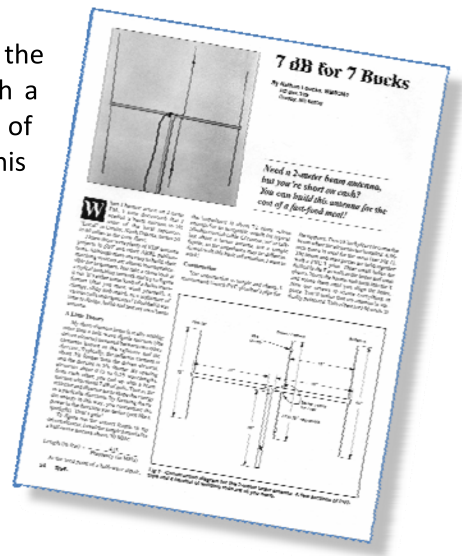
"FOX-HUNT" ANTENNA PROJECT SPRING 2010

GOALS	REQUIREMENTS
• Build a directional antenna for low cost from readily available materials	• Small physical size, light weight for handheld use
• Build an antenna that can be used portable or fixed	• Provide gain to detect weak signals
• Utilize the DARC Test Equipment for training and education	• High directivity to pinpoint the fox
• Gain practical experience in a Fox Hunt	• Simple design
• Have Fun!!	• Easily configured and tuned

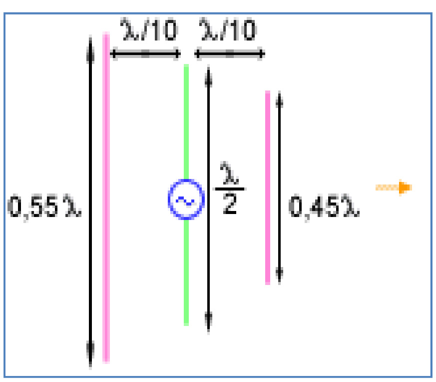
This project started as a collaboration effort to develop a training program for the DARC test equipment bank and the educational committee to come up with a spring project. As a result, we have created a "Fox Hunt" that will consist of building an antenna; testing and tuning the antenna; and employing it in the field. This document is the building instructions for the project.


7 dB for 7 Bucks

Need a 2-meter beam antenna, but you're short on cash? You can build this antenna for the cost of a fast-food meal!

The Yagi for our project is from a design published in QST, April 1993 by Nathan Loucks, WBØCMT. His design has been very slightly modified mechanically. The original article may be found on the ARRL archives at:
http://www.arrl.org/tis/info/pdf/9304054.pdf

The Yagi Antenna



Yagi Antenna Design
Text and graphic from Wikipedia.

A Yagi-Uda Antenna, named after its inventors, is commonly known simply as a Yagi antenna or Yagi, is a directional antenna system consisting of an array of a dipole and additional closely coupled parasitic elements (usually a reflector and one or more directors). The dipole in the array is driven, and another element, typically 5% longer, effectively operates as a reflector. Other parasitic elements shorter than the dipole may be added in front of the dipole and are referred to as directors. This arrangement gives the antenna increased directionality compared to a single dipole. Directional antennas, such as the Yagi-Uda, are also commonly referred to as beam antennas or high-gain antennas (particularly for transmitting). Many common television antennas are Yagi antennas.

Plans & Theory

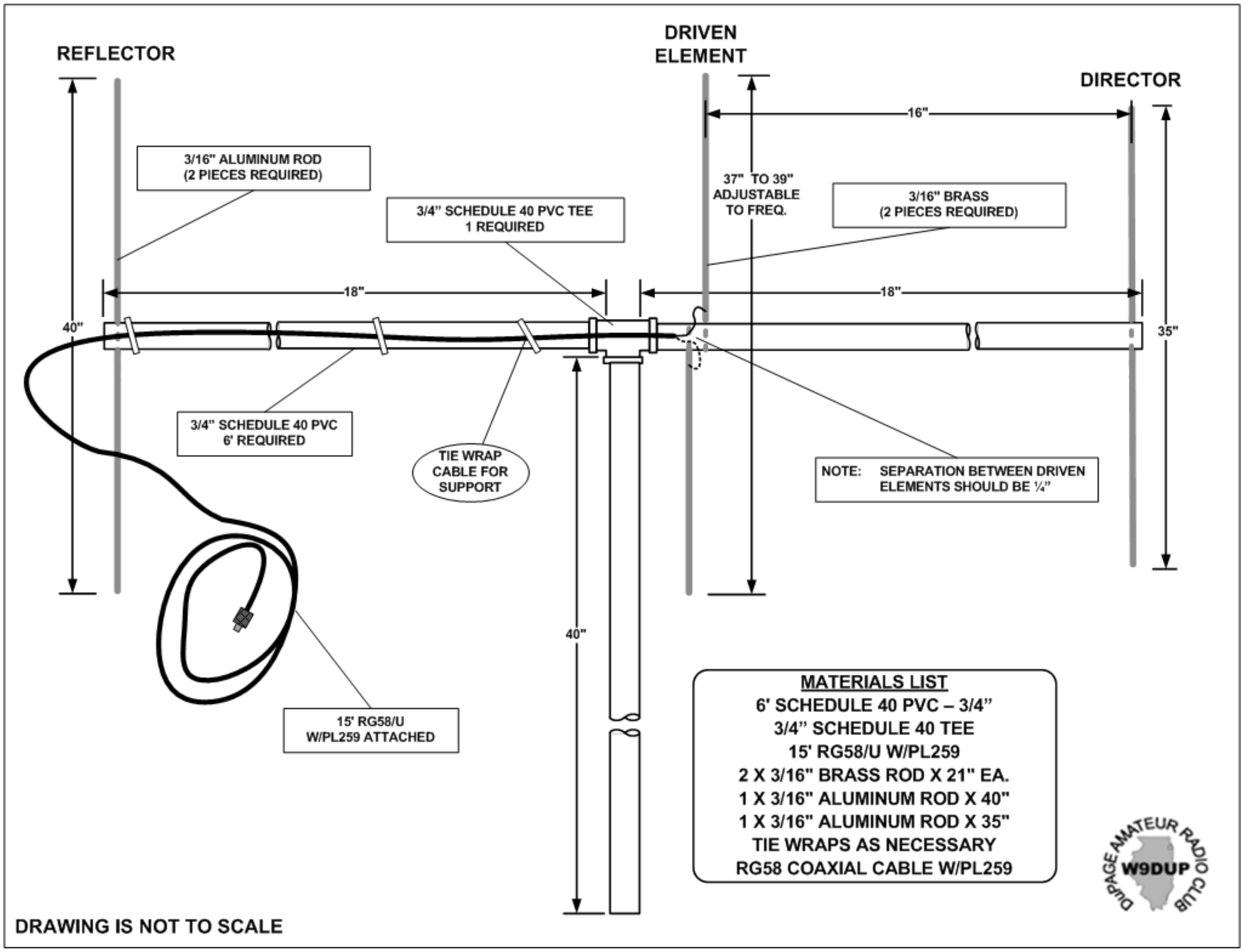


Figure 1 - ANTENNA CONFIGURATION

The project is provided in a kit, supplied with pre-cut, drilled and glued PVC. A coaxial cable with PL259 plug is included in the kit preassembled with the DRIVEN ELEMENTS. All components will be supplied in the kit bag.

The DIRECTOR, REFLECTOR and DRIVEN ELEMENTS will act together to shape the signal for both transmit and receive and are spaced approximately 0.15λ to 0.25λ apart, which should provide a theoretical 7dB of gain. The DIRECTOR and REFLECTOR act together to give a shape to the signal and focus the energy in a particular direction.

Construction

The construction steps are as follows:

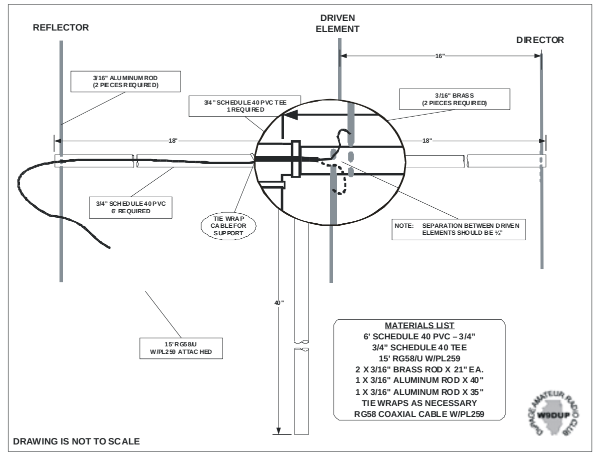


Figure 2 – COAXIAL CABLE CONNECTION DETAIL

1. Orient the PVC pipe with the 3 hole section towards the right side of your work surface.
2. The BRASS rods will be preassembled with the coaxial cable and connector. Use caution so as to not break the connection.
3. Insert the BRASS rod with the braided cable section into the center section, lower hole, by the TEE, making sure it goes through both sides. Leave ¼" to ½" of the end exposed. Use caution so as not to bend the elements.
4. Insert the other BRASS rod into the 2nd set of center holes as above. DO NOT GLUE THE DRIVEN ELEMENTS.
5. Insert the 35" DIRECTOR element into the right end of the PVC pipe - the end closest to the DRIVEN ELEMENT. Center the DIRECTOR in the PVC; the hole may be a snug fit. Use the SUPER GLUE to secure the element to the PVC. Use caution as the glue is permanent and will bond very quickly.
6. Insert the 40" REFLECTOR element into the left end of the PVC pipe - the end farthest from the DRIVEN ELEMENT. Glue the REFELCTOR as above.
7. The coaxial cable will be preconfigured with a PL259 connector and preassembled to the ends for the DRIVEN ELEMENTS. The coaxial cable will be connected above and below the PVC pipe as detailed above in Figure 2.
8. Tie wrap the cable to the boom section to act as a strain relief. Keep a little cable slack to allow for tuning the DRIVEN ELEMENTS.
9. An adaptor (not included) may be required for your particular radio to connect to the provided PL259.

In practical design of a YAGI antenna, the REFLECTOR is about 5% longer than the DRIVEN ELEMENT while the DIRECTOR will be approximately 5% shorter. The DRIVEN ELEMENT length is calculated as:

$$LENGTH(feet) = \frac{475}{FREQUENCY(MHz)} \qquad 3.25FT = \frac{475}{146.0MHz}$$

Testing & Tuning

Your new antenna is now built and ready for testing and tuning. This can be accomplished using two different pieces of test equipment:

MFJ -259B
Antenna Analyzer

BIRD WATTMETER
w/Element & Jumper

The BIRD WATTMETER will require your transmitter with appropriate cable adaptor to perform FORWARD and REFLECTED power measurements. The MFJ will only require your new antenna to be connected to the analyzer.

Bird Wattmeter

To use the BIRD WATTMETER you will need a jumper cable from your radio to the meter, the correct 2m SLUG, and your newly built antenna. The SLUGS are available in many frequency ranges and power levels. If using a portable radio, select the low power, standard wattmeter slug. This component will typically measure from 100MHz to 250MHz at a power level of up to 10 Watts.

The Bird 43 uses plug-in elements to make measurements. The element's frequency range and maximum power are listed on its label. The arrow on the element indicates directional sensitivity; i.e., the direction of power flow that the meter will read. Rotate the element to select forward or reverse power measurement.

1. Insert the appropriate element in the line section socket.
2. Turn the element so that the arrow points towards the load to measure forward power and towards the source for reflected power.
3. Turn on the RF source.
4. Read the power using the scale whose full-scale marking matches the element's maximum power.

MFJ-259B Analyzer

After turning on the **"POWER"** switch, or after applying external power with the **"POWER"** switch on, a sequence of messages appears on the display. If the "**MODE**" button is momentarily pressed during normal main mode operation, the MFJ-259B changes display modes. When the mode first switches, the measurement mode comes up on the screen for a few seconds.

CAUTION: DO NOT CONNECT ANALYZER DIRECTLY TO TRANSMITTER – PERMANENT DAMAGE WILL RESULT!

To tune a simple antenna for low SWR & Resonance:

1. Select any mode that indicates SWR.
2. Connect the antenna feedline to the MFJ-259B.
3. Adjust the MFJ-259B frequency to the desired frequency.
4. Read SWR, and adjust the MFJ-259B frequency until the lowest SWR is found.
5. Divide the measured frequency by the desired frequency.
6. Multiply the present DRIVEN ELEMENT length by the result of step 5. This will be close to the antenna length actually needed.

Note: This method of tuning will only work on full size vertical or dipole antennas that do not employ loading coils, traps, stubs, resistors, capacitors or capacitance hats. These antennas should be tuned according to the manufacturer's instructions while tested with the MFJ-259B, until the desired SWR is obtained.