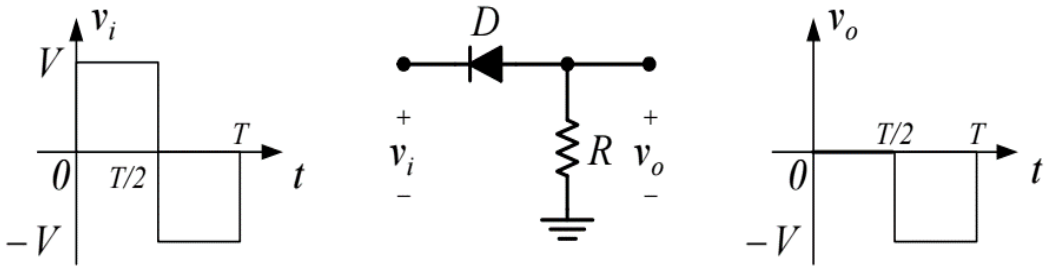
Lecturer: Dr. Ameer Al-khaykan

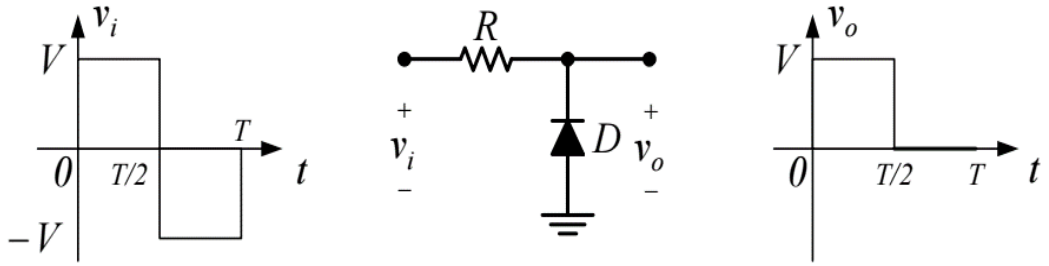
Lecture: Diode Clipping Circuits

Basic Definition:

There are a variety of diode circuits called clippers (limiters or selectors) that have the ability to "clip" off a portion of the input signal above (positive) or below (negative) certain level without distorting the remaining part of the alternating waveform. Depending on the orientation of the diode, the positive or negative region of the input signal is "clipped" off. There are two general categories of clippers: series and parallel. The series configuration is dined as one where the diode is in series with the load. While the parallel variety has the diode in a branch parallel to the load (see Fig.).



Simple Series (Positive) Clipper



Simple Parallel (Negative) Clipper

Example 3-1:

Biased Series (Negative) Clipper, see Fig. 3-2.

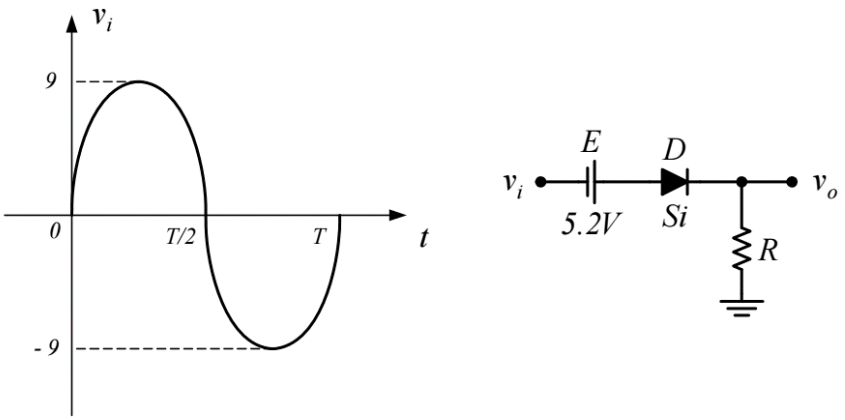
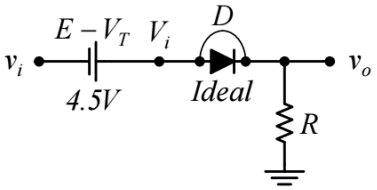
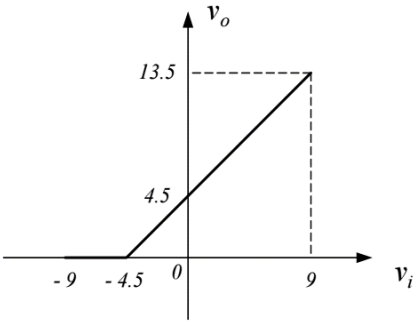


Fig. 3-2



For $t = 0 \rightarrow t_1$ and $t_2 \rightarrow T$; D ON,
and $v_o = v_i + 4.5$ V.
For $t = t_1 \rightarrow t_2$; D OFF,
and $v_o = 0$ V.



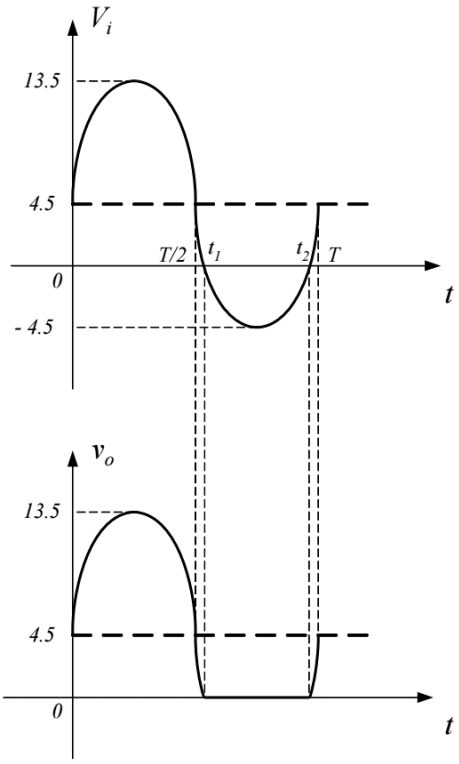


Fig. 3-2 (cont.)

Example 3-2:

Biased Parallel (Positive) Clipper, see Fig. 3-3.

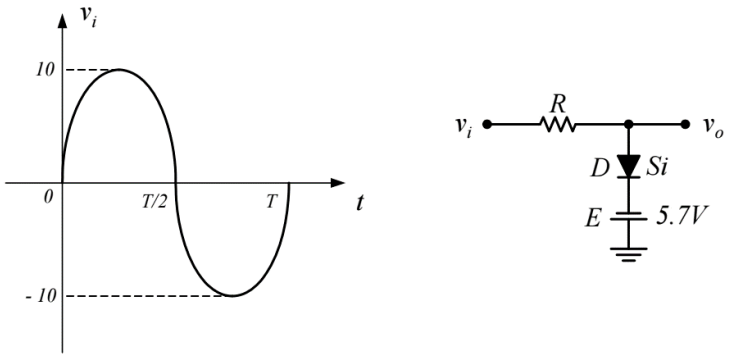
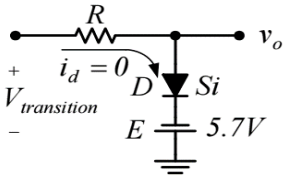
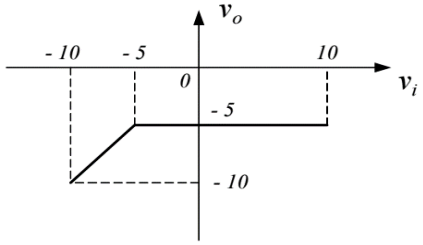


Fig. 3-3



$V_{transition} - i_d R - V_d + E = 0;$
$V_{transition} = 0.7 - 5.7 = -5$ V.
For $t = 0 \rightarrow t_1$ and $t_2 \rightarrow T$; D ON,
and $v_o = -5$ V.
For $t = t_1 \rightarrow t_2$; D OFF,
and $v_o = v_i$.



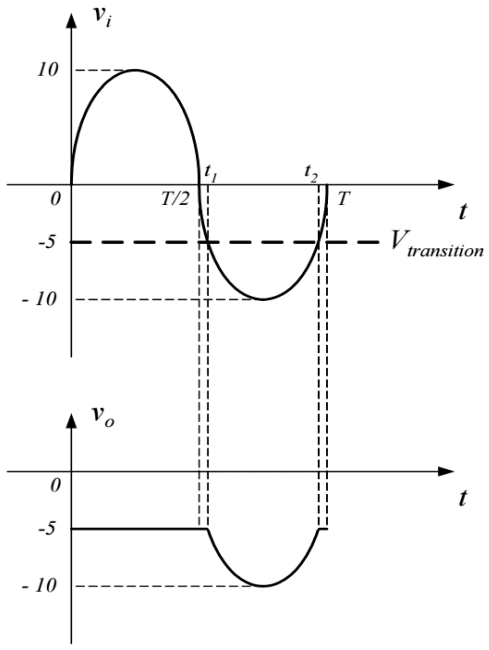


Fig. 3-3 (cont.)

Summary:

A variety of series and parallel clippers with the resulting output for the sinusoidal input are provided in Fig. 3-4.

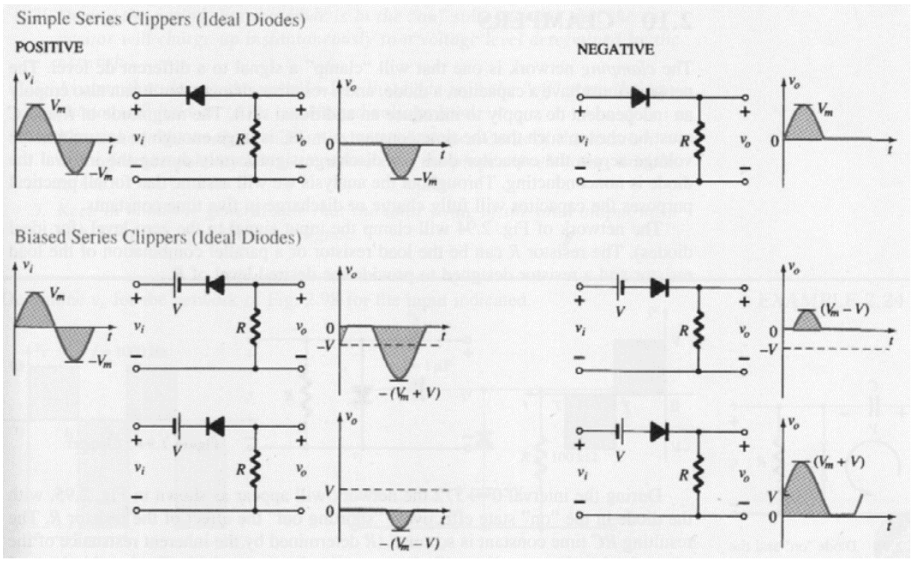


Fig. 3-4

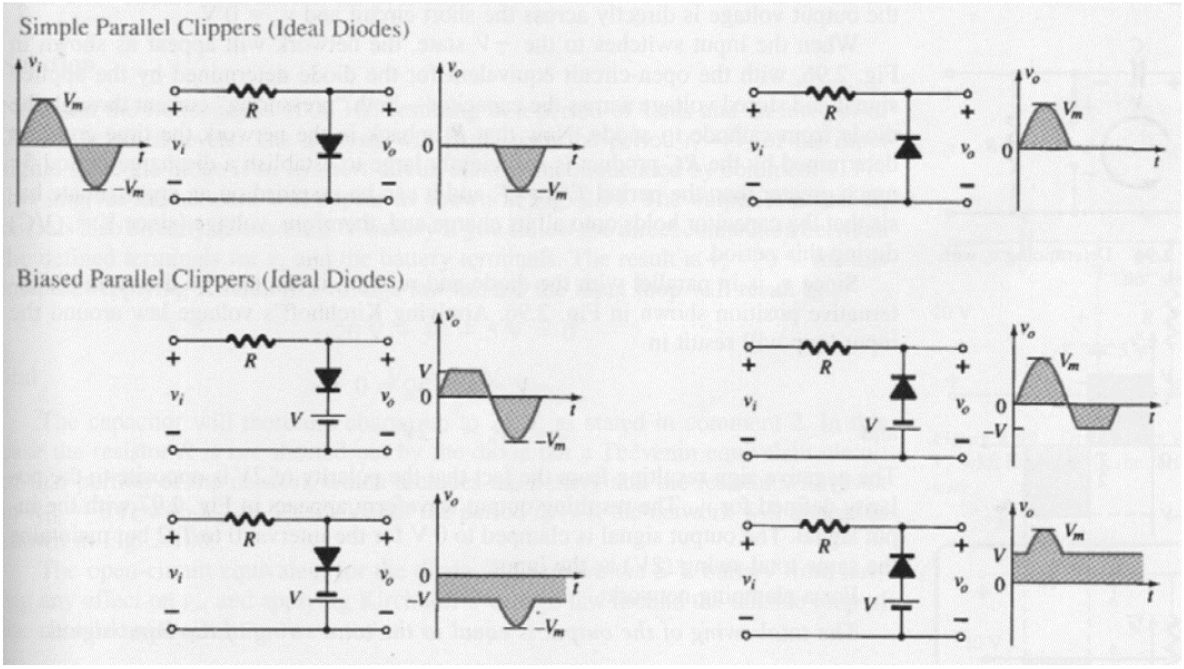


Fig. 3-4 (cont.)

Example 3-3:

Double Diode Series Clipper, see Fig. 3-5.

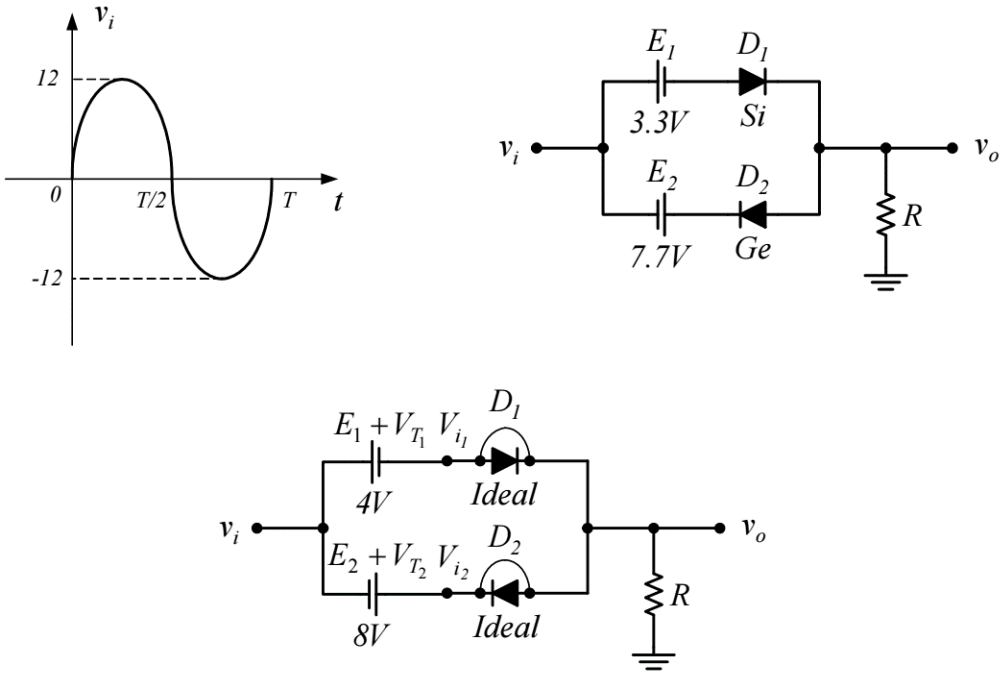
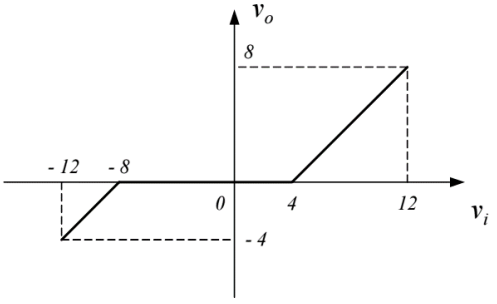


Fig. 3-5

For $t = 0 \rightarrow t_1$, $t_2 \rightarrow t_3$, and $t_4 \rightarrow T$; both D_1 and D_2 will be OFF, and $v_o = 0$ V.

For $t = t_1 \rightarrow t_2$; D_1 ON while D_2 OFF, and $v_o = V_{i_1} = v_i - 4$ V.

For $t = t_3 \rightarrow t_4$; D_1 OFF while D_2 ON, and $v_o = V_{i_2} = v_i + 8$ V.



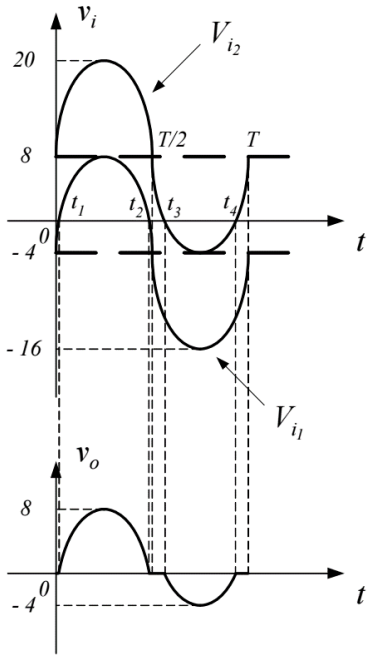
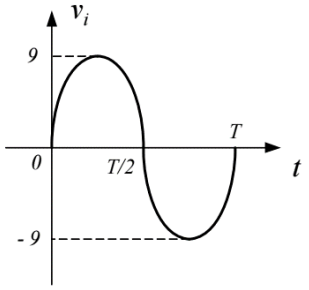
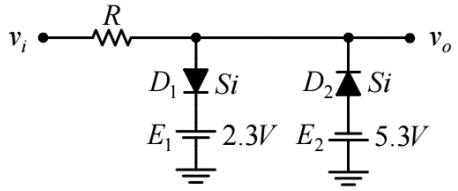


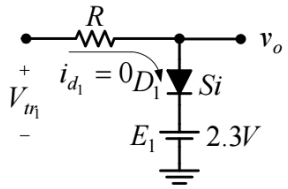
Fig. 3-5 (cont.)

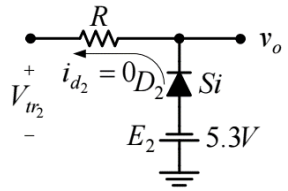
Example 3-4:

Double Diode Parallel Clipper, see Fig. 3-6.







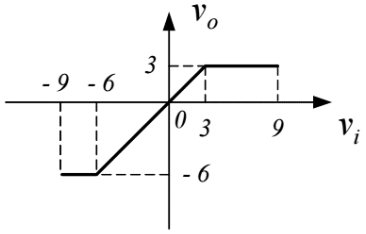


$V_{tr_1} - i_{d_1} R - V_d - E_1 = 0;$
$V_{tr_1} = 0.7 + 2.3 = 3$ V.

$V_{tr_2} + i_{d_2} R + V_d + E_2 = 0;$
$V_{tr_2} = -0.7 - 5.3 = -6$ V.

Fig. 3-6

For $t = 0 \rightarrow t_1$, $t_2 \rightarrow t_3$, and $t_4 \rightarrow T$;
both D_1 and D_2 will be OFF,
and $v_o = v_i$.
For $t = t_1 \rightarrow t_2$; D_1 ON while D_2 OFF,
and $v_o = 3$ V.
For $t = t_3 \rightarrow t_4$; D_1 OFF while D_2 ON,
and $v_o = -6$ V.



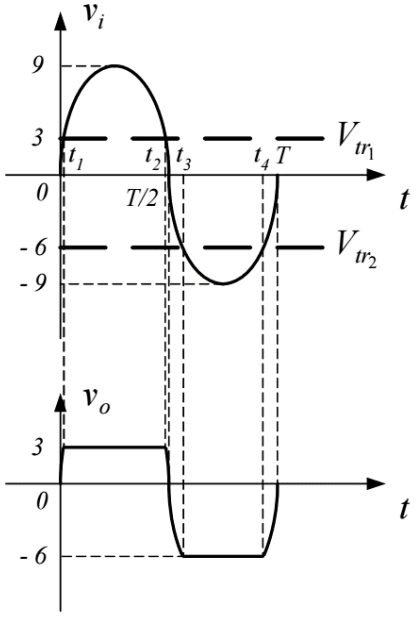
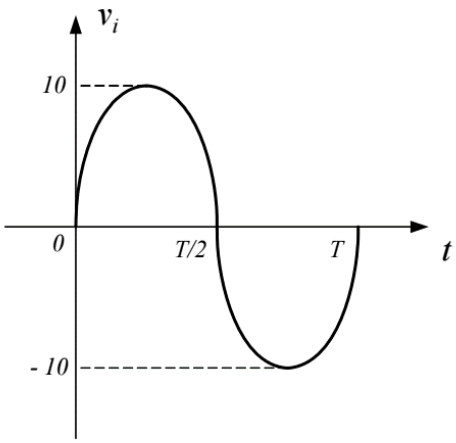
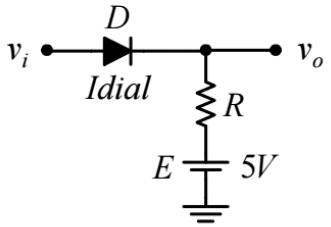


Fig. 3-6 (cont.)

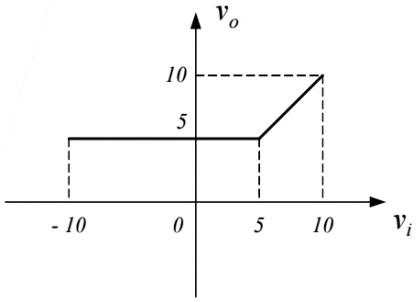
Example 3-5:

Special Type Clipper: A Comparator, see Fig. 3-7.





For $t = 0 \rightarrow t_1$ and $t_2 \rightarrow T$; D OFF,
and $v_o = E = 5$ V.
For $t = t_1 \rightarrow t_2$; D ON,
and $v_o = v_i$.



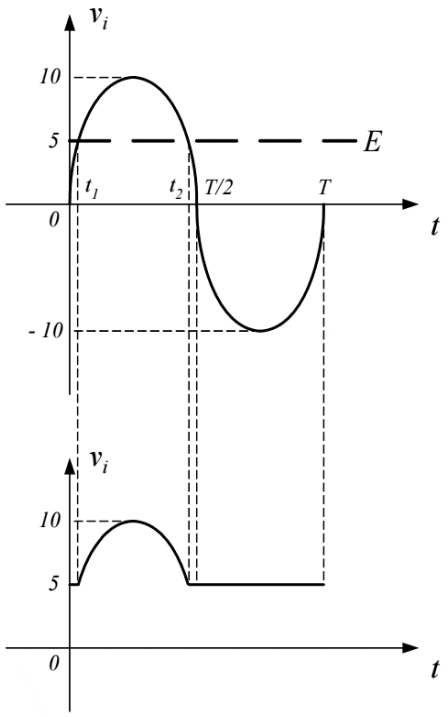
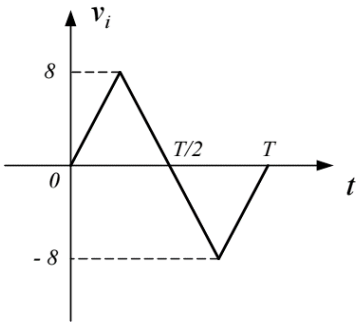
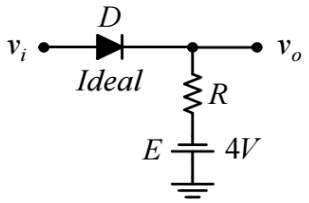


Fig. 3-7 (cont.)

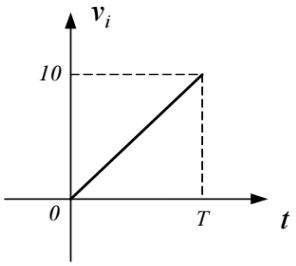
EXERCISES:

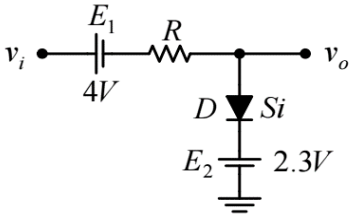
Sketch the output voltage (v_o) and the transfer characteristics (v_o against v_i) for eacl circuit of Fig. 3-9 for the input (v_i) shown.



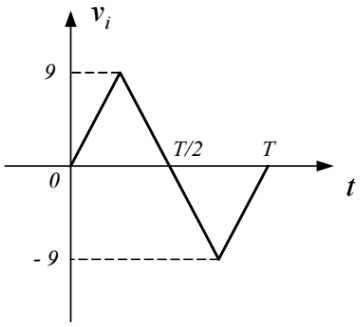


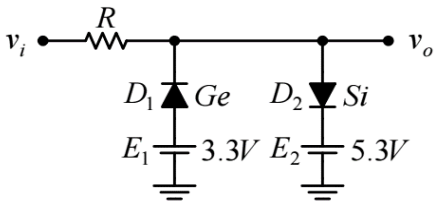
(a)



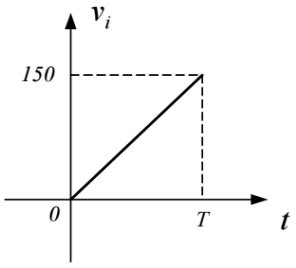


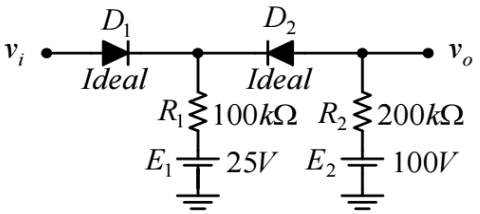
(b)





(c)





(d)

Fig. 3-9