

Regulations

29

Glossary

Amateur Service—A radio communication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.

Auxiliary station—An amateur station, other than in a message-forwarding system, transmitting communications point-to-point within a system of cooperating amateur stations.

Bandwidth—The width of a frequency band outside of which the mean power of the transmitted signal is attenuated at least 26 dB below the mean power of the transmitted signal within the band.

Beacon—An amateur station transmitting communications for the purposes of observation of propagation and reception or other related experimental activities.

Broadcasting—Transmissions intended for reception by the general public, either direct or relayed.

Carrier power—The average power supplied to the antenna transmission line by a transmitter during one RF cycle taken under the condition of no modulation.

Certification—An equipment authorization granted by the FCC. It is used to ensure that equipment will function properly in the service for which it has been accepted. Most amateur equipment does not require FCC certification, although HF power amplifiers and amplifier kits do. Part 15 Rules require FCC certification for all receivers operating anywhere between 30 and 960 MHz. Amateur transmitters may not be legally used in any other service that requires FCC equipment authorization. For example, it is illegal to modify an amateur transmitter to operate on police, fire or business services.

Control operator—An amateur operator designated by the licensee of a station to be responsible for the transmissions from that station to assure compliance with the FCC Rules.

Control point—The location at which the control operator function is performed.

Covenants—Private contractual agreements between two parties. PRB-1 does not apply to such agreements

CW—International Morse code telegraphy emissions having designators with A, C, H, J or R as the first symbol; 1 as the second symbol; A or B as the third symbol; and emissions J2A and J2B. See the sidebar, “[Classification of Emissions](#).”

Data—Telemetry, telecommand and computer communications emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1 as the second symbol; D as the third symbol; and emission J2D. Only a digital code of a type specifically authorized in this Part may be transmitted. See the sidebar, “[Classification of Emissions](#).”

External RF power amplifier—A device capable of increasing power output when used in conjunction with, but not an integral part of, a transmitter.

External RF power amplifier kit—A number of electronic parts, which, when assembled, is an external RF power amplifier, even if additional parts are required to complete assembly.

FCC—Federal Communications Commission.

Frequency coordinator—An entity, recognized in a local or regional area by amateur operators whose stations are eligible to be auxiliary or repeater stations, that recommends transmit/receive channels and associated operating and technical parameters for such stations in order to avoid or minimize potential interference.

Harmful interference—Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs or repeatedly interrupts a radiocommunication service operating in accordance with the international Radio Regulations.

Image—Facsimile and television emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1, 2 or 3 as the second symbol; C or F as the third symbol; and emissions having B as the first symbol; 7, 8 or 9 as the second symbol; W as the third symbol. See the sidebar, “[Classification of Emissions.](#)”

Information bulletin—A message directed only to amateur operators consisting solely of subject matter of direct interest to the amateur service.

International Morse code—A dot-dash code as defined in International Telegraph and Telephone Consultative Committee (CCITT) Recommendation F.1 (1984), Division B, I. Morse Code.

ITU—International Telecommunication Union.

Key clicks—Undesired switching transients beyond the necessary bandwidth of a Morse code transmission caused by improperly shaped modulation envelopes.

Mean power—The average power supplied to an antenna transmission line during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions.

Necessary bandwidth—The width of the transmitted frequency band which is just sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions.

Out-of-band emission (splatter)—An emission on a frequency immediately outside the necessary bandwidth caused by overmodulation on peaks (excluding spurious emissions).

PEP (peak envelope power)—The average power supplied to the antenna transmission line by a transmitter during one RF cycle at the crest of the modulation envelope taken under normal operating conditions.

Phone—Emissions carrying speech or other sound information having designators with A, C, D, F, G, H, J or R as the first symbol; 1, 2 or 3 as the second symbol; E as the third symbol. Also speech emissions having B as the first symbol; 7, 8 or 9 as the second symbol; E as the third symbol. See the sidebar, “[Classification of Emissions.](#)”

Power—Power is expressed in three ways: (1) Peak envelope power (PEP); (2) Mean power; and (3) Carrier power.

PRB-1—The limited federal government preemption of local zoning ordinances which states that local zoning authorities must be reasonable and that regulation must represent the minimum practicable to accomplish its legitimate purpose.

Pulse—Emissions having designators with K, L, M, P, Q, V or W as the first symbol; 0, 1, 2, 3, 7, 8, 9 or X as the second symbol; A, B, C, D, E, F, N, W or X as the third symbol. See the sidebar, “[Classification of Emissions.](#)”

RF—Radio frequency.

Radio Regulations—The latest ITU *Radio Regulations*.

RACES (Radio Amateur Civil Emergency Service)—A radio service that uses amateur stations for civil defense communications during periods of local, regional or national civil emergencies.

Remote control—The use of a control operator who indirectly manipulates the operating adjustments in the station through a control link to achieve compliance with the FCC Rules.

Repeater—An amateur station that simultaneously retransmits the signals of other stations on a different channel or channels.

RTTY—Narrow-band direct-printing telegraphy emissions having designators with A, C, D, F, G, H, J or R as the first symbol; 1 as the second symbol; B as the third symbol; and emission J2B. See the sidebar, “[Classification of Emissions](#).”

Space station—An amateur station located more than 50 km above the Earth’s surface.

Splatter—See [Out-of-band emission](#).

Spread Spectrum (SS)—Emissions using bandwidth-expansion modulation emissions having designators with A, C, D, F, G, H, J or R as the first symbol; X as the second symbol; X as the third symbol. See the sidebar, “[Classification of Emissions](#).”

Spurious emission—An emission, on frequencies outside the necessary bandwidth of a transmission, the level of which may be reduced without affecting the information being transmitted. They include harmonic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Telecommand—A one-way transmission to initiate, modify, or terminate functions of a device at a distance.

Telecommand station—An amateur station that transmits communications to initiate, modify, or terminate functions of a space station.

Telemetry—A one-way transmission of measurements at a distance from the measuring instrument.

Test—Emissions containing no information having the designators with N as the third symbol. Test does not include pulse emissions with no information or modulation unless pulse emissions are also authorized in the frequency band. See the sidebar, “[Classification of Emissions](#).”

International and national radio regulations govern the operational and technical standards of all radio stations. The International Telecommunication Union (ITU) governs telecommunications on the international level and broadly defines radio services through the international Radio Regulations. In the United States, its trust territories and possessions, the agency responsible for nongovernmental and nonmilitary stations is the Federal Communications Commission (FCC). Title 47 of the *US Code of Federal Regulations* governs telecommunications. Different rule Parts of Title 47 govern the various radio services in the US. The Amateur Radio Service is governed by Part 97. Some other Parts are described in the sidebar “Other FCC Rule ‘Parts’.” *The ARRL RFI Book* contains a detailed chapter on these FCC Rule parts which affect Amateur Radio directly and indirectly.

Experimentation has been the backbone of Amateur Radio for almost a century and the amateur rules provide a framework within which amateurs have wide latitude to experiment in accordance with the basis and purpose of the service. The rules should be viewed as vehicles to promote healthy activity and growth, not as constraints that lead to stagnation. A brief overview of Amateur Radio regulations follows with special emphasis on technical standards.

BASIS AND PURPOSE OF THE AMATEUR RADIO SERVICE

There’s much more in the regulatory scheme than Part 97. The basis for the FCC regulations is found in treaties, international agreements and statutes that provide for the allocation of frequencies and place conditions on how the frequencies are to be used. For example, Article S25 of the international *Radio Regulations* limits the types of international communications amateur stations may transmit and mandates that the technical qualifications of amateur operators be verified.

Other FCC Rule “Parts”

Part 97 is just a small piece of the overall regulatory picture. An up-to-date copy of Part 97 can be found on the web at <http://www.arrl.org/field/regulations/news/part97>. The *US Code of Federal Regulations*, Title 47, consists of telecommunications rules numbered as Parts 0 through 300. These Parts contain specific rules for the many telecommunications services the FCC administers. Individuals may purchase or obtain from the Web a specific rule Part for a particular service from the Superintendent of Documents, US Government Printing Office (see the Address List in the [References](#) chapter). Here is a list of FCC Parts amateurs may find of interest:

Part

- 0 Commission organization
- 1 Practice and procedure
- 2 Frequency allocation and radio treaty matters; general rules and regulations, and type acceptance procedures
- 15 Low-power radio-frequency transmitting devices
- 17 Construction, marking and lighting of antenna structures
- 18 Industrial, scientific and medical equipment
- 73 Radio broadcast services
- 76 Cable Television Service
- 90 Private Land Mobile Radio Service
- 95 Personal radio services, including CB and GMRS
- 97 Amateur Radio Service

It's the FCC's responsibility to see that amateurs are able to operate their stations in a manner consistent with the basis and purpose of the amateur rules. The FCC must also ensure that amateurs have the knowledge and ability to operate powerful and potentially dangerous equipment safely without causing harmful interference to others. The sidebar “The FCC's Role” discusses the Commission in a bit more detail. A review of each of the five basic purposes of the Amateur Radio Service, as they appear in Part 97, follows:

Recognition and enhancement of the value of the amateur service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications [97.1(a)].

Probably the best known aspect of Amateur Radio to the general public is its ability to provide emergency communications. One of the most important aspects of the service is its noncommercial nature. Amateurs are prohibited from receiving any form of payment for operating their stations.

Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art [97.1(b)].

For nearly a century, hams have carried on a tradition of learning by doing, and since the beginning have remained at the forefront of technology. Through experimenting and building, hams have pioneered advances, such as techniques for single-sideband transmissions, and are currently engaged in the development of new digital schemes which continue to improve the efficiency of such communications. Hams' practical experience has led to technical refinements and cost reductions beneficial to the commercial radio industry.

Encouragement and improvement of the Amateur Radio Service through rules which provide for advancing skills in both the communication and technical phases of the art [97.1(c)].

Amateurs have always been experimenters and that's what sets the Amateur Service apart from other services. The cost to the government for licensing and enforcement is minimal when compared to the benefit the public receives. Hams have contributed greatly to the development of

Classification of Emissions

§2.201 Emission, modulation and transmission characteristics.

The following system of designating emission, modulation and transmission characteristics shall be employed.

- (a) Emissions are designated according to their classification and their necessary bandwidth.
- (b) A minimum of three symbols are used to describe the basic characteristics of radio waves.

Emissions are classified and symbolized according to the following characteristics:

- (1) First symbol—type of modulation of the main carrier;
- (2) Second symbol—nature of signal(s) modulating the main carrier;
- (3) Third symbol—type of information to be transmitted.

Note: A fourth and fifth symbol are provided for additional information and are shown in Appendix 6, Part A of the ITU Radio Regulations. Use of the fourth and fifth symbol is optional. Therefore, the symbols may be used as described in Appendix 6, but are not required by the Commission.

(c) First symbol—types of modulation of the main carrier:

- | | |
|--|---|
| (1) Emission of an unmodulated carrier | N |
| (2) Emission in which the main carrier is amplitude-modulated (including cases where subcarriers are angle-modulated): | |
| —Double sideband | A |
| —Single sideband, full carrier | H |
| —Single sideband, reduced or variable level carrier | R |
| —Single sideband, suppressed carrier | J |
| —Independent sidebands | B |
| —Vestigial sideband | C |
| (3) Emission in which the main carrier is angle-modulated: | |
| —Frequency modulation | F |
| —Phase modulation | G |

Note: Whenever frequency modulation (F) is indicated, phase modulation (G) is also acceptable.

- | | |
|--|---|
| (4) Emission in which the main carrier is amplitude- and angle-modulated either simultaneously or in a pre-established sequence | D |
| (5) Emission of pulses ¹ | |
| —Sequence of unmodulated pulses | P |
| —A sequence of pulses: | |
| —Modulated in amplitude | K |
| —Modulated in width/duration | L |
| —Modulated in position/phase | M |
| —In which the carrier is angle-modulated during the period of the pulse | Q |
| —Which is a combination of the foregoing or is produced by other means | V |
| (6) Cases not covered above, in which an emission consists of the main carrier modulated, either simultaneously or in a pre-established sequence in a combination of two or more of the following modes: amplitude, angle, pulse | W |
| (7) Cases not otherwise covered | X |
| (d) Second Symbol—nature of signal(s) modulating the main carrier: | |
| (1) No modulating signal | 0 |
| (2) A single channel containing quantized or digital information without the use of a modulating subcarrier, excluding time-division multiplex | 1 |
| (3) A single channel containing quantized or digital information with the use of a modulating subcarrier, time-division multiplex | 2 |
| (4) A single channel containing analog information | 3 |

¹ Emissions where the main carrier is directly modulated by a signal which has been coded into quantized form (e.g., pulse code modulation) should be designated under (2) or (3).

(5) Two or more channels containing quantized or digital information	7
(6) Two or more channels containing analog information	8
(7) Composite system with one or more channels containing quantized or digital information, together with one or more channels containing analog information	9
(8) Cases not otherwise covered	X
(e) Third Symbol—type of information to be transmitted: ²	
(1) No information transmitted	N
(2) Telegraphy, for aural reception	A
(3) Telegraphy, for automatic reception	B
(4) Facsimile	C
(5) Data transmission, telemetry, telecommand	D
(6) Telephony (including sound broadcasting)	E
(7) Television (video)	F
(8) Combination of the above	W
(9) Cases not otherwise covered	X
(f) Type <i>B</i> emission: As an exception to the above principles, damped waves are symbolized in the Commission's rules and regulations as type <i>B</i> emission. The use of type <i>B</i> emissions is forbidden.	
(g) Whenever the full designation of an emission is necessary, the symbol for that emission, as given above, shall be preceded by the necessary bandwidth of the emission as indicated in § 2.202(b)(1).	

² In this context, the word "information" does not include information of a constant, unvarying nature such as is provided by standard frequency emissions, continuous wave and pulse radars, etc.

Note: For an electronic copy of this information, see <http://www.itu.int/radioclub/rr/aps01.htm>.

computer communications techniques. The FCC and industry have also credited the amateur community with the development of Low-Earth-Orbit (LEO) satellite technology. The same can be said for a number of digital modes that have arrived on the scene in the 1990s, such as PacTOR, CLOVER and PSK31.

Expansion of the existing reservoir within the Amateur Radio Service of trained operators, technicians and electronic experts [97.1(d)].

Amateurs learn by doing. While all amateurs may not be able to troubleshoot and repair a transceiver, all amateurs have some degree of technical competence.

Continuation and extension of the amateur's unique ability to enhance international goodwill [97.1(e)].

Amateur Radio is one of the few truly international hobbies. It is up to amateurs to maintain high standards and to represent the US as its ambassadors, because, in a sense, all US amateurs serve that function.

The FCC's Role

The Federal Communications Commission (FCC) is the US government agency charged by Congress with regulating communications involving radio, television, wire, cable and satellites. This includes Amateur Radio. The objective of the FCC is to provide for orderly development and operation of telecommunications services.

The FCC functions like no other Federal agency. It was created by Congress and it reports directly to Congress. The FCC allocates bands of frequencies to nongovernment communications services and assigns operator privileges. (The National Telecommunications and Information Administration allocates government frequencies.)

Federal Restrictions on the Installation of Amateur Stations

The following Federal restrictions apply to amateur antennas (see *The FCC Rule Book* for complete details):

- Amateurs must take certain actions before placing an amateur station on land of environmental importance or on land significant in American history, architecture, or culture [97.13(a)].
- Amateurs must protect FCC monitoring stations from harmful interference if an amateur is operating within one mile of such a facility [97.13(b)].
- Before causing or allowing an amateur station to transmit from any place where its operation could cause RF exposure in excess of Federal guidelines, an RF exposure evaluation may be required. [97.13(c)].
- Amateurs must have the FAA's approval before installing a tower over 200 ft high and the structure must be registered with the FCC per Part 17 of the *Code of Federal Regulations* (Construction, Marking and Lighting of Antenna Structures) [97.15]. See <http://www.fcc.gov/WTB/antenna/what.html>.
- Amateurs located near airports must meet additional limitations [97.15]. Details appear in *The FCC Rule Book*.
- Amateurs may install an antenna up to 20 ft above the ground or other natural features or on top of any man-made structure except antenna towers. Such antennas are exempt from the rules described in Part 17 of FCC regulations.
- Amateurs must notify the Interference Office of the National Radio Astronomy Observatory if a beacon station is planned for the National Radio Quiet Zone, a small area in Maryland, Virginia and West Virginia [97.203(e) and 1.924]. New stations within a 10 mile radius of the Arecibo Observatory in Puerto Rico [97.203(h), 1.924] must notify the Interference Office.

A QUICK JOURNEY THROUGH PART 97

The Amateur Radio Service rules, Part 97, are organized in six major subparts: General Provisions, Station Operation Standards, Special Operations, Technical Standards, Providing Emergency Communications and Qualifying Examination Systems. A brief discussion of the highlights of each subpart follows:

General Provisions

Subpart A covers the basics that apply to all facets of Amateur Radio. The “Basis and Purpose” of Amateur Radio, discussed above, is found at the beginning of Part 97 [97.1]. Definitions of key terms used throughout Part 97 form the foundation of Part 97 [97.3].

The remainder of the subpart is devoted to Federal restrictions on amateur installations (see sidebar), which include a mention of FCC standards for RF exposure. The ARRL publication *RF Exposure and You* details these RF exposure requirements.

Station Operation Standards

Subpart B, “Station Operation Standards,” concerns the basic operating practices that apply to all types of operation. Amateurs must operate their stations in accordance with good engineering and amateur practice [97.101(a)]. Part 97 doesn't always tell amateurs specifically how to operate their stations, particularly concerning technical issues, but the FCC provides broad guidelines. The use of good engineering and amateur practice means, for example, that amateurs shouldn't operate a station with a distorted signal and that amateurs shouldn't operate on a busy band like 20 m just to talk to a ham across town. Also, amateurs must share the frequencies with others—no one ham or group has any special claim to any frequency [97.101(b)]. The station licensee is always responsible for the proper operation of an amateur station, except where the control operator is someone other than the station licensee, in which case both share responsibility equally [97.103(a)].

The requirements for control operators, station control and reciprocal licensing authority are also addressed in Subpart B. Each station must have a control point [97.109(a)]. A control operator must always

be at the control point, except in a few cases where the transmitter is controlled automatically [97.109(b), (c), (d) and (e)]. The purpose of the Amateur Radio Service is to communicate with other amateurs [97.111]. Certain one-way transmissions are allowed. Amateurs can send a one-way transmission to:

- make adjustments to equipment for test purposes
- call CQ
- remotely control devices
- communicate information in emergencies
- send code practice and information bulletins of interest to amateurs [97.111(b)]

Broadcasting to the public is strictly prohibited [97.113(b)]. The section on prohibited transmissions states that amateurs cannot: be paid for operating a station, make transmissions on behalf of an employer, transmit music (unless otherwise allowed in the rules), transmit obscenity, use amateur stations for news-gathering purposes or transmit false signals and ciphers. The FCC has relaxed the previously restrictive business rules to encourage public service and personal communications [97.113].

Station identification is addressed in this subpart. The purpose of station identification is to make the source of its transmissions known to those receiving them, including FCC monitors. The rules cover identification requirements for the various operating modes. Section 97.119 details the station-identification requirements. Amateurs must transmit their call sign at the end of the communication and every 10 minutes during communications. CW and phone may be used to identify an amateur station. RTTY and data (using a specified digital code) may be used when all or part of the communications are transmitted using such an emission. Images (Amateur Television, for example) may be used to identify when all or part of the transmission is in that mode. A final section addresses restricted operation and sets forth the conditions that must exist in an interference case involving a neighbor's TV or radio before the Commission can impose "quiet hours"—hours of the day when a particular amateur may not operate an amateur transmitter [97.121(a)]. Imposition of quiet hours by the FCC is rare, however.

Special Operations

Subpart C, "Special Operations," addresses specialized activities of Amateur Radio including the various types of stations an amateur may operate. This subpart gives specific guidelines concerning repeaters, beacons, space stations, Earth stations, message forwarding systems, and telecommand (remote control) stations. These rules are of particular interest to the technically minded amateur. An amateur may send ancillary functions (user functions) of a repeater on the input of the repeater—to turn on and off an autopatch, for example. However, the primary control links used to turn the repeater on and off, for example, may be transmitted only above 222.150 MHz since such one-way transmissions are auxiliary transmissions. Every repeater trustee/licensee and user should understand the rules for repeaters and auxiliary links. An important regulatory approach to solving interference problems between repeaters is addressed in that section: Repeater station licensees are equally responsible for resolving an interference problem, unless one of the repeaters has been approved for operation by the recognized repeater coordinator for the area and the other has not. In that case, the owner of the uncoordinated repeater has primary responsibility to resolve the problem [97.205(c)]. The control operator of a repeater that inadvertently retransmits communications in violation of the rules is not held accountable [97.205(g)]. The originator and first forwarding station of a message transmitted through a message forwarding system are held accountable for any violations of Part 97. Other forwarding stations are not held accountable [97.219]. For a detailed explanation, see the ARRL's *FCC Rule Book*.

Technical Standards

The word *standard* means consistency and order—and this is what the technical standards in Subpart D are all about. The FCC outlines the specific frequency bands available to US amateurs [97.301] as well as the sharing agreements [97.303]. (The [References](#) chapter of this book includes a table of frequencies

Local Zoning Ordinances, Covenants and Deed Restrictions

Amateurs may be restricted by local antenna zoning ordinances. PRB-1 is a limited preemption of local zoning ordinances. It outlines three rules for local municipalities to follow in regulating antenna structures: (1) state and local regulations that operate to preclude amateur communications are in direct conflict with federal objectives and must be preempted; (2) local regulations that involve placement, screening or height of antennas based on health, safety or aesthetic considerations must be crafted to reasonably accommodate amateur communications; and (3) such local regulations must represent the minimum practicable regulation to accomplish the local authority's legitimate purpose. Amateurs faced with unreasonable zoning restrictions should request the "PRB-1 package" from the Regulatory Information Branch at ARRL HQ. *The FCC Rule Book* gives details.

PRB-1 does not address deed, lease or rental covenants or restrictions; in fact, it specifically excludes them since such agreements are *voluntarily* entered into by the buyer or tenant and seller or landlord in their contract. Because these restrictions are not established by government, they don't fall under FCC jurisdiction. Amateurs restricted by covenants or deed restrictions may contact the Regulatory Information Branch at ARRL HQ for suggested wording that may be written into such agreements.

allocated to the Amateur Radio Service.) The Commission made these standards a basic framework so all types of amateur operation may peacefully coexist with other radio occupants in the spectrum neighborhood. Emission standards for RTTY, data and spread spectrum are discussed, as are standards for the type acceptance of RF power amplifiers. FCC type acceptance is not needed for most amateur equipment. This gives amateurs the freedom to experiment without being bound by specific equipment standards.

Providing Emergency Communications

Subpart E, "Providing Emergency Communications," addresses disaster communications, stations in distress, communications for the safety of life and protection of property and the Radio Amateur Civil Emergency Service (RACES).

Qualifying Examination Systems

The final subpart of the rules, Subpart F, deals with the examination system and covers exam requirements and elements and standards. In 1983, the Commission delegated much of the exam administration program to amateurs themselves. The rules provide for checks and balances on volunteer examiners (VEs), who administer exams at the local and regional levels. These checks and balances protect against fraud and provide integrity for the exam process.

REGULATION, THE ITU AND FREQUENCY SHARING

The International Telecommunication Union (ITU), an agency of the United Nations, plays the vital role of dividing the spectrum for reallocation by the telecommunications authorities of individual countries. For convenience in organizing frequency allocations for the various services, the ITU divides the world into three Regions: 1, 2 and 3. See [Fig 29.1](#). North and South America and the adjoining waters comprise Region 2.

Frequency allocations for Amateur Radio and other services can differ among ITU Regions. Today, there are numerous radio services vying for pieces of the spectrum, all with legitimate purposes. To accommodate them all, the international and domestic regulatory agencies may allocate the same frequency bands to more than one service. While some of our allocations are *exclusive*, we share others on the basis of priority. In some cases, the Amateur Radio Service is *primary*. In other cases, amateurs are *secondary*. Stations in a secondary service must not cause harmful interference to, and are not protected from interference caused by stations in the primary service.

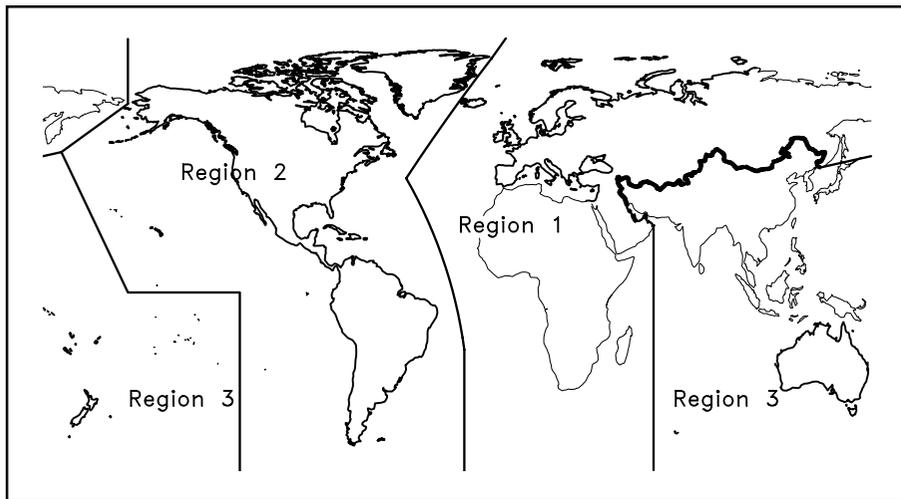


Fig 29.1—Frequency allocations for Amateur Radio and other radio services can differ, depending on location. There are three administrative ITU Regions, each with its own allocations.

- A station in a secondary service must not cause interference to and must accept interference from stations in the primary service.
- Stations in one ITU Region shall not cause harmful interference to services in another Region.
- Many other services share frequencies with amateurs on and above the 70-cm band, and amateurs must be mindful of these services.
- Amateurs near large military bases should check Section 97.303 carefully, since additional restrictions may apply.

Voluntary Band Plans

Another aspect of frequency sharing is voluntary band plans. Although the FCC Rules set aside portions of some bands for specific modes, there's still a need to further divide amateur bands among user groups by "gentlemen's agreements." These agreements usually emerge by consensus of the band occupants, and are sanctioned by a national body like ARRL. These agreements allow many modes of operation to be used by amateurs in a given band. For example, amateurs avoid the domestic "DX windows" set aside on some bands, so that stations can hear and work weak-signal DX stations. Detailed band plans for the amateur HF bands can be found in the [References](#) chapter of this book. The complete band plans can be found in *The FCC Rule Book* and *The ARRL Repeater Directory*.

Emission Standards and Bandwidth

Like most of Part 97, the technical standards exist to promote operating techniques that make efficient use of the spectrum and minimize interference. The standards in Part 97 identify problems that must be solved. Section 97.307 spells out the standards FCC expects amateur signals to meet. It states, in part: "No amateur station transmission shall occupy more bandwidth than necessary for the information rate and emission type being transmitted, in accordance with good amateur practice" [97.307(a)]. Simply stated, don't transmit a wide signal when a narrow one will do. Specific bandwidth limits are given for RTTY and data emissions. Specific bandwidth limits are not given for other modes of operation, but amateurs must still observe good engineering and operator practice.

The rules state: "Emissions resulting from modulation must be confined to the band or segment available to the control operator" [97.307(b)]. Every modulated signal produces sidebands. Amateurs must not operate so close to the band edge that the sidebands extend out of the subband, even if the frequency readout says that the carrier is inside the band. Further: "Emissions outside the necessary

The FCC specifies amateur frequencies and what, if any, restrictions apply. Since the detailed list of frequencies and the sharing requirements is far too long to be included in this short chapter, they can be found in Subpart D of Part 97. *The FCC Rule Book* and *The ARRL Operating Manual* give details of the sharing requirements of each band.

Guidelines based upon the actual sharing requirements of amateur frequencies outlined in Section 97.303 follow:

bandwidth must not cause splatter or key-click interference to operations on adjacent frequencies” [97.307(b)]. The rules simply codify good operating practice. Key clicks or over-processed voice signals shouldn't cause interference up and down the band.

Spurious emissions

Spurious emissions include harmonic emissions, parasitic emissions, inter-modulation products and frequency conversion products, but do not include splatter [97.307(c)]. Definitions for *necessary bandwidth* and *out-of-band emission* appear in the [Glossary](#) at the beginning of this chapter. Also see [Fig 29.2](#).

Emission standards

The FCC is very specific concerning spurious emission standards [97.307(d)]. If an amateur transmitter or RF power amplifier was built after April 14, 1977, or first marketed after December 31, 1977, and transmits on frequencies below 30 MHz, the mean power of any spurious emissions must:

- never be more than 50 mW;
- be at least 30 dB below the mean power of the fundamental emission, if the mean power output is less than 5 W; and
- be at least 40 dB below the mean power of the fundamental emission if the mean power output is 5 W or more.

The requirement that no spurious emission exceed 50 mW means that above 500 W, the suppression must be greater than 40 dB. At 1500 W, the suppression must be 44.77 dB. The requirements for transmitters operating below 30 MHz are shown graphically in [Fig 29.3](#).

The following requirements apply between 30 and 225 MHz [97.307(e)]:

- In transmitters with 25 W or less mean output power, spurs must be at least 40 dB below the mean power of the fundamental emission and never greater than 25 μ W (microwatt), but need not be reduced further than 10 μ W. This means that the spurs from a 25-W transmitter must be at least 60 dB down to meet the 25-W restriction.
- In transmitters with more than 25 W mean output power, spurious emissions must be at least 60 dB below the mean power of the fundamental emission.

The situation for transmitters operating between 30 and 225 MHz is more complex. The combination of the requirement that spurious emissions be less than 25 μ W and the stipulation that they don't need to be reduced below 10 μ W makes the requirements vary significantly with power level. This ranges from 0 dB suppression required for a transmitter whose power is 10 μ W to 60 dB of suppression required for power levels above 25 W. The requirements for transmitter

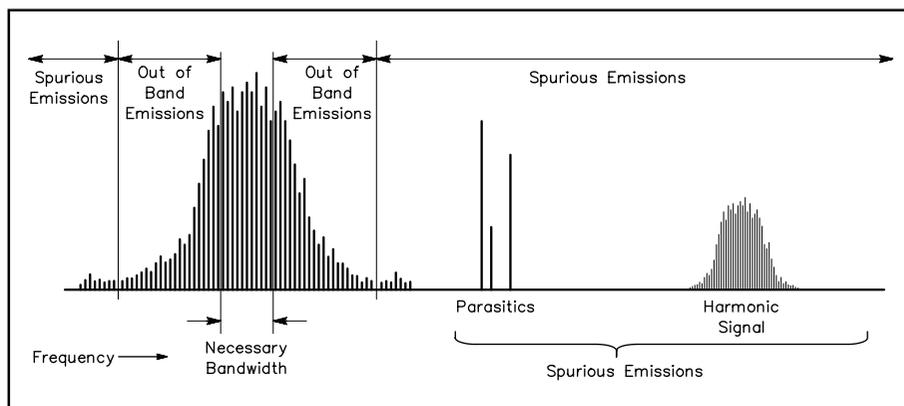


Fig 29.2—Some of the modulation products are outside the necessary bandwidth. These are out-of-band emissions, but they are not considered spurious emissions. On the other hand, these out-of-band emissions must not interfere with other stations [97.307(b)]. The harmonics and parasitics shown in this figure are spurious emissions, and they must be reduced to the levels specified in Part 97. The FCC states that all spurious emissions must be reduced “to the greatest extent practicable” [97.307(c)]. Further, if any spurious emission, including chassis or power-line radiation, causes harmful interference to the reception of another radio station, the licensee of the interfering amateur station is required to take steps to eliminate the interference.

operation between 30 and 225 MHz are shown graphically in **Fig 29.4**. There are no absolute limits for transmitters operating above 225 MHz, although the requirements for good engineering practice would still apply.

Transmitter Power Standards

Amateurs shall not use more power than necessary to carry out the desired communication [97.313(a)].

Don't use 700 W when 10 m is wide open, for example. No station may use more than 1.5 kW peak envelope power [97.313(b)] and no station may use more than 200 W in the 30-m band. Novices and Technicians are limited to 200 W in their HF segments [97.313(c)]. Amateurs may use no more than 50 W in the 70-cm band near certain military installations [97.313(f) and (g)].

The FCC has chosen and published the following standards of measurement: (1) Read an in-line peak-reading RF wattmeter that is properly matched; and (2) calculate the power using the peak RF volt-

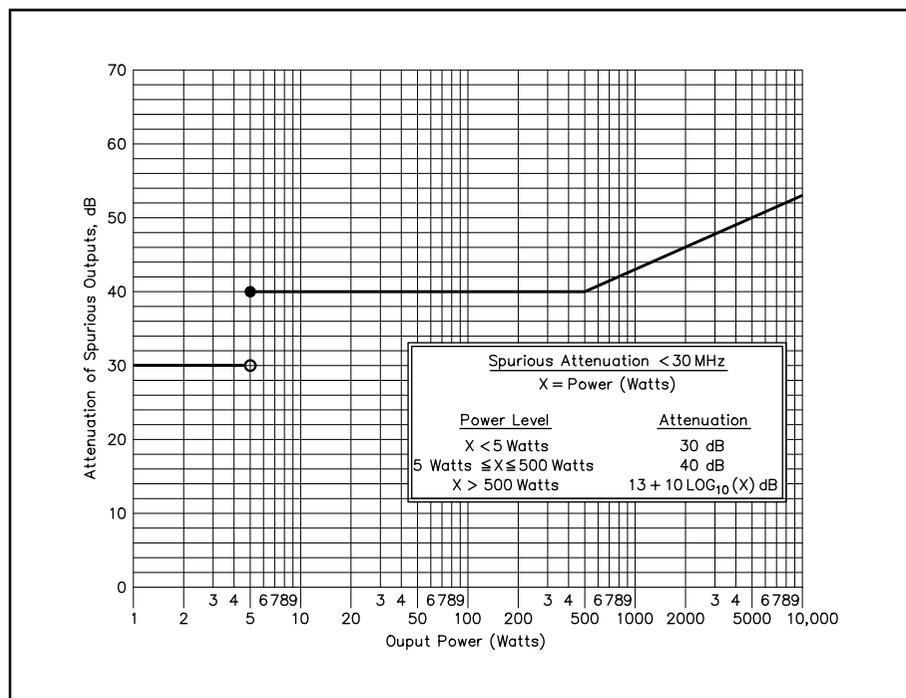


Fig 29.3—Required attenuation of spurious outputs below 30 MHz is related to output power.

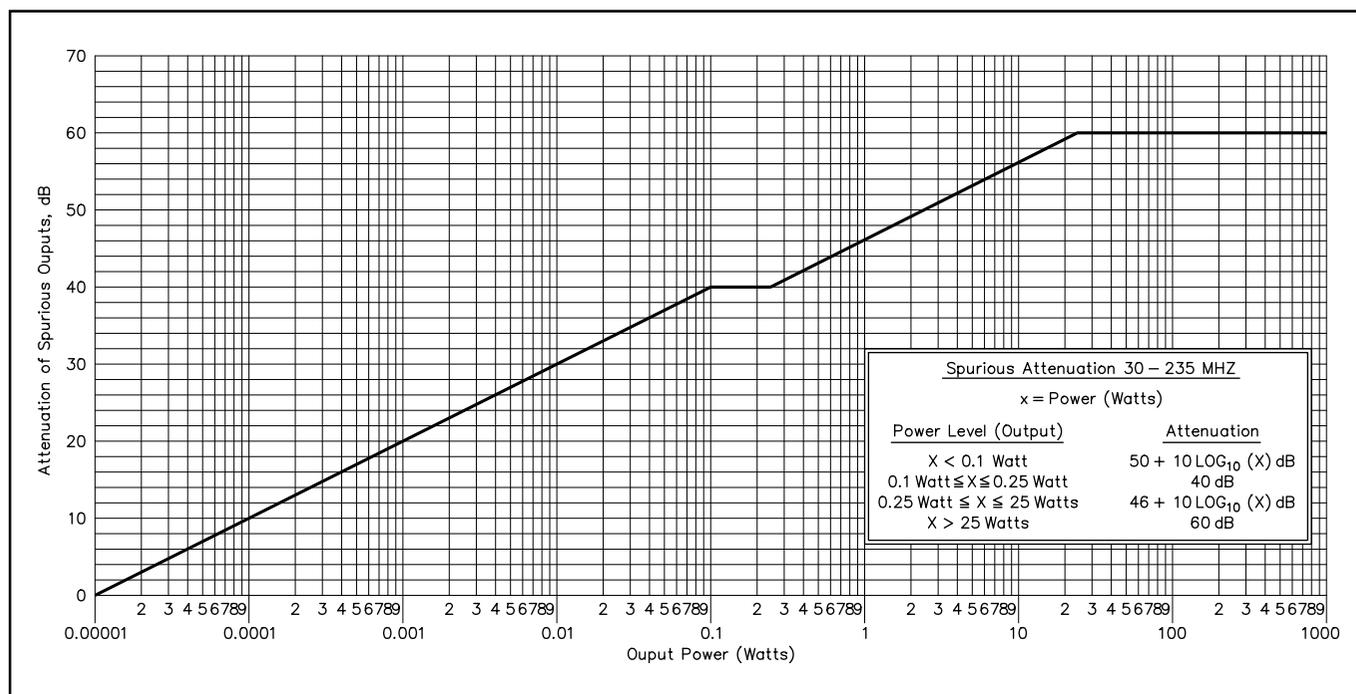


Fig 29.4—Required attenuation of spurious outputs, 30-235 MHz.

age as indicated by an oscilloscope or other peak-reading device. Multiply the peak RF voltage by 0.707, square the result and divide by the load resistance. The SWR must be 1:1.

The FCC requires that you meet the power output regulations, but does not require that you make such measurements or possess measurement equipment. The methods listed simply indicate how the Commission would measure your transmitter's output during a station inspection.

As a practical matter, most hams don't have to worry about special equipment to check their transmitter's output because they never approach the 1500-W PEP output limit. Many common amplifiers aren't capable of generating this much power. However, if you do have a capable amplifier and do operate close to the limit, you should be prepared to measure your output along the lines detailed above.

External RF Power Amplifiers: Certification and Standards

In 1978, the FCC banned the manufacture and marketing of any external RF power amplifier or amplifier kit capable of operation on any frequency below 144 MHz, unless the FCC has issued a grant of type acceptance (now called FCC certification) for that model amplifier. The FCC also banned the manufacture and marketing of HF amplifiers that were capable of operation on 10 m to stem the flow of amplifiers being distributed for illegal use in and around frequencies used by CB operators.

Amateurs may still use amplifiers capable of operation on 10 m. While the rules may make it difficult to buy a new amplifier capable of operation on 10 m, the FCC allows amateurs to modify an amplifier to restore or include 10-m capability. An amateur may modify no more than one unit of the same model amplifier in any year without FCC certification [97.315(a)].

Of course, amateurs are permitted to build amplifiers, convert equipment from any other radio service for this use or to buy used amplifiers. When converting equipment from other services, it must meet all technical standards outlined in Part 97, and it can no longer be used in the service for which it was intended since the type acceptance would have been voided. Nonamateurs are specifically prohibited from building or modifying amplifiers capable of operation below 144 MHz without FCC certification [97.315(a)]. All external amplifiers and amplifier kits capable of operation below 144 MHz must be FCC certified in order to be marketed [97.315(b)]. A number of amplifiers, manufactured prior to the April 28, 1978, cutoff were issued a waiver of the new regulations [97.315(b)(2)]. Amateurs may buy or sell an amplifier that has either been FCC certified, granted a waiver or modified so that the certification is no longer valid. There are restrictions that would be valid regardless of whether the amplifier was capable of operation below 144 MHz. Some amplifiers marketed before April 28, 1978, are covered under the waiver if they are the same model that was granted a waiver [97.315(b)(2)]. An individual amateur may sell his amplifier regardless of grants or waivers, provided that he sells it only to another amateur operator [97.315(b)(4)]. Amateurs may also sell a used amplifier to a bona fide amateur equipment dealer [97.315(b)(5)]. The dealer could sell those amplifiers only to other hams [97.315(b)(5)].

In some cases, the FCC will deny certification. Some features that may cause a denial are (1) any accessible wiring which, when altered, would permit operation in a manner contrary to FCC rules; (2) circuit boards or similar circuitry to facilitate the addition of components to change the amplifier's operation characteristics in a manner contrary to FCC rules; (3) for operation or modification of the amplifier in a manner contrary to FCC rules; (4) any internal or external controls or adjustments to facilitate operation of the amplifier in a manner contrary to FCC rules; (5) any internal RF sensing circuitry or any external switch, the purpose of which is to place the amplifier in the transmit mode; (6) the incorporation of more gain than is necessary to operate in the amateur service.

CONCLUSION

A common thread in Amateur Radio's history has been a dynamic regulatory environment that has nurtured technological growth and diversity. This thread continues to sew together the elements of Amateur Radio today and prepare it for tomorrow's challenges.