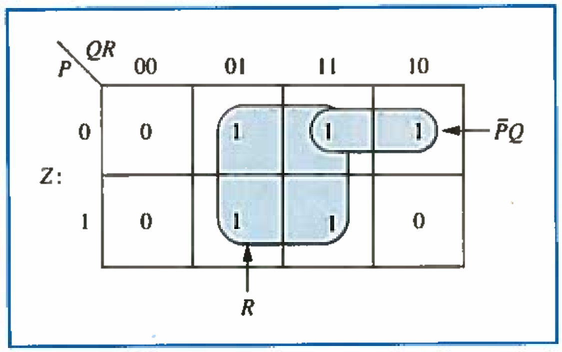
Figure 3–54
K-map with a group of four adjacent 1-cells.



remains constant in that group of four cells. Therefore the term produced by the group of four cells is R. The logic equation for the K-map in Figure 3–54 is

Equation (3–51)

$$Z = R + \bar{P}Q$$

It should now be apparent that the larger the group of adjacent 1-cells, the smaller the resulting term, and consequently the simpler the resulting logic equation. In a three-variable K-map the first attempt should be to try to find groups of four adjacent 1-cells, then groups of two adjacent 1-cells, and finally single 1-cells. The following example illustrates other K-map configurations and their logic equations.

Four-variable Karnaugh maps

Four-variable K-maps have 2^4, or 16, cells, each cell representing a unique combination of the four independent variables. As stated earlier, the value in each cell corresponds to the value of the dependent variable. Figure 3–56 shows the general configuration of a four-variable K-map that maps the dependent variable X against the independent variables A, B, C, and D. For convenience we have numbered each cell (in hexadecimal) with numbers that correspond to the binary values of the variables A, B, C, and D (assuming that A is the MSB and D is the LSB). Notice that the cells are arranged in the same manner as a three-variable K-map so that only one variable changes in going from one adjacent cell to another. As before, cells located diagonally opposite each other are *not* adjacent. Notice that cells in all rows and columns are adjacent and that the cells in each corner of the K-map (0, 2, A, 8) are adjacent.

As stated earlier care must be taken when filling in the cells of the K-map with the values of the dependent variable from a truth table, since the cells are not arranged in the same order as the entries in the truth table. Figure 3–57 shows a four-variable truth table with its K-map representation.

To obtain the simplified sum-of-products equation from a four-variable K-map we must again combine the adjacent 1-cells in groups that are as large as possible. In a four-variable K-map, the largest possible group is a group of eight adjacent 1-cells as shown in Figure 3–58. A group of eight adjacent 1-cells (cell numbers 0, 1, 4, 5, C, D, 8, 9) will only have one variable ($\bar{C}$ in this case) that remains constant. A group of eight adjacent 1-cells will therefore yield a term that has a single variable. The next largest group of cells in a four-variable K-map is 4. In Figure 3–58, cell nos. 0, 1, 3, and 2, make up a group of four adjacent 1-cells