1 RF Exposure Compliance

1.1 Test Standards

Test standard : FCC 47 CFR Part 2 Section 2.1091
RSS-102 Issue 5 Section 3.2

FCC ID:2AF6B-RAK7289C
Contains FCC ID: 2AF6B-RAK634, 2AF6B-RAK5146, XMR201807EG95NA
Contains IC: 25908-RAK634, 25908-RAK5146, 10224A-2018EG95NA

1.2 MPE Limits of FCC and IC

MPE Limit for FCC

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(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

MPE Limit for IC

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
$0.003\text{-}10^{21}$	83	90	-	Instantaneous*
0.1-10	-	$0.73/f$	-	6**
1.1-10	$87/f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	$58.07/f^{0.25}$	$0.1540/f^{0.25}$	$8.944/f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142f^{0.3417}$	$0.008335f^{0.3417}$	$0.02619f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000/f^{1.2}$
150000-300000	$0.158f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000/f^{1.2}$

Note: f is frequency in MHz.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

1.3 Test Result

Test Result: PASS

This device is mobile device, and the applicant declares that the minimum separation distance is greater than 20cm, detail minimum distance refer to to below calculation table. Therefore MPE measurement or computational modeling should be used to determine compliance.

MPE Calculation is based on the conducted power, and considering maximum power and antenn gain. The following formula is used to MPE evaluation.

(1) The power density according to far-field model is:

$$S = \frac{P \times G_{(\theta,\phi)}}{4 \times \pi \times R^2}$$

Where:

P = input power of the antenna.
G = antenna gain relative to an isotropic antenna.
θ, ϕ = elevation and azimuth angles.
R = distance from the antenna to the point of investigation.

(2) For single or multiple RF sources, the calculated power density should comply with following:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Where:

S_i = the power density when the f is i.
$S_{Limit,i}$ = the reference level requirement for power density when f is i.
f = operating frequency.

A. Stand-alone operation mode (worst mode)

Operating Mode	Band	PG (dBm)	PG (W)	Calculation (mW/cm^2)	FCC Limit (mW/cm^2)	Verdict
Lora	902-928MHz	30.49	1.119	0.056	0.601	Pass
WIFI	2.4GHz	28.94	0.77983	0.039	1.0	Pass
WCDMA	II	29.00	0.79433	0.040	1.0	Pass
	IV	29.00	0.79433	0.040	1.0	Pass
	V	29.00	0.79433	0.040	0.55	Pass
LTE	2	29.00	0.79433	0.040	1.0	Pass
	4	29.00	0.79433	0.040	1.0	Pass
	5	29.00	0.79433	0.040	0.55	Pass
	12	29.00	0.79433	0.040	0.47	Pass
	13	29.00	0.79433	0.040	0.52	Pass

Operating Mode	Band	PG (dBm)	PG (W)	Calculation (W/m^2)	IC Limit (W/m^2)	Verdict
Lora	902-928MHz	30.49	1.119	0.557	2.74	Pass
WIFI	2.4GHz	28.94	0.77983	0.388	5.35	Pass
WCDMA	II	28.00	0.63096	0.314	4.48	Pass
	IV	28.00	0.63096	0.314	4.24	Pass
	V	28.00	0.63096	0.314	2.58	Pass
LTE	2	28.50	0.70795	0.352	4.48	Pass
	4	28.50	0.70795	0.352	4.24	Pass
	5	28.50	0.70795	0.352	2.58	Pass
	12	28.50	0.70795	0.352	2.30	Pass
	13	28.50	0.70795	0.352	2.47	Pass

B. Simultaneous Transmission operation mode (worst mode)

	FCC						
Operating Mode	Lora Ratio1	Lora Ratio2	WIFI Ratio	LTE Ratio	Sum Ratio	Limit	Result
Lora+ WIFI+ LTE	0.093	/	0.039	0.085	0.217	<1	Pass
Lora+ WIFI+ LTE	0.093	0.093	0.039	0.085	0.310	<1	Pass
	IC						
Operating Mode	Lora Ratio1	Lora Ratio2	WIFI Ratio	LTE Ratio	Sum Ratio	Limit	Result
Lora+ WIFI+ LTE	0.203	/	0.073	0.153	0.429	<1	Pass
Lora+ WIFI+ LTE	0.203	0.203	0.073	0.153	0.632	<1	Pass

Note:

1. The host has one or two identical Lora module.
2. The GSM/ UMTS /LTE modes cannot transmit simultaneous
3. The above RF output power refer to original FCC ID: 2AF6B-RAK634, 2AF6B-RAK5146, XMR201807EG95NA
4. . The above RF output power refer to original IC: 25908-RAK634, 25908-RAK5146, 10224A-2018EG95NA
5. R = 0.4m