Maxi-Core® Baluns

Formed Aluminum Case Cast Aluminum Case Formed Aluminum Case

DXE-BAL-INS Rev 8

DXE-BAL050-Series 1:1 Ratio
DXE-BAL100-Series 2:1 Ratio
DXE-BAL200-Series 4:1 Ratio
DXE-BAL300-Series 6:1 Ratio
DXE-BAL450-Series 9:1 Ratio
DXE-BAL600-Series 12:1 Ratio

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Introduction

The DX Engineering **Baluns**, using Maxi-Core® Technology, are 50 Ω current (choke) baluns that operate from 1.8 MHz to 30 MHz. Maxi-Core® Technology contributes significantly higher common mode impedance and a larger effective core area than similar designs, including conventional enameled wire or bead baluns. This results in:

- Higher power handling with lower loss - more power to the antenna
- Improved antenna bandwidth - easier on the tuner and radio
- Reduced RFI - less interference to and from your radio

These baluns allow your antenna to perform to its full potential and reduce the stress on your equipment. Additional construction benefits include:

- Internal DC shield ground and arc gaps improve lightning protection and reduce static
- PTFE silver coax connector, ceramic output posts, stainless steel terminals, and rugged aluminum housing provide maintenance-free operation

DX Engineering baluns are available in formed or cast aluminum case styles, three power-handling levels and come in standard or tuner versions.

Tuner baluns are for use with antenna tuners or systems with high SWR. These baluns use high-voltage wire and have excellent performance at very high SWR. Tuner baluns (denoted by "T" at the end of the balun part number) have slightly higher SWR when the load is perfectly matched, when no tuner is required. Because of that, we do NOT recommend T-suffix tuner baluns for higher resonant frequency antennas (above 15 MHz) unless they are used with tuners. The tuner-baluns can be used on the input or output of the tuner and can handle the same power in either location.

General Information on Baluns

Balun is an acronym for **BAL**anced to **UN**balanced, which describes certain circuit behavior in a transmission line, source or load. Most communications applications deal with two-terminal sources, transmission lines, and loads. This includes coaxial cables, open wire lines and systems working against earth or a ground plane as the "second conductor".

The balun has to do a good job and be reliable. DX Engineering has the expertise to design and build a better balun that will deliver more power to the antenna, be more reliable, and in many cases cost less than products made by others.

We also realized that advertising hype over the years had confused the issue of just what type of balun was appropriate to each antenna. This article is an attempt to define in simple terms how to get the most performance from your system, both on receiving and transmitting.

There are two types of baluns: **Current Baluns** and **Voltage Baluns**. The DX Engineering baluns are current-type baluns.

Current Baluns
Current baluns (also known as choke baluns) allow the output voltage, with respect to "ground" or outside world, to float to any value required to provide equal currents to each feedline conductor. In essence, current baluns are a universal device which will be used to drive either balanced or unbalanced lines or loads equally well. Current baluns isolate the device connected at one end from the device

connected at the other end. The balanced terminals on a current balun can be used to feed unbalanced or balanced loads or lines equally well. They can also be used as broadband phase-invertors, baluns or ununs.

Voltage Baluns
Voltage baluns always try to force the output terminals to equal voltages, which means currents can be far from even. A voltage balun almost certainly guarantees some feedline radiation (or reception), because there are very few "perfectly balanced" loads.

We recommend current baluns, rather than voltage baluns, whenever possible. Current baluns provide better balance, power handling, often have lower loss, and tolerate load impedance and balance variations much better than voltage baluns.

Systems Requiring Antenna Tuners

Antenna systems requiring use of an antenna tuner for matching often have very high voltages or currents on the transmission lines and baluns, even at modest power. In some cases, coax is used to connect the tuner directly to the antenna. The feedline is connected to a coaxial connector on the tuner, and the tuner "matches" the poor SWR of the antenna system to the station equipment. The feedline beyond the tuner still has very high voltage, current and loss, even if the tuner input is matched to 50 Ω.

In other cases, the antenna feedline is balanced, and the tuner has an internal or external balun. Unfortunately, most of the internal tuner baluns are 4:1 voltage baluns, which we will see is a poor choice.

Less often, balanced tuners are used. Such tuners, while often better at power handling than the more common but less robust "T" network tuners, may still not provide the best transmission-line balance. They would have to be ground independent; otherwise, they are the resonant equivalent of a voltage balun.

There are four areas of concern in such systems:

1. In a multi-band system, the antenna almost never presents a uniform load to the balun. As the operating frequency changes, the balun load impedance can change from several thousand ohms to a few ohms.
2. Most antenna tuners work best into high impedances, rather than low impedances. Most baluns inside antenna tuners step the antenna impedance down. The tuner would actually work better if the balun simply passed the line impedance through without stepping it down.
3. 4:1 Baluns inside antenna tuners, which are usually voltage-type baluns, are very poor performers when presented with mismatched loads. 1:1 baluns are generally much more efficient and have a wider operating impedance range.
4. Voltage baluns have restricted frequency response. The "good performance" frequency range is much narrower in voltage baluns than in equivalent current-type baluns.

Based on the above facts, a 4:1 balun or any voltage-type balun is the wrong choice for use with antenna tuners in multi-band systems. Most tuners use them because they are cheap, easy to build, and because almost everyone else uses them.

Special DX Engineering Tuner Baluns

For antenna tuners or systems with high SWR, we have a special balun. This balun uses high-voltage wire and has excellent performance at very high SWR. Even standard DX Engineering baluns are better than many competing baluns, because many competing baluns use enameled wire for insulation. Our standard balun wire insulation doesn't fail until voltage significantly exceeds 7,500 volts, while most competing baluns that use enameled wire fail at less than 25% of that voltage. That means, for the same mismatched load impedance, our standard balun can handle ***sixteen times*** the power of enameled wire baluns! Our tuner balun has a breakdown voltage of over 15,000 Volts. Need we say more?

Tuner baluns (denoted by "T" at the end of the balun part number) have slightly higher SWR when the load is perfectly matched on resonant antennas, when no tuner is required. Because of that, we do NOT recommend T-suffix tuner baluns for higher frequencies (above 15 MHz) on resonant antennas unless they are used with tuners. DX Engineering tuner-baluns work equally well and handle the same power on the tuner input or output, so use them wherever most convenient for your system. For resonant antennas use a standard DX Engineering balun, which are models that end without a "T" in the part number suffix.

DX Engineering Baluns

The chart on the next page shows a balun selection chart covering most types of antenna configurations. For further information, please visit the DX Engineering website at: **www.DXEngineering.com**

DX Engineering High-Power Transmission Line Transformers and Baluns with patented **Maxi-Core®** technology let your antenna perform to its fullest potential and reduce the stresses on your equipment. Only DX Engineering baluns will deliver the power to your antenna with minimum loss and perform a perfect transition from balanced to unbalanced. This will provide the strongest signal that your antenna is capable of producing consistently with the lowest SWR under given conditions, resulting in less stress on your transmitter so that components will last longer and operate better. DX Engineering baluns exhibit far wider bandwidths than conventional baluns because more of the flux is confined to the immediate vicinity of the core, so much more energy goes to your antenna. Extremely high efficiency is achieved over the entire frequency range.

Additional features include:

- A better match from the coax impedance to the impedance of the antenna for the lowest SWR
- Force equal currents for maximum efficiency and better patterns
- Exhibit an increased operating bandwidth over other baluns
- Allow for use of antenna tuner and maximum power amplifier without damage ("T" baluns only)
- Reduce transmit RFI and receive noise
- Unbalanced output uses PTFE/silver SO-239 connector
- Handle high power (up to 10 kW per published spec) with minimum energy loss
- Mounted in sturdy aluminum boxes designed for outdoor use
- Convenient mounting holes
- Perform at the highest levels of efficiency in transmit or receive applications
- Balanced input uses ceramic insulators with stainless steel hardware

DX Engineering Maxi-Core® Balun Selection Chart

Antenna Types	Suggested Balun(s)		
Dipole, coax fed, resonant	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C
Dipole, double extended	DXE-BAL200H10AT	DXE-BAL200H11CT	
Dipole, folded, 300 ohm feed	DXE-BAL300-H10-A		
Dipole, folded, coax fed, resonant	DXE-BAL300-H10-A		
Dipole, folded, multi-wire	DXE-BAL450-H10-A		
Dipole, folded, non-resonant	DXE-BAL300-H10-A		
Dipole, folded, two-wire	DXE-BAL200-H10-A	DXE-BAL200-H11-C	
Dipole, inverted vee, non-resonant	DXE-BAL050H10AT	DXE-BAL050H11CT	
Dipole, inverted vee, resonant	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C
Dipole, ladder line fed, non-resonant	DXE-BAL050H10AT	DXE-BAL050H11CT	
Dipole, linear load, ladder line fed	DXE-BAL200H10AT	DXE-BAL200H11CT	
Dipole, long, non-resonant	DXE-BAL200H10AT	DXE-BAL200H11CT	
Dipole, multi-band resonant	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C
Dipole, off-center fed (80/20 OCF)	DXE-BAL200H10AT	DXE-BAL200H11CT	
Dipole, snake type, ladder line fed	DXE-BAL200H10AT	DXE-BAL200H11CT	
Dipole, trap	DXE-BAL050-H10-A	DXE-BAL050-H11-C	
Doublet, multi-band, ladder line fed	DXE-BAL050H10AT	DXE-BAL050H11CT	
Horizontal vee doublet	DXE-BAL450-H10-A		
Inverted vee, coax fed, resonant	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C
Log periodic, 150-250 ohm feedpoint	DXE-BAL200-H10-A	DXE-BAL200-H11-C	
Log periodic, 50 ohm, direct coax feed	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C
Log periodic, 75-150 ohm feed	DXE-BAL100-H11-C		
Long wire with ground system	DXE-BAL200H10AT	DXE-BAL200H11CT	
Loop, horizontal, coax fed	DXE-BAL200-H10-A	DXE-BAL200-H11-C	
Loop, horizontal, non-resonant	DXE-BAL050H10AT	DXE-BAL050H11CT	
Loop, terminated, resonant (rhombic)	DXE-BAL600-H10-A		
Loop, vertical, non-resonant	DXE-BAL050H10AT	DXE-BAL050H11CT	
Loop, vertical, resonant, coax feed	DXE-BAL100-H11-C		
Matched 450 ohm systems	DXE-BAL450-H10-A		
Multi-band, ladder line fed	DXE-BAL050H10AT	DXE-BAL050H11CT	
Multi-band, remote balun	DXE-BAL200H10AT	DXE-BAL200H11CT	
Quad - 100 ohm feed	DXE-BAL100-H11-C		
Rhombic, resonant	DXE-BAL600-H10-A		
Rhombic, terminated	DXE-BAL600-H10-A		
Unipole, folded, resonant	DXE-BAL100-H11-C		
Unipole, multi-wire	DXE-BAL200H10AT	DXE-BAL200H11CT	
V-beams, resonant	DXE-BAL600-H10-A		
V-beams, terminated	DXE-BAL600-H10-A		
Windom, balanced feed	DXE-BAL450-H10-A		
Windom, conventional single wire	DXE-BAL200H10AT	DXE-BAL200H11CT	
Yagi, 100 ohm feedpoint	DXE-BAL100-H11-C		
Yagi, 200 ohm feedpoint (KT-34, X-7)	DXE-BAL200-H10-A	DXE-BAL200-H11-C	
Yagi, 50 ohm, direct coax feed	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C
Yagi, gamma matched	DXE-BAL050-H05-A	DXE-BAL050-H10-A	
Yagi, hairpin/beta matched	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C
Yagi, trap tri-bander	DXE-BAL050-H05-A	DXE-BAL050-H10-A	DXE-BAL050-H11-C

DX Engineering Maxi-Core® Balun Case Style Chart

DX Engineering Balun Part Number	Ratio	CW Power Rating	SSB Power Rating	Impedance	Case Style	Figure	Weight	Comments
DXE-BAL050-H05-A	1:1	2kW	5kW	50 Ω	Formed	1	1.7 lb	
DXE-BAL050-H10-A	1:1	5kW	10kW	50 Ω	Formed	2	2.3 lb	
DXE-BAL050-H11-C	1:1	10kW	10kW+	50 Ω	Cast	3	2.8 lb	
DXE-BAL050H10AT	1:1	5kW	10kW	50 Ω	Formed	2	2.9 lb	Designed to work with Tuner
DXE-BAL050H11CT	1:1	10kW	10kW+	50 Ω	Cast	3	2.8 lb	Designed to work with Tuner
DXE-BAL100-H11-C	2:1	10kW	10kW+	50 Ω	Cast	4	3.7 lb	
DXE-BAL200-H10-A	4:1	5kW	10kW	200 Ω	Formed	2	2.4 lb	
DXE-BAL200-H11-C	4:1	10kW	10kW+	200 Ω	Cast	4	3.6 lb	
DXE-BAL200H10AT	4:1	5kW	10kW	200 Ω	Formed	2	2.9 lb	Designed to work with Tuner
DXE-BAL200H11CT	4:1	10kW	10kW+	200 Ω	Cast	4	3.6 lb	Designed to work with Tuner
DXE-BAL300-H10-A	6:1	5kW	10kW	300 Ω	Formed	2	2.9 lb	
DXE-BAL450-H10-A	9:1	5kW	10kW	450 Ω	Formed	2	2.9 lb	
DXE-BAL600-H10-A	12:1	5kW	10kW	600 Ω	Formed	2	2.9 lb	
Frequency Range is 1.8 through 30 MHz.			**Top termination is 10-32 studs with Wing Nuts.**				**SO-239 Coaxial Cable Connection.**	

Figure 1

Formed Aluminum Case

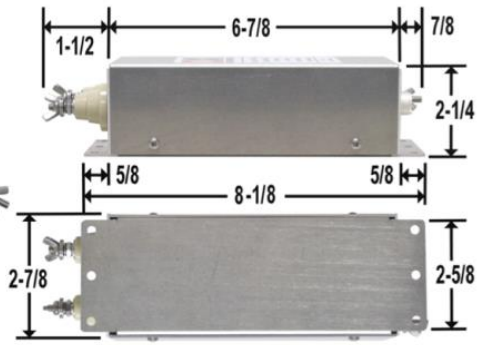


Figure 2

Formed Aluminum Case

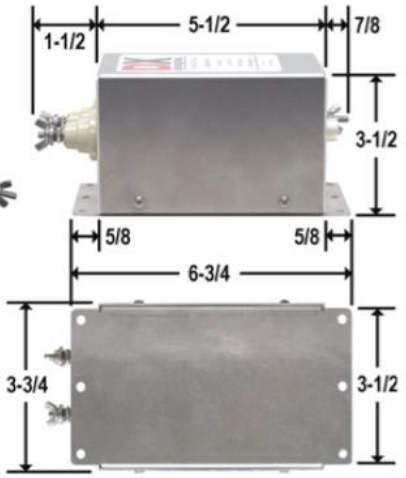
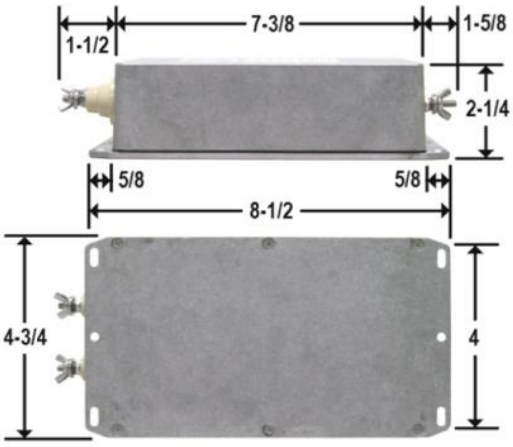


Figure 3

Cast Aluminum Case

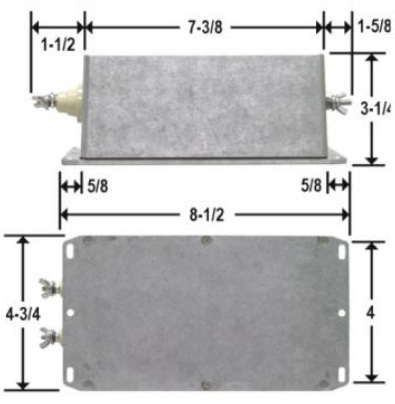


Note: Some models may have a threaded lug with a wing nut on the same side as the coaxial cable connector.

This is NOT a ground lug - this is a spare wing nut holder only.

Figure 4

Cast Aluminum Tall Case



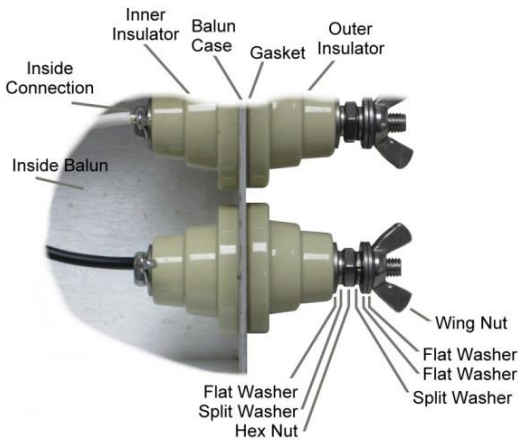
Connections

Both balanced terminals are effectively **floating**, or **ground independent**, over the operating frequency of the balun. The balanced terminals do have a phase relationship with the unbalanced coax connector. The **RED "D"** in DX Engineering on the balun label is adjacent to the positive phase terminal as shown below. In some applications, such as resonant or trapped dipoles and Yagis, the phase is not important. Other applications, such as single-wire-fed antennas, require the antenna system ground to be attached to the negative phase terminal.

Balun Used With Single-Wire Feed

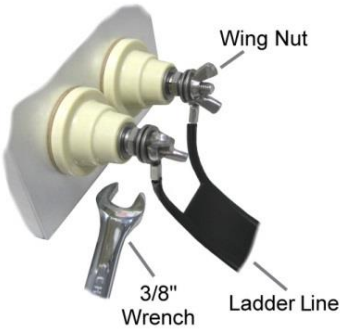
Note: ***The RED D in the DX Engineering logo is closest to the Positive Phase Terminal. The other terminal is the Negative Phase Terminal. Both terminals must be used for balanced or unbalanced lines or loads. The BLACK X is the Negative Phase Terminal and is on the shield side of the unbalanced coax connection. Do not attach a ground, counterpoise, or radial array to this terminal.***

Some models may have a threaded lug with a Wing Nut on the same side as the coaxial cable connector. This is **NOT** a ground lug - this is a spare wing nut holder only.



When making connections to the balanced terminals, the antenna wire should be placed between the flat washers. **The supplied wing nuts should be hand tightened only.** Do not use pliers or other tools to tighten them as excessive force may damage the internal connections or the ceramic insulators.

When making connections to the balanced terminals, it is recommended that you install ring terminals on the ladder line rather than just twisting the bare wire around the terminals. Using ring terminals will provide a longer lasting reliable connection.



Using 3/8" wrench - hold hex nut steady

Additionally, the use of a 3/8" open end wrench is strongly suggested to hold the hex nut in place while you hand tighten the wing nut. This will prevent the 2-1/2" long hex bolt that goes inside the balun from rotating and possibly breaking an internal soldered connection.

The supplied wing nuts should be hand tightened only. Do not use pliers or other tools to tighten them as excessive force may damage the internal connections or the ceramic insulators.

If DX Engineering baluns are used in an array of two or more phased vertical antennas, it is essential that the positive phase terminal be connected to the antennas and the negative phase terminal to ground. Reversing these connections can put the antennas in the array out of phase with each other and ruin the phase relationship you have established, and for the desired antenna pattern.

The same is true of any phased antenna array. The elements must be fed in the same phase from the balun. For example, if the positive phase terminal is connected to the left side of a yagi driven element on one antenna, the same connection must be made on subsequent antennas in the array.

Installation

While the installation of this balun is a simple process, there are a multitude of factors to consider when designing and erecting antenna systems. The antenna mounting height, proximity to structures, the feedline type, length and velocity factor are all factors that affect antenna performance.

Resonant Dipole Applications

A resonant dipole is cut for a particular band and its planned use is only within that band or on odd-harmonics where the SWR is naturally low. The well known formula for the length of the element is in feet is 468/F. The ultimate length may vary a few percent either shorter or longer so better to make it a little longer to start. The best balun for this application is the 1:1 ratio current balun.

This antenna can use a coax feed and the balun is usually located right at the dipole element to ensure that the each side of the element receives equal currents and to keep currents off of the feedline. The feedline should then be led away from the antenna at right angles which will keep the antenna field from introducing current on the outside of the feedline after it leaves the balun and will keep the feedline from introducing noise onto the antenna element.

The **DXE-BAL050-H05-A** 1:1 balun is shown installed with the optional **DXE-UWA-KIT** Universal Wire Antenna Center-T (*U.S. Patent No. 7,764,244*) insulator in **Figure 5**. The optional **DXE-CSR8X-1** cable strain relief kit shown in **Figure 5** removes the load of the RG-8X cable weight from the connector. When using RG-213 or RG-8 coaxial cable, the **DXE-CSR213-1** Cable Strain Relief Kit would be used.

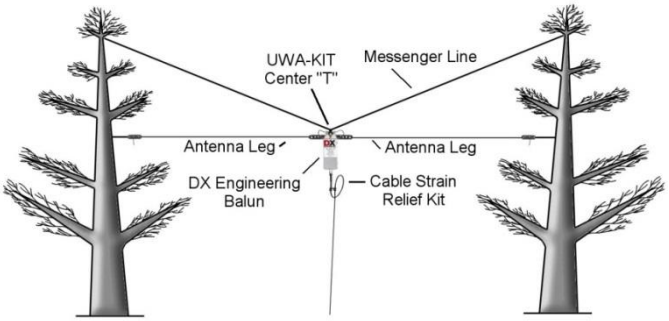
The top hole (3/8" dia.) in the Center-T (*US Patent No. 7,764,244*) is used for rope support of the balun and feedline in the event that:

- The antenna will be used in the Inverted-V configuration.
- The balun hangs lower than desired.
- The stress on the wires is higher than usual due to wind or ice loading

The **DXE-UWA-KIT** Center-T is used for the attachment of a "messenger line" which can be strung above the antenna wire. This line can be thin 3/32" Dacron rope such as DX Engineering **SYN-DBR-94-100** which has a breaking strength of 260 pounds. The use of this line will keep the antenna element from stretching over time and changing its resonant frequency.

The connection from the balun to shack would then be handled by coax. The best coax that you can afford is always the right choice.

Figure 5



Multi-band Dipole Applications

A Multi-band Dipole antenna is cut for a specific frequency, but plans call for it to be used on any frequency above that.

Feedline Length with Multi-band Dipoles
Feedline length is critical to antenna performance. Always choose a feedline (connects the antenna to the balun in this instance) that is an electrical 1/8-wavelength or some odd-multiple of 1/8-wavelength long on the lowest band. **Table 1** shows the correct dimensions for the antenna and feedline for your Multi-band Dipole antenna when using DX Engineering Ladder Line. Make the feedline any **odd** multiple of the lengths shown. Be sure you use the correct column for 300 Ω or 450 Ω feedline.

Lowest Frequency on which the Antenna will be Used (MHz)	Half-Wave Dipole (feet) located 1/2-wavlength or more above ground*	Recommended length (feet) if non-resonant dipole and less than 1/2-wavelength above ground	Make the feedline an ODD multiple of this electrical 1/8-wave length in feet (x 1, 3, 5, etc.)	
			Select Column Corresponding to Correct Velocity Factor of Your Feedline. Velocity Factors Shown Are For DX Engineering Ladder Line	
			0.91 (450Ω ladder)	0.88 (300Ω ladder)
1.8	260	220	62.2	60.0
3.5	134	110	32.0	30.9
5.3	88	76	21.1	20.4
7	67	55	16.0	15.4
10.1	46	41	11.1	10.7
14	33	29	8.0	7.7
18	26	22	6.2	6.0
21	22	19	5.2	5.1
24	20	-	4.7	4.5
28	17	-	4.0	3.9

Table 1 - Feedline Length for Multi-band Dipoles

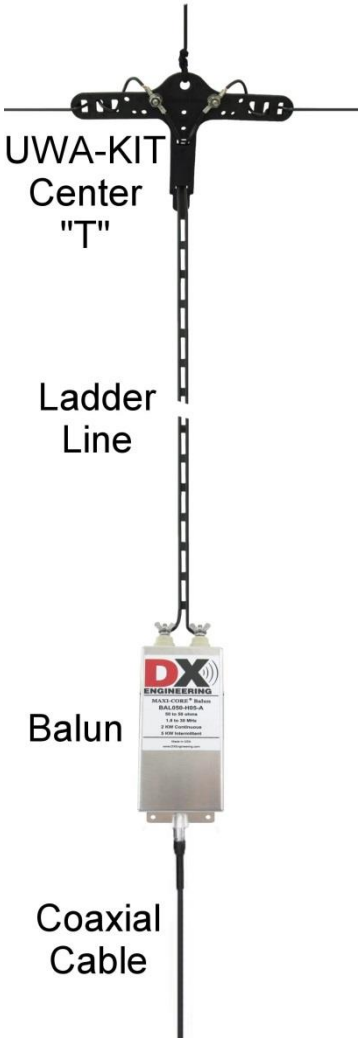
Formula for Half-Wave Dipole:

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

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

A feedline made in the appropriate electrical length closely duplicates the antenna feedpoint impedance which, in these cases, makes it easier to match a 50 Ω impedance. Avoid using coax for antennas with an SWR of more than 5:1 due to the high loss of coax under these circumstances as well as high current and voltage potential.

Often, a 4:1 balun is suggested for Multi-Band Dipoles. However, the best balun to use for this application is a 1:1 ratio - **DXE-BAL050H10AT** or **DXE-BAL050H11CT**. The impedance at the end of the feedline will vary considerably 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 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.



The parallel conductor feedline should be constructed according to the chart above, and routed to the balun located at a convenient location. The balun should be located such that the **coax between it and the tuner is as short as possible.** However, do not route the parallel line so close to the tuner or the rest of the station 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.

Although it may not seem logical, shortening a relatively low to the ground multi-band dipole, intended for 160 through 10 meter operation, to less than 220 feet will actually help your wide range antenna tuner cover lower frequencies easier. That is because you are using a non-resonant antenna system, when you use ladder line feed systems for multi-band operations also, changing the length of the ladder line will alter resulting impedances enough so that the tuner may 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.

You can read more about this on the DX Engineering web site (**www.DXEngineering.com**) look for the article "*Choosing the Correct Balun*".

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. You should use good low loss coaxial line and keep the coaxial line length as short as possible. RG-8X and smaller may not do a proper job; DX Engineering RG-213/U or equivalent is the minimum recommended coaxial cable.

Using a 1:1 balun with a Loop antenna is not recommended except when using the Loop antenna far from a resonant or harmonic frequency. When operating the Loop antenna on random unplanned frequencies far from resonance, use the balanced feedline with the lowest impedance and loss available. Using 300 Ω **DXE-LL300** transmitting ladder line is best. Place the balun as close to the tuner as possible. Use a 1:1 tuner balun. Avoid using coax in any part of the system with high SWR (over 5:1).

Many amateur multi-band wire antennas such as the off-center fed, Windom and other unbalanced dipoles as well as short 'no radial' verticals use voltage baluns to accomplish multiple resonances at the expense of efficiency. DX Engineering current baluns will not function as a voltage balun, so they are not direct replacements for voltage balun antenna systems.

For more information about antenna design and safety, consult a reliable text such as the *ARRL Antenna Handbook* or visit the DX Engineering website at **www.DXEngineering.com**.

Mounting

All DX Engineering baluns are manufactured with sealed cast aluminum or formed aluminum enclosure, depending on the model number. Both are pictured on the cover for comparison. Although mounting is application specific, follow these general guidelines:

Cast Aluminum Enclosure
This enclosure employs a gasket and is sealed. When vertically mounted it is recommended that the coax side be pointed down to reduce connector exposure. If desired, a small 1/8" diameter "weep hole" may be carefully drilled at the lowest point in the vertically mounted cast aluminum enclosure.

Formed Aluminum Enclosure
DX Engineering baluns are not affected by moisture and may be left outside in all types of weather, including heavy rain, as long as the balun is positioned so that water will drain from the case. However, they may not be *immersed* in water and care should be taken to avoid blocking the drainage of any water that could get inside.

For most installations, weather-sealing of the formed aluminum enclosure balun is not required. If you chose to add weather-sealing to enhance weather resistance, it may be useful to put a bead of high quality, non corrosive, marine grade silicone **PTX-82180**, along the top facing seam where the two halves of the case meet. Depending on the mounting orientation, leave a small opening in the seam at the lowest point to allow any condensation to drain. Silicone sealant which contains acetic acid, which has a vinegar-like smell, is corrosive to aluminum and should be avoided.

A high quality **DXE-PL259** PTFE silver plated PL-259 connector is recommended. Be sure to weather-seal the coax connection with proper tape layers. Use **TES-2155** rubber splicing tape and wrap the connector with one layer from end-to-end while stretching the tape by a factor of about 2:1. Follow with a wrap of **TES-06132** vinyl tape. Unlike some waterproofing solutions promoted to the Amateur market, the **TES-2155** splicing tape can be easily removed at any time and will not permanently adhere to the fitting.

DX Engineering baluns require no maintenance when properly installed.

Mounting Kits

DX Engineering offers several optional mounting kits. For boom or mast mounting, use the optional **DXE-BMB** series Balun Mounting Kits which include an aluminum bracket and stainless steel circular clamps and hardware. Kits are available to fit booms, masts or tower legs from 0.75" OD to 3" OD. Refer to **Figure 6**.

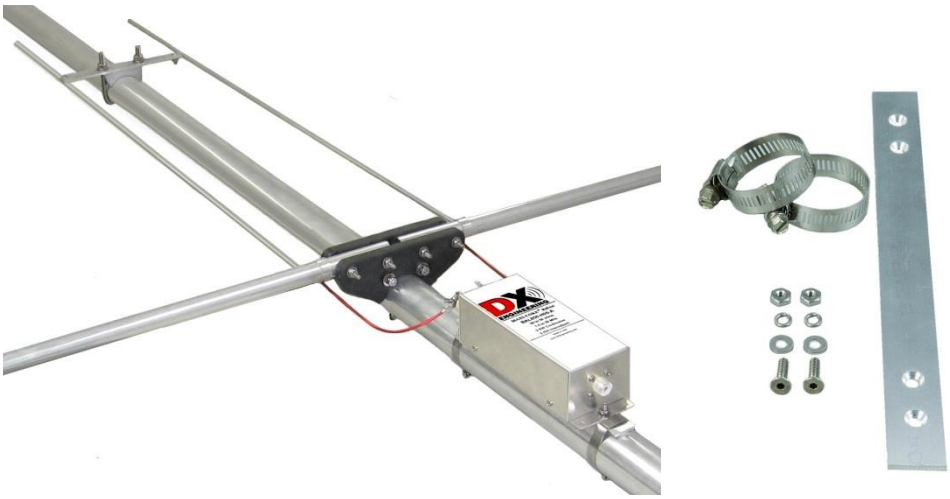


Figure 6 - Installation of a formed aluminum enclosure on a 2" boom using the optional **DXE-BMB-2P** Balun Mounting Kit.

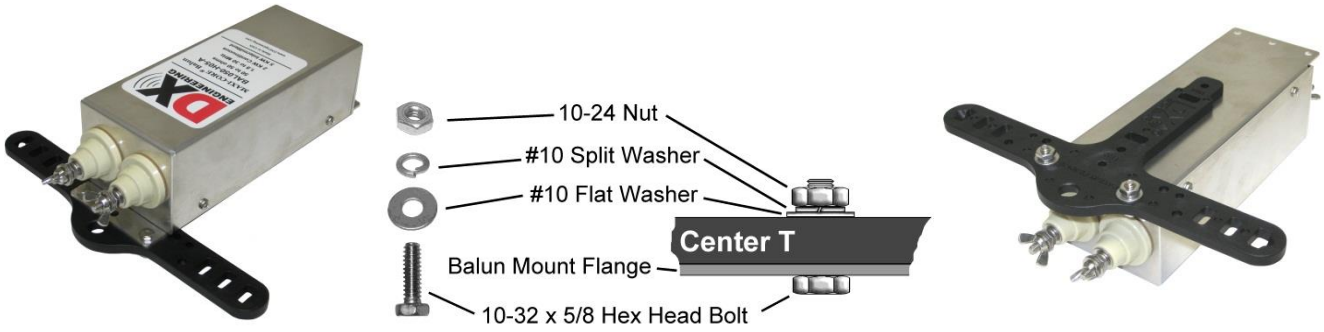
Mounting a Balun to the UWA-KIT Center-T (*U.S. Patent No. 7,764,244*)

For Dipoles, the **DXE-UWA-KIT** Universal Wire Antenna Kit which attaches directly to the balun and has mounting holes (3/8" dia.) for a center support rope and the wire elements, making a compact, integrated solution.
Refer to **Figure 7**.

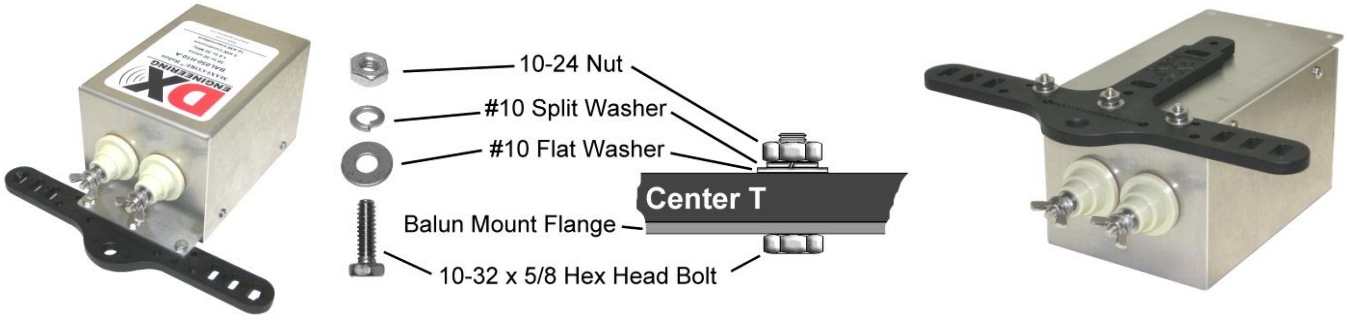
Figure 7 - DXE-UWA-KIT Universal Wire Antenna Kit mounted on a formed aluminum enclosure balun with an optional **DXE-CSR8X-1** coaxial cable strain relief kit.

There are three types cases used for DX Engineering Baluns. Two are formed aluminum and one is cast aluminum. The following are typical examples of the three types of cases for the available baluns showing the method for mounting them to the Center-T (*U.S. Patent No. 7,764,244*) of a **DXE-UWA-KIT**.

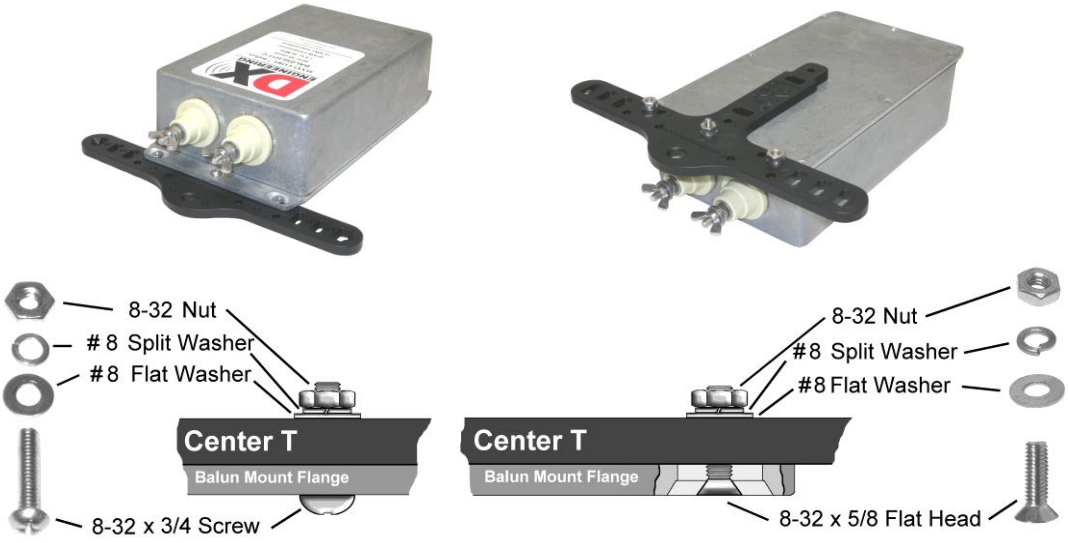
1. **DXE-BAL050-H05-A** Uses a Formed Aluminum Case that is approximately 7" x 3" x 2-1/4" thick. Use two sets of the #10 hardware as shown below.



2. **DXE-BAL050-H10-A** Uses a Formed Aluminum Case that is approximately 5-1/2" x 3-3/4" x 3-3/8" thick. Use three sets of the #10 hardware as shown below.



3. **DXE-BAL050-H11-C** Uses a Cast Aluminum Case that is approximately 7-1/4" x 4-1/2" x 2-1/4" thick. Use two sets of the # 8 hardware with the flat head screws for the outside, and one set of the # 8 hardware with the Philips head screw for the center as shown below.



Optional Items

Balun, FCC & VFCC Mounting Kits Use one of these BMB kits to mount your DX Engineering Balun to the bottom of a vertical, the boom of a Yagi, antenna mast or a tower leg. Three different kits fit tubing or pipes from 3/4 in. to 3 in. The Dipole Adapter Bracket kit can be used as the center insulator of a dipole and allow a balun to be mounted right at the feedpoint. These kits will work with any DX Engineering balun.

DXE-BMB-1P	Balun Mounting Kit for a .750 in. thru 1.50 in. Boom
DXE-BMB-2P	Balun Mounting Kit for a 1.56 in. thru 2.25 in. Boom
DXE-BMB-3P	Balun Mounting Kit for a 2.31 in. thru 3.00 in. Boom

DXE-9551 - Replacement Ceramic Insulators
2 ceramic insulators for use with DX Engineering Baluns.
DX Engineering Baluns utilize 4 Ceramic Insulators per balun, however our replacement insulators are sold in pairs.

DXE-UWA-KIT - Universal Wire Antenna Kit
This is the basic model of the versatile DX Engineering **EZ-BUILD**® Universal Wire Antenna Kit. It allows you to build a wire antenna of almost any design. The patented insulators feature a unique serpentine wire grip for DX Engineering's insulated Antenna Wire and for our high strength, high power 300 Ω Ladder Line. The serpentine wire connection grip is strong enough to support the antenna wires without looping or wrapping the wire ends. This allows fast and easy field adjustments of antenna length without soldering. This kit includes light weight, high strength, UV protected Center-T (*U.S. Patent N0. 7,764,244*) and End Insulators, as well as stainless steel hardware to build an antenna system using any combination of wire and feedline without the need to solder.

DXE-CSR8X-1 and **DXE-CSR213-1** are coaxial Cable Strain Relief kits especially designed to be used with DX Engineering Baluns. The **DXE-CSR8X-1** includes clamps for RG-8X coaxial cable and the **DXE-CSR213-1** includes clamps for RG-213 coaxial cable. Coaxial cable is heavy. If not properly restrained, the weight of cable can cause a failure in your feed line connection and in some cases the cable can pull completely out of the PL-259 connector. The **DXE-CSR** Cable Strain Relief kits are designed with corrosion-resistant aluminum and use stainless steel hardware. These kits are very durable and will ensure cable strain is relieved to keep you on the air.

DXE-CSR8X-1	Cable Strain Relief Kit, For RG-8X sized coaxial cable
DXE-CSR213-1	Cable Strain Relief Kit, For RG-213 sized coaxial cable

300 Ω Ladder Line
DX Engineering offers high-quality, 300 Ω ladder line rated for full legal transmit power. Each conductor is 18 gauge consisting of 19 strands of copper clad steel wire, resulting in a Velocity Factor of 0.88. This ladder line is ideal for use with multi-band dipoles or other multi-band antennas and is recommended when using our tuner baluns. We use the same line with the DX Engineering Multi-band Dipole antennas

DXE-LL300-1C	Ladder Line, 300 ohm, #18 - 19 strand, 100 feet
DXE-LL300-2C	Ladder Line, 300 ohm, #18 - 19 strand, 200 feet
DXE-LL300-3C	Ladder Line, 300 ohm, #18 - 19 strand, 300 feet
DXE-LL300-4C	Ladder Line, 300 ohm, #18 - 19 strand, 400 feet
DXE-LL300-5C	Ladder Line, 300 ohm, #18 - 19 strand, 500 feet

SYN Antenna Support Rope

SYN Double-braided Polyester ropes are not weakened by decay or mildew and provide excellent resistance to abrasion. The color sealed black polyester yarn used in the braided jacket also protects the cord from damage due to ultra-violet light.

SYN-DBR-94-100	3/32 in. Diameter, Double-Braid Dacron/Polyester Rope, 100 ft. Roll
SYN-DBR-94-1000	3/32 in. Diameter Double-Braid Dacron/Polyester Rope, 1000' roll
SYN-DBR-125-100	1/8 in. Diameter, Double-Braid Dacron/Polyester Rope, 100 ft. Roll
SYN-DBR-187-100	3/16 in. Diameter, Double-Braid Dacron/Polyester Rope, 100 ft. Roll
SYN-DBR-187-350	3/16 in. Diameter, Double-Braid Dacron/Polyester Rope, 350 ft. Roll
SYN-DBR-187-500	3/16 in. Diameter, Double-Braid Dacron/Polyester Rope, 500 ft. Roll
SYN-DBR-312-100	5/16 in. Diameter, Double-Braid Dacron/Polyester Rope, 100 ft. Roll
SYN-DBR-312-500	5/16 in. Diameter, Double-Braid Dacron/Polyester Rope, 500 ft. Roll
SYN-DBR-437-500	7/16 in. Diameter, Double-Braid Dacron/Polyester Rope, 500 ft. Roll

TES-2155 - 3M Temflex™ 2155 Rubber Splicing Tape

Conformable self-fusing rubber electrical insulating tape. It is designed for low voltage electrical insulating and moisture sealing applications. For outdoor use, it should be protected from UV deterioration with an overwrap of **TRM-06132**

TES-06132 - Scotch® Super 33+.

Highly conformable super stretchy tape for all weather applications. This tape provides flexibility and easy handling for all around performance. It also combines PVC backing with excellent electrical insulating properties to provide primary electrical insulation for splices up to 600V and protective jacketing. Both tape products are available from DX Engineering.

PTX-82180 - DX Engineering Approved Black RTV Sealant By Permatex®

We have all used RTV to seal water out of things, right? Have you ever sealed a piece of electronic gear with it -- then opened it some time later to find that it had still managed to become corroded inside? Guess what? It's not the rain that corroded it - It's the RTV. Normal RTV gives off acetic acid when it cures. That's the vinegar smell. The acetic acid causes the corrosion. DX Engineering has located a Neutral Cure RTV made right here in Ohio that is non-corrosive and is safe for sealing those baluns and other electronic gear that are going to be out in the weather. Applies just like "normal" RTV, dries in one hour and cures in 24 hours at 70 degrees F. And it doesn't smell like vinegar. 3.3 oz. Tube

*This part is classified hazardous and is limited to domestic UPS Ground shipping only

JTL-12555 Jet-Lube™ SS-30 Pure Copper Anti-Seize 12555

Jet-Lube™ SS-30 Pure Copper Anti-Seize is the top choice of engineers and technicians in government, industry and leading Amateur Radio contest stations, for protecting mechanical assemblies of aluminum tubing, general hardware and copper grounding systems. An environmentally preferred thread lubricant and conductive termination compound, Jet-Lube™ SS-30 helps keep your equipment in serviceable condition. It contains a high concentration of copper flakes, a requirement for heavy loads or compression; controlled frictional characteristics allow the surfaces of nuts and bolts to be tightened to their design torque specifications. This anti-seize product assures full hydraulic efficiency by allowing the metal surfaces to slide over each other without damaging metal-to-metal contact. Jet-Lube™ SS-30 is also designed to work as a similar and dissimilar component between two metal surfaces to prevent seizing and galvanic action. Jet-Lube™ SS-30 Pure Copper Anti-Seize Features include: Meets MIL-PRF-907E spec - K-factor: 0.13 - Service rating: -65 degrees F (-54 degrees C) to 1800 degrees F (820 degrees C) - SS-30 Resistivity (ohm-CM x 108) 5

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 DX Engineering at: DXEngineering@DXEngineering.com

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

Warranty

All products manufactured by DX Engineering are warranted to be free from defects in material and workmanship for a period of one (1) year from date of shipment. DX Engineering's sole obligation under these warranties shall be to issue credit, repair or replace any item or part thereof which is proved to be other than as warranted; no allowance shall be made for any labor charges of Buyer for replacement of parts, adjustment or repairs, or any other work, unless such charges are authorized in advance by DX Engineering. If DX Engineering's products are claimed to be defective in material or workmanship, DX Engineering shall, upon prompt notice thereof, issue shipping instructions for return to DX Engineering (transportation-charges prepaid by Buyer). Every such claim for breach of these warranties shall be deemed to be waived by Buyer unless made in writing. The above warranties shall not extend to any products or parts thereof which have been subjected to any misuse or neglect, damaged by accident, rendered defective by reason of improper installation, damaged from severe weather including floods, or abnormal environmental conditions such as prolonged exposure to corrosives or power surges, or by the performance of repairs or alterations outside of our plant, and shall not apply to any goods or parts thereof furnished by Buyer or acquired from others at Buyer's specifications. In addition, DX Engineering's warranties do not extend to other equipment and parts manufactured by others except to the extent of the original manufacturer's warranty to DX Engineering. The obligations under the foregoing warranties are limited to the precise terms thereof. These warranties provide exclusive remedies, expressly in lieu of all other remedies including claims for special or consequential damages. SELLER NEITHER MAKES NOR ASSUMES ANY OTHER WARRANTY WHATSOEVER, WHETHER EXPRESS, STATUTORY, OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS, AND NO PERSON IS AUTHORIZED TO ASSUME FOR DX ENGINEERING ANY OBLIGATION OR LIABILITY NOT STRICTLY IN ACCORDANCE WITH THE FOREGOING.

Specifications subject to change without notice.