HF Antennas 101

SARA Monthly Meeting

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HF Antennas 101

- 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
- Major antenna types
  - Vertical ¼ wave monopole
  - Horizontal ½ wave dipole
  - Beam/Gain (Yagis, quads, etc.)
  - Other (longwires, loops, etc.)
- 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

- Unless you desire to become a crispy critter don’t do antenna-related activities anywhere near power lines EVER; during a thunderstorm; etc.
- 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
- Quit if you get tired or if the weather turns against you or if darkness falls.

A Modest Station in Finland…

- 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

- 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?

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

How to get started?

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

½ Wave (Dipole) Wire Antennas

- Easy to Build
- Two pieces of wire, 1:1 Current Balun, coax from balun to transceiver, support for wire (ends) or balun (center)
- Basic formula for overall length of wire (both pieces) is L=468/f(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.
- 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

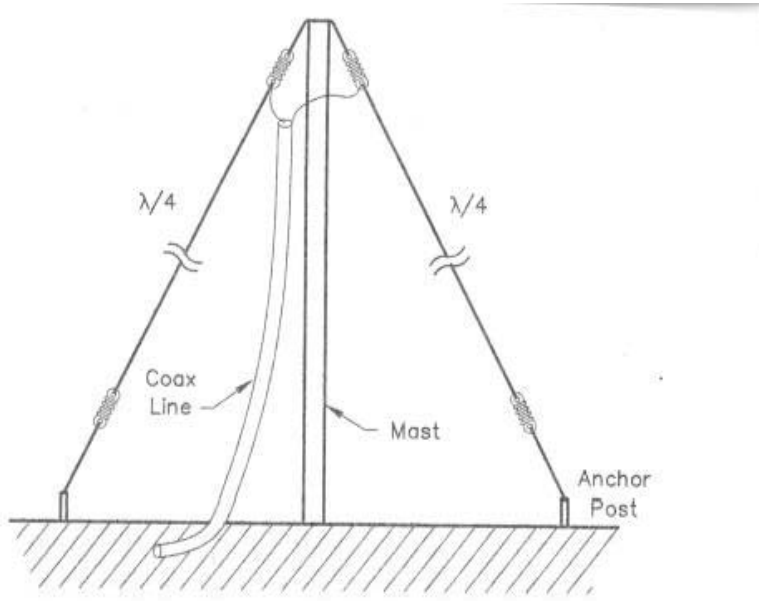


Fig 8—The inverted-V dipole. The length and apex angle should be adjusted as described in the text.

Multi-band Wire Antennas

- Similar to ½ wave wire antennas
  - include “Traps” on each side to allow resonance on more than one frequency.
- more expensive
- can be problematic if the traps fail (and they do)

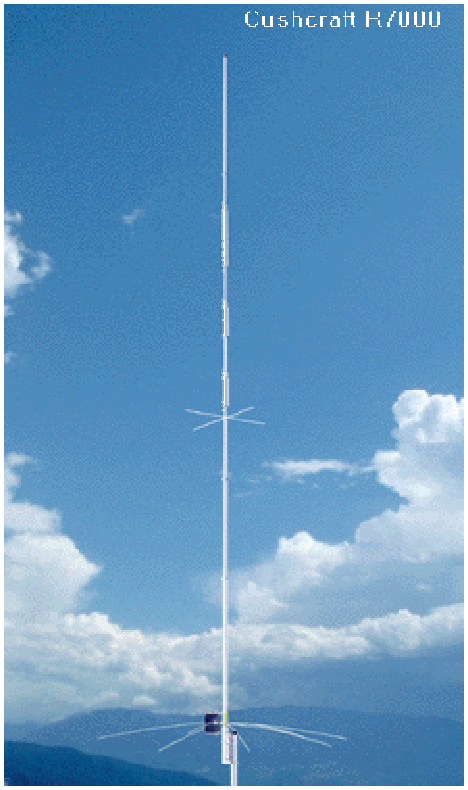
Multi-band Verticals w/ Counterpoise

- 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

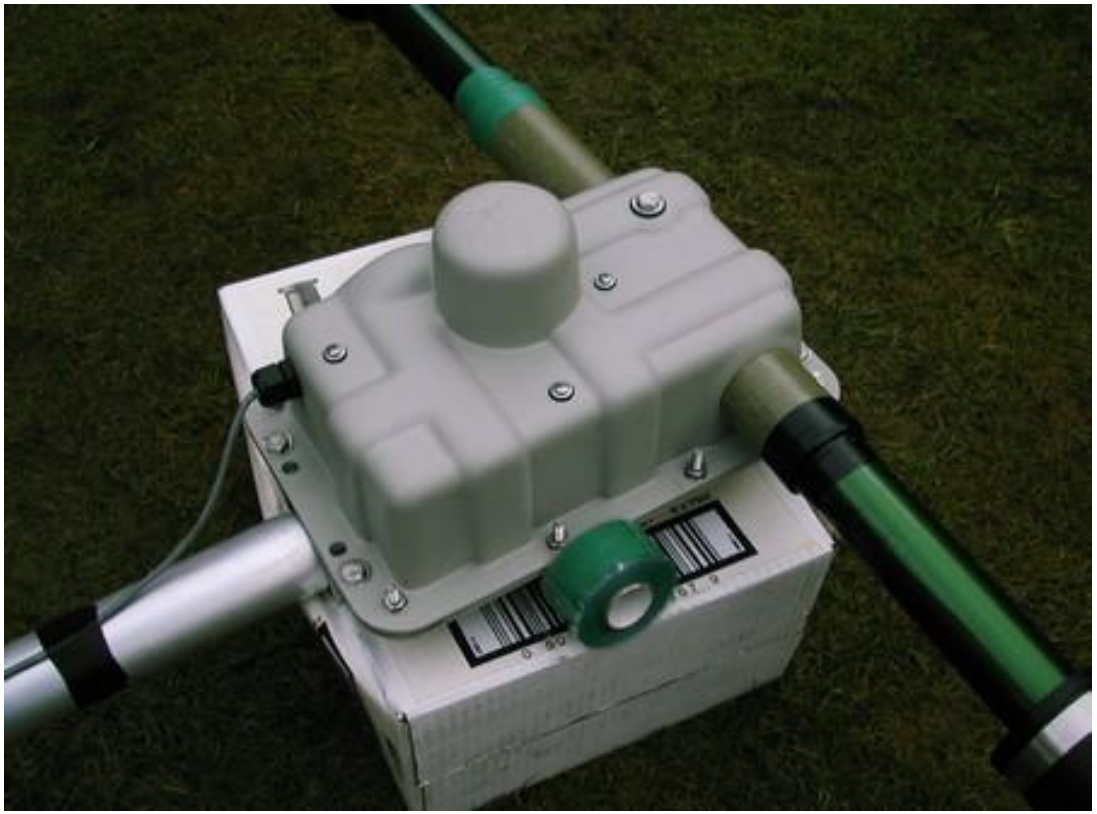


Low Profile Yagis – Steppir 2 Element

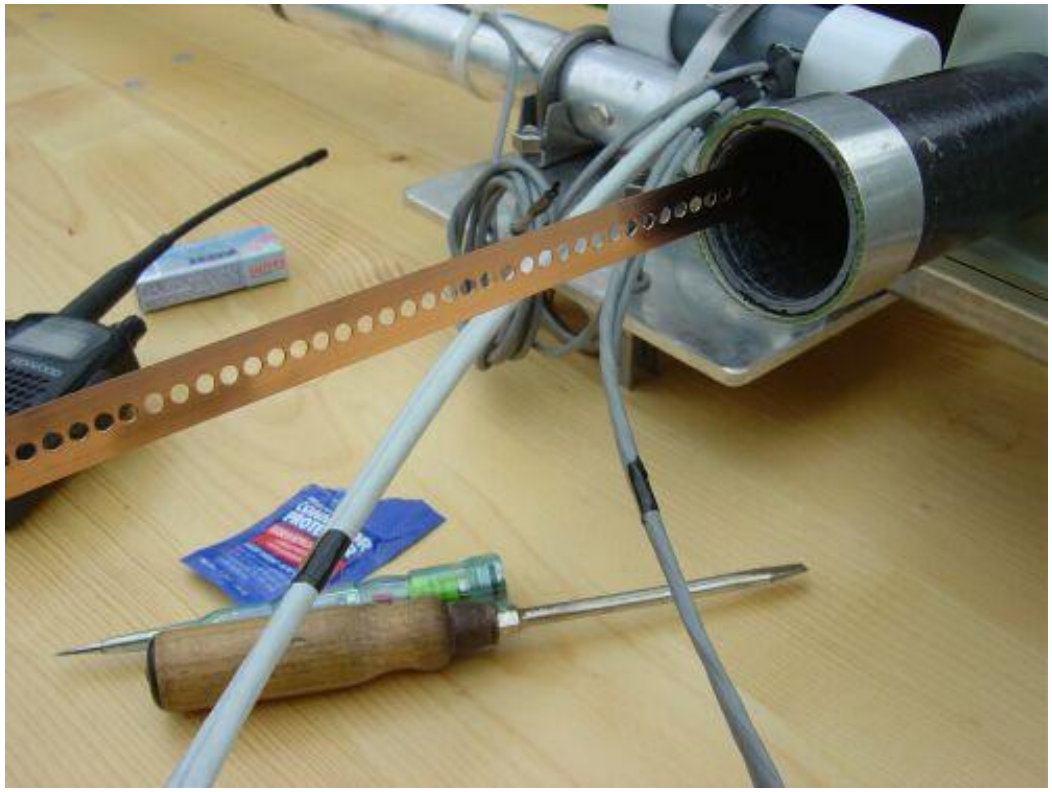
- Steppir has a very low profile 2 Element Yagi
- Excellent Performance
- A bit on the expensive side
- Low Wind Profile
- Easily installed on a roof-mounted tower
- Somewhat stealthy

Steppir 2-Element

Steppir Step Module

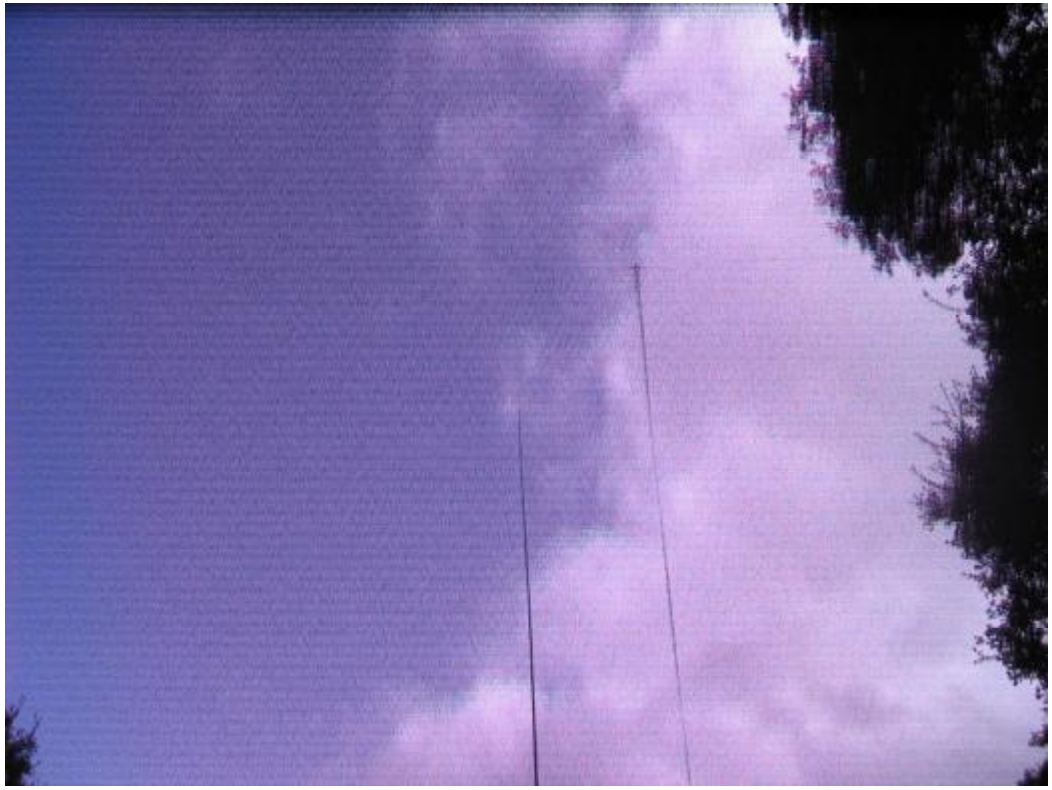


Steppir Step Module - Conductor



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

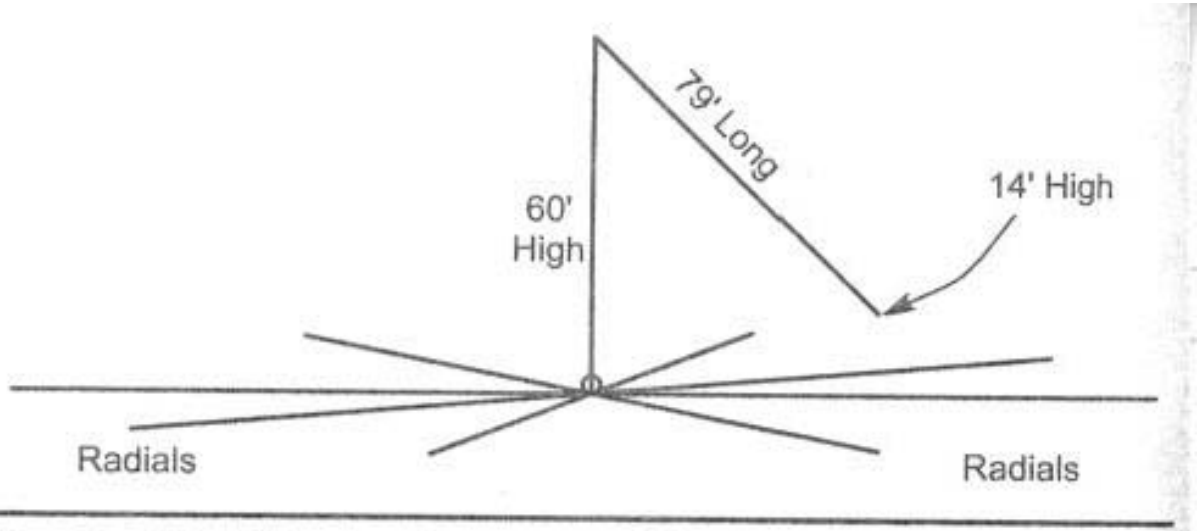


Fig 58—Sketch showing a modified 160-meter inverted L, with a single supporting 60-foot high tower and a 79-foot long slanted top-loading wire. The feed-point impedance is about 12 Ω in this system, requiring a quarter-wave matching transformer made of paralleled 50-Ω coaxes.

Inverted-L on 160M

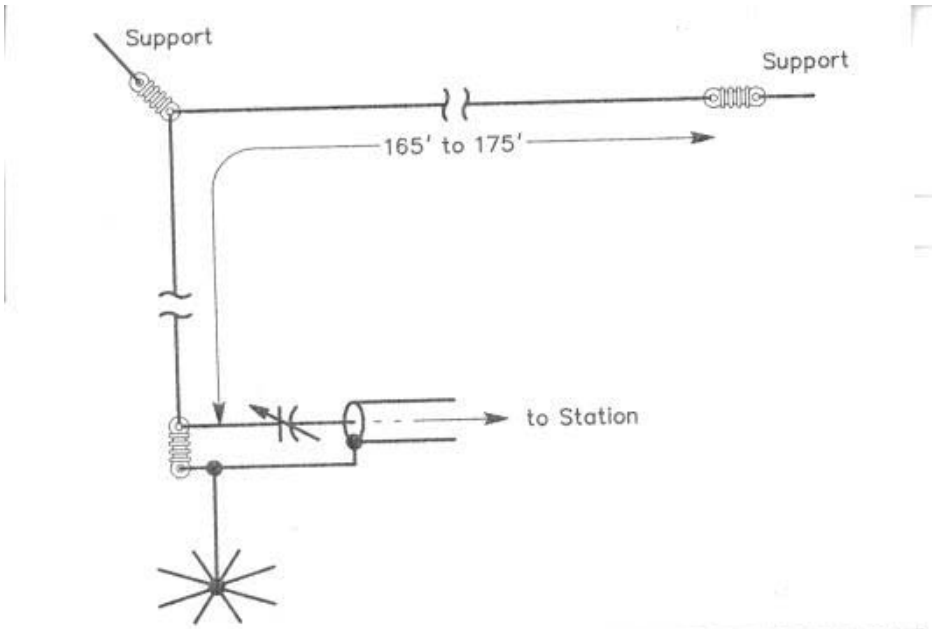


Fig 57—The 1.8-MHz inverted L. Overall wire length is 165 to 175 feet. The variable capacitor has a capacitance range from 100 to 800 pF, at 3 kV or more. Adjust antenna length and variable capacitor for lowest SWR.

Stealth Antennas: End Fed Wire

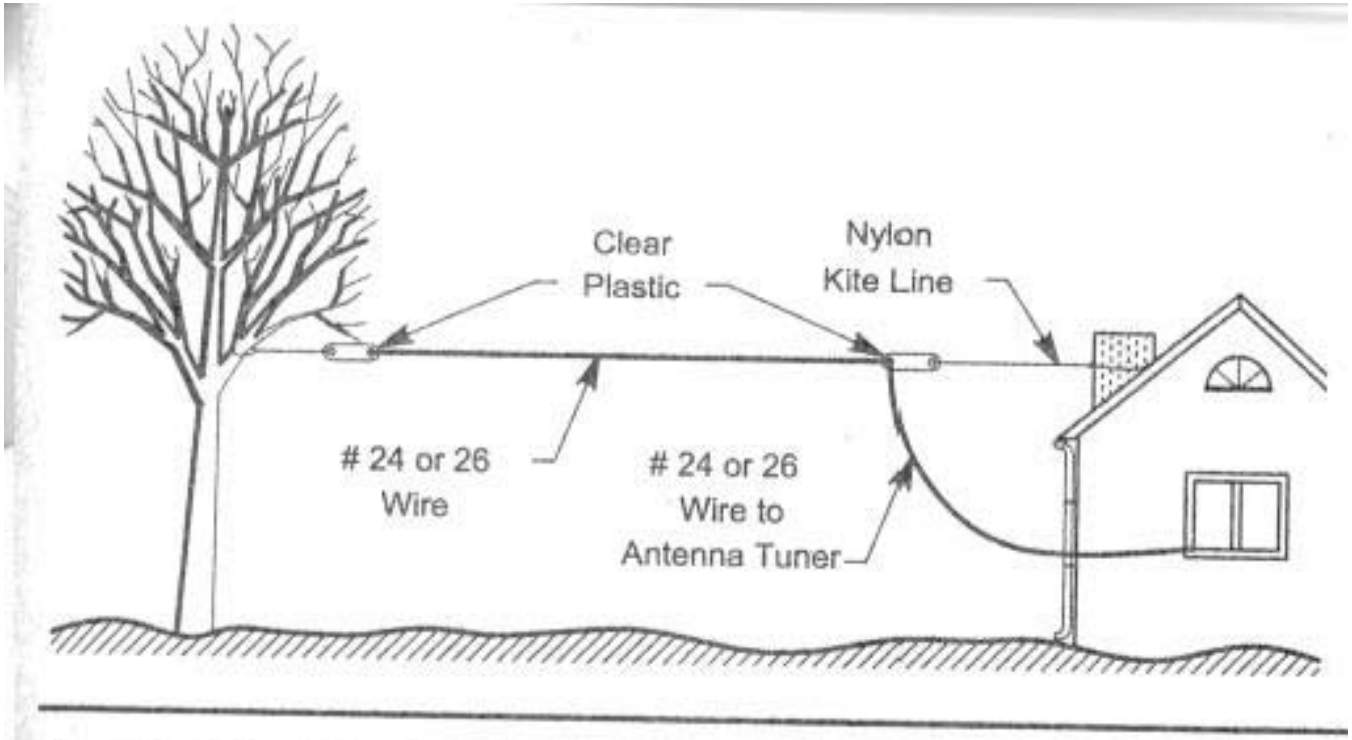


Fig 28—The "invisible" end-fed antenna.

Stealth Antennas: Inverted L Gutter

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

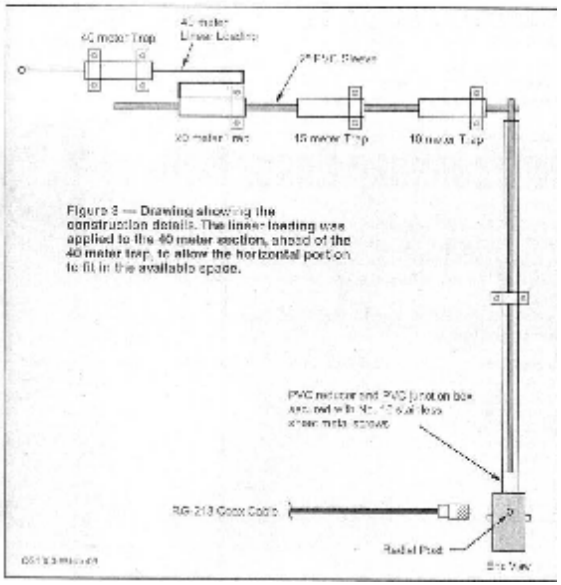


Figure 3 — Drawing showing the construction details. The linear loading was applied to the 40 meter section, ahead of the 40 meter trap, to allow the horizontal portion to fit in the available space.

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