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19ECB231/ Digital Electronics

Code converters - Magnitude Comparator

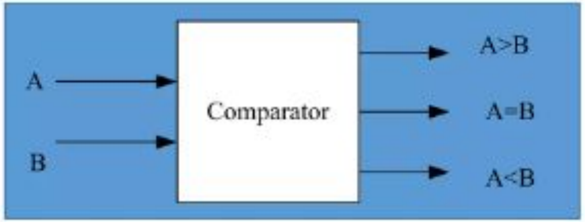
Magnitude Comparator

- A magnitude digital comparator is a combinational circuit that compares two digital or binary numbers (consider A and B) and determines their relative magnitudes in order to find out whether one number is equal, less than or greater than the other digital number.
- Three binary variables are used to indicate the outcome of the comparison as A>B, A<B, or A=B. The below figure shows the block diagram of a n-bit comparator which compares the two numbers of n-bit length and generates their relation between themselves.

LOGIC DESIGN PROCEDURE

Magnitude comparator is a combinational circuit that compares two numbers and determines their relative magnitude. A comparator is shown as Figure 2.1. The output of comparator is usually 3 binary variables indicating:

- A>B
- A=B
- A<B



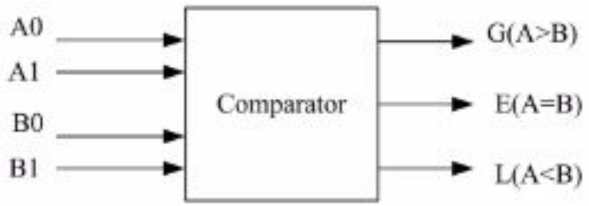
LOGIC DESIGN FOR 2-BIT COMPARATOR

For a 2-bit comparator, we have four inputs A1A0 and B1B0 and three outputs:

E (is 1 if two numbers are equal)

G (is 1 when A > B) and

L (is 1 when A < B)



RESULT

If we use truth table and K-MAP, the result is

$E = A'_1A'_0B'_1B'_0 + A'_1A_0B'_1B_0 + A_1A_0B_1B_0 + A_1A'_0B_1B'_0$

or

$E = ((A_0 \oplus B_0) + (A_1 \oplus B_1))'$

$G = A_1B'_1 + A_0B'_1B'_0 + A_1A_0B'_0$

$L = A'_1B_1 + A'_1A'_0B_0 + A'_0B_1B_0$

Here we use simpler method to find E (called X) and G (called Y) and L (called Z)

CASE 1: A=B if all Ai= Bi

It means $X_0 = A_0B_0 + A'_0B'_0$ and

$X_1 = A_1B_1 + A'_1B'_1$

If $X_0=1$ and $X_1=1$ then $A_0=B_0$ and $A_1=B_1$

Thus, if $A=B$ then $X_0X_1 = 1$ it means

$X = (A_0B_0 + A'_0B'_0)(A_1B_1 + A'_1B'_1)$

since $(x \oplus y)' = (xy + x'y')$

$X = (A_0 \oplus B_0)'(A_1 \oplus B_1)' = ((A_0 \oplus B_0) + (A_1 \oplus B_1))'$

Ai	Bi	Xi
0	0	1
0	1	0
1	0	0
1	1	0

It means for X we can NOR the result of two exclusive-OR gates.

CASE 2: A>B

means

If $A_1=B_1$ ($X_1=1$) then A_0 should be 1 and B_0 should be 0

A1	B1	Y1
0	0	0
0	1	0
1	0	1
1	1	0

For A> B: A1 > B1 or

$A_1 = B_1$ and A0 > B0

It means $Y = A_1B'_1 + X_1A_0B'_0$ should be 1 for A> B.

CASE 3: For B>A : B1 > A1

$A_1=B_1$ and $B_0 > A_0$

$Z = A'_1B_1 + X_1A'_0B_0$

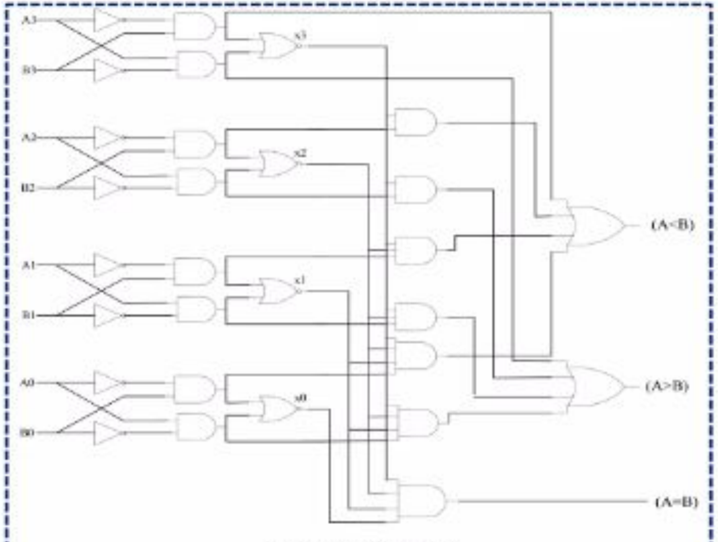
A0	B0	Y0
0	0	1
0	1	0
1	0	0
1	1	0

4-BIT COMPARATOR

The procedure for binary numbers with more than 2 bits can also be found in the similar way. Figure shows the 4-bit magnitude comparator.

Input: $A=A_3A_2A_1A_0$

$B=B_3B_2B_1B_0$



4-Bit Magnitude Comparator


RECAP


Thank You!