

Oscillators

Oscillators are electronic circuits that generate periodic alternating voltage signals (square, triangle, or sine waves), which serve as clock signals for devices or carrier waves for communication.

RC relaxation circuits using RC components operate by charging two capacitors alternately through a resistor until a threshold voltage is reached, creating a rectangular waveform visualized by LEDs.

The 555 timer is introduced as an easy-to-use oscillator that consists of comparators and flip-flops. By connecting specific resistors and capacitors, users can create stable and variable rectangular waves; frequency adjustments are possible but have limits on visibility.

LC resonators (tank circuits) are discussed for generating high frequencies. They operate by charging a capacitor and discharging it through an inductor.

The cycle involves energy transfer between electrostatic energy in the capacitor and magnetic energy in the inductor, producing oscillations.

The resonance frequency occurs when the reactance of the coil equals that of the capacitor, allowing voltages to exceed initial power supply values near this frequency.

To sustain oscillation without interruption, output from the tank circuit can be fed into an amplifier (e.g., NPN transistor).

Proper amplification ensures a stable megahertz sine wave output; however, building these circuits on breadboards is discouraged due to potential connection issues.

For even more stable frequencies, crystal oscillators utilize mechanical vibrations from piezoelectric crystals to produce consistent signals (e.g., 16 MHz).

These crystals are commonly found next to microcontrollers to regulate processing speeds effectively.