

CHAPTER 8
ANTENNAS

Slide 2



Antennas

A good antenna works
A bad antenna is a waste of time & money
Antenna systems can be very inexpensive and simple
They can also be very, very expensive



Antenna Considerations

- The space available for an antenna
- The proximity to neighbours
- The operating frequencies you will use
- The output power
- Money

Some Math

Velocity of propagation 300,000,000 m/sec

For 1 wavelength, above 30 MHz

Frequency (f) = 300 / wavelength

Frequency measured in megahertz

Wavelength (λ) = 300 / frequency

Wavelength measured in meters

Above 30 MHz, λ = 300/f metres or 984/f feet

For a half wave λ = 150/f metres or 492/f feet

Below 30 MHz λ = 286/f metres or 936/f feet (including the velocity factor of 0.95)

For a half wave λ = 143/f metres or 468/f feet

The length of a half wave dipole for 3.65 MHz

The length of a half wave dipole for 3.65 MHz

$$L = 143/f = 143/3.65 = 39.18 \text{ metres}$$

The higher the frequency the shorter the antenna
The lower the frequency the longer the antenna

Types of Antennas

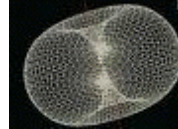
- Metal
- Vertical
- Yagi
- Trap Yagi
- Phased arrays
- Loops
- Vertical or Horizontal
- Horns for super ultra high frequencies
- Mobile antennas

Isotropic Antenna

- The isotropic antenna is a hypothetical point source.
- It does not exist in reality but is considered as an important starting point considering different
- antennas from the theoretical to the practical
- The pattern is a Cardioid - a donut shape or a sphere



Dipole Radiation
Pattern



Polarization - Practical

Antennas radiating a vertical polarization are best received by an antenna of like polarization

Cross polarization reduces reception by as much as 30 db

Bouncing DX signals probably have both polarizations

Designing antenna polarization usually depends on the frequency being used - at 70 cm in th eUHF band the elements are very short so either polarization is possible. Usually vertical is used as repeaters are vertically polarized.

Resonance

Antenna length is dependant on frequency

The lower the frequency the longer the antenna elements

Examples

80 metres	3.750 Mhz	124 ft
40	7.055	66
10	28.5	16.4
6	52	9
2	145	3.2

Isotropic Source

Polarization by Element Orientation

Page 48 / 9

An isotropic antenna is a: **hypothetical point source**

What is the antenna radiation pattern for an isotropic radiator? **A sphere**

Polarization of an antenna is determined by: **the electric field**

What does horizontal wave polarization mean? **The electric lines of force of a radio wave are parallel to the earth's surface**

What does vertical wave polarization mean? **The electric lines of force of a radio wave are perpendicular to the earth's surface**

Wavelength vs Physical Length

Page 49

The speed of a radio wave: **is the same as the speed of light**

The velocity of propagation of radio frequency energy in free space is: **300 000 kilometres per second**

If an antenna is made longer, what happens to its resonant frequency? **It decreases**

If an antenna is made shorter, what happens to its resonant frequency? **It increases**

The resonant frequency of an antenna may be increased by: **shortening the radiating element**

Wavelength vs Physical Length

Cont.

To lower the resonant frequency of an antenna, the operator should: **lengthen it**

Adding a series inductance to an antenna would: **decrease the resonant frequency**

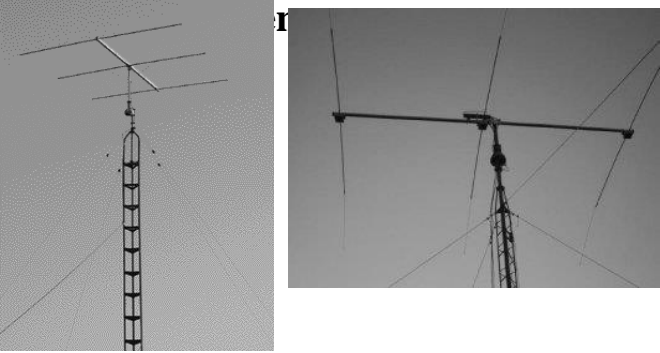
Horizontal lines for writing notes.

Wavelength vs Physical Length

Con't

- The wavelength for a frequency of 25 MHz is:
12 metres (39.4 ft)
- The wavelength corresponding to a frequency of 2 MHz is:
150 m (492 ft)
- At the end of suspended antenna wire, insulators are used. These act to: **limit the electrical length of the antenna**
- One solution to multi-band operation with a shortened radiator is the "trap dipole" or trap vertical. These "traps" are actually: **a coil and capacitor in parallel**

Yagi-Uda Three-Element



Yagi Antennae

How many directly driven elements do most Yagi antennas have? **One**

Approximately how long is the driven element of a Yagi antenna for 14.0 MHz? **10.21 metres (33 feet and 6 inches)**

Approximately how long is the director element of a Yagi antenna for 21.1 MHz? **6.4 metres (21 feet)**

Approximately how long is the reflector element of a Yagi antenna for 28.1 MHz? **5.33 metres (17.5 feet long)**

The spacing between the elements on a three-element Yagi antenna, representing the best overall choice, is : **0.2 of a wavelength.**

What is one effect of increasing the boom length and adding directors to a Yagi antenna? **Gain increases**

What are some advantages of a Yagi with wide element spacing? **High gain, less critical tuning and wider bandwidth**

Yagi Antennae

Con't

What are some advantages of a Yagi with wide element spacing? **High gain, less critical tuning and wider bandwidth**

Why is a Yagi antenna often used for radiocommunications on the 20-metre band? **It helps reduce interference from other stations off to the side or behind**

What does "antenna front-to-back ratio" mean in reference to a Yagi antenna? **The power radiated in the major radiation lobe compared to the power radiated in exactly the opposite direction**

What is a good way to get maximum performance from a Yagi antenna? **Optimize the lengths and spacing of the elements**

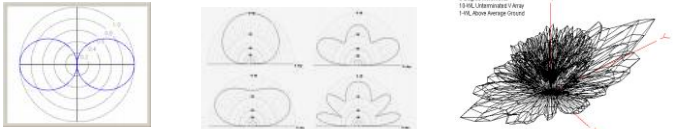
If the forward gain of a six-element Yagi is about 10 dB, what would the gain of two of these antennas be if they were "stacked"? **13 dB**

Wire Antennae

If you made a half-wavelength dipole antenna for 28.550 MHz, how long would it be? **5.08 metres (16.62 ft)**

What is the low angle radiation pattern of an ideal half-wavelength dipole HF antenna installed parallel to the earth? **It is a figure-eight, perpendicular to the antenna**

The impedances in ohms at the feed point of the dipole and folded dipole are, respectively: **73 and 300**



Quad / Loop antennae

What is a cubical quad antenna? **Two or more parallel four- sided wire loops, each approximately one-electrical wavelength long**

What is a delta loop antenna? **A type of cubical quad antenna, except with triangular elements rather than square**

The cubical "quad" or "quad" antenna consists of two or more square loops of wire. The driven element has an approximate overall length of: **one wavelength**

The delta loop antenna consists of two or more triangular structures mounted on a boom. The overall length of the driven element is approximately: **one wavelength**

Approximately how long is each side of a cubical quad antenna driven element for 21.4 MHz?
3.54 metres (11.7 feet)

Approximately how long is each side of a cubical quad antenna driven element for 14.3 MHz?
5.36 metres (17.6 feet)

Approximately how long is each leg of a symmetrical delta loop antenna driven element for 28.7 MHz?
3.5 metres (11.5 feet)

Slide 30

