Sheet (8)

1. What are the basic components in a series regulator?

Control element, error detector, sampling element, reference voltage

2. A certain series regulator has an output voltage of 8V. If the op-amp's closed loop gain is 4, what is the value of the reference voltage?

2 V

3. How does the control element in a shunt regulator differ from that in a series regulator?

In a shunt regulator, the control element is in parallel with the load rather than in series.

4. What is one advantage of a shunt regulator over a series type? What is a disadvantage?

A shunt regulator has inherent current limiting. A disadvantage is that a shunt regulator is less efficient than a series regulator.

5. What are the three terminals of a fixed-voltage regulator?

Input, output, and ground

6. What is output voltage of a 7809? Of a 7915?

A 7809 has a +9 V output; A 7915 has a −15 V output.

7. What are the three terminals of an adjustable-voltage regulator?

Input, output, adjustment

8. What external components are required for basic LM317 configuration?

A two-resistor voltage divider

9. (a) Determine the output voltage for the series regulator shown in figure 1.
(b) If R3 is increased to 4.7KΩ, what happens to output voltage?
(c) What is the output voltage if zener voltage becomes 2.7V?

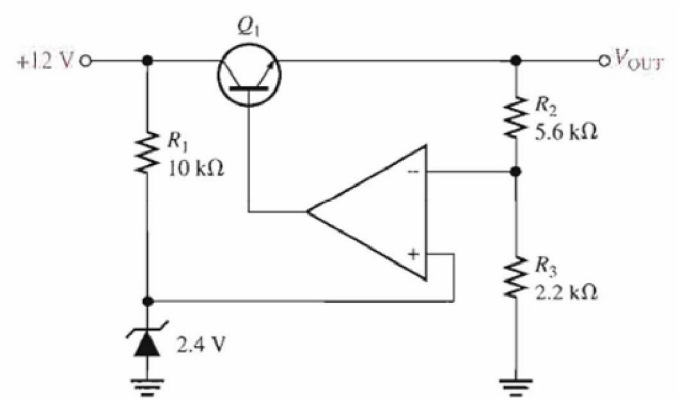

Figure 1

a.

$$V_{OUT} = \left(1 + \frac{R_2}{R_3}\right) V_{REF} = \left(1 + \frac{5.6\,\text{k}\Omega}{2.2\,\text{k}\Omega}\right) 2.4\,\text{V} = \mathbf{8.51\ V}$$

b.

For $R_3 = 2.2\ \text{k}\Omega$:

$$V_{OUT} = \left(1 + \frac{R_2}{R_3}\right) V_{REF} = \left(1 + \frac{5.6\,\text{k}\Omega}{2.2\,\text{k}\Omega}\right) 2.4\,\text{V} = 8.5\ \text{V}$$

For $R_3 = 4.7\ \text{k}\Omega$:

$$V_{OUT} = \left(1 + \frac{R_2}{R_3}\right) V_{REF} = \left(1 + \frac{5.6\,\text{k}\Omega}{4.7\,\text{k}\Omega}\right) 2.4\,\text{V} = 5.23\ \text{V}$$

The output voltage **decreases by 3.27 V** when R_3 is changed from 2.2 kΩ to 4.7 kΩ.

c.

$$V_{OUT} = \left(1 + \frac{R_2}{R_3}\right) V_{REF} = \left(1 + \frac{5.6\,\text{k}\Omega}{2.2\,\text{k}\Omega}\right) 2.7\,\text{V} = \mathbf{9.57\ V}$$

10. (a) In shunt regulator of figure 2, Assume I_L remains constant and V_{IN} changes by 1V, what is the change in the collector current of Q1?

(b) If the maximum allowable input voltage is 25V, what is the maximum possible output current when the output is short-circuited? What power rating should R1 have?

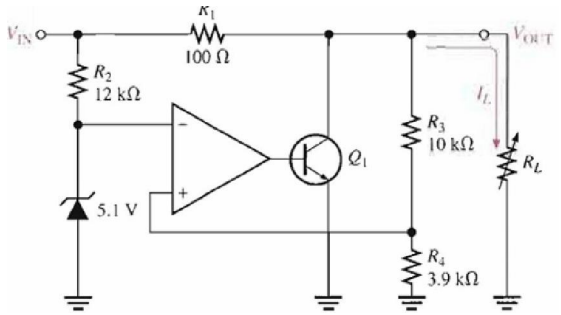

Figure 2

a.

$$\Delta I_C = \frac{\Delta V_{R1}}{R_1} = \frac{1\text{ V}}{100\,\Omega} = \mathbf{10\text{ mA}}$$

b.

$$I_{L(max)} = \frac{V_{IN}}{R_1} = \frac{25\text{ V}}{100\,\Omega} = \mathbf{250\text{ mA}}$$

$$P_{R1} = I^2_{L(max)} R_1 = (250\text{ mA})^2 100\,\Omega = \mathbf{6.25\text{ W}}$$

11. Determine the output voltage of IC voltage regulator seen in figure 3, if I_{ADJ}=50μA**,** then with no load connected, how much current is there through the regulator with neglecting the adjustment terminal current**.**

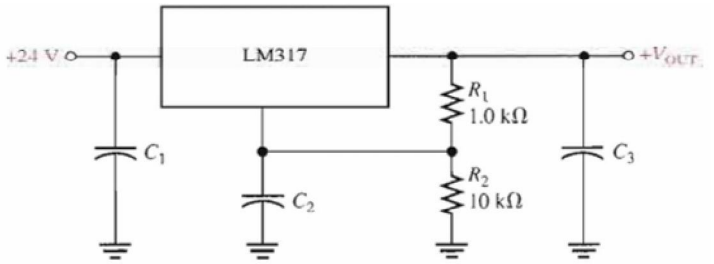

Figure 3

a.

$$V_{OUT} = \left(1 + \frac{R_2}{R_1}\right) V_{REF} + I_{ADJ} R_2 = \left(1 + \frac{10\text{ k}\Omega}{1.0\text{ k}\Omega}\right) 1.25\text{ V} + (50\ \mu\text{A})(10\text{ k}\Omega)$$

$$= 13.7\text{ V} + 0.5\text{ V} = \mathbf{14.3\text{ V}}$$

b.

The regulator current equals the current through $R_1 + R_2$.

$$I_{REG} \cong \frac{V_{OUT}}{R_1 + R_2} = \frac{14.3\text{ V}}{11\,\text{k}\Omega} = \mathbf{1.3\text{ mA}}$$

12. Determine the minimum and maximum output voltages for the circuit in figure 4 if I_{ADJ}=50μA

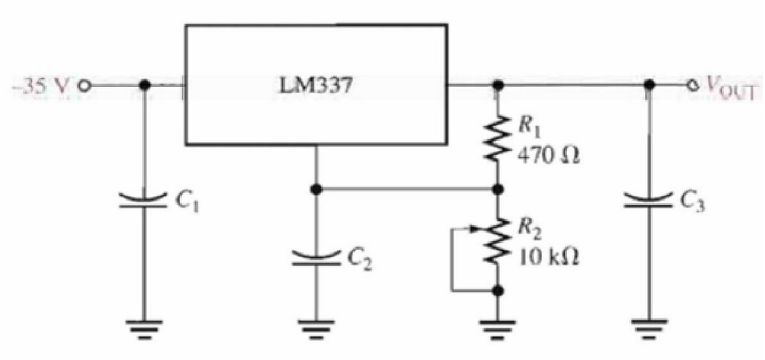

Figure 4

$$V_{OUT(min)} = -\left[\left(1+\frac{R_{2(min)}}{R_1}\right)V_{REF} + I_{ADJ}R_{2(min)}\right]$$

$$R_{2(min)} = 0\ \Omega$$

$$V_{OUT(min)} = -\left(1.25\ \text{V}(1+0)+0\right) = \mathbf{-1.25\ V}$$

$$V_{OUT(max)} = -\left[\left(1+\frac{R_{2(max)}}{R_1}\right)V_{REF} + I_{ADJ}R_{2(max)}\right] = -\left[1.25\ \text{V}\left(1+\frac{10\,\text{k}\Omega}{470\,\Omega}\right) + (50\ \mu\text{A})(10\,\text{k}\Omega)\right]$$

$$= -\left(1.25\ \text{V}(22.28)+0.5\ \text{V}\right) = \mathbf{-28.4\ V}$$

Good Luck

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