Put on your thinking cap, get a pencil and paper (you can use your computer if you want to), and follow along with VE3ERP as he describes an affordable, available-space antenna.

A Closer Look at The Extended Double Zepp Antenna

BY GEORGE MURPHY*, VE3ERP

The Zepp could possibly be the daddy of all antennas, harking back to the very early years of the 20th century, when it was used in Zepplins while the Wright Brothers were still building bicycles. The Extended Double Zepp (EDZ) has been in popular amateur radio use almost ever since. I call it "Daddy Long Legs" because in its pristine form (see fig. 1) it requires a lot of real estate. For instance, a 1/2-wave dipole cut for the electrical center of the 12 meter band (24.940 MHz) is a sparse 5.7 m (18' 9") long, while an EDZ for the same frequency needs about 14.6 m (48'0") of countryside to stretch out in. The good news (conveyed to me by Dean Manley, KH6B) is that in its multiband configuration the EDZ can be shortened to fit a more reasonable available space!

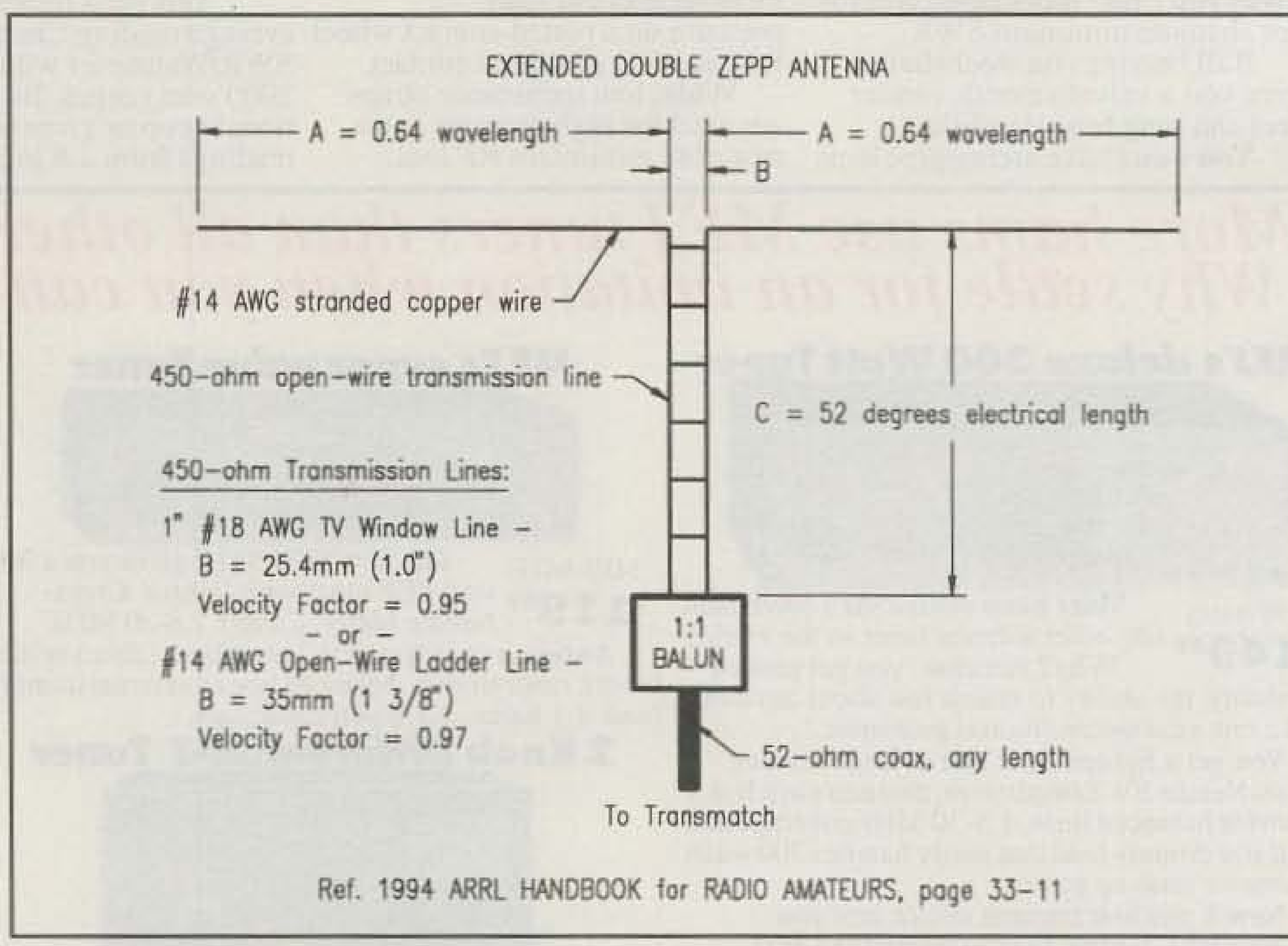

Fig. 1– The extended double Zepp antenna.

Design Considerations

If you think this is a studious dissertation containing impressive equations, think again. I know very little about antenna theory, and I do all my math on a computer.[1] If you want an excellent technical description of the EDZ, you can find one in the *1994 ARRL Handbook*.[2]

Basically, the EDZ is a two-element collinear array that exhibits superior gain and directivity over a conventional 1/2-wave dipole. Any necessary pruning should be done on the 450 ohm transmission line, not on the horizontal elements, which should retain their 0.64 wavelength dimension. Pruning the line to a low SWR will ensure that the transmission line length is close to the optimum 52% electrical length. If this length is altered, the antenna tends to act more like a center-fed longwire, resulting in (good news!) the possibility of multiband operation at the (bad news!) expense of some gain. In any event, a Transmatch is required for multiband operation.

You can design your own EDZ very easily either by using the following simplified equations or by a computer using *HAM-CALC*.[3]

The (shudder) Math

There are two choices to start things off. If you have decided on a frequency for a monoband EDZ, you can determine the length of each 0.64 wavelength leg and of the open-wire transmission line. If you are restricted to a leg length for a multiband antenna, you can determine the base frequency. The following equations include factored-in allowances for end effect and velocity factor of the horizontal legs of the antenna.

Step 1: Determine frequency and length of horizontal legs:

To find leg length *A* where frequency is known:

$$\text{(Eq. 1)} \qquad A\ (\text{ft.}) = \frac{598.5}{f\ (\text{MHz})}$$

$$A\ (\text{m}) = \frac{182.4}{f\ (\text{MHz})}$$

To find frequency *f* where leg length *A* is known:

$$\text{(Eq. 2)} \qquad f\ (\text{MHz}) = \frac{598.5}{A\ (\text{ft.})}$$

$$f\ (\text{MHz}) = \frac{182.4}{A\ (\text{m})}$$

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Step 2: Calculate length of transmission line:

To find length *C* of the transmission line for a monoband EDZ:

$$\text{(Eq. 3)} \quad C\ (\text{ft.}) = \frac{142\ VF}{f\ (\text{MHz})}$$

$$C\ (\text{m}) = \frac{43.3\ VF}{f\ (\text{MHz})}$$

where VF = Velocity Factor of line

That's all there is to designing an EDZ monoband antenna. The real fun starts if you decide to create a multiband EDZ by altering the length of the transmission line. It has long been known that a dipole fed with open-wire line and a Transmatch is capable of multiband operation. While the EDZ is designed as a center-fed longwire, its two legs also form a dipole cut for some seemingly unrelated frequency. You may want to know this frequency.

Step 3: Find resonant frequency of a dipole formed by the legs of an EDZ:

To find resonant frequency Df of a dipole 2 × A long:

$$\text{(Eq. 4)} \quad Df\ (\text{MHz}) = \frac{234}{A\ (\text{ft.})}$$

$$Df\ (\text{MHz}) = \frac{71.3}{A\ (\text{m})}$$

The multiband EDZ can be designed for a *lowest* frequency that is less than Df. This lowest frequency is determined by the new length of transmission line.

Step 4: Choose the desired lowest frequency of operation and determine the length of transmission line required. The chosen frequency Lf must be lower than Df from Equation 4.

To find new length *C* of transmission line:

$$\text{(Eq. 5)} \quad C\ (\text{ft.}) = VF \left[\frac{466}{Lf} - 2.1A\ (\text{ft.})\right]$$

$$C\ (\text{m}) = VF \left[\frac{142}{Lf} - 2.1A\ (\text{m})\right]$$

where Lf = lowest frequency of operation and $Lf < Df$
VF = Velocity Factor of line

Some Design Examples

Suppose you want to design a monoband EDZ cut for 24.940 MHz, fed by 450 ohm 1 inch TV window line (velocity factor of 0.95):

From Eq. 1 the length of each leg is:

$598.5 \div 24.94 = 24.00' = 24'\ 0''$

From Eq. 3 the length of the transmission line is:

$142 \times .95 \div 24.94 = 5.41' = 5'\ 5''$

You then decide to turn this into a multiband EDZ. From Eq.4 the resonant frequency of the horizontal legs as a dipole is:

$234 \div 24.00 = 9.75$ MHz

The lowest operating frequency must be less than 9.75 MHz, so you decide on starting at the 40 meter band with a lowest operating frequency of 6.9 MHz.

From Eq.5, the new length *C* of the transmission line is:

$.95 \times (466 \div 6.9 - 2.1 \times 24.00) = 16.28' = 16'\ 3''$

Proof of the Pudding

Just in case you have any doubts about any of this, let's try one more. You have only 102 feet of yard space available and you want to see what you can do with it. From Eq. 4 you find you can erect a multiband EDZ with a lowest operating frequency less than:

$234 \div 51 = 4.5$ MHz

Now we're getting somewhere. Why not build an EDZ that will operate on 3.5 to 30 MHz, using AWG #14 open-wire ladder line with a velocity factor of 0.97? Let's choose an 80 meter band lowest operating frequency at random—say, oh, about 3.278 MHz[4]? From Eq.5 the length of the transmission line is:

$0.97 \times (466 \div 3.278 - 2.1 \times 51) = 34.0$ ft.

You have just designed a 102 ft. flat top antenna center-fed with a 34 ft. matching section of open-wire line, connected by any length of 52 ohm coax back to the shack. Sound familiar? It should. If the Zepp is the daddy of antennas, what you have just cloned is its most famous offspring, the G5RV.[5]

Footnotes

1. *HAMCALC—Painless math for radio Amateurs,* containing nearly 200 programs, is *free* software obtainable from its author (me) at the address shown at the beginning of this article. For a 3 1/2" 1.44 Mb MS-DOS/Windows disk send US$5 check or money order (no stamps or IRCs, please) to cover cost of materials and airmail shipping anywhere in the world.
2. "An Extended Double Zepp for 12 Metres," pp. 33-11 to 33-13.
3. HAMCALC version 34—"Zepp EDZ Antenna" program.
4. I am pulling a fast one on you. There is nothing random about 3.278 MHz. I worked it out using *HAMCALC*'s "Zepp EDZ Antenna" program to prove a point, as you are about to find out.
5. Contrary to some advertised claims, any antenna the dimensions of which have been scaled up or down from those of the original G5RV is *not* a G5RV, but is, and will perform as, some form of center-fed random-wire antenna. ■