5–8 System Design Applications

Let's summarize the entire chapter now by working through two complete design problems. The following examples illustrate practical applications of a K-map to ensure that when we implement the circuit using an AOI, we will have the simplest possible solution.

NOTE: The construction of digital circuits with higher complexity than those of these examples will be more practically suited for implementation using PLDs, which are discussed in Section 5–9.

SYSTEM DESIGN 5–1

Design a circuit that can be built using an AOI and inverters that will output a HIGH (1) whenever the 4-bit hexadecimal input is an odd number from 0 to 9.

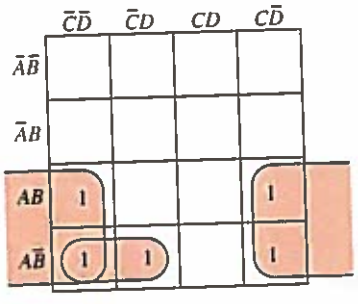
Team Discussion

The LSB (variable *A*) is always HIGH for an odd number. Why can't we just say "odd number = *A*"?

Table 5–7 Hex Truth Table Used to Determine the Equation for Odd Numbers[a] from 0 to 9

D	*C*	*B*	*A*	*DEC*	
0	0	0	0	0	
0	0	0	1	1	$\leftarrow \bar{A}\bar{B}\bar{C}D$
0	0	1	0	2	
0	0	1	1	3	$\leftarrow A\bar{B}\bar{C}D$
0	1	0	0	4	
0	1	0	1	5	$\leftarrow \bar{A}B\bar{C}D$
0	1	1	0	6	
0	1	1	1	7	$\leftarrow AB\bar{C}D$
1	0	0	0	8	
1	0	0	1	9	$\leftarrow \bar{A}\bar{B}CD$

[a]Odd number = $\bar{A}\bar{B}\bar{C}D + A\bar{B}\bar{C}D + \bar{A}B\bar{C}D + AB\bar{C}D + \bar{A}\bar{B}CD$.



Odd number = $A\bar{D} + A\bar{B}\bar{C}$ where A = LSB

(a)

Figure 5–76 (a) Simplified equation derived from a Karnaugh map;