Fundamentals of Engineering Design (FED) 101- LCA

Test 3

Student name:
Student ID number:

Please provide complete and clear answers.

1. Consider the 555 timer shown in Figure 1 with $C_1=10\mu F$ and $C_2=100nF$. The voltage at pin 3 is shown in Figure 2.
   a) What is the duty cycle of the pulses? (2 points)
   b) Determine the values of $R_1$ and $R_2$ from the information in Figure 2. (4 points)
   c) What could you do to increase the duty cycle of the pulses? Explain your answer. (4 points)

Solution:

a) $T_{ON} = 2s, T_{OFF} = 1s, T = 3s$
   
   \[
duty\ cycle = \frac{T_{ON}}{T} = \frac{2}{3} = 0.667, duty\ cycle = 66.7\%
\]

b) $T_{OFF} = 0.693(R_2)(C_1)$
   
   \[
   1 = 0.693(R_2)(10 \times 10^{-6})
   
   R_2 = 144300 = 144.3K\ ohms
\]

   $T_{ON} = 0.693(R_1 + R_2)(C_1)$
   
   \[
   2 = 0.693(R_1 + 144.3K)(10 \times 10^{-6})
   
   R_1 + 144.3K = 288.6K \Rightarrow R_1 = 144.3\ K\ ohm
\]

c) Increase $R_1$ or decrease $R_2$
   
   When $R_1 \gg R_2$, the duty cycle approaches 100%