The End Fed Half Wave Antenna

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Voltage and Current Distribution on a Half Wave Antenna

“Standing Wave” pattern =>

• To get EM radiation, we need to accelerate some electrons
• At end => Voltage max & current min
• At center => Voltage min & current max
• Feed impedance changes as the feed point moves
  • Min Z at center (typically 50-75 ohms)
  • Max Z at ends (typically 2-5K ohms)
  • Off Center Fed Dipole (OCFD) (typically ~200 ohms)
For Radiation to Occur the RF Circuit Must Be Closed

1) **Accelerating** electrons (ie., AC current) create an RF field
   • The larger the current => the larger the field
   • DC voltage creates an electric field (not an electromagnetic wave)
   • DC current creates a magnetic field (not an electromagnetic wave)

2) Every antenna must have a place for a field to originate **AND** terminate
   • If there is no place for the EM field to originate **AND** terminate, no RF current will flow, and no EM field will be generated
Examples of a Closed RF Circuit

- Both of These Can Work Well as Antennas Because:
  - RF circuits are CLOSED
  - SWR losses are low
- Note: a lossy ground will reduce the current flow => smaller RF Field
• Theoretically, there will be no radiation for this setup
• Many hams believe that no counterpoise is required for an end fed half wave antenna to work well
  • In many cases, radiation can occur with no physical counterpoise
The Ground Mounted Monopole Antenna

- Won’t work very well when Height = ½ wavelength:
  - Circuit is closed, but SWR > 50:1
Feeding an End Fed Half Wave Antenna

• May work (somewhat) since the coax shield acts as a counterpoise:
  • Coax shield provides the return path for the RF field
  • Performance will vary with X, proximity to ground, etc
  • SWR losses on the coax can be a problem
    • Tuner needs to be at the base of the antenna
• **Theoretically:** this antenna will *not* radiate
  • No counterpoise
• In practice, it might radiate (somewhat) depending on *parasitic* coupling to coax shield
Typical Tuner for an End Fed Half Wave Antenna

- Not the best approach, but might be ok for some applications
- Coax shield is the counterpoise
With proper choice of components, can achieve an SWR ~1:1
  • The capacitor simplifies tuning, but is not necessary

Counterpoise:
  • Important to have for stable, predictable performance
  • Length isn’t critical, but little/no benefit for lengths > 0.05 wavelength
    • Don’t go > 0.25 wavelength

Watch out for the high voltages (at X)
  • At 5 W (and 2000 ohms), $V_{\text{CAP}}(\text{Peak}) = 100$ V
  • At 100 W (and 2000 ohms), $V_{\text{CAP}}(\text{Peak}) = 450$ V
  • At 1500 W (and 2000 ohms), $V_{\text{CAP}}(\text{Peak}) = 2400$ V
Feed Impedance Versus Counterpoise Length

Ohms and Ohms

"Counterpoise" in Wave Lengths
Example Transformer (not for high power)
The J-Pole Antenna

\[ Z = 2000 \text{ ohms} \]

\[ Z = 50 \text{ ohms if } Z_0 = 316 \text{ ohms} \]

Quarter Wave Transmission Line (Impedance Transformer)
The J-Pole Antenna

\[ Z = 2000 \text{ ohms} \]

\[ Z = 50 \text{ ohms if } Z_0 = 316 \text{ ohms} \]
Problems With End Fed Half Wave Antennas

• #1 Problem: Common mode currents on feedline
  • RF in shack
  • High noise levels on receive
  • Feedline and grounding can affect SWR and tuning
  • Isolating the feedling from the antenna can be difficult, even with a common mode choke
• High voltages, even at low power
• FCC RF exposure limits can be exceeded at low power levels
Bottomline

Tom Rauch (W8JI):

End fed half wave antennas are a good option for a temporary antenna when using low power and battery operation, far from power mains and noise sources.