Deutsche Akkreditierungsstelle D-PL-21375-01-00

LENHARDT WORLDWIDE | TESTING | CERTIFICATION

Bundesnetzagentur

BNetzA-CAB-19/21-51

Assessment Report

Test report no.: 23089057-35992-0
Date of issue: 2024-02-29

Test result: The test item **- passed - and complies** with the listed standards.

Applicant

RFbeam Microwave GmbH

Manufacturer

Same as applicant

Test Item

K-LD2-FLK

MPE Assessment according to:

FCC 47 CFR Part 15
Radio frequency devices
Parts 1.1307, 1.1310, 2.1091, 2.1093

Tested by (name, function, signature)	*Andreas Bender* *Deputy Managing Director*	
Approved by (name, function, signature)	*Sebastian Janoschka* *Lab Manager*	

Applicant and Test item details	
Applicant	RFbeam Microwave GmbH Schuppisstrasse 7, 9016, St. Gallen, Switzerland Fon: +41 71 245 33 80
Manufacturer	Same as applicant
Test item description	24 GHz field disturbance sensor
Model/Type reference	K-LD2-FLK
Standard specific information	
Frequency	24.05 GHz – 24.25 GHz
Technology	Radar
Antenna	PCB antenna
Power supply	3.2 – 5.5 V DC
Temperature range	-40 °C – +85 °C
FCC ID	2ASYV-K-LD2-FLK

Disclaimer and Notes

The content of this report relates to the mentioned test sample(s) only.
IBL-Lab GmbH does not take samples. The samples used for testing are provided by the applicant.
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The last valid version is available at TAMSys®.
Signatures are done electronically, if signer does not match stated signer, it is signed per order.
Information supplied by the applicant can affect the validity of results. The data is marked accordingly.

Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjected to its use.

Decision rule: See parent Test Report IBL-Lab GmbH.
Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2.

1 TABLE OF CONTENTS

2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: http://ib-lenhardt.com/ E-Mail: info@ib-lenhardt.com
Accreditation / Designation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: • Attachment to the accreditation certificate D-PL-21375-01-00 ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement. • Designations ○ FCC Testing Laboratory Designation Number DE0024 ○ ISED ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 ○ Kraftfahrt-Bundesamt KBA-P 00120-23
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	-
Start – End of tests	- – -

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS)
Test sample does not meet the requirements	F (FAIL)
Requirement does not apply to the test sample	N/A (Not applicable)
Requirement not performed	N/P (Not performed)
Requirement not available	N/V (Not available)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and Interpretations

No additional appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

2.5 Document History

-0 Initial Version
-

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions of test lab

Temperature	25°C ± 5°C
Relative humidity	25-75% r.H.
Barometric Pressure	860-1060 mbar
Power supply	230/400 V AC 50Hz

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	*RADIO FREQUENCY DEVICES*

Test standard (not accredited)	Description
-	-

Reference	Description
447498 D04 Interim General RF Exposure Guidance v01	*RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices*
FCC 47 CFR Part 1.1307(b)	*Actions that may have a significant environmental effect, for which Environmental Assessments (EAs) must be prepared.*
FCC 47 CFR Part 1.1310	*Radiofrequency radiation exposure limits.*
FCC 47 CFR Part 2.1091	*Radiofrequency radiation exposure evaluation: mobile devices.*
FCC 47 CFR Part 2.1093	*Radiofrequency radiation exposure evaluation: portable devices.*

5 Device Data

Parameters declared by the manufacturer:

The declared maximum output powers including tune-up tolerances are used with regard to the maximum antenna gains to find the maximum EIRP and ERP values.

Type	Band [GHz]	Simultaneous transmission	Max. EIRP (average) [dBm]
Radar	24	N/A	12.70

Measurements of power levels and declared antenna gains detailed in this test report and were taken from the following RF module test report(s). EUT test information such as test equipment used, date of actual test, environmental conditions, measurement uncertainty and the person who performed the original tests are referenced in the listed test report/s.

Type	Test Report	Radio Standard	Issued by	Band [GHz]	RF output Power + Antenna Gain (average) [dBm]	P.
Radar	23089057-35993-1	FCC 47 CFR Part 15, §15.249	IBL-Lab GmbH	24	(106.0 dBµV/m Peak @ 3m) Calculated: 10.77 dBm (Peak is assumed as the worst case average)	28

6 MPE Assessment Requirements

6.1 FCC 47 CFR

6.1.1 FCC 47 CFR Part 1.1307 (b)(3) - Determine that they qualify for an exemption

(i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

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

Where

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

and

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

d = the separation distance (cm);

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

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	19.2 R^2

6.1.2 FCC 47 CFR Part 1.1310 Radiofrequency radiation exposure limits.

Frequency range [MHz]	Electric field strength [V/m]	Magnetic field Strength [A/m]	Power density [mW/cm^2]	Averaging time [minutes]
(A) Limits for Occupational/Controlled Exposure				
0.3 – 3.0**	614	1.63	* 100	6
3.0 – 30	1842/f	4.89/f	* 900/f^2	6
30 – 300	61.4	0.163	1.0	6
300 – 1,500	N/A	N/A	f/300	6
1,500 – 100,000	N/A	N/A	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3 – 1.34**	614	1.63	* 100	30
1.34 – 30	824/f	2.19/f	* 180/f^2	30
30 – 300	27.5	0.073	0.2	30
300 – 1,500	N/A	N/A	f/1500	30
1,500 – 100,000	N/A	N/A	1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

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Frequency range [a]	FCC Rules	OET Equipment Authorization Policies
≤ 100 kHz	N/A (under consideration) [c]	All devices assessed case-by-case, with field strength limits of E = 83 V/m and H = 90 A/m, in all body exposure relevant positions
100 kHz < f ≤ 300 kHz [b]	SAR limits in § 1.1310 (b), (c)	MPE limits at 300 kHz in Table 1 to § 1.1310(e)(1): E = 614 V/m and H = 1.63 A/m
300 kHz < f ≤ 4 MHz [b]	§ 2.1091 Mobile Devices: MPE limits in Table 1 to § 1.1310(e)(1)	MPE limits in Table 1 to § 1.1310(e)(1)
	§ 2.1093 Portable Devices: SAR limits in § 1.1310 (b), (c)	

[a] = For all f ≤ 6 GHz, SAR limits in §§ 1.1310 (b), (c) can always be applied where available, in place of MPE limits

[b] = Policies for 100 kHz < f ≤ 4 MHz reflect capabilities of available SAR measurement equipment. Numerical simulations may be also acceptable, under PAG

[c] = NPRM, ET Docket No. 19-226; FCC 19-126, 34 FCC Rcd 11743

6.1.3 FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices.

(a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular §1.1307(b), chapter (6.1.2).

(b) For purposes of this section, the definitions in § 1.1307(b)(2) of this chapter shall apply. A mobile 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 a separation distance of at least **20 centimeters** is normally maintained between the RF source's radiating structure(s) and the body of the user or nearby persons. In this context, the term **"fixed location"** means that the device is physically secured at one location and is not able to be easily moved to another location while transmitting. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal desktop computer, are considered to be **mobile devices** if they meet the **20-centimeter** separation requirement.

(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 mobile devices with single RF sources having either more than an available maximum time-averaged power of **1 mW** or more than the ERP listed in Table 1 to § 1.1307(b)(3)(i)(C), whichever is greater. For mobile devices not exempt by § 1.1307(b)(3)(i)(C) at distances from **20 centimeters** to **40 centimeters** and frequencies from **0.3 GHz to 6 GHz**, evaluation of compliance with the exposure limits in § 1.1310 of this chapter is necessary if the ERP of the device is greater than ERP_{20cm} in the formula below. If the ERP of a single RF source at distances from **20 centimeters** to **40 centimeters** and frequencies from **0.3 GHz to 6 GHz** is not easily obtained, then the available maximum time-averaged power may be used (*i.e.,* without consideration of ERP) in comparison with the following formula only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

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

(c)(2) For multiple mobile or portable RF sources within a device operating in the same time averaging period, routine environmental 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.

(c)(3) Unless otherwise specified in this chapter, any other single mobile or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in § 1.1307(c) and (d) of this chapter.

6.1.4 FCC 47 CFR Part 2.1093 Radiofrequency radiation exposure evaluation: portable devices.

(a) Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular § 1.1307(b).

(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.

(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 Pth 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.

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

Where

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

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

(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.

(3) Unless otherwise specified in this chapter, any other single portable or multiple mobile and portable RF source(s) associated with a device is exempt from routine environmental evaluation for RF exposure prior to equipment authorization or use, except as specified in § 1.1307(c) and (d) of this chapter.

6.2 447498 D04 Interim General RF Exposure Guidance v01

6.2.1 Tolerances in RF Exposure Test Methodologies

Device samples used for compliance testing must have the same physical, mechanical, and thermal characteristics, and operational tolerances as for production units.

All devices must be tested within the tune-up tolerance specification range. More specifically, each device must be evaluated for SAR or MPE compliance in the required operating modes and test configurations, at the maximum rated output power, and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance.

6.2.2 1-mW Test Exemption for Multiple Sources

As discussed in § 1.1307(b)(3)(ii)(A), the 1-mW exemption intended for single transmitters may be also applied to simultaneous transmission conditions, within the same host device, according one of the following criteria:

a) When maximum available power each individual transmitting antenna within the same time averaging period is ≤ 1 mW, and the nearest parts of the antenna structures of the simultaneously operating transmitters are separated by at least 2 cm.

b) When the aggregate maximum available power of all transmitting antennas is ≤ 1 mW in the same time-averaging period.

This exemption may not be combined with any other exemption.

6.2.3 Simultaneous Transmission with both SAR-based and MPE-Based Test Exemptions

This case is described in detail in § 1.1307(b)(3)(ii)(B) and covers the situations where both SAR-based and MPE-based exemption may be considered for test exemption in fixed, mobile, or portable device exposure conditions. For these cases, a device with multiple RF sources transmitting simultaneously will be considered an RF exempt device if the condition of Formula (1) is satisfied.

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

Appendix C of KDB provides additional details.

For these test exemptions to apply, the maximum output power, duty factor, and other applicable parameters used in the standalone ERP determination tests, must be the same, or corresponding to a more conservative choice, than those required for simultaneous transmission.

The power level of the standalone SAR used to qualify for SAR test exemption, or additional test exemption, must be clearly explained in the SAR report. When simultaneous transmission SAR- based test exemptions, or when the SPLSR test exemption [Section 2.2.3] cannot be applied, enlarged zoom scan [Glossary] SAR measurements must be performed at the maximum output power required for the applicable simultaneous transmission scenarios. This power level shall account for the tune-up tolerance [Glossary] requirements of all transmitters, but not more than **2 dB lower than the maximum tune-up tolerance limit**.

7 MPE Calculation Method

7.1 Standalone MPE Calculation Method

Conversion of output power

$$\boldsymbol{P(mW) = 10^{(\frac{Lp(dBm)}{10})} \times 1mW}$$

E:	E-field strength [V/m]
P:	Power input to antenna [W]
G:	Gain of the antenna in the direction of interest relative to an isotropic radiator [dBi]
PG:	EIRP (effective isotropic radiated power) [W]
r:	Distance [m]

$$E = \frac{\sqrt{30PG}}{r}$$

S:	Power density [W/m2]
P:	Power input to antenna [W]
G:	Gain of the antenna in the direction of interest relative to an isotropic radiator [dBi]
PG:	EIRP (effective isotropic radiated power) [W]
r:	Distance [m]

$$S = \frac{PG}{4\pi r^2}$$

The EUT is a wireless device with a distance of at least 0.2m from any body part of nearby persons.

FCC: § 1.1307(b)(3)(i)(C)	RSS: N/A

Type	Band [GHz]	Max. EIRP [dBm]	Max. EIRP [W]	Power Density [W/m²]	Power Density [mW/cm²]	FCC Limit [mW/cm²]	FCC Verdict	FCC Exemp. [W]	FCC Exemp. fulfilled	ISED Limit [W/m²]	ISED Verdict	ISED Exemp. [W]	ISED Exemp. fulfilled
Manufacturer declared values													
Radar	24	12.70	0.0186	0.0371	0.00371	N/A	N/A	0.768	yes	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Measured values for reference													
Radar	24	10.77	0.0119	0.0238	0.00238	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

447498 D04 Interim General RF Exposure Guidance v01 - Tolerances in RF Exposure Test Methodologies

Requirement: Values for MPE compliance in the required operating modes and test configurations, at the maximum rated output power, are not within 2 dB lower than the maximum *tune-up tolerance limit.*
Verdict: Passed

7.2 Simultaneous transmission MPE

FCC 1.1307 / (3) Determination of exemption / (ii) For multiple RF sources:
Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

(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.

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

a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph (b)(3)(i)(B) of this section for P_{th}, 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.

P_i = 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).

$P_{th,i}$ = the exemption threshold power (P_{th}) according to paragraph (b)(3)(i)(B) of this section for fixed, mobile, or portable RF source *i.*

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

$ERP_{th,j}$ = 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.

$Evaluated_k$ = 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.

$Exposure\ Limit_k$ = 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.

Type	Band [GHz]	Max. EIRP [dBm]	Max. EIRP [W]	Power Density [W/m²]	Power Density [mW/cm²]	FCC Limit [mW/cm²]	FCC Verdict	FCC Exemp. [W]	FCC Exemp. fulfilled	ISED Limit [W/m²]	ISED Verdict	ISED Exemp. [W]	ISED Exemp. fulfilled
						N/A	-	N/A	-	N/A	-	N/A	
						N/A	-	N/A	-	N/A	-	N/A	
						N/A	-	N/A	-	N/A	-	N/A	
						N/A	-	N/A	-	N/A	-	N/A	
Σ(f_x)	-	-	-			N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

8 MPE Conclusion

FCC: The results do comply with the requirements.

9 List of test equipment used

#	Equipment Class	ID	Calibration due date
	N/A		

End of Assessment Report