A SHRUNKEN 3-BAND QUAD SYSTEM

By Erwin Schweigl, VE3CVS

It is common knowledge in the Amateur community that a good antenna is one of the most important aspects for any HF operator. During most of my years operating the bands, I was hampered by location, local bylaws, etc. and was not able to set up a good antenna system. While dipoles, verticals and various modifications of the same work, they rarely helped me to snag rare contacts or get through when conditions on the bands were poor.

I might add, that I was never tempted to use amplifiers and go to higher power than 100 watts — occasionally I even rose to the challenge of QRP, which made me look with envy to users of big beams. I was particularly intrigued with Quads, but the sheer size and mechanical stability issues had so far prevented me from building or buying one.

Several years ago (March 1994), I read in *QST* about the Pfeiffer Quad system and was impressed by the size reduction that could be achieved without losing too much in terms of performance. But alas, this system did not lend itself to a multiband operation which was one of my "must haves". Then an article on shrunken 2-element quads by L. B. Cebik, W4RNL, appeared on the Internet, which really intrigued me. Mr. Cebik still commented about the unsuitability of this system to nest antennas for multiband use, but with this statement I disagreed and set out to use similar features to model a 20-,15-,10m shrunken quad.

Early trials, closely following his design, using a reflector showed the potential of the capacity hat design. Because I did not intend to mount this antenna on a separate tower, but wanted a roof mount and a light duty antenna rotor, I tried some drastically shortened booms with a director element, which did not yield the desired F/B ratio. So, a reflector design it was to be.

Practical Design

With the help of my son, Guenther, I set out to first design a suitable arrangement considering the above and used L. B. Cebik's design but in square rather than diamond configuration. The square yields a smaller turning radius, which is certainly helpful in my neighbourhood where houses are closely spaced.

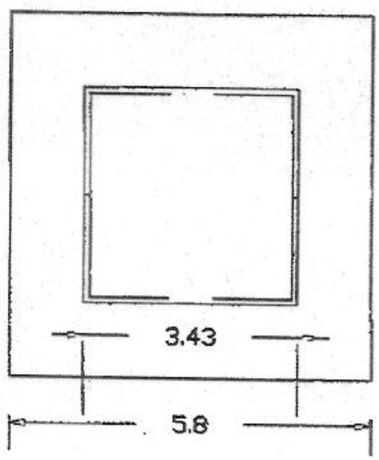


Figure 1

For the following refer to Figure 1 — for simplicity only the 20m dimensions are shown for both a full-sized vs. the shrunken Quad reflector element. The outer square represents the standard 20m element, and the inner configuration shows that of the shortened quad with the capacity hat. Note: the standard quad has a spreader diagonal of about 8.2m, whereas the shortened element spreader is only 4.9 m across. The 15m and 10m elements can be nestled inside — proportionally reduced in size.

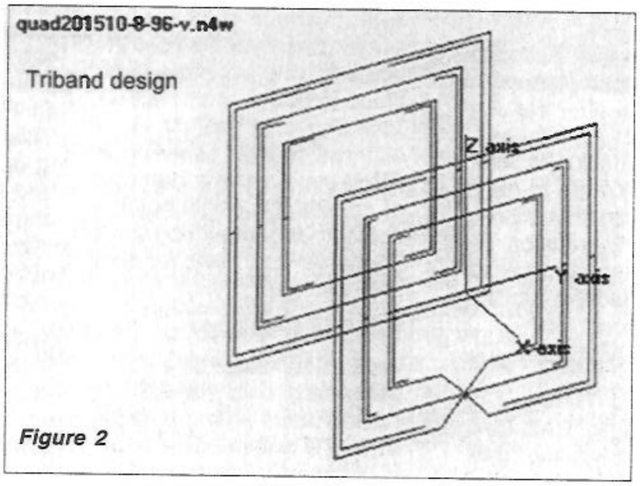


Figure 2

Figure 2 shows a view of the triband design using 8 feet (2.4m) boom length. According to the modelling program, it yields better than 12db F/B ratio for the 20m band, up to over 26db on 15m and to over 18db on 10m with reasonable gain on all 3 bands. Note: A 50-foot antenna height was assumed for modelling and 100 ohms were used as feed impedance.

The charts on the next page show gain and F/B as modelled. As can be seen, the beam was designed to optimize F/B ratio rather than gain and also that 15m is the author's preferred band. Better results on 20m can be achieved with a longer boom, but this would also increase turning radius and make it more difficult to pack.

Reflector elements were constructed with the same outside dimensions as the driven elements, and with the capacity hats lengthened to yield optimum performance. This provided a reasonable operating bandwidth with an antenna tuner: 20m and 15m bands are covered for the greatest part and on 10m close to a 1 MHz portion can be utilized. A nice surprise was the relative insensitivity of this antenna to height above ground: very little tuning was necessary after the initial adjustments on the ground, but tuning (pruning) was rather simple since only the ends of the capacity hats had to be trimmed and they were made longer to start out with!

Line Connection

All driven elements were connected at a common feedpoint. Initially, I contemplated using 450 ohm ladder line and connect it to an external antenna tuner, but when measuring Z at the feedpoint it was apparent that a reasonable match could be achieved with a 50-ohm line, a choke balun and a tuner.

Practical Experience

Using the Kachina 505D transceiver, a number of contacts were made and the reports were surprisingly good. First, the Kachina's automatic antenna tuner was able to match the system without problems. Second, I was able to snag overseas stations on the first try using 100 watts or less. Often I competed successfully with stations sporting multi-element beams and high power equipment, which was a new and pleasant experience for me.

Many operators helped me with "honest" feedback instead of the usual — and most often flattering 59. Frequently, they reported background noise levels, weather conditions, station set up and other pertinent information. While this method was not very scientific, it still gave a good account of actual antenna performance. F/B ratio on receive amounted to a difference of 1 to 3 s units, with the signal very often disappearing in noise until not readable with the antenna turned 90 and 180 degrees. When comparing the little beam to a commercial trap vertical, I was able to work stations with the small quad that were not understandable when using the vertical antenna.

The photos show part of the sequence of unfolding and the ease of erecting this beam.

Summary

While probably not yielding the performance of a full-sized Quad, this little multiband beam presents a number of advantages:

1. A weight of less than 30 lbs — combined with a small turning radius of about 7 feet — make this antenna suitable for roof mounting with light duty rotors. Wind loading is only about three square feet, which should be of help in bad weather conditions. Performance seems better than most "mini" yagis and bandwidth seems to be as good or better than many of the trap designs.

2. The folding feature not only made this antenna very easy to mount, but also provided the opportunity to pack it easily into 8-foot sections (Field Day use). Its short design made it very stiff and less vulnerable to twisting from high winds.

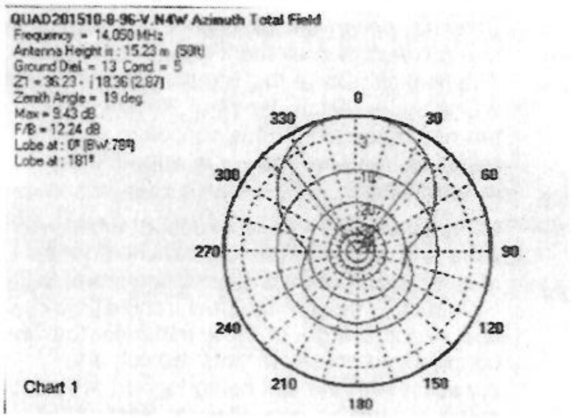


Chart 1

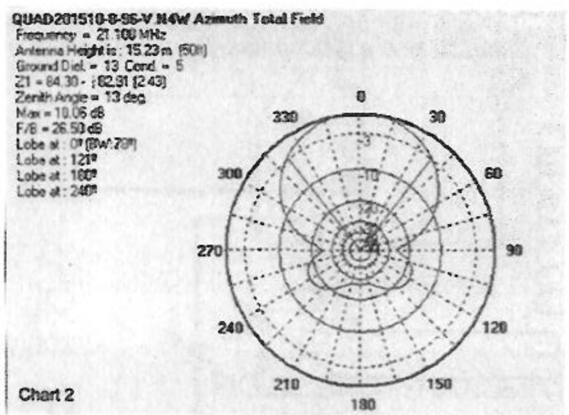


Chart 2

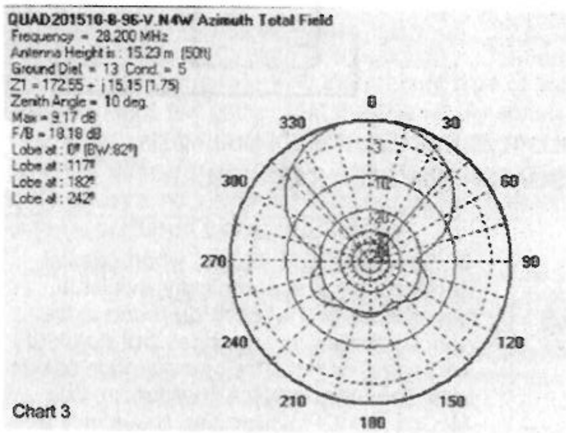


Chart 3

Note: To date, the antenna has been up and down the roof at least four times and it takes less than one hour to remount every time.

Acknowledgements

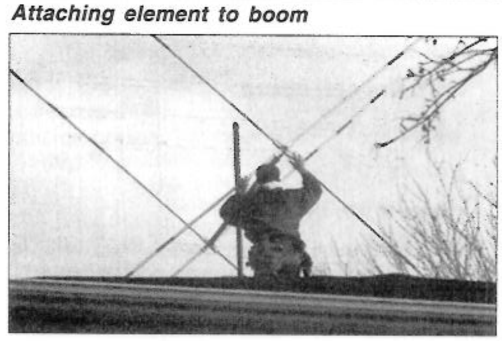
It was my wife, Gertrude, who actively encouraged me to proceed with this, for me, very new venture of antenna design. I would not have persisted throughout the many difficulties without her active support. Most of the credit should go to my son who designed the Quad mechanically and had the idea for the folding feature that makes this antenna so convenient to transport and mount.

Element fully folded

Element unfolding

Securing element

Attaching element to boom



Literature references:

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L. B. Cebik, W4RNL, "Some Model Quads: Shrunken 2-Element Quads"

William Orr, W6SAI, Stuart D. Cowan, W2LX, "Cubical Quad Antennas"

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Edward M. Noll, W3FQJ, "Vertical, Beam and Triangle Antennas"

The ARRL Handbook – chapters on transmission lines, antennas & projects.

TCA