Monoband Yagi for 20 Meters

More dBs for the buck.

by Kenneth C. Kemski AB4GX

Like many amateurs, I live in a residential neighborhood where local sentiments do not favor large antenna arrays. Among my favorite operations, however, is hunting DX on 20 meters. This requires attempting to be heard through the pile-ups that develop around almost any semi-rare station that fires up its rig.

There would appear to be three distinct means of achieving the end of "pile-up crashing": blind luck; shouting your call hundreds of times, despite who is talking or listening (much to the consternation of everyone involved); or having an effective signal that allows you to "get in-and-out" within a few calls.

The chain between your microphone and the desired DX station's ears may include many links, and among the most important (after professional protocol) is the antenna. It is difficult to construct an antenna that affords good gain, directional performance, and usable bandwidth in a small package that won't antagonize the neighbors!

My results with semi-inconspicuous verticals, inverted vees and slopers were somewhat discouraging. It appears that one can develop an S-5 to S-6 signal anywhere in the world where propagation exists, and enjoy many a fine QSO. Unfortunately, pile-ups of any size became primarily a means of killing time until the DX station went QRT for the day.

I finally decided to attempt to design a reduced size monoband yagi that would give me a "fighting chance" under adverse conditions (. . . most DX contacts).

The criteria were to obtain: the smallest size possible, 10 dBi forward gain, usable front-to-back and front-to-side ratios, and the ability to withstand Florida's high winds. The result is the antenna described here.

I began to design by purchasing an antenna analysis program, based on the successful Minninec format. It is written and distributed by W7EL, and called "ELNEC." This PC-based program is an absolutely fine undertaking, and is worth many times the asking price. (See the ELNEC review in the January 1991 issue of *73 Amateur Radio Today*.) A detailed description of this program would require an article in its own right. Suffice it to say that I fed my ideas for this antenna into ELNEC over a two-month period, scrutinized the results, and then assembled and tested the final design. I achieved almost total agreement between ELNEC's analyses and real-world performance; for example, the calculated element lengths were within 3/8″ of final tuning!

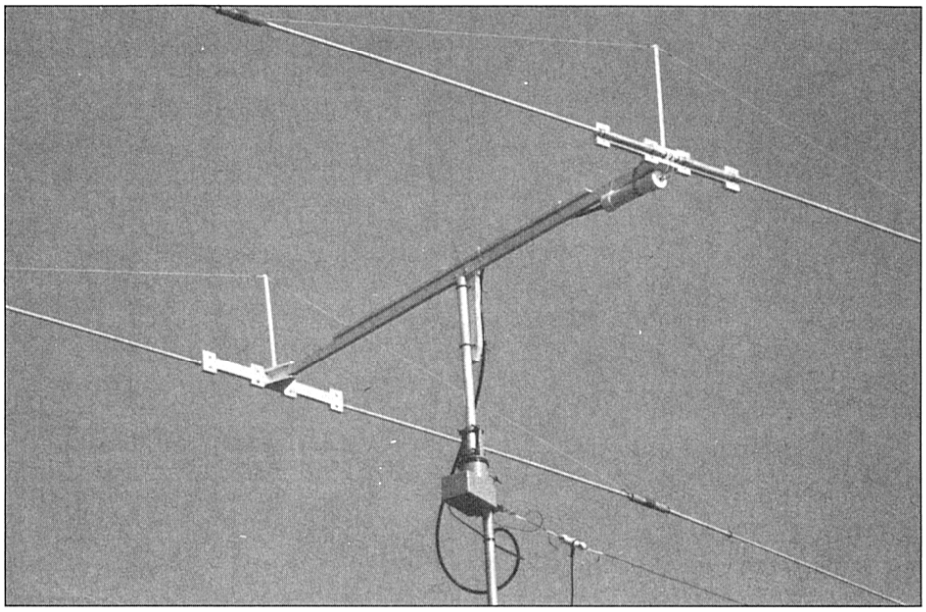

Photo A. The completed 20 meter mono-bander.

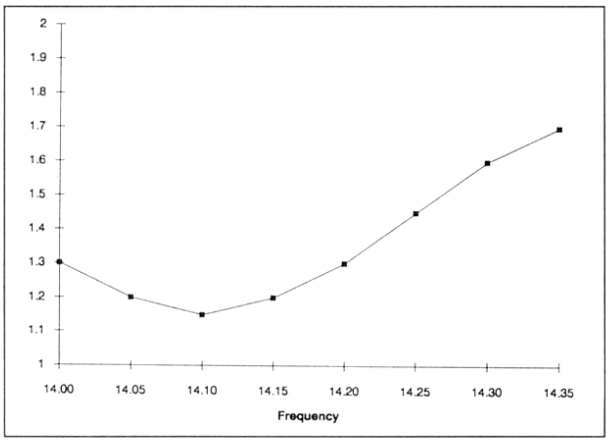

Figure 1. Measured SWR of the 20m shortened yagi.

Design Parameters

The main considerations and variables included the following important areas:

1. **Gain** This was paramount in importance, because they can't hear you if they can't hear you . . . Every available parameter was "tweaked" for maximum forward gain commensurate within the SWR and bandwidth constraints. The result is +10 dBi of forward gain at the frequency of interest, increasing to +11 dBi in the general portion of the band (albeit with reduced front-to-back) and decreasing to +9 dBi in the CW portion of the band. (See Figure 2.)

2. **SWR** An electrically-shortened antenna usually has low radiation resistance and requires a matching network of some type. I watched gain while decreasing the element spacing, at the same time varying reflector tuning and other parameters. I found I could match this antenna directly to 50 ohm coax using only a 1:1 wideband current balun. The balun was used to eliminate radiation from the transmission line and preserve the calculated patterns. I would have incorporated a gamma match if it would have helped, but