DEFINITIONS

AM (amplitude modulation). In AM radio, music, voice or television signals are impressed on a radio carrier wave by varying the wave's amplitude. In contrast, FM impresses music, voice or other signals on a radio wave by varying the wave's frequency.

Antenna Wire The antenna wire picks up the radio wave electricity. A crystal radio needs a long antenna wire. Big antennas pick up more radio wave electricity. The antenna wire is just any electric wire that goes from the radio high up in the air. Longer than 50 feet is good. It works better outside and high up. Higher than 20 feet high is good. A good crystal radio antenna can be a small copper wire going out of a window and up high into a tree. Short antennas in the house work a little bit. Antennas near power lines are **dangerous** and do not work well.

For crystal radios, most outside antennas act like capacitors. The antenna wire is one 'plate' and the ground beneath it acts like the other 'plate'. That is how a coil can resonate with an antenna to tune a crystal radio. This lets some crystal radio circuits tune with only a coil and no capacitor. The antenna acts as the capacitor while it also picks up the radio wave signal.

Capacitor A component capacitor is two or more metal plates separated by insulators. A wire is connected to each plate. A capacitor will hold electric charge something like a rechargeable battery. When something puts positive electric charges on one plate and negative electric charges on the other plate, the capacitor holds that charge. It holds the charge because there is no electrical conductor path inside the capacitor. If there is an electrical conductor path outside the capacitor, the charges in the capacitor will flow around the path as electricity and the charge will be lost.

Crystal-set builders sometimes make a capacitor by sandwiching a sheet of picture glass between two sheets of craft copper foil. Commercial capacitors are often named for their insulating material, such as ceramic of mylar. A capacitor stores energy in its electric field. A capacitor supplies energy to the headphones during the part of the cycle that the detector diode is switched off. Resonant circuits also use capacitors.

Cat whisker (AKA, "cat's whisker"). A cat whisker is a piece (often springy) of pointed wire. It presses against a piece of semiconductor rock such as galena, iron pyrite, germanium or silicon. Usually, it provides the anode end of a diode detector. A variety of conductors have been employed as cat whiskers. I've used safety pins and partially straightened phosphor-bronze ball-point pen springs. If you have a glass enclosed germanium diode, you can use a magnifying glass to see the cat whisker inside. You may have to scrape some paint off. You can even smash the glass and experiment directly with the cat whisker and germanium crystal individually. I've used the crystal from the diode with other pointed wires as cat whiskers. In principle you could use the cat whisker from the diode with some other semiconductor such as natural galena or fool's gold from a rock-hound shop. In junction diodes the connecting wires play no role in diode action. Therefore, junction diodes don't have cat whiskers in the same sense point-contact diodes do.

Coil A coil is a length of electric wire wrapped around and around a form to help it make a strong magnetic field. There are many forms for a coil. When other parts in the radio make electricity flow through the wire, the coil builds up a magnetic field. This makes the electricity want to keep flowing even after the source is taken away. The effect is measured in Henrys, or Micro Henries. Taps on coils assist in impedance matching.

Condenser. Condenser is an older word for capacitor.

Conductor. Anything that electricity easily flows through. Conductors include wire, capacitor plates, bolts, screws, iron pipes and damp salty ground. When a conductor fails (perhaps by breaking mechanically or oxidizing), the barrier to electricity is called an open circuit.

Crystal. A piece of semiconductor material. Some crystals, such as galena and iron pyrite (fool's gold) occur geologically. Modern crystals, such as germanium, silicon, gallium arsinide and even diamond and some plastics are produced by carefully-controlled laboratory or industrial processes. For a natural crystal to show diode action, it must be mechanically clamped or set in a small cup of solder. A wire attaches to the clamp or solder cup. Then a cat whisker point is moved into contact with a sensitive spot on the crystal.

Detector As an AM radio wave is received, the negative-going half cycles cancel the positive-going half cycles. In AM the detector is a crystal or diode that removes the negative-going (or positive-going) half cycles.

The detector changes the radio wave electricity into sound electricity. Radio stations make the radio waves get stronger and weaker as the sound changes. The strength of the radio waves copy the sound vibrations. The detector changes the back and forth radio wave electricity into one way sound electricity. When the radio wave is strong, it makes strong sound electricity. When the radio wave is weak, it makes weak sound electricity. This makes sound electricity that copies the sound vibrations. The detector works by letting electricity flow one way but not the other. Normal wires let electricity flow in both ways.

When radio first started, inventors found rocks that work for detectors. They were crystal rocks, like galena, pyrite and lots of others. That is where the name Crystal Radio came from. Now detectors are made with wires on them. Engineers call them diodes.

Earphone The earphone makes sound you can hear out of the sound electricity. The earphone connects the sound electricity to an electromagnet. The electromagnet pulls on a thin metal plate that can move. The electromagnet makes the plate vibrate and make sound. When we hold the earphone to our ear, we can hear the radio. The sound is not very loud. That is because the radio gets all its power from the radio wave. The wave does not have much power. You need to add more power from a battery or plug to make it louder.

Ground is a metal thing that connects to something big, like the world. Dirt is a good ground. It gives the antenna electricity a place to flow into and out of. A good ground is a metal pipe several feet down in the dirt outside; cold water pipes are good since they go in the ground on one end. Your body acts like a ground a little bit. Your body is too small and does not work well.

Inductor. Inductor is another word for coil.

Insulator. 1) Any material that does not conduct electricity or that conducts electricity very poorly. 2) An object made to prevent electricity from flowing through an unwanted path. When an insulator fails, the path followed by the electricity is called a short circuit.

KHz KHz is short for kilohertz. It is the numbers we see on the radio tuning dial. This is the way radio stations are separated. When radio first started, before 1920, tuning dial numbers gave the distance between waves. Engineers call this distance the wavelength. Today it is how many waves hit the antenna in a second. When the waves are closer together, like for a station at 1200 kHz (kiloHertz), there are more waves per second crossing the antenna. When the waves are far apart, there is a longer time between waves. Engineers call this number the frequency. Today's AM broadcast band has the frequencies between 535 kHz and 1610 kHz.

Resonance and frequency Resonance happens in electric circuits and in mechanical things. It is easier to understand in mechanical things first. If you hang a small weight on a string about 9 inches long (about 23 cm) it will swing back and forth one time each second. If you try to speed it up of slow it down, you can't. It swings at just one frequency, which is one cycle per second. That is resonance. The string and weight is resonant at one cycle per second. To make it slow down by half, make the string twice as long. The length of the string changes the resonant frequency. You can say that the length of the string "tunes" the resonant frequency.

For electricity, a coil and capacitor make a resonant circuit. The capacitor plates get an electric charge from other parts in the radio. That charge flows through the coil. As it does, it builds up a magnetic field in the coil. When all the charge is gone from the capacitor, the magnetic field makes the electricity keep on flowing a little. This charges the capacitor plates the opposite way. As the opposite charge builds up on the capacitor plates, it finally stops the charge flow in the coil. Then the charge in the capacitor plates makes electricity flow the opposite way through the coil. That builds up a magnetic field in the opposite direction. The charge swings back and forth between the coil and capacitor at one certain frequency. That is the resonant frequency of the coil and capacitor.

Frequency is measured in cycles per second, and also in Hertz, abbreviated Hz. and in kHz. and MHz.

Tuner The tuner separates one radio station from all the others. Different radio stations send out waves that have different space between them. A station at "600 kHz" on the tuning dial sends out radio waves with twice as much space between them as one at "1200 kHz". Also, a station at 1200 kHz sends out twice as many waves per second as one at "600 kHz. The number of waves per second is called frequency. The tuner uses the radio station frequency to separate stations and tune in only the station you want. The tuner uses resonance to make the radio sensitive to just one frequency at a time.

Tap. A tap is an electrical connection made to some point on a coil other than an end. Taps are used for impedance matching and for changing tuning ranges.

Tuned circuit. Tuned circuit means the same as resonant circuit.

Wave. A radio wave consists of a magnetic vibration and an electrical vibration superimposed on each other. If we could watch an AM broadcast wave approach us, the magnetic part would look something like a rope being shaken left to right and the electric part like a rope shaking up and down.

Radio waves are invisible waves of electricity and magnetism. Each radio station sends out radio waves. They travel out from the station something like water waves travel out from a splash in a pond. Water waves travel slow, about 10 miles each hour. Radio waves travel very fast, at 186,000 miles each second.

Radio Wave Electricity Radio wave electricity is electricity that radio waves make in the antenna wire. Radio waves hit the antenna something like ocean waves hit the shore. Ocean waves make water rush up and back with each wave. Radio waves make electricity flow up and down in the antenna wire like that. Radio wave electricity flows back and forth about a million times each second. It changes back and forth faster for a shorter distance between the waves. Engineers call this Radio Frequency electricity, or RF.