Diode Applications

Session 5c for Electronics and Telecommunications
A Fairfield University E-Course
Powered by LearnLinc

Module: Semiconductor Electronics (in two parts)

- Text: "Electronics," Harry Kybett, Wiley, 1986, ISBN 0-471-00916-4
- References:
  - Electronics Tutorial (Thanks to Alex Pounds)
  - Electronics Tutorial (Thanks to Mark Sokos)
- Semiconductors, Diodes and Bipolar Transistors
  - 5 on-line sessions plus one lab
- FETs, SCRs, Other Devices and Amplifiers
  - 5 on-line sessions plus one lab
- Mastery Test part 3 follows this Module

Section 5: Semiconductors, Diodes and Bipolar Transistors

- 0BJECTIVES: This section reviews semiconductors, doping and junctions. The characteristics and application of Diodes and Bipolar Transistors are then studied.

Section 5 Schedule:

Session 5a	– 09/18	Semiconductors and Doping	Elect 1-7 1.23 – 1.39
MT2 Results	– 09/23	We'll discuss MT2	
Session 5b	– 09/25	Diodes	Kybett Chapter 2
Session 5c	**– 09/30**	**Diode Applications**	**Kybett Chapter 11**
Session 5d	– 10/02	Bipolar Transistors	Kybett pp 51 - 70
(lab - 10/05, Sat.)			
Session 5e	– 10/07	Transistor Amplifiers	Kybett pp 173 - 201
(Quiz 4 due 10/12)			
Session 5f	– 10/14	Review (Discuss Quiz 4)	
Break to introduce Learnlinc version 6.1		About 2 weeks to set up the computers and retrain us	

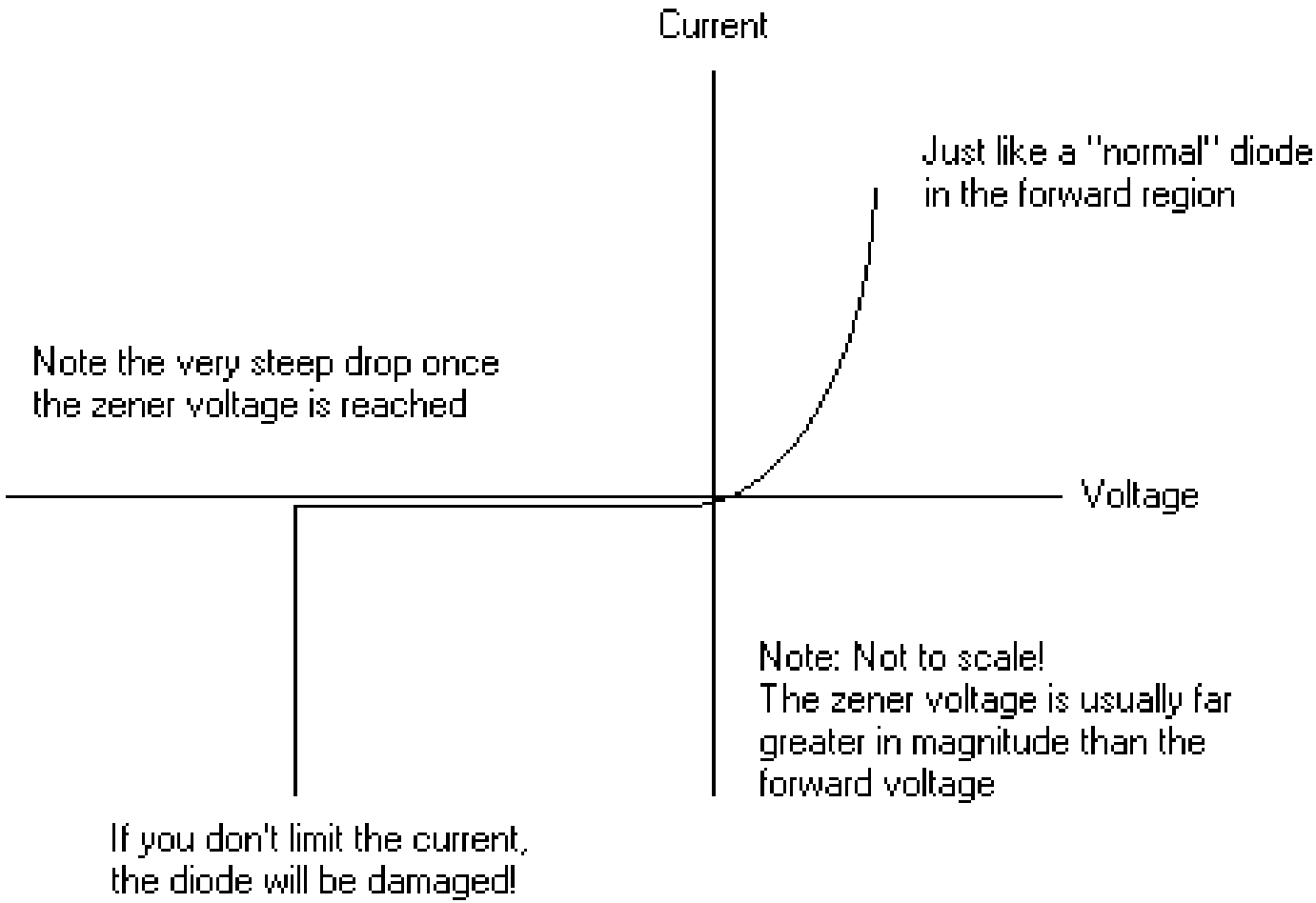
Diode Review

- Diodes are electronic one-way valves
  - Current can flow from anode to cathode
  - Current is blocked in the reverse direction
- Forward voltage drop

Current flows from A to B
but not from B to A.

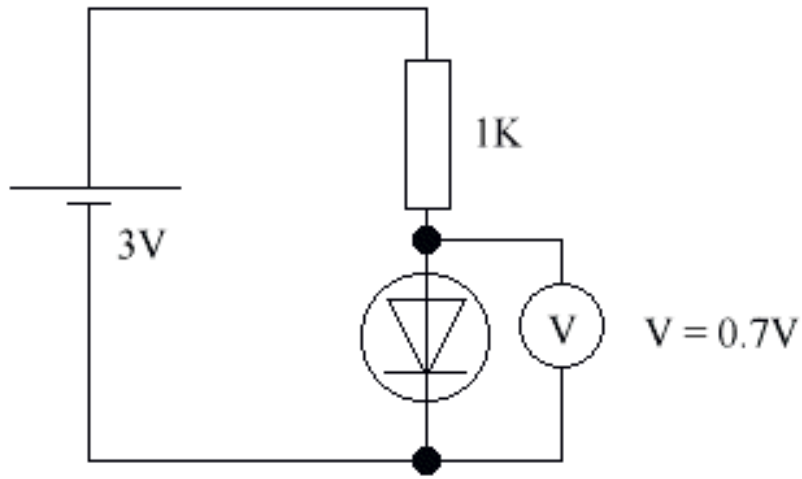
  - Silicon $V_f = 0.7$ volts
  - Germanium $V_f = 0.3$ volts
  - Schottky $V_f = 0.1$ volts
  - GaAs $V_f = 2$ volts
- Peak Inverse Voltage (PIV, PRV, Zener)
- These are non-linear devices (no superposition)

Diode VI Curve



A Diode Circuit

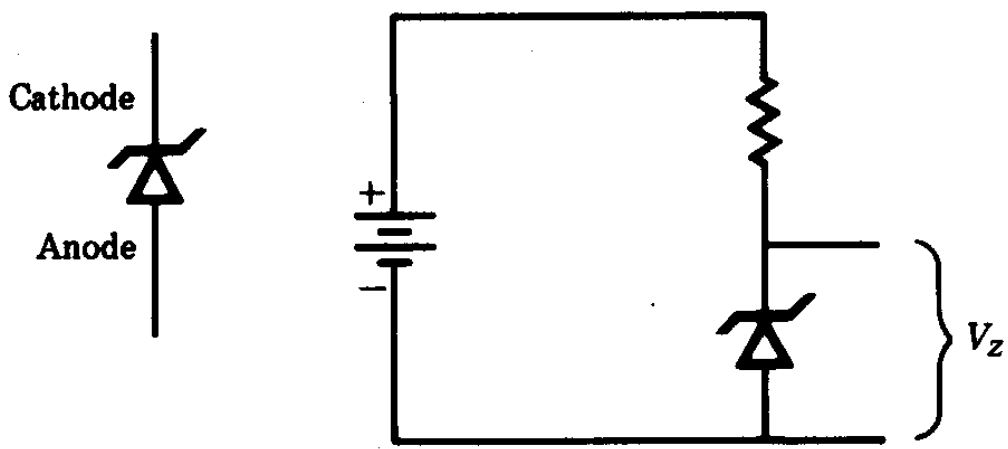
- What is the “loop” current?
- The resistor voltage is: $V_r = 3 – 0.7 = 2.3$ volts
- Using Ohm’s Law $I_r = 2.3 / 1000 = 2.3$ mA which is also the loop current



Zener Diode Application
(Shunt Voltage Regulator)

Kybett pp 42-47 (Problems 26 – 47)

26. Zener diodes operate in reverse breakdown. Series resistor limits the current to a safe level.
$I_R = (V_S - V_Z) / R$



Zener
(continued)

27. Determine resistor to maintain voltage/current for light at specifications
28. If the source voltage drops; the light dims

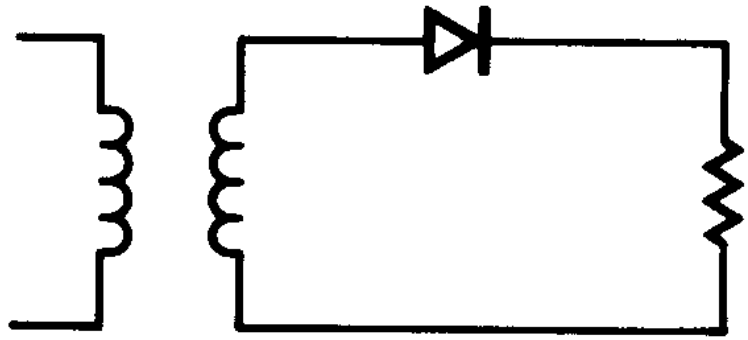
29 – 30. Put a 20v zener across the bulb and redesign resistor for the worst case (35v source)

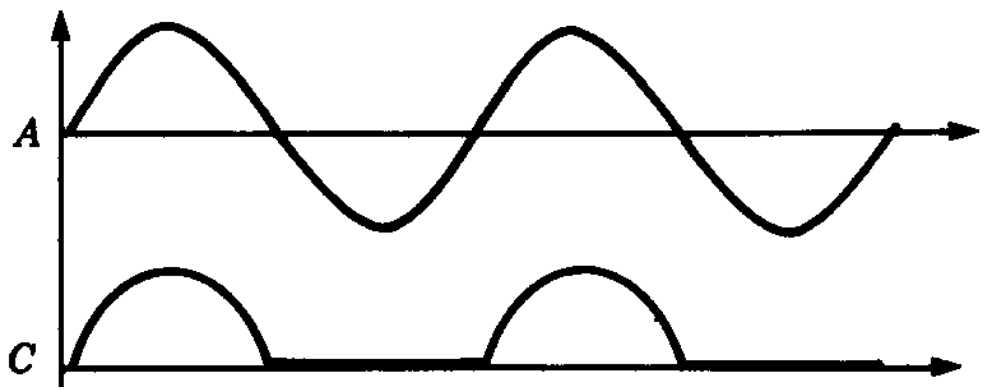
31. At 50v the bulb remains at 20v; the zener now conducts the excess current and the bulb remains at specifications

32 - 34. Determine maximum power dissipation for the zener diode and the resistor (avoid burn out at 50v).

Half Wave Rectifier

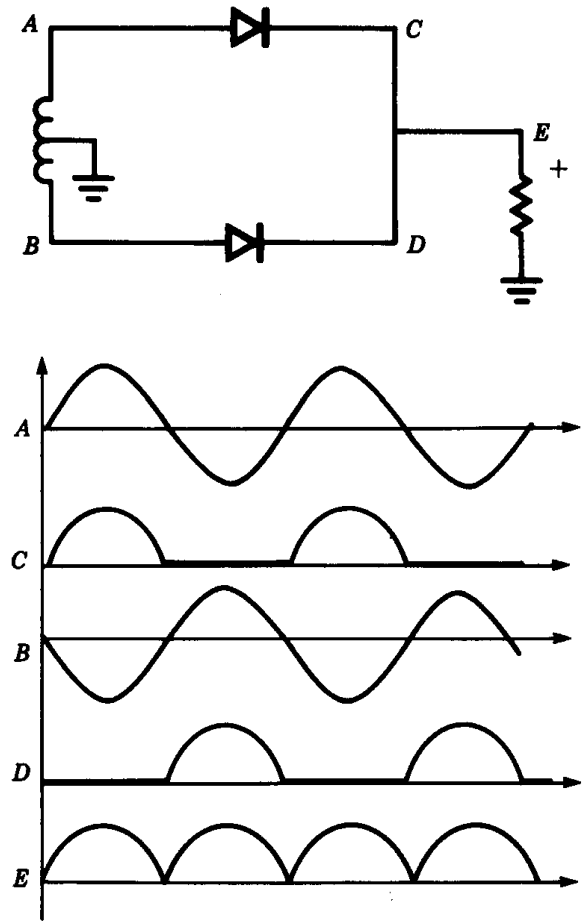
- Current flows during the positive half of the AC sine wave
- Current is blocked during the negative half of the AC sine wave
- The pulse output waveform has a non-zero average value (a DC component)





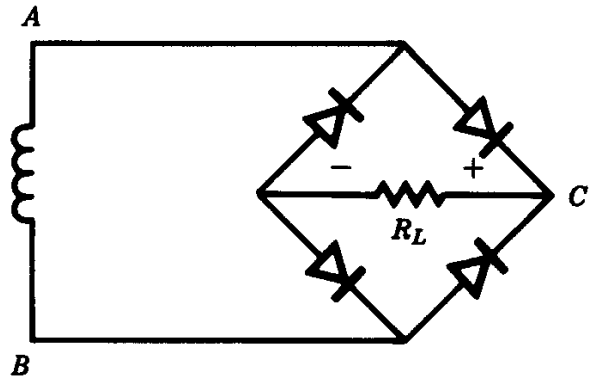
Full Wave Rectifiers

- Center tapped transformer produces two AC sine waves, 180º apart
- The diodes produce positive pulse waveforms during opposite halves of the input sine wave
- They add in the load. The time between peaks is half that of the half-wave rectifier (more efficient producer of DC)

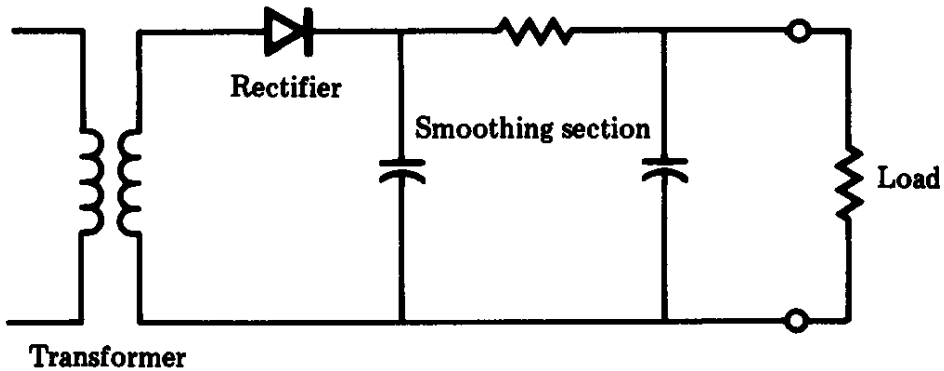


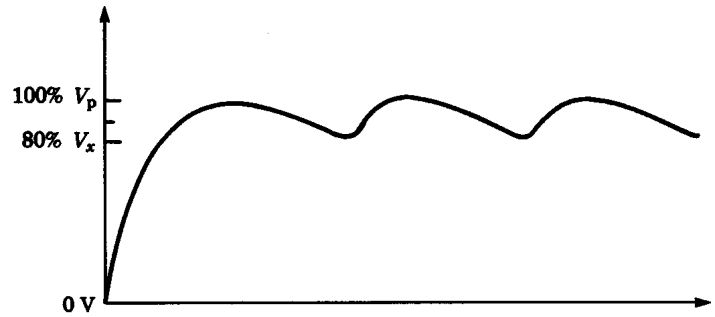
“Bridge” Rectifiers

- Another form of full-wave rectifier
- Doesn’t require a center-tapped transformer
- Transformer secondary now “floats” at ½ the DC output voltage (assuming that the load is connected to ground)



DC Power Supply





- Now the diode conducts to charge the capacitor to "peak" AC voltage.
- The capacitor discharges between peaks of the source pulses
- Result: an average (DC) of about 80% of the AC peak and a small "saw tooth" AC ripple voltage.
- A full-wave rectifier produces smaller ripple (less time between pulses)

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