

## RF Exposure evaluation

FCC ID: 2APB2-LIME41GL

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

### 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

### 4. Antenna Information

Lime-4.1-GL 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/2.4GWIFI	--	FPC antenna	1.0dBi	2400-2500MHz
WCDMA/LTE	--	PIFA antenna	0.5dBi for WCDMA Band 2/4; -1.0dBi for WCDMA Band V; -2.8dBi for LTE Band 2; -3.3dBi for LTE Band 4; -2.5dBi for LTE Band 12; -2.8dBi for LTE Band 13; -2.5dBi for LTE Band 17;	Band V: 869 MHz ~ 894 MHz Band II: 1930 MHz ~ 1990 MHz Band IV: 2110 MHz ~ 2155 MHz LTE Band 2:1850~1910MHz LTE Band 4:1710~1755MHz LTE Band 12:699~716MHz LTE Band 13:777~787MHz LTE Band 17:704~716MHz

### 5. Manufacturing Tolerance

BLE GFSK(Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	0	2.0	2.0
Tolerance ±(dB)	1.0	1.0	1.0

WCDMA			
Channel	BAND 2	BAND 4	BAND 5
Target (dBm)	23.0	25.0	22.0
Tolerance ±(dB)	1.0	1.0	1.0

LTE					
Channel	BAND 2	BAND 4	BAND 12	BAND 13	BAND 17
Target (dBm)	24.0	24.0	24.0	24.0	24.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0

WIFI(Peak)

Frequency (MHz)	11b		
	2412	2437	2462
Target (dBm)	15.0	15.0	15.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11g		
	2412	2437	2462
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT20)		
	2412	2437	2462
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT40)		
	2422	2437	2452
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

## 6. 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	3.0	1.9953	1.0	1.2589	0.0005	1.0000
2.4GWIFI	16.0	39.8107	1.0	1.2589	0.0100	1.0000
WCDMA B2	23.0	199.5262	0.5	1.1220	0.0446	1.0000
WCDMA B4	26.0	398.1072	0.5	1.1220	0.0889	1.0000
WCDMA B5	23.0	199.5262	-1.0	0.7943	0.0315	0.5493
LTE Band 2	25.0	316.2278	-2.8	0.5248	0.0330	1.0000
LTE Band 4	25.0	316.2278	-3.3	0.4677	0.0294	1.0000
LTE Band 12	25.0	316.2278	-2.5	0.5623	0.0354	0.4660
LTE Band 13	25.0	316.2278	-2.8	0.5248	0.0330	0.5180
LTE Band 17	25.0	316.2278	-2.5	0.5623	0.0354	0.4693

*Remark:*

1. Output power (Peak) including turn-up tolerance;

2. MPE evaluate distance is 20cm from user manual provide by manufacturer.

## 7. simultaneous MPE Result

2.4GWIFI MPE (Ratio)	WCDMA MPE (Ratio)	simultaneous MPE (Ratio)	MPE Limits (Ratio)
0.0100	0.0889	0.0989	1.0000

## 8. Conclusion

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

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