Vectored Comparator

Thursday, July 2, 2020 1:18 PM

Consider 1-bit comparator. Max range - 0 to 3

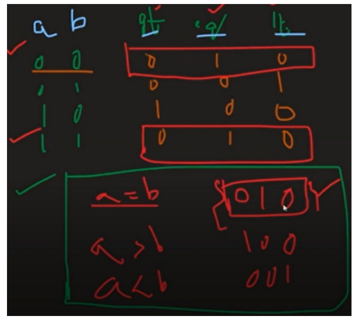
Make a habit of writing gt first and lt last !

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

Observation:

Whenever A,B are same
A=0 ; B=0
A=1 ; B=1

The output is 0-1-0



Equation for 1 bit comapator
A.(~B) + (~A)B + (A XOR B)

VECTORED COMPARATOR:

[m:n]a,b : digit comparator

Consider [1:0]a,b

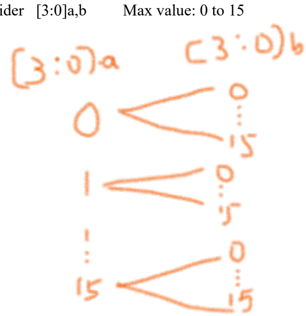
a	b
00 - 0	00- 0
01 - 1	01 - 1
10 - 2	10 - 2
11 - 3	11 - 3

Different combinations are possible, each case having its own output.

Power of VECTOR ! Increase 1 bit, and see different combinations

A0 a1 b0 b1
----
0 0 0 0
0 1
1 0
1 1
0 1 0 0
0 1
1 0
1 1
01 0 0
0 1
1 0
1 1
11 0 0
0 1
1 0
1 1

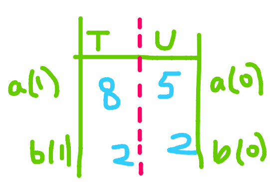
Consider [3:0]a,b Max value: 0 to 15



Consider 2 numbers
A= 85
B= 22

A>B o/p: 1-0-0

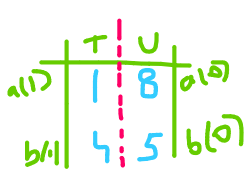
Kid can compare numbers using the concept of Unit's place, Tens's place and so on….



If in ten's place, a(1)>b(1),
we can determine the final output as greater than,
without worrying about the digits in Unit's place

Consider 2 numbers
A= 18
B= 45

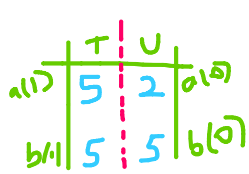
A<B o/p: 0-0-1



If in ten's place, a(1)<b(1),
we can determine the final output as less than,
without worrying about the digits in Unit's place

Consider 2 numbers
A= 52
B= 55

A<B o/p: 0-0-1



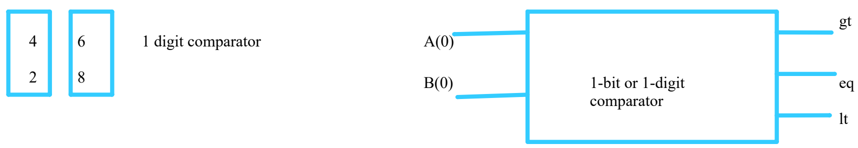
If in ten's place, a(1)=b(1),
we can determine the final output by determining the status of the digits in Unit's place

	T	U
1.	5	X
	8	X
2.	8	X
	2	X
3.	5	X
	5	X

GT	EQ	LT
0	0	1
1	0	0
1	0	0
0	0	1

DECIDING FACTOR - UNIT'S PLACE DIGIT

Design of circuit - consider 2 numbers : 46 and 28

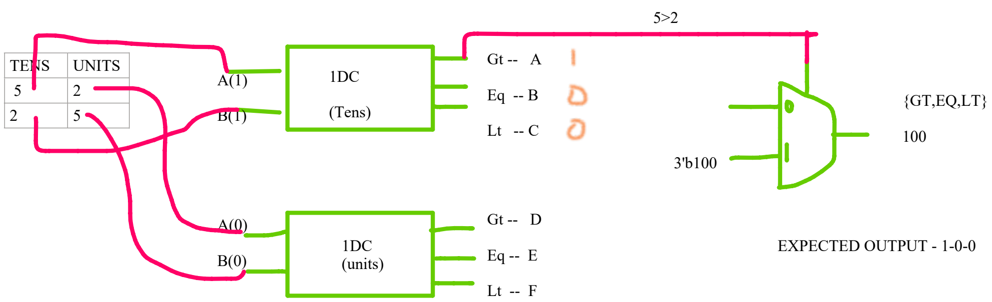


A(1)>B(1) -- we can determine final output.
Output : 1-0-0

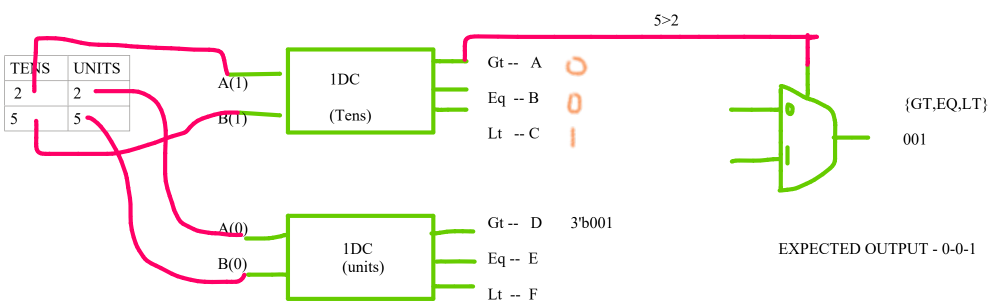
A(1)<B(1) -- we can determine final output.
Output : 0-0-1

A(1)=B(1) -- we can determine final output.
Output : 0-1-0

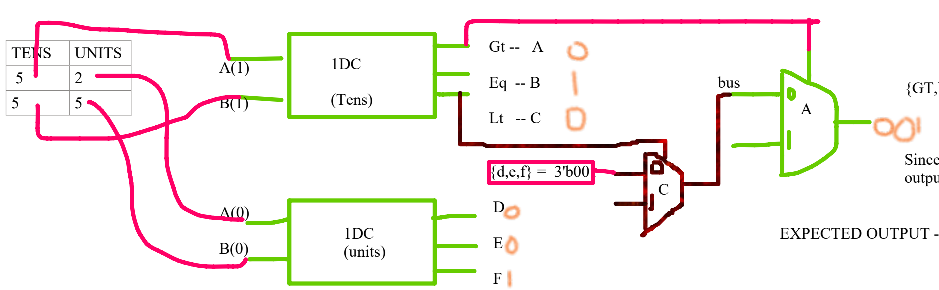
EXAMPLE: 52 and 25



EXAMPLE: 22 and 55

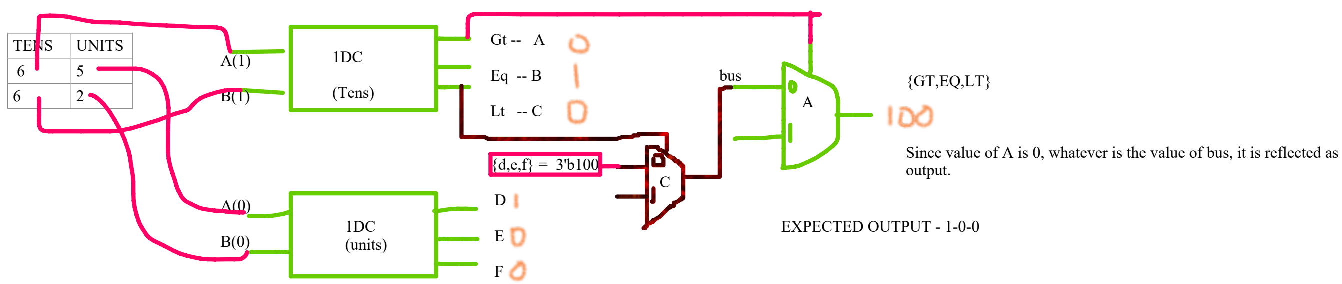


EXAMPLE: 52 and 55



Since value of A is 0, whatever is the value of bus, it is reflected as output.

EXAMPLE: 65 and 62



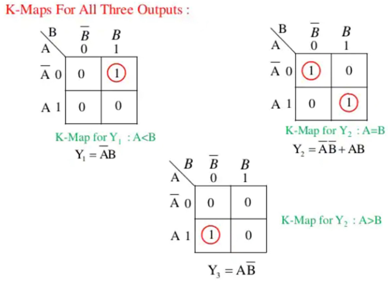
To design a 3-digit comparator, we need
1 1-digit comparator
1 2-digit comparator

1- Bit Magnitude Comparator:

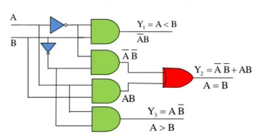
- This magnitude comparator has two inputs A and B and three outputs A<B, A=B and A>B.
- This magnitude comparator compares the two numbers of single bits.
- Truth Table of 1-Bit Comparator

INPUTS		OUTPUTS		
A	B	Y_1 (A<B)	Y_2 (A=B)	Y_3 (A>B)
0	0	0	1	0
0	1	1	0	0
1	0	0	0	1
1	1	0	1	0

K-Maps For All Three Outputs :



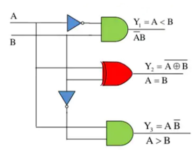
Realization of One Bit Comparator



$Y_1 = \bar{A}B$

$Y_2 = \bar{A}\bar{B} + AB$

$Y_3 = A\bar{B}$



2-Bit Comparator:

- A comparator which is used to compare two binary numbers each of two bits is called a 2-bit magnitude comparator.
- Fig. 2 shows the block diagram of 2-Bit magnitude comparator.
- It has four inputs and three outputs.
- Inputs are A_0 ,A_1,B_0 and B_1 and Outputs are Y_1, Y_2 and Y_3

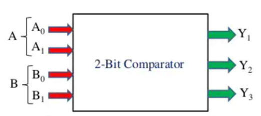


Fig. 2

TRUTH TABLE

INPUT				OUTPUT		
A_1	A_0	B_1	B_0	Y_1=A<B	Y_2=(A=B)	Y_3=A>B
0	0	0	0	0	1	0
0	0	0	1	1	0	0
0	0	1	0	1	0	0
0	0	1	1	1	0	0
0	1	0	0	0	0	1
0	1	0	1	0	1	0
0	1	1	0	1	0	0
0	1	1	1	1	0	0
1	0	0	0	0	0	1
1	0	0	1	0	0	1
1	0	1	0	0	1	0
1	0	1	1	1	0	0
1	1	0	0	0	0	1
1	1	0	1	0	0	1
1	1	1	0	0	0	1
1	1	1	1	0	1	0

K-Map for A<B:

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

K-Map for A=B:

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

K-Map For A>B

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

For A<B

$$Y_1 = \overline{A_1}\,\overline{A_0}\,B_0 + \overline{A_1}\,B_1 + \overline{A_0}\,B_1\,B_0$$

$$Y_3 = A_0\,\overline{B_1}\,\overline{B_0} + A_1\,\overline{B_1} + A_1A_0\,\overline{B_0}$$

For A=B

$$Y_2 = \overline{A_1}\,\overline{A_0}\,\overline{B_1}\,\overline{B_0} + \overline{A_1}\,A_0\,\overline{B_1}\,B_0 + A_1A_0B_1B_0 + A_1\,\overline{A_0}\,B_1\,\overline{B_0}$$

$$Y_2 = \overline{A_1}\,\overline{A_0}\,\overline{B_1}\,\overline{B_0} + \overline{A_1}\,A_0\,\overline{B_1}\,B_0 + A_1A_0B_1B_0 + A_1\,\overline{A_0}\,B_1\,\overline{B_0}$$
$$Y_2 = \overline{A_0}\,\overline{B_0}(\overline{A_1}\,\overline{B_1} + A_1B_1) + A_0B_0(\overline{A_1}\,\overline{B_1} + A_1B_1)$$
$$Y_2 = (\overline{A_1}\,\overline{B_1} + A_1B_1)\;(\overline{A_0}\,\overline{B_0} + A_0B_0)$$
$$Y_2 = (A_1 \odot B_1)(A_0 \odot B_0)$$

<u>LOGIC DIAGRAM OF 2-BIT COMPARATOR:</u>