Digital Logic Design Lab #5

Objectives

Application of Timer, Counters in a synchronous logic circuits binary up counter with a 7-segment display. Improving proficiency in requirement analysis, design, implementation and testing by designing Synchronous binary counter.

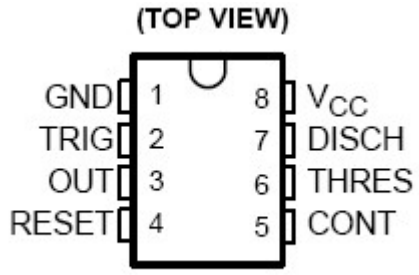
Preparation

Complete the following steps before starting to work on the experiments in this lab:

1) Complete lecture and assignments in Combinational Logic Circuits Chapter
2) Complete Lab 4 and associated report

Experiment #1. NE 555 P Astable Operation (Clock generator application)

Implement the following design to generate a clock signal where t_L is the low and t_H is the high part of period. This clock generator will be used later in this so it should be set up at one end of the proto board.



Device #	Pin#	Value
U1	1	GND
U1	3	Out
U1	8	Vcc
U1	5	Open

$t_H = 0.693\ (R_A + R_B)\ C$

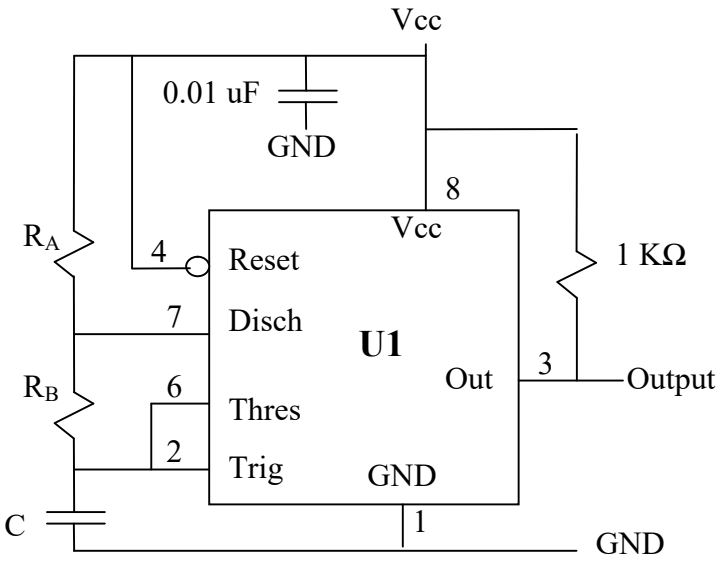
$t_L = 0.693\ (R_B)\ C$

where

$R_A = 1\ M\Omega$

$R_B = 1\ M\Omega$

$C = 1\ UF$



Calculate and draw the clock signal based on the formulas provided. Compare the clock signal waveform observed on the output pin of NE 555 with the calculated waveform. Explain any differences between the two waveforms.

Experiment #2. Synchronous Up Counter

Use 74HC93 (4-bit binary counter), clock generator from previous experiment and 7-segment display to implement an up counter. This counter counts the number of clock cycles from 0 to 7 and back to 0. Complete the following steps for this design:

1) A system diagram with clearly identified independent variables (input) and dependent variables (output)
2) A detailed schematic, timing diagram and test plan
3) Implement and test your design on TinkerCAD

Hints:

** Consider using CD4511 seven-segment display driver to convert binary data to 7-segement display input.*

** 74HS93 is pin compatible with 74LS93 so you can use its datasheet for this lab.*

Report Requirements

This lab and associated report must be completed individually. All reports must be computer printed (formulas and diagrams may be hand drawn) and at minimum:

For each experiment include:

- Clear problem statement; specify items given and to be found.
- Answer experiment questions
- Resulting circuit schematics, simulation results, and other relevant information from the experiment.

For the whole report include:

- A Cover sheet with your name, class, lab and completion date.
- A Lessons Learned section which summarizes your learning from this lab.
- A New Experiment section that has description of a new experiment and the experiment's results. Experiment should be related to material covered in class but not similar to one of the experiments in this lab.