

# RF Exposure evaluation

FCC ID: 2AZBC-QICO-K1

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

## 1. Reference

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

KDB447498 D01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

For wireless charging

KDB 680106 D01 RF Exposure Wireless Charging Apps v03

According to the item 5 of KDB 680106 D01v03:

Inductive wireless power transfer applications that meet all of the following requirements are excluded from

submitting an RF exposure evaluation.

- (1) Power transfer frequency is less than 1MHz.
- (2) Output power from each primary coil is less than or equal to 15 watts.
- (3) The transfer system includes only single primary and secondary coils. This includes charging systems that may have multiple primary coils and clients that are able to detect and allow coupling only between individual pairs of coils.
- (4) Client device is placed directly in contact with the transmitter.
- (5) Mobile exposure conditions only (portable exposure conditions are not covered by this exclusion).
- (6) The aggregate H-field strengths at 15 cm surrounding the device and 20 cm above the top surface from all simultaneous transmitting coils are demonstrated to be less than 50% of the MPE limit.

Remark: Meet all the above requirements.

## 2. Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	6
3.0 – 30	1842/f	4.89/f	(900/f <sup>2</sup> )*	6
30 – 300	61.4	0.163	1.0	6

300 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 30	824/f	2.19/f	(180/f <sup>2</sup> )*	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

### 3. MPE Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S=PG/4\pi R^2$$

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator

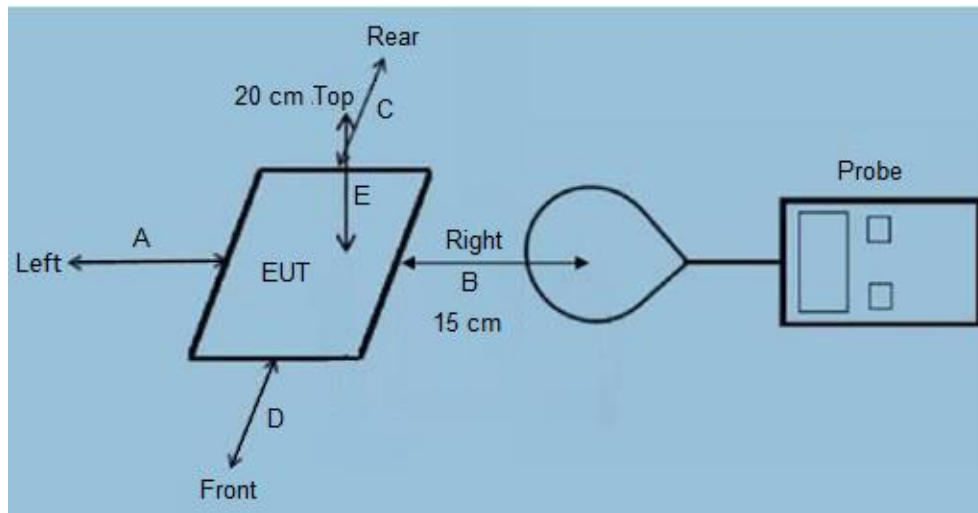
R=distance to the center of radiation of the antenna

For wireless charging

- 1) The RF exposure test was performed in anechoic chamber.
- 2) The measurement probe was placed at test distance (15 cm from all sides and 20 cm from the top) which is between the edge of the charger and the geometric center of probe.
- 3) The highest emission level was recorded and compared with limit as soon as measurement of each points (A, B, C, D, E) were completed.
- 4) The EUT was measured according to the dictates of KDB 680106 D01v03.

Remark: The EUT's test position A, B, C, D and E is valid for the E and H field measurements.

## 4. Test Setup



## 5. Equipment Approval Considerations

The EUT does comply with KDB 680106 D01 as follow table.

Requirements of KDB 680106 D01	Yes / No	Description
Power transfer frequency is less than 1 MHz	Yes	The device operate in the frequency range 110KHz~205KHz
Output power from each primary coil is less than 15 watts	Yes	The maximum output power for each primary coil is 15W.
The transfer system includes only single primary and secondary coils. This includes charging systems that may have multiple primary coils and clients that are able to detect and allow coupling only between individual pairs of coils.	Yes	The transfer system includes two primary coils but can only transmit between a pair of primary and secondary coils at the same time.
Client device is placed directly in contact with the transmitter.	Yes	Client device is placed directly in contact with the transmitter.
Mobile exposure conditions only (portable exposure conditions are not covered by this exclusion).	Yes	Mobile exposure conditions only
The aggregate H-field strengths at 15 cm surrounding the device and 20 cm above the top surface from all simultaneous transmitting coils are demonstrated to be less than 50% of the MPE limit.	Yes	The EUT H-field strengths at 15 cm surrounding the device and 20 cm above the top surface from all simultaneous transmitting coils are demonstrated to be less than 50% of the MPE limit.

## 6. Antenna Information

L4K1 can only use antennas certificated as follows provided by manufacturer;

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
BT	/	PCB ANT	2.81dBi for 2400-2500MHz;	

## 7. Description of the test mode

Equipment under test was operated during the measurement under the following conditions:

☒ Charging and communication mode

Test Modes:		
Mode 1	AC/DC Adapter (5V/3A) + EUT + Mobile Phone1 (Battery Status: <1%)	Record
Mode 2	AC/DC Adapter (5V/3A) + EUT + Mobile Phone1 (Battery Status: <50%)	Record
Mode 3	AC/DC Adapter (5V/2A) + EUT + Mobile Phone1 (Battery Status: 100%)	Record
Mode 4	AC/DC Adapter (9V/2A) + EUT + Mobile Phone1 (Battery Status: <1%)	Pre-tested
Mode 5	AC/DC Adapter (9V/2A) + EUT + Mobile Phone1 (Battery Status: <50%)	Pre-tested
Mode 6	AC/DC Adapter (9V/2A) + EUT + Mobile Phone1 (Battery Status: 100%)	Pre-tested
Mode 7	AC/DC Adapter (12V/1.5A) + EUT + Mobile Phone1 (Battery Status: <1%)	Pre-tested
Mode 8	AC/DC Adapter (12V/1.5A) + EUT + Mobile Phone1 (Battery Status: <50%)	Pre-tested
Mode 9	AC/DC Adapter (12V/1.5A) + EUT + Mobile Phone1 (Battery Status: 100%)	Pre-tested
Note: All test modes were pre-tested, but we only recorded the worst case in this report.		

## 8. Test Instruments list

Test Equipment	Manufacturer	Model No.	SN.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
Exposure Level Tester	Narda	ELT-400	N-0231	June 29 2020	June 28 2021
Magnetic field probe 100cm <sup>2</sup>	Narda	ELT probe 100cm <sup>2</sup>	M0675	June 29 2020	June 28 2021

## 9. Manufacturing Tolerance

BLE GFSK(Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	-3.0	-4.0	-4.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

## 10. Standalone MPE Result

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance,  $r=20\text{cm}$ , as well as the gain of the used antenna is 0.0dBi, the RF power density can be obtained.

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW				
BLE	-2.0	0.6310	2.81	1.9099	0.0002	1.0000

*Remark:*

1. Output power (Peak) including turn-up tolerance;
2. MPE evaluate distance is 20cm from user manual provide by manufacturer.

*For wireless charging*

H-Field Strength at 15 cm from the edges surrounding the EUT and 15cm from the top surface of the EUT

Charging Battery Level	Unit	Frequency Range (MHz)	Measured E-Field Strength Values (A/m)					FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
			Test Position A	Test Position B	Test Position C	Test Position D	Test Position E		
1%	uT	0.116	0.2038	0.1888	0.1913	0.1838	0.1863	--	--
1%	A/m	0.116	0.163	0.151	0.153	0.147	0.149	0.815	1.63
50%	uT	0.116	0.2013	0.1950	0.1925	0.2013	0.1850	--	--
50%	A/m	0.116	0.161	0.156	0.154	0.161	0.148	0.815	1.63
99%	uT	0.116	0.1863	0.1975	0.1825	0.1788	0.1950	--	--
99%	A/m	0.116	0.149	0.158	0.146	0.143	0.156	0.815	1.63

E-Field Strength at 15 cm from the edges surrounding the EUT and 15cm from the top surface of the EUT

Charging Battery Level	Unit	Frequency Range (MHz)	Measured E-Field Strength Values (V/m)					FCC E-Field Strength 50% Limits (V/m)	FCC E-Field Strength Limits (V/m)
			Test Position A	Test Position B	Test Position C	Test Position D	Test Position E		
1%	V/m	0.116	61.451	56.927	57.681	55.419	56.173	307.0	614.0
50%	V/m	0.116	60.697	58.812	58.058	60.697	55.796	307.0	614.0
99%	V/m	0.116	56.173	59.566	55.042	53.911	58.812	307.0	614.0

Note:  $V/m = A/m \times 377$

H-Field Strength at 20cm from the top surface of the EUT

Charging Battery Level	Unit	Frequency Range (MHz)	Measured E-Field Strength Values (A/m)	FCC H-Field Strength 50% Limits (A/m)	FCC H-Field Strength Limits (A/m)
			Test Position E		
1%	uT	0.116	0.1775	--	--
1%	A/m	0.116	0.142	0.815	1.63
50%	uT	0.116	0.1863	--	--
50%	A/m	0.116	0.149	0.815	1.63
99%	uT	0.116	0.1838	--	--
99%	A/m	0.116	0.147	0.815	1.63

Note:  $A/m = uT/1.25$

## 11. simultaneous MPE Result

Maximum SAR Ratio <sub>BT</sub>	Maximum MPE Ratio <sub>WPC</sub>	$\sum SAR_{ratio} + MPE_{ratios}$	Limit	Results
0.0002	0.1879	0.1881	1.0	PASS

## 12. Conclusion

The detected emissions with a distance of 20 cm from center of probe to the top surface of EUT and 15cm from center of probe to edge of EUT are below the limitations according to FCC KDB 680106 D01 Section 3. RF Exposure Requirement Clause 3.

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile exposure conditions.

### 13. Test Set-up Photo



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