

# Digital Circuits

# Analog vs. Digital

- Analog circuits use continuous variables that can take an infinite number of possible values (usually, the **real numbers**).
- Digital circuits use digitized variables that can take a finite number of distinct values (usually two: hence **binary numbers**).

# Advantages of Digital Circuits

- Perform faster calculations
- Easier to design
- Information storage is easy
- Accuracy and precision are greater
- Operation can be programmed
- Immunity to effects of noise
- Compact integrated circuit (IC) chips

Digital circuits are built with analog components (transistors, diodes).

# Truth Table

A truth table describes how the output of a digital circuit depends on its inputs.

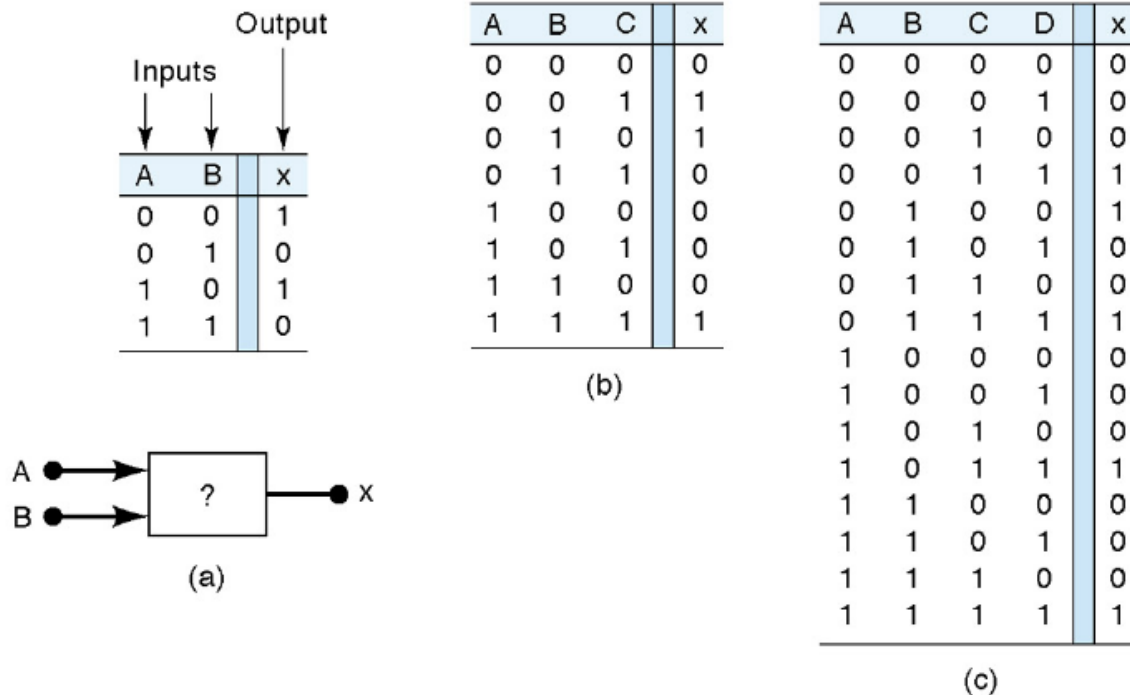


Figure 3-1  
 Ronald J. Tocci and Neal S. Widmer  
*Digital Systems, Eighth Edition*

# Basic Gates - AND Gate

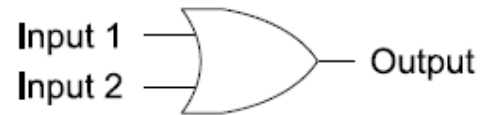


**Figure 12.1:** Schematic symbol for an 'AND'-gate.

input 1	input 2	output
0	0	0
0	1	0
1	0	0
1	1	1

**Table 12.1:** Truth table of a 2-input 'AND'-gate.

# Basic Gates - OR Gate



**Figure 12.2:** *Schematic symbol for an 'OR'-gate.*

input 1	input 2	output
0	0	0
0	1	1
1	0	1
1	1	1

**Table 12.2:** *Truth table of a 2-input 'OR'-gate.*

# Basic Gates - OR Gate

## Example: Use of OR Gate in Alarm System

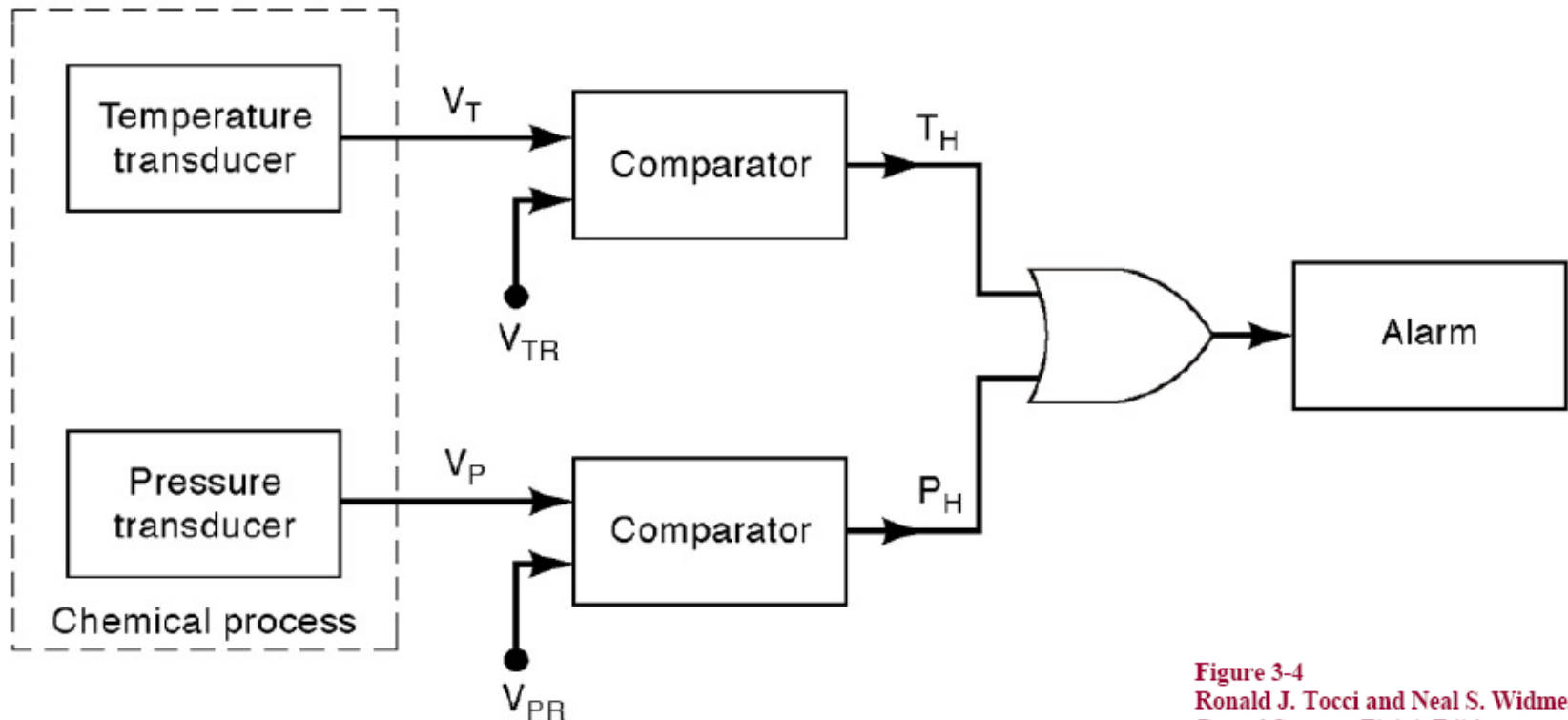


Figure 3-4  
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# Basic Gates - XOR Gate



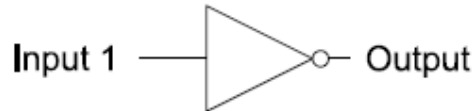
**Figure 12.3:** *Schematic symbol for a 'XOR'-gate.*

input 1	input 2	output
0	0	0
0	1	1
1	0	1
1	1	0

**Table 12.3:** *Truth table of a 2-input 'XOR'-gate.*



# Basic Gates - NOT Gate



**Figure 12.4:** *Schematic symbol for an inverter.*

input 1	output
0	1
1	0

**Table 12.4:** *Truth table of an inverter.*

# Combined Gates - NAND Gate

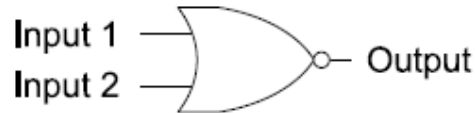


**Figure 12.5:** *Schematic symbol for a 'NAND'-gate.*

input 1	input 2	output
0	0	1
0	1	1
1	0	1
1	1	0

**Table 12.5:** *Truth table of a 2-input 'NAND'-gate.*

# Combined Gates - NOR Gate



**Figure 12.6:** *Schematic symbol for a 'NOR'-gate.*

input 1	input 2	output
0	0	1
0	1	0
1	0	0
1	1	0

**Table 12.6:** *Truth table of a 2-input 'NOR'-gate.*

# Logic Integrated Circuits

- Logic Integrated circuits (ICs) contain several gates.
- Two types of ICs:
  - 4000 CMOS
  - 7400/74LS/74HC/74HCT series

# The Road Ahead

- Sensors and Actuators
- Digital Circuits
- Microcontrollers
- Digital Communications
- Signal Processing
- ...
- Practice in projects