

Figure 3-41 Solution to Example 3-16.

EXAMPLE 3-17

Simplify the following equation using the Karnaugh mapping procedure:

$$X = \bar{A}\bar{B}\bar{C} + A\bar{C}\bar{D} + A\bar{B} + ABC\bar{D} + \bar{A}\bar{B}C$$

Solution:

Note in Figure 3-42 that a new technique called *wraparound* is introduced. You have to think of the K-map as a continuous cylinder in the horizontal direction, like the label on a soup can. This makes the left row of cells adjacent to the right row of cells. Also, in the vertical direction, a continuous cylinder like a soup can lying on its side makes the top row of cells adjacent to the bottom row of cells. In Figure 3-42, for example, the four top cells are adjacent to the four bottom cells to combine as eight cells having the variable \bar{B} in common.

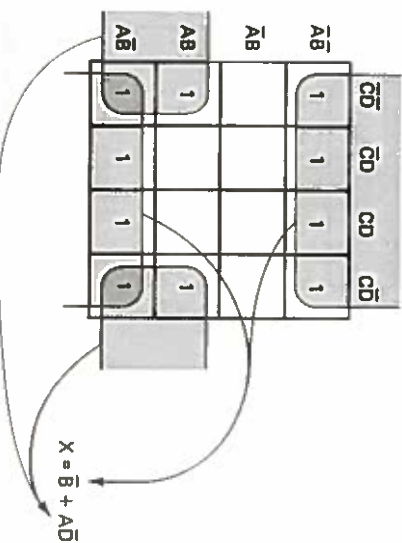


Figure 3-42 Solution to Example 3-17 illustrating the wraparound feature.

Another circle of four is formed by the wraparound adjacencies of the lower-left and lower-right pairs combining to have $A\bar{D}$ in common. The final equation becomes $X = \bar{B} + A\bar{D}$. Compare that simple equation with the original equation that had five terms in it.

EXAMPLE 3-18

Simplify the following equation using the Karnaugh mapping procedure:

$$X = \bar{B}(CD + \bar{C}) + C\bar{D}(\bar{A} + \bar{B} + AB)$$

Solution:

Before filling in the K-map, an SOP expression must be formed:

$$\begin{aligned} X &= \bar{B}CD + \bar{B}\bar{C} + C\bar{D}(\bar{A}\bar{B} + AB) \\ &= \bar{B}CD + \bar{B}\bar{C} + \bar{A}\bar{B}C\bar{D} + ABC\bar{D} \end{aligned}$$

The group of four 1s can be encircled to form $\bar{A}\bar{B}$, as shown in Figure 3-43. Another group of four can be encircled using wraparound to form $\bar{B}\bar{C}$. That leaves two 1s that are not combined with any others. The unattached 1 in the bottom row can be combined within a group of four, as shown, to form $\bar{B}D$.

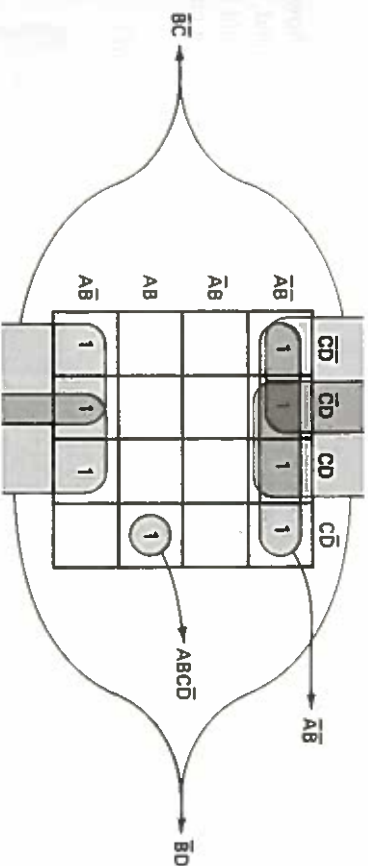


Figure 3-43 Solution to Example 3-18.

The last 1 is not adjacent to any other, so it must be encircled by itself to form $ABC\bar{D}$. The final simplified equation is

$$X = \bar{A}\bar{B} + \bar{B}\bar{C} + \bar{B}D + ABC\bar{D}$$

EXAMPLE 3-19

Simplify the following equation using the Karnaugh mapping procedure:

$$X = \bar{A}\bar{D} + A\bar{B}\bar{D} + \bar{A}\bar{C}D + \bar{A}CD$$

Solution:

First, the group of eight cells can be encircled, as shown in Figure 3-44. \bar{A} is the only variable present in each cell within the circle, so that the circle of eight simply reduces to \bar{A} . (Note that larger circles will reduce to fewer variables in the final equation.)

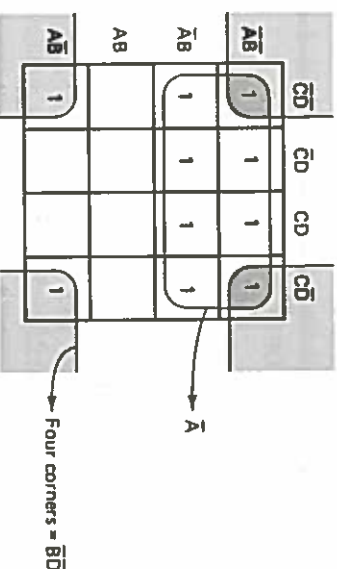


Figure 3-44 Solution to Example 3-19.