Antennas receive and transmit radio waves

Current flowing through a wire creates an electromagnetic field around it. When current flow varies in strength or changes direction, the field is affected. When the frequency of direction change is high, the magnetic field moves away from the wire and travels through space. These higher frequencies are **radio frequencies** or **rf**.

Passing rf current through a long wire causes the magnetic field to move through space and be **radiated**. This field then can pass through another long wire.

The wire through which rf current passes is a **transmitting antenna**. The magnetic field then passes through a **receiving antenna**. The magnetic field is a **radio wave**.

How to find wavelength

An antenna acts the same whether it is transmitting or receiving. To work most efficiently, however, its length must have a relationship to the frequency of the radio wave.

Radio waves travel at the speed of light - 300,000,000 meters per second. For example, if a radio wave had a frequency of 300,000,000 hertz, or cycles, then 300,000,000 cycles of wave would pass some point every second. Since they move at 300,000,000 meters each second, each cycle then is one meter in length. That's its **wavelength**.

To find wavelength:

divide frequency in hertz into 300,000,000

Example:

$$6 \text{ meters} = \frac{300{,}000{,}000}{50{,}000{,}000}$$

Inside an antenna

Antennas have a **resonant frequency** – a specific frequency where inductive reactance and capacitive reactance are equal

a. **inductive reactance**
- ability of wire to generate magnetism is **inductance**
- frequency of ac voltage flowing through wire affects current flow
- combined effect of frequency and inductance on current flow is **inductive reactance**
- measured in ohms
- the greater the inductive reactance in ohms, the lower the current flow

b. **capacitive reactance**
- ability of capacitors to store electrons is **capacitance**
- the smaller the capacitance, the smaller the current flow
- the factor in a capacitor that limits the current flow is **capacitive reactance**
- measured in ohms

Inductive reactances and capacitive reactances act together to limit current flow. When they are equal at the **resonant frequency**, the maximum amount of current flows. This circuit is then said to be **tuned**.

How long should an antenna be?

Every frequency has a wavelength. The antenna's length is cut in proportion to the resonant frequency's wavelength.

An antenna's resonant frequency is changed by changing the length of the wire.

A circuit's opposition to the flow of current is called its **impedance**. This is the net ohmage after inductive reactance and capacitive reactance are subtracted. Impedance is zero at the resonant frequency.

There are many kinds of antennas. None is perfect. The effectiveness of antennas is usually compared to the **half-wave dipole.**

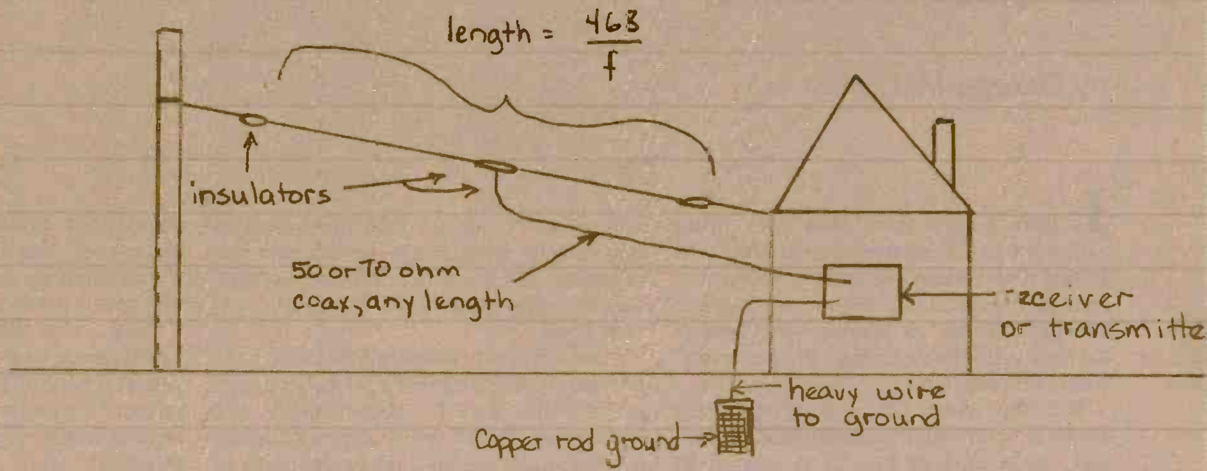
Half-wave dipole antenna

- two lengths of wire connected at the center having an overall length of one-half wavelength
- its impedance is 50 ohms
- lengths of wire are connected at center by an insulator and insulators are at each end
- coaxial cable transmission line runs from center to transmitter-receiver

Finding length in feet of a half-wave dipole

$$\text{length in feet} = \frac{468}{f}$$

f = frequency at which you want to transmit

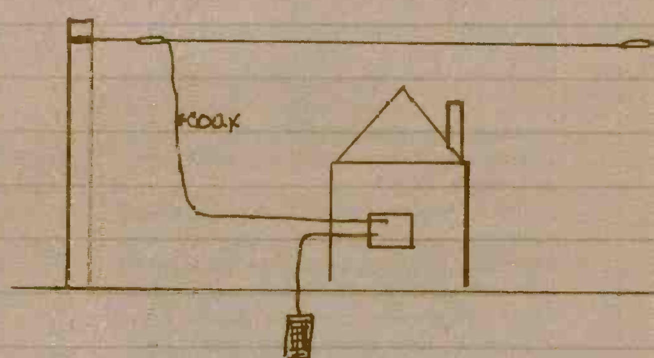


dipole antenna

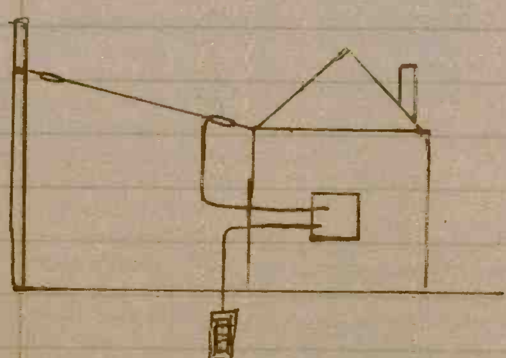
Different types of antennas

Antennas should be:

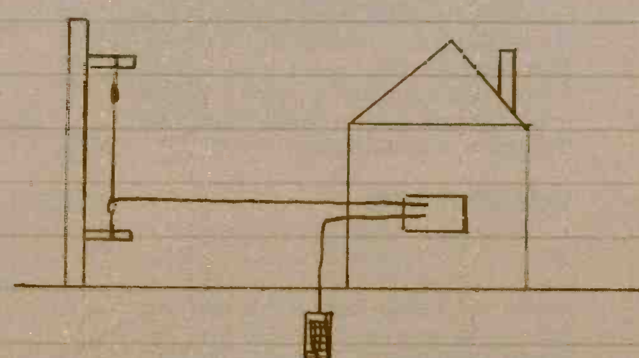
a. placed as high as possible
b. tuned as close as possible to the resonant frequency
c. placed away from power lines
d. receiver and transmitter must be grounded



inverted-L long wire antenna



slant long wire antenna



vertical long wire antenna