

## Laboratory Goals

Use your knowledge of various gates to construct a non-trivial circuit. You will analyze each gate you will be using, learn about their construction and properties, and finally use them to construct a two-bit comparator. The comparator will take two two-bit values and assert one of three output lines depending on the values of the two numbers.

## Pre-lab reading

- Quick gate connection reference  
<http://www.kpsec.freeuk.com/components/74series.htm>
- 7400 data sheet\*
- 7410 data sheet\*
- 7420 data sheet\*
- 7404 data sheet\*

\*(All datasheets are found on the course website)

## Equipment needed

- Lab notebook, pen
- Prototyping board
- Anti-Static mat
- Logic Probe (obtain one or make your own from wire)

## Parts needed

- Lab parts kit
- 7400 2-input NAND IC
- 7410 3-input NAND IC
- 7420 4-input NAND IC
- 7404 inverter
- Wire

## Lab safety concerns

Make sure all circuit connections are correct, and no shorted wires exist. Be sure that the power is off before adjusting your circuit.

### 1. Pre-Lab Comparator Design

This lab's comparator will take two 2-bit values and assert a certain line depending on the result. Fill in the chart below comparing the two two-bit values A and B

AGTB : A greater than B      AEQB : A equal to B      ALTB : A less than B

A1	A0	B1	B0	AGTB	AEQB	ALTB
0	0	0	0			
0	0	0	1			
0	0	1	0			
0	0	1	1			
0	1	0	0			
0	1	0	1			
0	1	1	0			
0	1	1	1			
1	0	0	0			
1	0	0	1			
1	0	1	0			
1	0	1	1			
1	1	0	0			
1	1	0	1			
1	1	1	0			
1	1	1	1			

Using the table as a reference, create k-maps for the system:

AGTB	00	01	11	10
00				
01				
11				
10				

AGTB=

ALTB	00	01	11	10
00				
01				
11				
10				

ALTB=

AEQB	00	01	11	10
00				
01				
11				
10				

AEQB=

## 2. Circuit Construction and Testing

- ❑ For this Lab you are to implement your equations using only inverters and NAND chips. Be sure to review DeMorgan's Theorem before you start converting your equations and designing your circuit layout.
- ❑ Construct your circuit on the prototyping board. Exercise care when making connections and double-check each section of your circuit.
- ❑ Test your circuit against the truth table you made in the pre-lab section. If your circuit doesn't perform according to the truth table, carefully go back over the circuit with a logic probe and test each section of your circuit.
- ❑ Demonstrate your circuit and correct results to the Lab TA.
- ❑ Disassemble the circuit
- ❑ Power off the prototyping board

**Before leaving the lab, take a few minutes to make sure all equipment and test leads are returned to your cabinet, and that you have cleaned up your work space.**

## 3. Analysis

- ❑ Write a summary report for this lab. Be sure to also include the following topics:
- ❑ Why use NAND gates and inverters instead of the normal AND, OR, etc. What effects would this have on gate delays and propagation delay? Use the knowledge you gained from building NANDS and inverters in previous labs.
- ❑ What applications can you think of to use this circuit?
- ❑ Explain any difficulties you had with this lab.  
(Please include suggestions to improve the lab, if you have them).