



EXPERIMENT - 8

Switching Theory and Logic Design (STLD)

Aim

To realize 2 bit Magnitude Comparator.

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EXPERIMENT - 8

AIM:

To realize 2 bit Magnitude Comparator.

Hardware and Software Apparatus Required

Hardware:

Breadboard, IC 7400 (NAND), IC 7410 (3 input NAND), IC 7404 (NOT), LEDs, 5V power supply, connecting wires.

Software Simulation:

The schematic models of the desired circuits will be stimulated on MULTISIM (Free Software), easily accessible at www.multisim.com.

Components used – Source (Clock Voltage), Passive elements (resistor), Digital components (AND, OR, NAND, NOR, XOR, XNOR, Inverter), Probe for Analysis and annotation (Digital), Schematic connectors (Ground)

Theory:

Magnitude Comparator is a logical circuit, which compares two signals A and B and generates three logical outputs, whether $A > B$, $A = B$, or $A < B$. The outcome of comparison is specified by three binary variables that indicate whether $A > B$, $A = B$, or $A < B$. 2-Bit Magnitude Comparator Compares two numbers each having two bits (A_1, A_0 & B_1, B_0).

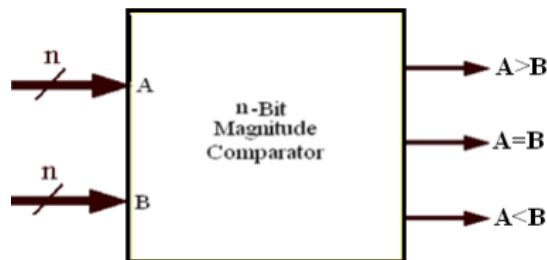


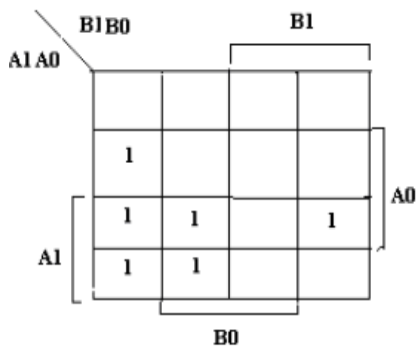
Fig 11.1 Block Diagram Of comparator

Designing of 2 bit comparator

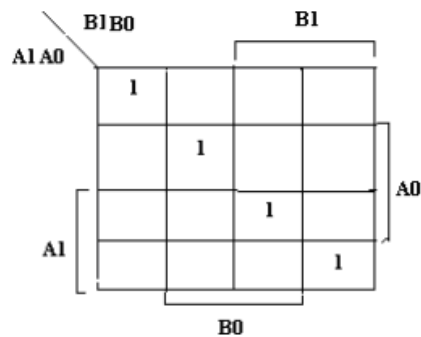
INPUT				OUTPUT		
A1	A0	B1	B0	A>B	A=B	A<B
0	0	0	0	0	1	0
0	0	0	1	0	0	1
0	0	1	0	0	0	1
0	0	1	1	0	0	1
0	1	0	0	1	0	0
0	1	0	1	0	1	0
0	1	1	0	0	0	1
0	1	1	1	0	0	1
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	1	0
1	0	1	1	0	0	1
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	1	0

K-Map is used to minimize Boolean function obtained from truth table as shown below

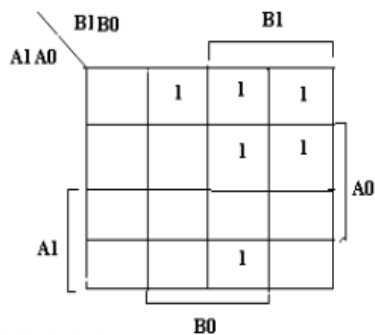
a) FOR A>B



FOR A=B



FOR A<B



$$\begin{aligned}
 A > B &= A1B1' + A0B0'A1'B1' + A0B0'A1B1 \\
 &= A1B1' + A0B0'(A1'B1' + A1B1) \\
 &= A1B1' + A0B0' X1
 \end{aligned}$$

$$\begin{aligned}
 A = B &= A1'A0'B1'B0' + A1'A0B1'B0 + A1A0'B1B0' + A1A0B1B0 \\
 &= (A1'B1' + A1B1)(A0'B0' + A0B0) \\
 &= X1X0
 \end{aligned}$$

$$\begin{aligned}
 A < B &= A1'B1 + A0'B0A1'B1' + A0'B0A1B1 \\
 &= A1'B1 + A0'B0(A1'B1' + A1B1) \\
 &= A1'B1 + A0'B0 X1
 \end{aligned}$$

b)

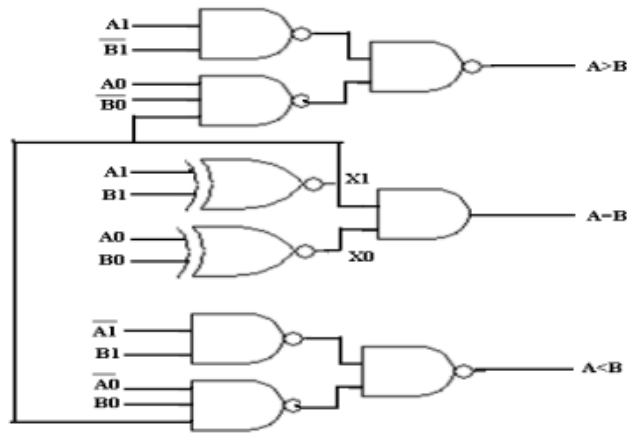


Fig 11.2 a)K Map minimization b) logic Diagram of comparator

From the above K-maps logical expressions for each output can be expressed as follows:

$$A > B: A1B1' + A0B1'B0' + A1A0B0'$$

$$A = B: A1'A0'B1'B0' + A1'A0B1'B0 + A1A0B1B0 + A1A0'B1B0'$$

$$: A1'B1' (A0'B0' + A0B0) + A1B1 (A0B0 + A0'B0')$$

$$: (A0B0 + A0'B0') (A1B1 + A1'B1')$$

$$: (A0 \text{ Ex-Nor } B0) (A1 \text{ Ex-Nor } B1)$$

$$A < B: A1'B1 + A0'B1B0 + A1'A0'B0$$

Procedure:

1. Check all the components for their working.
2. Insert the appropriate IC into the IC base.
3. Make connections as shown in the circuit diagram.
4. Verify the results and observe the outputs.

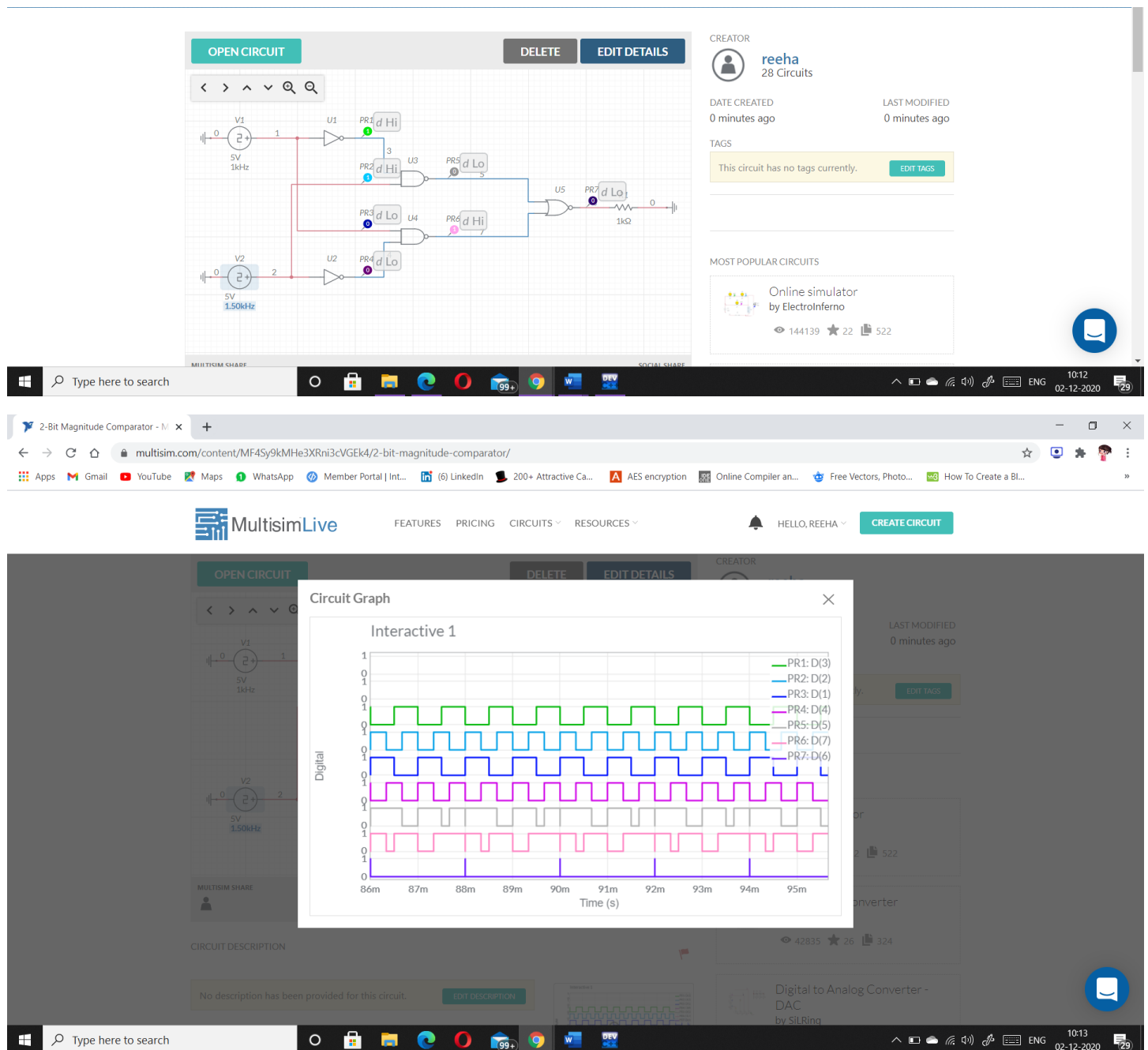
PRECAUTIONS:

1. All ICs should be checked before starting the experiment.
2. All the connection should be tight.
3. Always connect ground first and then the supply.
4. Switch off the power supply after completion of the experiment.

RESULT:

2 bit magnitude comparator has been studied and its truth table is verified.

Circuits and Output waveform for 1 bit magnitude comparator.



Circuits and Output waveform for 2 - bit magnitude comparator:

multisim.com/content/LIPd4pHwPxANztpbdN5MLS/2-bit-magnitude-comparator/

MultisimLive

2-Bit Magnitude Comparator

Favorite 0 Copy 0 Views 1

OPEN CIRCUIT DELETE EDIT DETAILS

CREATOR: reeha 34 Circuits

DATE CREATED: 2 minutes ago

LAST MODIFIED: 1 minute ago

TAGS: This circuit has no tags currently. EDIT TAGS

CIRCUIT COPIED FROM: 2-Bit Magnitude Comparator

MOST POPULAR CIRCUITS: Online simulator by ElectroInferno

Circuit Graph

Interactive 1

Digital

Time (s)

Legend:

- A1: D(1)
- A0: D(2)
- B1: D(4)
- B0: D(5)
- AgreaterthanB: D(17)
- AequalsB: D(18)
- AlessthanB: D(19)

The image displays a screenshot of the MultisimLive web interface. The main window shows a 2-bit magnitude comparator circuit. The circuit includes two 2-bit binary inputs, A and B, each connected to a 2-to-4 decoder. The outputs of these decoders are connected to a network of logic gates (AND, OR, NOT) to produce three comparison outputs: A greater than B, A equals B, and A less than B. The circuit is simulated, and the output waveforms are shown in a 'Circuit Graph' window. The graph displays the digital signals for the inputs and the three comparison outputs over a time interval from 31.5ms to 35.5ms. The legend identifies the signals: A1: D(1) (green), A0: D(2) (blue), B1: D(4) (purple), B0: D(5) (magenta), AgreaterthanB: D(17) (black), AequalsB: D(18) (pink), and AlessthanB: D(19) (dark blue). The waveforms show the logic levels (0 and 1) for each signal over time.

VIVA-VOCE QUESTIONS:

Q1. Write down expressions for 4-bit magnitude comparator.

Ans.

- If $A_3 = 1$ and $B_3 = 0$, then A is greater than B ($A > B$). Or
- If A_3 and B_3 are equal, and if $A_2 = 1$ and $B_2 = 0$, then $A > B$. Or
- If A_3 and B_3 are equal & A_2 and B_2 are equal, and if $A_1 = 1$, and $B_1 = 0$, then $A > B$. Or
- If A_3 and B_3 are equal, A_2 and B_2 are equal and A_1 and B_1 are equal, and if $A_0 = 1$ and $B_0 = 0$, then $A > B$.

From the above statements, the output $A > B$ logic expression can be written as

$$G = A_3 \overline{B_3} + (A_3 \text{ Ex-NOR } B_3) A_2 \overline{B_2} + (A_3 \text{ Ex-NOR } B_3) (A_2 \text{ Ex-NOR } B_2) A_1 \overline{B_1} + (A_3 \text{ Ex-NOR } B_3) (A_2 \text{ Ex-NOR } B_2) (A_1 \text{ Ex-NOR } B_1) A_0 \overline{B_0}$$

Similarly the logic expression for the L or $A < B$ output can be expressed as

$$L = \overline{A_3} B_3 + (A_3 \text{ Ex-NOR } B_3) \overline{A_2} B_2 + (A_3 \text{ Ex-NOR } B_3) (A_2 \text{ Ex-NOR } B_2) \overline{A_1} B_1 + (A_3 \text{ Ex-NOR } B_3) (A_2 \text{ Ex-NOR } B_2) (A_1 \text{ Ex-NOR } B_1) \overline{A_0} B_0$$

The equal output is produced when all the individual bits of one number are exactly coincides with corresponding bits of another number. Then the logical expression for $A=B$ output can be written as

$$E = (A_3 \text{ Ex-NOR } B_3) (A_2 \text{ Ex-NOR } B_2) (A_1 \text{ Ex-NOR } B_1) (A_0 \text{ Ex-NOR } B_0)$$

Q2. What are applications of magnitude comparator?

Ans.

Digital comparator and magnitude comparator is used in different applications where data comparison is mostly required in many of the activities, and these hold many benefits too.

- Now, look into few of the applications of comparators
- Used for authorization purposes (such as password management) and biometric applications.
- These are implemented in process controllers and also in servo motor controls.
- Implemented for the data comparison of variables like temperature, the pressure is compared with that of reference values.
- Used to address decoding circuitry in computers.

Thus, this is all about digital comparator and magnitude comparator. So, the augmented performance of comparators allowed these devices to gain more prominence in the electronics industry and let them be implemented in many applications.

Q3. What are Magnitude comparators?

Ans.

A magnitude digital Comparator is a combinational circuit that compares two digital or binary numbers in order to find out whether one binary number is equal, less than or greater than the other binary number. We logically design a circuit for which we will have two inputs one for A and other for B and have three output terminals, one for $A > B$ condition, one for $A = B$ condition and one for $A < B$ condition.

