



RFI Solutions from KHz to GHz

Ham Radio Antenna Application Notes

BULLET End Fed Half Wave Antenna

Antenna Tip Sheet 2023

Need a high performance, multi-band, stealthy antenna system that is easy to setup and use? Get the Bullet-49 matching unit, the antenna wire, insulator and feed line choke (for tuning the antenna SWR) all in one convenient package (great for HOA restricted areas, camping and portable operations) and remember the feed line choke to reduce common mode noise in your receiver.

One of the most popular antennas today is the end fed half wave due to its ease of installation, portability and stealth in various installations. It can be a condo dweller's only access to the world of ham radio or the best alternative for a backpacking SOTA (Summits on the Air), NPOTA (National Parks of the Air), mountaintop expedition, field day or portable outing. Excellent performance for permanent installations as well.



The antenna is simple to deploy, folds up easily for transport, and weighs under a pound, yet, with the 66 foot included wire, can work the 40-10 meter bands easily with the built in antenna tuner of most current day transceivers.

The key to the antenna's success is the very efficient proprietary antenna matching unit between the antenna and the coax feed line to the transceiver. The Bullet-49-500 antenna matcher employs a broadband transformer for wide bandwidth (1.8-30 MHz), a conservative 500 watt PEP rating, an easy on/off antenna wire connector, a connection for an optional wire counterpoise, and a SO-239 female coax connector for easy attachment of 50 ohm coax cable.

BULLET-49-500 Matching Unit

Our antenna matching network is called the "Bullet" because of its shape and its effectiveness at taking down or contacting distant (DX) stations all over the world under the right conditions.

We sell the antenna as a complete antenna system including Bullet-49U-500, antenna wire, end insulator and coax feed line choke to reduce common mode receiver noise and stop coax braid RFI to your radio as well as fine tune the SWR characteristics of the antenna.

For best results we recommend the suggested minimum coax feed line lengths shown in the table below. The coax feed line choke is a convenient snap on ferrite bead (Part# SOFLC) with 5-6 turns of RG-8X coax line. We also recommend a coax noise filter (Part# CMNF-500-50 for 500 watts) at the radio end of the coax feed line to suppress RFI common mode noise picked up by the coax outer braid.

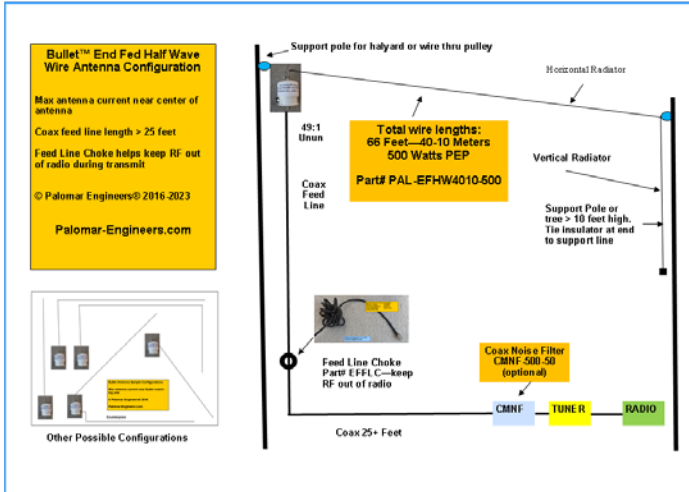
Suggested wire lengths (measured from Bullet wire terminal):

Bands Covered (meters)	Wire Length (feet)	Min Coax Length (feet)	Counterpoise Choke (feet)
40-10	66	25	16

Installation

The Bullet-49 antenna wire can have many configurations. For best results, extend the antenna wire horizontally or as an "L" (horizontal "tail" with vertical matching unit end drop). The antenna may also be deployed as a sloper with the Bullet matching unit at the top (best) with the wire sloping toward the ground (with the end high enough to avoid contact by humans or animals), or at the bottom of the sloper with the antenna wire rising to a higher point. A typical setup which has proven successful in many portable installations is shown below:

Configurations



Any length of 52 ohm feed line ok but longer feed lines over 50 feet may show reduced SWR on some bands due to soil conductivity, nearby objects, etc. Due to local ground conditions, antenna height and feed line length, SWR may vary and an antenna tuner will be required or some bands to bring SWR at end of feed line to acceptable levels

Use a good quality 50 ohm cable adequate for the power level of your station. The Bullet-49-500 matching unit is conservatively rated for 500 watts PEP for SSB or 250 watts CW/digital. If the matching unit becomes warm to the touch after transmitting at high power, reduce the power output or the internal matching unit may be damaged.

NOTE: The matching unit output is DC grounded to bleed off static electricity, however it is not RF grounded as the RF signal (at the coax connector) will see approximately 1/49 of the antenna impedance on the antenna terminal of the matching unit.

ON the 40-10 meter antenna we found the best place for the feed line choke was at 16 feet for our installation giving very low SWR on all the bands and preventing coax braid currents from getting into the radio.

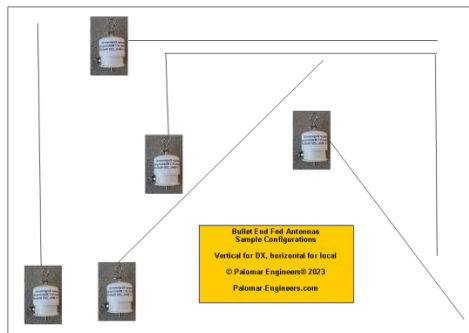
Your antenna is cut for 66 feet (40-10 meters) but you may have to tie back 1-4 feet depending upon the geometry of your installation and ground characteristics of your installation. Just bring any extra wire thru the insulator and wind around the existing wire effectively subtracting the length of wires that are next to each other.

Extending wire length of antenna. You have two choices: extend the current wire length with additional wire or take off the existing wire by loosening the wire nut on the halyard hoist and slipping out the fork spade lug from between the washers and replace with a new length of wire as needed. Make sure you choose one of the lengths shown in the above table so as not to cause a mismatch for the 49:1 unun.

DO NOT UNSCREW THE HALYARD HOIST EYEBOLT FROM THE BULLET CASE AS YOU WILL NOT BE ABLE TO SCREW IT BACK IN!!

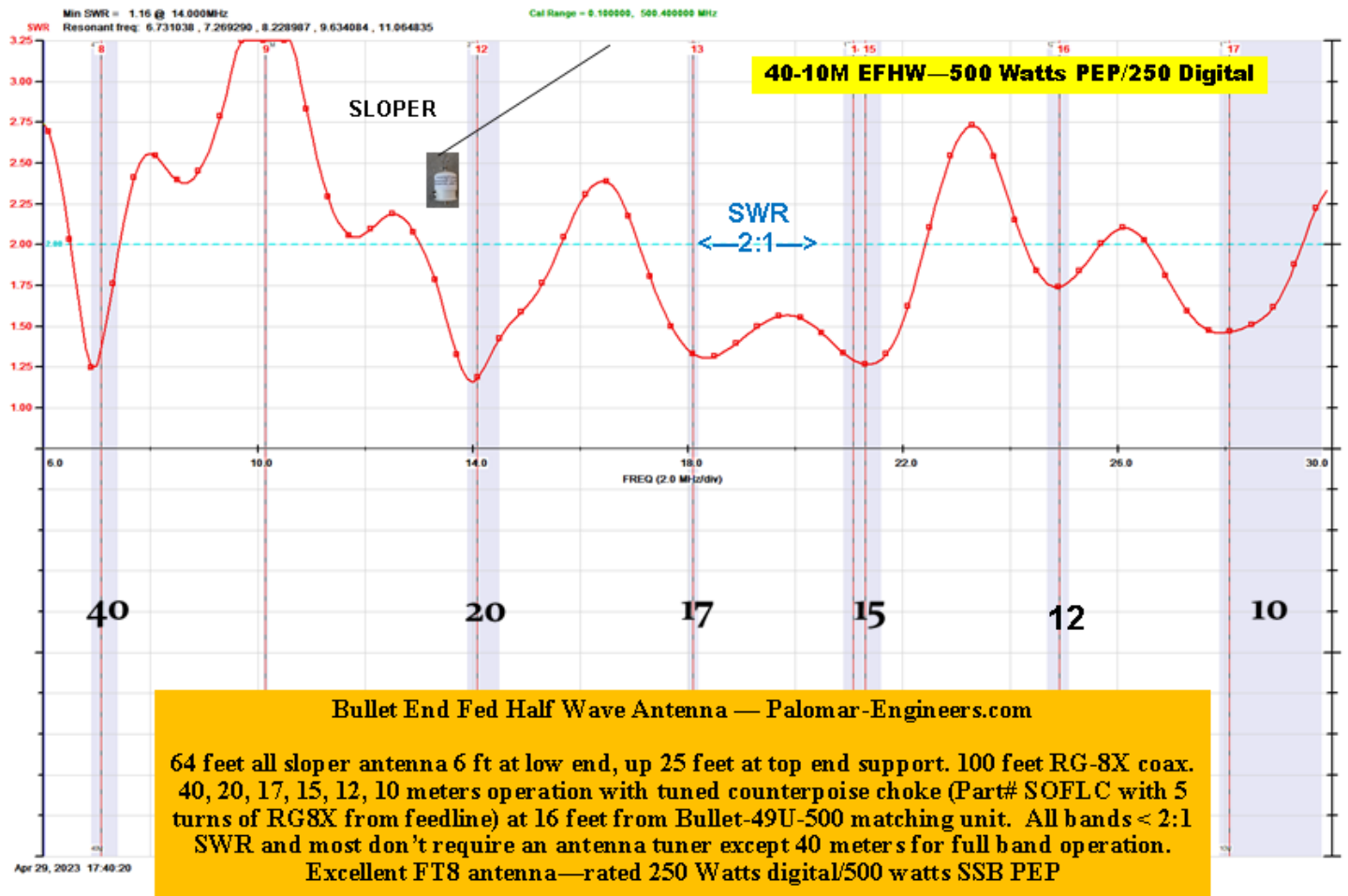
Additional Typical Antenna Configurations:

This antenna can be installed in a number of different configurations including vertical, high or low matching unit sloper, inverted L, inverted U. In general it is better to get the matching unit as high as possible since the antenna current is highest near the matching unit. Horizontal antennas and sloper antennas with the matching unit at the high end work particularly well since the radiating coax is also above ground. Radiation will be perpendicular to the wire on some bands and in-line with the wire on others depending upon the frequency of operation. Have fun and experiment with different configurations! Many different configurations and measured SWR curves are shown on the following below.



Typical SWR Measurements:

Bullet49-4010-500 Antenna – all horizontal sloper up from 6 feet up to 25 feet. 100 feet of RG-8X with coax feedline choke (5 turns) 16 feet from matching unit. No external counterpoise or ground is needed. May need tuner on some bands. DO NOT GROUND THIS ANTENNA – the side terminal is for a wire counterpoise of approximately 16 feet (40-10 meter version) in case you have a short coax under 25 feet.



Bullet-49 application note: AK6R has used this antenna to work many countries on FT8 on all bands from 40-10 meters. Works very well as sloper and I am amazed how well it works on 10 meters into Europe from California during late afternoon into nightfall. I have used up to 300 watts on FT8 with this antenna on 20-10 meters and 250 watts on 40 meters for extended periods, but have also worked many contacts under 100 watts to test its effectiveness and I am very pleased with the configuration and simplicity of this installation between two trees. The use of a tuned counterpoise with the feedline choke makes a huge difference in the SWR characteristics and also keeps RF out of the shack from the coax braid common mode current.

Great antenna for portable operations like NPOTA, SOTA, Field Day, etc., or for permanent installations like installing in an attic, under the eaves of a house, along a fence, etc. This is a short, effective and easy-to-hide antenna which gives a good account of itself on 40-10 meter bands.

General Notes

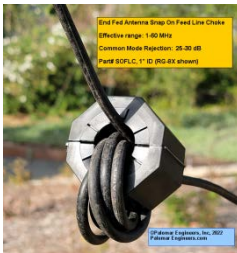
For antennas of 66 feet, use 25 feet coax minimum for best overall SWR results. This antenna is also known as a EOCF or extremely off center fed dipole and requires a counterpoise as the other side of the dipole. We tune the length of the counterpoise (by changing the choke position on the coax feed line since the coax braid is used as the counterpoise) to give the best average SWR results for all bands. Also, any End Fed Antenna with a native (no antenna tuner used) SWR above 2.5:1 should also be run at two-thirds power.

CAUTION: This antenna is fed at a **VOLTAGE MAXIMUM** point which means the antenna wire connection to the 49:1 unun is at a high voltage which may be over 1000 volts for high power operation! **YOU MUST ENSURE THAT NO CONTACT WITH THE WIRE ATTACHMENT POINT IS MADE DURING TRANSMIT OPERATION AS THIS COULD PROVE TO BE FATAL! KEEP THE UNUN OUT OF REACH OF PETS, CHILDREN AND HUMANS TO PREVENT ANY ACCIDENTS!**

Feed line Choke Options

Many different types of feed line chokes will work with the end fed antenna. The purpose of the choke is to stop the RF current on the outside of the coax braid during transmit and suppress common mode noise during receive operations.

Use Feedline choke EFFLC or SOFLC for RG-8X size cable or choke MC-1-500 (500 watts PEP) or MC-1-3000 (3KW PEP) for larger coax with UHF connectors. Coax position of feed line choke is measured from the 49:1 matching unit back to the radio station.



SOFLC - Snap On Feed Line choke (works on RG-8X (6 turns) or RG-8 (3 turns) up to 38 dB suppression



Mini-Choker™ MC-1-500-50 (500 watts PEP) – up to -38 dB suppression



Maxi-Choker™ MC-1-3000 (3KW PEP) – up to -48dB suppression

Coax Noise Filter



If the distance from the coax feed line choke is over 25 feet, it may be beneficial to use a coax noise filter which suppresses common mode noise picked up on the coax outer braid during RECEIVE operation. You hear this “noise” as a higher than normal noise floor when you connect the outside of the coax connector to your radio. Vertical antennas in general have a higher noise factor due to the vertical polarity nature of noise sources in the neighborhood.

A simple 500 Watt PEP Common Mode Noise Filter (Part# CMNF-500-50) is pictured here. To install, simply connect the coax line from the antenna to one connector and add a small coax jumper from the other connector to your radio. You will still need a feed line choke at

the appropriate distance from the matching unit unless the noise filter is installed at the correct distance.

Wire Pulleys



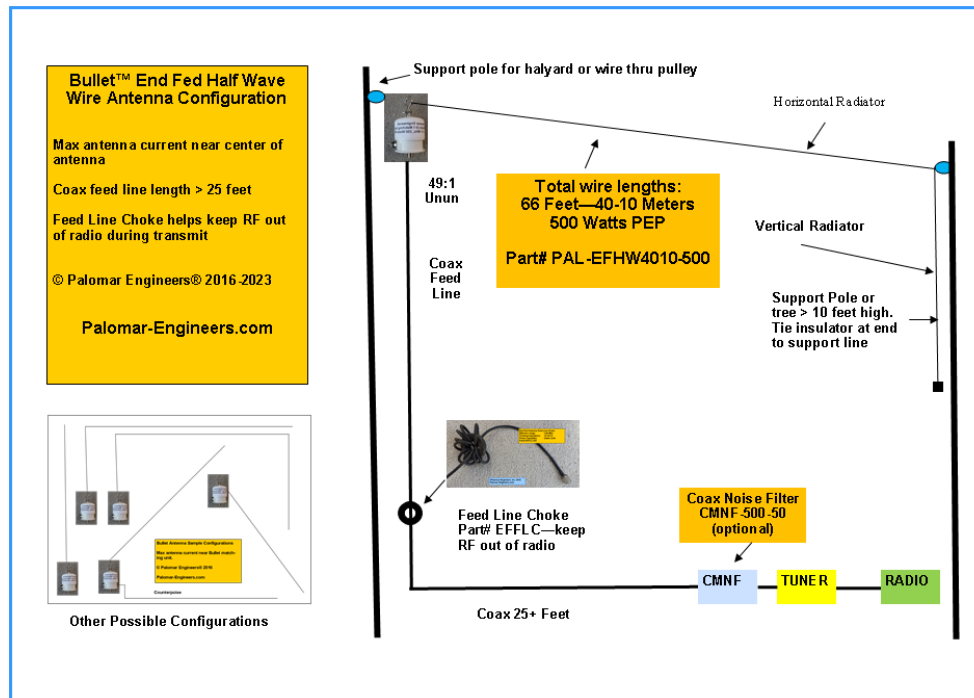
Split wire pulleys are very useful for installing free running antenna wire. Use a halyard hoist on first pulley carabiner and free run the wire from the matching unit thru the first and any additional pulleys. Support the wire every 50-75 feet thru a pulley (and separate halyard hoist/support attachment to the carabiner part of the pulley) and the antenna will be much easier to raise and maintain in the future.

Part#: Pulley-1.75

Tuning Your Bullet EFHW Antenna

The Bullet-49 antenna configurations shown in this manual have been used successfully by many radio amateurs around the world, however your installation geometric shape, height, soil conditions, and coax cable length may be different and your SWR results may not match the ones shown or you may have a higher than wanted SWR on a particular band or bands.

So how do you tune the antenna for your installation? First start off with the suggested dimensions for the antenna wire and measure the SWR's on the various bands. This antenna is tuned by adjusting the total wire length which should be a $\frac{1}{2}$ wave length at the fundamental frequency. Further adjustment is made by placing the counterpoise choke at different locations. For example the 40 meter EFHW will work on 40, 20, 15 and 10 meters as they are harmonically related. The 17 and 12 meter bands may require an antenna tuner and power rating may need to be reduced depending upon installation. Adjust the length of the antenna for the best SWR's on all bands of interest and also the position of the counterpoise choke. We found that a position of 16 feet from the matching unit provided the best overall SWR's for the 40-10 meter version, but your placement may be slightly different.



WARNING

This antenna is a half wave antenna and is fed at a high voltage point of the antenna. Depending upon the power applied, the voltage at the antenna connection can range from 157 volts (10 watts input) to 1107 volts (500 watts input). You **MUST** ensure that the antenna feed point is isolated from contact by pets, children, and curious adults who may be injured if contacting the antenna feed point while a signal is being transmitted.

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Phone: 760-747-3343

Email: Sales@Palomar-Engineers.com

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