The ESV Mod Quad

Inexpensive performer for any band from 50 through 1296 MHz.

by Martin Beck WBØESV

Because the idea of once again working DX on 6 meters appealed to me, I began searching for a method of building a really good antenna system. I prefer the quad, but in the past that ended up being expensive. This time, I decided I'd see what I could do using my favorite material: Acrylite™, a tough, clear plastic formulated for use with a chemical known as I.P.S. Weld-on #4.

The Mod Quad has some particularly desirable features. There is absolutely no metal employed in the spider assembly to skew the pattern. Even the boom is nonmetallic. The only tools you need to construct this quad are a measuring tape, a drill, and a saw. Once the materials are assembled, each quad element can be put together in one hour. No special skills are required, making this antenna an easy project for anyone. It's the least expensive antenna to build that I have seen to date.

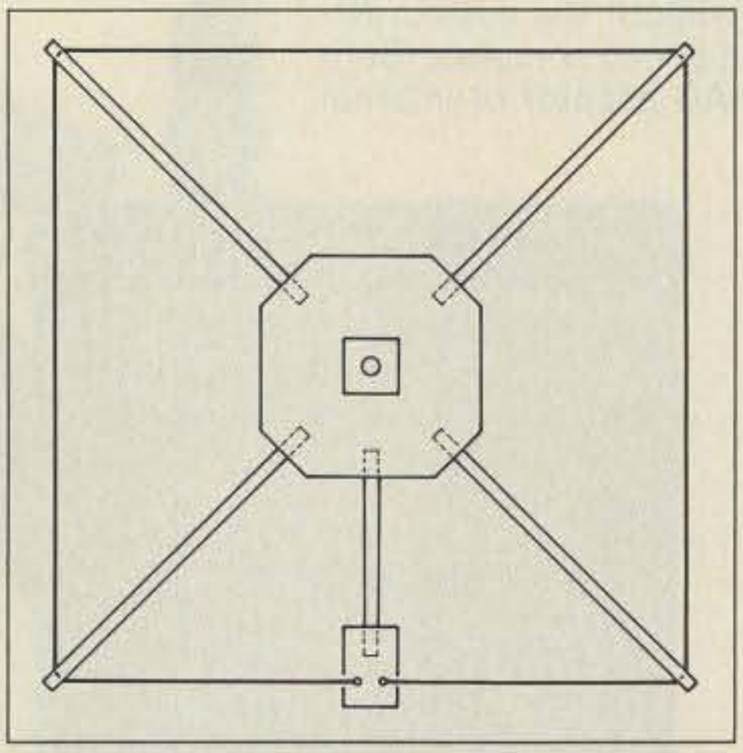

Figure 1. The ESV Mod Quad driven element.

Plastic Welding

In the plastic industry, the term "welding" means something entirely different from what it means in regard to working with metals. To illustrate: Let's say we place two clean, dry pieces of Acrylite together, and apply a couple of drops of Weld-on #4 at the edges of the junction. What happens? The chemical literally flows into the joint through capillary action. Once inside, it dissolves both surfaces, and the surfaces merge, becoming one. This is not a glued joint; the two pieces of Acrylite are now as much a single piece as if they had been originally cast that way.

Allowed to set overnight, the joint has twice the strength of one of the original two pieces.

The Spider Support

Make the spider supports by cutting out 10″ by 10″ squares of ½ inch thick Acrylite sheet (see Figure 2 and Table 1). If the ½ inch material is too expensive or unavailable in your area, just glue two squares of ¼ inch sheet together. For 6m and 2m, I like to glue enough squares together to make a 1 inch thick support (you can get away with ½ inch thick material as long as you beef up the corners to 1 inch, as shown in Figure 2). For 220 MHz and above, the ½ inch thick plate will work just fine, although it's best to trim it down to a 3″ by 3″ square (again, the corners need to be padded up to 1 inch, as in Figure 2).

Drill ½ inch holes into the edge of the support plate at the places marked 'G' on Figure 2. Insert a spreader arm (½ inch O.D. tubing or rod) into these holes and weld it (see Figure 1). Repeat this three times, and you have the ultimate quad spider—no metal, no mess. And it only takes a few minutes. Piece 'B' is used to beef up the main support plate 'A' where the boom joint is made. It's optional for 220 MHz and above. First drill four 1/16″ holes in piece B (don't drill through the 'A' plate) to facilitate getting the welding chemical through to the 'A-B' surfaces. Glue piece 'B' onto the main square (6m and 2m quads). After everything is dry, drill a 1″ hole in the center of the assembly to mount onto the boom (½ inch boom material can be used for 420 MHz and higher). Note that the arm labelled 'D' and the plate labelled 'C' are used on the driven element to support the coax attachment point.

The spider's center plate is joined to the 1″ diameter Acrylite rod (the boom) by the same welding technique as above (see Figure 4). The boom should be carefully marked (I use a piece of masking tape) for element positioning and spacing, because once you've welded it—that's it!

Figures 1 and 5 include feedpoint construction, but of course, that is not needed for the reflector and directors. Also, you can have more than four elements by merely joining more 1″ Acrylite joints, as shown in Figure 3, for a longer boom. The 0.2λ spacing can

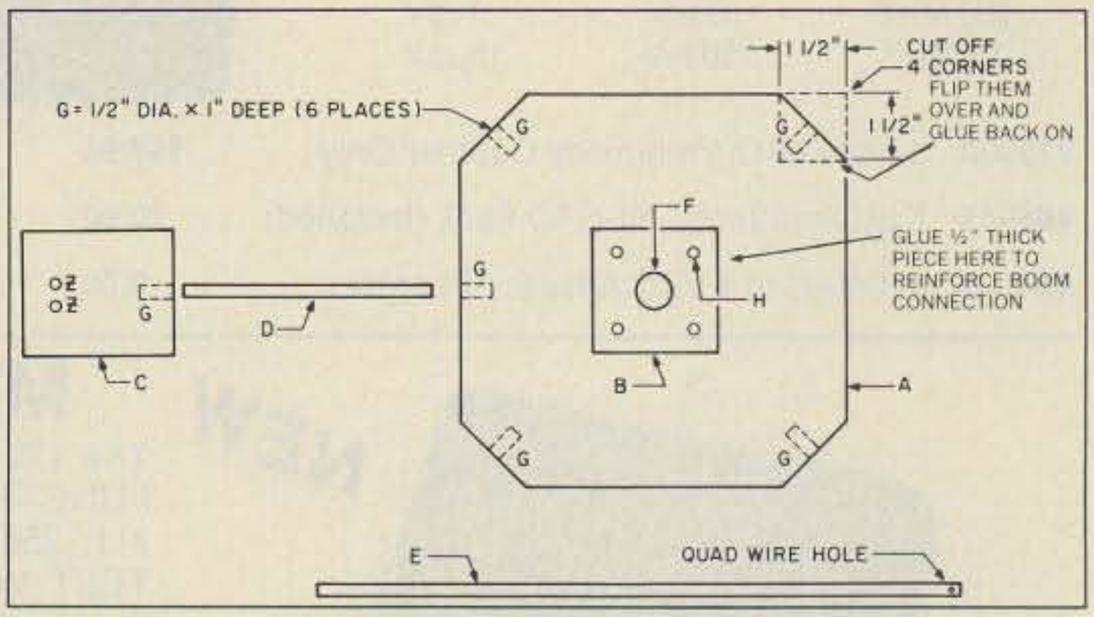

Figure 2. Details of the spider support arm. See Table 1.

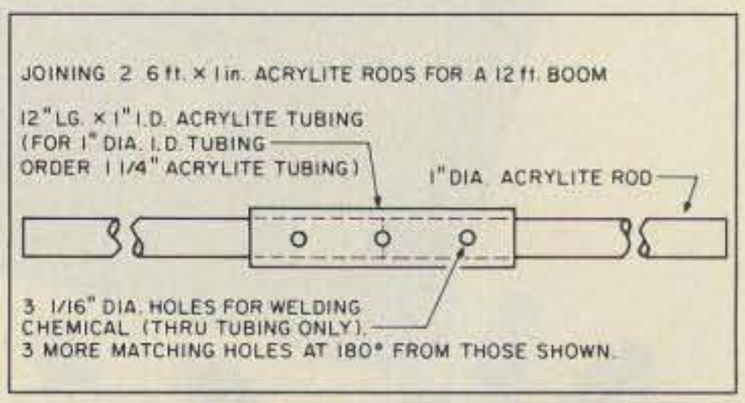

Figure 3. A small (glass only) syringe is handy for inserting the chemical into 1/16" holes. If you use a glass eyedropper, don't get the chemical in the bulb—it's plastic-based! Two to four drops per hole is ample. Allow 20 minutes set-time, then turn the assembly over and put the chemical in the three holes on the opposite side. Again, wait 20 minutes before disturbing the joint. Let it set overnight.

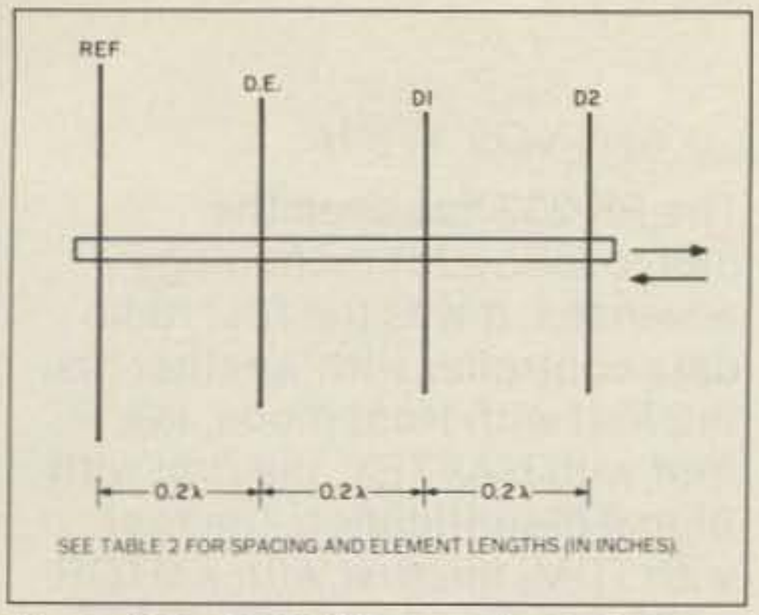

Figure 4. See Table 2 for spacing and element lengths in inches.

Table 1. The ESV Mod Quad Dimensions for 6m

Refer to Figure 2.

A	10" x 10" x 1" Acrylite sheet
B	4" x 4" x 1" Acrylite sheet. Drill four 1/16" holes for entry of Weld-on #4.
C	4" x 4" x 1" Acrylite sheet. Drill two holes for 6-32 bolts for feedpoint.
D	½" dia. x 22"L Acrylite rod or tube
E	½" dia. x 40"L Acrylite rod or tube. Cut four for spider arms.
F	1" hole through A and B for 1" Acrylite rod boom.

Note: Weld A and B together before drilling 1" boom hole.

G	1" deep x ½" dia. holes
H	1/16" holes
Z	Holes for feedpoint.

Note: The quad loop wire attachment hole on the spreader arm 'E' can be calculated from the following formula:

$$E\ (inches) = \sqrt{(Element\ Length/4)^2/2}.$$ *(See Table 2 for Element Lengths).*

This distance is measured from the center of the boom. Make the length of your spreader arms an inch or so longer than this measurement.

also be used with a small two or three element antenna.

What do you do if by some weird circumstance you have a broken spider arm? Simple: Cut it off at the plate edge, redrill the hole, and weld in a new one! If you were to get two elements welded onto the boom with incorrect spacing, you could simply saw the boom in half between the elements, slip the sawed ends into a piece of 1" I.D. Acrylite tube, adjust the spacing—and, yes—weld the new joints in place. You can also use this method to increase the boom length beyond 6 feet (see Figure 3).

Acrylite is not expensive. Even with that latter term being relative, I feel the money is well within most hams' pocketbooks. And it's a strong material. Last year, a 116 mph wind storm broke all of my metal antennas, but not the Mod Quad. A friend reminded me of the Oriental tale of the resilient bamboo shoot that bent in the storm and sprang back, while the mighty but rigid oak was snapped. When buffeted by the wind, the Mod Quad does display a small amount of springiness.

Performance

The Mod Quad's gain is around 10 dBd. Properly spaced, a box of four quads makes a very potent system with a clean pattern. Since this quad is lightweight, it could be an outstanding antenna for Field Day. A simple TV rotor handles it easily.

While the spacing of 0.2λ gives excellent performance, you can play around with other spacings and possibly squeeze out a bit more gain. However, if you use the 0.2λ spacing, I have done all the element length and spacing for you. Refer to Table 2. The SWR is below 1.2:1 across 1 MHz, so this table is merely for the perfectionist. Most of the popular frequencies are listed. Many deadly serious DXers use 6 meters as their liaison band, but to avoid QRM, they stay higher up in the band. I computed the elements' sizes for that area as well.

Table 2. ESV Mod Quad and Delta Beam Element Lengths and Spacings

MHz	Sp."	Ref."	D.E."	D1", D2"
50.1	47.00	246.70	240.70	233.50
51.0	46.30	242.30	236.40	229.40
53.5	44.00	231.00	225.40	218.70
144.2	16.38	85.71	83.63	81.13
144.5	16.34	85.54	83.46	80.97
146.0	16.18	84.66	82.60	80.14
147.0	16.07	84.08	82.04	79.59
221.5	10.66	55.80	54.45	52.82
223.0	10.59	55.43	54.08	52.47
432.1	5.47	28.60	27.91	27.08
440.0	5.37	28.09	27.41	26.59
449.0	5.26	27.53	26.86	26.06
903.2	2.62	13.68	13.35	12.95
910.0	2.60	13.58	13.25	12.86
915.0	2.58	13.51	13.18	12.79
925.0	2.55	13.36	13.04	12.65
1250.0	1.89	9.89	9.65	9.36
1296.0	1.82	9.54	9.31	9.03

Note 1: Element spacing (Sp") = 0.2λ
Note 2: Element Length Formulas:
Reflector Length (Ft.) = 1030/F (MHz)
Driven Element (Ft.) = 1005/F (MHz)
Directors (Ft.) = 975/F (MHz)

What You'll Need

With the figures and tables, construction should be a breeze. Acrylite can be obtained from your local plastics store. Call Cyro Industries at (800) 223-2976 for a distributor near you. You may be able to find enough scrap material at one of these stores to complete the whole quad. If you can't find a local outlet, you can mail order materials from Lustercraft Plastics, Inc., PO Box 17367, Wichita KS 67217. When you write, be specific about items and sizes, and be sure to enclose an SASE. The manager requests that all orders be accompanied by a money order or cashier's check.

You can buy a four-ounce can of the chemical for a little over $2. That's enough for four Mod Quads, since only a small amount is used per joint. Full instructions are printed on the can. You can apply it with a toothpick, glass syringe, eyedropper, or even a small artist's brush.

The only materials you need for the 6m Mod Quad are five 6-foot joints (standard length) of ½" diameter Acrylite tubing or rod, a 6 foot length of 1" diamater tubing or rod (6m and 2m) for the boom (a ½ inch diameter boom can be used for 220 MHz and above), and as many 10" x 10" x 1" (or ½") thick plates as desired.

This methodology is inexpensive, fast, and very easy to follow. It produces a lightweight antenna of superior design, strength, and gain. While the system shown here is geared to 6 meters, it is even better as we use it on 144, 220, and 432 MHz; for the higher you go, the lower the cost. 73

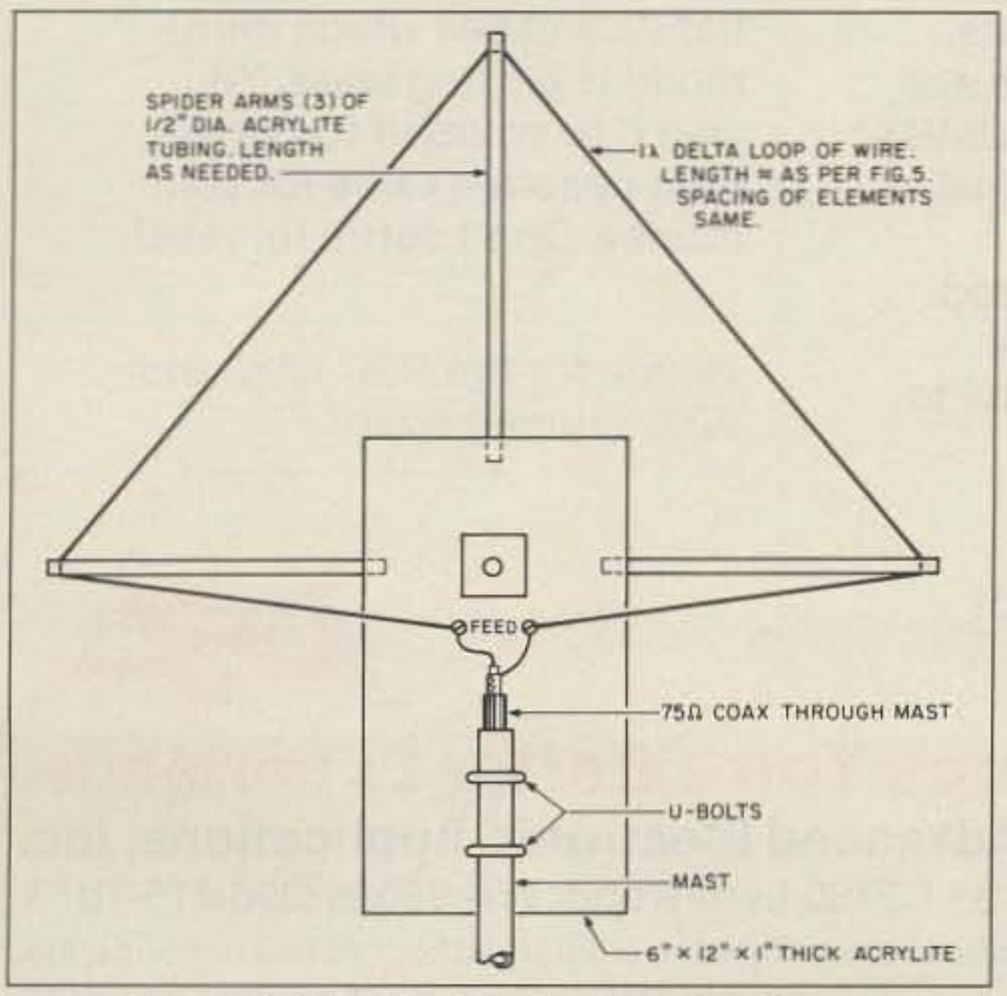

Figure 5. Modifications for delta loop beam.

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