EEE 3101: Digital Logic and Circuits

Magnitude Comparator

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The Digital Comparator

Another common and very useful combinational logic circuit is that of the **Digital Comparator** circuit. Digital or Binary Comparators are made up from standard AND, OR and NOT gates that compare the digital signals present at their input terminals and produce an output depending upon the condition of those inputs.

There are two main types of Digital Comparator available, and these are.

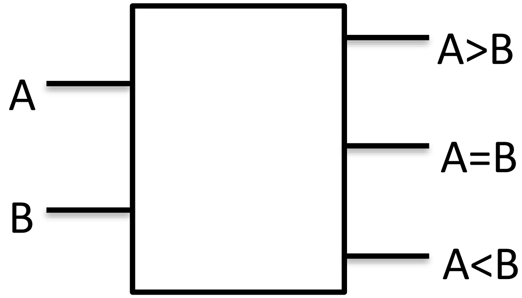
1. **Identity Comparator** – an *Identity Comparator* is a digital comparator that has only one output terminal for when A = B either "HIGH" A = B = 1 or "LOW" A = B = 0

2. **Magnitude Comparator** – a *Magnitude Comparator* is a type of digital comparator that has three output terminals:

$$A > B, \quad A = B, \quad A < B$$

Which means: A is greater than B, A is equal to B, and A is less than B

1-bit Digital Magnitude Comparator



Truth Table:

Inputs		Outputs		
A	B	A < B	A = B	A > B
0	0	0	1	0
0	1	1	0	0
1	0	0	0	1
1	1	0	1	0

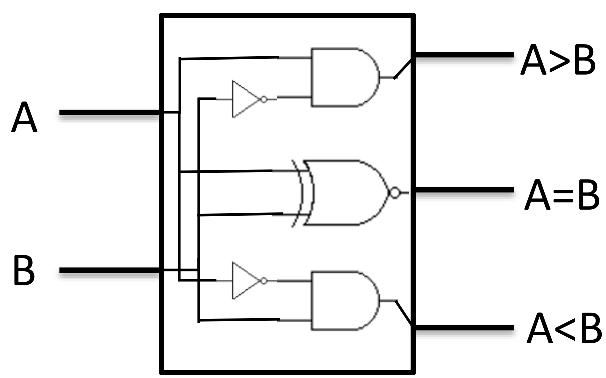
Logic Expression:

$(A=B)=A'B'+AB = (A \odot B) = X$

$(A>B)= AB'$

$(A<B)= A'B$,

Logic Diagram:



2-bit Digital Magnitude Comparator

$A = A_1\ A_0$

$B = B_1\ B_0$

Logic Expression:

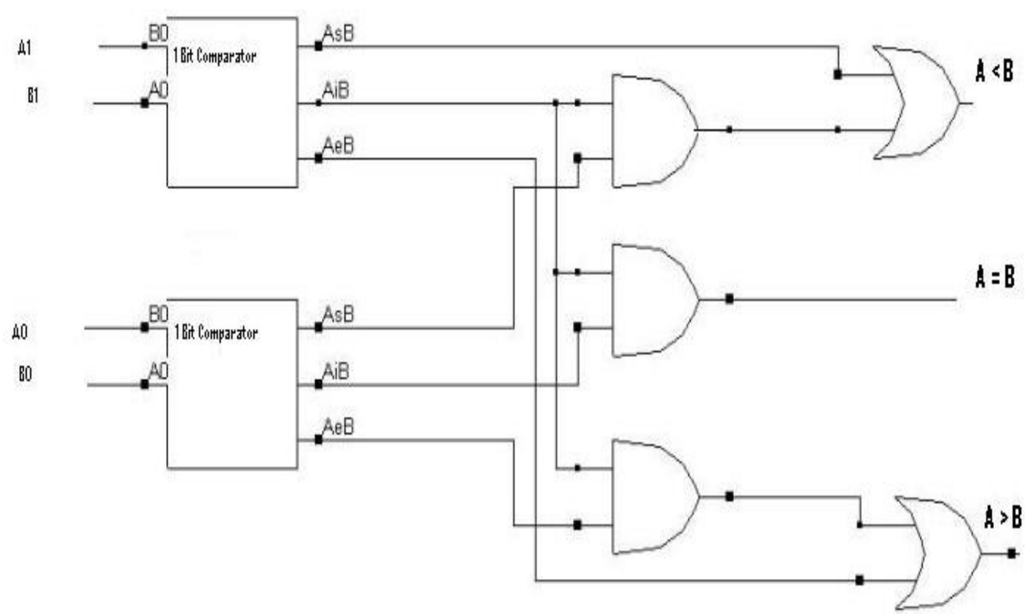
$X_n = A_nB_n + A_n'B_n'$

$(A=B) = X_1X_0$

$(A>B) = A_1B_1' + X_1A_0B_0'$

$(A<B) = A_1'B_1 + X_1A_0'B_0$

Block Diagram:



3-bit Digital Magnitude Comparator

$$A = A_2\ A_1\ A_0$$
$$B = B_2\ B_1\ B_0$$

Logic Expression:

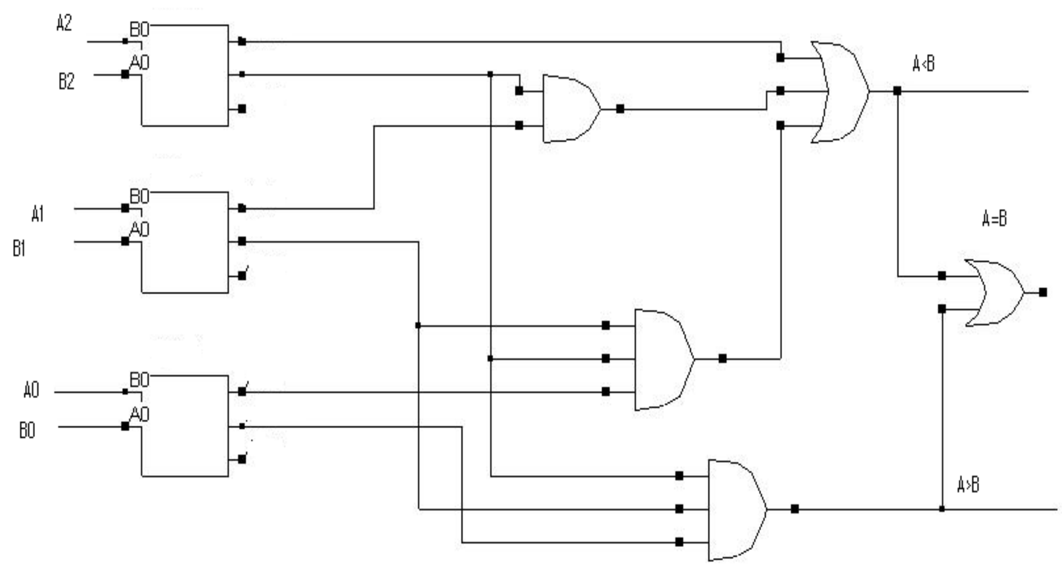
$X_n = A_n B_n + A_n' B_n'$

$(A=B) = X_2 X_1 X_0$

$(A>B) = A_2 B_2' + X_2 A_1 B_1' + X_2 X_1 A_0 B_0'$

$(A<B) = A_2' B_2 + X_2 A_1' B_1 + X_2 X_1 A_0' B_0$

Block Diagram:



5-bit Digital Magnitude Comparator

$$A = A_4\,A_3\,A_2\,A_1\,A_0$$
$$B = B_4\,B_3\,B_2\,B_1\,B_0$$

Logic Expression:

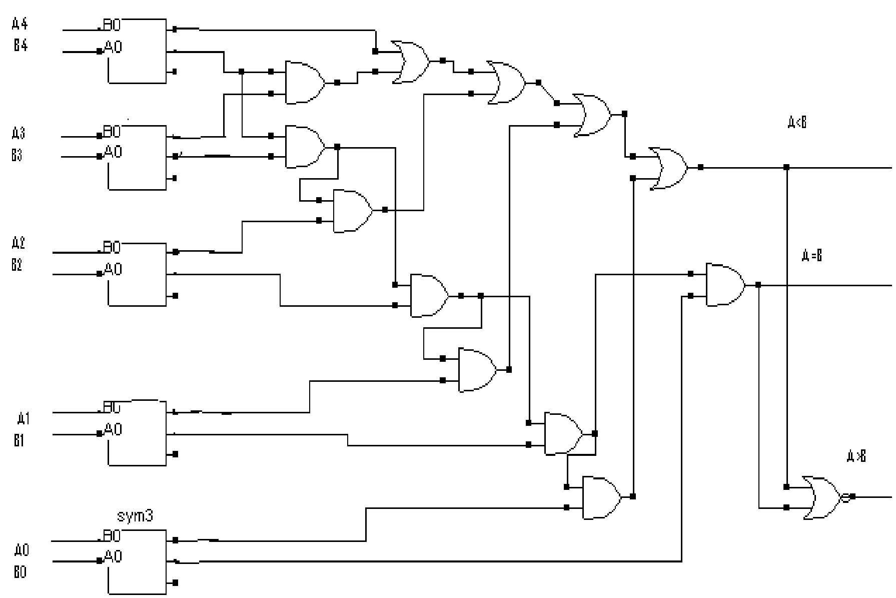
$X_n = A_nB_n + A_n'B_n'$

$(A=B) = X_4X_3X_2X_1\,X_0$

$(A>B) = A_4B_4' + X_4A_3B_3' + X_4X_3A_2B_2' + X_4X_3X_2A_1B_1' + X_4X_3X_2X_1A_0B_0'$

$(A<B) = A_4'B_4 + X_4A_3'B_3 + X_4X_3A_2'B_2 + X_4X_3X_2A_1'B_1 + X_4X_3X_2X_1A_0'B_0$

Block Diagram:



Reference:

[1] Thomas L. Floyd, "Digital Fundamentals" 11th edition, Prentice Hall.
[2] M. Morris Mano, "Digital Logic & Computer Design" Prentice Hall.

Thanks