

RF Exposure evaluation

FCC ID: SMQSE120XPRO

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 V06: 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

Internal Identification	Antenna Identification in Internal photos	Antenna type and antenna number	Operate frequency band	Maximum antenna gain
Antenna 1	2.4G/5G Wifi/BT	FPC antenna	2.4GHz – 2.5 GHz	2.4 dBi
			5.1GHz – 5.8 GHz	3 dBi
Antenna 2	LTE	FPC antenna	LTE Band 2	2.74 dBi
			LTE Band 4	2.74 dBi
			LTE Band 5	1.88 dBi
			LTE Band 7	3.03 dBi
			LTE Band 12	1.25 dBi
			LTE Band 17	1.25 dBi
			LTE Band 41	3.03 dBi

5. Maximum tune-up value of the EUT

Target Power for LTE

Mode	Target Power		
	1RB	50%RB	100%RB
LTE BAND 2	24 ± 1.5 dBm	24 ± 1.5 dBm	24 ± 1.5 dBm
LTE BAND 4	24 ± 1.5 dBm	24 ± 1.5 dBm	24 ± 1.5 dBm
LTE BAND 5	24 ± 1.5 dBm	24 ± 1.5 dBm	24 ± 1.5 dBm
LTE BAND 7	23 ± 1.5 dBm	23 ± 1.5 dBm	23 ± 1.5 dBm
LTE BAND 12	24 ± 1.5 dBm	24 ± 1.5 dBm	24 ± 1.5 dBm
LTE BAND 17	24 ± 1.5 dBm	24 ± 1.5 dBm	24 ± 1.5 dBm
LTE BAND 41	22 ± 1.5 dBm	22 ± 1.5 dBm	22 ± 1.5 dBm

Mode	Target Power		
	1RB	50%RB	100%RB
LTE BAND 2	23 ± 1.5 dBm	23 ± 1.5 dBm	23 ± 1.5 dBm
LTE BAND 4	23 ± 1.5 dBm	23 ± 1.5 dBm	23 ± 1.5 dBm

LTE BAND 5	23 ± 1.5 dBm	23 ± 1.5 dBm	23 ± 1.5 dBm
LTE BAND 7	22 ± 1.5 dBm	22 ± 1.5 dBm	22 ± 1.5 dBm
LTE BAND 12	23 ± 1.5 dBm	23 ± 1.5 dBm	23 ± 1.5 dBm
LTE BAND 17	23 ± 1.5 dBm	23 ± 1.5 dBm	23 ± 1.5 dBm
LTE BAND 41	21 ± 1.5 dBm	21 ± 1.5 dBm	21 ± 1.5 dBm

Target Power for WIFI 2.4G

802.11b (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1	1	1
802.11g (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	21.0	21.0	21.0
Tolerance ±(dB)	1	1	1
802.11n HT20 (Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	21	20	20
Tolerance ±(dB)	1	1	1
802.11n HT40 (Average)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	19	20	20
Tolerance ±(dB)	1	1	1

Target Power for UNII

Mode	Channel	Target (dBm)
11A	5180	13 ± 1
	5200	13 ± 1
	5240	13 ± 1
	5260	13 ± 1
	5280	13 ± 1
	5320	13 ± 1
	5745	13 ± 1
	5785	13 ± 1
11N20SISO	5180	13 ± 1
	5200	13 ± 1
	5240	13 ± 1
	5260	13 ± 1
	5280	13 ± 1
	5320	13 ± 1
	5745	13 ± 1
	5785	13 ± 1

	5825	13±1
11N40SISO	5190	13±1
	5230	13±1
	5270	13±1
	5310	13±1
	5755	13±1
	5795	13±1
11AC20SISO	5180	13±1
	5200	13±1
	5240	13±1
	5260	13±1
	5280	13±1
	5320	14±1
	5745	13±1
	5785	13±1
11AC40SISO	5190	13±1
	5230	13±1
	5270	13±1
	5310	13±1
	5755	13±1
	5795	13±1
11AC80SISO	5210	12±1
	5290	12±1
	5775	12±1

Bluetooth

BLE-GFSK			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	-3	-3	-4
Tolerance ±(dB)	1	1	1

GFSK			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	8.0	8.0	8.0
Tolerance ±(dB)	1	1	1

8DPSK			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	8.0	7.0	7.0
Tolerance ±(dB)	1	1	1

π/4DQPSK			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	8.0	7.0	7.0

Tolerance \pm (dB)	1	1	1
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6. Standalone MPE Result

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, $r=20\text{cm}$, the RF power density can be obtained.

Bluetooth

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
GFSK	9	7.9433	2.4	1.7378	0.0027	1.0000
$\pi/4$ DQPSK	9	7.9433	2.4	1.7378	0.0027	1.0000
8-DPSK	9	7.9433	2.4	1.7378	0.0027	1.0000
BLE 1M	-2	0.6310	2.4	1.7378	0.0002	1.0000
BLE 2M	-2	0.6310	2.4	1.7378	0.0002	1.0000

2.4GHz WIFI

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11b	22	158.4893	2.4	1.7378	0.0548	1.0000
IEEE 802.11g	22	158.4893	2.4	1.7378	0.0548	1.0000
IEEE 802.11n HT20	22	158.4893	2.4	1.7378	0.0548	1.0000
IEEE 802.11n HT40	21	125.8925	2.4	1.7378	0.0435	1.0000

5GHz WIFI

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
IEEE 802.11a	14	25.1189	3	1.9953	0.0100	1.0000
IEEE 802.11n HT20	14	25.1189	3	1.9953	0.0100	1.0000
IEEE 802.11ac VHT20	15	31.6228	3	1.9953	0.0126	1.0000
IEEE 802.11n HT40	14	25.1189	3	1.9953	0.0100	1.0000
IEEE 802.11ac VHT40	14	25.1189	3	1.9953	0.0100	1.0000
IEEE 802.11ac VHT80	13	19.9526	3	1.9953	0.0079	1.0000

LTE

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
LTE Band 2	25.5	354.8134	2.74	1.8793	0.1327	1.0000
LTE Band 4	25.5	354.8134	2.74	1.8793	0.1327	1.0000
LTE Band 5	25.5	354.8134	1.88	1.5417	0.1088	0.5498

LTE Band 7	24.5	281.8383	3.03	2.0091	0.1126	1.0000
LTE Band 12	25.5	354.8134	1.25	1.3335	0.0941	0.4664
LTE Band 17	25.5	354.8134	1.25	1.3335	0.0941	0.4710
LTE Band 41	23.5	223.8721	3.03	2.0091	0.0895	1.0000

Remark:

1. MPE evaluate distance is 20cm from user manual provide by manufacturer.

7. Summary simultaneous transmission information

Synchronization transmit between WIFI and BT

Modulation Type	Modulation Type	Modulation Type	Synchronization transmit
IEEE 802.11a	BT	LTE	Yes
IEEE 802.11b	BT	LTE	Yes
IEEE 802.11g	BT	LTE	Yes
IEEE 802.11n HT20	BT	LTE	Yes
IEEE 802.11n HT20	BT	LTE	Yes
IEEE 802.11n HT40	BT	LTE	Yes
IEEE 802.11ac VHT20	BT	LTE	Yes
IEEE 802.11ac VHT40	BT	LTE	Yes
IEEE 802.11ac VHT80	BT	LTE	Yes

8. Summary simultaneous transmission results

Synchronization transmit between WIFI ,BT, and LTE

Max. $\sum MPE_{(wifi)}$ (mW/cm ²)	$MPE_{(BT)}$ (mW/cm ²)	$MPE_{(LTE)}$ (mW/cm ²)	$\sum MPE_{(WIFI+BT+LTE)}$ ratios	Limit (mW/cm ²)	Results
0.0548	0.0027	0.1327	0.1902	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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