Emil Pocock, W3EP*

The Dual Rhomboid Revisited

The photograph of the 1296-MHz dual rhomboid built by Dayton Johnson (WØOZI) that appeared in the December column sparked a good deal of unexpected interest. Several dozen requests for dimensions and other information needed to build this unusual high-gain UHF antenna swamped Dayton. It light of this interest, it seems appropriate to follow up with some additional details about the dual rhomboid.

The rhomboid (a parallelogram with no right angles and adjacent sides of unequal length) is not new to antenna design. It is a variation of the rhombic, which has been used for many decades to achieve high-gain, primarily on the high-frequency bands. The dual rhomboid achieves even higher gain than a traditional rhombic by combining two antennas in such a way that useful sidelobes are reinforced, while those in unwanted directions are canceled.

Dayton based his antenna, which he uses for 1255-MHz ATV, on the plans provided by Bill Parker, W8DMR, in his magazine article, "Dual Rhombic for VHF-UHF" (*73*, Aug 1977). The dimensions provided here have been rescaled for 1296-MHz, but good performance does not require precise measurements, because the dual rhomboid is exceptionally broadbanded. It should provide about 20 dB gain compared to a dipole.

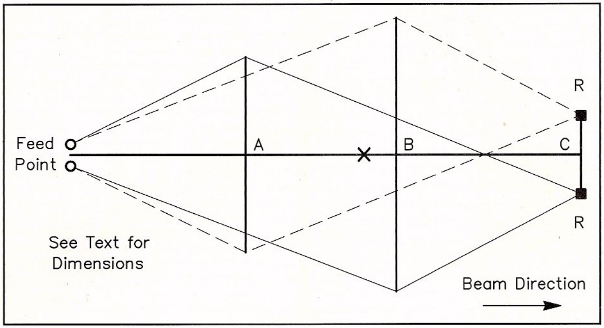

Figure 1—Schematic of the dual rhomboid antenna, which provides about 20 dB gain over a dipole. The boom is about 8.6 wavelengths long. The longer sides of each rhomboid are 6 wavelengths and the shorter sides are 3.5 wavelengths. R marks the position of the 600-W termination resistors.

Dimensions and Construction

The configuration of wires and supports (Figure 1) that constitutes the dual rhomboid looks confusing at first glance, but a close inspection shows that the antenna is simply two identical wire rhomboids in the same plane, with one flipped over. The rhomboids are fed in parallel and terminated at their opposite ends with 600-Ω resistors. Here are the essential dimensions, scaled for 1296 MHz:

Reference point	*Distance from feed point to cross arm (inches)*	*Cross-arm length (inches)*
A	27.5	30.5
B	50	42.5
C	77	12.0

The total boom length is just under 6½ feet.

The boom and cross pieces must be nonmetallic. Dayton recommends clear fir, protected from the weather by paint or other proactive coating. Other lightweight material might work as well. About 30 feet of wire is needed. The wire should be as large as can be accommodated by the frame, and insulated where the wires cross. Dayton had good success with #12 enameled wire, but this is probably as small as should be used.

Each of the two terminating resistors must be noninductive, about 600 Ω and capable of dissipating at least one-quarter of the power input. These could be made by connecting five 3000-Ω, 2-W carbon-composition resistors in parallel. This arrangement would be sufficient for 40 W continuous power at the antenna. In practice, as much as 80 W could be applied when using SSB or CW modes. The dual rhomboid can also be built without the terminating resistors. In that case, the ends are left open. The antenna then becomes bi-directional and resonant at the design frequency.

Feeding and Mechanics

The dual rhomboid has an impedance of 300 Ω and thus presents a matching problem with standard 50-Ω coaxial transmission line. It can be fed directly with 300-Ω open-wire feeders or other quality 300-Ω balanced line to a convenient point and then transformed to 50-Ω coaxial cable with an antenna tuner. The 300-Ω balanced line is inexpensive and exhibits very low losses if properly insulated from all other objects.

Another scheme involves mounting a balun right at the feedpoint. A common half-wave balun made with 75-Ω coaxial line transforms the 300-Ω balanced load of the dual rhomboid to 75 Ω, unbalanced. This arrangement provides a convenient match for an inexpensive run of 75-Ω CATV line down to the shack, where a simple quarter-wave matching transformer can make the last step to 50 Ω, if desired. Dayton built an effective λ/4 sleeve balun using ⅜-inch-diameter brass tubing. Other balun and transformer schemes might work equally well.

Mount the dual rhomboid with the element in either a horizontal or vertical plane, depending on which polarization you require. The center of gravity is on the feedpoint side of cross arm B, but the exact spot depends on construction techniques.

Other Designs

The dual rhomboid can be easily scaled to any other VHF or UHF band. To make a 432-MHz version, for example, multiply all of the dimensions by 3. Its inherently broad-banded characteristics may also make it feasible to design a dual rhombic for 1100 MHz and use it for both 903 and 1296 MHz. It also makes a fine broadband TV antenna that can be fed directly with 300-Ω line.

Bill Parker's article provides suggestions for other rhomboid designs. The same principles can be used to design dual rhomboids with longer sides with additional gain, for example. A four-rhomboid antenna, which occupies no more space than the dual design and presents a lower impedance, also provides additional gain. Rhomboids at 144 MHz might be too large to rotate using conventional means, but they can make cheap and effective stationary EME antennas. A 50-MHz dual rhomboid of similar design would be longer than 150 feet and require six supports at least 35 feet high to be effective.

The terminated dual-rhomboid design is worth considering. It is inexpensive to build using commonly available materials and is tolerant of sloppy measurements. The dual rhomboid provides greater gain and exceptional bandwidth compared to a longer Yagi, although its total effective surface area is probably greater.

This Month

March 8-9	Very good EME conditions (but new Moon)
March 21	Transequatorial propagation peaks ±2 weeks

*Send reports to Emil Pocock, Box 100, Lebanon, CT 06249. Leave voice messages at 860-642-4347, or fax 860-594-0259 or e-mail **w3ep@arrl.org**.