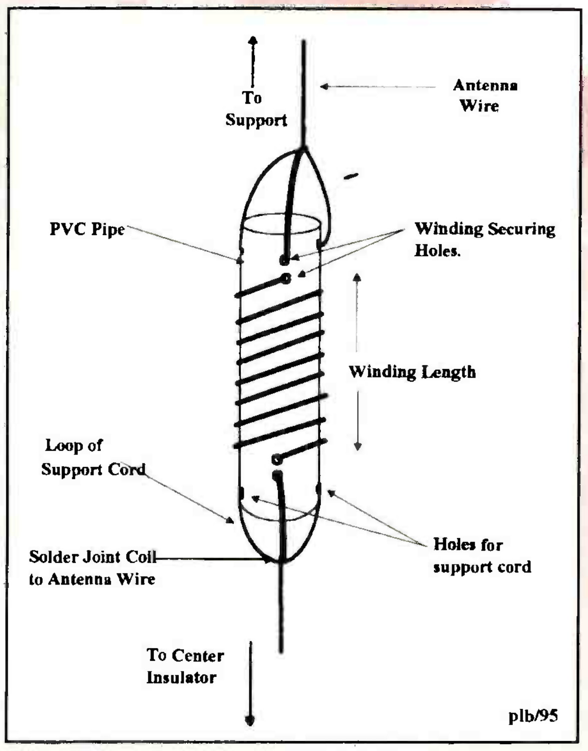
MEET THE LOW SUNSPOT CHALLENGE WITH COMPACT, EFFICIENT ANTENNAS

By Peter L. Barker



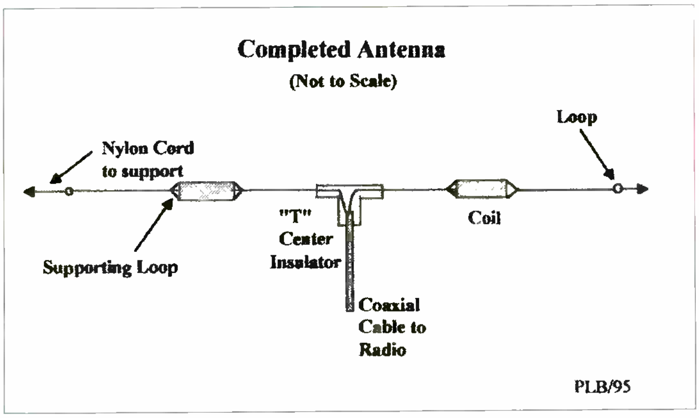
Our ability to receive shortwave signals (3 to 30 megahertz) is largely at the mercy of the refracting ability of the ionosphere. The shell of ionized particles that surrounds the earth enables signals to be refracted (bent) so that they return to earth rather than disappearing out into space. This ability to refract depends largely upon the amount of radiation emitted from sunspots on the sun.

The number of sunspots, and therefore the amount of radiation from the sun, follows an approximately 11 year cycle. At the peak of the cycle transmissions from the other side of the earth can be received on the proverbial "wet noodle" and ham operators can communicate worldwide on the 28 MHz band with, at times, milliwatts of power. At the bottom of the cycle—about now—the higher frequencies are not refracted, and traffic moves to the lower frequencies where, even so, communication is often barely possible.

To combat the loss of "propagation" as it is called, commercial broadcasters, utility stations, as well as hams are crowding into the lower frequencies for long distance communication.

The challenge of effectively receiving at these frequencies is complicated by the fact that the lower the frequency the longer the antenna needed. Even though reasonable reception may still be achieved with a random wire antenna coupled with an antenna tuner and a *good* radio frequency ground, there is no real substitute for the half-wave dipole for the serious monitor.

A standard dipole has an overall length of one-half of the wavelength of the desired center frequency, and that is exactly the problem for those of us



with restricted space and funds. For 6 MHz (45 meter band), a full size dipole would be roughly 37 feet end to end. 3 MHz would simply be double—a substantial 74 feet of wire to be strung up as high and straight as possible.

The physics of resonance will come to our aid, however. By placing a suitable coil at the mid-point of each arm of the antenna, its overall length can be reduced with very little loss in efficiency or range of frequencies that can be received. This method should not be confused with a trapped antenna, which also uses coils in order to isolate different lengths of antenna to allow it to cover various bands, and which does create some shortening at the lowest frequency.

The shortened antenna is just that—an antenna 50% of the size of a full size antenna.. There is a down side, of course: The shortened antenna is most efficient at its design frequency. It can be used on other frequencies with the aid of an antenna tuner, but this is a compromise. Like all half wave dipoles, for longest range reception it should be mounted at a height of 1/2 wave-length above the ground.

Build one to your specs

The magic number for the design of the coil is that it must have an impedance of 950 ohms at the design frequency. If you are not familiar with these terms, a basic text on radio electronics or ham radio would help. If you are not a "techie," that's okay, too! Just use the cook book approach below.

The coil can be wound on almost any insulation material, such as waterproofed wood or plastic. The most convenient and economical material is PVC water pipe. Only short pieces are needed and can often be begged from someone's scrap box. Two identical coils are needed for each antenna.

Apart from the PVC pipe you will need some 1/8 inch nylon cord or something similar and some 16 awg enamel-covered magnet wire. (Note: 14 awg household insulated wire can be substituted. The resulting antenna will be slightly less effective and the coils a little heavier. Be sure to use the data in Table 2 for winding the coils.) The finished coil is shown in Diagram #1.

A hole is drilled at each end of the tube of sufficient size to allow the cord to pass through. A quarter turn of the

Table 1

Coil Winding and Antenna Data

16 awg Magnet Wire	Frequency MHz 3.9	6.1	7.2
Approx length of coil wire (")	240	150	135
Number of turns in coil	49	34	30
Length of winding (inches)	2.7	1.9	1.7
Length of antenna section (ft)	15	9.1	7.75
Overall length of antenna (ft)	61.5	40	32

Table 2

Coil Winding and Antenna Data

14 awg Household Wire	Frequency in MHz 3.9	6.1	7.1
Approx length of coil wire (")	280	185	170
Number of turns in coil	63	43	37
Length of winding (inches)	5.1	3.5	3
Length of antenna section (ft)	15	9.1	7.75
Overall length of antenna (ft)	62	40.1	42.1

The dimensions and winding data for 14 AWG wire with insulation are approximate as the thickness of the insulation varies somewhat with manufacturer.

tube away from. these holes drill two holes 1/2" inch apart, and large enough to clear the coil wire.

Thread one end of the coil wire down through one of the two smaller holes and up through the one closest to the end of the tube. Leave about 6" protruding. Now snugly wind the required number of turns on the PVC tube spacing them as shown. Secure the free end of the winding in the same manner as at the start.

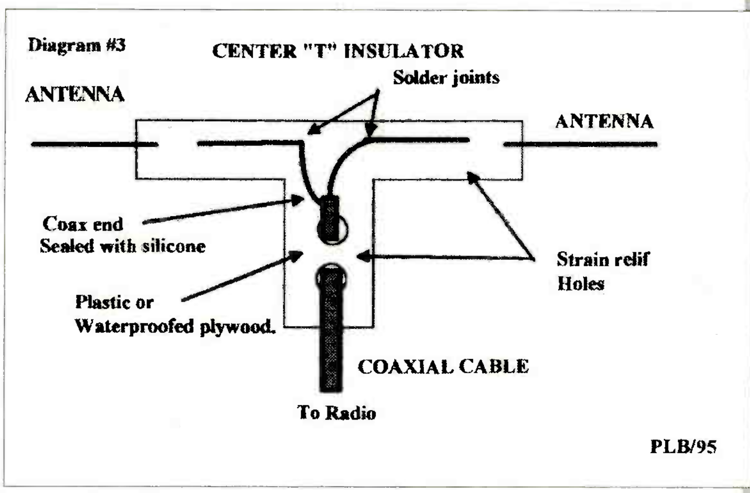
Try to keep the winding as tight and even as possible. Needle-nosed pliers will help with the threading. Two coils, as closely identical as possible, must be made. Pass a short length of the cord through the larger holes and form a loop. This complete the coils themselves.

Our example is for 6.1 MHz. The dimensions for the coils for 7.2 MHz and the 3.9 MHz band are given in the tables below (Tables 1 and 2).

For a 6.1 MHz antenna you will need four pieces of antenna wire (#14 household wire can be used). Pass one end to the wire through the cord .loop and secure with a knot or cable tie as shown, then strip the ends of this wire and the coil wire and solder together (the enamel can be removed with sandpaper). If absolutely necessary you can just twist the wires together as tightly as possible and coat with silicon sealant.

Now re-measure the antenna wire from the end of the last turn on the coil to the distant end of the wire and trim to the length given. To the remaining end of the coils do likewise, but leave an additional 3" for the suspension loop at the outer ends of the antenna. To weatherproof the coils and prevent the turns from moving they should be sprayed with a clear urethane coating; they can then be wrapped tightly with PVC tape if desired.

The final assembly step is to construct the center insulator (these are available commercially, but for our purposes a scrap of plywood or plastic will serve) and attach the feed line. The insulator provides the center point of the antenna and the connection point for the feed line. It must be strong enough to withstand the tension in the mounted antenna. The simplest insulator can be made in the form of a "T" with holes for the strain reliefs (see Diagram #3).



The feed line, which can be any reasonable length, should be coaxial cable as long as it is low-loss. Do *not* use TV ribbon twin lead. Strip the coaxial cable to show the center conductor and outer braid. Tease out the braid with a sewing needle or similar and twist into a pigtail.

Feed the inner ends of the antenna wires through the strain relief holes and strip 1/2" of insulation. Tin the ends of theses wires and the prepared coaxial cable, and solder the center conductor to one end of the antenna and the braid pigtail to the other, (it does not matter which way you do this). This junction, when cool, *must* be well sealed with silicone sealer, as any water entering the coax will drastically affect its performance. Use of the so-called "UHF" connectors at the antenna feed point is not recommended as these just add weight, cost, and are *not* waterproof.

The opposite end of the coax feedline should be fitted with the appropriate connectors for your radio, and the braid connected to an electrical ground.

Form a small loop at the outer ends of the antenna and you are ready to mount it. It can be hung horizontally between two supports with reasonable tension. If this is not possible it can be mounted as an "inverted V" from one central support. The angle between the two "legs" should be greater than 90 degrees and the ends kept at least 3-4 feet above the ground. A short (3 feet or so) length of nylon chord must be used between the end loops of the antenna and supports.

Once you have gathered the material to make this antenna, it will take only a little longer to make than it does to read this article. Give it a try and experience the thrill of building an effective antenna for a few dollars and enjoy superior reception during these years at the bottom of the propagation pit.