Diode Clippers

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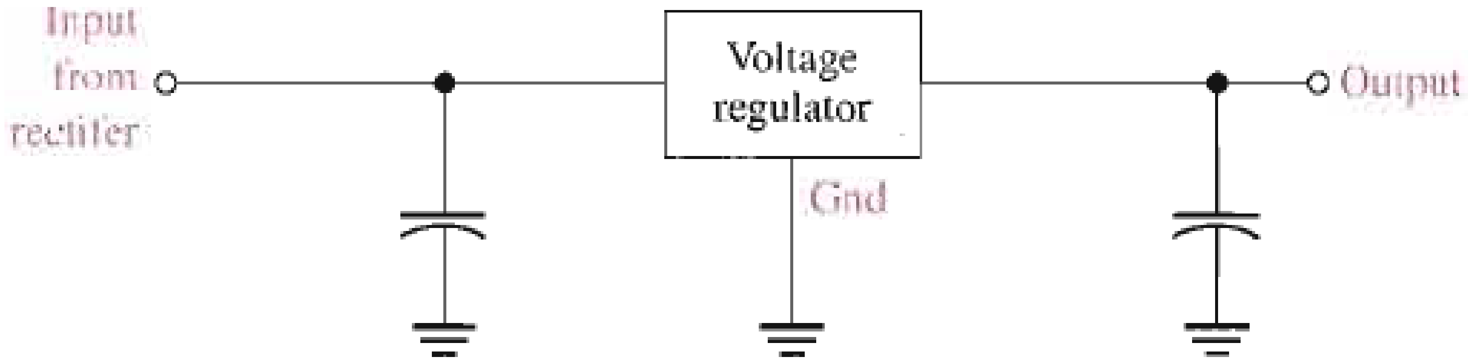
REGULATOR Section OF THE Power Supply

- A Voltage Regulator is connected to the output of a filtered rectifier.
- The purpose of a voltage regulator is to maintain a constant output voltage despite changes in the input, the load current, or the temperature.



Percent Regulation

The regulation expressed as a percentage is a figure of merit used to specify the performance of a voltage regulator. It can be in terms of input (line) regulation or load regulation. **Line regulation** specifies how much change occurs in the output voltage for a given change in the input voltage. It is typically defined as a ratio of a change in output voltage for a corresponding change in the input voltage expressed as a percentage.

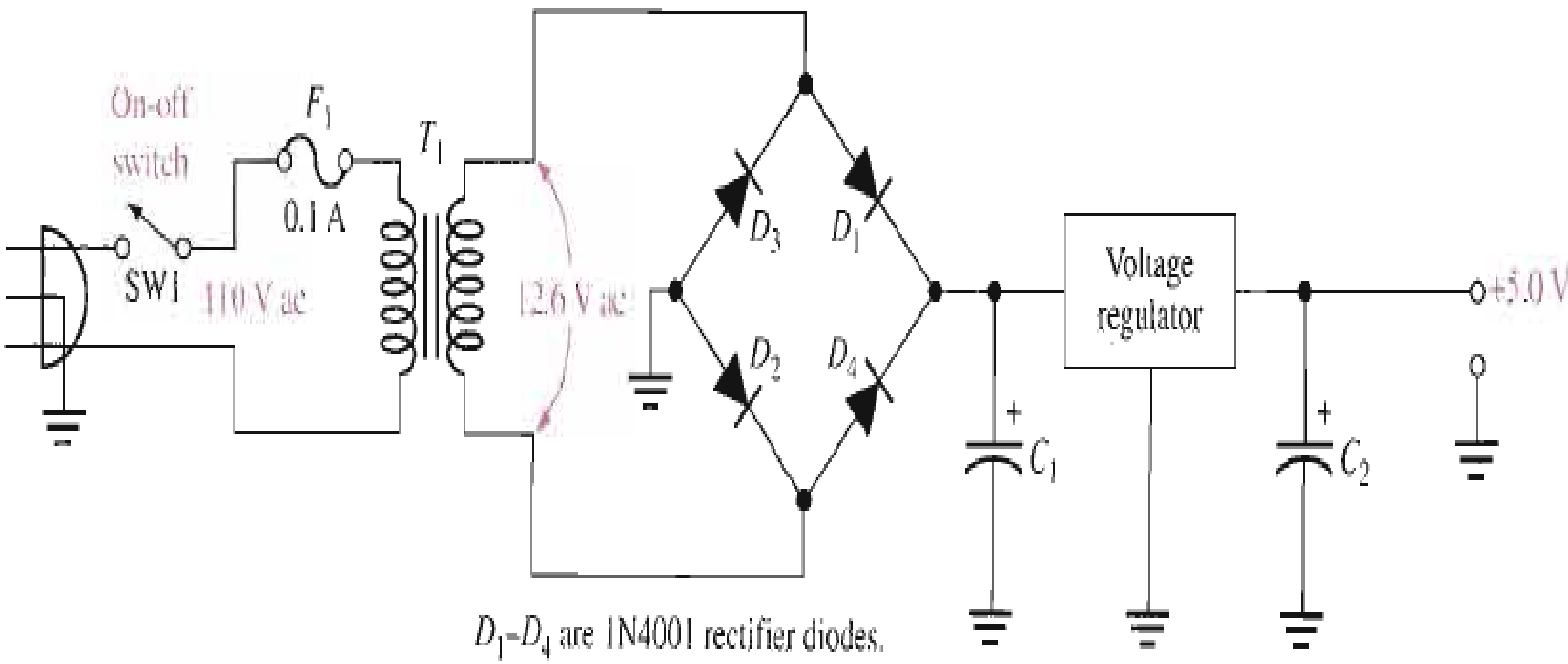
$$\text{Line regulation} = \left(\frac{\Delta V_{OUT}}{\Delta V_{IN}}\right)100\%$$

Load regulation specifies how much change occurs in the output voltage over a certain range of load current values, usually from minimum current (no load, NL) to maximum current (full load, FL). It is normally expressed as a percentage and can be calculated with the following formula:

$$\text{Load regulation} = \left(\frac{V_{NL} - V_{FL}}{V_{FL}}\right)100\%$$

where V_{NL} is the output voltage with no load and V_{FL} is the output voltage with full (maximum) load.

Power Supply Circuit

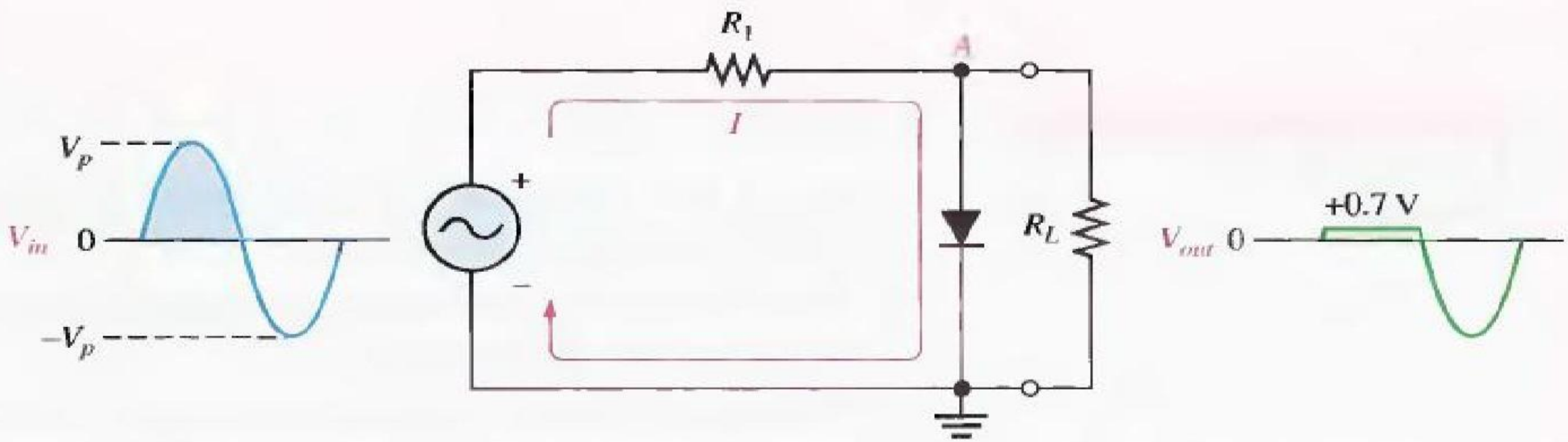


DIODE LIMITING (CIPPING) and CLAMPING CIRCUITS:

DIODE CIPPERS/LIMITERS:

- Diode Clippers/Limiters are used to clip off (remove) portions of signal voltages above or below certain levels.
- These circuit works on the principle that a diode when forward biased act as a shorted path and a diode when reverse biased act as an open circuit.

Positive Clipper:



(a) Limiting of the positive alternation. The diode is forward-biased during the positive alternation (above 0.7 V) and reverse-biased during the negative alternation.

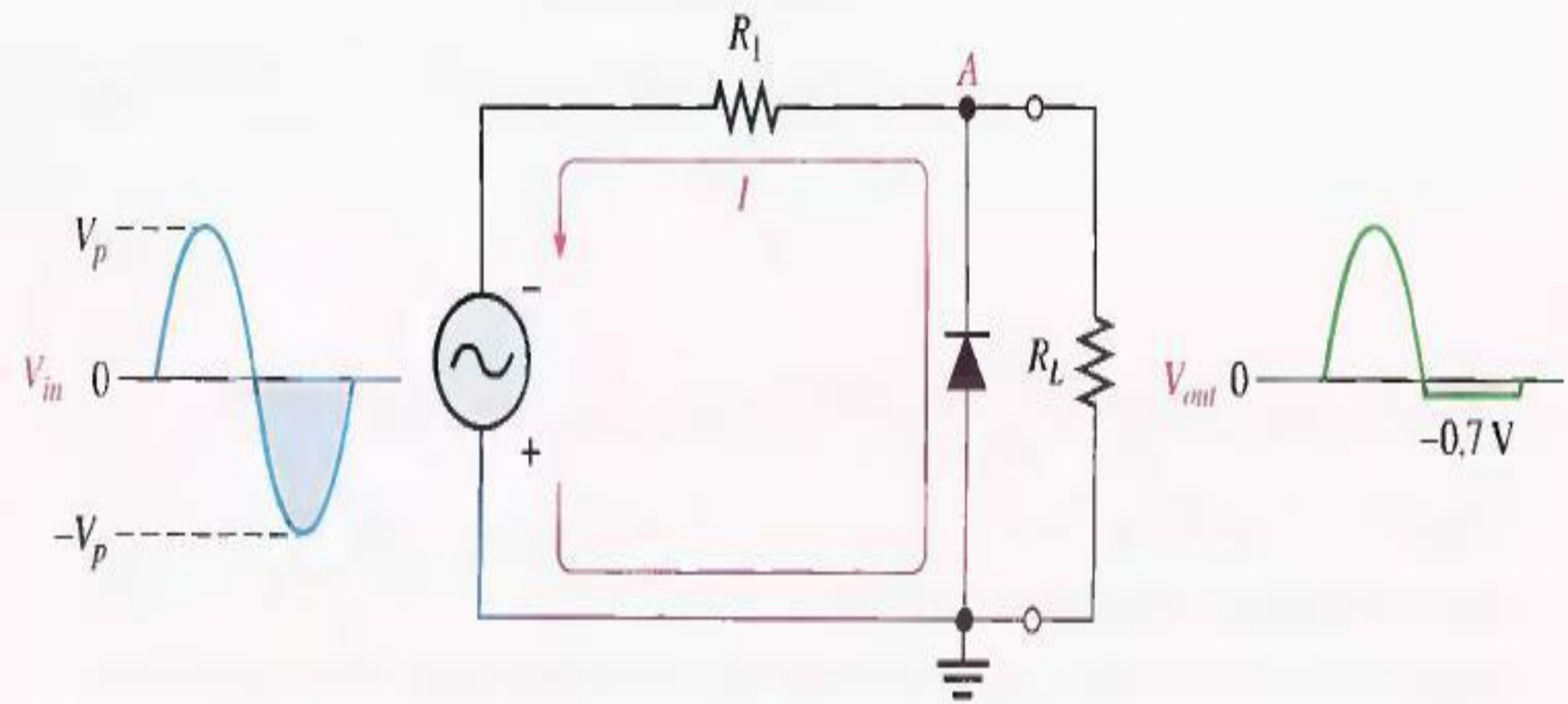
$$V_{out} = \left(\frac{R_L}{R_1 + R_L}\right) V_{in}$$

If R_1 is small compared to R_L, then $V_{out} = V_{in}$.

➢For Positive half cycle of the input signal the diode is forward biased and it ensures that the output signal voltage value remains equal to the diode drop voltage of +0.7 Volt.

➢Whereas for the negative half cycle of the input signal the diode is reverse biased and the magnitude of output voltage values are determined by the voltage divider stated above.

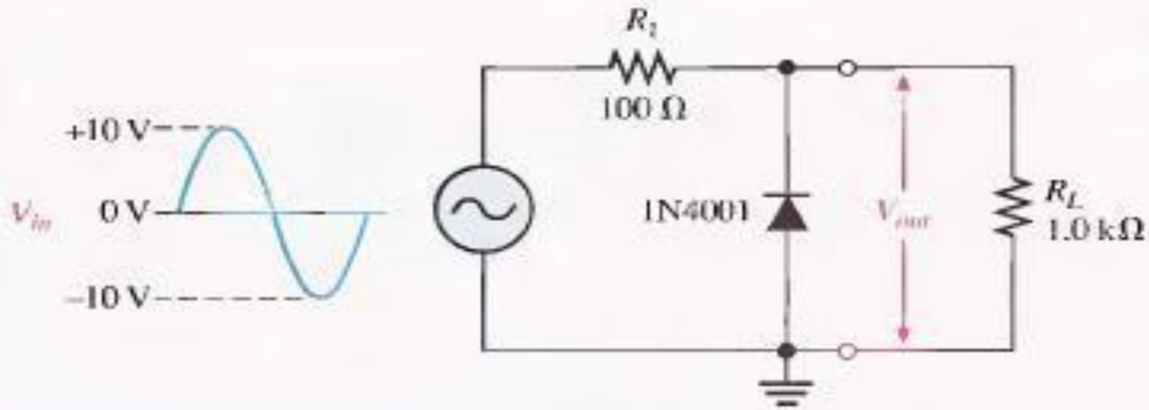
Negative Clipper:



(b) Limiting of the negative alternation. The diode is forward-biased during the negative alternation (below −0.7 V) and reverse-biased during the positive alternation.

- For negative half cycle of the input signal the diode is forward biased and it ensures that the output signal voltage value remains equal to the diode drop voltage of -0.7 Volt.
- Whereas for the positive half cycle of the input signal the diode is reverse biased and the output voltage values are determined by the voltage divider stated above.

Example:



The diode is forward-biased and conducts when the input voltage goes below −0.7 V. So, for the negative limiter, determine the peak output voltage across R_L by the following equation:

$$V_{p(out)} = \left(\frac{R_L}{R_1 + R_L}\right)V_{p(in)} = \left(\frac{1.0\ \text{k}\Omega}{1.1\ \text{k}\Omega}\right)10\ \text{V} = 9.09\ \text{V}$$

The scope will display an output waveform as shown in Figure 2–36.

FIGURE 2–36

Output voltage waveform for Figure 2–35.