

Radiofrequency radiation exposure evaluation: mobile devices

RESULT :

Pass

Test Specification

Test item : Robotic Lawn Mower
 Identification / Type No. : LM2H1, LM2S1
 FCC ID : 2BFWS-LUBAMN2
 IC : 32325-LUBAMN2
 Test standard : CFR47 FCC Part 2: Section 2.1091
 CFR47 FCC Part 1: Section 1.1310
 FCC KDB Publication 447498 D04
 RSS 102 Issue 6

➤ FCC requirements

FCC requirement: 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 limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 20cm normally can be maintained between the user and the device.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(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
300-1,500			f/1500	<30
1,500-100,000			1.0	<30

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

RF Exposure Evaluation Result

RF exposure evaluation method is based on KDB 447498 D01, this calculation is based on the conducted power, maximum power and antenna gain with provides the minimum separation distance. The formula shown below is from OET Bulletin 65 Edition 97-01 Per KDB 447498 D01:

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

S = Power Density (mW/m²)

P = RF output Power (mW)

G = EUT Antenna gain (numeric)

R = Separation distance between radiator and human body (cm)

From the minimum separation distance, R=20cm

Test mode	Max. RF Output Power (dBm)	Antenna Gain (dBi)	Max EIRP (dBm)	Max EIRP (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	MPE Radio	Result
BLE	7.92	2.5	10.42	11.015	0.002192	1	0.002192	Pass
2.4G WLAN	20.11	2.5	22.61	182.390	0.036304	1	0.036304	Pass
5G WLAN	20.44	2.8	23.24	210.863	0.041971	1	0.041971	Pass
LTE B2	24	3.4	27.4	549.541	0.109383	1	0.109383	Pass
LTE B4	24	1.6	25.6	363.078	0.072269	1	0.072269	Pass
LTE B5	24	2.4	26.4	436.516	0.086886	0.550	0.157975	Pass
LTE B12	24	2.3	26.3	426.580	0.084908	0.466	0.182206	Pass
LTE B17	24	2.3	26.3	426.580	0.084908	0.471	0.180272	Pass
LTE B13	24	2.3	26.3	426.580	0.084908	0.520	0.163285	Pass
LTE B66	24	1.6	25.6	363.078	0.072269	1	0.072269	Pass
LTE B71	24	2.3	26.3	426.580	0.084908	0.444	0.191234	Pass

The product also has multiple transmitters. The Simltaneous Transmission Possibilities are as below

Mode	Configuration
1	LTE + WLAN + BLE

Test mode	Result ratio	Total	Limit	Result
BLE	0.002192	0.235	1.0	Pass
5G WLAN	0.041971			
LTE	0.191234			

➤ **IC requirements:** The EUT shall comply with the requirement of RSS-102 section 4 Exposure Limits.

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz⁶ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

a) EUT RF Exposure Evaluation standalone operations, Worst Case mode

Test mode	Max. RF Output Power (dBm)	Antenna Gain (dBi)	Max EIRP (dBm)	Max EIRP (W)	Limit of MPE EIRP (W ²)	MPE Radio	Result
BLE	7.92	2.5	10.42	0.011015	2.68	0.00411	Pass
2.4G WLAN	20.11	2.5	22.61	0.18239	2.68	0.068056	Pass
5G WLAN	20.44	2.8	23.24	0.210863	4.88	0.04321	Pass
LTE B2	24	3.4	27.4	0.549541	2.24	0.245331	Pass
LTE B4	24	1.6	25.6	0.363078	2.12	0.171263	Pass
LTE B5	24	2.4	26.4	0.436516	1.28	0.341028	Pass
LTE B12	24	2.3	26.3	0.42658	1.15	0.370939	Pass
LTE B17	24	2.3	26.3	0.42658	1.15	0.370939	Pass
LTE B13	24	2.3	26.3	0.42658	1.23	0.346813	Pass
LTE B66	24	1.6	25.6	0.363078	2.12	0.171263	Pass
LTE B71	24	2.3	26.3	0.42658	1.23	0.346813	Pass

The product also has multiple transmitters. The Simltaneous Transmission Possibilities are as below

Mode	Configuration
1	LTE + WLAN + BLE

Test mode	Result ratio	Total	Limit	Result
BLE	0.00411	0.418	1.0	Pass
5G WLAN	0.04321			
LTE	0.370939			

“RF Radiation Exposure Statement Caution: This Transmitter must be installed to provide a separation distance of at least 20 cm from all persons.”