

Circuit Simulation Project

<https://esim.fossee.in/circuit-simulation-project>

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Project Guide: Dr. MAHESWARI. R

Title of the Project: -

Design of Half adder using 2 x 4 decoder with enable

Theory/Description: -

Half adder is a combinational circuit that performs an arithmetic addition of two bits. Half adder takes two inputs and produces two outputs. It usually has two inputs A and B along with two outputs S (sum) and C (carry) be the two outputs.

For a half adder, if $A=0$, $B=0$ that is both the inputs applied are 0. Then both the outputs SUM and CARRY are 0. Among two inputs applied if anyone the input is 1 then the SUM will be 1 but the CARRY is 0. If both the inputs are 1 then the SUM will be equal to 0 and the CARRY will be equal to 1.

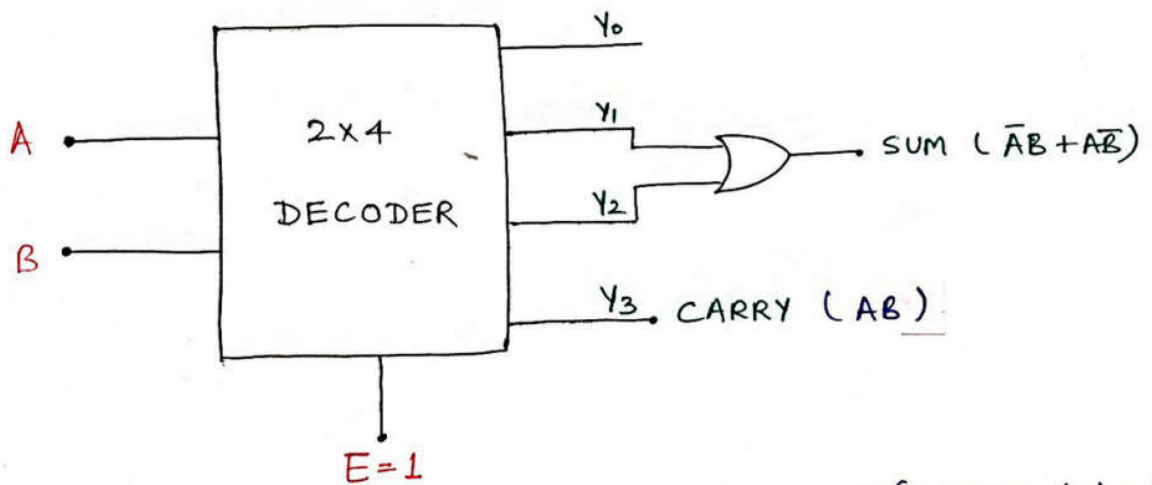
It is used in Calculators, computers, digital measuring devices etc. A half adder is used for adding together the two least significant digits in a binary sum. It can be implemented using only logic gates and also it can be done using 2x4 decoder with enable along with an or gate where the inputs will be three including the enable input E. The output will be same as a normal half adder made by logic gates whenever $E = 1$ and there won't be any output if $E = 0$.

Truth Table for Half adder circuit with enable input(of 2x4 decoder):

E	A	B	Sum	Carry
0	X	X	0	0
1	0	0	0	0
1	0	1	1	0
1	1	0	1	0
1	1	1	0	1

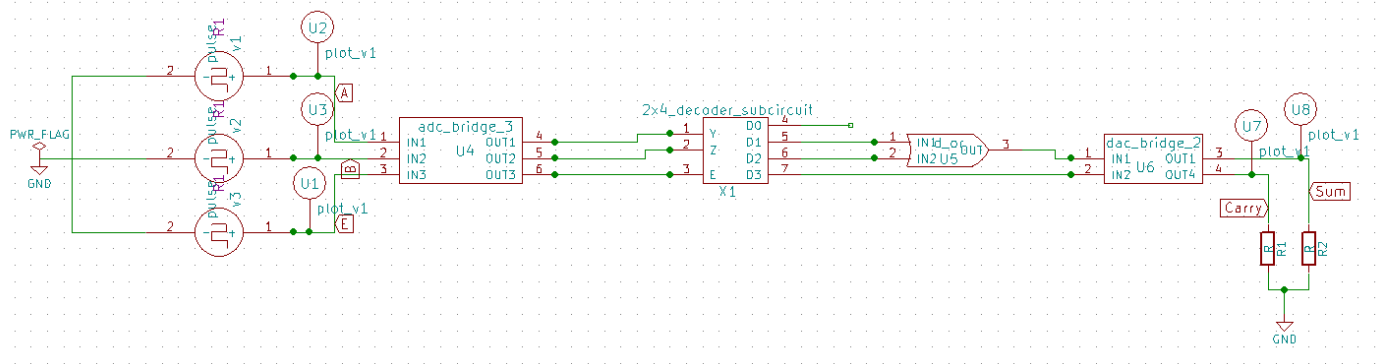
Here, E, A, B are inputs and Sum, Carry are outputs.

Circuit for Half Adder using 2 x 4 decoder with enable:

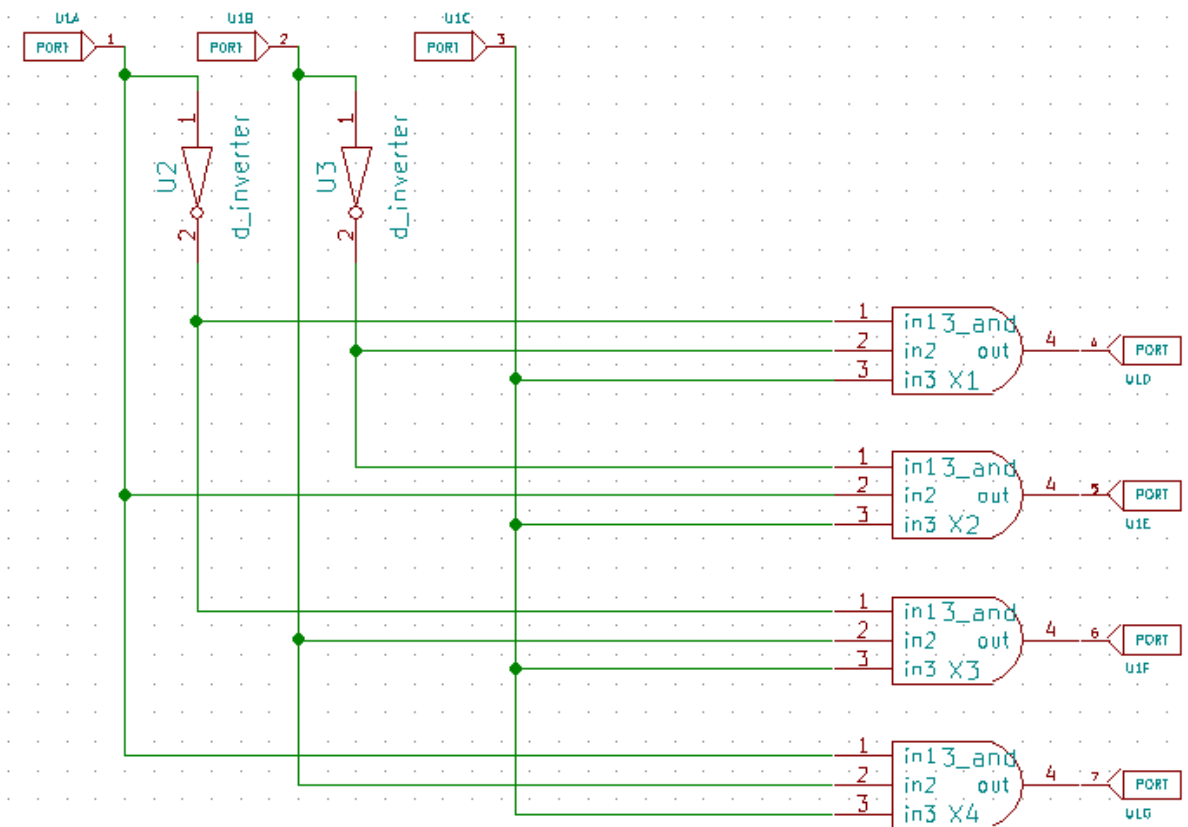


Schematic Diagram:

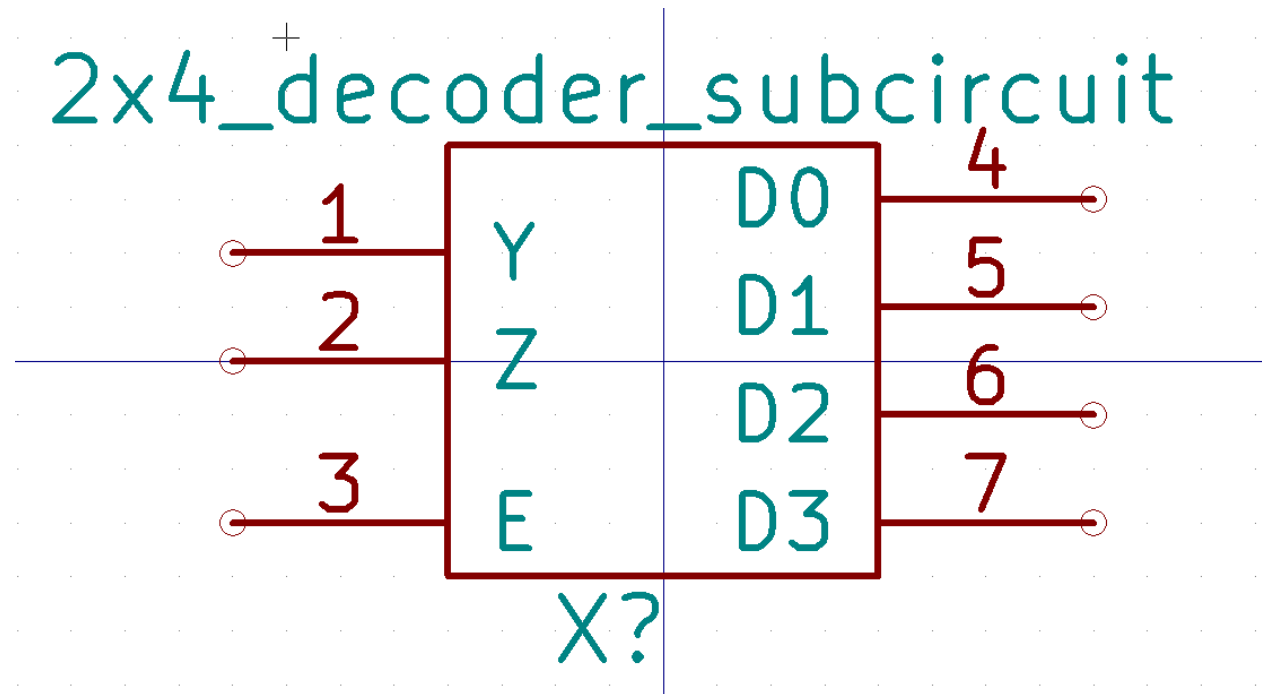
The circuit schematic for Half Adder using 2 x 4 decoder with enable in eSim is as shown below:



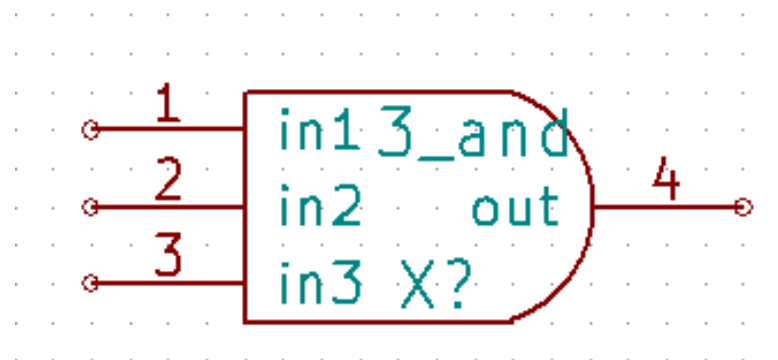
The Schematic for 2 x 4 decoder in eSim which is used as an sub-circuit is as shown below:



The Symbol for 2 x 4 decoder in eSim is as shown below:



The Symbol for 3 input and gate which is already present in eSim is as shown below:



Source details:

kicadToNgspice-2

Analysis Source Details NgSpice Model Device Modeling Subcircuits

Add parameters for pulse source v1

Enter initial value(Volts/Amps):	0
Enter pulsed value(Volts/Amps):	5
Enter delay time (seconds):	5
Enter rise time (seconds):	0
Enter fall time (seconds):	0
Enter pulse width (seconds):	5
Enter period (seconds):	10

Analysis Source Details NgSpice Model Device Modeling Subcircuits

Add parameters for pulse source v2

Enter initial value(Volts/Amps):	0
Enter pulsed value(Volts/Amps):	5
Enter delay time (seconds):	10
Enter rise time (seconds):	0
Enter fall time (seconds):	0
Enter pulse width (seconds):	10
Enter period (seconds):	20

Add parameters for pulse source v3

Enter initial value(Volts/Amps):	0
Enter pulsed value(Volts/Amps):	5
Enter delay time (seconds):	20
Enter rise time (seconds):	0
Enter fall time (seconds):	0
Enter pulse width (seconds):	20
Enter period (seconds):	40

Analysis:

Transient Analysis

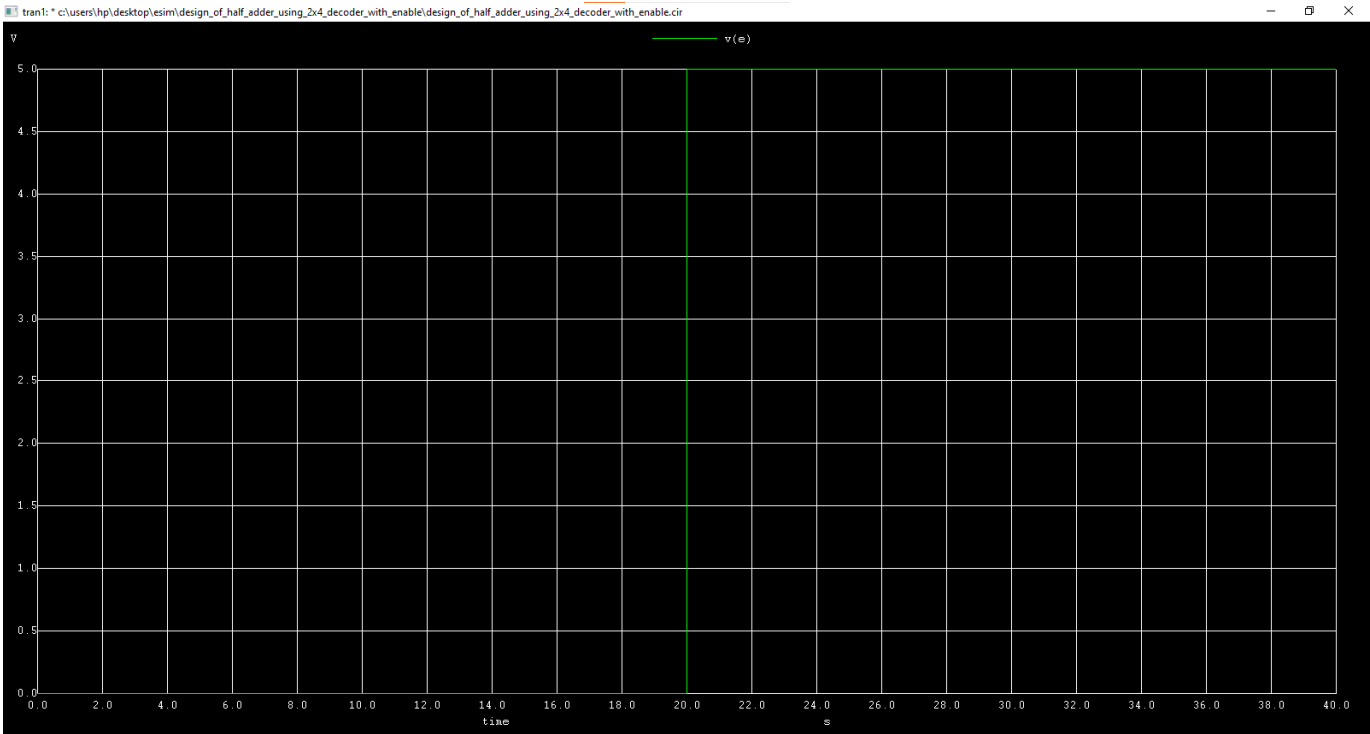
Start Time	0	Sec
Step Time	10	ms
Stop Time	40	Sec

Simulation Results :

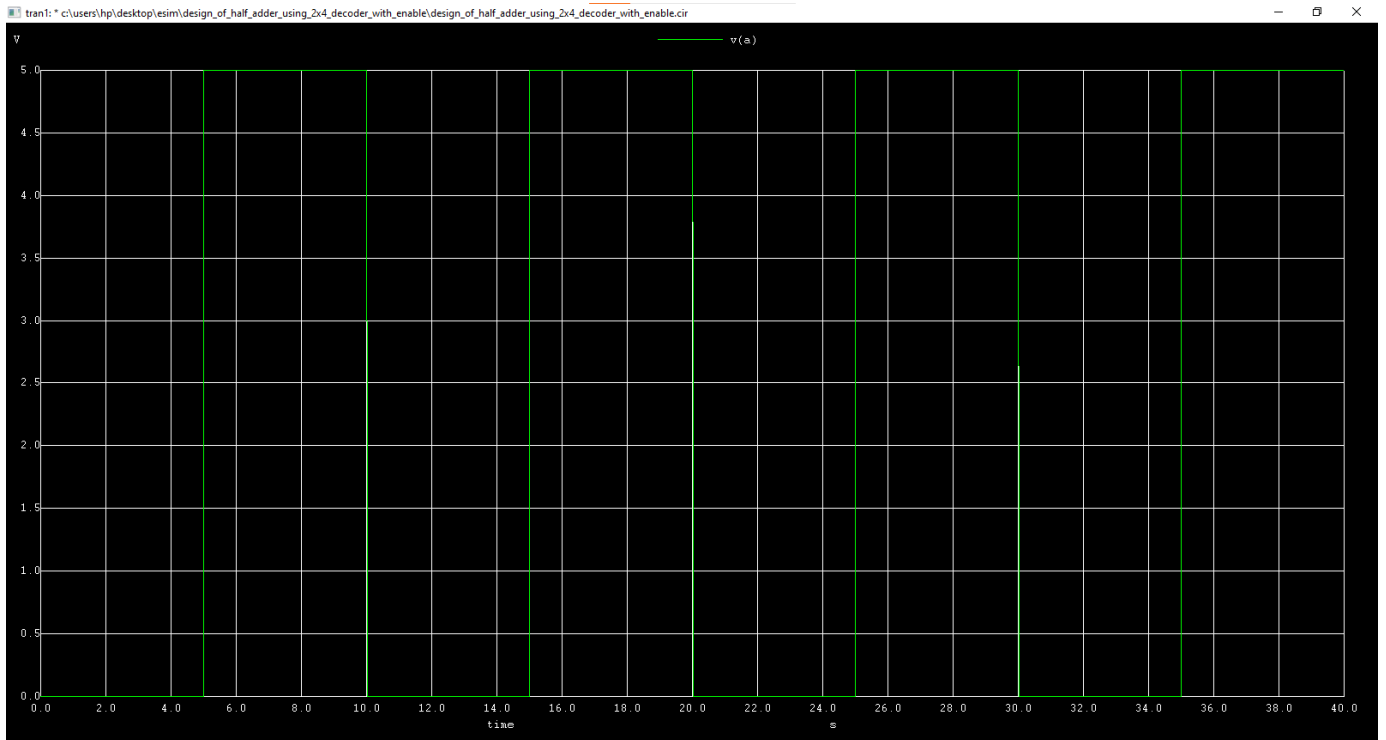
1) Ngspice plots:

Input waveforms:

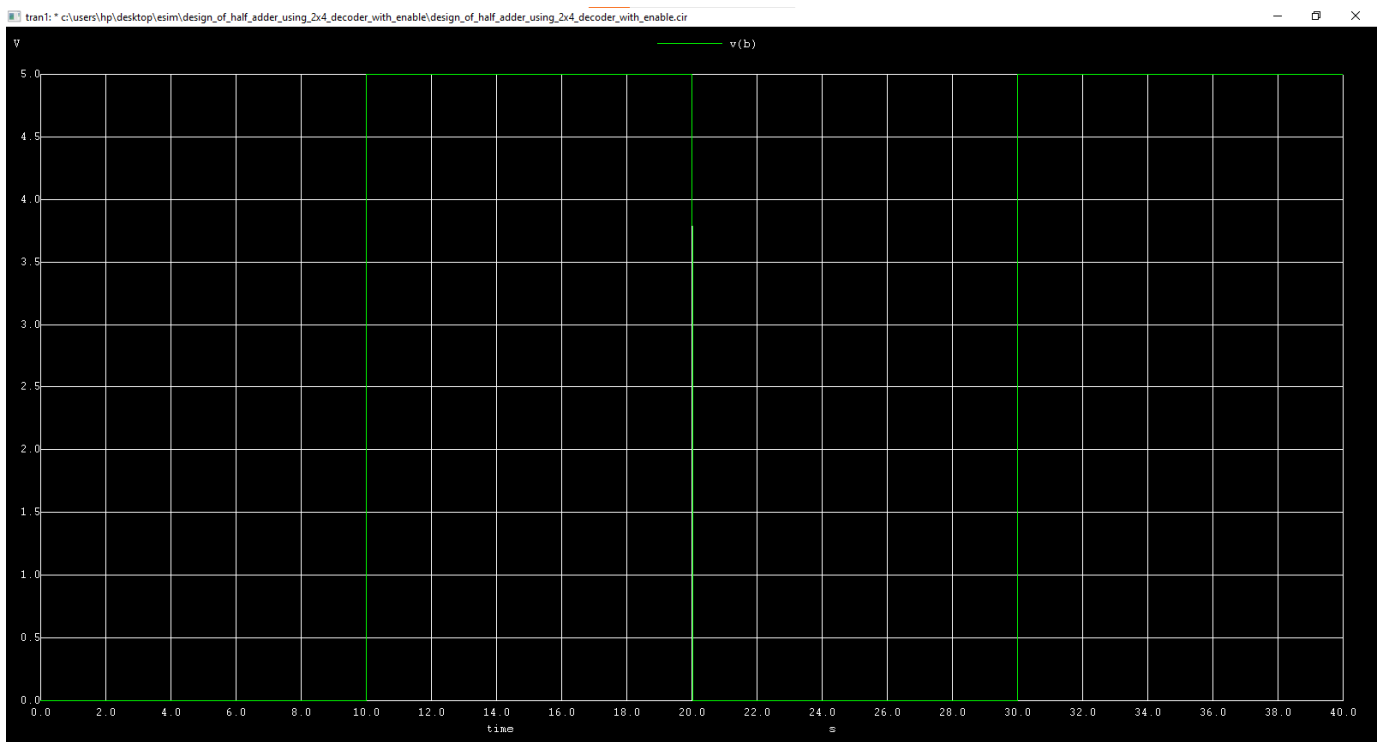
E:



A:

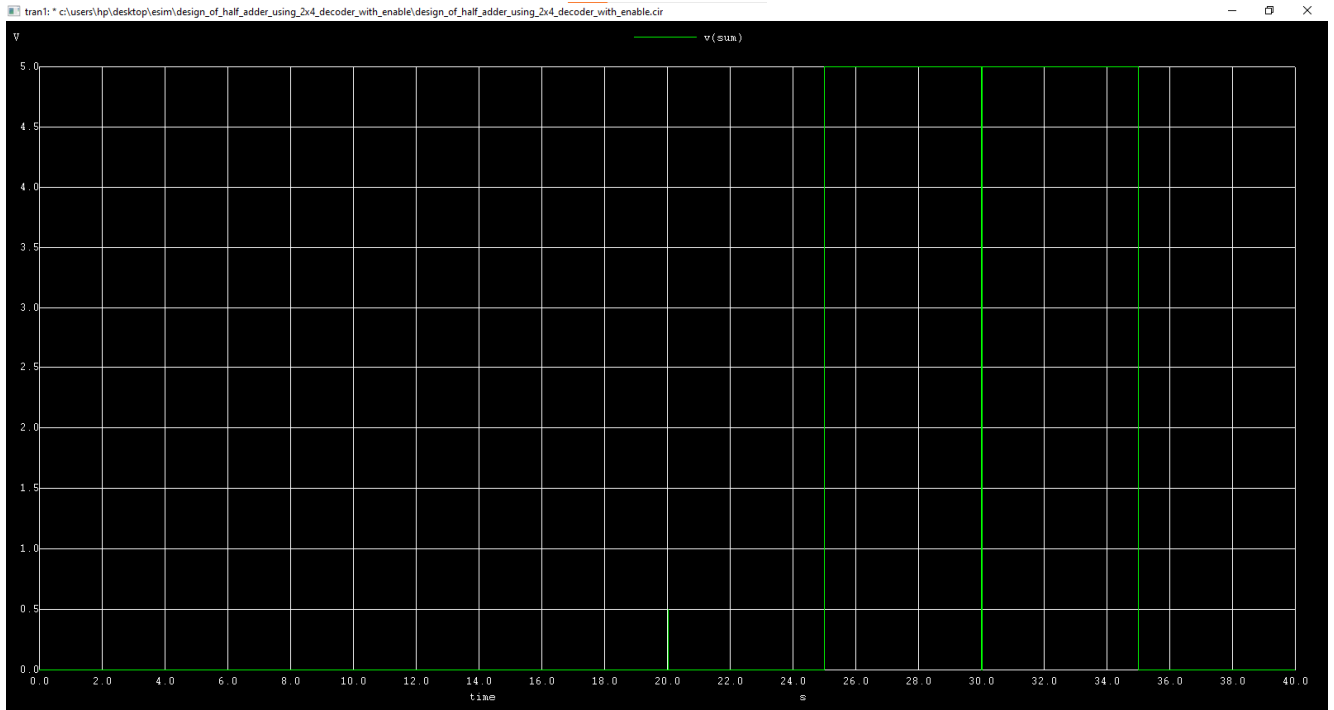


B:

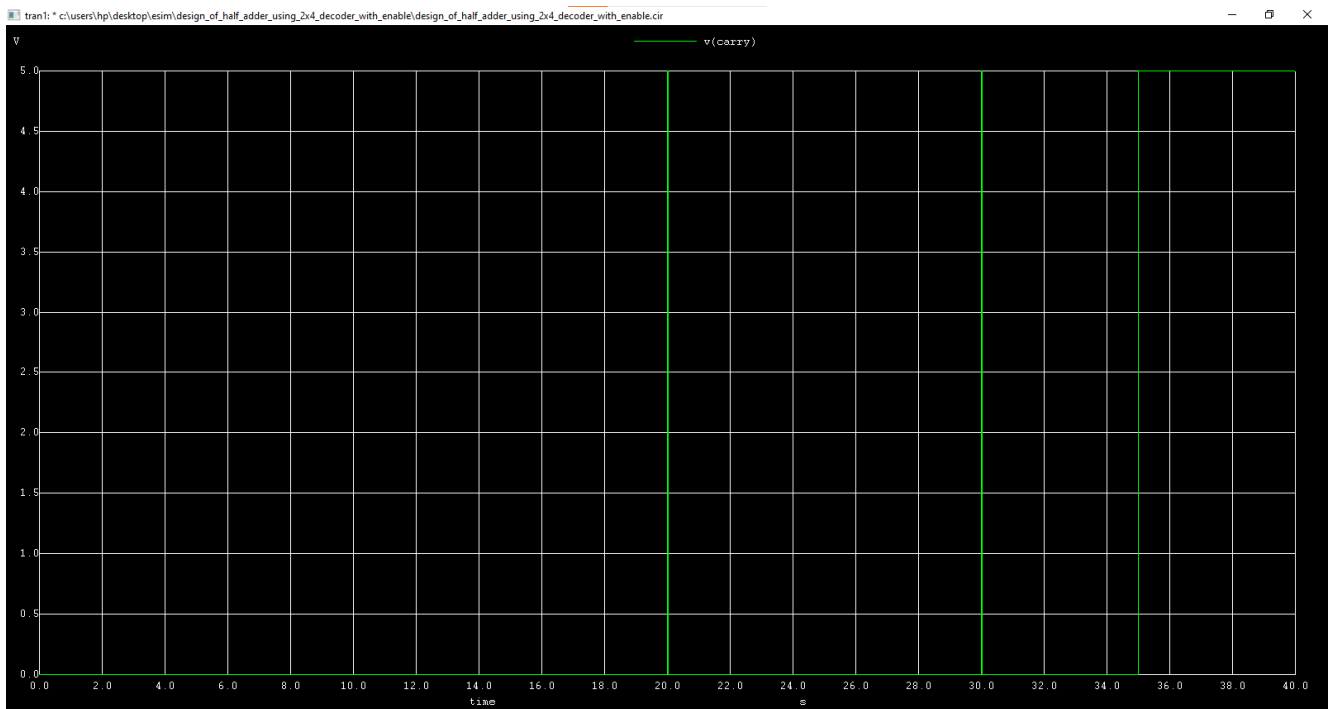


Output Waveforms:

Sum:



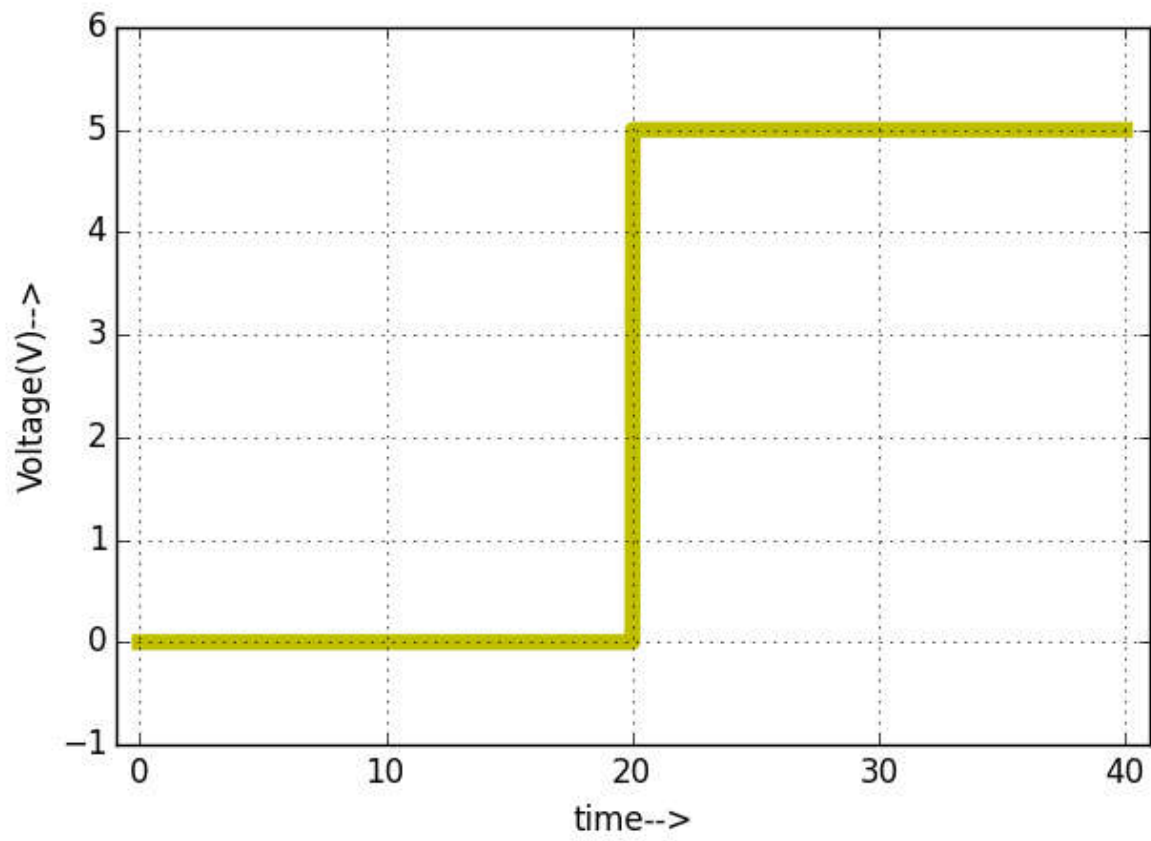
Carry:



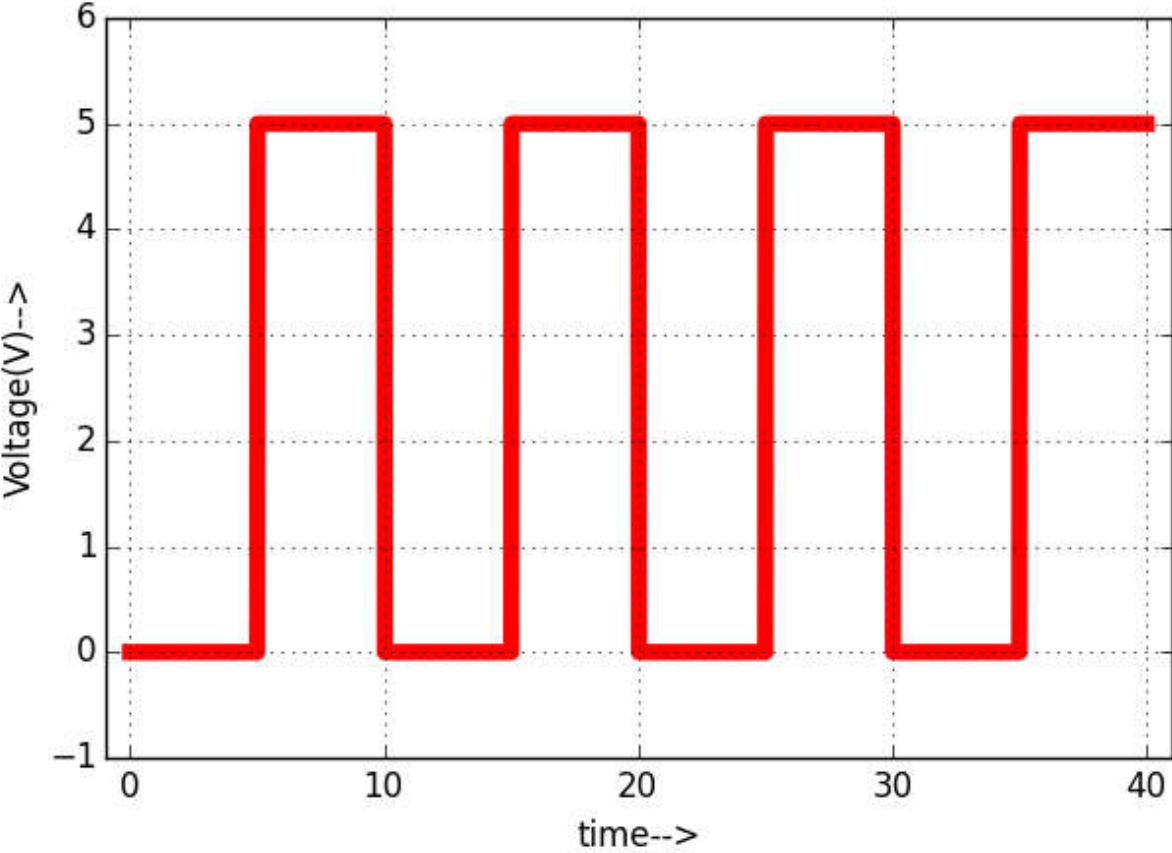
2) Python plots:

Input waveforms:

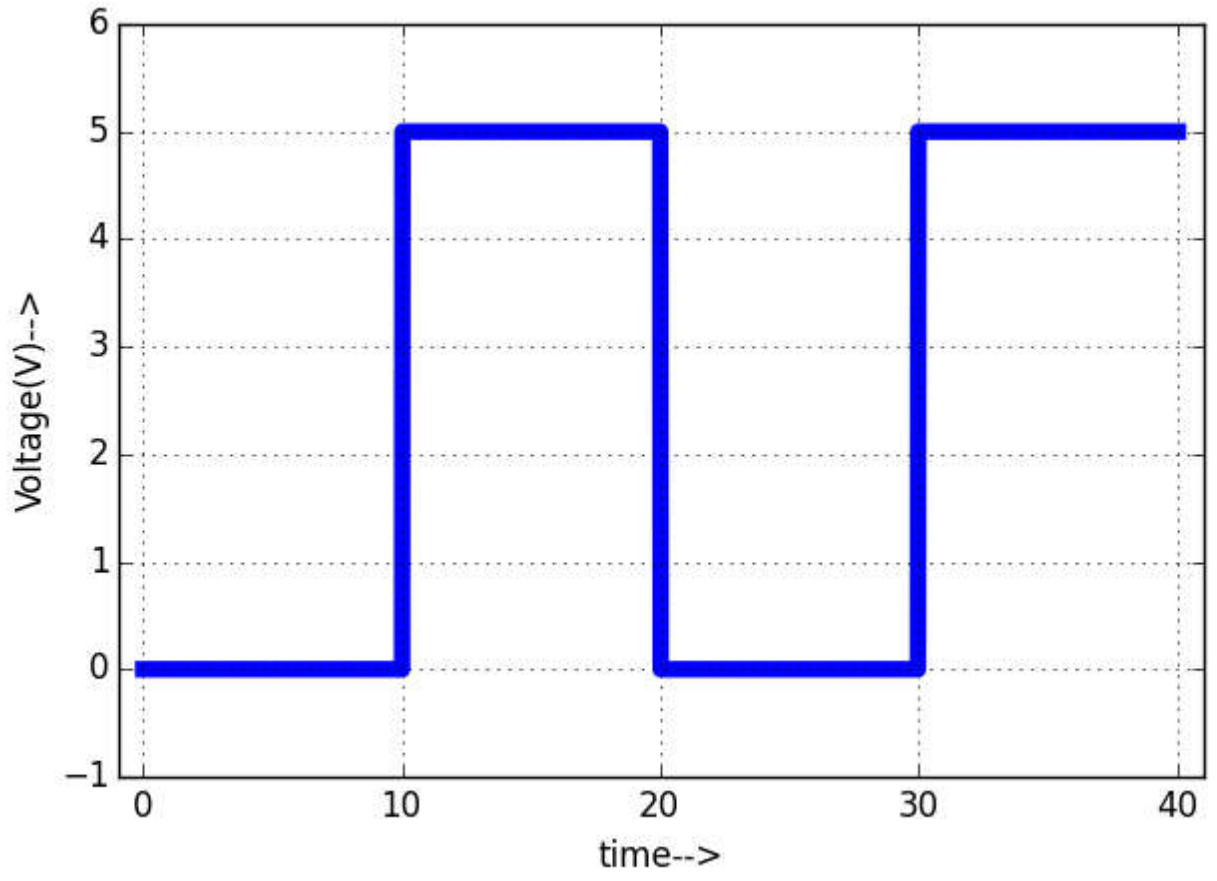
E:



A:

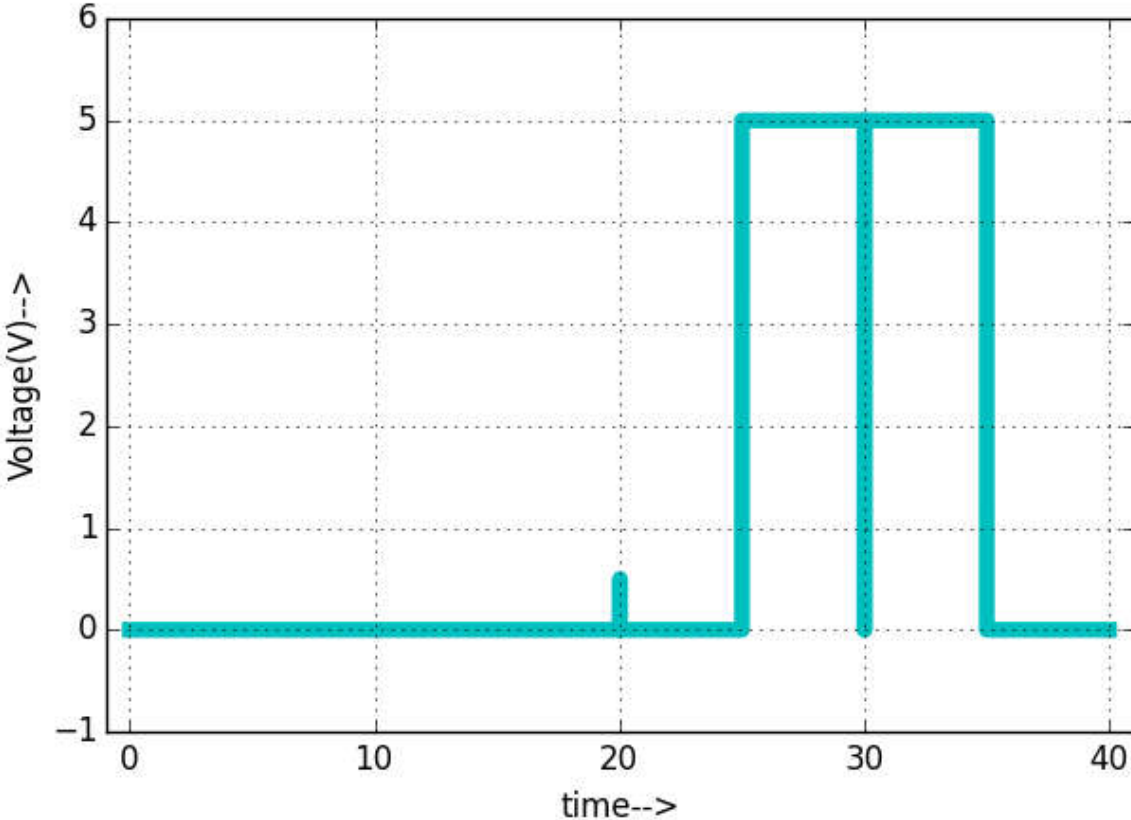


B:

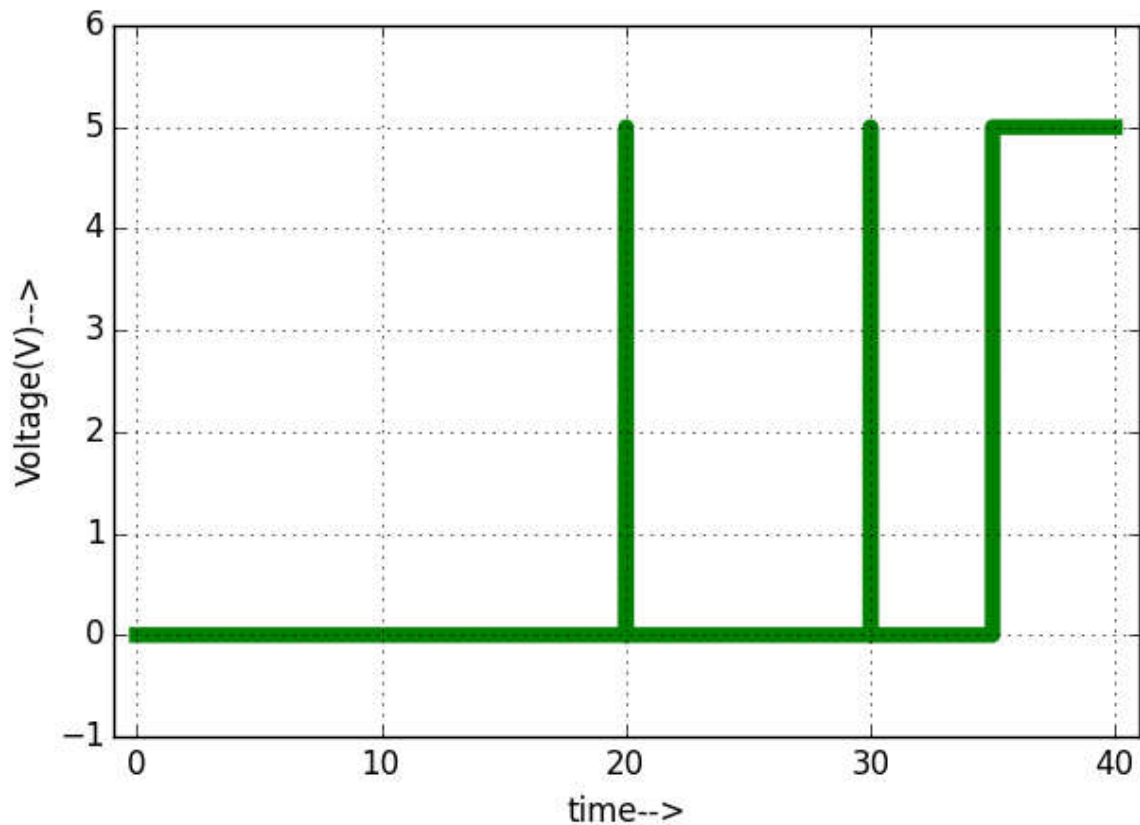


Output waveforms:

Sum:



Carry:



Conclusion:

Thus, we have studied the design of half adder using 2 x 4 decoder with enable using eSim and we get the appropriate waveforms.

References:

- <https://slaystudy.com/half-adder/>
- <https://player.uacdn.net/lesson-raw/J1W72U4SUDR5CQGDQTDK/pdf/9695656515.pdf>