

MEGABYTES to MOTHERBOARDS:

A Friendly Guide to Computer Hardware



A popular IBM-PC clone, called the Leading Edge Model D, is set up here with monitor, keyboard, and 20-Mbyte Hard drive.

BY PAUL BLECHARCZY

As a contractor and small business owner, you may feel that it's time to take the plunge on your first computer, but don't know where to start. This article will help you take the first steps toward making a sensible hardware purchase. For starters, you'll need to familiarize yourself with a lot of new gadgets and a strange, new language (see glossary). If it seems a bit overwhelming at first, don't despair. After a few months, it will all make sense: computer bits will seem as normal to you as drill bits.

Why Computerize?

Assess your business needs. What kinds of tasks do you want the compu-

ter to assist in? The major applications a personal computer can perform for a builder are:

Word processing: writing of proposals, specifications, job descriptions, and letters in an efficient manner with a professional appearance.

Database functions: maintaining lists for easy retrieval and updating such as for equipment or material inventory, customer references, and mailing lists and payroll.

Spreadsheet functions: estimating and then final accounting of time and materials on a job or all jobs for the year, determining depreciation upon capital equipment, billing records,

determining profit or loss.

Scheduling and project management: estimating time and materials on new work, tracking labor-hours to determine percentage complete for justifying billing of progress payments, scheduling time and human resources on multiple jobs to forecast work loads.

Computer-assisted design: producing and modifying sketches and illustrations, presentation drawings, and full working drawings for projects.

Each of the previous applications successively grows more sophisticated and more demanding upon the computer system. Since you don't know all the applications you might want to add later, it makes sense to buy a system that can grow with you.

For example, avoid purchasing components that are targeted specifically for word processing. Although you can buy a good "dedicated" word-processor for as little as \$600, they cannot be expanded to perform the other functions listed. By comparison, a carefully purchased personal computer costing as little as \$1000 could easily meet your existing needs and be expanded at a later time to perform any of these jobs. Find out whether the computer you are buying is expandable—more on this later.

System Components

What constitutes a personal computer? This is a class of computer made popular by Apple and IBM (in that order!) in the early '80s. They are characterized by a microprocessor; working memory in the form of random access memory (RAM); permanent, large-scale storage area on removable flexible disks (floppy disks), or non-removable rigid disks (hard disks), keyboards, and display screens all packaged so as to easily fit on desk tops and sometimes lap tops—and in most cases costing well under \$5,000. Let's take one apart!

Microprocessor. This is the brain of the computer. The ultimate capacity of the machine is paced by the capabilities of these circuits, which are contained on a single chip of silicon and mounted in a miniature plastic package commonly referred to as an integrated circuit (IC). It is the availability of more advanced microprocessor chips that usher in a new wave of computers with higher levels of performance.

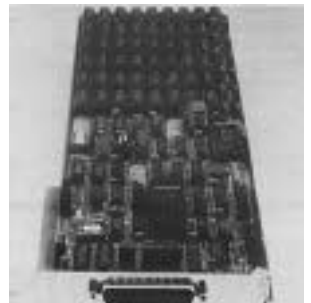
One measure of performance is a chip's speed or *clock rate*. The IBM PC/XT operates at a 4.7 Mhz clock rate and the IBM PC/AT's at 8 Mhz. The new Compaq 386 wins the race at 16

Mhz. Most other systems come in several speeds in between. For our application, 4.7 Mhz is antiquated but adequate; 6 Mhz is desirable; and speeds of 8 Mhz are worth looking at if available at a reasonable premium in price. At speeds of 10 or more, you may have compatibility problems with software.

If you really want to speed up math or CAD functions, a math coprocessor is a good investment.

Memory

Just as the human brain would be worthless without memory, the microprocessor needs temporary places to store the instructions that direct it as



A six-function card from PC's Limited has clock/calendar, three ports, and software.

well as the results of its calculations. Working memory (RAM) in personal computers takes the form of rows of integrated circuits (IC's) called chips that store information during the time that the computer is turned on. A quantity of 256 Kbytes (256,000 bytes) of RAM is needed for modest applications, but 640 Kbytes is the recommended minimum.

Power Supply. This component comes with the computer and provides all the voltages and currents it needs from the ac source. Make sure that the power capacity can handle the needs of the system as purchased as well as with future options. A 150- to 200-watt power supply will usually suffice.

Also be sure to purchase an external combination ac power strip with electrical surge suppressor. This will reduce the risk of damage to your system in the event of electrical disturbances in the ac supply. Culprits include lightning, switching by the utilities, and "noise" caused by electrical motors in the home.

Storage. The computer can store information in working memory

EDUCATE YOURSELF

Read some computer publications to get familiar with what's currently for sale and what it costs. Compare the range of costs for individual components as well as total systems. Get a feeling for why some products vary widely in price. Sometimes it's due to significant differences in performance. In other cases you are paying for a name brand. The *Computer Shopper* (Titusville, FL) offers a bonanza of information in the form of hundreds of descriptive, although not impartial, advertisements placed by sellers. Periodicals such as *PC Magazine* (New York, NY) evaluate new

computer equipment and programs and can be helpful.

If at all possible talk with a friend who has a PC in a small business environment. This can be of great value if the person can relate your situation and needs to his own business. Try to visit his location and view his equipment. Take notes.

Visit all your local dealers and at least one that is distant if they have a good reputation. In this process, you will hear a variety of opinions about specific brands of equipment but probably some converging information about the general type of system suitable for your business. Also, you will be walking away with armloads of brochures, note pads of pricing, and assessments about the retail dealers themselves. While you're visiting the dealers, don't forget to ask about

what support you'll get after the sale. Find out about money-back guarantees, equipment exchanges, the extent of their repair capabilities, and the availability of loaners if your new machine should end up in the shop.

All along you've been wondering how much to spend. It's premature to determine that until you've determined exactly what components you need. But you should be familiarizing yourself with equipment costs and performance—and the trade-offs—during the learning and selecting process. Finally, let your configuration dictate the initial cost of the system. There will be ways of adjusting the price down if necessary—for example, postponing the purchase of a low-priority option that can be added later.



(RAM) when it's turned on. But long-term data storage usually is done on disk. The disk can store a lot more data than RAM and at a lower cost per memory element (byte).

Think of the disk as a small, magnetically-coated phonograph record. Information can be stored on the surface and played back. The most popular disk size is 5-1/4 inches and stores 360 Kbytes of storage (about 30 typewritten pages). A similar disk for the IBM/AT and compatibles stores 1.2 Mbyte. The technology, however, seems to be headed toward smaller, more durable 3-1/2-inch disks with 720 to 800 Kbytes of storage. The new IBM Personal System/2, and all Apple Macintosh computers use the small disks.

You can buy software in all disk formats, so the choice may hinge on what other computers—if any—you need to swap files with. You need at least one floppy drive so you can load programs into the computer and save the results. Two floppy drives is a nice feature in a system that also has a hard drive. Without a hard drive, two floppies are necessary.

Mass storage. Although not absolutely necessary, some users feel that it is crazy to have a PC in a business application without a hard disk drive. Why? It offers speed (faster access to data than floppy drives) and convenience (you don't have to swap disks to handle large bodies of data). One hard disk is equal to about 60 floppy disks for a typical 20 Mbyte hard drive which costs \$400-\$600. Although hard drives demand a higher degree of organization (to set up directories and commitment (to do back-ups) on the part of the user, most simply can't live without them once they are learned and in place.

Conquering the basics of the hard disk and DOS functions is essentially an exercise in intellectual bicycling. You have to keep getting on and falling off until the operation becomes second-

hand. A friend who owns a computer can be the training wheels. For him, it's a piece of cake to set up a hard-disk menu that leads you and your employees to their applications in a simple and friendly way. My advice is to buy a hard disk with your computer, unless you want to start with a rock-bottom system for simple tasks like word processing. You can add the hard disk later.

Displays. You've got to see your data to work with it, and the display screen is your window of view. Screens take the form of cathode-ray tube (CRT) units that sit on a desk-top and LED or LCD screens for portable computers, similar

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to the screens found on portable calculators. For stationary desk-top applications, the CRT is the clear choice. The screens can be large and more readable, and can display simultaneous colors. For our application we should choose the monochrome (green or amber on black) background high-resolution display. This will provide for 80 characters displayed across the screen and 24 lines of characters down—with extremely sharp appearance—all at a reasonable cost. This type of display is referred to as a high-resolution TTL (input-signal type) monitor and should be purchased with a Hercules-type monochrome graphics adapter card. Avoid any mono-

chrome monitor referred to as composite-signal type. They are basically television sets without tuners and don't have the sharpness of the TTL type. Both the monitor and the card can be purchased for between \$200 and \$300. By comparison, and enhanced-graphic adapter (EGA) card and monitor that will provide similar, but not quite equal, resolution in color would cost \$600 to \$800. We can live without color for our applications.

Keyboard. The keyboard remains the most practical device for talking to your computer—for giving it commands and data. No system is complete without one, no matter how heavily it uses alternatives such as digitizing

Although some nonstandard operating systems are fire-sale priced, they will continue to lose support in hardware and software produced by others. Remember the Osborne.

tablets, light pens, mice, touch screens, and voice recognition. Choose a full-size keyboard that is arranged for comfortable typing. Do you like the feel of the keys? An arrangement with a separate numeric key pad (number keys) is useful for entering long lists of numerals. Fortunately for the consumer, most poor keyboard arrangements have disappeared from the marketplace and have been replaced with the "AT-style" arrangement. AT style keyboards, when sold separately, cost under \$80.

Ports. A port is a path for data into and out of your computer. Your printer and other "peripheral" devices require such connection points. Ports can be serial or parallel type. Modems, mice and plotters use the serial type, and printers usually interface to the parallel type. Check your printer to be sure. Determine how many ports of each type exist within the system you are considering, and know what is needed to add additional ports.

Printer. This device generally is not considered part of a computer but is classified as a peripheral device. You'll need at least one printer for any office application. Consider a nine-pin (\$200 to \$500) or up to 24-pin (\$500 to \$1,000) dot-matrix printer as your first printer if only buying one. Add a daisy wheel printer later if you need impeccable print quality.

Decisions. I can't make specific recommendations as to brand or system design for this application. There are many ways to go. But some general advice is in order: Avoid the non-standard operating systems of the TI Professional, Tandy 200, Victor 9000, and Sanyo 500. Although fire-sale priced, they will continue to lose supporting hardware and software produced by others. Remember the Osborne? Technically, the Apple II, Macintosh, IBM PC/XT, IBM PC/AT, Tandy 1000 SX, Leading Edge Model D, Epson Equity, AT&T 6300, and literally hundreds of clones of the IBM XT and AT will do the job.

The clones and compatibles of the IBM (using PC/DOS or MS/DOS

operating systems) accounted for 75 percent of all retail sales last year. They have the largest base of available software and the largest number of installed PCs, easily ten times greater than Apple. Combine this with the open architecture (expandability) of the IBM product line and the proliferation of low-cost clones and compatibles, and it's easy to see why the IBM standard has become so widely accepted.

Your way out of the personal-computer (PC) jungle might be directed by the need to have compatibility with someone else's computer. Or your favorite software could steer the choice. But if you have no compelling reason to do otherwise, purchasing a computer built around an 8088 or 80286 microprocessor—classified as an IBM clone or 99.9-percent compatible—is certainly a safe choice. With all the users and third-party software sellers, the risk of buying a white elephant is minimal.

Where to Go Next

Certainly the direction of technology is to continually offer buyers more performance for the money but how long should you wait? Ask yourself how much can your business benefit now and is it worth waiting.

When comparing prices of computer systems, be sure to account for subtle or not so subtle differences in the base offerings. What exactly are you getting? For example, you can often find an advertisement for a "system" priced at \$499. Even though the illustration shows a display monitor and floppy-disk drive, these items and their respective driver cards have been omitted from the pricing. Be sure to check quantity of memory (RAM), resolution of monitor, storage capacities of hard disk drives, existence of ports, and inclusion of interconnecting cables. In a nutshell ask, "What else is needed?"

Clones! Because of their low price, no prudent buyer should fail to at least consider them. Tread cautiously by purchasing from a reputable seller who offers a one-year guarantee; a 30 day unconditional money-back guarantee; and preferably a location no further away than an easy one-day round trip by car. The conservative approach is to steer clear of products that have no clear identity. Buying no-name products by mail can have its disappointments. Question the seller as to just how closely the particular clone or "IBM compatible" actually approximates the IBM in terms of running common software. Ask about the BIOS, which is the key to software compatibility. Finally, try out the computer yourself. If possible, bring in software you'll be running on the machine.

For those potential buyers who still are undecided about their equipment choice and possibly their application, I suggest rental. Try to get an arrangement that deducts all rental fees from the buy-out price of the system.

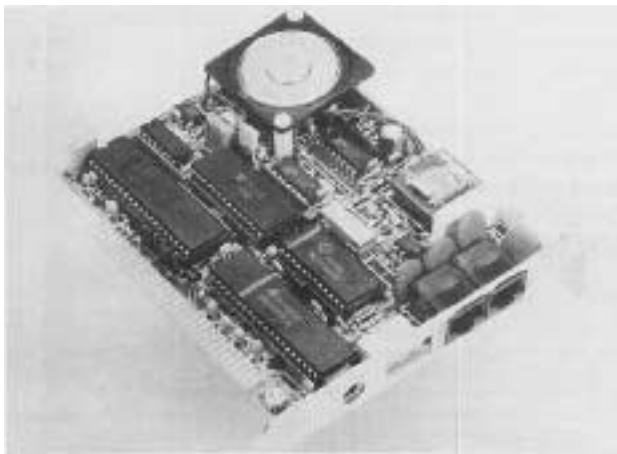
What's Coming

Although the 8088 has been a dependable workhorse in the industry for over six years, it has no appeal to those persons wanting something closer to the cutting edge of technology. Those persons could move up in performance to the 80286 microprocessor of the IBM PC/AT.

The AT and compatibles could be more than enough for any business that doesn't need high-performance graphics (such as for CAD) or require multi-tasking. The 80286 is a good choice



A 20-Mbyte hard drive (top) stores as much information as about 60 standard floppies, and is a great convenience. Typing skills are not needed, but the keyboard (above) is the main tool for talking to your computer. Find one that's well laid out and comfortable.



An internal modem fits into one of your computer's "slots," and lets your computer talk to others over the telephone.

because it offers good performance for the price, and moreover has an upgrade path to compatibility with the brand new 80386. This path is via Intel's new version of the 80386, which uses 16 bit addressing and will be electrically and physically identical and exchangeable.

The new IBM Personal System/2 series offers distinctly sharper graphics and a bit more speed than the existing line of XT's and AT's. Few of the applications discussed in this article, however, need this. Ditto for the new Macintosh SE and II, especially given their current prices, and that compatibility with MS/DOS requires a \$500 option card. As for the computers built around the new 80386 microprocessor from Intel, the operating system that will take full advantage of it—DOS 5—will not be available before the end of this year. And the

application software will come still later, so don't hold your breath.

Closing

Like an unskilled user of a new construction tool, the novice computer user can be coached to perform useful work in short time. But like the skilled craftsman, you'll only get the finest results after many hours of use. Seek out the support of local user groups and clubs. The payback will be tremendous.

Now go carve out some time, and start computing. ■

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Hardware Glossary

(see Software Glossary in this issue's "Picking the Right Software")

BIOS. Basic input-output system. A set of instructions permanently stored in read-only memory (ROM). This tells the computer how to operate the monitor, cursor, disk drives, and other components. The BIOS of the PC/XTs and ATs is copyrighted by IBM, so others can only approximate it. If done well (for example, Phoenix BIOS), 99 percent of software will run successfully.

Boards. Printed circuit boards. A thin phenolic or epoxy-resin material about 1/10-inch thick, outfitted with conductive paths and electronic components to form a complete circuit.

Card. A type of circuit board that plugs into a socket on the motherboard, adding a feature to the computer.

Clone. A successful imitation of an original design, such as an IBM—that is 99-percent compatible with the original in all aspects of equipment and program execution.

Compatibility. The ability of two or more computers to exchange files, run each other's programs, or swap cards in the expansion slots of the motherboard.

CPU. Central-processing unit. The more general name for a microprocessor.

This is the core of the computer, and includes all the circuits that control the interpretation and execution of instructions.

Modem. A device that lets your computer exchange data over a telephone line with other computers. Short for modulator-demodulator.

Microprocessor. See CPU.

Motherboard. The main circuit board in a computer that contains the microprocessor, memory, associated support circuitry and sockets for adding option cards.

Open architecture. A computer design that allows the user to upgrade the computer by adding optional circuit boards to expansion slots inside the computer.

Peripherals. Any piece of hardware other than the computer itself, such as printers, monitors, and modems.

Pixel. The smallest picture element (dot) that a computer controls on a monitor. A higher density of pixels produces a sharper image. Hercules graphic adapter (HGA) cards provide 740x380 pixel resolution, which translates into 24 lines of 80 characters each.