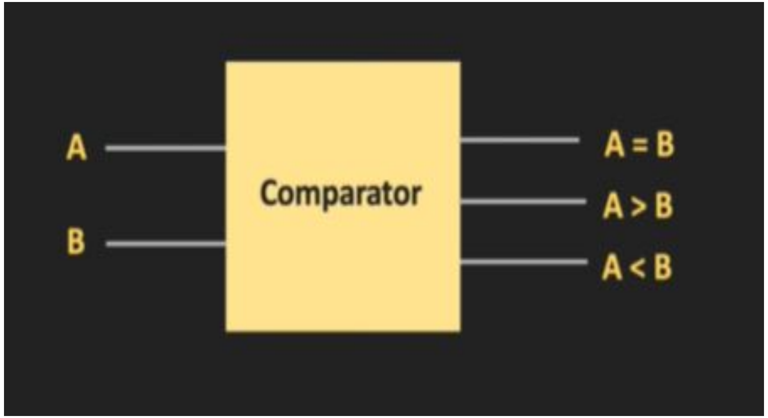
Magnitude Comparators

Silicon Community - Varun Kouda

Comparator Introduction

A magnitude comparator is a digital circuit that compares two numbers and determines their relative magnitudes. It is commonly used in digital systems, such as arithmetic units and control circuits, to perform tasks like equality checking, greater-than/less-than comparisons, and sorting operations.



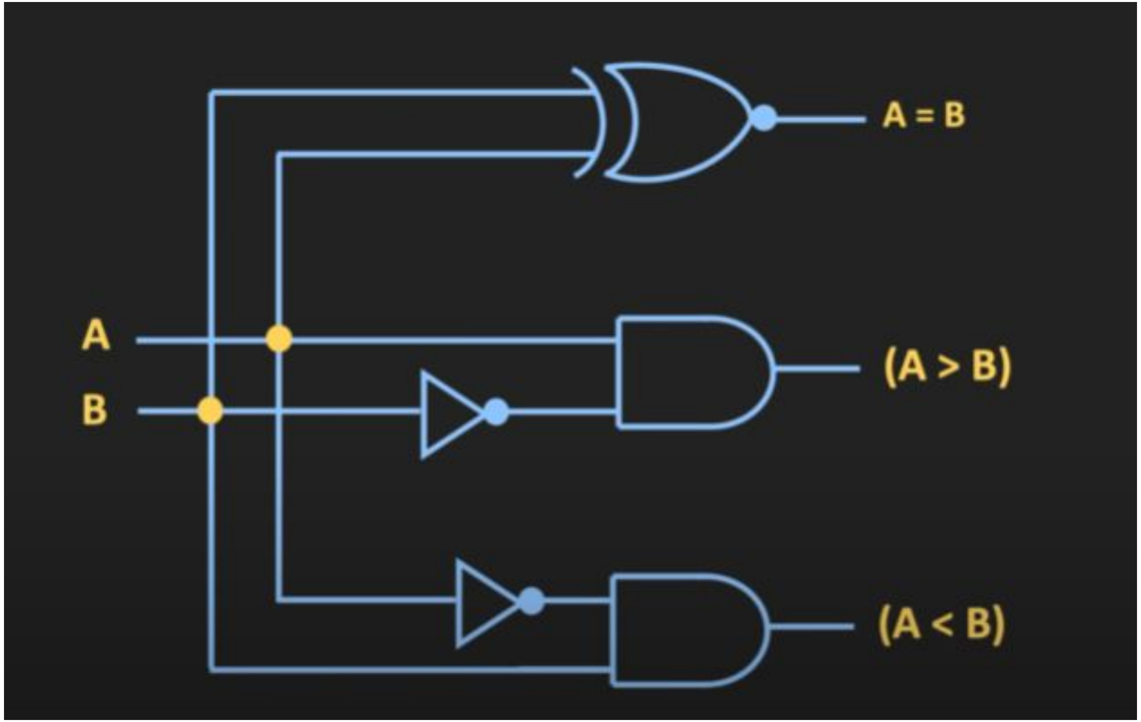
The magnitude comparator takes two n-bit binary numbers as inputs and produces a set of output signals indicating the relationship between the two numbers

1 bit comparator

Truth Table

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

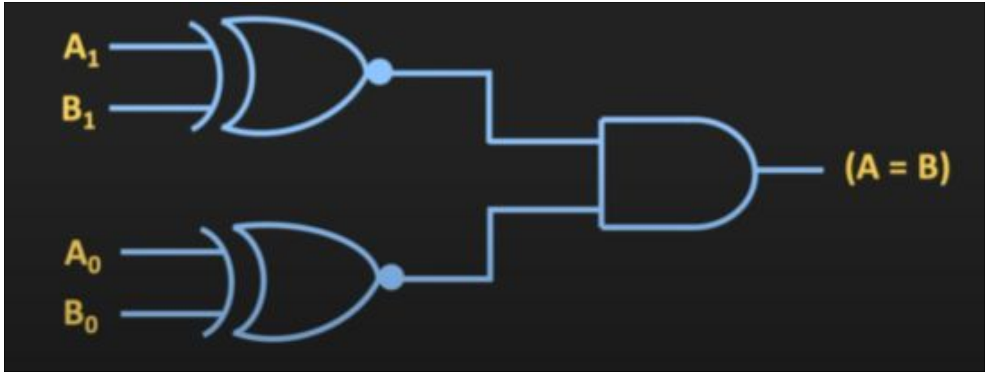
1 bit comparator



2 bit comparator (1)

Let the numbers are A and B. 2 bits are represented as A1, A0 and B1, B0
A1 and B1 are MSB. A0 and B0 are LSB of A and B respectively

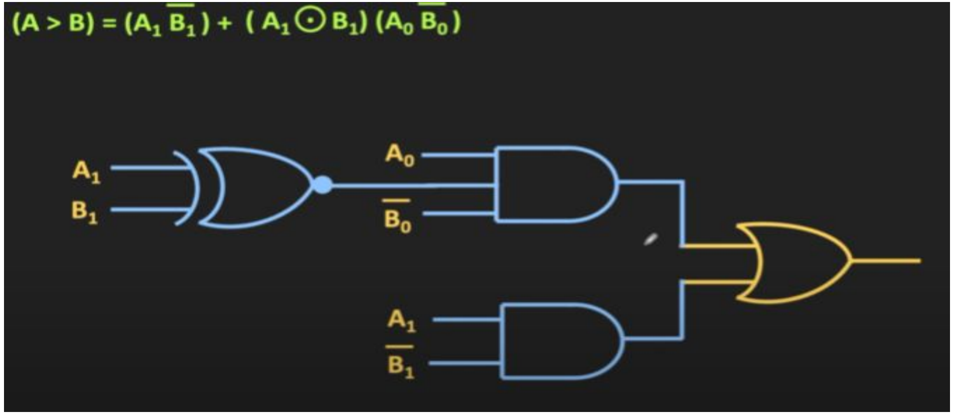
1. **A = B condition**
   A = B only if A1 = B1 and A0 = B0
   y(A=B) = (A1 EXNOR B1).(A0 EXNOR B0)



2 bit comparator (2)

Let the numbers are A and B. 2 bits are represented as A1, A0 and B1, B0
A1 and B1 are MSB. A0 and B0 are LSB of A and B respectively

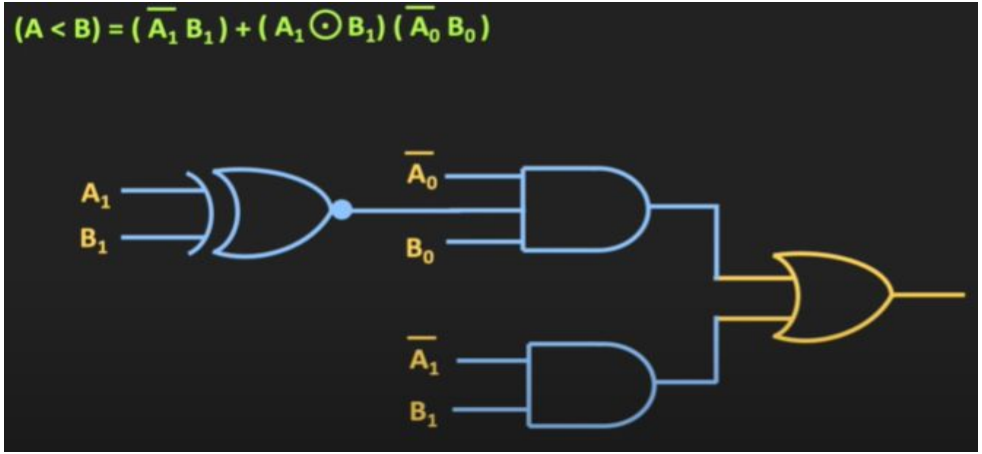
1. **A > B condition**
   If A1 > B1 then A > B
   If A1 = B1 and if A0 > B0 then A > B



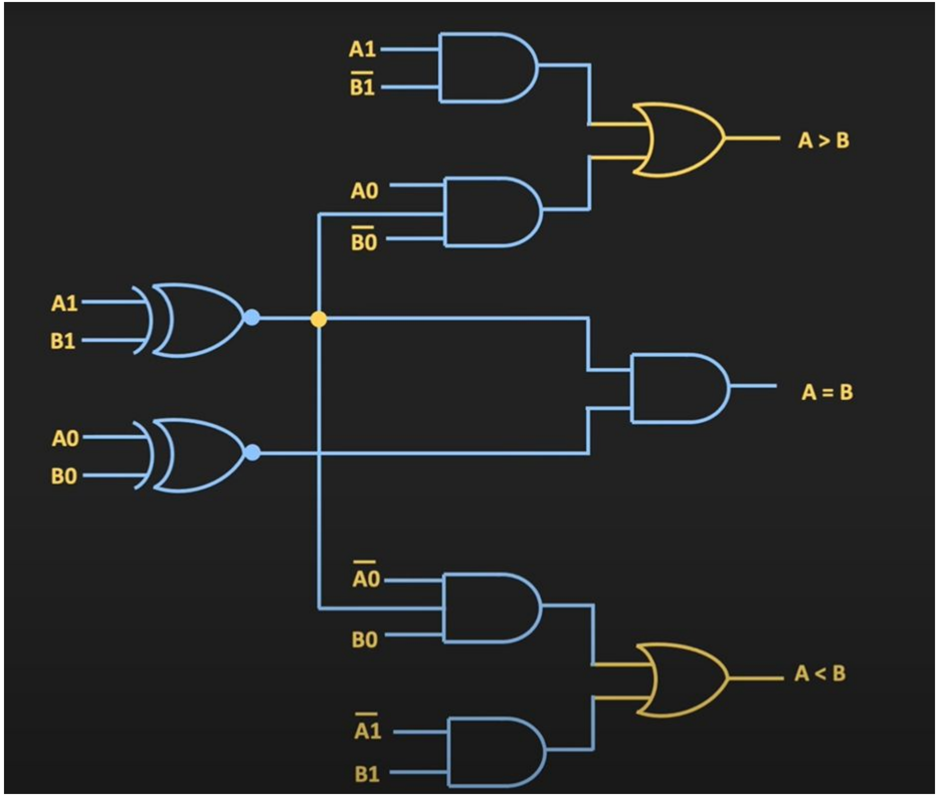
2 bit comparator (3)

Let the numbers are A and B. 2 bits are represented as A1, A0 and B1, B0
A1 and B1 are MSB. A0 and B0 are LSB of A and B respectively

1. **A < B condition**
   If A1 < B1 then A < B
   If A1 = B1 and if A0 < B0 then A < B



2 bit comparator (4)



4 bit comparator (1)

$A > B \Rightarrow$ $A_3 > B_3$

OR

If $A_3 = B_3$ and $A_2 > B_2$

OR

If $A_3 = B_3$ and $A_2 = B_2$ and $A_1 > B_1$

OR

If $A_3 = B_3$ and $A_2 = B_2$ and $A_1 = B_1$ and $A_0 > B_0$

$$(A > B) = A_3 \overline{B_3} + (A_3 \odot B_3) A_2 \overline{B_2} + (A_3 \odot B_3)(A_2 \odot B_2) A_1 \overline{B_1} + (A_3 \odot B_3)(A_2 \odot B_2)(A_1 \odot B_1) A_0 \overline{B_0}$$

4 bit comparator (2)

$A > B \Rightarrow A_3 > B_3$

OR

If $A_3 = B_3$ and $A_2 > B_2$

OR

If $A_3 = B_3$ and $A_2 = B_2$ and $A_1 > B_1$

OR

If $A_3 = B_3$ and $A_2 = B_2$ and $A_1 = B_1$ and $A_0 > B_0$

$$(A > B) = A_3 \overline{B_3} + (A_3 \odot B_3) A_2 \overline{B_2} + (A_3 \odot B_3)(A_2 \odot B_2) A_1 \overline{B_1} + (A_3 \odot B_3)(A_2 \odot B_2)(A_1 \odot B_1) A_0 \overline{B_0}$$

4 bit comparator (3)

$A < B \Rightarrow$ $A_3 < B_3$

OR

If $A_3 = B_3$ and $A_2 < B_2$

OR

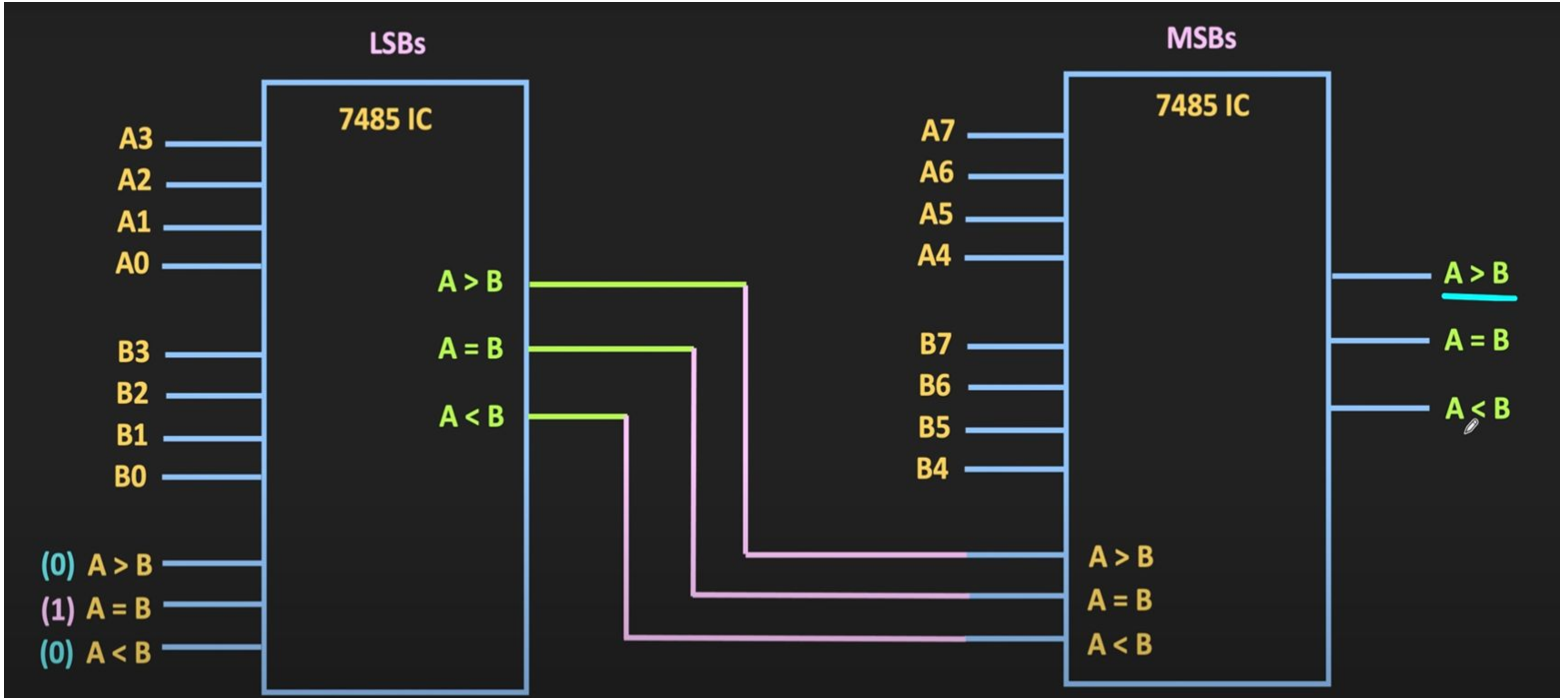
If $A_3 = B_3$ and $A_2 = B_2$ and $A_1 < B_1$

OR

If $A_3 = B_3$ and $A_2 = B_2$ and $A_1 = B_1$ and $A_0 < B_0$

$$(A < B) = \overline{A_3} B_3 + (A_3 \odot B_3)\overline{A_2} B_2 + (A_3 \odot B_3)(A_2 \odot B_2)\overline{A_1} B_1 + (A_3 \odot B_3)(A_2 \odot B_2)(A_1 \odot B_1)\overline{A_0} B_0$$

8 bit comparator (1)



8 bit comparator (2)

- First, MSB are compared if they are all equal then the LSBs are compared
- If MSB bits are equal then it sends A=B to the LSB and then LSB are compared and accordingly comparison is done