Problems

SEC. 5–1 THE ZENER DIODE

5-1 MultiSim An unloaded zener regulator has a source voltage of 24 V, a series resistance of 470 Ω, and a zener voltage of 15 V. What is the zener current?

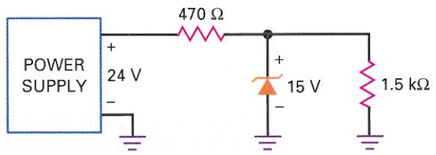
5-2 If the source voltage in Prob. 5-1 varies from 24 to 40 V, what is the maximum zener current?

5-3 If the series resistor of Prob. 5-1 has a tolerance of ±5 percent, what is the maximum zener current?

SEC. 5–2 THE LOADED ZENER REGULATOR

5-4 MultiSim If the zener diode is disconnected in Fig. 5-40, what is the load voltage?

Figure 5-40



5-5 MultiSim Calculate all three currents in Fig. 5-40.

5-6 Assuming a tolerance of ±5 percent in both resistors of Fig. 5-40, what is the maximum zener current?

5-7 Suppose the supply voltage of Fig. 5-40 can vary from 24 to 40 V. What is the maximum zener current?

5-8 The zener diode of Fig. 5-40 is replaced with a 1N963B. What are the load voltage and the zener current?

5-9 Draw the schematic diagram of a zener regulator with a supply voltage of 20 V, a series resistance of 330 Ω, a zener voltage of 12 V, and a load resistance of 1 kΩ. What are the load voltage and the zener current?

SEC. 5–3 SECOND APPROXIMATION OF A ZENER DIODE

5-10 The zener diode of Fig. 5-40 has a zener resistance of 14 Ω. If the power supply has a ripple of 1 V pp, what is the ripple across the load resistor?

5-11 During the day, the ac line voltage changes. This causes the unregulated 24-V output of the power supply to vary from 21.5 to 25 V. If the zener resistance is 14 Ω, what is the voltage change over the foregoing range?

SEC. 5–4 ZENER DROP-OUT POINT

5-12 Assume the supply voltage of Fig. 5-40 decreases from 24 to 0 V. At some point along the way, the zener diode will stop regulating. Find the supply voltage where regulation is lost.

5-13 In Fig. 5-40, the unregulated voltage out of the power supply may vary from 20 to 26 V and the load resistance may vary from 500 Ω to 1.5 kΩ. Will the zener regulator fail under these conditions? If so, what value should the series resistance be?

5-14 The unregulated voltage in Fig. 5-40 may vary from 18 to 25 V, and the load current may vary from 1 to 25 mA. Will the zener regulator stop regulating under these conditions? If so, what is the maximum value for R_S?

5-15 What is the minimum load resistance that may be used in Fig. 5-40 without losing zener regulation?

SEC. 5–5 READING A DATA SHEET

5-16 A zener diode has a voltage of 10 V and a current of 20 mA. What is the power dissipation?

5-17 A 1N968 has 5 mA through it. What is the power?

5-18 What is the power dissipation in the resistors and zener diode of Fig. 5-40?

5-19 The zener diode of Fig. 5-40 is a 1N4744A. What is the minimum zener voltage? The maximum?

5-20 If the lead temperature of a 1N4736A zener diode rises to 100°C, what is the diode's new power rating?

SEC. 5–6 TROUBLESHOOTING

5-21 In Fig. 5-40, what is the load voltage for each of these conditions?

a. Zener diode shorted

b. Zener diode open

c. Series resistor open

d. Load resistor shorted

5-22 If you measure approximately 18.3 V for the load voltage of Fig. 5-40, what do you think the trouble is?

5-23 You measure 24 V across the load of Fig. 5-40. An ohmmeter indicates the zener diode is open. Before replacing the zener diode, what should you check for?

5-24 In Fig. 5-41, the LED does not light. Which of the following are possible troubles?

a. V130LA2 is open.

b. Ground between two left bridge diodes is open.

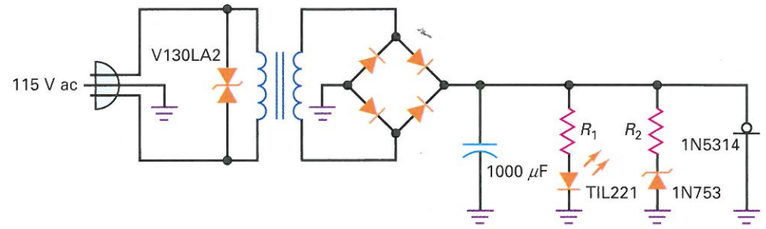
c. Filter capacitor is open.

d. Filter capacitor is shorted.

e. 1N5314 is open.

f. 1N5314 is shorted.

Figure 5-41



SEC. 5–8 OPTOELECTRONIC DEVICES

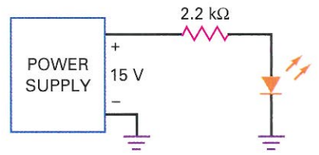
5-25 MultiSim What is the current through the LED of Fig. 5-42?

5-26 If the supply voltage of Fig. 5-42 increases to 40 V, what is the LED current?

5-27 If the resistor is decreased to 1 kΩ, what is the LED current in Fig. 5-42?

5-28 The resistor of Fig. 5-42 is decreased until the LED current equals 13 mA. What is the value of the resistance?

Figure 5-42



Critical Thinking

5-29 The zener diode of Fig. 5-40 has a zener resistance of 14 Ω. What is the load voltage if you include R_Z in your calculations?

5-30 The zener diode of Fig. 5-40 is a 1N4744A. If the load resistance varies from 1 to 10 kΩ, what is the minimum load voltage? The maximum load voltage? (Use the second approximation.)

5-31 Design a zener regulator to meet these specifications: Load voltage is 6.8 V, source voltage is 20 V, and load current is 30 mA.

5-32 A TIL312 is a seven-segment indicator. Each segment has a voltage drop between 1.5 and 2 V at 20 mA. The supply voltage is +5 V. Design a seven-segment display circuit controlled by on-off switches that has a maximum current drain of 140 mA.

5-33 The secondary voltage of Fig. 5-41 is 12.6 V rms when the line voltage is 115 V rms. During the day the power line varies by ±10 percent. The resistors have tolerances of ±5 percent. The 1N4733A has a tolerance of ±5 percent and a zener resistance of 7 Ω. If R_2 equals 560 Ω, what is the maximum possible value of the zener current at any instant during day?

5-34 In Fig. 5-41, the secondary voltage is 12.6 V rms, and diode drops are 0.7 V each. The 1N5314 is a constant-current diode with a current of 4.7 mA. The LED current is 15.6 mA, and the zener current is 21.7 mA. The filter capacitor has a tolerance of ±20 percent. What is the maximum peak-to-peak ripple?

5-35 Figure 5-43 shows part of a bicycle lighting system. The diodes are Schottky diodes. Use the second approximation to calculate the voltage across the filter capacitor.

Figure 5-43