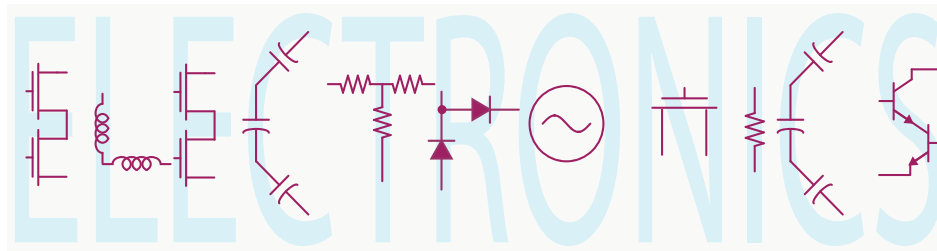


*EE 42/100*  
*Lecture 20: Diodes and Applications*



Rev B 4/2/2012 (10:59 PM)

Prof. Ali M. Niknejad

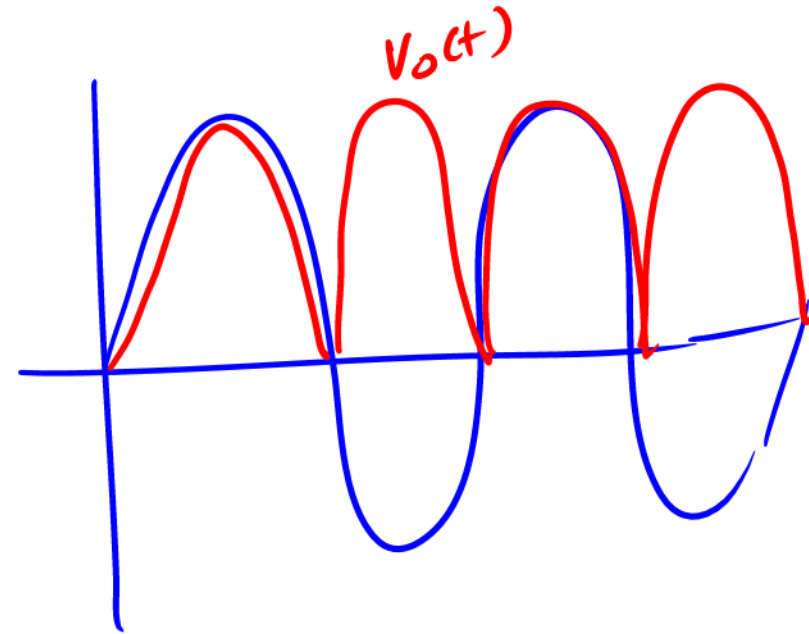
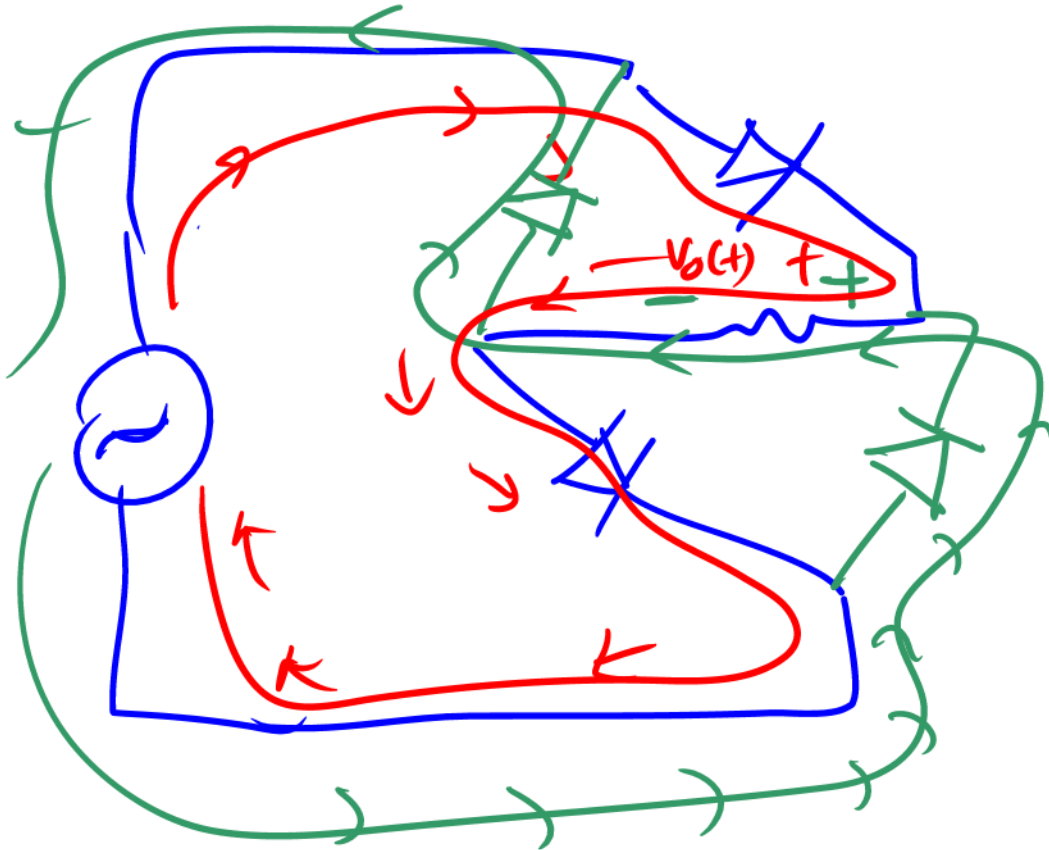
University of California, Berkeley

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# Full-Wave Rectifier

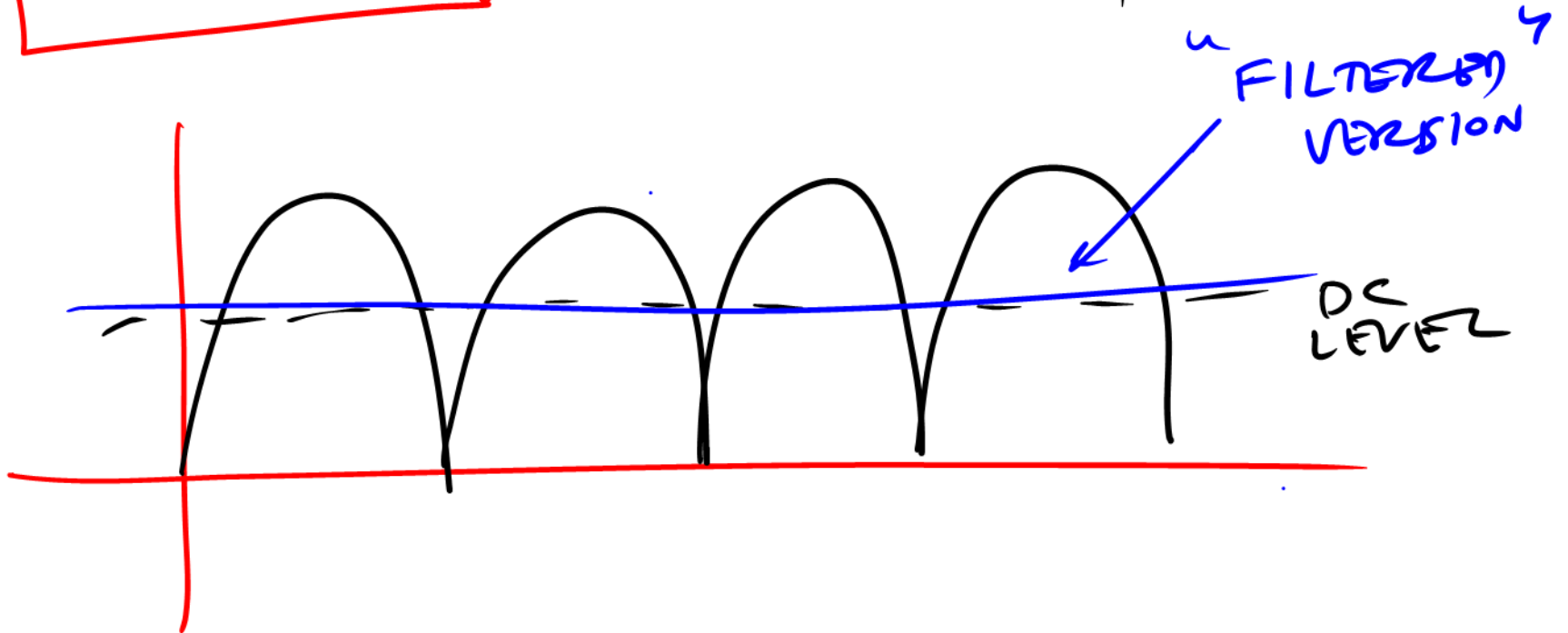
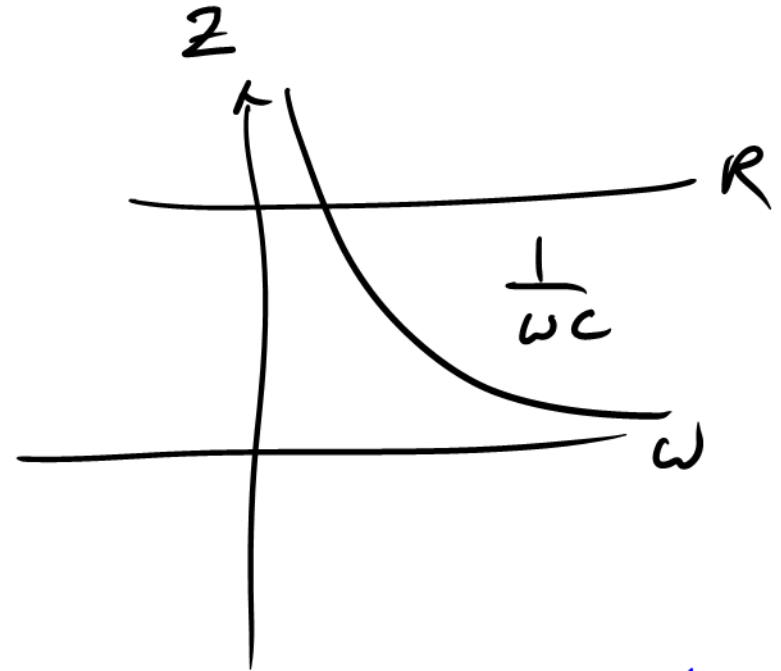
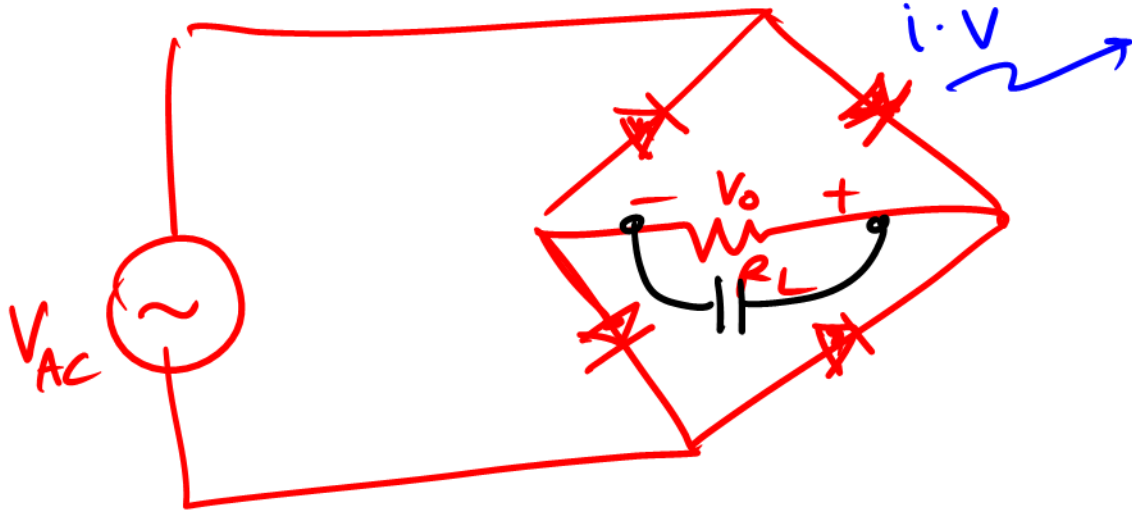


- This bridge circuit will conduct current during both cycles. Due to the polarity of the diodes, current is always flowing in the same direction through the load, even for a negative voltage.
- This means that the circuit performs an absolute value function.



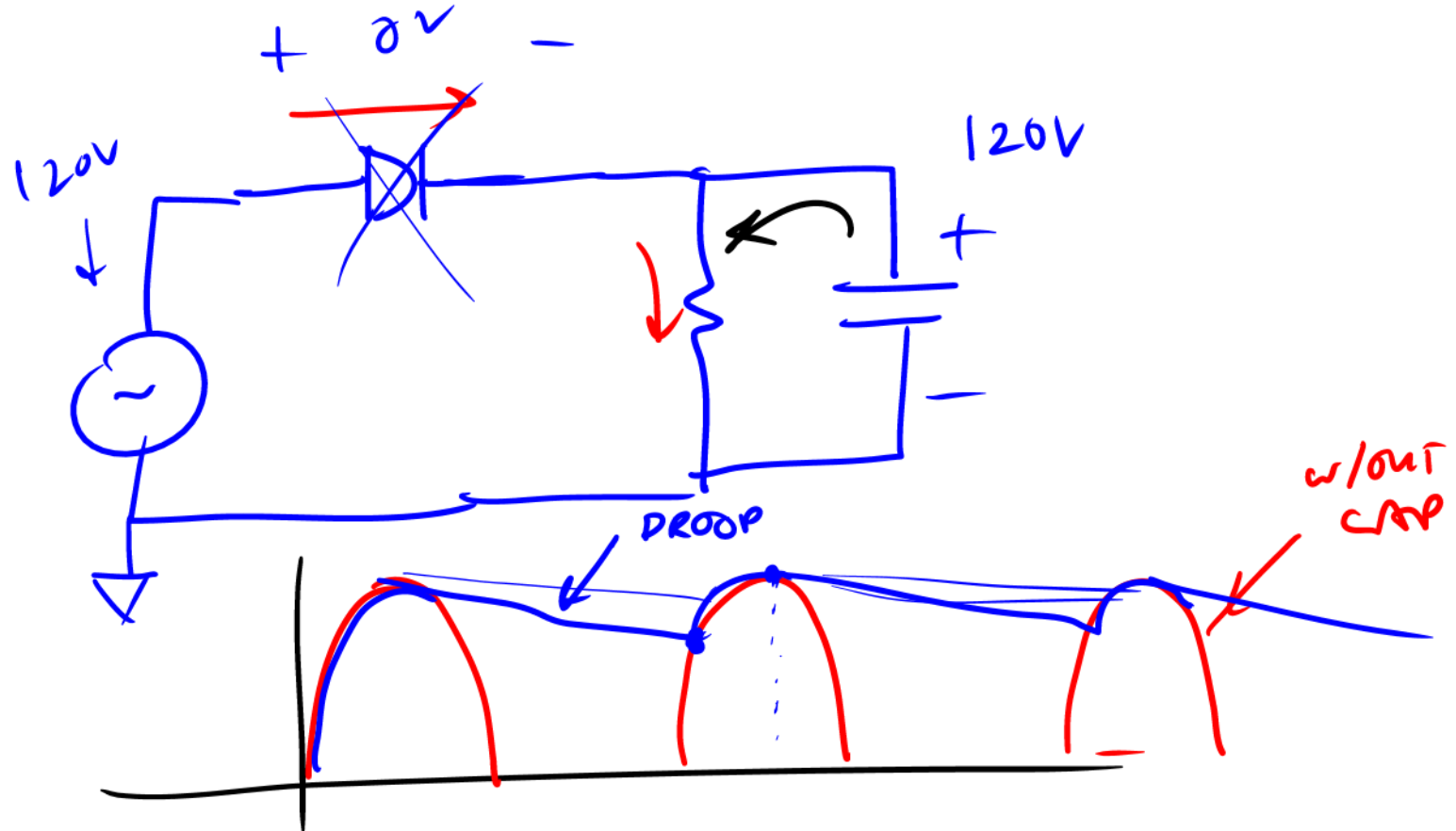
ASSUMING DIODES  
DO NOT BREAKDOWN

AC  $\rightarrow$  DC



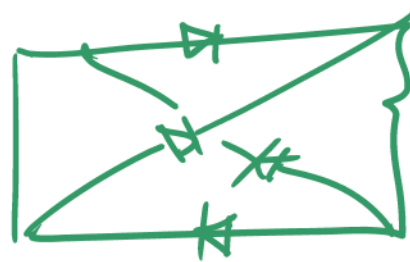
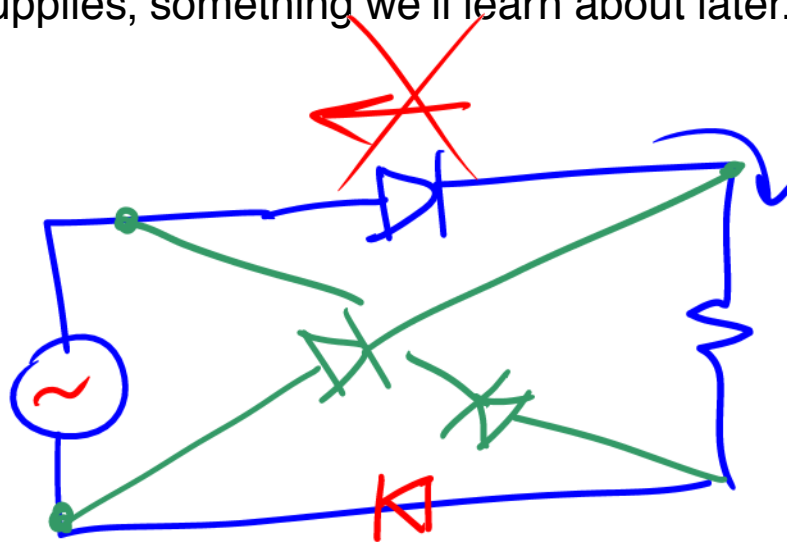
## Filtered Rectified Voltage

- The capacitor is used to filter out the variations in the voltage.
- During the positive cycle, the capacitor is charged and it holds its output steady. The charging time is very fast because the diode “on” resistance is very small.
- During the negative cycle, the diode turns off and the output voltage is provided by the capacitor. If the load is sufficiently large, then the discharge time constant is relatively long, and so the voltage droops only a bit.



## Full-Wave Filtered Output

- The same idea works for the full-wave rectifier, and now the output variation is even less.
- Bridge rectifiers are ubiquitous in equipment used to convert AC line voltages to DC voltages used by most electronic equipment. A transformer is needed to bring down the line voltage. Increasingly, transformers are replaced by switching power supplies, something we'll learn about later.



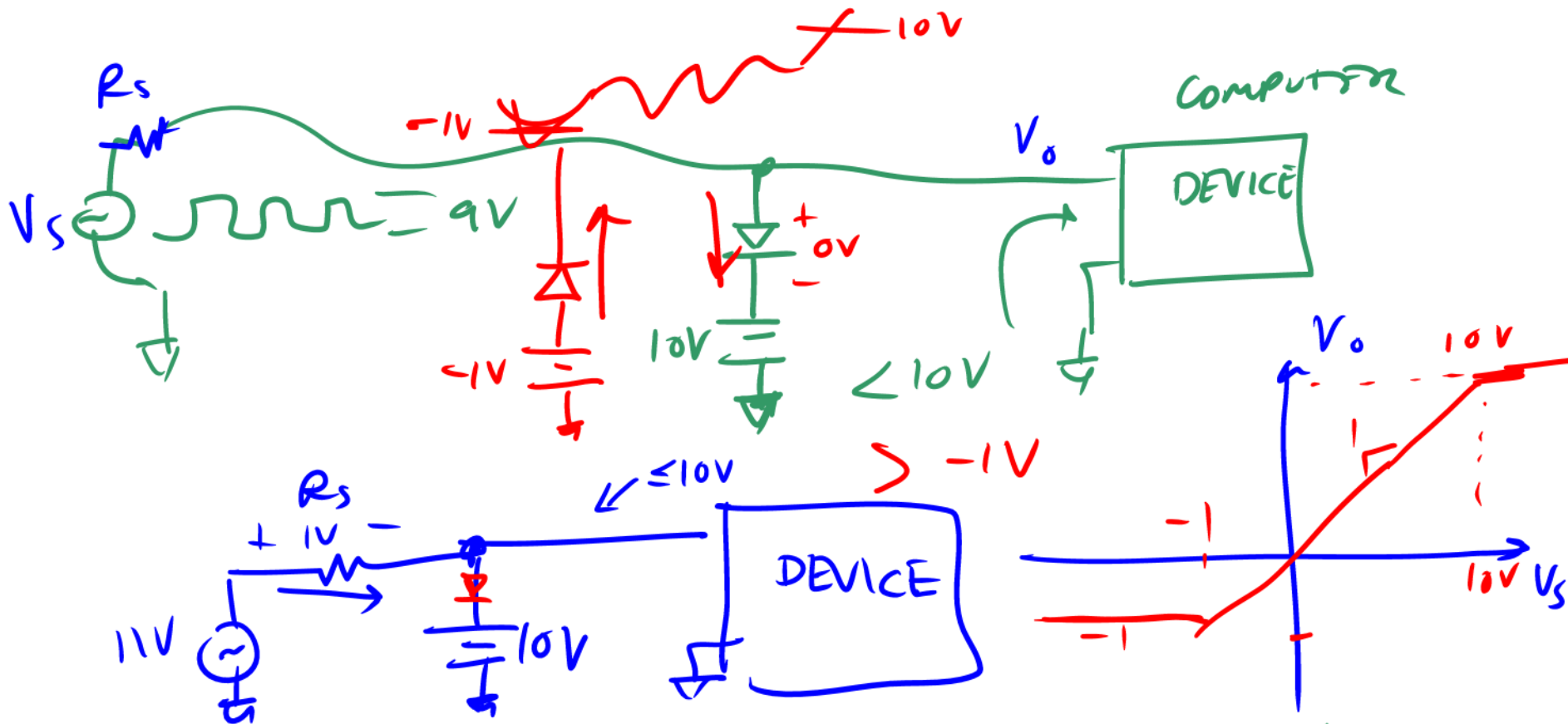
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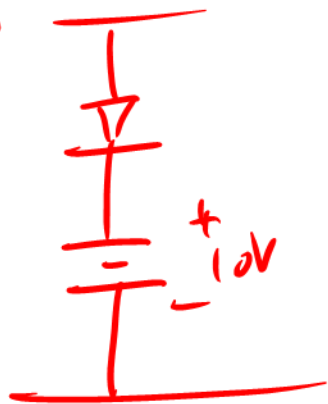
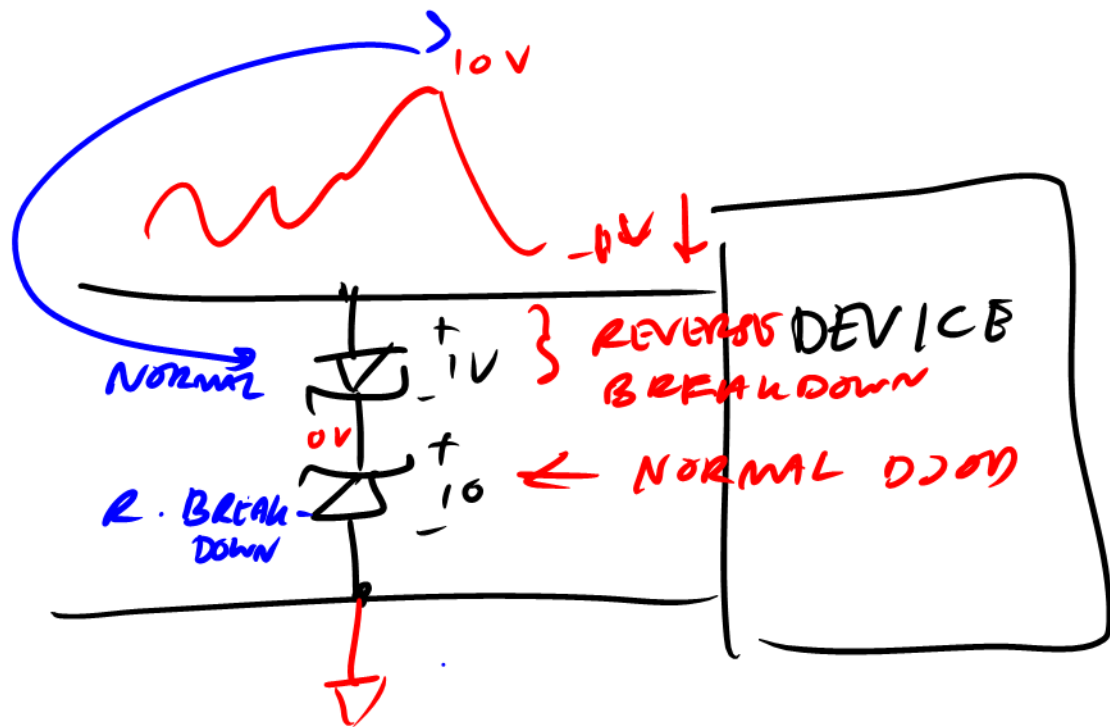
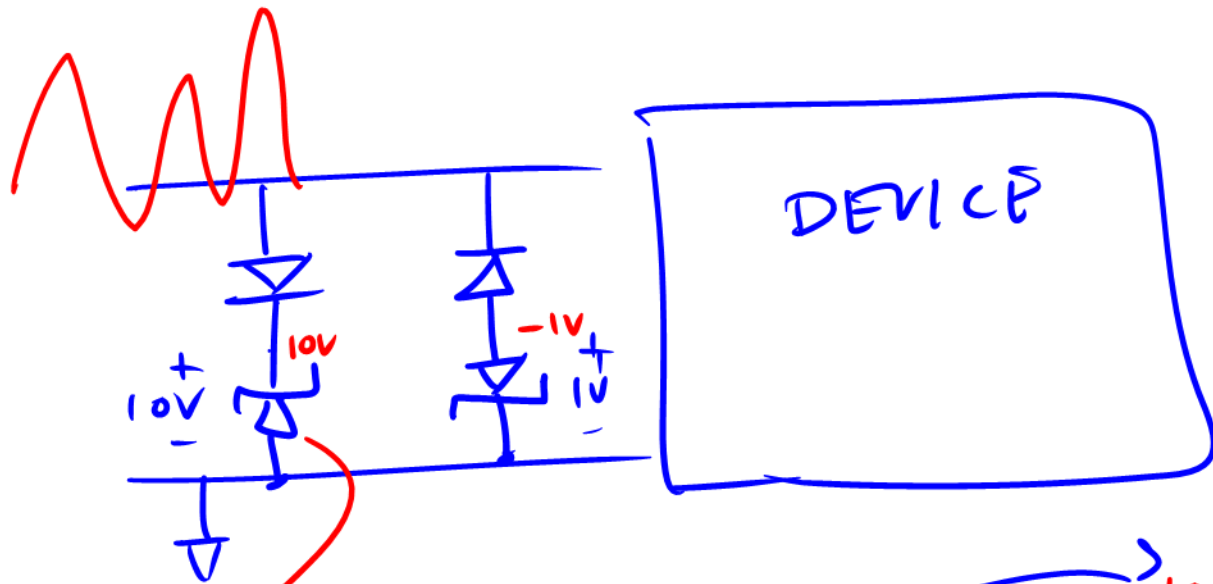


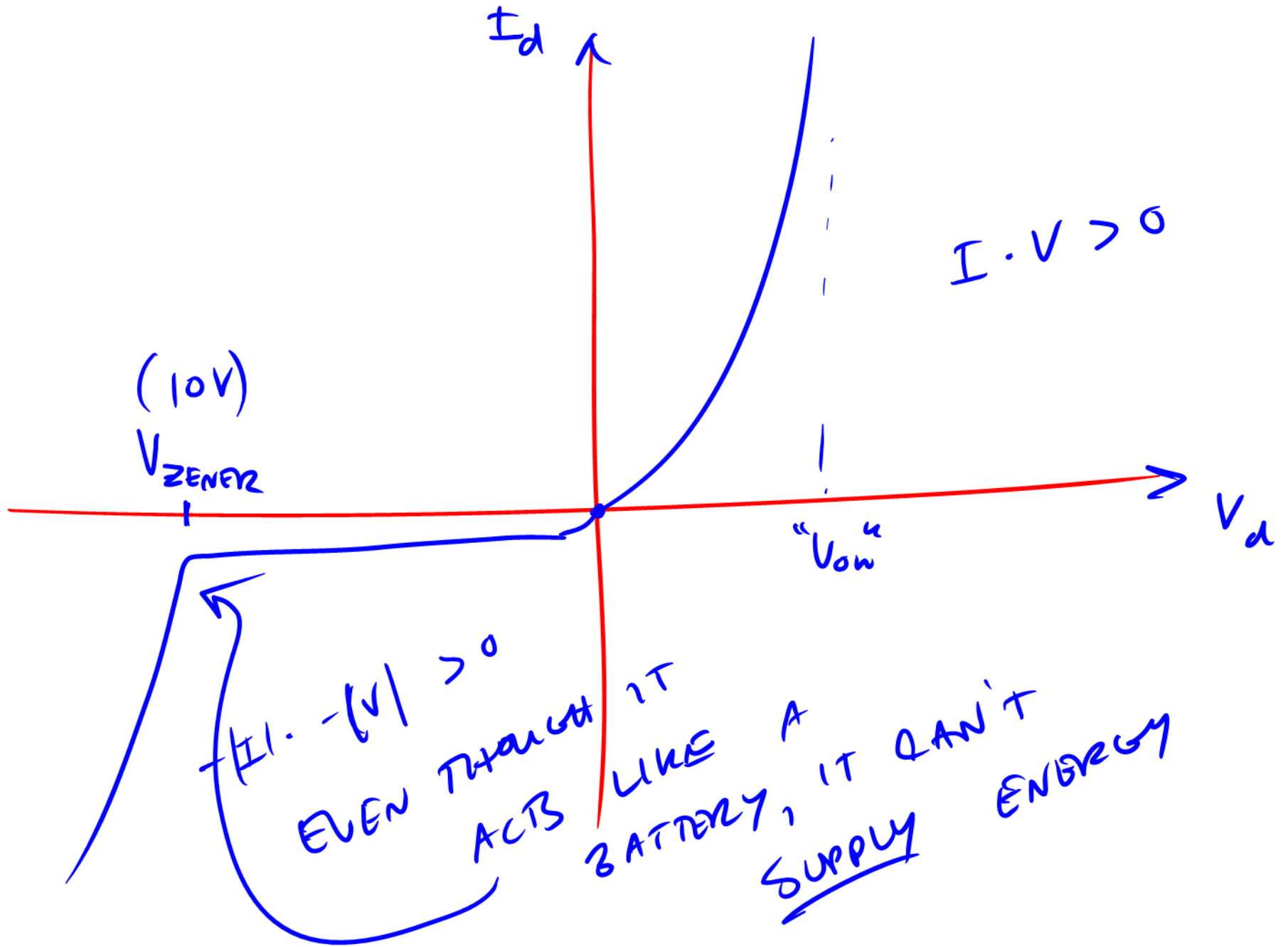
# Clippers

- Diodes are often used to limit the voltage excursion, especially to protect a circuit.
- When DC sources are used in series with the diodes, the clip point can be set to any desired value. Zener references are handy for this application.

ESD - Electro Static Discharge





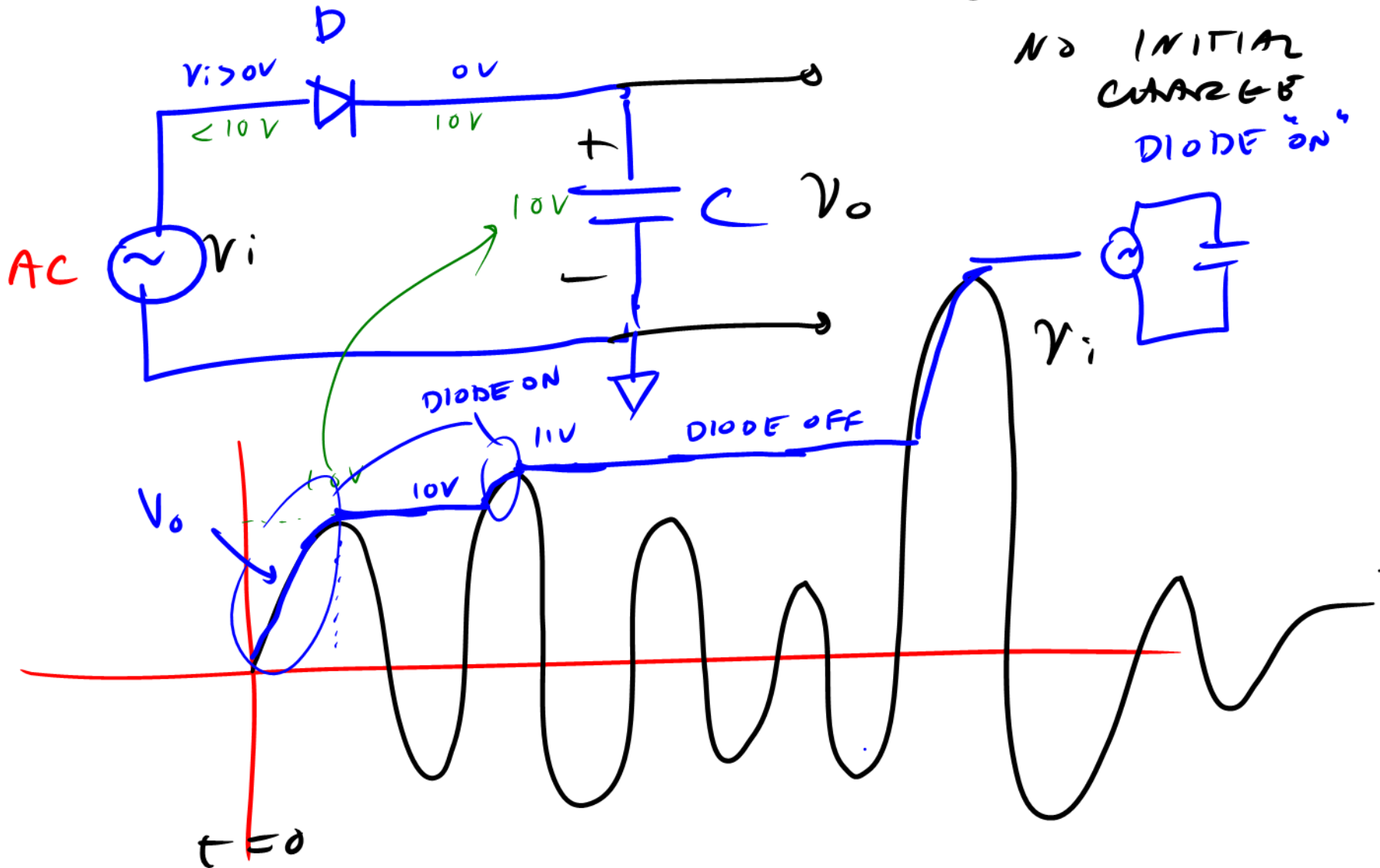




# PEAK DETECTORS

$$V_0(0) = 0V$$

NO INITIAL CHARGE  
DIODE ON



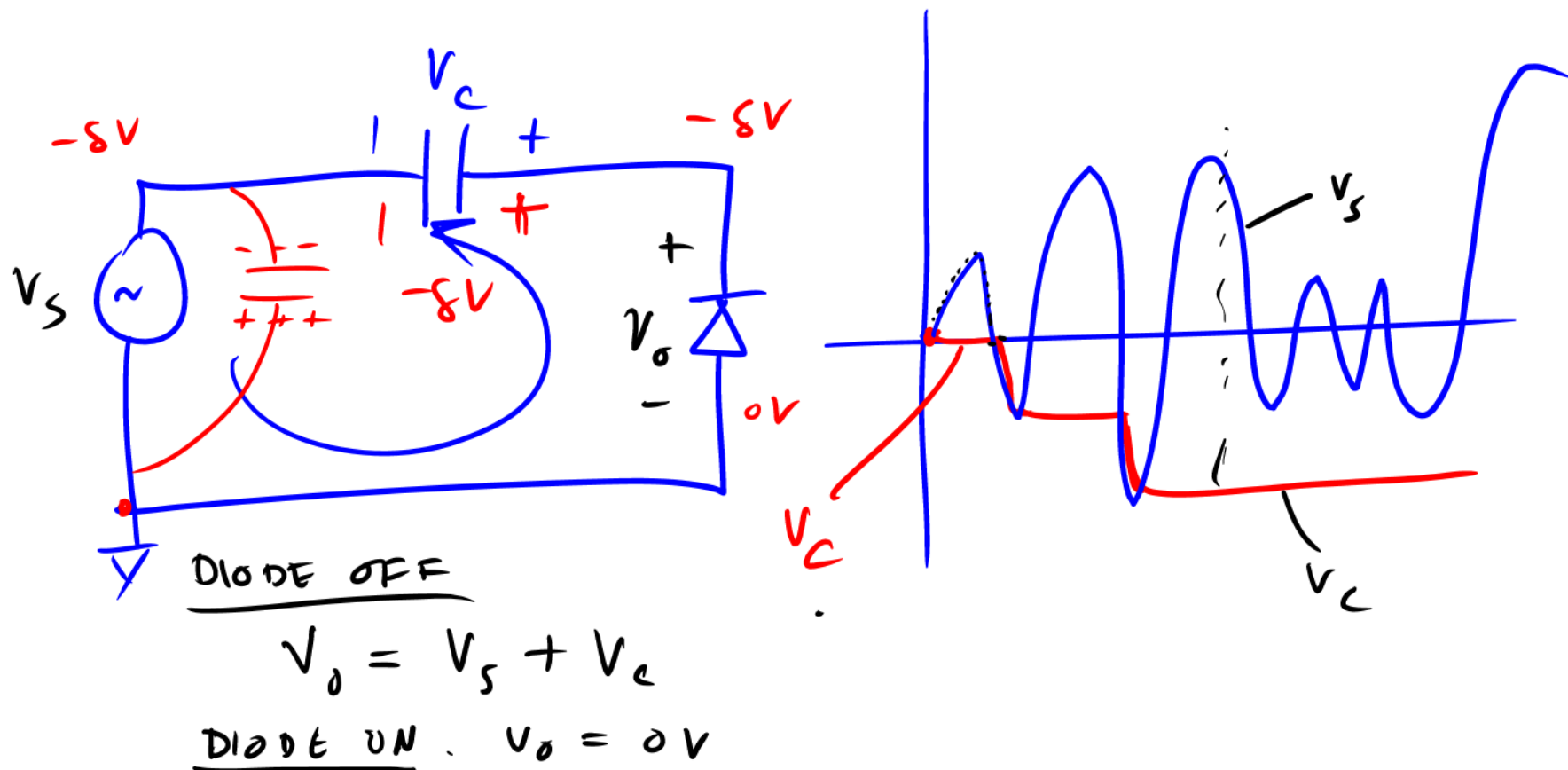
WHY CAN'T I USE PHASORS?

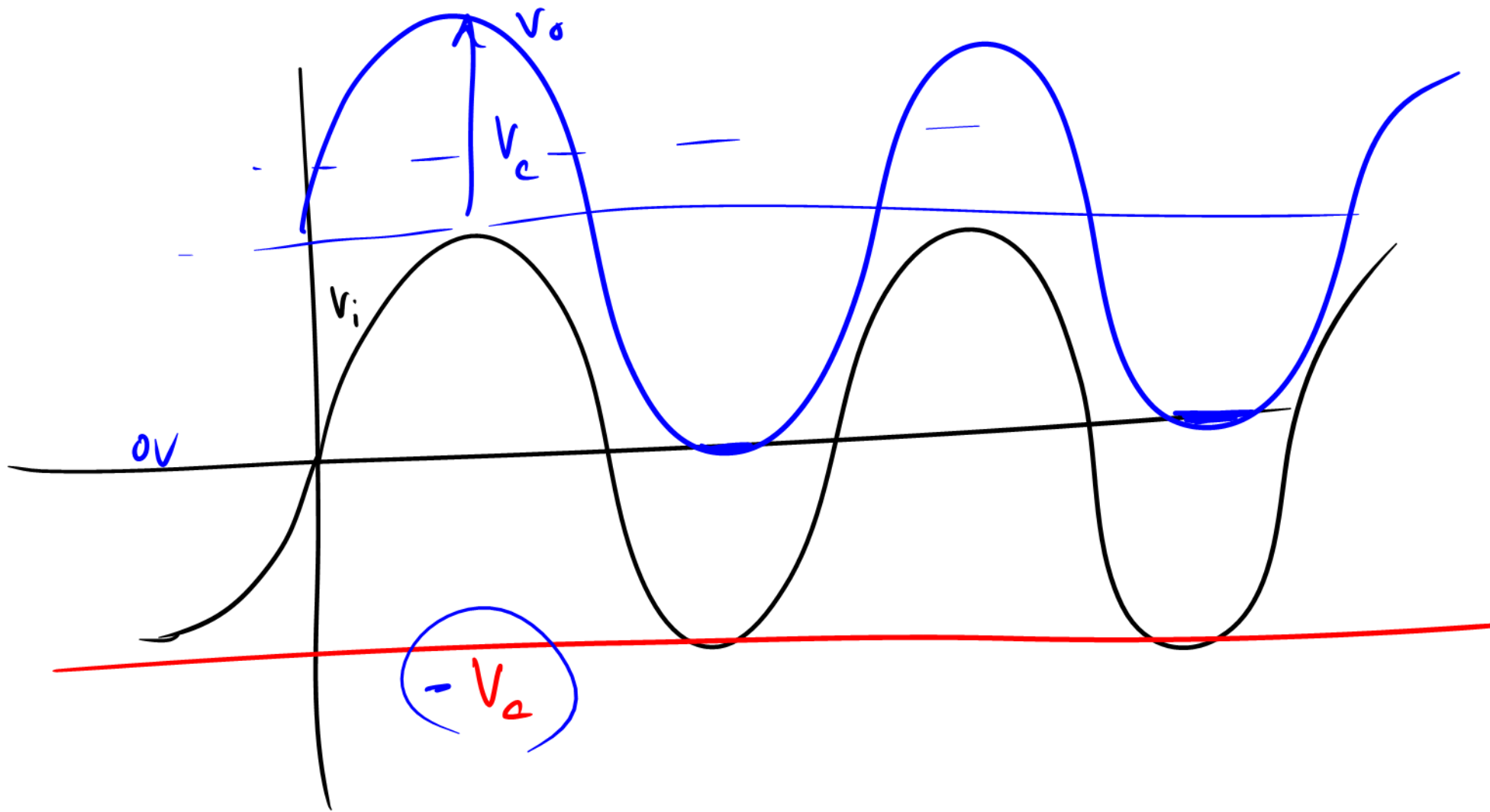
A NOT IN SINUSOIDAL STEADY-STATE  
(S.S.S.)

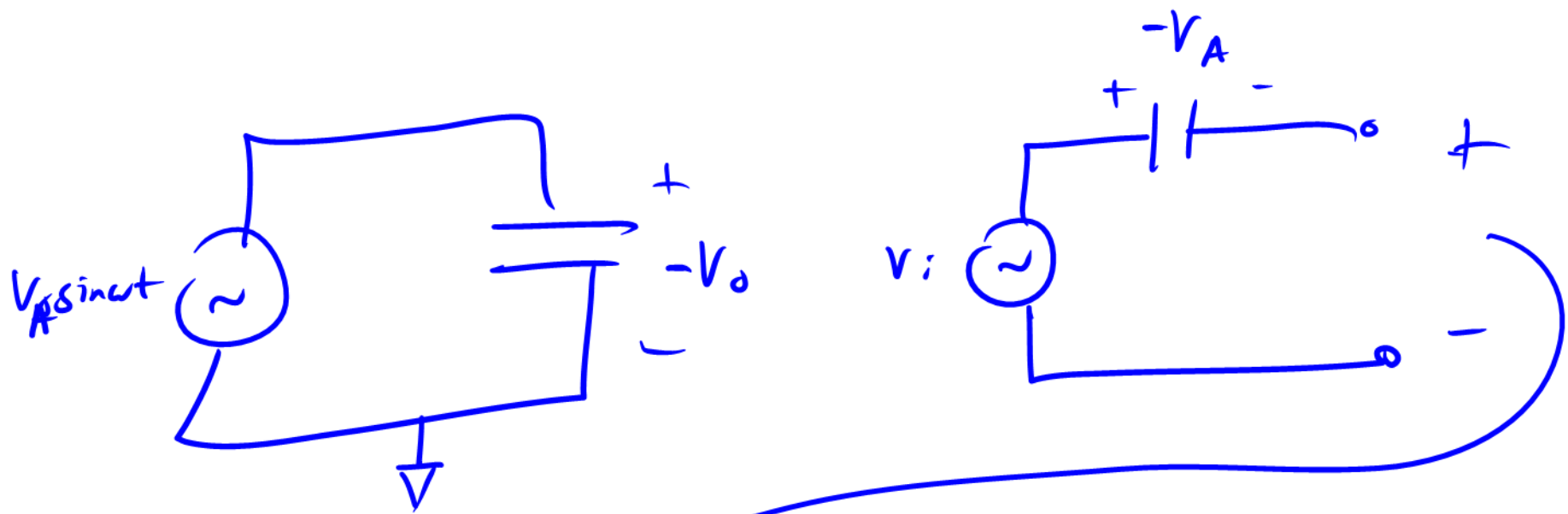
B IF DIODE IS TURNING ON/OFF,  
THEN THE CIRCUIT IS NON-LINEAR  
& S.S.S. DOES NOT APPLY

## Level Restorers

- In this circuit the diode turns on initially and charges the capacitor to the AC voltage. Note that once the voltage starts to drop, the diode turns off.
- The output voltage is therefore level shifted by the DC voltage held on the capacitor.
- In this case the voltage excursions are now negative and never rise above zero!
- If a load is connected, then the capacitor should be large enough to minimize the droop.







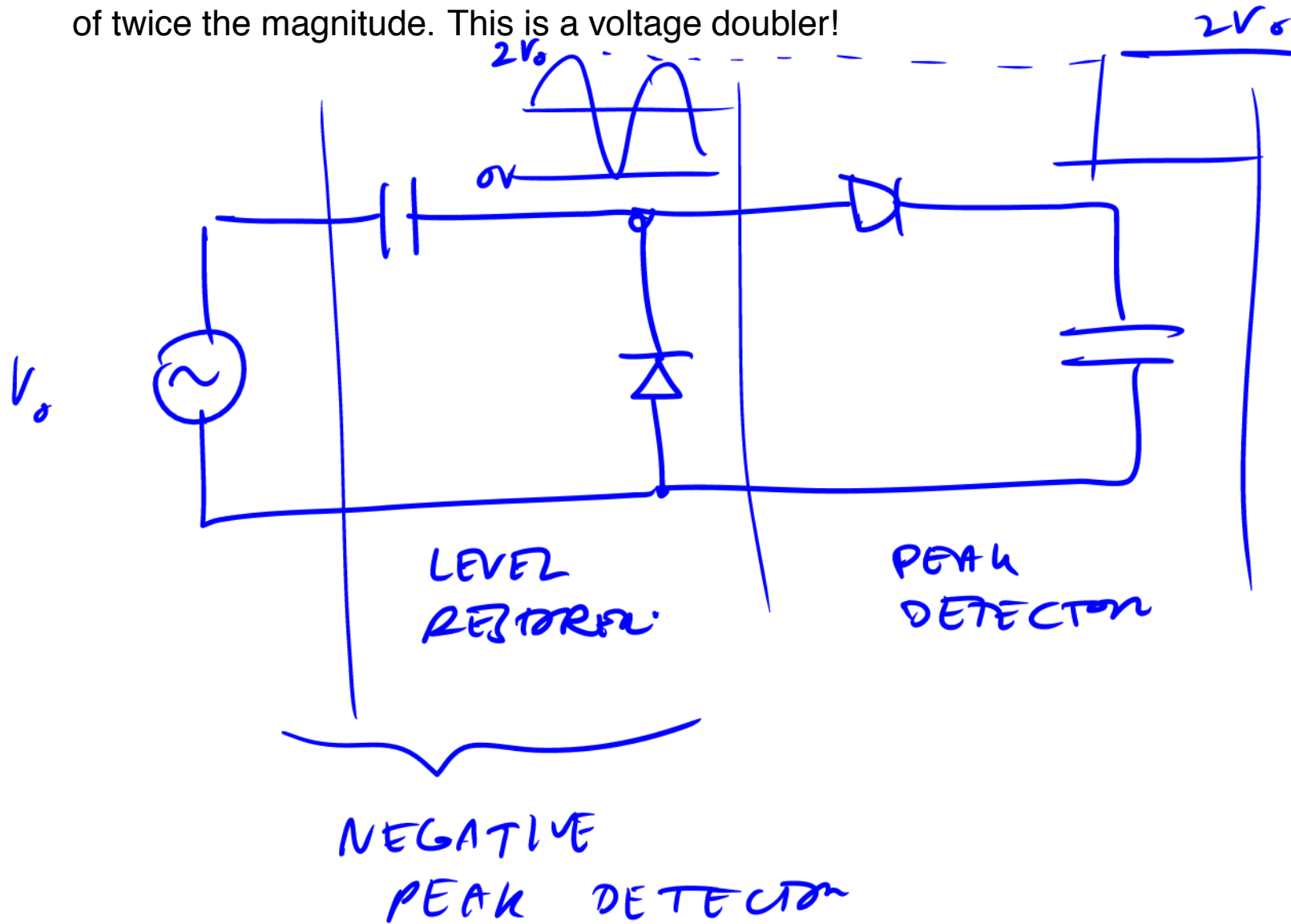
$$\begin{aligned}
 V_o &= V_i - V_c \\
 &= V_i - (-V_A) \\
 &= V_i + V_A
 \end{aligned}$$

## *Another Level Restorer*

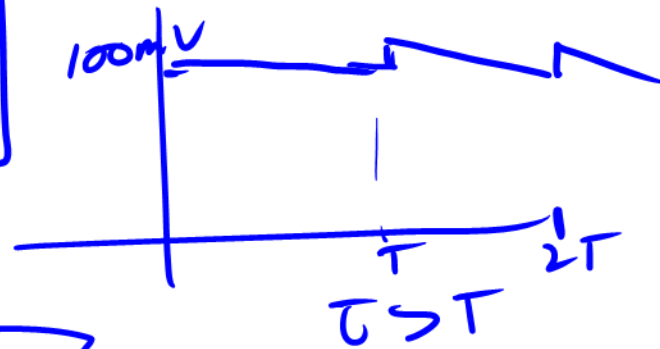
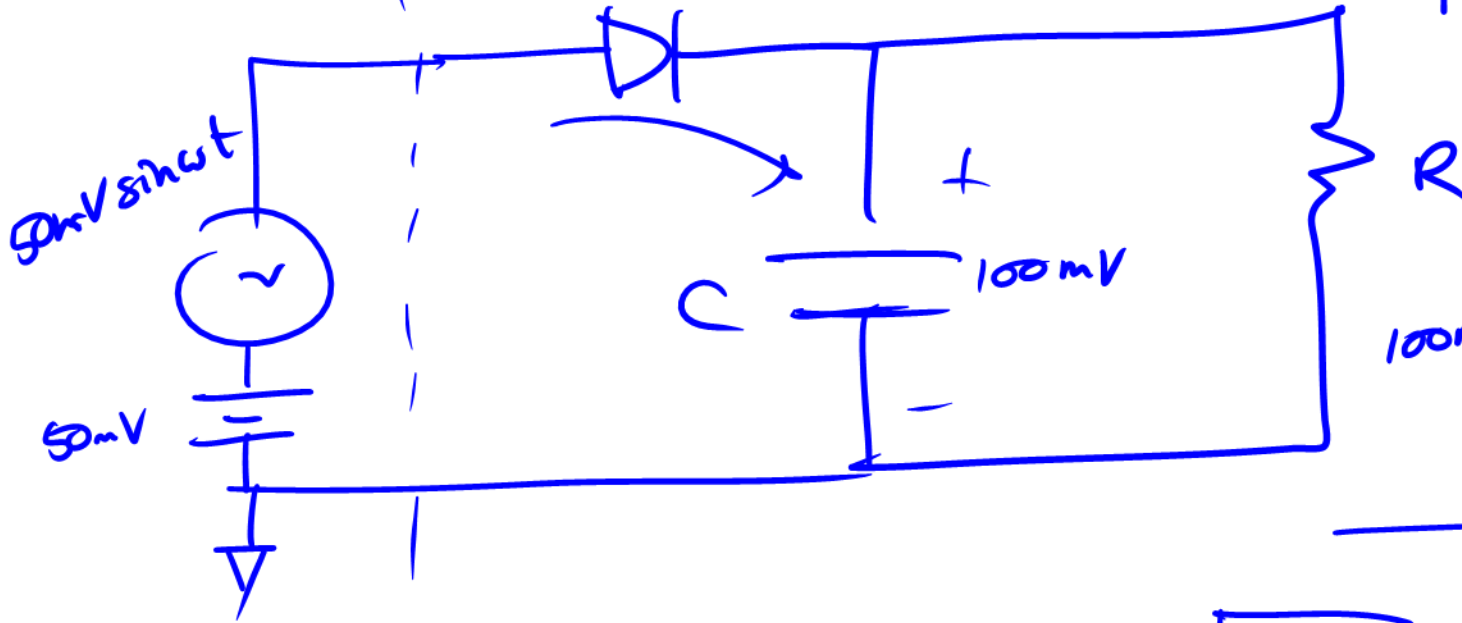
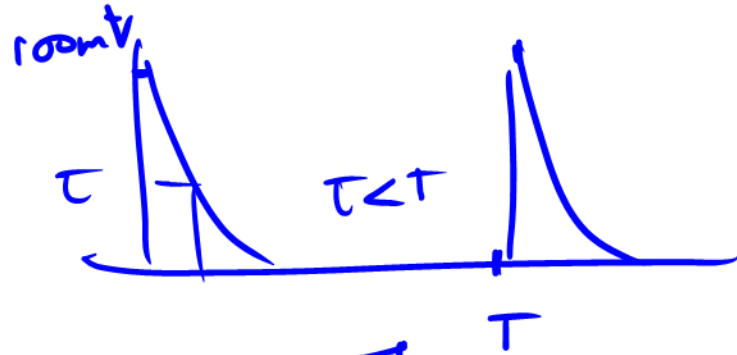
- If we now flip the direction of the diode, the current will only flow during the negative half cycle, charging the capacitor now in the opposite direction.
- Then output is now lifted by the DC voltage stored on the capacitor. The voltage will now always remain positive and never go below zero!

# Voltage Doubler

- If we rectify the above voltages, we can generate positive or negative DC voltages of twice the magnitude. This is a voltage doubler!



LEVEL RESPONSE



$$\tau = RC$$

