

**WELCOME**  
**to**  
**The NFARL SIG Antenna Discussion**  
**on**  
**Horizontal Wire Antennas**

**Presented by**

**Chuck AE4CW**  
**Roger AA2HT**  
**Wes W3WL**  
**Jim K4DLI**

**TODAY WE WILL DISCUSS SEVERAL DIFFERENT  
TYPES OF HORIZONTAL WIRE ANTENNAS  
AND WHAT YOU CAN EXPECT FROM THE  
VARIOUS TYPES.**

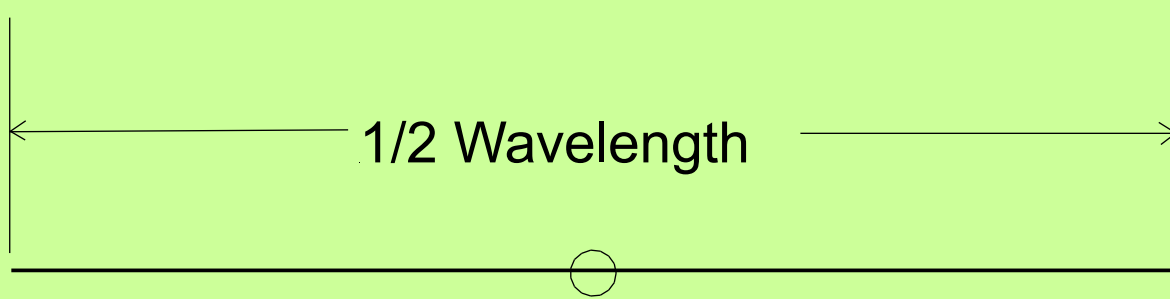
**We will also offer some samples of the patterns of what  
you can expect when the various antennas are operated on  
their harmonic frequencies.**

Antennas to be discussed today are:

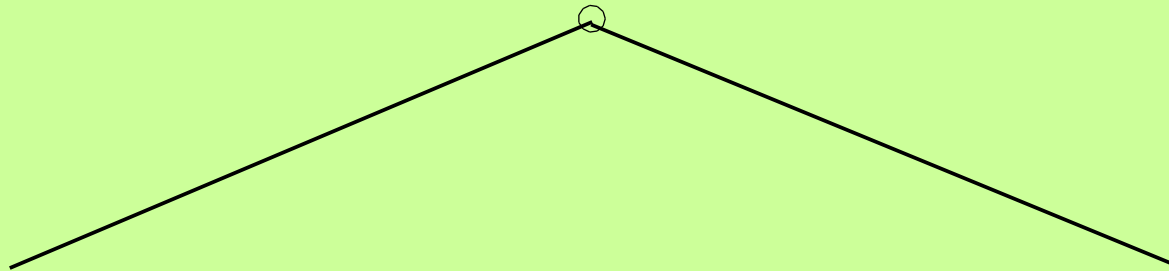
1. Flat dipole and Doublet
2. Inverted “V”
3. Off Center Fed Dipole or OCF
4. Multiple Wire Dipoles and Fan Dipoles
5. G5RV Antenna
6. End feed dipole

# **OTHER ITEMS WE WILL LOOK AT ARE:**

1. The impedance distribution along a 1/2-Wave antenna
2. The effect of height above ground on an antenna.
3. Determining the feed point for an Off Center Feed Antenna.
4. Have some hands on demonstration of some of the effects of antenna configuration between a flat dipole and an Inverted “V”.
5. Discuss other things that can effect the operation of an antenna.



Standard Half Wave Dipole --Center Feed



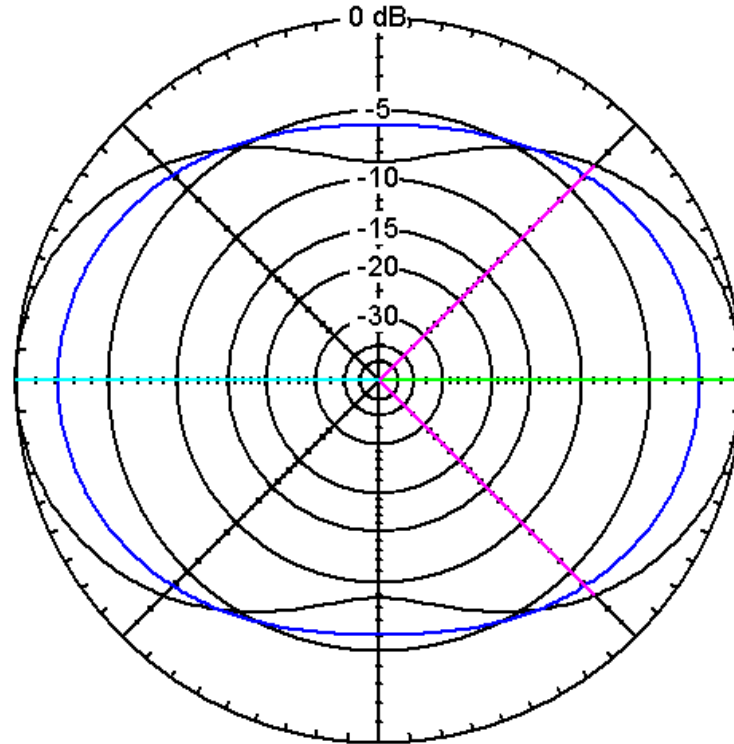
Half Wave Dipole in Inverted "V" Configuration

**Total Field**

**\* Primary**

40-Meter Inv V at 40 feet 45 deg

EZNEC Pro/2



7.15 MHz

**Inverted “V” in Blue, Flat Dipole in Black**

**40-Meter flat dipole at 40 feet**

**Feed point impedance  $88.69 - J 0.953$  ohms**

**Flat dipole length 33.27 feet per side. Total 66.54 feet.**

**40-Meter Inverted V of 30 deg at 40 feet**

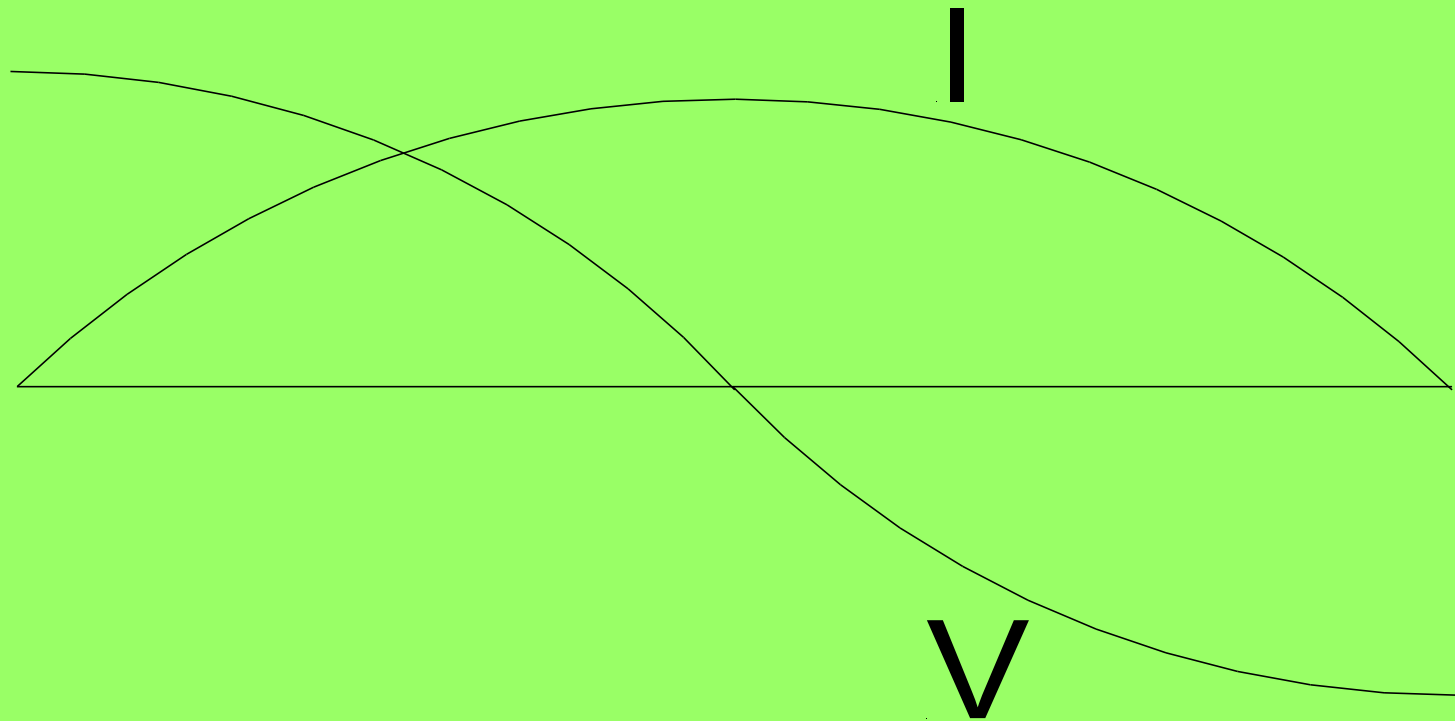
**Feed point impedance  $72.14 + J 0.1253$  ohms**

**Inverted V length 33.45 feet per side. Total length 66.9 feet**

**40-Meter Inverted V 45 deg at 40 feet**

**Feed point impedance  $54.06 - J 0.5375$  ohms**

**Inverted V length 33.82 feet per side. Total length 67.74 feet**



Voltage "V" and Current "I" distribution along a 1/2 Wave

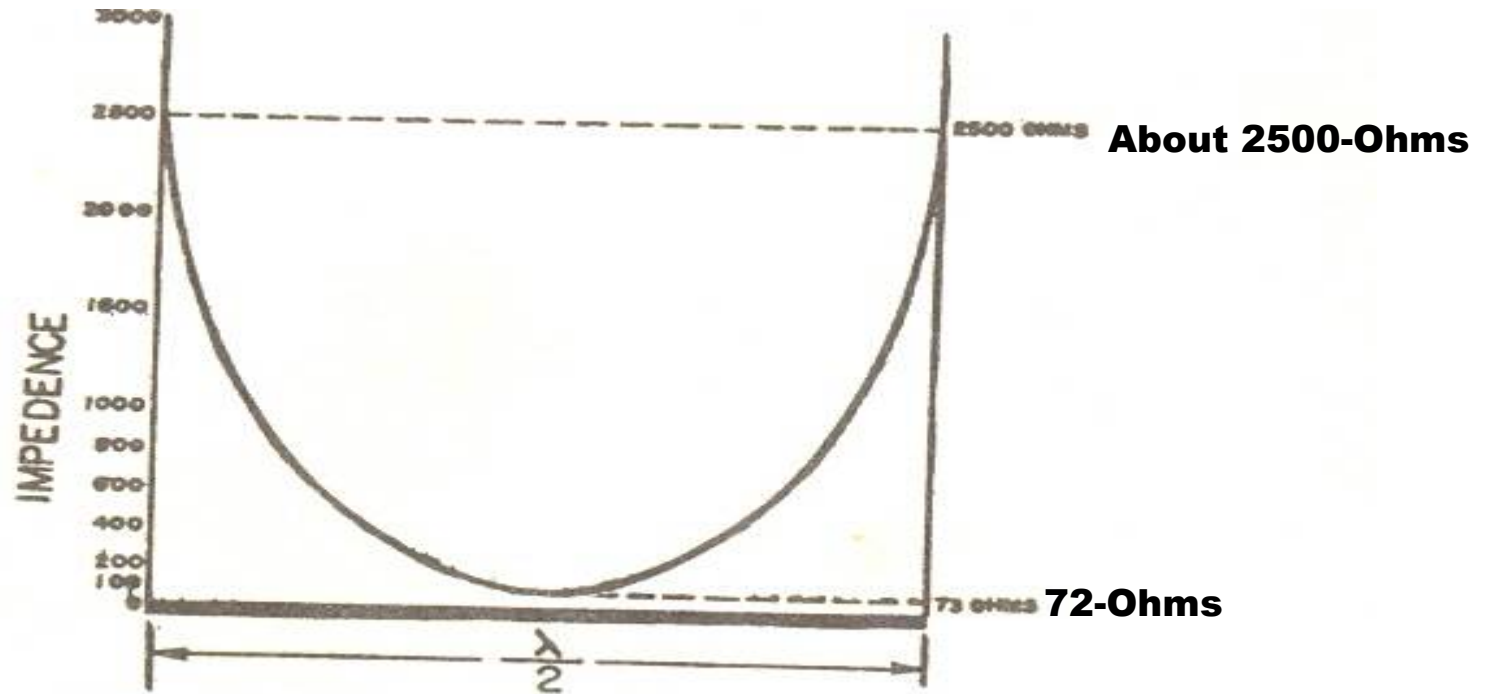
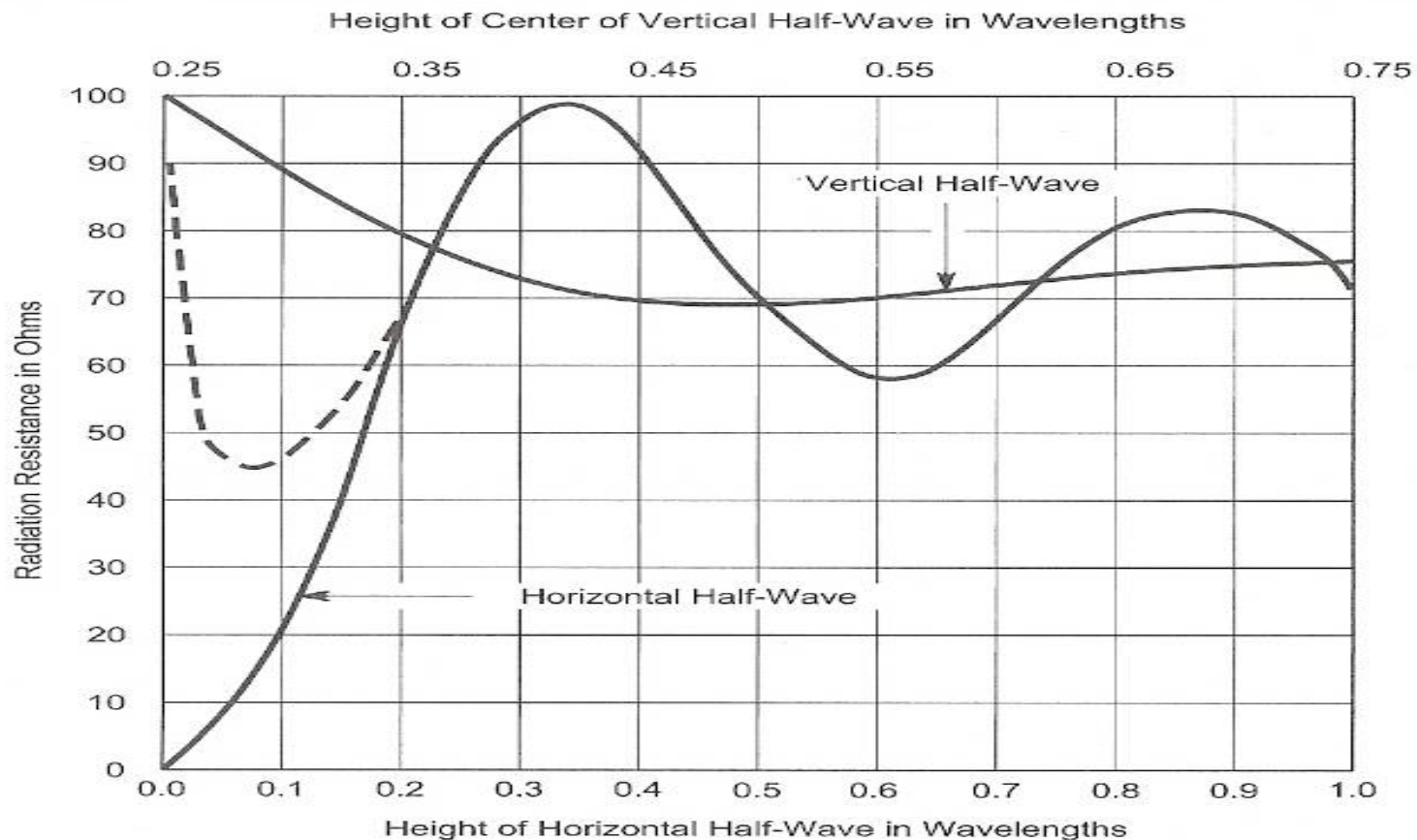


Fig. 13 Impedance along a typical half-wave dipole.



**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.**

**UNLESS THE ANTENNA CAN BE LOCATED AT LEAST 2-WAVELENGTH FROM ALL OTHER OBJECTS HERE ARE A FEW OF THE THINGS THAT CAN EFFECT THE OPERATION OF YOUR ANTENNA:**

**1. Other antennas**

**UNLESS THE ANTENNA CAN BE LOCATED  
AT LEAST 2-WAVELENGTH FROM ALL OTHER  
OBJECTS HERE ARE A FEW OF THE THINGS  
THAT CAN EFFECT THE OPERATION OF  
YOUR ANTENNA:**

- 1. Other antennas**
- 2. Metal Fences**

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- 1. Other antennas**
- 2. Metal Fences**
- 3. House wiring**

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- 2. Metal Fences**
- 3. House wiring**
- 4. Electric and telephone wires**

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- 3. House wiring**
- 4. Electric and telephone wires**
- 5. Metal house gutters**

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- 4. Electric and telephone wires**
- 5. Metal house gutters**
- 6. Flag Poles**

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- 1. Other antennas**
- 2. Metal Fences**
- 3. House wiring**
- 4. Electric and telephone wires**
- 5. Metal house gutters**
- 6. Flag Poles**
- 7. Flying Saucers and Irate Neighbors**

**To give some idea of the distance we are talking about, here are a few examples of just how far 2-Wavelengths is:**

**160-Meters                      1,092 feet**

**80- Meters                      562 feet**

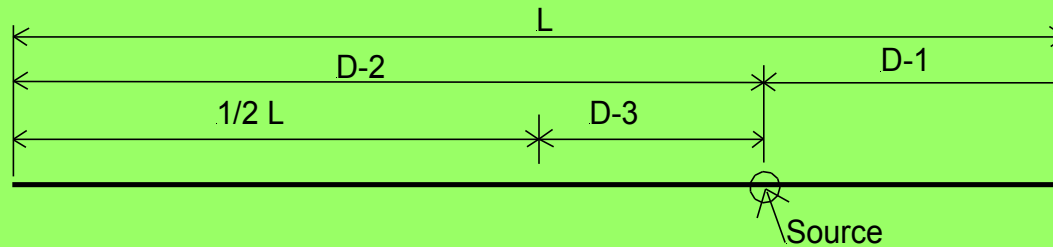
**40-Meters                      280 feet**

**20-Meters                      140 feet**

**15-Meters                      94 feet**

**10-Meters                      70 feet**

**6-Meters                      40 feet**



### OFF CENTER FEED

For antenna height of 35 feet the following dimensions would be the required offset for 100-ohms and 300-ohms.

100-ohms:  $L=135.25$  feet     $D-1= 34.7$  feet     $D-2= 100.55$  feet

300-ohm:     $L=135.67$  feet     $D-1=18.2$  feet     $D-2=117.47$  feet

For antenna height of 70 feet the following dimensions would be the required offset for 100-ohms and 300-ohms.

100-ohms  $L=135.7$  feet     $D-1= 50.5$  feet     $D-2= 85.2$  feet

300-ohms  $L= 136.55$  feet     $D-1= 24.1$  feet     $D-2=112.45$  feet

**How do you determine the length of each section of the OCF?**

**WELL-----**

**That depends on who you believe!!**

**For plain copper wire with no insulation the regular formula  
for “L” is  $468/F_{\text{MHz}}$   
No surprise here!**

**Windom gave the formula of  $D-3 = 0.14 \times L$**

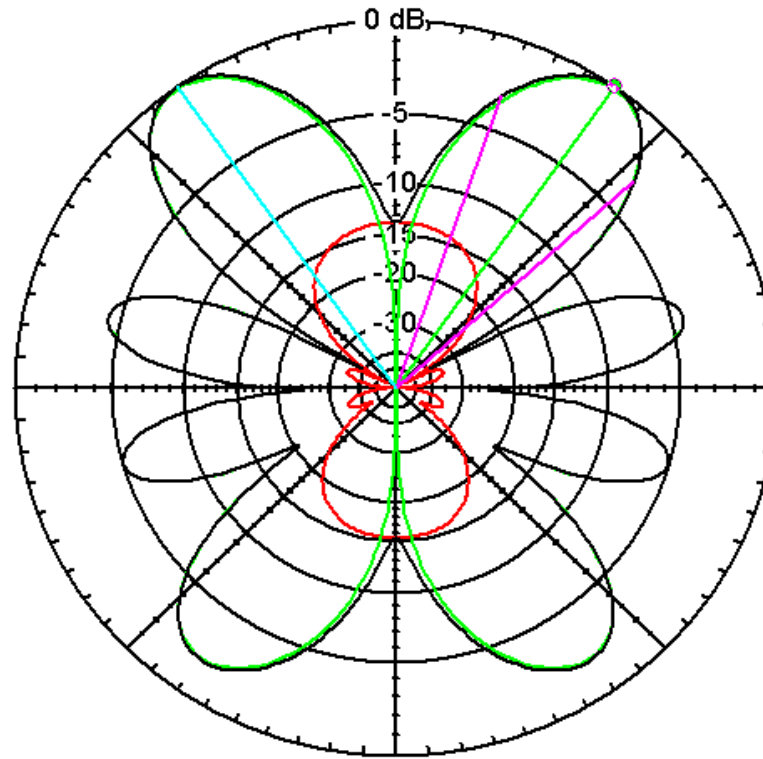
**From the *ARRL Antenna Book* the formula for 2 wire feed is  
 $D-3 = 0.167 \times L$**

**Carr, in *Practical Antenna Hand Book* gives  
 $D-3 = 0.174 \times L$**

**A more recent version of the antenna cut for 40-Meters uses**

**$D-1 = 0.38 \times L$  and  $D-2 = 0.62 \times L$**

**This value is thought to hit the 100-ohm point for a 2:1 balun**

**\* Total Field**Horizontal PolVertical Pol**28.45 MHz**

Azimuth Plot  
 Elevation Angle 12.0 deg.  
 Outer Ring 10.26 dBi

Slice Max Gain 10.26 dBi @ Az Angle = 55.0 deg.  
 Front/Back 1.82 dB  
 Beamwidth 28.9 deg.; -3dB @ 41.9, 70.8 deg.  
 Sidelobe Gain 10.26 dBi @ Az Angle = 125.0 deg.  
 Front/Sidelobe 0.0 dB

Cursor Az 55.0 deg.  
 Gain 10.26 dBi  
 0.0 dBmax

**40-Meter OCF feed 16% from one end and operated on 10-Meters.  
 Impedance is 106.9 - J 201.5 ohms and gain is 10.26 dbi.**

**40-Meter Off Center feed Dipole on 40 -meters.  
Feed 38% from one end. Impedance 256.5 - J 36.8 ohms**

**40-Meter Off Center feed Dipole on 14.175 MHz  
Feed 38% from one end. Impedance 85.34 - J 95.91 ohms**

**40-Meter Off Center feed Dipole on 18.100 MHz  
Feed 38% from one end. Impedance 2510 - J 1060 ohms**

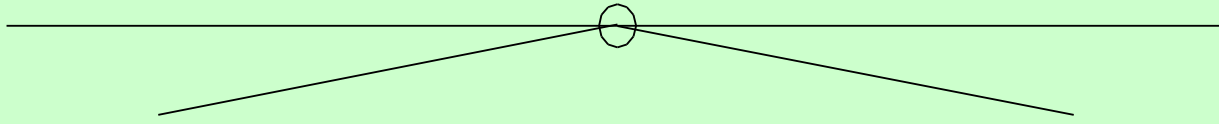
**40-Meter Off Center feed Dipole on 21.25 MHz  
Feed 38% from one end. Impedance 107.2 - J 147 ohms**

**40-Meter Off Center feed Dipole on 24.90 MHz  
Feed 38% from one end. Impedance 344.7 + J 686.6 ohms**

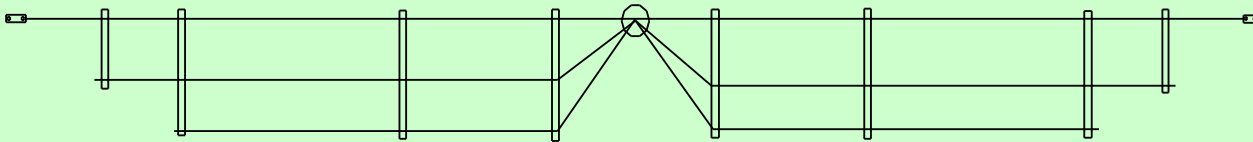
**40-Meter Off Center feed Dipole on 28.45 MHz  
Feed 38% from one end. Impedance 386.6 - J 390.6 ohms**

**40-Meter End feed Dipole on 28.45 MHz  
Feed 0% from one end. Impedance 521.1 - J 2763 ohms**

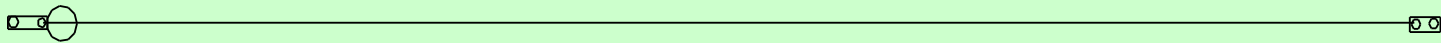
**40-Meter End feed Dipole on 40 -meters.  
Feed 0% from one end. Impedance 3882 - J 14320 ohms**



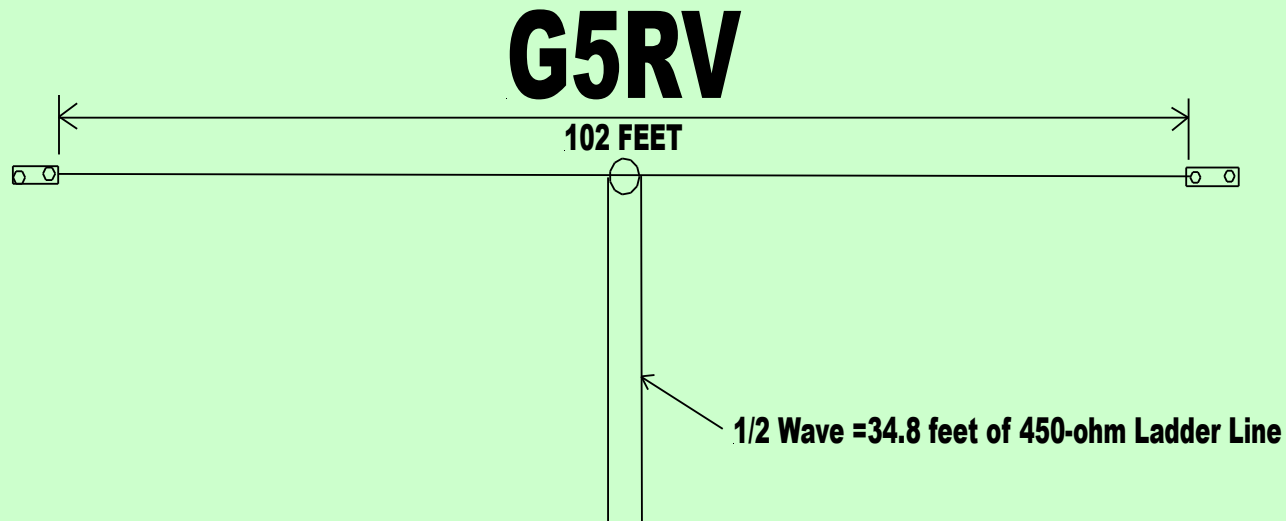
Fan Type Dipole



Parallel Dipoles



End Feed Zepp  
Several wave lengths long



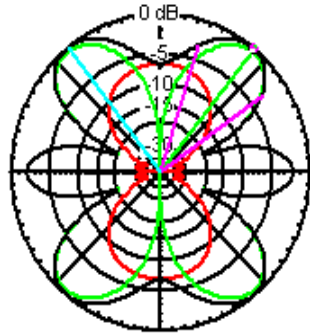
**Louis Varney (G5RV) recommended the use of an antenna tuner on all bands other than 20-meters.**

**Analysis of the G5RV feed-point impedance shows there is NO length of balanced Line of ANY characteristic impedance that will transform the terminal impedance to either the 50 or 75 ohm range on all bands.**

**\* Total Field**

Horizontal Pol

Vertical Pol



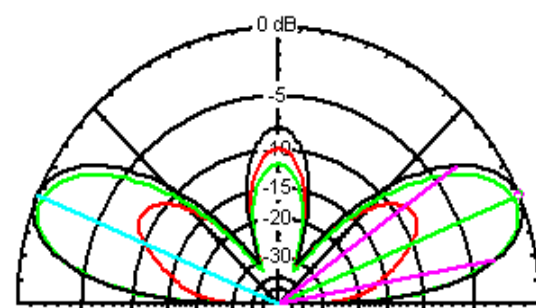
EZNEC Pro/2

**\* Total Field**

Horizontal Pol

Vertical Pol

14.2 MHz



EZNEC Pro/2

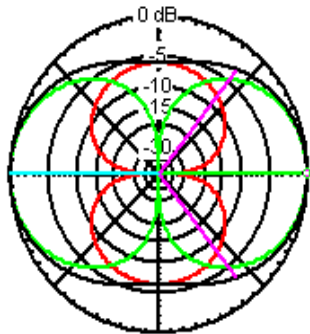
14.2 MHz

**G5RV on 20-Meters Impedance  $102.5 + J 0.4406$  ohms Gain 7.82 dbi at 23-deg.**

**\* Total Field**

Horizontal Pol

Vertical Pol



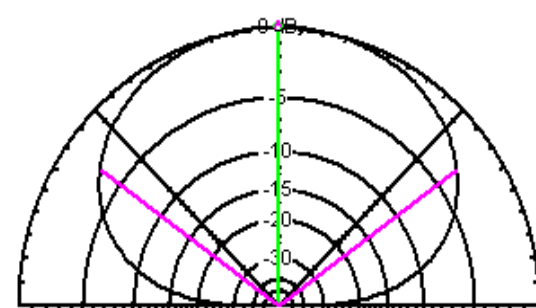
EZNEC Pro/2

**\* Total Field**

Horizontal Pol

Vertical Pol

3.75 MHz



EZNEC Pro/2

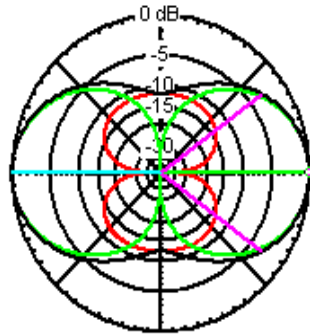
3.75 MHz

**G5RV on 3.75 MHz Impedance  $23.77 + J 92.05$  ohms Gain 1.77 dbi at 30-deg.**

**\* Total Field**

Horizontal Pol

Vertical Pol

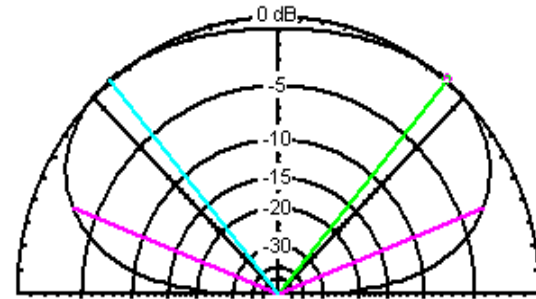


EZNEC Pro/2

**\* Total Field**

Horizontal Pol

Vertical Pol



EZNEC Pro/2

7.2 MHz

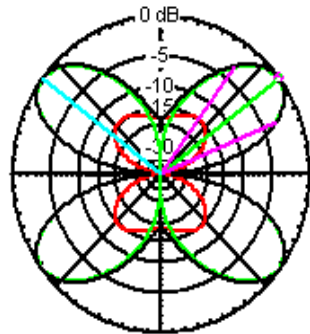
7.2 MHz

**G5RV on 40-Meters Impedance 64.07 - J 101.2 ohms Gain 5.27 dbi at 30-deg.**

**\* Total Field**

Horizontal Pol

Vertical Pol

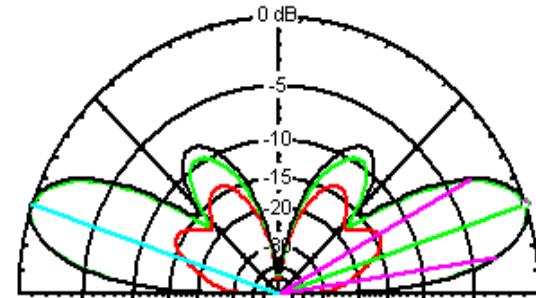


EZNEC Pro/2

**\* Total Field**

Horizontal Pol

Vertical Pol



EZNEC Pro/2

18.1 MHz

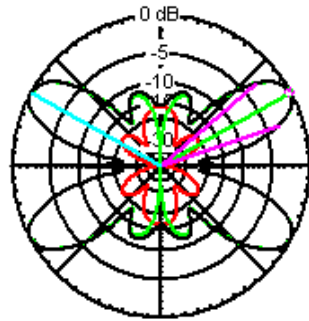
18.1 MHz

**G5RV on 17-Meters Impedance 85.9 - J 345.3 ohms Gain 9.07 dbi at 19 Deg.**

**\* Total Field**

Horizontal Pol

Vertical Pol



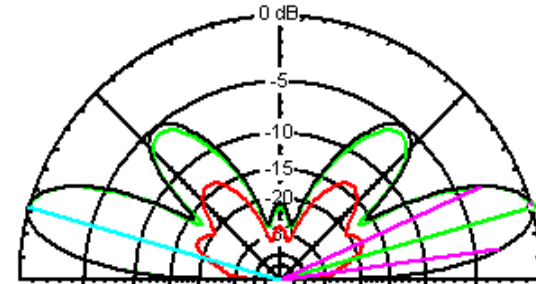
EZNEC Pro/2

**\* Total Field**

Horizontal Pol

Vertical Pol

21.3 MHz



EZNEC Pro/2

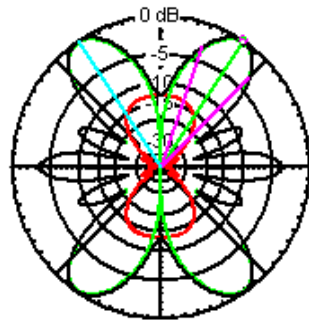
21.3 MHz

**G5RV on 15-Meters Impedance  $72.64 + J 279.6$  ohms Gain 9.4 dbi at 16 Deg.**

**\* Total Field**

Horizontal Pol

Vertical Pol



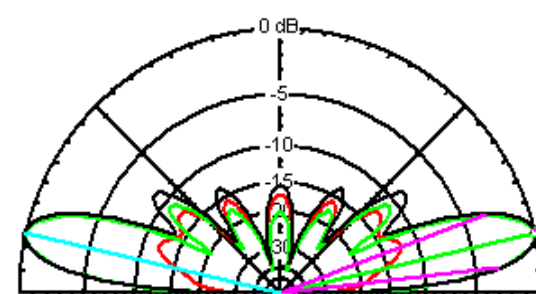
EZNEC Pro/2

**\* Total Field**

Horizontal Pol

Vertical Pol

24.9 MHz



EZNEC Pro/2

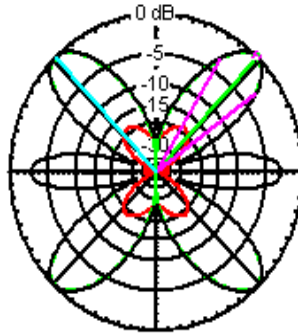
24.9 MHz

**G5RV on 12-Meters Impedance  $125.5 + J 35.19$  ohms Gain 10.13 dbi at 13 Deg.**

\* **Total Field**

Horizontal Pol

Vertical Pol



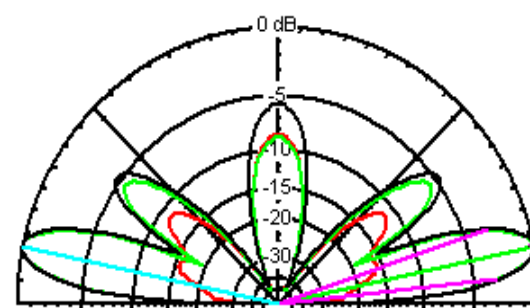
EZNEC Pro/2

\* **Total Field**

Horizontal Pol

Vertical Pol

28.25 MHz



EZNEC Pro/2

28.25 MHz

**G5RV on 10-Meters Impedance 1433 - J 1462 ohms Gain 9.77dbi**

**All of the G5RV plots were made with a 450-ohm transmission line of 32.55-feet that had been adjusted in length to provide a reactance of less than 1-ohm at the feed point of the transmission line on 20-meters at 14.2 MHz. The impedance's on all other bands shows why the best way to operate this antenna as an all band antenna is with balanced ladder line to a balanced tuner. The use of a balun on bands other than 20-Meters would result in excessive loss in the balun.**

**Now, lets say you cut your antenna to the formula length of  $L=468/F_{\text{MHz}}$  at 7.200 MHz and you come up with a length of 65-feet. You install the antenna and measure the impedance and find the antenna is resonant at 7.150 Mhz. How much do you remove?**

**By the way: Do you know what resonance is?**

**WELL!**

**My method has been the following:**

**What you got(7.15) / What you want(7.20) X What you have (65 Feet)**

**This gives a length of 64.548 feet**

**Martin Jue, founder of MFJ, gave this method during his talk at Georgia Tech the other night. It works the same way only it uses the formula for the length of a dipole to calculate a new value for “K”.**

**“K” in this case is the constant 468.**

**Take the same situation!**

**$L=468/7.2$  this gives the length of 65 feet**

**Measure the resonant frequency of 7.15 MHz**

**Now**

**Place these values in the formula and you have  
 $65= K/7.15$  solving for K gives an new value of  
464.75**

**Use this new value.**

**$L= 464.75/7.2$  gives 64.548 feet**

**Original length of 65-64.548 = 0.452 feet**

**OR--- 5.4 inches of total length.**

**Take 1/2 of each end PLEASE!!**

## **One final note:**

**When installing any antenna, be sure to keep good records of the length of the antenna wire and the length of the feed line.**

**In case of trouble shooting this information can be very useful. With the length of the feed line known, it is possible to make measurements at the input end and translate them back to the antenna to check if there has been any change.**

**I know this is sometimes easy to forget in the heat of getting the antenna up.**

**I know I have!**

**THE END**