

# Chapter 6

## PC Memory

### *In This Chapter*

- ▶ Understanding memory
- ▶ Using chips and dips (and DIMMs)
- ▶ Measuring memory quantity
- ▶ Discovering how much memory is in your PC
- ▶ Adding memory to your computer
- ▶ Understanding virtual memory

**M**emories, like a PC full of RAM . . .

With plenty of memory installed in the console, your PC has ample elbow room to handle a variety of tasks easily and swiftly. When the computer lacks a sufficient amount of memory, things get cramped worse than a tour bus overflowing with sweaty-drunk PhDs returning from a binge at an all-you-can-eat kimchi bar. But I digress. When it comes to PC memory, more is better.

## *What Is Computer Memory?*

If your computer were a sport, memory would be the field on which competition would take place. Memory is where the action is.

Your computer needs memory because the processor has no storage. Well, it has *some* storage, but not a lot. Basically, the processor works like an old-fashioned calculator but without the paper tape. Computer memory acts like that paper tape to help the processor store information and work on data.

Computer memory is often referred to as *temporary* storage. That's because the memory chips require electricity to maintain their information. So, when you're done creating something in memory, you must *save* that information

to long-term storage in the PC's mass storage system. But for working on things, creating stuff, and engaging in general computer activity, memory is where it's at.

- ✔ All computers need memory.
- ✔ Memory is where the processor saves and stores its work.
- ✔ The more memory in your PC, the better. With more computer memory on hand, you can work on larger documents, work graphics programs without interminable delays, play games faster, edit video, and boast to your friends about your PC having all that memory.
- ✔ The term *RAM* is used interchangeably with the word *memory*. They're the same thing.
- ✔ RAM stands for *random access memory*, in case you have been working any crossword puzzles lately.
- ✔ Incidentally, more acronyms exist for computer memory types than I care to mention.
- ✔ Turning off the power makes the *contents* of memory go bye-bye. The memory chips themselves aren't destroyed, but without electricity to maintain their contents, the information stored on the chips is lost.
- ✔ Computer memory is *fast*. The processor can scan millions of bytes of memory — the equivalent of Shakespeare's entire folio — in fractions of a second, which is far less time than it took you to trudge through *Hamlet* in the 11th grade.
- ✔ The PC's mass storage system is for long-term storage. See Chapter 7.
- ✔ Memory is reusable. After you create something and save it, the computer allows that memory to be used again for something else.
- ✔ Yes, Mr. Smartypants, some types of computer memory do not require electricity to maintain information. The problem is that this type of memory isn't fast enough. Only fast RAM, which requires electricity, is best used as temporary storage in your PC.



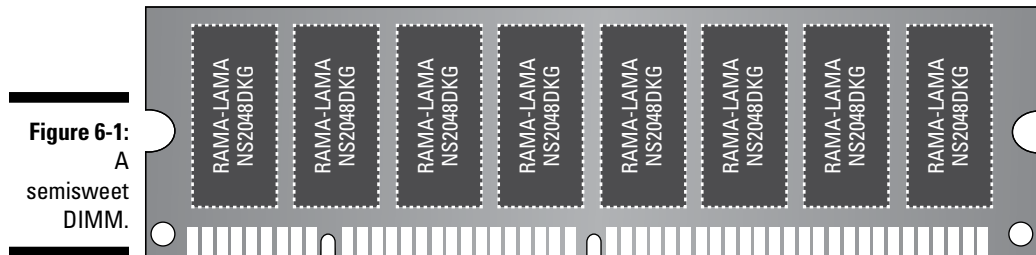
## Tasty Chocolate Memory Chips

Physically, memory dwells on the PC's motherboard, sitting very close to the processor for fast access and ready dispatch. The memory itself resides on a tiny memory expansion card, or *DIMM*. On the DIMM, you find the actual memory chips.

DIMM stands for dual inline memory module, and it's pronounced "jaga-da-wawa."

No, I'm kidding. It's pronounced "dim."

A typical DIMM is illustrated in Figure 6-1, although in real life you'll find chips on both sides. That's why it's a DIMM and not a SIMM, or single inline memory module.



Each DIMM contains a given chunk of RAM, measured in megabytes or gigabytes using one of the magical memory quantities of 1, 2, 4, 8, 16, 32, 64, 128, 256, or 512. See the later section “Memory, One Byte at a Time” for information on megabytes and gigabytes.



## Boring details on RAM, ROM, and flash memory

*RAM*, or *random access memory*, refers to memory that the processor can read from and write to. When you create something in memory, it's created in RAM. RAM is memory, and vice versa.

*ROM* stands for *read-only memory*: The processor can read from ROM, but it cannot write to it or modify it. ROM is permanent, like some members of Congress. ROM chips contain special instructions or other information that the computer uses — important stuff that never changes. For example, the chipset on the

motherboard is in ROM (refer to Chapter 5). The processor can access information stored on a ROM chip, but unlike with RAM, the processor cannot change that information.

*Flash memory* is a special type of memory that works like both RAM and ROM. Information can be written to flash memory, like RAM, but like ROM the information isn't erased when the power is turned off. Sadly, flash memory isn't as fast as RAM, so don't expect it to replace standard computer memory any time soon.

A DIMM is plugged into a slot on the motherboard, where it forms a *bank* of memory. So, a PC with 2GB of RAM may have four banks of 512MB DIMMs installed or two banks of 1GB DIMMs. That's all trivial, however. The only time you need to give a rip is when you want to upgrade memory. I'll write more about that task later in this chapter.



- ✓ The most common type of memory chip installed in a PC is the DRAM, which stands for *dynamic random access memory*. It's pronounced "dee-ram."
- ✓ It's gigabyte, not giggle-byte.
- ✓ Other types of memory chips exist, each with a name similar to DRAM, such as EDORAM or BATTERINGRAM or DODGERAM. And then there's DDR3 and WRAM and RAMA LAMA DING DONG. Most of these are merely marketing terms, designed to make one type of memory sound spiffier than another.

## Memory, One Byte at a Time

Computer memory is measured by the byte. So what is a byte?

A *byte* is a very tiny storage unit, like a small box. Into that box fits a single character. For example, the word *cerumen* is seven letters (characters) long, so it requires seven bytes of storage. That's seven bytes of computer memory, which isn't a lot these days, thanks to inflation.

Individual bytes aren't very useful. It's only when you have lots of bytes that you can store interesting and wonderful things.

Back in the 1970s, having a few thousand bytes of computer storage was *really something!* The Apollo lunar module computer had 2,048 bytes of memory. Today's PCs demand *millions* of bytes just to run the operating system. That works because today's PCs typically have *billions* of bytes of storage available.

Because the words *million* and *billion* represent values too large for the human mind to comprehend, and to keep things lively, computer scientists use special terms to reference large quantities of computer storage. That jargon is shown in Table 6-1.

**Table 6-1** Memory Quantities

<i>Term</i>	<i>Abbreviation</i>	<i>About</i>	<i>Actual</i>
Byte		1 byte	1 byte
Kilobyte	K or KB	1 thousand bytes	1,024 bytes
Megabyte	M or MB	1 million bytes	1,048,576 bytes
Gigabyte	G or GB	1 billion bytes	1,073,741,824 bytes
Terabyte	T or TB	1 trillion bytes	1,099,511,627,776 bytes

Although it's handy to say “kilobyte” rather than mouth out “1,024 bytes,” it's difficult to visualize how much data that is. For comparison, think of a kilobyte (KB) as a page of text from a novel. That's about 1,000 characters.

One *megabyte* (MB) of information is required to store one minute of music in your computer, a medium-resolution photograph, or as much text information as in a complete encyclopedia.

The *gigabyte* (GB) is a huge amount of storage — 1 billion bytes. You can store about 30 minutes of high-quality video in a gigabyte.

The *terabyte* (TB) is 1 trillion bytes, or enough RAM to dim the lights when you start the PC. Although I can think of no individual item that requires 1TB of storage, lots of 1GB items abound that fit happily into that 1TB of storage, which is why the term is needed.

A *trilobite* is an extinct arthropod that flourished in the oceans during the Paleozoic era. It has nothing to do with computer memory.

Other trivia:

- ✓ The term *giga* is Greek and means *giant*.
- ✓ The term *tera* is also Greek. It means *monster!*
- ✓ Your computer's long-term mass storage media is also measured in bytes; see Chapter 7.
- ✓ A PC running the 32-bit version of Windows 10 requires at least 1GB of memory to work well. Windows 10 64-bit requires 2GB of memory. Having at least 4GB of RAM is considered optimum.
- ✓ The PC's processor can access and manipulate trillions and trillions of bytes of memory. Even so, because of various hardware and software limitations, your computer can access only a given amount of RAM. The exact value depends on the motherboard design as well as on the version of Windows.





## The holy numbers of computing

Computer memory comes in given sizes. You see the same numbers over and over:

1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, and so on

Each of these values represents a *power of two* — a scary mathematical concept that you can avoid while still enjoying a fruitful life. To quickly review:  $2^0 = 1$ ,  $2^1 = 2$ ,  $2^2 = 4$ ,  $2^3 = 8$ , and up to  $2^{10} = 1024$  and more, until you get a nosebleed.

These specific values happen because computers count by twos — 1s and 0s — the

old binary counting base from medieval times. So, computer memory, which is a binary-like thing, is measured in those same powers of two. RAM chips come in quantities such as 512MB, 1GB, 2GB, and so on.

Note that, starting with 1024, the values take on a predictable pattern: 1024 bytes is really 1K; 1024K is really 1M; and 1024M is 1G. So, really, only the first ten values, 1 through 512, are the magical ones.

Enough of that.

## Memory Q&A

It doesn't matter where I am — greeting people at church, gesturing to my fellow drivers on the freeway, or leaving detox — folks stop and ask me questions about computer memory. Over the years, I've collected the questions and distilled the answers in this section. They should help clear up any random access thoughts you may have about computer memory.

### *“How much memory is in my PC right now?”*

You may not know how much RAM resides in your PC's carcass, but the computer knows! Summon the System window to find out: Press Win+Break on the computer keyboard to behold the System window.

The amount of memory (RAM) appears right below the type of processor that lives in your PC. Looking at the value is about all you can do in the System window, so close that window when you've had enough.

## ***“Do I have enough memory?”***

If you have to keep asking this question, the answer is no.

## ***“Does my PC have enough memory?”***

Knowing how much memory is in your PC is one thing, but knowing whether that amount is sufficient is entirely different.

The amount of memory your PC needs depends on two things. The first, and most important, is the memory requirement of the computer’s software. Some programs, such as video editing programs, require lots of memory. Just check the software’s hardware requirements to see how much memory is needed. For example, the Adobe Premier Pro video editing program demands at least 2GB of RAM to run properly.

- ✓ Not enough memory? You can upgrade! See the upcoming section “Can I add memory to my PC?”
- ✓ Here’s one sure sign that your PC needs more memory: It slows to a crawl, especially during memory-intensive operations, such as working with graphics or switching between running programs. See the next section.

## ***“Can I test whether my PC has enough memory?”***

Your computer is designed to function even when it lacks a sufficient amount of memory. To test whether your PC has enough memory installed, make the computer *very* busy, by loading and running several programs simultaneously. I’m talking about *big* programs, such as Photoshop and Word and Excel. While all those programs are running, switch between them by pressing the Alt+Esc key combination.

If you can use Alt+Esc to easily switch between several running programs, your PC most likely has plenty of memory. When you press Alt+Esc and the system slows down, the mass-storage lamp flashes, and it takes a bit of time for the next program’s window to appear, your PC could use more memory.

Close any programs you have opened.

## ***“Can I add memory to my PC?”***

You bet! The best thing you can do for your PC is to add memory. It's like putting garlic in a salad. *Bam!* More memory provides an instant boost to the system.

Adding memory to your computer is LEGO-block simple. Well, if LEGOs cost a few hundred dollars each and required electricity, then it would be LEGO-block simple. Knowing how much memory and which type to buy is the tough part. Because of that, I highly recommend that you have a dealer or computer expert do the work for you.

If you opt to perform your own PC memory upgrade, I can recommend Crucial at [www.crucial.com](http://www.crucial.com). The website uses special software to determine which type of memory you need and how much. You can then buy the memory directly from the site.

## ***“Will the computer ever run out of memory?”***

Nope. Unlike mass storage, which can fill up just like a closet full of shoes and hats, your PC's memory can never truly get full. At one time, back in the dark ages of computing, the “memory full” error was common. That doesn't happen now, thanks to something called virtual memory.

## ***“What is virtual memory?”***

*Virtual memory* is a fake-out. It lets the computer pretend that it has much more memory than it has physical RAM.

To make the scheme work, Windows swaps out chunks of memory to mass storage. Because Windows manages both memory and mass storage, it keeps track of things quite well: Chunks of data are swapped back and forth between memory and mass storage. *Et, voilà!* — you never see an “out of memory” error, thanks to virtual storage.

Alas, there's trouble in paradise. One problem with virtual memory is that the swapping action slows things down. Although the swapping can happen quickly and often without your noticing, when memory gets tight, virtual memory takes over and things start moving more slowly.





- ✓ The solution to avoiding the use of virtual memory is to pack your PC with as much RAM as it can hold.
- ✓ Windows never says that it's "out of memory." No, you just notice that the hard drive is churning frequently as the memory is swapped into and out of mass storage. Oh, and things tend to slow down dramatically.
- ✓ You have no reason to mess with the virtual memory settings in your computer. Windows does an excellent job of managing them for you.

## ***"What is video memory?"***

Memory used by your PC's video system is known as *video memory*. Specifically, memory chips live on the display adapter expansion card. Those memory chips are used for the computer's video output and help you see higher resolutions, more colors, 3D graphics, bigger and uglier aliens, and girlie pictures that your husband downloads from the Internet late at night but says that he doesn't.

As with regular computer memory, you can upgrade video memory if your PC's display adapter has room. See Chapter 8 for more information on display adapters.

## ***"What about shared video memory?"***

*Shared video memory* is used on some computers to save money. What happens is that the PC lacks true video memory and instead borrows some main memory for use in displaying graphics. This strategy is fine for simple home computers but not nearly good enough to play cutting-edge games or to use photo editing software.

