HF Vertical Antennas

Nov 11, 2024

Jerry, VE6TL

HF Verticals - Introduction

Advantages:

- **Ideal for limited spaces**
- Omnidirectional – "Work equally poorly in all directions"
- Suitable for DX – Low take-off angle when properly configured
- Many designs include multiple bands (6m through 40m or even 80m)
  - Single feedline
- Ground-mounted – easier to access than roof or tower mounted antennas
- Low wind/snow load

Disadvantages:

- **Susceptible to noise from vertically polarized sources**
- Omnidirectional – No azimuthal gain
- Requires a good ground plane for optimal performance
- Suffer more acutely from two main types of losses: ground return losses and far-field ground losses (more on this later)
- Some are difficult to build and tune on multiple bands

¼λ HF Verticals – Ground Loss

"How many radials do I need?"

Table A

Optimum Ground-System Configurations

Configuration Designation	*A*	*B*	*C*	*D*	*E*	*F*
Number of radials	*16*	*24*	*36*	*60*	*90*	*120*
Length of each radial in wavelengths	0.1	0.125	0.15	0.2	0.25	0.4
Spacing of radials in degrees	22.5	15	10	6	4	3
Total length of radial wire installed, in wavelengths	1.6	3	5.4	12	22.5	48
Power loss in dB at low angles with a quarter-wave radiating element	3	2	1.5	1	0.5	0*
Feed-point impedance in ohms with a quarter-wave radiating element	52	46	43	40	37	35

Note: Configuration designations are indicated only for text reference.

*Reference. The loss of this configuration is negligible compared to a perfectly conducting ground.

*From "Optimum Ground Systems for Vertical Antennas" QST 1976 – John Stanley, K4ERO

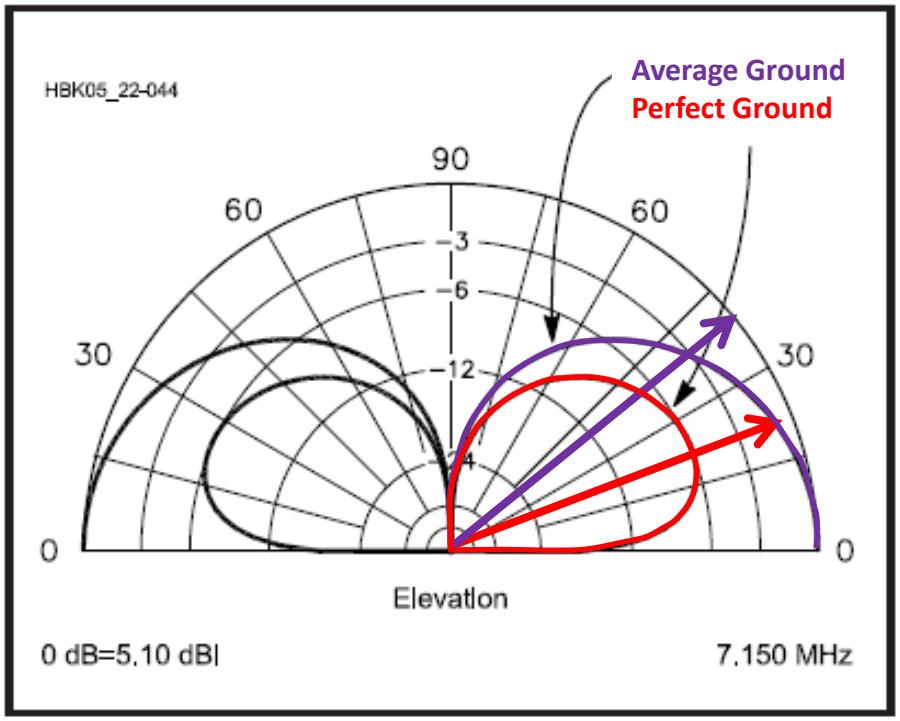
Example: 20m Vertical: Configurations A and C

- A would require 32m of wire, while C would require 108m of wire
- C would cut ground loss by 1.5 dB – (41% power gain)
- Note: D would require 240m of wire and result in 58% power gain

¼λ HF Verticals – Ground Systems

- A large number of shorter radials is better than a few longer ones
- Conductor size of radials not significant (#4 through #20 gauge just fine)
- Copper wire is preferred, bare or insulated
- Insulated wires usually last longer – reduces corrosion from soil chemicals
- Radials can be buried a few inches or on the surface
- Radials may be bent to fit on your property
- All radial wire should be connected together at the base of the antenna
- Best results achieved when radial wires soldered at a junction point (lowest resistance)
- Ground return losses are lower when vertical is elevated and as few as four 1/4λ elevated radials are used (3 to 6m above ground)

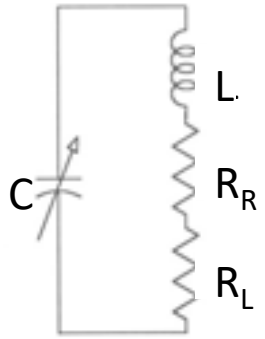
¼λ HF Verticals – Ideal Ground



The difference in the first hop can be well over 1,000 Km !

¼λ HF Verticals – Radiator Length

- As radiator is made shorter, the radiation resistance decreases, with 6Ω being typical for a 0.1λ high antenna
- The lower the radiation resistance the more the antenna efficiency depends on ground conductivity and the less bandwidth the antenna will have (lower Q)
- Longer wavelength verticals require loading coils in order to achieve practical lengths (heights) – especially on 160m



Equivalent Circuit

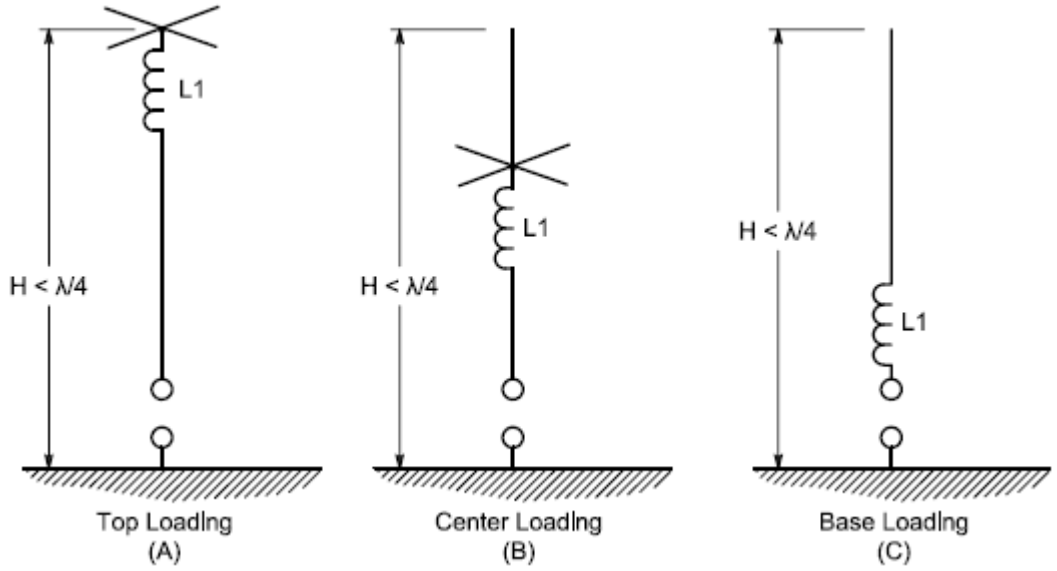
But what is RADIATION RESISTANCE?

"Radiation resistance (R_R) is a hypothetical electrical analogy that allows a mathematical representation of resistance. Just as current flows through normal resistance (R_L) and the resultant power is converted to heat, current through the radiation resistance results in power converted to electromagnetic radiation." – Ted Hart, W5QJR

¼λ HF Verticals – Tuned Radials

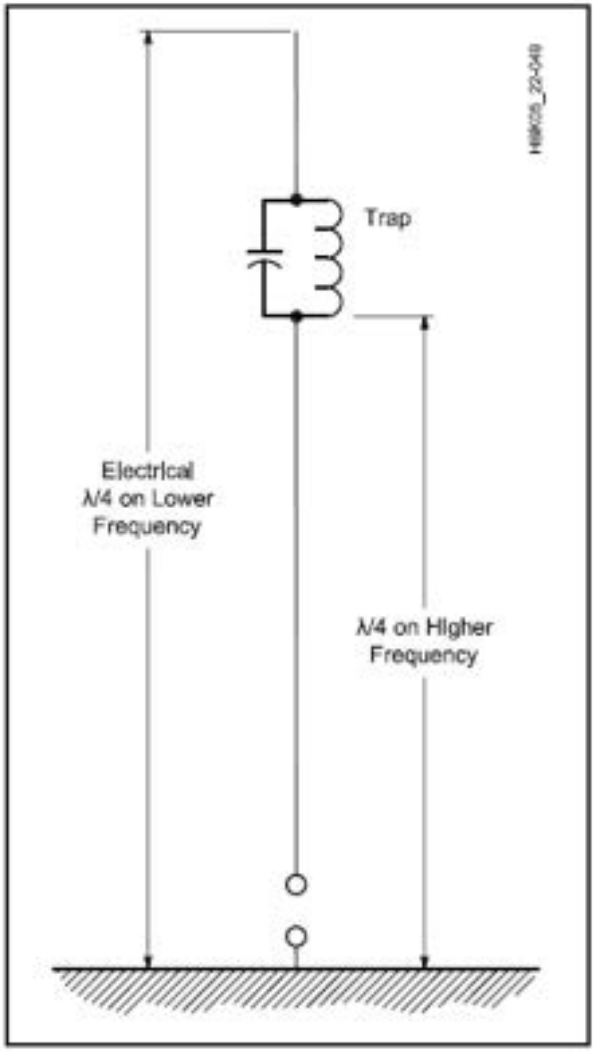
- With four equidistant radial wires drooped 30°, the feed-point impedance is roughly 50Ω
- When the radials are perpendicular to the radiator, the impedance approaches 36Ω
- Radials can also serve as guy wires to support the vertical antenna when mounted well above the ground

Physically Short Verticals



- A capacitance hat is shown for each example and should be as large as possible to increase radiation resistance, as well as bandwidth
- The loading coil's wire should be as large as practical to reduce I^2R losses
- The high current portion of the vertical exists in the coil rather than in the driven element, which means the base-loaded vertical is least effective for radiating RF energy
- The radiation resistance of the coil-loaded vertical is usually less than 16Ω

Trap Verticals – More than one Band



Two-band trap vertical antenna

- The trap is a parallel resonant circuit at center of operating range for the higher frequency band
- For the lower frequency band the trap will act as loading inductor, adding electrical length to the total antenna
- Example: If you prefer to operate between 21.0 MHz and 21.1 MHz, tune the trap (with grid dip meter) for resonance of 21.05 MHz. The trap should be measured separate from the rest of the antenna.

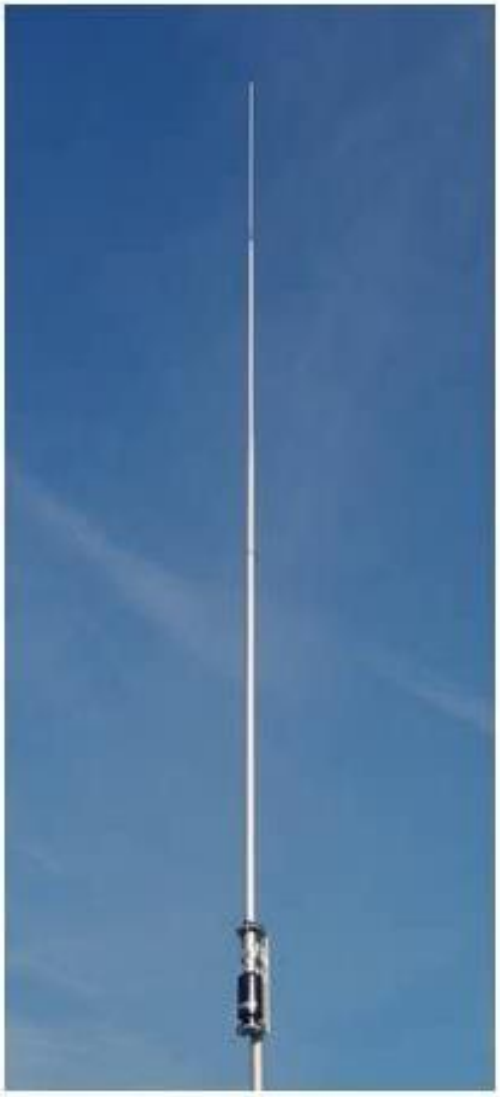
Which Vertical is Best?

The Comparison Table of 9 Best HF Vertical Antenna 2024 (Updated)

Brand Name	Details
Comet Original CHA-250B	Check Price
Hustler HF MultiBand	Check Price
Super Antenna MP1DXTR80	Check Price
MFJ-1778 G5RV	Check Price
Super Antenna MP1LX Tripod	Check Price
Hy-Gain AV-18VS	Check Price
Super Antenna MP1LXMAX	Check Price
SE HF-360 Fibre Glass	Check Price
Super Antenna MP1DXG	Check Price

*Source: Radio4all.org – Based on user satisfaction, flexibility and price

Comet Original Base Antenna



Highlighted Features

- Wide bandwidth (3.5-57 MHz)
- No adjustments needed
- Fits all cable types
- Can take 250 Watts

Pros

- Broad range
- Easy installation
- Sturdy product

Cons

- Poor appearance due to height

Comet CHA-250HD HF/VHF Vertical Antennas CHA-250HD

Antenna, Base Vertical, Multi-Band, 3.5 - 57 MHz TX, 2.0 - 90 MHz RX, Aluminum, 23.42 ft. Height, SO-239, 250 W, Each

Part Number: CMA-CHA-250HD

★★★★★ (23)

Only 7 left in stock - order soon

Estimated USA Ship Date: Today

Estimated International Ship Date: Today

Oversize $9.99

Documentation **Multiple Images**

CAD $594.62 *DX Engineering Price

eHam: 3.7/5.0 from 139 reviews

- Must be installed at least 35’ above ground for “maximum performance”?

Hustler Trap Vertical Antenna

Highlighted Features

- Works as ham radio
- Transmits and receives
- 25 feet tall
- Ground or roof mounting

Pros

- Durable item
- Simple setup
- Diverse function

Cons

- Poor tuning performance

Hustler 6BTV 6-Band HF Vertical Antenna and DXE Installation Guide Packages 6BTV

Antenna, Vertical, HF, 6-Band, 80, 40, 30, 20, 15, 10 meters, 1,500 W SSB, 1,000 W CW, 24 ft., + DXE BTV High Perf. Guide, Each

Part Number: HSR-6BTV

★★★★★ (40)

In Stock (more than 10 available)

Estimated USA Ship Date: Today
Estimated International Ship Date: Today

Oversize Documentation

CAD $636.09 *DX Engineering Price

eHam: 4.6/5.0 from 167 reviews

Super Antenna MP1DXTR80

Highlighted Features

- Largest model available
- Includes all setup material
- A diverse set of functions
- Lightweight design

Pros

- Works at all bandwidths
- Corrosion resistance
- 20-meter height

Cons

- Controls can be tricky

The maximum Super Antenna Go Bag setup with 80 meters. The new ruggedized upgraded version of the MP1 SUPER ANTENNA, with TRIPOD, UNIVERSAL MOUNT, TITANIUM SUPER-WHIP, plus 80 METER COIL, and GO BAG. The #1 HF Portable Vertical Antenna worldwide. This package includes the entire /portable /backpack /base /travel antenna system for Ham Radio. Operators who demand top performance choose the MP1DXTR80 for transmitting and receiving on HF and VHF radio frequencies. Bag totals 5 pounds. Power Rating: 500W SSB, 300W CW/DATA.

HRO Discount Price: $389.95*

eHam: 4.4/5.0 from 160 reviews

HY-Gain Vertical

Hy-Gain AV-680 Patriot-Plus HF Vertical Antennas AV-680

Antenna, Vertical, Patriot-Plus HF, 80, 40, 30, 20, 17, 15, 15, 12, 10, 6 meters, 1,500 W, 26 ft. Height, UHF Female, SO-239, Each

Part Number: HGN-AV-680

★★★½☆ (12)

Only 5 left in stock - order soon

Estimated USA Ship Date: Today

Estimated International Ship Date: Today

Oversize $9.99 **Documentation**

CAD $1,064.74 *DX Engineering Price

eHam: 3.6/5.0 from 15 reviews

Highlighted Features

- Sturdy base
- Aluminum material
- Durable connections
- Handles 1500 Watts

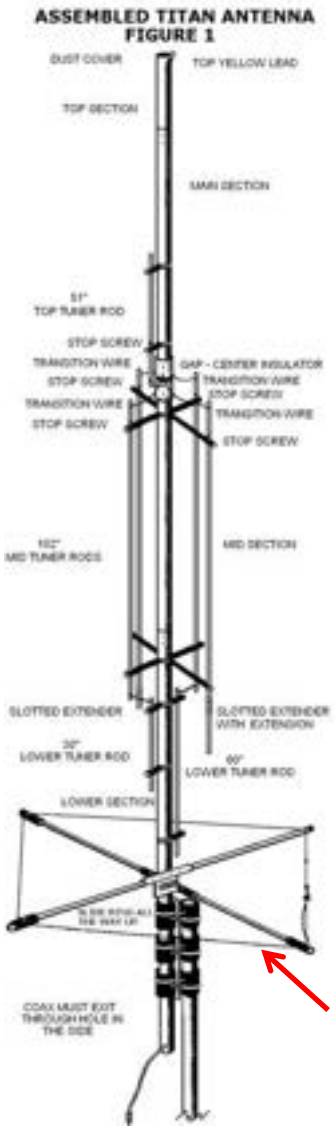
Pros

- Versatile lengths
- High powered
- Broad range

Cons

- Lacks mounting plate

8-Band Gap Titan Vertical



Counterpoise Hoop – controls center freq on 40m

- Center feed – Reduces ground loss
- No radials needed – vertical dipole design
- Good for limited space
- Continuous coverage under 2:1 VSWR 10m – 40m
- 100 kHz bandwidth on 80m
- 25’ tall and weighs 25 pounds
- eHam: 4.4/5.0 from 194 reviews
- US$589.95

Butternut HF-9V

- All bands 6m thru 80m
- 26’ tall – 14 pounds
- 1,500W on 10/15/20/40/80m (less on 12/17/6m)
- VSWR 1.5 to 2.5:1 or better on all bands
- Requires radials
- Difficult to assemble and more difficult to tune
- Flimsy construction (2.2 ft^2 wind load Max 80MPH survivability and no ice loading)
- eHam rating 4.6/5.0 from 73 reviews
- DX Engineering price CAD $1,328.49

SteppIR - BigIR Vertical

- All bands 6m thru 40m
- Requires controller for shack (SDA 100) plus 4 conductor control cable ($0.84/ft)
- ¼ wave on all bands – precisely tuned with stepper motor
- Optional 80m loading coil (requires 2x4 conductor cable)
- Acts as dummy load on 6m (personal experience)
- Rated up to 3 kW (less on 60/80m)
- 32’ height, 15 lb weight, 2 ft^2 wind load
- Wind rating 70 mph w/1 guy set or 100 mph w/2 guy sets
- eHam rating: 4.6/5.0 from 61 reviews
- MSRP: US$2,324.41 to $2,874.41

Cushcraft R9 Vertical Antenna

- Height 31.5’, 25 lbs
- No radials required
- Wind rating: 4 ft^2
- Power rating: 1,500W PEP (500W CW)
- eHam rating: 2.6/5.0 from 20 reviews
  - Reviews ranged from horrible to great??
- MSRP: CAD $1,107.02 (DX Engineering)

Vertical Accessories

Predrilled 60 holes for radials –
CAD $138.37 DX Engineering

DX Engineering OMNI-TILT™ Vertical Antenna Tilt Bases DXE-OMNITILT-1P

OMNI-TILT™ Tilt Base for Trap Vertical Antennas, All 1/8 in. Stainless Steel, Each

CAD $146.66

Part Number:
DXE-OMNITILT-1P

★★★★★ (28)

Vertical Accessories – Cont'd

- Timewave ANC-4 Noise Canceller
- eHam rating: 4.3/5.0 from 79 reviews
- USD $259.95 HRO