element

Safety Safety Safety Safety Safety Safety Safety Safety Safety Safety

Applicant:
Uhlmann & Zacher GmbH
Gutenbergstraße 2-4
97297 Waldbüttelbrunn
Tel.: +49 931 40672-0

Test report no.:
220470-AU01+W03
for:
Uhlmann & Zacher GmbH
Electronic Door Handle
EDH420

according to:
47 CFR Part 2
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: 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

List of tables

1 Summary of test results

1.1 FCC standard

FCC standard	*Requirement*	*Page*	*Result*
47 CFR Part 2, § 2.1093	SAR test exclusion, except WPT	8	Passed
47 CFR Part 2, § 2.1093	Simultaneous transmissions - SAR test exclusion, except WPT	12	Passed

1.2 IC standard

IC standard	*Requirement*	*Page*	*Result*
RSS-102 Issue 5, section 2.5.1	SAR test exclusion, except 3 kHz – 10 MHz	14	Passed
RSS-102 Issue 5, section 2.5.1	Simultaneous transmissions SAR test exclusion, except 3 kHz – 10 MHz	17	Passed

Straubing, August 17, 2023

Tested by
Konrad Graßl
Department Manager Radio

Approved by
Christian Kiermeier
Reviewer

2 Test regulations

2.1 FCC standards

Standard	*Title*
OET Bulletin 65, 65A, 65B Edition 97-01, August 1997	Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields
Part 1, Subpart I, Section 1.1307 October 2022	Actions that may have a significant environmental effect, for which Environmental Assessment (EAs) must be prepared.
Part 1, Subpart I, Section 1.1310 October 2022	Radiofrequency radiation exposure limits
Part 1, Subpart 2, Section 2.1093 October 2022	Radiofrequency radiation exposure evaluation: portable devices.
KDB 447498 D04 v01 November 29, 2021	RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
KDB 865664 D01 v01r04 August 7, 2015	SAR Measurement requirements for 100 MHz to 6 GHz
ANSI C96.1: 2005	IEEE Standard for Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
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) Amendment 1 (February 2, 2021)	Spectrum Management and Telecommunications Radio Standards Specification Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands)
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.

3 Equipment under Test

3.1 General information

Product type:	Electronic Door Handle	
Model name:	EDH420	
Serial number:	0010E00D	
Manufacturer:	Uhlmann & Zacher GmbH	
Version:	Hardware:	4.2.2
	Software:	edh_nrf_CPR_HW4_2_0_cardReadable_noTimeout_app.hex
Short description:	EUT is a door handle with a RFID module operating at the frequency 13.56 MHz. The EUT also employs Bluetooth Low Energy	
FCC ID:	2APV6-EDH420	
IC certification number:	24382-EDH420	
Technology 1:	RFID	
Operating frequency:	13.56 MHz	
Antenna types:	Loop antenna	
	☐ detachable	☒ not detachable
Technology 2:	Bluetooth low energy	
Application frequency band:	2400 MHz to 2483.5 MHz	
Antenna types:	PCB antenna	
	☐ detachable	☒ not detachable
Power supply:	Battery supply Nominal voltage: 3 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 B of test report 220470-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.

4.1 FCC

4.1.1 SAR test exclusion, except WPT

Requirement:	Part 2, §2.1093
Reference:	KDB 447498 D04 v01

Performed by:	Konrad Graßl	Date of test:	August 17, 2023
Result:	☒ Limits kept	☐ Limits not kept	

4.1.1.1 Requirements and limits for separation distance ≤ 20 cm

According to §2.1093(b):
For purposes of this section, the definitions in §1.1307(b)(2) of this chapter shall apply. A portable device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that the RF source's radiating structure(s) is/are within 20 centimeters of the body of the user.

According to §2.1093(c)(1):
Evaluation of compliance with the exposure limits in §1.1310 of this chapter, and preparation of an EA if the limits are exceeded, is necessary for portable devices having single RF sources with more than an available maximum time-averaged power of 1 mW, more than the ERP listed in Table 1 to §1.1307(b)(3)(i)(C), or more than the P_{th} in the following formula, whichever is greater. The following formula shall only be used in conjunction with portable devices not exempt by §1.1307(b)(3)(i)(C) at distances from 0.5 centimeters to 20 centimeters and frequencies from 0.3 GHz to 6 GHz.

Note:
1. According to the TCB Workshop on April 27, 2022 P_{th} can be calculated to the extended frequency range 100 kHz to 6 GHz. The formulas in the presentation of the TCB workshop beginning at slide 17 were used in addition to the KDB 447498 D04 v01.

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right)$$ and f is in GHz;

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

Table 1: Formula for calculation P_{th}

d = the minimum separation distance (cm) in any direction from any part of the device antenna(s) or radiating structure(s) to the body of the device user.

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

Table 2: Table 1 to §1.1307(b)(3)(i)(C)—Single RF Sources Subject to Routine Environmental Evaluation

4.1.1.2 Process to determine RF Exposure Compliance

According to Appendix A of KDB 447498 D04 Interim General RF Exposure Guidance V01:
Generally, the sequence to apply for single portable RF sources includes the following steps:

1) Determination of 1 mW exemption
2) Determination of exemption according to Table 2
3) Determination of exemption according to formula in Table 1

4.1.1.3 Results

RF technology 1:

The following data are based on applicants document: Test report 220470-AU01+W01 of the test laboratory Element Materials Technology Straubing GmbH

Application:	RFID
Operation frequency:	13.56 MHz
Maximum field strength:	30.99 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
Applied determination process:	Step 3 of clause 4.1.1.2

Separation distance (mm)	*Channel frequency (MHz)*	*ERP + tolerance (dBm)*	*ERP + tolerance (mW)*	*Limit (mW)*	*Ratio of limit*	*Result*
< 5	13.56	-42.32	$5.86 \cdot 10^{-5}$	413.86	$1.42 \cdot 10^{-7}$	Passed

Table 3: 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)

ERP = EIRP – 2.15 dB

RF technology 2:

The following data are based on applicants document: Test report 220470-AU01+W02 of the test laboratory Element Materials Technology Straubing GmbH

Application:	Bluetooth low energy
Operation frequency band:	2400 MHz to 2483.5 MHz
Antenna gain:	-5.58 dBi at 2402 MHz -7.20 dBi at 2440 MHz -5.59 dBi at 2480 MHz
Maximum conducted output power:	-6.02 dBm at 2402 MHz -6.19 dBm at 2440 MHz -6.88 dBm at 2480 MHz

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
Applied determination process:	Step 3 of clause 4.1.1.2

Separation distance (mm)	*Channel frequency (MHz)*	*ERP + tolerance (dBm)*	*ERP + tolerance (mW)*	*Limit (mW)*	*Ratio of limit*	*Result*
< 5	2402	-9.75	0.11	2.79	0.04	Passed
< 5	2440	-11.54	0.07	2.75	0.03	Passed
< 5	2480	-10.62	0.09	2.72	0.03	Passed

Table 4: Result of SAR test exclusion, exposure to the head and body

ERP = EIRP – 2.15 dB

4.1.2 Simultaneous transmissions - SAR test exclusion, except WPT

Requirement:	Part 2, § 2.1093
Reference:	KDB 447498 D04 v01

Performed by:	Konrad Graßl	Date of test:	August 17, 2023
Result:	☒ Limits kept	☐ Limits not kept	

4.1.2.1 Requirements and limits

According to §2.1093(c)(2):
For multiple mobile or portable RF sources within a device operating in the same time averaging period, evaluation is required if the formula in §1.1307(b)(3)(ii)(B) of this chapter is applied to determine the exemption ratio and the result is greater than 1.

According to §1.1307(b)(3)(ii)(B)
in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Where:

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for Pth, including existing exempt transmitters and those being added.

b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added.

c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters.

Pi = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive).

Pth,i = the exemption threshold power (Pth) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i.

ERPj = the ERP of fixed, mobile, or portable RF source j.

ERPth,j = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π according to the applicable formula of paragraph (b)(3)(i)(C) of this section.

Evaluatedk = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure.

Exposure Limitk = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from §1.1310 of this chapter.

According to clause 4.3.2 of KDB 447498 D01 General RF Exposure Guidance:
Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to the simultaneous transmission configuration.

4.1.2.2 Results

Note(s):
1. The SAR ratios are taken from clause 4.1.1.3.
2. Worst case ratio of Technology 2: 0.08

Technology	*SAR ratios*	*Sum of SAR ratios*	*Limit*	*Result*
1	$1.42 \cdot 10^{-7}$	0.0400001	≤ 1	Passed
2	0.04			

Table 5: Result of SAR test exclusion, simultaneous transmissions

4.2 Canada

4.2.1 SAR test exclusion, except 3 kHz – 10 MHz

Requirement:	RSS-102 Issue 5, section 2.5.1
Reference:	n/a

Performed by:	Konrad Graßl	Date of test:	August 17, 2023
Result:	☒ Limits kept	☐ Limits not kept	

4.2.1.1 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.

4.2.1.2 Results

RF technology 1:

The following data are based on applicants document: Test report 220480-AU01+W01 of the test laboratory Element Materials Technology Straubing GmbH

Application:	RFID
Operation frequency range:	13.56 MHz
Maximum conducted output power:	30.99 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	-40.17	$9.62 \cdot 10^{-5}$	71.00	$1.35 \cdot 10^{-6}$	passed

Table 6: 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)

RF technology 2:

The following data are based on applicants document: Test report 220470-AU01+W02 of the test laboratory Element Materials Technology Straubing GmbH

Application:	Bluetooth low energy
Operation frequency band:	2400 MHz to 2483.5 MHz
Antenna gain:	-5.58 dBi at 2402 MHz -7.20 dBi at 2440 MHz -5.59 dBi at 2480 MHz
Maximum conducted output power:	-6.02 dBm at 2402 MHz -6.19 dBm at 2440 MHz -6.88 dBm at 2480 MHz

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)*	*Conducted power + tolerance (dBm)*	*Conducted power + tolerance (mW)*	*Limit (mW)*	*Ratio of limit*	*Result*
< 5	2402	-2.02	0.63	4.00	0.16	Passed
< 5	2440	-2.19	0.60	4.00	0.15	Passed
< 5	2480	-2.88	0.52	4.00	0.13	Passed

Table 7: Result of SAR test exclusion, exposure to the head and body

4.2.2 Simultaneous transmissions SAR test exclusion, except 3 kHz – 10 MHz

Requirement:	RSS-102 Issue 5, section 2.5.1
Reference:	Notice 2016-DRS001 KDB 447498 D01 v06

Performed by:	Konrad Graßl	Date of test:	August 17, 2023
Result:	☒ Limits kept	☐ Limits not kept	

4.2.2.1 Requirements and limit

According to Notice 2016-DRS001:
The SAR exemption limits outlined in clause 2.5.1 of RSS-102 have been derived based on an approximate SAR value of 0.4 W/kg using half-wave dipole antennas. As such, when simultaneous transmitter SAR evaluations include transmitters that have been exempt from routine SAR evaluation, the SAR must be estimating based on the ratio between the maximum tune-up tolerance limit of the transmitter that has been exempt and the exemption limit at the specific distance and frequency for that transmitter. This ratio must be multiplied by 0.4 W/kg (2.0 W/kg for controlled use and 1.0 W/kg for limb worn devices) in order to calculate the estimated SAR level.

Exposure tier	*Region of body*	*SAR exemption limit* (W/kg)
General public	Head and trunk	0.4
General public	Limbs	1.0
Occupational	Head and trunk	2.0
Occupational	Limbs	5.0

Table 8: SAR exemption limits

The procedure defined in Section 4.4.2 of FCC KDB 447498 D01 V06 “Area scan based 1-g SAR estimation” is now accepted by the department.

4.2.2.2 Results

Note(s):
1. The ratios are taken from clause 4.2.1.2.
2. Worst case ratio of technology 2: 0.16
3. There are no simultaneous transmissions below 10 MHz (nerve stimulation).

Exposure tier: Head and trunk

Technology	*Ratio*	*Factor (W/kg)*	*Estimated SAR (W/kg)*	*Sum of estimated SAR (W/kg)*	*SAR exemption limit (W/kg)*	*Result*
1	$1.35 \cdot 10^{-6}$	0.4	$5.40 \cdot 10^{-7}$	0.0640005	0.4	Passed
2	0.16	0.4	0.064			

Table 9: Result of SAR exemption, simultaneous transmissions

5 Revision history

Revision	*Date*	*Issued by*	*Description of modifications*
0	2023-08-17	Konrad Graßl	First edition

Template: RF_FCC_IC_Human Exposure_V1.6