RF EXPOSURE EVALUATION

According to FCC 1.1310: 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 §1.1307(b)

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 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
(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
300-1,500			f/1500	30
1,500-100,000			1.0	30

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

MPE Calculation Method

E (V/m) = $\frac{\sqrt{30 * P * G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

Pd = $\frac{30 * P * G}{377 * D^2}$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

MAX OUTPUT POWER

Measurement Result

Operation Frequency: BT: 2402-2480MHz, LORA: 902.3 MHz~914.9MHz

Power density limited: 1mW/ cm^2

Antenna Type: BLE: PCB Antenna, LORA: External adhesive rod Antenna

Antenna gain: BLE:2.7dBi, LORA: 0.98dBi

R=20cm

BLE

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density (mW/cm2)
2402	BLE 1M	3.38	3±1	4	2.512	2.70	1.86	0.0009	1
2440		3.4	3±1	4	2.512	2.70	1.86	0.0009	1
2480		3.33	3±1	4	2.512	2.70	1.86	0.0009	1
2402	BLE 2M	3.32	3±1	4	2.512	2.70	1.86	0.0009	1
2440		3.35	3±1	4	2.512	2.70	1.86	0.0009	1
2480		3.28	3±1	4	2.512	2.70	1.86	0.0009	1

LORA

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)	Max tune-up power (mW)	Antenna Gain (dBi)	Antenna Gain Numeric	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
902.3	GFSK	12.831	12±1	13	19.953	0.98	1.25	0.00497	0.6015
908.9		12.608	12±1	13	19.953	0.98	1.25	0.00497	0.6059
914.9		12.557	12±1	13	19.953	0.98	1.25	0.00497	0.6099

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2, H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leq 1$$

MPE should not exceed unity. That is

Max. SIMULTANEOUS TRANSMISSIONS for BLE+ LORA

Mode	Evaluation result	Power density Limits	Calculation result	Limit	Conclusion
BLE	0.0009	1	0.00916	1.000	Pass
Lora	0.00497	0.6015			

Conclusion:
For the max result : 0.00916≤ 1.0 for Max Power Density, compliance RF exposure..

Signature: **Date:** 2023-12-08

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