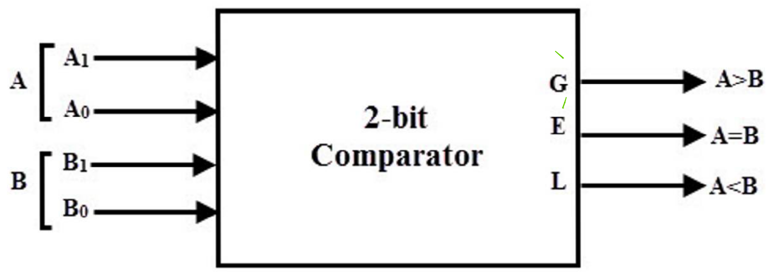
2-Bit Magnitude Comparator

A comparator used to compare two binary numbers each of two bits is called a 2-bit Magnitude comparator. It consists of four inputs and three outputs to generate less than, equal to and greater than between two binary numbers.



← i/ps → ← o/ps →

A B

A1	A0	B1	B0	A>B	A<B	A=B
0	0	0	0	0	0	1
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0	1	0	0	1	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	0
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	0	1
1	0	1	1	0	1	0
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	0	1

A > B

① $A_1 = 1$, $B_1 = 0$ $\Rightarrow A_1 > B_1$

$A_1 = 0$ & $B_1 = 0$ =

② $\underbrace{A_1 = 1 \text{ \& } B_1 = 1}_{A_1 = B_1 \;\; A_1 \odot B_1}$, $\underbrace{A_0 = 1, B_0 = 0}_{A > B}$

$$\boxed{\begin{aligned} A > B &= A_1\overline{B_1} + (A_1 = B_1) \cdot A_0\overline{B_0} \\ &= A_1\overline{B_1} + (A_1 \odot B_1) \cdot A_0\overline{B_0} \end{aligned}}$$

A < B

① $A_1 = 0$ & $B_1 = 1$ $\Rightarrow$ $A < B = \overline{A_1} B_1$

(2)

$A_1 = 0$, $B_1 = 0$ $\rightarrow A_1 = B_1$

$A_1 = 1$, $B_1 = 1$ $\rightarrow A_1 = B_1$

$A_1 = B_1$

If $A_0 = 0$ & $B_0 = 1 \Rightarrow A < B$ $\quad \rightarrow \bar{A}_0 B_0$

$(A_1 = B_1)\ \bar{A}_0 B_0$

$\downarrow$

$(A_1 \odot B_1)\ \bar{A}_0 B_0$

$$\boxed{A < B = \bar{A}_1 B_1 + (A_1 \odot B_1)\bar{A}_0 B_0}$$

(3) $A = B$

$A_1 = B_1 \Rightarrow A_1 \odot B_1$

$A_0 = B_0 \Rightarrow A_0 \odot B_0$

$$\boxed{A = B \Rightarrow (A_1 \odot B_1)(A_0 \odot B_0)}$$

A>B

A1A0 \ B1B0	00	01	11	10
00	0	0	0	0
01	1	0	0	0
11	1	1	0	1
10	1	1	0	0

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

$\rightarrow A_1 A_0 \bar{B}_0$

$\rightarrow A_1 \bar{B}_1$

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

A =B

A1A0 \ B1B0	00	01	11	10
00	1	0	0	0
01	0	1	0	0
11	0	0	1	0
00	0	0	0	1

$A_1 = B_1$

$A_0 = B_0$

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

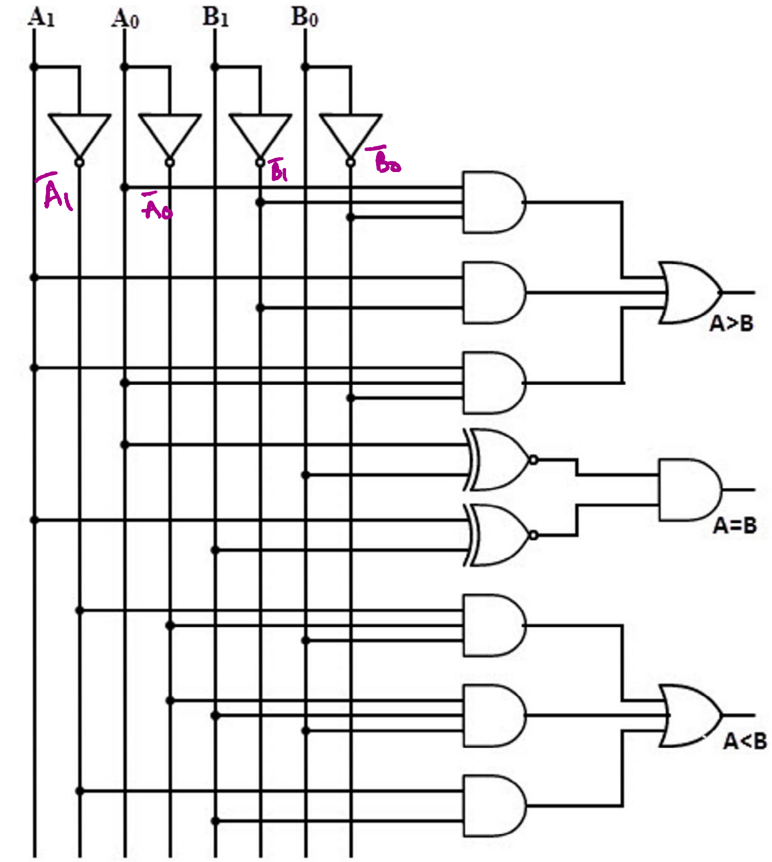
A <B

A1A0 \ B1B0	00	01	11	10
00	0	1	1	1
01	0	0	1	1
11	0	0	0	0
00	0	0	1	0

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

$\rightarrow \bar{A}_1 B_1$

$\bar{A}_0 B_1 B_0$



A) In a 2-bit comparator the condition of A>B can be possible in the following cases:

1. If A1 = 1 and B1 = 0 $\longrightarrow A_1 \bar{B}_1$
2. If A1 = B1 and A0 = 1 and B0 = 0 $\Longrightarrow (A_1 \odot B_1) A_0 \bar{B}_0$

$$A > B \Rightarrow A_1 \bar{B}_1 + (A_1 \odot B_1) A_0 \bar{B}_0$$

B) Similarly the condition for A<B can be possible in the following cases:

1. If A1 = 0 and B1 = 1
2. If A~~1 =~~ B1 and A0 = 0 and B0 = 1

$\Longrightarrow \bar{A}_1 B_1$

$\Longrightarrow (A_1 \odot B_1) \bar{A}_0 B_0$

$$A < B \Rightarrow \bar{A}_1 B_1 + (A_1 \odot B_1) \bar{A}_0 B_0$$

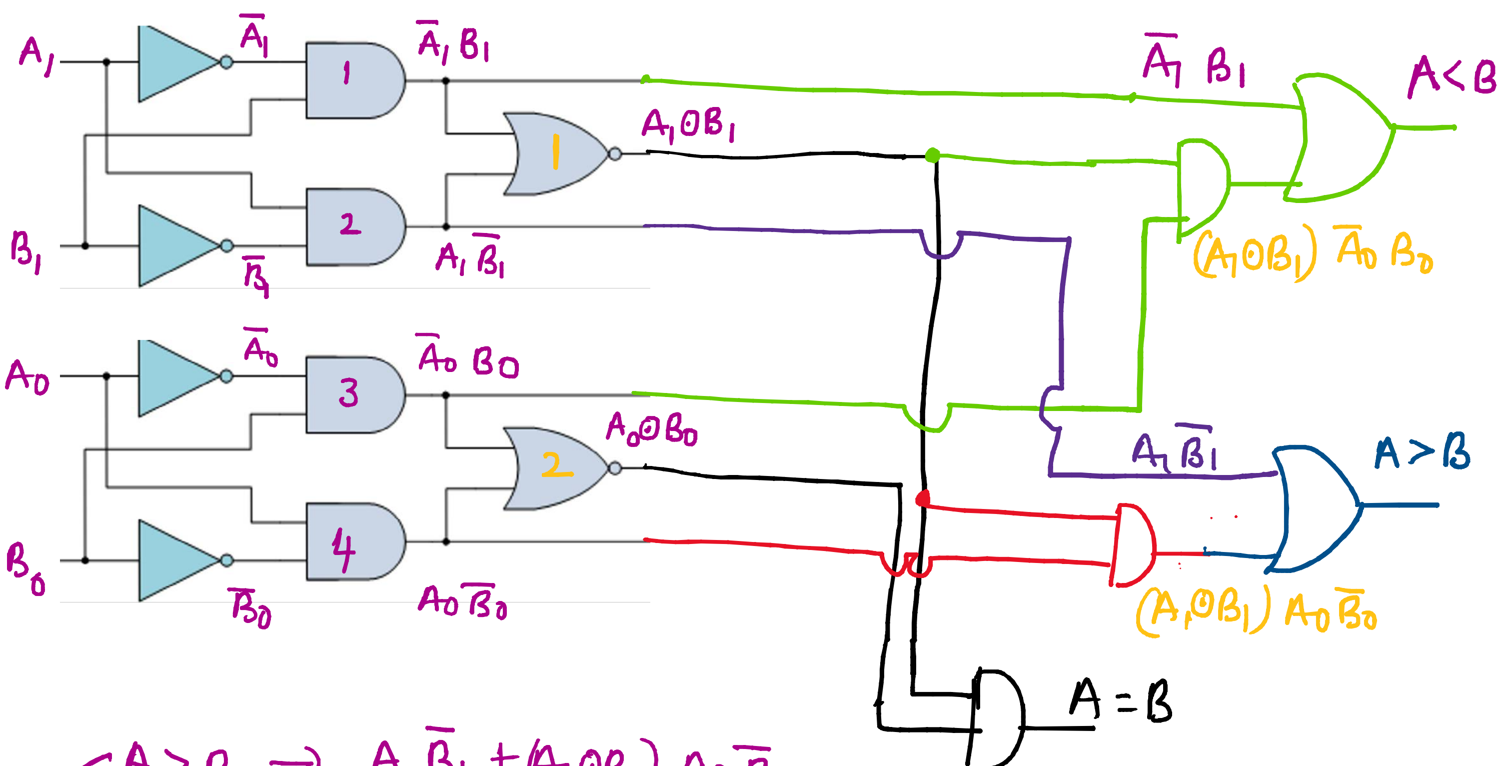
C)The condition of A=B is possible only when all the individual bits of one number exactly coincide with corresponding bits of another number.

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

$$A < B \Rightarrow \bar{A}_1 B_1 + \boxed{(A_1 \odot B_1)\bar{A}_0 B_0}$$

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

2 bit Comparator



$$A > B \Rightarrow A_1 \bar{B}_1 + (A_1 \odot B_1) A_0 \bar{B}_0$$