Multi-Band Dipole Kit

DXE-WA-070  40-10 Meters
DXE-WA-135  80-10 Meters
DXE-WA-260  160-10 Meters

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Introduction

The DX Engineering Multi-Band Dipoles are designed to be rugged yet lightweight. Using a tuner, they are usable to 30 MHz. They come complete with the extra length wire elements, 100 feet of premium 300 Ω ladder feedline, Center-T support (U.S. Patent No. 7,764,244), and end mounting insulators (U.S. Patent No. D534,905). All hardware is stainless steel.

Dipole Models

There are 3 configurations. Depending on the tuner used, each model can be used at the low end of the respective 40, 80 or 160m band through 30 MHz:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Length in Feet</th>
<th>Band Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>DXE-WA-70</td>
<td>70</td>
<td>40M through 10M*</td>
</tr>
<tr>
<td>DXE-WA-135</td>
<td>135</td>
<td>80M through 10M*</td>
</tr>
<tr>
<td>DXE-WA-260</td>
<td>260</td>
<td>160M through 10M*</td>
</tr>
</tbody>
</table>

* Band coverage depends on location of the antenna, the use of a wide range tuner and the appropriate DX Engineering balun designed for use with an antenna tuner.

Specifications

All DX Engineering Multi-Band Dipole Antennas are built using the highest quality components.

- Elements - 14 AWG stranded copper, black PVC jacket for flexibility and strength
- Feedline - 18 AWG stranded, 300 Ω ladder line, UV-resistant, 0.88 Velocity Factor
- Hardware - Stainless steel
- Center-T support and end-insulators - Black, high impact, and UV-resistant
- Power rating - The correct DX Engineering 1:1 Current Balun is DXE-MC20-1-1 for one band resonant or DXE-MC20-1-1T for multi-band using a Tuner. These baluns provide better balance, have lower loss, and are more tolerant to load impedance and balance variations than other baluns. the limiting factor in band coverage will be the height above ground, location and the tuner used.

Safety Considerations

WARNING!
INSTALLATION OF ANY ANTENNA NEAR POWER LINES IS DANGEROUS

Warning: Do not locate the antenna near overhead power lines or other electric light or power circuits, or where it can come into contact with such circuits. When installing the antenna, take extreme care not to come into contact with such circuits, because they may cause serious injury or death.

Overhead Power Line Safety

Before you begin working, check carefully for overhead power lines in the area you will be working. Don't assume that wires are telephone or cable lines: check with your electric utility for advice. Although overhead power lines may appear to be insulated, often these coverings are intended only to protect metal wires from weather conditions and may not protect you from electric shock. Keep your distance! Remember the 10-foot rule: When carrying and using ladders and other long tools, keep them at least 10 feet away from all overhead lines - including any lines from the power pole to your home.
Mounting Considerations
When planning the location of your antenna, consideration should be given to the height, location of suitable support structures and feedline positioning and length.

Generally speaking, these antennas should be mounted as high as possible for best performance. Antenna height will affect the exact resonance point, radiation pattern, and takeoff angle. The higher the antenna, the lower the takeoff angle to the horizon, which increases the effective range of the antenna.

For DX, the minimum height above ground should be 1/2-to 1-wavelength at the lowest operating frequency. On the low bands, this height becomes impractical for most hams. For example, an 80m dipole at 70 feet is about 1/4-wavelength above the ground. This antenna would be good for local and short distance communications, but not optimal for DX, due to the high takeoff angle and ground absorption. A 40M dipole at 70 feet is approximately 1/2-wavelength high and is likely to be good for DX and less optimal for local or short range communications. For more information on antenna design, feedline and radiation angles, consult a reliable text such as the ARRL Antenna Book.

The antenna, including the 300 Ω feedline, should also be mounted as far from other structures as possible. This includes the ends of the wire elements, which are actually the most sensitive part of the antenna. Any objects, metal in particular, within the near-field radiation pattern can affect the impedance and radiation pattern of the antenna.

The feedline should also come away from the antenna at right angles for at least 1/2-wavelength for best performance.

Most installations involve compromises due to local terrain, available supporting structures, or other restrictions. Do the best you can with what you have.

Multi-Band Center Fed Shortened Dipole using Ladder Line Feedline
The DX Engineering Multi-Band Dipoles include 100 feet of high quality legal limit capable 300 Ω ladder line. Depending on your specific installation, this feedline will need to be shortened or lengthened. The optional DXE-LLC-1P Ladder Line Couplers can be used for connecting ladder line together for lengthening the ladder line.

Also included are two rolls of element wire, a hardware packet and four ring terminals. Two of the ring terminals accommodate 14 gauge wire and are used for the elements. The smaller ring terminals accommodate 18 gauge wire and are used for the ladder line.

Unroll the 2 wire elements and the ladder line using a hand-over-hand technique. This will prevent kinks and allow the wires to lay flat for assembly.

The ladder line feedline should be installed in odd multiple lengths of 1/8-wavelength on the lowest operating frequency to optimize the impedance presented to the balun over the frequency range of the antenna. This length can be calculated using the formula shown above Table 1 or use Table 1. DX Engineering 300 Ω ladder feedline has a velocity factor (VF) of 0.88.

If you have excess ladder line, it can be zigzagged while suspended in air, but it can't be closer than a few conductor spacings to metallic objects and should not be coiled or laid on the ground. If it is necessary to pass close to a metallic object, twist the line to partially balance the effect on both sides of the feedline.

If you need additional feedline, 100 ft. rolls (part number DXE-LL300-1C) and a convenient line coupler (part number DXE-LLC-1P) are available from DX Engineering. The line coupler includes a high impact,
insulated splice block, ring terminals and stainless hardware, permitting strong and consistent splices of ladder line. See Figure 2.

**Note:** When using an external balun, the feedline length should be calculated from the Center-T ladder line connection to the balun.

Often, a 4:1 balun is suggested for Multi-Band Dipoles. However, the best balun to use for this application has a 1:1 ratio. The impedance at the end of the feedline will vary from very high to very low. Tuners have an easier time with high impedance than a low one. A balun with a ratio of 4:1 or more will transform the already low impedance to an even lower one that will make the antenna hard to tune. The 1:1 ratio balun will just pass the low impedance through. Provide strain relief so the ladder line is not directly pulling on the balun connections.

The correct DX Engineering 1:1 Current Balun is **DXE-MC20-1-1** for one band resonant or **DXE-MC20-1-1T** for multi-band using a Tuner. These baluns provide better balance, have lower loss, and are more tolerant to load impedance and balance variations than other baluns.

Even when properly done, this arrangement will subject the coaxial line between the tuner and balun to very high standing waves and high voltage and/or current. Keep the coaxial line length as short as possible. If an externally mounted balun is not used, do not route the ladder line so close to the tuner or the rest of the station cables and equipment that RF feedback occurs. This will manifest itself by making the antenna very difficult to tune and the tuner controls will be very touchy. There may also be RF present on the microphone, key, etc. At a minimum, use good low loss coaxial line like **DXE-213U** an RG-213 or equivalent. RG8X and smaller coax will not do a proper job.

A simple multi-band dipole may be constructed for the lowest band on which operation is desired, but the overall length of the dipole antenna should be a shortened half wavelength as shown in Table 1. This antenna may be fed with ladder line and an antenna tuner with balanced connections. You should use a DX Engineering external balun connected with coaxial cable to a wide range unbalanced tuner for tuning the different bands.

Although it may not seem logical, shortening a multi-band dipole intended for 160 through 10 meter operation to less than 220 Ft. will actually help your wide range antenna tuner cover the lower frequencies easier. The same is true for a 80 through 10 meter coverage, shortened antenna to 110 ft. That is because you are using a non-resonant antenna system when you use ladder line feed systems for multi-band operations.

Changing the length of the ladder line will alter resulting impedances so the tuner should be able to reach a certain frequency that was giving it trouble. The coax from the DX Engineering 1:1 Balun to the tuner should be kept short; typically 5 to 15 feet is best.

The **DXE-LL300** - 300 Ω ladder feedline for a multi-band dipole must be close to an odd multiple length of 1/8 wavelength on the lowest operating frequency, used to optimize the impedance presented to the balun and tuner over the frequency range of the antenna. This length can be calculated using the following formula or use Table 1. The DX Engineering 300 Ω ladder feedline has a VF (Velocity Factor) of 0.88.

**Formula:**

\[
\text{Length} = \frac{123}{\text{Freq (MHz)}} \times 0.88
\]

**Where:**

- 123 = 1/8-Wavelength Factor
- Freq = Frequency in MHz
- 0.88 = Velocity Factor of **DXE-LL300** 300 Ω Ladder Feedline

Multiply the result times the odd multiple (1, 3, 5, 7, etc.) to get the correct length closest to your required feedline length.
Table 1
Recommended Antenna and Feedline Length for Shortened Multi-Band Dipoles for easier tuning

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Shortened Dipole (Ft.)</th>
<th>Make feedline an Odd Multiple of or close to this length in Feet (x 1, 3, 5, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>220</td>
<td>60</td>
</tr>
<tr>
<td>3.5</td>
<td>110</td>
<td>31</td>
</tr>
<tr>
<td>5.3</td>
<td>76</td>
<td>20</td>
</tr>
<tr>
<td>7</td>
<td>55</td>
<td>15</td>
</tr>
<tr>
<td>10.1</td>
<td>41</td>
<td>11</td>
</tr>
<tr>
<td>14</td>
<td>29</td>
<td>8</td>
</tr>
<tr>
<td>18</td>
<td>22</td>
<td>6</td>
</tr>
<tr>
<td>21</td>
<td>19</td>
<td>5</td>
</tr>
</tbody>
</table>

**Example:** To use an antenna from 80 meters to 10 meters, the feedline should be in odd 1/8 wavelength multiples on 80 meters.

The 80 meter band starts at 3.5 MHz. Therefore, 123/3.5 = 35.1.

DX Engineering 300 ohm ladder line has a velocity factor (VF) of 0.88, so 35.1 x 0.88 = 30.9 ft. per 1/8-wavelength.

If 90 feet is required to get to your balun mounting position, the nearest odd multiple 1/8 wavelength length is 92.7 feet (30.9 x 3).

If you need over 100 feet, you would have to add to the feedline to achieve 154.5 feet (30.9 x 5) to maintain the odd 1/8th multiple rule for length of the DX Engineering 300 ohm ladder line.

**Assembling the Dipole**

**Center-T Support**

The Center-T support has pre-drilled holes for attachment of the wire elements, ladder line feedline, and a support or messenger line.

<table>
<thead>
<tr>
<th>Kit Contents</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qty</td>
<td>Ladder Line Center “T”</td>
</tr>
<tr>
<td>1</td>
<td>End Insulator</td>
</tr>
<tr>
<td>2</td>
<td>Element Wire (length depends on model)</td>
</tr>
<tr>
<td>2</td>
<td>Ladder Line, 100 Ft.</td>
</tr>
<tr>
<td>2</td>
<td>Ring Terminal - 14 ga. - #10 hole</td>
</tr>
<tr>
<td>2</td>
<td>Ring Terminal - 18 ga. - #10 hole</td>
</tr>
<tr>
<td>4</td>
<td>Flat Washer, #10</td>
</tr>
<tr>
<td>2</td>
<td>Split Lock Washer, #10</td>
</tr>
<tr>
<td>2</td>
<td>External Tooth Lock Washer, #10</td>
</tr>
<tr>
<td>2</td>
<td>Hex Head Bolt, 10-24 x 3/4”</td>
</tr>
<tr>
<td>4</td>
<td>Hex Head Nut, 10-24</td>
</tr>
</tbody>
</table>

Install two the two 18 ga. Ring Terminals on one end of the ladder line. Crimping works fine, soldering is optional.
Install one 14 ga. Ring Terminal on each of the wire lengths at one end. Crimping works fine, soldering is optional.

Install the Hex Head Bolts into the two upper holes in the Center-T. Note one side of the Center-T has recessed areas for the hex head on the bolts.

Install a flat washer and then a hex nut on each of the hex head bolts and tighten. Refer to Figure 1 for a picture showing the hardware installed.

Weave the end of the ladder line with the attached Ring Terminals through the Center-T as shown in and place the ring terminals on the hex head bolts. Remove the excess slack in the ladder line on the Center-T support prior to putting up the antenna.

Install external tooth lock washers over the ladder line terminals.

Weave the ends of the element wires with ring terminals through the Center-T as shown and place the ring terminals on the hex head bolts. Remove the excess slack in the wire elements on the Center-T support prior to putting up the antenna.

Install flat washers on top of the element ring terminals. Install split lock washers on top of the flat washers. Finally install hex nuts on top of the split lock washers and tighten the assembly.

**Ladder Line Length**

Determine the length of ladder line needed for your particular antenna design. Refer to Table 1 for details on ladder line lengths.
If you need additional feedline, the optional DX Engineering DXE-LLC-1P Ladder Line Coupler can be used to create a strong and consistent splice. See Figure 2.

![Figure 2 - DXE-LLC-1P Line Coupler](image)

**Element Wire Lengths**

Determine the length of the element wires needed for your particular antenna design. Refer to Table 1 for details on element wire lengths.

**Attaching UV Resistant Rope to the End Insulators**

UV resistant Rope should be secured to the Center-T and/or the End Insulators (depending on your installation) using a non-slip knot. One suggestion for attaching the rope is shown in Figure 4. The ends of the rope should be cauterized with a small flame to prevent the rope braid from fraying.

![Figure 4 - Non-Slip Knot using UV resistant Rope](image)

**Support Line**

The center-T support top hole is used for the attachment of a UV resistant “messenger line” that can be strung above the antenna wire and is used to provide support for the antenna wire and feedline. The use of the messenger line, which is strongly recommended, will reduce stress on the element wires and keep the antenna from stretching over time, which will change its resonant frequency.

Determine the required length for the messenger line. Ideally, it should attach to the same structure used for the dipole, only above it, forming at least a 30 degree angle between the dipole and the messenger line. The ends of the rope should be cauterized with a small flame to prevent the rope braid from fraying.

After determining the proper length needed, form a loop at the mid-point of the messenger rope. Push this loop through the center-T support top hole, then pull the rest of the rope through the loop.
Manual Updates and Information

Every effort is made to supply the latest manual revision with each product. Occasionally a manual will be updated between the time your DX Engineering product is shipped and when you receive it. Please check the DX Engineering web site (www.dxengineering.com) for the latest revision manual.

Technical Support

If you have questions about this product, or if you experience difficulties during the installation, contact DX Engineering at (330) 572-3200. You can also e-mail us at: DXEngineering@DXEngineering.com

For best service, please take a few minutes to review this manual before you call.

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