RF Exposure evaluation

FCC ID: **2A4FR-LS4G-6-G**

1. Applicable Standard

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.
According to §1.1310 and §2.1091 RF exposure is calculated.
KDB447498 v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

2. Limit

FCC:

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.
In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.
In accordance with KDB447498D01 for 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 MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
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 – 1500	/	/	f/300	6
1500 – 100,000	/	/	5	6

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Averaging Time (minute)
Limits for Occupational/Controlled Exposure				
0.3 – 3.0	614	1.63	(100) *	30
3.0 – 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

F=frequency in MHz

*=Plane-wave equivalent power density

3. MPE Calculation Method

FCC：

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$S=PG/4\pi R^2$

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator

R=distance to the center of radiation of the antenna

4. Result

Mode	Minimum Separation Distance	Output Power (Turn-up Procedure)		Antenna Gain (Numeric)	Power Density At 20 cm (mW/cm^2)	Power Density Limit (mW/cm^2)	MPE Ratios	Test Results
	(cm)	dBm	mW					
LTE Band 2-M1	20.00	22.0	158.49	2.0	1.58489	1.0	0.049973	PASS
LTE Band 4-M1	20.00	21.0	125.89	2.0	1.58489	1.0	0.039694	PASS
LTE Band 5-M1	20.00	22.0	158.49	2.0	1.58489	0.549	0.049973	PASS
LTE Band 12-M1	20.00	21.0	125.89	2.0	1.58489	0.466	0.039694	PASS
LTE Band 13-M1	20.00	22.0	158.49	2.0	1.58489	0.518	0.049973	PASS
LTE Band 18-M1	20.00	23.0	199.53	2.0	1.58489	0.543	0.062913	PASS
LTE Band 19-M1	20.00	22.0	158.49	2.0	1.58489	0.553	0.049973	PASS
LTE Band 85-M1	20.00	22.0	158.49	2.0	1.58489	0.519	0.049973	PASS
LTE Band 2-NB2	20.00	25.0	316.23	2.0	1.58489	1.0	0.099709	PASS
LTE Band 4- NB2	20.00	23.0	199.53	2.0	1.58489	1.0	0.062913	PASS
LTE Band 5- NB2	20.00	24.0	251.19	2.0	1.58489	0.549	0.079201	PASS
LTE Band 12- NB2	20.00	24.0	251.19	2.0	1.58489	0.466	0.079201	PASS
LTE Band 13- NB2	20.00	24.0	251.19	2.0	1.58489	0.518	0.079201	PASS
LTE Band 18- NB2	20.00	24.0	251.19	2.0	1.58489	0.543	0.079201	PASS
LTE Band 19- NB2	20.00	22.0	158.49	2.0	1.58489	0.553	0.049973	PASS
LTE Band 25- NB2	20.00	24.0	251.19	2.0	1.58489	1.0	0.079201	PASS
LTE Band 66- NB2	20.00	23.0	199.53	2.0	1.58489	1.0	0.062913	PASS
LTE Band 71- NB2	20.00	24.0	251.19	2.0	1.58489	0.442	0.079201	PASS
LTE Band 85- NB2	20.00	24.0	251.19	2.0	1.58489	0.465	0.079201	PASS
GSM850	20.00	28.0	630.96	2.0	1.58489	0.549	0.198944	PASS
GSM1900	20.00	26.0	398.11	2.0	1.58489	1.0	0.125526	
BLE	20.00	2.0	1.58	0.44	1.10662	1.0	0.000348	PASS
WIFI	20.00	13.0	19.95	0.44	1.10662	1.0	0.004392	PASS

Note: F/1500(F=frequency in MHz)

Band 5: Power Density Limit (mW/cm2)=824/1500=0.549 mW/cm2

Band 12: Power Density Limit (mW/cm2)=699/1500=0.466 mW/cm2

Band 13: Power Density Limit (mW/cm2)=777/1500=0.518 mW/cm2

Band 18: Power Density Limit (mW/cm2)= 814/1500=0.543 mW/cm2

Band 19: Power Density Limit (mW/cm2)= 830/1500=0.553 mW/cm2

Band 71: Power Density Limit (mW/cm2)= 663.1/1500=0.442 mW/cm2

Band 85: Power Density Limit (mW/cm2)=778.8/1500=0.519 mW/cm2

Band 85-NB2: Power Density Limit (mW/cm2)=698/1500=0.465 mW/cm2

GSM850: Power Density Limit (mW/cm2)=824/1500=0.549 mW/cm2

5. Simultaneous transmission MPE Considerations

According to KDB447498 :For mobile exposure host platform to qualify for simultaneous transmission MPE test exclusion, all transmitters and antennas in the host must be either evaluated for MPE compliance, by measurement or computational modeling, or qualify for the standalone MPE test exclusion in section 7.1.
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.
This means that:
∑ of MPE ratios ≤ 1.0

WiFi and LTE Simultaneous evaluation
0.004392+0.198944/0.549=0.36677 <1

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6. Conclusion

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.