Digital Logic Design

(EL-1005)

LABORATORY MANUAL

SPRING 2024

LAB 09

Binary Comparator

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STUDENT NAME ROLL NO SEC

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FACULTY'S SIGNATURE & DATE

MARKS AWARDED: /02

NATIONAL UNIVERSITY OF COMPUTER AND EMERGING SCIENCES (FAST-NUCES), KARACHI

Lab Session 09: Binary Comparator

OBJECTIVES:

- To learn and understand how to design a multiple output combinational circuit.
- To learn and understand the working of 2-bit binary comparator.
- To learn and understand the working and usage of Exclusive-OR and Exclusive-NOR gates.

APPARATUS: Logic trainer, Logic probe

COMPONENTS: ICs 74LS08, 74LS32, 74LS04, 74LS86, 74LS02

THEORY:

Binary comparator is a combinational circuit that compares magnitude of two binary data signals A & B and generates the results of comparison in the form of three output signals A>B, A=B, A<B. Binary comparator is a multiple input and multiple output combinational circuit. When a combinational circuit has two or more than two outputs then each output is expressed separately as a function of all inputs. Separate K-map is made for each output.

One-bit comparator:

One-bit comparator compares magnitude of two numbers A and B, 1 bit each, and generates the comparison result. The result consists of three outputs let us say L, E, G, so that.

$$L = 1\ if\ A < B$$

$$E = 1\ if\ A = B$$

$$G = 1\ if\ A > B$$

Truth Table:

Inputs		Outputs		
A	B	L	E	G
0	0	0	1	0
0	1	1	0	0
1	0	0	0	1
1	1	0	1	0

K-Maps for Outputs:

A \ B	0	1
0		$\boxed{1}$
1		

K-Map for Output L

A \ B	0	1
0	$\boxed{1}$	
1		$\boxed{1}$

K-Map for Output E

A \ B	0	1
0		
1	$\boxed{1}$	

K-Map for Output G

Boolean Expressions of Outputs:

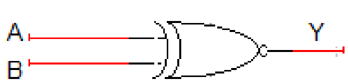
L: $\bar{A}B$

E: $AB + \bar{A}\bar{B}$_

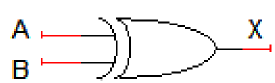
G: $A\bar{B}$_

Exclusive-OR & Exclusive-NOR gates:

The figure given below shows the symbol of Exclusive-OR (XOR) and Exclusive-NOR (XNOR) gates.

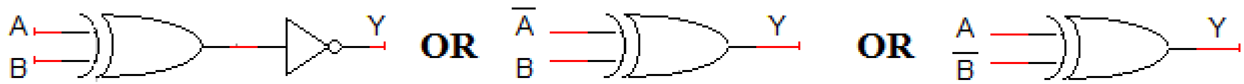


XNOR gate

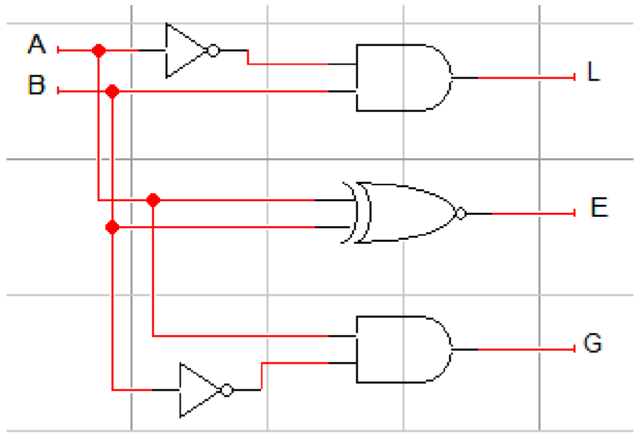


XOR gate

Boolean expression of XNOR gate is $AB + \overline{A}\overline{B}$ and Boolean expression of XOR is $\overline{A}B + A\overline{B}$. Boolean expression of XNOR gate can be implemented using XOR gate as shown in figure below:



Circuit Diagram for one-bit comparator:



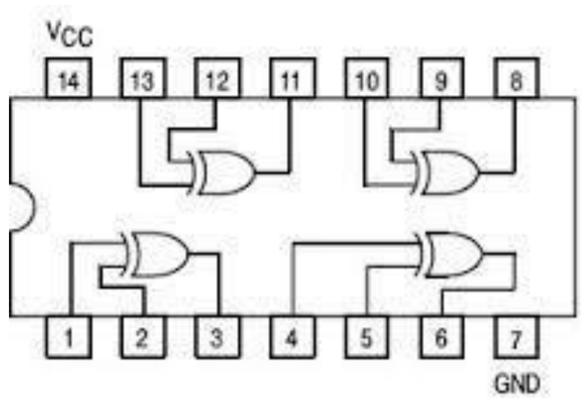
In this experiment 74LS86 IC will be used for implementation of XOR gate function. 74LS86 IC contains four 2-input XOR gates. The function table and connection diagram for this IC are shown below:

Function Table:

Inputs		**Output**
A	**B**	**Y**
L	**L**	**L**
L	**H**	**H**
H	**L**	**H**
H	**H**	**L**

H= Logic High, L= Logic Low

Connection Diagram:



LAB TASKS

Name ________________________________ Student ID _______________ Section _________

Exercise # 1

Write a truth table of a combinational circuit that compares two 2-bit numbers and generates the comparison result. The result consists of three outputs let us say L, E, G, so that.

$$L = 1 \ if \ A < B$$

$$E = 1 \ if \ A = B$$

$$G = 1 \ if \ A > B$$

1. **Write truth table**

Exercise # 2

Find minimal SOP expressions for the outputs L, E, and G using K-map. Draw separate K-map for each output in the space given below.

Exercise # 3

Implement the combinational circuit of 2-Bit Binary comparator.