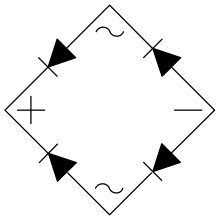
SIERRA COLLEGE

MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

Class 18
Diodes & Rectifiers



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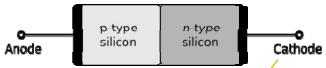
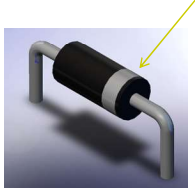
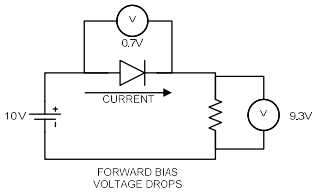
MECH 10
Fundamentals of Electronics

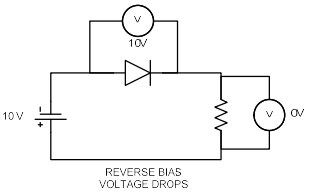
Mechatronics
Real Skills Real Jobs

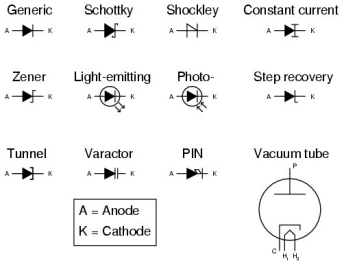
- Diodes
  - A two-terminal semiconductor that allows current flow in one direction











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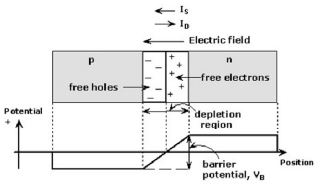
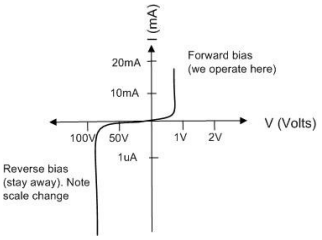
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Diodes
  - Ratings
    - **Forward voltage drop** (V_F) – also barrier potential, is the forward conducting junction voltage
      - Silicon – 0.7 V
      - Germanium – 0.3 V
    - **Average forward current** – the maximum sustainable forward current
    - **Peak reverse voltage** – also breakdown voltage, is the largest sustainable reverse bias voltage





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MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Diodes
  - Rectifier diode
    - For AC to DC conversion
    - High forward current
    - Rugged packaging

Type and ordering number	V_{RSM}	V_{RRM}	I_{FAVM}	I_{FSM}		V_{F0}	r_F	T_{VJM}	R_{thJC}	R_{thCH}	F_m
** = V_{RSM}/100 V		T_{VJM}	T_c = 85°C	8.3 ms T_{VJM}	10 ms T_{VJM}	T_{VJM}	T_{VJM}				
	V	V	A	kA		V	mΩ	°C	K/kW		kN
5SDD 40B0200	200	200	6130	50.0	45.0	0.80	0.030	170	10	5	22
5SDD 71B0200	200	200	7110	60.0	55.0	0.74	0.026	170	10	5	22

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MECH 10
Fundamentals of Electronics

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- Diodes
  - Switching diode
    - High frequency switching
    - Reverse recovery time – time required to switch polarities
      - < 50nS
    - Low current & voltage ratings
    - Applications – communications & computers

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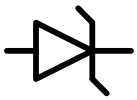
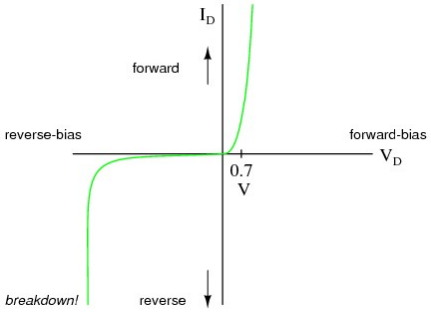
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Diodes
  - Zener diode
    - A reverse biased diode that operated at reverse breakdown voltage
      - Designed for specific voltages
      - Voltage regulator
    - Power Rating
      - $P_Z = V_Z \times I_R$
      - Usually in series with load resistor





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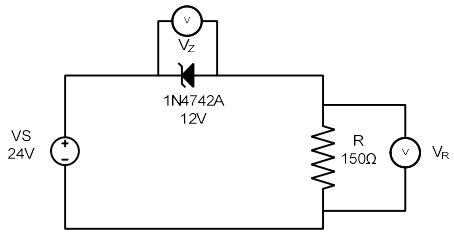
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Diodes
  - Zener diode
    - Power Rating Circuit Example
      - 1N4742A – 12V @ 1 watt



$$I_R = \frac{(V_S - V_Z)}{R}$$

$$I_R = \frac{(24V - 12V)}{150\Omega}$$

$$I_R = ?$$

$$P_Z = V_Z \times I_R$$

$$P_Z = 12V \times I_R$$

$$P_Z = ?$$

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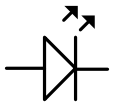
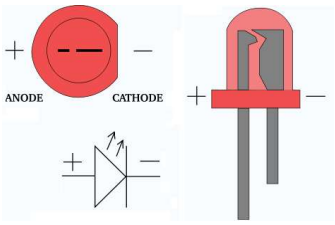
MECH 10
Fundamentals of Electronics

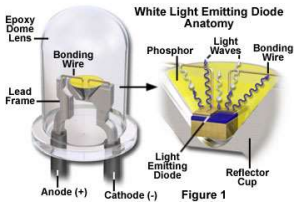
Mechatronics
Real Skills Real Jobs

- Diodes
  - Light emitting diodes
    - Function
      - Electrons emit photons between conduction & valence band jumps
    - Materials
      - Gallium, arsenic, phosphorous, carbon (colors)
    - Specifications
      - Operate forward biased (1.4 to 2V)
      - 5 to 50mA, series load resistor common



LED





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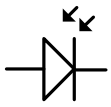
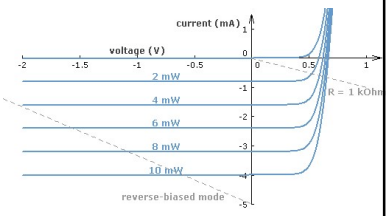
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Diodes
  - Photodiodes
    - Senses and responds to light intensity
    - Materials
      - Silicon, germanium, indium
    - Operations
      - Photodiode mode
        - Reverse bias
      - Photovoltaic mode
        - Zero bias



Photodiode



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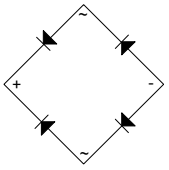
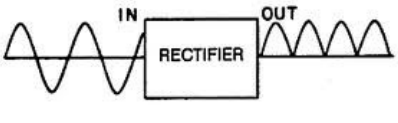
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Rectifiers
  - A diode assembly that converts AC to pulsating DC
    - Types
      - Half-wave
      - Full wave
      - Bridge





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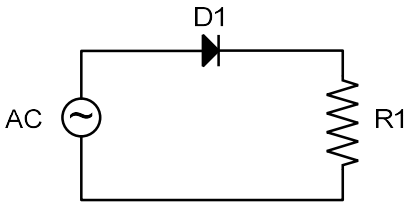
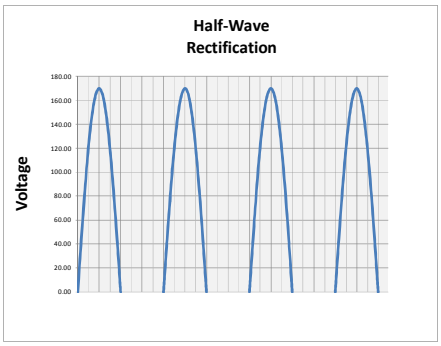
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

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





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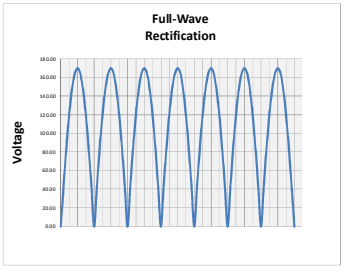
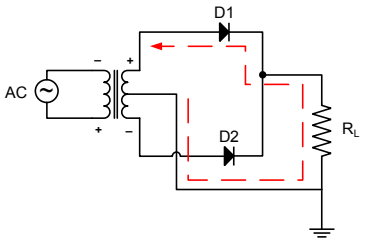
MECH 10
Fundamentals of Electronics

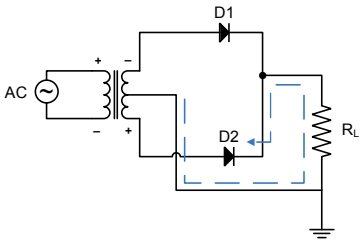
Mechatronics
Real Skills Real Jobs

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





Positive Alternation



Negative Alternation

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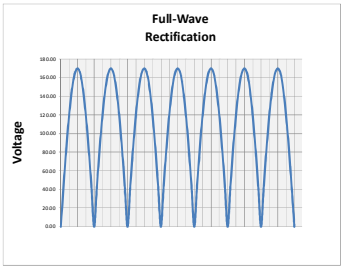
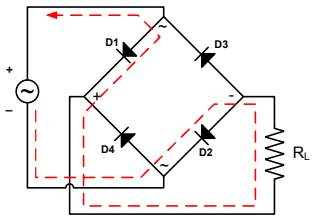
MECH 10
Fundamentals of Electronics

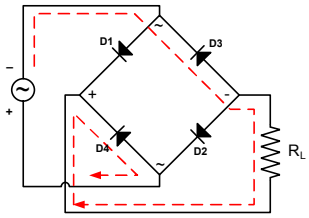
Mechatronics
Real Skills Real Jobs

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





Positive Alternation



Negative Alternation

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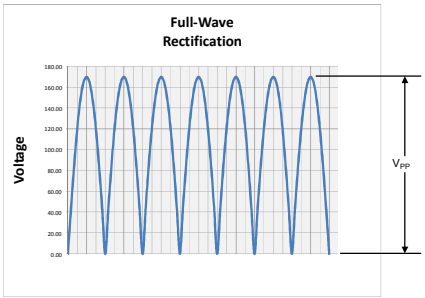
MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Rectifiers
  - Ripple
    - The unwanted periodic variation in the DC output of a rectifier
      - Acts like AC



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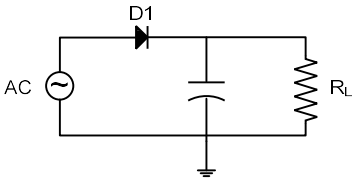
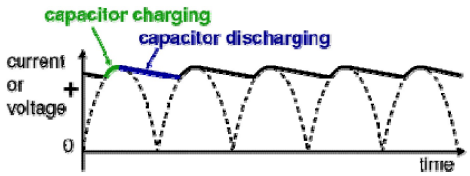
Mechatronics
Real Skills Real Jobs

- Rectifiers
  - Ripple
    - Capacitive filter
      - V_{PP} – ripple voltage

$$V_{PP} = \frac{I}{fC}$$ **Half-wave**

$$V_{PP} = \frac{I}{2fC}$$ **Full-wave**





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MECH 10
Fundamentals of Electronics

Mechatronics
Real Skills Real Jobs

- Lab 18 – Rectifiers

Learning Objectives

- Build and test a half-wave rectifier
- Build and test a full-wave rectifier
- Visualize and analyze rectifier waveforms
- Test a filter capacitor's impact on rectifier waveform

		Points Possible
Documentation	Quality of documentation (neatness, clarity, spelling, grammar), Expected and measured values recorded on schematic diagram	**10**
Half-wave Rectifier	Diode test results recorded, test point A & B waveforms represented with amplitude & period, frequencies calculated	**10**
Half-wave Rectifier, Filtered	Rectifier output recorded with DMM & DO-scope, ripple recorded	**10**
Full-wave Rectifier	Diode test results recorded, test point A & B waveforms represented with amplitude & period, frequencies calculated	**10**
Full-wave Rectifier, Filtered	Rectifier output recorded with DMM & DO-scope, ripple recorded	**10**
Conclusions	Questions answered completely & accurately.	**20**
	Total	**70**