Experiment No. 1
Introduction to the SANPER Lab Unit
ECE 441

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Date Performed:	September 4 & 11, 2013
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1 Introduction

1.1 Purpose

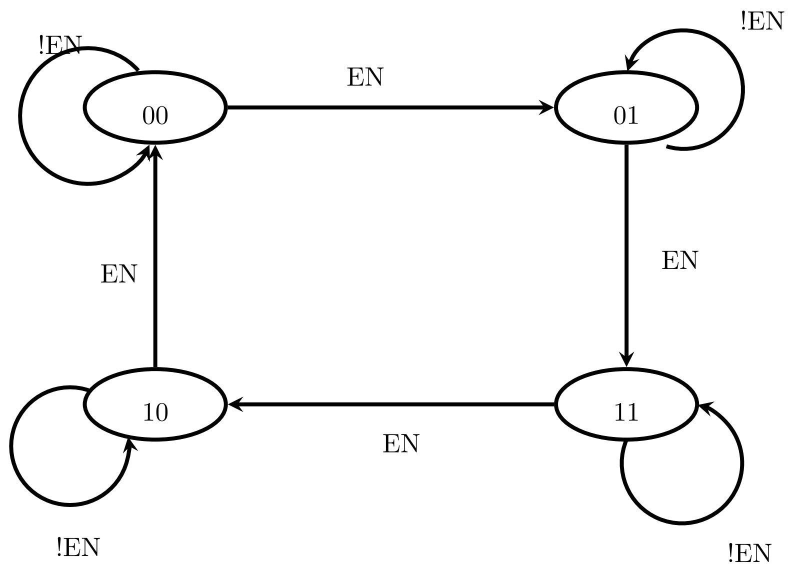
This experiment will review counters. Students will design counters from flip-flops and combinational logic and explore the capabilities of TTL counter chips.

1.2 Background

A counter is a sequential logic circuit that goes through a specific sequence of states. The binary counter is the best-known form of counter. It goes through a sequence of states in which the flip-flop values represent incresing binary values. For example, a two bit counter goes through states "00", "01", "10" and "11" before returning to state "00."
In the prelimiary assigment we were asked a series of questions:

a. 0000000000_2 to 1111111111_2, that is 0_{10} to 1024_{10}

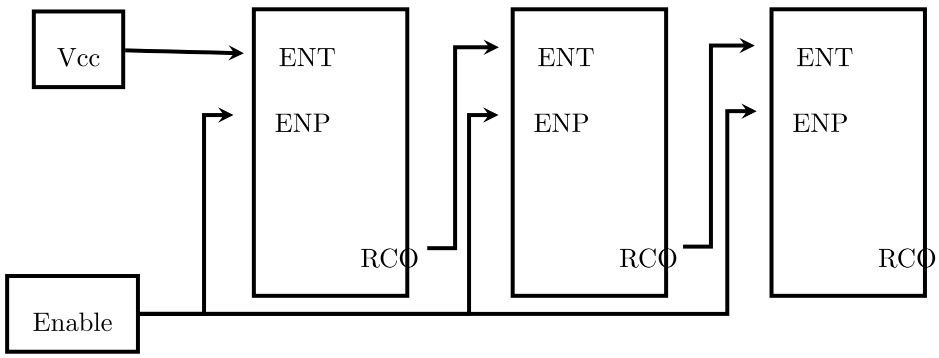
b. Not completeable without more information

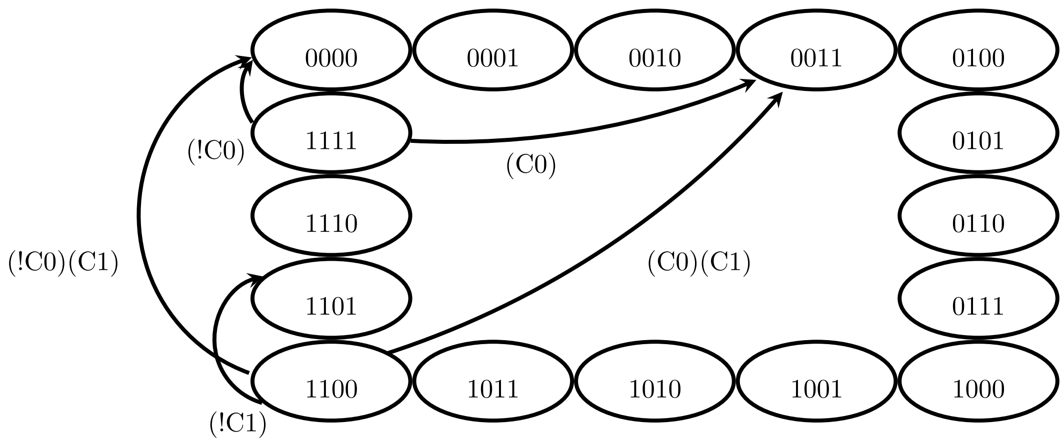


c.

Input			Output	
EN	High Bit	Low Bit	High Bit	Low Bit
0	0	0	0	0
0	0	1	0	1
0	1	1	1	1
0	1	0	1	0
1	0	0	0	1
1	0	1	1	1
1	1	1	1	0
1	1	0	0	0

d. Eqution for low bit input L(!E) + (!H)E. Equation for high bit input (!E)H+LE. Multiplication is AND, addition is OR and ‘!’ is NOT. L is low bit output, H is high bit output, E is enable.

e. 

f. 

2 Lab Procedure and Equipment List

2.1 Equipment

- Digital Multimeter
- Function Generator
- Power Supply
- 74LS163
- SN74LS08
- SN74LS32N
- SN74LS175N
- Protoboard

2.2 Procedure

2.2.1 Grey Code Counter

The grey code counter should be constructed to implement the equations in the prelab. This should only requrire AND, OR and NOT gates. NOT gates can (and were) substituted for NAND gates with the gates tied together.

2.2.2 Specalized Counter

The specalized counter requires a bit more prephiery circutry. Some additonal input/output work must be done to implement the input C0 and C1 signals, and to display the bits of the counter on LEDs. The input was built by connecting one side of a SPST switch to VCC, then splitting the other side between signal output and a 1k resistor briding to ground. The 1k resistor pulls the output low when the switch is open so there is never a floating, undefined state on the pin of the flip flop. The output leds are connected from an output pin of the counter, then are conneted in series with a 330 Ohm resistor to ground. When the bit is high, the LED is lit.
The logic to feed into the actual counting section comes from the following equations. In these equations, Load is L, R is the Reset pin, C0 and C1 are the inputs specified, and Bits 0 through 3 are B0-B3. NOT is !, AND is multiplication, & OR is +
$R =!((B3)(B2)(C1))$
$L =!((B3)(B2)(C0)(C1 + (B1)(B0)))$
Both low bits on the load inputs should be tied to Vcc and both high bits should be tied to GND.

3 Results and Analysis

The grey code counter and the specilized counter operation was verified to the Teaching Assistant in the lab. There are no additional results to present.

4 Conclusions

This experiment was accomplished. Both counters were built. Through building the counters, other designs arose to solve the problem of input/output. This lab acheived its goals to teach counter, combinational logic and TTL chips.