

Semiconductor PN Junction Characteristics

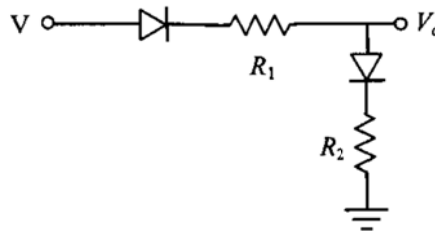
Forward and Reverse Biasing PN Junction

Diode Circuits (Rectifiers, Clamps, Clippers)

Diode Circuits & Zener Diode Circuits

See Attached Example Problems

1. Given:

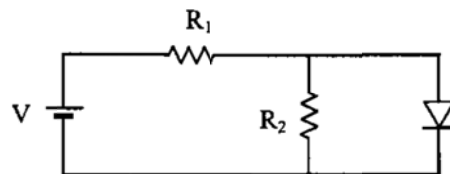
 D_1 and D_2 silicon diodes $V = 18$ volts $R_1 = 1800 \Omega$ $R_2 = 470 \Omega$ 

Calculate:

Diode Currents

 V_o

2. Given:

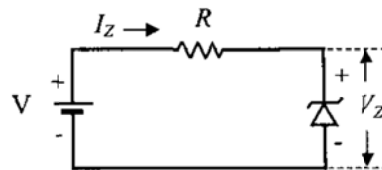
 D_1 silicon diode $V = 14$ volts $R_1 = 220 \Omega$ $R_2 = 750 \Omega$ 

Calculate:

Diode Current

 V_{R1} V_{R2} I_{R1} I_{R2}

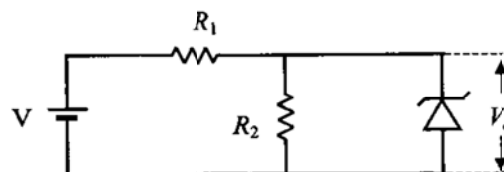
3. Given:

 $V = 18$ volts $V_Z = 15.1$ volts $R = 620 \Omega$ 

Calculate:

 I_Z V_R

4. Given:

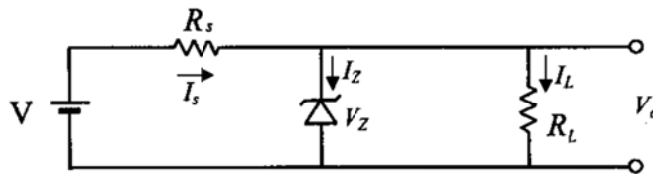
 $V = 24$ volts $V_Z = 3.3$ volts $R_1 = 680 \Omega$ $R_2 = 200 \Omega$ 

Calculate:

 V_o I_{R1} I_{R2} I_Z I_{Total}

5. Given:

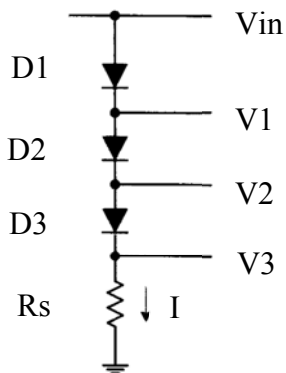
- $V = 9$ volts
- $V_Z = 3.3$ volts
- $R_S = 180 \Omega$
- $R_L = 220 \Omega$



Calculate:

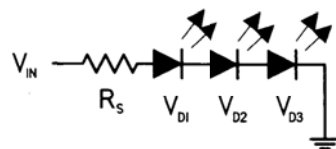
- V_o
- I_L
- I_Z
- I_S

6. Diode Voltage Divider



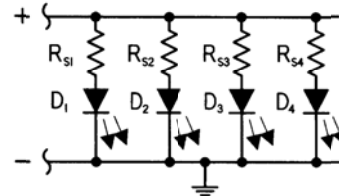
- Calculate R_s for
- $V_{in} = 9$ V
 - $V_D = 0.7$ V
 - $I = 7$ mA

7. LEDs in Series



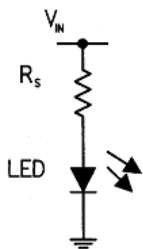
- Calculate R_S for
- $V_{in} = 12$ V
 - $V_{LED} = 1.5$ V
 - $I_{LED} = 20$ mA

8. LEDs in Parallel



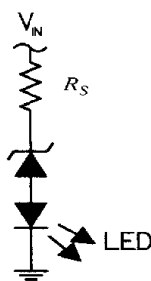
- Calculate R_{Si} for
- $V_{in} = 9$ V
 - $V_{LED1} = 1.2$ V $I_{LED} = 20$ mA
 - $V_{LED2} = 1.8$ V $I_{LED} = 20$ mA
 - $V_{LED3} = 2.4$ V $I_{LED} = 24$ mA
 - $V_{LED4} = 3.0$ V $I_{LED} = 15$ mA

9. Current Limiting Resistor



- Calculate R_s for
- $V_{in} = 3$ V
 - $V_{LED} = 1.2$ V
 - $I_{LED} = 15$ mA

10. Voltage Indicator



- Calculate Minimum Input Voltage
- $R_s = 470$
 - $V_{Zener} = 3.3$ V
 - $V_{LED} = 1.2$ V
 - $I_{LED} = 10$ mA

1. Diode Circuit

$$\text{Diode Currents} = 7.3 \text{ mA}$$

$$V_0 = 4.1 \text{ V}$$

2. Diode Circuit

$$\text{Diode Current} = 59.5 \text{ mA}$$

$$V_{R1} = 13.3 \text{ V}$$

$$V_{R2} = 0.7 \text{ V}$$

$$I_{R1} = 60.4 \text{ mA}$$

$$I_{R2} = 0.93 \text{ mA}$$

3. Zener Circuit

$$I_Z = 4.7 \text{ mA}$$

$$V_R = 2.9 \text{ V}$$

4. Zener Circuit

$$V_o = 3.3 \text{ V}$$

$$I_{R1} = 30.4 \text{ mA}$$

$$I_{R2} = 16.5 \text{ mA}$$

$$I_Z = 13.9 \text{ mA}$$

$$I_{\text{Total}} = 30.4 \text{ mA}$$

5. Zener Circuit

$$V_o = 3.3 \text{ V}$$

$$I_L = 15 \text{ mA}$$

$$I_Z = 16.7 \text{ mA}$$

$$I_S = 31.7 \text{ mA}$$

6. Diode Voltage Divider

$$R_s = 986 \Omega$$

7. LEDs in Series

$$R_s = 375 \Omega$$

8. LEDs in Parallel

$$R_{S1} = 390 \Omega \quad R_{S2} = 360 \Omega$$

$$R_{S3} = 275 \Omega$$

$$R_{S4} = 400 \Omega$$

9. Current Limiting Resistor

$$R_s = 120 \Omega$$

10. LED Voltage Indicator

$$V_{in} = 9.2 \text{ V}$$