

1 Human Exposure Assessment

1.1 Maximum Permissible Exposure

1.1.1 Limit of Maximum Permissible Exposure

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 ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
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 ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	F/1500	30
1500-100,000	-	-	1.0	30
Note 1: f = frequency in MHz ; *Plane-wave equivalent power density				
Note 2: For the applicable limit, see FCC 1.1310				

1.1.2 MPE Calculation Method

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

E = Electric field (V/m)

G = EUT Antenna numeric gain (numeric)

The formula can be changed to

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

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

P = RF output power (W)

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

1.1.3 Result of Maximum Permissible Exposure (2.4G)

Transmitter Chains & Receiver Chains Information					
IEEE Std. 802.11 Protocol	Number of Transmit Chains (N _{TX})	Number of Receive Chains (N _{RX})	Correlation Signals with Multiple N _{TX}	RF Output Power (dBm)	Co-location
b	1	1	Correlated	24.34	Yes
g	1	1	Correlated	24.61	Yes
n (HT20)	2	2	Uncorrelated	24.51	Yes
n (HT40)	2	2	Uncorrelated	19.43	Yes

Note 1: RF output power specifies that Maximum Conducted (Average) Output Power.

Worst Maximum RF Output Power Result							
Exposure Environment		General Population / Uncontrolled Exposure					
Separation Distance (cm)		20					
Power Level	1	RF Output Power (dBm)					
Modulation Mode	N _{TX}	Chain-Port 1	Chain-Port 2	Sum Chain	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
b	1	24.34	-	24.34	2.40	26.74	0.09391
g	1	24.61	-	24.61	2.40	27.01	0.09994
n (HT20)	2	21.30	21.70	24.51	5.41	29.92	0.19555
n (HT40)	2	16.20	16.63	19.43	5.41	24.84	0.06065
Maximum Permissible Exposure Limit (mW/cm ²)							1

Note 1: N_{TX} = Number of Transmit Chains

1.1.4 Result of Maximum Permissible Exposure (5.2G)

Transmitter Chains & Receiver Chains Information					
IEEE Std. 802.11 Protocol	Number of Transmit Chains (N _{TX})	Number of Receive Chains (N _{RX})	Correlation Signals with Multiple N _{TX}	RF Output Power (dBm)	Co-location
a	1	1	Correlated	21.69	Yes
n(HT20)	2	2	Uncorrelated	24.78	Yes
n(HT40)	2	2	Uncorrelated	25.03	Yes
ac(VHT20)	2	2	Uncorrelated	24.78	Yes
ac(VHT40)	2	2	Uncorrelated	25.09	Yes
ac(VHT80)	2	2	Uncorrelated	17.24	Yes
Note 1: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.) Note 2: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result							
Exposure Environment		General Population / Uncontrolled Exposure					
Separation Distance (cm)		20					
Power Level	1	RF Output Power (dBm)					
Modulation Mode	N _{TX}	Chain-Port 1	Chain-Port 2	Sum Chain	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
a	1	21.29	-	21.69	2.58	24.27	0.05318
n(HT20)	2	21.93	21.61	24.78	5.59	30.37	0.21681
n(HT40)	2	22.03	22.00	25.03	5.59	30.62	0.22924
ac(VHT20)	2	21.96	21.57	24.78	5.59	30.37	0.21663
ac(VHT40)	2	22.12	22.04	25.09	5.59	30.68	0.23271
ac(VHT80)	2	14.41	14.04	17.24	5.59	22.83	0.03817
Maximum Permissible Exposure Limit (mW/cm ²)							1
Note 1: N _{TX} = Number of Transmit Chains							

1.1.5 Result of Maximum Permissible Exposure(5.8G)

Transmitter Chains & Receiver Chains Information					
IEEE Std. 802.11 Protocol	Number of Transmit Chains (N _{TX})	Number of Receive Chains (N _{RX})	Correlation Signals with Multiple N _{TX}	RF Output Power (dBm)	Co-location
a	1	1	Correlated	22.47	Yes
n(HT20)	2	2	Uncorrelated	22.83	Yes
n(HT40)	2	2	Uncorrelated	23.14	Yes
ac(VHT20)	2	2	Uncorrelated	22.94	Yes
ac(VHT40)	2	2	Uncorrelated	23.18	Yes
ac(VHT80)	2	2	Uncorrelated	13.89	Yes
Note 1: Co-location, Co-location is generally defined as simultaneously transmitting (co-transmitting) antennas within 20 cm of each other. (i.e., EUT has simultaneously co-transmitting that operating 2.4GHz and 5GHz.) Note 2: RF output power specifies that Maximum Conducted (Average) Output Power.					

Worst Maximum RF Output Power Result							
Exposure Environment		General Population / Uncontrolled Exposure					
Separation Distance (cm)		20					
Power Level	1	RF Output Power (dBm)					
Modulation Mode	N _{TX}	Chain-Port 1	Chain-Port 2	Sum Chain	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
a	1	22.47	-	22.47	2.58	25.05	0.06364
n(HT20)	2	20.52	18.98	22.83	5.59	28.42	0.13822
n(HT40)	2	20.69	19.48	23.14	5.59	28.73	0.14842
ac(VHT20)	2	20.57	19.17	22.94	5.59	28.53	0.14171
ac(VHT40)	2	20.75	19.50	23.18	5.59	28.77	0.14989
ac(VHT80)	2	11.39	10.30	13.89	5.59	19.48	0.01765
Maximum Permissible Exposure Limit (mW/cm ²)							1
Note 1: N _{TX} = Number of Transmit Chains							

Worst Maximum RF Output Power Result							
Exposure Environment		General Population / Uncontrolled Exposure					
Separation Distance (cm)		20					
Condition		RF Output Power (dBm)					
Modulation Mode	N _{TX}	Chain-Port 1	Chain-Port 2	Sum Chain	DG (dBi)	EIRP Power	PD (S) (mW/cm ²)
n (HT20)	2	21.30	21.70	24.51	5.41	29.92	0.19555
ac(VHT40)	2	22.12	22.04	25.09	5.59	30.68	0.23271
Co-location Total							0.42826
Maximum Permissible Exposure Limit (mW/cm ²)							1
Note 1: N _{TX} = Number of Transmit Chains							