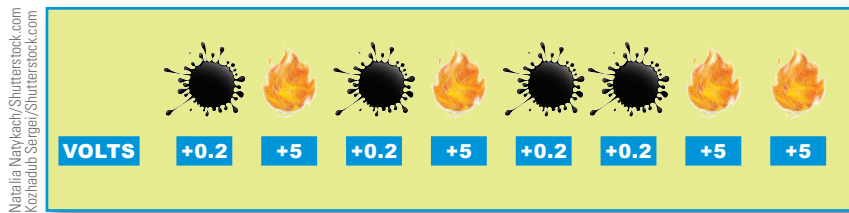


CIRCUITS AND CHIPS

► **How do digital devices store and transport all those bits?** Because most digital devices are electronic, bits take the form of electrical pulses that can travel over circuits in much the same way that electricity flows over a wire when you turn on a light switch. All the circuits, chips, and mechanical components that form a digital device are designed to work with bits.

At the simplest level, you can envision bits as two states of an electric circuit; the state used for a 1 bit would be on and the state for a 0 bit would be off. In practice, the 1 bit might be represented by an elevated voltage, such as +5 volts, whereas a 0 bit is represented by a low voltage, such as 0.2.



TRY IT!

Suppose for a moment that you are a microprocessor and you get the set of signals shown at left. What letter are you processing?

- ☐ Q
- ☐ a
- ☐ j
- ☐ S

► **What's inside?** If it weren't for the miniaturization made possible by digital electronic technology, computers, cell phones, and portable media players would be huge and contain a complex jumble of wires and other electronic gizmos. Instead, today's digital devices contain relatively few parts—just a few wires, some microchips, and one or more circuit boards.

► **What's a computer chip?** The terms *computer chip*, *microchip*, and *chip* originated as technical jargon for integrated circuit. An **integrated circuit** (IC), such as the one pictured in Figure 1-30, is a super-thin slice of semiconducting material packed with microscopic circuit elements, such as wires, transistors, capacitors, logic gates, and resistors.

Semiconducting materials (or semiconductors), such as silicon and germanium, are substances with properties between those of a conductor (like copper) and an insulator (like wood). To fabricate a chip, the conductive properties of selective parts of the semiconducting material can be enhanced to essentially create miniature electronic pathways and components, such as transistors.

Integrated circuits are packaged in protective carriers that vary in shape and size. Figure 1-31 illustrates some chip carriers, including small rectangular DIPs (dual in-line packages) with caterpillar-like legs protruding from a black, rectangular body; and pin-cushion-like PGAs (pin-grid arrays).

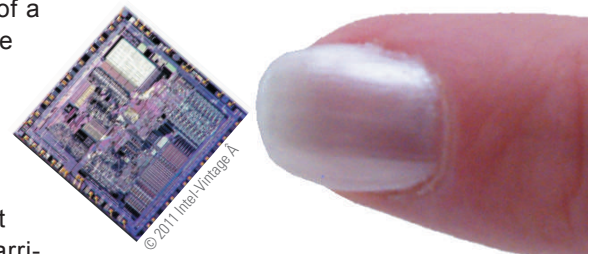


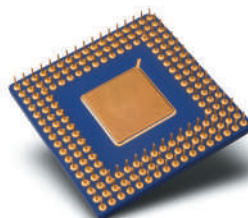
FIGURE 1-30

The first computer chips contained fewer than 100 miniaturized components, such as diodes and transistors. The chips used as the CPUs for today's computers and cutting-edge graphics cards contain billions of transistors.

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A DIP has two rows of pins that connect the IC circuitry to a circuit board.



A PGA is a square chip package with pins arranged in concentric squares, typically used for microprocessors.

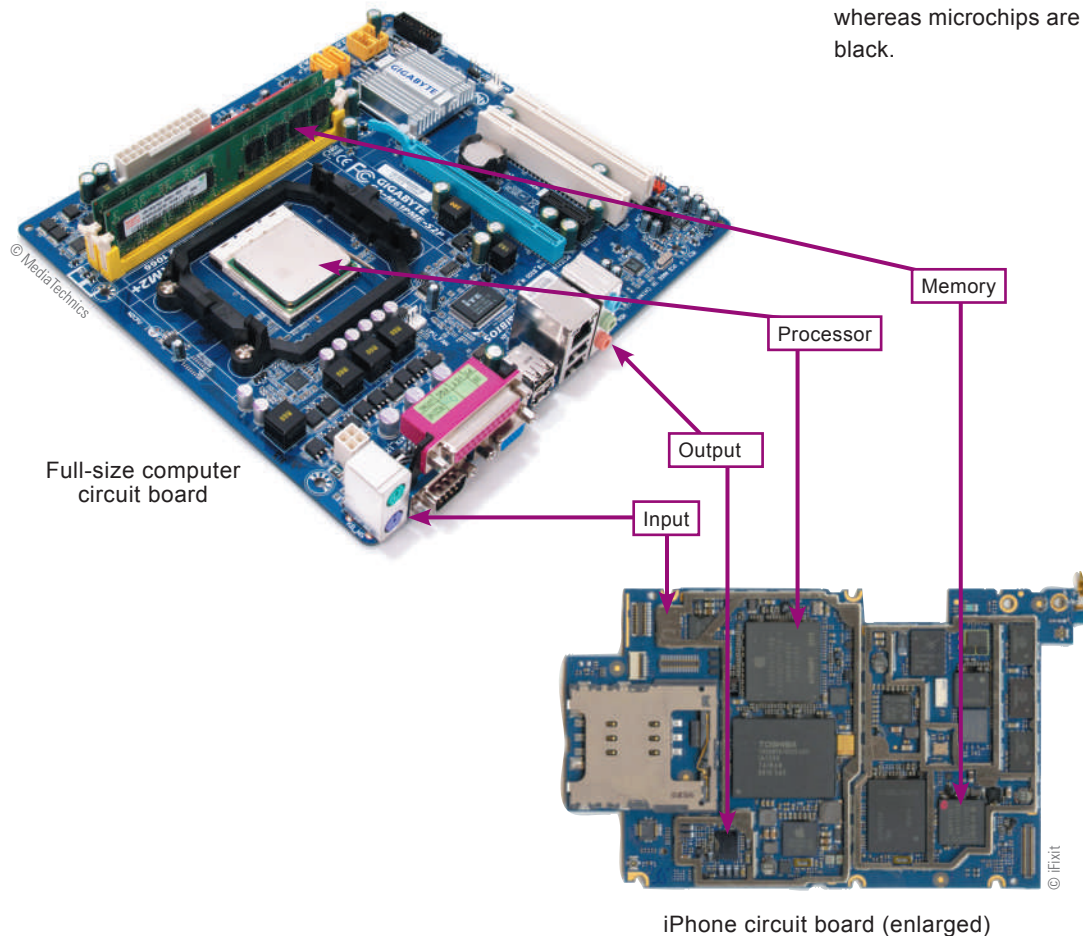
FIGURE 1-31

Integrated circuits can be used for microprocessors, memory, and support circuitry. They are housed within a ceramic carrier. These carriers exist in several configurations, or chip packages, such as DIPs and PGAs.

► **How do chips fit together?** The electronic components of most digital devices are mounted on a circuit board called a system board, motherboard, or main board. The **system board** houses all essential chips and provides connecting circuitry between them. Figure 1-32 illustrates circuit boards for two digital devices. Although one device is a full-size computer and the other is an iPhone, they both have chips for processing, memory, input, and output.

FIGURE 1-32

The electronic components of computers and handheld devices have many similar elements, including microchips and circuit boards. Circuit boards are usually green, whereas microchips are usually black.



QuickCheck

SECTION C

1. Data refers to the format in which data is stored, processed, and transferred.
2. Digital devices often use the number system to represent numeric data.
3. Most computers use Unicode or Extended code to represent character data. (Hint: Use the acronym.)
4. KB is the abbreviation for .
5. Integrated circuits are fabricated from materials that have properties of a conductor and an insulator.

 **CHECK ANSWERS**