Pulse Width Modulation (PWM)

Understanding PWM

Pulse Width Modulation (PWM) is a technique used to simulate analog signals using digital means. It involves creating a square wave, a signal that rapidly switches between "on" (high voltage) and "off" (low voltage). By varying the duration of the "on" time (called the pulse width), we can effectively control the average voltage level of the signal.

How PWM Works:

1. **Square Wave Generation:** A digital signal is used to create a square wave.
2. **Pulse Width Modulation:** The duration of the "on" time (pulse width) is adjusted.
3. **Analog Simulation:** By varying the pulse width, we can simulate different voltage levels.

Example: Controlling an LED's Brightness

When applied to an LED, PWM can control its brightness. By rapidly switching the LED on and off at different duty cycles (the ratio of on time to off time), we can create the illusion of a steady intermediate brightness.

PWM Duty Cycle:

- **0:** LED is always off.
- **255:** LED is always on (100% duty cycle).
- **127:** LED is on for half the time and off for half the time (50% duty cycle).

Diagram:

Output of Waveform Timing Diagram

Key Points:

- PWM is a digital technique used to simulate analog signals.
- It involves creating a square wave and varying its pulse width.
- By adjusting the duty cycle, we can control the average voltage level of the signal.
- PWM is commonly used to control the brightness of LEDs, motor speeds, and other analog devices.

Additional Notes:

- The frequency of the PWM signal should be high enough to avoid visible flickering.
- PWM can be implemented using hardware or software.
- PWM is a versatile technique with numerous applications in electronics and control systems.

Video: Understanding Pulse Width Modulation