EE 322 Advanced Analog Electronics, Spring 2010
Homework #4 solution

SS 13.34. Figure P13.34 shows a monostable multivibrator circuit. In the stable state, $v_o = L_+$, $v_A = 0$, and $v_B = -V_{\text{ref}}$. the circuit can be triggered by applying a positive input pulse of height greater than V_{ref}. For normal operation, $C_1 R_1 \ll CR$. Show the resulting waveforms of v_o and v_A. Also, show that the pulse generated at the output will have a width T given by

$$T = CR \ln\left(\frac{L_+ - L_-}{V_{\text{ref}}}\right)$$

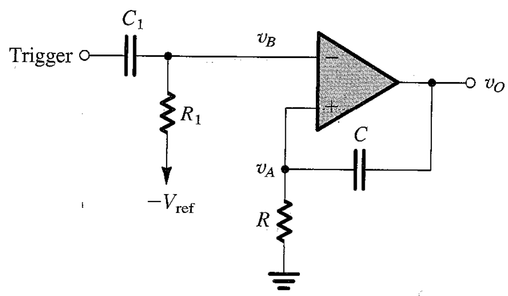
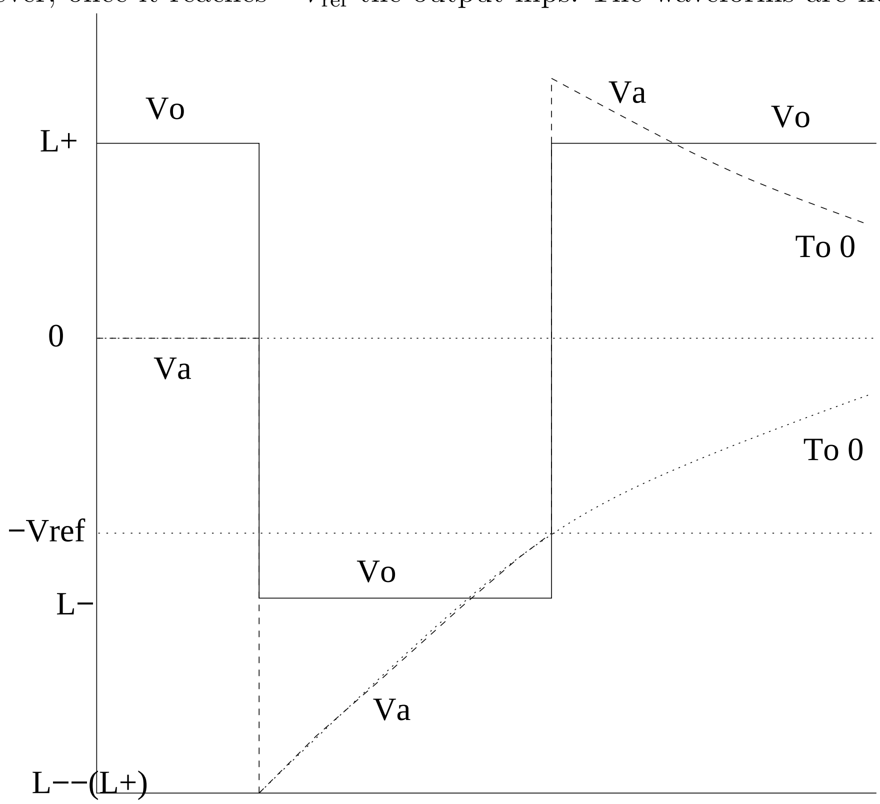


FIGURE P13.34

v_A begins at ground because there is no current through R. As the positive pulse is applied to trigger, v_B is pulled low which causes v_o to go low. The voltage across the capacitor is still L^+, so the voltage $v_A = L_- - L_+$. The capacitor begins to charge from that voltage to ground. However, once it reaches $-V_{\text{ref}}$ the output flips. The waveforms are here



and here is the expression for determining T

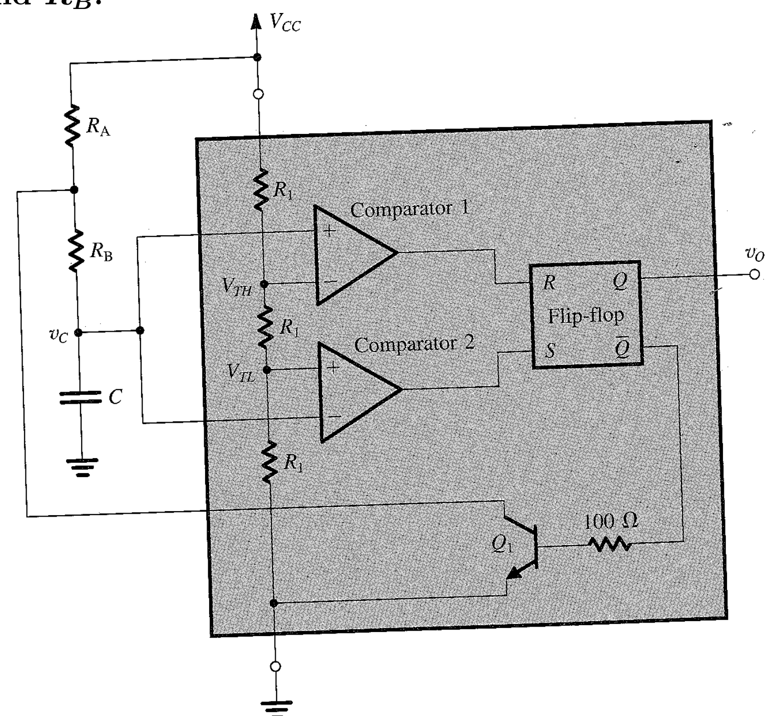
$$(L_- - L_+)\, e^{-\frac{T}{RC}} = -V_{\text{ref}}$$

which can be re-written as

$$\ln\left(\frac{-V_{\text{ref}}}{L_- - L_+}\right) = -\frac{T}{RC}$$

$$T = RC \ln\left(\frac{L_+ - L_-}{V_{\text{ref}}}\right)$$

SS 13.39. Using a 680 pF capacitor, design the astable circuit of Fig. 13.29(a) to obtain a square wave with a 50 kHz frequency and a 75% duty cycle. Specify the values of R_A and R_B.



This is a straightforward application of formulas given in the text book,

$$T = \frac{1}{f} = 0.69C\,(R_A + 2R_B) \qquad \text{duty} = \frac{R_A + R_B}{R_A + 2R_B}$$

Begin by finding $R_A + 2R_B$,

$$R_A + 2R_B = \frac{1}{0.69\, f\, C} = \frac{1}{0.69 \times 50 \times 10^3 \times 680 \times 10^{-12}} = 42.63\,\text{k}\Omega$$

Next, find $R_A + R_B$ from the duty cycle formula,

$$R_A + R_B = \text{duty} \times (R_A + 2R_B) = 0.75 \times 42.63 = 31.97\,\text{k}\Omega$$

Next,

$$R_B = (R_A + 2R_B) - (R_A + R_B) = 42.63 - 31.97 = 10.66\,\text{k}\Omega$$

and

$$R_A = (R_A + R_B) - R_B = 31.97 - 10.66 = 21.31\,\text{k}\Omega$$