high-gain log-periodic antenna for 10, 15 and 20

This 17-element log-periodic antenna provides approximately 13-dB gain over three amateur bands

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In a previous article I described two fixed, doublet-type log-periodic antennas which cover the entire frequency range from 14 to 30 MHz.[1] Although both of these antennas have 12 elements, one, 70-feet long, provides approximately 10-dB gain. The other, 40-feet long, gives approximately 8-dB forward gain.

Since writing that article I have built eight more log-periodic antennas for various frequency ranges, including several for 40 meters.[2] One of these log periodics which is especially interesting uses 17 elements to provide 12- to 13-dB forward gain on the amateur 20-, 15- and 10-meter bands. This antenna is of interest to amateurs who want a single fixed wire beam aimed in one particular direction and it will be described here.

the antenna

The high-gain, three-band log periodic shown in **fig. 1** is 100-feet long and has an apex angle of 16 degrees ($\alpha = 8°$). The minimum space required for this antenna is approximately 125-feet long by 80-feet wide. Four masts or other supports are required. The antenna is suspended between the four masts with two nylon catenary side lines as shown in **fig. 2.**

Unlike the antenna described in reference 1, the center open-wire feedline carries some of the weight of the antenna. This eliminates two of the nylon support lines used in the earlier design.

I used number-15 aluminum wire for both the center feedline and for the 17 active elements. The use of aluminum wire minimizes overall weight of the large antenna. This wire is manufactured for use in electric fences and is available from Sears (catalog number 13K22065) at $8.70 for a quarter-mile roll. Approximately 570-feet of wire are used in this three-band log-periodic antenna.

Although this aluminum electric-fence wire is strong and inexpensive, be careful not to put any kinks in it when you are putting the antenna together — aluminum wire breaks easily after it has been once kinked. As with any aluminum wire, special precautions must be taken when making electrical joints and splices.

If you use sturdy steel masts or wooden poles for the four antenna supports, copper wire can be used for the antenna.

However, the weight of the antenna will be much greater. At my station I use 75-foot-high pine and cedar trees for supports, so antenna weight must be kept to an absolute minimum.

construction

As with my previous log periodics, the center insulators are made from ¼-inch thick lucite or plexiglass as shown in **fig. 3.** The center element ends are attached to the two outer holes; the center open-wire feedline passes through the other two.

The center insulators are secured to the open-wire feedline by serving several turns of number-18 tinned copper wire over the feeders on each side of the insulator as shown in **fig. 4.**

The photograph shows a mockup of the center feedline and element arrangement. (In this mockup the elements are much more closely spaced than in the actual antenna.) Ceramic egg insulators are required at the front (element 17) and rear (element 1) because the homemade insulators will not take the stress at these points.

Ceramic egg insulators can also be used for the end insulators for the front and rear elements, up to 250 watts. For higher power, 6- to 8-inch Isolantite antenna insulators are better. Monofilament fishing line, 40- to 50-pound test, is used as end insulators for the rest of the elements. I used 40-pound test monofilament from Sears (catalog number 6KV32232), priced at $1.88 for a 325-yard spool.

The center feedline to each of the elements must be transposed as shown in **fig. 1.** The photograph shows that the necessary crossover is located below the center insulator — this provides a rain drip and lowers the center of gravity of the antenna. Since this log periodic uses an odd number of elements, the front and rear element connections do not have to be transposed, and the center feedline can be connected directly to the ends of the front and rear elements. You can use a 4:1 balun and coaxial line or 300-ohm tv twinlead with this antenna, as described in the previous articles.

The photo also illustrates the aluminum-to-aluminum connections between

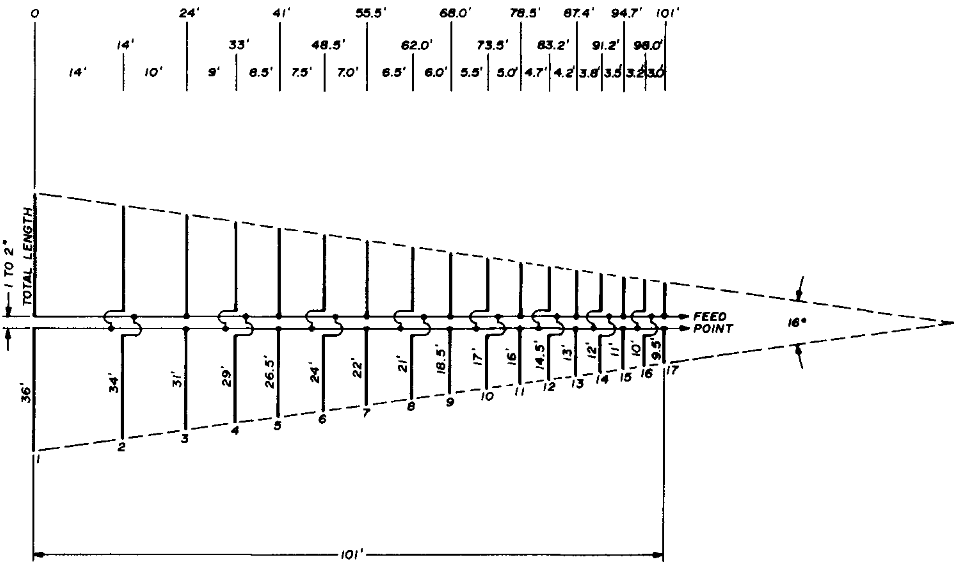


fig. 1. High-performance log-periodic antenna for 20, 15 and 10 meters uses 17 elements to provide approximately 13 dB gain. Installation requires four support masts and a space 125-feet long by 80-feet wide.

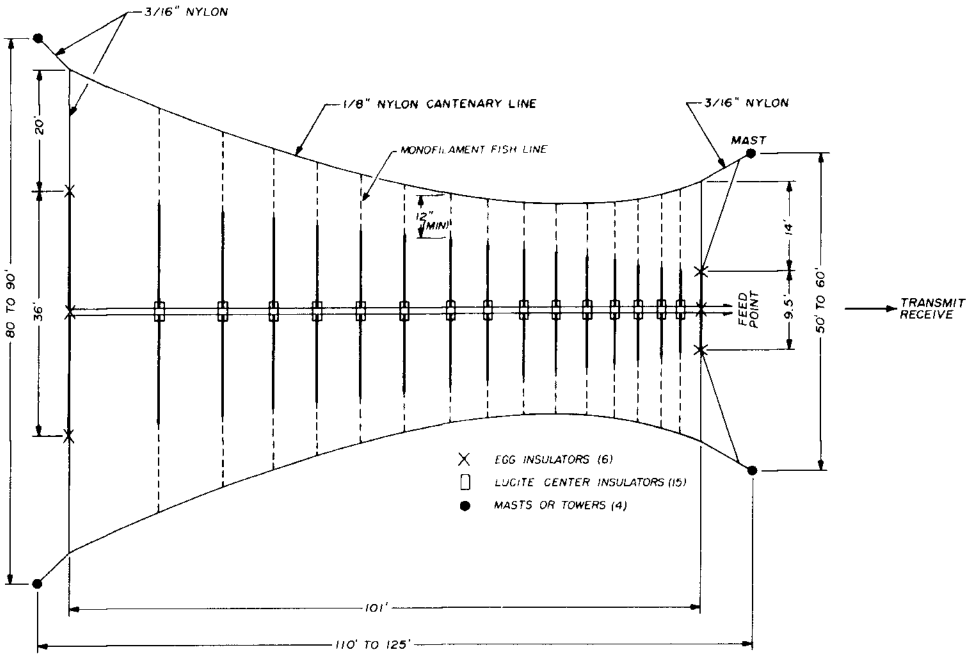


fig. 2. Installation of the 17-element log-periodic antenna. Masts should be a minimum of 40-feet high — 70 feet is better.

the elements and the center feedline. The center element ends are cut 10 to 12 inches longer than the specified element length. This extra length is then fed through the end hole of the center insulator and given three wraps over the element to secure it to the insulator. The remaining length is connected to the center feedline.

All aluminum-to-aluminum electrical connections use mechanical joints. When connecting the transmission line or balun to the antenna, use stainless steel or cadmium-plated hardware. By using large cadmium-plated shakeproof washers with internal teeth good contact can be made to the aluminum wire. I used this method with my first log periodic, and it has been in constant service since September, 1970, with no corrosion or electrolytic problem, to date.

If copper conductors must be used at the feedpoint, use large cadmium-plated terminals or solder lugs, bolting them to the aluminum wire with plated screws and nuts. This eliminates any direct aluminum-to-copper contact that could lead to problems with electrolysis.

performance

This is the highest gain log periodic I have built so far. It is beamed west and is installed about 60 feet above the ground. Stations in California often tell me I am the strongest W4 on the band. Considering that I'm using a barefoot transceiver, while most of the competition are running 1000 watts, it gives me satisfaction to know that by properly using a few hundred feet of wire, such gain is possible for less than $20.00.

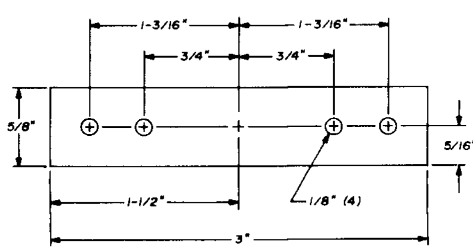
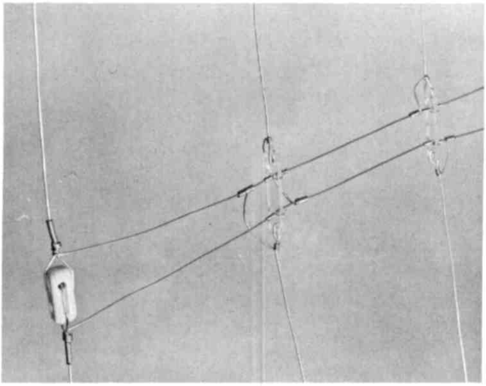


fig. 3. Center insulators for the log-periodic antenna. Material is ¼" lucite or plexiglass.



Mockup of center feedline showing installation of the center insulators and mechanical aluminum-to-aluminum connections.

I have not tried to make quantitative front-to-back or side attenuation tests, but from on-the-air tests signals from stations off the side of the antenna seem to be about 30-dB down. This is a great help here for attenuating the extremely strong signals that pour in from South and Central America.

I have not been able to obtain much data on the front-to-back ratio as there is not much to the east of here except the Atlantic Ocean. However, I was recently monitoring a VK1 in the evening by long path from the east. He was about S4 on my non-gain, non-directional antennas but was absolutely nil off the rear of the 17-element log periodic. I was also recently monitoring a CR6 in Angola — he was good S5 copy with my non-gain antenna, but was only S1 or less off the back of the log periodic. These simple observations seem to indicate that this log periodic has a better front-to-back ratio than the other log periodics I have built in the past.

When I designed this long log periodic I tried to improve the front-to-back ratio by increasing the spacing between elements 1 and 2 to 0.2-wavelength. This is 14 feet, as opposed to a spacing of 11 feet which would be normal. Normally the front-to-back ratio of a log periodic is 14 to 15 dB minimum. However, to date I have not been able to determine if the increased spacing between elements 1 and 2 was of any help. The rest of the element spacings are normal for a log periodic having this boom length and apex angle.

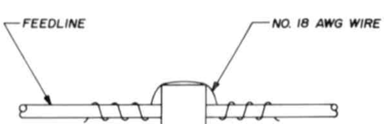


fig. 4. Lucite insulators are secured to the center feedline with a few twists of no. 18 wire.

summary

If you need a high-gain, fixed beam and have the available space, a long log periodic should be considered. Even a long log periodic of this type requires less acreage than a rhombic antenna designed for the same gain on 20 meters. Furthermore, unlike the rhombic, the gain of a log periodic does not fall off at the lower end of the frequency range. If anything, the log periodic seems to perform slightly better at its low frequency end.

table 1. Price list of materials for the 17-element log-periodic antenna.

600-feet	no. 15 aluminum electric-fence wire	$ 3.60
250-feet	1/8" nylon line	7.50
100-feet	3/16" nylon line	5.00
25 sq. in.	1/4" lucite for center insulators	1.00
6 each	ceramic egg insulators	.90
1 roll	40-pound monofilament fishing line	1.88
		$19.88

references

1. George Smith, W4AEO, "Three-Band Log Periodic for 20, 15 and 10," *ham radio,* September, 1972, page 28.
2. George Smith, W4AEO, "40-Meter Log Periodics," *ham radio,* May, 1973, page 16.

ham radio