

RF Exposure evaluation

FCC ID: 2AWCS-SU

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

1. Reference

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 D01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

2. Limit

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

Predication of MPE limit at a given distance

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

$$S = \frac{PG}{4\pi R^2}$$

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. Antenna Information

KF-V4591Q can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna WIFI	2.4G	External Antenna	2.4GHz – 2.5 GHz	0 dBi
Antenna BT	2.4G	Internal Antenna	2.4GHz – 2.5 GHz	0 dBi

5. Conducted power

[2.4GHz WLAN Antenna 0]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)
<i>IEEE 802.11b</i>	1	2412	13.02
	6	2437	13.52
	11	2462	13.58
<i>IEEE 802.11g</i>	1	2412	15.04
	6	2437	15.33
	11	2462	15.17
<i>IEEE 802.11n HT20</i>	1	2412	15.91
	6	2437	16.15
	11	2462	16.47

[2.4GHz WLAN Antenna 1]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)
<i>IEEE 802.11b</i>	1	2412	13.35
	6	2437	14.4
	11	2462	14.67
<i>IEEE 802.11g</i>	1	2412	15.92
	6	2437	16.38
	11	2462	16.3
<i>IEEE 802.11n HT20</i>	1	2412	16.22
	6	2437	17.76
	11	2462	17.21

6. Manufacturing Tolerance

[2.4GHz WLAN Antenna 0]

Frequency (MHz)	<i>IEEE 802.11b (Peak)</i>		
	2412	2437	2462
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	<i>IEEE 802.11g (Peak)</i>		
	2412	2437	2462
Target (dBm)	15.0	15.0	15.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	<i>IEEE 802.11n HT20 (Peak)</i>		
	2412	2437	2462
Target (dBm)	15.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

[2.4GHz WLAN Antenna 1]

Frequency (MHz)	<i>IEEE 802.11b (Peak)</i>		
	2412	2437	2462
Target (dBm)	13.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	<i>IEEE 802.11g (Peak)</i>		
	2412	2437	2462
Target (dBm)	15.0	16.0	16.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	<i>IEEE 802.11n HT20 (Peak)</i>		
	2412	2437	2462
Target (dBm)	16.0	17.0	17.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

7. Standalone MPE Result

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, $r=20\text{cm}$, as well as the gain of WIFI antenna is 0dBi, the gain of BT antenna is 0dBi. the RF power density can be obtained.

[2.4GHz WLAN Antenna 0]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11b	14.00	25.1189	2.00	1.5849	0.0079	1.0000
IEEE 802.11g	16.00	39.8107	2.00	1.5849	0.0126	1.0000
IEEE 802.11n HT20	17.00	50.1187	2.00	1.5849	0.0158	1.0000

[2.4GHz WLAN Antenna 1]

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11b	15.00	31.6228	2.00	1.5849	0.0100	1.0000
IEEE 802.11g	17.00	50.1187	2.00	1.5849	0.0158	1.0000
IEEE 802.11n HT20	18.00	63.0957	2.00	1.5849	0.0199	1.0000

Remark:

1. Output power (Peak) including turn-up tolerance;
2. Output power was adjust to duty cycle at 100% if measured duty cycle less than 98%;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer.

8. Summary simultaneous transmission results

The sample supports 2 antennas for 2.4G WLAN. The antenna 0 and antenna 1 can transmit simultaneous.

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

$\sum$ of MPE ratios ≤ 1.0

Antenna 0 and Antenna 1 for 2.4GWLAN

Modulation Type	MPE _{ant0} (mW/cm ²)	MPE _{ant1} (mW/cm ²)	$\sum$ MPE ratios	Limit	Results
WIFI	0.0158	0.0199	0.0357	1.0	PASS

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

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