



RF Exposure Evaluation

Limits

The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
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
(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
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

Friis transmission formula: $Pd = (Pout \cdot G) / (4 \cdot \pi \cdot r^2)$

Where

Pd = power density in mW/cm², **Pout** = output power to antenna in mW;

G = gain of antenna in linear scale, **Pi** = 3.1416;

R = distance between observation point and center of the radiator in cm

Pd is the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.



Test Result of RF Exposure Evaluation

BLE GFSK(Peak)			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	-1	-2.0	-2.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

WIFI(Peak) ANT1

Frequency (MHz)	11b		
	2412	2437	2462
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11g		
	2412	2437	2462
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT20)		
	2412	2437	2462
Target (dBm)	13.0	12.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT40)		
	2412	2437	2462
Target (dBm)	13.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW20)		
	2412	2437	2462
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW40)		
	2412	2437	2462
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0



WIFI(Peak) ANT2

Frequency (MHz)	11b		
	2412	2437	2462
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11g		
	2412	2437	2462
Target (dBm)	12.0	13.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT20)		
	2412	2437	2462
Target (dBm)	12.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11n(HT40)		
	2412	2437	2462
Target (dBm)	13.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW20)		
	2412	2437	2462
Target (dBm)	12.0	14.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW40)		
	2412	2437	2462
Target (dBm)	13.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0



WIFI(Average) ANT1

Frequency (MHz)	802.11a		
	5180	5200	5240
Target (dBm)	12.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT20)		
	5180	5200	5240
Target (dBm)	13.0	14.0	14.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT40)		
	5190	/	5230
Target (dBm)	12.0	/	13.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT20)		
	5180	5200	5240
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ac(VHT40)		
	5190	/	5230
Target (dBm)	13.0	/	13.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT80)		
	/	5210	/
Target (dBm)	/	13.0	/
Tolerance $\pm$ (dB)	/	1.0	/
Frequency (MHz)	11ax(HEW20)		
	5180	5200	5240
Target (dBm)	12.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW40)		
	5190	/	5230
Target (dBm)	12.0	/	13.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ax(HEW80)		
	/	5210	/
Target (dBm)	/	12.0	/
Tolerance $\pm$ (dB)	/	1.0	/



WIFI(Average) ANT2

Frequency (MHz)	802.11a		
	5180	5200	5240
Target (dBm)	13.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT20)		
	5180	5200	5240
Target (dBm)	13.0	13.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT40)		
	5190	/	5230
Target (dBm)	12.0	/	13.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT20)		
	5180	5200	5240
Target (dBm)	14.0	13.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ac(VHT40)		
	5190	/	5230
Target (dBm)	14.0	/	12.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT80)		
	/	5210	/
Target (dBm)	/	13.0	/
Tolerance $\pm$ (dB)	/	1.0	/
Frequency (MHz)	11ax(HEW20)		
	5180	5200	5240
Target (dBm)	13.0	12.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW40)		
	5190	/	5230
Target (dBm)	12.0	/	13.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ax(HEW80)		
	/	5210	/
Target (dBm)	/	13.0	/
Tolerance $\pm$ (dB)	/	1.0	/



WIFI(Average) ANT1

Frequency (MHz)	802.11a		
	5745	5785	5825
Target (dBm)	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT20)		
	5745	5785	5825
Target (dBm)	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT40)		
	5755	/	5795
Target (dBm)	13.0	/	13.0
Tolerance ± (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT20)		
	5745	5785	5825
Target (dBm)	13.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	11ac(VHT40)		
	5190	/	5230
Target (dBm)	13.0	/	13.0
Tolerance ± (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT80)		
	/	5210	/
Target (dBm)	/	14.0	/
Tolerance ± (dB)	/	1.0	/
Frequency (MHz)	11ax(HEW20)		
	5745	5785	5825
Target (dBm)	14.0	13.0	13.0
Tolerance ± (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW40)		
	5745	5785	5825
Target (dBm)	13.0	/	13.0
Tolerance ± (dB)	1.0	/	1.0
Frequency (MHz)	11ax(HEW80)		
	/	5775	/
Target (dBm)	/	14.0	/
Tolerance ± (dB)	/	1.0	/



WIFI(Average) ANT2

Frequency (MHz)	802.11a		
	5745	5785	5825
Target (dBm)	13.0	12.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT20)		
	5745	5785	5825
Target (dBm)	13.0	13.0	12.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	802.11n(HT40)		
	5755	/	5795
Target (dBm)	13.0	/	13.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT20)		
	5745	5785	5825
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ac(VHT40)		
	5190	/	5230
Target (dBm)	12.0	/	13.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ac(VHT80)		
	/	5210	/
Target (dBm)	/	14.0	/
Tolerance $\pm$ (dB)	/	1.0	/
Frequency (MHz)	11ax(HEW20)		
	5745	5785	5825
Target (dBm)	14.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
Frequency (MHz)	11ax(HEW40)		
	5745	5785	5825
Target (dBm)	13.0	/	14.0
Tolerance $\pm$ (dB)	1.0	/	1.0
Frequency (MHz)	11ax(HEW80)		
	/	5775	/
Target (dBm)	/	14.0	/
Tolerance $\pm$ (dB)	/	1.0	/



MPE Result

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
BLE	0	0.7943	2.0	1.585	0.00032	1.0000
2.4GWIFI ANT1	14.0	25.119	2.0	1.585	0.00792	1.0000
5.2GWIFI ANT1	15.0	31.623	2.0	1.585	0.00997	1.0000
5.8GWIFI ANT1	15.0	31.623	2.0	1.585	0.00997	1.0000

Modulation Type	Output power		Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm ²)	MPE Limits (mW/cm ²)
	dBm	mW				
2.4GWIFI ANT2	15.0	31.623	2.0	1.585	0.00997	1.0000
5.2GWIFI ANT2	15.0	31.623	2.0	1.585	0.00997	1.0000
5.8GWIFI ANT2	15.0	31.623	2.0	1.585	0.00997	1.0000

Remark:

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

Simultaneous MPE Result

2.4GWIFI ANT1 MPE (Ratio)	2.4GWIFI ANT2 MPE (Ratio)	BLE MPE (Ratio)	simultaneous MPE (Ratio)	MPE Limits (Ratio)
0.00997	0.00997	0.00032	0.02026	1.0000

Remark: antenna gain=2.4G:2.0dBi/ 5G:2.0dBi,5.8GWIFI:2.0dBi
So a SAR test is not required