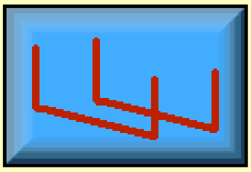

The Half-Square on 2 Meters

L. B. Cebik, W4RNL (SK)

Part 1: A Bi-Directional Vertical Antenna

If you need a vertically polarized bi-directional 2-meter antenna with deep side nulls for direction finding or nulling out adjacent channel interference, try the half-square.

The half-square (see **Figure 1**) offers a vertically polarized pattern with the figure-8 pattern usually found only with horizontally polarized antennas. Although the gain of a half-square in the desired direction (broadside to the array) over a vertical dipole is about 2.5 dB, the gain is less important than the front-to-side ratio (edgewise to the array), which offers a minimum of three S-units of rejection even for sloppy construction. The half-square also offers a direct match for 50-ohm coax. This property simplifies construction and minimizes the number of connections to gradually go bad in the weather.

The horizontal wire of the half-square is a phase line in which two things occur. First, the current and its phase at the far end of the line allow the fields from the two vertical elements to produce a strong signal broadside to the assembly, with deep nulls in the plane of the array. Second, the fields from the horizontal wire largely cancel themselves, leaving the antenna strongly vertically polarized.

Positioning the horizontal wire above or below the half-square vertical wires makes no difference to antenna operation either in free space or several wavelengths above ground. At HF, builders usually find it more convenient to suspend the vertical wires below the horizontal wire. A VHF, self-supporting vertical elements suggest placing the horizontal wire on the bottom so that the feedline is removed as far as possible from the antenna fields.

In general, the most critical dimension is the length of the horizontal wire. For most construction methods, it is best to set this length and then trim the verticals for resonance. The result will be an antenna with close to a 50-ohm feedpoint impedance.

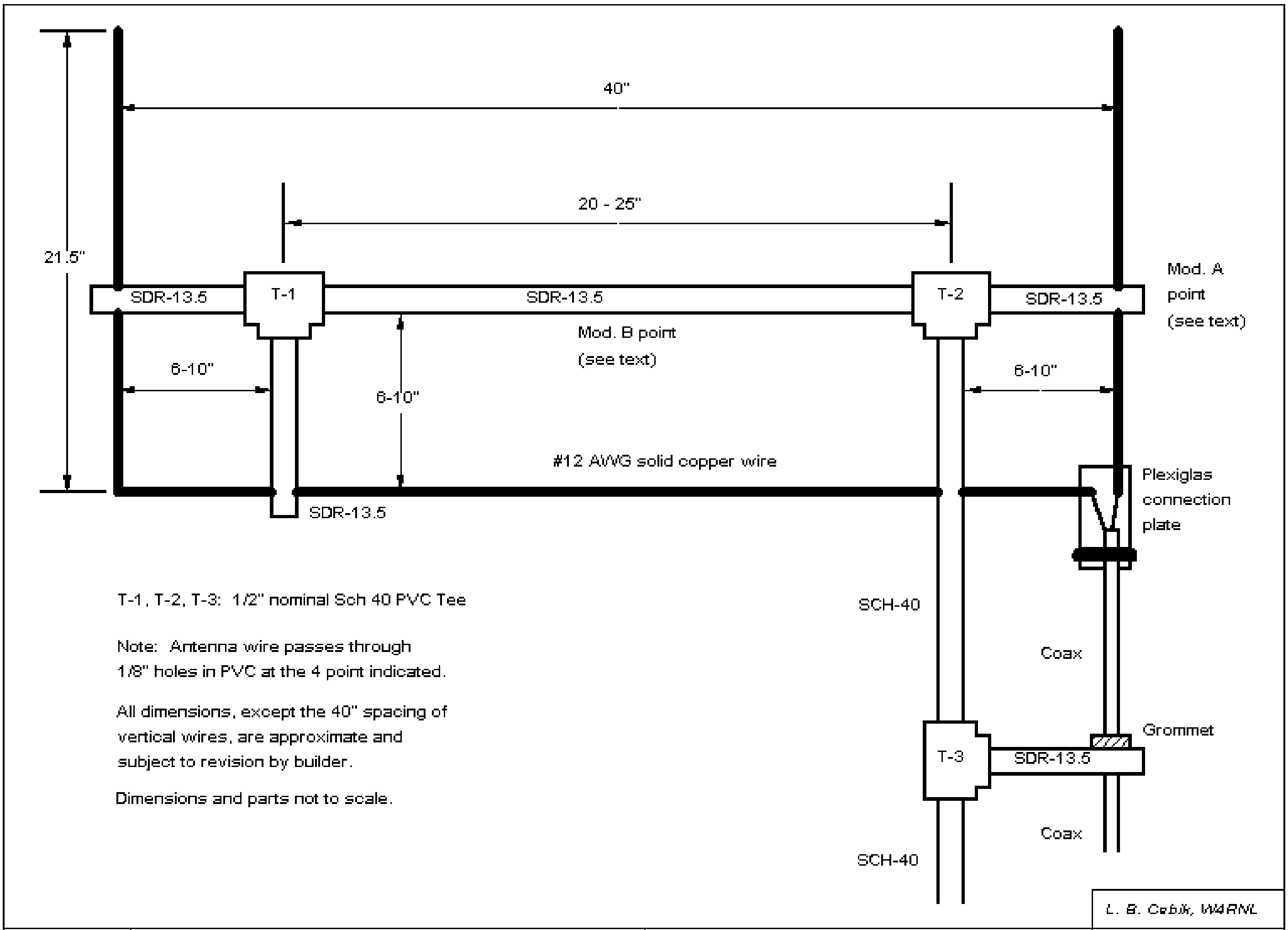

Figure: 1 | Title: Sketch of 2-Meter Half-Square PVC Support System | Project: 2-Meter Half Square | October 9, 1998

My test antenna used a highly flexible construction method: supporting #12 copper wire (stripped house wiring) with a light, adaptable PVC frame. Figure 1 shows the main features of the structure. The antenna proper consists of two pieces of wire: a 61.5" piece for the horizontal leg and the far vertical leg and a 21.5" piece for the directly fed vertical leg. (For actual construction, it is best to begin with slightly long wires.) There are only two connections, one to each side of the coax feedline.

The basic PVC structure uses lengths of 1/2" nominal SDR-13.5 light duty PVC for most parts. This lighter PVC uses the same Tee connectors and glue as the sturdier Schedule 40 material, which is used wherever strength is needed. Each short leg of PVC from the Tees has a 1/8" hole to pass the #12 wire. The holes pass the wire freely, since the function of the legs is only to position the wire and resist wind-bending. The main vertical support on the right uses Schedule 40 that transitions with couplers up to 1 1/4" nominal schedule 40 PVC, which slips over a standard 1-1/4" diameter steel mast.

The test antenna is a top-mount assembly. The offset mount allows the coax weight to counter-balance the longer run to the other vertical side of the antenna. The feedpoint connection is simple, consisting of a 1" by 2" scrap of 1/8" Plexiglas with two holes to pass short bends at the ends of the antenna wires. The coax center conductor and braid are soldered to these wire ends. A half grommet is placed over the coax and the grommet-coax combination clamped in place with a cable tie. The connections are well coated with coax sealant.

Before soldering the connections, I passed the coax through a 1/4" hole drilled in the short section of PVC extending to the right of the main PVC mast. I cut open a 1/4" inside diameter grommet and used contact cement to lock it to the coax above the hole. The fixed grommet protects the antenna connections from downward forces.

Two points on the diagram are marked as Mod. A and Mod. B. Modification point A is for side mounting the antenna to a tower. A builder could replace the short right thin-walled PVC with a longer length of Schedule 40 material. Modification point B is for mounting the antenna broadside to a tower. A builder may choose to cut the horizontal PVC at the center and insert a Tee with the opening facing the tower. A length of Schedule 40 PVC would again provide the strength for supporting the antenna from the tower legs.

The test antenna performs as modeled. Tuning consisted trimming the two vertical elements for minimum SWR on 146 MHz. Excursions across 2-meters show well below a 2:1 SWR at heights from 5' upward. The side nulls are sharp enough to make the antenna useful for direction-finding exercises. Adjacent channel repeater interference from the antenna sides is easily eliminated by careful antenna aiming. See **Figure 2**

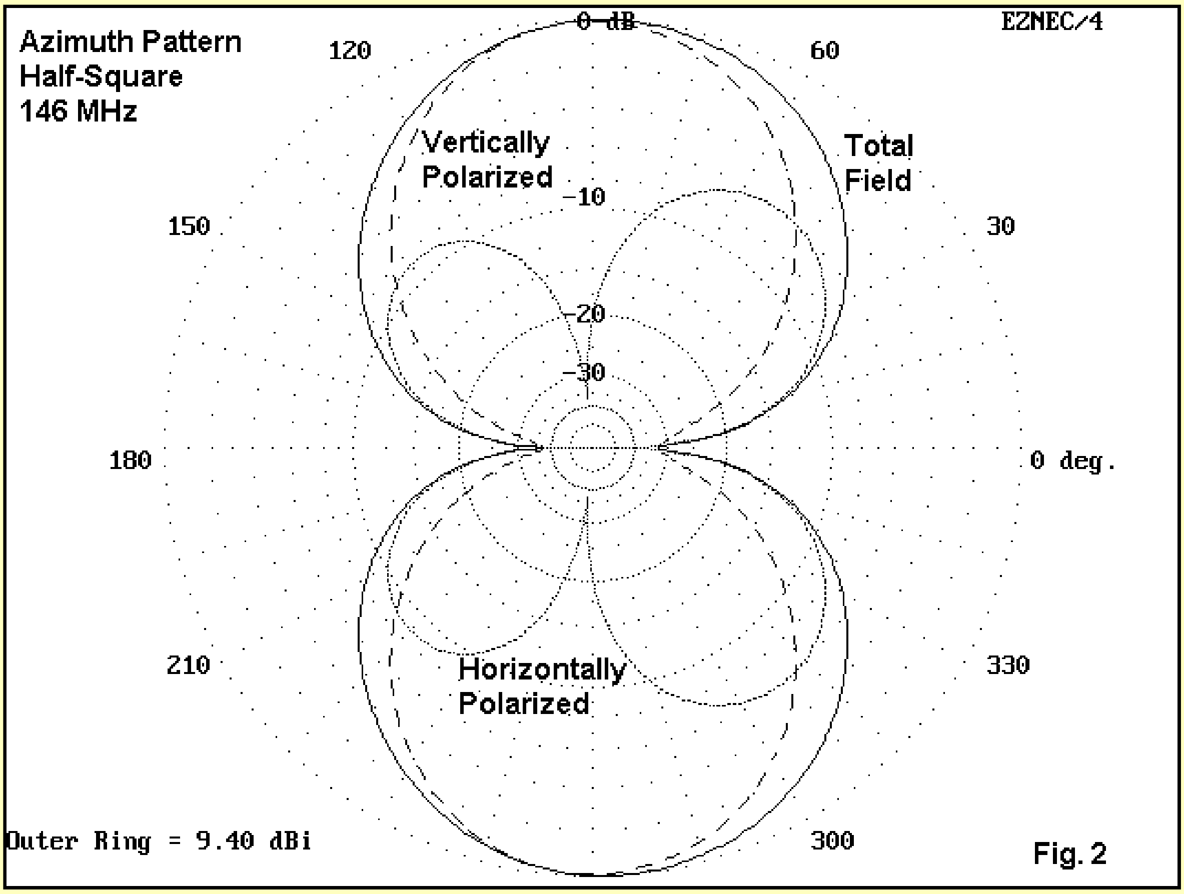

Fig. 2

Models suggest that the antenna is relatively unaffected if side mounted to a tower, that is, with the tower in a plane with the elements. Hence, for a true bi-directional pattern, the edge-wise mounting scheme of Mod. A is recommended. Models also suggest that a non-resonant mast or tower can distort the pattern of the antenna if mounted broadside, as suggested in Mod. B. A distance of 16-18" from the mast raises the gain away from the mast by about 1 dB and yields a front-to-back ratio of about 6 dB.

The half-square is simple, effective, easy, and cheap, a pretty good ham combination.

However, we have not exhausted the possibilities with the half square: we can make from it 2 and 2 element parasitic beams, also predominantly vertically polarized, but without the very wide beam width of a Yagi turned vertical.

This item first appeared in Rack Panels*, December, 1996. A more extended technical discussion of the antenna appears in* Communications Quarterly *(Spring, 1999) 65-70.*

Return to Main Index