University of Central Punjab

Digital logic design final project

4-bit magnitude comparator (74HC/HCT 85)

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Section:	**B-5**
Date:	**January 22nd, 2024**
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General description:

A magnitude digital Comparator is a combinational circuit that **compares two digital or binary numbers** in order to find out whether one binary number is equal, less than, or greater than the other binary number. We logically design a circuit for which we will have two inputs one for A and the other for B and have three output terminals, one for A > B condition, one for A = B condition, and one for A < B condition.

The circuit works by comparing the bits of the two numbers starting from the most significant bit (MSB) and moving toward the least significant bit (LSB). At each bit position, the two corresponding bits of the numbers are compared. If the bit in the first number is greater than the corresponding bit in the second number, the A>B output is set to 1, and the circuit immediately determines that the first number is greater than the second. Similarly, if the bit in the second number is greater than the corresponding bit in the first number, the A<B output is set to 1, and the circuit immediately determines that the first number is less than the second.

If the two corresponding bits are equal, the circuit moves to the next bit position and compares the next pair of bits. This process continues until all the bits have been compared. If at any point in the comparison, the circuit determines that the first number is greater or less than the second number, the comparison is terminated, and the appropriate output is generated.

If all the bits are equal, the circuit generates an A=B output, indicating that the two numbers are equal.

4-bit Magnitude comparator

A comparator used to compare two binary numbers each of four bits is called a 4-bit magnitude comparator. It consists of eight inputs each for two four-bit numbers and three outputs to generate less than, equal to, and greater than between two binary numbers.

In a 4-bit comparator, the condition of A>B can be possible in the following four cases.

If A3 = 1 and B3 = 0

If A3 = B3 and A2 = 1 and B2 = 0

If A3 = B3, A2 = B2 and A1 = 1 and B1 = 0

If A3 = B3, A2 = B2, A1 = B1 and A0 = 1 and B0 = 0

Similarly, the condition for A<B can be possible in the following four cases.

If A3 = 0 and B3 = 1

If A3 = B3 and A2 = 0 and B2 = 1

If A3 = B3, A2 = B2 and A1 = 0 and B1 = 1

If A3 = B3, A2 = B2, A1 = B1 and A0 = 0 and B0 = 1

The condition of A=B is possible only when all the individual bits of one number exactly coincide with the corresponding bits of another number.

From the above statements, logical expressions for each output can be expressed as follows.

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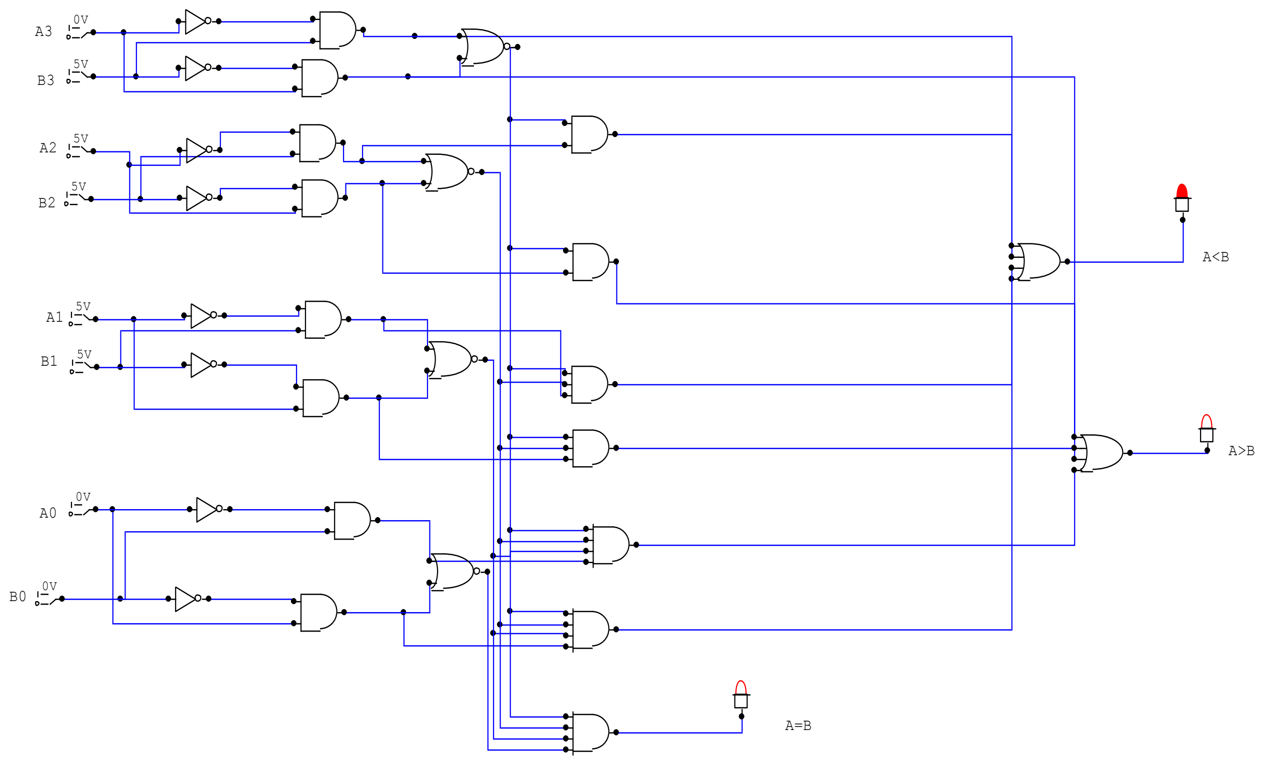
Function Table

COMPARING INPUTS				CASCADING INPUTS			OUTPUTS		
A3, B3	A2, B2	A1, B1	A0, B0	I A>B	I A<B	I A=B	QA>B	QA<B	QA=B
A3>B3	X	X	X	X	X	X	H	L	L
A3<B3	X	X	X	X	X	X	L	H	L
A3=B3	A2>B2	X	X	X	X	X	H	L	L
A3=B3	A2<B2	X	X	X	X	X	L	H	L
A3=B3	A2=B2	A1>B1	X	X	X	X	H	L	L
A3=B3	A2=B2	A1<B1	X	X	X	X	L	H	L
A3=B3	A2=B2	A1=B1	A0>B0	X	X	X	H	L	L
A3=B3	A2=B2	A1=B1	A0<B0	X	X	X	L	H	L
A3=B3	A2=B2	A1=B1	A0=B0	H	L	L	H	L	L
A3=B3	A2=B2	A1=B1	A0=B0	L	H	L	L	H	L
A3=B3	A2=B2	A1=B1	A0=B0	L	L	H	L	L	H
A3=B3	A2=B2	A1=B1	A0=B0	X	X	H	L	L	H
A3=B3	A2=B2	A1=B1	A0=B0	H	H	L	L	L	L
A3=B3	A2=B2	A1=B1	A0=B0	L	L	L	H	H	L

Note:

- **H = High voltage level**
- **L = Low voltage level**
- **X = Don't care**

Logic diagram for 4-bit magnitude comparator



K-map for 2-bit magnitude comparator: