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An Updated 2 Meter Log Periodic Dipole Array

A classic antenna design from The ARRL Antenna Book *is updated to use easily available materials and to facilitate construction.*

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It all started when I got my ICOM IC-706 Mark II HF and VHF transceiver. Previously for me, 2 meters was a band for short distance FM communications using simplex channels or repeaters. After I got the '706 I found out that there was also such a thing as 2 meter SSB. The Rocky Mountain VHF+ group hosts a 2 meter SSB net covering all of Colorado, as well as some of the adjacent states, using simplex without repeaters.[1] I had only an indoor vertical J-pole antenna and had problems hearing some of the very distant stations.

The net control operator suggested that I try a horizontal beam antenna such as a Yagi, but the log periodic dipole array described in recent editions of *The ARRL Antenna Book* looked like it would be easier to construct.[2] The main disadvantage of the log periodic antenna is that, for a given size (see Figure 1), it has less gain than a Yagi, since not all elements are active at any given frequency. Its main advantage is a wide bandwidth. I also liked the construction, because it permitted easy disassembly and assembly in less than 5 minutes. I did, however, run into some problems trying to collect the required materials. I decided to simplify the construction using easily available components.

Materials

The 1/16 inch thick right angle ½ × ½ inch aluminum stock is available in the usual home supply stores. Spacer material is available on the Internet, but it involves cutting and I did not feel too comfortable with fastening by short 6-32 screws. A neater solution for me was to use locally available ¼ inch nylon screws, nuts and spacers, as shown in Figure 2.

The next problem was obtaining the rods. I could not find anything locally. I found **OnlineMetals.com** while searching the Internet. Their selections and service were exceptional. It was very easy to choose the required materials. I selected rods with an outside diameter (OD) of 0.25 and an inside diameter (ID) of 0.134 inches. This can be tapped with an 8 × 32 if drilled out to 0.136 inch with a #29 drill bit. Just make sure that the material is at least 6061 T6. Grades 2024 or 7075 would be even better, but I could not find any tubing in that material in the 0.25 inch OD size. I used fairly long 8-32 mounting screws since I do not trust short tapped holes in aluminum and wanted maximum amount of thread engagement. The screws, split washers and nuts are stainless steel to eliminate dissimilar metal and rust problems (see Figure 2). The above

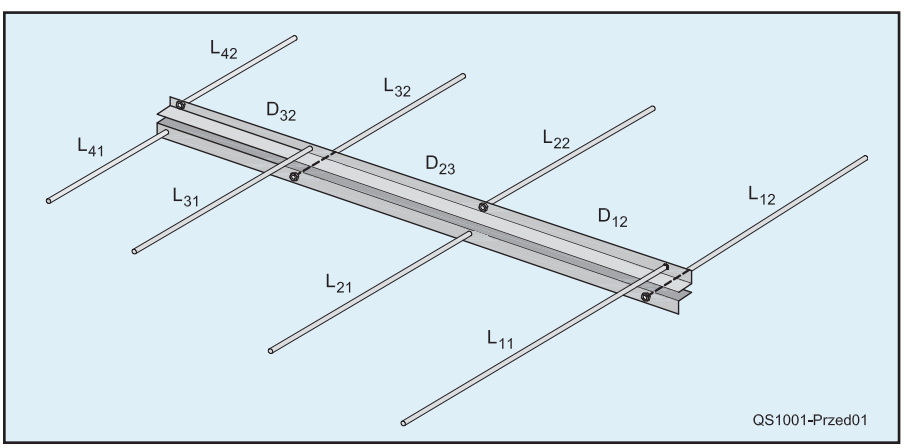

Figure 1 — Layout of the antenna as seen from the top. Alternate elements are attached to parallel sub booms that are insulated from each other. Designations refer to those shown in Table 1.

Table 1
Element Dimensions (see Figure 1)

	Element Spacing (Inches)	
D_{12}	1 to 2	4 3/8
D_{23}	2 to 3	4 1/32
D_{34}	3 to 4	3 11/16
	Element Lengths (Inches)	
	As Shown	*Reversed*
L_{11}, L_{12}	20 7/32	20 11/16
L_{21}, L_{22}	19 1/32	18 9/16
L_{31}, L_{32}	17 1/32	17 17/32
L_{41}, L_{42}	16 1/8	15 11/16

L_{11}, L_{12}, L_{31} and L_{32} are mounted on the outside of the rails as shown in Figure 2.

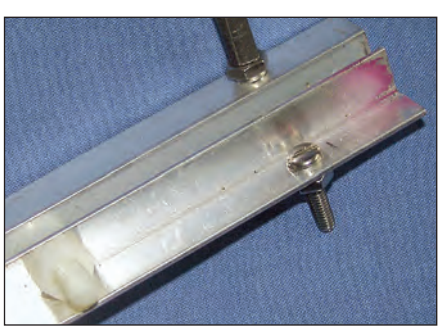

Figure 2 — Close-up of sub boom insulators and element attachment. The machine screw is ready for the element on the opposite boom.

[1]Notes appear on page 45.

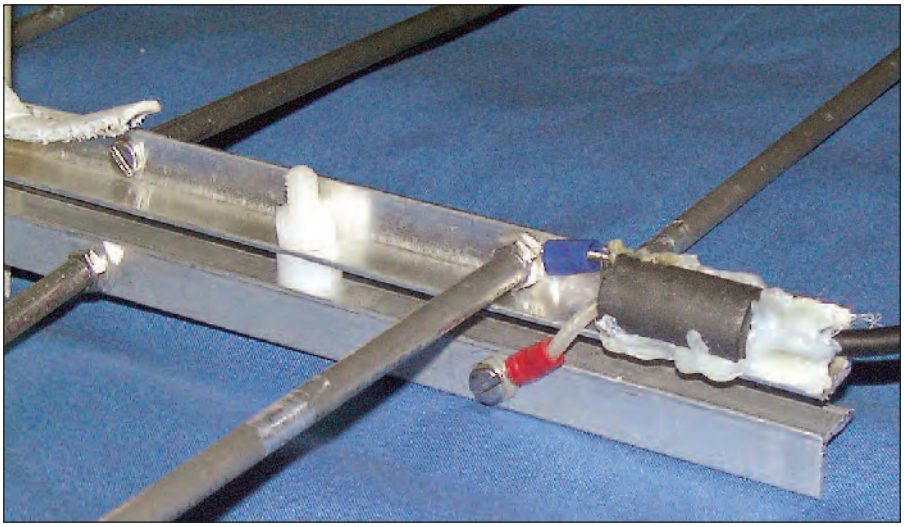

Figure 3 — Assembled antenna showing ferrite bead balun and coaxial cable attachment.

Figure 4 — Detail of PVC mast to boom attachment.

Table 2
Antenna Impedance Measurements

Frequency (MHz)	*SWR*	*R (Ω)*	*X (Ω)*
140.0	3.1	16	–3
141.0	2.5	20	–1
142.0	1.7	29	4
143.0	1.7	30	9
144.0	1.3	41	10
145.0	1.1	47	4
146.0	1.4	41	–14
147.0	1.7	30	–13
148.0	1.9	25	–5
149.0	2.0	24	–1
150.0	2.0	28	12
151.0	1.9	36	22
152.0	1.8	56	30

Measured using MFJ-259 antenna analyzer with 68 inches of RG-58 cable.

covers the mechanical aspects of the antenna assembly.

Calculations

Before drilling holes and cutting the rods to size, the theoretical dimensions given in *The ARRL Antenna Book* were converted to inches. The rod dimensions were then adjusted to take into account the thicknesses of the nuts and washers as well as the spacing between the rods. These dimensions are given in Table 1.

Assembly

There are two possibilities for arranging the rods; both are shown in Table 1. While there is no easy way to achieve perfect symmetry, it is possible to have rod symmetry by mounting the two rails asymmetrically. This leaves room for additional possible experimentation.

The method of connecting the coax feed line to the antenna is shown in Figure 3. The long ferrite bead is attached to one of the mounting rails with hot-glue, but other fastening arrangements such as a hose clamp, can be used. The connection to the antenna is made using crimp on spade lugs (available in hardware and car parts stores) secured under the rod screws, as shown in Figure 3. To make the antenna more useful, a male (or female) BNC connector is used.

All components used in the antenna are easily available and the assembly does not involve special equipment or difficult techniques. The tapping of the rods is probably the most time consuming and difficult part. A sharp tap is needed and it should be used in small steps clearing the aluminum shavings frequently.

Mounting

There are several possible ways of mounting the antenna. A simple solution is shown in Figure 4: a ¾ inch ID white PVC pipe is slotted. The slots are about ½ inch wide and 2 inches long. The cut pieces can be easily bent with pliers. The antenna will slide in easily and can be held fast with a screw and a wing nut, as shown in Figure 4. The screw can be either a #8 or #10, about 1¼ inches long. Once the wing nut is tightened, the beam is quite rigidly mounted. A 1 inch mounting pole can also be used if a longer mounting screw is provided. The entire assembly can be easily broken down and reassembled without any tools.

Performance

After assembly, I checked SWR over the 144 to 148 MHz range. The results, as measured using an MFJ-259B antenna analyzer, are shown in Table 2.

I do not have an antenna range and could not get any quantitative numbers for gain or directivity. I did compare it to a vertical ¼ wave antenna and found that the signal improved from S7 to S9. The pattern was quite broad, in a cardioid shape, but the rear null was very deep. The signal off the back dropped from S9 in front to less than S1.

The antenna continues to operate well at frequencies above the band edge, making it suitable for use with a scanner covering public service, marine and weather frequencies. The dimensions of the cuts remain the same.

Notes

[1]The Rocky Mountain VHF+ Group is dedicated to promoting weak signal VHF, UHF and microwave activities for both novices and veterans alike. Find out more at **www.rmvhf.org**.

[2]R. D. Straw, Editor, *The ARRL Antenna Book,* 21st Edition, pp 10-22 to 10-24. Available from your ARRL dealer or the ARRL Bookstore, ARRL order no. 9876. Telephone 860-594-0355, or toll-free in the US 888-277-5289; **www.arrl.org/shop**; **pubsales@arrl.org**.

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