Laboratory Report Cover Sheet

SRM Institute of Science and Technology Faculty of Engineering and Technology Department of Electronics and Communication Engineering
15EC203J Digital Systems **Third Semester, 2018-19 (odd semester)**

Name :

Register No. :

Day / Session :

Venue :

Title of Experiment :

Date of Conduction :

Date of Submission :

Particulars	Max. Marks	Marks Obtained
Pre-lab questions	10	
In-lab experiment	20	
Post-lab questions	10	
Total	40	

REPORT VERIFICATION

Date :

Staff Name :

Signature :

Lab 3: Design of Magnitude Comparator

TWO BIT MAGNITUDE COMPARATOR:

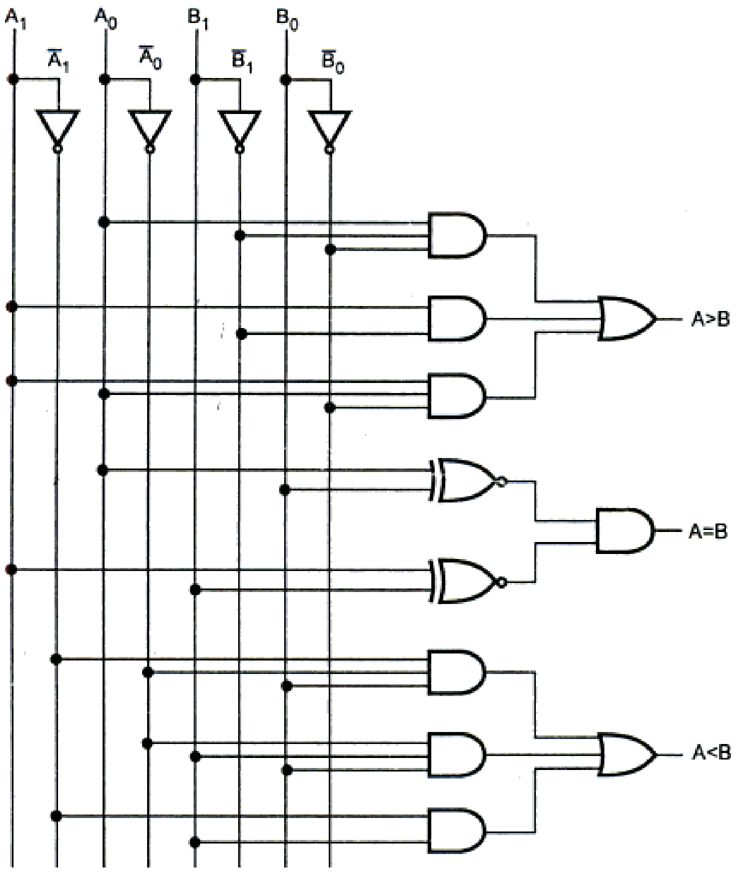


Figure 2.1: 2-bit Magnitude Comparator

Truth Table of 2-bit Magnitude Comparator

INPUTS				OUTPUTS		
A1	**A0**	**B1**	**B0**	**A < B**	**A = B**	**A > B**
0	0	0	0	0	1	0
0	0	0	1	1	0	0
0	0	1	0	1	0	0
0	0	1	1	1	0	0
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	1	0	0
0	1	1	1	1	0	0
1	0	0	0	0	0	1
1	0	0	1	0	0	1
1	0	1	0	0	1	0
1	0	1	1	1	0	0
1	1	0	0	0	0	1
1	1	0	1	0	0	1
1	1	1	0	0	0	1
1	1	1	1	0	1	0

Lab 3: Design of Magnitude Comparator

Introduction
The purpose of this experiment is to introduce the design of 2-Bit & 8-bit Magnitude Comparator.

Hardware Requirement

Equipment	:	Digital IC Trainer Kit
Software	:	Logisim (Optional- Tinkercad / LTspice)
Discrete Components	-	74LS02 Quad 2-Input NOR gate 74LS04 Hex 1-Input NOT gate 74LS08 Quad 2-Input AND gate 74LS00 Quad 2-Input NAND gate 74LS266 Quad 2-Input XNOR gate 74LS85 4-bit magnitude comparator 74LS86 Quad 2-Input XOR 74LS10 Triple 3-Input NAND

Theory:

Digital or Binary Comparators are made up from standard AND, NOR and NOT gates that compare the digital signals at their input terminals and produces an output depending upon the condition of the inputs. For example, whether input A is greater than, smaller than or equal to input B etc.

Digital Comparators can compare a variable or unknown number for example A (A1, A2, A3, An, etc) against that of a constant or known value such as B (B1, B2, B3, ... Bn, etc) and produce an output depending upon the result. For example, a comparator of 2-bit, (A and B) would produce the following three output conditions. **A > B, A = B, A < B** This is useful if we want to compare two values and produce an output when the condition is achieved. For example, produce an output from a counter when a certain count number is reached. Consider the simple 2-bit comparator below.

2 – Bit Magnitude Comparator
Implementation
$A = A_1A_0$
$B = B_1B_0$
Here each subscript represents one of the digits in the numbers.

Equality

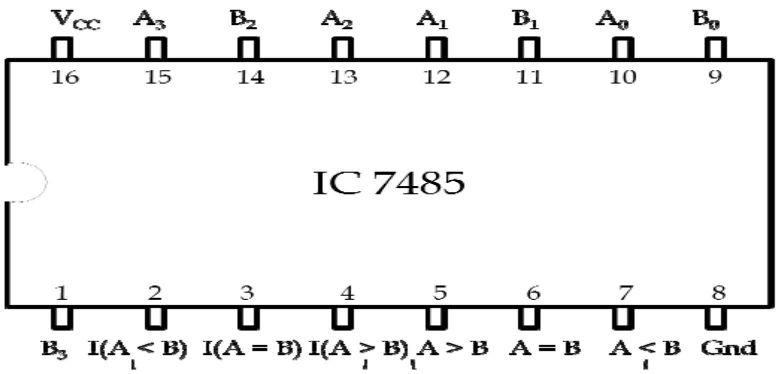
The binary numbers A and B will be equal if all the pairs of significant digits of both numbers are equal, i.e.,

$A_1 = B_1$ and $A_0 = B_0$

Since the numbers are binary, the digits are either 0 or 1 and the Boolean function for equality of any two digits Ai and Bi can be expressed as $x_i = Ai.B_i + \overline{A_i}.\overline{B_i}$

8- bit Magnitude Comparator using IC 7485:

PIN DIAGRAM FOR IC 7485:



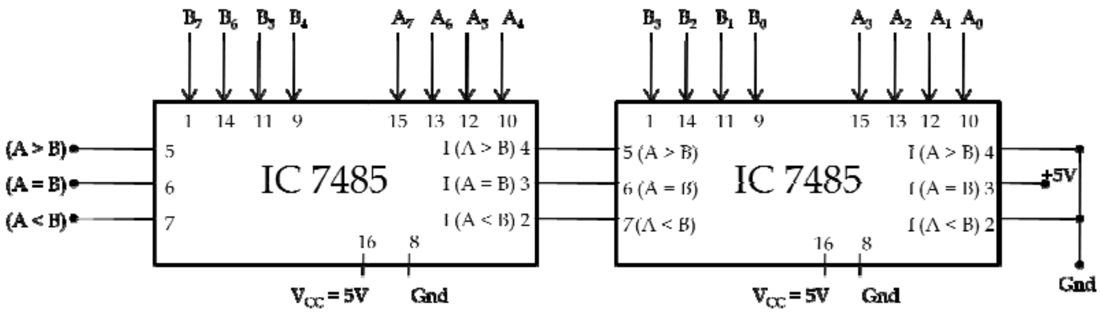


Figure. Connection diagram for 8- bit Magnitude Comparator using IC 7485

Function Table:

A_7, B_7	A_6, B_6	A_5, B_5	A_4, B_4	A_3, B_3	A_2, B_2	A_1, B_1	A_0, B_0	A > B	A = B	A < B
$A_7> B_7$	x	x	x	x	x	x	x	1	0	0
$A_7< B_7$	x	x	x	x	x	x	x	0	0	1
$A_7= B_7$	$A_6> B_6$	x	x	x	x	x	x	1	0	0
$A_7= B_7$	$A_6< B_6$	x	x	x	x	x	x	0	0	1
$A_7= B_7$	$A_6= B_6$	$A_5> B_5$	x	x	x	x	x	1	0	0
$A_7= B_7$	$A_6= B_6$	$A_5< B_5$	x	x	x	x	x	0	0	1
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4> B_4$	x	x	x	x	1	0	0
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4< B_4$	x	x	x	x	0	0	1
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3> B_3$	x	x	x	1	0	0
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3< B_3$	x	x	x	0	0	1
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3= B_3$	$A_2> B_2$	x	x	1	0	0
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3= B_3$	$A_2< B_2$	x	x	0	0	1
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3= B_3$	$A_2= B_2$	$A_1> B_1$	x	1	0	0
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3= B_3$	$A_2= B_2$	$A_1< B_1$	x	0	0	1
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3= B_3$	$A_2= B_2$	$A_1= B_1$	$A_0> B_0$	1	0	0
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3= B_3$	$A_2= B_2$	$A_1= B_1$	$A_0< B_0$	0	0	1
$A_7= B_7$	$A_6= B_6$	$A_5= B_5$	$A_4= B_4$	$A_3= B_3$	$A_2= B_2$	$A_1= B_1$	$A_0= B_0$	0	1	0

x_i is 1 only if A_i and B_i are equal.

For the equality of A and B, all xi variables (for i=0,1) must be 1. So the equality condition of A and B can be implemented using the AND operation as $(A = B) = x_1 x_o$

The binary variable (A=B) is 1 only if all pairs of digits of the two numbers are equal.

Inequality
In order to manually determine the greater of two binary numbers, we inspect the relative magnitudes of pairs of significant digits, starting from the most significant bit, gradually proceeding towards lower significant bits until an inequality is found. When an inequality is found, if the corresponding bit of A is 1 and that of B is 0 then we conclude that A>B. (A>B) and (A < B) are output binary variables, which are equal to 1 when A>B or A<B respectively.

8 – Bit Magnitude Comparator

The comparison of two numbers is an operation that determines whether one number is greater than, less than or equal to the other number. A magnitude comparator is a combinational circuit that compares two numbers A and B and determines their relative magnitudes. The outcome of the comparison is specified by three binary variables that indicate whether (A > B), (A = B) or (A < B). The circuit for comparing two n- bit numbers has 22n entries in the truth table and this is difficult even with n = 3 as it requires 64 entries in the table.

Here we give the truth table for 2- bit magnitude comparator and thereby obtain the logic diagram by finding the expression for the output variables. Due to this disadvantage of making the truth table more complex for even 3- bit number we derive an algorithm to design a magnitude comparator. For any n- bit number, the algorithm is given as follows.

First, the most significant bit of both the numbers A & B is compared. In that bit position it is checked whether (A > B), (A = B) or (A < B). If (A > B) or (A < B) that is the final output. But if (A = B), then the next significant bit is compared. Likewise the procedure goes until all the bits are compared. IC 7485 is a 4- bit Magnitude Comparator whose pin diagram is as
shown. On cascading two ICs it can be used to compare 8- bit numbers which is as shown in the connection diagram.

Pre – Lab questions

1. Define magnitude comparator?
2. Write the output expressions for A<B and A>B.
3. Find out and label the output terminals (A<B, A=B and A>B) for the given 2 bit comparator circuit. (experimental circuit diagram)
4. List out the applications of comparators?
5. Which Logic gate is used to find A=B?

Lab Procedure
1. Construct the logic circuit of the 2-bit magnitude comparator shown in Figure 2.1.
2. Use different sets of inputs for A and B to check each of the outputs A<B, A=B and A>B.
3. Construct the logic circuit of the 8-bit magnitude comparator shown in Figure .
4. Use different sets of inputs for A and B to check each of the outputs A<B, A=B and A>B

Post Lab question

1. How many IC 7485 required to design 24 bit comparator?
2. Give a summary of the points that you have learned from this experiment.
3. Design a 4-bit comparator using two 2-bit comparators.
4. Design a 8-bit comparator using two 4-bit comparators.

Result: