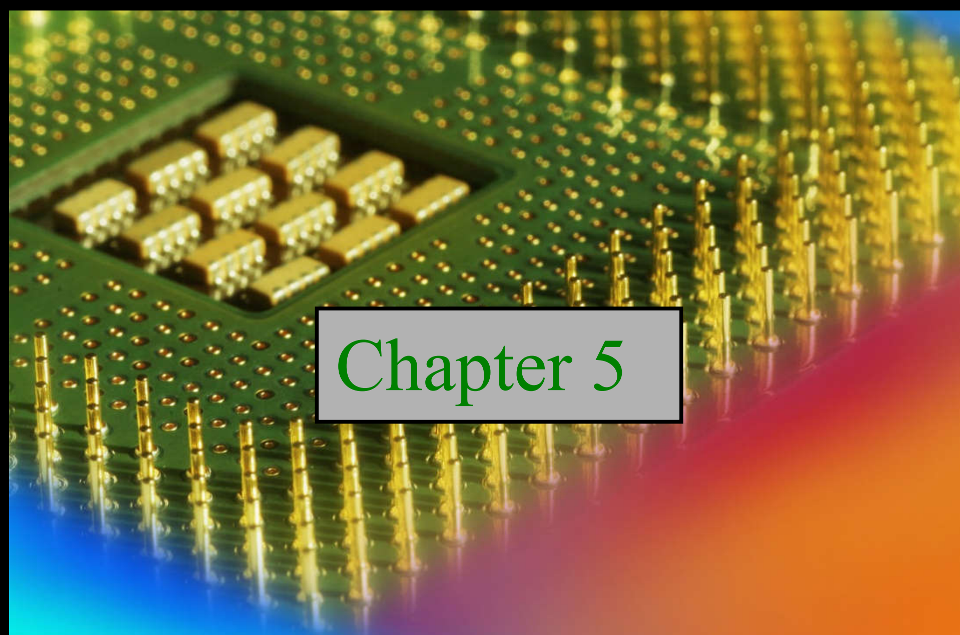
Digital Fundamentals

Tenth Edition

Floyd

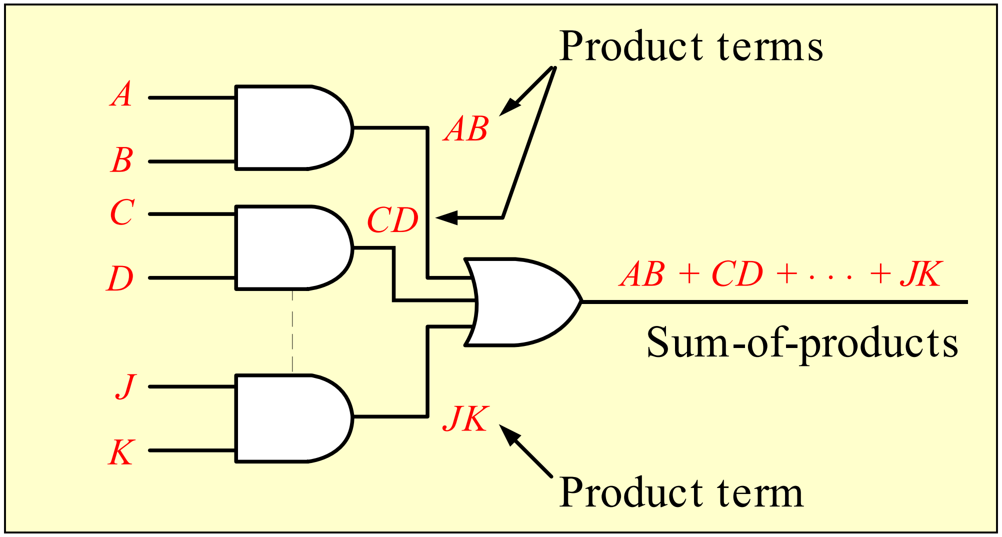


Chapter 5

Summary

Combinational Logic Circuits

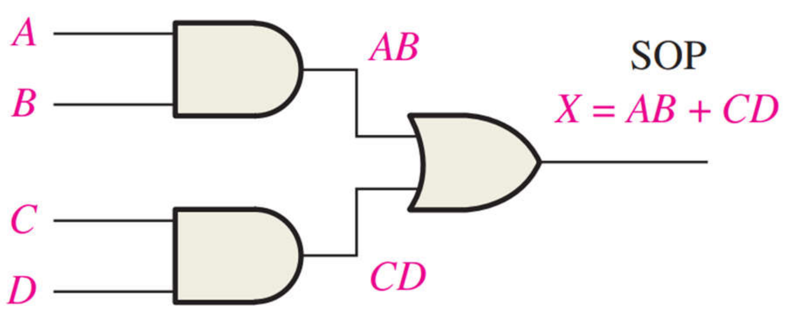
In Sum-of-Products (SOP) form, basic combinational circuits can be directly implemented with **AND-OR** combinations if the necessary complement terms are available.



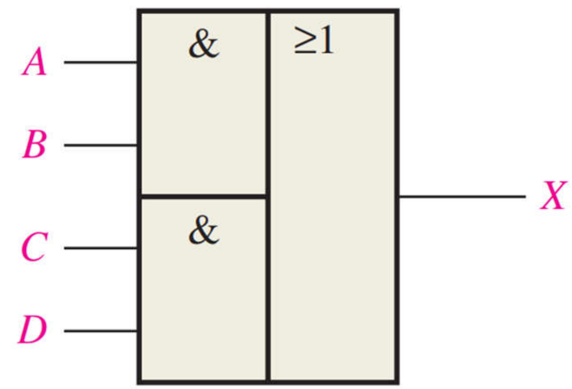
Summary

Combinational Logic Circuits

An example of an SOP implementation is shown. The SOP expression is an AND-OR combination of the input variables and the appropriate complements.



(a) Logic diagram (ANSI standard distinctive shape symbols)



(b) ANSI standard rectangular outline symbol

For a 4-input AND-OR logic circuit, the output *X* is HIGH (1) if both input *A* and input *B* are HIGH (1) or both input *C* and input *D* are HIGH (1).

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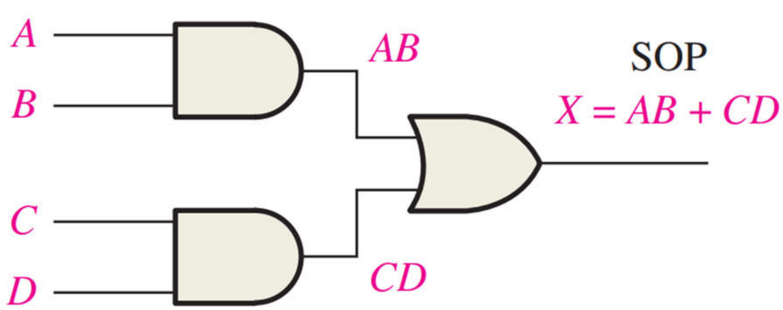


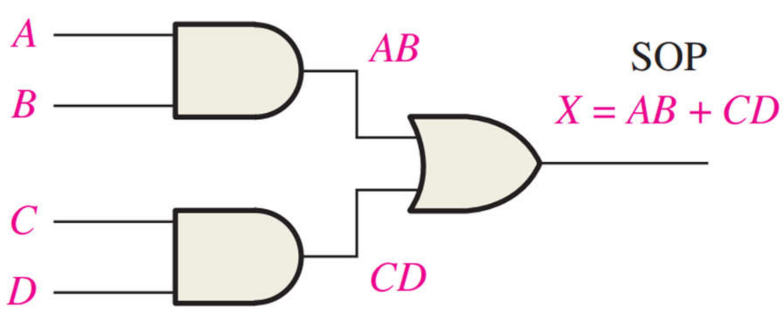
(a) Logic diagram (ANSI standard distinctive shape symbols)

Task 1:
Generate Truth Table for this logic circuit.

Summary

Combinational Logic Circuits

An example of an SOP implementation is shown. The SOP expression is an AND-OR combination of the input variables and the appropriate complements.



(a) Logic diagram (ANSI standard distinctive shape symbols)

Task 2:

Use Truth Table to write logic expression in standard SOP form.

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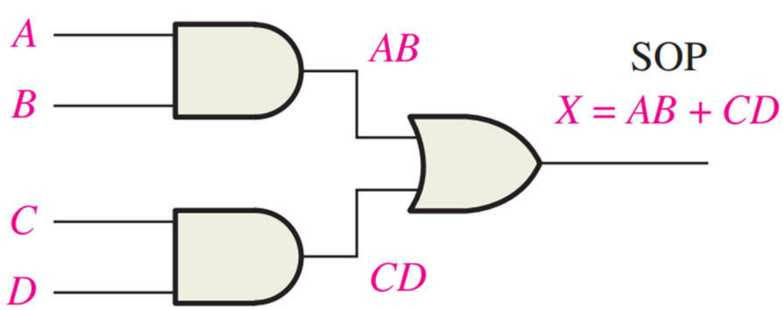


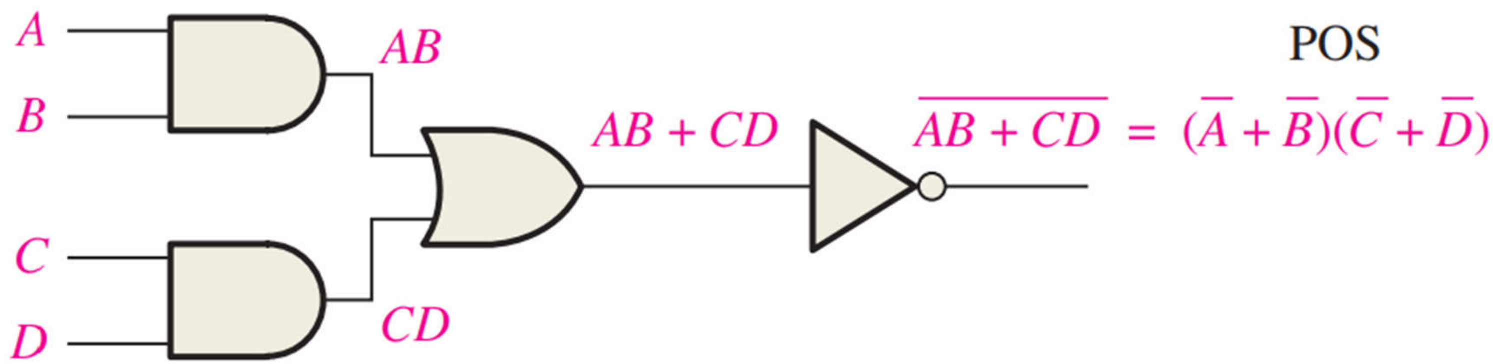
(a) Logic diagram (ANSI standard distinctive shape symbols)

Task 3:
Implement K-map to simplify this standard SOP form.

Summary

Combinational Logic Circuits

When the output of a SOP form is inverted, the circuit is called an **AND-OR-Invert** circuit. The AOI configuration lends itself to product-of-sums (POS) implementation.



For a 4-input AND-OR-Invert logic circuit, the output *X* is LOW (0) if both input *A* and input *B* are HIGH (1) or both input *C* and input *D* are HIGH (1).

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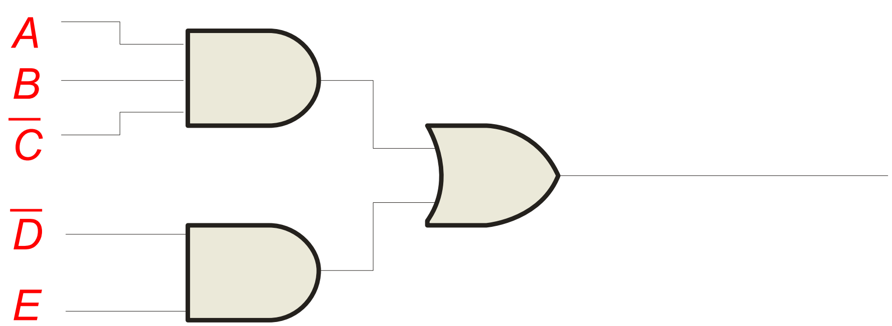

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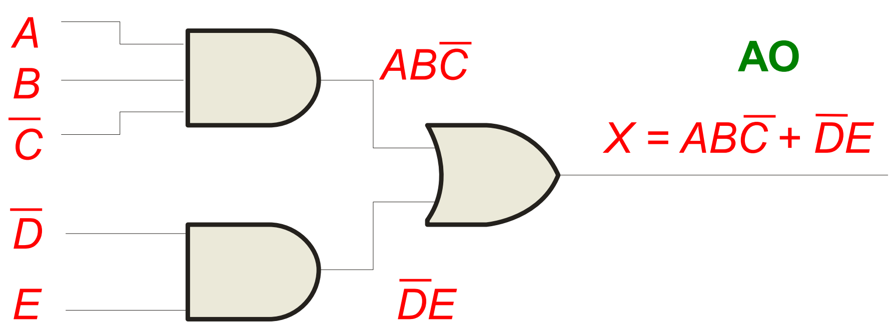

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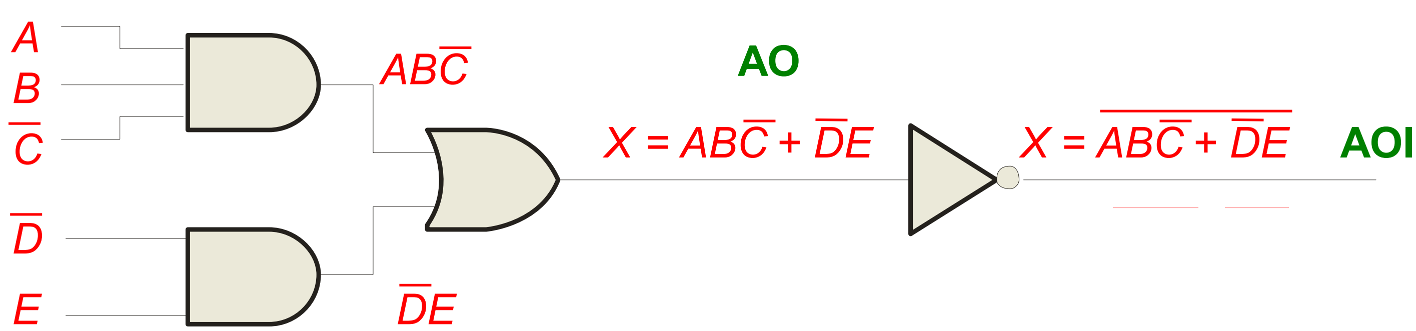

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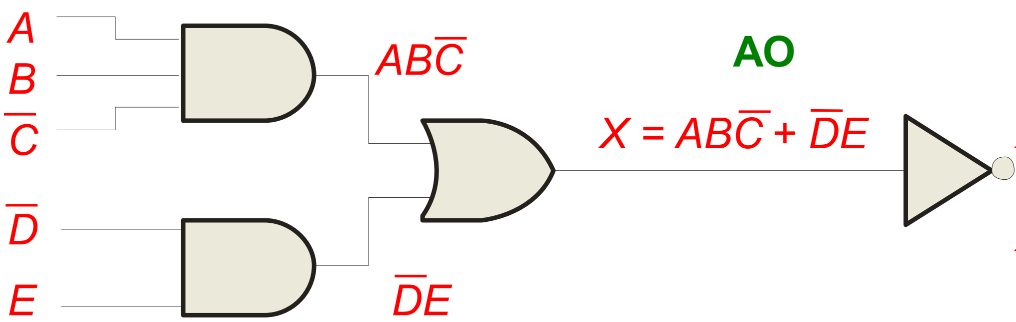


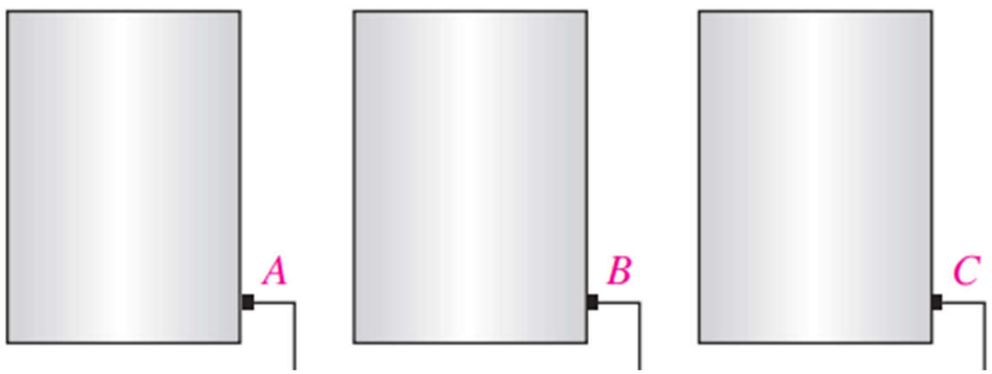
$X = \overline{AB\overline{C} + \overline{D}E}$ **AOI**

$X = (\overline{AB\overline{C}})(\overline{\overline{D}E})$ DeMorgan

$X = (\overline{A} + \overline{B} + C)(D + \overline{E})$ POS

In a certain chemical-processing plant, a liquid chemical is used in a manufacturing process. The chemical is stored in three different tanks. A level sensor in each tank produces a HIGH voltage when the level of chemical in the tank drops below a specified point.

Design a circuit that monitors the chemical level in each tank and indicates when the level in any two of the tanks drops below the specified point.



1. Direct method

In a certain chemical-processing plant, a liquid chemical is used in a manufacturing process. The chemical is stored in three different tanks. A level sensor in each tank produces a HIGH voltage when the level of chemical in the tank drops below a specified point.

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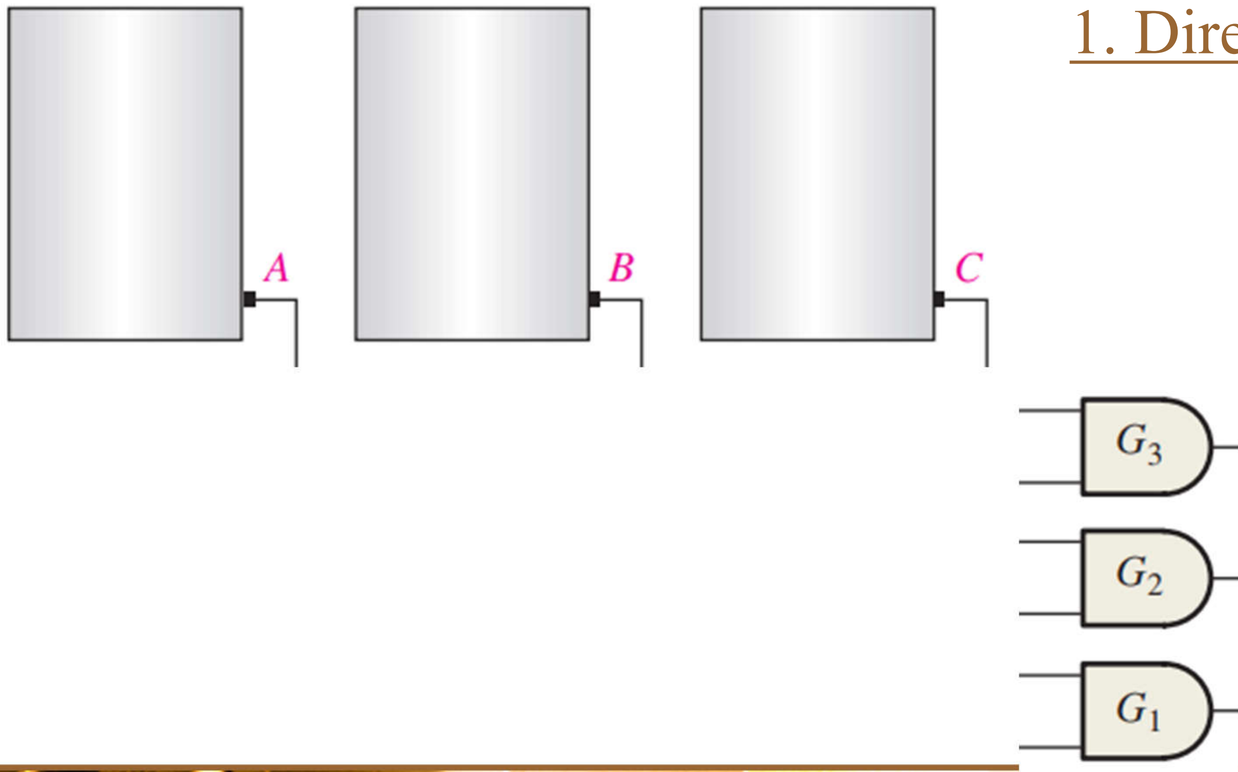
1. Direct method



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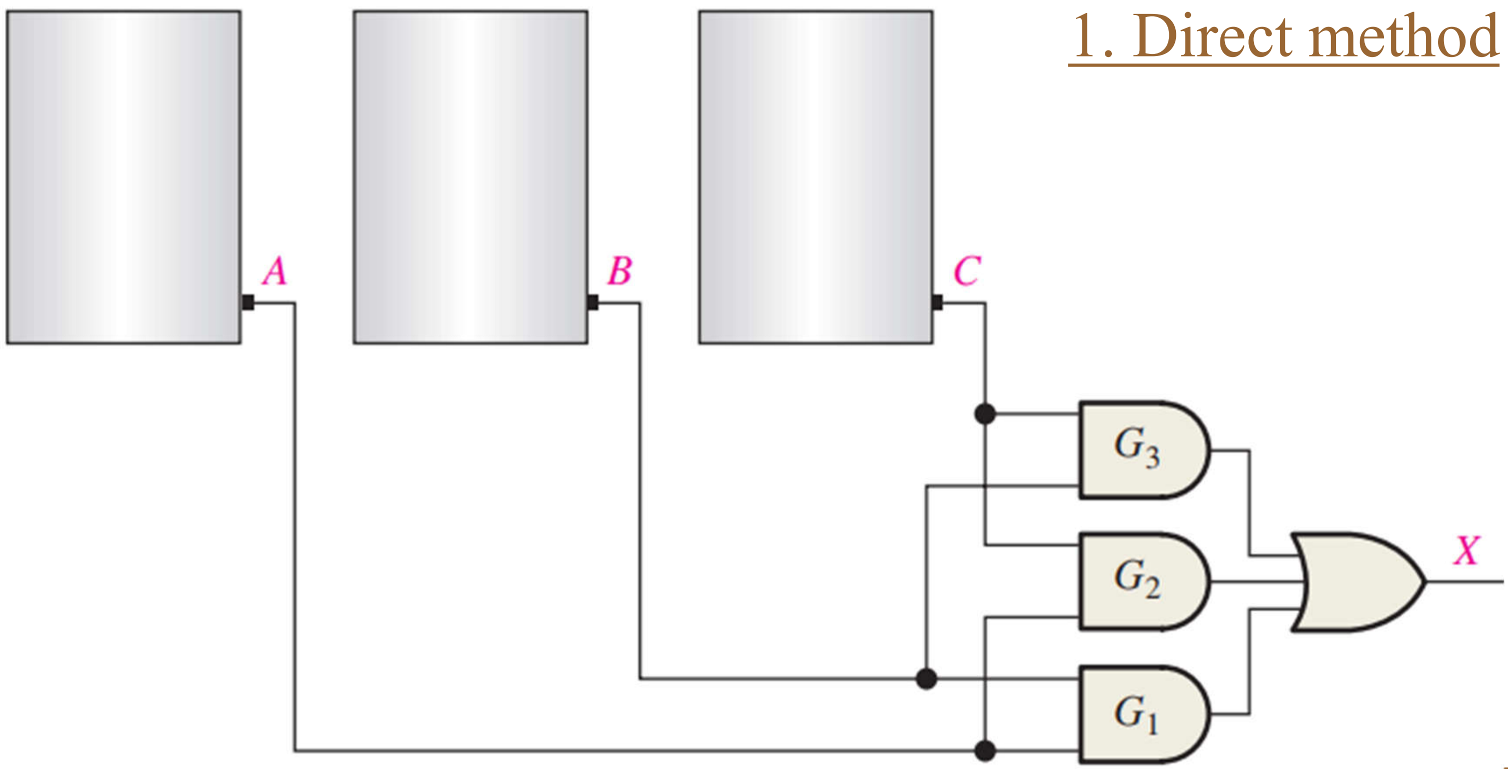

Floyd, Digital Fundamentals, 10th ed

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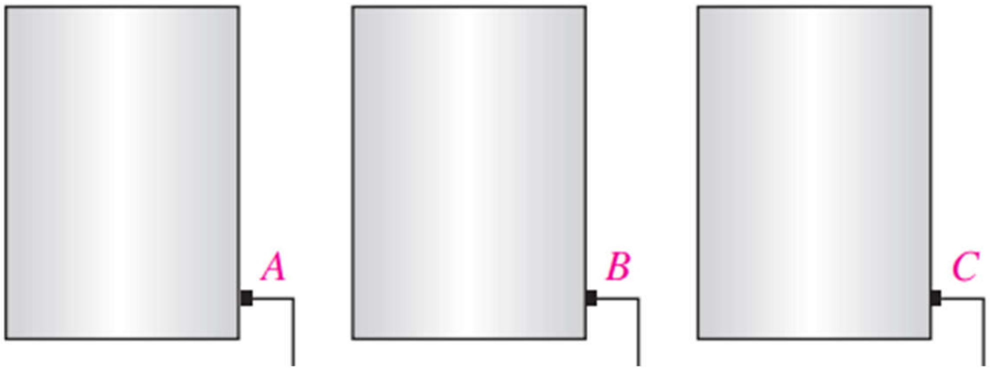

2. Truth table to logic expression

A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

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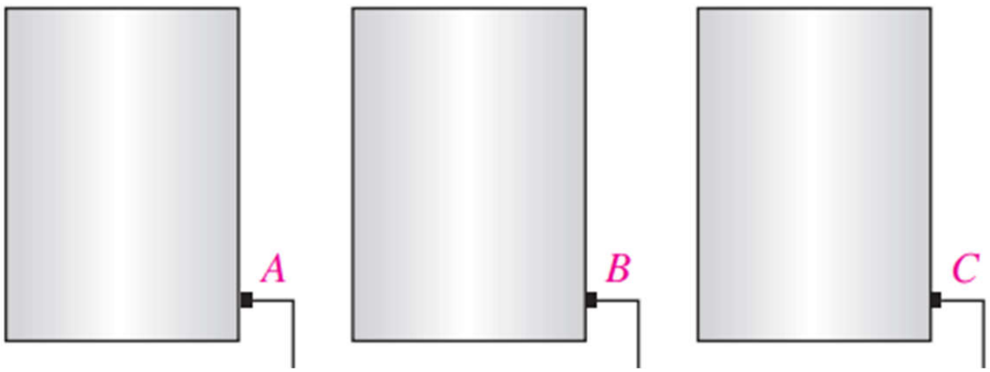


3. Truth table to K-map

		1	
	1	1	1

A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Summary

Exclusive-OR Logic

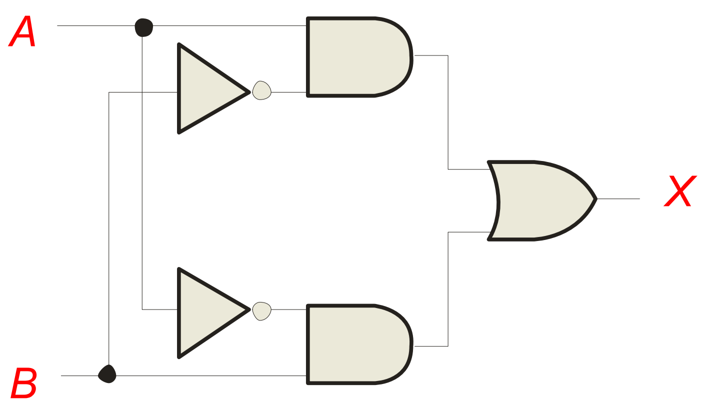
The truth table for an exclusive-OR gate is

Inputs		Output
A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

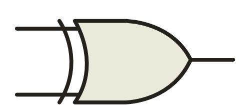
Notice that the output is HIGH whenever A and B disagree.

The Boolean expression is $X = \overline{A}B + A\overline{B}$

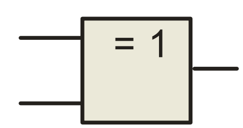
The circuit can be drawn as



Symbols:



Distinctive shape



Rectangular outline

Summary

Exclusive-NOR Logic

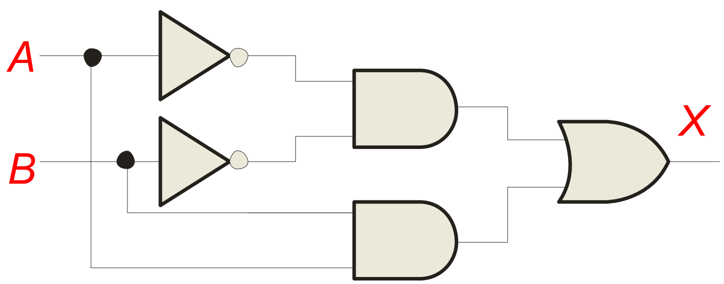
The truth table for an exclusive-NOR gate is

Inputs		Output
A	*B*	*X*
0	0	1
0	1	0
1	0	0
1	1	1

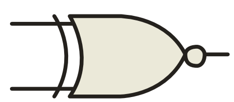
Notice that the output is HIGH whenever *A* and *B* agree.

The Boolean expression is $X = \overline{A}\overline{B} + AB$

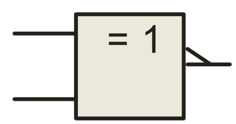
The circuit can be drawn as



Symbols:



Distinctive shape



Rectangular outline

Summary

Exclusive-NOR Logic

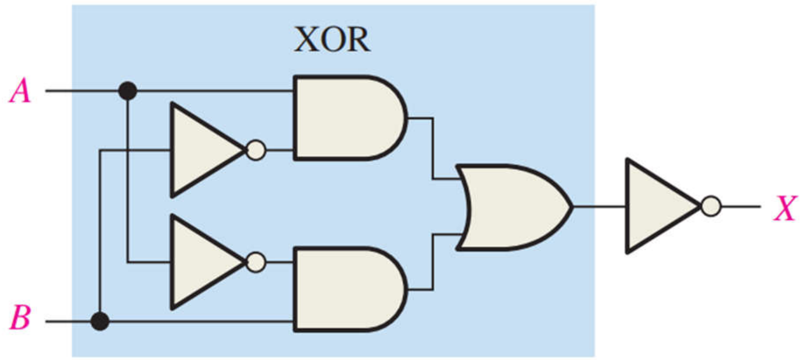
The truth table for an exclusive-NOR gate is

Inputs		Output
A	B	X
0	0	1
0	1	0
1	0	0
1	1	1

Notice that the output is HIGH whenever A and B agree.

The Boolean expression is $X = \overline{A}\,\overline{B} + AB$

The circuit can be drawn as



(a) $X = \overline{A\overline{B} + \overline{A}B}$

Symbols:

Distinctive shape Rectangular outline

Summary

Exclusive-OR Logic

Exclusive-OR gates can be used in Parity encoding.

Try to implement an even-parity code generator for an original 2-bit code

Truth table for an exclusive-OR.

A	*B*	*X*
0	0	0
0	1	1
1	0	1
1	1	0

Summary

Exclusive-OR Logic

Exclusive-OR gates can be used in Parity encoding.

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Truth table for an exclusive-OR.

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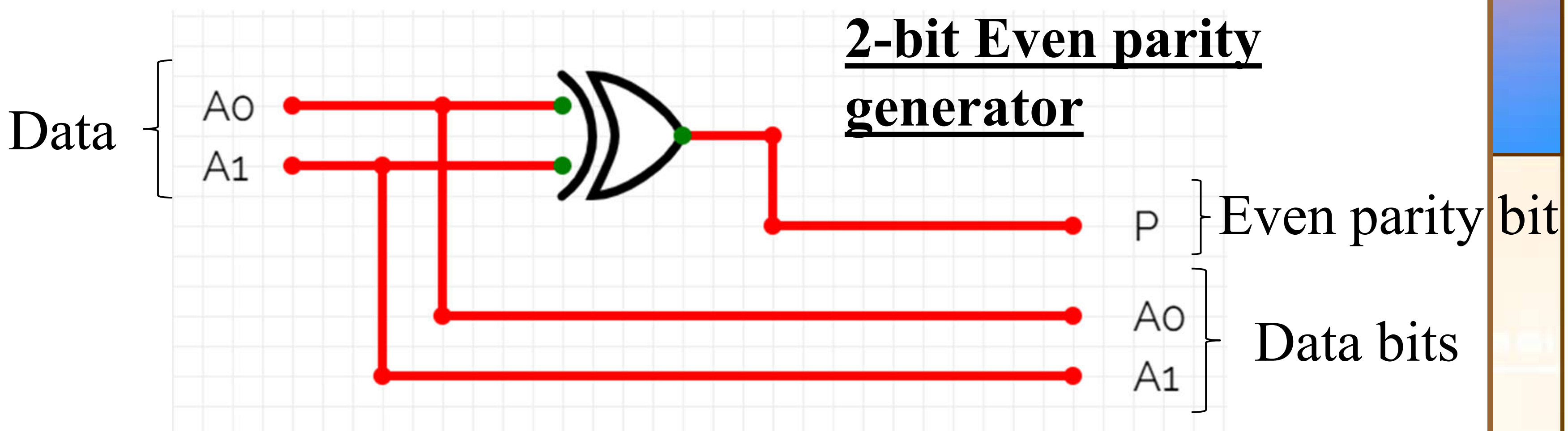
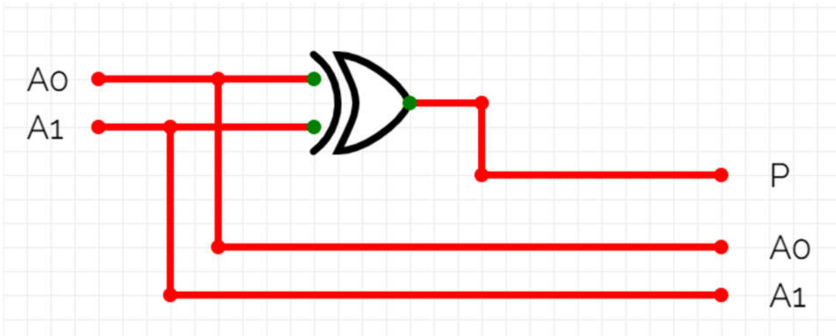
2-bit Even parity generator



Summary

Exclusive-OR Logic



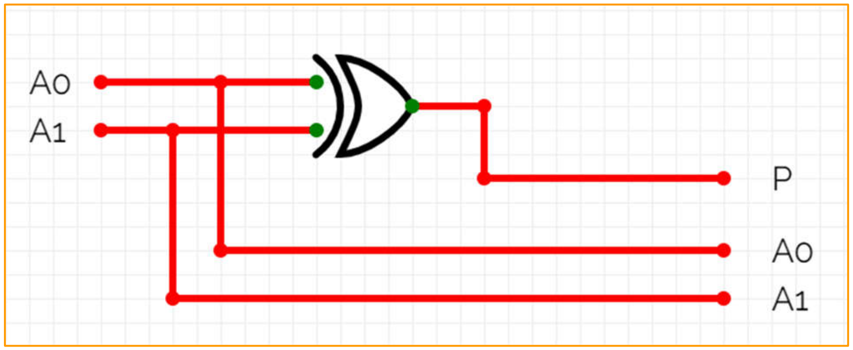
What about even parity checker circuit on the other end?

Truth table for an exclusive-OR.

A	*B*	*X*
0	0	0
0	1	1
1	0	1
1	1	0

Summary

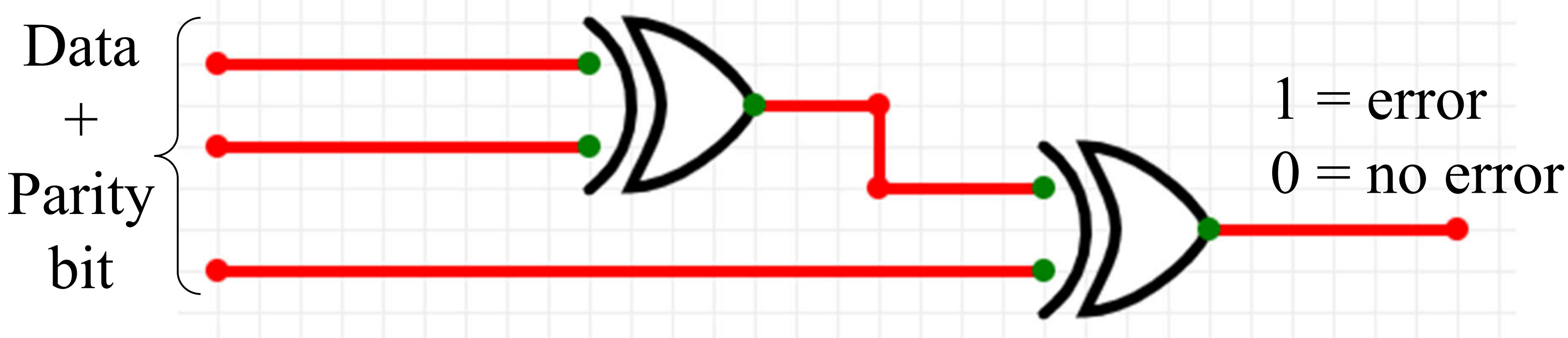
Exclusive-OR Logic



Truth table for an exclusive-OR.

A	*B*	*X*
0	0	0
0	1	1
1	0	1
1	1	0

2-bit Even parity checker



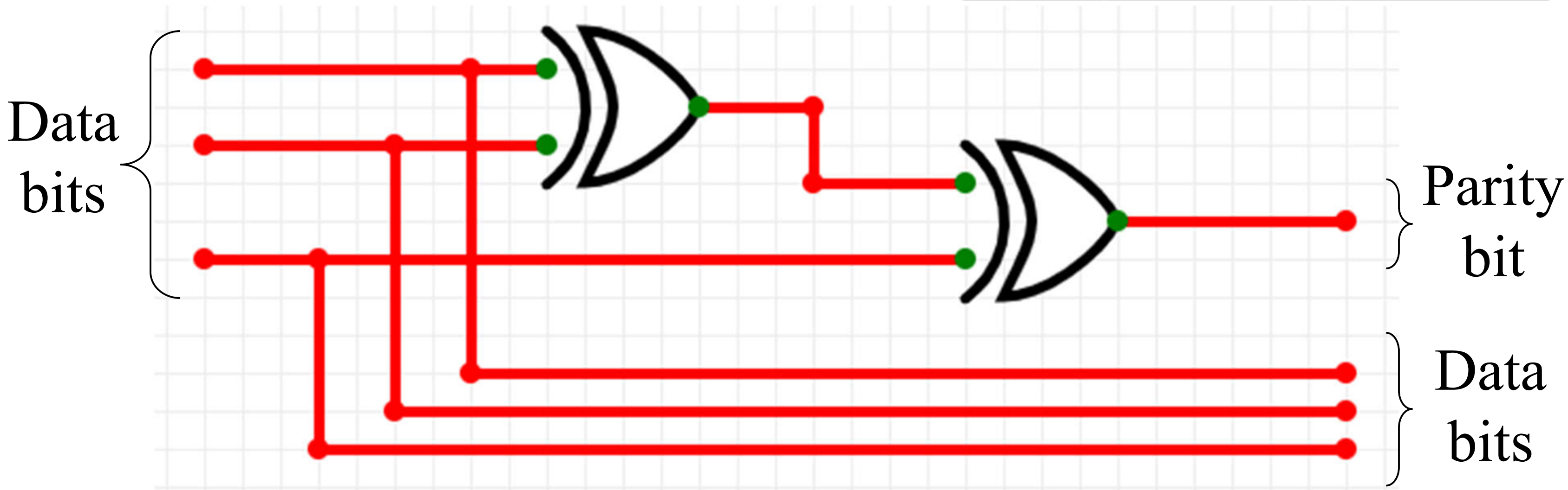
Summary

Exclusive-OR Logic

Now try to implement an even-parity code generator for an original 3-bit code.

Truth table for an exclusive-OR.

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0



EXAMPLE 5–3

Use exclusive-OR gates to implement an even-parity code generator for an original 4-bit code.

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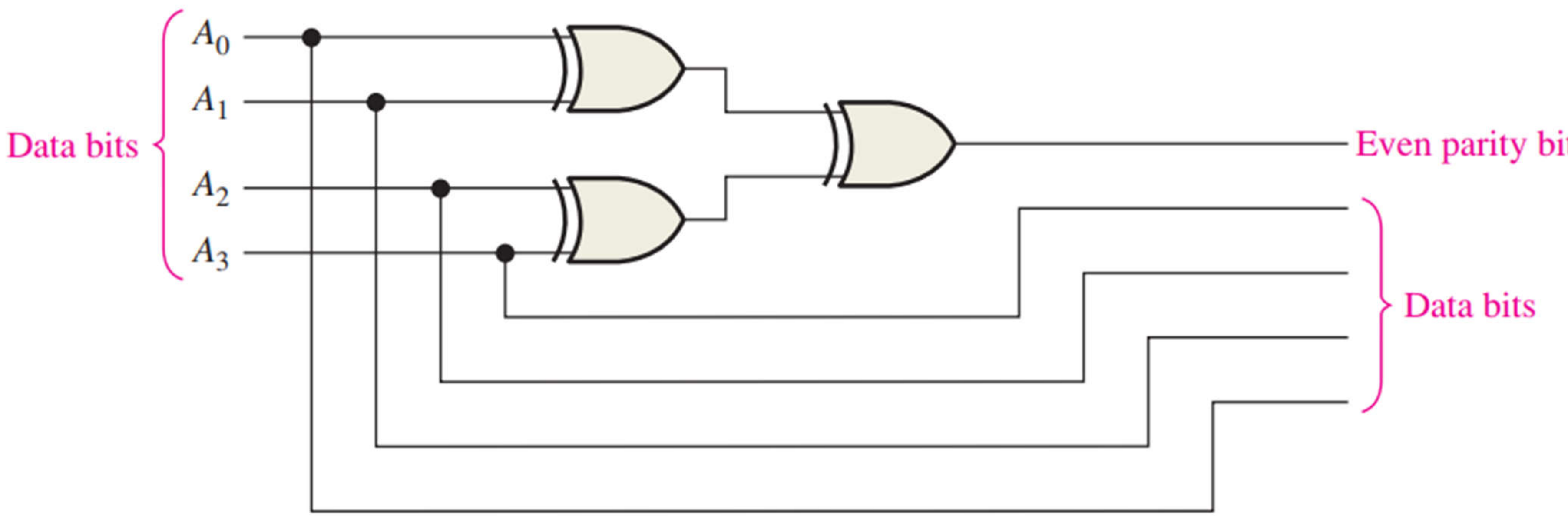

FIGURE 5–7 Even-parity generator.

EXAMPLE 5–3

Use exclusive-OR gates to implement an even-parity code generator for an original 4-bit code.

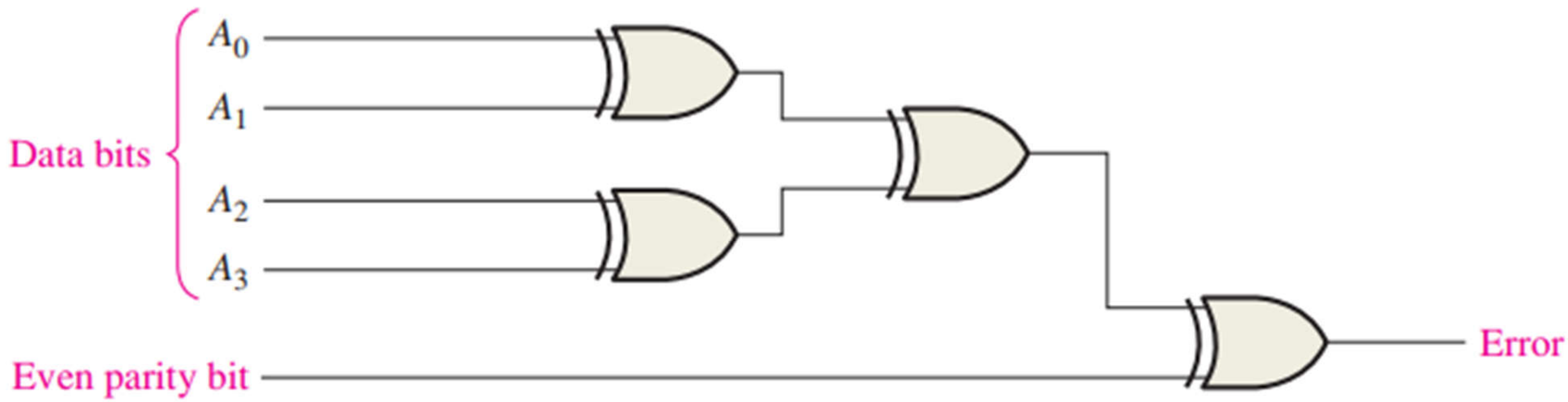

FIGURE 5–8 Even-parity checker.