

# End Fed Antenna Secrets

## How to

### Select, Install & Operate



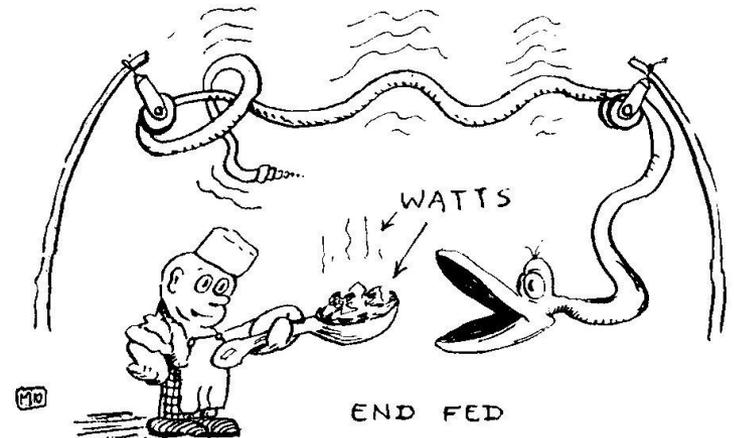
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YUMA Hamfest - February 2019  
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# End Fed Workshop Topics



- Short overview of antenna feed points
- 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

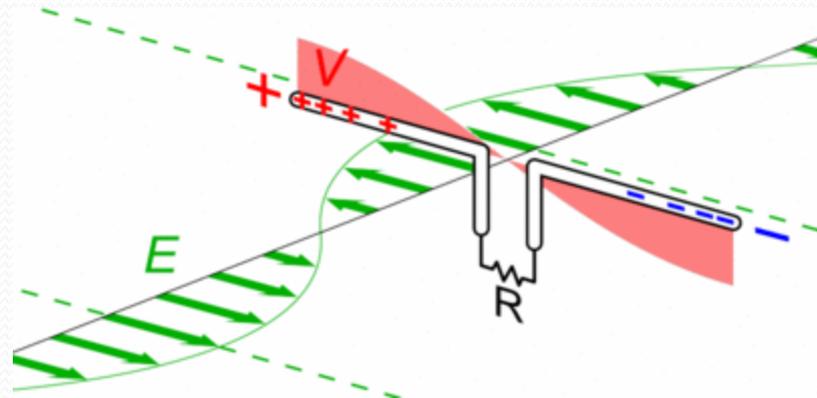
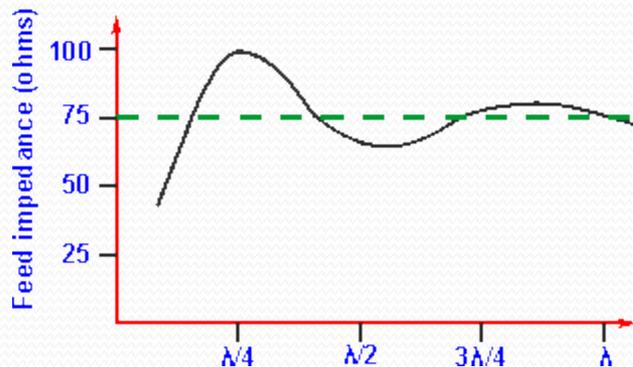
CENTER FED

OFF-CENTER FED

END FED

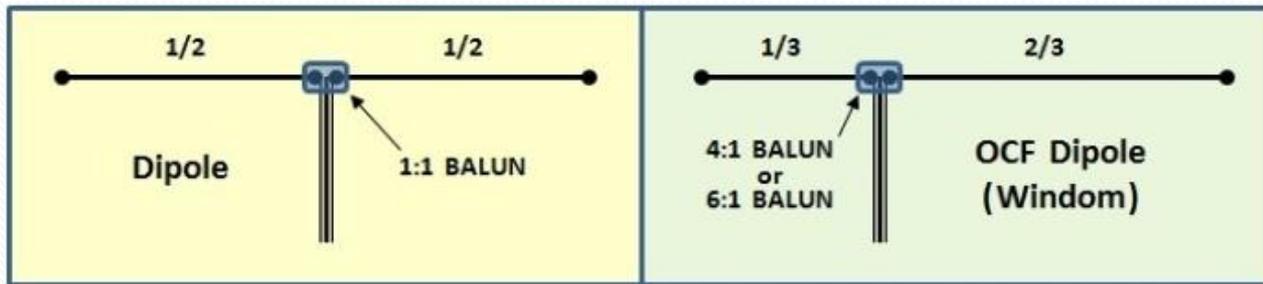
# Dipole Concepts

- Total Length is  $\frac{1}{2}$  wavelength =  $468/F(\text{MHz})$ 
  - Center Fed (50%/50%),  $Z=25-100\Omega$
  - Off Center Fed (66/34%, 80/20%),  $Z=200-300\Omega$
- Feed Point Impedance =  $F(\text{height above RF ground, offset})$



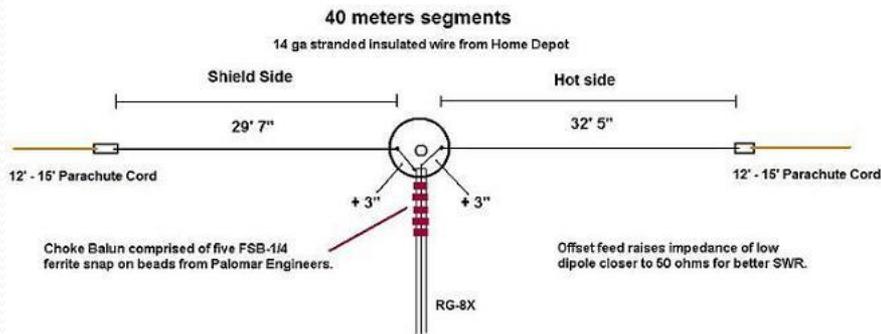
# Dipole Examples

- Horizontal Half Wave

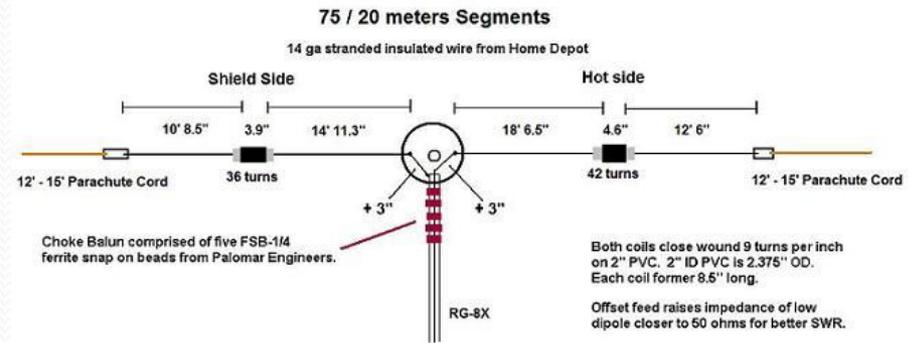


DJoIP Image

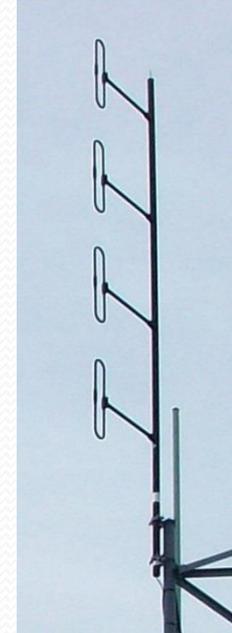
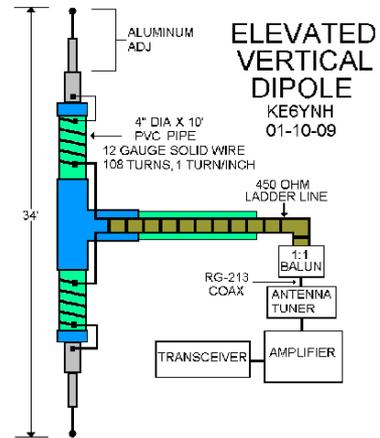
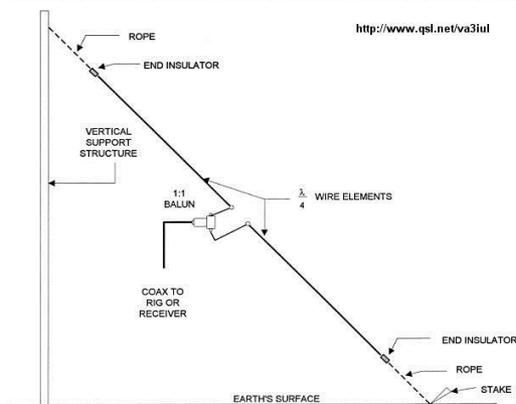
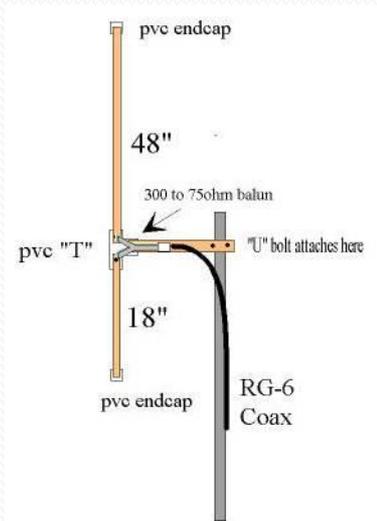
62' – 40 meters only-offset for  $50\Omega$



66' – 75/20 meters (traps)



# Vertical Half Wave Dipoles



Off-Center Fed, sloper, center fed, phased

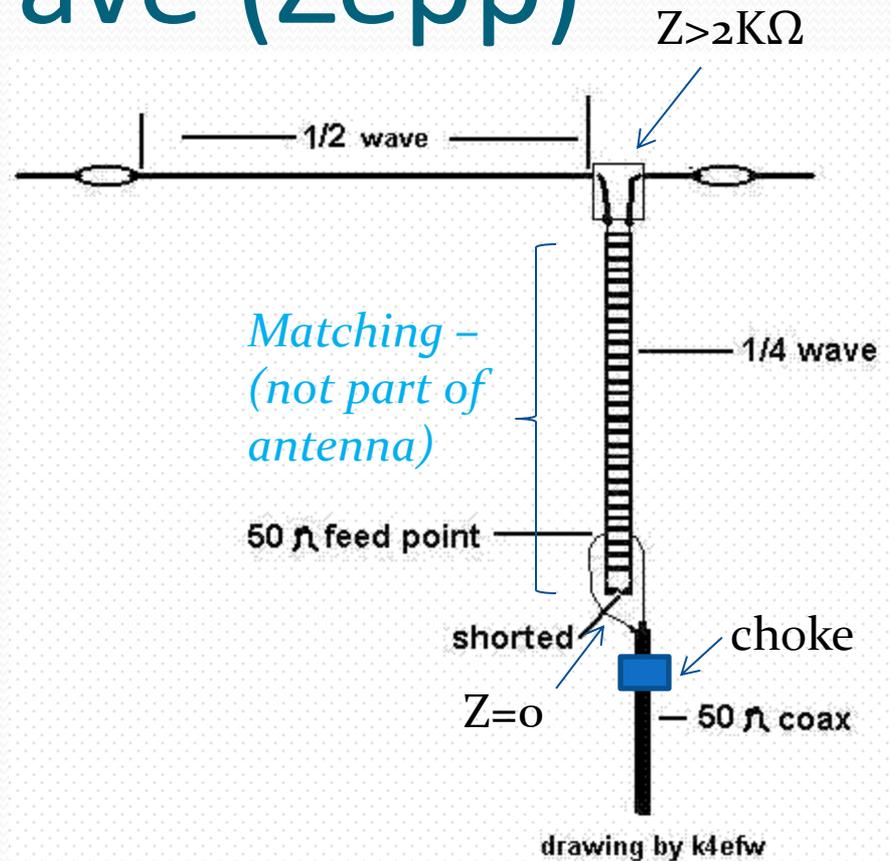
End Feds

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



# EFHW Zepp Antennas



HF

R5,R7,R9



VHF



UHF



EFHW

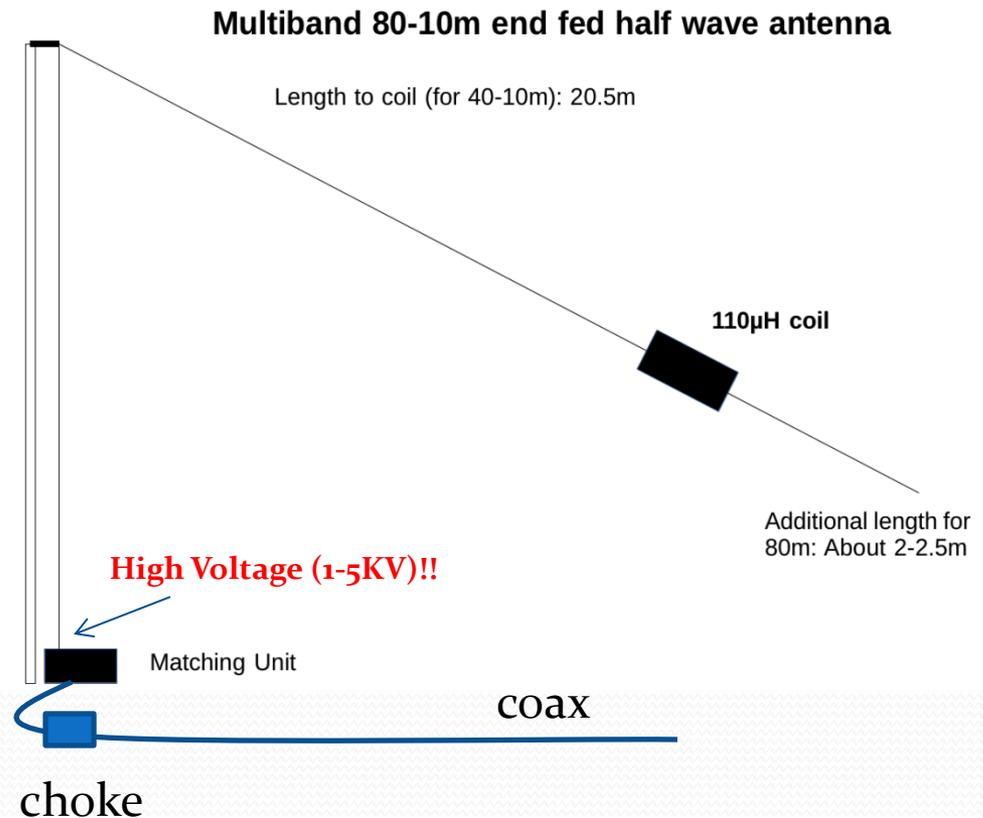
# End Fed Half Wave (EFHW)

- Pros

- Multi-band – even harmonics (80-40-20-10 cw)
- 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)
- Needs feedline choke at coax feed point
- Matching unit gets “HOT” with power or non-harmonic bands



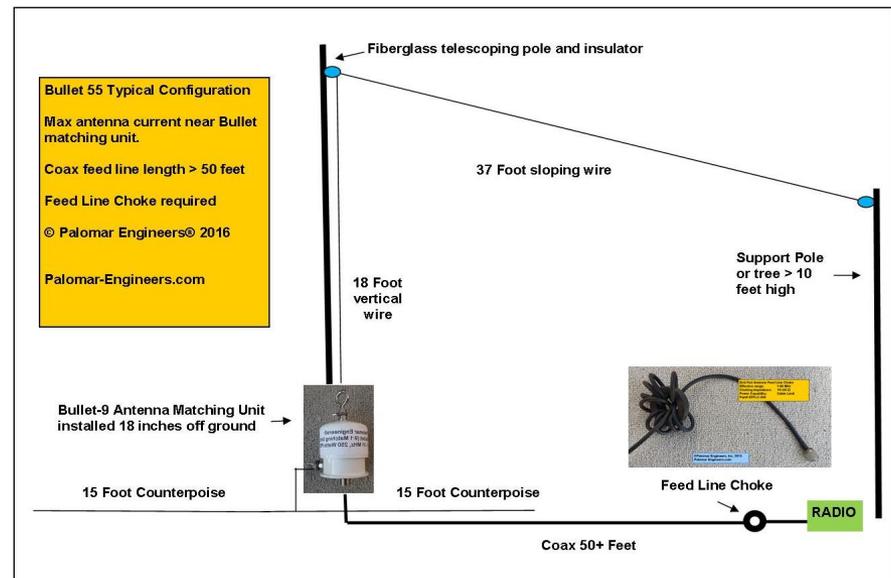
# Non-Resonant End Fed Antenna

- Pros

- Shorter length (80 Meters  $\geq 71'$ , not 130')
- Easy to deploy
- Wide bandwidth
- Non critical length
- Lots of configurations
- Simple matching unit

- Cons

- Coax radiates
- Counterpoise may be needed on some bands



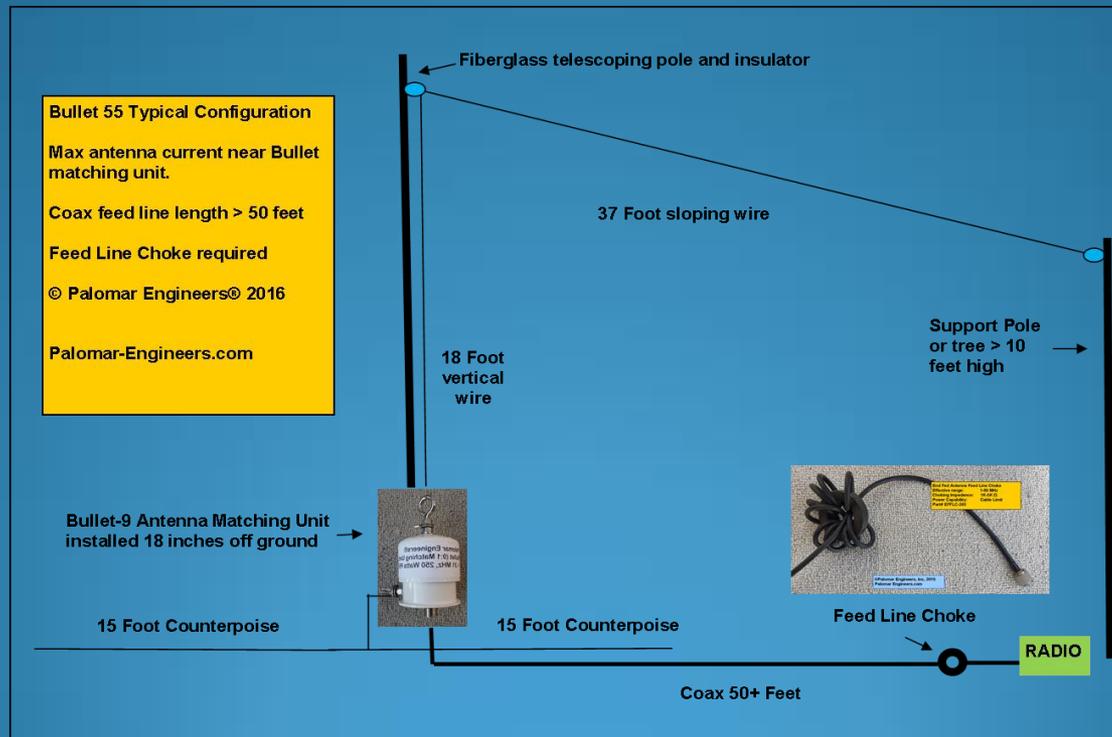
# End Fed Antenna Choices Recap

- End Fed Zepp uses ladder line for matching to coax
- End Fed Half Wave – even harmonics, requires special high impedance 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

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

# Secrets of Non Resonant End Fed Antennas



# NREF Antenna Secrets

- 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**
  - (selection and installation)

How do 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 with various lengths

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

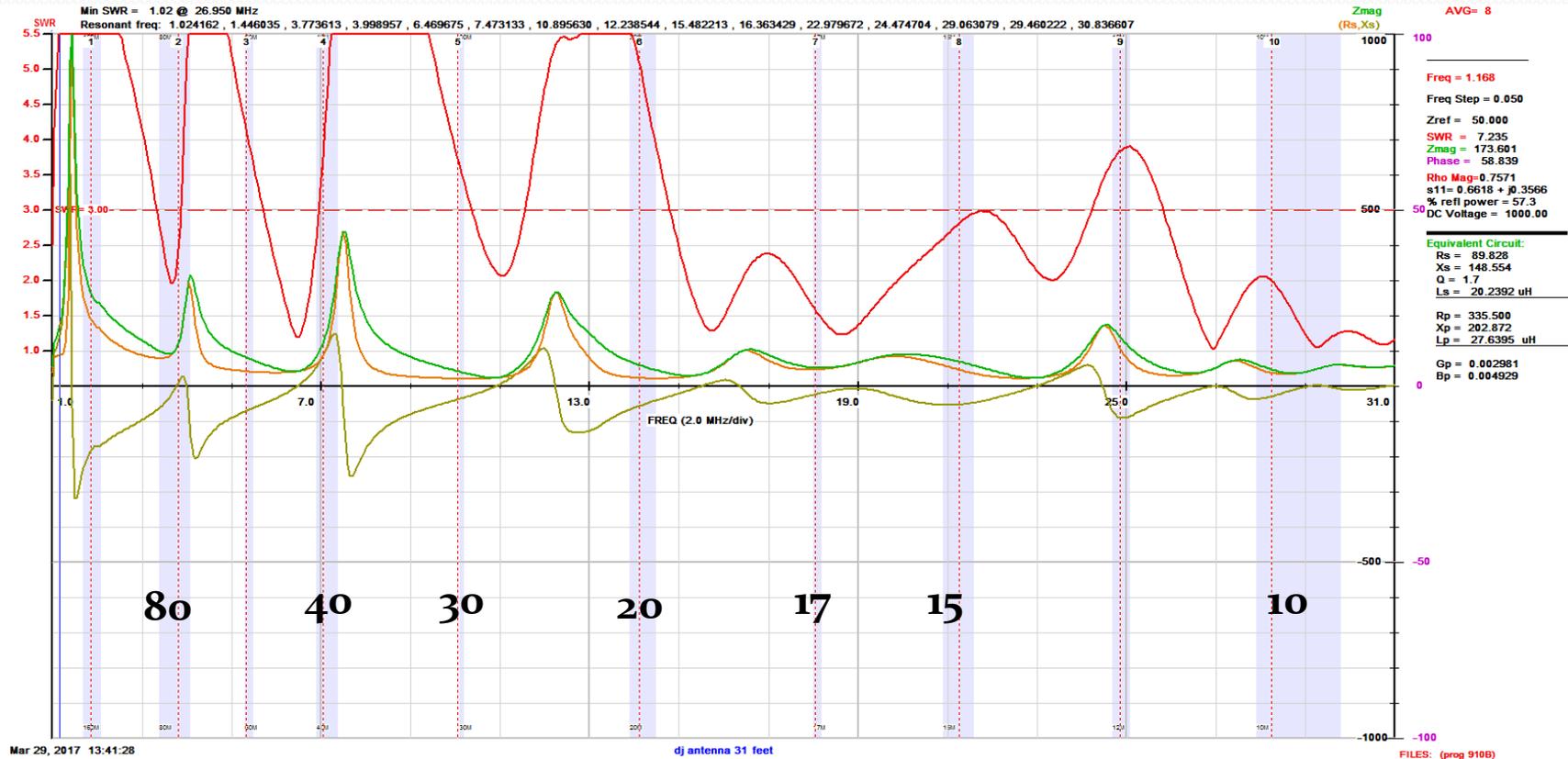
# End Fed SWR Factors

- 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 (no  $\frac{1}{4}$  wavelength wires)

Some SWR plots vs length →

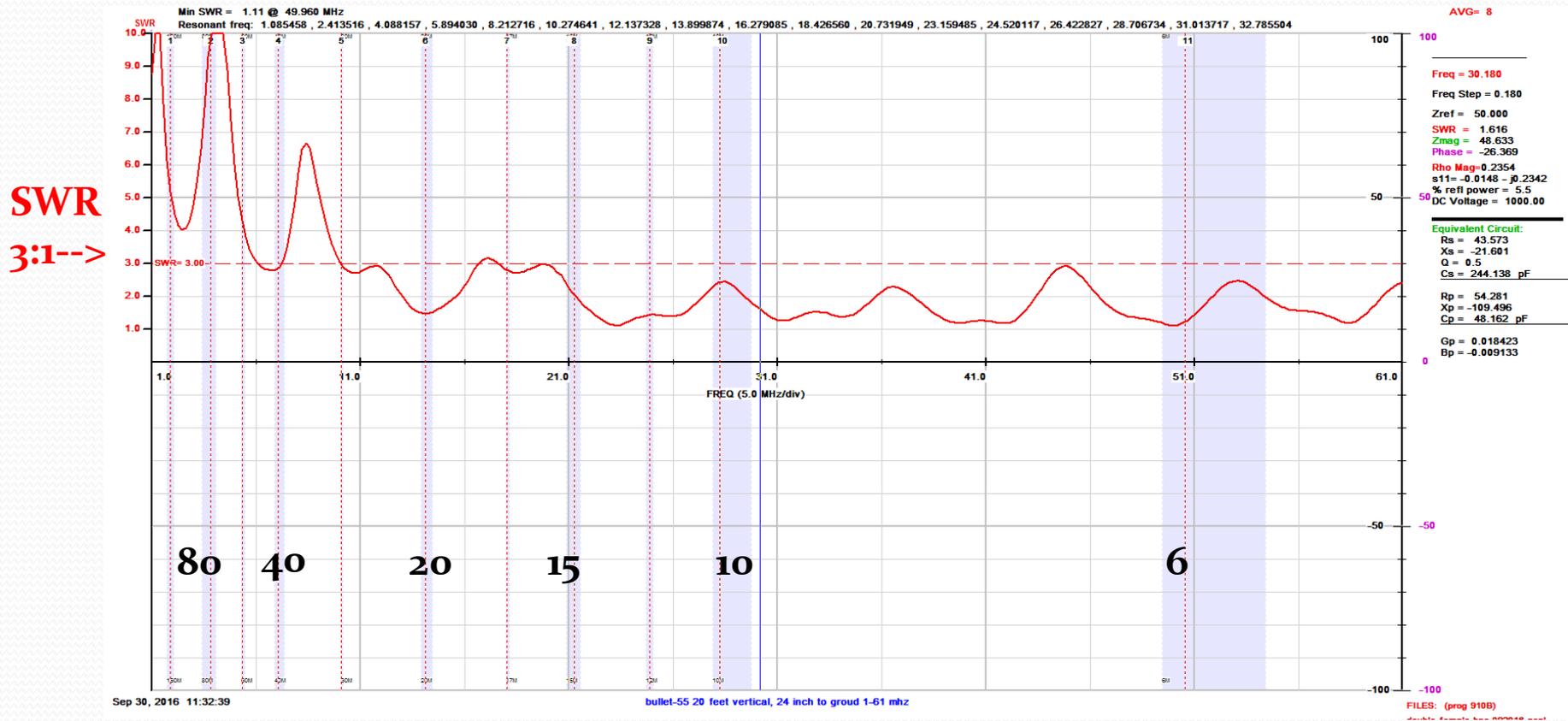
# Bullet-31'- SWR & Z (after 9:1)

SWR  
3:1-->



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

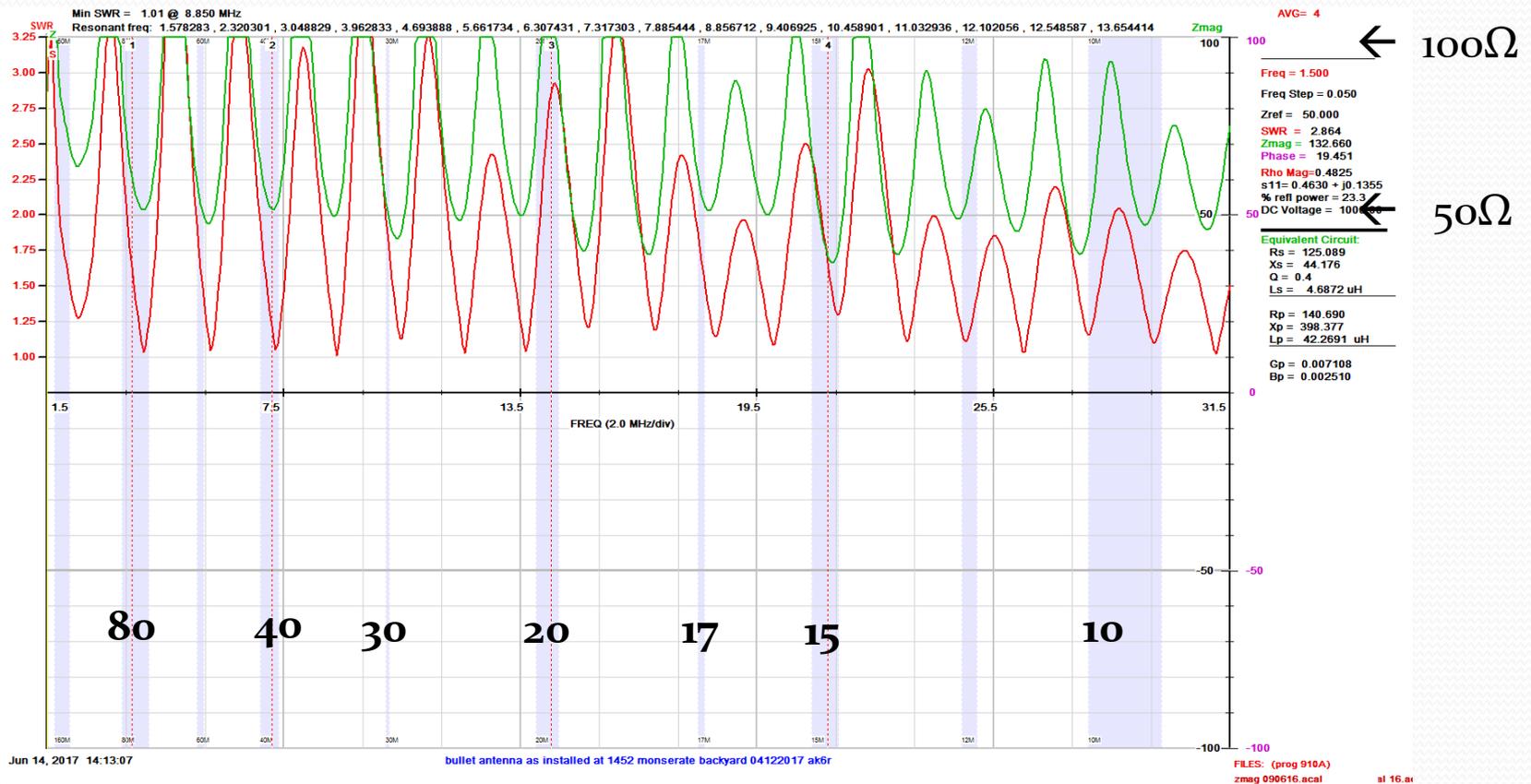
# Bullet-55'- SWR (after 9:1)



20' vertical, 35 horizontal, two 15' counterpoises, 1-61 MHz. <3:1 40-6 meters

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

SWR  
2:1-->



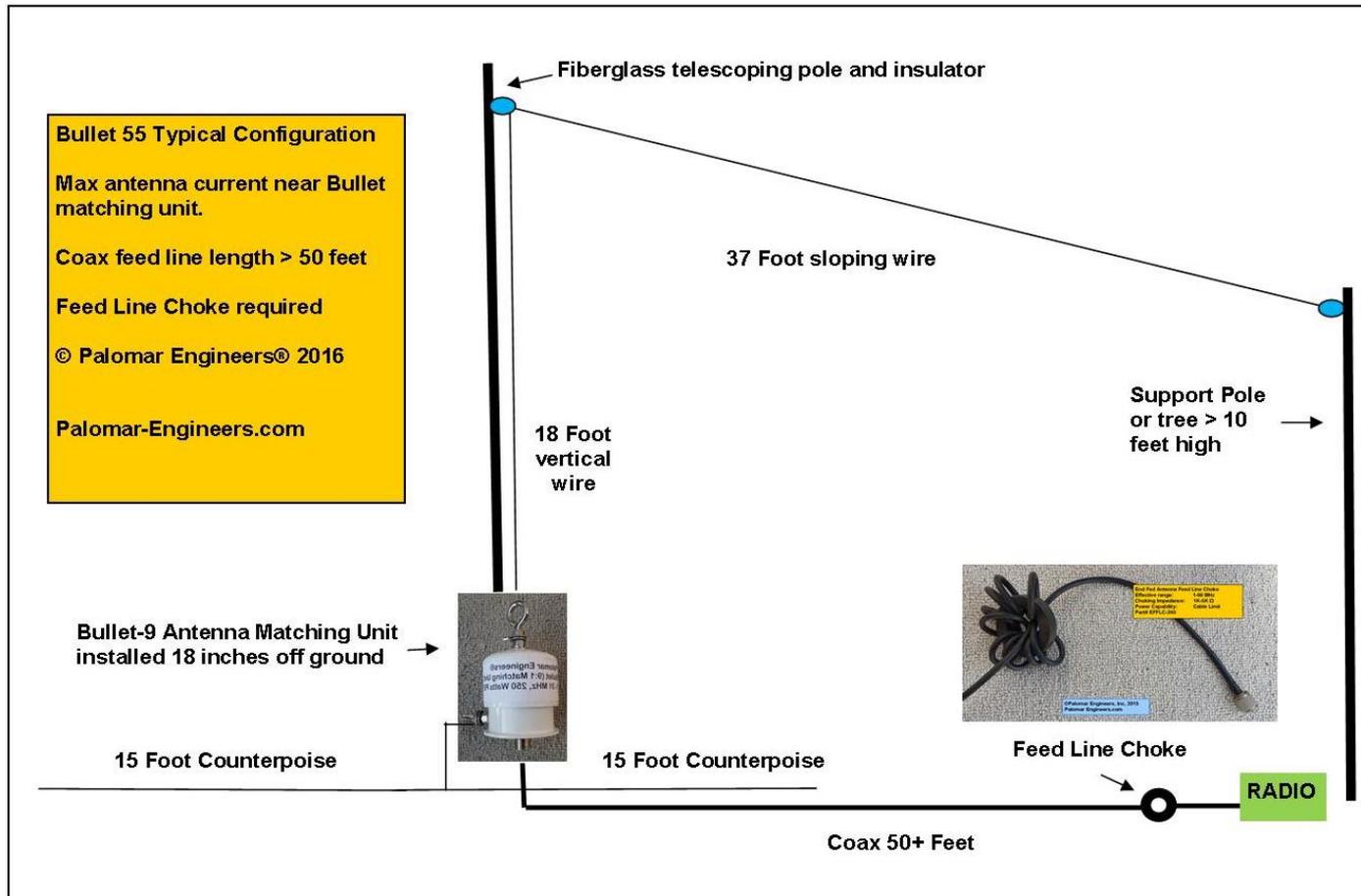
20' vertical, 72' horizontal, two 15' counterpoises, 24" to nail in ground, 1-31 MHz

# Matching the 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



# Typical End Fed Antenna Setup



# Coax Feed Line Chokes and Noise Filters

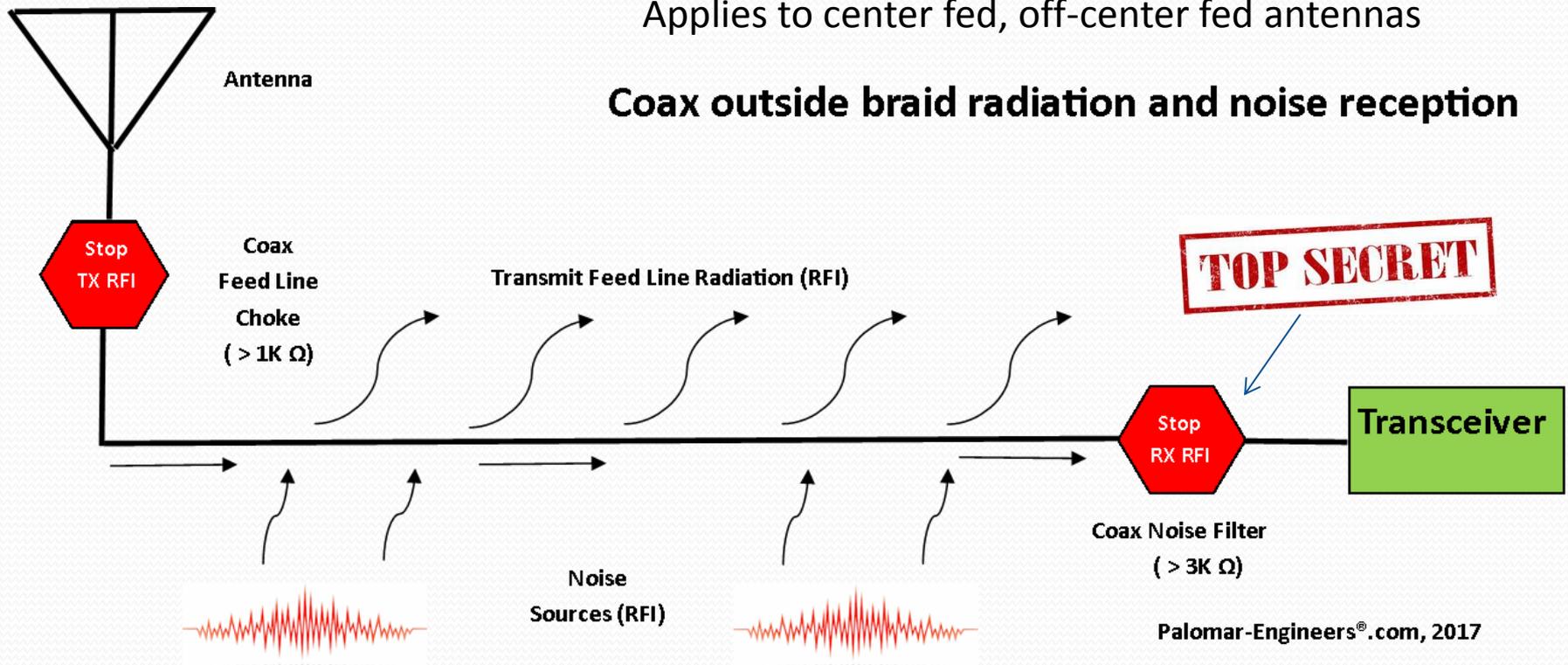
Lower noise floor = Higher SNR = More DX!



# Typical Coax Fed Antenna System

Applies to center fed, off-center fed antennas

**Coax outside braid radiation and noise reception**



How the end fed antenna is different

# Choosing an End Fed Coax Choke



Snap On Choke  
500-1000 $\Omega$



Ring Choke  
1K-4K $\Omega$



Noise Filter  
2K-10K $\Omega$

## Criteria to Consider

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

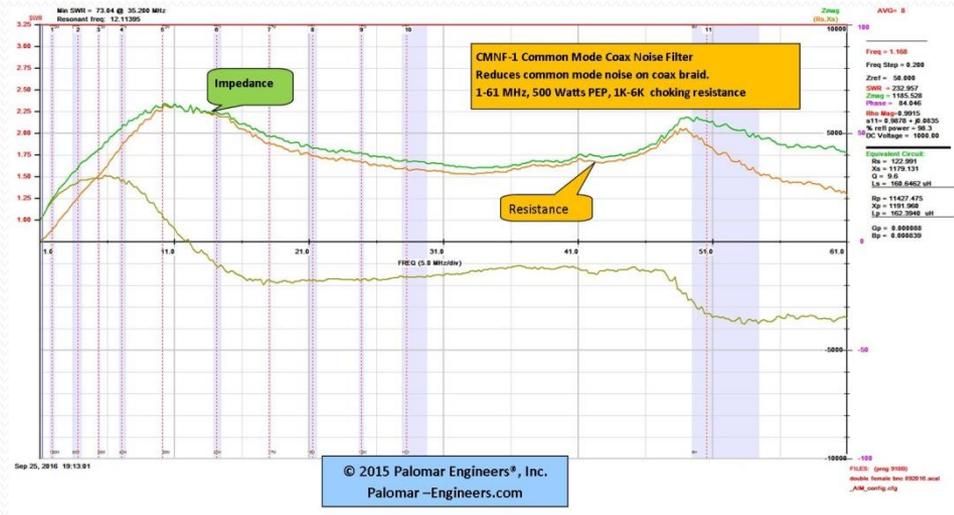
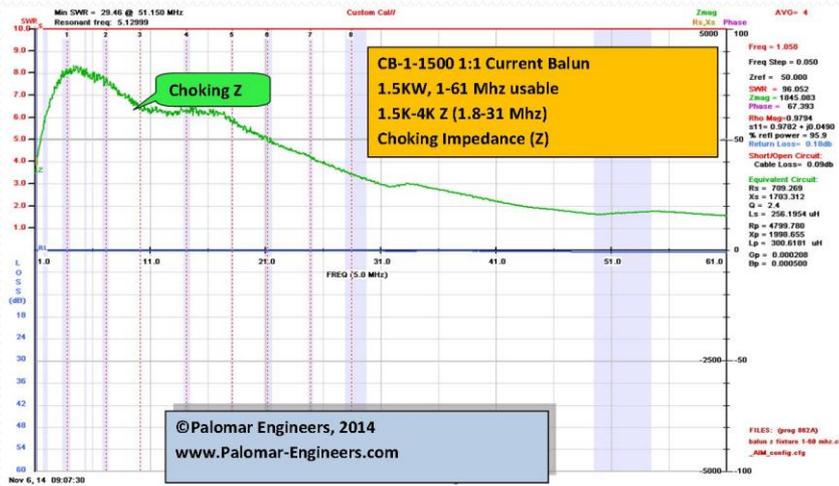
First: Impedance

# 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	Attenuation (dB)
200	-9.5
500	-15.6
1000	-20.8
1500	-24.0
3000	-29.8
5000	-34.2
10000	-40.0

# Choose choking impedance > 500Ω at frequency of use



**Ferrite Ring**  
 3-60 MHz >500 Ω  
 500 Watts PEP  
 1K-4K Ω  
 1/2 pound, fragile



**Coax Noise Filter**  
 .1-150 MHz >2K  
 500 Watts PEP  
 1K-6K Z - 50Ω  
 1/2 pound, rugged



# Bullet Antenna Parts for DIY



What about RFI Issues?

# Solving End Fed Antenna RFI Problems

Stop Transmit RFI  
Reduce Receiver RFI noise





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

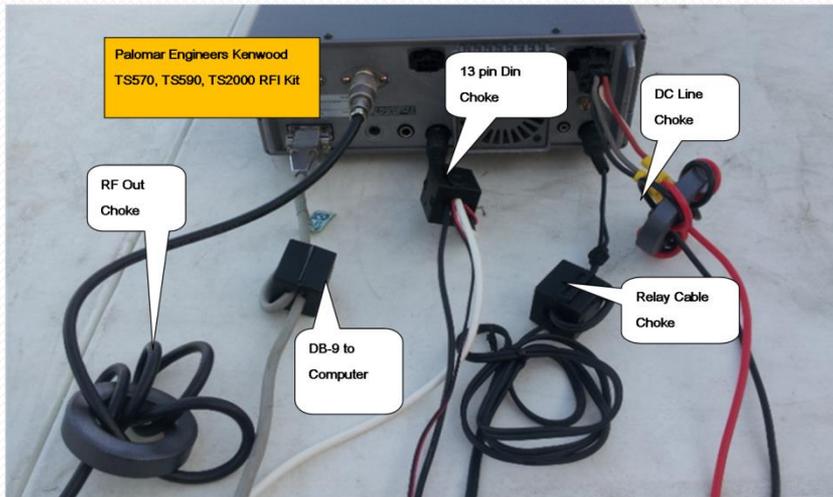
# Typical RFI Solutions

- 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.

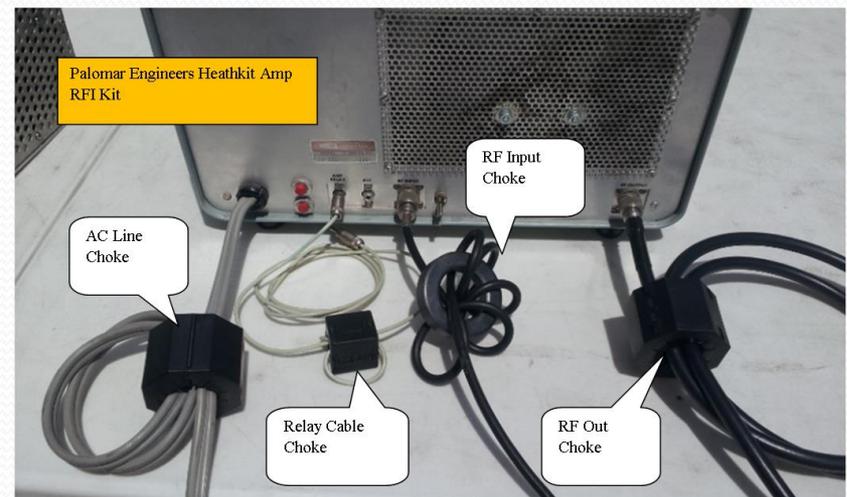
# Transceiver/Amp RFI Kits

Palomar RFI kits for all brands of transceivers and amplifiers

Transceiver RFI Kit



Linear Amplifier RFI Kit



Clean up your transmitter 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.

# Prize 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 has a broader bandwidth than fixed length half wave
  - D) All of the above
  - E) None of the above
  - F) Some of the above
  - G) I have no idea - I was asleep during the talk

# Prize 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
- 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

# Prize Question #3

**TOP SECRET**

- 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

## 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.