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Lutz-Electronics

HB9NBG und HB9FZC

Ham Radio/SWL Antenna Application Notes

BULLET End Fed Antenna

Need a high performance, multi-band, stealthy antenna system that is easy to setup and use? Get the Bullet-9 matching unit, the antenna wire and insulator all in one convenient package (great for HOA restricted areas, camping and portable operations) and remember to add the feed line choke.

One of the most popular antennas today is the end fed 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) mountaintop expedition, field day or portable outing.



The antenna is simple to deploy, folds up easily for transport, and weighs under a pound, yet, with the 71 foot included wire, can work the 80-10 meter bands easily with the built in antenna tuner of most current day transceivers.

The key to the antenna's success is the proprietary matching unit between the long wire antenna and the coax feed line to the transceiver. The antenna matcher employs a dual core broadband transformer for wide bandwidth (1.8-61 MHz), a conservative 500 watt PEP rating, an easy on/off antenna wire connector, a connection for a counterpoise or radial if desired, and a SO-239 female coax connector for easy attachment of coax cable (50 or 75 ohm is ok).

BULLET-9, 9LF Matching Unit



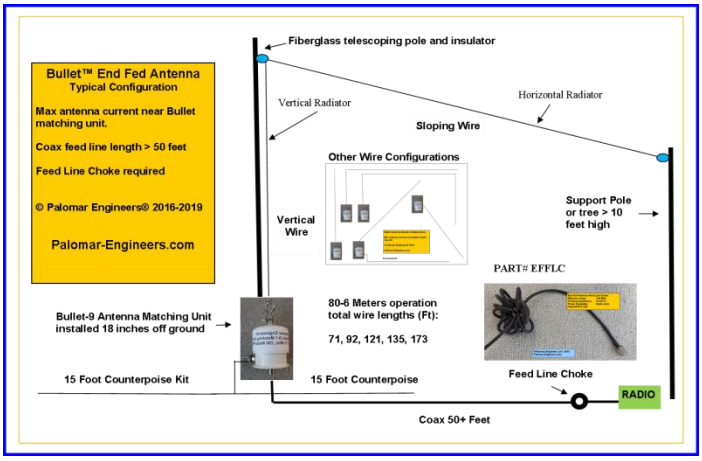
Our antenna matching network is called the "Bullet" because of it shape and its effectiveness at taking down or contacting distant (DX) stations all over the world under the right conditions.

We sell the Bullet matching unit separately so you can add you own wire type and length (see table of suggested lengths below) or you can purchase a complete antenna system including wire, end insulator and support cord. Available as the Bullet-9 (1.8-61 MHz) or 9LF (.02-30 MHz) for VLF use down to 20 KHz. The matching unit is available up to 7.5KW PEP.

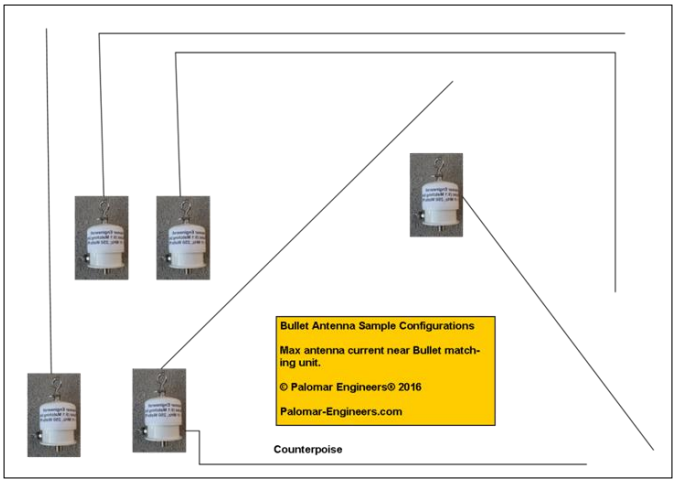
For best results we recommend that the coax feed line be at least 1/4 wavelength on the lowest operating frequency since the coax braid is used as a counterpoise if you don't use the external counterpoise terminal on the matching unit. We also recommend a feed line choke at the end of the coax feed line near the radio to prevent RFI common mode current from interfering with the radio. A simple ferrite ring (Part# EFFLC) with 8-10 turns of the coax line at the 50 feet from the matching unit will work very well on RG-8X (1/4″ cable).

Installation

The Bullet 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:



Additional Typical Antenna Configurations:



Antenna Length Modifications

For best results, chose a length from the table below as these lengths will form a non-resonant antenna for the amateur bands indicated. The antenna length should NOT be ¼ or ½ wavelength on any frequency that you transmit as the impedance will be very high (or low) and will

not transfer through the matching unit at favorable impedance to your antenna tuner. The theory of the antenna length is to make the antenna non-resonant on any amateur band so that the impedance at the antenna side of the matching unit is in the range of 200-600 ohms and when divided by 9 will be in the range of your transceiver antenna tuner.

Any length of 52 ohm feed line ok (50 feet minimum for 80 meter operation) 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 may be required or some bands to bring SWR at end of feed line to acceptable levels. Use of one or more random length counterpoise(s) connected to the ground post of the matching unit may also improve antenna efficiency and reduce SWR on certain bands. The first counterpoise should be installed under the horizontal portion of the antenna for best results. Suggested counterpoise lengths are 12, 16, 24 and 32 feet with a 50 foot coax feed and a choke installed 50 feet from the antenna feed point. Counterpoises can be straight or zig-zagged.

Use a good quality 50 ohm cable adequate for the power level of your station. The Bullet matching unit is conservatively rated for 500 watts PEP for SSB or 375 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 1/9 of the RF impedance on the antenna terminal of the matching unit (if the antenna impedance is between 200-600 ohms).

Suggested wire lengths for 1.8-61 MHz operation (measured from Bullet wire terminal):

Bands Covered (meters)	Wire Length (feet)	Minimum Coax Length (feet)
40-30-20-15	35-43, 49-63, 70-85	25
40-30-20-17	35-45, 54-64, 67-77	25
80-40-30-20-17-15-12-10	68-73	50
80-60-40-30-20-17-15-12-10	68-73, 85, 92, 102	50
160-80-40-30-20-17-15-12-10	135, 141-148, 173, 203, 218, 268	100

Feed Line Choke Needed

Many different 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 from getting into the radio. In this antenna system, the outer part of the braid acts as part of the antenna and you need to suppress the current at the radio end. Install at the 50 foot mark for 80 meter use.



Coax Noise Filter

Instead of the ferrite ring you may use a coax noise filter which has the dual purpose of suppressing RF from the transmitted signal AND suppressing common mode current noise picked up on the coax braid during receive operation. You hear this "noise" as a higher than normal noise floor on your receiver. 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, high choking power Common Mode Noise Filter (Part# CMNF-500HF) is pictured below:



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. This encapsulated filter is also more durable than the ferrite ring which can fracture if dropped on the ground.

High Power

End Fed Antenna

Options

1.5KW or 5KW



If you run more than 500 watts PEP and need a high power 9:1 unun for your end fed antenna, check out the Super Bullet (SBULLET-9U-1500) (1.5KW PEP) or the CU-9-5000 (5KW PEP) ununs on the 9:1 impedance transformer page in our website at Palomar-Engineers.com You can also purchase antenna wire and higher power noise filters and feed line chokes to meet your station requirements.

We look forward to your successful use of the BULLET antenna. You can also review other user's comments on the BULLET antenna on **EHAM review here**

Note: On some frequencies/bands you may require an antenna tuner depending on individual installation, soil conductivity, length of counterpoise and/or coax used. Adjust length of antenna, coax or counterpoise to suit your needs.

Disclaimer: No guarantee or liability is either expressed or implied pertaining to damages to persons, property, or equipment in the installation or use of Palomar Engineers, Inc. antennas. Use caution when working near power lines or any power source. If part of the antenna, feed line or antenna mast comes into contact with a power line or power source of any type, it may result in serious injury or death.

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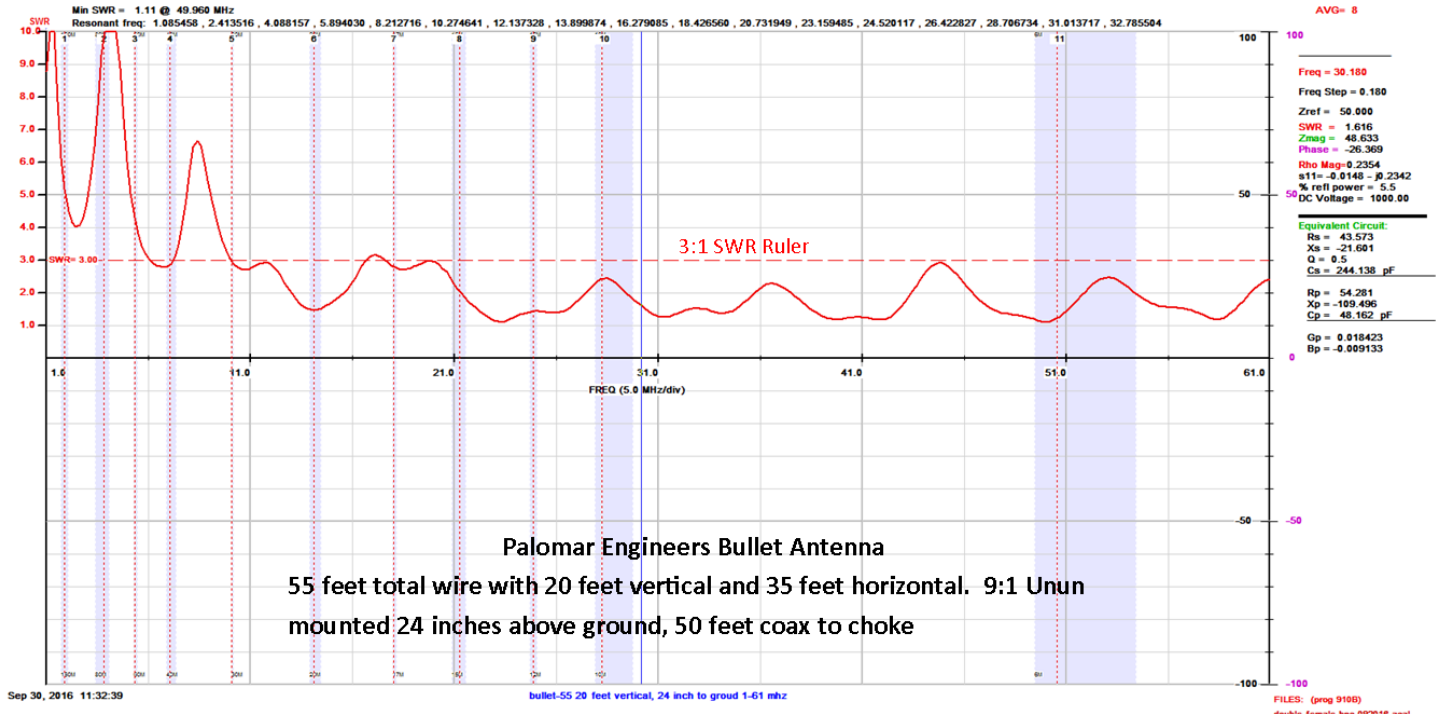
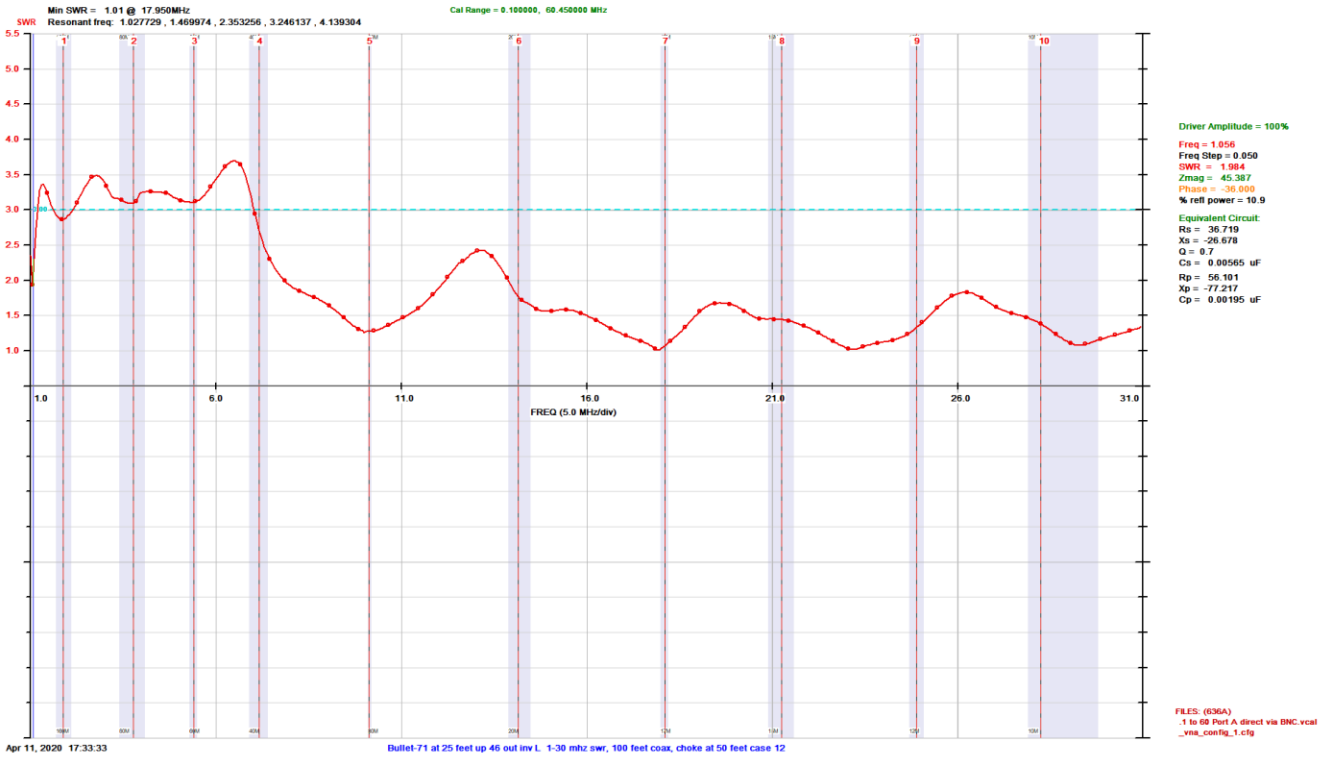
Bullet 55 Inverted L (vertical 20', horizontal 35', Bullet-9U 2 feet above ground) – 50 Feet coax, choke at 50 feet from antenna feed point only – no counterpoises wires. Total antenna length = 71 + 50 = 121 feet. Feed point at 71/121 = 59% of total length.

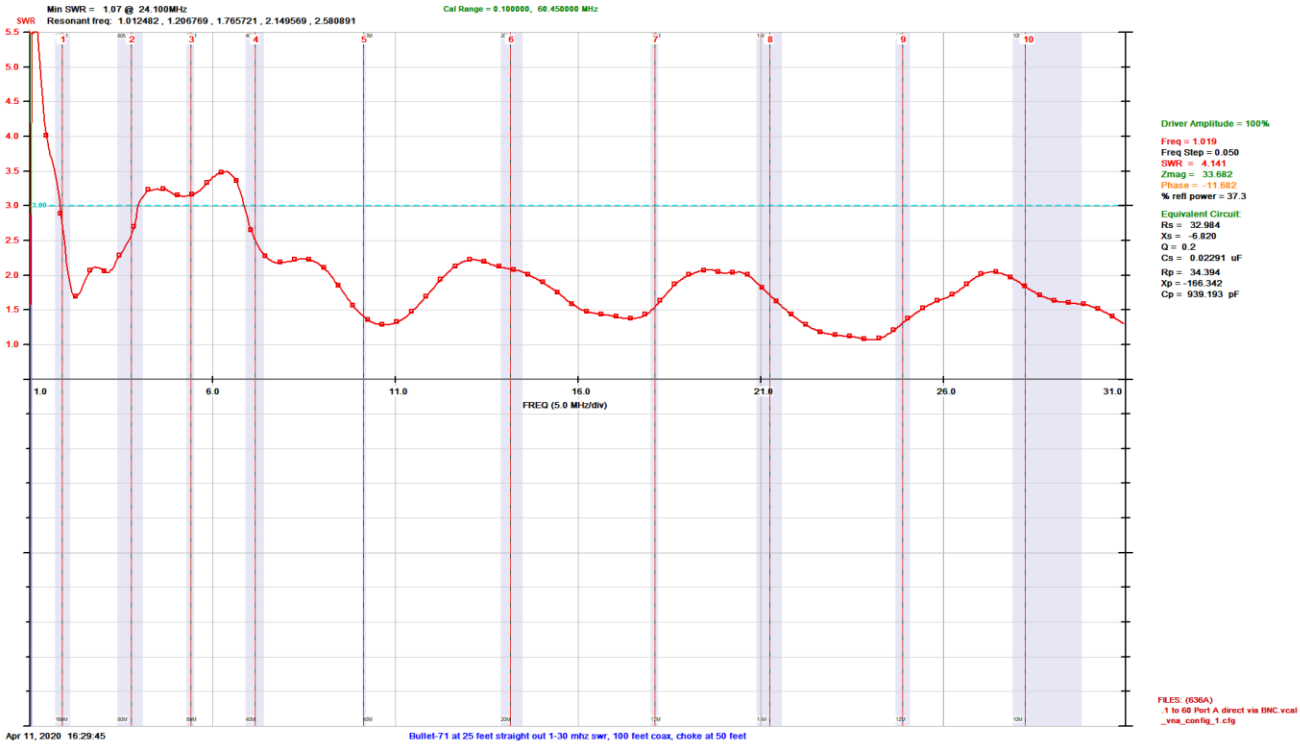


Bullet 71 Inverted L (vertical 25', horizontal 46', Bullet-9U (2 feet above ground) – 100 Feet coax, choke at 50 feet from antenna feed point only – no counterpoises wires. Total antenna length = 71 + 50 = 121 feet. Feed point at 71/121 = 59% of total length

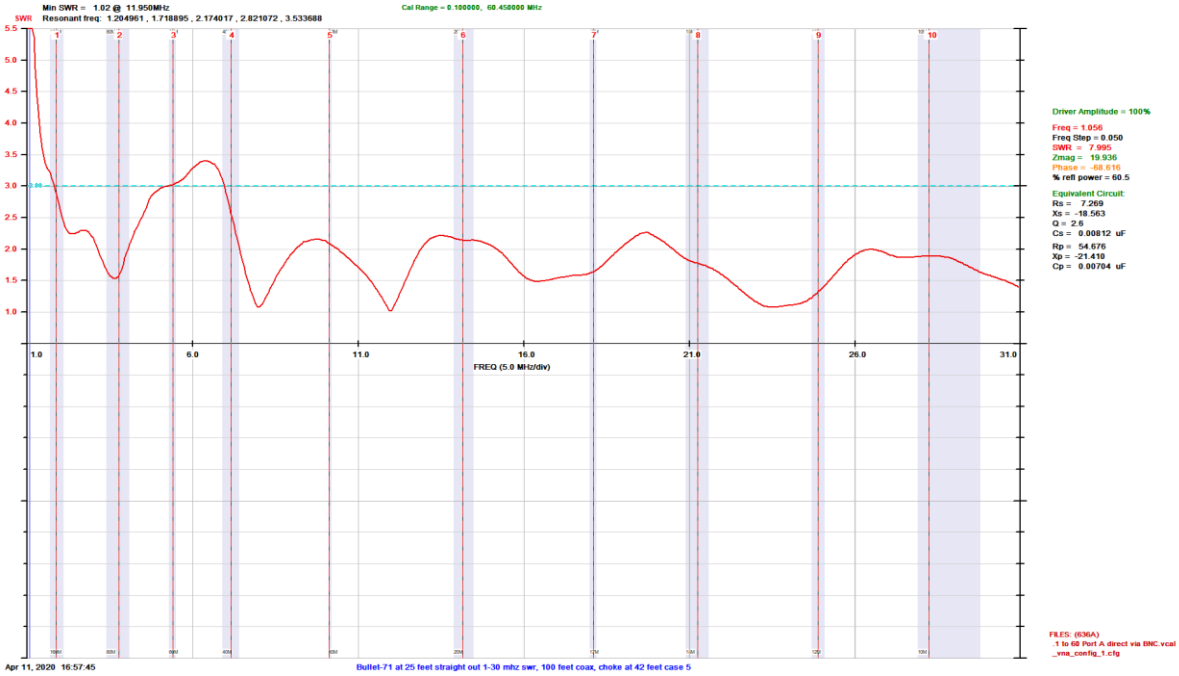


Revised11/18/2020

Bullet 71 all horizontal up 25 feet – 100 Feet coax, <u>choke at 50 feet</u> from feed point only – no counterpoises wires – you can adjust SWR response curve by adjusting position of choke from antenna feed point. Total antenna length = 71 + 50 = 121 feet. Feed point at 71/121 = 59% of total length.

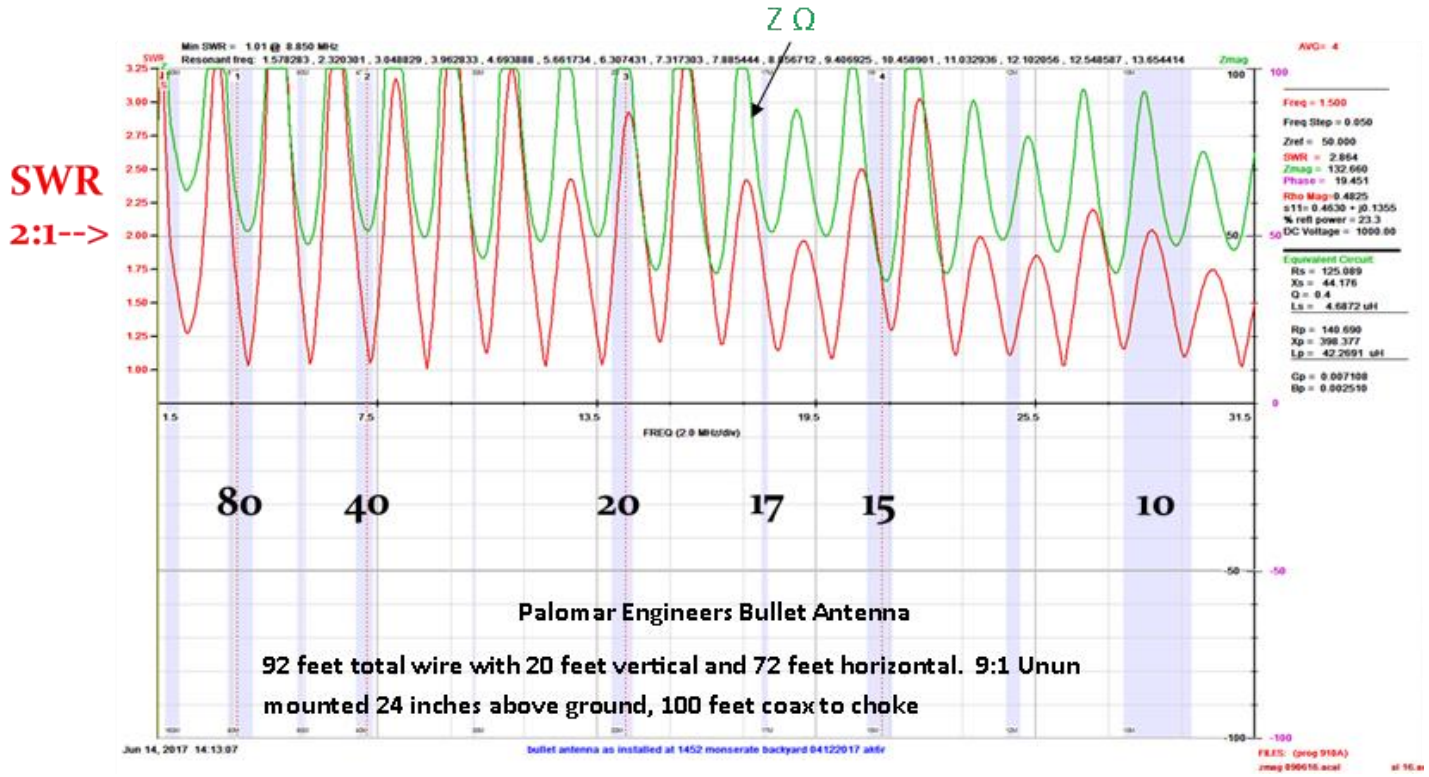


Bullet 71 all horizontal up 25 feet – 100 Feet coax, <u>choke at 42 feet</u> from antenna feed point only gives better 80 meter SWR – no separate counterpoise wires. Total antenna length = 71 + 42 = 113 feet. Feed point at 71/113 = 63% of total length

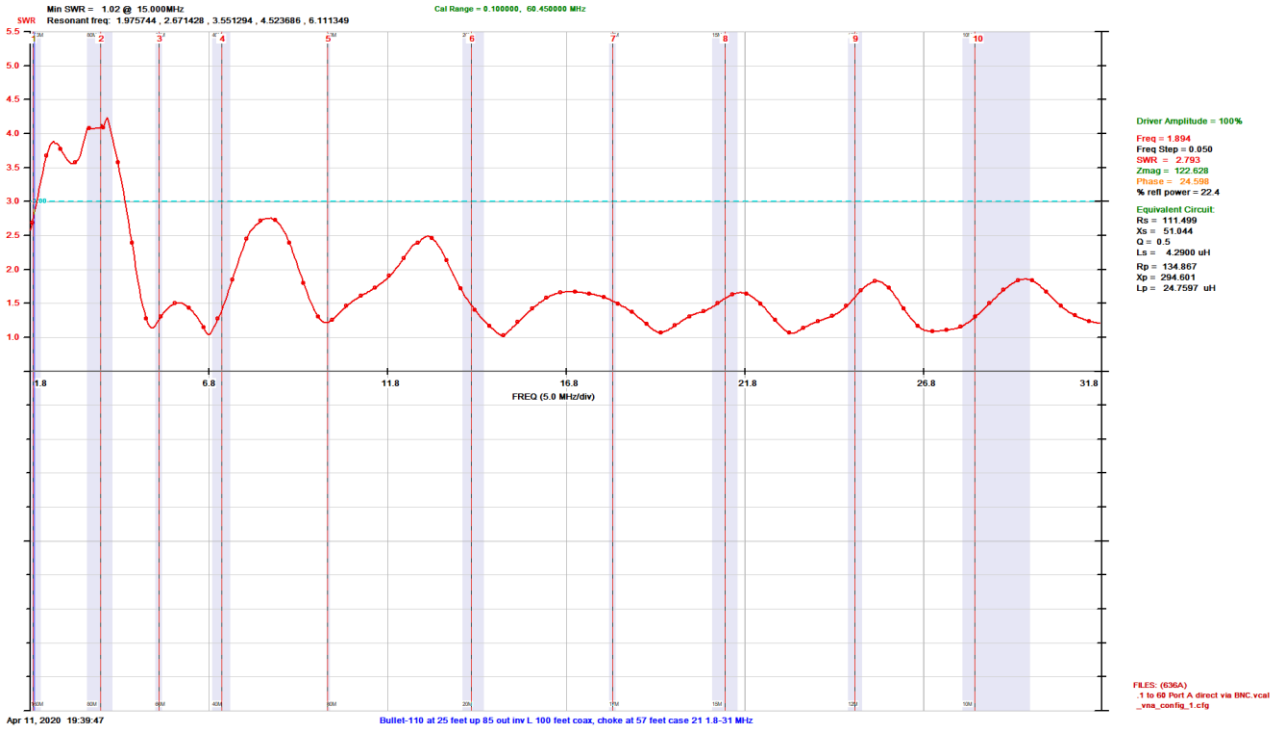


Revised11/18/2020

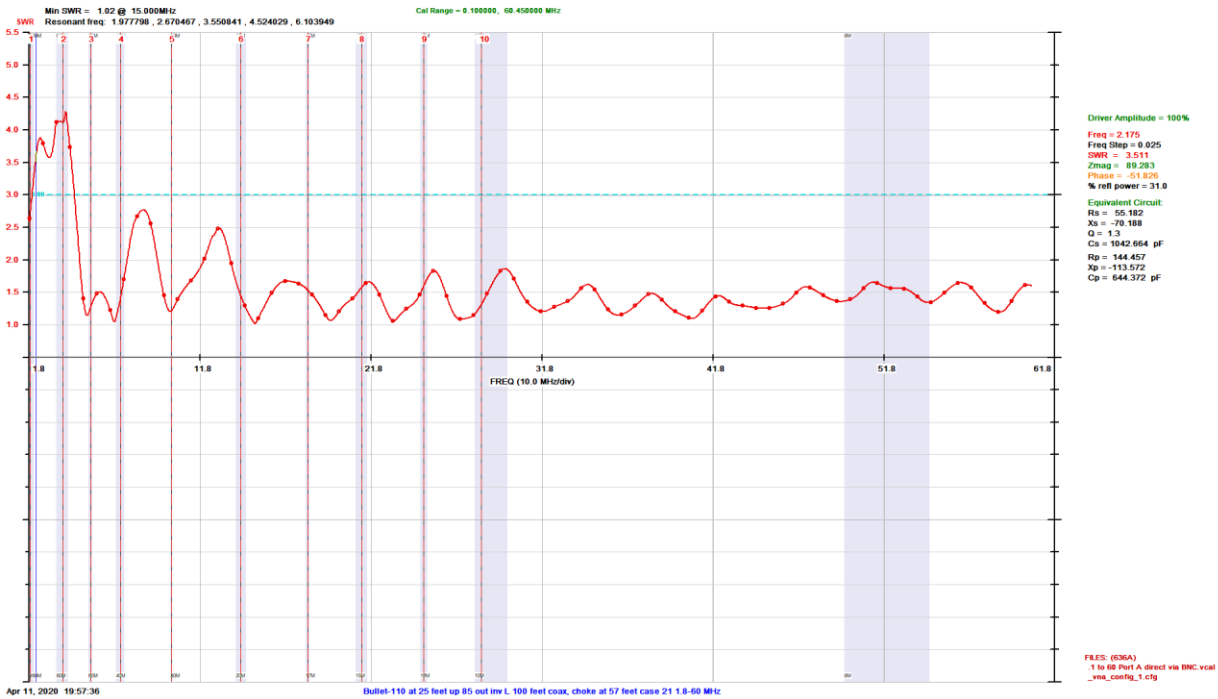
Bullet 92 Inverted L (vertical 20', horizontal 72', Bullet-9U (2 feet above ground) – 100 Feet coax, choke at 90 feet from antenna feed point only – two 15' counterpoises wires. Total antenna length = 92 + 90 = 182 feet. Feed point at 92/182 = 50% of total length.



Bullet 110 Inverted L (vertical 25', horizontal 85', Bullet-9U (2 feet above ground) – 100 Feet coax, choke at 57 feet from antenna feed point only – two 15' counterpoises wires. Total antenna length = 110 + 57 = 167 feet. Feed point at 110/167 = 65.9% of total length.



Bullet 110' antenna 1.8-65 MHz SWR Scan (under 2:1 for all bands except 160 meters)



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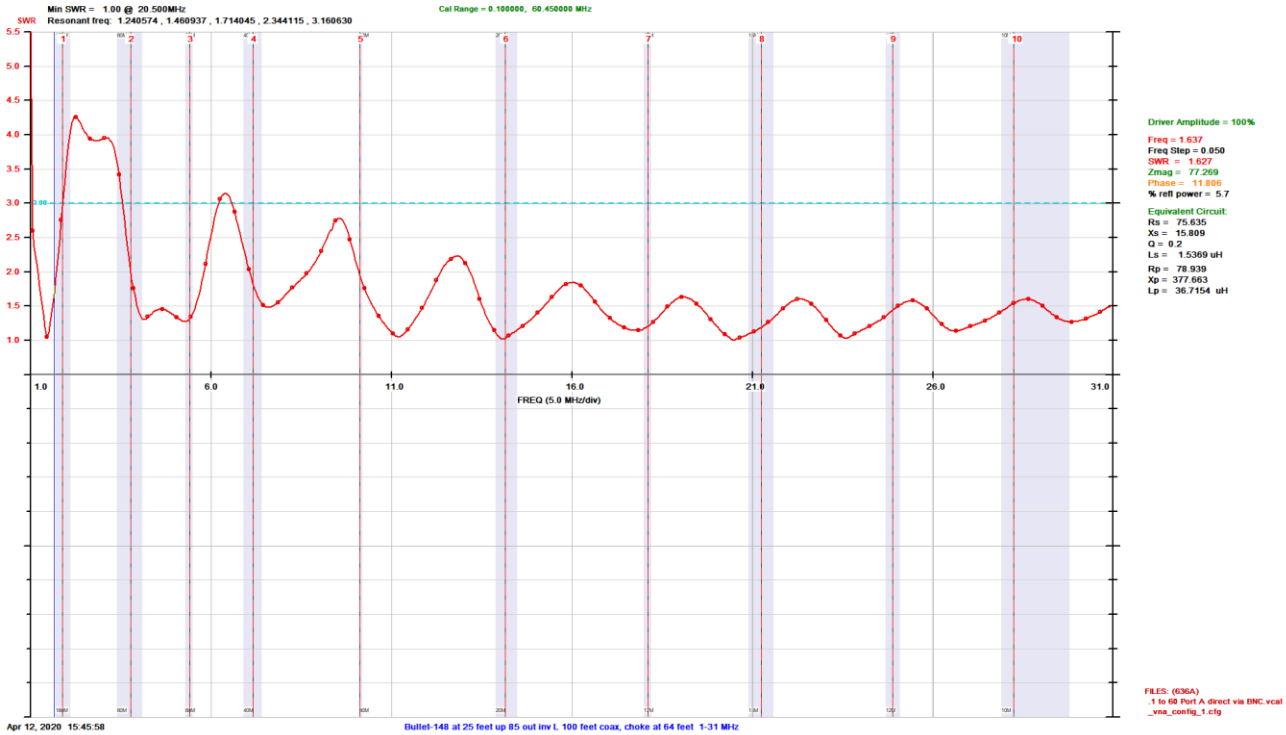
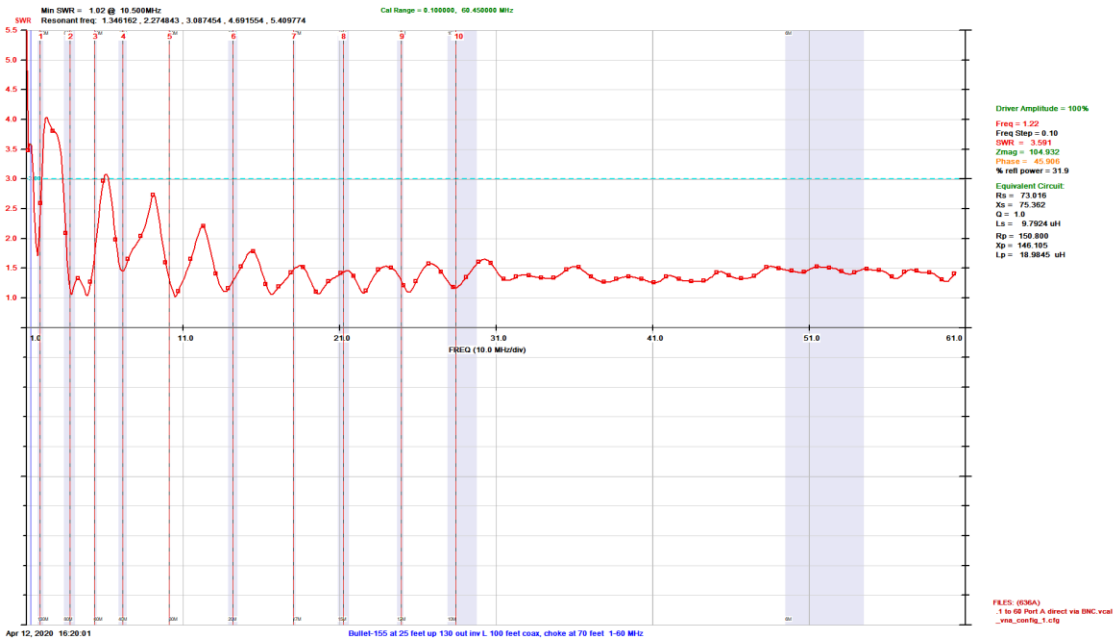
Bullet 148 Inverted L (vertical 25', horizontal 123', Bullet-9U (2 feet above ground) – 100 Feet coax, choke at 64 feet from antenna feed point only – two 15' counterpoises wires. Total antenna length = 148 + 64 = 212 feet. Feed point at 148/212 = 69.8% of total length.



Bullet 155 Inverted L (vertical 25', horizontal 130', Bullet-9U 2 feet above ground) – 100 Feet coax, choke at 70 feet from antenna feed point only – no separate counterpoises wires. Total antenna length = 155 + 70 = 225 feet. Feed point at 155/225 = 69% of total length.



Revised11/18/2020

General Notes

For antennas over 92 feet, use 100 feet coax minimum and place choke in a position such that the total antenna wire is 70% of the effective length of the antenna. This choke position will be a good starting point for tuning your antenna on the bands you want to operate. Here are some examples of antenna wire and choke placement (units are in feet):

Antenna Wire length (70%)	Antenna feed point to choke length (30%)	Total Antenna Wire + coax length
102	44	146
110	47	157
125	54	179
135	58	193
148	63	211
155	66	221
173	74	247
203	87	290
218	93	311
268	115	383

Choke measurement is from antenna feed point at 9:1 unun coax connector to choke.

Use Feedline choke MC-1-3000 (3KW PEP) for larger coax with UHF connectors.



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