

HF Antennas 101

SARA Monthly Meeting

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HF Antennas 101

- I A good antenna may be the most important component of a good HF station
 - 1W QRP station + good antenna can be heard worldwide
 - 1KW station + bad antenna can warm the shack in winter
- I Major antenna types
 - Vertical $\frac{1}{4}$ wave monopole
 - Horizontal $\frac{1}{2}$ wave dipole
 - Beam/Gain (Yagis, quads, etc.)
 - Other (longwires, loops, etc.)
- I You need something to get started – it need not be the best but once you get something up you'll be able to experience HF communications, work DX, play in the contests – good antennas don't have to be expensive – some of the best ones are just made of wire

SAFETY FIRST

- I Unless you desire to become a crispy critter don't do antenna-related activities anywhere near power lines EVER; during a thunderstorm; etc.
- I Be careful; have at least one partner present during antenna activities; plan things out ahead of time and get knowledgeable help if you are out of your depth
- I Quit if you get tired or if the weather turns against you or if darkness falls.

A Modest Station in Finland...

- I Radio Arcala – OH8X
 - Finland
 - 7 huge towers
 - Professional engineering
 - 5 element 80M Yagi
 - 3 element 160M Yagi
 - www.radioarcala.com



OH2BH With the Rotor



But most hams aren't THAT crazy

- I You can do almost as well with a few \$ of wire, practical know-how and a little bit of antenna theory
 - Group called "Zuni Loopers" used to put up wire "gain" antennas for Field Day and were competitive with $< 5W$
 - Many home stations get on the air with single or multi-band wire dipole
 - Gain antennas important when contesting or DX'ing, but not needed for casual contacts or getting started



What makes a good HF antenna?

- I Whatever fits the desired situation
 - Cost - what is the budget?
 - I Short term installation – wire antennas go up quickly, may come down easily
 - I Long term installation – towers require engineering, permits and \$\$\$
 - Location - where does it need to go?
 - I Terrain, lot size, available supports, feedline routing?
 - Bands – what is the available space?
 - I Low bands (160M, 80M) usually require more room
 - Coverage – where does the signal need to go?
 - I Antennas can be omni-directional, partially directional or strongly directional
 - Esthetics – spouse appeal, CC&R's, neighbors
 - I Verticals and wire antennas are usually less visible than towers
 - I Shortened antennas are also less visible, but even less efficient

How to get started?

- I Easy to get started
 - Higher HF band coverage (40M through 6M)
 - ½ Wave wire antennas
 - Multiband wire antennas
- I Compromise
 - Multi-band verticals incorporating a counterpoise
 - I Lower signal level, higher noise
- I Bigger Projects
 - Low band coverage (160M & 80M)
 - Towers & Yagis
 - Verticals that require external groundplanes/counterpoises
 - Complex oddballs (quads, rhomboids, etc)

1/2 Wave (Dipole) Wire Antennas

- I Easy to Build
- I Two pieces of wire, 1:1 Current Balun, coax from balun to transceiver, support for wire (ends) or balun (center)
- I Basic formula for overall length of wire (both pieces) is $L=468/f(\text{MHz})$ (so at 14.2 MHz the antenna wire is 32.96 feet long or 16.48 feet long on each side. Always cut the wire a bit long so that you can trim it down to the exact match you want as environmental conditions often affect antenna resonance frequency.
- I Current Balun keeps RF off the shield of the coax – this is a good thing.

40 Meter Dipole



The Coax-Fed Inverted-V Dipole Antenna

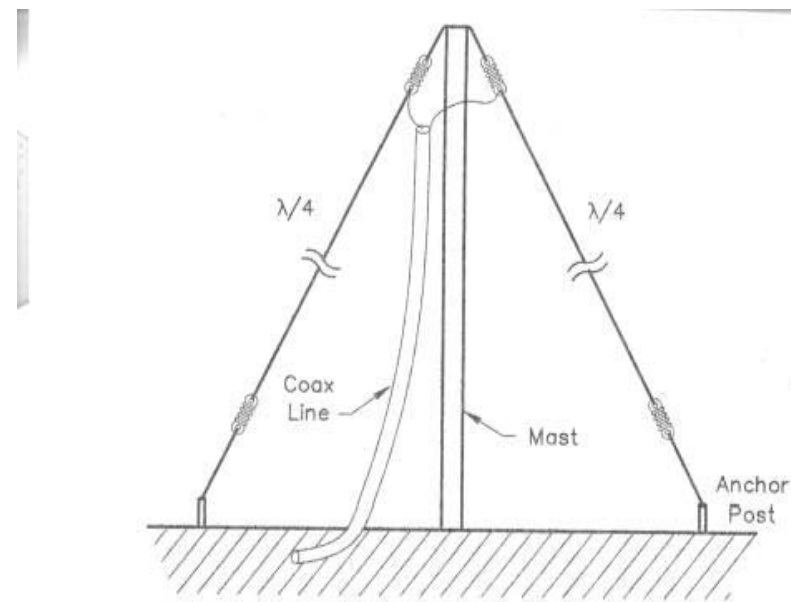


Fig 8—The inverted-V dipole. The length and apex angle should be adjusted as described in the text.

Multi-band Wire Antennas

- I Similar to $\frac{1}{2}$ wave wire antennas
 - include “Traps” on each side to allow resonance on more than one frequency.
- I more expensive
- I can be problematic if the traps fail (and they do)

Multi-band Verticals w/ Counterpoise

- | A number of approaches
- | Steppir Vertical: Adjustable-length vertical radiator is set to correct length
- | Trap Vertical
- | Inverted-L (part vertical, part horizontal)
- | All Usually require a counterpoise
 - | Elevated Radials (typically 4 at resonance)
 - | Buried Radials (can require about 100 @ 50+')
- | Some require a tuner of some sort at the feedpoint

Steppir Vertical Base Unit

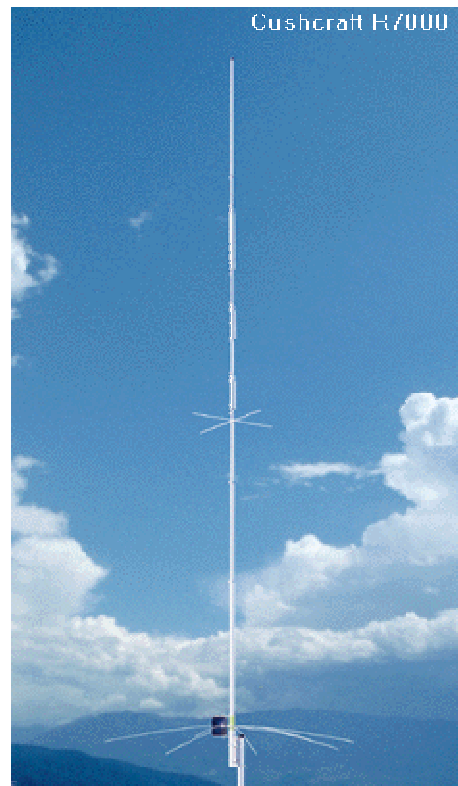


Steppir Vertical (BiggIR Model)



Cushcraft R7000 Vertical – No Radials

– lots of traps and linear loading



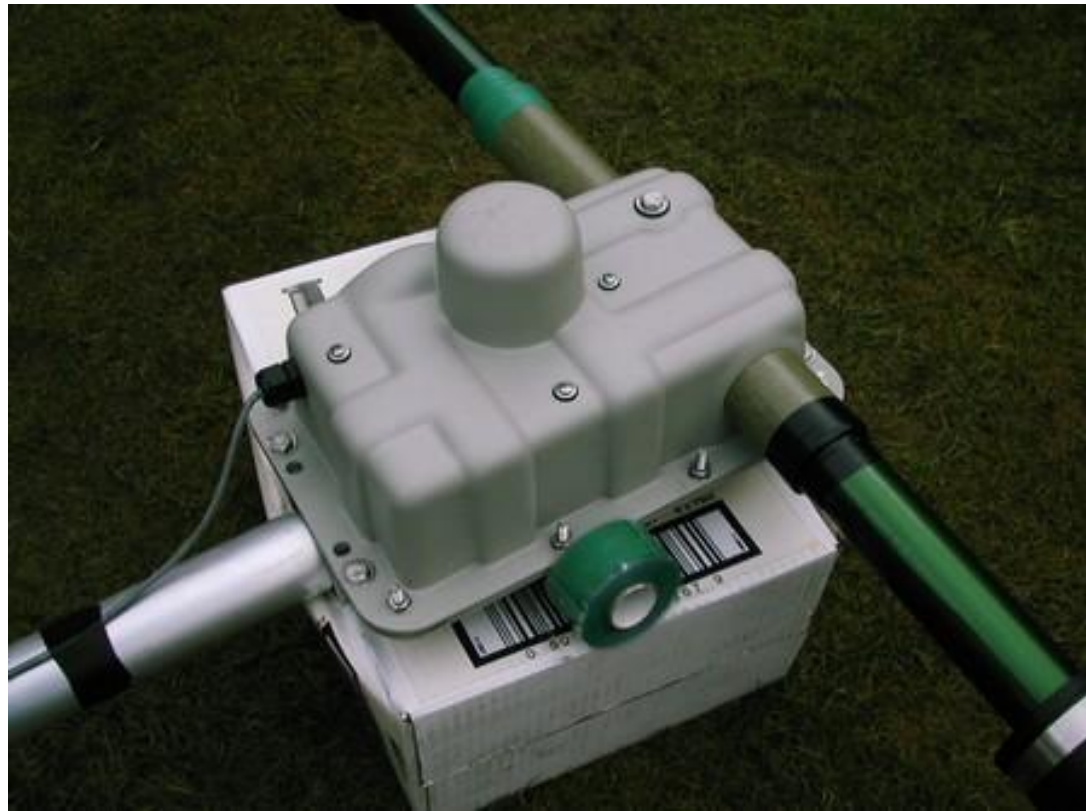
Low Profile Yagis – Steppir 2 Element

- | Steppir has a very low profile 2 Element Yagi
- | Excellent Performance
- | A bit on the expensive side
- | Low Wind Profile
- | Easily installed on a roof-mounted tower
- | Somewhat stealthy

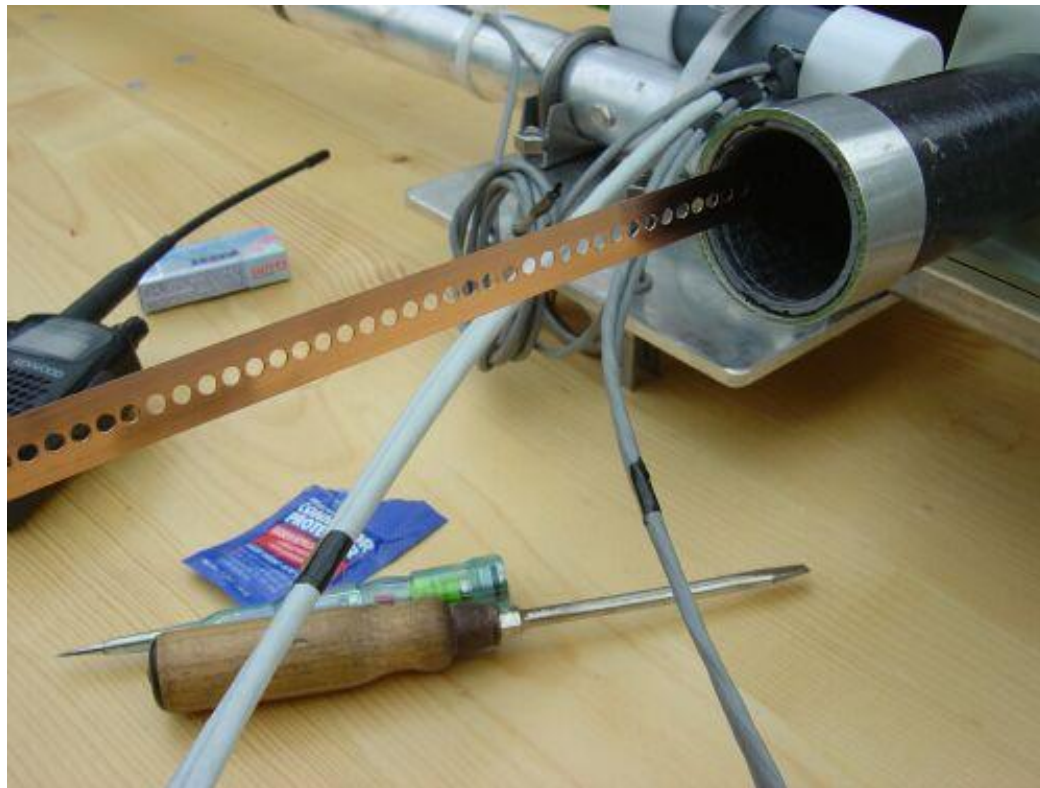
Steppir 2-Element



Steppir Step Module



Steppir Step Module - Conductor



W6DR's Roof Tower Installation: 2 Ele Steppir for HF and 5 Ele KLM for 6M



W6DR - Full Size 160m Dipole – Balanced Feed – Tree Supported



Best Way to Feed Balanced Antennas at 1.5KW: PALSTAR BT1500A



Palstar BT1500A Insides



Inverted-L

- | Somewhat stealthy
- | Can be fed with an automatic tuner for increased bandwidth – otherwise bandwidth will be somewhat narrow
- | Requires counterpoise
- | Can be hung between a couple of tall trees
- | (-) Noisier than a horizontal antenna
- | (+) Lower take-off angle than a horizontal antenna

Inverted-L – Good Choice for 40-160M

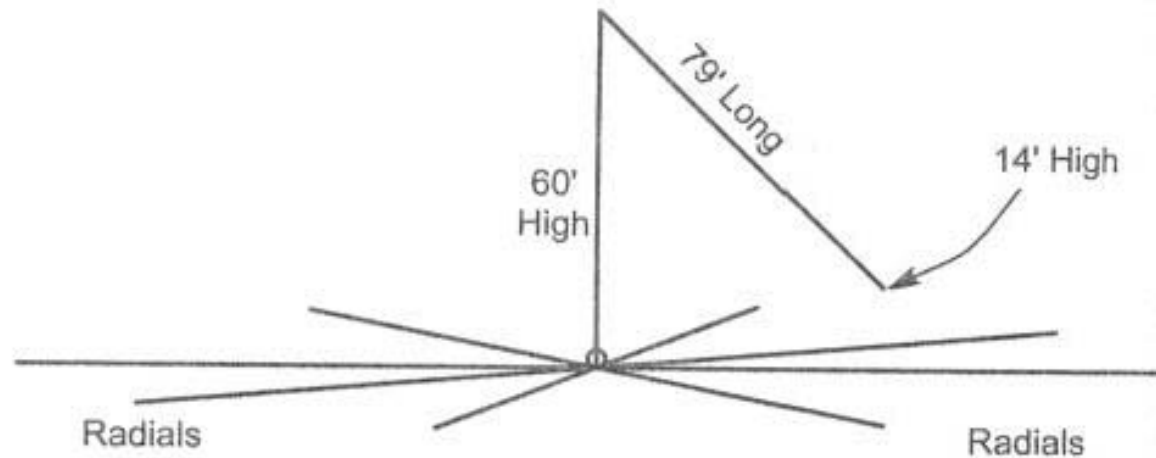


Fig 58—Sketch showing a modified 160-meter inverted L, with a single supporting 60-foot high tower and a 79-foot long slanted top-loading wire. The feed-point impedance is about 12Ω in this system, requiring a quarter-wave matching transformer made of paralleled 50- Ω coaxes.

Inverted-L on 160M

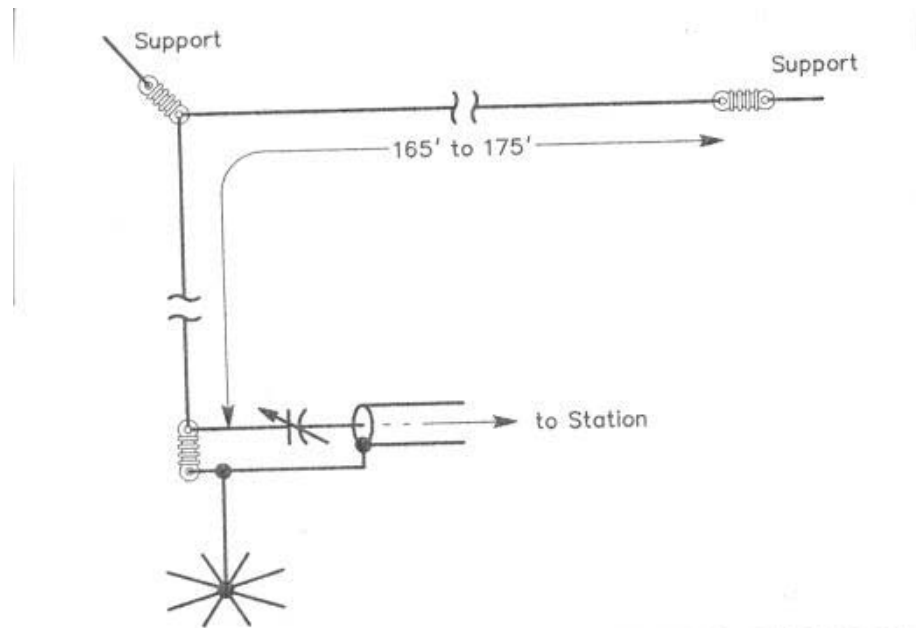


Fig 57—The 1.8-MHz inverted L. Overall wire length is 165 to 175 feet. The variable capacitor has a capacitance range from 100 to 800 pF, at 3 kV or more. Adjust antenna length and variable capacitor for lowest SWR.

Stealth Antennas: End Fed Wire

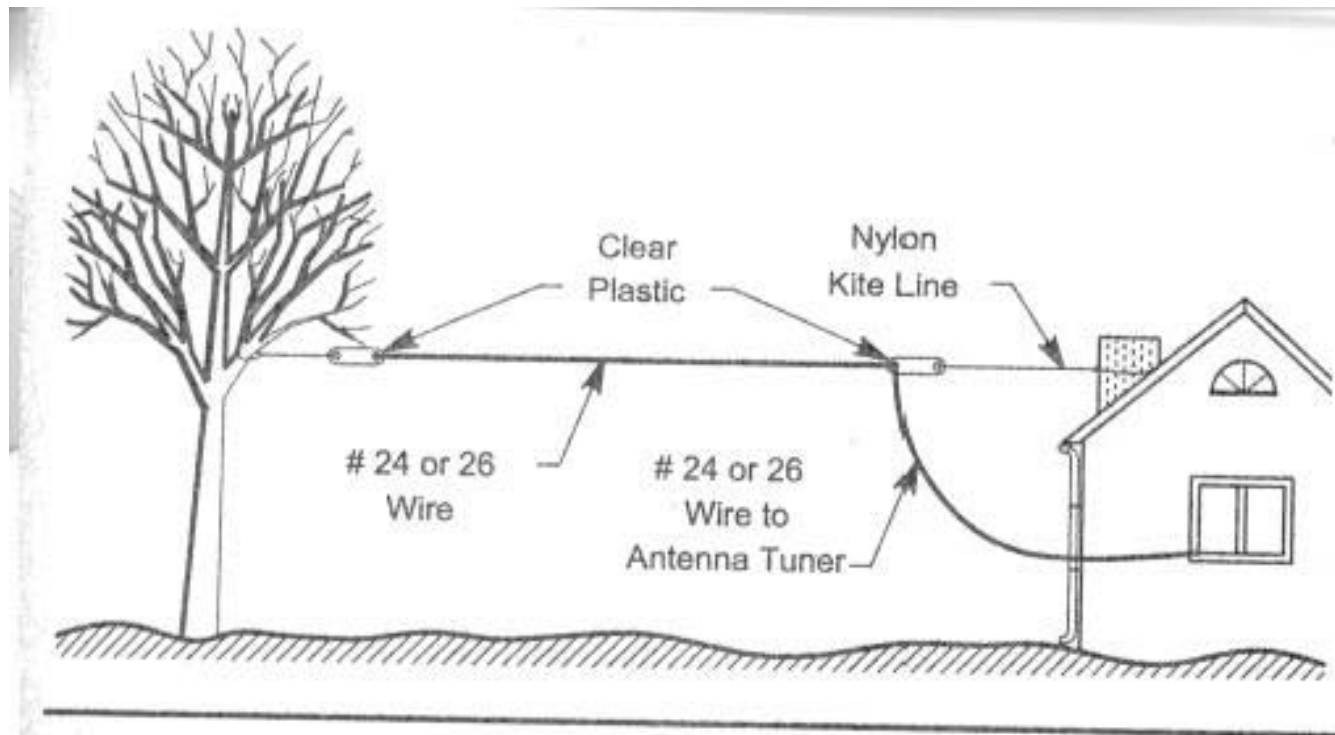
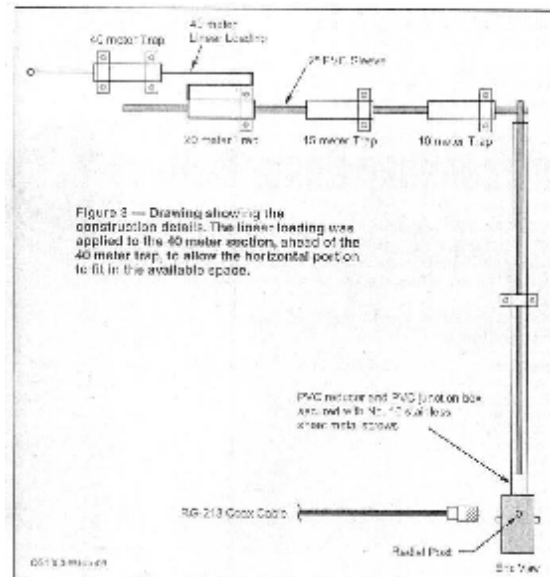


Fig 28—The “invisible” end-fed antenna.

Stealth Antennas: Inverted L Gutter



Figure 2 — The horizontally mounted portion of the antenna, as seen from inside the radio.



Automatic Tuner-Based Antennas

- | Tuner costs a bit
- | Will work with almost any conductor (longer usually better)
- | Will work in a vertical/counterpoise configuration
- | Will work in a balanced antenna configuration
- | Limited Power (60W/100W/200W/500W units available)
- | Excellent Stealth characteristics

Automatic Tuners – SGC-230



Stealth Antennas: SGC-230 Feeding a Vertical Aluminum Pole



Stealth Antennas: Other Ideas

- | Attic Dipole (be careful not to start a fire)
 - Can broaden the bandwidth by using multiple conductors to form a “fat” element
- | Gutters
- | Wires in trees
- | Wires in fences
- | Loop antennas on roof