

provide any other products or services that could compromise confidentiality, objectivity or impartiality of the testing laboratory's testing process and decisions.

(iii) Subsequent to the successful testing of its initial M-UDCP, a manufacturer or importer is not required to have other M-UDCP models tested at a qualified test facility for compliance with M-UDCP-PICS-I04-080225, "Uni-Directional Cable Product Supporting M-Card: Multiple Profiles; Conformance Checklist: PICS," February 25, 2008 (incorporated by reference, see §15.38) unless the first model tested was not a television, in which event the first television shall be tested as provided in paragraph (c)(5)(i) of this section. The manufacturer or importer shall ensure that all subsequent models of M-UDCPs comply with M-UDCP-PICS-I04-080225, "Uni-Directional Cable Product Supporting M-Card: Multiple Profiles; Conformance Checklist: PICS," February 25, 2008 (incorporated by reference, see §15.38) and all other applicable rules and standards. The manufacturer or importer shall maintain records indicating such compliance in accordance with Supplier's Declaration of Conformity requirements in part 2, subpart J of this chapter. For each M-UDCP model, the manufacturer or importer shall further submit documentation demonstrating compliance with M-UDCP-PICS-I04-080225, "Uni-Directional Cable Product Supporting M-Card: Multiple Profiles; Conformance Checklist: PICS," February 25, 2008 (incorporated by reference, see §15.38) to the qualified test facility.

(iv) M-UDCPs must be in compliance with M-UDCP-PICS-I04-080225, "Uni-Directional Cable Product Supporting M-Card: Multiple Profiles; Conformance Checklist: PICS," February 25, 2008 (incorporated by reference, see §15.38) in accordance with the procedures set forth in TP-ATP-M-UDCP-I05-20080304, "Uni-Directional Digital Cable Products Supporting M-Card; M-UDCP Device Acceptance Test Plan," March 4, 2008 (incorporated by reference, see §15.38) or an equivalent test procedure that produces identical pass/fail test results. In the event of any dispute over the applicable results

under an equivalent test procedure, the results under TP-ATP-M-UDCP-I05-20080304, "Uni-Directional Digital Cable Products Supporting M-Card; M-UDCP Device Acceptance Test Plan," March 4, 2008 (incorporated by reference, see §15.38) shall govern.

(d) Manufacturers and importers shall provide in appropriate post-sale material that describes the features and functionality of the product, such as the owner's guide, the following language: "This digital television is capable of receiving analog basic, digital basic and digital premium cable television programming by direct connection to a cable system providing such programming. A security card provided by your cable operator is required to view encrypted digital programming. Certain advanced and interactive digital cable services such as video-on-demand, a cable operator's enhanced program guide and data-enhanced television services may require the use of a set-top box. For more information call your local cable operator."

[68 FR 66733, Nov. 28, 2003, as amended at 76 FR 40277, July 8, 2011; 77 FR 4914, Feb. 1, 2012; 82 FR 50833, Nov. 2, 2017]

### Subpart C—Intentional Radiators

#### §15.201 Equipment authorization requirement.

(a) Intentional radiators operated as carrier current systems, devices operated under the provisions of §§15.211, 15.213, and 15.221, and devices operating below 490 kHz in which all emissions are at least 40 dB below the limits in §15.209 are subject to Suppliers Declaration of Conformity pursuant to the procedures in subpart J of part 2 of this chapter prior to marketing.

(b) Except as otherwise exempted in paragraph (c) of this section and in §15.23, all intentional radiators operating under the provisions of this part shall be certified by the Telecommunication Certification Bodies pursuant to the procedures in subpart J of part 2 of this chapter prior to marketing.

(c) For devices such as perimeter protection systems which, in accordance with §15.31(d), are required to be measured at the installation site, each application for certification must be accompanied by a statement indicating

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that the system has been tested at three installations and found to comply at each installation. Until such time as certification is granted, a given installation of a system that was measured for the submission for certification will be considered to be in compliance with the provisions of this chapter, including the marketing regulations in subpart I of part 2 of this chapter, if tests at that installation show the system to be in compliance with the relevant technical requirements. Similarly, where measurements must be performed on site for equipment subject to Supplier's Declaration of Conformity, a given installation that has been found compliant with the applicable standards will be considered to be in compliance with the provisions of this chapter, including the marketing regulations in subpart I of part 2 of this chapter.

(d) For perimeter protection systems operating in the frequency bands allocated to television broadcast stations operating under part 73 of this chapter, the holder of the grant of certification must test each installation prior to initiation of normal operation to verify compliance with the technical standards and must maintain a list of all installations and records of measurements. For perimeter protection systems operating outside of the frequency bands allocated to television broadcast stations, upon receipt of a grant of certification, further testing of the same or similar type of system or installation is not required.

[54 FR 17714, Apr. 25, 1989, as amended at 68 FR 68546, Dec. 9, 2003; 82 FR 50834, Nov. 2, 2017]

### § 15.202 Certified operating frequency range.

Client devices that operate in a master/client network may be certified if they have the capability of operating outside permissible part 15 frequency bands, provided they operate on only permissible part 15 frequencies under the control of the master device with which they communicate. Master devices marketed within the United States must be limited to operation on permissible part 15 frequencies. Client devices that can also act as master devices must meet the requirements of a

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master device. For the purposes of this section, a master device is defined as a device operating in a mode in which it has the capability to transmit without receiving an enabling signal. In this mode it is able to select a channel and initiate a network by sending enabling signals to other devices. A network always has at least one device operating in master mode. A client device is defined as a device operating in a mode in which the transmissions of the device are under control of the master. A device in client mode is not able to initiate a network.

[70 FR 23040, May 4, 2005]

### § 15.203 Antenna requirement.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

[82 FR 41559, Sept. 1, 2017]

### § 15.204 External radio frequency power amplifiers and antenna modifications.

(a) Except as otherwise described in paragraphs (b) and (d) of this section, no person shall use, manufacture, sell

or lease, offer for sale or lease (including advertising for sale or lease), or import, ship, or distribute for the purpose of selling or leasing, any external radio frequency power amplifier or amplifier kit intended for use with a part 15 intentional radiator.

(b) A transmission system consisting of an intentional radiator, an external radio frequency power amplifier, and an antenna, may be authorized, marketed and used under this part. Except as described otherwise in this section, when a transmission system is authorized as a system, it must always be marketed as a complete system and must always be used in the configuration in which it was authorized.

(c) An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator. An intentional radiator may be authorized with multiple antenna types. Exceptions to the following provisions, if any, are noted in the rule section under which the transmitter operates, e.g., § 15.255(b)(1)(ii) of this part.

(1) The antenna type, as used in this paragraph, refers to antennas that have similar in-band and out-of-band radiation patterns.

(2) Compliance testing shall be performed using the highest gain antenna for each type of antenna to be certified with the intentional radiator. During this testing, the intentional radiator shall be operated at its maximum available output power level.

(3) Manufacturers shall supply a list of acceptable antenna types with the application for equipment authorization of the intentional radiator.

(4) Any antenna that is of the same type and of equal or less directional gain as an antenna that is authorized with the intentional radiator may be marketed with, and used with, that intentional radiator. No retesting of this system configuration is required. The

marketing or use of a system configuration that employs an antenna of a different type, or that operates at a higher gain, than the antenna authorized with the intentional radiator is not permitted unless the procedures specified in § 2.1043 of this chapter are followed.

(d) Except as described in this paragraph, an external radio frequency power amplifier or amplifier kit shall be marketed only with the system configuration with which it was approved and not as a separate product.

(1) An external radio frequency power amplifier may be marketed for individual sale provided it is intended for use in conjunction with a transmitter that operates in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands pursuant to § 15.247 of this part or a transmitter that operates in the 5.725–5.825 GHz band pursuant to § 15.407 of this part. The amplifier must be of a design such that it can only be connected as part of a system in which it has been previously authorized. (The use of a non-standard connector or a form of electronic system identification is acceptable.) The output power of such an amplifier must not exceed the maximum permitted output power of its associated transmitter.

(2) The outside packaging and user manual for external radio frequency power amplifiers sold in accordance with paragraph (d)(1) of this section must include notification that the amplifier can be used only in a system which it has obtained authorization. Such a notice must identify the authorized system by FCC Identifier.

[69 FR 54034, Sept. 7, 2004, as amended at 78 FR 59850, Sept. 30, 2013]

#### § 15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110 .....	16.42–16.423	399.9–410	4.5–5.15
1.0495–0.505 .....	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905 .....	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128 .....	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775 .....	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775 .....	73–74.6	1645.5–1646.5	9.3–9.5

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MHz	MHz	MHz	GHz
6.215–6.218 .....	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825 .....	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225 .....	123–138	2200–2300	14.47–14.5
8.291–8.294 .....	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366 .....	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675 .....	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475 .....	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293 .....	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025 .....	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725 .....	322–335.4	3600–4400	( <sup>2</sup> )
13.36–13.41 .....			

<sup>1</sup> Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.

<sup>2</sup> Above 38.6

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this section:

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to § 15.213.

(4) Any equipment operated under the provisions of §§ 15.255 and 15.256 in the frequency band 75–85 GHz, § 15.257 in the 92–95 GHz band or § 15.258.

(5) Biomedical telemetry devices operating under the provisions of § 15.242 of this part are not subject to the restricted band 608–614 MHz but are subject to compliance within the other restricted bands.

(6) Transmitters operating under the provisions of subparts D or F of this part.

(7) Devices operated pursuant to § 15.225 are exempt from complying with this section for the 13.36–13.41 MHz band only.

(8) Devices operated in the 24.075–24.175 GHz band under § 15.245 are exempt from complying with the requirements of this section for the 48.15–48.35 GHz and 72.225–72.525 GHz bands only, and shall not exceed the limits specified in § 15.245(b).

(9) Devices operated in the 24.0–24.25 GHz band under § 15.249 are exempt from complying with the requirements of this section for the 48.0–48.5 GHz and 72.0–72.75 GHz bands only, and shall not exceed the limits specified in § 15.249(a).

(10) White space devices operating under subpart H of this part are exempt from complying with the requirements of this section for the 608–614 MHz band.

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of § 15.245

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shall not exceed the limits specified in § 15.245(b).

[54 FR 17714, Apr. 25, 1989, as amended at 55 FR 46791, Nov. 7, 1990; 56 FR 6288, Feb. 15, 1991; 57 FR 13048, Apr. 15, 1992; 58 FR 33774, June 21, 1993; 60 FR 28068, May 30, 1995; 61 FR 14503, Apr. 2, 1996; 62 FR 4655, Jan. 31, 1997; 62 FR 58658, Oct. 30, 1997; 67 FR 34855, May 16, 2002; 68 FR 68546, Dec. 9, 2003; 69 FR 3265, Jan. 23, 2004; 69 FR 72031, Dec. 10, 2004; 79 FR 12678, Mar. 6, 2014; 80 FR 73069, Nov. 23, 2015; 84 FR 25691, June 4, 2019]

### § 15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dB $\mu$ V)	
	Quasi-peak	Average
0.15–0.5 .....	66 to 56*	56 to 46*
0.5–5 .....	56 .....	46 .....
5–30 .....	60 .....	50 .....

\*Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000  $\mu$ V within the frequency band 535–1705 kHz, as measured using a 50  $\mu$ H/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the ra-

diated emission limits in § 15.205, § 15.209, § 15.221, § 15.223, or § 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

[54 FR 17714, Apr. 25, 1989, as amended at 56 FR 373, Jan. 4, 1991; 57 FR 33448, July 29, 1992; 58 FR 51249, Oct. 1, 1993; 67 FR 45671, July 10, 2002]

### § 15.209 Radiated emission limits; general requirements.

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490 .....	2400/F(kHz)	300
0.490–1.705 .....	24000/F(kHz)	30
1.705–30.0 .....	30	30
30–88 .....	100**	3
88–216 .....	150**	3
216–960 .....	200**	3
Above 960 .....	500	3

\*\* 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 other sections of this part, e.g., §§ 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this

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table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

(f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device.

(g) Perimeter protection systems may operate in the 54–72 MHz and 76–88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to indus-

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trial, business and commercial applications.

[54 FR 17714, Apr. 25, 1989; 54 FR 32339, Aug. 7, 1989; 55 FR 18340, May 2, 1990; 62 FR 58658, Oct. 30, 1997]

### § 15.211 Tunnel radio systems.

An intentional radiator utilized as part of a tunnel radio system may operate on any frequency provided it meets all of the following conditions:

(a) Operation of a tunnel radio system (intentional radiator and all connecting wires) shall be contained solely within a tunnel, mine or other structure that provides attenuation to the radiated signal due to the presence of naturally surrounding earth and/or water.

(b) Any intentional or unintentional radiator external to the tunnel, mine or other structure, as described in paragraph (a) of this section, shall be subject to the other applicable regulations contained within this part.

(c) The total electromagnetic field from a tunnel radio system on any frequency or frequencies appearing outside of the tunnel, mine or other structure described in paragraph (a) of this section, shall not exceed the limits shown in §15.209 when measured at the specified distance from the surrounding structure, including openings. Particular attention shall be paid to the emissions from any opening in the structure to the outside environment. When measurements are made from the openings, the distances shown in §15.209 refer to the distance from the plane of reference which fits the entire perimeter of each above ground opening.

(d) The conducted limits in §15.207 apply to the radiofrequency voltage on the public utility power lines outside of the tunnel.

### § 15.212 Modular transmitters.

(a) Single modular transmitters consist of a completely self-contained radiofrequency transmitter device that is typically incorporated into another product, host or device. Split modular transmitters consist of two components: a radio front end with antenna (or radio devices) and a transmitter control element (or specific hardware on which the software that controls the

radio operation resides). All single or split modular transmitters are approved with an antenna. All of the following requirements apply, except as provided in paragraph (b) of this section.

(1) Single modular transmitters must meet the following requirements to obtain a modular transmitter approval.

(i) The radio elements of the modular transmitter must have their own shielding. The physical crystal and tuning capacitors may be located external to the shielded radio elements.

(ii) The modular transmitter must have buffered modulation/data inputs (if such inputs are provided) to ensure that the module will comply with part 15 requirements under conditions of excessive data rates or over-modulation.

(iii) The modular transmitter must have its own power supply regulation.

(iv) The modular transmitter must comply with the antenna and transmission system requirements of §§15.203, 15.204(b) and 15.204(c). The antenna must either be permanently attached or employ a “unique” antenna coupler (at all connections between the module and the antenna, including the cable). The “professional installation” provision of §15.203 is not applicable to modules but can apply to limited modular approvals under paragraph (b) of this section.

(v) The modular transmitter must be tested in a stand-alone configuration, *i.e.*, the module must not be inside another device during testing for compliance with part 15 requirements. Unless the transmitter module will be battery powered, it must comply with the AC line conducted requirements found in §15.207. AC or DC power lines and data input/output lines connected to the module must not contain ferrites, unless they will be marketed with the module (see §15.27(a)). The length of these lines shall be the length typical of actual use or, if that length is unknown, at least 10 centimeters to insure that there is no coupling between the case of the module and supporting equipment. Any accessories, peripherals, or support equipment connected to the module during testing shall be unmodified and commercially available (see §15.31(i)).

(vi) The modular transmitter must be equipped with either a permanently affixed label or must be capable of electronically displaying its FCC identification number.

(A) If using a permanently affixed label, the modular transmitter must be labeled with its own FCC identification number, and, if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: “Contains Transmitter Module FCC ID: XYZMODEL1” or “Contains FCC ID: XYZMODEL1.” Any similar wording that expresses the same meaning may be used. The Grantee may either provide such a label, an example of which must be included in the application for equipment authorization, or, must provide adequate instructions along with the module which explain this requirement. In the latter case, a copy of these instructions must be included in the application for equipment authorization.

(B) If the modular transmitter uses an electronic display of the FCC identification number, the information must be readily accessible and visible on the modular transmitter or on the device in which it is installed. If the module is installed inside another device, then the outside of the device into which the module is installed must display a label referring to the enclosed module. This exterior label can use wording such as the following: “Contains FCC certified transmitter module(s).” Any similar wording that expresses the same meaning may be used. The user manual must include instructions on how to access the electronic display. A copy of these instructions must be included in the application for equipment authorization.

(vii) The modular transmitter must comply with any specific rules or operating requirements that ordinarily apply to a complete transmitter and the manufacturer must provide adequate instructions along with the module to explain any such requirements. A copy of these instructions must be included in the application for equipment authorization.

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(viii) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of modular transmitters under this section must contain a statement confirming compliance with these requirements. The modular transmitter must comply with any applicable RF exposure requirements in its final configuration. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(2) Split modular transmitters must meet the requirements in paragraph (a)(1) of this section, excluding paragraphs (a)(1)(i) and (a)(1)(v), and the following additional requirements to obtain a modular transmitter approval.

(i) Only the radio front end must be shielded. The physical crystal and tuning capacitors may be located external to the shielded radio elements. The interface between the split sections of the modular system must be digital with a minimum signaling amplitude of 150 mV peak-to-peak.

(ii) Control information and other data may be exchanged between the transmitter control elements and radio front end.

(iii) The sections of a split modular transmitter must be tested installed in a host device(s) similar to that which is representative of the platform(s) intended for use.

(iv) Manufacturers must ensure that only transmitter control elements and radio front end components that have been approved together are capable of operating together. The transmitter module must not operate unless it has verified that the installed transmitter control elements and radio front end have been authorized together. Manufacturers may use means including, but not limited to, coding in hardware and electronic signatures in software to meet these requirements, and must describe the methods in their application for equipment authorization.

(b) A limited modular approval may be granted for single or split modular transmitters that do not comply with all of the above requirements, e.g.,

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shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation, if the manufacturer can demonstrate by alternative means in the application for equipment authorization that the modular transmitter meets all the applicable part 15 requirements under the operating conditions in which the transmitter will be used. Limited modular approval also may be granted in those instances where compliance with RF exposure rules is demonstrated only for particular product configurations. The applicant for certification must state how control of the end product into which the module will be installed will be maintained such that full compliance of the end product is always ensured.

[72 FR 28893, May 23, 2007, as amended at 85 FR 18149, Apr. 1, 2020]

### § 15.213 Cable locating equipment.

An intentional radiator used as cable locating equipment, as defined in §15.3(d), may be operated on any frequency within the band 9–490 kHz, subject to the following limits: Within the frequency band 9 kHz, up to, but not including, 45 kHz, the peak output power from the cable locating equipment shall not exceed 10 watts; and, within the frequency band 45 kHz to 490 kHz, the peak output power from the cable locating equipment shall not exceed one watt. If provisions are made for connection of the cable locating equipment to the AC power lines, the conducted limits in §15.207 also apply to this equipment.

### § 15.214 Cordless telephones.

(a) For equipment authorization, a single application form, FCC Form 731, may be filed for a cordless telephone system, provided the application clearly identifies and provides data for all parts of the system to show compliance with the applicable technical requirements. When a single application form is submitted, both the base station and the portable handset must carry the same FCC identifier. The application shall include a fee for certification of each type of transmitter and for certification, if appropriate, for each type of receiver included in the system.



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(b) A cordless telephone that is intended to be connected to the public switched telephone network shall also comply with the applicable regulations in part 68 of this chapter. A separate procedure for approval under part 68 is required for such terminal equipment.

(c) The label required under subpart A of this part shall also contain the following statement: "Privacy of communications may not be ensured when using this phone."

(d) Cordless telephones shall incorporate circuitry which makes use of a digital security code to provide protection against unintentional access to the public switched telephone network by the base unit and unintentional ringing by the handset. These functions shall operate such that each access of the telephone network or ringing of the handset is preceded by the transmission of a code word. Access to the telephone network shall occur only if the code transmitted by the handset matches code set in the base unit. Similarly, ringing of the handset shall occur only if the code transmitted by the base unit matches the code set in the handset. The security code required by this section may also be employed to perform other communications functions, such as providing telephone billing information. This security code system is to operate in accordance with the following provisions.

(1) There must be provision for at least 256 possible discrete digital codes. Factory-set codes must be continuously varied over at least 256 possible codes as each telephone is manufactured. The codes may be varied either randomly, sequentially, or using another systematic procedure.

(2) Manufacturers must use one of the following approaches for facilitating variation in the geographic distribution of individual security codes:

(i) Provide a means for the user to readily select from among at least 256 possible discrete digital codes. The cordless telephone shall be either in a non-operable mode after manufacture until the user selects a security code or the manufacturer must continuously vary the initial security code as each telephone is produced.

(ii) Provide a fixed code that is continuously varied among at least 256 dis-

crete digital codes as each telephone is manufactured.

(iii) Provide a means for the cordless telephone to automatically select a different code from among at least 256 possible discrete digital codes each time it is activated.

(iv) It is permissible to provide combinations of fixed, automatic, and user-selectable coding provided the above criteria are met.

(3) A statement of the means and procedures used to achieve the required protection shall be provided in any application for equipment authorization of a cordless telephone.

[56 FR 3785, Jan. 31, 1991, as amended at 63 FR 36603, July 7, 1998; 66 FR 7580, Jan. 24, 2001]

### RADIATED EMISSION LIMITS, ADDITIONAL PROVISIONS

#### **§ 15.215 Additional provisions to the general radiated emission limitations.**

(a) The regulations in §§15.217 through 15.257 provide alternatives to the general radiated emission limits for intentional radiators operating in specified frequency bands. Unless otherwise stated, there are no restrictions as to the types of operation permitted under these sections.

(b) In most cases, unwanted emissions outside of the frequency bands shown in these alternative provisions must be attenuated to the emission limits shown in §15.209. In no case shall the level of the unwanted emissions from an intentional radiator operating under these additional provisions exceed the field strength of the fundamental emission.

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth

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may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

[54 FR 17714, Apr. 25, 1989, as amended at 62 FR 45333, Aug. 27, 1997; 67 FR 34855, May 16, 2002; 69 FR 3265, Jan. 23, 2004; 70 FR 6774, Feb. 9, 2005; 79 FR 24578, May 1, 2014]

## § 15.216 [Reserved]

## § 15.217 Operation in the band 160–190 kHz.

(a) The total input power to the final radio frequency stage (exclusive of filament or heater power) shall not exceed one watt.

(b) The total length of the transmission line, antenna, and ground lead (if used) shall not exceed 15 meters.

(c) All emissions below 160 kHz or above 190 kHz shall be attenuated at least 20 dB below the level of the unmodulated carrier. Determination of compliance with the 20 dB attenuation specification may be based on measurements at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be demonstrated by measuring the radiated emissions.

## § 15.219 Operation in the band 510–1705 kHz.

(a) The total input power to the final radio frequency stage (exclusive of filament or heater power) shall not exceed 100 milliwatts.

(b) The total length of the transmission line, antenna and ground lead (if used) shall not exceed 3 meters.

(c) All emissions below 510 kHz or above 1705 kHz shall be attenuated at least 20 dB below the level of the

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unmodulated carrier. Determination of compliance with the 20 dB attenuation specification may be based on measurements at the intentional radiator's antenna output terminal unless the intentional radiator uses a permanently attached antenna, in which case compliance shall be demonstrated by measuring the radiated emissions.

## § 15.221 Operation in the band 525–1705 kHz.

(a) Carrier current systems and transmitters employing a leaky coaxial cable as the radiating antenna may operate in the band 525–1705 kHz provided the field strength levels of the radiated emissions do not exceed 15  $\mu\text{V}/\text{m}$ , as measured at a distance of  $47,715/(\text{frequency in kHz})$  meters (equivalent to  $\text{Lambda}/2\text{Pi}$ ) from the electric power line or the coaxial cable, respectively. The field strength levels of emissions outside this band shall not exceed the general radiated emission limits in § 15.209.

(b) As an alternative to the provisions in paragraph (a) of this section, intentional radiators used for the operation of an AM broadcast station on a college or university campus or on the campus of any other education institution may comply with the following:

(1) On the campus, the field strength of emissions appearing outside of this frequency band shall not exceed the general radiated emission limits shown in § 15.209 as measured from the radiating source. There is no limit on the field strength of emissions appearing within this frequency band, except that the provisions of § 15.5 continue to comply.

(2) At the perimeter of the campus, the field strength of any emissions, including those within the frequency band 525–1705 kHz, shall not exceed the general radiated emission in § 15.209.

(3) The conducted limits specified in § 15.207 apply to the radio frequency voltage on the public utility power lines outside of the campus. Due to the large number of radio frequency devices which may be used on the campus, contributing to the conducted emissions, as an alternative to measuring conducted emissions outside of

the campus, it is acceptable to demonstrate compliance with this provision by measuring each individual intentional radiator employed in the system at the point where it connects to the AC power lines.

(c) A grant of equipment authorization is not required for intentional radiators operated under the provisions of this section. In lieu thereof, the intentional radiator shall be verified for compliance with the regulations in accordance with subpart J of part 2 of this chapter. This data shall be kept on file at the location of the studio, office or control room associated with the transmitting equipment. In some cases, this may correspond to the location of the transmitting equipment.

(d) For the band 535–1705 kHz, the frequency of operation shall be chosen such that operation is not within the protected field strength contours of licensed AM stations.

[56 FR 373, Jan. 4, 1991]

**§ 15.223 Operation in the band 1.705–10 MHz.**

(a) The field strength of any emission within the band 1.705–10.0 MHz shall not exceed 100 microvolts/meter at a distance of 30 meters. However, if the bandwidth of the emission is less than 10% of the center frequency, the field strength shall not exceed 15 microvolts/meter or (the bandwidth of the device in kHz) divided by (the center frequency of the device in MHz) microvolts/meter at a distance of 30 meters, whichever is the higher level. For the purposes of this section, bandwidth is determined at the points 6 dB down from the modulated carrier. The emission limits in this paragraph are based on measurement instrumentation employing an average detector. The provisions in §15.35(b) for limiting peak emissions apply.

(b) The field strength of emissions outside of the band 1.705–10.0 MHz shall not exceed the general radiated emission limits in §15.209.

**§ 15.225 Operation within the band 13.110–14.010 MHz.**

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209.

(e) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(f) In the case of radio frequency powered tags designed to operate with a device authorized under this section, the tag may be approved with the device or be considered as a separate device subject to its own authorization. Powered tags approved with a device under a single application shall be labeled with the same identification number as the device.

[68 FR 68546, Dec. 9, 2003]

**§ 15.227 Operation within the band 26.96–27.28 MHz.**

(a) The field strength of any emission within this band shall not exceed 10,000 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

(b) The field strength of any emissions which appear outside of this band shall not exceed the general radiated emission limits in §15.209.

**§ 15.229 Operation within the band 40.66–40.70 MHz.**

(a) Unless operating pursuant to the provisions in §15.231, the field strength of any emissions within this band shall not exceed 1,000 microvolts/meter at 3 meters.

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(b) As an alternative to the limit in paragraph (a) of this section, perimeter protection systems may demonstrate compliance with the following: the field strength of any emissions within this band shall not exceed 500 microvolts/meter at 3 meters, as determined using measurement instrumentations employing an average detector. The provisions in §15.35 for limiting peak emissions apply where compliance of these devices is demonstrated under this alternative emission limit.

(c) The field strength of any emissions appearing outside of this band shall not exceed the general radiated emission limits in §15.209.

(d) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

[54 FR 17714, Apr. 25, 1989, as amended at 55 FR 33910, Aug. 20, 1990]

**§ 15.231 Periodic operation in the band 40.66–40.70 MHz and above 70 MHz.**

(a) The provisions of this section are restricted to periodic operation within the band 40.66–40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not per-

mitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66–40.70	2,250 .....	225
70–130 .....	1,250 .....	125
130–174 .... <sup>1</sup>	1,250 to 3,750 .....	<sup>1</sup> 125 to 375
174–260 ....	3,750 .....	375
260–470 .... <sup>1</sup>	3,750 to 12,500 .....	<sup>1</sup> 375 to 1,250
Above 470	12,500 .....	1,250

<sup>1</sup> Linear interpolations.

(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a

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CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

(d) For devices operating within the frequency band 40.66–40.70 MHz, the bandwidth of the emission shall be confined within the band edges and the frequency tolerance of the carrier shall be  $\pm 0.01\%$ . This frequency tolerance shall be maintained for a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emission (microvolts/meter)
40.66–40.70	1,000 .....	100
70–130 .....	500 .....	50
130–174 ....	500 to 1,500 <sup>1</sup> .....	50 to 150 <sup>1</sup>
174–260 ....	1,500 .....	150
260–470 ....	1,500 to 5,000 <sup>1</sup> .....	150 to 500 <sup>1</sup>
Above 470	5,000 .....	500

<sup>1</sup> Linear interpolations.

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

[54 FR 17714, Apr. 25, 1989; 54 FR 32340, Aug. 7, 1989, as amended at 68 FR 68546, Dec. 9, 2003; 69 FR 71383, Dec. 9, 2004]

### § 15.233 Operation within the bands 43.71–44.49 MHz, 46.60–46.98 MHz, 48.75–49.51 MHz and 49.66–50.0 MHz.

(a) The provisions shown in this section are restricted to cordless telephones.

(b) An intentional radiator used as part of a cordless telephone system shall operate centered on one or more of the following frequency pairs, subject to the following conditions:

(1) Frequencies shall be paired as shown below, except that channel pairing for channels one through fifteen may be accomplished by pairing any of the fifteen base transmitter frequencies with any of the fifteen handset transmitter frequencies.

(2) Cordless telephones operating on channels one through fifteen must:

(i) Incorporate an automatic channel selection mechanism that will prevent establishment of a link on any occupied frequency; and

(ii) The box or an instruction manual which is included within the box which the individual cordless telephone is to be marketed shall contain information indicating that some cordless telephones operate at frequencies that may cause interference to nearby TVs and VCRs; to minimize or prevent such interference, the base of the cordless

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telephone should not be placed near or on top of a TV or VCR; and, if interference is experienced, moving the cordless telephone farther away from the TV or VCR will often reduce or eliminate the interference. A statement describing the means and procedures used to achieve automatic channel selection shall be provided in any application for equipment authorization of a cordless telephone operating on channels one through fifteen.

Channel	Base transmitter (MHz)	Handset transmitter (MHz)
1 .....	43.720	48.760
2 .....	43.740	48.840
3 .....	43.820	48.860
4 .....	43.840	48.920
5 .....	43.920	49.020
6 .....	43.960	49.080
7 .....	44.120	49.100
8 .....	44.160	49.160
9 .....	44.180	49.200
10 .....	44.200	49.240
11 .....	44.320	49.280
12 .....	44.360	49.360
13 .....	44.400	49.400
14 .....	44.460	49.460
15 .....	44.480	49.500
16 .....	46.610	49.670
17 .....	46.630	49.845
18 .....	46.670	49.860
19 .....	46.710	49.770
20 .....	46.730	49.875
21 .....	46.770	49.830
22 .....	46.830	49.890
23 .....	46.870	49.930
24 .....	46.930	49.990
25 .....	46.970	49.970

(c) The field strength of the fundamental emission shall not exceed 10,000 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

(d) The fundamental emission shall be confined within a 20 kHz band and shall be centered on a carrier frequency shown above, as adjusted by the frequency tolerance of the transmitter at the time testing is performed. Modulation products outside of this 20 kHz band shall be attenuated at least 26 dB below the level of the unmodulated carrier or to the general limits in §15.209, whichever permits the higher emission levels. Emissions on any frequency more than 20 kHz removed from the center frequency shall consist solely of unwanted emissions and shall not

exceed the general radiated emission limits in §15.209. Tests to determine compliance with these requirements shall be performed using an appropriate input signal as prescribed in §2.989 of this chapter.

(e) All emissions exceeding 20 microvolts/meter at 3 meters are to be reported in the application for certification.

(f) If the device provides for the connection of external accessories, including external electrical input signals, the device must be tested with the accessories attached. The emission tests shall be performed with the device and accessories configured in a manner which tends to produce the maximum level of emissions within the range of variations that can be expected under normal operating conditions.

(g) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency. The tolerance shall be maintained for a temperature variation of  $-20$  degrees C to  $+50$  degrees C at normal supply voltage, and for variation in the primary voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(h) For cordless telephones that do not comply with §15.214(d) of this part, the box or other package in which the individual cordless telephone is to be marketed shall carry a statement in a prominent location, visible to the buyer before purchase, which reads as follows:

NOTICE: The base units of some cordless telephones may respond to other nearby units or to radio noise resulting in telephone calls being dialed through this unit without your knowledge and possibly calls being misbilled. In order to protect against such occurrences, this cordless telephone is provided with the following features: (to be completed by the responsible party).

An application for certification of a cordless telephone shall specify the complete text of the statement that

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will be carried on the package and indicate where, specifically, it will be located on the carton.

[54 FR 17714, Apr. 25, 1989; 54 FR 32340, Aug. 7, 1989, as amended at 56 FR 3785, Jan. 31, 1991; 56 FR 5659, Feb. 12, 1991; 60 FR 21985, May 4, 1995]

### § 15.235 Operation within the band 49.82–49.90 MHz.

(a) The field strength of any emission within this band shall not exceed 10,000 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

(b) The field strength of any emissions appearing between the band edges and up to 10 kHz above and below the band edges shall be attenuated at least 26 dB below the level of the unmodulated carrier or to the general limits in §15.209, whichever permits the higher emission levels. The field strength of any emissions removed by more than 10 kHz from the band edges shall not exceed the general radiated emission limits in §15.209. All signals exceeding 20 microvolts/meter at 3 meters shall be reported in the application for certification.

(c) For a home-built intentional radiator, as defined in §15.23(a), operating within the band 49.82–49.90 MHz, the following standards may be employed:

(1) The RF carrier and modulation products shall be maintained within the band 49.82–49.90 MHz.

(2) The total input power to the device measured at the battery or the power line terminals shall not exceed 100 milliwatts under any condition of modulation.

(3) The antenna shall be a single element, one meter or less in length, permanently mounted on the enclosure containing the device.

(4) Emissions outside of this band shall be attenuated at least 20 dB below the level of the unmodulated carrier.

(5) The regulations contained in §15.23 of this part apply to intentional radiators constructed under the provisions of this paragraph.

(d) Cordless telephones are not permitted to operate under the provisions of this section.

### § 15.236 Operation of wireless microphones in the bands 54–72 MHz, 76–88 MHz, 174–216 MHz, 470–608 MHz and 614–698 MHz.

(a) *Definitions.* The following definitions apply in this section.

(1) *Wireless Microphone.* An intentional radiator that converts sound into electrical audio signals that are transmitted using radio signals to a receiver which converts the radio signals back into audio signals that are sent through a sound recording or amplifying system. Wireless microphones may be used for cue and control communications and synchronization of TV camera signals as defined in §74.801 of this chapter. Wireless microphones do not include auditory assistance devices as defined in §15.3(a) of this part.

(2) *600 MHz duplex gap.* An 11 megahertz guard band at 652–663 MHz that separates part 27 600 MHz service uplink and downlink frequencies.

(3) *600 MHz guard band.* Designated frequency band at 614–617 MHz that prevents interference between licensed services in the 600 MHz service band and channel 37.

(4) *600 MHz service band.* Frequencies in the 617–652 MHz and 663–698 MHz bands that are reallocated and reassigned for 600 MHz band services under part 27.

NOTE TO PARAGRAPHS (a)(2), (3) AND (4): The specific frequencies will be determined in light of further proceedings pursuant to GN Docket No. 12–268 and the rules will be updated accordingly pursuant to a future public notice.

(5) *Spectrum Act.* Title VI of the Middle Class Tax Relief and Job Creation Act of 2012 (Pub. L. 112–96).

(b) Operation under this section is limited to wireless microphones as defined in this section.

(c) Operation is permitted in the following frequency bands.

(1) Channels allocated and assigned for the broadcast television service.

(2) Frequencies in the 600 MHz service band on which a 600 MHz service licensee has not commenced operations, as defined in §27.4 of this chapter. Operation on these frequencies must cease no later than the end of the post-auction transition period, as defined in §27.4 of this chapter. Operation must

cease immediately if harmful interference occurs to a 600 MHz service licensee.

(3) The 657–663 MHz segment of the 600 MHz duplex gap.

(4) [Reserved]

(5) The 614–616 MHz segment of the 600 MHz guard band.

(6) Prior to operation in the frequencies identified in paragraphs (c)(2) through (5) of this section, wireless microphone users shall rely on the white space databases in part 15, Subpart H to determine that their intended operating frequencies are available for unlicensed wireless microphone operation at the location where they will be used. Wireless microphone users must register with and check a

white space database to determine available channels prior to beginning operation at a given location. A user must re-check the database for available channels if it moves to another location.

(d) The maximum radiated power shall not exceed the following values:

(1) In the bands allocated and assigned for broadcast television and in the 600 MHz service band: 50 mW EIRP

(2) In the 600 MHz guard band and the 600 MHz duplex gap: 20 mW EIRP.

(e) Operation is limited to locations separated from licensed services by the following distances.

(1) Four kilometers outside the following protected service contours of co-channel TV stations.

Type of station	Protected contour		
	Channel	Contour (dBu)	Propagation curve
Analog: Class A TV, LPTV, translator and booster .....	Low VHF (2–6) .....	47	F(50,50)
	High VHF (7–13) .....	56	F(50,50)
	UHF (14–51) .....	64	F(50,50)
	Low VHF (2–6) .....	28	F(50,90)
Digital: Full service TV, Class A TV, LPTV, translator and booster.	High VHF (7–13) .....	36	F(50,90)
	UHF (14–51) .....	41	F(50,90)

(2) The following distances outside of the area where a 600 MHz service licensee has commenced operations, as defined in §27.4 of this chapter.

Type of station	Separation distance in kilometers	
	Co-channel	Adjacent channel
Base .....	7	0.2
Mobile .....	35	31

(f) The operating frequency within a permissible band of operation as defined in paragraph (c) must comply with the following requirements.

(1) The frequency selection shall be offset from the upper or lower band limits by 25 kHz or an integral multiple thereof.

(2) One or more adjacent 25 kHz segments within the assignable frequencies may be combined to form a channel whose maximum bandwidth shall not exceed 200 kHz. The operating bandwidth shall not exceed 200 kHz.

(3) The frequency tolerance of the carrier signal shall be maintained

within  $\pm 0.005\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. Battery operated equipment shall be tested using a new battery.

(g) Emissions within the band from one megahertz below to one megahertz above the carrier frequency shall comply with the emission mask in §8.3 of ETSI EN 300 422–1 V1.4.2 (2011–08), *Electromagnetic compatibility and Radio spectrum Matters (ERM); Wireless microphones in the 25 MHz to 3 GHz frequency range; Part 1: Technical characteristics and methods of measurement*. Emissions outside of this band shall comply with the limits specified in section 8.4 of ETSI EN 300 422–1 V1.4.2 (2011–08).

[80 FR 73069, Nov. 23, 2015, as amended at 81 FR 4974, Jan. 29, 2016; 82 FR 41559, Sept. 1, 2017]



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### § 15.237 Operation in the bands 72.0–73.0 MHz, 74.6–74.8 MHz and 75.2–76.0 MHz.

(a) The intentional radiator shall be restricted to use as an auditory assistance device.

(b) Emissions from the intentional radiator shall be confined within a band 200 kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the above specified frequency ranges.

(c) The field strength within the permitted 200 kHz band shall not exceed 80 millivolts/meter at 3 meters. The field strength of any emissions radiated on any frequency outside of the specified 200 kHz band shall not exceed the general radiated emissions limits specified in § 15.209. The emission limits in this paragraph are based on measurement instrumentation employing an average detector. The provisions in § 15.35 for limiting peak emissions apply.

[54 FR 17714, Apr. 25, 1989, as amended at 57 FR 13048, Apr. 15, 1992; 78 FR 34927, June 11, 2013]

### § 15.239 Operation in the band 88–108 MHz.

(a) Emissions from the intentional radiator shall be confined within a band 200 kHz wide centered on the operating frequency. The 200 kHz band shall lie wholly within the frequency range of 88–108 MHz.

(b) The field strength of any emissions within the permitted 200 kHz band shall not exceed 250 microvolts/meter at 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in § 15.35 for limiting peak emissions apply.

(c) The field strength of any emissions radiated on any frequency outside of the specified 200 kHz band shall not exceed the general radiated emission limits in § 15.209.

(d) A custom built telemetry intentional radiator operating in the frequency band 88–108 MHz and used for experimentation by an educational institute need not be certified provided the device complies with the standards in this part and the educational institution notifies the Office of Engineering and Technology, in writing, in ad-

vance of operation, providing the following information:

(1) The dates and places where the device will be operated;

(2) The purpose for which the device will be used;

(3) A description of the device, including the operating frequency, RF power output, and antenna; and,

(4) A statement that the device complies with the technical provisions of this part.

[54 FR 17714, Apr. 25, 1989; 54 FR 32340, Aug. 7, 1989; 80 FR 53750, Sept. 8, 2015]

### § 15.240 Operation in the band 433.5–434.5 MHz.

(a) Operation under the provisions of this section is restricted to devices that use radio frequency energy to identify the contents of commercial shipping containers. Operations must be limited to commercial and industrial areas such as ports, rail terminals and warehouses. Two-way operation is permitted to interrogate and to load data into devices. Devices operated pursuant to the provisions of this section shall not be used for voice communications.

(b) The field strength of any emissions radiated within the specified frequency band shall not exceed 11,000 microvolts per meter measured at a distance of 3 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The peak level of any emissions within the specified frequency band shall not exceed 55,000 microvolts per meter measured at a distance of 3 meters. Additionally, devices authorized under these provisions shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than 60 seconds and be only permitted to reinitiate an interrogation in the case of a transmission error. Absent such a transmission error, the silent period between transmissions shall not be less than 10 seconds.

(c) The field strength of emissions radiated on any frequency outside of the specified band shall not exceed the general radiated emission limits in § 15.209.

(d) In the case of radio frequency powered tags designed to operate with

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a device authorized under this section, the tag may be approved with the device or be considered as a separate device subject to its own authorization. Powered tags approved with a device under a single application shall be labeled with the same identification number as the device.

(e) To prevent interference to Federal Government radar systems, operation under the provisions of this section is not permitted within 40 kilometers of the following locations:

DoD Radar Site	Latitude	Longitude
Beale Air Force Base .....	39°08'10" N	121°21'04" W
Cape Cod Air Force Station .....	41°45'07" N	070°32'17" W
Clear Air Force Station .....	64°55'16" N	143°05'02" W
Cavalier Air Force Station ..	48°43'12" N	097°54'00" W
Eglin Air Force Base .....	30°43'12" N	086°12'36" W

(f) As a condition of the grant, the grantee of an equipment authorization for a device operating under the provisions of this section shall provide information to the user concerning compliance with the operational restrictions in paragraphs (a) and (e) of this section. As a further condition, the grantee shall provide information on the locations where the devices are installed to the FCC Office of Engineering and Technology, which shall provide this information to the Federal Government through the National Telecommunications and Information Administration. The user of the device shall be responsible for submitting updated information in the event the operating location or other information changes after the initial registration. The grantee shall notify the user of this requirement. The information provided by the grantee or user to the Commission shall include the name, address, telephone number and e-mail address of the user, the address and geographic coordinates of the operating location, and the FCC identification number of the device. The material shall be submitted to the following address: Experimental Licensing Branch, OET, Federal Communications Commission, at the address of the FCC's main office indicated in 47 CFR 0.401(a), ATTN: RFID Registration.

[69 FR 29464, May 24, 2004, as amended at 85 FR 64406, Oct. 13, 2020]

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**§ 15.241 Operation in the band 174–216 MHz.**

(a) Operation under the provisions of this section is restricted to biomedical telemetry devices.

(b) Emissions from the device shall be confined within a 200 kHz band which shall lie wholly within the frequency range of 174–216 MHz.

(c) The field strength of any emissions radiated within the specified 200 kHz band shall not exceed 1500 microvolts/meter at 3 meters. The field strength of emissions radiated on any frequency outside of the specified 200 kHz band shall not exceed 150 microvolts/meter at 3 meters. The emission limits in this paragraph are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

**§ 15.242 Operation in the bands 174–216 MHz and 470–668 MHz.**

(a) The marketing and operation of intentional radiators under the provisions of this section is restricted to biomedical telemetry devices employed solely on the premises of health care facilities.

(1) A health care facility includes hospitals and other establishments that offer services, facilities, and beds for use beyond 24 hours in rendering medical treatment and institutions and organizations regularly engaged in providing medical services through clinics, public health facilities, and similar establishments, including governmental entities and agencies for their own medical activities.

(2) This authority to operate does not extend to mobile vehicles, such as ambulances, even if those vehicles are associated with a health care facility.

(b) The fundamental emissions from a biomedical telemetry device operating under the provisions of this section shall be contained within a single television broadcast channel, as defined in part 73 of this chapter, under all conditions of operation and shall lie wholly within the frequency ranges of 174–216 MHz and 470–668 MHz.

(c) The field strength of the fundamental emissions shall not exceed 200 mV/m, as measured at a distance of 3 meters using a quasi-peak detector.

Manufacturers should note that a quasi-peak detector function indicates field strength per 120 kHz of bandwidth  $\pm 20$  kHz. Accordingly, the total signal level over the band of operation may be higher than 200 mV/m. The field strength of emissions radiated on any frequency outside of the television broadcast channel within which the fundamental is contained shall not exceed the general limits in § 15.209.

(d) The user and the installer of a biomedical telemetry device operating within the frequency range 174–216 MHz, 470–608 MHz or 614–668 MHz shall ensure that the following minimum separation distances are maintained between the biomedical telemetry device and the authorized radio services operating on the same frequencies:

(1) At least 10.3 km outside of the Grade B field strength contour (56 dBuV/m) of a TV broadcast station or an associated TV booster station operating within the band 174–216 MHz.

(2) At least 5.5 km outside of the Grade B field strength contour (64 dBuV/m) of a TV broadcast station or an associated TV booster station operating within the bands 470–608 MHz or 614–668 MHz.

(3) At least 5.1 km outside of the 68 dBuV/m field strength contour of a low power TV or a TV translator station operating within the band 174–216 MHz.

(4) At least 3.1 km outside of the 74 dBuV/m field strength contour of a low power TV or a TV translator station operating within the bands 470–608 MHz or 614–668 MHz.

(5) Whatever distance is necessary to protect other authorized users within these bands.

(e) The user and the installer of a biomedical telemetry device operating within the frequency range 608–614 MHz and that will be located within 32 km of the very long baseline array (VLBA) stations or within 80 km of any of the other radio astronomy observatories noted in footnote US385 of Section 2.106 of this chapter must coordinate with, and obtain the written concurrence of, the director of the affected radio astronomy observatory before the equipment can be installed or operated. The National Science Foundation point of contact for coordination is: Spectrum Manager, Division of Astronomical

Sciences, NSF Room 1045, 4201 Wilson Blvd., Arlington, VA 22230; tel: (703) 306-1823.

(f) Biomedical telemetry devices must not cause harmful interference to licensed TV broadcast stations or to other authorized radio services, such as operations on the broadcast frequencies under subparts G and H of part 74 of this chapter, land mobile stations operating under part 90 of this chapter in the 470–512 MHz band, and radio astronomy operation in the 608–614 MHz band. (See § 15.5.) If harmful interference occurs, the interference must either be corrected or the device must immediately cease operation on the occupied frequency. Further, the operator of the biomedical telemetry device must accept whatever level of interference is received from other radio operations. The operator, *i.e.*, the health care facility, is responsible for resolving any interference that occurs subsequent to the installation of these devices.

(g) The manufacturers, installers, and users of biomedical telemetry devices are reminded that they must ensure that biomedical telemetry transmitters operating under the provisions of this section avoid operating in close proximity to authorized services using this spectrum. Sufficient separation distance, necessary to avoid causing or receiving harmful interference, must be maintained from co-channel operations. These parties are reminded that the frequencies of the authorized services are subject to change, especially during the implementation of the digital television services. The operating frequencies of the part 15 devices may need to be changed, as necessary and in accordance with the permissive change requirements of this chapter, to accommodate changes in the operating frequencies of the authorized services.

(h) The manufacturers, installers and users of biomedical telemetry devices are cautioned that the operation of this equipment could result in harmful interference to other nearby medical devices.

[62 FR 58658, Oct. 30, 1997, as amended at 77 FR 76248, Dec. 27, 2012]

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§ 15.243 Operation in the band 890–940 MHz.

(a) Operation under the provisions of this section is restricted to devices that use radio frequency energy to measure the characteristics of a material. Devices operated pursuant to the provisions of this section shall not be used for voice communications or the transmission of any other type of message.

(b) The field strength of any emissions radiated within the specified frequency band shall not exceed 500 microvolts/meter at 30 meters. The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

(c) The field strength of emissions radiated on any frequency outside of the specified band shall not exceed the general radiated emission limits in §15.209.

(d) The device shall be self-contained with no external or readily accessible controls which may be adjusted to permit operation in a manner inconsistent with the provisions in this section. Any antenna that may be used with the device shall be permanently attached thereto and shall not be readily modifiable by the user.

§ 15.245 Operation within the bands 902–928 MHz, 2435–2465 MHz, 5785–5815 MHz, 10500–10550 MHz, and 24075–24175 MHz.

(a) Operation under the provisions of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency (MHz)	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (millivolts/meter)
902–928 .....	500	1.6
2435–2465 .....	500	1.6
5785–5815 .....	500	1.6
10500–10550 .....	2500	25.0
24075–24175 .....	2500	25.0

(1) Regardless of the limits shown in the above table, harmonic emissions in

the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

(i) For the second and third harmonics of field disturbance sensors operating in the 24075–24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.

(ii) For all other field disturbance sensors, 7.5 mV/m.

(iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075–24175 MHz band, fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).

(2) Field strength limits are specified at a distance of 3 meters.

(3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

[54 FR 17714, Apr. 25, 1989, as amended at 55 FR 46792, Nov. 7, 1990; 61 FR 42558, Aug. 16, 1996; 68 FR 68547, Dec. 9, 2003]

**§ 15.247 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz.**

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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. Alternatively, frequency hopping systems operating 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The 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.

(i) For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725–5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the *maximum conducted*

*output power* is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) 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 conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(ii) 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 conducted output power.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, 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 or digitally modulated 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 provisions in paragraphs (b)(1), (b)(3), (b)(4) and

(c)(1)(i) of this section, 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 provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays 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 limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, 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:

(A) 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.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, *e.g.*, due to shading of the array or coherence loss in the beamforming.

(iii) 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 paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

(e) For digitally modulated systems, 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. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

(f) For the purposes of this section, 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 power spectral density conducted from the intentional radiator to the antenna due to the digital modula-

tion operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

NOTE TO PARAGRAPH (f): The transition provisions found in §15.37(h) will apply to hybrid devices beginning June 2, 2015.

(g) 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 this section 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.

(h) 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.

NOTE TO PARAGRAPH (h): Spread spectrum systems are sharing these bands on a non-interference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U. S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.

(i) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified

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in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

[54 FR 17714, Apr. 25, 1989, as amended at 55 FR 28762, July 13, 1990; 62 FR 26242, May 13, 1997; 65 FR 57561, Sept. 25, 2000; 67 FR 42734, June 25, 2002; 69 FR 54035, Sept. 7, 2004; 72 FR 5632, Feb. 7, 2007; 79 FR 24578, May 1, 2014; 85 FR 18149, Apr. 1, 2020]

### § 15.249 Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz.

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz .....	50	500
2400–2483.5 MHz .....	50	500
5725–5875 MHz .....	50	500
24.0–24.25 GHz .....	250	2500

(b) Fixed, point-to-point operation as referred to in this paragraph shall be limited to systems employing a fixed transmitter transmitting to a fixed remote location. Point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information are not allowed. Fixed, point-to-point operation is permitted in the 24.05–24.25 GHz band subject to the following conditions:

(1) The field strength of emissions in this band shall not exceed 2500 millivolts/meter.

(2) The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.001\%$  of the operating frequency over a temperature variation of  $-20$  degrees to  $+50$  degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equip-

ment tests shall be performed using a new battery.

(3) Antenna gain must be at least 33 dBi. Alternatively, the main lobe beamwidth must not exceed 3.5 degrees. The beamwidth limit shall apply to both the azimuth and elevation planes. At antenna gains over 33 dBi or beamwidths narrower than 3.5 degrees, power must be reduced to ensure that the field strength does not exceed 2500 millivolts/meter.

(c) Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in § 15.209, whichever is the lesser attenuation.

(e) As shown in § 15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

[54 FR 17714, Apr. 25, 1989, as amended at 55 FR 25095, June 20, 1990; 67 FR 1625, Jan. 14, 2002; 77 FR 4914, Feb. 1, 2012]

### § 15.250 Operation of wideband systems within the band 5925–7250 MHz.

(a) The  $-10$  dB bandwidth of a device operating under the provisions of this section must be contained within the 5925–7250 MHz band under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

(b) The  $-10$  dB bandwidth of the fundamental emission shall be at least 50 MHz. For transmitters that employ frequency hopping, stepped frequency or



similar modulation types, measurement of the  $-10$  dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency following the provisions of §15.31(m).

(c) Operation on board an aircraft or a satellite is prohibited. Devices operating under this section may not be employed for the operation of toys. Except for operation onboard a ship or a terrestrial transportation vehicle, the use of a fixed outdoor infrastructure is prohibited. A fixed infrastructure includes antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole.

(d) Emissions from a transmitter operating under this section shall not exceed the following equivalent isotropically radiated power (EIRP) density levels:

(1) The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following RMS average limits based on measurements using a 1 MHz resolution bandwidth:

Frequency in MHz	EIRP in dBm
960–1610 .....	–75.3
1610–1990 .....	–63.3
1990–3100 .....	–61.3
3100–5925 .....	–51.3
5925–7250 .....	–41.3
7250–10600 .....	–51.3
Above 10600 .....	–61.3

(2) In addition to the radiated emission limits specified in the table in paragraph (d)(1) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164–1240 .....	–85.3
1559–1610 .....	–85.3

(3) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs and this 50 MHz bandwidth must be contained within the

5925–7250 MHz band. The peak EIRP limit is  $20 \log (\text{RBW}/50)$  dBm where RBW is the resolution bandwidth in megahertz that is employed by the measurement instrument. RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than RBW. If RBW is greater than 3 MHz, the application for certification filed with the Commission shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

(4) Radiated emissions at or below 960 MHz shall not exceed the emission levels in §15.209.

(5) Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in §15.209 provided it can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in §15.3(k), e.g., emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in subpart B of this part. Emissions from these digital circuits shall not be employed in determining the  $-10$  dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs.

(e) Measurement procedures:

(1) All emissions at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Unless otherwise specified, all RMS average emission levels specified in this section are to be measured utilizing a 1 MHz resolution bandwidth with a one millisecond dwell over each 1 MHz segment. The frequency span of the analyzer should equal the number of sampling bins times 1 MHz and the sweep rate of the analyzer should equal the number of sampling bins times one millisecond. The provision in §15.35(c) that allows emissions to be averaged over a 100 millisecond period does not apply to devices operating under this section. The video bandwidth of the

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measurement instrument shall not be less than the resolution bandwidth and trace averaging shall not be employed. The RMS average emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(2) The peak emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(3) For transmitters that employ frequency hopping, stepped frequency or similar modulation types, the peak emission level measurement, the measurement of the RMS average emission levels, and the measurement to determine the frequency at which the highest level emission occurs shall be made with the frequency hop or step function active. Gated signals may be measured with the gating active. The provisions of § 15.31(c) continue to apply to transmitters that employ swept frequency modulation.

(4) The -10 dB bandwidth is based on measurement using a peak detector, a 1 MHz resolution bandwidth, and a video bandwidth greater than or equal to the resolution bandwidth.

(5) Alternative measurement procedures may be considered by the Commission.

[70 FR 6774, Feb. 9, 2005]

**§ 15.251 Operation within the bands 2.9–3.26 GHz, 3.267–3.332 GHz, 3.339–3.3458 GHz, and 3.358–3.6 GHz.**

(a) Operation under the provisions of this section is limited to automatic vehicle identification systems (AVIS) which use swept frequency techniques for the purpose of automatically identifying transportation vehicles.

(b) The field strength anywhere within the frequency range swept by the signal shall not exceed 3000 microvolts/meter/MHz at 3 meters in any direction. Further, an AVIS, when in its operating position, shall not produce a field strength greater than 400 microvolts/meter/MHz at 3 meters in any direction within  $\pm 10$  degrees of the horizontal plane. In addition to the provisions of § 15.205, the field strength of radiated emissions outside the frequency range swept by the signal shall be limited to a maximum of 100

microvolts/meter/MHz at 3 meters, measured from 30 MHz to 20 GHz for the complete system. The emission limits in this paragraph are based on measurement instrumentation employing an average detector. The provisions in § 15.35 for limiting peak emissions apply.

(c) The minimum sweep repetition rate of the signal shall not be lower than 4000 sweeps per second, and the maximum sweep repetition rate of the signal shall not exceed 50,000 sweeps per second.

(d) An AVIS shall employ a horn antenna or other comparable directional antenna for signal emission.

(e) Provision shall be made so that signal emission from the AVIS shall occur only when the vehicle to be identified is within the radiated field of the system.

(f) In addition to the labelling requirements in § 15.19(a), the label attached to the AVIS transmitter shall contain a third statement regarding operational conditions, as follows:

\* \* \* and, (3) during use this device (the antenna) may not be pointed within  $\pm$  \* \* degrees of the horizontal plane.

The double asterisks in condition three (\*\*) shall be replaced by the responsible party with the angular pointing restriction necessary to meet the horizontal emission limit specified in paragraph (b).

(g) In addition to the information required in subpart J of part 2, the application for certification shall contain:

(1) Measurements of field strength per MHz along with the intermediate frequency of the spectrum analyzer or equivalent measuring receiver;

(2) The angular separation between the direction at which maximum field strength occurs and the direction at which the field strength is reduced to 400 microvolts/meter/MHz at 3 meters;

(3) A photograph of the spectrum analyzer display showing the entire swept frequency signal and a calibrated scale for the vertical and horizontal axes; the spectrum analyzer settings that were used shall be labelled on the photograph; and,

(4) The results of the frequency search for spurious and sideband emissions from 30 MHz to 20 GHz, exclusive

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of the swept frequency band, with the measuring instrument as close as possible to the unit under test.

[54 FR 17714, Apr. 25, 1989; 54 FR 32340, Aug. 7, 1989]

### § 15.252 Operation of wideband vehicular radar systems within the band 23.12–29.0 GHz.

(a) Operation under this section is limited to field disturbance sensors that are mounted in terrestrial transportation vehicles. Terrestrial use is limited to earth surface-based, non-aviation applications.

(1) The –10 dB bandwidth of the fundamental emissions shall be located within the 23.12–29.0 GHz band, exclusive of the 23.6–24.0 GHz restricted band, as appropriate, under all conditions of operation including the effects from stepped frequency, frequency hopping or other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

(2) The –10 dB bandwidth of the fundamental emission shall be 10 MHz or greater. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the –10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency following the provisions of §15.31(m).

(3) For systems operating in the 23.12–29.0 GHz band, the frequencies at which the highest average emission level and at which the highest peak level emission appear shall be greater than 24.075 GHz.

(4) These devices shall operate only when the vehicle is operating, e.g., the engine is running. Operation shall occur only upon specific activation, such as upon starting the vehicle, changing gears, or engaging a turn signal. The operation of these devices shall be related to the proper functioning of the transportation vehicle, e.g., collision avoidance.

(b) Emissions from a transmitter operating under this section shall not exceed the following equivalent

isotropically radiated power (EIRP) density levels:

(1) For transmitters operating in the 23.12–29.0 GHz band, the RMS average radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following EIRP limits based on measurements using a 1 MHz resolution bandwidth:

Frequency in MHz	EIRP in dBm
960–1610 .....	–75.3
1610–23,120 .....	–61.3
23,120–23,600 .....	–41.3
23,600–24,000 .....	–61.3
24,000–29,000 .....	–41.3
Above 29,000 .....	–61.3

(2) In addition to the radiated emissions limits specified in the table in paragraph (b)(1) of this section, transmitters operating under the provisions of this section shall not exceed the following RMS average EIRP limits when measured using a resolution bandwidth of no less than 1 kHz:

Frequency in MHz	EIRP in dBm
1164–1240 .....	–85.3
1559–1610 .....	–85.3

(3) There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs and this 50 MHz bandwidth must be contained within the 24.05–29.0 GHz band. The peak EIRP limit is  $20 \log (\text{RBW}/50)$  dBm where RBW is the resolution bandwidth in MHz employed by the measurement instrument. RBW shall not be lower than 1 MHz or greater than 50 MHz. Further, RBW shall not be greater than the –10 dB bandwidth of the device under test. For transmitters that employ frequency hopping, stepped frequency or similar modulation types, measurement of the –10 dB minimum bandwidth specified in this paragraph shall be made with the frequency hop or step function disabled and with the transmitter operating continuously at a fundamental frequency. The video bandwidth of the measurement instrument shall not be less than RBW. The limit on peak emissions applies to the 50

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MHz bandwidth centered on the frequency at which the highest level radiated emission occurs. If RBW is greater than 3 MHz, the application for certification shall contain a detailed description of the test procedure, the instrumentation employed in the testing, and the calibration of the test setup.

(4) Radiated emissions at or below 960 MHz shall not exceed the emission levels in §15.209.

(5) Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in §15.209 provided it can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in §15.3(k), e.g., emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in subpart B of this part. Emissions from these digital circuits shall not be employed in determining the -10 dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs.

(c) Measurement procedures:

(1) All emissions at and below 960 MHz are based on measurements employing a CISPR quasi-peak detector. Unless otherwise specified, all RMS average emission levels specified in this section are to be measured utilizing a 1 MHz resolution bandwidth with a one millisecond dwell over each 1 MHz segment. The frequency span of the analyzer should equal the number of sampling bins times 1 MHz and the sweep rate of the analyzer should equal the number of sampling bins times one millisecond. The provision in §15.35(c) that allows emissions to be averaged over a 100 millisecond period does not apply to devices operating under this section. The video bandwidth of the measurement instrument shall not be less than the resolution bandwidth and trace averaging shall not be employed. The RMS average emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum

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hold until the amplitude stabilizes.

(2) The peak emission measurement is to be repeated over multiple sweeps with the analyzer set for maximum hold until the amplitude stabilizes.

(3) For transmitters that employ frequency hopping, stepped frequency or similar modulation types, the peak emission level measurement, the measurement of the RMS average emission levels, the measurement to determine the center frequency, and the measurement to determine the frequency at which the highest level emission occurs shall be made with the frequency hop or step function active. Gated signals may be measured with the gating active. The provisions of §15.31(c) continue to apply to transmitters that employ swept frequency modulation.

(4) The -10 dB bandwidth is based on measurement using a peak detector, a 1 MHz resolution bandwidth, and a video bandwidth greater than or equal to the resolution bandwidth.

(5) Alternative measurement procedures may be considered by the Commission.

(d) Wideband vehicular radar systems operating in the 23.12–29.0 GHz band are subject to the transition provisions of §15.37(l) through (n).

[70 FR 6775, Feb. 9, 2005, as amended at 82 FR 43870, Sept. 20, 2017]

## § 15.253 [Reserved]

## § 15.255 Operation within the band 57–71 GHz.

(a) *General.* Operation under the provisions of this section is not permitted for equipment used on satellites.

(b) *Operation on aircraft.* Operation on aircraft is permitted under the following conditions:

(1) When the aircraft is on the ground.

(2) While airborne, only in closed exclusive on-board communication networks within the aircraft, with the following exceptions:

(i) Equipment shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure.

(ii) Except as permitted in paragraph (b)(3) of this section, equipment shall not be used on aircraft where there is little attenuation of RF signals by the body/fuselage of the aircraft.

(iii) Field disturbance sensor/radar devices may only operate in the frequency band 59.3–71.0 GHz while installed in passengers' personal portable electronic equipment (*e.g.*, smartphones, tablets) and shall comply with paragraph (b)(2)(i) of this section, and relevant requirements of paragraphs (c)(2) through (c)(4) of this section.

(3) Field disturbance sensors/radar devices deployed on unmanned aircraft may operate within the frequency band 60–64 GHz, provided that the transmitter not exceed 20 dBm peak EIRP. The sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds. Operation shall be limited to a maximum of 121.92 meters (400 feet) above ground level.

(c) *Radiated power limits.* Within the 57–71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(1) Devices other than field disturbance sensors shall comply with one of the following power limits, as measured during the transmit interval:

(i) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(ii) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

(A) The provisions in this paragraph (c) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (c)(1)(i) of this section.

(B) The provisions of § 15.204(c)(2) and (4) that permit the use of different antennas of the same type and of equal or less directional gain do not apply to in-

tentional radiator systems operating under this provision. In lieu thereof, intentional radiator systems shall be certified using the specific antenna(s) with which the system will be marketed and operated. Compliance testing shall be performed using the highest gain and the lowest gain antennas for which certification is sought and with the intentional radiator operated at its maximum available output power level. The responsible party, as defined in § 2.909 of this chapter, shall supply a list of acceptable antennas with the application for certification.

(2) Field disturbance sensors/radars shall not exceed –10 dBm peak conducted output power and 10 dBm peak EIRP except that field disturbance sensors/radars that limit their operation to all or part of the specified frequency band may operate without being subject to a transmitter conducted output power limit if they operate in compliance with paragraph (b)(3) of this section or with one or more of the provisions below:

(i) *57.0–59.4 GHz:* the peak EIRP level shall not exceed 20 dBm for indoor operation or 30 dBm for outdoor operation;

(ii) *57.0–61.56 GHz:* the peak EIRP shall not exceed 3 dBm except that the peak EIRP shall not exceed 20 dBm if the sum of continuous transmitter off-times of at least two milliseconds equals at least 16.5 milliseconds within any contiguous interval of 33 milliseconds;

(iii) *57.0–64.0 GHz:*

(A) The peak EIRP shall not exceed 14 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 25.5 milliseconds within any contiguous interval of 33 milliseconds, except as specific in paragraph (c)(2)(iii)(B) of this section;

(B) The peak EIRP shall not exceed 20 dBm, and the sum of continuous transmitter off-times of at least two milliseconds shall equal at least 16.5 milliseconds within any contiguous interval of 33 milliseconds when operated outdoors:

(1) As part of a temporary or permanently fixed application; or

(2) When being used in vehicular applications to perform specific tasks of

moving something or someone, except for in-cabin applications;

(iv) A field disturbance sensor may operate in any of the modes in the above sub-sections so long as the device operates in only one mode at any time and does so for at least 33 milliseconds before switching to another mode.

(v) *61.0–61.5 GHz*: For field disturbance sensors/radars that occupy 500 MHz bandwidth or less that are contained wholly within the frequency band 61.0–61.5 GHz, the average power of any emission, measured during the transmit interval, shall not exceed 40 dBm, and the peak power of any emission shall not exceed 43 dBm. In addition, the average power of any emission outside of the 61.0–61.5 GHz band, measured during the transmit interval, but still within the 57–71 GHz band, shall not exceed 10 dBm, and the peak power of any emission shall not exceed 13 dBm.

(3) For pulsed field disturbance sensors/radars operating in the 57–64 GHz band that have a maximum pulse duration of 6 ns, the average EIRP shall not exceed 13 dBm and the transmit duty cycle shall not exceed 10% during any 0.3  $\mu$ s time window. In addition, the average integrated EIRP within the frequency band 61.5–64.0 GHz shall not exceed 5 dBm in any 0.3  $\mu$ s time window. Peak emissions shall not exceed 20 dB above the maximum permitted average emission limit applicable to the equipment under test. The radar 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.

(4) The provisions in §15.35(b) and (c) that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under paragraphs (c)(2) and (3) of this section.

(d) *Limits on spurious emissions*. (1) The power density of any emissions outside the 57–71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm<sup>2</sup> at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

(e) *Limits on transmitter conducted output power*. (1) Except as specified in paragraph (e)(2) of this section, the peak transmitter conducted output power of devices other than field disturbance sensors/radars shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (c) of this section.

(2) Devices other than field disturbance sensors/radars with an emission bandwidth of less than 100 megahertz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 megahertz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kilohertz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (*e.g.*, for frequency hopping devices).

(f) *Frequency stability*. Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range –20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

(g) *Radio frequency radiation exposure*. Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of

mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(h) *Group installation.* Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

(i) *Compliance measurement.* Measurement procedures that have been found to be acceptable to the Commission in accordance with § 2.947 of this chapter may be used to demonstrate compliance.

(1) For purposes of demonstrating compliance with this section, corrections to the transmitter conducted output power may be made due to the antenna and circuit loss.

(2) Compliance measurements of frequency-agile field disturbance sensors/radars shall be performed with any related frequency sweep, step, or hop function activated.

[63 FR 42279, Aug. 7, 1998, as amended at 66 FR 7409, Jan. 23, 2001; 68 FR 68547, Dec. 9, 2003; 78 FR 59850, Sept. 30, 2013; 81 FR 79936, Nov. 14, 2016; 83 FR 63, Jan. 2, 2018; 85 FR 18149, Apr. 1, 2020; 88 FR 47394, July 24, 2023]

**§ 15.256 Operation of level probing radars within the bands 5.925–7.250 GHz, 24.05–29.00 GHz, and 75–85 GHz.**

(a) Operation under this section is limited to level probing radar (LPR) devices.

(b) LPR devices operating under the provisions of this section shall utilize a dedicated or integrated transmit antenna, and the system shall be installed and maintained to ensure a vertically downward orientation of the transmit antenna's main beam.

(c) LPR devices operating under the provisions of this section shall be installed only at fixed locations. The LPR device shall not operate while being moved, or while inside a moving container.

(d) Hand-held applications are prohibited.

(e) Marketing to residential consumers is prohibited.

(f) The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.

(1) The minimum fundamental emission bandwidth shall be 50 MHz for LPR operation under the provisions of this section.

(2) LPR devices operating under this section must confine their fundamental emission bandwidth within the 5.925–7.250 GHz, 24.05–29.00 GHz, and 75–85 GHz bands under all conditions of operation.

(g) *Fundamental emissions limits.* (1) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP).

(2) The EIRP level is to be determined from the maximum measured power within a specified bandwidth.

(i) The EIRP in 1 MHz is computed from the maximum power level measured within any 1-MHz bandwidth using a power averaging detector;

(ii) The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50-MHz bandwidth centered on the frequency at which the maximum average power level is realized and this 50 MHz bandwidth must be contained within the authorized operating bandwidth. For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by 20 log(RBW/50) dB where RBW is the resolution bandwidth in megahertz. The RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than the RBW. If the

RBW is greater than 3 MHz, the application for certification filed shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

(3) The EIRP limits for LPR operations in the bands authorized by this rule section are provided in Table 1. The emission limits in Table 1 are based on boresight measurements (*i.e.*, measurements performed within the main beam of an LPR antenna).

TABLE 1—LPR EIRP EMISSION LIMITS

Frequency band of operation (GHz)	Average emission limit (EIRP in dBm measured in 1 MHz)	Peak emission limit (EIRP in dBm measured in 50 MHz)
5.925–7.250 .....	–33	7
24.05–29.00 .....	–14	26
75–85 .....	–3	34

(h) *Unwanted emissions limits.* Unwanted emissions from LPR devices shall not exceed the general emission limit in §15.209 of this chapter.

(i) *Antenna beamwidth.* (A) LPR devices operating under the provisions of this section within the 5.925–7.250 GHz and 24.05–29.00 GHz bands must use an antenna with a –3 dB beamwidth no greater than 12 degrees.

(B) LPR devices operating under the provisions of this section within the 75–85 GHz band must use an antenna with a –3 dB beamwidth no greater than 8 degrees.

(j) *Antenna side lobe gain.* LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in Table 2.

TABLE 2—ANTENNA SIDE LOBE GAIN LIMITS

Frequency range (GHz)	Antenna side lobe gain limit relative to main beam gain (dB)
5.925–7.250 .....	–22
24.05–29.00 .....	–27
75–85 .....	–38

(k) Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in §15.209 of this chapter provided it

can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in §15.3(k) of this part, *e.g.*, emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in subpart B, part 15 of this chapter. Emissions from these digital circuits shall not be employed in determining the –10 dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs.

(1) *Measurement procedures.* (1) Radiated measurements of the fundamental emission bandwidth and power shall be made with maximum main-beam coupling between the LPR and test antennas (boresight).

(2) Measurements of the unwanted emissions radiating from an LPR shall be made utilizing elevation and azimuth scans to determine the location at which the emissions are maximized.

(3) All emissions at and below 1,000 MHz except 9–90 kHz and 110–490 kHz bands are based on measurements employing a CISPR quasi-peak detector.

(4) The fundamental emission bandwidth measurement shall be made using a peak detector with a resolution bandwidth of 1 MHz and a video bandwidth of at least 3 MHz.

(5) The provisions in §15.35(b) and (c) of this part that require emissions to be averaged over a 100 millisecond period and that limits the peak power to 20 dB above the average limit do not apply to devices operating under paragraphs (a) through (1) of this section.

(6) Compliance measurements for minimum emission bandwidth of frequency-agile LPR devices shall be performed with any related frequency sweep, step, or hop function activated.

(7) Compliance measurements shall be made in accordance with the specific procedures published or otherwise authorized by the Commission.

[79 FR 12678, Mar. 6, 2014]



**§ 15.257 Operation within the band 92–95 GHz.**

(a) Operation of devices under the provisions of this section is limited to indoor use;

(1) Devices operating under the provisions of this section, by the nature of their design, must be capable of operation only indoors. The necessity to operate with a fixed indoor infrastructure, e.g., a transmitter that must be connected to the AC power lines, may be considered sufficient to demonstrate this.

(2) The use of outdoor mounted antennas, e.g., antennas mounted on the outside of a building or on a telephone pole, or any other outdoors infrastructure is prohibited.

(3) The emissions from equipment operated under this section shall not be intentionally directed outside of the building in which the equipment is located, such as through a window or a doorway.

(4) Devices operating under the provisions of this section shall bear the following or similar statement in a conspicuous location on the device or in the instruction manual supplied with the device: “This equipment may only be operated indoors. Operation outdoors is in violation of 47 U.S.C. 301 and could subject the operator to serious legal penalties.”

(b) Operation under the provisions of this section is not permitted on aircraft or satellites.

(c) Within the 92–95 GHz bands, the emission levels shall not exceed the following:

(1) The average power density of any emission, measured during the transmit interval, shall not exceed 9 uW/sq. cm, as measured at 3 meters from the radiating structure, and the peak power density of any emission shall not exceed 18 uW/sq. cm, as measured 3 meters from the radiating structure.

(2) Peak power density shall be measured with an RF detector that has a detection bandwidth that encompasses the band being used and has a video bandwidth of at least 10 MHz, or uses an equivalent measurement method.

(3) The average emission limits shall be calculated based on the measured peak levels, over the actual time period during which transmission occurs.

(d) Limits on spurious emissions:

(1) The power density of any emissions outside the band being used shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm<sup>2</sup> at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

(e) The total peak transmitter output power shall not exceed 500 mW.

(f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range –20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

(g) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

[69 FR 3265, Jan. 23, 2004, as amended at 85 FR 18149, Apr. 1, 2020]

**§ 15.258 Operation in the bands 116–123 GHz, 174.8–182 GHz, 185–190 GHz and 244–246 GHz.**

(a) Operation on board an aircraft or a satellite is prohibited.

(b) Emission levels within the 116–123 GHz, 174.8–182 GHz, 185–190 GHz and 244–246 GHz bands shall not exceed the following equivalent isotropically radiated power (EIRP) limits as measured during the transmit interval:

(1) The average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm; or

(2) For fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The provisions in this paragraph (b)(2) for reducing transmit power based on antenna gain shall not require that the power levels be reduced below the limits specified in paragraph (b)(1) of this section.

(3) The peak power shall be measured with a detection bandwidth that encompasses the entire occupied bandwidth within the intended band of operation, *e.g.*, 116–123 GHz, 174.8–182 GHz, 185–190 GHz or 244–246 GHz. The average emission levels shall be measured over the actual time period during which transmission occurs.

(4) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak radiated power to the product of the maximum permissible radiated power (in milliwatts) times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph (b)(4), emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during

normal operation (*e.g.*, for frequency hopping devices).

(c) Spurious emissions shall be limited as follows:

(1) The power density of any emissions outside the band of operation, *e.g.*, 116–123 GHz, 174.8–182 GHz, 185–190 GHz or 244–246 GHz, shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in § 15.209.

(3) Between 40 GHz and the highest frequency specified in § 15.33, the level of these emissions shall not exceed 90 pW/cm<sup>2</sup> at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

(d) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range –20 to + 50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

(e) Regardless of the power density levels permitted under this section, devices operating under the provisions of this section are subject to the radio-frequency radiation exposure requirements specified in §§ 1.1307(b), 2.1091, and 2.1093 of this chapter, as appropriate. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(f) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

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(g) Measurement procedures that have been found to be acceptable to the Commission in accordance with § 2.947 of this chapter may be used to demonstrate compliance.

[84 FR 25691, June 4, 2019]

### Subpart D—Unlicensed Personal Communications Service Devices

SOURCE: 58 FR 59180, Nov. 8, 1993, unless otherwise noted.

#### § 15.301 Scope.

This subpart sets out the regulations for unlicensed personal communications services (PCS) devices operating in the 1920–1930 MHz band.

[69 FR 77949, Dec. 29, 2004]

#### § 15.303 Definitions.

*Asynchronous devices.* Devices that transmit RF energy at irregular time intervals, as typified by local area network data systems.

*Emission bandwidth.* For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Compliance with the emissions limits is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

*Isochronous devices.* Devices that transmit at a regular interval, typified by time-division voice systems.

*Peak transmit power.* The peak power output as measured over an interval of time equal to the frame rate or transmission burst of the device under all conditions of modulation. Usually this parameter 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.

*Personal Communications Services (PCS) Devices [Unlicensed].* Intentional

radiators operating in the frequency band 1920–1930 MHz that provide a wide array of mobile and ancillary fixed communication services to individuals and businesses.

*Spectrum window.* An amount of spectrum equal to the intended emission bandwidth in which operation is desired.

*Thermal noise power.* The noise power in watts defined by the formula  $N = kTB$  where  $N$  is the noise power in watts,  $k$  is Boltzmann's constant,  $T$  is the absolute temperature in degrees Kelvin (e.g., 295 °K) and  $B$  is the emission bandwidth of the device in hertz.

*Time window.* An interval of time in which transmission is desired.

[58 FR 59180, Nov. 8, 1993, as amended at 59 FR 32852, June 24, 1994; 60 FR 13073, Mar. 10, 1995; 69 FR 62620, Oct. 27, 2004; 69 FR 77949, Dec. 29, 2004; 77 FR 43013, July 23, 2012]

#### § 15.305 Equipment authorization requirement.

PCS devices operating under this subpart shall be certified by the Commission under the procedures in subpart J of part 2 of this chapter before marketing. The application for certification must contain sufficient information to demonstrate compliance with the requirements of this subpart.

#### § 15.307 [Reserved]

#### § 15.309 Cross reference.

(a) The provisions of subpart A of this part apply to unlicensed PCS devices, except where specific provisions are contained in subpart D.

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

#### § 15.313 Measurement procedures.

Measurements must be made in accordance with subpart A, except where specific procedures are specified in subpart D. If no guidance is provided, the

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measurement procedure must be in accordance with good engineering practice.

### § 15.315 Conducted limits.

An unlicensed PCS device that is designed to be connected to the public utility (AC) power line must meet the limits specified in § 15.207.

### § 15.317 Antenna requirement.

An unlicensed PCS device must meet the antenna requirement of § 15.203.

### § 15.319 General technical requirements.

(a) [Reserved]

(b) All transmissions must use only digital modulation techniques. Both asynchronous and isochronous operations are permitted within the 1920–1930 MHz band.

(c) Peak transmit power shall not exceed 100 microwatts multiplied by the square root of the emission bandwidth in hertz. Peak transmit 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 for the emission in question over the full bandwidth of the channel.

(d) Power spectral density shall not exceed 3 milliwatts in any 3 kHz bandwidth as measured with a spectrum analyzer having a resolution bandwidth of 3 kHz.

(e) The peak transmit power shall be reduced by the amount in decibels that the maximum directional gain of the antenna exceeds 3 dBi.

(f) The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. The provisions in this section are not intended to preclude transmission of control and signaling information or use of repetitive codes used by certain digital technologies to complete frame or burst intervals.

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(g) Notwithstanding other technical requirements specified in this subpart, attenuation of emissions below the general emission limits in § 15.209 is not required.

(h) Where there is a transition between limits, the tighter limit shall apply at the transition point.

(i) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§ 1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

[58 FR 59180, Nov. 8, 1993, as amended at 59 FR 32852, June 24, 1994; 59 FR 40835, Aug. 10, 1994; 60 FR 13073, Mar. 10, 1995; 61 FR 41018, Aug. 7, 1996; 69 FR 62621, Oct. 27, 2004; 69 FR 77949, Dec. 29, 2004; 77 FR 43013, July 23, 2012; 85 FR 18149, Apr. 1, 2020]

### § 15.321 [Reserved]

### § 15.323 Specific requirements for devices operating in the 1920–1930 MHz band.

(a) Operation shall be contained within the 1920–1930 MHz band. The emission bandwidth shall be less than 2.5 MHz. The power level shall be as specified in § 15.319(c), but in no event shall the emission bandwidth be less than 50 kHz.

(b) [Reserved]

(c) Devices must incorporate a mechanism for monitoring the time and spectrum windows that its transmission is intended to occupy. The following criteria must be met:

(1) Immediately prior to initiating transmission, devices must monitor the combined time and spectrum windows in which they intend to transmit for a period of at least 10 milliseconds for systems designed to use a 10 milliseconds or shorter frame period or at least 20 milliseconds for systems designed to use a 20 milliseconds frame period.

(2) The monitoring threshold must not be more than 30 dB above the thermal noise power for a bandwidth equivalent to the emission bandwidth used by the device.

(3) If no signal above the threshold level is detected, transmission may commence and continue with the same emission bandwidth in the monitored time and spectrum windows without further monitoring. However, occupation of the same combined time and spectrum windows by a device or group of cooperating devices continuously over a period of time longer than 8 hours is not permitted without repeating the access criteria.

(4) Once access to specific combined time and spectrum windows is obtained an acknowledgment from a system participant must be received by the initiating transmitter within one second or transmission must cease. Periodic acknowledgments must be received at least every 30 seconds or transmission must cease. Channels used exclusively for control and signaling information may transmit continuously for 30 seconds without receiving an acknowledgment, at which time the access criteria must be repeated.

(5) If access to spectrum is not available as determined by the above, and a minimum of 20 duplex system access channels are defined for the system, the time and spectrum windows with the lowest power level may be accessed. A device utilizing the provisions of this paragraph must have monitored all access channels defined for its system within the last 10 seconds and must verify, within the 20 milliseconds (40 milliseconds for devices designed to use a 20 milliseconds frame period) immediately preceding actual channel access that the detected power of the selected time and spectrum windows is no higher than the previously detected value. The power measurement resolution for this comparison must be accurate to within 6 dB. No device or group of co-operating devices located within 1 meter of each other shall during any frame period occupy more than 6 MHz of aggregate bandwidth, or alternatively, more than one third of the time and spectrum windows defined by the system.

(6) If the selected combined time and spectrum windows are unavailable, the device may either monitor and select different windows or seek to use the same windows after waiting an amount of time, randomly chosen from a uniform random distribution between 10 and 150 milliseconds, commencing when the channel becomes available.

(7) The monitoring system bandwidth must be equal to or greater than the emission bandwidth of the intended transmission and have a maximum reaction time less than  $50 \times \text{SQRT}(1.25/\text{emission bandwidth in MHz})$  microseconds for signals at the applicable threshold level but shall not be required to be less than 50 microseconds. If a signal is detected that is 6 dB or more above the applicable threshold level, the maximum reaction time shall be  $35 \times \text{SQRT}(1.25/\text{emission bandwidth in MHz})$  microseconds but shall not be required to be less than 35 microseconds.

(8) The monitoring system shall use the same antenna used for transmission, or an antenna that yields equivalent reception at that location.

(9) Devices that have a power output lower than the maximum permitted under this subpart may increase their monitoring detection threshold by one decibel for each one decibel that the transmitter power is below the maximum permitted.

(10) An initiating device may attempt to establish a duplex connection by monitoring both its intended transmit and receive time and spectrum windows. If both the intended transmit and receive time and spectrum windows meet the access criteria, then the initiating device can initiate a transmission in the intended transmit time and spectrum window. If the power detected by the responding device can be decoded as a duplex connection signal from the initiating device, then the responding device may immediately begin transmitting on the receive time and spectrum window monitored by the initiating device.

(11) An initiating device that is prevented from monitoring during its intended transmit window due to monitoring system blocking from the transmissions of a co-located (within one meter) transmitter of the same system,

may monitor the portions of the time and spectrum windows in which they intend to receive over a period of at least 10 milliseconds. The monitored time and spectrum window must total at least 50 percent of the 10 millisecond frame interval and the monitored spectrum must be within 1.25 MHz of the center frequency of channel(s) already occupied by that device or co-located co-operating devices. If the access criteria is met for the intended receive time and spectrum window under the above conditions, then transmission in the intended transmit window by the initiating device may commence.

(12) The provisions of (c)(10) or (c)(11) of this section shall not be used to extend the range of spectrum occupied over space or time for the purpose of denying fair access to spectrum to other devices.

(d) Emissions outside the band shall be attenuated below a reference power of 112 milliwatts as follows: 30 dB between the band and 1.25 MHz above or below the band; 50 dB between 1.25 and 2.5 MHz above or below the band; and 60 dB at 2.5 MHz or greater above or below the band. Emissions inside the band must comply with the following emission mask: In the bands between 1B and 2B measured from the center of the emission bandwidth the total power emitted by the device shall be at least 30 dB below the transmit power permitted for that device; in the bands between 2B and 3B measured from the center of the emission bandwidth the total power emitted by an intentional radiator shall be at least 50 dB below the transmit power permitted for that radiator; in the bands between 3B and the band edge the total power emitted by an intentional radiator in the measurement bandwidth shall be at least 60 dB below the transmit power permitted for that radiator. B'' is defined as the emission bandwidth of the device in hertz. Compliance with the emission limits is based on the use of measurement instrumentation employing peak detector function with an instrument resolution bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

(e) The frame period (a set of consecutive time slots in which the posi-

tion of each time slot can be identified by reference to a synchronizing source) of an intentional radiator operating in this band shall be 20 milliseconds or 10 milliseconds/X where X is a positive whole number. Each device that implements time division for the purposes of maintaining a duplex connection on a given frequency carrier shall maintain a frame repetition rate with a frequency stability of at least 50 parts per million (ppm). Each device which further divides access in time in order to support multiple communication links on a given frequency carrier shall maintain a frame repetition rate with a frequency stability of at least 10 ppm. The jitter (time-related, abrupt, spurious variations in the duration of the frame interval) introduced at the two ends of such a communication link shall not exceed 25 microseconds for any two consecutive transmissions. Transmissions shall be continuous in every time and spectrum window during the frame period defined for the device.

(f) The frequency stability of the carrier frequency of the intentional radiator shall be maintained within  $\pm 10$  ppm over 1 hour or the interval between channel access monitoring, whichever is shorter. The frequency stability shall be maintained over a temperature variation of  $-20^{\circ}$  to  $+50^{\circ}$  °C at normal supply voltage, and over a variation in the primary supply voltage of 85 percent to 115 percent of the rated supply voltage at a temperature of  $20^{\circ}$  °C. For equipment that is capable only of operating from a battery, the frequency stability tests shall be performed using a new battery without any further requirement to vary supply voltage.

[58 FR 59180, Nov. 8, 1993; 59 FR 15269, Mar. 31, 1994. Redesignated at 59 FR 32852, June 24, 1994, as amended at 59 FR 32853, June 24, 1994; 59 FR 40835, Aug. 10, 1994; 59 FR 55373, Nov. 7, 1994; 60 FR 3303, Jan. 13, 1995; 69 FR 62621, Oct. 27, 2004; 77 FR 43013, July 23, 2012]

## Subpart E—Unlicensed National Information Infrastructure Devices

### § 15.401 Scope.

This subpart sets out the regulations for Unlicensed National Information

Infrastructure (U-NII) devices operating in the 5.15–5.35 GHz, 5.47–5.895 GHz bands, and 5.925–7.125 GHz bands.

[86 FR 23295, May 3, 2021]

#### § 15.403 Definitions.

*Access Point (AP).* A U-NII transceiver that operates either as a bridge in a peer-to-peer connection or as a connector between the wired and wireless segments of the network or as a relay between wireless network segments.

*Automated Frequency Coordination (AFC) System.* A system that automatically determines and provides lists of which frequencies are available for use by standard power access points operating in the 5.925–6.425 GHz and 6.525–6.875 GHz bands.

*Available Channel.* A radio channel on which a *Channel Availability Check* has not identified the presence of a radar.

*Average Symbol Envelope Power.* The average symbol envelope power is the average, taken over all symbols in the signaling alphabet, of the envelope power for each symbol.

*Channel Availability Check.* A check during which the U-NII device listens on a particular radio channel to identify whether there is a radar operating on that radio channel.

*Channel Move Time.* The time needed by a U-NII device to cease all transmissions on the current channel upon detection of a radar signal above the DFS detection threshold.

*Client Device.* A U-NII device whose transmissions are generally under the control of an access point and is not capable of initiating a network

*Contention-based protocol.* A protocol that allows multiple users to share the same spectrum by defining the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which a transmitter provides reasonable opportunities for other transmitters to operate. Such a protocol may consist of procedures for initiating new transmissions, procedures for determining the state of the channel (available or unavailable), and procedures for managing retransmissions in the event of a busy channel.

*Digital modulation.* The process by which the characteristics of a carrier wave are varied among a set of predetermined discrete values in accordance with a digital modulating function as specified in document ANSI C63.17–1998.

*Dynamic Frequency Selection (DFS)* is a mechanism that dynamically detects signals from other systems and avoids co-channel operation with these systems, notably radar systems.

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

*Emission bandwidth.* For purposes of this subpart the emission bandwidth is determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier.

*Fixed client device.* For the purpose of this subpart, a client device intended as customer premise equipment that is permanently attached to a structure, operates only on channels provided by an AFC, has a geolocation capability, and complies with antenna pointing angle requirements.

*Indoor Access Point.* For the purpose of this subpart, an access point that operates in the 5.850–5.895 GHz or the 5.925–7.125 GHz band, is supplied power from a wired connection, has an integrated antenna, is not battery powered, and does not have a weatherized enclosure. Indoor access point devices must bear the following statement in a conspicuous location on the device and in the user's manual: FCC regulations restrict operation of this device to indoor use only.

*In-Service Monitoring.* A mechanism to check a channel in use by the U-NII device for the presence of a radar.

*Non-Occupancy Period.* The required period in which, once a channel has been recognized as containing a radar signal by a U-NII device, the channel will not be selected as an available channel.

*Operating Channel.* Once a U-NII device starts to operate on an Available

## § 15.405

Channel then that channel becomes the Operating Channel.

*Maximum Power Spectral Density.* The maximum power spectral density is the maximum power spectral density, within the specified measurement bandwidth, within the U-NII device operating band.

*Maximum Conducted Output Power.* The total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (*e.g.*, alternative modulation methods), the *maximum conducted output power* is the highest total transmit power occurring in any mode.

*Power Spectral Density.* The power spectral density is the total energy output per unit bandwidth from a pulse or sequence of pulses for which the transmit power is at its maximum level, divided by the total duration of the pulses. This total time does not include the time between pulses during which the transmit power is off or below its maximum level.

*Pulse.* A pulse is a continuous transmission of a sequence of modulation symbols, during which the average symbol envelope power is constant.

*RLAN.* Radio Local Area Network.

*Standard Power Access Point.* An access point that operates in the 5.925–6.425 GHz and 6.525–6.875 GHz bands pursuant to direction from an Automated Frequency Coordination System.

*Subordinate Device.* For the purpose of this subpart, a device that operates in the 5.850–5.895 GHz band or in the 5.925–7.125 GHz band under the control of an Indoor Access Point, is supplied power from a wired connection, has an integrated antenna, is not battery powered, does not have a weatherized enclosure, and does not have a direct connection to the internet. Subordinate devices must not be used to connect devices between separate buildings or structures. Subordinate devices must be authorized under certification procedures in

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part 2 of this chapter. Modules may not be certified as subordinate devices.

*Transmit Power Control (TPC).* A feature that enables a U-NII device to dynamically switch between several transmission power levels in the data transmission process.

*U-NII devices.* Intentional radiators operating in the frequency bands 5.15–5.35 GHz, 5.47–5.895 GHz, and 5.925–7.125 GHz that use wideband digital modulation techniques and provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions.

[85 FR 31410, May 26, 2020, as amended at 86 FR 23295, May 3, 2021]

### § 15.405 Cross reference.

(a) The provisions of subparts A, B, and C of this part apply to unlicensed U-NII devices, except where specific provisions are contained in subpart E. Manufacturers should note that this includes the provisions of §§ 15.203 and 15.205.

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

[63 FR 40835, July 31, 1998]

### § 15.407 General technical requirements.

(a) *Power limits:*

(1) For the band 5.15–5.25 GHz.

(i) For an outdoor access point operating in the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6



dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For client devices in the 5.15–5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz

band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) *For the band 5.725–5.895 GHz:* (i) For the band 5.725–5.850 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum 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 operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(ii) For an indoor access point operating in the 5.850–5.895 GHz band, the maximum power spectral density must not exceed 20 dBm e.i.r.p. in any 1–

megahertz band. In addition, the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm. Indoor access points operating on a channel that spans the 5.725–5.850 GHz and 5.850–5.895 GHz bands must not exceed an e.i.r.p. of 36 dBm.

(iii) For client devices operating under the control of an indoor access point in the 5.850–5.895 GHz band, the maximum power spectral density must not exceed 14 dBm e.i.r.p. in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 30 dBm. Client devices operating on a channel that spans the 5.725–5.850 GHz and 5.850–5.895 GHz bands must not exceed an e.i.r.p. of 30 dBm.

(iv) For a subordinate device operating under the control of an indoor access point in the 5.850–5.895 GHz band, the maximum power spectral density must not exceed 20 dBm e.i.r.p. in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm.

(v) In the 5.850–5.895 GHz band, client devices must operate under the control of an indoor access point. In all cases, an exception exists for transmitting brief messages to an access point when attempting to join its network after detecting a signal that confirms that an access point is operating on a particular channel. Access points may connect to other access points. Client devices are prohibited from connecting directly to another client device.

NOTE TO PARAGRAPH (a)(3): The Commission strongly recommends that parties employing U-NII devices to provide critical communications services should determine if there are any nearby Government radar systems that could affect their operation.

(4) For a standard power access point and fixed client device operating in the 5.925–6.425 GHz and 6.525–6.875 GHz bands, the maximum power spectral density must not exceed 23 dBm e.i.r.p. in any 1-megahertz band. In addition, the maximum e.i.r.p. over the frequency band of operation must not exceed 36 dBm. For outdoor devices, the maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(5) For an indoor access point operating in the 5.925–7.125 GHz band, the maximum power spectral density must not exceed 5 dBm e.i.r.p. in any 1-megahertz band. In addition, the maximum e.i.r.p. over the frequency band of operation must not exceed 30 dBm.

(6) For a subordinate device operating under the control of an indoor access point in the 5.925–7.125 GHz band, the maximum power spectral density must not exceed 5 dBm e.i.r.p. in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 30 dBm.

(7) For client devices, except for fixed client devices as defined in this subpart, operating under the control of a standard power access point in 5.925–6.425 GHz and 6.525–6.875 GHz bands, the maximum power spectral density must not exceed 17 dBm e.i.r.p. in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 30 dBm and the device must limit its power to no more than 6 dB below its associated standard power access point's authorized transmit power.

(8) For client devices operating under the control of an indoor access point in the 5.925–7.125 GHz bands, the maximum power spectral density must not exceed –1 dBm e.i.r.p. in any 1-megahertz band, and the maximum e.i.r.p. over the frequency band of operation must not exceed 24 dBm.

(9) Access points operating under the provisions of paragraphs (a)(5) and (a)(6) of this section must employ a permanently attached integrated antenna.

(10) The maximum transmitter channel bandwidth for U-NII devices in the 5.925–7.125 GHz band is 320 megahertz.

(11) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

(12) Power spectral density measurement: 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 in the

5.725–5.895 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in all other bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

(b) *Undesirable emission limits.* Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15–5.25 GHz band: All emissions outside of the 5.15–5.35 GHz band shall not exceed an e.i.r.p. of –27 dBm/MHz.

(2) For transmitters operating in the 5.25–5.35 GHz band: All emissions outside of the 5.15–5.35 GHz band shall not exceed an e.i.r.p. of –27 dBm/MHz.

(3) For transmitters operating in the 5.47–5.725 GHz band: All emissions outside of the 5.47–5.725 GHz band shall not exceed an e.i.r.p. of –27 dBm/MHz.

(4) For transmitters operating solely in the 5.725–5.850 GHz band:

(i) All emissions shall be limited to a level of –27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

(5) For transmitters operating solely in the 5.850–5.895 GHz band or operating

on a channel that spans across 5.725–5.895 GHz:

(i) For an indoor access point or subordinate device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of 15 dBm/MHz and shall decrease linearly to an e.i.r.p. of –7 dBm/MHz at or above 5.925 GHz.

(ii) For a client device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of –5 dBm/MHz and shall decrease linearly to an e.i.r.p. of –27 dBm/MHz at or above 5.925 GHz.

(iii) For a client device or indoor access point or subordinate device, all emissions below 5.725 GHz shall not exceed an e.i.r.p. of –27 dBm/MHz at 5.65 GHz increasing linearly to 10 dBm/MHz at 5.7 GHz, and from 5.7 GHz increasing linearly to a level of 15.6 dBm/MHz at 5.72 GHz, and from 5.72 GHz increasing linearly to a level of 27 dBm/MHz at 5.725 GHz.

(6) For transmitters operating within the 5.925–7.125 GHz band: Any emissions outside of the 5.925–7.125 GHz band must not exceed an e.i.r.p. of –27 dBm/MHz.

(7) For transmitters operating within the 5.925–7.125 GHz bands: Power spectral density must be suppressed by 20 dB at 1 MHz outside of channel edge, by 28 dB at one channel bandwidth from the channel center, and by 40 dB at one- and one-half times the channel bandwidth away from channel center. At frequencies between one megahertz outside an unlicensed device's channel edge and one channel bandwidth from the center of the channel, the limits must be linearly interpolated between 20 dB and 28 dB suppression, and at frequencies between one and one- and one-half times an unlicensed device's channel bandwidth, the limits must be linearly interpolated between 28 dB and 40 dB suppression. Emissions removed from the channel center by more than one- and one-half times the channel bandwidth must be suppressed by at least 40 dB.

(8) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(9) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(10) The provisions of §15.205 apply to intentional radiators operating under this section.

(11) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

(c) 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 signalling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

(d) *Operational restrictions for 6 GHz U-NII devices.* (1) Operation of standard access points, fixed client devices and indoor access points in the 5.925–7.125 GHz band is prohibited on oil platforms, cars, trains, boats, and aircraft, except that indoor access points are permitted to operate in the 5.925–6.425 GHz bands in large aircraft while flying above 10,000 feet.

(2) Operation of transmitters in the 5.925–7.125 GHz band is prohibited for control of or communications with unmanned aircraft systems.

(3) Transmitters operating under the provisions of paragraphs (a)(5), (a)(6), and (a)(8) of this section are limited to indoor locations.

(4) In the 5.925–7.125 GHz band, indoor access points and subordinate devices must bear the following statement in a conspicuous location on the device and in the user's manual: FCC regulations restrict operation of this device to indoor use only. The operation of this device is prohibited on oil platforms, cars, trains, boats, and aircraft, except that operation of this device is permitted in large aircraft while flying above 10,000 feet.

(5) In the 5.925–7.125 GHz band, client devices, except fixed client devices, must operate under the control of a standard power access point, indoor access point or subordinate devices; Subordinate devices must operate under the control of an indoor access point. In all cases, an exception exists for transmitting brief messages to an access point when attempting to join its network after detecting a signal that confirms that an access point is operating on a particular channel. Access points and subordinate devices may connect to other access points or subordinate devices. Client devices are prohibited from connecting directly to another client device.

(6) Indoor access points, subordinate devices and client devices operating in the 5.925–7.125 GHz band must employ a contention-based protocol.

(7) Fixed client devices may only connect to a standard power access point.

(e) Within the 5.725–5.850 GHz and 5.850–5.895 GHz bands, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

(f) Radio frequency devices operating under the provisions of this part are subject to the radio frequency radiation exposure requirements specified in §§1.1307(b), 1.1310, 2.1091, and 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of mobile or portable devices operating under this section must contain a statement confirming compliance with these requirements. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(g) Manufacturers of U-NII 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 users manual.

(h) Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS).

(1) 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.

(2) Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating with any part of its 26 dB emission bandwidth 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. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is –64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is –62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna. For the initial channel setting, the manufacturers shall be permitted to provide for either random channel selection or manual channel selection.

(i) Operational Modes. The DFS requirement applies to the following operational modes:

(A) The requirement for channel availability check time applies in the master operational mode.

(B) The requirement for channel move time applies in both the master and slave operational modes.

(ii) Channel Availability Check Time. 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 paragraph (h)(2) of this section, is detected within 60 seconds.

(iii) Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall con-

sist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(iv) Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

(i) *Device Security*. All U-NII devices must contain security features to protect against modification of software by unauthorized parties.

(1) Manufacturers must implement security features in any digitally modulated devices capable of operating in any of the U-NII bands, so that third parties are not able to reprogram the device to operate outside the parameters for which the device was certified. The software must prevent the user from operating the transmitter with operating frequencies, output power, modulation types or other radio frequency parameters outside those that were approved for the device. Manufacturers may use means including, but not limited to the use of a private network that allows only authenticated users to download software, electronic signatures in software or coding in hardware that is decoded by software to verify that new software can be legally loaded into a device to meet these requirements and must describe the methods in their application for equipment authorization.

(2) Manufacturers must take steps to ensure that DFS functionality cannot be disabled by the operator of the U-NII device.

(j) *Operator Filing Requirement*: Before deploying an aggregate total of more than one thousand outdoor access points within the 5.15–5.25 GHz band, parties must submit a letter to the Commission acknowledging that, should harmful interference to licensed services in this band occur, they will be required to take corrective action. Corrective actions may include reducing power, turning off devices, changing

frequency bands, and/or further reducing power radiated in the vertical direction. This material shall be submitted to Laboratory Division, Office of Engineering and Technology, Federal Communications Commission, 7435 Oakland Mills Road, Columbia, MD 21046. Attn: U-NII Coordination, or via Web site at <https://www.fcc.gov/labhelp> with the SUBJECT LINE: “U-NII-1 Filing”.

(k) *Automated frequency coordination (AFC) system.* (1) Standard power access points and fixed client devices operating under paragraph (a)(4) of this section must access an AFC system to determine the available frequencies and the maximum permissible power in each frequency range at their geographic coordinates prior to transmitting. Standard power access points and fixed client devices may transmit only on frequencies and at power levels that an AFC system indicates as available.

(2) An AFC system must be capable of determining the available frequencies in steps of no greater than 3 dB below the maximum permissible e.i.r.p of 36 dBm, and down to at least a minimum level of 21 dBm.

(3) An AFC system must obtain information on protected services within the 5.925–6.425 GHz and 6.525–6.875 GHz bands from Commission databases and use that information to determine frequency availability for standard power access points and fixed client devices based on protection criteria specified in paragraph (1)(2) of this section.

(4) An AFC system must use the information supplied by standard power access points and fixed client devices during registration, as set forth in this section, to determine available frequencies and the maximum permissible power in each frequency range for a standard power access point at any given location. All such determinations and assignments must be made in a non-discriminatory manner, consistent with this part.

(5) An AFC system must store registered information in a secure database until a standard power access point or fixed client device ceases operation at a location. For the purpose of this paragraph, a standard power access point or fixed client device is considered to have ceased operation when

that device has not contacted the AFC system for more than three months to verify frequency availability information.

(6) An AFC system must verify the validity of the FCC identifier (FCC ID) of any standard power access point and fixed client device seeking access to its services prior to authorizing the access point to begin operation. A list of standard power access points with valid FCC IDs and the FCC IDs of those devices must be obtained from the Commission’s Equipment Authorization System.

(7) The general purposes of AFC system include:

(i) Enacting all policies and procedures developed by the AFC system operators pursuant to this section.

(ii) Registering, authenticating, and authorizing standard power access point and fixed client device operations, individually or through a network element device representing multiple standard power access points from the same operating network.

(iii) Providing standard power access points and fixed client devices with the permissible frequencies and the maximum permissible power in each frequency range at their locations using propagation models and interference protection criteria defined in paragraph (1) of this section.

(iv) Obtaining updated protected sites information from Commission databases.

(8) Standard power access points and fixed client devices:

(i) Must register with and be authorized by an AFC system prior to the standard power access point and fixed client device’s initial service transmission, or after a standard power access point or fixed client device changes location, and must obtain a list of available frequencies and the maximum permissible power in each frequency range at the standard power access point and fixed client device’s location.

(ii) Must register with the AFC system by providing the following parameters: Geographic coordinates (latitude and longitude referenced to North American Datum 1983 (NAD 83)), antenna height above ground level, FCC identification number, and unique

manufacturer's serial number. If any of these parameters change, the standard power access point or fixed client device must provide updated parameters to the AFC system. All information provided by the standard power access point and the fixed client device to the AFC system must be true, complete, correct, and made in good faith.

(iii) Must provide the registration information to the AFC system either directly and individually or by a network element representing multiple standard power access points or fixed client devices from the same operating network. The standard power access point, fixed client device or its network element must register with the AFC system via any communication link, wired or wireless, outside 5.925–6.425 GHz and 6.525–6.875 GHz bands.

(iv) Must contact an AFC system at least once per day to obtain the latest list of available frequencies and the maximum permissible power the standard power access point or fixed client device may operate with on each frequency at the standard power access point and fixed client device's location. If the standard power access point or fixed client device fails to successfully contact the AFC system during any given day, the standard power access point or fixed client device may continue to operate until 11:59 p.m. of the following day at which time it must cease operations until it re-establishes contact with the AFC system and re-verifies its list of available frequencies and associated power levels.

(v) Must incorporate adequate security measures to prevent it from accessing AFC systems not approved by the FCC and to ensure that unauthorized parties cannot modify the device to operate in a manner inconsistent with the rules and protection criteria set forth in this section and to ensure that communications between standard power access points, fixed client devices and AFC systems are secure to prevent corruption or unauthorized interception of data. Additionally, the AFC system must incorporate security measures to protect against unauthorized data input or alteration of stored data, including establishing communications authentication procedures

between client devices and standard power access points.

(9) Standard power access point and fixed client device geo-location capability:

(i) A standard power access point and a fixed client device must include either an internal geo-location capability or an integrated capability to securely connect to an external geolocation devices or service, to automatically determine the standard power access point's geographic coordinates and location uncertainty (in meters), with a confidence level of 95%. The standard power access point and fixed client device must report such coordinates and location uncertainty to an AFC system at the time of activation from a power-off condition.

(ii) An external geo-location source may be connected to a standard power access point or fixed client device through either a wired or a wireless connection. A single geo-location source may provide location information to multiple standard power access points or fixed client devices.

(iii) An external geo-location source must be connected to a standard power access point or fixed client device using a secure connection that ensures that only an external geo-location source approved for use with a standard power access point or fixed client device provides geographic coordinates to that standard power access point or fixed client device. Alternatively, an extender cable may be used to connect a remote receive antenna to a geo-location receiver within a standard power access point or fixed client device.

(iv) The applicant for certification of a standard power access point or fixed client device must demonstrate the accuracy of the geo-location method used and the location uncertainty. For standard power access points and fixed client devices that may not use an internal geo-location capability, this uncertainty must account for the accuracy of the geo-location source and the separation distance between such source and the standard power access point or fixed client device.

(10) An AFC system operator will be designated for a five-year term which can be renewed by the Commission based on the operator's performance

during the term. If an AFC system ceases operation, it must provide at least 30-days' notice to the Commission and transfer any registration data to another AFC system operator.

(11) The Commission will designate one or more AFC system operators to provide service in the 5.925–6.425 GHz and 6.525–6.875 GHz bands.

(12) The Commission may permit the functions of an AFC system, such as a data repository, registration, and query services, to be divided among multiple entities; however, entities designated as AFC system operators will be held accountable for the overall functioning and system administration of the AFC system.

(13) The AFC system must ensure that all communications and interactions between the AFC system and standard power access points and fixed client devices are accurate and secure and that unauthorized parties cannot access or alter the database, or the list of available frequencies and associated powers sent to a standard power access point.

(14) An AFC system must implement the terms of international agreements with Mexico and Canada.

(15) Each AFC system operator designated by the Commission must:

(i) Maintain a regularly updated AFC system database that contains the information described in this section, including incumbent's information and standard power access points and fixed client devices registration parameters.

(ii) Establish and follow protocols and procedures to ensure compliance with the rules set forth in this part.

(iii) Establish and follow protocols and procedures sufficient to ensure that all communications and interactions between the AFC system and standard power access points and fixed client devices are accurate and secure and that unauthorized parties cannot access or alter the AFC system, or the information transmitted from the AFC system to standard power access points or fixed client devices.

(iv) Provide service for a five-year term. This term may be renewed at the Commission's discretion.

(v) Respond in a timely manner to verify, correct, or remove, as appropriate, data in the event that the Com-

mission or a party presents to the AFC system Operator a claim of inaccuracies in the AFC system. This requirement applies only to information that the Commission requires to be stored in the AFC system.

(vi) Establish and follow protocols to comply with enforcement instructions from the Commission, including discontinuance of standard power access point operations in designated geographic areas.

(16) An AFC system operator may charge fees for providing service in registration and channel availability functions. The Commission may, upon request, review the fees and can require changes to those fees if the Commission finds them unreasonable.

(1) *Incumbent Protection by AFC system: Fixed Microwave Services.* A standard power access point or fixed client device must not cause harmful interference to fixed microwave services authorized to operate in the 5.925–6.425 GHz and 6.525–6.875 GHz bands. Based on the criteria set forth below, an AFC system must establish location and frequency-based exclusion zones (both co-channel and adjacent channel) around fixed microwave receivers operating in the 5.925–6.425 GHz and 6.525–6.875 GHz bands. Individual standard power access points and fixed client devices must not operate co-channel to fixed microwave system frequencies within co-channel exclusion zones, or on adjacent channel frequencies within adjacent channel exclusion zones.

(1) *Propagation Models:* Propagation models to determine the appropriate separation distance between a standard power access point or a fixed client device and an incumbent fixed microwave service receiver. For a separation distance:

(i) Up to 30 meters, the AFC system must use the free space path-loss model.

(ii) More than 30 meters and up to and including one kilometer, the AFC system must use the Wireless World Initiative New Radio phase II (WINNER II) model. The AFC system must use site-specific information, including buildings and terrain data, for determining the line-of-sight/non-line-of-sight path component in the WINNER II model, where such data is available.



For evaluating paths where such data is not available, the AFC system must use a probabilistic model combining the line-of-sight path and non-line-of-sight path into a single path-loss as follows:

$$\text{Path-loss (L)} = \sum_i P(i) * L_i = P_{\text{LOS}} * L_{\text{LOS}} + P_{\text{NLOS}} * L_{\text{NLOS}},$$

where  $P_{\text{LOS}}$  is the probability of line-of-sight,  $L_{\text{LOS}}$  is the line-of-sight path loss,  $P_{\text{NLOS}}$  is the probability of non-line-of-sight,  $L_{\text{NLOS}}$  is the non-line-of-sight path loss, and  $L$  is the combined path loss. The WINNER II path loss models include a formula to determine  $P_{\text{LOS}}$  as a function of antenna heights and distance.  $P_{\text{NLOS}}$  is equal to  $(1 - P_{\text{LOS}})$ . In all cases, the AFC system will use the correct WINNER II parameters to match the morphology of the path between a standard power access point and a fixed microwave receiver (*i.e.*, Urban, Suburban, or Rural).

(iii) More than one kilometer, the AFC system must use Irregular Terrain Model (ITM) combined with the appropriate clutter model. To account for the effects of clutter, such as buildings and foliage, that the AFC system must combine the ITM with the ITU-R P.2108-0 (06/2017) clutter model for urban and suburban environments and the ITU-R P.452-16 (07/2015) clutter model for rural environments. The AFC system should use the most appropriate clutter category for the local morphology when using ITU-R P.452-16. However, if detailed local information is not available, the “Village Centre” clutter category should be used. The AFC system must use 1 arc-second digital elevation terrain data and, for locations where such data is not available, the most granular available digital elevation terrain data.

(2) Interference Protection Criteria:

(i) The AFC system must use  $-6$  dB I/N as the interference protection criteria in determining the size of the co-channel exclusion zone where  $I$  (interference) is the co-channel signal from the standard power access point or fixed client device at the fixed microwave service receiver, and  $N$  (noise) is background noise level at the fixed microwave service receiver.

(ii) The AFC system must use  $-6$  dB I/N as the interference protection cri-

teria in determining the size of the adjacent channel exclusion zone, where  $I$  (interference) is the signal from the standard power access point or fixed client device's out of channel emissions at the fixed microwave service receiver and  $N$  (noise) is background noise level at the fixed microwave service receiver. The adjacent channel exclusion zone must be calculated based on the emissions requirements of paragraph (b)(6) of this section.

(m) *Incumbent Protection by AFC system: Radio Astronomy Services.* The AFC system must enforce an exclusion zones to the following radio observatories that observe between 6650–6675.2 MHz: Arecibo Observatory, the Green Bank Observatory, the Very Large Array (VLA), the 10 Stations of the Very Long Baseline Array (VLBA), the Owens Valley Radio Observatory, and the Allen Telescope Array. The exclusion zone sizes are based on the radio line-of-sight and determined using  $\frac{4}{3}$  earth curvature and the following formula:

$$\text{dkm\_los} = 4.12 * (\text{sqrt}(\text{Htx}) + \text{sqrt}(\text{Hrx})),$$

where  $\text{Htx}$  is the height of the unlicensed standard power access point or fixed client device and  $\text{Hrx}$  is the height of the radio astronomy antenna in meters above ground level. Coordinate locations of the radio observatories are listed in section 2.106, notes US 131 and US 385 of this part.

(n) *Incumbent Protection by AFC system: Fixed-Satellite Services.* Standard power access points and fixed client devices located outdoors must limit their maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon to 21 dBm (125 mW) to protect fixed satellite services.

[63 FR 40836, July 31, 1998, as amended at 69 FR 2687, Jan. 20, 2004; 69 FR 54036, Sept. 7, 2004; 79 FR 24579, May 1, 2014; 79 FR 56988, Sept. 24, 2014; 79 FR 76903, Dec. 23, 2014; 81 FR 19901, Apr. 6, 2016; 85 FR 18149, Apr. 1, 2020; 85 FR 31411, May 26, 2020; 86 FR 23295, May 3, 2021]

## Subpart F—Ultra-Wideband Operation

SOURCE: 67 FR 34856, May 16, 2002, unless otherwise noted.