

RF Exposure evaluation

FCC ID: SMC-K970AO

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

EUT can only use antennas certificated as follows provided by manufacturer;

Antenna No.	Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Frequency range:
BT	/	FPC ANT	1.80dBi for 2400-2500MHz	
BLE	/	FPC ANT	1.80dBi for 2400-2500MHz	
2.4GWIFI	/	FPC ANT	Ant 1: 1.90dBi for 2400-2500MHz Ant 2: 1.80dBi for 2400-2500MHz	
5GWIFI	/	FPC ANT	Ant 1: 3.40dBi for for 5180MHz to 5240MHz, 5260MHz to 5320MHz, 5500MHz to 5700MHz, 5745MHz to 5825MHz Ant 2: 3.40dBi for for 5180MHz to 5240MHz, 5260MHz to 5320MHz, 5500MHz to 5700MHz, 5745MHz to 5825MHz	

5. Manufacturing Tolerance

BLE(Peak)

GFSK 1Mbps			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	5.0	5.0	5.0
Tolerance ±(dB)	1.0	1.0	1.0
GFSK 2Mbps			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	5.0	5.0	5.0
Tolerance ±(dB)	1.0	1.0	1.0

BT(Peak)

GFSK			
Channel	Channel 00	Channel 39	Channel 78

Target (dBm)	8.0	8.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
π /4QPSK			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	8.0	8.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
8DPSK			
Channel	Channel 00	Channel 39	Channel 78
Target (dBm)	8.0	8.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

For ANT1

2.4GWIFI(Peak)

802.11b			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11g			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT20			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	13.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT40			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	14.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11ax HE20			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11ax HE40			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	14.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

5GHz WLAN

IEEE 802.11a (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825

Target (dBm)	11.0	11.0	11.0	11.0	11.0	11.0	12.0	12.0	12.0	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	11.0	11.0	11.0	11.0	11.0	11.0	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	11.0	11.0	11.0	11.0	12.0	12.0	12.0	12.0	12.0			
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0			
IEEE 802.11ac VHT20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	12.0	12.0	12.0	13.0	13.0	13.0	14.0	14.0	14.0	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	11.0	11.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0			
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0			
IEEE 802.11ac VHT80 (Average)												
Frequency (MHz)	5210		5290		5530		5610		5775			
Target (dBm)	11.0		12.0		12.0		12.0		12.0			
Tolerance ± (dB)	1.0		1.0		1.0		1.0		1.0			
IEEE 802.11ax HE20 (Average)												

Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	12.0	12.0	13.0	13.0	13.0	13.0	13.0	13.0	12.0	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ax HE40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0			
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
IEEE 802.11ax HE80 (Average)												
Frequency (MHz)	5210		5290		5530		5610		5775			
Target (dBm)	11.0		11.0		13.0		13.0		13.0			
Tolerance ± (dB)	1.0		1.0		1.0		1.0		1.0			

For ANT2

2.4GWIFI(Peak)

802.11b			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	14.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11g			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT20			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT40			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11ax HE20			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

802.11ax HE40			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	14.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

5GHz WLAN

IEEE 802.11a (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	11.0	11.0	11.0	13.0	13.0	13.0	12.0	12.0	12.0	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	13.0	13.0	13.0	13.0	13.0	12.0	12.0	13.0	13.0	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	13.0	13.0	13.0	13.0	12.0	12.0	12.0	13.0	13.0			
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0			
IEEE 802.11ac VHT20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	13.0	13.0	13.0	13.0	13.0	12.0	12.0	13.0	13.0	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	13.0	13.0	13.0	13.0	11.0	12.0	12.0	12.0	12.0			

Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
IEEE 802.11ac VHT80 (Average)												
Frequency (MHz)	5210		5290		5530		5610		5775			
Target (dBm)	12.0		12.0		12.0		12.0		12.0			
Tolerance ± (dB)	1.0		1.0		1.0		1.0		1.0			
IEEE 802.11ax HE20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	13.0	13.0	13.0	13.0	13.0	13.0	12.0	12.0	12.0	12.0	12.0	12.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ax HE40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	13.0	13.0	13.0	13.0	11.0	11.0	11.0	13.0	13.0			
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		
IEEE 802.11ax HE80 (Average)												
Frequency (MHz)	5210		5290		5530		5610		5775			
Target (dBm)	12.0		12.0		12.0		12.0		12.0			
Tolerance ± (dB)	1.0		1.0		1.0		1.0		1.0			

For MIMO:

2.4GWIFI

802.11n HT20			
Channel	Channel 01	Channel 6	Channel 11
Target (dBm)	16.5	16.5	16.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT40			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	16.5	16.5	16.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11ax HE20			
Channel	Channel 01	Channel 6	Channel 11

Target (dBm)	16.5	16.5	16.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11ax HE40			
Channel	Channel 03	Channel 6	Channel 9
Target (dBm)	17.0	17.0	17.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

5GHz WLAN

IEEE 802.11n HT20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0	15.5	15.5	15.5	16.0	16.0	16.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0			
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0			
IEEE 802.11ac VHT20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0			
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0			
IEEE 802.11ac VHT80 (Average)												
Frequency (MHz)	5210		5290		5530		5610		5775			
Target (dBm)	15.5		15.0		15.0		15.0		15.0			

Tolerance ± (dB)	1.0		1.0		1.0			1.0		1.0		
IEEE 802.11ax HE20 (Average)												
Frequency (MHz)	5180	5200	5240	5260	5280	5320	5500	5580	5700	5745	5785	5825
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ax HE40 (Average)												
Frequency (MHz)	5190	5230	5270	5310	5510	5550	5670	5755	5795			
Target (dBm)	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0		
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
IEEE 802.11ax HE80 (Average)												
Frequency (MHz)	5210		5290		5530			5610		5775		
Target (dBm)	14.5		14.5		15.5			15.5		15.5		
Tolerance ± (dB)	1.0		1.0		1.0			1.0		1.0		

6. 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 the used antenna refer to antenna information, the RF power density can be obtained.

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
BLE	6.0	3.9811	1.80	1.5136	0.00120	1.0000
BT	9.0	7.9433	1.80	1.5136	0.00239	1.0000
2.4GWIFI ANT 1	15.0	31.6228	1.90	1.5488	0.00975	1.0000
2.4GWIFI ANT 2	15.0	31.6228	1.80	1.5136	0.00953	1.0000
2.4GWIFI MIMO	18.0	63.0957	4.86	3.0620	0.03846	1.0000
5GWIFI ANT 1	14.0	25.1189	4.60	2.8840	0.01442	1.0000
5GWIFI ANT 2	14.0	25.1189	4.40	2.7542	0.01377	1.0000
5GWIFI MIMO	17.0	50.1187	6.41	4.3752	0.04365	1.0000

Remark:

- 1. Output power (Peak) including turn-up tolerance;*
- 2. MPE evaluate distance is 20cm from user manual provide by manufacturer.*

Simultaneous Evaluation

BT MPE (mW/cm ²)	5GWIFI MIMO MPE (mW/cm ²)	MPE	MPE Limits
0.00239	0.04365	0.04604	1.0000

7. Conclusion

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

-----THE END OF REPORT-----