antennas

Stacking Dissimilar Antennas

BY KENT BRITAIN,* WA5VJB

Perhaps you have this common problem: 10 feet of mast sticking out the top of the rotator, and 63 antennas you would like to mount on that mast. Along with that comes the question of just how closely we can mount all these antennas before seriously damaging their gain and radiation patterns. I decided to find out.

In these tests, I took two commercial Yagis for 440 MHz and 915 MHz and tested both their gain and then their patterns at different spacings. In each case, the antenna not being tested was terminated with a 50-ohm load.

440 + 915

The test started with just the 440-MHz Yagi, measuring its gain and its pattern. Then the 915-MHz Yagi was mounted 16 inches above it, as shown in photo A, and forward gain was again measured. I lowered and lowered the 915-MHz Yagi, keeping the 440-MHz Yagi in the same spot (see photo B), until gain dropped 1/4 dB. That 1/4 dB was really determined by physical limits. As you can see in photo C, the mounting brackets were touching before I saw even a 1/4-dB degradation in forward gain of the 440-MHz Yagi.

Next we have the combined patterns for the two antennas in Plot 1. The pattern of the 440 MHz Yagi alone is in red, and the plot with both the 440-MHz Yagi and the 915-MHz Yagi as close as their hardware would permit is plotted in blue. There is some minor differences in the side lobes, but not much difference overall.

At this point, I would like to thank David, KF5FPA, for helping to bring my data into the polar formats. When I do antenna pattern measurements, I use a rotator that makes a full turn in almost exactly 60 seconds for 1 RPM. I then set the spectrum analyzer to zero span, 60-second sweep, one sweep only. I mount the antenna, start the rotator and the spectrum analyzer at the same time, and the spectrum analyzer displays a nice linear plot of the antenna and antenna side lobes. Linear plots are great for my work and have many advantages over polar plots, but most of you are more familiar with the polar-type antenna plots. So I saved the trace data and KF5FPA put the data into Excel and produced the polar plots in this column.

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Photo A– Measuring a 440-MHz Yagi and its interaction with a 915-MHz Yagi.

Photo B– Spacing before we saw 1/4-dB drop in forward gain.

915 + 440

Now we go the other way in photo D. In Plot 2, I have the plot of just the bare 915-MHz Yagi in red, and then mounted the 440-MHz Yagi above it. This time I kept the 915-MHz Yagi in the same place and slowly lowered the 440-MHz Yagi until I again got a 1/4-dB drop in forward gain. This time the spacing was 5.5 inches. The lower-frequency Yagi with its longer elements had far more effect on the 915-MHz antenna than the 915 MHz had on the 440 MHz, but again the effects were small.

Of course I went further. In photo E, you can see that I took the 440-MHz beam right down to where the driven elements were about to touch. In this setup, I saw –3.2 dB lower forward gain, but most of the loss in gain was really due to a higher SWR in the 915-MHz antenna. Therefore, the loss indi-

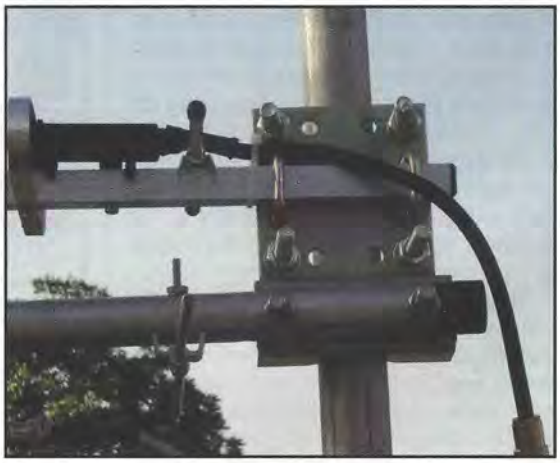
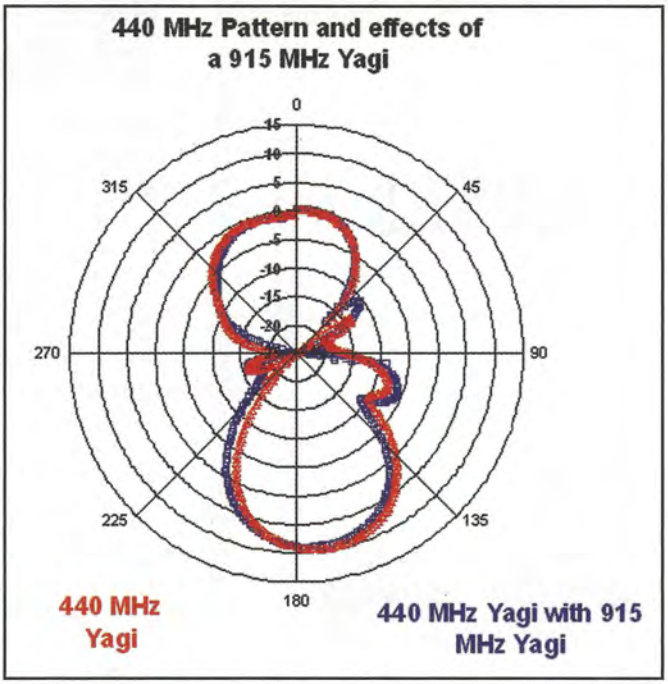
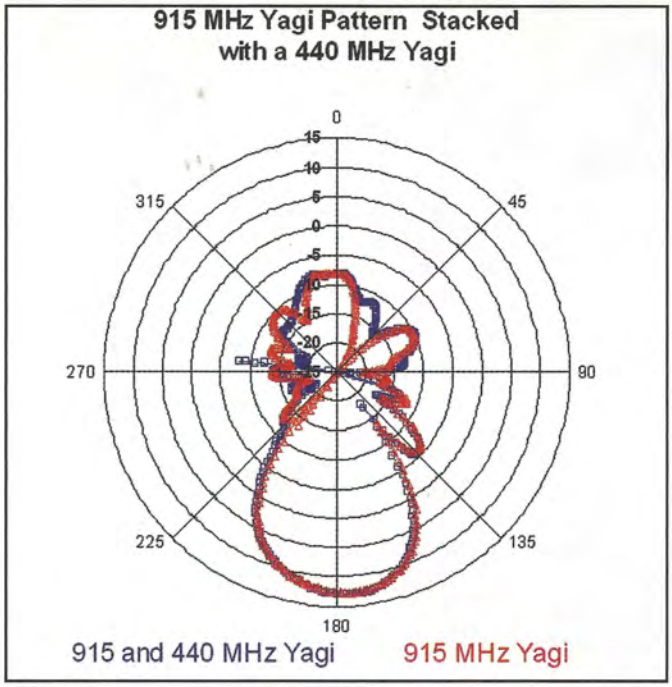


Photo C– It was really the mechanical limits of the mounts!



Plot 1– 440-MHz Yagi with and without a close-spaced 915-MHz Yagi (see text for details).



Plot 2– 915-MHz Yagi with a 440-MHz Yagi spaced at 5.5 inches.

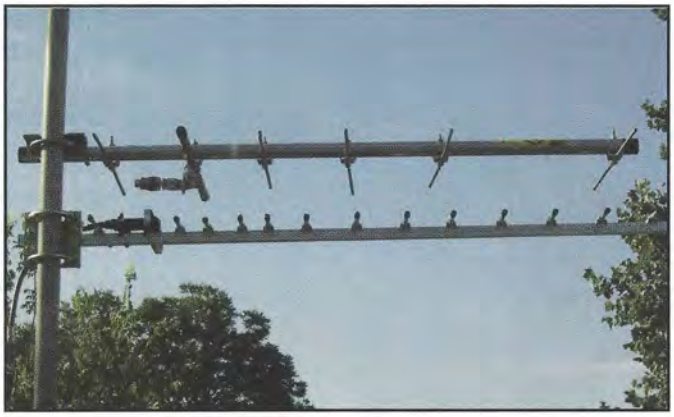


Photo D– Measuring a 915-MHz Yagi and its interaction with a 440-MHz Yagi.

Photo F– This Force 12 multiband HF Yagi has elements for different bands so close they're on the same boom! (Courtesy of Force 12 Antennas)

Photo E– Again, measuring to the mechanical limits.

cated that the power was being mismatched and reflected, not that there was a pattern change.

Bottom line: The higher-frequency Yagi has almost no measurable effect on the lower-frequency Yagi until the hardware is touching. The lower-frequency Yagi has more effect on the higher-frequency Yagi, but again, you have to get them pretty close. Yes, I have a virtually infinite number of antenna variations to look at, but antennas can be stacked much more closely than many pundits suggest!

Heck, just look at the multiband Yagis you see on HF where three, four, even five bands might be built onto one boom, such as the Yagi from Force 12 in photo F. Yes, when you look ahead in your design work, the interaction among elements for the different bands can be better allowed for, but it doesn't seem to be all that bad to begin with.

Coming Attractions...

Looking ahead, keep an eye out for old fiberglass whip antennas. Old CB whips such as the ones in photo G are perfect for this, and while you're at it, some heat-shrink tubing that