VHF/UHF ANTENNAS

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ANTENNAS

A device that matches 377 ohm to your feed line!!

- FUN STUFF

In 1913, the Eiffel Tower was used an antenna. Back when communication was at very low frequencies, the antennas had to be very large to get any sort of radiation. The Eiffel Tower fit this bill well, and was used to communicate with the United States Naval Observatory in Arlington, Virginia.

A 70-meter dish antenna. Part of NASA's Jet Propulsion Laboratory (JPL) communication system.

EIRP DISCUSSION

EIRP is *Effective Isotropic Radiated Power*, also called the *Equivalent Isotropic Radiated Power*. In antenna measurements, the measured radiated power in a single direction.

As an example, suppose the radiated power is measured for an arbitrary antenna. Suppose the peak power is measured at is EIRP = 20 dBm = -10 dB = [0.1 W = 100 mW]. Then a perfectly isotropic antenna radiating 20 dBm would radiate equally poorly in all directions.

DECIBELS????

- Some background info

0dBW = 1 Watt = 1000 milliwatts = 30 dBm
10log(Watts) = dBW
10LOG(Milliwatts) = dBm

$10^{(dBW/10)}$ = Watts
$10^{(dBm/10)}$ = milliwatts

Convert 1000 Watts to dBW and dBm
1000 Watts = 1,000,000 milliwatts

LOG(1000) = 3
LOG(1000000) = 6
10LOG(1000) = 30 dBW
10LOG(1000000) = 60 dBm
Or 30 dBW = 60 dBm = 1000 Watts

ANTENNA GAIN

- GAIN AND EIRP

If the peak EIRP and the directivity (D) are known for an antenna, then the Total Radiated Power (TRP) can be found from the equation:

TRP = EIRP - D
D = DIRECTION AND GAIN INFORMATION

Example 1

Transmit power 10 watts   Antenna Gain 6 dB all directions
TRP = 100 watt (30 dBw)+9dB = 39dBw or 800 watts!
Of course the antenna direction is important
No sense in radiating up when you want to talk to the county!!

WHAT GOES INTO ANTENNA DESIGN

Decibels (dB) E-plane
Effective Isotropic Radiated Power (EIRP)
Effective Isotropic Sensitivity (EIS)
Electric Field (E-field)
Electric Flux Density
Folded Balun
Fractional Bandwidth (FBW)
Front-to-Back Ratio
H-plane
Intrinsic Impedance
Magnetic Field (H-field)
Magnetic Flux Density
Maxwell's Equations
Multipath
Permeability
Permittivity
Q
Reciprocity
Resonant
S-Parameters
Specific Absorption Rate (SAR)
Spherical Coordinates
Steering Vector
Tapered Baluns
Total Isotropic Sensitivity (TIS)
Total Radiated Power (TRP)
VSWR or SWR

½ WAVE ANTENNA

The **half-wave dipole antenna** is important. Note that the "half-wave" term means that the length of this dipole antenna is equal to a half-wavelength at the frequency of operation.
To make it crystal clear, if the antenna is to radiate at 144 MHz,
what size should the half-wavelength dipole be?
One wavelength at 144 MHz is $= c / f = 2.08$ meters. Hence, the half-wavelength dipole
antenna's length is 1.04 meters. OR IN TEXAN 3.4120734908136483 feet. ¼ wavelength = 1.7 feet = 20.4 inches
The half-wave dipole antenna is as you may expect, a simple half-wavelength wire fed at the center
as shown in Figure 1:
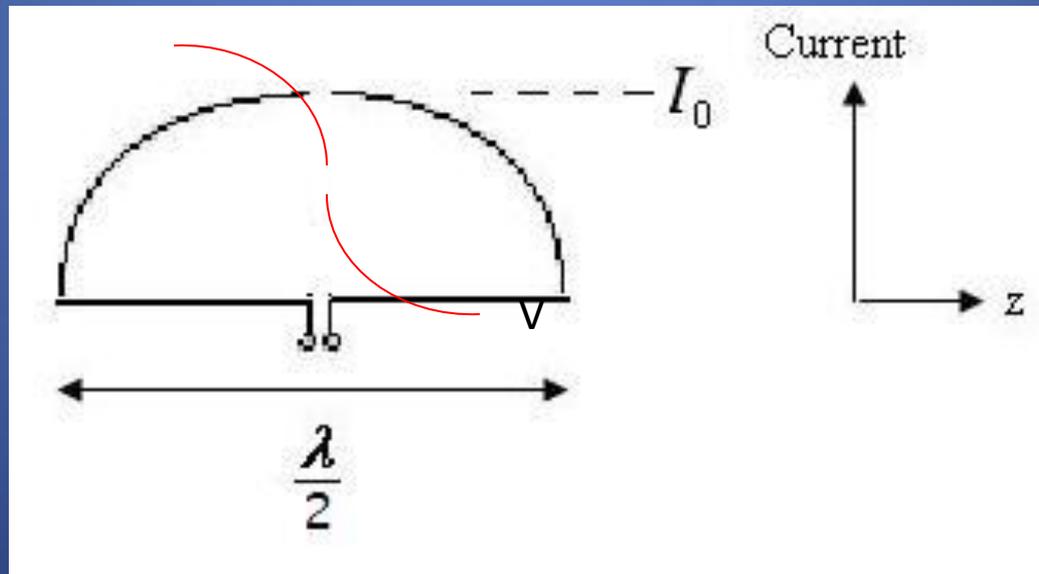
Band width considerations

 A standard rule of thumb in antenna design is: an antenna can be made more broadband by increasing the volume it occupies. Hence, a dipole antenna can be made more broadband by increasing the radius *A* of the dipole.

the fatter the dipole gets the lower the resonant frequency becomes. In other words, if an antenna is to resonate at 100 MHz, the resonant length decreases as the dipole gets fatter.
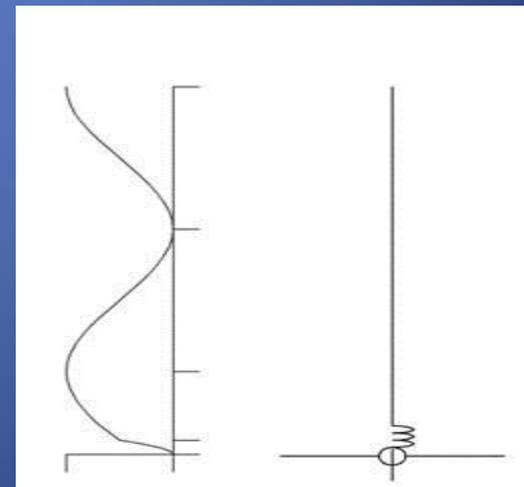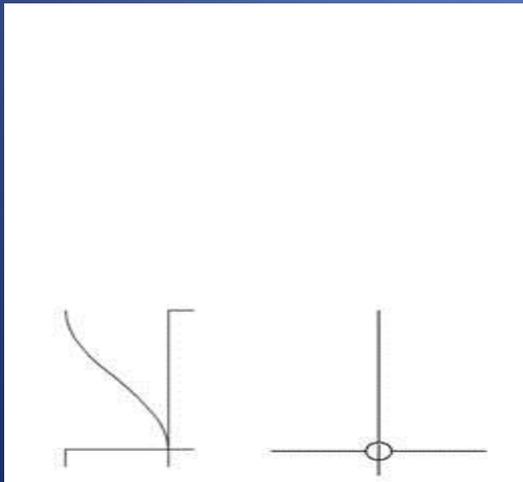
MONOPOLE ANTENNA

A **monopole antenna** is one half of a dipole antenna, almost always mounted above some sort of ground plane. The case of a monopole antenna of length L mounted above an infinite ground plane is shown in Figure 1(a).
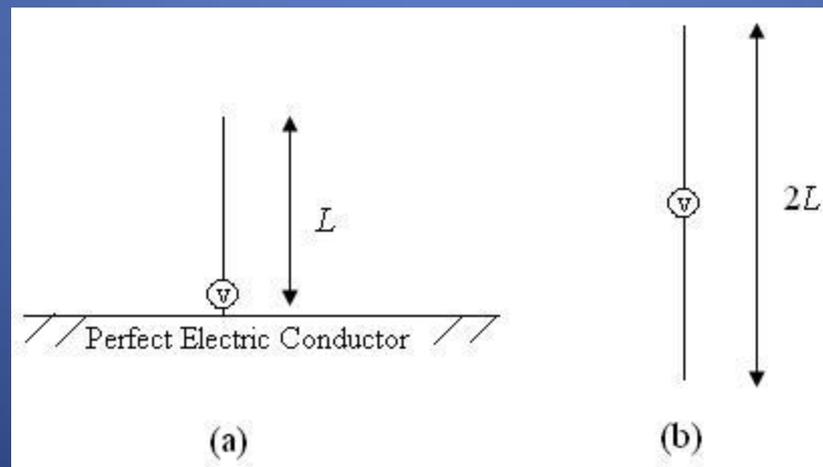
5/8 Wave antennas
Very common for VHF/UHF

The 5/8 wave antenna consists of a vertical radiator, a loading coil and colinear plane at the base of the antenna. The best RF transmission system consists of matching impedence across all sections. For maximum power transmission, 50 Ohm coax cables are used to match the RF PA's output impedence. Since 5/8 wave length antenna is no longer matching the transmission line impedence, a feeding coil must be added between the antenna and the feedline so that the antenna can match the impedence of the tranmission feedline..

COLLINEAR ANTENNAS

In telecommunications, a **collinear (or co-linear) antenna array** is an array of dipole antennas mounted in such a manner that the corresponding elements of each antenna are parallel and collinear, that is they are located along a common line or axis.

A collinear array is usually mounted vertically, in order to increase overall gain and directivity in the horizontal direction. When stacking dipole antennas in such a fashion, doubling their number will, with proper phasing, produce a 3 dB increase in gain.
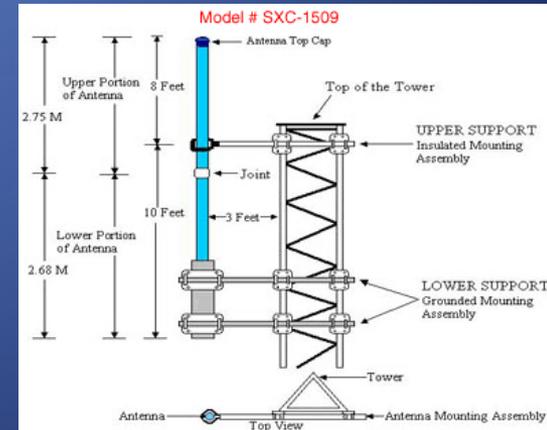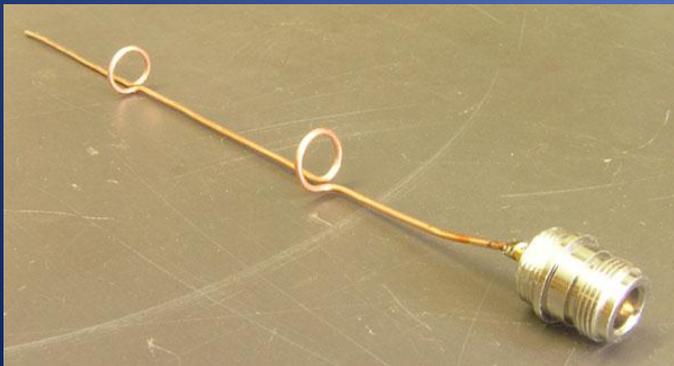
BEAM ANTENNAS

A **directional antenna** or **beam antenna** is an antenna which radiates greater power in one or more directions allowing for increased performance on transmit and receive and reduced interference from unwanted sources. Directional antennas like yagi antennas provide increased performance over dipole antennas when a greater concentration of radiation in a certain direction is desired.

All practical antennas are at least somewhat directional, although usually only the direction in the plane parallel to the earth is considered, and practical antennas can easily be omnidirectional in one plane.

The most common types are the yagi antenna, the log-periodic antenna, and the corner reflector, which are frequently combined and commercially sold as residential TV antennas.

Cellular repeaters often make use of external directional antennas to give a far greater signal than can be obtained on a standard cell phone. Satellite Television receivers usually use parabolic antennas.

For long and medium wavelength frequencies, tower arrays are used in most cases as directional antennas.

Radiation Angle

In the field of antenna design the term **radiation pattern** most commonly refers to the *directional* (angular) dependence of the strength of the radio waves from the antenna
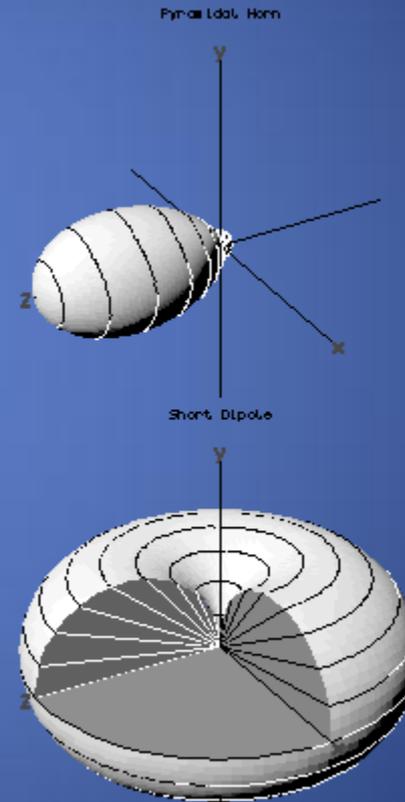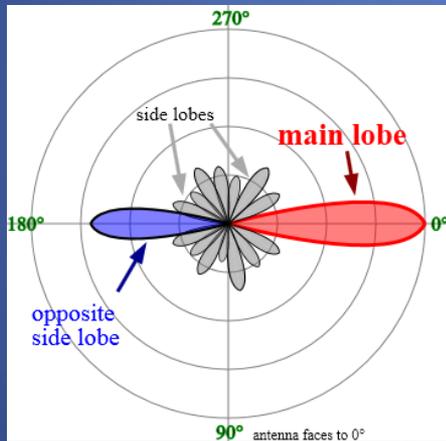
Polarization

An antenna is a transducer that converts radio frequency electric current to electromagnetic waves that are then radiated into space. The electric field plane determines the polarization or orientation of the radio wave. In general, most antennas radiate either linear or circular polarization.
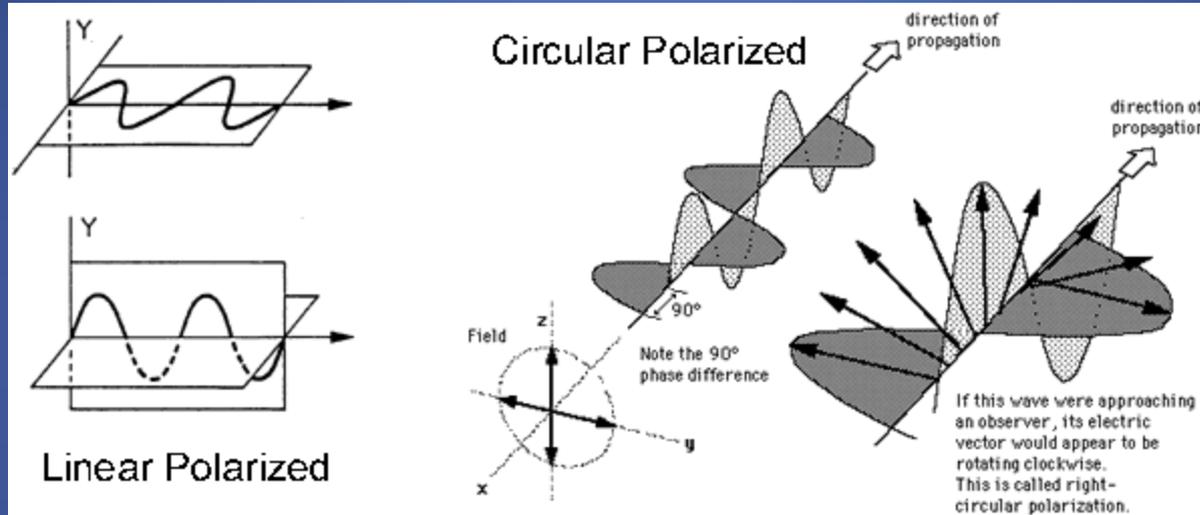
Typical Applications

Vertical polarization is most commonly used when it is desired to radiate a radio signal in all directions over a short to medium range.

Horizontal polarization is used over longer distances to reduce interference by vertically polarized equipment radiating other radio noise, which is often predominantly vertically polarized.

QUESTIONS?