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

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

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.

Measurement Result

LORA:
Antenna Type: External antenna
Antenna gain: 5 dBi,

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power		Antenna Gain		Evaluation result (mW/cm2)	Power density (mW/cm2)
				(dBm)	(mW)	(dBi)	Numeric		
923.3	LORA	13.496	13±1	14	25.119	5.00	3.16	0.0158	0.6155
925.1		12.919	13±1	14	25.119	5.00	3.16	0.0158	0.6167
927.5		12.608	13±1	14	25.119	5.00	3.16	0.0158	0.6183

GSM850/GSM1900
Antenna Type: PCB antenna
Antenna gain: -1.5 dBi,

Operating Mode	Frame-Avg Power (dBm)	Frame-Avg Power (mW)	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
GSM 850	29.51	893.3054837	0.1777	0.5495
GSM 1900	27.7	588.8436554	0.1171	1.0000

Note: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots. The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 TS) - 9.03 dB

For WCDMA/LTE
Antenna Type: PCB antenna
Antenna gain: -1.5 dBi,

| Operating Mode	Maximum measured EIRP(ERP) (dBm)	Maximum measured EIRP(ERP) (mW)	Evaluation result (mW/cm2)	Power density Limits (mW/cm2)
WCDMA Band II	22.41	174.1806873	0.0347	1.0000
WCDMA Band V	19.75	94.40608763	0.0188	0.5493
LTE Band 7	19.29	84.9180475	0.0169	1.0000
LTE Band 2	20.67	116.6809617	0.0232	1.0000
LTE Band 4	19.95	98.85530947	0.0197	1.0000
LTE Band 5	18.86	76.91304403	0.0153	0.5498

Synchronous transmission:
  According KDB 447498 D01, simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0.
  The evaluation here considers a LTE/WCDMA transmitter &a WIFI transmitter. The MPE ratio is defined by the ratio of power density to MPE limit. The sum of the MPE ratios is calculated as follows:
  $\Sigma MPE\ Ratio$ = Max (GSM/LTE/WCDMA MPE ratio) + Max (Lora MPE ratio)
Conclusion:
For the max result : 0.0158+0.1777=0.1935≤0.5493 for Max Power Density, compliance the RF Exposure.
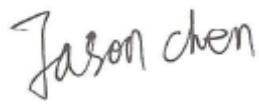
Signature:　　　　　　　　　　　　　　　　**Date:**　2019/5/29

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