

FCC RF Exposure Evaluation

Report Number:

F251949E11

Equipment under Test (EUT):

Laser Scanner

LS-R-100

Applicant:

Hexagon Metrology GmbH

Manufacturer:

Hexagon Metrology GmbH



Deutsche
Akkreditierungsstelle
D-PL-17186-01-00

References

- [1] **CFR 47 Rule part 1** Practice and Procedure
- [2] **CFR 47 Rule part 2** Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
- [3] **KDB 447498 D04 Interim General RF Exposure Guidance v01**

Assessed and
written by:

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Martin Eppinger
31.07.2026

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Contents:	Page
1 Identification	4
1.1 Applicant	4
1.2 Manufacturer	4
1.3 Test Laboratory	4
1.4 EUT (Equipment under Test)	5
1.5 Technical Data of Equipment	6
2 Evaluation Method	8
2.1 RF exposure test exemptions for single sources	8
2.1.1 General Exemption CFR 47 §1.1307(b)(3)(i)(A)	8
2.1.2 SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)	8
2.1.3 MPE Based Exemption CFR 47 §1.1307(b)(3)(i)(C)	8
2.1.4 Stand-alone MPE evaluation limits	9
2.2 RF exposure test exemptions for simultaneous transmission sources	10
2.2.1 1 mW Test Exemption for simultaneous transmission sources	10
2.2.2 Simultaneous transmission SAR based and MPE based test exemptions	10
2.2.3 Test exemption based on the SAR to Peak Location Separation Ratio	11
3 Results of evaluation	12
3.1 Used evaluation methods	12
3.2 Evaluation Distance	12
3.3 BLE 2.4 GHz emissions	13
3.4 Proprietary emissions	14
3.5 UNII-I band emissions	14
3.6 Simultaneous emissions	15
4 Conclusion	15
5 Report History	15

1 Identification

1.1 Applicant

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Applicant represented during the test by the following person:	---

1.2 Manufacturer

Name:	Hexagon Metrology GmbH
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Country:	Germany
Name for contact purposes:	Mr. Christoph WIEST
Phone:	+49 7529 9733838
eMail address:	christoph.wiest@hexagon.com
Manufacturer represented during the test by the following person:	---

1.3 Test Laboratory

The tests were carried out by: **NMi TESTLAB GmbH formerly PHOENIX TESTLAB GmbH**
Königswinkel 10
32825 Blomberg
Germany

accredited by **Deutsche Akkreditierungsstelle GmbH (DAkkS)** according to DIN EN ISO/IEC 17025:2018. The accreditation is only valid for the scope of accreditation listed in the annex of the certificate D-PL-17186-01-00. FCC Test Firm Designation Number DE0004, FCC Test Firm Registration Number 469623, CAB Identifier DE0003 and ISED# 3469A.

1.4 EUT (Equipment under Test)

Test object: *	Laser Scanner
Model name: *	LS-R-100
Part number: *	LS-R-100#
FCC ID: *	MFFLSR100
Additionally Contains FCC ID: *	R68XPICO200
PCB identifier: *	MAIN PCBA LSR100 HW01
Hardware version: *	01
Software version: *	01

* Declared by the applicant

Note: NMI TESTLAB GmbH does not take samples. The samples used for tests are provided exclusively by the applicant.

1.5 Technical Data of Equipment

General EUT data			
Power supply EUT: *	DC by battery		
Supply voltage EUT: *	$U_{nom} = 14.4 \text{ V}$	$U_{min} = 10.0 \text{ V}$	$U_{max} = 17.0 \text{ V}$
Temperature range: *	0 °C to + 40°C		
Highest internal clock frequency: *	5240 MHz		

* Declared by the applicant

Bluetooth® low energy radio mode		
Fulfil radio specification: * ¹	Bluetooth® low energy (BLE) 5.3	
Radio chip: * ¹	Silicon Labs EFR32MG24B210F1536IM48	
Antenna type: * ¹	Internal PCB antenna	
Antenna name: * ¹	ANTENNA PCBA LSR100 HW01	
Antenna gain: * ²	Ant 1: 3.39 dBi	
Antenna connector: * ¹	i-pex (MHF4)	
Type of modulation: * ¹	BLE (1 Mbps PHY)	GFSK
Operating frequency range: * ¹	BLE (1 Mbps PHY)	2402 – 2480 MHz
Number of channels: * ¹	BLE (1 Mbps PHY)	40 (2 MHz channel spacing)

*¹ declared by the applicant

*² based on the antenna test report F251949E14 issued by NMI TESTLAB GmbH

Proprietary radio mode	
Fulfil radio specification: * ¹	- (Proprietary radio mode based on IEEE 802.15.4)
Radio chip: * ¹	Silicon Labs EFR32MG24B210F1536IM48
Antenna type: * ¹	Internal PCB antenna
Antenna name: * ¹	ANTENNA PCBA LSR100 HW01
Antenna gain: * ²	Ant 1: 3.39 dBi (Only one antenna is active simultaneously, Ant 2: 1.11 dBi switched every other transmission)
Antenna connector: * ¹	i-pex (MHF4)
Type of modulation: * ¹	O-QPSK
Operating frequency range: * ¹	2405 – 2480 MHz
Number of channels: * ¹	16 (5 MHz channel spacing)

*¹ declared by the applicant

*² based on the antenna test report F251949E14 issued by NMI TESTLAB GmbH

IEEE 802.11 radio mode (5 GHz)	
Fulfil radio specification: * ¹	IEEE 802.11 a, IEEE 802.11 n (20 MHz), IEEE 802.11 n (40 MHz)
Radio chip: * ¹	Lantronix xPico 240
Antenna type: * ¹	PCB
Antenna name: * ¹	Brand: ethertronics; Model: 1000668 / 1001077
Antenna gain: * ²	4.45 dBi (typical)
Antenna connector: * ¹	U.FL
Type of modulation: * ¹	IEEE 802.11 a BPSK, QPSK, 16-QAM, 64-QAM (6/9/12/18/24/36/48/54 Mbit/s)
	IEEE 802.11 n20 BPSK, QPSK, 16-QAM, 64-QAM (up to 72.2 Mbit/s 1 spatial stream)
	IEEE 802.11 n40 BPSK, QPSK, 16-QAM, 64-QAM (up to 150 Mbit/s 1 spatial stream)
Operating frequency range: * ¹	IEEE 802.11a/n (20 MHz) 5180 - 5240 MHz
	IEEE 802.11a (40 MHz) 5190 - 5230 MHz
Number of channels: * ¹	IEEE 802.11a/n (20 MHz) 4
	IEEE 802.11n (40 MHz) 2

*¹ declared by the applicant

*² based on the test report FCC ID: R68XPICO200

As declared by the applicant, all other bands of FCC ID: R68XPICO200 are disabled and are not accessible by the end user.

2 Evaluation Method

2.1 RF exposure test exemptions for single sources

2.1.1 General Exemption CFR 47 §1.1307(b)(3)(i)(A)

The available maximum time-averaged power is not 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);

2.1.2 SAR Based Exemption CFR 47 §1.1307(b)(3)(i)(B)

The available maximum time-averaged power of 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 from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz inclusive.

For the following separation distances d and frequency ranges, P_{th} is given by the following formulas.

	0.5 cm $\leq d \leq 20$ cm	20 cm $< d \leq 40$ cm
0.2 GHz $\leq f < 1.5$ GHz	$P_{th}(mW) = ERP_{20cm} \left(\frac{d}{20} \right)^x$ $ERP_{20cm}(mW) = 2040f$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm}\sqrt{f}} \right)$	$P_{th}(mW) = ERP_{20cm}$ $ERP_{20cm}(mW) = 2040f$
1.5 GHz $\leq f \leq 6$ GHz	$P_{th}(mW) = ERP_{20cm} \left(\frac{d}{20} \right)^x$ $ERP_{20cm}(mW) = 3060$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm}\sqrt{f}} \right)$	$P_{th}(mW) = ERP_{20cm}$ $ERP_{20cm}(mW) = 3060$

2.1.3 MPE Based Exemption CFR 47 §1.1307(b)(3)(i)(C)

By using Table 1 and the minimum separation distance (d 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, d must be at least $\lambda/2\pi$, 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 $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

RF Source frequency [MHz]	Threshold ERP [W]
0.3 - 1.34	$1920 d^2$
1.34 - 30	$3450 d^2/f^2$
30 - 300	$3.83 d^2$
300 - 1500	$0.0128 d^2/f$
1500 - 100000	$19.2 d^2$

d : Minimum separation distance from antenna to the user

2.1.4 Stand-alone MPE evaluation limits

The human exposure to RF emissions from such devices could be evaluated based on the MPE limits adopted by the FCC for electric and magnetic field strength and / or power density. The limits for General Population / Uncontrolled Exposure are given in the following table from CFR 47 §1.1310(e)1:

Frequency range [MHz]	Electric field strength (E) [V/m]	Magnetic field strength (H) [A/m]	Power density (S) [mW/cm ²]	Averaging time [min]
(i)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			f/300	<6
1,500 – 100,000			5	<6
(ii)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 – 1500			f/1500	< 30
1500 – 100,000			1.0	< 30

Note: f = frequency in MHz; * Plane – wave equivalent power density

The power density is calculated as follows:

$$S = \frac{P \cdot G \cdot D}{4 \cdot \pi \cdot d^2}$$

Where:

P: conducted power

G: Antenna gain (linear)

D: Duty Cycle

d: Minimal separation distance from antenna to the user

2.2 RF exposure test exemptions for simultaneous transmission sources

2.2.1 1 mW Test Exemption for simultaneous transmission sources

As discussed in CFR 47 §1.1307(b)(3)(ii)(A) [1] 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:

- When the maximum available power each individual transmitting antenna with 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
- 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.

2.2.2 Simultaneous transmission SAR based and MPE based test exemptions

Although this is not a module integration in the sense of product approval, the procedure for simultaneous transmission specified in KDB 447498 D04 Interim General RF Exposure Guidance v01 [3] in chapter 2.2 was considered:

According to the RF exposure KDB 447498 D04 General RF Exposure Guidance v01 [3] in chapter 2.2.2: This case is described in detail in CFR 47 §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 the following formular is satisfied.

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

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.

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0 , according to calculated/estimated, numerically modelled, or measured field strengths or power density. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to the MPE limit at the test frequency.

2.2.3 Test exemption based on the SAR to Peak Location Separation Ratio

When the ERP-based condition in the previous section does not apply, a test exemption may be still applicable based on the SAR to peak location separation ratio (SPLSR) procedure.

In this case, the simultaneously transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SPLSR that qualifies for the additional test exemption.

This ratio is defined as:

$$SPLSR = (SAR_1 + SAR_2)^{\frac{1.5}{R_i}}$$

Where: SAR₁ and SAR₂ = highest reported SAR or estimated SAR values for the two sources in the pair i, and R_i is their distance in mm.

When SPLSR ≤ 0.04 (rounded to two decimal digits), for all antenna pairs in the configuration, then the device qualifies for 1 g SAR test exemption.

When 10 g SAR applies (e.g. for extremities) the corresponding test exemption condition is SPLSR ≤ 0.10. If any antenna pair does not qualify for simultaneous transmission SAR test exemption, then the device must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Pub. 865664 D01.

3 Results of evaluation

3.1 Used evaluation methods

RF Exposure test exemptions for single sources			
Used	Method	See sub-clause	Comment
☐	General Exemption acc. CFR 47 §1.1307(b)(3)(i)(A)	2.1.1	-
☐	SAR Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(B)	2.1.2	-
☒	MPE Based Exemption acc. CFR 47 §1.1307(b)(3)(i)(C)	2.1.3	-
☐	MPE Calculation	2.1.4	-

RF Exposure test exemptions for simultaneous transmission sources			
Used	Method	See sub-clause	Comment
☐	Not applicable		
☐	1 mW test Exemption acc. 2.2.1 [3]	2.2.1	-
☐	SAR Based Exemption acc. 2.2.2 [3]	2.2.2	
☒	MPE Based Exemption acc. 2.2.2 [3]	2.2.2	
☐	SAR to Peak location separation ratio acc. 2.2.3 [3]	2.2.3	

3.2 Evaluation Distance

According to CFR47 §2.1091 the device as declared by the applicant is a **mobile device** which is used at least with the following separation distances between the device and the users.

Antenna	Min separation distance as declared by the applicant
Ant 1	20 cm
Ant 2	20 cm
Ant 3	20 cm

3.3 BLE 2.4 GHz emissions

The following information are based on test report:

- **F251949E8** by NMI TESTLAB GmbH (BLE)

A tune up range of +/- **1dB** was used

MPE Based Exemption CFR 47 §1.1307(b)(3)(i)(C):

P _{con} [dBm]	tune-up [dB]	P _{con} [mW] incl. tune-up	Antenna gain [dBi]	Cable attenuation [dB]	P _{e.i.r.p} [dBm]	P _{e.i.r.p} [mW]	P _{e.r.p} [dBm]	P _{e.r.p} [mW]
3.10	1.00	2.57	3.39	0.00	7.49	5.61	5.34	3.42

Frequency [GHz]	Wavelength λ [cm]	$\lambda/2\pi$ [cm]	d [cm]	d > $\lambda/2\pi$
2.440	12.29	1.96	20.00	fulfilled

Frequency [GHz]	d [cm]	Threshold ERP [mW]	P _{e.r.p.} [mW]	Result
2.440	20.00	768	3.42	exempted

The separation distance d is larger than the wavelength divided by 2 π . Therefore, the MPE Exemption may be used.

The P_{e.r.p.} of the EUT is lower than the threshold ERP, therefore this emission is exempted from MPE evaluation.

3.4 Proprietary emissions

The following information are based on test report:

- **F251949E9** by NMI TESTLAB GmbH (Proprietary) – worst case scenario

A tune up range of +/- 1dB was used

MPE Based Exemption CFR 47 §1.1307(b)(3)(i)(C):

P _{con} [dBm]	tune-up [dB]	P _{con} [mW] incl. tune-up	Antenna gain [dBi]	Cable attenuation [dB]	P _{e.i.r.p} [dBm]	P _{e.i.r.p} [mW]	P _{e.r.p} [dBm]	P _{e.r.p} [mW]
5.00	1.00	3.98	3.39	0.00	9.39	8.69	7.24	5.30

Frequency [GHz]	Wavelength λ [cm]	$\lambda/2\pi$ [cm]	d [cm]	d > $\lambda/2\pi$
2.440	12.29	1.96	20.00	fulfilled

Frequency [GHz]	d [cm]	Threshold ERP [mW]	P _{e.r.p.} [mW]	Result
2.440	20.00	768	5.30	exempted

The separation distance d is larger than the wavelength divided by 2 π . Therefore, the MPE Exemption may be used.

The P_{e.r.p.} of the EUT is lower than the threshold ERP, therefore this emission is exempted from MPE evaluation.

3.5 UNII-I band emissions

The following information are based on test report:

- **SA170513E01 by Bureau Veritas Consumer Products Services (H.K.) Ltd. (FCC ID R68XPICO200)**

As declared by the applicant only UNII-1 is active in the device, all other bands are deactivated and not accessible to the end user

Frequency Band [MHz]	Max. Power [mW]	Antenna Gain [dBi]	Distance [cm]	Power density [mW/cm ²]	Limit [mW/cm ²]
5180-5240	69.343	4.45	20	0.038435	1.0

3.6 Simultaneous emissions

As declared by the applicant only WLAN (UNII-1) and Proprietary can transmit simultaneously.

BLE cannot transmit simultaneously.

	$P_{e.r.p}$ [mW]	P_{th} [mW]	$P_{e.r.p} / P_{th}$ Ratio
2.4 GHz Proprietary	5.3	768	0.007

	Power Density [mW/cm ²]	Limit [mW/cm ²]	Power Density / Limit Ratio
5 GHz UNII	0.038	1.000	0.038

Limit	Sum Ratios
1.000	0.045

4 Conclusion

The EUT complies in all operational modes to the limits given in CFR 47 §1.1310(e)1 in a separation distance of 20 cm for ant 1 and for ant 2.

5 Report History

Report Number	Date	Comment
F251949E11	30.07.2026	Initial evaluation test report
-	-	-
-	-	-

----- end of evaluation report -----