CLAMPERS

ELA1110

INTRODUCTION

- A clamper is a network constructed of a diode, a resistor, and a capacitor that shifts a waveform to a different dc level without changing the appearance of the applied signal.
- Additional shifts can also be obtained by introducing a dc supply to the basic structure.
- The resistor and capacitor of the network must be chosen such that the time constant must sufficiently large.
- The voltage across the capacitor does not discharge significantly during the interval the diode is nonconducting.
- Also known as DC restorer.

- Clamping networks have a capacitor connected directly from input to output with a
- Resistive element in parallel with the output signal.
- The diode is also in parallel with the output signal but may or may not have a series dc supply as an added element.

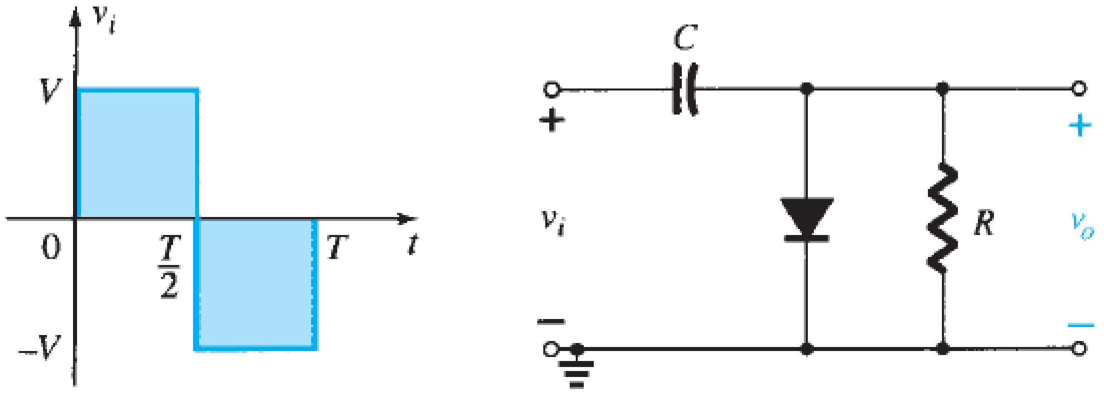


Fig.1: Clamper

Steps used for analysis:

- **Step 1:** start the analysis by examining the response of the portion of the input signal that will forward bias the diode.
- **Step 2:** During the period that the diode is in the "on" state, assume that the capacitor will charge up instantaneously to a voltage level determined by the surrounding network.
  - For fig. 2,the diode will be forward biased for the positive portion of the applied signal.
- **Step 3:** assume that during the period when the diode is in the "off" state the capacitor holds on to its established voltage level.
  - When the input switches to the -*V* state, the network will appear as shown in fig.3.
  - Diode will be replaced by open circuit equivalent and stores voltage across the capacitor

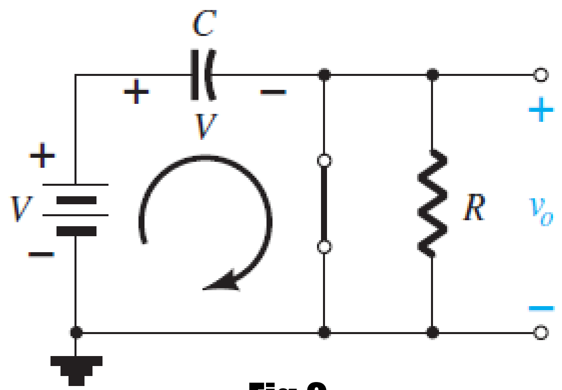


Fig.2

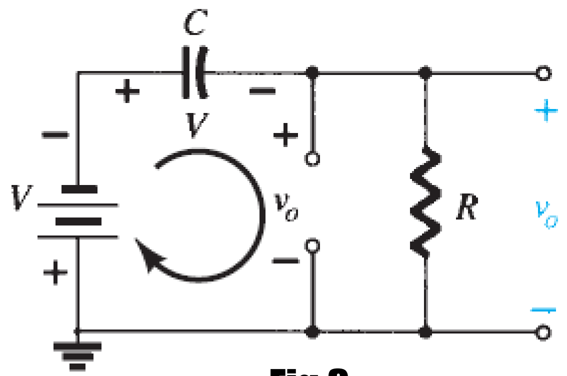
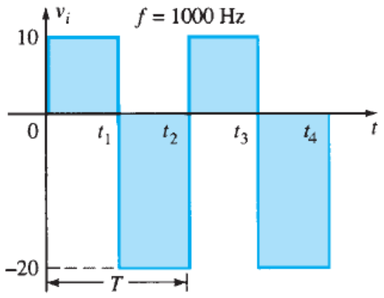
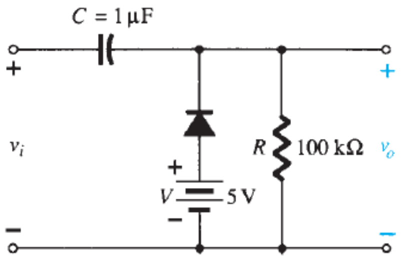


Fig.3

Example1: Determine v_o for the network of fig.4. for the input indicated.





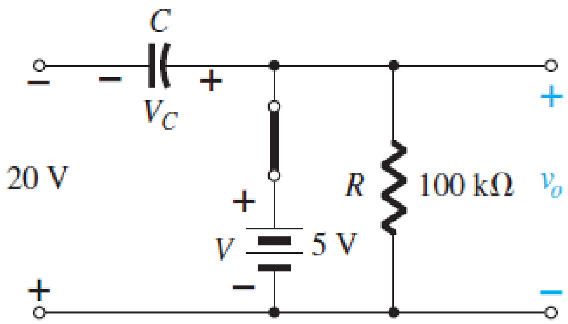
Solution:

Applying Kirchhoff's voltage law around the input loop results in

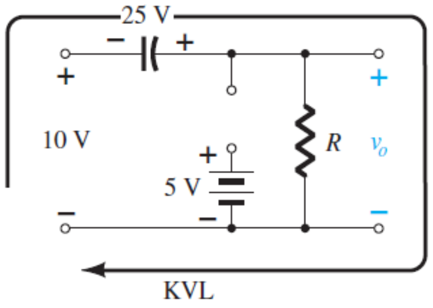
$$-20\text{ V} + V_C - 5\text{ V} = 0$$

$$V_C = 25\text{ V}$$

The capacitor will therefore charge up to 25 V.



Determining V_o and V_C with the diode in the "on" state.



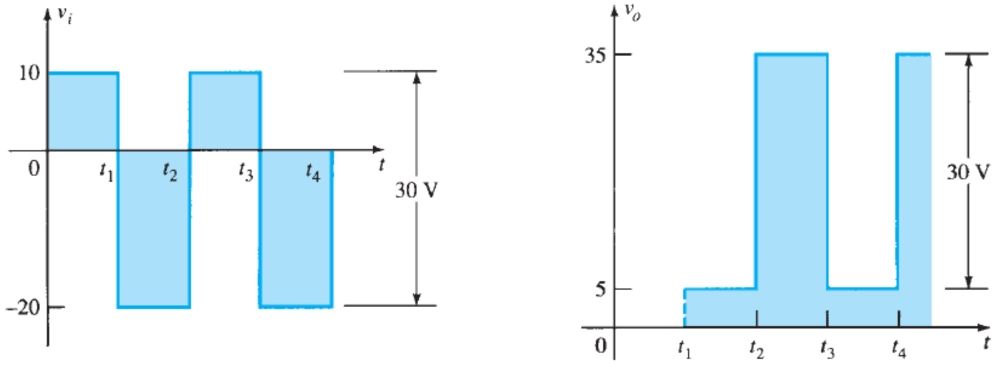
Determining v o with the diode in the "off" state.

The open-circuit equivalent for the diode removes the 5V battery from having any effect on V_O, and applying Kirchhoff's voltage law around the outside loop of the network results in

$$+10\text{ V} + 25\text{ V} - v_o = 0$$
$$v_o = 35\text{ V}$$

The time constant of the discharging network of Fig. 2 is determined by the product *RC* and has the magnitude

$$\tau = RC = (100\text{ k}\Omega)(0.1\ \mu\text{F}) = 0.01\text{ s} = 10\text{ ms}$$



Input and Output Waveform

Example 2: Repeat example 1, using a silicon diode with $V_K = 0.7V$.

Solution: V_O can be determined by Kirchhoff's voltage law in the output section of Fig.4

$$+5\text{ V} - 0.7\text{ V} - v_o = 0$$

$$v_o = 5\text{ V} - 0.7\text{ V} = 4.3\text{ V}$$

For the input section Kirchhoff's voltage law results in

$$-20\text{ V} + V_C + 0.7\text{ V} - 5\text{ V} = 0$$

$$V_C = 25\text{ V} - 0.7\text{ V} = 24.3\text{ V}$$

Applying Kirchhoff's voltage law yields

$$+10\text{ V} + 24.3\text{ V} - v_o = 0$$

$$v_o = 34.3\text{ V}$$

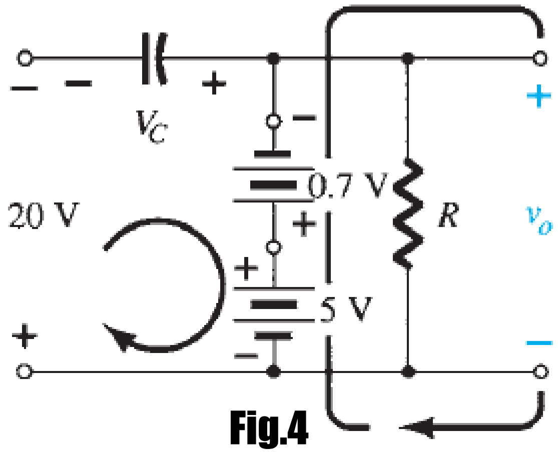


Fig.4

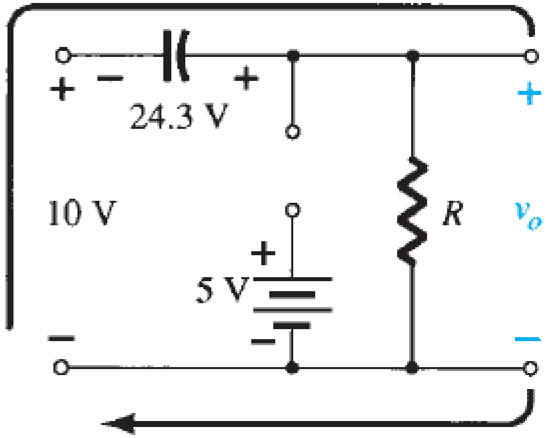
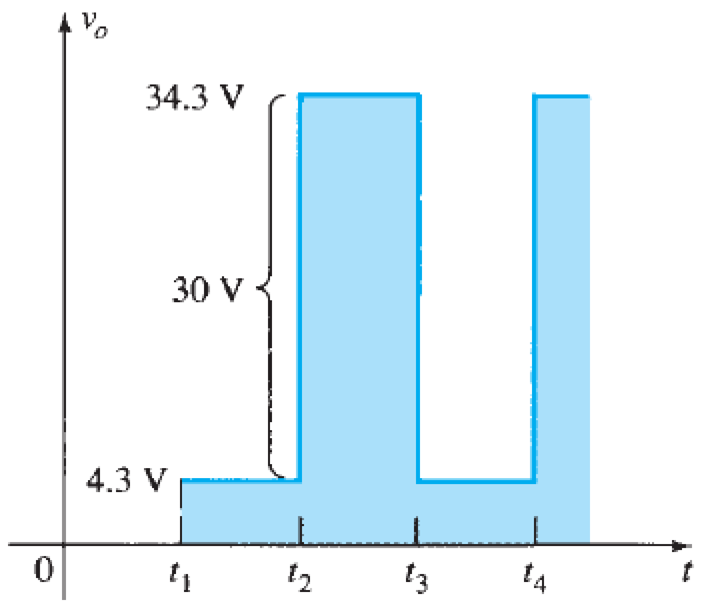
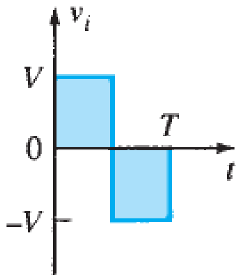
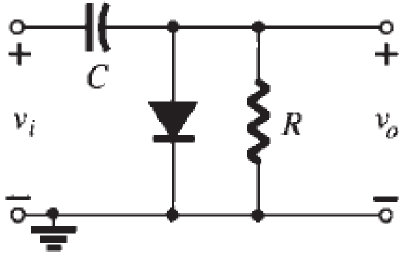
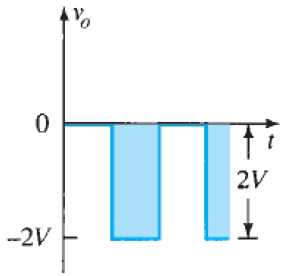
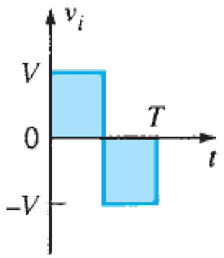
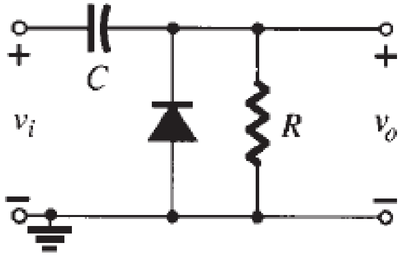
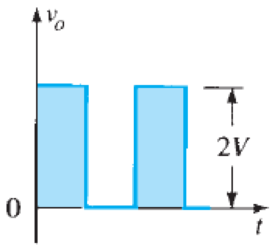
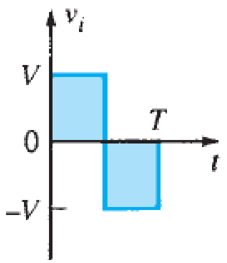
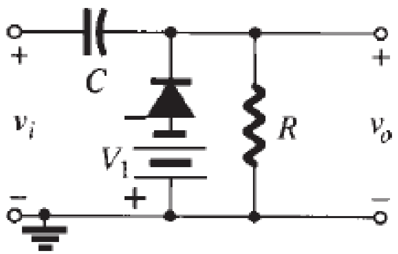
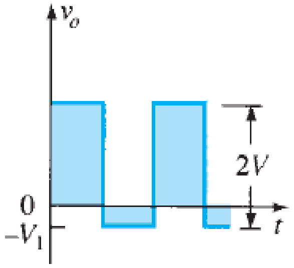


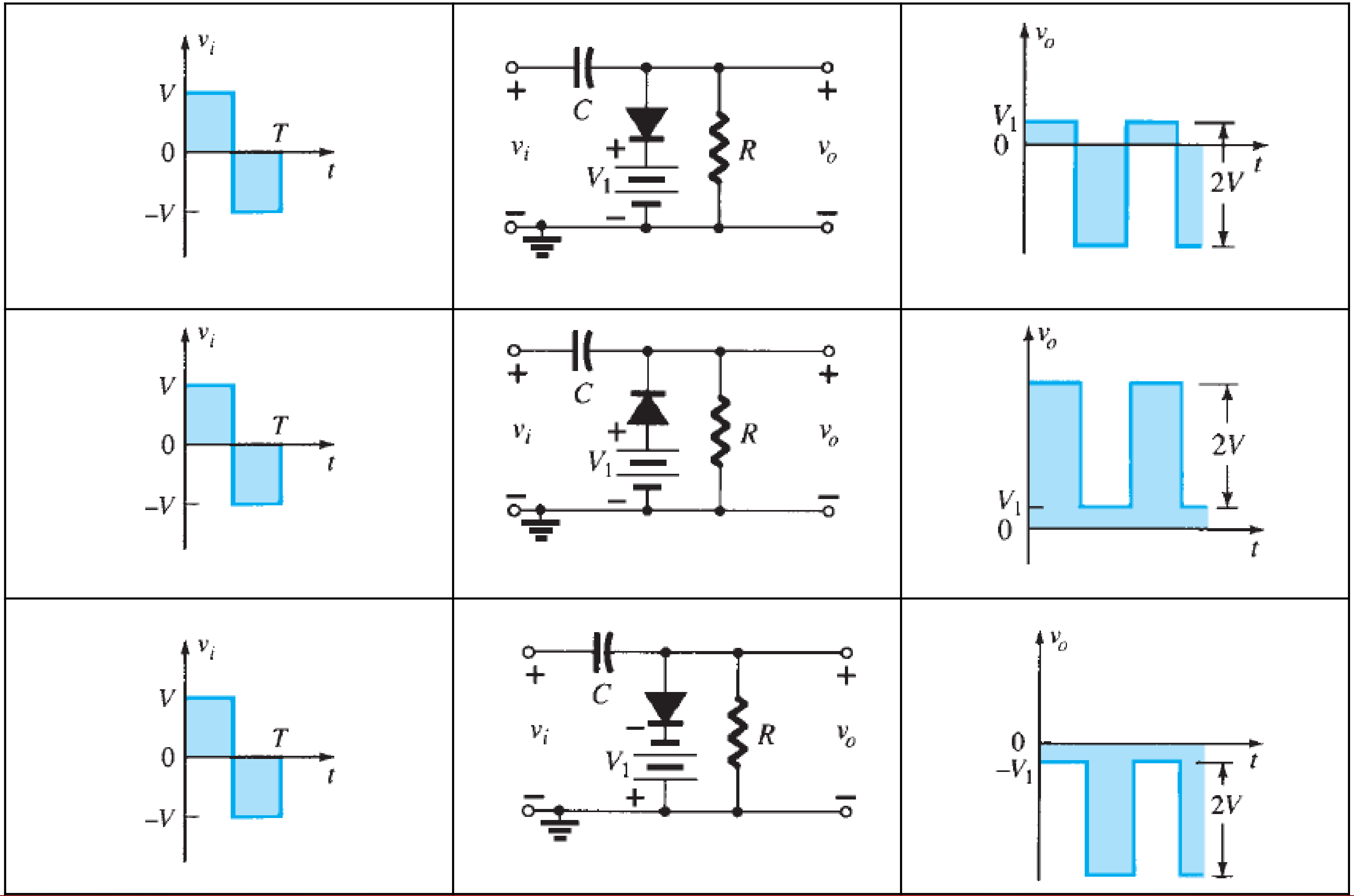
Fig.5



Output Waveform

SOME MORE CLAMPING NETWORK

Input Waveform	Clamping Circuit	Output Waveform
		
		
		



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