1. MAXIMUM PERMISSIBLE EXPOSURE

1.1. Limits

1.1.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	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/f²)	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/f²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

1.1.2. IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/f	2.19/f		6
10–30	28	2.19/f		6
30–300	28	0.073	2*	6
300–1 500	1.585$f^{0.5}$	0.0042$f^{0.5}$	f/150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 /$f^{1.2}$
150 000–300 000	0.158$f^{0.5}$	4.21 x 10$^{-4}f^{0.5}$	6.67 x 10^{-5}f	616 000 /$f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

1.1.3. LIMITS APPLICABLE TO THE EUT

For mobile radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency, as 824 MHz / 1500 = 0.55 mW/cm^2 (FCC) and 824 MHz / 150 = 5.5 W/m^2 (IC).

For operation in the PCS band, the 2.4 GHz band and the 5 GHz bands, from FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2 and from IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2.

1.2. EQUATIONS

Power density is given by:

$$S = EIRP / (4 * Pi * D\char`^2)$$

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

$$Total\ EIRP = (P1 * G1) + (P2 * G2) + ... + (Pn * Pn)$$

where

Px = Power of transmitter x
Gx = Numeric gain of antenna x

For multiple colocated transmitters operating simultaneously in frequency bands where different limits apply, either the lowest limit applicable to the operating frequency ranges of the co-located transmitters can be applied or a fraction of the exposure limit is established for each band, such that the sum of the fractions is less than or equal to one.

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

1.3. RESULTS

1.3.1. SINGLE TRANSMITTER (WiMAX OR WLAN)

Based on conducted power

Freq. Band & Freq. Range (MHz)	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m^2)	FCC Power Density (mW/cm^2)
5MHz	QPSK	0.20	22.81	3.00	0.76	0.076
2498.5-2687.5	16QAM	0.20	22.77	3.00	0.75	0.075
10MHz	QPSK	0.20	22.86	3.00	0.77	0.077
2501.0-2685.0	16QAM	0.20	22.85	3.00	0.77	0.077

Based on EIRP Data

Freq. Band & Freq. Range (MHz)	Mode	Separation Distance (m)	EIRP (dBm)	Antenna Gain (dBi)	IC Power Density (W/m^2)	FCC Power Density (mW/cm^2)
EUT ALONE						
5MHz	QPSK	0.20	27.28	0.00	1.06	0.106
2498.5-2687.5	16QAM	0.20	27.45	0.00	1.11	0.111
10MHz	QPSK	0.20	28.22	0.00	1.32	0.132
2501.0-2685.0	16QAM	0.20	28.18	0.00	1.31	0.131
EUT WITH CRADLE						
5MHz	QPSK	0.20	25.21	0.00	0.66	0.066
2498.5-2687.5	16QAM	0.20	25.18	0.00	0.66	0.066
10MHz	QPSK	0.20	25.88	0.00	0.77	0.077
2501.0-2685.0	16QAM	0.20	25.94	0.00	0.78	0.078

Each Power Density is less than 10 W/m^2 or 1 mW/cm^2, which is the limit for these operating frequency ranges.