FCC Maximum Permissible RF Exposure Regulations

The Federal Communications Commission (FCC) is the United States' governing body for the electromagnetic spectrum. They are the Big Brother of radio waves. As with most (hopefully) government functions, the intentions are good, and the people working in them are sincere in the execution of their duties, but they are not always right. If that were not the case, then there would never be a need to challenge policies. One of the biggest challenges for the average citizen these days is keeping frequency band allocations that are dedicated to hobbyists from being re-delegated to commercial applications.

One area where the FCC has excelled is in the consumer safety realm, regarding safe exposure limits to electromagnetic fields. Even that is somewhat subject to political concerns - for instance, the SAR (specific absorbed radiation) limits for cell phone radiation in the human body. Phone manufacturers say no harm is done with 2 W of 1-2 GHz radiation blasting an inch from your brain, or from 1 W of 2.4 GHz energy sitting on your crotch (notebook computer). Time will tell, but a recent study found that the normal 10-year development period for cancer is beginning to reveal high incidences of brain cancer on long-time, high-use mobile phone addicts.

Here are the most current Maximum Permissible Exposure number form the FCC (2007).

Limits for Maximum Permissible Exposure (MPE) - from §1.1310

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Averaging Time (minutes)
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

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm2)	Averaging Time (minutes)
0.3-3.0	614	1.63	100 †	30
3.0-30	842/f	2.19/f	180/f2 †	30
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 (see note)
Note: Equivalent far field strength that would have the E-field or H-field components calculated or measured.
Equivalent far field density for near and far fields can be calculated using
Power Density = |Etotal|2/3770 mW/cm2 or Power Density = |Htotal|2/37.7 mW/cm2

Here are some excerpts from the FCC website that address some commonly asked questions about RF radiation:

WHAT IS "RADIOFREQUENCY" AND MICROWAVE RADIATION?

Electromagnetic radiation consists of waves of electric and magnetic energy moving together (i.e., radiating) through space at the speed of light. Taken together, all forms of electromagnetic energy are referred to as the electromagnetic "spectrum." Radio waves and microwaves emitted by transmitting antennas are one form of electromagnetic energy. They are collectively referred to as "radiofrequency" or "RF" energy or radiation. Often the term "electromagnetic field" or "radiofrequency field" may be used to indicate the presence of electromagnetic or RF energy.

The RF waves emanating from an antenna are generated by the movement of electrical charges in the antenna. Electromagnetic waves can be characterized by a wavelength and a frequency. The wavelength is the distance covered by one complete cycle of the electromagnetic wave, while the frequency is the number of electromagnetic waves passing a given point in one second. The frequency of an RF signal is usually expressed in terms of a unit called the "hertz" (abbreviated "Hz"). One Hz equals one cycle per second. One megahertz ("MHz") equals one million cycles per second.

Different forms of electromagnetic energy are categorized by their wavelengths and frequencies. The RF part of the electromagnetic spectrum is generally defined as that part of the spectrum where electromagnetic waves have frequencies in the range of about 3 kilohertz (3 kHz) to 300 gigahertz (300 GHz). Microwaves are a specific category of radio waves that can be defined as radiofrequency energy where frequencies range from several hundred MHz to several GHz.

Exam Questions

T0C01 (D) What type of radiation are VHF and UHF radio signals?
A. Gamma radiation
B. Ionizing radiation
C. Alpha radiation
D. Non-ionizing radiation

T0C02 (B) Which of the following frequencies has the lowest value for Maximum Permissible Exposure limit?
A. 3.5 MHz
B. 50 MHz
C. 440 MHz
D. 1296 MHz

T0C03 (C) What is the maximum power level that an amateur radio station may use at VHF frequencies before an RF exposure evaluation is required?
A. 1500 watts PEP transmitter output
B. 1 watt forward power
C. 50 watts PEP at the antenna
D. 50 watts PEP reflected power

T0C04 (D) What factors affect the RF exposure of people near an amateur station antenna?
A. Frequency and power level of the RF field
B. Distance from the antenna to a person
C. Radiation pattern of the antenna
D. All of these choices are correct

T0C05 (D) Why do exposure limits vary with frequency?
A. Lower frequency RF fields have more energy than higher frequency fields
B. Lower frequency RF fields do not penetrate the human body
C. Higher frequency RF fields are transient in nature
D. The human body absorbs more RF energy at some frequencies than at others

T0C06 (D) Which of the following is an acceptable method to determine that your station complies with FCC RF exposure regulations?
A. By calculation based on FCC OET Bulletin 65
B. By calculation based on computer modeling
C. By measurement of field strength using calibrated equipment
D. All of these choices are correct

T0C07 (B) What could happen if a person accidentally touched your antenna while you were transmitting?
A. Touching the antenna could cause television interference
B. They might receive a painful RF burn
C. They might develop radiation poisoning
D. All of these choices are correct

T0C08 (A) Which of the following actions might amateur operators take to prevent exposure to RF radiation in excess of FCC-supplied limits?
A. Relocate antennas
B. Relocate the transmitter
C. Increase the duty cycle
D. All of these choices are correct

T0C09 (B) How can you make sure your station stays in compliance with RF safety regulations?
A. By informing the FCC of any changes made in your station
B. By re-evaluating the station whenever an item of equipment is changed
C. By making sure your antennas have low SWR
D. All of these choices are correct

CT0C10 (A)
Why is duty cycle one of the factors used to determine safe RF radiation exposure levels?
A. It affects the average exposure of people to radiation
B. It affects the peak exposure of people to radiation
C. It takes into account the antenna feed line loss
D. It takes into account the thermal effects of the final amplifier

T0C11 (C) What is the definition of duty cycle during the averaging time for RF exposure?
A. The difference between the lowest power output and the highest power output of a transmitter
B. The difference between the PEP and average power output of a transmitter
C. The percentage of time that a transmitter is transmitting
D. The percentage of time that a transmitter is not transmitting

T0C12 (A) How does RF radiation differ from ionizing radiation (radioactivity)?
A. RF radiation does not have sufficient energy to cause genetic damage
B. RF radiation can only be detected with an RF dosimeter
C. RF radiation is limited in range to a few feet
D. RF radiation is perfectly safe

T0C13 (C) If the averaging time for exposure is 6 minutes, how much power density is permitted if the signal is present for 3 minutes and absent for 3 minutes rather than being present for the entire 6 minutes?
A. 3 times as much
B. 1/2 as much
C. 2 times as much
D. There is no adjustment allowed for shorter exposure times