Title :- 8 BIT BINARY MAGNITUDE COMPARATOR

Theory :-

8bit comparator is implemented using two 4 bit comprators in cascaded mode.

A 4-Bit Magnitude Camparator which compares two 4-bit words (A, B), each word having four Parallel Inputs (A0 –A3, B0 –B3); A3, B3 being the most significant inputs.

Here the subcircuit named 7485 is a 4 bit comparator.

Three Outputs are provided: “A greater than B” (A>B(out)),
“A equal to B” (A=B(out)),
“A less than B” (A<B(out)),

Three Expander Inputs, A>B(in), A=B(in), A<B(in), allow cascading without external gates.

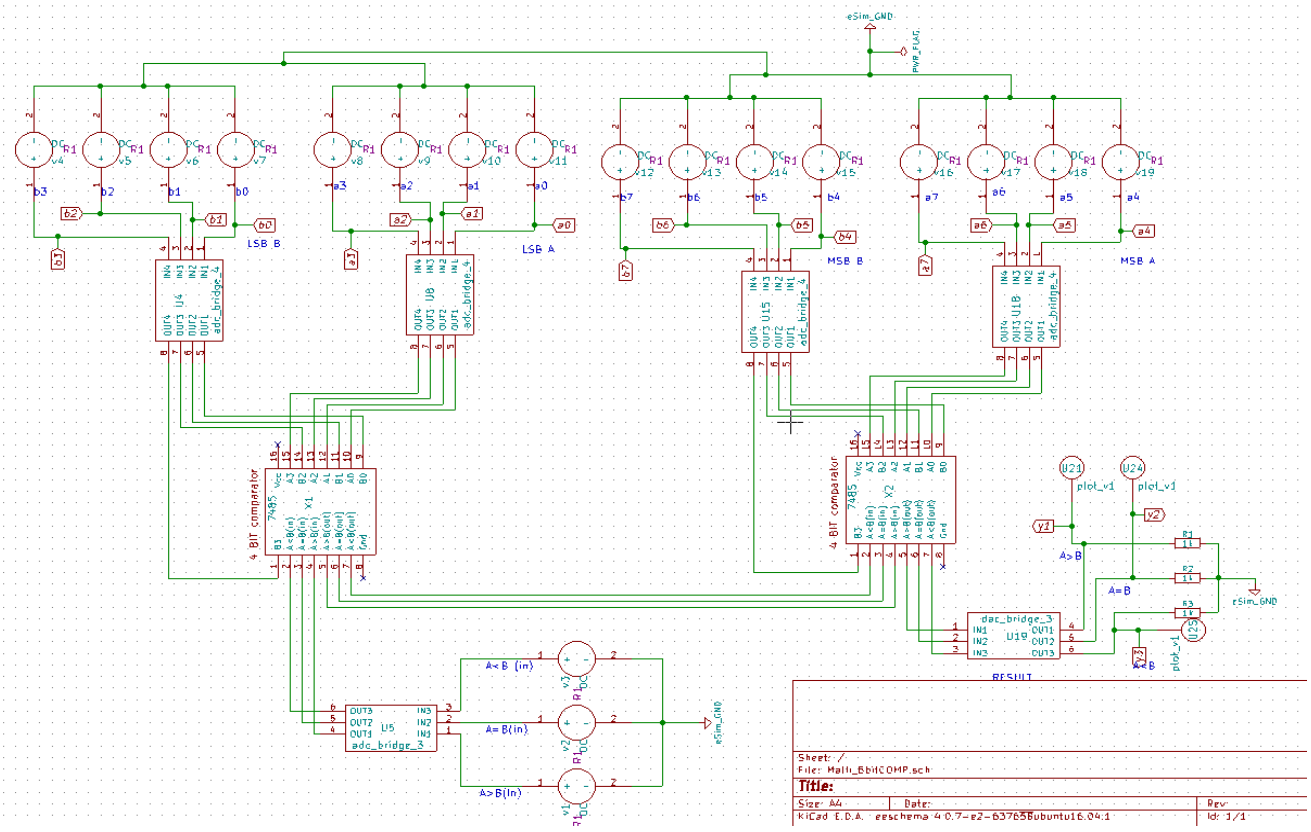
For proper compare operation, the Expander Inputs to the least significant position must be connected as follows: A>B(in)=’low’, A=B(in)=’high’, A<B(in)=’low’.

For serial (ripple) expansion, the A>B(out), A=B(out),A<B(out), Outputs are connected respectively to the A>B(in), A=B(in), A<B(in) Inputs of the next most significant comparator

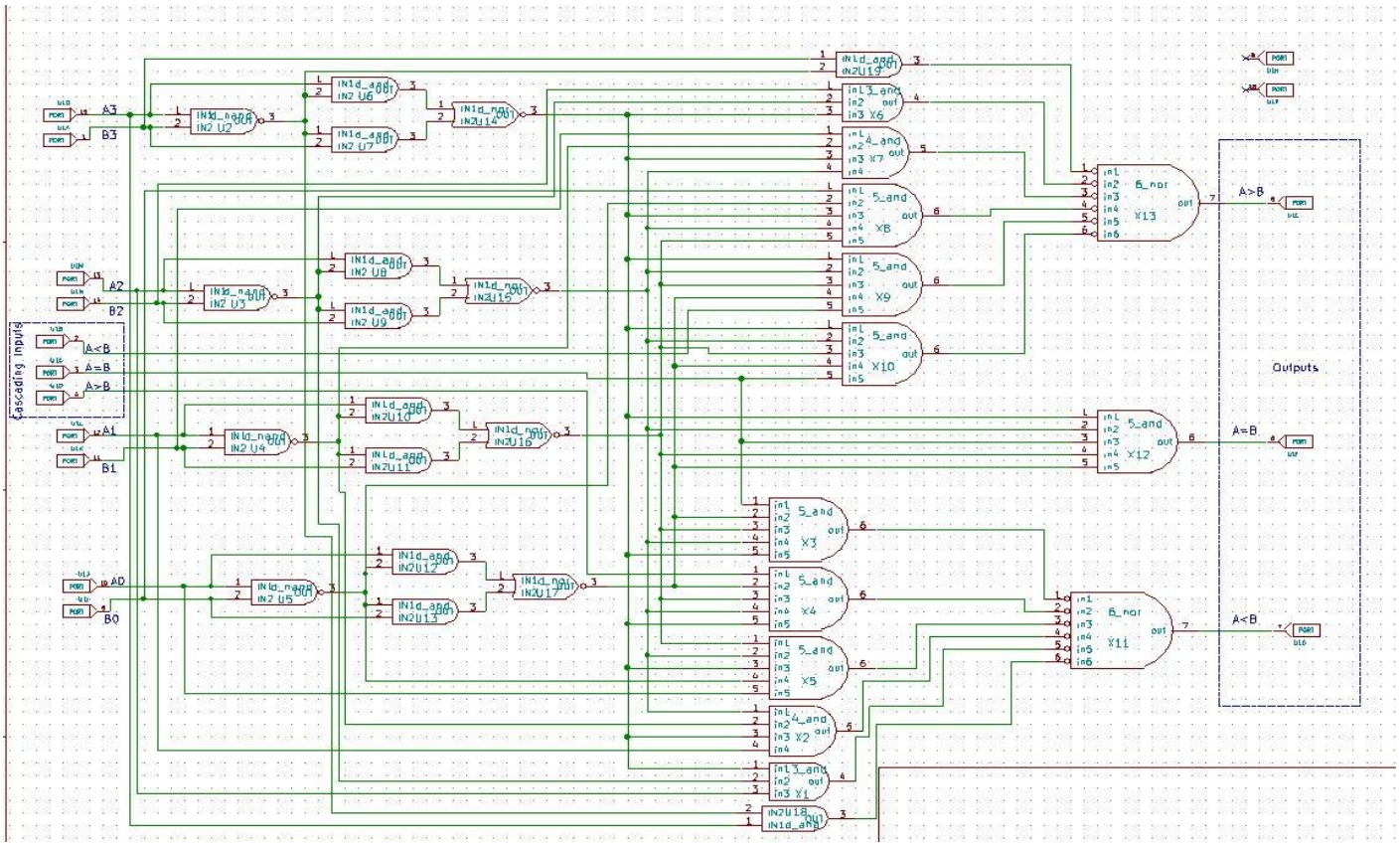
Table 10.1 Truth table of 7485

Comparing inputs						Cascading inputs			Outputs		
A_3, B_3	A_2, B_2	A_1, B_1	A_0, B_0	$A>B$	$A<B$	$A=B$	$A>B$	$A<B$	$A=B$
$A_3 > B_3$	×	×	×	×	×	×	1	0	0
$A_3 < B_3$	×	×	×	×	×	×	0	1	0
$A_3 = B_3$	$A_2 > B_2$	×	×	×	×	×	1	0	0
$A_3 = B_3$	$A_2 < B_2$	×	×	×	×	×	0	1	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 > B_1$	×	×	×	×	1	0	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 < B_1$	×	×	×	×	0	1	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 > B_0$	×	×	×	1	0	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 < B_0$	×	×	×	0	1	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 = B_0$	1	0	0	1	0	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 = B_0$	0	1	0	0	1	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 = B_0$	0	0	1	0	0	1
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 = B_0$	×	×	1	0	0	1
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 = B_0$	1	1	0	0	0	0
$A_3 = B_3$	$A_2 = B_2$	$A_1 = B_1$	$A_0 = B_0$	0	0	0	1	1	0

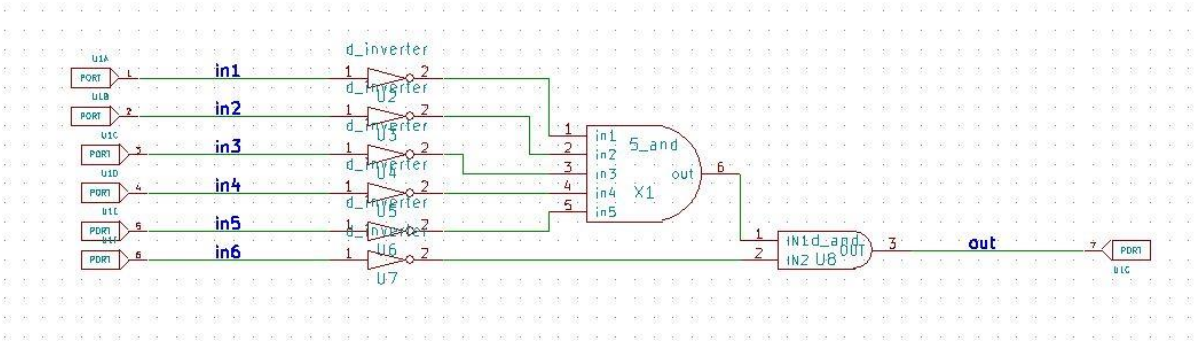
Schematic Diagram :-



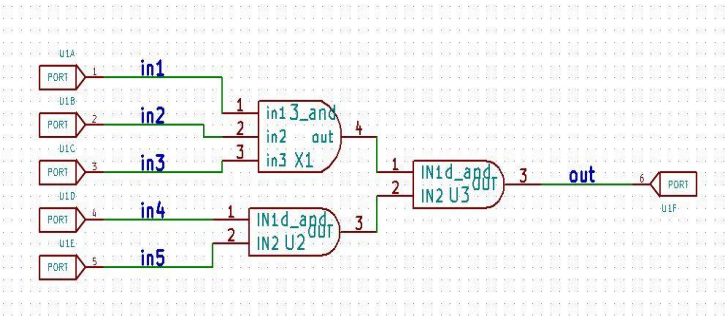
Subcircuit schematic for 7485 block :-



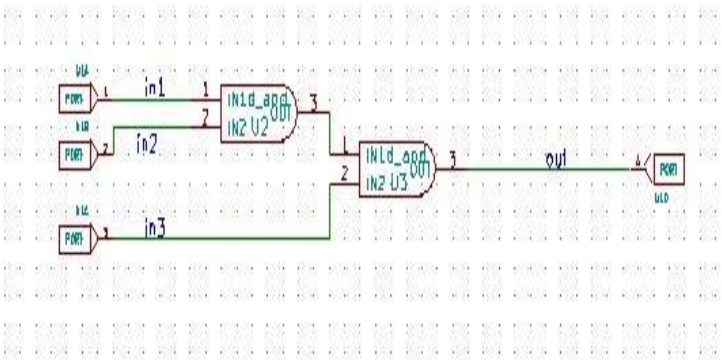
Subcircuit Schematic for “6_nor” used in 7485 :-



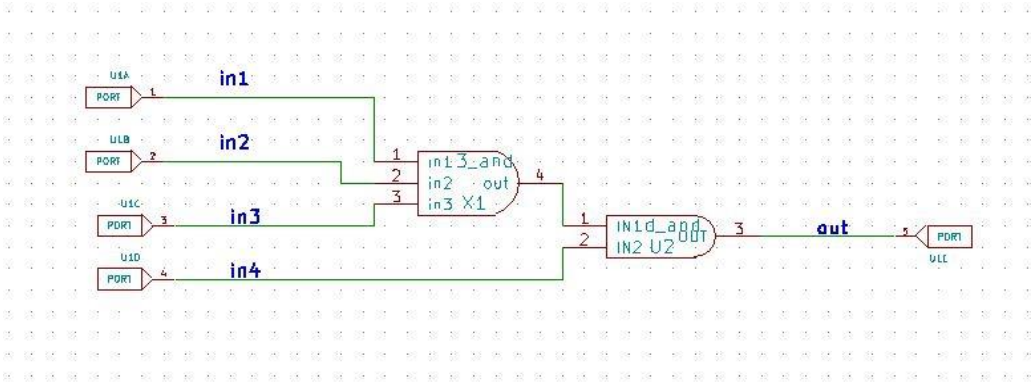
Subcircuit Schematic for “5_and” used :-



Subcircuit for “3_and”:-



Subcircuit Schematic for “4_and” used:-



NOTE :- Here in E-SIM software, no need to connect Vcc(pin 16) and GND (pin 8) pins to Dc source and gnd respectively , you can leave them unconnected using NO CONNECT symbol . This is because in circuit simulation softwares , we use BASIC GATES (AND, NAND etc.) they don’t need Vcc and GND. As in manufacturing an IC , they use MOSFETs to implement those GATES ,there MOSFETs require Vcc and Gnd

Simulation Results :-

Input:-

A[7 : 0] - 0 1 1 0 1 0 0 0

A	Bit	Voltage source	Value (v)
7	0	V16	0
6	1	V 17	5
5	1	V18	5
4	0	V19	0
3	1	V8	5
2	0	V9	0
1	0	V10	0
0	0	V11	0

B[7 : 0] - 1 0 0 1 0 0 0 0

B	Bit	Voltage source	Value (v)
7	1	V12	5
6	0	V 13	0
5	0	V14	0
4	1	V15	5
3	0	V4	0
2	0	V5	0
1	0	V6	0
0	0	V7	0

Output :-

Plot y1 corresponds to A>B

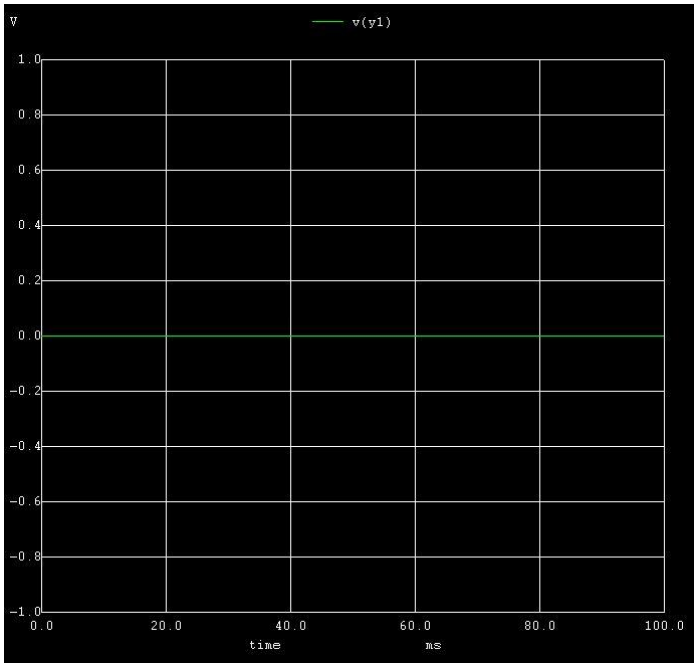
Plot y2 corresponds to A=B

Plot y3 corresponds to A<B

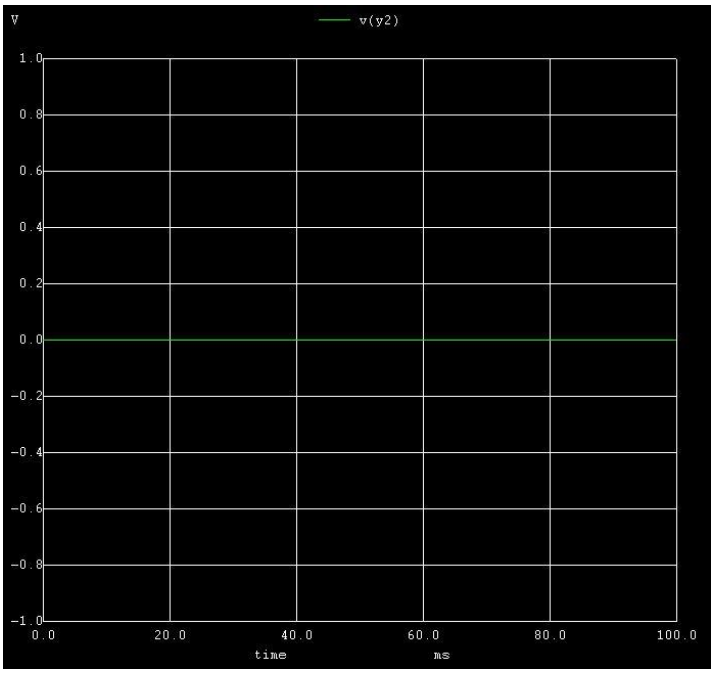
RESULT:- A<B i.e. y3 =5v

Ngspice Plots

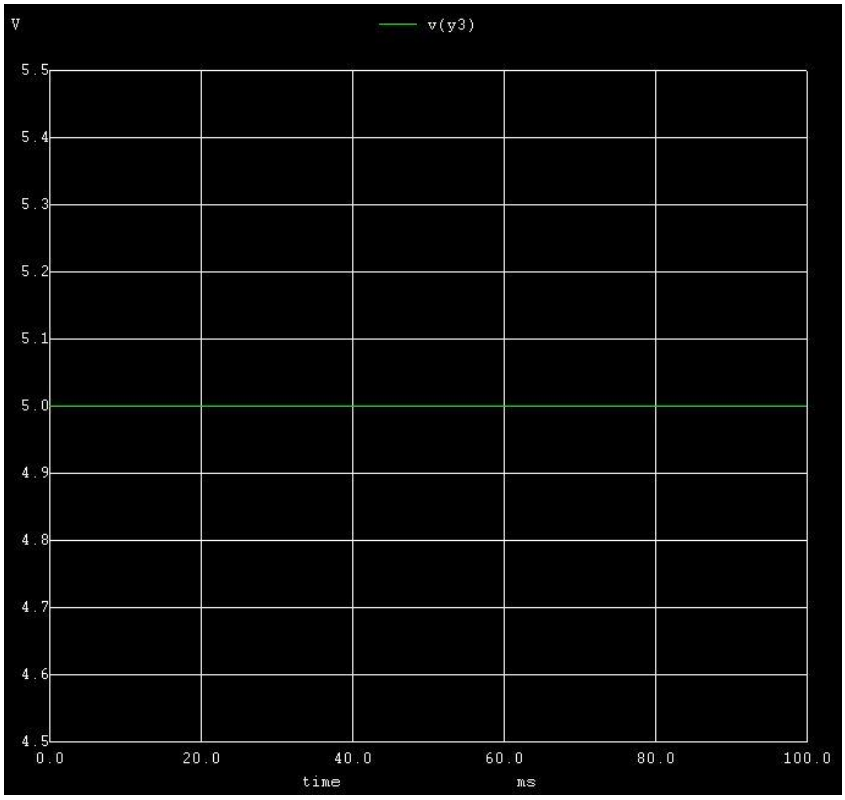
Y1 (A>B)



y2 (A=B)

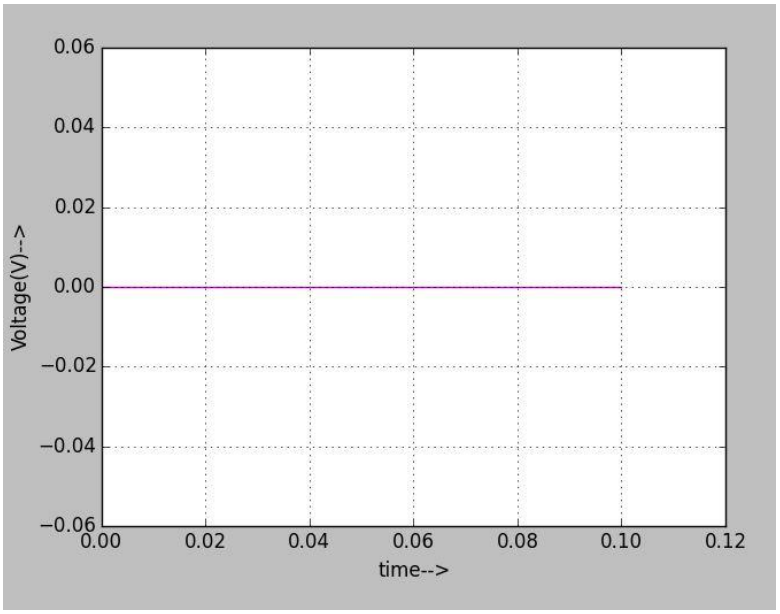


Y3 (A<B)

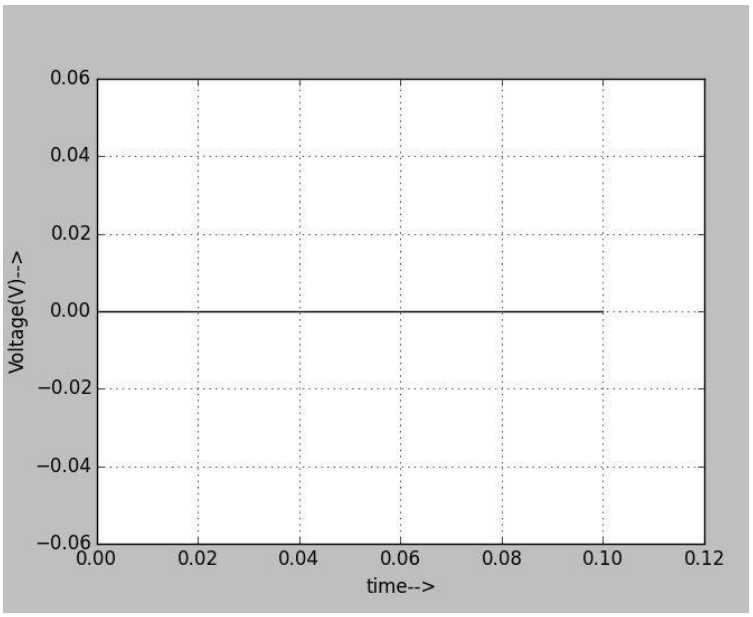


Python Plots

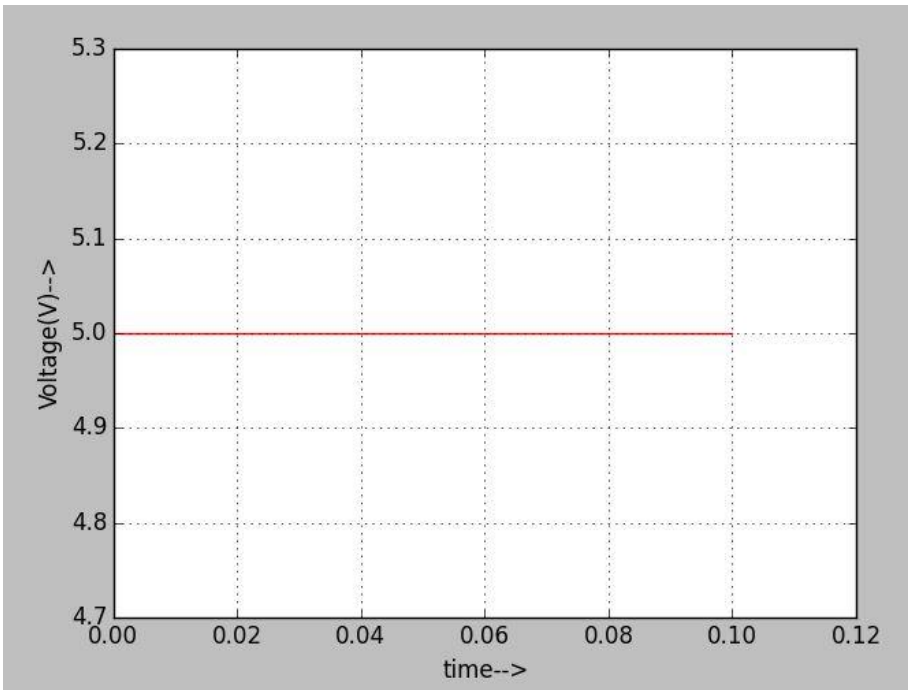
Y1 (A>B)



y2 (A=B)



Y3 (A<B)



fwef

Input:-

A[7 : 0] - 1 0 0 0 1 1 0 1

A	Bit	Voltage source	Value (v)
7	1	V16	5
6	0	V 17	0
5	0	V18	0
4	0	V19	0
3	1	V8	5
2	1	V9	5
1	0	V10	0
0	1	V11	5

B[7 : 0] - 1 0 0 0 1 1 0 0

B	Bit	Voltage source	Value (v)
7	1	V12	5
6	0	V 13	0
5	0	V14	0
4	0	V15	0
3	1	V4	5
2	1	V5	5
1	0	V6	0
0	0	V7	0

Output :-

Plot y1 corresponds to A>B

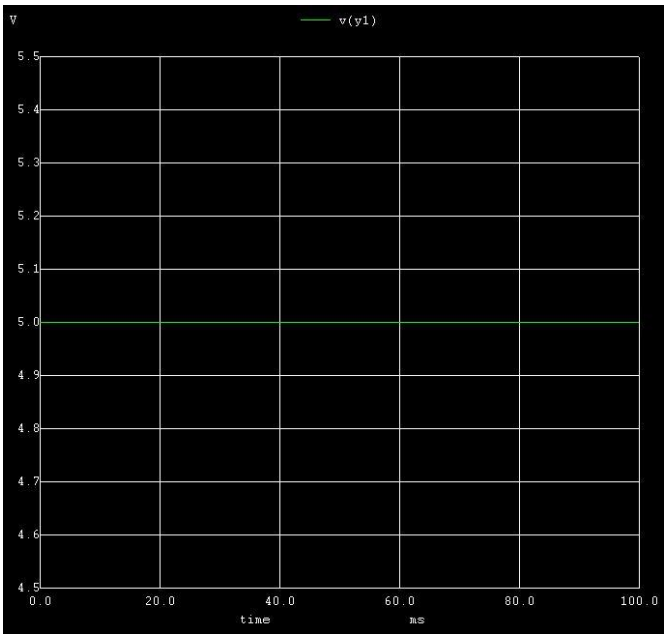
Plot y2 corresponds to A=B

Plot y3 corresponds to A<B

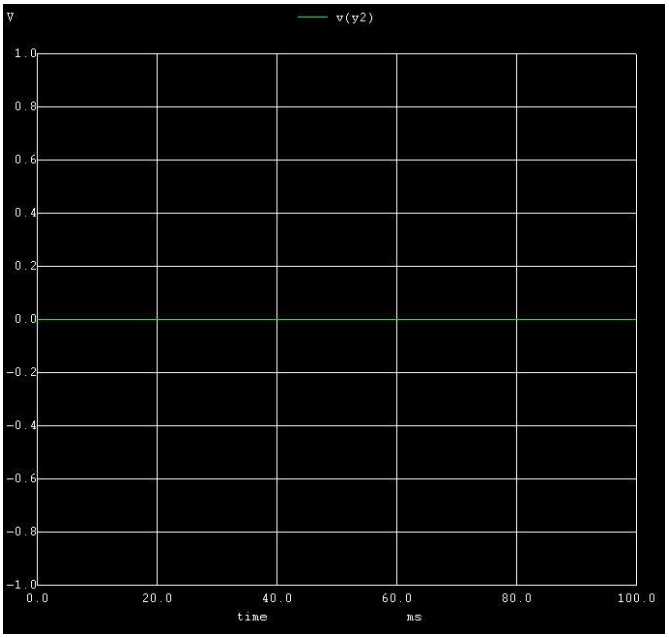
RESULT:- A>B i.e. y1 = 5v

Ngspice Plots

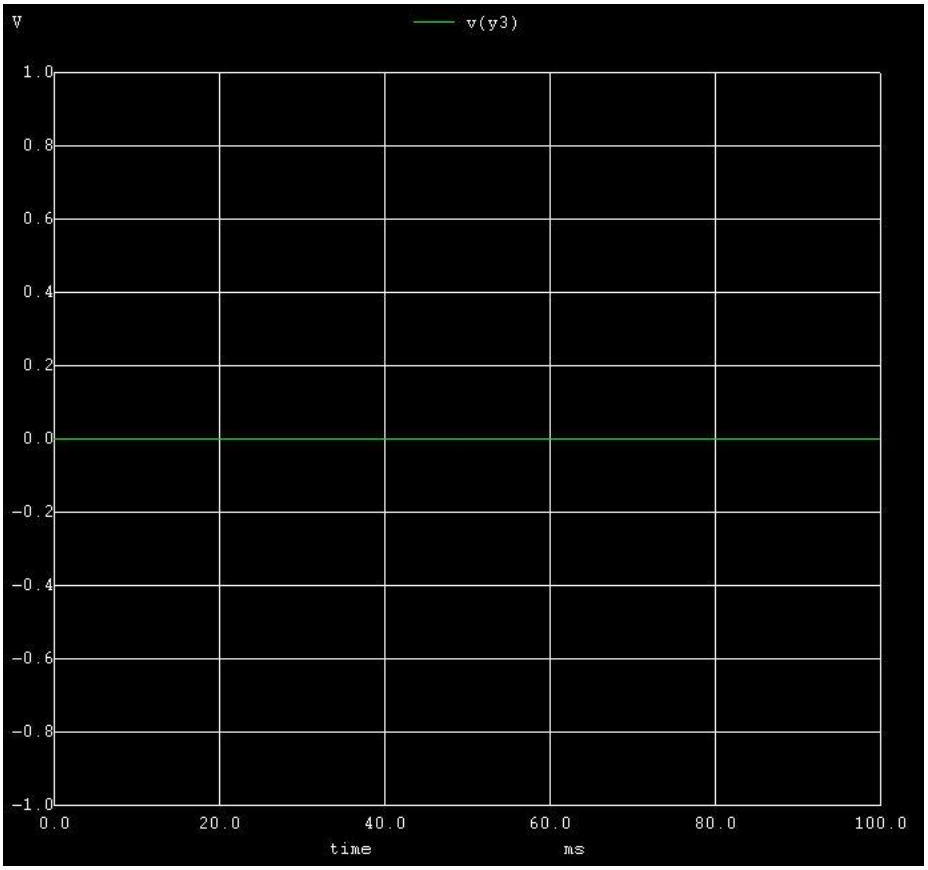
Y1 (A>B)



y2 (A=B)

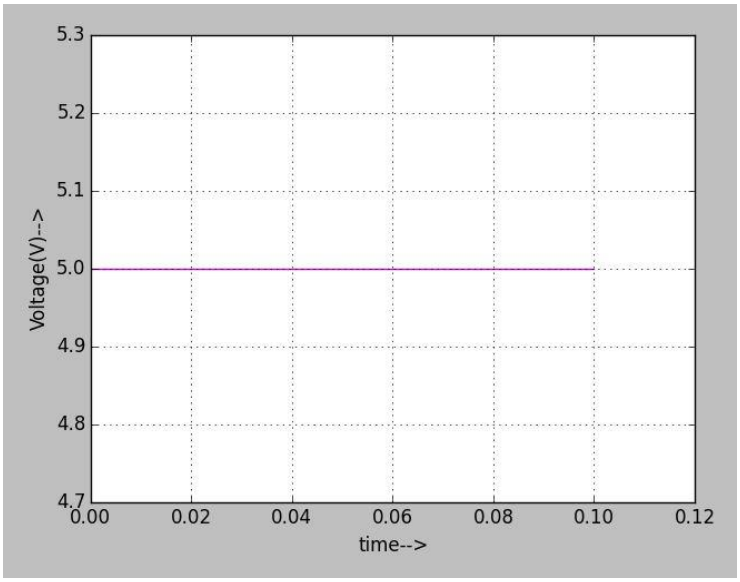


Y3 (A<B)

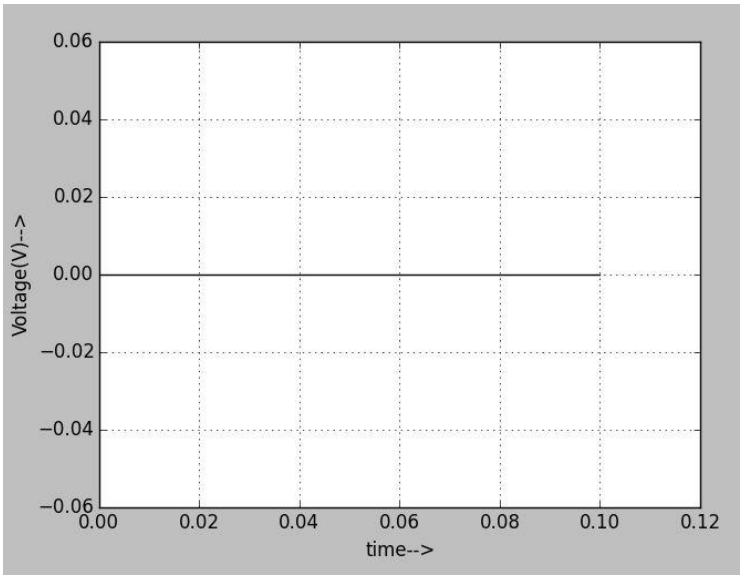


Python Plots

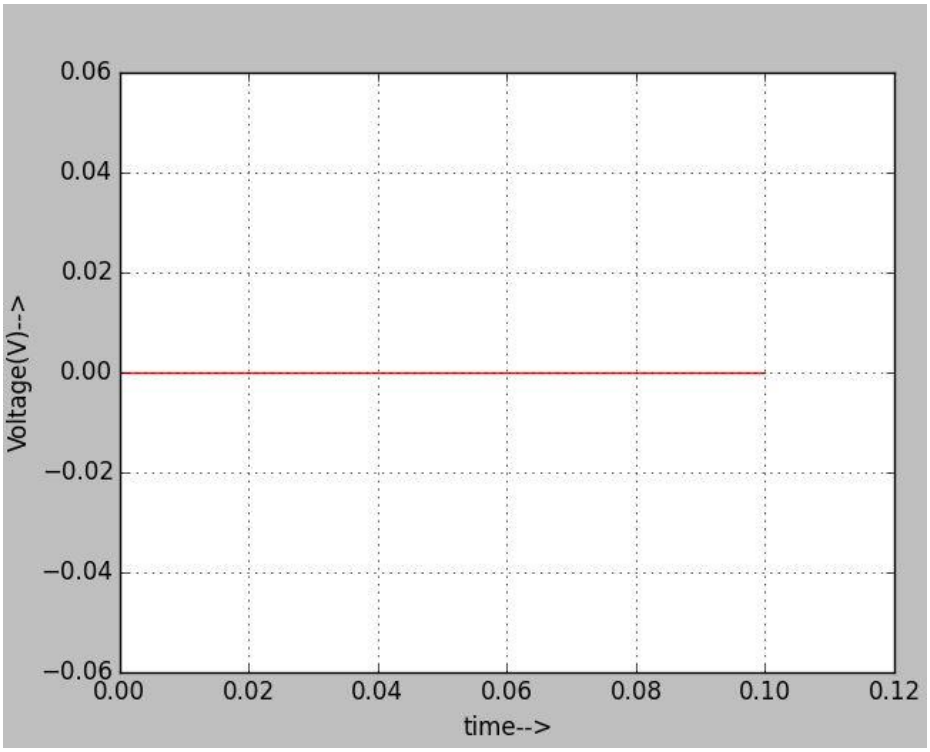
Y1 (A>B)



y2 (A=B)



Y3 (A<B)



Input:-

A[7 : 0] - 0 0 0 0 1 0 0 0

A	Bit	Voltage source	Value (v)
7	0	V16	0
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4	0	V19	0
3	1	V8	5
2	0	V9	0
1	0	V10	0
0	0	V11	0

B[7 : 0] - 0 0 0 0 1 0 0 0

B	Bit	Voltage source	Value (v)
7	0	V12	0
6	0	V 13	0
5	0	V14	0
4	0	V15	0
3	1	V4	5
2	0	V5	0
1	0	V6	0
0	0	V7	0

Output :-

Plot y1 corresponds to A>B

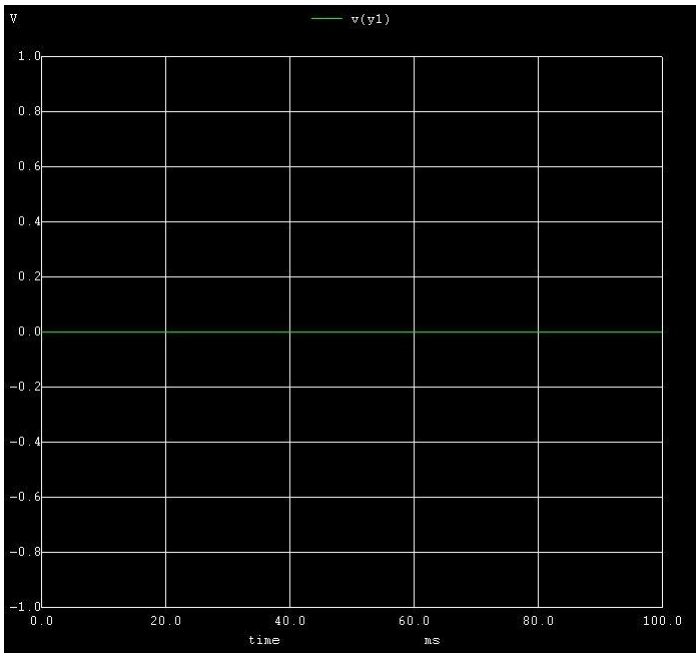
Plot y2 corresponds to A=B

Plot y3 corresponds to A<B

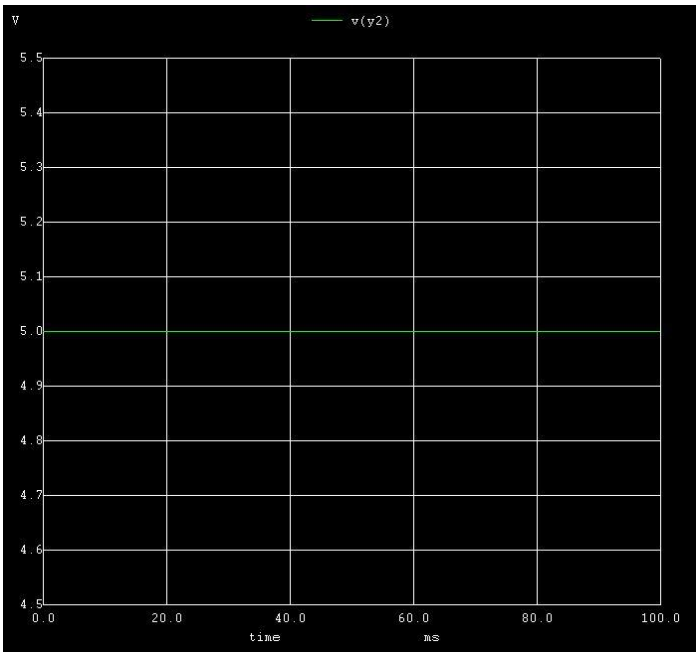
RESULT:- A=B i.e. y2 = 5v

Ngspice Plots

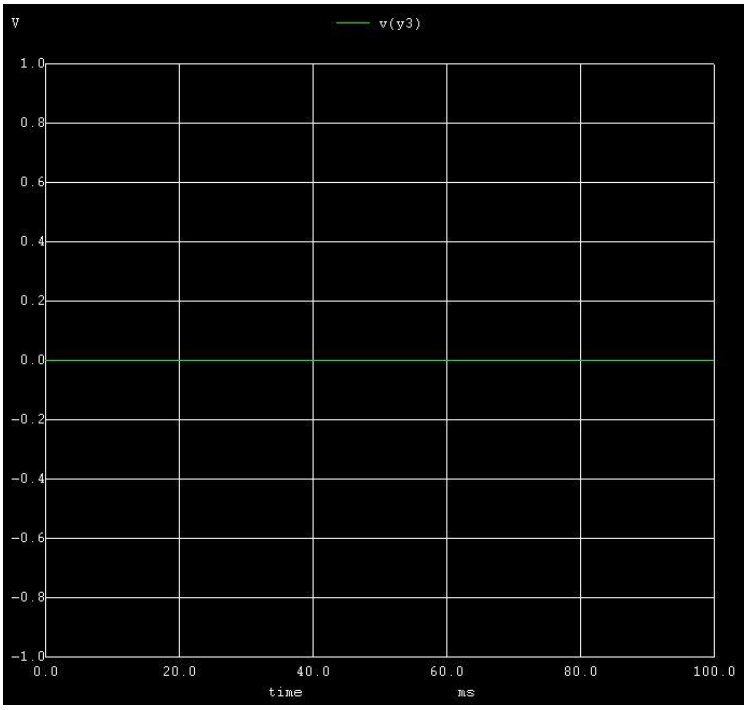
y1 (A>B)



y2 (A=B)

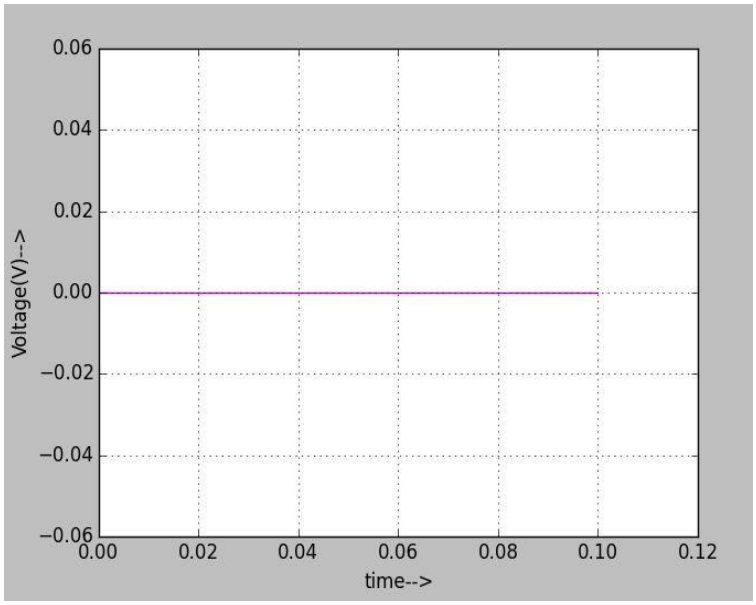


Y3 (A<B)

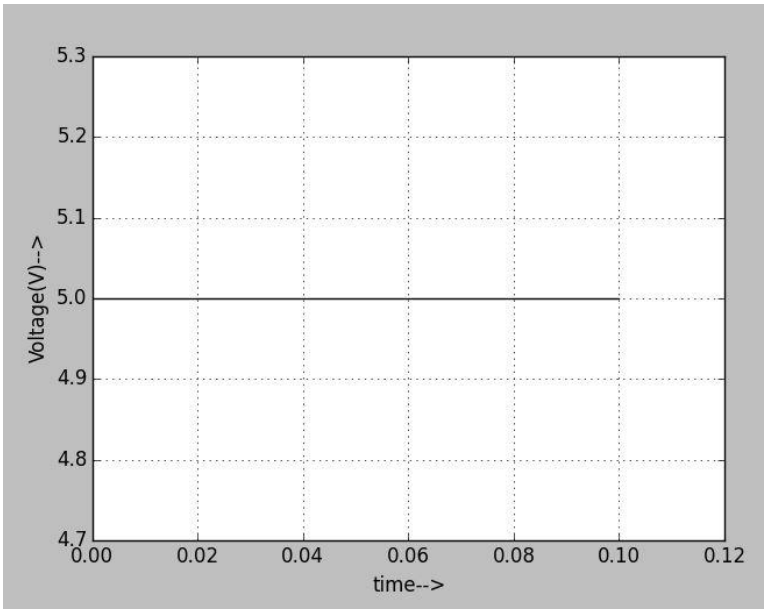


Python Plots

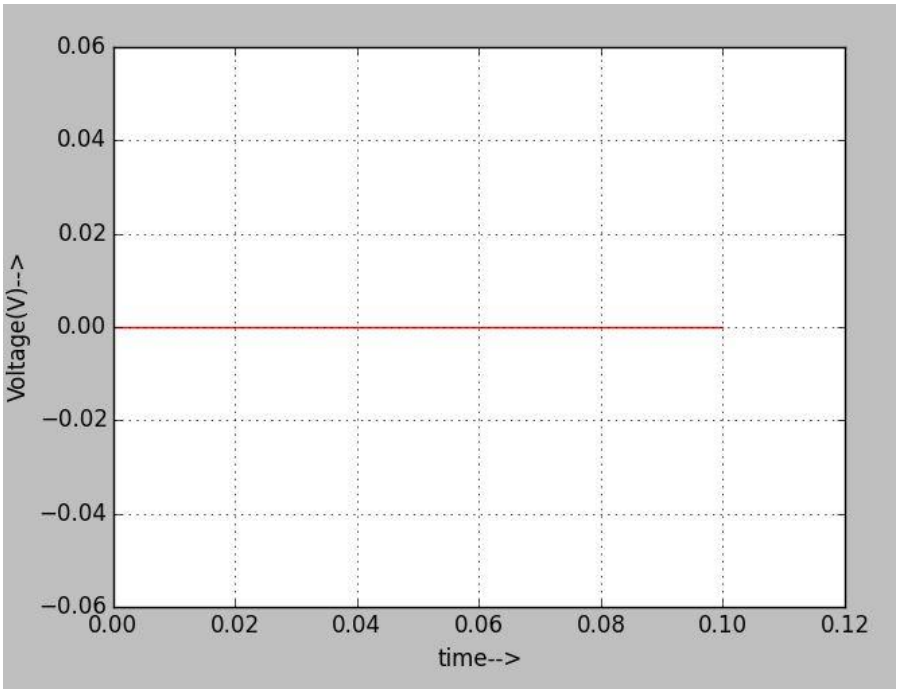
y1 (A>B)



y2 (A=B)



Y3 (A<B)



References:-

1) http://www.sycelectronica.com.ar/semiconductores/74LS85.pdf
2) https://www.youspice.com/spiceprojects/spice-simulation-projects/general-electronics-spice-simulation-projects/digital-basic-components-spice-simulation-projects/8-bit-comparator-with-two-4-bit-comparator-in-cascade/