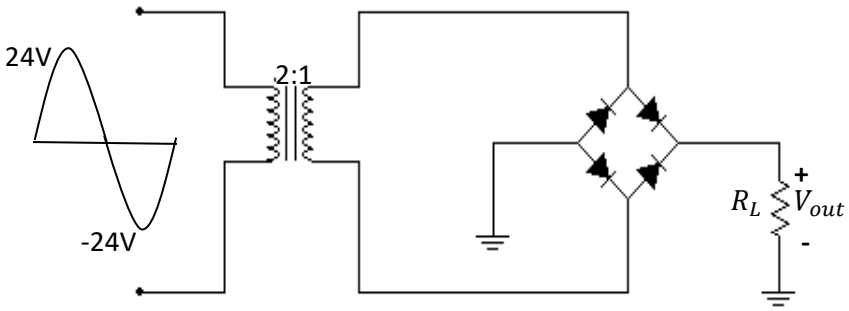
Example: Determine the output voltage for the bridge rectifier in the following figure, what minimum PIV rating is required for the Silicon diodes ?



Output voltage

$$V_{p(out)} = V_2 - 2V_B$$

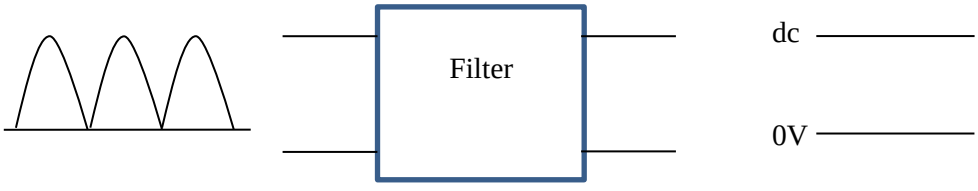
$$= \frac{1}{2}V_{p(in)} - 2V_B = 12V - 1.4V = 10.6V$$

PIV for each diode

$$PIV = V_{p(out)} = 10.6V + 0.7V = 11.3V$$

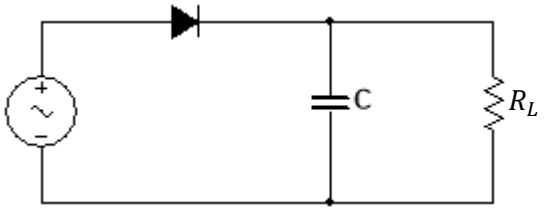
2-4 Rectifier Filters

- A full-wave rectifier voltage can be applied to a filter input, this is part of the power supply application.

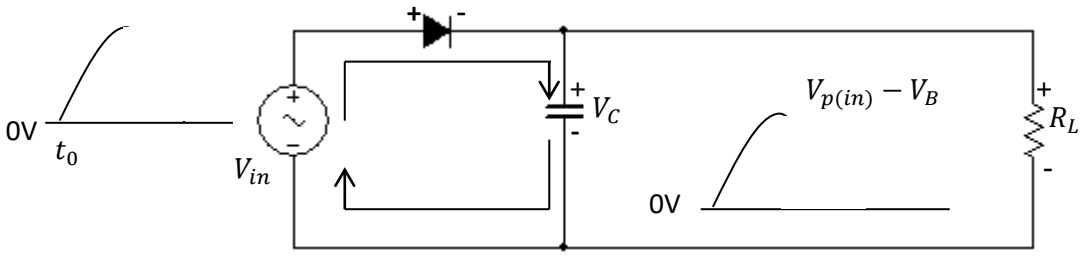


2-4.1 Capacitor-Input Filter

- A full-wave rectifier with capacitor-input filter is shown:

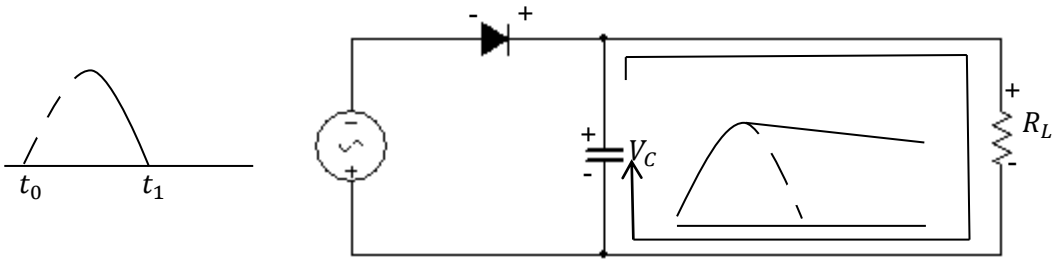


During the positive first quarter-cycle of the input, the diode is forward-biased allowing the capacitor to charge to within a diode drop of the input peak as follows:



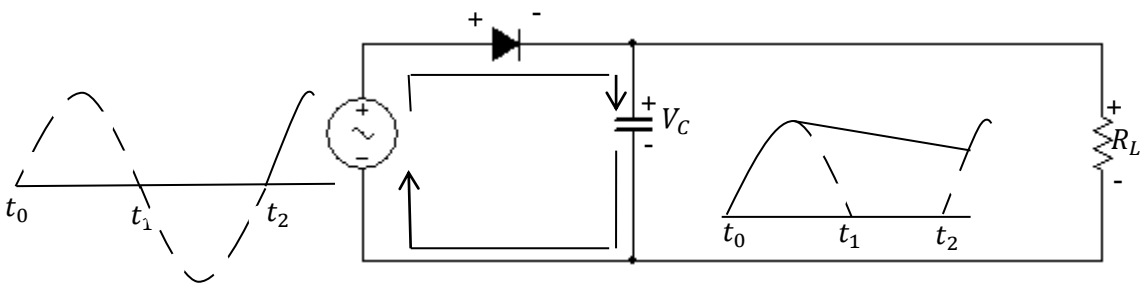
Initial Charging

When the input begins to decrease below its peak, the capacitor retains its charge and the diode becomes reverse biased. During the remaining part of the cycle, the capacitor can discharge only through the load resistor at a rate determined by $R_L C$ time constant. The larger the time constant, the less the capacitor will discharge.



Discharging

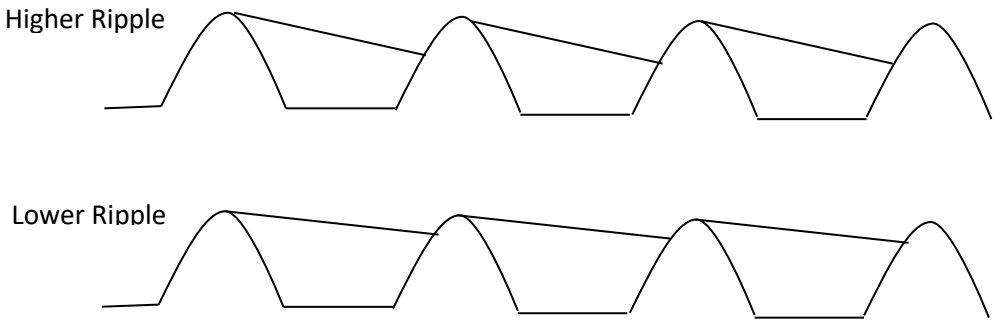
During the first quarter of the next cycle, the diode will again becomes forward biased when the input voltage exceeds the capacitor voltage by approximately a diode voltage drop.



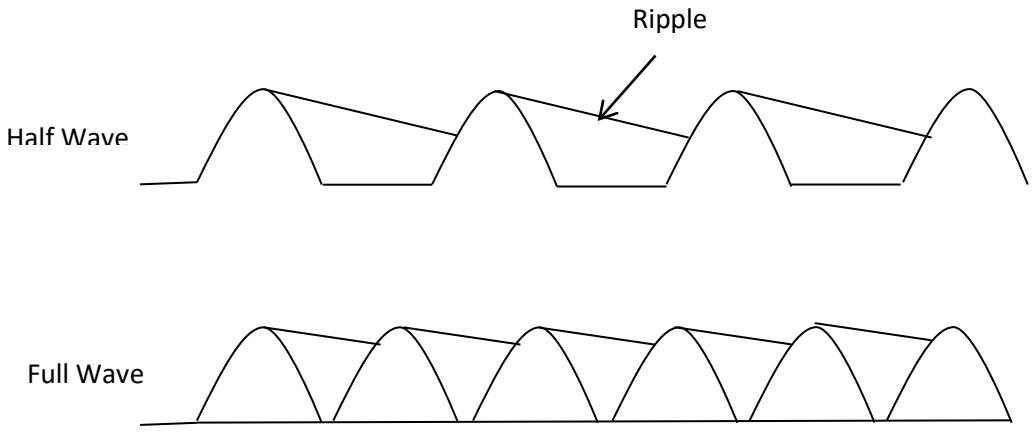
Charging

Ripple

- The capacitor quickly charges at the beginning of a cycle and quickly discharges after the positive peak (when the diode is reverse-biased).



- The variation in the output voltage due to the charging and discharging is called the ripple.
- When filtered, the full-wave rectified voltage has less ripple than does a half-wave signal for the same load resistor and capacitor values.

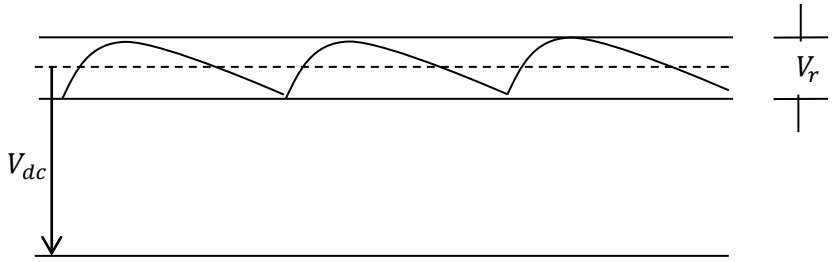


- This is because the capacitor discharges less during shorter interval between the full-wave pulses.
- The ripple factor is an indication of the effectiveness of the filter:

$$r = \frac{V_r}{V_{dc}}$$

V_r is the rms ripple voltage

V_{dc} is the average value of the filter's output voltage.



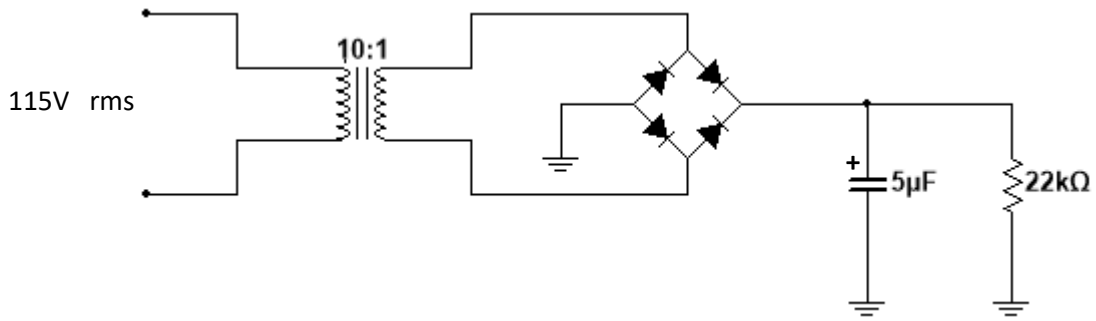
For a full-wave rectifier,

$$V_{dc} = \left(1 - \frac{0.00417}{R_L C}\right) V_{p(in)}$$

$$V_r = \frac{0.0024}{R_L C} V_{p(in)}$$

- $V_{p(in)}$ is the peak rectified voltage applied to the filter

Example: Determine the ripple factor for the filtered bridge rectifier in the following figure:



The peak primary voltage

$$V_{p1} = (1.414)115V = 162.6V$$

The peak secondary voltage

$$V_{p2} = \left(\frac{1}{10}\right)162.6V = 16.26V$$

The peak full-wave rectified voltage at the filter input

$$V_{p(in)} = V_{p2} - 2V_B = 16.26V - 1.4V = 14.86V$$

تكملة الحل في المحاضرة التاسعة