

FCC COMPLIANCE INFORMATION

[Part 15](#) of the FCC's Rules governs the operation of unlicensed devices and is designed to facilitate their use while preventing interference to licensed operations. Accordingly, operation of unlicensed devices is subject to the following conditions:

1. Unlicensed devices may not cause harmful interference, and
2. Unlicensed devices must accept any interference received, including interference that may cause undesired operation.

Sections [15.247](#) and [15.407](#) of the FCC's Rules most directly affect unlicensed systems that rely on Ubiquiti devices. Ubiquiti provides a brief summary, current as of March 2013, of these rules below. However, Ubiquiti recommends that readers carefully study the full text of the up-to-date version of the FCC's regulations. Links are provided to the electronic version of the Code of Federal Regulations, which is generally updated promptly to reflect changes in the rules. In the event of any conflict between the FCC's rules and the summary provided below, the rules control. Additionally, the full text of the rules contains additional information not summarized below.

SECTION 15.247

Operation of unlicensed systems under Section [15.247](#) of the FCC's rules is limited to frequency hopping and digitally modulated systems operating within the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands.

Frequency Hopping System Requirements:

1. Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.
 - Frequency hopping systems in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 KHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
2. Frequency hopping systems shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. System receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.
3. The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

4. Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in Section [15.247](#) should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.
5. General technical requirements for frequency hopping systems operating within the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands are provided in the chart below:

GENERAL TECHNICAL REQUIREMENTS FOR FREQUENCY HOPPING SYSTEMS			
Frequency Band	Hopping Frequencies	Max allowed 20 dB bandwidth of the hopping channel	Max Peak Conducted Output Power*
902-928 MHz	<p>If the 20 dB bandwidth of the hopping channel is less than 250 kHz: Use at least 50 hopping frequencies, avg. time of occupancy on any frequency shall not be greater than 0.4s within a 20s period</p> <p>If the 20 dB bandwidth of the hopping channel is 250 kHz or greater: Use at least 25 hopping frequencies, avg. time of occupancy on any frequency shall not be greater than 0.4s within a 10s period</p>	500 kHz	<p>For systems employing at least 50 hopping channels: 1 Watt</p> <p>For systems employing less than 50 hopping channels but at least 25 hopping channels: 0.25 Watts</p>
2400-2483.5 MHz	Use at least 15 channels, avg. time of occupancy on any channel shall not be greater than 0.4s within a period of 0.4s multiplied by the number of hopping channels employed	May avoid or suppress transmissions on a particular hopping frequency provided that a min. of 15 channels are used	<p>For systems employing at least 75 non-overlapping hopping channels: 1 Watt</p> <p>For all other systems: 0.125 Watts</p>
5725-5850 MHz	Use at least 75 hopping frequencies, avg. time of occupancy on any frequency shall not be greater than 0.4s within a 30s period	1 MHz	1 Watt
*Based on the use of antennas with directional gains that do not exceed 6 dBi			

Digital Modulation System Requirements:

1. The minimum 6 dB bandwidth of the signal shall be at least 500 kHz.
2. The maximum peak conducted output power is 1 Watt for transmitters used with antennas with directional gains that do not exceed 6 dBi.
3. The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Requirements for Systems with Transmitting Antennas of Directional Gain Greater than 6 dBi:

1. Except as noted below, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

- Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power and the maximum conducted output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.
 - Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power or conducted output power.
 - Fixed, point-to-point operation, as used above, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.
2. In addition to the above, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers must comply with the following:
- Different information must be transmitted to each receiver.
 - If a transmitter employs an antenna system that emits multiple directional beams but does not emit multiple directional beams simultaneously, the total output power conducted to the array(s) that comprise the device (*i.e.*, the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels) shall not exceed the maximum peak conducted output power limits for frequency hopping or digital modulation systems specified above. Additionally, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi.
 - The directional antenna gain shall be computed as follows: (1) the directional gain shall be calculated as the sum of $10 \log$ (number of array elements or staves) plus the directional gain of the element or stave having the highest gain); (2) a lower value for the directional gain than that calculated in (1) will be accepted if sufficient evidence is presented (*e.g.*, due to shading of the array or coherence loss in the beamforming).
 - If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in the preceding paragraph. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in the preceding paragraph. In addition, the aggregate power transmitted simultaneously

on all beams shall not exceed the limit specified in the preceding paragraph by more than 8 dB.

- Transmitters that emit a single directional beam shall operate under the rules for fixed point-to-point operation summarized above.

Hybrid Systems

Hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements for digital modulation systems.

Out of Band Emissions:

1. In any 100 kHz bandwidth outside the frequency band of operation the power shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.
2. Radiated harmonic and spurious emissions which fall within the restricted bands, as defined in Section [15.205](#) of the FCC's Rules, must comply with the radiated emission limits specified in Section [15.209](#).
3. Systems operating under Section [15.247](#) shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines, set forth in Section [1.1307\(b\)\(1\)](#).

SECTION 15.407

Section [15.407](#) sets forth the general technical requirements for unlicensed National Information Infrastructure ("U-NII") devices operating in the 5.15-5.35 GHz, 5.47-5.725 GHz and 5.725-5.825 GHz bands.

1. The provisions of Section [15.205](#) apply to intentional radiators operating under this section.
2. The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals.
3. The requirements for systems operating with transmitting antennas of directional gain no greater than 6 dBi are summarized in the below chart:

General Technical Requirements for U-NII Devices With Transmitting Antennas of Directional Gain No Greater Than 6 dBi			
Frequency Band	Maximum Conducted Output Power	Peak Power Spectral Density	Undesireable Emission limits*
5.15-5.25 GHz**	Shall not exceed the lesser of 50 mW or 4 dBm + 10 log B***	Shall not exceed 4 dBm in any 1 MHz band	Emissions outside 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz
5.25-5.35 GHz	Shall not exceed the lesser of 250 mW or 11 dBm + 10 log B***	Shall not exceed 11 dBm in any 1 MHz band	Emissions outside the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm/MHz Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band
5.47-5.725 GHz	Shall not exceed the lesser of 250 mW or 11 dBm + 10 log B***	Shall not exceed 11 dBm in any 1 MHz band	Emissions outside the 5.47-5.725 GHz band shall not exceed an EIRP of -27 dBm/MHz
5.725-5.825 GHz	Shall not exceed the lesser of 1 W or 17 dBm + 10 log B***	Shall not exceed 17 dBm in any 1 MHz band	From band edge to 10 Mhz above or below the band edge: emissions within such a frequency range shall not exceed an EIRP of -17 dBm/MHz For frequencies 10 MHz or greater above or below the band edge: emissions shall not exceed an EIRP of -27 dBm/MHz
* Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Section 15.209 of the FCC's rules. Any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in Section. 15.207.			
** Within the 5.15-5.25 GHz band, U-NII devices will be restricted to indoor operations to reduce any potential for harmful interference to co-channel MSS operations.			
*** B is the 26-dB emission bandwidth in MHz			

Requirements for U-NII Devices with Transmitting Antennas of Directional Gain Greater than 6 dBi:

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices may employ transmitting antennas with directional gain up to 23 dBi without any reduction in the transmitter peak output power or peak power spectral density. For fixed, point-to-point U-NII transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in peak transmitter power and peak spectral density for each 1 dB of antenna gain in excess of 23 dBi is required.

Dynamic Frequency Selection (“DFS”):

U-NII devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems in order to reduce the likelihood of interference to radar.

1. The minimum DFS detection threshold for devices with a maximum EIRP of 200 mW to 1 W is -64 dBm. For devices that operate with less than 200 mW EIRP the minimum detection threshold is -62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna.
2. The DFS process shall be required to provide a uniform spreading of the loading over all the available channels.
3. A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in Section 15.407(h)(2) is detected within 60 seconds.
4. After a radar’s presence is detected, all transmissions shall cease on the operating channel within 10 seconds.
5. A channel that has been flagged as containing a radar system is subject to a non-occupancy period of at least 30 minutes.
6. The DFS requirement for channel availability check time applies in the master operational mode and the requirement for channel move time applies in both the master and slave operational modes.

Transmit Power Control (“TPC”):

U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p of less than 500 mW.

Radio Frequency Exposure Requirements:

U-NII devices are subject to the radio frequency radiation exposure requirements specified in Sections [1.1307\(b\)](#), [2.1091](#), and [2.1093](#) of the Commission’s Rules.

FCC WARNING

The modification of wireless broadband and other transceiver devices to operate on unauthorized frequencies or the disabling of DFS or TPC capabilities is a violation of FCC rules and may result in unlawful interference to radio communications services critical to public safety.

The FCC maintains a webpage for Weather Radar Interference Enforcement actions, available here: <http://www.fcc.gov/encyclopedia/weather-radar-interference-enforcement>