

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

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

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: 905 MHz~919.7MHz

Power density limited: 1mW/ cm²

Antenna Type: BLE: PCB Antenna, LORA: PCB Antenna

Antenna gain: BLE: ANT Port 1: 1.73dBi; ANT Port 2: 1.83dBi, LORA: 2.43dBi

R=20cm

BLE

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density (mW/cm ²)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
2402	ANT Port 1	17.42	17±1	18	63.096	1.73	1.49	0.0187	1
2440		18.64	19±1	20	100.000	1.73	1.49	0.0296	1
2480		19.28	19±1	20	100.000	1.73	1.49	0.0296	1
2402	ANT Port 2	17.38	17±1	18	63.096	1.83	1.52	0.0191	1
2440		19.29	19±1	20	100.000	1.83	1.52	0.0303	1
2480		18.62	19±1	20	100.000	1.83	1.52	0.0303	1

LORA

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max		Antenna		Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
				tune-up power		Gain			
				(dBm)	(mW)	(dBi)	Numeric		
905	GFSK	25.589	25±1	26	398.107	2.43	1.75	0.13859	0.6033
912.5		25.559	25±1	26	398.107	2.43	1.75	0.13859	0.6083
919.7		25.441	25±1	26	398.107	2.43	1.75	0.13859	0.6131

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	0.0303	1	0.26002	1.000	Pass
LORA	0.13859	0.6033			

Note: This product does not support 2.4G multi-source transmission.

Conclusion:

For the max result : $0.26002 \leq 1.0$ for Max Power Density, compliance RF exposure..



Signature:

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