Magnitude comparators

LAB # 08

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"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Student Signature: ______________

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Magnitude comparators

OBJECTIVES:

After completing this experiment, you will be able to:

- Realization of 1-bit comparator using logic gates.
- Realization and implementation of 2-bit comparator using logic gates on breadboard.
- Implementation of 4-bit magnitude comparator on breadboard using IC 7485.

EQUIPMENT:

- Dc power supply
- Breadboard

COMPONENTS:

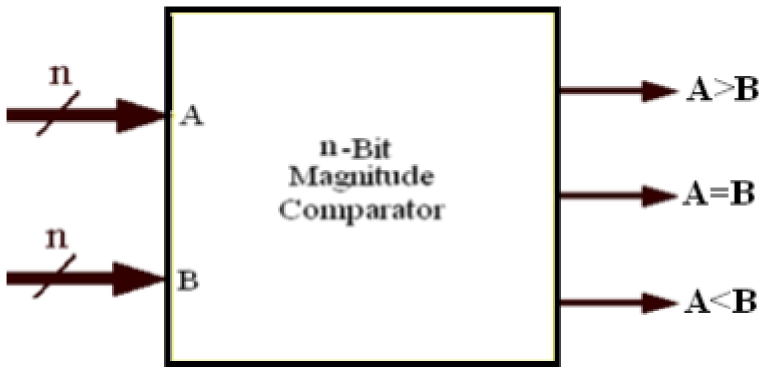
- IC 7486 quad 2-input XOR gate
- IC 7408 quad 2-input AND gate
- IC 7400 quad 2-input NAND gate
- IC 7486 quad 2-input XOR gate
- IC 7410 quad 3-input NAND gate
- IC 7404 hex inverter
- LEDs
- DIP switch
- Two 280 Ω resistors
- Wires
- IC Type 74L85 4-bit magnitude comparator.

THEORY:

MAGNITUDE COMPARATOR:

Magnitude comparators are mostly utilized in microcontrollers and CPUs to address data comparison, register and perform all other arithmetic operations. Magnitude comparators are implemented in many devices and every auto-turn-off device is surely designed using a comparator.

A comparator is a decision-making tool and it holds the ability to be executed in numerous control devices. Accepting two binary numbers as input (A and B), data comparison through magnitude comparators produces the output to indicate equality (A=B), logic 1 in two conditions when (A>B or A<B).



Block diagram of n-bit Magnitude Comparator.

1-BIT MAGNITUDE COMPARATOR:

A comparator that compares two binary bits and produces three outputs based on the relative magnitudes of given binary bits is called a 1-bit magnitude comparator.

(a)Block diagram

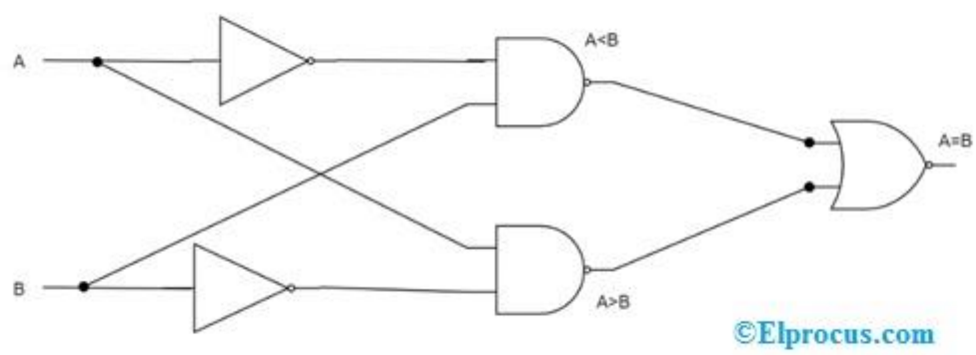
TRUTH TABLE:

A	B	A<B	A>B	A=B
0	0	0	0	1
0	1	1	0	0
1	0	0	1	0
1	1	0	0	1

The truth table derives the expressions of A<B, A>B and A=B as below

A<B – A'B
A>B – AB'
A=B – A'B'+AB

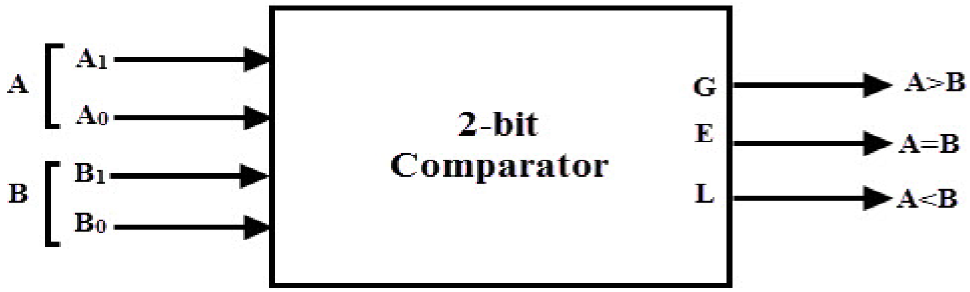
With these expressions, the Circuit diagram can be as follows



1-bit-magnitude

2-BIT MAGNITUDE COMPARATOR:

A comparator that compares two binary numbers (each number having 2 bits) and produces three outputs based on the relative magnitudes of given binary bits is called a 2-bit magnitude comparator.



(a)Block diagram

TRUTH TABLE:

Inputs				Outputs		
A_1	A_0	B_1	B_0	A>B	A=B	A<B
0	0	0	0	0	1	0
0	0	0	1	0	0	1
0	0	1	0	0	0	1
0	0	1	1	0	0	1
0	1	0	0	1	0	0
0	1	0	1	0	1	0
0	1	1	0	0	0	1
0	1	1	1	0	0	1
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	1	0
1	0	1	1	0	0	1
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	1	0

(b) Truth tabl

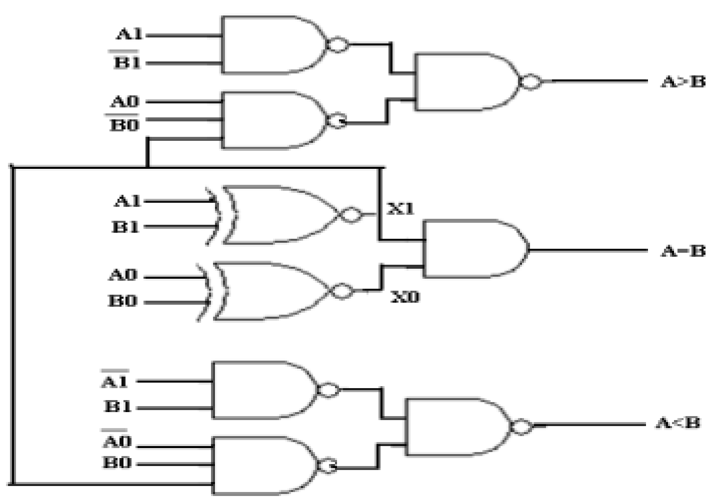
Using key-map, the simplified Boolean function for the outputs A>B, A=B and A<B is shown below:

A=B:
=A1 'A0 'B1 'B0 '+ A1 'A0B1 'B0+ A1 A0 'B1 B0 '+ A1A0B1B0
=(A1 'B1 '+ A1B1) (A0 'B0 '+ A0B0)
= (A1 □B1) ' (A0 □B0) '
=X1.X0

A>B:
=A1B1'+A1'A0B1'B0'+A1A0 B1B0'
= A1B1'+A0B0'(A1'B1'+A1B1)
= A1B1'+A0B0'(A1 □B1) '
=A1B1'+X1.A0B0

A<B:
=A1 'B1+A1'A0 'B1'B0+A1A0 'B1B0
= A1 'B1+A0 'B0(A1'B1'+A1B1)
= A1 'B1+A0 'B0(A1 □B1) '
=A1 'B1+X1.A0 'B0

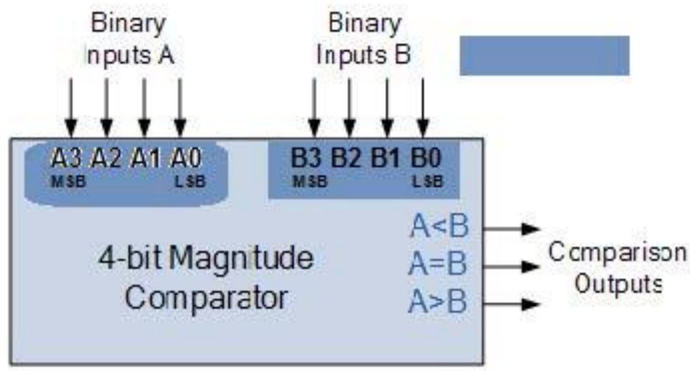
Based on the simplified Boolean functions for the three outputs A>B, A=B and A<B, the logic diagram of the 2-bit magnitude comparator is shown below:



Logic Diagram of 2-bit Comparator

4-BIT MAGNITUDE COMPARATOR:

A comparator used to compare two 4-bit words. The two 4-bit numbers are word A: A3A2A1A0, and word B: B3 B2B1B0) So the circuit has 8 inputs and 3 binary outputs: A>B, A=B and A<B.



(a)Block diagram

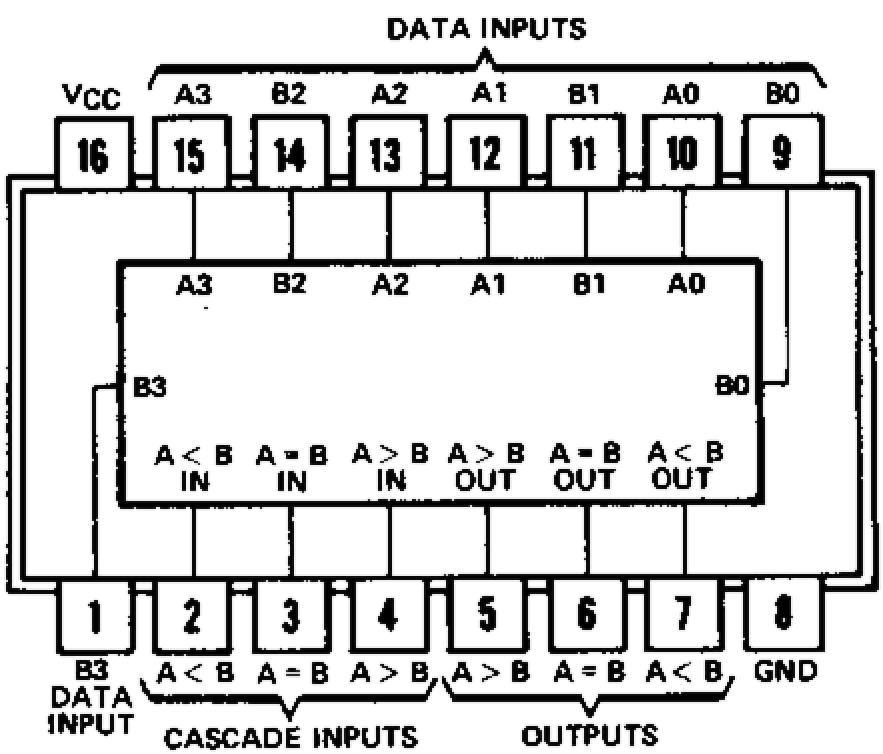


Figure 6

(b) Pin description for IC 7485

Figure 6 shows the block diagram and pin configuration of IC 7485 for 4-bit magnitude comparator. Three inputs are available for cascading comparators. This comparator generates an output of 1 at one of three comparison outputs such that:

- If word A is bigger than word B; A>B output (pin 5) is "1",
- If word A is smaller than word B; A<B output (pin 7) is "1",
- If word A is equal to word B; A=B output (pin 6) is "1".

This IC can be used to compare two 4-bit binary words by grounding the cascade inputs A<B (pin 2) and A>B (pin 4) and connecting the cascade input A=B (pin 3) to Vcc.

How does a 4-bit comparator work?

EQUALITY:

Word A equal word B iff: A3=B3, A2=B2, A1=B1, A0=B0.

INEQUALITY:

- If A3 = 1 and B3 = 0, then A is greater than B (A>B). Or
- If A3 and B3 are equal, and if A2 = 1 and B2 = 0, then A > B. Or
- If A3 and B3 are equal & A2 and B2 are equal, and if A1 = 1, and B1 = 0, then A>B. Or
- If A3 and B3 are equal, A2 and B2 are equal and A1 and B1 are equal, and if A0 = 1 and B0 = 0,

then **A > B.**

- If A3 = 0 and B3 = 1, then A is less than B (A<B). Or
- If A3 and B3 are equal, and if A2 = 0 and B2 = 1, then A < B. Or
- If A3 and B3 are equal & A2 and B2 are equal, and if A1 = 0, and B1 = 1, then A<B. Or
- If A3 and B3 are equal, A2 and B2 are equal and A1 and B1 are equal, and if A0 = 0 and B0 = 1,

then **A < B.**

PROCEDURE:

1. Check all the components for their working.
2. 2.Insert the appropriate ICs into the IC base.
3. 3.Make connections as shown in the circuit diagram in figure 5.
4. 4.Verify the Truth Table and observe the outputs.
5. 5.Repeat the same steps but for the circuit diagram in figure 6 and apply inputs in the following table.Record the outputs for the given values of A and B.

A	**B**	**A=B**	**A<B**	**A>B**
1001	**0110**	**0**	**0**	**1**
1100	**1110**	**0**	**1**	**0**
0011	**0101**	**0**	**1**	**0**
0101	**0101**	**1**	**0**	**0**

CONCLUSION:

Thus Magnitude Comparator are studied. They have type of magnitude comparator are studied and to draw the logic function and logic diagram in verify by experimental to the truth table in the logic gates.