

# End Fed Antenna Secrets

## Select, Install & Operate



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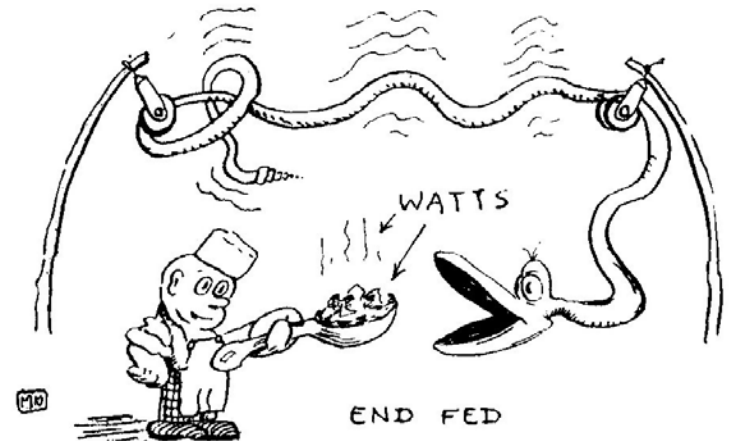
PVARC - July 2018

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# End Fed Workshop Topics



- Popular End Fed Antenna Types
- 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 Noise Filters
- Q & A as time permits



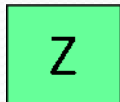
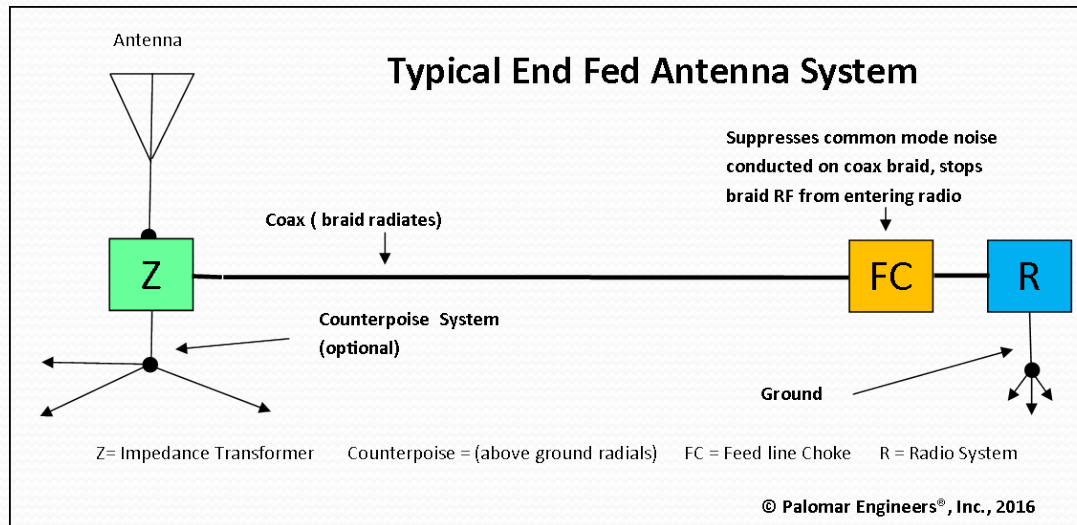
Thinking cap time.....

# End Fed Antennas 101

Pros and Cons of different end fed antenna types

For newbies and old timers too!

# Anatomy of an End Fed Antenna



The antenna impedance matching components (BOX "Z" above) to match the antenna impedance to the coax line impedance (usually 50 ohms). For non-resonant end antennas, the typical feed point impedance is 300 to 600 ohms and a 9:1 impedance transformer (e.g. 450 ohm average antenna impedance to 50 ohm coax, also know as a 9:1 unun).



With end fed antennas, the coax is meant to radiate as part of the antenna system (serving as the "ground" or counterpoise) and you need to use a Feed line Choke (BOX "FC" above) to suppress the common mode current on the outside of the coax feed line so it does not enter the radio while transmitting and also to reduce common mode noise while receiving. The Feed line (FC) acts as a stop sign for RF current flowing back on the outside of the coax. The higher the choking resistance of the fed line choke, the less the coax braid RFI common mode current and the less noise enters the radio.



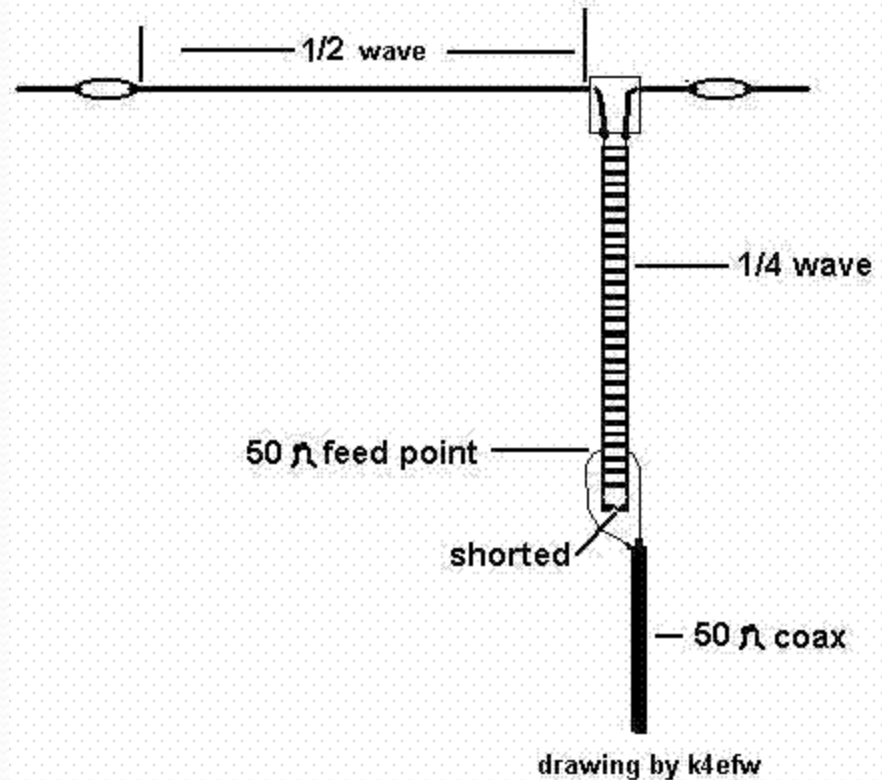
The radio station is also a key component of the antenna system and has two functions: transmit and receive. Matching the transmitter to the coax feed line is often done with an antenna tuner and receiver systems should be installed to maximize signal to noise ratio. Reducing receiver noise is critical for weak signal reception and the use of coax noise filters AND receiver power supply lines (AC or DC) noise filters is usually needed for optimum reception.

# End Fed Antenna Types

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

# End Fed Zepp

- Pros
  - Low loss
- Cons
  - Ladder line match
  - Single band w/o antenna tuner
  - High and long
  - Needs feed line choke at coax feed point



# EFHW Zepp Antennas



HF



VHF



UHF



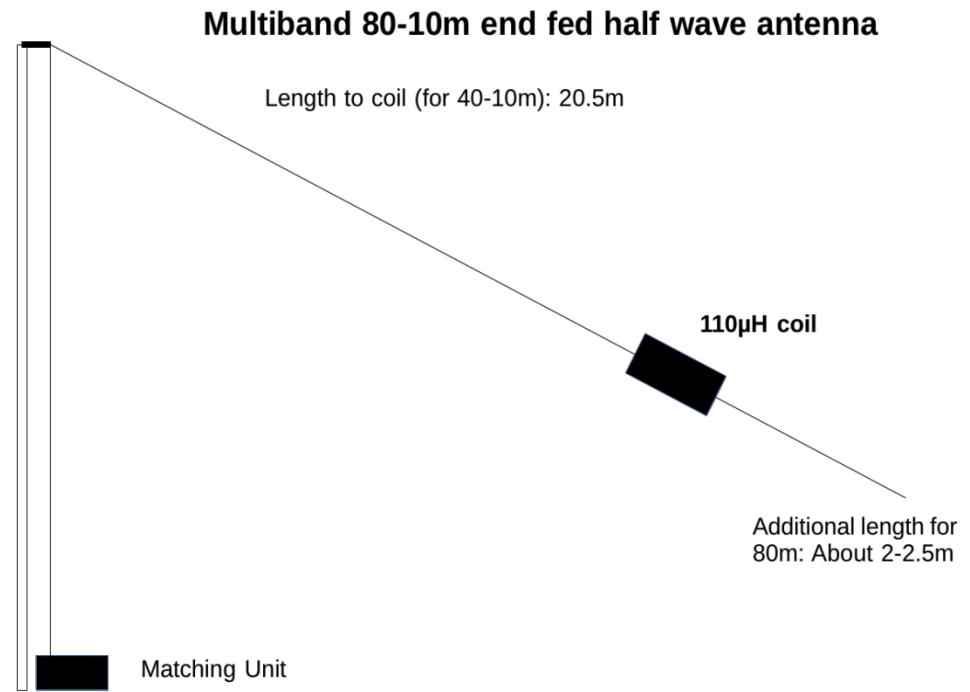
# End Fed Half Wave (EFHW)

- Pros

- Multi-band – even harmonics only
- Hi Z feed = < ground loss %

- Cons

- Long - coil to shorten, needs tuner for multi-band use
- Complex matching unit (64:1 to 49:1)
- Needs feedline choke at coax feed point
- Matching unit gets “HOT” with power or non-harmonic bands





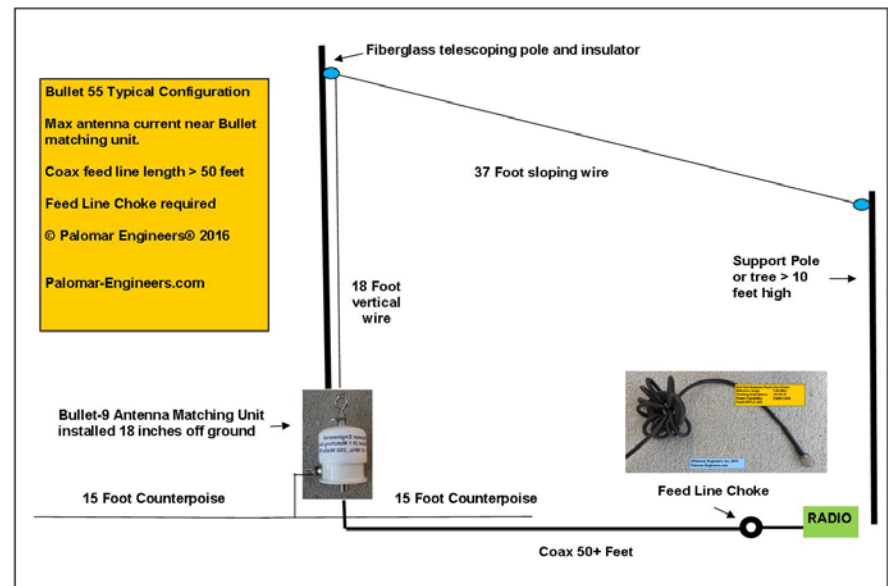
# Non-Resonant End Fed Antenna

- Pros

- Shorter length
- Easy to deploy
- Wide bandwidth
- Non critical length
- Lots of configurations
- Simple matching unit

- Cons

- Coax radiates
- Counterpoise may be needed on some bands



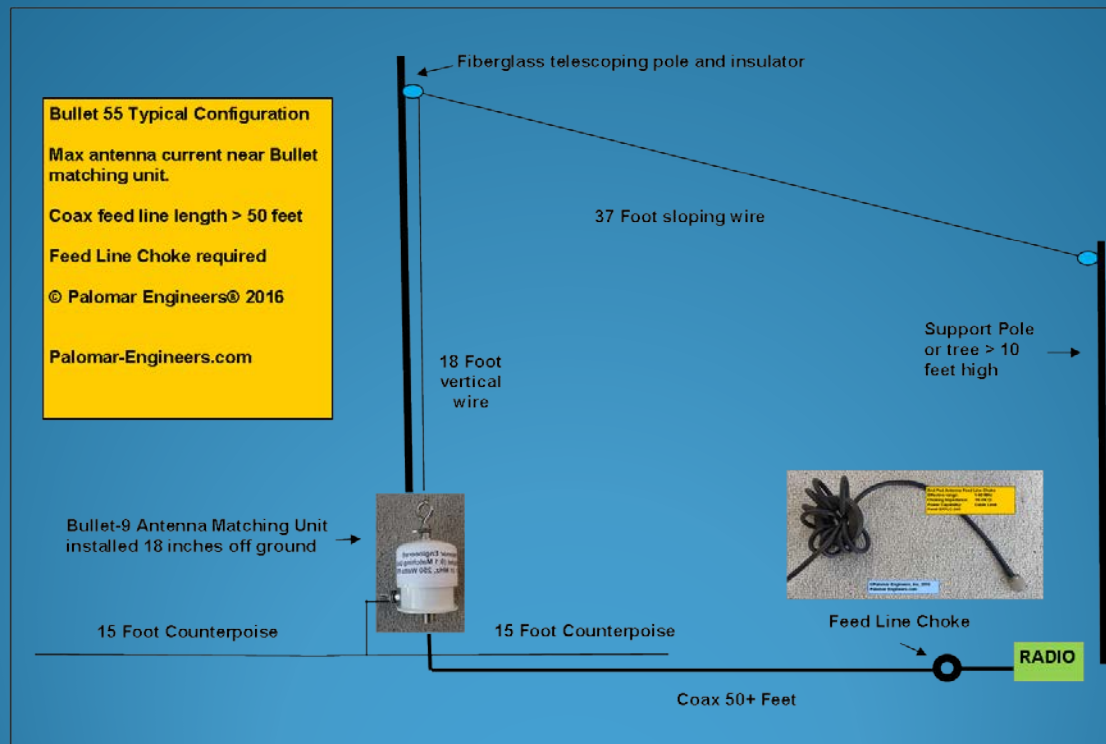
# End Fed Antenna Choices Recap

- End Fed Zepp uses ladder line for matching to coax
- End Fed Half Wave is long and requires special high impedance/voltage matching
- Non-resonant end fed is shorter, uses simple matching and works many bands in less space and will work in many different configurations

Most Popular End Fed is the Non-Resonant

Question: How do I set up a non-resonant end fed?

# Secrets of Non Resonant End Fed Antennas



# Secrets to success with a Non-Resonant End Fed Antenna

- 1** • **How to determine the wire length to use**
  - (antenna, coax and counterpoise lengths)
- 2** • **How to match the antenna to coax cable**
  - (matching unit values and placement)
- 3** • **Choosing a configuration that fits the location**
  - (vertical, sloper, inverted L, horizontal options)
- 4** ■ **Choosing a feed line choke or noise filter**

How does these steps apply to your end fed?

# 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 and a “nail in the ground”

Suggested wire lengths for 1-31 MHz operation (measured from Bullet antenna wire terminal):

Bands Covered (meters)	Wire Length (feet)	Minimum Coax Length (feet)
40-30-20-15	35-43, 49-63, 70-85	35
40-30-20-17	35-45, 54-64, 67-77	35
80-40-30-20-17-15-12-10	38-44, 55, 60, 68-73	50
80-60-40-30-20-17-15-12-10	55, 68-73, 85, 92, 102, 120-125	65
160-80-40-30-20-17-15-12-10	135, 141, 173, 203	130

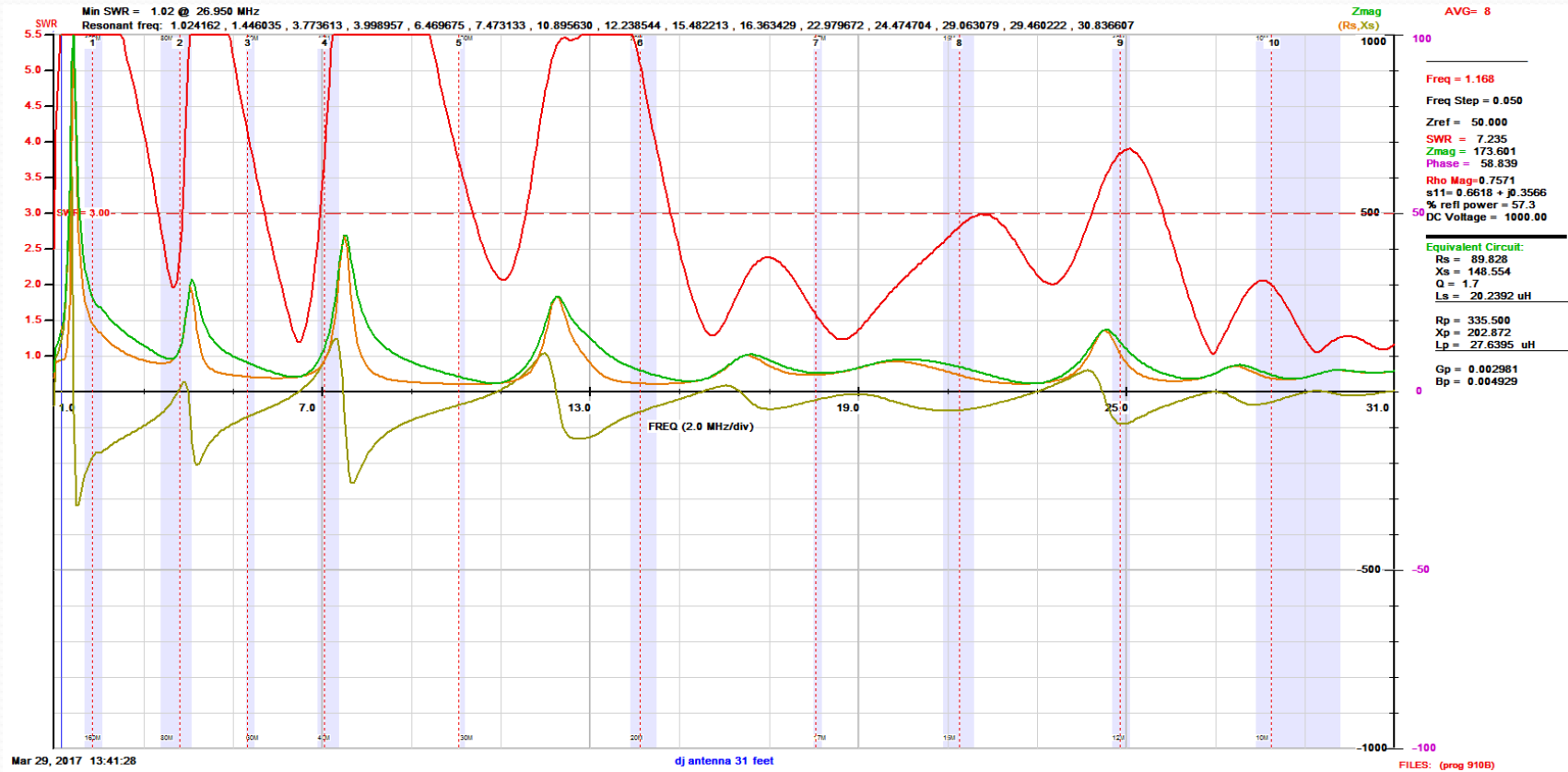
# End Fed SWR Factors

- Configuration shape (Inverted L, flat top, sloper, etc.)
- Length of coax feed line – use recommended values
- Feed line choke 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

Some  
SWR  
plots vs  
length →

# Bullet-31 SWR & Z (after 9:1)

SWR  
3:1-->



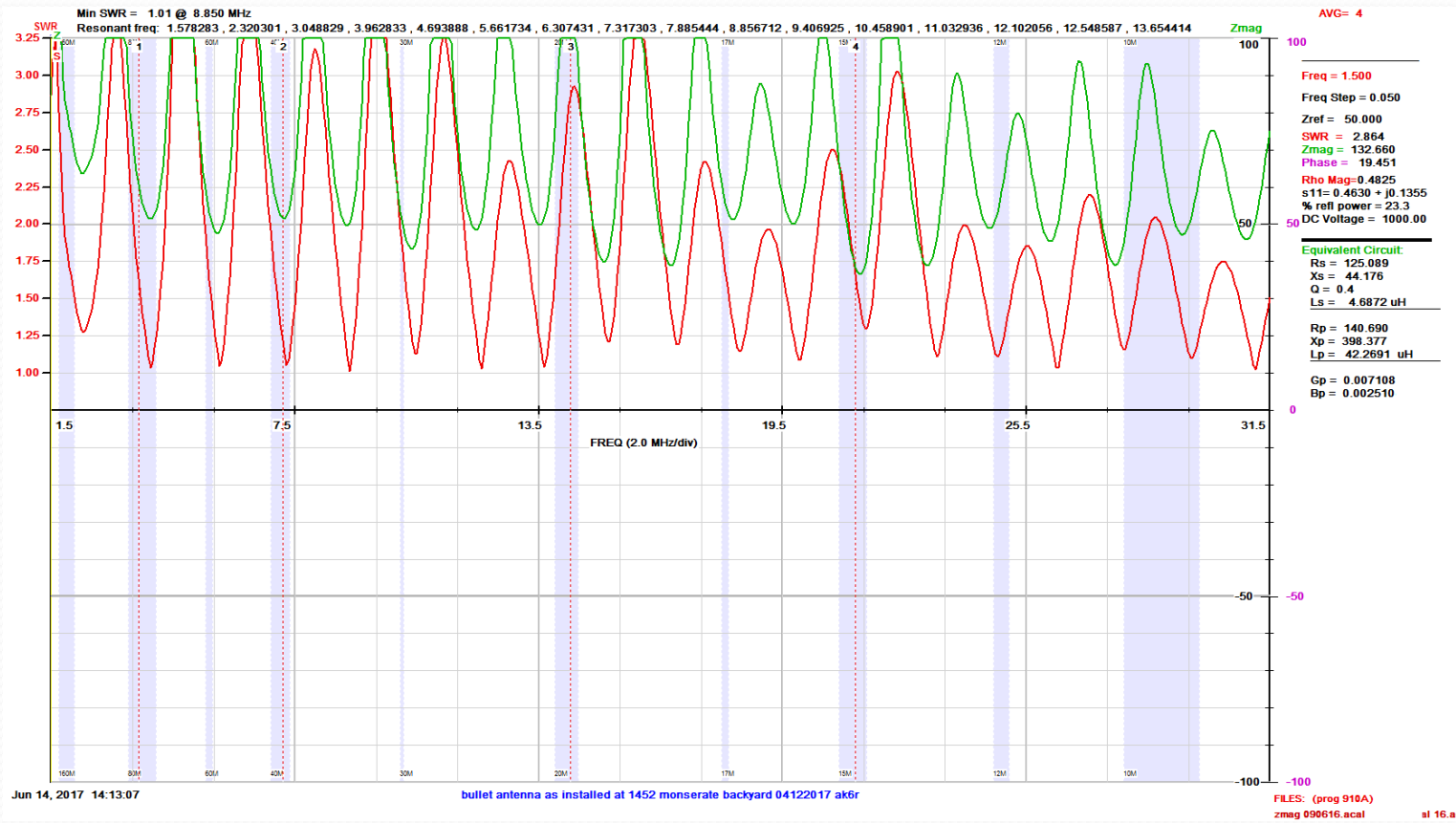
15' vert, 16' horizontal, two 15' counterpoises





# Bullet-92 SWR & Z (after 9:1)

SWR  
2:1-->



20' vertical, 72' horizontal, two 15' counterpoises, 24" to nail in ground, 1-31 MHz

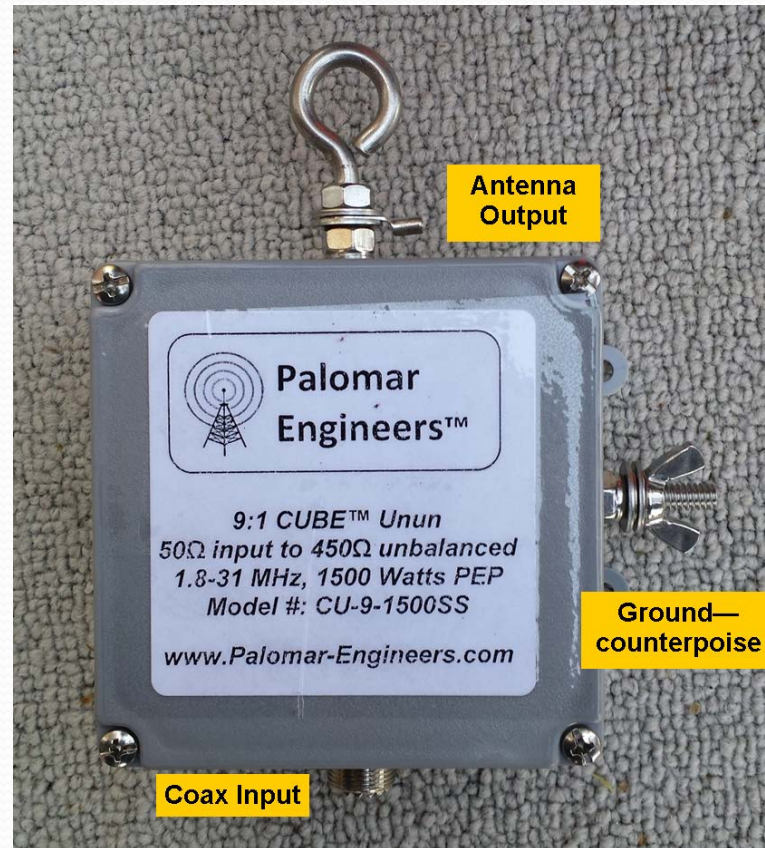
# Matching the antenna to coax cable

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



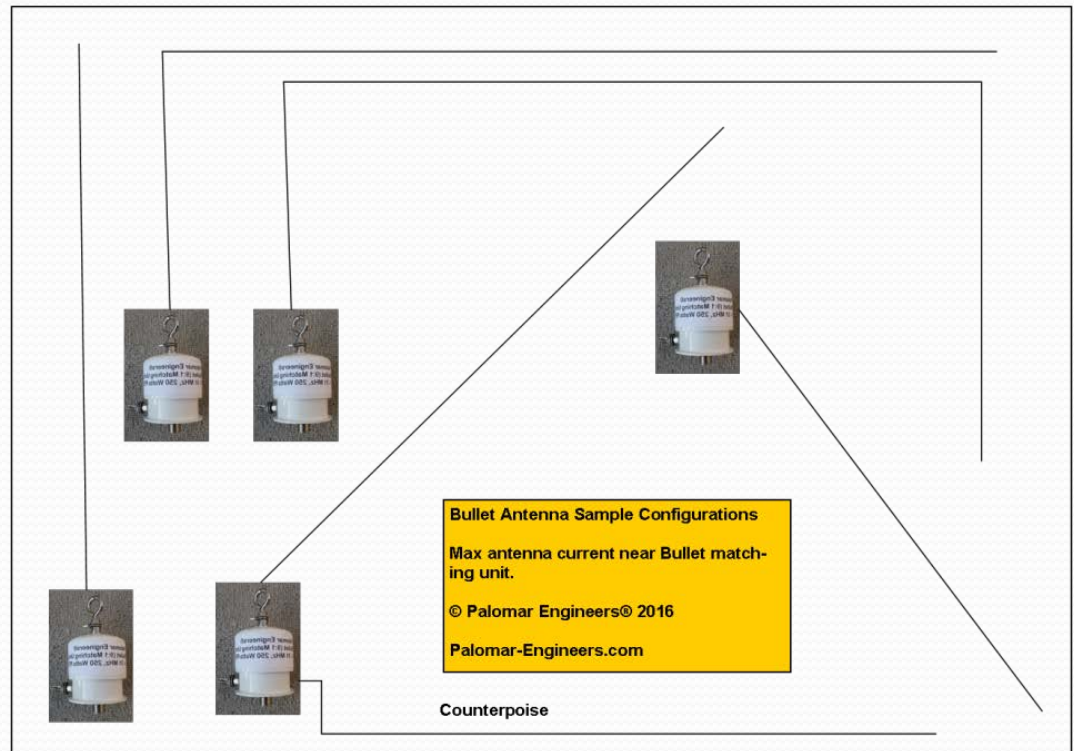
# High Power Ununs are available

- 1.5KW Model
- Similar I/O connections
- PEP rating up to 5KW



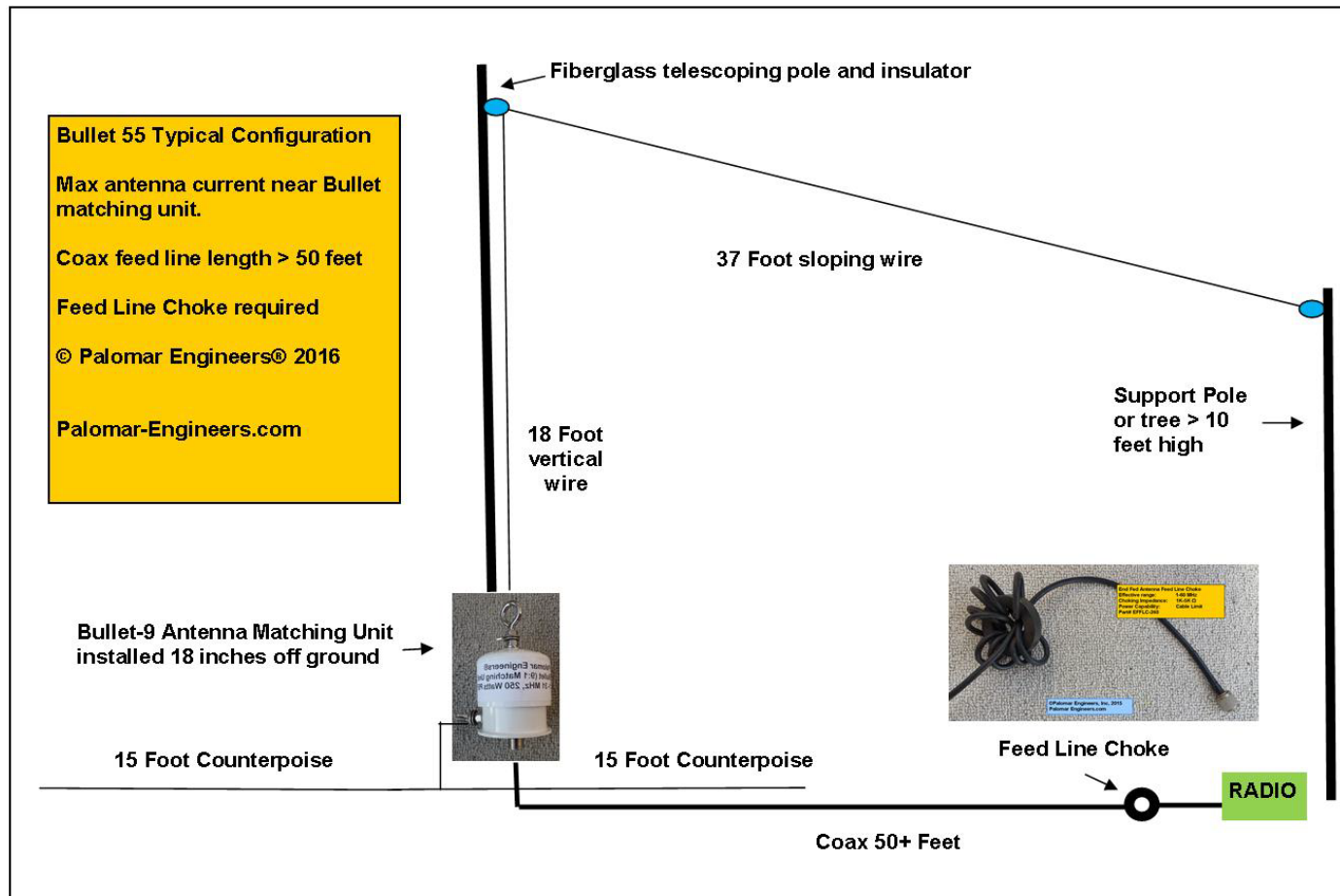
# Antenna Configuration Options

- Vertical
- Sloper Up, Sloper Down
- Inverted L, U
- Horizontal





# Typical End Fed Antenna Setup

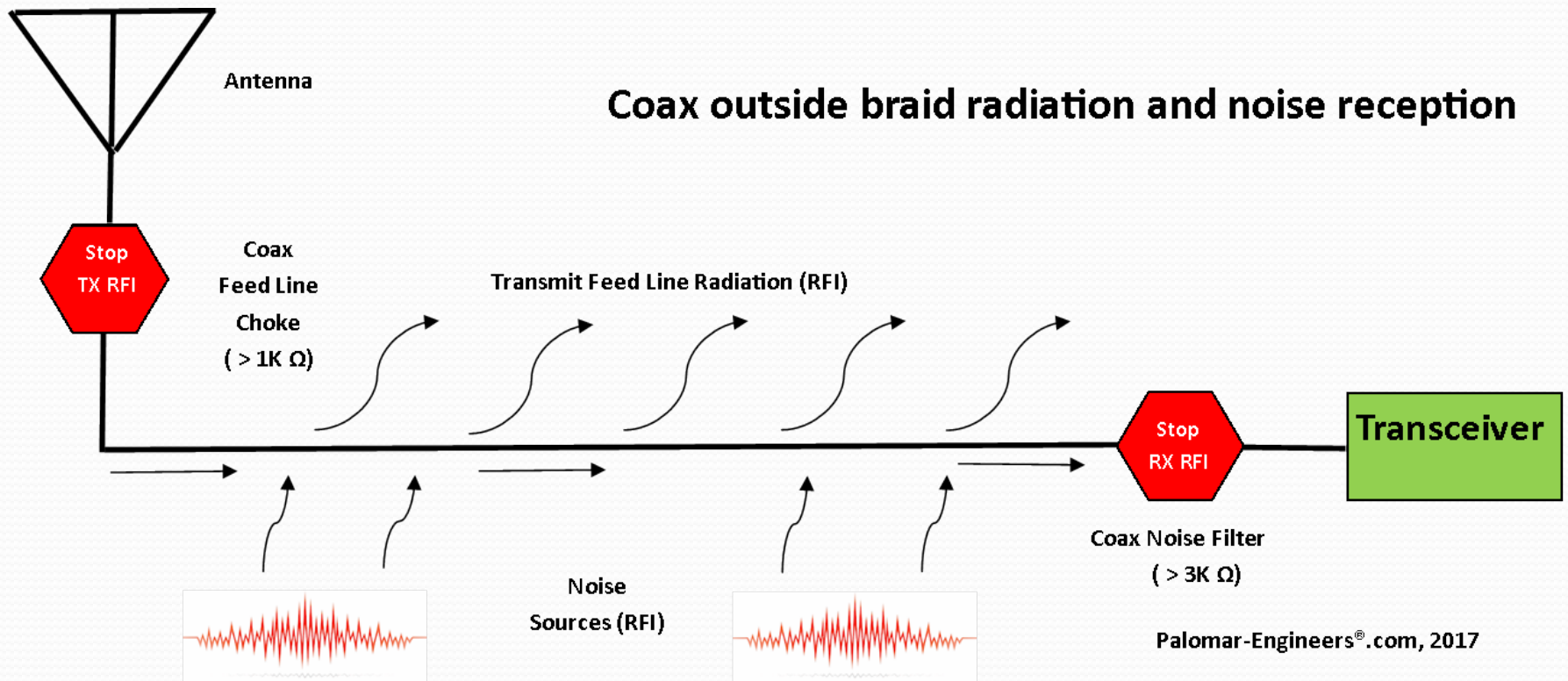


# Coax Feed Line Chokes and Noise Filters

Lower noise floor = Higher SNR = More DX!

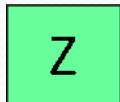
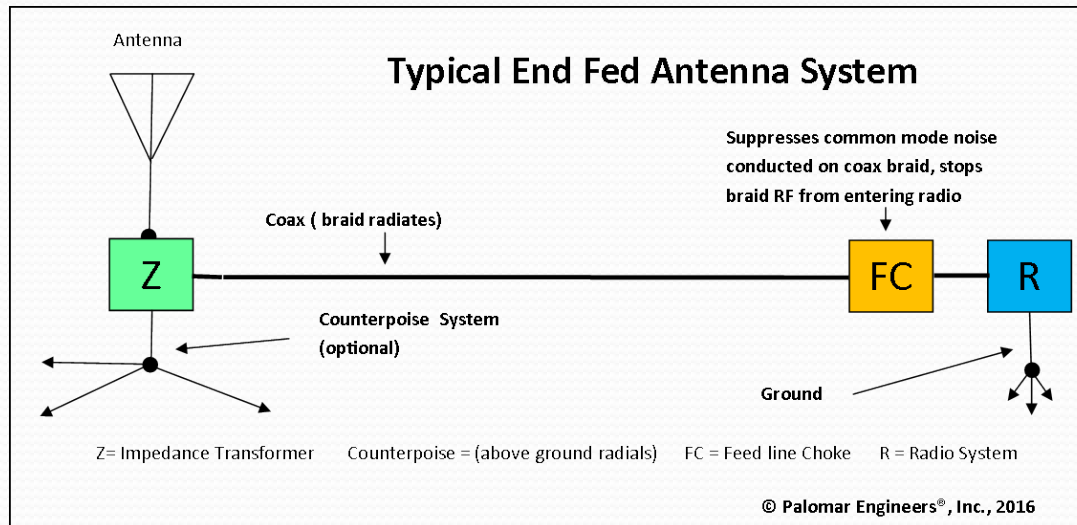


# Typical Coax Fed Antenna System



How the end fed antenna is different

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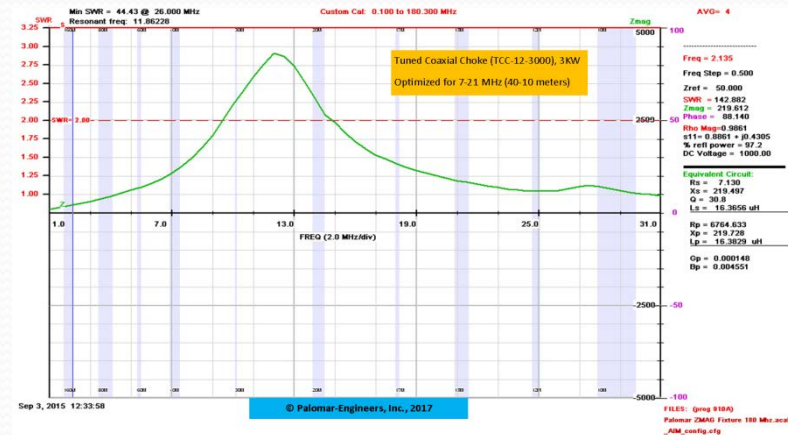
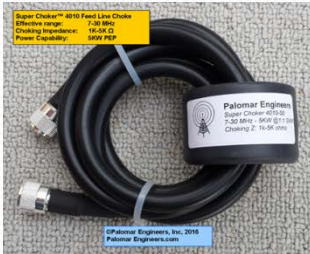


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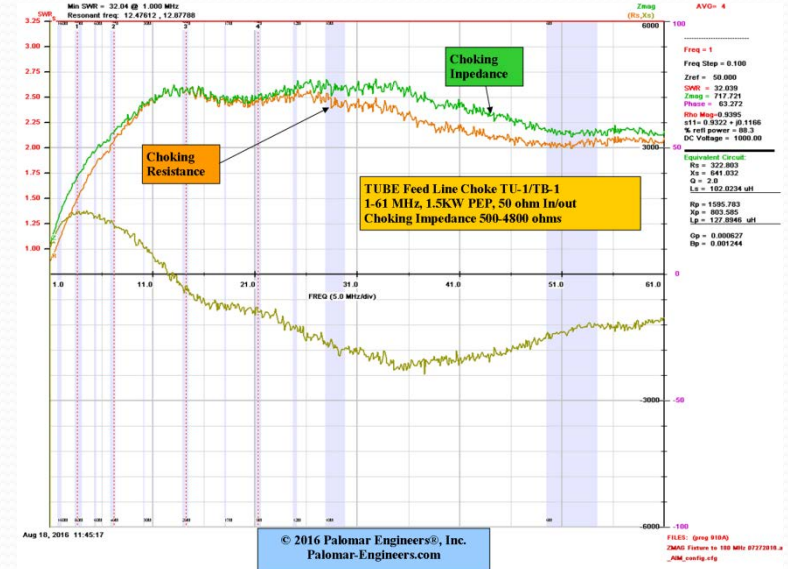
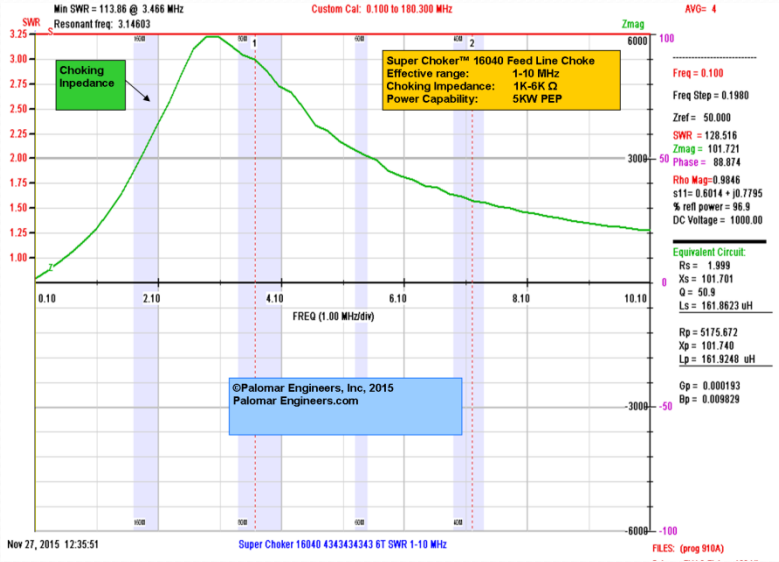
# Choosing a Feed Line Choke



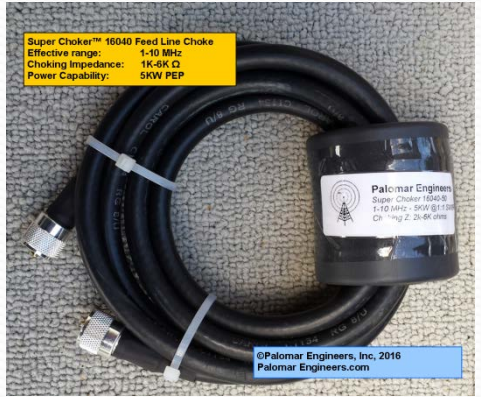
## Criteria to Consider

- Effective Frequency Range
- Adequate Choking Impedance > 500Ω
- Sufficient Power Rating
- Physical Size/weight
- Balun or unun output

# Choose choking impedance > 500Ω at frequency of use



**Super Choker**  
 1-10 MHz >2K  
 5KW PEP  
 1K-6K Z  
 3 pounds  
 Verticals  
 AM/RTTY  
 Contesting

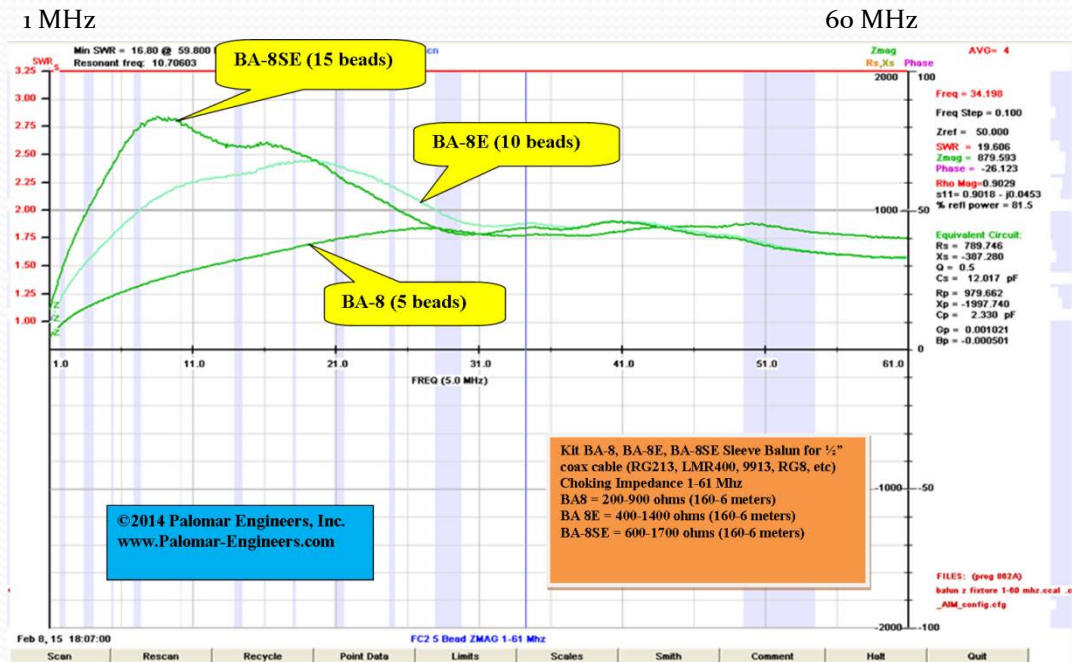


**Line isolator**  
 1-160 MHz >2K  
 1.5KW PEP  
 1K-6K Z  
 1 pound  
 All coax lines  
 Optional  
 ground, static  
 bleeder





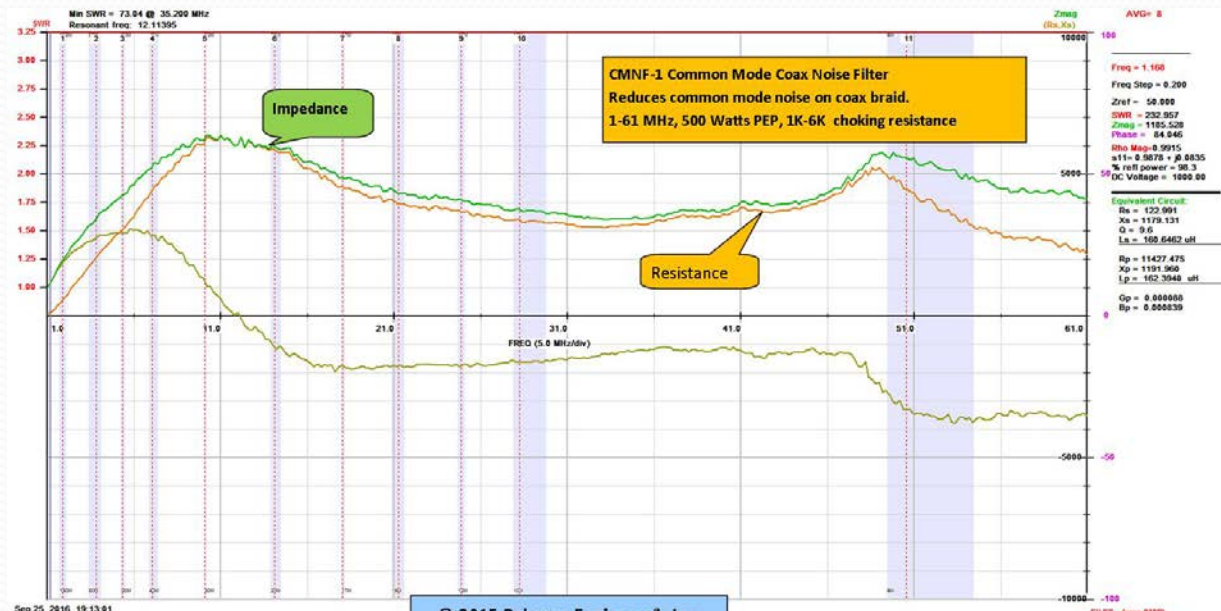
# Feedline Chokes for all antennas



Medium choking Z (500-2000Ω) – 5KW PEP for RG213,  
only 5 beads needed over 30 MHz

# Coax Feed Line Noise Filters

>>> One of the best kept secrets in ham radio!!! <<<



Placed at RADIO END of coax feed line to suppress common mode current on coax braid between antenna feed point choke and radio

Choke Attenuation

# Choking Impedance vs Attenuation

- Palomar Engineers specify RFI/EMI chokes in terms of impedance (in/out), but often the customer needs to know the attenuation to choose which product best suits the application. (1 “S” unit = 6db)

Choke Impedance ( $Z_{sc}$ )	Attenuation (dB)
200	-9.5
500	-15.6
1000	-20.8
1500	-24.0
3000	-29.8
5000	-34.2
10000	-40.0



# A \$10 DIY End Fed Feed Line Choke



+

C  
o  
a  
x

=



- Ring Ferrite + 1/4" Coax Cable = feed line choke – 2-5K ohms
- Use at radio end of coax to stop transmitted signal from entering radio station. Remember the coax radiates in the non-resonant end fed antenna
- Use RG-8X/58 for low power, RG142/303/400 for high power > 1KW PEP

# Bullet Antenna Options



**Bullet BAS-500NF**

**50 Ft Coax**



## Palomar Engineers

**Bullet™ Antenna System**

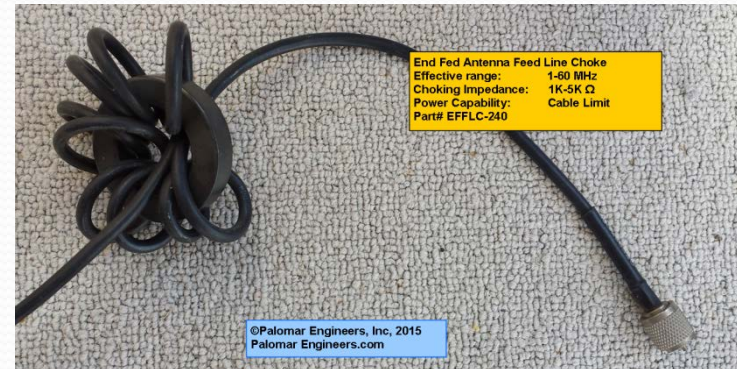
**includes**

**71 Ft End Fed Antenna (80-6M) +**

**50 Feet RG-8X Coax feed line +**

**500 Watt Coax Noise Filter**

# Bullet Antenna Parts for DIY



What about RFI Issues?



# Solving End Fed Antenna RFI Problems

Unbalanced antennas need a ground to call home



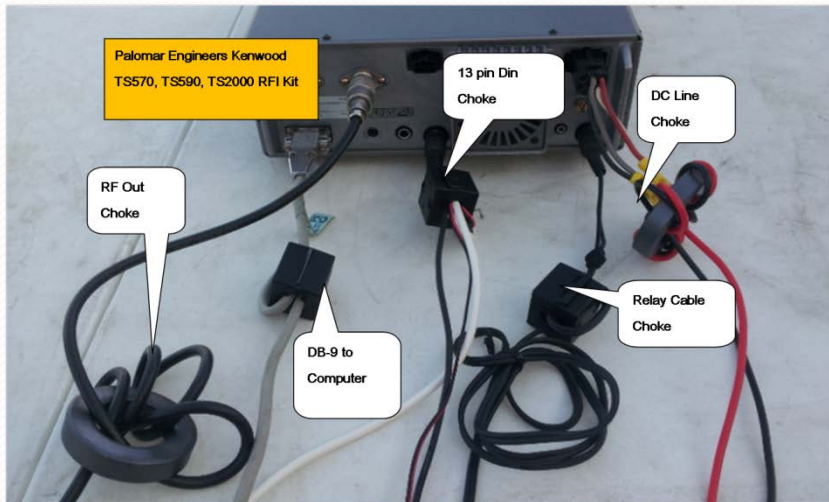
# Typical RFI Issues

- Keep antenna away from house wiring including AC power, Cable/Satellite feeds, telephone lines as these wires can act as antennas and overload attached electronics OR transmit spurious signals (and noise) to your antenna.
- Use Palomar RFI kits to solve RFI interference or noise issues in your own home or neighbor's. See website for more details.

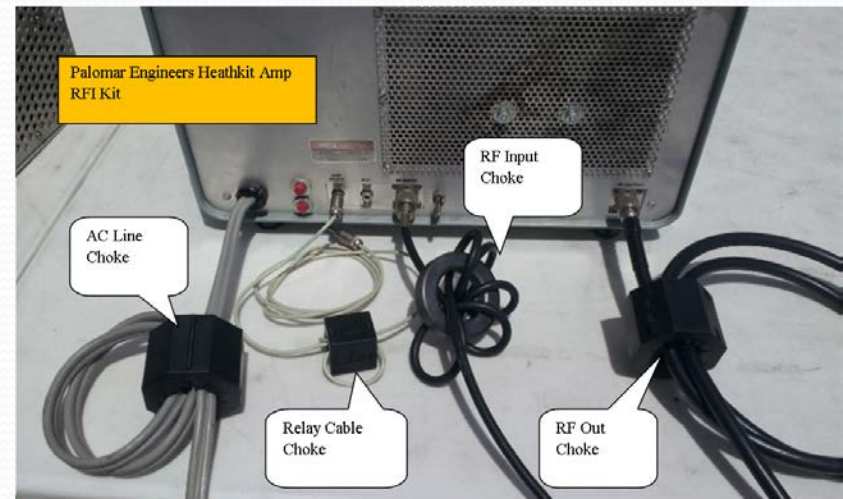
# Transceiver/Amp RFI Kits

Palomar RFI kits for all brands of transceivers and amplifiers

Transceiver RFI Kit



Linear Amplifier RFI Kit



Clean up your transmitter RFI first

# 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.



# RFI Solutions Experts

## Palomar Engineers

- 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.