

RF Exposure Evaluation

1. Maximum Permissible Exposure

1.1. Applicable Standard

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 levels in excess limit for maximum permissible exposure. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as a mobile device whereby a distance of 0.2 m normally can be maintained between the user and the device.

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842 / f	4.89 / f	(900 / f)*	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

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

1.2. MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Peak RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

1.3. Calculated Result and Limit

Antenna Type : PIFA Antenna
Max Conducted Power for 2.4GHz

Mobile

For Single Chain:

IEEE 802.11b

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
2.462	20	2.26	1.682674	19.57	90.5733	0.0303

IEEE 802.11g

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
2.437	20	2.26	1.682674	23.73	236.0478	0.0791

Configuration of IEEE 802.11n (20MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
2.412	20	2.26	1.682674	23.85	242.6610	0.0813

Configuration of IEEE 802.11n (40MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
2.422	20	2.26	1.682674	23.52	224.9055	0.0753

For Two Chains:

Configuration of IEEE 802.11n (20MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
2.412	20	2.26	1.682674	26.68	465.5861	0.1559

Configuration of IEEE 802.11n (40MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
2.422	20	2.26	1.682674	26.19	415.9106	0.1393

Max Conducted Power for 5GHz

Mobile

For Single Chain:

Configuration of IEEE 802.11a

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.280	20	4.95	3.126079	18.37	68.7068	0.0428

Configuration of IEEE 802.11n (20MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.280	20	4.95	3.126079	18.51	70.9578	0.0442

Configuration of IEEE 802.11n (40MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.670	20	4.95	3.126079	18.56	71.7794	0.0447

IEEE 802.11a

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.825	20	4.95	3.126079	24.53	283.7919	0.1766

Configuration of IEEE 802.11n (20MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.785	20	4.95	3.126079	24.51	282.4880	0.1758

Configuration of IEEE 802.11n (40MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.795	20	4.95	3.126079	24.42	276.6942	0.1722

For Two Chains:**Configuration of IEEE 802.11n (20MHz)**

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.280	20	4.95	3.126079	20.84	121.3389	0.0755

Configuration of IEEE 802.11n (40MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.670	20	4.95	3.126079	21.73	148.9361	0.0927

Configuration of IEEE 802.11n (20MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.785	20	4.95	3.126079	27.42	552.0774	0.3435

Configuration of IEEE 802.11n (40MHz)

Operating Frequency (GHz)	Min. User Distance (cm)	Gain (dBi)	Numeric Gain	Output Power (dBm)	Conducted Power (mW)	Power Density (mW/cm ²)
5.795	20	4.95	3.126079	27.33	540.7543	0.3365