

RF EXPOSURE EVALUATION

EUT Specification

EUT	LoRaWAN Module
Model Number	MKL110BC
FCC ID	2AO94-MKL110BC
Antenna gain (Max)	0.69dBi
Operation Frequency	2402-2480MHz
Input Rating	DC 3.3V
Standard	47 CFR Part 1.1307 47 CFR Part 1.1310 KDB447498D01 General RF Exposure Guidance v06
Modulation	BLE

Limits

According to FCC Part1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in part1.1307(b)

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	60
3.0–30	1842/f	4.89/f	*(900/f ²)	60
30–300	61.4	0.163	1.0	60
300–1500			f/300	60
1500–100,000			5	60
(B) 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

Friis Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

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

P_d is the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

Test Procedure:

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

Calculated Result and Limit

BLE:

Mode	Frequency (MHz)	Peak output power (dBm)	Peak output power (mW)	Target power (dBm)	Maximum tune-up Power (mW)	Antenna gain		Power Density (S) (mW /cm ²)	Limited of Power Density (S) (mW /cm ²)	Test Result
						(dBi)	(Linear)			
BLE	2402	2.74	1.88	2±1	1.99	0.69	1.17	0.0005	1	Complies
	2440	2.95	1.97	2±1	1.99	0.69	1.17	0.0005	1	Complies
	2480	2.91	1.95	2±1	1.99	0.69	1.17	0.0005	1	Complies

The Maximum power is less than the limit, complies with the exemption requirements, SAR is exempted.

For 915MHz SRD

Ant gain=-2.1dBi

Ant numeric gain= 0.0616

Field strength = 92.29dBuV/m@3m

$$P = \{ [10^{\left(\frac{92.29}{20}\right)} / 10^6 * 3]^2 / (30 * 0.0616) \} * 1000\text{mw} = 0.123\text{mW}$$

$$P_d = (0.123 * 0.0616) / (4\pi * 20^2) = 0.0000015 < 1$$

Remark: The Max Conducted Peak Output Power data refer to report Report No.:

90059-23-72-23-PP001 , 90059-23-72-23-PP002

BLE and LoRa can be launched simultaneously.

So, total $P_d = 0.0005 + 0.0000015 = 0.0005015 < 1$