40-meter log-periodic antennas

How to design and build simple, high-performance wire beams that provide 8- to 10-dB gain and low swr over the entire 40-meter band

G.E. Smith, W4AEO, 1816 Brevard Place, Camden, South Carolina 29020

In a previous article I described two fixed log-periodic antennas of the doublet type which cover the complete frequency range from 14 to 30 MHz.[1] These two antennas are suitable for use on 10, 15 and 20 meters. After that article appeared I received a large number of inquiries from amateurs who were interested in building a similar antenna for 40 meters. Although I didn't have a special requirement for a 40-meter beam, the possibility of building a log periodic for 40, 20 and 15 was interesting and presented a challenge.

Since there was space available between some of the high pines and cedars on my property, the large log-periodic beam shown in **fig. 1** was assembled. To reduce size and weight as much as possible, this log periodic is a *skip-band* type with a portion of the frequency range between 7.0 and 14 MHz deleted. Since this portion of the spectrum is not assigned to the amateur service, it is easily deleted and reduces the number of elements and the length of the antenna.

My available space only allowed a maximum antenna height of about forty feet, so I suspected that the beam would have little gain on 40 meters. However,

after running on-the-air tests for a few days, practically all the stations off the front of the antenna reported 8 to 10 dB gain from the 40-meter log periodic as compared with my non-gain 40-meter doublet. Reports from stations off the back of the beam indicated a front-to-back ratio of about 10 dB (signal strength but still retain the gain indicated by the 40-20-15 log periodic.

The first 40-meter beam I built used six elements; the gain of this antenna was about 10 dB. Another log periodic was then built with only five elements; signal reports still indicated the same forward gain.

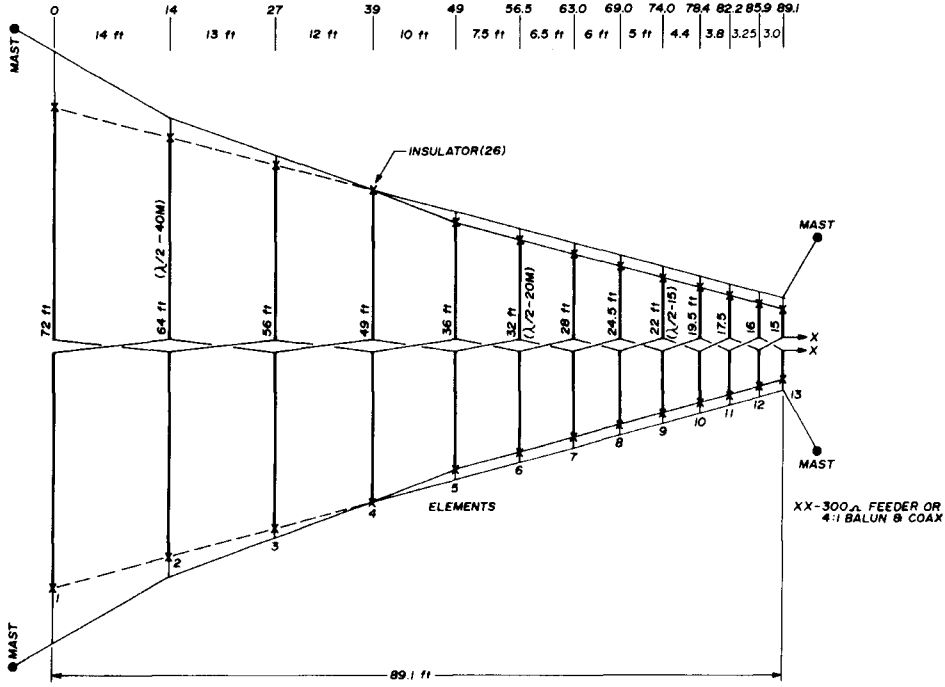

fig. 1. Three-band log-periodic antenna for 40, 20 and 15 meters. Forward gain of this antenna is 8 to 10 dB.

about the same as the non-gain antenna). Gain on 14 and 21 MHz is about 10 dB, and front-to-back ratios are about 15 dB, very similar to the three-band log-periodic previously described in *ham radio*.

forty-meter beams

Since many of the operators who work 40 meters are not interested in the higher bands, I decided to try a log-periodic for single-band use on the 7.0-MHz band. This would use a minimum number of elements and reduce the overall length,

These signal reports were very encouraging, but I wanted to obtain more accurate data, especially front-to-back ratio and side selectivity. As two high trees about 250-feet apart were available to the east of the three-band log periodic shown in **fig. 1**, I decided to put up a 5-element, single-band, 40-meter log periodic. Since only two high trees were available, I decided to use an inverted-vee configuration (center high, element ends low).

This arrangement would probably also

be better adapted to the needs of the average amateur because the antenna could be erected with two telescoping TV masts. With the two masts 60-feet apart, a single 40-meter log periodic can be installed in a space 60-feet wide by 75-feet long.

With inverted-vee construction a center A line between the two masts supports the open center feedline and the

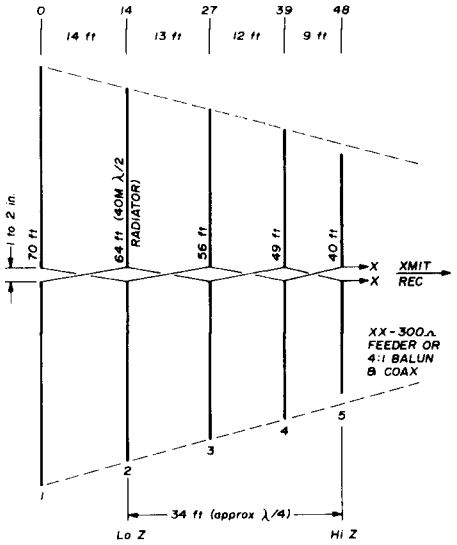

fig. 2. Simple single-band 5-element log periodic for forty meters. This antenna may by used in either the horizontal or inverted-vee configuration.

five elements. Each of the elements droop down about 45 degrees. The dimensions of this antenna are shown in **fig. 2.**

At my station the 40-meter inverted-vee log periodic was installed parallel to the 40-20-15 log periodic, at the same height, but about 150 feet away. By switching between the two beams I was able to determine what losses, if any, I had sustained by going to five elements in an inverted-vee arrangement.

I estimated that I would be lucky to obtain 5- or 6-dB gain with this shortened log periodic, but after about a week of on-the-air tests, I was convinced that there was little or no difference in forward gain between the two antennas. However, the front-to-back ratio of the five-element log-periodic was not quite as good as the 40-20-15 antenna. The signal reports that I received were usually confirmed by the S-meter at my station.

dual log-periodic beam

Another 5-element, inverted-vee, forty-meter section was mounted to the rear of the first beam and headed in the opposite direction (see **fig. 3**). The rear elements of the two back-to-back log periodics were spaced about 20-feet apart. On-the-air tests indicated that forward gain was still 8 to 10 dB. Reports from stations to the rear or off to the side of the antenna are about equal to a non-gain antenna, indicating a 10 dB front-to-back ratio.

construction

Monofilament fish line (40-lb test) is used for the element end insulators and also serve as the element support lines. These lines are brought down to posts or ground anchors. For one of the log periodics which I built I hung a line between several small trees and tied the monofilament end insulators to these. Square lucite insulators (**fig. 4**) are used as center insulators and support the open-wire center feeder.

The most recent log periodics which I have built have eliminated the center A

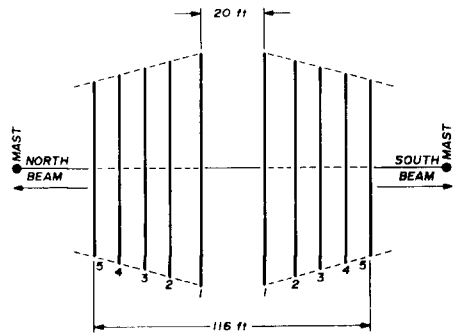

fig. 3. Single-band 40-meter log periodic for north-south communications consists of two back-to-back 5-element antennas (see fig. 2). This antenna, when used in the horizontal configuration, 50-feet above ground, provided 12-dB forward gain.

line. In these antennas the center is supported entirely by the center feeder. However, special precautions are required during assembly if you use this method of construction; the A line is easier if you are building your first log periodic.

It will be noted from **fig. 2** that the open-wire center feedline between the second element and the rear element is approximately one-quarter wavelength long. The feedpoint impedance at the center of the front element is 100 to 300 ohms; the quarter-wave line acts as a transformer between the low-impedance at the center of the second element and the feedpoint at the rear. Three methods of feeding the antenna are suggested:

1. Open-wire tuned line with an antenna tuner in the shack.

2. A broadband 4:1 balun between the log-periodic feedpoint and a coaxial feedline to the shack.

3. 300-ohm TV twin-lead from the log periodic to the shack with a 4:1 balun at the shack with coax to the transmitter. I used this method of feed since my other log periodics are fed with 300-ohm tv line.

performance

Compared with my center-fed 40-meter doublet which is 50-feet high the inverted-vee log periodic consistently provides signal reports 8 to 10 dB better. Comparison with a commercial trap vertical mounted on the roof of the house indicate essentially the same thing. These are not just spotty tests, but are consistent, reliable reports from several old acquaintances in Florida with whom I have been working on 40 meters for several months. They were quite familiar with my normal signal on 40 using the two non-gain antennas before I put up the 40-meter log periodic.

After several weeks of testing I decided to increase the height of the 5-element south beam to at least 50 feet and use horizontal elements rather than the inverted-vee configuration. The results from this change were hard to believe. The signal reports were consistently at least 12 dB better as compared to the doublet, also 50-feet high. All signal comparisons were made when fading was at a minimum and there was no skip.

The front-to-back ratio of the horizontal log-periodic antenna is approximately 12 dB. This is near the possible maximum for log periodics built and tested here over the past two years,

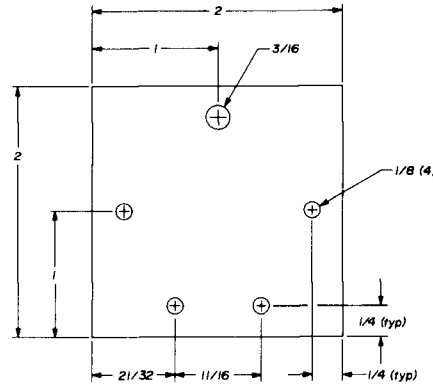

fig. 4. Center insulators for the log periodic antenna. Material is ¼" lucite or plexiglass.

reports from the back and sides are about the same as with the doublet I use as a standard.

As with any horizontal log periodic, the forward lobe is broader (about 100 degrees) than with most beams. This is good when you must use a fixed beam to cover a certain part of the country. Considering that most 40-meter beams are limited to 3- to 5-dB gain, the greater gain of the log periodic is certainly worth considering if you have the necessary space to put one up. By doubling the element lengths and spacing distances it should be possible to make a very excellent 80-meter beam.

I would appreciate hearing from anyone who builds and tests one of these antennas.

reference

1. G.E. Smith, W4AEO, "Three-Band High-Frequency Log-Periodic Antennas," *ham radio*, September, 1972, page 28.

ham radio