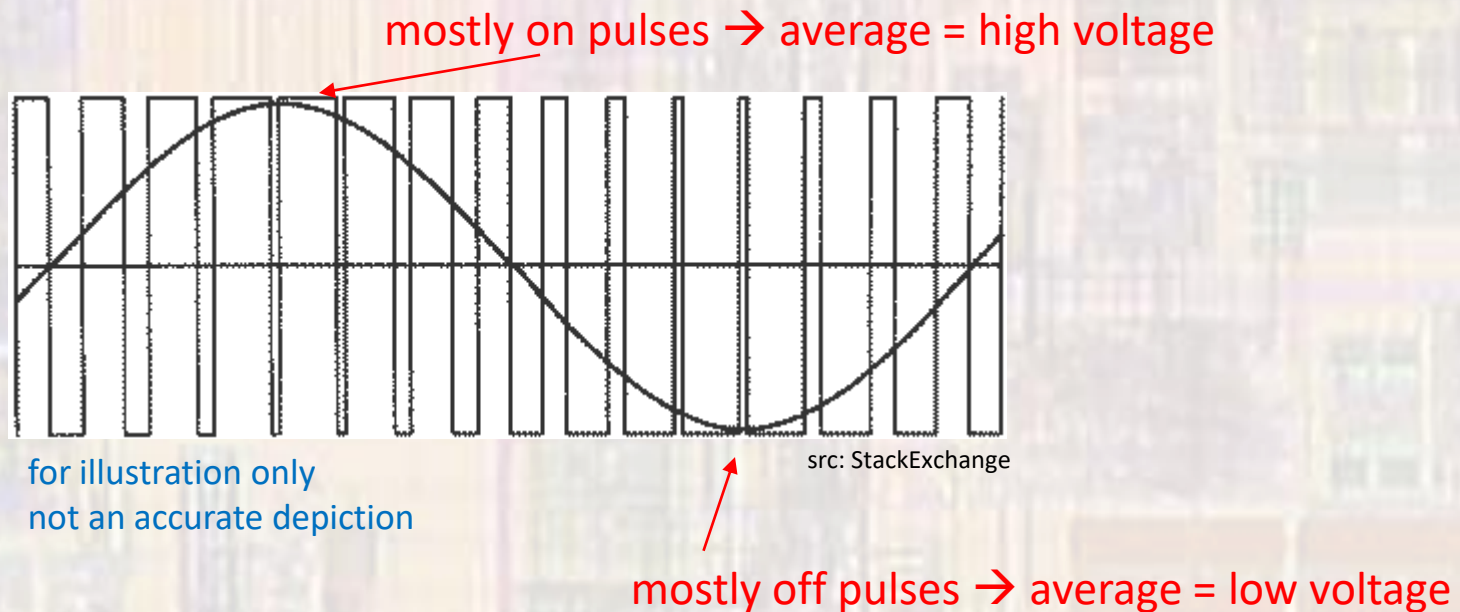# PWM Basics

Last updated 10/30/18
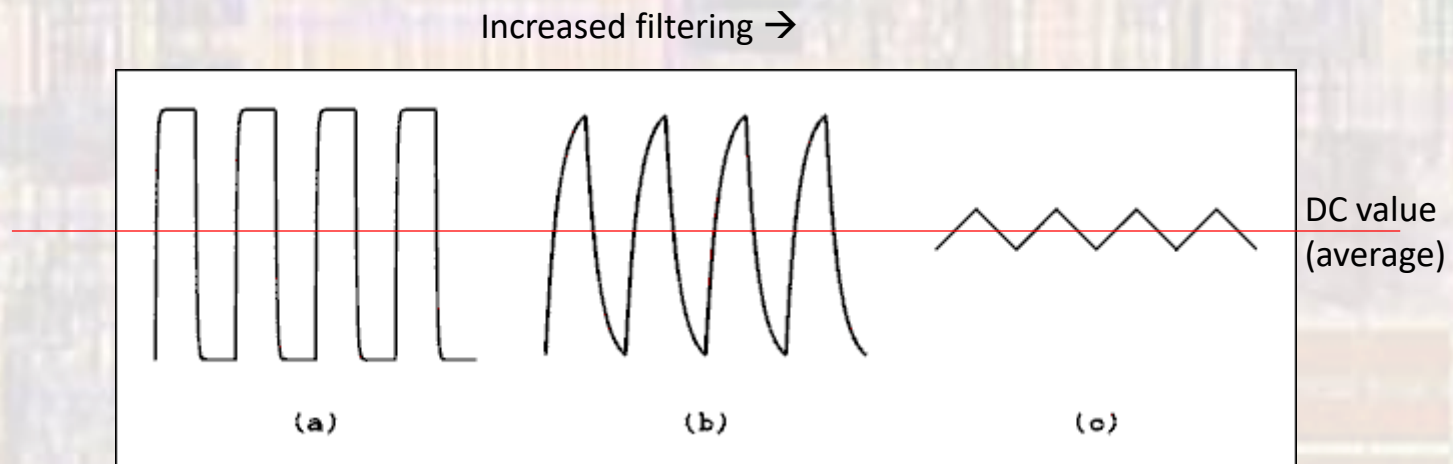
PWM Basics

- Pulse Width Modulation(PWM)

  - Create a fixed frequency square wave
  - Vary the duty cycle (pulse width) to emulate an analog signal

mostly on pulses → average = high voltage

for illustration only
not an accurate depiction

src: StackExchange

mostly off pulses → average = low voltage

PWM Basics

- Pulse Width Modulation(PWM)

  - When a PWM signal is fed to a circuit that has a low pass filter characteristic:
    - The high frequency components are removed
    - The low frequency components remain
    - The DC component remains

Increased filtering →

DC value (average)

src: StackExchange

PWM Basics

- Pulse Width Modulation(PWM)

  - DC value is proportional to the duty cycle (pulse width)
    - With a 3.3v signal
    - Effective DC values: ———

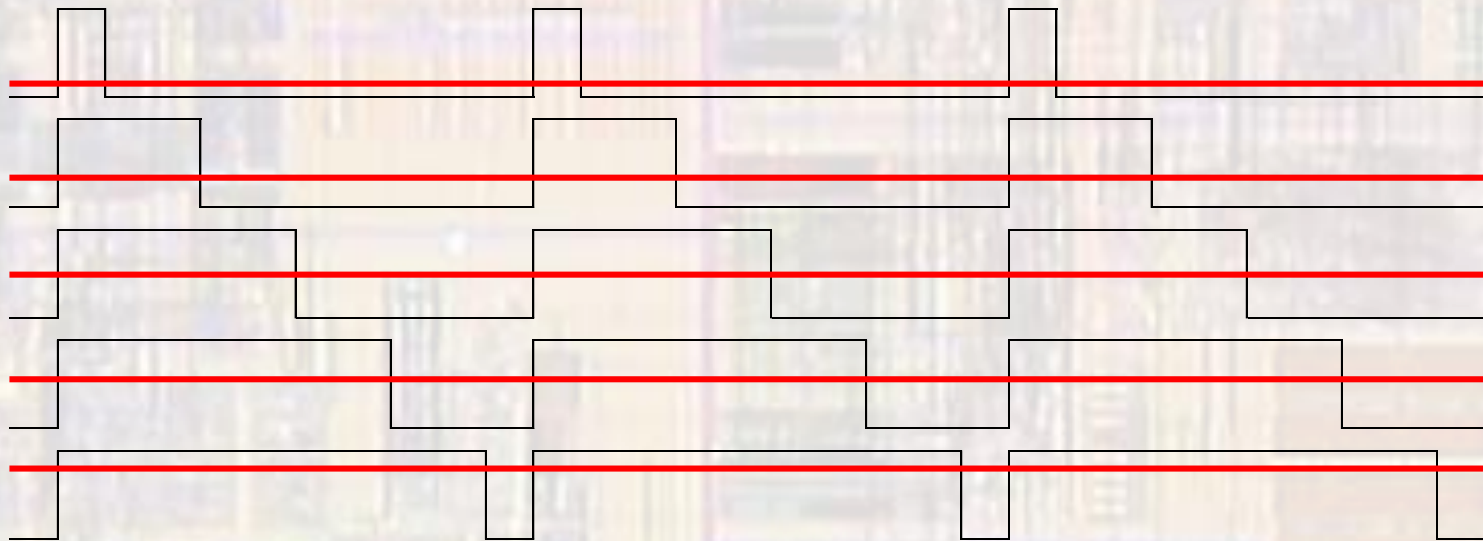| Duty Cycle		Effective DC Voltage
10%		0.33v
30%		0.99v
50%		1.65v
70%		2.31v
90%		2.97v

PWM Basics

- Pulse Width Modulation(PWM)

  - Persistence in LEDs
    - LEDs do not act like low pass filters but can show similar effects if switched on/off fast enough

    - Our eyes act like low pass filters

    - If we turn on/off LEDs fast enough they look like they are always on but at varying brightness depending on the duty cycle

    - Always on – full brightness
    - On ½ time – half brightness