How do I?

An occasional series

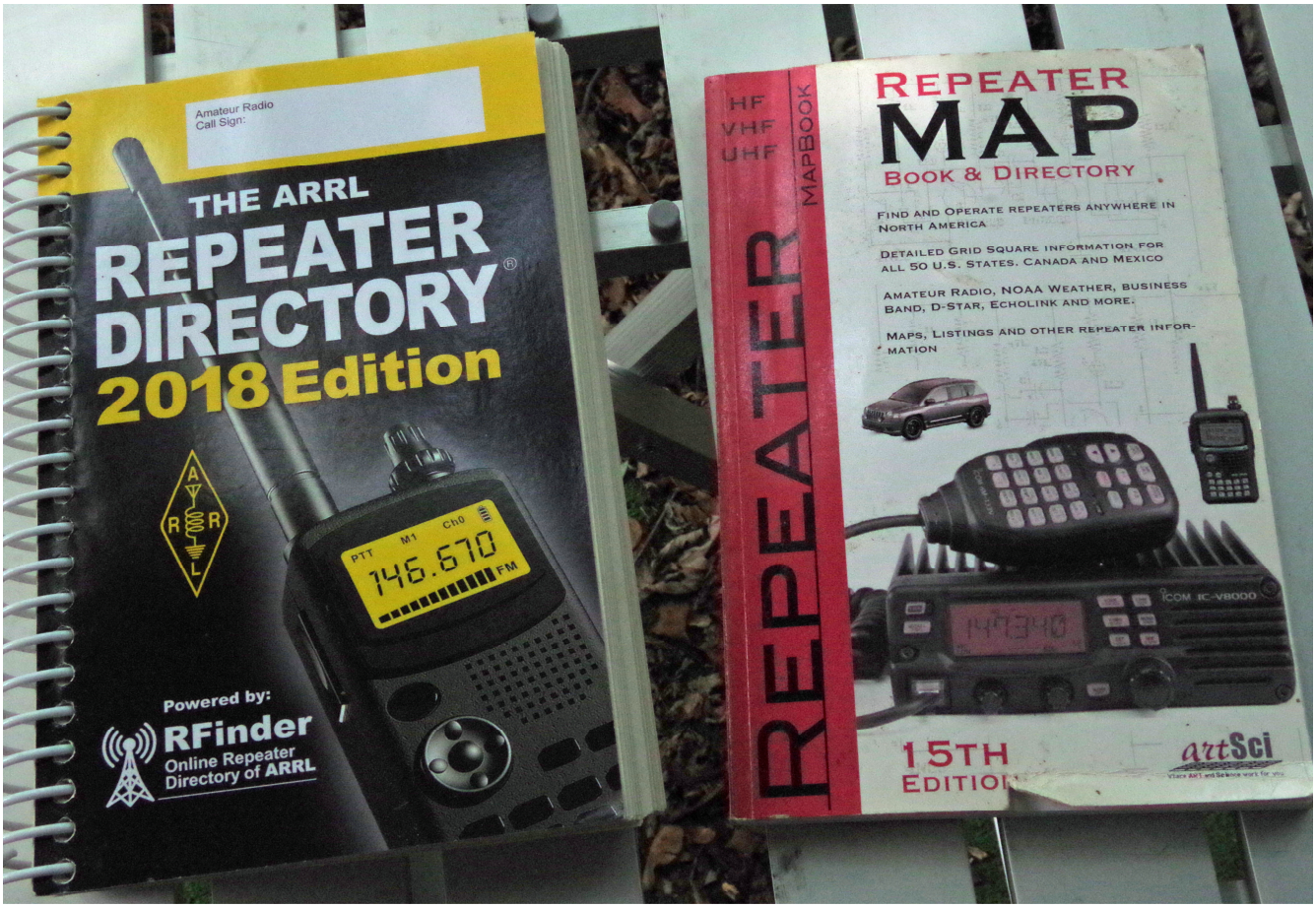
This week: Using FM Repeaters

If you are reading this, there is probably a good chance you are a recently licensed Technician class amateur radio operator. Sometime around maybe 1980 or so, it seems that because technicians have a lot of VHF and UHF privileges and not so many on the HF bands, many Technicians were encouraged to start with a hand held radio or HT. Some progressed to mobile radios mounted in cars. Either way, range can be limited, and VHF and UHF are highly dependent on line of sight. So if you are "hidden" from the other station, even if you are not far away, they may not hear you.

FM (Frequency Modulated) radios entered the amateur sphere after WWII using mostly ex military Motorola gear. VHF (50 to 300 MHz) is generally thought of as line of sight. And many seem to think that if you want to talk to someone on VHF, and you cannot reach out and touch them, you must use a repeater. A repeater is a radio(s) connected to a controller. You, using your radio, call on the INPUT Frequency for example 147.820 MHz and the repeater with rebroadcast your transmission on the OUTPUT frequency. For example 147.120 MHz. There are Repeater Coordinators nationwide who work together to make sure that repeaters do not interfere with each other. FM Simplex (only 1 frequency) works well and you may be surprised at how far you can actually communicate without a repeater. **FM Analog** whether using simplex or a repeater is 2 meter radio at its simplest.

Most repeaters are solo and have a coverage area a few miles in diameter. Some repeaters are linked or daisy-chained-where a series of repeaters is placed close together and if you call the input frequency, in central PA, a ham in southern NJ may hear the call, and come back to you. Both of you clearly hear each other, even though you are over 100 miles apart and could well have thought you were both using the same repeater.

Originally, once radios with memory frequency storage became available about 45 years ago, you had to enter frequency information by hand. How to know where repeaters are and what they do? That is when The Repeater Book ™ became common. They were issued by a number of publishers and were typically updated annually. Two examples are shown in the photo. While programming software such as the RT Systems software (see various articles in the Know-How Resources section) and CHIRP have transformed radio programming, and there are various smart phone apps (*Repeaterbook* ™) is one of the more popular and highly rated, you may want to acquire a printed copy. Why? The books have a lot of information on the basics of repeaters and more information on the services provided. The first *ARRL Repeater Directory* I received listed services such as Time, Temperature, Phone Patch and other useful services that truthfully are probably provided now by your smart phone. Today's books list functions such as D-STAR, FUSION, DMR and others that either didn't exist or were in their infancy a decade ago.



How do you make a contact on a repeater? Let's pretend you have no knowledge of the area and are completely reliant on outside information. Open the repeater book and find the section for Pennsylvania. The Harrisburg listing will have several listings. W3UU is the Harrisburg Radio Amateurs Club repeater. We see the repeater mode is FM. That means it is NOT a digital mode such as FUSION or D-STAR. D-STAR was developed by the Japanese Amateur Radio League (the counterpart in Japan of the American Radio Relay League) and was the first developed by amateurs for amateurs. D-STAR is an open standard (such as *Linux* in computer operating systems) meaning that any manufacturer could offer it. Icom seems to have been the first commercial firm to produce D-Star Radios. A few years ago Kenwood became the second major manufacturer to offer D-Star products. FUSION, also known as CF4, or System Fusion is a proprietary Yaesu product. It is a reinvention of WIRES. WIRES is about the same age as D-STAR but was not widely used. At the moment, while traditional FM is still the most widely used, and your analog radio still has value, there are places where local hams have instead a fair number of DSTAR or FUSION repeaters. California has a lot of hams and lot of repeaters. Randomly looking up San Jose reveals 2 1/2 pages of repeater listings -- One is ATV (amateur television, one P25 (a mode that originated in the EMS community and migrated to ham radio), one FUSION, ten DSTAR and two DMR -- that is not even the half page, so there are over two full pages of traditional FM analog repeaters.

In our example, we have an FM radio so W3UU seems to be a good choice of repeater.

The next column is the call sign (W3UU) and the next is the OUTPUT frequency. This is what we will hear the repeater on. It is 146.760. Because the 2 meter band is relatively small, and repeaters are crammed into a relatively small portion, hams often refer to a repeater by the numbers following the decimal point. So 146.760 becomes “The 76 machine”.

The next column is the INPUT. In this case it is a minus symbol **(-**). The standard offset is 600 KHz. A **-** means you subtract .600 KHz from the output and a **+** means you add 600 KHz. A non-standard offset will have a frequency listed instead of the + or -. In our case, either our programming software will insert the correct input when we select minus, or we have to manually enter 146.160 as the input.

The final column will be labeled ACCESS or TONE or PL or something similar. Repeaters are pretty expensive and if someone is transmitting on the input, it will broadcast whatever it hears. Whether naturally through propagation or by human action, if the repeater was always transmitting, no one could get a word in edgewise. The introduction of the Motorola Private Line or PL tone about 60 years ago really made modern repeater function possible, In our case the PL is 100.00 Hz. This is an example of Continuous Tone Coded Squelch System or CTCSS. This is an analog system and any VHF/UHF radio made since 1995 or so has it a standard feature. On older radios it could have been an option. This is a very simplified description as books have been written on the subject. In essence, CTCSS was designed to allow multiple commercial users to share radio frequencies without hearing each other and that technology was adapted by hams. To access W3UU, you need the CTCSS tone programmed. There is a list of standard CTCSS frequencies, and the programming software uses a drop down box to allow you to select the tone you need.

At this point you have the data and hopefully have the radio programmed. A digital mode, such as D-Star or Fusion, use the same concepts but may require additional information.

Ok! We are set to make a QSO. If you are using a Hand-held Transceiver, depending on your location, you will probably need full power and may want an antenna better than that stock factory “rubber-duck”. (There are several articles posted under Know-How Resources about HTs and antennas.) VHF is not like HF. Calling CQ and using other Q codes and shortcuts like “73” are generally frowned on. Using 10-codes..such as “What’s your 20? if you want to know someone’s location” are also frowned on. Simply put your radio in memory mode, select the memory channel for the repeater and say “KB3PQT monitoring” or “KB3PQT mobile” and someone may come back to you. If no one does, do not panic. Just try again. There have been many times where I heard someone and didn’t get the radio to stop scanning in time to know the frequency, and had to wait until they tried again.

Catch ya on the air!