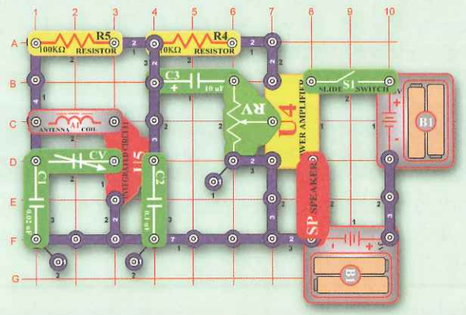
AM radio was developed before FM radio, because the transmitter and receiver circuits are not as complex. FM's greater complexity means it is better protected from interference (such as storms). FM also has wider channel bands (25kHz vs. 7kHz for AM), which gives it better music quality. AM radio uses a carrier frequency range of 500 to 1600kHz while FM radio uses 88 to 108MHz.

There are many different radio signals floating around, but we only want to listen to one. Think of this as being in a large, crowded room and trying to talk to someone on the other side. Connecting the antenna to a capacitor in sort of an antenna-capacitor oscillator solves this. Together, these two components "filter" out a small range of frequency that you listen to.

8-5 Radio Circuits

Experiments

Consider this AM radio receiver circuit (which is project 242 and is pictured on the front cover of your "Experiments 102-305" manual):



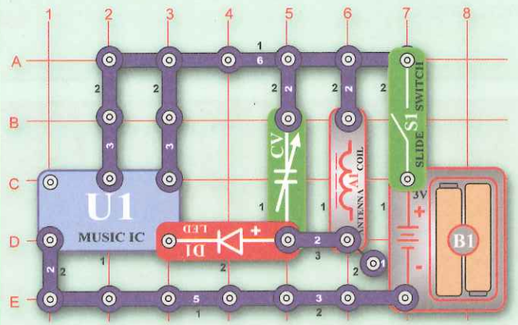
Adjusting the variable capacitor changes the range of frequency that you are listening to. The high frequency IC amplifies and decodes the modulation into the original signal (voice or music). This is amplified by the power amplifier IC. Varying the adjustable resistor makes the sound louder or softer.

This simple radio has the same types of circuits as AM radios sold in stores, but does not have as much filtering and amplification circuitry. Take a look inside an old AM radio in your house; you'll see a lot more components. The tuning dial on all AM and FM radios is a variable capacitor just like yours.

Snap circuits project 288 shows another AM receiver circuit, but using a 2-transistor amplifier instead of the power amplifier IC. This circuit has similar performance and appears to be more complex than the circuit with the IC, but there is actually a lot more circuitry hidden in the IC. Snap circuits project 289 is similar to project 242 but without loudness control.

Experiments

Consider this AM radio transmitter circuit (which is project 213):



Place the circuit next to an AM radio in your home. Tune the radio so no stations are heard. Turn on the switch. You should hear the song on your radio. Adjust the variable capacitor for the loudest signal.

This circuit uses the antenna to transmit electromagnetic energy to your AM radio. The antenna-capacitor combination tunes the transmit frequency. The music IC provides the amplitude modulation.

Notice that this circuit transmits across a wide part of the AM radio band, not just one station. This circuit has just two components tuning the transmit frequency; a commercial AM radio station will have a complex filtering circuit doing this.

Snap circuits projects 122, 145-150, 214, and 255 are variations of this basic AM transmitter circuit, using the alarm IC, space war IC, or the photoresistor. These circuits also show how to use this circuit as an alarm.

Snap circuits project 198 (in most manuals) is similar but transmits your voice to a radio. It also shows how variations in air pressure (caused by your talking) can make an electrical signal in a speaker – like a microphone, and opposite to how a speaker is normally used. Replace the speaker with the microphone in this circuit (+ side to Q2) and compare the performance.

Quick Quiz

1. List all the products in your home that use some form of radio or remote control.

Summary

Summary of Chapter 8:

1. An electrical current that is changing is called an alternating current (AC). An electrical signal that is constant and unchanging is called a direct current (DC).
2. The electricity in homes is AC power, with a voltage of 120V and a frequency of 60Hz.
3. Transformers allow one circuit to create a current in another using magnetic fields. This can change the voltage without wasting power.
4. Inductance is a measure of one coil of wire's ability to create a current in another, and is expressed in Henrys. Inductance can be increased by adding more loops of wire or by placing an iron bar inside the coil.
5. Radio uses electromagnetic waves to send information through the air. The coils used for transmitting and receiving these signals are called antennas.
6. Coils are inductors, which have lower resistance at lower frequencies but higher resistance at higher frequencies. Inductors and capacitors are often combined in radios to filter out a range of frequencies.
7. Modulation uses one signal to modify another.
8. In AM radio, a music/voice signal amplitude-modulates the transmit carrier frequency. In FM radio, frequency modulation is used instead.

Quiz

Chapter 8 Practice Problems

1. Why can't DC currents transfer energy across transformers?
   A. DC currents have no magnetic properties.
   B. DC currents don't have enough power to overcome the resistance of transformers.
   C. Transformers block the transfer of energy from both AC and DC currents.
   D. They are not digital circuits.

2. The following are true about transformers except:
   A. They allow circuits to be isolated from each other.
   B. They allow electricity to be efficiently transported over great distances.
   C. They allow a small voltage to create a large voltage.
   D. The coils used can never have the same number of loops.

3. The following are true about radio except:
   A. Frequency modulation circuits are simpler than amplitude modulation circuits.
   B. The FCC regulates radio transmission frequencies.
   C. FM has better music quality than AM.
   D. For DC currents, antennas act like ordinary wires.

4. At low frequencies, the snap circuits antenna acts like a _____.
   A. 10KΩ resistor
   B. 0.1μF capacitor
   C. 3-snap wire
   D. whistle chip

Answers: 1. A, 2. D, 3. A, 4. C