

A 2 Meter and 70 CM Portable Tape Measure Beam

Work the OSCAR ham satellites or go transmitter hunting with this inexpensive portable dual band handheld tape measure Yagi.

John Portune, W6NBC

Many hams have made 2 meter tape measure beams for transmitter hunting. In this article we'll take that design two steps farther. First, we'll reduce cost and then we'll add OSCAR satellite Mode J capacity. A bonus is that a double boom design lets you fold the antenna up conveniently for transport or storage.

Keeping the Cost Down

When I first saw a tape measure 2 meter beam for transmitter hunting, I said: "What a great idea." So I bought a kit with tape measure material, PVC pipe, PVC X fittings and stainless steel hose clamps. It worked very well. Later I thought: "This would make a great ham club project if I could just get the cost down." Lightning struck — there's an easy approach that doesn't use expensive stainless steel hose clamps or PVC X fittings.

Simply drill $\frac{7}{16}$ inch holes through a $\frac{1}{2}$ inch inside diameter PVC boom and push the tape measure elements through. (See Figure 1.) It works just as well and is much less expensive. The long elements do need a short length of $\frac{3}{8}$ inch wood or fiberglass dowel and a couple of tie wraps to stiffen them in the wind. The dowels push through the same holes. Now the most expensive parts of the beam is the RG-58 coax and the connector. Since then, local club members have made many 2 meter tape measure beams for transmitter hunting.

Working the OSCARs as Well

More recently I became interested in working Mode J OSCAR satellites — 2 meter FM phone toward the satellite, 70 cm FM phone from the satellite. What kind of antenna should I use? At a local club meeting I learned that there are several commercial handheld satellite beams on the market. The lecturer gave us a live demo of one during an actual satellite pass. But were there any good homebrew designs?

Then I remembered my handy little

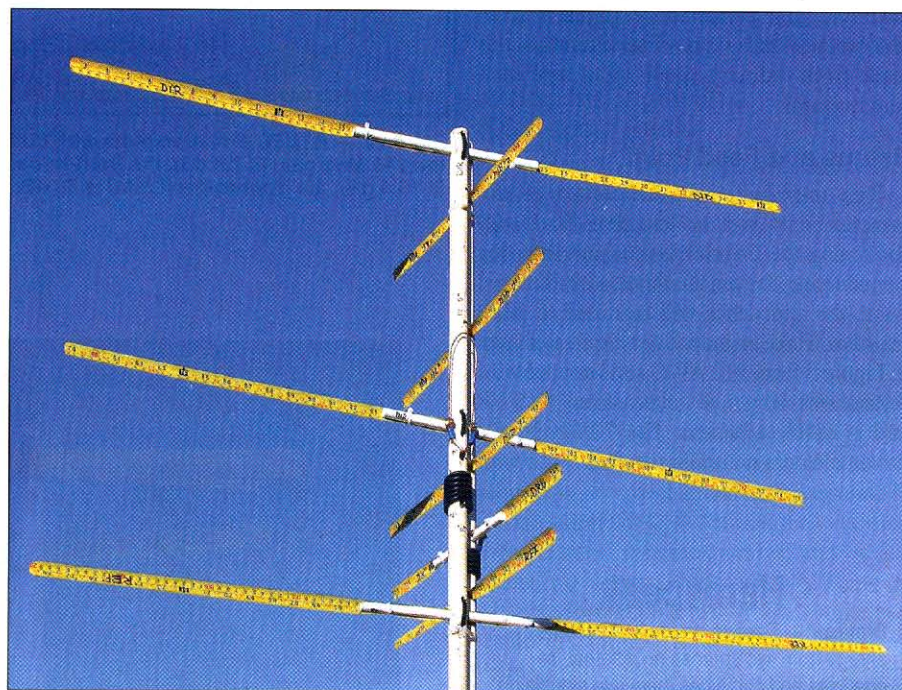


Figure 1 — Dual purpose, dual boom portable tape measure Yagi for 2 meters and 70 cm.

2 meter tape measure transmitter hunting beam. Why not just add a 70 cm beam to it? The one shown is the result. I did not make any changes to the existing three element 2 meter transmitter hunting beam. For though it is a little shorter than most commercial satellite beams, and is optimized more for front to back ratio, it works just fine for the "birds" and of course still for transmitter hunting. I did, however, optimize the new 70 cm beam for forward gain. Figure 2 shows *EZNEC* elevation plots for both, with the beams turned vertically.

As just a bit of simple theory, the 70 cm beam needs to be rotated axially 90° from the 2 meter beam. This makes the two invisible to each other. I've seen designs in which they are in the same plane. I tried this and found it unsatisfactory. The reason, I believe, is that a 2 meter Yagi has a third harmonic resonance near 70 cm. The directivity of the 2 meter Yagi on UHF is poor. If you mount

the two beams in the same plane, the patterns clash. I modeled this with *EZNEC* and saw that it is a poor idea.¹

Folding for Storage

A particularly handy feature of this design is the dual boom. I had at first thought to just drill extra holes in the existing single boom for the 70 cm Yagi. In terms of performance, that would have been fine. But on the 2 meter only version I had been folding the element ends back under tie wraps for transport or storage (see Figure 3). Had I added a 90° fixed position UHF beam, the whole structure would have become cumbersome. Two rotatable booms is a better approach. By holding the booms together with two tie wraps one can easily rotate the beams into

¹Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at www.eznec.com.

the same plane for storage or transport. Most of the figures in the article show them in that mode. The folded-up dual-band beam is now no bigger than before.

Compatible Element Spacing

One of the slightly tricky parts was to design a 70 cm beam with elements that fit well between the existing elements of the 2 meter beam. Fortunately, the spacing of Yagi elements isn't critical. Experience has shown me that one can select almost any spacing, within limits, and by simply then adjusting element length, you get pretty much the same performance. Figure 4 gives placements and sizes. The elements are made from ordinary small-width tape measure material.

Baluns and Feed Point

The impedance at the center of the 2 meter beam will be less than 50 Ω . By shortening the driven element and inserting an inductive hairpin in shunt with the feed point, the impedance will be raised to 50 Ω resistive. Make an inductive hairpin as shown in Figure 5 from #12 AWG solid copper wire, 8½ inches in length. It yields reasonable SWR and is easily adjusted. The 70 cm Yagi's driven element naturally matches 50 Ω with-

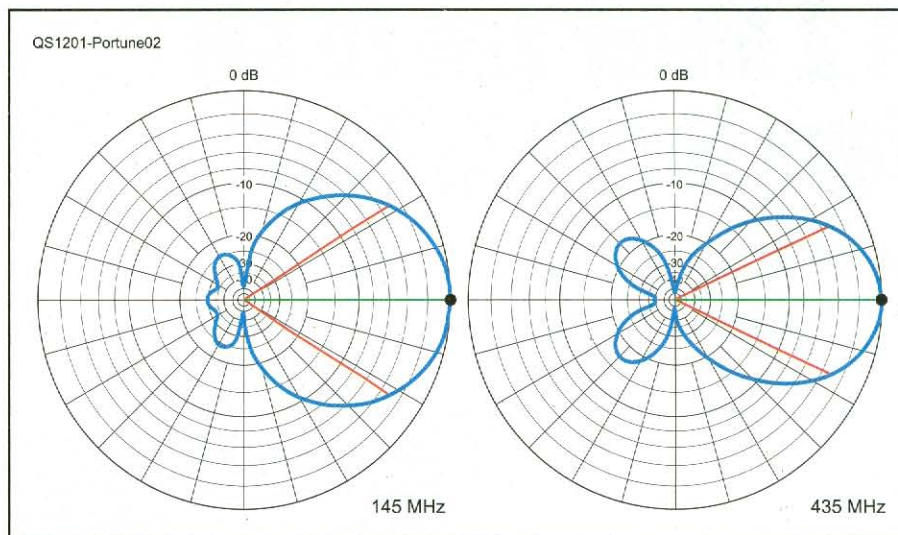


Figure 2 — EZNEC elevation plots with both Yagis vertically polarized. As shown, the 145 MHz gain is 7.5 dBi, the front-to-back ratio is 29 dB. For 435 MHz, the gain is 10.4 dBi, the front-to-back ratio is 38 dB.

Hamspeak

Diplexer — Passive device that accepts energy from two sources on different frequencies and combines them into signals on a single port. Alternately, it can accept signals on two frequencies combined into a single stream and separate them into signals on two ports based on their frequency.

EZNEC — Antenna modeling software that provides a user friendly interface to the powerful *Numerical Electromagnetic Code* (NEC) calculating engine. Several versions of EZNEC antenna modeling software are available from developer Roy Lewallen, W7EL, at www.eznec.com.

OSCAR — Orbiting Satellite Carrying Amateur Radio. Name given to a set of Amateur Radio satellites. The number following the name indicates the deployment sequence.

OSCAR Mode J — Amateur satellite mode referring to a single channel FM repeating satellite that has a 2 meter uplink and a 70 cm downlink.

Yagi — Multielement directive antenna array in which one or more elements are driven by connection to a transmission line and the others are parasitically coupled. Yagis are generally characterized by high gain for their size accompanied by narrow operating frequency range.

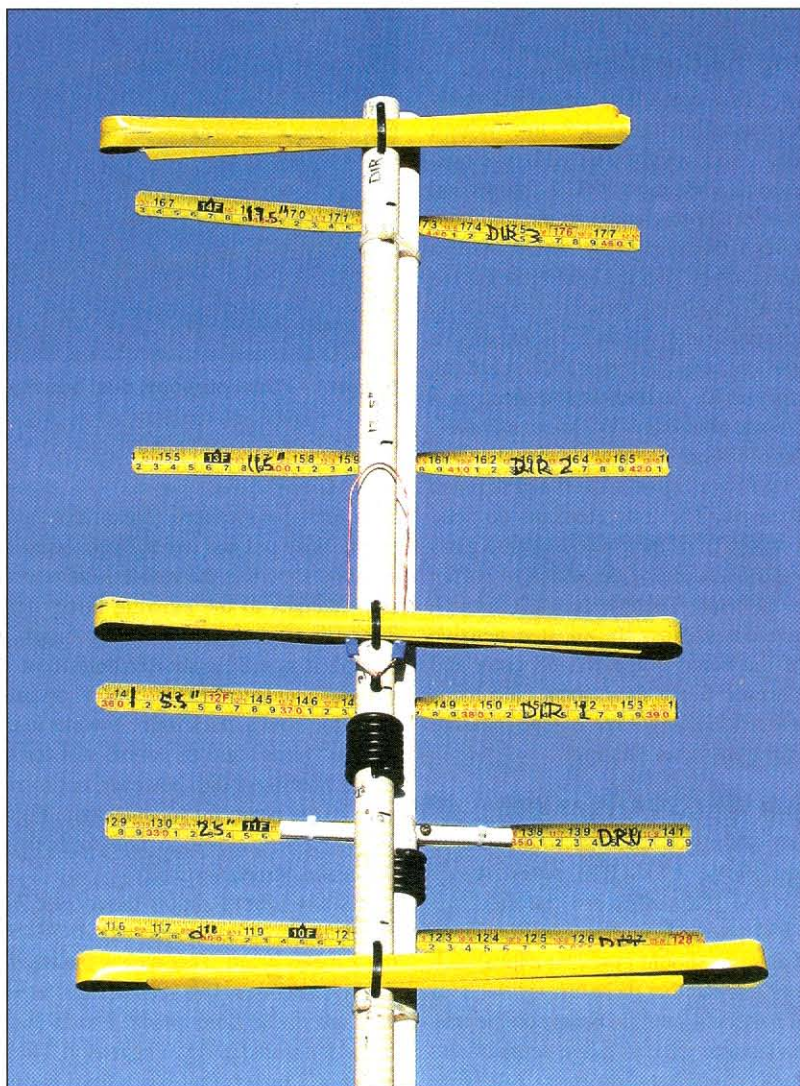


Figure 3 — Booms rotated 90° and 2 meter elements folded back. Note tie wraps to hold ends.

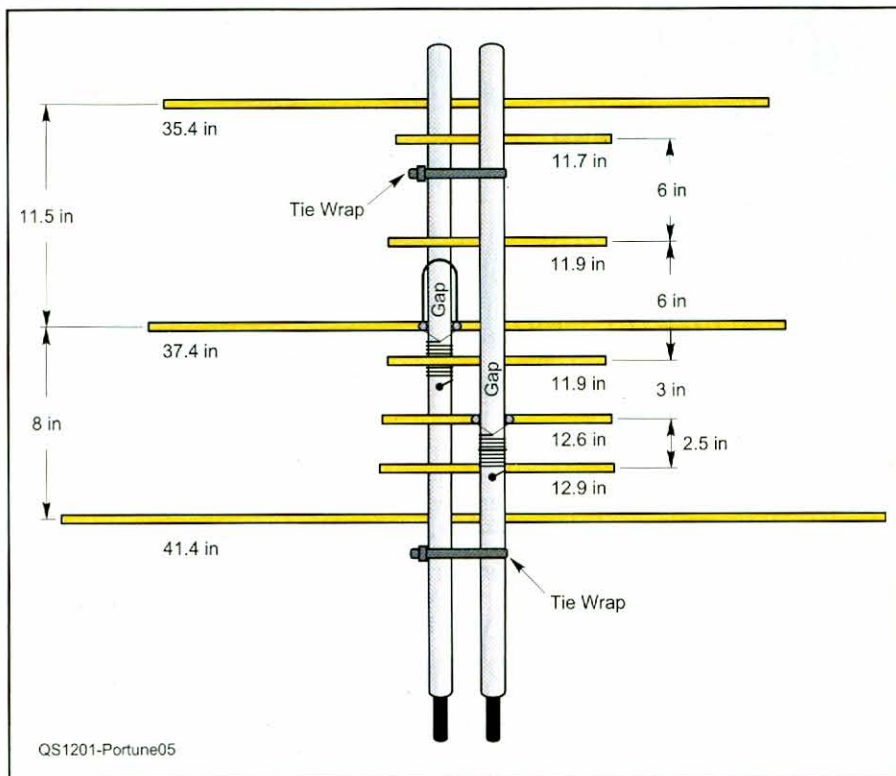


Figure 4 — Dimensions with booms rotated. Note the boom rotation tie wraps.

out any added tuning elements.

As with most coax fed antennas, baluns on both beams is highly recommended. Shown are choke baluns made by wrapping the RG-58 feed coax around the boom several times. Secure the ends through holes in the boom. For 2 meters, six turns is adequate; for 70 cm, use four turns. Run the coax down the inside of the boom and out the end. Use two 6-32 screws and four nuts to connect to each driven element. Leave a 1/4 inch gap in the middle. Scrape the paint off the tape measure material and tin the area with solder to provide a good connection. Separate out a short length of the coax's inner and outer conductors and crimp on ring terminals.

Using the Yagi with a Dual-band Radio

I normally make my OSCAR contacts using two separate handheld transceivers, one for each band. You may, of course, use a dual band handheld, but in that case you will need a diplexer to connect the two antenna feed lines to the radio's antenna port. There are also several satisfactory homebrew diplexer designs on the Internet.

I claim no special magic for this antenna design. The Yagis are classical designs and the tape measure method well known. The charm is the mechanical arrangement. By eliminating PVC X fittings and stainless hose clamps, it is inexpensive, and by also using two booms it folds up neatly. I now can seamlessly combine two of my favorite ham radio disciplines, transmitter hunting and ham satellites in one handy portable antenna.

Photos by the author.

ARRL Member John Portune, W6NBC, received a BSc in physics from Oregon State University in 1960, his FCC Commercial General Radiotelephone license in 1961 and his Advanced class amateur license in 1965. He spent five years in England as G5AJH and upgraded to Amateur Extra class in 1985. John retired, first as a broadcast television engineer and technical instructor at KNBC in Burbank and then from Sony Electronics in San Jose, California.

John is active on many bands and modes, predominantly from his HF equipped RV mobile station. He has written various articles in ham radio and popular electronics magazines and remains active as a VE team leader, ham license teacher and website designer. You can reach John at 1095 W McCoy Ln #99, Santa Maria, CA 93455, or at jportune@aol.com or via his website at w6nbc.com.

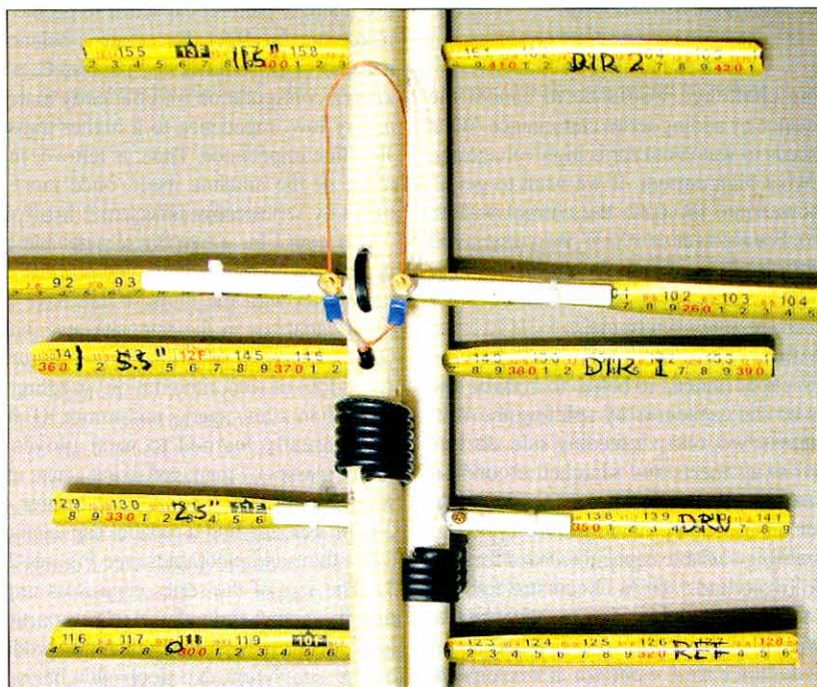


Figure 5 — Feed-point detail showing choke baluns, element stiffeners and hairpin match on the 2 meter beam. The booms have been rotated into storage mode.

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