The Off-Center Fed Long Wire

Long-Wire Antennas

An antenna is only a long wire if it is one wavelength or greater overall. A physically long piece of wire does not constitute a "long wire," contrary to what you may have heard people call them. Length in this case relates to electrical dimensions of *1 wavelength or more.*

A long wire may be fed at one end, as recommended for the Zepp antenna. Alternatively, you may locate the feed point 1/4 wavelength from one end of the wire to allow the use of low-impedance coaxial transmission line. Illustrations of both methods are shown in Fig 1. The length of a long wire is dependent upon the number of wavelengths it contains. The following formula may be used to find the antenna length:

Equation 1:

$$L\ (\text{feet}) = \frac{984\ (N - 0.025)}{f\ (\text{MHz})}$$

where N is the number of wavelengths in the antenna.

Long-Wire Characteristics

Perhaps you are wondering what advantages you can realize from using a long wire instead of a dipole. The primary benefit is that the system will provide gain over a dipole. The gain increases in proportion to the number of wavelengths used, assuming the antenna is high above ground. For example, the gain for a 3-wavelength long wire (referenced to a dipole) is 2 dB. A 6-wavelength wire yields a 4.8-dB gain, and a 10-wavelength long wire provides nearly 7-1/2 dB of gain. A gain curve that includes the radiation angles versus number of wavelengths may be found in chapter 7 of The ARRL Antenna Book, 14th edition.

The greater your long-wire length the higher the gain and the lower the radiation angle of the major lobes. This is ideal for DX work. Maximum radiation is off the ends of the wire, but numerous minor lobes exist at various angles, respective to the wire. I have found that there are lobes that are suitable for almost any type of propagation at a given period. Because of this feature, I have had, under certain band conditions, better results with a long wire than with my triband Yagi at 60 feet.

An interesting characteristic of long wires is that they do not need to be as high above ground as does a dipole for the same frequency, respective to directivity and useful radiation angles. A height of 30 feet is, for example, quite acceptable at 20 meters. You should be aware, however, that the greater the height the lower the radiation angle. Wave angles as low as 10 degrees are possible with large long wires, and angles of 15 to 20 degrees are typical when several wavelengths are used. I recommend that you design your long wire for 20 meters where optimum performance is most desirable, generally speaking. If several wavelengths are employed, the antenna will give good performance on 80, 40 and 30 meters. The radiation angles will be higher on these lower bands, and this can be advantageous for communications out to a few hundred miles.

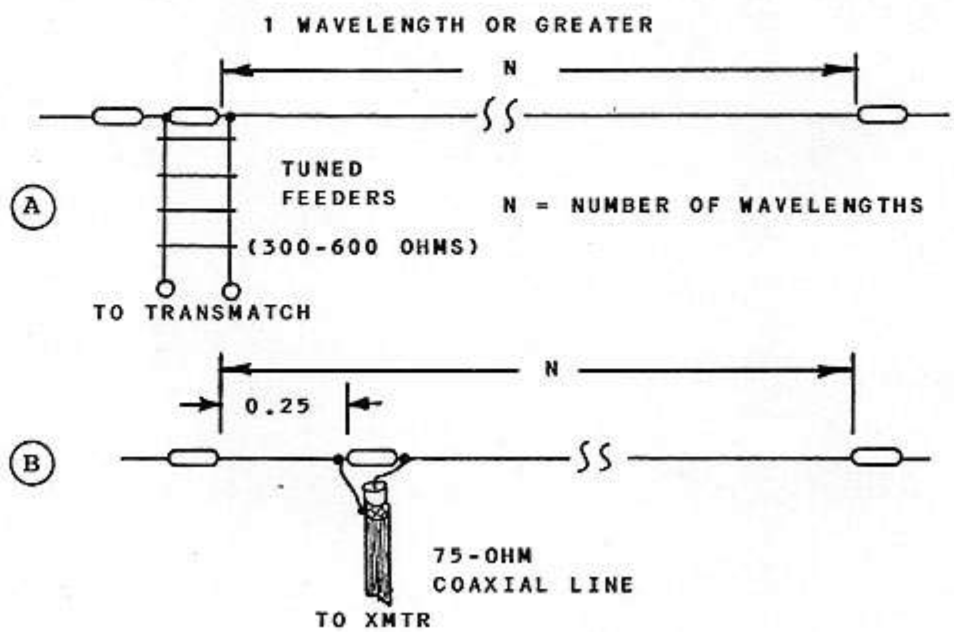
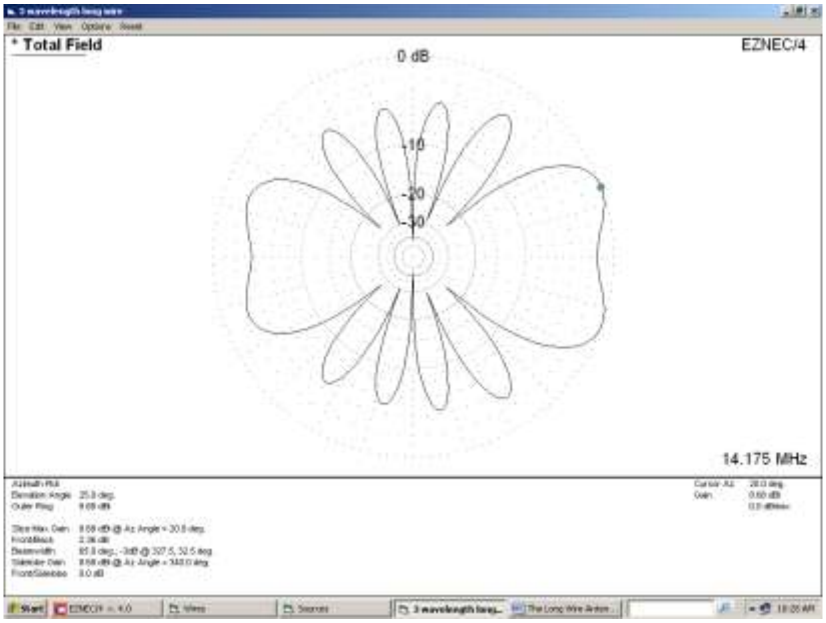
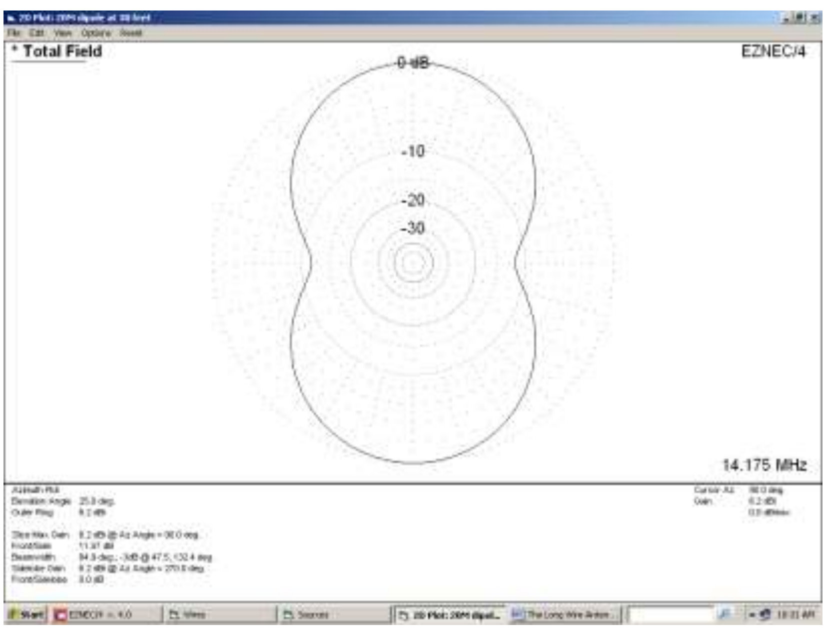


Fig 1 -- Suitable methods for feeding long-wire antennas. Feed-line balance will be best with the system at B. With method A, the antenna suffers the same shortcomings of the end-fed Zepp (Some feed-line radiation will occur because one side of the feed line is unterminated). Balanced feeders may be used for the system at B. They should be 1/2 wavelength long, or multiples thereof. This will cause the low feed impedance to be repeated at the Transmatch or transmitter.

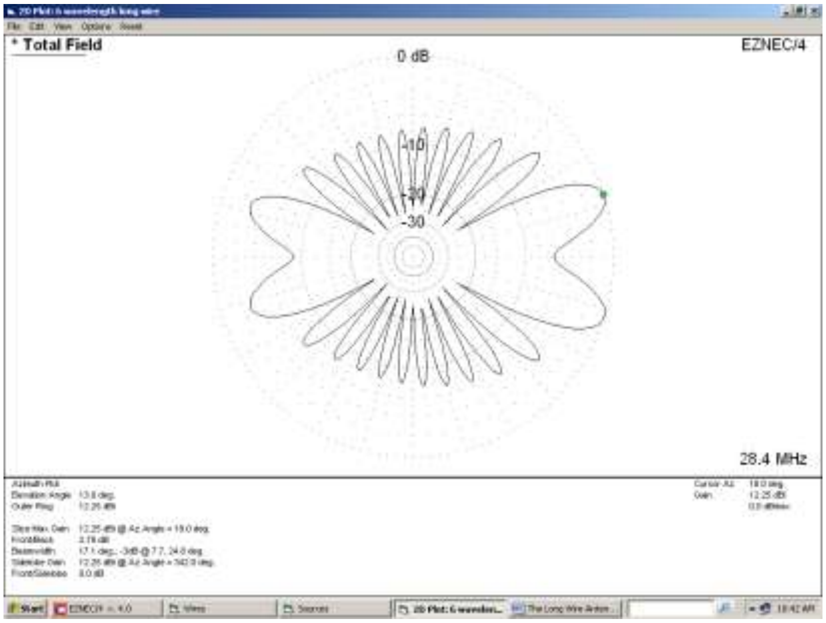
From pages 36 through 38 of W1FB's Antenna Notebook, written by Doug DeMaw. This book is out of print.



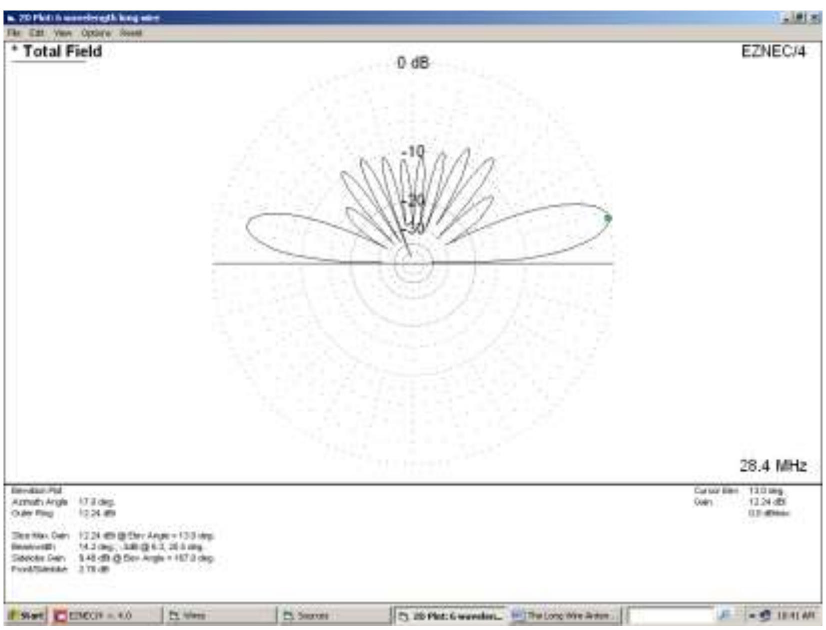
A three wavelength long wire has 8.7dBi of gain at 25 degrees elevation and an azimuth of 20 degrees. This is just 1 to 1-1/2 dB gain over a half wave dipole at the same height, but the lobes may be in a more appropriate direction for your antenna supports. The wire runs across the page from left to right—the maximum gain is to the right. The wire is 206 feet long, fed 16’ 6” from the end on the left. The height above ground is 30 feet. With #10 copper wire, the feedpoint impedance is 129.8 - J 42.06 ohms. The high accuracy NEC 4 model is used with a conductivity of 0.005 S/m and a dielectric constant of 13.



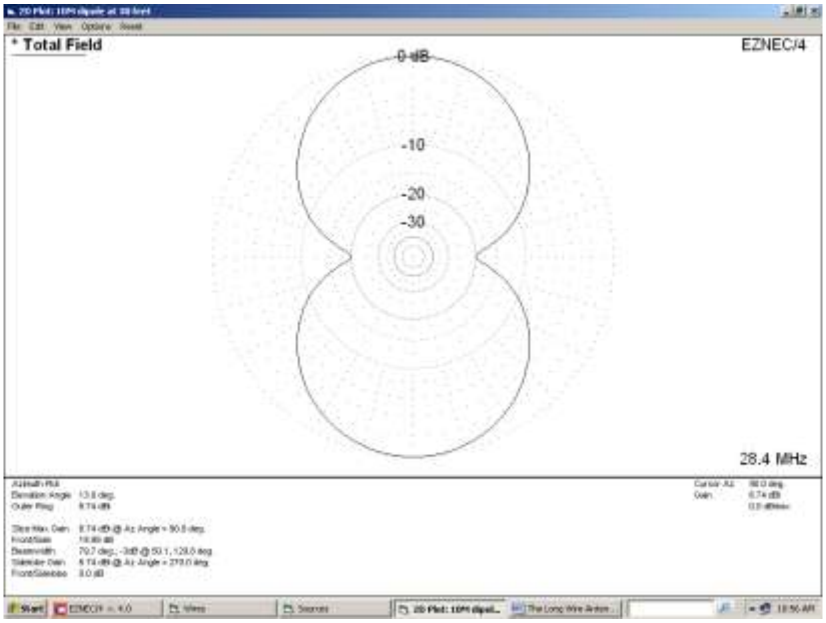
A half wave 20M dipole at 30 feet The gain is 6.2dBi at an elevation angle of 30 degrees. 33 feet of #10 wire fed in the center. The dipole has a little more gain, 6.64dBi, at an elevation angle of 30 degrees.



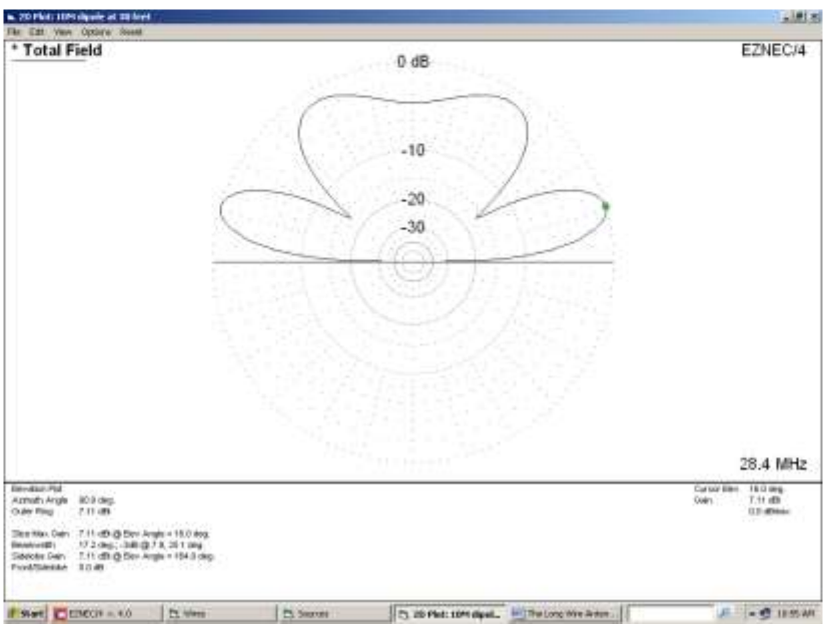
A six wavelength long wire has 12.2 dBi of gain. This 5 dB to 5-1/2 dB more you can get from a half wave dipole at the same height, depending on your choice of reference. The wire runs across the page from left to right—the maximum gain is to the right. The wire is 207 feet long, fed 8 feet 3” from the end on the left. The height above ground is 30 feet. With #10 copper wire, the feedpoint impedance is 134.1 - J 14.13 ohms. The high accuracy NEC 4 model is used with a conductivity of 0.005 S/m and a dielectric constant of 13.



This is the elevation pattern of the six wavelength long wire. The Azimuth is 17 degrees, where the gain is maximized.



A half wave reference 10M dipole at 30 feet. The gain at an elevation angle of 13 degrees is 6.7dBi. The dipole has a gain of 6.9dBi at an elevation angle of 16 degrees.



The elevation plot of the 10M reference dipole. The azimuth is 90 degrees—where the gain is maximized. EZNEC can be purchased from Roy W7EL at www.eznec.com