a technical discussion

The Cubical Quad

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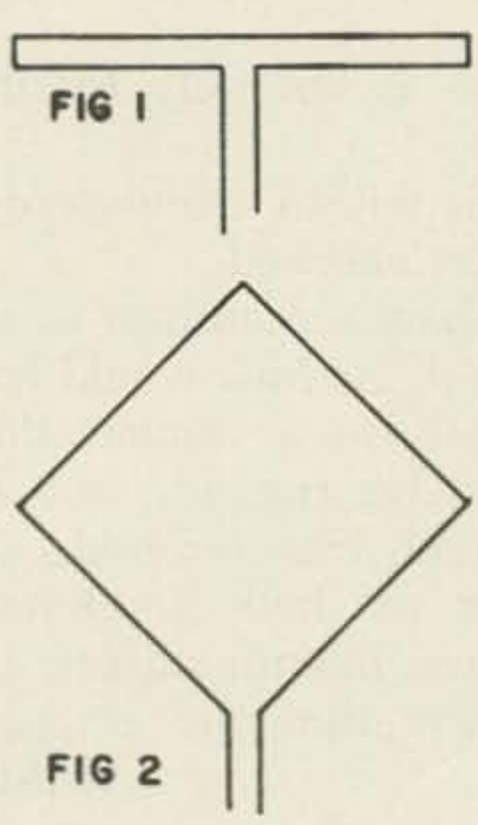
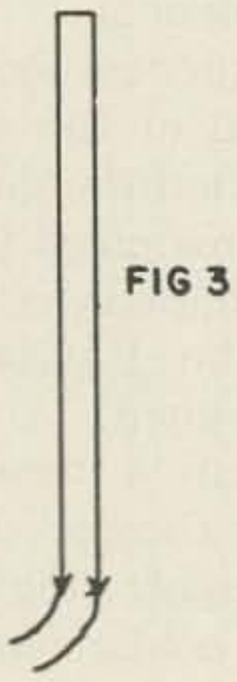
The cubical quad is a natural development of the folded dipole. Observe Fig. 1. This is a folded dipole. The input impedance is approximately 300 ohms. Now stretch the sides of the folded dipole out so the included angles formed are 90 degrees. Fig. 2. This is now a quad, and the input impedance is approximately 125 ohms. Continue to stretch the sides out and we finally have a shorted half wave line, with an input impedance of approximately zero ohms at resonance. Fig. 3.

We are interested in the quad wire, stretched only half way out, so that a square is formed. As noted above, the input impedance of this configuration is approximately 125 ohms. Now add a reflector ⅛ wavelength (about 8 feet) behind the radiator portion, and the input impedance drops to approximately 75 ohms, a good match for RG11U co-ax.

The power gain of the radiator portion of the quad only approximates 1 db over a dipole. The power gain of a quad with a reflector approximates 7-8 db over a simple dipole. With a properly adjusted reflector stub, or coil, the F/B ratio approximates 25 db. The F/S ratio is even higher.





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The Q of a cubical quad is low. The Q is the ratio of the reactance of an antenna to it's radiation resistance. The advantage of a low Q antenna is that it is less frequency selective, and therefore easier to feed. If the SWR of a quad is, or approaches 1:1 at resonance in the middle of an amateur band, then the SWR rises very slowly as the transmitter is tuned towards the ends of a band. This is a distinct advantage.

It must be understood that the figures mentioned above concerning F/B ratios and gain figures, may vary considerably from those mentioned, due to local conditions. They may be greater or less. The height above an effective ground, the presence of nearby objects, etc., all affect these figures, either for better or for worse.

The half power point of a quad is approximately 75 degrees. It is truly a broad band beam. Of course, the F/B ratio will vary as the quad is tuned away from resonance, but it varies rather slowly, and may be considered as good at any place in the amateur band, if the quad is resonated at the center of the band.

The total length of wire for a 20 meter quad should be 844″ for the 15 meter quad 575 inches, and for the ten meter quad 414 inches.

These figures change somewhat when a quad is built for three bands on a single framework, as shown in the diagram, Fig. 4. In general, the sides of the quad for 20 and 10 should be modified somewhat, and made somewhat less, due to the fact that the 10 and 20 quad wires are pulled in to the feed point of the 15 quad. This reduction, in the case of the 20 meter quad is about 4 inches per side less and in the case of the 10 meter quad, the reduction in length is approximately 2 inches. If this is not done, the bands in question will resonate somewhat lower in frequency. This will not materially effect the operation, however, and may be ignored in the practical case.

14.0-40 ohms	14.2 -70	14.4 -80
21.0-50 ohms	21.22-50	21.35-50
28.0-50 ohms	29.0 -50	30.0 -80

Fig. 5

The quad is particularly suited to multiband construction, as shown in Fig. 4. A single framework will hold all three quads very nicely. In fact, the three band model is more rigid than a single quad. There is no noticeable reaction between quads when the multiband quad is used.

A single feed line may be used to feed all three quads, and no switchover system is needed or desired. The input impedance, as measured on a three band single feed line system, is as shown in Fig. 5. This indicated that the feed line may be either RG8U or RG11U. Use 8U if xmtr output x req. The SWR on the three bands has been measured as indicated in Fig. 6.

A quad may also be constructed for 40 meters, but the size is such that it first must be determined whether or not there is room for erection. The length of a side would be approximately 35 feet and the boom length would be 16 feet.

The reflector portion of a quad must resonate at approximately 5% lower than the radiator. This may be accomplished by the use of either a tuning stub, or a reflector coil. The reflector coil is compact, and needs no arrangement for holding the ends. A stub is somewhat easier to tune correctly, but is more cumbersome, and needs an arrangement for holding the stub in place. A stub arrangement is a likely arrangement for a single quad, but the coils are much superior for a three band quad, due to the complicated lash up necessary where three stubs are used. A reflector coil may consist of several turns of wire wound on a one inch diameter, non-hygroscopic tube. The same wire as used for the quad elements may be used for the coils. No. 14, enamelled copper wire is recommended, as it will carry a full kilowatt with ease.

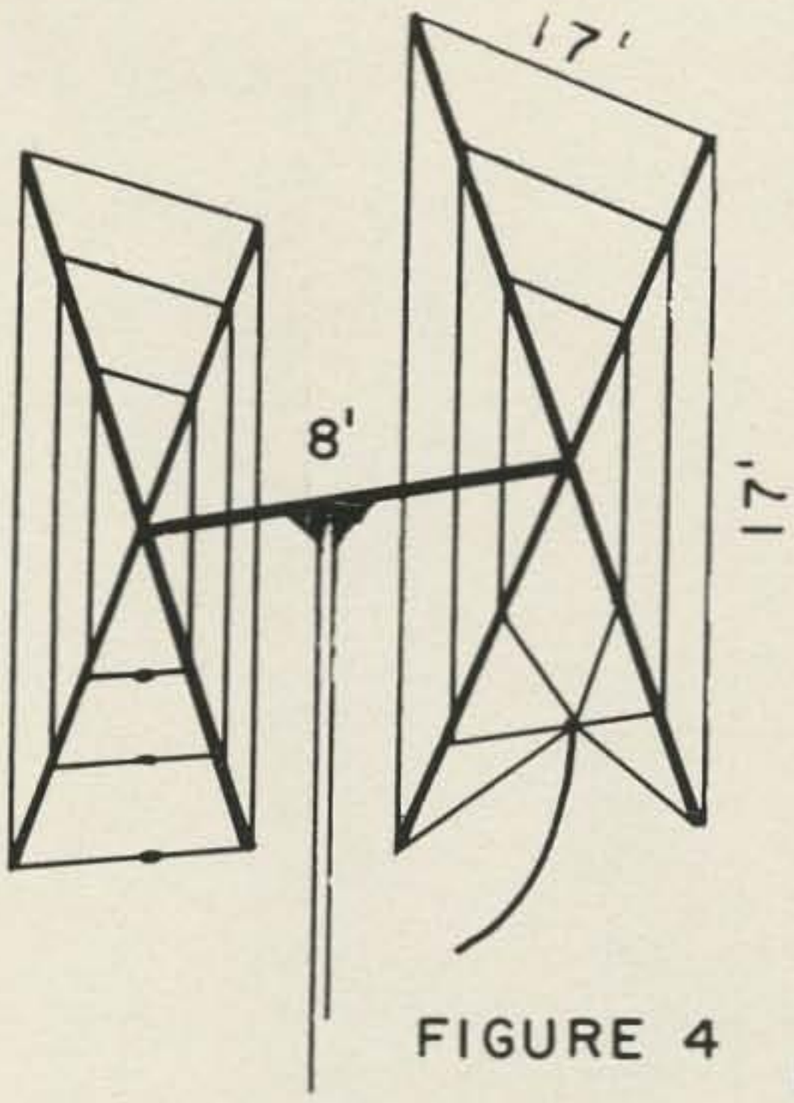

FIGURE 4 L.T.

Quad spreaders may be either of bamboo or fiberglass. The bamboo spreader will last for several years if properly treated with several coats of alkyd resin enamel. Another way to treat bamboo is to spiral wrap it with plastic tape, wrapping from the small end. It is well to dab the bolts which hold the quad wires with a bit of roofing cement to prevent entry of water in this case.

Fiberglass spreaders are of course, ideal for spreader arms. They deteriorate but little from the weather. They are even lighter than the bamboo, and are extremely resistant to lateral stresses, although they can be crushed by dropping a heavy weight on them. Of course, they are absolutely straight, while bamboo is not. They are more expensive, of course. They need no treatment against the weather whatsoever. Bamboo should be bought in 20 foot lengths, and cut to the 12½ feet necessary for the spreader arms, in order to have a reasonably large tip at the outer end. Curved washers should be used to fasten the bamboo or fiberglass to the end spider, and they should also be used in either the bamboo or fiberglass where the quad wires cross. This distributes the pressure of the bolts over a greater area than if flat washers were used.

A quad is truly an outstanding performer on the amateur bands. It possesses all the desirable qualities of a good beam, namely, reasonably low cost, good gain, good F/B ratio, and low Q tuning characteristics. It is an easy beam to feed, and seldom, if properly made and adjusted, exhibits appreciable reactance at the load. Check the signals, on the air, of amateurs using cubical quads. They are almost invariably outstanding. . . . W4YM

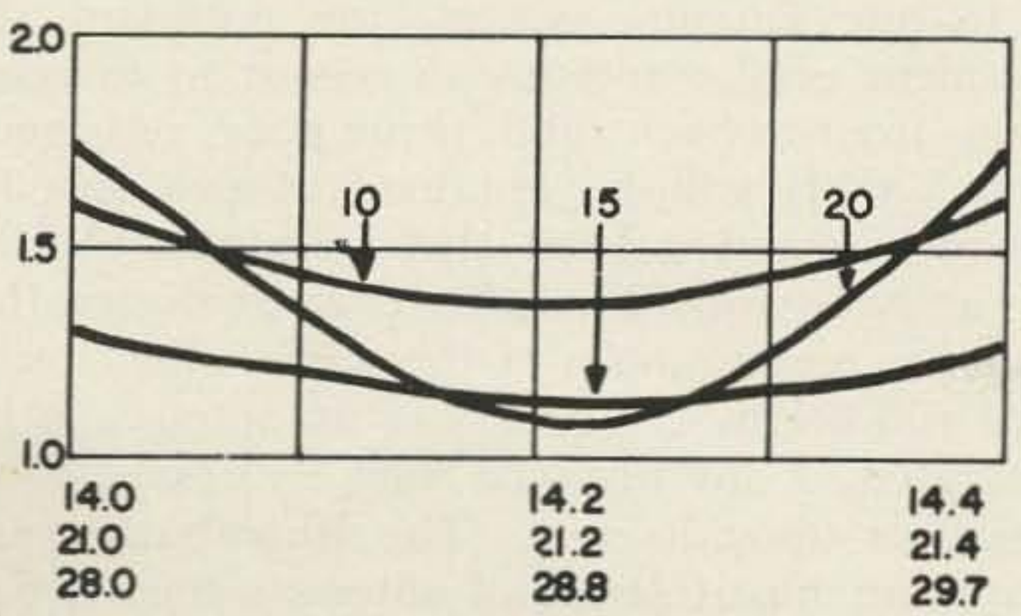

FIGURE 6 L.T.