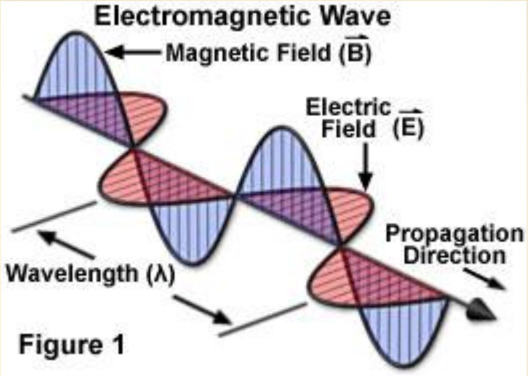
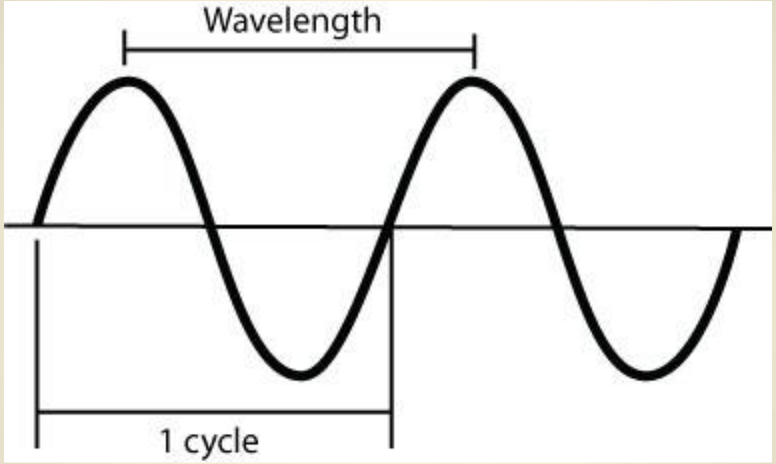
INTRODUCTION TO THE J POLE ANTENNA

Back to Basics

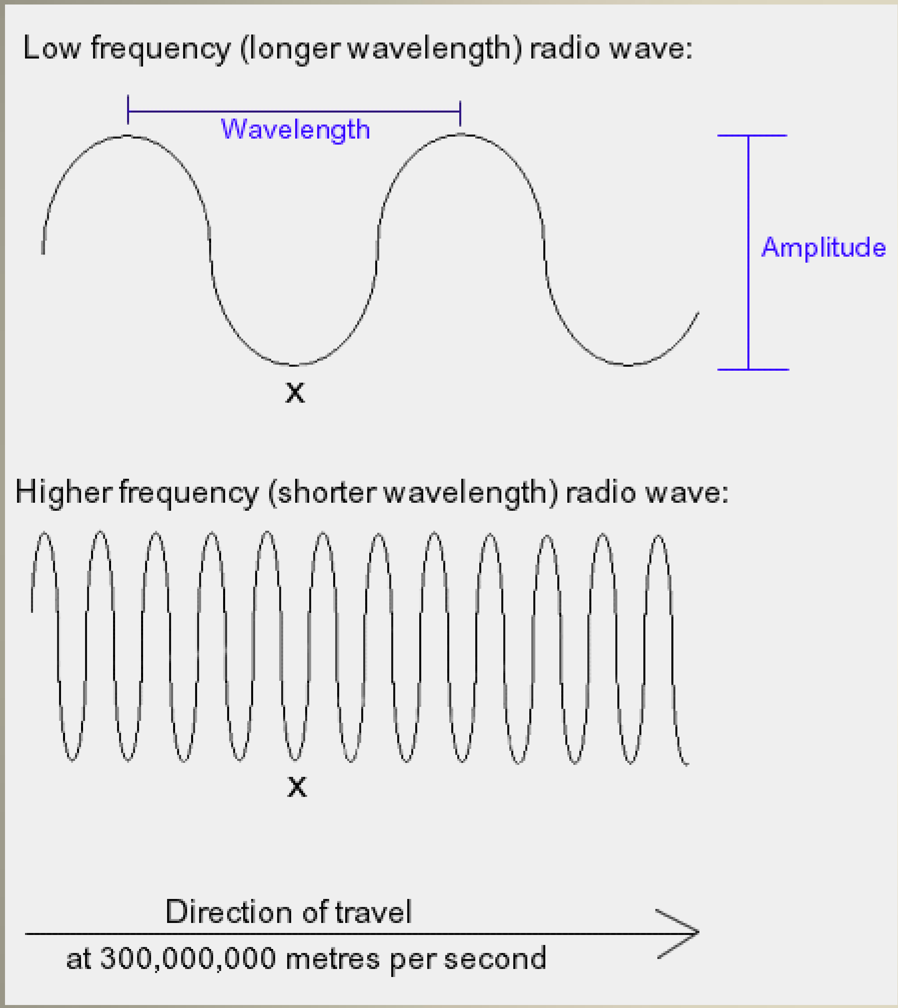


Radio Waves consist of an electric field and an magnetic field

One oscillation is called a “cycle”



The length of one cycle is called the “Wavelength”



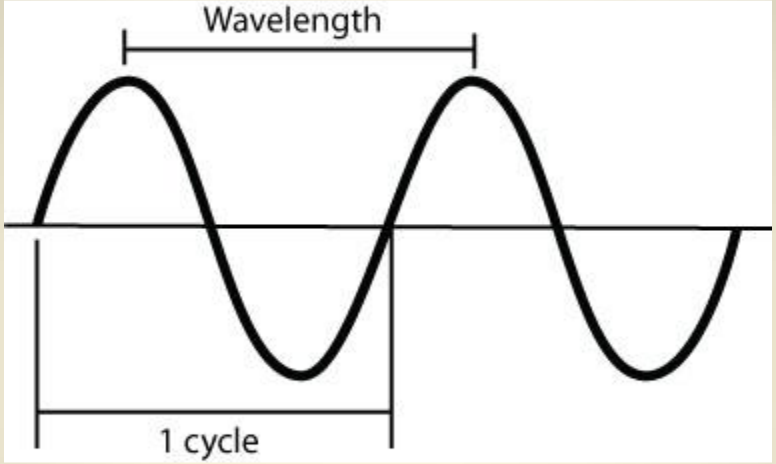
The number of cycles that pass a point (x) in one second is called the Frequency

The longer the wave length, the lower the frequency

The shorter the wavelength, the higher the frequency

Radio waves travel at a speed of approx 300,000,000 metres per second
(in free space)

Wavelength has the symbol λ



$$\lambda\ (m) = \frac{\text{Speed (m/sec)}}{\text{Frequency (cycles/sec)}}$$

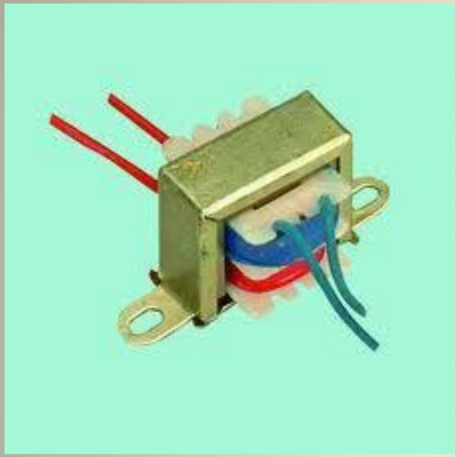
Wavelengths at VHF and UHF Frequencies

At 52 MHz λ = 300,000,000 / 52,000,000 = 300/52 = 5.78 metres

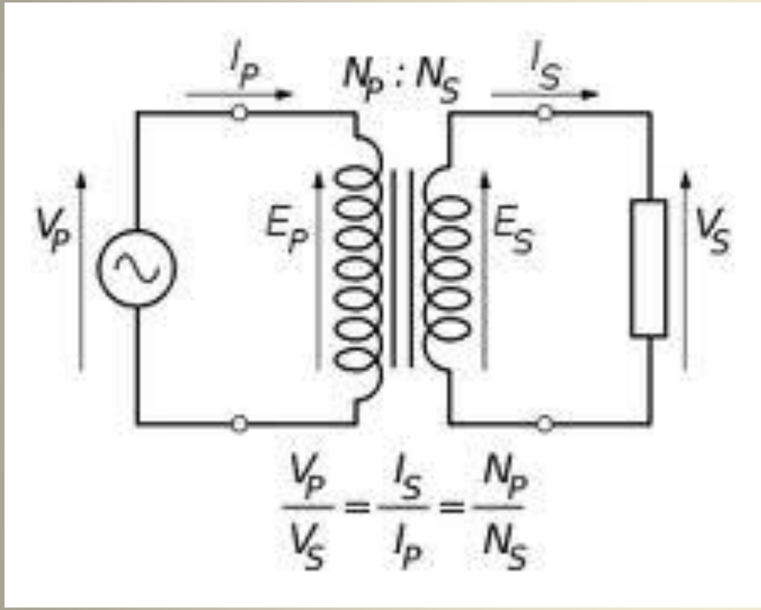
At 146 MHz λ = 300/146 = 2.05 metres

At 438 MHz λ = 300/438 = 0.68 metres

TRANSFORMATIONS



Transformers are commonly used to change voltage or current. Other applications are impedance matching and changing frequency(*).

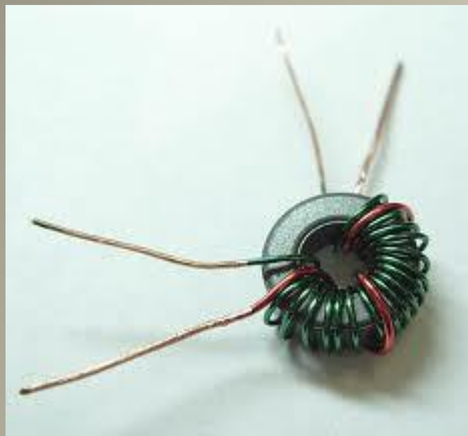


Voltage Transformer Turns Ratio

$$\frac{Vp}{Vs} = \frac{Np}{Ns}$$

Current Transformer Turns Ratio

$$\frac{Ip}{Is} = \frac{Ns}{Np}$$



Impedance Transformer Turns Ratio

$$\frac{Z_p}{Z_s} = \frac{(N_p)^2}{(N_s)^2}$$

Example: $Z_p = 200$ Ohms $Z_s = 50$ Ohms $N_s = 1$

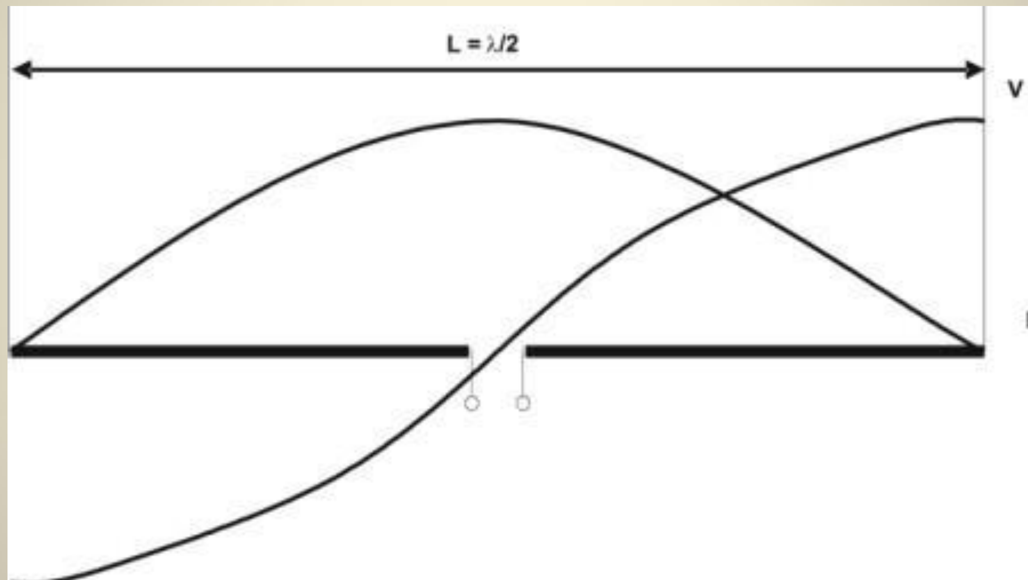
$$\frac{(N_p)^2}{(1)^2} = \frac{200}{50} = \frac{4}{1}$$

$N_p = \sqrt{4} = 2$

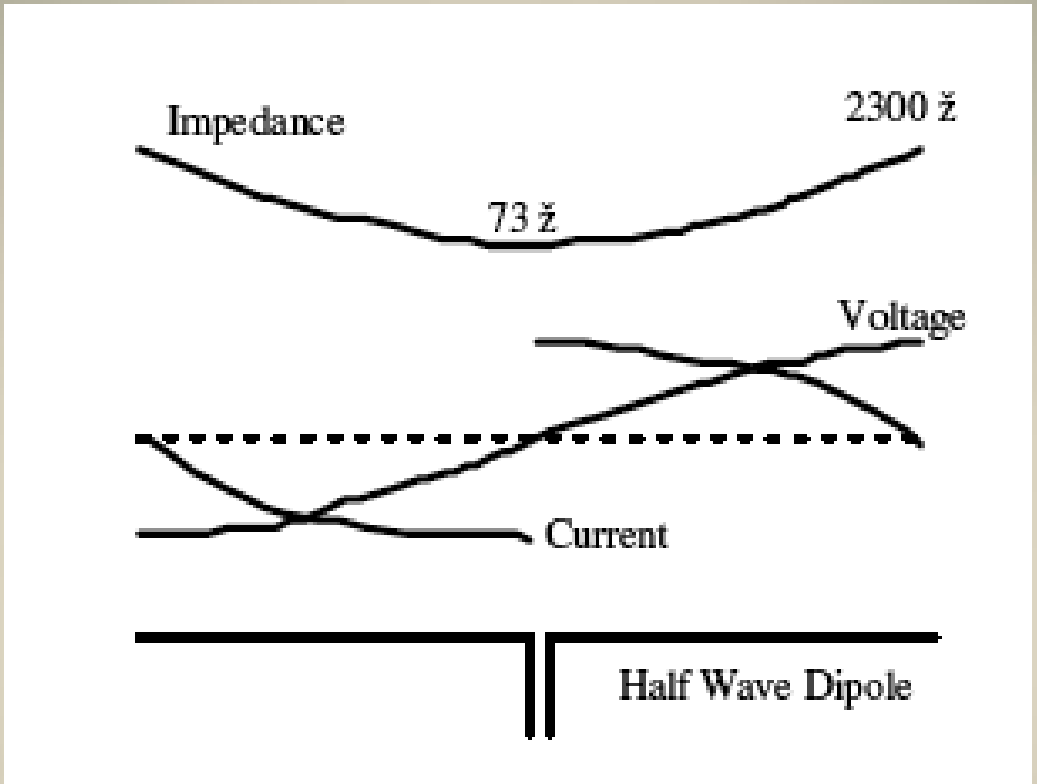
Turns Ratio = 2:1

Di POLE ANTENNA

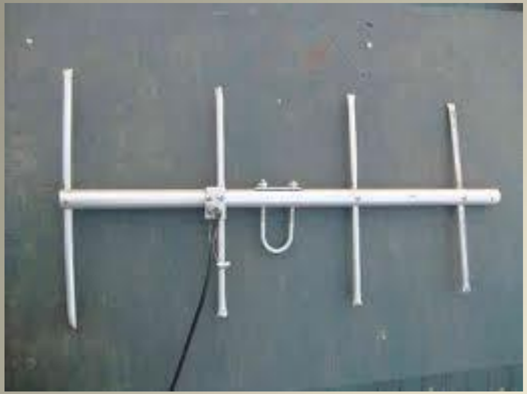
Antennas are used to transmit and receive radio waves
A commonly used antenna is the half wave Di Pole Antenna



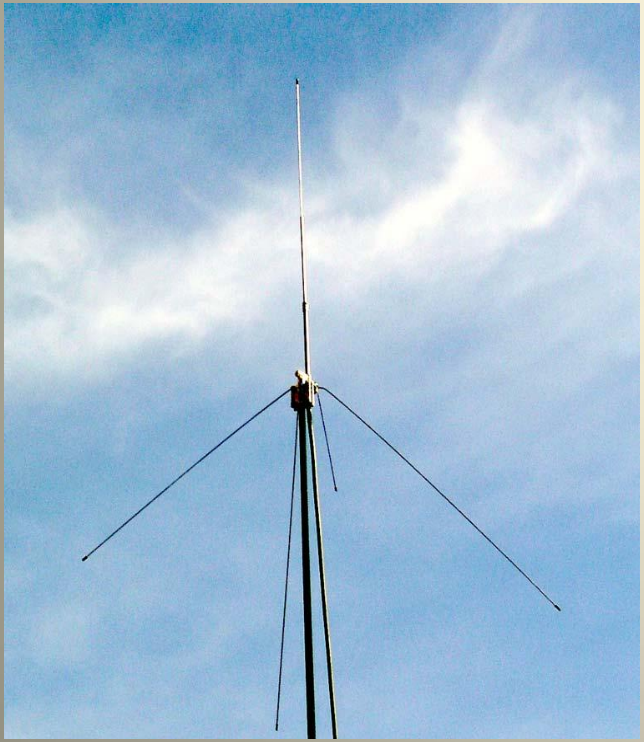
The Di Pole Antenna is so called as the half wavelength antenna has two electrical poles



Half Wave Dipole antennas are usually fed in the middle were the impedance is low at 73 Ohms

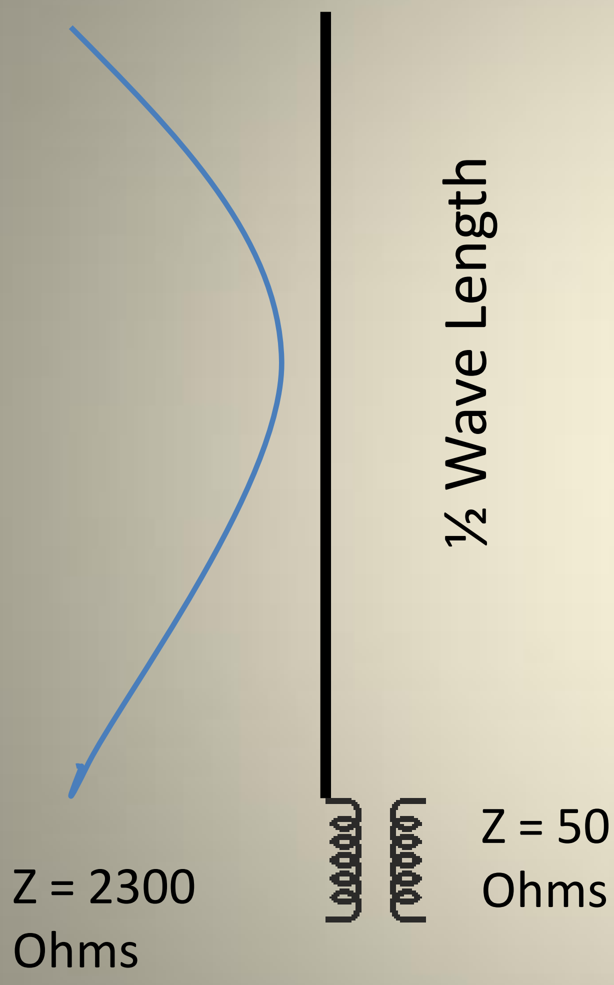


A Half Wave Di Pole is commonly used as part of a yagi antenna as the driven element



A variation of the Half Wave Di Pole is also used as the popular
¼ Ground Plane Antenna
By placing the Di Pole in the vertical polarity, converting one of the ¼ wave sections into a ground plane
With the ground plane radials at 40 deg, the feed point impedance is reduced to about 50 Ohms

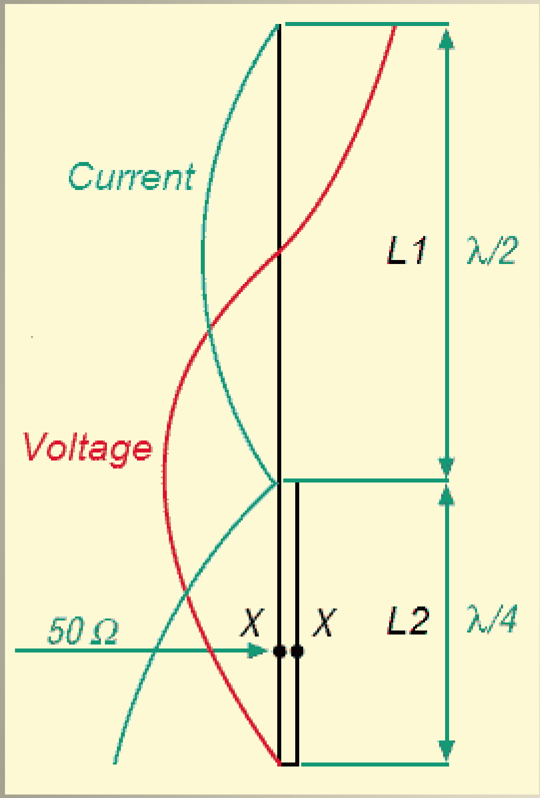
What about the J Pole Antenna?



The J Pole Antenna is a vertical ½ wave length element which is end fed
What about the 2300 Ohm end impedance?

To match the high impedance end with the 50 Ohm coaxial feed line, an impedance matching transformer is used

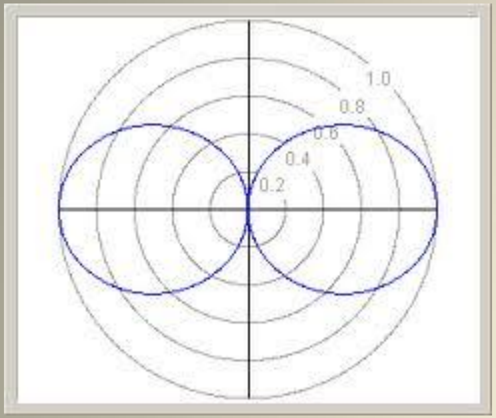
Transformer Ratio - 6.8 : 1



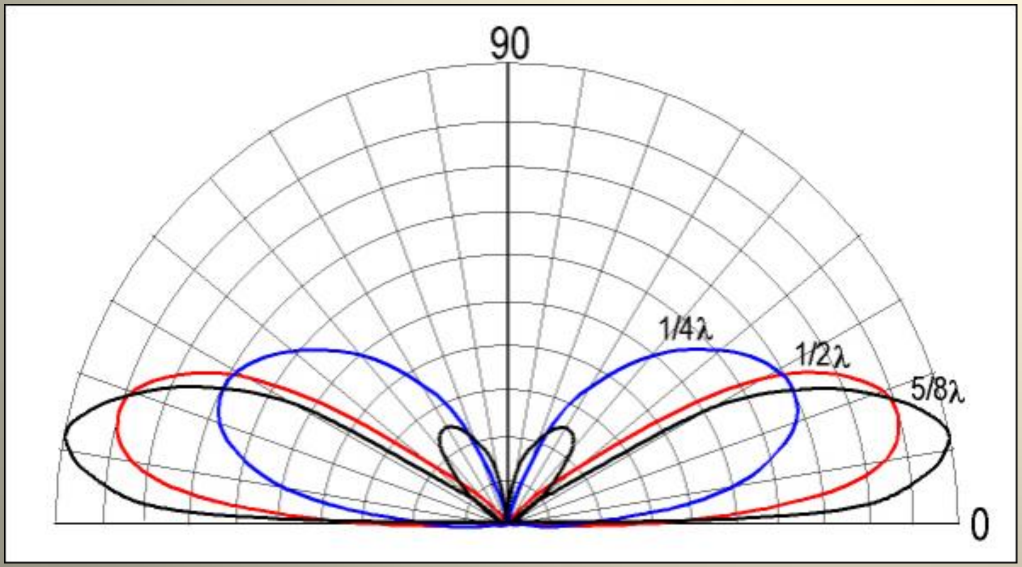
The transformer is a ¼ wave length matching stub, located at the bottom of the ½ wave length section, and becomes part of the antenna, forming the "J" shape

The impedance of the matching stub is zero at the bottom and 2300 Ohms at the top.
The 50 Ohm coaxial feed line is connected at the 50 Ohm point.

Radiation Patterns

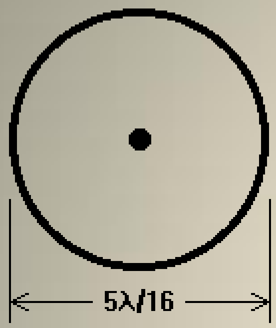


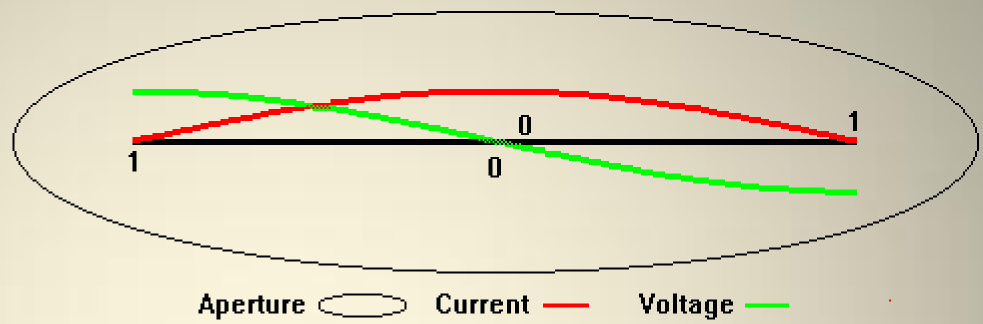
The radiation pattern for a ½ wave length (centre fed), is a typical doughnut shaped, omni-directional pattern



Comparison of the radiation patterns for a ¼ wave ground plane, ½ wave J pole and 5/8 wave vertical antennas

GAIN – Fact or Fiction?





The cross section area of the aperture of a dipole is 1.64 times that of an isotropic source.

A1 = aperture of a dipole, A2 = aperture of an Isotropic Source:

Gain = 10 LOG(A1/A2) = 10 LOG(1.64/1) = 2.15 dBi

Some also state the gain as 3 dB over a ¼ wave ground plane

Gain can be effected by the mounting height and distance from other surfaces including mounting support.

Let's Get Physical

"J" Pole Antenna

Dimensions in metres

Dim "A" = 215

F (MHz)

Dim "B" = 6.72

F (MHz)

Dim "C" = 71.25

F (MHz)

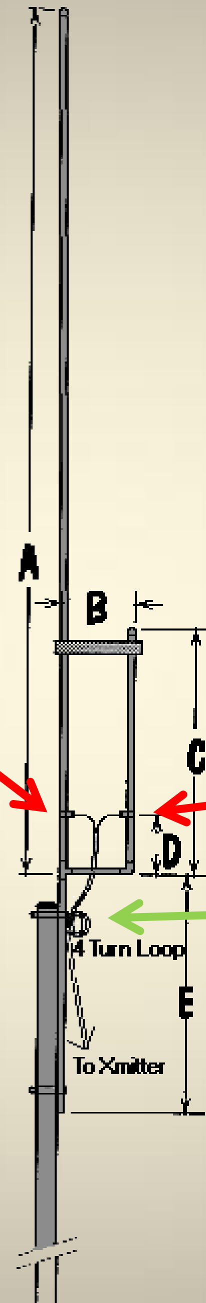
Dim "D" = 7.15

F (MHz)

Dim "E" = 71.25

F (MHz)
Minimum dimension

Coax inner conductor



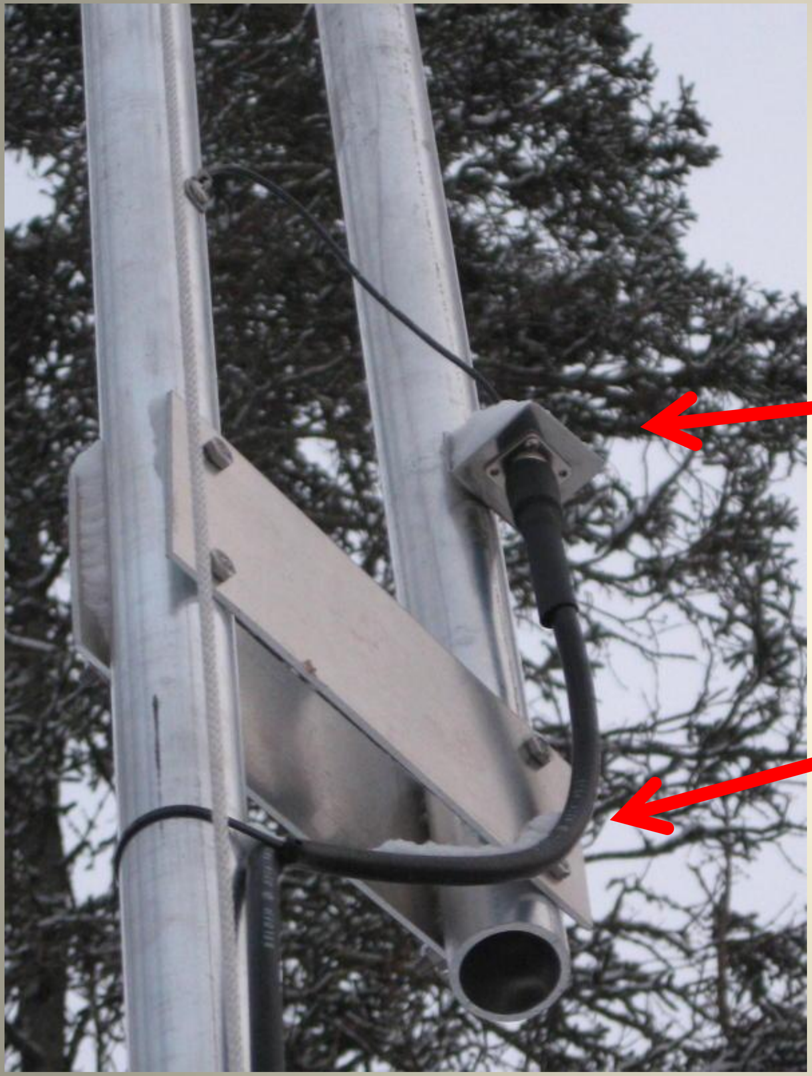
Coax shield

BALUN
4 to 6 turns

NOTE: Lengths may change with respect to the ratio of material diameter to wavelength

Construction Methods

Material is ½ inch copper pipe soldered into a T piece and elbow
SO238 socket soldered onto the side of the pipe

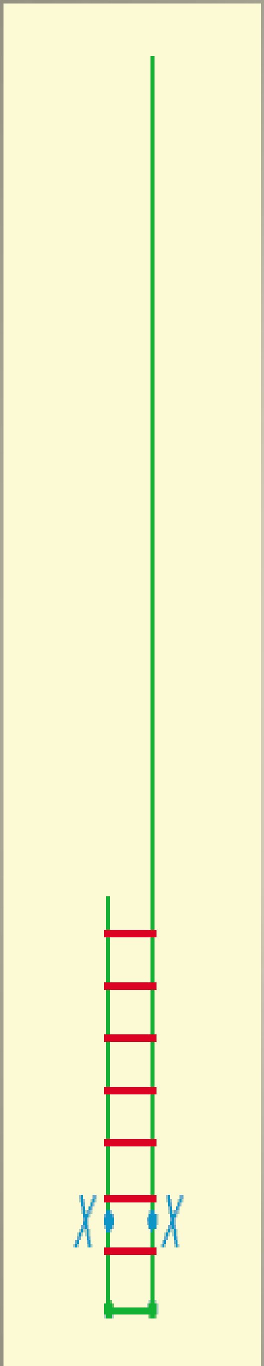


Aluminium Tube

Mounting bracket for coax socket

Zero impedance point of matching stub

Suggest the use of anti corrosion paste such as Penotrox



Ladder Line or Ribbon Cable construction

Popular as a portable antenna
Hang from a tree or ceiling with string or fishing line

Tuning your "J" Pole

Measuring the VSWR does NOT indicate that the antenna is resonate at the design or test frequency. The Voltage Standing Wave Ratio (VSWR) is only the ratio between the impedances of the feed line and the load.

The length of the feed line may influence the impedance of the feed line.

If the feed line impedance matches the antenna impedance,
the VSWR will be 1:1. This does not mean the antenna impedance is 50 Ohms.

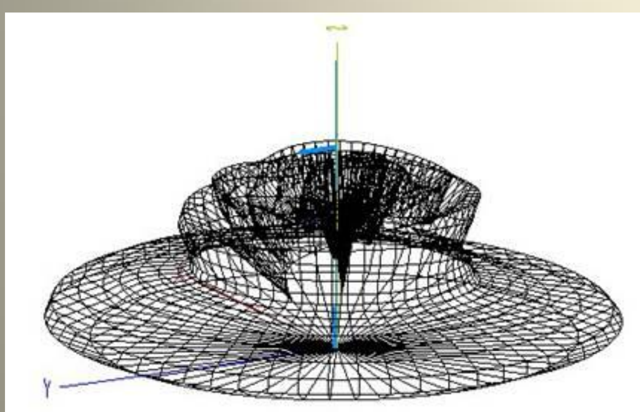
A "Dip Meter" should be used to determine the resonant frequency.

The length of the feed line should be a multiple of an electrical ½ wave length(*)

At 146 Mhz the ½ wave length of RG58U coaxial cable = 300/146/2*0.65 = 0.668 metres (0.65 being the velocity factor).

But wait there is more !!

Super “J” Pole



Radiation Pattern

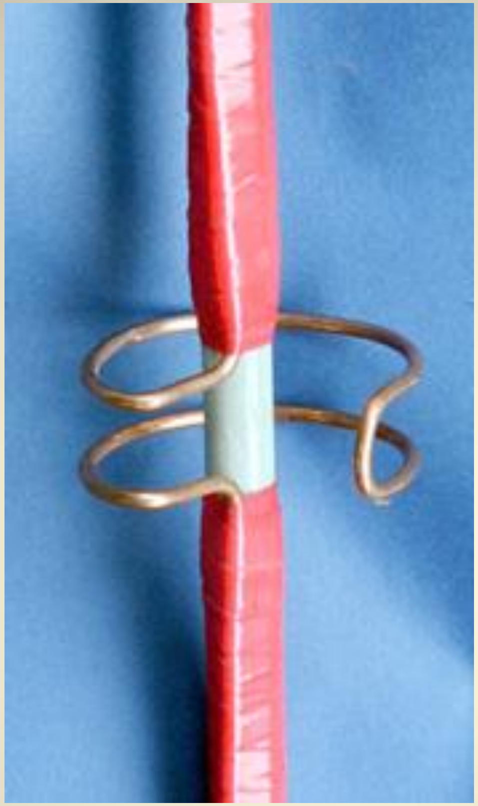
½ wave length top section

½ wave length matching section

½ wave “J” Pole

Gain around 3 dB over a regular J-pole

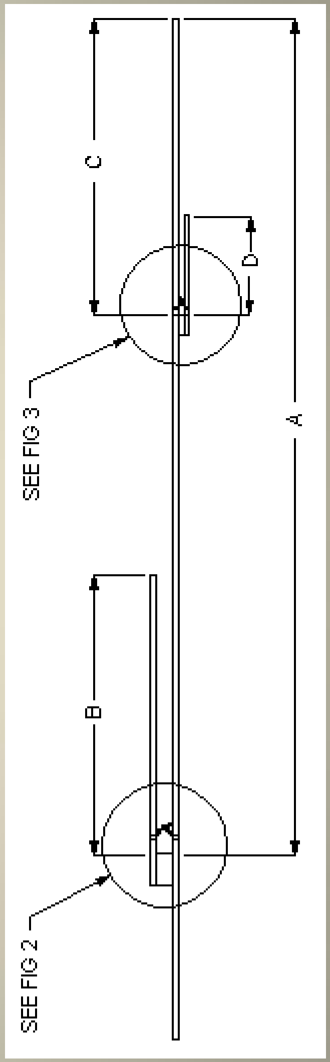
Adjustable feed point



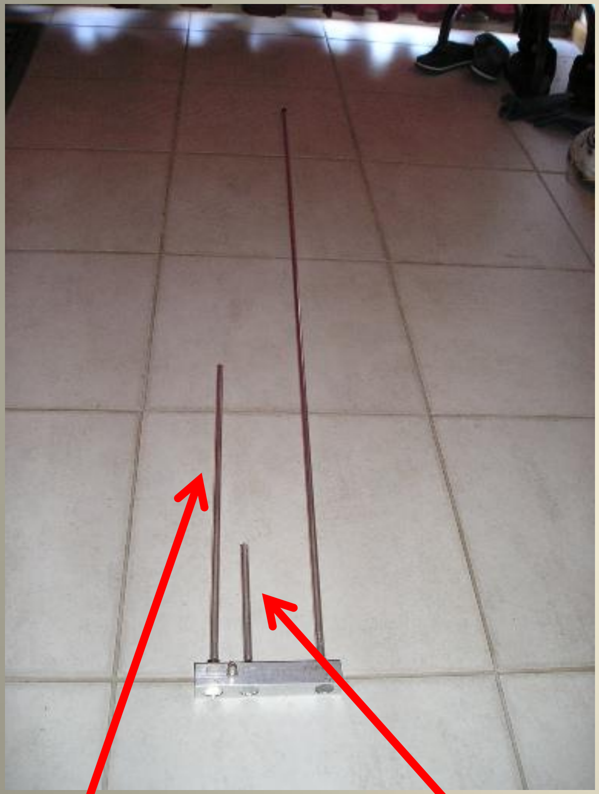
Matching Stub

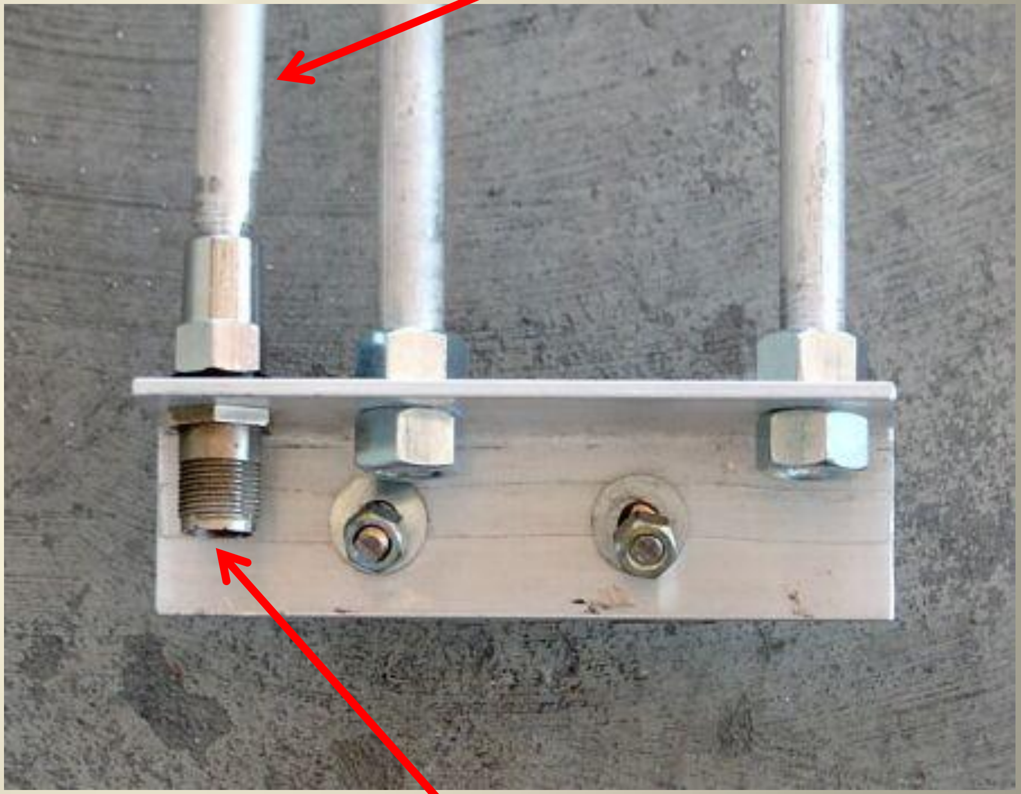
Complete Assembly

Dual Band "J" Pole Antenna design by VK6YSF



Dual Band "J" Pole Antenna for 2m & 70cm





Driven Element

2m ¼ wave section

70cm ¼ wave section

Inner Conductor connected Driven Element

Advantages of a "J" Pole Antenna

- ❖Broad band coverage
- ❖Ground independent
- ❖Gain over an Isotropic antenna
- ❖Gain over a ¼ wave antenna??
- ❖Low angle radiation pattern
- ❖Simple construction

Reference Sources

- A DISCUSSION OF ANTENNA THEORY by Paul Graham (K9ERG)
- J Pole Calculator and drawing by K4ABT G. E. "Buck" Rogers Sr
- Practical Antenna Handbook by Joseph J. Carr
- Design by G. Forrest Cook WB0RIO.
- KF4EOK'S 2 meter super j-pole antenna build
- SUPER J-POLE FOR 435MHz by VK6YSF
- The World Wide Web

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