

Draft recommended TVWS Rules –3/28/08

§ 15.209 Radiated emission limits, general requirements.

(a) * * *

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under Subpart H and under other sections of this Part, e.g., Sections 15.231, 15.241 and 15.242.

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Subpart H – Unlicensed TV Band Devices

§ 15.701 Scope

This subpart sets out the regulations for unlicensed TV band devices operating in the 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz bands.

§ 15.703 Definitions.

(a) *TV Band Device*. An unlicensed intentional radiator allowed to operate in the 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz bands subsequent to February 17, 2009. A TV band device must be designed in such a manner that it dynamically determines the spectrum in these bands that is vacant of primary users in a given geographic area, and transmits only on that vacant spectrum.

(1) *Class A TV Band Device*. A TV band device that employs geo-location techniques to enable protection of primary users either directly on the device or via another device (a device operating in *Master Mode*). A class A TV band device can operate in master mode or client mode.

(i) *Master Mode*. A Class A TV band device that must know its location and have access to database information regarding spectrum use.

(ii) *Client Mode*. A Class A TV band device that relies on a *Master Mode* Class A TV band device for location and database information.

(2) *Class B TV Band Device*. A TV band device that employs sensing-only techniques and is suitable for use in the home.

(b) *Available Channel*. A radio channel on which a *Channel Availability Check* has not identified the presence of a licensed station signal.

(c) *Channel Availability Check*. A check during which the TV band device identifies whether there is a licensed station operating on that radio channel.

(d) *Channel Move Time*. The time needed by a TV band device to cease all transmissions on the current operating channel upon detection of a licensed station above the *DFS Detection Threshold*.

(e) *Dynamic Frequency Selection (DFS)* is a mechanism that identifies usable channels by dynamically detecting signals from licensed systems and provides protection with these systems.

(f) *DFS Detection Threshold*. The required detection level defined by detecting a received signal strength that is greater than a threshold specified, within the specified bandwidth.

(g) *In-Service Monitoring*. A mechanism to check a channel in use by the TV band device for the presence of a station.

(h) *Operating Channel*. Once a TV band device starts to operate on an *Available Channel* then that channel becomes the *Operating Channel*.

§ 15.705 Cross reference.

(a) The provisions of Subparts A, B, and C of this part apply to unlicensed TV band devices, except where specific provisions are contained in subpart H. Manufacturers should note that this includes the provisions of Sections 15.203 and 15.205.

(b) The requirements of subpart H apply only to the radio transmitter contained in the TV band device. Other aspects of the operation of a TV band device may be subject to requirements contained elsewhere in this chapter. In particular, a TV band device that includes digital circuitry not directly associated with the radio transmitter also is subject to the requirements for unintentional radiators in subpart B.

§ 15.707 General technical requirements.

(a) Power Limits

(1) Class A TV band device may operate with a maximum conducted power of 2 watts and maximum EIRP of 4 watts in any 6 MHz TV channel

(2) Class B TV band device may operate with a maximum conducted power of 10 mW and maximum EIRP of 10 mW in any 6 MHz TV channel.

(3) The maximum power spectral density conducted from the intentional radiator to the antenna shall not be greater than 11 dBm in any 3 kHz band during any

time interval of continuous transmission. The same method of determining the conducted output power shall be used to determine the power spectral density.

(4) The conducted output power limit specified in paragraphs (a)(1) and (a)(2) of this section is based on the use of antennas with directional gains that do not exceed 3 dBi. If transmitting antennas of directional gain greater than 3 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (a)(1) and (a)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 3 dBi.

(i) Systems that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 3 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 3 dBi.

(5) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement conforming to the above definitions for the emission in question.

(6) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

(7) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

(b) Unwanted emissions shall comply with the following:

(1) Class A TV unwanted emissions on frequencies outside the authorized channel of operation must be attenuated no less than following amounts below the average transmitted power within the authorized channel. In the mask specifications, A is the attenuation in dB and f is the frequency difference in MHz from the edge of the channel:

(i) Unwanted emissions must be attenuated no less than 46 dB at the TV channel edges. More than 6 MHz from the TV channel edges, emissions must be attenuated no less than 71 dB. At any frequency between 0 and 6 MHz from the TV channel edges, emissions must be attenuated no less than the value determined by the following formula:

$$A \text{ (dB)} = 46 + (f^2 / 1.44)$$

(ii) The attenuation values are based on a measurement bandwidth of 500 kHz. Other measurement bandwidths may be used and converted to the reference 500 kHz value by the following formula:

$$A(\text{dB}) = A_{\text{alternate}} + 10 \log (BW_{\text{alternate}} / 500)$$

where A(dB) is the measured or calculated attenuation value for the reference 500 kHz bandwidth, and $A_{\text{alternate}}$ is the measured or calculated attenuation for a bandwidth $BW_{\text{alternate}}$. Emissions include sidebands, spurious emissions and radio harmonics. Attenuation is to be measured at the output terminals of the transmitter (including any filters that may be employed).

(2) Class B TV band device unwanted emissions outside the channel of operation must comply with the general field strength limits set forth in Section 15.209.

(3) The provisions of Section 15.205 of this part apply to intentional radiators operating under this section.

(4) Any devices using an AC power line are required to comply with the conducted limits set forth in Section 15.207.

(c) The device shall automatically discontinue transmission in case 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 maintain frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

(d) TV band devices are subject to the radio frequency radiation exposure requirements specified in Sections 1.1307(b), 2.1091 and 2.1093 of this chapter, as appropriate. TV band portable and mobile devices shall be subject to the limits for "general population/uncontrolled" exposure or limits for "occupational/controlled" exposure, as

appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with the applicable requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(e) Manufacturers of TV band devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

(f) Provisions for geolocation / database protection techniques:

(1) All Class A TV band devices operating in master mode must determine its location and access the database before it may initiate a transmission on a vacant channel and when it has to move to a new vacant channel. While in operation the location and database access must be determined as below:

(i) A Class A TV band device operating in master mode that has moved more than 300 m from its prior location must re-access the database prior to continued operation on any vacant channels.

(ii) If a Class A TV band master device loses its capability to determine geolocation information for more than a specified period of time the TV band master device and associated slaves must comply with Class B TV band device requirements or cease operation.

(A) For Class A TV band master mobile and portable devices the time is 15 seconds. Beyond 15 seconds the master device may continue operation only on channels that are known to be vacant within $t \cdot 72$ km of the previous known location, t is time in hours since last known location. The distance is not to exceed the lesser of 72 km or extents beyond the database stored on the master device.

(B) For Class A TV band master fixed devices the time is 24 hours.

(2) A Class A TV band master device must determine the geographic coordinates at its location with an accuracy of 300 meters with a 95% confidence level.

(3) The database will be maintained by either the Commission or a third party designated by the Commission to do so. Database will contain:

(i) Database shall include all licensed services operating in the 70-88 MHz, 174-216 MHz, 470-608 MHz and 614-704 MHz Bands.

(ii) Database shall include all TV band devices operators that choose to register.

(4) If the database information is more than 72 hours old in the Class A TV band device, the device must either stop operation until a update to the database has been downloaded or operate as a Class B device.

(5) A user is permitted to register up to four 6 MHz channels into the database for operation in a limited geographic area:

(i) A registered user is afforded priority access to these registered channels.

(ii) Other Class A master devices attempting to operate in area which contain registered channels can only use registered channels when other channels are found not to be suitable for communications.

(iii) The geographic area is limited to areas and channels that the database is shown to be vacant, furthermore the registered area cannot be larger than a Cellular Market Area.

(g) Provisions for sensing protection techniques:

(1) Dynamic Frequency Selection (DFS). Class B TV band devices shall employ a DFS detection mechanism to detect the presence of licensed stations in the TV bands and to avoid co-channel with the licensed stations. The detection threshold is referenced to a 0 dBi gain antenna and co-polarized operation.

(i) For protection of DTV signals the minimum DFS detection threshold for co-channel TV band devices is XXX dBm.

(ii) For protection of low power NTSC signals the minimum DFS detection threshold for co-channel TV band devices is YYY dBm.

(iii) For protection of wireless microphones the minimum DFS detection threshold is ZZZ dBm in a 200 kHz.

(2) Class B TV band devices shall further limit transmit power level based on sensing of the upper and lower adjacent channel. The EIRP would be the lower of the below formula or 10 dBm.

$$\text{Tx power} = (\text{Minimum of sensed power in upper or lower adjacent channel}) \\ - (-10 \text{ dB D/U}) - (\text{free space loss on operating channel for 10 m})$$

(3) Channel Availability Check Time. Class B TV band device shall check if there is a licensed station already operating on the channel before it may initiate a transmission on a channel and when it has to move to a new channel. The TV band device may start using the channel if no licensed station with a power level

greater than the detection threshold value listed above is detected within 30 seconds.

(4) In-Service Monitoring. Class B TV band device shall perform in-service monitoring at intervals no greater than 10 seconds. In service monitoring shall apply to both co-channel DFS checks described in Section 15.707(g)(1), and to Class B operating power level limits described in Section 15.707(g)(2).

(5) Channel Move Time. After a licensed station presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 2 seconds after detection of the licensed station signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(h) Any base, fixed, or mobile station operating as a master device must employ a channel access protocol to enable co-existence with other unlicensed devices. This channel access protocol is one in which the device will select operational channels from the list of vacant channels based on sensed power level and/or duty cycle.

(i) All TV band devices, regardless of power must be designed with provisions to detect a disabling beacon conforming to the IEEE 802.22.1 standard. Upon detection of the beacon signal, the TV band device must cease operation with 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 2 seconds after detection of the disabling beacon. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(j) Transmit power control (TPC). All TV band devices shall employ a TPC mechanism. The TV band device is required to have the capability to operate at least 6 dB below the maximum conducted output power limit specified in paragraph (a) of this section.

(k) A Class A TV band device must protect TV stations from harmful interference within the following service contours.

Type of station	Protected contour		
	Channel	Contour (dBu)	TV contour propagation curve
Analog TV	Low VHF (2-6)	47	F(50,50)
	High VHF (7-13)	56	F(50,50)
	UHF (14-69)	64	F(50,50)
Analog Class A, LPTV, translator and booster	Low VHF (2-6)	62	F(50,50)
	High VHF (7-13)	68	F(50,50)
	UHF (14-69)	74	F(50,50)
Digital TV	Low VHF (2-6)	28	F(50,90)
	High VHF (7-13)	36	F(50,90)
	UHF (14-51)	41	F(50,90)
Digital Class A	Low VHF (2-6)	43	F(50,90)
	High VHF (7-13)	48	F(50,90)
	UHF (14-51)	51	F(50,90)

A TV channel will be considered vacant and available for use by an intentional radiator operating under the provisions of this section if the following desired-to-undesired (D/U) signal ratios between co-channel and adjacent channel TV stations and the intentional radiator are met at all points within the service area of the unlicensed transmitter. In determining if a channel is vacant the TV Band devices should take into account their emissions which fall co-channel to the affected TV receiver, in addition to their emissions which fall on an adjacent channel to the affected TV receiver. The propagation method can be either the specified curves listed in the tables or any other model, such as a two-ray model, that is more conservative than those listed in the table below.

Type of station	Protection ratios		
	Channel separation	D/U ratio (dB)	TV Band Device Propagation curve
Analog TV, Class A, LPTV, translator and booster	Co-channel	34	F(50,10)
	Upper adjacent	-17	F(50,50)
	Lower adjacent	-14	F(50,50)
Digital TV and Class A	Co-channel	23	F(50,10)
	Upper adjacent	-26	F(50,50)
	Lower adjacent	-28	F(50,50)

(l) Operation is not permitted within the service contours of co-channel stations. Operation within the service contours of an adjacent TV station is permitted, the adjacent channel is considered vacant and available for use by an intentional radiator operating under the provisions of this section if the D/U values above are not exceeded. To determine if the D/U values are not exceeded:

(i) The desired signal levels shall be the higher of the protected contour value in the table above or computed based on FCC F(90,90) curves.

(ii) The calculation of undesired signal levels shall be based on FCC F(50,50) curves or any other model, such as two-ray models, that is more conservative than FCC F(50,50) curves.

(m) Operation on channels shared with the PLMRS or CMRS is permitted only if every point in the reception area of an unlicensed transmitter is separated by the following distances from the center coordinates of the metropolitan areas: 134 kilometers for co-channel operation and 131 kilometers for adjacent channel operation.

(n) Operation of TV band device under the provisions of this section is permitted on VHF channels within 32 kilometers of the border with Mexico, on UHF channels within 40 kilometers of the border with Mexico, or on either VHF or UHF channels within 60 kilometers of the border with Canada. Such operations must take into account the licensed operations in those countries.

§ 15.709. Operational Restrictions

(a) A TV band device may be deployed for Fixed, Mobile or Portable applications.

(b) A TV band device must be designed in such a manner that it dynamically determines the spectrum within the band of potential operation that is vacant in a given geographic area, and transmits only on that vacant spectrum. A TV band device is permitted to operate as either a Class A or Class B device, when operating in any class the device must comply with the rules associated with that class.

(i) Class A TV band master mode devices must incorporate geo-location and database techniques in accordance with Section 15.707(f).

(ii) Class A TV band device (client) may rely on another Class A TV band device (master) connected by wire or wireless means to provide access to the database and provide geolocation information. In such cases, the client and master devices shall be certified as a combined system and the client device must not be operate at Class A power levels without association to a master device.

(iii) Class B TV band devices must not operate in 470-512 MHz and must comply with sensing techniques in accordance with Section 15.707(g).

(iv) A device that is capable of operating in compliance with Class A requirements and Class B requirements is permissible. When operating as a Class A device it must comply with the technical requirements for Class A devices, when operating as a Class B device it must comply with the technical requirements for Class B devices.

(c) TV band devices may operate with an occupied bandwidth not to exceed 18 MHz.

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§ 74.832 Licensing requirements and procedures

(h)(i) Operations of low power auxiliary stations outside the area of operation specified in the authorization and in the 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz bands must register that area of operation in the database prescribed in Section 15.707(f)(3) or use a beacon as prescribed in Section 15.707(i) to receive protection from TV band devices.

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§ 74.870 Wireless video assist devices

(g)(4) This notification information must be registered in the database prescribed in Section 15.707(f)(3) for devices in the 180-210 MHz, 470-608 MHz and 614-698 MHz bands.

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§ 74.882 Measures for protection from TV Band Devices

(a) Licensees are permitted to operate a beacon compliant with Section 15.707(i) to receive protection from TV band devices in the 76-88 MHz, 174-216 MHz, 470-608 MHz and 614-698 MHz bands, licensees must register such operation with the FCC and or designate 3rd party provider prior to beginning operation.