

RF Exposure Evaluation

LIMIT

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 Exposures				
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
300–1500	-	-	f/300	6
1500–100,000	-	-	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
300–1500	-	-	f/1500	30
1500–100,000	-	-	1.0	30

Note: f = frequency in MHz

EVALUATION METHOD

Transmission formula: $Pd = (Pout * G) / (4 * \pi * r^2)$

Where

Pd = power density in mW/cm², **Pout** = output power to antenna in mW, **G** = gain of antenna in linear scale;

Pi = 3.1416, **R** = distance between observation point and center of the radiator in cm

TEST RESULT

Passed

Not Applicable

Radio Type	Frequency range (MHz)	Conducted Average Power (dBm)*	Maximum Tune-up (dBm)	Power Density (mW/cm ²)	Limit (mW/cm ²)	Result
GSM850 (1 Tx Slot)	824.2-848.8	31.72	32.00	0.059	0.549	Pass
PCS1900 (1 Tx Slot)	1850.2-1909.8	28.35	29.00	0.028	1.000	Pass
WCDMA Band II	1852.4-1907.6	23.73	24.00	0.072	1.000	Pass
WCDMA Band IV	1712.4-1752.6	23.64	24.00	0.072	1.000	Pass
WCDMA Band V	826.4-846.6	23.78	24.00	0.074	0.551	Pass
LTE Band 2	1850.7-1909.3	23.02	24.00	0.075	1.000	Pass
LTE Band 4	1710.7-1754.3	22.41	23.00	0.059	1.000	Pass
LTE Band 5	824.7-848.3	22.90	23.00	0.059	0.550	Pass
LTE Band 7	2502.5-2567.5	22.89	23.00	0.059	1.000	Pass
LTE Band 12	699.7-715.3	22.91	23.00	0.059	0.446	Pass
LTE Band 17	706.5-713.5	23.35	24.00	0.075	0.471	Pass
LTE Band 38	2572.5-2617.5	22.01	23.00	0.059	1.000	Pass
LTE Band 66	1710.7-1779.3	22.95	23.00	0.059	1.000	Pass

Radio Type	Frequency range (MHz)	Conducted Average Power (dBm)	Maximum Tune-up (dBm)	Power Density (mW/cm ²)	Limit (mW/cm ²)	Result
LORA	903-914.2	11.10	12.00	0.005	0.602	Pass
WIFI	2412-2462	16.32	17.00	0.019	1.000	Pass

Note:

- 1) The maximum antenna gain,
LORA: 1.78dBi
WIFI: 2.9dBi
GSM850: 1.73dBi
PCS1900: 1.57dBi
WCDMA Band II: 1.57dBi
WCDMA Band IV: 1.57dBi
WCDMA Band V: 1.73dBi
LTE Band 2: 1.74dBi
LTE Band 4: 1.74dBi
LTE Band 5: 1.74dBi
LTE Band 7: 1.74dBi
LTE Band 12: 1.74dBi
LTE Band 17: 1.74dBi
LTE Band 38: 1.74dBi
LTE Band 66: 1.74dBi
- 2) The exposure evaluation safety distance is 20cm.
- 3) *refer to module which FCC ID is ZMONL668LA05.

Consider the LORA, WIFI and GSM850 can transmitting simultaneously, the total transmitting MPE rate as below formula:

$$\text{MPE rate} = \text{Power density of LORA/limit} + \text{Power density of WIFI/limit} + \text{Power density of GSM850/limit} < 1$$

The worst case is BT-EDR and 2.4G WIFI transmitting simultaneously, the result as below:

Evaluation mode	Power density/limit	Sum of the MPE rate	limit
LORA	0.008	0.134	1
WIFI	0.019		
GSM850(1 Tx Slot)	0.107		