Report on the FCC and IC Testing of the Marquardt GmbH NFC door handle Model: HH2 In accordance with FCC 47 CFR Part 2 and KDB 447498 and ISED RSS-102 and ISED RSS-Gen

Product Service

Add value.
Inspire trust.

Prepared for:

Marquardt GmbH
Schloßstr. 16
78604 Rietheim-Weilheim
Germany

FCC ID: IYZHH2
IC: 2701A-HH2

COMMERCIAL-IN-CONFIDENCE

Date: 2021-09-03
Document Number: TR-33652-24237-06 (Edition 02)

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Martin Steindl	2021-09-03	Steindl Martin SIGN-ID 550030
Authorised Signatory	Alex Fink	2021-09-03	Fink SIGN-ID 550068

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

Engineering Statement:
This measurement shown in this report were made in accordance with the procedures described on test pages.
All reporded testing was carried out on a sample equipment to demonstrate limited compilance with with FCC 47 CFR Part 2 and KDB 447498 and ISED RSS-102 and ISED RSS-Gen.
The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Martin Steindl	2021-09-03	Steindl Martin SIGN-ID 550029

Laboratory Accreditation DAkkS Reg. No. D-PL-11321-11-02 DAkkS Reg. No. D-PL-11321-11-03	Laboratory recognition Registration No. BNetzA-CAB-16/21-15	Industry Canada test site registration 3050A-2

Executive Statement:
A sample of this product was tested and found to be compilant with FCC 47 CFR Part 2 and KDB 447498 and ISED RSS-102 and ISED RSS-Gen

Trade Register Munich
HRB 85742
VAT ID No. DE129484267
Information pursuant to Section 2(1) DL-InfoV (Germany) at www.tuev-sued.com/imprint

Managing Directors:
Walter Reithmaier (CEO)
Dr. Jens Butenandt
Patrick van Welij

Phone: +49 (0) 9421 55 22-0
Fax: +49 (0) 9421 55 22-99
www.tuev-sued.de

TÜV SÜD Product Service GmbH
Äußere Frühlingstraße 45
94315 Straubing
Germany

Product Service

Content

Content 1
1 Report Summary 2

1.1 Modification Report 2
1.2 Introduction 2
1.3 Brief Summary of Results 3
1.4 Product Information 4
1.5 EUT Modifications Record 5
1.6 Test Location 6

2 Test Details 7

2.1 RF Exposure 7

3 Measurement Uncertainty 10

Product Service

1 Report Summary

1.1 Modification Report

Alternations and additions of this report will be issued to the holders of each copy in the form of a complete document.

Issue	*Description of changes*	*Date of Issue*
1	First Issue	2021-09-01
2	Correction of antenna size	2021-09-03

Table 1: Report of Modifications

1.2 Introduction

Applicant	Marquardt GmbH Schloßstr. 16 78604 Rietheim-Weilheim Germany
Manufacturer	Marquardt GmbH Schloßstr. 16 78604 Rietheim-Weilheim Germany
Model Number(s)	HH2
Serial Number(s)	Continuous_Mode, System_Test_Mode
Hardware Version(s)	N/A
Software Version(s)	N/A
Number of Samples Tested	2
Test Specification(s) / Issue / Date	FCC 47 CFR Part 2 J, Clause 2.1093 KDB 447498 D01 V06, section 4.3.1 ISED RSS-Gen, Clause 3.4 ISED RSS-102, Clause 2.5.1
Test Plan/Issue/Date	---
Order Number Date	6200494494
Date of Receipt of EUT	2021-08-13
Start of Test	2021-08-16
Finish of Test	2021-08-20
Name of Engineer(s)	M. Steindl
Related Document(s)	ANSI C63.10:2013

Product Service

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with KDB 447498 D01 and ISED RSS-102 is shown below.

Section	*Specification Clause*	*Test Description*	*Result*
2.1	4.3.1	Standalone SAR test exclusion	Pass

Table 2: Results according to FCC 47 CFR Part 152

Section	*Specification Clause*	*Test Description*	*Result*
2.1	2.5.1	Exception Limits for Routine Evaluation – SAR Evaluation	Pass

Table 3: Results according to ISED RSS-210

Product Service

1.4 Product Information

1.4.1 Technical Description

Functional description

The **HH2** is a door handle for a car with capacitive touch sensors and NFC. An integrated NFC antenna inside into the door handle, smartphones, wearables and NFC tags can be identified and a driver can be authorized by the car so the door can be opened.
The **HH2** is connected to the car using a CAN-FD interface. It acts as communication channel between CAR Electronics control Unit and NFC Readers. The car ECU NFC Reader requests to the **HH2** which communicates with the NFC device on the integrated antenna using a magnetic field.

User manual

The user places his authorized NFC device (a smartcard or a mobile phone / wearable with an integrated secure element ID) onto the door handle. The **HH2** authorizes the user to the car automatically as soon as a valid device is recognized. Then the door is unlocked and the driver can access the car. The NFC communication is only activated once a NFC device is placed onto the door handle.

Test mode

For the radio testing, a test mode is configured in software. After providing the power supply, **HH2** will transmit continuously at 13.56 MHz

Product Service

Temperature Range

Working temperature:	-40 °C to + 80 °C
Storage temperature:	-40 °C to + 85 °C

Data of RF-Part

Transmission Mode	Continuous Transmission mode
Reader to card	100 % ASK, Miller Coded, 106 kbit/s
Card to reader	Subcarrier Load Modulation, Manchester Coded, 106 kbit/s
Transmission center frequency	**13.56 MHz**
3 dB bandwidth	400 kHz
Maximum magnetic field strength	7.5 A/m
Antenna	Integrated PCB antenna, approx. 73x15.5 mm

1.4.2 EUT Ports / Cables identification

Port	Usage	Type	Screened
Wiring harness		DC supply CAN	No

Table 4

1.5 EUT Modifications Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied by the customer	Not Applicable	Not Applicable

Table 5

Product Service

1.6 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing test laboratory:

Test Name	Name of Engineer(s)
RF Exposure	M. Steindl

Office Address:
Äußere Frühlingstraße 45
94315 Straubing
Germany

Product Service

2 Test Details

2.1 RF Exposure

2.1.1 Specification Reference

FCC 47 CFR Part 2 J, Clause 2.1093
KDB 447498 D01 V06, section 4.3.1
ISED RSS-Gen, Clause 3.4
ISED RSS-102, Clause

2.1.2 Equipment under Test and Modification State

HH2 - S/N: System_Test_Mode - Modification State 0

2.1.3 Date of Test

2021-08-18

2.1.4 Environmental Conditions

Ambient Temperature	26 °C
Relative Humidity	46 %

2.1.5 Specification Limits

KDB 447598 D01, section 4.3.1
Systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy levels in excess of the Comission's guideline.
Acc. to KDB 477498:
The 1 g and 10 g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separations distances ≤ 50 mm are determined by:

$$\frac{max.\ power\ of\ channel, incl.\ tune-up\ tol., mW}{min. test\ separation\ distance, mm} \cdot \sqrt{f, GHz} \leq \begin{Bmatrix} 3.0\ \ for\ 1\ g \\ 7.5\ for\ 10\ g \end{Bmatrix}\ extremity\ SAR$$

1. f (GHz) is the RF channel frequency in GHz;
2. Power and distance are rounded to the nearest mW and mm before calculation;
3. The result is rounded to one decimal place for comparison;
4. 3.0 and 7.5 are referred to as the numeric thresholds

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied.

Product Service

ISED 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 the table.
For controlled use devices where the 8 W/kg for 1 gram of tissue applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 5. For limb-worn devices where the 10 gram value applies, the exemption limits for routine evaluation in the table are multiplied by a factor of 2.5. If the operating frequency of the device is between two frequencies located in the table, 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.:

Frequency (MHz)	Exemption limits (mW)1 at separation distance of									
	≤5 mm	10 mm	15 mm	20 mm	25 mm	30 mm	35 mm	40 mm	45 mm	≥50 mm
≤300 2	71	101	132	162	193	223	254	284	315	345
450	52	70	88	106	123	141	159	177	195	213
835	17	30	42	55	67	80	92	105	117	130
1900	7	10	18	34	60	99	153	225	316	431
2450	4	7	15	30	52	83	123	173	235	309
3500	2	6	16	32	55	86	124	170	225	290
5800	1	6	15	27	41	56	71	85	97	106

2.1.6 Test Method

The test result is based on a radiated emission test. See test report TR-33652-24237-04 for details

Product Service

2.1.7 Test Results

Field strength: 59.02 dBµV/m
Distance: 3 m
E.I.R.P.: 239.398 nW

KDB 477498, section 4.3.1, c) 2)

Maximum output power:	239.398 nW
Minimum test separation distance:	5 mm
Frequency:	13.56 MHz
SAR test exclusion threshold (calculated):	
Limit (1 g SAR):	237.2 mW
Limit (10 g SAR):	592.9 mW
Test Result:	Pass

ISED RSS-Gen, Clause 3.4

Frequency:	13.56 MHz
Test distance:	5 mm
Carrier Power (e.i.r.p.):	239.398 nW
Exemption limit:	71 mW
Test Result:	Pass

Product Service

3 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

The measurement uncertainty in the laboratory is less than or equal to the maximum measurement uncertainty according to CISPR16-4-2: 2011 + A1 + A2 + Cor1 (U_{CISPR}). This normative regulation means that the measured value is also the value to be assessed in relation to the limit value.

Radio Interference Emission Testing		
Test Name	*kp*	*Expanded Uncertainty*
Conducted Voltage Emission		
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB
100 kHz to 200 MHz (50Ω/5µH AMN)	2	± 3.6 dB
Discontinuous Conducted Emission		
9 kHz to 150 kHz (50Ω/50µH AMN)	2	± 3.8 dB
150 kHz to 30 MHz (50Ω/50µH AMN)	2	± 3.4 dB
Conducted Current Emission		
9 kHz to 200 MHz	2	± 3.5 dB
Magnetic Fieldstrength		
9 kHz to 30 MHz (with loop antenna)	2	± 3.9 dB
9 kHz to 30 MHz (large-loop antenna 2 m)	2	± 3.5 dB
Radiated Emission		
30 MHz to 300 MHz	2	± 4.9 dB
300 MHz to 1 GHz	2	± 5.0 dB
1 GHz to 6 GHz	2	± 4.6 dB
Test distance 10 m		
30 MHz to 300 MHz	2	± 4.9 dB
300 MHz to 1 GHz	2	± 4.9 dB
The expanded uncertainty reported according to to CISPR16-4-2: 2011 + A1 + A2 + Cor1 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%		

Table 6 Measurement uncertainty based on CISPR 16-4-2

Product Service

Radio Interference Emission Testing		
Test Name	*kp*	*Expanded Uncertainty*
Occupied Bandwdith	2	± 5 %
Conducted Power		
9 kHz ≤ f < 30 MHz	2	± 1.0 dB
30 MHz ≤ f < 1 GHz	2	± 1.5 dB
1 GHz ≤ f ≤ 40 GHz	2	± 2.5 dB
1 MS/s power sensor (TS8997)	2	± 1.5 dB
Occupied Bandwidth	2	± 5 %
Power Spectral Density	2	± 3.0 dB
Radiated Power		
9 kHz ≤ f < 26.5 GHz	2	± 6.5 dB
26.5 GHz ≤ f < 60 GHz	2	± 8.0 dB
60 GHz ≤ f < 325 GHz	2	± 10 dB
Conducted Spurious Emissions	2	± 3.0 dB
Radiated Spurious Emissions	2	± 6.0 dB
Voltage		
DC	2	± 1.0 %
AC	2	± 2.0 %
Time (automatic)	2	± 5 %
Frequency	2	± 10^{-7}
The expanded uncertainty reported according to to ETSI TR 100 028:2001 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%		

Table 7 Measurement uncertainty based on ETSI TR 100 028