The DX Magazine REVIEW

DX, DX When We Call, Who's the Loudest of Them All?

A Look at Antennas

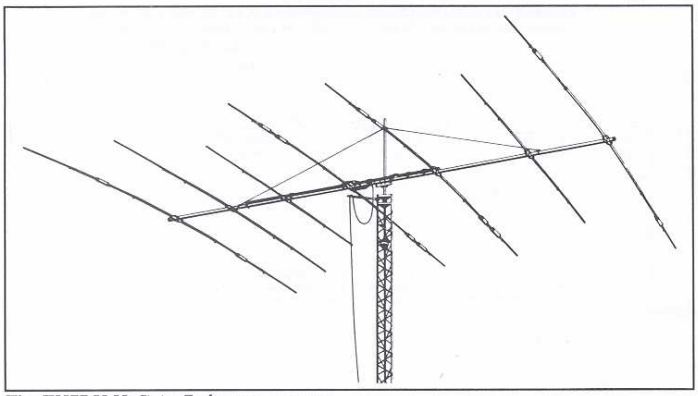
by Walt Stinson WØCP

We all get beaten in a pile-up or bested in a contest from time to time. Some people just shrug it off and resign themselves to the fact that a few are always going to be louder. Others, including me, get competitive and start trying to figure out ways to improve their signal.

The easiest way to improve your signal is to increase the power. Just replace your KW with a new 1.5 KW amp, plug it in and presto, 2db. The problem is that all the big guns are running the legal limit or very close to it; that's a given. Moreover, an amp won't help you a bit on receive. To put real muscle behind your signal and to pull 'em out of the mud, you must optimize the antenna configuration.

My workhorse antenna is a HyGain TH7DX. The TH7 is a fine antenna. It is extremely well engineered, it's rugged, broad-banded, and it generally performs well. I have it stacked on a Tri-EX 70' crank-up tower with a Cushcraft 40-2CD. I had no desire whatsoever to change, until recently.

I was reasonably content sitting at the top of the regional Sweepstakes low-power scores and pushing for DXCC Honor Roll. Then Randy KØEU upset the balance of power. Not content with his rightful place just behind me in the standings, he put up mono-banders on 10, 15, and 20 meters and waxed me good. In 1990 he took first nationally on both CW and phone: not bad.



The TH7DX HyGain 7-element antenna

My new perspective on things has stimulated me to take another look at my antenna situation, and the first place I looked was at the TH7. I wondered if there might be something out there that would play better against the mono-banders. For a few months the *CQ* Antenna catalog never left my bedside. I studied it every night, memorizing the specs of every antenna that might fit the bill. I even considered putting up another tower, but what I was really looking for was a magic bullet.

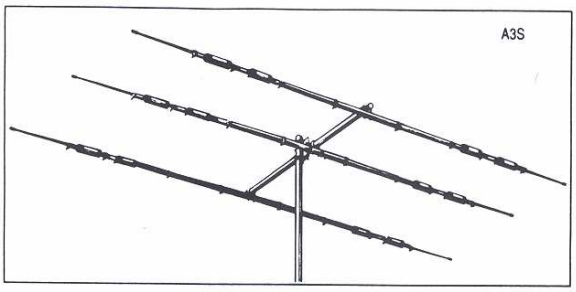
I began to zero in on the KLM KT34-XA. It certainly is enticing. Boom is 8 feet longer, 1 additional element on each band; and still very compact and the same weight as the TH7. Moreover, there's lots of empirical evidence from local cohorts and XA owners N2IC and WØZV who most always beat me in the piles. When I checked with them, they suggested I stay with the TH7 -- more reinforcement! But how much better is it?

In 1982, before computer modeling became popular, an outfit called Amateur Radio Profiles reviewed a bunch of tribanders, including the TH7 and the XA, and concluded that the gain differences between these two antennas is 0.2

db or less on 10, 15, and 20. While I wanted to believe this, I could never reconcile these results against my on-the-air experiences or with published antenna theory. Are they really that close in gain performance?

To find out, I bought antenna modeling programs from W7EL and K6STI. Armed with a 386SX computer with a math co-processor, the programs zip along quite nicely. For comparing these tri-banders, I settled on a program called YO (Yagi Optimizer) from K6STI. [Yagi Optimizer was reviewed in the May, 1989, issue of *The DX Magazine*. -ed] I modeled each antenna three times: as a mono-bander on 10, 15, and 20 meters with fixed boom length and element positions, but with variable element lengths. I also dropped the second driven element, viewing it as a constant since both models use one. Modeling traps and dual driven elements is quite complex and this approach allowed me to simplify the modeling while still achieving a reasonably valid comparison.

The KT34-XA employs a linear loading trap system which should have roughly half the loss of conventional traps. All of the other antennas modeled employ high-quality conventional traps with a total loss of somewhere around 2db average per band. Thus, the XA should have roughly a 1db overall advantage in trap design on each band, which I have added to the calculated results.



The A3S Cushcraft 3-element antenna

The KLM was modeled as 5 elements on 10 meters, 4 on 15, and 4 on 20. The HyGain was 4 elements on 10 meters, 3 on 15, and 3 on 20. The antennas were modeled at 70 feet over average ground and were optimized for front-to-back ratio.

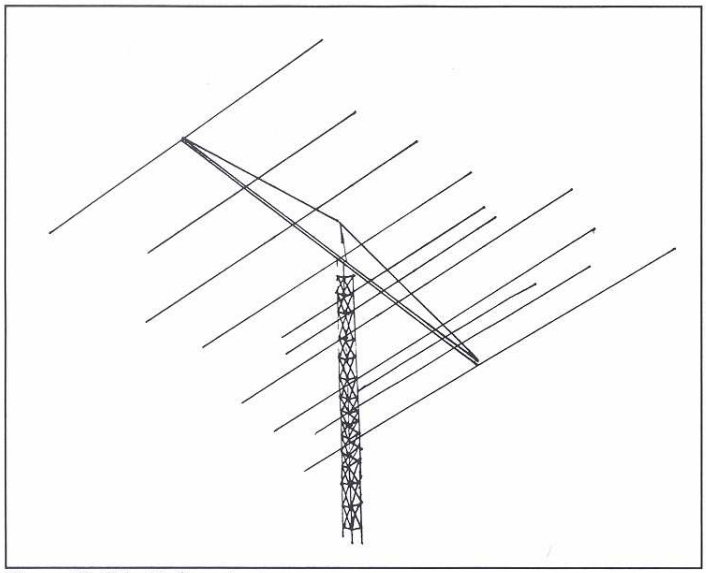
I must stress that the figures above are not the actual performance figures. They are simply theoretical optimums, given the constraints I introduced into the model. They are useful only for comparing the potential of the two antenna designs when they are both optimized under the same conditions. I have purposefully omitted front-to-back ratios for these antennas, as they are highly distorted by the absence of the second driven element from the model.

I am including figures for the Cushcraft A-3 because I thought some of you vertical users might be interested in seeing just how close you can get to the big guns with a 27-pound tribander on a fourteen-foot boom. I have subtracted .4bd from the A3's results as it is the only antenna modeled lacking dual driven elements. The wild card here is the Nagara T3-11dx, a Japanese tribander that is considered the top model there. I was introduced to it by JA4BJT/3 and picked up some literature on a visit to Tokyo. It is a real monster with 11 elements on a 36-foot boom. Excluding multiple driven elements, it has 5 elements on 20, 6 on 15, and 6 on 10.

Going down the list the A3 makes a pretty good showing. At its best, on 15 meters, it is just over 1/2 db down from the TH7. Comparing the TH7 and the XA, the focus of my study, the differences are 1.8db on 20 meters, 2.6db on 15, and 2.7db on 10. Surprisingly, the Nagara is slightly better than the XA on all bands except 10 meters. The XA is better than 3db up on the A3 on all bands, the equivalent of twice the RF power output.

The results of the modeling have only reinforced my already favorable opinion of the KT34-XA as a very competitive antenna. When you factor in the additional trap loss that the other antennas suffer, it is right up there with the Nagara and is probably no more than 1.5db down from a similar sized monobander. By the way, the Nagara can be yours for about $1500. The KT34-XA

Estimated Relative Gain				
Antenna	20 Meters	15 Meters	10 Meters	Boom Length
Cushcraft A3	5.03	8.38	10.2	14
HyGain TH7-DX	6.48	8.94	11.03	24
KLM KT-34XA	8.33	11.56	13.71	32
Nagara T3-11dx	8.54	11.58	13.32	36



Nagara T3-11dx 11-element antenna

sells for about $600, the TH7 for $800, and the A3 for about $300.

So what does this say about the TH7? While the TH7 might appear over-priced, it has a longer life expectancy and lower maintenance than the KT34-XA. XA owners have told me to expect unscheduled maintenance every few years, but that TH7's just keep on truckin' year after year after year. XA owners also say that the antenna sacrifices some front-to-back, whereas the TH7 performs well. For the DXer concerned about being down when a New One comes up or for someone who favors F/B over gain, the TH7 is still a good choice.

Once again, I want to stress that these figures do not necessarily reflect actual performance. They are for comparison only. Also, keep in mind that I adjusted the XA up 1db and the A3 down 1/2 db from YO's results to account for design differences which were not incorporated into the computer model.

OK, now we have some relative differences, but what do they mean? Would there be a noticeable difference in actual on-the-air use or should we all be using A3's? If you have been in ham radio long, you probably have some sense of what 6db (one S unit) means on the bands. Would you be willing to put out money and sweat to improve your signal by 1db?

To try to put 1db into perspective, I made a study of ARRL Sweepstakes all-time records, as published in the September, 1989 *NCJ* magazine. I compared the top all-time low-power phone score to the top all-time high-power score in each ARRL section and assumed a 10db difference in power (10 times). The top low-power scores average 40% less than the high-power scores.

This data indicates an expected score difference of approximately 4% per db. Based upon these assumptions, I would expect to see about 10% improvement in score by switching from the TH7 to the XA, just slightly more if I import a Nagara, and about 15% if I go with mono-banders.

As any contester who has ever been in the Top Ten can testify, even 4% is often enough to make a difference in the standings, even though a one db difference would be virtually imperceptible in on-the-air A/B tests. So don't be too discouraged if you upgrade your system or try an A/B test and people tell you that they can't hear the difference! These differences are inconsequential in the clear and are apparent only in the heat of battle. Yet they are worth pursuing by the DXer/contester, for whom just one db can improve the pecking order in pileup's and final contest scores.

When weighing the price performance ratio, keep in mind too that every doubling of height above ground adds roughly 3 db to your low-angle signal, up to 2.5 wavelengths above ground. It might be cheaper to put an A3 at 90 ft than a KT34 or a TH7 at 50 ft and be just as effective for long hauls.

Before you decide to tackle any major antenna upgrade, make sure that all the little things are taken care of, as these could easily add up to a db or two. Don't let the coax get too old and consider upgrading to hardline when it's time to replace it, especially if you have a long run. Make sure that your coax fittings are properly installed. Use an antioxidant on all joints when assembling beams. Keep in-line coax switches and meters to a minimum (I count 3 in my system at about 0.1db each.)

As I was putting all this information together, I happened to hear a rumor that HyGain is planning a TH9. I called HyGain and confirmed that such an antenna is now on the test range and may be available as early as the spring of 1991. The antenna as planned has a 34-foot boom and provisions for 17 and 12 meter operation, plus additional elements on 10, 15, and 20. While it will still use coils and therefore will have higher trap loss than the XA, it will no doubt be a strong contender.