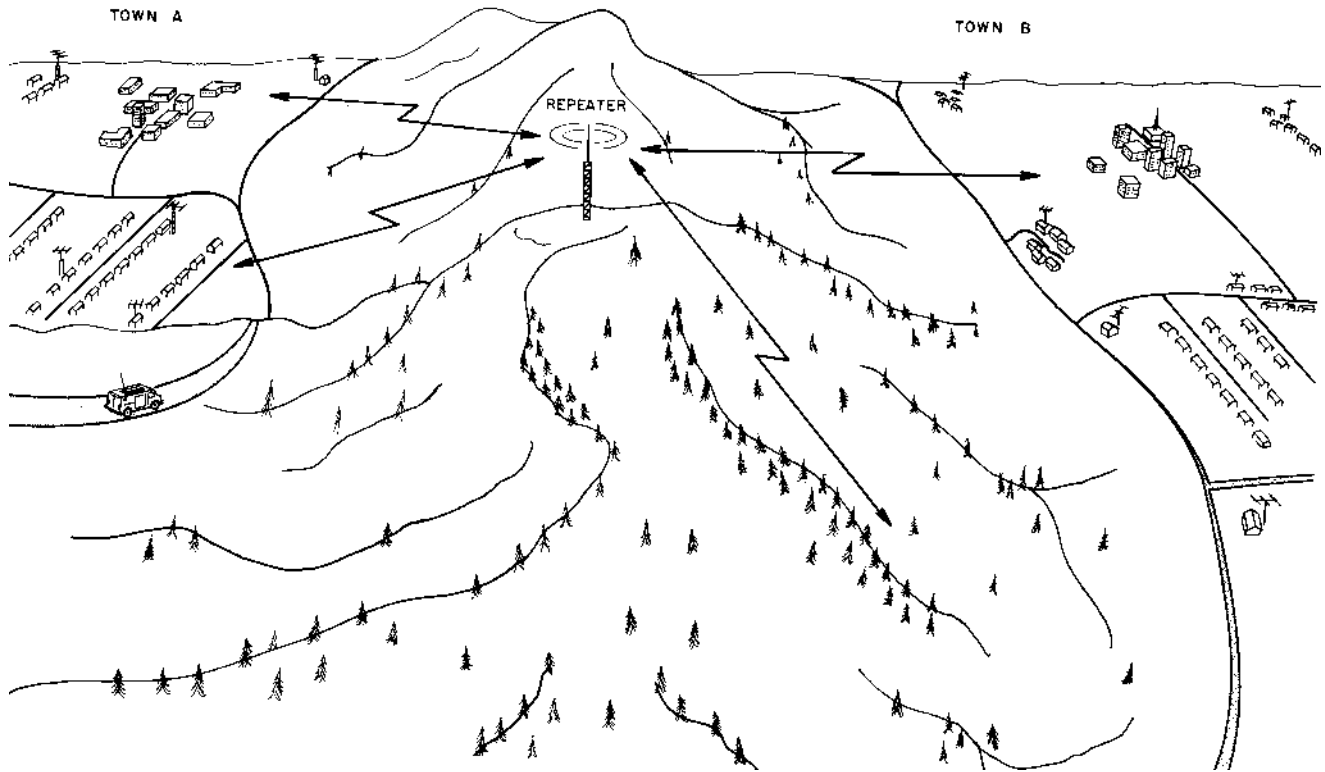


# Repeaters – what are they and how to use them



More hams use frequency-modulated (FM) voice than any other communications mode. Most hams have an FM rig of some type. They use it to keep in touch with their local friends. Hams often pass the time during their morning and evening commute talking on the air. In most communities, amateurs interested in a specialized topic (such as chasing DX) have an FM frequency where they meet regularly to exchange information. At flea markets and conventions, hand-held FM units are in abundance as hams compare notes on the latest bargain.

Generally, it's a good idea to use VHF or UHF for all local communications. The HF bands should be reserved for longer-distance contacts to reduce interference on the HF bands.

VHF and UHF FM voice operation takes two forms: simplex and repeater. **Simplex operation** means the stations are talking to each other directly, on the same frequency. This is similar to making a contact on the HF bands.

FM voice operation is well-suited to local VHF/UHF radio communication because the audio signal from an FM receiver is not affected by static-type electrical noise. Car engines and ignition systems produce quite a bit of static electrical noise, and many hams like to operate their FM radios while they are driving or riding in a car. (This is called *mobile* operation.) An AM or SSB receiver is affected much more by static-type electrical noise.

The communications range for VHF and UHF FM simplex is usually limited to your local area (5-15 miles). If you live high on a mountain and use a high-gain directional antenna, you may be able to extend your range considerably. Unfortunately, most of us do not have the luxury of ideal VHF/UHF operating conditions. Often, we want to make contacts even though we live in a valley, are driving in a car or are using a low-power, hand-held transceiver.

Enter repeaters. A repeater receives a signal and re-transmits it, usually with higher power and from a better location, to provide a greater communications range. Often located atop a tall building or high mountain, VHF and UHF repeaters greatly extend the operating range of amateurs using mobile and hand-held transceivers. If a repeater serves an area, it's not necessary for everyone to live on a hilltop. You only have to be able to hear the repeater's transmitter and reach the repeater's receiver with your transmitted signal.

A repeater receives a signal on one frequency and **simultaneously retransmits** (repeats) it on **another** frequency. The frequency it receives on is called the **input frequency**, and the frequency it transmits on is called the **output frequency**.

To use a repeater, you must have a transceiver that can transmit on the repeater's input frequency and receive on the repeater's output frequency. The input and output frequencies are separated by a predetermined amount that is different for each band. This separation is called the *offset*. For example, the offset on 1.25 meters is 1.6 MHz. A repeater on 1.25 meters might have its input frequency on 222.32 MHz and its output on 223.92 MHz. Repeater frequencies are often specified in terms of the output frequency (the frequency you set your receiver to listen on) and the offset. Your transmitter operates on a frequency that is different from the receive frequency by the offset amount.

Most transceivers designed for FM repeater operation are set up for the correct offset. They usually have a switch to change between **simplex operation** (transmit and receive on the same frequency) and **duplex operation** (transmit and receive on different frequencies). So, if you wanted to use the repeater in the preceding example, you would switch your transceiver to the duplex mode and dial up 223.92 to listen to the repeater. When you transmit, your rig will automatically switch to 222.32 MHz (1.6 MHz lower in frequency), the repeater input frequency.

When you have the correct frequency dialed in, just key your microphone button to transmit through ("access") the repeater. Most repeaters are **open** -- that is, available for use by anyone in range. Some repeaters, however, have limited access. Their use is restricted to exclusive groups, such as members of a club. Such **closed** repeaters require the transmission of a continuous subaudible tone or a short "burst" of tones for access. These are called CTCSS (continuous tone-coded squelch system) or PL (Private Line PL is a Motorola trademark) tones. There are also some repeaters available for use by everyone that require the use of special codes or subaudible tones to gain access. The reason for requiring access tones for "open" repeaters is to prevent interference from extraneous transmissions that might accidentally key the repeater. If you wish to join a group that sponsors a closed repeater, contact the repeater control operator.

## Finding a Repeater

Most communities in the United States are served by repeaters. While the majority of repeaters (over 6000) are on 2 meters, there are more than 1600 repeaters on 222 MHz, more than 5000 on 440 MHz, over 70 on 902 MHz and more than 200 on 1270 MHz. More repeaters are being put into service all the time. Repeater frequencies are selected through consultation with **frequency coordinators** -- individuals or groups that recommend repeater frequencies based on potential interference and other factors.

There are several ways to find the local repeater(s). Ask local amateurs or contact the nearest radio club. Each year, the ARRL publishes [\*The ARRL Repeater Directory\*](#), a comprehensive listing of repeaters throughout the United States, Canada, Central and South America and the Caribbean. Besides finding out about local repeater activity, the *Directory* is handy for finding repeaters to use during vacations and business trips. Another handy tool for travelers is [\*TravelPlus for Repeaters™ CD-ROM\*](#).

Certain segments of each band are set aside for FM operation. For example, on 1.25 meters, repeater inputs are found between 222.32 and 223.28 MHz. The corresponding outputs are between 223.92 and 224.98 MHz.

Frequencies between 223.42 and 223.9 MHz are set aside for simplex operation. On 23 cm, repeater inputs run between 1270 and 1276 MHz, with corresponding outputs between 1282 and 1288 MHz. Simplex operation is between 1294 and 1295 MHz.

## Repeater Operating

Before you make your first FM repeater contact, you should learn some repeater operating techniques. It's worth a few minutes to listen and familiarize yourself with the procedures used by other hams in your area. Accepted procedures can vary slightly from repeater to repeater.

### Your First Transmission

Making your first transmission on a repeater is as simple as signing your call. If the repeater is quiet, just say "N1GZO" or "N1GZO listening" -- to attract someone's attention. After you stop transmitting, you will usually hear the unmodulated repeater carrier for a second or two. This *scquelch tail* lets you know that the repeater is working. Someone interested in talking to you will call you after your initial transmission. Some repeaters have specific rules for making yourself heard. In general, however, your call sign is all you need.

Don't call CQ to initiate a conversation on a repeater. It takes longer to complete a CQ than to transmit your call sign. (In some areas, a solitary "CQ" is permissible.) Efficient communication is the goal. You are not on HF, trying to attract the attention of someone who is casually tuning across the band. In the FM mode, stations are either monitoring their favorite frequency or not. Except for scanner operation, there is not much tuning across the repeater bands.

To join a conversation in progress, transmit your call sign during a break between transmissions. The station that transmits next will usually acknowledge you. Don't use the word "break" to join a conversation -- unless you want to use the repeater to help in an **emergency**. To make a distress call over a repeater, say "*break break*" and then your call sign to alert all stations to stand by while you deal with the emergency.

A further word about emergencies: Regardless of the band, mode or your class of license, FCC Rules specify that, in case of emergency, the normal rules can be suspended. If you hear an emergency call for help, you should do whatever you can to establish contact with the station needing assistance, and immediately pass the information on to the proper authorities. If you are talking with another station and you hear an emergency call for help, stop your QSO immediately and take the emergency call.

To call another station when the repeater is not in use, just give both calls. For example, "N1II, this is N1BKE" If the repeater is in use, but the conversation sounds like it is about to end, wait before calling another station. If the conversation sounds like it is going to continue for a while, however, transmit only your call sign between their transmissions. After you are acknowledged, ask to make a quick call. Usually, the other stations will stand by. Make your call short. If your friend responds, try to meet on another repeater or on a simplex frequency. Otherwise, ask your friend to stand by until the present conversation ends.

*Use plain language* on a repeater. If you want to know someone's location, say "Where are you?" If you want to know whether someone you're talking with is using a mobile rig or a hand-held radio, just ask: "What kind of radio are you using?" You get the idea.

## Courtesy Counts

If you are in the midst of a conversation and another station transmits his or her call sign between transmissions, the next station in line to transmit should acknowledge the new station and permit the new arrival to make a call or join the conversation. It is impolite not to acknowledge new stations, or to acknowledge them but not let them speak. The calling station may need to use the repeater immediately. He or she may have an emergency to handle, so let him or her make a transmission promptly.

A brief pause before you begin each transmission allows other stations to break in -- there could be an emergency. Don't key your microphone as soon as someone else releases theirs. If your exchanges are too quick, you can prevent other stations from getting in.

The *courtesy tones* found on some repeaters prompt users to leave a space between transmissions. The beeper sounds a second or two after each transmission to permit new stations to transmit their call signs in the intervening time. The conversation may continue only after the beeper sounds. If a station is too quick and begins transmitting before the beeper sounds, the repeater may indicate the violation, sometimes by shutting down!

*Keep transmissions as short as possible*, so more people can use the repeater. Again, long transmissions could prevent someone with an emergency from getting the chance to call for help through the repeater. All repeaters encourage short transmissions by "timing out" (shutting down for a few minutes) when someone gets longwinded. The **time-out timer** also prevents the repeater from transmitting continuously, due to distant signals or interference. Because it has such a wide coverage area, a continuously transmitting repeater could cause unnecessary interference. Continuous operation can also damage the repeater.

You must transmit your call sign at the end of a contact and at least every 10 minutes during the course of any communication. You do not have to transmit the call sign of the station to whom you are transmitting.

*Never transmit without identifying.* For example, keying your microphone to turn on the repeater without saying your station call sign is illegal. If you do not want to engage in conversation, but simply want to check if you are able to access a particular repeater, simply say "N1KB testing."

## Fixed Stations and Prime Time

Repeaters were originally intended to enhance mobile communications. During commuter rush hours, mobile stations still have preference over fixed stations on some repeaters. During mobile prime time, fixed stations should generally yield to mobile stations. When you're operating as a fixed station, don't abandon the repeater completely, though. Monitor the mobiles: your assistance may be needed in an emergency. Use good judgment: Rush hours are not the time to test your radio extensively or to join a net that doesn't deal with the weather, highway conditions or other subjects related to commuting. Third-party communications nets probably should not be conducted on a repeater during prime commuting hours.

## Simplex Operation

After you have made a contact on a repeater, move the conversation to a *simplex* frequency if possible. The repeater is not a soapbox. You may like to listen to yourself, but others, who may need to use the repeater, will not appreciate your tying up the repeater unnecessarily. The easiest way to determine if you are able to communicate with the other station on simplex is to listen to the *repeater input frequency*. Since this is the frequency the other station uses to transmit to the repeater, if you can hear his signals there, you should be able

to use simplex. If you want to perform an on-the-air test of a pair of hand-held radios, you should select an unoccupied simplex frequency.

The function of a repeater is to provide communications between stations that can't otherwise communicate because of terrain, equipment limitations or both. It follows that stations able to communicate without a repeater should not use one. That way, the repeater is available for stations that need it. (Besides, communication on simplex offers a degree of privacy impossible to achieve on a repeater. On simplex you can usually have extensive conversations without interruption.)

Select a frequency designated for FM simplex operation. Otherwise, you may interfere with stations operating in other modes without realizing it. (The reason for this is simple: Changing to a simplex frequency is far easier than changing the frequencies a repeater uses.) To see if you and the other station can communicate on a simplex frequency, listen on the repeater input frequency. If you can clearly hear what's going into the repeater, you don't need the repeater to communicate.

### Common VHF/UHF FM Simplex Frequencies

<b>2-Meter Band</b>	<b>1.25-Meter Band</b>	<b>70-cm Band</b>
146.52*	223.42	446.0*
146.535	223.44	
146.55	223.46	<b>33-cm Band</b>
146.565	223.48	906.5*
146.58	223.50*	
146.595	223.52	<b>23-cm Band</b>
147.42		1294.5*
147.435		1294.000
147.45		1294.025
147.465		Every 25 kHz to 1295
147.48		
147.495		
147.51		
147.525		
147.54		
147.555		
147.57		
147.585		

\* National simplex frequency

### Autopatch: Use it Wisely

An **autopatch** allows repeater users to make telephone calls through the repeater. To use most repeater autopatches, you generate the standard telephone company tones to access and dial through the system. The tones are usually generated with a telephone-type tone pad connected to the transceiver. Tone pads are available from equipment manufacturers as standard or optional equipment. They are often mounted on the front of a portable transceiver or on the back of a fixed or mobile transceiver's microphone. Whatever equipment you use, the same autopatch operating procedures apply.

There are strict guidelines for autopatch use. The first question you should ask is "Is the call necessary?" If it is an **emergency**, there is no problem -- just do it! Calling for an ambulance or a tow truck is okay. Other

reasons may fall into a gray area. As a result, some repeater groups expressly forbid autopatch use, except for emergencies.

Don't use an autopatch where regular telephone service is available. One example of poor operating practice can be heard most evenings in any metropolitan area. Someone will call home to announce departure from the office. Why not make that call from work before leaving?

Never use the autopatch for anything that could be considered business communications. The FCC strictly forbids you to conduct communications in Amateur Radio for your business or for your employer. You may, however, use Amateur Radio to conduct your own personal communications. The rules no longer forbid you to use the autopatch to call your doctor or dentist to make an appointment, or to order food, for example.

Don't use an autopatch just to avoid a toll call. Autopatch operation is a privilege granted by the FCC. Abuses of autopatch privileges may lead to their loss for everyone.

You have a legitimate reason to use the autopatch? Here's how most systems operate. First, you must access (turn on) the autopatch, usually by pressing a designated key on the tone pad. Ask the other hams on a repeater how to learn the access code. Many clubs provide this information only to club members. When you hear a dial tone, you know that you have successfully accessed the autopatch. Now, simply punch in the telephone number you wish to call.

Once a call is established, remember that you are still on the air. Unlike a normal telephone call, only one party at a time may speak. Both you and the other person should use the word "over" to indicate that you are finished talking and expect a reply. Keep the call short. Many repeaters shut off the autopatch after a certain time.

Turning off the autopatch is similar to accessing it. A key or combination of keys must be punched to return the repeater to normal operation. Ask the repeater group sponsoring the autopatch for specific information about access and turn-off codes, as well as timer specifics. Don't forget to identify your station. Most groups expect you to give your call sign, the date and time just before accessing the autopatch and just after turning it off.