SIERRA COLLEGE

MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

Class 19
DC Power Supplies

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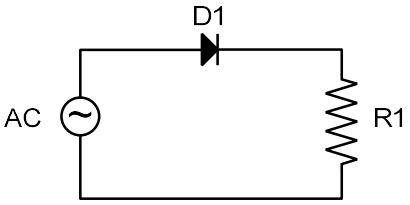
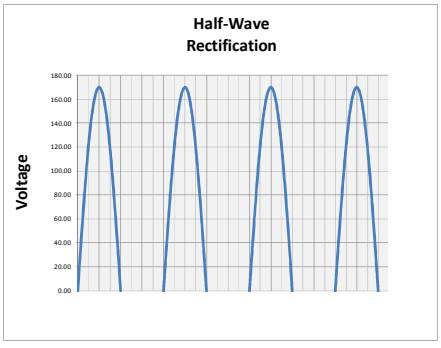
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Rectifiers
  - Half-wave
    - Positive or negative alternations passed





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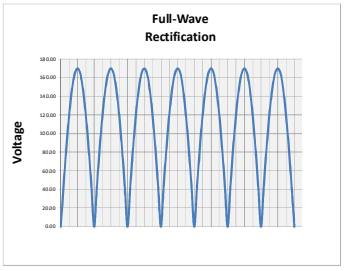
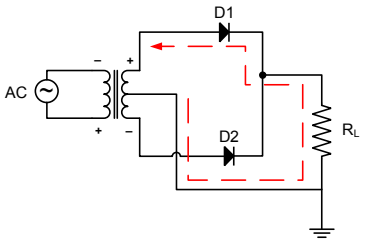
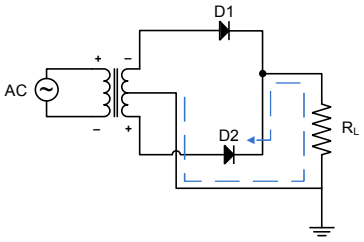
Mechatronics
Real Skills Real Jobs

- Rectifiers
  - Full Wave
    - Positive alternations
      - D1 conducts
    - Negative alternations
      - D2 conducts





Positive Alternation



Negative Alternation

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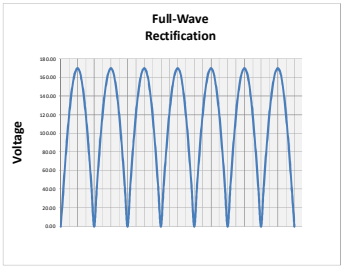
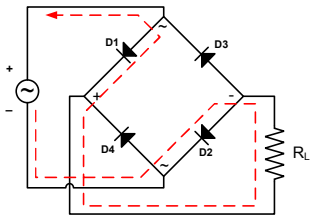
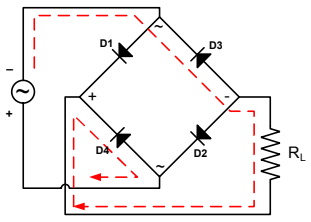
Real Skills Real Jobs

- Rectifiers
  - Bridge
    - Positive alternations
      - D1 & D2 conducts
    - Negative alternations
      - D3 & D4 conducts





Positive Alternation



Negative Alternation

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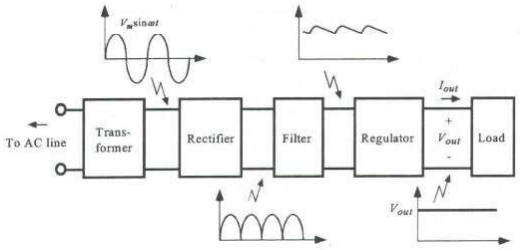
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- DC Power Supply
  - A device that supplies electrical energy as direct current
  - Functions
    - Voltage transformation
    - Energy conversion
    - Filtration
    - Regulation
    - Isolation
    - Protection



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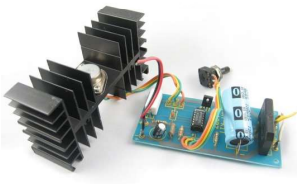
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- DC Power Supply
  - Types
    - Linear – regulates output using transistors operating in linear mode. Power is supplied as a continuous voltage and current
    - Switched Mode – regulates output using transistors operating in saturation mode. Power is supplied as voltage pulses with controlled duty cycle



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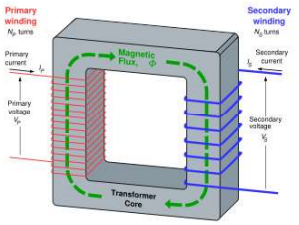
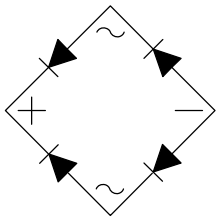
Real Skills Real Jobs

- DC Power Supply
  - Functions
    - Voltage transformation – the use of an AC transformer to step down line voltage
    - Energy conversion – the conversion of electrical energy from alternating to direct current





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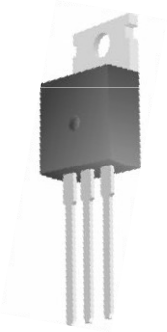
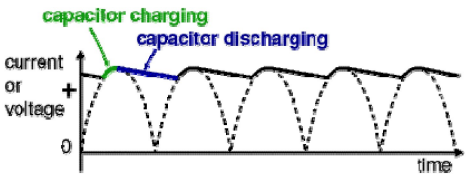
Real Skills Real Jobs

- DC Power Supply
  - Functions
    - Filtration – the reduction of pulsating DC ripple
    - Regulation – the control of a power supply's output current, voltage or both





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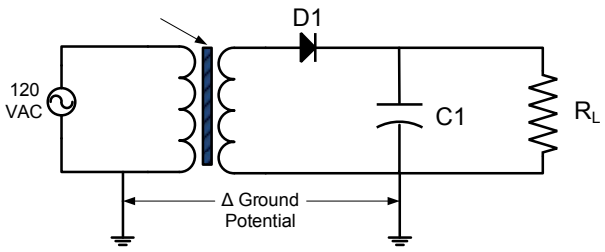
Real Skills Real Jobs

- DC Power Supply
  - Functions
    - Isolation – the prevention of charge transference between electrical systems.
      - Ground loops - Noise, interference, shock hazard



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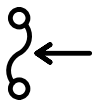
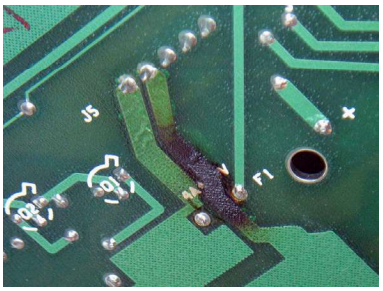
Real Skills Real Jobs

- DC Power Supply
  - Functions
    - Protection – the protection of power supply hardware from electrical faults
      - Over Current
      - Over / Under Voltage
      - Over / Under Frequency

Circuit Breaker

Fuse





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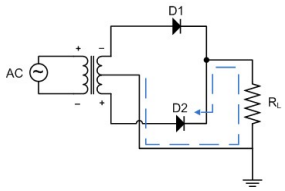
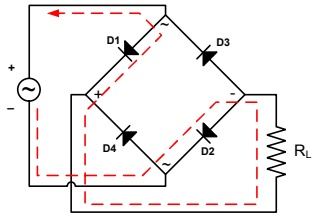
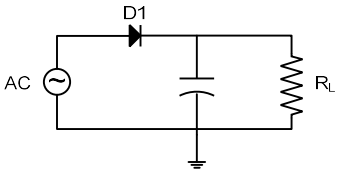
MECH 10
Fundamentals of Electronics

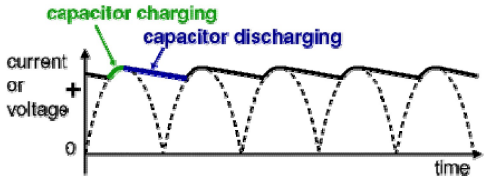
Mechatronics
Real Skills Real Jobs

- DC Power Supply
  - Linear PS Functions
    - Voltage transformation
      - AC transformer
    - Energy conversion
      - AC to DC
    - Filtration
      - Capacitor









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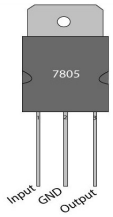
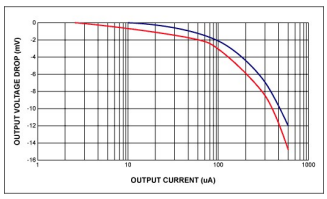
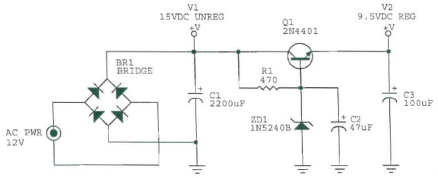


- DC Power Supply
  - Linear PS Functions
    - Regulation – constant output voltage
      - **Load regulation** – the change in output voltage caused by a load change
        - e.g. 100mV @ 1 amp
      - **Line regulation** – the change in output voltage caused by a change input voltage
        - e.g. 130mV / 1 volt





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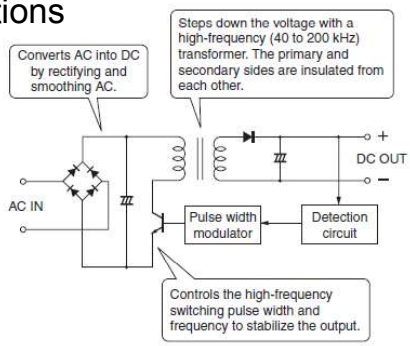
- DC Power Supply
  - Switched Mode PS Functions
    - Energy Conversion
      - Rectifier
    - Filtration
      - Capacitors
    - Voltage transformation
      - Primary – PWM
      - Secondary – filtered DC
    - Isolation
      - Transformer magnetic coupling



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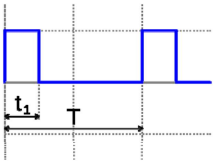
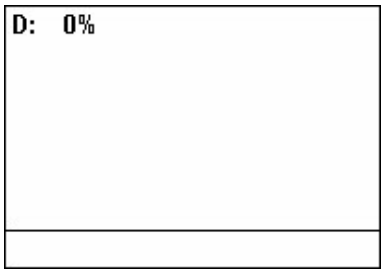
- DC Power Supply
  - Switched Mode PS Functions
    - Pulse width modulation



Duty Cycle

$$V_{eff} = D \times V_{MAX} + (1 - D) \times V_{\min}$$

Where;
D = duty cycle (%)
V_{MAX} = max voltage
V_{MIN} = min voltage



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- DC Power Supply
  - Linear v Switched

	Linear PS	SMPS
Size & Weight	Xfmr & heat sinks add bulk & size	Smaller & lighter (HF inductor v xfmr, heat sinks)
Efficiency	30 to 40% (function of V_{in} versus V_{out})	60 to 90% (low resistive losses between input & output, precise load regulation)
Radio Frequency Interference	Mild high frequency from AC rectifier	Strong due to current switching

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- Lab 19 – MagLev Power Supply

Learning Objectives

- Measure the output of a bridge rectifier
- Measure ripple voltage from a DC power supply
- Visualize voltage ripple in a DC power supply output.
- Understand the benefits of filtered and regulated power supplies

		Points Possible
Documentation	Quality of documentation (neatness, clarity, spelling, grammar), Expected and measured values recorded on schematic diagram	**10**
Setup	Power supply voltages measured and calculated	**5**
Unfiltered Bridge Rectifier	Waveform captured, frequency calculated,	**5**
Filtered Bridge Rectifier	LED V_F, C1 voltage drop, V_{PP}, V_{R2}, I_{R2}, Q1 V_{PP}, ripple waveform captured	**10**
Conclusions	Questions answered completely & accurately.	**20**
	Total	**50**