

RF EXPOSURE EVALUATION

According to FCC 1.1310 and KDB 447498 D01 V06, 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

$$E \text{ (V/m)} = \frac{\sqrt{30 * P * G}}{d}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

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.

Measurement Result

BLE :

Operation Frequency: 2402-2480MHz,

ANT+:

Operation Frequency: 2457MHz,

Power density limited: 1mW/ cm²

Power density limited: 1mW/cm

Antenna Type: FPC Antenna

nordic: 0.86 dBi

Siche: 2.55 dBi

R=20cm

mW=10^{^(dBm/10)}

Note: The product features two RF chips, namely the Siche chip and the Nordic chip.

Nordic:

Mode	Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density Limits
			(dBm)		tune-up power		Gain			
					(dBm)	(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)
BLE 1M	2402	GFSK	-5.41	-5±1	-4	0.398	0.86	1.22	0.0001	1
	2441		-5.5	-5±1	-4	0.398	0.86	1.22	0.0001	1
	2480		-5.06	-5±1	-4	0.398	0.86	1.22	0.0001	1
BLE 2M	2402	GFSK	-5.34	-5±1	-4	0.398	0.86	1.22	0.0001	1
	2441		-5.45	-5±1	-4	0.398	0.86	1.22	0.0001	1
	2480		-4.97	-5±1	-4	0.398	0.86	1.22	0.0001	1
ANT + 1M	2457	GFSK	-6.88	-6±1	-5	0.316	0.86	1.22	0.0001	1
ANT + 2M	2457	GFSK	-6.31	-6±1	-5	0.316	0.86	1.22	0.0001	1

Siche:

Mode	Channel Freq. (MHz)	modulation	conducted power	Tune-up power (dBm)	Max		Antenna		Evaluation result	Power density
			(dBm)		tune-up power		Gain			Limits
					(dBm)	(dBm)	(mW)	(dBi)	Numeric	(mW/cm2)
BLE 1M	2402	GFSK	-6.63	-6±1	-5	0.316	2.55	1.80	0.0001	1
	2441		-6.66	-6±1	-5	0.316	2.55	1.80	0.0001	1
	2480		-6.42	-6±1	-5	0.316	2.55	1.80	0.0001	1
BLE 2M	2402	GFSK	-6.78	-6±1	-5	0.316	2.55	1.80	0.0001	1
	2441		-6.75	-6±1	-5	0.316	2.55	1.80	0.0001	1
	2480		-6.49	-6±1	-5	0.316	2.55	1.80	0.0001	1

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 MPE should not exceed unity. That is

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

Max. SIMULTANEOUS TRANSMISSIONS for nordic Module + Siche Module

Band	ANT	Standalone	Standalone	Simultaneous		Verdict
		Evaluation result	Power density Limits	Evaluation result	Power density Limits	
		(mW/cm2)	(mW/cm2)	(mW/cm2)	(mW/cm2)	
nordic Module + Siche Module	BLE	0.0001	1	0.000200	1	PASS
	BLE	0.0001	1			

Conclusion:

For the max result : $0.0002 \leq 1.0$, SAR is not required.

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