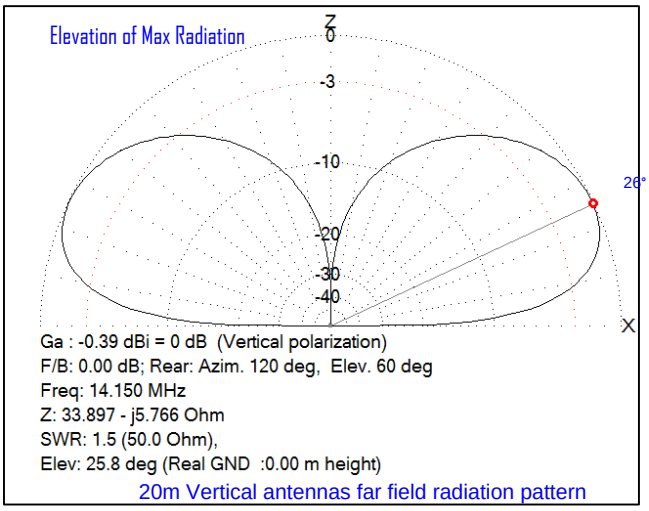
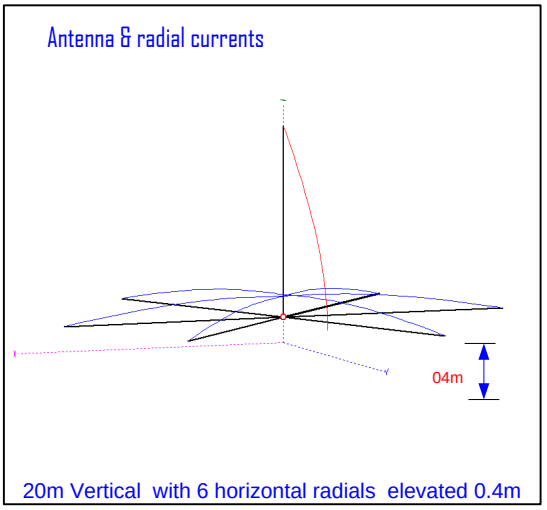
Study of the Quarter Wave Vertical 20m Antenna with Elevated Ground Plane

The vertical, when installed over a good ground structure, will outperform a 1 /2 wave dipole at 1/4 wave above ground for radiation angles less than 30 degrees. Even a shortened loaded vertical similarly installed, will still outperform 1/ 2 wave dipole at heights lower than 1/4 wave for radiation angles below 30 degrees. It is relatively easy to have such a ground set up with just a few elevated radials. Antenna modelling using NEC (Numerical Electromagnetic Computation) software has shown that 4 wires can perform just as well as 90 or 120 buried wires. However, with just 4 elevated radial wires, scalloping can occur resulting in a slight clover leaf pattern, using 6 elevated radial wires this effect is minimised. Consider this 20 m Vertical antenna model below.



20m Vertical antennas far field radiation pattern



20m Vertical with 6 horizontal radials elevated 0.4m

MMANA-GAL MODEL

The 20 m vertical with 6 horizontal radials elevated 0.3m above the ground - model's real ground parameters

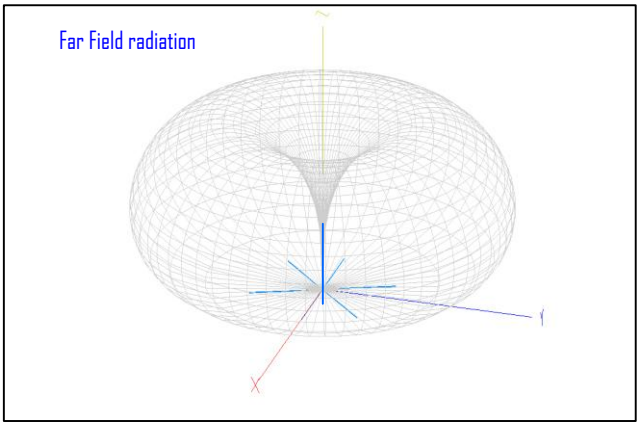
- 5 mS/m & dielectric of 13 – i.e. for typical average ground.

Calculated results

No.	F (MHz)	R (Ohm)	jX (Ohm)	SWR 50	Gh dBd	Ga dBi	F/B dB	Elev.	Ground	Add H.	Polar.
1	14.15	33.9	-5.766	1.51	---	-0.39	-0.0	25.8	Real	0.0	vert.

The 1/4 wave antenna performs well because the far field vertical polarisation rejects signals coming via NVIS (near vertical incident) and also high angle skip propagation. This means it helps it to reject relatively " local" signals from 50 miles to 400 miles away in favour of low angle DX signals. The **"SAFARI" 40-30m ROACH POLE VERTICAL ANTENNA - G3RWF** is an example of such an antenna with elevated radials that are easy to set up and also help to support the vertical section. Additionally, drooping or tilting the radials improves the SWR as this increases the increases the antenna's radiation resistance.

See also RSARS article 20m Elevated Vertical antenna.



Explanation of the model's calculated SWR

An SWR of 1.48:1 ref 50Ω in the MMANA-GAL freeware model may appear to be less than ideal i.e. not 1:1. It is important to remember that the 1/4 wave antenna is half a dipole and therefore the radiation resistance will be half of a 1/2 wave dipole's or 36Ω. Also, it is necessary to recall the SWR formula for non-reactive loads. There are two possible formulas, but the correct one provide values >1

SWR = Z load / Z coax or SWR = Z coax / Z load

The obvious choice here is therefore, SWR = Z coax / Z load = 50Ω / 36Ω = 1.38

This is normally written as SWR 1.38:1 and is very close to 1.51:1 value from the MMANA-Gal model.

Thus a 1/4 wave resonant antenna perpendicular to a near perfect ground and connected to 50Ω coax will actually have an SWR of 1.38:1 and <u>not an SWR of 1:1 .</u> This situation can be easily improved by tilting the elevated radials down.

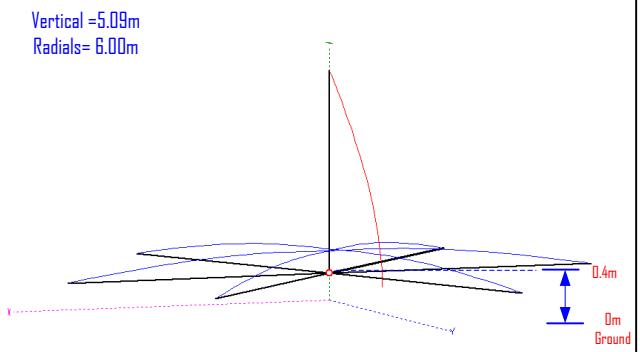
Proofread by G3YEU

Study & Graphic Design - G8ODE 3 Mar 2009 iss 1.3

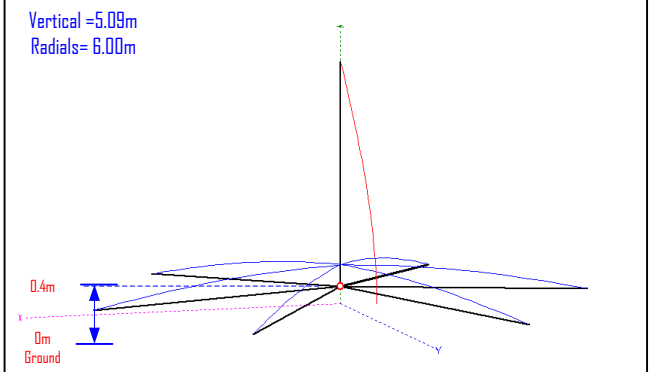
Study of the Quarter Wave Vertical 20m Antenna with Elevated Ground Plane

The two MMANA-GAL models are intended to demonstrate the differences between having horizontal and tilted radials above the ground. A modest 0.4m elevation of the base of the vertical is used to illustrate the effectiveness of this technique. In both cases the ground is assumed to be “average ground” with 5mS/m conductivity & dielectric of 13. The dimensions of the antenna in case is the same..

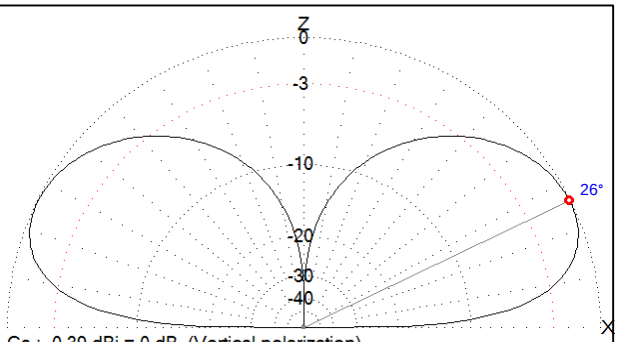
The diagrams for the Far Field radiation pattern, show that the angle for maximum radiation remains unchanged and that the SWR improves when the radials are only slightly tilted towards the ground. The % reflected power reduces from 4% for an SWR of 1.5:1 to about 1.7% for the SWR of 1.3:1.



20m Vertical with 6 horizontal radials elevated 0.4m above ground

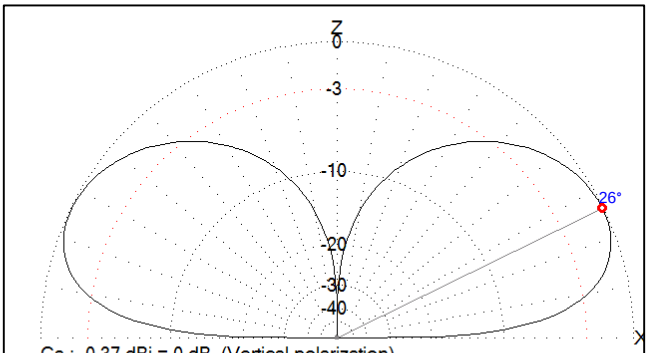


20m Vertical with 6 radials drooped from 0.4m. to 0.1m above ground



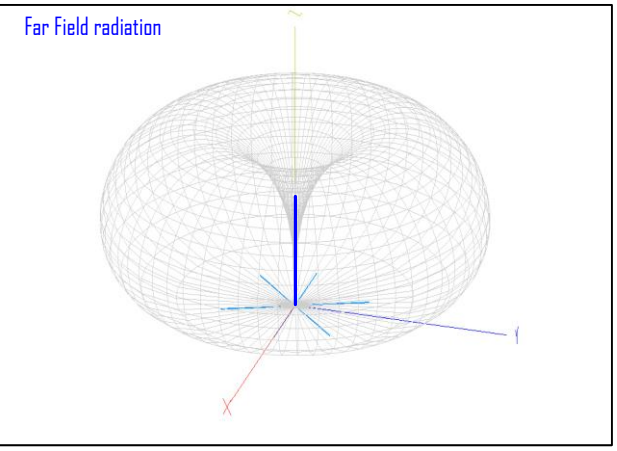
Ga : -0.39 dBi = 0 dB (Vertical polarization)
F/B: 0.00 dB; Rear: Azim. 120 deg, Elev. 60 deg
Freq: 14.150 MHz
Z: 33.766 - j0.004 Ohm
SWR: 1.5 (50.0 Ohm), SWR OK..but can be improved 33.9 R – j 5.8
Elev: 26.0 deg (Real GND :0.00 m height)

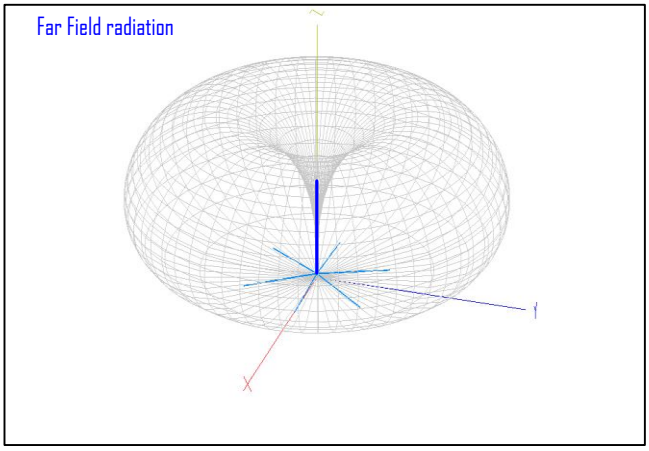
20m Vertical antennas far field radiation pattern



Ga : -0.37 dBi = 0 dB (Vertical polarization)
F/B: -0.01 dB; Rear: Azim. 120 deg, Elev. 60 deg
Freq: 14.150 MHz
Z: 38.429 + j1.416 Ohm
SWR: 1.3 (50.0 Ohm), SWR improved with drooped radials 38.4 R + J 1.4
Elev: 26.0 deg (Real GND :0.00 m height)

20m Vertical antennas far field radiation pattern





With special thanks to G3YEU for helping with proofreading

Graphic Design - G8ODE 3 Mar 2009 iss 1.3