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Building the 10-GHz Horn Antenna

Last month, I discussed some of the theory behind pyramidal horn antennas. This month, I'll show you how to build one yourself from readily available materials.

The first design parameter is usually the required gain, or the maximum antenna size. These are, of course, related, and the relationships can be approximated to the following:

L = H-plane length (λ) = 0.0654 × gain (Eq 1)

A = H-plane aperture (λ) = 0.443 × $\sqrt{\text{gain}}$ (Eq 2)

B = E-plane aperture (λ) = 0.81 A (Eq 3)

Note that gain should be expressed as a ratio for these calculations; 20 dB gain = 100.

Let's calculate the dimensions for a 20-dB-gain horn for use at 10.368 GHz. Using Eq 1 through Eq 3, it is easy to determine the dimensions. One wavelength at 10.368 GHz is 1.138 inches. The length (L) of such a horn would be 0.0654 × 100 = 6.54 λ. At 10.368 GHz, this is 6.54 λ × 1.138 inches/λ = 7.44 inches. The corresponding H-plane aperture (A) would be 4.43 λ (5.04 inches), and the E-plane aperture (B) 4.08 inches.

The easiest way to make such a horn is to cut pieces from brass sheet stock and solder them together. Fig 1 shows the dimensions of four triangular pieces for the sides and a square piece for the waveguide flange. (You could use a standard commercial waveguide flange if you have one.) Since the E-plane and H-plane apertures are different, the horn will not be "square." You'll need two pieces of brass cut to the dimensions given for side A and two for side B.

Sheet thickness doesn't matter; 0.02 to 0.03 inch works fine. Brass sheet is often available from hardware or hobby shops. If you can't find material locally, one source is Small Parts Inc, 6901 NE Third Ave, Miami, FL 33138, tel 305-751-0856.

Note that the triangular pieces are trimmed at the apex to fit the waveguide aperture (0.9 × 0.4 inch). This necessitates that the length, from base to apex, of the smaller triangle (side B) is shorter than that of the larger (side A). Note that the side length, S, of the two different sides of the horn must be the same if the horn is to fit together! For such a simple looking object, getting the parts to fit together properly requires a little thought.

Although the dimensions can be calculated with a little simple geometry, it is easier to draw out templates on a sheet of cardboard. The templates can be used to build a mock antenna to make sure everything fits together properly before going on to cut the actual metal parts.

First, mark out the larger triangle (side A) on cardboard. Then determine at what point its width is 0.9 inch and draw a line parallel to the base as shown in Fig 1. Now measure the length of the side S; this will also be the length of the sides of the smaller (side B) pieces.

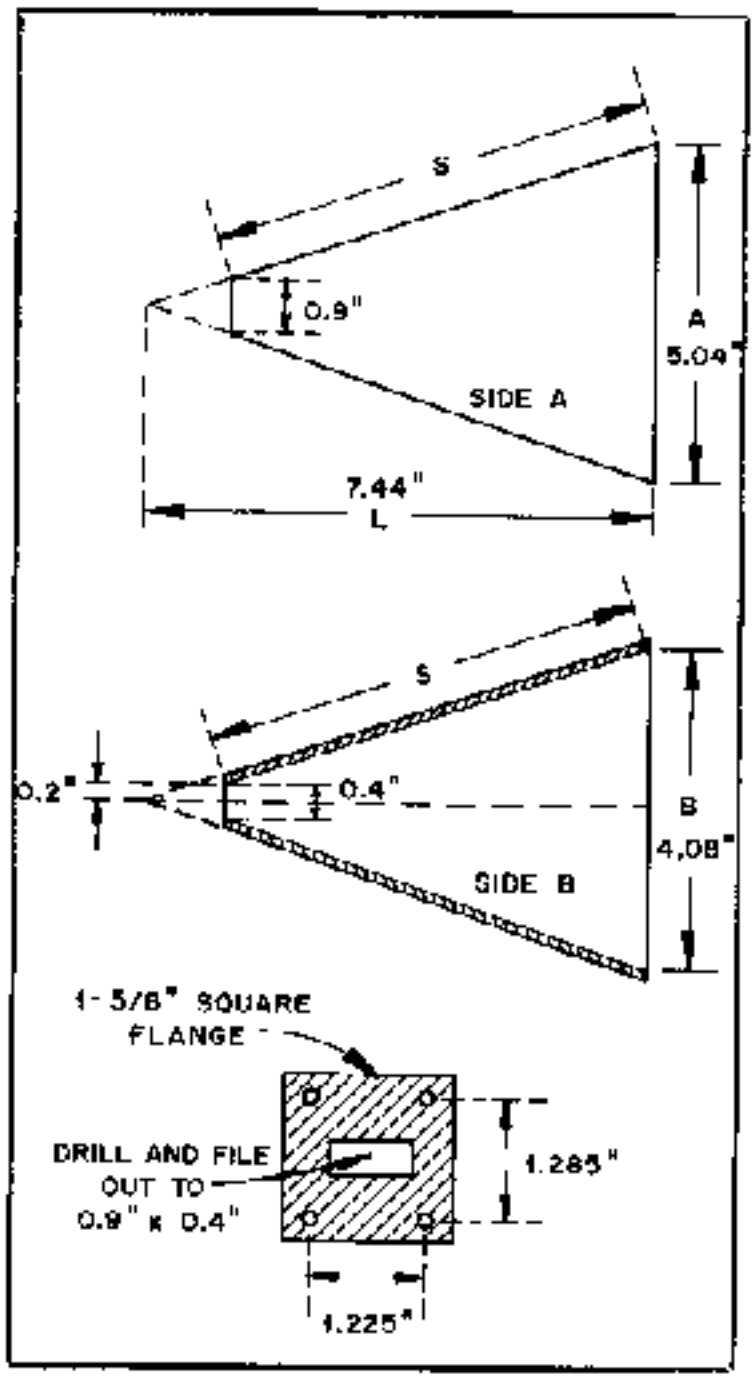

Fig 1—Dimensions of the brass pieces used to make the 10-GHz horn antenna. Construction requires two of each of the triangular pieces (side A and side B).

Next, mark out the shape of the smaller pieces by first drawing a line of length B and then constructing a second line of length S. One end of line S is an end of line B, and the other is 0.2 inch above a line perpendicular to the center of line B as shown in Fig 1. Don't worry; this is much easier to do than to describe! These smaller pieces are made slightly oversize (shaded area in Fig 1) so you can construct the horn with solder seams on the outside of the horn during assembly.

Now it's time to see if everything fits. Cut out two cardboard pieces for side A and two for side B and tape them together. The aperture at the waveguide end should measure 0.9 × 0.4 inch, and the aperture at the other end should measure 5.04 × 4.08 inches.

If all is well, use the cardboard templates to mark out pieces of brass sheet. The brass sheet should be cut with a bench shear if one is available because using scissors-type metal shears tends to bend the metal. Jig the pieces together and solder them on the *outside* of the seams. It is important to keep both solder and flux from contaminating the inside of the horn; they can absorb RF and reduce gain. Assembly is shown in Fig 2. The horn can then be soldered to a standard waveguide flange, or one cut out of sheet metal as shown in Fig 1. Make sure that the transition between the flange and the horn is smooth, and it's all finished—a 20-dB-gain antenna for about $5! CQ DX.

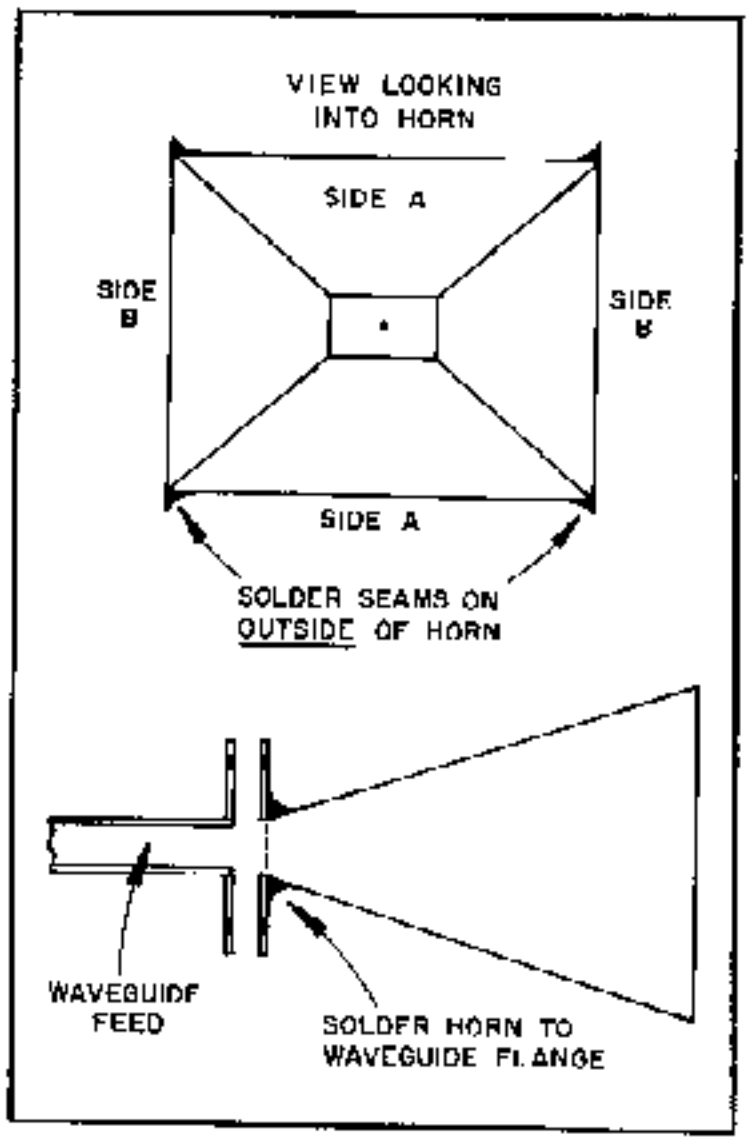

Fig 2—Assembly of the 10-GHz horn antenna.

MICROWAVES IN VIRGINIA...

On Jan 31, 1987, the first meeting of the Blue Ridge Microwave Society (BRMS) was held at the studios of WBRA-TV in Roanoke, Virginia. The purpose of the society is to promote activity above 1 GHz. Twelve amateurs attended the first meeting, at which Dennis Sweeney, WA4LPR, discussed a 10-GHz PLL circuit of his own design. The group is interested in narrowband 10-GHz techniques. For more information about BRMS, contact Stanley Dillon, WB4YJC, PO Box 507, Martinsville, VA 24114.

...AND NEBRASKA

According to the Midwest VHF Report, published by Roger Cox, WBØDGF, there is new 10-GHz activity in the Lincoln, Nebraska area. Charlie Conner, KØNG, has a 10-GHz beacon on his tower that can be turned on by request. KØNG recently worked KCØQR over a 9.25-mile path on FM using horn antennas and 10-15 mW.