5/8-wavelength two-meter antenna

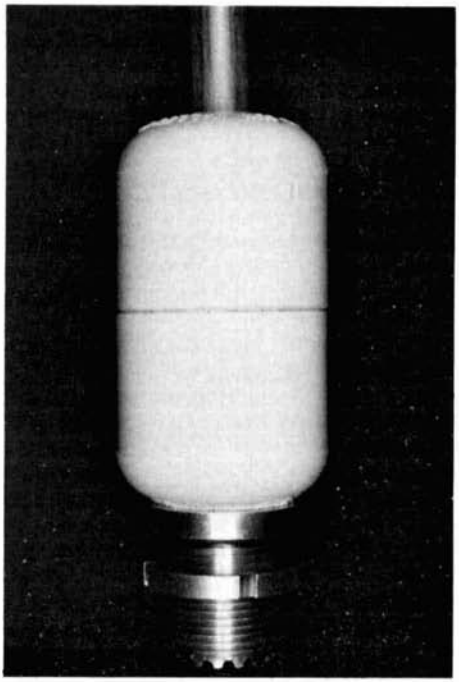
How to build a low-cost gain antenna for your two-meter mobile or base-station

Dave Sargent, K6KLO, 5343 Clovercrest Drive, San Jose, California 95118

The simplest way to match a 5/8-wavelength end-fed radiator to a 50-ohm feed system is to lengthen it by 1/8 wavelength with loading to make the antenna electrically 3/4-wavelength long.[1] The antenna will then present the same 50-ohm load as the familiar 1/4-wave whip. Radiation from the small loading coil will be almost nil, and the low angle radiation of a 5/8-wavelength radiator will be realized. Two-meter antennas of this type are available from several antenna manufacturers, but at rather dear prices. Described here is a 5/8-wavelength two-meter antenna which can be assembled for less than five dollars. The necessary materials are available from any hardware store, and standard hand tools are all that is needed for its construction. An electric drill is the only power tool required.

The 5/8-wavelength radiator is a replacement-type adjustable automobile antenna. The one I used was purchased from Allied Radio Shack for $1.39 (catalog number 12-1309). Many auto supply stores also carry these antennas, and any of them that will extend to 48 inches (1.22 meters) should be satisfactory.

fig. 1. Completed loading coil for 5/8-wave two-meter antenna. The type-uhf fitting at the base lends itself to a variety of mounting methods, and a replacement-type automobile broadcast antenna slips handily over the 5/16-inch brass rod on the top.



With the radiator portion of the antenna taken care of, all that is needed is a loading coil with a good mechanical base. Many approaches were considered, but none were going to be easy to construct. I finally tried the design shown in **fig. 4**, which went together successfully on the first try. All parts are labeled in the drawing. The 1/2-inch (12.7-mm) PVC plastic pipe caps cost about a quarter. Half-inch (12.7-mm) PVC pipe is usually available in ten-foot (3-meter) lengths for about fifty cents. Only two inches (5.1 cm) of pipe is needed, but the remainder may prove handy for some other project. Some number-16 copper bus wire for the coil, some epoxy, about two inches (3 cm) of 5/16 inch (7.9 mm) diameter brass rod, and a uhf coax connector (UG-266/U) or a piece of 3/8-24 (standard U.S. mobile mount) threaded brass stock round out the bill of materials. Although other coax connectors may be used the UG-266/U is best. A special PVC cement is available which is better than epoxy for gluing the plastic parts together.

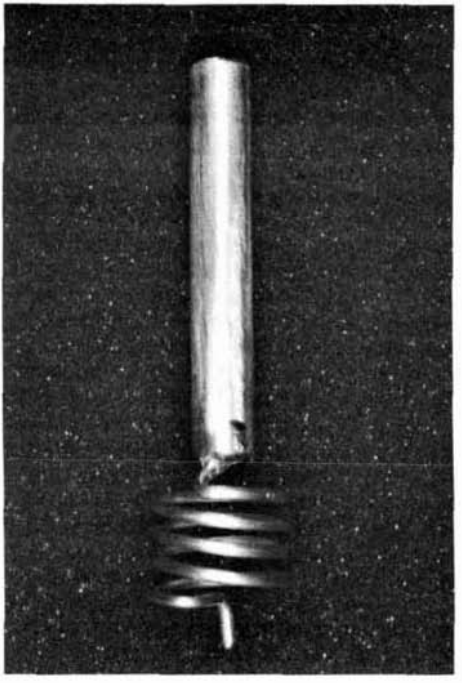
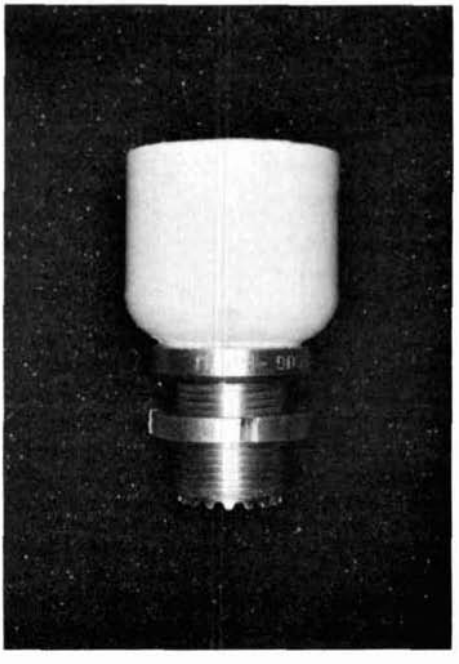


fig. 3. The loading coil is soldered to a hole drilled in the end of the brass rod, which then slips through a hole drilled in the top PVC cap.

fig. 2. PVC pipe cap with the UG-266/U coax connector installed.



coil assembly

To start the assembly, glue a two-inch (5.1-cm) piece of PVC pipe into one of the caps. The cap and pipe are then filled with about 3/4 inch (19 mm) of epoxy. This filling provides support for the 5/16-inch (7.9-mm) diameter rod used to mount the whip. With this assembly set aside for the epoxy to cure, a 9/16-inch (14.3-mm) diameter hole is drilled into the center of the other cap for the connector. A tapered hand reamer is satisfactory for making this hole if a large enough drill is not available. Screw the connector a short way into this hole, being careful to maintain alignment. Now heat the connector with a large iron or solder gun. When it is too hot to touch, grasp it with a pair of pliers and screw it into the cap. The heat will soften the PVC enough to allow this to be done and, after cooling, the connector will be molded into the PVC as shown in **fig. 2**.

After the epoxy has set, drill a 5/16-

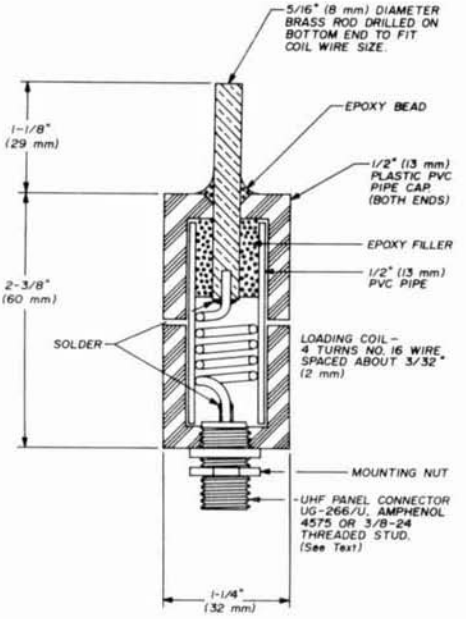


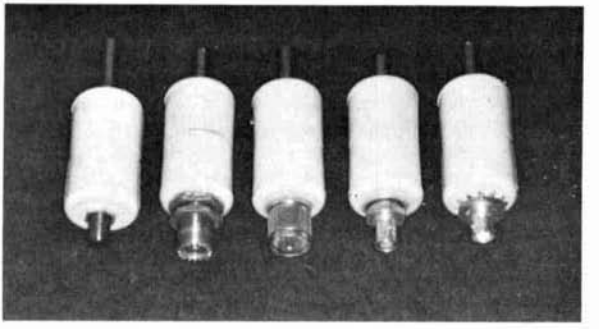
fig. 4. Cross-sectional drawing of completed loading coil assembly.

inch (7.9-mm) diameter hole in the center of the other cap. File this hole out slightly to allow easy insertion of the brass rod, bevel the top of the hole with a countersink or drill. Trim the PVC pipe to a length which will allow the caps to just come together when the halves are assembled. Wind four turns of number-16 wire on a form which will allow the finished coil to just fill the inside of the PVC pipe (about 9/16-inch (14.3-mm) diameter), and bend the ends of the coil to protrude radially from its center line.

Drill a small hole about 1/2-inch (12.7-mm) deep into one end of the 5/16-inch (7.9-mm) diameter brass rod and solder one end of the coil into it as shown in **fig. 3**. Solder the other end to the center terminal of the coax connector. Slip the top cap and PVC pipe assembly over the coil and rod to check the fit of the entire unit.

alternate mounting

In many mobile installations it is desirable to have the antenna screw into a standard mobile mount. In this case, the bottom cap should be drilled out with a size Q (about 21/64 inch or 8.4 mm) drill. A 3/8-24 threaded stud can then be heated and inserted in the same way that the connector was. A hole in the inside end of the stud should be drilled and tapped to provide a place for a solder lug for soldering the coil. Finally, a 3/8-24 nut should be run up the stud and tightened against the plastic cap. About 1/8 inch (3.2 mm) of the stud should protrude inside the cap, and some epoxy filler should be put around it to increase the strength of the base. This is necessary because the stud has 1/4 inch (6.4 mm) less diameter than the connector and might break out of the plastic if sufficient stress were placed on it.



Other connectors which have been used successfully are (left to right): 3/8-24 screw, UG-363/U UHF bulkhead feedthrough, UG-273/U UHF/BNC adapter, UG-492A/U BNC bulkhead feedthrough, and UG-911A/U panel jack (mounted from inside).

Before the assembly is sealed, its operation should be checked. For mobile installations, mount the antenna on an appropriate mobile mount. For a good match the base should be close to the car body, so do not use a large base spring.

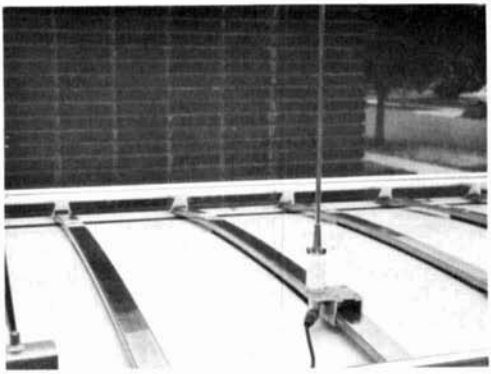


fig. 5. The 5/8-wave two-meter antenna installed on the roof of the author's station wagon. The set screws for mounting the whip have been replaced by thumb screws to permit quick removal for entering the garage.

For mast installations, the connector is mounted to an angle bracket through a hole, and four or more 20-inch (51-cm) radials must be added. In either case, adjust the whip to 48 inches (1.22 meters) and check the vswr. If it is not close to 1:1, adjust the whip length for minimum reflected power. If the whip needs to be lengthened the loading coil inductance needs to be increased; a shorter whip length means the coil requires less inductance. A whip adjusted to slightly shorter than 48 inches (1.22 meters) is acceptable, but whips of longer lengths should be avoided since undesirable high angle lobes will increase, and the low angle lobe will be weakened.

After any needed coil adjustments are made, coat the lower 3/4 inch (19 mm) of the brass rod with epoxy. The bottom cap may now be glued in place and a bead of epoxy placed in the beveled edge around the top cap as shown in the cross-section drawing, **fig. 4**. The final assembly is now a rugged, air-tight unit equal in performance to expensive commercial gain antennas. It is well-suited to a variety of mountings such as the one used on the K6KLO station wagon in **fig. 5**.

reference

1. R.L. Crawshaw, "5/8 Wavelength Verticals," *73*, May, 1970, page 36.

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