Applications of Schottky diodes

Although Schottky and PN diodes follow the same IV expression

$$I = I_0(e^{qV/kT} - 1) , \qquad (4.19.1)$$

I_0 of a silicon Schottky diode can be 10^3–10^8 times larger than a typical PN junction diode, depending on ϕ_B (i.e., the metal employed). A smaller ϕ_B leads to a larger I_0. A larger I_0 means that a smaller forward bias, V, is required to produce a given diode current as shown in Fig. 4–40.

This property makes the Schottky diode the preferred rectifier in low-voltage and high-current applications where even a ~0.8 V forward-voltage drop across a PN junction diode would produce an undesirably large power loss. Figure 4–41 illustrates the switching power supply as an example. After the utility power is rectified, a 100 kHz pulse-width modulated (square-wave) AC waveform is produced so that a small (lightweight and cheap) high-frequency transformer can down-transform the voltage. This low-voltage AC power is rectified with Schottky diode (~0.3 V forward voltage drop) and filtered to produce the 50 A, 1 V, 50 W DC

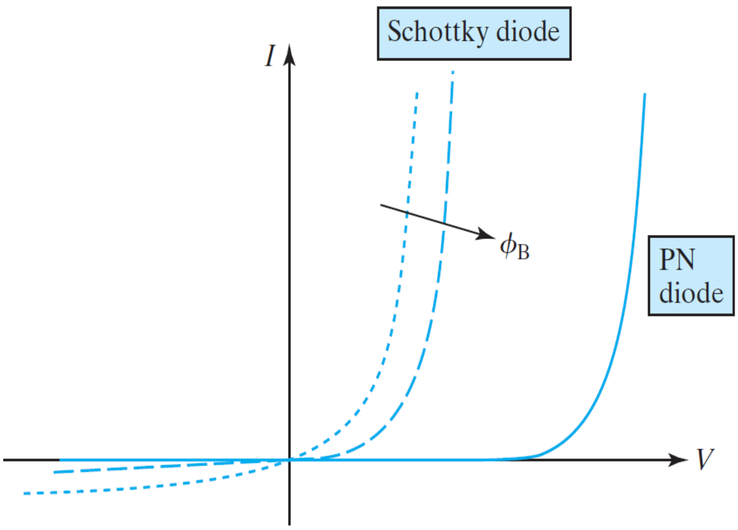

FIGURE 4–40 Schematic IV characteristics of PN and Schottky diodes having the same area.

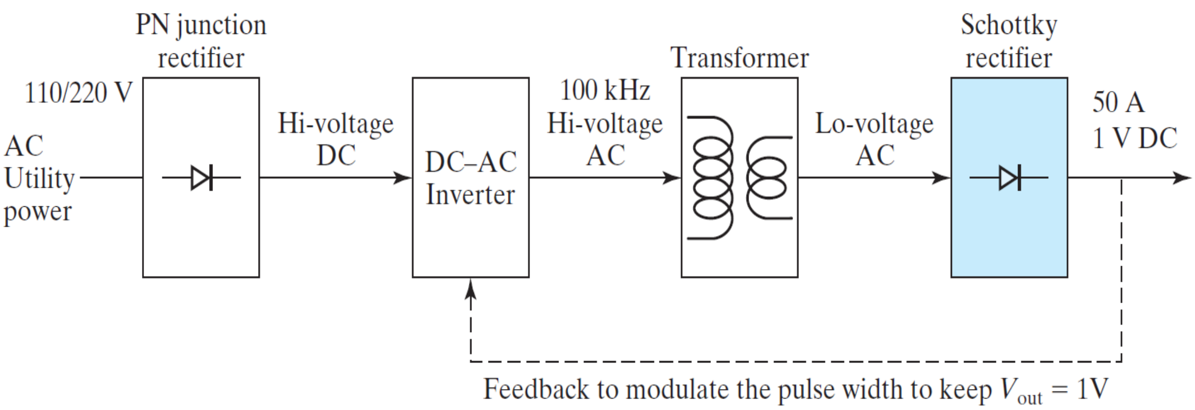

FIGURE 4–41 Block diagram of a switching power supply for electronic equipment such as PCs.

Applications of Schottky diodes

output. If a PN diode with 0.8 V forward voltage drop is used, it would consume 40 W (50 A × 0.8 V) of power and require a larger fan to cool the equipment.

For this application, a Schottky contact with a relatively small ϕ_B would be used to obtain a large I_0 and a small forward voltage drop. However, ϕ_B cannot be too small, or else the large I_0 will increase the power loss when the diode is reverse biased and can cause excessive heat generation. The resultant rise in temperature will further raise I_0 [Eq. (4.18.1)] and can lead to **thermal runaway**.

$$I_0 = AKT^2 e^{-q\phi_B/kT} \qquad (4.18.1)$$

A is the diode area and