

Repeaters, Auxiliary Stations, and "Remote Base" FAQ (Updated with 2/23/07 changes)

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Introduction

Amateurs who use repeaters and associated operations are often faced with Part 97 rules dilemmas. Part 97 gives amateurs "pieces" which can be incorporated into a system. Part 97 doesn't address all uses, "remote bases" or crossband repeaters, for example, by name.

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What is an auxiliary station?

When an amateur station, such as a repeater, is remotely controlled over a radio link, there is another station involved--the station doing the controlling. This "control" station is, under the FCC rules, called an *auxiliary station* defined by the FCC as "*An amateur station, other than a message forwarding system, that is transmitting communications point-to-point within a system of cooperating amateur stations* [97.3(a)(7)]." There are a few important rules that apply to auxiliary stations:

- 1) All amateurs, except Novices, may put auxiliary stations on the air [97.201(a)].
- 2) An auxiliary station may transmit only on the 2 m and shorter wavelength bands, except the 144.0-144.5 MHz, 145.8-146.0 MHz, 219-220 MHz, 222.00-222.15 MHz, 431-433 MHz, and 435-438 MHz segments.
- 3) When there is interference, licensees are equally responsible for solving the interference, except where one station is coordinated and the other is not [97.201(c)]. Control links should be coordinated.
- 4) An auxiliary station may, under certain circumstances, be automatically controlled and may send one-way transmissions [97.201(d), (e)].

What are the uses for auxiliary stations?

There are several forms of auxiliary operation, such as:

- 1) Remote control of a station at a different location (such as a repeater on a mountaintop), where a radio link is used to make one-way transmissions of DTMF tones to change its operating parameters
- 2) Voice links between two or more stations within a system of stations, such as:
 - (a) Point-to-point links from a repeater's remote receiver(s) back to the main repeater site.
 - (b) Dedicated point-to-point links between different repeaters in a "system" of either full-time or part-time linked repeaters.
 - (c) A combination of remote control and point-to-point voice links intended to control *and* carry the voice signals from the control point to the transmitter(s) of a remotely controlled station. (This is the equivalent of replacing the wire between the microphone and the transmitter's mike input with a radio link from the microphone to the remotely located transmitter.) This is commonly referred to as an "uplink."
 - (d) Point-to-point links from the receiver(s) of a remotely located station back to the station's control operator(s) at their control point(s). This is the equivalent of replacing the wire between the receiver's audio output terminals and its loudspeaker with a radio link from the receiver to a remotely located loudspeaker. This is commonly referred to as a "downlink."

What does the FCC mean by a "system of cooperating stations?"

The FCC uses the terms "system" and "cooperating" in its definition of "auxiliary stations." A repeater transmitter, its associated receivers, link transmitters and receivers, and any associated control stations and control receivers, constitute such a "system" [97.3(a)(7)]. "*Users of the repeater are not part of the system.*" Remember that all of the different combinations of stations described in items [2\(a\) through 2\(d\)](#), form closed "systems" of stations.

What is a "remote base?"

Auxiliary stations are also used in what have come to be known as "remote bases." The term "remote base" does not appear anywhere in the FCC rules. But, if you combine [items 2\(c\) and 2\(d\)](#), you can create the basics of a radio remotely controlled base station, or a "remote base." There are *many* possibilities for remotely controlled amateur stations.

Is a "remote base" the same as a repeater?

No. With a repeater, the users don't need to send any sort of primary control signals in order to use the repeater; and normally, *anyone* can be a user. Users transmit and receive on the repeater's input and output frequencies, which can only operate in repeater segments of the 29.5 MHz or higher frequency bands.

With a **repeater**, *users* are *not* a part of its "system," but the control operator(s) for a radio remotely controlled repeater *are* a part of its "system." They must conduct all of their primary control functions for the repeater by a form of auxiliary operation on authorized frequencies above 222.15 MHz, except 431--433 and 435--438 MHz [97.201(b)].

With a **"remote base,"** or, more precisely, a remotely controlled station, all users are conducting a form of auxiliary operation to remotely control *and use* the station. It is personal property of the owner. *All* of these users *are* control operators of the remote station. Therefore, they are all a part of the "system," and all of them must conduct their control and voice links to and from the remote base on authorized (and hopefully coordinated) auxiliary frequencies above 222.15 MHz [97.201(b)].

A remote base always operates under the rules for remotely controlled stations. The rules for local control and automatic control do not apply. This includes periods when the remote receiver and downlink are active, but none of the control operators are actually talking, i.e., when the remote station is in a "listening only" mode.

Are "open" remote bases legal?

No. Just as you wouldn't allow any unknown ham to just walk into your shack and start talking on your radio without your permission, the same rule applies to the use of a remote base. *Every* user must be specifically authorized by the station's licensee to use the station, thus making each of them "designated control operators" of the station. By the way, the receiver(s) and transmitter(s) at the remotely controlled station may operate on any frequency for which the acting control operator has license privileges. For

instance, if the control operator holds an Advanced Class license, the operator may use a remote base which operates on any appropriate HF phone band, provided that he or she doesn't exceed his or her own privileges. The control operator may allow other amateurs to talk over the remote base while he is in control, but even though they may hold amateur licenses, these other people are only talking over the station under provisions of the "third party" rules, not as control operators.

Is it legal to have a "remote base" with an output on HF below 29.5 MHz?

No. If you look at the rules regarding the frequencies available for auxiliary operation, you will conclude that there is no such thing as a legal "remote base" which uses frequencies anywhere in the 2-meter band for the "uplink" and "downlink." Those systems that go from 2-meter FM to 10-meter FM, or from 2-meter FM to 6-meter FM, for example, are not technically "remote bases," even though some hams like to call them that. They are really "crossband repeaters" and they are legal only if *both* ends are within authorized repeater segments of both bands. Repeater operation (including all input and output frequencies) is prohibited on *all* HF amateur bands, except the top end of 10 meters. Likewise, there is no such thing as a legal 2-meter FM to 75-meter SSB "remote base," since auxiliary uplinks and downlinks must *all* be above 222.15 MHz [97.201(b)].

How can I legally make my VHF/UHF station into a crossband repeater?

Modern dual-band or tri-band VHF/UHF rigs often have the capability to do crossband linking. When operating in this mode, the users may call them "crossband repeaters." Actually they are often remote bases, such as when they are used to allow an operator with a hand-held radio to access a repeater from a location where he or she would normally not be able to do so. For example, a hiker in a remote location might leave his car where his dual-band mobile rig can access a distant 2-meter repeater. Leaving the mobile rig on, he then takes his UHF hand held with him, and can access the 2-meter repeater via his mobile rig.

A crossband repeater (or "portable remote base") is okay as long as several conditions are met:

- 1) The user communicates with his crossband rig via the UHF side. Since this serves as his control and voice uplink, it is a form of auxiliary operation and must be conducted above 222.15 MHz. Since the operator is the control operator, *that person* must actually be able to *control* the station! That person must be able to turn it off remotely if a problem develops. If the operator can't control it, it's not legal [97.7, 97.201, 97.213].
- 2) If the control link fails, the remote station must shut down within three minutes which means a 3-minute timer is required [97.213].
- 3) The unattended station must be identified on *all* frequencies it transmits on. Since this is a form of remote base, the user's ID over the UHF uplink to the dualband radio also serves to ID the VHF output of the mobile rig. In the other direction, however, there is no way for the control operator to ID the UHF downlink from the mobile remote base, so some form of automatic ID must be employed [97.119]. Unfortunately, few manufacturers include the capabilities listed above in their rigs. Hence, to be fully legal, some form of add-on controller may be necessary.

Another use for crossband operation is to link together two existing repeaters on different bands. This is usually done on a temporary basis during an emergency, a drill or a special event. Again, the requirements for proper station identification and control on *both sides* of the dualband radio's transmissions still apply. If both the VHF and UHF transmitters are not properly identified and controlled, the operation is not legal. In the examples cited above, the control requirement can be satisfied by having a control operator at the station, thus making it a locally controlled station. Although this may not always be convenient, it is a way to satisfy all of the station control required.

How does the FCC define a repeater?

A repeater station is an amateur station that simultaneously retransmits the transmission of another amateur station on a different channel or channels [97.3(a)(39)]. Only repeaters, some types of auxiliary stations, and space stations may automatically retransmit the radio signals of other amateur stations [97.113(f)]. Holding your mic in front of the loudspeaker of a receiver so you can retransit the signals of another station is not "automatic," so this is not "repeater" operation.

How is a repeater configured?

A repeater normally consists of a receiver, a transmitter, an antenna, and a repeater controller (which controls the retransmission and various other functions). Many repeaters also use a duplexer which allows the use of a single antenna for *simultaneous* transmitting and receiving. The most popular band for repeaters is the 2-meter band (144 MHz), with the 440, 222 and 50 MHz bands following closely behind.

How does a repeater's "primary" control system work? What are local, remote and automatic control?

When transmitting, every amateur station must have a control operator who must have access to the primary control functions of the station [97.7]. There is a very special exception to this rule, as described in the following section on automatic control.

There are three types of "primary" control for a repeater: **local, remote and automatic control.**

1) **Local control** is when the control operator is physically located at the repeater site and is actually monitoring and controlling the repeater's operation whenever it's on. This is the simplest form of control, and is typical where the repeater is located at the licensee's home or other place. It is defined by the FCC as *the use of a control operator who directly manipulates the operating adjustments in the station to achieve compliance with FCC rules [97.3(a)(30)]* Most people can't listen 24 hours each day..

2) **Remote control** (also known as "telecommand"), is when the repeater is located away from the licensee, such as on a tall building or tower, or a mountain. The FCC defines "remote control" as *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 [97.3(a)(38)]*. Under remote control, the repeater's control operator(s) can monitor and control its operation by some form of control link from distant locations. The duties of monitoring and controlling the repeater can be shared by several amateurs, all of whom have been designated by the repeater's licensee as "control operators". They have been given access to the remote control system, and also been given the "secret" codes used to control the repeater's various functions.

Such a remote control link can take any of several forms. There are three basic types:

(a) *A dedicated wireline from the remote control point(s) to the repeater site.* Although such a system might be somewhat expensive, as renting a dedicated line from the telephone company is not cheap, it is very secure! Nobody else has any access to this type of line. One limitation is that it can only be accessed from those specific locations where it terminates.

(b) *A non-published telephone line into the repeater site.* Such a line can be accessed from any telephone, so precautions must be implemented such that an accidentally dialed "wrong number" won't inadvertently cause the repeater to do something the control operator doesn't want it to do. The simplest form of controller is a "ring counter" which counts the number of times the telephone rings then performs some function. This is, however, not very secure, and should not be used as a means by which a repeater can be turned on. A more secure controller usually answers the telephone line, after which the control operator must send a non-published sequence of DTMF tones to perform the desired control function.

Note that in both cases (a) and (b), above, the control link must be available 100% of the time! Therefore, a telephone control line can not also be used for an autopatch. This is because if the autopatch is in use, the telephone line is busy, in which case the control operator could not gain access to the repeater's control system if he needed to.

(c) *A radio control link using auxiliary stations, operated by designated control operators and transmitting on authorized auxiliary frequencies above 222.15 MHz.* Again, this control link must be available to the control operator(s) 100% of the time, so it cannot be used for any other purpose. The frequency and control codes are not published and are known only by the licensee and control operators (and the frequency is known by the area frequency coordinator).

3) **Automatic control** is used when no control operator is available to "babysit" the repeater. This is the exception mentioned earlier. **Automatic control** is defined by the FCC as *the use of devices and procedures for control of a station when it is transmitting so that compliance with the FCC Rules is achieved without the control operator being present at a control point [97.3(a)(6)]*.

Under automatic control, the licensee has installed a control device which continuously monitors the technical operation of the repeater. If the controller detects a malfunction, it shuts the repeater down. From a practical standpoint, most repeaters operate under some form of automatic control most of the time. However, they also have a control link as described in the preceding section on remote control of a repeater

which allows the repeater to be disabled by remote control if necessary. This remote control link also allows the control operator(s) to enable or disable various repeater functions such as an autopatch or links.

Does the control operator of an automatically controlled repeater have to listen 24 hours each day?

No, but a controller cannot detect and correct improper use of the repeater. The licensee is always responsible for the proper operation of the station, Part 97 states **The control operator of a repeater that retransmits inadvertently communications that violate the rules in this Part is not accountable for the violative communications [97.205(g)].** In the event of improper use of the machine, the licensee is responsible for correcting the problem as soon as practicable and for making sure that the problem will not happen again. *Although no control operator is required to be present at a control point while the repeater is operating under automatic control, it is still the station licensee's responsibility to see that the repeater operates properly at all times [97.103(a)].* The repeater's licensee should prevent unauthorized tampering with the equipment by implementing various security procedures and devices, such as having an unpublished remote control link frequency and unpublished primary remote control codes for the control operator(s) to use. Finally, the licensee should make sure word gets out quickly if something is wrong, and that authorized individuals have quick access to the repeater shutdown function.

From this discussion of the three basic types of primary station control, you can correctly conclude that a repeater is *not* restricted to *only one* form of control. During those periods when a control operator is awake and "on duty," the repeater is operating under either "local" or "remote control." When the maintenance crew is working at the repeater site, it is also operating under "local control." When all the control operators are asleep or at work and there is nobody around to babysit the machine, it can be operated under "automatic control."

What is ancillary operation?

The FCC makes a distinction between *functions which the repeater users can perform* (activating a crossband link, getting a weather or time-of-day report, or making a phone call via the autopatch, for example), and those *primary control functions reserved exclusively for the control operators in effecting basic control of the station*. The rules state that "ancillary (which also means "secondary") functions of a repeater that are available to users on the input channel are not considered remotely controlled functions of the station" [97.205(e)]. These "user" functions are conducted on the repeater's input frequency. However, the primary control functions (turning the repeater on or off, for example) must be performed via the repeater's primary control system which is separate from the input frequency. The repeater owner and use an "emergency backup" means to shut down a repeater via its regular input frequency, as long as the turn-on function can only be performed via the primary control system.

This distinction applies to crossband links and other functions. If the control operator enables a crossband link for use by a user by changing the repeater's command state through the control link, then users, including Technicians on a 2-meter repeater, may turn on and use the crossband link on the repeater input frequency to communicate with other hams on 10-meter FM. Changing the command state to allow users access to the crossband link is a "primary" control function. The user accessing the crossband link on the repeater input frequency is an "ancillary" function.

Who may use a repeater or remote base?

The licensee of *any* amateur station has the right to limit the use of his or her station to only certain other licensees! When it comes to repeaters, the FCC even says so in Part 97. This rule states **limiting the use of a repeater to only certain users is permissible [97.205(e)].** "Closed" repeaters may use CTCSS or other techniques to limit access to designated users.

Why would a repeater owner limit access to a repeater?

Just because a repeater may use some form of coded access, such as CTCSS, this does not necessarily mean that it is a "closed" repeater with the intent of keeping certain users out. Many "open" repeaters employ coded access, either full-time or part-time, in order to eliminate, or reduce, various types of interference, *not* to restrict who is welcome to use the machine. Also, repeater upkeep is expensive and it is not unreasonable to ask users to help financially with repeater expenses including site rental fees, utility bills,

phone line expenses, property insurance and equipment maintenance. There's no rule which requires the repeater owner to let you use it. A repeater is *nota* public utility--you don't have a "right" to use it! When you are using someone else's repeater you are, in effect, a visitor in the owners station. So, you should conduct yourself accordingly. If you use that station in a manner which the owner finds objectionable, that person has every right to revoke your privilege of using it.

What other repeater rules are there?

In addition to the somewhat complex rules mentioned thus far for repeaters, amateurs must be aware of a few more, though simpler, repeater station rules:

- 1) A Novice licensee may not operate, or be the control operator of a repeater [97.205(a)].
- 2) Repeaters may operate on any frequency authorized to the Amateur Radio Service above 29.5 MHz except for 50.0 - 51.0, 144.0 - 144.5, 145.5 - 146.0, 222.0 - 222.15, 431 - 433 and 435 - 438 MHz [97.205(b)]. Note that these frequencies include *both* the input *and* output frequencies of all repeaters.
- 3) If there is an interference problem between two repeaters on the same frequency, the two repeater licensees must work together to solve an interference problem between the repeaters, unless one repeater is coordinated and the other is not. The licensee of an uncoordinated repeater bears the primary responsibility for solving an interference problem [97.205(c)].
- 4) If the control operator is someone other than the licensee, *both* are equally responsible for the proper operation of the station [97.103(a)].
- 5) The licensee and control operator(s) of a repeater that inadvertently retransmits communications which violate the rules in Part 97 are not normally held accountable for the violative communications [97.205(g)]. However, they will be held accountable if they become aware of the illegal communications and allow them to continue, because they are no longer "inadvertent." They must make an effort to prevent such communications from continuing. If they are unsuccessful, they must shut the repeater off until the problem can be corrected. The operator of the station originating the illegal communications will be held accountable at all times by the FCC.
- 6) Before establishing a repeater within 10 miles of the Arecibo Observatory in Arecibo, Puerto Rico, the facility must be notified [97.205(h)].

What is a "simplex repeater"?

A "simplex repeater" is used to extend the range of low power rigs such as handhelds by storing the signal transmitted on a frequency and then retransmitting it through a more powerful or better-situated transmitter on the same frequency. According to the rules, however, such a device is *not* a repeater since it does not *simultaneously* retransmit the signals of another station and it does not retransmit the signals on a *different* channel or channels, as specified in the FCC's definition of a repeater, so it can't be operated under automatic control. If a control operator is present and controlling the device, either locally or by remote control, then it can be used. But it cannot be left unattended! On the other hand, it is not limited by the other repeater rules, such as repeater frequencies.

What is Frequency Coordination?

Although it is not "required" by the FCC rules, most repeater operators coordinate the input and output frequencies for their repeaters, as well as any auxiliary link and control frequencies, with their local or regional frequency coordinators.

The FCC defines a *frequency coordinator* as *An entity, recognized in a local or regional area by amateur operators whose stations are eligible to be repeater or auxiliary stations, that recommends transmit/receive channels and associated operating and technical parameters for such stations in order to avoid or minimize potential interference* [97.3(a)(22)]. The primary function of frequency coordinators is to help amateurs, who desire to put up new repeaters, in selecting frequencies which will cause, and receive, a minimum amount of interference within the limited number of repeater frequency pairs available. Coordinators are volunteers who serve with the approval of the amateurs within their region. They have no authority to "assign" frequencies - they make recommendations. They maintain an accurate database of information on every coordinated station within their area (this data is held in strict confidence), and they use this data in forming their recommendations. If repeater users do experience harmful interference,

coordinators are happy to assist in resolving the problem. The FCC considers frequency coordination to be "good amateur practice". You can find your regional coordinator at <http://www.arrl.org/nfcc/>.

What is the difference between a repeater licensee and trustee?

If the repeater or remote base is operating under the auspices, and using the callsign of an individual amateur's personal station license, then the operator is the "licensee" of the station, not the "trustee." If it is operating under the auspices of an FCC-issued club station license, and using the FCC-issued club callsign, then the person whose name appears on the license is the "trustee," not the "licensee."

What is telecommand?

Telecommand is defined by the FCC as *a one-way transmission to initiate, modify or terminate functions of a device at a distance [97.3(a)(43)]*. If you are using a radio or wire line link to remotely control a station, this is "telecommand." The rules contain several requirements for remote control and telecommand operation:

- 1) Provision must be incorporated to limit transmissions to no more than three minutes if the control link fails. If the control link fails while your transmitter is keyed, the transmitter could be seriously damaged (not to mention the interference it would cause) if there was no three-minute timer to shut it off [97.213(b)]. But this also means that if the control link is functioning properly, there is no requirement for the station to have a three-minute "reset" or turn-off timer.
- 2) The station must be protected so that unauthorized transmissions cannot be made, whether deliberately or accidentally. This refers to providing safeguards on your remotely controlled station so it cannot be used by unauthorized operators. Most remote station licensees incorporate the use of DTMF tones or CTCSS systems to limit access to the control system to only those people who know the codes. You, as the licensee, are responsible for all transmissions from your remote station, just as you are responsible for your home station [97.213(c)]. This responsibility applies all the time, even if you share the control operator duties with other amateurs.
- 3) A photocopy of the station license and a label with the name, address, and telephone number of the station licensee and at least one designated control operator must be posted in a conspicuous place at the station location [97.213(d)].
- 4) Control (or telecommand) links may be wire (a telephone or fiber optic line, for example) or radio. The FCC says that if a radio link is used, the station where the control commands are performed is an auxiliary station [97.213(a)] and an auxiliary station is "an amateur station transmitting communications point-to-point within a system of cooperating amateur stations" [97.3(a)(7)]. All auxiliary operations must be conducted on appropriate frequencies above 222.15 MHz.

Can a Technician operate on 2 meters through a repeater which has an output in the 10 meter FM repeater segment which causes the Technician's signal to be retransmitted on 10 meter FM?

Yes, this is not a problem as long as the Technician is transmitting in his authorized Technician bands. If a Technician transmits through a repeater which also has a part time link to a 10 meter repeater with an output at say, 29.680 MHz, this is not a problem because the repeater station is re-originating the transmission and there must be a control operator with the appropriate 10 meter FM privileges. All that the Technician must be concerned about is his own transmitting frequency, not where his output falls. Of course, a Technician can not transmit **directly** outside the 28.1-28.5 MHz segment.

Updated information, with changes effective February 23, 2007

Subpart C--Special Operations

§97.201 Auxiliary station.

(a) Any amateur station licensed to a holder of a Technician, Technician Plus, General, Advanced or Amateur Extra Class operator license may be an auxiliary station. A holder of a Technician, Technician

Plus, General, Advanced or Amateur Extra Class operator license may be the control operator of an auxiliary station, subject to the privileges of the class of operator license held.

(b) An auxiliary station may transmit only on the 2 m and shorter wavelength bands, except the 144.0-144.5 MHz, 145.8-146.0 MHz, 219-220 MHz, 222.00-222.15 MHz, 431-433 MHz, and 435-438 MHz segments.

(c) Where an auxiliary station causes harmful interference to another auxiliary station, the licensees are equally and fully responsible for resolving the interference unless one station's operation is recommended by a frequency coordinator and the other station's is not. In that case, the licensee of the non-coordinated auxiliary station has primary responsibility to resolve the interference.

(d) An auxiliary station may be automatically controlled.

(e) An auxiliary station may transmit one-way communications.