feed system

for log-periodic antennas

How to find the optimum point for feeding a multi-band log periodic

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

Log-periodic antenna texts provide little information on methods of getting a practical transmission line matched to the antenna feedpoint. References 2, 5 and 7 describe methods of matching and feeding vhf log periodics by use of boom balun to coax matches, but most of these systems are not suitable for high-frequency log periodics.

The original log-periodic antennas built here[9] were first fed by using a 1:1 balun with the balanced winding across the normal short-element feedpoint. Although the swr was relatively low across the 20-meter band and not too bad on 15, there was some variation between these two bands. On 10 meters there were some bad swr excursions when going from 28.0 to 29.7 MHz, some exceeding 2.5:1, showing a bad mismatch on these higher frequencies. Equipment was not readily available to make a complete swr run over the antenna's entire bandwidth, 14 to 30 MHz.

Though some of the vhf references [1,2,3,etc.] indicate that the swr could be expected to go up to 2.5:1 over a log periodic's bandwidth, it was felt this could be improved by a better matching system between the transmission line and the antenna. Upon checking several log periodics at the normal short-element feedpoint using the Omega Antenna

Noise Bridge, it was noted that there was considerable variation in impedance over the three bands.

analysis

Upon anaylzing this result it became evident that the active or driven elements (one-half wavelength long at a specific frequency) were at various electrical distances (1/4 wave-wise) from the feedpoint. In **fig. 1** for example, the second element, which is the driven element on 20 meters, is 35 feet (10.7 meters) or approximately a half wavelength to the rear of the feedpoint at the front of the antenna. Since previous tests with the antenna bridge had indicated the driven element exhibited 30 to 33 ohms input impedance, it can be assumed that this impedance would be repeated at the feedpoint since the two are connected with a feedline which is a half-wavelength long. This was confirmed by tests with the bridge on 20 meters.

Consider the situation on 15 meters. Element 6 is a half-wavelength long on that band so it becomes the active or driven element. It is located about 16.5 feet (5.1 meters) from the feedpoint, but a quarter-wave of open-wire feedline on 15 is about 11.25 feet (3.4 meters) and a half-wave about twice that long (22.5 feet or 6.9 meters). Thus, the feedpoint is about halfway between a high- and low-impedance point on 15 meters.

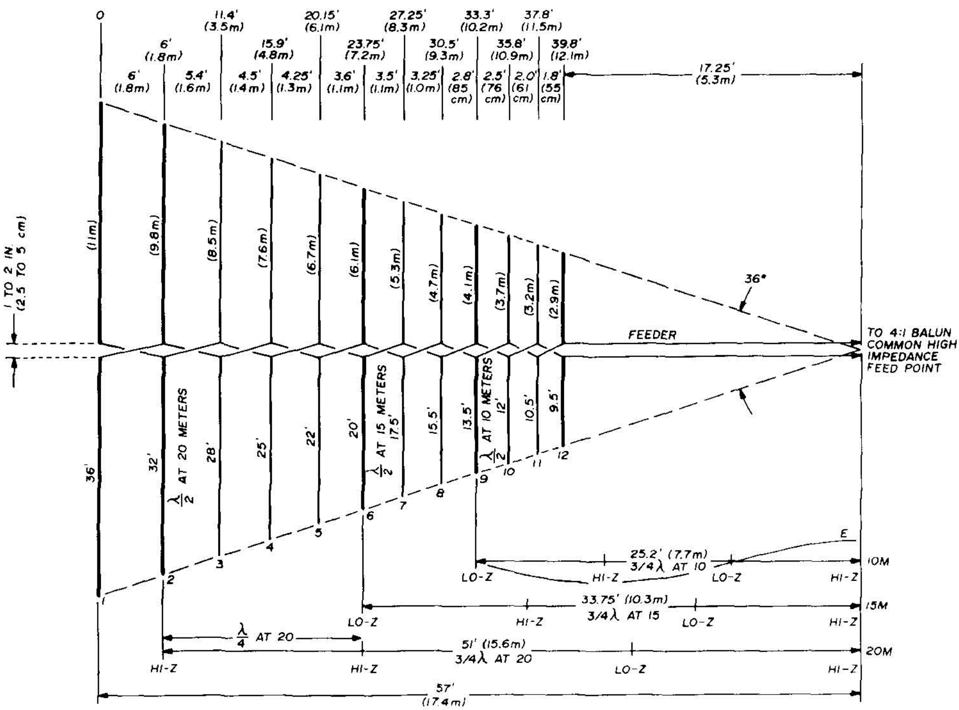

fig. 1. A 12-element three-band log-periodic antenna showing the electrical relationship of the extended feedpoint to the driven element on each of the three bands.

Looking at 10 meters, element 9 is about 16 feet (5 meters) long so it is the active element on that band. It is about 6.5 feet (2 meters) to the rear of the feedpoint. A quarter-wavelength feedline on 10 meters is about 8.4 feet (2.6 meters) and a half wave, 16.8 feet (5.2

meters). Again, the feedpoint is at an intermediate point with respect to the active element.

In summary, it will be noted that although the feedpoint at element 12 presents a fairly predictable impedance on 20 meters, it presents a highly variable match on 15 and 10. This was confirmed by swr readings across each of the three bands.

wavelength open-wire line acts as a matching transformer.

The low and high impedance points along the open-wire line for each of the three bands are shown in **fig. 1**. Incorporation of this modification extends the feedpoint 17.25 feet (5.3 meters) forward of the short-element end of the antenna.

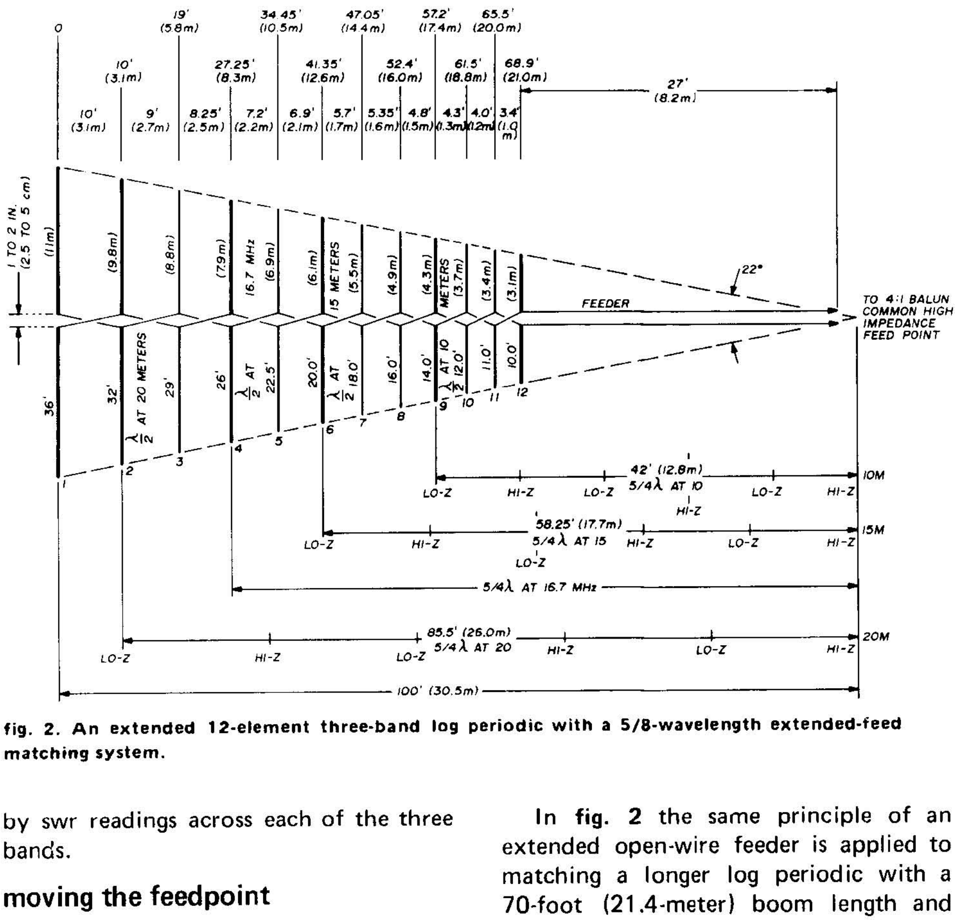

fig. 2. An extended 12-element three-band log periodic with a 5/8-wavelength extended-feed matching system.

moving the feedpoint

By extending the open-wire feedline toward the antenna apex as shown in **fig. 1**, a point is reached near the apex where elements 2, 6 and 9 are all about 3/4 wavelength from this common, higher impedance, feedpoint for their respective bands. The impedance at this point appears to be on the order of 200 to 300 ohms, so it can be fed with 50-ohm coax through a 4:1 balun with a satisfactory match on all three bands. The 3/4-

In **fig. 2** the same principle of an extended open-wire feeder is applied to matching a longer log periodic with a 70-foot (21.4-meter) boom length and 22-degree apex angle. This requires an open-wire feeder 5/8-wavelength long to reach the common-impedance feedpoint, also approximately at the apex angle. In this case the open-wire feeder has been extended 27 feet (8.2 meters) from the center of the short element. Note that these extended feeders can hang down from the short-element end of the antenna if necessary; they need not be extended horizontally as shown.

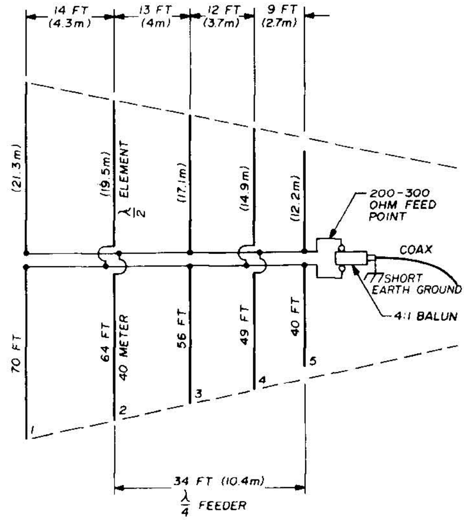

fig. 3. A 5-element, 40-meter monoband log periodic. The center of the short element is just a quarter wavelength from the driven element, providing an optimum feed point.

The longest 20-, 15-, and 10-meter log periodic in use here (17 elements, with a 100-foot (30.5-meter) boom and 16 degree apex angle) requires seven quarter-wavelengths between each active element and the common feedpoint.[14] Further, it will be noted that any active element on any of the antennas shown is an odd number of quarter wavelengths, three in **fig. 1** or five in **fig. 2**, from the common feedpoint. For example, element 4 in **fig. 2** is 28 feet (8.5 meters) long and will resonate at 16.7 MHz. It is approximately 5/4-wavelength from the common feedpoint at this frequency, so we can therefore assume that this antenna is a true log periodic.

The monoband log periodics of **fig. 3**, tested here on 10, 15, 20 and 40 meters in 5-element versions (some 4- and 6-element types were also tested) have all had element 2 exactly a quarter wavelength from the high-impedance, short-element feedpoint. These have worked extremely well using a 4:1 balun to match them to coaxial transmission lines. The swr has been relatively low across each band.

Similarly, the single-band vertical monopole log periodics of **fig. 4**, tested on 40 and 80, also used the quarter-wavelength feed and were similarly flat.[15] The swr readings on the 80-meter version were:

4.0 MHz	1.25:1
3.9 MHz	1.4:1
3.8 MHz	1.2:1
3.7 MHz	1.1:1
3.6 MHz	1.2:1
3.5 MHz	1.2:1

similar approach

This system for feeding log-periodic antennas was believed to be original at

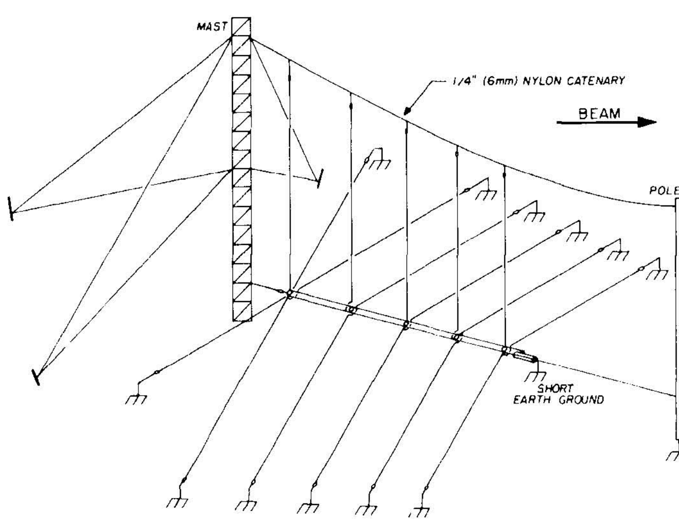

fig. 4. Overall view of the five-element vertical monopole log periodic. Construction details and dimensions are shown in fig. 5 and table 1.

table 1. Vertical monopole log-periodic antenna dimensions (5-element arrays).

	frequency in MHz			
element	**3.5-4.0[1]**	**3.8-4.0[2]**	**7.0-7.3[2]**	**14.0-14.35[1]**
E1	70' (21.4 m)	65' (19.8 m)	35' (10.7 m)	17.5' (5.3 m)
E2	67' (20.4 m)	62' (18.9 m)	33' (10.0 m)	16.5' (5.0 m)
E3	58' (17.7 m)	55' (16.8 m)	28' (8.5 m)	14.0' (4.3 m)
E4	50' (15.3 m)	45' (13.7 m)	24.5' (7.5 m)	12.2' (3.7 m)
E5	43' (13.1 m)	40' (12.2 m)	20' (6.1 m)	10.0' (3.0 m)
S1	30' (9.2 m)	26' (7.9 m)	14' (4.3 m)	7.0' (2.1 m)
S2	27' (8.2 m)	24' (7.3 m)	13' (4.0 m)	6.5' (2.0 m)
S3	24' (7.3 m)	23' (7.0 m)	12' (3.7 m)	6.0' (1.8 m)
S4	19' (5.8 m)	18' (5.5 m)	9' (2.7 m)	4.5' (1.4 m)
total length	100' (30.5 m)	91' (27.8 m)	48' (14.6 m)	24' (7.3 m)
mast height	80' (24.4 m)	75' (22.9 m)	50' (15.3 m)	30' (9.2 m)
pole height	45' (13.7 m)	40' (12.2 m)	25' (7.6 m)	20' (6.1 m)

1. Calculated design, not actually built and tested.
2. Built and tested design, with measured swr under 1.5:1 over frequency range shown.

the time I worked it out. However, after it was mentioned briefly in a previous article[9] it was learned that Ray Rosenberry, K8EBF, developed a similar method that was described and covered by his patent of 16 February, 1971, which covers "Broad Band Transformer Antenna and Related Feed System."[13] Therefore, I do not claim the odd quarter-wavelength feed method for log periodics to be original. K8EBF and I have since exchanged several letters regarding these log-periodic feed methods.

In any case, it is hoped the above information on improved methods of feeding log-periodic antennas will be helpful to amateurs using these interesting antennas. I would like to hear from anyone trying this technique.

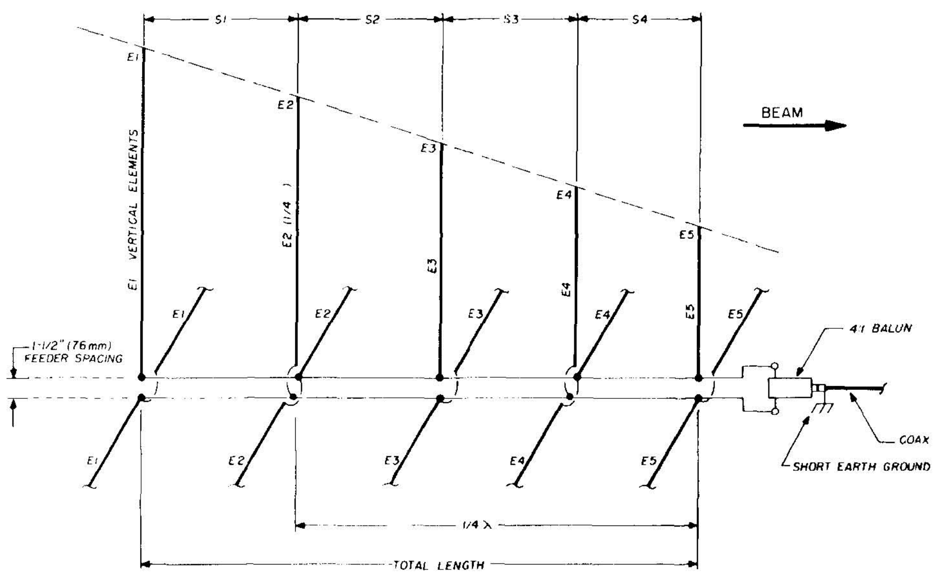

fig. 5. Construction details for a 5-element vertical monopole log periodic. Dimensions for 80, 75, 40 and 20 meters are given in table 1.

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ham radio

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