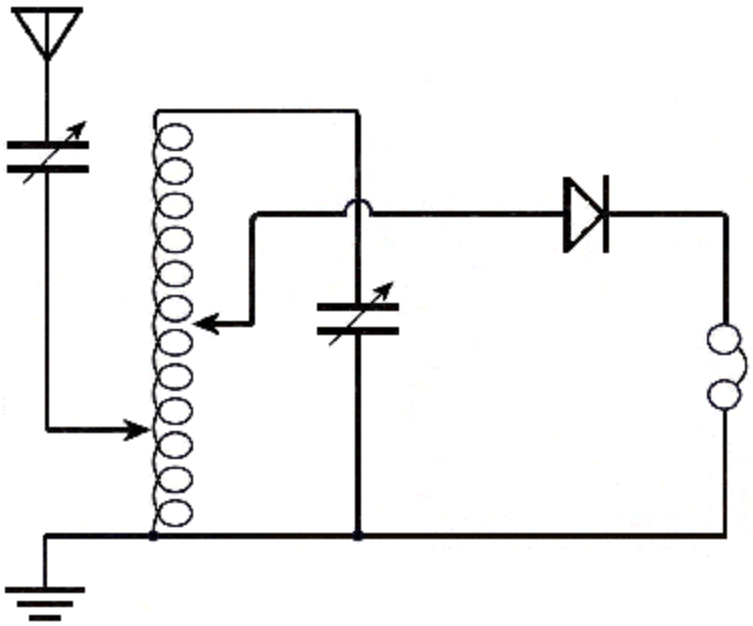
Project Xtal Radio - Basic Theory of Operation



Radio waves are electromagnetic radiation that is a **c**ontinuous **w**ave (**CW**) with information imposed upon it. The imposed information is placed there by varying the amplitude of the signal (**a**mplitude **m**odulation – **AM**) or by varying the frequency of the signal (**f**requency **m**odulation – **FM**). The information can be received and decoded by a simple circuit like the one shown above. A variation of the above is single sideband (**SSB**). **SSB** is a very efficient method of transmitting voice signals but due to the nature of this specialized means of communication, it is not good for music.

When amateur radio operators use Morse Code, they use a telegraph key to make and break the **CW** signal into dots and dashes. Amateur radio operators primarily use **SSB** to transmit voice long distances (**DX**) but on occasions they will use **AM** or **FM** for voice communications.

Review the difference between **AC** and **DC** emf. Electromagnetic energy is always in the form of **AC**. As the electromagnetic energy of the transmitted radio wave crosses a wire, a current is produced in the wire by **induction**. The longer the wire, then the more induced current and the more stations can be received.

From the antenna wire, the current (**AC**) flows into the inductor (**L1**) and tuning capacitor (**C1**) connected in parallel with each other. The parallel combination of the inductor and the capacitor form a resonant tuning circuit. When the transmitted radio frequency (**RF**) matches the frequency of **L1** and **C1**, one **RF** signal is trapped and the others pass through the circuit to ground. As you change the capacitance in your crystal radio you alter the characteristics of the circuit and a different radio frequency will enter the coil/capacitor combination and become "trapped." In other words, you have selected a different radio signal that will be trapped and then decoded by the detector.

The diode (**D1**) in your crystal radio provides a path for this current to leave the trapping circuit. The diode functions as a detector by permitting one direction of the **AC** to pass but prohibiting the other direction of the **AC** to pass. The result is a pulsating **DC** is allowed to continue. The pulsating **DC** is carrying the audio frequency (**AF**) information (voice, music) that was imposed upon it at the transmitting station and that current flows to the earphone. The earphone converts the electrical energy to mechanical energy (sound waves) for our ears to convert into electrical impulses. The circuit is complete when the remaining current from the earphone returns to the Earth via the **ground connection** and then back to the radio transmitting station via the ground connection. The ground connection greatly improves reception in crystal radios because the crystal radio does not have any battery powered amplification circuits.

The schematic diagram shows a second capacitor in the radio. **C2** functions as a coupling capacitor and the level of the received signal can be determined by the adjustment of **C2**. If a very strong signal is present, it can leak through the tuning circuit and **C2** can be adjusted to reduce the strength of the strong signal.

Notice the placement of the connections of the antenna and diode on **L1**. The function of these adjustable connections is to provide a maximum transfer of energy to and from the tuning circuit. Different adjustments of **C1**, **L1** and **C2** can provide different levels of sensitivity and selectivity of the radio. Work with these adjustments to maximized the reception of the desired radio station.

Bonus points:

1. Construct a dual tuned circuit and/or a wave trap for your crystal radio

2. Convert your crystal radio into a regenerative receiver

3. Change the received frequencies of your regenerative receiver from BCB to SW