

CIRCUIT SIMULATION PROJECT

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

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Project Guide: Dr. Maheswari. R

4x1 Multiplexer using 2x1 Multiplexer

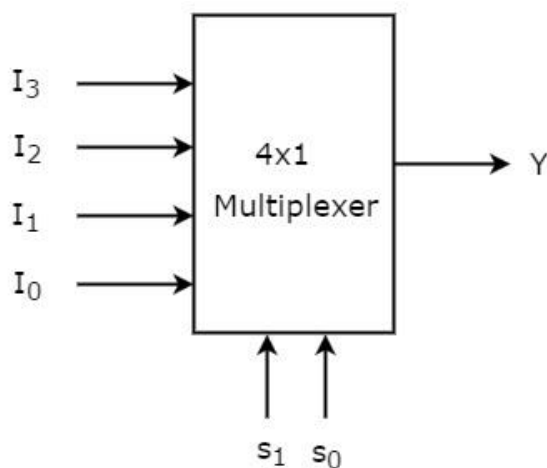
Theory:

Multiplexer is a combinational circuit that has maximum of 2^n data inputs, 'n' selection lines and single output line. One of these data inputs will be connected to the output based on the values of selection lines.

Since there are 'n' selection lines, there will be 2^n possible combinations of zeros and ones. So, each combination will select only one data input. Multiplexer is also called as Mux.

4x1 Multiplexer:

4x1 Multiplexer has four data inputs I_3 , I_2 , I_1 & I_0 , two selection lines s_1 & s_0 and one output Y. The block diagram of 4x1 Multiplexer is shown in the following figure.



One of these 4 inputs will be connected to the output based on the combination of inputs present at these two selection lines. Truth table of 4x1 Multiplexer is shown below.

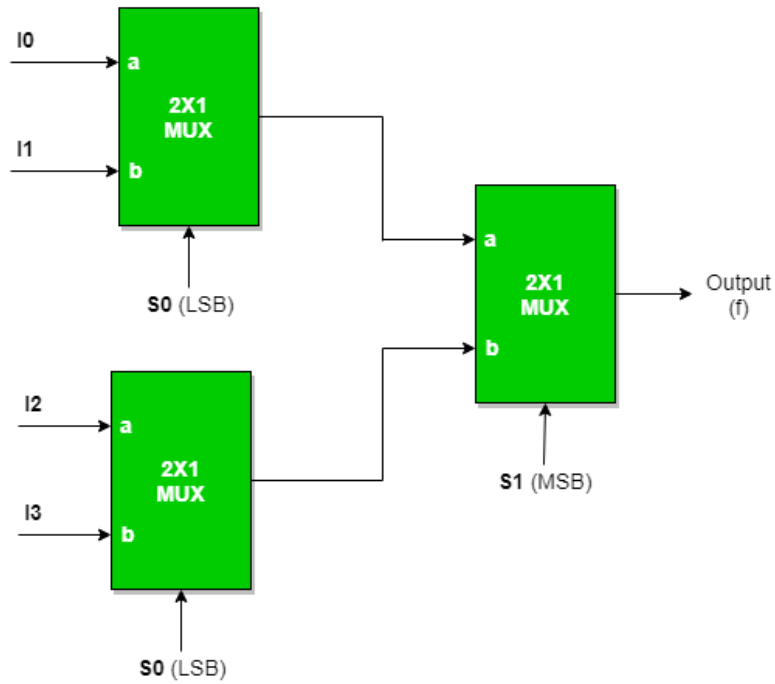
DATA SELECT INPUTS		INPUT SELECTED	INPUT	OUTPUT
A	B	D	D	Z
0	0	D0	0	0
			1	1
0	1	D1	0	0
			1	1
1	0	D2	0	0
			1	1
1	1	D3	0	0
			1	1

Based on the truth table of the 4:1 MUX we can write the equation of the multiplexer. The equation of the 4:1 MUX is described in the diagram below.

EQUATION OF 4:1 MUX

$$Z = \bar{A}.\bar{B}.D_0 + \bar{A}.B.D_1 + A.\bar{B}.D_2 + A.B.D_3$$

Inputs

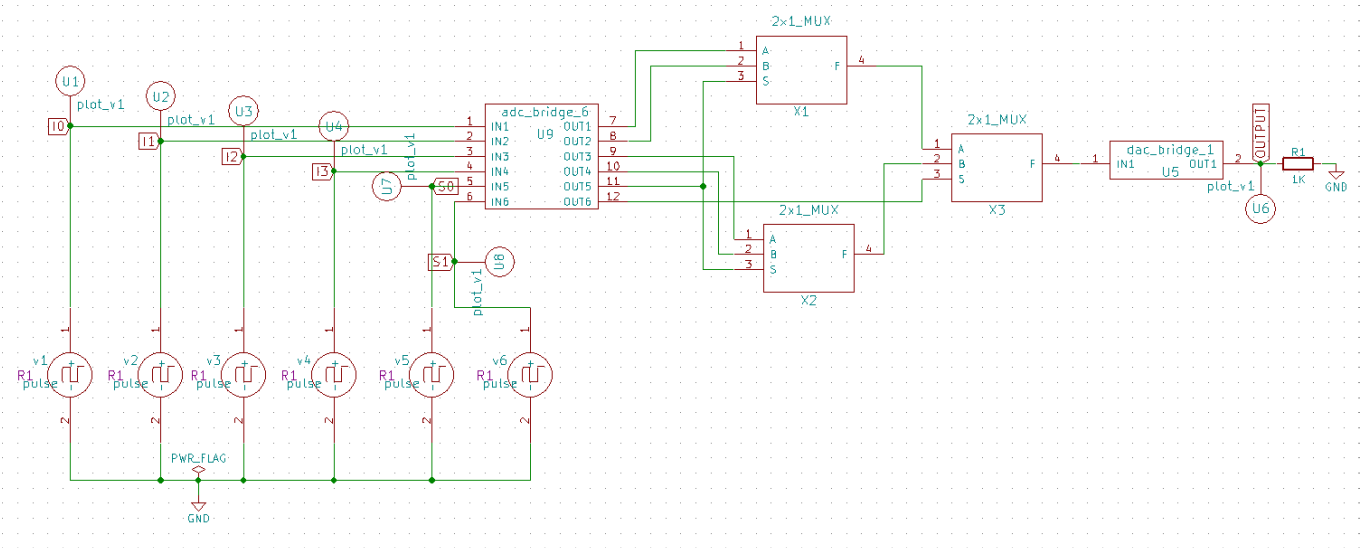


Truth Table

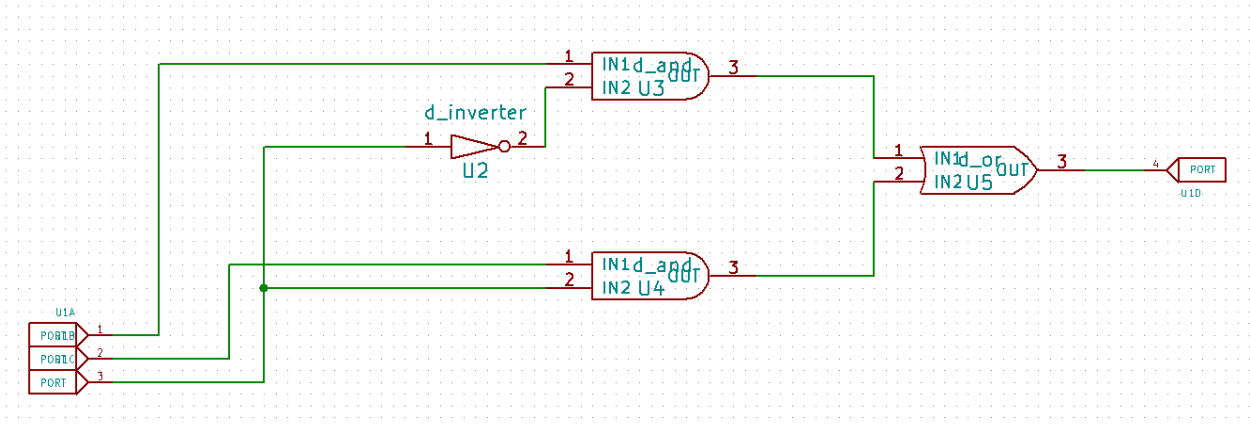
S0	S1	f
0	0	I0
0	1	I1
1	0	I2
1	1	I3

Circuit diagram:

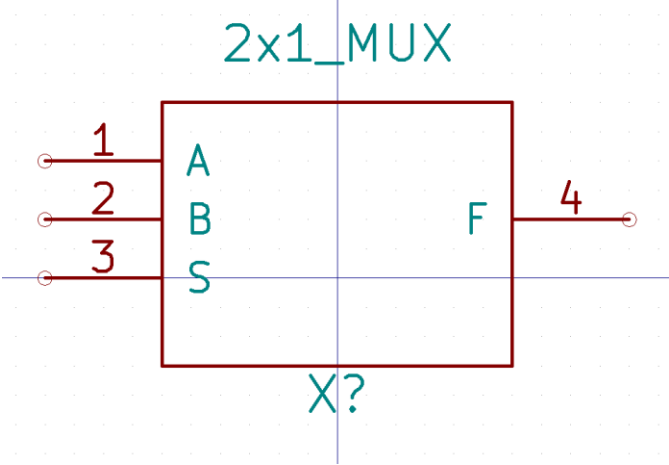
4x1 multiplexer circuit diagram:



2x1 multiplexer diagram:



Symbol used for 2x1 Multiplexer:



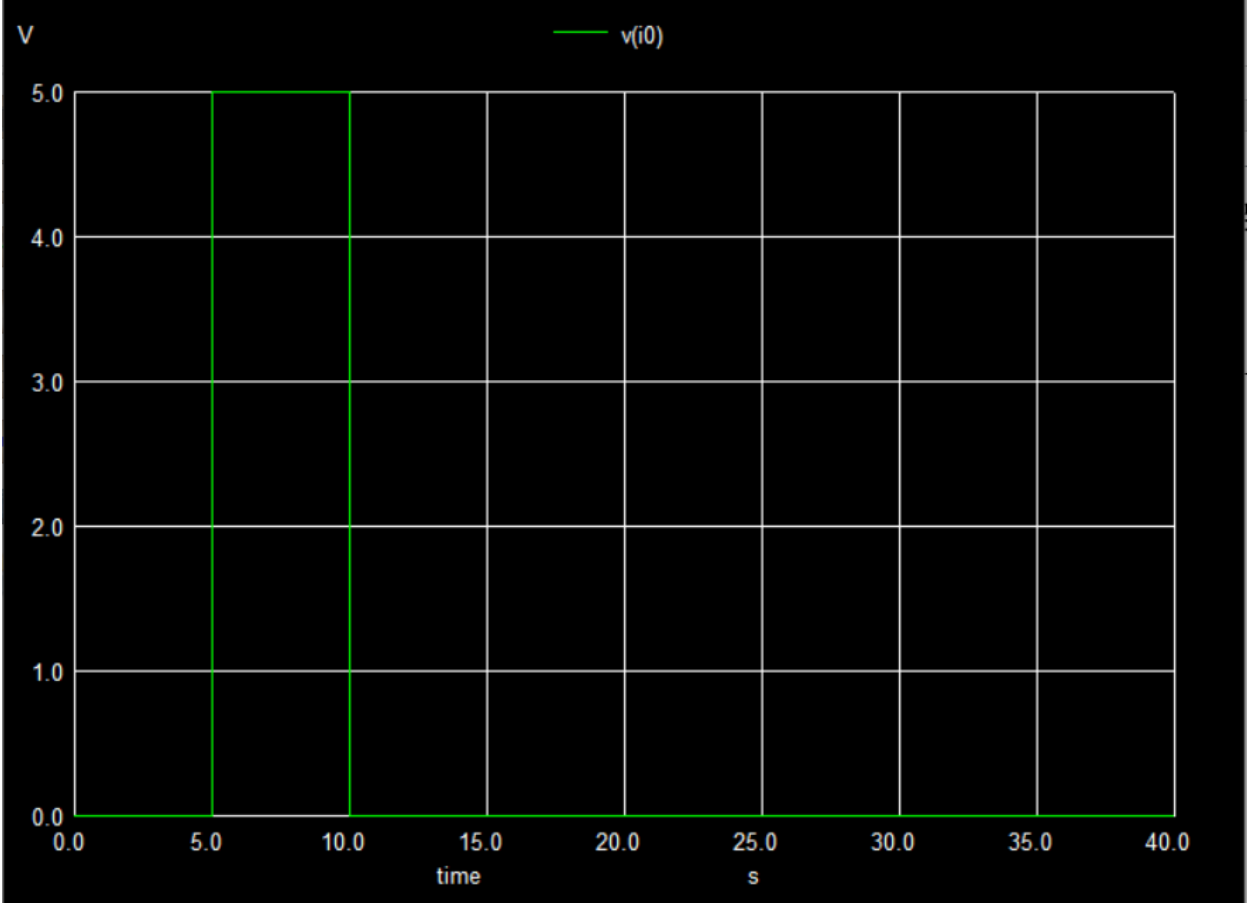
4X1 multiplexer is created using three 2X1 multiplexers

SIMULATION RESULTS:

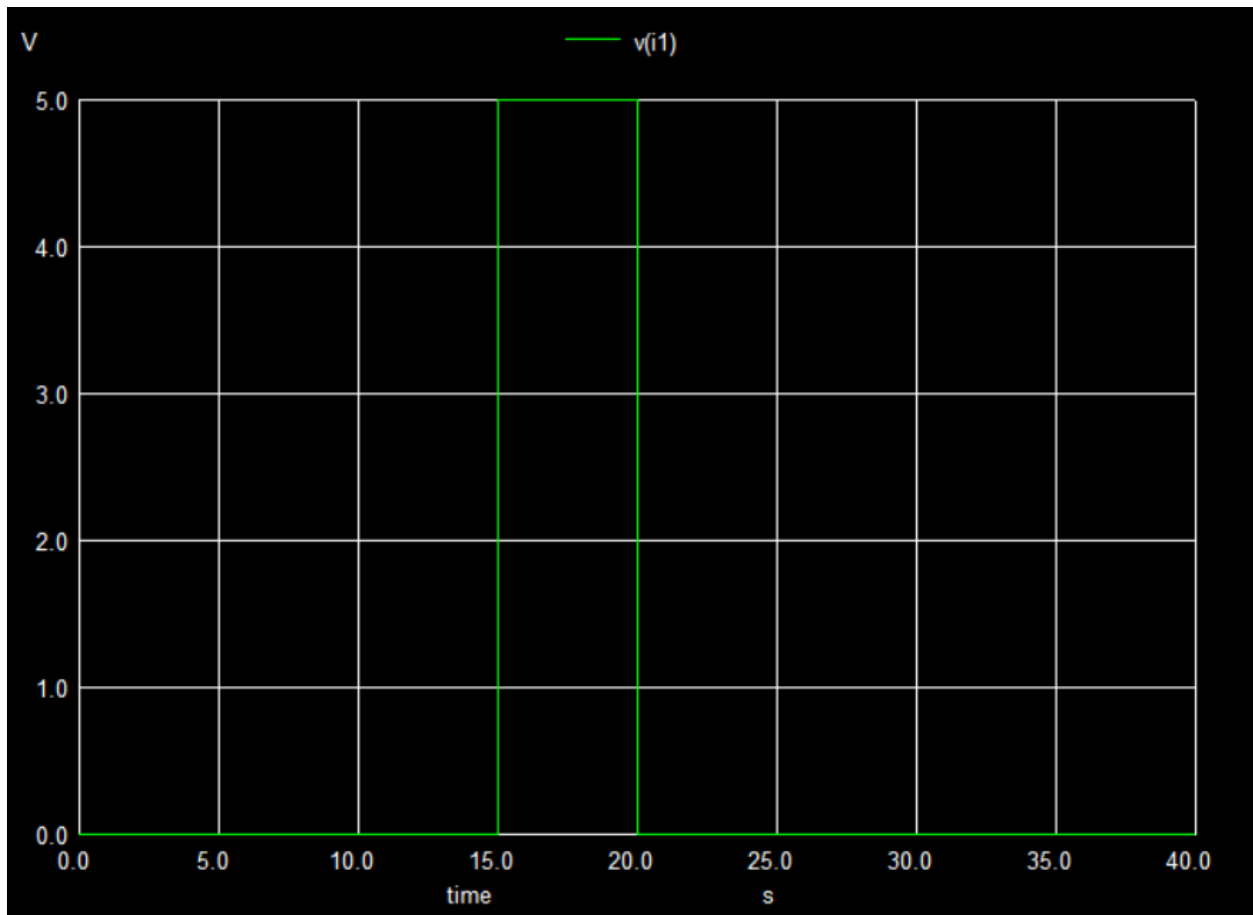
NGspice Plots:

INPUT waveforms:

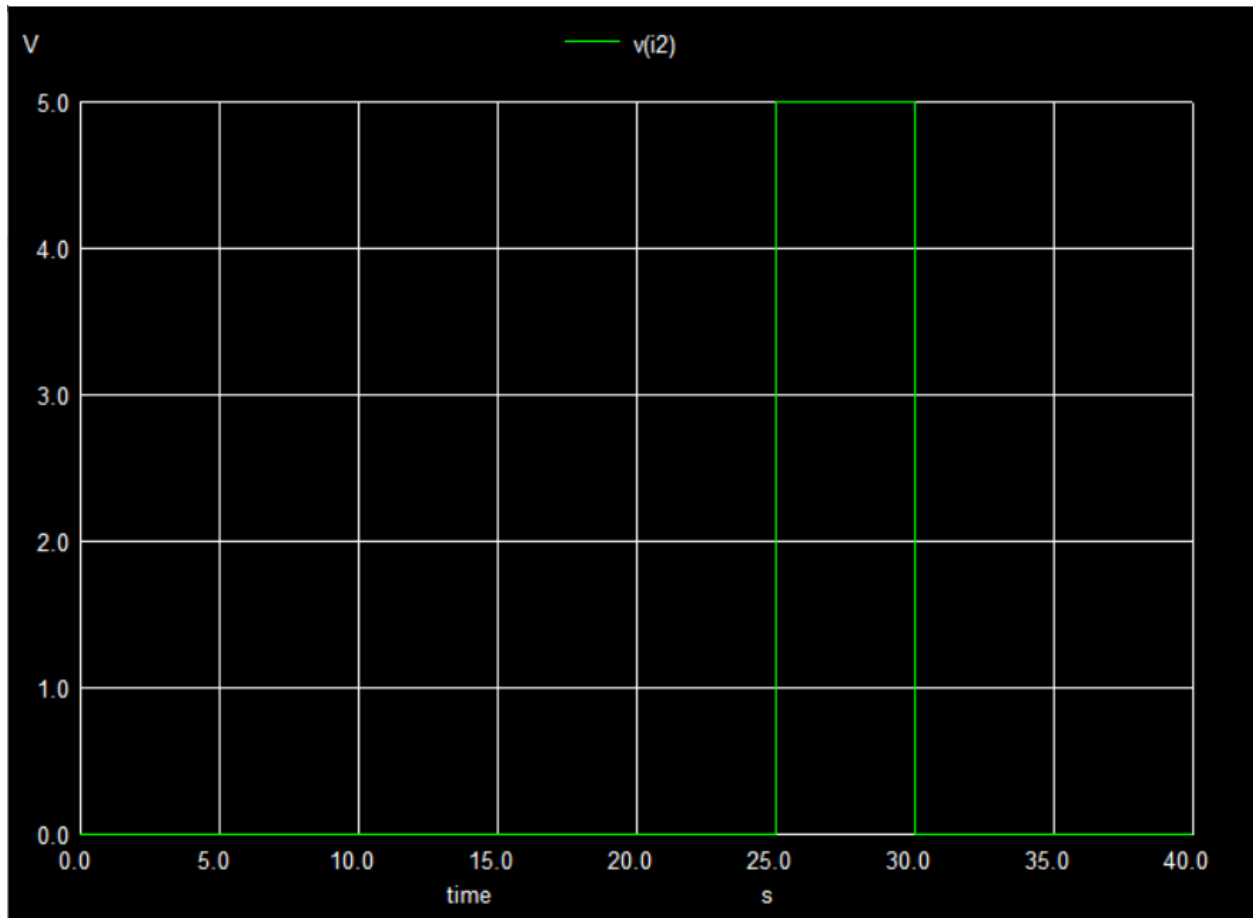
IO:



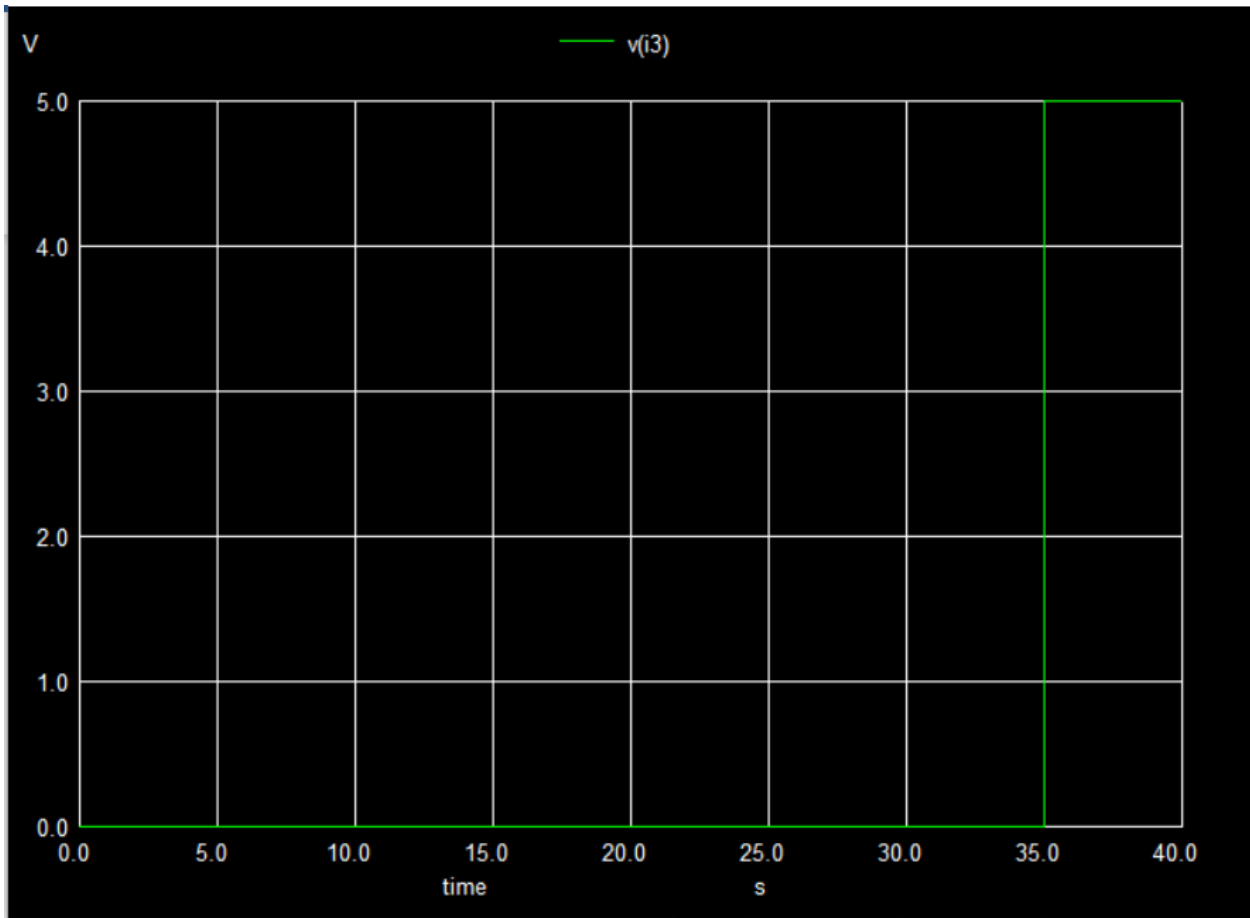
11:



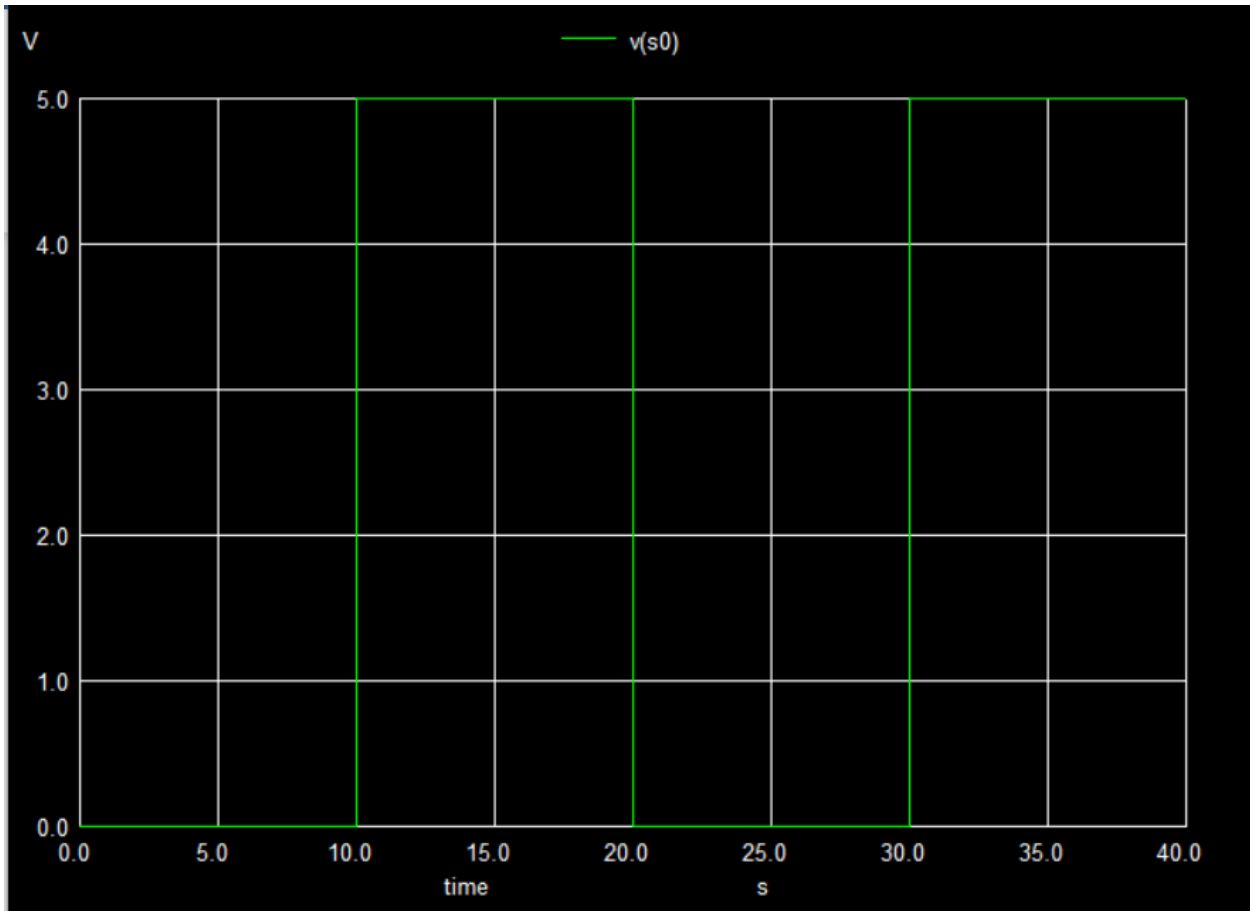
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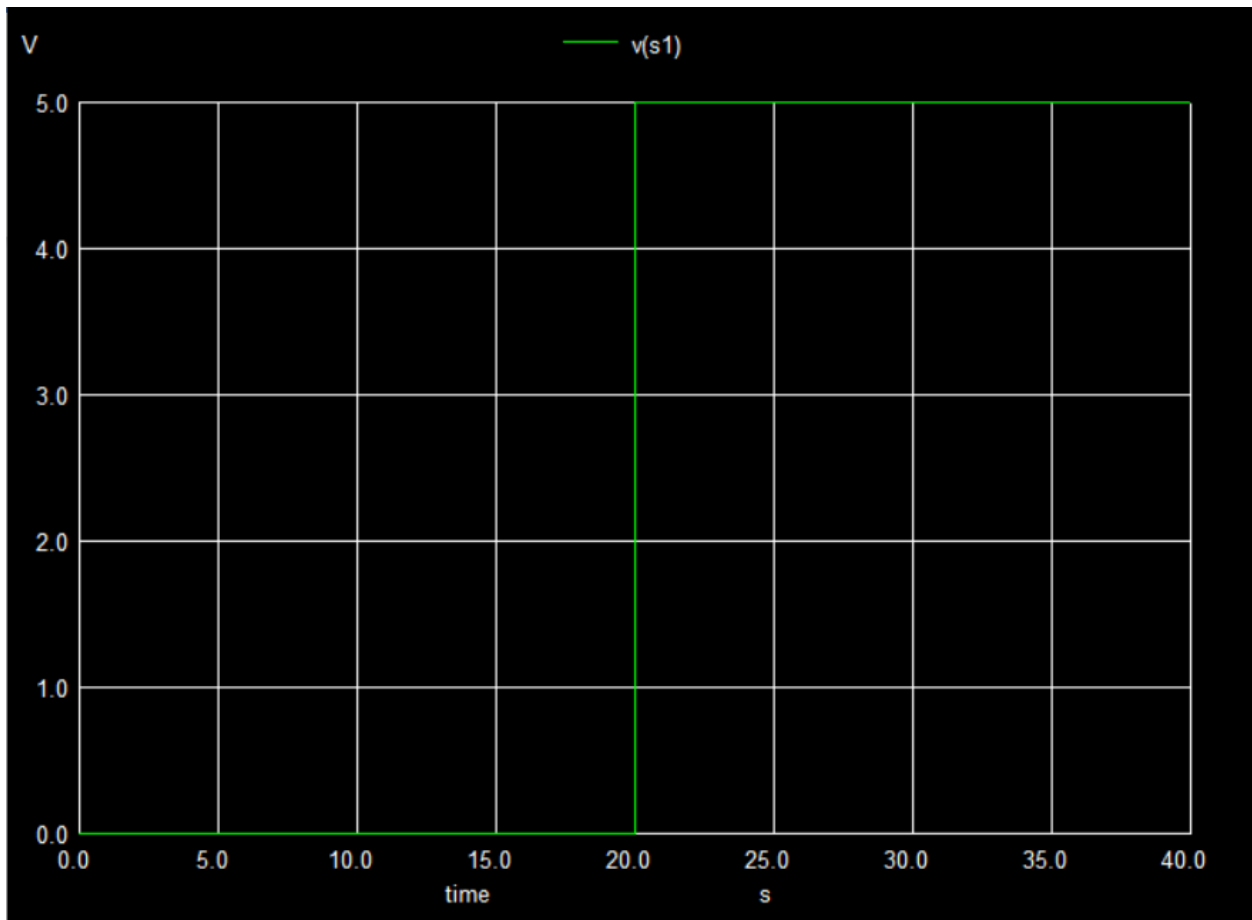
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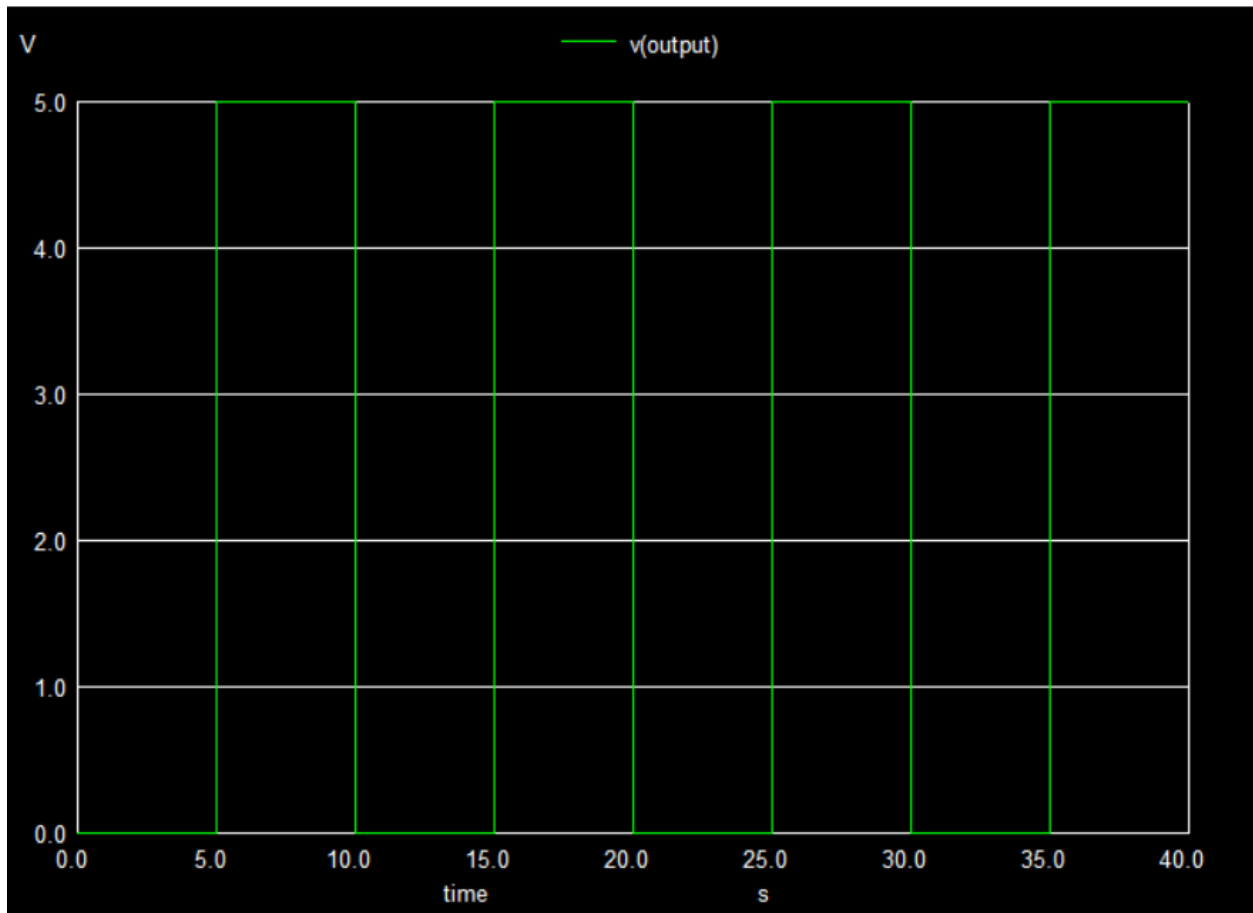
S0:



S1:

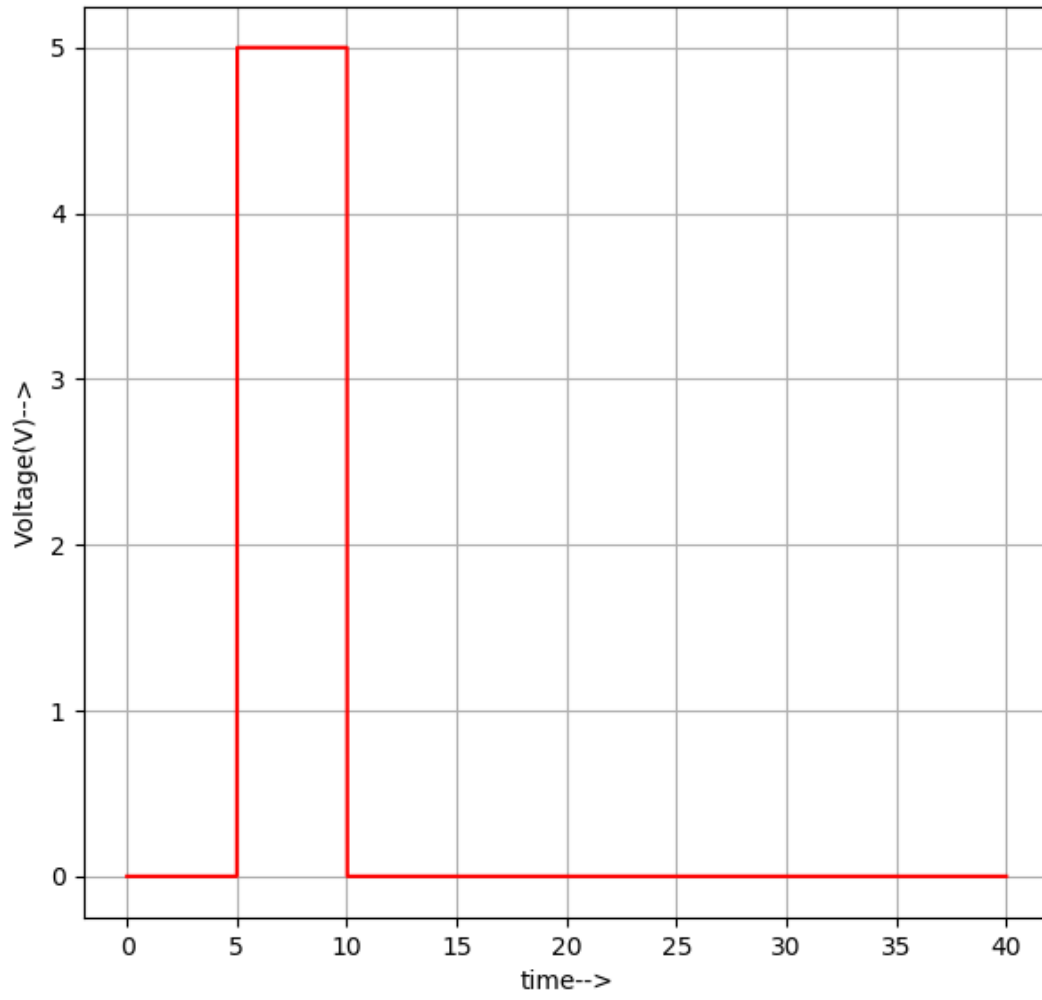


OUTPUT:

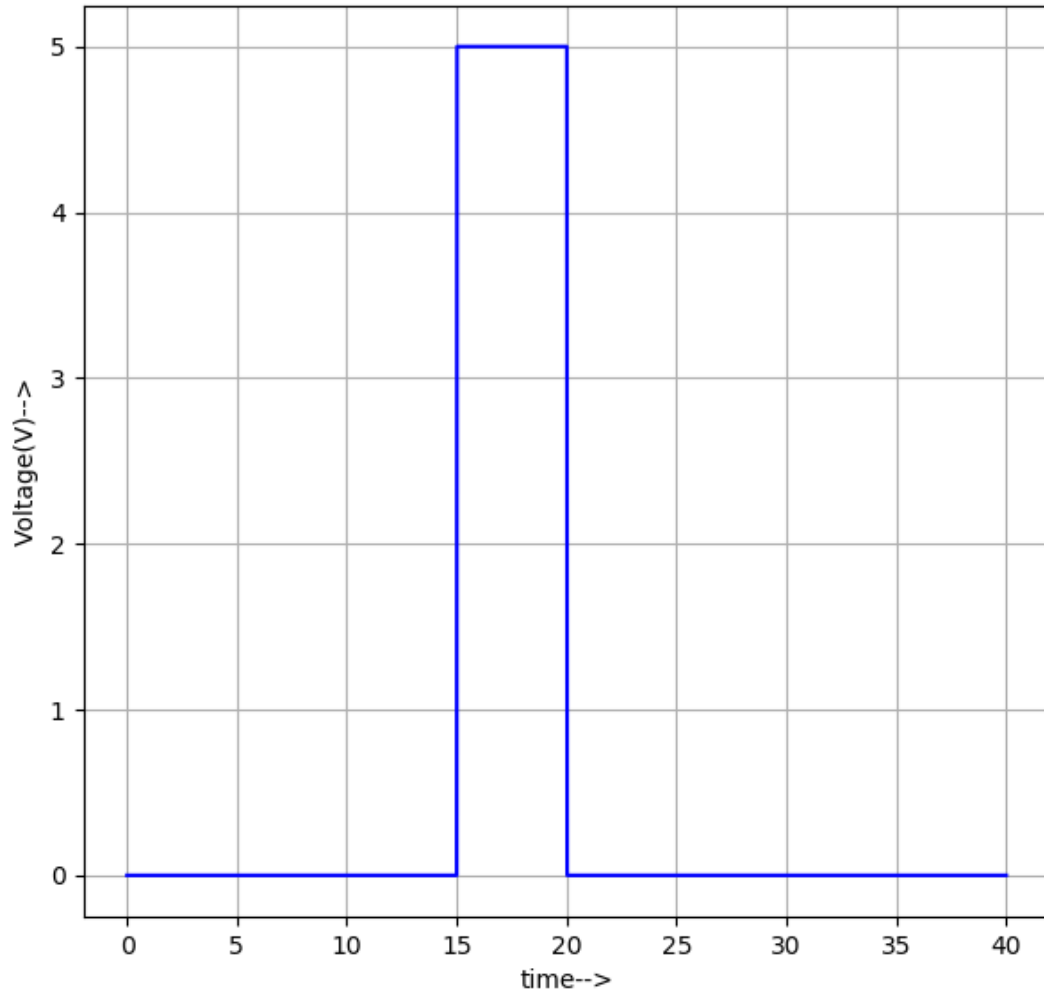


PYTHON PLOTS:

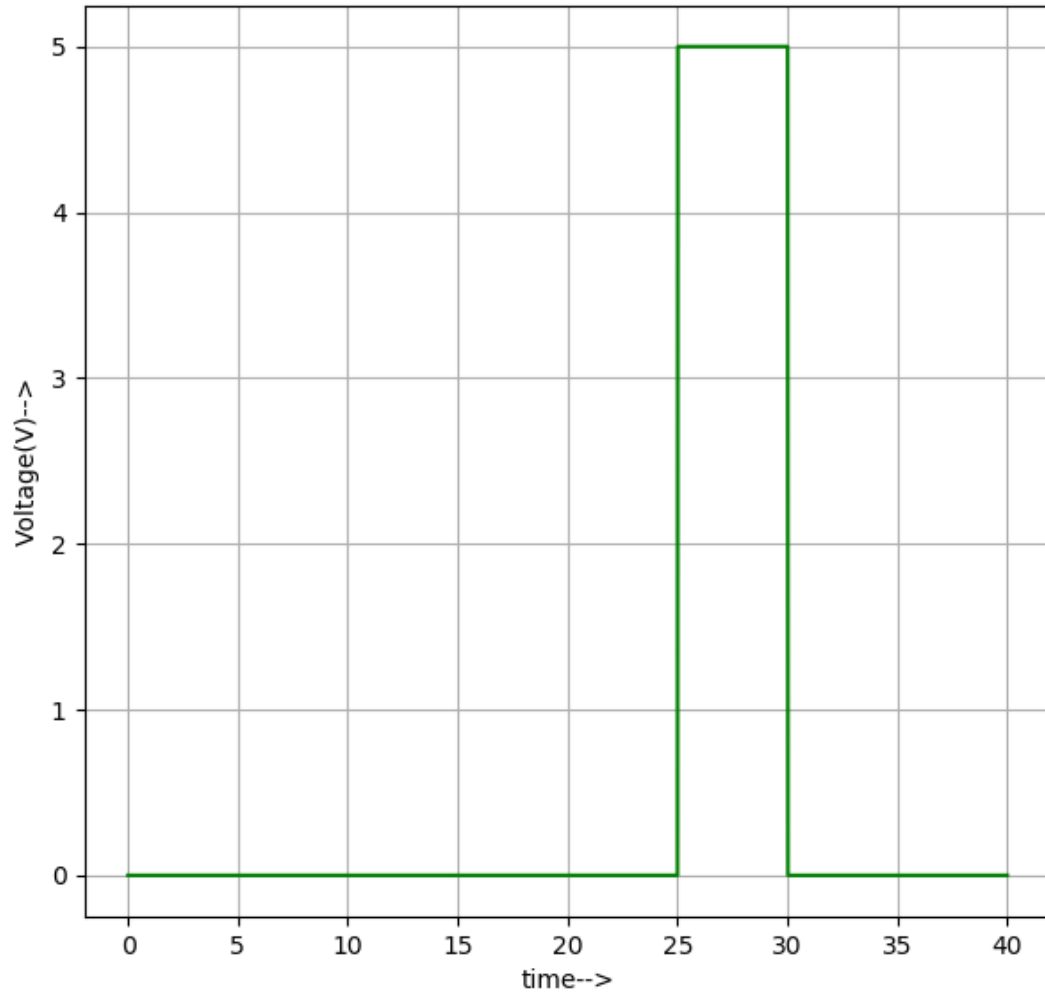
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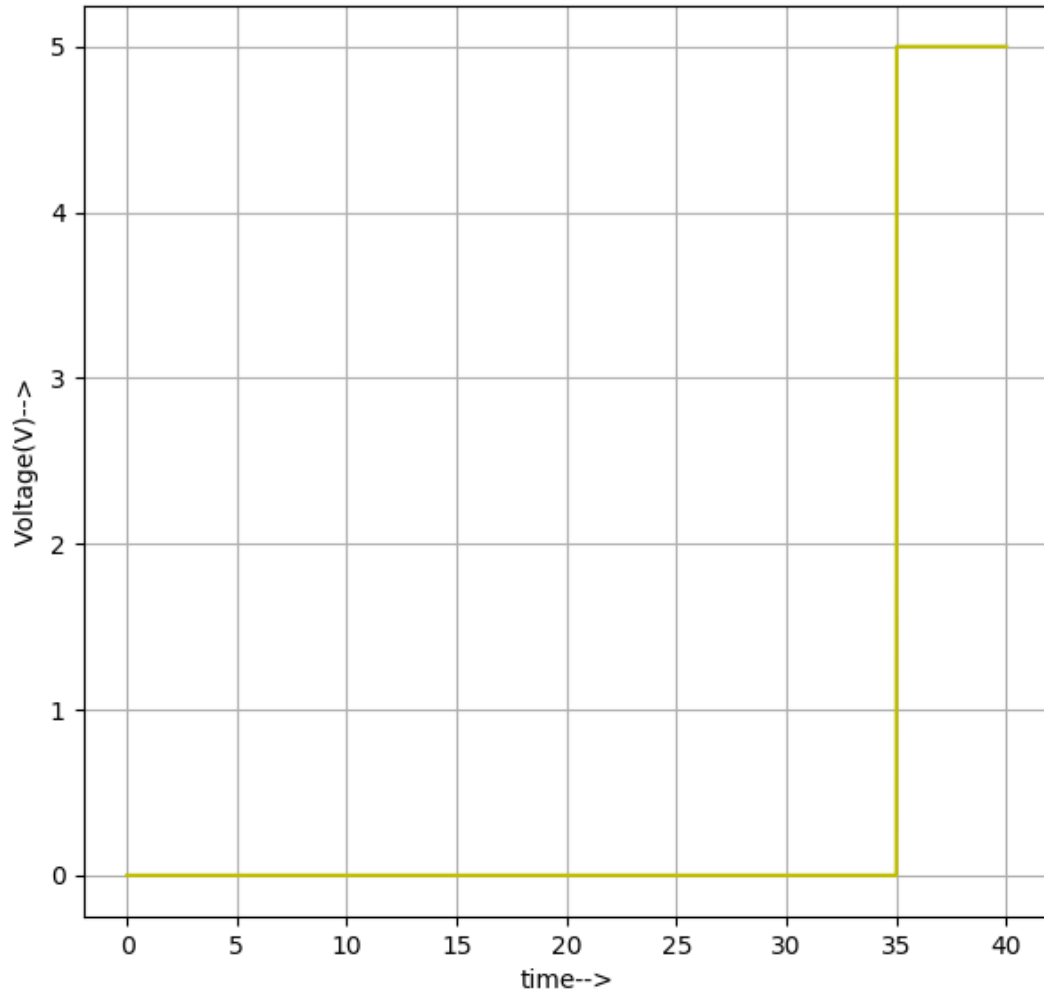
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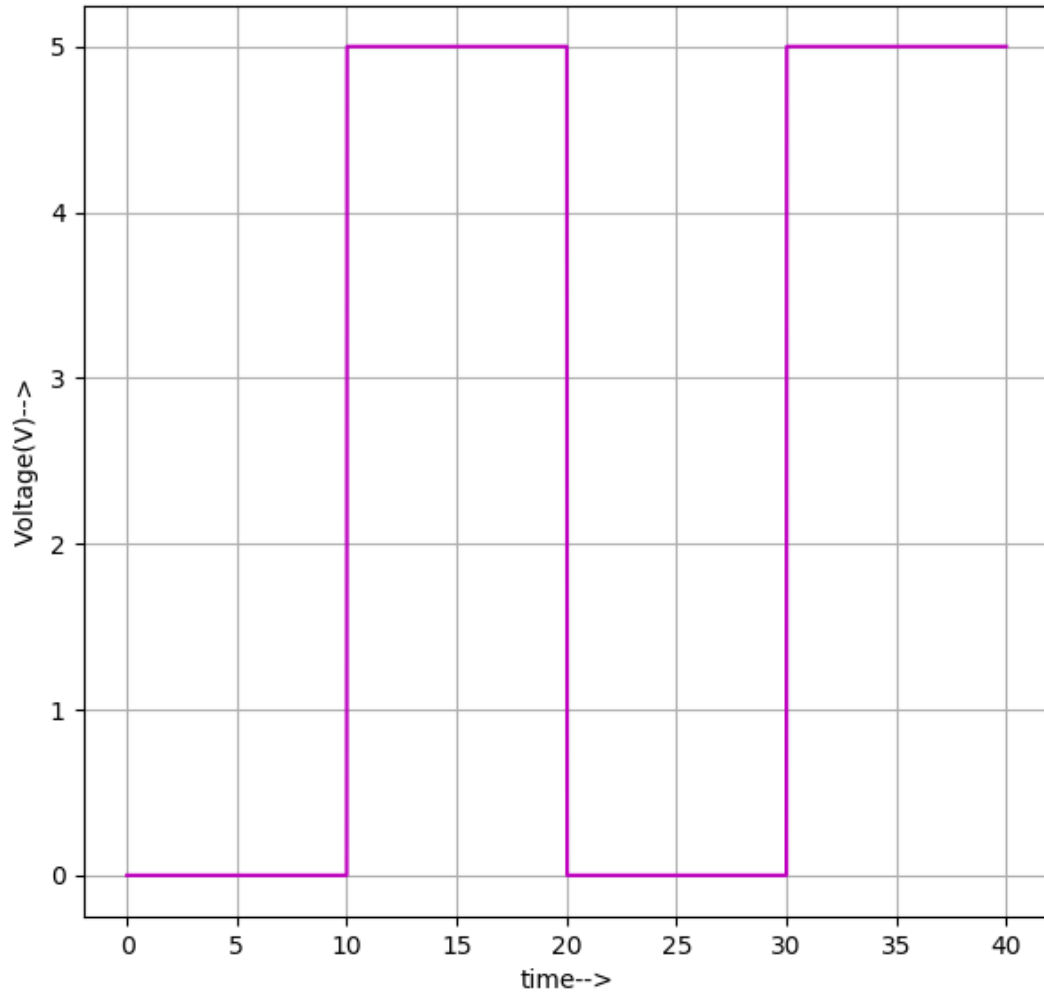
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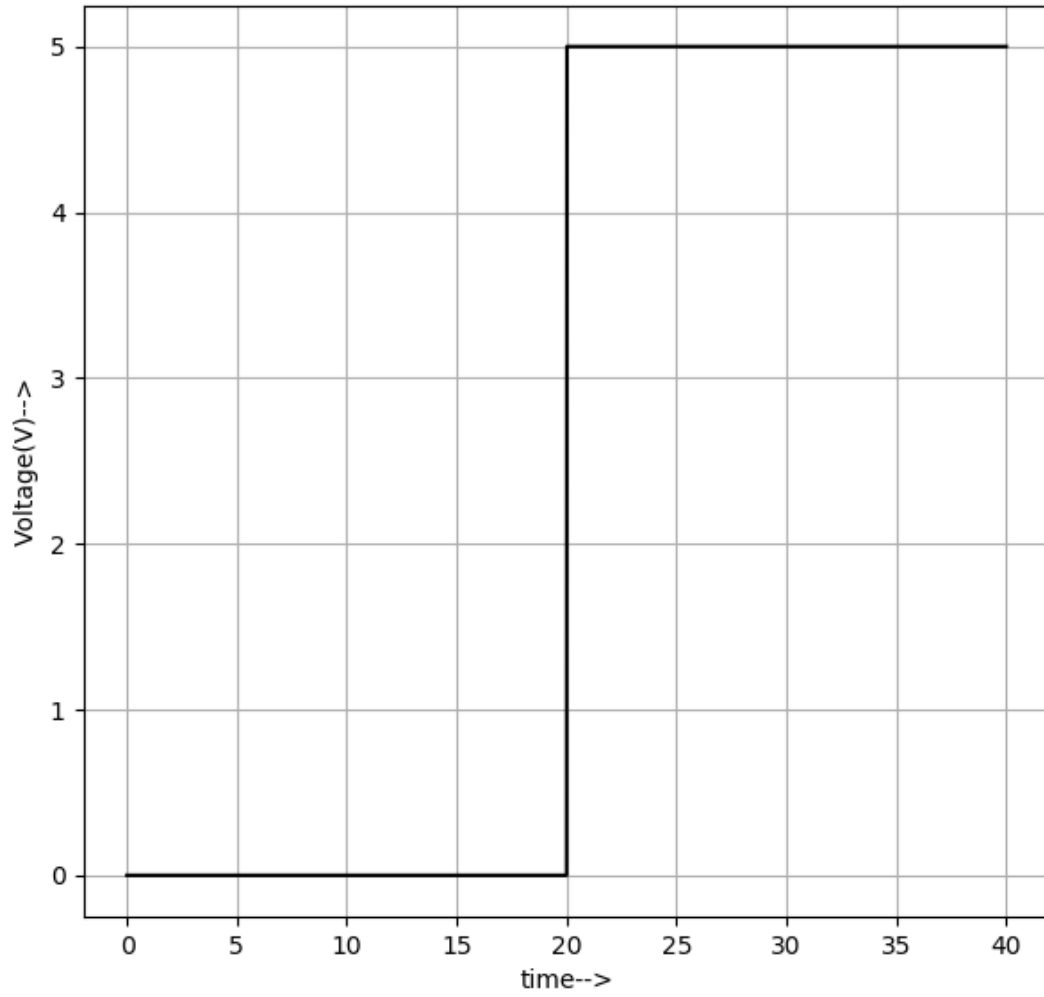
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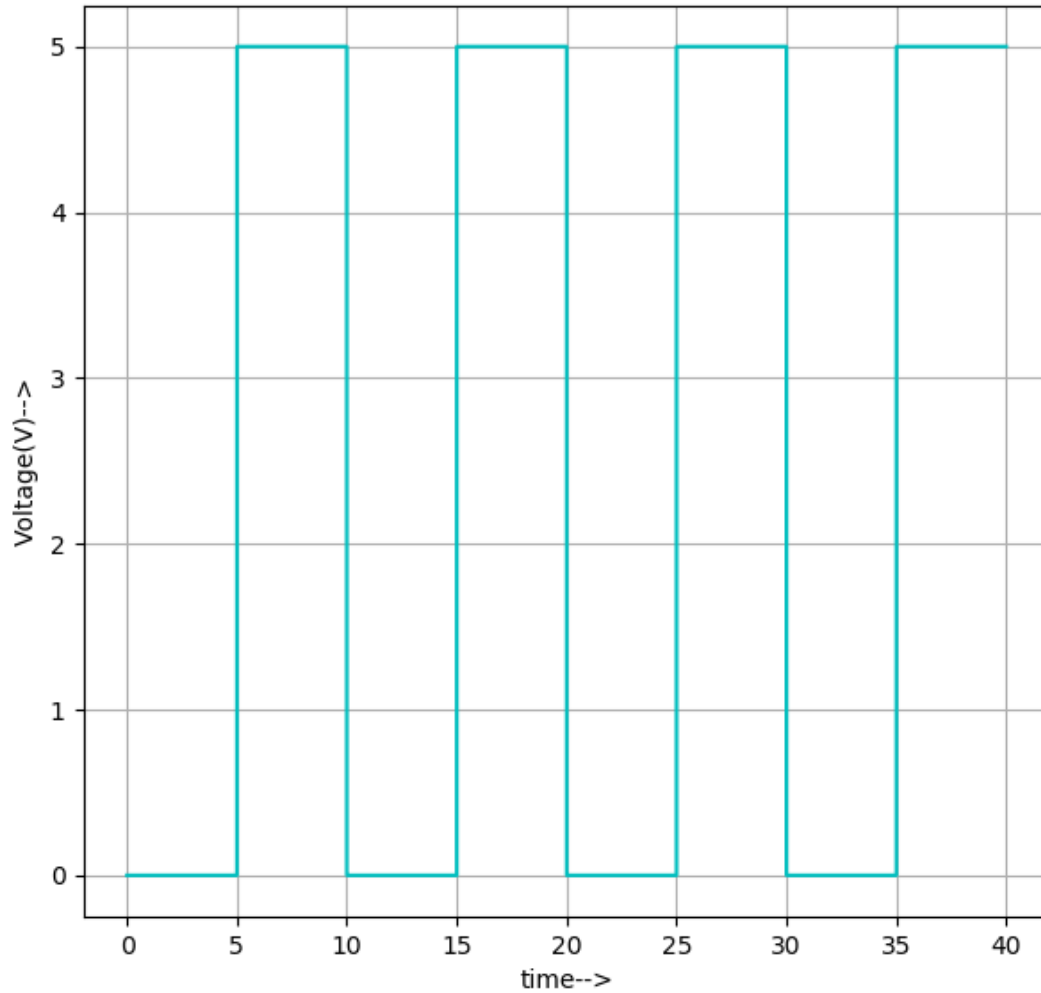
S0:



S1:



OUTPUT:



References:

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

<https://electronicscoach.com/digital-multiplexer.html>

[https://www.geeksforgeeks.org/multiplexers-in-digital-logic/#:~:text=a\)%204%20%3A%201%20MUX%20using%20%20%3A%201%20MUX](https://www.geeksforgeeks.org/multiplexers-in-digital-logic/#:~:text=a)%204%20%3A%201%20MUX%20using%20%20%3A%201%20MUX)