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Steve Gibson, InfoWorld

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John C. Dvorak

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Under $3,000
John Dickinson, Bill
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champion in the laser printer
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Hewlett-Packard is
hoping its new Laserjet
Series II will be tops in
the low-cost laser
printer market, page 123.
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**LETTERS TO PC MAGAZINE**

**QUICKBASIC QUALM**
I would like to make an addition to Ethan Winer's "Wish List for QuickBASIC 3" (sidebar to PC Lab Notes, Volume 6 Number 1)—8087 support. I do not understand how a language whose very name implies that everything possible was done to make it fast can fail to provide 8087 support. Although QuickBASIC has many good features, I will remain a True BASIC user (at least until I have the chance to try Borland's Turbo BASIC).

George E. Birch
Rockville, Maryland

Ethan Winer replies:
I agree. With so much else going for it, it's a shame that Microsoft decided not to provide access to the 8087/80287 numeric coprocessor. One of the difficulties in supporting the device is the fact that QuickBASIC uses a nonstandard method of storing floating-point numbers internally. Borland wisely chose to use the IEEE format for Turbo BASIC, thereby eliminating that obstacle. In an informal test, I had both compilers compute the arc tangent of a double precision number 1,000 times. Turbo creamed QuickBASIC, coming in at 0.49 seconds versus a leisurely 9.1 for QuickBASIC 2.0.

**QUICKBASIC QUITE PLEASING**
As someone who has taken IBM's BASIC class for as far as it can go, I really appreciated the article on Microsoft's QuickBASIC 2.0 by Ethan Winer (PC Lab Notes, PC Magazine, Volume 6 Number 1). I was interested in finding a more powerful BASIC and had seen ads in your magazine for QuickBASIC, Better Basic, and True Basic, but never knew what they did in comparison with just plain BASIC.

At least as far as QuickBASIC is concerned, I now feel I have been given an excellent preview by Mr. Winer. In fact, I was so impressed with the article, I have decided not to hold off until I can figure out the pros and cons of Better Basic to order QuickBASIC.

Donald T. Houghby
Birmingham, Missouri

**SCANNER FEATURES CLARIFIED**
Thank you for your excellent review on scanners, "Page-to-Disk Technology: Nine State-of-the Art Scanners" (PC Magazine, Volume 5 Number 16). While the background and analysis of the various products were well designed and prepared, there were some inaccuracies regarding our Microtek MS 300A Intelligent Image Scanner that should be clarified.

The price of the MS 300A, which includes scanner hardware, image-processing software, and an interface kit, is $2,495. The MS 300A's text-scanning output includes ASCII text files in addition to the ones that can be used directly by WordStar, WordPerfect, WordStar 2000, MultiMate, DisplayWrite, Symphony, PFS:Write, and PC Write. The graphics scanning resolution offers the widest range of resolutions of any scanner tested, with a total of 16 resolutions, from 300 dpi to 75 dpi (in 5 percent decrements). Our halftoning logic provides 12-halftone cell-resolution/texture selections and up to 52 gray levels for outstanding halftone renderings. The graphics output includes raw bitmap, CCITT Group III compressed, TIFF, PC Paint, PC Paintbrush, GEM Paint, and MacPaint formats.

In addition to these omissions, the review also implied that one must physically remove the paper-feed rollers to clear a paper jam. In fact, opening the output door releases the pressure on the rollers much like the release on a typewriter.

Finally, while the MS 300A is currently distributed through several hundred retail dealers and VARs, all requests for information should be forwarded to our National Sales Offices: 16901 S. Western Ave., Gardena, CA 90247; (213) 321-2121.

Robert Hsieh
Vice President
Microtek Labs
Gardena, California

Authors Diane Burns and S. Venit reply:
At the time we prepared our review, the price of OCR Systems' optical character recognition software had not yet been determined; therefore, we did not include it in the article.

We reported on the optical character recognition software as it performed at the time of our review. In the features table, our list of word processing formats supported is accurate; further, we qualified the list with "any word processor that does not override the keyboard."

We did speak with technicians at Microtek regarding the file formats graphic scans could be saved in, and we understand the conversion to PC Paintbrush to be the only translation available at the...
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With all the recent hoopla over performance, it's ironic that two of the PC's ergonomic deficiencies have been overlooked—its slow cursor, and the tendency of the cursor to remain in motion (run-on) after a cursor key has been released. Finally, the solution—Cruise Control™ from Revolution Software.

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LETTERS

time. Perhaps the company should make available to the public a timetable of the various translations that have become possible in the last few months.

Since we have completed the review, we have seen that a paper jam is indeed easy to correct. However, the manual for the scanner fails to mention the technique used to clear the jam.

PC Magazine acknowledges a production error stating the resolution of the Microtek 300A to be 200 dpi.

THE PERFECT LAPTOP

Of course there is no perfect laptop! Stewart Alsp is at least right to that extent ("The Perfect Laptop," Stewart Alsp, PC Magazine, Volume 6 Number 2). However, the laptop he proposes as ideal is certainly not the one that many of us are looking for. As a traveling columnist who writes with a Tandy Model 100 in his lap while flying in an airplane, Mr. Alsp is obviously looking for a specific type of computer of relatively limited function—a temporary extension of his desktop system. I, on the other hand, need a computer that will permit me to write in hotel rooms and borrowed offices with the ease and flexibility I enjoy in my office at home.

Hugh Bayless
Carmel, California

Stewart Alsp replies:

Mr. Bayless is quite right. As with desktop systems, no one laptop computer could suit the needs of all users. The point I wanted to make, though, was that there are different kinds of users and that the computer manufacturers' current rush to put the be-all desktop computer inside a laptop package is going overboard. Why doesn't a PC manufacturer start designing different kinds of laptops for different kinds of users—without sacrificing the power all laptops should have?

Stewart Alsp speaks good sense ("The Perfect Laptop")! The company that can meet his specifications will have my business. I hope someone is listening out there.

Charles W. Fowlkes
Bozeman, Montana

Stewart Alsp's column ("The Perfect Laptop") should be read by future laptop designers. It's hard to believe there are too few potential customers to make producing his kind of laptop profitable.

William T. Hamrick
Kleen, Alabama

ZOOM/MODEM SPEAKS OUT

The article "Beyond the Hayes Standard" (PC Magazine, Volume 5 Number 20) contains errors, omits important information, and evidences an oversimplified understanding of the ZOOM/Modem PC 1200. It implies that a hardware product is of little use unless the package also provides software to exploit the hardware capabilities fully.

The article omits a number of important features: The ZOOM/Modem PC 1200 is upgradeable to 2,400 bits per second, the clock/calendar will time-date-stamp messages left in the RAM buffer, and the RAM buffer is upgradeable to 32K bytes.

Also, the author failed to mention that jumper block J5, which allows the modern

Why doesn't a PC manufacturer start designing different kinds of laptops without sacrificing the power all laptops should have?

Author M. David Stone acknowledges that the upgradability of the modem to 2,400
“Dac-Easy Accounting staged an astounding coup in the accounting category...”

PC WORLD
October 1986

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"We had never made an offer to buy back a system before. It was risky for a small company like ours, but the gamble paid off.

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bps and of its RAM buffer to 32K, as well as the time-and-date-stamping features, would have been worth noting had the manual mentioned these: it did not. Moreover, jumper block J5 is mentioned neither on page 117 (the glossary) nor in the section where jumpers are discussed. According to page 16, the A/A1 configuration is handled by jumper block J3, and no mention is made of J5.

As for the modem itself, Mr. Stone replies: "My concluding paragraph reads: 'To truly take advantage of the ZOOM/Modem PC's extra features, you'll have to write your own communications programs or ... scripts. If you enjoy doing that sort of thing, you'll have a lot of fun with the ZOOM/Modem. Otherwise, you probably won't be able to take advantage of all its extra features.' Far from condemning the product, this statement simply points out who will be able to make use of the extra features and who won't."

PC Magazine acknowledges a printed error: 400 MHz should have been 400 Hz.

OVERTYPE MODE PREFERRED
Thank you for the recent First Looks review of our Electric Pencil PC (First Looks, page 38, PC Magazine, Volume 6 Number 2). While I agree with most of Christopher Johnston's comments, I would like to take issue with the objection he had with Electric Pencil PC running in the overtype mode.

Many of the popular word processors default to the overtype mode and toggle in and out of the insert mode. Based on present user input, we sincerely feel that running in the overtype mode and toggling to the insert mode when required satisfies the majority of users.

Stan Feldman
President
Electric Software Corp.
Dallas, Texas

CORRECTIONS/AMPLIFICATIONS
In the article "Asynchronous Communications: Shopping for Software" (PC Magazine, Volume 5 Number 18), there were several errors in the Summary of Features table concerning the Mycroft Labs' Mite line of software. MaxiMite, MaxiMite Plus, and DynaMite do support manual dial, fully automated auto-dial/auto-log-on, half duplex, all protocols in remote mode, up to 15 repeat dials, and up to 38,400 bits per second. In addition, the three products do exit to DOS without dropping a carrier.

MaxiMite does include ANSI COLOR emulation and is available for CP/M-B0. DynaMite supports a script language (Morse) and VT52 and does not have a learn feature.

Brown Bag Software no longer copy protects its software. Its products are shareware, not public domain ("Abort, Retry, Ignore?", PC Magazine, Volume 6 Number 1).

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Can even extend a file across two drives — even two hard disks. Version 4.2 adds DOS interaction for large menu-keyed files, enables variable length records stored in virtually any length, verifies accuracy optionally! with read after write, useful in editing unwritten data, offers password and data access.

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**PERSONAL FINANCES**
I'm interested in buying some software for managing my personal finances. The kinds of things I'm interested in include income tax and tax planning, budgeting, modest investing, and various forms of record keeping.

F. Louis Floyd
Strongsville, Ohio

Many people find that the tools of business they use every day work quite well for the occasional personal chore. Spreadsheets can balance a dizzy checkbook in a pinch; sophisticated databases have been known to manage a Christmas card list or two; and a pop-up calculator can quickly predict the impact of a new purchase.

For a complete look at your portfolio, nothing beats Andrew Tobias's Managing Your Money (MECA, Westport, Conn.; (203) 222-1000; $199.95). It will track your bonds, mortgages, insurance premiums, and other recurring costs, while dispensing sage advice. If you're willing to put in the hours, it will balance your checkbook, but few people have the discipline for that. Tax planning and investment forecasting are very easily controlled with this elegant package.

**HERCULES AT HIGH SPEEDS**
I need to know if a Hercules Graphics Plus card will run in my Leading Edge Model MP-1673L. The local dealer said the card would not work, but the national technical advisor for Leading Edge said it would.

Jim Gomez
Iberville, Louisiana

Any problems that develop would result from running the computer at a clock speed above 4.77 MHz—a level at which the BIOSs on some non-IBM PCs give the Herc card trouble. If you ever have such problems, slow the machine down when using that program.

**CONVERTING 8½-INCH DISKS**
Can you direct us to a product that will allow us to convert our 8½-inch CPT disks to 5¼-inch disks in WordPerfect format?

A.B. Cooper, Jr.
Atlantic Beach, North Carolina

Keyword has a full line of disk conversion hardware and software. The Keyword 7000 has two disk drives: it will read your 8½-inch CPT disks and write the documents on 5¼-inch floppy disks (Keyword Office Technologies, Colgary, Alberta, Canada; (800) 661-8161; $5,695). The Keyword 7000 goes beyond conversion services that give you a stripped-down ASCII document; the formatting codes are saved in WordPerfect style.

By the way, the company sells units to convert a wide variety of systems, including DEC VAXmate, AES/Lanier, IBM Displaywriter, Xerox Writer, NBI, and Convergent/DEF. The units will write to these PC formats: DisplayWrite (2 or 3), Office-Writer, MultiMate, WordStar, MASS-11, or Microsoft Word.

If you need to convert only a couple of disks, the company has a conversion service that's more economical than buying one entire system.

**EASIER ENVELOPE PRINTING**
Is there a printer that can accept stacks of envelopes?

Bill Madler
Pittsburgh, Pennsylvania

No printer I know of can properly shuffle envelopes. But a recently introduced sheet-feeder does the job where others have failed. Rutishauser's Poperpro 88 Cut Sheet/Envelope Feeder (Dallas, Tex.; (214) 343-9154; $895) clips on to a variety of Toshiba, Qume, C. Itoh, Focit, and Fujitsu printers. You can have two or three bins with up to 50 envelopes or up to 300 sheets of paper in each. It won't stuff or lick your envelopes, but it will collate the sheets and envelopes.

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Intel’s Inboard 386 Blazes An Upgrade Path for ATs

**PC HANDS ON**

**BY WINN L. ROSCH**

The engine that runs the personal computer industry is regrets. Buy one computer and 6 months later, you regret not waiting just a little while longer to get the latest technology. Everyone who bought an 80286-based AT or compatible learned this lesson when the 80386 microprocessor became the latest rage.

Intel Corp.'s Inboard 386/AT is the latest regret remover. Pop this expansion board, and your AT becomes an 80386-based powerhouse. Your remorse should go into remission.

One megabyte of memory (in the form of 36 parity-checked, 120-nanosecond, 256K-bit dynamic RAM chips) and a high-speed cache on the Inboard 386/AT give it full 32-bit operation at its microprocessor's top-rated speed of 16 MHz. At best, that's enough to double the processing performance of an AT, challenging Compaq's state-of-the-art Deskpro 386.

Achieving that end means backfilling the AT's DOS-addressable memory, except for the first 256K bytes, using half a megabyte of the Inboard's fast RAM, to take advantage of the Inboard's faster clock speed. The AT's bus still operates at 8 MHz; 6-MHz ATs must be speeded up to 8 MHz, and Intel provides a faster crystal to do just that. The rest of the Inboard's bytes can be used as extended or EMS expanded memory, using a software driver supplied by Intel.

An additional 2 megabytes (continues on page 34)

WordStar 4.0: Face-lift Adds Speed, Keeps Logic Structure

**PC HANDS ON**

**BY MARTIN PORTER**

WordStar Professional, Release 4.0, is like an aging actress who refuses to leave the stage long past her prime. The faded actress has had a face-lift and has trod the boards long enough to know how to remain in fashion.

Those who loved her when she was young will find that this latest upgrade, WordStar Professional, Release 4.0, is even more of a beauty now. Many of the inherent problems that have irritated users for so long have finally been solved, and occasionally a thoughtful perquisite has been added.

But let the innocent be forewarned: the faded star has a style from another era. Her famed clandestine command logic remains as baffling as ever and even some newly coined control codes follow MicroPro's pattern.

International Corp.'s credo: confuse them into oblivion.

Still, here is what the readers need to know.

(continues on page 34)
**WordStar**

(continued from page 33)

vamped WordStar allows you to do now: You can edit or store a file in any directory (or subdirectory) simply by identifying its directory path. You are able to salvage obliterated type with an unerase function key (the solution to Ctrl-T and Ctrl-Y mix-ups). The function keys are easily customized for up to 40 different strings of commands (or text).

The program now supports proportional spacing. It lets you skip to any page or line in the document and it lets you perform 14 built-in math functions straight from the text.

More: It lets you draw boxes and lines around your copy. Underline and boldface are displayed on-screen. The remaining disk space and file sizes are furnished at the main directory. Add the furnished spelling checker and thesaurus that come along for the ride and its main menu indexing and tabular-contents features, and it becomes a pretty damn complete word processor.

It also runs faster. Bravo.

So why am I not so in love with it? The programmers assumed they had to dress WordStar up—besides adding the new features—in order to compete with newer, more-accessible programs. The makeup doesn't make anything easier; it just makes it look unfamiliar and new. Besides, the new main menu isn't any easier to read now that they eliminated the section headings.

The stacked function key descriptions are an eyesore at the bottom of the screen. And I'm still not used to working with the keyboard overlay needed to memorize my 40 new function keys; hasn't MicroPro heard of pull-down menus?

Oddly, the programmers added keystrokes to some older commands; Ctrl-O-S-2 for double space has become Ctrl-O-S-2-Return.

A cursor move won't satisfy many of the program's Y/N security clearances. And MicroPro made the Delete key work like Ctrl-G so that it rubs out the character at the cursor. I'm so accustomed to the Delete key's backspace/rgb/put by now that I'm now making more erase mistakes than before.

But just when I was getting fed up with Release 4.0's unnecessary jive and just when I started to wonder why (after 8 years) MicroPro still hasn't got anything exactly right, I found some new hidden powers in the program—the clearly defined block marked text and the multiple printout option—and I exclaimed, "Hey, Release 4.0's worth the switch."

First-time users will probably not be as impressed.

---

**Inboard 386/AT**

(continued from page 33)

of fast RAM can be installed on an optional Inboard daughter-card. If you need more speed, the Inboard 386/AT has space for an 80387 numeric coprocessor—or, until the new chips become readily available later this year, a small adapter board equipped with a 10-MHz 80287. Intel recommends that you have a dealer install your Inboard.

To install the Inboard 386/AT, you'll first have to pull the 80286 microprocessor out of your AT (and the 80287, if your system is equipped with one), using a special tool supplied by Intel, and then plug a connector cable into the vacant socket. You may have to pull out your disk drive, unplug disk drives from the controller, and rearrange boards to provide sufficient access. Replace the crystal if the machine is a 6-MHz AT. Finally, plug the other end of the cable into the Inboard...
StarFixer Makes WordStar Manageable

BY MARTIN PORTER

You’ve heard for years how easy it is to customize WordStar. It takes only an AUTOEXEC command here, a BASIC patch there. Or you somehow locate a pamphlet called Underground WordStar and make all your changes from the classic itself. Relatively speaking, it’s all a pain.

However, a new do-it-yourself fix-it program called StarFixer (from Hard/Soft Press and sold by Bantam Electronic Publishing in retail stores) puts new life in any 3.24 through 3.x WordStar disk and provides longtime users with instant fixes for which they’ve long been hunting. StarFixer addresses most of WordStar’s quirks and foibles with simple and relatively elegant solutions.

The package itself includes a 276-page manual—probably the most-comprehensive discussion of underground WordStar fixes and user advice since the publication of Underground WordStar itself. Not surprisingly, StarFixer’s authors are PC Magazine editors Stephen Manes and Paul Somerson, who, as the elusive Ward Starr and Mel Murch, originally penned that WordStar broadside in 1983.

There are multiple fixes on the single disk, including a rescue program that’s a simple save for up to 20 pages of lost text and a file fixer that automatically strips control codes and dot commands from text files (for shipping them over MCI mail, for example). Four programs that train your WordStar disk to handle 43-line EGA screens are also provided.

However, the program’s main fare are the StarFixer and KeyFixer programs that directly modify your WordStar’s WS.COM file. These quick fixes have been over 10,000 hours in the making.

For those with blind trust in the experts, StarFixer even comes with an Instant Fix key (1) which optimally reconfigures the program all at once. For those who prefer to do it themselves, a wide range of customization options are easily accessed from WordStar-looking menus. In fact, if the program has one particular strong point it’s the sameness of all its menus—making it easy to work with and easy to use even by the ingrown WordStar rank and file.

Moreover, the program’s customization commands are much simpler to use than those obtainable with WordStar’s own Install program. An additional dot menu allows you to change all the line and page length defaults. The function key label line can be toggled off for additional screen space. The rub-out direction of the backspace and Del keys can be modified. And the program can be hot-wired to bypass WordStar’s opening message.

What is possibly its most famous fixes change the line-delete command to back-to-back (as opposed to a single) Ctrl-Y’s, a security step against slipped Ctrl-Ts.

As an added attraction, KeyFixer lets you customize and reinforce your function keys with extras. Ten extra function keys can be added. These additional keys, as well as the normal function and cursor pad keys, can also be customized for your convenience. And if you should ever get sick of all this extravagant key muddling, you can instantly reset the program to its factory default settings.

You’ll probably never glance at those factory defaults again once you hotrod your WordStar with this StarFixer. WordStar, Release 4.0, it’s not. But it may already be more than you need.
Halo DPE: As a Page Design Tool, It’s a Great Drawing Aid

BY TOM STANTON

Halo DPE (Desktop Publishing Editor) has some interesting features as a drawing program and some astounding flaws as a publishing package. At first glance, the software is identical to the original Dr. Halo II, which costs $60 less, but there are a number of enhancements, including scanner input, expanded memory support, and output to IMG and TIFF graphics file formats. A frame grabber, a slide show program, and numerous fonts are also included, and like its predecessor Halo DPE has an impressive list of hardware support—there are drivers for most pointing devices and display adapters.

As a graphics program, Halo DPE has few peers, but it’s the DPE part that bothers me most. On the surface it looks easy. Since you can import text from any ASCII file, I selected one of my test documents. Surprise—Halo DPE treats text as one graphics block, so unless you have formatted the text into the desired column width in advance, you get a block of text.

There are no editing functions, in spite of the title. You cannot change fonts or change sizes once the text appears in Halo DPE, which treats graphics as bit-mapped images. You can move blocks of text, but there is no way to readjust the existing text. You cannot adjust character or line spacing, change the column width, or redo column formats. There are no page guides to hold the text in place—you point and shoot and hope for the best.

Worst of all, each column of text must be in a separate ASCII file. If you import a long file, you lose text that goes beyond the page margin. If you’re using graphics, you must also calculate the depth of the graphics before you can decide how long you must make each column (again, each in a separate file).

To Halo DPE’s credit, there is an invisible grid function that helps with text alignment, and a virtual page, which displays an approximation of the finished page. Both features are useful, but they hardly make up for the work required to produce a finished page.

If you’re looking for an excellent graphics program, Halo DPE is it. As a publishing program, it barely qualifies.

Mix C Works’ Blend of Tools Is a Good Choice for a Novice

BY J.H. SMITH

The Mix C Works combines a compiler, linker, editor, and full-screen debugger for $89.95. The compiler, sold separately for $39.95, is aimed at novice C programmers.

The language tutorial is enough to teach the language. The compiler is reasonably quick, but the resulting programs are somewhat slow and large. It produces nonstandard object files, handled by an included linker. Source code is provided for about half the functions; more comments would help.

If your program can’t compile, errors will be pointed to in the listing with a numeric code. You’ll find readable messages only at the end of the listing. That’s no way to treat a novice!

If you compile from within the split-screen editor, you’ll be directed to the first error, and a readable message will be shown at the bottom of the screen. The editor’s documentation is too intimidating; it’s full of setup instructions for CP/M. There’s no tutorial, and the PC-specific commands are hidden in an appendix.

The debugger is genuinely helpful, the best part of the package. Even beginners will have no trouble tracing through the code, seeing variables change and setting breakpoints. A language as complex and hostile as C is much easier with a tool like Mix C Works.

Overall, Mix C Works is a good package for learning C. Unlike Turbo Pascal and Quick-BASIC, it’s not appropriate for developing commercial software on a tight budget. An expected $39.95 large-model upgrade may change that, but for now, novices will get the most out of Mix C Works.
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Yet with all this speed and design innovation, PC Designs engineers—unlike other manufacturers—have customized the BIOS and retained the standard IBM PC-AT bus timing (yet another PC Designs exclusive). The result is unparalleled compatibility with existing software and peripherals.

There's a boxcar load of other design features and the GV-286 can be ordered up in virtually any configuration you can imagine. Best of all, standard systems start at less than $4000 (including Desqview multitasking software).

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CIRCLE 372 ON READER SERVICE CARD
Look Slighly From Designed Desktop

PC HANDS ON

BY WINN L. ROSCH

Unless you're carefully balancing international relationships and Swiss bank accounts, the biggest advantage of using a computer is also its biggest disadvantage. All your work is transitory: simple electronic flashes that are apt to evaporate at the slightest hiccup in the power supply or when an experimental program runs awry.

Bookmark, from Intellisoft International, is aimed at ensuring your work doesn't disappear without your approval.

It makes the fleeting electronic memory of your PC more permanent by stealthily copying its contents to disk while you are at work on something else. This memory save works both manually and automatically.

You can simply press a couple of keys and Bookmark will write a snapshot of your PC's full RAM complement and display memory to a hidden directory on your hard disk. Or the program will automatically make its saves periodically, at fixed intervals or number of keystrokes or both.

Bookmark works like a bookmarker because it allows you to instantly reload your memory snapshot, so that you're dumped right back into the exact place you were when the save was made—programs loaded, data files open, same directories logged, and everything executing.

Restoring the entire system configuration requires only a couple of seconds, and the memory-restoration process can be password protected.

Although it's a truly clever idea, Bookmark has its shortcomings. You lose the amount of hard disk space (the program requires a hard disk) equal to one or two times (depending on operating mode) your total system RAM and display memory. Bookmark will not save anything in extended or expanded memory or the memory used by nonstandard display adapters.

It misses a few details, such as screen border colors and timer settings. And it's copy protected using the Super-Lok (Softguard) system, so backing up Bookmark is troublesome at best.

Memory resident, Bookmark requires only 6K bytes of RAM. Its installation process is menu driven, short and sweet, as is the documentation.

F A C T F I L E

Bookmark
Intellisoft International
70 Digital Dr.
Novato, CA 94948
(800) 544-6275
(800) 543-6275 (in Calif.)
List Price: $69.95
Requires: 64K RAM, hard disk, DOS 2.1 or later.

In Short: A place-saving system that automatically copies the contents of RAM to disk. The RAM copy can be quickly restored, putting you back where you were when the save was made. Copy protected.

Less expensive than a power backup system and as reliable as a guilty conscience, Bookmark may help you avoid disasters—particularly if you're irresponsible enough to forget to regularly save your work.

F A C T F I L E

Princeton LS300 Scanner
Princeton Graphics Systems
601 Ewing St.
Princeton, NJ 08540
(800) 221-1490
(609) 683-1660
List Price: $1,095
Requires: 320K RAM, mouse, DOS 2.0 or later.

In Short: A 75- to 300-dot-per-inch scanner that uses PC Paintbrush Plus as the scanning interface. It scans line art and photographs for editing and printing or to store on disk.

A noticeable loss of detail. The ability to alter the image in detail using the Zoom feature gives this product a big advantage over many other scanners that rely on screen grabbers or their own graphics editors.

The Princeton Graphics documentation shows you only how to install the hardware—after that you're on your own. This is unfortunate because it has a nice product that is easy to use once you've installed it. Its biggest limitation is the dithering of halftones, but even there it does a respectable job. The LS300 is a good candidate for users who want a general-purpose scanner for desktop publishing.

PC HANDS ON

BY TOM STANTON

The name Princeton Graphics Systems is synonymous with monitors, so I was surprised to see that its latest offering, the Princeton LS300 Scanner, is a desktop graphics scanner system. The LS300 is, in fact, the Canon IX-12 scanning engine, with no notable changes.

The LS300 scanner is well designed and easy to use. It has a small footprint (13 by 11 1/2 inches), which makes it ideal for desktop use. The paper path is ideal: pages feed directly from front to back with only a slight bend at the output tray, which makes it perfect for photographs, transparencies, and mylar, where too much bending causes the image to crack.

The LS300 uses a special interface card that fits in the short slot of your PC. Jumpers on the card allow you to configure the DMA (direct memory access) channel and the hex address if the factory settings conflict with other boards on your system.

The LS300 uses PC Paintbrush Plus as its scanner interface—a big improvement over many scanners because you can scan, edit, and print before committing an image to disk.

The Scan Options dialog box lets you set brightness, contrast, resolution (up to 300 dots per inch), and the scan mode. The LS300 supports black-and-white scanning (line drawing), and a dither mode, which is used to scan photographs and other images with continuous tones. Dithering is similar to half-toning and screening, but can't scale an image without a noticeable loss of detail.

The Princeton LS300's paper tray is well designed for scanning fragile artwork.
Protecting Files: Top Priority.

Hard drive users know tape backup is indispensable, but equipping each of your PCs with its own backup is costly. That’s why we developed the MaynStream, our lightning-quick, file-by-file tape backup system. Just snap the MaynStream onto any PC equipped with a low-cost MaynStream controller. Simple menus guide you through backup in seconds and restoring data is just as easy. So when your hard drive forgets to treat your files like your business depends on them, the MaynStream remembers.

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You select the information you need.

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<table>
<thead>
<tr>
<th>Description</th>
<th>Amount 1</th>
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<td>7379.14</td>
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</tr>
<tr>
<td>Insurance Deb Tal MTD</td>
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CIRCLE 154 ON READER SERVICE CARD
Envelope Please Picks Up Addresses

PC HANDS ON

BY JONATHAN MATZKIN

The Envelope Please, from Quaid Software, allows dot matrix printers to accept—and print—envelopes the long way. That makes it easier to entice the envelope into the wilds of your printer carriage, a place where envelopes normally fear to tread.

Uses Address Window

The memory-resident program pops up over your word processor; you simply position and size the address window over the inside address of the letter. The Envelope Please picks up the address and prints it on your envelope, along with a return address that you can specify when you set up the program. Sound too good to be true? It may be, depending on your printer. Not all printers are designed to accept envelopes, and The Envelope Please is not compatible with all makes and models.

I got good results with an Epson FX-85, but it took some trial runs before I learned to position the envelope so it would travel properly through the paper path. And the sideways print, while quite readable, is primitive compared with the usual output from a dot matrix machine.

The program prints in the standard fashion on daisy wheel printers; support for laser printers is on the way.

List Price: The Envelope Please, $39.
Requires: Epson-compatible friction-feed dot matrix or daisy wheel printer. Not copy protected.
Quaid Software Ltd., 4S Charles St. East, Third Floor, Toronto, Ontario, Canada M4Y 1S2; (416) 961-8243.

CIRCLE 421 ON READER SERVICE CARD

Assembler Book Teaches by Example

PC HANDS ON

BY ETHAN WINER

What makes Peter Norton's Assembly Language Book for the IBM PC stand out is not merely that it was written by PC wizard Peter Norton and partner-in-programming John Socha but the manner in which the material is presented. The book's strategy is for you to work with the authors in building a complete sector-editing utility.

Many interesting and useful tricks of the trade are presented along the way, and a number of the macro assembler's lesser-known features are discussed.

Norton's clear, straightforward writing style is evident throughout, making the book both enjoyable and easy to read.

But what I appreciate most of all is the accuracy of the material, as well as the depth of coverage provided. While many other beginner tutorials gloss over much of the assembler's more-advanced capabilities, Norton and Socha leave no stone unturned.

For example, rather than discussed and examples are shown.

List Price: Peter Norton's Assembly Language Book for the IBM PC by Peter Norton and John Socha, $19.95. Copyright: 1986. Brady/Premiere Hall Press, One Gulf + Western Plaza, New York, NY 10023; (212) 373-8500.

CIRCLE 422 ON READER SERVICE CARD

Pizazz Puts New Life in PrtSc Key

PC HANDS ON

BY JONATHAN MATZKIN

Has the fun gone out of the romance with your printer? Well, perhaps what you need is a little Pizazz to make things exciting again. Technically, Pizazz is a memory-resident print utility, but it is really more like a turbocharger for your PrtSc key. It takes the place of DOS's plain-vanilla screen print program and provides you with all sorts of new options.

Tapping Shift-PrtSc pops Pizazz up over any screen that you want to print and presents a main menu. The program looks at the image to be printed and takes note of displayed colors. Each displayed color can be replaced and printed with any of over 200 available shades.

Monochrome printers have access to 30 different shades and fill patterns, and images can be printed with standard or reverse-black-and-white and color or relationships.

But Pizazz is not simply a palette. It has some of the image manipulation capabilities normally associated with packages like Freelance or EGA Paint. The displayed image can be rotated or sized, and a "smooth" function helps minimize jaggy.

You can also place a variably sized window over a portion of the screen and print the contents of the window. The program will also store an image, along with all selected settings, in a file. That file can be printed out with the same results on any other system, within the limits of the printer used.

And, in case you really want to use it, Pizazz has a menu option for DOS's print-screen function. But that's an option that clearly lacks Pizazz by comparison.

List Price: Pizazz, $49.95.
Requires: 32K RAM. Not copy protected. Application Techniques Inc., 10 Lomar Park Dr., Pepperell, MA 01463; (617) 433-5201.

CIRCLE 423 ON READER SERVICE CARD
**New Mac to Run DOS Software Using AST’s Coprocessor Plug-in Boards**

AST Research will sell add-in boards for the latest generation of Macintosh computers, enabling the Mac SE and the Mac II to run MS-DOS programs.

The $599 Mac86 coprocessor board features a 10-MHz Intel 8086 CPU and installs in the single expansion slot of Apple’s new Macintosh SE. The Mac86 runs any MS-DOS application that supports the IBM Monochrome Display Adapter or Color/Graphics Adapter. The 8086 coprocessor shares the Macintosh SE’s internal memory with the host Motorola 68000 processor that is in the Mac SE.

The Mac86 provides a controller for a 5⅛-inch MS-DOS floppy disk drive, which is required for MS-DOS processing, and must be added separately. When installed, the MS-DOS environment appears as an icon that can be called from the Mac’s Finder as a normal Macintosh application.

The $1,499 Mac286 is a self-contained 80286-based microcomputer that plugs into two adjacent NuBus slots in the Mac II. A two-board set, Mac286 comes with 1 megabyte of RAM, a direct memory access controller, a socket for an optional 80287 math coprocessor, and a 5¼-inch MS-DOS floppy disk drive controller. When running MS-DOS software, the Mac286 handles all applications processing, while the Mac controls I/O functions. An external 5¼-inch floppy disk drive is required. Once loaded, DOS applications run in a window in the Mac II’s 12-inch screen.

AST expects to ship both products in late spring.

**Project Management Package Is Targeted at All Business Managers**

Project Vision, $349 from Inmax International Publishing, is a project management program that isn’t just for professional project managers, according to Inmax. The software features a spreadsheet-style user interface and can present information in the form of a unique “box precedence” diagram. The diagram can be zoomed in on or scrolled.

**Dot Matrix Printers: One Is Fast, the Other Has Network Features**

New serial dot matrix printers from Output Technology Corp. offer blinding speed and eye-opening connectivity features.

The $2,395 TriMatrix 850XL charges through print jobs with a burst speed of 850 characters per second and a throughput of 240 lines per minute, Output Technology says. The printer handles 80-column applications but is optimized for 136-column printing. With 850XL offers features that can be found on the earlier 700 series printers, including front-panel programming, front and bottom paper feed, 8-K-byte data buffers, and Epson and...
AdaptaPak $399 Battery for Toshiba T3100 Frees Laptop from AC Power

For all its power and features, Toshiba’s 80286-based T3100 laptop is limited by its power cord. The T3100 can operate only as far from an AC outlet as the cord will stretch. So Product R&D Corp. has introduced the $399 AdaptaPak, an adapter, battery, and charger kit that gives the T3100 computing mobility. R&D says AdaptaPak provides over an hour of computing time for the Toshiba.

The adapter is available without battery, for $299, for users who want to run the T3100 off a car cigarette lighter or select their own 12-volt battery. Called the Adapta80, the adapter-only version fits with the T3100 inside the laptop’s carrying case and weighs a mere pound.


DEC printer emulations.

The TriMatrix 850 PrintNet, which costs $2,995, adds networking capabilities to the speed of the 850XL. Up to five users can connect simultaneously to the 850 PrintNet through resident serial ports. The printer serves not only as a multiuser print station but also as the basis for a simple plug-and-play network.

Any device capable of serial communications—including computers, modems, and other printers—can be connected to the 850 PrintNet and exchange data in RS-232C or RS-422 formats at speeds up to 19.2K bits per second.


New Security System Utilizes Steel Plates to Prevent Theft of PC

Computers don’t have legs, but they do sometimes walk away when left unattended. Doss Industries has introduced the $89.95 Padlock security system to help keep your PC on your desk, where it belongs.

Two interlocking steel pads and an acrylic adhesive fix a PC or compatible, printer, or other unit securely to the work surface. The Padlock system is user-installable without cables or drilling, according to Doss Industries. Each system comes with an offer from Safeware Insurance Co. to provide coverage for your equipment.

List Price: Padlock, $89.95. Doss Industries, 1224 Mariposa St., San Francisco, CA 94107; (415) 861-2223.

Hercules Develops Color Graphics Card That Is Compatible with Its Software

Known as a standard setter for monochrome graphics, Hercules Computer Technology is maintaining compatibility with the Hercules body of software drivers, while setting a new standard for color graphics. The Hercules InColor card displays 16 colors at a time from a palette of 64, with 720-by-348-pixel resolution.

The board also displays any application in white on black or in two other user-selected colors. Color drivers have already been developed for AutoCAD, 1-2-3, Symphony, and Microsoft Windows, and Hercules expects all popular Hercules-compatible programs to support the InColor card shortly.

The card supports an expanded version of the RamFont display mode, which gives applications programs access to a library of up to 3,072 software-definable characters or patterns, displayed in up to 16 colors.

List Price: InColor, $499.

Requires: ECD or multisync monitor. Hercules Computer Technology, 2550 Ninth St., Berkeley, CA 94710; (800) 532-0600.

Bridge Connects Up to 32 Different NetWare LANs Simultaneously

Connectivity, like the universe, continues to expand at high speed. New products like GRemote Bridge from Gateway Communications link individual LANs to produce a new level of connectivity.

GRemote Bridge transparently connects any NetWare-based LAN to any other NetWare-based LAN. The bridge is immediately available to more than 37 types of networks offered by LAN suppliers, according to Gateway.

GRemote Bridge is a combination of hardware and software that creates a virtual link between remote LANs as a packet assembler/disassembler interface over X.25 trunk lines, public data networks, or private data networks. As many as 32 LANs can be connected at one time. Gateway says that because GRemote Bridge uses the X.25 protocol, LAN transmission speeds of up to 19.2K bits per second are achieved.

List Price: GRemote Bridge, $2,990 for starter kit that includes everything needed to connect two LANs; GRemote Bridge Link for connecting additional LANs, $1,595; GRemote PC, for connecting remote PC to LAN, $795. Requires: At least two NetWare-based LANs with nondedicated PCs as communications servers. Not copy protected. Gateway Communications Inc., 2941 Alton Ave., Irvine, CA 92714; (714) 553-1555.

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Xerox Puts Spelling Checker in a Box That Uses No RAM or Slot

BY MITT JONES

Xerox Corp.’s PC Type Right manages the minor miracle of putting a 100,000-word spelling checker at your service while staying out of your way and taking none of your expansion slots, RAM, or ports.

Just plug your keyboard into Type Right and plug Type Right’s cable into your system’s keyboard jack, and you’ve got a spelling checker that spots errors as fast as you can crank them out. Whereas most spelling checkers operate in batch mode, Type Right checks for errors as you type by monitoring keyboard scan codes. When you type a word it doesn’t hold in its dictionary, Type Right beeps twice.

Since it monitors your typing without regard to what software you’re using, Type Right will sometimes nag at your spelling when you’re correct—such as when you change directories or start your word processor. But Xerox included two remedies for that problem. You can easily turn spelling checking off by entering Alt-Asterisk (on the keypad), or you can add up to 1,200 words to a secondary dictionary.

To add to the dictionary, you type the appropriate word and then enter Alt-Plus sign. You can remove words just as easily. I left Type Right on all the time and found it very easy to live with once I added the most-common DOS commands, my batch-file names, and my directory names. However, I still got an occasional beep for unrecognized words when I entered some applications programs’ commands.

Perhaps Type Right’s most-impressive feature is its ability to keep track of changes you make on the current line. Until you move to a new line, you can edit using the Backspace, Del, Ins, and cursor keys without Type Right losing track of the words. For instance, you can type person computer and then cursor over and add al to person without causing an error.

To account for the different ways programs define the Backspace, Del, and Ins keys, Type Right offers six different edit modes. The thorough documentation lists the suggested mode for 34 programs, including the most-used word processing programs and other giants such as dBASE III, 1-2-3, and Symphony. The modes help Type Right keep track of only changes you make, so sticking with the mode for your most-used program won’t render Type Right useless for other applications.

If you use a word processor that includes a batch spelling checker, Type Right may be a great product you don’t need. But for a friendly, versatile spelling checker, it’s hard to beat.

Turbofonts Generates More Than 1,000 Special Characters

BY EDWARD MENDELSON

If you need more than the 256 characters on the IBM PC, Image Processing Software’s Turbofonts can change them. This resident program replaces IBM’s higher-order character set—the foreign and graphics characters above ASCII 127—with predefined sets of characters that your monitor displays and, amazingly, you can print out.

Turbofonts’ characters range from foreign letters to scientific symbols to fragments that you can combine for equations or double-size letters. If you don’t like the 30 predefined sets, you can build your own from a 1,000-character library. Most every Western language is supported, as well as Hebrew, classical Greek, and Cyrillic alphabets; only a romanized Arabic is included. You can modify the characters or design new ones from scratch. A separate feature allows you to import a graphics file into any word processing document.

The program works most smoothly with an EGA or a Hercules Graphics Card Plus; other boards require replacement PROM chips and won’t let you edit the characters displayed. It also works best with programs like WordPerfect that know how to handle IBM’s higher-order characters and don’t fill the screen with graphics characters that Turbofonts might alter. Some of the supplied character sets make the frame in MicroSoft Word and the ruler in Symphony look incongruously ornate. Don’t even try to use the program effectively with WordStar.

Turbofonts intercepts files on their way to the printer and inserts strings that generate the specially defined characters. Almost every standard dot matrix printer is supported. The

(continues on page 51)
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CIRCLE 298 ON READER SERVICE CARD
Oversize Monitors Display EGA Graphics Off Standard Adapters

PC HANDS ON

BY MITT JONES

Several manufacturers have announced bigger-than-life monitors in the works, but Aydin Controls and Epsilon Graphics Systems are already shipping 19-inch monitors that display EGA graphics like you've never seen them before.

Both monitors claim a good deal of real estate—and don't try to move them if you've got a bad back. But for small meetings, detailed graphics work, and control-room applications, these monsters are well worth their bulk. Unlike other 19-inch displays from Genius and Moniterm Corp., these monitors run off standard EGA adapters.

The Aydin Patriot Enhancer is IBM Enhanced Color Display compatible, able to display either CGA or EGA graphics and to switch between modes automatically.

The monitor worked flawlessly with all the software and EGA-compatible display adapters I tried. Its antireflective screen surface keeps glare to a minimum, and the 16 colors are easy to read from as far as 5 feet or so.

But Aydin's engineers were asleep at the wheel when they laid out the controls. The only control you'll find on the front is the cabinet is labeled contrast, but it seems to control brightness instead. A brightness control, which one can only assume would control contrast, is missing.

Epsilon's EG-19 Enhanced Graphics Display is actually a 19-inch Mitsubishi C3922K analog color monitor. An Epsilon-made EGA interface box enables it to display EGA graphics. The interface box mounts less than firmly with Velcro to the rear of the cabinet.

But the biggest drawback to the EG-19—which costs $700 less than Aydin's Enhancer—is its inability to display CGA graphics. The screen goes blank or scrolls if the scan rate alters from the EGA frequency, rendering the monitor useless for many applications.

Epsilon attempts to sidestep the limitation by including a pass-through port for a true

(Continues on page 51)

Tandy Does EGA

Tandy/Radio Shack's new EGM-1 Enhanced Graphics Monitor doesn't leave much room for improvement. Its colors match or better those of the IBM Enhanced Color Display, and its 14-inch glare-resistant screen is a bit larger than most displays. The EGM-1's high-brightness level and .31-millimeter pixel size make for easy-to-read text.

While the monitor sells for $699, the company is offering its no-frills EGA-compatible display adapter, the Tandy Enhanced Graphics Adapter, for $349.95. The full-length card follows the industry standard, so you're still out of luck if you own a Tandy 1000EX, which uses special proprietary Tandy boards. Like most EGA-compatible adapters, the card uses the Chips and Technologies' CHIPSet, but Tandy dispensed with the RCA jacks that have become probably the least-used industry standard.

With 256K bytes of RAM on-board, the adapter supports 16 colors at 640 by 350 resolution and generates a 14- by 8-character box in EGA mode. The Tandy display card also supports IBM's standard CGA resolutions, as well as 640 by 350 graphics and a 14- by 9-character box in monochrome mode. The EGM-1 and Enhanced Graphics Adapter are solid products for a decent price and a smart way to upgrade to EGA.

—By Mitt Jones

Tandy Enhanced Graphics Adapter

EGM-1 Enhanced Graphics Monitor

Tandy/Radio Shack

1700 One Tandy Center

Fort Worth, TX 76102

(817) 390-3300

List Price: EGM-1, $699;

Enhanced Graphics Adapter,

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Remember the old days when your hard drive was new? Remember that smooth, fast, slick performance? Those quick retrievals, rapid reads, lightning-like database sorts?

Well ever since, DOS has been doing its best to slow your hard drive down. Not by slowing down the motor, but by breaking your files up into pieces. Storing different chunks in different places. Data files, programs, overlays and batches that started out in one seamless piece are now scattered all over.

Loading is slower. Sorting is slower. Retrieving, backing-up, everything takes longer because your disk has to work harder.

Problem is, it's something that happens so gradually you may not notice the difference. At least, not until you see the dramatic improvement after using Disk Optimizer.

File fragmentation—It's a problem you can see.

Watch your hard drive the next time it reads or writes a file. Each "blip" of the LED means the drive-head is moving to another place on the disk—either to pick up or lay down another chunk of data.

And the truth is, head movement takes time. Far more time than actual reading and writing. What's worse, all this head movement causes extra wear and tear that can shorten the life of your drive.

Disk Optimizer—Tunes up your disk by cleaning up your files.

Disk Optimizer works by finding all the scattered pieces of your files and putting them back together where they belong. Next time your drive reads it, there's just one place to look.

And the results are often dramatic. Reading and writing times may be cut by as much as two thirds. Database sorts that used to take hundreds of head moves now proceed quickly and efficiently. And since head movement is now at an absolute minimum, your disk drive will lead a longer, more productive life.

Analyze, scrutinize, optimize.

Before you optimize, you'll probably want to analyze. So Disk Optimizer shows you, in percentages, how much fragmentation has taken place—on the entire disk, in individual directories, or for groups of files you specify using global or wildcard names.

Plus, there's built-in data security that lets you assign passwords to as many files or file groups as you want. And the File Peeker gives you an inside look at the structure of files. It's a great way for non-programmers to learn more about computers and a powerful tool for professionals who want to analyze the contents of their disks.

Get your hard disk back in shape—with new improved Version 2.0

Hard to believe, but new Disk Optimizer Version 2.0 is even better than before. Not only will it optimize your disks in far less time than it used to, but it actually speeds up retrievals even more by letting you give priority treatment to your most used files, like programs and batches.

When you think about it, it's simple. The longer you own your hard drive, the more you come to depend on it. But the longer you want to get Disk Optimizer, the less performance you'll get.

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Smoller than 1-2-3, Silk Has Text Search, Keystroke Logs

BY JARED TAYLOR

Silk is the latest spreadsheet to slide into the market, claiming to be a 1-2-3 killer. Advertising itself as everything a 1-2-3, Release 3.0, would be and more, it comes with a host of fine features.

Although by no means a clone, Silk is highly compatible with Release 2 of 1-2-3. Some macros and a few offbeat functions are not compatible, but you can translate models back and forth without much fuss.

The 20-line screen looks very much like 1-2-3's and the Slash-key, two-line menus are standard spreadsheet fare. Some simple commands like /Q and /F are identical, but most commands are original. One of Silk's real draws is "live" help. When you turn it on, the right half of the screen becomes a constant tutor, updating to explain your options every time you make a move.

Silk has made the screen the primary documentation, putting only an overview and tutorial in the manual. Other major features include search and search-and-replace, which work for both labels and formulas.

Silk also has a novel model-saving technique. As you build a spreadsheet, it saves your keystrokes to a hard disk file called KEYSTROKE.LOG. If you lose your work, you can read the log file, and Silk will rebuild your model, step by step. It takes a little time, but it's quicker than doing yourself. Though Silk doesn't have the data query features of 1-2-3, it includes single-cell goal seeking, which tells you what price you must charge to get a certain profit. It also does data allocation, so that if you specify a sum, the computer on, in the rows beneath. You can then define formulas such as Profits = Sales - Expenses, and every cell in the Profits row will show that period's profits.

Silk lets you write formulas up to 4,000 characters long and gives you a half-screen window to edit them if you need it. You can tack useful comments onto the ends of formulas and track down circular references with a single key stroke.

Feature for feature, Silk looks like a better spreadsheet than 1-2-3. "Nothing runs as smooth as Silk," claim the ads, and despite the bad grammar they may be right.

Turbofonts (continued from page 46)

only lasers on the list are the HP models. For the HP Laserjet Plus there's a library of downloadable characters.

Your new characters can be used as simple substitutes for IBM's—you can access them by number using the Alt key and the number pad, or you can redefine your word processor's keyboard. But you can also use a toggle key to transform the whole keyboard to produce Russian or Greek. A dead-key system allows you to customize mnemonic access to individual characters. The customization procedure is clear, but the inadequate manual makes you figure out the default setup on your own. For total frustration, try the procedure for changing character sets—the program keeps complaining that it can't find files on disks that it never asked you to insert. You'd do better to start over with a fresh installation. Turbofonts does the job, especially when it

Monitor's display, though the white isn't quite as crisp.

The .31-millimeter dot pitch matches the Enhancer's, but the brighter Mitsubishi screen makes text easy to read from a bit farther—if you can see past the glare.

Compared head to head, the Enhancer's true ECD compatibility, glare-resistant screen, and stylish appearance put it way out in front of the EG-19, though its colors are not quite as good as IBM's. But if all you need is large-scale EGA graphics, either monitor will give you what you want and will likely give your coworkers a heavy dose of monitor envy as well.
**Do What I Mean, Not What I Say**

"If you're considering an IBM-compatible personal computer, don't be misled by price alone."

—COMB mail-order catalog ad for Xerox 6064 PC

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**Don't Be Misled by The Instructions**

Directions for using Rockwell Chemical's CRT cleaner: "Apply to clean, dry surfaces . . . ."

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**On the Skids?**

A recent Logitech Inc. advertisement says PC Paintbrush "offers 11 type fonts, a pallet of 16 colors . . . ."

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**Bank on It**

"Intel has also announced the 83385 cash controller . . . ."

—Computer Software News, February 16, 1987

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**Classified Intelligence**

[Hyundai] Bluechip Options Now Available at Evans: M/S DOS 3.2 with GW Basic Software Package .................69.97
TTL Green Monochromatic Mirror .....................89.97
Second Floppy Disk Drive ..........................129.97


Learn MultiMate Basic: Entre Computer Center conducts a course in MultiMate Basic, 9 a.m.-noon, Thursday and Friday, 2929 W. Anderson Lane. Cost is $175. Call xxx-xxxx.

—Austin (Tex.) American Statesman, February 9, 1987

APPLE II+, 48K, Disc Drive, color monitor, dot metric sprinter, with Apple writer. Only $995. xxx-xxxx.

—Battle Creek (Mich.) Enquirer, February 1, 1987

IBM Compatible Kaypro 16, 512K RAM, 360K disk drive, meg hard drive, portable color card, serial & parallel ports, DOS 1.1, Basic, Wordstar, Datastar, Calcstar, included all documentation and carrying case, $1200, xxx-xxxx.

—The Buffalo News, February 23, 1987

IBM AT, hard drive, Hayse monitor, 1.2 Sloppy, LQ printer, $3000. Call Chris, xxx-xxxx.

—The Rocky Mountain (Denver) News, January 25, 1987

IBM compatible, special promotion, 1024k turbo, complete with 2 drives, high resolution monitor, clock, ports, $1397; Hyperion $699. Computronics, xxx-xxxx.

—Ottawa (Ontario, Canada) Citizen, January 27, 1987

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**If You Can't, We Can**

A sample amortization table in R & R Direct Software’s ad for Financial Consultant, an $89 financial calculator program, is off by a factor of 10. It shows $9,009.69 interest paid in the first month of a 30-year loan on a $95,000 house ($900 is more like it). The headline for the R&R ad says: "With this Financial Consultant you can't make a mistake."

Read something bizarre about the PC industry? Send entries to Communiques. PC Magazine, One Park Avenue, New York, NY 10016. Contributors this issue: Charles Julian (COMB), David Neme (Apple), John Darrow (CRT cleaner), Harvey Zabinzki (endless loop), Noelle Whitney (cash controller), Stephen Cohen (DOS to J), Bruce Hilfer (Financial Consultant), Jorge del Pinal (Hyundai), Sam Kaplan (MultiMate), Camela Vassen (metric sprinter), Terry Burkhard and J. Robert Sherwood (Hayse monitor), John Miyasaki (PC Paintbrush), J. Scarowsky (high resolution monitor).
How to choose an online service

Online services make your PC come alive. But before you settle on one, here are some helpful tips.

1. What are you going to need it for?
   Some services cater primarily to investors, while others are trying to be all things to all people. The Source, on the other hand, offers a carefully developed blend of sophisticated communications tools, easy-to-find information and active Special Interest Groups that can be used for business support, personal enjoyment and household education.

2. What will it cost to learn?
   After you find a couple of services that seem to fit your needs, ask about their tutorial offerings. If they don't have any, forget it. Beware of services that offer free connect time without a tutorial. This time gets used up fast and then you're on your own.

   The Source has a free, award-winning tutorial that's an easy, step-by-step guided tour of services including business and investing, travel and communications. It gives you all the time you need to learn because there are never online charges for the tutorial.

3. Check out the customer support staff.
   Can you get through to them easily? Are they helpful? Do you like them? Ask tough questions about the service and see if they can handle them. Our customer support number is 1-800-336-3330, by the way.

4. Be sure you get your money's worth.
   This is tough sometimes. Services that advertise that they cost less can end up costing more. Services that look like they offer everything can be a disappointment when you join and have to pay extra for the services you really wanted. Before you join, find out which services have surcharges or premium program charges. The Source is one of the few networks that doesn't offer a lot of "a la carte" pricing. We actually charge less for heavily used services like our Special Interest Groups.

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CIRCLE 136 ON READER SERVICE CARD
SuperCalc4 combines networking and standalone capabilities with the introduction of Version 1.1. The new release runs on most LANs, including Novell Advanced NetWare, 3Com 3 Plus, IBM PC Network, and IBM Token Ring Network, and has standard network capabilities such as file locking and network print spooling. A single copy of Version 1.1 is priced at $495. A SuperCalc4 LanPack, which allows three users to access the spreadsheet only in network mode, is priced at $495. Registered users of earlier versions can upgrade to either product for $100. Also, Computer Associates is now shipping all its software products, including SuperCalc4 and EasyWriter II System, with 3½-inch and 5½-inch disks. Computer Associates, San Jose, Calif.; (408) 942-1727.

Intex Solutions has announced a new pricing policy on its X-Y-Z products that work on multiple (more than 12) I-2-3 or Symphony spreadsheets. Customers can purchase the larger versions of any two X-Y-Z products for $395 (the original price for one product) or any three for $495. The small versions, which work with up to 12 worksheets, will continue to retail for $145 each. Intex Solutions Inc., Wellesley, Mass.; (617) 431-1063.

EasyLAN, Version 3.0, adds compatibility with NETBIOS, allowing users to run applications programs written to IBM’s network interface standard and to develop their own NETBIOS-compatible LAN applications. Single copies of EasyLAN are priced at $99.95, and upgrades are $25 for registered users. A two-PC kit containing two copies and a connecting cable is also available for $219.95. Server Technology, Sunnyvale, Calif.; (408) 738-8377.

Brown Bag Software has ceased distribution of the Brown Bag Word Processor with Mail Merge, though it will continue to provide technical support to current users. Brown Bag will direct future orders to Quicksand, which had licensed portions of its PC-Write code for use in the Brown Bag Word Processor. Quicksand, Seattle, Wash.; (206) 282-0452.

Toshiba reduced prices on its 24-pin P351 and P351C Model 2 dot matrix printers by $200 and $150, respectively. Toshiba America Inc., Irvine, Calif.; (714) 583-3000.

Nashoba Systems’ Nutshell flat-file database manager, previously distributed by Leading Edge until taken off the market in August 1986, is available again through CTC of Framingham, Mass. The suggested retail price of Nutshell is $150. Registered users who could not obtain Release 2.0 can upgrade for $75. For information on Nutshell dealer locations, call (617) 879-7444.

Zenith Data Systems has reduced prices on four of its portable and desktop personal computers. The dual-drive Z-148 was reduced $200, to $1,299, and the price of the Z-148 with a 20-megabyte hard disk dropped $300, to $1,899. Zenith’s Z-248 with a 40-megabyte hard disk now costs $4,999, a reduction of $700, and the Z-171 portable dropped $400, to $1,999. Zenith Data Systems, Glenview, Ill.; (312) 391-8860.

Okidata is offering Microline 292 and 293 printer drivers that speed the printing of 1-2-3 and Symphony graphs. The software, called the Lotus-compatible Microline 292/293 Driver, contains 11 drivers that provide support of high-density (240- by 144-dot-per-inch) color and monochrome graphics. Okidata is shipping the software, valued at $49.95, to Microline 292 and 293 buyers free of charge until May 1. The company says it plans to make the drivers available to current owners in the future. Okidata, Mount Laurel, N.J.; (609) 235-2600.

Okidata is offering new buyers of its Microline 292 and 293 printers free printer drivers that enhance 1-2-3 and Symphony graphics.

In brief: Software Publishing Corp. is offering a free conversion disk to current PFS:File owners that allows them to convert their data files to First Choice file folders. Users should contact the company at (415) 962-8910 to obtain the disk... Commodore Business Machines is bundling a free copy of Borland’s Sidekick with its new 8088-based machines, the PC10-1 and PC10-2. The two machines are priced at $999 and $1,199, respectively. Commodore Business Machines Inc., West Chester, Pa.; (215) 431-9100... The latest release of 101 Macros for Lotus 1-2-3 now has 106 macros written in both the 1A version and the 2.0/2.01 versions of 1-2-3. The price of the new release is $69.95, an increase of $20; upgrades are $20 for registered users. Macropac International, Cupertino, Calif.; (408) 996-8143... Wilkinson Software of Westminster, Calif., is offering owners of Eagle Computer systems a hot line number—(714) 895-1759—for technical support, parts, and service... R&R Relational Report Writer, Version 2, has 75 enhancements, including 16 printer fonts that can be specified for fields and text, a report title page, and nine new calculated field functions. The new version also includes Relational Merge, which allows users to prepare form letters directly from related dBASE files. R&R is priced at $149; upgrades are $35. Concentric Data Systems Inc., Westboro, Mass.; (617) 366-1122... Scientific Systems has reduced the price of Forecast Master by $200, to $595. Scientific Systems, Cambridge, Mass.; (617) 661-6364... ChipSoft has announced a new electronic bulletin board for users of its TurboTax programs. The board, which can be reached by dialing (619) 581-2439, has information on release schedules and the current status of all TurboTax programs. ChipSoft Inc., San Diego, Calif.; (619) 581-2233... Mastersoft has added support for four additional word processor formats to the latest version of its Word For Word document file conversion utility. Version 2.0, priced at $149, now supports DisplayWrite 3, Microsoft Word, OfficeWriter, and “Smart” ASCII formats. Upgrades are free to registered users. Mastersoft, Phoenix, Ariz.; (602) 277-0900.
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<table>
<thead>
<tr>
<th>Frequency</th>
<th>Display</th>
</tr>
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<tbody>
<tr>
<td>15.75 KHz</td>
<td>CGA 320 x 200</td>
</tr>
<tr>
<td>18.75 KHz</td>
<td>MDA (Hercules) 720 x 348</td>
</tr>
<tr>
<td>21.8 KHz</td>
<td>EGA 640 x 350</td>
</tr>
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</table>
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<table>
<thead>
<tr>
<th>Frequency</th>
<th>Resolution</th>
</tr>
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<tbody>
<tr>
<td>30.0 KHz</td>
<td>PGA resolution 640 x 480, 1056 x 352, 132 col. x 44</td>
</tr>
<tr>
<td>31.5 KHz</td>
<td>CGA DoubleScan: 320 x 400, 640 x 400</td>
</tr>
<tr>
<td>35.0 KHz</td>
<td>CAD/CAM 800 x 600</td>
</tr>
</tbody>
</table>

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CIRCLE 114 ON READER SERVICE CARD
HOW FAST IS FAST?

Despite the technical obstacles and the changing meaning of "fast," everyone wants faster machines. We'll figure out what to do with them later.

Just when you thought your PC AT was pretty quick, along comes a generation of 80286- and 80386-based machines that run twice as fast. Twice as fast is just that—the difference between driving at 55 and 110. The chip manufacturers, meanwhile, are looking forward to clock speeds in the 20- to 24-MHz range, or three times the current 8-MHz standard.

Kid stuff. To be in step with the future, you’ve got to think in terms of 10, 100, or even 1,000 times faster than the current generation. To do so, we’ll have to step beyond today’s stodgy processors and look at two emerging technologies, superfans chips and parallel processing.

Silicon has been the semiconductor of choice for building transistors and integrated circuits almost from the beginning. Today’s designers, however, are beginning to find the limits of silicon’s capabilities. There’s a limit to how many transistors you can pack onto one chip and how close together they can be. Much design and engineering effort goes into shrinking the grooves and ridges that define the parts of the transistors. As the features approach 1 micron (a thousandth of a millimeter), weird things begin to happen. Logic chips don’t do what they’re supposed to. Tiny lines of metal carrying electrical signals vaporize as the current density exceeds thousands of amps per square inch. The combined heat buildup of thousands of infinitesimal transistors causes meltdown of the entire chip.

A stopgap solution is to build integrated circuits on materials that are better heat conductors or that have electrical characteristics more conducive to high-speed operations. Silicon-on-sapphire (SOS) is as exotic as it sounds. Integrated circuits using this technology are finally available after more than 15 years of research. Silicon-on-insulator (SOI) technology is maturing rapidly, too. Both can potentially double the operating speed of today’s microprocessors in the next 3 years.

Even the fastest silicon-based technologies can’t hold a candle to the incredible speeds being offered by gallium arsenide devices. Gallium is a weird metal that melts in your hand. Arsenic is . . . well, arsenic. Together they make a semiconductor that is ideal for high-speed transistors and integrated circuits.

Recent advances in gallium arsenide (GaAs) technology have pushed the clock speed up to 18 GHz, or over a thousand times faster than the clock speed of today’s 80386. Of course, no one has yet built a GaAs circuit that in any way approaches the complexity of an 80386 chip, but they’re laying the groundwork. GaAs also promises to be one of the lowest-power-consumption technologies. This is especially important in avoiding deadly heat buildup in dense chips.

GaAs speeds will force breakthroughs in memory technology, too. Until then, however, we will see more intelligent memory management units (MMUs). The MMU’s job is to second-guess the processor and figure out what data and instructions it needs before it needs them. It then moves the required information from slow, cheap memory to fast, expensive memory. Sophisticated statistical techniques make MMUs effective 85 to 99 percent of the time.

Parallel processing is a completely different solution. It is much more complicated—and more elegant—than simply mashing the throttle to the floor. Parallel processor chips are generally designed from scratch to work closely with one another, although Intel has a design that uses multiple 80286 chips.

The key to parallel processing is not so much in the processors themselves, but in the compilers and operating systems. They must understand how to decompose a task, spread it among multiple processors, and assemble their individual efforts into a usable end result.

Parallel processing also gets around a major limitation of faster processors: the response speed of memory and other system components. Rushing data around at 30 MHz is well and good, but chips that can keep pace are very expensive.
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THE COLD FACTS
Now let’s be utterly realistic and say that the obstacles to using these advanced technologies in PCs are enormous. You can buy a Transputer board that fits into a PC today. You can add up to four more Transputers to it. But your DOS programs have to handle it tasks, let them execute, and collect the results. That’s hardly the most efficient way to use parallel processing.

The PC (and AT) bus structure is at least part of the problem. As computer buses go, it’s not particularly fast or flexible. I recently saw a new desktop computer with an 8-MHz 80286 and EGA graphics right on the motherboard. The graphics performance was noticeably smoother and faster than what I was used to. Why? Because the chips were talking directly to one another rather than through the PC bus.

Speed is at least part of the reason why IBM has wanted to change the PC bus for some time now. On one hand, it’s great to be backward compatible. On the other, we’ve got to move forward and accept new technologies as they become available.

There is a huge software deficit caused by the embarrassment of riches on the hardware side. It’ll be a long time before an end-user system able to harness this power becomes available. It’ll be a longer time before applications programs avail themselves of the power. The advent of multitasking operating systems for today’s PCs is a good way for software designers to warm up.

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SUE YOU, SUE ME

Software developers who borrow another's "look" are starting to look over their shoulder. It's not the competition they're worried about; it's the lawyers who scare them.

Developers scream and yell. They moan and groan. Everyone is up in arms over the recent lawsuit brought on by Lotus against Paperback Software and Mosaic Software for selling Lotus clones.

The issue is over something called "look and feel." The grippers tell me that the lawsuits over software "look and feel" will hurt innovation. When I'm told this I ask: What innovation? Lotus clones and more Lotus clones? Is that innovation? I don't think so.

There is an irony here, too. The reaction of developers to the suit over use of the Lotus user interface has got to be the biggest change in attitude ever accomplished overnight. I hang around with developers and they are always complaining about getting ripped off. Now they are complaining about someone doing something about an alleged rip-off. What a bunch of complaining crybabies!

You can be sure that if the recent lawsuit was instigated by some small-timer against Lotus for its borrowing an idea or some code, the community would be cheering. With Lotus in the catbird seat, everyone is complaining. Nobody likes a bully, I guess, and that's the way Lotus is perceived. I suppose there is some justification for this attitude. You didn't see Lotus throw Boeing and its BoeingCalc into the pot, did you? "Let's not sue anyone with money! Let's find some small fry and bleed them." Nice guys.

But we can't ignore the varnish of hypocrisy that coats the grumbling developers. Shaking their collective fists at an unseen enemy, they're all saying, "Well, if Lotus wins then I'm going to sue so-and-so." The lawyers' phones are a-ringing.

Calm down, boys. Have a cup of hot cocoa.

DO IT YOURSELF What will these "look and feel" cases mean? It's apparent that developers will not get away with lifting a user interface or even a screen. This makes cloning harder than before. Then again, maybe not. Borland, for one, stumbled onto the ultimate solution to the clone issue: its new word processor, *Sprint*, will have a programmable, do-it-yourself interface.

The developer simply creates a kind of "front-end construction set" that allows you to design your own user interface. If you make it a dead ringer for, say, *WordStar*, then that's your business. I can see a book now: *Designing a User Interface in the Privacy of Your Own Home*.

Now the software vendor can legally tell you how to design a front-end that is similar to your favorite, but cannot provide it or encourage you to copy a protected interface. Meanwhile, you can be sure that clone templates will be flying at the user group.

So what the Lotus clones will have to do if they want to use the Lotus user interface is sell a spreadsheet kernel with a programmable user interface and let the end user turn it into Lotus.

The funny side of this is that you can be sure that once the user interface is taken out of the hands of developers, the end user will be far more creative than developers ever were. No mere cloning. I don't know about you, but I'd love to rearrange things a bit on the Lotus screen. Some really creative users may even design user interfaces that have never been seen—creating new ways to interact with the program. And why not? All the interesting innovation comes from the masses, the users, the creative guy on the street.

This means that the Lotus suit may be a boon to creativity, not a road to ruination and a way to stifle incremental development. But who listens to me? Especially when it concerns what seems to be a company that everyone loves to hate: Lotus. We'll watch these cases closely. Personally, I don't care who wins.

The funniest thing about all this is that Paperback Software's lawyers have asked the judge to throw out the suit. The reason? In all this commotion it turns out that Lotus never received an audiovisual copyright for its screens!
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INSIDE TRACK

Politics clouds the future of Windows; PCs outshine the Mac; and a paint program does away with icons.

Windows, Windows. All I hear about is Microsoft Windows. There are jokes about it (“I don’t do Windows!”) and prognostications (“Windows is the future”), but you still don’t see any end users running it.

Moreover, there is a major political problem with Windows among the developers. This was evident at one of our PC Magazine Editors’ Days in Los Angeles, where editors get together with developers and marketers to discuss the state of the world.

Here’s the litany (more or less) you hear from the paranoid developers: “Why should we put our program under Windows? We are competing with Microsoft because it publishes applications programs. If our program is a success, then Microsoft will do a version under Windows that may be able to perform undocumented feats that we don’t even know about. Worse, Microsoft may change Windows so that we’ll be unable to update our version and it’ll have the market to itself. We could be doomed if we go with Windows.”

Bill Gates, of course, denies there is any possibility of this happening. But, unfortunately, Gates has told friends (and I think it may be a public statement) that he wants Microsoft “to become the IBM of software.” And what’s IBM best known for? That’s right, tactics similar to the litany described above—pulling the rug out from under the competition. Perhaps Bill should have said he wants to be “the Mother Teresa of software.” He’d look kind of funky in a habit.

What I personally don’t like about Windows is the feel of the user interface. I use a Macintosh enough to know what a mouse-based point-and-click interface should feel like. Go play with a Mac and you’ll see what I mean. Windows is clunky by comparison. Very clunky.

When I’m shown Windows, it’s the user interface and whiz-bang features that are emphasized. For example, I’m always shown the way the graphical interface can shrink a program and have a miniature screen running in a smallish window. Would someone explain to me why I’d want to do this?

If today’s user needs anything, it’s true multitasking and a real busting of the 640K barrier. I’m sick and tired of having to reset my system with a special AUTOEXEC.BAT and CONFIG.SYS so I can go to my database manager and look something up. Normally, with an on-line thesaurus, cache, and a miscellaneous utility loaded as memory-resident programs or device drivers, I get an “Insufficient Memory” message. When will this lunacy end? Memory is cheap.

But after reading this diatribe, are we missing the point of Windows? I found that my old friend, Alan Cooper, an ex-hippie turned super-programmer, has turned into a Moonie for Windows. “I had to be convinced while kicking and screaming,” he told me. “Windows isn’t a user interface; it’s an applications programming interface and that’s all it is. It makes it easy for a programmer like me to get his job done without having to reinvent the wheel. The routines available are fantastic and perform well,” he says, as he drools over the library of routines he won’t have to write, debug, or worry about.

Forget the user interface; Windows is actually a set of supported software libraries designed to speed software development. Some may say Microsoft wants to turn the world into mental midgets: clones of lazy 68000-type programmers who hate to code anything complicated and in anything other than C. “Why, I remember back when you were a young whippersnapper that no real man ever wrote in whatcha call your C! It’s for wimps. We wrote in assembly language—period! This Windows thingamajig is for wimps, too.”

Immediately I wonder why all this help for programmers isn’t in the plain-vanilla DOS! I ask around and discover that most of the heavy-hitting part of Windows will be in the 386 DOS in some way, shape, or form. We’ll see. I’m Windowed out.

Turning Your PC into a Macintosh Dept.: Macintosh users like to show off their machines to the unwaried by wowing them with MacPaint, which uses the mouse to doodle on the screen. For some unknown reason, the IBM world doesn’t like to emphasize these capabilities. It can be done.

If you want to amaze and delight your friends, then get a Mouse Systems or Microsoft mouse (the bus mouses are the best) for about $199. Make sure you have an EGA-type graphics card, then buy one of two paint programs that I like a lot. The most popular is PC Paintbrush for $99 (and PC Paintbrush Plus, $149). Over 400,000 copies of this thing are in use, so someone is having fun. (ZSoft, 1950 Spectrum Circle, #A-495, Marietta, GA 30067; (404) 980-1950.) This is like a full-color version of MacPaint, with a similar user interface. On an AT, this program is a real attention-getter. Highly recommended for even the most pompous IBM user.

I also like the Rix Software product, EGA Paint. (Rix Software, 18552 MacArthur Blvd., #470, Irvine, CA 92715; (714) 476-8266.) It uses a totally different interface with windowing (not like in Microsoft Windows) pop-up menus to select functions. If you hate the Macintosh icon idea, this is the package for you. For $79, it’s a real steal.
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WHERE E-MAIL SYSTEMS FALL SHORT

Services that ought to be boons to productivity don't quite make it, because the tools to use them are too crude. Lotus's Express is but a start in the right direction.

Communications software is unquestionably getting better and more sophisticated. ProComm, Relay Gold, and reportedly the new version of Crosstalk are powerful, flexible programs. At the other end of the spectrum, PFS:Access remains a good choice if your needs are simple—and we may have to drop that qualifier when the inevitable PFS:Professional Access upgrade comes out later this year.

Most interesting of all, though, is Lotus's new Express package. Not just because of its appealing features and style, but because it marks the advent, finally, of a new category of comm software: the dedicated e-mail comm package. I love all those bells and whistles in Relay Gold, for example, when I'm trying to solve a tricky comm problem; but when all I want to do is check my MCI box, they're superfluous.

By contrast, Express recognizes the different needs of the habitual e-mailer. Get and a few other products, such as Transend, have made moves in that direction, but none are fully realized answers to the e-mail sending, checking, reading, and filing needs of that large and growing class of PC users who've come to rely on a third-party e-mail service.

However . . .

Lotus still hasn't given us a good answer to what I think has been the most visible, most infuriating lapse in comm packages: the lack of an easy-to-use, pop-up full-screen editor that's usable while you're on-line, as a refuge from the truly horrible line editors lurking within the e-mail systems.

If you haven't used e-mail much, this column won't make much sense. If you have . . . well, I can tell who you are, because I can hear you banging your tin cups on the table, à la George Raft, shouting, 'Better editors! Better editors! Better editors!'

When you're on-line, reading your incoming mail, and find a message that needs a response, you're forced into either of two options. If you can get by with one of those terse, one-or-two-sentence e-mailly answers, just peck it in, ignore the typos (or hit a couple of x's after mistakes), and send it.

EVERYBODY NEEDS AN EDITOR

But if the message you're responding to requires more than just a few words, you'll probably save it to disk, go through the rest of your mail, drop off-line, load your word processor, write the response, save it in plain ASCII form, go back on-line, log on, type in the recipient's name or account number . . .

Whew. Ain't PC productivity grand? You'll do all that—in the process losing most of the immediacy of e-mail—because trying to write longer messages on-line will force you, inevitably, into using your e-mail service's on-line editor, which is so bad that it's useless.

But let's say that instead your comm software has a pop-up text editor for those times when you want to write a longer response while you're on-line, then squirt it into the system. Let's say that editor opens a nice horizontal window about 60 characters wide and maybe 12 to 15 lines high.

Within that window you compose your message. And within that text-editing window you've got three or four levels of relatively shallow (to save on transmission costs) three-character tabs. You've got the PC's usual jump-around keys (PgUp, PgDn, Home, and End). You're normally in insert mode but can toggle into replace mode.

There are no margin settings, because your text is automatically formatted (with word wrap) into lines no longer than are visible in that 60-character-wide window (which, along with the 12- to 15-line window height, is intended to let enough of that "live" on-line screen show to remind you you're still on-line and the meter is ticking).

When you're finished, you give the message a once-over. You spot a mistake up in the third line; just cursor up and over and fix it. Then with one or two keystrokes you squirt the message out into the e-mail.
system—to which, of course, it appears to have come hot from the keyboard.

The editor is smart enough, of course, to insert hard carriage returns at the end of each of those 60-character-or-shorter lines as they feed out into the e-mail system, to avoid gagging the system with lines that are too long.

Bingo: your comm software has outsmarted the clowns who built the e-mail systems' line editors (though to be fair, these make more sense than full-screen editors, which would be shipping characters back and forth endlessly at 300 to 2,400 bits per second to give you that full-screen freedom).

You can roughly simulate that kind of convenience now by loading a pop-up editor accessory, such as the one in SideKick, along with your comm software. But that's clumsy and lacks the special features, such as hard carriage returns at line ends, you need for e-mailing. That editor ought to be in the communications program.

CALLING SYSTEMS DESIGNERS

There's nothing hard about coding and adding that kind of pop-up editor to a comm program. The hard work is in seeing that it's needed, and that doesn't happen until we get enough people who design

- Trying to write longer messages on-line will force you, inevitably, into using your e-mail service's on-line editor, which is so bad that it's useless.

software to use e-mail systems themselves so they'll notice what they'd like to have in such a package.

That's begun to happen, and it's a good part of the reason why we're seeing such mail-fetching packages as Express. A program like Express, which captures everything for a later, off-line reply (but preserves such nice details as auto-addressing of responses), is in some sense finesses the need for a decent on-line editor.

But not everyone wants a background-function auto-fetching e-mail comm program. Many of us will continue to prefer interacting directly—on-line—with e-mail systems. For that we need decent editors built into our comm software.
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THE DEATH OF PROGRAMMING?

Dependable BASIC is not quite ready to give up the ghost, it just needs a little nourishment. High-level languages, on the other hand, have something to worry about.

This, as we all are coming to realize, is the year programming languages will become utterly obsolete. The arrival of amazing tools called applications generators will finally wrest control of computers from the hands of the high priests known as programmers and put power squarely in the hands of users. By answering a few simple questions, anyone, no matter how untrained, can now create his or her own customized database, spreadsheet, word processor—or indeed any application he or she can envision. Imagination suddenly and truly will become the user's only boundary.

So mark this year well. The year that true user power finally arrives. The year that programmers begin searching frantically for new jobs. The year: nineteen eighty—

Oops. Excuse me. Apparently I opened the wrong file. This one says down at the bottom, "Advance material. Not to be used till next year." I guess I got mixed up because it's dated 1981.

YOU STILL HAVE TO PROGRAM I'm sure you can understand my confusion. For years now, oracles have routinely announced the impending demise of programming. But applications generators, while undeniably useful, never quite go all the way. The one that comes with Paradox, for example, can churn out line after line of useful code. But for certain just-beyond-rudimentary operations (such as automatically generating sequential record numbers), the bad news is that you still have to program. And what you have to program in is a tongue you probably didn't learn at your mother's knee: the Paradox Application Language. Time to hit the manuals, PAL.

Final proof that applications generators aren't the whole story? We still need programmers to generate them. It's safe, then, to assume that we could still make excellent use of better languages. The way things are going, we're not likely to get them.

At one time, programmers actually encouraged the development of higher-level, more-English-like languages. Now that idea seems to have been banished from the realm of general-purpose languages. The thought that someone who hasn't undergone years of training in the "right way" of programming might be able to create something useful seems to fill longtime programmers with nameless dread. I get the feeling that programmers sense that hard languages mean high salaries.

So now C has suddenly become the language of "real programmers," while BASIC is considered with the sort of disdain reserved for computer toys. And even the designers of the latest versions of BASIC are doing the things "real" programmers want instead of the things BASIC aficionados want. Microsoft's QuickBASIC and Borland's new Turbo BASIC, for example, offer the ability to abandon line numbers and make the language more structured, more like a "real" language. Nice, but if BASIC programmers wanted a structured programming language, they'd learn one; what they want is a faster, slicker version of what they already know and love.

WHAT'S MISSING What's missing from the new BASICS is twofold: stuff that's already in interpreted BASIC and stuff that BASIC programmers desperately crave. The BASIC interpreter makes it easy to renumber a program in a flash. The new compilers can't do that at all. To renumber, you end up wasting time loading your program into the interpreter. The catch is that once the program gets beyond 64K bytes, the interpreter is off limits.

Now, you might want to renumber your program selectively to define clear regions of code, but the interpreter has never been able to do that. So, naturally, neither can the compilers; apparently the "real" programmers who designed them are so tickled with the idea of deep-sixing line numbers altogether that they want to make using them as uncomfortable as possible.

Another thing desperately missing from BASIC is decent technical documentation.
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About all you get in the way of heavy-duty technical help is a dumb little memory map, so trial and error is the only way to find out what a particular programming practice is likely to mean in terms of speed, size, or memory usage. What’s needed is a set of comparative charts of sample routines that says if you use this straight GOTO jump, it’ll take up this much memory and work this fast, whereas if you turn it into a GOSUB, it’ll work out this way. Do long variable names take up a lot more space than short ones? Is subroutine performance dependent on where the routines are placed within the program? Current documentation doesn’t give you a clue.

Worse, there’s currently no means of optimizing certain compiler-dependent portions of your program—unless you’re an assembly-language programmer. What would be lovely is a BASIC that allowed you to optimize what you need. For example, if screen rewriting was extremely important to you, you could customize the compiler to use superfast screen routines, with the caveat that compatibility might suffer.

To hear many programmers tell it, BASIC is a dead letter. I wonder. Along with virtually every microcomputer jockey, an awful lot of business programmers grew up with BASIC or COBOL, not C. No one would accuse COBOL of being a modern, highly structured language, yet there are probably more programmers who know and use it than any other language except BASIC. Yet C is all that seems to count anymore. And part of the reason is that higher-level languages aren’t as flexible or as fast as they ought to be.

It’s irritating that programmers always seem to want to keep making things more complicated. Why should we have to program in C and invest in prepackaged subroutine libraries just to clear the screen instead of being able to use an improved version of a more intuitive, more accessible language? The answer seems to lie in the realm of job retention and dogma rather than the realm of possibility.

FORTNIGHTLY FOLLIES Switching gears, a certain new Infocom text adventure offers Tame, Suggestive, and Lewd levels and comes complete with a Scratch ‘n’ Sniff card. However, IBM PC users with hard disks will discover the dirtiest, stickiest thing about the program is that its installation procedure wipes out their cherished CONFIG.SYS files without a word of warning.

Infocom’s advertising claims “there’s room for you on every disk.” What it doesn’t say is that you have to delete something first.

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I want to like the companies that publish the software I use. In fact, I think most people want to like the companies that publish the software they use.

This is a funny thing about software. It's not particularly true of hardware, either computer or peripherals, since I just want hardware to work. I want software not only to work but also to come from companies that I like and wouldn't mind working for. Maybe it's because software exists only in some sort of computerized ionosphere, and so it's hard to develop a relationship with a program.

Anyway, this is a long-winded way of introducing what amounts to my second confessional column (I confessed to buying mail-order products some months ago). My confession: I've been having an intense affair for more than 4 years now with Lotus's 1-2-3.

THE START OF SOMETHING BIG

Like any affair, my liaison with 1-2-3 has had many ups and downs. It all started one day (not particularly dark or gloomy) in the basement of Lotus's very first building in Cambridge, Massachusetts, in July 1982. Actually, the basement was the company's whole office. Mitch Kapor wanted to show me his new program, which he and his co-workers had just named, although he wouldn't tell me what the name was.

I had become involved with personal computers because of VisiCalc, which I had discovered running on an Apple II about a year earlier. I was heavily using that program, since I was ambitiously planning the launch of a new magazine (never published). Kapor showed me how 1-2-3 used more-complete menus and was more flexible; he demonstrated the features it had that VisiCalc didn't and then got to the pièce de résistance, 1-2-3's ability to graph any part of a worksheet. (Graphs were Kapor's specialty. He had just sold his first program, Visiplot/Visi-trend, to Visicorp for $1.3 million.)

COULD THIS BE LOVE? After I left, I thought 1-2-3 was a neat program: exciting, fast on the uptake, fun to be around. But it didn't do much for me at the time because I had an Apple II and 1-2-3 ran on an IBM PC. But I liked Kapor; I knew he'd raised a lot of money, and I thought he would probably be successful. (It must have been ESP.)

By the next year, after 1-2-3 had made its debut and was a clear hit, I got a real computer and started using 1-2-3 to plan yet more unpublished magazines and a newsletter or two. And yes, I fell in love with the program, even though I have yet to use it to graph a single named range. 1-2-3 was fast. Because it ran on the PC, I could build gigantic worksheets. Because 1-2-3 was so endearing, I fell in love with Lotus, too. It was a hot company that wanted to make a difference in its customers' lives and to treat its employees like real human beings. It was a fun company to deal with, full of grand ideas and bold strategies. And it had a hot product.

TROUBLE IN PARADISE Then something happened on the way to the bank. Lotus was so successful that it began to believe it knew everything and could do no wrong. Symphony, the company's second program, was introduced in 1984 with much hoopla. When the PC industry and users said it was a poorly designed failure, Lotus acted like it knew better. Jazz, the company's third major program, was introduced in 1985 with even more hoopla. When the industry complained that it was late and users complained that it was slow, Lotus acted as if it couldn't believe anybody would have the gall to criticize a Lotus product.

Meanwhile, 1-2-3 stood still. I began to fall out of love with it. I didn't use the graphing and sorting capabilities. I stopped trying to figure out how to write macros. As word processors and databases got faster and more capable, 1-2-3's speed began to look less impressive. I started writing tough articles about Lotus, criticizing the company for being arrogant and out of touch. This turned for the worse in my per-
sonal feelings toward 1-2-3, however, didn’t seem to affect its sales, which continued to grow and grow.

When Lotus finally introduced an improved version of 1-2-3, Release 2.0, in 1985, my feelings about it remained sour. Lotus had managed, first of all, to introduce some remarkable incompatibilities into 1-2-3, forcing users to keep track of which version of the program had produced each worksheet if a coworker had decided not to upgrade to the new version. More seriously, the company didn’t seem to improve the program in any substantial way. Instead it chose to improve upon what had largely been seen as weaknesses in the program.

Even though such features as linked worksheets, multiple windows, and macro recording were available in competitive products, the new version of my old flame did not have them. Now I was beginning to feel somewhat like a jilted lover, as though 1-2-3 not only looked old but was trying to dump me.

**FALLING IN LOVE AGAIN** Something marvelous has been happening in the last 6 months. 1-2-3 is beginning to look spry again, and I’m beginning to take a real interest in it and the rest of the Lotus family. Even though the current version of 1-2-3, Release 2.01, is essentially the same as Release 2.0, Lotus has been craftily improving the program’s wardrobe. With 1-2-3’s new sidekick, *Hal*, a rambunctious but friendly fellow, it’s much easier to talk to 1-2-3 and get it to do things that it wasn’t able to do in earlier incarnations. With 1-2-3’s sister programs *Manuscript* and *Freelance Plus*, it’s possible to create reports and other documents that really show off its number-crunching and graphing abilities to other people. With 1-2-3’s new add-in programs, it can do a number of things as though it were designed for them, including making faster calculations, processing words, and printing worksheets sideways. And most recently, with its little cousins *Metro* and *Express*, 1-2-3 can even do things like take notes, keep track of phone numbers, and call for and send electronic mail, all without bothering me in the least.

I’m beginning to think that this is one very exciting program. I’m even beginning to think that Lotus is a hot company again: maybe it isn’t as idealistic as it once was, but it certainly has produced a raft of hot products and is treating its customers like real people. Now, if only Lotus would do some serious internal surgery on 1-2-3 and take that nuisance of copy protection off my one true love, I might get so enthusiastic that I’d write a few macros and get another monitor to show off the graphs.
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<thead>
<tr>
<th>Feature</th>
<th>PrintQ</th>
<th>Buffers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A complete Print Spooler like those used on mainframe and minicomputer systems</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Automatically spools printer or plotter data to disk, not RAM</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Each printfile kept separate</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Allows control of report printing</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Re-start printing at any page</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Print reports in any order</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Automatically print multiple copies</td>
<td>YES</td>
<td>some</td>
</tr>
<tr>
<td>Prompt for form changes</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Prompt for forms alignment</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Hold for later printing</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Cancel printing at any time</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>&quot;Pop-up&quot; Status Display to control printing at any time</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>View reports on the screen before, during or after printing</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Save printed reports (archive) for reprinting</td>
<td>YES</td>
<td>NO</td>
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<tr>
<td>Works with GRAPHICS software</td>
<td>YES</td>
<td>some</td>
</tr>
<tr>
<td>Select any printer port</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Capture reports to ASCII file</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Programmable using batch (.BAT) file commands</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Price</td>
<td>$89</td>
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intel
In a world in which PCs cost hard-earned dollars and data that's taken years to build up can be destroyed in moments, you should consider the hardware alternatives that can keep your machine and your data secure.

As personal computer operations expand and consume an increasing portion of corporate assets, the security of the system and its data is more important than ever. Yet protecting your PC and the data it harbors is like treating a dog with fleas. As soon as you eliminate the problem in one place, it jumps to another.

A roundup of hardware security products now on the market, some of which we look at here, could make the least-suspicious person paranoid about his chances of becoming a victim. The many diverse products currently available are all designed to thwart tamperers, thieves, saboteurs, busybodies, mischief-makers, and just plain inexperienced users who, from within or without, intentionally or unintentionally, come into contact with your PC and its data.

But instead of calming your apprehensions, their number and variety can add to your fear of being ripped off. Unless you assess carefully what you really need and why you need it, as well as what you are getting and from whom, you run the risk of creating additional problems, incurring unnecessary costs, and diminishing your capabilities.

At the same time that security is becoming more essential, the PC battle cry continues to rally the industry around data and machines that users can access easily. When you restrict easy access, you risk losing as much as you gain from a more secure environment. Tightened security can impede the free flow of resources and information and the ease of administering systems. Also, too much security in one place can produce a security gap in another. On the other hand, security that's too tight may add far more to the administrative burden than it's worth.

When you're using a PC that sits out in the open, how do you protect the sensitive data that was once relegated to the sacrosanct security-intensive mainframe environment? How do you make sure that you're not putting more obstacles in your way than in the way of tamperers and thieves?

Both software and hardware vendors
COMMONSENSE SECURITY
Practical advice for keeping your PC and data secure.

You don't need any additional hardware or software to take the first steps toward making your PC and your data more secure. Here's a list of data security practices that are good common sense:

- The cardinal rule: If your data is sensitive and you're using a hard disk, don't leave it on the machine. Copy data to a floppy disk and lock it up for safekeeping. But be sure to obliterate the original on your hard disk when you do copy it to a floppy disk. Using the DOS DEL or ERASE commands doesn't wipe out the file; someone with The Norton Utilities, Mace Utilities, or similar programs can easily bring it back to life. Norton's Wipe File program will obliterate every last trace of the file. And so will PC Magazine's DELZ.COM utility (Programming/Utilities, PC Magazine, Volume 4 Number 21). All other rules are secondary to this.

- Name sensitive files somewhat cryptically. Instead of calling this year's budget plan BUD87.WKS, try calling it MOM.DOC. And keep a separate printed index somewhere prying eyes can't find it that tells you which files have which innocent-sounding aliases. It's awful to have to guess whether your new budget is called MOM or PICNIC or APPLE.PIE or PURPLE.COW.

If your software has built-in password protection and/or encryption, use it. For instance, with I-2-3, Release 2, "File Save File Name P" prompts for a password (twice) and then encrypts the worksheet.

- Use existing security devices. If you have a lock on your office door, use it. It may not be 100 percent burglarproof, but it's certainly a deterrent. If you're really concerned about security, lock your office when you step out. That's when you're especially vulnerable.

- Watch how you dispose of paper printouts. They often supply the easiest access to confidential information, especially in offices in which printouts are the primary form of backups. And if your printer uses a carbon ribbon, be careful what you do with it when it runs out. It's simple to reconstruct a file by reading the ribbon backwards.

- Be neat—it pays off. Don't tempt fate by leaving floppy disks with your data out in the open. If tamperers and snoops don't get 'em, coffee spills, dust, and fingerprints will. When you leave your desk, no matter how briefly, store floppy disks in a safe place.

- Avoid the obvious and be creative with user IDs and passwords. Tamperers and thieves have been able to get around some perfectly good security schemes because users insisted on using parts of their names or their initials as passwords. Don't tape the password to the bottom of your keyboard.

- Avoid putting sensitive passwords in your communications. If you feel you must script your passwords into your automatic log-on to take full advantage of your communications' capabilities, lock up communications scripts containing personal passwords when you leave the computer. Some communications programs, like Lotus Express, encrypt the password.

- Use special snooperproof disks, marked with unique physical "fingerprints." No two of these disks have the same fingerprint. A description of the fingerprint is encoded on the disk. When a protected file is accessed, the print and the description are compared to make sure you have an exact match before the decrypted data will be released. (Vault's Filelok is the most popular of this genre.)

- Use your AT lock for its intended purpose. While the lock may be only token security (see accompanying sidebar "Locked Out: The PC AT Lock and Key"), it's better than nothing. Record the key number (not on the hard disk!) and keep a copy in a safe place. An info center manager responsible for acquiring PCs should also keep track of the key numbers since he is the first person a user turns to if a key is lost.

- Consider purchasing removable media such as the Bernoulli Box or other removable hard disks. Some tape and disk combo units provide easy security because the device is external to the PC and tape backups are quick and efficient. (See "Drawing a Bead on Bernoulli," PC Magazine, Volume 6 Number 1.)

- Protect against unintentional destruction: hide or protect your FORMAT command. Versions of DOS later than 2.0 are smarter about avoiding formatting the hard drive accidentally, but it can still happen. Some smart users rename the command (one user I know calls it TAMROF, which is FORMAT spelled backwards). Others write simple batch programs that don't allow the PC to use FORMAT on anything but the floppy disk. And PC Magazine's User-to-User column has published several sophisticated techniques for preventing unautho-

have attempted to find the answers to these questions. In this issue we focus on the hardware method and on systems that combine software and hardware—physical devices that protect both your investment and your information. The six devices we look at, examples of the many the market makes available, include ACCO International's Locking Keyboard Cover, Micro Security Devices' PC Guardian, CVI Laser Corp.'s KBD-Lock, A-O Electronics' X-Lock 100, Jones Futurax's AutoCrypt I, and MPP's PC Lock IV. But first, consider some of the issues.

HARDWARE SECURITY YIN/YANG
Just as the whole issue of taking added security measures has two sides, so does the use of various types of protection. Chaing your PC to the desk or attaching screaming sirens under the hood thwarts outside intruders, but it still leaves the ma-

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rized access to your hard disk.

- Use Charles Petzold's ATTR program (Programming/Utilities, PC Magazine, Volume 5 Number 11). This, like DOS's ATTRIB program, gives files a read-only status, which prohibits anyone from making intentional or unintentional alterations. But better than DOS's, ATTR lets users hide files so they don't appear under normal directory searches.

- Look for inexpensive software security utilities that offer file protection. PC Magazine's FREEZE program (Programming/Utilities, PC Magazine, Volume 5 Issue 22), written by Jeff Prose, can help get you started. It works in RAM to let you suspend a program in midstream, blank your display screen, and lock the computer until you enter a password giving it the go-ahead to resume operations.

- If you're more ambitious, try reassigning some keys in some cinematic fashion. If, for example, you reassign your Enter key to some little-used key, you're bound to throw a ringer to anyone who tries to take a look at your data.

- Be watchful and wary. Know your coworkers and investigate loitering visitors, especially if they appear overly interested in your computer.

- Use extra caution when employees in your area are fired, have resigned, have been laid off, or have quit in a fit of anger. Since resentful employees have been known to destroy data immediately after being fired or laid off, be sure to change the passwords of such staff before they get the bad news, not after, when it may be too late.

- Know what you've got on disk.

Many word processors create temporary and backup files that are erased after you are done. Yet, as with other DOS files, when these files are erased, they are not erased completely. If you're not careful, someone could use The Norton Utilities to unerase them.

- Make sure your printer buffer has been cleared. If you've printed something using a print spooler, and someone knows how, he can come along and reprint what's still in the buffer.

- Security is such a big issue that readers are writing to us all the time with their suggestions. In our User-to-User column, we've published dozens of tips on everything from changing COMMAND.COM to prevent users from using the TYPE command to look at files, to using the PROMPT command to issue a scary "Unauthorized Access" prompt, to starting an AUTOEXEC.BAT file with another name, to hiding subdirectories, to renaming your word processor so that a casual snooper can't use it to search through files.

- Finally, you should keep these precautionary measures in check with a strong dose of humility and perspective. Your data is probably not as important to others as you may think it is. Industrial secrets are one thing, but even the most daftardly criminal would find it difficult to make use of your annual budget, financial planning spreadsheet, or payroll information to sabotage your efforts. Unless you're working in an environment that is highly secrecy sensitive, you probably don't have to worry too much if you just use common sense.

—Robin Raskin

Establishing a rational PC security strategy is a difficult task, partly because it's hard to know what you should protect yourself against.

could modify or obliterate it. And on it goes.

Establishing a rational PC security strategy is a difficult task, partly because it's hard to know what you should protect yourself against. The National Center for Computer Crime Data's recent study of prosecuted computer crime cases found that, contrary to popular belief, there's no stereotypical computer criminal.

With little information to go on, companies don't know exactly what to defend themselves against, and apparently many are losing out. "Many instances of computer crime go unreported," says Jay Bloomecker, the center's director. According to Bloomecker, frequently businesses are reluctant to pursue legal action for a number of reasons, including embarrassing publicity and the cost of taking legal action.

Outright crime is only one of the problems. David Dettloff, product manager at ACCO International, a maker of PC security products (including the Locking Keyboard Cover reviewed here), contends that "about 70 to 80 percent of the damage done to PCs in the office is unintentional and not malicious." A study by International Resource Development, a market research firm, concurs. It found that MIS departments perceive employee revenge as the second greatest threat to data security, second only to users' accidental errors. Bob Nagel, a systems consultant and designer of PC Accessories, reports that casual tampering, including the swapping of PC boards by coworkers, is on the rise.
Office environments in which PCs are the common property of a group of users create additional security concerns. And although you may not be worried about security, your most important customers may be. If you deal with some branches of the government or even if you’re subcontracting to security-conscious private firms, your customers may insist that you use some type of data security system.

In response to the need for tightened security in many offices, new products are proliferating to meet the attack. Inmac, a California-based leading supplier of computer products to corporations, has tripled its security product offerings over the last 12 months. “Without equivocation,” says Inmac’s John Erb, “we’re finding an increased awareness of security issues from our buyers.”

LOCKS: LOW-COST SOLUTIONS At their most basic level, hardware devices to deter physical tampering take the form of locks. Everyone understands their message: Private property. No trespassing.

Locks require minimal installation and are inexpensive, usually costing from $20 to $100. PC Accessory’s Nagel enthusiastically cites the benefits of these devices: “They don’t interfere; there are no passwords to memorize, no boards to install, and no memory chewed up by software; and the price is right.”

Locking the PC provides a good measure of protection from the professional thief or the casual meddler—which one depends on where you decide to put the lock. You can find a device that locks your PC’s keyboard, on/off switch, backplate, or cover screw or one that locks your PC itself to the desk, floor, or any other permanent fixture.

Unobtrusive keyboard covers with locks eliminate the possibility of someone’s accidentally or intentionally hitting a key. Other keyboard variations attach to the keyboard plug and let your workstation keep running while the keyboard remains locked. A lock encasing the computer’s on/off switch prevents others from using your PC. A lock on the backplate or cover screw of the PC chassis prevents under-the-hood access. Some of these locks are sold as combination units, offering protection at multiple points.

Businesses can never fully protect their PCs from theft. But they can make it more difficult for thieves to succeed.

IMMOVABLE OBJECTS Where the flow of human traffic is heavy, a number of organizations have begun to incorporate physical security as a routine part of every computer installation. At Amoco’s 80-story office building in Chicago, each PC is routinely outfitted with steel-cable devices and sirens.

A recently built public-access computer lab facility at New York’s Columbia University incorporates a high-tech, highly tamperproof design. Steel bars and case-hardened locks protect the CPUs. Monitors are cemented to the desks with space-age adhesives. This elaborate security effort, according to Columbia’s Frank da Cruz, “isn’t a backlash to any inordinate amount of theft,” but the precaution is taken because the minimal expense required to protect the equipment this way easily justifies it.

Houghton-Mifflin has adopted a preventive approach to security. The publishing company has housed its newly acquired ATs in locked steel casings and permanently affixed them to steel carts as an antitheft tactic. “It’s a start of a trend we will continue with other new purchases,” says Audrey Whitfield of the Business Software Division.

Since anyone with enough time and energy can find a way to defeat even the best security system, businesses and other organizations can never fully protect their PCs from theft. But they can make it more difficult for thieves to succeed. The idea is to make stealing the equipment so troublesome that the thief will decide to go next door where the pickings are easier.

Other physical lock mechanisms fend off an array of less criminal but equally serious activity associated with equipment that’s located in a public-access area. ACCO’s Detloff has a favorite PC security tale, which tells of the office-cleaning person who thoughtfully shut off the PC AT server, destroying the data of those connected to it. The company forthwith installed a $30 lock on the power switch to eliminate future catastrophes.

Board swapping is the next wave in nonmalicious tampering. Coveting thy neighbor’s board enough to do something about it has become quite popular. It’s not uncommon for “Joe to be sitting next to Frank and decide that Frank doesn’t need that fancy display card as much as he does,” observes Nagel of PC Accessories. “Joe then pops off the cover and helps himself.” Similarly, an employee may decide that his home computer needs the company’s memory expansion card more than the office computer. The best protection against board swapping, tampering, and messings under the hood are locks for the cover screw or backplate of the PC.

Despite the variety of products, some companies are reluctant to lock up the goods. Lack of a corporate security program seems to be a major obstacle. One New York bank vice president I spoke with feels that security is viewed as nonproductive work, and so it’s relegated to being a low priority. He confided that his bank did not have a comprehensive PC security policy and that it probably would not until “the first unpleasant occurrence.”

Rick Koenig of the Computer Security Institute, a Massachusetts-based clearinghouse for security professionals, compared security measures to backing up your data: “You believe in the procedure only after you’ve lost a couple of files.”

Some people are also leery of making the PC look like a prisoner on a chain gang. Unsightly locks and padlocks can be psychologically disturbing. According to Inmac’s Erb, attractive cabinets with built-in locks are preferred over bulky cables. Most of the locking-device manufacturers appear to be doing their utmost to give their installed products a low profile.

PROTECTING DATA Protecting the physical machine is certainly important, but in most cases the stored information is
A Mighty Fortress Is Our Computer?

What are you trying to protect and from whom? As the processing power of the PC increases, so does the sensitive nature of data stored on it. The old mainframe security procedures: lock down, log on, restrict access, and encrypt are back to haunt PC users who thought that personal meant "free from security concerns." Hardware security devices offer a variety of barricades against the forces that intentionally or unintentionally invade your office.
LOCKED OUT: THE PC AT LOCK AND KEY

The PC AT lock offers good data protection, but for some reason PC AT owners tuck the keys away rather than lock up their machines.

When PC Magazine first reviewed the AT, executive editor Paul Somerson predicted (“IBM Brings Out the Big Guns,” PC Magazine, Volume 3 Number 22) that the AT key lock would become a high-tech status symbol, worn ornamentally around the neck. During the auspicious AT debut, glossy photos showed the AT key dangling seductively from the AT lock.

The AT lock sits prominently on the front panel of the machine. You can remove the AT key from the lock in either the locked or the unlocked position. When locked, the AT cannot be booted. Furthermore, you can’t (easily) remove the system unit cover.

When it was first introduced, the AT lock represented a new dimension; it meant that the PC could handle the security needs, as well as the high-speed processing needs, of corporate users. Yet a few years later, most AT locks have atrophied from disuse.

User perceptions are to blame. It seems the user is more paranoid about losing the key than about losing the data. Informal surveys indicate that the AT lock has become primarily decorative, with most keys tucked away—out of sight and out of mind.

The disappearance of the keys is strange because the AT lock actually affords a good bit of built-in data protection. Somerson wrote optimistically about life before and after locks. “It’s possible [before the AT],” he said, “for an interloper with a nut driver to snap off the cover, twist out the hard disk, and walk through the front door with all your firm’s sensitive files under his arm. To the security guard, it’s just a can with a few wires hanging out; to you it’s your job, your whole future, down the sewer. But not with the AT. To pry the cover off, you need the sinews of Arnold Schwarzenegger and a crowbar the size of your leg.”

The AT lock and key are made by Chicago Lock Co. The circular design was originally developed by CLC founder Lyle Schinn in 1934. It’s the same lock you find on vending and pinball machines. The lock design is superior or to many others because it has more variations and is more difficult to duplicate than conventional locks. In addition, the lock’s “shallow” size doesn’t interfere with the AT internals. The lock trails two wires attached to the PC motherboard, which sense the position of the lock.

Obviously the lock protects your AT from casual, unintentional, and nonmalicious interference. The lock keeps out basically honest folks with inquisitive fingers, but the brutes truly dedicated to getting into a machine will not be hindered. It’s common knowledge that if you pry the cover off the machine, you can easily hot-wire the PC and bypass the lock.

Locking yourself out is an important concern though. “I think people are basically afraid of losing the key,” says PC Magazine contributing editor Charles Petzold. “If you drive a car, you know that if you leave the keys inside you can open the door with a clothes hanger. If you live in an apartment, you know that if you lose your key, you can get a lockman to make you a new one. But in my apartment, you can’t drive a car without a key. In the computer world, you can’t be locked out and easily get a new key. So developing a better lock is important.”

When you lock your PC AT, you can prevent unauthorized use, and often provide an audit trail.

Although installing this type of hardware requires a much greater level of sophistication than sticking a lock or bolt on the PC does, the benefits are many, especially when compared with software programs that perform the same functions. Unlike software, hardware—once you’ve installed it—requires little participation from you. Hardware is fast. The boards have their own processors; the protection is burned right into the ROM or PROM chips, eliminating the software journeys to disk and back. Finally, hardware leaves precious PC RAM available for applications.

Hardware can offer more-complex protection. As evidenced by the trail of broken copy-protection schemes, most software publishers are reluctant to use more than token out-and-back protection systems to check for unauthorized use. The more complex the software protection scheme, the more likely it is to interfere with the hardware.

Hardware is harder to violate than software. Even if the software protection schemes prohibit you from viewing data, you can seriously mess things up by simple tampering. Disks by their very nature are readable and writeable—hence susceptible. “The ability to reformat and erase data easily is the Achilles’ heel of software,” says Amoco’s Jesse Hernandez.

Hardware is so crucial to secure data absolutely that the National Bureau of Standards insists that the data encryption algorithm (DEA) be on a chip to comply with its rigorous specifications. You sim-
smite to come. But the key for the AT looks so funny that people are afraid if they lose it they won’t be able to use their machines again."

Since corporate mandates concerning the lock are few, the decision to lock or not to lock becomes an individual one. Some think the risk is worth it; they lock their machines. Others pretend the lock doesn’t exist. If you weigh the protection offered against the risk of playing with locks, you may put the keys away, deciding it’s safer not to use them.

What happens if you do lose the key? When you get your AT, you receive a plastic bag containing two keys and a hard tag with a number on it. You also get the phone number of Chicago Lock, which you can call to request a duplicate key—if you have the tag number. When I called IBM to find out where I might go for duplicate keys in the event that I lost my tag number, a helpful IBM spokesperson scrounged around the company vaults to unearth the Personal Computer Family Service Information Manual, which specifically states that duplicate keys are the responsibility of the customer. IBM apparently doesn’t keep records of lock numbers linked to AT serial numbers. Undaunted, I called Chicago Lock and learned that I could secure duplicate keys—if I had the key number. Lose the number and you’re at the mercy of a locksmith.

So it’s no wonder many people are nervous or skeptical about the lock. It’s come to be generally perceived as a nuisance that offers little protection. In fact, hardware reviewers barely note the presence or absence of a lock in the clones they review. Yet, as problem-ridden as it may be, the AT lock is one area where IBM bests the clones; the IBM PC AT key is much more complex and sturdy, and, if you have the tag number, you can get a replacement. Some clones offer locks and keys but include no instructions about duplication or replacement.

More important, the AT lock is actually a functioning lock. One reviewer told me about a clone with a “lock to nowhere.” The “AT lock” was achieved with a fake lock.—Robin Raskin

file after you’ve written it. Some hardware also encrypts on a file level, but because encryption on chips take so little time, they can encrypt and decrypt “on the fly.”

With this system, every time your program writes to disk, the data is automatically encrypted, and every time it reads from disk, the data is decrypted. This method is obviously more secure than writing a normal file out to disk, encrypting it, and then decrypting the whole thing when you want to work on it. With integral encryption, the only time the data is in readable form is when it’s in your computer’s memory, providing an efficient but transparent encryption mechanism. Yet the determined perpetrator could use a memory-resident Trojan horse to make a copy of the PC’s memory, thereby bypassing the encrypted disk file.

Encryption algorithms come in two basic styles: DES (Data Encryption Standard), which is the standard published by the U.S. government and repeatedly tested by the National Bureau of Standards, and proprietary algorithms, which are developed by the manufacturer or other party. Proprietary algorithms tend to be less expensive than the DES chip, and they often run faster, but DES is the way to go if you want the recognized standard.

CONTROLLING ACCESS Ideally you should have a system in place for assuring that unauthorized persons cannot get on the PC in the first place. As Dennis Stein- auer, manager of computer security and management for the National Bureau of Standards’ Institute of Computer Sciences and Technology, says, “Without user identification, you might as well eliminate many of the high-tech security products and go back to a physical lock.”

“Encrypting a file provides confidentiality, but user authentication ensures integrity,” says John Vyhnal, explaining the multitactic approach of the Jones Futurer line of boards. Hardware devices designed to authenticate or identify users control access to the PC, generally by distinguishing between different users of the same system (although some single users do install security boards on their personal rigs). They typically use a password-type scheme with different levels of password verification.

The devices actually grab control of the
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**X-LOCK 100**
The X-LOCK 100 is a complete security and usage management system for the IBM PC and compatibles. It ensures information integrity by restricting computer access only to authorized users and by encrypting and "hiding" selected files. The X-LOCK 100 also provides a usage management system that tracks computer resources and time. It is ideal for project tracking, time analysis and billing purposes. Important features include:
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- File protection and encryption
- Centralized control and management
- System usage reports and invoice generation

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**MDSS**
MDSS is a multi-dimensional voice security technology designed for a wide range of applications. Using both time and frequency scrambling, MDSS reduces the intelligibility of transmitted sounds and reconstructs them at the receiving end. This helps eliminate the possibility that confidential information can be overheard by eavesdroppers. MDSS technology can be used in a wide range of voice security applications, including:
- Two-way radios
- Base stations
- Mobile
- Truck and hold units
- Satellite communications
- Cellular telephone systems

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**X-LOCK 50**
The X-LOCK 50 is an inexpensive "security only" version of the X-LOCK 100. Consisting of a plug-in module and software driver, the X-LOCK 50 provides up to 180 authorized user accounts which are controlled by a single "super-user". Each user's password is encrypted and stored in battery-backed-up RAM on the X-LOCK 50. The X-LOCK 50 also provides DES encryption for files or entire drives:
- Low-cost hacker resistant security system
- Hardware based DES encryption
- Data protection even when the X-LOCK 50 is removed or damaged
- Battery backed-up RAM

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**GTX-100**
The GTX-100 is an intelligent modem designed to protect unauthorized computer access from remote sites. It features dial-back verification from a list of pre-authorized telephone numbers as well as password access. The GTX-100 is compatible with all major computer systems and provides authorized access until the caller's location and password have been verified. Major features of the modem include:
- Dial-back security
- Password protection
- Successful and unsuccessful access log
- Bell 212A compatibility
- RS-232 interface
- Auto dial/auto answer

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**GTX-100R**
The GTX-100R provides the same security features as the GTX-100 plus the ability to remotely power a computer on or off. The GTX-100R's "remote-on" feature allows a caller to turn a system on from anywhere—provided the dial-back and password security tests have been passed. The remote-on feature provides added flexibility and eliminates the risk of a passerby who might be tempted to tamper with a "live" computer:
- AC power relay rated at 15 amps, 117 volts
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- Dial-back security and password protection
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machine during boot-up and post-process to identify the user. Typically, the ROM on the boards contains some nonvolatile read-write memory that can store ID and password information. If the board is satisfied with the password, it releases control back to DOS. If not, it usually shuts down the machine; many of the boards also store a record of the attempted entries.

Even after you’ve proved that you’re an authorized user, the system can restrict your access to certain file areas. For example, at the American Institute of Physics, users are allowed only restricted access to payroll and personnel files.

Many access control mechanisms use implicit file encryption. If you ask for a file but you can’t offer the password to decrypt it, then you can’t see it. Others work by associating a user ID with a list of files, directories, or subdirectories.

Some products offer greater control by restricting access to peripheral devices on the basis of their predetermined status. Clarence Williams, of A-O Electronics (makers of X-Lock 100, reviewed here), notes that this restriction, combined with access control, prevents the disgruntled employee who’s just been fired from spending his last days on the job printing inordinate amounts of your company’s proprietary materials.

As National Bureau of Standards’ Steinauer notes, restricting access in different ways and at different levels brings up the question of efficiency. Wade Clark, president of MMPI, the data security board maker that sells PC Lock IV (reviewed here), feels that restricting data on the subdirectory level provides a sufficient degree of security without overcomplicating administrative issues. Kevin Powell at Shell Offshore reports that since his organization keeps only low-level data on the PC, restricting users to their personal subdirectories offers adequate security.

Those with more-sensitive data may opt to restrict on a file-by-file basis; doing so requires more system administration, often by a “superuser.” Implicit in any restriction of PC territory is the notion of such a superuser, endowed with superpowers, who can make and modify assignments. “The trick,” says Amoco’s Hernandez, “is to specify access with minimal impact on productivity.”

■ The next frontier in protection will address the issues raised by multitasking, multiprogramming environments.

AUDITING When the superuser sets up accounts, passwords, and restrictions, he can also use audit capabilities, supplied by hardware security devices, to monitor usage. Auditing hardware devices store records of usage in their RAM. Users can recall this information for use as the basis for report generation and invoicing.

SHARED INFORMATION The next frontier in protection will address the issues raised by multitasking, multiprogramming environments. “Physical devices are stopgap measures,” says Computer Security Institute’s Koenig, “more suitable where the number of PCs is small and the assets of the information you are trying to protect are identifiable. As computers proliferate and connect into each other, the security and ownership issues grow more complex.” Koenig, who lectures frequently on the topic of security, postulates the evolution of a more comprehensive information management approach, which is emerging with some new hardware products.

Currently a few products restrict access to the network from any node. But it seems that for the most part organizations are still running these devices through experimental paces. Until the products are proven to be effective, companies are reluctant to keep extremely confidential data stored on a PC, and that goes double when the PC is on a network.

Shared data also requires secure communications. To be secure, data transmitted via modem must be encrypted and decrypted as it enters and leaves a telephone network. Hardware products that can pow-
er up a PC from a remote location and also offer callback verification and password protection are being incorporated in the communications environment.

KEEPING IT SIMPLE “We’ve come full circle,” asserts Bob Petrie, vice president at Manufacturers Hanover Trust. “Superusers, log-ons, IDs—these are all mainframe security measures that have migrated to the PC level. The concept of the PC as a mini data center is the concept we need to sell to the user.”

Yet the old-line mainframe approach to security is less than satisfactory. As Amoco’s Hernandez reminds us, “The mainframe approach can detract from the objective of using the PC.”

Steinauer, of the National Bureau of Standards, raises an important issue: devices like security boards often change the way things on your PC operate. Thus when you’re trying to restrict access to the computer at the board level, you may find yourself restricted in ways you hadn’t anticipated. As Steinauer notes, “Security devices can make two types of errors: first, denying an authorized user access; second, allowing an unauthorized user to get in. By trying to minimize the second, these devices inadvertently maximize the first.”

So the biggest problem with security devices appears to be not in implementing features but in keeping the products simple. “If the device is hard to use and bogs users down, they’ll be reluctant to use it at all,” says MPP’s Clark.

Hernandez advises that companies attempt to reconcile the benefits of the PC environment with a secure environment, and in recommending products and security measures, he tries to “preserve the beauty of using the PC by trying to minimize the administrative overhead that accompanies security measures.”

Remember, the reasons to implement some kind of security are probably as numerous as the number of PC uses. And more importantly, the solution to each security problem is different. Before you decide to buy one of the products reviewed here, you’ll want to ask yourself and your company some questions, beginning with: What do we need to secure? What hazards do we need to secure it from?

—Robin Raskin
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Options for protecting your PC and the data stored on it are varied. Solutions range from the simple to the sophisticated. Some users opt for the physical protection of a lock or cover, while others require the added insurance of data encryption. (1) The Locking Keyboard Cover from ACCO International. (2) MPP’s PC Lock IV. (3) A-O Electronics’ X-Lock 100. (4) The KBD-Lock from CVI Laser Corp. (5) The 304 board and software that make up Jones Futures’ AutoCrypt I security system. (6) The PC Guardian from Micro Security Devices.

ACCO INTERNATIONAL INC.
Locking Keyboard Cover

The ACCO International Locking Keyboard Cover is exactly that—a $24.95 plastic cover that hooks over your keyboard and lock. Locking covers for your keyboard like this one offer security at its most basic.

Despite their simplicity, such locking covers can be very valuable to the operator whose machine is working on a big silent job—a super sort operation, for example. Locking up the keyboard prevents a worker with wandering fingers from messing up the job when it’s left unattended.

Security measures need not be complex, rather they should be designed to meet the threat. If a wayward keyboarder is a threat, the ACCO keyboard cover is a good, inexpensive solution.

—Richard Aarons

A-O ELECTRONICS INC.
X-Lock 100

The X-Lock 100 hardware/software system, from A-O Electronics, has three main components: a printed circuit controller board, a floppy disk with security management software, and a locking device that replaces one of the computer’s cover screws, thus preventing access to the installed board.

The board has a coin cell battery that is mounted in a plastic holder; it helps maintain on-board memory storage. An onboard microprocessor maintains up to 72 individual user accounts.

System security is provided through the use of passwords (access codes). X-Lock 100 monitors assigned codes to allow access to the system and also maintains a full record of activity by code.

X-Lock 100 creates accounts (users) by limiting access to the hard disk(s) or print-er(s) attached to the computer. A user logs on by entering a valid access code. X-Lock 100 then allows him to use the equipment.

The X-Lock 100 card operates in the background and is thus invisible to the
user. It times his activities and prevents him from accessing a disk or printer he is not qualified to use. It also records (for the system manager's eyes only) any attempts the user makes to access a disallowed device.

Because some hackers know how to bypass a DOS lockout, the $495 X-Lock 100 system will shut down the system if someone attempts to access a locked-out drive.

With \(5.07 \times 10^{16}\) possible access codes available, it is unlikely that users will be able to guess the codes. X-Lock 100 prevents scanning by shutting the system down if a user or users enter five incorrect codes in a row. (This feature makes password search programs completely useless.)

This sophisticated, compact, easy-to-manage system is completely secure as long as the X-Lock 100 card is in place. It provides protection only at the device level, but that is often precisely what is needed. —Richard Aaron

CVI LASER CORP.

KBD-Lock

The KBD-Lock kit, $9.95 to $64.95 from CVI Laser Corp., is an electromechanical key-and-lock system similar to the one provided as standard equipment on the IBM PC AT. With the KBD-Lock in place, you use a key to turn a rear-mounted cylinder lock to the on or off position. The cylinder lock is actually a switch that opens or closes the keyboard circuit.

The system also sounds an alarm whenever someone hits a key on the keyboard while the lock is in the protect position and the system unit is on. Installing the lock takes about 5 minutes, but it does require some knowledge of the insides of the machine.

If you've already envied the lock and key on the AT (see sidebar "Locked Out: The PC AT Lock and Key"), you'll want to investigate the KBD-Lock. —Richard Aaron

JONES FUTUREX INC.

AutoCrypt I

AutoCrypt I, from Jones Futurex, is a sophisticated auto-encryption system that works in the background. It offers the system manager many features to meet the needs of special security situations.

The heart of the AutoCrypt system is a printed circuit board providing hardware-implemented Data Encryption Standard (DES) data security (government-grade protection). The board is available with a steel cover to prevent unauthorized tinkering with the encryption circuitry.

AutoCrypt I software uses the encryption circuitry to provide multiple levels of access to users, depending on privileges that the system manager grants. Basically, the system manager assigns users key phrases (passwords) and access levels. AutoCrypt I is a relatively expensive ($690) but highly flexible and sophisticated security system. If your security challenges are complex and serious, you'll want to consider this system. —Richard Aaron

MICRO SECURITY DEVICES INC.

PC Guardian

The challenge to PC security is sometimes relatively basic. In a school, for example, the real security job might be at best to keep the kids from using the machines when the teacher is out and, at worst, to keep the little loves from walking out the
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door with the machine when everybody’s out. Micro Security Devices offers a solution: PC Guardian, a locking steel cover that fits over the power switch.

While the keyboard locks that appear on the AT and on many AT clones prevent unauthorized keyboard operations, they do not prevent someone from manipulating the master power switch or transporting the machine without authorization.

Inexpensive mechanical locking devices like PC Guardian can do the trick against that type of threat. You can also use PC Guardian to anchor an optional steel cable that is secured to some stationary object, such as a stand pipe. With PC Guardian installed, only a key holder can activate or move the system unit.

—Richard Aarons

MPPi LTD.

PC Lock IV

MPPi makes a series of controller board/software encryption systems using either the Data Encryption Standard (DES) ($99) or its own proprietary ($299) standard. Its PC Lock IV system not only encrypts data, but it also logs user access and illegal access attempts.

In this system, all users may encrypt all files on a file-by-file basis. The system manager controls all the encryption keys.

PC Lock IV implements user access and controls at several levels, including system (boot), directory/subdirectory, file copy, and command (copy, rename, erase, or delete subdirectory or file).

MPPi systems like PC Lock IV are reasonably priced, highly sophisticated security/encryption systems. They are intended for serious users with serious security applications. MPPi will also help you find special solutions for your individual security problems.—Richard Aarons

Richard Aarons is a contributing editor of PC Magazine. Robin Raskin is a frequent contributor to PC Magazine.
AT Power, Toshiba-Style.

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CIRCLE 348 ON READER SERVICE CARD
New, low-cost laser printers are challenging the HP dynasty, which has countered with an impressive new entry. Supporting products are flooding the laser market: printer-sharing devices, multiple-bin sheet feeders, and a slew of hardware and software enhancements. This article looks at five low-cost lasers and at supporting products for both old and new lasers.

Schaup, tsk. Schaup, tsk. Schaup, tsk. Schaup, tsk. That odd, trademark-like whisper of desktop laser printers has replaced the Gatling gun rat-a-tat of daisy wheels and the grating whine of dot matrix printers in many offices. Now new, lower-priced, more-compact laser printers are moving more lasers into more offices.

This issue looks at the laser market's new printers and supporting products to enhance the older printers. In the reviews that follow in this article, HP Laserjet guru Alfred Poor takes a look at the new, low-priced challengers: the Epson GP-3500, the Okidata Laserline 6, the QMS Big Kiss, and the Ricoh PC Laser 6000. Also, PC Magazine Editor Bill Machrone reviews the latest entry from HP—the Laserjet Series II. Other companies, such as NEC, are also manufacturing laser printers for under $3,000. They will be reviewed in upcoming issues.

Phil Wiswell, yet another member of PC Magazine's growing team of laser printer fanatics, reviews multiple-bin sheet feeders from BDT Products and Ziyad, designed to alleviate the work load of users of the original Laserjet, who are so busy running back and forth to the paper bin that they're keeping Reebok on top in the sport shoe business. Wiswell went through several cartons of 20-pound bond to tell you how well they work (see "Laser Printer Technology: Sheet Feeders Multiply Your Printing Options").

A whole slew of vendors—both hardware and software purveyors—have seen an opportunity in the trials of Laserjet users. They've designed font generators, formatters, paper bins, boards, and the like to expand and upgrade the Laserjet's capabilities. PC Labs project leader Bill O'Brien selected a number of the best to tell you about, and more are arriving daily (see "Laser Printer Technology: Pluses for Your HP Laserjet").

PC Magazine's West Coast editor, Stewart Alsop, took PS Jet and PS Jet Plus, controller boards designed to give the HP Laserjet PostScript capabilities, for test drives. He found out that these boards are worth every dollar if you've already invested in an HP Laserjet (see sidebar, "PS Jet: Transforming Your HP with PostScript").

Winn L. Rosch—who has more patience with 25-pin D-shell connectors than most kindergarten teachers have with 5-year-olds—focuses on printer-sharing hardware devices. He hooked up a whole
raft of clever printer-sharing devices and tells you how they work (see "Laser Printer Technology: Sharing Your Laser's Power"). If you have a LAN, you'll be interested in Frank J. Derfler, Jr.'s discussion of how to use it to share your laser printer (see the sidebar, "Sharing the Wealth: Using Your Network to Get the Most from Your Laser Printer").

**The Original** What made all these new printers and supporting products possible was the original desktop laser printer for the PC—the Hewlett-Packard Laserjet. When it burst on the scene almost 3 years ago, users spotted three things they liked very much: the Laserjet produced superb-looking results; it was fast—at about 8 pages per minute (ppm) on straight text material; and it was quiet—silent, in fact, except for the sounds of paper-handling.

At last, a no-compromises challenger faced down the daisy wheel printers that had dominated the office and serious-PC landscape since Diablo invented the breed. Thus, the first of the three advantages seemed almost a qualifier: if the printed results didn't at least equal the results from a Diablo, Qume, NEC, or other very good daisy wheel—in other words, passing the "good as Selectric output" test—the desktop laser wasn't going to make much headway. With an effective print-on-paper resolution of 300 by 300 dots per inch (dpi), first-generation desktop lasers could effectively simulate the look of typeset material, though only the Corona (now Cordata) and HP models offered familiar print-shop typefaces such as Times Roman and Helvetica.

The second advantage—8-ppm output—got more attention from those early tire-kickers than any other feature. Anyone who's waited for a multipage document to come grinding through the page-a-minute-or-so speed of typical daisy wheel printers appreciates what 8 ppm can mean to efficiency. The new desktop lasers meant that you could print long contracts, manuscripts, reports, proposals, and other documents running more than a few pages on a demand basis, rather than queuing up for printing during lunch or overnight. In fact, first-generation lasers seemed so much faster than the daisy wheels they began to replace that, in many offices, printer sharing finally began to make sense: two or three PC users shared one laser printer, through a manual or automatic switching arrangement.

What seemed the least important of the laser's three advantages at the beginning of the laser boom—silent operation—has finally gotten some respect. Anyone who's worked near daisy wheel or dot matrix printers and then listened to a laser printer in operation requires little persuasion that quiet counts. In fact, the smaller, latest-generation laser printers are being bought for executive offices and other applications where neither high print quality nor fast throughput is terribly important.

The revolution wrought by the first-generation desktop lasers is now largely complete. Low-end lasers have devastated the high-end daisy wheel market: the $2,000 35- to 40-character-per-second (cps) daisy wheel (plus another $800 to $1,000 for a cut-sheet feeder), once the dominant printer for office PCs and word processing, is an anachronism. And mid- to high-end laser printers have largely re-defined what "letter quality" and "presentation graphics" mean, as well as making the whole desktop publishing boom possible.

**Software Compatibility** As convenient and quiet as desktop lasers are, and as good as their printed results can be, many of them still present problems requiring more time, money, and patience than many PC users are prepared to invest in getting a new peripheral up and running. Compatibility with popular applications programs—as opposed to compatibility with the PC hardware itself—is the single biggest hurdle. Most lasers just don't work the same way as do other printers. Typically, they have their own quirky sets of escape-code sequences to begin and end character enhancements such as underlining and boldfacing, and they require special, nonstandard printer drivers in the applications programs with which they'll be used.

By now, most new releases of major applications include printer drivers for the market-leading HP Laserjet—and sometimes for the Laserjet Plus—in their setup routines. But few other desktop lasers have enough market standing to warrant such attention from software developers.

To get out of this jungle, printer manufacturers have either built emulations of popular daisy wheels or dot matrix printers into laser printers or required users to purchase and use separate laser setup programs. The former sounds easy, but isn't necessarily a cinch, the latter shifts the burden onto the user, with unpredictable results.

Adding emulation should work well, especially if the printer being emulated is already in wide use, so that all or nearly all PC software packages support that printer. It also appears easy enough, since each laser printer vendor that puts its own label on a printer mechanism obtained from Canon, Ricoh, or another laser-engine manufacturer also produces his own printer-controller board, mounted inside the printer. Logic dictates that building the desired emulation circuitry onto that board ought to be trouble free. Unfortunately, experience has shown that there's emulation, and then there's *emulation*.

Emulating a popular and relatively primitive set of printer-control codes, of the sort used for alphanumericics only—such as the well-established and widely used Diablo 630 control sequence set—isn't so hard. The QMS Kiss and Big Kiss lasers, for example, built around the Canon laser engine, include circuitry that does a good job of emulating the Diablo standard. Because the Diablo 630 control codes set is so widely supported by applications software, it has been implemented on several desktop lasers, including many of the new, low-cost models. (PC Magazine thought the QMS Kiss laser printer was so good that we used it as the standard for the low-cost lasers reviewed here; our
THE RICOH ENGINE: PETITE AND POWERFUL

The latest stage in the incredible shrinking of laser printers began with the compact bundle called the Ricoh 1060 print engine. The new engine is about two-thirds the size and only half the weight of competing engines. The trade-off for its petite stature is speed; the Ricoh 1060 prints a mere 2 pages per minute (ppm) less—hardly noticeable in everyday use—than the standard 8-ppm lasers built on larger engines.

Besides being small and light, the Ricoh 1060 Engine is also popular; three of the five printers reviewed in this article use the 1060 Engine: the Okidata Laserline 6, the Epson QQ-3500, and the Ricoh PC Laser 6000. The QMS Kiss printers are based on a Canon engine, and the new HP LaserJet II is based on the newest engine in the Canon family; you'll get a good idea of what the new Canon engine can do in Bill Machrone's review of the LaserJet Series II.

A breakthrough in the design of the printer's photosensitive drum enabled Ricoh to make the engine so small. The drum is the component that gets charged by the laser's light and then picks up toner on the charged parts of its surface, which it deposits on the paper. Up until now, laser printers have required a drum or a belt whose circumference is at least as long as the page on which it prints.

Ricoh developed a system that works with a much smaller drum, using a patented "organic photoconductor," built with seamless construction so that the image is not marred by joints or seams in the middle of a printed page. This plays the major role in making the smaller engine possible.

As a result, one person can move a printer with a Ricoh 1060 engine fairly easily (two people are needed to carry a Canon-engine printer). A measure of a Ricoh-1060-based printer's portability is the fact that UPS will ship it, something it will not do with larger laser printers.

Ricoh provides separate toner, conductor, and cleaning magazine modules in the printer, making it possible to replace supplies as needed. The toner ($29) should last about 1,500 pages. You need to change the cleaning magazine (which collects excess toner from the drum) every 10,000 pages ($599). After every 20,000 pages, you should change both the photoconductor and the cleaning magazine, which come together in a kit ($199). The engine notifies the operator when each type of change is required. In comparison with the Canon-based printers, in which you replace the drum every time you run out of toner, the Ricoh-1060-based machines should be more economical to run.

The only problem with this design is that you have to be extra careful when inserting some of the components. The photoconductor, for example, is unprotected, and although the manuals give ample warnings, you could still damage or ruin the unit in a number of ways. The drum is sensitive to light, so if you work in bright sunlight while changing the conductor, you might overexpose it. Also, the drum is vulnerable to fingerprints and scratches from careless handling. The toner sits in a small bin that you must clean carefully before you transport the unit.

The engine has some design improvements in its favor, the best of which is the dual paper path. If you are using regular-weight paper such as stationery or photocopy paper, you can turn a small dial that redirects the paper to a facedown bin in the top of the printer for collated output. If you are feeding envelopes, acetate transparencies, sheets of labels, or heavy paper such as report covers, you can reduce the risk of paper jams by selecting a straight-through paper path that offers an almost perfect straight-line path through the printer. And if the paper jams, it's not so bad; the unit is easy to open, and the entire toner-conductor-cleaner assembly pivots up as a single unit to give clear access to the paper path.

The Ricoh 1060 has an adjustable-width paper input tray, plus a manual-feed guide. The engine also supports a bottom-feed paper tray, and while none of the manufacturers we contacted are shipping this option yet, all are developing designs for auxiliary trays that hold from 250 to 500 sheets.

All these features would count for little if the engine's output were substandard, but the Ricoh 1060's print quality is outstanding. The engine prints large areas of black as well as or better than any other engine for a laser printer priced under $10,000; its output easily surpasses that of the Canon engine in this respect, with the notable exception of the latest Canon engine, on which the new HP LaserJet Series II is based.

The Ricoh 1060 engine has precipitated significant changes in the PC laser printer market. Not only has the new engine brought laser printers down to a more affordable price range so that they can be found on more desks, it has also made them small enough to fit on those desks. The Ricoh 1060 engine will undoubtedly spur additional new developments in the laser printer market and, as a result, new products.—Alfred Poor

review of the QMS Kiss appeared in Volume 5 Number 19, page 268.)

But moving into more sophisticated control sequences, as required by graphics, is a lot trickier. And laser printers that attempt full-blown emulation of, say, the Hewlett-Packard Laserjet Plus code set stub their toes with regularity. Texas Instruments' new laser printers, for example, built around the first-generation Ricoh print engine, had problems with Laserjet Plus emulation. Even apparently simple graphics emulations, such as those for Epson MX/FX-80 graphics, turn out to be a lot tougher than some vendors expected.

If your software doesn't directly support the laser printer you want, and that printer either lacks emulation for a printer
supported by your software or has a flawed emulation, laser setup software can spare you the agony of downloading tricky control character sequences.

Don’t underestimate the complexity of these sequences. Here, for example, is what it takes to get an HP Laserjet to abandon its normal 10-character-per-inch Courier (internal) type that prints in “portrait” (vertical page) orientation and print in fairly common compressed (16-cpi) type in “landscape” orientation—the long way across the page—from a font cartridge plugged into the front panel.

I rest my case. You could automate the sending of that setup string with most keyboard macro programs, of course, and that’s just what many early laser printer users did.

But before long a horde of specialized laser printer setup programs appeared. Because these programs “know” about the requirements of specific laser printers, they communicate with the PC user in relatively plain English and then compose and send the correct setup strings. Most can either be run as standalones, before you load the application program to be used, or can popup within it for last-minute changes.

It’s better by far to avoid setup programs altogether by choosing a printer with enough accurate emulations to work with your software.

**Paper, RAM, Speed**

Beyond compatibility problems with existing applications software, lasers have other little quirks, like feeble paper-handling capability. While it’s nice that desktop lasers include built-in cut-sheet feeders without extra cost, most have only one feed tray. That’s not very convenient for anyone who must print two-page letters—the first page on printed letterhead stationery, the second on matching unprinted paper stock.

Only the HP Laserjet 500 Plus offers two paper-feed drawers that together accept a ream of paper at a time—a curious oversight on machines that are capable of emptying a 100-sheet feed drawer in less than 15 minutes. Moreover, all the desktop lasers built around the Canon engine eject their printed pages in backwards order, requiring time-consuming and tedious hand-collating to reverse the stack.

We look at some aftermarket answers to these paper-handling problems in this issue, but a fair question is, “Why should you have to turn to third-party vendors to get what should have been built in at the factory or offered by the printer maker as a tightly integrated, reasonably priced, user-installable option?”

Similarly, you ought to be able to install at least a megabyte and a half of memory as an inexpensive field upgrade of a half-brained laser printer without enough RAM on-board to produce full-page graphics at the printer’s maximum resolution (invariably 300 by 300 dpi). Who wants to spend nearly $3,000 to produce 75- by 75-dpi graphics output almost up to the standard of that old, ugly, and obsolete IBM Graphics Printer?

And with desktop publishing elbowing its way to the front of the PC industry, why don’t we see reasonably priced, easy-to-install upgrades with page-description-language ROMs already in place? Hewlett-Packard has taken some steps in this direction to help Laserjet owners who feel that they have been left out of the desktop publishing whirl, and the Laser Connection also offers a replacement board for Laserjets—PS Jet or PS Jet Plus.

And what about all those Canon, QMS, and other laser printers? Are they destined to remain fast, quiet replacements for daisy wheels but crippling at printing high-resolution graphics?

Speed remains a problem, too, despite the allure of those 8-ppm specs. When you start reproducing graphic images on laser printers, speed falls way off, down to as slow as several minutes to print one page. The problem isn’t the printer’s as much as it is the system’s: to reproduce a full-page 300- by 300-dpi image involves sending a lot of data to the printer to blink those 7,560,000 dots per page on or off. But using page description languages rather than the brute-force approach of raster (or dot-by-dot) images can help, and Adobe Systems, developers of PostScript, and other PDL vendors have been working on faster, more elegant algorithms for packing data into less space.

Many of the new desktop lasers show intelligent planning and design to handle the inevitable need for more memory and future releases of page description languages. The new Epson GQ-3500, for example, lets you add in memory up to 1.5 megabytes and add Diablo 630 and Laserjet Plus emulations to the built-in Epson LQ-series emulation.

**The Future**

The next challenges for lasers? One will be to live up to the possibility of a “form-free” office. Since a reasonably intelligent, well-behaved laser printer ought to be able to lay down a type-set-quality form and fill it in with information in one pass, we should be able to rid our offices of those closets, cabinets, rooms, and warehouses full of pads of forms that clutter our work lives. In theory, all you need is a desktop laser printer and a stack of plain paper.

Although some firms sell software and services to digitize, store, and recall letterheads and even signatures on demand, in a first step towards that form-free office, few businesses do one-pass letterhead-plus-message printing on small lasers as yet. And although a few firms sell hardware-plus-software packages that make it possible to capture office forms layouts, store them in the printer, and recall them at print time, the process is expensive and, so far, little used.

Color printing is the second big challenge. Manufacturers are speculating that color lasers will appear on the market in late 1987 or 1988. The technology to produce color laser printing, especially under the $5,000 barrier most market gurus posit as the threshold of pain for PC printer buyers, isn’t quite ready yet. There’s also a serious question about who needs color laser printing. And remember that shipping all that color information over to the printer will exacerbate the problem of printing speed. But within a few years, desktop color laser printers will probably be commonplace.

The real boost, though, to the establishment of desktop lasers as everyday PC tools will be the market success that the new, low-cost laser printers reviewed here are likely to experience this year.

—John Dickinson and Jim Seymour

*John Dickinson and Jim Seymour are contributing editors of PC Magazine.*
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Epson GQ-3500

What would you expect from the biggest name in dot matrix printers for microcomputers? To live up to its forebears' reputation, an Epson America laser printer would have to be dependable, flexible, and compatible out of the box with almost anything. With that as an expectation, the Epson GQ-3500 packs a few surprises.

Based on the new Ricoh engine, the Epson printer is small and sleek. The control panel has five buttons for the traditional functions such as form-feed and on-line. You can use these same buttons to change the printer settings, such as number of copies, font selection, or paper orientation. Unfortunately, a two-digit segmented display supplies the prompts, giving you very little information. (The manual is a little cryptic in this area and would benefit greatly from some illustrated examples.)

A set of DIP switches on the printer interface board also gives you some control over printer features. The interface board is a small printed circuit board that slides into a small slot in the side of the printer.

To change the settings, you simply turn two knurled screws and tug; no tools are required. The switch settings control the timing of the form-feed, the default page size and orientations, and the type of printer emulation.

You can select one of four emulations by using the DIP switches. The factory setting is what is called the page printer mode. You can also choose line printer, letter-quality emulation, or the emulation provided in a separate card inserted in an option slot in the end of the printer. The area of emulation is where the printer's flaws are most apparent.

If you leave the printer in page printer mode, you have easy access to the full range of the printer's font controls. You can select different typefaces, different modes (emphasized, underlined, and so forth), and proportional spacing, among others. Seven different fonts are available: four portrait-mode and three landscape-mode fonts. The proportionally spaced font is the only one not available in the landscape orientation. (The manual is undecided about how to distinguish between the two possible paper orientations. The appendix uses the common "landscape" and "portrait" terms, but elsewhere the book refers to "normal" and "rotated.")

One of the unusual commands in the page printer mode offers the ability to select the height and width of the character. You can specify each dimension at once, twice, or three times the normal size and control each individually. You can have tall, skinny letters (triple-height, single-width) or low, fat ones (single-height, triple-width), or just plain giant letters (triple both ways). These options are marred by the fact that the resulting characters are coarse and the line widths do not adjust to accommodate the taller letters. You can get novel effects with this command, but the quality is nothing to get excited about.

The basic format control commands are similar to the traditional Epson command set, and the printer easily passed the performance tests for text-formatting compatibility with the Epson MX-80. The only flaw we found was that the boldface text was no darker than the regular text. If you try to print Epson graphics, however, you'll be disappointed.

**GRAPHICS PROBLEMS** The Epson GQ-3500 does have sophisticated graphics capabilities in its page printer mode, but they are not compatible with the standard graphics commands. In addition to having the ability to create bit-mapped graphics, the printer also supports certain graphics primitives, which are commands that make it easy to create and fill boxes and circles. If you are writing your own pro-

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**Epson GQ-3500**

**Epson America Inc.**

**2780 Lomita Blvd.**

**Torrance, CA 90505**

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**In Short: The first laser printer from Epson, based on the Ricoh 1050 engine, offers high-density proprietary graphics handling or low-density LQ-1500 graphics emulation.**

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In fact, this ad copy was printed using Laser Fonts on an HP LaserJet printer!

1. Font Variety

SoftCraft’s complete library contains hundreds of fonts in various styles and sizes from 4 to 72 points. Each product comes with fonts in sizes from 8 to 24 points, including Roman, Sans Serif, Italic, Bold, Script, Old English and more.

2. Formatting Power

In addition to all of the conventional formatting commands, Fancy Font includes commands that deal with variable-width (proportional) fonts and different height fonts. This is especially useful in setting tables, math formulas and perfectly justified text.

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An included font editing program (optional with Fancy Word) allows you to modify any character and create new characters and logos, up to one inch by one inch. You can also create new fonts, scaled to size, from our database of character outlines.

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Fancy Font: A powerful text formatting and printing program that works with any word processor to provide a wide range of font styles and sizes. You embed simple commands in your document to control Fancy Font's extensive formatting capabilities.

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Laser Fonts: Downloads a large variety of fonts, up to 30 points in size, into laser printers at a significantly reduced price over HP. Laser Fonts automatically configures Microsoft Word to fully take advantage of the downloaded fonts and can be used with any other word processor that can access soft fonts. Laser Fonts can also be used with Fancy Font or Fancy Word to dramatically speed printing on laser printers.

SoftCraft software runs on PCDOS and MSDOS computers with HP, Canon, NCR, Tall Tree and compatible laser printers (Laser Fonts requires a printer with download capability). Fancy Font and Fancy Word are also available for dot matrix printers.

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LASER PRINTERS

grams, you can harness these powerful features.

If your program does not support the unique page printer mode commands, there is only one way to print graphics. You must set the printer for LQ emulation, and you can do that only by turning off the printer and resetting the DIP switches. Once you do so, you lose access to many of the font control features. To make matters worse, the aspect ratio of the graphics

Poor graphics could be overlooked if good font support were provided, but the Epson missed the boat here, as well.

will be correct only under high-resolution (120 by 180 dots per inch) graphics mode. The biggest disappointment was that in spite of the Ricoh engine’s ability to produce a stunning and solid black, the LQ emulation graphics were composed of visibly separate dots that ended up looking slightly faded.

Poor graphics could be overlooked if good font support were provided, but the Epson missed the boat here, as well. Of the seven fonts, only five are text. None support the higher-order characters, so they really have only half as many characters as most laser printer fonts. To provide compatibility with the IBM text graphics characters, Epson gives you a font called Extended Graphics. The major problem is that you must select either this font or a text font; you cannot use both at once. The graphics character font on its own is of little practical use: since it does not print a space character, all the line graphics get condensed into a meaningless jumble of characters. However, a separate command that is mentioned in the manual triggers the use of the higher-order characters with your current font.

Some of these problems will undoubtedly be addressed through the GQ-3500’s ability to accept little integrated circuit

PC Magazine’s Printer Guide provides data pertinent to your printer purchase decisions. Results come from PC Labs benchmark tests and hands-on evaluations.

PRINT QUALITY

To allow you to judge text and graphics print quality, text samples are shown both in their actual size and enlarged four times. The graphics sample—the PC Magazine logo—was created with a program custom-designed by Decision Resources of Westport, Connecticut.

SPEED

Rated speeds were obtained from the manufacturer. Default refers to tested speed in draft mode. Laser speeds are measured in pages per minute.

TYPE PITCHES

To give you a point of reference, 10 characters per inch is typical pica type, 12 cpi is typical elite, and 17 cpi is typical condensed mode.

FEATURES

Listings of each printer’s printing and formatting features tell you how far beyond plain-vanilla printing it will go.

PRINTING FEATURES

H Horizontal emphasis (bold)
V Vertical emphasis (double strike)
U Underline
S Subsuperscript

FORMATTING FEATURES

P Proportional spacing
J Justified lines
C Centered lines
LH Variable line heights
FL Variable form length
HT Horizontal tabs
VT Vertical tabs

SOUND LEVEL

Sound level doubles for each 10-decibel increase under real-life conditions. The average printer pounds away at 72 decibels. Although our equipment doesn’t test accurately below 60 decibels, the manufacturers’ ratings indicate that the laser printers are well below that level. Compare that with the 20 decibels of rustling leaves, the 50 decibels of the average office, or the 120 decibels of a rock concert. The blue bar shows the rated decibel level. The orange bar shows the measured decibel level.

COMPATIBILITY

The Printer Guide reports on each printer’s character compatibility with IBM’s low (ASCII code 0–127) and high (ASCII code 128–255) order character set. Low-order characters represent the letters, numbers, and symbols found on the keyboard. The high-order IBM display characters include some line- and box-drawing characters that are useful for nongraphics drawing programs.

If your printer emulates (is compatible with) the text or graphics of a printer that your applications program supports, you’ll have no trouble printing your output. We’ve tested for each printer’s emulation of many of the more-common printers.
Laser Printers

(Products listed in ascending price order)

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**Okidata Laserline 6**

  - **Times Roman** Bold. Courier
- Laser 8 rated 5.8 default 10.0 10.5 8-point 10-point 14.4-point
- 8.5 in.
- $1,995
- **Sound Compatibility:** IBM char. set
- **Price:** Proportional

**QMS Kiss**

- **QMS Kiss** Epson Underline. Power On Default. Times Bold. Underline
- Laser 8 rated 7.4 default 10.0 12.0 10.7
- 8.5 in.
- $1,995
- **Sound Compatibility:** HP Laserjet
- **Price:** Proportional

**Ricoh PC Laser 6000**

- **Ricoh PC 60** Bold and shadow. font. Power On Default. Times Bold. Underline
- Laser 8 rated 5.8 default 10.0 12.0 15.0
- 8.5 in.
- $2,395
- **Sound Compatibility:** Epson FX,MX: Diablo 630
- **Price:** Proportional

**Epson GQ-3500**

- **Epson GQ-35** Courier. Double Dotted Power
- Laser 8 rated 8 default 10.0 12.0 13.0
- 8.5 in.
- $2,495
- **Sound Compatibility:** Epson LX-1500
- **Price:** Proportional

**HP Laserjet Series II**

- Laser 8 rated 7.5 default 10.0 15.0
- 8.5 in.
- $2,495
- **Sound Compatibility:** HP Laserjet—all models
- **Price:** Proportional

**QMS Big Kiss**

- **QMS Bigg Kiss** pressed. Q-Roman
- Laser 8 rated 7.5 default 10.0 13.0 12.0 18.7
- 8.5 in.
- $2,995
- **Sound Compatibility:** Epson FX-80
- **Price:** Proportional

*Our testing equipment is not accurate below 60 decibels. However, in the case of laser printers noise is not a problem.*
cards in two small slots in the machine. These can add more fonts or additional emulation options, but these cards were not provided with the machine we tested.

The GQ-3500 does print quickly and quietly at a good price. But compared with the existing competition, you can do much better.—Alfred Poor

Hewlett-Packard Co.
HP Laserjet Series II

Hewlett-Packard Co. created the desktop laser printer market with a machine that did little more than emulate a daisy wheel printer. The market has changed dramatically since then, with the emergence of high-quality graphics and desktop publishing. HP's Laserjet and Laserjet Plus were beginning to look a little stodgy and expensive compared to the competition.

HP hasn't been resting on its laurels. The Laserjet II is a completely new printer. It's smaller and has more features than the old one but remains fully compatible and costs dramatically less. The Laserjet Series II is built on the new Canon engine and, at $2,495, is priced aggressively.

The all-new design features in-order paper stacking, two font-cartridge sockets, an improved, 200-sheet paper tray, and a manual feed for undersized or heavy stock. Like the Laserjet Plus, the Laserjet II has both serial and parallel interfaces. It also has an I/O option expansion slot that accepts either the forthcoming high-speed interface for the DDL page description language or a sharing device for up to three computers.

The Laserjet II has no configuration switches. You control everything from the front panel. A 16-character LCD gives you informative menus and access to everything, right down to fonts and symbol sets.

The Print Fonts key on the front panel dumps all the fonts currently loaded in an attractive and useful format. It identifies them as internal, left cartridge, right cartridge, or memory resident. You can then use the font numbers and symbol set numbers to select the exact font and extended characters you want. The Laserjet II has more built-in fonts than its predecessor, with Courier, Courier Bold, and Line Printer in both portrait and landscape modes. Both modes also have a full IBM extended character set. Thus you can put the printer to useful work without buying so much as a single font cartridge.

Speaking of which, the cartridges are coming down in price. Although they formerly cost in the range of $200 to $400, they will soon be in the $150-to-$330 range.

HP and several other companies offer a formidable range of downloadable soft fonts for the Laserjet (see "Laser Printer Technology: Pluses for Your HP Laserjet" in this issue for more information). The Laserjet II is prepared to use more of them through its memory expansion capability. It comes with the same 512K bytes as the Laserjet Plus, but you can get HP expansion boards that take the total capacity to 1.5, 2.5, or 4.5 megabytes.

BLACK IS BLACK Hewlett-Packard's competitors have taken some pleasure in pointing out that their offerings print a denser black than the old Laserjet prints. They're going to have to find something else to complain about, because the Laserjet II has blacks that are simply stunning. The edge definition is better too, and some of the fonts have been reworked to improve definition even more.

Paper handling is likewise improved. At 200 sheets, the feed tray holds twice as much paper as the old Laserjet, and an ad-
WHAT HAVE THEY DONE WITH THE BERNOUlli BOX?
EVERYTHING THEY

Who are they? Over 100,000 computer users who have discovered a truly unique data storage solution—The Bernoulli Box®. Over 100,000 users who have learned firsthand why the Bernoulli Box has won the World Class Award® as best product in its data storage category for the past two years. Over 100,000 users who have found hundreds of ways to improve their data management, growth, security and flexibility using the Bernoulli Box and its removable 10- or 20-megabyte disk cartridges. Over 100,000 users just like you.

ACCOUNTING:
A Big Eight accounting firm does extensive tax preparation and in-depth financial analysis, and maintains audit trails utilizing the Bernoulli Box. Its large 10- or 20-megabyte capacity provides adequate storage for such applications and security for each client. Instead of tying up the firm's mainframe system with heavy number crunching, accountants download client information and data onto Bernoulli Cartridges and develop the client analysis at individual PC workstations.

BANKING:
A credit firm that supplies information to banks and other financial institutions employs Bernoulli Boxes to work with smaller banks and credit unions. Credit requests and information are controlled on individual cartridges, making it easy to keep track of information and disperse it to the appropriate users. This unique approach to database management uses individual cartridges as electronic file cabinets, combining the best of physical and electronic data management. And instead of relying on electronic security measures, credit information can be kept private by removing cartridges and safely storing them in a physically secure area.

DISTRIBUTION:
A large lumber company in the Northwest regularly sends its U.S. offices Bernoulli Disk Cartridges containing updates of rate schedules and lumber inventory. Instead of costly, time-consuming electronic transfer of data via modem, information is copied in just minutes onto cartridges which are mailed overnight to locations all over the country. This cost-effective transportation of data is possible because of the Bernoulli Box’s rugged design and guarantee of interchangeability between systems.

MANUFACTURING:
An appliance manufacturer with massive inventory manages its large databases on Bernoulli Boxes. As parts lists and inventory lists are updated, the company’s plant managers and distributors are kept current by sending them copies on cartridges. With large databases conveniently stored on individual cartridges, the manufacturer can more easily perform functions like process control, inventory control, equipment testing and data logging. Each function has a high data growth rate and requires large amounts of data, and managing both is an ideal application for the Bernoulli Box.

PUBLIC UTILITIES:
A utility company in one Western city uses CAD software and Bernoulli Boxes to keep track of power and water lines. The company has divided quadrants, utility mapping for each quadrant on a single 20-megabyte cartridge. Copies can be quickly made to allow several people to work on different projects in the same quadrant at the same time. And cartridges can be easily archived for historical reference, just like electronic file drawers of information.

PROGRAMMING:
One of the largest software developers in the U.S. uses Bernoulli Box Systems to manage enormous amounts of software source code. Because Bernoulli Disk...
Cartridges come in 10- or 20-megabyte sizes, programmers are able to record their source code for an application on one cartridge, make backup cartridges for protection, and work directly from a "working" cartridge loaded in the Bernoulli Box. Programmers can change and modify code, or develop different revisions on multiple cartridges, without fear of damaging the original source code, which is safely stored on the "backup" cartridge.

**Graphics:**
An architect in Chicago uses over 40 Bernoulli Cartridges a year storing and archiving lengthy architectural designs generated on a CAD system. Using a Bernoulli Box and cartridges gives him unlimited storage capacity, plus the portability to take cartridges with him when he meets with clients and contractors (many of whom also use a Bernoulli Box). This fast growth is a powerful benefit of Bernoulli Technology™ whether for CAD, business graphics or desktop publishing.

**Record Keeping:**
A medical insurance carrier with offices worldwide must keep track of an enormous number of records for millions of claimants. The company uses Bernoulli Boxes which allow easy access to information, infinite storage capacity and a simple system for database management of archival data. Individual offices use cartridges to update critical information on a timely basis and send updates to the company's central database.

**Government Contractors:**
An important defense contractor with need for total security on classified projects uses Bernoulli Boxes for data management. Large amounts of classified data can be stored on hand-carried Bernoulli Cartridges which are secured in vaults when not in use. In addition, specific pieces of data can be copied onto cartridges, rather than giving users access to an entire database of sensitive information.

**Think About It.**
But is a Bernoulli Box right for you? If you need to store a great deal of data, or you need to share that data with others, or you need to keep it completely secure or deal with multiple databases, it's time you thought about the Bernoulli Box. If you turn the page, you'll find more food for thought.

**And More.**

**A Few of Our Best Customers.**
- American Express
- Amoco Oil
- Arthur Anderson & Co.
- AT&T
- Bank of America
- Blue Cross/Blue Shield
- Boeing
- Campbell Soup
- Chase Manhattan Bank
- Citicorp
- City of Dallas
- Coca-Cola
- Dean, Witter, Reynolds
- Florida Power & Light
- General Dynamics
- General Foods
- Harvard University
- IBM
- Intel
- ITT
- Lockheed
- Lotus Development
- McGraw-Hill
- Merrill Lynch
- Michelin Tire Corporation
- Mobil Oil
- Nabisco
- New York Life Insurance
- Pacific Northwest Bell
- Parke Davis
- RCA
- Shell Oil Co.
- TRW
- Union Carbide
- United Technologies
- U.S. Army, Navy, Air Force
- Weyerhaeuser Co.
- Yellow Freight System

- CIRCLE 164 ON READER SERVICE CARD -
WHAT MAKES THE BERNOLLI BOX FLY?

In the truest sense, it is the remarkable Bernoulli Technology™ that makes the Bernoulli Box fly. That's because when a Bernoulli Disk spins inside the Box, it literally "flies" beneath the read/write head on an air bearing. Any disturbance that might easily cause a normal hard disk to crash the head into the data simply causes the Bernoulli Disk to temporarily fall safely away from the head. At the same time, the airflow that cushions the disk also serves to purge contaminating particles from the disk end result is a mass storage system that is unparalleled in its performance, durability and flexibility.

For a fraction of the cost of a new hard disk, at that rate, it doesn't take long to bring the cost-per-megabyte of your data storage down to a bargain level. Not to mention the efficiency gained in performance and managing data in large usable segments.

SHARE YOUR THOUGHTS.

How much does it cost to share data? You could buy a LAN to share large amounts of data with others. Or you could send it over modems. Either way, you pay a great deal for the luxury of sharing data, and you tie up your network or your modem lines with the burdensome task of heavy data transfer.

When you buy a Bernoulli Box, sharing data is as easy as removing a cartridge and carrying it or mailing it where you want the data to go. The most you have to pay is a few dollars for postage or a few minutes' walk. And data stored on a Bernoulli Cartridge is much safer and more secure than data transferred electronically.

PROTECT YOUR INVESTMENT.

How much is your data worth? (Rules of thumb say $1,000 per megabyte or your entire business.) You may use passwords for security, but how secure are passwords? The ultimate form of security is physical security. When you put your data on a Bernoulli Cartridge, you can remove it and store it safely, or even take it with you. That's secure.

For backup, floppy and tape are no match for Bernoulli Cartridges. It takes just under two minutes to copy 10 megabytes on a Bernoulli Cartridge. It also takes scores of floppy to equal the storage of one Bernoulli Cartridge. And while you can work directly from a Bernoulli Cartridge, taped data must be transferred to a hard or floppy disk before it can be accessed. Plus, with a dual drive Bernoulli Box, backup is built in, not extra.

WHAT ABOUT VALUE?

Of course, it takes more than breakthrough technology to make a product worth buying. When you can buy a 10- to 20-megabyte hard disk for less than half the cost of a Bernoulli Box, why shouldn't you? Because the numbers tell a different story.

LOOK DOWN THE ROAD.

How much is expandability worth? While it may seem like you could never fill a 20-megabyte hard disk, you should look again. Twenty megabytes can go rather quickly. Then you have to buy another hard disk, or worse yet, store everything on floppy.

When you buy a Bernoulli Box, you buy unlimited data storage capability. When one 10- to 20-megabyte cartridge is full, you just put in a new one.

A SEA OF ENTHUSIASTIC USERS.

With over 100,000 Bernoulli Systems and 1,500,000 Bernoulli Cartridges in use, the Bernoulli Box is more than a data storage option. It is a data storage standard. And Bernoulli Box users are our best references. Give it some thought. Then put the Bernoulli Box to work, doing whatever you can think of. For information, see your local Authorized Reseller, or call 1-801-778-3000.

FREE 1-YEAR WARRANTY:

One-year limited warranty on the Bernoulli Box®.
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IOmEGA Corporation
1821 West 4090 South, Roy, Utah 84067

CIRCLE 164 ON READER SERVICE CARD
justable chute handles envelopes and odd-sized pieces of paper. If you do much printing on special forms, you'll really appreciate being able to insert them from the front of the machine instead of from the back. Forms go in top first, face up, which is much more convenient than the old way. A door at the back of the machine gives nonstandard forms a straight-through path, so they don't have to bend around to the receiver bin on top. At a tested 7.4 pages per minute, the new machine prints exactly as fast as its predecessor. And you don't have to worry about Laserjet compatibility: it is a Laserjet.

You'll appreciate two other improvements: The warm-up time is a mere 30 seconds, instead of the tedious 2 minutes of the old Laserjets. Also, the documentation is vastly better. You can actually find things, and the examples are easy to understand.

The Laserjet II is definitely smaller than the old Laserjet, but not as small as the Okidata and Ricoh machines reviewed here. On the other hand, it feels more solid than the smaller machines. Everything from inserting the paper tray to closing the toner drum cover proceeds with reassuring clicks, thunks, and feelings of solidity.

This printer is a winner. HP has obviously listened well to its customers and has built the Laserjet Series II to be competitive today and tomorrow.

—Bill Machrone

Okidata

Okidata Laserline 6

I was prejudiced about the Okidata Laserline 6, both favorably and unfavorably, before I plugged it in. On the plus side, I have had an Oki 92 for years, and it has been a dependable workhorse. I have developed the impression that Okidata is the Avis of dot matrix printers; second behind the huge Epson, but trying harder to build more value into its machines. I expected Okidata's first laser printer to live up to that reputation.

On the other hand, I had already tested one of the other Ricoh-engine machines covered here and found it to be less than I had expected. I resigned myself to the apparent fact that the new low-end lasers were short on features and would be a generally disappointing class of products.

Wow, was I ever right and wrong! I should never have let my faith in Oki products waver, for the company has certainly packed plenty of value into this box. It is not competing with the other low-end lasers; it is hot on the trail of the big boys.

To start with, the Okidata Laserline 6 accepts different interfaces that are part of "personality" modules. To date, only one is available, but that one emulates the HP Laserjet. Others are slated for release, including one that does HP Laserjet Plus emulation, plus a memory expansion capability that increases the page buffer from 128K to 512K bytes (which will allow up to half a page of 300-dot-per-inch graphics). Until then, you will have to settle for the HP Laserjet emulation.

Fonts Galore You might want the HP Laserjet Plus feature so that you can use the downloaded font features. With the Laserline 6, you may find that you don't need that feature as much as you think. While the HP Laserjet comes with a grand total of two resident fonts, the Laserline 6 comes with 15 fonts, none of them dry or repetitious, either. You get Courier boldface and italic in portrait mode (in addition to the expected portrait and landscape Courier fonts), plus the 16.66-pitch Line Printer font that comes in portrait mode with the HP Laserjet Plus, except that on the Laserline 6 you get both portrait and landscape. You also get six 10-point and two 8-point Times Roman proportional fonts in portrait mode, including medium, boldface, italic, and compressed versions. You would have to spend hundreds of dol-

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Okidata's Laserline 6 emulates the entire HP Laserjet command set. It printed the graphics test in low, medium, and very high resolution, and its Ricoh engine produced a strong black image.
## Laser Printers: Internal Fonts

<table>
<thead>
<tr>
<th>Font Family</th>
<th>Font Style</th>
<th>Epson EPL-3500</th>
<th>HP LaserJet Series II</th>
<th>Okidata Laserline 6</th>
<th>QMS Big Kiss</th>
<th>QMS Kiss</th>
<th>Ricoh PC Laser 6000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Century PS</td>
<td>Regular</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>Courier</td>
<td>10-point</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>EPSON Pica</td>
<td></td>
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<td>✗</td>
<td>✗</td>
<td>✗</td>
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</tr>
<tr>
<td>Hamilton</td>
<td>Medium</td>
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<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>HELVETICA</td>
<td>Bold</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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<td>✗</td>
</tr>
<tr>
<td>LETTER GOTHIC</td>
<td>12-point</td>
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<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>LINE PRINTER</td>
<td>Regular</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>MODERN PROPORTIONAL</td>
<td>10-point</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
<tr>
<td>Prestige Elite</td>
<td>12-point</td>
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<td>✗</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>O-Roman</td>
<td>Medium</td>
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<tr>
<td>TIMES ROMAN</td>
<td>8-point</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

- Yes
- No

Whereas the original HP LaserJet came equipped with only one internal font, machines we've reviewed in the under $3,000 category can generate as many as 13.
lars to get similar fonts in HP Laserjet cartridges, but here they come standard.

Of course, emulation can be tricky to pull off correctly, and I am a little wary of anyone who claims compatibility. The Laserline 6 passed the printer performance tests for HP Laserjet compatibility for both texts and graphics, except that the cursor position reset to the home position before printing the graphics test. The printer was able to print the graphics test in low, medium, and very high resolution, and the Ricoh engine managed to produce a strong black image. For everyday word processing, I fired up XyWrite II Plus with the HP Laserjet driver, and the Laserline 6 handled boldface and underline without a hitch.

As far as I can determine, the Laserline 6 emulates the entire HP Laserjet command set. Many of the printer's software packages support these commands directly, which is just as well, because some HP escape commands can run 30 or more characters long.

If you have to set up the printer with assistance from your program, all is not lost. Okidata is currently bundling a printer utility called LaserControl with the Laserline 6. Based on LaserControl 100 from Insight Development Corp., the program has been re-packaged with a new manual and default settings designed specifically to take advantage of the Laserline 6's features.

LaserControl is one of the best HP Laserjet setup programs; you can use it as a program called from DOS or load it as a pop-up resident utility. Not only can you set various printer settings and select fonts but you can also choose from Diablo, NEC, Qume, Epson, and IBM Graphics printer emulations. I tried the IBM emulation with the graphics test, and the printer passed with flying colors. These emulations make it a snap to use your printer with programs that may not support the HP Laserjet commands directly.

So the Laserline 6 gives you more standard fonts than on an HP Laserjet Plus, total Laserjet command compatibility, more printer emulation options than the QMS Big Kiss, and one of the lowest prices going. The Okidata Laserline 6 packs enough value to make it worth quite a bit more, but at this price it is a flat-out bargain. This printer should not only give the daisy wheel manufacturers fits, but it may shake up the upper levels of the laser market as well.—Alfred Poor

QMS Inc.

QMS Big Kiss

QMS shook the micro printer market last year when it broke the $2,000 barrier for laser printers with the QMS Kiss. Based on the Canon engine, this no-frills printer offered emulation of a few popular daisy wheel and dot matrix printers and nine utilitarian monospaced fonts (seven portrait and two landscape). (See review in "The Third Annual Survey: Printers," PC Magazine, Volume 5 Number 19.)

For some users, the QMS Kiss, true to its name, "Kept It Simple, Sweetheart," but too simple. They wanted more from their laser, and QMS responded with the Big Kiss. This newer model starts with the same 8-page-per-minute Canon engine and all the features of the lesser Kiss and builds on them.

The most immediately apparent improvement is that the Big Kiss has more fonts. It lacks the large sans serif font of the Kiss, but it adds a medium and an italic font similar to a Times Roman, two sans serif proportional uprights and an italic, and a 13-pitch landscape font. In all, the 14 fonts give you enough to choose from for most uses.

The QMS Big Kiss offers resident emulation of the Diablo 630, Epson FX-80, and the Qume Sprint. Through these emulations, you should be able to easily run and load most major software.
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Business software integrating spreadsheet, graphics and database.

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LASER PRINTERS UNDER $3,000

If you need other fonts, you have other options available. The printer accepts optional font cartridges that insert into a slot on the front of the printer, much like the HP Laserjet printers. (Since the test unit supplied no cartridge, we did not test this feature.)

One of the most striking features of the Ricoh PC Laser 6000 is the amount of memory available: 1,024K bytes!

Also, two commands permit you to copy fonts into the printer's memory. You can use either the special QMS command language or, if you are using the Epson emulation, the Epson font download command. If you are using a utility program that offers Epson fonts, remember that the characters will be defined only to the 8-by-9-dot matrix supported by Epson FX series printers, so your letters will not have as fine a resolution as that of the resident or cartridge fonts.

MEMORY OF A KISS One nice feature about the download capabilities is that you can copy cartridge fonts into memory. You can then remove the cartridge from the slot and insert another one. In this way, up to 64 fonts can be available at one time, provided that you have sufficient memory in your printer.

As with the Kiss, one of the printer's strongest features is that it offers resident emulation of three popular printers: the Diablo 630, the Epson FX-80, and the Qume Sprint. Through these emulations, you should be able to load and run almost any major software without too much hassle. The printer passed the printer performance tests for text command compatibility with all three printers (although the boldface did not work well).

One problem with the two daisy wheel emulations is that they do not support the use of the proportional fonts. This seems

---

Laser Printers: Manufacturers' Specifications Table

(Produced in ascending price order)

<table>
<thead>
<tr>
<th>FEATURES INCLUDED IN BASE PRICE</th>
<th>Okidata Laserline 8/Okidata 6/Okidate</th>
<th>QMS Kiss OMS Kiss Inc.</th>
<th>Ricoh PC Laser 6000 Ricoh Corp.</th>
<th>Canon LaserJet Series II Hewlett-Packard Co.</th>
<th>QMS Big Kiss OMS Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>List price</td>
<td>$1,995</td>
<td>$1,995</td>
<td>$2,495</td>
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<tr>
<td>RAM</td>
<td>272K</td>
<td>384K</td>
<td>1 Mbyte</td>
<td>640K</td>
<td>512K</td>
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<tr>
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<td>o</td>
<td>o</td>
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</tr>
<tr>
<td>Toner cartridge (including developer)</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Print/image drum or organic photoconductor cartridge</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Engine</td>
<td>Ricoh 4600</td>
<td>Canon CX</td>
<td>Ricoh 1060</td>
<td>Ricoh7</td>
<td>Canon SX</td>
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<tr>
<td>No. of built-in fonts</td>
<td>15</td>
<td>12</td>
<td>8</td>
<td>7</td>
<td>6</td>
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<tr>
<td>No. of font cartridge slots</td>
<td>1</td>
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<td>1</td>
<td>2</td>
<td>2</td>
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<tr>
<td>PERSONALITY MODULES</td>
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<td></td>
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<td>Built-in modules</td>
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<td>Epson FX-80</td>
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<tr>
<td>IBM Graphics Printer</td>
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<td>IBM Proprietary</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
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</tr>
<tr>
<td>Diablo 630</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>HP Laserjet</td>
<td>o</td>
<td>o</td>
<td>o</td>
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<tr>
<td>HP Laserjet Plus</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
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</tr>
<tr>
<td>Other</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>PERFORMANCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pages per minute, claimed</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
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<tr>
<td>Pages per minute, tested</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>8</td>
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<tr>
<td>Rated machine life before major overhaul (pages)</td>
<td>180,000</td>
<td>100,000</td>
<td>180,000</td>
<td>180,000</td>
<td>Info not available</td>
</tr>
<tr>
<td>Rated duty cycle per month (pages)</td>
<td>3,000-5,000</td>
<td>3,000-5,000</td>
<td>3,000</td>
<td>3,000</td>
<td>5,000</td>
</tr>
<tr>
<td>PAPER HANDLING</td>
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<tr>
<td>Output delivered in correct order</td>
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<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>No. of paper trays</td>
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<td>1</td>
<td>1</td>
<td>1</td>
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<td>No. of manual paper feed slots</td>
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<td>1</td>
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<td>Sheet capacity of paper tray</td>
<td>150</td>
<td>100</td>
<td>150</td>
<td>150</td>
<td>200</td>
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</table>

PC MAGAZINE — APRIL 28, 1987

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## OPTIONS

<table>
<thead>
<tr>
<th>Product Manufacturer</th>
<th>Okidata Laserline 6</th>
<th>Okidata</th>
<th>QMS Kiss QMS Inc.</th>
<th>Ricoh PC Laser 8600</th>
<th>Ricoh Corp.</th>
<th>Epson GO-3500 Epson America Inc.</th>
<th>HP Laserjet Series II Hewlett-Packard Co.</th>
<th>QMS Big Kiss QMS Inc.</th>
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<tbody>
<tr>
<td>Memory</td>
<td>656K None</td>
<td>$249</td>
<td>512K 1.5 Megabytes</td>
<td>Info not available</td>
<td>$495; $4,995 N/A</td>
<td>$199*</td>
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<td>$149*</td>
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<td>List price</td>
<td>$399 N/A</td>
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<td>$199*</td>
<td>$199*</td>
<td>$149*</td>
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<td>Serial or parallel interface</td>
<td>(N/A)</td>
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<td>(N/A)</td>
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<td>(N/A)</td>
<td>(N/A)</td>
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### TONER CARTRIDGES (including developer)

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<th>Sealed units</th>
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<tr>
<td>List price</td>
<td>$29</td>
<td>$99</td>
<td>$29</td>
<td>$29</td>
<td>$199*</td>
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<tr>
<td>Life (pages)</td>
<td>1,500</td>
<td>3,000-5,000</td>
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<td>1,500</td>
<td>4,000</td>
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### PRINT/IMAGE DRUM OR ORGANIC PHOTOCONDUCTOR CARTRIDGE

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<tr>
<th>List price</th>
<th>Kit 1. $199</th>
<th>Kit 2. $89</th>
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<th>$119*</th>
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<tr>
<td>Life (pages)</td>
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<td>20,000</td>
<td>20,000</td>
<td>4,000</td>
<td>Included in toner cartridge</td>
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### FONT CARTRIDGES

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<tr>
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<th>4</th>
<th>11</th>
<th>10</th>
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<th>17</th>
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<tbody>
<tr>
<td>List price</td>
<td>$149 each</td>
<td>N/A</td>
<td>$200-$300</td>
<td>$149-$199</td>
<td>$150-$330</td>
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<td>Multiple PC option</td>
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<tr>
<td>List price</td>
<td>$600</td>
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<td>N/A</td>
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### PERSONALITY MODULES

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<tr>
<th>Diablo 630</th>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Epson FX-90</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>HP Laserjet</td>
<td></td>
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<td>HP Laserjet Basic</td>
<td></td>
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</tr>
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<td>HP Laserjet Plus</td>
<td></td>
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</tr>
<tr>
<td>HP Laserjet Plus Multi-User Advanced</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>IBM Proprinter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

* Indicates Editor's Choice

---

unfortunate, since one of the main differences between the Big Kiss and its less capable sibling is the use of proportional fonts. While you can use the commands to turn proportional spacing on and off, you are advised to use only the 10-pitch fonts because the others cause the margins to change.

The Epson emulation also did a fine job with graphics. The printer managed both regular- and high-resolution FX-80 graphics output without a hitch, although the Canon engine does not print as solid a black image as the Ricoh engines do. More of a problem, though, is that the Canon engine can print 300 dots per inch, but the Epson high-resolution mode can produce only 120 by 144 dots per inch. As a result of this combination, you get a very sharp image of a coarse graphic.

The Big Kiss measurably increases your control over graphics and other features through another "emulation," called ANSI x3.64, which is based on the American National Standards Institute specifications for the transfer of data between terminals. In addition to giving you bit-mapping and cursor control, the commands also let you specify fonts, download overlay forms, and draw graphics primitives such as lines and boxes. Unfortunately, this command set is not yet widely supported and is therefore of only limited usefulness at present unless you are developing your own programs or drivers.

Like the regular Kiss, this printer has a control panel that you can use to change the various printer settings without the use of complex escape command sequences. You can select fonts, change margins, select the emulation mode, and more. A two-digit readout shows the prompts, and as a result they are a bit cryptic. You can toggle some options off and on and set others by using the appropriate digit. The accompanying manual does a fairly good job of explaining the use of these front-panel settings, but getting the hang of it still takes some amount of practice. Fortunately, the printer worked flawlessly straight out of the box without any need to change the factory default settings.

At 7 1/2 ppm, the QMS Big Kiss is faster than the other low-cost lasers reviewed here, but speed is one of its few outstanding virtues. It is also about a third larger,
LASER PRINTERS UNDER $3,000

Ricoh Corp.
Ricoh PC Laser 6000

Ricoh has long been involved in the electronics industry, but its name is not well known since it primarily supplied components and products to other manufacturers. It has recently started marketing products under its own name, first with the larger LP4080R and now the Ricoh PC Laser 6000.

The PC Laser 6000 uses the same print engine as the Okidata and Epson printers reviewed here, but it has its own personality traits.

When you run the printer self-test, you get a printed summary sheet showing the different printer settings and features. One of the most striking features listed on the sheet is the amount of memory available: 1,024K bytes! Yes, you get a full megabyte of memory in the standard machine. You can expand the memory to 2 megabytes by using half-megabyte modules (at $249 each). As a result, you start with more memory than an HP Laserjet Plus, and you can expand to enough for full legal-size page graphics in 300-dot-per-inch resolution and still have room for dozens of downloadable fonts.

On the other hand, the summary sheet shows that only four fonts are available: 10-pitch Courier, 12-pitch Prestige Elite, 15 pitch Letter Gothic, and proportionally spaced Century. This would appear to be a striking limitation, but as it turns out, you effectively get ten different fonts. The PC Laser 6000 controller is unique among low-end laser printers in that it can print any available font in either portrait or landscape mode; other printers require two separate fonts to achieve this. The printer also has a "compressed font" mode, in which it squeezes extra white space from the letters in the smallest available font to produce a 16.6-pitch font. This operation, which is done on the fly, does not require a separate resident font.

The PC Laser 6000 has its own set of commands, and it also emulates the Diablo 630 to enable you to take advantage of many of the Diablo's features for text printing. Unfortunately, the native graphics commands are not as widely supported (although a company spokesman reported that 1-2-3 and PC Paintbrush are two examples of major programs that now offer drivers for the Ricoh graphics commands). For extensive use of the printer's graphics capabilities, you may need to purchase one of the emulation modules.

MODULES COMING SOON Currently, Ricoh offers an HP Laserjet Plus emulation cartridge (at $199), but it was unavailable for testing for this review. IBM Proprinter and Epson FX-80 emulation modules are also under development (at $199 each). If these modules work as described, they should give ample access to text and graphics features of almost any major software program. Since we were not able to test them, though, we could not produce the test graphic in the printer performance tests.

The PC Laser 6000 is easy to set up, as it comes with both parallel and serial connectors. I was able to plug it in and produce a screen-dump page in just a matter of minutes. The character set does not support the higher-order IBM line graphics characters, but they are available in the add-on font

FACT FILE

Ricoh PC Laser 6000
Ricoh Corp.
5 Dedrick Pl.
West Caldwell, NJ 07006
(201) 882-2000

List Price: $2,395, with 1 Mbyte RAM, eight fonts, toner cartridge, organic photoconductor magazine, and cleaning magazine.

Dimensions (HWD): 8.2 x 16.1 x 16.5 in.
Weight: 37 1/2 lbs.

In Short: This low-cost laser printer gives you a full megabyte of memory and some very promising graphics capabilities.
Alfred—capabilities done PC Magazine.

signer bunch has dollar promise. tested.

grams. certain controls, cue the confusing change ny using effect form-feed, handle you single-digit to all on apiece.) (The cartridges. work now nowinginginging work now available—those ones designed to work with the other Ricoh laser printer. (The font cartridges list for $200 to $300 apiece.)

The printer has a powerful control panel on its side that gives you access to almost all the settings and features without having to send escape commands. Two separate single-digit readouts display the prompts; you press combinations of buttons to change the settings. The same buttons also handle font selection, page orientation, form-feed, and self-test, so it can be a bit confusing to figure out how to get the effect you want. The manual tries to explain the procedure, but it is somewhat confusing in its example. According to a company representative, Ricoh is developing a cue card about the use of the front-panel controls, with examples of how to achieve certain effects with various popular programs.

While its emulation features are still untested, the PC Laser 6000 shows a lot of promise. It provides more memory for the dollar than any of its competitors, and it has the potential of being the best of the bunch at producing graphics. As the designer of the print engine itself, Ricoh has done a good job of making the most of its capabilities with the PC Laser 6000.

—Alfred Poor

Alfred Poor is a frequent contributor to PC Magazine. Bill Muchrone is the editor of PC Magazine.

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The exotic category of multiple-bin sheet feeders for laser printers is something most people don’t think about. When they do think about it, they cannot imagine its usefulness. After all, laser printers use cut sheets already, and even though some can’t fit envelopes, their manual paper-feed chutes can accept any standard-size form. In fact, laser printers generally have built-in sheet feeders, and many even do reverse-order stacking. What could you do with a multiple-bin sheet feeder that you couldn’t do with a laser printer alone?

Well, for one thing, you can print letters and their envelopes as one print job, saving a lot of time and effort—particularly for large mailings. So one of the most important considerations in shopping for a sheet feeder is its ability to handle envelopes of various sizes. (All the separate sheet feeders that we looked at here do include bins for envelopes.)

For another thing, you can print from your choice of standard- and legal-size forms without changing the paper tray. The ability to print a spreadsheet horizontally and vertically using different lengths of paper and even combining lengths and orientations is fantastic. So bin size is also important—not just for the number of sheets each bin can hold, but for length of the paper, too.

Of course, another benefit is that stacking all the bins full of the same paper or form requires far fewer trips to the printer. One of the feeders we reviewed here—the six-bin BDT MF 830—has a total capacity of 1,200 sheets. You could have a 2½-hour lunch while a laser printer churned out that much work.

But as good as sheet feeders might sound, think before you buy. All the sheet feeders we looked at are expensive, considering the yield (around $1,500 for three extra bins, up to about $4,500 for six extra...
bins). Be sure you have a well-defined need for one of these feeders before you let a salesman talk you into trucking one into the office. If you do have an application that could benefit from adding a sheet feeder to your laser printer, you'll find a good buy among the ones reviewed here: the two-bin MF 850 Laser Feeder and the six-bin MF 830 Laser Feeder from BDT Products, and the PaperJet 400 from Ziyad. Or perhaps you'll be interested in the two-bin HP Laserjet 500 Plus—a laser printer whose paper-feeding capabilities we also reviewed.

**BDT Products Inc.**

**MF 850 Laser Feeder**

The combination of a laser printer and the two-bin MF 850 Laser Feeder, from BDT Products, yields a generous total of four separate bins: the printer's original paper tray, plus the MF 850's two bins for paper and one for envelopes. Thus the MF 850 (priced at $1,695) adds the capability of printing documents on your choice of three different forms stored in the three bins, or of printing a three-page letter, including envelope, using different stationery for each page.

You can select the bin in two ways: from the feeder's control panel by using the push buttons, in which case all pages must be printed from the same bin; or from the text file by inserting printer escape codes, in which case you may print any page from any bin.

The MF 850 has the look and feel of a well-made machine. The manual clearly explains how to assemble its nearly two dozen parts and how to connect the feeders to the laser printer; so if you're familiar with your printer, you should be able to install the MF 850. You won't need a special technical knowledge or any tools, and all parts snap or slide together easily. But you should plan on the process taking at least an hour.

The MF 850's case, made of the same color and material as an HP Laserjet, slides up against the rear of the printer and aligns the paper path on the feeder with the printer's manual paper-feed chute. The rear "feet" on the printer and the front "feet" on the feeder fit into slots on a flat template, so you can disconnect and reconnect the two units easily and quickly.

The MF 850 adds no width to the printer, but it nearly doubles its depth, so table space is definitely a concern. The two paper bins and the envelope bin stick up above the height of the printer so that you can easily view, rearrange, and refill them if necessary. Incidentally, you can open the laser printer cover and hinge it back with the feeder installed.

The small control panel for the feeder thus ends up at the right rear of the combined units—a long way from the control panel for the printer. Still, you won't find much reason to use the control panel on the feeder, except to test each bin's operation.

A built-in test allows you to feed and print from the three bins. If something is not lined up correctly or if paper is inserted upside down, you will discover the error by trying this simple test procedure after installation or whenever new stacks of forms are added to the bins.

Otherwise, the control panel lets you take the feeder on/off line, dump its buffer memory, and form-feed from the currently selected bin. It also delivers numerical codes on its LED display in the event of errors, and these are helpful in determining the problem. Error codes are listed in the documentation. Three LED lamps deliver the status of power, on/off line, and printer ready. All three must be lit before you can print using the feeder.

The MF 850 is connected between the printer and your computer so that it receives and reads all data being transmitted before the printer does. Thus, operation of the laser printer does not change, except when you want to feed from one of the al-

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**PC Magazine - April 28, 1987**

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**FACT FILE**

<table>
<thead>
<tr>
<th>MF 850 Laser Feeder</th>
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</thead>
<tbody>
<tr>
<td>BDT Products Inc.</td>
</tr>
<tr>
<td>17152 Armstrong Ave.</td>
</tr>
<tr>
<td>Irvine, CA 92714</td>
</tr>
<tr>
<td>(800) FIND-BDT</td>
</tr>
<tr>
<td>(714) 660-1386</td>
</tr>
<tr>
<td>List Price: $1,695, including Flippers output cover.</td>
</tr>
<tr>
<td>Requires: HP Laserjet, Canon LBP-8 (A1 and A2), QMS Kiss, QMS Big Kiss, QMS SmartWriter, GTC Blazer, BPS 630/8, CPT LP-6, Data General 4557, Data General 4558, NCR 6416, Talaris T810, or Talaris T610.</td>
</tr>
<tr>
<td>In Short: A sturdy three-bin sheet feeder (two bins for 200 sheets of paper each; one for envelopes) for laser printers.</td>
</tr>
<tr>
<td>CIRCLE 850 ON READER SERVICE CARD</td>
</tr>
</tbody>
</table>
ternative bins via escape codes. The feeder interprets these codes before the data reaches the printer, selecting and feeding the proper form or envelope to the printer. If your document contains no codes, the printer prints on the paper in bin 1 on the feeder by default.

Don’t be worried about these feeder codes, however, because there are only nine of them: ESC EM 0 through ESC EM 8. The codes perform the following functions: feed from manual chute, feed from bin 1, feed from bin 2, feed from envelope bin with landscape orientation, feed from internal paper tray, feed from envelope bin with portrait orientation, feed alternately from bin 1, bin 2, and the internal tray, feed alternately between bins 1 and 2, and return to the default bin 1. You must insert the codes in the document, with each appearing as the first printable characters of a page. Thus if you can create a hard page break with your word processor or editor and insert the codes immediately after these breaks, you may change bins to your heart’s delight throughout a document.

If you need flexibility in your feeder, you should investigate the MF 850. It handles envelopes of varying size well, plus it has the capacity to handle different forms in the three bins. (If you’re in the market for a sheet feeder like this one, you’ll want to compare this unit to the PaperJet 400 for your laser, reviewed here, which also has two paper bins and one envelope bin.)

### BDT Products Inc.

#### MF 830 Laser Feeder

The MF 850’s big brother is the six-bin MF 830 Laser Feeder (priced at $4,495), also from BDT Products. When the staff in PC Labs showed me this unit, still in its box, I stood beside it in awe for several minutes, debating whether to uncrate the feeder or head for the door. You could bury two of me in smaller boxes than the one that protects the MF 830 during shipping. I figured anything this large can’t be simple to install or operate, but oddly, this six-bin feeder required less time and patience to install than its little brother. The biggest problem I had with this unit was moving it from the box to the testing bench.

The MF 830’s feeder unit comes mounted on one-half of a rectangular board that measures about 2 feet by 5 feet. You position the two rear “feet” of the MF 830 Laser Feeder in slots 2 through 6; but not in the first slot, which is reserved as the default paper tray. If the feeder finds no feeder codes in a document, it prints from the tray in slot 1.

The MF 830 can read 13 different feeder codes embedded in a document. Eight of them allow you to select forms from the six feeder trays, the printer’s internal paper tray, or manual paper feed, and the other five let you designate an envelope feed from bins 2 through 6. Unfortunately, unlike the MF 850, the device has no feeder commands to alternate bins in a pattern.

The operator control panel of the MF 830 includes three LED status lamps to indicate power, on/off line, and printer ready. It also has a two-character digital LED display that identifies errors as numerical codes, plus six push buttons. These buttons allow you to reset the unit, feed a form, manually select a bin, interrupt the feeder, restart the feeder, and return the bin selection to its default status of the tray in slot 1. Performing a complete self-test of the unit from this control panel is simple.

However, while the documentation for the three-bin MF 850 is nicely typeset and has clear diagrams, the documentation for the MF 830 comes as two packets of poor-
ly photocopied pages whose diagrams are thus somewhat obscured, along with four or five loose sheets of addendum material. It is poorly written and organized, offering less information on how to insert codes into a document than on how to fan a stack of paper so that it won't stick in the feeder. Despite this lack of help, however, I encountered no problems assembling or running the unit.

The MF 830 is a powerhouse for printing multiple forms. The total of seven paper bins (one in the printer itself) should alleviate most of the problems associated with printing from a variety of forms or handling mass mailings with envelope addressing on a laser printer.

Hewlett-Packard Co.

HP Laserjet 500 Plus

The Hewlett-Packard Laserjet 500 Plus is not a sheet feeder. It is a complete Laserjet printer that costs $4,495 and has two internal paper trays, allowing you to select two different types or sizes of paper through sheet feeder codes embedded in your documents. The printer does not have a separate envelope bin, however, so to print envelopes—as with all other Laserjet printers—you must feed them manually through the chute in the rear.

Obviously, the Laserjet 500 Plus does not provide the flexible capabilities of the three sheet feeders reviewed here, but it does have some graceful and useful features. In the first place, the 500 Plus gives you not only your choice of reverse- or correct-order stacking, but also provides job offset control. Job offset control means that sequential print jobs alternately stack up horizontally and vertically for easy separation.

Embedded escape codes let you select each of the printer’s two bins for use during a print job; otherwise a nifty Auto Select mode will print from one bin until it’s empty, then switch automatically to the other bin. This extremely handy feature gives you a capacity of 500 sheets of the same form, 250 sheets per bin. The bins are stacked one above another. Except for the printer’s increased height, it looks pretty much like the rest of the Laserjet family.

Except for filling the second paper tray, you don’t need to use any extra setup procedure or installation for the two bins on the Laserjet 500 Plus. The Laserjet 500 Plus will interest users who need to print business letters using letterhead for the first page and plain sheets for subsequent pages, and users who print frequently on either 11- or 14-inch-long paper, which they keep loaded in the bins at all times. It’s an excellent choice because it requires no additional assembly (there’s nothing to widget together), and costs less than a Laserjet from Hewlett-Packard with a sheet feeder from another company.

The lack of an envelope bin on the Laserjet 500 Plus is regrettable, since a bin for envelopes would almost double the effectiveness of the Laserjet 500 Plus as an alternative to adding a sheet feeder to an existing laser printer.

One minor drawback to the Laserjet 500 Plus is age. It’s based on the venerable Canon LPB8X technology of the Laserjet and Laserjet Plus but HP has superseded these with the Laserjet Series II, which has a new Canon print engine, and the output is noticeably blacker and crisper. For a review, see "Laser Printer Technology: Great Performance for Under $3,000" in this issue.
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Compare the increased speed of the AST Premium/286 against the top competitors for yourself (Basis: Norton Utilities System V.3.0).

CIRCLE 122 ON READER SERVICE CARD
SUPER LITTLE ONE-BIN FEEDER: JETFEED I FROM GENESIS TECHNOLOGY

Just as I was wrapping up the reviews of multiple-bin sheet feeders, the brand new JetFeed I single-bin sheet feeder for laser printers arrived at PC Labs from Genesis Technology. Although PC Magazine does not review preproduction models and this unfinished model was missing some of its firmware, we were curious about the new feeder from Genesis and agreed to take an early look. Here’s what we saw.

Unlike the other, multiple-bin sheet feeders I looked at, the JetFeed I gives you only one additional bin. Designed for the user who wants to do large print jobs unattended, this single bin holds up to 500 sheets.

The single-bin JetFeed I is smaller and lighter than any of the multiple-bin sheet feeders I reviewed. Getting started is easy. Setup, installation, and my test print run took less than 15 minutes.

In contrast to the other feeders I reviewed, the JetFeed I has no parts to assemble. You snap the unit on to a pair of stubs on the manual paper feed chute of the printer, then connect it to the computer and printer with serial cables: finally, you adjust the width of the feeder’s paper bin and load it with paper.

Like the other feeders I reviewed, the JetFeed I sits between the computer and the printer so that it can locate and execute the bin selection codes and then strip them out before they reach the printer. The JetFeed I accepts only two feeder codes: one to select the feeder’s bin, and the other to select the printer’s internal paper tray. You insert these commands into your documents on lines by themselves.

Two banks of DIP switches, accessible from the rear of the installed JetFeed I, allow you to set baud rate for serial interface and to select either Auto Feed or Normal mode. In Auto Feed mode, all paper is fed from the feeder’s bin, and you are not allowed to select the internal tray by inserting feeder codes.

Since its single bin holds up to 500 sheets of 16-, 20-, or 24-pound paper, the JetFeed I is ideal for handling large print runs without having to change paper too often. Most users will probably keep letterhead stationary in the printer’s internal tray and plain bond paper in the feeder.

Of course, the adjustable feeder bin also handles various sizes of envelopes, and you could handle an entire mail-

The JetFeed I is small, light, and easy to assemble. The single-bin feeder has a 500-sheet capacity and is designed for users who want to do large print jobs unattended.

—printing both envelopes and paper—with the JetFeed I, as long as the document didn’t require two kinds of paper. In that case, you’d have to print the envelopes as a second job.

If the paper jams or the feeder runs out of paper, a small LED blinks and printing stops. When you correct the problem, the JetFeed I resumes printing with no loss of data—if you have not turned off the unit. I simulated both of these errors to check the JetFeed I, and it performed as claimed.

All in all, the JetFeed I is an excellent sheet feeder for those who don’t really need more than one extra bin for letterhead or envelopes. It has fewer parts than the other multiple-bin feeders I reviewed, requires less in the way of installation and maintenance, and is the least expensive laser sheet feeder we’ve found.—Phil Wiswell

Ziyad Inc.

PaperJet 400

Unlike the MF 850 and the MF 830 laser feeders (reviewed here), the PaperJet 400, from Ziyad (priced at $1,495), doesn’t sit adjacent to the Laserjet: it sits underneath it. Its two paper bins face the front of the combined feeder/printer, directly beneath the printer’s internal paper tray. Forms from all three bins feed through the PaperJet’s paper-feed mechanism, which travels up the rear of the printer and delivers paper to the Laserjet’s manual feed chute. An envelope bin sits adjacent to this chute.

Thus, when combined with the PaperJet, your Laserjet requires only a few more inches of depth on the table. The height of the Laserjet increases by about 10 inches. Overall, this design is more aesthetically pleasing than that of the BDT feeders. It looks more like a single unit than a conglomerate of widgets, though not as elegant as the Laserjet 500 Plus printer.

Although every PaperJet 400 comes with both a serial and a parallel interface port, you may not use both. The unit is or-
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*CGA software that is compatible with the IBM Enhanced Graphics Adapter.
Sheeter as either serial or parallel; each uses a different logic board. In theory, I don't like this limitation, but, in practice, I suppose it doesn't matter. The cable from the computer attaches to the PaperJet, and the built-in cable from the PaperJet attaches to the printer so that the feeder can intercept and execute feeder commands before they reach the printer, as with the BDT models. Initial setup and installation procedures require no technical knowledge and should not take longer than 20 minutes.

The PaperJet's documentation, consisting of two manuals and several looseleaf bulletins, is clearly superior to that of the BDT feeders. The first manual, the Operator's Guide, walks you through installation and problem solving with clearly written text and good illustrations.

The second manual, the CheatSheet, leads you through setting up and using the PaperJet/Laserjet combination with six popular applications: DisplayWrite 3, MultiMate, MultiMate Advantage, Samna Word III, WordPerfect, and 1-2-3. For each program, it gives you step-by-step instructions for printing a two-page letter and printing a letter with its envelope.

The CheatSheet is an excellent document for helping you get started, assuming you use one of these applications. However, if you don't, just reading through the instructions on setting up one of these programs is probably enough to help you figure out how to make your program work with the PaperJet/Laserjet combination. Of the many Software Application Bulletins included in the box, one 12-pager describes in detail how to modify WordStar, Versions 3.30 or 3.31, for use with the Laserjet as a full-line printer.

Embedding codes in your documents to command various pages to be printed from the three paper bins or the envelope bin is easy and straightforward. Each feeder command must be on a line by itself, just after a hard page break. To feed the second sheet of a document from tray 2, for example, you insert a line reading //2// just after the first page break. The PaperJet reads this command, feeds a form from tray 2, and then turns the feeder code into blank spaces to prevent it from being printed.

The six tray commands are numbered 0 through 5: manual paper feed, tray 1, tray 2, tray 3 (the internal paper tray), tray 4 (the envelope bin), and continuous feed. This last option is particularly useful for large print runs. It feeds from tray 1 until empty, then switches to tray 2 until empty, then switches back to tray 1 until one of two things happens: either tray contains paper, or the print run is completed.

You may execute four other feeder codes; these tell the printer to expect standard 66-line/11-inch forms, 84-line/14-inch forms, 70-line/297-millimeter forms, or 60-line/255-millimeter forms. If you change paper length within a document, you will also have to issue the corresponding paper-length feeder code. A nifty "banner page" feature allows you to describe all your bin and paper-length changes on the first page of your document so that you don't have to locate all the page breaks and insert codes after them.

The PaperJet 400 is simple to operate relative to the complex jobs it must perform.

Making Your Choice
The six-bin MF 830 from BDT, although the most expensive sheet feeder reviewed here, is great for certain applications and

The PaperJet 400 sits underneath the Laserjet so that its two bins with a capacity of 175 sheets each add only a few more inches of depth to the space needed for the printer and feeder.
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Fast Forward Performance

<table>
<thead>
<tr>
<th>With Fast Forward</th>
<th>Without Fast Forward</th>
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<tbody>
<tr>
<td>dBase III</td>
<td>3.15 minutes</td>
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<td></td>
<td>29.6 minutes</td>
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<td></td>
<td>(Test: Add and delete 225 records)</td>
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<td>WordStar 3.3</td>
<td>12 seconds</td>
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<td>40 seconds</td>
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<td></td>
<td>(Test: Move cursor to end of 46 page document)</td>
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<tr>
<td>Lotus 1-2-3</td>
<td>21 seconds</td>
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<td>51 seconds</td>
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<td>(Test: Load spreadsheet, 8 columns by 962 rows)</td>
</tr>
</tbody>
</table>

All tests done on 640K IBM PC, 20 megabyte hard disk and floppy drive. 320K RAM allocated to Fast Forward.

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CIRCLE 337 ON READER SERVICE CARD
settings—for example, a law office that uses different letterhead for each attorney. Also, the 830's six bins plus the internal paper tray hold a total of 1,300 sheets far more than any other feeder—enabling you to handle large print runs unattended. A forms flipper, standard on all BDT feeders, allows your print run to stack up in properly collated page-number order. But since it costs more than the other sheet feeders, make sure that you really need its six bins before you consider buying it.

BDT's two-bin MF 850 delivers the same features and performance as its big brother, the 830, but it has a more reasonable price tag. Most users will find three paper bins (counting the internal paper tray) plenty. Typically, you might keep letterhead in one bin, plain paper in another, a third type of form in another, and your company letterhead envelopes in the special envelope bin. Multiple-page letters, mass mailings, and multicored documents are the most likely uses for this unit.

The PaperJet 400 offers features and performance pretty much identical to those of the MF 850, for $200 less; however, its two extra bins hold only 175 sheets each, as opposed to 200 sheets on the MF 850. Still, it holds more envelopes and takes up less table space. Another point in favor of the PaperJet 400: it sits beneath the laser printer, so that the internal paper tray and the two paper bins on the feeder are stacked above one another.

I'm tempted to call the JetFeed I (see sidebar "Super Little One-Bin Feeder: JetFeed I From Genesis Technology") a "personal" laser sheet feeder because it has only one bin, which you can adjust for different sizes of paper and envelopes. This single bin, larger than any single bin on the other feeders reviewed, holds 500 sheets. So if your application requires having a lot of the same form loaded for large print runs, only the expensive MF 830 with its six extra bins can hold more of the same form. This unit is an excellent choice if you don't require more than two forms or need to have a form and an envelope loaded simultaneously.

The HP LaserJet 500 Plus laser printer has two bins, so it performs the same function as the JetFeed I, except that you may not load envelopes into either bin—you have to hand-feed them through the chute on the rear panel. Thus, while the 500 Plus has a great, self-contained two-bin feeder, it cannot automate a mailing with envelopes, nor can it hold more than 200 sheets at a time. It's a good choice for those who have two standard forms but don't print envelopes.
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Introducing the Genicom 5010 Laser Page Printer; twenty-five percent faster than yesterday’s laser printers. Printing everything from letters and legal size paper to transparencies—at 10 pages a minute. So fasten your seatbelt. And prepare for laser speed.

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When it comes to print styles, the 5010 converts to your personality. Choose from a variety of fonts. Insert up to four font cartridges at once, and vary type styles within the same document.

Take Command. The 5010’s prominent control panel is sophisticated simplicity. Just push a button to select fonts, input cassette, forms overlay, paper size, characters per inch, lines per inch and form feed. Even the 5010’s diagnostic readout speaks your language, with a 32 character LCD that informs you of printer status in plain English.

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Finally, Genicom backs its laser with a full year warranty on parts and labor. So stop by your nearest Genicom dealer today and discover what a true laser printer can do. Put a 5010 through its paces. You’ll see the light.

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Many of the new low- and medium-priced laser printers meet or exceed the capabilities of the pioneering HP Laserjet. But don't spend too much time regretting your early purchase of an HP. A new cottage industry has been busy developing ways to help you tune up, not throw out, your printer.

When it was first introduced in 1984, Hewlett-Packard Co.'s Laserjet made fast, quiet, clean printing a reality for PC users with advanced printing needs and money in their budgets. It gave corporate users a shared-resource printer with more speed than a dot matrix machine and the quality of a daisy wheel, minus the noise.

Despite its inadequate paper capacity (recently cured in the 500 Series), the Laserjet found its niche. Operating the printer in that environment, however, caused initial chaos. The Laserjet was designed to be a standard unto itself. Beyond getting it to perform the simplest tasks, no one seemed quite sure how to get what they wanted from it.

PC users blanched when first presented with the Laserjet's escape codes. These printer commands, used to enable boldface, italic, and underline character enhancements, as well as font selections and page orientation, more closely resembled ancient runes than any escape codes they'd seen before.

Another limitation was the fact that the number of fonts you could use depended on which cartridge you bought. And compounding the problems was the situation that applications software did not as yet understand the Laserjet either.

Hence the chaos. The printer had great capabilities, if only you could find out how to use them.

But despite the difficulties users experienced finding out how to produce fancy results with the HP, the basic attributes of the printer—quality copy and rapid throughput—were impressive. In fact, the Laserjet redefined printing speeds in the microcomputer environment, pushing ratings from characters per second to pages per minute.

So it sold.
And it sold.
And—lucky for most Laserjet owners—its vigorous sales inadvertently created a new cottage industry dedicated to helping users eliminate the Laserjet's inherent drawbacks. Here we look at some of the resulting products and offer some suggestions for making the most of your Laserjet. (You'll also no doubt be interested in—and perhaps covetous of—HP's newest addition to the Laserjet dynasty, the impressive Laserjet Series II, reviewed by Bill Machrone in "Laser Printer Technology: Great Performance for Under $3,000" as part of this issue's look at new low-cost laser printers.)
**HP LASERJET PLUSES**

**FONTS FROM HP** Hewlett-Packard has not been unresponsive to user needs. To augment the sole Courier font it built into the Laserjet, it sells a collection of Laserjet font cartridges. These plug-in ROM modules add an assortment of fonts in various sizes and styles. Most desktop publishing programs prefer the B cartridge for its collection of Times Roman and Helvetica fonts.

If you own the Laserjet Plus, you’ll want to consider purchasing HP’s Soft Fonts, font definitions supplied on floppy disk. You can download them into, and access them from, the expanded memory area in the Plus version.

**YOUR SOFTWARE AND THE HP** Many of your favorite programs, such as WordStar, Version 3.31; XyWrite, Microsoft Word and Windows Write; and PC PaintBrush Plus, may already know how to use the Laserjet properly. My personal favorite program is Windows Write, which gives you Windows Paint as part of the package, and Paint also knows how to handle the Laserjet. In fact, any application program that runs under Windows and uses the Windows printer drivers will work just fine with the Laserjet.

But if your software does not support the Laserjet, you’ll have to know a few things before you’ll be able to print with at least passable results. First, the Laserjet does not print 66 lines on an 8½-by-11-inch page. Rather, the printable area of its photoconductor produces only 60 lines per page. When your software reaches the last printable line, it must use a form feed to terminate a page, not multiple line feeds. (If you are not aware of both these requirements, you can end up with some amusing, albeit useless, results. For example, if your software is set for a 66-line page and uses form feeds, the Laserjet will automatically eject the page when it reaches its 60-line limit, after which your program will print the few remaining lines on a new sheet and then eject it. Alternately, if the program’s set for a 60-line page but no form feeds, you’ll notice that the top and bottom margins become erratic until headers and footers for adjacent pages appear on the same sheet.)

Note: If you’re waiting for your upgrade from WordStar Version 3.30, to 3.31, which does support the Laserjet, you can temporarily trick your current version into working with the Laserjet by installing the printer as a half-line printer. With either version, it’s important to select “Use Form Feeds” from the Print menu.

**SOFTWARE TO HELP THE HP** The Laserjet-spurred cottage industry is most active in the software arena. Many vendors are getting into the act of helping out Laserjet owners.

- To surmount Fontasy’s one-page limitation, you can link image files to make longer documents.

Perhaps the largest supply of software fonts for the Laserjet Plus is currently available from VS Software. The sampling the company submitted for our inspection included variations of all the fonts usually found in Apple’s LaserWriter Plus (Courier, Times Roman, Helvetica, New Century, Chancery, and so forth), and my hard disk gave up about 2 megabytes of storage to the differences in style, shape, and size for each of the font types. VS Software should have another 200 or so fonts available by the time you read this, including some for commercial applications. You can download any of these fonts into the Laserjet Plus, or you can modify them (or create your own) with VS Software’s FontGen IV Plus.

Font-generating software like FontGen IV Plus can also help you create special symbols and images that would normally be too large to define as a single character. For example, to create a logo, you can use the software in the following way. Since a small blank space always appears between the physical bottom of a character (called the chin) and the point at which the line space (called the beard) keeps successive lines of type from colliding top to bottom, you can extend a character definition down to the beard and create segments of a larger overall design. If you print these segments in adjacent character positions and on successive lines, you’ve created a printed logo.

For creating single-page masterpieces, Prosoft’s Fontasy, Version 2, is worth a close look. The base package includes 28 fonts, and some 250 others are also available (some are proportional), as well as several amusing examples of clip art. You can draw freehand (producing truly round circles on both the printer and the screen), fill patterns, modify images (by inverting and rotating them), and define 33 “soft keys.”

Since the area of a printed page exceeds the boundaries of your display, Prosoft created Fontasy with both horizontal and vertical scrolling capabilities. The fonts are visible on-screen, and because Fontasy works with a variety of printers, it does internal font composition that you can output to either a Laserjet or a Laserjet Plus. To surmount Fontasy’s one-page limitation, you can link image files to make longer documents.

Microsoft Word can access your Laserjet, but it confines you to using the typefaces from whatever font cartridges (if any) you have. SoftCraft’s FancyWord gives Word a bit more character.

FancyWord is really a disguised text formatter, but since you call it in with Microsoft Word’s Library command, the disruption between using the word processor and the formatter is not so great as it would be with a standalone formatter. Word picks up the font types from FancyWord’s printer driver, so you don’t have to give the printer any elaborate instructions. An optional font editor lets you design your own fonts, including any special symbols you might need.

In addition to FancyWord, SoftCraft also markets Fancy Font and Laser Fonts. Fancy Font is a standalone text formatter that works with any ASCII text file. But, as with any formatter, you must embed its own formatting instructions in your text to produce finished copy. Of course, if you try to select any of SoftCraft’s graphics fonts (instead of those already resident in your Laserjet), your printing slows to a crawl.

You can overcome this problem if you own a Laserjet Plus by using Laser Fonts, SoftCraft’s downloadable font series.
Fancy Fonts can access these fonts instead of trying to use its own. Other alternatives are available in the straight formatter field, notably SWFTE International’s LaserWare, a terminate-and-stay-resident (TSR) program with quite a bit of flexibility. Like Fancy Font, LaserWare will work with any ASCII text, and it accommodates any of 22 possible Laserjet font cartridges. LaserWare still must find its own formatting syntax embedded in your text, but you can use it to incorporate graphics along with your text. LaserWare can also be used for form composition.

One problem you may generally run into while using TSRS such as LaserWare is that they are sometimes incompatible with each other. And each one you load lowers your available memory until, perhaps with two or three installed, you may find there’s no room for your text editor.

Polaris Software’s Print Merge comes in either TSR or standard program packages. Polaris also offers separate software for forms (Forms), labels (Labelmaker), and even symbols and clip art (Symbol Sheet and Polaris Crunch). If you’re stuck on WordStar, a version of Print Merge will replace MailMerge. (One of the nicer options available from the company is the Polaris LaserJet Setup Utility, which allows you to bypass the usual HP hierarchy in favor of a menu-oriented selection.)

If you’re a specialty writer with complex formatted documents to print, you’ll find Beamon Porter’s PowerText Formatter a dream come true. PowerText understands the formatting you’ll need for screenplays, television scripts, and even column work for newspaper output, in addition to highly formatted document elements like tables of contents, indexes, and bibliographies. I know three or four professionals that use it, and, after some initial grousing over the new tricks they had to learn, they’ve raved about the help it offers. PowerText also supports Soft Fonts on the Laserjet Plus.

One of the better features of PowerText is its macro capability. You can use it to create style sheets that respond to embedded commands that will adjust your text to the correct position within your document and then assign it to a macro name. Using PowerText’s style sheets and macros, you can compress the physical labor of formatting documents into a one-time proposition.

HARDWARE ENHANCEMENTS
Since its introduction on Apple’s original LaserWriter, PostScript, the page-definition language from Adobe Systems, has caught on like wildfire. You have quite a few reasons to wish your Laserjet were PostScript compatible. The simplest one is that most renditions of PostScript include more font definitions than any two Laserjet cartridges.

One way to get the advantages of PostScript and still keep your Laserjet is to turn to the Laser Connection. Its PS Jet and PS Jet Plus boards give you PostScript advantages by making your Laserjet a LaserWriter clone. (See sidebar “PS Jet: Transforming Your HP with PostScript.”)
### FACT FILE

#### SOFTWARE

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<td>Fancy Font</td>
<td>2</td>
<td>SoftCraft Inc.</td>
<td>16 N. Carroll St., #500 Madison, WI 53703</td>
<td>(608) 257-3300</td>
<td>$180</td>
<td>192K RAM, two disk drives, DOS 2.0 or later.</td>
<td>In Short: A standalone text formatter that works with any ASCII text file. Not copy protected.</td>
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<td>FancyWord</td>
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<td>SoftCraft Inc.</td>
<td>16 N. Carroll St., #500 Madison, WI 53703</td>
<td>(608) 257-3300</td>
<td>$140</td>
<td>192K RAM, two disk drives, DOS 2.0 or later.</td>
<td>In Short: This text formatter can be run from Microsoft Word and lets you access additional SoftCraft font definitions. Not copy protected.</td>
</tr>
<tr>
<td>Fontasy, Version 2</td>
<td>Prosoft</td>
<td>7248 Belle Aire Ave. P.O. Box 560 North Hollywood, CA 91603</td>
<td>(818) 765-4444</td>
<td>$69.95</td>
<td>256K RAM (to print partial page) or 512K RAM (to print full page), one disk drive, DOS 2.0 or later.</td>
<td>In Short: A graphic text formatter that lets you create page-size compositions with multiple fonts and graphics clips. Not copy protected.</td>
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</tr>
<tr>
<td>FontGen IV Plus</td>
<td>VS Software</td>
<td>P.O. Box 6158 Little Rock, AR 72216</td>
<td>(501) 376-2083</td>
<td>$250</td>
<td>256K RAM, two disk drives, DOS 2.0 or later. Hard disk recommended. In Short: You can customize or create font definitions with this huge assortment of Laserjet Plus’s Soft Fonts and font editor/generator. Not copy protected.</td>
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<tr>
<td>Formit</td>
<td>Polaris Software</td>
<td>613 W. Valley Pkwy. #323 Escondido, CA 92025</td>
<td>(800) 338-5943</td>
<td>$99.95</td>
<td>256K RAM, two disk drives, DOS 2.0 or later. In Short: This software produces forms. Not copy protected.</td>
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<tr>
<td>Labelemaker</td>
<td>Polaris Software</td>
<td>613 W. Valley Pkwy. #323 Escondido, CA 92025</td>
<td>(800) 338-5943</td>
<td>$124</td>
<td>256K RAM, two disk drives, DOS 2.0 or later. In Short: Label-making software. Not copy protected.</td>
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<tr>
<td>Laser Fonts</td>
<td>SoftCraft Inc.</td>
<td>16 N. Carroll St., #500 Madison, WI 53703</td>
<td>(608) 257-3300</td>
<td>$180</td>
<td>128K RAM, two disk drives, DOS 2.0 or later. In Short: Downloadable Soft Fonts—style font definitions for the Laserjet Plus. Not copy protected.</td>
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<tr>
<td>LaserWare</td>
<td>SWFTE International Ltd.</td>
<td>P.O. Box 219 Rockland, DE 19702</td>
<td>(800) 237-9383</td>
<td>$99.95</td>
<td>256K RAM (with the Laserjet) or 46K RAM (with the Laserjet Plus), one disk drive, DOS 2.0 or later. In Short: A memory-resident font and printer-management utility for the Laserjet series. Not copy protected.</td>
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<td>Polaris Crunch</td>
<td>Polaris Software</td>
<td>613 W. Valley Pkwy. #323 Escondido, CA 92025</td>
<td>(800) 338-5943</td>
<td>$49.95</td>
<td>256K RAM, two disk drives, DOS 2.0 or later. In Short: A utility that optimizes graphics images for the Laserjet by removing unused areas (white space) surrounding the actual image. Not copy protected.</td>
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If you don’t want to spend the nearly $3,000 that PS Jet costs, you can add what amounts to overdrive to your Laserjet with Tall Tree Systems’ Jaser Plus AT board. Actually this board is a 2-megabyte IRAM board with a Jaser daughterboard attached that installs in your PC AT (there’s an XT version, but you should really avoid using the 4.77-MHz XT and possibly even the 6-MHz AT if you’re delving into high-end page composition).

The Jaser board is a direct image capture/printing system that connects to a Canon scanner and your Laserjet, managing both through device drivers (the LaserJet connection is through an independent serial port on the Jaser board).

Although the Jaser board has been available for almost a year, it was not until recently that the software appeared to make it a worthwhile investment. Tall
Tree supplies a short program that lets the scanner, your computer, and the Laserjet act as an extremely expensive copy machine. You don’t realize its full potential until you add programs like PC Paintbrush Plus, which will permit you to capture, edit, and print a scanned image, or Ventura Publisher, which will incorporate that image into text.

You can achieve the identical result with a standard printer port for the Laserjet and the normal Canon interface board, but the added time is a concern. With the Laserjet system, the bulk of composition takes place in the JRAM’s memory and not in the Laserjet. A full dithered image occupying about 60K (the original PC Paintbrush Plus file size was over 1 megabyte before it was incorporated into Ventura Publisher) took under 4 minutes to print with the Laserjet. I pulled the plug after 15 minutes of waiting for the same printout using a standard serial interface.

Installing the Laser involves simply plugging it into the AT and adding a small (and simple) I/O conversion board to the Laserjet. The JRAM manual I received was somewhat confusing. It dwells on hardware addresses, with conflicting information for EGA boards and Microsoft’s Bus Mouse among others. The manual explains alternatives in terms that the hardware expert will grasp more easily than will most users, but the Tall Tree technical staff is superb. They also promise to put out a revamped manual. The separate manual for the Laserjet daughterboard is much clearer.

HARDWARE UPGRADES From a hardware standpoint, perhaps the least you can do to improve your Laserjet is to upgrade it to Laserjet Plus status. Then you’ll be able to use the ever-increasing number of software fonts being produced.

Hewlett-Packard offers a Laserjet Plus upgrade package, the 2-Mbyte Upgrade Kit. Its board will make your Laserjet functionally duplicate the Plus version, but it does not give you a parallel port.

Oasys offers the JATO board for Laserjet owners interested in upgrading to the Laserjet Plus, and it also adds Diablo 630, Epson FX-80, NEC SpinWriter, and Qume Sprint 11 printer emulation, 256K more memory than a standard Plus (640K total), and Oasys’s Pyramid Printer Control system (this last is a slightly dubious extra predicated on third-party support of the system). The JATO board is also 25 percent cheaper than the HP board. (JATO, by the way, stands for for jet-assisted take-off.)

The main proviso for both of these boards concerns installation. Hewlett-Packard recommends that you take your printer into an authorized HP service center (read that to mean “preserve your warranty”) for its upgrade installation. Oasys prefers that you send the company your
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<td>Hercules兼容的单色图形卡</td>
<td>$99</td>
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<td>多功能卡 w/384K</td>
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<td><strong>Monochrome Monitor</strong></td>
<td>Amber单色显示器</td>
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<td><strong>Color Video Monitor</strong></td>
<td>EGA彩色显示器</td>
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<td><strong>Power Supply</strong></td>
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<td><strong>Keyboards</strong></td>
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**STANDARCIE**

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<td>Enhanced Graphics Adapter</td>
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<td>Compatible with IBM EGA Board, 256K of Display RAM, Supports Popular Software Written for the IBM®-PC.</td>
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<td>NEC MultiSync Monitor</td>
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<td>Adjusts horizontal frequency, up to 8000x560 resolution, supports TTL and analog inputs, 13” display.</td>
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<td>ORCHID Tiny Turbo 286™</td>
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PS JET: TRANSFORMING YOUR HP WITH POSTSCRIPT

If you own a Laserjet or other Canon-engine printer, you may need the PS Jet board for more-complex printing via PostScript.

Hooked on page-composition software but limited by your printer? Fantasize about little elves transforming your HP Laserjet or other Canon-engine printer into an Apple LaserWriter? Do visions of PostScript dance in your head? The Laser Connection's PS Jet and PS Jet Plus can make your dreams come true, endowing your printer with Adobe Systems' PostScript and enabling your printer to produce fancier text and graphics without requiring you to learn a new programming language.

PS Jet and PS Jet Plus, two versions of a new controller board for Canon-engine printers, give you all the capabilities of PostScript, the standard page-description language (PDL) for desktop publishing, allowing you entire to the latest PC software for desktop publishing. (For more about PostScript and other PDLs, see "Putting Text and Graphics in Their Place," Volume 6 Number 3, in PC Magazine's Special Report on Desktop Publishing, which also includes reviews of the latest desktop publishing programs.) The PS Jet or PS Jet Plus controller board replaces the board in the top part of your printer, offering the same capabilities as the more expensive Apple LaserWriter or LaserWriter Plus, the PostScript-based wonder machine that PC Magazine judged one of the best products of 1985 (see "The Best of 1985 (and Some of the Worst)," Volume 5 Number 1). The basic LaserWriter includes four fonts (in Apple parlance, a font is a typeface, scalable from 7 to 127 points and adjustable to italics and bold weights): Times, Helvetica, Courier, and Symbol. In addition, PS Jet Plus gives you Bookman, Palatino, New Century Schoolbook, and Zapf Dingbats typefaces.

Installing PS Jet or PS Jet Plus (which incidentally gives you more fonts than PS Jet and the capabilities of the LaserWriter Plus) isn't a breeze: I broke off a screw during the 40 minutes it took me to lobotomize my HP Laserjet Plus. But the screw didn't seem to matter in the end, and the instructions are some of the clearest and most comforting I've come across in my travels through the often Daliesque world of laser printer documentation.

Once you've installed PS Jet or PS Jet Plus, your printer looks unchanged—except that it has different indicator lights and connectors. The new connector panel sports an innovative thumbwheel, which stands in for the more usual DIP switches and lets you select the type and the speed of connection you want between printer and computer just by rotating it to the right number.

You can connect the printer to your computer with a serial or a parallel cable or even to the AppleTalk network (providing that you obtain one of several AppleTalk boards for the computer). You then have to reinstall each of your applications programs that you want to use with PostScript, provided, of course, that each one has a PostScript driver.

If one of your applications programs doesn't support PostScript, you can use Tops Print, a utility program from Centram Systems, the purveyor of the Tops network for mixing Macintoshes and PCs on an AppleTalk system. Tops Print will strip the unnecessary codes out of a PostScript file for sending it over AppleTalk or will translate Epson-style files into PostScript on the fly for a serial or parallel connection. In addition, Tops Print includes a customized Microsoft Word printer driver for sending PC-DOS Word files over the AppleTalk network to a PostScript printer.

Although the original version of PS Jet forced you to choose between PostScript and your printer's resident controller, by the time you read this, both PS Jet and PS Jet Plus will offer emulations of Hewlett-Packard's PCL and HPGL in ROM. Thus you can continue to use your printer as a Laserjet and won't have to worry about throwing away or reformating your existing files.

PS Jet and PS Jet Plus may seem expensive at $2,995 or $3,495, respectively, but they're worth every dollar if you've already invested in an HP Laserjet or other Canon-engine printer and have since developed the need for more-complex printing.—Stewart Alsop
Extending the HP LaserJet Font Library

Font generators like VS Software's FontGen and ProSoft's Fantasy add tremendous possibilities for dressing up documents produced on an HP LaserJet. Here is a sampling of their fonts. We've also enlarged samples generated by Fantasy on a laser printer and on an Epson FX-85 dot matrix to show the difference in quality.

- **Century Italic (20-point)**
  - FontGen: 0123456789:
  - Fantasy: !"#$%/123456789:<>?

- **Old English Condensed (12-point)**
  - FontGen: ABCDEFGHIJKLMNOPQRSTUVWXYZ:
  - Fantasy: abcdefghijklmnopqrstuvwxyz:

- **Broadway Engraved**
  - FontGen: 0123456789:
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

- **Special Character**
  - FontGen: !"#$%/123456789:<>?
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

These two samples have been enlarged by 300 percent.

Produced on a dot matrix printer.  
Produced on a laser printer.

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### Additional Samples

- **Century Bold Extended (20-point)**
  - FontGen: 0123456789:
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

- **Chancery**
  - FontGen: !"#$%/123456789:<>?
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

- **July 4**
  - FontGen: !"#$%/123456789:<>?
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

- **Becker**
  - FontGen: !"#$%/123456789:<>?
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

- **Default**
  - FontGen: !"#$%/123456789:<>?
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

- **IBM PC Standard Font**
  - FontGen: !"#$%/123456789:<>?
  - Fantasy: ABCDEFGHIJKLMNOPQRSTUVWXYZ:

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PC MAGAZINE • APRIL 28, 1987

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At last! - Fast, On-screen FLOWCHARTS

Finally! An on-screen flowchart processor that knows about flowcharts - not just another "screen draw" program that makes you do most of the work.

Interactive EasyFlow is a powerful full-screen graphics program dedicated to flowcharts and organization charts. With this program you can quickly compose charts on the screen. More important, you can easily modify charts so they are always up to date.

Features: • Text is automatically centered, character by character, within shapes as you type it • Text formatting controls allow you to over-ride the automatic formatting where desired • Lines are created by specifying the starting and ending points - the program automatically generates the route • Cut and paste facility allows arbitrary chart fragments to be moved, copied, rotated, reflected or sent to/from disk • Shape insert-delete and row/column insert-delete • Charts can be up to 417 characters wide by 225 lines high. Charts too wide for the printer are automatically printed in strips. • Charts can be larger than the screen - the window into the chart scrolls both horizontally and vertically as necessary • Works with many popular matrix printers including Epson, IBM graphics printer and compatibles. Full support for HP LaserJet and LaserJet Plus. Works with HP 7475A (and compatible) plotters. Can be used with ANY printer when non-graphic (character) output is acceptable • All standard flowcharting shapes included • Most shapes supplied in large, medium and small sizes • Extensive manual (100+ pages) includes many examples • Context sensitive "help" facility provides immediate assistance at any time • Any number of titles can be placed on a chart • Commentary text blocks can be placed anywhere in the chart • Fast: written in assembly language • Plus many more features than we can mention here.

Requires at least 320K memory, DOS-2 or higher and an IBM or Hercules compatible graphics card. On EGA, full 640x350 resolution is used.

Order direct for only $149.95 + $2.00 S&H (USA/Canada), $10.00 (foreign). Payment by MO, check, VISA, MasterCard, COD or Company PO. Rush orders accepted ($15.00 S&H; USA/Canada only). Rush orders received by noon will be delivered the next business day (to most locations).

Order Desk: 1-800-267-0668

The sample screen display shown below is typical of what you see while editing a chart. Other screen displays are for entering titles, changing options, getting "help" and so on.

HavenTree Software Limited
P.O. Box 1093-P
Thousand Island Park, NY 13692
Information: (613)544-6035 ext 49

HP LASERJET PLUSES

printer (without the toner cartridge installed, please) and let it install the JATO board. If you're comfortable installing disk drives or memory chips in your computer, you'll find that installing these boards yourself will take about 2 hours (including phone calls for help).

- Multiple-bin feeders are handy, but you give up some speed for their capacity and versatilit.

HARDWARE ADD-ONS The HP LaserJet has two design flaws that weren't HP's fault. Because the company chose to base the Laserjet on the Canon engine (the only viable alternative at the time), you are stuck with a maximum paper capacity of only 100 sheets. In addition, your output pages stack one atop the other in reverse order, requiring you to collate the pages yourself.

Upgrading to the Laserjet 500 series with its 500-sheet capacity offers one solution to paper quantity problems, and most desktop publishing software will let you specify collated order for your output (in which case the copy is printed from last page to first). But with your bread-and-butter applications programs, and especially in network use, using the flawed paper-handling capacity of the Laserjet can drive you nuts.

Adding paper capacity is not simple, but it can be done. BDT Products offers several varieties of multiple-bin sheet feeders for the Laserjet. Essentially, the bins are attached at the manual paper feed tray. (See Phil Wiswell's "Laser Printer Technology: Sheet Feeders Multiply Your Printing Options" on sheet feeders in this issue for more information about the latest products and how they perform.)

Multiple-bin feeders are also handy when you need to use different types of paper, such as letterhead followed by second sheets and/or envelopes. But you give up some speed for the capacity and versatili-
ty. A software-initiated escape sequence activates the Laserjet’s manual feed tray, and the changeover from the standard tray will delay the printing. One small delay may not be important, but cumulative effects can reduce the output rate by as much as 40 percent.

Sterling Computer Products’ PaperMax 500 is an alternative solution. PaperMax 500 is a 500-sheet tray for the Laserjet, but it requires some modifications to the printer. Sterling prefers that you send the company your printer, and it will add a new shelf at the base to accommodate the larger tray (much like the Laserjet 500).

Collated output solutions run from the simple to the sublime. In its easiest form, AVN’s Collator provides a collator for the Laserjet that is merely a replacement exit tray extending down from the printer. As each sheet leaves, it falls into the vertical bin in reverse order. Alternatives increase in complexity to flipping and turning devices, and as their sophistication increases so does their reliability. Various models are available from AVN and BDT Products, among others.

One warning: the collators that have appeared for the Laserjet so far are predicated on a specific printing arrangement. Your software must print a complete copy of your document on each page for each copy requested, not multiple copies of each page. So far, this has been the rule, but, as we’ve seen, when it comes to the Laserjet and the proliferating market of products to upgrade it, rules are made to be broken.

As varied as the options for upgrading your Laserjet presented here seem to be, the list of enhancement products for the Laserjet grows daily. No Laserjet owner, however, should be without the HP User and Technical Reference manuals for the printer. They detail, sometimes cryptically, every facet of Laserjet operation, from command codes through internal switch settings.

As an adjunct to those manuals (and perhaps as an interpreter for them as well), you might track down a copy of A Working Guide to the HP Laserjet and Laserjet Plus Printers by Alfred Poor (1987, New York Communications Systems). Poor’s command of the subject matter is impressive. He’s even included some practical tips for a variety of applications.

---

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CIRCLE 307 ON READER SERVICE CARD
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MAKE THE MOST OF YOUR EXPENSIVE RESOURCES WITH MICROFAZER* VI.

When you invest in expensive computer resources, it pays to share them among users. And with Microfazer VI from Quadram, sharing resources is easier than ever.

Microfazer VI connects printers, plotters, daies, and other peripherals to different computers, giving your users direct access to the equipment they need. Choose from two models: one with 6 serial ports, or one with 4 serial ports and 2 parallel ports. Then set the input/output combination that's right for you: 5-in/1-out, 3-in/3-out, whatever you need.

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MICROFAZER VI BECAUSE RESOURCES WERE MEANT TO BE SHARED.

CIRCLE 190 ON READER SERVICE CARD
Sharing Your Laser's Power

Sharing a printer can make a lot of sense and save a lot of dollars. Expensive printers, such as today's favored laser machines, usually combine top quality with high speed—more speed, in fact, than a single person or PC is likely to need. Sharing a fast printer puts its otherwise idle time to work, giving you more work for your hardware investment and cutting capital costs when one printer can do the work of two, three, or a half-dozen.

A $3,000 laser shared among five users costs no more than putting dot matrix printers beside each PC.

The several alternatives for printer sharing range in price from almost nothing to more than the cost of a PC. The least expensive is simply a screwdriver for detaching the printer cable from one PC and plugging it into the next. One step up in the price spectrum is an A-B switch, costing from $50 to $150, which lets you manually toggle the connection between two computers and a printer without tangling with cables. Next comes the automatic printer-sharing device, or printer resource manager, which does the thinking and switching for you, keeping several PCs in ready contact with one or more printers. These cost from $150 to $1,500. Most expensive is the full-blown network, which, in most glorious form, permits you to do anything with your PCs short of magic.

Given the choice, undoubtedly everyone would choose the network, probably because networking is the loudest buzzword in computing circles today. But for most smaller installations, the network is far from the best choice. The network is expensive, both in equipment expenses and in the time required to train users and the necessary network manager. In many cases, the power of the network is unnecessary. You don't need electronic messaging if you can turn around and talk to your fellow computerists. You don't need file sharing if you have no files to share—or want to maintain the utmost in security.

Automatic printer-sharing devices are generally an easier way to make better use of your investment in hard-copy hardware. At best, you won't need any additional training because the systems are essentially invisible. At worst, you'll need to read a manual to get to know all the special features of the hardware, such as code-controlled switching.

Best of all, a printer-sharing system is much less expensive than a network (and much more convenient than a screwdriv-
PRINTER-SHARING DEVICES

er). Even the most costly sharing systems that link six or more PCs are priced only a little higher than a single node of some networks.

That's the fundamental difference between true networks and printer-sharing systems. When installing a network, your goal should be an increase in versatility and functionality. Your aim in adding a printer-sharing system should be to reduce equipment costs.

MIX AND MATCH The decisions involved in selecting a printer-sharing device are manifold, mostly involving accurately matching the features of various products to your interconnection needs and your equipment.

Before you consider any of these devices, you should have more than one computer and one or more moderately expensive printers. After all, spending $300 to share a $300 printer is rather pointless. Even when the printer and the sharing device are equally priced, getting two printers usually makes more sense because both printers will likely last longer with less severe use. But if you have a laser printer or other more expensive, high-quality, high-speed printer, you're a good candidate for a printer-sharing device.

Once you've determined that you can benefit from sharing your printer resources, you should determine the number and the type of ports that you'll need. Each computer will require an input port on the printer-sharing device. Each printer will require an output port.

In addition to mere numbers, you'll have to determine the type of connection to use—serial or parallel—in each link in the system. The connection to the printer is often a foregone conclusion—the printer you have (or are planning to buy) comes equipped with the style of port that you will have to match.

The links to the various PCs require more thought. Your obvious preference would seem to be the parallel connection. After all, both PC hardware and DOS are designed to favor parallel ports for printers. Moreover, in the realm of personal computers, the parallel connection is more straightforward and trouble-free. Generally, IBM-style parallel circuits work when they are plugged in.

In fact, the only problem you face when making the parallel connection is getting the right cable. IBM chose a different connector than had previously been used for its parallel output. With the groundswell of support for the PC standard, the IBM parallel port has become standard, and the ordinary Centronics-to-Centronics parallel cabling preferred by some printer-sharing devices may be more difficult, and more expensive, to obtain.

Getting a serial channel to work can elicit the foulest of language from conservative mouths.

LONG DISTANCE When sharing printers, however, the parallel connection poses its own problems. Foremost among them is distance. Because of their high-speed nature, parallel interconnections have a limited reach. In most cases, manufacturers recommend that parallel cables run no longer than 10 feet. While you may encounter no problems with more-distant parallel links, you have no assurance that they will work. Cables that stretch too long can result in errors in transmission or even a failure of the circuit to work at all. (I have personally encountered such failure with a 25-foot parallel cable run.)

Another shortcoming of parallel interconnections that's often forgotten is the cost of the cable itself. By their very design, parallel circuits require a greater number of cable conductors (25- and 36-pin connectors) than do most serial channels (9- or 25-pin connectors). As a result, cable costs are often higher for parallel circuits. Although in short cable runs the costs of fabrication overshadow the difference in price between serial and parallel wiring, the difference can be substantial when circuits get long.

Shared resource systems naturally tend to stretch all over the countryside, and a 10-foot cable is a harsh restriction. Consequently, most resource-sharing devices rely on serial connections—to the detriment of everyone's sanity. Suffice it to say that getting a serial channel to work can perplex the best engineers and elicit the foulest of language from the most conservative mouths.

Fortunately, the manufacturers of most printer-sharing devices will either supply cables that work in the serial ports of a PC or provide instructions for making the cables needed to work with their own devices. Moreover, most manufacturers now understand where the largest share of their market lies and have designed their printer-sharing systems to work optimally with IBM PCs. When you use the manufacturer's own cables and follow a few simple rules (see sidebar "Serial Considerations"), such a serial printer-sharing system can be as easy to install as one based on parallel links.

INTELLIGENCE TEST Printer-sharing systems differ both in their intelligence and in their mode of operation. By definition, an intelligent device possesses the built-in smarts of a microprocessor. There are some microprocessors that have higher IQs than others, however.

In printer-sharing devices, this native intelligence shows up in the handling of multiple input. Most dumb units, as well as some supposedly smart ones, operate by polling ports and switching their output to the first port found that has data that needs to be printed. All other input is switched off until that first print job is completed. So, anyone else who tries to print a document after the first job starts must wait —and wait and wait.

The smarter printer-sharing system design allows concurrent input. The printer resource manager accepts information from multiple ports simultaneously. While one job is printing, the others are stored or "spooled" in a memory buffer without a wait. After the first job finishes, the sharing device automatically sends the next one to the printer.

Simple polled/switching systems may be sufficient for small systems with light printing loads. However, when the demand for the printer is high, they are likely to cause substantial waiting. The smarter units avoid the wait.

Many printer resource managers allow
SERIAL CONSIDERATIONS

A few of the ground rules of serial connections may help you cope rather than grope with getting everything to work when you're using serial connections in a printer-sharing system.

All serial ports can be classified as either DTE (data terminal equipment) or DCE (data communications equipment), terms that define which pins in the cable connector handle particular signals. The important thing to remember is that only unlike ports can be directly connected—a DTE device can be directly connected to only a DCE device. Connecting like ports (for instance, DTE to DTE) requires a "null modem" or crossover cables that rearrange the signal pinout. The serial ports on the IBM PC are configured as DTE with a 25-pin (PC, XT) or a 9-pin female connector. The inputs to printer-sharing devices may be either—or they might even be switchable.

Using a serial port to drive a printer or most printer-sharing devices also requires you to use DOS's MODE command to reassign the printer port name to a serial port and to set up the serial port conditions, which usually amounts to two additional lines in your system's AUTOEXEC.BAT file.

Some software, however, may attempt to drive your computer's printer port directly and may not recognize the reassignment. The easiest way around this problem is a parallel-to-serial converter, which makes the parallel output of your computer into a serial signal.

Serial circuits also have other characteristics that you must consider, such as bit rate, word length, parity, and handshaking. Most printer-sharing devices offer their own recommendations for which values to use, for example, 9,600 bps with standard PC serial ports, eight data bits, one stop bit, and no parity. Use the fastest available bit-per-second rate your device supports.

Some serial-oriented printer-sharing devices allow you to configure each port differently. Others force you to use the same parameters for each port. When you have control over all the PCs sharing a printer, even the latter style of port management should be sufficient.

Nearly all devices automatically handle protocol conversion, allowing the attached computers to operate at different data speeds than the printers—or even converting serial computer signals into parallel printer signals. You may or may not need these features, depending on the printers and computers that you want to connect and how you want to connect them.—Winn L. Rosch

there the connection of more than one printer to the system and use some form of software steering to select which of them is used for a particular print job. Usually the switching commands take the form of control characters embedded in the data stream, sent to the printer-sharing device either inside the file to be printed or as an entirely separate command. These control codes are captured and relayed along to the printer for hard-copy output. Some devices may instead allow the manual selection of which print jobs go where, usually by pressing front panel buttons on the device itself. Depending on your mechanical and programming talents and your ability to remember sometimes arcane control sequences, either style of control may be best for you.

Other generalizations about printer-sharing systems are difficult to make. Each manufacturer has its own concept of the proper configuration and function of the devices. The best way to find the system that's right for you is to look at what's available and match the features of the different products to your own needs. To help you make your decision, here's a look at nine intelligent printer-sharing devices from Black Box Corp., Buffalo Products, Crosspoint Systems, Digital Products, Extended Systems, Fifth Generation Systems, Rose Electronics, Server Technology, and Western Telematic. We did not review manual switches. While there are differences in construction, quality, and reliability, the prices and the units are more alike than not and most units should work adequately. Reviews are arranged in alphabetical order by company name.

**Black Box Corp.**

**Auto Six Shooter**

Black Box Corp. specializes in solving communications problems, and the Auto Six Shooter is only one of the company's solutions to sharing one printer among several PCs. As an automatic printer-sharing device, it is simple in both conception and operation. It accepts input from up to six PCs and connects them to a single printer, using a simple arbitration scheme to divide up the printing resource.

The Auto Six Shooter works like a police-band radio scanner, sequentially investigating each input for a computer that wants to use the printer. At first, all of the PCs connected to the unit are given a hard-wire signal that tells them that the printer is busy. One at a time, in sequence, the unit turns off the busy signal and then waits for the connected computer to attempt to send something to the supposedly just-free printer.

If the PC tries within a short period, the Auto Six Shooter latches onto that PC's input port and connects it directly to printer output. It maintains the connection until a pause in the data stream stretches out for another predefined period. After the delay, the Auto Six Shooter assumes the print job is done and starts scanning the input ports.
design goal, but in busy systems you might lose both your aplomb and your patience. When one computer is using the attached printer, all others must wait. With single-minded software, that prospect can effectively turn your PC into a vegetable while you wait. Should someone ahead of you decide to print out a 500-page manual, you might as well go to lunch.

In light-duty applications, though, in which multiple, simultaneous requests to use the printer are minimal, the Auto Six Shooter may be the only arbiter you need.

**Buffalo Products**

**Buffalo XL-256**

Although the most modest device examined here, with two computer input ports and two printer output ports, the Buffalo XL-256, from Buffalo Products, may be the most useful to the individual PC user. The XL-256 is a manually operated printer switch enhanced with a bit of automation and a 256K-byte buffer. (Other models are available with internal buffers of 64K, 512K, and 1 megabyte.)

In operation, the XL-256 allows either of the two PCs connected to it to use either of the two printers, assigning each computer to each printer under manual control. Not only can signals be routed straight through (for example, computer A to printer A and computer B to printer B), but they can also be routed in crossed-over configuration (computer A to printer B, and so on) or with both computers sharing a single printer.

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**Photography** | Thomas O'Connor

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**Up to six PCs can be connected to a single printer with the Auto Six Shooter. The device sequentially investigates each input for a computer that wants to use the printer.**

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**BUFFALO PRODUCTS**

**BUFFALO XL-256**

**BUFFALO PRODUCTS**

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(415) 697-6249

List Price: $485

Requires: Parallel port

In Short: A combination 256K-byte print spooler and manually activated parallel port switch. It allows two computers to share one or two printers with concurrent operation.

**CIRCLE 688 ON READER SERVICE CARD**

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**F A C T  F I L E**

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**P C  M A G A Z I N E  •  A P R I L  2 8 , 1 9 8 7**

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**178**
EasyPRINT—The New Easy Solution to Printer Sharing

That starts at less than $100 per PC

Before

Using hardware switch boxes to share printers is now obsolete.

Introducing EasyPRINT, the advanced low-cost solution to the problem of how to share laser, dot matrix, letter quality printers, and plotters among multiple PCs.

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- Print Spooling. The spooler on the HUB PC supports simultaneous printing from all satellite PCs. The spool size on the HUB PC is limited only by the size of the disk.
- Advanced Forms Support. It solves the paper changing problem without adding expensive hardware sheet feeders to your printer.
- Supports cable lengths to 500 feet.
- Economical. An EasyPRINT 2-PC Kit with cable costs only $159.95. Now you can afford laser jet printers needed for desktop publishing by sharing the cost between multiple PCs.

**INSTALLATION**

EasyPRINT can be installed in less time than it takes to enjoy a coffee break. The EasyPRINT cables plug into your PC's serial ports.

EasyPRINT's printer configuration program provides a menu driven installation program that will guide you step-by-step through the software installation process and lets you redefine your network as your printing requirements change.

you run programs with embedded PostScript™ support.

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The HUB PC requires a serial port for each satellite PC and a licensed copy of EasyPRINT®. Our COM Port Boards are used to expand the number of serial ports. The HUB PC memory requirement is 20k for each satellite PC. The HUB PC supports up to four printers.

MS DOS or PC DOS 2.0 or above is supported. All IBM PCs or compatibles are supported.

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EasyPRINT Kits are available with all the cables, serial port expansion boards, and software necessary to install 2-PC, 3-PC, or 7-PC configurations.

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EasyPRINT is particularly effective with expensive laser printers. EasyPRINT supports LaserJET®, LaserWriter®, printers and lets you run programs with embedded PostScript™ support.

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**EasyPRINT—Printer Sharing System**

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**Item**

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<th>Description</th>
<th>Price</th>
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<td>EP 01 EasyPRINT Kit No. 1 for 2 PCs</td>
<td>$159.95</td>
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<tr>
<td>30' cable, two disks &amp; manuals</td>
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<tr>
<td>EP 02 EasyPRINT Kit No. 2 for 3 PCs</td>
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<td>two 30' cables, COM2 board, three disks &amp; manuals</td>
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<tr>
<td>EP 03 EasyPRINT Kit No. 3 for 7 PCs</td>
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<td>six 30' cables, COM5 board, seven disks &amp; manuals</td>
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<td>EP 11 EasyPRINT disk &amp; manual (39&quot; disk $84 95)</td>
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<td>EP 14 COM6 serial port expansion board, six ports</td>
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<td>EP 15 Custom length cables, call for quote</td>
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**CIRCLE 147 ON READER SERVICE CARD**
SHARING THE WEALTH: USING YOUR NETWORK TO GET THE MOST USE FROM YOUR LASER PRINTER

Zero-slot or RS-232C LANs, such as EasyLAN, from Server Technology, or LANLink, from The Software Link, allow several PCs to exchange files and share printers by using only their RS-232C ports.

Zero-slot LANs are a little harder to set up than are digital switch devices, but after the initial setup they are as easy to use and usually offer the same features. Some systems can share a printer between as many as six PCs, but using two or three PCs is more practical.

Although zero-slot LANs run about $100 per port (about half the price per port of a digital switch) and allow you to transfer files from PC to PC in addition to sharing a printer, they put an added workload on the processor of every PC in the network. In addition, the regular computing activities of the machine acting as the print server in an RS-232C LAN can be slowed significantly.

The most expensive alternative for printer sharing is a media-sharing LAN using separate network adapter cards such as 3Com Corp.'s EtherLink, AT&T's StarLAN, or Proteon's ProNET-10. This type of system usually offers a major increase in network speed over the RS-232C LAN or a digital switch, but it has few other operational advantages for printer sharing. In sophisticated systems, the network administrator can assign a specific priority of work to every user, and users can ask to receive messages telling them that a printing job is done.

10-NET, from Fox Research (see "Making Connections: Fox Research's 10-NET," PC Magazine, Volume 6 Number 3), has an excellent print job spooling system built into its networking software. 10-NET's retail price of about $600 per workstation is several hundred dollars less than most other media-sharing networks (see "NetWare Utilities Fill the Duty Roster," PC Magazine, Volume 6 Number 7, for more information about NetWare utilities).

A media-sharing network is hard to justify in terms of cost if you need only to share a printer between several PCs. If you use other LAN features such as a networked database management system, printer sharing is essentially free.

People using a media-sharing network to share printers usually rely on DOS batch jobs created by the network administrator to route the output of an applications program through the network to the print server. A user might type the word LAZER at the DOS level to designate that the printed output of all programs that follow should go to the shared laser printer. The network administrator would put the appropriate commands in LAZER.BAT to link the user's workstation with the shared printer. Other batch files named DOT, PLOTTER, or COLOR could be created to send output to other appropriate devices. The most popular networking software packages include menus allowing users to choose from the available networked output devices, but batch files are more commonly prepared to do the job.

—Frank J. Derfler, Jr.

Frank J. Derfler, Jr., is a contributing editor of PC Magazine.

In the last configuration, the XL-256 functions as an intelligent printer-sharing device. Both input ports are held ready. The first computer to send data to the XL-256 gets direct access to the printer. If the other computer then also begins to send data, the information from it is buffered inside the XL-256.

The XL-256 determines the end of a print job—when to make the switch—by a pause in the data stream. You can define the length of pause necessary to trigger a changeover at either 0.5, 1, 4, 15, or 60 seconds by an internal DIP switch. (The default is 4 seconds.) If multiple jobs that are all bound for the same printer stack up in the buffer, they are handled on a first-in, first-out basis.

The most modest device examined here may be the most useful to the individual user.

Despite the nominal 256K-byte rating of the buffer inside the XL-256, its effective capacity may be somewhat larger in that the device uses an unspecified form of data compression. You'll have to take the manufacturer's word for its effectiveness, however, because the amount of squeeze is not readily determined, and 256K bytes (equal to 125 double-spaced pages) should be sufficient for all but the most bombastic essayists.

The plastic front panel of the attractive beige metal 6½- by 3- by 9-inch case is divided into two identical control sections, one for each computer. Each control area is equipped with two push buttons. The large, square one labeled "Select" permits the print job from the associated computer to switch from one printer to the other. The XL-256 has no provision for code-controlled switching.

If you press the Select push button associated with a computer while no job is being processed, the switch is made. If, how-
"Dear Jim, For once I'm fast, not furious."

This is the first day I can remember getting even a memo produced without a problem. It's also my first day using this new PFS:Professional Write program. That's no coincidence. For once my documents looked really professional, and they took less time and hassle. This program has everything, even mail merge pulling in data from our company files, and a built-in address book to keep track of people like you. I know we've had our furious moments getting documents out on time, Jim. That's why I thought you should know about Professional Write.

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Neither of these PCs connected to the Buffalo XL-256 can use more than two printers. Signals can be routed straight through, or crossed-over configuration, or with both computers sharing one printer. The device's ability to eliminate cabling swapping and speed up throughput with print buffering makes it an ideal accessory for the individual user or for very small systems.

Crosspoint Systems

Crosspoint 8

As its name (and the name of its manufacturer) implies, the Crosspoint 8 can be described technically as a crosspoint switch. You can connect any of its ports individually to any of its other ports, as with the connections made on a telephone switchboard (the classic case of a crosspoint switch). No operator is required, however, because the Crosspoint 8 is entirely electronically controlled. Several connections can be made simultaneously.

All the eight switchable ports provided by the Crosspoint 8 are serial and function bidirectionally as input, output, or both. All use six-pin telephone-style modular jacks.

Crosspoint Systems manufactures a number of adapters to convert standard DB-25 (and AT-style DB-9) connectors to modular and supplies eight of the adapters (the most useful two of the four available 25-pin styles) with the Crosspoint 8. Eight modular-to-modular cables are also supplied: two that are 20 feet long and six that are 6 feet long. You get a complete kit of everything you need to set up a full system.

A software program supplied with the Crosspoint 8 controls the various interconnections between the ports, from computers that can be attached to any of the ports.
Various levels of authorization for control are provided. For instance, some PCs may be allowed to break into any connection; others can only switch ports that are not currently in use. Up to 16 different user-defined interconnection schemes are supported.

You can choose to run the control program in one of three ways: menu-driven and loaded directly from the DOS prompt, menu-driven as a memory-resident program activated by "hot keys" (Ctrl-Shift) like SideKick, or in a command-driven batch mode. Batch mode permits you to construct batch files that automatically configure the Crosspoint 8 to match each application that you run.

The real intelligence of the system is not in the Crosspoint 8 but rather in a PC attached to it and designated as the "host." The host receives information from and controls the Crosspoint 8 through a parallel port.

A jack is provided on the Crosspoint 8 to daisy-chain a parallel printer so the host does not sacrifice the normal use of this parallel port to the Crosspoint 8. This parallel printer is not controlled by the Crosspoint 8 and cannot be connected to any of its serial ports. For the host to have access to the switchable ports in addition to controlling them, it must also be linked serially to the Crosspoint 8.

To control the Crosspoint 8, the host computer runs a special driver program in the background. If this program is not running or the host is otherwise unavailable, the unit will not switch but will maintain existing connections, for instance, if the host crashes during use.

The Crosspoint 8 also operates as a form of protocol converter. All the operating parameters of each port can be individually defined (except for its definition as DTE or DCE, which is controlled by the modular plug adapter). All configurations are made using software. Crosspoint Systems supplies a paper worksheet to help organize the complex configuration job. Each PC attached to the Crosspoint 8 and able to switch it requires a copy of the setup information and control software.

In addition to sharing printers—seven PCs can share one serial printer, six can share two, five can share three, and so on—PCs linked to the Crosspoint 8 can share files if your communications software permits such transfers. The Crosspoint 8 can also link non-PC serial devices to one another without a PC being involved, for instance, connecting a modem directly to a printer.

The Crosspoint 8 is an unassuming physically, just a flat rectangular aluminum-tube about the size of a modem, 1 1/4 by 5 1/2 by 7 inches, painted black. The eight modular jacks fill one end. The other end has a female DB-25 connector for the parallel printer, a ribbon cable terminating in a male DB-25 connector to attach to the host's parallel port (either LPT1 or LPT2), a jack to plug in the small external transformer, and three LEDs to monitor its operation.

Digital Products Inc.
PrintDirector MS-1
Based on a Z80A microprocessor, the PrintDirector MS-1, from Digital Products, combines the features of a protocol converter, a printer-sharing device, and a print buffer. By itself, it provides seven

**FACT FILE**

<table>
<thead>
<tr>
<th>PrintDirector MS-1</th>
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<tbody>
<tr>
<td>Digital Products Inc</td>
</tr>
<tr>
<td>108 Water St.</td>
</tr>
<tr>
<td>Watertown, MA 02172</td>
</tr>
<tr>
<td>(800) 243-2333</td>
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<tr>
<td>(617) 924-1680</td>
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<tr>
<td>List Price: $1,395</td>
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<tr>
<td>Requires: Serial or parallel port.</td>
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<td>In Short: A resource-sharing device that permits the sharing of printers and other peripherals using three parallel and two serial ports. It supports protocol conversion, concurrent printing, and 256K bytes of spooling.</td>
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Synphony ... MultiMate ... WordPerfect
- Toshiba ... 1 year
- P321 S/P printer (80 col., 216 cps) ... 479.
- P351 S/P printer Model 2 (136 col., 286 cps) ... 949.
- Toshiba T1100 PLUS Laptop Computer ... call
- Toshiba T3100 Laptop Computer ... call

Tseng Labs ... 1 year
- EVA 430 Drive (5¼" half-height, includes Dr. Halo ii & drivers for AutoCAD & Lotus 1-2-3) ... 399.
- Video 7 ... 2 years
- VEGA Deluxe (supports 640x480) ... 379.

DRIVES
Control Data Corp. ... 1 year
- 70 Meg (formatted capacity) Int. Hard Drive for IBM PC or XT (w/Western Digital controller & cables, & Wren Manager II software, 28 ms) ... 1069.
- 70 Meg (formatted capacity) Int. Hard Drive for IBM AT (w/Wren Manager II software, 28 ms) ... 997.
- IOMEGA ... 90 days
- Bernoulli Box 20 Meg w/PC2 card ... 1849.
- 10 Meg cartridge ... 57.
- Bernoulli Box 40 Meg w/PC2 card ... 2449.
- 20 Meg cartridge ... 79.
- PC2B (Bootable) Card ... 229.
- Bernoulli Box Care Kit ... 79.
Mountain Computer ... 1 year
- Drive Card 20 Meg (80 ms) ... 499.
- Drive Card 36 Meg (76 ms) ... 589.
Seagate ... 1 year
- 20 Meg Internal Hard Drive (w/HDC controller and cables, 65 ms) ... 339.
- 20 Meg Internal Hard Drive (w/Western Digital controller and cables, 65 ms) ... 369.
- 30 Meg Internal Hard Drive (w/Adaptec ALL controller and cables, 65 ms) ... 429.
- AT 30 Meg Internal Hard Drive (w/cables & instructions, 39 ms) ... 589.
- TEAC ... 1 year
- PC, XT 360K Drive (5¼" half-height) ... 109.
- Toshiba ... 1 year
- PC, XT 360K Drive (5¼" half-height) ... 109.
- AT 360K Drive (5¼" half-height) ... 117.
- AT 1.2 Meg Drive (5¼" half-height) ... 135.
Western Digital ... 1 year
- File Card 20 Meg (w/XT/386, 80 ms) ... 499.

MEMORY
- 64K Upgrade Set (150 ns, set of 9) ... 12.
- 256K Upgrade Set (150 ns, set of 9) ... 29.

DISKS
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- DS/DD Disks for the PC & XT (40 TPI) ... $12.
- Verbatim Dataflo (10 disks per box) ... 15.
- Maxell MD-2 (10 disks per box) ... 15.
- DS/High Density Disks for the AT (96 TPI) ... 24.
- Fuj (10 disks per box) ... 27.
- Verbatim (10 disks per box) ... 27.
- Maxell (10 disks per box) ... 27.
- 3½" Double-sided Diskettes (720k) ... Sony (10 disks per box) ... 23.
- Maxell (10 disks per box) ... 23.

MISCELLANEOUS
- CompuServe Information Service (includes subscription, manual, $25 usage credit, monthly publications) ... 24.
- Dow Jones Membership Kit ... 24.
- Innovative Concepts
- Flip n File 50 (holds 50 disks) ... 16.
- Flip Sort (holds 70 disks) ... 15.
- PC Connection
- Computer Toolkit (all the tools you need to go with your PC in a software style binder) ... 29.

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For the IBM-PC (XT & AT) exclusively.
The design of the PrintDirector MS-1 allows several ports to be simultaneously connected to each other. The device can be programmed to give any PC access to the first available printer.

The design of the MS-1 allows any port to be connected to any other port or group of other ports. Several such connections can be made simultaneously. In addition, the MS-1 can be programmed to give any PC access to the first available printer or any particular printer. PCs can also communicate to modems or other PCs through the serial connections.

All of the switching is controlled through software by injecting command codes—character sequences preceded by a user-definable attention character, normally a tilde—into the data stream. This software control rates as the most versatile and feature-laden of the devices examined here.

All ports are identified by one or more names, which you define to suit your needs when you set up the system. When references are made to a port, you only use as many characters of the name as are needed to unambiguously identify it. Ambiguous references are handled like wildcards: all ports sharing the ambiguity are connected.

For instance, if you have two ports called Epson and IBM, a single character would be sufficient to identify which one you wanted to use. However, if you called the ports Epson Printer and IBM Printer, making a reference to Printer (or an abbreviation thereof) would automatically access both.

As with most printer-sharing devices, the MS-1 determines the end of a print job by a pause in the data stream. You can program any period from 1 second to 255 seconds or infinity.

The MS-1 also offers facilities to send lead-in sequences (for instance, printer initialization codes) and end-of-job codes automatically to the appropriate devices, all keyed to the port assignment.

As would be expected from a device as versatile as the MS-1, programming it can be complex. The job is not facilitated by the instruction manual, however, which seems organized more by stream of consciousness than by logic. Digital Products includes an auto-install program to simplify matters and allow you to make all the setup adjustments from your PC. Alternatively, you can assign ports and change communication settings using the eight front-panel switches and LEDs of the MS-1 (a task actually much easier than wading through the instructions would lead you to believe). Configuration information is stored in CMOS memory that is kept alive when the MS-1 is turned off by an internal rechargeable nickel cadmium battery with sufficient reserves to keep that data (but not the information in the buffer) intact for a month or so.

Physically, the MS-1 is cleverly designed and well made. The entire system, including the self-contained power supply, fits into a blue metal box that's about 3 1/2 by 12 by 11 inches, not counting its 3/4-inch rubber feet. On the whole, it's little more than one big, cleanly laid-out printed circuit board.

The serial ports all use female DB-25 connectors, and the parallel ports are equipped with female Centronics-style 36-pin connectors. Only the eight blue front-panel push buttons are disconcerting: press one, and the whole bank dips rather ominously.

At nearly $1,400, the MS-1 is the most expensive device of this group, and its cost alone might give you second thoughts. It is, however, also the most versatile printer-sharing device and still offers considerable savings over dedicating one printer to every computer.
SHARE PRINTERS AND BUFFER PRINT JOBS WITH ONE VERSATILE UNIT

Print Master from BayTech is an intelligent printer controller that connects between your computers and printers. It allows you to share one printer automatically, contend for multiple printers automatically, or switch between several printers by sending a simple code, not by changing cables. Plus, Print Master's generous built-in buffer spoils data until your printers can receive it.

Because Print Master is a very flexible device, you can set it up to fit your application, even if your application changes.

YOU SET UP THE IN-OUT PORTS

You configure Print Master's ports for any combination of printers and computers by answering questions from easy-to-follow menus. For example, with the ten port Print Master, nine computers can share one printer, eight computers can share two printers, seven computers can share three printers, and so on, to one computer which can share nine printers. You can also menu-select the disconnect time-out, form feeds, etc. and on serial models, the configuration of individual ports to translate for printers and computers using different configurations.

512K OR ONE MEGABYTE BUFFER KEEPS YOU WORKING INSTEAD OF WAITING

Since Print Master can accept data faster than your printer (up to 19.2KB serial or 5,000 characters per second parallel), you can send a print job to Print Master's standard 512K buffer and then go on to another project. All users connected to Print Master can send data to this common pool buffer, and they can be doing it simultaneously, even if no printer is available. Data is stored in the buffer until it can be sent on a first-job-in first-job-out basis to the selected printer. If you need more memory than 512K, Print Master is optionally available with one megabyte buffer.

If several users are sharing one printer, printer sharing via Print Master is completely automatic. There are no codes to send. You simply perform your normal print operation. If you are sharing several identical printers, connection is also automatic. Again, you perform your normal print operation and are connected to the next available printer on a first-come-first-serve basis. Print Master will send data to all printers simultaneously to keep your printers running at full capacity.

If you are sharing several different printers, such as a laser-jet, a dot matrix and a plotter, and you wish to select a specific printer, you do your normal print routine and also send a printer select code (which you can define yourself) before the first characters of your data. The data is then routed to the selected printer. It's that easy.

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CIRCLE 214 ON READER SERVICE CARD
Extended Systems Inc.
ShareSpool ESI-2076

Based on a Z80 microprocessor, Extended Systems’ ShareSpool ESI-2076 is an intelligent printer-sharing system that incorporates a 256K-byte buffer that’s expandable to 512K. It accommodates up to seven computers, mediating their demands to a single printer.

All devices attached to the ShareSpool use serial signals. The seven input ports from computers are equipped with modular connectors; the output to the printer uses a female DB-25 jack. (Another similar printer-sharing system that uses parallel signals is available from Extended Systems as the ShareSpool ESI-2078.) Extended Systems supplied sufficient adapter cables with the ShareSpool to connect a full system. The company will also supply cables separately and includes instructions in the manual for making your own.

All computer connections are simultaneously active and can receive data concurrently. All data bound for the printer is spooled separately in the RAM of the ShareSpool until the completion of the print job, marked by a pause in the flow of data of more than 10 seconds (or other user-definable period). Multiple print jobs are queued in a first-in, first-out sequence.

The memory of the ShareSpool is partitioned dynamically, so each print job uses only as much as it needs. The whole of the unused memory is available to each job.

The operating parameters of each serial port are set by using three banks of eight DIP switches behind the front panel of the ShareSpool. All ports support speeds between 300 and 9,600 bits per second. The manual recommends setting all ports to a word length of eight, no parity, and one stop bit, although other settings are also available.

Both hardware and XON/XOFF handshaking are supported. In the computer-to-ShareSpool connections, handshaking appears to be necessary only when the entire buffer is full; otherwise the serial connections are always active and operate at full speed.

The microprocessor in the ShareSpool also recognizes a limited repertory of commands that are embedded in the characters sent to it for printing. The system uses an unchangeable attention string of period-comma-colon (.:), which is unlikely to occur in normal text.

One command changes the timeout period representing the end of a print job from its factory default of 10 seconds to any period up to 255 seconds. A second command allows you to designate an end-of-job reset string, which is sent to the printer at the conclusion of each print job. The default is a form-feed.

Two commands allow you to print multiple copies of a single job (up to 255) without tying up the originating computer. One assigns high priority to the multiple printing job, so that finishing all copies takes precedence over other multiple-copy jobs. Low priority allows other jobs to interrupt after each copy has printed. All individual print jobs and the first copy of a multiple-copy run are treated as high priority.

The final command switches off the detection of all commands until the conclusion of the current print job. This is useful in graphics printing and “cascading” ShareSpools (connecting the output of one to the input of another).

One hardware control is provided, a
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THE INTERFACE SPECIALISTS

INTEGRATED MARKETING CORP.
### Printer-Sharing Devices: Summary of Features

(in ascending price order)

<table>
<thead>
<tr>
<th>Product/Manufacturer</th>
<th>List price</th>
<th>Type</th>
<th>Connections</th>
<th>Input arbitration</th>
<th>Buffer size</th>
<th>Type</th>
<th>Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>EasyPrint Server Technology</td>
<td>$74.95 (manual and disk) $159.95 (two-PC kit)</td>
<td>15 serial*</td>
<td>N/A</td>
<td>Concurrent</td>
<td>Unlimited (disk)</td>
<td>2 serial*</td>
<td>N/A</td>
</tr>
<tr>
<td>Auto Stx Shooter Black Box Corp.</td>
<td>$485.00</td>
<td>6 parallel</td>
<td>Centronics</td>
<td>Scanned</td>
<td>None</td>
<td>1 parallel</td>
<td>Centronics</td>
</tr>
<tr>
<td>Buffalo XL-256 Buffalo Products</td>
<td>$485.00</td>
<td>2 parallel</td>
<td>Centronics</td>
<td>Concurrent</td>
<td>256K</td>
<td>2 parallel</td>
<td>Centronics</td>
</tr>
<tr>
<td>Logical Connection Fifth Generation Systems</td>
<td>$495.00 (256K RAM buffer) $595.00 (512K RAM buffer)</td>
<td>4 serial</td>
<td>DB-25F</td>
<td>Concurrent</td>
<td>256K</td>
<td>Bidirectional</td>
<td>DB-25F</td>
</tr>
<tr>
<td>Crosspoint 8 Crosspoint Systems Inc.</td>
<td>$599.00</td>
<td>8 serial</td>
<td>Modular</td>
<td>Concurrent</td>
<td>None</td>
<td>Bidirectional</td>
<td>DB-25F</td>
</tr>
<tr>
<td>Caretaker Plus CTP-8/P-268 Rose Electronics</td>
<td>$995.00</td>
<td>8 parallel</td>
<td>Centronics</td>
<td>Concurrent</td>
<td>256K</td>
<td>1 parallel</td>
<td>Centronics</td>
</tr>
<tr>
<td>Western Telematic PSU-81B Western Telematic Inc.</td>
<td>$995.00</td>
<td>8 serial</td>
<td>DB-25F</td>
<td>Scanned</td>
<td>256K</td>
<td>1 serial</td>
<td>DB-25M</td>
</tr>
<tr>
<td>ShareSpool ESI-2076 Extended Systems</td>
<td>$995.00 (256K RAM buffer) $1,095.00 (512K RAM buffer)</td>
<td>7 serial</td>
<td>Modular</td>
<td>Concurrent</td>
<td>256K</td>
<td>1 serial</td>
<td>DB-25F</td>
</tr>
<tr>
<td>PrintDirector MS-1 Digital Products Inc.</td>
<td>$1,395.00</td>
<td>4 serial</td>
<td>DB-25F</td>
<td>Centronics</td>
<td>Concurrent</td>
<td>256K</td>
<td>Bidirectional</td>
</tr>
</tbody>
</table>

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*Input port/connector can also function as output port/connector.

---

A single push button on the front panel of the ShareSpool that aborts the current print job (but leaving those following unscathed). When you press the button, the printer is sent a message "**** Job Aborted by User ****" and a form-feed.

When nothing is printing and the ShareSpool is idle, this same switch elicits a diagnostic self-test. The test results are displayed very simply: if the ShareSpool passes, a nearby LED glows green; if it fails, the same LED glows red.

The ShareSpool is packaged in a naturally finished rectangular extruded aluminum tube, 2½ by 6½ by 13 inches with blue-painted end caps. The front panel is adorned with the solitary square black Abort/Test push button and the two-color LED used in testing. The rear features an on/off toggle switch, the seven modular connectors, the DB-25 jack, and a DIN-jack that receives power from an outlet-mounted transformer.

#### Fifth Generation Systems

**Logical Connection**

Fifth Generation Systems' Logical Connection supplies an unusual and, seemingly, almost illogical array of connectors: four serial ports, two parallel input ports, and two parallel output ports. Otherwise, no push buttons, controls, blinking lights, or navigational beacons are visible on the long, flat, 1-by-14-by-5-inch box. A white power supply brick plugs into one end.

The logic of the system is brought to life by the Z80 microprocessor inside. The 8-bit CPU allows the ports of the Logical Connection to be patched together in almost any arrangement, making protocol conversions along the way. Multiple Logical Connections—up to 45 units spanning up to 4,000 feet of twisted-pair cable—can be daisy-chained and run cooperatively, effectively yielding approximately 315 locations to plug in peripherals.

The intelligent design of the Logical Connection (intelligent because of its microprocessor base; we'll let you judge the abilities of its engineering) permits you to connect it to both your PCs and your printers by either serial or parallel ports, and the CPU makes sense out of everything. It even translates serial port data rates, word lengths, and parities and handles both XON/XOFF and hardware handshaking itself.

The system is entirely programmable, so you can switch the connection between any two ports on the fly merely by sending an eight-character control string (which you define yourself) to let the Logical Connection know what to do. The Z80 microprocessor is fast enough to handle all the ports at normal communication rates without performance degradation. When simultaneous requests are made to print to a port, the standard 256K-byte or optional
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CIRCLE 155 ON READER SERVICE CARD

PC MAGAZINE • APRIL 28, 1987

CIRCLE 287 ON READER SERVICE CARD
The 8-bit CPU allows the Logical Connection's ports to be attached in almost any arrangement. Multiple Logical Connections can be daisy-chained to yield 315 places to plug in peripherals.

The Logical Connection itself. This program is accessed through the first serial port of the device by sending an Escape code within 15 seconds of powering up the unit. Fifth Generation Systems supplies a primitive terminal emulator and a serial cable to talk to the box. You can also use a dumb terminal or other terminal emulation program to set things up. The unit automatically deciphers the bit rate and other parameters of the serial signal, so you don't even have to worry about the initial port configuration.

Setup involves defining which device is connected to each port. In the case of serial ports, the basic communications parameters are set first. Timeout periods for closing print files and character strings to switch ports are also fixed at this time. All configuration memory is retained by a small lithium battery that Fifth Generation Systems claims (with wild optimism) will last up to 10 years. Two and a half years is more like it.

In a typical configuration, the Logical Connection can be connected as if it were a standard parallel printer to two PCs (through the parallel input ports), to two parallel printers (through the parallel output ports), and to any other combination of printers and computers through the four serial ports. If more than one Logical Connection is daisy-chained, the first serial port is given over to that link.

The Logical Connection is capable of yeoman duty as either a mere printer-sharing device or as a more versatile tangle eliminator. With communications software just slightly more elaborate than the terminal emulator supplied with the product, the Logical Connection might even be used for shifting files between PCs (through the serial ports), as well as handling plain printouts. We're actually tempted to call it something more than logical—maybe inspired. Our only complaint is the lack of any mounting scheme for the flat metal package.

Rose Electronics
Caretaker Plus CTP-8P/256
Rose Electronics, maker of the Caretaker Plus CTP-8P/256, manufactures a full line of printer-sharing devices (as well as ordinary port switches and exotic networking components) with either four or eight ports, serial or parallel interfaces, with or without internal buffers from 16K to ¼ megabyte. The Caretaker Plus tops the list, equipped with eight parallel input ports, a single parallel output port, and 256K bytes of memory for print spooling.

The Caretaker Plus is an intelligent printer-sharing device that's based on an Advanced Micro Devices P8031 chip. It can simultaneously receive data on all eight input ports, buffer the data, and route each print job on a first-in, first-out basis to the printer.

The Caretaker Plus's internal buffer is permanently, and somewhat arbitrarily, partitioned among the input ports, however, with six each receiving one-eighth of the total RAM and two sharing another eighth. (The device apparently uses the remaining one-eighth for system operation and overhead.)

The Caretaker Plus determines the end of a print job by the lapse of the data stream from the associated input. The default setting for the timeout period is set at 10 seconds, but you can change it to any full-second interval between 1 and 99 seconds when the device is configured.

The rather plain rectangular case of the Caretaker Plus, which measures 4 by 10½ by 5½ inches, is attractively finished in two-tone beige. Inside, the device is elegantly engineered, using one small circuit board for its power supply and main processor with separate daughtercards for each input, the output, and buffer memory componentry.

The rear panel of the case is filled with nothing but jacks—eight female Centronics-style 36-pin connectors and a DIN-jack for attaching an external wall-mounted transformer. You can thus easily connect PCs to the Caretaker Plus using normal printer cables. The manufacturer also su-
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plies a Centronics-to-Centronics cable with the unit for the connection between it and the printer.

The front panel of the Caretaker Plus has two controls and 13 indicators. The controls comprise two push buttons labeled "Advance" and "Select", which together change the operating mode of the unit. Pressing both buttons when the device is already turned on forces it into configuration mode, and pressing them again returns it to normal operation. Holding the buttons on when it is turned on enters it into a diagnostic mode, which is canceled only by switching it off again.

A green LED serves as a pilot light. Eight red LEDs indicate whether each of the input ports is inactive (unlit), waiting to print (illuminated), or currently printing (flashing).

Four additional red LEDs monitor the operating status of the Caretaker Plus: Mode indicates whether it is in diagnostic mode or set for normal operation; Data illuminates when data is being received across the currently connected port; Busy lights indicate that the printer is busy; and Error signifies that an error has occurred. The port status LEDs then indicate the type of error.

You set up the Caretaker Plus by entering configuration mode, then sending the appropriate instructions to it through its number-one input port. You can use either LPRINT commands in BASIC or a terminal emulator to send the simple setup instructions.

In most normal installations, parallel models of the Caretaker Plus will require no configuration; however, some parallel port parameters and the timeout required for port switching can be modified. With serial models, the various port parameters (bit rate, parity, and so on) are set by using configuration mode.

The Caretaker Plus offers a very effective means of sharing a printer between PCs. Its only apparent shortcoming, the inflexible buffer partitioning, is a drawback only in installations where long print jobs and user impatience are commonplace.

node-to-node communication.

Viewed as a network, EasyPrint uses "star" architecture: one PC functions as a server, or hub, to which one or more workstations, called satellites, may be connected. Each satellite has access to up to five printers that are physically connected to the serial and parallel ports of the hub but are logically addressed by each server by standard DOS names, for instance, LPT1. The EasyPrint software allows the same printer to have different DOS designations on each satellite and the hub.

EasyPrint runs the serial ports it uses to connect the hub to the satellites at 9,600 bits per second and maintains control with hardware handshaking. Interconnecting cables, which are available from Server Technology and computer supplies dealers, use a "null modem," or a crossover configuration of the six-conductor shielded twisted-pair cable that is recommended.

EasyPrint works by using six short memory-resident programs, which require a total of 20K bytes of RAM on each satellite, to capture all information directed toward the various printers and reroute it to the serial connection leading to the hub. Background programs running on the hub, which require 20K bytes for the first satellite and 12K more for each additional satellite, route all printer information received directly to disk.

In this way, all print jobs are spooled to disk until their transmission is completed and a user-designated delay has elapsed. Multiple-print jobs can be simultaneously

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**EasyPrint**

As a printer-sharing device, Server Technology's EasyPrint is unusual because it is a software-only product. Connected through standard RS-232 serial ports, it works as a reduced-functionality network that allows resource sharing but not direct

---

**EasyPrint**

Server Technology
1095 E. Duane Ave., #103
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List Price: $74.95 for manual and disk; $159.95 for two-PC kit.

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In Short: A software-only printer-sharing system that uses standard serial ports. It operates smoothly and invisibly but is prone to the vagaries of the server.

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For small systems—a hub and two satellites—EasyPrint appears to be the best bargain.

captured and queued to print on a first-in, first-out basis. In addition, EasyPrint allows different forms to be defined, in which case the spooled print jobs are kept on disk until the designated paper form is loaded into the appropriate printer.

Each satellite connected to the EasyPrint system requires a serial port on the host. Server Technology also supplies add-on ports in blocks of two or six that allow you to extend the serial port capacity of the host up to a total of 14. Ports beyond the two accessible by DOS (that is, COM1 and COM2) are addressable only by EasyPrint.

EasyPrint will work even with systems equipped solely with floppy disk drives, but because of the extensive spooling done on the hub, however, a hard disk there is almost mandatory. Hard disks are also welcome on the satellites because of the huge amount of code contained in the EasyPrint system.

Although both the documentation and the design of the installation programs fall far short of perfection, you can set up the system relatively quickly, and it works amazingly well. Contention for the disk resources is handled quite well, and with a light printing load, no degradation of the performance of the host was noticeable.

Testing showed that the system was not entirely trouble-free, however. The hub crashed when Peter Norton’s Disk Test program executed on it at the same time a print job was sent to it. No indication of the failure—other than a printer timeout message from DOS—appeared on the satellite. A well-behaved program that issues standard DOS and BIOS calls proved to be no problem, however.

An EasyPrint system requires that you buy a copy of the program, which costs $79, for each computer on which it runs (one for the hub and each satellite). A basic kit containing everything necessary for a two-station system (two copies of the program and a 25-foot interconnecting cable) is priced at $159.

Truly large systems with much printer activity will probably require dedicating a computer to the hub function because of the memory and disk access demands made on it. However, for small systems (a hub and one or two satellites) EasyPrint appears to be the best bargain in printer sharing.

Western Telematic Inc.
Western Telematic PSU-81B
The Western Telematic PSU-81B ordinarily would be classified as an intelligent printer-sharing device, but its abilities and capabilities fall short of more-recent products. Although microprocessor-based, managed by a M68008 chip operating at 3.68 MHz, and equipped with a 512K-byte internal buffer, the PSU-81B functions as a mere scanner.

In normal operation, all eight of the serial inputs of the PSU-81B are effectively switched off. Either hardware handshaking is broken or no XON character is transmitted to the port. One by one, in sequence, each of the serial input ports is scanned; depending on how the PSU-81B is set up, it closes the hardware handshaking to the chosen port or transmits an XON flow control character to it. If the chosen port does not respond by sending data within a short period (150 milliseconds), the PSU-81B breaks the handshake or sends an XOFF character, then switches to the next port.

If a polled port does indeed start transmitting data, the PSU-81B latches onto it and absorbs the information as fast as it can be sent, at a selectable data rate of 300, 1,200, 2,400, or 9,600 bits per second. This information is immediately sent to the attached serial or parallel printer. Only if the printer cannot keep up with the data flow is the buffer used.

Because of this scanning system, only one input port can be active at a time. The PSU-81B resumes its scan for the next active port only after data flow from a selected port has been completed for a user-determined time (which can be set to 0.25, 1, 2, or 5 seconds by a DIP switch). While the PSU-81B allows you to configure all communications parameters of its eight inputs and one output serial ports, including bit rate, parity, word length, number of stop bits, and handshaking, all input ports must be configured the same. The settings
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*February 16, 1987 issue

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of the output port are independent.

Both the serial and parallel output ports can be used independently to connect two printers to the PSU-81B. The active port is selected through commands embedded in the data bound for the printer.

The 3¾-by-12- by 8½-inch rectangular metal case is finished in a moderate beige, and the front and back panels are black. Three user controls are available on the front panel: Clear, which ends the current print job; Pause, which temporarily interrupts the current print job; and TOF, which sends a top-of-form command directly to the printer (for instance, to put two printscreen commands on separate sheets).

Two banks of red LED indicators also decorate the front panel. One group of three LEDs monitors the status of the PSU-81B, indicating whether the printer is online and ready, the amount of buffer memory in use and whether the buffer has been completely filled. Another set of eight LEDs indicates which input port is active.

Eight female DB-25 connectors on the rear panel are provided for input, hard-wired as DTE so that connection to a PC will require a null-modem cable. The serial output, configured as DCE (so it will plug into a serial printer with a "straight-through" cable) uses a male DB-25 connector, and the parallel output uses a female 36-pin Centronics-style connector.

Modes of operation and the serial communications parameters are set using a DIP switch bank that is accessible through a cutout in the rear panel. The PSU-81B has an internal power supply and plugs directly into any standard wall outlet.

Most of the limitations of the PSU-81B will be eliminated with the introduction of its successor, the PSU-81C, which will allow multiple input ports to receive data concurrently, permit individual configuration of each input port's serial communication parameters, and offer a 2-megabyte internal buffer. Although scheduled for release in March, the new unit was not available for review at the time of writing.

Winn L. Rosch is a contributing editor of PC Magazine.
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Note: Photos show color and resolution obtained on an IBM PC equipped with an IBM Enhanced Graphics Adapter Monochrome display generated when an IBM Color/Graphics Adapter or compatible graphics adapter card is used.
hew! We’ve described, evaluated, and tested 13 local area network products since we began work on our first special LAN issue (PC Magazine, Volume 5 Number 21). The LANs we’ve examined over the past 5 months are products of well-known companies like 3Com Corp., Texas Instruments, Novell, IBM Corp., and AT&T Information Systems and of small start-up companies like Invisible Software.

We’ve learned a lot.

One of the things we’ve discovered is that looking at LANs today is a little like looking at the automobile 30 years ago. Then car makers had developed a good automatic transmission, and designers were experimenting with tail fins and gull-wing doors. Buyers made their decisions on the basis of price, performance, their trust in the dealer, or the recommendation of a friend who bought a certain brand or model and had good luck with it.

Similarly, today the visible differences between the top dozen LANs are in their tail fins and elapsed time in the quarter mile. LANs have major differences under the hood, but those are for engineers and

Over the past 5 months we’ve reviewed and benchmark-tested a total of 13 LANs. The time has come for us to show you how these LANs fit into the big picture. Here we discuss the issues and how the various products reviewed fill different bills.

FRANK J. DERFLER, JR.
The LAN-Topology Lineup

Networks operate with very different combinations of electrical and physical topologies; a LAN that uses a given physical topology, for instance, is not thereby limited to a single corresponding electrical arrangement. Systems in which the station cables physically terminate in a hub can be either an electrical bus or ring. The station-to-station physical topology, which would seem to be the most logical way to wire an electrical ring, is not used in any of the products reviewed that have an electrical ring topology.

**Screwdriver turners to worry about. Serious LAN buyers find that, as with cars, factors such as price and dealer support are more important than technical design points like what media sharing protocol the LAN uses.**

Here we describe what we have learned from our in-depth look at LANs. First we present the hardware design alternatives—broken down into wiring, topology, access protocol, and interface card—and how these alternatives affect the selection, installation, and operation of network systems. Then we look at the options in network servers. Finally, we examine networking software.

This summary of our findings brings all these considerations to the forefront—to bring you up to date on the state of the art of PC LANs and to help you select one that meets your needs.

**Wiring.** The first design alternative for network hardware that we will consider is wiring. The cables used to connect stations in a local area network almost always use copper wire. The copper wire in network cables can be arranged in one of two ways: twisted together into a pair or molded into a shielded coaxial cable.

Coaxial cable has a reputation for generally being difficult to install, and companies like AT&T and Fox Research promote the advantages of using the twisted-pair telephone wiring already in the walls. We found that neither the reputation nor the advertising for using twisted-pair telephone wire is always true. Although the ability to use existing telephone wiring might be appealing, it may be impossible in your case, either because the existing wire doesn't go to the right place in the right way or because it really isn't twisted. In both instances, you'd have to install new wiring.

Some systems, such as an expanded version of AT&T's StarLAN and IBM's Token-Ring Network, require that the cabling go from each network station to a hub at a central point. They also impose a limitation on the total length of wire that can be used between the station and the hub. If the existing wiring doesn't come together in a single place within the specified distance, you can't use it in those systems.

In contrast, smaller StarLAN systems, 10-NET, and the Invisible Network use a station-to-station wiring scheme. This arrangement doesn't require as many free pairs of wire as does the hub arrangement, but the pairs that are used must appear in every room in which a station is to be placed.

Also, not all telephone wiring is twisted pair. In true twisted-pair wiring, the twisting of the wire furnishes an electromagnetic cancellation that prevents the wire from radiating or absorbing electrical energy. Our tests on networks using true twisted-pair wire showed them to be highly resistant to interference from nearby sparking motors and VHF radio transmissions from a hand-held radio.

Wire that was extended to older telephone systems, called key systems, and the common "house wire" used in

**— If you can use existing twisted-pair telephone wiring, you will save money, and it probably won't limit the system's operational effectiveness.**

<table>
<thead>
<tr>
<th>ELECTRICAL TOPOLOGY</th>
<th>PHYSICAL TOPOLOGY</th>
<th>Trunk and drop cable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bus</td>
<td>Standard Microsystems' ARChnet AT&amp;T's StarLAN Invisible Network AT&amp;T's StarLAN Fox Research's 10-NET 3Com's Ethernet Gateway's G/NET Orchid Technology's PCnet Texas Instruments' Business-Pro LAN Server Standard Microsystems' ARChnet</td>
<td>3 Com's Token-Ring</td>
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<tr>
<td>Ring</td>
<td>Protein's ProNET-10 IBM's Token-Ring Network</td>
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<tr>
<td>Polling</td>
<td>Novell's NetWare/S-Net</td>
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Note: Tallgrass Technologies' LanCourier topology depends on the network interface card used with it.
Networking Software: Summary of Features
(Listed in ascending price order)

Networking software is the tool not of network users but of network administrators, who use it to satisfy the needs of network users. The best networking software packages offer similar performance. The differences between the programs generally come down to the features and accessory programs such as menus, mail, chat, and network reporting. The packages are all relatively easy to install on the server; the difficulty of setting up users depends on the number of utilities you install and features you implement. For an in-depth description of the method used to evaluate each feature, see "Making Connections: LANs Under Netware," PC Magazine, Volume 5 Number 21.

<table>
<thead>
<tr>
<th>Software Manufacturer</th>
<th>List price</th>
<th>PC Local Area Network Program IBM Corp. $125</th>
<th>StartLAN Network Program AT&amp;T Information Systems $125</th>
<th>10-NET Fox Research Inc $695*</th>
<th>3 + Shares 3Com Corp. Inc $895</th>
<th>VINEx Banyan Systems Inc $1,895</th>
<th>Advanced NetWare 286 Novell Inc $2,195</th>
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<tr>
<td>INSTALLATION</td>
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<td>Station-to-station file transfer</td>
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The widely held belief that twisted-pair wiring is less expensive and easier to install than coaxial cable isn’t necessarily true either. Much of the common “wisdom” surrounding coaxial cable was gained through exposure to the large-diameter cable used in links from mainframe computers to terminals. However, the coaxial cable used in systems such as 3Com’s Ethernet and Gateway Communications’ G/NET is smaller than most twisted-pair cables and easier to install. Our experience with cabling boils down to this advice: If you can reuse existing twisted-pair telephone wiring, you will certainly save money, and the existing wiring probably won’t limit the system’s operational effectiveness. But if you cannot

*Price of 10-NET installation package; software is not sold separately.
reusing such wiring, the decision to install new coaxial cable or new twisted-pair wiring is one of the last things you should worry about. Almost all the other factors that affect your selection of a LAN are more important, from the cost of the network interface cards to the availability of vendor support.

(Note: We haven’t tested any fiber-optic cable systems, although both Proteon and Fox Research market fiber-optic versions of their network interface cards. Since the IBM standard cabling scheme includes fiber optic cables, the product managers at IBM certainly must have plans to release more networking devices that transmit and receive with light. We’ll look at them as they arrive on the scene.)

**TOPOLOGY** Another hardware design consideration is the topology. The phrase “network topology” refers to the shape or geometry of the network.

We described two topologies, electrical and physical, in every review of every LAN we looked at since our first LAN issue. These topologies can be very different from each other. Among the many possible electrical topologies, the LANs marketed for personal computers primarily use the bus or the ring, with the bus predominating. In fact, every network we evaluated except the IBM Token-Ring Network and the 3Com Token-Ring used a common electrical bus between stations.

The electrical bus topology is designed so that every station receives every signal generated on the network media. In the electrical ring topology, the signal is actually regenerated and repeated as it is passed from station to station.

However, the ring and the bus electrical topology can have one or both of two very different physical topologies. In each electrical topology, you can choose between running cables from station to station and bringing one cable from each station back to a central point called a wiring hub. The station-to-station and hub (also called star) physical topologies predominate in PC LANs.

The station-to-station arrangement of Gateway Communications’ G/NET, 3Com’s Ethernet, Fox Research’s 10-NET, and other systems uses less wire and may be easier to install, but if the cable is connected to every station, and the stations must use a protocol—either the CSMA or the token-passing protocol—that determines when they may transmit a message.

CSMA is a listen-before-transmit protocol that works like a citizen’s band radio channel. Under the CSMA protocol, a station may begin to transmit a message if the channel is clear of traffic. However, it is possible that two or more stations may detect a clear channel at the same time and begin transmitting together. If this happens, their messages collide and become garbled. Various techniques can detect or avoid these collisions. Perhaps the most unique is the one the Invisible Network uses, called Heartbeat Collision Avoidance. This technique sends a timing signal on a separate set of wires; a station may transmit during a certain time slot only if the channel is clear. The majority of the networks in the marketplace, including Ethernet, StarLAN, 10-NET, and many others, use the CSMA protocol.

In contrast to the CSMA protocol, the token-passing protocol prohibits a station from transmitting until it receives a specific permission message, or “token.” Although Standard Microsystems’ ARQnet, IBM’s Token-Ring Network, Proteon’s ProNET-10, and 3Com’s Token-Ring differ in their electrical topology, physical topology, and network media, they all use some variation of a token-passing protocol to access the media.

The advantage of the CSMA system is that it is able to handle short messages quickly and efficiently. The disadvantage of the CSMA system is that a station with a long message or many messages to send can easily monopolize the network. Token-passing systems, on the other hand, theoretically put more overhead into the network and are not as efficient for handling many small messages. Yet token-passing protocols give every station an opportunity to transmit their messages on a regular basis.

The media-sharing protocol you choose is slightly more important than, and closely linked to, your choice of physical topology. The same types of considerations apply. If you are supporting manufacturing, security, medical, or other critical applications, you should give strong consider-
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PC-PLUS — The Fastest Growing Multi-user PC Solution

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Alloy Computer Products, Inc., 100 Pennsylvania Avenue, Framingham, Massachusetts 01701, (617) 875-6100, TWX: 710-346-0394

CIRCLE 345 ON READER SERVICE CARD
ating to selecting a token-passing protocol. If you are in an office or work-group environment, selecting a system using a CSMA protocol may give you slightly improved response time with some applications and lower cost.

**INTERFACE CARD** Another hardware design alternative is the network interface card the LAN uses. Two network interface cards using the same media, arranged in the same topology, and using the same access protocols can still have some major differences between them.

Some modern cards, such as 3Com's TokenLink Plus, 3Com's EtherLink Plus, and IBM's Token-Ring Network, have connectors that mate with the special expansion slots of the PC AT. These connectors allow the cards to make use of the faster interrupts available in the PC AT bus. Using these cards in a network server can significantly improve the operational speed of the entire network.

Interface cards equipped with powerful processors can also speed up a LAN. IBM's Token-Ring Network and 3Com's TokenLink Plus cards have their own 80186 processors, RAM, and programming in ROM. Gateway Communications' G/Net cards have a fast Z-80 processor. Selecting network interface cards with a processor more powerful or faster than the 8088 in the typical PC might sound unusual, but if the processor on the interface card unloads work from the PC, both systems benefit. However, since powerful interface cards such as 3Com's EtherLink Plus sell for several hundred dollars more than less-powerful alternatives, putting them into every workstation may not be practical.

Several manufacturers of network interface cards, including Gateway and Fox Research, sell optional ROMs that allow a network workstation to boot without using a local disk drive. Invisible Software includes this feature as a standard part of its relatively inexpensive cards. When a workstation PC's interface card is equipped with one of these ROMs, the PC uses the network to reach the server and boot with DOS from the server's hard disk. This feature is desirable if you want to use diskless PCs as network workstations.

---

**LAN PRODUCT INFORMATION**

**SOFTWARE:**

- Advanced NetWare/86
- Advanced NetWare/286
- SFT NetWare

Novell Inc.
122 E. 1700 South
Provo, UT 84601
(801) 379-5900

**Prices:**
- Advanced NetWare/86, $1,595
- Advanced NetWare/286, $2,195
- SFT NetWare, $2,995.

**Requires:** 40K RAM, DOS 3.1.

**In Short:** A well-integrated and advanced LAN software system that contains features other vendors are still struggling to develop. Not copy protected.

**PC Local Area Network Program**

IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900

**Prices:** $125

**Requires:** 256K RAM, DOS 3.2.

**In Short:** Easy to install and maintain. Although it has a good station-to-station message utility, the program cannot send store-and-forward electronic mail. Its security and troubleshooting features do not compare well with those of other popular networking programs. Copy protected.

**StarLAN Network Program**

AT&T Information Systems
295 N. Maple Ave., #17-2326F2
Basking Ridge, NJ 07920
(201) 221-8851

**Price:** $125

**Requires:** 512K RAM, DOS 3.1 or later.

**In Short:** An adaptation of 3Com's networking software. StarLAN Network Program is easy to install and maintain. However, it lacks some of the network station-to-station communications features found in packages from other vendors. The package slows hardware performance in the PC Labs benchmark tests. Not copy protected.

**10-NET**

Fox Research Inc.
7016 Corporate Way
Dayton, OH 4549
(513) 433-2238

**Price:** 10-NET installation package (including network interface board, tap box, 8-foot connecting cable, documentation, and the 10-NET software), $695.

**Requires:** 124K RAM, one disk drive, DOS 2.0 or later.

**In Short:** 10-NET offers many features while retaining ease of use and installation. Its security and station-to-station communications features are particularly strong, as is its status reporting. The installation process is not complex, but it requires you to create batch files for every user and workstation on the network. Not copy protected.

**3+Share**

3Com Corp.
3165 Kifer Rd.
Santa Clara, CA 95052
(408) 562-6400

**Prices:** 3+Share for PC servers (maximum five users), $895; 3+Share for PC servers (unlimited number of users), $1,790; 3+Share software for 3Server (unlimited number of users), $1,790.

**Requires:** 640K RAM, DOS 3.1 or later.

**In Short:** 3+Share comes with a menu driven installation program that makes the process relatively easy. Its monitoring and diagnostic capabilities could stand improvement, since they provide little information to the network administrator about the functioning and workload of the network. Nor does the software provide "rude messaging." Network security is also a concern since anyone can gain access to all of the files on the server if it is booted up with a DOS disk. Copy protected.

**VINES**

Banyan Systems Inc.
115 Flanders Rd.
Westborough, MA 01581
(617) 366-6681

**Price:** $1,895 (including Network Administration).

**Requires:** 512K RAM (1 Mbyte RAM recommended), DOS 2.0 or later.

**In Short:** VINES is extremely flexible and has powerful communications capabilities. The troubleshooting and displays are excellent. The system's security features are good, but access permissions for network users could be more flexible. Copy protected.
EasyLAN—Networking With Netbios Support. And it's Only $99.95 Per PC.

EasyLAN SPECIFICATIONS

Each PC in the network requires an individual licensed copy of the EasyLAN program and takes 20k of memory on each satellite PC, a serial port, and DOS 2.0 or above. EasyLAN runs on all IBM PC models and compatibles. The central PC requires a serial port for each satellite PC. The COM2 and COM6 are serial port on ports which permit you to add serial ports to the central PC.

EASY TO INSTALL

EasyLAN can be installed in less than time than it takes to enjoy your coffee break. Just plug the EasyLAN cables into existing serial ports. The EasyLAN Network Configuration Program provides menu driven installation program that will guide you step by step through the software installation process.

New Version 3.0 with
- New Network Commands
- NETBIOS Support

If you own two or more PCs then you need EasyLAN™ version 3.0.

THE EASYLAN OFFICE NETWORK

EasyLAN shares printers and disk drives between IBM PCs. EasyLAN can save you $1,000 more per PC by eliminating duplicate equipment purchases. And now, you can run NETBIOS supported applications. Or you can write your own network applications for EasyLAN and other NETBIOS compatible networks.

EasyLAN VERSION 3.0 HIGHLIGHTS

- EasyLAN shares printers, plotters, data, and disk storage.
- Supports up to 16 PCs or compatibles
- New NETBIOS Commands
- New NETBIOS
- PC to PC file transfer
- Print spooling
- PBX support
- Easy to install
- Easy to operate
- Modern support
- Performs in the background

EasyLAN low price matches the small business user's cost-sensitive budget. It is the office network solution for less than $100 per PC.

EasyLAN performs its operations concurrently in the background. EasyLAN communications, file transfers and printer operations all take place while each PC simultaneously performs such normal DOS applications as Lotus 1-2-3, WordStar, and dBASE.

NEW NETBIOS SUPPORT—WRITE YOUR OWN COMMUNICATIONS PROGRAMS.

Programmers may use EasyLAN to develop network applications using NETBIOS (interrupt 5c). These applications can now be operated across the low cost RS 232 communications links used by EasyLAN. Our new EasyLAN program is an example of a network application that uses NETBIOS for program to program communications. Multi-user data base management applications that require a high overhead network operating system will perform faster on high cost networks operating at megabit speeds.

NEW VERSION 3.0 COMMANDS EXPAND NETWORK FLEXIBILITY

EZCLOCK lets PCs attached to the network read the time and date from a single master clock on the central PC, eliminating the need to install individual clock boards in each PC and insuring that all files entries and updates made across the network are dated.

The EZ Make Directory and EZ Remove Directory commands function identically to the DOS MKDIR and RMDIR commands, and give remote users increased flexibility when it comes to managing subdirectories on the central PC.

EZBEEP lets you send an audible signal across the network, alerting a PC user that a file or message is being sent.

EasyLAN PBX SUPPORT BRINGS NEW FLEXIBILITY TO PC CONNECTIVITY

With EasyLAN's PBX support, users can share peripheral devices and file transfer users using PBX switched circuit connections and existing twisted-pair wiring. EasyLAN has already been installed on a number of different PBXs, and recently was certified by Northern Telecom for use on the Meridian SL-1.
The Differe Networking A

When you really sit down and analyze it, the critical element in a successful PC network isn't what you connect. It's who you connect with.

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And our systems engineers are uniquely equipped to implement the best possible PC connectivity solution for any business environment. For one thing, they average 20 network installations in experience. They specialize in multi-vendor systems, having worked with major networking product vendors. They come, not with products, but with a business/solutions orientation. And an open mind.

The systems engineers don't make recommendations until they fully understand your way of doing business.
When they do, it's not a sales proposal. It's an objective, long-term plan based on your situation, their expertise, the best technology from the best vendors and Businessland's experience with over 1700 successful network installations, nationwide.

That's the beginning. Systems engineers stay involved in each project as a key team member, through installation, software set-up, training and service. They assure competence and continuity in every network.

The Businessland systems engineer is a real part of your networking solution from day one. It's a different way of working. And it works.

BUSINESSLAND
A Different Kind of Computer Company

Lorraine Donohue
Systems Engineer

Todd MacDonald
Systems Engineer

Bill Webb
Systems Engineer
LAN PRODUCT INFORMATION

13 LANs

Ethernet
3Com Corp.
3165 Kifer Rd.
Santa Clara, CA 95052
(408) 562-6400

Workstation Requirements: 320K RAM, DOS 3.1 or later.

Server Requirements: 640K RAM, DOS 3.1 or later.

Networking Software: 3+Share.
Prices: EtherLink boards, $595 each; terminator kit $50; cable prices vary depending on length; 3+Share for PC servers (maximum five users), $895; 3+Share for PC servers (unlimited number of users), $1,790; 3+Share software for 3Serverv (unlimited number of users), $1,790, 3Server 3. $5,995.

In Short: Although you can easily install the cards, making changes is difficult because the network comes with 40 jumpers. Running under 3+Share on the 3Server 3, this LAN performs very well on the benchmark tests. It also has the flexibility of the standardized Ethernet interface.

G/NET
Gateway Communications Inc.
2941 Alton Ave.
Irvine, CA 92714
(714) 553-1555


Networking Software: Advanced Net-Ware/E-TI.
Prices: TI Business-Pro computer (basic configuration), $3,995; TI Business-Pro computer (including 512K RAM, TI Mode CRT controller, 40-Mbyte hard disk drive), $5,770; Advanced NetWare/E-TI, $1,595; two terminating resistors, $40.

In Short: The Business-Pro LAN Server network software is well suited for its native mode on the LAN. Although this LAN is slower than other systems, the server can carry heavy loads of hard disk, tape backup, and add-on peripherals. Although TI provides excellent documentation, installation is complicated because you must set over 40 jumpers on each card.

IBM Token-Ring Network
IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900

Workstation Requirements: 256K RAM, DOS 3.2.

Server Requirements: 256K RAM, DOS 3.2.

Networking Software: PC Local Area Network Program, Advanced Net-Ware, Tapestry; all networking software that supports NETBIOS.
Prices: IBM Token-Ring Network Starter Kit, S4,065; PC Local Area Network Program, S125; Adapter Cards, S695; Multistation Access Unit (#8228 Setup Aid), $660; cabling prices vary among authorized IBM dealers.

In Short: An industrial-strength network system that is fast and flexible but lacks built-in troubleshooting and diagnostic reporting tools.

Invisible Network
Invisible Software Inc.
481 47th Ave.
San Francisco, CA 94121
(415) 221-0916

Workstation Requirements: 320K RAM (640K RAM recommended), DOS 3.1 or later.

Server Requirements: 320K RAM (640K RAM recommended), hard disk, DOS 3.1 or later.

Networking Software: PC Local Area Network Program, Tapestry, Advanced Net-Ware, Advanced NetWare/286, C/BS Network OS.

Prices: Starter Kit, including two Invisible Network cards, 30-foot cables, two copies of the user manual, two copies of Invisible Network disk, $499.90; additional Invisible Network cards, $249.95 each; additional cabling, $10 per 30 feet; Invisible Network Novell Driver (for Advanced NetWare/86 and Advanced NetWare/286), $99 per site.

In Short: The Invisible Network, using IBM's PC Local Area Network Program and the power of NETBIOS, gives you good performance at an economical price. Best used on a network with no more than a few dozen workstations.

P C M A G A Z I N E  •  A P R I L  2 8 ,  1 9 8 7  2 1 8
LANCOURIER

Tallgrass Technologies Corp.
110 W 82nd St.
Overland Park, KS 66214
(913) 492-6002

Workstation Requirements: 256K RAM (512K RAM recommended), one floppy disk drive.

Networking Software: VINES.

Prices: LANCOURIER TG-8000 server with 43-
Mbyte hard disk without software, $8,495; VINES (including NETMAN), $1,895, XCom’s EtherLink cards, $750.

In Short: The LANCOURIER TG-8000 server combined with VINES makes a flexible and powerful LAN with outstanding communication capabilities.

CIRCLE 627 ON READER SERVICE CARD

NetWare/S-Net
Novell Inc.
122 E 750 South
Provo, UT 84601
(801) 379-5900

Workstation Requirements: 256K RAM, DOS 3.1.

Networking Software: Advanced NetWare 68.

Prices: Server 68B, $8,000; network interface boards, $250; NDS2 disk subsystems, 68-Mbyte disk drive, $4,995; 109-Mbyte disk drive, $6,495; 183-Mbyte disk drive, $10,995; NDS4 disk subsystems: 68-Mbyte disk drive, $5,995; 109-Mbyte disk drive, $7,995; 183-Mbyte disk drive, $11,495.

In Short: NetWare/S-Net with Server 68B is a good, solid network for heavy-duty transaction processing. The server is a rugged, conservatively designed machine. NetWare/S-Net is also quite a remarkably steady performer, showing little degradation from the lightest to the heaviest test loads. In addition, NetWare/S-Net is easy to install—except that the documentation neglects to mention that you must attach a terminal to the server.

CIRCLE 631 ON READER SERVICE CARD

PCnet
Orchid Technology Inc.
477 Westminster Dr
Fremont, CA 94536
(415) 490-8586

Workstation Requirements: 256K RAM, DOS 2.0 to 3.1.

Networking Software: Advanced NetWare86. PCnet, all other NETBIOS compatible software, including PC Local Area Network program and Tapestry.

Prices: Two-user starter kit, including the PCnet software, $1,909; including Advanced NetWare86, $1,550; PCnet network interface board, $495; Conquest multifunction board with network daughterboard, $795; 100 feet of cable, $50; PCnet adapter cards, $495.

In Short: Orchid Technology’s LAN is easy to install and can adapt to the needs of individual systems. Its Conquest board could help those short on space slot. In addition, each PCnet network interface board comes with some useful software designed to circumvent hardware contention problems. It’s not the fastest network around, but it should suffice for office and light transactional processing uses.

CIRCLE 630 ON READER SERVICE CARD

ProNET-10
Procom Inc.
2 Technology Dr.
Woburn, MA 01801
(617) 899-2810

Workstation Requirements: 256K RAM, DOS 3.1.

Networking Software: Advanced NetWare86, Advanced NetWare286, DECnet, TCP/IP, VINES.

Prices: p130 network interface card, $799; p130 network interface card, $899; eight-wire node center, $630; four-node wire center, $335.

In Short: The ProNET-10’s adapter cards are easy to install. Small networks can be set up without problems, but networking more than 12 workstations is unduly complicated. Another plus: LEDs next to the connector glow when an electrical connection is made, which helps in network troubleshooting.

CIRCLE 635 ON READER SERVICE CARD

StarLAN
AT&T Information Systems
295 N. Maple Ave., #17-2326F2
Basking Ridge, NJ 07920
(201) 221-8851

Workstation Requirements: 256K RAM, one floppy disk drive.

Server Requirements: 512K RAM, hard disk drive.

Networking Software: StarLAN Network Program, Advanced NetWare86, Advanced NetWare286.

Prices: Network Access Unit interface board, $595; 300 feet of cable, $23; 1,000 feet of cable, $55.

In Short: StarLAN is an easy-to-install, flexible network for future expansion, but the 6300 server is inadequate, and StarLAN Network Program, while easy to use, is slow.

CIRCLE 636 ON READER SERVICE CARD

10-NEI, Version 3.1
Fox Research Inc.
7016 Corporate Way
Dayton, OH 45459
(513) 433-2238

Workstation Requirements: 192K RAM, one floppy disk drive, DOS 2.0 or later.

Networking Software: 10-NET.

Prices: 10-NET installation package (including network interface board, tap box, 8-foot connecting cable, the 10-NET software, documentation), $695; twisted-pair telephone wiring, $120 per 1,000-foot roll.

In Short: 10-NET includes everything you need for a workstation node in a single package. The 10-NET software includes features such as a public calendar and chat capabilities that are optional or nonexistent in other networking software packages. This is a good package for office or university environments that require such software features. However, the network’s slow speed makes it inappropriate for DBMS applications that need fast transaction processing.

CIRCLE 635 ON READER SERVICE CARD

3Com Token-Ring
3Com Corp.
3165 Kaiser Rd.
Santa Clara, CA 95052
(408) 562-6400

Workstation Requirements: 320K RAM, DOS 3.1 or later.

Server Requirements: 640K RAM, DOS 3.1 or later.

Networking Software: 3+Share.

Prices: Starter Kit (including three TokenRing Plus network press adapters, three RingTaps, two trunk cables), $3,755; 3+Share for PC servers (maximum five users), $895; 3+Share for PC servers (unlimited number of users), $1,790; 3+Share for 3Server3 (unlimited number of users), $1,790, 3Server3, $5,995.

In Short: This network pays attention to detail with large captive screws on the connectors, and you can add stations to the ring without buying another network hub. The TokenRing Plus cards with the 3Server3 would make a particularly good network for applications that require every workstation to communicate during the busiest times.

CIRCLE 634 ON READER SERVICE CARD

PC MAGAZINE • APRIL 28, 1987
219
The more advanced something is, the simpler it should be to use. That's exactly what we had in mind when we designed our new printer, the P321SL. It doesn't just look sophisticated, it makes turning your hard work into hard copy a lot easier.

The fanfold bypass feature eliminates the need to unload the continuous form paper when using single sheets. Just insert and print. The auto-load feature does away with platen cranking for both fanfold and single sheet paper. Just pull a lever to instantly and accurately load either of them. There's even a built-in tear bar to make tearing off the continuous form paper at any point both neat and easy.

You won't be tearing your hair out trying to find and switch dip switches anymore. There aren't any. The P321SL's front panel lets you choose type fonts, pitch, emulation, quiet mode, lines per inch, page length and more at the touch of a button.

Compatible as it is with you, the new P321SL is also compatible with IBM Pro...
printer. Qume Sprint 11. And of course our own P351. These emulations, in addition to five resident fonts, optional plug-in type font cards and downloadable type fonts, give you a lot to choose from. Without a lot of work.

There's another thing the P321SL gives you less of — options. That's because it comes with more standards like the tractor, quiet mode and IBM emulation.

Also standard is our excellent 24-pin print quality that's head and shoulders above 9-pin heads. (Made even better with Toshiba's letter-quality multistrike film ribbon.) And high-resolution graphics. So really the only other options to consider are the sheet feeder and larger memory.

That should make choosing the affordable P321SL as easy as using it. For the name of your Toshiba printer and computer dealer, call 1-800-457-7777.

1 IBM Printer is a registered trademark of International Business Machines Corp.
2 Qume Sprint 11 is a registered trademark of Qume Corp.
Benchmark Tests: 13 LANs

This test stresses the network interface card in the server and the media-sharing protocols. Systems are listed from slowest to fastest according to their performance running four stations. The token media-sharing protocols used by ARCnet and the IBM Token-Ring Network do well in this test and show a relatively small amount of speed degradation because they ensure that all stations in a busy network have an opportunity to use the network without collisions or contention. 10-NET did particularly poorly because it handles batch files only 1 byte at a time end (at the time these tests were run) had no disk cache option.

Network Speed Under Contention

Performance Times
(Times given in seconds)

<table>
<thead>
<tr>
<th>System/Manufacturer</th>
<th>Interface cards</th>
<th>Software</th>
<th>Server</th>
<th>Zero stations</th>
<th>One station</th>
<th>Two stations</th>
<th>Three stations</th>
<th>Four stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-NET</td>
<td>10-NET</td>
<td>10-NET</td>
<td>All workstations</td>
<td>82.44</td>
<td>150.32</td>
<td>223.43</td>
<td>295.22</td>
<td>392.33</td>
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<tr>
<td>PCNet/Orchid Technology Inc.</td>
<td>PCnet</td>
<td>Advanced NetWare/86</td>
<td>6-MHz IBM PC AT</td>
<td>67.50</td>
<td>140.37</td>
<td>225.22</td>
<td>245.63</td>
<td>279.55</td>
</tr>
<tr>
<td>Invisible Network/Invisible Software Inc.</td>
<td>Invisible Network</td>
<td>Local Area Network Program</td>
<td>6-MHz IBM PC AT</td>
<td>75.00</td>
<td>93.00</td>
<td>127.00</td>
<td>159.00</td>
<td>223.00</td>
</tr>
<tr>
<td>StarLAN/AT&amp;T Information Systems</td>
<td>StarLAN</td>
<td>StarLAN Program</td>
<td>8-MHz IBM PC AT</td>
<td>105.49</td>
<td>118.58</td>
<td>149.61</td>
<td>160.00</td>
<td>188.51</td>
</tr>
<tr>
<td>Ethernet/3Com Corp.</td>
<td>EtherLink Plus</td>
<td>3 + Share</td>
<td>8-MHz IBM PC AT</td>
<td>51.00</td>
<td>87.00</td>
<td>110.00</td>
<td>140.00</td>
<td>170.00</td>
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<tr>
<td>Business-Pro LAN Server/Texas Instruments</td>
<td>EtherLink</td>
<td>Advanced NetWare/E-TI</td>
<td>TI Business-Pro</td>
<td>41.11</td>
<td>68.07</td>
<td>106.87</td>
<td>129.49</td>
<td>153.48</td>
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<tr>
<td>G/Net/Gateway Communications Inc.</td>
<td>G/Net</td>
<td>Advanced NetWare/98</td>
<td>8-MHz IBM PC AT</td>
<td>54.65</td>
<td>74.20</td>
<td>85.64</td>
<td>106.25</td>
<td>134.20</td>
</tr>
<tr>
<td>ProNET-10/Proten Inc.</td>
<td>ProNET-10</td>
<td>Advanced NetWare/286</td>
<td>8-MHz IBM PC AT</td>
<td>58.96</td>
<td>64.46</td>
<td>68.60</td>
<td>92.25</td>
<td>124.27</td>
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<tr>
<td>3Com Token-Ring/3Com Corp.</td>
<td>TokenLink Plus</td>
<td>3 + Share</td>
<td>3Server3</td>
<td>52.00</td>
<td>58.00</td>
<td>70.00</td>
<td>90.00</td>
<td>117.00</td>
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<tr>
<td>NetWare/S-Net/Novell Inc.</td>
<td>NetWare/S-Net</td>
<td>Advanced NetWare/68</td>
<td>Novell Server 66B</td>
<td>71.00</td>
<td>83.70</td>
<td>94.29</td>
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<td>115.68</td>
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<tr>
<td>IBM Token-Ring Network/IBM Corp.</td>
<td>IBM Token-Ring</td>
<td>PC Local Area Network Program</td>
<td>8-MHz IBM PC AT</td>
<td>63.68</td>
<td>71.54</td>
<td>83.47</td>
<td>97.41</td>
<td>110.73</td>
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<tr>
<td>Ethernet/3Com Corp.</td>
<td>Ethernet</td>
<td>3 + Server3</td>
<td>3Server3</td>
<td>44.00</td>
<td>54.00</td>
<td>66.00</td>
<td>78.00</td>
<td>97.00</td>
</tr>
<tr>
<td>StarLAN/AT&amp;T Information Systems</td>
<td>StarLAN</td>
<td>Advanced NetWare/286</td>
<td>8-MHz IBM PC AT</td>
<td>58.41</td>
<td>70.12</td>
<td>75.68</td>
<td>81.86</td>
<td>93.46</td>
</tr>
<tr>
<td>ARCnet/Standard Microsystems Corp.</td>
<td>ARCnet</td>
<td>Advanced NetWare/286</td>
<td>8-MHz IBM PC AT</td>
<td>59.45</td>
<td>62.14</td>
<td>67.83</td>
<td>78.21</td>
<td>92.56</td>
</tr>
<tr>
<td>LanCourier/Telgrass Technologies Corp.</td>
<td>EtherLink</td>
<td>VINES</td>
<td>LanCourier TG-8000</td>
<td>38.81</td>
<td>56.80</td>
<td>74.66</td>
<td>85.07</td>
<td>91.23</td>
</tr>
<tr>
<td>IBM Token-Ring Network/IBM Corp.</td>
<td>IBM Token-Ring</td>
<td>Advanced NetWare/286A</td>
<td>8-MHz IBM PC AT</td>
<td>55.83</td>
<td>60.15</td>
<td>64.10</td>
<td>73.29</td>
<td>79.52</td>
</tr>
</tbody>
</table>

The PC Labs benchmark tests were run using three IBM PCs, one PC-XT, and one PC AT as workstations. The load provided by these stations is heavier and more consistent than that found in normal office or data processing applications. Therefore, the results of these tests can be interpolated to networks with a larger number of workstations but with a more sporadic workload.

The default server for these tests is an IBM PC AT running at 8 MHz. When a network system depends on a proprietary server, we used that. The IBM PC AT contains only 512K bytes of RAM, and we found that that limitation degrades some performance times in comparison with other servers tested with more memory. For the sake of consistency, we tested the network systems, whenever possible, running the appropriate version of Novell's NetWare. We also tested the systems running under any proprietary or other software from the system's vendor.

Timing on these tests was done through the use of a separate clock not on the computer motherboard and therefore not subject to interruption by programs that disable interrupts.

For the Network Speed Under Contention benchmark test, the dependent variable is the time it takes for the IBM PC-XT on a LAN to perform a standard set of DOS read-write commands against a single data file residing in the server. This inde-

(Diskless PCs will be reviewed in an upcoming issue of PC Magazine.) Using a diskless PC reduces the cost of each workstation and improves network security since users cannot make a copy of a program or data file on the local disk drive and walk away with the floppy disk.

All possible combinations of processor, boot, media, and protocol are not available in network cards. Your choice of a network interface card will probably be guided by more important factors such as the networking software you choose. If they are available, you should install cards that can use faster PC AT bus interrupts and that carry their own powerful processor for at least the network server.

NETWORK SERVERS The term "network server" designates both a machine and a function. Sometimes the functions of
file server, print server, and communication server. These servers are distributed among several machines and sometimes they are combined in one server. Software controls the approach that some appear in very small networks, but as the network grows, they become more prominent as they require more powerful computers and large memories.

Many applications require a lot of storage. This function can be handled by the file server, by using dedicated file servers. The file server provides a way to maintain data files on the network even if they are not available directly from the disk drives. When files are stored in the file server, they can be accessed from anywhere on the network.

Several factors can affect the performance of the file server. One of these factors is the number of clients accessing the server. If there are too many clients, the server may become overloaded and response times may increase. To improve performance, the server may be configured with additional processors, memory, or disk drives.

The file server is usually a dedicated server. It is designed to handle the heavy load of file access and not be used for other purposes. This allows the file server to provide optimal performance for file access operations. The file server can also be configured with redundant hardware to ensure availability in case of a failure.

The file server is an important component of a network. It provides the necessary storage and access to files for users on the network. By properly configuring and managing the file server, network administrators can ensure that network operations are efficient and reliable.

---

**FILE SERVERS**

Machine designed to be the server full-integrated features such as the SIFF, the EII, and the AII. These machines are designed to be used in a lab environment and are capable of handling large amounts of data. They have dedicated CPUs and memory for expansion and can be configured with additional storage options.

The file server handles the storage and management of files on the network. It acts as a central repository for data, allowing users to access files from anywhere on the network. The file server can be configured with additional hardware, such as disk drives, to provide more storage capacity.

The file server is an important component of a network. It provides the necessary storage and access to files for users on the network. By properly configuring and managing the file server, network administrators can ensure that network operations are efficient and reliable.
Benchmark Tests: 13 LANs

This test simulates heavy access to a database management system. This is the most general test of network performance we run. The factors that made networks effective in the other tests also carried over to this test: Disk-caching software, an efficient media-sharing protocol, and an effective server-to-network interface made Standard Microsystems Corp.'s ArcNet and both of 3Com Corp.'s networks top performers. The excellent response time of AT&T Information Systems' StarLAN under Novell's NetWare should do away with fears that such a system using twisted-pair wiring is too slow for heavy work.

Smart Applications

<table>
<thead>
<tr>
<th>Performance Times</th>
<th>(Times given in seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Manufacturer</td>
<td>Interface card</td>
</tr>
<tr>
<td>LeeCrourr/Tallgrass Technologies Corp</td>
<td>EtherLink</td>
</tr>
<tr>
<td>10-NET/Fox Research Inc</td>
<td>10-NET</td>
</tr>
<tr>
<td>PCnet/Orchid Technology Inc</td>
<td>PCnet</td>
</tr>
<tr>
<td>Invisible Network Invisic Software Inc</td>
<td>Invisible Network</td>
</tr>
<tr>
<td>StarLAN/AT&amp;T Information Systems</td>
<td>StarLAN</td>
</tr>
<tr>
<td>IBM Token-Ring Network/IBM Corp</td>
<td>IBM Token-Ring</td>
</tr>
<tr>
<td>G-NET/Gateway Communications Inc</td>
<td>G-NET</td>
</tr>
<tr>
<td>ProNET-10/Procom Inc</td>
<td>ProNET-10</td>
</tr>
<tr>
<td>IBM Token-Ring Network/IBM Corp</td>
<td>IBM Token-Ring</td>
</tr>
<tr>
<td>StarLAN/AT&amp;T Information Systems</td>
<td>StarLAN</td>
</tr>
<tr>
<td>Business-ProLAN Server/Texas Instruments</td>
<td>EtherLink</td>
</tr>
<tr>
<td>NetWare/S-Net/Novell Inc</td>
<td>NetWare/S-Net</td>
</tr>
<tr>
<td>Ethernet/3Com Corp</td>
<td>EtherLink Plus</td>
</tr>
<tr>
<td>3Com Token Ring/3Com Corp</td>
<td>TokenLink Plus</td>
</tr>
<tr>
<td>Ethernet/3Com Corp</td>
<td>EtherLink</td>
</tr>
<tr>
<td>ARCNet/Standard Microsystems Corp</td>
<td>ARCNet</td>
</tr>
</tbody>
</table>

The PC Labs benchmark tests were run using three IBM PCs, one PC-XT, and one PC AT as workstations. The load provided by these stations is heavier and more consistent than that found in normal office or data processing applications. Therefore, the results of these tests can be interpolated to networks with a larger number of workstations but with a more sporadic workload. The default server for these tests is an IBM PC running at 8 MHz. When a network system depended on a proprietary server, we used that. The IBM PC AT contains only 512K bytes of RAM, and we found that that limitation degrades some performance times in comparison with other servers tested with more memory. For the sake of consistency, we tested the network systems, whenever possible, running the appropriate version of Novell's NetWare. We also tested the systems running under any proprietary or other software from the system's vendor.

Timing on these tests was done through the use of a separate clock not on the computer motherboard and therefore not subject to interruption by programs that disable interrupts.

The Smart series of integrated network programs from Innovative Software gave us a practical approach to running small LANs on low-cost hardware. A second class of machines designed to be file servers are those that are dedicated to the job. They have no capability for running local DOS applications. Primary among them are 3Com's 3Server3, Tallgrass Technologies' LanCourier TG-8000, and Novell's Server 68B. The TG-8000 and Server 68B machines use Motorola's 68000 processor and require unique versions of the network operating system. 3Com's 3Server3 uses an Intel 80186 (a highly integrated and fast version of the 8086).

These dedicated servers typically require a separate dedicated terminal or console and are loaded with the networking software either from an internal tape or from a workstation acting temporarily as a remote disk drive. They are treated much more like a minicomputer acting as a host than like a PC.
A general rule about file servers is that they are the bottleneck of the network. The narrowest point in the bottleneck is the server's hard disk. Hard disks move data at speeds from 75K to 100K bits per second. Even the slowest combination of network cards and media has a throughput much faster than that. The fastest processor will not significantly improve the performance of a slow hard disk.

A fact that is becoming more important for servers is that silicon is faster than hardware. 3Com's new 3Server3 uses 2 megabytes of RAM to store large portions of the hard disk while it is in use. This method yields exactly the same advantage in speed that individual PC users enjoy when they use a RAMdisk. As the size and the price of RAM continue to shrink, we can expect to see more network servers using megabytes of RAM as buffers for the hard disk—an efficient and effective way to "lubricate" an electromechanical bottleneck with silicon.

The selection of a server is closely tied to the price you can afford to pay. Machines designed to be dedicated servers can have price tags of over $8,000, but they give excellent performance in heavily loaded networks.

Lower-priced machines designed along the lines of an IBM PC AT can perform as well on most networks as those expensive machines perform. In fact, some situations would permit you to split the file server load between two PC AT-type machines and therefore gain redundancy, performance, and network reliability for about the same cost as for one specialized server.

If you need top-end performance in an industrial or developmental system, we recommend that you select a machine designed especially for the server role. But if you have a network in an office doing word processing and administrative support with one or two dozen workstations, then an AT-class machine with the right networking software can serve you well.

One thing that's crucial to a file server is the ability to back up a hard disk on removable media such as a tape or Bernoulli Box cartridge. The method of backup almost doesn't matter, as long as it is accomplished easily enough to be done regularly.

If you are using a network in one of those critical applications we described earlier, you should also consider an uninterruptible power supply (UPS) for your server. As these file server systems rely more on large RAM buffers to hold hard disk data, they also increase your vulnerability to power failures. A UPS can completely avoid problems a temporary power loss can cause, and it will give you precious minutes to shut the system down in the event of a long-term outage.

NETWORKING SOFTWARE Before you consider the topology, media, access protocol, or other more arcane issues of PC
Lotus® always wanted to get into pictures. It was just a matter of getting the product exactly right. That's why Freelance® Plus is big news. It's a powerful graphics package for business that adds real punch, real impact to all your work. Whether it's memos, reports, forms, bulletins, schedules or full-blown presentations.

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One Program
charts, symbols, diagrams, etc., etc.

Overheads + slides, too.
Benchmark Tests: 13 LANs

This test moves files between subdirectories on the server's hard disk. It loads the network interface card in the server and the media-sharing protocols, and it introduces the factor of server disk access speed and efficient I/O handling. The use of write and copy commands minimizes the value of a RAM cache in the server, but magnifies the value of techniques that efficiently move the heads on the hard disk drive (called "elevator seeking").

Networks using software with efficient I/O handling and servers with fast hard disk drives will perform well in this test. The fast disk drive used in Novell's NetWare/S-Net server gives it outstanding performance. 3Com's 3Server3 has so much memory available for disk caching that it did an outstanding job under every load or task we could provide.

The active file read, write, and transfer activities of this test are similar to actions taken during the use of a network for program development. They are also similar to the activities of certain types of database management applications.

<table>
<thead>
<tr>
<th>Network plus Server Cruncher</th>
<th>Performance Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Manufacturer</td>
<td>(Times given in seconds)</td>
</tr>
<tr>
<td></td>
<td>Zero stations</td>
</tr>
<tr>
<td>10-NET/Procon Inc.</td>
<td>82.44</td>
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<tr>
<td>ProNET-10/Procon Inc.</td>
<td>51.00</td>
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<tr>
<td>Ethernet/3Com Corp.</td>
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</tbody>
</table>

The PC Labs benchmark tests were run using three IBM PCs, one PC XT, and one PC AT as workstations. The load provided by these stations is heavier and more consistent than that found in normal office or data processing applications. Therefore, the results of these tests can be interpolated to networks with a larger number of workstations but with a more sporadic workload.

The default server for these tests is an IBM PC AT running at 8 MHz. When a network system depended on a proprietary server, we used that. The IBM PC AT contains only 512K bytes of RAM, and we found that that limitation degrades some performance times in comparison with other servers tested with more memory. For the sake of consistency, we tested the network systems, whenever possible, running the appropriate version of Novell's NetWare. We also tested the systems running under any proprietary or other software from the system's vendor.

Timing on these tests was done through the use of a separate clock not on the computer motherboard and therefore not subject to interruption by programs that disable interrupts.

For the Network plus Server Cruncher benchmark tests, the dependent variable is the time it took for the IBM PC XT on a LAN to perform a standard set of DOS read-write commands against a single data file residing in the server. The independent variable is the network load. We began with the heaviest load, four network workstations running DOS batch files, asking for constant reads

LAN selection, you should tentatively choose the networking software you want to use.

Like the media and the access protocol a LAN uses, the networking software is largely invisible to the users of the network, but it is very visible to the network administrator. The networking software is the tool the network administrator uses every day to satisfy the needs of the network users. As with any good tool, it must be manageable, flexible, and strong.

In our evaluations we found that the best networking software packages are very similar in performance and features. The internal architectural differences, though, among Banyan Systems' VINES, Novell's NetWare, 3Com's 3Share, IBM's PC Local Area Network Program, AT&T StarLAN and Network Program, and Fox Research's 10-NET are signifi-
...cam.

(calling mail...)

...menus what stalled.

...comparison, the time the them loads stations same number...)

If you differentiate between installation (getting the files installed and in the right place) and setup (getting the LAN ready for users), none of the networking software programs we reviewed were particularly difficult to install. IBM’s PC LAN was probably the easiest of all; you simply boot a disk, make one keystroke, and follow the screen directions. (However, we did experience a problem with the automatic installation procedure on an 8-MHz IBM PC AT.)

The difficulty of system setup varies with the number of utilities you install and features you implement. On a feature-by-feature basis, we found Fox Research’s 10-NET the easiest networking software to set up. Its method of creating a profile file holding each individual’s identification, permissions, and other factors is easy to understand and follow. In contrast, installing the 3Com’s 3+Share software always seemed to be complex and not completely intuitive, even though we did it at least six times over the course of our work. Novell’s NetWare falls in between 10-NET and 3+Share: it appears complex, but it isn’t once you discover that it involves a number of nice but not entirely necessary media tests. Its setup process takes some time but requires organization more than difficult labor.

One element of LAN software that sounds like a good idea but has only limited use is the menu.

- One element of LAN software that sounds like a good idea but has only limited use is the menu.

...
This chart is designed to help you select from among the many information-transfer and resource-sharing alternatives. As you can see on the chart, if all you really need to do is exchange files or share printers, then you should consider devices such as PBXs and patch boxes. If your organization has not already invested heavily in PCs or DOS programs, then a minicomputer might meet your needs more economically. But if you want many users to share data files simultaneously under DOS, a LAN may be the best alternative. Once you’ve decided on a LAN, the need for station-to-station resource sharing and other factors will influence your network purchasing decision.

Because manufacturers include many different features in their networks, some products will not fit neatly into one decision box in this guide. You’ll also find that the lack of differentiation between LANs is becoming as large a problem in the LAN industry as the lack of standards was 2 years ago. But overlapping features and technical similarity between networks are good news for potential buyers. They will let you concentrate on more-traditional factors such as dealer support and price instead of on more-technical considerations.

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- Vol. 5 No. 21
- Vol. 5 No. 22
- Vol. 6 No. 1
- Vol. 6 No. 2
- Vol. 6 No. 3
- Vol. 6 No. 4
- Vol. 6 No. 6
- Vol. 7 No. 7
Think You Need an AT?

Think Again.

TABLE OF BENCHMARK RESULTS

This table shows the results of the processor/coprocessor speed tests using the April 1986 release of PC Magazine's 'PC Labs Benchmark Tests'. These are public domain programs, and are available on diskette from PC Magazine, or via the PC Magazine bulletin board. These results were obtained by us at PC Magazine and are not yet official published PC Magazine figures. The last line in the table, the Norton System Information Test, is not from PC Magazine, but is part of the popular 'Norton Utilities.' The version we used was 3.1, which is the latest version but may not give identical results to older versions.

<table>
<thead>
<tr>
<th>Test Description</th>
<th>IBM PC</th>
<th>IBM AT</th>
<th>BREAKTHRU 286</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clock speed in MHz (IBM PC is 4.77)</td>
<td>4.77</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>Empty Loop</td>
<td>1.99</td>
<td>3.34</td>
<td>5.15</td>
</tr>
<tr>
<td>Integer add from memory</td>
<td>3.35</td>
<td>4.41</td>
<td>6.02</td>
</tr>
<tr>
<td>Integer multiply from memory</td>
<td>6.06</td>
<td>6.55</td>
<td>8.3</td>
</tr>
<tr>
<td>Floating point without coprocessor</td>
<td>3.33</td>
<td>4.42</td>
<td>5.76</td>
</tr>
<tr>
<td>Prime number test</td>
<td>1.95</td>
<td>2.85</td>
<td>3.7</td>
</tr>
<tr>
<td>Lotus 123 macro (640K)</td>
<td>2.64</td>
<td>3.69</td>
<td>4.62</td>
</tr>
<tr>
<td>Lotus 123 macro (256K)</td>
<td>1.77</td>
<td>3.54</td>
<td>4.38</td>
</tr>
<tr>
<td>Norton System Information Test</td>
<td>5.73</td>
<td>7.34</td>
<td>10.2</td>
</tr>
</tbody>
</table>

In every case but clock speed the numbers indicate how many times faster a test is performed than on a regular IBM PC.
The Next Generation in

Make Your IBM PC Faster Than an AT in Just 5 Minutes!

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PRICE</th>
<th>NORTON SI TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakthru 286 (8MHz)</td>
<td>$395</td>
<td>7.3 X faster</td>
</tr>
<tr>
<td>Breakthru 286-12 (12MHz)</td>
<td>$595</td>
<td>10.1 X faster</td>
</tr>
<tr>
<td>LIGHTNING™ speedup software</td>
<td>FREE with Breakthru</td>
<td>$89.95 purchased separately</td>
</tr>
</tbody>
</table>

DON'T TAKE OUR WORD FOR IT. USE EITHER BREAKTHRU 286 SPEEDUP BOARD FOR 60 DAYS. IF YOU ARE NOT TOTALLY SATISFIED SIMPLY RETURN FOR A FULL REFUND.

© Copyright 1987 PCSG

We are excited about our three speedup products. You probably know about our Lightning disk access speedup software that was awarded PC magazine's Best of 1986 award (see box). After the smashing success of Lightning, we developed the Breakthru 286 board to be literally the most advanced, fastest, most feature-rich board available. Now we go ourselves one better with the Breakthru 286-12. This new board has the clock speed cranked up from 8 to 12 MHz for speeds up to 10.1 times faster than an IBM PC.

From September 1986 we guaranteed that Breakthru was the best designed and most functional speedup card available. And the runaway success it has enjoyed truly proved that assertion.

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But, no speedup board cuts disk access time in half

LIGHTNING™

software can

"Lightning is almost mandatory.... It has been utterly trouble free in the year I have used it." - Steve Manes, PC Magazine Best of 86 review.

Loads with the DOS - always ready as a background program to accelerate disk access. You do nothing - everything is automatic.

LIGHTNING does what a speedup board can't. You are going to be so amazed when you start to work with LIGHTNING installed. Most programs that frequently access the disk (hard disk or floppy) like databases or word processors are made instantly faster - up to 2 to 4 times faster.

LIGHTNING enables any program to approach the same rapid speed as a RAM Disk, but it does it without the RAM Disk danger of losing precious data if you forget to save it. It works by a principle borrowed (and greatly enhanced) from main frame technology called caching. But it doesn't speed up the microprocessor. You need a speedup board to improve operational speed.

LIGHTNING is the standard against which all our competition measures itself because we achieve universal compatibility with other software and with complete reliability. Data is never lost. LIGHTNING fully exploits Above Board memory.

Order LIGHTNING separately or get it free with your Breakthru 286 board.

Turn back for test results.
And now we have a new Breakthru 286-12 board that is 33% faster than the regular Breakthru or regular 8MHz IBM AT, and up to a whopping 1,000% faster than a regular PC. How wonderful to convert a PC or XT or clone to a $4000 AT without the expense. But when you get ready to spend $395.00 or $595.00 you want to be sure your choice is the very best.

Faster and smarter than an AT-PCSG guarantees it.

HERE'S WHY THESE TWO BOARDS ARE SO SPECIAL.

First, they install so easily. It is a half-slot card, only five inches in length. You don't even have to give up a full slot. What's more, unlike competing products it works in the Compaq Portable and most clones. Easy diagrams show how you just place the card in an open slot, remove the original processor and connect a single cable. There is no software required. From that moment you are running faster than an AT.

Second, it is advanced. The BREAKTHRU 286 replaces the CPU of the PC or XT with an 80286 microprocessor that is faster than the one found in the AT. You have your choice of 8MHz at $395 or 12MHz at $595. You can plug in an optional 80287 math coprocessor chip for numeric intensive applications. A 16K cache memory provides zero-wait-access to the most recently used code and data. Look at the benchmark tests box to see how our two boards compare with the PC and the AT. Speed is addictive. You'll never want to go back to slow again.

Third, you have full compatibility. All existing system RAM, hardware, and peripheral cards can be used without software modification. Our boards operate with LAN and mainframe communication products and conform to the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). Software compatibility is virtually universal.

Fourth, these are the best. There are several other boards on the market. We at PCSG have compared them all, and there simply is no comparison. What we discovered is that many cards being sold offer only a marginal speedup in spite of their claims and others are just poorly engineered. For example some boards have a cumbersome mechanical switch for going back to 8088 speed, but the Breakthru boards have speed switching software that allows you to drop back to a lower speed on the fly for timing sensitive applications. The 8MHz BREAKTHRU 286 and the 12MHz are unequivocally the best executed and most completely reliable speedup boards manufactured today.

We are so pleased with the BREAKTHRU speedup card. We use them on our own PC's to make them faster than AT's. We are really excited about this product.

PCSG makes the unabashed statement that the BREAKTHRU 286 card represents more advanced technology than boards by Orchid, Quadram, P.C. Technologies, Phoenix...we could go on. The Breakthru 286 is indisputably the fastest turbo board with the biggest bang for the buck. And we include FREE the $89.95 acclaimed Lightning software, which complements the Breakthru 286 by dramatically speeding up disk operations.

But an ad can't let you experience it for yourself. That's why we sell either BREAKTHRU 286 8MHz or 12MHz on a 60-day trial. If you aren't completely satisfied return it within 60 days for a full refund. Call today with your MasterCard, Visa, American Express or COD instructions and we will ship your card the very next day.

PCSG
11035 Harry Hines Blvd. Suite 206 Dallas, Texas 75229
(214) 351-0564

CIRCLE 489 ON READER SERVICE CARD
provide excellent performance out of the box, but you can also easily tune it. 10-
NET is particularly rigid and could significantly benefit from the use of more buffers
and disk cache.

Another difference between networking software programs is in communications
functions. 3Com and Novell provide good communications capabilities in their
product lines, but Banyan’s VINES (also marketed as part of Tallgrass’s LanCourier
system) stands out from the other products we reviewed in its ability to handle com-
communications tasks. If your network re-

requirements are heavily weighted toward
modern sharing, network bridging, and
communications gateway activity, VINES
should be a prime candidate. VINES takes
a lot of time to set up, but it has great power
and flexibility.

SECURITY While all the products we
examined had good password protection
schemes, we feel that if security is an
important factor to you, Novell’s NetWare
should be high on your list for consider-
ation. NetWare provides an array of per-
missions and limitations. It also protects
the server’s hard disk from access from the
server’s keyboard.

A special version of NetWare, System
Fault Tolerant (SFT) NetWare, enhances
the reliability of some critical components
on a network. SFT NetWare has redundant
directories and special verification pro-
dures when files and the file allocation
table are written. It can also run hard disk
drives or even complete servers in the
“shadow” mode, which performs all ac-
tions on both drives or servers. If one drive
or server falters, an automatic reconstruc-
tion process takes data from the other unit
without halting the network.

One area of networking software that
begs for improvement is network trouble-
shooting and reporting. Administrators
need good tools to see who is using the
network, how it is being used, and what trans-
mision problems are being encountered.
Fox Research’s 10-NET and Banyan’s
VINES have the best tools among the sys-
tems we tested, but they are barely ade-
quate for real work. IBM’s PC LAN is par-
cularly barren of any monitoring,
reporting, or diagnostic tools. This area is
prime ground for a third-party software

vendor to develop a product that offers
these tools.

One difference between the networking
software products that may be important
to you has to do with available RAM. IBM’s
PC LAN, AT&T’s StarLAN Network Pro-
gram, and 3Com’s 3+Share steal RAM
on every workstation, even if the network
is not being used at the moment. This ac-
tivity could limit the ability of worksta-
tions on the network to load other RAM-
resident programs or to run applications
that use a lot of RAM—large spread-
sheets, for example.

Some other brief observations about
networking software: Novell’s on-screen
tutorial (done with Software Recording
Co.’s AutoMentor) is excellent. Fox Re-
search has an audiotape and 35mm slide
show that corporate training people love.
The on-line chat (CB) capability of 10-
NET and VINES is one of the main uses
of the network in many organizations. Ad-
vanced NetWare/286 works very well with
an 8-MHz PC AT that is nominally limited
to 512K bytes of RAM. 3Com’s software
has an excellent communications interface
with MCI Mail.

We expected to be able to measure sig-
ificant differences in the amount of time
an administrator spends maintaining one
networking software package versus an-
other, but we were not able to find them.
We concluded that a well-trained and
knowledgeable network administrator will
probably spend about an hour a week
maintaining the software for a network of
12 to 24 stations—a smaller workload than
we had anticipated. An untrained or inex-
perienced person, on the other hand, can
spend weeks in trial-and-error learning.

NETBIOS NETBIOS is an interface
program, originally developed by IBM
and Sytek, that works between the net-
work adapter hardware and the networking
software. Some communications pro-
grams such as DCA’s IRMALAN use
NETBIOS to establish communications
sessions across the network. Certain net-
work hardware manufacturers (such as In-
visible Software and Orchid Technology)
offer versions of NETBIOS so that you can
use networking programs from other com-
panies (IBM, 3Com, and Novell) on their
hardware. Almost all companies have ac-
The Most Powerful LAN Fits on a Disk.

Network Power. You knew that someday there would be a powerful LAN that didn't need old-technology network boards. It would be fast, easy to install, and run 99% of PC-DOS software. It would be expandable, provide remote access, password-protection, and enable you to use inexpensive terminals as workstations in a PC-DOS environment.

Dream no more, because the power is here. Its name is LANLink.

A Software-Driven LAN Powerful Enough To Use RS-232 Ports for Network Communications. In development for over three years, LANLink represents the next generation of local area networks. All of the logic which has traditionally resided on network boards is on LANLink's Satellite and Server Diskettes.

No additional hardware is required. Inexpensive serial ports replace "Kilobuck" Network Interface Boards making installation costs one-third that of a board-driven network.

How To Configure a Smart Network...With Dumb Terminals, But Without Dedicated Servers. Boasting a wide variety of configurations, LANLink is most often set up as a "Star" having up to eight satellites connected to a central, nondedicated server. Larger networks can have multiple servers, supporting a total of 73 or more network users.

R-LAN (Remote-LAN) gives users the ability to interact with a LANLink network in real time via modem. Plus, if MultiLink Advanced is run on a Satellite, inexpensive dumb terminals can be used to access network disks, files, and programs.

99% of PC-DOS Applications Run In a Totally-Transparent Network Environment. If you know DOS, you already know how to use LANLink COPY transfers files among users, and a 2-drive PC Satellite boots 1-2-3 from the Server's hard disk with the entry :\lotus. Each satellite's access can be limited to specific disks, printers, and sub-directories. A wide variety of software including Lotus 1-2-3, dBASE III, and WordStar 2000 is fully compatible. LANLink has a collision-free data transfer rate which exceeds 115,000 BPS.

Power Up Your PCs Today. For complete details and the authorized dealer nearest you, call The Software Link TODAY. The LANLink Starter Kit is $495 and includes modules for both a Server and a Satellite. For a limited time, 50 feet of shielded RS-232 cable will be included free of charge. Additional Satellite Modules are only $95, each. LANLink is immediately available and comes with a money-back guarantee. VISA, MC, AMEX accepted.
LAN SELECTION CRITERIA

If you’re still hazy about which LAN would best serve your needs, the following guidelines will help you match the right LAN with different environments.

To help you select the type of network that is right for your needs, we have been giving you a Connectivity Decision Guide with our reviews that presents the various issues to consider.

But after you’ve worked through the matrix we published originally, how do you choose from the 13 local area networks we evaluated and the other offerings in the marketplace? Let’s look at some other important factors you can use to guide you as you go further down the LAN decision tree.

PREMIUM FOR RELIABILITY? An early LAN selection decision you’ll want to make is how much of a premium you’re willing to pay for redundancy and reliability.

Assume that the uses of a local area network can be divided into two categories: critical and normal. A network falls into the critical-use category if you use it for process control during manufacturing, security, medical applications, online service, or other applications that have an immediate impact on the operation of the organization. The normal category includes all the other networks, those used for administrative support, accounting, and functions that won’t immediately affect health, safety, or the bottom line if the network fails.

If your application falls into the critical category, we suggest that you consider networks that use the token-passing protocol and the hub physical topology. Examples of such networks include IBM Corp.’s Token-Ring Network, Standard Microsystems Corp.’s ARCnet, Proteon’s ProNET-4 and ProNET-10, and (in a slightly different physical topology) 3Com Corp.’s Token-Ring.

If you require network reliability, Proteon has systems that offer significantly improved media reliability through the use of redundant cabling. Novell offers a special version of NetWare that can operate hard disk drives and/or complete servers in a shadow mode, so that if one system faults, the other can pick up without dropping a bit.

If your application is in the normal rather than the critical category, you don’t need to pay the added cost of the wiring hub, which can vary widely in specific installations but at a minimum costs an estimated $100 per workstation more than a station-to-station configuration. This estimate could increase by a magnitude of 10 in some installations.

For normal network reliability, a less expensive system using a station-to-station wiring scheme and the CSMA (carrier sense multiple access) protocol can satisfy your requirements. The products of many companies, ranging from 3Com’s fast Ethernet to Fox Research’s slower but less expensive 10-NET, meet these criteria.

SECURITY The next major criterion you should consider is how to meet your need for business-level security to keep documents private, accounts safe, and data free from harm. The need for enhanced security should influence your choice of networking software as well as the physical topology and the media of the network.

A LAN’s networking software is the basic element in its security program. The software recognizes the name of a user, confirms identity with a password, and allows that user to perform specific functions on certain information based on a profile established by the network administrator. Certain programs have more-elaborate lists of functions than others.

If you have data moving across your network that would interest industrial spies, you should make some effort to protect it. People with equipment that can gain access to the media of your network can easily capture and read all the information the LAN transmits. The media should traverse only those areas under positive control.

Fiber-optic cable is much more difficult, if not impossible, to tap than coaxial cable. Fox Research and Proteon market systems that use fiber-optic cable, and several companies market fiber-optic adapters that can replace coaxial cable in areas of higher risk.

Other physical security factors involve access to the server and its files. People intent on snooping or destroying files should not be able to access the server’s hard disk from the server’s console.
Since the network server can limit the network's performance significantly, it must be properly selected and the workload properly divided. As a rule of thumb, plan for one high-quality file server (80286- or 68000-based) for every 24 active workstations. If your workstations have their own internal hard disks and use the server only infrequently for specific applications, the network can serve many more stations.

The nature of the workload can influence your choice of access protocol. If network workstations exchange many long files, you should consider a token-passing protocol so that all stations get an equal chance at the network. If the load is made up of many short transmissions, the CSMA protocol might serve you better than the token-passing protocol, but the difference will be slight.

**MULTIVENDOR STATIONS**

Another factor that may affect your selection is the presence of stations on the network that don't use the IBM PC bus or operating system. A local area network can carry much more than PC-to-PC communications and DOS file access.

If you need to interconnect computers and terminals with very different architectures, consider the ProNET-10 and Ethernet networks. Proteon markets network adapters for several different minicomputers. Many companies, including IBM, sell ports or market adapters for Ethernet networks. 3Com's EtherLink cards in a PC can communicate (at least at a primitive level) with network adapters made by other companies in an Ethernet network.

**EXISTING WIRING**

Finally, existing cable or wire can influence your choice of network. If properly twisted and installed telephone wiring that goes to the right places is available, AT&T Information Systems' StarLAN or Fox Research's 10-NET might be an economical choice. If RG-62 or similar cable from an IBM 3270 installation is available, you could reuse it for certain coaxial LAN installations, such as Ethernet.

**WHOM DO YOU TRUST?**

After you work through the technical factors of LAN selection, consider the important managerial element. You need help when you're installing and maintaining a large local area network with many features, and we strongly suggest that one of the most important factors you should evaluate is the support you can expect from the LAN manufacturer and dealer.

If you want a turnkey installation (often worth the price), you should be able to trust the dealer. If you want to do your own installation and don't want to buy a maintenance contract, you'll need to be able to rely on telephone support from the manufacturer.

- If you have data that would interest industrial spies, you should make an effort to protect it.

While we did not attempt to evaluate the technical support available from all the vendors whose products we saw, we can state from our experience that 3Com, Novell, Gateway Communications, and Fox Research have excellent telephone-support services. Typically, these services are busy; you generally have to leave a message and wait for a return call. Often the support staffs will answer questions only if you can supply the serial number of the registered product or have opened a service account, but the technicians we talked to at these companies were both well informed and helpful.

**MORE HELP**

*PC Magazine*'s new column, Connectivity Clinic, is designed to supply solutions to common and uncommon problems in all types of information transfer systems. Send your questions to Connectivity Clinic, *PC Magazine*, P.O. Box 691, Herndon, VA 22070. —Frank J. Derfler, Jr.
We can help you connect the dots.

Connect the dots and you get a very different picture of your system capabilities and potentials.

Suddenly, the whole is much greater than the sum of its parts, because your computer systems can share expensive hardware like hard disks and printers through distributed resource management.

Now, Standard Microsystems can help you draw the line on which local area network is right for you. We offer a complete ARCNET® solution, from state-of-the-art hardware to field-proven software.

The ARCNET® advantage.

We've based our LAN products on ARCNET® for several key reasons. The system supports up to 255 nodes per network and is virtually user-transparent. Its token-passing ring topology avoids CSMA/CD collisions, assuring efficient use of its 2.5 Megabit data rate. It also has automatic system reconfiguration whenever nodes are added or removed.

But most importantly, ARCNET® is a proven technology. There are over 35,000 ARCNET® LAN installations worldwide.

Hardware to software.

Standard Microsystems offers a family of LAN controller boards, as well as hubs and active links (repeaters), that provide a simple yet flexible network interface for IBM® and IBM®-compatible personal computers. You can set up both STAR and BUS topologies. Fiber optic links for building-to-building connections or high noise environments are also available.

In addition, we can provide any of several popular network operating system software packages, including NetWare™, ViaNet® and NETBIOS.

No substitute for experience.

For years, the name Standard Microsystems has stood for innovation and quality in the semiconductor industry. Among our many technological achievements was the development of the first commercially available single-chip LAN controller (COM 9026) to incorporate a rate ARCNET® protocol.

Using our extensive experience, we've been able to perfect totally integrated, cost-effective LAN system products. Everything you need to build a high-performance LAN is now available from one source: Standard Microsystems. That's what we mean by "a complete ARCNET® LAN solution."

For more information, contact Standard Microsystems Corporation, 35 Marcus Blvd., Hauppauge, NY 11788. (516) 273-3100.

Dealer inquiries are welcome.

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IBM® is a registered trademark of the International Business Machines Corporation.

NetWare™ is a trademark of Novell, Inc.

ViaNet® is a registered trademark of ViaNetex, Inc.

For Professional Career Opportunities, contact our personnel department.

CIRCLe 129 ON READER SERVICE CARD
- 13 LANs

- If you want a lot of capability at a good price, you'll want to consider 10-NET.

Acknowledged that NETBIOS has a place in their product plans.

One of the products we reviewed, Fox Research's 10-NET, is not NETBIOS capable, as we went to press. The company has publicly demonstrated NETBIOS products in Europe, but they have not been released. If you want to use Fox Research's software products only on Fox Research's network interface cards, you won't care about NETBIOS capability. If, however, you want to introduce new capabilities (such as IRM/HALAN), NETBIOS is important to you.

Our bottom line on networking software selection? From what we have seen, if you want flexibility in network card and media selection, we advise that you stick with NetWare, 3+Share, or VINES. Making a choice based on the differences between them comes down to selecting the features you need. If you want a lot of capability at a good price, you'll want to consider 10-NET.

LESSONS LEARNED There you have it: our observations based on months of work and what we estimate to have been over 75 separate network installations. (We installed many networks three or four times because of hardware, personnel, testing, shipping, and operational reasons.)

Our experience shows us that the PC LAN industry has mature products that are reliable and easy to use and can be installed with reasonable care. Selecting one of these products for your own particular needs is now up to you—with some additional help from us in the accompanying sidebar, "LAN Selection Criteria."

Frank J. Derfler, Jr., is a contributing editor of PC Magazine.
INTRODUCING

PC Communications Software for Demanding Business Needs

RELAY Silver™ meets the very high standards that business communications require. It transfers any file, 100% error free. For a wide variety of users, with a wide variety of needs.

RELAY Silver™ is forged from the same metal as our critically acclaimed RELAY Gold®, the communications software that PC Magazine made Editor's Choice, saying "If you're looking to establish a corporate-wide standard for communications, look at RELAY Gold." (10/28/86)

RELAY Silver™ is the newest member of The RELAY Family.™ It can do every PC communications task Gold can. So, if you don't need support of 3270 emulation boards, protocol converters or RELAY mainframe software, RELAY Silver is the standard to choose. And RELAY Silver lists for only $150.

Here are a few more outstanding reasons to choose RELAY Silver:
• Menus and context-sensitive help screens make it easier for beginners to use.
• A powerful script language lets experienced users reduce complex file transfers to one step.
• Concurrent operation lets users run other software during transmission of long files.

Additional Advantages:
• Learn mode to record logon sequences.
• Tutorial diskette.
• Resident and unattended modes.
• RELAY bi-directional protocol plus XMODEM and KERMIT.
• TTY, TELEX, VT100 and VT52 terminal emulation.
• Support of IBM PC and compatibles.

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CIRCLE 131 ON READER SERVICE CARD
10-MHz COMPUTERS: HIGH SPEED, LOW RISK

Once a stratospheric speed rating, 10 MHz is becoming the minimum standard operating speed for AT-compatible computers. Here's a look at the first rush of racy products at this performance level.

Ten MHz sounds like a compelling figure: a nice, round number with its own kind of perfection in a world that prefers decimal notation. As a computer operating speed, however, 10 MHz at first appears to be little more than an orphan number, faster than the base level of compatibility but not fast enough to claim the status of ultrahigh performance.

In the face of the lower- and higher-performance competition, justifying a choice of a 10-MHz clock speed for an AT compatible seems difficult. The speed standard set by almighty IBM is currently 8 MHz, and when you break through its bonds in search of speed, the sky's the limit: 12- and 16-MHz AT compatibles and the first generation of 80386 machines typically running at 16 MHz. For a look at reviews of four 12- and 16-MHz machines, see "High-Speed ATs: Life in the Fast Lane" in the previous issue (PC Magazine, Volume 6 Number 7).

Soon, however, 10-MHz operation may need no justification. It may become the minimum level of performance to be expected from any AT compatible. Given a few more months and the fierce competition in the personal computer marketplace, 8 MHz may become the orphan speed, as 6 MHz has now become.

Already the only people who are not candidates to buy a 10-MHz AT compatible are those who are firmly committed to IBM beyond all hope of reprieve. As this is written, IBM seems to be the lone company reluctant to tread past the 8-MHz speed barrier. The seven new machines reviewed here and two we've looked at before all deign to dip to slower speeds, if at all, only for that rare, irascible software that resorts to system timing loops to befuddle you with copy protection. For these computers, 8 MHz—or worse, a super-compatible 6—is a degradation rather than an operating speed.

The higher base speed exacts no other penalties, not even from your wallet. All seven of these systems are less expensive than any official IBM computer with an
80286 microprocessor—even the latest IBM PC-XT Model 286, which drags along at a laggardly 6 MHz. The least expensive of the systems investigated here, from Computer Direct, costs little more than half of what the cheapest 8-MHz machines sold for just a year ago. That company, among others, doesn't even offer a slower (or cheaper) PC AT.

Power users may look down their noses at a mere 10 MHz when faster PCs are readily available. But PC ATs running at 12 MHz and higher still command a premium price. Some of them also suffer from hardware incompatibilities. Venture more than 10 MHz up the speed spectrum and signals, as well as components, become quirky and expensive. For instance, 10-MHz is about the upper limit that you (with luck) might squeeze out of an IBM PC AT sans its ROM-based speed governor. Twelve MHz is definitely over the line. Memory and support chips rated to run at 10 MHz are commonplace; faster varieties are exotic, more expensive, and sometimes only experimental (even though they may be used in some supposedly production machines).

**PERILS OF SPEED** Many ordinary add-on expansion boards won't work when speeds shoot past the 10-MHz boundary. Even high-performance disk controllers can tailspin into trouble. You can never be absolutely sure that a particular internal peripheral will work in a super-performance computer (unless, of course, the maker of the board guarantees that it will). Worse, a marginal component can fail at any time—usually just before you make that all-important save—and send your system and your sanity crashing.

Because the 12- and 16-MHz machines are sailing somewhat uncharted waters, rather than single out any of the four machines reviewed last issue as an Editor's Choice, we recommended “Proceed with Caution.” That's not the case with the 10-MHz machines reviewed here: the AST Premium/286, CD/286, Kaypro 286i, PC's Limited 286-10, and Proteus Tech-
Many ordinary add-on expansion boards won’t work when speeds shoot past the 10-MHz boundary.

Pro 386, avoid speed incompatibilities with hardware by operating their expansion buses at a lower speed than the advertised ratings at which part of their memory may operate. Slowing down a system for any reason steals some of the luster from the high-performance promise and makes a mere 10-MHz computer more competitive than you would think at first.

At compatibles that are both faster and slower than 10 MHz are likely to be available for a long time to come. But as these machines (reviewed in alphabetical order by company name) ably demonstrate, you need not settle for less—and you may not want to pay more. Also note that the list prices for the mail-order machines are the prices you’ll pay, while machines available through dealers (AST, Epson, Kaypro) can be had at a discount.

<table>
<thead>
<tr>
<th>Model</th>
<th>Company</th>
<th>Year</th>
<th>Clock speed (MHz)</th>
<th>Controller card handles</th>
<th>RAM</th>
<th>Floppy disk drives</th>
<th>Hard disk drives</th>
<th>Clock/calendar</th>
<th>Ports</th>
<th>Slot</th>
<th>Power supply (watts)</th>
<th>Reset key</th>
<th>Keyboard style</th>
<th>Warranty</th>
<th>BIOS manufacturer</th>
</tr>
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<tbody>
<tr>
<td>Accel 900</td>
<td>Multitech Electronics Inc.</td>
<td>1987</td>
<td>6, 10</td>
<td>2 hard, 2 floppy disk drives</td>
<td>512K</td>
<td>One 1.2-Mbyte</td>
<td>None</td>
<td>2 serial, 2 parallel</td>
<td>6</td>
<td>8</td>
<td>200</td>
<td>●</td>
<td>Original</td>
<td>1 year</td>
<td>Award Software</td>
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<tr>
<td>PC's Limited 286-10</td>
<td>PC's Limited</td>
<td>1987</td>
<td>6, 10</td>
<td>2 hard, 2 floppy disk drives</td>
<td>1 Mbyte</td>
<td>One 1.2-Mbyte</td>
<td>None</td>
<td>1 serial, 1 parallel</td>
<td>7</td>
<td>6</td>
<td>220</td>
<td></td>
<td>Original</td>
<td>1 year</td>
<td>Phoenix Software</td>
</tr>
<tr>
<td>AST Pramium/286</td>
<td>AST Research Inc.</td>
<td>1987</td>
<td>6, 8, 10</td>
<td>2 hard, 2 floppy disk drives</td>
<td>512K</td>
<td>One 1.2-Mbyte</td>
<td>None</td>
<td>1 serial, 1 parallel</td>
<td>9</td>
<td>6</td>
<td>200</td>
<td>●</td>
<td>Enhanced</td>
<td>1 year</td>
<td>1986 Seiko</td>
</tr>
<tr>
<td>Epson Equity III Plus</td>
<td>Epson America Inc.</td>
<td>1987</td>
<td>6, 8, 10</td>
<td>2 hard, 2 floppy disk drives</td>
<td>640K</td>
<td>One 1.2-Mbyte</td>
<td>None</td>
<td>1 serial, 1 parallel</td>
<td>9</td>
<td>6</td>
<td>200</td>
<td>●</td>
<td>Enhanced</td>
<td>1 year</td>
<td>Kaypro</td>
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<tr>
<td>Kaypro 286i</td>
<td>Kaypro Corp.</td>
<td>1987</td>
<td>6, 8, 10</td>
<td>2 hard, 2 floppy disk drives</td>
<td>640K</td>
<td>One 1.2-Mbyte</td>
<td>None</td>
<td>1 serial, 1 parallel</td>
<td>9</td>
<td>6</td>
<td>185</td>
<td>●</td>
<td>Original</td>
<td>1 year</td>
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</tr>
</tbody>
</table>

**BASE PRICE INCLUDES**
- RAM
- Floppy disk drives
- Hard disk drives
- Clock/calendar
- Ports
- Slots
- Power supply (watts)
- Reset key
- Keyboard style
- Warranty
- BIOS manufacturer

**SPECIFICATIONS**
- Clock speed (MHz)
- Controller card handles
- RAM
- Floppy disk drives
- Hard disk drives
- Clock/calendar
- Ports
- Slots
- Power supply (watts)
- Reset key
- Keyboard style
- Warranty
- BIOS manufacturer
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ORCHID'S TURBO FAMILY.

<table>
<thead>
<tr>
<th>Turbo</th>
<th>286</th>
<th>PCturbo</th>
<th>Jet 386</th>
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<td>Host Computer</td>
<td>PC, XT</td>
<td>PC, XT AT</td>
<td>AT</td>
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<td>8 x XT</td>
<td>3 x AT</td>
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<td>Accelerator Type</td>
<td>Replaces 8088, Coprocessor, Replaces 80286</td>
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<tr>
<td>CPU</td>
<td>8 MHz</td>
<td>12 MHz</td>
<td>16 MHz</td>
</tr>
<tr>
<td>RAM</td>
<td>512K</td>
<td>1 or 2 M, 64K Cache</td>
<td></td>
</tr>
</tbody>
</table>

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Orchid's accelerator cards give you the best compatibility in the industry. So you protect your existing investment, and extend your computer's useful life. While avoiding the headaches of learning a new system - not to mention the cost of buying one.

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TinyTurbo 286 gives you a high level of compatibility that lets you run software like Lotus and Windows at AT speed with EGA graphics, EMS memory, or networking cards. You can even go back to your PC's regular 8088 chip, which remains in the system, giving you 100% hardware compatibility.

ADD AWESOME PERFORMANCE: PCTurbo 286e.

The front runner today in the accelerator stock card race for power users is clearly the PCTurbo 286e. It revs up to 8 times faster than an XT or up to 2.5 times AT speed. Giving you - among other things - the world's fastest screen I/O. Plus the PCTurbo 286e comes factory equipped with 1 Megabyte of fast RAM, expandable to 2.

PCTurbo 286e is a powerful tool for developers and systems integrators. Through its advanced design, it lets you build minicomputer-like performance into standard PCs. With features like an optional 10-MHz 80287 math chip, and coprocessing software for concurrent foreground/background tasks.

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CIRCLE 306 ON READER SERVICE CARD
**AST RESEARCH INC.**

**AST Premium/286**

The IBM PC AT had a devastating effect on the expansion board industry because all the traditional PC hardware add-ons were built-in. Companies specializing in add-on accessories adopted various strategies to cope, the most successful of which was diversification. One result is the AST Premium/286, a product of the renowned memory board maker, AST Research.

The Premium/286 lives up to its name and looks like its part. The stylist responsible for it should take credit for the most elegant variation on the basic AT chassis. The white-beige plastic front bezel is cut by a wide swath of darker gray-beige that unifies the square indicator/control panel on the left with the disk drive bay on the right. Both the AST monitor (an EGA display with the evaluation unit) and keyboard are styled to match. The machine should complement any office, including the CEO’s.

Pull the lid forward and off, and things look even better. Workmanship is clearly top-notch.

The system is designed around the Chips and Technologies VLSI CHIPSet, and compatibility is assured with a BIOS written by Phoenix Software.

Run PC Labs benchmark tests, and the Premium/286 is even more impressive. The starting combination is good: an 80286 microprocessor running at 10 MHz with an extra socket for an optional 80287 numeric coprocessor.

The telling difference is the unusual memory arrangement of the Premium/286 that permits no-wait-state RAM access without the sacrifice of compatibility. At best, the system can retrieve bytes from RAM 43 percent faster than an 8-MHz PC AT can.

The system clock speed can be reduced to either 8 or 6 MHz by pressing a combination of keys. A front-panel indicator shows your choice — the system gives no other confirmation (such as a beep or on-screen message) that its speed has been changed. A keylock and a hardware reset switch also decorate the front panel.

No RAM is installed on the system board. Every byte is relegated to a special memory expansion card. The card is unusual in that it has three connectors: two for the standard AT 16-bit bus, plus an extra one at the opposite end of the board that allows the microprocessor to get at the RAM without going through the waste of time involved with normal bus control circuitry. The normal 16-bit bus remains completely AT compatible and allows the use of ordinary memory boards with one wait state.

One bank of 18 100-nanosecond 256K-bit DRAM (dynamic RAM) chips is soldered to the memory board, yielding a total of 512K bytes of memory. Three additional banks of sockets are available for adding extra chips in half-megabyte blocks. The evaluation unit had one of these banks filled.

The elegant look of the Premium/286 is subtly accented by the slightly reduced width of the chassis — it’s about 2 inches narrower than the IBM PC AT at 6½ by 19½ by 16½ inches (HWD). The inches were pared from the expansion board area, leaving room for only seven slots. Two use the 8-bit PC XT bus, and the remaining five match the 16-bit PC AT bus, with two of the latter also having zero-wait-state connectors.

In the standard configuration, one 8-bit slot is filled with a display adapter, one 16-bit slot is filled with a Western Digital WD1003-style combined floppy/hard disk controller, and one zero-wait-state slot is equipped with the proprietary memory board.

**NO SPACE WASTED**

No drive space was sacrificed to the chassis slim-down. Both a full-height internal disk drive bay and a right-hand bay that allows front-panel access to three half-height devices are supplied. Disk drives are mounted without rails by screwing them directly into place. But because a solid chassis panel covers the front of the internal disk drive bay, hard disks installed there must be lowered into place.

A high-density, 5¼-inch, 1.2-megabyte floppy disk comes as standard equipment in the top of the right-hand bay. The Premium/286 we evaluated came equipped with a high-performance 40-megabyte Micropolis hard disk in the internal bay. Models equipped with 60- or 70-megabyte hard disks are also available. A 200-watt Astec power supply fills the right rear corner of the chassis.

Both a parallel and a serial port are built.

---

**The AST Premium/286 has been named an Editor's Choice because of its winning price/performance combination. Inside the machine are seven expansion slots, a full-height drive bay, and three half-height bays. The EGA display is optional.**

---

**PC MAGAZINE • APRIL 28, 1987**
Crossing your fingers is great when you're telling your mother-in-law you'd love to have her visit for a month. But, you are pressing your luck when you run your computer system without backup protection.

Crossed fingers won't help when a crash wipes out your data and you have to spend hour after hour trying to retrieve what has been lost, recreate what has been forgotten or re-enter what is gone.

But, a Cipher 5400 tape backup system can offer dependable security for that important data. Designed for today's high capacity disks systems on the IBM PC XT, AT and compatibles, the Cipher 5400 is available as a stand alone, self powered unit offering 60 megabytes of fast backup and compatibility with such networks as Novell. The 5400 is completely read/write compatible with IBM's 6157 tape backup system. And, Cipher backs it with a two-year warranty and six-month warranty exchange program.*

Best of all, the Cipher 5400 frees your fingers for more important tasks, like signing contracts and shaking hands after a successful deal.

So, why not uncross your fingers and use one to dial 1-800-843-3751, Ext. 9; or within California, 1-800-722-0670, Ext. 9, for more information about the Cipher 5400 backup system.

* If your 5400 fails to operate within the first six months of use, Cipher will replace it. IBM PC XT, AT and IBM 6157 are trademarks of IBM Corporation. Cipher is a Registered Trademark of Cipher Data Products, Inc.
into the system board. The parallel port uses an IBM standard female DB-25 connector. The serial port uses a PC-XT-style male DB-25. A lithium battery pack, attached to the power supply with Velcro, powers the built-in clock and CMOS (complementary metal oxide semiconductor) configuration memory.

System setup is accomplished as with the IBM PC AT, using a special program on the AST diagnostic disk.

Accompanying the Premium/286 is a small shelf full of documentation, four IBM-sized binders filled with manuals covering MS-DOS 3.1, BASIC, system operation, utilities, and options. The books are clearly written and are suitable for a newcomer to computing. They lack attention to technical details, however, and give the most-experienced user little guidance as to the inner workings and intricacies of the machine.

One of the utilities supplied by AST is an expanded memory manager to make the bytes beyond DOS's 640K usable by programs written for the Lotus/Intel/Microsoft expanded memory specification. This driver slows down the system, however. In PC Labs testing, the memory manager retarded RAM access by about 20 percent, though still leaving it faster than that of most 10-MHz AT compatibles.

The keyboard supplied with the Premium/286 closely matches the IBM enhanced keyboard in every way but feel. Among its 101 keys are 12 top-row function keys, a separate cursor keypad, and a number of relocated and duplicated keys (such as Ctrl and Alt). The touch of each keypress is very good—springy with a positive over-center feel—but lacks audible feedback.

An AST EGA display was supplied with the Premium/286 we evaluated. This 13-inch monitor comes complete with a tilt/swivel pedestal, has a near-black background, and is antiglare treated. Images are sharp and bright, in every way equivalent to the matching IBM display, except that the monitor was decidedly unhappy about switching into 40-column display mode.

Overall, the AST Premium/286 rates as what may be the best-designed and built AT compatible on the market today. Others come only faster, not better.

**COMPUTER DIRECT**

**CD/286**

Computer Direct is a relatively new mail-order supplier of very low cost PC products, of which the CD/286 is the least-expensive AT compatible. Despite its 10-MHz, one-wait-state speed rating, the CD/286 logs in as one of the cheapest AT compatibles currently available. Its case and circuitry rank it as a true PC AT clone. Styling, layout, and expansion all match the IBM PC AT standard. The only readily apparent differences are its speedier performance, lack of ROM BASIC, and lighter-weight keyboard.

Of course, the CD/286 is based on the 80286 microprocessor and has a vacant socket for an 80287 numeric coprocessor. The 10-MHz speed can be reduced to 6 MHz with a keypress to accommodate finicky software (if such stuff still exists). You can make the big switch even within an application or a disk access. Most of the system support circuitry is contained in VLSI chips made by Chips and Technologies—the critical components stamped with a "10 MHz" label.

Four banks of nine sockets comprise up to 1 megabyte of parity-checked system board RAM memory. Only two banks are filled with 120-nanosecond 256K-bit chips in standard configuration. Memory expansion must take the form of 18 additional 256K-bit chips.

The full memory endowment can be split, with either 512K bytes consigned to DOS and 512K to extended memory, or a
### TAS-Books vs. Dac-Easy

<table>
<thead>
<tr>
<th>Feature</th>
<th>DAC</th>
<th>TAS-Books</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full price including Payroll, G/L, A/R, A/P, Sales order/Invoicing/P/O/Inventory &amp; Tutorial</td>
<td></td>
<td><strong>$99</strong></td>
</tr>
<tr>
<td>Written using 4th generation language</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Source code included/modifiable</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Easy-to-change file structures</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Report generator</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Multi-user option available</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>On-line help messages</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>3-yr. GL data by month</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>Create mail/merge files</td>
<td>NO</td>
<td>YES</td>
</tr>
</tbody>
</table>

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full 640K given over to DOS and 384K to extended. A single DIP-switch bank sets system options, including the memory split, size of ROM chips used, and the default display.

The BIOS, locked into a pair of 256K-bit ROM chips that are physically labeled with a 1986 DCC copyright, bears an internal imprint giving copyright to AMI with portions attributed to Computer Direct. The code exhibited no outward problems during testing and proved compatible with both DOS 3.2 and all the applications that we tried. As with all compatibles, the CD/286 lacks ROM BASIC and is not compatible with the BASICA included with DOS.

Eight expansion slots are arrayed on the system board. Two on the left use the PCXT-style 8-bit data bus, and the rest use a full 16-bit data bus. All are full length and full PC-AT height. Supplied as standard equipment, one 16-bit slot is filled with a combined floppy/hard disk controller. No other expansion options are offered.

At the right rear inside the chassis is the chrome-plated metal box of an Astec power supply rated at 200 watts. For mass storage, provision is made for adding a full-height internal disk drive bay and three half-height bays on the right, two of which can be accessed through the front panel.

All disk drives are mounted using hardware identical to that favored by IBM: slide-in mounting rails held in place by small brackets at the front, which means that most after-market products should just slide into place.

Computer Direct supplies a high-density, 1.2-megabyte floppy disk drive as standard equipment. The evaluation unit was equipped with a half-height Lapine 20-megabyte hard disk in the internal disk drive bay.

**LACKS ATTENTION TO DETAIL.** The mechanical workmanship of the CD/286 can best be described as adequate because it shows a definite lack of attention to detail. For instance, inside the evaluation unit, rear-panel cutouts, which allow the installation of two extra DB-9 and three DB-25 port connectors without wasting expansion slots, were covered with a roughly cut piece of sheet steel.

The case and retaining brackets of this machine were secured with what must be cut-rate hexagonal-headed screws—the slots were cut too shallow to give an average screwdriver a good grip. Worse, the screws must have been twisted into place by Rambo’s weight-trainer wielding an impact wrench. You’ll be likely to need a quarter-inch nut driver (as we did) to remove these screws when adding expansion cards.

The setup program for the CD/286 is encoded in ROM firmware and can be called up at any time by pressing Ctrl-Alt-Enter. With the simple menu system, you can configure the hardware options of the CD/286, park the heads of the hard disk, or defeat the parity-checking of memory. If you enter the program from within an application, however, the return is far from elegant, with the screen turning into a confusion of old and new text. Then again, you’ll want to execute few of the setup routines while within 1-2-3.

Neither monitor nor adapter is supplied with the base model CD/286. The evaluation system, one of several turnkey packages offered by Computer Direct, was equipped with a dual-mode color-and-monochrome/graphics board (Hercules compatible) with a built-in printer port.

On its bottom, the Computer Direct keyboard was labeled as made by Maxi-Switch. On top, the key layout conformed precisely to the 84 keys of the original AT with ten left-hand function keys, enlarged Enter and Shift keys, and shift-state indicators at the upper right. The keyboard is lightweight and its touch is better than average, with a nice snap-over action but little audible feedback.

Perhaps the most surprising—and thought-provoking—aspect of the CD/286 is the similarity of its system board to that of the PC’s Limited 286-10. They appear identical, right down to the silk-screened copyright message that Computer Direct hides under a tab of metal foil emblazoned “Warranty Void If Removed.” Further, both computers bear exactly the same FCC Class B certification number.

The CD/286 may find its best application as a foundation on which computer tinkerers can build the systems of their dreams at the lowest possible cost. One caveat, however. The Lapine hard disk that came with the evaluation unit ran with BIOS errors, and we could not obtain a replacement disk from Computer Direct. The company says it is working on new technologies, so the future availability of this model is uncertain.

**KAYPRO CORP.**

**Kaypro 286i**

Back when CP/M was king of the operating systems for small-business computers (remember CP/M?), Kaypro Corp. moved into the computer business with an affordable portable computer packaged with a wealth of software. While the biggest competitor from those bygone days, Osborne, has fallen by the wayside, Kaypro...
has plodded steadily along. The Kaypro 286i is the company’s latest creation. The Kaypro 286i Model C, which we received for review, packs a plethora of programs into one affordable package, just like earlier Kaypro models. The basic system, designated Model A, is physically identical except for hardware and software options.

As you’d expect, the microprocessor of choice in the 286i is an 80286, operating at 10 MHz with one wait state. Unlike most other fast systems, the 286i can’t be slowed and always runs at its lickety-split speed. However, you can speed up some of the software you run on it by adding an 80287 numeric coprocessor to an empty socket on the system board.

Standard memory in both 286i models is 640K spread among four banks of nine socketed 256K-bit DRAM (dynamic RAM) chips, a mixture of 100- and 80-nanosecond versions in the evaluation machine. The excess memory beyond the DOS limit is apparently unused and unavailable.

Styling on the 286i system unit is similar to the IBM PC AT’s—the case and its layout match, but details and colors don’t. The front panel is a greenish-beige, its ventilation slots are bent and skewed, disk drives are finished in basic black, and the cutout for the right-hand disk drive bay spans three half-height units. Otherwise, the face is familiar and includes a small left-hand control panel with cylindrical keylock, drive activity, and power indicators. On the rear panel, three cutouts for DB-25 connectors are available but blocked off with screwed-on panels.

The system board itself is made in the U.S.A. by Kaypro and is based primarily on discrete components. The BIOS also bears a Kaypro copyright and proved compatible with DOS 3.2 and all IBM applications that we tried. Two extra sockets are available for adding your own firmware.

Eight full PC AT-height expansion slots are supplied—two 8-bit slots, and the rest using the entire 16-bit PC AT bus. In Model C configuration, one 8-bit slot is filled with a Kaypro-made parallel-and-serial adapter card. As with the IBM PC AT, the parallel port uses a female DB-25 connector and the serial port a male DB-9. In both 286i models, one 16-bit slot is occupied by a Western Digital WD1003 combined floppy/hard disk controller.

Standard equipment includes a single 5¼-inch, high-density (1.2-megabyte) floppy disk drive. The Model C adds a Seagate ST-4038 30-megabyte high-performance hard disk.

System configuration information, which is set with a utility program run from the DOS prompt, is stored in a 64K-byte block of static CMOS (complementary metal oxide semiconductor) RAM. This memory and the system clock are kept alive when the machine is off by a small lithium battery that is attached inside the rear panel of the chassis by Velcro.

**EXCELLENT SOFTWARE** The big bonus with the Model C is its software endowment. It features a very good, if aged, word processor—venerable WordStar—as well as its companion programs, MailMerge, CorrectStar, and Star Index. The software complement is completed with Mite, a communications package; PolyWindows Desk Plus; GW-BASIC; and MS-DOS 3.2. Only the last two are included with the Model A.

The only substandard item supplied with the 286i is the keyboard. Made in Taiwan by BTC, it conforms to the original PC AT 84-key layout. Its touch is its own, however, with a linear feel that gives neither tactile nor audible feedback. At best, it rates as acceptable for everyday use—letters at least appear on the screen when you press the keys.

If you’re looking for unchangeable fast speed and an assortment of fine software programs at a reasonable price, the Kaypro 286i is an appropriate choice.
Benchmark Tests:
10-MHz AT Compatibles

The NOP test shows the true measure of comparative processor speed among the 10-MHz machines. As expected, all run a good 20 percent faster than the 8-MHz IBM PC AT. Both the Proteus Technology 286 Standard and the AST Premium/286 edge out the other contenders in the 8086 Instruction Mix, Conventional Memory, and Floating-Point Calculation tests because of their zero-wait-state RAM enhancements. The AST Premium/286 uses a unique memory configuration to gain top honors in RAM-access time.

Performance Times
(Times given in seconds except where noted)

<table>
<thead>
<tr>
<th>Product</th>
<th>NOP</th>
<th>8086 Instruction Mix</th>
<th>Conventional Memory</th>
<th>Floating-Point Calculation</th>
<th>BIOS Disk Seek (milliseconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM PC AT (8 MHz)</td>
<td>4.20</td>
<td>9.00</td>
<td>1.30</td>
<td>36.00</td>
<td>37.00</td>
</tr>
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<td>Accel 900</td>
<td>3.35</td>
<td>7.25</td>
<td>1.02</td>
<td>28.01</td>
<td>34.48</td>
</tr>
<tr>
<td>CD/286</td>
<td>3.35</td>
<td>7.20</td>
<td>1.02</td>
<td>28.01</td>
<td>N/A</td>
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<td>1.02</td>
<td>28.01</td>
<td>37.34</td>
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<tr>
<td>ALR PC2E/10 MHz</td>
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<td>7.17</td>
<td>1.02</td>
<td>27.96</td>
<td>38.92</td>
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<tr>
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<td>7.17</td>
<td>1.02</td>
<td>28.01</td>
<td>30.20</td>
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<tr>
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<td>1.02</td>
<td>28.01</td>
<td>32.46</td>
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<td>Keypro 286i</td>
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<td>AST Premium/286</td>
<td>3.35</td>
<td>5.69</td>
<td>0.74</td>
<td>22.41</td>
<td>30.14</td>
</tr>
</tbody>
</table>

N/A—Not applicable: tested machine unable to run BIOS Disk Seek test without errors.

The NOP benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The 8086 Instruction Mix benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 8086 instruction code. These instructions are a subset of the total processor instruction set.

The Conventional Memory benchmark test allocates 256K bytes of conventional memory and treats it as a series of 64-byte records. Then 16,384 random records are read into and written from the memory. The result shown is the average of the read and write times.

The Floating-Point Calculation benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The BIOS Disk Seek benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.
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PC's Limited
PC's Limited 286-10

While IBM's line of 80286-based computers tops out at 8 MHz, that's where the product line of PC's Limited begins. The PC's Limited 286-10 fits in the middle of that Austin, Texas-based computer manufacturer's AT-compatible line, filling whatever niche there might be for people who want better-than-IBM performance but don't want to go all the way to a 12- or 16-MHz machine.

As with all AT compatibles, the 286-10 is based on Intel's 80286 microprocessor. Although its top speed is set by firmware to 10 MHz with one wait state to accommodate common memory chips, you can also slow the 286-10 by a keypress to 6 MHz. You can make the switch any time after booting up, even within applications or during disk access.

An empty socket is available for an 80287 math coprocessor.

Standard memory in the 286-10 consists of 1 megabyte in four fully socketed parity-checked banks of nine 120-nanosecond 256K-bit DRAM (dynamic RAM) chips. The system supports two memory configurations that are DIP-switch selectable: 512K bytes consigned to DOS and 512K to extended memory, or a full 640K for DOS and 384K for extended.

The system board is designed around the Chips and Technologies VLSI CHIPSET, and the BIOS, locked into a pair of 256K-bit ROM chips, bears a copyright shared by PC's Limited and AMI. In PC Labs tests, it demonstrated no bad habits and proved itself capable of running DOS 3.2. Neither an operating system nor BASIC is included with the machine, and no vacant ROM sockets are available.

The expansion area of the 286-10 matches the current industry norm, eight full-length slots: two of which use the PC-XT-style 8-bit data bus, and six the PC AT-style 16-bit bus. All are tall enough to accommodate PC AT-height boards except the leftmost 8-bit slot, which has a chassis-stiffening bar above it. This height limitation should not be a problem if this slot is used for a display adapter, as it was in the evaluation sample.

The rightmost 16-bit expansion slot was filled with a standard-equipment Western Digital WD1003-style combined floppy/hard disk controller. All other slots were vacant.

Electricity for the whole system is produced by a 220-watt power supply made in California by Tri-Mag.

The styling of the PC's Limited 286-10 most resembles that of a truncated PC AT: it's squared off, colored a pale two-tone gray beige, and has numerous vertical ventilation slots in the front panel. Near the upper left of the machine is a monitor panel adorned with a system keylock plus power and disk activity indicators.

**SMALL FOOTPRINT**  The 286-10 achieves its small footprint—6½ by 18½ by 16½ inches (HWD)—primarily by chopping out the space normally assigned to the PC AT's internal hard disk drive bay. The remaining right-hand disk drive bay provides space for three half-height devices, with only the top two having front-panel access.

The standard disk drive in the 286-10 is a high-density (1.2-megabyte) 5½-inch floppy disk drive. The evaluation machine was also equipped with an optional high-performance full-height 40-megabyte Micropolis hard disk, for which PC's Limited supplies a driver that makes the area beyond the DOS 32-megabyte limit accessible as a virtual second drive.

The disk devices mount with guide rails identical to those used in the Compaq Deskpro 286—slightly larger than those of the IBM PC AT—and are secured by the simple but effective scheme of driving screws through the side of the disk drive bay and into the rail.

PC's Limited augments the modest IBM arrangement with two additional displays that make its machines stand out

---

**FACT FILE**

**PC's Limited 286-10**

**PC's Limited**

1611 Highway Circle, Bldg. 3
Austin, TX 78754
(800) 426-5150
(512) 339-6800

**List Price:** With 1 Mbyte RAM, one 1.2-Mbyte floppy disk drive, $2,295.

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MORE 10-MHz MACHINES: COMPLETING THE PICTURE
Four other computers with top operating speeds of 10 MHz have come under scrutiny by author Winn L. Rosch. Here are short summaries of his views of those machines.

ADVANCED LOGIC RESEARCH INC.
ALR PC2E/10 MHz
Advanced Logic Research's 80286-based PC-XT compatible, the ALR PC2E/10 MHz (first reviewed in "The In-Between Machines: 80286-Based XT Compatibles, PC Magazine, Volume 6 Number 4), was named an Editor's Choice at that time for its excellent performance.

Although it is exactly the same size as a PC-XT, the PC2E/10 MHz looks much like a miniature PC AT and performs like one. At top speed the machine will beat IBM's best by up to 30 percent.

Inside, two side-by-side full-height disk drive bays are available. Only the right one is divided in half and open to the outside. The left bay is designed solely for full-height hard disks or a single half-height device.

Power users will appreciate the 1 megabyte of RAM factory-installed on the board. Laid out like the original AT keyboard, its feel and workmanship are not up to par. The computer deserves better.

At $2,995, with display and hard disk, the PC2E/10 MHz is a bargain, especially when you consider its speedy performance. This coincidence of low price and high performance makes this computer worth a look.

EPSON AMERICA INC.
Epson Equity III Plus
Epson America's totally redesigned Equity III Plus (first reviewed in "Epson Does It Again," PC Magazine, Volume 6 Number 4) generates true excitement with 10-MHz performance at a bargain price of $2,695. Add another $1,200 and you get an enhanced model with a high-performance hard disk that leaves IBM in the dust.

The system unit contains Epson-developed VLSI circuitry and a novel board layout that leaves room for five half-height devices, three of them accessible from the outside.

Nine expansion connectors are included: three with the PC-XT-style 8-bit bus and six with the full 16-bit PC AT bus. All of the slots run the full length of the chassis.

The Equity III Plus microprocessor operates at either 6, 8, or 10 MHz with one wait state. Even though it isn't the fastest AT compatible on the market, it can outperform the IBM PC AT by a respectable 25 percent.

Standard equipment includes a single high-density floppy disk drive and a 101-key keyboard that closely matches the new IBM Enhanced Keyboard layout.

Overall, the Equity III Plus is a trend-setting and competitive computer with an excellent future. It contains all the ingredients of Epson's formula for success.

MULTITECH ELECTRONICS INC.
Accel 900
Multitech Electronics' Accel 900 (first reviewed in "AT Alternatives: Extra Features and Cheaper, Too," PC Magazine, Volume 6 Number 3) is a solid machine that is functionally equivalent to the IBM PC AT, with a laundry list of extra features. It has the same standard con-
configuration as many of the other AT compatibles reviewed here: 512K bytes of RAM, combination floppy/hard disk controller card, keyboard, and 1.2-megabyte floppy disk drive. It also includes a high-resolution monochrome monitor, MS-DOS 3.2, and PC-Write, a popular word processing program.

Inside the Accel 900 is a conventional layout that includes eight expansion slots (two 16-bit and six 8-bit), one full-height drive bay in the center, and three half-height bays stacked on the right, arranged exactly like the IBM PC AT.

The design of the 97-key keyboard falls between the new AT style and the old PC-XT style, with function keys on the left and separate cursor control keys.

The Accel 900 is a fine machine overall. It can be a good investment in desktop data processing for an individual or a whole department.

PC DESIGNS INC.
PC Designs ET-286i

The PC Designs ET-286i (first reviewed in "AT Alternatives: Extra Features and Cheaper, Too," PC Magazine, Volume 6 Number 3) appears strikingly similar to the IBM PC AT. Standard equipment includes 512K bytes of RAM, a PC AT-style keyboard, and a 1.2-megabyte floppy disk drive. At $3,145 for a configuration that includes a Princeton Graphics Max-12 monochrome monitor and a 30-megabyte hard disk, the ET-286i holds its own in the cost competition.

The ET-286i's most interesting feature is the unique configuration of memory chip sockets. Dynamic RAMs. This type of motherboard allows up to 4 megabytes of RAM for Xenix, UNIX, and other multiuser operating systems. You can toggle the 10-MHz clock speed down to 8 or 6 MHz by hitting Ctrl-Shift-Alt-Del.

Two 16-bit and six 8-bit expansion slots fill the chassis, and all of them are full AT height. A wealth of ports, two parallel and three serial, are also standard. A wide variety of hard disk storage options are available, including high-performance disks from Core.

The ET-286i outperforms the IBM PC AT and comes with a moderate package price tag. Although it could use a little more attention to detail, it remains a likable and hardworking system.
from all the competition (including IBM). Called SmartVU, the extra indicators include a four-segment alphanumeric display and a set of LED chaser lights. The alphanumeric display gives an amazingly accurate readout of diagnostics during power-up, duplicating the monitor display. The LED lights monitor system interrupts.

As is increasingly becoming the practice in the AT-compatibles industry, the setup program for the 286-10 is built into its ROM firmware. The various routines—which include hard disk head parking, defeating memory parity checking, and switching off the scanning red lights of the SmartVU panel in addition to normal setup—can be activated within most applications by pressing the Ctrl, Alt, and Enter keys simultaneously.

A display and adapter are not included in the 286-10 standard configuration. The evaluation unit was equipped with a PC's Limited EGAAd! board, an enhanced graphics adapter.

The keyboard that came with the 286-10 was manufactured by Maxi-Switch and conformed exactly to the original PC AT keyboard layout. Ten function keys were arrayed on the left; the Shift and Enter keys were appropriately enlarged; and indicators were provided above the combined numeric/cursor keypad at the right side. The touch proved very good, with a positive over-center feel but little audible feedback. While it weighed substantially less than the IBM keyboard (what doesn’t?), typing on it was pleasant.

**SUPPLIES LIMITED** Time may be running out for the 286-10, however. PC's Limited, which makes 8-, 10-, 12-, and (in ultra-limited quantities) 16-MHz AT compatibles, appears to be phasing out (or at least down) the 10-MHz 286-10 and pushing the 286-12. If you want less speed, it will cost you more. A sales representative at PC's Limited explained that while several package deals that include a monitor and hard disk are available for the firm's 8- and 12-MHz computers, the 286-10 will cost over $3,800. However, an equally equipped 286-12 (which can be throttled back to 6 MHz if compatibility requires) will cost only $3,595.

Nevertheless, the PC's Limited 286-10 proved to be an affordable and compact AT alternative, well made and essentially quirky-free. The SmartVU will help you tell a crashed computer from a program that works in mysterious ways, and it should alleviate most of your fears of mail-order support. While PC's Limited customers had rocky experiences a year or two ago, the company has done a lot of growing up.

**PROTEUS TECHNOLOGY CORP.**

**Proteus Technology 286 Standard**

Custom-made to your order is how Proteus Technology Corp. offers its products. Call the company and tell it the options you want, and its staff will assemble a computer to match, burn in the complete system (not just the system board), and send it to you with a 30-day money-back guarantee, 15-month warranty, and 60 days of free on-site service through Computer Maintenance Corp.

The starting point for all its systems, including the Proteus Technology 286 Standard, is an Applied Computer Solutions (ACS) system board equipped with an 80286 microprocessor running either at 10 MHz with one wait state, or at 6 or 8 MHz with none. For $200 extra, a stepped-up model, the 286-10-0, will add zero wait state performance at 10 MHz.

Unlike most AT compatibles, the ACS board is crammed with discrete components instead of just a handful of VLSI chips. A socket is available for installing an optional 80287 math coprocessor. The evaluation system had a 10-MHz 80287 with a small printed circuit board of high-speed support.

One megabyte of RAM is contained on the system board in four banks of nine 100-nanosecond 256K-bit memory chips. All of the chips are socketed in oversize sockets that will accommodate megabit memory chips (when they become widely available) to push system board memory capacity up to 4 megabytes. Even more RAM, up to 16 megabytes, can be added with expansion boards.

Also built into the system board are three serial and two parallel ports. The serial ports use PC-XT-style male DB-25 connectors installed in the back panel to conserve expansion slots. The parallel ports are equipped with IBM-standard te-
**Monographics Systems**

All monographics systems include a high-resolution monochrome graphics adapter board and a twelve-inch amber monochrome monitor.

<table>
<thead>
<tr>
<th>Config</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>With 20MB Seagate</td>
<td>$1535</td>
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<td>With 30MB Seagate</td>
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<td>fixed disk drive, 40ms access time</td>
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<tr>
<td>With 42MB MiniScribe</td>
<td>$1895</td>
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</tr>
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<td>With 70MB MiniScribe</td>
<td>$2135</td>
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<tr>
<td>fixed disk drive, 28ms access time</td>
<td></td>
</tr>
</tbody>
</table>

**EGA Systems**

All EGA systems include an enhanced graphics adapter video card and a fourteen inch high-resolution EGA color monitor.

<table>
<thead>
<tr>
<th>Config</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>With 20MB Seagate</td>
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<td>With 30MB Seagate</td>
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<td>With 70MB MiniScribe</td>
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<tr>
<td>fixed disk drive, 28ms access time</td>
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</tbody>
</table>

**Memory and Math Coprocessors**

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- 256K Chips (120ns) . . . $35
- Intel 80287-8 math coprocessor . . . $269

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male DB-25 connectors installed in two expansion-card retaining brackets. The three serial ports are configured as COM1, COM2, and COM3, the last of which is not supported by DOS or most PC software. All ports are plainly labeled with their DOS designations on the rear panel of the 286 Standard.

The ACS system board includes connectors for eight expansion slots, two of which use the PCXT-style 8-bit data bus, and the rest use the full 16-bit bus of the PC AT. One of the (electrically) wider slots is devoted to a combined floppy/hard disk controller on a 5-inch-long short card made in Japan by National Computer. In typical 286 Standard configurations, one of the 8-bit slots will be given over to a display adapter board.

The chassis is a close match to that of the IBM PC AT. Color and styling are nearly identical, including the small control panel in the upper left that has a system lock as well as disk activity and power indicators.

As with the standard PC AT design, two disk expansion areas are available to the user: an internal full-height disk drive bay and a bay on the right with room for three half-height devices, giving front-panel access to the top two.

Standard equipment in the 286 Standard includes a 5¼-inch, high-density (1.2-megabyte) floppy disk drive in the top slot and a 3½-inch, double-sided, double-density (360K-byte) disk drive underneath. Several hard disk options are available. The evaluation system was equipped with a Seagate ST-4038 30-megabyte full-height disk drive that proved to be a good match for the overall performance of the system.

The power supply, located at right rear is an Astec 200-watt model.

As with most AT compatibles, system configuration information is stored in CMOS (complementary metal oxide semiconductor) memory. This tiny block of memory and the built-in time-of-day clock are kept fresh by a lithium battery that is attached inside the rear panel of the 286 Standard by a Velcro pad.

Configuring the 286 Standard requires running a setup program that is contained in the BIOS firmware (which bears a Proteus copyright on the chip). The setup program can be started at any time after boot up by pressing a combination of four keys.

Underneath the Proteus label of the keyboard accompanying the 286 Standard is the name Quimax. Its 84 keys are laid out in the same pattern as that of the original IBM PC AT keyboard, although its styling is a bit more square. Its touch is positive but linear and lacks both tactile and audible feedback. It's satisfactory but not outstanding for typing upon.

The Proteus documentation appears aimed at the beginner. It starts with computer fundamentals and is clearly written, but lacks the depth of technical detail a more demanding user may want.
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If you measure your backup needs in terms of 10-megabyte files and hard disks that harbor 1,500 subdirectories, you're sure to go for one of the large-scale backup utilities that Winn L. Rosch reviews in this issue. But if you need to handle those nagging little backup chores so that you'll never find yourself in a debilitating my-data-disappeared-funk—you'll cheer the simplicity and ease of use of *PC Magazine*’s own BAC.COM. BAC.COM, a backup program by contributing editor John Dickinson, does the job for simple backup tasks, improving on the slow, flawed DOS BACKUP program. Taking a cue from one alternative to BACKUP, DOS's COPY command, BAC.COM keeps your backed-up files DOS-readable and supports the * and ? DOS wildcard characters. Getting COPY one better, it lets you easily continue the backup on a new floppy disk when your target disk is full. Plus BAC.COM sidesteps another COPY drawback: it won't make the mistake of overwriting a file that has a more recent time/date stamp with an older version.

In a word, BAC.COM is super—and it's free. You can download the handy program by modem from the *PC Magazine* Interactive Reader Service. It's also included with *The PC Utilities*, Volume 1, available from PC Labs. —Craig L. Stark

**CUTTING TOO DEEP**

These time-saving techniques can be very effective; in some cases they cut backup time by a factor of 20. Reliability is another matter, however. In the all-out effort to shave backup seconds, some programs forgo the safeguards that help maintain disk integrity.

The most unexpected result in testing this software was the peril in which some of the programs may leave your data. Several of these backup systems had difficulty restoring from floppy disks data that had been written only minutes before.

Of particular interest was the manner in which various programs dealt with disk errors. A few gave no warning that something might be wrong with a disk—even when the program formatted the disk during the backup process—and proceeded to use all sectors, bad or not. Better programs detected such errors during the backup and rejected the defective disks. The best detected the errors, marked the bad sectors, and continued without a hitch—albeit with less capacity on the defective disk. The same was true during the restoration process. When some programs detected disk errors, they called a halt to the restoration, leaving no way to salvage anything from the bad session. On the other hand, the best of the lot, Core International's Corefast, could detect and correct such errors, restoring everything perfectly even from a disk gone bad.

**BIGFILE AND SCATTER**

The test setup was relatively simple. We used an 8-MHz AT compatible with a standard 20-megabyte AT-style hard disk drive manufactured by Computer Memories Inc. (a particularly apt test bed given the CMI disk’s propensity to die in early PC ATs). The hard disk’s rated average access time is 40 milliseconds; this particular unit clocked at 43.3 milliseconds. To back up the hard disk, we used a 1.2-megabyte floppy disk drive. A Western Digital WD10002 combined hard and floppy disk controller governed both disk drives. Before the backup session was started, we formatted our floppy disks, using either DOS or the format utility included with the particular backup system. The results thus reflect the fastest backup possible with each system.

Testing involved backing up two different hard disk environments: Bigfile, consisting of one file exactly 10 million bytes long; and Scatter, a hierarchy of 1,578 subdirectories, each filled with two files 2,048 bytes long. The former is an extreme case of a system based on a few large...
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files; the latter, a system made up of many small files and subdirectories. Results in actual systems should fall between the results for these two.

Note that the results obtained will not reflect the backup times to be expected from a PC system, because of the higher processing speed of the AT, the faster data transfer rate of its floppy disk drives, and the wider, 16-bit data channel connecting the AT disk controller to the host system.

The rank-order relationship among the various programs’ performances should be the same, however, because the speedup techniques are equally effective for both systems.

Backup times will also vary depending on the number of disk buffers specified in the host system’s CONFIG.SYS file. For instance, with BUFFERS=2, Fastback required more than 88 minutes to back up Scatter; with BUFFERS=20, it needed about 6 minutes. For the sake of fairness, we tested all programs with BUFFERS=20, even if their automatic installation routines set a different figure (they varied from 16 to 40). (If you do not have a buffers statement in your CONFIG.SYS file, your system will default to either 2 or 3 buffers, depending upon the computer and version of DOS you are using.)

One variable could not be controlled—the time required to swap floppy disks. However, the same person (me) conducted all tests from the same chair in the same relationship to the disk drive, always having a sufficient stack of floppy disks waiting. I timed several dozen disk changes and found the time for each to be within 1 second of 5 seconds. Thus, the variance in the time required for disk changes amounted to less than 1 percent of the total backup time.

The following reviews are in alphabetical order by product name.

**Backup Master**
Underlying the design of Intersecting Concepts’ Backup Master is the philosophy that you’ll make more backups if they are less boring and time-consuming. The $89.95 program seems designed for the utmost in backup speed and succeeds amazingly at meeting its aim. In addition to a DOS-compatible backup mode, it features a high-speed mode that’s claimed to cut backup time by a third, using, among other acceleration techniques, a proprietary disk format.

In our tests, however, the high-speed mode sacrificed something more important—reliability. We couldn’t successfully restore any high-speed backup of the Bigfile environment, even after three different backup sessions. Each of these backups re-
warded us with a stack of floppy disks that was purportedly security against the worst, yet even when we immediately tried to restore Bigfile, the program reported data errors and halted the restoration. The same disks had worked when testing other backup programs. Moreover, the errors appeared on different disks with each unsuccessful backup restoration cycle.

Intersecting Concepts president Mark Graybill says that the high-speed restoration problem could have been the result of working on a non-IBM AT clone (although currently more than half of all computers sold are non-IBM machines). He also said that Version 2 of Backup Master will be released soon and may resolve some of the problems.

High-speed restoration problems aside, however, Backup Master is a friendly and convenient program with both menu-driven and command-based options. Choose the menus, and after you start the program you'll need only to select among the many choices on the screen to make a backup. Odds are you won't even need to glance at the context-sensitive help system. A special setup menu allows you to configure the defaults so you don't have to wander through the whole menu system each time you run the program. Or another program option records each keystroke that you make. Later, you can use that recording to make backups automatically from the DOS prompt or from a batch file command.

You can select any or all files to be included or excluded from your backup, Furthermore, Backup Master gives you unusual control over DOS's file archive bit. You can use the bit to pick files to back up or not, then reset it or leave it alone when you're done.

When using the DOS-compatible mode, you'll need a stack of preformatted double-density or high-density floppy disks. In high-speed mode, Backup Master will either add its own special format on the fly, which imposes a substantial speed penalty, or reuse disks that have previously been formatted on the fly. The program offers no option for preformatting floppy disks.

For restorations, Backup Master gives you a similar plethora of options, including date-stamp-keyed overwriting of existing files. As with nearly all backup programs, it will completely re-create your original disk directory structure or merely restore a single file. A backup directory, the last file on the last backup disk, helps you find individual files for restoration.

Corefast
Originally designed as the operating software for a high-speed tape backup system, Corefast was adapted by its manufacturer, hard disk system integrator Core International, to make a full-featured backup system that can use any standard DOS device, including floppy disks. The winning result is a $149 program with an unbeatable combination of virtues: speed, versatility, and reliability.

Not only is Corefast much quicker than DOS, it offers more backup modes than any other package reviewed here. Floppy-disk-based backups can be made at either of two speeds: a slower, DOS-compatible mode that uses normally formatted (and readable) disks and a higher-speed mode that ups capacity modestly and kicks in much quicker performance. The high-speed mode requires specially formatted disks, however—and although you can format them on the fly, this increases backup time to nearly that of the DOS mode. A utility function allows preformatting disks for high-speed backups. And unlike other utility programs (such as Pdisk, examined here) that reject an entire disk when an error is encountered in formatting, Corefast merely marks bad sectors in the manner of DOS's FORMAT command.

Like earlier Core International backup software, Corefast permits both file-by-file and disk image backups. And in addition to standard file-by-file restorations (image restoration can be made only to disk partitions identical in size to the original), the program allows file-by-file restorations of image backups (limited, however, to 250 files per restoration session).

Corefast can be run in either command- or menu-driven mode. The latter relies heavily on function keys to select operating parameters and gives context-sensitive help at the press of F1. The control hierarchy here, which often requires an elaborate string of function-key presses, is probably the program's weakest link. It is at its worst when preformatting disks for high-speed use. Instead of allowing you to encode a whole stack of disks at once, it drops you back to the main menu after each disk and again makes you pick your way to the format function. Of course, the menu-driven mode almost eliminates the need to glance at the unusually understandable documentation. Still, power users and other impatient people will probably prefer the command-driven mode.

Both modes provide all of the various DOS backup options. You can select files for backing up by date, with the choice of before or after the given date, or by archive bit (which denotes whether the file has been changed since the last backup). Sub-
directories can be searched at your option. A cataloging feature allows you to specify groups of files to be backed up (or restored) automatically.

An additional utility puts your system in a waiting mode to make backups at an appointed time. Because the wait program runs in the foreground, you cannot use your PC while it's biding its time. This feature is useful primarily for backing up to a nonfloppy device, such as a tape drive or another hard disk.

The Corefast system's reliability is enhanced by an optional error-correcting protocol and a verification procedure that ensure backup integrity. The former seemed to impose no penalty on performance and proved quite effective. When disk errors cropped up during a restoration, the program flagged them on-screen and, commendably, corrected them. The completed restoration was entirely error-free.

While not the fastest backup program tested in this batch, Corefast did make the quickest restorable backup, using its non-DOS high-speed mode. It also handled the Scatter directory hierarchy in both its image and file-by-file modes, although the latter required nearly twice as much time as did the quickest program (Backup Master). The price may seem high for a backup utility, but Corefast earns its tag with features and reliability.

DSBackup Plus
DSBackup Plus is Design Software's attempt to improve on the standard DOS utilities. The program operates somewhat faster than DOS (although hardly three times as fast, as the manufacturer claims), will make backups on any DOS device, lets you squeeze files along the way if you desire, and costs $79.95. When making backups to floppy disks, the program estimates the number of floppy disks you'll need before you start. Should you not have enough formatted disks on hand, you can format as many more as you need without leaving the program.

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DSBackup Plus operates either as command driven (from the DOS prompt or in batch files) or as menu driven. You get all the expected file handling options, including subdirectory searches (with or without prompting for each directory) and file selection by archive bit. The program can generate a hard-copy report of the entire backup session. It also offers on-line help.

During testing, however, DSBackup Plus proved quirky and unreliable. For instance, as soon as we selected the subdirectory search option, the program started digging into the source disk to determine how much backup space it would need. With the Scatter environment on disk, the hunt lasted more than 2 minutes before the error message “Sorry, Maximum Number of Files Exceeded” popped on the screen. The documentation makes no mention of a file or subdirectory maximum.

Furthermore, the Restore option was hardly trouble-free. Immediately after making an ordinary backup of Bigfile, we attempted to restore the file. When a disk error came up on the second floppy disk, DSBackup Plus canceled the entire session. Had we been trying to restore our only copy of important files, we would have been sunk. Worse, the program left about a megabyte’s worth of hard disk sectors marked as in use but unattached to a file; they had to be cleared with CHKDSK. Although the program does provide a verify option, and although other restoration attempts from different backup sessions were successful, we would not feel safe using DSBackup Plus while keeping only one copy of important files.

The squeeze feature also proved of dubious value. Selecting that option didn’t reduce the number of disks required to back up Bigfile. Moreover, the program incorrectly estimated the number of disks required, because its guess did not take into account the use of high-density disks (which it did when the squeeze option was not selected).

Design Software also supplies a companion program called Speedbak that achieves much higher backup speed by abandoning the standard DOS disk format. Although we would guess that this feature’s performance should be on a par with that of programs like Fastback, we couldn’t make a successful backup with it. Though we set the program to use high-density floppy disks and though the screen confirmed our selection, Speedbak treated our first test disk as merely double density. The program died on the second disk and could not be revived.

If the manufacturer has an excuse for this behavior, it may be that we were using an AT compatible that was not compatible enough. Since the same machine functioned well with all the other programs, and since about 60 percent of PCs now sold are compatibles, we would regard

KEEP ITS WORD”- MARY RICH

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such an explanation as unconvincing.

The DSBackup Plus distribution disk also includes a rather unusual addition: a demo backup program that can be copied and distributed free—and legally. The demo contains all the backup features of Speedbak but none of its restoring abilities. The idea is intriguing. With the free program you could make backups as long as you want; you'd need to pay only if the worst befall your system and you needed to make a restoration. We would applaud this strategy—if you could depend on the program's backups.

Fastback

Fastback was one of the eye-openers; it helped point out the deficiencies not only in DOS BACKUP but in the IBM PC hardware itself. With this $179 program, Fifth Generation Systems Inc., pioneered the idea of a faster, safer, and easier-to-use alternative to the DOS program. The latest release of Fastback has advanced far beyond its first realization. No longer copy protected, the program can be installed quickly and easily on a hard disk through a query procedure that sets the program's defaults, checks out the host system, and matches the program to it to ensure optimum operation. Compared with other backup systems now available, however, Fastback looks austere. Its simplicity never rises to elegance.

The moderately expensive package includes three programs for three separate functions—backup, restoration, and installation. The primary program itself, Fastback, uses a query structure and lacks many of the options in other backup systems. It will, however, search subdirectories and select files by archive bit.

The program can be operated in two modes: query and batch. Normally, after you type the program name, it responds by asking several questions about how you want the ensuing backup handled—the de-
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BACKUP SOFTWARE

Intelligent-Backup
An outgrowth of a mainframe disk-management program and once called Data Management System for Personal Computers (or DMS/PC) by its publisher, Sterling Software, Intelligent-Backup combines a menu-driven DOS interface with backup and restoration utilities. Based on standard DOS files and structures, Intelligent-Backup takes the system approach to backup. For $149.95, it gives you everything you need to make a complete, regularly used backup system, including disk labels and exact instructions on how often to back up each file. In addition, you can forgo the advanced system interface and use the program as a command-driven backup utility from the DOS prompt or from within a batch file.

The Intelligent-Backup system relies on ritual rather than speed. Follow the instructions, and you’ll be completely prepared for any disaster—and probably bored stiff. The program actually required 50 percent more time than DOS to back up Bigfile and took more than twice as long to restore it. Moreover, when it came to the Scatter disk environment, Intelligent-Backup played dumb and refused to do anything about backing it up.

The system used by Intelligent-Backup is unusual in that it divides files into three categories: altered files, new files, and old files. Altered files are those that have changed since the last backup—that is, they have their DOS archive bit set. New files are those that haven’t changed today but have in the last 45 days (or some other user-definable period) as indicated by their DOS time stamps. Old files haven’t changed in living memory. The three-tier approach should, in theory, cut down the program’s speed penalty, because you can choose from three backup modes—updated files only, updated files and new files consolidated, and full disk—to select the one that best fits your needs. The first two selections back up fewer files and hence take less time.

To help you set up a backup system, Sterling Software includes about 50 labels for tagging your backup disks. The program itself keeps a log of your backup activities, and if you mind your backup system properly, you can keep track of which file is backed up on which disk. Individual files, blocks of files, and whole disks can be restored. If you want, the system will also automatically remind you to make a backup each day.

Intelligent-Backup can use any DOS-disk-type device, including floppy tape (tape drives that use a disk controller), cartridge hard disks, and Corvus network virtual disks. Media must be formatted before use. To crowd more data onto every backup disk, Intelligent-Backup uses both data compression and file compaction, but these features saved nothing on a backup of Bigfile.

As might be expected from a program written by a mainframe software company, Intelligent-Backup is huge—256K bytes, not including necessary auxiliary files. It’s so big, in fact, that Sterling Software uses the unusual strategy of compressing files on the distribution disk with an ARC utility like that used in many bulletin board systems. The program is also packed with extra features, such as its own built-in editor.

If you need or want the regimen of a system, Intelligent-Backup may be the program for you. It will help you get organized and stay that way.

Pdisk
Phoenix Technologies’ Pdisk is a set of directory-oriented file utilities linked by a menu-driven control program. The utilities—which include backup, restore, copy, delete, and directory removal pro-
grams that can handle multiple files and search subdirectories—can also be used individually in a command-driven mode. The whole set goes for $145.

The Pdisk backup utility is completely DOS-oriented; it puts ordinary DOS files onto preformatted DOS disks. Back up a program with Pdisk and you can probably run it right off the floppy disk. Although Pdisk will break files between disks in its attempt to squeeze as much data as possible onto each disk, command options let you keep all files whole if you want.

As a DOS-oriented backup program, Pdisk is relatively quick—about twice as fast as DOS BACKUP itself. In addition, it scored high on reliability during testing, detecting a bad floppy disk during the backup process and refusing to use it. While it did waste an entire floppy disk for the sake of a few bad sectors, we prefer this conservative approach over ignoring disk errors entirely.

The biggest problem we encountered with Pdisk was its inability to handle the Scatter hard disk environment. The program diligently searched through all files in all subdirectories and reported the total but then refused to do anything about backing them up, ending with a "File Access Error" message.

The greatest strength of Pdisk is versatility. Each program has an almost mind-boggling array of options, including all the standards: date selection, archive bit selection, and subdirectory searches. The documentation requires the full, IBM-size

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binder. Both the backup and restore functions give you intimate control over program operation.

As an added bonus, the package includes tree-oriented disk utilities. One, called Move, relocates files and entire directory trees from one directory to another with a single command. (Move only changes directory entries; it does not copy the contents of a file. Consequently, the move of a directory tree is much faster and easier than copying everything from one directory to another.) Another, Treecpy, copies an entire directory hierarchy and all the files it contains between disks and di-

Dr. Dr. Zucker ‘Cures’
SLOT PHOBIA REACHES EPIDEMIC PROPORTIONS
Sunnyvale, CA, April 1987

In California, we are sensitive to wine snobs who favor the more expensive French wines to domestic wines, even though California wines are often superior in quality and price.

A similar situation exists with add-on boards. What do foreign-made boards have over U.S. made boards from companies like ATD, makers of Zuckerboards? Nothing!

Foreign manufacturers are good at imitation. Anyone can do that. Americans are adept at quality, reliability, fast delivery, low prices and, most important, innovation.

My cures for “slot phobia” are examples of such innovation.

My cures allow you, the buyer (and not the profit-hungry manufacturer), to decide what board functions you pay for.

My cures, simply put, let you mix and match two full function half cards that snap together to make a long card, which does the work of two full function cards, but only occupies one slot.

I’ve had a flood of mail on these innovative new products. Most have been positive. A few skeptics have said this concept isn’t new, and have asked, “Haven’t so-called piggy-back boards been around a long time?” This kind of question misses the point.

The cure for slot phobia is not a piggy-back bandage others have placed on the problem, but a cure. The Zuckerboard cure uses a Zucker “bus,” extended off the backend of the primary card with the help of a unique mechanical system (patent pending) to let you snap a secondary card into the same place as the first card. In short, the Zuckerboard cure truly makes long boards of two short boards.

The piggy-back imitations merely sandwich two boards into the slot. This results in slot overlap. Even if this could be avoided, piggy-back boards never are the full function equivalent of long boards.

In two previous columns, we have discussed the first two “cures” for slot phobia. The first product, “The First Cure,” uses a primary board for the AT or compatibles with either 1 meg of EMS or extended memory or 0.5 megs and 128K of conventional memory, plus secondary boards to pack-up to 9 megs in a single slot in easy-to-take dosages of one, two, or four megs. The “Second Cure” uses a primary board for the PC/AT or XT with up to two serial and one parallel port, plus secondary boards to activate a video port with color, monochrome graphics or enhanced graphics.

Like all Zuckerboards, these products are priced about half the price of more familiar brands. In addition, they are U.S. made and offer unusual quality and reliability, backed by a two year warranty.

With your continued support, we can conquer the disease of slot phobia, plus other computing ills, such as the high cost of up-grading your personal computer.

To all my readers, stay tuned for future columns which will appear every other issue. Thank you for buying Zuckerboards.

Note: Dr. Dr. Zucker (Matt Zuckerman, PhD) is President of ATD Inc. of Sunnyvale, CA 235 Santa Ana Court, 408-720-1942.

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EDITOR’S CHOICE

Corefast

Unexpectedly, one program stands out among the backup utilities tested here—Core International’s Corefast. This program has more features than any of the others. It includes both a high-speed and a DOS-compatible mode. It will back up to and from any DOS device and will even make an image backup of a floppy disk in about 15 seconds!

Although other programs backed up files faster, Corefast was fast enough to get the job done—and, unlike some others, it easily restored what it backed up. Moreover, it handled both the Bigfile and Scatter environments without a hitch.

We were the most impressed by the program’s error-correcting abilities, however. Among the packages we tested, we’d feel safest using Corefast.

tectors. Similar utilities will erase all files in a directory tree and remove all the subdirectories in a tree.

Some options would not work as claimed, however. For instance, the subdirectory file-deleting program, Treedel, offers two choices: prompting before deleting each file or prompting once before making its entire, massive deletion. When we selected the latter to erase the entire Scatter environment, the program erased six files, then queried about two, then erased six more, and so on. Once the various bugs are eliminated, however, hard disk users may treasure Pdisk for its file utilities alone.
Pretty soon, this might become standard computer equipment. Unless, of course, our VEGA Deluxe card does first.

And that's a distinct possibility. After all, this short-card video adapter offers 37% higher screen resolution than standard EGA cards. Visualize it: your existing software sharper and clearer by more than a third. Programs like Lotus 1-2-3 and Symphony, with 132 columns and 43 lines. Microsoft Windows in 640 x 480, too. And AutoCAD. As well as EASYCAD, EGA Paint, GEM, Dr. Halo II, In-A-Vision, Windows Draw, Windows Graph, and much more.

In fact, with all this information on the screen, there's only one thing there's less of. Strain on your eyes.

That's because the VEGA Deluxe gives you both 640 x 480 and 752 x 410 resolution. (Of course, for more than 640 x 350, the VEGA Deluxe requires a Multisync* or equivalent.)

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CIRCLE 313 ON READER SERVICE CARD
A SYSTEM BOARD ANALYZER

Both DOS and your applications programs monitor the status of your configuration switches. Here’s a way you can check it yourself without popping the cover.

The configuration of your PC’s system board switches (or of the bits in a nonvolatile byte in the AT) and the jumper settings on peripheral boards tell both the operating system and your applications programs just what equipment is installed. Specifically, these settings reflect such critically important information as the presence or absence of a math coprocessor, the amount of memory on the system board, the initial video mode, and the number of disk drives.

The switches on a PC or XT do not actually make electrical connections between the system and the equipment involved. Rather, the status of the switch settings is read and stored during the BIOS POST (Power-On Self-Test) routine as a series of “on” or “off” bits. (In an AT these bits are set when you run the diagnostic disk setup program, and their memory is kept alive by a small battery that remains active even after you power down.)

On an XT, then, if switch position 2 (bit 2) is set to “off” (0)—indicating that you have no math coprocessor—but in fact a coprocessor is installed, the switch will not electronically disconnect it. An application that tested for the presence of a coprocessor by looking at this setting, however, on finding the bit low would switch to its own number-crunching routines and cost you the additional power and speed your 8087 would have provided. (This is actually a poor way for an applications program to test for a coprocessor, but some packages do it just that way.)

The configuration of peripheral boards is done by jumpers, little pieces of plastic with metal contacts that make a connection across exposed stiff wires. The settings of the jumpers do actually make the electrical connections that enable the ports involved. Usually, one jumper activates the port on the board and another selects the interrupt to be used when communicating with the port. (For example, IRQ 4 is used with COM1 and IRQ 3 with COM2.) If you have two serial ports on your machine and both were to be configured as COM1, the conflict in port addressing would prevent one or both from functioning. The same holds true for parallel ports and/or a game port. If the jumpers are improperly set, the equipment won’t work.

One obvious way to check whether the switches and jumpers are properly set is to power down, extract the cover screws of your anesthetized computer, and perform exploratory surgery. A less invasive technique is to use a program I’ve written, called STATUS. STATUS.COM provides a quick visual presentation of your switches—and the meaning of each—without your having to touch a screwdriver or yank out peripheral cards. STATUS also displays additional information about the presence or absence of an EGA, extended/expanded memory, free memory, and DOS and BIOS versions that go beyond the switch settings themselves.

The source code for STATUS is shown in Figure 1, and Figure 2 contains a BASIC program that will create the .COM file for you if you prefer this route to working with assembler. The .COM, .ASM, and .BAS files are also available for downloading by modem, without charge, from the PC Magazine Interactive Reader Service. The procedure is described in the sidebar “Downloading STATUS.”

Once you have the program on your machine, simply enter

STATUS

at the DOS prompt and you will get a full report similar to that shown in Figure 3.

HOW STATUS WORKS The BIOS POST routine reads the system board switches by latching through port 61h and
PC LAB NOTES

The first thing that STATUS does is to clear the screen with the color at the current cursor position.

page is then scrolled with that attribute via INT 10h function 6. An easier way to clear the screen would be to call function 0 (Set Mode) of INT 10h. This would fill the screen with blanks with an attribute of white on black. The little extra trouble in clearing the screen with the current color attribute, however, will please those who have customized color screens. Further, clearing the screen and writing from top to bottom instead of scrolling the text on the screen makes for a better presentation.

The presentation itself begins by printing the title lines on the screen via DOS INT 9 (Print String). Placement of all text strings is controlled by another INT 10h call, this time function 2 (Set Cursor Position). Next comes a graphic presentation of the switch settings. A box is drawn using the high ASCII graphic character set.

Figure 1: The Assembler listing for STATUS.COM.
Mack; Hark; jEqulptent – Else, Assume
- Else, Assume
- Print
01SPLAY BIT2
- A88URe PRN_GAMB
- IBM Display
- PRINT.COM
- PRINT
- Isbit
- CH EGA
- Else,
- FINISH
- C0M1j
- SERIAL.
- CH
- }
- DISPL_2
- PPI
- ,
- PRNli
- PRN
- PORT:
- BITli
- the -
- JZ
- CALL
- TEST
- NOV
- CALL
- ADD
- MOV
- MOV
- PRINT
- SEG
- BLE
- the
- AH,10000B
- DL,’0’
- LOCATE
- BP,1601H
- AH,10B
- IIH
- BITS
- BP,1027H
- BP,
- PRINT.es
- DL,2
- PRINT
- CS
- DL,
- BP,100H
- BX,2
- BP,
- OFFSET
- STRING
- CHAR
- CHAR
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283
PC LAB NOTES

As I mentioned earlier, the equipment word is located at 40:10h. The low half of the word has the bit settings for the switches, whether for the hardware switch of the XT/PC or the software switch of the AT. The STATUS program retrieves this word via BIOS INT 11 (equipment determination). Each bit of the low byte is TESTed with a value of 00000001b to see if it is on. A rotation (ROR) to the right before each TEST enables STATUS to find out easily whether or not each bit is on or off. If on, a solid box (the extended-ASCII character 219) is displayed; if off, a blank space is shown.

Next, an explanation of the bit settings is displayed, and the current settings of the machine are marked with an asterisk. For example, if you have two disk drives and, appropriately, bit 7 is off and bit 8 is on, then an asterisk will appear as follows:

<table>
<thead>
<tr>
<th>Bits 7-8</th>
<th>no. of disks</th>
<th>11 = 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>* 01</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>00</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Incidentally, STATUS numbers the bits starting at 1 instead of 0. Also, the switch reads from left to right, that is, from 1 to 8 instead of from 7 to 0 (this latter is the usual convention for reading a binary number). This is for better readability and to follow the convention found in IBM’s Guide to Operations.

Unless you’re the only known person ever to use a cassette tape recorder for I/O, bit 1 should always be on. Bit 2, as men-

(Figure 1 continues)
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PC LAB NOTES

After the initial video mode is marked with an asterisk corresponding to the bit settings, STATUS checks to see if an EGA (enhanced graphics adapter) is installed. The IBM EGA BIOS (and that of almost all clone boards) has a "signature" (the letters "IBM") at C000:001E. If STATUS finds this signature, it adds the characters "(EGA)" to its video mode report.

PORTS The high half of the word retrieved from INT 11h contains the information about the number of printer (parallel) ports, serial ports, and a game port. The same TESTing method used to determine the switch settings is used to calculate the number of existing active ports. The top two bits, 14 and 15, are for the parallel ports. (From here on, since we don’t have to be concerned with switch positions numbered from 1 to 8, I’ll revert to the conventional “bit” numbering: bit 15, not 16, is the highest bit in the word.) Bit 13 is not used. Bit 12 is on if a game adapter is present. Bits 11, 10, and 9 are for the serial ports. Bit 8 is not used. Note that with the three serial port bits, a number as large as 7 can be represented. However, there are only four reserved word memory locations (starting at 40:00h) to store the addresses of the ports, and only three are currently supported. The same logic (or lack of it) applies to the parallel ports. The four storage addresses start at 40:00h, and only three are supported.

CONVENTIONAL MEMORY Main memory, i.e., the memory found on the system board, is a simple matter to retrieve via BIOS interrupt 12h. This short BIOS routine returns with the number of 1K contiguous blocks in AX. This value can also be found directly by reading the BIOS data area, 40:13h. The BIOS determines this value on power-up by reading ports 60h through 62h.

The number returned is in hex kilobytes. STATUS converts this to decimal by successively dividing by 10,000, 1,000, 100, 10, and 1. If the division results in zero, STATUS does not show it unless a significant number (something other than zero) has already been displayed. This method suppresses confusing

(Figure 1 continues)
and meaningless leading zeros.

This same division routine is used to display bytes free, the decimal portion of the DOS version, and, if it exists, extended or expanded memory.

BYTES FREE Bytes free consists of conventional memory, less what is used by the operating system (DOS), the resident portion of COMMAND.COM, and any resident programs. This figure indicates the amount of RAM available to applications programs. Any extended or expanded memory is not included in the byte count of bytes free.

Normally, when a program is loaded, DOS allocates all the available memory to the program. To determine the bytes free, STATUS first returns all memory allocated to it back to the system pool. This is done via INT 21 function 4Ah (Modify Allocated Memory Blocks) with BX = 0. This frees up all memory including what is presently being used by STATUS. Then
THE BIOS DATA AREA

For those of you who do not have a Technical Reference manual, Figure A presents a listing and brief description of the other bytes in the BIOS data area. STATUS uses only the words at offset of 10H and 13H. An interesting way to watch the data area in motion is to monitor the changes in the keyboard status flag or the timer storage words.

To do this, load DEBUG and enter

R DS
DS XXXX
: 40

This will change the data segment to 40H. Then it's easy to look at any of the data areas with the dump command. For example, if you enter

D 17 L 1

DEBUG will display the first byte of the keyboard status. Then change the caps state by pressing CapsLock and enter the same dump command again. The byte will change the value depending on the other shift states. Experiment with the other Shift keys—for example, enter the dump command while you are depressing one and/or both Shift keys.

The other word that will change rapidly is the timer. Just enter the following several times in succession:

D 6C L 2

When you're through, to exit DEBUG, enter Q. —Michael J. Mefford

<table>
<thead>
<tr>
<th>Bytes in the BIOS Data Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segments 40H</td>
</tr>
<tr>
<td>Offset</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>0H</td>
</tr>
<tr>
<td>6H</td>
</tr>
<tr>
<td>10H</td>
</tr>
<tr>
<td>12H</td>
</tr>
<tr>
<td>13H</td>
</tr>
<tr>
<td>15H</td>
</tr>
<tr>
<td>17H</td>
</tr>
<tr>
<td>18H</td>
</tr>
<tr>
<td>19H</td>
</tr>
<tr>
<td>1AH</td>
</tr>
<tr>
<td>1CH</td>
</tr>
<tr>
<td>1EH</td>
</tr>
<tr>
<td>3EH</td>
</tr>
<tr>
<td>3FH</td>
</tr>
<tr>
<td>40H</td>
</tr>
</tbody>
</table>

41H Byte | Disk status. Bit settings code type of disk error. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7 Time-out failure</td>
</tr>
<tr>
<td>1</td>
<td>6 Seek failure</td>
</tr>
<tr>
<td>2</td>
<td>5 Controller failure</td>
</tr>
<tr>
<td>3</td>
<td>4 CRC failure</td>
</tr>
<tr>
<td>4</td>
<td>3 DMA overrun</td>
</tr>
<tr>
<td>5</td>
<td>2 Sector not found</td>
</tr>
<tr>
<td>6</td>
<td>1 Write protected</td>
</tr>
<tr>
<td>7</td>
<td>0 Address not found</td>
</tr>
</tbody>
</table>

42H 7 bytes | NEC status. |

49H Byte | Current CRT (video) mode. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7 Monochrome</td>
</tr>
<tr>
<td>1</td>
<td>6 640 × 200 BW</td>
</tr>
<tr>
<td>2</td>
<td>5 320 × 200 BW</td>
</tr>
<tr>
<td>3</td>
<td>4 320 × 200 color</td>
</tr>
<tr>
<td>4</td>
<td>3 80 × 25 color</td>
</tr>
</tbody>
</table>

4AH Word | Current number of columns on the screen. |

4CH Word | Size of the video buffer. |

50H 5 words | Starting offset of the video buffer. |

50H 5 words | Current cursor position for each of eight pages, starting with page 0. |

50H Word | Starting and ending line of cursor. |

52H Byte | Current active display page. |

53H Word | Port address of active display. |

54H Byte | TFT setting of the CRT mode register. |

56H Byte | Current palette. |

57H Word | Data edge time count. |

58H Word | CRC register. |

59H Byte | Last input value. |

5AH Word | Low half of time. |

5EH Word | High half of time. |

70H Byte | Timer overflow. One if time went past midnight. |

71H Byte | Bit 7 = 1 to indicate Break was depressed. |

72H Word | Reset flag. A warm boot instead of a cold boot is done if this word equals 1234H when Ctrl-Alt-Del is pressed. |

74H 2 words | Hard disk status. |

78H 4 bytes | Time-out for the parallel ports. |

7CH 4 bytes | Time-out for the serial ports. |

86H Word | Offset address for start of keyboard buffer. |
DOWNLOADING STATUS

The programs that appear in our PC Lab Notes column (as well as other programs we publish) can be downloaded by modem from the PC Magazine Interactive Reader Service. There is no charge for this service, but users are cautioned that these programs are copyright material and are made available only for individual, noncommercial use. You may make copies for others (including placement on noncommercial electronic bulletin boards), as long as no charge is involved. However, making copies for any commercial purpose is strictly prohibited.

The modem number for PC-IRS is (212) 696-0360. Set your modem and communications software to use 1,200 (or 300) bps, 8 data bits, I stop bit, no parity. PC-IRS files with a .COM, .EXE, or .ARC extension require that you also use the Xmodem error-checking protocol; our other files (e.g., those with extensions of .ASM or .BAS) can be downloaded using either regular ASCII or Xmodem transmission.

STATUS.BAS, whether typed in from the magazine at your keyboard or downloaded from PC-IRS, will automatically create STATUS.COM when run once in BASIC. STATUS.ASM, also listed both here and on PC-IRS, allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft) and the following commands:

```
MASM STATUS;
LINK STATUS;
EXEC2BIN STATUS STATUS.COM
```

STATUS AT A GLANCE

Syntax:

```
[d:] [path] STATUS
```

Operation: STATUS provides an on-screen display of the current system-board configuration settings for an IBM PC or XT (or the equivalent AT equipment byte). The data reported includes the number of disk drives, presence/absence of a math coprocessor, amount of on-board system memory (not for AT), initial video mode (including EGA), amount of installed and free RAM, amount of extended and expanded memory, number of parallel, serial, and game ports, and DOS and BIOS versions. Some information may not be reported by non-IBM "compatibles."

INT 21 function 48h (Allocate Memory) is issued with BX = 0FFFFh. BX is equal to the requested paragraphs of memory, one paragraph equating to 16 bytes. OFFFFh paragraphs (1024K) is, obviously, more memory than is actually available to us. DOS, being just as smart, refuses the request and on return, politely prompts us with the amount of memory that is available. Voilà!

The amount of free memory is also returned in paragraphs. This number is converted to kilobytes by dividing by 64 (1024/64 = 16). The result is rounded up if the remainder is equal to 32 or above. (This is analogous in decimal arithmetic to rounding up if the remainder is equal to 0.5 or above.)

**EXTENDED MEMORY** To determine the amount (if any) of extended memory installed, INT 15h is issued with AH = 88h. INT 15h is the old cassette I/O. In an AT (remember that extended memory is available only in an AT-class machine) INT 15h returns with AX = number of K bytes of extended memory. (For more discussion about extended and expanded memory, see "Enlarging the Dimensions of Memory," PC Magazine, Volume 5 Number 1.) If INT 15h is issued in a machine other than an AT, unpredictable results will occur. So, before issuing INT 15h, STATUS must check to see if it is operating on an AT-class machine. This is determined by the ID byte in high ROM memory. The coding of the byte at address F000:FFE is as follows:

- **FF** = PC or early XT
- **FE** = XT
- **FD** = Jr
- **FC** = AT

If FCh is found, STATUS issues INT 15h to get the available memory.

Programmers should note that the interrupts must be turned back on with an STI instruction upon return from INT 15h. Unlike other interrupts, INT 15h shirks this responsibility. Failure to enable the interrupts will let interrupts stack up, and eventually the program will perform that most embarrassing act of locking up the machine. The correct assembly code looks like this:

```
MOV AH, 88H
INT 15H
STI
```

**EXPANDED MEMORY** INT 67h is used by the expanded memory manager device driver. Issuing INT 67h with AH = 42h will return with a value in DX equal to the number of 16K blocks of expanded memory. If no expanded memory manager has been installed, however, the vectors for INT 67h will simply be zeros and the machine will crash. So STATUS must first determine whether or not expanded memory exists by checking if the memory manager is installed.

INT 67h is a device driver with a header starting at offset 0. Unlike .COM files, which construct a PSP (program segment prefix) in the first 100 bytes, device driv-
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ers use the space for a header. Eight bytes, starting at offset 0Ah, are reserved for the device name. STATUS first retrieves the vector for the manager via INT 21, function 35 (Retrieve Interrupt Vector). The interrupt is called with AL = 67h, the vector of interest. ES:BX returns with vector. The expanded memory manager has a name of EMMxxxx, so STATUS first verifies that EMM is installed by looking for the characters EMM at offset 0Ah of INT 67h. If found, the available memory can be retrieved via issuing INT 67h with AH = 42h. DX returns with the number of 16K blocks. This is multiplied by 16 to display the memory in kilobytes.

**DOS VERSION** Getting the DOS version is a simple matter of issuing INT 21h function 30h. On return, AL contains the major version number (the number to the left of the decimal point) and AH has the minor version number. If AL returns with zero, then the version is pre-2.00. (Unless you're still in the Dark Ages, you'll have upgraded at least to 2.00.)

**BIOS VERSION** The last thing STATUS reports is the BIOS release date and copyright. STATUS looks for the release date at address F000:FFFF.

---

Figure 2: A BASIC program that will automatically produce STATUS.COM

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BUG and then entering the commands:

d F000:FFFF L0 for the release date

d F000:FFFF L1 for the ID bytes

The location of the copyright is most unpredictable from BIOS to BIOS. To find a copyright notice, STATUS goes on a scavenger hunt looking for one of several key phrases. The program assumes that the BIOS authors used Copyright, COPR., (C), or (c) as a preface to their name. If none of these phrases are found, STATUS gives up, surmising the authors wish to remain anonymous. Note that STATUS insists on a period after the two Copr. phrases. This is to avoid getting a match on the word Coprocessor.

The search is conducted starting at the address F000:0000 and continuing to the end of ROM (F000:FFFF). Starting at address F000:F600, 32K is reserved for Cassette Basic (subroutines used by PC BASIC). In most clones, this memory is unused; that’s why you have to run GWBASIC or some other generic BASIC program. In this case, obviously, STATUS will not have a chance in finding a match until it gets to the BIOS routines starting at address F000:F000. It’s in this last 8K of ROM that a match is most likely to be found.

The assembly instructions to search for a string are not as complicated as you might think, thanks to the CMPSB and REP instructions. The routine STATUS uses can be found in the assembly listing at the label SEARCH. The source point (SI) is initialized to zero and the counter (CX) is initialized to the length of the string to be found. The destination (DI) is set to the offset of the string to be matched (COPR., for example). Then the powerful combined instruction REPZ CMPSB is executed. This instruction compares the 2 bytes pointed to by SI and DI until either they are not found to be the same or CX becomes zero. The same instruction increments SI and DI to point to the next pair of bytes in the string and, at the same time, it decrements the counter (CX).

All that needs to be done, then, is to check if CX made it to zero with a JZ instruction. If CX = 0, then STATUS branches to the subroutine to handle a match. Otherwise, the source is bumped to the next starting byte in ROM, and the compare instruction is executed again. Now that’s a powerful instruction!

Before exiting, STATUS moves the cursor to line 24. Since the entire screen is used and the last place to which STATUS writes is line 25, if an exit were made without this correction, DOS would scroll the screen by issuing the carriage return-linefeed before returning the prompt.

That’s it. Stick STATUS in your toolbox. Give your machine a checkup. And, as with all good medical tools, it’s hoped that you will not need STATUS for serious equipment problems, but if need be, it will be nice to have around for quick, painless exploration before resorting to surgery. Michael J. Mefford is a microcomputer consultant who works out of his home in Gleneden Beach, Oregon.
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CIRCLE 205 ON READER SERVICE CARD
If the pitch in your office has become as sharp as a 444-Hz A, here's a utility that lets you create a more restful tempo without even going into BASIC.

It's nice occasionally to take a short break from the serious side of utilities programming. In this issue you'll learn how to musically noodle with PLAY, and next time you can graphically doodle with DRAW. After time out for some fun, you'll return to the grindstone with rested wits.

PLAY.COM emulates the BASIC command set of the same name, but frees your musical creativity from the constraints of working within BASIC. Not that you have to be a Henry Mancini to use PLAY: as a youth I played the accordion; that's my only musical (?) background.

You can save the chore of entering either the assembly language listing for PLAY (shown in Figure 1), or the BASIC program (Figure 2) that will create PLAY.COM automatically, by taking advantage of the PC Magazine Interactive Reader Service. Instructions for downloading any or all of the PLAY files from the IRS by modem are given in the accompanying sidebar.

The syntax for PLAY is

\[
\text{PLAY } \{\text{string}\} /K \text{ filespec:/F[\{K\}\]}\]

Don't let such a strange-looking format alarm you. It means only that you have several options when using PLAY.COM. If you give PLAY no arguments, that is, just enter PLAY, the program will automatically try to use a file called PLAY.DAT in the current directory. You are responsible for creating the PLAY.DAT data file (think of it as composing a score). Incidentally, when preparing PLAY.

![Figure 1: The assembly language listing for PLAY.COM.](continued)
.DAT, note that PLAY strips the high bit, so you can use any word processor that does not include a header with the text. That includes WordStar’s document mode.

The second option is to give PLAY arguments directly from the command line as a string. Using this method, you can give PLAY up to 123 commands (128 less the 5 for PLAY and a space). Note: when you do this, omit the quotes that BASIC demands. Here’s an example of a short command line entry:

```
PLAY T15002L6G03CE18G.EL2G
```

Note above the difference in the number 0 used in setting tempo, and the letter O, which denotes the octave.

Another way you might use the immediate mode of PLAY is to create different frequency and length beeps to use as prompts in a batch file. For example, try

```
PLAY T255164GAGAGAGAGAGAGA
```

Or, if you want to just hear all 12 notes of the scale in one octave, enter

```
PLAY C C# D D# E F F# G G# A A# B
```

Notice that in this example I placed spaces between the notes for better readability. You can also use commas or semicolons for delimiters that won’t affect the actual music.

Your third option is to give PLAY a data file that contains the commands. You can use any legal DOS filespec, including paths. The filename must be immediately followed by /F, so PLAY knows that the command line characters represent a filename and not individual PLAY commands. If this is omitted, PLAY will try to play any legal characters in the filename. This error may lead to interesting but probably not very musical results. PLAY does not look for leading delimiters on the command line, so be sure to enter only one space between PLAY and the filespec.

As a working example, Figure 3 contains a data file for the Scott Joplin rag “The Entertainer,” best known as the theme music for the movie The Sting, as well as files for “Greensleeves” and the “Dragnet” theme. You can create each of
Howdy, partner.

Howdy, partner???

You've got a date with a cowgirl tonight.

Uh oh. Have you been playing Interlude again?

Let's see... I'll need a hat, boots, chaps... and maybe spurs.

What time does the rodeo start?

As soon as you walk through the door, Cowboy!

Interlude II. The long-awaited sequel to the first adult computer game in history is finally here. It's provocative and playful! Outrageous and romantic! It has all the excitement of the original Interlude, plus significant new features.

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these as data files with your word processor, and then, for example, simply enter

PLAY STRING.DAT/F

Or, by entering the data and naming the file PLAY.DAT, you could just enter PLAY with no arguments.

HOLIDAY FOR STRINGS  The vertical bar shown in the parameter syntax means you can give PLAY a string or filename, but not both in one command. The /K option will cause PLAY to ignore the keyboard. It can be included with either a string or, in the more practical case, with filenames. Use the /K option if you don’t want the user to interrupt the play. PLAY defaults to termination with any keystroke.

You can create data files with your word processor for the Scott Joplin rag “The Entertainer,” as well as for “Greensleeves” and the “Dragnet” theme.

In the event that you use the PLAY.DAT option—that is, no parameters on the command line—and you want to PLAY to ignore user keystrokes, place a K at the beginning of the string in the file rather than on the command line.

PLAY works so nearly like BASIC’s Play statement that it’s easier to point out the differences to list all the similarities. If you don’t have a copy of the BASIC manual, you’ll find the commands for PLAY.COM listed in the table “PLAY’s Command Set.”

PLAY does not recognize the < and > commands. These are reserved DOS characters, so I did not include them in PLAY’s command set. Also, PLAY will not recognize the option of entering the length of the note after the note. In other words, use L16A in place of A16.

<table>
<thead>
<tr>
<th>STRIP:</th>
<th>JS</th>
<th>NEXT_FORMAT</th>
<th>JMP</th>
<th>SHORT_END_FORMAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOOP</td>
<td>NEXT_STRIP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is the command processor.

READ_COMMAND: MOV $1,92E
NEXT_COMMAND: CMP POLL_KEY,1
JS GET_COMMAND
MOV AN,1
INT 16H
JMI EXIT
GET_COMMAND: LODSB
CMP AL,13
JA CONTINUE
JMP EXIT
CONTINUE: CMP AL,32
JS NEXT_COMMAND
CMP AL,7
JS NEXT_COMMAND
CMP AL,7
JS NEXT_COMMAND
CMP AL,0
JMS CK_L
CALL CK_NUMBER
CMP AL,7
JA NEXT_COMMAND
MOV OCTAVE,AL
JMP SHORT_NEXT_COMMAND

CK_L:
CMP AL,7
JNS CK_L
CALL CK_NUMBER
CMP AL,7
JA NEXT_COMMAND
MOV AL,64
JA NEXT_COMMAND
XOR DX,DX
MOV AX,255
DIV BX
MOV LEN,AX
JMP SHORT_NEXT_COMMAND

CK_TEMPO:
CMP AL,7
JNS CK_N
CALL CK_NUMBER
CMP AL,32
JB NEXT_COMMAND
MOV AX,255
SUB AL,BL
INC AX
MOV TEMPO,AX
JMP SHORT_NEXT_COMMAND

CK_N:
CMP AL,7
JNS CK_NOTE
CALL CK_NUMBER
CMP AL,8
JA NEXT_COMMAND
CMP AL,8
JS G1
DEC AX
GOT_N:
XOR AX,AX
MOV CL,12
DIV CL
MOV CX,8
SUB CL,AL
MOV EL,AX
XOR BH,BH
SRL BX,1
MOV BX,[OFFSET NOTE+BX]
CALL PLAY_NUMBER
JMP NEXT_COMMAND

CK_NOTE:
CMP AL,7
JE COMMAND_END
CMP AL,0
JA CK_P
CMP AL,8
JS ABOVE_C1
SUB AL,7
SUB AL,68
XOR AH,AL

(First subtract 7 for C and above.
Finish points adjustment.
Zero in high half.)
MOV DI,AX
; Move to entry pointer.
MOV CL,2
; Convert to word pointer.
SHL DI,CL
; by multiplying by 2.
CMP DI,0
; Adjust if necessary.
JNE GOTO_NOTE
SUB DI,2

GOT_NOTE:
CALL BLACK_KEY
CALL PLAY
JMP NEXT_COMMAND

CK_P:
CMP AL,0
; Is it "P"? pause?
JNZ CK_X
CALL CK_NUMBER
CMP AL,0
; Is it between 0 and 64?
JNZ CK_2
CMP AL,64
JA COMMAND_END
; Else, zero in high half.
XOR DX,DX
MOV AX,256
DIV BX
; Divide by length
JRNS PAUSE_DELAY
CALL NEXT_COMMAND

CK_X:
CMP AL,0
; Is it "X"? non keyboard poll?
JNZ CK_H
MOV POLL_KEY,1
JMP COMMAND_END

CK_H:
CMP AL,0
; Is it "H"? music?
JNZ CK_M
JMP COMMAND_END

LOADS
CMP AL,13
JMP CK_N2
JMP EXIT

CK_N2:
CMP AL,0
; Is it "N"? normal?
JNZ CK_L1
MOV MUSIC,1
; Else, flag as music one.
JMP COMMAND_END

CK_L1:
CMP AL,0
; Is it "L"? legato?
JNZ CK_S2
MOV MUSIC,2
; Else, flag as music two.
JMP COMMAND_END

CK_S2:
CMP AL,0
; Is it "S"? staccato?
JNZ CK_M2
MOV MUSIC,3
; Else, flag as music three.
JMP COMMAND_END

COMMAND_END:
JMP NEXT_COMMAND

; ************
; Subroutines
; ************

CK_NUMBER: XOR BX,BX
; Initialise to zero.
MOV BYTE PTR [BX],0
; Is it number? if no, we're done.
CMP BYTE PTR [BX],9
JNZ END_NUMBER
; Get number.
MOV BL,AL
; Convert to hex.
LODS
SUB AL,30H
; Shift decimal by ten.
NUL
MOV BL,AL
; Result in BL.
ADD BL,DL
; Get next number.
JMP SHORT NEXT_NUMBER

END_NUMBER:
MOV AL,BL
; Return with number in AL.
XOR AX,AX
; Zero in high half.
RET

; ************
; This subroutine checks for sharps or flats.
; ************

BLACK_KEY:
CMP BYTE PTR [SI],0
; Is it sharp?
JNZ CK_SHARP
ADD DI,2
; Else, point to next note.
JMP COMMAND_END

CK_SHARP:
CMP BYTE PTR [SI],0
; Do same for flats except.
JNZ CK_FLAT
INC SI
JMP COMMAND_END

CK_FLAT:
CMP BYTE PTR [SI],0
; Do same for flats except.
JMP COMMAND_END

END_BLACK:
INC SI
RET

(Figure 1 continues)
BASIC's MF and MB commands make no sense to PLAY.COM, and the X variable is also ignored. If any of the above commands appear in BASIC strings you have already constructed, you'll want to edit them out. Otherwise, PLAY.COM's command set is the same.

If you've already "scored" a certain number of strings for use in BASIC, you can save the time of retyping them by loading the BASIC program that contains the play strings and then saving it with the ASCII option. That is

SAVE filename

Next, exit BASIC to DOS and load your word processor with the BASIC listing, then edit out all but the PLAY command strings. Unlike BASIC, PLAY's file strings can be longer than 256 bytes.

Comments can be added by prefacing them with a colon. Anything after the colon on the same line will be ignored by PLAY. The colon works the same way

```asm
; This subroutine play the note.

PLAY:    MOV  B, [OFFSET NOTE+DI]     ;Retrieve the note.
        MOV  CX, B
        SUB  CL, OCTAVE        ;Divide by octave base two.
        MOV  BX, CL
        MOV  DX, 12B
        XOR  AX, AX
        MOV  BX, AX
        MOV  AL, 006B
        OUT  43H, AL
        OUT  42H, AL
        MOV  AX, BX
        OUT  42H, AL
        MOV  AL, AL
        OUT  42H, AL
        IN  AL, 61H
        OR  AL, 3
        OUT  61H, AL
        CALL  DILAY
        ;Turn byte 0 and 1 on 8255 chip
        ;to turn speaker on.
        DELAY.
        OFF: IN  AL, 61H
             AND  AL, 1111111B
             OUT  61H, AL
             MOV  CX, BX
             CALL  STACCATO
             RET
```

(Figure 1 continues)

## DOWNLOADING PLAY

The programs that appear in our Programming/Utilities column (as well as other programs we publish) can be downloaded by modem from the PC Magazine Interactive Reader Service. There is no charge for this service, but users are cautioned that these programs are copyright material and are made available only for individual, noncommercial use. You may make copies for others (including placement on noncommercial electronic bulletin boards), as long as no charge is involved. However, making copies for any commercial purpose is strictly prohibited.

The modem number for PC-IRS is (212) 696-0360. Set your modem and communications software to use 1,200 (or 300) bps, 8 data bits, 1 stop bit, no parity. PC-IRS files with a .COM, .EXE, or .ARC extension require that you also use the Xmodem error-checking protocol; our other files (e.g., with extensions of .ASM or .BAS) can be downloaded using either regular ASCII or Xmodem transmission. PC-IRS has 18 lines and is open 24 hours a day.

PLAY.BAS, whether typed in from the magazine at your keyboard or downloaded from PC-IRS, will automatically create PLAY.COM when run once in BASIC. PLAY.ASM, also listed both here and on PC-IRS, allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft) and the following commands:

```
MASM PLAY;
LINK PLAY;
EXE2BIN PLAY PLAY.COM
```

## PLAY AT A GLANCE

The syntax for PLAY.COM is

```
PLAY [string[/K] | filename[/K]]
```

Operation: PLAY.COM is intended to provide many of the music-producing functions of the BASIC PLAY statement without the need to work in BASIC. If entered with no arguments on the command line, PLAY looks in the current directory for a file named PLAY.DAT and executes the commands in that file.

Alternatively, PLAY can use either a command-line string or any legal DOS filename to supply the music command arguments. When the musical "score" is in a file, a /F must be appended to the filename. Filenames may include a path designation. With either a directly entered string or a filename, an optional /K switch may be added to prevent a keystroke from halting execution.

The music-generating commands to which PLAY.COM responds are listed in the accompanying table "PLAY's Command Set."
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CIRCLE 377 ON READER SERVICE CARD
that the apostrophe does in BASIC and the semicolon does in assembly.

**INSIDE THE CODE** This is how PLAY works. The parsing of the command line is straightforward: you've seen it a dozen times in other assembly language programs. All commands, whether they come from the command line or from a file, are capitalized by ANDing with 5Fh, and file strings are also ANDed with 7Fh to strip the WordStar high bit. If you tell PLAY to get its data from either PLAY.DAT, the default, or from a file of your choice, the file is read into a buffer area at the end of code.

Before executing the commands, PLAY strips any comments and any characters equal to space or below. This is done by initializing the source (SI) and destination (DI) registers to point to the beginning of the buffer. Each byte is then loaded with LODSBB. If the character is found to be above space, it is stored with STOSB. If it is a colon, it is not stored, and no other character will be stored until PLAY sees a linefeed (0Ah).

When the end of the buffer is reached, PLAY tacks on a carriage return. PLAY's cue to terminate and return to DOS is the carriage return at the end of the command line or at the end of file data.

A long loop is used to examine each character to see whether it is a command. At the beginning of each loop, if PLAY does not find a K in the string or /K on the command line, an INT 16h is issued with AH = 1. This BIOS routine will return with the zero flag cleared (not zero) if a keystroke is available, and the entry remains in the keyboard buffer. If a key has been struck, PLAY exits.

To interpret a command, PLAY examines each character in the string for a key command letter. If, for example, L is found, the number characters that follow it are converted from decimal to hex and stored in a variable called LEN. When playing a note, say A, PLAY converts the letter to a pointer by subtracting 41h. Another small correction is then made to place the A and B at the end to reflect the order of the scale, namely CDEFGAB.

The pointer is then used to retrieve the appropriate frequency from the data table called NOTE.
THE SOUND OF MUSIC

The chromatic scale is based on precise mathematical formulas, making it easily adaptable to the computer. Counting the black keys, the piano produces 12 tones in each octave, and each octave is a multiple of 2 of the previous octave.

Each note in the scale is a function of the power of 2 to the $\frac{1}{12}$ power. The formula to arrive at the constant ratio between notes follows:

$$freq = freq_1 \times 2^{12} = 1.059463$$

PLAY avoids the floating-point multiplication needed to calculate the frequencies by creating a table of the 12 notes of the highest octave (octave 6). These frequencies can be found in the data section of the assembly listing. Since each octave is a multiple of 2, calculating a note of a lower frequency is a breeze with the SHR instruction. Each shift to the right will divide by 2.

Once the frequency is found, it has to be converted to a divisor for the 8253 chip. The divisor is inversely proportional to the frequency. The appropriate dividend constant for the 8253 is 1200000. This is divided by the frequency and fed to the 8253 chip. More on that in a moment.

The length of time the note is to be played is retrieved from the variable LEN. LEN is partitioned into play time and pause time. MN, the default, plays the note $\frac{7}{8}$ of the total length specified and pauses $\frac{1}{8}$ of the time before proceeding to play the next note. Once the 8253 chip is set up, the speaker is turned on for the duration of a delay loop, after which the speaker is turned off.

PLAY programs two chips on the system board to control the frequency of the note and the length of play time. A third chip responsible for end-of-interrupt is also programmed in the process.

It's in the programming of the 8253 interval timer and the 8255 peripheral interface (see Figure 4) that PLAY becomes interesting. There are two ways to control the speaker. One is to pulse the speaker by directly programming the 8255 by sending a zero to bit 0 and a one to bit 1 very rapidly. The rate of pulsing controls the frequency of pitch.

The second method—the one used by...
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The most significant byte (MSB).

Once the 8253 is programmed, the speaker is turned on by turning on bit 0 and 1 of the 8255. Communications to the 8252 are served through port 61h. Thanks to the 8253, PLAY can then go about its business of calculating the length of play without continually having to pulse the speaker.

**AS TIME GOES BY** You have probably seen delay loops executed by loading CX with a value and then doing nothing but decrementing CX to zero with the LOOP instruction. This is a poor method of achieving a delay, however, because of the different clock speeds used on different machines. At first glance it might seem acceptable to look at the 16-bit counter at F000:FEFF and, if an FCH is found, to assume the equipment was the faster AT 80286 and then adjust the length of the delay loop accordingly. But with all the accelerator boards and all the clones on the market now, this, too, would give inconsistent results.

The only reliable method for executing delay loops is to monitor the system clock. The minute-second-millisecond word of the clock is found in low RAM at 40:6Ch. This clock is normally updated by the BIOS 18.2 times a second. Channel 0 of the 8253 is responsible for sending the interrupt (IRQ 0) that updates this word. The reason I say “normally” is because 18.2 times per second is not a fine enough resolution to time trills in PLAY.

**Figure 2:**
The Entertainer by Scott Joplin

**Figure 3:** Three sample music selections for use with PLAY.COM

*Note: The code listings are omitted for brevity.*
If PLAY reads the system clock, turns on the speaker, and then sits in a loop reading the clock until it is incremented by one, the finest resolution can be only one-eighth of a second. Sound fast enough? Not if you want to produce chirping noises.

To increase the resolution, then, PLAY programs channel 0 of the 8253 to generate an interrupt four times as often. Normally the divisor for channel 0 is 65,536 or zero. By changing it to 16,384, the interrupts will occur 72.8 times a second. Now we're ticking.

Programming channel 0 is similar to programming channel 2. First it must be latched—this time by turning both bits 7 and 6 of port 43h off. Then the divisor can be sent a byte at a time to port 40h.

This faster clock speed creates a small problem, however. With the timer tick interrupting four times as fast now, the system clock will run four times as fast as well. I'm talking about the clock you see when you enter TIME at the DOS prompt. With short command line entries, this speedup of the clock would not be noticeable, and even with longer file entries, the clock would gain a minute or two at the most. But we might as well get things right.

The solution is to take the timer tick (INT 8). Then on each tick of the system clock, PLAY gets serviced first and passes on the interrupt to the BIOS at every fourth interrupt. An IRET is issued on the other three interrupts, so the system clock is not updated. It's a simple feat to take over an interrupt. You've seen it before in resident programs, so I won't go into the details here. There is, however, one thing that should be mentioned that must be done before an IRET. The 8259 command port, 20h, must receive a 20h to signal end-of-interrupt so that other interrupts can occur. (I didn't stutter on that 20h. It just so happens that the port address and the bit settings are both 20h.) The assembly instructions are

```
MOV AL, 20H
OUT 20H, AL
```

Finally, the last thing PLAY does before exiting is set the system clock back to its normal 18.2 ticks per second.

![Productivity](image)

- The last thing PLAY does before exiting is set the system clock back to its normal 18.2 ticks per second.
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THE INTERNATIONAL TOUCH

Release 2 of 1-2-3 lets you put international characters in your text, but only by means of a clumsy "compose" sequence. For example, to compose an uppercase A with an umlaut (Ä), you have to hit Alt-F1, Shift-A, Shift-" just to get one character. If you use a lot of such characters, this routine can really slow you down.

I have written several macros, shown in Figure 1, that make it easier to go international. Obviously, the simplest solution would be to write a separate macro for each letter, so you would hit Alt-A for Ä, Alt-O for Ö, etc. But what about lowercase letters with umlauts? If you use up one macro per character, you'd have to use something besides Alt-A for Ä.

My macros let you choose between uppercase and lowercase within the same macro. When you run the first macro, \A, you get a lowercase A with an umlaut provided you type something within 1 second. Whatever you type will immediately follow the Å normally. If you wait more than 1 second after running the macro, the Å will automatically change to Ä, after which you can again continue typing. I have made the lowercase letter appear first because most letters with an umlaut are lowercase. A delay of one second works best for me, but you can adjust it by changing the contents of the \time function. The next two macros, \O and \U, work the same way for the letters Ö and Ü.

All three macros use the LOOK keyword to see whether you have typed a character while the macro is running. By typing a character within the 1-second delay, you cause the execution of one branch. By waiting for 1 second, you cause execution of the other branch.

The last macro, \E, has an additional line that lets you choose one of three kinds of accents for an E. If you want an acute accent, just keep typing. For a circumflex, hit the Spacebar. If you want a grave accent, wait 1 second.

If you set up these macros, be sure to give the range names in the left-hand column to the cells to their right. This in-

Figure 1: Macros that make it easy to use international characters in 1-2-3, Release 2.
SPREADSHEET CLINIC

includes IN_CHAR and START. To get the international characters into the macros to begin with, follow the regular Lotus compose sequences.

Fred Röösli
Wheat Ridge, Colorado

I had never seen the LOOK keyword in action before. While I studied the example on page 194 of the 1-2-3 manual, I couldn’t think of a useful application. Hats off to Mr. Röösli for an elegant, useful one.

I would change only one thing. In the \E macro, hitting the Spacebar does get you an è, but it also moves the cursor one space (no surprise). This is inconvenient for two reasons. Many words end with an è, so a space is what often logically follows the default character (the one you get if you keep typing). You have to type something to keep that è on the screen, and what if the natural thing to type is a space? You end up with a circumflex instead. Also, I can think of no French word that ends in è, so it does no good to automatically put a space after it.

The simple solution is to reverse the positions of è and è in the macro. The more amusing solution is to get rid of that space altogether. I tried putting \{bs\} into the third line of the macro just before {quit}, but that failed completely. The character that is read into IN_CHAR is saved in a buffer and is executed after the macro ends. Thus, an additional \{bs\} wipes out the è and leaves you with nothing.

The solution is to use a key that is neither a character nor a space, but one that the macro will recognize. {def} or {graph} or \{abs\} will work fine. If you change the third line of the macro to

{if IN_CHAR="\{abs\}"}{bs}â{quit}

and hit F4 before the 1-second delay, you’ll get a circumflex. Hitting the absolute key doesn’t make sense at this point so you get a beep, but the macro recognizes the keystroke and branches correctly.

CENTERING TEXT

In 1-2-3 there is no easy way to center a string of text within a spreadsheet. The usual procedure is to subtract the number of characters in the string from the total width of the prinout, divide this difference by two, and print the string that many spaces from the left margin. Release 2.0 of 1-2-3 provides a way to do this even if each column in your spreadsheet is a different width.

Figure 2 shows a spreadsheet of only three columns: C, D, and E. I have centered the title, in cell D5, using a two-step process. First, I put the {at cell("width")} formula in cells C4 through E4 to count the widths of the columns used in the spreadsheet. Then I used the long formula shown below in the figure to center the title according to the method described above. Since the formula works by adding blanks to the text of the title, the formula itself is actually in C5, but the title spills over into the next column and seems to be in D5. The actual text of the title is in cell C3, which is referenced twice in the formula in cell C5.

When I print the worksheet, line 5 will be the first row of the print range and will contain a centered title. You can use the same technique to copy any number of different, centered titles to the top of a spreadsheet.

Richard Bellin
Washington, D.C.

The centering formula in cell C5 works exactly as it should, though I might use it a little differently. If I didn’t need to know the widths of the different columns in my spreadsheet, I’d skip the first step by getting rid of the formulas in cells C4 to E4. I would put that information into the centering formula by replacing \{at sum(C4..E4)\} with the alternative formula that I have added to Figure 2.

If I wanted to display column-width information, for strict aesthetic reasons I would put it at the bottom of the spreadsheet rather than at the top. Then I would have a cell that totaled the column-width numbers, so I could tell at a glance how many characters wide my spreadsheet was. That way I’d know, without wasting time and paper, whether the printout would fit on my printer.

RUNNING 1-2-3 FROM A RAMDISK

A submission in Spreadsheet Clinic of November 25, 1986 (Volume 5 Number 20), highlights the advantages of running SuperCalc from a RAMdisk. In your comments, you note that this can’t be done with Lotus products because of their copy-protection schemes. It’s true that the Softguard protection scheme involves hidden and uncopyable files, which can’t be put into RAMdrive.

There are, however, at least two copy programs—CopyWrite and CopyIf PC—that let you replace the original Lotus 123.COM file with an executable 123.EXE file that runs without the hidden Softguard files. As long as you also have all the other necessary program files (such as .CMP and .SET) on the RAMdisk, you can run 123.EXE entirely in RAM, thereby speeding up disk access.

Matthew Shapiro
Baltimore, Maryland
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This is true. It's also legal. Fortunately, unless you are printing graphs a lot or using the help screens all the time, 1-2-3 doesn't do much disk access.

Another way to get some older copy-protected programs onto a RAMdisk is to use a disk utility to find the protection scheme files, unhide them, and put them on the RAMdisk, too. This won't work, however, for the recent versions of Softguard that let you run 1-2-3 from a hard disk without a key disk. That's because part of the installation process includes an assessment of the characteristics of your hard disk. If the program finds that it is being run somewhere else—a RAMdisk, for example—it won't load.

HIDING SPREADSHEET FILES
In the October 14, 1986, Spreadsheet Clinic (Volume 5 Number 17), there was an interesting submission called “Poor Man's Worksheet Protection.” [This discussed a simple way to keep people out of your 1-2-3 files. If you use /wey or /ig as the autoexecuting macro, the spreadsheet won't stay on the screen. The trick to getting into the spreadsheet yourself is to hit Ctrl-Break just as the macro executes. Or, you can use /File Combine to read the booby-trapped spreadsheet into one that's not—preferably, into one that contains your settings and ranges, since /File Combine won't automatically retrieve them.—Ed.]

Another simple way to protect or hide files is to change their extensions. Lotus products display only those files with .WKS, .WR1, .PRN, and other legal extensions. Even in DOS, if a snoot is looking for worksheet files, he might overlook anything that doesn’t have a Lotus extension. When you want to use the files yourself, just rename them with the proper extension so that 1-2-3 or Symphony can recognize them.

This isn't perfect protection, but it will stop a lot of people. Also, it's a good way to keep backup files that won’t be overwritten every time you need to make a change.

Claude Hurt
Center Point, Alabama

Not perfect, but not bad, either. One especially nice thing is that this is a trick that works with any program, spreadsheet or otherwise, that recognizes data files by their extensions.

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CONNECTIVITY CLINIC

The police are subject to a higher authority (in this case, the laws of physics) and a restaurant chain has a hard time swallowing long-distance-line noise.

SERVER SLOWDOWN
We have a six-workstation 3Com LAN using an IBM PC AT as a server. Lately, it seems the response time has increased. We are doing the same jobs, but things seem to take longer. Any ideas?

Yes, two: disk and cables. First, carefully clean up the hard disk on the server. Working from a network workstation, erase all unused files on the server. Back up the hard disk on tape, floppy disks, or another AT using a file-by-file backup (not "disk image"). Shut down the network, bring the server up only under DOS, and run CHKDSK. It is never a good idea to run CHKDSK over an operational network (many network programs block the command). After a lot of use, files often become fragmented and may be spread all over the hard disk. Network operation puts a lot of stress on the disk, and if the heads have to fly all over to read a file, the inefficiency shows. If you really want to do the job right, make sure you have a good backup and then run the AT diagnostics on the hard disk. Restore the files to the disk on a file-by-file basis.

Second, check the cables. The 3Com software and Ethernet protocols are designed to overcome lost and garbled messages and transmission collisions. But this effort can take time. Make sure that the cables are still good conductors and not burdens the network is trying to overcome. Immediately check the grounded terminator on one (and only one) end of the cable to make sure it is still grounded. Then go through and disconnect and reconnect every T-connector and cable connector several times. These things oxidize. They are silver-plated and can tarnish. There can be oxides and molds growing in the warm, dark connections that conduct poorly. Check your cabling carefully. If no other changes were made in the system, then one or both of these actions should bring the operation back up to snuff.

DATA INDIGESTION
Our long-distance phone lines are getting worse. We transmit sales and inventory data in ASCII files from our restaurants in North and South Carolina and Georgia to our office in Charleston every night. The system uses PCs, US Robotics 1,200-bps modems, and dialed phone calls on MCI. Lately we get a lot of garbles that take another phone call and two people to clear up. MCI and the local telephone companies say their lines are clear. Is there a way to move data that doesn’t garble?

To move data without garbling it, consider an electronic courier: *Lotus Express* uses MCI Mail to transfer files with error checking.

You have four alternatives: overnight courier, an electronic courier, improving your long-distance service, and using error-detection software. Why not put the data on a floppy disk and give it to Federal Express or some other overnight courier? They don’t garble bits. Why go high-tech if high-touch will work?

Consider an electronic courier: *Lotus* has a new product called *Lotus Express* that automatically and invisibly uses MCI Mail to transfer document or spreadsheet files, complete with error checking. Express operates in the background, leaving the computer available for other tasks. It steals RAM, but in your application you could load it into a machine at the end of each day and leave it running all night. Express costs $100 and includes the initial subscription to MCI Mail (you will need one for each location). If there are MCI Mail hubs or Tymnet access ports in the local dialing range of your restaurants, the cost is very low. (Lotus Development Corp., Cambridge, Mass., (617) 577-8500, MCI Mail, Washington, D.C., (800) MCI-2255.)

Even if you use overnight or electronic couriers, you should still clean up your telephone problems. You can have more than one long-distance telephone company, so open accounts with other carriers (there may be a small charge to establish an account) and see what the "garble factor" of each one is.

Don’t make a decision on the long-distance carrier to be used for all your restaurants based on a sample of one location, and don’t buy long-distance services on
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<td>SuperCalc IV 1.0</td>
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<td>Sylvia Porter Swiftpub</td>
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<td>Symphony 1.2</td>
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<td>Turbo Lightning w/Word</td>
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<td>Ventura Desktop Publisher</td>
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| PRINTER SALES          |
|------------------------|------------------|
| EPSON                  |                  |
| LX 86 120 CPS, 16 NLQ  | $199             |
| FX 86E 200 CPS, 40 NLQ | $369             |
| FX 286E 200 CPS, 40 NLQ| $499             |
| LQ 800 180 CPS, 60 NLQ | $459             |
| LQ 1000 180 CPS, 60 NLQ| $639             |
| LQ 2500 324 CPS, 108 NLQ | $1015          |
| EX 800 300 CPS, 60 NLQ  | $439             |
| DX 1000                 | $559             |
| DX 35 Daisywheel        | $599             |

| OKIDATA                |
|------------------------|------------------|
| 182 120 CPS            | $229             |
| 192 Plus 200 CPS       | $359             |
| 193 Plus 200 CPS       | $535             |
| 292 Plus 200 CPS, 100 NLQ | $549         |
| 293 Plus 200 CPS, 100 NLQ | $675         |
| 294 Plus 400 CPS       | $1095            |
| Laser Line 6           | $1599            |

| TOSHIBA                |
|------------------------|------------------|
| 321 180 CPS, 60 NLQ    | $449             |
| 351 II 300 CPS, 100 NLQ| $949             |
| 341 180 CPS, 72 NLQ    | $629             |
| 351 Color 240 CPS, 100 NLQ | $1150        |

| NEC SPECIAL PRICING    |
|------------------------|------------------|
| CALL PRIMEAGE 90       |
| w/Pagimate III        |
| 90 CPS Daisywheel      | $1550            |

| FUJITSU                |
|------------------------|------------------|
| 2100/2200 220 CPS 44 CPS... | $349/459  |
| 2400/2400 Color        | $779/899        |
| DLP24 288 CPS, 96 CPS  | $865            |

| TAPE DRIVES            |
|------------------------|------------------|
| Everex 60 m.b. internal | $710             |
| external               | $695             |
| Everex 20 mb internal  | $525             |
| external               | $595             |
| Genoa Galaxy 60 mb internal | $689     |
| external               | $695             |
| Genoa Galaxy 20 mb internal | $589    |
| external               | $695             |
| Sysgen Quic 60 Internal | $949             |
| external               | $995             |
| Sysgen 20 mb internal  | $575             |
| external               | $650             |
| Tallgrass 20 mb int/ext | $395/550        |
| Tallgrass 20 mb internal tape plus 25 mb hard disk | $995 |
| tape                   | $1050            |

Prices Subject To Change
For Orders Call: 1-800-438-6039
For Shipping, Technical, Returns & In Georgia Call: 1-404-860-7364

BULLDOG COMPUTER PRODUCTS
Incorporated as Georgia Micro
price alone. Each location may get a different quality of long-distance service from the same company. The price of a long-distance service probably has no relationship to its quality. Be ready to change if the quality of a carrier's service in a particular location falls off.

If you transfer the data over long-distance calls, you should use a communications program that does error detection and retransmission. Many of the major programs in the market—Crosstalk XVI, Relay, Hyper Access, and others—can transfer your files automatically using error detection and correction. My favorite program designed for just this job is Transporter. It is very easy to use and does every file transfer with error detection. However, none of these programs will work efficiently over noisy phone lines. Clear up the phone lines, then try Transporter. ($295, Microstuf, Roswell, Ga., (404) 998-3998.)

CALLING ALL CARDS
Our city police department uses PCs networked with 3Com EtherLink cards and running Novell's NetWare for administrative services. Each precinct has between 3 and 12 workstations. Our one trouble spot is in a precinct station near the airport. The response time through that network varies greatly and sometimes the network just seems to hang up. We have exchanged every networking card, the entire network software, the server, all the cable, and lots of hardware in the PCs. My boss says it's the radios from all the planes. Could that be?

NetWare and EtherLink usually either work well or not at all. Intermittent problems are not typical. The first things I would suspect from the symptoms are a bad cable connector or problems with the hard disk drive in the network server. But, since you say you changed those pieces out of the network, I go along with at least a part of what your boss says.

The radios used in air traffic control are too low in power to interfere with your local network. Errant signals from nearby aircraft-control radios would probably interfere with police radios as well. However, some of the navigational aids used around an airport have peak pulse power measured in megawatts. It is possible that the network cable is picking up pulses from surveillance radars or weather radars as their antennas sweep by. Radars aren't always on, can use different transmitters, and may use different antenna polarizations. All these factors could affect how much RF the network picks up at any one time.

RF pulses can deafen the receivers on
You don't have to take this from your accountant anymore.

Do it yourself instead.

With the In-House Accountant from Migent, generating your own financial statements every month is a breeze.

That's because In-House Accountant is the only program for IBM PCs and compatibles that has all the features you need to make routine bookkeeping a painless, natural part of the way you do business.

Pop-up windows give you immediate access to account information (by name, or number, or whatever criteria you choose). As well as balances. And recurring transactions. All of which you can just point to and paste into your forms or records.

There's even an on-screen calculator, full-function financial formulas and help screens at the same level of the program that you're currently in.

Unlike other accounting software that's been designed merely to automate paper-based systems, In-House Accountant was designed from scratch to take full advantage of your computer's power.

That means there's no need to switch modules when you want to go from accounts payable to accounts receivable—or vice versa.

It means you can easily write financial reports the way you want to see them. Or even retrieve data from damaged disks.

But it also means one other important thing.

In-House Accountant costs only $99.

That's the difference between our product and those built on outdated methods: We're able to save you money right from the start.

Which is something your accountant will appreciate, too.

If you'd like more information about In-House Accountant, or the name of the dealer nearest you, give us a call at 800-633-3444. Or just send in the coupon.

In-House Accountant. It'll help put your house in order.

Please send me more information about In-House Accountant. And send me the name of the dealer in my area.

Name

Address

City State Zip

Phone

Send to: Migent, Inc.
865 Tahoe Blvd., Call Box 6, Incline Village, Nevada 89450-6062

CIRCLE 384 ON READER SERVICE CARD
Create dBASE® Reports in Half the Time, Without Programming, or Your Money Back!

A proven timesaver.
R&R™ users say they can create reports in half the time or less, compared with programming in dBASE. So can you. And then print them from R&R, or from within your own dBASE programs using the R&R Runtime program (included with an unlimited-use license).

More flexibility than you’ll ever need.
Relate and report from up to 10 files at once using one-to-one and one-to-many relations through dBASE indexes. Place free-form text and fields anywhere. Calculate new fields with more than 60 predefined functions, including IF/THEN.
Eight sort levels. Eight levels of record grouping. Running totals, or subtotals by group or by page. Plain-English query.

The ease of use that saves you time.
Lotus®-like commands. Move fields and text freely on the screen. Automatic trim and alignment. Predefined field formats such as currency, commas, and word-wrap, or create your own. Merge and word-wrap text and fields. Memo field support, including query.

Print selectively: underline, italics, bold, combinations.
Change reports any time. Saved reports work even after file STRUCTURES are MODIFIED. Instant on-line HELP. Fully-indexed User’s Guide. Tutorial.

Release 2, with new Relational Merge. Only $149. Satisfaction guaranteed.
Try R&R. If you aren’t satisfied for any reason, return it within 30 days for a full refund (if purchased directly from Concentric or a Concentric Authorized Reseller).

Order now.
Call 800-325-9035.
Or call (617) 366-1122.
Major credit cards, checks, COD, and POs (from major corporations and institutions) accepted. Add $3 shipping, $2 if COD, 5% tax in Mass. R&R works with dBASE III®, III PLUS®, and file-compatible products. Clipper™ Module $49.95 additional. Not copy protected.

Relate and Report, then rest and relax — with R&R. Another time-saving tool from the authors of 1-2-3 Report Writer™

Concentric Data Systems, Inc.
18 Lyman Street, PO Box 4063
Westboro, MA 01581-4063

the EtherLink cards. I have seen similar problems in IBM 3270 coaxial cable installations near a radar.

Check to see that one of the EtherLink terminating resistors is properly connected to a good electrical ground. The chassis of the computer might not be good enough to do the trick. Take the usual precautions, such as making sure that all covers and access plates are screwed on tightly. Run a wire from the nearest cold water pipe to some point on the network and attach it to the outer shield of the cable. Also, be sure to check for sources of pickup such as printer cables. Everything in a high-RF area must be fully shielded. A printer switch box that didn’t properly ground the unselected printer was found to be the culprit in one installation.

Since you have several networks serving important public functions, I suggest that the department budget for a network analysis system like Excelan’s LANalyzer. This is a powerful tool for troubleshooting, debugging, and managing local area networks. It is available either as a separate board and software system that you install in a desktop PC or as a LANalyzer System Package installed in a Compaq for portability.

The LANalyzer software produces statistics for up to 200 network stations concurrently. It can describe network utilization, packet and error counts, packet rates and size distribution, and other factors. The board and software cost $9,500, but with the investment in network hardware and software you already have, buying a maintenance system like the LANalyzer makes a lot of sense. Specify the model for “thin” Ethernet. (Excelan, San Jose, Calif., (408) 434-2300.)

SHARE YOUR NETWORKING SECRETS

Connectivity Clinic gives you practical solutions to networking problems of all types. We’ll pay $50 for any tips we print, plus an extra $25 if you submit your letter on a disk—and we’ll gladly answer any questions you have, at no charge. Mail your contributions to Connectivity Clinic, PC Magazine, One Park Avenue, New York, NY 10016, or contact Frank J. Derfler, Jr., via MCI Mail (use Derfler’s special box named PC Mag-LANS).
FEATURES STANDARD WITH US, OTHERS DON'T EVEN OFFER AS OPTIONS.

Take our ARC Turbo 12, for example.
Take its speed. The fastest off-the-shelf AT™ compatible you can buy. (12.5 MHz, 50% faster than IBM™.)
Take the ARC Turbo 12's exclusive MIPS Meter™ which gives you a digital readout of the actual number of millions of instructions per second currently being processed. And take ARC's unmatched reliability. Which is what you'd expect from one of the fastest growing computer manufacturers.
We back our equipment with a two-year limited warranty, the longest in the industry. Each unit also comes with 90 days of Free on-site service. And our technical support Hot Line gives you direct access to our expert staff.

Ask your ARC Authorized Dealer for all the details. (For a list, call 800-654-6151.)
It's a fast world. With ARC, it won't pass you by.
In California call (213) 265-0835

American Research Corporation

CIRCLE 327 ON READER SERVICE CARD
POWER USER
A deadly bug in dBASE and Clipper, a sticky solution for envelopes, widening your database horizons, painting with WordPerfect graphics, and letting Roget be Webster.

BATTING OUT BOXES
While experimenting with the .BAT file routines in PC Lab Notes (Volume 5 Number 6), I wondered if I could create something more interesting on-screen than just text menus. As a WordPerfect user, the obvious approach was to use WordPerfect's line-drawing function to create the displays, then try saving them as DOS text files. My .BAT files then call up the menus using the TYPE command, as suggested by Tom Sheldon.

As Figure 1 graphically shows, the trick works. I've found I can draw boxes or use any alternate character available within WordPerfect. My menus are much more readable this way, and creating them is a lot of fun.

John T. Jensen
Oren, Utah

The key here is to make sure you save the files as DOS text files, using the Text Out command (Ctrl-F5, 1). If you try to TYPE a file in DOS that's been saved in WordPerfect format, you will find mostly garbage on your screen.

Readers should also be aware that this trick is by no means confined to WordPerfect. You can create this kind of menu with any text editor that can use the PC's high-order character set and can produce straight ASCII files. This eliminates programs like WordStar that can't use the high-order character set. But it includes programs like XyWrite. One admitted advantage with WordPerfect, however, is the line-drawing feature. With programs like XyWrite, you would have to draw a box keystroke by keystroke. WordPerfect lets you "paint" the box with ease, using the arrow keys.—M. David Stone

DOUBLESCREEN
In many applications, while it's essential to scan the database horizontally (i.e., one record per line), the narrow 80-character screen width too severely limits what you can see. 2SCREEN.PRG, shown in Figure 2, lets the user pan left and right, doubling the display width.

Of course, dBASE's BROWSE lets you pan, as well. But BROWSE can be too powerful, since it allows the user to edit and append to his heart's content—all completely outside the programmer's control. Suddenly all kinds of things go awry.

You start to get urgent phone calls.

Besides protecting the data's integrity, 2SCREEN offers other benefits. For example, BROWSE automatically clears the screen upon exiting, whereas the user may want very much to retain the last display. Furthermore, BROWSE takes over the whole screen, while 2SCREEN gives you the top five and bottom two lines to display your client's name, program name, time, record number, etc., and also to customize the field headings. I've used the lower lines as a menu area, and one could easily add other choices like GOTO and FIND.

To demonstrate this subroutine, I wrote it as a standalone program, using a sample database called 2SCREEN.DBF that you'll have to create to test the program.
For Daisy Wheel, Dot Matrix & Ink Jet Printers

$89.00 Desktop Publishing Breakthrough

Imagine using a word processing and drawing program that lets you integrate charts and pictures that you 'paint' or 'clip' into your text. Well, if you use an IBM PC or Clone, now you can have graphically dramatic documents, from business or personal letters, to proposals, to organization charts, even with a daisy wheel printer.

By David Kaplan

It's easy. It's impressive. And, now your thoughts can be powerfully illustrated in both words and graphics.

After all, for illustrating abstract data and ideas, a graphic is worth a thousand words, and in this case, much more. So, let your ideas leap off the page by using integrated text and graphics. Your thoughts are sure to make an impressive impact.

Whether you write letters, bank proposals, term papers, company manuals or news letters, you can forget complicated and expensive laser printing. And, you can forget complicated expensive desktop publishing programs.

Now for just $89.00, you can use your daisy wheel, dot matrix or ink jet printer to print normal text. Plus, you can integrate simply fabulous graphs and drawings into your text.

INCREDIBLY EASY

Savtek, a brain trust group, has developed an easy to use yet intricately sophisticated integrated word processing and graphics program.

Just create your letters, proposals, or reports as you would with any other word processor. In fact, if you already have a document created in virtually any other word processor, you can 'grab' it into Savtek's instantly.

You'll produce visually powerful technical papers and manuals with drawings and charts, and dramatic marketing reports with graphs. You'll produce sales proposals with panache.

And since there's no complicated training needed (if you can run a word processor, you can run Savtek), you'll make great impressions, fast.

And, before you created the written part of your report, using Savtek's sophisticated automatic word processing features, you're ready to add pictures, charts and graphs.

Just select from the over 100 supplied changeable pictures or draw your own, using the automated ICON based drawing program.

Later, you'll learn much more about the sophisticated drawing program that lets you draw, paint, fill, expand, reduce, copy, and move your pictures.

And, you'll form squares, circles and triangles automatically. Anyone can draw with Savtek, it's totally automated and uses arrow keys and doesn't require a mouse. But, read on.

Once you've selected a picture, the computer will produce an automatically sized box representing it. Just position the box wherever you want the picture to be in the text.

Like magic, the actual picture will appear and the text will automatically reformat itself around it.

And, speaking of reformatting, this program will automatically make page breaks and recalculate each page as you write or edit it. If you make an addition to page 1 of a 10 page report, that effect will ripple through all 10 pages.

So, whatever length you've chosen for each page (including headers, footers and automatic page numbering), will automatically be preserved.

You'll particularly like the cut and paste features of this word processing program which allow you to copy, move or delete sections of your text.

Of course, you'll have automatic Wordwrap, Hidden Hyphenation, Justified Smooth Right or Ragged Right text. Plus, you'll have Find, Replace and Search.

And look how you can '_wrap_up' your document. There are 5 page templates called rulers which allow you to automatically set up your page.

You can select any right and/or left margins, your tabs, one, two or three line spacing, and the number of blank lines at the beginning of your page.

Each of the 5 rulers comes with different default settings. But, you can adjust and save them or change them and even use several at one time on a page.

HOW DO THE PRINTERS WORK?

I use a daisy wheel printer because I like my letters to look personal. I've always had to switch to a dot matrix printer for graphs and illustrations.

Unfortunately, I couldn't have my graphics on the same page as my text.

Now, because this program can use the period on the daisy wheel to create all the charts and graphic symbols you see within this ad, I don't need to switch printers any more.

And while it doesn't create the graphics as fast as a dot matrix, the quality is superb. Now my graphics can be impressively integrated into my text.

Note: Every single sample page shown in this ad, was printed out on my EXP 400 Silver Reed daisy wheel printer.

Note: This program does not produce two column news letters in a single action. Simply create a double length column and cut it when you have it printed.

No matter what printer you use, daisy wheel, dot matrix (with or without near letters) or ink jet (color or single color), you'll have powerful looking documents to really present your ideas in the most professional manner.

DESKTOP PUBLISHING

Desktop publishing is about the hottest category of computer programming. And it seems that everyone has discovered the impact of combining text and graphics. And very impressive presentations are just what Savtek's ETG Desktop publishing system provides for you.

Imagine leveraging the capabilities of your own IBM or Clone, your own printer and your own keyboard to produce the documents you see on these pages, with nothing else to buy.

THE 1000 WORD PICTURE

First a confession. I can't draw. That's why you don't see drawings in DAK's catalog. But I've been amazed at how creative I can be with the program.

It's easy. You do everything with the arrow keys and the return key. By using the arrow keys you can draw in any direction with a choice of 12 brush shapes. There's an erase function to eliminate anything you don't like. And here's my favorite function. UNDO is a function that works throughout this program.

...Next Page Please
You can copy or move a picture or even part of a picture right on the screen. So, draw it once and copy it or move it. But, here's my favorite. You can enlarge or reduce any picture or part of a picture right on the screen. So you can change its size equally, or you can stretch it out or make it tall and thin. Wow!

There are 12 included font/sizes. So you can have large or small type in your choice of styles within a picture or integrated with your text.

And, each of the 12 font/sizes can be shown on the screen and printed normally, in bold, in italic, or in shadow. Plus, you can write normally across the page, up the page, down the page or upside down.

Finally, you can zoom into any small section of the screen and edit your pictures, pixel by pixel. With this kind of power, you don't need to be an artist. Just have the ability to push a button.

You can operate this Paint program independently. Or, you can access any picture from within word processing.

So, for banners and pictures, you can print directly from the Paint Program.

Or, for everything previously described, simply access your pictures, captions, graphs or charts through the desktop publishing section.

This program is incredibly powerful, yet you'll be comfortable using it within just a few hours.

Every picture in this ad was created with this program. And, you haven't even seen the tip of the iceberg of its capabilities. For example, if you have a picture on the screen, you can bring a second picture up and join them together.

**WHO CAN USE THE SYSTEM?**

You're the one! You can be from 612 to 619, or 100% compatible with standard IBM CGA or EGA graphics capability. It must have at least 256K, and either two floppy disk drives or one floppy and a hard disk.

Below is a list of some of the dot matrix, ink jet and daisy wheel printers that have been tested with this program. If your printer is compatible with any of these printers, it should work too.

**Special Note: Moat Daisy wheel printers are Diablo 620/630 compatible, so they will work with this program.**

**Special Note: With a color printer you can print in color!**

**Design Layouts**

It simply removes the last thing you did. So, no matter what you do wrong, you're a button away from removing it.

If you don't want a solid line, just spray an area. It's like using a spray can.

Let's say you want to connect two points with a straight line. Use the Angle Line. It accepts a computer generated straight line between any two points.

What if you want a circle? Just touch the return key. Then use the diagonal arrow key to enlarge or reduce the circle. If you use the up/down or right/left arrows, you'll get an ellipse.

In these ways you can create squares, rectangles or triangles. And you'll be amazed how many things, from houses to technical drawings, are made up of squares, rectangles, circles and triangles.

But, that's not all. You can choose any of 32 background patterns to fill in enclosed areas or draw lines. And if 32 isn't enough, you can design your own.

There's so much more. You can juggle a picture. Imagine, turning it over or sideways with the touch of a button.
Open 7 days a week
(703) 847-4740  (800) 642-2395
Information and Technology Services, Inc.
Micro Systems Specialists
8478 Tyco Rd., Vienna, VA 22180

Prison SENSATIONS!
20 MB SEAGATE DRIVE $379
30 MB SEAGATE DRIVE $479
SAMSUNG AMBER MONITOR $79
NEW ENHANCED KEYBOARD $79
MONO GRAPHICS CARD $69
OTHER SYSTEMS
BIOs AT 8Mhz $1769
SPERRY MICRO IT $1795
IBM XT $1195
IBM AT $2395
1800 + AT (EVEREX) $1195

LAPTOPs AND ACCESSORIES
Toshiba T1100 w/640 (new screen) $1795
Toshiba 3100 $3195
Sharp PC 7000A CALL
NEC Multispeed $1599
Zenith 181 $1795
Centronics GLP II Printer $215
Toshiba Ext. 525 Drive $339
Toshiba 1200 Modem $329

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Centronics GLP II Printer $215
Toshiba Ext. 525 Drive $339
Toshiba 1200 Modem $329
ProSync your Multisync.

The best-selling name in EGA now brings out the best in your Multisync-type monitor.

You've decided to purchase a multisync-type monitor. Smart choice. But don't stop there. Bring out the best your Multisync has to offer with QuadEGA ProSync, the maximum performance EGA board from Quadram.

QuadEGA ProSync. All four graphics standards plus two higher resolution modes.

QuadEGA ProSync will support all four display standards, plus when teamed up with your multisync-type monitor, will give you two additional high resolution modes: 640x480 and 752x410. With QuadEGA ProSync your Multisync (or equivalent) can display 37% more data, giving you incredibly sharp characters and better defined, brilliant graphics.

Enhanced EGA from Quadram, the World's EGA Expert.

Quadram's QuadEGA ProSync, together with your multisync monitor, takes EGA to new performance heights.

So remember if you're in the market for a multisync-type monitor, don't settle for a medium performance graphics board. Bring out the best in your monitor with the maximum performance board from Quadram, QuadEGA ProSync. For more information contact us at One Quad Way, Norcross, Georgia 30093. Or call 404-564-5566.

Quadonga ProSync

Compatible with the world's best selling software

For a complete list, give us a call.

Windows by Microsoft • 1-2-3 by Lotus (120 columns) • In**A**Vision and Draw! by Micrografx • PageMaker by Aldus • EGA Paint by R&D Softworks • Dr. Halo II by Media Cybernetics • GEM by Digital Research • AutoCAD by AutoDesk • and Ventura Publishing by Xerox

Quadram An Intelligent Systems Company

Now Save Even More! 70% Off!

- Quadram Optical Mouse
- Microsoft Windows
- DRI GEM Desktop & Graph

Discount coupons included with each QuadEGA ProSync

Total Savings — $398

Free Mouse
In Specialy Marked Boxes Limited Time Only

CIRCLE 199 ON READER SERVICE CARD
**POWER USER**

*** 2SCREEN.PRG  Pans 2 screens.
SET TALK OFF
USE 2screen
* (Sample .dbf for testing)

PRIV client,sp,head1,head2,fld1,fld2
yrclient=[ABC COMPANY - PURCHASER FILE]
sp=SPAC(2)
head1=' REC# COMPANY NAME-----------------';
  +' CONTACT NAME-------------';
  +' CONTACT TITLE----------';
head2=' REC# CO NAME (Abbrev)----';
  +' STREET ADDRESS------------';
  +' CITY-------------------- ST ZIP--';
fld1='STR(RECN(),4)+sp+Co+sp+Name+sp+Tit1'
fld2='STR(RECN(),4)+sp+SUBS(Co,1,20)+sp';
  +'Str+sp+City+"+St+"+Zip'
* you customize above 6 variables

PRIV scr, xk, xkey1, xkey2, rec, ans
scr="1"
xk=' 3, 5, 13, 18, 24, 27, 88,101,120'
xkey1=' 2, 4,'+xk
xkey2=' 19, 26,'+xk
CLEA
SET ESCAPE OFF
@ 1,0 TO 3.79 DOUBLE
@ 2,(48-LEN(yrclient)/2) SAY yrclient
DO WHIL .T.
  @ 4,0 CLEA
  @ 4,0 SAY head&scr
  @ 5,0 TO 5.79
  @ rec=RECN()
  @ cfld=fld&scr
  @ DISP OFF NEXT 15 &cfld
  @ IF ,NOT. EOF() DO
      @ SKIP
  ENDI
  @ 23,0 TO 23.79
  @ 24,4 SAY IIF(EOF(),"END OF FILE","MORE: PgDn")+" PgUp"
  @ 24,32 SAY IIF(scr="1",CHR(26);" Left",CHR(27)+" Right")+" Screen"
  @ 24,55 SAY "E<=>it or <ESC>a"* Screen"
(continues)

Figure 2: This dBASE subroutine lets you scan up, down, left, and right.

yourself. Its structure is

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Name</th>
<th>Type</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NAME</td>
<td>Char</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>TITL</td>
<td>Char</td>
<td>22</td>
</tr>
<tr>
<td>3</td>
<td>CO</td>
<td>Char</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>STR</td>
<td>Char</td>
<td>25</td>
</tr>
<tr>
<td>5</td>
<td>CITY</td>
<td>Char</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>ST</td>
<td>Char</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>ZIP</td>
<td>Char</td>
<td>5</td>
</tr>
</tbody>
</table>

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CIRCLE 115 ON READER SERVICE CARD

---

ans=" 0"
DO WHIL .NOT. ans$&key&scr
   ans=STR(INKE(),3)
ENDDO
DO CASE
   CASE ans$' 2, 4, 19, 26'
      scr=IF(ans$' 2, 4', "2", "1")
      GOTO scr
   CASE ans$' 5, 18'
      GOTO scr
   temp=0
   DO WHIL temp<15 .AND..NOT.BOF()
      SKIP -1
      temp=temp+1
   ENDDO
   CASE ans$' 27, 88,120'.OR.EOF()
   EXIT
ENDDO
ENDCASE
ENDD
 USE
SET ESCAPE ON
SET TALK ON
* Above 3 lines for testing only
@ 23,0 CLEA
RETU
(Figure 2 ends)

IE's BROWSE command is versatile and powerful—there's nothing like it for active use. But BROWSE was never rived as a read-only displaying tool. tightly knit application, Mr. Vu is ably right about there being a real damn letting users change data outside of ramb control. Fools rush in where an should be led.  
4r. Vu's coding is both concise (e.g., space-saving use of the &scr macro IIF statements) and flexible (you can with <Esc>, 'x', or 'X'). If you d to see still more data for each record, you could easily convert 2SCREEN.PRG into 3SCREEN.PRG.

Now let's go full circle, from dBASE to Clipper, and from read-only scanning to direct editing. Clipper itself does not support the BROWSE interactive commands, and sometimes you need all the power of BROWSE's scanning, panning, editing, appending, and file-positioning capabilities. Happily, however, Personal Programming has produced an excellent emulation of BROWSE, details of which are shown in the accompanying Fact File. 
—Brad Stark
POWER USER

ENVELOPES WITH TRACTORS
On most printers with a tractor feed, you have to remove the paper every time you want to print an envelope. There’s an easier way. First, slide the bottom edge of the envelope between the printhead and the paper, then work the envelope backwards, under the platen, through the paper feed path. Then use a Post-it note to “stick” the envelope in position. Put half of the sticky portion on the envelope and half on the paper, being careful not to cover the return address area. Finally, line up the envelope and print.

W.C. Ginn
Albuquerque, New Mexico

A good idea, but unfortunately it just doesn’t work with all printers: in some cases it’s impossible to slide the envelope backwards into the paper path. With other printers, the top corners of the envelope will hit the tractor feed doors as the paper advances, dislodging the envelope from the paper, Post-it or no. In such a situation, however, you may be able to engage the friction feed to hold the envelopes with the tractor doors open.—M. David Stone

SPELLING BY THESARIUS
The Microsoft Word Spell program can’t find the right spelling of a word while you are writing or editing. With Word, Version 3.1, however, you can use the Thesaurus facility to spot-check a word. If it’s spelled right, you get a list of synonyms and can continue by hitting Escape. If the word is not in the Thesaurus, you get a list of near misses; if the correct spelling is listed, simply copy it into your document. Even with a floppy-based system, this is quicker than using a dictionary, and you don’t use up valuable RAM with an on-line spelling checker.

David Ross
Winterville, Georgia

A neat trick, and one that will work with the Word Finder Thesaurus program with nearly any word processor.—M. David Stone

MISSING PERSONS REPORT
dBASE III and Clipper users should be alerted to a potentially serious bug that occurs when INDEX UNIQUE encounters records marked for deletion. If you depend on precise accuracy from this command, beware. Here’s a simplified example, in which records marked for deletion are indicated by an asterisk:

Record# Name
1 Jones
2* Jones
3* Psmith
4 Psmith

If you INDEX UNIQUE with SET DELETE OFF, the software will see the first Psmith it finds but will show it marked for

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deletion (where it could be lost if you pack later).

1 Jones
3* Psmith

If you INDEX UNIQUE on this field with SET DELETE ON, the software will note that the first Psmith is deleted and ignore the rest of that key! All you'll have left is

1 Jones

A major vendor like Ashton-Tate should make its users aware of the situation and not take the attitude, “You find the bug first, then we'll send you the fix.” With a large database, identifying and fixing an error like this can be a nightmare.

— Antonio D. Wilkinson
Dallas, Texas

Moral: You should always PACK your file before using INDEX UNIQUE, or use dBASE's TOTAL ON capability instead. Actually, INDEX UNIQUE sometimes fails in other ways too. Call it dBASE roulette—a new game you can play on your own computer! I recently used INDEX.

— A major vendor should not take the attitude, “You find the bug, then we'll send you the fix.”

UNIQ on a 9,900-record file and lost all the records between CO and GU plus all those below WH. Repeating the process three times produced the same gaps using a Compaq Portable 286, and again using an IBM PC AT. One might want to list a key field from every 100th record to make sure you're playing with a full deck!

— Brad Stark

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ULTIMATE ERRORLEVEL ROUTINE
The YESNO script in Figure 1 improves the standard ERRORLEVEL batch file branching program five ways:

It accepts both uppercase and lowercase responses and then makes the appropriate conversions. If a user enters a key other than y, Y, n, or N, the program beeps and the cursor remains where it is. If the user presses Ctrl-Break or Ctrl-C, the program exits normally without changing the current ERRORLEVEL setting. The program prints a prompt on-screen, so the batch file doesn't have to. In addition, it makes it extremely simple for programmers to change the on-screen prompt.

Incidentally, DEBUG script files should really end with a .DEB extension rather than .SCR, since .SCR is widely used by graphics programs to designate screen files and screen dumps.

Adani Baruch
Kiriath Ha'm. Israel

If you want to change the message from "Enter Yes or No:", make the change in the last line (starting with the db). Then adjust the hex number 44 at the end of the script between rcx and w accordingly. If you make the message bigger, increase the 44; if you make it smaller, decrease the 44. Remember it's a hex number, not a decimal one, so that if your new prompt is five characters shorter, the new hex number is 3f, not 39. And remember to put a final $ at the end of your new prompt, before the last quote.

A sample batch file to exploit this program would be:

```plaintext
n yesno.com
s
mov dx,132
mov ah,9
int 21
;output character string
mov ah,9
;character output without echo
int 21
;do it
and al,df
;return response to upper case
push ax
;put AX onto stack
cmp al,4e
;compare response to "$"
jmp ax
;jump to N errorlevel status
cmp al,59
;compare response to "Y"
jmp 1123
;jump to Y errorlevel status
mov di,7
;output prompt with CHR$(7)
mov ah,2
;character output
int 21
;do it
pop ax
;remove AX from stack
jmp 107
;and go back to beginning
mov bl,0
;set errorlevel to 0 = N
jmp 125
;and jump around Y
mov bl,1
;set errorlevel to 1 = Y
pop ax
;remove AX from stack
mov dl,al
;get ready to display responses
mov ah,6
;direct console I/O (display)
int 21
;do it
mov ah,4c
;terminate with return code
int 21
;do it
db "Enter Yes or No: $"
rcx
44
w
q
```

**Figure 1:** YESNO script to create YESNO.COM. Type this in using a pure-ASCII word processor or the DOS COPY CON command. Be sure to leave a blank line before rcx and hit the Enter key at the end of each line, especially the last one. Then put it and a copy of DEBUG.COM (Version 2.0 or later) on your disk and type DEBUG<YESNO. A Y (or y) returns an ERRORLEVEL of 1, an N (or n) an ERRORLEVEL of 0.
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USER-TO-USER

Rouse and Larry Zimmerman in Volume 5 Number 17. Both programs made it easy to turn text files into small .COM files that displayed almost instantly. This technique let users create fast menus, help screens, readme files, etc.

Interestingly, several readers mentioned the difficulty in putting borders around the entire screen while in BASIC. BASIC normally scrolls the screen up when it prints a character in the last column of the 24th or 25th row.

There are several ways around this. Microsoft's QuickBASIC 2.0 lets you print in the lower-right-hand corner of the screen. Or you can lengthen the screen with a POKE so that the 25th line isn't really the lower-right-hand corner. If you do try this, remember to use another POKE command to bring the screen back to normal size, or BASIC will start printing things out below the 25th line, and you won't see them. To lengthen the screen, simply type

```
DEF SEG:POKE 92,27
```

To bring the screen back to normal, type

```
DEF SEG:POKE 92,24
```

POKE 41,x adjusts the right edge of the screen, POKE 91,x the top, and POKE 92,x the bottom (where x is the value you want to POKE in). The sample program in Figure 2 demonstrates the effect.

Finally, you can POKE values directly into the screen memory and prevent scrolling. If you're using a mono monitor, issue a DEF SEG=&H8000 instruction; with color make it DEF SEG=&H8800. Then just do a POKE 3838,x to put something in column 80 of row 24 and a POKE 3998 to print a character in column 80 of row 25. If you want to set the attribute, POKE a value into the following byte. To color the end of the 24th line, do a POKE 3839,x. For the 80th column of the 25th line, it's POKE 3999,x. This will put a red, white,

```
100 'BORDER.BAS -- by PC Magazine
110 *** pick border type ***
120 CLS:LOCATE 12,32:PRINT "Single or Double border (S/D)?"
130 IF INKEY$="S" THEN PRINT "BORDER=";DEF SEG=1:END
140 IF INKEY$="D" THEN PRINT "BORDER=";DEF SEG=3:END
150 IF INKEY$="." THEN PRINT "BORDER=";DEF SEG=0:END
160 ' *** fill screen with random text string ***
170 CLS:FOR p=3 TO 23:PRINT STR$(p):NEXT
180 FOR 1=1 TO LEN(STR$(p)):NEXT
190 Locate 8,48-LEN(STR$(p))/2:PRINT STR$(p):NEXT
200 ' *** jump to border/leave subroutine ***
210 LOCATE 25,25:PRINT "Now hit any key for your border;"
220 WHILE INKEY$=!"END"
230 GOSUB 288
240 ' *** reload text screen ***
250 CLS:LOCATE 12,32:PRINT "Now hit any key"
260 WHILE INKEY$=!"END":DEF SEG=1:END
270 '------------------------ subroutine ------------------------
280 DEF SEG=1
290 ' *** check monitor type and set segment accordingly ***
300 IF (PEEK(4E48)&15600)=4E48 THEN SEG=3 ELSE SEG=0
310 DEF SEG=1
320 IF *** poke border into memory ***
330 POKE 8,A:POKE 159,B
340 FOR A=2 TO 156 STEP 2:POKE A,C;NEXT
350 FOR A=148 TO 364 STEP 160:POKE A,A,158,D:NEXT
360 POKE 3844,E:POKE 3996,F
370 FOR A=3942 TO 3996 STEP 2:POKE A,C;NEXT
380 ' *** aava image as file called TEST ***
390 BSAVE "TEST",1,1,1,1
400 DEF SEG=RETURN
```

Figure 2: Sample screen-size-changing program.

Figure 3: Program that fills the screen with random text strings, then POKEs a border into memory. BSAVEs the image (as a file called TEST), and then reloads the image complete with border.
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CIRCLE 503 ON READER SERVICE CARD
and blue "US" in the lower-right-hand corner of a color screen:

10 DEF SEG=&H8000
20 POKE 3838,85
30 POKE 3839,23
40 POKE 3998,83
50 POKE 3999,71

The program in Figure 3 will fill the screen with random text strings, then POKE a border into memory, BSAVE the image (as a file called TEST), and then re-load the image complete with border.

**COMPILED WINDOWS**

Edison Hsu's BASIC windowing technique in April 1985, issue (Volume 4 Number 8) works in interpretive but not compiled BASIC. This is because the string length location pointed to by VARPTR is 1 byte in interpretive BASIC, but 2 bytes long in compiled BASIC be-

100 ' WINDOW.BAS -- for compiled BASICS only!
110 ' Original by Edison Hsu; revised by Francesco Francescangeli
120 DEFINT I: FOR I=1 TO 24:PRINT STRING$(80,"\"\"");: NEXT
130 LOCATE 12,25:PRINT * Hit any key to clear window *
140 WHILE INKEY$=**': : WEND
150 ** parameters: last row,last row,last col,last col ***
160 CALL ILR(3,20,10,70):END
17000 *** subroutine to clear the window ***
17010 SUB ILR(I1P1,I2P1,I3P1,I4P1) STATIC
17015 65985 RESTORE: CLR$=**'
17016 65980 FOR I=1 TO 10:READ I1A$: CLR$=CLR$+CHR$(VAL("**")*I1A$)): NEXT
17017 65986 MID$(CLR$,5,1)=CHR$(I1P1): MID$(CLR$,11,1)=CHR$(I2P1)
17018 65970 MID$(CLR$,7,1)=CHR$(I3P1): MID$(CLR$,8,1)=CHR$(I4P1)
17019 65980 ' *** address low byte ***
17020 65980 IPS=PEEK(VARPTR(CLRS)+2)
17021 65980 ' *** prevent overflow error on high address byte ***
17022 65980 IPS=PEEK(VARPTR(ClRS)+3): IF IPS>127 THEN IPS=IPS-256
17023 65980 ' *** find CLR$ address ***
17024 65990 IPS=IPS+(IPS*256)
17025 65990 ' *** execute DATA program ***
17026 65990 CALL ABSOLUTE (III)
17027 65990 END SUB

Figure 4: Program to blank a window, for Microsoft BASIC compilers, Versions 2.0 and above. This will create a gray-out-black window; for a colored window change the first 7 (between B7 and CD) in line 63040.

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CIRCLE 330 ON READER SERVICE CARD
cause of the increased string length (32767) that the compiler supports.
VARPTR+1 and VARPTR+2, which point to string address, must be changed in
any compiled version to VARPTR+2 and VARPTR+3.

If you're using the compiler, it's also a
good idea to take advantage of CALL ABS-
SOLUTE and supply the parameters. The
WINDOW.BAS program (designed for
Microsoft BASIC Compiler 2.0 or later) in
Figure 4 demonstrates how fast such win-
dowing works.

Calling the subroutine is very simple,
using the format

CALL ILR(r1,r2,c1,c2)

where r1 and r2 are the first and last rows,
and c1 and c2 are the first and the last col-
umns of the window to be blanked. All
four values must be decreased by 1, so if
you want to blank from row 6 to row 24
and from column 10 to column 70, you
should substitute values 5, 23, 9, and 79.
Francesco Francescangeli
Istia, Italy

This does indeed work quickly. The initial
7 (between B7 and CD) in line 65040 sets
the window color to gray on black; for a
colored window, substitute another value
there. For instance, a 4E will change it to
bright yellow on red.

8087 SNIFTER
Some compilers (for example, Turbo-87
Pascal) support the
8087/80287 coprocessor
but do not check to see
if one is installed.

To create CHK8087.COM, type in the
following CHK8087 script using a pure-
ASCII word processor or the DOS COPY
CON command. Then put it and DEBUG

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---

USER-TO-USER

.COM (Version 2.0 or later) onto your disk and type DEBUG < CHK8087. Be sure to leave a blank line before rcx and hit the Enter key at the end of each line, especially the last one.

a
int 11
and al,2
xor al,2
mov ah,4c
int 21
rcx
a
n chk8087.com
w
q

The program calls BIOS INT 11H to retrieve the switch settings on the system board and then DOS function 4CH to exit with the appropriate code. DOS Version 2.0 or later is required, and the utility may not work on some non-IBM machines.

The following batch program runs the program FASTPROG if a coprocessor is installed and runs SLOWPROG otherwise:

Echo off
Chk8087
If ErrorLevel 2 goto RunSlow
FastProg
Goto ExitBat
:RunSlow
SlowProg
:ExitBat
Echo Execution is complete

Russell V. Lenth
Iowa City, Iowa

Any program that can use a math coprocessor but that locks up if none is found really should include a routine that checks for the presence or absence of the chip and acts accordingly. This is the next best thing.

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WIDENING THE PATH

I tend to create a lot of subdirectories on my hard disk, many of which contain executable files. I use the PATH command in an AUTOEXEC.BAT file so I can access these executable files from within other subdirectories.

However, my PATH is quite long, and if I want to add something to it I have to retype the whole thing with the new subdirectory at the end.

I program in C, but I've discovered that the compiler functions that modify the environment alter only the environment of the C program, not DOS's environment table. When the C program terminates, DOS's environment is still the same.

How can I get access to DOS's environment table?

Brian Murphy
Ann Arbor, Michigan

The environment is maintained by COMMAND.COM in an area of memory to which you don't have direct access. You can see the contents of the environment by executing the SET command with no parameters. The environment contains a variable called COMSPEC, which indicates the disk and directory where COMMAND.COM is stored. If you've used the PATH and PROMPT commands, the environment will contain those as well.

Whenever COMMAND.COM loads an executable program into memory, it makes a copy of the environment table for use by that program. The segment address of this copy is stored at offset 2Eh in the program's Program Segment Prefix (PSP).

Figure 1: This ADDPATHC.C program appends a command line parameter onto your current path string and loads a secondary copy of COMMAND.COM.

```c
#include <stdio.h>
#include <stdlib.h>
#include <process.h>

main (argc, argv)

int argc;
char *argv [1];
{
static char path [256] = [ "PATH= " ];
char *comspec;
if (argc < 2) exit (255);
strcat (path, getenv ("PATH"));
strcat (path, ";" );
strcat (path, argv [1]);
putenv (path);
comspec = getenv ("COMSPEC");
spawnl (P_WAIT, comspec, comspec, NULL);
}
```

Figure 2: This DEBUG script creates EDPATHA.COM, a program that lets you edit your path string with the DOS editing keys. It uses the undocumented (and strange) interrupt 2Eh.

```
N EDPATHA.COM
A
MOV BX,0368 ; Above top of program
MOV SP,BX ; New stack pointer
ADD BX,+8F
MOV CL,04
SHR BX,CL ; Convert BX to segment
MOV AH,4A ; Deallocate memory
INT 21
PUSH ES
MOV ES,[002C] ; Points to environment
SUB DI,DI
MOV SI,016A ; Points to "PATH=
CLD
ES: ; SEARCH:
CMP BYTE PTR [DI],00 ; See if end
JZ 0133 ; JZ TRANSFER
PUSH SI
MOV CX,0085 ; 5 bytes to compare
REPZ
(continues)
```
As you've noticed, any changes a program makes to this environment alter only the copy, not the original.

If you need only to add a new directory path to an existing path string, however, you can do so very easily with a one-line batch file. Let's call it ADDPATH.BAT:

PATH=%PATH%;%1
You'd execute it by entering

ADDPATH C: subdir

where subdir is the subdirectory on drive C: that you want to add to your path string.

Don't go hunting through your DOS manual looking for the meaning of %PATH%. This batch file feature is not documented. (Interestingly enough, page 502 of the defunct MS-DOS Technical Reference Encyclopedia has a few words to say about it.)

Here's how it works: In a batch file you can use an environment variable name as a replaceable parameter by surrounding the name with percent signs. When COMMAND.COM executes the batch file, it replaces %PATH% with the existing directory path from the environment. In ADDPATH.BAT, this is followed by a semicolon and the parameter on the ADDPATH command line. When COMMAND.COM runs this batch file, then, it's as if the whole new PATH command were being executed.

The only real problem is that a bug in DOS 3.0 chokes on the %PATH% construction. ADDPATH won't work under DOS 3.0.

If you already have something programmed in C that changes the program's copy of the environment, you can make that the current environment by having the program load a secondary copy of COMMAND.COM. This second copy of COMMAND.COM then inherits the environment modified by the C program. The problem is that you end up with somewhat less memory than before, because both the

C program and the resident portion of the first COMMAND.COM are still sitting in memory not doing much of anything but taking up space. However, the advantages are that you can return to your original environment by executing an EXIT on the DOS command level.

Figure 1 shows a C program called ADDPATHC that does this. (The C at the end of “ADDPATH” is just to distinguish the name from the batch file ADD-

PATH shown above.) The command syntax is the same as for ADDPATH. ADDPATHC has been compiled under Microsoft C 4.00; other compilers may require some changes or may lack the necessary functions. You can significantly reduce the amount of memory that ADDPATHC takes up by using the /CPARMAXALLOC parameter on LINK. Note that after ADDPATHC loads the new COMMAND.COM, the environment will also include the string "C_FILE_INFO". Microsoft C puts this string into the environment whenever it spawns a new process.

In theory, an ADDPATHB.BAS program that works the same way as the C program is also possible. Here's one written for QuickBASIC 2.0:

HYPATH = ENVIRON("PATH") + ";" + COMMANDS_ENVIRONMENT HYPATH $ SHELL

(I did not use the BASICA interpreter for this job because it does not have any built-in procedure for accessing the command line parameter.)

Unfortunately, however, ADDPATHB almost always fails, returning an "Out of
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From GTE Corporation 1985 Annual Report

Throughout 1985 the GTE telephone companies pressed vigorously ahead with an array of integrated strategies that transformed them into "new" growth businesses poised for continued competitive success in the age markets of this decade. As a result, GTE's operational revenues reflect the latest technologies and high levels of reliability—all at the most competitive prices possible.

<table>
<thead>
<tr>
<th>1985 Telephone Revenues by Area (Dollars in Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. California</td>
</tr>
<tr>
<td>2. Midwest</td>
</tr>
<tr>
<td>3. Southwest</td>
</tr>
<tr>
<td>4. Florida</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

- California: $2,433
- Midwest: $2,085
- Southwest: $1,088
- Florida: $623
- Total: $5,140

Examples of GTE's commitment to productivity gains and operational excellence include a $10 million support program to train employees and convert them to GTE's office productivity systems and tools. At the same time, GTE expended $4 million to train their management teams and employees.
PC TUTOR

main ()
{
    static char editbuffer [80] = { "\x80\x80PATH=" };
    strcat (editbuffer, getenv ("PATH"));
    editbuffer [1] = etrlen (editbuffer + 2); /* count */
    editbuffer [2 + editbuffer [1]] = 13; /* CR */
    editbuffer [0] = editbuffer [1]; /* count */
    editbuffer [1] = ' '; /* blank */
    editbuffer [2 + editbuffer [0]] = 13; /* CR */
    INT2E (editbuffer);
}

Figure 3: This EDPATHC program does the same thing as EDPATHA but is written in C for greater clarity.

...memory" error. The QuickBASIC 2.0 manual warns about this. QuickBASIC seems to be working only with the environment area passed along to it by COMMAND.COM, while the C compiler moves the copy of the environment ADDPATHC created elsewhere and can allocate more memory for it if necessary. (Where is BASIC's dynamic memory allocation when you really need it?)

Neither the batch file nor the C program approach is entirely satisfactory, however. The ADDPATH batch file only lets you add new paths onto your current path; you can't take them off again. The ADDPATHC program could be expanded to allow full editing of path strings, but you're stuck with loading a new COMMAND.COM every time you run it.

It would be nice to have full editing control over a path string yet not have to load secondary copies of COMMAND.COM. Here's a way this can be done, using a batch file called EDPATHB.BAT (EDPATHB stands for "EDit PATH with Batch file"):

    ECHO PATH=%PATH% NEWPATH.BAT EDLIN NEWPATH.BAT

The first line creates a file called NEWPATH.BAT that contains a PATH command with your current path. (Once again, you can't use this under DOS 3.0.) The second line loads that into EDLIN. Once in EDLIN, you press I to edit the first (and only) line. You can then use the DOS editing keys (Right Arrow to recall characters, Del to delete them, Ins to go into insert mode, etc.) to change the path. Now hit Enter, followed by E to end EDLIN. EDPATHB then executes the NEWPATH.BAT batch file with your new path.

(If you don't like EDLIN, you can have this batch file load NEWPATH into the ASCII text editor of your choice. Even among DOS jocks, EDLIN is one of the most neglected DOS programs. But it's great for small jobs like this.)

UNDOCUMENTED INTERRUPT

There is yet another way to change COMMAND.COM's environment from within a program without having to reload a secondary copy of COMMAND.COM. This method requires the use of the undocu-

It would be nice to have full editing control over a path string yet not have to load a secondary copy of COMMAND.COM. This can be done using a batch file.

...mentioned and little-known (but strange) DOS interrupt 2EH. This interrupt passes a command line addressed by DS:S1 to COMMAND.COM. The command line must be formatted just like the unformatted parameter area of a PSP. That is, the first
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byte must be a count of characters, and the
second and subsequent bytes must be a
command line with parameters. The whole
thing is terminated by a carriage return.

When this command line is passed to in-
terrupt 2Eh, COMMAND.COM executes it.
If the transient part of COM-
MAND.COM is not present in memory,
the resident part will reload it. However, it
does not load a new copy of COM-
MAND.COM into memory, as do ADD-
PATHC and ADDPATHB.

Interrupt 2Eh is very strange. If it is
called from a program executed from with-
in a batch file, it will abort the batch file. If
it's executed in a program run from a Run-
a-Program or Shell option in an applica-
tion that has itself been executed from a
batch file, it aborts the whole chain and
will probably crash your system. Interrupt
2Eh is also difficult to use because it de-
str os the contents of all regis ters in-
cluding the stack pointer. I've found no part
of DOS that actually uses interrupt 2Eh, and
I don't know why it exists.

Nevertheless, let's see how we can take
advantage of it.

Figure 2 contains a DEBUG script that
will create a program called ED-
PATHA.COM (''EDit PATH with As-
sembly program''). You can create the pro-
gram in one step by going into DEBUG
and typing in the lines shown (you don't
need to type the semicolons or the com-
ments that follow them). Alternatively, you
can use an ASCII editor to create a script
file (.SCR) consisting of the lines shown.
Then use the redirect arrow to feed the
script file into DEBUG thus:

DEBUG < EDPATHA.SCR

When you run EDPATHA, it searches
the environment for a PATH and saves it in
an area of memory following the charac-
ters ''PATH=''. EDPATHA then passes
this string to DOS function call 0Ah. You
can then use the DOS editing keys to edit it.
For instance, if you want to add something
onto the end, press F3. This recalls the
whole line on-screen, and you just type the
addition. You could also do inserts and de-
letes. When you're done, hit the carriage
return, and EDPATHA will send the string
to interrupt 2Eh. COMMAND.COM then
executes the string like a regular PATH
command.

Because EDPATHA is in assembler, its
inner workings may not be quite clear.

Figure 3 shows a C program called ED-
PATHC.C (''EDit PATH with C'') that
does what the assembler program does but
with a lot of help from the C built-in func-
tions. (Again, Microsoft C 4.00 was used.)
Because interrupt 2Eh destroys all the reg-
isters, including the stack pointer, the nor-
mal int86 function cannot be used. EDP-
PATHC instead requires an assembly
language routine called INT2E.ASM,
which is shown in Figure 4. You can create
EDPATHC.EXE with the following com-
mands:

MSC EDPATHC;
MASM INT2E;
LINK EDPATHC INT2E;

Of course, you can always take the
brute force approach by having a program
search around in memory for COM-
MAND.COM's environment table and
then go in there and modify it. This I would
not recommend.

Heavy use of the environment, particu-
larly from within an AUTOEXEC.BAT
file, can cause it to become full. Under
DOS 3.1 (and higher), you can expand the
amount of memory COMMAND.COM re-
serves for the environment by putting the
following line in your CONFIG.SYS file:

SHELL=COMMAND.COM /P /E: x

where x is a number between 10 and 62 in-
dicating the number of paragraphs to allo-
cate for the environment. The default is 10
paragraphs. Each paragraph is 16 bytes,
so this allows you to set the environment to
anything between 160 bytes and 992 bytes.
This feature was not documented in DOS
3.1. In DOS 3.2 the /E parameter was doc-
mumented, but it was also changed. You
use exactly the same syntax, but now x di-
rectly specifies the number of bytes re-
served for the environment, and its value
may range from 160 to 32768.

Microsoft C 4.00 includes a program
that will patch previous versions of COM-
MAND.COM so that it can be used for
larger environments.

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<td>AT 512K, 30MB</td>
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<td>AT 339 w 30 MB</td>
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<td>Despro 286 Model 1</td>
<td>$2399</td>
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<td>Despro 286 Model 3</td>
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<td>Portable 286</td>
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<td>Portable 256K,2Drv.</td>
<td>$1599</td>
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<td>Portable II Model 3</td>
<td>$3799</td>
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<td>EPSON FX-286</td>
<td>$475</td>
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<td>FX-85</td>
<td>$399</td>
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<tr>
<td>LQ 800</td>
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<td>LQ 1000</td>
<td>$649</td>
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<td>BROTHER M 1709</td>
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<td>M 1509</td>
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<td>P341/351</td>
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<td>NEC P6</td>
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<td>NEC P7</td>
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<td>20 MB Sub Systems</td>
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<tr>
<td>30 MB Sub Systems</td>
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<td>20 MB (40ms)</td>
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<td>30 MB (40ms)</td>
<td>$699</td>
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<td>40 MB (40ms)</td>
<td>$849</td>
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<td>AST 6 pk w. 0k</td>
<td>$169</td>
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<td>MFC w.384 K, C,S,P,G</td>
<td>$179</td>
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<td>$349</td>
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<td>1200b Modem (Int.)/SW</td>
<td>$129</td>
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<td>2400b Modem (Int.)/SW</td>
<td>$279</td>
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<td>Mini I/O C,S,P,G</td>
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<td>AT SER/PAR</td>
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<th>Software</th>
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<td>LOTUS 1-2-3 Ver.2.0</td>
<td>$319</td>
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<td>dBase III + FW II</td>
<td>$389</td>
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<td>WORD PERFECT 4.1</td>
<td>$199</td>
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<td>VP Planner</td>
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<td>SAMSUNG TTL</td>
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<td>AMDEK 310A</td>
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<td>TAXAN EGA 760</td>
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<td>NEC Multisync</td>
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<table>
<thead>
<tr>
<th>Test</th>
<th>NOP executive spanning 128K</th>
<th>1.67</th>
<th>1.31</th>
<th>1.43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>&quot;do nothing&quot; 1 NOP loop</td>
<td>1.80</td>
<td>1.59</td>
<td>1.53</td>
</tr>
<tr>
<td>Test</td>
<td>Integer add from memory</td>
<td>1.85</td>
<td>1.53</td>
<td>1.56</td>
</tr>
<tr>
<td>Test</td>
<td>Integer multiply from memory</td>
<td>1.13</td>
<td>0.82</td>
<td>0.94</td>
</tr>
<tr>
<td>Test</td>
<td>Floating point without 8087</td>
<td>1.97</td>
<td>1.59</td>
<td>1.66</td>
</tr>
<tr>
<td>Test</td>
<td>Floating point with 8087</td>
<td>1.95</td>
<td>-1.43</td>
<td></td>
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COMING UP

COMMUNICATIONS ISSUE Connecting your personal computer to the world beyond your desk is one of the best ways to become a true participant in "the information age." A telephone line, a modem, and a copy of PC Magazine's special issue devoted to communications are all you'll need to get started down the road to on-line activity.

MOUNTAINS OF MODEMS First, the modems. In true blockbuster tradition, we have gathered over 80 modems from all price ranges and technical categories and subjected them to an exhaustive series of benchmark tests using PC Labs' new modem testing equipment. All the reviews of the modems focus on ease of use and each product's special features. We've also provided an extensive glossary of communications terms and a comprehensive features table that will turn you into an instant modem expert.

ON-LINE DATABASES If you've ever considered linking up with an on-line database, take a look at Tom Badgett's introduction to 12 of today's most popular on-line databases, including The Source, CompuServe, Dow Jones News/Retrieval, BRS, GEnie, and Vu/Text. These electronic almanacs offer their subscribers everything from current stock quotations and news bulletins to movie reviews and even on-line personal ads. Also included are reviews of three database search software packages that will help you maximize your on-line productivity and minimize your phone bills by helping you find the most direct route to the information you need.

ELECTRONIC MAIL Barbara Krasnoff reports on the ever-expanding world of electronic mail. It's the quick and easy way to send messages without the hassles of stamps or busy signals. Reviews include the three leading public e-mail services, MCI Mail, EasyLink, and AT&T Mail, as well as several of the more exclusive corporate e-mail services.
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