CIRCUIT SIMULATION PROJECT

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

Name of the participant: Sam Meshach D

Project Guide: Dr. Maheswari. R

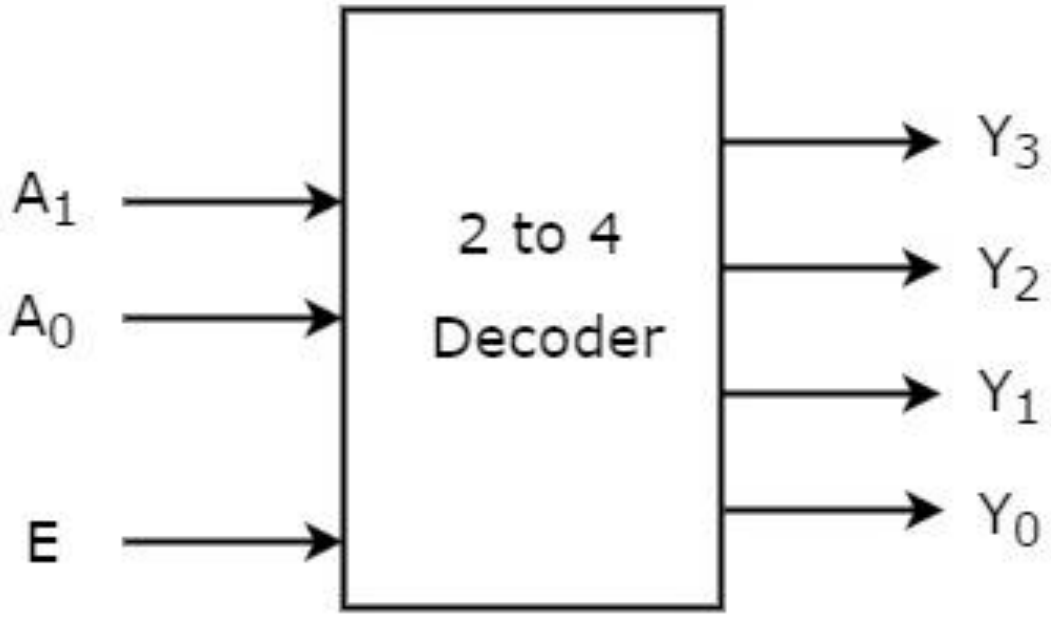
Title of the circuit:

2 TO 4 DECODER (WITH ENABLE)

THEORY/DESCRIPTION:

Decoder is a combinational circuit that has ‘n’ input lines and maximum of 2n output lines. One of these outputs will be active High based on the combination of inputs present, when the decoder is enabled. That means decoder detects a particular code. The outputs of the decoder are nothing but the min terms of ‘n’ input variables lines when it is enabled.

2 to 4 Decoder has two inputs A1 & A0 and four outputs Y3, Y2, Y1 & Y0. The block diagram of 2 to 4 decoder is shown in the following figure.



One of these four outputs will be ‘1’ for each combination of inputs when enable, E is ‘1’.

TRUTH TABLE OF 2 TO 4 DECODER (WITH ENABLE):

Enable	Inputs		Outputs			
E	**A_1**	**A_0**	**Y_3**	**Y_2**	**Y_1**	**Y_0**
0	x	x	0	0	0	0
1	0	0	0	0	0	1
1	0	1	0	0	1	0
1	1	0	0	1	0	0
1	1	1	1	0	0	0

From Truth table, we can write the Boolean functions for each output as

$$Y3=E.A1.\ A0$$

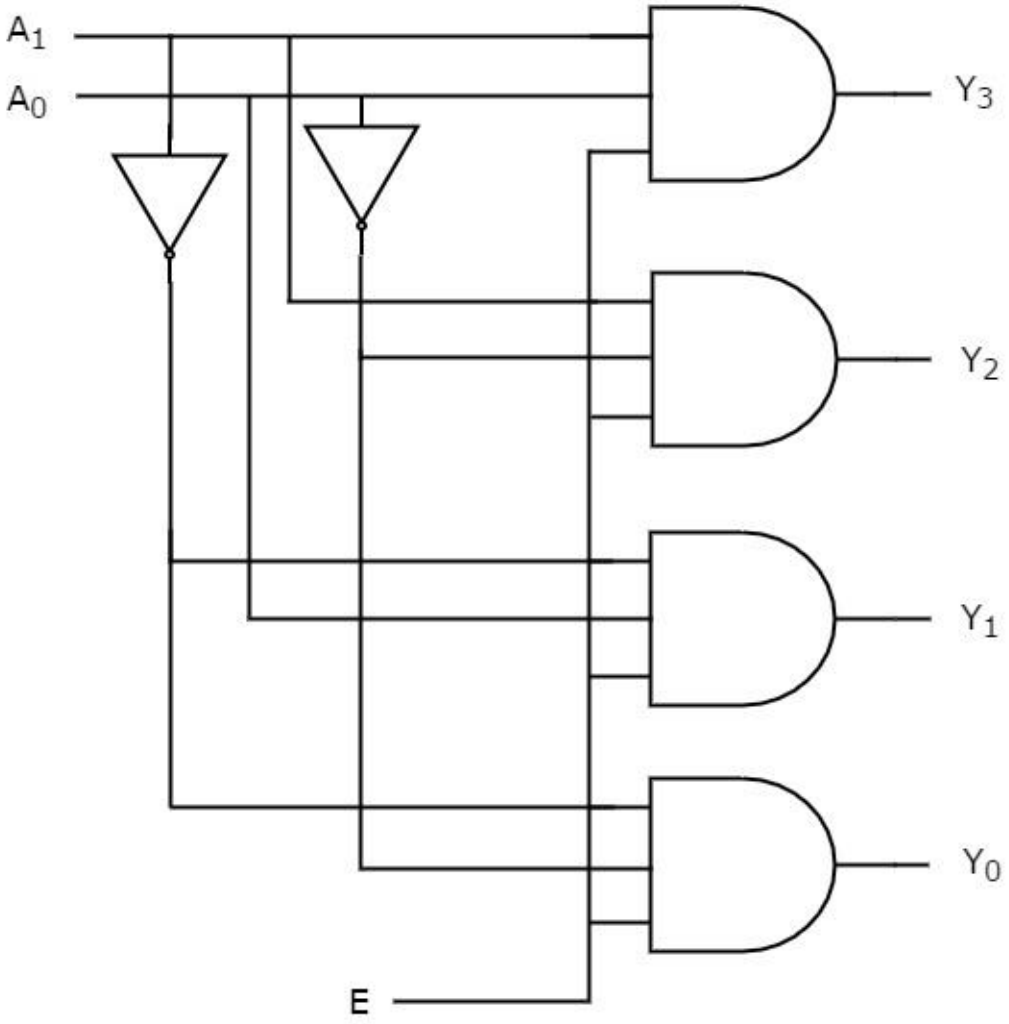
$$Y2=E.A1.\ A0'$$

$$Y1=E.A1'.\ A0$$

$$Y0=E.A1'.\ A0'$$

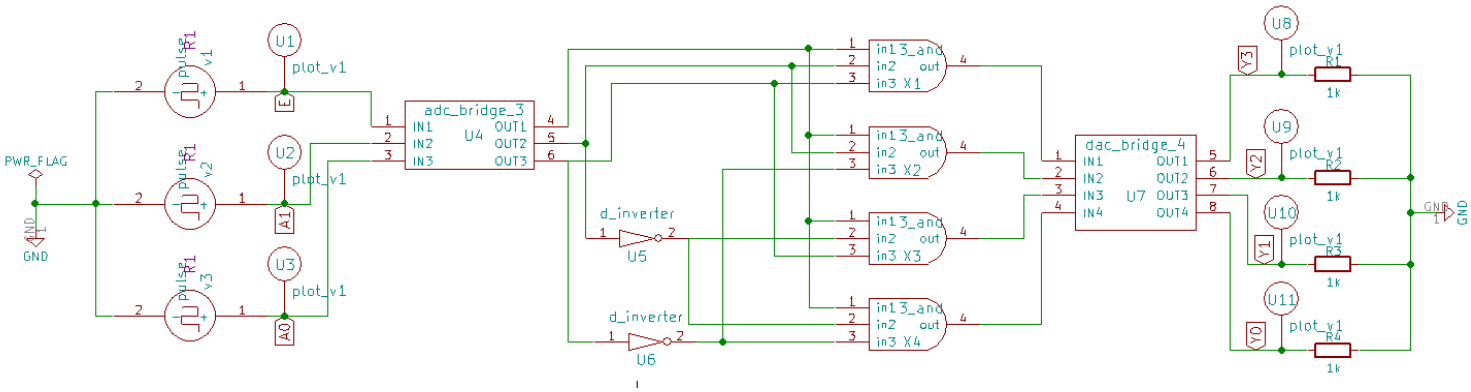
Each output is having one product term. So, there are four product terms in total. We can implement these four product terms by using four AND gates having three inputs each & two inverters.

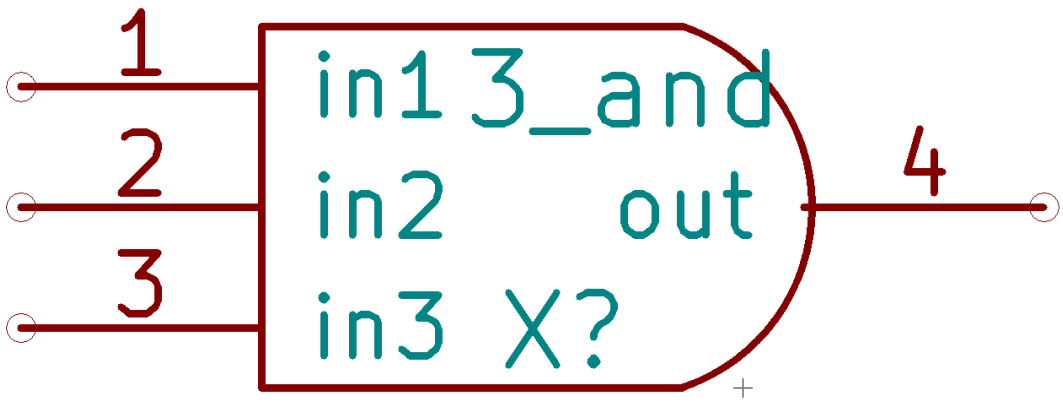
BASIC CIRCUIT DIAGRAM OF 2 TO 4 DECODER (WITH ENABLE):



Therefore, the outputs of 2 to 4 decoder are the min terms of two input variables A1 & A0, when enable, E is equal to one. If enable, E is zero, then all the outputs of decoder will be equal to zero.

ESIM CIRCUIT DIAGRAM FOR 2 TO 4 DECODER (WITH ENABLE):



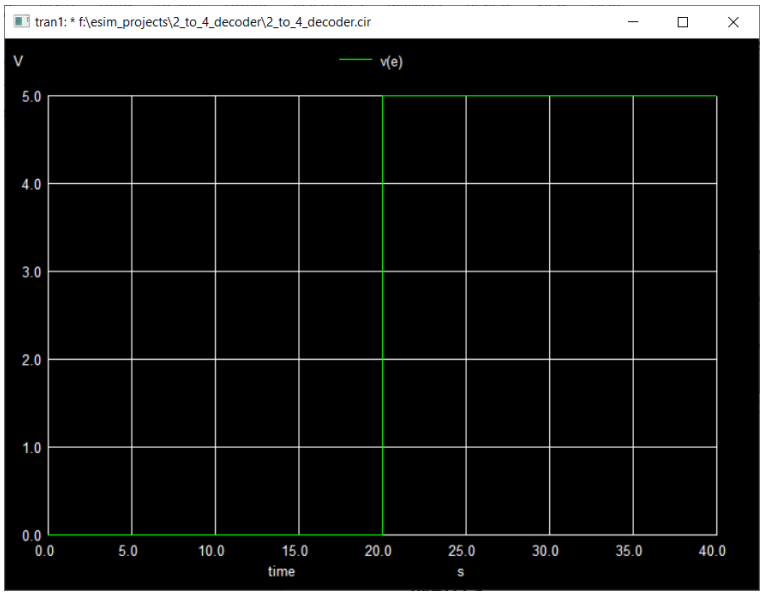


Subcircuit Symbol for 3-Input AND Gate (already exists in eSim_Subckt)

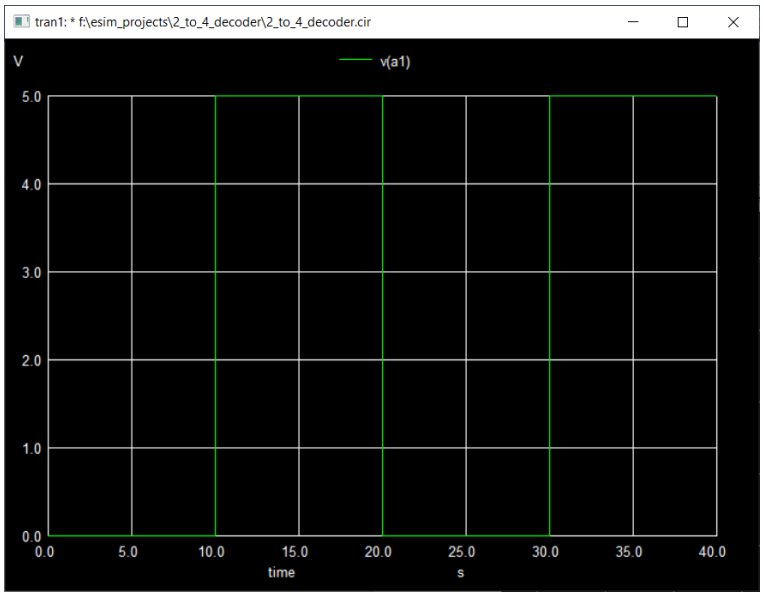
RESULT/OUTPUT:

- ## NGSPICE PLOTS:

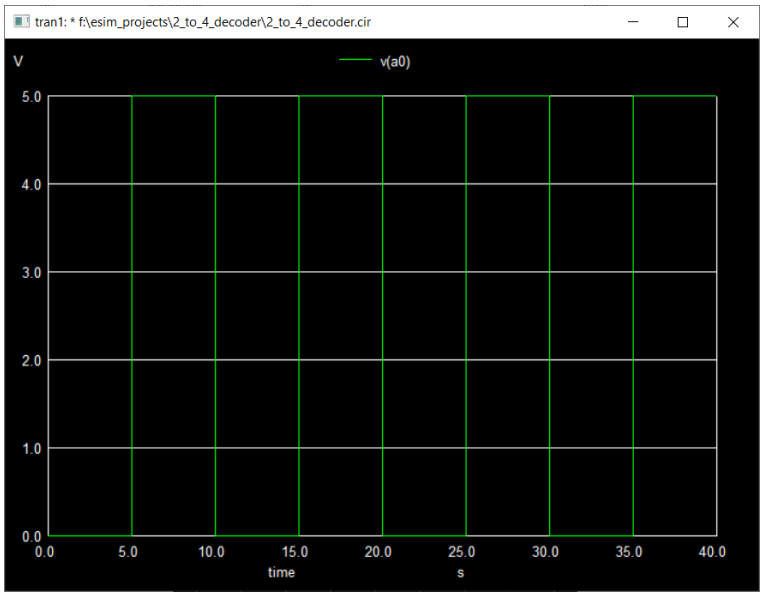
  ## INPUTS:



Enable (E)

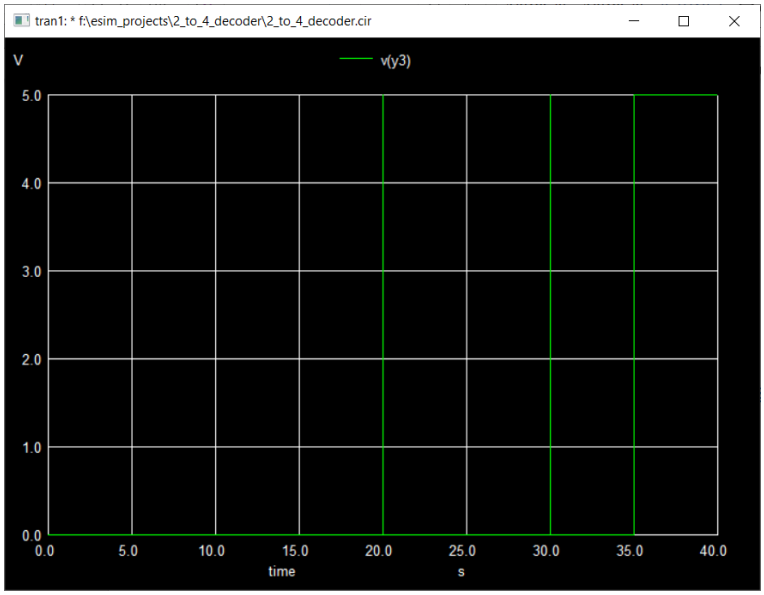


A_1

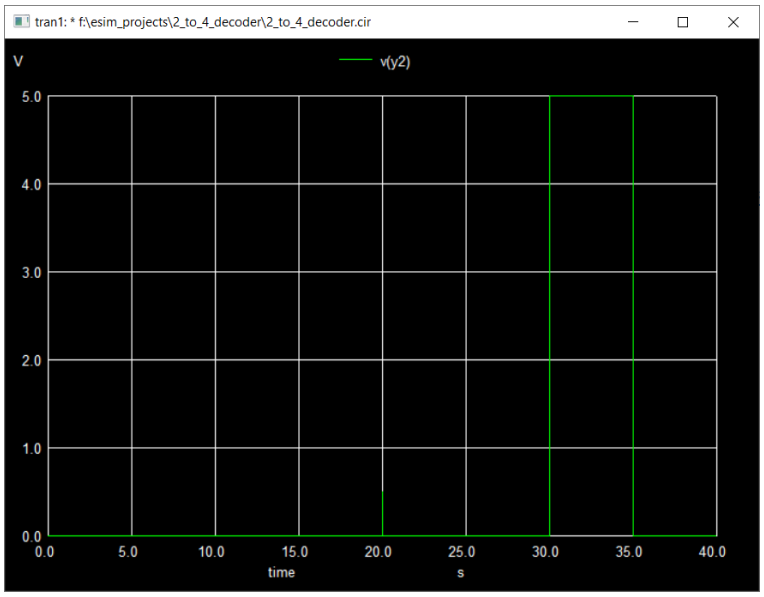


A_0

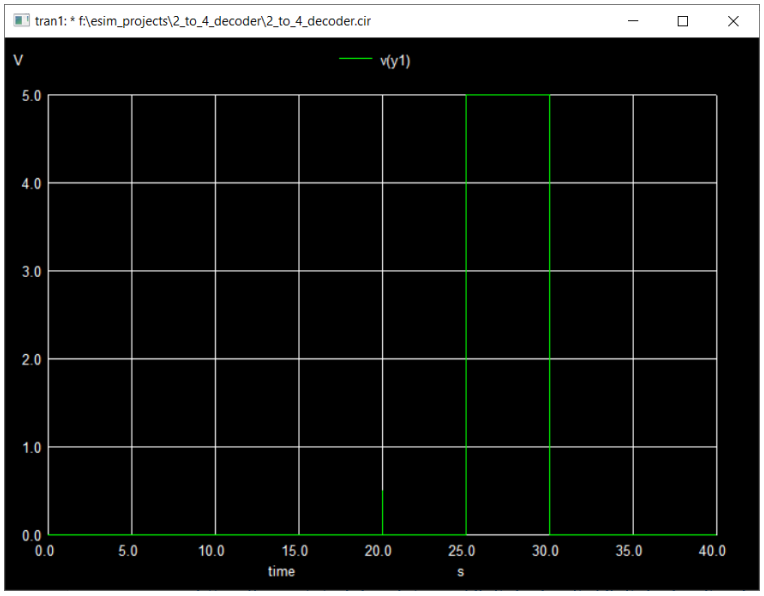
OUTPUTS:



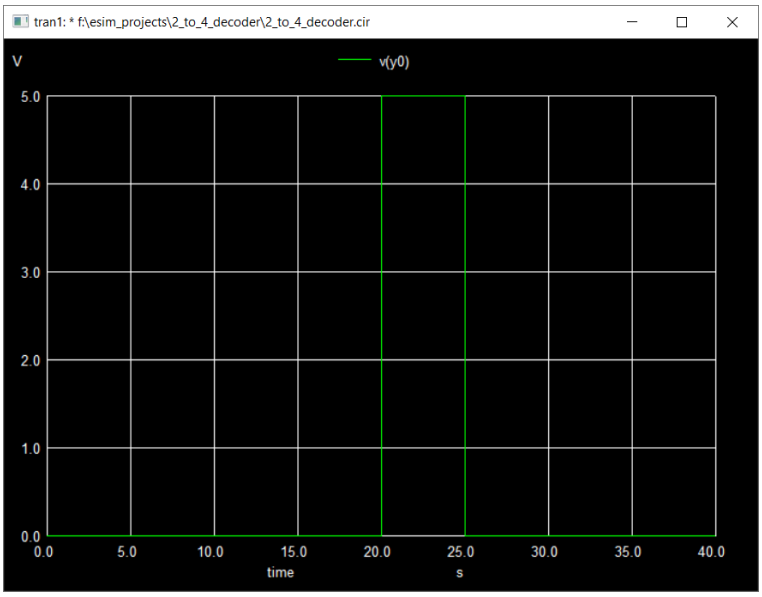
Y_3


tran1: * f:\esim_projects\2_to_4_decoder\2_to_4_decoder.cir
V
v(y2)
5.0
4.0
3.0
2.0
1.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
time
s

Y_2


tran1: * f:\esim_projects\2_to_4_decoder\2_to_4_decoder.cir
V
v(y1)
5.0
4.0
3.0
2.0
1.0
0.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
time
s

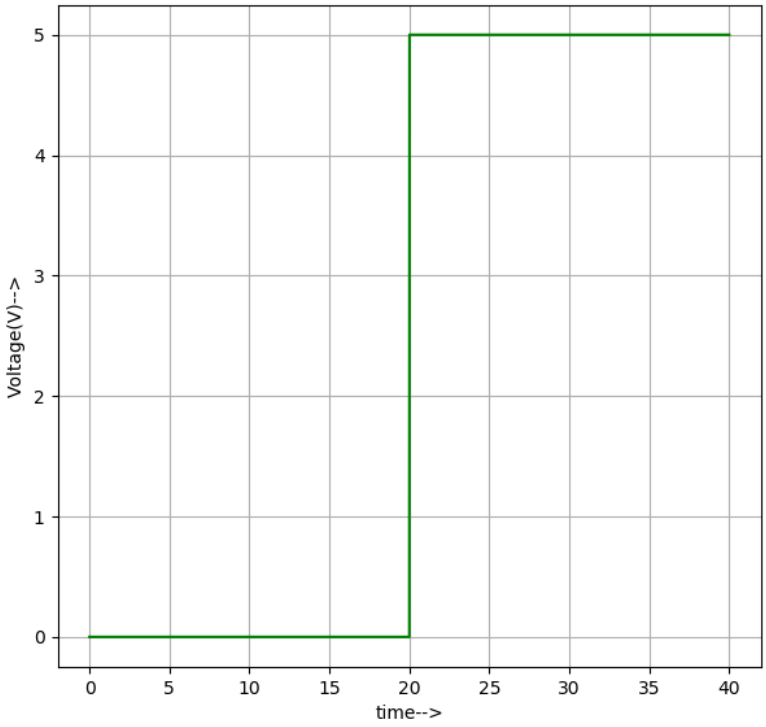
Y_1



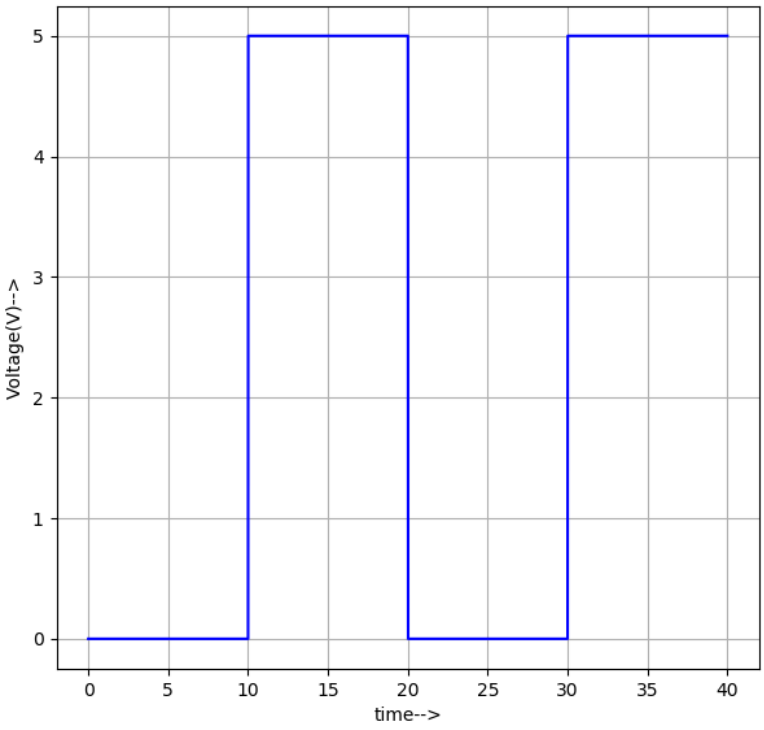
Y_0

- **PYTHON PLOTS:**

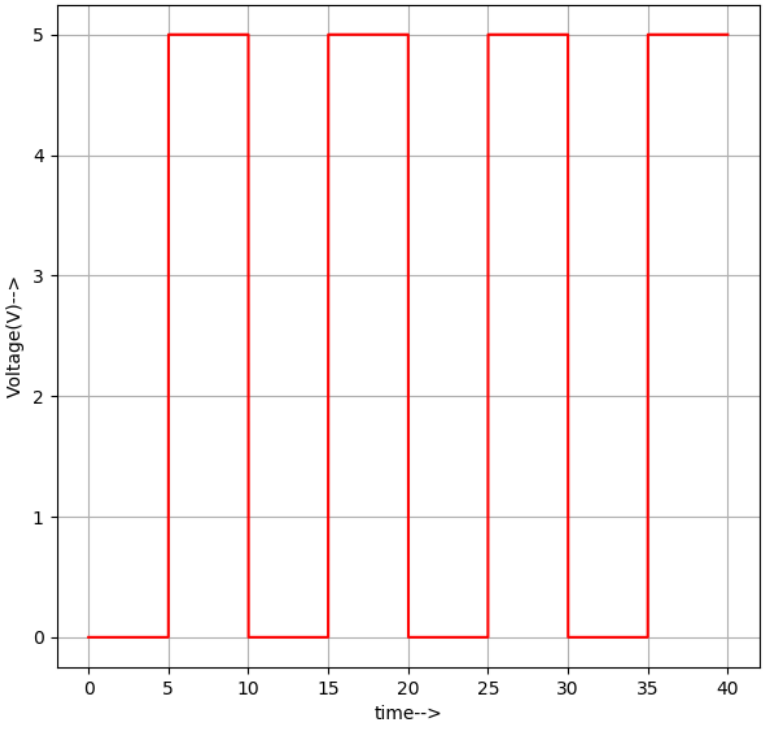
  INPUTS:



Enable (E)

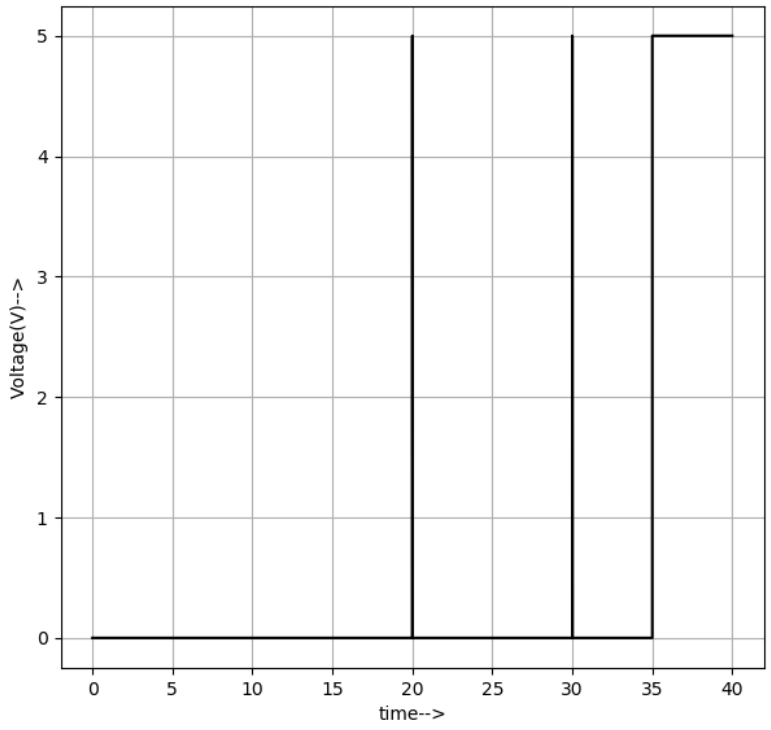

Voltage(V)-->
time-->
0
1
2
3
4
5
0
5
10
15
20
25
30
35
40

A_1

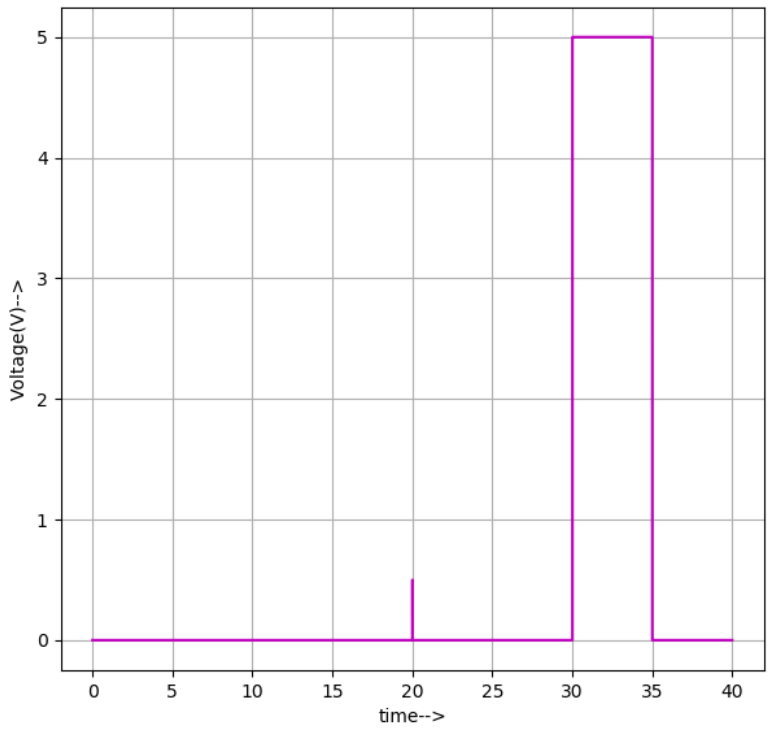

Voltage(V)-->
time-->
0
1
2
3
4
5
0
5
10
15
20
25
30
35
40

A_0

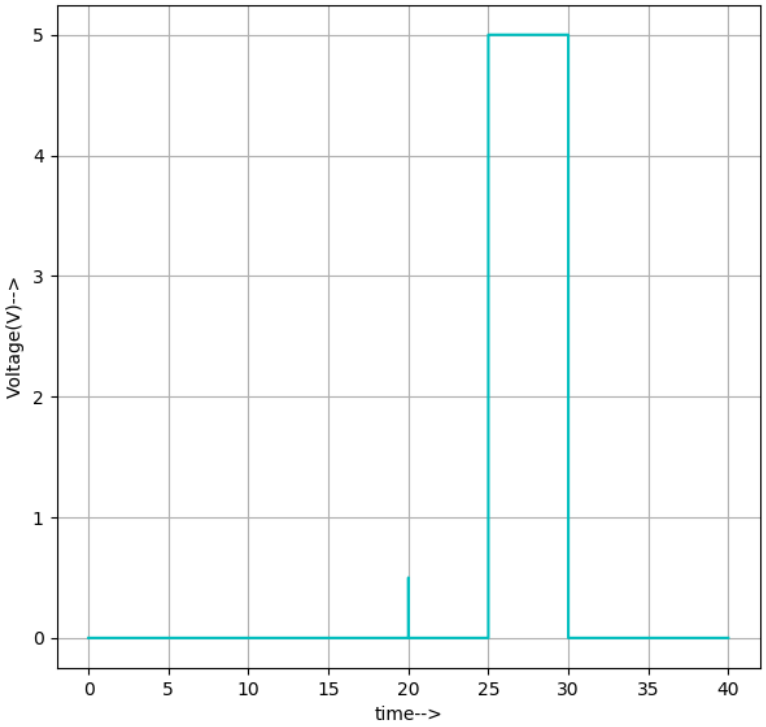
OUTPUTS:



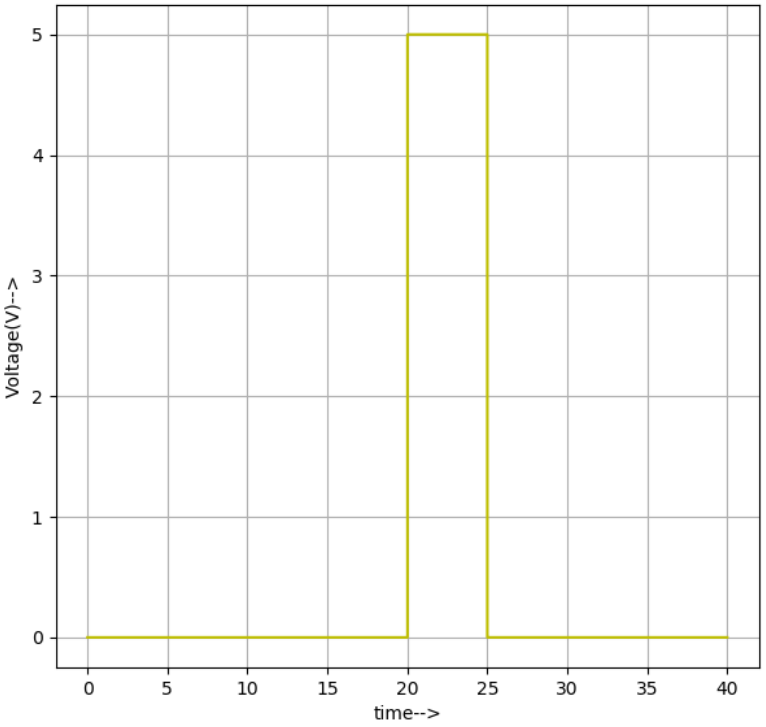
Y_3



Y_2


Voltage(V)-->
time-->
0
1
2
3
4
5
0
5
10
15
20
25
30
35
40

Y_1


Voltage(V)-->
time-->
0
1
2
3
4
5
0
5
10
15
20
25
30
35
40

Y_0

Source/Reference(s):

https://www.tutorialspoint.com/digital_circuits/digital_circuits_decoders.htm