



Technician License Course Chapter 9

Lesson Module 21 Radio Frequency Exposure



ARRL *The national association for
AMATEUR RADIO*

RF Exposure

The energy in Radio waves can create currents in anything which conducts, including human tissue. Exposure to high levels of RF can cause problems. FCC sets limits on exposure called Maximum Permissible Exposure (MPE).

- Energy from RF is “non-ionizing” (not radioactive).
- Hams must evaluate their potential to exceed MPE

The hazard to human body is heating of tissues.

- Heating depends on the RF intensity and frequency and body absorption.
- Intensity can be limited by controlling distance and power.



Controlling RF Exposure

Exposure is related to frequency and intensity of the RF field. Make sure that people are not exposed by:

- Preventing access to locations where strong fields are present.
- Making sure that strong fields are not directed to areas where people might be present.

Touching antennas or ungrounded equipment can produce an “RF Burn”. May be painful but not an RF Hazard. Just like any other burn.

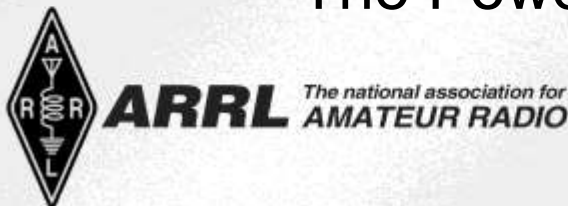
- Antenna parts should be out-of-reach.
- Bonding and grounding can prevent hot chassis.



RF Intensity

Power Density in milliWatts per square centimeter (mW/cm^2) is related to transmitted power, antenna gain and proximity.

- Higher power means higher risk.
- Antenna gain
 - Beam antennas focus available energy.
 - Standing in the beam direction increases risk.
- Proximity.
 - The energy spreads with distance so the area increases and the density decreases.
 - The Power density is highest near the antenna



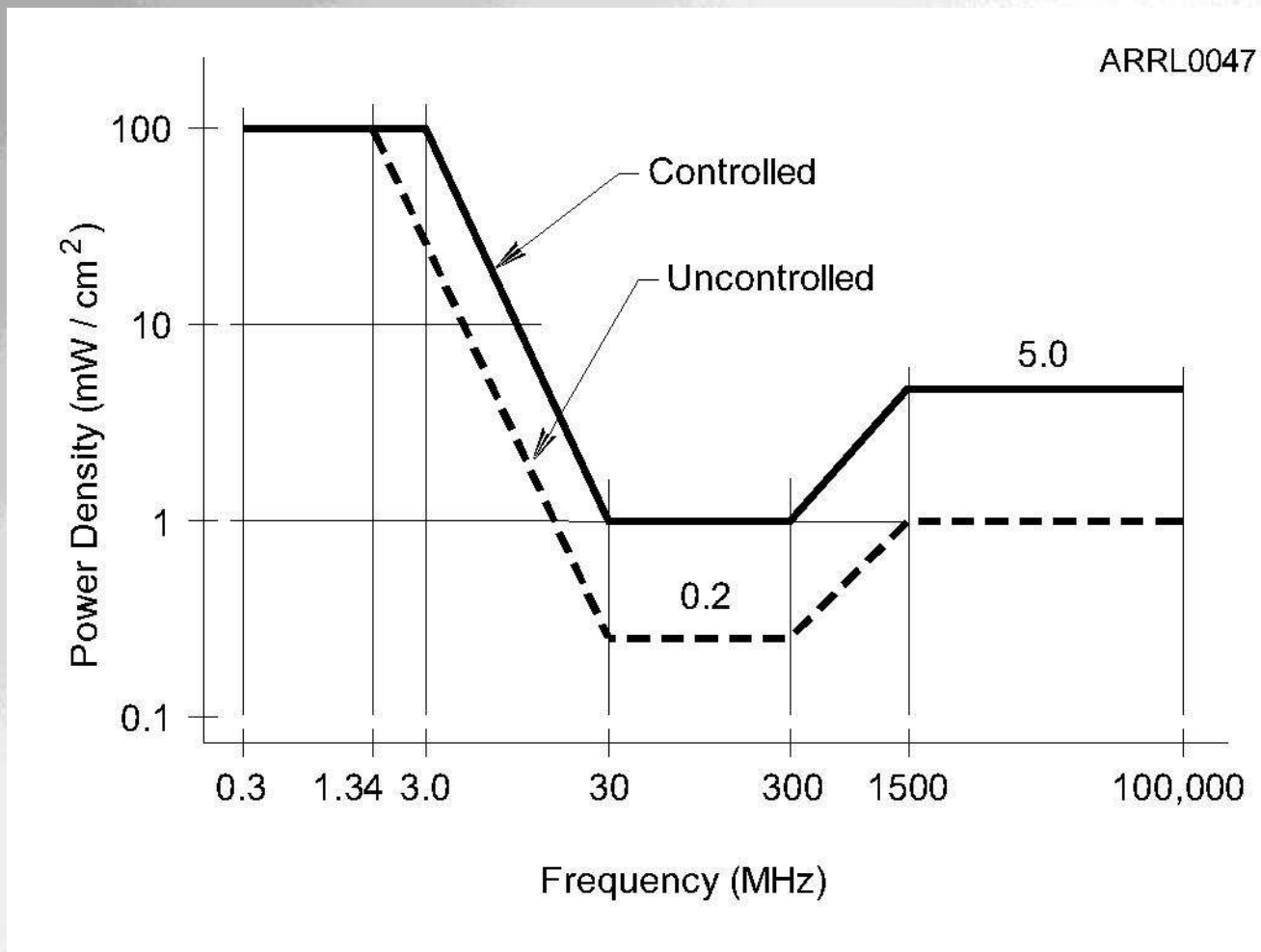
Antenna Proximity

There are two conditions regarding exposure control.

- Controlled Environment.
 - People are aware of their exposure and can do something to minimize it.
 - More power is allowed because you can make adjustments if needed.
- Uncontrolled Environment.
 - People are not aware of their exposure.
 - Areas open to general public
 - Neighbors
 - Less power is allowed because you have to assume the worse case scenario.



RF Exposure and Frequency



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RF Exposure and Frequency

Body parts absorb RF energy at shorter wavelengths more efficiently and with increased risk. The Specific Absorption Rate (SAR) in Watts per Kilogram is a measure of heating.

- Highest bodily SAR is from 30MHz to 1500MHz.
- Human body is resonant at ~35Mhz to70MHz.
- The FCC MPE varies with frequency.
 - More caution is dictated at frequencies where highest SAR occurs.
 - Who uses those frequencies?
 - US cellphones are limited to 1.6 W/Kg in head tissue at ~800MHz.



Mode vs. Duty Cycle

Duty cycle is the ratio of on-time to off-time of the transmitter expressed as a percentage.

The duty cycle depends on transmit mode.

The higher the duty cycle for a given power level, the greater the exposure risk.

Operating Duty Factor of Modes Common

<i>Mode</i>	<i>Duty Cycle</i>
Conversational SSB	20%
Conversational SSB	40%
SSB AFSK	100%
SSB SSTV	100%
Voice AM, 50% modulation	50%
Voice AM, 100% modulation	25%
Voice AM, no modulation	100%
Voice FM	100%
Digital FM	100%
ATV, video portion, image	60%
ATV, video portion, black screen	80%
Conversational CW	40%
Carrier	100%



RF Exposure Evaluation

All fixed stations must perform an exposure evaluation.
Several methods are available to do this

- FCC Office of Engineering Technology Bulletin 65.
- Antenna Modeling software or measured field strength.
- At lower power levels, no evaluation may be required. Varies with frequency – example: below 50 W at VHF.
- Relocating and fencing antennas is one way to reduce RF exposure.
- Make sure that people cannot come into contact with your antennas – the voltage on an antenna can produce a fatal shock or burn just like any other type of voltage.

