End Fed Antennas for Portable, Emergency & Stealth Installations

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This presentation available on website

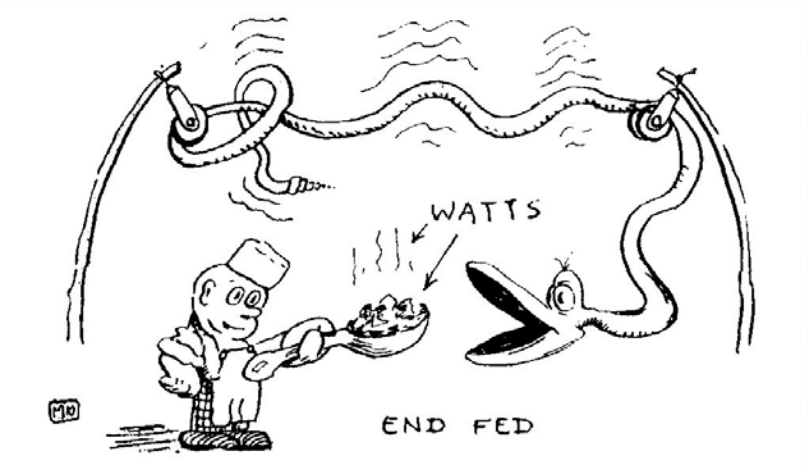
Palomar History

- 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

Let's talk about End Feds

End Fed Workshop Topics

- Short overview of antenna feed points
- Dipole, OCF, Zepp, Loop overview
- Popular End Fed Antenna s
- 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

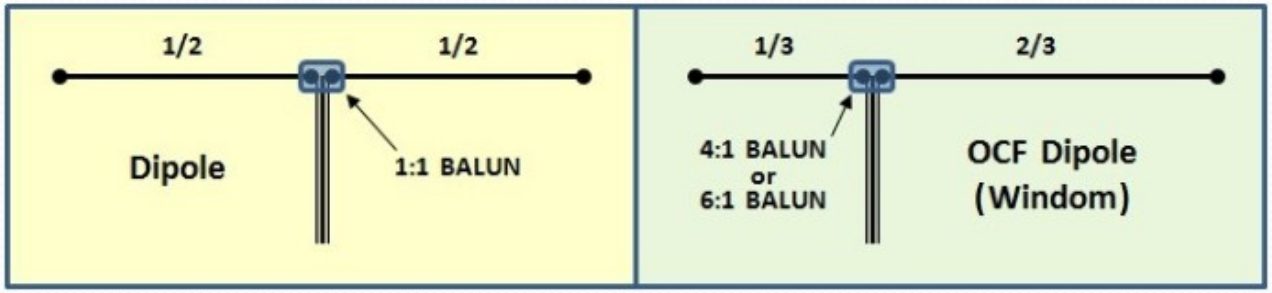
CENTER FED

OFF-CENTER FED

END FED

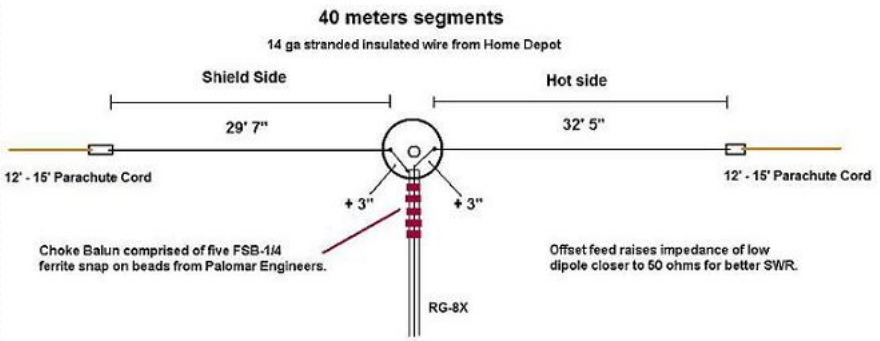
Resonant Dipole Examples

- Center Fed Half Wave (single band, 50-100Ω),
- Off Center Fed Feed Point (multi-band, 100-400Ω)

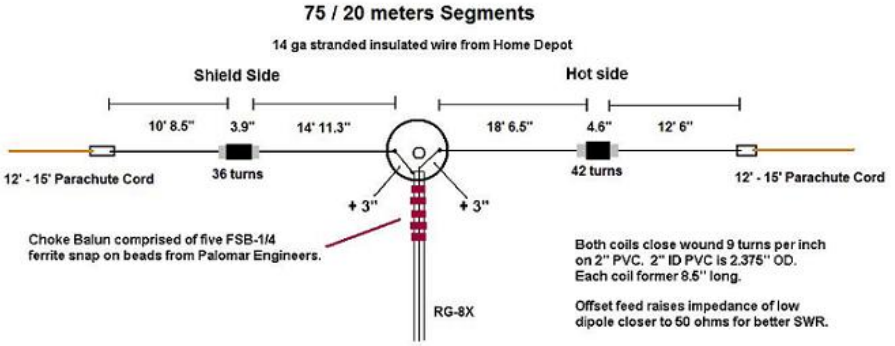


DJoIP Image

62' – 40 meters only-offset for 50Ω



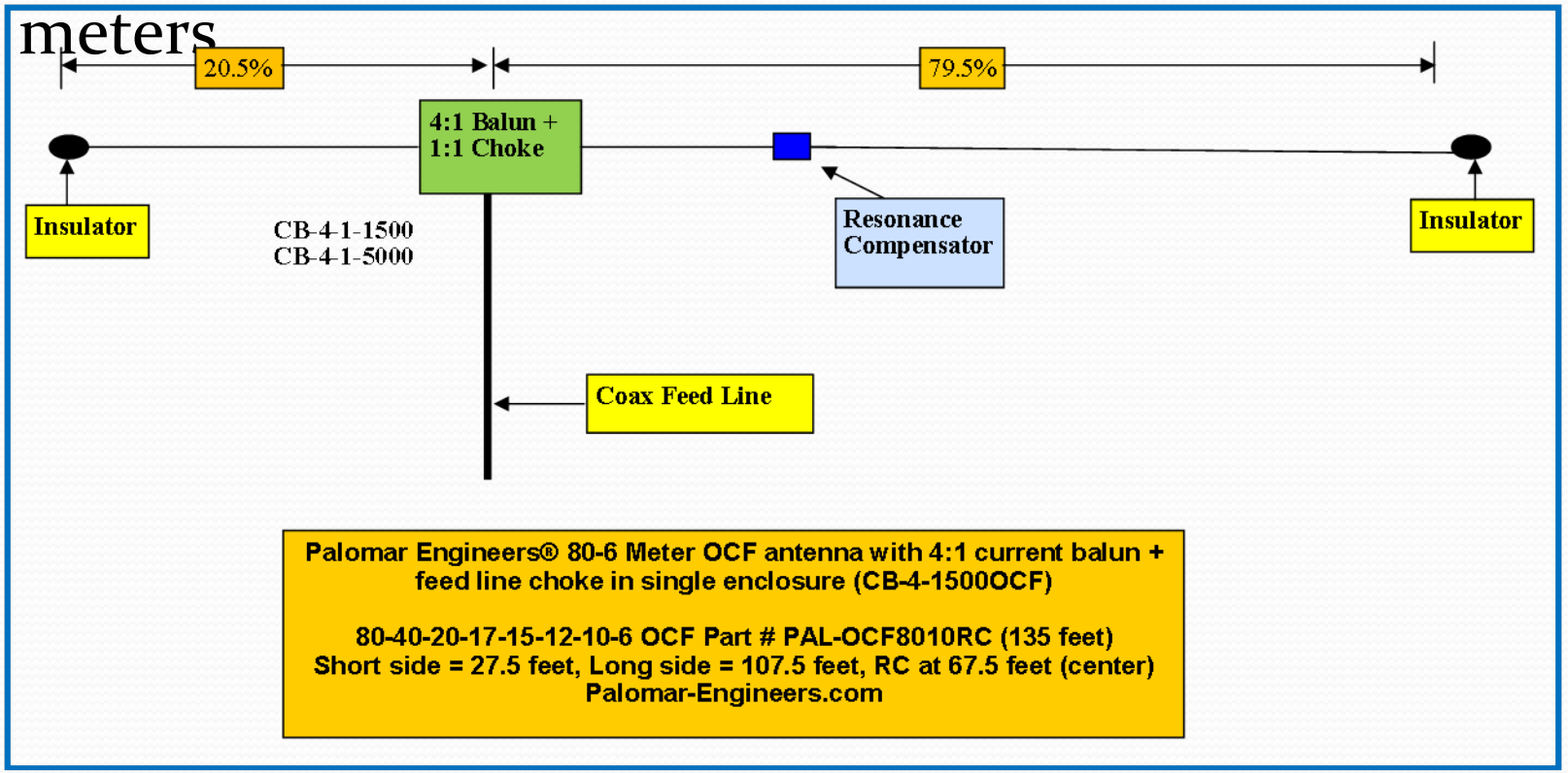
66' – 75/20 meters (loading coils)



Palomar OCF

Palomar Off Center Fed (OCF)

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



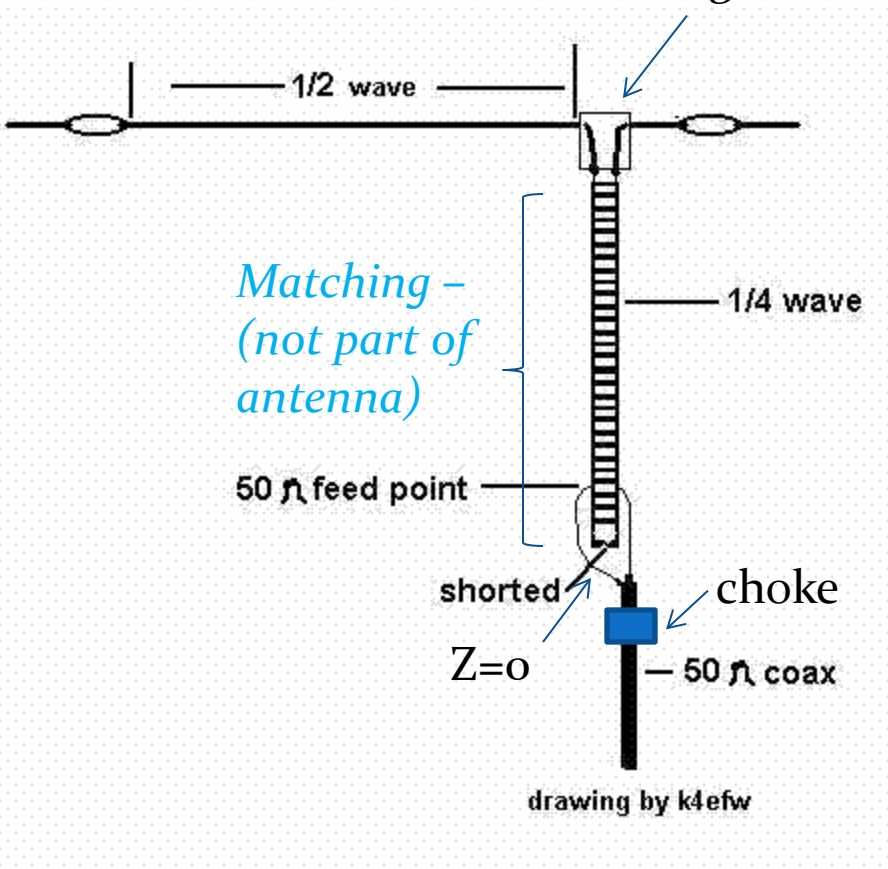
Zepps

End Fed Antenna Types

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

End Fed Half Wave (Zepp)

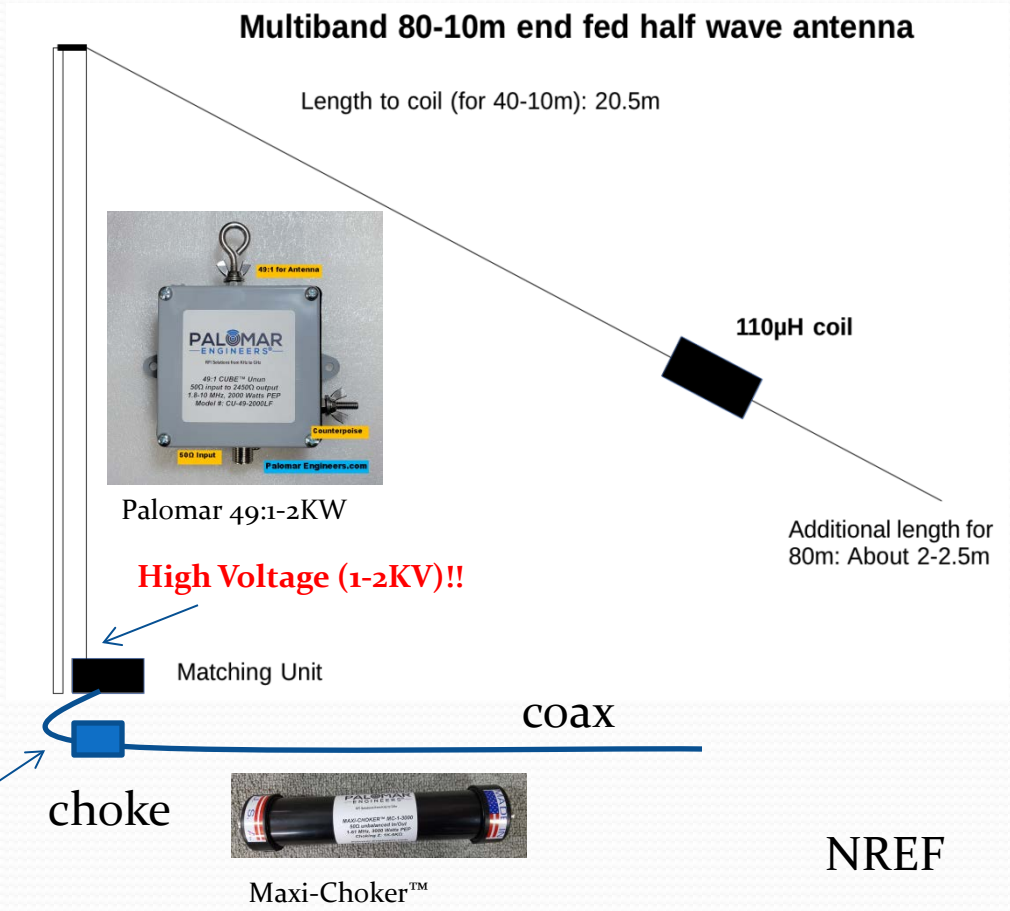
- Pros
  - Low loss
- Cons
  - Match ladder line/solid
  - Single band w/o antenna tuner
  - High and long
  - Needs feed line choke at coax feed point to prevent coax braid from radiating



examples

End Fed Half Wave (EFHW)

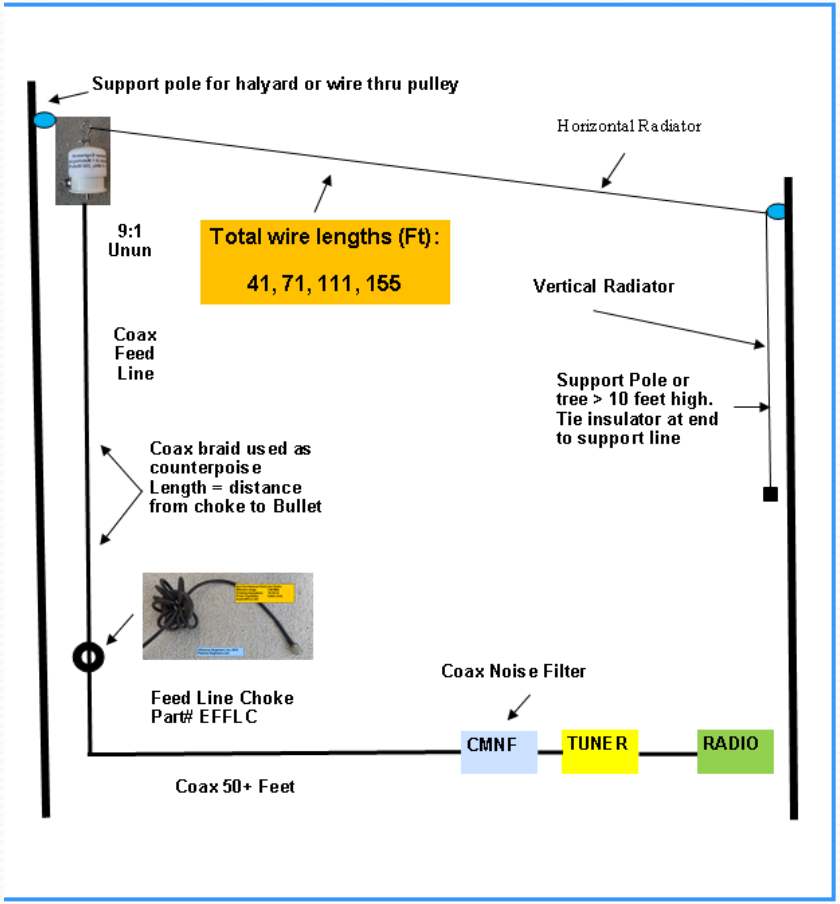
- Pros
  - Multi-band – (80-40-20-15-10) may need tuner
  - Hi Z feed = < ground loss %
- Cons
  - Long – use coil to shorten, needs tuner for multi-band
  - Complex matching unit (49:1 to 64:1 broadband unun, hi Z = high voltage!)
  - Needs feedline choke near coax feed point
  - Matching unit gets "HOT" with power or non-harmonic WARC bands



NREF

Palomar End Fed Long Wire Antenna

- Pros
  - Shorter length (80 Meters >=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 Recap

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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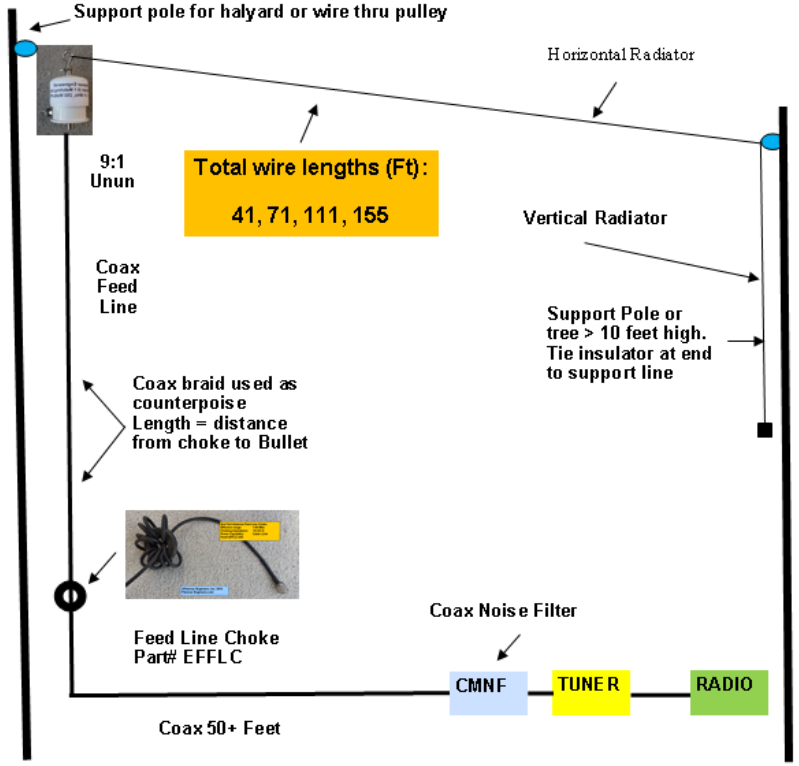
Other Possible Configurations



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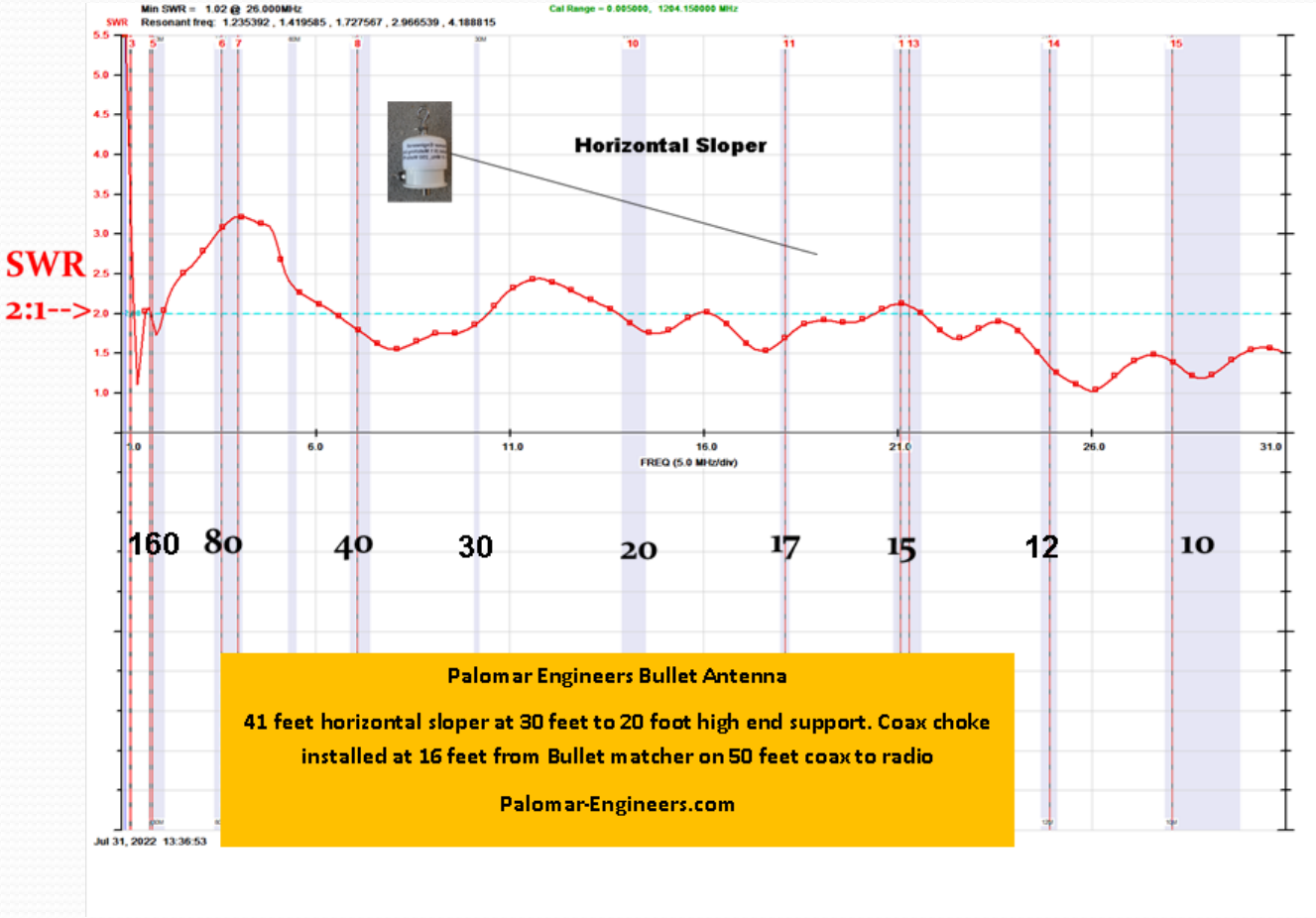
SWR Factors

End Fed SWR Factors

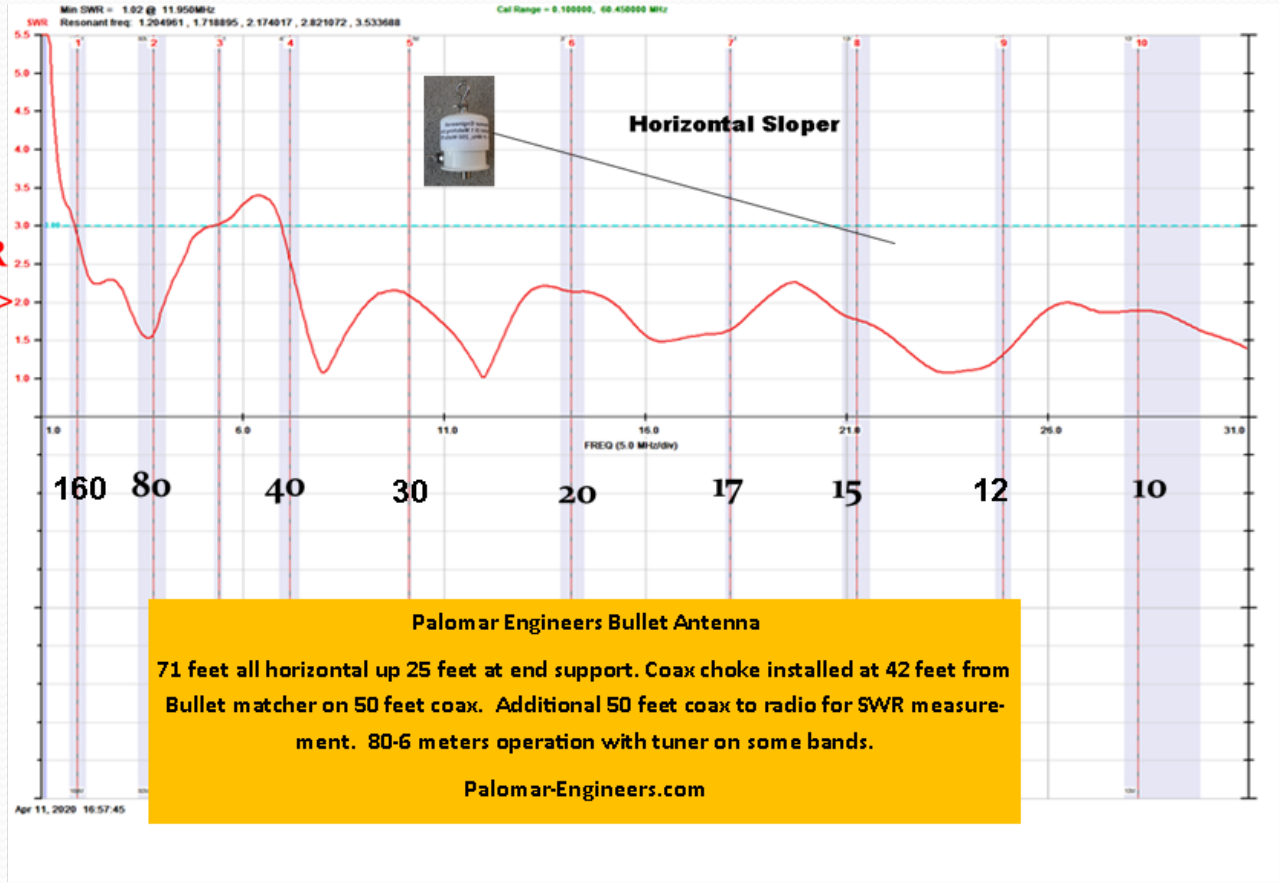
- Configuration shape (Inverted L, flat top, sloper, zig-zag)
- Length of coax feed line – typically 30% coax, 70% wire
- Feed line choke/noise filter placement – <u>at radio end</u>
- Top feed or bottom feed – feed sloper at top end
- Soil Conductivity – install over/near water
- Length and number of counterpoise(s) – use several with variable lengths, experiment with lengths for bands of interest (no ¼ wavelength wires!) – 30%

Some SWR plots vs antenna length →

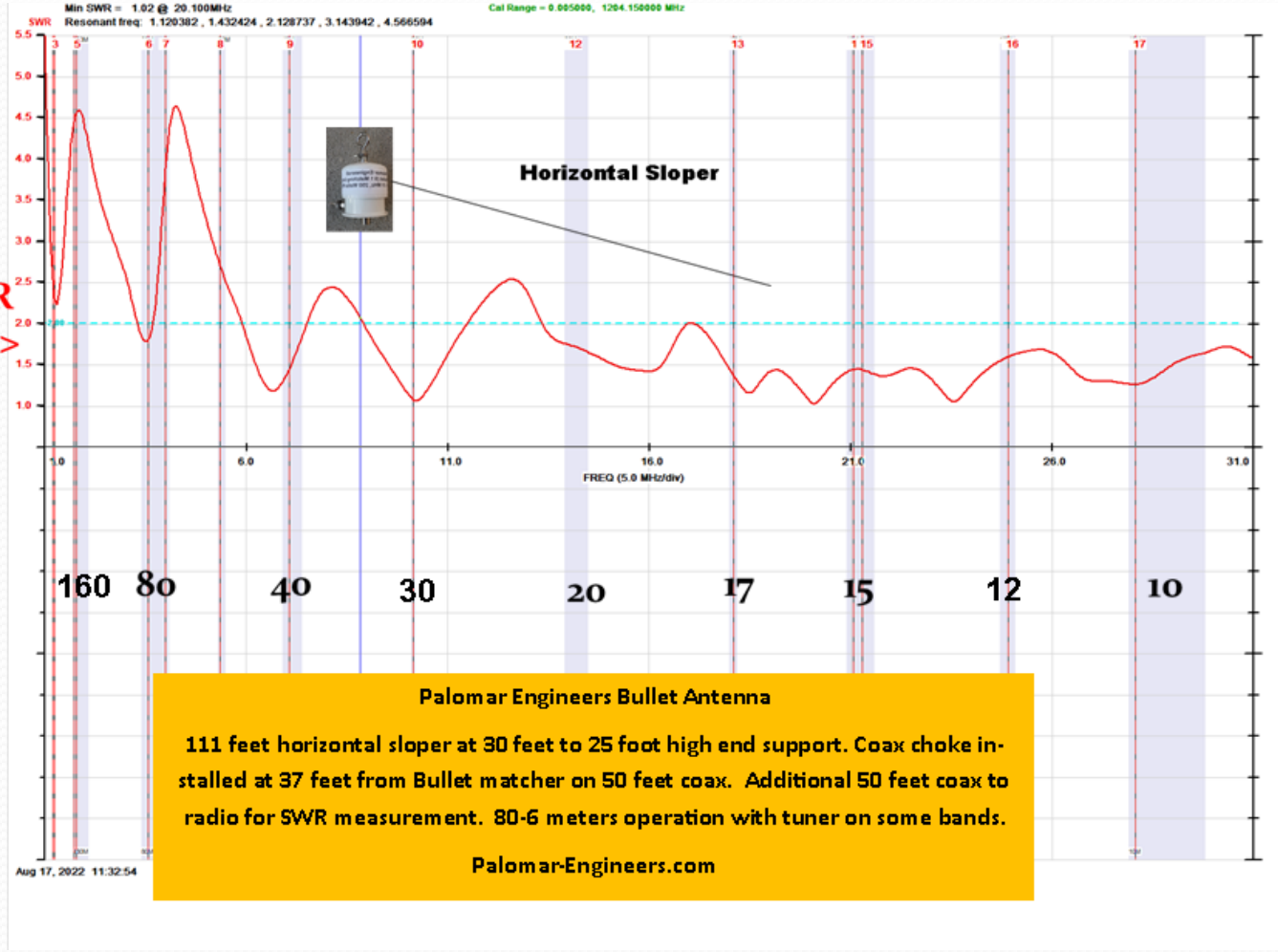
Bullet 41 – most popular length for portable, SOTA, NPOTA expeditions



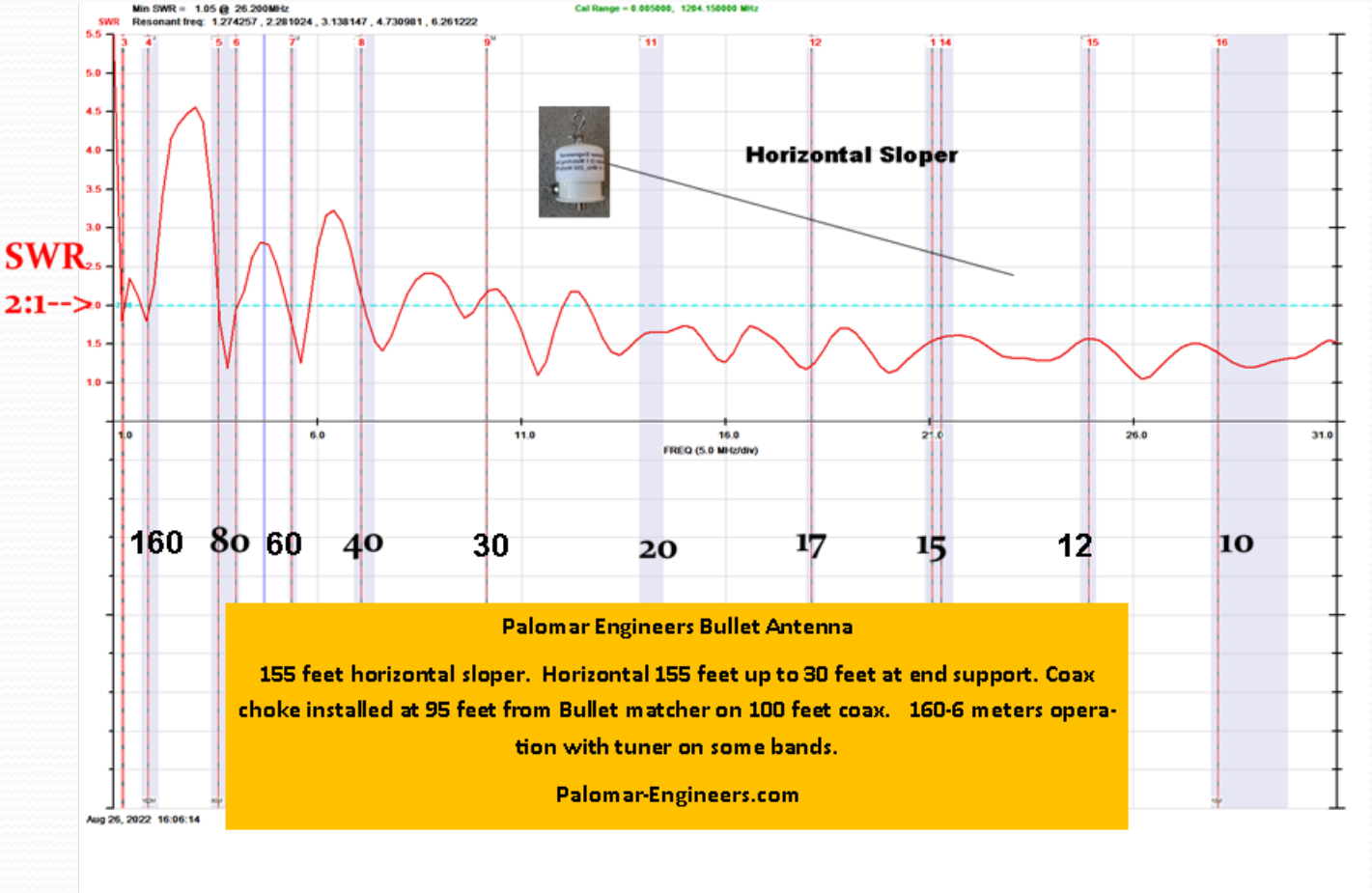
Bullet-71’- SWR



Bullet-111’- SWR



Bullet 155 (160-6M)



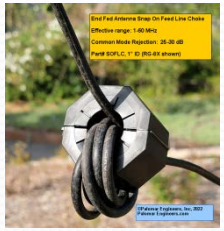
End Fed Antenna Notes

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



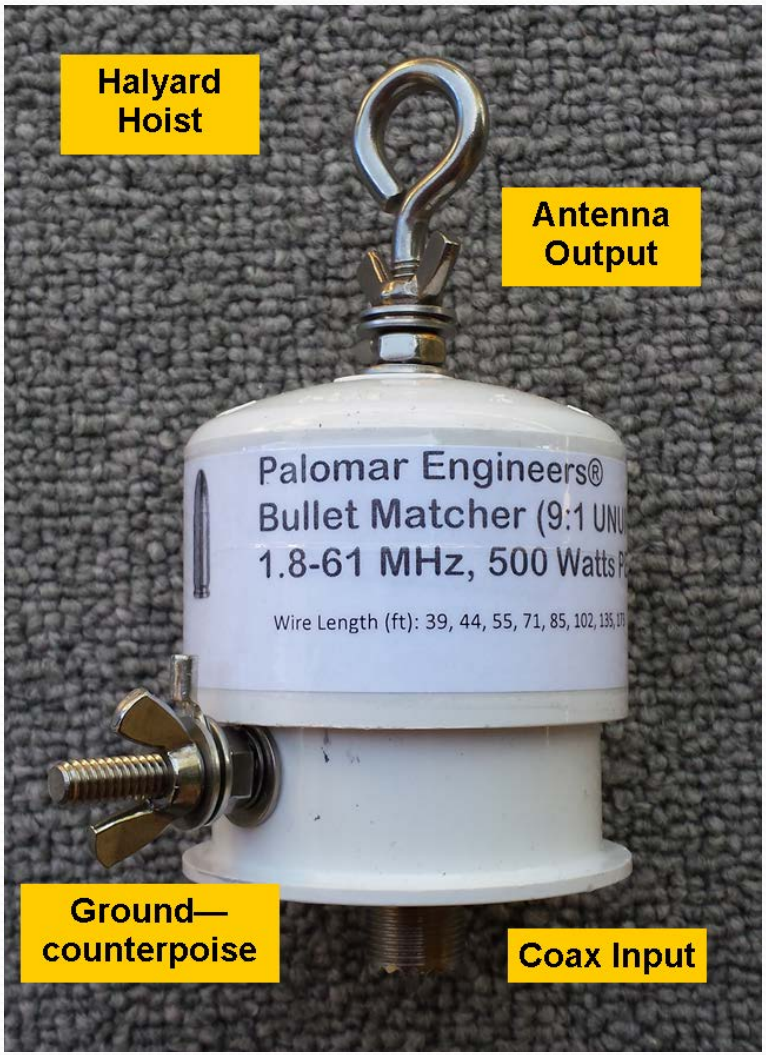
SOFLC (RG-8X coax not included)

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

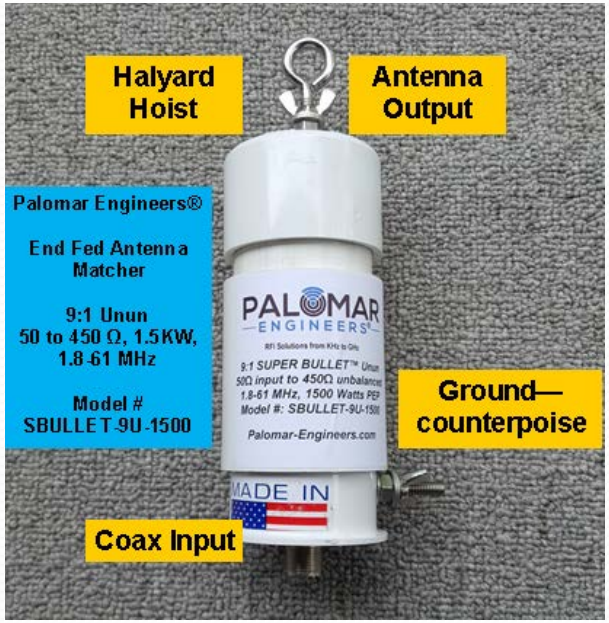
Maxi-Choker MC-1-3000 (3KW PEP)

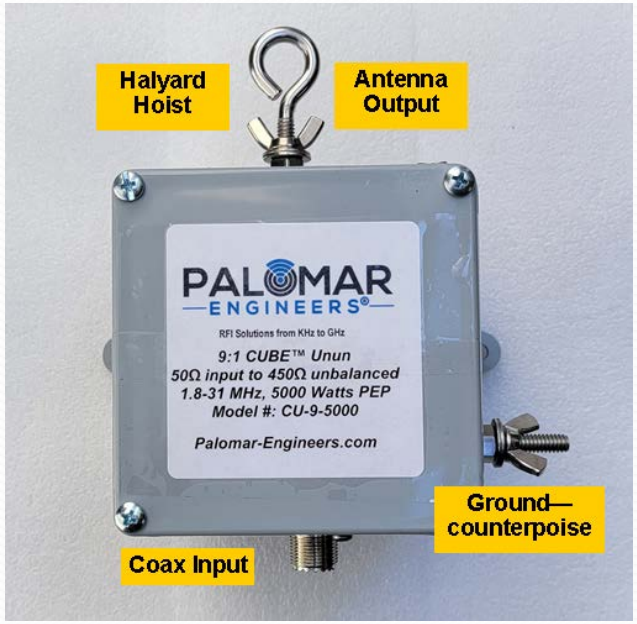
Matching the end fed antenna to coax cable

- UNUNs are your friend
  - Antenna feed point impedance: 300-900Ω
  - 9:1 transformer gives 33 to 100Ω 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

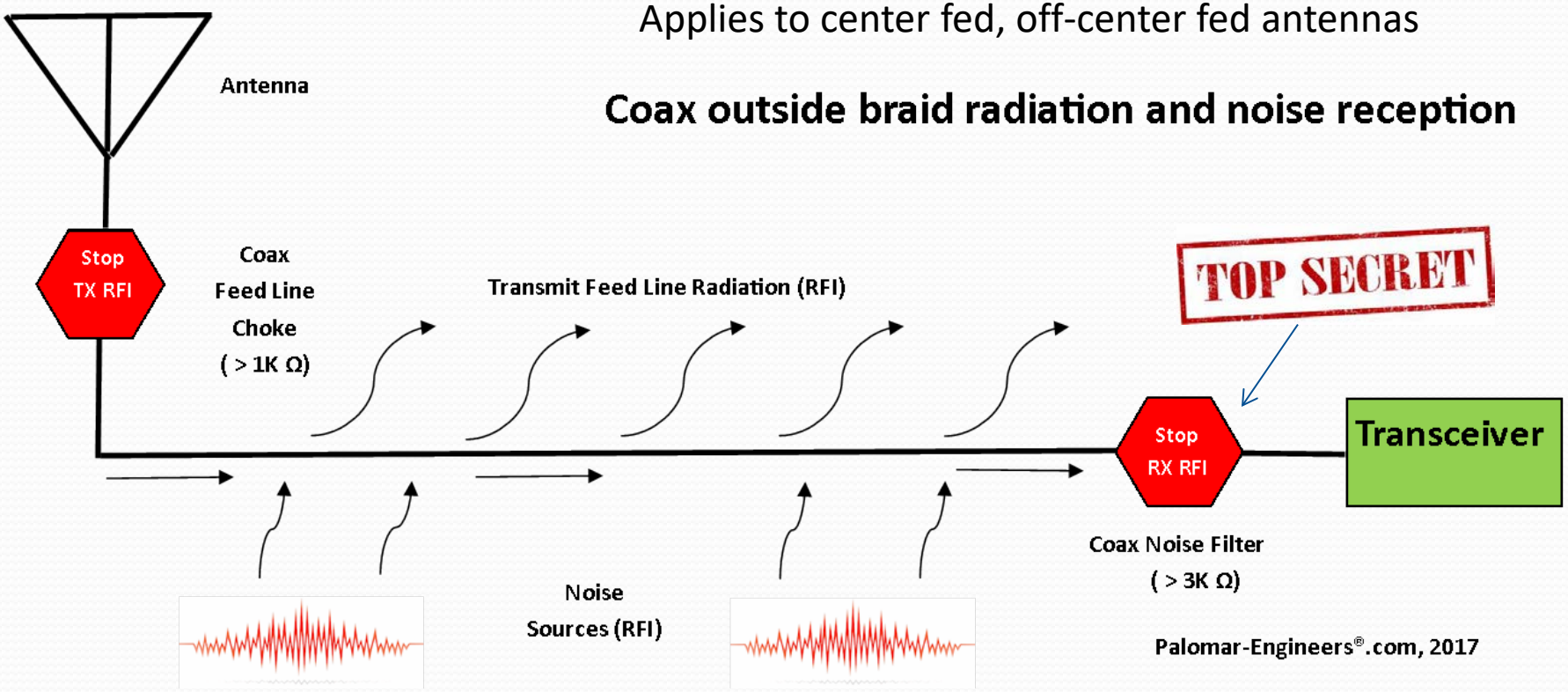
Coax Feed Line Chokes and Noise Filters

Lower noise floor = Higher SNR = More DX!

Typical Coax Fed Antenna System

Applies to center fed, off-center fed antennas

Coax outside braid radiation and noise reception

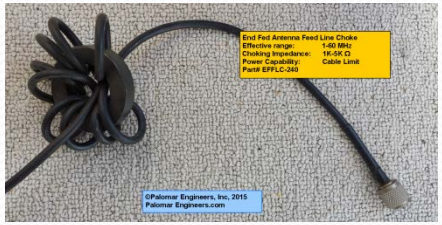


How the end fed antenna is different

Choosing an End Fed Coax Choke

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

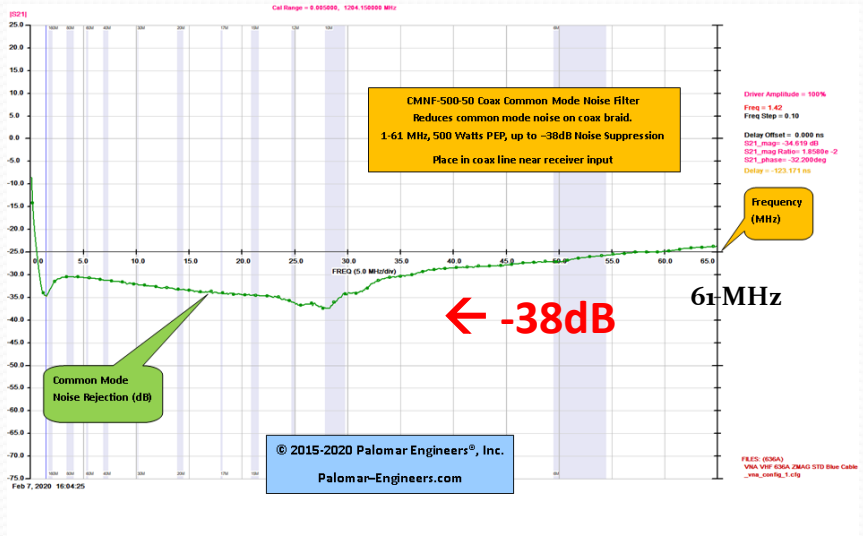
SOFLC - Snap On Feed Line choke (works on RG-8X (6 turns) or RG-8 (3 turns) up to 38 dB suppression

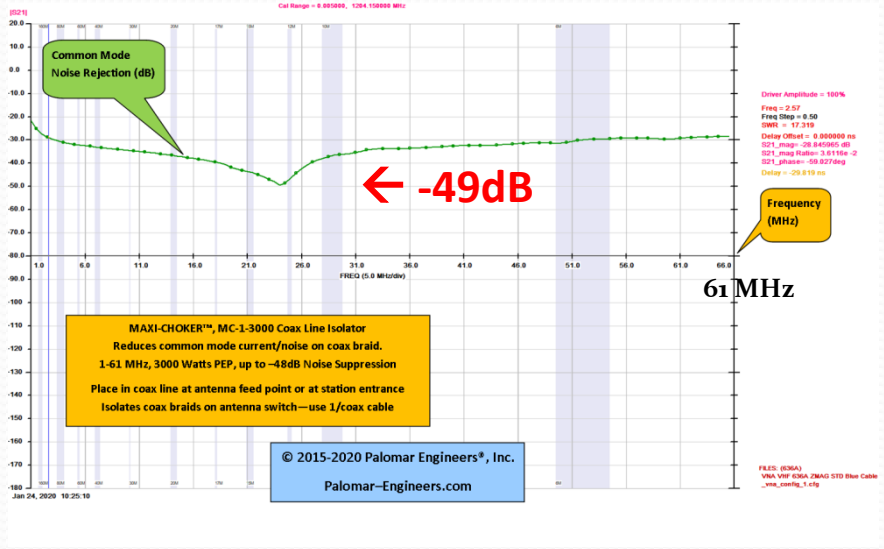
Criteria to Consider

- Adequate Choking Impedance (Z) > 500 Ω
- Effective Frequency Range where Z>500 Ω
- 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!

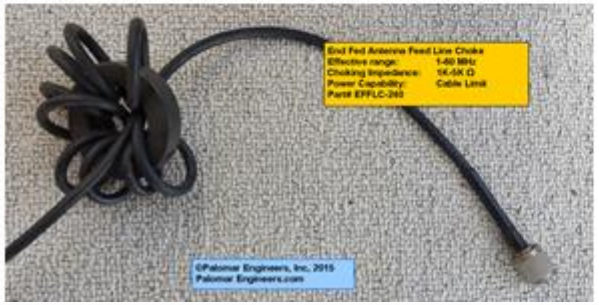
Line isolator (part# MC-1-3000 – 3KW PEP)
1-61 MHz >2K, 3KW PEP, 1K-6K ZΩ, 1 pound. All coax lines, Optional ground, static bleeder, up to 49 dB suppression!

1 "S" unit = 6 dB, 36 dB = 6 "S" units

DO NOT BUY CHOKES with NO SPECS!

Bullet Antenna Systems at HRO

Part# BAS-71



PALOMAR ENGINEERS®

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!

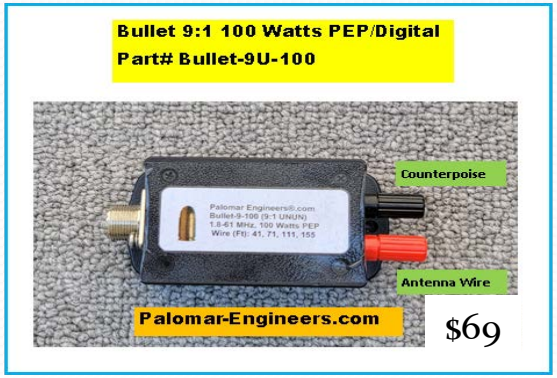
Bullet Antenna Parts for DIY

$99

$69

$109

$69



$69

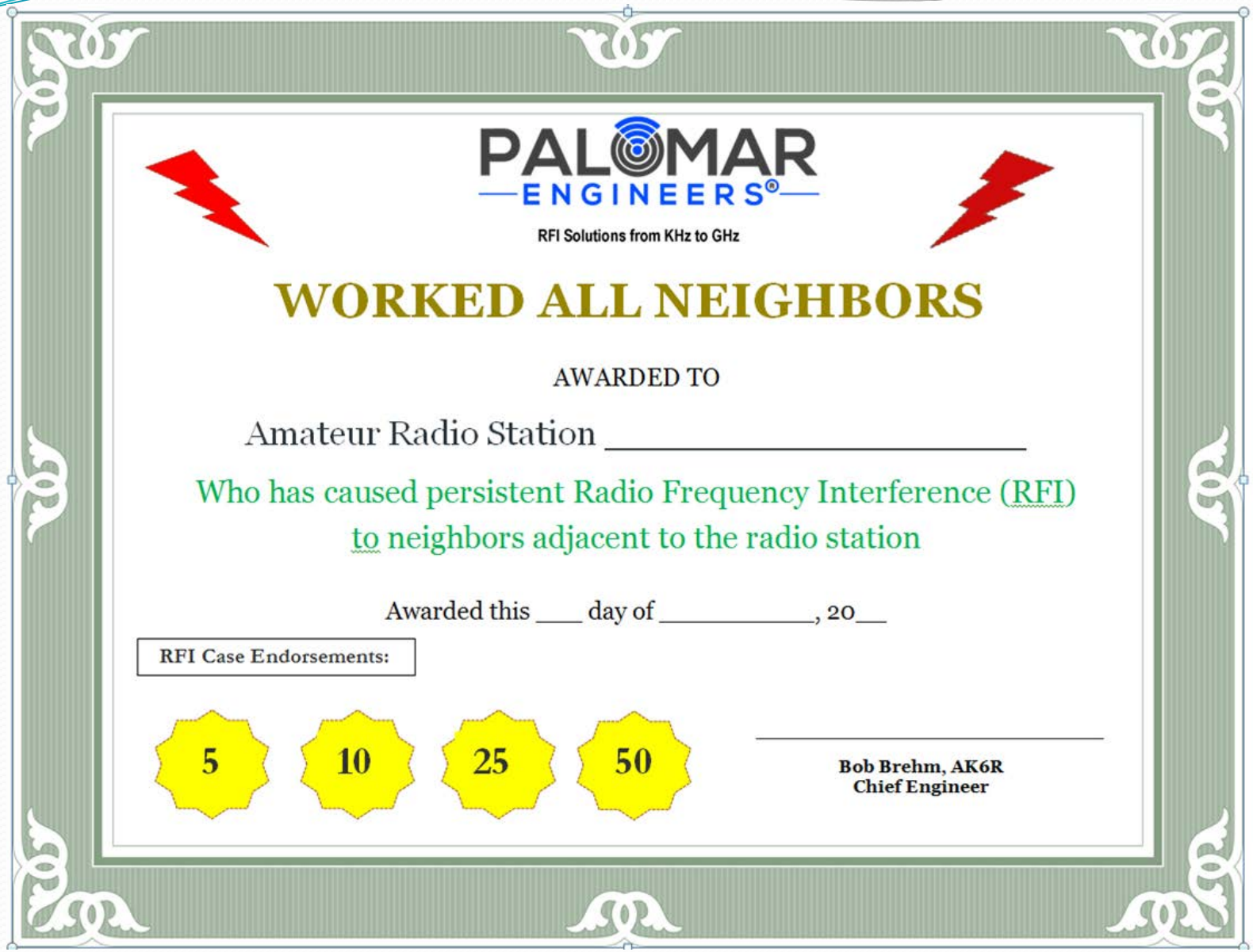
$10

What about antenna RFI Issues?

Solving End Fed Antenna RFI Problems

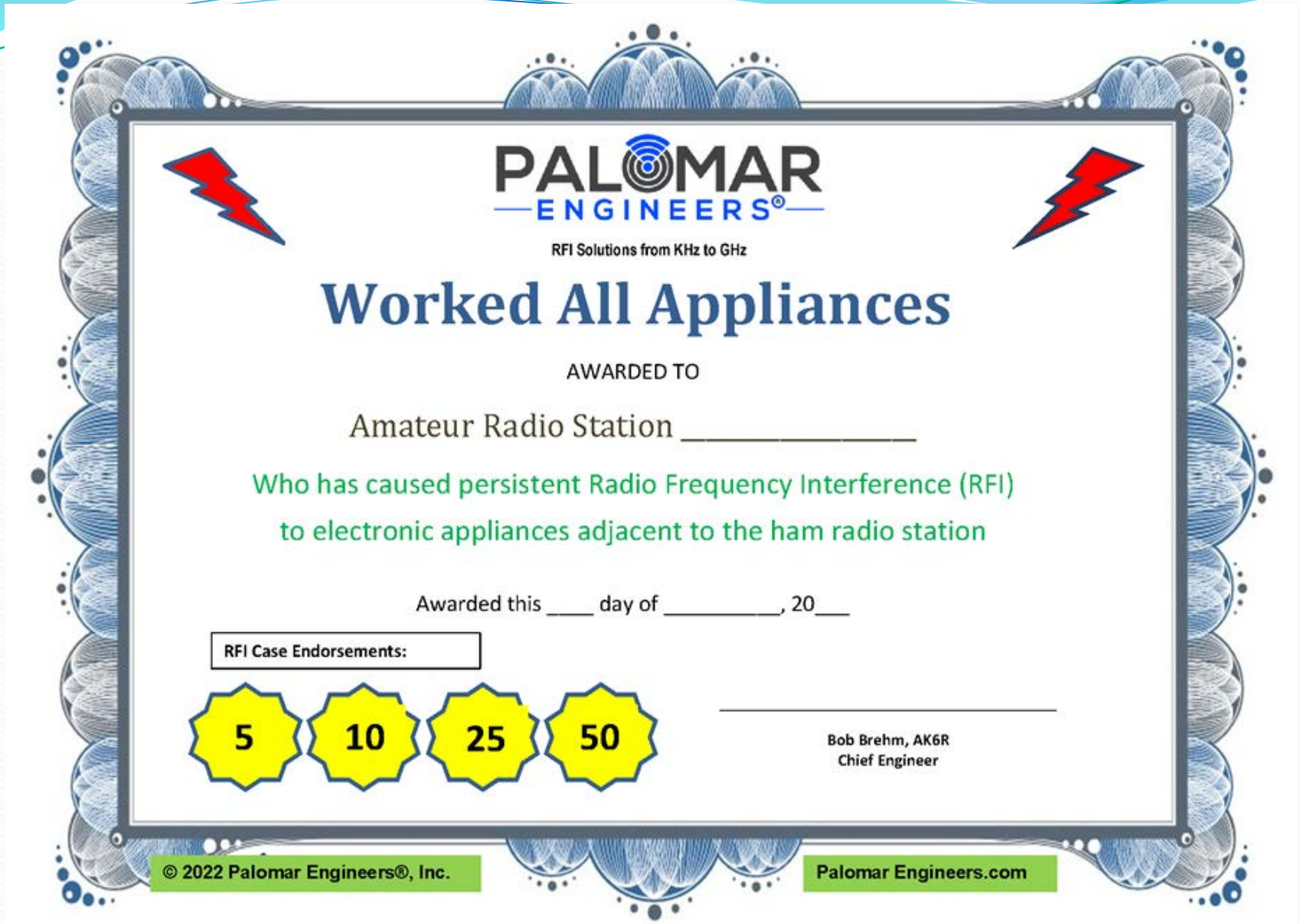
Stop Transmit RFI
Reduce Receiver RFI noise

GOT WANA?



Free download at Palomar-Engineers.com

Got WAA?



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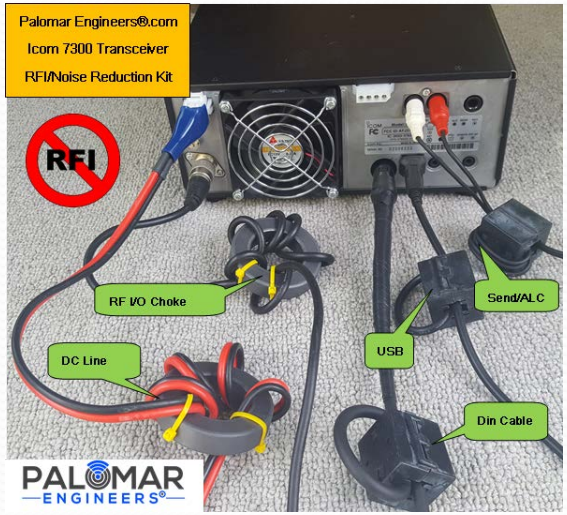
Typical RFI Solutions

- 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.

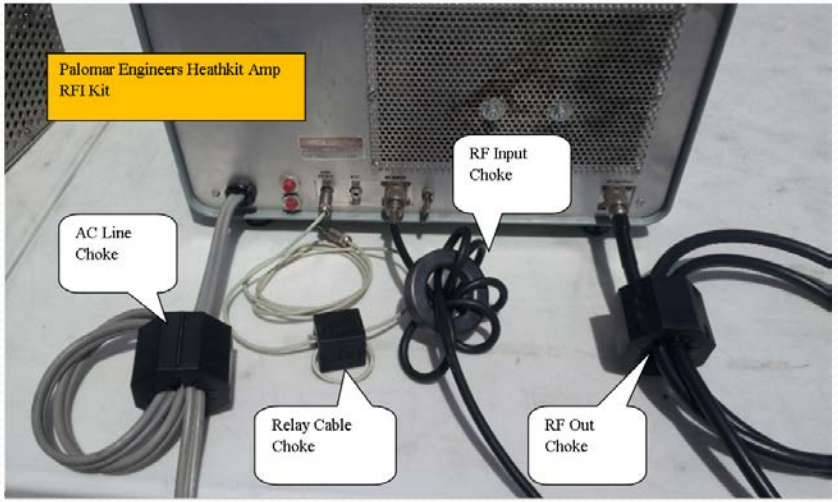
Transceiver/Amp RFI Kits

Palomar RFI kits for all brands of transceivers and amplifiers

Transceiver RFI Kit



Linear Amplifier RFI Kit



RULE # 1: Clean up your transmitter RFI first!

Neighbor's RFI

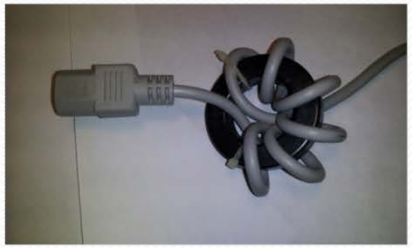
Neighborhood RFI Solutions

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

PALOMAR ENGINEERS®

RFI Solutions from KHz to GHz

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