2 | The Macintosh Family

The Mac is no one-size-fits-all computer. With new models introduced every six months or so, and dozens of discontinued ones on the used market, it's hard to decide what's right for you. The good news (unless you're trying to sell a used Mac) is that each year's new Macs nearly always do more, work faster, and cost less than the ones introduced in the previous year.

In this chapter, we explain what makes a Mac, so you'll understand what makes one model different from another—to help you if you're looking for a new Mac, or just better understand the one you have.

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Contents

The Inside Story

It used to be easy to buy a Mac—for years, the single current model was replaced by a new one. When Apple first offered a multi-model Mac line, it was still simple because the differences were so obvious ("Oh, you want *color?*"). But in the years since, Apple has created—and killed—many Mac product lines, and most included several models whose differences were quite minor. To add to the confusion, lines were not only added and dropped, they were also sometimes blended (Centris and Quadra) or given a new niche (Performa).

So, unfortunately, it becomes more and more important that you understand the basics of the Mac's component parts. That way, when you read a description of some model or another, you can judge whether it adds up to what you want and need. That's what this section's all about.

Processors and Clocks   (SZA)

At the very heart of the computer is—to mix a metaphor—its brain, which goes by many names: *CPU*, *central processing unit*, *microprocessor*, *processor chip*, *processor*, or, simply, *chip* (although there are other kinds of chips, too, including memory chips). Just what does a processor chip process? Instructions—many millions are sent to the chip every second by applications and system software.

CPU and CPU. The CPU is the central processing unit, but ever since the modular Mac II came out, "CPU" has also referred to the actual box that holds the CPU (and the motherboard, and slots, and other things).

The PowerPC processor. Most current Macs—that is, the ones currently being sold—are based on the PowerPC chip made by IBM and Motorola. These chips use a special technology called *RISC (reduced instruction set computing)* to churn out more raw power than the previous chip technology, *CISC (complex instruction set computing)*. So far, there are four different PowerPC chips in use: the 601 in the original Power Macs; the 603, a lower-cost version of the 601; the 603e, a version for the PowerBook with a low power draw; and the 604.

The 68000 family. Until the introduction of the PowerPC chip, Macs used processing chips from the Motorola 68000 series, starting with the 68000 itself, and progressing through the 68020, 68030, and 68040. The PowerBook 190 was the last model to be manufactured with a Motorola 68000-series processor.

A quick look at some of the capabilities of the chips in this family shows how technology continually improves and speeds a computer's performance. You can skip this list if you hate the technical stuff—but you'll find all the terms explained later in this chapter.

- The 68000 was given that name because it has 68,000 transistors on it (the 68040 has well over a million!). Although it was considered a 32-bit chip, it handles only 16-bit chunks of information internally.

- The 68HC000 is a special low-power version of the 68000 chip. ("Low-power" refers to the electricity needed to keep it running, not to its capabilities; it was used in the battery-powered PowerBook 100.)

- The 68020, introduced in the Mac II, deals with 32-bit chunks internally and has a 256-byte instruction cache to hold frequently accessed information.

- The 68030 includes a 256-byte data cache in addition to the instruction cache and provides two 32-bit data paths instead of one so it can handle twice the information traffic. The '030 includes a *paged memory management unit*, known as a PMMU, something that's necessary for System 7's virtual memory feature.

- The 68040 has instruction and data caches 16 times larger than the ones in the '030, and has built-in capabilities for most of the functions of the math coprocessor that had to be added separately to earlier machines.

- The 68LC040 is a special, low-cost version of the 68040 that doesn't include the math coprocessor functions.

Nicknames   (SZA)

The 68000 chip is called the "sixty-eight thousand," but other chips in the series aren't pronounced as real numbers; the 68020, for instance, is "sixty-eight oh-twenty." But that's a mouthful, so the chips are abbreviated, in writing and speaking, to the numbers that differentiate them: '020 ("oh-twenty"), '030 ("oh-thirty"), and '040 ("oh-forty"). If you're referring to a 68000-series chip without meaning any specific one, you use the number 680x0 or the abbreviation 68K (the K is for the "kilo" prefix that means 1000).

Clock speed (SZA/JK/DH). Information marches through a processor chip to the beat of a very special drum: a quartz crystal that vibrates in response to an electric current. The pulses are so rapid that they're measured in *megahertz*—millions of cycles per second. A chip that runs at 80MHz is beating 80 million times a second. *[So, in one minute it beats more often than your heart will in your entire lifetime!—SZA]* This crystal "clock" determines the *clock rate*, or *clock speed*, or simply, the *speed* of your processor.

Clock speed is useful as a measure of relative speed only between processors of the same type: All other factors being equal, a Mac with a 601 chip running at 80MHz is

faster than a 601 running at 60MHz. But a more advanced chip can outperform an earlier one even if the clock speed on the new chip is slower than the older one.

Coprocessors

A *coprocessor* is a secondary processor that specializes in a specific kind of computation, relieving the main processor of some work, and speeding up the tasks it's specifically designed for. A computer can have more than one kind of coprocessor.

FPU (SZA/JK/DH). The most common coprocessor used on 68K Macs is the *math coprocessor*, also called a *floating-point unit*, or *FPU*. (The *floating-point* part of the phrase refers to a type of number.) It's so common, in fact, that if someone refers to "the coprocessor," that means the FPU, even though there are other coprocessors. The fancy math handled by an FPU doesn't make a difference to basic spreadsheet calculations, but it greatly accelerates the kind of sophisticated calculations used in programs like three-dimensional modeling and animation. In addition to the speed benefit, an FPU keeps things more accurate, working with up to 18 places after the decimal point instead of the basic processor's 14-place accuracy.

A Mac's FPU is a Motorola chip; the Mac II uses the 68881 coprocessor, while the '030 Macs use its successor, the 68882. Macs with '040 processors don't need FPUs because the coprocessor's functions are built into the '040 itself. Power Macs don't need FPUs either.

PMMU (SZA). A *PMMU (paged memory management unit)* is a coprocessor whose functions were built into the 68030 and later chips, so you don't hear much about it anymore. But because the Mac II, the first color model, had a 68020, it used to be a big deal. Since System 7's virtual memory feature needs PMMU functions to work, the phrase "an '030 or a Mac II with a PMMU" as a system requirement description was widespread for awhile.

SoftwareFPU (RW/JK)

Some programs need an FPU to run at a reasonable speed; some need an FPU to run at all. If your 68K Mac doesn't have an FPU, John Neil's shareware SoftwareFPU can usually take care of the problem. (Although some applications check the hardware environment for an actual FPU and won't run unless it's found, SoftwareFPU is effective in the majority of cases.)

And, if you're running a 68K version of an FPU-needy program on a Power Mac, you can upgrade SoftwareFPU to a special "fat" version that includes the native PowerPC code.

DSP (JK/DH). The '040-based AV Macs include a *digital signal processor* chip—a DSP—that some programs use to allow or expedite the processing of certain types of data (typically, sounds or images). To get the full benefit of the DSP, software has to be designed to take advantage of it. There's a plug-in file available on-line, for example, called **AV DSP Power** that enables Adobe's PhotoShop (there's lots about that in Chapter 15) to use the DSP chip. With the plug-in, screen redraws and filters are 10 to 30 percent faster.

General Terminology

Here are a few miscellaneous, but important, hardware concepts.

ROM (SZA/JK). ROM stands for *read-only memory*. It's like software that's hard-wired into your Mac—basic, permanent information that tells it things like how to load up the operating system when you turn it on. As Macs evolve, new capabilities—like the ability to display colors—get added to their ROMs.

The ROMs in the Mac have grown from storing 64K of information in the first Mac to 4MB (megabytes) in the Power Macs. In some cases, installing a system specifically made for an older Mac will let that Mac fake the capabilities of a newer one because the later ROM information goes into the System file. In other cases, a separate file can be added to the System Folder to provide capabilities not in the older Mac's ROMs. Of course, in many cases, you're just out of luck and can't get the capabilities of a newer machine no matter what.

Clean and Dirty ROMs   (SZA)

Starting with the Mac II, Macs were theoretically able to address more than eight megabytes of memory. But it was in theory only for that model, as well as for the Mac II, IIx, and IIcx because of their ROMs—later known as "dirty" ROMs. For these machines to use more than 8MB of RAM, you need an extension called Mode32. (This is covered in more detail in Chapter 4.)

Logic, mothers, and daughters (SZA/JK). There are many things inside a Mac's case, but none so important as the all-important *logic board*, or *motherboard*. The "board" part of each phrase comes from *printed circuit board*, which is a board with silver tracings (the circuits); the little black boxes on these boards are chips. The logic board is what makes a computer a computer. Continuing the matriarchal metaphor, a board connected to motherboard—either soldered directly onto it or inserted in a slot—is called a *daughterboard*.

The data bus (SZA/JK). Macs have an internal pathway—called the *data path* or *data bus*—for shuttling data around. The wider and faster this path is for a given processor

and clock speed, the faster the Mac can handle tasks that require a lot of data transfer. A Mac's data path usually performs at the same speed as its processor, but sometimes it's slower, which slows down the overall operation of the computer.
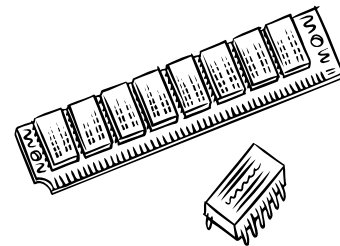
A narrow data path can cripple a computer, no matter what its speed. For example: The LC had an '020 processor running at 16MHz, while the LC II had a much improved '030 processor at 16MHz. The LC II should have been faster because of its better processor, but the two machines had almost identical performance because they both had 16-bit data buses.

The 68000-based Macs have a data path that's either 16 or 32 bits wide; the Power Macs use a 64-bit-wide bus.

Memory

One of the most essential computer components—*memory*— is so important that it's always included in the specs when a computer is being sold.

RAM (SZA/JK). A computer's *RAM (random access memory)*, usually referred to simply as *memory*, is an electronic work space. Whenever the Mac is on, it keeps at least part of its system software and any opened programs and documents

An insect-like memory chip, and chips mounted on a SIMM.

in memory. So, the amount of RAM in a Mac determines how many files and applications you can have open at once, and how large they can be. All Macs come with some RAM inside, but you can buy and install more.

Physically, RAM comes as little black memory chips soldered directly to the motherboard (for built-in memory) or onto little boards called *SIMMs* or *DIMMs* (for memory that you add). There's lots more about memory in Chapter 4.

Memory caches (SZA/JK). A *memory cache* (pronounced "cash," not "ca-shay" or "catch") increases a Mac's performance by storing frequently used instructions either in the processor itself or in high-speed memory outside the processor; that way, they don't have to be fetched from regular RAM (which is slow in comparison) every time they're needed. A *Level 1* cache is one built into the processor; a *Level 2*, or *secondary*, cache is an external one installed in a slot on the motherboard. Most Power Macs come with secondary caches.

GOOD FEATURE

The DMA chip (JK). Processors spend a lot of time supervising the transfer of data between memory and hard drives, floppy drives, and other devices; that's time taken

Bits, Bytes, and Beyond (SZA)

The units of measure used in computerdom are based on the binary numbering system that's at the heart of the computer's processor (in contrast to the human-friendly *decimal*, or *base 10* system). Both memory and disk space (and, therefore, file size) are measured in these binary-based units.

The smallest unit of information a computer deals with is a *bit*, a word that comes from the phrase *binary digit*. Eight bits together make a *byte*, but the measurements we use after that are a sometimes confusing blend of binary numbers and the words we use in our decimal system of numbering.

The prefix *kilo*, for instance, stands for *thousand*, but a *kilobyte* is not 1,000 bytes: It's 1,024 bytes, the closest "round" number to a thousand in binary. The kilobyte, abbreviated as *K*, is something you're probably familiar with as a unit measurement for file sizes.

With *mega* standing for million, a *megabyte* is roughly a million bytes. Just as 1,000,000 in decimal is actually 1,000 thousands, the megabyte (abbreviated *MB)* is 1,024 kilobytes. The amount of memory in your computer, and the size of many hard drives are usually given in terms of megabytes, or *megs.*

The next unit is the *gigabyte*, which—as you may have anticipated—is 1,024 megabytes. The term is often shortened to *gig,* and is abbreviated *GB.* Many hard drives now offer a gig of storage; in fact, drives that offer about 500 megabytes of room are sometimes referred to as a "half gig" in size.

Here's a quick review:

```
        8 bits = 1 byte
 1,024 bytes = 1 kilobyte
       1,024K = 1 megabyte
    1,024MB = 1 gigabyte
```

away from other things the processor could be doing. Some Macs—including Power Macs and the AV Macs—have *direct memory access* (DMA) chips, which handle this processing, either for specific types of devices (like disk drives) or for input and output from all sources.

VRAM (SZA/JK). It takes a lot of memory to keep a display going. Back when Mac screens were black-and-white, 9-inch displays, this wasn't such a problem. But the bigger a display is, and the more colors you want showing at one time, the more memory you need. Early Macs grabbed screen memory from the general system memory, but later Macs use separate, specialized memory called, logically enough, *video memory*, or *VRAM.*

Older models like the IIsi and IIci, and the Performa 630 and 6100, Quadra 630, and Power Mac 6100 still use part of regular memory (DRAM) instead of VRAM for the screen. This can noticeably slow down the performance of the non-PowerPC models because memory is being shared between the monitor and whatever software is running. The PowerPC is generally fast enough that you won't notice the penalty being extracted for DRAM-based video support.

BAD FEATURE

Storage

In the beginning, Macs came with a single storage device: a 400K floppy drive and disk. The first Mac hard drive from Apple was an external 20-megabyte model (which, by the way, cost $1,500 and couldn't act as the startup disk—you had to start with a floppy and then turn control over to the hard drive!). Current models still have only a single floppy drive, but the floppies now hold 1.4MB of information. Internal hard drives of 700 to over 1,000 megabytes are the norm. And a third storage option—the CD-ROM drive—is standard equipment now.

Floppy drives (SZA/JK). Floppy drives use 3.5-inch floppy disks whose metal-shuttered plastic cases don't look all that floppy because the flimsy part is stored inside the case. Since 1990, the standard built-in floppy drive uses high-density 1.4MB floppy disks; Apple calls it the *FDHD*, for Floppy Drive High Density, but it's commonly known as the *SuperDrive*.

Hard drives (SZA/JK). The hard drive (or *hard disk*—the terms are interchangeable) is the Mac's large storage area for all your applications, files, and system software. When you're working, the computer copies data it needs from the hard disk into RAM, where the data can be accessed and manipulated much more quickly.

CD-ROM drives (SZA/JK). Unlike floppies and hard drives, which let you both store your information and get it back, a CD-ROM drive offers a one-way capability, evidenced in its very name: *compact disk read only memory*. A CD—the same shiny disc used for audio—can store as much as a large hard drive: 600 megabytes. The selection of CDs for your computer is vast; because they can store so much information, and because high-quality graphics take so much room on a disk, you'll find the fanciest, most involved game software on CDs now. On the serious side, reference materials like encyclopedias and dictionaries are also proliferating on CD.

Expansion

No matter what basic hardware is included with your Mac, you can always add more, both inside and out.

Internal   (SZA)

The earliest Macs weren't made to be opened by their owners—not that that stopped everybody! Later, the modular Macs were designed not only for a pick-and-choose approach to putting together a Mac system, but also for easy opening so a user could add internal components. As the Mac evolved, it has, for the most part, stayed modular and "openable," whether you can do it yourself or need professional help.

Slots and cards. An expansion *slot* is a connector inside the Mac where you plug in a *card* or *board* (that's the same board as in "logic board" and "motherboard"—a printed circuit board). There are many different types of slots inside an expandable Mac, but they're not always so easy to get at. Just to install memory in the 7100, for instance, requires removing the power supply, the internal hard drive, the floppy drive, and the CD-ROM drive—not a process for the faint-of-heart! So, while the illustration here is a good representation of how you might install a card into a Mac, it's not always so simple.

Plastic strips pop out

Expansion cards plug into slots
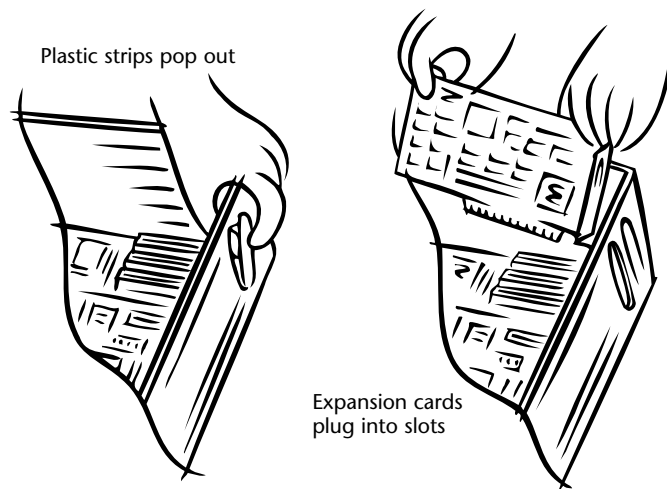
Installing a card in an internal slot isn't always this easy, because some slots are hard to get at, but the basics remain the same.

Basic slots. Most of the Mac's expandability comes from slots for general-purpose cards that range from processor accelerators to video controllers to an entirely different computer from the one you bought originally. There are three types of general-purpose slots:

- *PDS (Processor Direct Slot)* is a direct connection to the computer's processor. A Mac can have only a single PDS. ("PDS slot" is an accepted phrase, but it actually translates to "processor direct slot slot.")

- *NuBus* was, until fairly recently, the basic expansion slot for the Mac, with anywhere from one to six of them in an expandable Mac. NuBus is an elegant standard for handling add-in boards, with the Mac directing the signals from multiple boards. But NuBus has served its purpose and can no longer keep up with the demands of the fastest Mac models.

- *PCI (Peripheral Component Interconnect)* slots are the new standard, replacing the slower NuBus technology. Many current models use PCI slots, and all future ones will.

The type and number of these slots vary from one model to another. Some models need 7-inch NuBus cards, others take 14-inch ones; there are different kinds of PDS cards too, named for the machines in which they first appeared—SE PDS, LC PDS, and LC III PDS, for instance. In some models, using a PDS card blocks one of the NuBus slots. Then again, some models have a PDS slot that takes an adapter so you can plug in a NuBus card instead!

Specialized slots. There are a variety of specialized slots that might be inside a Mac. In addition to memory slots, which are in every Mac, you might also find a slot for a *cache card* (described a little earlier), for a DAV card (*digital audio video*, for AV Macs), or for an internal modem (referred to as a *communications slot*).

Expansion bay and PCMCIA slots. PowerBooks have two special expansion capabilities not found on desktop Macs: the expansion bay and the PCMCIA slot. The expansion bay is *not* the same thing as a "storage bay" in tower-design desktop Macs, which is merely a space (and waiting cables) to add internal storage devices. (Both the bay and PCMCIA are covered in "PowerBooks" later in this chapter.)

External

You don't need to open the Mac to add hardware. In fact, the most common and useful hardware add-ons are, by their very name—*peripheral*—outside the Mac: modems,

The exposed backside of a Mac. The number and position of ports vary from one Mac to another, but most are easy to identify, and only the modem and printer ports accept the same cable, so it's hard to attach something incorrectly.

printers, keyboards, scanners, and so on. The socket where you plug in a peripheral's cable is called a *port*, and there's a wide variety of them on the back of the Mac. They're sometimes referred to as *I/O ports*, for Input/Output.

The basic ports (SZA/JK). Not all Macs have all the ports listed here. In fact, if you include PowerBooks, there are some Macs with only a single port available. But most Macs provide about a half-dozen ports for standard peripherals.

✂	🖶	☎	◇	▢	◁)))
ADB	printer	modem	SCSI	monitor	sound out
⭘	‹•••›	⌒	⊡ IN	⊡ OUT	→ ←
sound in	Ethernet	headphone	video-in	video-out	stereo in

The ports on every Mac are labeled with icons.

- The *ADB* port (*Apple Desktop Bus*—a bus being something that information travels on in a computer) is for your keyboard and mouse, and anything that replaces one or the other—a trackball, for instance. Most Macs have a single ADB port, since you can plug the keyboard into it and then plug the mouse into the keyboard.

- The *printer* port accommodates not only printers, but also serves as the main connector for Apple's AppleTalk network.

- The *modem* port is used, of course, for modems, but can also handle other serial devices, like printers. (But not printers which require AppleTalk connections, as do most LaserWriters.)

- The *SCSI* port is for external SCSI devices like hard drives, CD-ROM drives, removable storage (SyQuest and magneto-optical, for instance), and scanners. Desk Macs use a 25-pin SCSI connector; PowerBooks use a more compact one called HDI-30.

- The *display*, or *monitor port*, is on Macs that provide support for a monitor. But keep in mind that there are different levels of "support": few models can run an extra-large display from their internal video, and many are limited in the number of colors they can display on even a standard-size screen.

- *Video-in* and *video-out* ports are included on all AV and some Power Mac models. The video-in port lets you hook up a camcorder or VCR to play into a window on the Mac. The video-out port (not to be confused with the monitor port) lets you send a video signal to a standard TV or a VCR.

- The *sound out* port, available on most Macs, lets you plug in headphones or small speakers that use a standard miniplug (like Walkman headphones). All Macs already have built-in speakers.

- The *sound input* port accepts an Apple microphone (some models just have built-in mikes so you wind up talking to the screen). Some Macs have, in addition, *stereo sound input*, with separate ports for left and right input.

- The *Ethernet* port, available at least as an option on most new Macs, is for Ethernet network connections.

- There's a separate *headphone* port on some later Mac models, conveniently located on the front of the case rather than on the back.

SCSI and IDE (SZA). The internal hard drive on most Macs is a SCSI device, but some lower-priced models (to date, the LC 580, Quadra and Performa 630, Power Mac 5200, and PowerBook 150) have an IDE interface for their internal drives; IDE *(Integrated Drive Electronics)* drives are less expensive than SCSI drives. Models with IDE drives still provide an external SCSI port so you can use other SCSI devices.

If you have an IDE drive and you're not using Apple's formatting software, make sure the third-party utility you're using can handle IDE drives and not just SCSI ones.

Serial and parallel (SZA). Ports can be divided into two general categories: *serial*, where the information travels in a stream of data pretty much single file, one bit at a time; and *parallel*, which is more like a multi-lane highway, letting the information march along at least eight bits abreast. Parallel, of course, is a much faster connection; the Mac's modem and printer ports are serial, while the SCSI port is parallel.

HOT TIP

The GeoPort (SZA). The GeoPort isn't a separate port at all, but a specialized version of a serial (modem or printer) port. This port provides extra speed, so that it can be used for multiple purposes—sending a fax, printing a document, maintaining a network connection—all at the same time. The modem port on Quadra AV models is a GeoPort, and both the modem and the printer ports on Power Macs are GeoPorts. GeoPorts have room for a 9-pin connector instead of the standard 8-pin serial connector, so you can tell something's a GeoPort just by looking at it. Because the GeoPort difference is an extra hole, it can still function as a standard serial connector.

GeoPort and Telecom Adapter   (SZA/JK)

A Mac with a GeoPort can function as a speakerphone, an answering machine, and a fax modem if you get Apple's **GeoPort Telecom Adapter** ($130) so you can hook it to a phone line. The Adapter comes with the software you need for all of this, including MegaPhone from Cypress and SITcomm from Aladdin Systems. If you like to type while you talk, the **Jabra** is a headset and software necessary to use any Mac with a GeoPort as a hands-free telephone (from Jabra, $100 for standard, $170 for Quadra AV/Power Mac version).

The high-density display port (JK). Many PowerPC-based Macs have a special, over-sized display port called the *AV* or *high-density* port. The AV port is actually a combination monitor, ADB, sound, and video port that was designed for multimedia monitors like Apple's AudioVision 14 Display, which has built-in speakers, a microphone, and places to plug in a keyboard and other peripherals. It supports monitors up

to mid-size or portrait, but not large 19- to 21-inch models. You need a **Power Mac Display Adapter** ($30) to connect any other monitor to an AV high-density port.

Video support and port names (SZA/JK). Macs vary in their built-in ability to support a monitor. Some can't do it at all; some have built-in video support for a screen of up to a certain size for a certain number of colors; a limited number of models actually provide support for two monitors.

Whatever the built-in support, you can always add a video card that will let you hook up a monitor that the Mac can't handle by itself, whether that means it's your only monitor, or a second one in addition to the one that the Mac runs by itself. On a smaller scale, adding more *video RAM (VRAM)* on models that are upgradable in that area will let you display more colors on the screen.

The name of the port for built-in monitor support has been gradually evolving; it's generally called the *video port*, although sometimes it's called the *monitor port*. Apple has begun referring to it as the *display port* since it introduced Macs with ports for hooking up video equipment like TVs and camcorders. If you see or hear the term *video port* or *video support*, you'll have to judge from the context whether it's referring to a monitor display or the more general video capability.

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Current Model Lines

Mac model lines appear, disappear, and get reorganized more often than departments at Apple Computer—and that's quite frequently! At this writing, there are three major product lines: Power Macs, Performas, and PowerBooks. In addition, there's what you might call the "sideline": WorkGroup Servers for a special niche market.

And then there's the growing clone market: You don't have to buy a Macintosh to get a Macintosh. That is, you don't have to buy an Apple-brand Macintosh computer to have a computer that works just like a Macintosh. Of course, that's what a lot of Windows 95 users say, but that's not what we mean—we mean the genuine Macintosh OS!

Power Mac

The Power Mac line was launched in March 1994 as the first branch of the Mac family to use the new, more powerful RISC technology of the PowerPC processor chips. The first group of machines (the 6100, 7100, and 8100, using the 601 chip) was barely in the stores before they were each upgraded to faster speeds. The next round (the 5200, 6200, and 7200) included two machines with the less-expensive 603 PowerPC

chip instead of the 601. A year later, the newest group (the 7500, 8500, and 9500), included two machines with the 604 processor.

The Power Macs don't have a lock on the PowerPC processor: Many Performa models use it too. In fact, it's the only processor Apple's going to be using in every Mac from now on.

Power Mac names (SZA/JK). Don't rely on the model number to tell you what's what on a Power Mac. The only number you can count on is the one after the slash in the model name (9500/120 versus 9500/132), which tells you the speed of the processor. The rest of the numbers aren't directly related to the machine's capabilities—what processor it uses, for instance, or what kind of internal expansion it provides.

So far, the only meaningful grouping is that the 6000s use a single-slot case; the 7000s provide three slots in a larger box; and, the 8000s use a 3-slot tower design. The 9500 (the only one in the 9000 series at this writing) provides six slots in a tower.

In addition, a 500 is still significant at this point: The 7500, 8500, and 9500 all use PCI slots instead of NuBus. But folks at Apple never plan ahead on model numbers, or, if they do, they seldom stick to the plan, so always check the specs of any machine instead of making assumptions based on model names.

Native and emulation modes (SZA). A Power Mac can work in two different modes: *native*, which means it's using software made to take advantage of the PowerPC chip, and *emulation*, which means it's pretending to be a 68000-based machine, running software made for earlier Macs. These modes are invisible to the user: The Mac works in whatever mode is necessary to get the job done, switching back and forth without your telling it to—in fact, without your even knowing.

Many programs still come in only a 68K version, since that runs on both types of Macs; soon, though, the high-end graphics and layout programs will be available in only PowerPC versions. Some programs actually have separate versions, one each for 68000-based and PowerPC-based machines. Others come as something called *fat binary*, which contains instructions for both types of processors, using whatever's necessary for the machine you install it on.

> ### *WorkGroup Server*   (SZA/JK)
>
> A WorkGroup Server is basically a Quadra or Power Mac that's been souped up to work better as a *server*—a Mac that provides a central location for resources accessed by a network of other Macs. They're sold without monitors or keyboards. Any Mac can be used as a file server, but these machines are customized with file-server software and hardware enhancements for particularly demanding networks; some even include tape backup units.

The emulator slowdown (JK). Since the 68K and PowerPC processor families each have their own language for communicating with software, and neither can run programs written for the other, Apple built an interpreter (the *emulator*) into the Power Mac's ROM. This translates instructions from 68K software for the PowerPC chip and interacts with 68K software the way a 68K processor would.

BAD FEATURE

The result is that most 68K programs will run on a Power Mac, but only about as fast as they would on an '040 Mac because the translation slows things down. Also, since the emulator doesn't include an FPU, it won't let you run 68K programs that require one.

Power Mac AVs (SZA/JK). Power Mac AV models include an AV card in the PDS slot instead of an accelerated display card. The AV card (which you can order separately for some Mac models) provides a second display port and video-in and video-out ports; it gives you (not surprisingly, considering its name—the AV stands for *audio-visual*) all the special video capabilities of a 68K AV Mac, but on a faster machine.

Forms and Functions

The Mac has evolved both inside and out over the years. The familiar compact original went through only very minor changes for many models. The modular approach that started with the Mac II has many variations: the CPU box that usually sits under the monitor varies in height, width, and depth (one was so slim it was christened the "pizza box"), while the tower design, meant to stand on the floor (so much for desktop computing!), also comes in different heights.
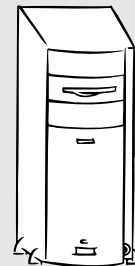
Some later models went back to an all-in-one design, with a built-in 14-inch color monitor on top of what would normally be the CPU box. And, of course, there's the line of PowerBooks with its diversity—including the Duo model which, when inserted in its Duo Dock, looks like another style of desktop Mac.
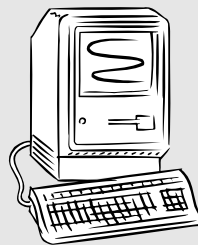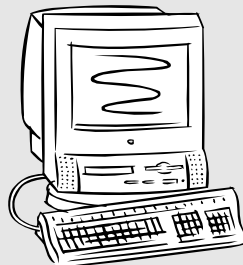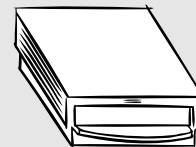
Compact
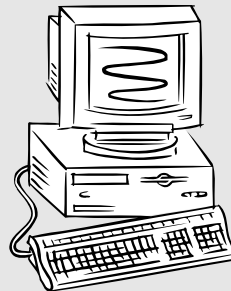
Tower design

Modular case with monitor on top

Built-in 14-inch monitor

PowerBook

Duo Dock

The body types in the Mac family are about as varied as those in the human family!

There's no DSP chip on the card (as there is in the AVs) because the PowerPC chip can handle all its functions at speeds rivaling that of a dedicated chip. There is a DAV slot on the AV board that you can use to add cards that extend the audio and video capabilities of the computer.

Performa (SZA)

Performas were originally marketed as Apple's consumer machine: bottom-of-the-line power, prepackaged with a keyboard and not-so-great monitor, bundled with software, given a special set of "extra-easy" system software, and sold through general stores like Sears and K-Mart. In fact, to get around Apple's original agreements with its dealers, which prevented it from selling Macintoshes except through them, these machines were named "Performa" with no "Macintosh" anywhere in the name.

But everything changes: Current Performas aren't underpowered by any means; they use standard Mac software, and even the name is, officially, "Macintosh Performa."

Performa names (SZA). Performa model names are probably the worst of any in the Mac family. Sometimes the only difference from one model to another is the inclusion of a CD-ROM drive or a modem; sometimes it's an even simpler matter of the size of the hard drive. So, we wind up with model numbers like 460, 466, and 467, and 5200, 5215, and 5216! Who can keep track? We've put all the specs in the chart at the end of the chapter but there are bound to be more models every year, so make sure you figure out what you want and check the particulars of the models you're looking at. In general, the last number of a three-digit model number (460, 466, 467) means a minor difference like a different hard drive or modem configuration, while the major components—processor, speed, slots—are the same. For a four-digit model number, the last two digits (6200, 6215) are the ones that indicate minor component differences.

Macintosh DOS (SZA)

Mac models with "DOS Compatible" in their names are two, two, two computers in one. The Power Mac 6100/66 DOS Compatible, the LC 630 DOS Compatible, and the Performa 630 and 640CD DOS Compatibles each has a 486DX2 processor on a separate card inside. But that processor is to the PC world what the '040 is to the Mac world; perhaps by the time you read this, you'll find that there are Pentium-based compatible cards available for the Mac.

Performa system software (SZA). Performa models up until the 580 were released with a special version of the system software, the "P" version of System 7 and System 7.1. The major differences between the P and standard versions are the inclusion of At Ease (a Finder replacement), a special Launcher window, and a different General

Controls control panel. But Performas are still Macs, and the standard versions of the system software can be installed on those early models.

There's no P version of System 7.5, because the Performa is now a mainstream Mac. At Ease is still, as of this writing, included on Performas, and the Launcher is now standard system software.

Performa equivalents (SZA/JK). Because of the original marketing idea for Performas (mainstream versus Apple dealer), many of the early Performa models are basically the equivalent of some other Mac (see table).

About This Macintosh
Performa — System Software 7.1P — © Apple Computer, Inc. 1983-1995
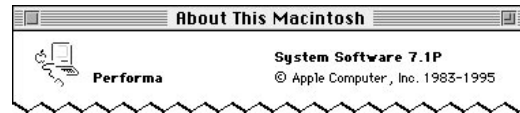
Performa "P" system software is identified in the About This Macintosh dialog from the Finder's Apple menu.

Performa	Equivalent Mac Model
200	Classic II
400	LC II
405, 410, 430	LC II (plus modem and larger drive)
450	LC III
460, 466, 467	LC III (with faster clock speed)
550, 560	LC 550
575, 577, 578	LC 575
600, 600CD	IIvx (without cache card and FPU)
630	LC 630
630 DOS	LC 630 DOS

Mac Clones   (SZA)

In early Mac days, a *clone* was definitely a Bad Thing: an illegal (and therefore behind-the-times and/or very glitchy) copy of the Mac's ROMs and supporting hardware in a cheaper setup than you could get from Apple. Now a clone is a Good Thing, because Apple has licensed its technology to a limited number of vendors who can build Macs (under another name) with Apple's blessing and support.

Send in the clones. Clone manufacturers generally target the two extremes of the market. On the low end, they'll put together hardware bundles cheaper than those Apple offers; on the high end, they'll put together "scream machines" whose power and speed are needed by only a relatively small group of users.

The fact that so many clones are available at lower prices than the comparable Apple models is not necessarily because the units use cheaper materials (although that's a possible factor for some machines); clone manufacturers can generally offer good deals because they're not hampered by big Research and Development budgets.

Should you buy a clone? Maybe. The cautionary tone of that answer is not because a clone isn't as good as a genuine Macintosh, because it truly is a Mac under the skin. But the problem lies in the manufacturer's longevity. We're reasonably sure Apple's going to be around to support its machines years down the road, but the same can't be said of the clone manufacturers. If your clone falls apart next year and the manufacturer is out of business—who you gonna call?

As of this writing, only Power Computing has shown any staying power. Radius, originally known for its great monitors, announced high-end clones that it couldn't deliver, and the company itself is not likely to survive much longer. DayStar, known mostly for its accelerators, sells a high-priced multi-processor model that hasn't yet found its market.

In all, getting a clone in what is still the earliest stage of the Mac clone marketing is a gamble; make sure the price break you're getting is worth the gamble.

DayStar. DayStar has cloned a Monster Mac. Its flagship Genesis MP 600 uses the 150MHz PowerPC 604 processor—*four* of them! The multiple-processor approach supplies nearly three times the speed of Apple's fastest 604-based Mac. But the unit is priced at nearly $11,000, and comes with no keyboard, no internal hard drive, and no RAM. The Genesis MP 528, for $9,000, is the same setup with the processors running at 132MHz, while the $6,000 MP 300 uses two 150MHz chips.

But the real problem with the Genesis is not the price. It's the fact that unless software is specifically written to take advantage of multiple processors, they don't give you any advantage at all—and Adobe's Photoshop is the only program, at this time, that knows how to do that.

PowerComputing. PowerComputing is clone-making the right way: It offers systems configured any which way (the customer chooses the speed, the size of the internal drive, the amount of RAM, and so on), bundled with get-started software and utilities, and offered at a price below a comparable Apple-brand machine. So, the cases are clunky PC-style boxes—you want *everything?*

In fact, PowerComputing offers several options Apple doesn't. How about a built-in Iomega Zip drive that stores 100MB of information on a removable, floppy-sized cartridge? Or a model that offers both PCI and NuBus slots? (See Chapter 2 for more about slot types.)

Because PowerComputing pretty much lets you "roll your own" system, it's difficult—in fact, nigh unto impossible—to make a chart to round up its models. But here's a short list of typical late-'96 configurations and prices. (As with Mac model names, the numbers after the name indicate the processor chip and its speed; if you need help deciphering any of the other specs, such as *4x CD-ROM drive* or *1GB hard drive*, check Chapters 2 and 5 for more information.)

- *PowerCurve 601/120*, 8MB RAM (expandable to 256MB), 850MB hard drive, 3 PCI slots, 1MB VRAM, Ethernet, keyboard, and mouse: $1800. With 4x CD-ROM drive and monitor: $2300.

- *PowerWave 604/120*, 8MB RAM (expandable to 512MB), 850MB hard drive, 4x CD-ROM drive, 3 PCI slots, 2MB VRAM, Ethernet, keyboard, and mouse: $2,500. With 16MB RAM, 1GB hard drive, internal Iomega Zip drive, and monitor: $3,257.

- *PowerWave 604/132*, 24MB RAM (expandable to 512MB), 1GB hard drive, 4x CD-ROM drive, 3 PCI slots, 2MB VRAM, Ethernet, keyboard, mouse, and monitor: $4,050.

- *PowerWave 604/150*, 32MB RAM (expandable to 512MB), 1GB hard drive, 4x CD-ROM drive, internal Iomega Zip drive, 3 PCI slots, 4MB VRAM, Ethernet, keyboard, mouse, and monitor: $5,150.

PowerBooks

Although Apple's first "portable" computer—the Portable—was a joke because of its weight, the PowerBook line truly deserved to be in the then-new category of *laptop* computer: everything you need in a package small enough and light enough to fit on your lap, powered by a battery so you don't have to sit near an electric outlet.

Components and Capabilities

The PowerBook generations so far have offered four different battery technologies, three different types of screens, four different processors, and several different form factors; they've even introduced new types of connectors and connectivity.

Screen technology (RW/JK). The big division between types of PowerBook displays is not color versus black-and-white, as you might expect, but between two types of *LCD* (liquid-crystal display) technologies: *active* and *passive matrix*. Active-matrix screens provide crisp, sharp images when viewed from any angle, under any lighting condition.

Passive-matrix screens are less bright and sharp, have a narrow viewing angle, and are relatively slow to react: Drag an object on the screen, or move the cursor at a normal speed, and you'll see a trail of images left behind—move the cursor too quickly, and it totally disappears. (This is known as *submarining* because you see the cursor in its original spot, and again in its final position, but in between, where it disappears, it seems to have dipped beneath the surface of the screen.) While it's obvious that active-matrix displays are far superior, they have two major drawbacks: they're heavy, and they're expensive (on the order of $1,000 to $1,600 more for a color display).

BAD FEATURE

While active-matrix displays remain the screen of choice for those who can afford it, passive-matrix technology has improved: *Dual-scan* passive-matrix displays redraw the top and bottom halves simultaneously, for double the refresh rate.

The first PowerBooks were strictly black-and-white, regardless of the screen technology. Later models offered four, and then 16 shades of gray. Finally, color showed up on PowerBooks, first on the washed-out 165c passive-matrix screen and then in the superb 180c active-matrix one. Aside from the premium you pay for color, you also pay in terms of battery power—color screens need higher backlighting, which eats up power. But with battery technology improving, a color display is a more practical option now than it was in previous years.

Screen size (SZA/JK). PowerBook screens range from 8.4 to 10.4 inches on a diagonal measurement, but, as with desktop monitors, the measurements can be deceiving. It's a screen's *pixel resolution*—how many pixels are used horizontally and vertically—that determines how much information it can actually display. The 8.4-inch screen on the 180c, for instance, displays just as much as a 14-inch monitor—640 pixels across by 480 down; things just look much smaller because the pixels themselves are tinier. By contrast, the 10-inch screen on the 180 has a resolution of 640 by 400—one-sixth less information vertically—but at a more readable size.

There's a trade-off between the number of pixels on a screen and the color depth of the display due to memory constraints; so, models like the PowerBook 5300c provide 256 colors on the standard 640-by-480 display, but let you switch to thousands of colors in a 640-by-400 display.

Note that many games assume a 640-by-480 display, so older PowerBooks, even if they're capable with their memory, hard drive, and processor speed constraints, may not be able to run many games because of the dimensions of the screen.

BAD FEATURE

Keyboards, trackballs, and trackpads (SZA). PowerBook keyboards are cramped affairs that make users guiltily dream about IBM's "butterfly" laptop keyboard that expands to full size when the case is opened. PowerBook keyboards are missing numeric keypads, of course, and models before the 500 series don't have any function keys, or even a Power On key.

Although most PowerBooks have an ADB port where you can plug in a mouse if you want to, the built-in pointing device is either a trackball or a trackpad. Trackballs come in three different sizes: one for the 100, another for all the 100-series PowerBooks, and the tiny one used in the Duo.

Trackpads were introduced with the 500s and slowly improved. The one on the 190 takes taps and double-taps right on the pad instead of your having to use the button for clicking. Oddly enough, the most expensive PowerBooks (as of this writing) have

GOOD FEATURE

The Little Things Mean a Lot   (SZA)

Some of my favorite PowerBook products are tiny and relatively unimportant. **PowerBalls** ($5 each, $7 to $12 a four-pack) replace the old gray trackball with a variety of colors (or an eight-ball); mine's DayGlo Orange. Have a trackpad? Try a "tattoo," a thin mylar skin with nifty graphics ($7 for a sheet of 20 different ones). And don't forget the **PowerDoor**, a replacement I/O door for the one that constantly breaks off the back of 140–180 models; it has an opening for the phone jack, so you won't have to open the entire door (and break it off) so often. All these items are available from APS Technologies.

And if you travel outside the country, you'll be boggled by the wide variety of phone jacks used around the world, but you can stay on-line if you choose one of TeleAdapt's hundreds of international phone plug adapters. They are available individually ($30) or in multipacks ($50 to $450) for various geopolitical regions. And if you don't know what you need, don't worry—TeleAdapt seems to know it all!

slightly behind-the-times trackpads that don't understand tapping, although Apple sort of promised an upgrade for them. It looks like trackpads are the only pointing device available now on any new PowerBooks, which is a shame for those of us who just don't like them.

Batteries (RW). The continuing quest for inexpensive, lightweight, but long-lasting batteries for laptop computers has resulted in five distinct battery technologies for PowerBooks (so far).

- *Lead acid*, the same type of battery as in your car, was used only for the PowerBook 100. It's particularly unfriendly (that is, *toxic*) to the environment when disposed of.

- *Nickel-cadmium (NiCad)* batteries are used by the 100-series PowerBooks.

- *Nickel-metal-hydride (NiMH)* batteries are used in the Duos and in the 500-series PowerBooks. The original one, now referred to as Type I, recharges faster and lasts longer than a NiCad. It was followed by (what else?) Type II and then Type III, which provide even more staying power.

- The *intelligent battery* in the 500-series PowerBook is a NiMH battery, but it includes a special chip to help the PowerBook manage its power needs more efficiently and provide a more accurate charge reading than is available from other, "dumb" batteries.

- *Lithium-ion (LiIon)* batteries were originally slated for use in the 5000-series PowerBooks. Now they're set for the newest PowerBook line (which isn't even announced as I write this, but should be out by the time you read this).

SCSI connections (RW/JK). PowerBooks have a different type of SCSI port than desktop Macs because there's not much room at the back of a PowerBook; it's called the *HDI-30* (for *high-density interface*, with 30 pins). To connect a standard SCSI device, you need the HDI-30 SCSI cable, which plugs into the back of the PowerBook and provides a standard 25-pin SCSI connector at the other end.

All PowerBooks except the 140, 145, 145B, and 170 provide a unique feature called *SCSI disk mode*, where you can use the PowerBook itself as an external SCSI drive. You use the **HDI-30 SCSI Disk Adapter** cable ($30, from Apple—not the same as the SCSI cable) to attach a PowerBook to a desktop Mac. You turn on the PowerBook and then the desktop Mac, and voilà: The PowerBook's internal drive shows up as an icon on your desktop Mac. The transfer of files across a SCSI connection is much faster than using a network connection.
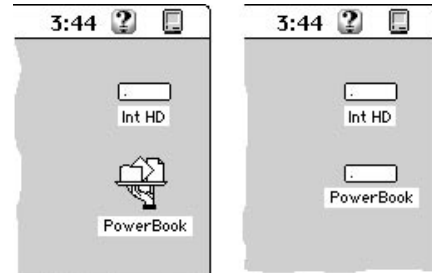
At left, a PowerBook that's connected to a desktop Mac on a network. At right, the PowerBook has been connected in SCSI Disk Mode and is treated as an external hard drive.

Sleep (RW/JK). PowerBooks use a special power-saving mode called *sleep* which drastically cuts down on battery drain. You can put a PowerBook to sleep manually (there are several ways—the Sleep command in the Finder's Special menu is the most self-evident, and later models go to sleep when you close the cover), or set it to go to sleep after a particular interval of inactivity. In sleep, the screen goes blank and the hard disk stops spinning, but those are only the most obvious results; all sorts of internal components are also powered down during sleep. A touch of a key wakes up a sleeping PowerBook instantly.

Sleeping Desk Macs   (David Ramsey)

PowerBooks are no longer the only Macs that go to sleep. Power Mac models 7200, 7500, and 8500 (so far) also have a sleep mode that saves energy: The screen blanks and the hard drive spins down. Only the 7200, though, also powers down parts of the logic board and meets the EPA's "Energy Star" rating of using less than 30 watts of power in its sleep state.

Putting a PowerBook to sleep is the usual way to turn it off rather than actually shutting down; newer models, as a matter of fact, go to sleep if you just shut the case. While Apple has always recommended shutting down a PowerBook when you're transporting it, few, if any, users ever bother—and you shouldn't, either.

Video output (RW/JK). With the exception of the PowerBook 100, every black-and-white and grayscale PowerBook still "thinks" in color, and can provide color information for an external color monitor. But the 140, 145B, and 170, despite their

hidden color capabilities, have no video port to accommodate a monitor hookup. Some third-party adapters were available in the first heady year of PowerBook existence, but none is available now. Other all-in-ones have video ports available, although the level of support they provide (how large a monitor, or how many colors) varies from model to model. The Duos, of course, can support a monitor when inserted into a Dock or attached to a mini dock.

PCMCIA cards (SZA). The 500-series PowerBooks introduced a new type of slot: *PCMCIA* (for *Personal Computer Memory Card International Association*). To use the slot, though, you need Apple's **PCMCIA Expansion Module** (commonly known as the "card cage," $200) to replace the left-hand battery. The 190 and the 5000-series PowerBooks have built-in, accessible PCMCIA slots.

The PCMCIA acronym is such a mouthful that the cards for the slot are commonly referred to as simply PC cards. They come in three sizes: Type I, Type II, and Type III. They all have the same surface area but their thicknesses vary. PCMCIA slots usually come in pairs, but can accommodate only one Type III card because its girth blocks the second slot.

An amazing amount of functionality can be built into a PC card: Modems, memory, Ethernet connections, and combinations thereof are all on PC cards for PowerBooks, from such trustworthy vendors as VST Systems, Dayna, Farallon, and Global Village.

The expansion bay (SZA). The 5000-series PowerBooks, and the look-alike 190, include an *expansion bay*, which comes with a floppy drive in it. Pop out the floppy drive and insert hard drives, memory modules and even magneto-optical drives for the bay from third-party developers like VST Systems and APS Technologies.

Infrared networking (SZA). Everyone's getting tired of wires, and infrared is the coming thing. The 5000 PowerBooks introduced yet another new feature: infrared capability. (It's optional on the 190). You set up an infrared network connection much the same way you work with AppleTalk, and it's intriguing to see the network window acknowledge an interrupt of the signal and then pick it up again without having lost a bit of the data transfer.

The Next Round of PowerBooks (RW)

As of this writing, the PowerBook 5300 is the newest and the top-of-the-line model, but rumors run rampant about what's next. Disregarding the ones that are more wishful thinking than anything else, we're left with one very significant feature: a redesign of the expansion bay so that it can accommodate a drive for a standard CD-ROM. But the new bay will have a "double door" setup so that you can still use modules designed for the smaller expansion bay in the 5000-series PowerBook.

And if you're enamored of a wireless office, check out VST's **AIRPlex** modem ($600, including the base unit), a PC-card based modem that connects by infrared to a base unit (that's plugged into a phone line) up to 50 feet away!

PowerBook Models

The 15-pound Mac Portable was Apple's humorous first entry into the portable market; it had a full-size keyboard, a trackball off to the right, and a beautiful active-matrix screen (although only a few late units came with backlighting). Now, onto the 7-pound (and less) wonders!

The PowerBook 100 (SZA). One of the three original models, the PowerBook 100, stood out not only because of its light weight (5.1 pounds) and the lack of an internal floppy drive, but also because it used the 68000 processor, a chip that had long been abandoned in desktop models. Its display is a slow passive-matrix one; it's the only PowerBook to use a lead-acid battery.

The 100-series models (SZA). The 100-series PowerBooks (with the exception of the 100 itself) are referred to as "all-in-ones" because they include an internal floppy drive; all but the 190 use the 68030 processor, and all use NiCad batteries.

• The PowerBook 140 and 170 were in the original group of PowerBook offerings. The 170 was the top-of-the-line primarily because of its beautiful active-matrix screen which, of course, added to its weight. But it bettered the 140 in several other ways, too: a faster '030 processor and an FPU. The 145 replaced the 140, its single difference being a faster clock speed. The 145B is identical—it was just redesigned internally for cheaper manufacturing. All these models have black-and-white displays and are limited to 8MB of RAM.

• The PowerBook 160 introduced the grayscale passive-matrix screen; the 165 is its twin except for a faster processor. The 165c was the first color PowerBook, but its passive-matrix screen displayed washed-out colors. The 180 was the first PowerBook to use the standard 640-by-480 pixel proportions of a desktop monitor, in a grayscale active-matrix screen. The 180c had a tiny but beautiful active-matrix color screen. All these second-round PowerBooks have a 14MB RAM limit.

• The PowerBook 150 was positioned as an entry-level PowerBook at a point when the first PowerBook models were out of production and the price tags of current models were prohibitive. At heart, it's just a 145B with a 40MB RAM limit and four levels of gray in a 600-by-480 screen—and a severely limited set of I/O ports, not even including video out.

- The PowerBook 190, released at the end of 1995, is the last of the 68K Power-Books. While it uses the low-power '040 chip, it shares most of its design with the 5000-series PowerBooks released at the same time: infrared capability, PCMCIA slots, and an expansion bay. The 190c is the color version.

The 500 series (SZA). The 500-series PowerBooks (four models offering different types of screens) provide '040 power in an all-in-one laptop design. The 68LC040 chip used in these PowerBooks (and in the Duo 280 and 280c) is a special low-power version of the chip so it uses less battery power; it's missing some of the built-in FPU functions of the standard '040 chip. The 500 PowerBooks introduced the double-battery approach, and use special "intelligent" batteries that keep track of the charge and time that's left. You can replace one of the batteries with a PCMCIA adapter (described earlier in "Components and Capabilities").

The Duos (RW). The Duos introduced a new concept in take-it-with-you computing. For traveling, you have a lightweight laptop, but back at the desk, it slips into a docking station and performs as the brains of a desktop system that includes a standard monitor and keyboard, and even slots for expansion. To keep the Duo small and light, the design called for no internal floppy drive and few ports—in fact, there's only a single serial port (for an external modem or printer), a connector for a dock, and the option of a phone jack for an internal modem. To hook up anything else to a Duo when it's not in its Duo Dock, you need a mini-dock that provides extra ports. So, the thrill of traveling light is often mitigated by the necessity of schlepping a bag full of extras for either planned activities (a presentation, say) or in case of emergencies (you need the **Floppy Adapter** [$95] and an external floppy drive to reinstall a corrupted system from floppies).

Duo Docks (RW). Apple's Duo Docks turn a laptop Duo into a desktop Mac. The Duo slides in the front of the Dock, creating a setup that includes an internal floppy drive, a complete set of I/O ports, NuBus slots, and a connection for an internal hard drive.

The Duo Dock II was introduced to accommodate the thicker, color Duos (although you can upgrade the original with a new top). Additional features included a math coprocessor (optional on the original), a 32K memory cache, an Ethernet port, and support for a 20-inch monitor (the original was limited to a 16-inch monitor).

Then there's the Duo Dock II+ which really should be called a "minus" instead of a "plus" because it doesn't have the math coprocessor—it's made for '040 and PowerPC Duos, which don't need an FPU.

If you don't need a full Duo Dock (and you don't *want* it when you're traveling), there are a variety of mini docks available from Apple and Newer Technologies. These small docks let you hook up a duo to floppy drives, hard disks, Ethernet networks, monitors, and other external devices.

PowerBook Specs

Model	Chip[1]	Speed (MHz)	FPU[2]	Max. RAM (MB)	Screen	Display size (diag. in.)	Colors	Pixel Resolution	Battery	PCMCIA slots	Infrared	Weight (lbs.)	"Mouse"
100	68000	16	no	8	passive	10	b&w	640x400	lead-acid			5.1	trackball
140	68030	16	no	8	passive	10	b&w	640x400	NiCad			6.8	trackball
145	68030	25	no	8	passive	10	b&w	640x400	NiCad			6.8	trackball
145B	68030	25	no	8	passive	10	b&w	640x400	NiCad			6.8	trackball
150	68030	33	no	40	passive	9.5	4 grays	640x480	NiCad			5.5	trackball
170	68030	25	yes	8	active	10	b&w	640x400	NiCad			6.8	trackball
160	68030	25	no	14	passive	10	16 grays	640x400	NiCad			6.8	trackball
165	68030	33	no	14	passive	10	16 grays	640x400	NiCad			7	trackball
165c	68030	33	yes	14	passive	10	256	640x400	NiCad			6.8	trackball
180	68030	33	yes	14	active	10	16 grays	640x400	NiCad			6.8	trackball
180c	68030	33	yes	14	active	8.4	256	640x480	NiCad			7.1	trackball
190	68LC040	33	no	40	passive, dual-scan	9.5	16 grays	640x480	NiCad[3]	2	(opt)	6	trackpad
190cs	68LC040	33	no	40	passive, dual-scan	10.4	256 colors	640x480	NiCad[3]	2	(opt)	6.3	trackpad
520	68LC040	25	no	36	passive	9.5	16 grays	640x480	NiMH	(cage)		6.3	trackpad
520c	68LC040	25	no	36	passive	9.5	256 thousands	640x480 640x400	NiMH	(cage)		6.4	trackpad
540	68LC040	33	no	36	active	9.5	16 grays	640x480	NiMH	(cage)		7.1	trackpad
540c	68LC040	25	no	36	active	9.5	256 thousands	640x480 640x400	NiMH	(cage)		7.3	trackpad
5300	603e	100		64	passive, dual-scan	9.5	16 grays	640x480	NiCad[3]	2	yes	5.9	trackpad
5300cs	603e	100		64	passive, dual-scan	10.4	256	640x480	NiCad[3]	2	yes	6.2	trackpad
5300c	603e	100		64	active	10.4	256 thousands	640x480 640x400	NiCad[3]	2	yes	6.2	trackpad
5300ce	603e	117		64	active	10.4	thousands	800x600	NiCad[3]	2	yes	6.2	trackpad
Duos													
210	68030	25	(Dock)	24	passive	9	16 grays	640x400	NiMH			4.2	trackball
230	68030	33	(Dock)	24	passive	9	16 grays	640x480	NiMH			4.2	trackball
250	68030	33	(Dock)	24	active	9	16 grays	640x400	NiMH			4.2	trackball
270c	68030	33	yes	32	active	8.4	256 thousands	640x480 640x400	NiMH			4.8	trackball
280	68LC040	33	no	40	active	9	16 grays	640x480	NiMH			4.2	trackball
280c	68LC040	33	no	40	active	8.4	256	640x480	NiMH			4.8	trackball
2300c	603e	100		56	active	9.5	16 grays	640x400	NiMH			4.8	trackpad

Notes:

1 6xx is PowerPC chip; others are Motorola

2 Not an issue for '040 and PowerPC chips

3 Can run on, but not charge, LiIon batteries

The 5000 series (SZA). The four models of the 5000 series got off to a bumpy start: Consumers complained about the absence of a CD-ROM drive, the supply fell far short of demand, and a few early problems with lithium-ion batteries cast a pall over the new lineup. But the 5000-series machines are cutting edge as of this writing, incorporating all the best of the features described earlier in "Components and Capabilities": PowerPC processors, 64MB RAM expansion, 10.4-inch screens (on three of the four), infrared capability, PCMCIA slots, and an expansion bay.

Apple is backtracking on the battery issue for these models and will supply only NiCads for them. LiIons will come with the newest PowerBook models and, although the new battery will run a 5000 PowerBook, the 5000 models won't be able to recharge them.

Older Macs

You don't need the latest technology (they don't call it the *cutting* edge for nothing!) to get a lot of productive work done. There's plenty of life left in the pre-Power Mac models. (For more on this issue, see "Is an Older Mac Usable?" in Appendix C.)

The Previous Generation   (SZA)

The generation of Macs before whatever is the current model line always includes perfectly fine, workable machines that, for the most part, can run current software, even if they can't match the newest speed demons. With the exception of software written especially for PowerPC-based Macs (and that includes the long-awaited System 8 operating system), '040-based machines can still handle all your needs.

Centris. The short-lived Centris line debuted in early 1993, in the midst of a veritable explosion of new Mac models; it was the first to use the '040 processor. The 610 runs at 20MHz, has no FPU, and offers a single slot that can be used for either a NuBus or a PDS card. The original 650 version runs at 25MHz, has an FPU, and offers one PDS and three NuBus slots. Within a year, these models were sucked into the Quadra line in Apple's effort to streamline its offerings.

Quadra. The Quadras derived their name from the '040 chip. They introduced the "tower" style case that offers bays for extra internal storage devices; they were also the first Macs to include Ethernet network connections.

Quadra/Centris. The Centris 650, introduced with a 25MHz processor, got a boost to 33MHz and was rechristened the Quadra 650 less than a year later. So, you'll often see the name Quadra/Centris used to refer to it and to the 610, which was also renamed a Quadra after a speed boost to 25 MHz.

But in both cases there are also some other minor differences between the Centris and the Quadra models. For the 650, the Quadra offers an FPU as standard instead of optional, includes an Ethernet port, and has a 132MB instead of a 136MB memory limit. (In fact, the Centris 650 is actually closer in specs to the Quadra 800 because they have the same RAM limit.) For the 610, the Quadra provides an optional FPU (instead of no possibility) and Ethernet capability.

Ephemeral Macs   (SZA)

Did you ever hear of the Mac TV? An all-in-one design, 32MHz-'030 with an 8MB RAM limit, a CD-ROM drive, a 14-inch color monitor, stereo speakers—and a TV tuner, all in a consumer-electronics black casing? It was an odd animal, with very limited availability during its short lifetime, so don't be surprised if you never knew of its existence.

There are other Mac models whose names are sometimes bandied about, yet it's hard to find solid information about them. This is usually because the model was strictly for the overseas market. The IIvi, for instance, was basically the same as the IIvx; the Color Classic II was a slightly improved version of the now-defunct compact unit; and, the 5300 (not to be confused with the PowerBook 5300) is a 100MHz Performa 5200.

The Centris 660AV and the Quadra 660AV, on the other hand, are absolutely identical.

The AV models (SZA/JK). The Quadra and Centris AV models have special features related to audio and video, and telephone communications, made possible by their DSP coprocessor (described earlier). They can record and play back video and CD-quality stereo sound, making them well-suited to people who design multimedia presentations, or those who like experimenting with digital audio and video recording. They can output directly to TV or tape using NTSC, PAL, or S-video signals.

Oldies But Goodies   (SZA)

A fast '030-based machine is still viable, as long as you up the memory and get a larger hard drive to accommodate memory- and space-hungry applications.

The II Line. The Mac II line started with, what else—the Mac II, which was the first *modular* Mac. It had no built-in screen but came with slots so you could add a video card of your choice (not that there was much choice then) and other cards as they became available. The Mac II was the first to go beyond the 68000 processor chip; it uses the 68020, while all the other Macs in the line use the '030 chip.

Just for Fun (SZA)

There are lots of nifty little things hidden in the older Mac models. (Maybe there are things in the newer Macs too, but we haven't found them yet.)

- There's a secret message in the Mac Plus. Press the interrupt switch at the left side of the computer. Type *G 40E118* (type the space and use a zero, not the letter O), then press `Return`.

- The SE has the same secret message. Press the interrupt switch and type *G 40E118* and press `Return`.

- The SE also has a built-in slide show. Press the interrupt switch, type *G 41D89A*, then press `Return`.

- For the SE/30's secret message, press the interrupt switch and type *DM 4082E853 20* (type both spaces!) and press `Return`.

- The IIci doesn't have a message—it has a picture of the design team buried in it, and it's more complicated to find. Set the Mac's date to 9/20/89, set the monitor to 256 colors, and restart while holding down `⌘` `Option` `C` `I`.

- The IIfx design team left its picture inside, too: Set the clock to 3/19/89, the monitor to 256 colors, and then restart holding down `⌘` `Option` `F` `X`.

In each case, restart the Mac by using the reset switch.

During the five-year life span of the II line, six other models came out:

- The IIx introduced the '030 chip and included an FPU; it also was the first to use 1.4MB floppy drives.

- The IIcx was a slightly faster IIx, with three NuBus slots instead of six.

- The IIci ran at 25MHz instead of its predecessors' 16MHz, and was the first Mac to have a built-in video card and a cache card slot.

- The IIsi, meant as a low-cost alternative to the IIci, introduced the "pizza box" case, RAM on the motherboard, and a sound input port with a microphone.

- The IIvx replaced the IIci, and provided an innovation that's now standard: an internal CD-ROM drive.

- The top of the II line was the IIfx, with its 40MHz processor and six NuBus slots.

The LC line. The LC line was meant to be the low-cost alternative to other Macs (that's what the "LC" stands for) and they were, for a while. But once the Performas—that other low-cost alternative—were no longer limited to stores like Sears, the LC family became an educational-institution-only line before it just faded away.

The LC models range from the original LC with its 16MHz '020 chip to the later '040 models, but they're all severely limited in expansion possibilities, with no NuBus or PCI slots.

Classics. The first Mac Classic was a throwback in more than just the return to a compact case: It also returned users to a 9-inch black-and-white screen and the pokey 68000 processor, with no FPU and a 4MB RAM limit—hardly better than the long-dead Mac Plus. The Classic II bettered the situation with a 16MHz '030 chip and the ability to address up to 10MB of memory. The Color Classic finally put a color screen into a classic case, allowed for an optional FPU, and provided a PDS slot. But to no avail: Performa models were finally offered as all-in-one units with larger screens, and no one wanted a compact after that!

The Classic has a unique feature: a *ROM disk* that lets you start up the machine with the built-in System 6.0.3 without any disk. To access it, you start up while holding down ⌘ Option X O.

HOT TIP

Ancient History   (SZA)

How can we not mention, at least in passing, the Macs that started it all, and their immediate successors?

- The original Mac, which we retroactively refer to as the 128K, was ground-breaking in concept, design, and execution—all in 128K of memory, with a single, 400K floppy drive. The so-called Fat Mac, with quadruple the memory (all of 512K), was introduced about 10 months later. (The upgrade to 512K of RAM for the original model cost $1,000—for 384K of memory! That's over $2,600 per meg!) The 512Ke, released the following year, offered an 800K drive.

- The Mac Plus came out two years after the first Mac, with an 800K floppy drive, a SCSI port for a hard drive (even though there was no hard drive available), and a full megabyte of memory, expandable to 4MB.

- The Mac SE showed up more than a year after the Plus, with an internal slot (that you couldn't get at), the ADB connector for keyboard and mouse, and a second floppy or an internal hard disk; later production models included the SuperFloppy drive. The SE/30 introduced the '030 chip and the FPU, and was the first compact Mac to break the 4MB RAM barrier.

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Upgrades

"Upgrading" really refers to any hardware improvement—adding memory, getting a larger (or second) hard drive, adding a CD-ROM drive if there wasn't one included originally. But in this section we're referring to more gut-level upgrades: getting more processing power with new or accelerated processor chips.

Keep in mind that changing any specific component of one Mac model to match another doesn't necessarily mean that you then have all the capabilities of the better model; there's internal circuitry and speeds to consider, as well as a model's internal expandability and external ports.

PowerPC Upgrades

I've never been one to insist that the latest and greatest Mac is always the one to get, but the truth is that non-PowerPC Macs, at this point, have an extremely limited life span because so much software, and even the newest operating system (System 8) will run only on the PowerPC chip. Luckily, the later 68K models can be upgraded to a PowerPC chip. There are two basic approaches to turning your 68K Mac into a PowerPC Mac: add a card with a PowerPC processor, or replace the current 68K logic board with a PowerPC logic board.

Upgrade cards (SZA/JK). For the most part, an added PowerPC card goes into the PDS slot of an '040 machine, and gives you two computers in one case (you have to restart to switch from one to the other). This flexibility is an advantage if you're going to keep using 68K applications, since they'll often run faster on your old processor than under the upgrade card's 68K emulator.

In the evolving world of software, however, issues like this—how to bridge the "old" and "new" machines, processors, or even operating systems—fade in importance as time goes on and everything is made to work on the newer system. In fact, Apple seemed to make the issue fade a lot faster than many users did, discontinuing certain PowerPC upgrade cards only months after announcing them. Luckily, third-party vendors like DayStar have stepped into that particular void.

Board replacement (SZA/JK). Many later-model 68K Macs which have the same "body" as certain PowerPC models can be turned into the PowerPC model by a logic board swap (strictly an Apple product). This is more expensive than an upgrade card, but you get all sorts of PowerPC-based capabilities that you don't get with the simple upgrade card approach: GeoPorts, CD-quality sound recording and playback, and

voice recognition. Also, you should note that while the processor on Apple's PowerPC upgrade card runs at twice the speed of the computer's original processor (giving you speeds of 40 to 66MHz), a new logic board has a *minimum* speed of 66MHz, and it can be upwards of 100MHz and more. At this stage of Mac development, if you're going to upgrade at all, the logic board swap is the better approach.

PowerPC for PowerBooks (RW). Apple promised that the 500-series PowerBooks and the Duo 200s would be upgradable to PowerPC, but it hasn't kept its word, *exactly*. The 500-series upgrade (from Apple and from Newer Technologies) is on a daughtercard, and at this writing the word is that Apple engineers are not going to be spending enough testing time on it to warrant that the upgraded PowerBook, though it will run at PowerPC speeds, will be able to run System 8—the long-awaited new system software. It's certainly not much of an upgrade if you're locked out of the system software meant for the upgraded machine.

The Duo upgrade, on the other hand, because it's a new logic board (only available from Apple), will be totally compatible with system upgrades.

Other Upgrades

Most computer upgrades are for increasing the speed of your Mac, so it's no surprise that many of the upgrades concentrate on changing the CPU itself, or its *clock rate*. Since those aren't the only speed factors in a computer, you'll find a variety of other options as well. But think carefully before spending too much money on accelerating or otherwise enhancing an older Mac; it may be all you need to keep your system humming for a couple of years—or you may decide after only a few months that you really need a PowerPC-based Mac, and all its trimmings, after all.

Accelerators (SZA/JK). One of the basic approaches for accelerating a Mac's abilities is an *accelerator card*, which either supplants the original CPU with something faster or adds a specialized coprocessor that handles only certain specific tasks. An accelerator card usually plugs into a PDS slot; sometimes you get a CPU replacement that goes into the CPU socket or clips onto the original CPU's legs. The new CPU usually totally supplants the old one, taking over all its tasks.

But an '030 machine usually just gets a faster '030 chip (or, at best, an '040 chip), and an '040 machine a faster '040 chip. Since an '030's top speed is 50MHz and an '040's is 40MHz, that's the maximum improvement you can expect in an accelerated version.

Coprocessors (SZA/JK). Another way of accelerating a Mac is to give it a coprocessor to take some of the burden off the main processor for certain tasks, the way the FPU takes over certain math functions. A *coprocessor accelerator* (that is, a coprocessor

that accelerates the Mac, not an accelerator that makes a coprocessor work faster) specializes in one area and does certain work much more efficiently than the CPU. In most cases, a coprocessor accelerator works only with an application that's been designed to use it; if your needs are very specific and there's an accelerator designed to meet them, this is definitely a way to go.

Choosing an accelerator (DH). Many accelerators come with, or can be upgraded with, additional memory, memory caches, FPUs, or other specialized acceleration. It's worth paying attention to such features, because they can have a significant impact on performance. For example, a memory cache can add another 50 percent to the speed of an '040 accelerator card but costs only about 20 percent of its price.

Speed differences between comparable accelerators from different manufacturers are likely to be slight. More important are the cards' compatibility and expandability, and the companies' customer support and trade-up policies. DayStar has the best reputation in most of those areas; its accelerators are also the only ones that let you use Apple's virtual memory.

QuickDraw acceleration (SZA). Sometimes the real bottleneck of a Mac system is not its processing speed, but how long it takes to draw information on the screen. A QuickDraw accelerator doesn't make the processor work faster but it makes the screen draw faster (QuickDraw is the set of routines in the Mac's ROM that draws things on the screen). Many video cards include QuickDraw acceleration.

Increasing clock speeds (SZA/JK). A few years back, some intrepid soul discovered that you could make a Mac IIsi run about as fast as a IIci by replacing its clock crystal with a faster one—a job that costs less than $10 in parts if you're good with soldering equipment. Now you can find upgrades—through kits or mail-in services—that do the same for the many other Mac models, including Power Macs and PowerBooks.

Such boosting depends on the fact that the processors in most of these Macs can handle a speed higher than the one for which they're rated. Boosting the clock rate isn't always a miracle: Sometimes a chip can't work faster than it was meant to; sometimes a speedier chip is crippled by slow memory; sometimes the extra heat generated by the faster chip can cause problems. A good upgrade will let you revert to the original chip speed; it might even include a fan or a heat sink that conducts extra heat away from the processor.

One company that provides these speed boosts is Newer Technologies, whose **Variable Speed Overdrives** ($150) for some of the older II models and some Quadras allow the user to fine-tune the oscillator speed until a stable level is reached; their **PowerClips** ($100 to $150) are for different Power Mac models.

Cache cards (DH). As mentioned earlier, cache cards speed up the Mac by providing a small amount—typically 32K to 512K—of high-speed RAM where the processor can quickly store and access data while it's working. (Don't confuse these with DayStar's PowerCache cards, which are actually full-blown accelerators.) Cache cards don't provide as big a speedup as accelerators, but they're less expensive. The Power Macs, '040 Macs, and the IIci, IIsi, and LC III all show significant performance improvement with the addition of a cache card.

Adding an FPU (JK). On 68K Macs, certain programs perform dramatically better with an FPU—and some require one to run at all. If you use this type of software (programs that handle sophisticated math functions, three-dimensional modeling, or high-end graphics) on a 68K-based Mac that doesn't have an FPU, you may be able to add one. The table at the end of the chapter shows which Macs have a built-in FPU; you can add one to many '020 and '030-based models.

While FPU functions are built into the standard '040 chip, the 68LC040 chip doesn't have all the FPU functions, nor can it cooperate with an external FPU; but, some companies provide a replacement for the CPU itself, to a full-fledged '040.

Apple provides FPU upgrades for the LC II, the Color Classic, and the IIsi (there's an FPU built into the adapter cards that are required to use the IIsi's expansion slot). You can also get FPU upgrades for earlier LCs (about $100) from third-party vendors like Digital Eclipse and Shreve Systems.

Adding slots and ports (JK). If your Mac is meeting your needs except that it doesn't let you add peripherals that you'd like, it's possible to add ports and slots. Most "boxes" that provide additional serial ports, like Momentum's **PortJuggler** ($100), don't let you use all the new ports at the same time—you flip a switch to activate whichever device you want at the moment. Creative Solutions' **Hurdler** NuBus cards, on the other hand, provide two ($300) or four ($380) serial ports that can be used simultaneously.

For a Mac that doesn't supply enough slots, you can try products like DGR Technologies' **Max** and Sonnet Technologies' **Twin Slot LC** which provide an LC or LC II extra PDS slots for $200 to $350; Second Wave has a line of products that expand PDS and NuBus options for other Mac models.

Apple provides NuBus adapter cards for the IIsi, Centris and Quadra 660AV, Centris 610, and Power Mac 6100; the adapter fits into the Mac's PDS slot and lets you plug in a NuBus card instead.

Apple CPU upgrades (SZA). Although Apple is no longer providing logic board upgrades for older Macs (except those which can move up to a PowerPC), they did

More Mac Than Meets the Eye		
Original model	**changed to this**	**with part number**
Mac Classic	Mac Classic II	M1545LL/A
Mac LC or LC II	Mac LC III	M1386LL/A
Performa 400, 405, 410, 430	Performa 450	M0375LL/A
Mac II or IIx	Mac IIfx	M1330LL/A
Mac IIvx, Performa 600, 600CD	Quadra 650	M1421LL/A
Quadra 900	Quadra 950	M6940ZA

provide upgrades for a short time to several different models. If you're buying or dealing with used equipment whose owners insist that there's a different machine "inside" than the one identified on the outside, the table "More Mac Than Meets the Eye" of past Apple CPU upgrades may be helpful.

For PowerBooks (SZA). There are several options for squeezing more speed out of an early 100-series PowerBook. For instance, the 140 can be enhanced with an FPU and new clock chip at 25MHz; the 160 can get an FPU and a 33MHz clock; the 160 and the 145 can get FPUs. Digital Eclipse and Shreve Systems both specialize in these kind of PowerBook upgrades. But think twice, or thrice (I've always wanted to use that word) before sinking a few hundred dollars in an old PowerBook for what will amount to perhaps only a few minutes saved each day (how fast can you type, anyway?).
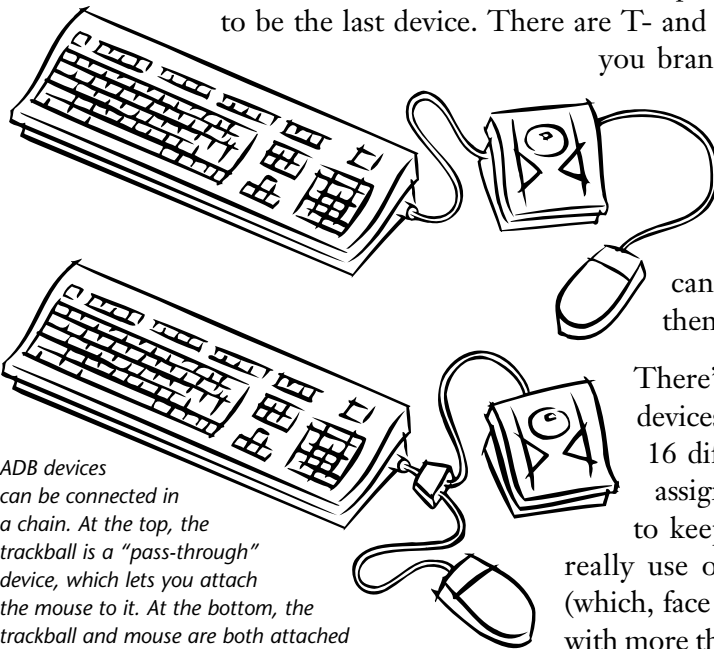
Hardware Tips

Inside and Out

HOT TIPS

Numbers in names (SZA/JK). A set of slashed numbers (8/230 or 7100/80, for instance) can stand for one of two things. As a rule of thumb, when the first number is smaller than the second (8/230), the numbers stand for the amount of memory (8MB of RAM) and the size of the hard drive (230MB). For Power Mac models, the first number (7100/80) is larger and is the model number; the second number is the speed of the processor.

ADB cable (SZA). The ADB cable used on the Mac is the same as Super VHS cabling—even the connectors are the same. So if you want an extra-long or extra-short custom ADB cable, you can get one at a local electronics store.

ADB chains (SZA). You can create a *chain* of ADB devices—a keyboard, a trackball, and a mouse, for instance. But because the mouse presents a dead end, it always has to be the last device. There are T- and Y-connectors available that let you branch two items (a mouse and a trackball, for instance) from a single ADB connector. And many devices, especially trackballs, come with "pass-through" connectors so you can plug in the new device and then the mouse.

ADB devices can be connected in a chain. At the top, the trackball is a "pass-through" device, which lets you attach the mouse to it. At the bottom, the trackball and mouse are both attached to the keyboard by means of a Y-connector.

There's a theoretical limit of 16 ADB devices for the Mac, because there are 16 different "addresses" that can be assigned internally to ADB devices to keep track of them. But you can really use only three or four in a chain (which, face it, ought to be plenty) because with more than that, the signal from the last device is too weak to reach the Mac. That's probably because the other ADB chain limitation kicks in—the total length of the chain shouldn't exceed five meters (about 16 feet).

Live ADB unplugging (David Ramsey). Although it's generally believed that plugging or unplugging an ADB connector while the Mac is turned on is a dangerous thing, it was a problem that first surfaced on the Mac II and was also present only on the IIx and, to a lesser degree, on the IIcx.

There was nothing inherently dangerous about the ADB per se on these machines, but the design of the logic board was such that a minor flexion of the board could occur if the ADB plug was inserted or removed a little too vigorously—resulting in a short from the ADB power line to the metal shielding on the inside of the case.

Later Macs have thermal, self-resetting fuses which prevent this problem. *[But you are left with this minor annoyance: If you have to connect your mouse after the computer's on, it's going to move the cursor very slowly, and using the Mouse control panel to reset the tracking speed isn't going to help much. You need to restart the Mac to get the mouse to behave correctly.—SZA]*

HOT TIPS

Not always a GeoPort (SZA). The external difference between a GeoPort and a standard serial port is the presence of a ninth pin. The Power Mac 5200 and the Performa 5200 and 6200, however, have a ninth pin on their modem ports—but they are *not* GeoPorts.

Power Macs

Monitor slowdown (JK). The high-density monitor port on some PowerPC Macs, which runs Apple's AV Display (or, with an adapter, standard monitors) uses the Power Mac's system memory, and not separate VRAM as do other video setups on the Mac. This slows down the display considerably.

Acceleration by system software upgrade (JK). Power Macs come with a PowerPC version of System 7, but in fact, only part of the system software has been translated into PowerPC code.

With any Mac or system version, applications make heavy use of a part of the system called the *Toolbox*, a collection or pre-written routines that perform common tasks. Programs use only about 20 percent of the routines 80 to 90 percent of the time. Those are the routines Apple optimized for the PowerPC chip, with the rest left in 68K code that would be translated a little more with each new system release. Consequently, if you upgrade a Power Mac's system software when new releases come out, when more of the system software has been converted to native PowerPC code, the computer should actually run faster.

No DSP software on a Power Mac (JK). Software written to take advantage of the DSP chip in the Quadra AVs won't work on a Power Mac because there is no DSP—its functions are handled by the PowerPC chip.

Old extension problem (JK). Some older extensions and control panels have a serious negative impact on the performance of native applications on the Power Mac, because extensions written for a 68K machine force the Power Mac to continually switch between the emulator and the PowerPC.

Old drives are slow (JK). Some older hard drives, whose drivers don't support SCSI Manager 4.3, slow down dramatically when used with a Power Mac. If you have an old Apple drive, you can update its drivers with HD SC Setup 7.3 or later to speed things up. For a non-Apple drive, find the latest formatter and updater from its manufacturer, or get a general hard disk formatter like La Cie's Silverlining or Casa Blanca Works' Drive7.

PowerBooks

No burn-in (SZA). Although screen burn-in was never an issue for PowerBook screens, as it was for early phosphor-coated monitors, a PowerBook screen is subject to a shadowing effect if you leave it on and unchanged for, say, 24 hours. To cure the shadowing, put the PowerBook to sleep; the longer the screen was on, the longer a sleep period it needs to cure the shadows.

Battery protectors (Susan McCallister). It's important to use the case Apple provides for the 100- and 200-series PowerBook batteries, or to buy, or create one yourself. The batteries' contacts can accidentally short if they're bridged by a metal object such as a paper clip, keys, or a metal pen barrel. A short could cause a fire or burns and, of course, ruin the battery. *[If you travel, you'll find that the "shoe-polish mitt" provided by many hotels along with their other bathroom paraphernalia is the perfect size for a battery cover.—SZA]*

Conserving battery power (SZA/JK). Keeping the power drain to a minimum lets you work longer on a single battery charge. Here are some things you can do to maximize your battery life:

- Keep AppleTalk turned off (in the Chooser).

- Keep the backlight turned down as far as possible.

- Keep hard disk access to a minimum: don't use virtual memory; allocate *lots* of memory to an opened application so it won't go to the disk so often; and use a RAM disk whenever possible.

- Keep *processor cycling* turned on in the PowerBook control panel.

- Put the PowerBook to sleep whenever you're not using it for more than two minutes.

- Keep the settings in the PowerBook control panel at maximum conservation settings.

- If yours is an older model that lets you run the CPU at two different speeds, set it to run at the slower speed.

Color and contrast don't count (SZA). Color PowerBook screens eat up more battery power than do their grayscale and black-and-white counterparts. But it's not the color itself that's drawing the power—it's the extra backlight needed on these screens that eats up power. So, running a color PowerBook in black-and-white won't conserve any battery power—and changing the contrast settings makes no difference on any screen.

HOT TIPS

NiCad reconditioning (RW). NiCad batteries need occasional reconditioning in order to hold a complete charge. If you continually charge a NiCad, then use it for awhile, then recharge it, use it for awhile, and so on, without ever totally draining the charge, a "full" charge won't last very long.

Occasionally recondition the battery by running it down totally. The best way to get a complete discharge is to use an external charger/reconditioner, but the easiest way is to use something like VST System's **PBTools** software or Jeremy Keizer's shareware **DeepDischarge**. A deep discharge can bring an anemic battery back to life.

Later batteries better (SZA). NiCad batteries have gone through two subtle revisions, each one providing longer-lasting power. The original one, whose model number is #5417, is a 2.3 amp-hour model labeled 140/170. The second-generation NiCad is 2.5 amp-hours, model #5653; the third one is #5654, a 2.9 amp-hour version. When you buy a new, or second, battery, make sure you get the latest model.

Later adapters better, too (RW). The power adapters for the 100-series Power-Books were quietly improved over time, with the later ones able to recharge your battery in a shorter time. The first model (#M5140) is a 15-watt version with a dangerous propensity: The black ring at the tip of the plug was prone to hairline cracks which could result in serious damage to the motherboard. The second version is a 17-watt model (#M5651); the best is the third model (#M5652), a 24-watt version. (The 500-series PowerBooks use 40-watt adapters, sending 20 watts to each battery.)

Rechargeable, not immortal (SZA). Rechargeable batteries have a limited *life cycle*—the number of times the battery can be drained and recharged. NiCads, for instance, have an average of 500 life cycles which translates to two to three years of use. If your battery just won't recharge anymore, it may be really and truly dead.

The stupid smart battery (SZA). The "intelligent battery" in the 500-series Power-Books has a chip whose memory is easily corrupted, especially when left uncharged for a long period of time. Symptoms of this stupidity include: the battery can't be charged in the PowerBook or externally; the battery isn't recognized by the battery icon; the battery completely discharges in a sleeping PowerBook in a day or two (instead of a week); and the battery is extremely hot to the touch when removed from the PowerBook.

There are two cures for a dumbed-down smart battery. Apple provides a free fix with its later system software, Intelligent Battery Reconditioner; **EMMpathy** (the Energy Monitoring Module controller in the battery is what's at fault), put out as freeware from VST Systems, also fixes the problem.

SCSI cables (RW). There are two PowerBook SCSI cables used for two very different purposes. The HDI-30 SCSI System Cable is used for connecting SCSI peripherals to the PowerBook; the HDI-30 SCSI Disk Adapter Cable is used to connect the PowerBook *as* a SCSI device to another Mac. These two cables are often confused, but there are several differences between them:
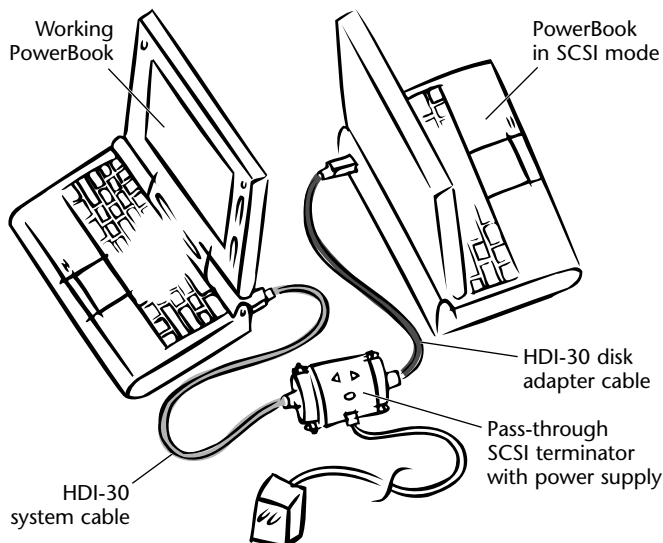
	System Cable	**Disk Adapter Cable**
PowerBook connector:	HDI-30	HDI-30
Pins (on HDI-30):	29	30
Second connector:	50-pin male	50-pin female
Length:	18 inches	10 inches
Color:	light gray	dark gray

But if you're connecting SCSI devices to the PowerBook, the best way to go is something called **SCSI Doc** ($40, APS Technologies). It plugs into the HDI-30 connector on the PowerBook and provides a standard 25-pin SCSI connector on the other end—with a switch that lets you choose standard SCSI or SCSI-mode connection.

PowerBook to PowerBook connection (RW). You can't just connect one PowerBook in SCSI disk mode to act as an external hard drive for another PowerBook, even if you have all the right cables. A PowerBook in SCSI disk mode doesn't provide any termination *power*, usually provided by the desk Mac on a normal hookup. To make a reliable PowerBook-to-PowerBook SCSI connection, you need this chain:

1. The first PowerBook

2. HDI-30 SCSI System Cable

3. Pass-through SCSI 50-pin terminator with power supply

4. HDI-30 SCSI Disk Adapter Cable

5. PowerBook in SCSI mode

APS Technologies' **SCSI Sentry** ($40) is the perfect product for the center of this chain: it works as an end-of-chain or a pass-through device that detects and solves many SCSI signal problems. You can get a separate termination power supply ($20) for situations like this PowerBook chain.

Hooking up a PowerBook in SCSI disk mode to another PowerBook.

HOT TIPS

Alternative power sources (SZA/JK). You don't have to stick with the AC adapter that came with your NiCad-based PowerBook, or depend solely upon the internal battery for any PowerBook model. A number of companies make products like: special power adapters that let you recharge your PowerBook from, say, a car's cigarette lighter; external battery chargers that let you charge two batteries at a time; and, best of all, external batteries for the NiCad-based PowerBooks to double their unplugged run time. Based on weight, price, length of charge, and included software (because a Power-Book doesn't know anything about external batteries), VST Power Systems' **ThinPack** external batteries are the best.
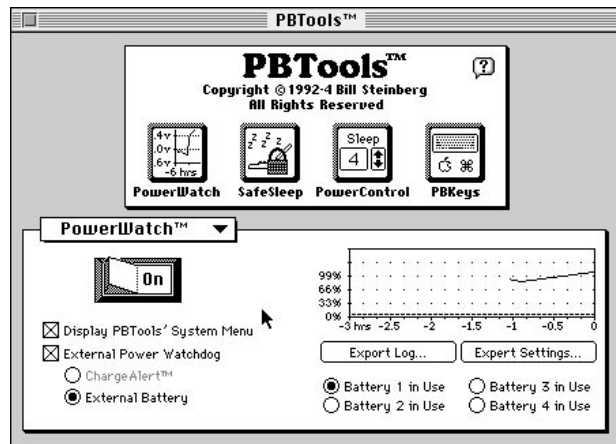
VST's PBTools makes a PowerBook "aware" of an external battery; it's also the perfect PowerBook utility for anyone from a casual user to a true wirehead.

Resetting the Power Manager (SZA/RW). Resetting the Power Manager is a panacea for all sorts of ills on a PowerBook—much like zapping PRAM is for all Macs. When your battery isn't charging, or it's not lasting too long, or the PowerBook thinks you didn't even put a battery in, try resetting the Power Manager.

Resetting the Power Manager consists of many small steps, and some of them differ from one model to another. For any model other than a 500-series, start by shutting down the computer, and removing the AC adapter and the battery (or batteries). Then do the following:

- *For the 100:* Hold in the reset and interrupt buttons for 15 seconds.

- *For the 140, 145, 145B, and 170:* Press the reset and interrupt buttons simultaneously by pushing them with a paper clip bent into a U-shape; hold the buttons in for 30 seconds.

- *For the 150:* Hold in the reset button for 30 seconds. (Note the special later step for this model, in the following numbered list).

- *For the 160, 165, 180 PowerBooks* and *200 and 2300 Duos:* Hold in the rear power button for 30 seconds.

- *For the 5300-series* and *190:* Hold in the reset button for 30 seconds.

After the appropriate procedure listed above, do these steps in this order (which is *not* the order you'd normally follow!):

1. Reconnect the AC adapter.

2. Plug in the PowerBook.

3. For all but the 150: Turn on the PowerBook.
   or
   For the 150: Briefly press the reset button again. You might hear a pop from the speaker, and the PowerBook may start up. If it doesn't, press the main power button in back.

4. *Now*, reinsert the battery.

For the 500 series, all you have to do is just shut down the computer, hold down ⌃⌘Option Ctrl and Power On for a few seconds, and turn it back on.

X-ray away (RW). You can't damage your PowerBook by putting it through the x-ray machine at an airport. Honest. X-rays are a form of light; it's magnetic waves that might erase your disk or otherwise damage something in your computer.

Quadra and Centris   (SZA)

Greenish screen fix (SZA). If you're using the Apple Basic Color Monitor on a Centris or Quadra, you may find the screen is greenish or washed-out blue. Use the Apple Basic Color Monitor extension to clear it up.

Quadra RAM disk problem (SZA). A Quadra 950 filled to its maximum 256MB of RAM can't use a RAM disk. Honest!

Quadra 950 display problem (SZA). If you use the built-in video card and set the monitor to millions of colors, you may find that many graphics images don't display correctly. Use the 950 Color Addition extension to clear it up.

The II Line   (SZA)

Speeding up the IIci. The IIci uses system RAM instead of separate video RAM for its display when you use the internal video card, which slows things down. Using a separate video card speeds things considerably.

If you're running on the internal video in anything but black-and-white *and* you have four 256K SIMMs in Bank A *and* you have a total of 5, 9, or 11MB, you can get a

Desktop Mac Specs

Model	CPU[1]	Speed (MHz)	FPU[2]	Max RAM (MB)	Level 2 Cache	PCI slots	NuBus slots	Other slots[3]	GeoPort	Built-in Ethernet
PowerMacs										
9500/120, 9500/132	604	120, 132		768	512K	6			yes	yes
8500/120	604	120		512	256K	3			yes	yes
8100/80, 8100/100, 8100/110	601	80, 100, 110		264	256K		3			yes
7500/100	601	100		512	256K or 512K	3			yes	yes
7200/75, 7200/90	601	75, 90		256	256K or 512K	3			yes	yes
7100/66, 7100/80	601	66, 80		136	256K		3			yes
6200/75	603	75		64	256K			LC PDS, CS, video		yes
6100/66 DOS Compatible	601[4]	66		722	256K					yes
6100/60, 6100/66	601	60,66		72	256K		(1)[6]	(PDS)[6]		yes
5200/75 LC	603	75		64	256K			LC PDS, CS, video		(opt)
Performas										
200	68000	16	no	10						
400, 405, 410, 430	68030	16	no	10				LC PDS		(opt)
450	68030	25	(opt)	36				LC III PDS		(opt)
460, 466, 467	68030	33	(opt)	36				LC III PDS		(opt)
475, 476	68030	25	no	36				LC III PDS		(opt)
520	68030	25	(opt)	36				LC III PDS		
550	68030	33	(opt)	36				LC III PDS		
560	68030	33	(opt)	36				LC III PDS		(opt)
575, 577, 578	68LC040	66/33	no					LC PDS, CS		(opt)
600, 600 CD	68030	32	(opt)	68			2	LC PDS		
630	68LC040	66/33	no	36				LC PDS, CS, video		(opt)
630 and 640CD DOS Compatible	68LC040[4]	66	no	52[5]				CS, video		(opt)
5200CD	603	75		64			0	LC PDS, CS, video		(opt)
6100	601	60		72			(1)[6]	(PDS)[6]		yes
6200CD	603	75		64			0	LC PDS, CS, video		(opt)
Quadra & Centris										
Centris 610	68040	20		136			(1)[6]	(PDS)[6]		
Centris 650	68040	25		136			3	PDS		
Quadra 605	68LC040	25	no	20				LC III PDS		
Quadra 610	68040	25		68			(1)[6]	(PDS)[6]		
Quadra 630	68040	66/33		36				LC PDS, CS, video		(opt)
Quadra 650	68040	33		132			3	1		
Quadra 700	68040	25		64			2	PDS		
Quadra 900	68040	25		256			5	PDS		
Quadra 950	68040	33		256			5	PDS		

Model	CPU[1]	Speed (MHz)	FPU[2]	Max RAM (MB)	Level 2 Cache	PCI slots	NuBus slots	Other slots[3]	GeoPort	Built-in Ethernet
Quadra & Centris (continued)										
Quadra 800	68040	33		136			3	PDS		
Quadra/Centris 660AV	68040[7]	50		68			(1)[6]	(PDS)[6]	yes	yes
Quadra 840AV	68040[7]	80		128			3			
WorkGroup Servers										
60	68040	25		68				040 PDS		
80	68040	33		136				040 PDS		
95	68040	66		256	256K or 512K		5	040 PDS		yes
6150/66	601	66		72	256K		(1)[6]	(PDS)[6]		yes
8150/110	601	110		264	256K		3	PDS		yes
9150/120	601	120		264	1MB		4	PDS		yes
The II Line										
Mac II	68020	16	(opt)	20			6			
Mac IIx	68030	16	yes	32			6			
Mac IIci	68030	25	yes	32			3			
Mac IIcx	68030	16	yes	32			3			
Mac IIsi	68030	20	yes	17			(1)[6]	(PDS)[6]		
Mac IIvx	68030	32	yes	68			2			
Mac IIfx	68030	40	yes	32			6	1		
The LC's										
LC	68020	16	no	10				LC PDS		
LC II	68030	16	yes	10				LC PDS		
LC III	68030	25	(opt)	36				LC PDS		
LC 475	68LC040	50/25	no	36				LC III PDS		
LC 520	68030	25	(opt)	36				LC PDS		
LC 550	68030	33	(opt)	36				LC PDS		
LC 575	68040	66/33		36				LC PDS, CS		(opt)
LC 580	68LC040	66/33	no	52				LC PDS, CS, video		(opt)
LC 630	68LC040	66/33	no	36				LC PDS, CS, video		(opt)
LC 630 DOS Compatible	68LC040[4]	66	no	52[5]				CS, video		(opt)
Compacts										
Classic	68000	8	no	4						
Classic II	68030	16	no	10						
Color Classic	68030	16	opt	10				LC PDS		
Color Classic II	68030	33	opt					LC III PDS		

Notes:
1 6xx is PowerPC chip; others are Motorola
2 not an issue for 68040 or PowerPC processors
3 CS = communications slot
4 DOS Compatibles include 486DX2/66 processor
5 32MB limit for DOS
6 1 NuBus OR 1 PDS
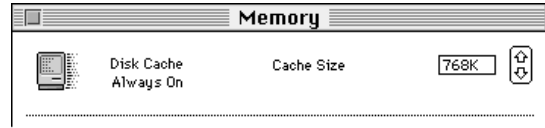7 Also includes DSP processor

HOT TIPS

speed increase by setting the Disk Cache in the Memory control panel to 768K.

For an all-round, but small, speed increase, keep 32-bit addressing turned on in the Memory control panel even if you don't have more than 8MB of memory.

Setting the Memory control panel's disk cache to 768K can, under some circumstances, speed up a IIci or a IIsi.

Finally, if yours is an early IIci that doesn't have a cache card, see if you can get one—they were originally $70 but if you can find one at all, it will only be about $20 now. It's well worth it if you're sticking with the IIci. It's easy to see if you have one: Open the case and look at the motherboard—the cache slot is right in the center.

Speeding up the IIsi. If you use the internal video support on the IIsi, you can almost double its speed by switching the monitor to black-and-white. For any color setting, you can get a little speed boost by keeping the Disk Cache setting in the Memory control panel at 768K. Finally, a separate video card gives the best speed boost of all.

Sound on the IIsi. The IIsi has a finicky connection between the motherboard and the speaker; sometimes the sound output quits until you restart. Here are some things you can do about it: Open the Sound control panel, set the volume to maximum, and then reset it to the volume you want. Or, attach an external speaker to the sound port, because the problem is the connection to the internal speaker. Or, open the case, unplug the speaker cable, clean the contacts, and plug the cable back in.

1984

Apple's award-winning introductory commercial for its new Macintosh computer aired only once: during the 1984 SuperBowl. Its theme: why 1984 (the year) wouldn't be like 1984 (the book). Hundreds of brain-washed workers trudged into an auditorium to listen to a televised lecture, until the screen was smashed by a slow-motion sledge hammer throw. Most people have no idea just what propaganda was being spouted by that talking head, but here it is:

> Each of you is a single cell in the great body of the State. And today, that great body has purged itself of parasites. We have triumphed over the unprincipled of facts. The thugs and wreckers have been cast out. Let each and every cell rejoice! For today we celebrate the first glorious anniversary of the Information Purification Directive. We have created, for the first time in all history, a garden of pure ideology where each worker may bloom secure from the pests purveying contradictory and confusing truths. Our unification of thought is more powerful a weapon than any fleet or army on earth. We are one people. With one will. One resolve. One cause. Our enemies shall talk themselves to death, and we will bury them with their own confusion. We shall prevail!