

Design of 2-bit Magnitude Comparator

Experiment no. _____

Date: _____

Aim:

Design and verify the working of a 2-bit Magnitude Comparator.

Software Required: LTspice software

Circuit Diagram:

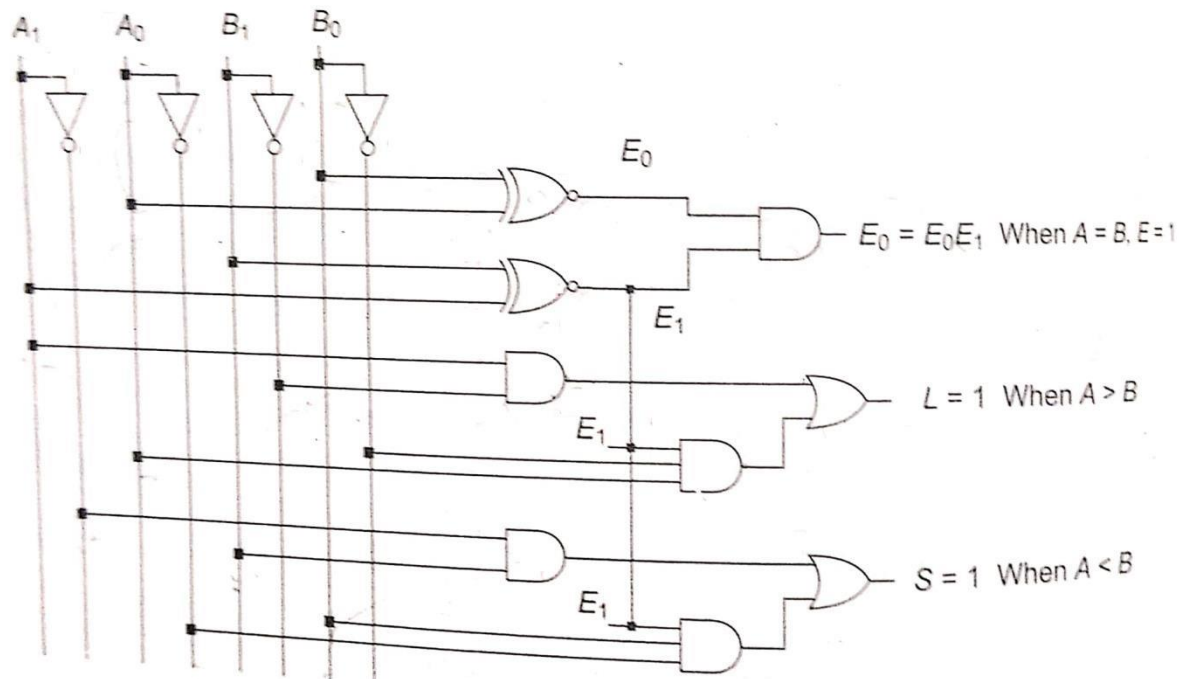


Fig.1 Circuit Diagram

Boolean Expressions:

For A=B

where,

$$E = E_1 E_0 = 1$$

where,

$$E_1 = \bar{A}_1 \bar{B}_1 + A_1 B_1$$

$$E_0 = \bar{A}_0 \bar{B}_0 + A_0 B_0$$

For A < B

$$S = \bar{A}_1 B_1 + E_1 \bar{A}_0 B_0$$

For A > B

$$L = A_1 \bar{B}_1 + E_1 A_0 \bar{B}_0$$

Theory:

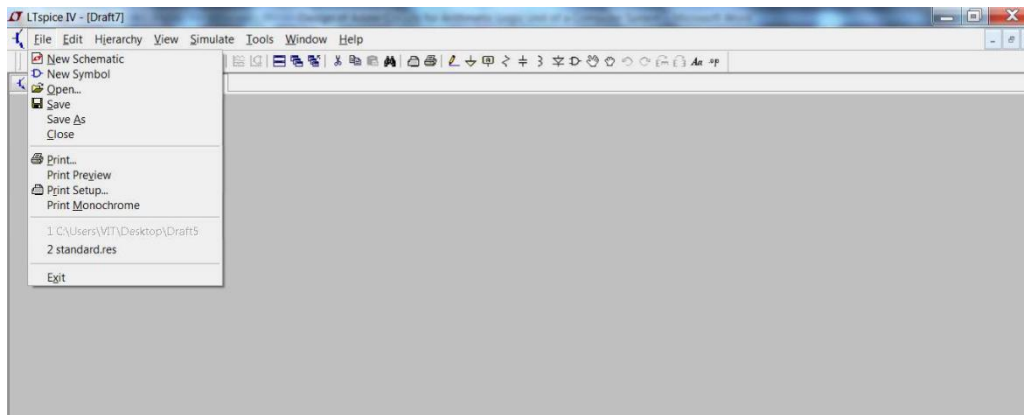
Comparators with three output terminals and checks for three conditions i.e greater than or less than or equal to is called **Magnitude comparator**. Let 2-bit 'A' input be denoted as A_1 and A_0 . Let 2-bit B input be denoted as B_1 and B_0 . The three outputs are denoted as A<B, A=B and A>B. The truth table is given in Table 1.

Table 1. Truth Table for 2-bit Magnitude Comparator

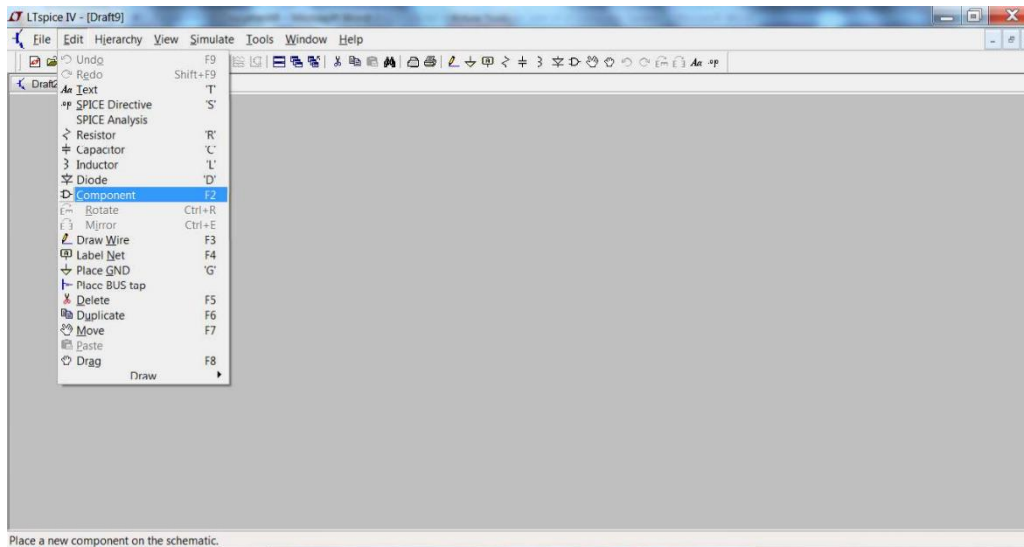
Input 1		Input 2		Output		
A_1	A_0	B_1	B_0	A > B (L)	A < B (S)	A = B (E)
0	0	0	0	0	0	1
0	0	0	1	0	1	0
0	0	1	0	0	1	0
0	0	1	1	0	1	0
0	1	0	0	1	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	0
0	1	1	1	0	1	0
1	0	0	0	1	0	0
1	0	0	1	1	0	0
1	0	1	0	0	0	1
1	0	1	1	0	1	0
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	0	1

Procedure for Simulation:

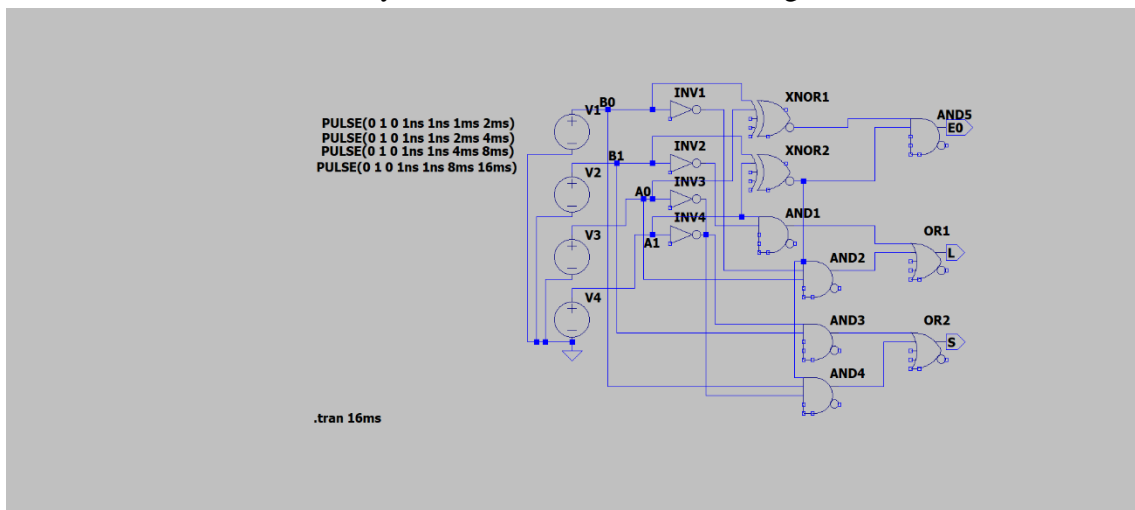
1. Open LTspice. Go to File– New Schematic.



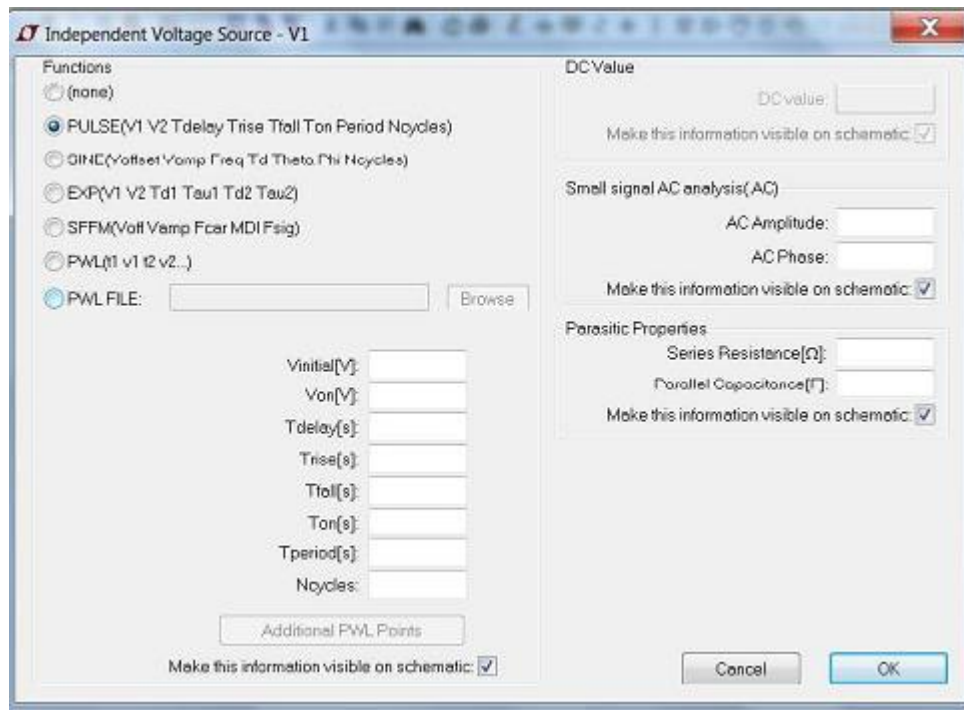
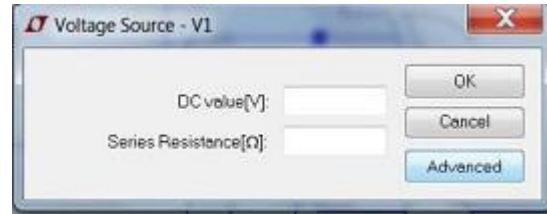
2. On the File Menu, click on Edit– Component.



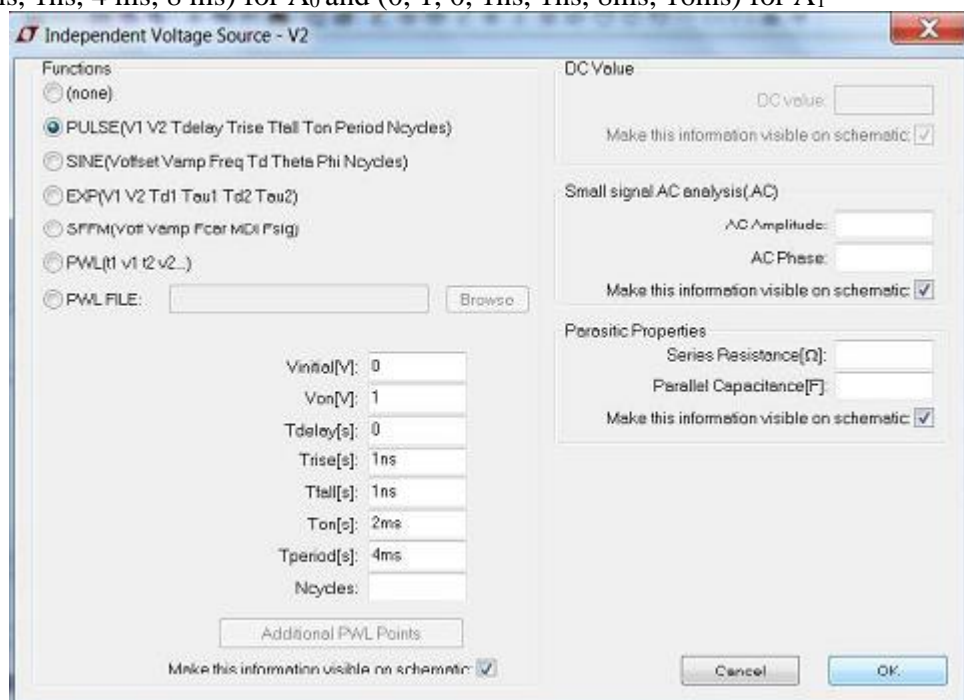
3. Place the voltage sources, NOT gate, XNOR gate, AND gate, OR gate and ground on to schematic and make necessary connections as shown in the Figure.



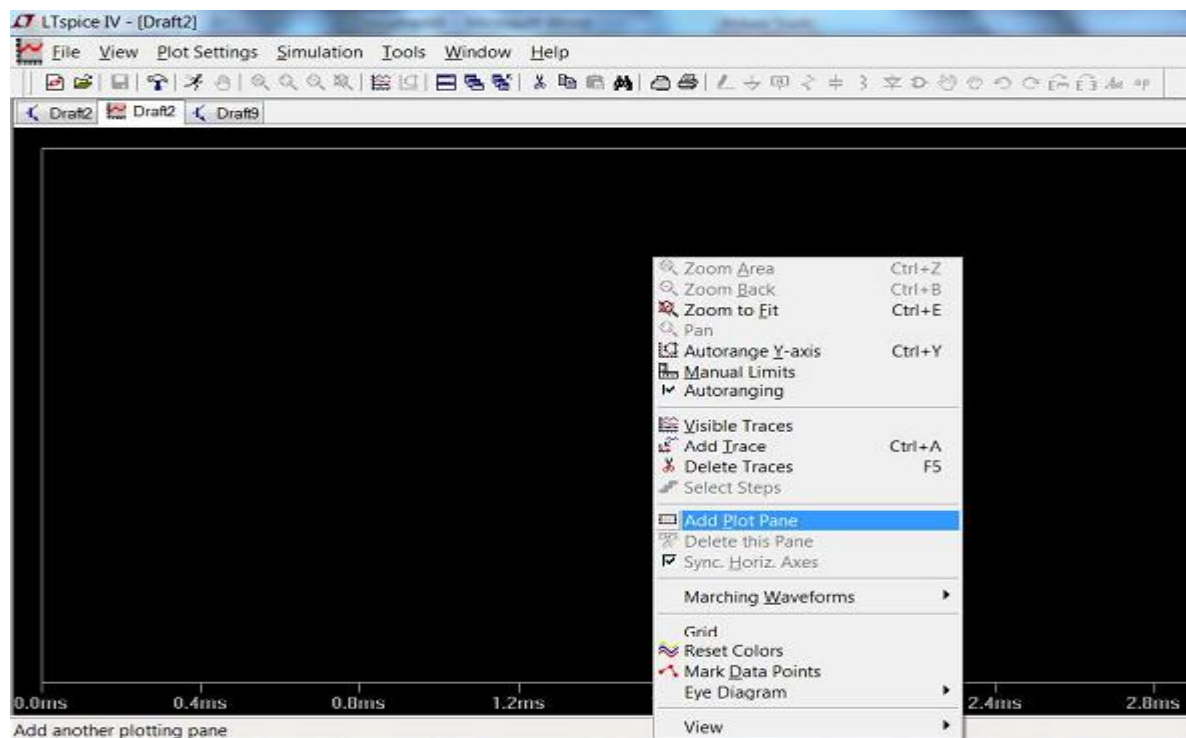
- As shown in the figures below, Right click on the voltage sources and click Advanced option and then Select PULSE (V1 V2 Tdelay Trise Tfall Ton Period Ncycles).



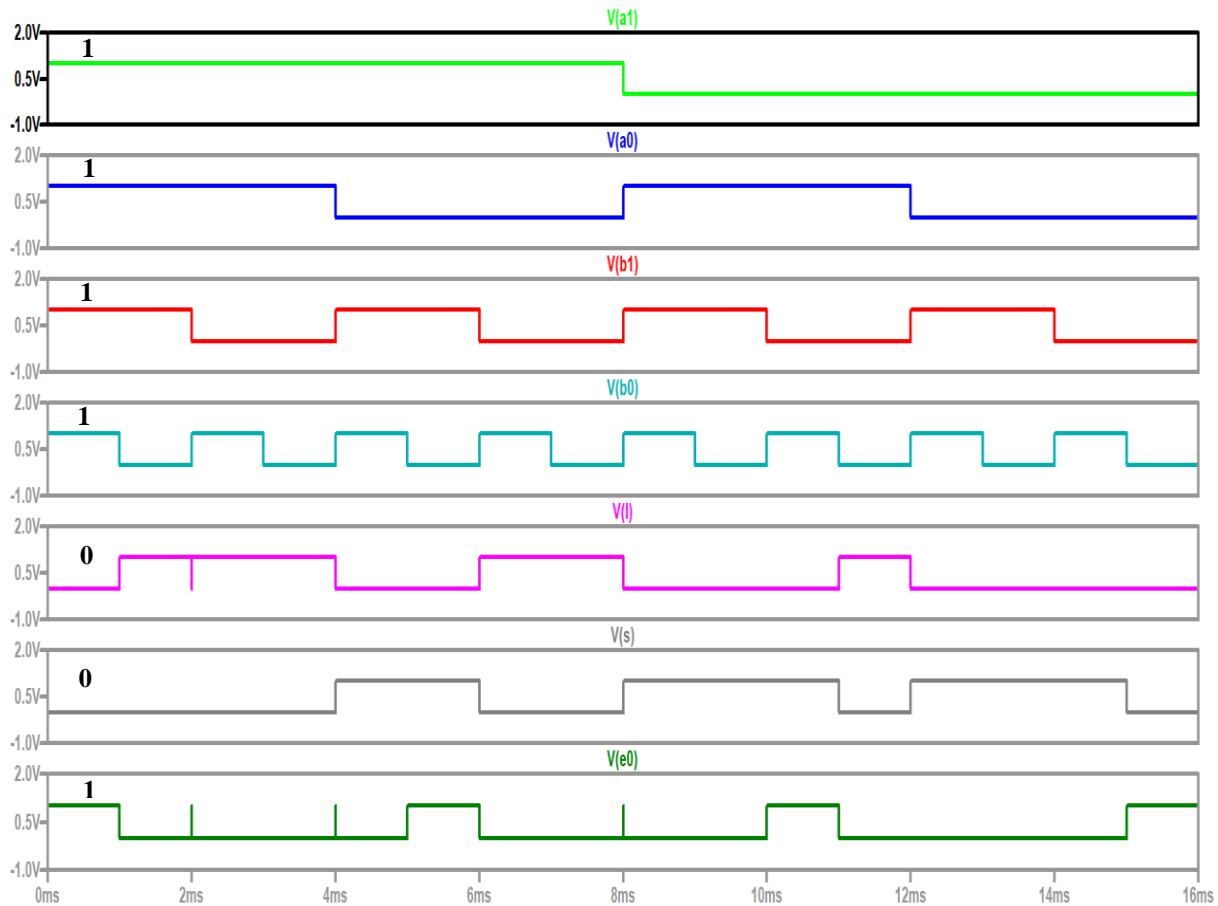
- Set the values as (0, 1, 0, 1ns, 1ns, 1ms, 2 ms) for B₀, (0, 1, 0, 1ns, 1ns, 2ms, 4 ms) for B₁, as (0, 1, 0, 1ns, 1ns, 4 ms, 8 ms) for A₀ and (0, 1, 0, 1ns, 1ns, 8ms, 16ms) for A₁



6. Go to Edit → SPICE analysis.
Set the stop time to 16 ms in Transient command and run the simulation
(run symbol on menu bar).
7. To view the results, right click→ Add Plot Pane, add 7 plot panes to view the input and output.
For each pane, right click → Add Trace → Select V (<<respective node>>).
(nodes correspond to input and output)



8. Observe the waveforms, change the appropriate colors for proper visibility using color preferences and control panel tool and verify the truth table **by writing 1's and 0's in each interval in figure**. Sample figure shown below.



Result

Thus 2-bit Magnitude Comparator circuit is designed, implemented and verified in LTspice Software.