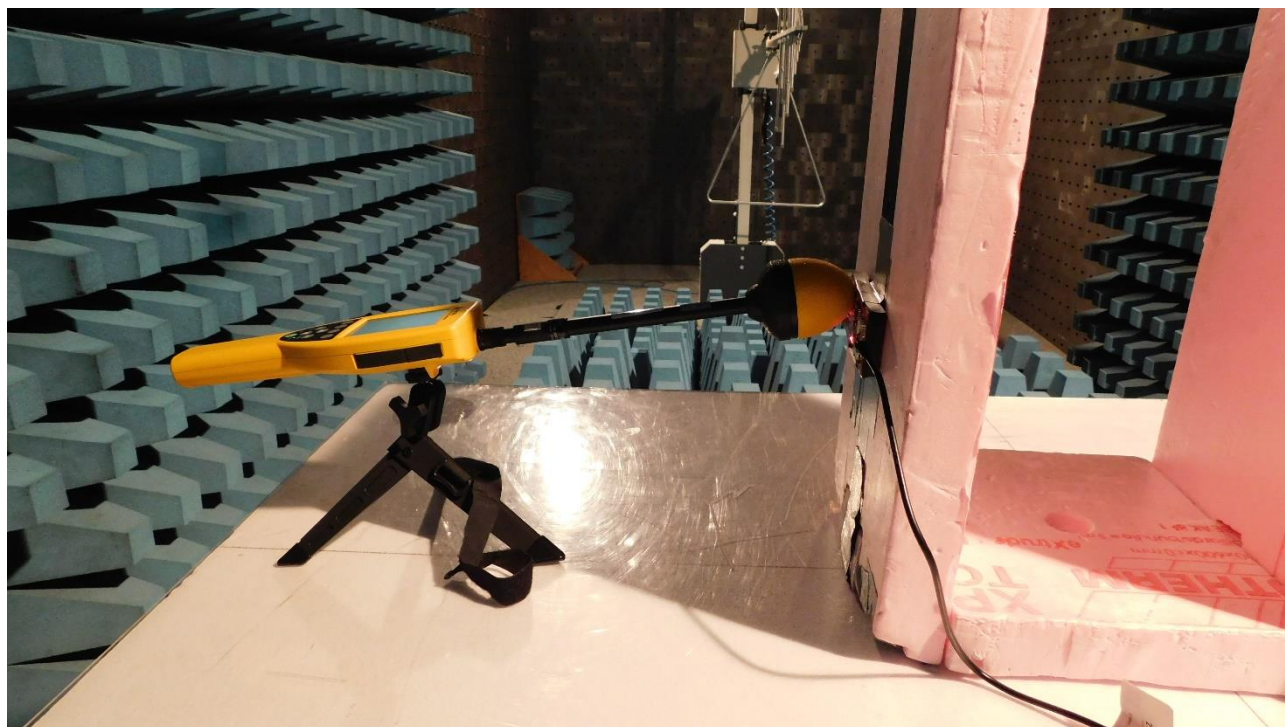
4.1.1.3 Test equipment

| 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:

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

Table 3: Electric field strength reference levels

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

Table 4: Magnetic field strength reference levels

Notes:

- 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.

| <i>Exposure condition</i> | <i>Relaxation factor</i> |
|---------------------------|--------------------------|
| 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.

| <i>Frequency (kHz)</i> | <i>Measured value (V/m)</i> | <i>Relaxation factor</i> | <i>Limit (V/m)</i> | <i>Ratio of limit</i> | <i>Result</i> |
|------------------------|-----------------------------|--------------------------|--------------------|-----------------------|---------------|
| 125 | 6.12 | 1.0 | 83 | 0.07 | Passed |

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

| <i>Frequency (kHz)</i> | <i>Measured value (V/m)</i> | <i>Relaxation factor</i> | <i>Limit (V/m)</i> | <i>Ratio of limit</i> | <i>Result</i> |
|------------------------|-----------------------------|--------------------------|--------------------|-----------------------|---------------|
| 125 | 6.42 | 1.0 | 83 | 0.08 | Passed |

Table 7: Electrical field strength at a distance of 0 cm, nerve stimulation of the body, RS232

| <i>Frequency (kHz)</i> | <i>Measured value (A/m)</i> | <i>Relaxation factor</i> | <i>Limit (A/m)</i> | <i>Ratio of limit</i> | <i>Result</i> |
|------------------------|-----------------------------|--------------------------|--------------------|-----------------------|---------------|
| 125 | 0.57 | 1.0 | 90 | 0.006 | Passed |

Table 8: Magnetic field strength at a distance of 0 cm, nerve stimulation of the body, USB

| <i>Frequency (kHz)</i> | <i>Measured value (A/m)</i> | <i>Relaxation factor</i> | <i>Limit (A/m)</i> | <i>Ratio of limit</i> | <i>Result</i> |
|------------------------|-----------------------------|--------------------------|--------------------|-----------------------|---------------|
| 125 | 0.59 | 1.0 | 90 | 0.007 | Passed |

Table 9: Magnetic field strength at a distance of 0 cm, nerve stimulation of the body, RS232

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: | February 10, 2022 |
| Result: | <input checked="" type="checkbox"/> Limits kept | <input type="checkbox"/> Limits not kept | |

4.1.2.1 Exemption Limits for Routine Evaluation – SAR Evaluation

According to 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 210716-AU01+W05 of the test laboratory Element Materials Technology Straubing GmbH.

| | |
|-------------------------|----------------------|
| Application: | RFID |
| Operational frequency: | 13.56 MHz |
| Antenna model | Loop antenna |
| Antenna connector: | none |
| Antenna type: | internal |
| | not detachable |
| Maximum field strength: | 50.09 dBµV/m at 30 m |

Information related to Exposure:

| | |
|--|----------------|
| Tune-up tolerance (according to the manufacturer): | ± 4 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) | Limit 1-g SAR (mW) | Ratio of limit | Result |
|--------------------------|-------------------------|------------------------|-----------------------|--------------------|----------------|--------|
| < 5 | 13.56 | -21.07 | 0.01 | 71.00 | 0.0001 | Passed |

Table 10: 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:

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

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 | 2024-03 |
| Broadband field meter with electric field probe | NBM-550 with EF0691 | H-0015 H-0318 | E00900 E00902 | 2021-03 | 2024-03 |

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 $TUR \geq 1:1$). 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.
4. All used test instrument 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 | 2022-02-10 | Jennifer Riedel B. Eng. | First edition |

Template: RF_FCC_IC_Human Exposure_V1.3