Kenneth Vito Zichi

3018 Moyer Road
Williamston, MI 48894-9566

Antenna Basics

Basic wire antenna design is a topic radio enthusiasts should know. Although there are now many commercially available antennas for all radio enthusiasts, wire antennas are relatively easy to build (the hard part is erecting them, and even if you buy a commercially made antenna, you will have to erect it!), and provide an opportunity for experimentation that is enjoyable in and of itself. Even if you do decide to buy a commercially made product, a basic understanding of the various designs will guide you in an intelligent purchase.

In this column, we will cover the basic antenna designs, and each design's characteristics. The emphasis here will be primarily on antennas useful at SW, MW and LW frequencies, but the theory applies to all antennas. One caveat though, a detailed analysis of design and construction is beyond the scope of this column, and can be found in Clem Small's "Antenna Topics" column in *MT*.

Do You Really Need an Antenna?

First you need to decide whether an external antenna is appropriate for you, or if the internal loop, whip or other built in antenna is sufficient. Depending on your receiver, interest and location you may not need one.

If you are primarily interested in listening to "powerhouse" or local stations, you probably do not need an external antenna. Many modern portable radios are so sensitive that installing an external antenna will hurt reception rather than help unless you install an antennuator as described in this issue (Technical Topics by Terry Staudt).

Outdoor Antenna Designs

If you are like most listeners you will want to seek out more difficult signals or more reliably receive the "easy" stations. An outdoor antenna is the first step to improving the situation. This is true for at least two reasons. First of all, an outdoor antenna is away from all the locally generated noise inside your house. Electrical appliances from vacuum cleaner to your computer all generate radio noise, and the farther away from that noise your antenna is, the better.

Second, an external antenna is less likely to be shielded from the signal you are trying to hear. Many modern buildings are made with metal superstructures, and act as a dandy shield for radio energy. Putting an antenna inside a modern apartment complex structure is a little like hiding the proverbial candle under a basket.

If you decide that an outdoor antenna is desirable for you based on the above criteria, the next decision you must make is what type of antenna you should erect. The rest of this article will look at the various types of outdoor antennas, and a future column will look at indoor and attic designs for those of you who have space or other limitations on outdoor "skyhooks."

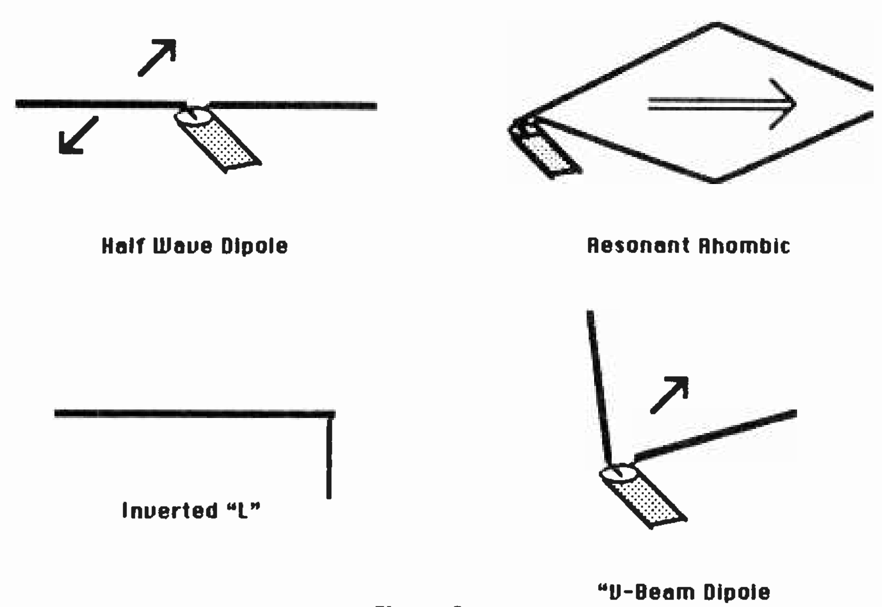

Figure One:
Antenna Types

Arrows indicate direction of maximum sensitivity

Dipoles

The dipole is the standard by which all other antennas are judged, so, let's look at it first. The basic form of dipole is called the "half wave" dipole (see figure 1). The dipole consists of two conductors each one quarter wavelength long at the desired frequency. It is connected to the receiver through a two conductor cable called a feed line.

A dipole, if erected high enough and far enough away from obstructions (at least one wavelength) will show greatest sensitivity to signals arriving off its sides, and a lack of sensitivity to signals off the ends. In most practical situations though this directivity cannot be predicted with any degree of certainty and one dipole will show a marked improvement in signals arriving from a particular direction while another will be generally omni-directional. In any case, though, such an outside antenna will be a marked improvement over a built in whip or loop.

You can calculate the length of a half wave dipole by using the formula 468 divided by the frequency in MHz. This will give you the length of the full dipole in feet. For example a dipole cut for 9 MHz. will be 468 divided by 9 or 52 feet. To find the length of each leg of the dipole divide this length by 2 to arrive at 26 feet on each side of the feedpoint.

The dipole is basically a single band antenna, but it can be made to function on many bands by two methods. The first is to cut dipoles for as many bands as you wish and connect them together at the center feedpoint and insulate the ends from each other. This scheme is called paralleled dipoles and works very well.

The second scheme uses a single wire with electrical traps located at strategic points along the length of the wire. These traps isolate each section of the antenna essentially turning the antenna into an effective multiband antenna. More information on both schemes can be found in the ARRL *Antenna Handbook,* available from Imprime, Box 241-R, Radnor Station, Radnor, PA 19087.

Dipoles can also be drooped, which is to say their legs can be lowered toward the ground. The most important advantage to letting the ends of a dipole droop is that now only one high support is required instead of three. Try to keep the angle of the droop between 120 and 90 degrees; going beyond 90 degrees will cause deterioration of performance (generally). This drooping dipole is often called an inverted V, but this is incorrect as the inverted V is an entirely different antenna.

Marconi Antenna

The Marconi antenna is one half of a dipole -- often called a quarter wave antenna. The missing half is replaced by the earth or a counter poise wire. It is not as effective generally as the half wave dipole, but it is easier to erect than a full size antenna in many cases and on the average will work well. The Marconi can take the form of a horizontal, sloping or vertical radiator, in each case though a ground connection must be provided.

The formula to calculate the length of a Marconi antenna is 234 divided by the frequency in MHz. As you might suspect it is possible to use the same formula to calculate each leg of a half wave dipole.

Long Wire Antenna

Usually long wire antennas exhibit gain and directivity over a half wave or quarter wave antenna. An antenna becomes a long wire when its length is one or more wavelengths at the desired frequency. The long wire can be fed at the end, the center or off center as the design dictates.

Two outstanding long wire antennas much favored by radio enthusiasts with enough room are the VEE Beam and the Rhombic antenna. The VEE beam is made up of two long wires (of same length) and looks like a V when viewed from the bottom. This antenna is bi-directional and depending upon its length and the included angle of the V, exhibits very high gain over a half wave dipole.

The second famous long wire antenna is the Rhombic; basically two VEE beams placed end to end to form a rhomboid shape. The Rhombic is also bi-directional and exhibits extremely high gain. Both the VEE and the Rhombic can be made uni-directional but such a discussion is beyond the scope of this article. As you can imagine both of these antennas are very large and require a great deal of real estate to erect.

Loop Antenna

There are several basic types of loop antennas. The first is the one we are all familiar with inside of our AM radio. Modern AM loop antennas are wound on a core of iron ferrite and work extremely well. They are quite directional and rotating the radio will improve reception from the desired station.

These small loop antennas very critical to tune, and if the user intends to cover a wide range of frequencies some method of tuning the loop must be included in the design; moving too far from the design frequency will cause the loop to become extremely inefficient unless a method of varying the tuning is included.

A second popular loop antenna is the full wave loop. The full wave loop can take the form of a triangle, square, trapezoid or circle. Full wave loops are very tolerant and provide the user with several advantages. First of all loops are very quiet, so if you live in a location with a lot of electrical noise the loop is a good choice. Second the full wave loop provides about 2 decibels of gain over a dipole (at the design frequency) and is directive at right angles to the plane of the loop.

Third, if the loop is fed with 300 ohm TV line and coupled to the receiver through an antenna tuner it can be used on a wide range of frequencies. Usually loop antennas are hung in a vertical plane, but angles up to 45 degrees will not cause the performance to deteriorate.

Two excellent antenna reference manuals are the *ARRL Antenna Handbook* and *The Radio Handbook* by William Orr. Both books are available from most radio book dealers.

That concludes our overview of antenna types. We have just scratched the surface and what I have not said here could fill books (it has). As always if you have a specific question or suggestion for a topic feel free to drop me a line at the address above. If you want a reply be sure to include an SASE. ■