

RF EXPOSURE REPORT



Applicant	Ludus Materials Ltd.
Address	Givat brenner, Israel

Manufacturer or Supplier	Qing Yuan Right Source Plastic Company Limited
Address	ZhangWu Village, Yinghua St, Donghua Town, Yingde City, GuangDong Province, PR China, Postal Code 513059
Product	Ludus Paddle
Brand Name	Ludus
Model	LMP01
Additional Model & Model Difference	N/A
Date of tests	Oct. 09, 2024 ~ Oct. 23, 2024

The submitted sample of the above equipment has been tested according to the requirements of the following standard:

- ☒ FCC Part 2 (Section 2.1093)
- ☒ KDB 447498 D04 Interim General RF Exposure Guidance v01

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

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	Date: Nov. 28, 2024

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Test Report No.: FM2409WDG0225

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
FM2409WDG0225	Original release	Nov. 28, 2024

1. GENERAL INFORMATION

1.1. GENERAL DESCRIPTION OF EUT

FCC ID	2BLAR-LMP01
PRODUCT	Ludus Paddle
MODEL NO.	LMP01
ADDITIONAL MODEL	N/A
SAMPLE STATUS	Engineering sample
POWER SUPPLY	DC 3.7V From Li-ion Battery or DC 5V From USB Host Unit
MODULATION TECHNOLOGY	GFSK&ASK
OPERATING FREQUENCY RANGE	BLE 1Mbps: 2402MHz ~ 2480MHz NFC(ASK): 13.56MHz
ANTENNA TYPE	PCB Antenna, 0dBi Gain For BT PCB Antenna, For NFC
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	See note5

NOTES:

- For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- For the test results, the EUT had been tested with all conditions, but only the worst case was shown in test report.
- Please refer to the EUT photo document (Reference No.: 2409WDG0225) for detailed product photo.
- When the EUT in charging mode that RF function can't working.
- Product cable information as follows:

ID	Descriptions	Qty.	Length (m)	Shielding (Y/N)	Cores (Qty.)	Remark
1	USB-A to Microusb cable	1	0.5	N	0	N/A

2. APPLICABLE RF EXPOSURE LIMIT

2.1. LIMITS

§ 1.1310 Radiofrequency radiation exposure limits.

(a) Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) of this part within the frequency range of 100 kHz to 6 GHz (inclusive).

(b) The SAR limits for occupational/controlled exposure are 0.4 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 8 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit for occupational/controlled exposure is 20 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 6 minutes to determine compliance with occupational/controlled SAR limits.

(c) The SAR limits for general population/uncontrolled exposure are 0.08 W/kg, as averaged over the whole body, and a peak spatial-average SAR of 1.6 W/kg, averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the parts of the human body treated as extremities, such as hands, wrists, feet, ankles, and pinnae, where the peak spatial-average SAR limit is 4 W/kg, averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). Exposure may be averaged over a time period not to exceed 30 minutes to determine compliance with general population/uncontrolled SAR limits.

(d) Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields

➤ Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
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

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

➤ Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (minutes)
Limits For General Population / Uncontrolled 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

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

2.2. DETERMINATION OF EXEMPTION

"Blanket" Exemption – §1.1307(b)(3)(i)(A)

- Regardless of the separation distance, the maximum time-averaged power is no more than 1mw.

"MPE" Exemption – §1.1307(b)(3)(i)(C)

- 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. The MPE-based test exemption condition is in terms of ERP, defined as the product of the maximum antenna gain and the delivered maximum time-averaged power.
- Table applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits.

RF Source frequency (MHz)	Minimum Distance		Threshold ERP (watts)
	$\lambda_L/2\pi$	$\lambda_H/2\pi$	
0.3-1.34	159 m–35.6 m		1,920 R ² .
1.34-30	35.6 m–1.6 m		3,450 R ² /f ² .
30-300	1.6 m–159 mm		3.83 R ² .
300-1,500	159 mm–31.8 mm		0.0128 R ² f.
1,500-100,000	31.8 mm–0.5 mm		19.2 R ² .
R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters.			

- For mobile devices that are not exempt per Table 1 of §1.1307(b)(1)(i)(C) and device at distances from 20 cm to 40 cm and in 0.3 GHz to 6 GHz. The MPE-based test exemption condition is in terms of ERP, defined as the product of the maximum antenna gain and the delivered maximum time-averaged power.

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

"SAR" Exemption – §1.1307(b)(3)(i)(B)

- 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:

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

where

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

And

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

2.3. MULTIPLE RF SOURCES ARE EXEMPT

Multiple RF sources are exempt– §1.1307(b)(3)(ii)

(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).

(b) Either SAR-based or MPE-based exemption may be considered for test exemption for fixed, mobile, or portable device exposure conditions; therefore, the contributions from each exemption in conjunction with the measured SAR (Evaluated_k term) should be used to determine exemption for simultaneous transmission according to Formula below,

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

The sum of the ratios of the applicable terms for SAR-based, MPE-based and measured SAR or MPE should be less than 1, to determine simultaneous transmission exposure compliance.

Where:

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 $\lambda/2\pi$ 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](#).

2.4. MPE CALCULATION FORMULA

$$P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot r^2)$$

where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

3. CLASSIFICATION

The antenna of this product, under normal use condition, is at less than 20cm away from the body of the user. So, this device is classified as **Portable Device**.

4. ANTENNA GAIN

The antennas provided to the EUT, please refer to the following table:

Mode	Transmitter Circuit	Peak Gain (dBi)	Antenna Type
GFSK (BLE 1Mbps)	Chain 0	0	PCB Antenna

5. CALCULATED RESULT OF MAXIMUM CONDUCTED POWER

The measured Power

$$\text{ERP(dBm)} = \text{E(dB } \mu\text{V/m)} - 95.23$$

Mode	Frequency (MHz)	Field strength (dB $\mu\text{V/m}$)	ERP (dBm)
NFC(ASK)	13.56	52.88	-42.35

The measured conducted Average Power

Mode	Frequency (MHz)	Averaged Power (dBm)
GFSK (BLE 1Mbps)	2402	-5.02

The tuned conducted Average Power (declared by client)

Mode	Frequency (MHz)	Target Power (dBm)	Tolerance (dBm)	Lower Tolerance (dBm)	Upper Tolerance (dBm)
GFSK (BLE 1Mbps)	2402-2480	-5	± 2	-7	-3
NFC (ASK)	2402-2480	-42	± 2	-44	-40

MPE-based Exemption §1.1307(b)(3)(i)(A)					
Operation Mode	Frequency Band (MHz)	Max. Power (dBm)	Max. Power (mW)	Limit Threshold (mW)	Test Result
GFSK (BLE 1Mbps)	2402-2480	-3	0.50119	1	Pass
NFC (ASK)	13.56	-40	0.0001	1	Pass
Total(BLE+NFC)	/	/	0.50129	1	Pass

Conclusion

Source-base time average power is below Exemption Criteria and/or Routine Evaluation MPE thresholds, therefore the device is compliant FCC RF exposure requirement.