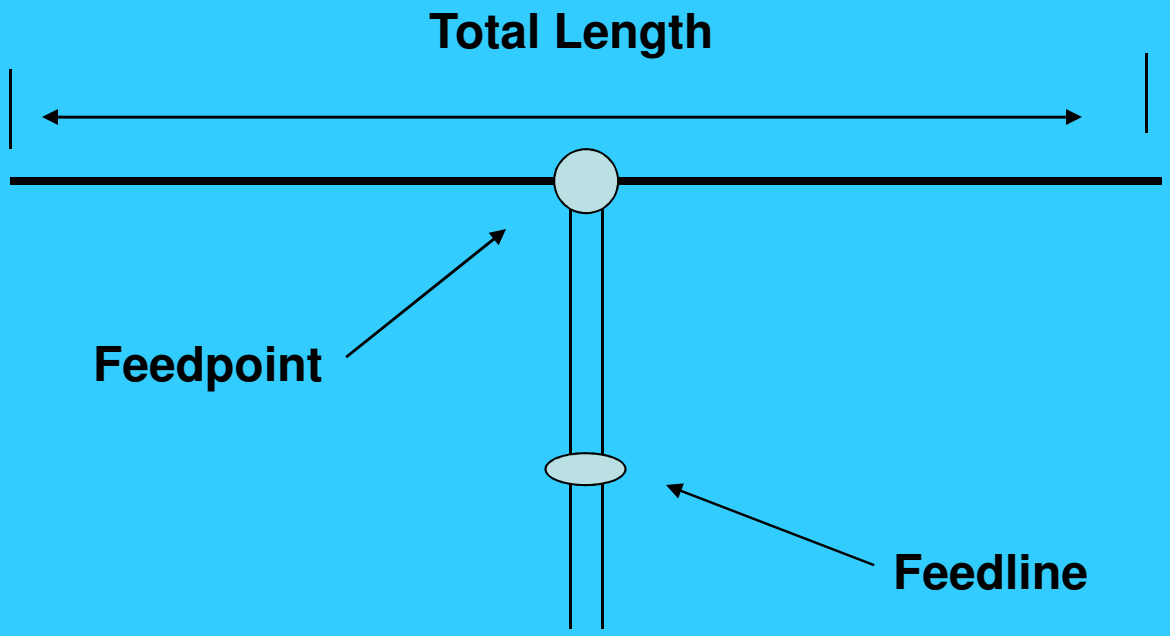
The Fabulous Dipole

Ham Radio's Most Versatile Antenna

What is a Dipole?

- Gets its name from its two halves
  - One leg on each side of center
  - Each leg is the same length
- It's a balanced antenna
  - The voltages and currents are balanced across each leg
  - Does not need a counterpoise or ground radials
- At resonance, the total antenna length is one-half design frequency wavelength
- One of the simplest and effective antennas

The Dipole



Antenna total length
468/freq. in mhz

Approximate Total Length for Half-wave Dipoles

Band	Freq., Mhz	Length
10	28.4	16” 6”
12	24.9	18” 10”
15	21.1	22” 2”
17	18.1	25” 10”
20	14.1	33” 2”
30	10.1	46” 4”
40	7.1	65” 11”
60	5.2	89’ 7”
80	3.6	130’
160	1.8	260’

Typical Construction Materials

- #14 or #12 gauge wire for the legs
  - Copperweld
  - Stranded
  - Do NOT use typical solid copper wire as it will stretch and go off design frequency
  - For short term use, the legs can be #18 or #16 gauge wire
- The feedline can be coax or twin-lead
  - If coax is used, a balun is desirable at feed point

Typical Dipole Characteristics

- **Feed point resistance**
  - **In free space, – 72 ohms**
  - **Above real ground – 30 to 70 ohms**
- **Reactance at feed point**
  - **Capacitive if too long**
  - **Inductive if too short**
  - **Null out by adding the opposite reactance**
- **At resonance, only resistance – no reactance**

More Dipole Characteristics

- **Bandwidth – the amount of frequency between the 2:1 SWR points**
  - **Narrow at low frequencies (100 khz @ 3.6 mhz - entire band @ 14.2 mhz)**
- **Take Off Angles**
  - **The angle of maximum radiation in the horizontal**
  - **Depends upon height (wavelength) above RF ground (not the ground surface)**
  - **The higher above RF ground, the lower the take off angle**
- **Reduced man-made noise reception**

Feed Point Resistance at Various Heights Above RF Ground

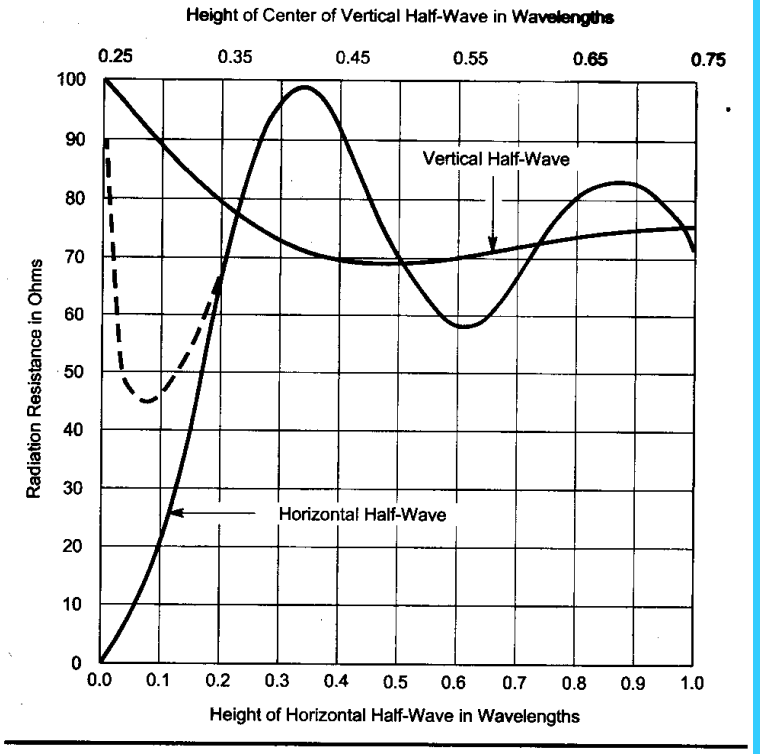


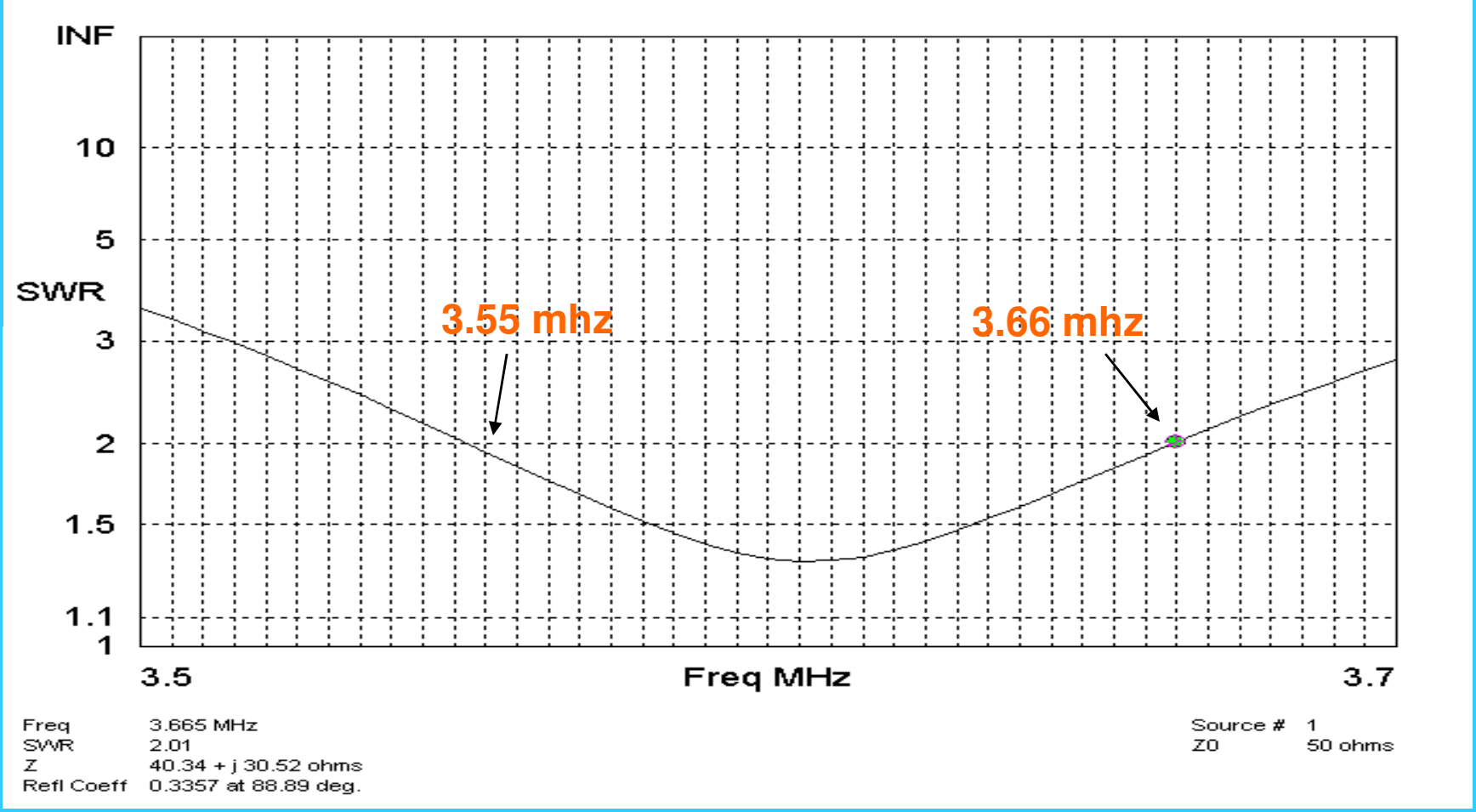
Fig 1—Variation in radiation resistance of vertical and horizontal half-wave antennas at various heights above flat ground. Solid lines are for perfectly conducting ground; the broken line is the radiation resistance of horizontal half-wave antennas at low height over real ground.

Source: ***Antenna Handbook,*** 20th ed., pg. 3-2

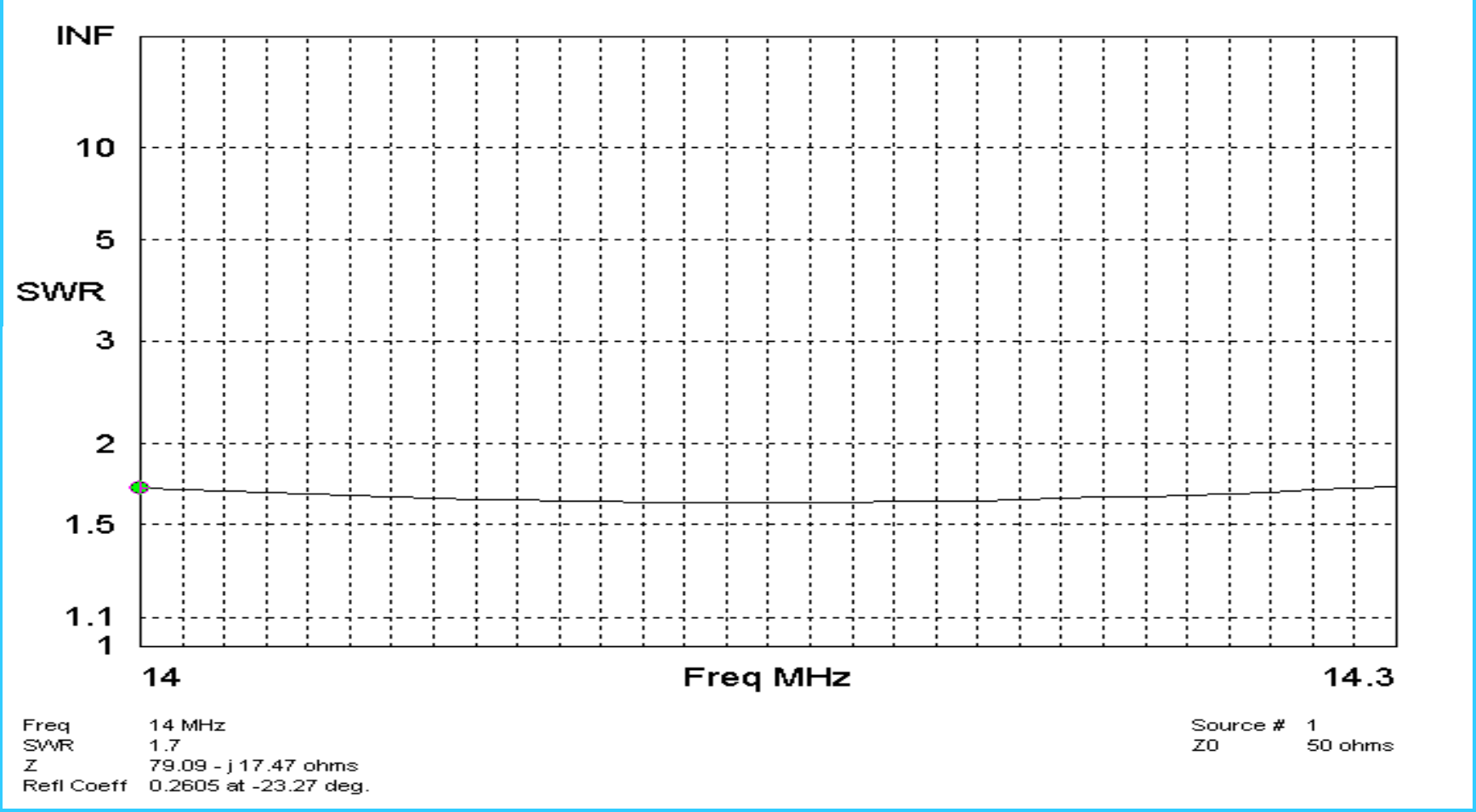
SWR – 2:1 Bandwidth

The frequency between the 2:1 SWR frequency points

3.6 mhz Dipole @ 30 ft. Eznec 4.0 Plot



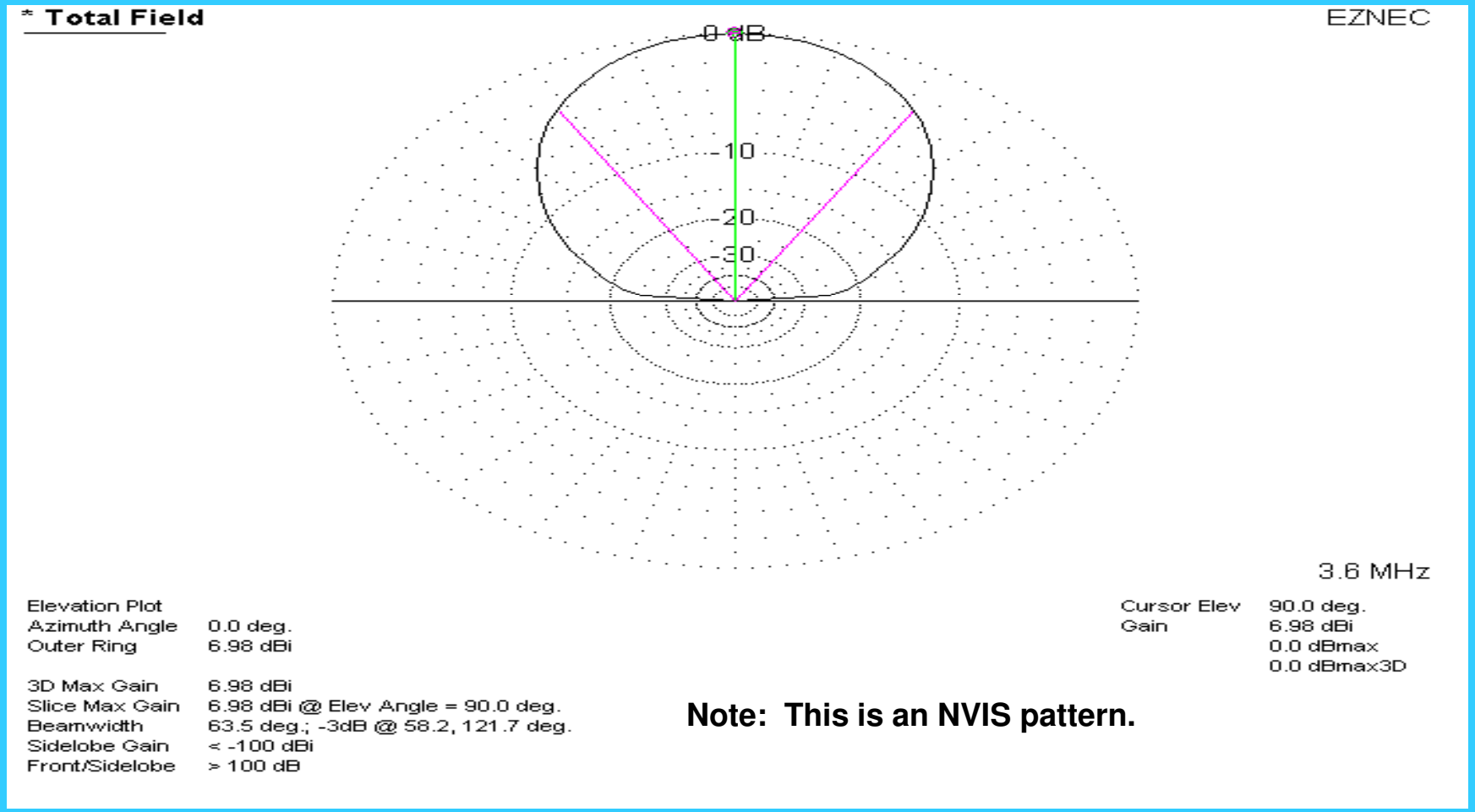
14.1 mhz Dipole @ 30 ft. Eznec 4.0 Plot



Take Off Angles

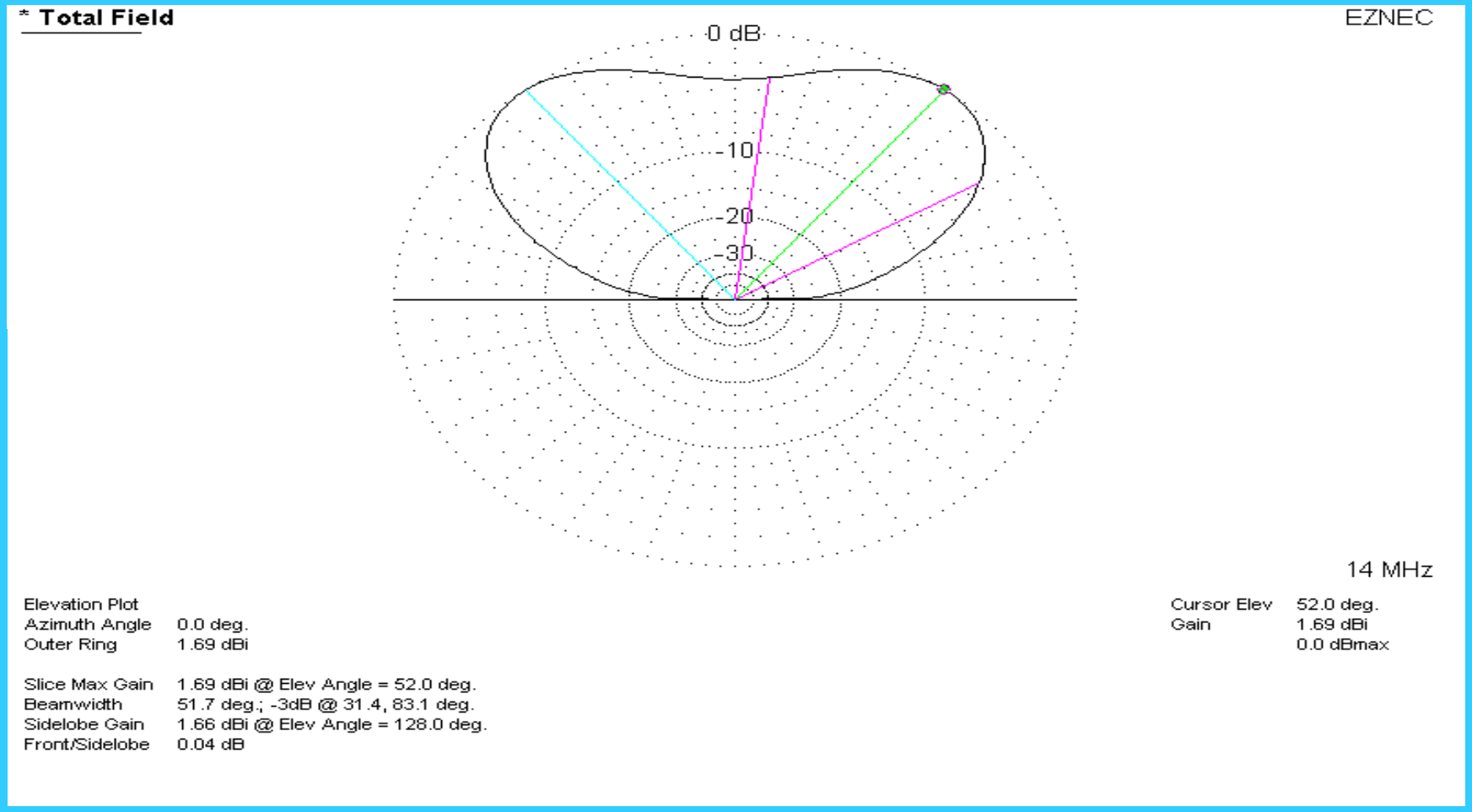
- **The angle above antenna horizontal that as the greatest gain.**
- **Also important is the -3 db "beam width"**
  - **The degrees of take off angles between the maximum gain and -3 db gain points**

Take Off Angle @ 3.6 mhz
30 feet above real ground

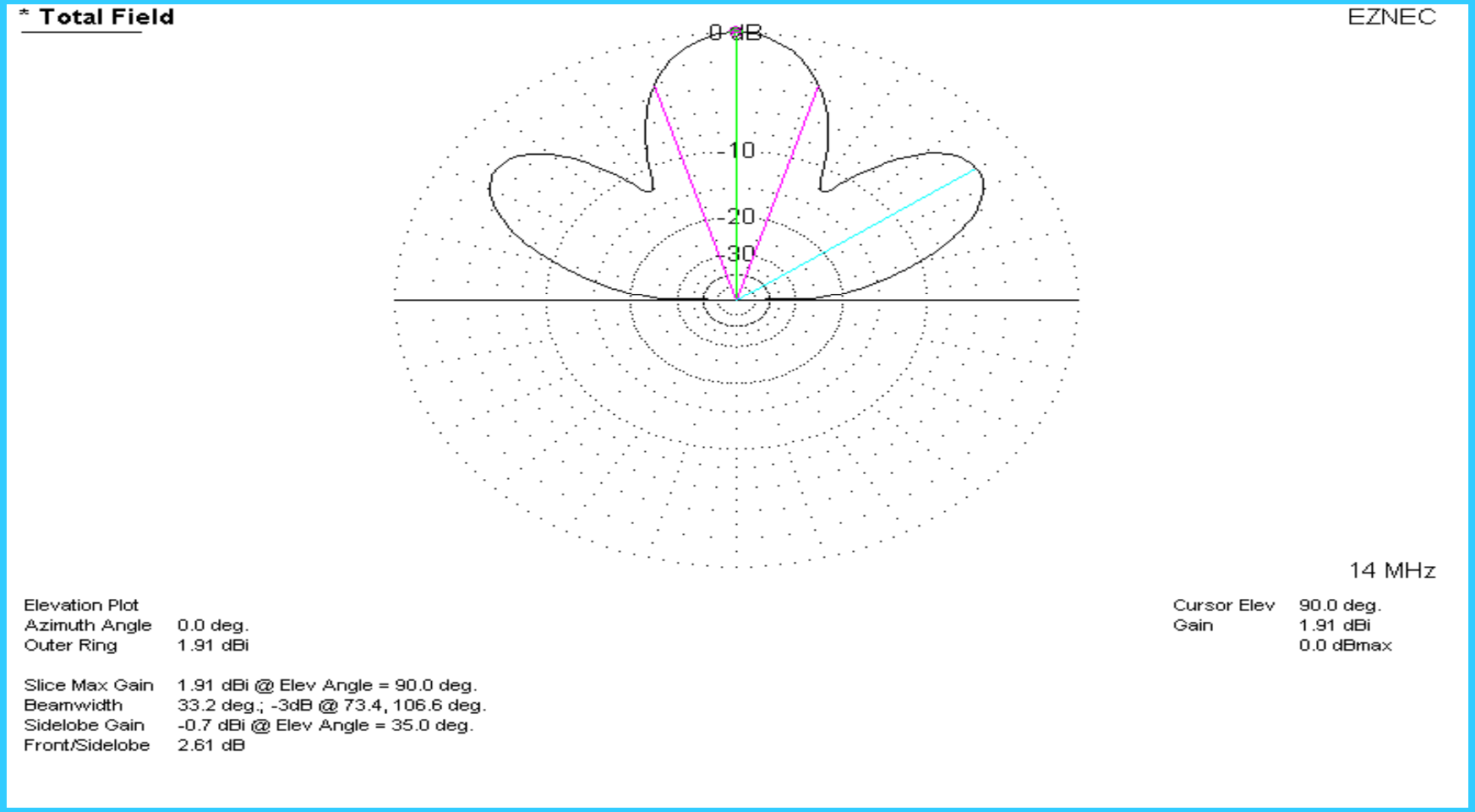


Note: This is an NVIS pattern.

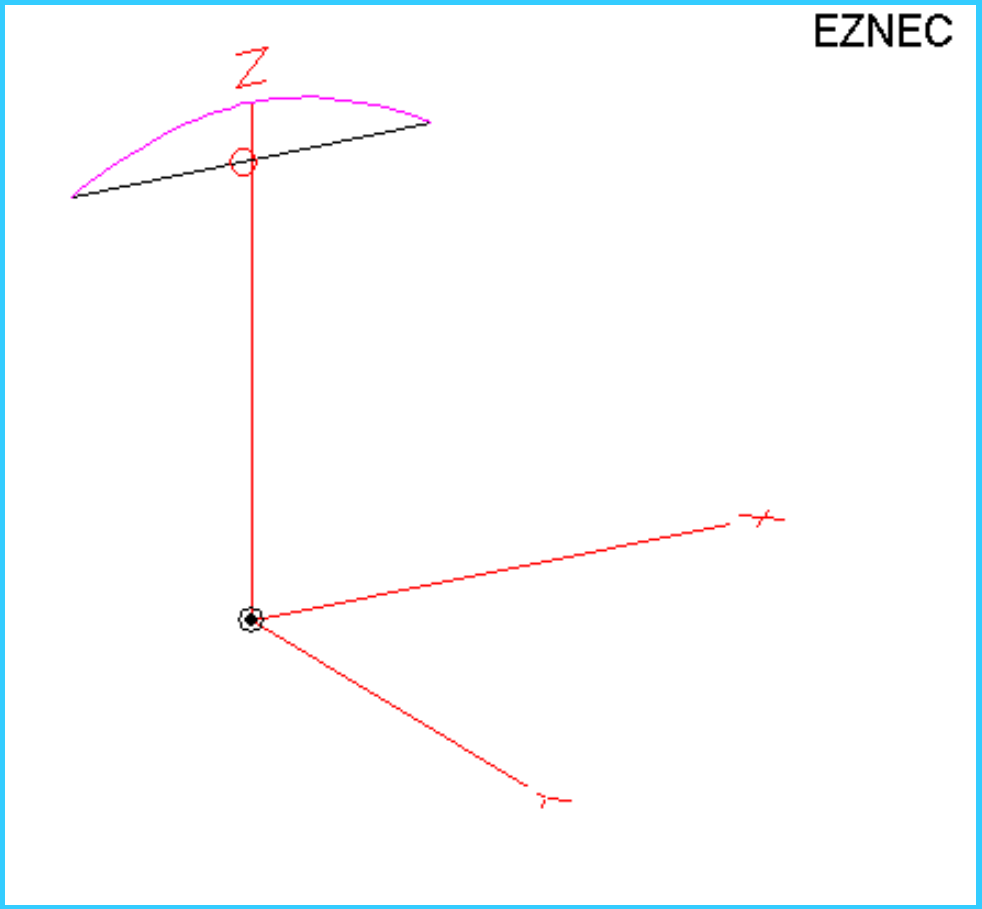
Take Off Angle @ 14.1 mhz
30 feet above real ground



Take Off Angle @ 14.1 mhz
40 feet above real ground



Current Distribution



Multiband Dipole

- **Total length of one-half wavelength at lowest operating frequency**
- **Use current balun**
- **Must use antenna tuner – lower losses for tuner which has air inductor rather than toroid inductor**
- **Install with feedpoint as high as possible (except for NVIS operation)**

Feedlines

- Coax
  - Either 50 ohm or 75 ohm impedance
  - RG-58 has too high of losses; RG-8 and 8X is preferred
  - Attached to antenna using 1:1 current balun
  - For multiband use, use antenna tuner
- Open line
  - Generally 300 ohm or 450 ohm
  - Attach directly to antenna
  - Use a 4:1 balun at antenna tuner

Typical Open-Wire Feed Setup

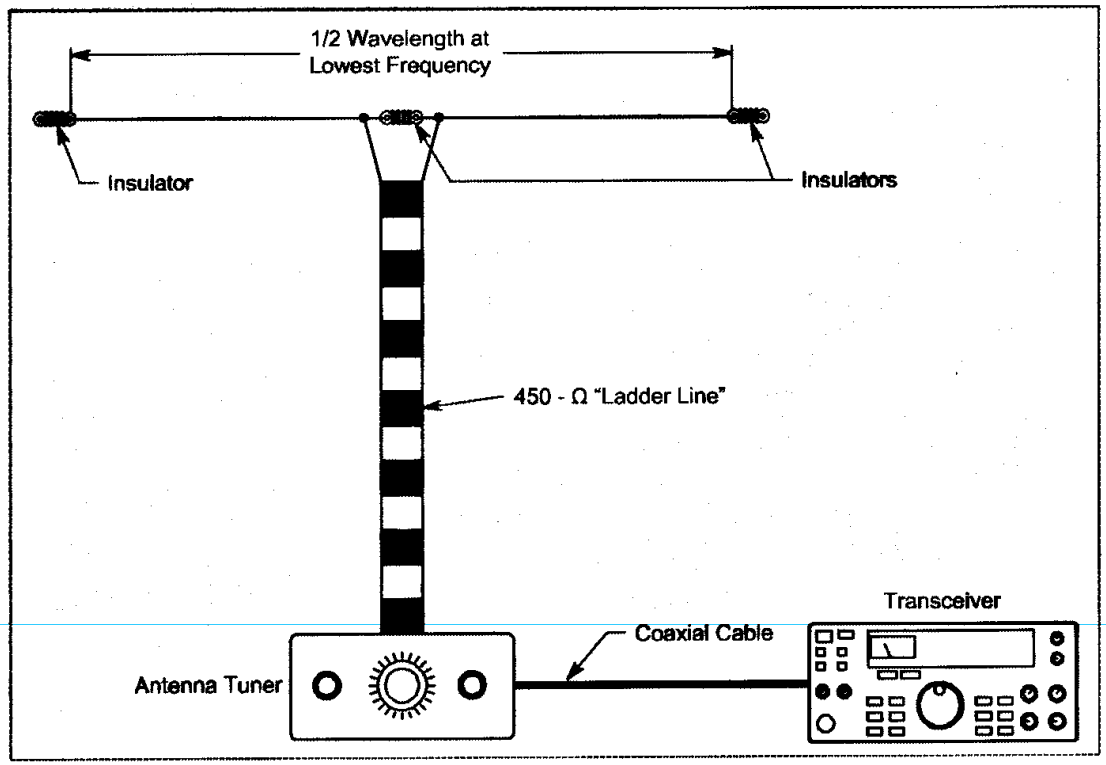


Figure 1—The classic open-wire feed line dipole antenna is easy to install and offers surprising performance on several bands. You can install it in almost any configuration; it doesn't have to be strung in the traditional horizontal "flat top" shown here.

Source: ***QST***, March 2004 pg. 65

Other Configurations for a Dipole Antenna

Inverted – Vee

Folded Dipole

Sloper Dipole

G5RV

Coaxial dipole

Two Band, Single Feed Dipole

Inverted L Dipole

References

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