By Kent Britain,* WA5VJB

ANTENNAS

Connecting the Radio to the Sky

Roving Antenna Range and Much More

I am sure the Central States VHF Society Conference in Irving, Texas this July 29–30, 2011 will be covered in many venues, but I would like to point out our roving antenna range. Marc, WBØTEM, takes care of the 50-, 144-, 222-, and 432-MHz antenna measuring.

I take care of 902 MHz though 24 GHz, and sometimes even higher. On a typical Friday morning we will measure 100–125 antennas. Even if you can't actually attend the conference, you may know someone who will, and if they have a bit of space and you have an antenna you have wondered about, here is your chance to get it tested. This way we can skip the specs of the antenna companies and measure the antennas side by side at the same time under the same conditions.

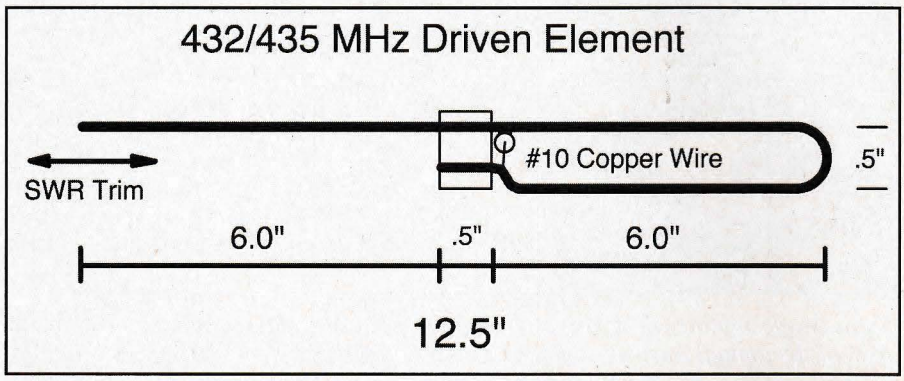

Figure 1. The 432/435-MHz driven element.

On the microwave range we take time to let you tweak your antenna designs. Quite often moving a dish feed in or out a bit can pick up several dB and help clean up the antenna pattern.

Do you think you have invented a new super-duper, gazillion-dB antenna? I have an HP415E and detector diode wait-

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Photo 1. CSVHF antenna range.

Element	Length	Distance from Reflector Element
Ref. Point	13.5	0
Driven	see fig. 1	5.25
D1	12.3	9.5
D2	11.9	14.0
D3	11.8	19.5
D4	11.8	27.3
D5	11.6	36.4
D6	11.4	47.3
D7	11.4	57.5
D8	11.4	68.8
D9	11.4	79.0
D10	11.4	89.0
D11	11.4	99.5
D12	11.4	109.5
D13	11.4	117.25
D14	11.4	124.5
D15	11.4	135.0
D16	11.4	146.5
D17	11.4	156.0
D18	11.3	166.0

Table 1. Dimensions for the 432/435-MHz driven element (see figure 1). All dimensions in are in inches. All elements are 1/8-inch diameter.

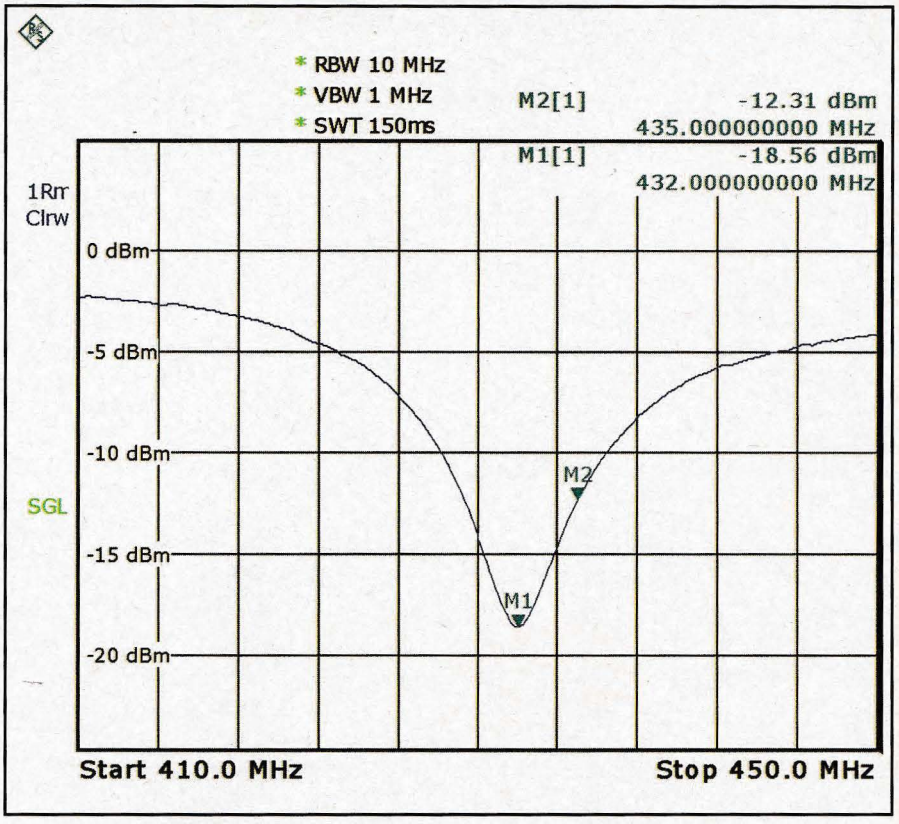
ing for you. Someday I'll have to mention the 123 dBi gain 1296-MHz antenna one chap submitted. It is a long story. Furthermore, the lad had some problems mixing linear and logarithmic math. Nevertheless, for a dish antenna to have 123 dBi gain at 1296 MHz, it would need to be about the size of the state of Texas. I'm afraid he came up about 111 dB short of his prediction.

Boom Correction Factor

"But I built it exactly to your dimensions!" As shown in an accompanying photo, a fence post may make a good strong boom, and while wood is an insulator, it still affects the length of elements.

When designing and then building an all-metal Yagi, you have to compensate for the part of the element that is inside the boom. In general, the element is slightly smaller to allow for that fat area in the middle of the element. We have a similar issue with a wood boom. If you have ever built a couple of 40-meter dipoles, you noticed that a dipole made of bare wire, and one with the same gauge wire but insulated, is about a foot shorter. Light waves travel more slowly when passing through water or glass, and radio waves travel more slowly when passing through a dielectric.

The plastic insulation on the wire is a dielectric and slightly slows down the radio wave. Therefore, the antenna has to be shorter to allow for the plastic. Wood does the same thing.



Plot 1. Return-loss plot of the prototype Yagi.

While many have worked out boom correction factors for metal booms, I don't know of anyone who has worked out similar correction factors for a wood boom. I can just see it now—tables of dimension corrections based on pine, ash, hickory, teak, etc. With additional correction factors for moisture content, I think that I'll just stick with my 1/2-inch wood on 1 1/4-inch wood for now.

Figure 1 shows the 432/435-MHz driven element (see Table 1 as well). You

Photo 2. "But I built it 'exactly' to your dimensions."

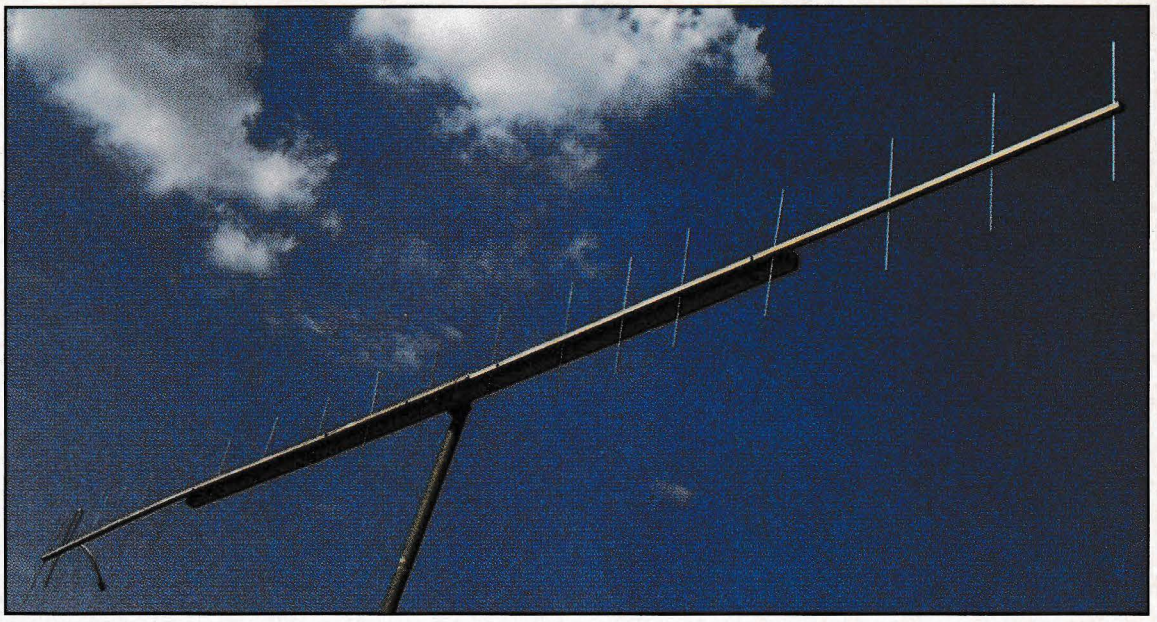


Photo 3. Twenty-element 432-MHz Yagi.

want to use something that is about 1/8-inch in diameter, and it is nice to have something to which you can solder. No. 10 bare copper wire works well. For this antenna I used 1/8-inch bronze welding rod. It is a bit stiff for bending the loop, and you need some pretty good wire cutters when trimming for best SWR. But hey, it was already on the work bench and time was short.

The coax is soldered directly to the driven element. Coax shield goes to the center of the element. The coax center conductor goes to the tip of the J. For those who are good at finding fly specs in pepper, yes, the connection points are not *exactly* the tip and the center, but close. Built to these dimensions, the SWR is usually better than 2 to 1.

If you can measure SWR at 432 MHz, then experiment to your heart's content. I have a supply of 1/8-inch hobby tubing. If, or when, I make that one-too-many-cuts mistake, then I just slip some tubing over the element tip and lengthen it back out a bit. The dimensions for the driven element are experimentally determined, the fancy way of saying these are the dimensions that worked best, not a computer prediction.

Plot 1 is the return-loss plot of the prototype 20-element Yagi. Minus 10 dB return loss is about a 2 to 1 SWR. -20 dB Return Loss is about a 1.2 to 1 SWR. SWR-wise, the antenna came out pretty successfully.

Construction

The boom is 1/2" × 3/4" trim wood. You have a lot of options here, but as we just talked about, you want the element to be inside about 1/2-inch of wood.

The elements can be just about any 1/8-inch diameter rod material. Aluminum ground-rod wire works well after you have straightened it out. Copper/brass hobby tubing and bare #10 copper wire also work. Oh, do I have some stories about a welding supply house that no longer wants to talk me about gasses and welders when I come in.

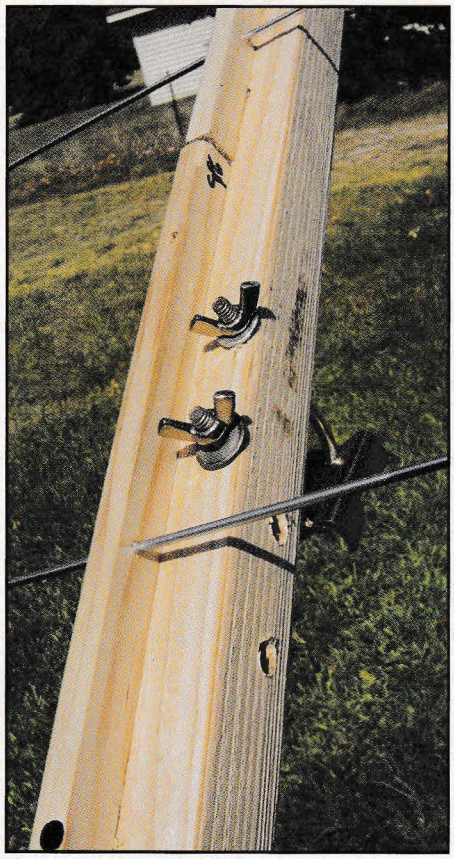


Photo 4. Support boom and mounting.

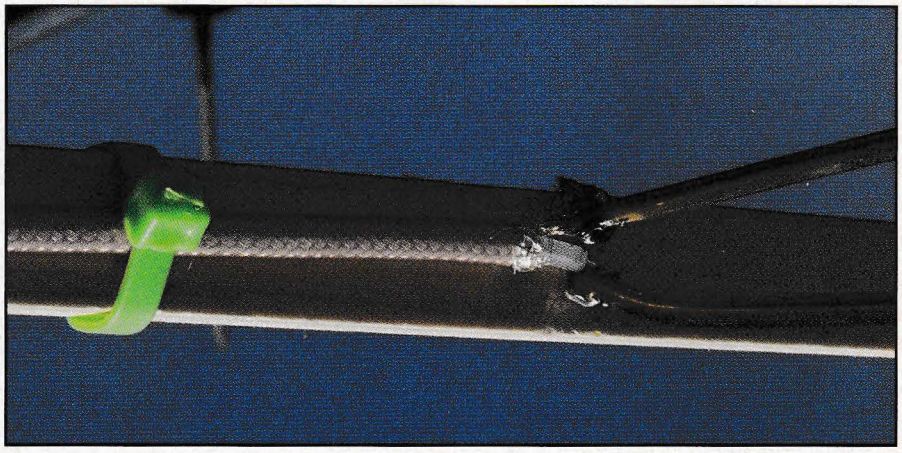


Photo 5. Driven element and coax attachment.

For this particular antenna the elements are 1/8-inch aluminum welding rod. The driven element can be either phosphor bronze or silicon bronze welding rod. The bronze welding rods are easier to solder to. There is nothing wrong with using the bronze welding rod for all the elements. It is just that the aluminum rods are a bit cheaper when they are selling the welding rods by the pound.

After drilling your boom with a 1/8-inch drill bit and putting in the elements, use a drop of glue to hold the elements in place. Almost any of the construction adhesives, or even "Super" glues, can be used. No big blobs of glue, however. We're back to that dielectric problem again.

I drilled a couple of holes in the antenna booms and fastened them to the larger wood with several drywall screws. Again, you can use your favorite fasteners, but I wanted to be able to take the antenna apart and store it when not in use.

When I get a second antenna built we will cover how to stack them for more gain or to run circular polarization. In another photo you can see how I drilled the boom for mounting the U-bolts. Don't do what I did; I drilled the wood for the U-bolts then attached the 1/2-inch wood with the elements.

You want any mast to split the elements—that is, it needs to be as far away from the director elements as possible. In the photo you can see the "oops" where the mast would hit a director element. Also note how I offset the elements to make room for the U-bolt.

AMSAT

Do you want to have one heck of a signal on one of the Low Earth Orbit (LEO) Birds? Trim the driven element ever so slightly for best SWR at 435 MHz and the antenna's 17 dBi gain is virtually unchanged from 432 MHz. From Plot 1 you can see the SWR hardly changes between 432 MHz and 435 MHz.

Arecibo and EME

From a short conservation with Joe Taylor, K1JT, at the Dayton Hamvention® this year, it seems there are plans to put the 1000-foot Aercbio dish on EME again. No exact dates have been set. However, another year or so is likely. Want to put 432-MHz KP4 in your logbook? Well, it's time to get prepared!

Oh, did I mention they want to have 1296 MHz off the Moon next time at Arecibo? How about some long Cheap Yagis for 1296 MHz? I have those in the pipeline.

Future Projects

I have a second 20-element 432-MHz Cheap Yagi under construction. I kind of ran out of time to write about it in this column. With the second antenna I can show combinations of phasing harness and mounting points such that the antennas can be mounted for vertical, horizontal, and right-hand circular or left-hand circular polarizations.

As always I welcome antenna questions and column suggestions from readers. Send an e-mail to <wa5vjb@cq-vhf.com>, or <wa5vjb@amsat.org> will work. Also, for several dozen other antenna projects, visit <http://www.wa5vjb.com>, the Reference section.

73, Kent, WA5VJB