

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)*	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)*	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				

RF Field Strength Limits for Controlled Use Devices (Controlled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1	600	4.9	-	6
1-10	600/ <i>f</i>	4.9/ <i>f</i>	-	6
10-30	60	4.9/ <i>f</i>	-	6
30-300	60	0.163	10*	6
300-1500	3.54 <i>f</i> 0.5	0.0094 <i>f</i> 0.5	<i>f</i> /30	6
1500-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/ <i>f</i> 1.2
150000-300000	0.354 <i>f</i> 0.5	9.4 x 10 ⁻⁴ <i>f</i> 0.5	3.33 x 10 ⁻⁴ <i>f</i>	616000/ <i>f</i> 1.2
RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)				
Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Averaging Time (minutes)
0.003-1	280	2.19	-	6
1-10	280/ <i>f</i>	2.19/ <i>f</i>	-	6
10-30	28	2.19/ <i>f</i>	-	6
30-300	28	0.073	2*	6
300-1500	1.585 <i>f</i> ^{0.5}	0.0042 <i>f</i> ^{0.5}	<i>f</i> /150	6
1500-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}
Note 1: <i>f</i> is frequency in MHz.				
Note 2: For the applicable limit, see IC RSS-102				

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	22.29	Yes
g	1	1	Correlated	21.01	Yes
n (HT20)	2	2	Uncorrelated	23.71	Yes
n (HT40)	2	2	Uncorrelated	17.49	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	22.29	-	22.29	5.00	27.29	0.10659
g	1	21.09	-	21.01	5.00	26.04	0.07938
n (HT20)	2	19.87	21.40	23.71	5.00	28.71	0.14790
n (HT40)	2	13.63	15.19	17.49	5.00	22.49	0.03530
Maximum Permissible Exposure Limit (mW/cm ²)							1

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

1.1.4 Result of Maximum Permissible Exposure (5.8G)

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	18.78	Yes
n(HT20)	1	1	Correlated	18.48	Yes
n(HT40)	1	1	Correlated	19.75	Yes
ac(VHT20)	1	1	Correlated	18.13	Yes
ac(VHT40)	1	1	Correlated	19.78	Yes
ac(VHT80)	1	1	Correlated	19.13	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	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
a	1	18.78	5.40	24.18	0.05209
n(HT20)	1	18.48	5.40	23.88	0.04861
n(HT40)	1	19.75	5.40	25.15	0.06512
ac(VHT20)	1	18.13	5.40	23.53	0.04487
ac(VHT40)	1	19.78	5.40	25.18	0.06557
ac(VHT80)	1	19.13	5.40	24.53	0.05646
Maximum Permissible Exposure Limit (mW/cm²)					1

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

1.1.5 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	14.35	Yes
n(HT20)	1	1	Correlated	14.82	Yes
n(HT40)	1	1	Correlated	16.06	Yes
ac(VHT20)	1	1	Correlated	14.65	Yes
ac(VHT40)	1	1	Correlated	15.85	Yes
ac(VHT80)	1	1	Correlated	15.33	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	Gain (dBi)	EIRP Power	PD (S) (mW/cm ²)
a	1	14.35	5.40	19.75	0.01878
n(HT20)	1	14.82	5.40	20.22	0.02093
n(HT40)	1	16.06	5.40	21.46	0.02784
ac(VHT20)	1	14.65	5.40	20.05	0.02013
ac(VHT40)	1	15.85	5.40	21.25	0.02654
ac(VHT80)	1	15.33	5.40	20.73	0.02355
Maximum Permissible Exposure Limit (mW/cm²)					1

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