Ham 110 – Antenna Dipole, Simply the Simplest

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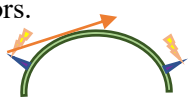
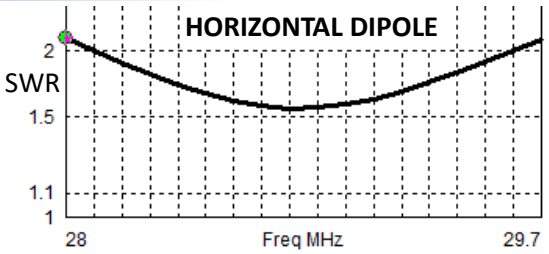
1. An antenna system consists of the radiator, return, and transmission line. All antennas are a compromise.
   a. The radiator is usually called the antenna. The return may be earth, ground plane, or counterpoise.
   b. On 2-meters and higher frequencies, small, commercially made antennas dominate.
   c. On longer wavelengths (low frequency), hams must build antennas to fit the location.
   d. This is not hokum. This is the science. We have modelled, built, and measured on multiple bands.
2. Dipole is a long-conductor (wire, tube) with one-half length as radiator and one-half as return.
   a. Use a coax connector or banana-plug. Connect the radiator to the center and the return to the frame. That's it.
   b. The resistance is about 75-Ohms.
   c. That is close enough to the coax of 50-Ω for a SWR about 1.9. Your radio can handle that.
   d. A simple dipole gain is about 6.1 dBi. With reflectors, stacked, and tweaked, 12 dBi is possible.
   e. AWG #12 insulated wire is self-supporting. Stranded is more flexible for outdoor, while solid holds its shape.
   f. What is not to like? A dipole is a single-band antenna. The SWR curves show a huge single dip.

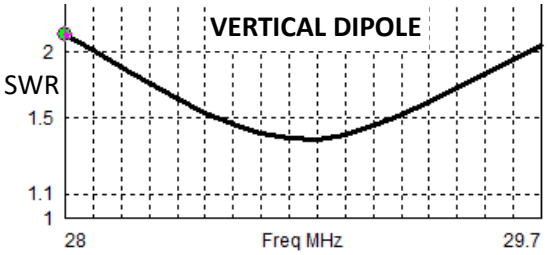
3. Anything that can change impedance, changes performance. Shape changes capacitance and inductance.
   a. *Tuning* is capacitive X_C equal to inductive reactance X_L. *Matching* is impedance of antenna equal to coax Z_0.
   b. *Reactive* near field <0.16λ, *near* field <1λ, *transition* zone >1λ <2λ, *far* field >2λ.
   c. Height is critical. More height improves gain. Height in far field gets out of ground effect. Easy UHF, cannot HF.
   d. Nearby conductive material like metal or solid reflective surfaces like buildings are major impactors.
   e. Whether free-space, grounded, or counterpoise, the return changes the pattern and impedance.

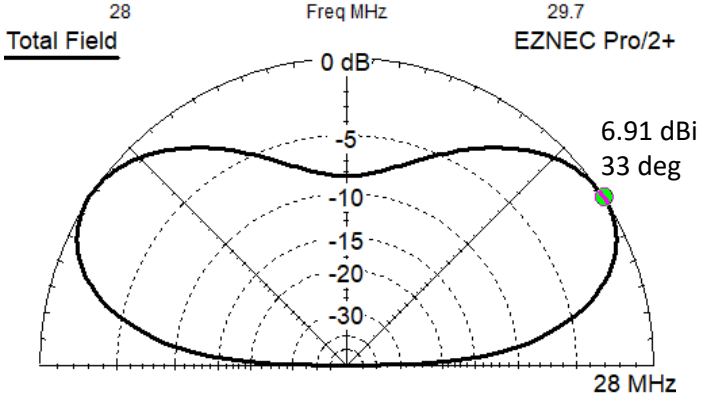


4. Horizontal polarization is more skywave. Vertical is more local. Curvature of earth changes signals.
   a. For 10-meter, with λ/4 = 8.32 ft, horizontal mounted at eave height of 15', the max take-off angle is 33 degrees.
   b. For 10-meter, with λ/4 = 8.25 ft, vertical with connector height of 15', the take-off is 13 degrees but little gain.
5. With a single-point toward earth, vertical does not couple to earth very well. So, it requires a good ground plane.
   a. Opposite polarization makes a single-point signal intersection that decreases signal 18 dB.
   b. For practical HF, horizontal is easier to build and has more gain.
6. The table lengths are approximately one-quarter wave, adjusted to minimize mid-band SWR.
   a. They are from Eznec models for 15' high horizontal. Tweak for your conditions.
   b. Radiators with larger diameter compared to wavelength gives wider bandwidth.
   c. The bandwidth on 80-meters is very skinny, even with ½" tubing.
7. Life is good. Enjoy!

MHz	λ-m	λ/4-ft
442 - 450	0.7	0.51
144 - 148	2	1.6
50 - 54	6	4.5
28.0 - 29.7	10	8.3
21 - 21.45	15	11.15
14.0 - 14.35	20	16.7
7.0 - 7.3	40	33.0
3.5 - 4.0	80	63.8



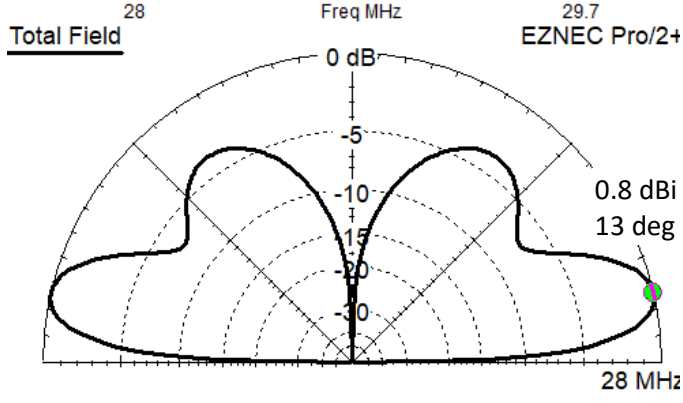




Elevation Plot
Azimuth Angle 0.0 deg.
Outer Ring 6.91 dBi

Cursor Elev 33.0 deg.
Gain 6.91 dBi
0.0 dBmax

Slice Max Gain 6.91 dBi @ Elev Angle = 33.0 deg.
Beamwidth 41.7 deg.; -3dB @ 15.6, 57.3 deg.
Sidelobe Gain 6.91 dBi @ Elev Angle = 146.0 deg.
Front/Sidelobe 0.0 dB



Elevation Plot
Azimuth Angle 0.0 deg.
Outer Ring 0.8 dBi

Cursor Elev 13.0 deg.
Gain 0.8 dBi
0.0 dBmax

Slice Max Gain 0.8 dBi @ Elev Angle = 13.0 deg.
Beamwidth 19.1 deg.; -3dB @ 5.1, 24.2 deg.
Sidelobe Gain 0.8 dBi @ Elev Angle = 167.0 deg.
Front/Sidelobe 0.0 dB