# fixed log-periodic beam for 15 and 20 meters

A simple, low-cost wire beam that provides lots of gain per dollar

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**Since retiring** from business in 1970 I have been designing, building and testing fixed, high-frequency, log-periodic beam antennas. I had long wondered why amateurs had made so little use of these very excellent beams which are used extensively by commercial, military and government communicators.

To date, over fifteen log periodics have been erected and thoroughly tested here. Most of these have been horizontal doublet log periodics for the 20-, 15- and 10-meter bands, as shown in plan form in **fig. 1**. Some have been for 40, 20 and 15. Two vertical monopole log periodics (with ground plane) were tested on 40 and 80, giving 10-dB gain with the low angle of radiation best suited for DX.

Since most of these log periodics cover a 2:1 or one-octave bandwidth, e.g., 7-14 or 14-28 MHz, they are rather long for the average amateur antenna farm. Two of the log periodics tested here for 14-30 MHz were one with a 40-foot (12.2-meter) boom length, having 8-dB gain, and one with a 70-foot (21.35 meter boom, giving 10-dB gain as comparec with a doublet at the same height. My longest log periodic is 100-feet (30.5 meters) long, has 17 elements, and gives 12- to 13-dB gain. The swr for these antennas is relatively low over the 20-15- and 10-meter bands, generally no exceeding 2:1 with 1.1:1 to 1.4:1 typical

Since these log periodics are wire beams, they are quite inexpensive con sidering their gain. They are also quite easy to build. The material cost usually runs from $15 to $25 each, less feedline and masts or other supports.

As a result of on-the-air discussions while testing and comparing these anten nas, and from several previous articles or log periodics, I receive many requests for information on the smallest possible log periodic to cover at least 14 through 21.5 MHz. The inquirers generally want gain equal to or better than the average ham beam.

## two-band log periodic

A log periodic having 8-dB gain and meeting these requirements, erected in a space 40 by 40 feet (12.2 x 12.2 meters), will be described here. This antenna, which is beamed south, has been in use for three years. It gives excellent performance. Also included is a list of materials, approximate total price and brief assembly information.

**Fig. 2** shows the layout for this simple 7-element log periodic for 20 and 15 meters. Its bandwidth or frequency coverage is 14 to 21.5 MHz. Theoretically it provides 8-dB gain in the forward direction. However, when compared with a dipole at the same height, reports in the direction of its beam generally show a 10-dB increase over the doublet. When an

S-9 report is received while using the doublet, a "20 over 9" is often received after switching to the log periodic. An equivalent S-meter increase at this end usually confirms the reports received.

At any rate, the reports received during three years of use give this log periodic a conservative 10-dB gain in its forward direction. It is mounted approximately 40 feet (12.2 meters) above ground. The measured swr over the two bands is:

| | | | |
|---|---|---|---|
| 14.0 MHz | 1.1:1 | 21.0 MHz | 1.01:1 |
| 14.1 MHz | 1.1:1 | 21.1 MHz | 1.01:1 |
| 14.2 MHz | 1.02:1 | 21.2 MHz | 1.05:1 |
| 14.3 MHz | 1.02:1 | 21.3 MHz | 1.15:1 |
| 14.35 MHz | 1.01:1 | 21.4 MHz | 1.25:1 |
| | | 21.45 MHz | 1.3:1 |

If even greater gain is desired and the space is available, a 9-element log periodic having a boom length of 57.3 feet (17.48 meters) can be used (**fig. 3**). This is actually the 20-15-10 log periodic of **fig. 1** with several of the short (10-meter) elements deleted, which reduces its bandwidth to 14 to 21.5 MHz for operation on 20 and 15 meters. This log periodic should give 10- to 11-dB gain on 20 and 15 if its height is at least a half wavelength above ground for 20, about 33 feet (10 meters).

If space is available for an even longer antenna, **fig. 4** illustrates another log periodic which should give 11- to 12-dB gain. The latter two antennas (**fig. 3** and 4) have not actually been tested here, but the gain figures were taken from the 3-band equivalents for 20-15 and 10. Deleting the 10-meter section should have little effect on performance for 20 and 15.

The front-to-back ratio of these log periodics will be approximately 10 to 12 dB, not as good as a Yagi, but with its other advantages over a Yagi the log periodic is well worth consideration.

**Fig. 5** shows the **fig. 2** log periodic as it would look suspended from four 40-foot (12.2 meter) masts. These can be inexpensive telescoping TV masts, available at any TV shop, or 45-foot (13.7 meter) wooden poles. Used poles are available from power companies in some areas at a very reasonable price. The TV masts will, of course, require guying, but wooden poles can usually be unguyed for the smaller log periodics. The log periodic of **fig. 2** as used here has its rear end supported by the roof and the short forward end by two cedar trees. This tree-roof configuration just happened to be perfect for suspending this log periodic 40 feet (12.2 meters) above ground, beamed due south.

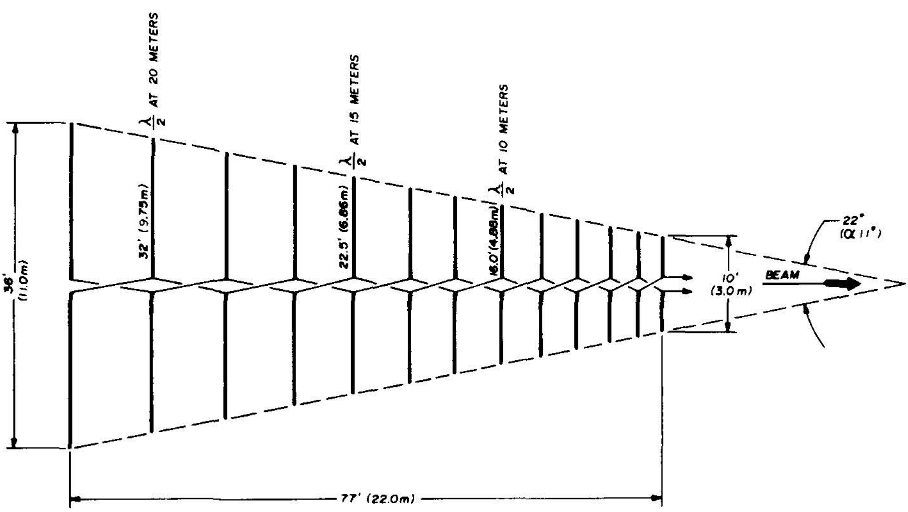


**fig. 1. Plan view of a typical log periodic beam for 14-30 MHz. With 13 elements and a boom length of 72 feet (22 meters) this antenna provides 10-dB gain over a reference half-wave dipole for 10, 15 and 20 meters. Note the feedpoint transposition of alternate elements — if this is not done, the antenna will not work.**

If any of these two-band log periodics can be suspended at least a full wavelength above ground (approximately 66 feet on 20 meters) they will no doubt provide a lower angle of radiation. This is better for DX and, in effect, will show greater gain, especially on 20. The highest I have been able to use here has been 60 feet (18.3 meters), and considerable improvement was noted on that particular antenna compared to the others installed

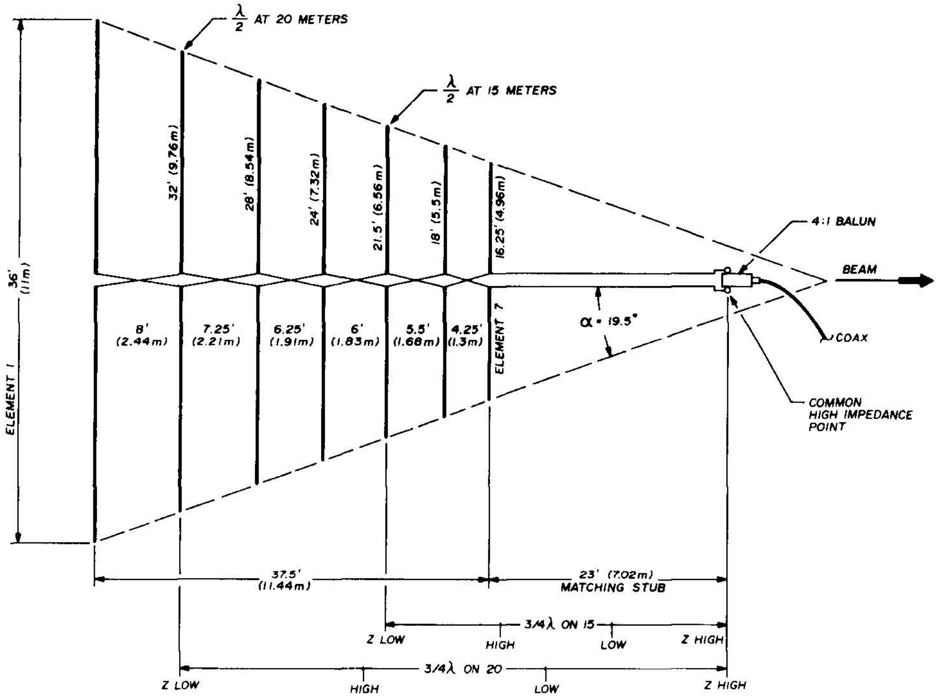


**fig. 2. Dimensional drawing of a practical log periodic for 15- and 20-meter operation that requires only a 40- by 40-foot (12- by 12-meter) space for installation. Though its theoretical gain is 8 dB, the author's version of this antenna has consistently shown 10 dB or better gain over a reference dipole at the same height. Note feedpoint transposition of alternate elements.**

approximately 40 feet (12.2 meters) above ground.

The beam width of a log periodic is generally about 90 degrees, which is good for a fixed beam required to cover a particular continent or a certain part of the U.S. From this location, the antenna beamed west covers the entire west coast and also Australia.

## construction

Fig. 6 illustrates the physical layout of the 7-element antenna showing location of the home-made Lucite insulators and the suspension of the seven elements between the two nylon sidelines or catenaries. Note the transposition of the feedline to alternate elements, a must for a log periodic.

**Fig. 7** is a drawing of the insulators, which are made from 1/4-inch (6-mm) Lucite. The end insulators have only the two end holes, while four holes are drilled in the center insulators. The two end holes are for fastening the center of the elements, while the two toward the center, spaced 1½ inches (3.8 cm), are for the two-wire center feeder. The center insulators serve two functions: First, they separate and space the two-wire open feeder, and second, being secured to the feeder at the points specified in **fig. 2,** they space the elements at the required distances so the antenna will function as a log periodic.

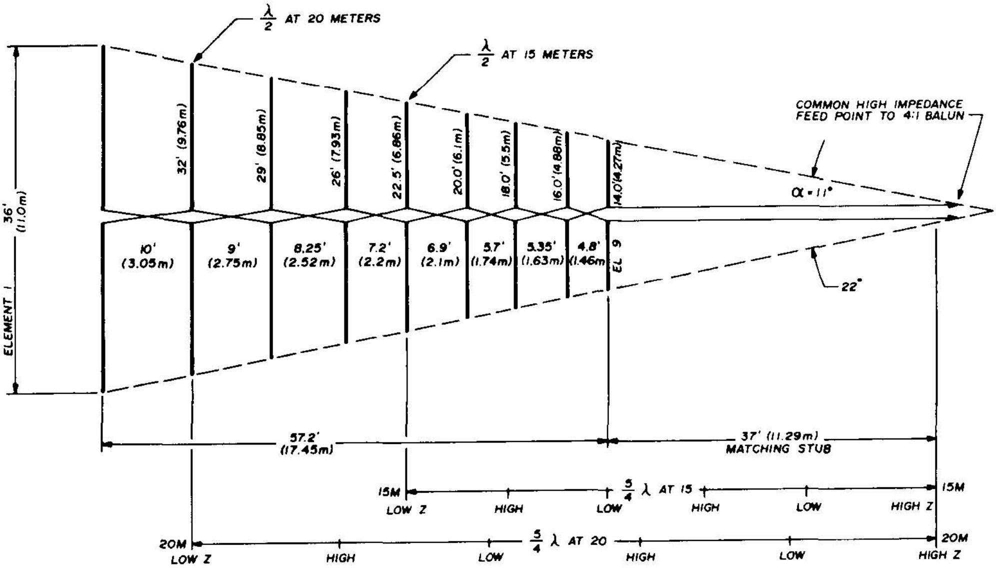


**fig. 3. Dimensional drawing of the log periodic of fig. 1 with the 10 meter elements omitted. Though its 57.2-foot (17.45-meter) boom length may be prohibitive in some installations, those who have the room for it should find a 2- to 3-dB improvement compared to the smaller antenna of fig. 2.**

Note that six egg-type ceramic insulators are used in place of Lucite for the long rear element, 1, and for the short forward element, 7. This is recommended due to the additional strain on these two elements, which must support the remaining five elements and the weight of the center feeder.

Note that the two-wire center feeder is extended 23 feet (7.0 meters) beyond the short forward element, 7. This provides a common impedance match on both 20 and 15 meters. A 4:1 balun is used to provide a match between the coax transmission line and the antenna. This 23-foot stub would not be necessary if a

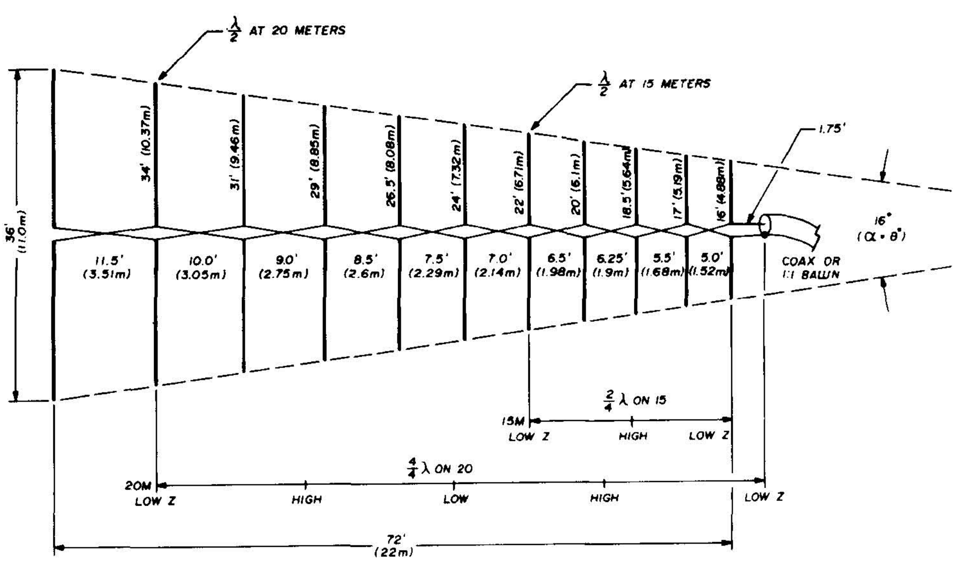


**fig. 4. Dimensional drawing of an even longer two-band log periodic. This 11-element array should provide at least 12-dB gain over a reference dipole.**

tuned line was used between the shack and the log periodic. However, this would require a tuner or *Match Box* at the equipment end. The use of the stub plus the 4:1 balun eliminates the need for the antenna tuner.

It may be of interest that the above feed method has a very desirable feature. Element 2, which is the driven or active radiator element on 20 meters, is spaced approximately 3/4 wavelength from the common feedpoint. Element 5, the driven or active element on 15 meters, is also

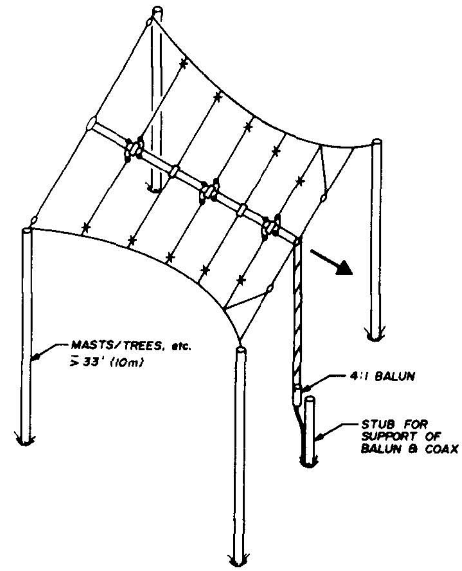


**fig. 5. TV masting or used utility poles provide an easy means for putting up a wire log periodic antenna such as the seven-element array of fig. 2.**

3/4 wavelength from the balun. Since the active element for a discrete frequency within the bandwidth of the antenna is 3/4 wavelength from the common feedpoint, the center feeder plus the 23-foot (7.0-meter) stub act as an impedance matching line and the impedance at the common feetpoint is relatively constant on either 20 or 15 meters.

The stub can hang down from the antenna as shown in **fig. 5.** A short stub mast can be used to support the balun and the coax, relieving the strain on the short-element end. Several additional

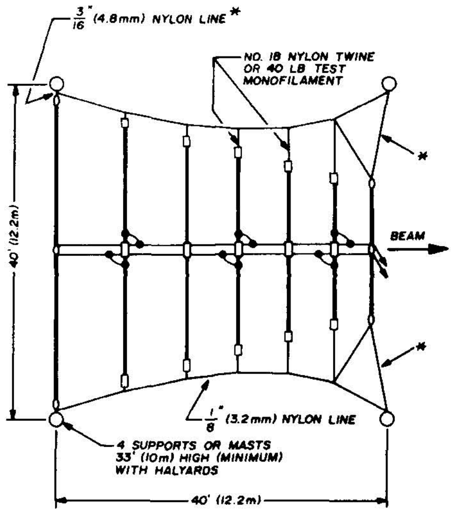


**fig. 6. Mechanical layout showing suspension of log periodic of fig. 2. Egg insulators are used on the first and last elements, while the Lucite insulators detailed in fig. 7 are used elsewhere.**

Lucite spacers should be used along the stub to keep the two wires separated and parallel. Spacers about every five feet (1.5 meters) are suggested.

## log-periodic theory

The log-periodic beam can be considered as a multi-element, broadband, uni-

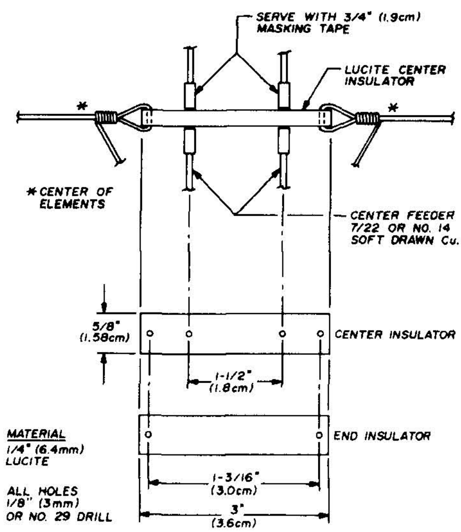


**fig. 7. Dimensional drawings of Lucite insulators used at centers and ends of center elements. Dimensions and material are not critical.**

**table 1. List of materials needed for building the log-periodic antennas described here (not including masts or coax).**

| item | 7 elements (figs. 6 & 2) | 9 elements (fig. 3) | 11 elements (fig. 4) |
|---|---|---|---|
| Antenna wire (elements)[2] | 190 feet (58 meters) | 225 feet (69 meters) | 290 feet (89 meters) |
| Antenna wire (center feeder)[1,2] | 125 feet (38 meters) | 196 feet (60 meters) | 160 feet (49 meters) |
| Ceramic egg insulators | 6 each | 6 each | 6 each |
| End insulators (Lucite) | 10 each | 14 each | 18 each |
| Center insulators (Lucite) | 5 each | 7 each | 9 each |
| Nylon line, 1/8 inch (3 mm) | 100 feet (30.5 meters) | 170 feet (52 meters) | 235 feet (72 meters) |
| Nylon line, 3/16 inch (5 mm) | 25 feet (7.6 meters) | 25 feet (7.6 meters) | 25 feet (7.6 meters) |
| Nylon twine, no. 18[3] | 1 roll | 1 roll | 1 roll |
| Total cost | $17.00 | $22.00 | $26.00 |

*notes*

1. The center feeder should be 7/24 copper (not copper-clad — too stiff) or other stranded wire so the two wires will remain parallel and not kink.
2. The author used number-15 aluminum electric fence wire on many of his log periodics to reduce weight and cost. Caution must be used when working aluminum, and care must be taken to avoid contact between dissimilar metals which can cause electrolysis. Aluminum is not recommended for use near sea coast or in a polluted environment.
3. 40 lb. test monofilament fish line can also be used, eliminating need for end insulators.

directional, end-fire array. The design formulas have appeared before in an amateur publication,[4] which although it covered only vhf log periodics, also applies to high-frequency log periodics. The design formulas are quite complex, so unless a computer is available it is suggested that the dimensions given in this article be followed.

**Table 1** is a list of materials for the short 20-15 meter log periodic, **fig. 2**, as well as the two longer models of **fig. 3** and **4**.

## summary

Anyone who has the space to put up one of these excellent log periodic antennas for 20 and 15 will be pleased with the results. Considering its moderate cost, its gain in the forward direction is about equivalent to adding a big linear. It is equally helpful in reception in the desired direction, giving the same gain in receiving. It also has a very pronounced diversity effect, especially important during bad signal fading. Of all the various beam antennas tried here during the past three years, the two-band log periodic for 20 and 15 has been the simplest and easiest to construct. I believe it gives more "miles per dollar" than almost any other amateur beam.

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