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## Applicant:

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### Test report no.:

240028-AU02+W08 for: Sesamsec GmbH RFID reader / writer Secustos MU20 LEGIC

> according to: 47 CFR Part 1 RSS-102





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FCC test firm accreditation expiration date: 2025-09-19 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

FCC standard	Requirement	Result	Page
47 CFR Part 1, § 1.1310(e)(1)	Maximum permissible exposure, except WPT, measurement	Passed	11
47 CFR Part 1, § 1.1310(e)(1)	Maximum permissible exposure, except WPT, calculation	Passed	20

## 1.2 IC standard

IC standard	Requirement	Result	Page
RSS-102 Issue 5, section 2.5.2	Evaluation for separation distance > 20 cm, except 3 kHz – 10 MHz	Passed	23

Straubing, August 14, 2024

Lamad Grapl

Tested by Konrad Graßl Department Manager Radio

in Muinis

Approved by Christian Kiermeier Reviewer



# 2 Test regulations

# 2.1 FCC standards

Standard	Title
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

Standard	Title
RSS-102 Issue 5 (March 19, 2015)	Spectrum Management and Telecommunications Radio Standards Specification
Amendment 1 (February 2, 2021)	Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)





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# 3 Equipment under Test

# 3.1 General information

Product type:	RFID reader / writer					
Model name:	Secustos MU20 LEGIC					
Serial number(s):	N/A	N/A				
Applicant:	Sesamsec GmbH	Sesamsec GmbH				
Manufacturer:	Sesamsec GmbH					
Hardware version:	Rev B					
Software version:	TWN4/B1.50/NKD4.70/CONT1.26/BSD					
Short description:	EUT is a RFID reader / writer operating at the frequencies 125 kHz and 13.56 MHz. BLE is additionally integrated.					
Additional modifications:	This modification only concerns the USB connection: 3 ferrites with the item number 742 711 11 of the manufacturer Würth were fixed around the USB cable. 2 ferrites were attached to the end of the cable that is plugged into the laptop and 1 ferrite was attached to the end of the cable that is plugged into the EUT.					
FCC ID:	2BAACMU20LE					
IC registration number:	30098-MU20LE					
Temperature range:	-25°C to +70 °C (Declared by customer)					
Device type:	Portable	□ Mobile	⊠ Fixed			



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# 3.2 Power supply

# 3.2.1 Wiegand

Power supply:	DC supply		
	Nominal voltage: Minimum voltage: Maximum voltage:	12.0 V 5.1 V 30.8 V	

# 3.2.2 RS485

Power supply:	DC supply	
	Nominal voltage: Minimum voltage: Maximum voltage:	12.0 V 5.1 V 30.8 V

# 3.2.3 USB

Power supply:	DC supply	
	Nominal voltage: Minimum voltage: Maximum voltage:	5.0 V 4.7 V 5.8 V



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# 3.3 Radio specifications

## Radio technology 1:

System type:	RFID Reader		
Application frequency band:	n/a		
Operating frequency:	125 kHz		
Number of RF channels	1		
Highest internal frequency:	2480 MHz (BLE)		
Modulation	ASK		
Antenna:	Туре:	Magnetic loop antenna	
	Inductance:	490 µH ± 5%	
	Diameter of wire:	0.11 mm	
	Turns:	135, max 140 Coil is fixed by using back Leadfree and RoHS confo	ed wire rm
	Connector:	<ul><li>external</li><li>temporary</li></ul>	<ul><li>☐ internal</li><li>⊠ none (integral antenna)</li></ul>

### 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:	2480 MHz (BLE)				
Modulation	ASK				
Antenna:	Type: Outer dimension: Inductance Width of wire Turns: Connector:	PCB antenna, 3 Layers 50.3 x 25.0 mm ± 1% 980 nH ± 5% 0.4 mm 4 □ external □ temporary	<ul> <li>□ internal</li> <li>⊠ none (integral antenna)</li> </ul>		



### Radio technology 3:

System type (Note 1):	Digital transmission system (DTS)			
Application frequency band:	2400.0 MHz - 2483.5 MHz			
Number of RF channels:	40			
Nominal bandwidth:	2 MHz			
Modulation(s):	GFSK			
Antenna:	Type: Gain: Model: Manufacturer: Connector:	<ul> <li>2.4 GHz Mini Antenna, SM</li> <li>0.5 dBi (peak)</li> <li>2450AT18A100</li> <li>JOHANSON TECHNOLOG</li> <li>external</li> <li>temporary</li> </ul>	IT GY □ ⊠	internal none (integral antenna)

Note(s):

1. • "DTS" is the equipment class for digital transmission systems, "DSS" for all other Part 15 spread spectrum transmitters as used for equipment authorization system form 731.

### 3.4 Human exposure specifications

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

## 3.5 Photographs of EUT

See Annex B of test report 240028-AU01+W04 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:

Ambient temperature	Ambient humidity	Ambient pressure
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:	Patricio Montenegro, M.ScIng.	Date of test:	August 13, 2024
Result:	⊠ Test passed	□ Test not passed	

## 4.1.1.1 Test configuration

Device	Type designation	Serial or inventory no.	Manufacturer
RFID reader / writer	Secustos MU20 LEGIC	N/A	Sesamsec GmbH

Table 1: EUT used for testing

Device	Type designation	Serial or inventory no.	Manufacturer
RFID-tag	125 kHz		Sesamsec GmbH
Wiegand adapter	SFTC-T4PM-A-100		Sesamsec GmbH
Power supply	3231.1	E01235	Statron

Table 2: Support equipment used for testing\_EUT operated via Wiegand

Device	Type designation	Serial or inventory no.	Manufacturer
RFID-tag	125 kHz		Sesamsec GmbH
Laptop	Latitude 3410	98DY103	Dell
Power supply for laptop	LA65NS2-01		DELL
Power supply	3231.1	E01235	Statron
RS485 Adapter			

Table 3: Support equipment used for testing\_EUT operated via RS485

Device	Type designation	Serial or inventory no.	Manufacturer
RFID-tag	125 kHz		Sesamsec GmbH
Laptop	Latitude 3410	98DY103	Dell
Power supply for laptop	LA65NS2-01		DELL
USB cable			

Table 4: Support equipment used for testing\_EUT operated via USB



# 4.1.1.2 Mode of operation

## 4.1.1.2.1 Mode 1

- The EUT was connected to a Wiegand adapter which was powered by a DC power supply.
- All tests were performed with a supply voltage of 12 V.
- By means of the test software "AppBlaster V4.05.04" the EUT was set in continuous interrogation mode at 125 kHz.

# 4.1.1.2.2 Mode 2

- The EUT was connected via a RS485 cable and a serial to USB adapter to a laptop and in addition to a DC power supply.
- All tests were performed with a supply voltage of 12 V.
- By means of the test software "AppBlaster V4.05.04" the EUT was set in continuous interrogation mode at 125 kHz.

## 4.1.1.2.3 Mode 3

- The device was powered by a laptop via USB.
- All tests were performed with a supply voltage of 5 V (normal USB connection to the laptop).
- By means of the test software "AppBlaster V4.05.04" the EUT was set in continuous interrogation mode at 125 kHz.



#### 4.1.1.3 **Test equipment**

Description	Designation	Manufacturer	Inventory number	Last check	Next check	Check type
Exposure level tester with magnetic field probe 100 cm <sup>2</sup>	ELT-400	Narda Safety Test Solutions	E00276	2024-03-12	2026-03-12	С
Broadband field meter with electric field probe	NBM-550 EF0691	Narda Safety Test Solutions	E00900 E00902	2023-09-18	2025-09-18	С

Note(s) 1. C = Calibration

#### 4.1.1.4 Test setup

#### 4.1.1.4.1 Mode 1



Picture 1: Setup of magnetic field test at a measurement distance of 20 cm, with RFID tag

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Picture 2: Setup of electric field test at a measurement distance of 20 cm, with RFID tag

### 4.1.1.4.2 Mode 2



Picture 3: Setup of magnetic field test at a measurement distance of 20 cm, with RFID tag



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Picture 4: Setup of electric field test at a measurement distance of 20 cm, with RFID tag

### 4.1.1.4.3 Mode 3



Picture 5: Setup of magnetic field test at a measurement distance of 20 cm, with RFID tag

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Picture 6: Setup of electric field test at a measurement distance of 20 cm, with 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 V/m and H = 1.63 A/m

Frequency	Electric field	Magnetic field	Power	Averaging
range	strength	strength	densitiy	time
(MHz)	(V/m)	(A/m)	(mW/cm²)	(minutes)
0.3-3.0	614	1.63	(100)(see note 1)	<30

Table 5: 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.



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#### 4.1.1.7 Results

### 4.1.1.7.1 Mode 1

### Radio technology 1:

Application:	RFID
Operation frequency:	125 kHz

### Information related to Exposure:

Separation distance:	20 cm
Exposure:	general public

Note(s):

- Áveraging time over 6 minutes was applied. 1
- 2 3 Worst case: with RFID tag
- Separation distance to the edge of the EUT: 20 cm

Type of measurement	Operation frequency (kHz)	Measured average value	Limit	Ratio of limit	Result
E-Field	125	0.40 V/m	614.00 V/m	0.0007	Passed
H-Field	125	0.45 A/m	1.63 A/m	0.2789	Passed

Table 6: Test results for electric, magnetic and electromagnetic fields



### 4.1.1.7.2 Mode 2

### 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: with RFID tag
- 3 Separation distance to the edge of the EUT: 20 cm

Type of measurement	Operation frequency (kHz)	Measured average value	Limit	Ratio of limit	Result
E-Field	125	0.44 V/m	614.00 V/m	0.0007	Passed
H-Field	125	0.46 A/m	1.63 A/m	0.2793	Passed

Table 7: Test results for electric, magnetic and electromagnetic fields



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## 4.1.1.7.3 Mode 3

### 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: with RFID tag
- 3 Separation distance to the edge of the EUT: 20 cm

Type of measurement	Operation frequency (kHz)	Measured average value	Limit	Ratio of limit	Result
E-Field	125	0.44 V/m	614.00 V/m	0.0007	Passed
H-Field	125	0.45 A/m	1.63 A/m	0.2773	Passed

Table 8: 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:	August 14, 2024
Result:	⊠ Limits kept	□ Limits not kept	

## 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.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power densitiy (mW/cm²)	Averaging time (minutes)
1.34-30	824/f	2.19/f	180/f <sup>2</sup> (see note 2)	<30
1500-100000			1.0	<30

Table 9: 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 240028-AU01+W05 of the test laboratory Element Materials Technology Straubing GmbH.

Operation frequency:	13.56 MHz
Field strength:	20.8 dBµV/m at 30 m

The following data are based on applicants document: Test report 240028-AU02+W06 of the test laboratory Element Materials Technology Straubing GmbH.

Operation frequency:	13.56 MHz
Field strength:	26.9 dBµV/m at 30 m

The following data are based on applicants document: Test report 240028-AU04+W06 of the test laboratory Element Materials Technology Straubing GmbH.

Operation frequency:	13.56 MHz
Field strength:	28.0 dBµV/m at 30 m

Information related to Exposure:

Worst case field strength:	28.0 dBµV/m at 30 m
Tune-up tolerance (according to the manufacturer):	0 dB
Separation distance:	20 cm
Exposure:	general public
Power averaging over time:	not applied

Operation frequency (MHz)	EIRP + tune-up tolerance (dBm)	Power densitiy (mW/cm²)	Limit (mW/cm²)	Ratio of limit	Result
13.56	-47.2	0.000000004	0.978933354	0.00000004	Passed

Table 10: Result of evaluation of compliance

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  $dB\mu V/m$ d = measurement distance in meters (m)



### Radio technology 3:

The following data are based on applicants document: Test report 240028-AU01+W07 of the test laboratory Element Materials Technology Straubing GmbH.

7.2 dBm at 2402 MHz

The following data are based on applicants document: Test report 240028-AU02+W07 of the test laboratory Element Materials Technology Straubing GmbH.

Conducted power: -7.1 dBm at 2402 MHz

The following data are based on applicants document: Test report 240028-AU04+W07 of the test laboratory Element Materials Technology Straubing GmbH.

Conducted power:	-7.2 dBm at 2402 MHz
------------------	----------------------

Information related to Exposure:

Worst case conducted power:	-7.1 dBm at 2402 MHz
Antenna gain:	0.5 dBi
Tune-up tolerance (according to the manufacturer):	0 dB
Separation distance:	20 cm
Exposure:	general public
Power averaging over time:	not applied

Operation frequency (MHz)	EIRP + tune-up tolerance (dBm)	Power densitiy (mW/cm²)	Limit (mW/cm²)	Ratio of limit	Result
2402	-6.6	0.00004	1.00000	0.00004	Passed

Table 11: Result of evaluation of compliance



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## 4.2 Canada

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

Requirement: Reference:	RSS-102 Issue 5, section 2.5.2 n/a			
Performed by:	Konrad Graßl	Date of test:	August 14, 2024	
Result:	⊠ Limits kept	□ 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 240028-AU01+W05 of the test laboratory Element Materials Technology Straubing GmbH.

Operation frequency:	13.56 MHz
Field strength:	20.8 dBµV/m at 30 m

The following data are based on applicants document: Test report 240028-AU02+W06 of the test laboratory Element Materials Technology Straubing GmbH.

Operation frequency:	13.56 MHz
Field strength:	26.9 dBµV/m at 30 m

The following data are based on applicants document: Test report 240028-AU04+W06 of the test laboratory Element Materials Technology Straubing GmbH.

Operation frequency:	13.56 MHz
Field strength:	28.0 dBµV/m at 30 m

Information related to Exposure:

Worst case field strength:	28.0 dB $\mu\text{V/m}$ at 30 m
Tune-up tolerance (according to the manufacturer):	0 dB
Separation distance:	20 cm
Exposure:	general public
Power averaging over time:	not applied

Channel Frequency (MHz)	EIRP + tuneup tolerance (dBm)	EIRP (W)	EIRP limit (W)	Ratio of limit	Result
13.56	-47.2	0.0000002	1.00000000	0.0000002	Passed

Table 12: 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 + 20log(d) - 104.7

Where: EIRP = equivalent isotropically radiated power in dBm E = electric field strength in dB $\mu$ V/m

d = measurement distance in meters (m)



### Radio technology 3:

The following data are based on applicants document: Test report 240028-AU01+W07 of the test laboratory Element Materials Technology Straubing GmbH.

Conducted power:	-7.2 dBm at 2402 MHz

The following data are based on applicants document: Test report 240028-AU02+W07 of the test laboratory Element Materials Technology Straubing GmbH.

Conducted power: -7.1 dBm at 2402 MHz

The following data are based on applicants document: Test report 240028-AU04+W07 of the test laboratory Element Materials Technology Straubing GmbH.

Conducted power:	-7.2 dBm at 2402 MHz
------------------	----------------------

Information related to Exposure:

Worst case conducted power:	-7.1 dBm at 2402 MHz
Antenna gain:	0.5 dBi
Tune-up tolerance (according to the manufacturer):	0 dB
Separation distance:	20 cm
Exposure:	general public
Power averaging over time:	not applied

Channel Frequency (MHz)	EIRP + tuneup tolerance (dBm)	EIRP (W)	EIRP limit (W)	Ratio of limit	Result
2402	-6.6	0.0002	2.6764	0.00008	Passed

Table 13: Result of exemption for routine evaluation of RF exposure

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Test	Frequency range	Equipment used	Expanded	U <sub>Limit</sub>	k=
			uncertainty		
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

### 5 Measurement uncertainty

Note(s):

3

- 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
  - The limits for the measurement uncertainty as listed above are
    - a) derived from ETSI EN 300 328 V2.1.1
    - b) equal to U<sub>CISPR</sub> 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<sub>Limit</sub>) 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. 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.



# 6 Revision history

Revision	Date	Issued by	Description of modifications
0	2024-08-14	Konrad Graßl	First edition

Template: RF\_FCC\_IC\_Human Exposure\_V1.8