General License Course

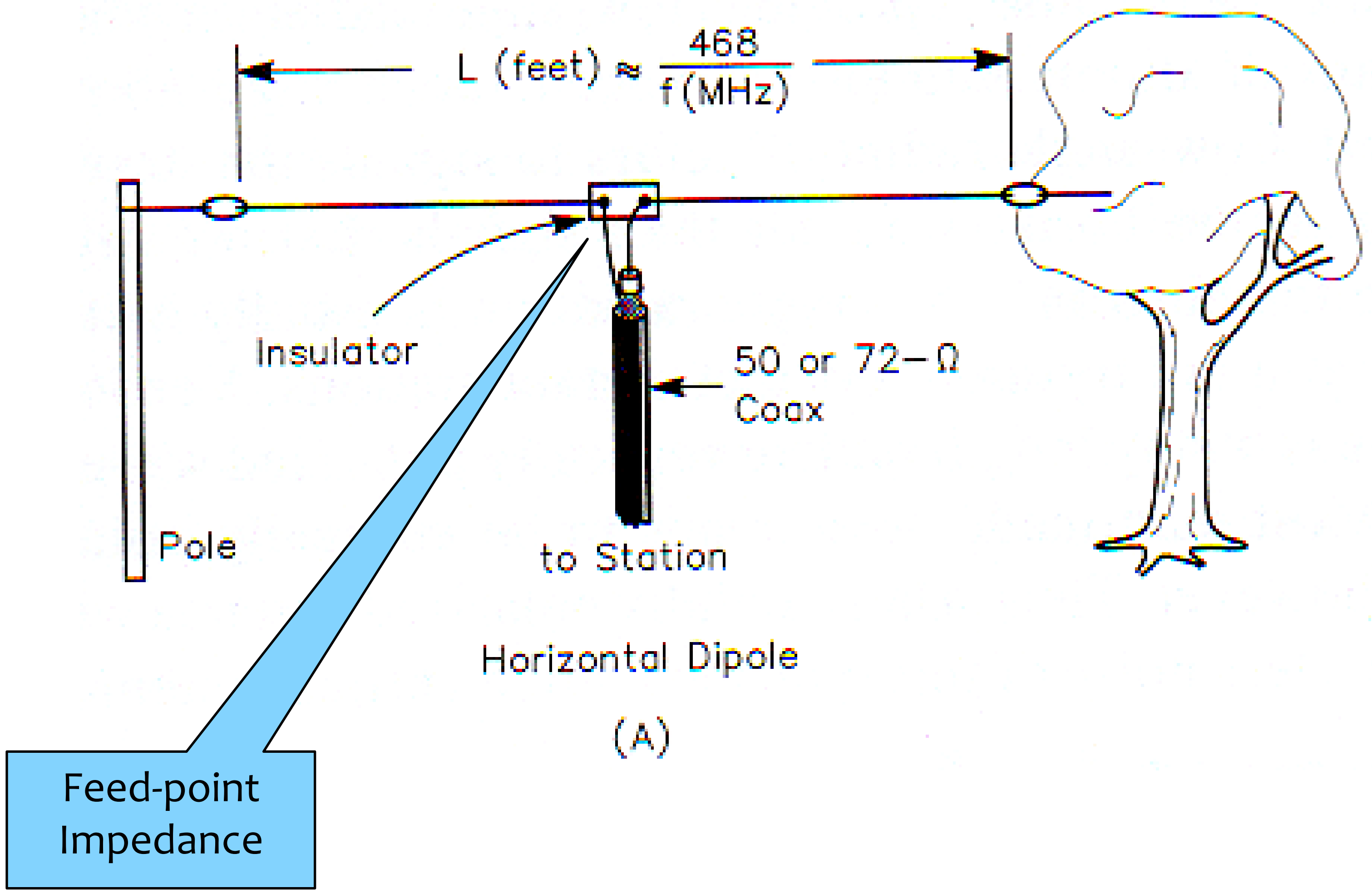
Chapter 7
Antennas

Jim Andera
K0NK
2/16/2019

A Look at Antennas

- ***The time, effort and money invested in your antenna system generally will provide more improvement to your station than an equal investment to any other part of the station.***

Antenna Review: The Dipole

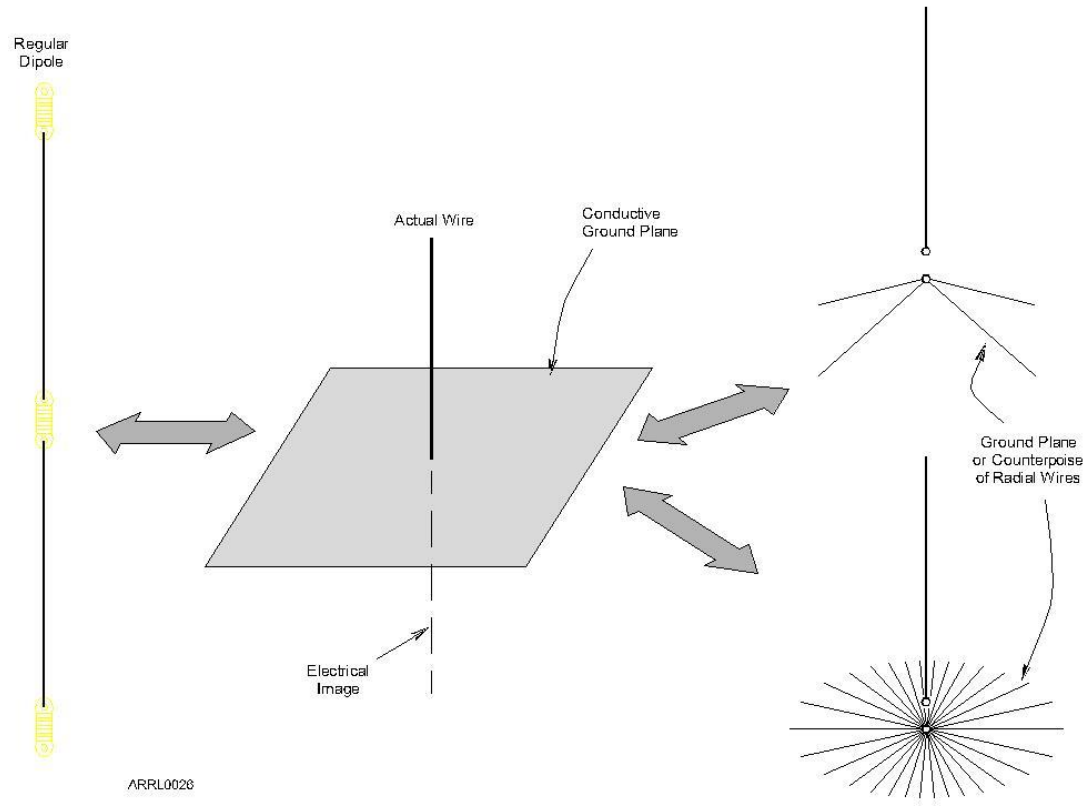


Antenna Review: Ground-Plane

Also called a
Vertical Antenna

One half of a
dipole is replaced
with a
"ground plane"

The ground plane
can be a metal
sheet or wires
(called radials)

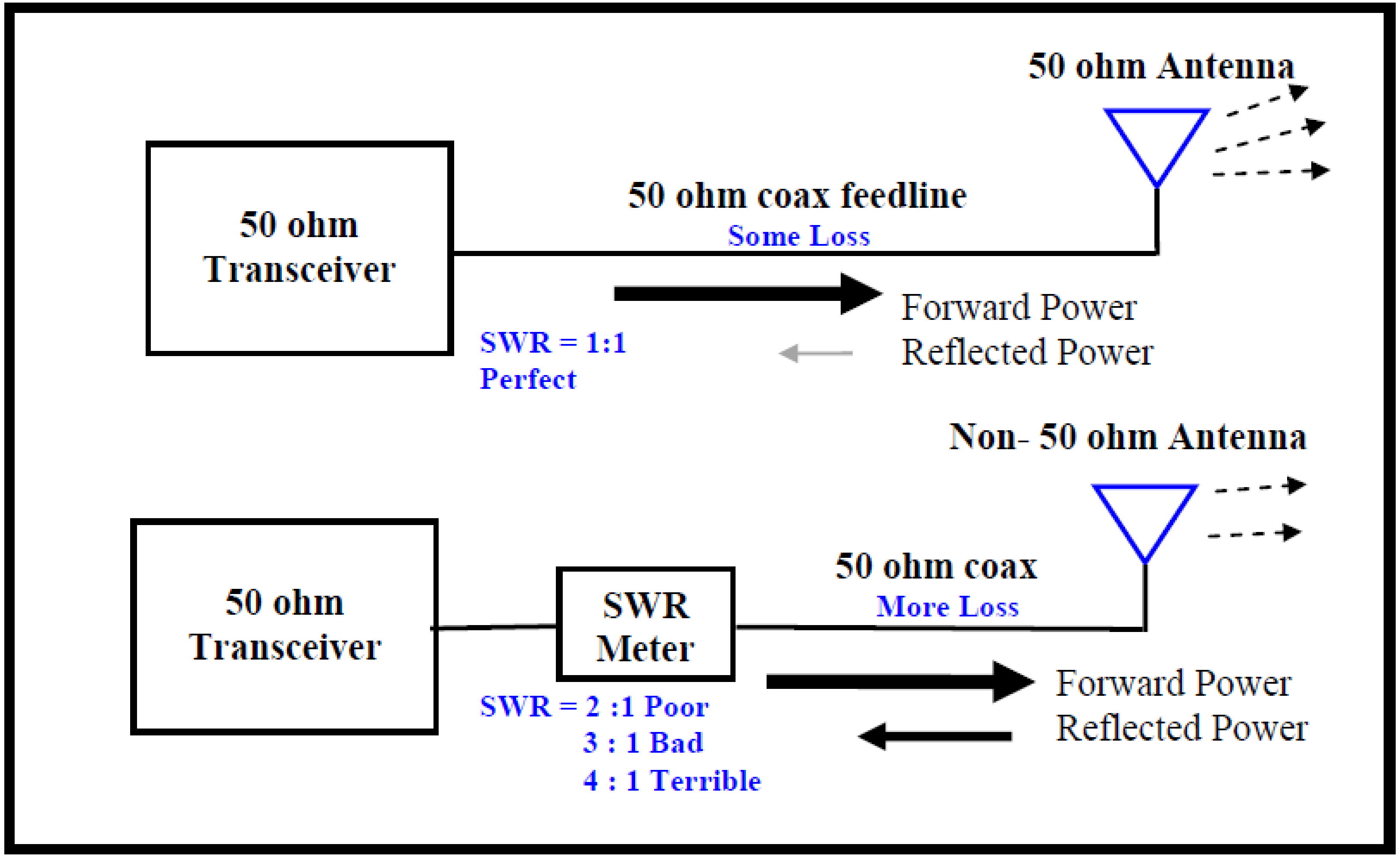


Decibels (dBs)

- The Decibel is a measure of *change* in the power of a signal.
- Abbreviated: dB
- Somewhat like percent of change—but dBs are non-linear

Decibel	Change in Power	Observed Effect	Example
1 dB	Only 20%	Hardly perceivable	1 W → 1.2 W
3 dB	Factor of 2	Just noticeable	1 W → 2 W
6 dB	Factor of 4	Significant	1 W → 4 W
10 dB	Factor of 10	Quite significant	1 W → 10 W
15 dB	Factor of 32	Very significant	1 W → 32 W
20 dB	Factor of 100	Huge difference	1 W → 100 W
30 dB	Factor of 1000	Extreme difference	1 W → 1000 W

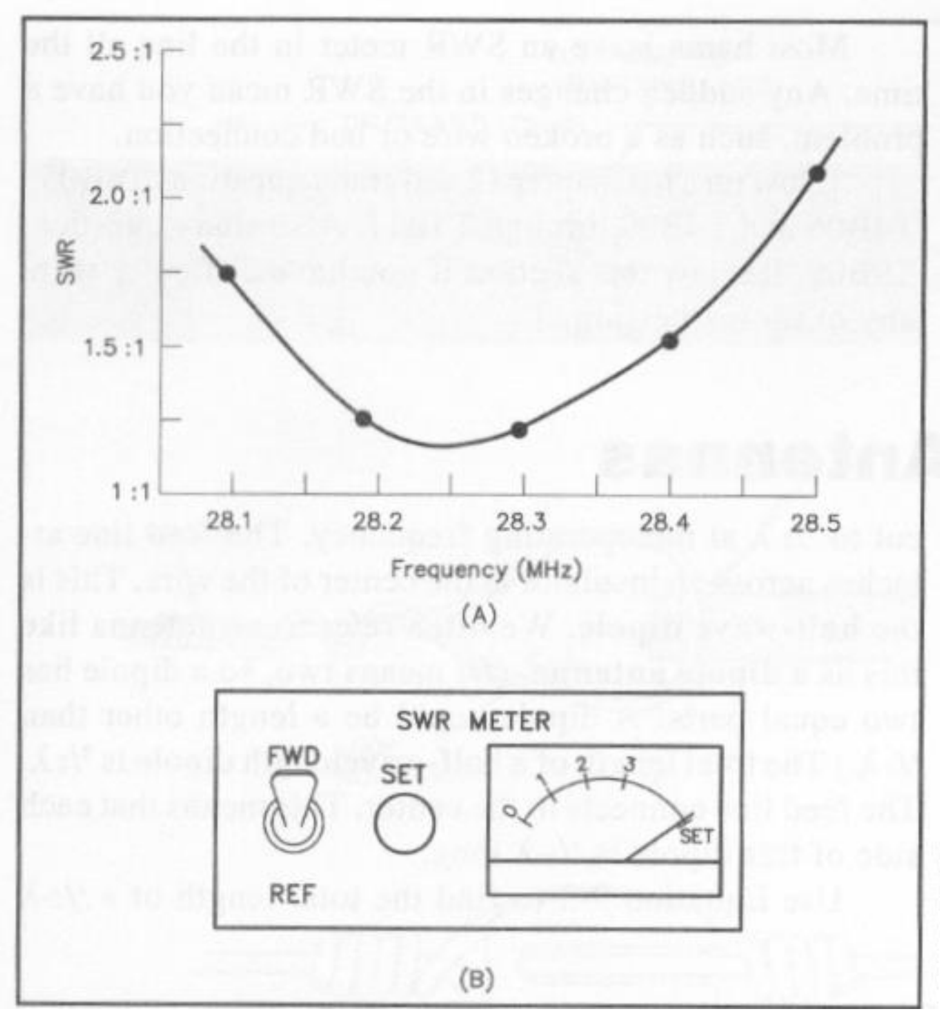
Review: Standing Wave Ratio (SWR)



Standing Wave Ratio (SWR)

SWR	% of power being reflected back from the antenna	What it means to operation:
1:1	0%	Perfect match.
1.5:1	4%	Good match.
2:1	10%	Fair match..
3:1	25%	Poor match.
4:1 or higher	38% or higher.	Bad match.

SWR Measurements



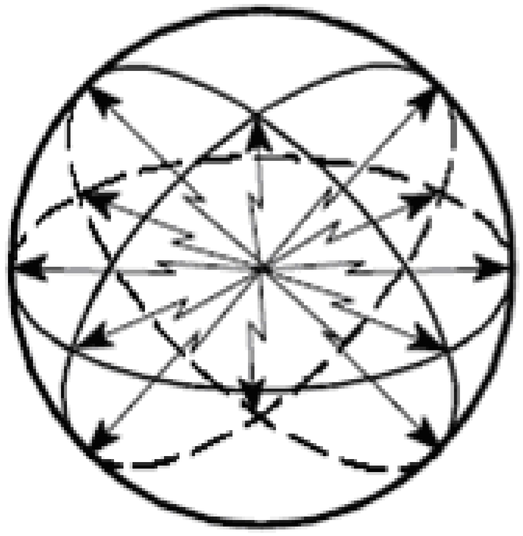
SWR Meter / Directional Wattmeter

Isotropic Radiator

* Isotropic radiators are used as reference radiators

* An **isotropic radiator** is a theoretical point source of electromagnetic or sound waves.

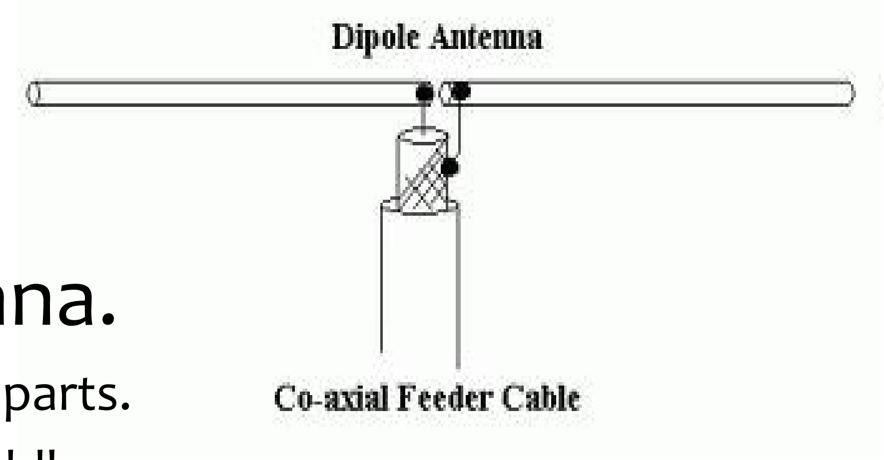
SPHERE (Isotropic source)



G = 0 dB

The Dipole

7-2

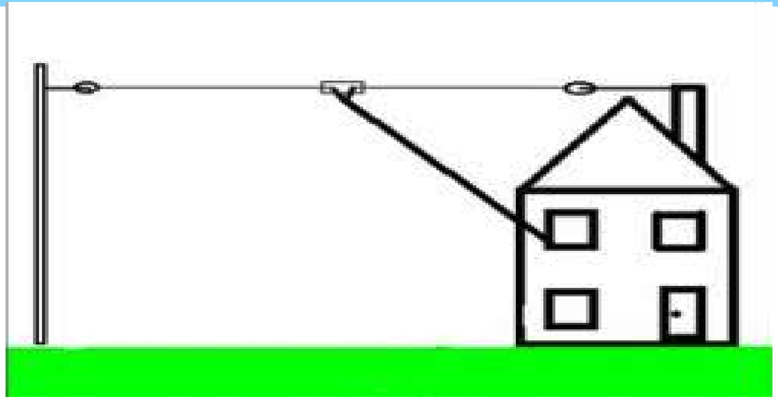


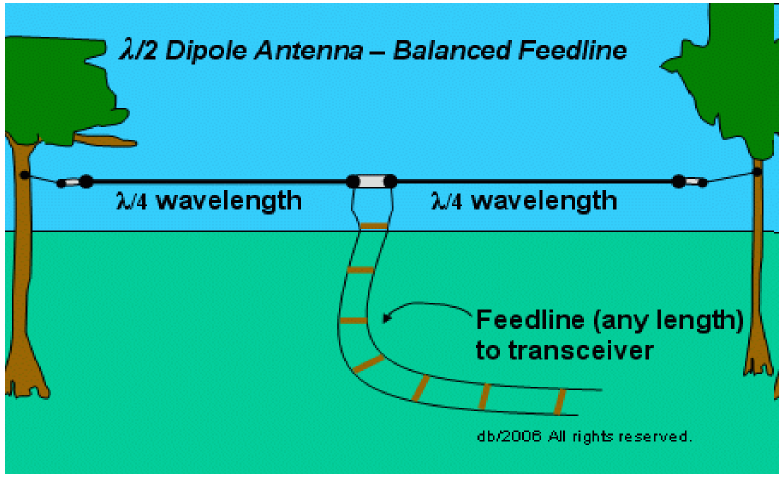
- The most basic antenna.
  - Two conductive, equal length parts.
  - Feed line connected in the middle.
- Total length is ½ wavelength.
- Length (in feet) = 492 / Frequency (in MHz).
  - For 146 MHz: 492 / 146 = 3.4 ft = 40.8 inches
  - For 28.5 MHz: 492 / 28.5 = 17.3 ft
- Many factors alter the exact length

Other books say
468/f

Dipole Antennas

- **33 feet** is the approximate length for a 1/2-wave dipole antenna cut for 14.250 MHz. (G9B10)
  - *Calculate ½ wavelength in feet by dividing 468 by the frequency in MHz.*
  - *468 / 14.250 =* ***32.8 Feet***
- The approximate length for a 1/2-wave dipole antenna cut for 3.550 MHz is **132 feet.** (G9B11)
  - *Calculate ½ wavelength in feet by dividing 468 by the frequency in MHz.*
  - *468 / 3.550 =* ***131.8 Feet***





Half-wave Dipole with 450 ohm feedline (not coax).

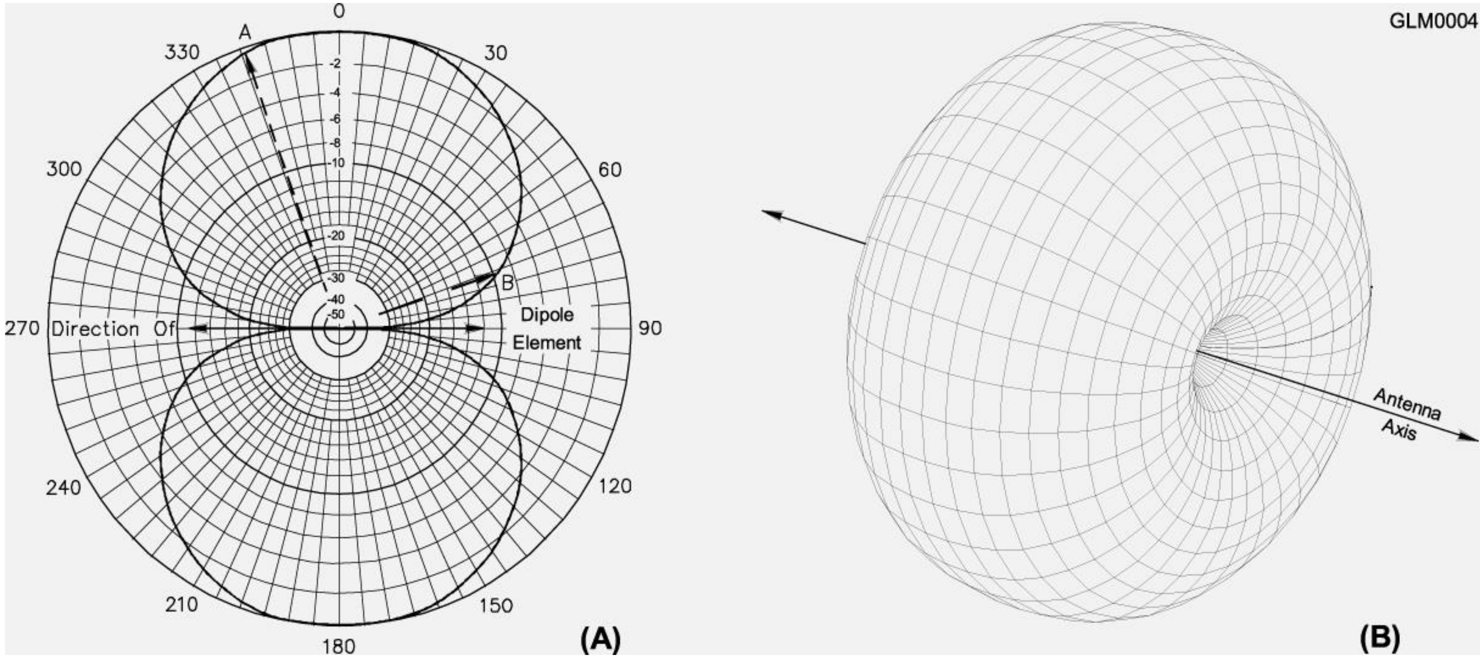
Practical Information – Dipole Lengths

Wavelength	*Frequency*	*Length*
80 meters	3.725 MHz	125.6 feet
40 meters	7.125 MHz	66 feet
15 meters	21.125 MHz	22 feet
10 meters	28.150 MHz	16.6 feet
10 meters	28.475 MHz	16.4 feet
2 meters	146.0 MHz	3.25 feet
1.25 meters	223 MHz	2.1 feet = 25 inches

Broadside Radiation Pattern

Pg 7-2

The low angle azimuthal radiation pattern of an ideal half-wavelength dipole antenna installed 1/2 wavelength high and parallel to the Earth **is a figure-eight at right angles to the antenna**. (G9B04)



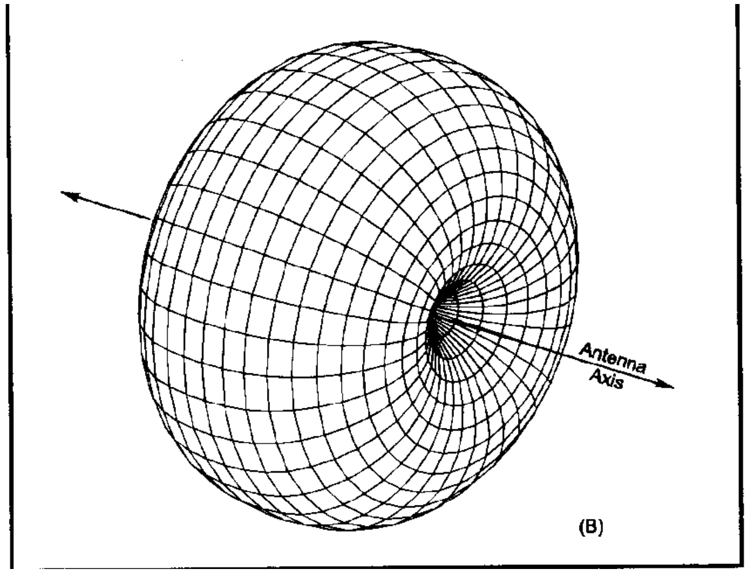
Azimuthal Pattern

Computer Generated Sketch

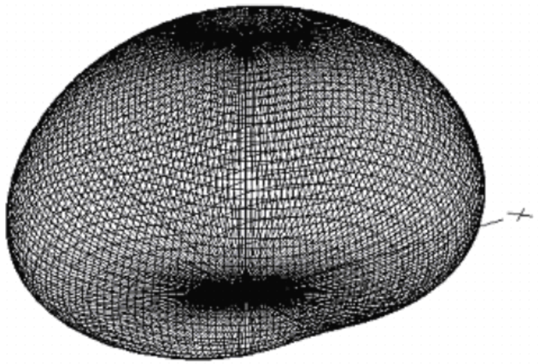
Dipole Antennas Pattern

- **If the antenna is less than 1/2 wavelength high, the azimuthal pattern is almost omnidirectional and maximum straight up.**

(G9B05)



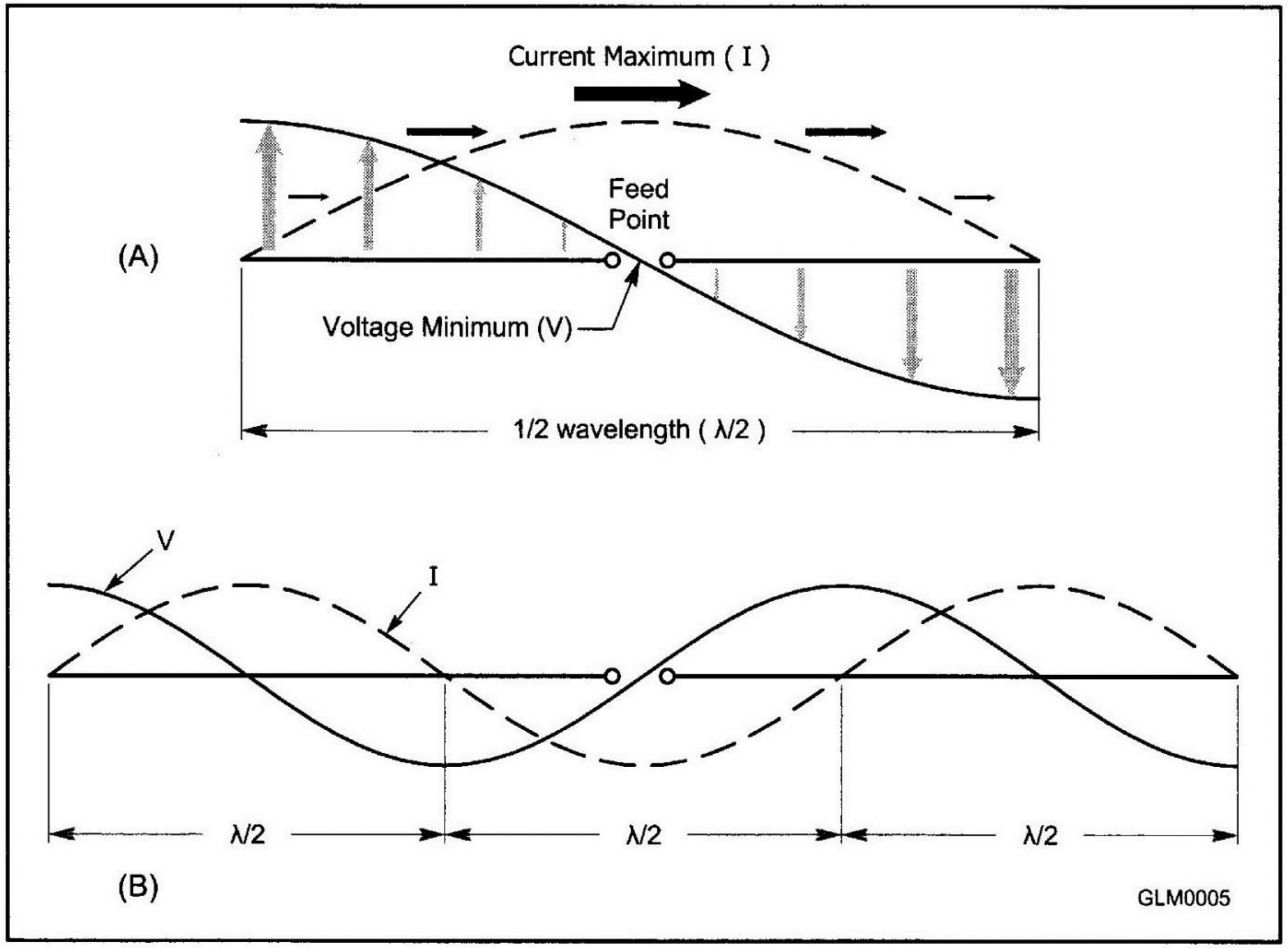
Free-space directional pattern



Omni-directional pattern

Dipole Antenna

7-3



The Ground-Plane (Vertical)

7-4

- A vertical is like a dipole that is oriented perpendicular (**vertical** to the Earth's surface).
- One half of the dipole is replaced by the ground-plane.
  - Earth
  - Car roof or trunk lid or other metal surface.
  - Radial wires.
- Length (in feet) = 246 / Frequency (in MHz).
  - For 146 MHz: 246 / 146 = 1.7 ft = 20.2 inches

Some books say

234/f

Vertical Antennas

7-4

- The approximate length for a 1/4-wave vertical antenna cut for 28.5 MHz is **8 feet.** (G9B12)

Calculate 1/4 wavelength in feet by dividing 234 by the frequency in MHz.

234/28.5 = 8.2 Feet

Practical Information: Vertical Lenghts

Wavelength	*Frequency*	*Length*
80 meters	3.700 MHz	63.24 feet
40 meters	7.125 MHz	32.8 feet
15 meters	21.125 MHz	11.1 feet
10 meters	28.150 MHz	8.3 feet
10 meters	28.4 MHz	8.2 feet
6 meters	52.5 MHz	4.5 feet
2 meters	146.0 MHz	1.6 feet (19.25 inches)
1.25 meters	223.0 MHz	1.05 feet (12.6 inches)
70 cm	440.0 MHz	0.53 feet (6.4 inches)
23 cm	1282.5 MHz	0.18 feet (2.2 inches)

Ground-Mounted Vertical Antennas

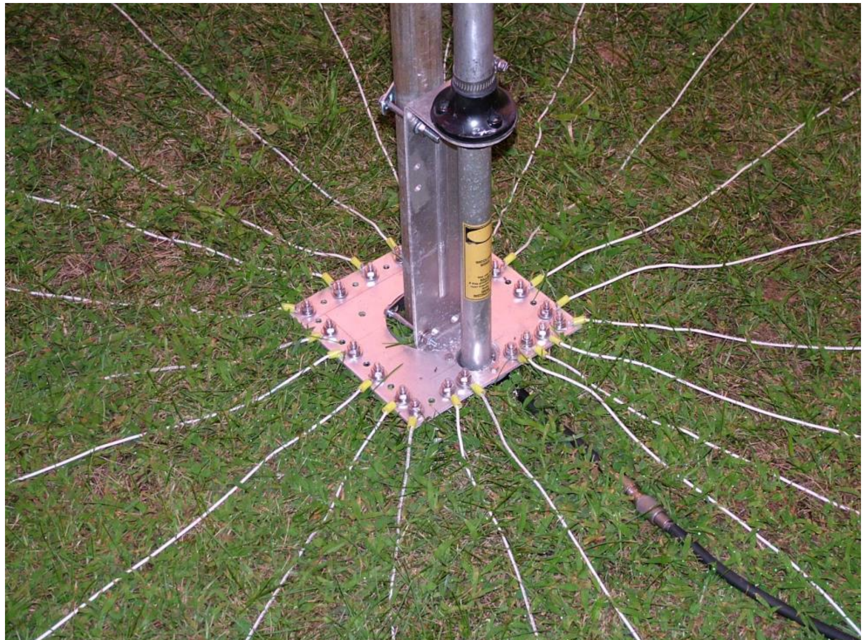
7-4

- The radial wires of a ground-mounted vertical antenna system should be placed **on the surface or buried a few inches below the ground.** (G9B06)

A common length for radials is ¼ wavelength.

Although on ground-mounted verticals the length of the radials is not that critical.

Ground wire kit.

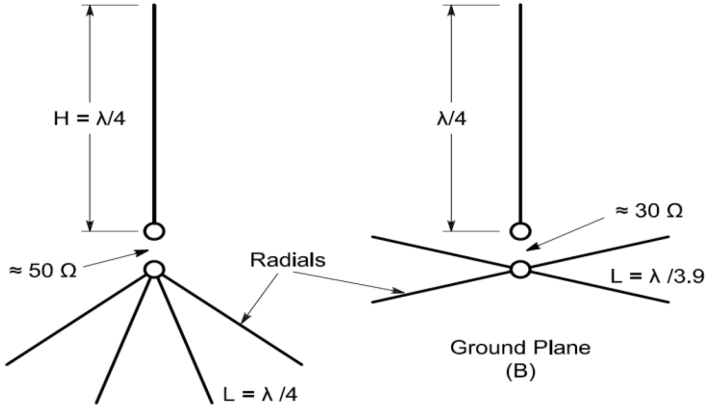


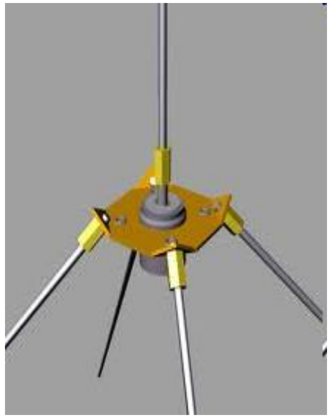
Surface mounted ground wires.

Elevated Vertical Antennas

7-5

- An advantage of downward sloping radials on a quarter wave ground-plane antenna is that **they bring the feed-point impedance closer to 50 ohms.** (G9B02)
- The natural feed point of a quarter-wave vertical is 35 ohms, but the feed-point impedance of a ground-plane antenna **increases** when its radials are changed from horizontal to downward-sloping. (G9B03)
  - Bending the radials changes the impedance up towards 50 ohms.



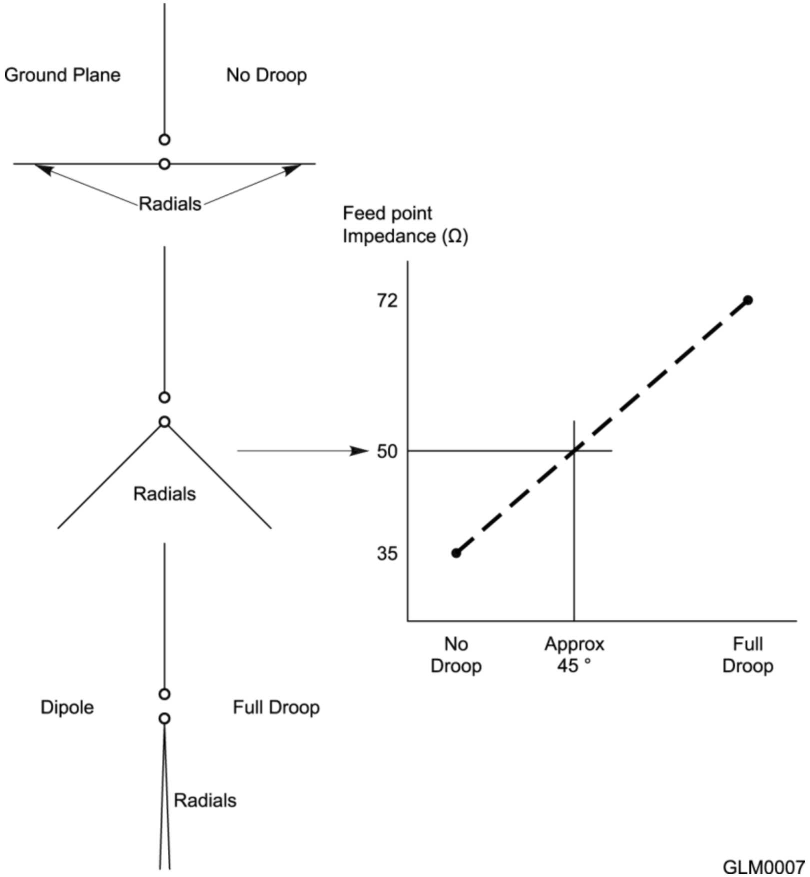


Notice ground plane elements are angled downwards.

Sloping Radials

7-5

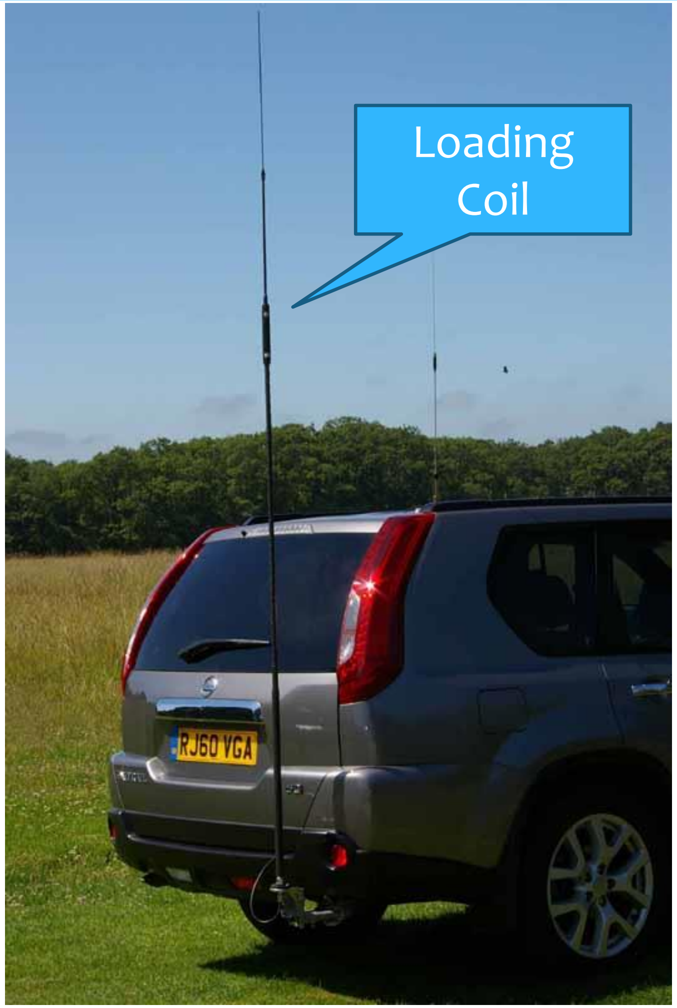
As the radials droop downward, the impedance is increased.

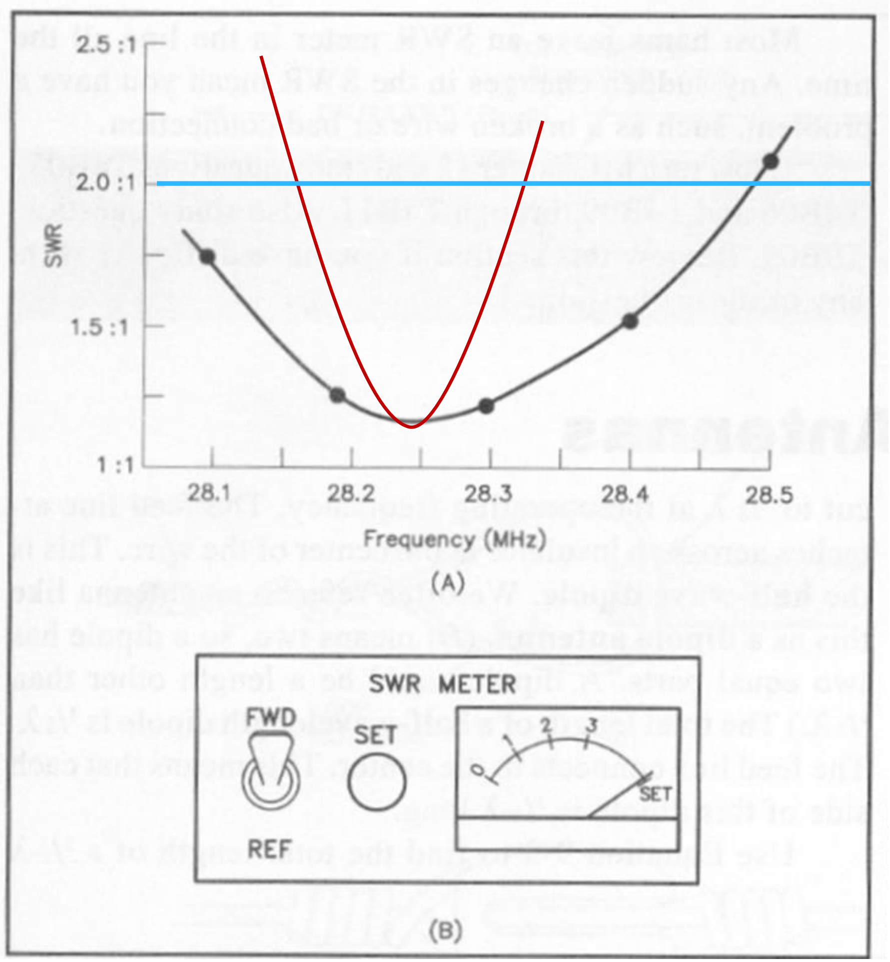


Mobile Antennas are Verticals

7-5

- Loading Coil
  - **Reduced bandwidth** (G4E06)
- Capacity Hat
  - Increases Bandwidth
- Corona Ball
  - Prevent high-voltage discharge

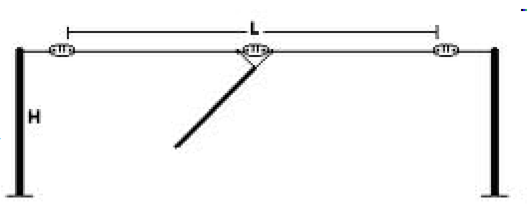




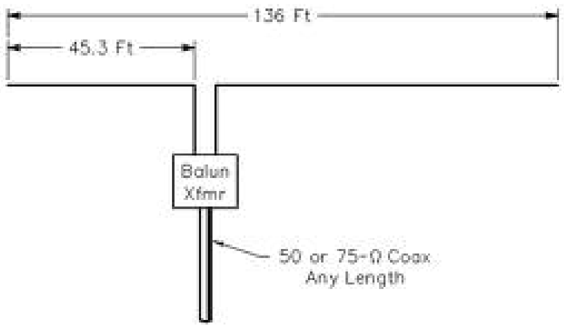
Dipole Antenna Impedance

7-6

- As the antenna is lowered from 1/4 wave above ground, the feed-point impedance of a 1/2 wave dipole antenna **steadily decreases.** (G9B07)
  - Antenna height affects the feed point impedance.

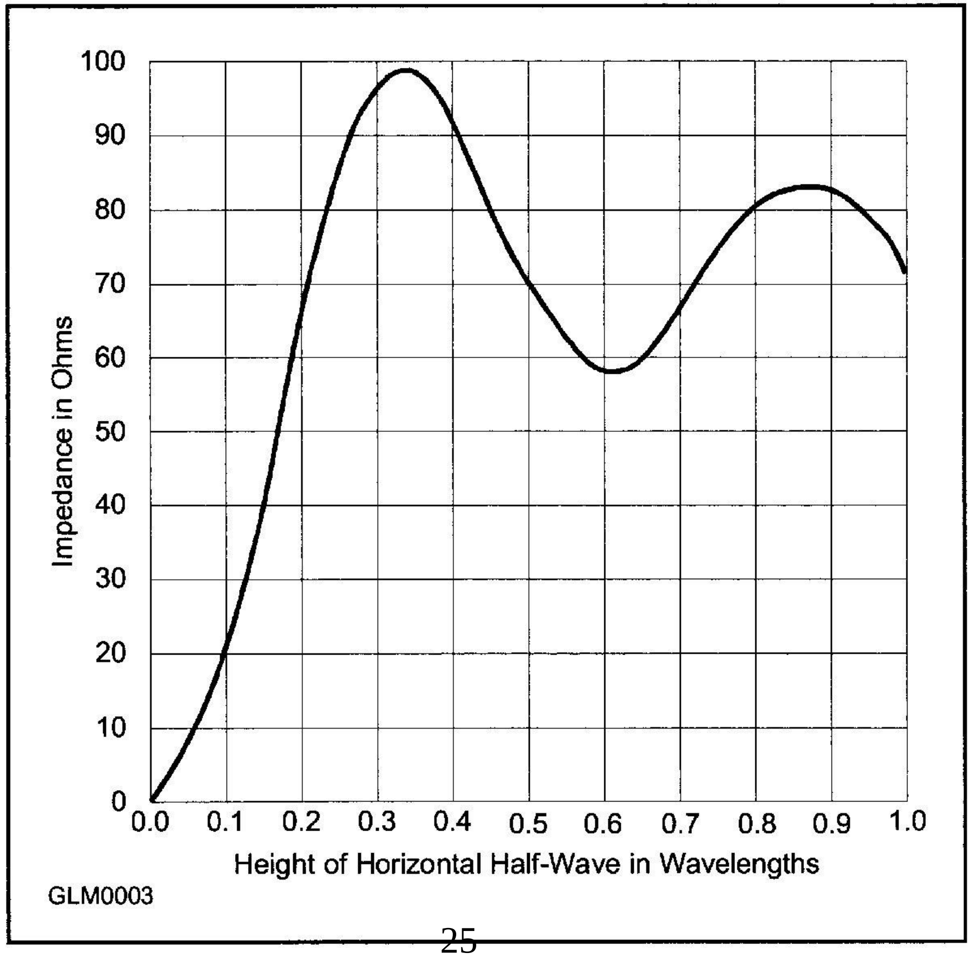


- The feed-point impedance of a 1/2 wave dipole **steadily increases** as the feed-point location is moved from the center toward the ends. (G9B08)



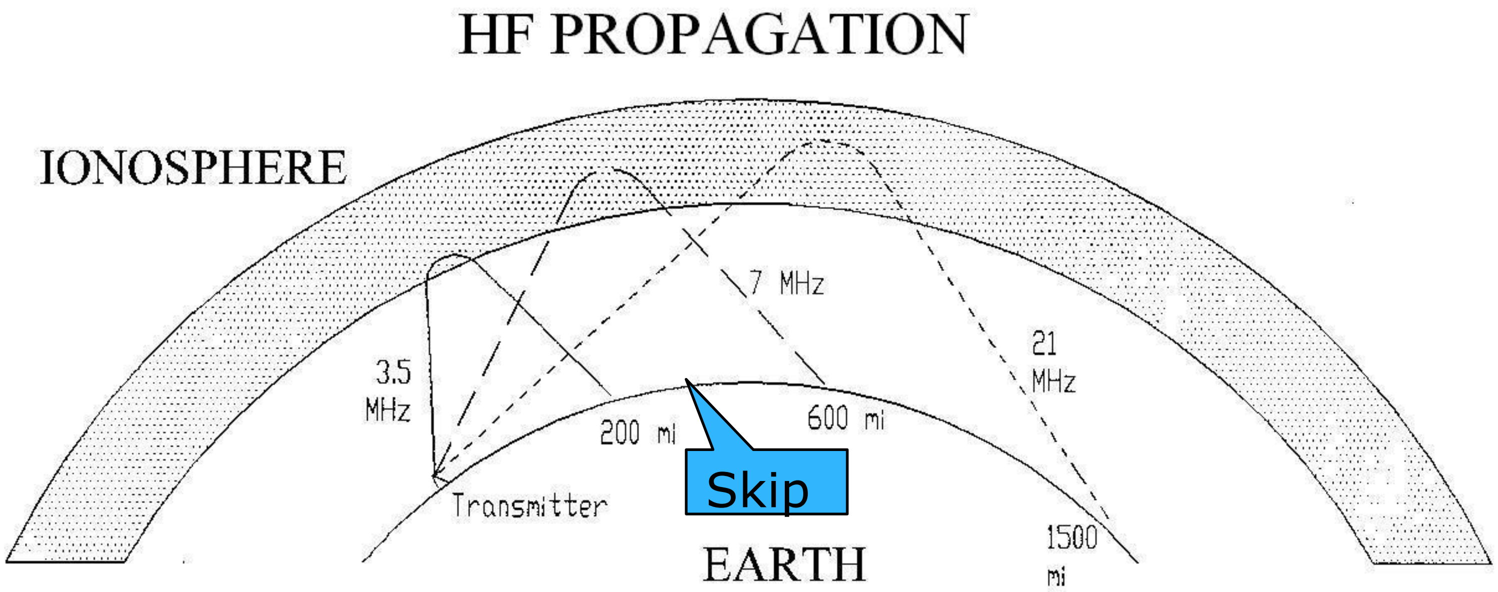
Dipole Antenna Impedance

7-6



HF Propagation

* The ionosphere reflects the radio waves



Multi-Hop Propagation

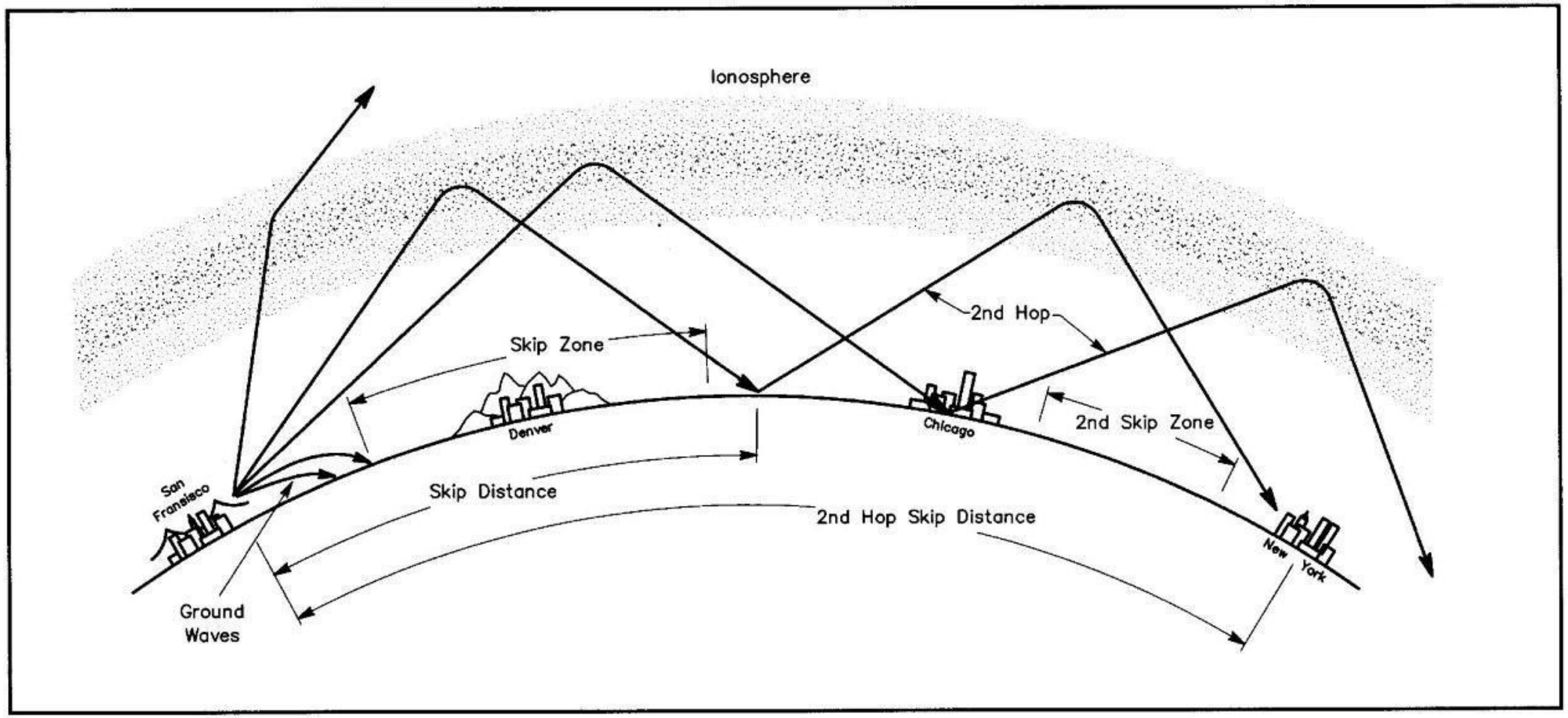
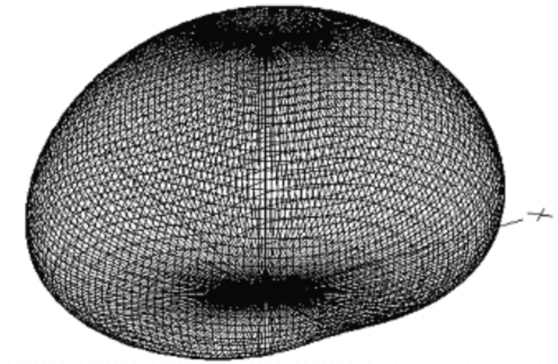


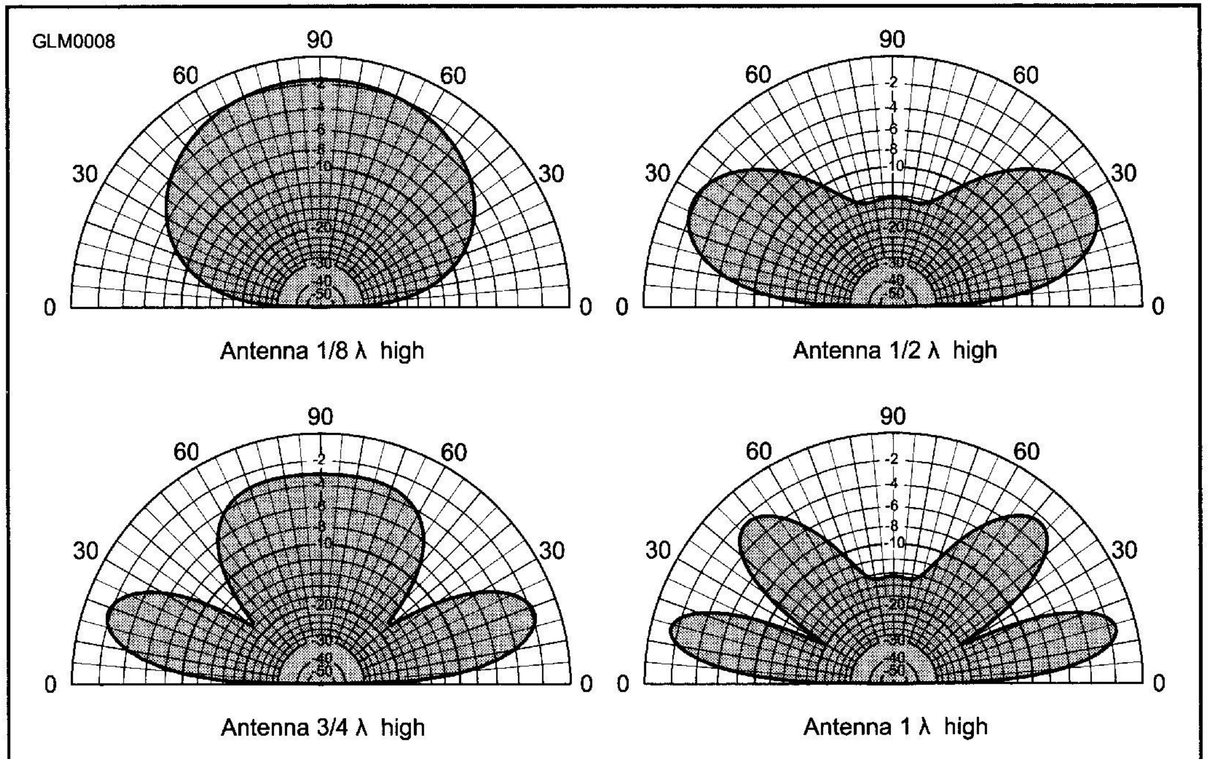
Figure 3-6 — This drawing illustrates how radio waves travel into the ionosphere and are bent back to Earth. Ground waves, skip distance and skip zone are all shown on the drawing.

Dipole Radiation Pattern - Elevation

7-6

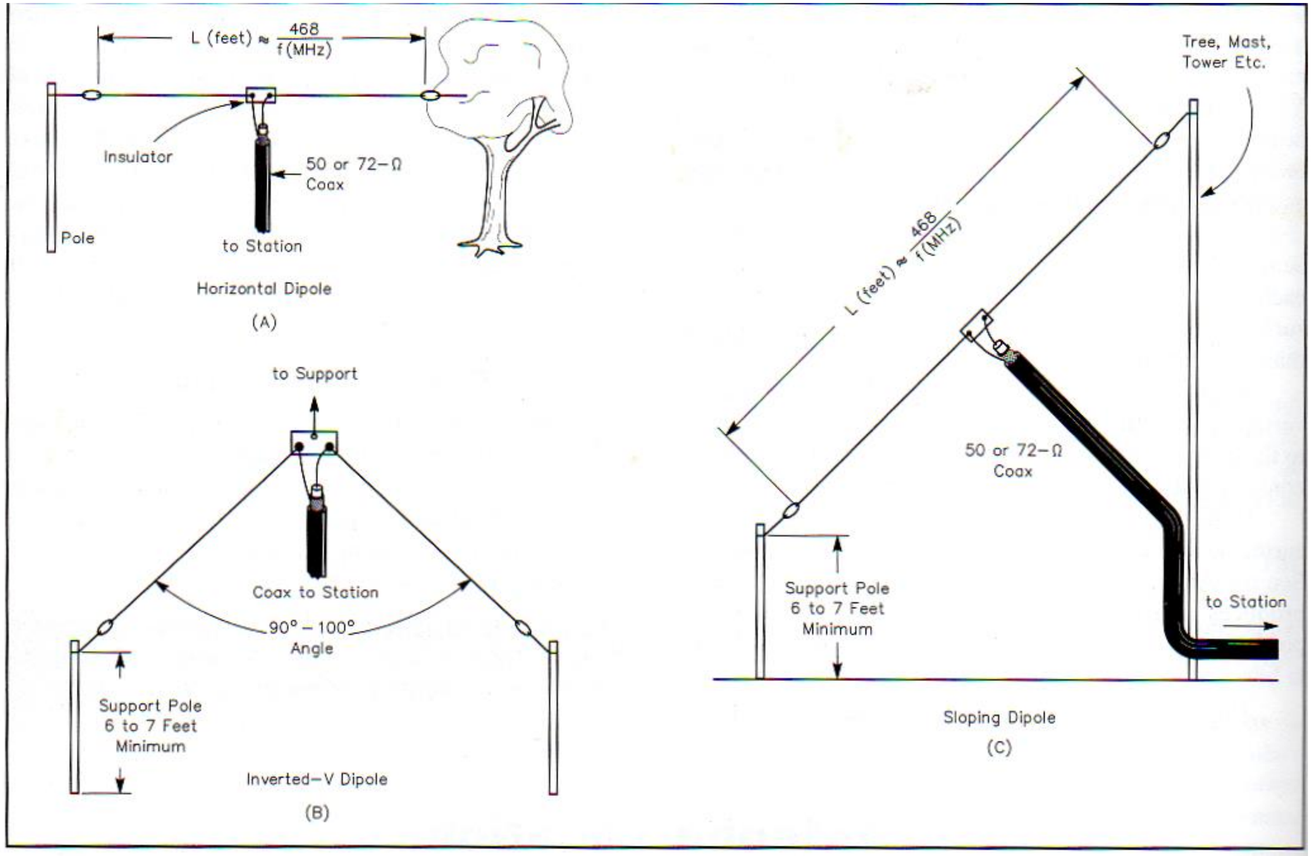
At heights below ½ wavelength, the dipole's pattern is almost omnidirectional.





Practical Information - Dipoles

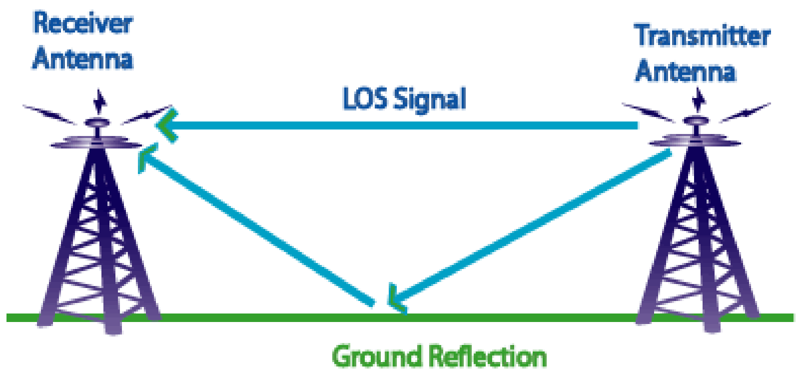
* Dipoles can be configured many different ways.



Antenna Polarizations

7-7

- An advantage of a horizontally polarized as compared to vertically polarized HF antenna is **lower ground reflection losses.** (G9B09)
  - Propagation via multi-hop refraction:
    - RF energy is lost each time the radio wave is reflected from the Earth's surface.
  - The amount of energy lost depends on:
    - Frequency of the wave
    - Angle of incidence
    - Ground irregularities
    - Electrical conductivity of the point of reflection.



Directional (Beam) Antennas

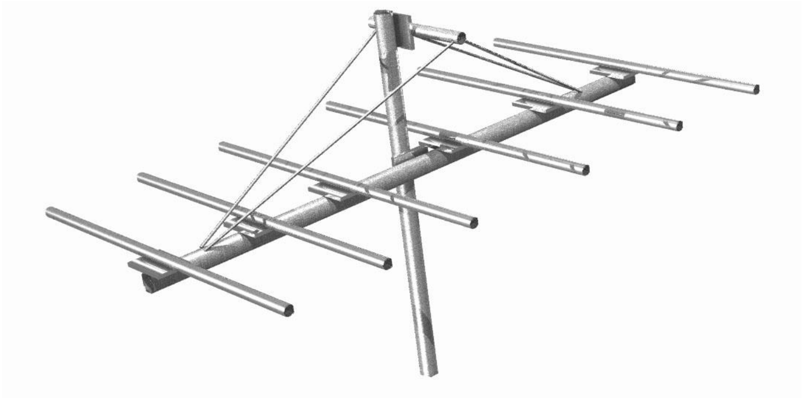
- Beam antennas focus or direct RF energy in one direction.
  - Gain
    - An apparent increase in power in the desired direction (both transmit and receive).

- Yagi (rod-like elements – TV antennas).

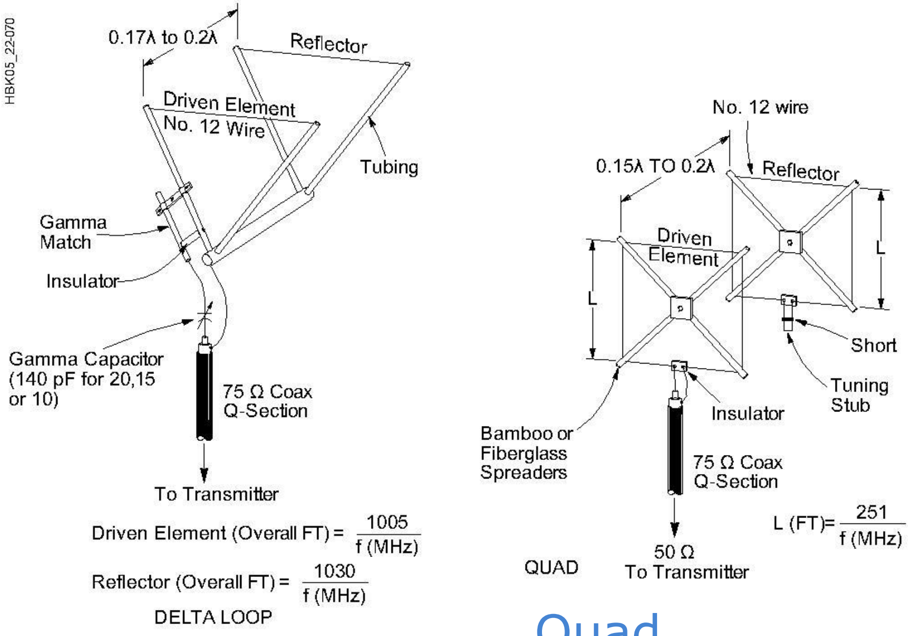
- Quad (square wire loop elements).
- Delta (triangle wire loop elements).

Directional (Beam) Antennas

Sections 7.3, 7.4



Yagi



Quad

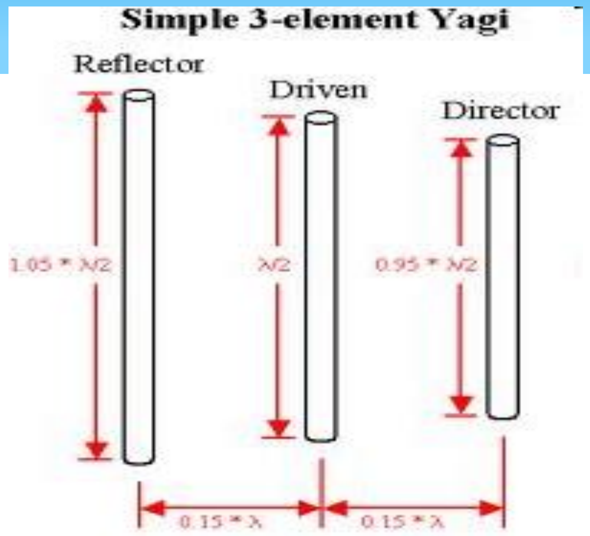
Directional (Beam) Antennas

7-9

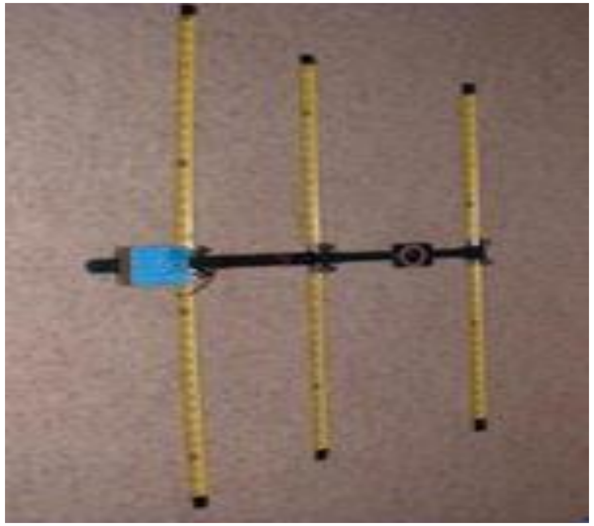
- Beam antennas have parts called elements.
  - Driven element connected to the radio by the feed line.
  - Reflector element is on the back side.
  - Director element is on the front side toward the desired direction.

Antennas

7-9



- **Larger diameter elements** increase the bandwidth of a Yagi antenna. (G9C01)
- The approximate length of the driven element of a Yagi antenna is **1/2 wavelength.** (G9C02)
- In a three-element, single-band Yagi antenna, **the director is normally the shortest parasitic element.** (G9C03)
- **The reflector is normally the longest parasitic element** of a three-element, single-band Yagi antenna. (G9C04)



Parasitic Energy

* Energy is coupled from one boat into the other.

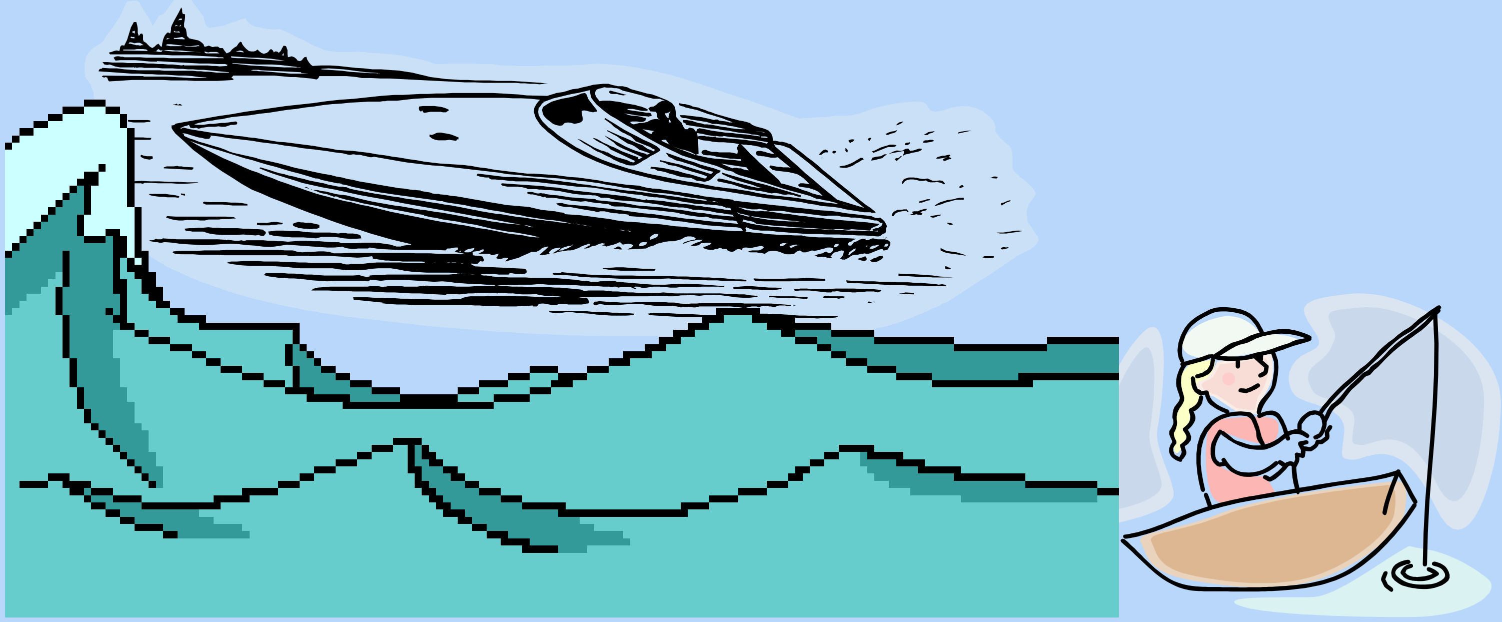
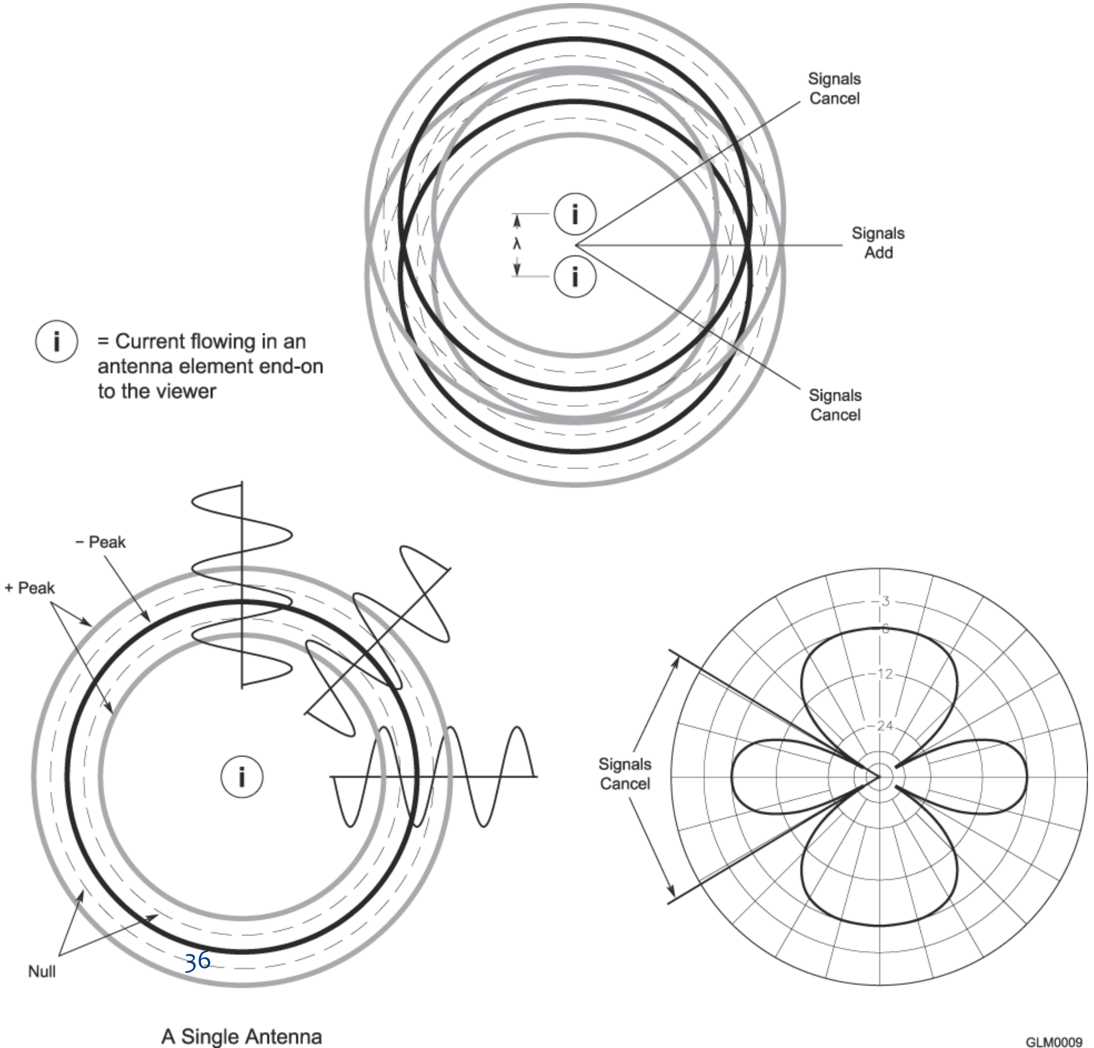


Figure 7-7

* Illustration of how the radiated signals add in some direction and cancel in other directions with two elements.



Directional (Beam) Antennas

7-9

- This Parasitic action creates:
  - GAIN in the forward direction
  - REJECTION in other directions

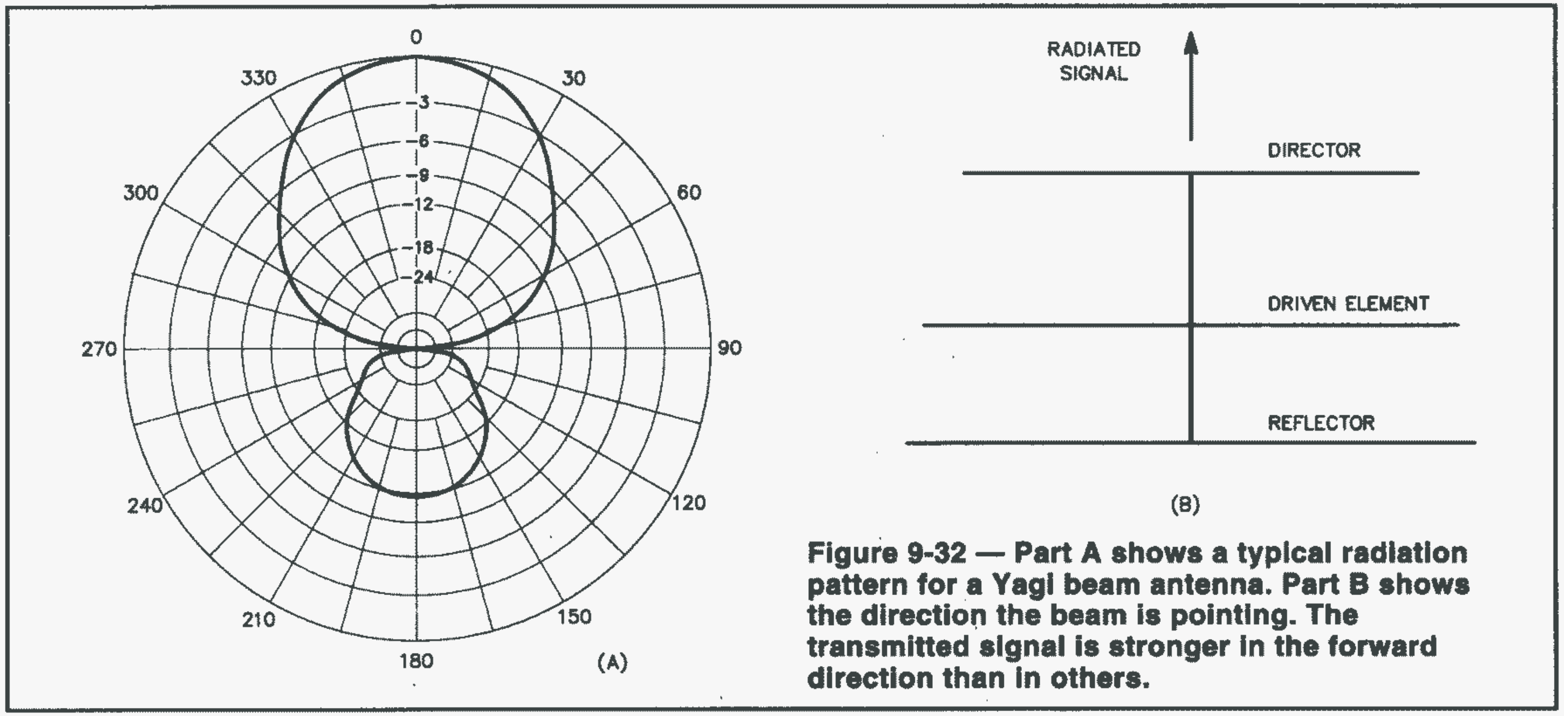


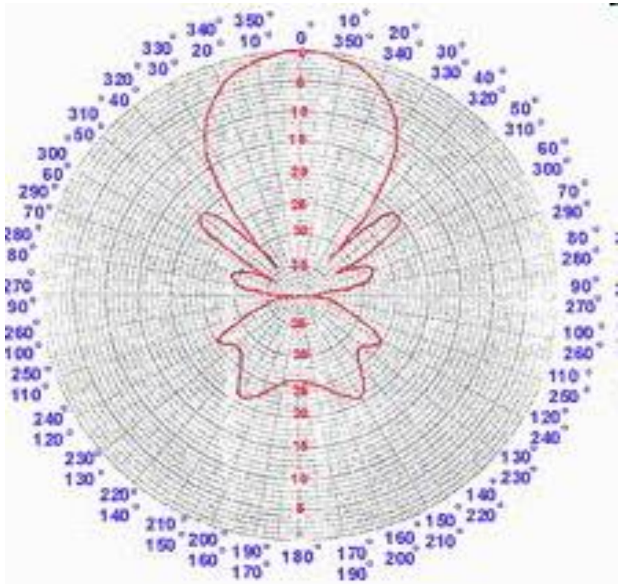
Figure 9-32 — Part A shows a typical radiation pattern for a Yagi beam antenna. Part B shows the direction the beam is pointing. The transmitted signal is stronger in the forward direction than in others.

Yagi Antennas

7-10

- The **gain increases** when **you increase boom length** and add directors to a Yagi antenna. (G9C05)

- A Yagi antenna is often used for radio communications on the 20 meter band because it **helps reduce interference from other stations to the side or behind the antenna.**

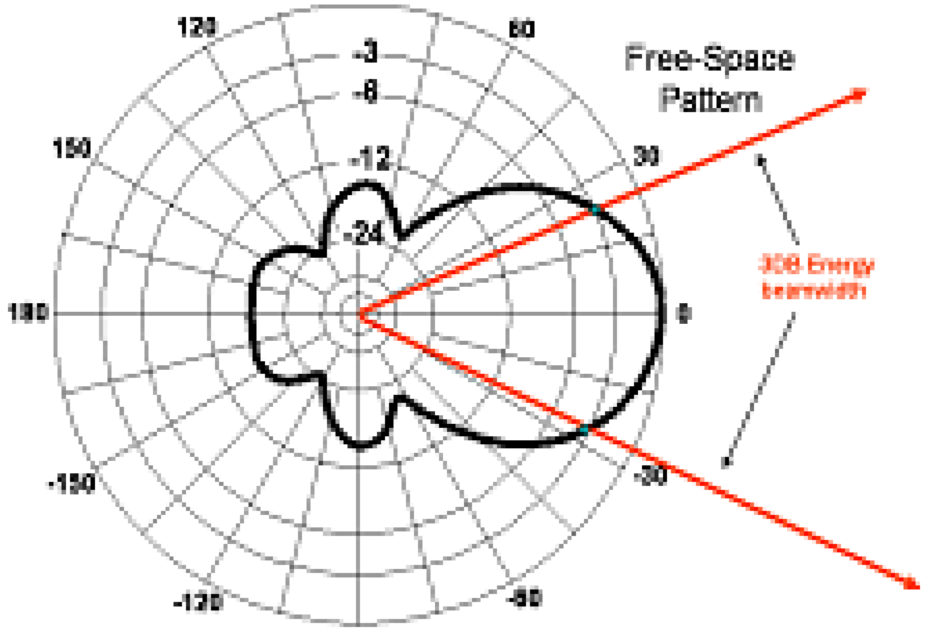


Yagi Antennas

7-9

- The "**front-to-back ratio**" of a Yagi antenna is **the power radiated in the major radiation lobe compared to the power radiated in exactly the opposite direction.** (G9C07)

- The "major lobe" or **"main lobe"** of a directive antenna is **the direction of maximum radiated field strength from the antenna.** (G9C08)

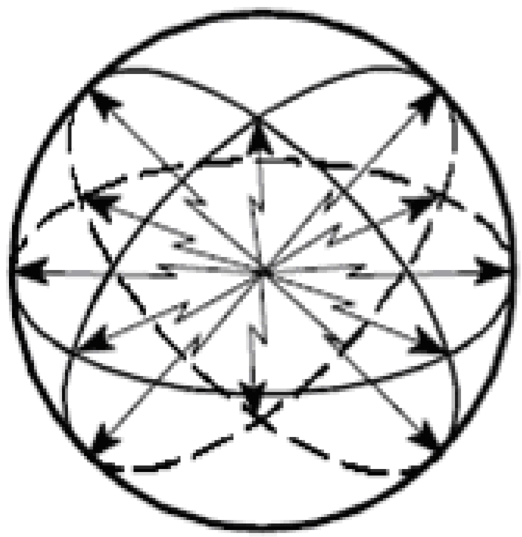


Isotropic Radiator

7-1

- Isotropic **radiators** are used as reference radiators
- An **isotropic radiator** is a theoretical point source of electromagnetic or sound waves.

SPHERE (Isotropic source)



G = 0 dB

Dipole Antenna Pattern

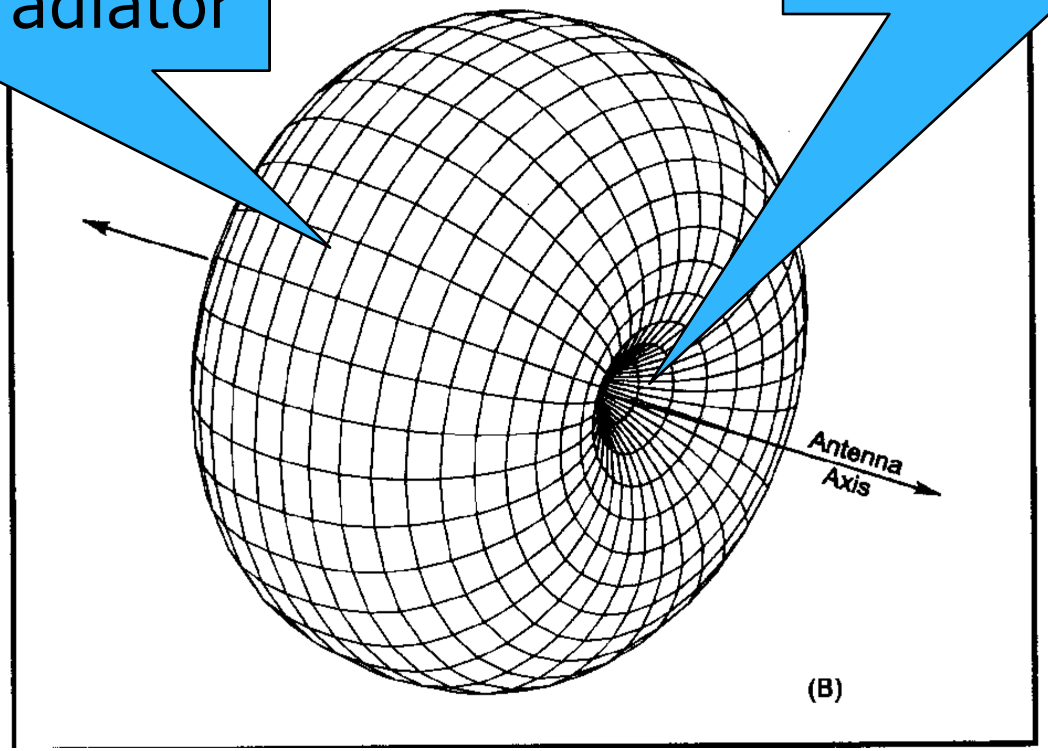
Pg 7-2

Maximun Radiation

2.15 dB more than an isotropic radiator

Minimum Radiation

Null



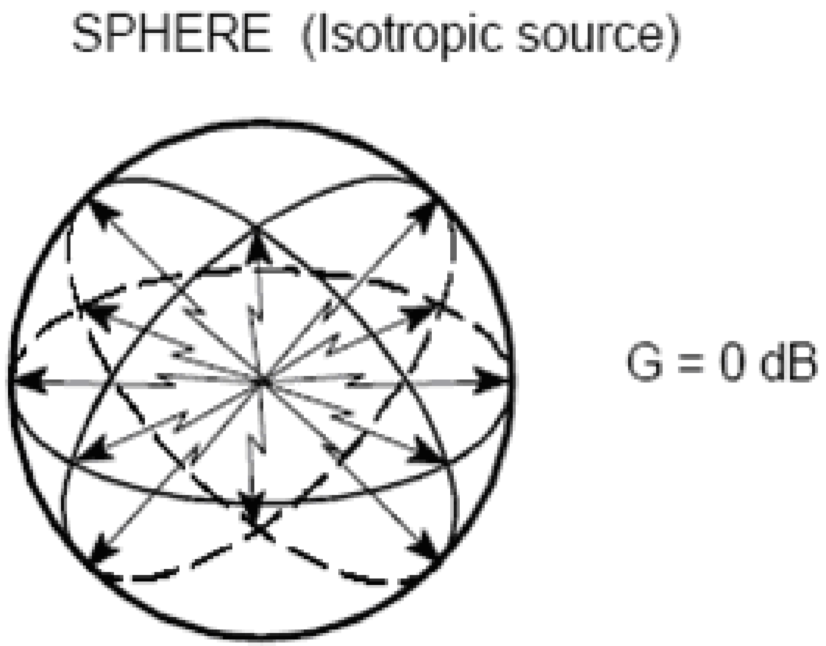
Either can be used as a reference

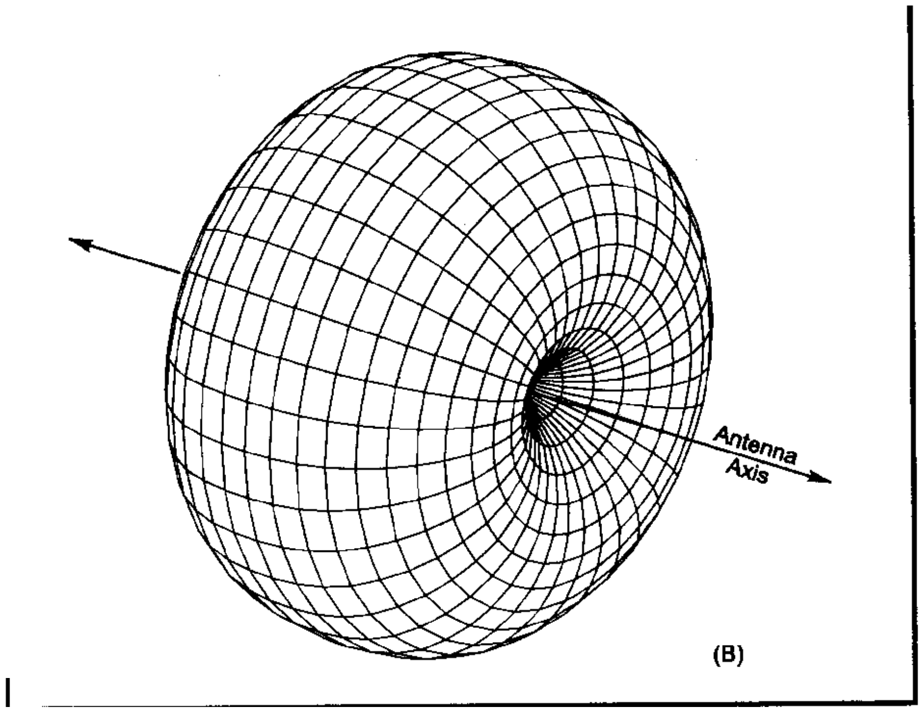
Pg 7-2

)

Isotropic

Dipole

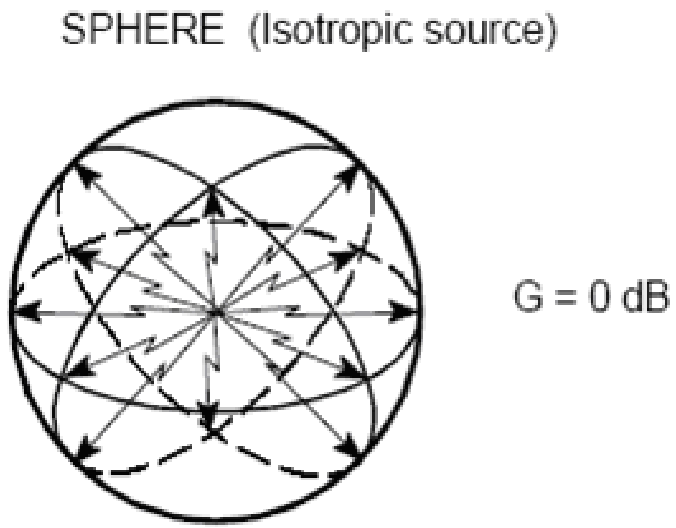


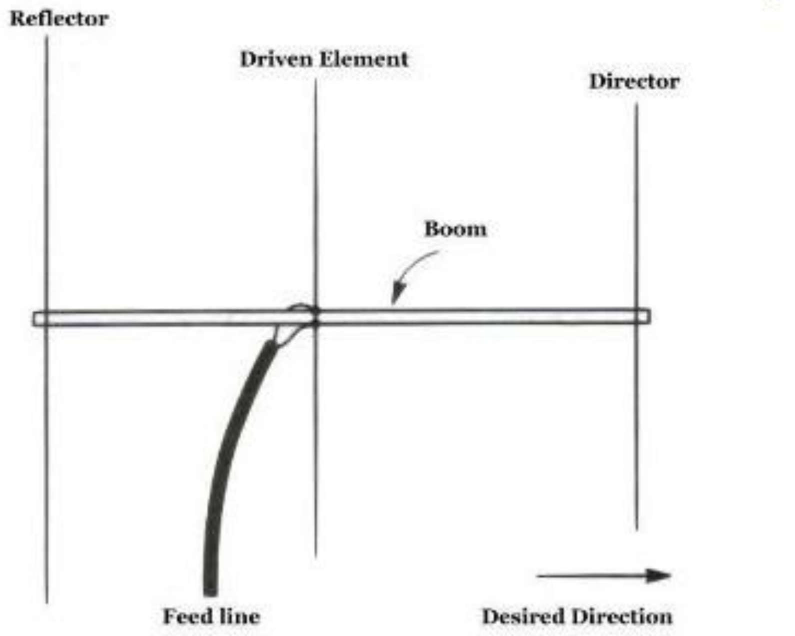


Antenna Gain in dBi

7-2

- The approximate maximum theoretical forward gain of a three element, single-band Yagi antenna is **9.7 dBi**.
  - ***dBi*** *refers to a reference level of dB Isotropic*

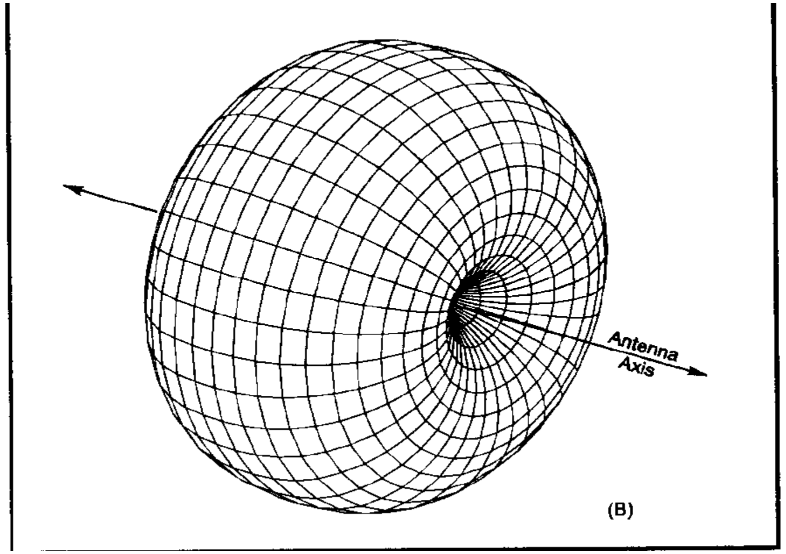


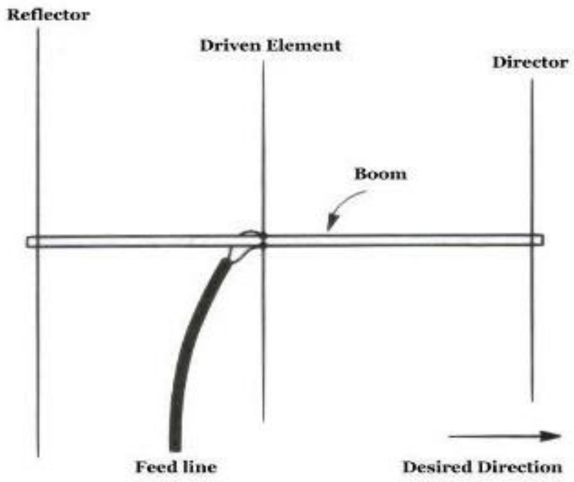


  - Isotropic radiators are used as reference radiators

Antenna Gain in dBd

- The approximate maximum theoretical forward gain of a three element, single-band Yagi antenna is **7.5 dBd**
  - ***dBd*** *refers to a reference level of the dipole at its maximum radiation point*





  - You may also see gain expressed as **dBd**, which is the gain referenced to a dipole. This is typically 2.15 dB less than the gain expressed in dBi.

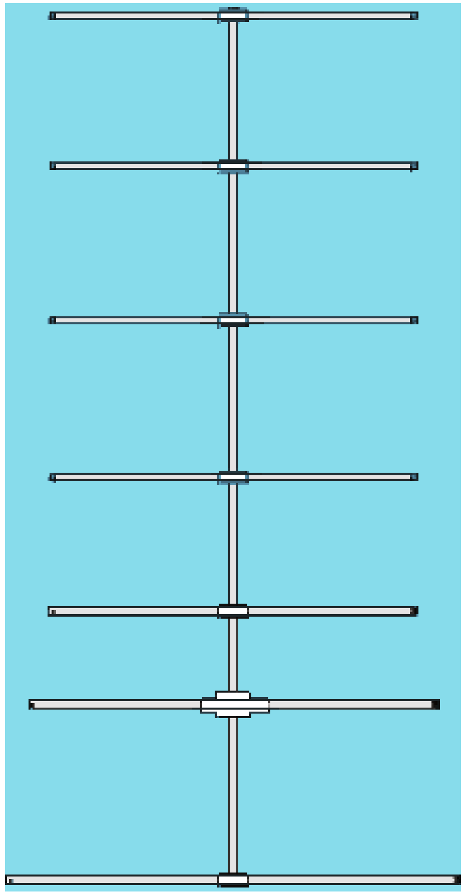
Yagi Antennas

7-10

- In a Yagi antenna design, the following variables that could be adjusted to optimize forward gain, front-to-back ratio, or SWR bandwidth (G9C10)

  - The physical length of the boom
  - The number of elements on the boom
  - The spacing of each element along the boom

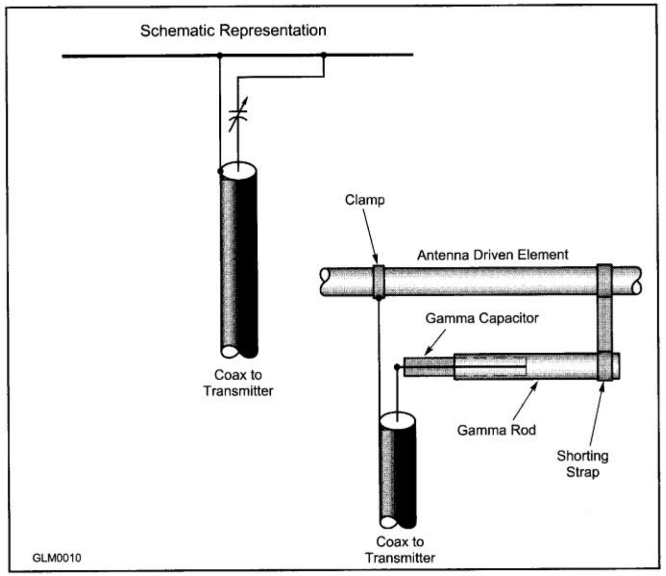
All of these choices are correct



Antennas – Gama Match

7-11

- The purpose of a **gamma match** used with Yagi antennas is **to match the relatively low feed-point impedance to 50 ohms.** (G9C11)

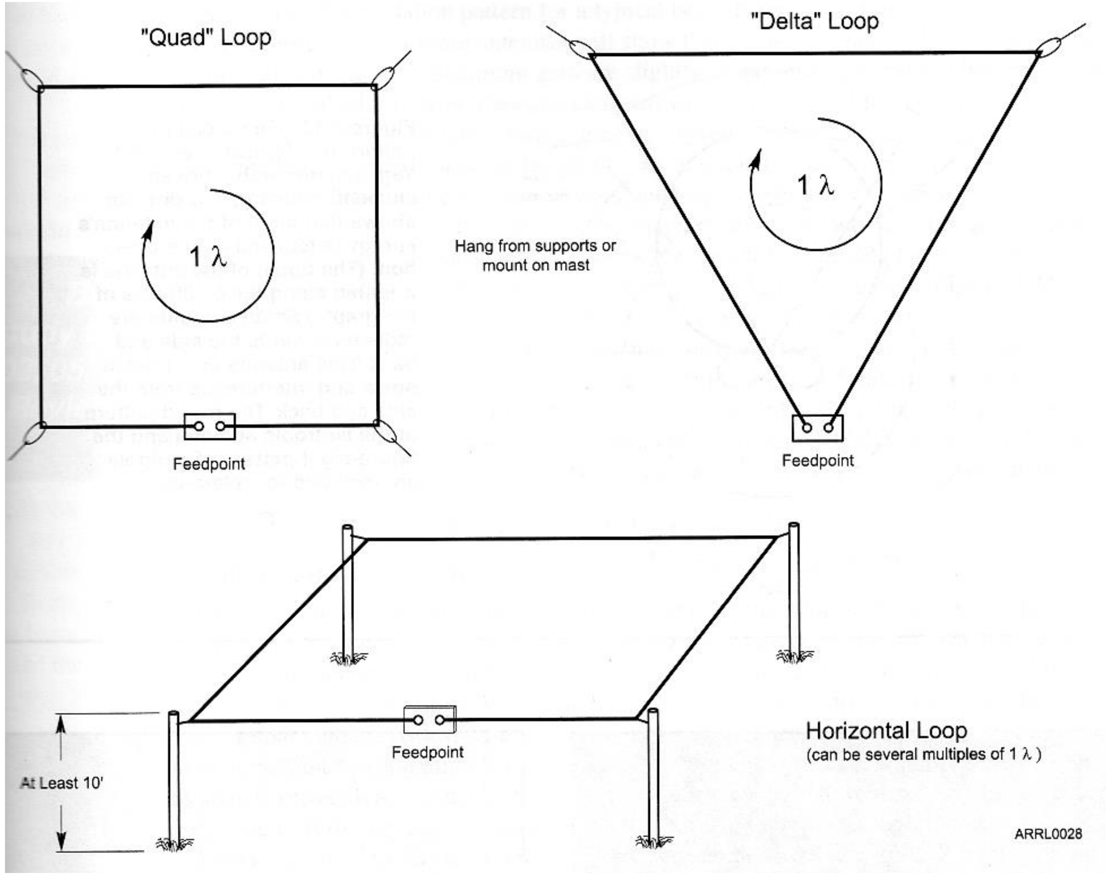


- An advantage of using a **gamma match** for impedance matching of a Yagi antenna to 50-ohm coax feed line is that **it does not require that the elements be insulated from the boom.** (G9C12)

Variations of the Loop Antennas

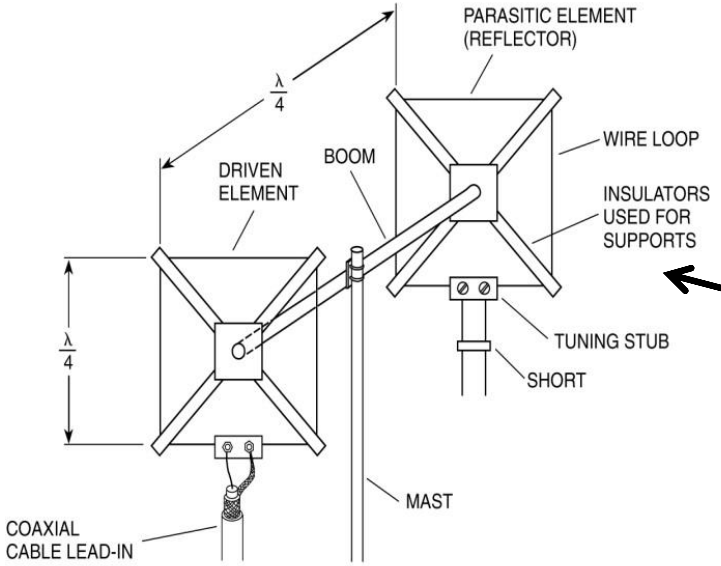
Review

- Quad
- Delta
- Horizontal



Quad Beam Antennas

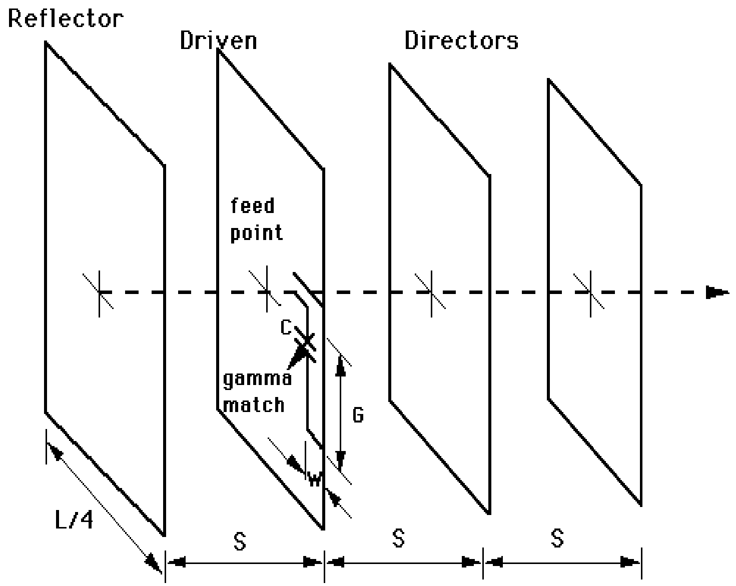
- The elements of a quad antenna are square loops. Each side of a quad antenna driven element is approximately **1/4 wavelength.**



Driven Element for each side (in feet) =

$$\frac{1005}{f\ (\text{MHz})} / 4$$

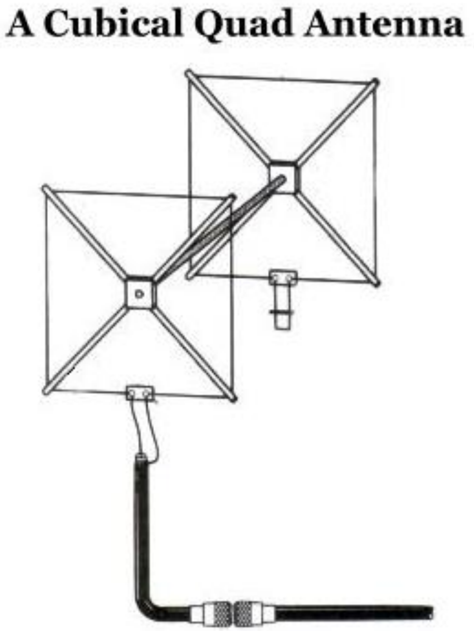
Reflector is 5% longer

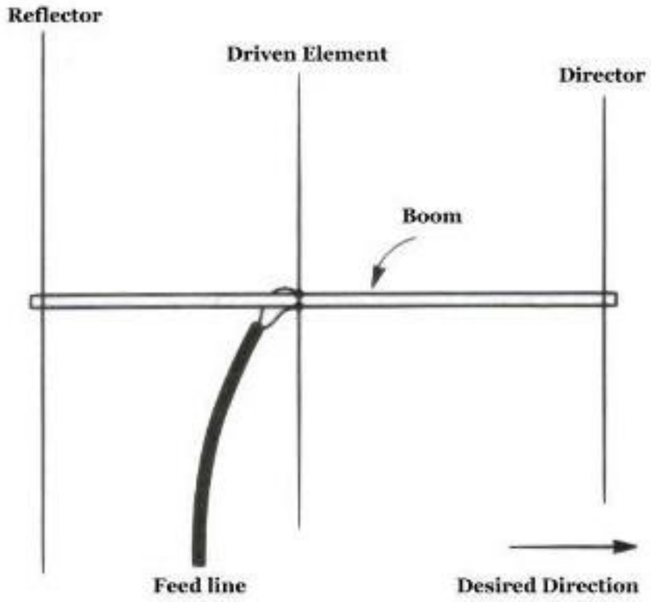


- **The reflector element must be approximately 5% longer than the driven element** for a two-element quad antenna when the antenna is meant to operate as a beam antenna, assuming one of the elements is used as a reflector.

Quad Antennas

- The forward **gain** of a **two-element quad** antenna is **about the same** as the forward gain of a **three-element Yagi** antenna**.** (G9C14)

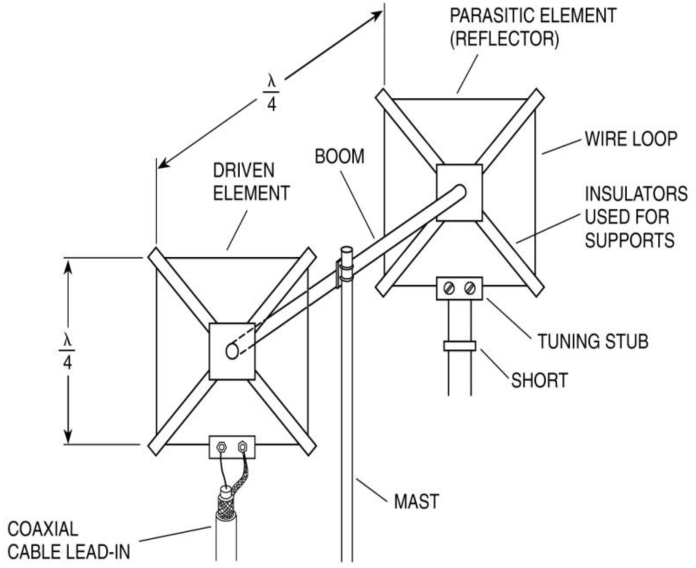




- Each side of a quad antenna reflector element is **slightly more than 1/4 wavelength.** (G9C15)

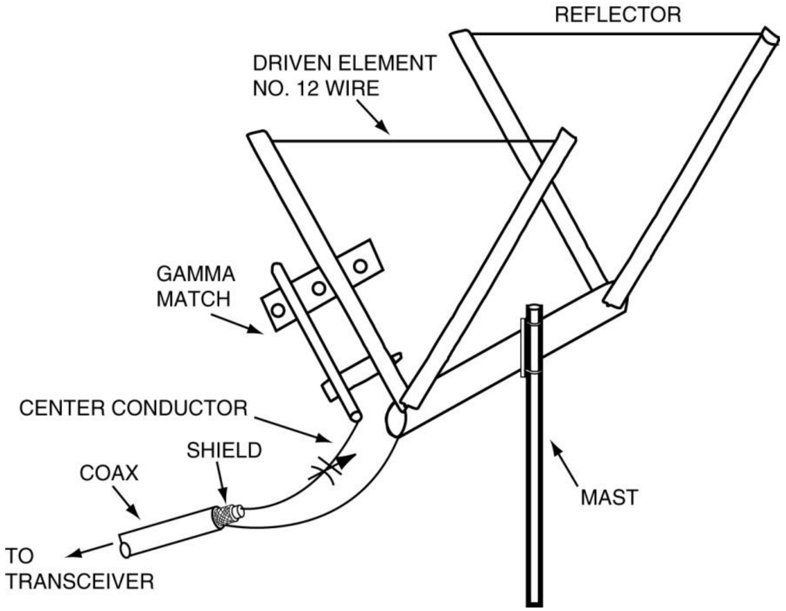
Delta Loop Antennas

- The gain of a two-element delta-loop beam is **about the same** as the gain of a two-element quad antenna. (G9C16)



Driven Element for each side (in feet) =

$$\frac{1005}{f\ (\text{MHz})} / 3$$

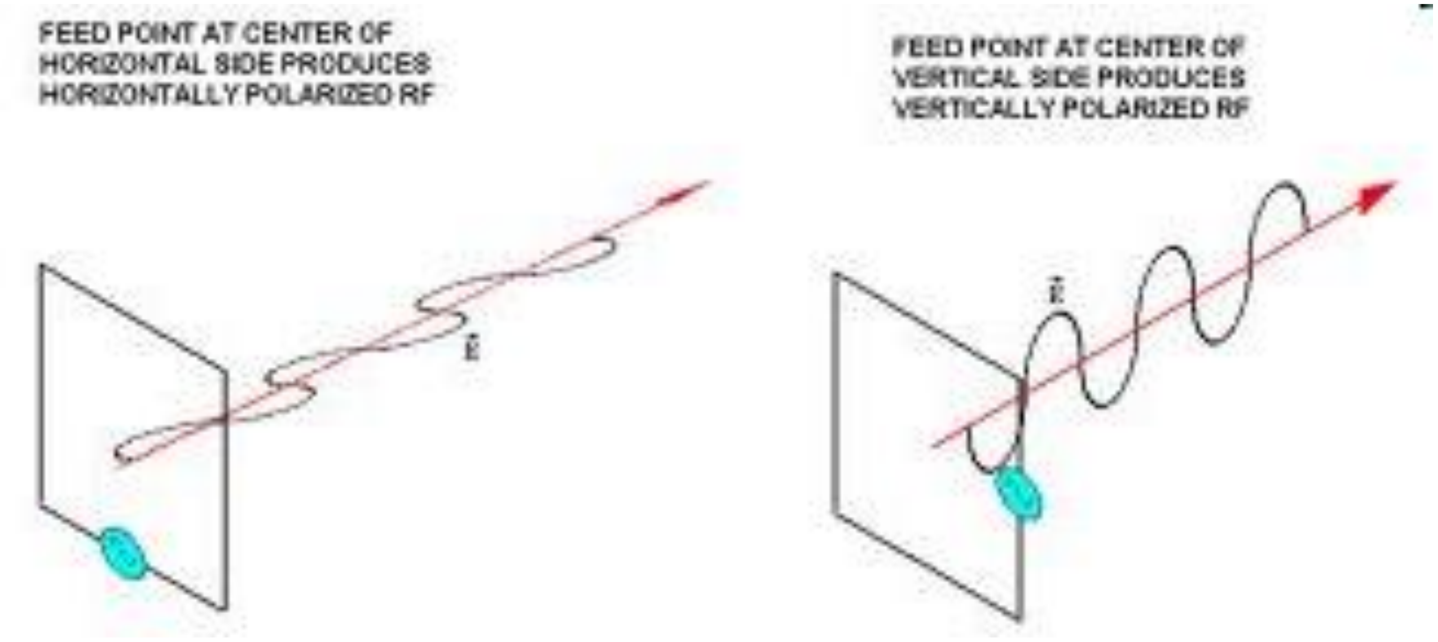


- Each leg of a symmetrical delta-loop antenna is approximately **1/3 wavelength.** (G9C17)

Antennas

7-13

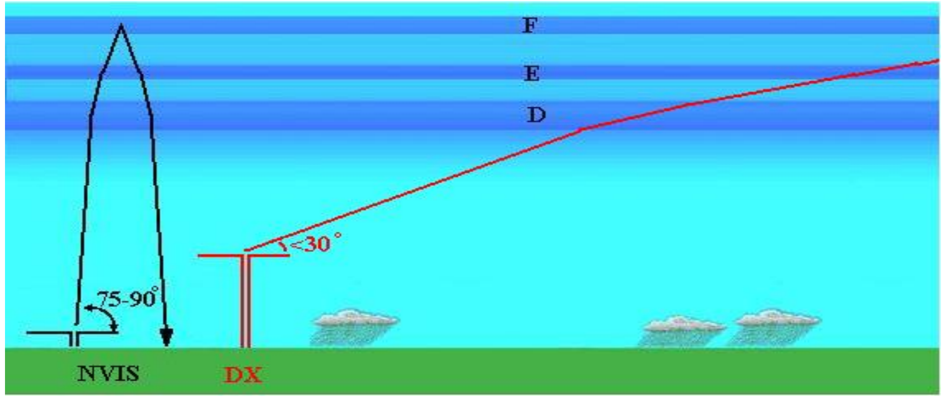
- **The polarization of the radiated signal changes from horizontal to vertical** when the feed point of a quad antenna is changed from the center of the either horizontal wire to the center of either vertical wire. (G9C18)



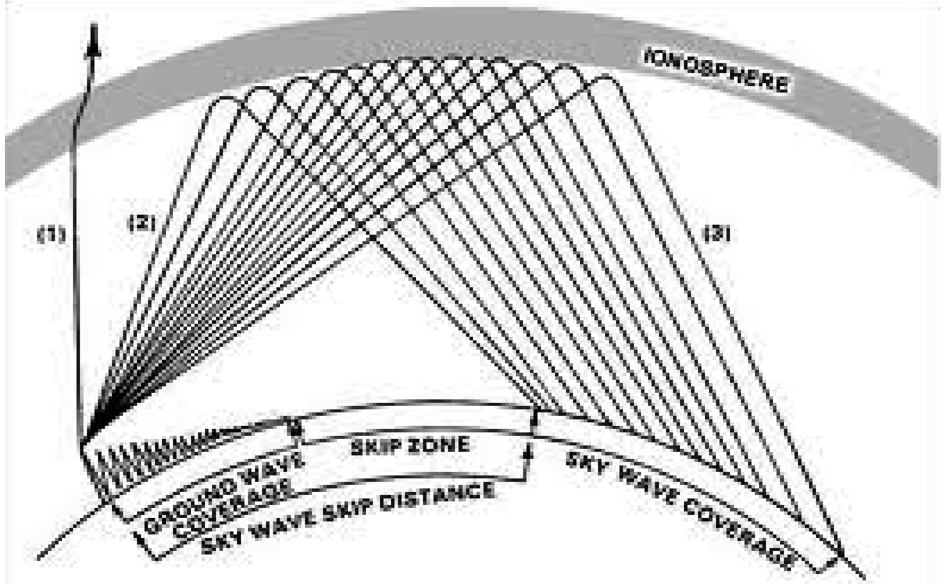
NVIS Antennas

7-13

- The term "NVIS" means **Near Vertical Incidence Sky wave** when related to antennas. (G9D01)



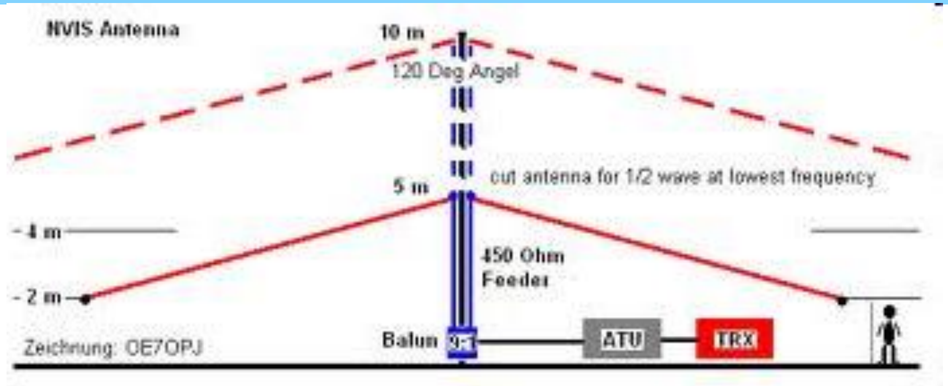
- An advantage of an NVIS antenna is **high vertical angle radiation for working stations within a radius of a few hundred kilometers.** (G9D02)



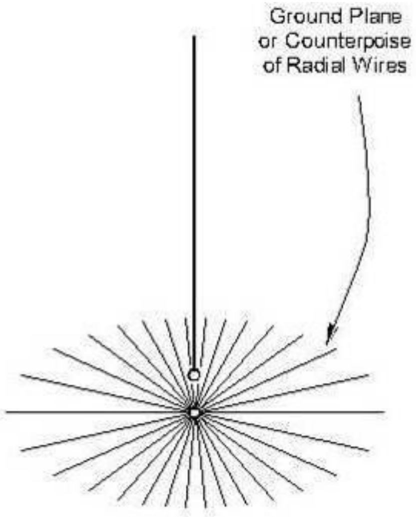
Angle of radiation determines the area of coverage

Antennas

- An NVIS antenna typically installed **between 1/10 and 1/4 wavelength** above ground. (G9D03)

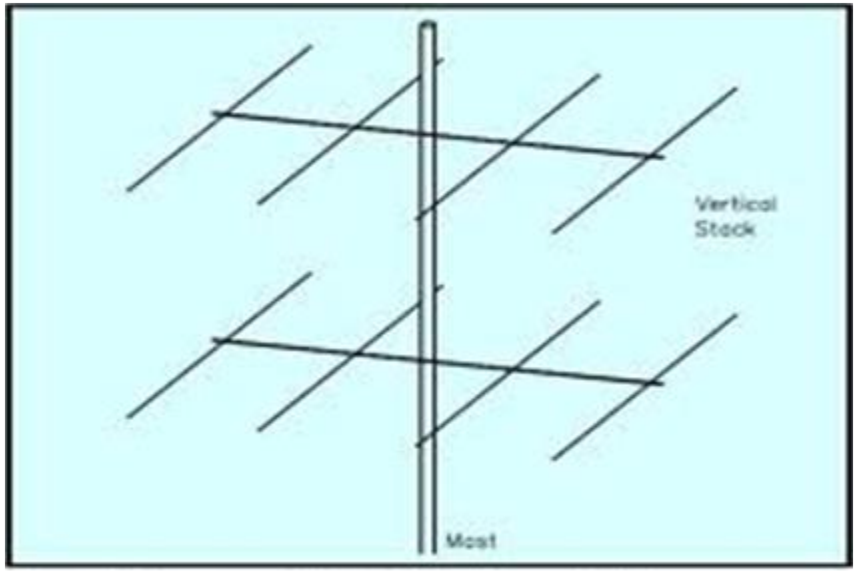


- **Practical information: Vertical antennas make <u>very poor</u> NVIS antennas.**



Stacked Antennas

- The advantage of vertical stacking of horizontally polarized Yagi antennas is that it **narrows the main lobe in elevation.** (G9D05)



Vertical Stacking of
Horizontally polarized.

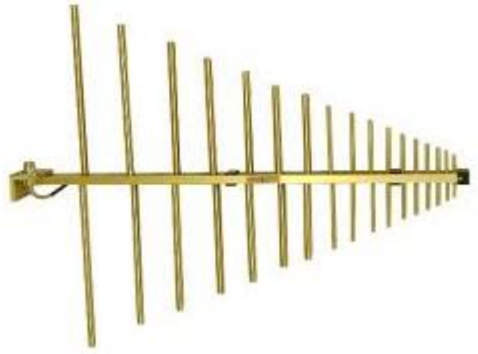
Horizontal Stacking of
Vertically polarized.

- Yagi antennas spaced vertically 1/2 wavelength apart typically is **approximately 3 dB higher** than the gain of a single 3-element Yagi. (G9C20)

Log Periodic Antennas

7-14

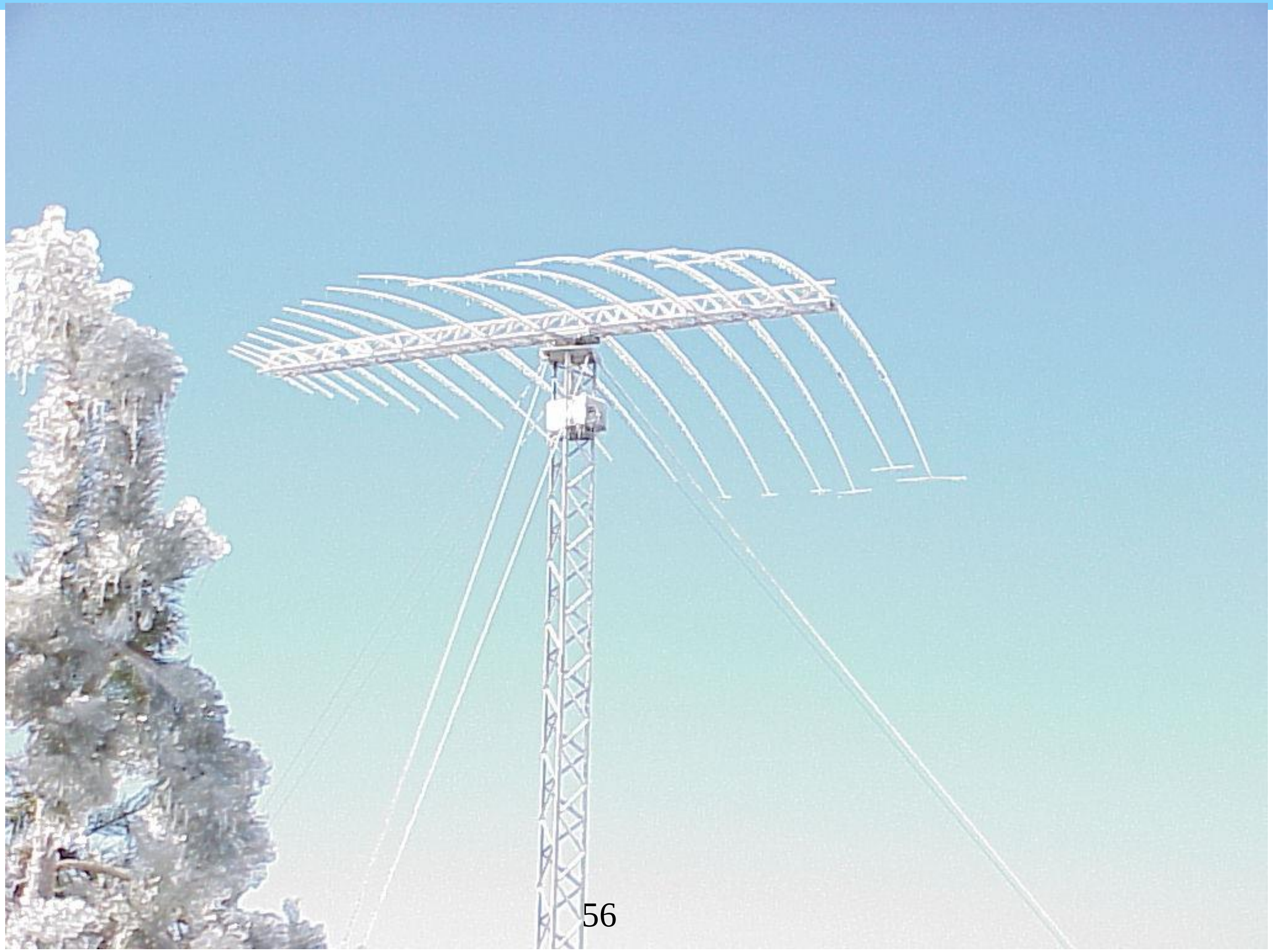
- The gain of a log periodic antenna is less than that of a Yagi, but an advantage of a log periodic antenna is **wide bandwidth.** (G9D06)
- For a log periodic antenna, the **length and spacing of the elements increases logarithmically from one end of the boom to the other.** (G9D07)



290 – 2000 MHz

EW8DQ, and his rotatable HF log-periodic beam antenna in Belarus

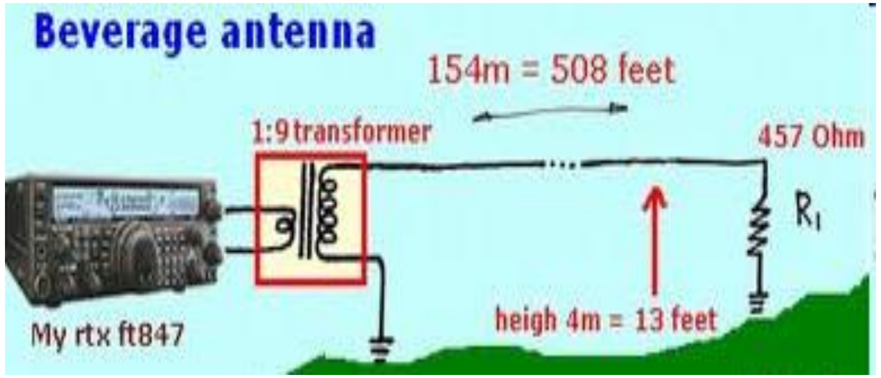
Log Periodic Antenna

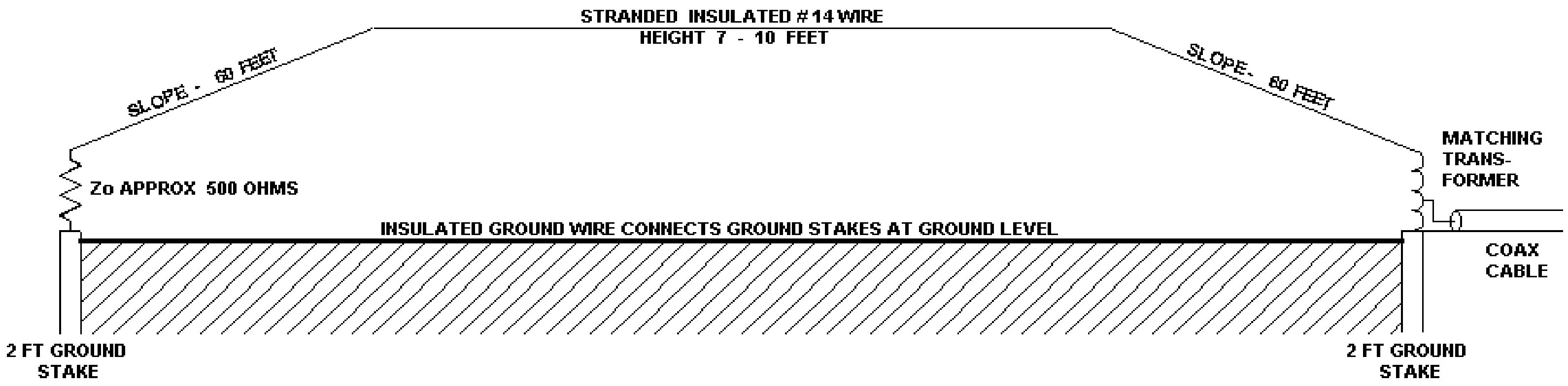


Beverage Antenna

7-15

- A Beverage antenna is not used for transmitting because **it has high losses compared to other types of antennas.** (G9D08)
- An application for a Beverage antenna is as a **directional receiving for low HF bands.** (G9D
- A Beverage antenna is **a very long and low directional receiving antenna.** (G9D10)



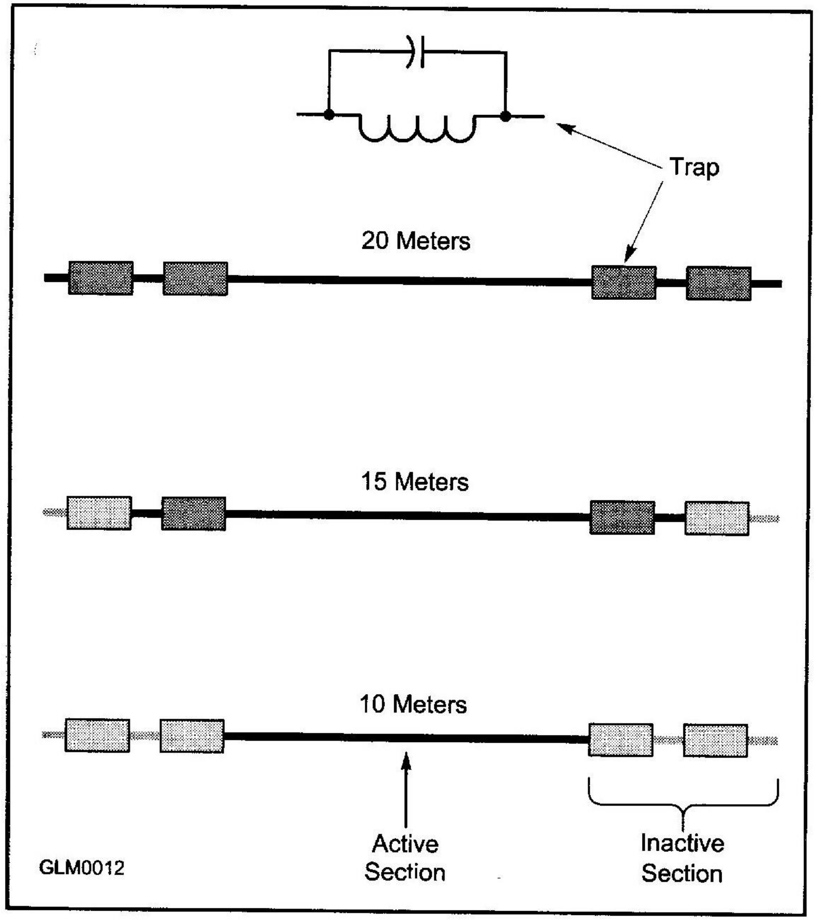


Practical Information: Multiband Antennas

7-16

- It is common, convenient and cost effective to have amateur radio antennas that operate on multiple bands.

- One such antenna uses traps to electrically isolate portions of the antenna, as in this trap dipole.



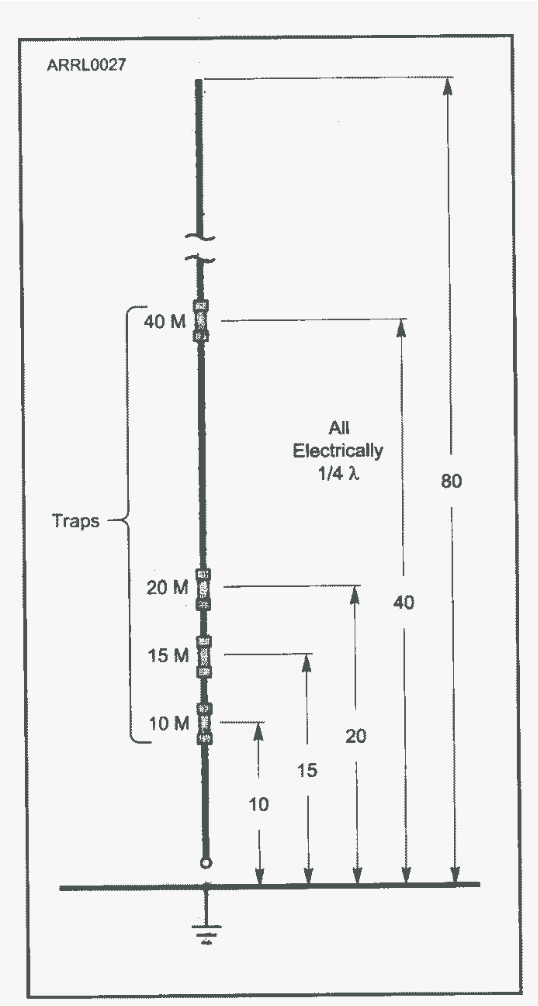
TRAP DIPOLE

Multiband Antennas

7-16

- Trap verticals are very common antennas that operate on multiple bands.
- A disadvantage of multiband antennas is that **they have poor harmonic rejection.** G9D11
- A vertical Antenna is has an **omnidirectional** azimuthal radiation pattern.

TRAP
VERTICAL



Multi-band Beam with Traps

* The primary purpose of antenna traps is **to permit multiband operation.**

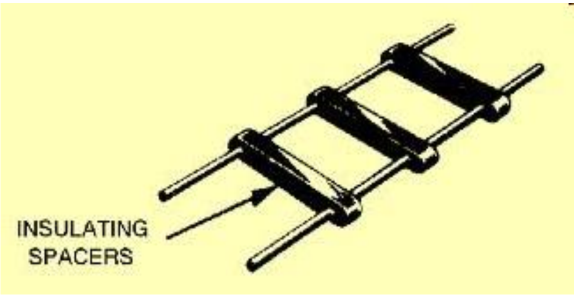
(G9D04)

Feed Lines

7-17

Parallel Conductor

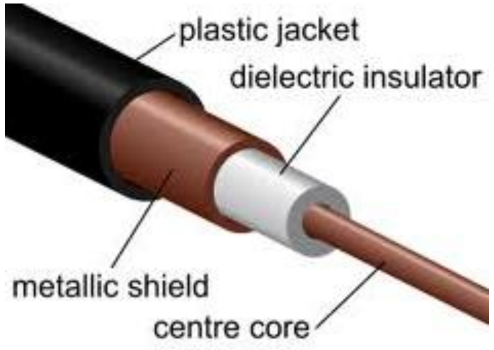
➢ **300 ohms** is the characteristic impedance of flat ribbon TV type twinlead. (G9A03)



➢ **450 ohms** is the characteristic impedance of most ladder line

Coax

➢ The attenuation of coaxial cable **increases** as the frequency of the signal it is carrying increases. (G9A05)



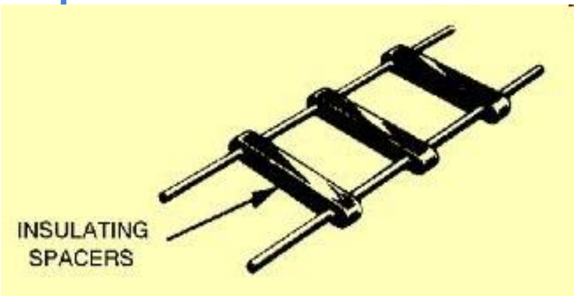
➢ RF feed line losses usually expressed in **dB per 100 ft.** (G9A06)

Feed Lines

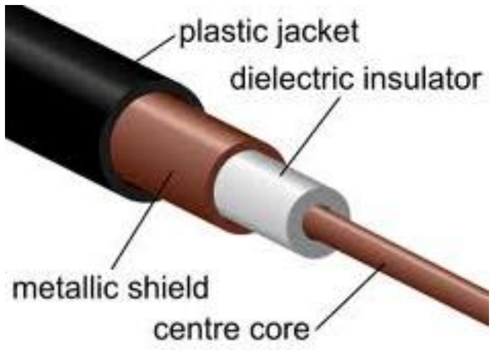
7-17

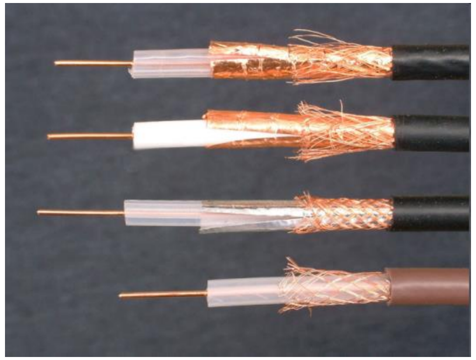
- **The distance between the centers of the conductors and the radius of the conductors** determine the characteristic impedance of a parallel conductor antenna feed line. (G9A01)

300 Ohm Twin Lead



Parallel two-wire line





Air Dielectric Coaxial Cable

- **50 and 75 ohms** are the typical characteristic impedances of coaxial cables used for antenna feed lines at amateur stations. (G9A02)

Feed Lines - Loss

6-19

Coax Cable Signal Loss (Attenuation) in dB per 100ft							
Loss	RG-174	RG-58	RG-8X	RG-213	RG-6	RG-11	9913
USE	HF	HF/VHF	HF	HF/VHF	VHF/UHF	HF/VHF	VHF/UHF
1MHz	1.9dB	0.4dB	0.5dB	0.2dB	0.2dB	0.2dB	0.2dB
10MHz	3.3dB	1.4dB	1.0dB	0.6dB	0.6dB	0.4dB	0.4dB
50MHz	6.6dB	3.3dB	2.5dB	1.6dB	1.4dB	1.0dB	0.9dB
100MHz	8.9dB	4.9dB	3.6dB	2.2dB	2.0dB	1.6dB	1.4dB
200MHz	11.9dB	7.3dB	5.4dB	3.3dB	2.8dB	2.3dB	1.8dB
400MHz	17.3dB	11.2dB	7.9dB	4.8dB	4.3dB	3.5dB	2.6dB
Imped	50ohm	50ohm	50ohm	50ohm	75ohm	75ohm	50ohm

Standing Wave Ratio (SWR)

- If the antenna and feed line impedances are not perfectly matched, some RF energy is not radiated into space and is returned (reflected) back to the source.
  - Something has to happen to this reflected energy – generally converted into heat or unwanted radio energy (bad).

- **A difference between feed-line impedance and antenna feed-point impedance** is the reason for the occurrence of reflected power at the point where a feed line connects to an antenna. (G9A04)

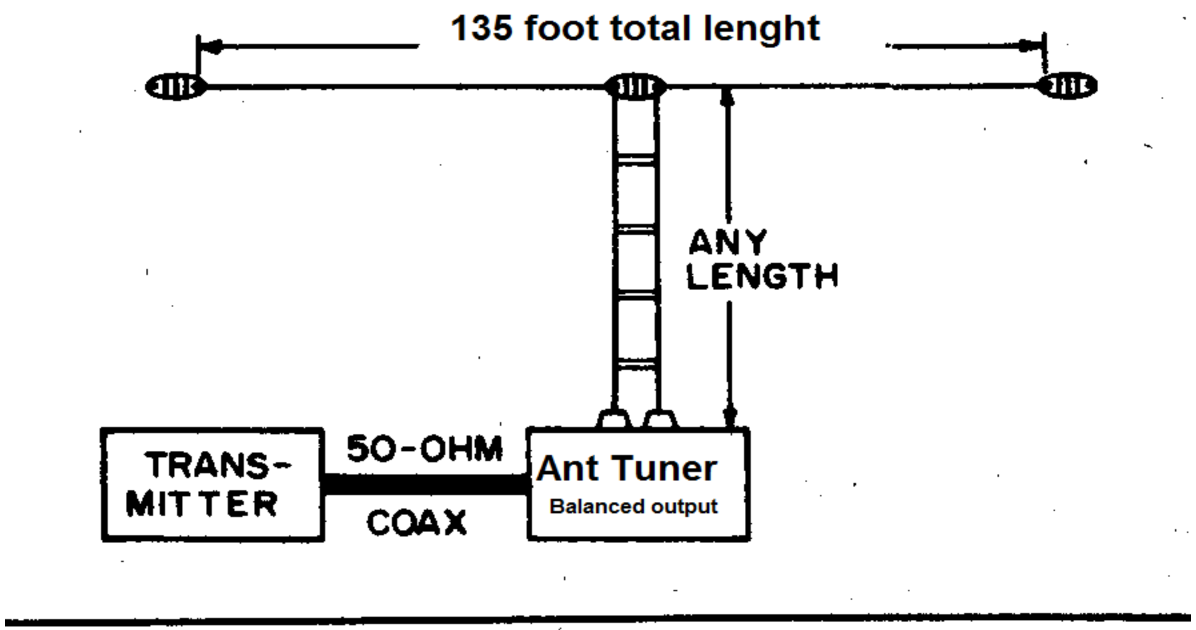
Standing Wave Ratio (SWR)

More disadvantages of high SWR:

- **The higher the SWR, the more feedline loss you will experience.** (G9A15)
- **With high feedline loss, the SWR measured at the radio end will be artificially lowered.** (G9A15)
- **High SWR increases the risk of high-voltage breakdown of the coax.**

Practical Information: My Favorite!

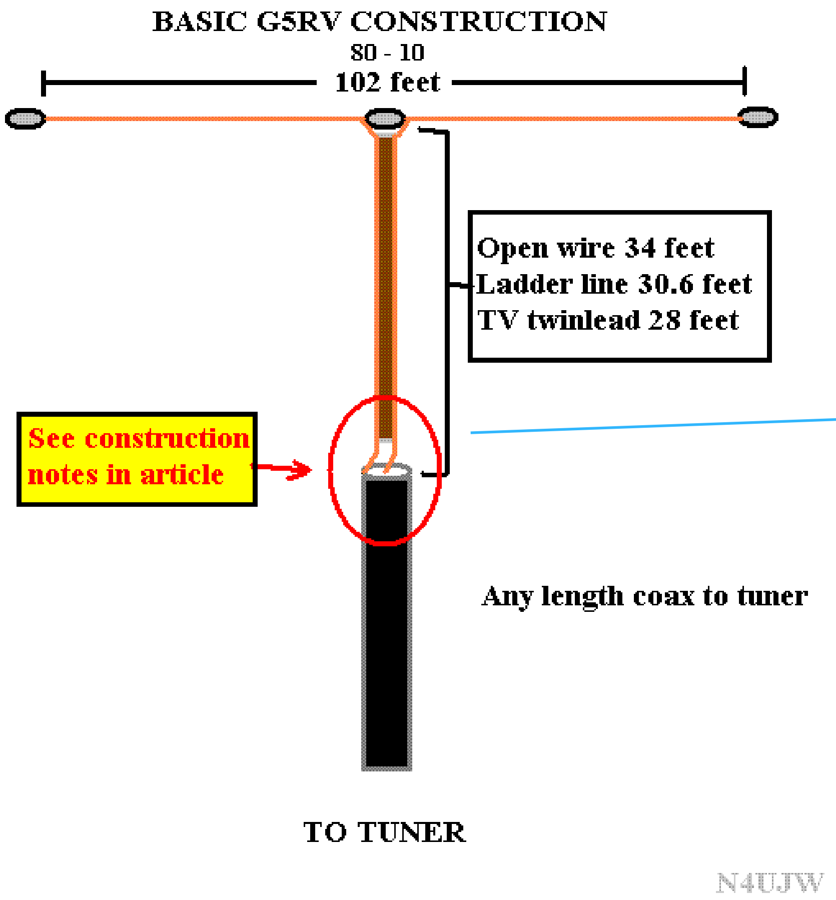
* 80 m Dipole fed with ladder line and an antenna tuner
* It is sometimes called a double-zepp antenna



—A center-fed antenna system for multiband use.

Practical Information: The G5RV

* 102 ft Dipole fed with ladder line and an antenna tuner



The mismatch between the ladder line and the coax can contribute to significant loss

Antenna Couplers

7-19

- An **antenna coupler** is often used to enable matching the transmitter output to an impedance other than 50 ohms. (G4A06)

Antenna Couplers go by many different names:

- Transmatch
- Antenna Tuner
- Impedance Matcher

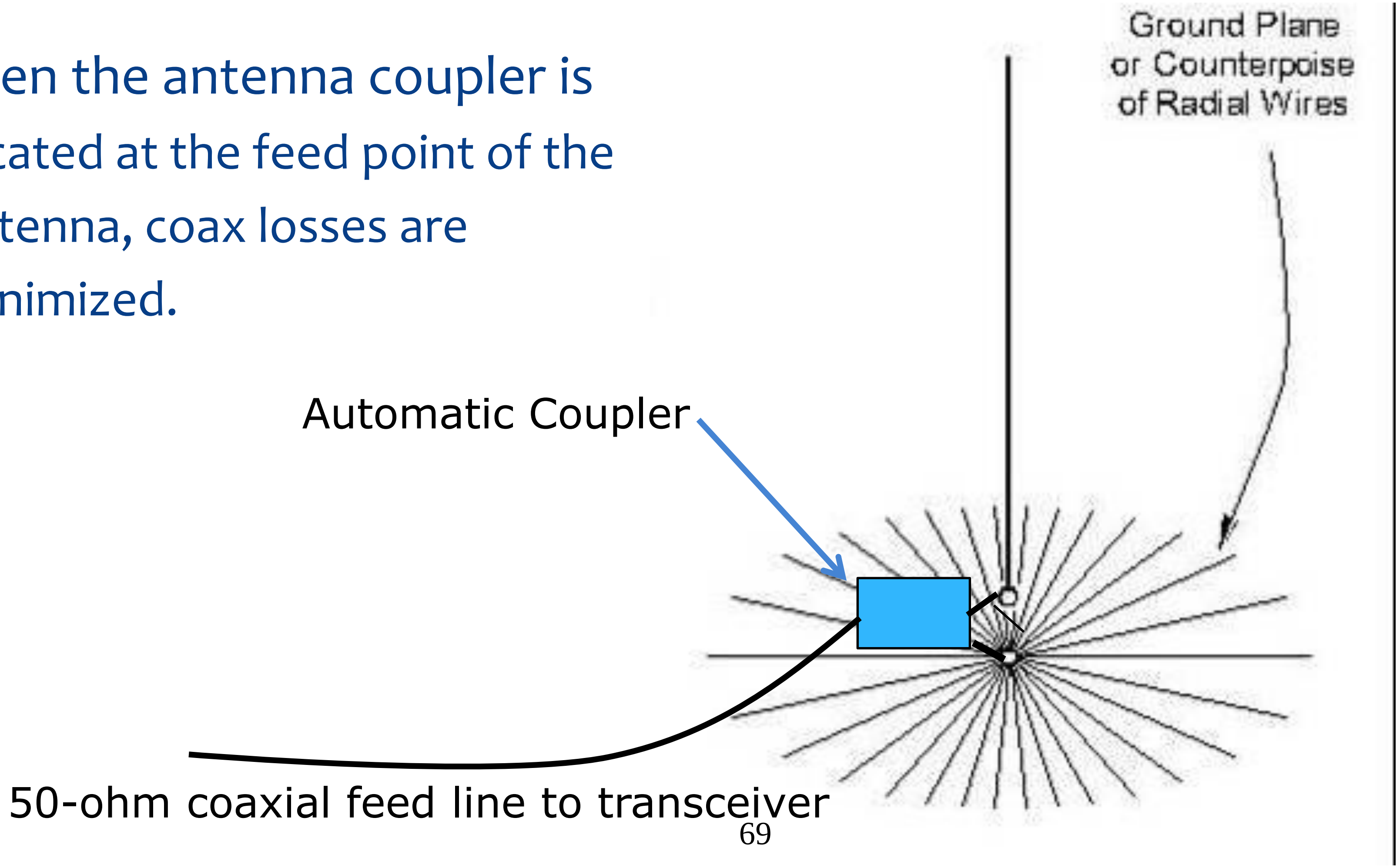
An automatic coupler can be placed directly at the feed-point of the antenna, providing good efficiency.

Manual Coupler

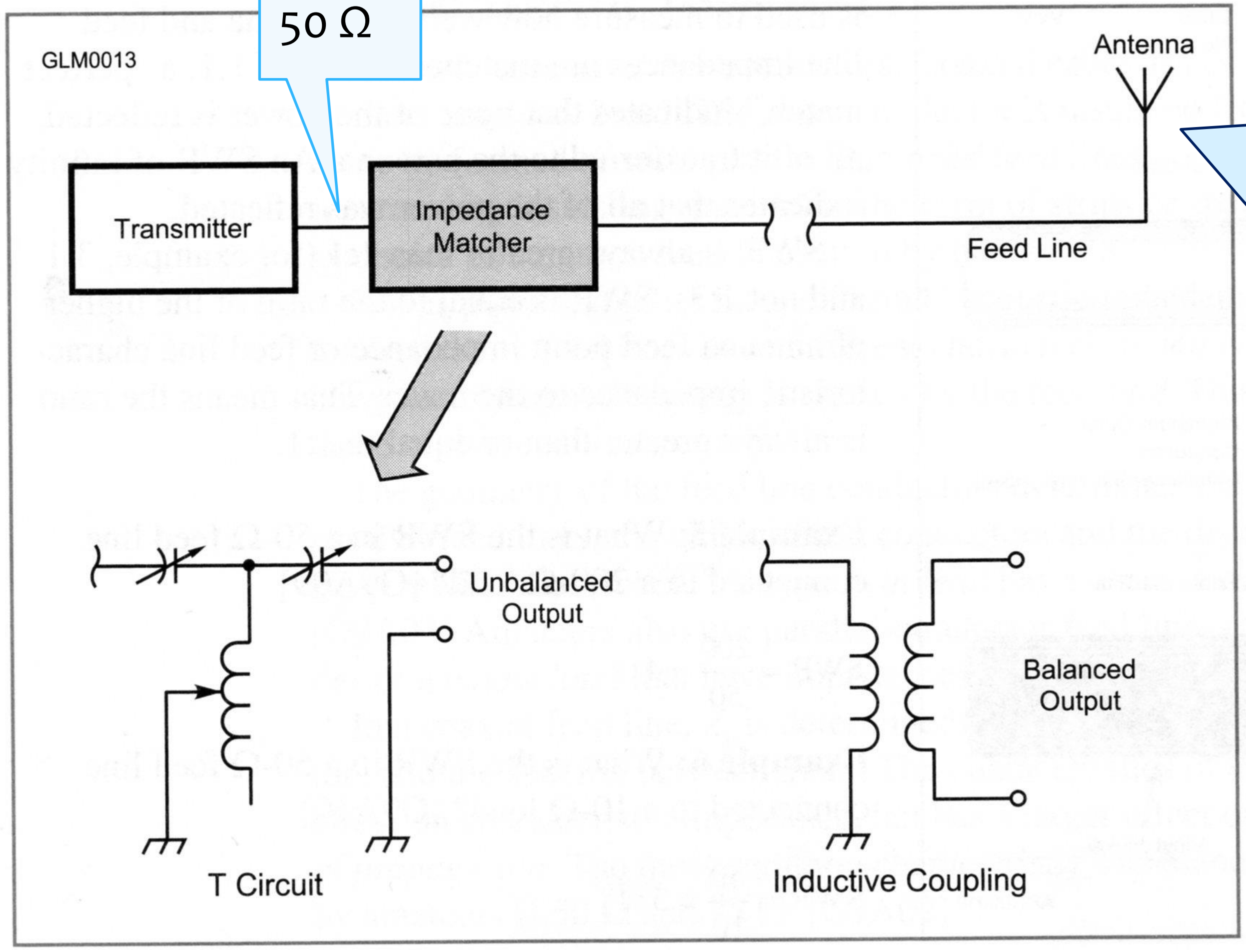
Automatic Coupler

Practical Information: Automatic Antenna Coupler

* When the antenna coupler is located at the feed point of the antenna, coax losses are minimized.



Practical Information: Multiband Antennas



50 Ω

Practical Info:
Coax may be used if the SWR is 3:1 or less.
(Risks:
- Excessive loss
- High voltage)

If the SWR is much above 3:1, use ladder line.

Practical Information: Feedlines

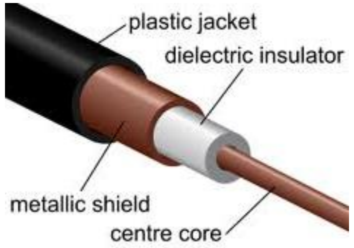
7-17

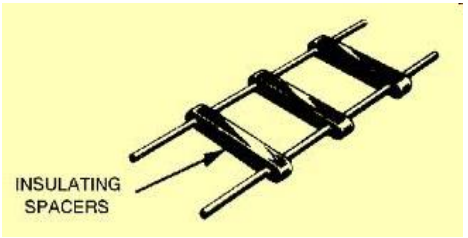
Coax (50 or 75 Ω)

* Is very Convenient
  * May be bundled with other coax or routed next to metal objects
  * Excess coax can be coiled up
* Good if used with low SWRs

Parallel Conductor

* Twin Lead (300 Ω)
* Ladder Line (450 Ω)
* Must be spaced away from other conductors or metal objects
* May not be coiled
* Tolerant of high SWRs

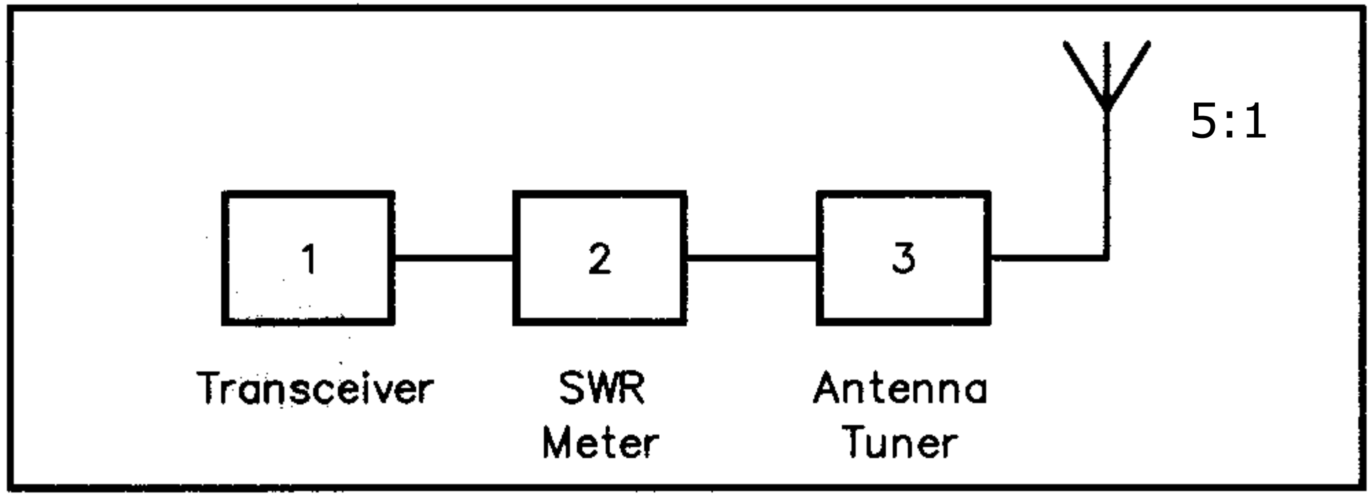




Antenna Tuners

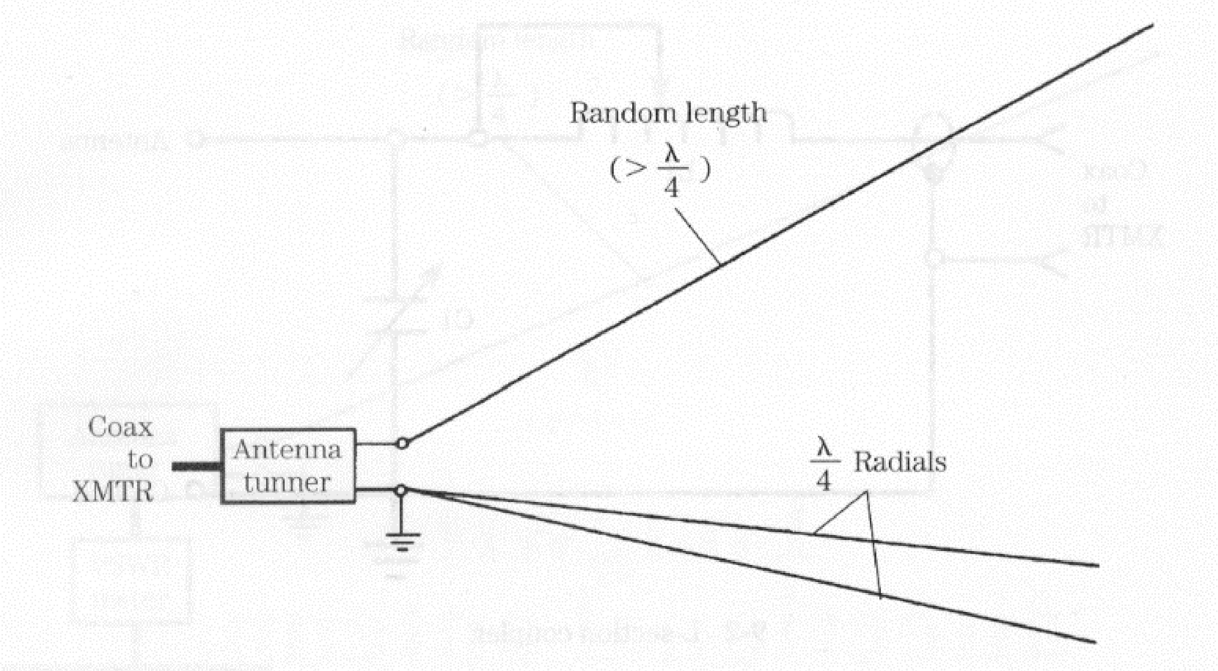
6-18, 6-19

- To prevent standing waves on an antenna feed line, **the antenna feed-point impedance must be matched to the characteristic impedance of the feed line.** (G9A07)
- If the SWR on an antenna feed line is 5 to 1, and a matching network at the transmitter end of the feed line is adjusted to 1 to 1 SWR, the resulting SWR on the feed line is still **5 to 1.** (G9A08)



Practical Information: Random Wire

- Random wire antennas with an antenna tuner can cover many bands
- A good ground is required or the operator may experience “RF burns”



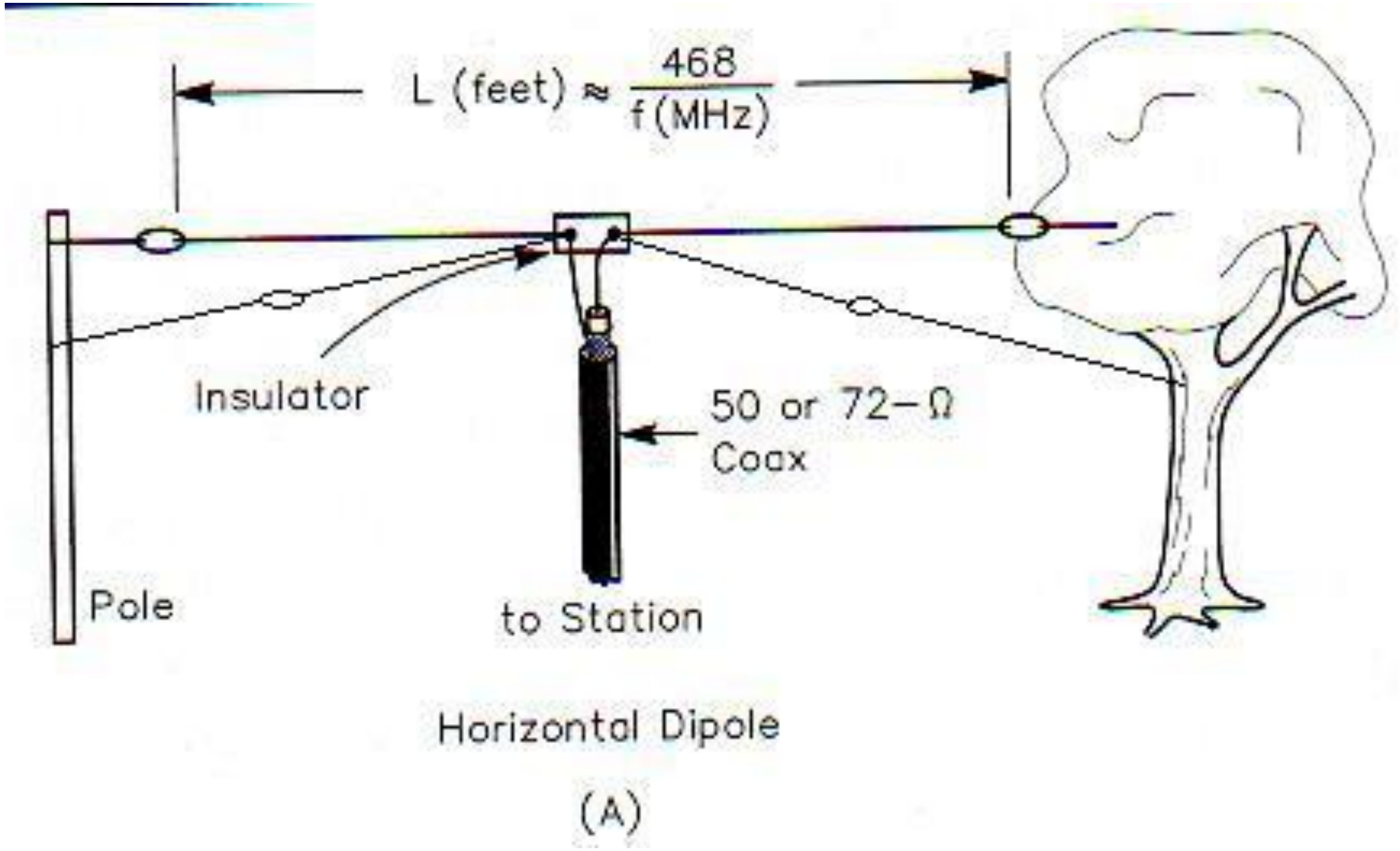
9-3 Radials improves the “ground” of random length antenna.

Random Wire Antenna

7-5

- One disadvantage of a directly fed random-wire antenna is that **you may experience RF burns when touching metal objects in your station.** (G9B01)
  - As the name implies, random-wire antennas are a random-length.
  - To match the antenna to the transmitter, you'll need an antenna tuner
  - Because of this, there may be high RF levels in the shack when you are transmitting.

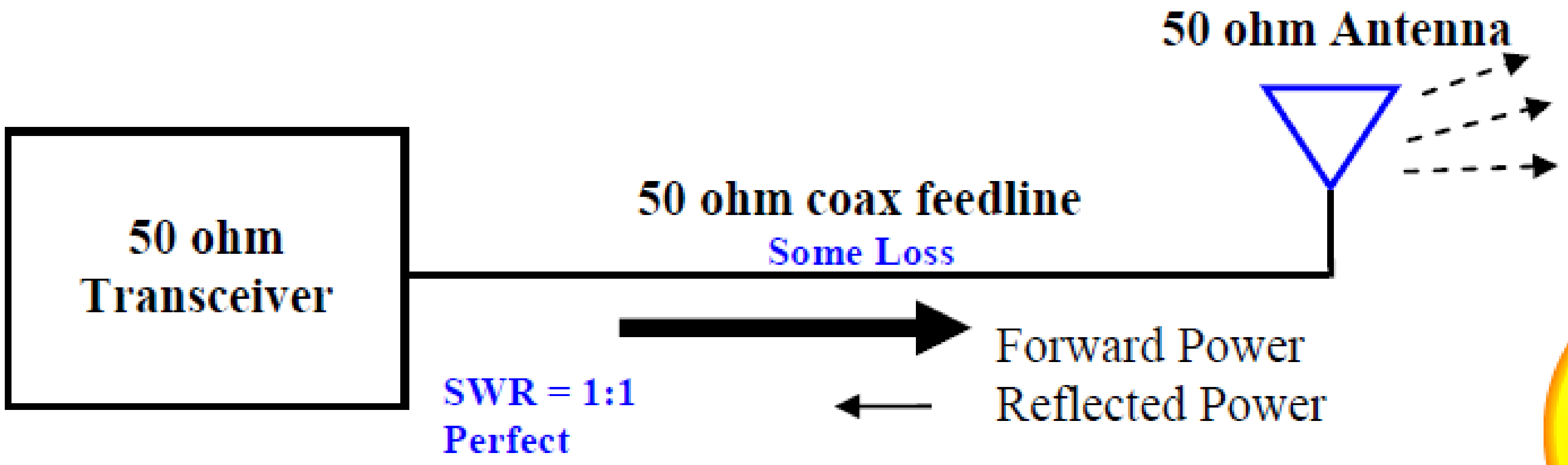
Practical Information: Fan Dipole



Antenna SWR

- A standing wave ratio of **1:1** will result from the connection of a 50-ohm feed line to a non-reactive load having a 50-ohm impedance. (G9A11)

$SWR = Z_1 / Z_2$ 50 / 50 1 : 1 VSWR



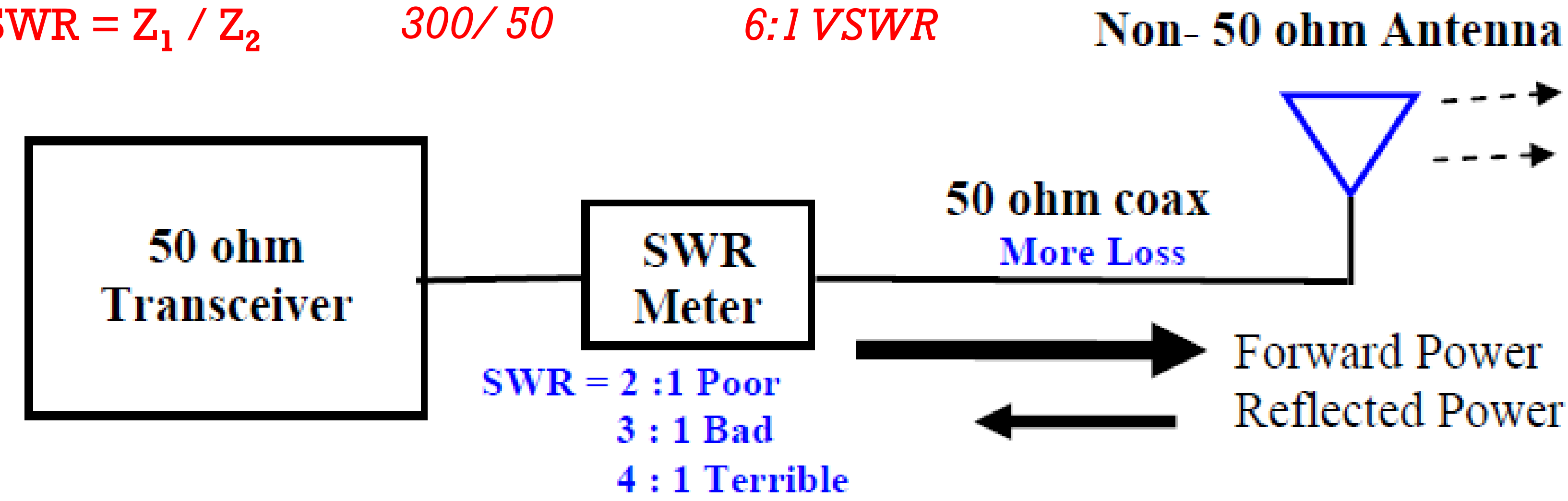
Antenna SWR

- If you feed a vertical antenna that has a 25-ohm feed-point impedance with 50-ohm coaxial cable, the SWR will be **2:1.** (G9A12)

  $SWR = Z_1 / Z_2$ *50 / 25* *2:1 VSWR*

- If you feed an antenna that has a 300-ohm feed-point impedance with 50-ohm coaxial cable, the SWR will be **6:1.** (G9A13)

  $SWR = Z_1 / Z_2$ *300/ 50* *6:1 VSWR*



Antenna SWR

- *A **4:1** standing wave ratio will result from the connection of a 50-ohm feed line to a non-reactive load having a 200-ohm impedance.* (G9A09)

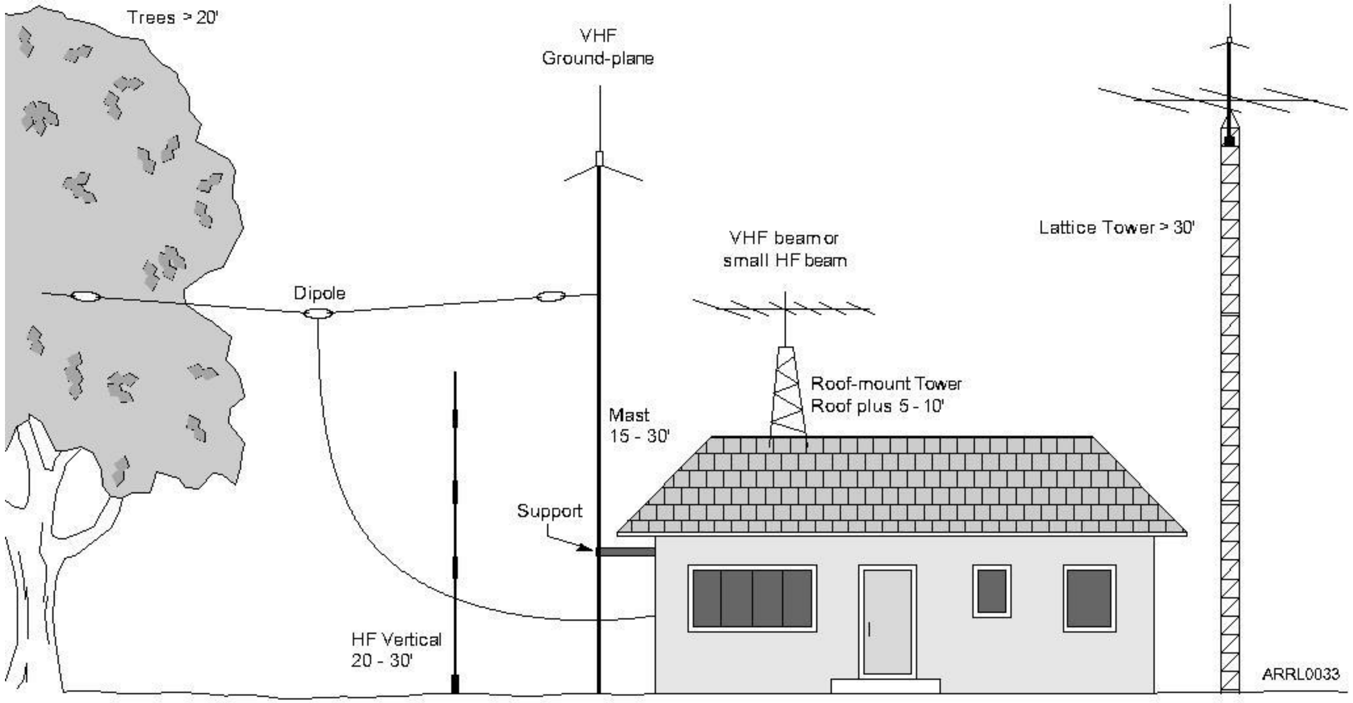
  $SWR = Z_1 / Z_2$ *200/ 50* *4:1 VSWR*

- *A standing wave ratio of **5:1** will result from the connection of a 50-ohm feed line to a non-reactive load having a 10-ohm impedance.* (G9A10)

  $SWR = Z_1 / Z_2$ *50/ 10* *5:1 VSWR*

Your Assignment Over the Next Year

Make your yard look like this!



How does antenna gain stated in dBi compare to gain stated in dBd for the same antenna?

A. dBi gain figures are 2.15 dB lower then dBd gain figures

B. dBi gain figures are 2.15 dB higher than dBd gain figures

C. dBi gain figures are the same as the square root of dBd gain figures multiplied by 2.15

D. dBi gain figures are the reciprocal of dBd gain figures + 2.15 dB

G9C19

How does antenna gain stated in dBi compare to gain stated in dBd for the same antenna?

A. dBi gain figures are 2.15 dB lower then dBd gain figures

B. dBi gain figures are 2.15 dB higher than dBd gain figures

C. dBi gain figures are the same as the square root of dBd gain figures multiplied by 2.15

D. dBi gain figures are the reciprocal of dBd gain figures + 2.15 dB

G9C19

What is meant by the terms dBi and dBd when referring to antenna gain?

A. dBi refers to an isotropic antenna, dBd refers to a dipole antenna

B. dBi refers to an ionospheric reflecting antenna, dBd refers to a dissipative antenna

C. dBi refers to an inverted-vee antenna, dBd refers to a downward reflecting antenna

D. dBi refers to an isometric antenna, dBd refers to a discone antenna

G9C20

What is meant by the terms dBi and dBd when referring to antenna gain?

A. dBi refers to an isotropic antenna, dBd refers to a dipole antenna

B. dBi refers to an ionospheric reflecting antenna, dBd refers to a dissipative antenna

C. dBi refers to an inverted-vee antenna, dBd refers to a downward reflecting antenna

D. dBi refers to an isometric antenna, dBd refers to a discone antenna

G9C20

How does increasing boom length and adding directors affect a Yagi antenna?

A. Gain increases

B. Beamwidth increases

C. Front to back ratio decreases

D. Front to side ratio decreases

G9C05

How does increasing boom length and adding directors affect a Yagi antenna?

A. Gain increases

B. Beamwidth increases

C. Front to back ratio decreases

D. Front to side ratio decreases

G9C05

What configuration of the loops of a two-element quad antenna must be used for the antenna to operate as a beam antenna, assuming one of the elements is used as a reflector?

A. The driven element must be fed with a balun transformer

B. There must be an open circuit in the driven element at the point opposite the feed point

C. The reflector element must be approximately 5 percent shorter than the driven element

D. The reflector element must be approximately 5 percent longer than the driven element

G9C06

What configuration of the loops of a two-element quad antenna must be used for the antenna to operate as a beam antenna, assuming one of the elements is used as a reflector?

A. The driven element must be fed with a balun transformer

B. There must be an open circuit in the driven element at the point opposite the feed point

C. The reflector element must be approximately 5 percent shorter than the driven element

D. The reflector element must be approximately 5 percent longer than the driven element

G9C06

What happens when the feed point of a quad antenna of any shape is moved from the midpoint of the top or bottom to the midpoint of either side?

A. The polarization of the radiated signal changes from horizontal to vertical

B. The polarization of the radiated signal changes from vertical to horizontal

C. There is no change in polarization

D. The radiated signal becomes circularly polarized

G9C18

What happens when the feed point of a quad antenna of any shape is moved from the midpoint of the top or bottom to the midpoint of either side?

A. The polarization of the radiated signal changes from horizontal to vertical

B. The polarization of the radiated signal changes from vertical to horizontal

C. There is no change in polarization

D. The radiated signal becomes circularly polarized

G9C18