3. Design and Troubleshooting of Clippers and Clampers

Course: ECE1008 – Electronic Hardware Troubleshooting LAB

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Vellore Institute of Technology

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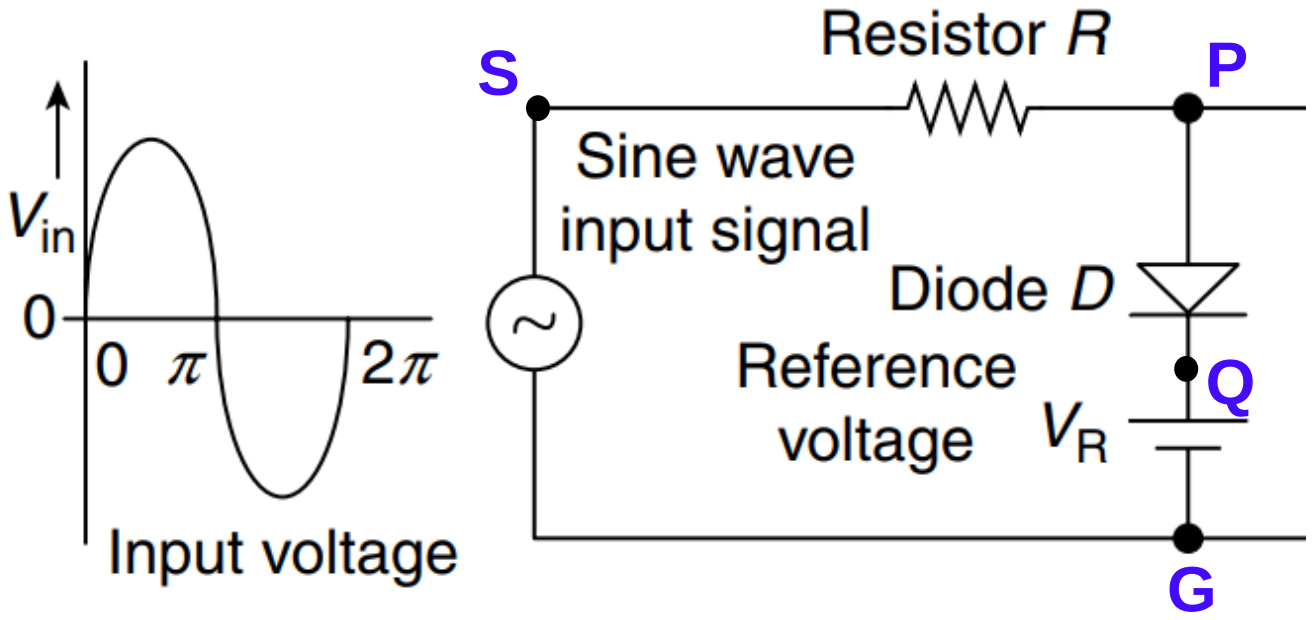
CHENNAI

1. Introduction to Clippers

- Circuit designed to prevent a signal from exceeding a predetermined reference voltage level

2. General Positive clipper circuit



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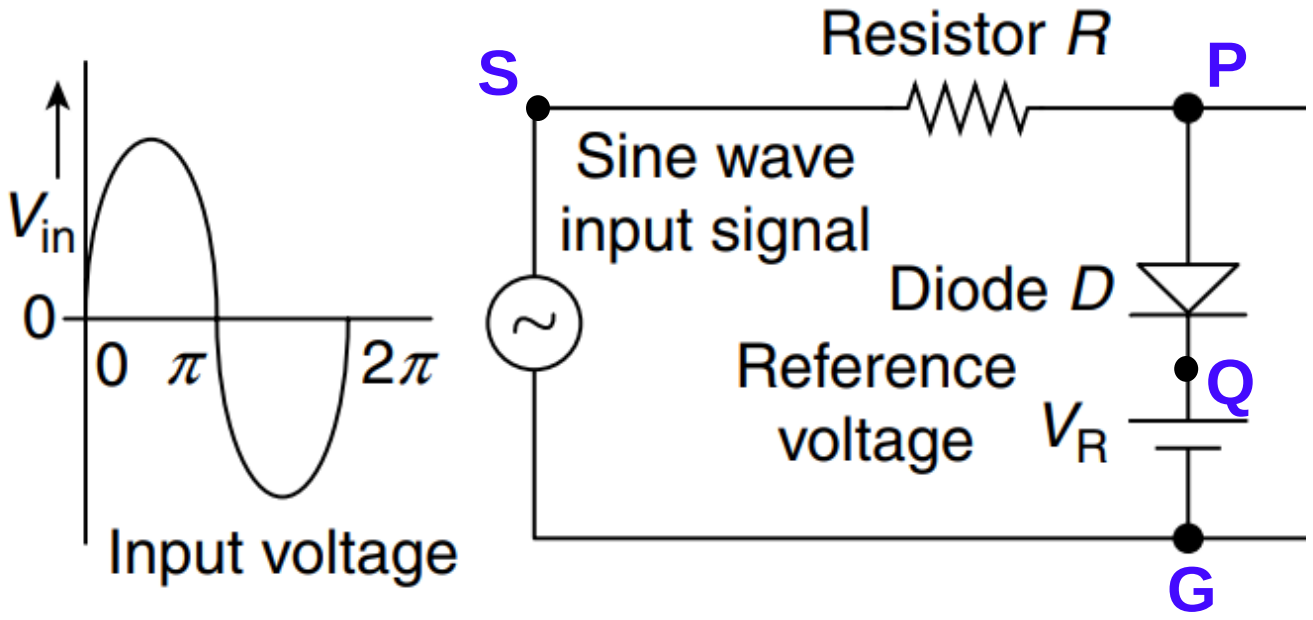

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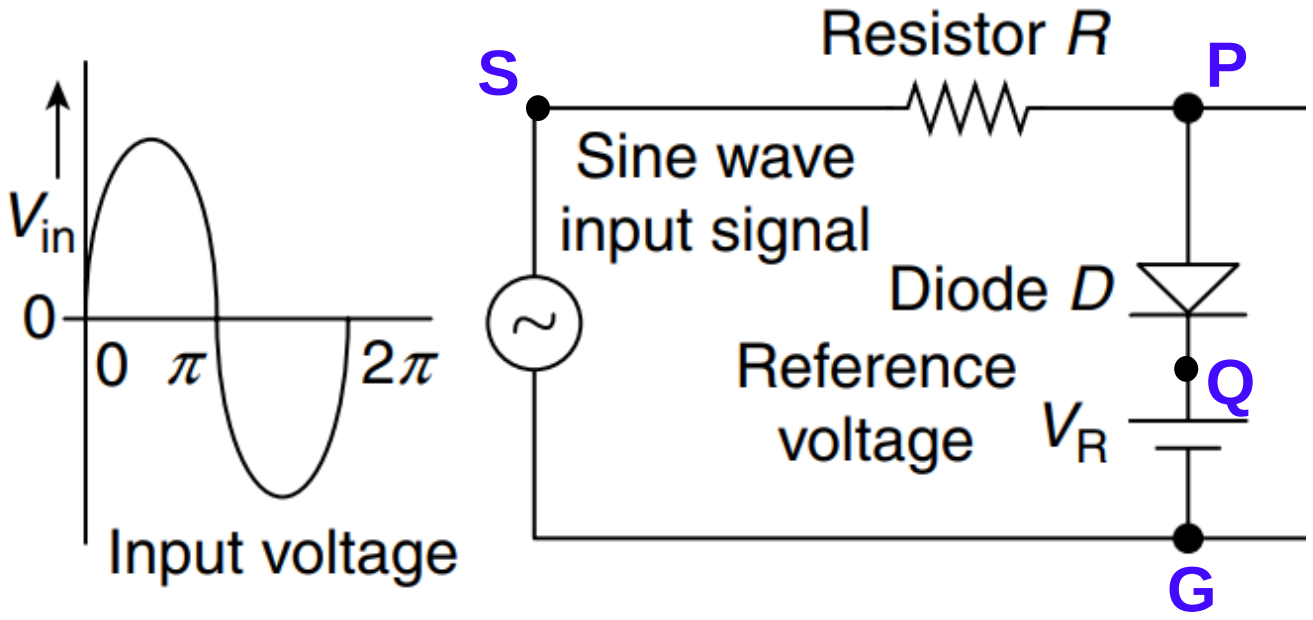

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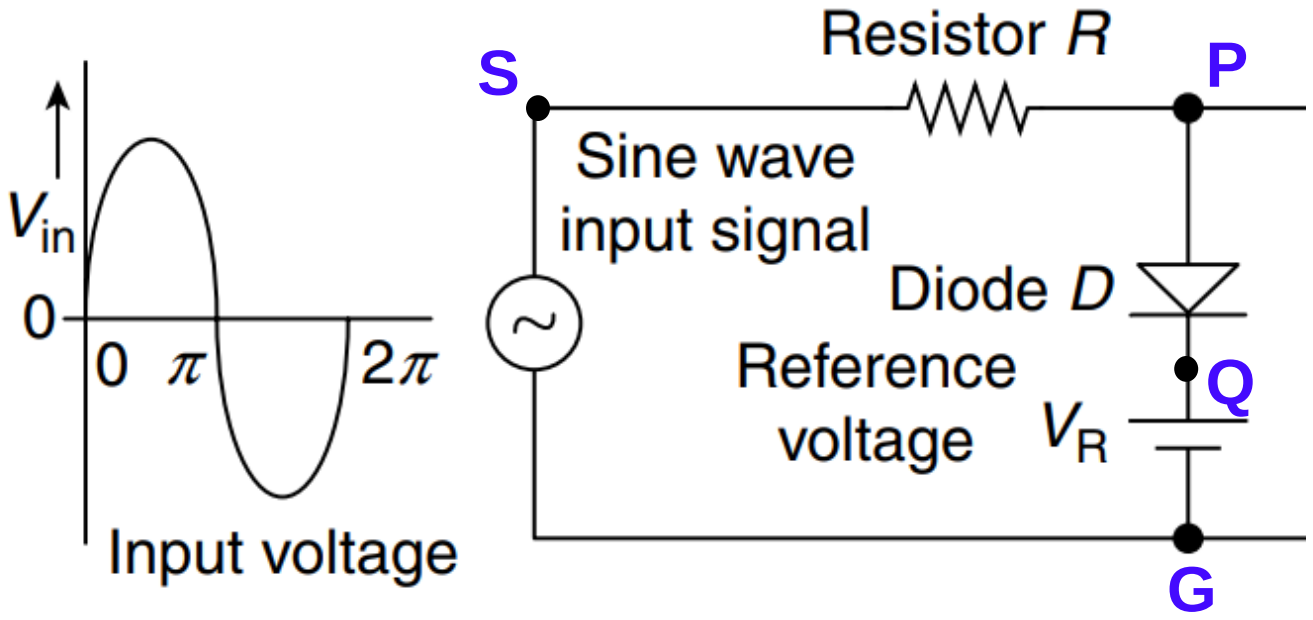

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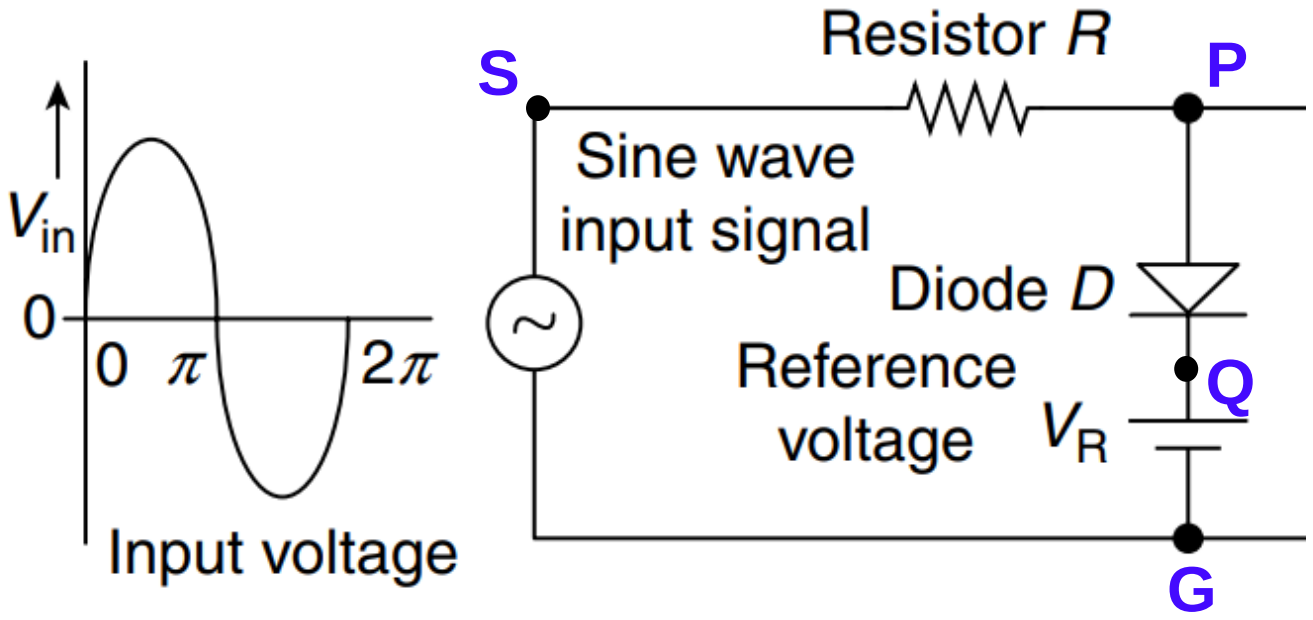

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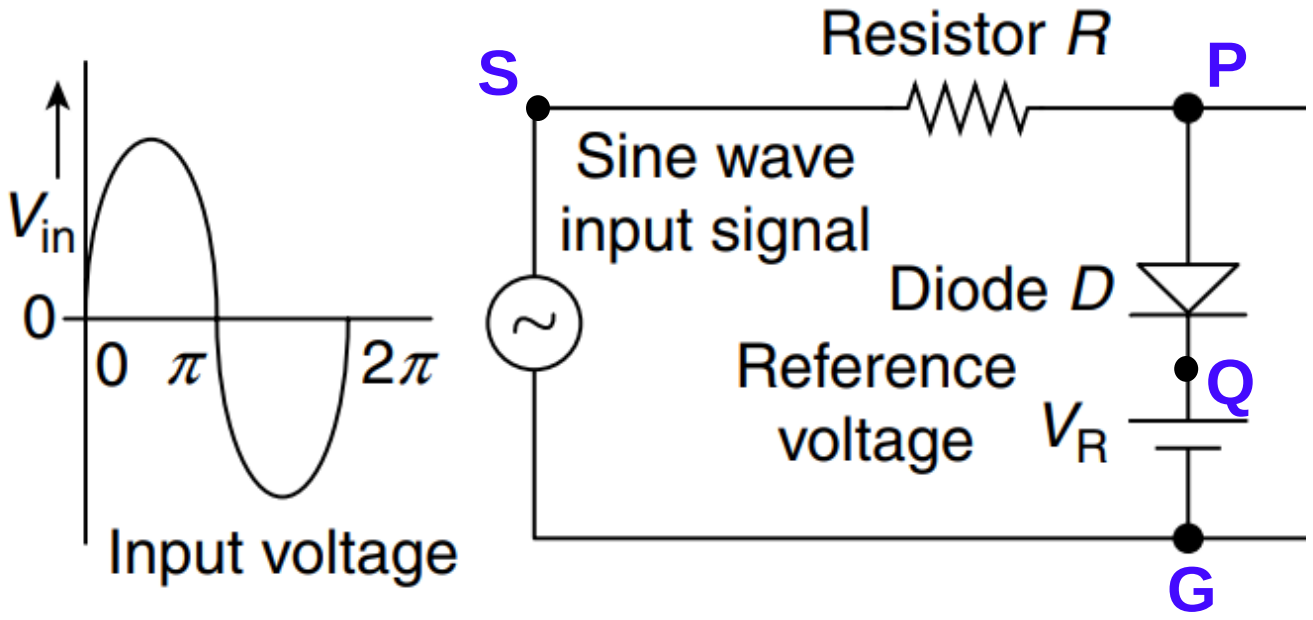

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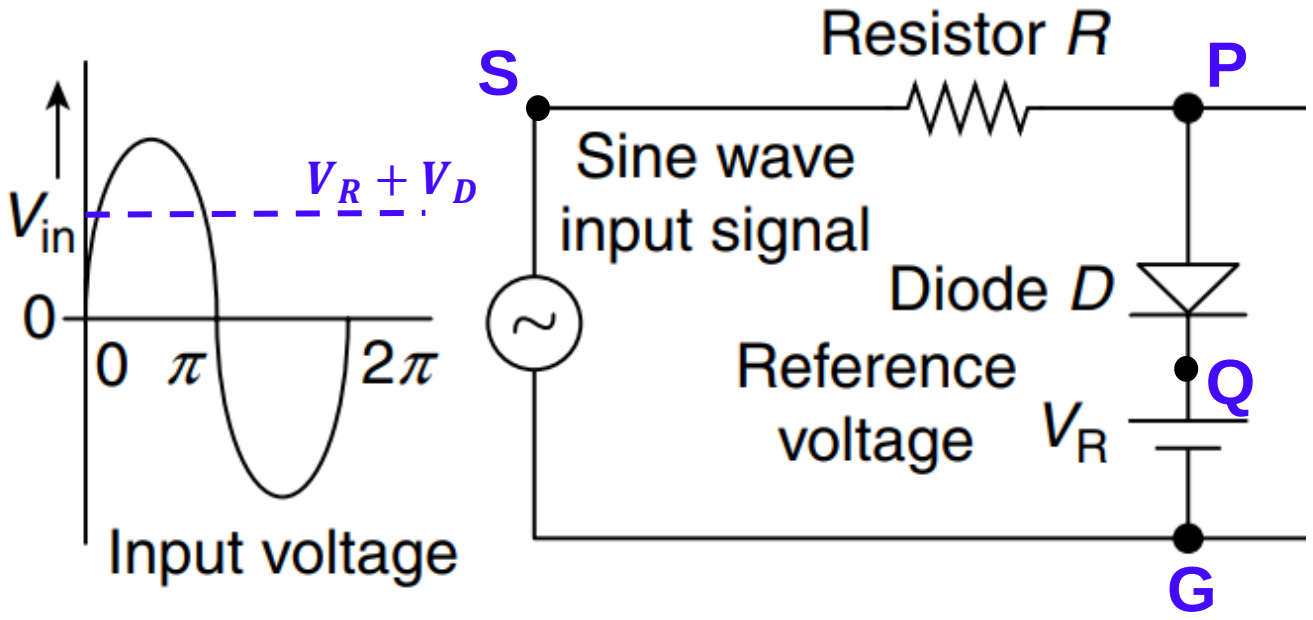

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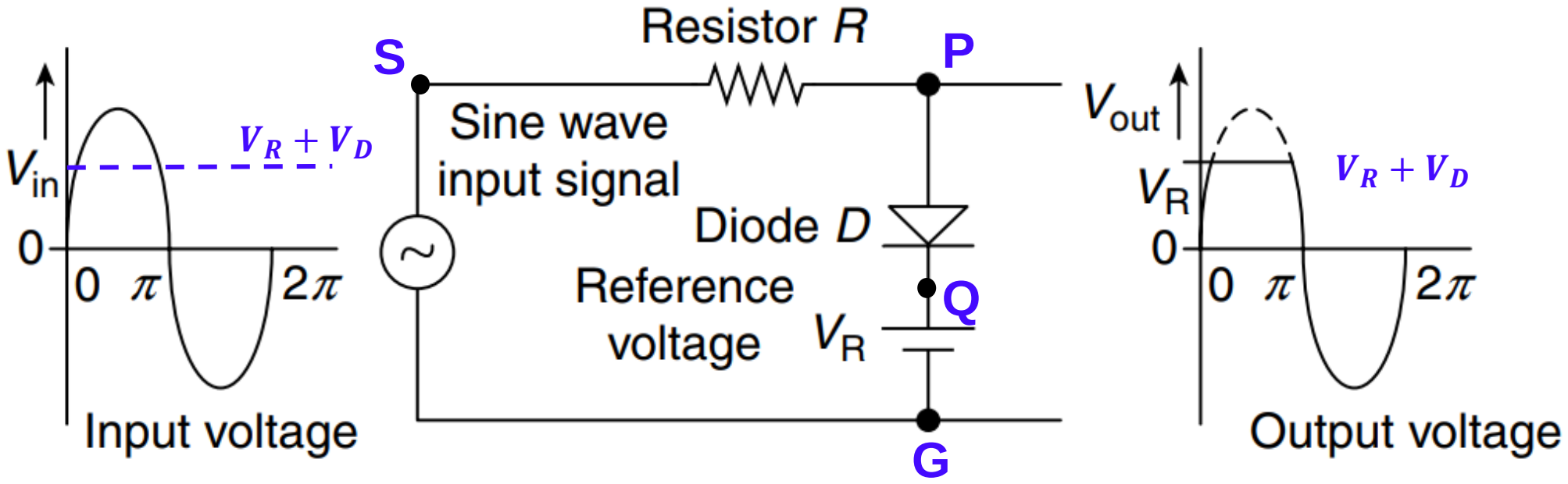

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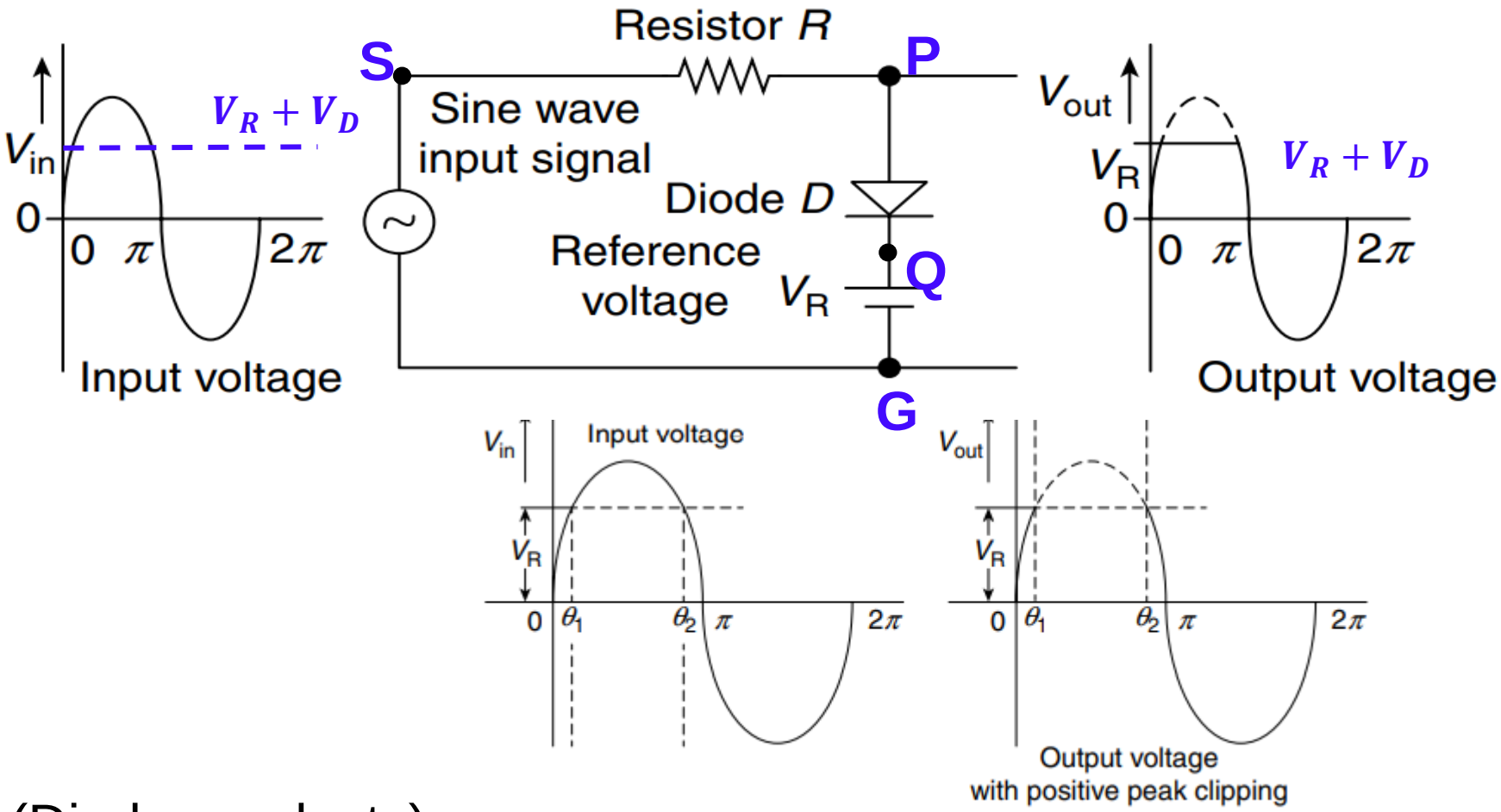
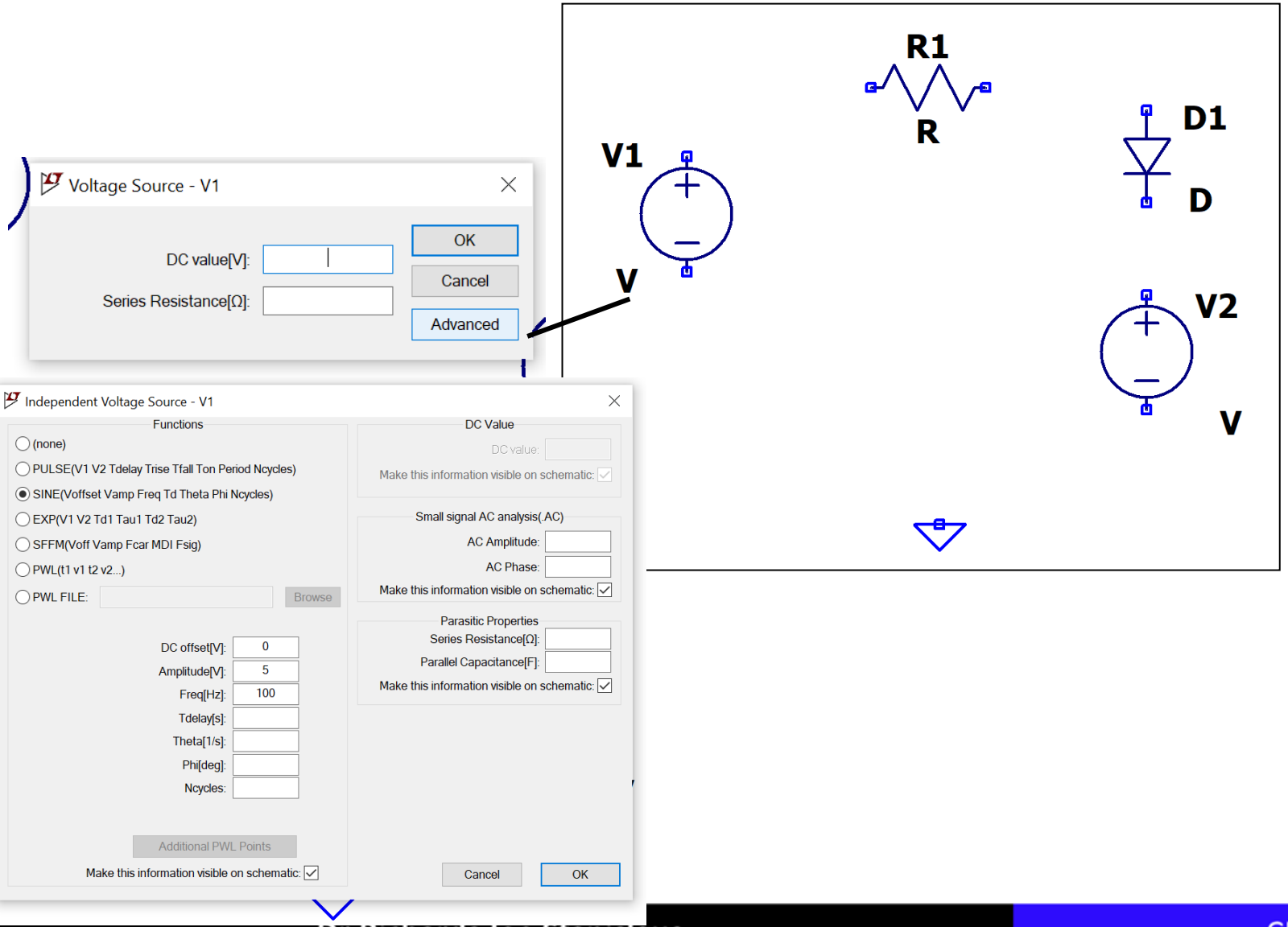


- In diode forward bias: (Diode conducts)
- $V_{in} > V_R + V_D$ $\quad V_{out} = V_D + V_R$

- In diode reverse bias ($I = 0$)
- $V_{in} < V_R + V_D$ $\quad V_{out} = \mathrm{V_{in}}$

2.2 Steps in LT Spice



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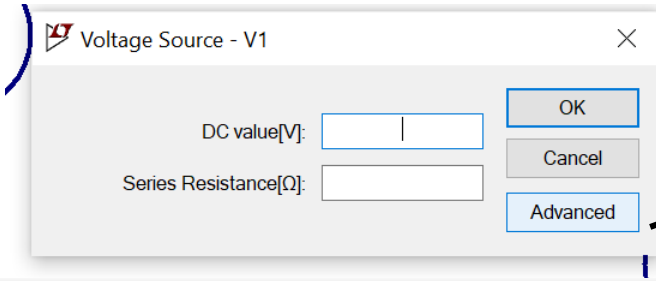

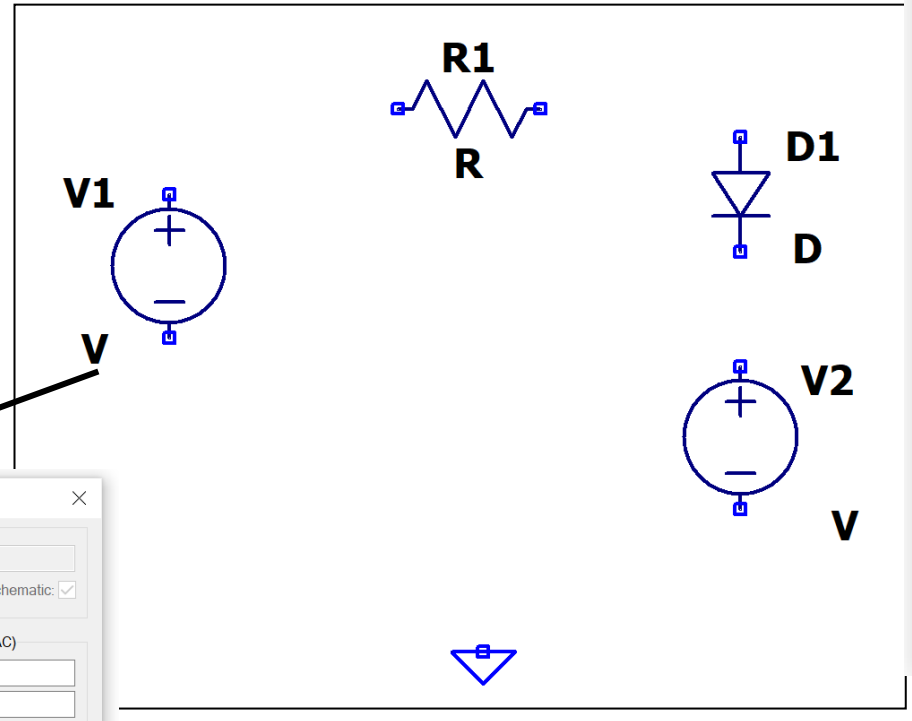

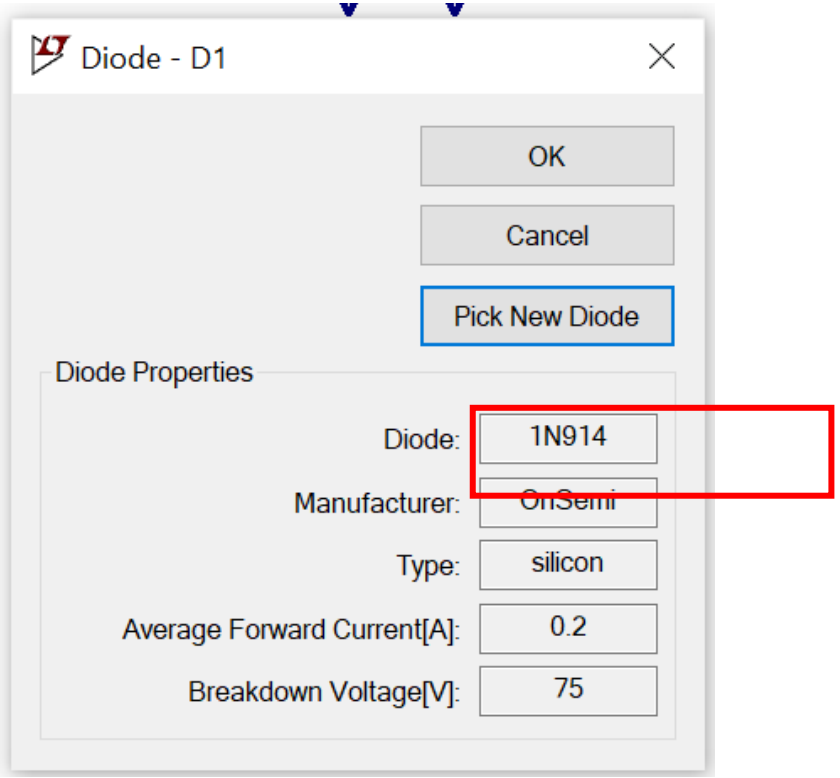

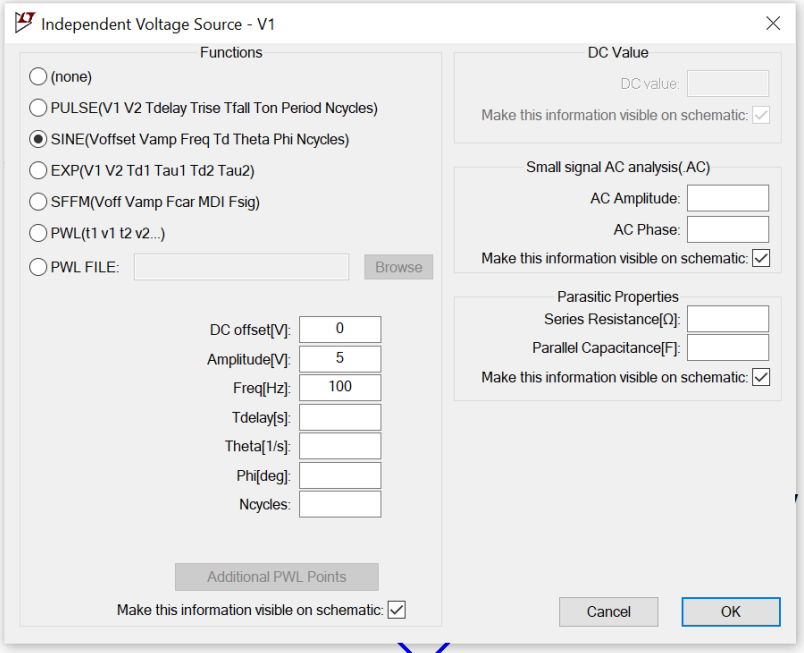

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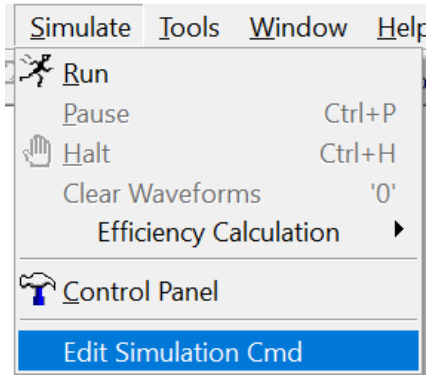

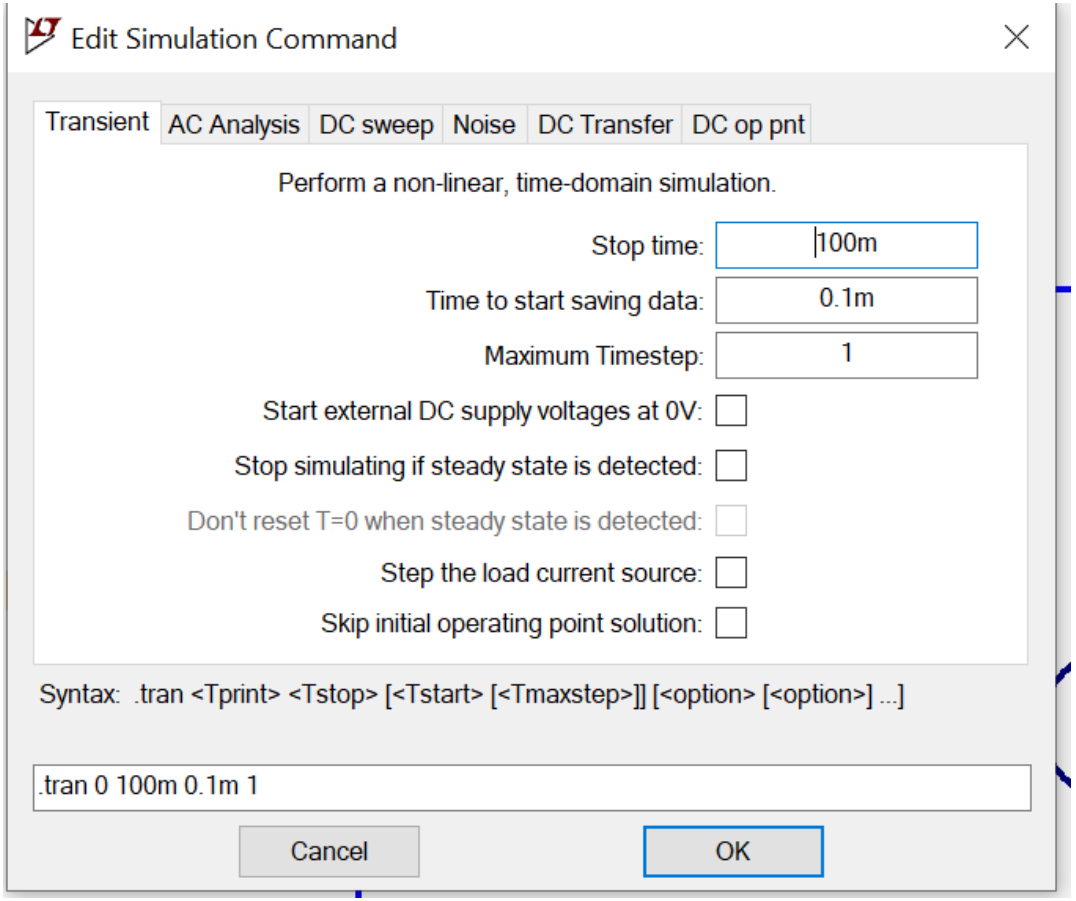

.tran 0 100m 0.1m 1

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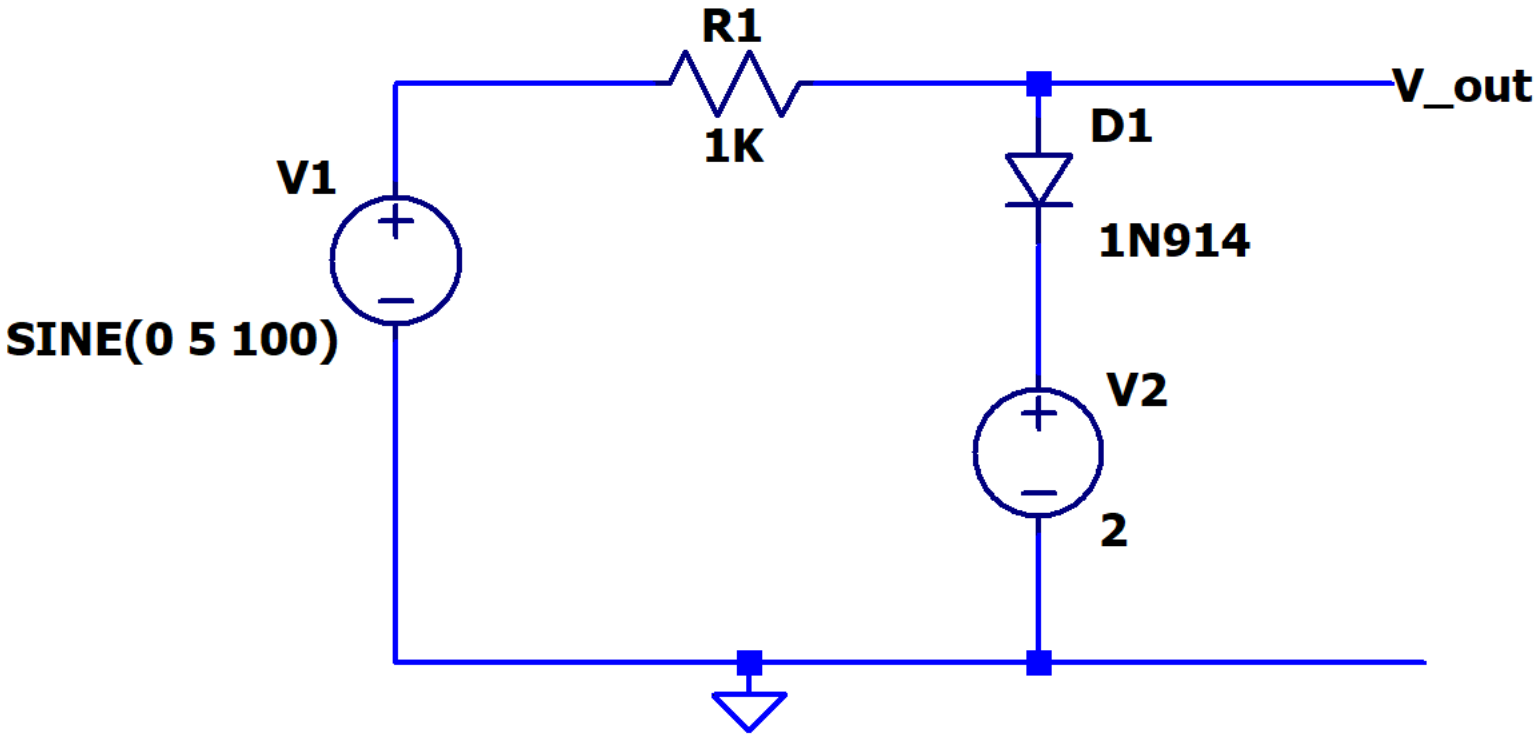

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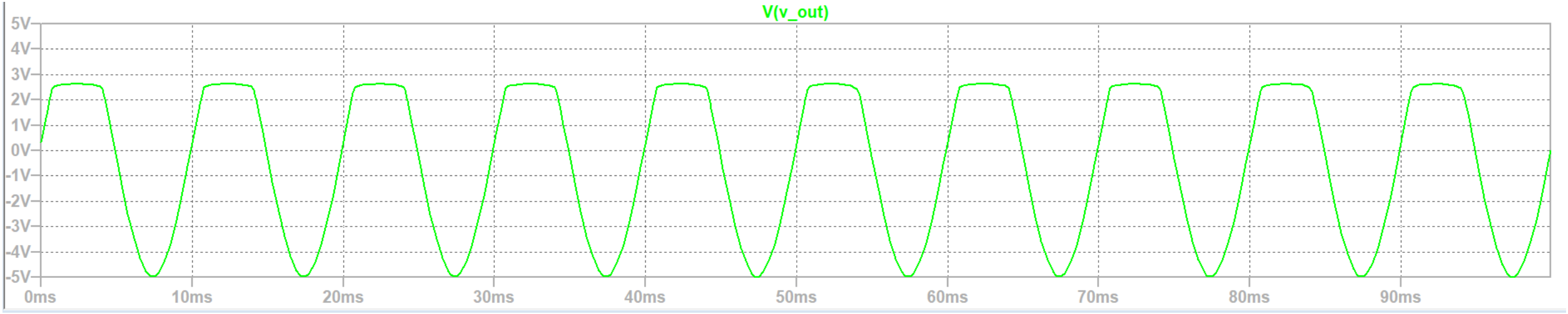

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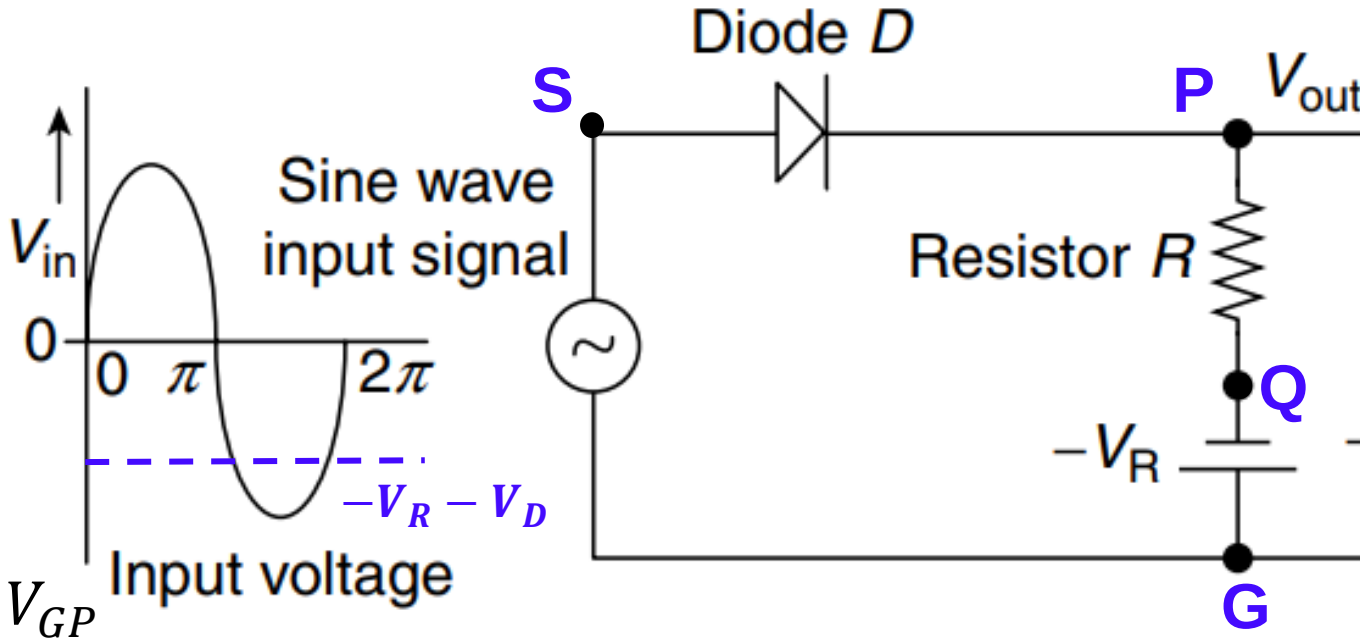

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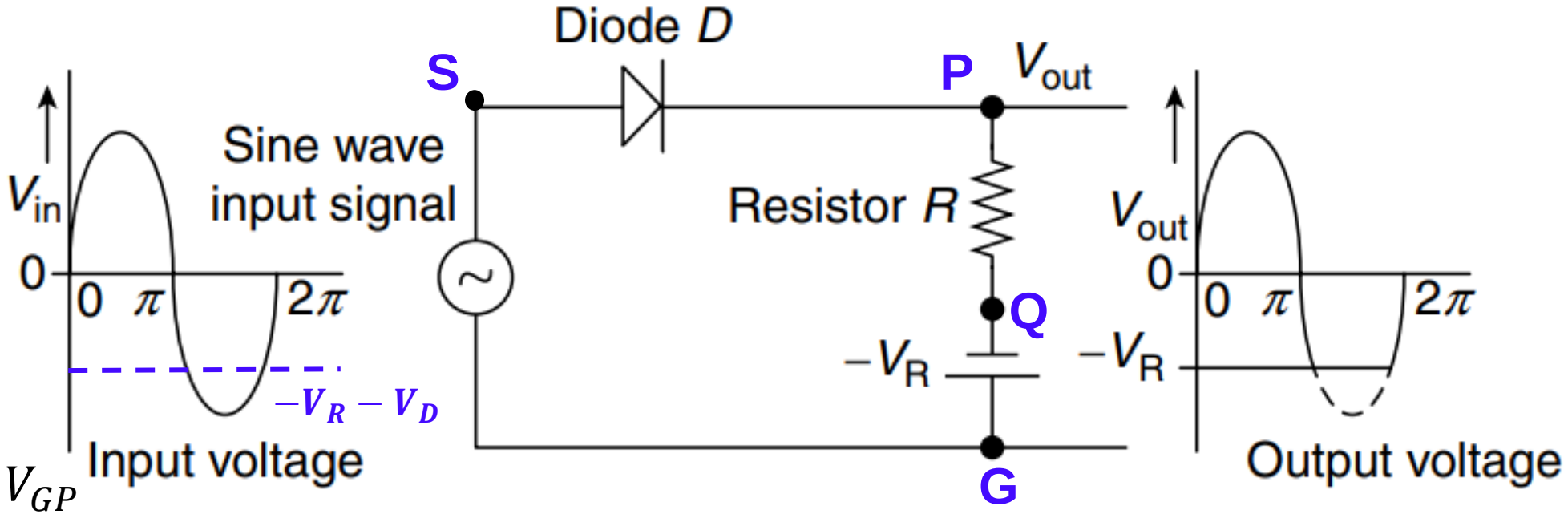

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- A prescribed level of DC voltage is introduced at the output of the clamper circuit.
- The DC voltage may be +ve or –ve
- Two types of clamping circuits: 1) Negative clamping circuit, and 2) Positive clamping circuit

5. Why do you need clamping circuits

- A signal that passes through a capacitive coupling (capacitor allows high frequency signals only), the DC component is lost.

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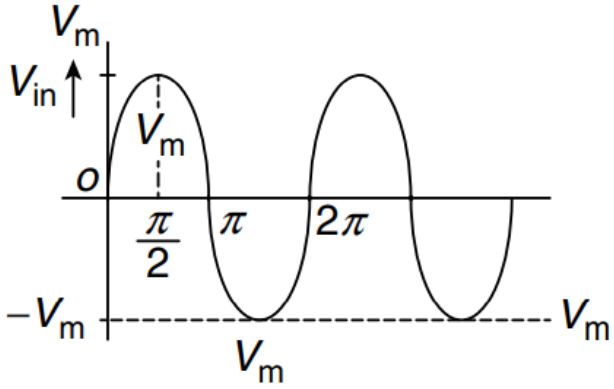
- A signal that passes through a capacitive coupling (capacitor allows high frequency signals only), the DC component is lost.
- To restore the DC component, Clamping circuits is necessary
- Other names of Clamper: DC Restorer, DC Reinserter, Baseline stabilizer

6.1 Negative clamping circuit: Basics

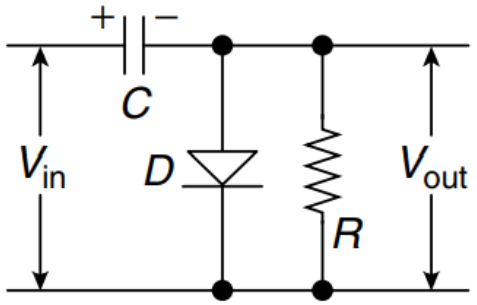
V_{in} Sinusoidal input with zero DC level

- Output: V_{out}

Output DC level: $-V_m$



Input signal sine wave



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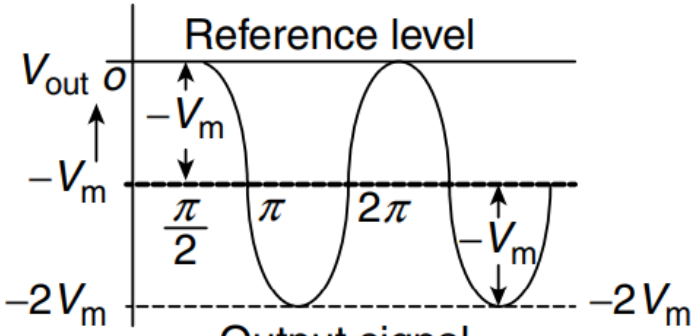

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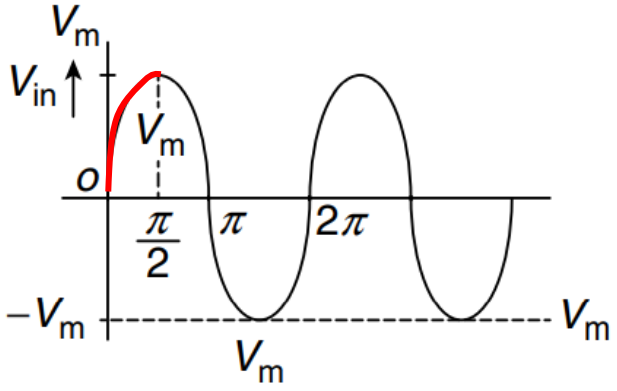

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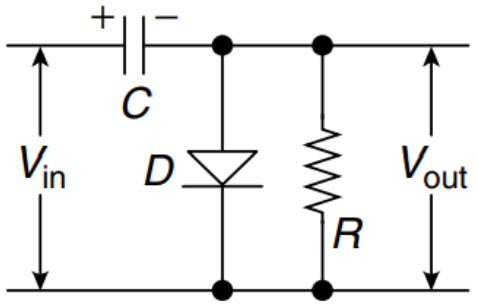

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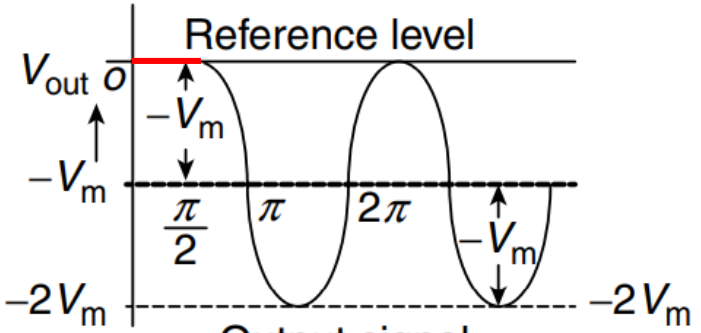

Output signal

1) Consider uncharged capacitor during the start $t = 0$.

When input is applied, V_c does not change instantaneously (Takes time to charge).

Semiconductor diode is forward biased in $t = 0\ to \frac{\pi}{2}$: Complete input voltage V_{in} is across the capacitor, and capacitor is charged upto ($V_c = V_m$) and $V_{out} = 0$.

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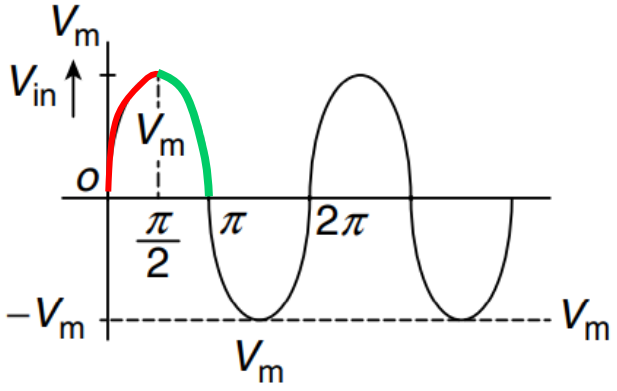

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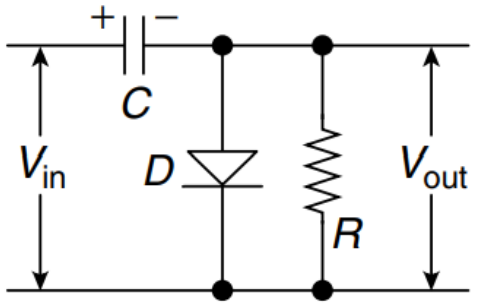

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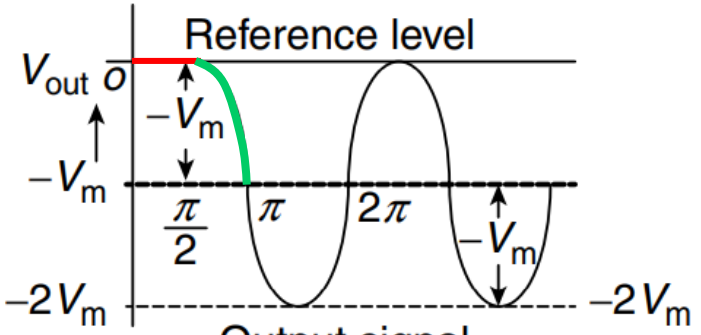

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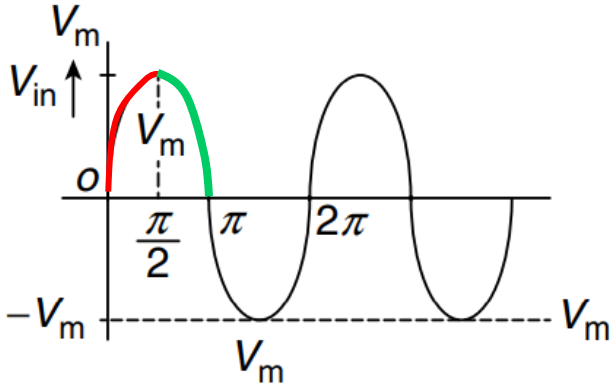

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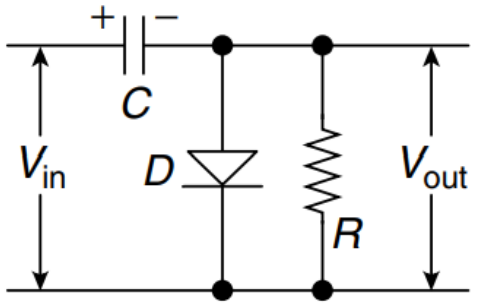

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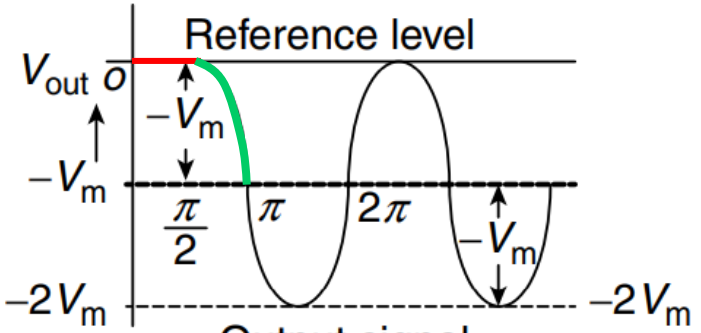

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2) At $t = \frac{\pi}{2}$ to $t = \pi$, When capacitor is charged $V_c = V_m$, Output voltage V_{out} which is across the diode is $\mathrm{V_{out}} = -V_c + V_{in} = -V_m + V_{in}$ Note: $V_{in} \leq V_m$ at all times. Then $V_{out} \leq 0$. Diode is reverse biased at all times.

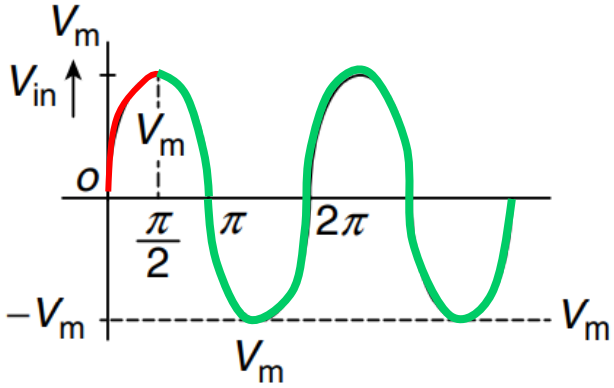
6.1 Negative clamping circuit: Basics

V_{in} Sinusoidal input with zero DC level

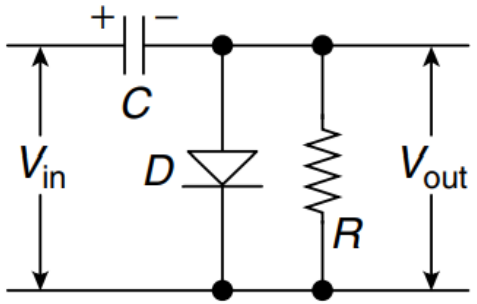
- Output: V_{out}

Output DC level: $-V_m$

$$V_{out} = V_{in} - V_m$$



Input signal sine wave



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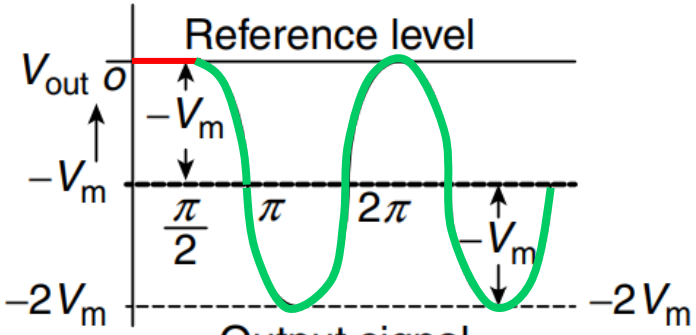
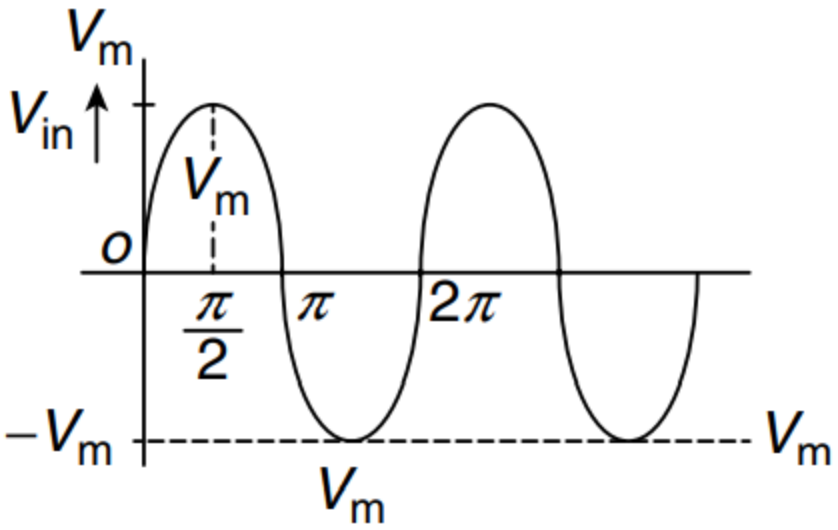
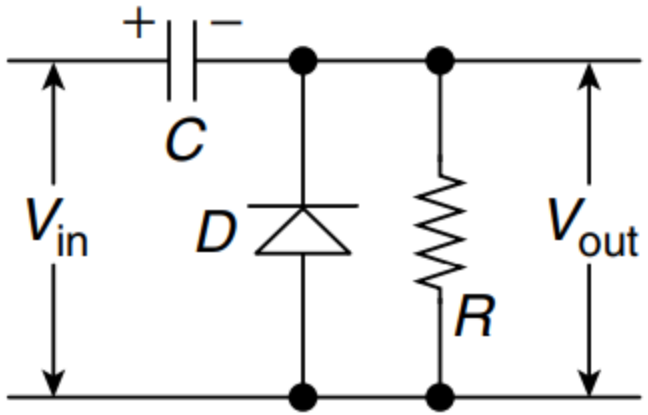


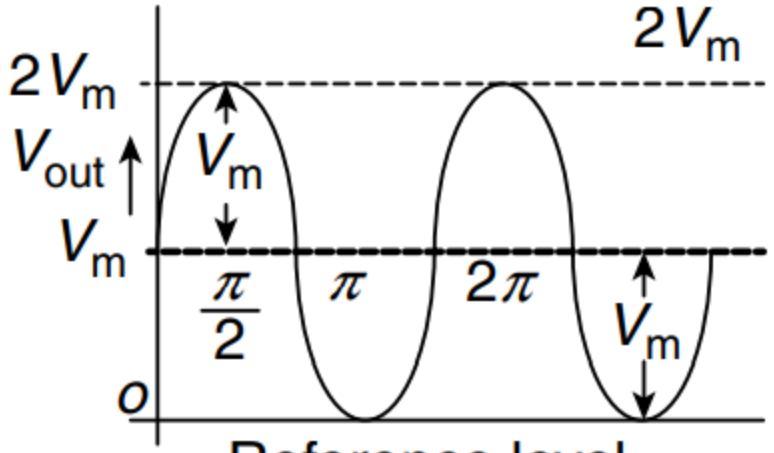
Output signal

7. Positive clamping circuit: Basics



Input signal sine wave

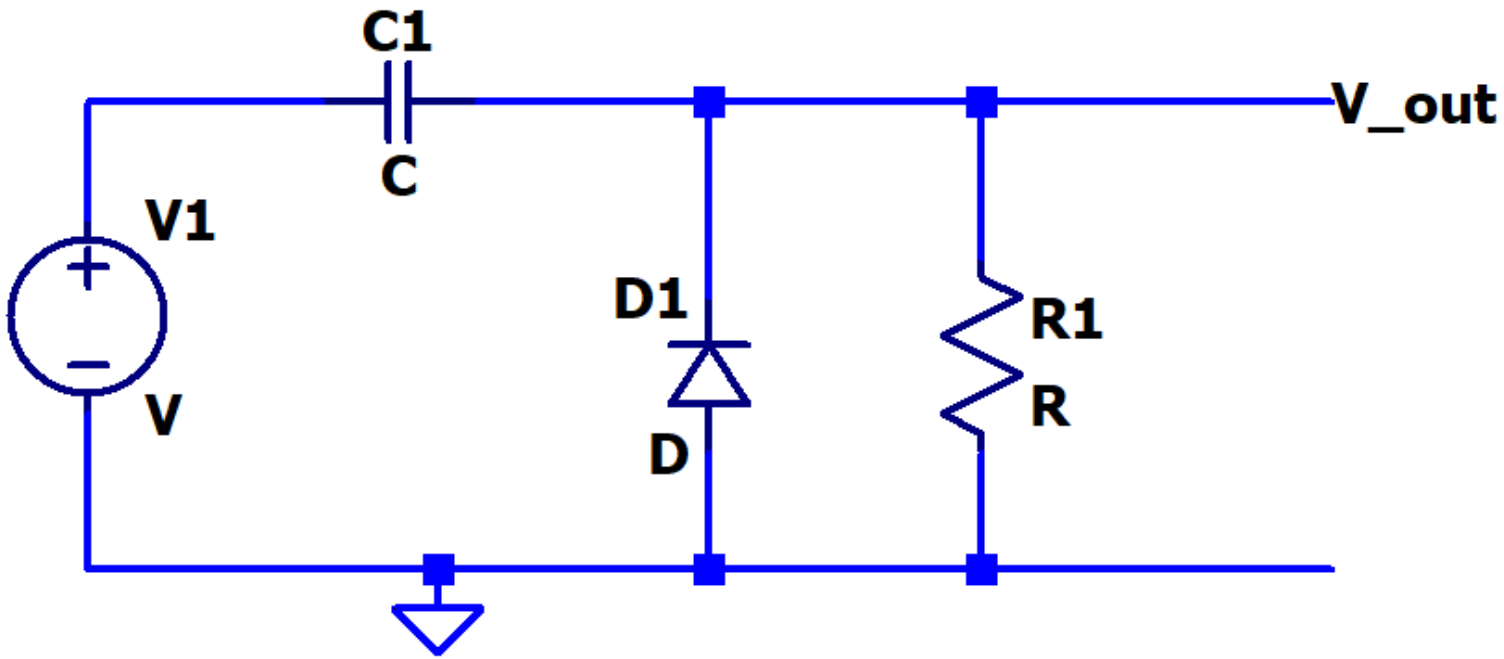




Reference level

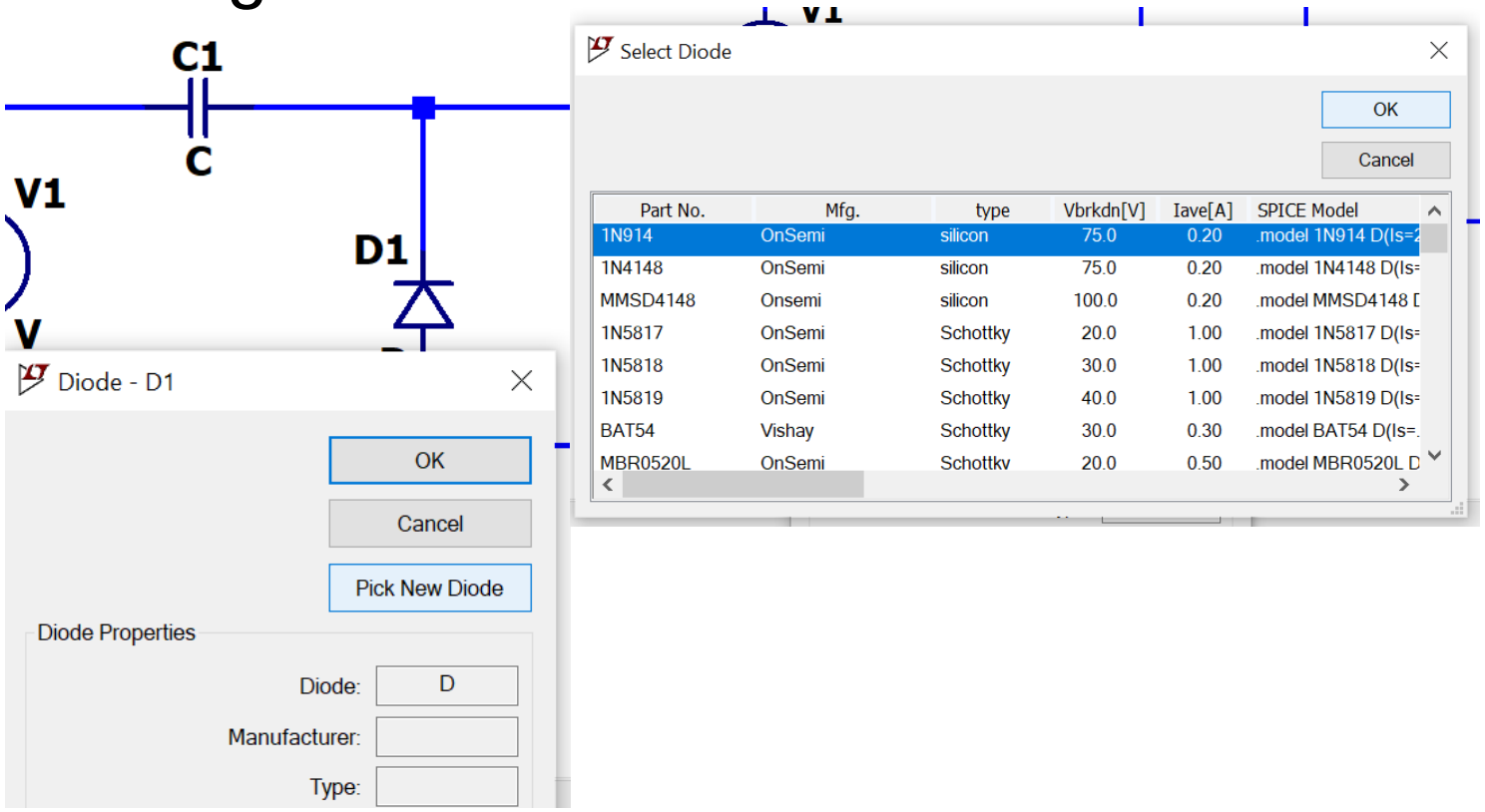
Output signal

7.2 Steps in LT Spice



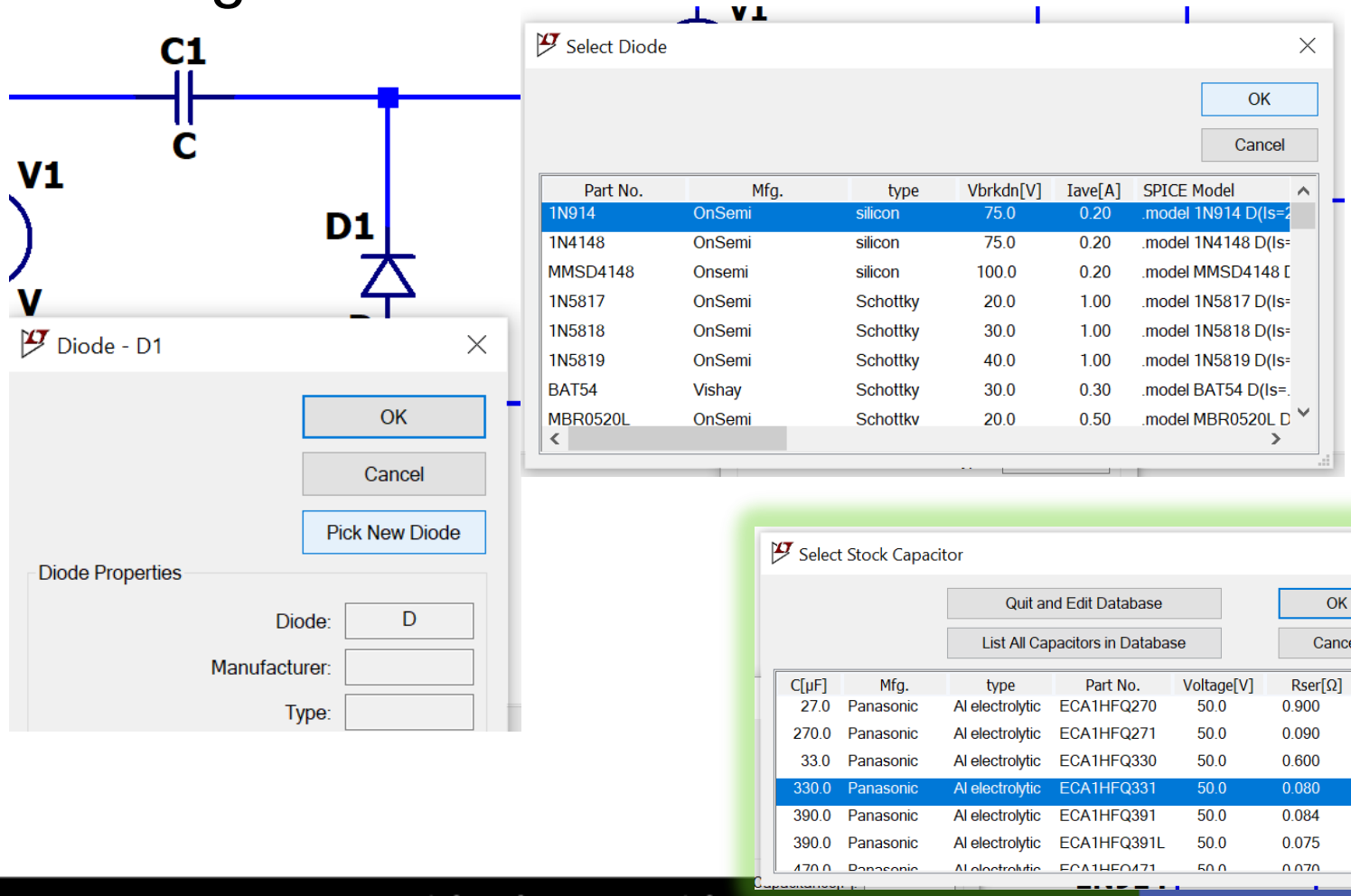
7.2 Steps in LT Spice

- Right click at diode:

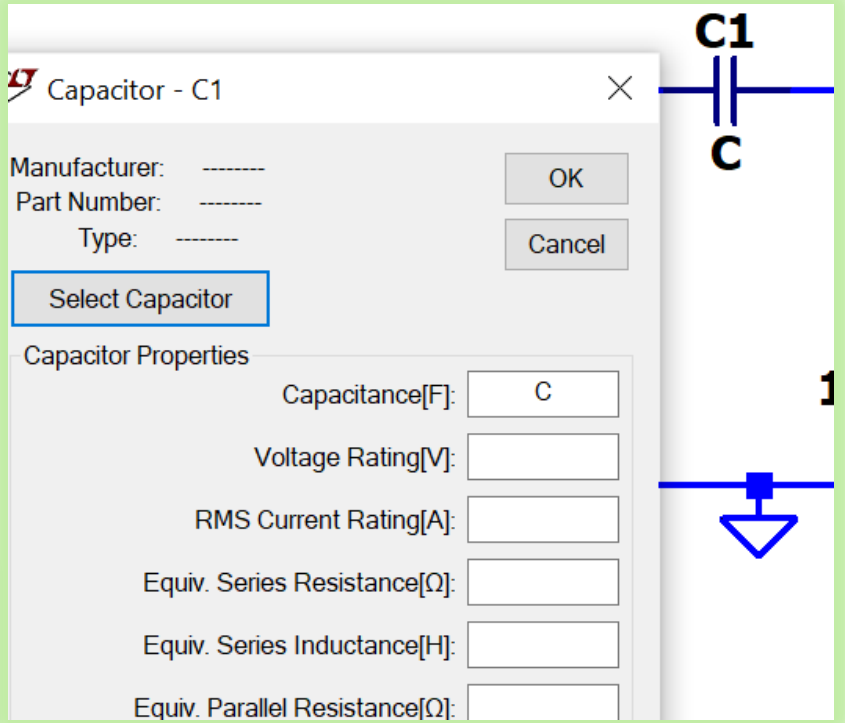


7.2 Steps in LT Spice

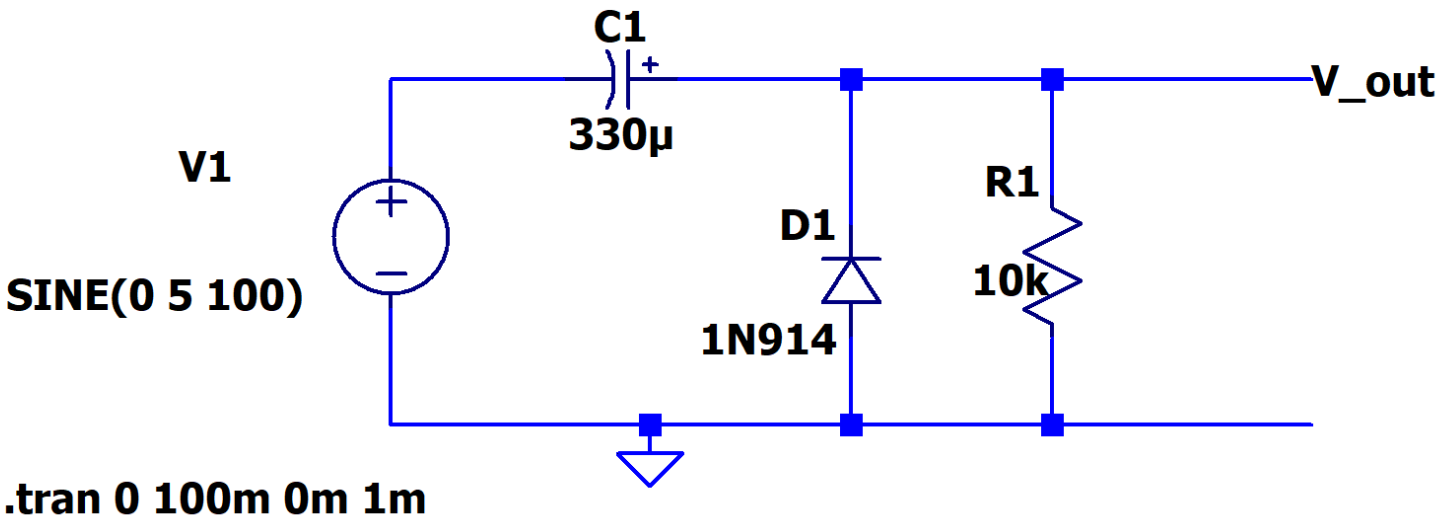
- Right click at diode:



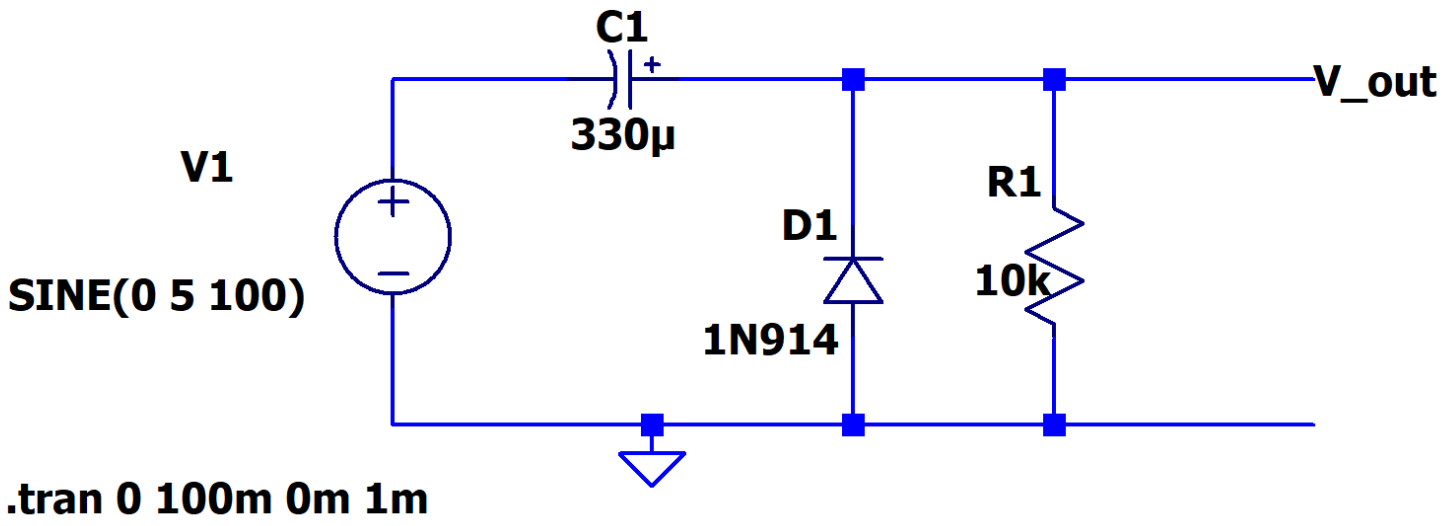
Right click at capacitor:

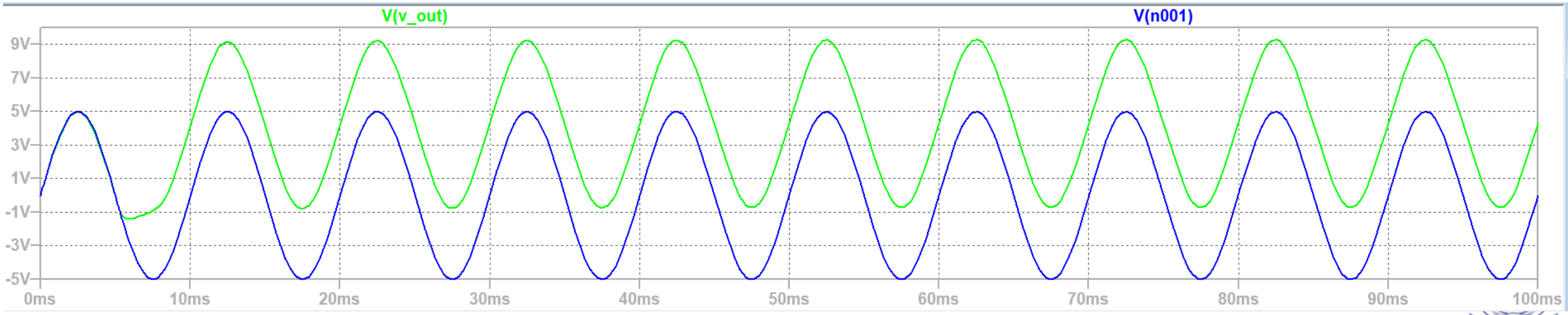


7.2 Steps in LT Spice



7.2 Steps in LT Spice





8. Tasks on Clipper: Design the following

1) +ve clipper at 2V
2) Clip complete +ve cycle
3) -ve clipper at -4V
4) Clip complete –ve cycle

9. Tasks on Clampers: Design the following clampers

Task	Clamper	+ve Peak of V_{in}	+ve peak of V_{ref}	+ve peak of V_{out}	-ve peak of V_{out}	How much the reference level was shifted (volts)
T1	Negative	5V	0V			
T2	Negative	5V	2V			
T3	Positive	5V	0V			
T4	Positive	5V	2V			

For each task in the record: Paste the circuit, plots with V_{in}, V_{ref}, V_{out}

Important NOTE

- Enter your **registration number** and **Full Name** next to

  all your circuits and
  the output plots.
- Keep the background of circuit and plot as white.

LAB record instructions:

For the lab experiment,

- Write the **Aim**.
- Complete the **Software/Hardware components used**.
- **Obtain the expression for the outputs.**
- Place the respective **circuits in LT Spice**.
- Connect the inputs and outputs. Name them and **write the same in the lab copy(inputs and outputs section)**.
- Use probe in LT spice to plot all possible combinations.
- Write a **concluding statement for each circuit**.
- **Submit** the document's soft copy **on time** in lms.vit.ac.in when available.