A 2-Meter Yagi Antenna That Definitely 'Measures' Up

AD6AE

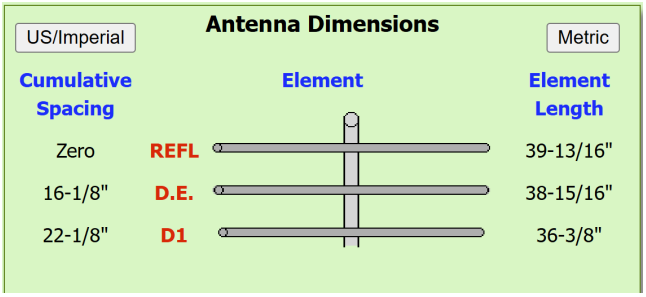
146.5 MHz Tape Measure Yagi – 3 Element

A compact, lightweight, portable Yagi antenna with folding elements and a 2-piece boom

Adapted from: Tape Measure Yagi – KC3SMW et.al.

Yagi Antenna Designer: VHF/UHF Yagi Antenna Quick Designer - K7MEM and DL6WU Yagi-Uda antenna online calculator - 3G-aerial

https://www.youtube.com/watch?v=ktoiyKoo36A&t=991s



Everyone seems to have their own measurements but none show any measurements

Materials List: 1/2-inch Sch. 40 PVC

- 10' beam & element support arms
- 3 - 'Crosses' for R, D.E., & Mast Mount
- 1 'Tee' for D1
- 10 (#4 x 3/8") sheet metal screws
- Solder and paste flux
- 1 (10' x 1") tape measure ≈7' required
- 1 (7") piece #12 solid wire for hairpin (beta) match
- 2 (#31 mix) clip-on ferrite choke beads, (sized to fit over coax or to loop coax thru
- Adapter or RG-xxx pigtail with connector
- Velcro tape to secure folded elements

Construction Note: If when removing the reflector boom piece fits too tight to twist, sand the circumference until the fit is 'comfortably snug' and can be disassembled by hand twisting.

Assembly: Study Photos First

1. Cut the boom pieces for center-to-center element spacings in the diagram. To allow for length added by connectors, measure the **outside diameter** across the connector opening (for ½" PVC it's ≈1-1/16"). Subtract that length from the boom piece by that amount. When fully seated, it should be the correct length for the center-to-center element distance (EX: R to DE is shown as 16-1/8." So, 16-1/8 – 1-1/16 = 15-1/16"). Cut pieces as exact as possible.
2. Trim corners of element tips at a 45° angle and sand to remove sharp edges. (see photo)
3. Centerpunch then drill a 7/64" dia. hole in the center of the Reflector and Director.
4. Assemble beam, fully seating connectors and rechecking distances; they will fit very tight. If wanting to separate the boom from the driven element, see construction note above. No glue is required.
5. For R&D1, centerpunch and drill a 5/64" pilot hole in the exact center on one side of their connectors (the point where the 'vee' is formed by the mold lines); fasten center of elements; center punch and drill a 7/64" hole in R&D1, roughly 1-inch in from ends of element supports; attach with #4 screws. (photos)

Driven Element: (See photos for clarity)

1. Cut the D.E. in half, trim ends at a 45° angle and sand. **For each half:** Clamp to a board and sand to remove 3/4" of paint from one end on the **convex** side; clean, apply soldering paste and tin well.
2. Center punch then drill a 7/64" dia. hole located 3/4" in from the tinned ends. (see photo)
3. Using the holes as a marking guide, center the 45° cuts into the vee lines of the 4-way cross; leaving a 1-inch gap between the two halves; mark then drill a 5/64-inch pilot hole in the 'cross' connector arms for attaching each half of the driven element (see hairpin photo).
4. Strip 3/4"- 1" of insulation off each end of a 7-inch long piece of #12" solid wire; tin ends.
5. Form hairpin into a "U" shape; adjust bend so leads are about 1" apart; ends even.
6. To avoid melting the PVC when soldering, slip a piece of cardstock under the tinned ends; lightly snug the screws; to keep elements halves aligned, temporarily tape them at the ends of support arms.
7. Prepare coax with a connector on one end. If not using an adapter or other connector, bare and tin pigtails; thread on 4 ferrite bead CM suppression chokes.
8. Solder each coax lead beside the hairpin ends. Measure SWR at center, high and low ends of the 2-meter band. Adjust hairpin length if necessary. **See Test and "Fine Tuning" procedure below.**
9. When tuning is completed and readings are satisfactory, remove card stock and tape; tighten D.E. screws; center punch then drill a 7/64" hole in DE element's ends; fasten to support arms. (see photo)

Adjusting SWR

Place antenna about 6-feet high – pointing straight up; take readings at 144, 146, & 148 MHz.

Match by adjusting length of hairpin for lowest VSWR at 146.5MHz; If 1.2 or less, let alone. Check edges.

6-1/2 inches of wire (after trimming) added sufficient inductance for a satisfactory SWR (see specs).

Tuning Tip: If VSWR is too high at 148MHz, make hairpin a little longer; if it's too high at 144MHz, make it a little shorter. Recheck SWR at center, lower and upper frequencies. Shoot for 1.2 at center and <2 at edges.

Adjust hairpin shape carefully. *This doesn't make much difference and should be done as a last resort*. The wire is very stiff; take care not to break the solder joints or bend the ends of the DE when changing shape.

Yagi Design Calculator: This calculator is for both round or rectangular elements; metallic, non-metallic or insulated from booms: DL6WU Yagi-Uda antenna online calculator - 3G-aerial. His design claims improved detuning immunity caused by construction variances and environmental factors.

This novel design is not new and uses unplated, spring-steel, ribbon elements making design calculations one of suggestion than of fact. Unplated steel is a very poor choice for RF applications but *appears* to work; range tests have not been performed. DL6WU's Calculator has no provision for calculating rectangular elements having a high width-to-thickness ratio like a tape measure ribbon (23.0mm/0.17mm) or having an irregular shape.

As shown in the videos, when adding a reflector and/or director(s), the mutual coupling between the driven and parasitic elements increases; with more current coupled into the parasitics and, like resistors in parallel, the feedpoint resistance drops which raises the SWR. SWR is less about resonance and more of matching the input impedance of the antenna to that of the line.

Trimming the driven element has little to no effect on SWR as is explained in the first video below; this was verified and the D.E. had to ultimately be replaced. If you use this antenna for transmitting, install a

common mode choke at the feedpoint (explained in the second video). All in all, this is a fun build and study.
https://www.youtube.com/watch?v=2DcvmGPLdT0, https://www.youtube.com/watch?v=J8S3iZ9-848.

SPECS

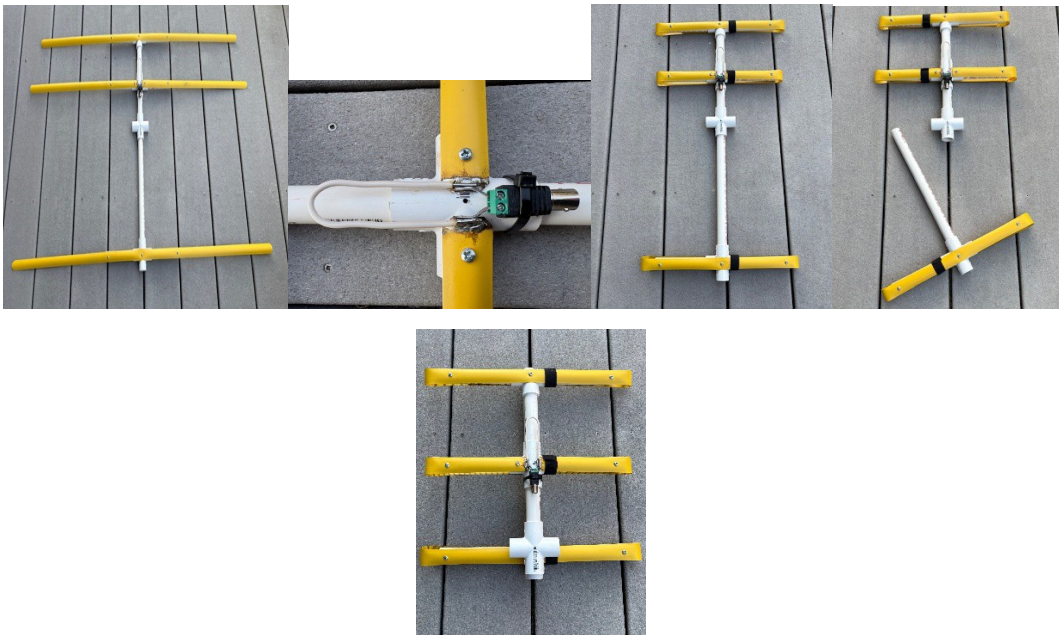
SWR: 144MHz: 2.34 / 146.5MHz: 1.22 / 148MHz: 2.25

Estimated Gain: 4.8dB
Typical Beamwidth: 55°
Estimated F/B Ratio: 15 dB

Weight: 1 lb.3 ozs (548g)
Length: 25-1/2" (64.8 cm)
Width: 39-3/16" (97.5 cm)

PHOTOS

Antenna elements fold and boom breaks down into a 14x14-inch package.

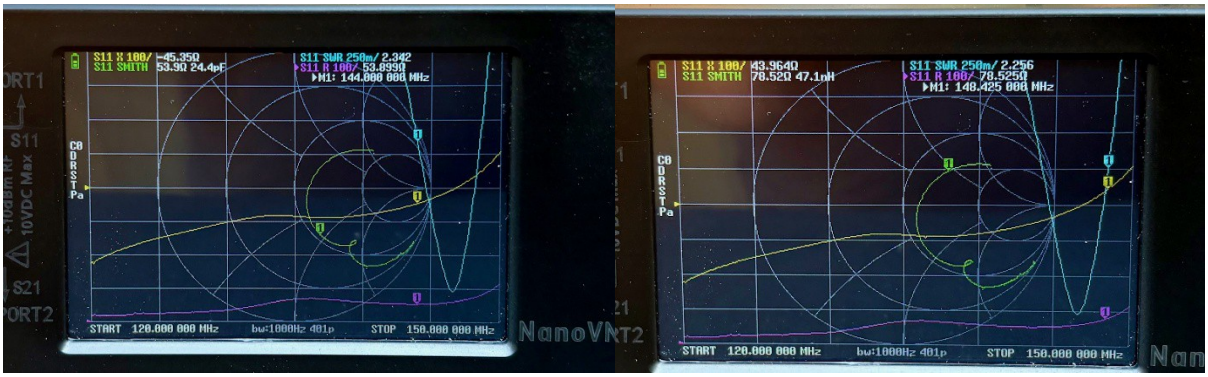


Mast Mount & Handheld Options **Hairpin Match** **Elements Folded** **Broken Down** **Nested Velcro strips were later attached using screws and washers.**

TRACE LEGEND. Yellow: Reactance (X) **Green:** Smith Chart **Magenta:** Resistance (R) **Blue:** VSWR

Test Setup ᵂ/CM Chokes using **146.5MHz – SWR 1.22 (Blue)**

a calibrated 5’ piece of RG-316



144MHz - SWR: 2.34 (Blue) **148.4MHz - SWR: 2.25 (Blue)**