



Test report

according to ISO/IEC 17025:2017

FCC

(Federal Communications Commission)

Test Firm Registration Number: 768032

Designation Number DE0022

ISED

(Innovation, Science and Economic Development)

CAB identifier: DE0012

ISED#: 6155A

RF Exposure



Deutsche
Akkreditierungsstelle
D-PL-17379-01-01
D-PL-17379-01-02
D-PL-17379-01-03

 **TESTED
IN GERMANY**

STC Germany GmbH
Ohmstrasse 1
84160 Frontenhausen, Germany
Tel.: + 49 (0) 8732 6381
Fax: + 49 (0) 8732 2345
E-mail: grstc@stc.group

Prüfbericht Nr./
Test report no.: **22/09-0001 G**

Seite 1 von 18 Seiten
Page 1 of 18 pages

Table of contents

Table of contents.....	2
1. Client information.....	3
2. Equipment under test (EUT)	3
3. Description of the equipment under test and test conditions	4
4. RF Exposure Evaluation	5
4.2 Evaluation §2.1093 Radiofrequency radiation exposure evaluation: portable devices.....	5
4.2 Evaluation RSS-102 - Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus.....	8
5. Conclusions	10
6. Measurement uncertainty according to CISPR 16-4-2 first edition 2003-11	11
7. Photos of tested sample	13

Location of test facility:



STC Germany GmbH
Ohmstrasse 1
84160 Frontenhausen
Germany

1. Client information

Name: Carl Zeiss AG
Address: Carl-Zeiss-Straße 22
73447 Oberkochen
Germany
Name of contact: Mr. Andreas Wolf
Telephone: +49 (0) 7364 20 87060
Fax:
E-mail: andreas2.wolf@zeiss.com

2. Equipment under test (EUT)

2.1 Identification of the EUT

Equipment: Wärmebildkamera / Thermal Imaging Monocular
Model: DTI 6
Types: DTI 6/20, DTI 6/40
Brand name: Zeiss
Serial no.: Sample 01: 5272768 Sample 02: 5272777
Sample 03: NVDEM085
Manufacturer: Carl Zeiss AG

Country of origin: Germany
Power rating: 7.2 V DC
Highest frequency generated or used in the device or on which the device operates or tunes: 2.48 GHz
Date Sample Received: 05.09.2022
Tests were performed: 05.09.2022 – 03.11.2022

2.2 Additional information about the EUT:

The EUT is a host devices where a modular approved module is integrated.
The EUT can also operate at 2.4 GHz in BLE mode simultaneously to the 2.4 GHz Wifi-function.

To duplicate parts of this test report needs the written confirmation of the test laboratory.

The test results relate only to the above mentioned test sample(s).

3. Description of the equipment under test and test conditions

Power:	Adaptor: RWD018G In: 100..240 V 50/60 Hz 0,6 A max Out: 5 V 3 A (15 W), 9 V 2 A(18 W), 12 V 1,5 A (18 W) Li-ion Battery: 21NR 19/66 Voltage: 7.2 V, Capacity: 3.2 Ah, Energy: 23.04 Wh Battery Charger Model: DD-PS2 In 5 V 3 A, 9V 3 A, 12 V 2.5 A, 15 V 2 A Out: 8.4 V 3 A	
Cables:	USB (PC) 94.5 cm, USB (charger) 141.2 cm	
Approx. Size (l x w x h):	(227 x 70 x 73) mm	
Test conditions:	The "Wärmebildkamera / Thermal Imaging Monocular" Model: DTI 6 (= equipment under test – EUT) had been tested with different type of connection as well as controlled by test software. 1) WLAN 2) BLE Types DTI 6/20 and DTI 6/40 are electrically identical and just differ by objective lens diameter. The tested configuration represents (based on the product specification) with the tested operation modes the worst case.	
RF Module Model Number:	Laird Sterling-LWB-Module, Part-Number: 450-0152	
RF Module FCC ID:	2AMSP-DTI6	
RF Module IC:	22938-DTI6	
Type of modulation (ITU designation):	-/-	
Operating temperature range:	-/-	
Operating voltage range:	-/-	
Frequency range:	2400 MHz ... 2483.5MHz	
Transmission protocol	WLAN	BLE
Specification	802.11 b/g/n	BLE 4.2
Number of channels:	11	3
Channel separation:	5 MHz	2 MHz
Output power (effective radiated power):	radiated: 8.21 dBm conducted: -/-	radiated: 5.02 dBm conducted: -/-
Environmental conditions during tests:	Ambient temperature: 22 °C Relative humidity 60 % Atmospheric pressure 966 mbar	
Antenna specification:	Model: Ceramic chip antenna 2450AT18D0100 Gain: 1.5 dBi Type: ☐ External (with accessible antenna socket) ☒ Internal (integrated)	
Test standard:	- KDB 996369 D04 Module Integration Guide v01 -§2.1093 Radiofrequency radiation exposure evaluation: portable devices. -RSS-102 issue 05 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus.	

4. RF Exposure Evaluation

It is declared that during operation a min. distance of 12.27 mm between antenna and user and/or bystander are guaranteed.

Evaluated against exposure limits:

General Public Use ☒
Controlled Use ☐

4.2 Evaluation §2.1093 Radiofrequency radiation exposure evaluation: portable devices

Applied Standard

-e-CFR Title 47 Chapter I Subchapter A §2.1093

Types of Evaluation

-§ 1.1307 (b) SAR based Exemption (KDB 447498 v07)

Requirements:

$$P_{th} \text{ (mW)} = \begin{cases} ERP_{20 \text{ cm}} (d/20 \text{ cm})^x & d \leq 20 \text{ cm} \\ ERP_{20 \text{ cm}} & 20 \text{ cm} < d \leq 40 \text{ cm} \end{cases} \quad (\text{B.2})$$

Where

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

$$ERP_{20 \text{ cm}} \text{ (mW)} = \begin{cases} 2040f & 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz} \\ 3060 & 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz} \end{cases} \quad (\text{B.1})$$

and f is in GHz, d is the separation distance (cm), and $ERP_{20 \text{ cm}}$ is per Formula (B.1).
Example values shown in Table B.2 are for illustration only.

The SAR-based exemption formula of §1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW). This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive).

For limb-worn devices the Threshold P_{th} in Formula B.2 are multiplied by a factor of 2.5

Table B.2—Example Power Thresholds (mW)

Table B.1 – Example Power Thresholds (mW)											
Frequency (MHz)	Distance (mm)										
		5	10	15	20	25	30	35	40	45	50
	300	39	65	88	110	129	148	166	184	201	217
	450	22	44	67	89	112	135	158	180	203	226
	835	9	25	44	66	90	116	145	175	207	240
	1900	3	12	26	44	66	92	122	157	195	236
	2450	3	10	22	38	59	83	111	143	179	219
	3600	2	8	18	32	49	71	96	125	158	195
	5800	1	6	14	25	40	58	80	106	136	169

Single Tx separation distance 12.27 mm

RF Function	Unit	TX WLAN 2.4 GHz	TX BLE 2.4 GHz	-/-	-/-
Max. RF output power (P)	dBm	8.21	5.02	-/-	-/-
Measurement uncertainty ¹	dB	3.10	3.10	-/-	-/-
Max. Duty cycle	%	100	100	-/-	-/-
RF output power (P')	mW	13.52	6.49	-/-	-/-
Threshold P _{th}	mW	38.30	38.30	-/-	-/-
Result		Pass	Pass	-/-	-/-

¹: Measurement uncertainty for radiated Measurements

Combinated Tx at the same time

Comparison with limit	TX WLAN 2.4 GHz	TX BT 2.4 GHz	-/-	Combined $\Sigma P' / P_{th}$
Power (P') / Threshold (P _{th})	0.35	0.17	-/-	0.52
Limit*	1.00	1.00	-/-	1.00
Result	Pass	Pass	-/-	Pass

$$*1 \geq \Sigma P' / P_{th}$$

Description:

Max. RF output power (P): max. radiated RF power

Average total radiated Power (P'): max. RF output power taking into account the measurement uncertainty, transmission time, tune up tolerance and antenna gain

Calculation of Power density

$$P_{density} = P' / (4 \times \pi \times d^2)$$

P_{density} = Power density [mW/cm²]

P' = Average total radiated power [mW]

d = distance to radiation source [cm]

It is deemed that the EUT complies with the provisions of the e-CFR Title 47 Chapter I Subchapter A Part 1, § 1.1307, since Average total radiated power at 12.27 mm separation distance compliance with the RF-Exposure limit

4.2 Evaluation RSS-102 - Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus

Applied Standard
- RSS-102 issue 05

Types of Evaluation

- ☐ (a) SAR Evaluation: Device Used in the Vicinity of the Human Head
☐ (b) SAR Evaluation: Body-Worn Device/Body-Supported Device
☐ (c) SAR Evaluation: Limb-Worn Device
☒ (d) RF Exposure Evaluation
- ☒ Exemption Limits for Routine Evaluation – SAR Evaluation; portable (equal/less 20 cm)
☐ Exemption Limits for Routine Evaluation – RF Exposure Evaluation, mobile/fixed equal/less (>20 cm)
- ☒ General Public (Uncontrolled Environment)
☒ Limb-worn device
- ☐ Controlled Use Devices (Controlled Environment)

Requirements:

RSS-102 issue 05 clause 2.5.1 Exemption Limits for Routine Evaluation - SAR Evaluation

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 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	101	132	162	193
450	52	70	88	106	123
835	17	30	42	55	67
1900	7	10	18	34	60
2450	4	7	15	30	52
3500	2	6	16	32	55
5800	1	6	15	27	41

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	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431
2450	83	123	173	235	309
3500	86	124	170	225	290
5800	56	71	85	97	106

Table 1: SAR evaluation – Exemption for routine evaluation based on frequency and separation distance

Single Tx separation distance: 12.27 mm

RF Function	Unit	TX WLAN 2.4 GHz	TX BLE 2.4 GHz	-/-	-/-
Max. RF output power (P)	dBm	8.21	5.02	-/-	-/-
Measurement uncertainty ¹	dB	3.10	3.10	-/-	-/-
Max. Duty cycle	%	100	100	-/-	-/-
RF output power (P')	mW	13.52	6.49	-/-	-/-
Exemption Limit P _{ex}	mW	24.70	24.70	-/-	-/-
Result		Pass	Pass	-/-	-/-

1: Measurement uncertainty for radiated Measurements

Combinated Tx at the same time

Comparison with limit	TX WLAN 2.4 GHz	TX BT 2.4 GHz	-/-	Combined $\Sigma P' / P_{ex}$
Power (P') / Exemption Limit (P _{ex})	0.55	0.26	-/-	0,81
Limit*	1.00	1.00	-/-	1.00
Result	PASS	PASS	-/-	PASS

*1 $\geq \Sigma P' / P_{ex}$

For high frequencies (1900 MHz and above) the Exemption Limit was derived from a third order polynomial fit.

For limb-worn devices the Exemption Limit for routine evaluation in Table 1 are multiplied by a factor of 2.5

It is deemed that the EUT complies with the provisions of the RSS-102, since maximum radiated power (EIRP), which is fixed by the manufacturer, is less than the Exemption Limit.

Therefore, the RF-exposure evaluation for the separation distance of 12.27 mm between the user and/or bystander and the antenna can be exempted.

5. Conclusions

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the relevant §2.1091 Radiofrequency radiation exposure evaluation: portable devices.

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the relevant
RSS-102 issue 05 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus.

Following specific modifications and/or special attributes are necessary to pass the above mentioned requirements:

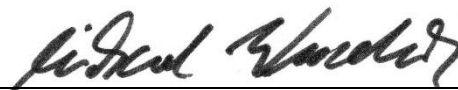
none

01.12.2022

Erstellt am/prepared on

M. Wundrak, Engineer

(Name/name / Stellung/position)



(Unterschrift/signature)

12.12.2022

Freigabe am/released on

K. Gisbert, Laboratory Supervisor

(Name/name / Stellung/position)



(Unterschrift/signature)

6. Measurement uncertainty according to CISPR 16-4-2 first edition 2003-11

Messgröße Measurement	berechnete Messunsicherheit calculated uncertainty U_{lab}	Vorgegebene CISPR Messunsicherheit nach CISPR 16-4-2 first edition 2003-11, Tabelle 1 Specified CISPR uncertainty according CISPR 16-4-2 first edition 2003-11, table 1 U_{CISPR}
Feldstärke/Fieldstrength Leistung/Power 30MHz - 1000MHz Semi anechoic chamber	4.2dB	5.2dB
Feldstärke/Fieldstrength Leistung/Power 30MHz - 1000MHz Open area test site	3.6dB	5.2dB
Leistung leitungsgebunden power conducted 30MHz - 1000MHz	2.8dB	4.5dB

The horizontal and vertical site attenuation for the semi anechoic chamber is within the tolerance of +/-4dB according to CISPR16-1 series.

The uncertainty of the measurement equipment fulfils the requirements of CISPR16-4-2, first edition, 2003-11, table 1.

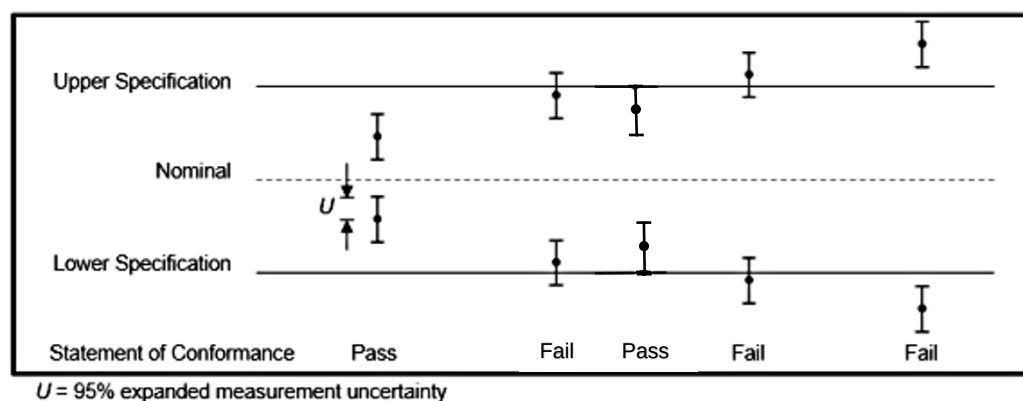
Zusätzliche Messunsicherheitsangaben/additional measurement uncertainty

Messgröße Measurement	Messunsicherheit Uncertainty	Messgröße Measurement	Messunsicherheit Uncertainty
Feldstärke/Fieldstrength Leistung/Power 1GHz - 26.5GHz	3.1dB	Temperatur/Temperature	0.58°C
Magnetische Feldstärke/ Magn. fieldstrength 9kHz - 30MHz	3.4dB	Feuchtigkeit/Humidity	0.58% rel.
Leistung an der Antennenbuchse/ power at antenna socket	2.1dB	Druck/ Pressure	3.1%

The shown measurement uncertainty is based on a coverage factor of $k = 2$ (95% level of confidence).

Applied Decision Rule:

☒ STC Germany Decision Rule applied for following tests: all



Explanation:

The dot indicates the measured value and "U" indicates the measurement uncertainty. If the measured value is exactly on the limit value (specification), the result is assessed with "pass" - see the drawing above.

☐ Decision Rule prescribed by

- | | |
|--|----------------------------------|
| ☐ Customer | applied for following tests: -/- |
| ☐ Regulations | applied for following tests: -/- |
| ☐ Normative Documents | applied for following tests: -/- |

7. Photos of tested sample













End of test report