

# End Fed Antennas for Portable, Emergency & Stealth Installations



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# Palomar History

- Founded in 1965 by Jack Althouse, K6NY
- Reorganized in 2013 as RFI Solutions company by AK6R and Spouse
- Product Line
  - Ferrite Core Products
  - RFI Solution Kits for hams, consumers and industry
  - Baluns, Ununs & Feedline Chokes
  - Antenna Systems (OCF, End Fed, Loop, Terminated)
  - Kurt Sterba Books/Downloads
- Distribution: Ham Radio Outlet, Direct, Ebay, WD6X
- Markets: Consumer, Commercial, and Military

Program Topics of Interest

# Additional Program Topics

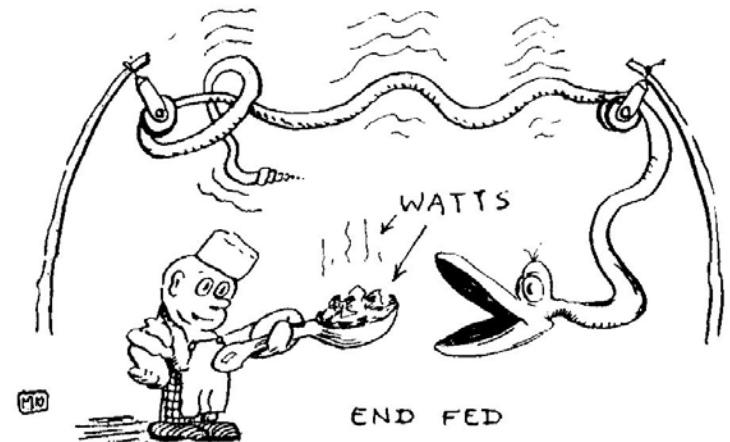
- ABC's of RFI for HAMS
- End Fed Antenna Secrets
- Using Coax Noise Filters & Feed Line Chokes to Optimize your Station
- Make Life Simple with an Off-Center Fed Antenna
- Horizontal & Vertical Loops for HF Operations
- Terminated Antennas – RF Magic or Dummy Load?
- The Lure and Lore of Ladder Line Antennas
- Using Baluns, Ununs and Chokes to Work More DX

Let's talk about End Feds

# End Fed Workshop Topics



- Short overview of antenna feed points
- Dipole, OCF, Zepp, Loop overview
- Popular End Fed Antennas
- How to choose an End Fed Antenna that fits your needs
- Secrets of Non-Resonant End Fed Antennas
- Typical Configurations that work all the time
- Feed Line Chokes, Counterpoises and Coax Noise Filters
- Solving End Fed Antenna RFI Problems
- Q & A



Thinking cap time.....

# Antenna Feed Options

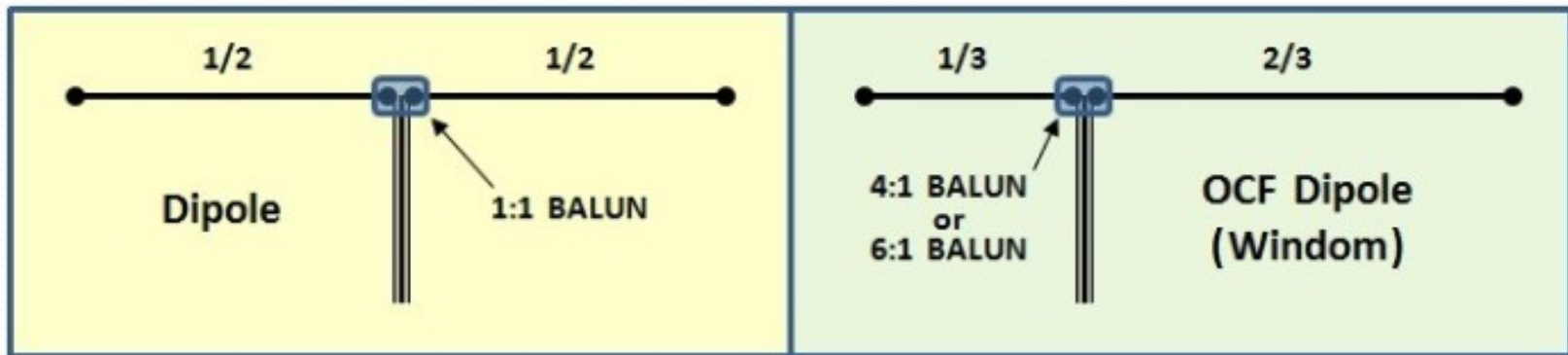
CENTER FED

OFF-CENTER FED

END FED

# Resonant Dipole Examples

DJoIP Image

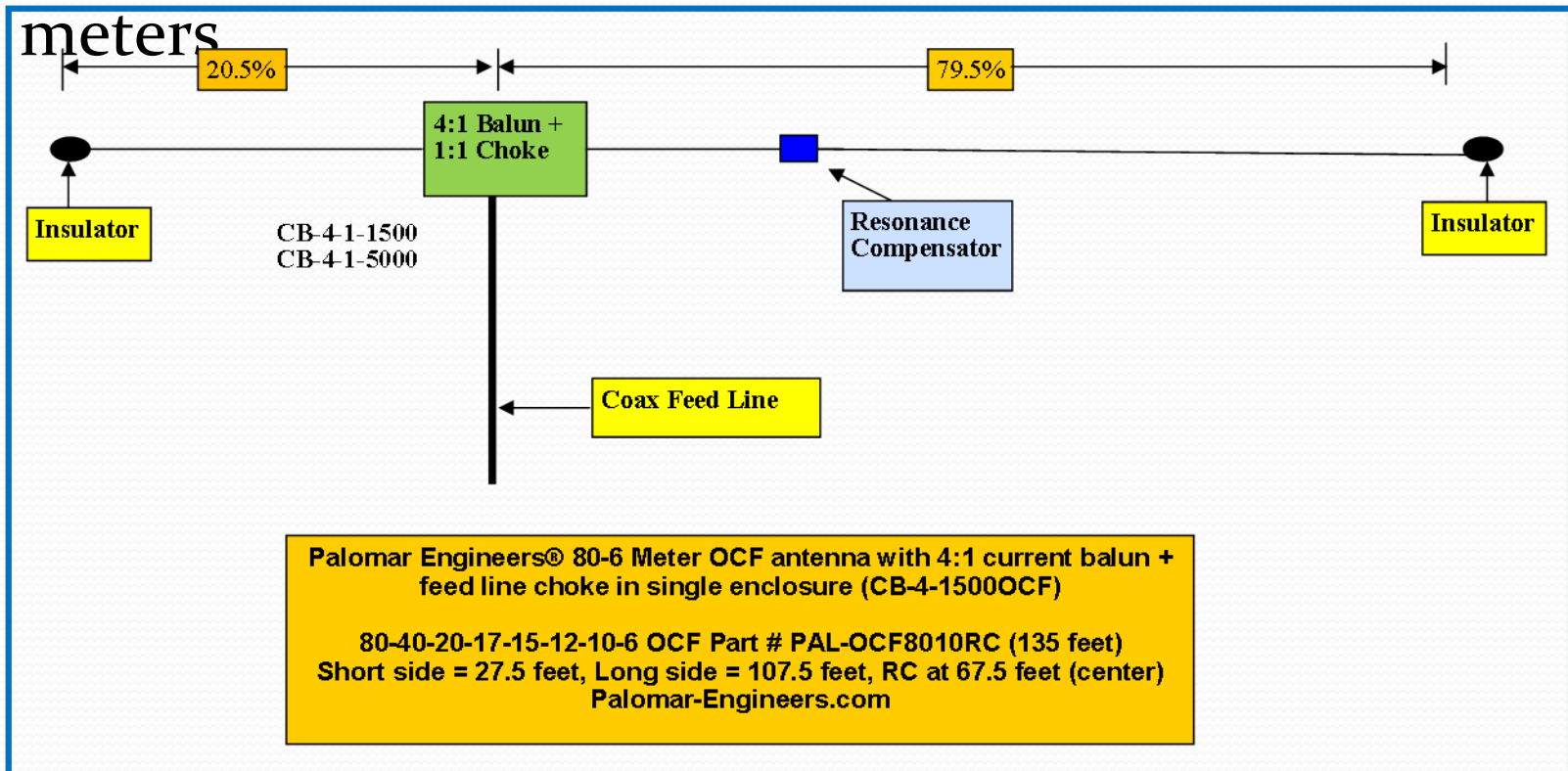


**Center Fed Single Band Dipole**  
 **$Z = 50-120$  ohms depending on height above ground**

**Off Center Fed Multi-Band Dipole**  
 **$Z = 200-300$  ohms depending on height above ground**

# Palomar Off Center Fed (OCF)

- 80/20% (adds 15M), Resonance Compensator for 80



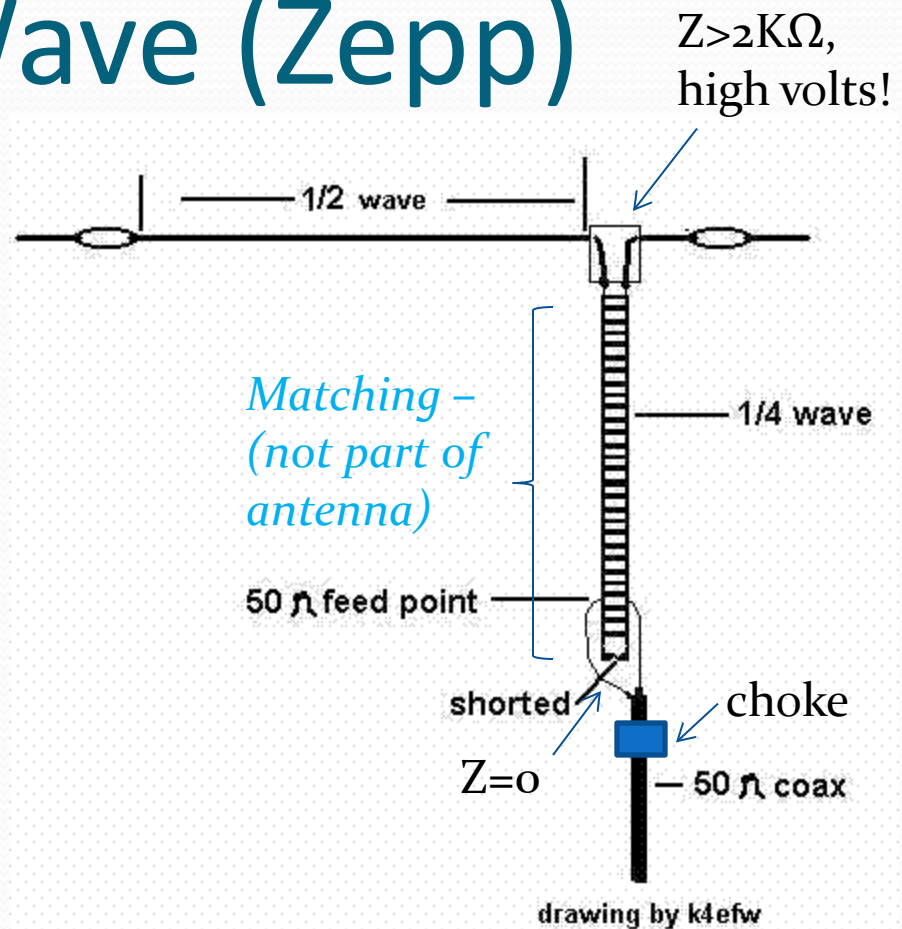
# End Fed Antenna Types

- End Fed Zepp (aka J-Pole)
  - End Fed Half Wave
- Non-Resonate End Fed



# End Fed Half Wave (Zepp)

- Pros
  - Low loss
- Cons
  - Match ladder line/solid
  - Single band, odd harmonic w/o antenna tuner
  - High and long
  - Needs feed line choke at coax feed point to prevent coax braid from radiating



EFHW

# End Fed Half Wave (EFHW)

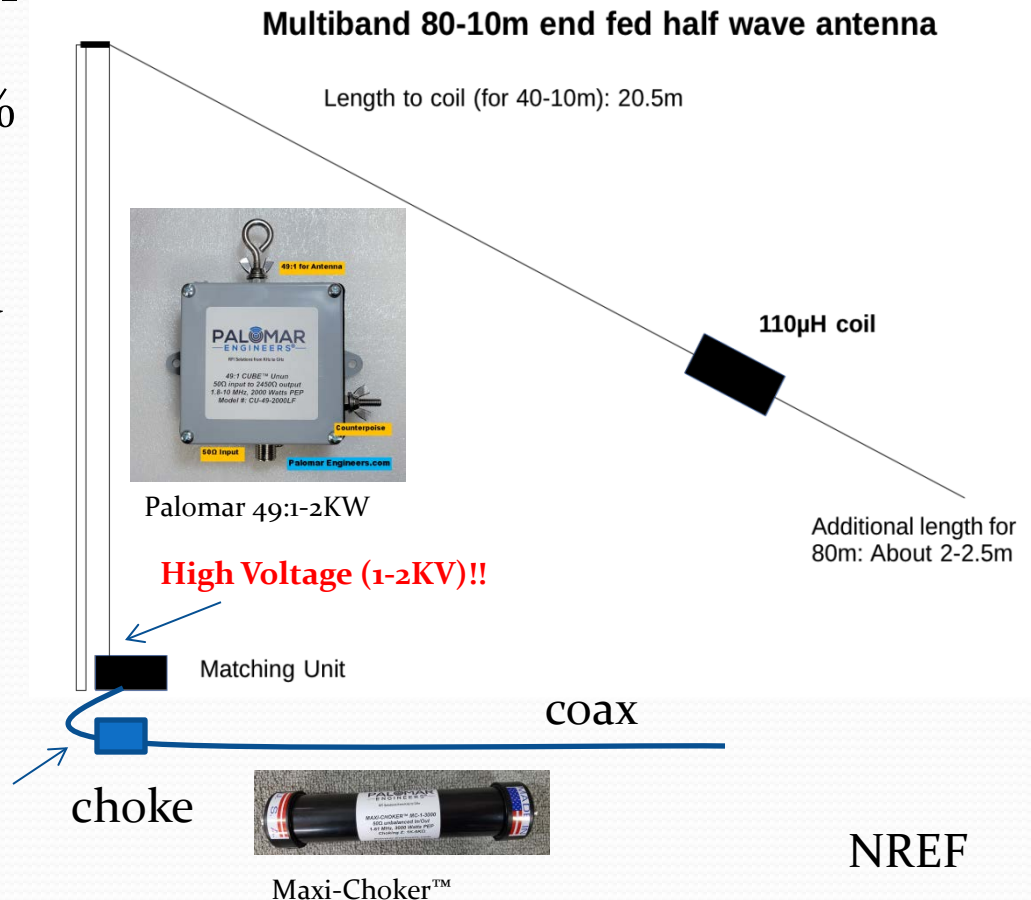
- Pros

- Multi-band – (80-40-20-15-10) may need tuner
- Hi Z feed = < ground loss %

- Cons

- Long – use coil to shorten, needs tuner for multi-band
- Complex matching unit (49:1 to 64:1 broadband unun, hi Z = high voltage!)
- Needs feedline choke near coax feed point
- Matching unit gets “HOT” with power or non-harmonic WARC bands

6-12' choke



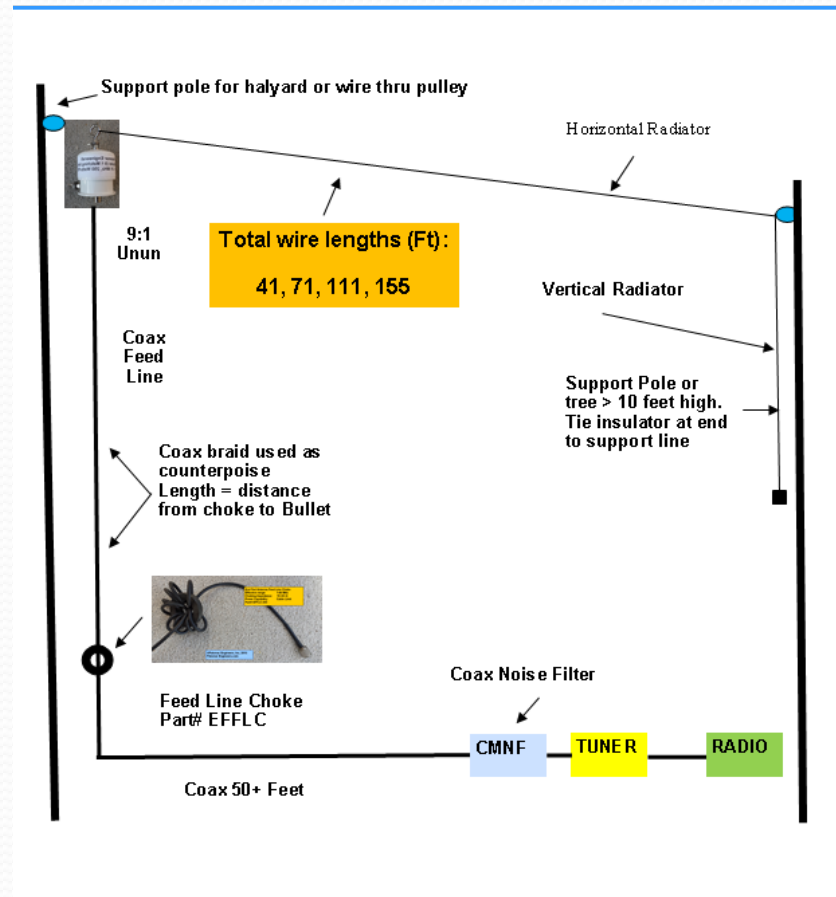
# Palomar Non-Resonant End Fed Long Wire Antenna

- Pros

- Shorter length (80 Meters  $\geq 71'$ , not 130')
- Easy to deploy
- Get WARC Bands
- Stealth for HOA
- Lots of configurations
- Safe & simple low voltage matching

- Cons

- Coax radiates (OCF)
- Counterpoises may be needed on some bands



# End Fed Antenna Choices Recap

- End Fed Zepp uses ladder line/solid for matching to coax
- End Fed Half Wave – even harmonics, requires complex high Z (49:1) matching unit, **high voltage** at feed point
- ✓ • Non-resonant end fed is shorter, uses simple matching, low voltage feed point, works many bands with shorter length, in less space and will work in many different configurations

Most Convenient End Fed is the Non-Resonant  
End Fed Long Wire Antenna

Question: So how do you set up a non-resonant end fed?

# Secrets of Non Resonant End Fed Antennas

**How to determine the wire length to use**  
(antenna, coax and counterpoise lengths)

**How to match the antenna to coax cable**  
(matching unit values and placement)

**Choosing a configuration that fits the location**  
(vertical, sloper, inverted L, horizontal options, zig-zag)

▪ **Choosing a feed line choke or noise filter**  
▪ (selection and installation)

How do these steps apply to your end fed use & location?

How long?

# How to determine the wire length

- Antenna Wire – longer for better low band operation
- Coax Cable – typically 50-75% of antenna length
- Counterpoises/radials – use non-resonant length, raised, multiple with various lengths if needed

Suggested non-resonant wire lengths for 1.8-31 MHz operation (measured from Bullet antenna wire terminal):

Bands Covered (meters)	Wire Length (feet)	Minimum Coax Length (feet)
40-30-20-17-15-12-10-6	41	25
80-40-30-20-17-15-12-10-6	71	50
80-60-40-30-20-17-15-12-10-6	111	100
160-80-40-30-20-17-15-12-10	155	100

Most Popular  
41', 71', 111',  
155' feet

configs

# Typical Non-Resonant End Fed Antenna Setup (like OCF)

**Bullet™ End Fed Long Wire Antenna Configuration**

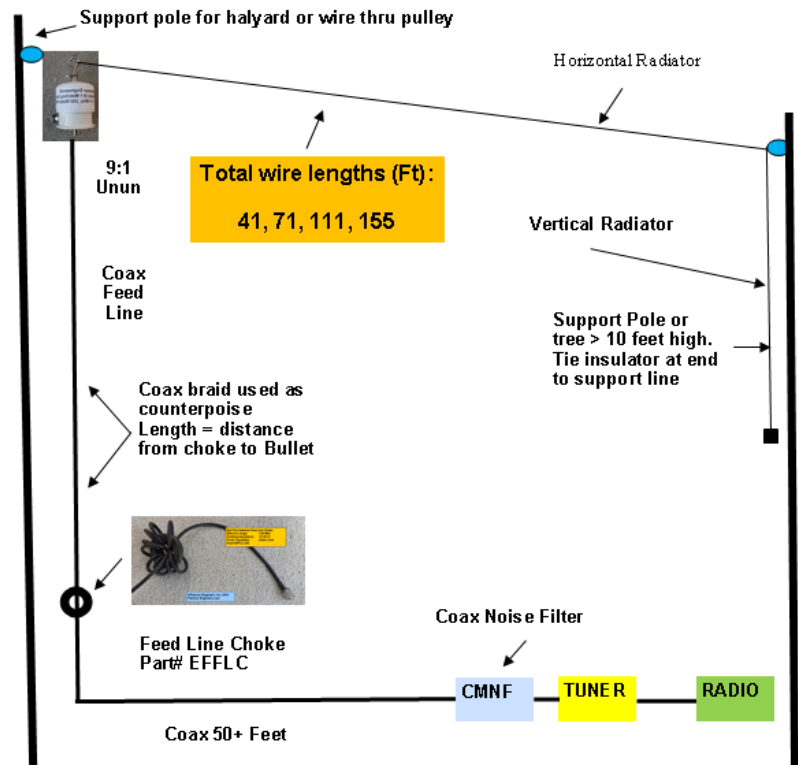
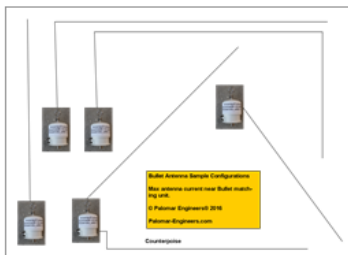
Max antenna current near Bullet matching unit.

Coax feed line length > 50 feet

Feed Line Choke required since counterpoise radiates

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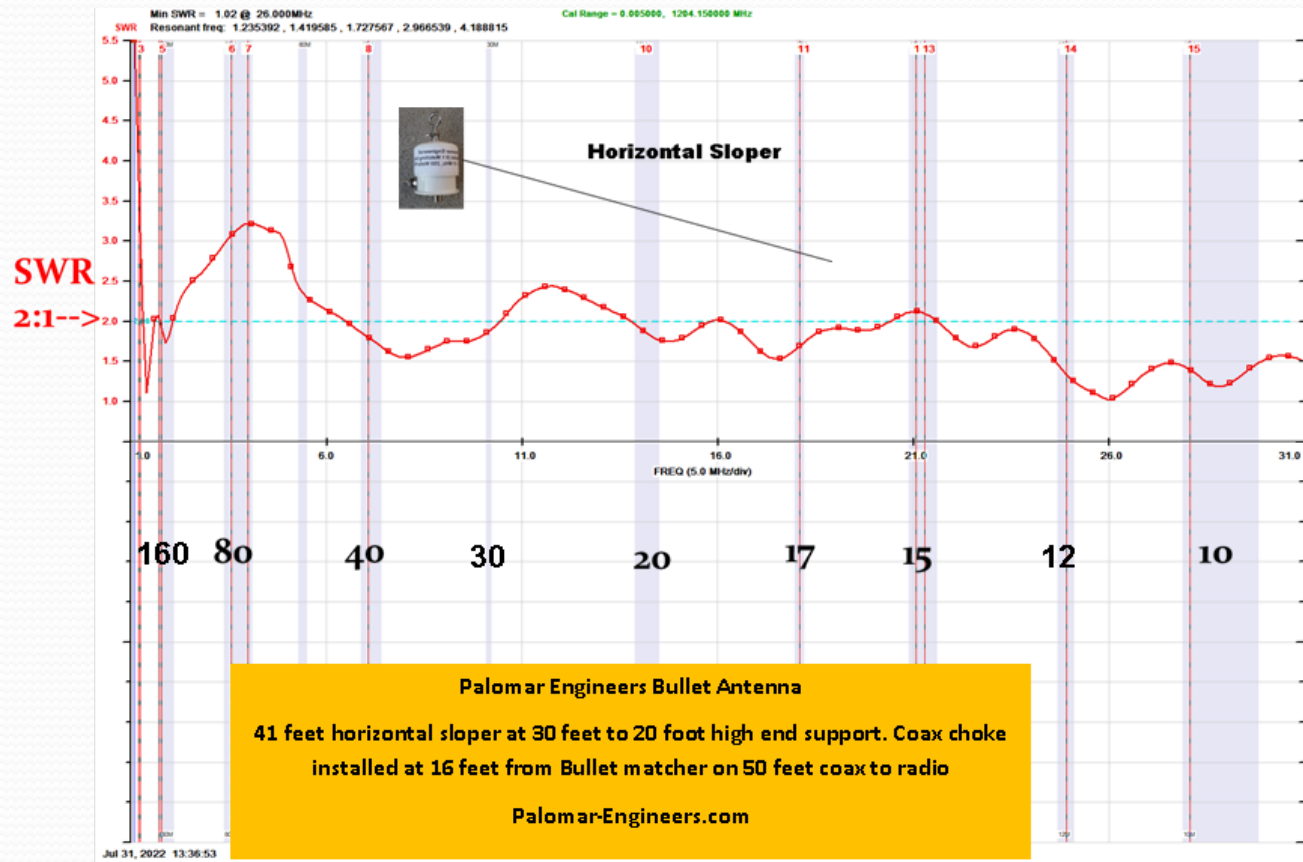
# End Fed SWR Factors

- Configuration shape (Inverted L, flat top, sloper, zig-zag)
- Length of coax feed line – typically 30% coax, 70% wire
- Feed line choke/noise filter placement – at radio end
- Top feed or bottom feed – feed sloper at top end
- Soil Conductivity – install over/near water
- Length and number of counterpoise(s) – use several with variable lengths, experiment with lengths for bands of interest (no  $\frac{1}{4}$  wavelength wires!) – 30%

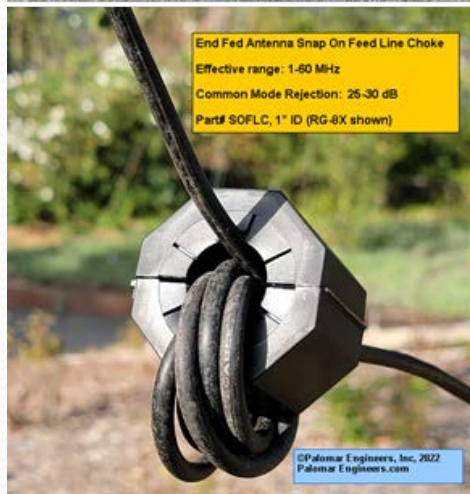
Some SWR plots vs antenna length →



# Bullet 41 – most popular length for portable, SOTA, NPOTA expeditions



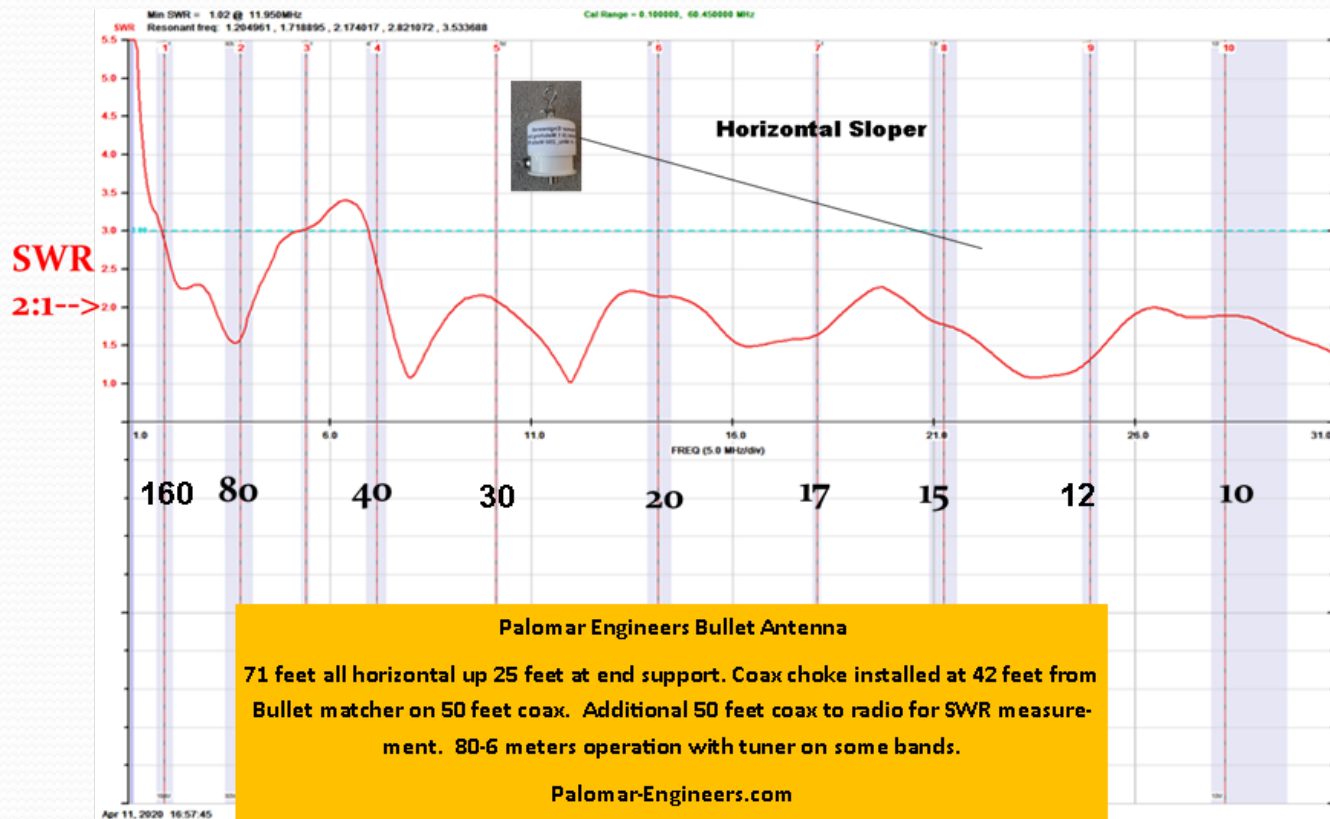
# Antenna in bag for portable use



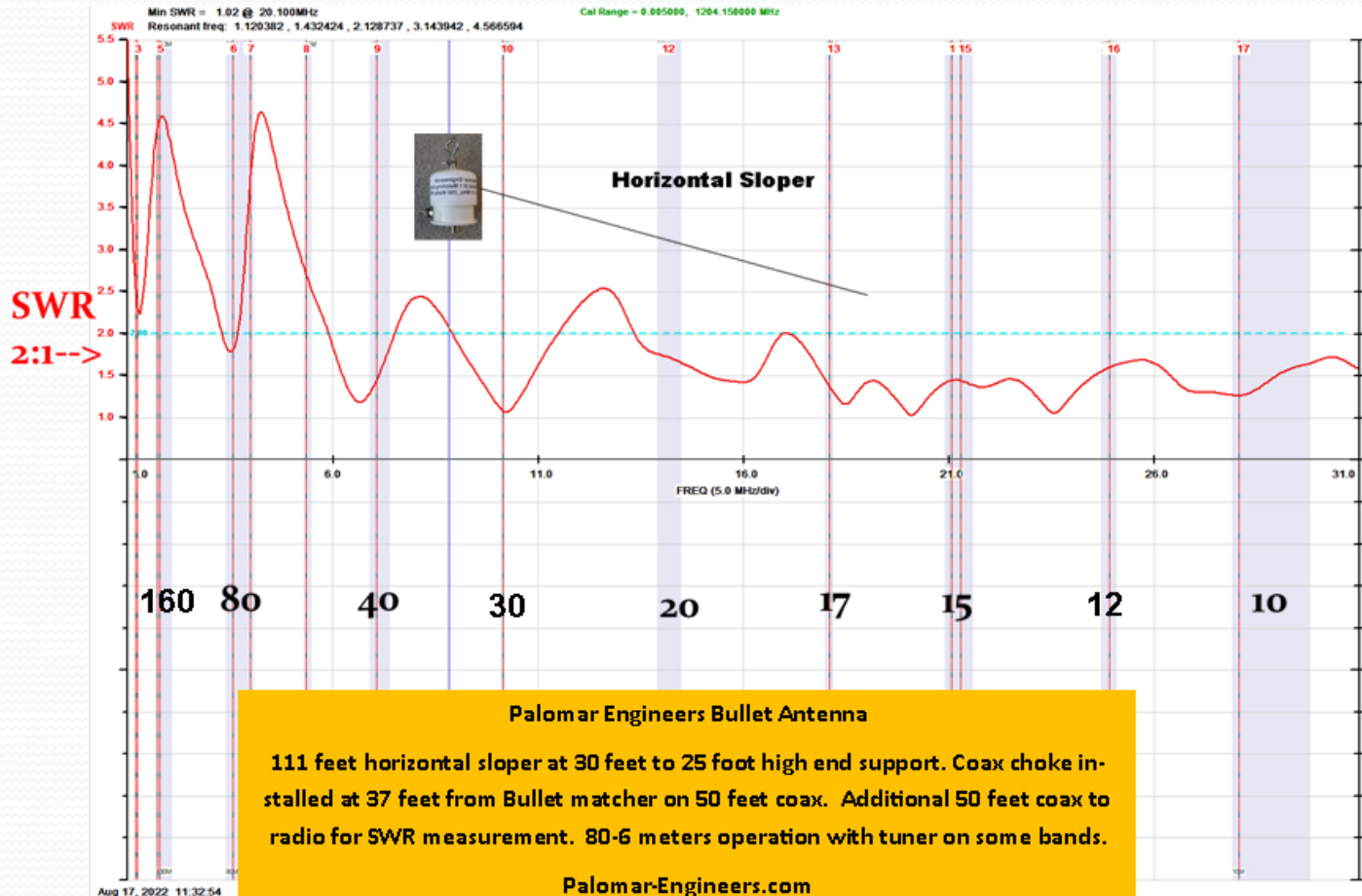
**PALOMAR**  
—ENGINEERS®—

100 Watts PEP  
Bullet™ End Fed Antenna System  
41 Ft Antenna Wire (160-6M) +  
25 Feet RG-8X Coax feed line +  
Snap On Feed Line Choke  
12" Travel Bag  
Part#: BBAS-100-41

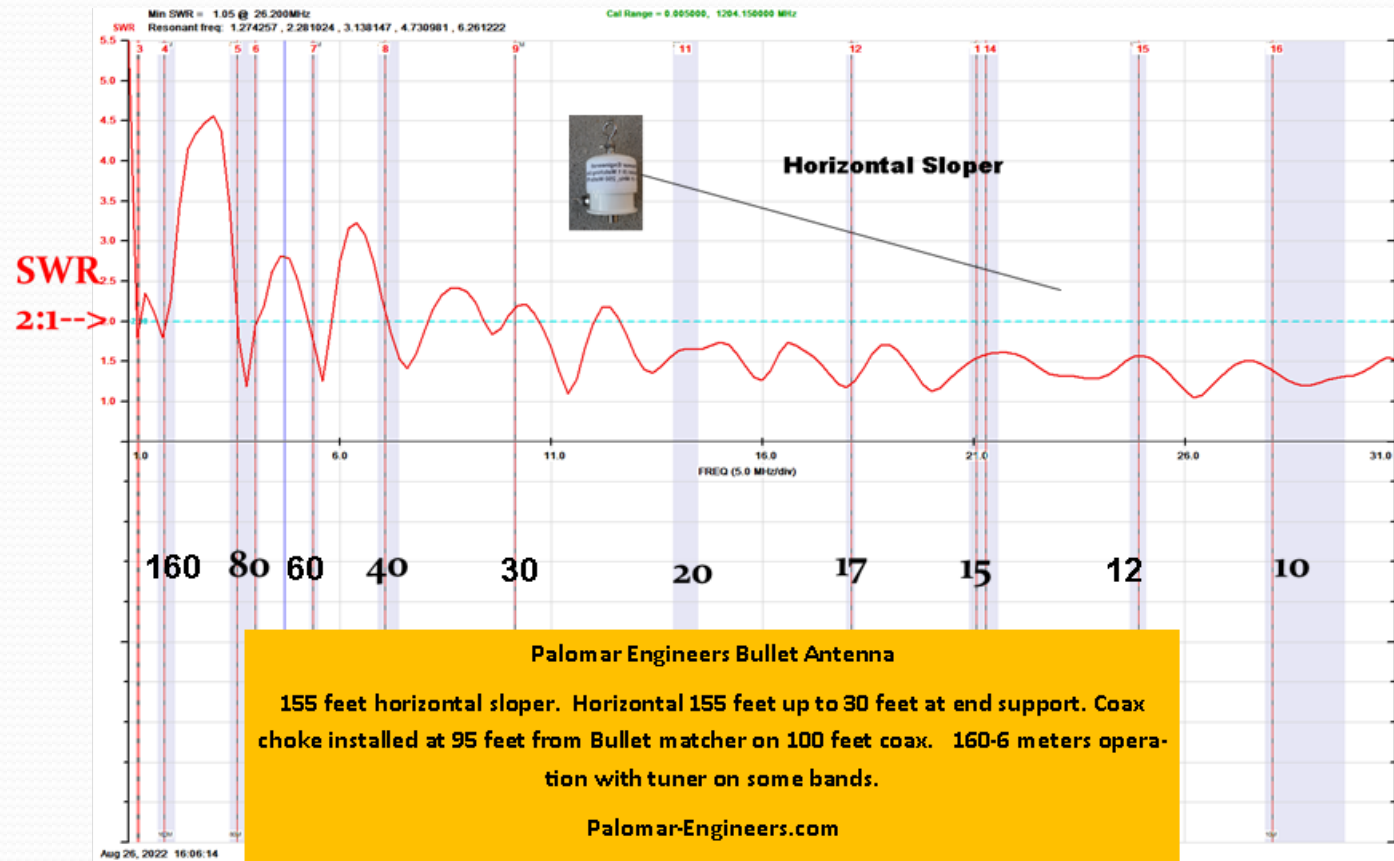
# Bullet-71'- SWR



# Bullet-111'- SWR



# Bullet 155' (160-6M)



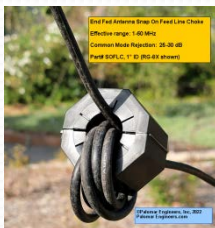
# End Fed Antenna Notes

## General Notes

For antennas over 71 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 (feet/%)	Antenna feed point to choke length (feet) – fine tune for best results for you configuration(*)	Total Antenna Wire + coax length (feet)
41 (72%)	16 (28%)	57 (100%)
71 (63%)	42-50 (37%)	113-121 (100%)
111 (75%)	37 (25%)	148 (100%)
155 (62%)	95 (38%)	250 (100%)

	End Fed Feedline Chokes	
EFFLC (RG-8X coax not included)	Mini-Choker MC-1-500-50 (500W PEP)	Maxi-Choker MC-1-3000 (3KW PEP)



SOFLC (RG-8X coax not included)



Mini-Choker MC-1-500-50 (500 watts PEP)



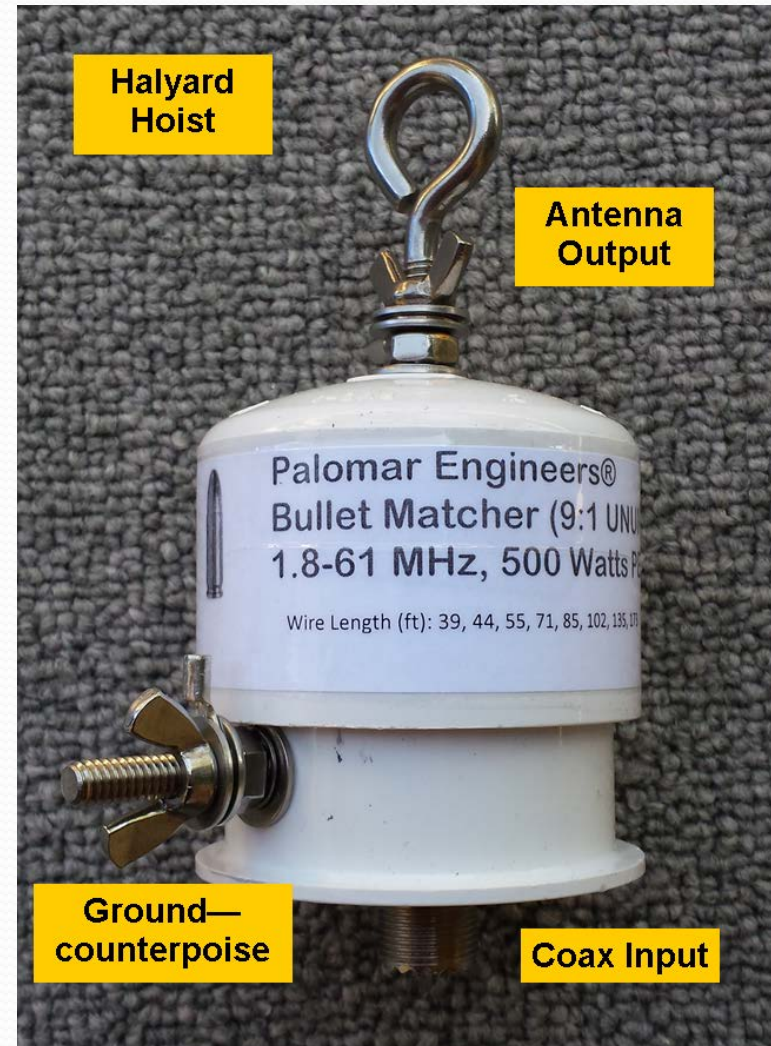
Maxi-Choker MC-1-3000 (3KW PEP)

Matching

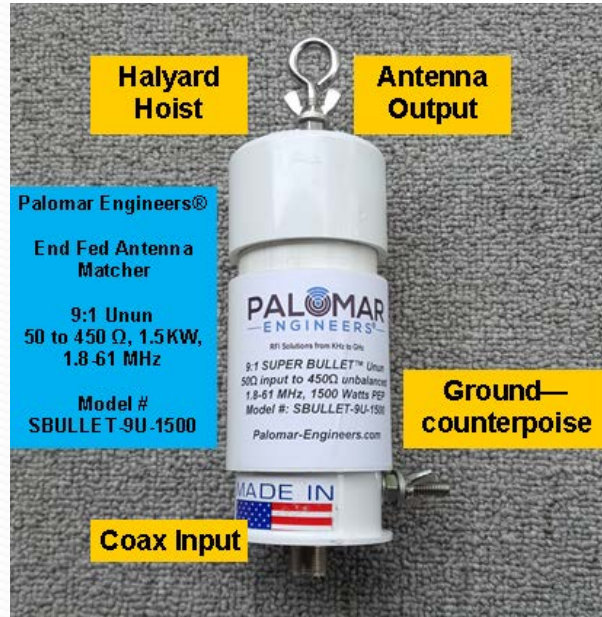


# Matching the end fed antenna to coax cable

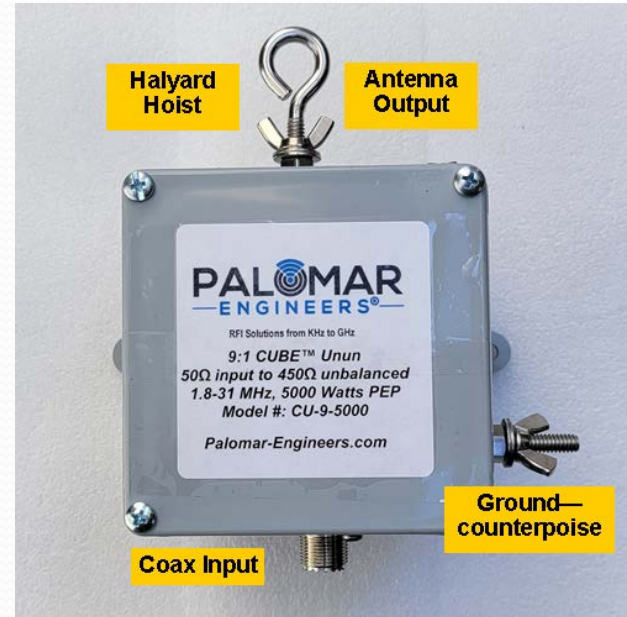
- UNUNs are your friend
  - Antenna feed point impedance:  $300\text{-}900\Omega$
  - 9:1 transformer gives  $33$  to  $100\Omega$  at coax
- Connections for coax, antenna feed point and counterpoise
- Power Ratings – PEP to match your station



# 9:1 Ununs – High Power



Super Bullet-9U-1500 -  
1500 Watts PEP



CU-9-5000 Cube Unun – 9:1,  
5KW Watts PEP

Feedline Chokes

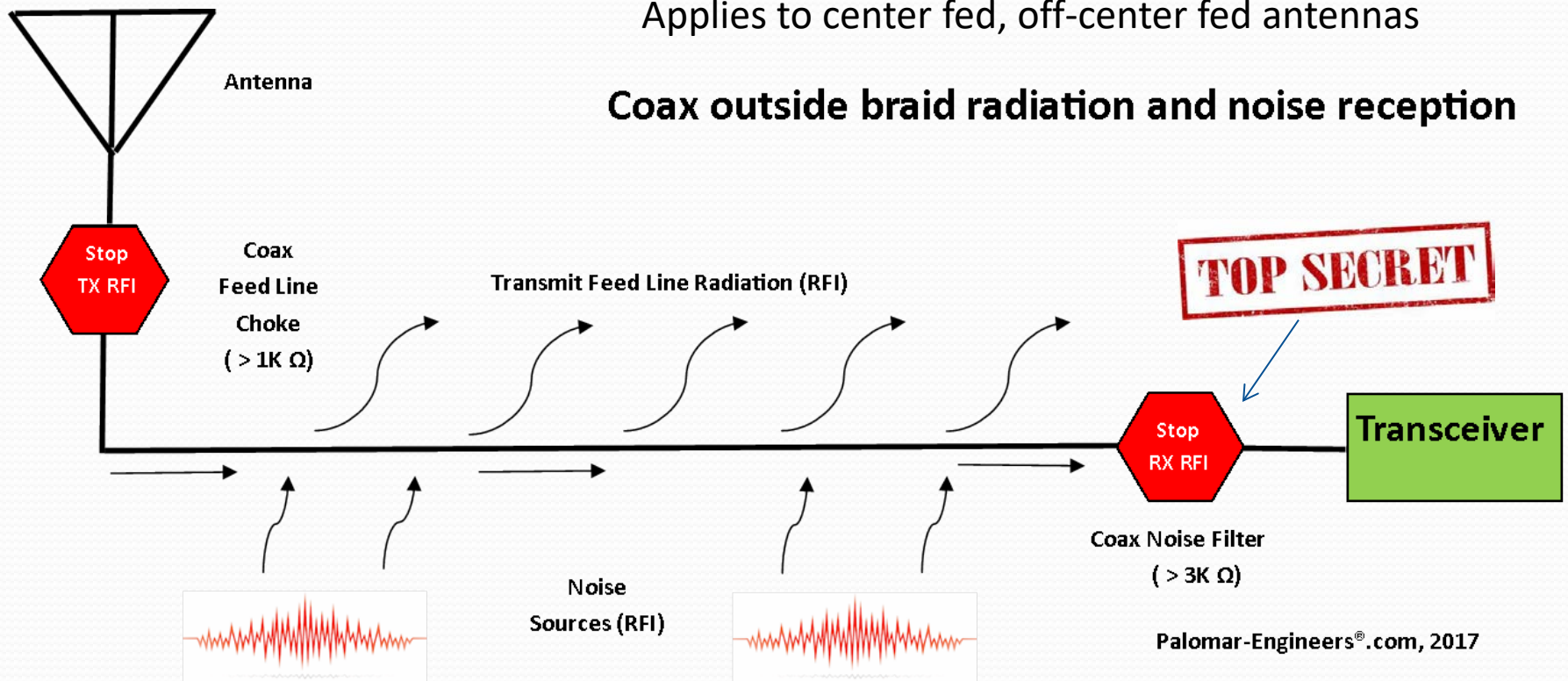


# Coax Feed Line Chokes and Noise Filters

Lower noise floor = Higher SNR = More DX!



# Typical Coax Fed Antenna System



How the end fed antenna is different

# Choosing an End Fed Coax Choke

## Feed line Choke Options

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.



EFFLC (RG-8X coax not included) – easiest to adjust length from matching unit– up to -30 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



CMNF-1500 (1.5KW) – wall mounting– up to -38 dB suppression



CMNF-5000 (5KW) – wall mounting – up to -38 dB suppression



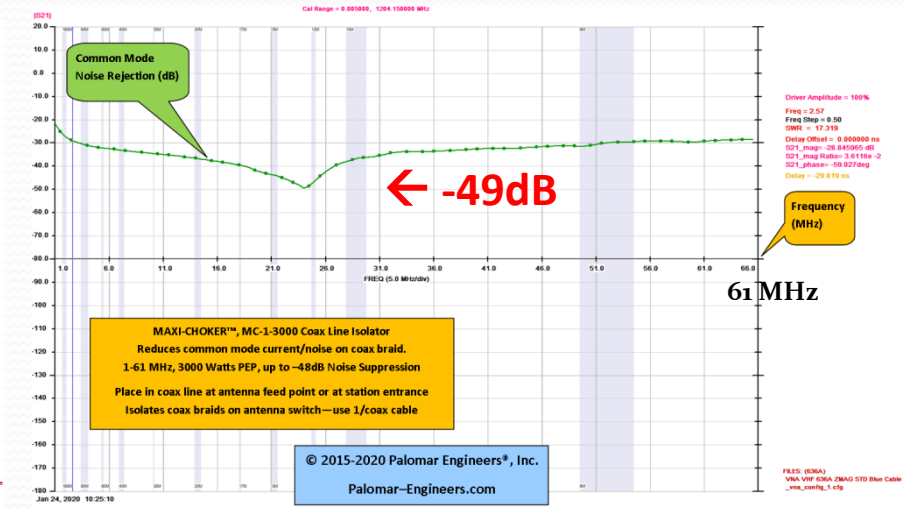
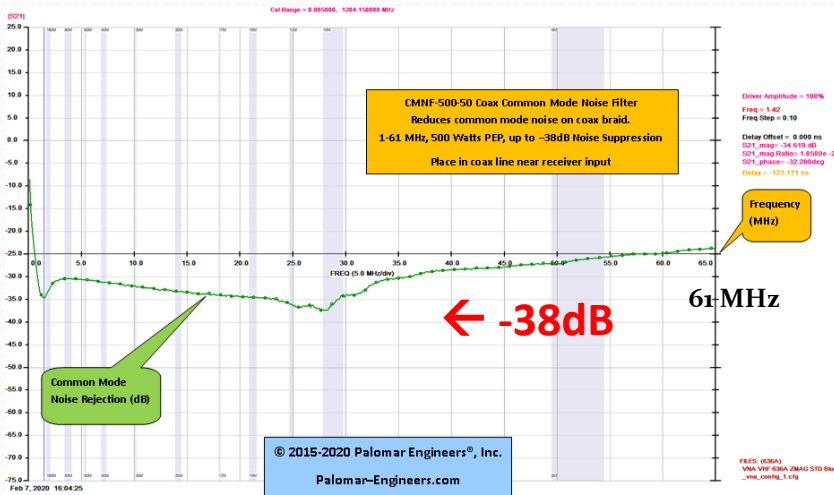
SOFLC - Snap On Feed Line choke (works on RG-8X (6 turns) or RG-8 (3 turns) up to 38 dB suppression

## Criteria to Consider

- Adequate Choking Impedance ( $Z$ ) > 500  $\Omega$
- Effective Frequency Range where  $Z > 500 \Omega$
- Sufficient Power Rating (PEP, Digital)
- Physical Size/Weight

# Choose choke with CMRR > 20 dB over frequency range used

CMRR = Common Mode Rejection Ratio



**Coax Noise Filter (CMNF-500-50)**  
1-65 MHz >2K  
500 Watts PEP, Up to 38 dB reduction (6 “S” units of common mode noise gone!



1 “S” unit = 6 dB, 36 dB = 6 “S” units



**Line isolator (part# MC-1-3000 - 3KW PEP)**  
1-61 MHz >2K, 3KW PEP, 1K-6K ZΩ, 1 pound. All coax lines, Optional ground, static bleeder, up to 49 dB suppression!

**DO NOT BUY CHOKES with NO SPECS!**



# Bullet Antenna Systems at HRO



Part# BAS-71



Bullet™ Antenna System with:  
71 Ft End Fed Antenna (80-6M) +  
Dual Wire Counterpoise Kit +  
End Fed Feed Line Choke

\$130

Many more lengths and power options on our website

Portable Special!

# BULLET™ in a Bag Special



**PALOMAR**  
—ENGINEERS®—

100 Watts PEP  
Bullet™ End Fed Antenna System  
41 Ft Antenna Wire (160-6M) +  
25 Feet RG-8X Coax feed line +  
Snap On Feed Line Choke  
12" Travel Bag  
Part#: BBAS-100-41

DIY parts too!



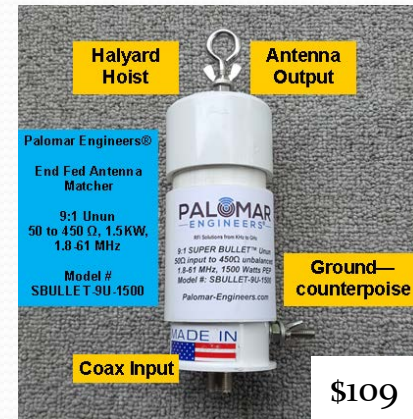
# Bullet Antenna Parts for DIY



\$99



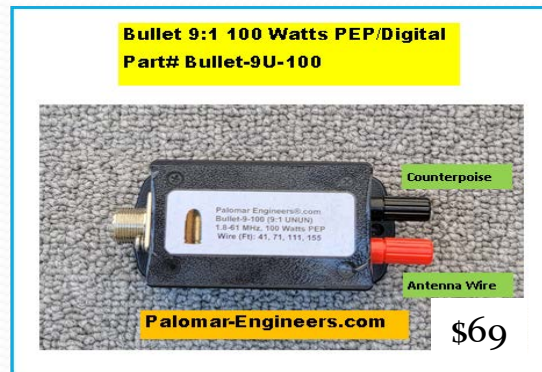
\$69



\$109



\$69



\$69



\$10

What about antenna RFI Issues?

# Solving End Fed Antenna RFI Problems

Stop Transmit RFI  
Reduce Receiver RFI noise



GOT WANA?





RFI Solutions from KHz to GHz



## WORKED ALL NEIGHBORS

AWARDED TO

Amateur Radio Station \_\_\_\_\_

Who has caused persistent Radio Frequency Interference (RFI)  
to neighbors adjacent to the radio station

Awarded this \_\_\_\_ day of \_\_\_\_\_, 20\_\_

RFI Case Endorsements:



\_\_\_\_\_  
Bob Brehm, AK6R  
Chief Engineer



RFI Solutions from KHz to GHz

# Worked All Appliances

AWARDED TO

Amateur Radio Station \_\_\_\_\_

Who has caused persistent Radio Frequency Interference (RFI)  
to electronic appliances adjacent to the ham radio station

Awarded this \_\_\_\_ day of \_\_\_\_\_, 20\_\_

RFI Case Endorsements:



\_\_\_\_\_  
Bob Brehm, AK6R  
Chief Engineer

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# Typical RFI Solutions

- Keep antenna (and coax) away from house wiring including AC power, Cable/Satellite feeds, telephone lines as these wires can act as receive “antennas” and overload attached electronics OR these “antennas” can transmit spurious signals (and noise) to your antenna and coax giving a high noise floor.
- Use Palomar RFI kits to solve RFI interference or noise issues in your own home or neighbor’s. See website for specific electronic device details.

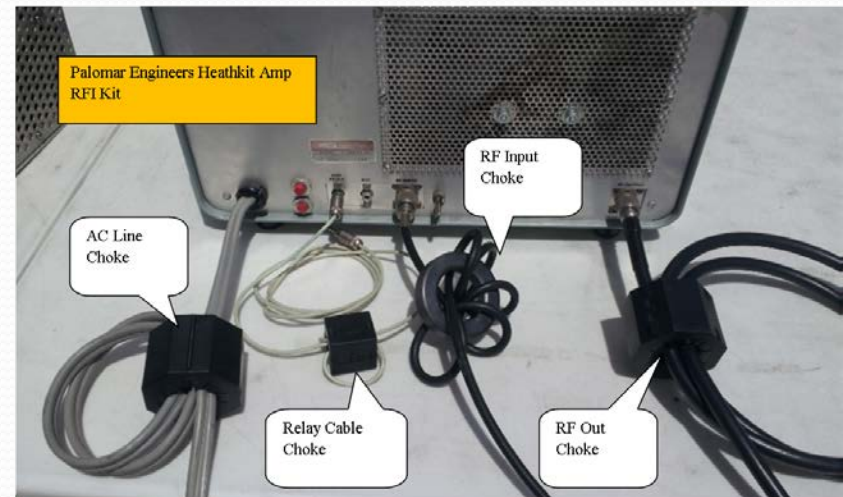
# Transceiver/Amp RFI Kits

Palomar RFI kits for all brands of transceivers and amplifiers

## Transceiver RFI Kit



## Linear Amplifier RFI Kit



**RULE # 1: Clean up your transmitter & amp RFI first!**

Neighbor's RFI



# Neighborhood RFI Solutions

## MY HOME or NEIGHBOR'S HOME



ALARM SYSTEM RFI



HOME THEATER RFI



COMPUTER RFI



MISCELLANEOUS RFI



GARAGE DOOR



TELEPHONE/DSL RFI

**Recommendation:** Use RFI kits for specific problems, have neighbor purchase and install – DO NOT make mods to neighbors equipment! MOST problems are RFI picked up by AC power/phone lines so ferrite filters work well.

QUIZ TIME

# Question #1

- What characteristics of a non-resonant end fed antenna make it superior to a half wave end fed antenna?
  - A) Non-resonant will work on even and odd harmonic frequencies
  - B) Half wave has complicated matching unit with high voltage, non-resonant has simple matching and lower feed point voltage
  - C) Non-resonant can work the WARC bands
  - D) Non-resonant antennas radiate as well as resonant antennas
  - E) All of the above
  - F) None of the above
  - G) I have no idea - I was asleep during the talk

## Question #2

Where do you place the feed line choke on a non-resonant end fed antenna?

- A) right below the matching unit to choke off all coax shield radiation
- B) at the radio end of the coax - about 30% of coax + antenna wire length
- C) in the middle of the coax length to balance the radiation
- D) between the antenna tuner and the transceiver
- E) end fed antennas don't need feed line chokes

# Question #3



- What is one of the best kept secrets in ham radio?
  - a) Ladder line has more loss than coax
  - b) An antenna has to be resonant in the ham bands to radiate in the ham bands
  - c) All ferrites work on all frequencies, so buy the cheapest
  - d) Coax noise filters reduce common mode noise level in your receiver so you can hear more stations
  - e) All extra class hams go to heaven

OK, 1 more!



# Bonus Prize Question #4

- Which company is your best source for End Fed Antennas and RFI solutions?

# RFI Solutions Experts



**RFI Solutions from KHz to GHz**

- Website: [www.Palomar-Engineers.com](http://www.Palomar-Engineers.com)
- Email: [Sales@Palomar-Engineers.com](mailto:Sales@Palomar-Engineers.com)
- Phone: 760-747-3343
- Bob Brehm, AK6R – Chief Engineer
- This presentation available on the website.