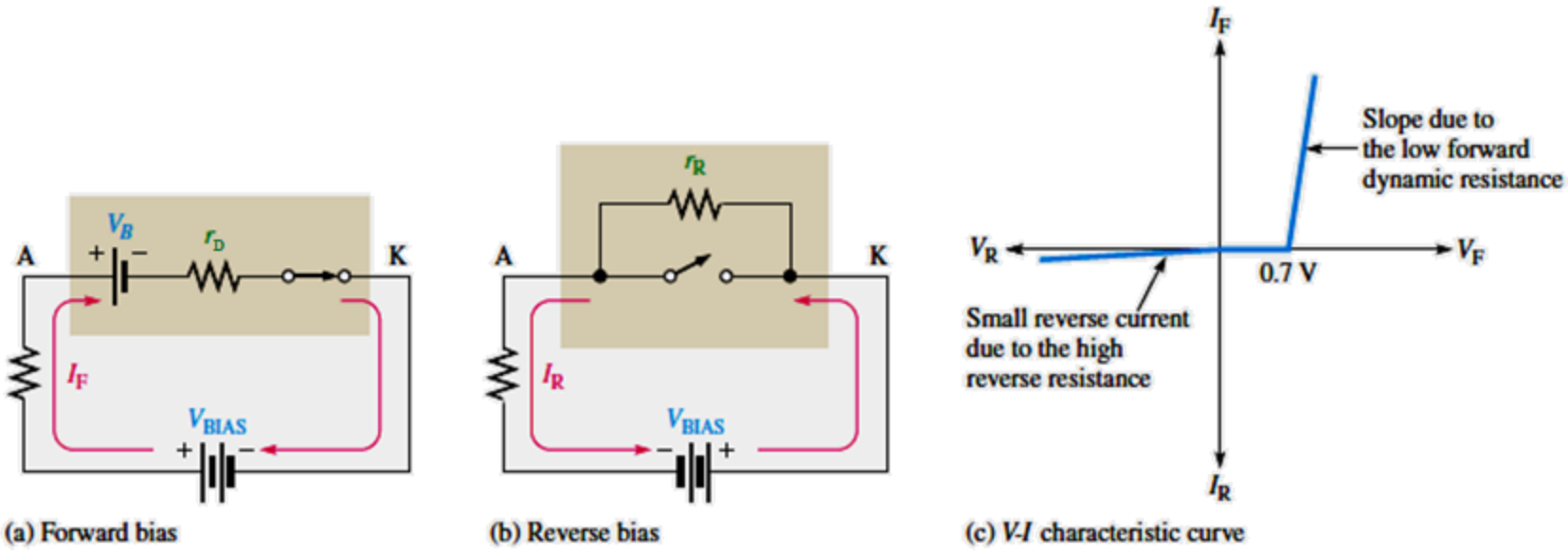
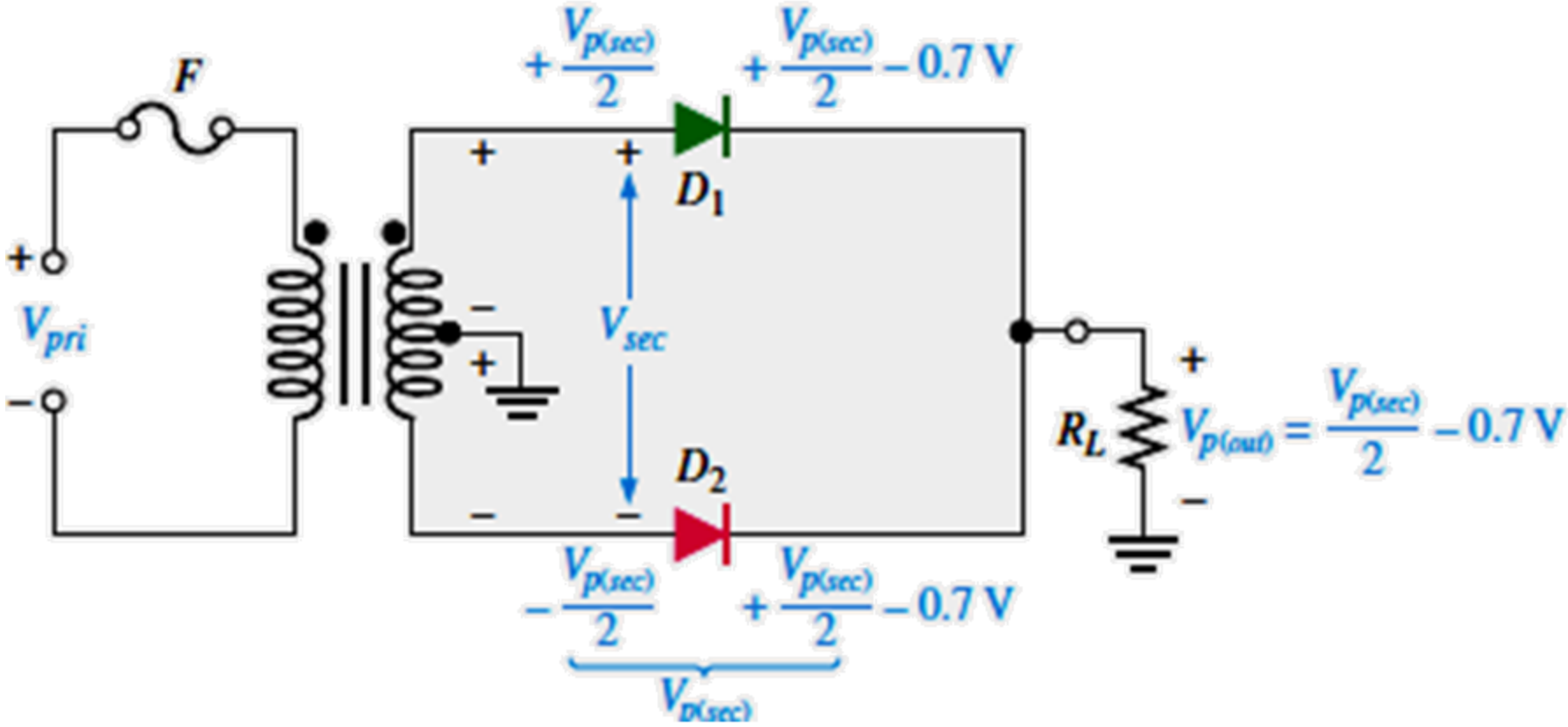
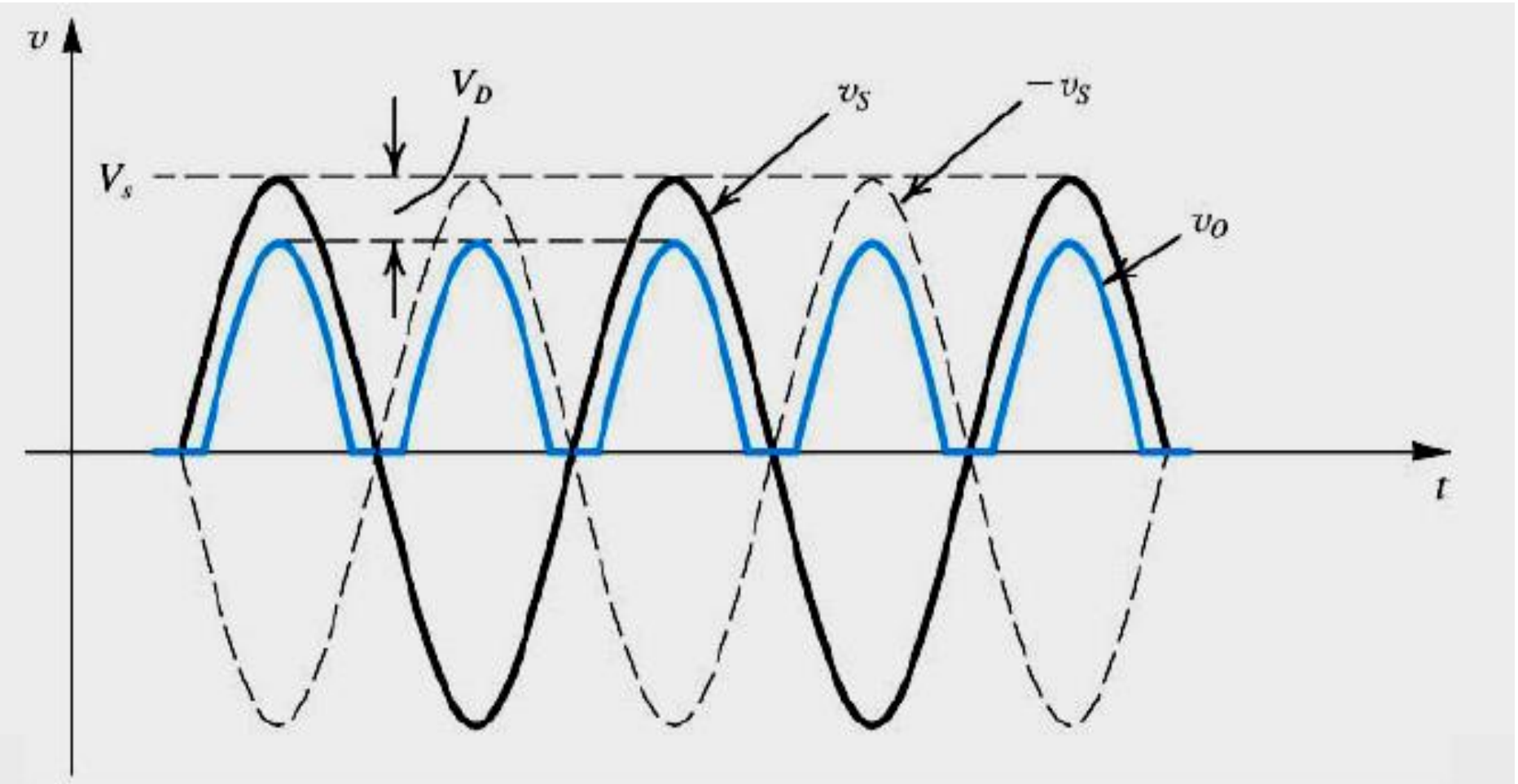
The Complete diode model




F
+
V_{pri}
−
+
−
+
−
V_{sec}
$\frac{V_{p(sec)}}{2}$
D_1
D_2
$\frac{V_{p(sec)}}{2}$ − 0.7 V
$-\frac{V_{p(sec)}}{2}$
$\frac{V_{p(sec)}}{2}$ − 0.7 V
$V_{p(sec)}$
R_L
+
$V_{p(out)} = \frac{V_{p(sec)}}{2}$ − 0.7 V
−

Transformer coupling provides two advantages.

- First, it allows the source voltage to be stepped down as needed.
- Second, the ac source is electrically isolated from the rectifier, thus preventing a shock hazard in the secondary circuit.



(c) input and output waveforms.

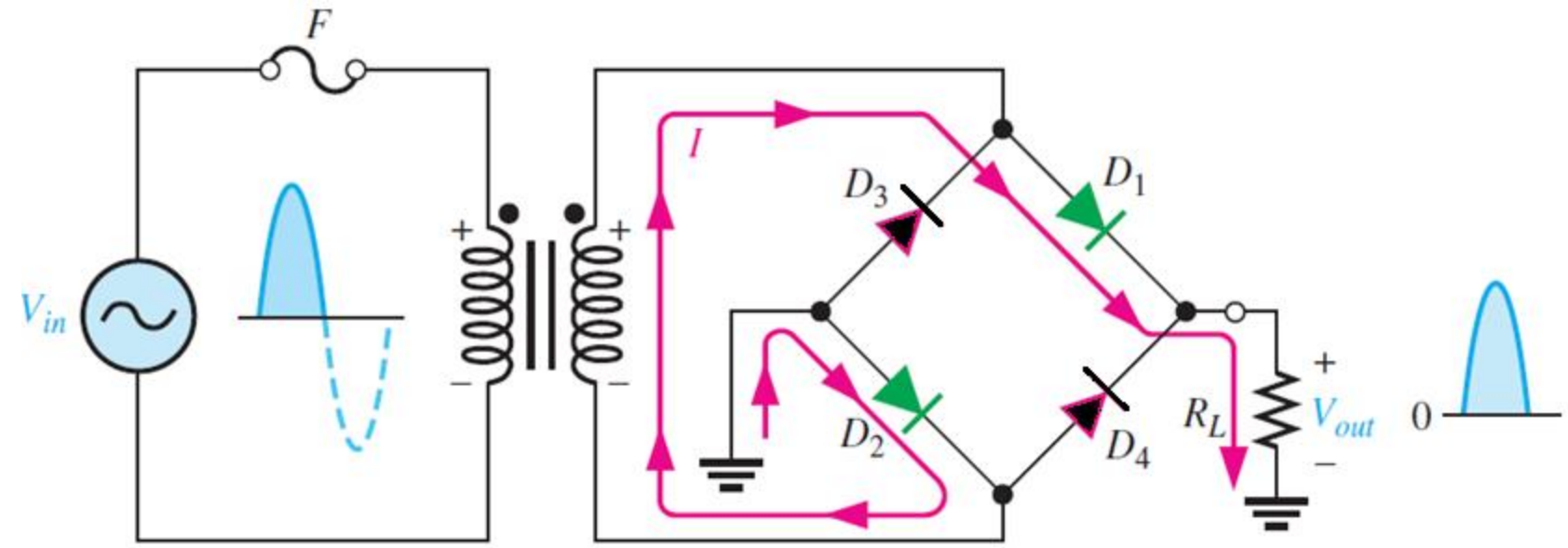
Bridge rectifier

Advantages :

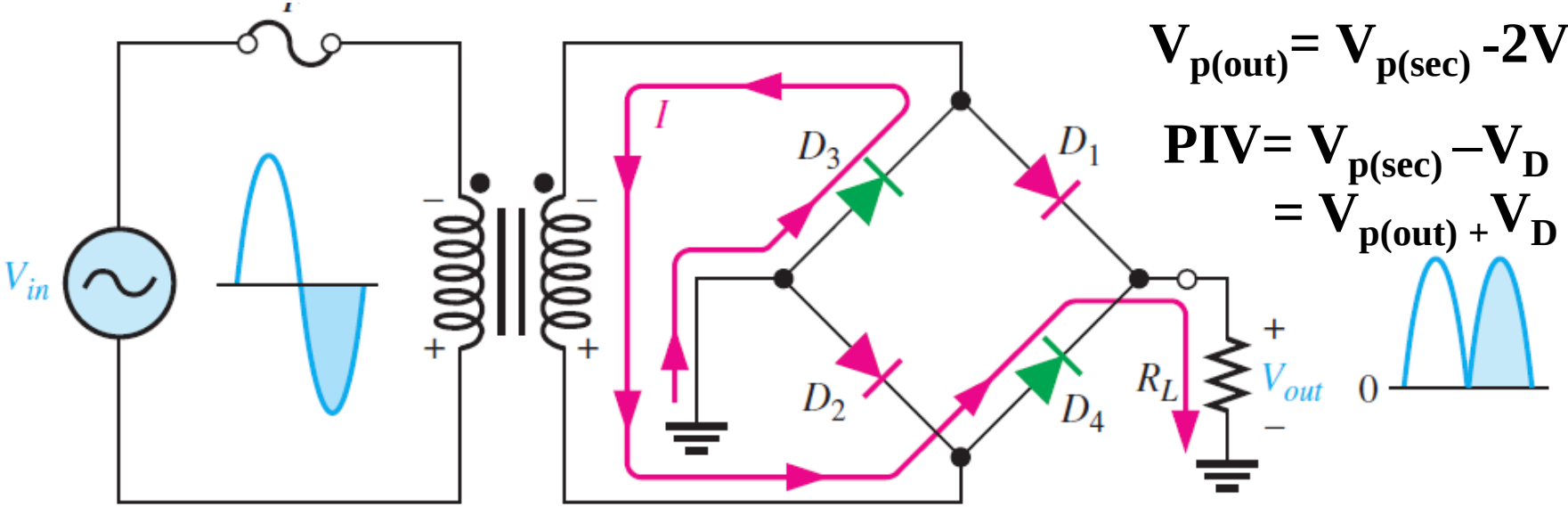
- **No center tap is required** in the transformer secondary so in case of a bridge rectifier the transformer required is **simpler**. If stepping up or stepping down of voltage is not required, transformer can be eliminated even.
- For a given power output, **power transformer of smaller size can be used** in case of the bridge rectifier because current in both primary and secondary windings of the supply transformer flow for the entire ac cycle.

Disadvantages:

- It requires **four diodes.**
- The use of two extra diodes cause an **additional voltage drop** thereby reducing the output voltage



(a) During the positive half-cycle of the input, D_1 and D_2 are forward-biased and conduct current. D_3 and D_4 are reverse-biased.



$$V_{p(out)} = V_{p(sec)} - 2V_D$$

$$PIV = V_{p(sec)} - V_D$$

$$= V_{p(out)} + V_D$$

(b) During the negative half-cycle of the input, D_3 and D_4 are forward-biased and conduct current. D_1 and D_2 are reverse-biased.

We assume $v_S = V_m \sin\alpha$ thus

$$V_{DC} = 2\times\left\{\frac{1}{2\pi}\int_0^{\pi} v_S d\alpha\right\}$$

$$= \frac{\cancel{2}\times 1}{\cancel{2}\pi}\int_0^{\pi} V_m \sin\alpha d\alpha$$

$$= \frac{V_m}{\pi}(-\cos\alpha|_0^{\pi})$$

$$= \frac{2\times V_m}{\pi} = 0.636 V_m$$

$$V_{rms} = \left[\frac{2\times 1}{2\pi}\int_0^{\pi} v_S^2 d\alpha\right]^{1/2}$$

$$V_{rms}^2 = \frac{2\times 1}{2\pi}\int_0^{\pi} V_m^2 \sin^2\alpha d\alpha$$

$$= \frac{\cancel{2}\times V_m^2}{\cancel{2}\pi}\int_0^{\pi}\left(\frac{1}{2} - \frac{1}{2}\cos 2\alpha\right)d\alpha$$

$$= \frac{V_m^2}{\pi}\left(\frac{1}{2}\alpha - \frac{1}{4}\sin 2\alpha\right)\Big|_0^{\pi}$$

$$= \frac{V_m^2}{2} \Rightarrow V_{rms} = 0.707 V_m$$

- Ripple factor is a measure of effectiveness of a rectifier circuit and defined as a ratio of rms value of ac component to the dc component (voltage or current) in the rectifier output.