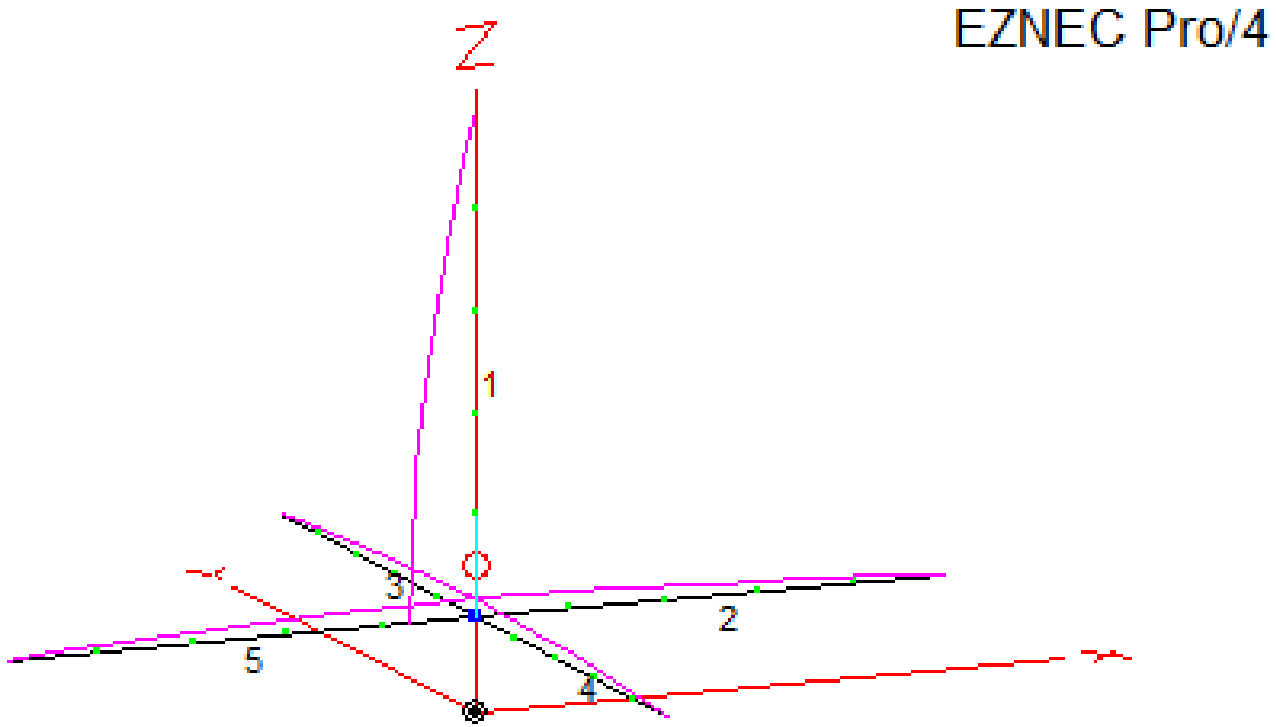
Vertical or horizontal antenna for limited space

If you have very limited space for a DX antenna, you may consider vertical, because it has low angle of radiation. But vertical polarization involves high ground reflection loss, about 6dB. The following examples illustrate power gain of a GP antenna in comparison to half wave dipole and inverted V-dipole at quite low heights.

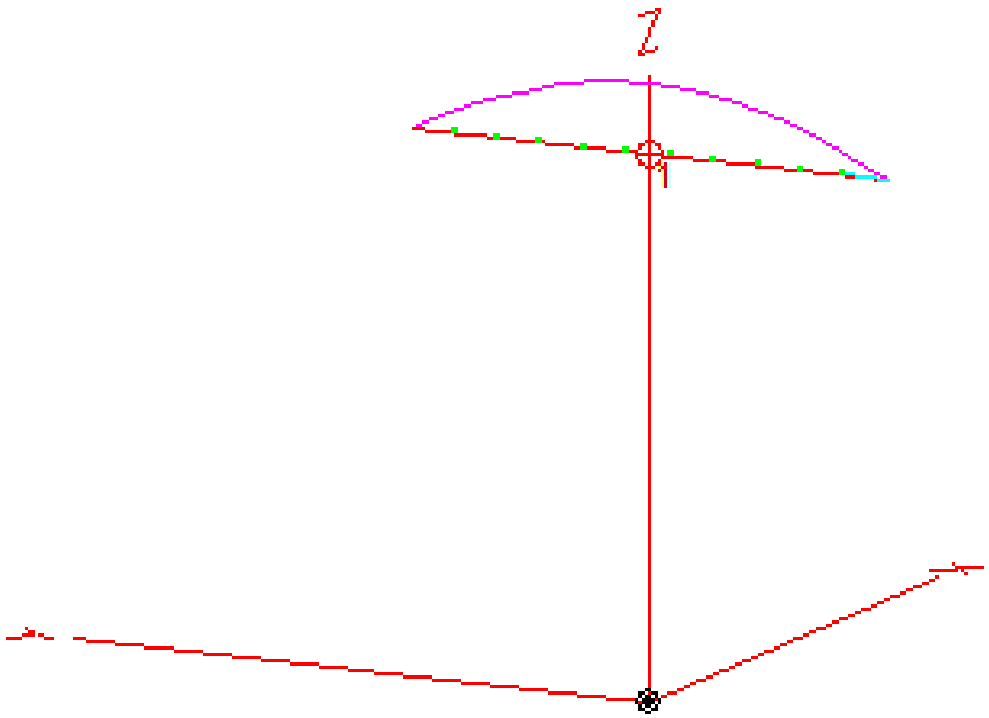
Comparison is made on 20m but results are quite the same on other bands when dimensions are scaled accordingly.

Comparison on 20m

Quater wave vertical, elevated radials

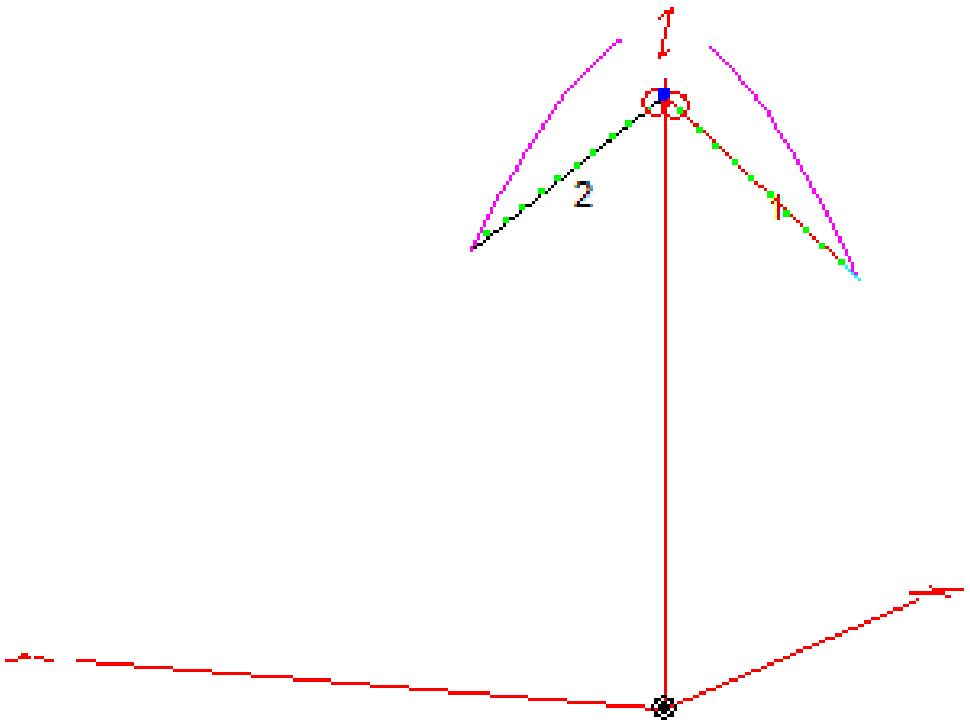


Half wave dipole



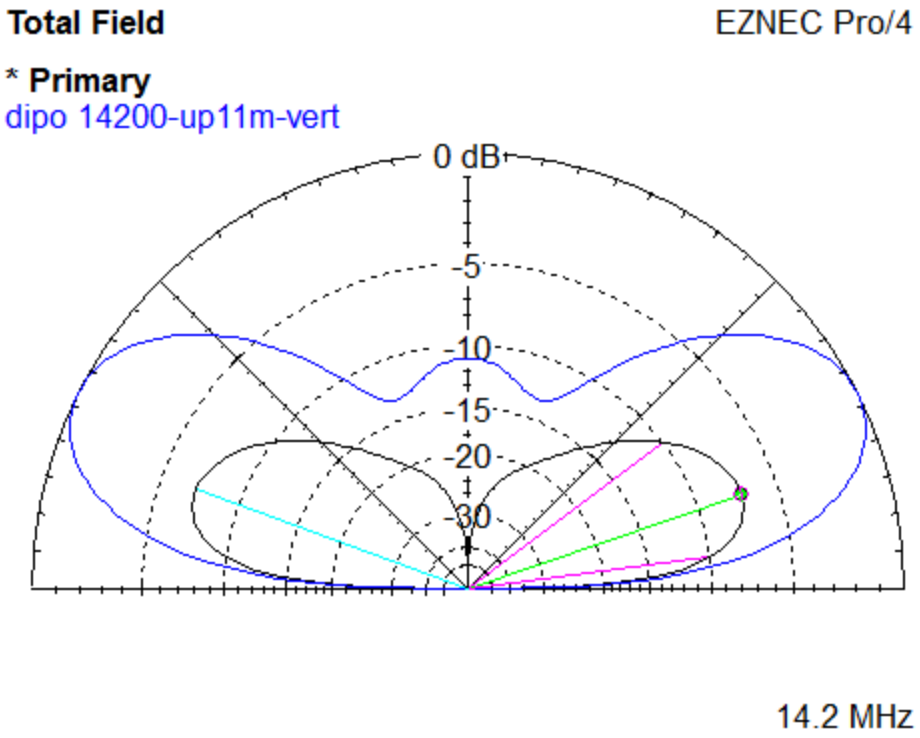
EZNEC Pro/4

Inverted V dipole



EZNEC Pro/4

20m dipole at 11m height versus GP, radials up 3m



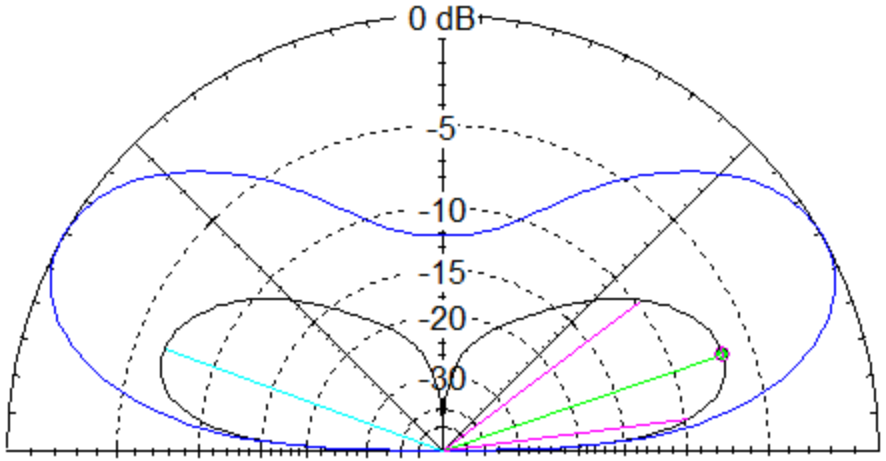
- Blue; Half wavelength dipole 11m above average ground (0.005, 13)
- Black: Quarter wave vertical with 4 radials 3m above average ground

- At 19deg dipole gain is >6.3dB better
- On all take off angles our 11m high dipole is better in transmitting

20m dipole at 10m height versus GP, radials up 3m

Total Field EZNEC Pro/4

*** Primary**
dipo 14200-up10m-vert



14.2 MHz

Elevation Plot		Cursor Elev	19.0 deg.
Azimuth Angle	0.0 deg.	Gain	0.43 dBi
Outer Ring	7.06 dBi		0.0 dBmax

Slice Max Gain	0.43 dBi @ Elev Angle = 19.0 deg.
Beamwidth	29.7 deg.; -3dB @ 7.4, 37.1 deg.
Sidelobe Gain	0.43 dBi @ Elev Angle = 160.0 deg.
Front/Sidelobe	0.0 dB

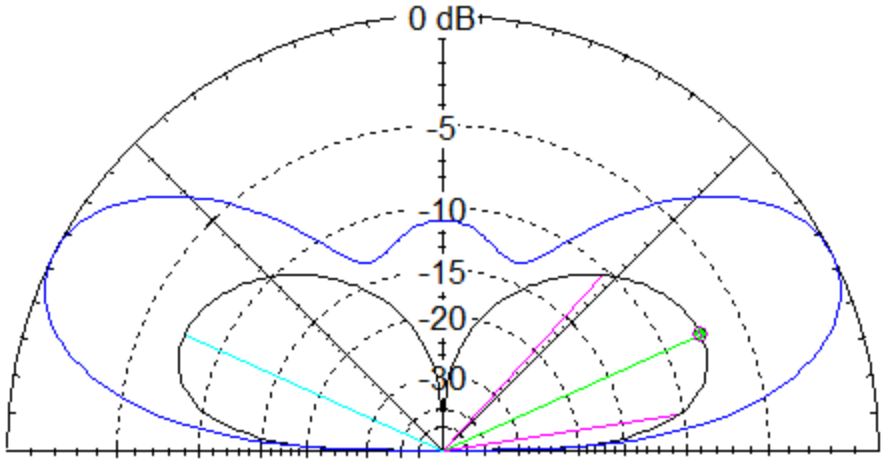
- Blue; Half wavelength dipole 10m above average ground (0.005, 13)
- Black: Quarter wave vertical with 4 radials 3m above average ground

- At 19deg dipole gain is >5.4dB better
- On all take off angles our 10m high dipole is better in transmitting

20m dipole at 11m height versus GP, radials up 1m

Total Field EZNEC Pro/4

*** Primary**
dipo 14200-up11m-vert



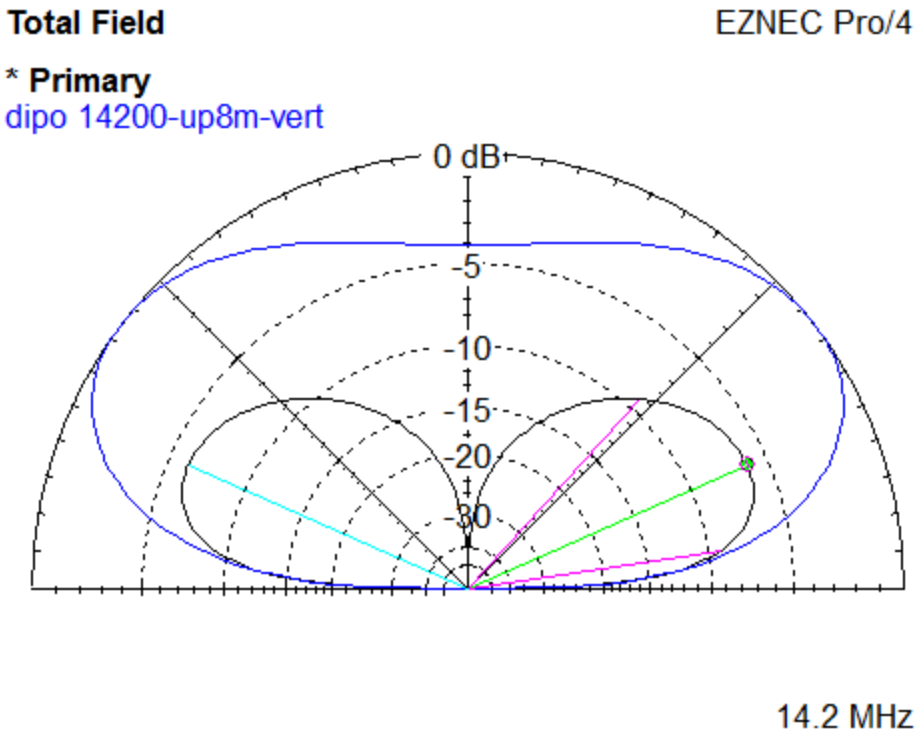
14.2 MHz

Elevation Plot		Cursor Elev	24.0 deg.
Azimuth Angle	0.0 deg.	Gain	0.04 dBi
Outer Ring	7.48 dBi		0.0 dBmax
Slice Max Gain	0.04 dBi @ Elev Angle = 24.0 deg.		
Beamwidth	39.0 deg.; -3dB @ 8.7, 47.7 deg.		
Sidelobe Gain	0.04 dBi @ Elev Angle = 156.0 deg.		
Front/Sidelobe	0.0 dB		

- Blue; Half wavelength dipole 11m above average ground (0.005, 13)
- Black: Quarter wave vertical with 4 radials 1m above average ground

- At 24deg dipole gain is >7dB better
- On all take off angles our 11m high dipole is better in transmitting

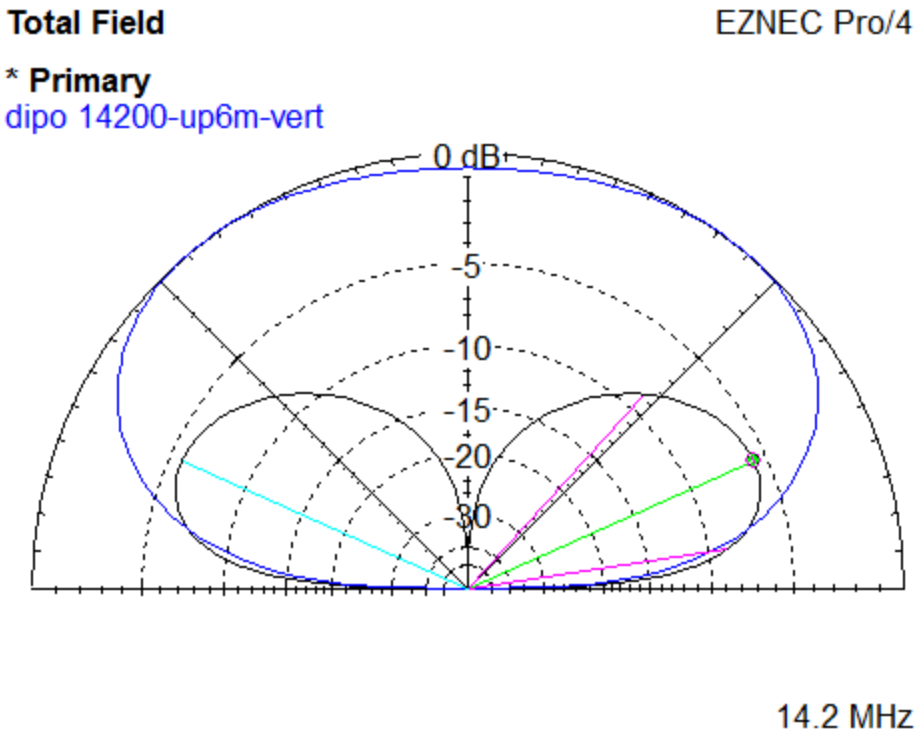
20m dipole at 8m height versus GP



- Blue; Half wavelength dipole 8m above average ground (0.005, 13)
- Black: Quarter wave vertical with 4 radials 1m above average ground

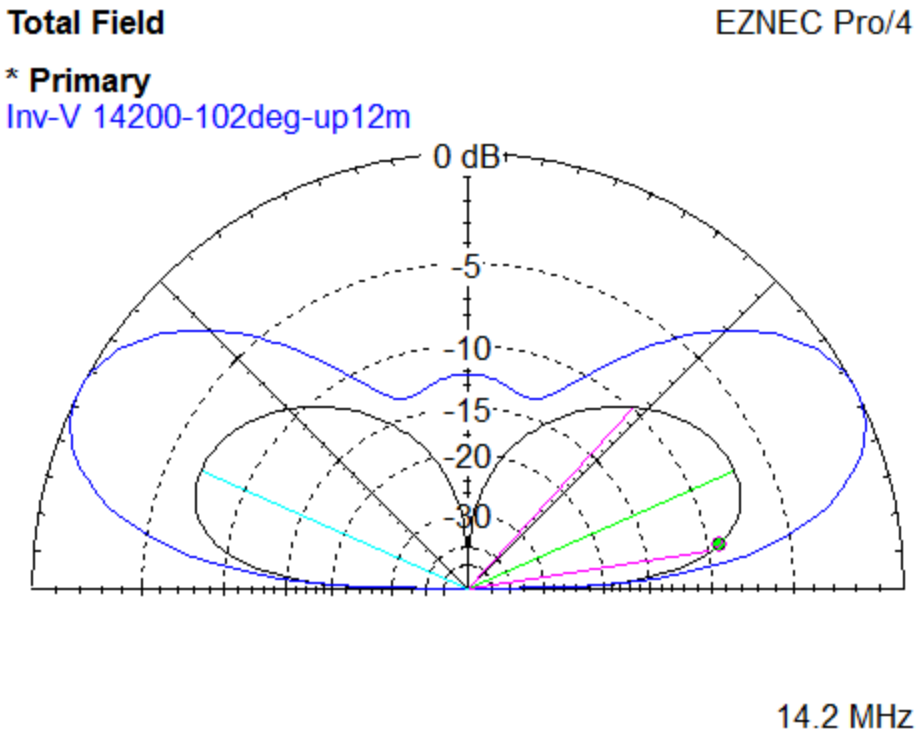
- At 24deg dipole gain is 5dB better
- On all angles our 8m high dipole is better in transmitting

20m dipole at 6m height versus GP



- Blue; Half wavelength dipole 6m above average ground (0.005, 13)
- Black: Quarter wave vertical with 4 radials 1m above average ground
- At 24deg dipole gain is 3.2dB better
- Below 11deg GP is better than dipole in transmitting
- For TOA 10deg DX GP is better than 6m high dipole.

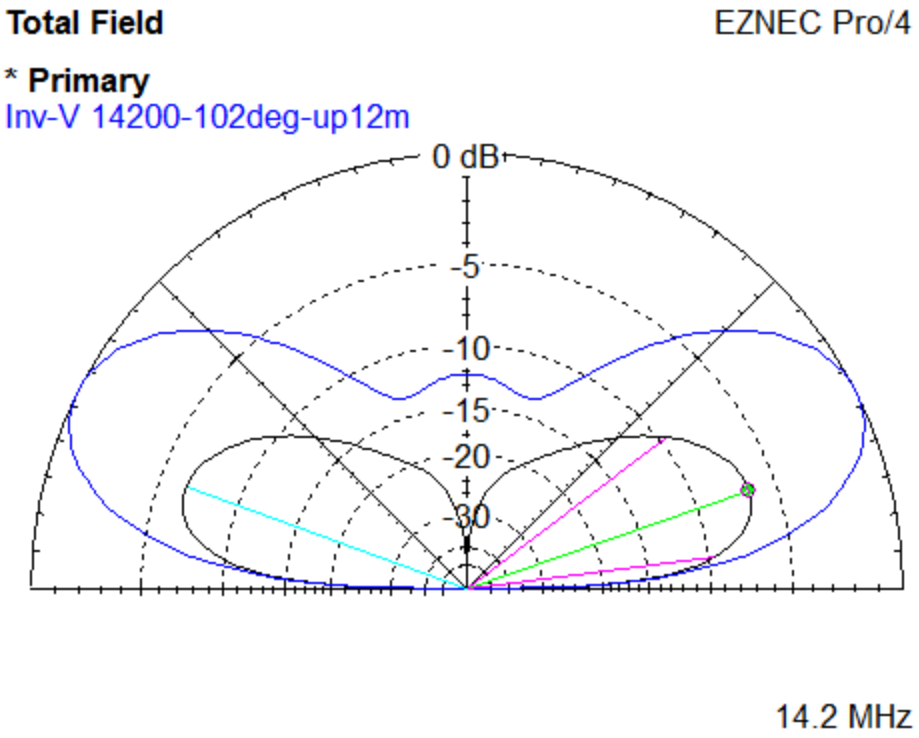
20m Inverted V-dipole at 12m versus GP, radials up 1m



- Blue; Inverted V dipole, apex 12m above average ground (0.005, 13), apex angle 102deg
- Black: Quarter wave vertical with 4 radials 1m above average ground

- At 24deg dipole gain is >6.7dB better
- On all angles our 12m high Inverted V dipole is better in transmitting

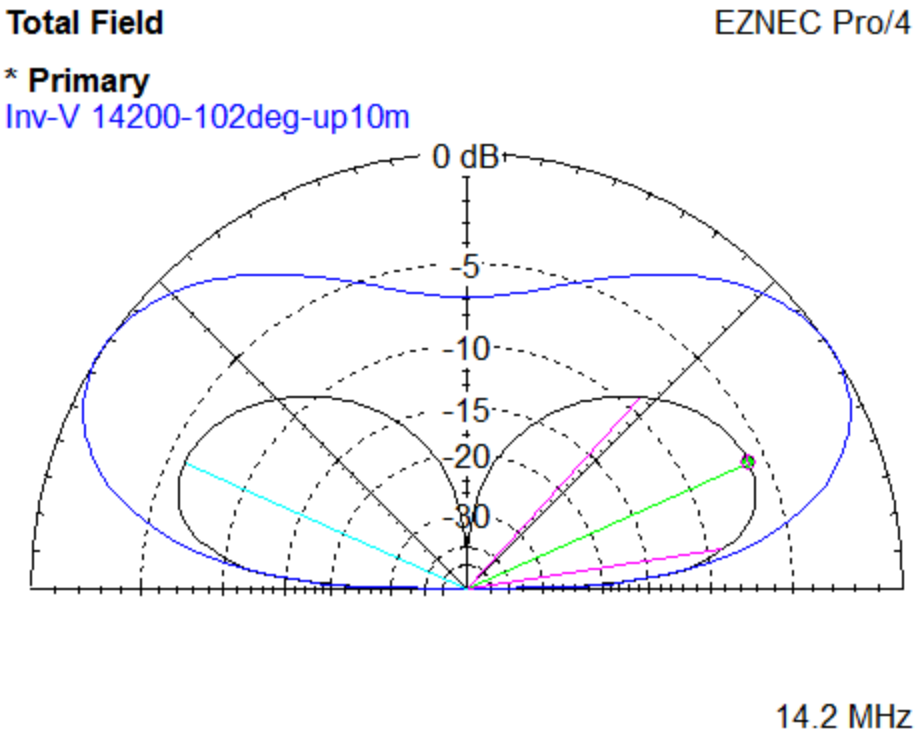
20m Inverted V-dipole at 12m versus GP, radials up 3m



- Blue; Inverted V dipole, apex 12m above average ground (0.005, 13), apex angle 102deg
- Black: Quarter wave vertical with 4 radials 3m above average ground

- At 19deg dipole gain is >5.6dB better
- Above 5deg our 12m high Inverted V dipole is better in transmitting
  - This covers almost all cases

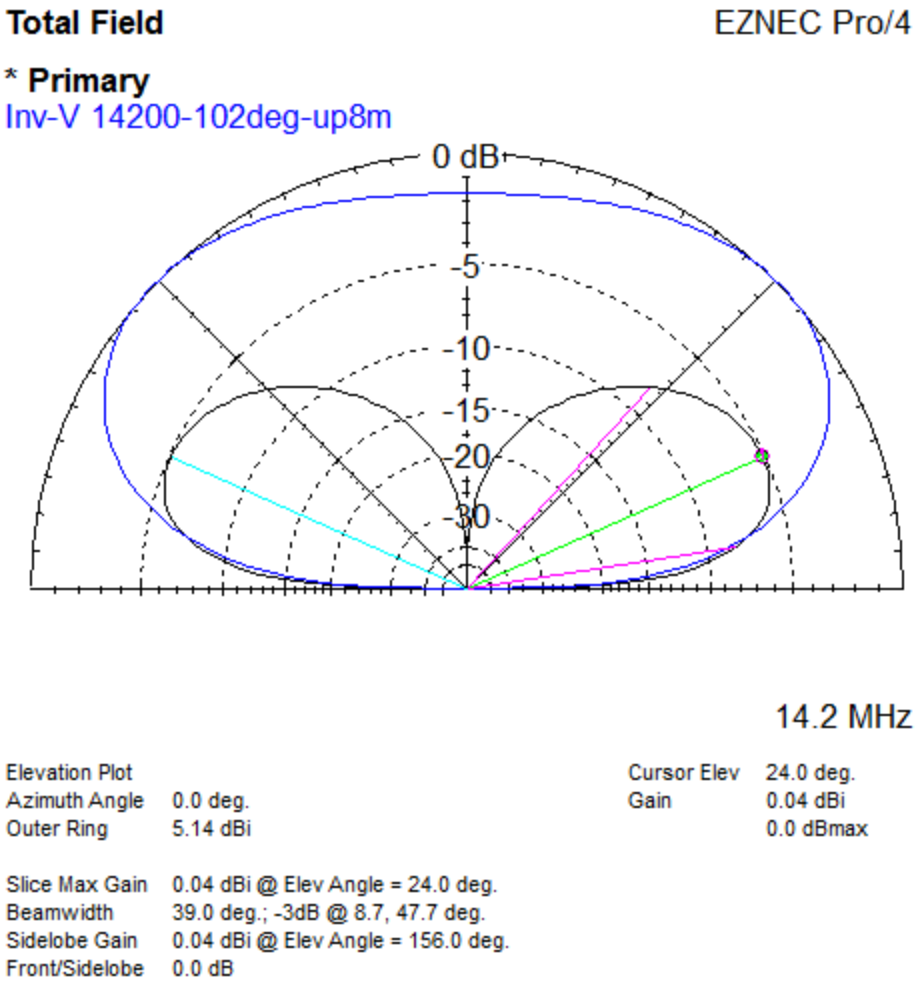
20m Inverted V-dipole at 10m versus GP



- Blue; Inverted V dipole, apex 10m above average ground (0.005, 13), apex angle 102deg
- Black: Quarter wave vertical with 4 radials 1m above average ground

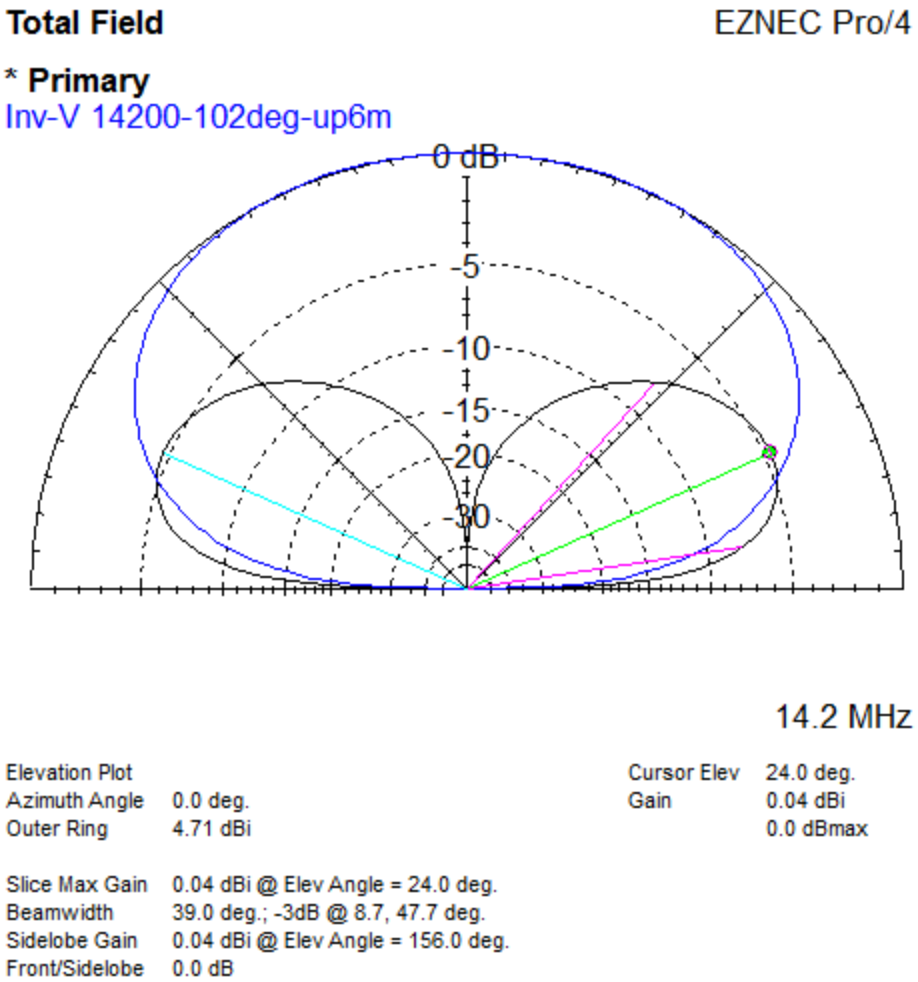
- <u>At 24deg dipole gain is >5.2dB better</u>
- On all angles our 10m high Inverted V dipole is better in transmitting

20m Inverted V-dipole at 8m versus GP



- Blue; Inverted V dipole, apex 8m above average ground (0.005, 13), apex angle 102deg
- Black: Quarter wave vertical with 4 radials 1m above average ground
- <u>At 24deg dipole gain is >3.3dB better</u>
- Below 10deg GP is better than dipole in transmitting
- For TOA 10deg DX GP and 8m high inverted V are about equal.

20m Inverted V-dipole at 6m versus GP

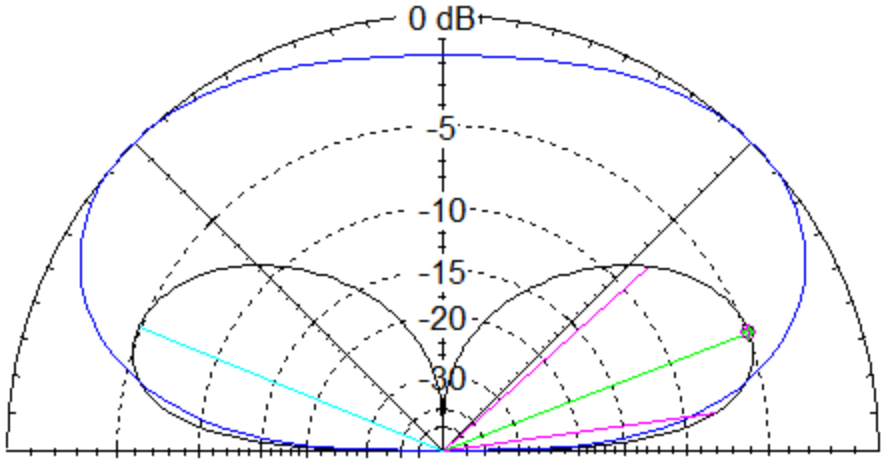


- Blue; Inverted V dipole, apex 6m above average ground (0.005, 13), apex angle 102deg
- Black: Quarter wave vertical with 4 radials 1m above average ground
- <u>At 24deg dipole gain is >1.1dB better</u>
- Below 20deg GP is better than dipole in transmitting
- For TOA 10deg DX GP is better than 6m high inverted V.

20m Inverted V-dipole at 8m versus GP, radials up 2m

Total Field EZNEC Pro/4

*** Primary**
Inv-V 14200-102deg-up8m



14.2 MHz

Elevation Plot		Cursor Elev	21.0 deg.
Azimuth Angle	0.0 deg.	Gain	0.26 dBi
Outer Ring	5.14 dBi		0.0 dBmax
Slice Max Gain	0.26 dBi @ Elev Angle = 21.0 deg.		
Beamwidth	33.9 deg.; -3dB @ 8.0, 41.9 deg.		
Sidelobe Gain	0.26 dBi @ Elev Angle = 158.0 deg.		
Front/Sidelobe	0.0 dB		

- Blue; Inverted V dipole, apex 8m above average ground (0.005, 13), apex angle 102deg
- Black: Quarter wave vertical with 4 radials 2m above average ground

- At 21deg dipole gain is >2.3dB better
- Below 12deg GP is better than dipole in transmitting

Conclusions, case 20m band

- To outperform quarter wave vertical with 1m high elevated radials on all practical take off angles
  - Half wave dipole has to be at least 8m high
  - Inverted V apex has to be at least 10m high
- To outperform quarter wave vertical with 1m high elevated radials on take off angles above 10deg (typical TOA of DX)
  - Half wave dipole has to be at least 6.5m high
  - Inverted V apex has to be at least 8m high

- To outperform quarter wave vertical with 3m high elevated radials on all practical take off angles
  - Half wave dipole has to be at least 10m high
  - Inverted V apex has to be at least 12m high
- When criteria above has been met, horizontal antenna is better in transmitting.