COMPARATOR.

6
B or A<B

- The basic function of a comparator is to compare the magnitude of two binary quantities to determine the relation between ~~two~~ them.
- It conveys if two numbers are equal.
- Thus conveys (a) Equality
  (b) Inequality
- To compare we need two inputs and there could be three possible outputs ie =, <, >.

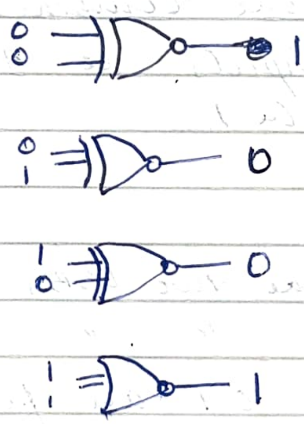
Previous knowledge: Exclusive NOR gate

symbol 

~~So~~ A ~~basic~~ EX-NOR gate can be used as a comparator

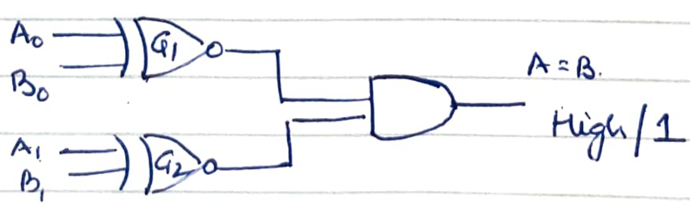
Truth Table

A	B	Y
0	0	1
0	1	0
1	0	0
1	1	1



→ Binary number A : A_1 A_0
Binary number B = B_1 B_0
↑ MSBs ↑ LSBs

2-Bit Comparator



B φ B

To get a single output / indicating when! two numbers are equal or not equal we use a ckt with AND gate that combines the input of two exclusive-NOR gates

~~The two least~~ LSBs .

The LSBs of the two number are compared by exclusive-NOR gate G_1 and the MSBs of the two number are compared by exclusive-NOR gate G_2.

Equality

If the two LSB's are equal then G_1 output is 1
If the two MSB's are equal " G_2 " is 1
These are combined with AND gate, with both inputs to and being 1, its output will be 1.

~~Inequality~~ :

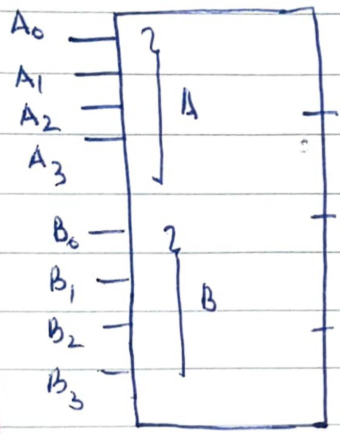
If the two LSB's are not equal then G_1 output is 0
" " " MSB's " " " " G_2 " is 0
These are combined with AND gate, with both inputs to AND gate being 0, its output will be 1.

Inequality

If the two LSB's are not equal then G_1 gives 0
" " " " are equal then G_1 output is 1
When 0 1 are fed to ~~output~~ as input to AND gate then output is 0

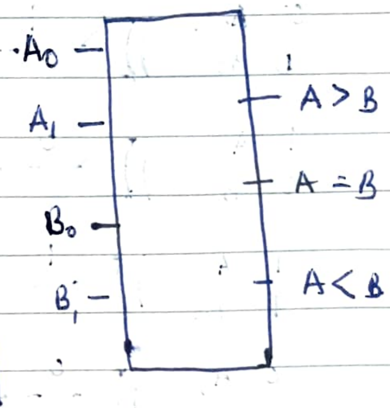
A four Bit Comparator

Logic symbol



A 2-Bit Comparator

Logic symbol



Soln for 2 Bit Comp.

A decimal	A_1	A_0	B_1	B_0	B Dec	A > B	A = B	A < B
0	0	0	0	0	0	0	1	0
0	0	0	0	1	1	0	0	1
0	0	0	1	0	1	0	0	1
0	0	0	1	1	2	0	0	1
1	0	1	0	0	0	1	0	0
1	0	1	0	1	1	0	1	0
1	0	1	1	0	1	0	1	0
1	0	1	1	1	2	0	0	1
1	1	0	0	0	0	1	0	0
1	1	0	0	1	1	1	0	0
1	1	0	1	0	1	0	1	0
1	1	0	1	1	2	0	0	1
2	1	1	0	0	0	1	0	0
2	1	1	0	1	1	1	0	0
2	1	1	1	0	1	1	0	0
2	1	1	1	1	2	0	1	0

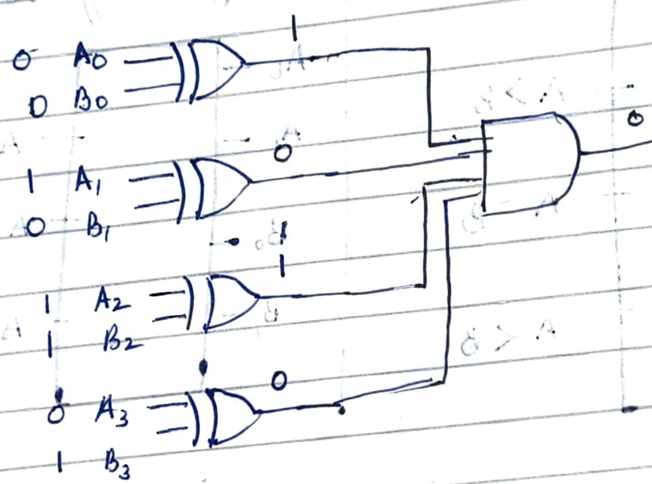
A = 0 compare B with the content of B

A = 01 (2 decimal compare for B)

A = 10 (2 compare with B)

A = 3

Using a 4-bit comparator determine if ~~A>B,~~ A=B or A<B A = 0110 and B = 1100 (use logic gates)



Check if implementation of comparator is in syllabus or not

Comparator

(3) Continued.

Two Bit Comparator Truth Table

A Decimal	A Binary A_1	A_0	B Binary B_1	B_0	B Decimal	A > B	A = B	A < B
0	0	0	0	0	0	0	1	0
0	0	0	0	1	1	0	0	1
0	0	0	1	0	2	0	0	1
0	0	0	1	1	3	0	0	1
1	0	1	0	0	0	1	0	0
1	0	1	0	1	1	0	1	0
1	0	1	1	0	2	0	0	1
1	0	1	1	1	3	0	0	1
2	1	0	0	0	0	1	0	0
2	1	0	0	1	1	1	0	0
2	1	0	1	0	2	0	1	0
2	1	0	1	1	3	0	0	1
3	1	1	0	0		1	0	0
3	1	1	0	1		1	0	0
3	1	1	1	0		1	0	0
3	1	1	1	1		0	1	0

In a 2 Bit Comparator what are the number of possibilities of (a) A > B (b) B = A (c) A < B

Ans (a) 6 cases of A > B

(b) 4 Cases of A = B

(c) 6 " " A < B

To Develop the logic ckt for such a comparator draw the K-map for each condition

For A > B

$\bar{B}_1 \bar{B}_0 A_0$

B_1B_0 \ A_1A_0	00	01	11	10
00	0	1	1	1
01	0	0	1	1
11	0	0	0	0
10	0	0	1	0

$\bar{B}_1 A_1$

$\bar{B}_1 \bar{B}_0 A_0$

For A = B

Reverse diagonal

$(A_1 \odot B_1) \cdot (A_0 \odot B_0)$

B_1B_0 \ A_1A_0	00	01	11	10
00	1	0	0	0
01	0	1	0	0
11	0	0	1	0
10	0	0	0	1

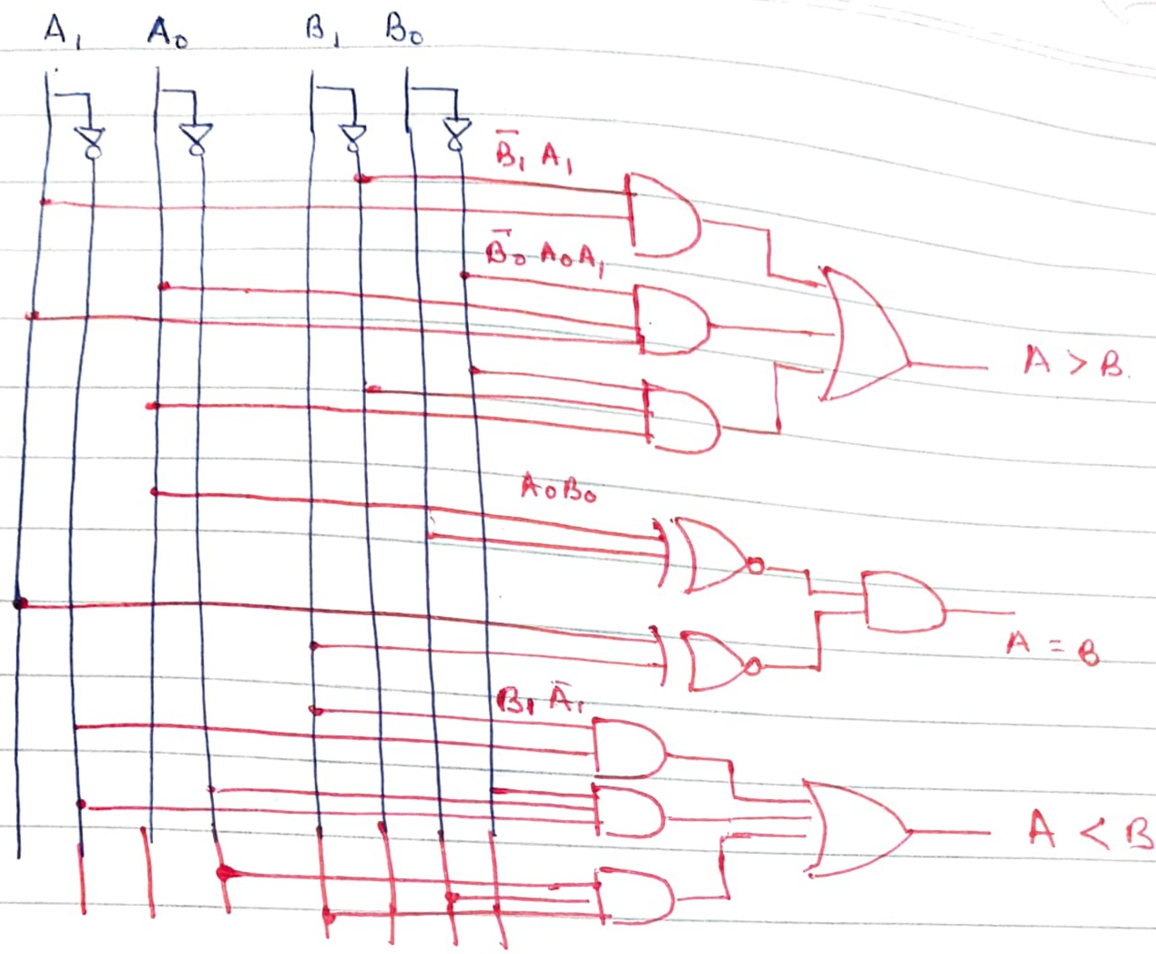
For A < B

$B_1 \bar{A}_1 +$

$B_0 \bar{A}_0 \bar{A}_1 +$

$B_1 B_0 \bar{A}_0$

B_1B_0 \ A_1A_0	00	01	11	10
00	0	0	0	0
01	1	0	0	0
11	1	1	0	1
10	1	1	0	0



A > B $\quad \bar{B}_1 A_1 + \bar{B}_0 A_0 A_1 + \bar{B}_1 \bar{B}_0 A_0$

A = B $\quad (A_0 \odot B_0)(A_1 \odot B_1)$

A - B $\quad B_1 \bar{A}_1 + B_0 \bar{A}_0 \bar{A}_1 + B_1 B_0 \bar{A}_0$