Sheet (7) - solution

1. Name the five basic elements in a 555 timer IC.

Two comparators, a flip-flop, a discharge transistor, and a resistive voltage divider

2. When the 555 timer is configured as an astable multivibrator, how is the duty cycle determined?

The duty cycle is set by the external resistors.

3. What are the two comparator reference voltages in a 555 timer when V_{cc}=10V.

$$\frac{1}{3}V_{CC} = \frac{1}{3}(10\text{ V}) = \mathbf{3.33\text{ V}}$$
$$\frac{2}{3}V_{CC} = \frac{2}{3}(10\text{ V}) = \mathbf{6.67\text{ V}}$$

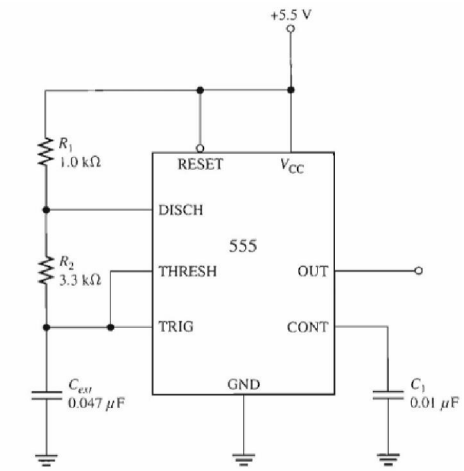
4. Determine the frequency of oscillation of the figure shown, and then to what value must C_{ext} be changed to achieve a frequency of 25 KHz.

$$f = \frac{1.44}{(R_1 + 2R_2)C_{ext}} = \frac{1.44}{(1.0\,\text{k}\Omega + 6.6\,\text{k}\Omega)(0.047\,\mu\text{F})} = \mathbf{4.03\text{ kHz}}$$

$$f = \frac{1.44}{(R_1 + 2R_2)C_{ext}}$$
$$C_{ext} = \frac{1.44}{(R_1 + 2R_2)f} = \frac{1.44}{(1.0\,\text{k}\Omega + 6.6\,\text{k}\Omega)(25\,\text{kHz})} = \mathbf{0.0076\,\mu\text{F}}$$

5. In astable 555 configuration, the external resistor R_1=3.3KΩ. What must R2 equal to produce a duty cycle of 75 percent?

$$\text{Duty cycle (dc)} = \frac{R_1 + R_2}{R_1 + 2R_2} \times 100\%$$
$$\text{dc}(R_1 + 2R_2) = (R_1 + R_2)100$$
$$75(3.3\,\text{k}\Omega + 2R_2) = (3.3\,\text{k}\Omega + R_2)100$$
$$75(3.3\,\text{k}\Omega + 150R_2 = 100(3.3\,\text{k}\Omega) + 100R_2$$
$$150R_2 - 100R_2 = 100(3.3\,\text{k}\Omega) - 75(3.3\,\text{k}\Omega)$$
$$50R_2 = 25(3.3\,\text{k}\Omega)$$
$$R_2 = \frac{25(3.3\,\text{k}\Omega)}{50} = \mathbf{1.65\,\text{k}\Omega}$$



6. Define line regulation, load regulation?

The percentage change in the output voltage for a given change in input voltage.

The percentage change in output voltage for a given change in load current.

7. The input of a certain regulator increased by 3.5V. As a result, the output voltage increased by 0.042V. The nominal output is 20V. Determine the line regulation in both % and in %/V.

1.2%; 0.06%/V

8. A certain regulator has no load output voltage of 10V and a full-load output voltage of 9.9V. What is the percent load regulation? If the full load is 250mA. Express the load regulation in %/mA.

$$\text{Percent load regulation} = \left(\frac{V_{NL} - V_{FL}}{\Delta V_{FL}}\right)100\% = \left(\frac{10\text{ V} - 9.90\text{ V}}{9.90\text{ V}}\right)100\% = \mathbf{1.01\%}$$

the percent load regulation is 1.01%. For a full load current of 250 mA, this can be expressed as

$$\frac{1.01\%}{250\text{ mA}} = \mathbf{0.00404\%/mA}$$