FCC Rules for License Free Wireless

Tech Talk

Summary of Power & Gain Limits

- Maximum power allowed (transmitter output less coax loss): 1 watt
- Maximum antenna gain: 6 dbi
- Antenna gain of more than 6 dBi is allowed if power is reduced by the amount over 6 dBi

Background

Generally, the transmission of radio signals requires a license in the United States. Certain unlicensed operation is permitted if it is in accordance with FCC regulations (Title 47, Code of Federal Regulations). Low power wireless transmitters may be considered "intentional radiators" and allowed to be marketed and used without a license if they are certificated pursuant to an FCC equipment approval process and operated within certain technical limits.

Several bands of low power operation, including the 902-928 Megahertz band, are discussed in FCC regulation 47 CFR 15.247. This section describes the "maximum peak conducted output power" as the power delivered to the antenna. The maximum allowed is 1 watt for license free operation.

Also, the antenna gain cannot exceed 6 dBi (decibels isotropic). An isotropic antenna is a theoretical antenna which radiates energy equally in all directions. Sometimes an antenna may have a gain compared to a dipole antenna (e.g. 7 dBd). A dipole antenna has 2.14 dB gain relative to an isotropic antenna (i.e. 2.14 dBi). Antenna gain should be specifically stated in terms of the reference antenna dBi or dBd to avoid confusion.

A 6 dB gain is equivalent to a 4 times power increase. The gain may be omni-directional as with a collinear antenna where the radiation is increased in all directions on the horizon. A directional antenna, such as a YAGI, increases the radiation in a particular direction. An antenna with higher gain will increase the transmitted signal strength and produce a higher signal at the receiver in the remote location. This same antenna will also produce an increased noise floor in the receiving mode.

A coaxial cable has losses (negative gain) from radiation and internal absorption. Depending on the design and materials of the particular type of cable, the loss may range from 3 db/100 feet to more than 20 db/100 feet. This loss is considered when choosing an antenna.

The regulations state that if an antenna is used with a gain greater than 6 dBi, the power must be reduced by the amount of antenna gain greater than 6 dBi. Again, power in the context of the FCC regulation means power to the antenna at the end of the transmission line (usually coaxial cable).

Note that 47 CFR 15.204(c) states only antennas of the same type and equal or less gain as originally approved with the intentional radiator by the FCC can be marketed or used. It also requires that an antenna for an intentional radiator be permanently attached or use a unique coupling. Industrial wireless products do not need to be professionally installed since they fall under an exception. Visit www.gpoaccess.gov/cfr/index.html for more specifics.