# The Extended Double Zepp Revisited

*A vintage favorite still makes a great single or multiband antenna.*

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The extended double Zepp (EDZ) antenna has been around for a lot of years. Yet, many amateurs still do not know much about it. The EDZ is an excellent, easy to build, wire antenna that produces real usable gain with a broadside pattern. It is also reasonably easy to match to 50 Ω using a ladder line matching section. The popular 88 and 44 foot all band antennas are actually EDZs on 20 and 10 meters respectively.[1] Below, I discuss antenna characteristics, design criteria and matching criteria for the 40 through 10 meter HF bands and give dimensions and construction information for several antennas.

## Antenna Characteristics

The EDZ is a 1.25 λ long center fed doublet as shown in Figure 1. It is the longest doublet that will yield a pattern with the major lobe broadside to the antenna. The azimuth plot is shown in Figure 2 and the elevation in Figure 3. Longer lengths will start to produce the classic "butterfly wing" pattern. Even longer lengths will produce multiple lobes broadside with the largest lobes approaching the ends of the antenna.

The EDZ also produces some very usable gain when compared to a ½ λ dipole. The typical gain is on the order of 2.5 to 3.0 dBd as shown in Figure 4. The EDZ derives its gain from the main lobe being compressed making the EDZ a bidirectional gain antenna. The EDZ azimuth plot shown in Figure 2 has a half power horizontal beamwidth of 34.8°. The elevation beam width (Figure 3) is 28.7°. These beamwidths will change depending the height of the antenna above ground. This antenna was analyzed at a height of 30 feet.[2]

The impedance of the EDZ will also vary depending on the height above ground, the ground conductivity and other proximity factors. Typical values at a height of ½ λ over average ground are 150 –*j*850 Ω. As you can see, the feed point is quite reactive. However, a balanced feed line of the appropriate length and impedance can cancel the reactance and move the resistance value closer to 50 Ω. To realize the full benefits of the EDZ, the antenna needs to be installed at a minimum height of ½ λ. Lower heights will result in a distorted pattern. This antenna needs to be installed as a flat top and not as an inverted V. Installation as an inverted V also distorts the pattern and results in reduced gain in the main lobe.

## Length

The formula for calculating the length of an EDZ is:

Length (ft) = 1240/frequency (MHz).

Table 1 shows some typical antenna lengths.

## Matching

The EDZ can be closely matched to 50 Ω by using a 0.155 λ (56°) matching section of 600 Ω balanced line.[3] A 1:1 balun or choke connects to 50 Ω coax of any length for the run to the station. The specified length of balanced line will cancel out the capacitive reactance of the antenna and transform the resistance value to about 50 Ω. Table 1 lists the actual length of the matching sections (Lf) needed to match the antennas shown.

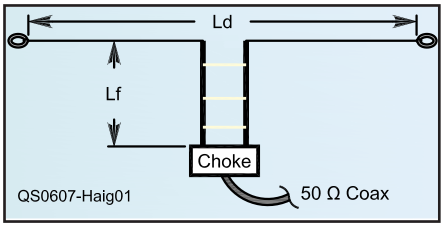


**Figure 1 — The extended double Zepp.**

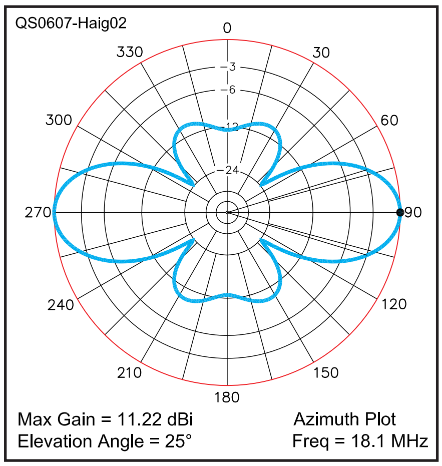


**Figure 2 — Azimuth pattern of the 17 meter EDZ antenna shown in Table 1.**

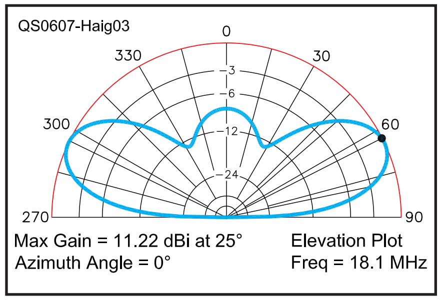


**Figure 3 — Elevation pattern of the 17 meter EDZ antenna shown in Table 1.**

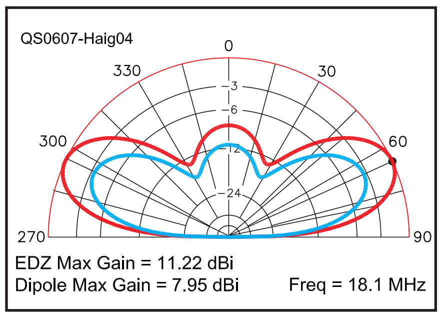


**Figure 4 — Comparison of the 17 meter EDZ antenna shown in Table 1 (red) versus a ½ wave dipole at the same height (blue).**

**Table 1**
**EDZ Antenna Dimensions for Different Bands**

| *Freq (MHz)* | *Ld (ft)* | *Min Height (ft)* | *Antenna Z* | *Feed-point Z* | *Lf (ft)* | *SWR* |
|---|---|---|---|---|---|---|
| 7.075 | 175.2 | 66 | 170.5 –*j*976.1 | 47.10 +*j*0.25 | 21.65 | 1.062:1 |
| 10.11 | 122.6 | 47 | 163.0 –*j*934.1 | 47.80 –*j*0.07 | 14.85 | 1.046:1 |
| 14.175 | 87.5 | 34 | 155.3 –*j*889.6 | 48.62 –*j*0.36 | 10.35 | 1.029:1 |
| 18.1 | 68.5 | 30 | 133.4 –*j*848.9 | 44.63 +*j*0.38 | 7.92 | 1.121:1 |
| 21.2 | 58.5 | 30 | 132.1 –*j*799.9 | 47.65 –*j*0.28 | 6.56 | 1.050:1 |
| 24.9 | 49.8 | 30 | 156.7 –*j*772.3 | 58.60 –*j*0.10 | 5.51 | 1.172:1 |
| 28.2 | 44 | 30 | 169.8 –*j*772.4 | 63.24 +*j*0.26 | 4.88 | 1.265:1 |

[1]Notes appear on page 36.

## Bandwidth

The 2:1 SWR bandwidth of the EDZ is approximately 2.2% and varies with height above ground. This fractional bandwidth will cover the CW portion of 40 meters, all of 30 through 12 meters (separate antennas for each band) and about 600 kHz of the 10 meter band.

## Multiband Operation

As designed, the EDZ is a single band antenna. The same pattern can be achieved by feeding the EDZ length dipole with low loss feed line all the way to an antenna tuner, either at the station or remotely operated in the antenna field. The antenna will load and work well on all bands at which it is ½ λ or longer, and be only slightly less efficient at the next lower band. The pattern will continue to be bidirectional for frequencies lower than the design frequency. At higher frequencies, as noted earlier, it will start to have multiple lobes, but still operate well into the covered areas.

## Building the EDZ

The EDZ is built much like any other doublet. Choose a strong conductive wire that is not prone to stretching. I typically use 7/22 gauge hard drawn copper wire for home antennas and 22 gauge silver plated, Teflon covered, stranded copper wire for portable use. The wire is measured allowing a little extra for the ends. Cut the doublet wire into two equal pieces and attach insulators. The wire is pushed through the hole in the insulator and wrapped back around itself. The wrap should then be soldered. Unsoldered connections will lead to noise and may become intermittent. The center insulator should be about the same width as the balanced line. End insulators can be any size that will handle the power you plan to use.

## Homebrewing 600 Ω Balanced Line

Balanced line can be homebrewed in several ways. First you need to determine the size of wire you want to use and then determine the distance apart the wires must be using the formula below. The characteristic impedance ($Z_0$) of a balanced line with air dielectric can be found from:

$$Z_0 = 276 \text{ Log } (2S/d)$$

where S is the center to center spacing between conductors, and d is the diameter of the wire used in the same units as the spacing.

Therefore, two 14 gauge (0.06408 inch diameter) wires spaced 4.8 inches apart will have a characteristic impedance of approximately 600 Ω. Larger diameter wire could be used for higher power and would have less loss but the spacing may be too great for the 10 meter band. The spacing should be held to less than 0.01 λ for the highest frequency used. Larger spacing may cause the feed line to start to radiate and look more like an antenna than a feed line. For portable use or low power, smaller diameter wire can be used without appreciable loss.

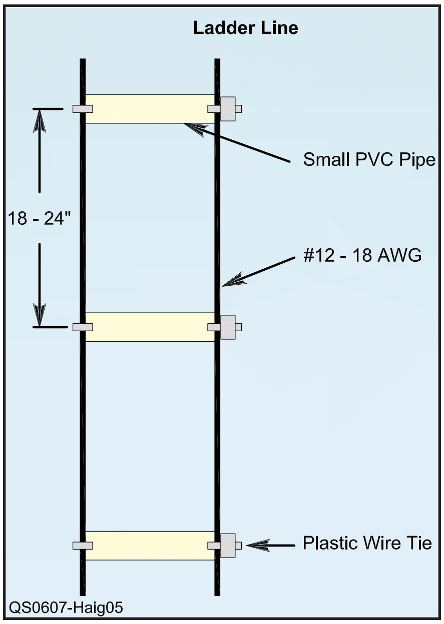


**Figure 5 — Diagram of type 1 ladder line.**

The spacers for the feed line can be made of any good insulating material. One method I have used is shown in Figure 5. The trick to this method is finding the long plastic wire ties. Another method uses plastic clothes hangers cut to the appropriate length and used as spacers. The spacers are drilled near the ends, and plastic wire ties are inserted in these holes and used to secure the wire to the end of the spacers. Alexander Krist, KR1ST, has documented this method of building ladder line on his Web page.[4]

## Installation

Before installing this antenna you will need to decide what areas you want to cover and orient the antenna accordingly. For example, if you are in the Midwest and you are interested in working Europe or VK/ZL DX, the antenna should be oriented so that the ends point toward the NW/SE. Since this antenna has a bidirectional broadside pattern, both areas would be covered. Keep the balanced line away from metallic objects and off the ground.

## Tuning

The matching section will need to be cut to correct length, or tuned, to achieve the desired match to the coax. The tuning process will require a 1:1 balun or choke, and preferably an antenna analyzer such as an MFJ-259B.[5] The balun can be a 1:1 voltage or current type or a choke. For 40 through 10 meters, I use eight turns of twisted pair wire wound through an FT140-61 ferrite core. This choke will isolate the balanced line from the coax shield and force equal currents in the balanced line conductors. Since the velocity factor can vary on homebrewed line by a few percent, the balanced feed line should be cut to be about 5% longer than the calculated value. The balanced line is connected to the center of the antenna, the choke is connected to the other end of the same line and the antenna analyzer should be connected as close as possible to the choke (see Figure 1).

Set the antenna analyzer to the frequency that the antenna was designed for. Measure the resistance and reactance. If the feed line reactance is positive (inductive), shorten the balanced feed line by 1 to 2 inches and measure again. If the feed line reactance is negative (capacitive), you will need to lengthen the balanced feed line. Continue adjusting the length of the balanced line to eliminate all reactance at the test frequency. Once the reactance has been eliminated, the SWR should be low and close to the values shown in Table 1. If you don't have access to an antenna analyzer, you can use a low power transmitter and SWR indicator to measure SWR. Lower the SWR by adjusting the length of the balanced feed line. When shortening the feed line, remove small amounts at a time to make sure you do not overshoot the correct length.

## Performance

The EDZ is truly a high performance wire antenna. It has a clean predictable pattern with enough gain to help seek out weak signals. The bandwidth is comparable to a ½ λ dipole. It is easily matched using 600 Ω ladder line and makes a great DX antenna. What more would you want?

### Notes

[1]See LB Cebik's Web site. For the 88 foot model **www.cebik.com/88.html**; for the 44 foot model **www.cebik.com/aledz.html**.

[2]The antennas shown here were analyzed with *EZNEC* version 3.0. *EZNEC* is available from Roy Lewallen, W7EL, at **www.eznec.com**.

[3]The match was determined using *TLDetails*. *TLDetails* can be obtained from AC6LA, **www.qsl.net/ac6la/tldetails.html**. [*TLW,* Transmission Lines for *Windows*, provided with *The ARRL Antenna Book*, can also be used.—*Ed.*]

[4]**www.kr1st.com/hfcoath.htm**.

[5]MFJ Enterprises, Inc, PO Box 494, Mississippi State, MS 39762, 800-647-1800, **www.mfjenterprises.com**.

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