

Prediction of MPE at a given distance

1. 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)

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 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
300-1,500			f/300	6
1,500-100,000			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
300-1,500			f/1500	30
1,500-100,000			1.0	30

2. Test Procedure

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

$$S = \frac{P \times G}{4 \times \pi \times R^2}$$

Where:

S = power density

P = power input to the antenna

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

R = distance to the centre of radiation of the antenna

3. Result

For Worst case Mode: UHF 410MHz-470MHz

Maximum peak output power at antenna input terminal: 30.35 (dBm)

Maximum peak output power at antenna input terminal: 1083.93 (mW)

Antenna gain(typical): 4 (dBi)

Maximum antenna gain: 2.51 (numeric)

Prediction distance: 50 (cm)

Source Based Time Average Duty Cycle: 100 (%)

Prediction frequency: 410.125 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 0.2734 (mW/cm²)

Power density at prediction frequency: 0.0866 (mW /cm²)

Power density at prediction frequency: 0.866 (W/m²)

Power density at a given distance is $0.0866 < 0.2734 \text{ mW/cm}^2$

For Worst case Mode: BT EDR 2042-2480MHz

Maximum peak output power at antenna input terminal: 1.479 (dBm)

Maximum peak output power at antenna input terminal: 1.6996 (mW)

Antenna gain(typical): 1 (dBi)

Maximum antenna gain: 1.26 (numeric)

Prediction distance: 50 (cm)

Source Based Time Average Duty Cycle: 100 (%)

Prediction frequency: 2441 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.0002 (mW /cm²)

Power density at prediction frequency: 0.002 (W/m²)

Power density at a given distance is $0.0002 < 1 \text{ mW/cm}^2$

For Worst case Mode: BT BLE 2042-2480MHz

Maximum peak output power at antenna input terminal: 1.501 (dBm)

Maximum peak output power at antenna input terminal: 1.7638 (mW)

Antenna gain(typical): 1 (dBi)

Maximum antenna gain: 1.26 (numeric)

Prediction distance: 50 (cm)

Source Based Time Average Duty Cycle: 100 (%)

Prediction frequency: 2441 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.0002 (mW /cm²)

Power density at prediction frequency: 0.002 (W/m²)

Power density at a given distance is $0.0002 < 1 \text{ mW/cm}^2$

For Worst case Mode: WiFi 2012-2462MHz

Maximum peak output power at antenna input terminal: 14.47 (dBm)

Maximum peak output power at antenna input terminal: 11.6047 (mW)

Antenna gain(typical): 1 (dBi)

Maximum antenna gain: 1.26 (numeric)

Prediction distance: 50 (cm)

Source Based Time Average Duty Cycle: 100 (%)

Prediction frequency: 2442 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.00046 (mW /cm²)

Power density at prediction frequency: 0.0046 (W/m²)

Power density at a given distance is $0.00046 < 1$ mW/cm²

For Worst case Mode: 3G(WCDMA)

Maximum peak output power at antenna input terminal: 23.91 (dBm)

Maximum peak output power at antenna input terminal: 246.04 (mW)

Antenna gain(typical): 0.5 (dBi)

Maximum antenna gain: 1.12 (numeric)

Prediction distance: 50 (cm)

Source Based Time Average Duty Cycle: 100 (%)

Prediction frequency: 1907.6 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.00877 (mW /cm²)

Power density at prediction frequency: 0.0877 (W/m²)

Power density at a given distance is $0.00877 < 1$ mW/cm²

For Worst case Mode: 4G (FDD LTE)

Maximum peak output power at antenna input terminal: 24.33 (dBm)

Maximum peak output power at antenna input terminal: 271.02 (mW)

Antenna gain(typical): 0.5 (dBi)

Maximum antenna gain: 1.12 (numeric)

Prediction distance: 50 (cm)

Source Based Time Average Duty Cycle: 100 (%)

Prediction frequency: 2567.5 (MHz)

MPE limit for uncontrolled exposure at prediction frequency: 1 (mW/cm²)

Power density at prediction frequency: 0.00966 (mW /cm²)

Power density at prediction frequency: 0.0966 (W/m²)

Power density at a given distance is $0.00966 < 1$ mW/cm²

Some radios transmit simultaneously, and the max evaluated ratio value are as below:

UHF + BT EDR + WLAN + WCDMA

$$\text{Ratio: } MPE_{\text{UHF}}/\text{Limit}_{410.125} + MPE_{\text{BT EDR}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{WiFi}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{WCDMA}}/\text{Limit}_{\text{above 1500}} = \mathbf{0.34546(mW/cm^2) <1 (mW/cm^2)}$$

UHF + BT BLE + WLAN + WCDMA

$$\text{Ratio: } MPE_{\text{UHF}}/\text{Limit}_{410.125} + MPE_{\text{BT BLE}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{WiFi}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{WCDMA}}/\text{Limit}_{\text{above 1500}} = \mathbf{0.34546(mW/cm^2) <1 (mW/cm^2)}$$

UHF + BT EDR + WLAN + FDD LTE

$$\text{Ratio: } MPE_{\text{UHF}}/\text{Limit}_{410.125} + MPE_{\text{BT EDR}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{WiFi}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{FDD LTE}}/\text{Limit}_{\text{above 1500}} = \mathbf{0.34635(mW/cm^2) <1 (mW/cm^2)}$$

UHF + BT BLE + WLAN + FDD LTE

$$\text{Ratio: } MPE_{\text{UHF}}/\text{Limit}_{410.125} + MPE_{\text{BT BLE}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{WiFi}}/\text{Limit}_{\text{above 1500}} + MPE_{\text{FDD LTE}}/\text{Limit}_{\text{above 1500}} = \mathbf{0.34635(mW/cm^2) <1 (mW/cm^2)}$$