R.L. Gruner W4UFT
3179 Boone St.
Memphis TN 38127

Perfect Parabolas

—use some solar technology on your next dish antenna

I became interested in building an MDS TV converter after reading an article in the August, 1979, issue of *73 Magazine* entitled "You Can Watch Those Secret TV Channels."

After building the converter and coffee-can feedhorn, I was concerned over the number of trees between my location and that of the MDS transmitting station. A line-of-sight path is normally required at the frequencies used for MDS TV and trees greatly attenuate signals. I suspected that I would need an antenna with more gain than that of the "snow-saucer" type.

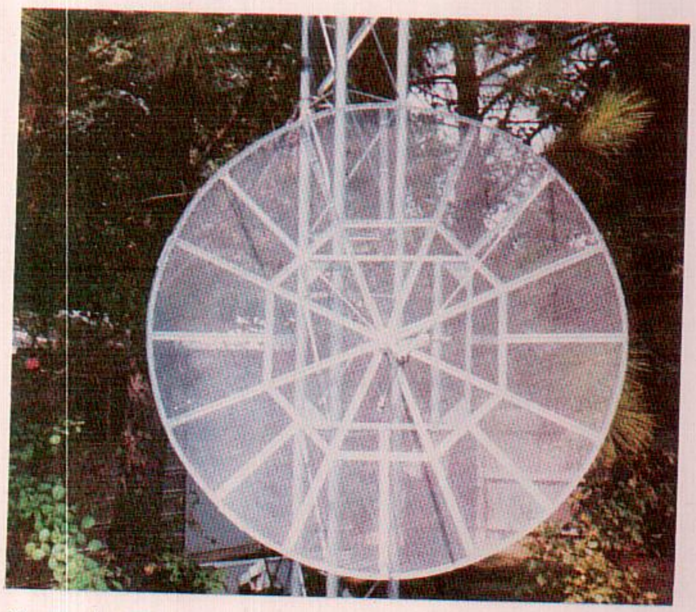


Photo A. Front view of completed four-foot dish showing rib structure.

Whenever UHF or microwave frequencies are mentioned, I form a mental image of a parabolic dish. However, they *are* expensive and I knew nothing about designing or building them. So what do I do now?

Research

After a long and fruitless search through my limited library of radio publications, I was ready to give up when I spotted my *Solar Energy Handbook*. It contains information on collecting light waves with parabolic reflectors. Having read that the properties of high frequency radio waves and light waves are similar, I decided to design and build a parabolic reflector based upon the information in the book. This information is shown in Figs. 1(a), 1(b), and 1(c) and illustrates three approaches that can be used to produce a parabolic curve.

Design materials needed are:

- Several sheets of linear graph paper
- Straightedge or ruler
- Compass for drawing circles
- Pencil
- Piece of wood—1″ × 6″ × 24″
- Approximately 5′ of string
- 4′ × 4′ piece of plywood or heavy cardboard

Dimensions

Due to my limited knowledge, my choice of dimensions was based upon common sense and convenience. Choosing a diameter of four feet for high gain and a focal length of 26 inches so the feedhorn mounting tube could be short and rigid, I followed the instructions shown in Fig. 1(a). I let each square on the graph paper represent one inch (not shown for purposes of clarity).

represented by the people participating. But it is possible to tell a little more about the ham who helped make it all possible, Jim Ott KB8CT.

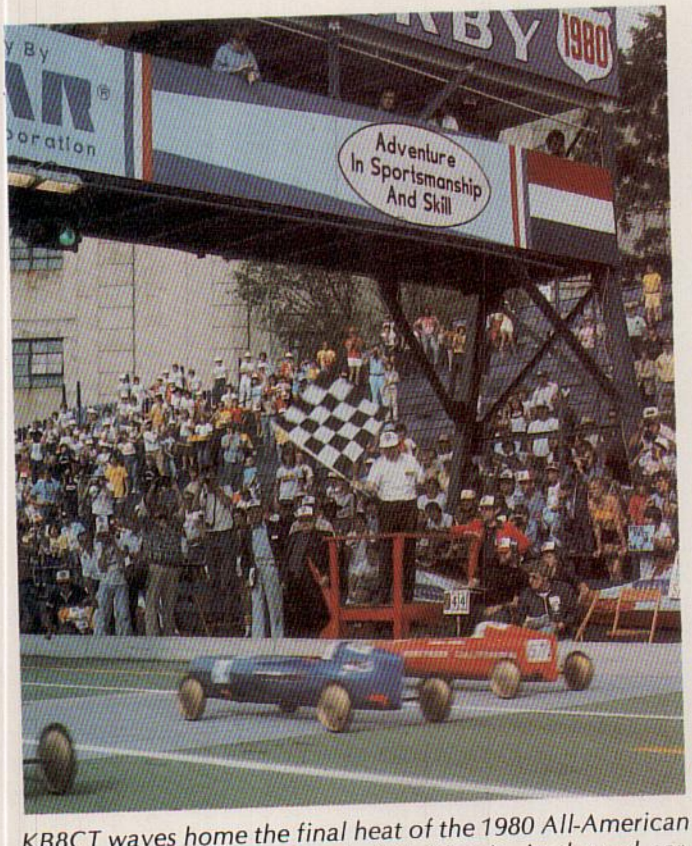
In the fall of 1972, Chevrolet officials (who had first sponsored the Derby in 1936) decided to withdraw their sponsorship. The Derby was sponsored by local groups until the fall of 1975 when another national sponsor was found. Novar Electronics of Barberton, an Akron suburb, pledged $165,000 toward the next Derby, and has supported each Derby since.

Ott, who was first licensed in 1962 as K8CAA, founded Novar when he was 17. (Novar stands for Northern Ohio Video and Radio.) Ott had gone to Ohio State University to study electrical engineering. While working with a deaf student there, he developed the Whisperlite, a device which converts sounds into light. When commercial interest in the device developed, Ott quit school and founded his company which, today, is a recognized leader in security systems including a new identification system which uses the vibrations created by the human body.

Though the Novar name is prominent during Derby week, on T-shirts and other Derby promotional materials, Ott does not make commercial use of his sponsorship during the rest of the year.

On race day, he said, "It's fun to be here seeing the kids enjoying themselves. This is a great program and I'm happy to be able to contribute."

Jim said that his work doesn't give him as much time on the air as he would like, but if you do hear KB8CT, jump in and say hello to a ham who helped make August 16 an important day to 91 champs.■



KB8CT waves home the final heat of the 1980 All-American Soap Box Derby. Dan Purol of California, in the red car, took home a $5000 scholarship and a California Replicar kit in addition to the trophy.


KB8CT presents the senior division All-American Derby trophy to Dan Purol of Fair Oak, California.

After marking the graph, it is necessary to obtain a full scale graph. This is accomplished by drawing vertical and horizontal lines 1" apart for the full length and width of the 1" × 6" × 24" board. Having done this, observe the markings on your graph paper and mark the corresponding points on the 1" squares on the board. If you draw a line from point to point on the board, you will have a full-scale pattern on the board for forming the ribs of the dish. See Fig. 2.

Attach the 5' length of string to the center of the 4' × 4' plywood and, holding the pencil tightly against the string, draw a four-foot diameter circle on the plywood. This is your "rim" pattern. A complete list of materials is provided in the Construction Materials box.

Construction Details

Cut eight 22½" pieces of "Tee" metal and bend each of these so the flat surface will conform to the pattern on the wood graph. Be accurate because these 8 pieces are the ribs which establish the curvature of the dish. Refer to Fig. 3 for the following assembly steps.

Position the most curved end of the ribs in 1" from the outer edge of the pipe flange. Attach these eight ribs so the flat side will be against the bottom of the flange and will radiate outwardly with equal spacing. This should form a hub with eight spokes.

Keeping the flat side outward, carefully bend a length of the Tee metal around a large round object such as a 55-gallon oil drum and make a four-foot circle to match the circle on the plywood pattern. Using flat strap aluminum as a backing plate, attach the ends of this circle to form a 4' hoop or rim.

Attach the rim to the top of the eight ribs. Measure in 12" from the rim and attach eight pieces of Tee metal braces between the ribs to form an octagon-shaped circle on the rear of the dish. Attach eight more pieces of the Tee metal from the octagon-shaped circle to the rim, centered between each of the main ribs. See Fig. 3(d).

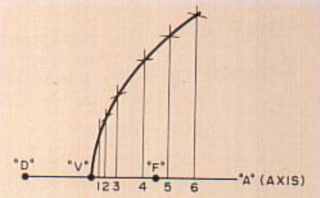


Fig. 1(a). If vertex "V" and focus "F" are given on axis "A", mark point "D" so that "DV" = "VF". Draw lines perpendicular to the axis at any points, 1, 2, 3, 4, 5, etc. Bisect each with an arc drawn from "F", with a radius equal to the distance of the particular point from "D". Thus, bisect line 3 with radius "D3" drawn from "F".

Dish Support

The dish supporting and mounting frame is made by making an 19" × 19" square with Tee metal. See Fig. 4. Each corner is braced with a 16-gauge triangle cut from the 4" × 4" sheet of aluminum. The frame is attached to the rear of the dish with 5" lengths of Tee metal. Additional braces from the frame to the dish are formed with the four 16-gauge 1" × 6" aluminum strips.

The two ½" × 8" aluminum strips are formed around one leg of the tower and will bolt to the rear, flat surface of the frame when the dish is mounted on the tower.

The 7/8" o.d. tubing, 3" long, is slipped over the ¾" × 19" aluminum tubing and the 19" tubing is attached to the upper and lower frame members. The 7/8" U-bolt clamps the 7/8" sleeve to the ½" × 23" aluminum tubing which will form the adjusting arm for the dish. This 23" length of tubing is inserted through a clamping bracket which is attached to another leg of the tower.

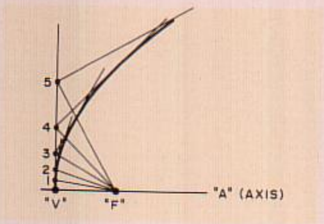


Fig. 1(b). If, as in 1(a), vertex "V" and focus "F" are given on axis "A", draw line from "V" perpendicular to axis. Mark any point on this line (1, 2, 3, etc.) and connect it to "F". Draw a line from each point at right angles to the line to "F". (Thus, from point 5, draw line at right angles to "5F".) Each of these lines will be a tangent of the parabola, which must be drawn inside these tangents, touching each section at its center.

Covering the Frame

Using ¼" mesh wire (hardware cloth) or aluminum window screen, cut four pie-shaped wedges and attach them with bare aluminum wire to the ribs of the dish. The "tie wires" are bent into a U shape and inserted through the mesh over the braces. They are spaced at 2" intervals. This causes the mesh to closely follow the curvature of the ribs when the wire is twisted. For a neater appearance, you may wish to spray the entire assembly with aluminum paint as I did.

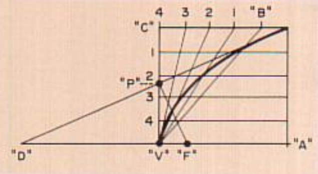


Fig. 1(c). If vertex "V" and axis "VA" are given as well as width "BA", draw "CB" parallel to axis and "CV" perpendicular to axis. Divide both into an equal number of equal sections (1, 2, 3, 4, etc.). Connect "V" to each point of "CB" (radial lines). Intersect each radial line with parallels drawn from corresponding points of "CV". The intersections are points of the parabola. Mark point "D" on extension of the axis so that "DV" = "VA". The line connecting "D" with "B" is a tangent at "B". Where "DB" intersects "CV", mark point "P". Draw line from "P" at right angles to "BD"; this will determine the position of focus, "F", on the axis.

Testing

After construction came

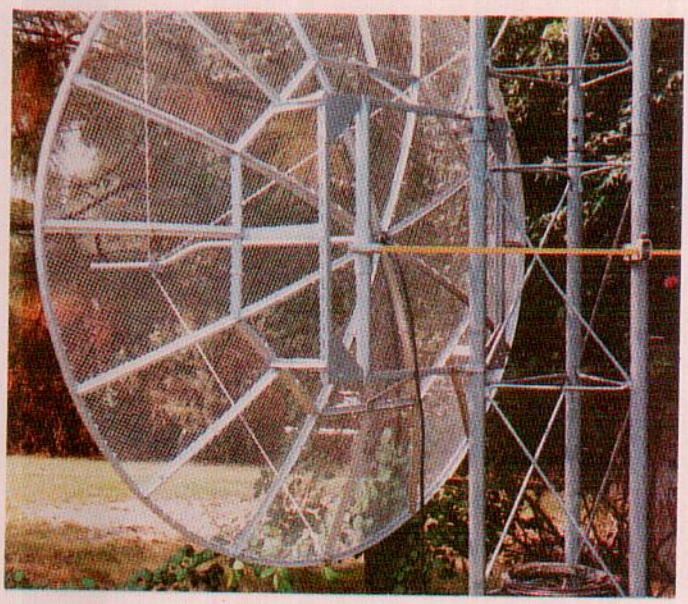


Photo B. Rear view of dish showing mounting details.

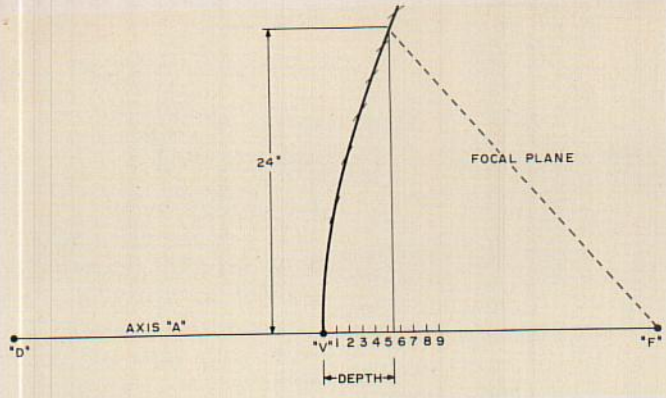


Fig. 2. Details for making full-size construction pattern (top half of the parabola graph).

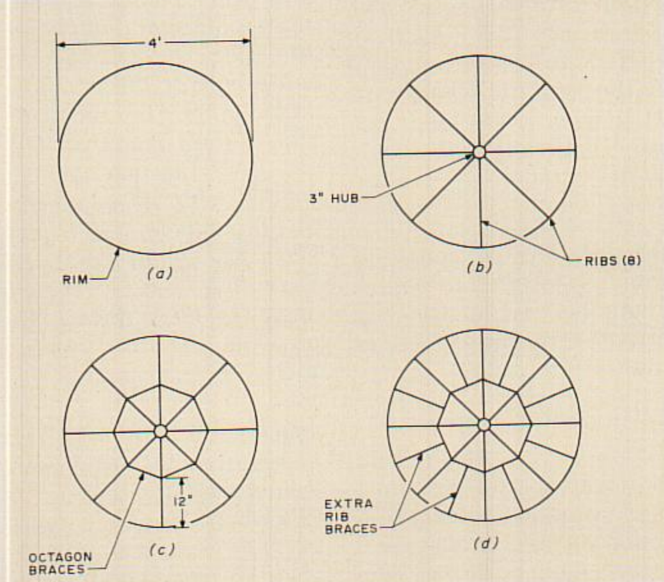


Fig. 3. (a) Rim dimensions. (b) Spoke installation. (c) Octagonal bracing placement. (d) Installation of extra rib braces.

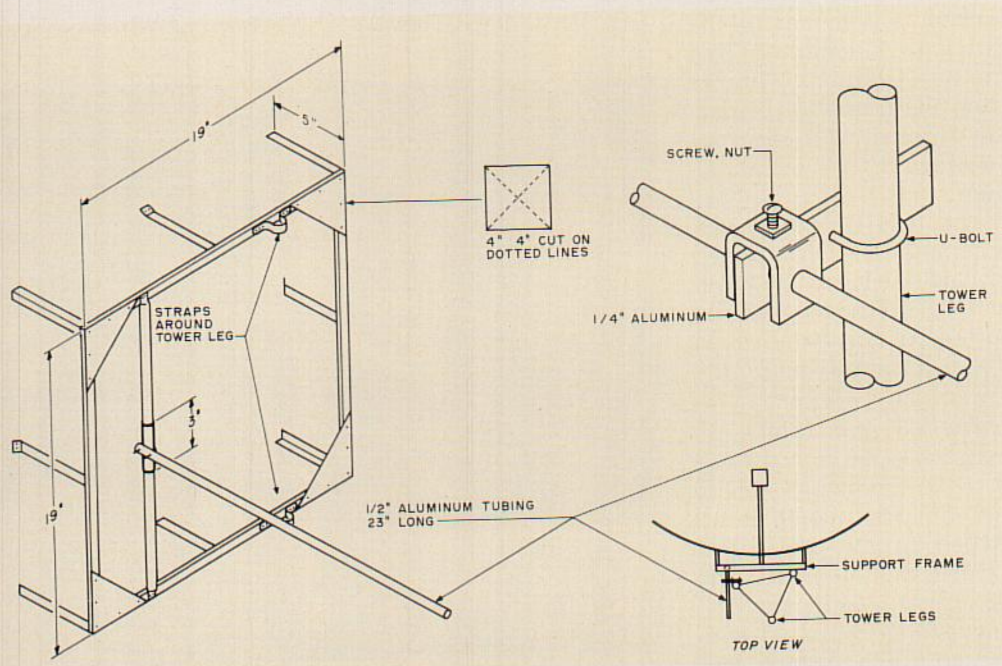


Fig. 4. Supporting and mounting construction details.

Construction Materials

½" × ½" × ½" Tee-shaped aluminum strips
Small nuts and bolts or "pop rivets"
3-inch pipe flange
¼" mesh wire (hardware cloth) or aluminum window screen—enough to cover the reflector.
Aluminum tubing, ¾" o.d. × 19" long
Aluminum tubing, 7/8" o.d. (¾" i.d.) × 3" long
Aluminum sheet, 16-gauge, 4" × 4"
Aluminum strips (2), ½" wide × 8" long
Aluminum strips (4), 16-gauge, 1" × 6"
Aluminum strip, 16-gauge, 1" × 2¼"
Aluminum tubing, ½" × 36"
Aluminum tubing, ½" × 23"
1 U-bolt clamp (to fit 7/8" pipe)
1 U-bolt clamp (to fit tower leg)
Several feet of aluminum wire (clothesline wire), small gauge

the pleasure of testing something that worked right the first try. I was fortunate enough to have a Gunn diode oscillator operating at 10.5 GHz and the waveguide-horn from an old police radar detector. The Gunn oscillator was set up facing the waveguide detector at a distance of ten feet and the meter reading was noted. The Gunn oscillator was then pointed at the mouth of the dish, and by standing to one side and moving the detector around, I was able to locate the point of highest rf concentration. This point was 26½" from the vertex of the dish, only a half-inch off the design and now the meter read full scale (100 microamperes). This was much greater than the direct reading without the dish, indicating a great deal of gain.

The Gunn oscillator was then moved to a point three feet from the front of the dish and the detector was used at the rear of the dish to check for rf leakage through the mesh cover. None could be detected. This would seem to indicate that spacings greater than ¼" could be used for frequencies below 10.5 GHz.

Miscellaneous

The pipe-flange center hub makes horn attachment easy. You may wish to thread a short pipe nipple into the flange and slide a piece of aluminum tubing or PVC plastic over the nipple to mount the horn. You can clamp the two together with screw-type pipe clamps or hose clamps.

Conclusion

If you should build a parabolic reflector from the solar book information given, I believe that you will be well pleased with the results. I certainly am. I have become so interested in the design of dishes that I have completely dropped the MDS project and I am presently contemplating a 12 footer for satellite reception. Good luck.■