

A Summary of FCC Rules for Ultra Wideband Communications

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Here is a look at some of the operating requirements and the initial emissions limits established by the FCC for the various proposed UWB systems

Ultra wideband (UWB) products will soon reach the marketplace. This new transmission system offers new capabilities for short-range communications, ground- and object-

penetrating radar, vehicular radar, security systems and measurement applications.

Although UWB theory is important for any engineer designing products that use, or will work with, UWB, we felt that another tutorial topic was equally important—the FCC rules and regulations governing UWB. These rules set the limits on the emissions from UWB systems and establish some operational rules to help avoid interference.

In the FCC's First Report and Order authorizing UWB, the Commission stated, "The standards adopted today represent a cautious first step with UWB technology," and, "Since there is no production UWB equipment available and there is little operational experience with the impact of UWB on other radio services, the Commission chose in this First Report and Order to err on the side of conservatism in setting emission limits when there were unresolved interference issues."

Definitions

Part 15.503 of the FCC rules provides the following definitions for UWB operation (application system definitions are omitted):

(a) *UWB bandwidth*. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system

including the antenna. The upper boundary is designated f_H and the lower boundary is designated f_L . The frequency at which the highest radiated emission occurs is designated f_M .

(b) *Center frequency*. The center frequency, f_C , equals $(f_H + f_L)/2$.

(c) *Fractional bandwidth*. The fractional bandwidth equals $2(f_H - f_L)/(f_H + f_L)$.

(d) *Ultra-wideband (UWB) transmitter*. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth.

(k) *EIRP*. Equivalent isotropically radiated power, i.e., the product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna. The EIRP, in terms of dBm, can be converted to a field strength, in dB μ V/m at 3 meters, by adding 95.2. With regard to this part of the rules, EIRP refers to the highest signal strength measured in any direction and at any frequency from the UWB device, as tested in accordance with the procedures specified in Part 15.31(a) and 15.523 of the rules.

Specific Rules by Application

In this first set of UWB rules, the FCC determined that each proposed application area had unique attributes that required different levels of regulation. We will look at these specific groups, but first, here are the key regulations for all UWB systems:

- No toys, and no operation on an aircraft, ship or satellite.
- Emissions from supporting digital circuitry is considered separately from the UWB por-

UWB REGULATIONS

Frequency Range (MHz)	960-1610	1610-1990	1990-3100	3100-10600	Above 10600	1164-1240 1559-1610
Ground penetrating radar, wall imaging Through D-wall imaging systems:	-65.3	-53.3	-51.3	-41.3	-51.3	-75.3
UWB bandwidth below 960 MHz	-65.3	-53.3	-51.3	-51.3	-51.3	-75.3
UWB bandwidth 1990–10600 MHz	-46.3	-41.3	-41.3	-41.3	-51.3	-56.3
Surveillance systems	-53.3	-51.3	-41.3	-41.3	-51.3	-63.3
Medical imaging systems	-65.3	-53.3	-51.3	-41.3	-51.3	-75.3/-53.3
Indoor UWB systems	-75.3	-53.3	-51.3	-41.3	-51.3	-85.3
Hand held UWB systems	-75.3	-63.3	-61.3	-41.3	-61.3	-85.3
Frequency Range (MHz)		1610-22000	22000-29000	29000-31000	Above 31000	
Vehicular radar systems	-75.3	-61.3	-41.3	-51.3	-61.3	-85.3
Emissions at 1164-1240 and 1559-1610 MHz to be measured using a resolution bandwidth no less than 1 kHz. All other frequencies to be measured using a resolution bandwidth of 1 MHz.						

Table 1 · Emissions limits (EIRP in dBm) for the various types of UWB systems. Below 960 MHz, all systems must comply with existing emission limits that apply to all unintentional radiators (Part 15.209).

tion, and is subject to existing regulations, not new UWB rules.

- The frequency of the highest radiated emission occurs, f_M , must be within the UWB bandwidth.
- Other emissions standards apply as cross-referenced in the UWB rules, such as conducted emissions into AC power lines.
- Emissions below 960 MHz are limited to the levels required in Part 15.209 for unintentional radiators.
- Within a 50 MHz bandwidth centered on f_M , peak emissions are limited to 0 dBm EIRP.
- UWB radar, imaging and medical system operation must be coordinated. Dates and areas of operation must be reported, except in the case of emergency. These systems also must have a manual switch (local or remote) to turn the equipment off within 10 seconds of actuation.

The rules regarding measurement methods, such as determining the frequency range, measurement bandwidth, type of detector, etc., are not included here. Discussion continues on UWB measurement methodology and these first rules are likely to change.

Table 1 lists the emissions limits

for the various types of UWB systems. Other notes on these systems are included below.

Ground-Penetrating and Wall-Penetrating Radars—These systems must operate with a UWB bandwidth below 10,600 MHz. Usage must be licensed and is limited to public safety, scientific research, commercial mining or construction.

Through D-Wall Imaging Systems—The use of through-wall imaging systems is limited to state or local public safety organizations, and must be licensed. There are two types of systems identified: those with UWB bandwidth below 960 MHz, and those with f_C and f_M contained within 1,990 to 10,600 MHz.

Surveillance Systems—The UWB bandwidth of these systems must be between 1,990 and 10,600 MHz. Operation must be licensed and is limited to public safety, manufacturers, petroleum and power licensees.

Medical Imaging Systems—UWB medical imaging systems must have a bandwidth contained between 3,100 and 10,600 MHz. They may only be operated by, or under supervision of, a licensed health care practitioner.

Vehicular Radar Systems—These

systems must only operate when the engine is running, and must have a specific activation such as engine starting, turn signal activation, etc. UWB bandwidth to be within 22 and 29 GHz and f_C must be higher than 24.075 GHz. Above 30 degrees elevation, signals at 23.6–24.0 GHz must be 25 dB lower than the listed limits, increasing to 35 dB at 30 degrees after Jan. 1, 2014.

Indoor UWB Systems—The term “indoor” is specific—these systems may not be used outdoors, their radiation cannot be directed outside of a building, and antennas may not be mounted on the outside of a building. These systems may only transmit to an associated receiver; these are short-range communication systems. Home video distribution and wireless computer interconnections are among the anticipated applications.

Hand Held UWB Devices—This class of devices is intended to be self-contained, including the antenna, requiring no infrastructure. Like indoor systems, these devices must have an associated receiver. Applications are expected to include such devices as video and still cameras with wireless links to a computer or other electronic equipment.