Circuit Simulation Project

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

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Project Guide: Dr R. Maheshwari

Title of the Circuit: DE Morgan's Verification Circuit

Description:

The designed circuit gives the verification of DE Morgan's laws.

DE Morgan's Theorem represents two of the most important rules of boolean algebra.

(i) (A . B)' = A' + B'
Thus, the complement of the product of variables is equal to the sum of their individual complements.
(ii) (A + B)' = A' . B'

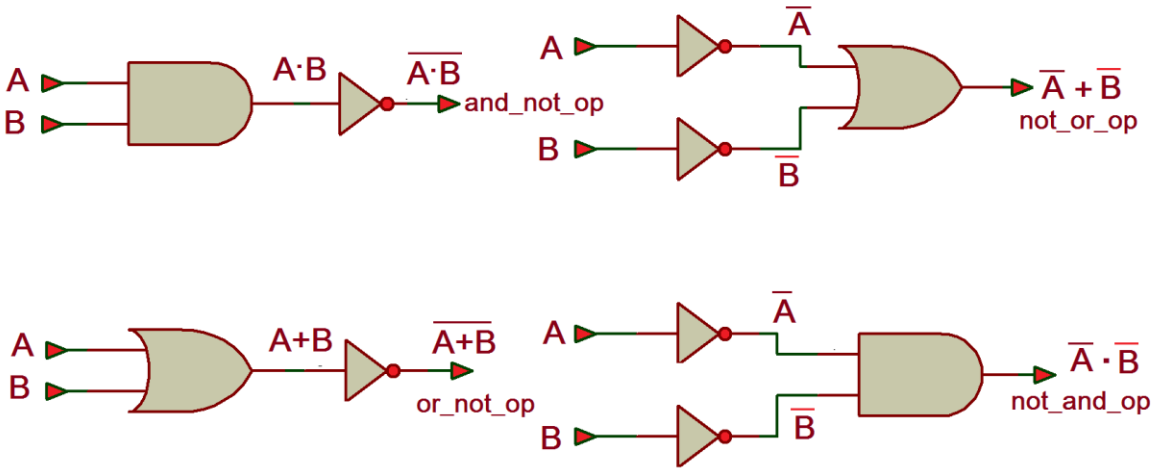
Thus, the complement of the sum of variables is equal to the product of their individual complements.

The above two laws can be extended for n variables as
(A1 . A2 . A3 ... An)' = A1' + A2' + ... + An'

And

(A1 + A2 + ... + An)' = A1' . A2' . A3' ... An'

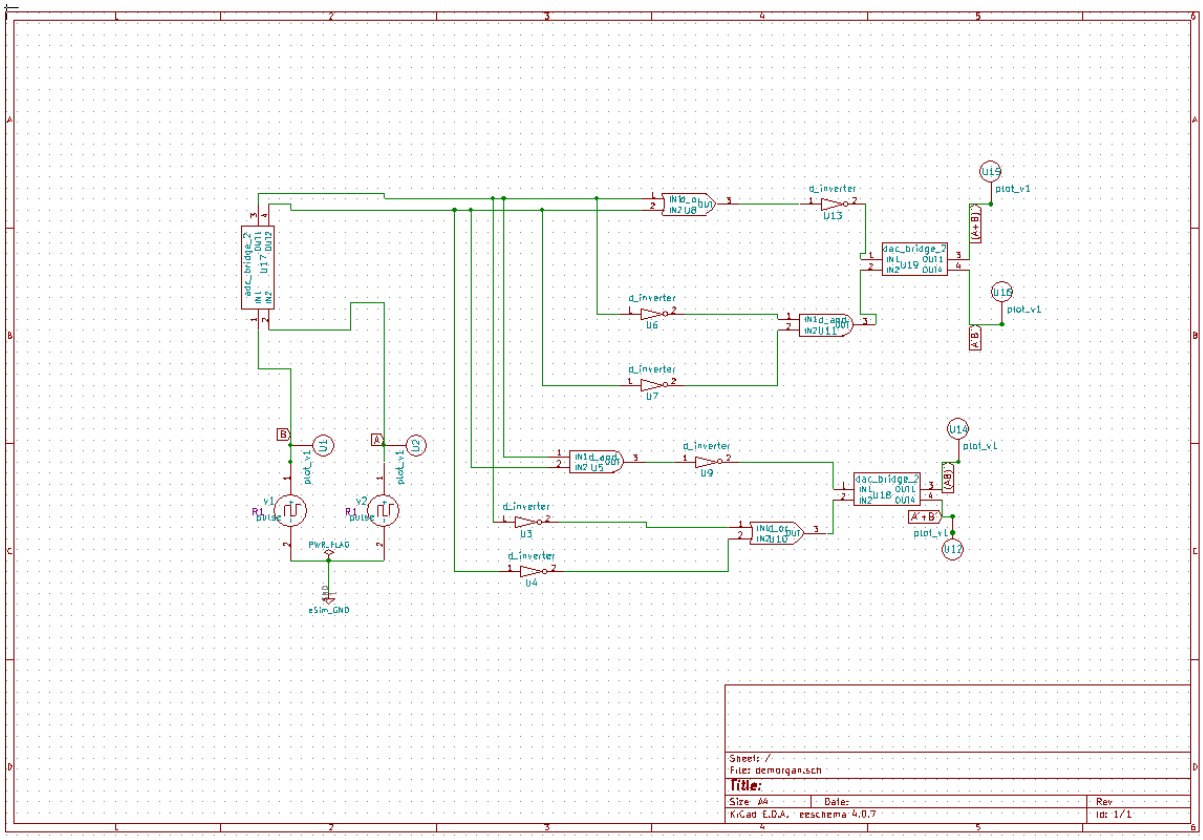
CIRCUIT DIAGRAM:



TRUTH TABLE:

Inputs		Truth Table Outputs For Each Term				
B	A	A.B	$\overline{A.B}$	$\overline{A}$	$\overline{B}$	$\overline{A} + \overline{B}$
0	0	0	**1**	1	1	**1**
0	1	0	**1**	0	1	**1**
1	0	0	**1**	1	0	**1**
1	1	1	**0**	0	0	**0**

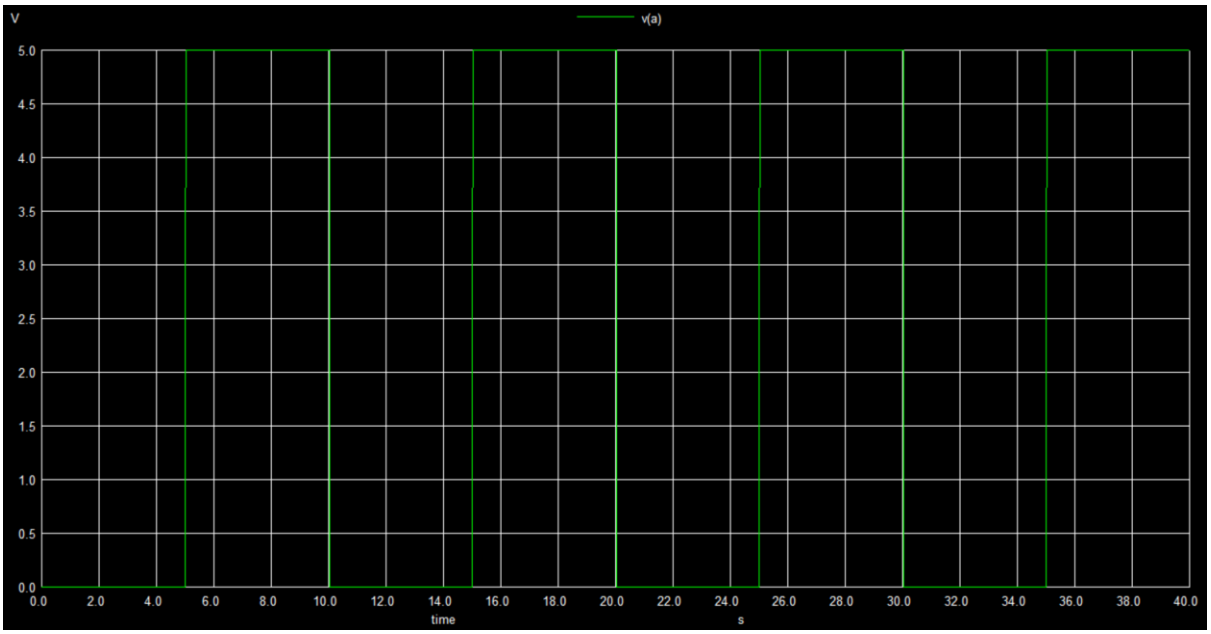
e-Sim Schematic



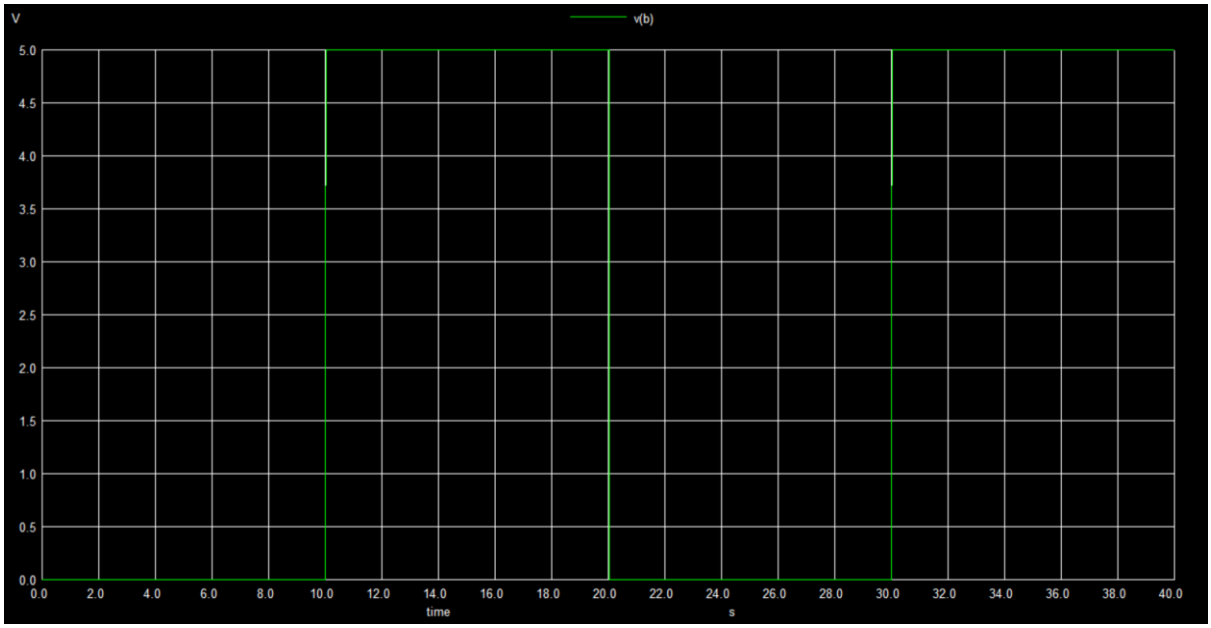
Simulation Results:

1. NG Spice Waveforms:

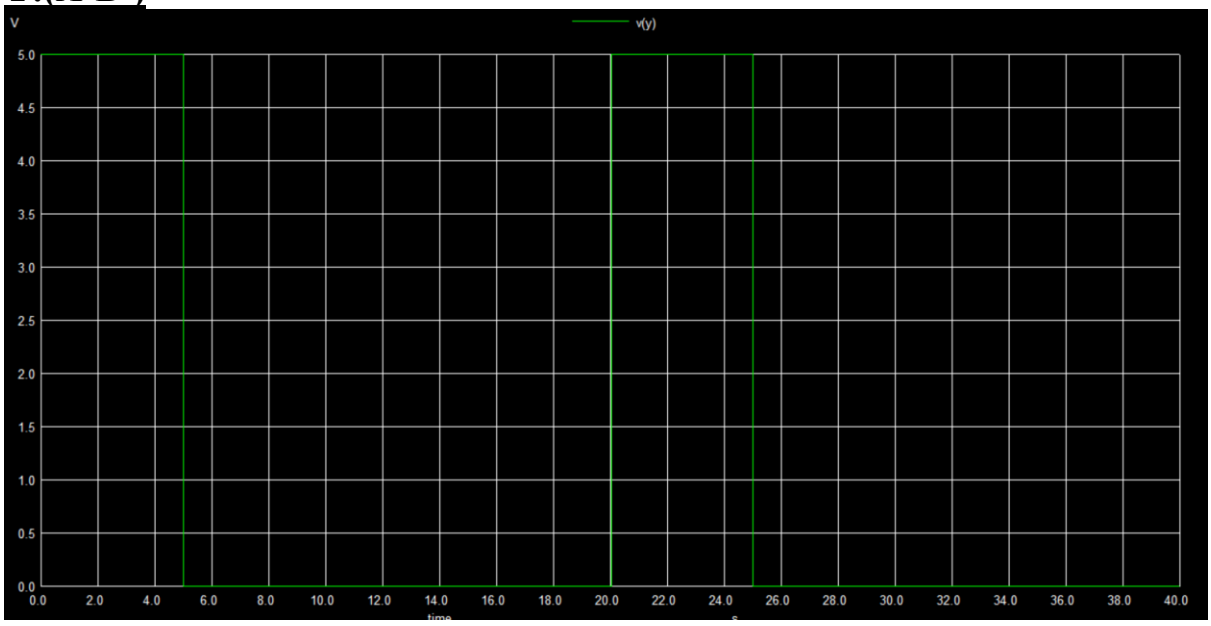
A



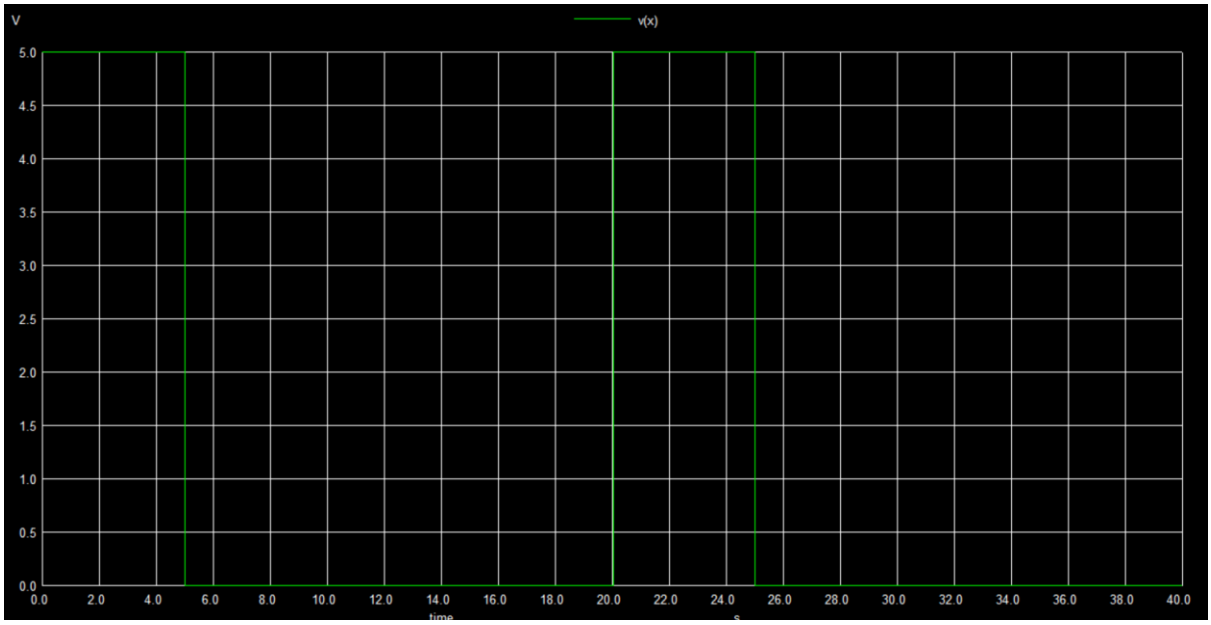
B


V
v(b)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0
time
s

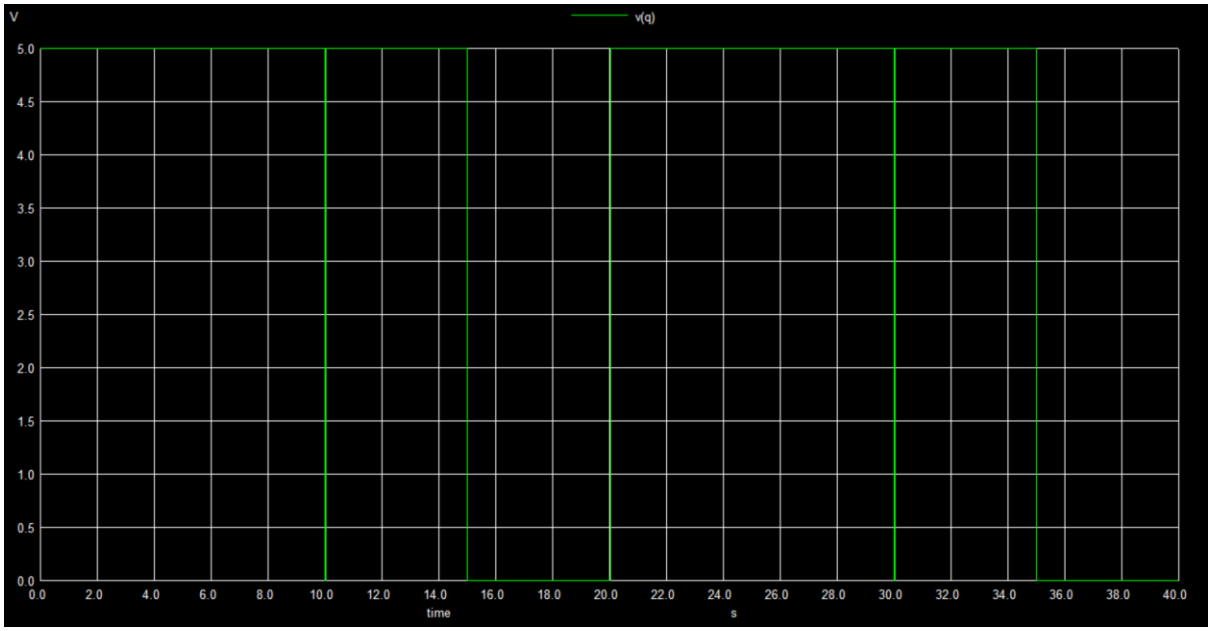
Y:(A'B')


V
v(y)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0
time
s

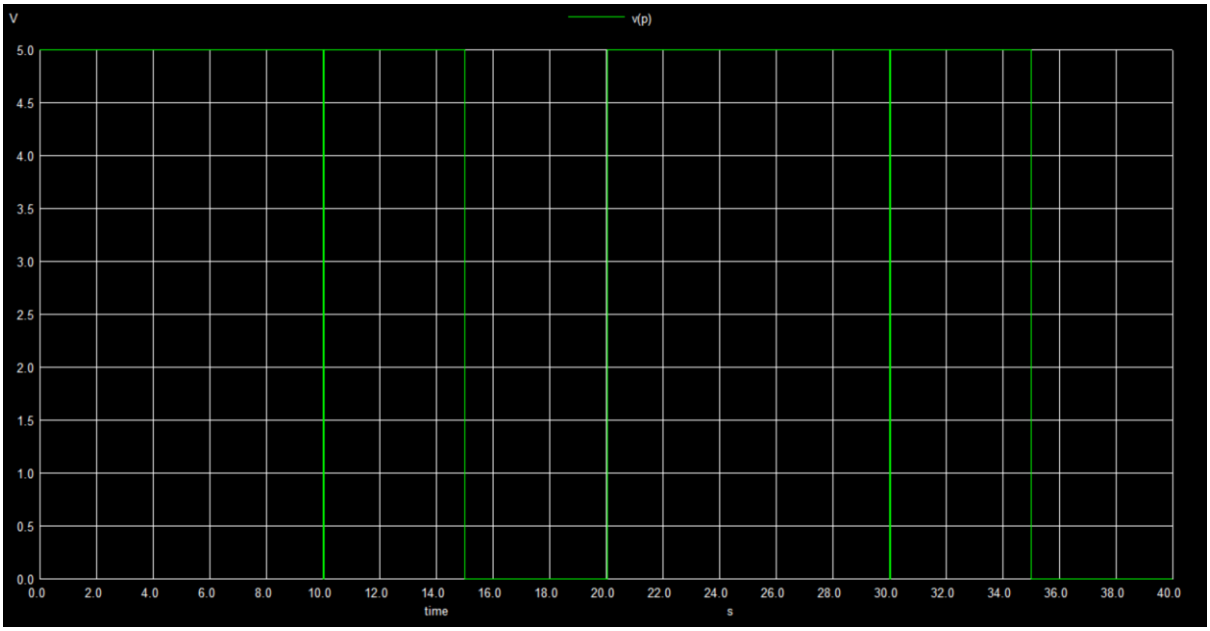
X: (A+B)’


V
v(x)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0
time
s

Q: (A’+B’)

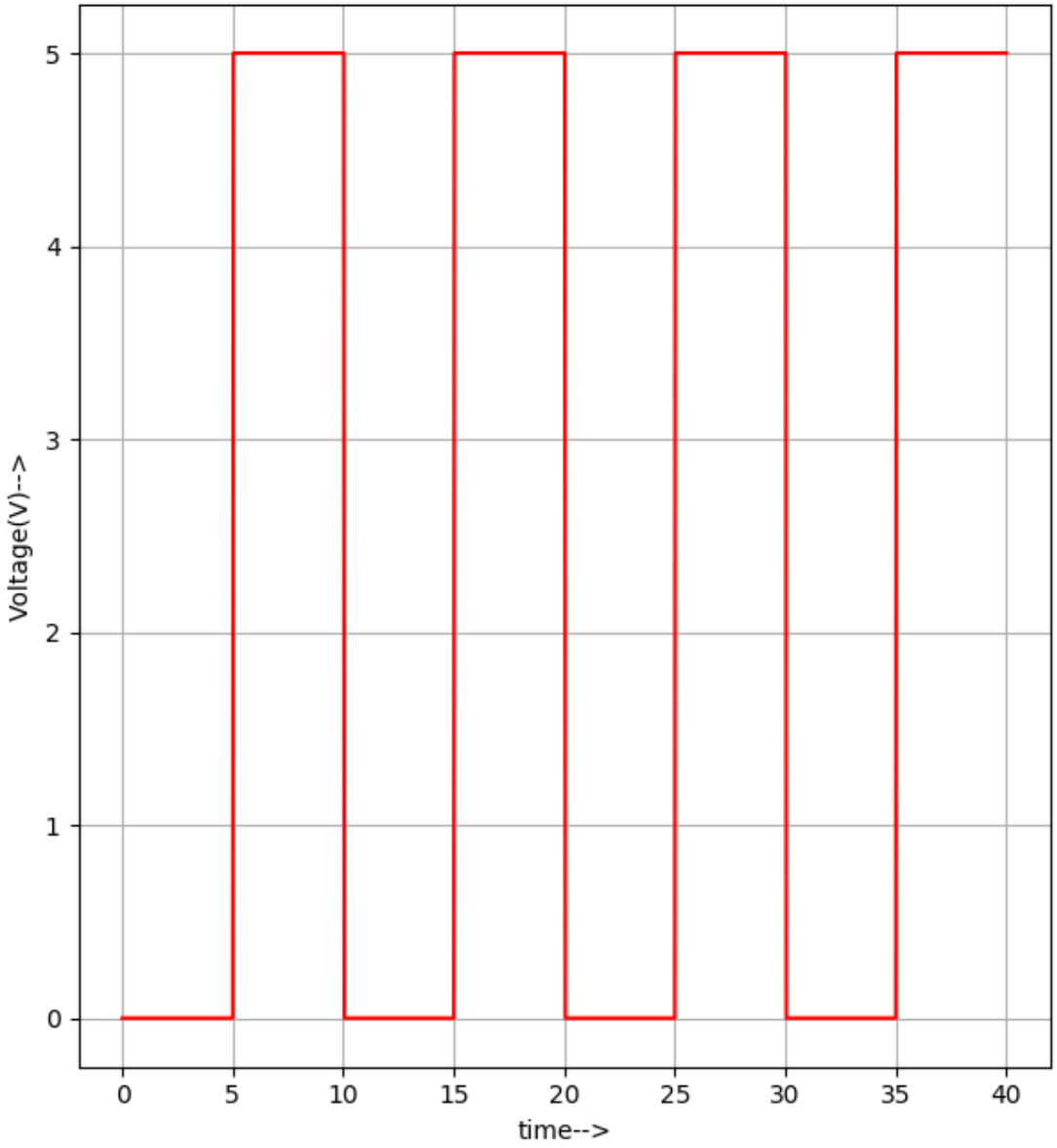

V
v(q)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0
time
s

P: (AB)’

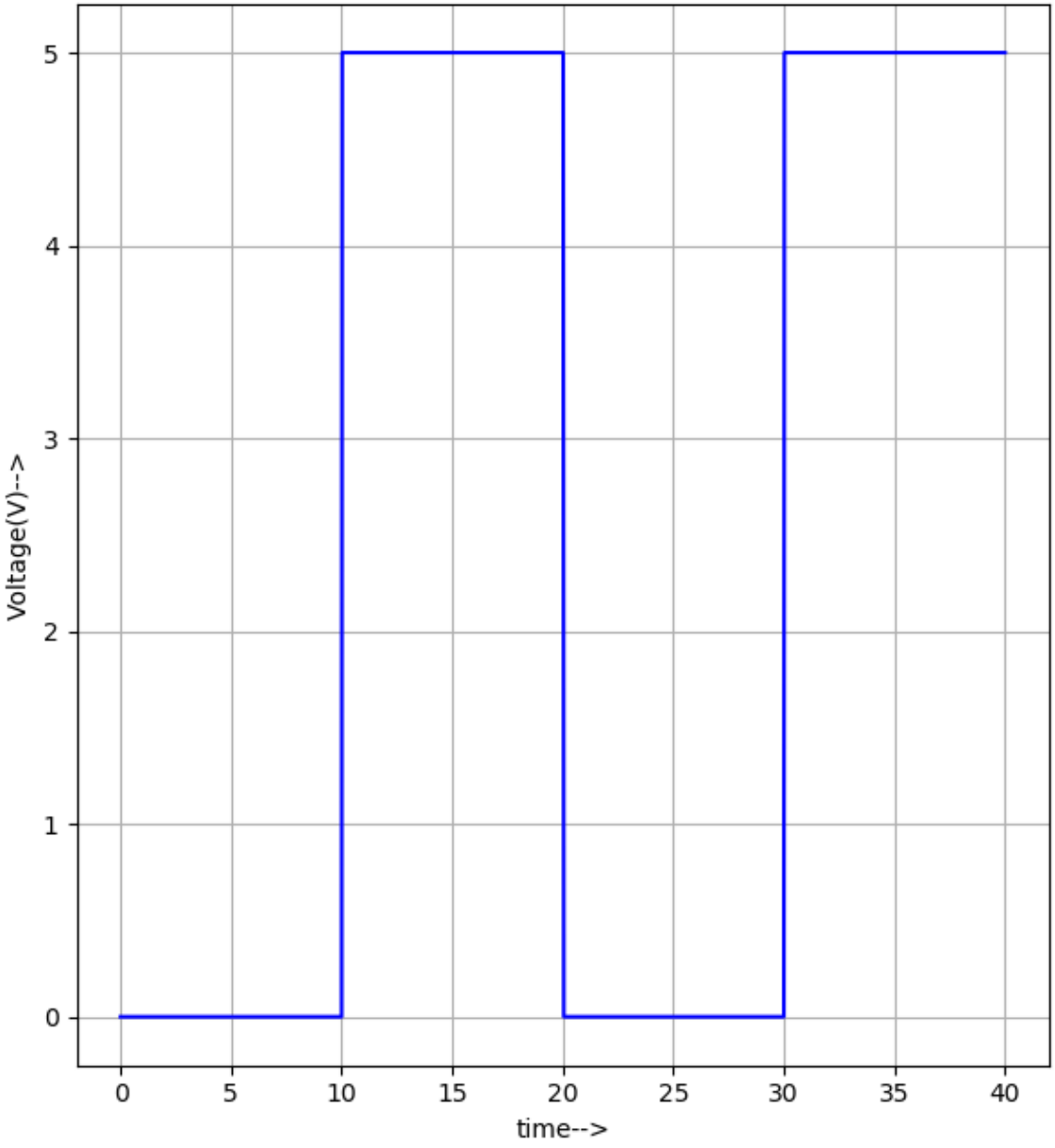


Python Waveforms:

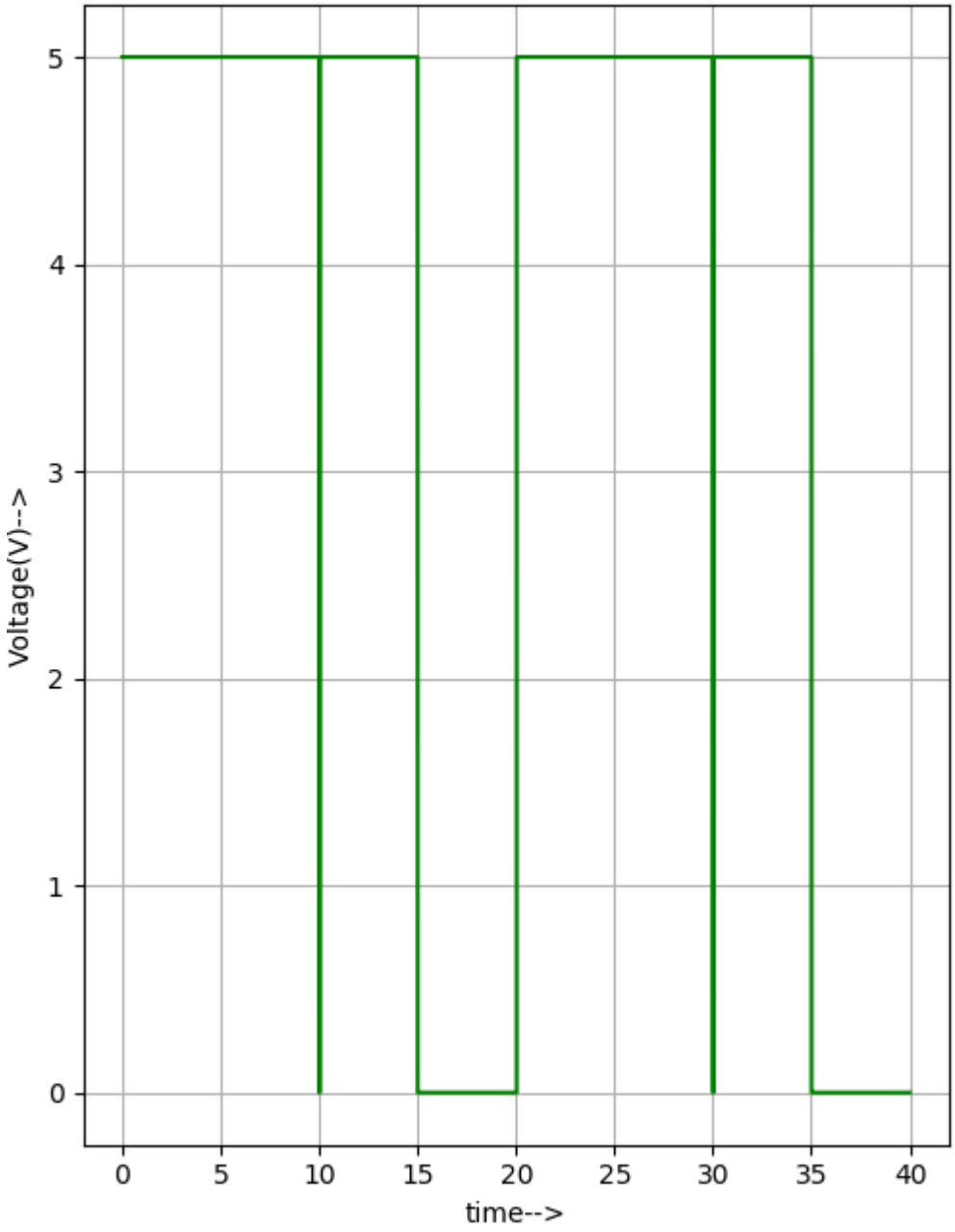
A:



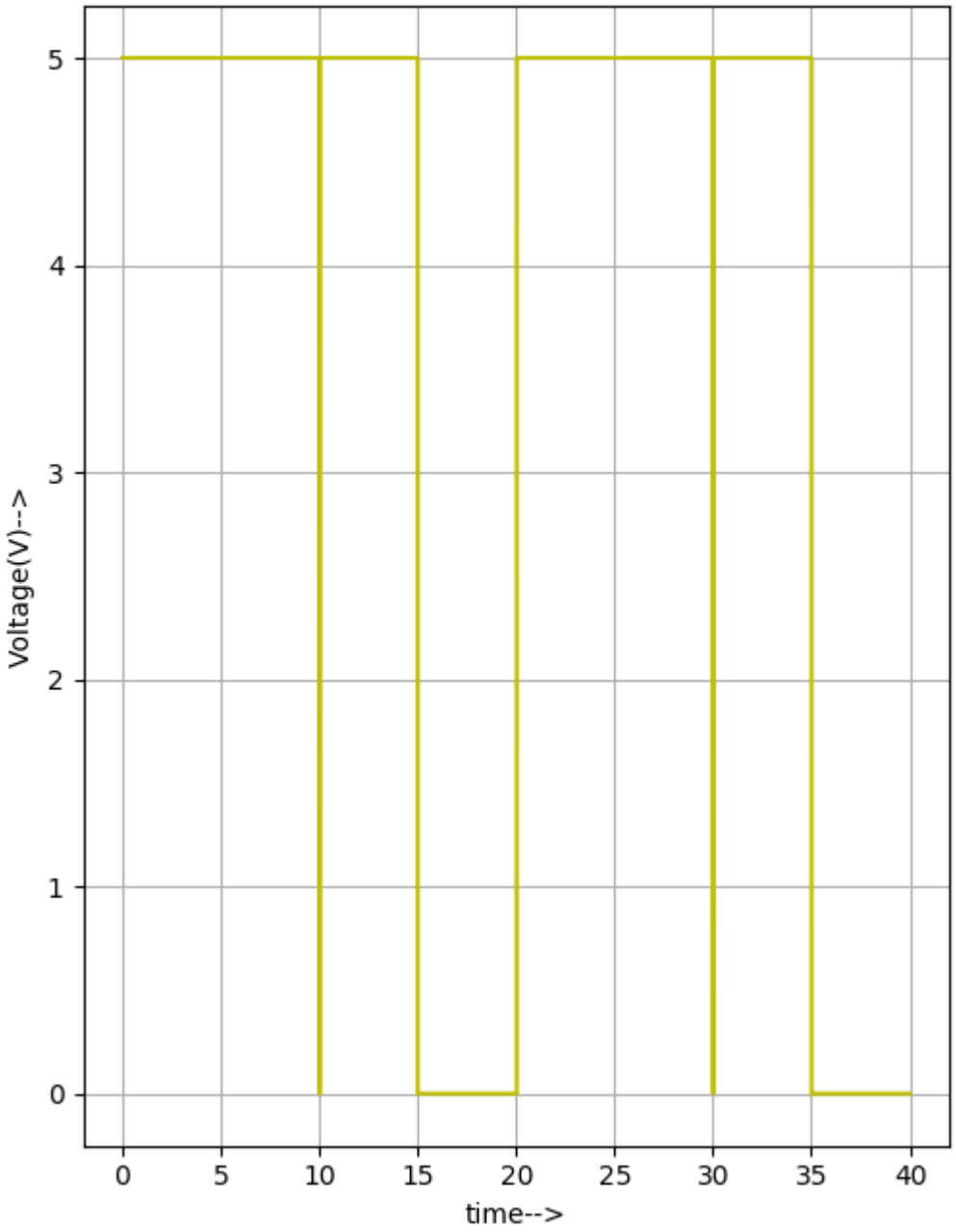
B:



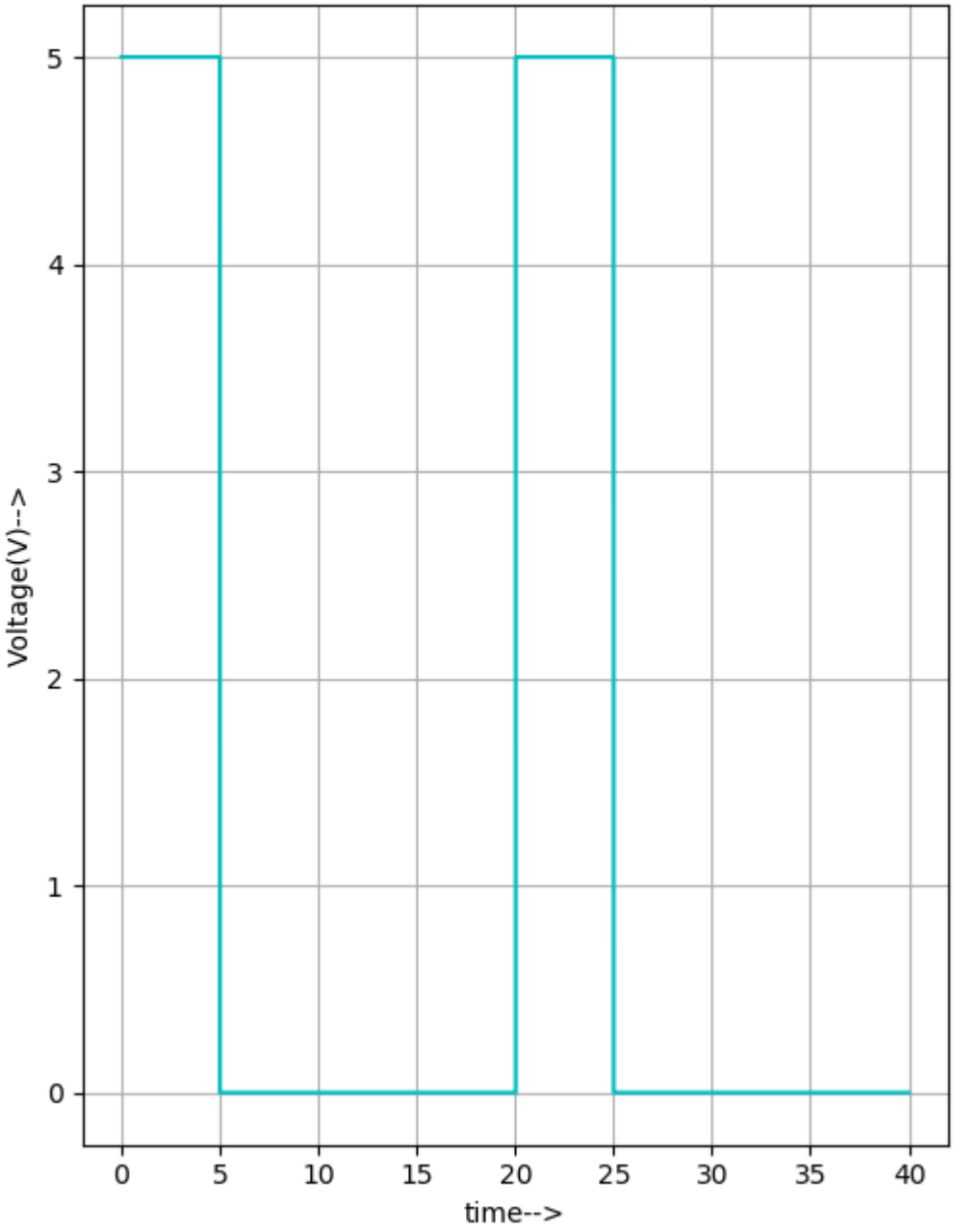
P: (AB)'



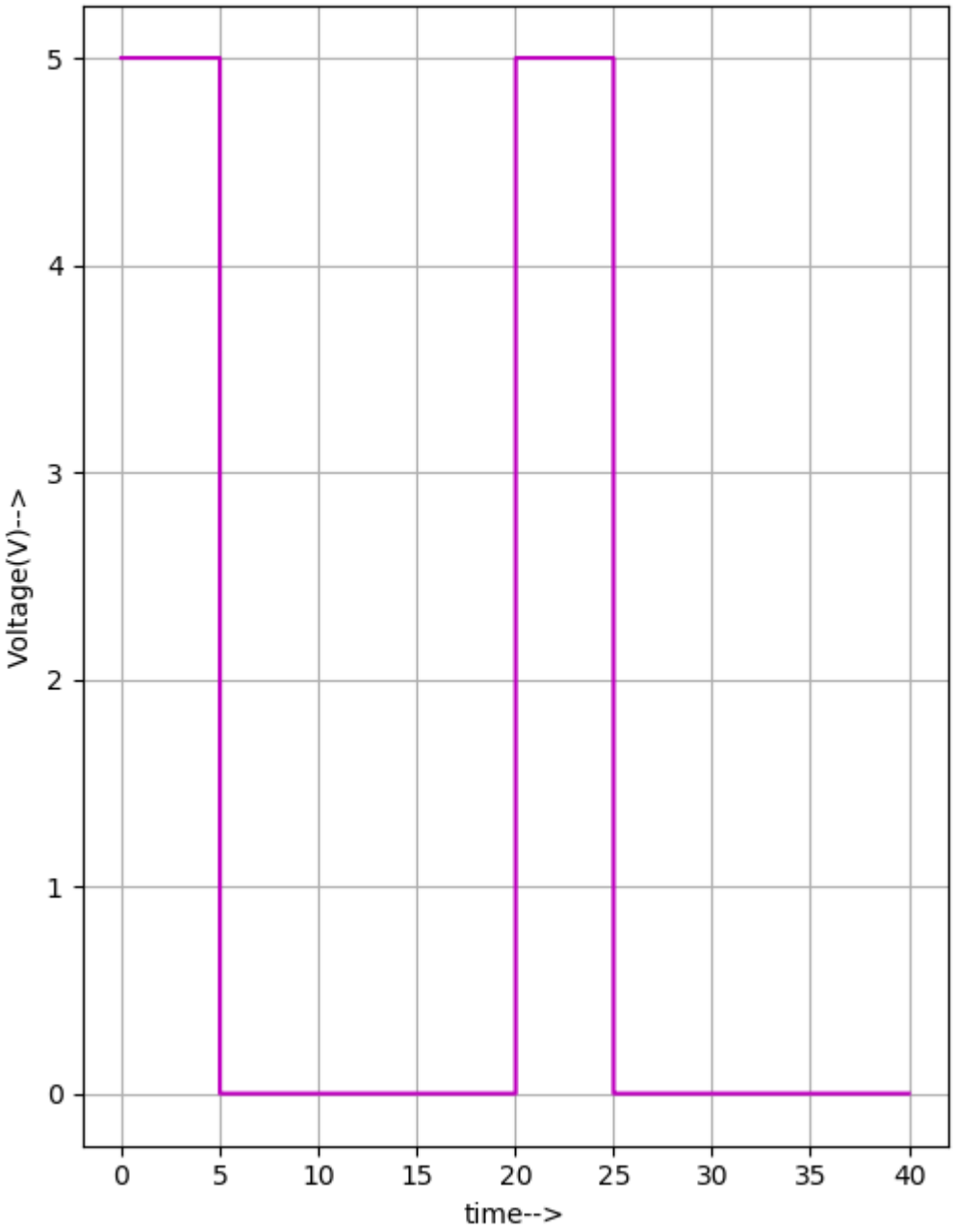
Q: (A'+B')



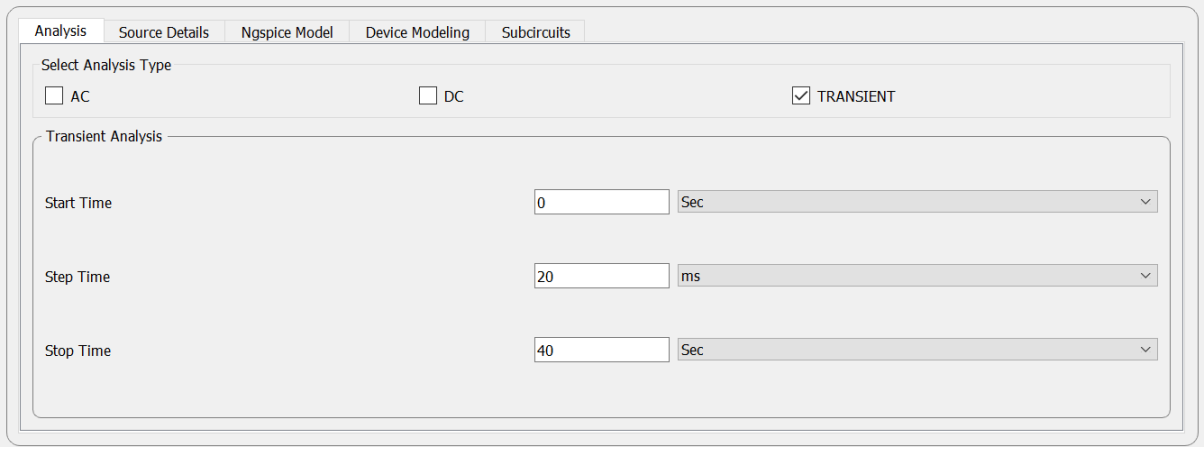
X: (A+B)'



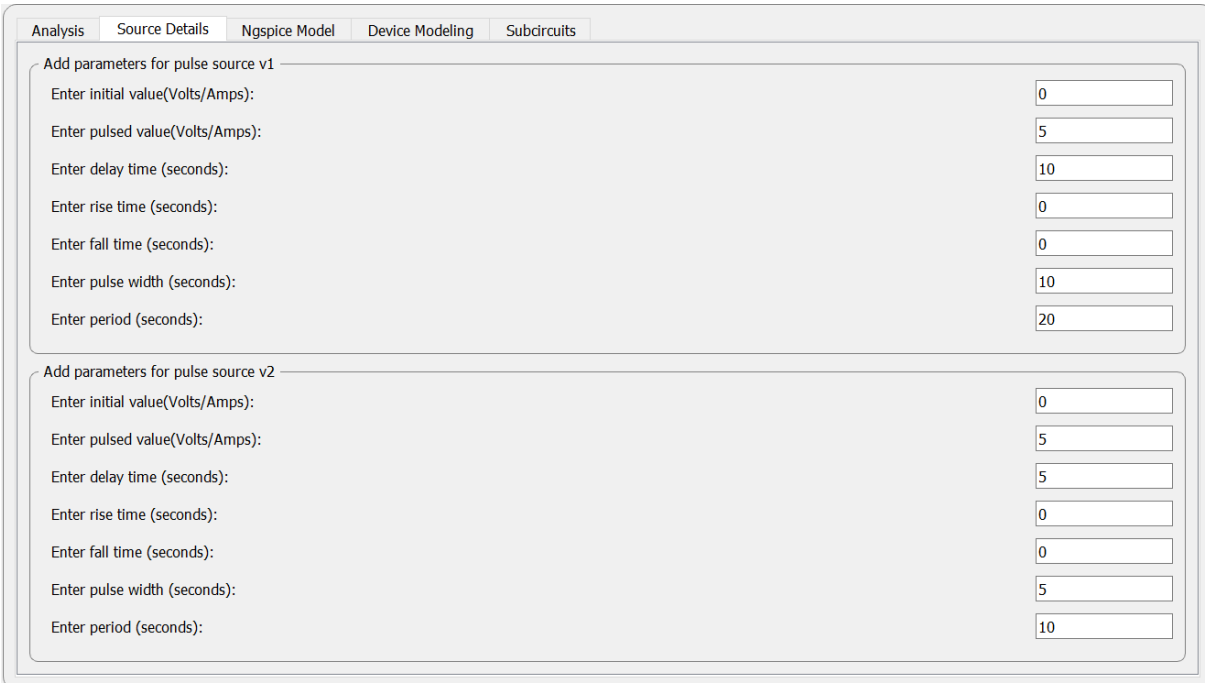
Y:(A'B')



Transient Analysis:



Source Details:



Conclusion:

Thus, the circuit was designed and DE Morgan's theorem has been verified.

References:

https://www.electronics-tutorials.ws/boolean/demorgan.html

https://www.geeksforgeeks.org/boolean-algebraic-theorems/