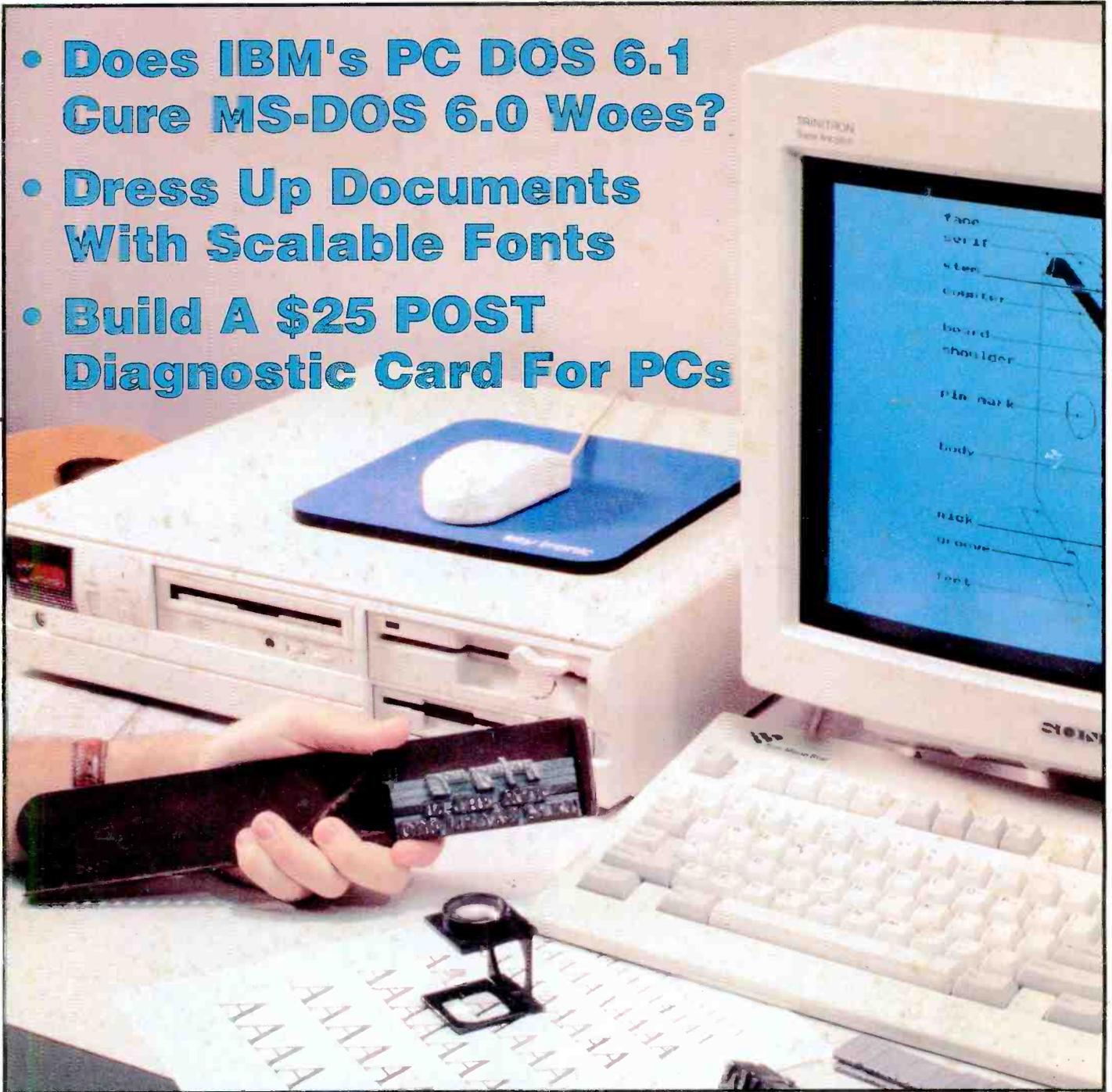


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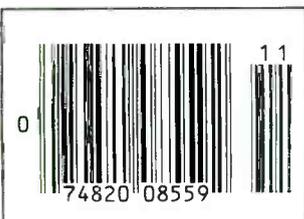
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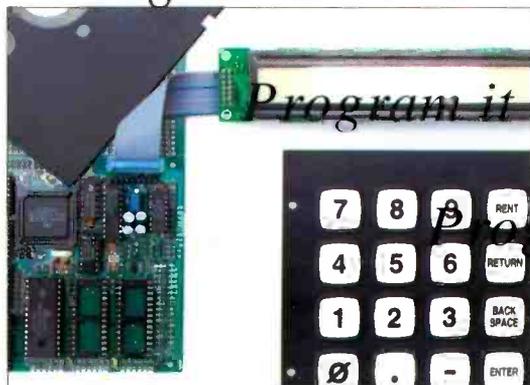
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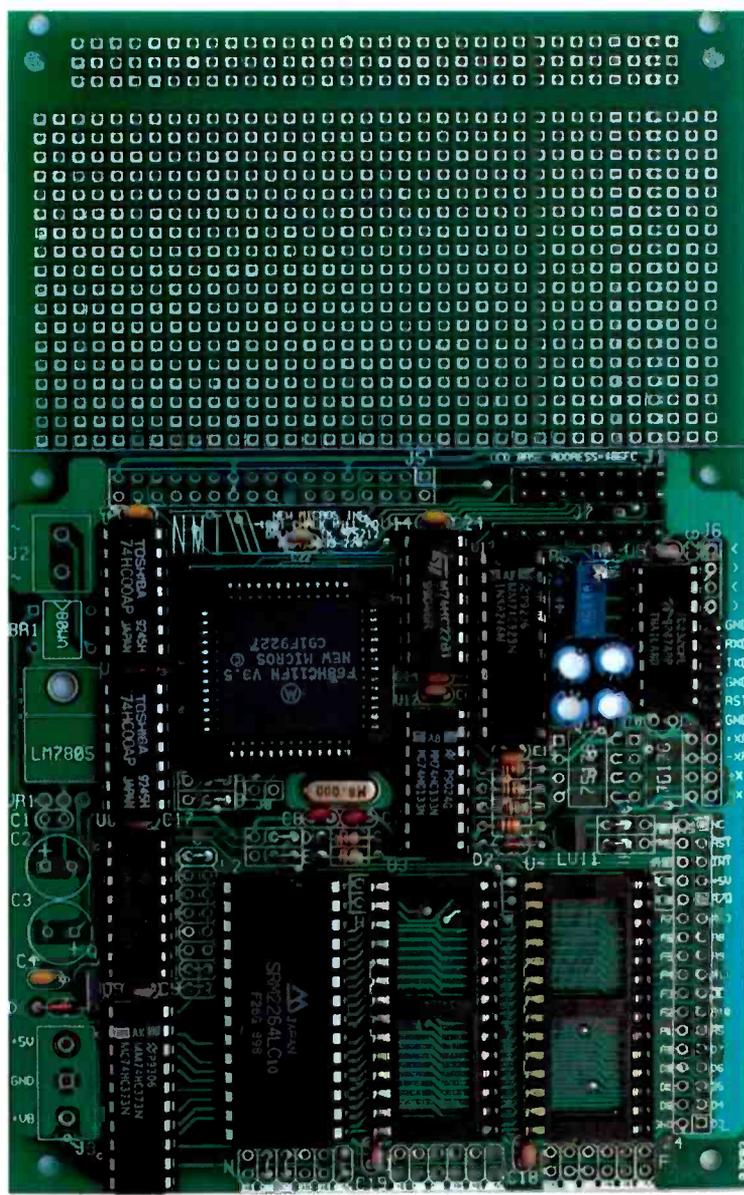
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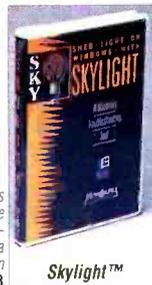


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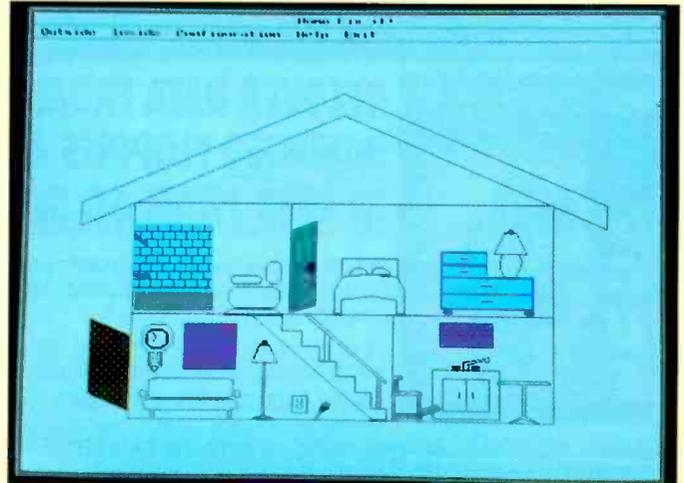
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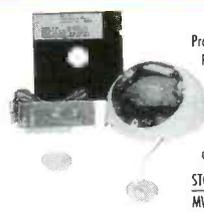
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Computer Pricing

I've always observed manufacturers' suggested retail prices with a mixture of amusement and chagrin. How in the world do these makers, especially software producers, come up with their "list" prices? *WordPerfect 5.1*, for example, carries a manufacturer's price tag of \$495, while the "street" price is more like \$275. *Norton Utilities 6.01* is listed at \$179 and carries a typical street price of around \$110, Microsoft MS-DOS 6.0 upgrade is listed at \$129, with a street price of around \$40.

There was a time when a list price and an actual selling price had a smaller gap. That was when most software was sold by computer stores, whose proprietors supported the merchandise they sold in a host of ways. Among them was a personal sales staff. A real person to whom you could talk face to face, who could often demonstrate how some of the more-popular packages worked. Many of these stores also had technical people who could, in the flesh, help you when the software wouldn't work on your machine.

This service costs the retailer money, of course, and he deservedly charged closer to the manufacturer's list price than, say, a mail-order company did that didn't incur these extra costs. Moreover, you could pop into a store any time you wished during its operating hours and get personal guidance. In contrast, mail-order operations typically had order takers, not counselors.

There was a time, too, when most consumers weren't even aware of the huge mail-order operations around the country that heavily discounted merchandise. Or, if they did, they didn't have much confidence in these companies, hesitating to fork over a lot of money to a phone voice before getting the product in their hot hands. And then there was the thought of an indeterminable wait before they received the products they ordered.

But much of this has changed. Many mail-order companies do provide some guidance. And private carriers can get the merchandise to you overnight for a fee. People are much more sophisticated today, too, and are aware that there are multitudinous mail-order computer-product companies that provide low prices with good service. Furthermore, local store-front operations have lowered their selling prices so that the differential isn't quite as great anymore. Moreover, there are local software discount chains across the country that more-closely resemble

mail-order companies in selling-price structure.

Nevertheless, the disparity between list price and street price remains. I guess manufacturers feel that their merchandise will move better if the prospective buyer believes he's getting a great bargain in any case.

It is, of course, a charade. I mean, a 50% discount from list on late-version software is ridiculous. If the automobile industry priced its cars this way, it would mean that a Lincoln Continental that lists for \$32,000, would typically sell for \$15,000 instead of, say, \$29,000.

With more and more manufacturers recognizing that they can sell computers and software direct to consumers, some machines and software now carry the same list price as the selling price. The computer makers in this group—IBM, Compaq, Epson, Samsung, and others—have entered the direct-response arena with "Value" computers, families of computer models that have lower prices than the store-sold models they distribute for sale to end-users. IBM, for example, recently mailed 80-page, four-color catalogs called the "SuperSource" to more than 1.3-million prospective customers. Using a toll-free 800 number. Interestingly, shoppers are also offered non-IBM personal-computer products.

One company, Panasonic, recently reduced its suggested retail printer prices to more accurately reflect actual selling prices. For example, its Model 4410 laser printer, previously listing for \$1,095, now lists for \$769. Good-bye, artificial discounts! Now Panasonic can advertise products with realistic prices attached to them. Congratulations, Panasonic, for starting to bring some sense to pricing practices in the computer field. I hope other manufacturers follow your common-sense lead and get rid of the non-sense vapor margins that insult the buyer.

Finally, here's a buying tip for you: If you're planning to purchase more memory, do it now. Memory chips are expected to soar in price because of an explosion in a key factory in Japan that makes about 60% of the world's epoxy for packaging ICs. Although there are plenty of ICs in the distribution pipeline right now, next year will likely see much higher prices.



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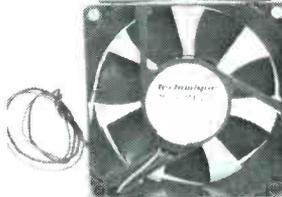


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- * EEPROMS (2816 . . . 28010)
- * Page Mode EPROMS (27C513, 27C011)
- * Flash E (E)PROMS (128F256 . . . 28F020)
- * 16 Bit (40 Pin) E (E)PROMS
- * Microchip PIC16C5x series
- * NS COP Microcontroller series
- * 8751 series (Intel)
- * 87C51, 87C52 series (Sig)

System Requirements

- * Type: IBM PC/XT/AT/386/486 or compatible
- * A hard disk drive is recommended for software installation
- * RAM: 300k
- * OS Environment: MS DOS 2.11 or later

Specs:

- * Dim 5.7" (L) x 3.3" (W) x 1.3" (H)
- * Socket: 32 Pin ZIF Textool (300-600 mil spacing)
- * Interface - parallel data transmission
- * Cable: 3 ft w/40 Pin ribbon cable
- * Program up to 4 EPROMS at once

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PREVENTIVE MAINTENANCE STUDY. According to a national study of PC service technicians conducted by the Read/Right Products Division of Texwipe, 87% of respondents felt that a regular cleaning and maintenance program could prevent 30% of failures. The greatest number of service managers, 24%, felt that a user should clean disk drive heads once a month, while 17% said once a week, and 14% said either every day, every two months or two months or more-frequent cleaning. About 38% reported spending up to one-quarter their time on repairing disk drives, 23% up to half their time and 25% from half to three-quarter of their time.

On regular cleaning of printers, 14% of service managers recommended once-a-week cleanings, 11% every two weeks and 38% every month. Sixty-two percent did not favor user maintenance of laser printers. Compressed air was used by 75% of respondents to clean keyboards, 14% used pre-saturated wipes and 11% plastic cleaning solutions.

According to the survey, the average hourly fee charged is \$70.62, with average time required for a service call at slightly more than 1-1/2 hours. Thus, a typical service call will cost about \$105.93.

INFORMATION SOURCES. The National Technical Information Service (NTIS) released a free catalog that lists hundreds of Government-produced software products and data files that deal with environmental topics. "U.S. Government Environmental Data files & Software for Microcomputers and Mainframes" sorts products into five subject areas: air, general health, solid and hazardous wastes and NASA software. Examples of programs are a microcomputer model of the effects of indoor air pollution, estimates of landfill air emissions, civil judicial cases filed on EPA's behalf by the Department of Justice, and a database of more than 400,000 facilities regulated by EPA. Descriptions include computer specs, program language and operating system. Call 703-487-4650, ask for the free PR-758KSN.

"ReCaL/z" from Information Handling Services is a database of resistors, capacitors, inductors and networks for those involved in electronic design, component engineering, purchasing, specification and maintenance. The search-able library allows engineers to locate and compare passive devices, find replacement or alternate parts and view manufacturers' data sheets in a matter of minutes, even seconds, including complete text, charts and graphics. Retrieval is by keywords or a manufacturer's catalog and using the table-of-contents. It's available for DOS and UNIX and is updated every 60 days. Contact IHS at 800-241-7824. The company also has a "Vendor Master Directory on CD-ROM" for stand-alone PCs and networks.

SPEEDY CD-ROM CHANGER. Third Wave Computing, Austin, TX, announced a new CD-ROM Changer that's said to combine the fastest transfer rate—612 kb/sec—with six-disc selection. The changer uses technology that causes the disc to rotate four times the normal speed. It also plays audio compact discs and automatically switches to audio mode. For more information, call Brad Sharp at 512-477-9848 ext. 470.

IBM OPTIONS. IBM has expanded into the computer peripherals market with new product line called "Easy Options." It consists of 53 categories, including audio and game cards, modems, video cards, TV cards, memory, keyboards, mice, trackballs, CD-ROM drives, hard drives, tape drives, floppy drives, power supplies and scanners. The products will be sold in retail stores. Also, IBM offers seven-days-a-week, toll-free support for the product line. And if within 30 days of purchase a consumer is dissatisfied with an Easy Options product, IBM will refund the purchase price.

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NRI training gives you a practical understanding of today's PCs...how they work, what can go wrong, and why. Best of all, you master state-of-the-art troubleshooting skills through hands-on training with a powerful AT-compatible computer, 40 meg IDE hard drive, and professional diagnostic hardware and software — PC Tools, R.A.C.E.R., and Quicktech — all yours to keep!

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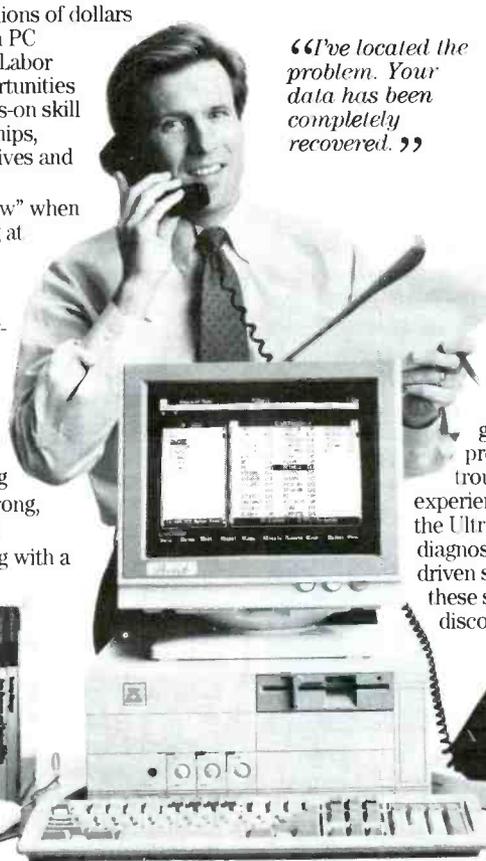
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Multimedia PC

The Tandy Multimedia Personal Computer is a 25-MHz 80486SX-based multimedia PC with 4M of RAM, 130M hard drive, SVGA graphics, mouse and Sound Blaster Pro eight-bit audio card. It includes a built-in CD-ROM drive and a vari-



ety of multimedia software programs, such as *The San Diego Zoo Presents the Animals*, *The Software Toolworks World Atlas and Reference Library* and America Online. DOS 6.0, Windows 3.1, and Microsoft Works for Windows are also included. \$1,599. Radio Shack, 700 One Tandy Center, Fort Worth, TX 76102.

CIRCLE NO. 1 ON FREE CARD

PC Telecommunications Center

IBM's WindSurfer Communications Adapter utilizes Mwave technology to consolidate the separate data/fax modem, audio, voice messaging and telephone-answering functions into a single add-in card. WindSurfer is one of IBM's first products to utilize the advanced Mwave DSP technology developed by the Mwave alliance partners of IBM, Texas Instruments and Intermetrics. The Mwave DSP processor and on-board Mwave/OS permits consolidation of functions normally found on separate add-in adapters.

WindSurfer is a 16-bit ISA busmaster adapter that occupies a single full-size slot in ISA or EISA systems with a 386SX or later processor. It operates under Microsoft Windows 3.1 and complies with MPC audio specifications.

WindSurfer's 16-bit DACs provide CD-quality stereo sound, with sample rates up to 44.1 kHz. Its MIDI sound comes from digital samples of real instruments.

WindSurfer includes two software programs: *Trio Data-FAX Lite for Windows* for FAX processing and a Prodigy service membership for modem processing. Also included is a telephone-answering function called PhoneFX. IBM Corp., 1133 Westchester Ave., White Plains, NY 10604.

CIRCLE NO. 2 ON FREE CARD

PC Sound System

Media Vision's Pro AudioStudio 16 sound system is an enhanced version of its Pro AudioSpectrum 16 sound card that includes a variety of new software applications to make it easier to use and provide broadened functionality. The Pro AudioStudio 16 features a full multimedia guided tour, installation software, voice rec-



ognition with 300 words, a MIDI sequencer for composition, audio editing tools and a computer mounted microphone. It 16 features 16-bit stereo digital audio recording and playback to 44.1 kHz and on-board FM synthesizer, software controllable mixer, MIDI support, game port and industry-standard SCSI CD-ROM controller interface. New enhancements include selectable input gains, line level and 4-watt speaker audio output and improved sound fidelity. Audio compression and decompression included with the product offers 4:1 compression.

The voice-recognition software, called *ExecuVoice*, was developed by Dragon Systems, Inc. Also included is *Monologue for Windows*, a text-to-speech software program from First Byte, that features 16-bit samples for higher quality. For users who want to record and

edit music or other audio input, there's *MIDIssoft Recording Session*, a Windows-based MIDI sequencer, and *Sound Impressions*, a professional digital-audio editing package from DigiVox. As with other Media Vision add-in cards, the Pro AudioStudio 16 comes with *Pocket Tools*, a set of application programs that can be used for everything from recording and editing digital audio to controlling playback of audio CDs in a CD-ROM drive attached to the PC. \$349. Media Vision, 3185 Laurelview Ct., Fremont, CA 94538; tel.: 800-348-7116; fax: 510-623-5749.

CIRCLE NO. 3 ON FREE CARD

Graphics Accelerator

The Pegasus VL24+ graphics accelerator card from STB is a VESA local-bus-compatible graphics accelerator capable of displaying 16.7-million colors at resolutions of 640 X 480, 800 X 600 and 1,024 X 768. Based on the S3 86C928 video controller, the VL24+ comes standard with 4M of VRAM and supports resolutions up to 1,024 X 768 at 16.7-million colors and up to 65,000 colors at 1,280 X 1,024. Refresh rates supported are 60, 72 and 76 Hz. The product comes with a BNC-type RGB connector and VGA 15-pin D-sub connector. Included drivers support Microsoft Windows 3.x and NT, IBM OS/2, SCO Open Desktop, Uniware, X-Windows and major CAD/CAM platforms. \$999. STB Systems, Inc., 1651 N. Glenville, Richardson, TX 75085; tel.: 214-234-8750; fax: 214-234-1306.

CIRCLE NO. 4 ON FREE CARD

Windows Video

Creative Labs' VideoSpigot for Windows digital video capture card for the PC is now available bundled with Cinepak CODEC and Microsoft Video for Windows. VideoSpigot for Windows and Cinepak provide a complete solution for professional video presentations by capturing full-motion video from VCRs, cameras and las-



erdiscs and giving you the ability to edit them as .AVI files with Microsoft Video for Windows. \$399. Creative Labs, Inc., 1901 McCarthy Blvd., Milpitas, CA 95035; tel.: 408-428-6600; fax: 408-428-2394.

CIRCLE NO. 5 ON FREE CARD

DOS Backup

Fastback Plus 6.0 is the latest version of Fifth Generation's DOS backup program. It has a simplified interface, added security and network features and a lower price. It also provides virus detection and enhanced tape support. With this new version, you can backup your desktop to tape drives connected to other desktops across networks. Administrators can schedule unattended backups of users' machines to tape drives during off hours. *Fastback Plus 6.0* includes the scanner portion of Untouchable, Search and Destroy, a top virus scanner. You can scan for viruses on the fly during the backup operation. Scan speeds exceed 200M per minute.

In addition to QIC 40/QIC 80 tape drives, Version 6.0 now supports large-capacity SCSI tape devices using a controller card with an ASPI interface, such as Adaptec, as well as Future Domain and Micro Channel-bus SCSI cards. The new version also lets users back up notebook computers to any device accessible to their desktop computer. \$149. Fifth Generation Systems, Inc., 10049 N. Reiger Rd., Baton Rouge, LA 70809; tel.: 504-291-7221.

CIRCLE NO. 6 ON FREE CARD

PC-to-TV Converter

TelevEyes/Pro from Digital Vision is a hardware-only video scan converter that converts computer video to recordable composite or S-video. Whatever appears on the computer monitor can be displayed simu-



Itaneously to a large-screen TV monitor or video projector, or it can be recorded to video tape. TelevEyes/Pro is an external device that connects between the computer's output and monitor.

A built-in genlock feature allows you to overlay computer-generated screens over live video. This feature gives TelevEyes/Pro the capability of doing video titling and special effects, such as combining computer animations with live video (the "Roger Rabbit" effect). TelevEyes/Pro works with IBM PC and compatible computers and Macintosh computers. \$799.95. *Digital Vision, Inc., 270 Bridge St., Dedham, MA 02026; tel.: 617-329-5400; fax: 617-329-6286.*

CIRCLE NO. 7 ON FREE CARD

Graphics and Sound

AudioGraphix from Genoa combines the technologies of a True Color graphics accelerator with a sound component capable of 16-bit recording and playback. The product is designed for VESA local-bus architecture. Sound performance is compatible with Sound Blaster, AdLib and Windows Sound System.

Based on the Cirrus Logic GD5426 GUI accelerator chip, the Audiographix accelerator



component delivers a maximum resolution of 1,280 X 1,024, with 16.8-million colors displayed at 640 X 480. The card ships with 1M of DRAM standard and can accommodate 2M. With additional DRAM installed, High Color (64K) is available at resolutions up to 1,024 X 768. Genoa's proprietary FlickerFree technology ensures a stable image display at vertical refresh rates up to 114 Hz.

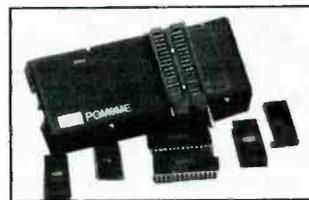
The audio component of AudioGraphix includes an 11-voice FM MIDI synthesizer. Recording and playback is achieved through a choice of compression methods, such as PCM and ESPCM. High-quality sampling is available at rates of 4 kHz to 22.05 kHz. A master volume control lets you make adjustments "on the fly," eliminating the need to manually adjust dials when changing from program to program.

Bundled with AudioGraphix is the *Audio Clips Library, Audio Recorder, Audio Reminder, Stopwatch, Timer, Talking Calculator, and Talking Clock and Chimes*. \$299. *Genoa Systems, 75 E. Trimble Rd., San Jose, CA 95131; tel.: 408-432-9090; fax: 408-434-0997.*

CIRCLE NO. 80 ON FREE CARD

E/EPROM Programmer

Advanced Transdata's PGM-8ME is a compact, portable programmer for EPROMs and EEPROMs. Designed to provide portability to its users, it



runs on IBM PC/compatibles, including notebook and laptop models, and operates transparently via a parallel port. It comes with a 32-pin ZIF socket and programs eight-bit 27xxx and 27Cxxx series, 12.5-volt EPROMs of up to 8M-bit capacity and EEPROMs from 2864 to 28040.

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CIRCLE NO. 52 ON FREE INFORMATION CARD

November 1993 / COMPUTER CRAFT / 9

mouse support. You choose manufacturer and device type, and the software automatically selects the manufacturer's recommended programming algorithm for maximum programming speed and reliability. Split programming is available to program devices up to 32 bits wide. A full-screen text editor is included. Supported data formats include Intel Hex, Motorola S-Record and Binary. \$149. *Advanced Transdata Corp., 14330 Midway Rd., Ste. 104, Dallas, TX 75244; tel.: 214-980-2960; fax: 214-980-2937.*

CIRCLE NO. 9 ON FREE CARD

RISC-Powered Lasers

Panasonic's KX-P5410 and KX-P4440 Laser Partners are each powered by Intel's i960 RISC processor. The KX-P5410 is a five-page-per-minute Adobe PostScript Level 2 laser printer that offers 17 Adobe fonts, can emulate the HP LaserJet IIP and includes 28 internal bit-mapped fonts. The 300-dpi KX-P5410 comes standard with 2M of RAM and a 200-sheet cassette.



The KX-P4440 is a 10-ppm laser printer that offers PCL5 compatibility and Panasonic's proprietary edge-smoothing and resolution-enhancement technology called SatinPrint. It comes with eight outline fonts and 28 internal bit-mapped fonts and features 300-dpi resolution, HP LaserJet III/PCL5 emulation, 1M of RAM and two 200-sheet cassettes. \$1,399/\$1,449, KX-P5410/KX-P4440. *Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; tel.: 201-348-7000.*

CIRCLE NO. 10 ON FREE CARD

Speech Recognition

Telaccount, Inc. has upgraded its *Speech Recognizer* software. Version 2.0 works with most Windows 3.1-compatible sound cards and offers a connected-word mode that doesn't require distinct pauses between spoken words. *Speech Recognizer* uses your computer's sound card to listen for spoken words and phrases. When it hears a word or phrase you trained it to recognize, it can carry out a command or transcribe your spoken words into a word processor, spreadsheet or any other Windows application. \$69. *Telaccount, Inc., 257 Robinson Ave., Bronx, NY 10465; tel./fax: 718-824-3493.*

CIRCLE NO. 11 ON FREE CARD

Harvard Graphics Update

Harvard Graphics for Windows Version 1.01 from Software Publishing enables you to add such multimedia elements as sound, MIDI music and animation to on-screen presentations. This is accomplished through a multimedia player called HGW Play, which works in conjunction with the product's Launch Application feature. Users running Windows 3.1 with Multimedia Extensions define an on-screen button and use it to trigger the multimedia clip.

Version 1.01 also provides you with faster access to RYr Presentation Styles and Symbol Library. You can now select and preview Presentation Styles in one step, enabling you to adapt the background design, color and style of a presentation to varying audience and A/V requirements. The new version's Symbol Library offers a new add-to-slide button that lets you quickly add symbols to slides in a presentation. \$595. *Software Publishing Corp., 3165 Kifer Rd., P.O. Box 54983, Santa Clara, CA 95056; tel.: 408-988-7518.*

CIRCLE NO. 14 ON FREE CARD

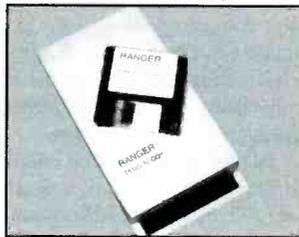
HiJaak Update

HiJaak PRO 2.0 is a graphics

PCMCIA Peripherals

PCMCIA Modems

Megahertz's XJ1144 and XJ124FM PCMCIA data/fax modems feature a patented XJACK—short for “extendible jack”—design that provides a fully internal bus extendible RJ11 jack on a PCMCIA modem card. When you're ready to send or receive data, you press on the exposed end of the PCMCIA card and the RJ11 automatically ejects. After transmission is complete, you push the connector back into its internal locked position. The data/fax modems with XJACK are compatible with PCMCIA 2.0 Type II, III

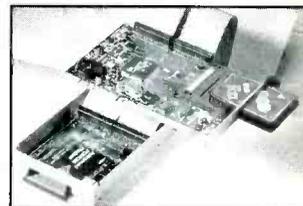


and Toshiba Type IV credit-card sized modems. The XJ1144 is a 14,400/14,400-bps data/fax modem and the XJ124FM is a 2,400/9,600-bps data/fax modem. Both models include V.42 advanced error correction and V.42bis data compression, as well as data communications and fax software. *Megahertz Corp., 4505 S. Wasatch Blvd., Salt Lake City, UT 84124; tel.: 801-272-6000; fax: 801-272-6077.*

CIRCLE NO. 12 ON FREE CARD

PCMCIA Drives

The CARDport family of PCMCIA drives from CNF enable PCMCIA cards to be accessed using standard DOS facilities. CARDport eX connects to the computer via the parallel port and is a self-contained, battery-powered portable unit. CARDport is an internal module that plugs directly into the ISA expansion bus of an AT type computer and provides two PCMCIA



card sockets, one in the back-plane and the other at the front in a spare drive bay. These devices look and feel just like a normal DOS disk drives that permit access just like DOS floppy disks. CARDports read from and write to all memory card types, such as SRAM, flash, EEPROM, PROM, OTP, etc., and all known data formats, such as Card Information Structure, HP-95, Sharp PC-3000, etc. CARDports also support the new ATA hard drives and solid state-drives, providing access to data storage capacities greater than 200M. *CNF, Inc., 17705 Hale Ave., Bldg. 1, Morgan Hill, CA 95037; tel.: 408-778-1160; fax: 408-779-6558.*

CIRCLE NO. 13 ON FREE CARD

utility that lets you view, convert, capture, enhance and print graphics images in the Windows environment. This upgrade of *HiJaak for Windows* places special emphasis on increasing the speed of opening and loading files, scrolling images and zooming. In addition to the more than 60 graphics formats it supported in Version 1.0, *HiJaak PRO* 2.0 adds Kodak Photo CD, ED5 and GED formats. JPEG compression gives the program the ability to compress images up to 200:1. For even greater compression ratios, the program in-

cludes CMP compression. The updated version also adds TIFF 6.0 support, including the ability to read and write JPEG-compressed TIFF files. In addition to the list of cross-platform formats is the Sun raster format. For connectivity with IBM mainframes and AS/400 workstations, *HiJaak PRO* 2.0 reads and writes the IOCA format.

HiJaak PRO 2.0 now supports the Aldus Graphics Import Filter specification and includes support for the *WordPerfect for Windows* API. The new version implements sup-



port for the TWAIN specification included in many popular scanners and digital cameras. \$169. *Inset Systems, Inc., 71 Commerce Dr., Brookfield, CT 06804; tel.: 203-740-2400; fax: 203-775-5634.*

CIRCLE NO. 15 ON FREE CARD

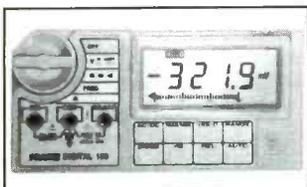
Point-And-Click Desktop

The Volante *Point & Click for Windows* GUI does on a PC what the Macintosh desktop has been doing for years. The interface features PC trash cans and file folders, drag-and-drop operation and the look and feel of a Mac desktop. The program runs with any Windows graphics card. \$99. *Volante, Inc., 1515 Capital of Texas Highway South, Austin, TX 78746; tel.: 512-329-5055; fax: 512-329-6326.*

CIRCLE NO. 16 ON FREE CARD

RS-232 Multimeter

Prairie Digital's Model 150-02 full-function true rms digital multimeter has a serial port for both data output and control input. It features true-rms ac voltage and current, dc voltage and current, resistance, frequency, continuity and diode-measurement capability, plus a full-scale count of 3,999. Remote RS-232 commands let the host computer request readings, change ranges, select ac/dc, enter or exit hold mode and re-initialize. An optically-isolated three-wire RS-232 interface offers greater than 2,000 volts of isolation between the host PC and the signal being measured.



Windows Software

Telephone Program

SmartCaller from Communications Research helps you obtain the lowest rate on every telephone call you make. The program lets you select a phone number on the screen. It then copies the number to the Windows Clipboard and dials the call. *SmartCaller* finds the lowest rate offered by the five major carriers, based on the number, time and estimated duration of the call. The program automatically adds the access code of the selected carrier as a prefix to the number and places the call using a modem. Additionally, it logs all calls to provide a record of telephone numbers, times, duration and notes. \$49.95. *Communications Research, Inc., 1100 Woodward Hts., Ferndale, MI 48220; tel.: 313-544-0170; fax: 313-544-2548.*

CIRCLE NO. 18 ON FREE CARD

Screen Saver

WinPak is a unique collection of six Windows screen-saver modules, four TrueType fonts and 200 icons from Rhode Island Software. Screen-saver modules are accessed directly from the Windows desktop configuration utility. You can choose from among three different volumes. \$19.95. *Rhode Island Soft Systems, Inc., P.O. Box 748, Woonsocket, RI 02895; tel./fax: 401-658-4632.*

CIRCLE NO. 19 ON FREE CARD

The Model 150-02 comes with PC-compatible data logging and demonstration software, cables, test leads, battery and manual. \$179. *Prairie Digital, Inc., 846 17 St., Industrial Park, Prairie du Sac, WI 53578; tel.: 608-643-8599; fax: 608-643-6754.*

CIRCLE NO. 17 ON FREE CARD

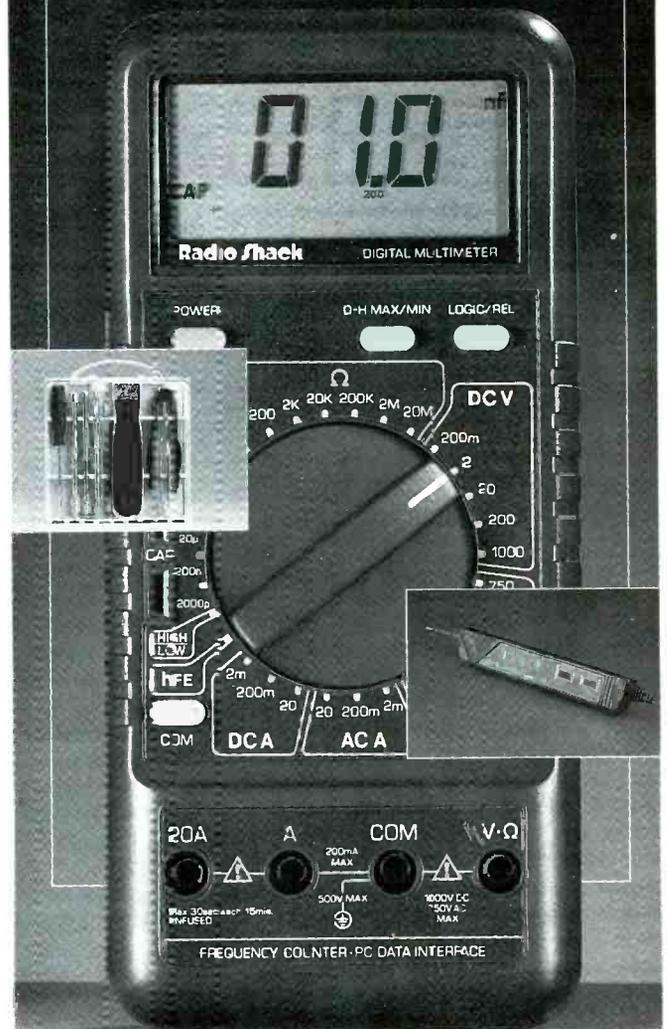
SCSI Adapter

Forex FR600A VL BusMaster 32-bit bus mastering VESA

FROM HOOKING UP TO BOOTING UP, WE'RE THE PLACE TO GO

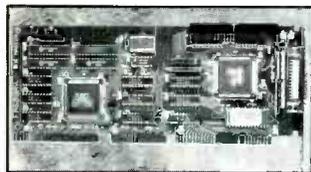
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CIRCLE NO. 87 ON FREE INFORMATION CARD

November 1993 / COMPUTERCRAFT / 11



SCSI host adapter achieves a SCSI-2 data-transfer rate of 10 M/sec and a VL-bus rate of 100 M/sec. Features include SRAM, board-level protocol, 32-bit interface and automatic detecting and adjusting for different types of hard-disk translation tables. It supports popular ASPI-based SCSI driver and application developers. \$240. *Forex Computer Corp., 2121 Ringwood Ave., San Jose, CA 95131; tel.: 408-955-9280; fax: 408-955-9611.*

CIRCLE NO. 20 ON FREE CARD

Subnotebook

Epson's ActionNote 4000 is a subnotebook computer that weighs just 3.8 pounds with the battery installed and features a 33-MHz 486SLC processor, 80M or 120M removable hard drive, PCMCIA capability and backlit high-contrast VGA



monochrome screen. The ActionNote 4000 features a convenient built-in two-button trackball and an external 3 1/2" floppy drive. It comes preloaded with Windows 3.1 and MS-DOS 6.0. \$1,995. *Epson America, Inc., 20770 Madrona Ave., Torrance, CA 90509.*

CIRCLE NO. 21 ON FREE CARD

Self-Propelled Scanner

Microtek's ScanMaker Scooter is a self-moving hand scanner that scans graphics and text. It's driven across an image at a steady controlled speed by a built-in motor that produced even images with every scan. The Scooter scans images mea-

suring up to 8" X 11" and produces quality results from a single scanning pass. This 24-bit motorized color scanner offers resolutions up to 400 dpi and reproduces images in black and white, 256 shades of gray and 6.7-million colors.

Included is a special auto-merge function and TrackPad scanner tracking pad. This straight tracking guide has right and left guide rails that permit accurate scanning of an image. Once an image has been scanned, the auto-merge function creates a seamless finished scan that ensures two halves of a large image fit together precisely.

ScanMaker Scooter can "stitch" images beyond 200 dpi and even at the maximum 400-dpi level. The Scooter is TWAIN-compliant and includes optical-character-recognition software for interpretation of text images. It requires Windows 3.1 and 4M of RAM. \$549. *Microtek Lab, Inc., 680 Knox St., Torrance, CA 90502; tel.: 213-321-2121; fax: 310-538-1193.*

CIRCLE NO. 22 ON FREE CARD

Voice Recognition

Covox's *Voice Blaster* is voice-recognition software that works with all popular sound cards and under both DOS and Windows. The software operates on both eight-bit monaural and 16-bit stereo audio cards. With the DOS interface, you can add voice commands to most spreadsheets, databases, word processors, CAD, games and other applications. *Voice Blaster* operates as a TSR, using about 30K of lower RAM with EMS enabled. Up to 1,023 voice commands can be in a file at once. In Windows, the number of voice commands is limited to available RAM space, with potentially thousands more from a dictionary of words on-disk. Verbal commands are trained to your voice and then linked to a corresponding keystroke macro.

A variety of functions come with the *Voice Blaster* main menuing system, including voice-recognition acceptance levels, mode settings, training

counts, test modes, user selections, and others. The DOS sound editor includes a three-dimensional spectrum analyzer. The *Windows* sound editor is an abridged version of *WAVE* for *Windows*. *Voice Blaster* comes with an amplifier filter module, a lightweight microphone headset, software and users manual. \$119.95. *Covox, Inc., 675 Conger St., Eugene, OR 97402; tel.: 503-342-1271; fax: 503-342-1283.*

CIRCLE NO. 23 ON FREE CARD

Data-Integrity Software

Integrity Master from Stiller Research ensures safe use of software like DOS 6.0's DoubleSpace and SmartDrive and other disk-compression, disk-cache and resident software. *Integrity Master* checks all files and system sectors for changes. Each change is then intelligently analyzed and optionally reported. Additionally, *Integrity Master* scans for viruses and provides comprehensive security. The program also has the ability to identify files or system sectors damaged by a virus, not just those that were infected. When CHKDSK reports damage, *Integrity Master* can determine exactly which files were affected. If you experience damage to your disk and DOS won't boot, or perhaps even recognize the disk, *Integrity Master* can reload system sectors to reactivate your disk.

Integrity Master provides information on a need-to-know basis, shielding users from needless complexity. Detailed on-screen explanations appear for each menu choice and extensive context-sensitive help is available. The manual provides a thorough explanation of threats to data integrity with a special emphasis on viruses. \$35. *Stiller Research, 2625 Ridgeway St., Tallahassee, FL 32310; tel.: 800-788-0787; fax: 314-966-1833.*

CIRCLE NO. 24 ON FREE CARD

Digital Camera

Logitech's FotoMan Plus is a significant upgrade to the com-

Windows 3.1

By Richard & Ruth Maran
(Prentice Hall, Soft cover.
94 pages. \$12.95.)

This is one in a series of "maranGraphics" simplified computer guides. It's a large-format book, measuring 8 1/2" X 11" and printed on heavy paper stock, with every page using lavish four-color graphics. Each two-page spread is integrated to cover a specific topic. Visual keys and flowing screen illustrations, coupled with succinctly written text, make it all an easy-to-comprehend package. This book is an inviting learning package for computer beginners using Microsoft Windows 3.1.

pany's FotoMan Digital Camera line. The new camera features an image definition of 496 X 360 pixels with 256 levels of gray and up to 100 hours of useful battery operation on a single charge. For better portrait pictures, the main lens has been changed from 55 to 65 mm. Additional features include improved self-regulating flash control for proper exposure from 16 inches to 6 feet, and faster, more-accurate serial communication that provides fewer errors in data transfer. The camera can snap up to 32 pictures at a time and has a built-in flash. Optional accessories include wide-angle, telephoto and close-up lenses. \$799. *Logitech, Inc., 6505 Kaiser Dr., Fremont, CA 94555; tel.: 510-795-8500; fax: 510-792-8901.*

CIRCLE NO. 25 ON FREE CARD

Removable-Disk Drives

The Ranger Plug 'n' Go' line of removable and transportable IDE hard drives are claimed to work with all industry-standard PCs to increase permanent storage capacity. Available in storage capacities of 80M to 540 M, they can easily be daisy-chained up to a total of eight units to give a system nearly 4G of storage capacity.

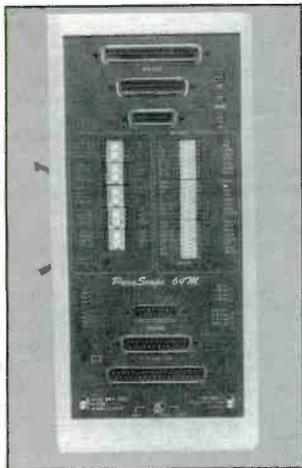
Plug 'n' Go' attaches directly to the parallel port of a PC/compatible via a pass-through

for the printer cable. Installation software handles partitioning and formatting. \$699 to \$1,799, 80M to 540M. DATA-Zone/SLOTDrive Technologies, Inc., P.O. Box 1045 Woodland Hills, CA 91365; tel.: 818-704-4966; fax: 818-704-1841.

CIRCLE NO. 26 ON FREE CARD

WAN Protocol Analyzer

ParaScope 64M, a hand-held PC-based protocol analyzer from Frederick Engineering, doesn't require a card slot. Together with general purpose WAN analyzer software called FELINE, ParaScope 64M handles such protocols as X.25, X.75, Q.921/Q.931, SNA HDLC, SDLC, IPARS, DDCMP, NRZI, NRZ, BSC, synchronous and asynchronous. Supported data codes are ASCII, EBCDIC, Baudot, six-bit Transcode, IPARS, and



EBCD. The instrument communicates with the PC via a standard four- or eight-bit parallel port. Its eight-bit interface capability is further enhanced through use of enhanced parallel-port technology on platforms that support this evolving industry standard.

ParaScope 64M achieves 64K bps performance and provides a breakout facility for RS-232, X.21, V.35/36, RS-449/423 and RS-449-422 interfaces. This operates independent of a connection to the PC. Also, ParaScope 64M permits connection to ISDN lines via standard FELINE interface pods. The instrument operates from both ac and battery pow-

er. \$3,295. Frederick Engineering, Inc., 10200 Old Columbia Rd., Columbia, MD 21046; tel.: 410-290-9000; fax: 410-381-7180.

CIRCLE NO. 27 ON FREE CARD

3 1/2" Optical Drive

Pinnacle's portable Tahoe-130 3 1/2" magneto-optical drive weighs just 1.8 pounds and fits in the palm of your hand. It's fully rewritable and connects to any SCSI interface or parallel port. Each removable 128M disk is ISO/ANSI standard-compliant for disk swapping between vendors. Tahoe provides a 28-ms seek time and a rotation speed of 3,600 rpm. A rechargeable battery pack is optional. \$1,199. Pinnacle Micro, 19 Technology, Irvine, CA 92718; tel.: 714-727-3300; fax: 714-727-1913.

CIRCLE NO. 28 ON FREE CARD

Welcome to CD-ROM

By Tom Benford
(MIS Press. Soft cover. 272 pages. \$19.95.)

With CD-ROMs promising enormous buying growth, this focused book represents an important learning/buying guide for this explosive-selling computer peripheral. Benford covers the gamut, from basic explanations about CD-ROM drives and discs to how to install them in a PC or Mac computer. In nine chapters, four appendices and a bibliography, the author gives the reader hands-on information about adding a CD-ROM to an existing PC, assessing one's present PC for efficient standard and multimedia use, other CD-ROM formats, configuring and using the device, building a CD-ROM library, a listing of CD-ROM drive models on the market with specifications and features, and detailed information on how the peripheral works. The easy-to-read text is bolstered by many very helpful photographs that show the reader just how to make hookups when installing either an internal or external drive. For beginner to intermediate user, this is a most welcome book.

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CIRCLE NO. 69 ON FREE INFORMATION CARD

IBM PC DOS 6.1

Is this the DOS Microsoft meant to ship?

Do you have you thinking twice about taking the plunge? If so, you're not alone. More than a few would-be DOS 6.0 users are putting off the upgrade until the sequel arrives. Surprisingly, the sequel may already be at hand—in the form of IBM's PC DOS 6.1. With scheduled-tape backup from Central Point for both DOS and *Windows*—plus *SuperStor* disk compression—IBM's new DOS may very well be the DOS most of us thought Microsoft had in mind. When you add to this IBM's new AntiVirus program and some really nifty notebook tools, it's one tempting package.

Of course, not all of PC DOS 6.1's features are gems. Compared to MS-DOS 6.0, IBM's help and diagnostic screens are primitive. And most users will be less than thrilled with IBM's choice of text editors. But these are annoyances, not major flaws.

So is PC DOS 6.1 the DOS you've been waiting for? Let's see how it stacks up against MS-DOS 6.0.

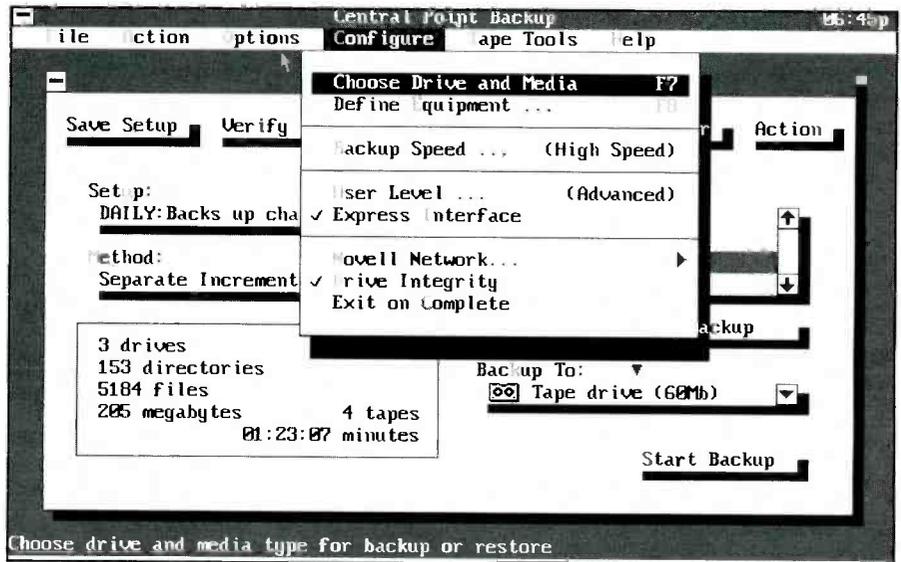
Fraternal Twins, Not Clones

Because the PC DOS 6.1 kernel is virtually identical to the MS-DOS 6.0 kernel, all the DOS-based features found in MS-DOS 6.0 are available in PC DOS 6.1. For instance, you'll find the new multiple-boot feature that lets you select your system's configuration from a menu at the time of boot, intact and fully functional. And there's the hot-key DOS override that lets you bypass the AUTO-EXEC.BAT and CONFIG.SYS files at boot-up. (See the May 1993 issue of *ComputerCraft* for details).

You'll also find that IBM decided to keep nearly all the new Microsoft DOS 6.0 utilities, such as Choice, Move and DeleteTree. The only major utility missing from PC DOS 6.1 is QBASIC, but this is understandable. IBM decided to drop BASIC programming support with PC DOS Version 5.0.

The biggest difference between the IBM and Microsoft packages is the quality of the disk-compression and backup utilities supplied. Here's where we separate the men from the boys.

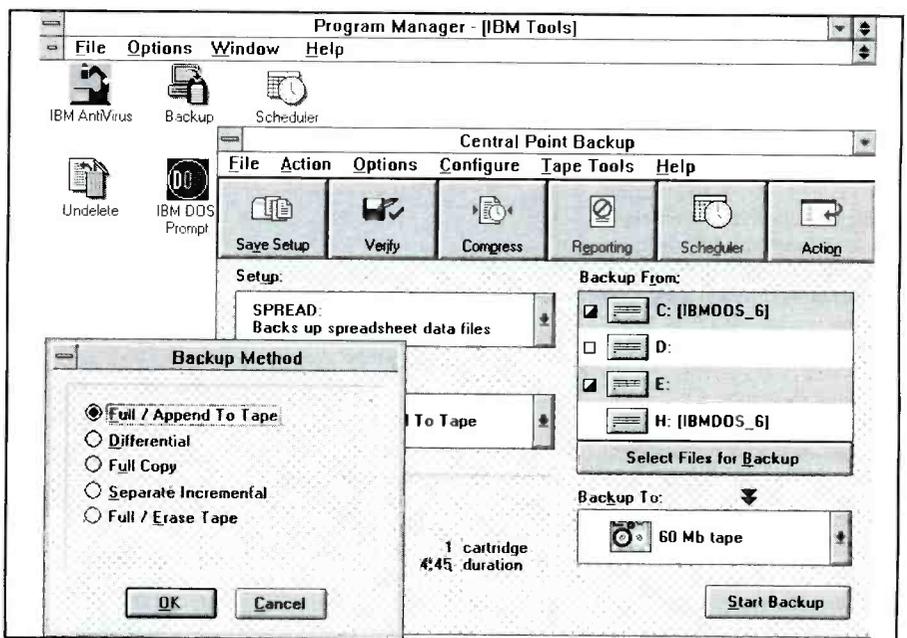
SuperStor To The Rescue. Without a



PC DOS 6.1 backup supports a wide range of backup media types, including QIC-40/80 tape drives.

doubt, the loudest complaint about MS-DOS 6.0 is Microsoft's DoubleSpace disk-compression utility. It's troubled at best of us. The horror stories I've heard range from total data annihilation at installation to periodic system crashes when it's working.

IBM's response is a switch to Adstors *SuperStor* technology that has won several awards for speed and compatibility. While ease of use hasn't been one of *SuperStor*'s strong points, the new *SuperStor/DS* program will reportedly be user friendly and run with Microsoft's



By default, backup performs a full backup of your disk drives. Other strategies are just a mouse-click away.

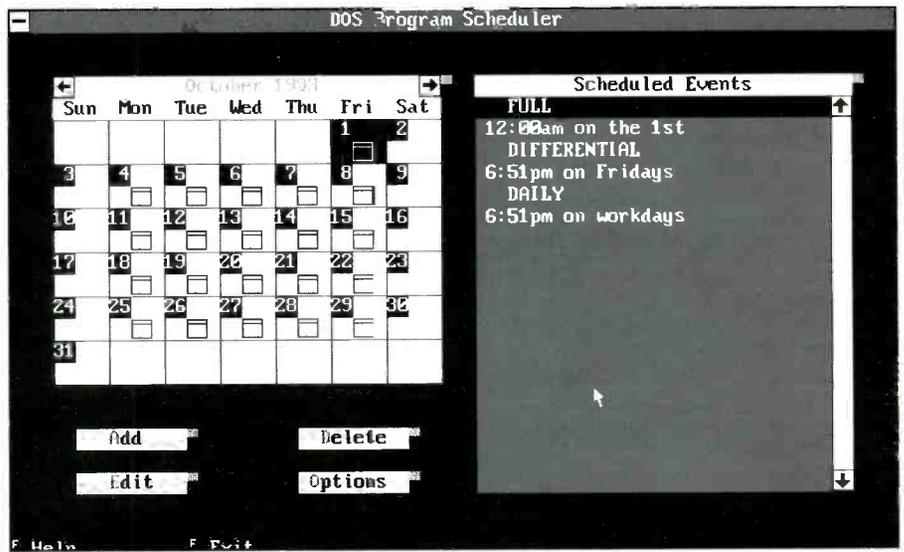
DoubleSpace, allowing for easy migration from DoubleSpace to SuperStor/DS. Reportedly, you ask? Unfortunately, the answer is "yes." Although the new-disk compression program is a major selling feature of PC DOS 6.1, SuperStor/DS wasn't available for review at the time of this writing. Instead, the shrink-wrapped package I looked at contained a coupon for SuperStor/DS that you must redeem before December 31 to get the new disk-compression utility. IBM states that the program should be ready by September 30, or thereabouts.

PC Tools Backup. IBM also keyed in on MS-DOS 6.0's skimpy backup support, which sadly lacks streaming-tape backup and data compression. Instead of using the Norton utility licensed by Microsoft, IBM wisely turned to Central Point, who provided full copies of their award-winning *PC Tools* backup software for both DOS and *Windows*. Both versions support a wide range of backup media types, including floppies, QIC-40/80 and Irwin Servo tape drives. They also support high-capacity SCSI and DAT tape backup, some of which can hold gigabytes, and network drives. And three levels of data compression are supported.

Either or both backup programs can be installed when you install PC DOS 6.1, or you can add them later. Like MS-DOS 6.0's backup program, the first time you use *Central Point Backup*, you have to configure it to work with your PC. During the setup procedure, the program examines your system for drive types and DMA (direct memory access) conflicts, then saves the information to a file. If you have a tape drive installed, the process takes a little longer because the drive is tested for confidence by first saving 60 files to the tape and then comparing the backed-up files to the original. In most cases, *Backup* is able to detect the make and model of your tape drive without your help. When it can't, it's simple enough to point to the right selection from a menu.

PC DOS 6.1 has three levels of user interface: beginner, intermediate and advanced. These levels, which are selected from a Configure pull-down menu, are designed to limit the number of options available to the user, which, in turn, streamlines the interface. The DOS version has an express-screen option that further reduces screen clutter by hiding the directory tree in a lower level.

At the beginner level, the user is



Scheduling is done using a wall-like calendar that displays a month's worth of events at a glance.

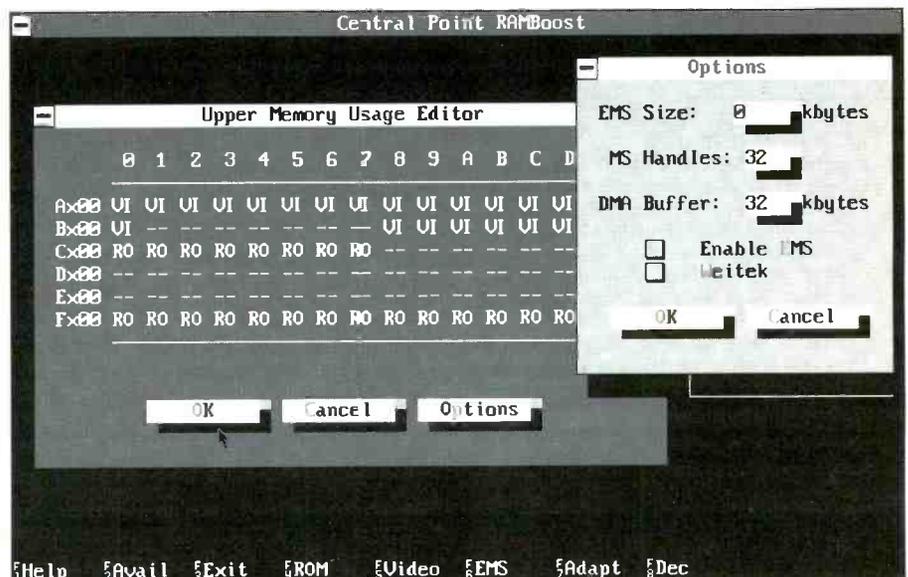
blocked from using certain features, such as data encryption and media format. Instead, the program automatically defaults to the options that reflect the highest degree of safety, security and ease of use. The intermediate level adds more options, including access to the backup scheduler, while maintaining a relatively uncluttered look that's easy to use. The advanced level interface is replete with options and pull-down menus.

By default, *Central Point Backup* performs a full backup of your disk drives. However, you can manually select files and directories for backing up. Alternatively, you can create backup sets that

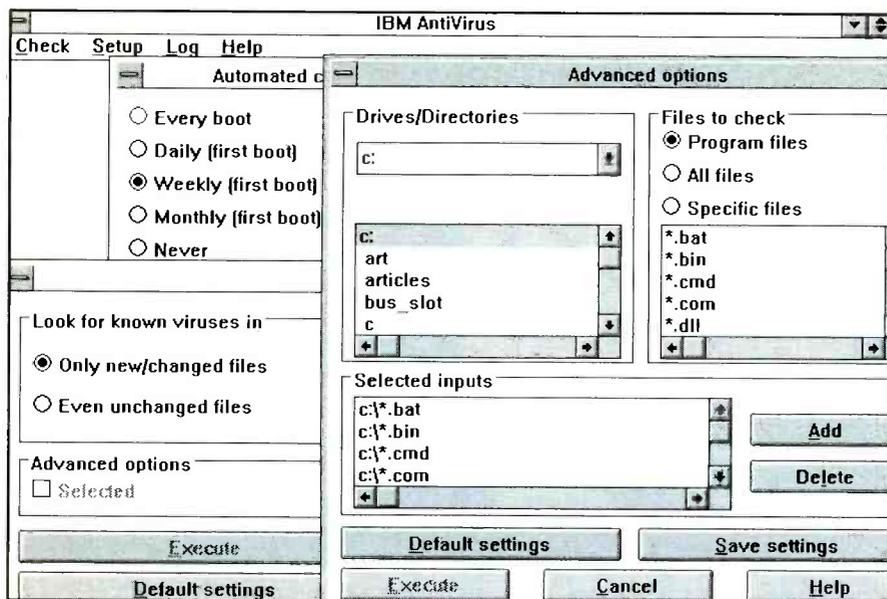
contain preselected files along with the desired backup strategy. Files can be hand-picked manually or selected by attribute, extensions and date range. Wildcards are supported.

Both backup programs come with five backup sets already configured for daily incremental, weekly full, database files, spreadsheet files or word processor files. These sets can be edited to match your specific backup needs. You can even add password protection to your backup sets to prevent unauthorized persons from reading your backed-up files.

Both backup programs have a viewer that lets you look inside files. The view-



RAMBoost first searches upper memory for open areas and makes a map of it. Changes to the map are easily made using F-keys.



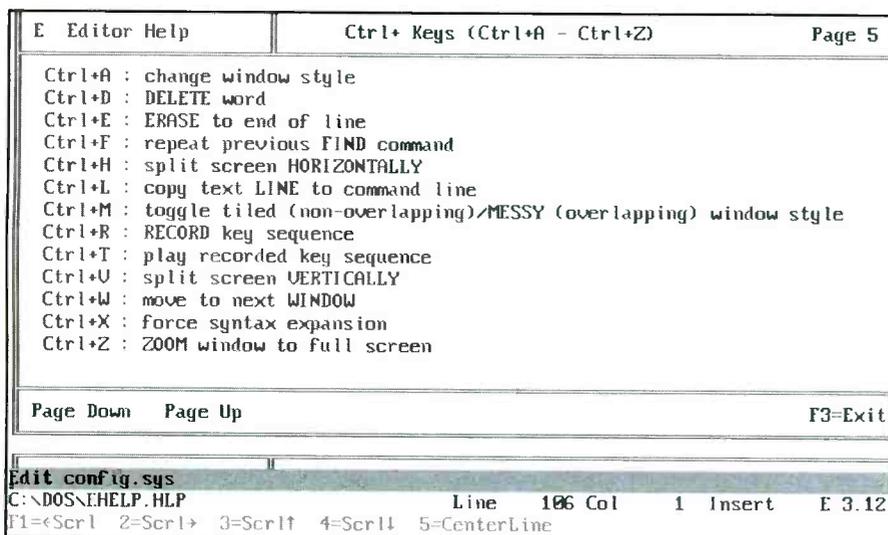
To speed up IBM's AntiVirus search, you can limit the file search by frequency and file type.

er supports many popular applications—even several graphic formats—and adjusts automatically to display the correct file format. This can be particularly useful if you have multiple files with the same name in different directories or if you can't remember the contents of a file. However, the viewer can't be used to edit a file.

• **Event Scheduler.** IBM also borrowed Central Point's event scheduler that lets you schedule *any* program to run automatically. This is especially useful for lengthy procedures that don't require your presence, such as a backup session. For example, it's much more convenient to perform a backup after you leave

work, rather than during the day. That's because the scheduler interrupts whatever program is running when a scheduled event occurs. However, it does issue a 15-second warning before it starts, in case you're using an application you don't want interrupted, such as a modem transmission. When the scheduled event is complete, the scheduler returns to the application it interrupted.

Scheduling is done using a wall-like calendar that displays a month's worth of events at a glance. Simply click on a date to schedule as many different or same events as you wish for that day, or for any daily, weekdays, weekly, monthly, or biweekly pattern.



The new IBM text editor uses a combination of F-keys, hot-keys and line commands.

The scheduler uses a small 8K TSR (terminate-and-stay-resident) utility that must be loaded before it can start a program at a scheduled time. Generally, the TSR is loaded into memory from the AUTOEXEC.BAT file at boot-up.

The *Windows* scheduler uses a weekly calendar, instead of a monthly one, that simply rolls over week after week. Consequently, changes to the schedule can't be made any sooner than seven days in advance. And it's currently limited to scheduled backup sessions only. However, it has the advantage of background operation, which means it will back up your data in the *Windows* background while you continue to work in your foreground applications.

• **RAMBoost Memory Manager.** Not surprisingly, the memory manager is also from Central Point. Like MS-DOS 6.0's MemMaker, RAMBoost frees up conventional memory for applications use by moving utilities and TSRs into upper memory, the area of RAM between 640K and 1M.

Because the open space in upper memory is usually spit into several pieces of different sizes, RAMBoost first searches upper memory for open areas and makes a map of it. It then arranges your memory-resident programs, device drivers and other DOS resources for a best fit and saves them in a file. This file is run at boot-up, just after CONFIG.SYS and before AUTOEXEC.BAT. Each time you boot, RAMBoost checks your system for hardware and software changes, making a new profile and updating the RAMBOOST.INI file, if needed.

In theory, it's a better method because changes to the system are automatically detected with each boot. This is unlike QuarterDeck's *QEMM386* and MS-DOS 6.0's MemMaker memory managers, which update memory usage only when you decide to run the memory manager's setup again.

Unfortunately, RAMBoost doesn't always do a thorough job of scanning the system, sometimes overlooking something that can cause problems. For example, it failed to find my *Windows* directory or read its .INI files. As a result, it allocated a portion of upper memory normally used by *Windows* for its own use. Consequently, I couldn't load *Windows* until I manually edited my CONFIG.SYS file to free up those memory blocks. While I could have made the same changes in the RAMBOOST.INI file, they remain in effect only until the next time

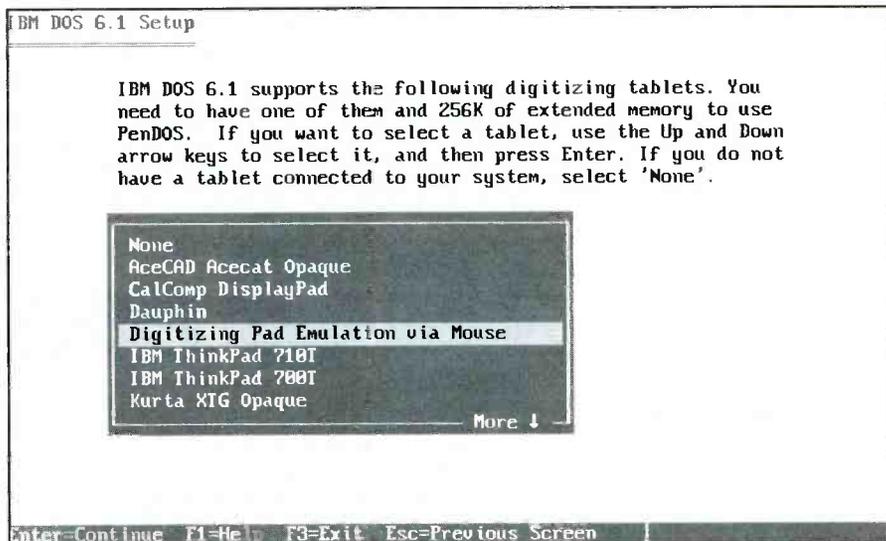
you make a system change—which, in my case, is often.

Installing RAMBoost is simpler than installing either MemMaker or QEMM-386. Even its advanced installation options, which let you do things like make room for Windows, are easier to use. But you need to know what you're doing when using them because a mistake here could disable your video card or lock up your system.

IBM AntiVirus. Of course this wouldn't be IBM DOS if IBM didn't put in its two cents worth. And this is exactly what it did when it added the two utilities of its own, IBM AntiVirus and a text editor called E Editor.

The problem with virus-killer programs is that, unless you purposely infect your system, it's difficult to gauge its performance. Even if you had access to all 1,400 viruses contained in IBM's AntiVirus database, it would only prove that IBM did its homework. It says nothing about how the program handles new strains or mutations. A better benchmark is the type of protection afforded and its ease of use.

IBM AntiVirus offers two kinds of protection, called Automated Check and Shield DOS. Both work with Windows



PenDOS lets you use pen-mouse devices and tablet digitizers with pen-based applications, as well as standard DOS applications.

and DOS, and both can be installed when you install PC DOS 6.1, or added later, if you prefer.

If it's installed in the AUTOEXEC.BAT file, Automated Check scans your fixed disks for viruses whenever you boot your system, or it can be run from

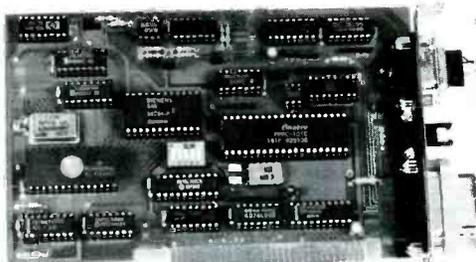
the DOS prompt at your request. When run, Automated Check scans the disks for viruses, reports on the types of viruses it detects and purges any detected viruses from the system and files.

With many systems today sporting 200M and larger-capacity hard drives,

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Computer Systems

Altex makes it easy to choose the system that best fits your needs. With three different case styles and six different motherboard configurations to choose from. Each system comes with 5-1/4" and 3-1/2" high density disk drives IDE hard drive controller, 2 serial, 1 parallel, and 1 game port. Enhanced 101 key keyboard, case and power supply.

To complete your system, choose the amount of memory you need, the size of hard drive, and the kind of monitor and controller card. * 486-33 and 486-66 VESA Local Bus mainboards are available for an additional \$10.00, by simply adding a "L" to the end of Altex Part Number. Computer Systems shown with Monitor MON-08 NOT INCLUDED

System I

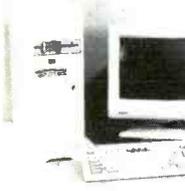
System I is designed into the STC-16 case. This deluxe vertical system measures 24-1/2" high x 7-1/2" wide and 17" deep. 4 external 5 1/4" drive bays and 2 external and 2 internal 3-1/2" drive bays makes this the perfect system for network file servers or where heavy expansion capabilities are needed.



3SX40-16	386SX 40MHz System	\$369
3DX33-16	386DX 33MHz System	429
3DX40-16	386DX 40MHz System	429
4DX33-16	486DX 33MHz System	759
4DX50-16	486DX 50MHz System	949
4DX66-16	486DX 66MHz System	1029

System II

System II is designed into the STC-08 case. This is our most popular system measuring 18-3/4" high x 7-1/4" wide and 15-3/4" deep and comes with 3 external 5-1/4" drive bays and 2 external and 2 internal 3-1/2" drive bays. This is the perfect system for power users who want to save space.



3SX40-08	386SX 40MHz System	\$329
3DX33-08	386DX 33MHz System	389
3DX40-08	386DX 40MHz System	389
4DX33-08	486DX 33MHz System	719
4DX50-08	486DX 50MHz System	899
4DX66-08	486DX 66MHz System	989

System III

System III is designed into the STC-05 case. This mini-vertical system measures 13" high x 7-1/4" wide x 16" deep and comes with 2 external 5-1/4" drive bays and 2 external and 1 internal 3-1/2" drive bays. Our most inexpensive system is great for family uses as well as networking stations.



3SX40-05	386SX 40MHz System	\$299
3DX33-05	386DX 33MHz System	369
3DX40-05	386DX 40MHz System	369
4DX33-05	486DX 33MHz System	689
4DX50-05	486DX 50MHz System	879
4DX66-05	486DX 66MHz System	959

CD Revolution

Multimedia Upgrade Kit

Contains a LMS Philips CD-ROM Drive, MPC compatible fast access of 375 ms with 32kb buffer/cache, SoundBlaster Pro Sound Card, software bundle of 7 programs, microphone, headphones and 2 shielded stereo speakers.

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Computer Cases

Altex No.	Style	Drive Bays	Slots	Size	Each
VERTICAL CASES (LED Display and Power Supply Included)					
STC-05	Baby	2 Ext 5.25", 2 Ext 3.5", 1 Int 3.5"	8	13" H x 7 1/4" W x 16" L	\$65
STC-08	Medium	3 Ext 5.25", 2 Ext 3.5", 2 Int 3.5"	8	18 3/4" H x 7 1/4" W x 15 3/4" L	89
STC-16	Full	4 Ext 5.25", 2 Ext 3.5", 2 Int 5.25"	8	24 1/2" H x 7 1/2" W x 17" L	136
DESKTOP CASES (LED Display and Power Supply Included)					
STC-12	Medium	3 Ext 5.25", 1 Ext 3.5", 1 Int 3.5"	8	6 1/2" H x 14 1/4" W x 15 3/4" L	75
STC-10	Full	3 Ext 5.25", 1 Ext 3.5", 2 Int 3.5"	7	6 1/2" H x 17 1/4" W x 16 3/4" L	95

Monitors



MON-05	12" Monochrome TTL Amber (720x348)	\$89.00
MON-06	14" Paper White TTI (800x480)	112.00
MON-09	14" Monochrome TTL Amber (800x480)	139.00
MON-07	14" VGA 41 dp (640x480)	239.00
MON-08	14" Super VGA (1024x768) Non-Interlaced	359.00
MON-11	17" Super VGA (1280x1024) Non-Interlaced	879.00
MON-12	20" Super VGA (1280x1024) Non-Interlaced	1379.00
COMBO-VGA1	MON-07 VGA Monitor with VGA 256k Card	269.00
COMBO-SVGA	MON-08 SuperVGA with VGA Card and 1Mb Ram	439.00

IDE Hard Drives



**** Low Profile Height for 3.5" Bay ****

ST-351A	42Mb Storage at 28.0 ms	\$119
ST-3120A	106Mb Storage at 14.0 ms	189
ST-3144A	131Mb Storage at 16.0 ms	209
ST-3290A	260Mb Storage at 16.0 ms	289

**** 1" Height for 3.5" Bay ****

ST-3243A	212Mb Storage at 15.0 ms	\$249
ST-3390A	344Mb Storage at 15.0 ms	399
ST-3550A	452Mb Storage at 12.0 ms	499
ST-3655A	528Mb Storage at 10.5 ms	739

**** 1" Height for 2.5" Bay ****

ST-9235A	209Mb Storage at 16.0 ms	\$479
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SCSI Hard Drives

**** Half Height for 3.5" Bay ****

ST-1480N	426Mb Storage at 14.0 ms	\$599
ST-11200N	1.05Gb Storage at 10.5 ms	1089

**** Full Height for 5.25" Bay ****

ST-4766N	663Mb Storage at 15.5 ms	\$829
ST-41650N 1	85Gb Storage at 15.0 ms	1056

**** 1" Height for 3.5" Bay ****

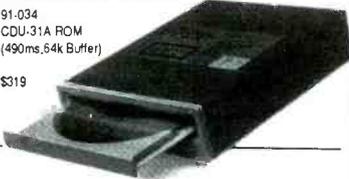
ST-3550N	425Mb Storage at 12.0 ms	\$599
ST-3600N	525Mb Storage at 10.5 ms	749

Floppy Disk Drives



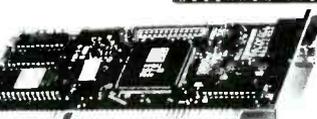
DDD-05	5 1/4" DSDD 360k w/Beige FP	\$49
DDH-06	5 1/4" DSHD 1.2Mb w/Beige FP	52
DDH-09	3 1/2" 720k w/Beige FP/Brkt	65
DDH-10	3 1/2" 1.44Mb w/Beige FP/Brkt	47
DDH-11	DDH-10 excluding 5 1/4" Brkt	44
5 25K1TFD	Mounts 3 1/2" FD to 5 1/4" Bay	9.95
5 25K1THD	Mounts 3 1/2" HD to 5 1/4" Bay	9.95
5 25K1THDA	Mounts ST-351A in 5 1/4" Bay	6.95
RALL01	AT Drive Rail Kit	1.99
FP-BLK	Half Height Black Faceplate	2.49

CD ROM Drive



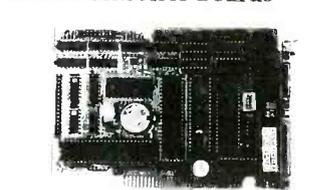
91-034	CDU-31A ROM (490ms, 64k Buffer)	\$319
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Video Boards



IFC-32	Mono Board, Printer Port XT/AT	\$16
IFC-33	Color Graphics, Printer Port XT/AT	25
IFC-35	BOCA Dual Graphics, Color Emulation	35
IFC-44	AEI 640x480, 16 Color VGA w/256k	45
IFC-46	Super VGA 1024x768, 256 Colors, 1Mb	99
VMEG	PC Logic VGA Card, 1Mb Memory	99
VCOLEOR	VGA (16.7M Colors), 1Mb Memory	109
VCOLEORXL	VGA (16.7M Colors), 1Mb, Hardware Driven	119
XGRAPHIC	11T Windows/CAD 20x Accelerator, 1Mb High Speed RAM, 65,536 Colors, 1280x960 resol.	189
PGVL-24	POWERGRAPH VESA Local Bus Color Accelerator for Windows (1280x1024) 1Mb DRAM, STB BIOS	169

Disk Controller Boards



IFC-15	Disk I/O Board (Serial, Parallel, Clock/Game)	\$25
IFC-24	Fixed Disk MFM/2 Floppy Controller AT	55
MIO-500	Dual IDE/Floppy Controller, 2S/H/PI/16	81.40
LCO-6924G	VESA LBUS Multi-IOQ/2FD/2IDE HD, 2S, 1P, 1G	25
IFC-27-2	Dual AT IDE and 2 Floppy Controller	19
IFC-28	Fixed Disk Controller Board PC/XT	47
ST-01	8Bit SCSI Controller Board	29
ST-02	8Bit SCSI/Floppy Controller Board	47
IN-2000	16Bit SCSI Hard/Floppy Controller Board	189
LCS-6941	VESA LB IDE Caching Ctrlr 16Mb (4HD, 2FD)	179

Expansion Boards

02BY4	BOCA 2 x 4 I/O Board (2 Parallel and 4 Serial Ports)	\$109.00
IFC-12	Serial Board for XT Primary Port only	11.00
IFC-13	Parallel Board for XT/AT, (LPT2 or LPT3)	9.00
IFC-25	2 Serial, 1 Parallel and 1 15 pin joystick ports	16.00
19033	SMART High Speed Game Card. Supports two 15 pin game ports.	17.00

Networking

LCS-8834	Longshine 8-Bit Ethernet LAN Card (NE1000/NETBIOS)	\$63.00
BEN100	BOCA 16-Bit 10-Base-T Ethernet Card	69
PTI-1500T	Pivotal Tech. 16-Bit 10-Base-T Ethernet Card	119.00
LCS-8634	Longshine 16-Bit Ethernet LAN Card (NE2000/NETBIOS)	72.00
ETHERNET STARTER KIT - Includes Connectors, 25' Cable, Terminators, 8-Bit Ethernet Cards and NOVELL NetWare Lite Software Nodes		
COMBO-NET	Network Starter Kit	299.00

Belden Cable

Altex No.	Descriptions	100-999 ft	1000+ ft
MATV Coaxial Cable (75 OHM)			
9275	Black RG59/U Type20, PVC Jacket, NEC CATV CSA	\$0.08	\$0.07
9275W	White RG59/U Type20, PVC Jacket, NEC CATV CSA	0.08	0.07
COMMERCIAL (50 OHM) COAXIAL TRANSMISSION-COMPUTER CABLE			
9201	RG-58/U, 20AWG 033 Solid, 78% Shield	0.14	0.11
9907	Thin Ethernet, 20AWG (19x32) Strd, 100% Shield, NEC CL2	0.19	0.15
9269	RG-62/U, 22AWG 025 Solid, 95% Shield, NEC CM CL2 CSA	0.15	0.11
8216	RG-174/U, 26AWG 019 (7x34) Stranded, 90% Shield	0.18	0.14
9258	RG-8X, 16AWG (19x29) Stranded, 95% Shield, NEC CM CSA	0.32	0.20
8237	RG-8/U, 13AWG (7x21) Stranded, 97% Shield, NEC CL2X CSA	0.49	0.46
8214	RG-8/U, 11AWG (7x19) Stranded, 97% Shield, NEC CL2 CSA	0.49	0.46
9913	Low Loss RG-8/U, 10AWG, 108 Solid, 100% Shield	0.59	0.46
PLENUM (50 OHM) COAXIAL COMPUTER-INSTRUMENTATION CABLE			
89907	Thin Ethernet, 20AWG (19x32), 100% Shield, NEC CL2P CSA	0.34	0.27
82269	RG-62/U, 22AWG 025 Solid, 96% Shield, NEC CMP CSA	0.39	0.30
LAN HIGH PERFORMANCE TWISTED PAIR CABLE (24AWG Solid, 100 Ohm)			
1596A	Level 4, Two Pair, Poly insulated, PVC Jacket, NEC CM CSA	0.07	0.06
1455A	Level 4, Four Pair, Poly insulated, PVC Jacket, NEC CM CSA	0.12	0.10
1598A	Level 4, Two Pair, Teflon ins., Plenum Jacket, NEC CMP CMP	0.16	0.13
1457A	Level 4, Four Pair, Teflon ins., Plenum Jacket, NEC CMP	0.26	0.21
1588A	Level 5E, Two Pair, Poly ins., PVC Jacket, NEC CM CSA	0.10	0.08
1583A	Level 5E, Four Pair, Poly ins., PVC Jacket, NEC CM CSA	0.15	0.12
1590A	Level 5E, Two Pair, Teflon ins., Plenum Jacket, NEC CMP	0.20	0.16
1585A	Level 5E, Four Pair, Teflon ins., Plenum Jacket, NEC CMP	0.33	0.26
ETHERNET TRANSCENDER CABLE (78 Ohms, PVC Jacketed)			
9901	Four Pair, 20AWG (7x28), 95% Shield, NEC CL2 CSA	0.92	0.73
EEE 802.5 IBM CABLING (Type 1A Mod, 150 Ohms)			
9688	Two Pair, 22AWG 025, 65% Shield, BELDFOIL, NEC MP/CM CS	0.31	0.24

Tape Back-Up Systems



TRAKKER-120	120Mb External, Parallel Port	\$339
TRAKKER-250	250Mb External, Parallel Port	399
AB-250	250Mb External, Parallel Port	349
DJ-10	120Mb Internal System	169
DJ-20	250Mb Internal System	199
IOMEGA250	250Mb Internal, 3.5" Slot to FDC	249
FT-252GB	2Gb Internal, 16bit SCSI Interface	1129
FC-10A	Add-On Controller Board (DJ1/Q20)	99
TC-15	FC-10A with HS Data Compression	235
KE-10	External Case Kit (DJ10/DJ20)	135

16-BIT Sound Blaster

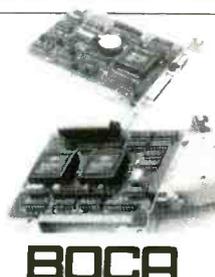
Stereo Card

With CD-ROM interface, MIDI interface, enhanced 4 operator, 20 voice FM music synthesizer, and stereo digital mixer with 10 channels. Compatible with Windows 3.1, MPC and OS/2 2.0.

STEREO-SB16	Sound Blaster 16-Bit Stereo Card	\$269
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Selected BNC Connectors

9021	BNC Male Solder (RG59)	\$1.40
9101	BNC 3 Pc. Male Crimp (RG59)	1.30
9208	BNC 3 Pc. Crimp On (Teflon)	2.30
9100	BNC 3 Pc. Male Crimp (RG59/62)	1.10
9001	BNC 2 Pc. Male Crimp (RG58)	1.50
9000	BNC 2 Pc. Male Crimp (RG59/62)	1.50
9051	BNC Male Twist On (RG58)	1.40
9050	BNC Male Twist On (RG59/62)	1.30
9140	BNC T (2 Female, 1 Male)	3.00
7430	BNC Female Splice	1.40
8470	BNC Chassis Mount Feed Thru 1/2"	3.00
9008	BNC 50 Ohm Terminator	2.40
9093	BNC 93 Ohm Terminator	2.40
588C-10	RG58 M-M, 10 foot Ethernet BNC Cable	4.59
588C-25	RG58 M-M, 25 foot Ethernet BNC Cable	6.79
628C-10	RG62 M-M, 10 foot Arnet BNC Cable	6.89
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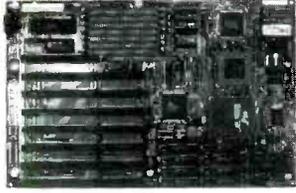


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Mother Boards



MB386SX is a IBM AT compatible 32-bit 80386SX based board running at 40MHz, with AMI BIOS and EMS support. Features six 16-bit I/O slots, expandable to 16Mb RAM using 256k, 1M or 4M SIMMs. Compact sized at 8 5/8" x 6 7/8"

MB386SX-40 40 Mhz \$95.00
MB386DX mainboard is a 32-bit 80386DX CPU with AMI BIOS, EMS support and a direct-mapped cache controller, 128k upgradeable. Six 16-bit I/O slots and Two 8-bit I/O slots, with RAM memory expandable up to 32M using SIMM Modules. Mini size of 250mm x 196mm.

MB386-33C MB386DX running at 33MHz \$169.00
MB386-40 MB386DX running at 40MHz 159.00
MB486DX mainboard is a 32-bit 80486DX CPU with AMI BIOS, EMS support and secondary write-back 256k cache. WEITEK Socket adaptor. Six 16-bit I/O slots and one 8-bit I/O slot. RAM expandable up to 32Mb using SIMM Modules. Mini sized at 204mm x 196mm.

MB486-33L MB486DX running at 33MHz \$499.00
MB486-50 MB486DX running at 50MHz 669.00
MB486-66 MB486DX running at 66MHz 749.00
MB15A MB486DX without CPU 199.00
MB486L VESA LOCAL BUS/ISA offers the same features as the MB486DX plus Two 32-bit VESA Local Bus Slots. Mini size of 250mm x 196mm.

ESB MAINBOARDS will transfer large amounts of data at high speeds! 32-bit mainboard CPU choice of 386 or 486. RAM Expandable to 64Mb, 256k cache memory. Features Six 32-bit EISA slots, Two 16 bit ISA slots and Two VL-Bus slots (Master & Slave Mode)
MB-EISA Without CPU \$339.00
MB-EISA-66 With Intel 80486-66 CPU 939.00



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2C87-20	For 286 machines up to 20 Mhz	60.00
3C87-25SX	For 386SX machines up to 25 Mhz	56.00
3C87-25	For 386 machines up to 25 Mhz	57.00
3C87-33SX	For 386SX machines up to 33 Mhz	63.00
3C87-33	For 386 machines up to 33 Mhz	63.00
3C87-40	For 386 machines up to 40 Mhz	69.00

Popular Cables

PPC301-6	Parallel Printer Cable (DB25 to 36P) 6 foot	\$2.99
PPC301-10	Parallel Printer Cable (DB25 to 36P) 10 foot	3.99
PPC301-15	Parallel Printer Cable (DB25 to 36P) 15 foot	4.99
PPC301-25	Parallel Printer Cable (DB25 to 36P) 25 foot	6.99
KEC-6	Keyboard Extension Cable (6 foot)	2.99
MEC-6	Monitor Extension Cable (6 foot)	2.99
PS2-MEC6	PS2 Keyboard Extension Cable (6 foot)	3.39
PS2-KA	Std AT Keyboard on PS2 (MD6P to D5S)	2.89
PS2-MA	VGA Card to MultiSync Monitor (HD15P to 9S)	4.29
APCC-02	PC Power Cord	2.49
APCC-04	PC Power Adaptor Cable	3.69
25MM-6	DB25 Male to Male, 6 foot cable	3.99
25MM-10	DB25 Male to Male, 10 foot cable	4.99
25MF-6	DB25 Male to Female, 6 foot cable	3.99
25MF-10	DB25 Male to Female, 10 foot cable	4.99
ATM-6	Modem Cable Assembly (9S to 25P) 6 foot	3.29
ATM-10	Modem Cable Assembly (9S to 25P) 10 foot	3.99
DFCXTS	Dual Floppy Cable (34E-34E-Twisted 34E)	2.49
DFCXTD	Dual Floppy Cable (34E-34E-Twisted 34E)	2.49
2HDIDE	Dual IDE Hard Drive Cable	2.99
SCSI-RC	Dual SCSI Drive Cable	4.95
36MM-6	36P Male to Male, 6 foot cable	3.99
36MM-10	36P Male to Male, 10 foot cable	4.99
36MF-6	36P Male to Female, 6 foot cable	3.99
36MF-10	36P Male to Female, 10 foot cable	4.99
58BC-10	RG58 M-M, 10 foot Ethernet BNC Cable	4.59
58BC-25	RG58 M-M, 25 foot Ethernet BNC Cable	6.79
62BC-10	RG62 M-M, 10 foot Aronit BNC Cable	6.89
62BC-25	RG62 M-M, 10 foot Aronit BNC Cable	9.39
ATSCA	9P Female to 25P Male Adapter	2.49
PCSCA	9P Male to 25P Female Adapter	2.49
TGC-9M	9P M-M Ultrathin Gender Changer	2.69
TGC-9F	9P F-F Ultrathin Gender Changer	2.69
TGC-25M	25P M-M Ultrathin Gender Changer	2.99
TGC-25F	25P F-F Ultrathin Gender Changer	2.99

Modems

MaxLife 144/PC -Pocket 14,400bps Send and Receive Fax/Data Supports ASCII, PCX, TIF and HP PCL file format conversions. On-board microprocessor for full background operation. V.42bis/MNP error correction, data compression and WINFAX 2.0 for Windows is 80296 to 80486 compatible with 5 year Mtg Warranty. MAXLIT144PC 14.4k Pocket Fax/Modem \$269.00
MAXFAX144PC Internal 14.4 Fax Modem Card 159.00

24IP	P.C. LOGIC 2400 Baud Internal Modem with PRODIGY	\$34.99
VFXV32BIS	ZOOM External 14.4k Fax Modem w/V 42bis Data Compression	199.00
VFPV32BIS	ZOOM Internal 14.4k Fax Modem w/V 42bis Data Compression	169.00
FAX192I	P.C. LOGIC 19.2k Turbo Fax Modem V.32bis	239.00

EPSON Printers

AP2250	9 Pin Narrow Carriage ACTION Printer	\$119.00
FX-1170	9 Pin Wide Carriage Printer	379.00
AP3250	24 Pin Narrow Carriage ACTION Printer	199.00
LQ-570	24 Pin, 80 Col. 225cps Draft/105cps LQ	249.00
LQ-1170	24 Pin, 132 Col. 300cps Draft/138cps LQ	639.00

PANASONIC Printers

KXP-2180	9 Pin, 80 Col. 240cps Draft/32cps NLQ	\$179.00
KXP1654	24 Pin, 132 Col. 375cps Draft/125cps LQ	579.00
KXP-2123	24 Pin, 80 Col. 240cps Draft/80cps LQ	269.00
KXP-2124	24 Pin, 80 Col. 320cps Draft/106cps LQ	349.00
KXP-2624	24 Pin, 132 Col. 300cps Draft/100cps NLQ	419.00

BJ-200 CANNON Bubble Jet Printer!

Great laser quality at a reasonable price. 248cps Draft, 173cps HLQ and 124cps Super HLQ. Print resolution of 360 dpi with a 64 nozzle print head. 49kb buffer, parallel interface, plain paper. 13 7/8" x 6 7/8" Hx7.60
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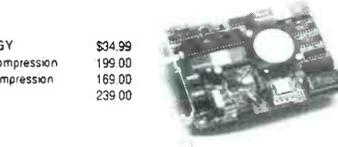
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this could take an awfully long time. Fortunately, you can limit the number and type of files scanned, plus the frequency of a scan. The default is to scan all hard disks at every boot-up, but you can change this to just the first boot-up of the day, week or month. Additionally, you can limit the file search to new file or changed files only, or program files only. The advanced option menu lets you select files by name and includes the use of wildcards.

Because it isn't memory resident, Automated Check can't detect viruses that invade the system after it runs. This

is the job of Shielded DOS, which is the TSR version of AntiVirus. Unlike Automated Check, Shielded DOS runs only in the background, where it constantly monitors your system for known viruses and abnormal system activity. Thanks to a built-in fuzzy-logic engine, it can identify mutating versions of known viruses. However, it can't check for viruses until the AntiVirus program is running, which is a good excuse for loading it ahead of other utilities. Like most popular virus-scanning programs, IBM plans to provide periodic virus upgrade at a cost of about \$20.

Many files today are in compression form, whether they're stored on your hard disk using a compression program like *SuperStor* or are distributed in compressed form on a floppy disk. Because compression changes the contents of the file, it also inhibits scanning software from examining the byte pattern within the original decompressed file to see if they match any known viruses.

While IBM's AntiVirus Automated Check can determine if individual compressed files have changed suspiciously, it isn't able to reliably search them for known viruses unless a supported compression program, such as *Stacker* or *SuperStor*, is currently active. Even then, detection isn't guaranteed. Shield DOS, on the other hand, can detect and deactivate any of its known viruses when you run an infected program, no matter what compression technique is used to store the file.

IBM Text Editor. Although IBM doesn't claim its E Editor text editor is a word processor, it has the look and feel of IBM's *Display Write* word-processing program that was very popular 10 years ago. Unlike a text editor like EDLIN (which is included in PC DOS 6.1), E Editor has word wrap, line draw and a math function—advanced features you expect from today's word processors.

The editor is considerably easier to use than EDLIN, but it's more difficult to use than MS-DOS EDIT and some true word processors, such as *MS Word*. The problem is with its command structure, which is a mixture of F keys, hot-keys and line commands.

Most-often-used commands, like QUIT and SAVE, are on the F keys, and you don't need a template to find their functions. They're displayed on-screen on the bottom line. A little more complex is the use of hot-keys, which does require a template or wall chart to jog your memory because the hot-key combinations aren't the same as those used by any other popular word processor. Their main functions are for marking, inserting and deleting text.

Finally, there are the line commands, such as MARGINS and MATH. Generally, there are no key equivalents to these commands because most require parameters. For example, the MARGINS command needs three parameters (start, stop and paragraph indent), while BOX serves up a list of line types you can draw around selected text. This means that you'll definitely need some kind of chart or prompter to remember these com-

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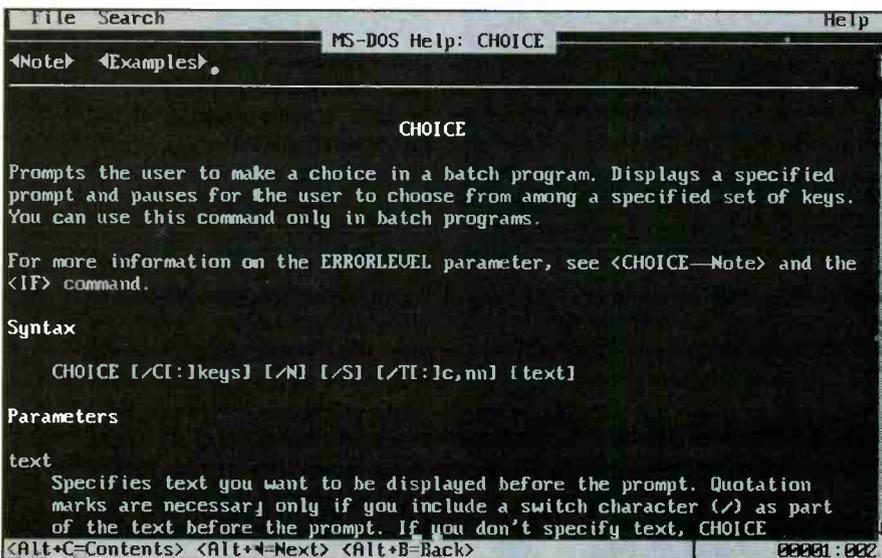
CHOICE [/C:]choices] [/N] [/S] [/T:]c,n] [text]

/C:]choices Specifies allowable keys. Default is YN.
/N - Does not display choices and ? at end of prompt string.
/S Treats choice keys as case sensitive.
/T:]c,n Defaults to choice to c after <nn> seconds.
text Prompts string to display.

ERRORLEVEL is set to offset of key you press in choices.

C:\DOS>

```



As shown in these two screens, Microsoft's (upper screen) MS-DOS 6.0's interactive help screen is leagues ahead of its IBM (lower screen) counterpart.

mands. By toggling the Esc key, you can move the cursor from the text area to the command line.

A lot of users will find the foregoing to be overkill. While E Editor is a capable entry-level word processor, most of us already have taken the time to learn a real word processor and have no desire to learn one with a fairly steep learning curve and fewer features just to edit simple ASCII text. Fortunately, PC DOS 6.1 works with MS-DOS's very popular EDIT text editor and even saves it (along with its QBASIC support files) if you're upgrading from MS-DOS 5.0 or MS-DOS 6.0.

Notebook Users, Take Note

Notebook users will be happy to discover two new programs in PC DOS

6.1's portable computer software arsenal. In addition to Microsoft's APM power-management and InterLink file transfer utilities, you'll find *PenDOS* from Communication Intelligence Corp. and Phoenix Technologies' full set of PCMCIA (Personal Computer Memory Card International Association) drivers. **•PCMCIA Support.** Though PCMCIA—the notebook equivalent of a PC expansion slot—has been around for a while, it has never really caught on for lack of a standard. But things are looking better now. At a recent Micro Systems Forum, most of the definitions for Types I through III were hammered out, plus adoption of Intel's ExCA (Exchangeable Card Architecture) standard.

PC Cards let you extend the capabilities of your computer by adding features,

such as modems, RAM and removable hard-disk drives. The PCMCIA standard defines both the hardware and software interfaces for PCMCIA sockets and cards. The goal is to be able to exchange PC Cards from one system to another with little or no knowledge of the technology involved in the inner workings of the software. It also provides for hot insertion and removal of PCMCIA cards without requiring re-boot. The Phoenix utilities provide the drivers needed to accomplish these goals.

The ExCA Socket Services utility that comes with the notebook's DOS must be loaded before the Phoenix utilities will load. All the Phoenix PCMCIA drivers can be loaded either through the CONFIG.SYS file or manually from the DOS prompt. A description of the PCMCIA drivers is shown in Table 1.

PCMCSE.EXE is responsible for coordinating access to the PC Cards and allocating system resources among Card Services client drivers. It must be loaded before any client driver. A client driver can be a device driver, utility or program designed to support a particular or multiple PC Cards.

PCMSCD.EXE is a super client driver that supports the configuration of several PC Cards. After configuration, the PC Card operates as an integral component of the system. However, the driver is intended to work with only the Phoenix Card Services and doesn't work on Card Services that are furnished by third-party suppliers.

The PCMATA.SYS virtual driver interfaces SRAM (Static RAM) cards with a FAT format to the operating system. This allows you to treat these devices as physical drives for read/write operations. SRAM PC Cards are formatted for DOS FAT file system drivers using the PCFORMAT.EXE utility. The maximum size supported is 32M. PCMATA.SYS also supports PCMCIA-ATA-compatible (IDE) fixed disks, which can be larger than 32M in capacity.

For PCMATA.SYS to work, the PCMCIA sockets should emulate diskette drives A or B using the PCMFDD.EXE diskette-drive emulation driver. PCMCIA slots are numbered, starting with 0. When the driver is loaded, it performs diskette-drive emulation on the specified socket.

PCMVCD.386 is the *Windows* virtual-device driver for PC Card support in the 386-enhanced mode. It permits *Windows* to recognize fax and modem cards

Table 1: PCMCIA Support

Driver Name	Description
PCMCS.EXE	Card Services 2.0, with ExCA Support
PCFORMAT.EXE	SRAM Format Utility for A or B
PCINFO.EXE	DOS Information Utilities
PCMATA.SYS	Virtual FAT Block Device Driver
PCMFDD.EXE	FAT Diskette Emulation
PCMMTD.EXE	Memory Technology Driver
PCMSCD.EXE	Super Client Driver
PCMVCD.386	Windows VxD Driver for Fax/Modem Cards
WPCMINFO.CPL	Windows Information Utilities

plugged into a PCMCIA slot and is a replacement module for the VCD driver provided in *Windows*.

The PCMMTD.EXE Memory Technology Driver is used for Flash and other memory cards. PCMCS.EXE, found on the PC's DOS disk, must be loaded prior to loading PCMMTD.EXE.

The PCMCIA Support Information Utilities provide information about each PCMCIA slot and the card plugged in it. Two information utilities are provided: PCMINFO.EXE is DOS-based and WPCMINFO.CPL is *Windows*-based.

PenDOS

PenDOS from Communication Intelligence Corp. lets you use pen-mouse devices and tablet digitizers with pen-based applications, as well as standard mouse-based DOS applications on any 386 or later system. The program supports 13 input devices, including the IBM ThinkPad and Samsung PenMaster. You even have the option of choosing a standard two-button mouse as a pen by selecting the "Digitizing Pad Emulation via Mouse" option.

Using a pen-tablet computer or externally-attached digitizing tablet, you can write naturally because *PenDOS* includes CIC's *Handwriter Recognition System* that translates pen strokes into letters and symbols. Because the pen strokes have to begin and end at specific points, it takes some training and practice to use this hardware, which the user's manual explains in detail using graphic examples.

Unfortunately, PC DOS 6.1 doesn't have the full-blown *Handwriter* package. The PC DOS 6.1 *Handwriter* software recognizes only numbers and symbols. A full version of *Handwriter* that recognizes uppercase and lowercase letters, numbers, punctuation marks and sym-

bols is available separately for \$39.95

However, the PC DOS 6.1 version of *Handwriter* does have the equivalent of a 101-key keyboard. If a DOS application doesn't provide mouse-aware menus or if you need to enter non-printable such characters as Alt+F1, you can use the keyboard to enter commands. The keystrokes are sent to the application as if they were typed from a physical keyboard.

A Better DOS?

In many respects, IBM's PC DOS 6.1 looks like the DOS most of us expected MS-DOS 6.0 to be. Hopefully, the new data-compression program will put an end to the problems caused by Microsoft's DoubleSpace. But since it's not yet shipping, this remains to be seen. The AntiVirus program works well, and the new notebook utilities are a welcome addition. But the real prize is the inclusion of Central Point *Backup*, with its tape support and backup scheduler.

On the negative side, the memory manager doesn't install as intelligently as MS-DOS 6.0's MemMaker does, and the text editor is difficult to learn and use.

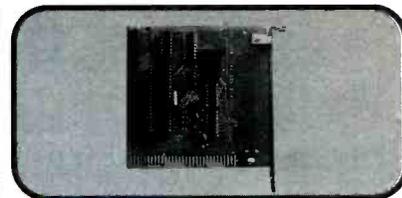
So the question still remains: "Is this the DOS you've been waiting for?" For the most part, it's certainly a better DOS than Microsoft is shipping. But if you're waiting for a verdict on which disk-compression scheme is better, the jury is still out on this one. ■

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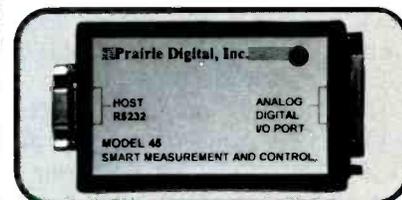
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CIRCLE NO. 75 ON FREE INFORMATION CARD

Build a POST Card

This easy-to-build \$25 diagnostic card can help you quickly locate the source of a problem that halts a PC from properly booting up

Sooner or later, it happens to all PC users. You switch on your computer, it runs through its start-up routine and then the procedure suddenly grinds to a halt, the video display locks up and the speaker begins to emit a long continuous chain of beeps. The computer has failed to boot. If you're lucky, its video screen may reveal a clue to the problem, like "Check Keyboard" or "Hard Drive Failure." More often than not, though, there will be no such help or you'll get a cryptic message like "I/O Error" that leaves you helpless.

At this point, you probably make an educated guess at which component or components are causing the problem and start testing from there. However, for this type of repair, there's a simpler, faster way to go. Many modern PCs can actually help you to isolate and troubleshoot problems because they generate a series of self-tests and diagnostic codes during the boot-up procedure that you can monitor and use to help you quickly and easily determine the nature of the problem. All you need to be able to do this is a device to intercept and display the code you get and a look-up table that tells you the test that failed.

The project presented here is a plug-in POST Code diagnostic card that does the job of monitoring and displaying the computer-generated test codes. It greatly simplifies your troubleshooting job by providing you with the ability to quickly and accurately diagnose failures to the component level on most IBM/compatible PCs. Since you can build the POST Card for about \$25, it's a handy device to have around even if you're simply looking to keep a single computer up and running. If you're a professional computer technician, the POST Card will pay for itself on the first repair job you do.

About the Circuit

When any computer is first turned on, it

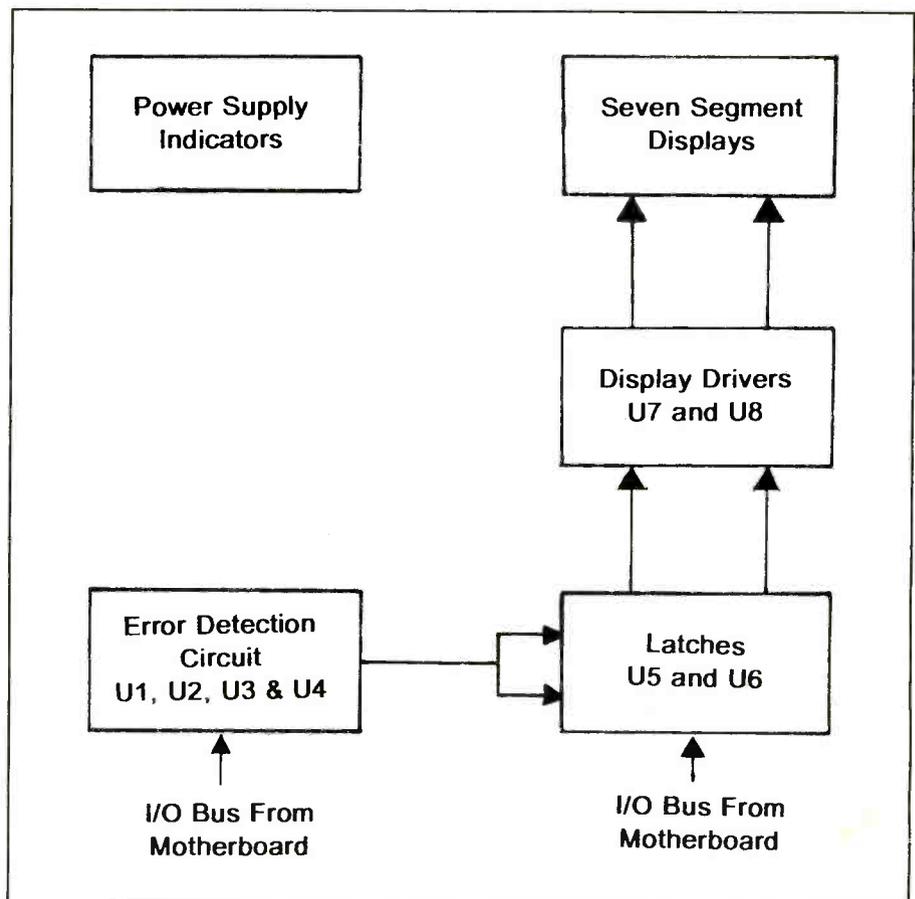


Fig. 1. Block diagram of overall POST Card circuitry.

goes through a procedure known as the "boot" process. For IBM and compatible computers, this process begins with a start-up routine known as the POST, an acronym for power-on self-test, which is part of a program contained in an on-board ROM chip known as the BIOS (basic input/output system) program that's designed to provide the proper interface between the motherboard and the other system components.

Because an unpowered computer contains no data in its user RAM, on power-up it looks for something to do. The only

thing it finds is the BIOS program in the ROM, which automatically leads the PC through its start-up routine and prepare it for use by the operator. During this process, the POST program tests and initializes the hardware components that make up the entire computer system. Devices like floppy drives, hard drive, keyboard, video monitor, memory chips and other support ICs, and all other key subsystems are checked out for correct operating capability.

As it performs the tests programmed into the BIOS ROM, the POST identi-

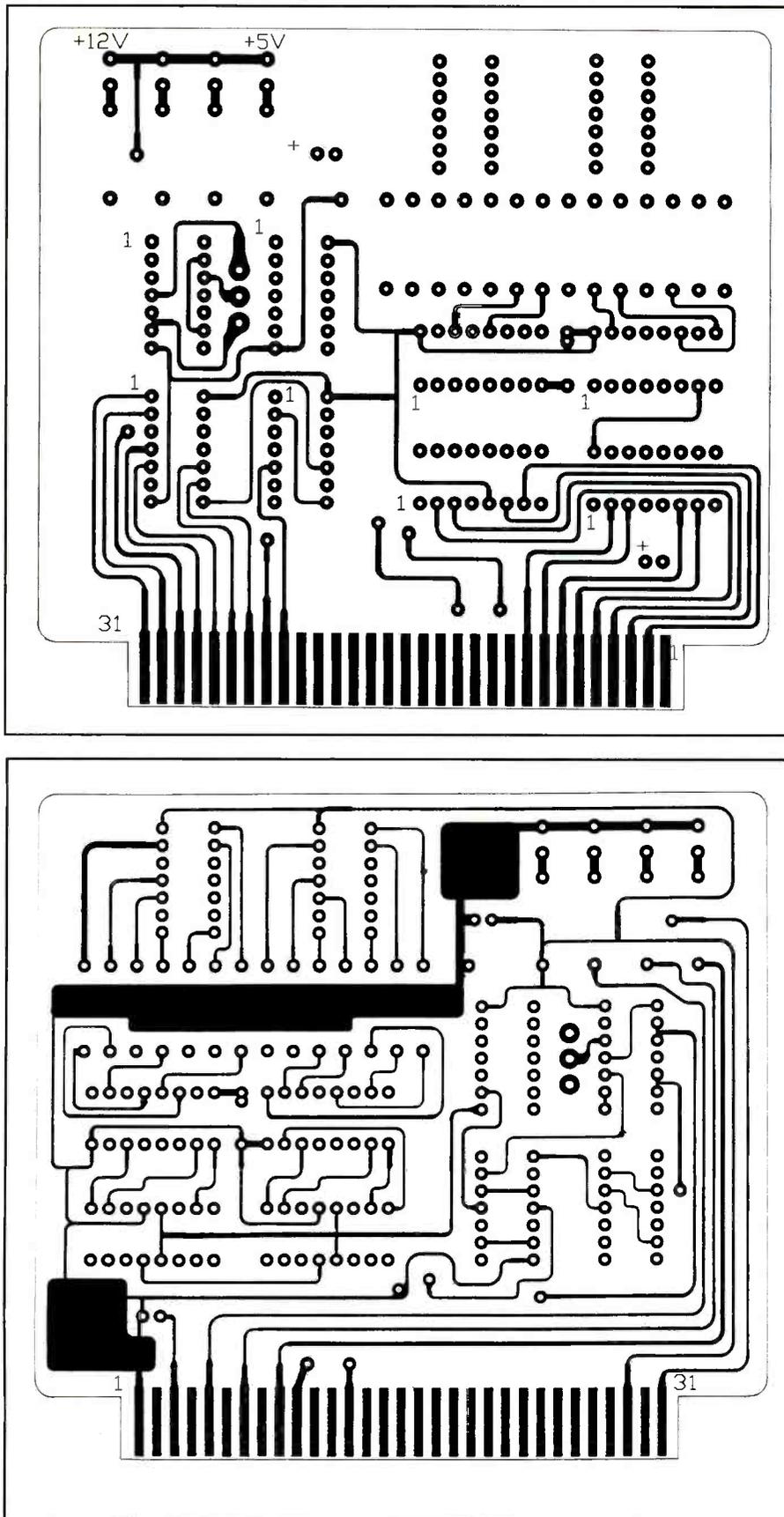


Fig. 3. Actual-size etching-and-drilling guide for POST Card printed-circuit board. This card must be double-sided to mate with the double-edged connectors on a PC/compatible's motherboard.

POST Card performs checks the status of the PC's power supply via four LED power indicators, one each for the four power-supply voltage lines that are used in all IBM-type computers: +5 volts, -5 volts, +12 volts and -12 volts. When each voltage is present, all LEDs on the POST Card light. If any one or more is missing, the corresponding LED(s) will be dark to provide a visual indication of the problem.

Construction

The first important thing to note with regard to construction is that this project requires a double-sided printed-circuit board (see Fig. 3 for actual-size etching-and-drilling guides for both sides of this board) so that the POST Card can make contact with the contacts on both sides of the expansion-bus slot sockets on a PC motherboard. Some connections are made to one side of the board and others go to the opposite side. If you decide to make your own PC board, don't mix up the Top (component) and Bottom (solder) guides. Alternatively, if you wish to avoid having to make a pc board, you can purchase a ready-to-wire one from the source given in the Note at the end of the Parts List.

When your pc card is ready, simply plug all the components in their respective locations, as shown in Fig. 4. From an operational viewpoint, lead lengths aren't critical, but you'll probably want to mount the components as close as possible to the surface of the card. Since you need soldering access to both sides of the card, don't use sockets for the ICs. Simply plug them into the board as shown.

Besides correct component placement and making absolutely certain of orientation with regard to the ICs, numeric displays, LEDs and electrolytic capacitors, the only other construction concern involves the proper soldering of the parts to the pads on the card. Because the board is double-sided but doesn't have plated-through holes, you must solder all connections on both the Top and Bottom of the card. Some component leads are used to make bridging connections between both sides of the card to complete conductor runs. If you fail to solder just one connection, the card will malfunction.

Checkout & Use

The only way to test the POST Card is to use it. Simply power down your PC and plug the card into any open slot on the motherboard of a PC. It doesn't mat-

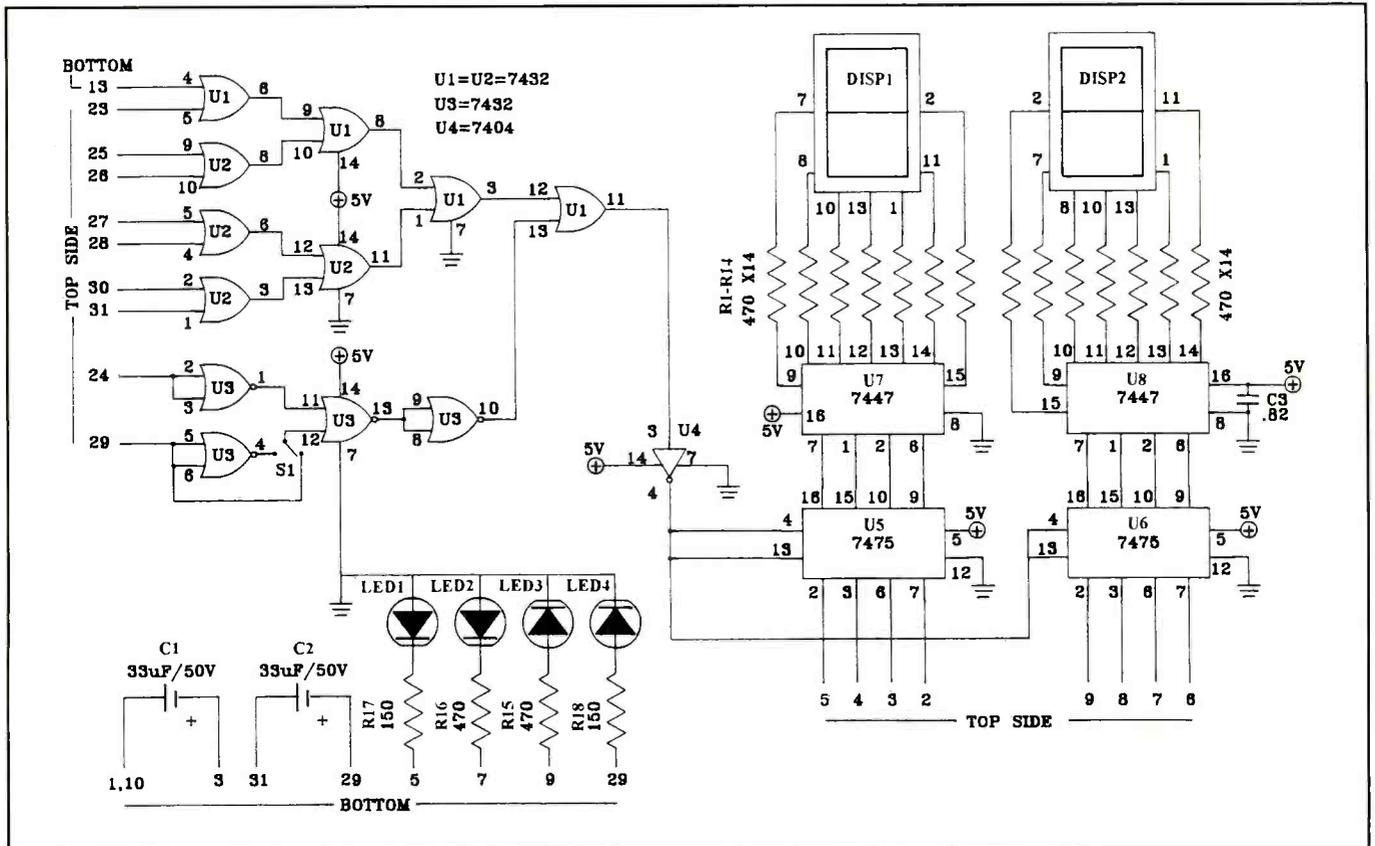


Fig. 2. Complete schematic diagram of POST Card circuitry.

fies each one by sending a two-digit identification code (known as the POST test code) along a test port (I/O Port 80h) that's shared by all the card slots on the motherboard. These codes can be monitored and displayed by the special-purpose plug-in test POST Card. You use these codes to determine where the problems are occurring in a system that won't boot.

As shown in the Fig. 1 block diagram, this project, consists of five sections: an error-detection circuit; latches; display drivers; displays; and power-supply indicators. The complete schematic diagram for the circuitry is shown in Fig. 2.

During execution of the POST procedure, test codes appear in hexadecimal format on fingers 6 through 9 of the card and go to pins 7, 6, 3 and 2 of U8 for digit 1 and fingers 2 through 5, which go to pins 7, 6, 3 and 2 of U5 for digit 2. The 7475 ICs used for U5 and U6 each contain four bistable latches. During normal operation, the latches appear to be transparent so that signals placed on the inputs appear directly on the outputs, just as though the chips weren't there. Since the outputs of the of U5 and U6 go

straight to display drivers U7 and U8, any POST test code numbers that appear on the latch inputs are displayed on the seven-segment LED displays DISP1 and DISP2.

Chips U5 and U6 are controlled by an on-board error-detection circuit that uses a combination of OR and NOR gates (U1, U2 and U3) to monitor 10 key pins on the bus lines. When a POST procedure tests okay, all 10 pins remain low. In turn, these lows are coupled through inverter gate U4 to latch-control pins 4 and 13 of U5 and U6, keeping these pins high and preventing latching from occurring.

When a problem occurs and the POST procedure detects a failure, one or more of the 10 monitored pins goes low and activates the latches. When this occurs, the last code number that was generated by the POST procedure is the one latched onto and displayed by the POST Card and indicates which test failed. At this point, all you have to do is look up the number in the POST-code table to determine which system component or components failed.

Besides reading the POST codes, the

PARTS LIST

Semiconductors

DISP1, DISP2—MAN72A seven-segment LED numeric display
 LED1 thru LED4—3-mm red light-emitting diode
 U1, U2—7432 quad OR gate
 U3—7402 quad NOR gate
 U4—7404 hex inverter
 U5, U6—7475 quad bistable latch
 U7, U8—7447 seven-segment decoder/driver

Capacitors

C1, C2—33-F, 25-volt electrolytic
 C3—0.82-F, 25-volt ceramic disc

Resistors (1/4-watt, 5% tolerance)

R1 thru R16—470 ohms
 R17, R18—150 ohms

Miscellaneous

S1—Miniature spst slide switch
 Printed-circuit board; hookup wire; solder; etc.

Note: The following items are available (U.S. only, no foreign orders please) from Paul E. Yost, PO Box 32291, Louisville, KY 40232: complete kit of parts, including pc board, \$24.95 plus \$1 P&H; bare pc board, \$12.95 postpaid. Also available is an assembled and tested POST Card for \$34.95 plus \$1 P&H. Kentucky residents, please add 6% state sales tax to all orders.

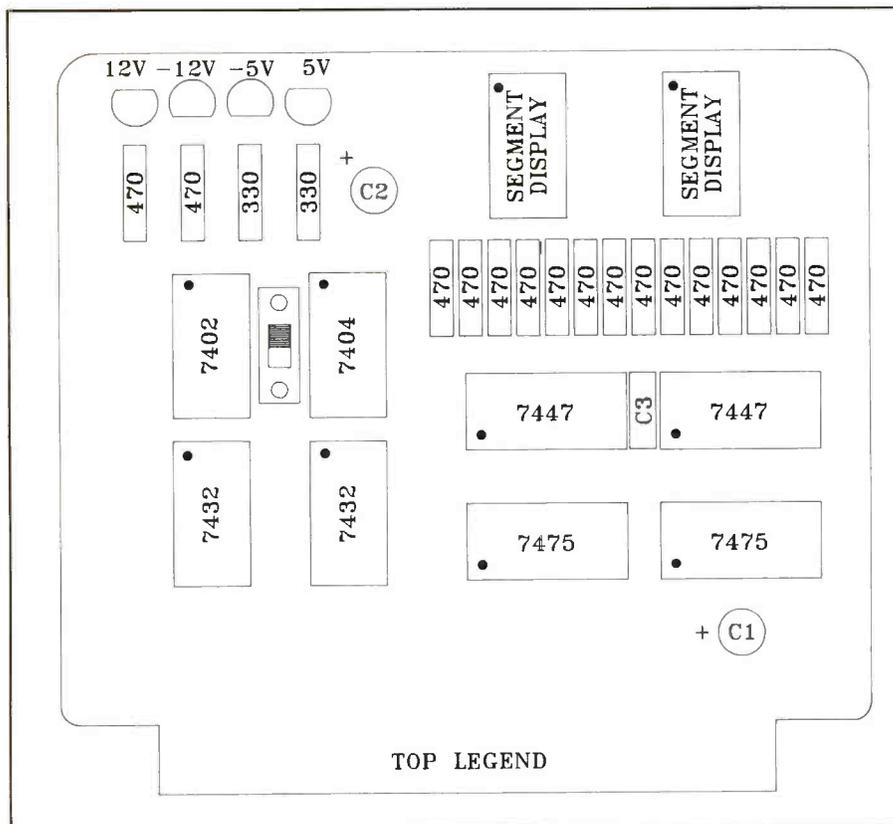


Fig. 4. Wiring guide for pc board.

ter if the slot is eight- or a 16-bit, since the POST Card will work in either. This done, turn on the computer and note if the four power-condition indicator LEDs on the POST Card are on. If they are, all power-supply voltages are present and functioning properly.

During a normal POST procedure, you should observe various pairs of numbers flashing on the numeric displays. Each number pair represents a specific test being performed. When all systems test okay, the run of number pairs eventually ends and the computer boots normally. During this procedure, if any test detects a failure, the card should latch onto the last code displayed. This is the code you used to determine the type of failure that occurred. (Note: Depending on computer type, you may have to set *SI* to its alternate position to invert the signal on pin 29 because some manufacturers keep this signal high instead of normally low.)

If the computer boots normally but no codes appear on the POST Card's numeric displays, power down, remove the POST Card from the PC and do the following to locate and solve the problem:

(1) First check to make sure that the

card is properly seated in the motherboard's expansion slot. To do this, turn off the power and then pull the card out and reinstall it. Next, turn on the computer and see if it reads now.

(2) Check all your soldered connections to make sure that you haven't missed any and that all those you made are good. If you missed any connections, solder them now. Similarly, if any connection appears to be dull and/or grainy, re-flow the solder on it to make sure you have a good electrical and mechanical connection.

(2) Check for proper component placement and orientation. It's very easy to accidentally place a LED, a display or an IC in backwards because all these parts are symmetrical.

(4) Check that all four supply voltages are present from the computer motherboard. If any of the LED indicators on the POST Card is off, there may be a problem with the computer's power supply. Test this out with a dc voltmeter or a multimeter set to the dc-volts function..

There's one other possibility that can make the POST Card fail to operate. Manufacturers of computers usually don't make the BIOS chips they use.

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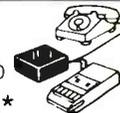
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Table 1. POST Codes

Code	Meaning	Code	Meaning	Code	Meaning
	American Megatrends, Inc. (AMI), 1346 Oakbrook Dr., Norcross, GA 30093; tel. 800-828-9264	5D	ERROR! Timer/Keyboard Interrupt	2B	Initialize Floppy-Disk Drives
01	286 Register Test	5E	8259 Interrupt Controller Error	2C	Detect And Initialize Serial Ports
02	Register Test Over	5F	8259 Interrupt Control Test OK	2D	Detect And Initialize Parallel Ports
03	ROM Checksum Test	70	Keyboard Test Start	2E	Initialize Hard Drive
04	8259 Chip Interrupt Test	71	Keyboard BAT Test OK	2F	Detect And Initialize Math Coprocessor
05	CMOS Chipset Test And Initialization	72	Keyboard Test OK	30	Reserved
06	Video Disabled And System Timer Test	73	Keyboard Global Initialization	31	Detect And Initialize Option ROMs (If Present)
07	CH-2 Of 8253 IC Test OK	74	Floppy-Drive Setup Start	3B	Initialize Secondary Cache (OPTi Chip Set)
08	CH-2 Of 8254 IC Test OK	75	Floppy-Drive Setup OK	CA	Micronics Cache Initialization (If Present)
09	CH-1 Of 8254 IC Test OK	76	Hard-Drive Setup Start	CC	NMI (Non-Maskable Interrupts) Handler Shutdown
0A	CH-0 Of 8254 IC Test OK	77	Hard-Drive Setup OK	EE	Unexpected Processor Exception
0B	Parity Status Check	79	Timer Data Area Initialization	FF	Boot Attempt
0C	Refresh And System Timer Test OK	7A	CMOS Battery Power Test		
0D	Reset Link Toggling Test OK	7B	CMOS Battery Power OK		
0E	Refresh Period ON/Off 50% OK	7D	Analyze POST Test Results		
10	Start Of 64K Base-Memory Test (Refresh On)	73	CMOS Memory Size Update		
11	Address Line Test OK	7F	Optional ROM Check		
12	64K Base-Memory Test OK	80	Keyboard Sensed to Enable Setup		
13	Interrupt Vectors Initialized	81	Optional ROM Control OK		
14	8042 Keyboard Controller Test OK	82	Printer Global Data Initialization		
15	CMOS Read/Write Test OK	83	RS-232 Global Data Initialization	01	CPU Register Test In Progress
16	CMOS Checksum And Battery Test OK	84	80287 Check and Test	02	CMOS Read/Write Failure
17	Monochrome Mode Test OK	85	About to Display Soft Error Messages	03	ROM BIOS Checksum Failure
18	Color Mode Test OK	86	About to Give Control to System ROM E000.0	04	Programmable-Interval Timer Failure
19	Optional Video ROM Test	87	System ROM E000.0 Test OK	05	DMA (Direct Memory Access) Chip Failure
1A	Optional Video ROM Test OK	00	Control Given to Boot Loader	06	DMA Page Register Read/Write Failure
1B	Display Memory Read/Write Test OK			08	RAM Refresh Failure
1C	Alternate Display Memory Test	Award Software, 130 Knowles Dr., Los Gatos, CA 95030; tel.: 408-370-7979		09	First 64K RAM Test In Progress
1D	Video Retrace Test	01	Processor Status Flags Verification (Carry, Zero, Sign And Overflow)	0A	First 64K RAM Chip Or Data Line Failure
1E	Global Equipment Byte Set For Video Test	02	Determine POST Type	0B	First 64K RAM Odd/Even Logic Failure
1F	Mode Set Call for Mono Or Color Test	03	Clear 8042 Keyboard Controller	0C	First 64K RAM Address-Line Failure
20	Video Test OK	04	Reset 8042 Keyboard Controller	0D	First 64K RAM Parity Failure
21	Video Display OK	05	Obtain Manufacturing Status	10	Bit 0 Failure (First 64K RAM)
22	Power-On Message Display	06	Initialize Chip Set	11	Bit 1 Failure (First 64K RAM)
30	Virtual Mode Memory Test Prepare	07	Processor Test 2 (Read/Write/Verify All CPU Registers Except SS, SP And BP)	12	Bit 2 Failure (First 64K RAM)
31	Virtual Mode Memory Test Started	08	Initialize CMOS Timer (Update Cycle Normally)	13	Bit 3 Failure (First 64K RAM)
32	Processor In Virtual Mode	09	EPROM Checksum	14	Bit 4 Failure (First 64K RAM)
33	Memory Address Line Test In Progress	0A	Initialize Video Interface	15	Bit 5 Failure (First 64K RAM)
34	Memory Address Line Test Continuing	0B	Test Timer, Channel 0 (8254 Chip)	16	Bit 6 Failure (First 64K RAM)
35	Memory Below 1M Byte Calculated	0C	Test Timer, Channel 1 (8254 Chip)	17	Bit 7 Failure (First 64K RAM)
36	Memory Size Computation	0D	Test Timer, Channel 2 (8354 Chip)	18	Bit 8 Failure (First 64K RAM)
37	Memory Size Computation	0E	Test CMOS Shutdown Byte	19	Bit 9 Failure (First 64K RAM)
38	Memory Initialization (Below 1M Byte)	0F	Test Extended CMOS	1A	Bit 10 Failure (First 64K RAM)
39	Memory Initialization (Above 1M Byte)	10	Test DMA (Direct Memory Access Chip) Channel 0	1B	Bit 11 Failure (First 64K RAM)
3A	Memory Size Displayed	11	Test DMA Channel 1	1C	Bit 12 Failure (First 64K RAM)
3B	Memory Test Start	12	Test DMA Page Registers	1D	Bit 13 Failure (First 64K RAM)
3C	Memory Test OK (Below 1M Byte)	13	Test Keyboard Controller	1E	Bit 14 Failure (First 64K RAM)
3D	Memory Test OK (Above 1M Byte)	14	Test Memory-Refresh Function	1F	Bit 15 Failure (First 64K RAM)
3E	About to Go To Real Mode (Shutdown)	15	Test First 64K Of System Memory	20	Master DMA Register Failure
3F	Shutdown Successful and Real Mode Started	16	Set Up Interrupt Vector Table	21	Slave DMA Register Failure
40	Disable Gate A20 Address Line	17	Initialize Video I/O Operations	22	Master Interrupt Mask Register Failure
41	Gate A20 Line Disable Completed	18	Test Video Memory	23	Slave Interrupt Mask Register Failure
42	DMA (Direct Memory Access Chip) Controller Test	19	Test 8259 Mask Bits, Channel 1	25	Interrupt Vector Loading In Progress
4E	Address Line Test OK	1A	Test 8259 Mask Bits, Channel 2	27	Keyboard Controller Test Failure
4F	Processor In Real Mode After Shutdown	1B	Test CMOS Battery Level	28	CMOS Power Failure And Checksum Calculation In Progress
50	DMA Page Register Test OK	1C	Test CMOS Checksum	29	CMOS Configuration Validation Test
51	DMA Unit-1 Base Register Test Start	1D	Test Configuration From CMOS	2B	Video Memory Failure
52	DMA Unit-1 Base Register Test OK	1E	System Memory-Size Test	2C	Screen Initialization Failure
53	DMA CH-2 Base Register Test OK	1F	System Memory Test	2D	Screen Retrace Test Failure
54	About To Test Flip-Flop Latch For Unit-1 And -2	20	Test Stuck 8259 Interrupt Bits	2E	Search For Video ROM In Progress
55	Flip-Flop Latch Test OK	21	Test Stuck NMI Bits (Parity I/O Check)	30	Screen Operable
56	DMA Unit-1 And -2 Programmed OK	22	Test 8259 Function	31	Monochrome Monitor Operable
57	8259 Initialization Complete	23	Test Protected Mode	32	Color Monitor Operable (40 Column)
58	8258 Mask Register Check OK	24	Extended-Memory-Size Test	33	Color Monitor Operable (80 Column)
59	Master 8259 Mask Register OK	25	Extended-Memory Test	34	Timer Tick Interrupt Test
5A	About To Check Timer And Keyboard Interrupt	26	Test Protected-Mode Exceptions	35	Shutdown Test Failure
5B	Timer Interrupt OK	27	Set Up Cache Control Or Shadow RAM	36	Gate A20 Failure
5C	About To Test Keyboard Interrupt	28	Set Up 8242 (Keyboard Controller Detection)	37	Unexpected Interrupt In Protected Mode
		29	Reserved	38	RAM Test In Progress Or Address Failure >FFFF
		2A	Initialize Keyboard Controller	3A	Interval Timer Channel 2 Test Or Failure
				3B	Time-Of-Day Clock Test Or Failure
				41	System-Board Select Failure
				42	Extended CMOS RAM Failure

Phoenix Technologies, 846 University Ave., Norwood, MA 02062; tel.: 617-551-4000

These are made by others who sell them to the computer manufacturers. The three most common BIOS manufacturers are American Megatrends, Inc. (AMI), Phoenix Technologies Limited and Award Modular BIOS. Some of the very early BIOS chips, particularly those used in the first IBM PC and XT computers, don't generate POST codes. In these cases, the POST Card can't read something that isn't there. However, you can still use the card with these computers, provided you replace the existing BIOS chip in the PC with an updated one. You'll probably want to do this in any case because older BIOS chips can't run such newer devices as IDE hard drives and 1.44M floppy drives.

There are no special requirements or procedures for using this POST Card. However, keep in mind that the card is meant to be used on computers that fail to boot properly. It wouldn't help you to troubleshoot computers that boot normally and then malfunction. It also can't help you troubleshoot non-boot-related problems because the POST procedure doesn't test for these. Since most hardware-problems cause a boot failure, though, you'll find POST Card to be a big help in most repair jobs.

To use the card, simply plug it into any available expansion slot on the motherboard and switch on the PC. At this time, you should observe two-digit codes on the numeric displays. When a problem occurs, the run of number pairs stops. The last number latched on the display indicates the test that was in progress when the failure was detected. Looking up this number in the appropriate section of the Table 1 will identify the component or system that failed.

Table 1 contains separate listings for each of the three manufacturers of BIOS chips commonly used in modern PCs. When you read the POST code displayed by the POST Card, also look to see which BIOS chip is being used on the motherboard. The chip should clearly display the manufacturer's name on its top surface. Once you have this name, you'll know which section of the POST-Code Table to use.

POST codes are in hexadecimal format. Hexadecimal, or "hex" for short, is a base-16 numbering system that uses the standard decimal numerals 0 through 9 and continues on with the letters A, B, C, D, E and F to obtain the additional six "digits" needed. Since the POST Card uses standard seven-segment displays, it

can't easily display the letters. Fortunately, the chip manufacturers thought of this when they designed these components. The 7447 display drivers can be used with hexadecimal systems. They can display 0 through 9, but for A through F, the 7447 displays special symbols. Table 2 lists the decimal, hexadecimal and 7447 driver symbols. Use Table 1 to help you translate between the different systems.

Once you've obtained a failed-test code, the Table 1 will help you determine the cause of the problem.

Tests performed by the POST procedure aren't very sophisticated, but they can provide valuable diagnostic help when troubleshooting a faulty computer system. This is particularly true when the problem is too severe for a PC to boot up and allow you to use other means, like disk-based utility programs, to perform more thorough testing. ■

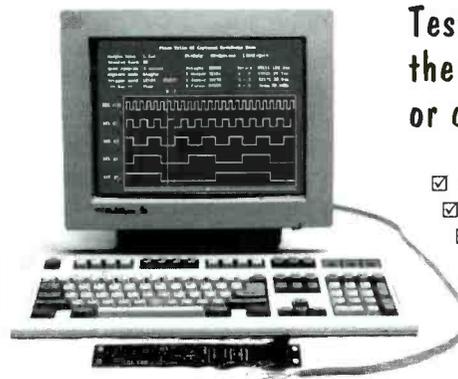
Table 2. Display Representations of Decimal and Hex Numbers

Decimal	Hexadecimal	7447 Equivalents
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9
10	A	ⓐ
11	B	ⓑ
12	C	ⓒ
13	D	ⓓ
14	E	ⓔ
15	F	ⓕ

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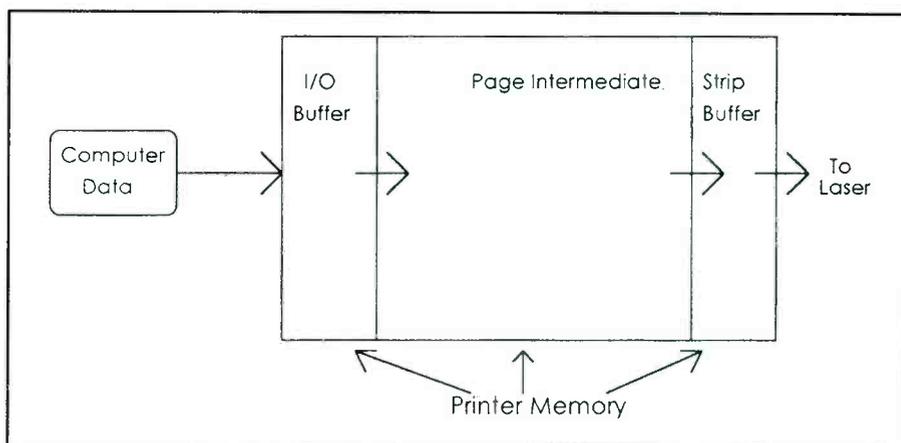
What they are, how they work and tips on buying the right one for your particular applications

Dot-matrix and daisywheel printers are easy to understand. The computer sends to the printer a number, perhaps a 68, which is the ASCII code for the upper-case D, at the beginning of this article. A daisywheel printer spins its type wheel until character 68 is facing the page; a dot-matrix printer looks up the dot pattern for character 68 in its ROM. Then either printer forms the character D by pressing the appropriate formed character on a metal or plastic slug (daisywheel) or the appropriate pin pattern (dot matrix) against an inked ribbon that, in turn, transfers the image onto the page at the correct locations. Both printers also understand a limited number of control codes that position text on the page and add features like underlining. Dot-matrix printers usually can print graphics, as well as text.

From the computer's point of view, a laser printer seems about the same as a daisywheel or dot-matrix printer. The computer sends ASCII text, control codes and graphics to the printer. This is where the similarity ends, however. A laser printer must go through several sets of operations, using a half-dozen different technologies, to transfer your text and graphics to a printed page.

The printer first handles the computer's data electronically. The printer stores the incoming data in a section of its memory called an input buffer. It parses the data here, separating commands, graphics and ASCII text. Next, it moves the data into a "page intermediate," which is an electronic representation of the final page. In page intermediate, the printer applies the commands it has received to the data, adding features like underlining and bold-facing to type, selecting the appropriate built-in or downloaded fonts, etc. It stores graphics in a 1s-and-0s format, with a 1 representing each dot that will be printed and a 0 representing locations at which nothing will be printed. To conserve internal memory space, the printer leaves text in its ASCII representation.

Unlike a dot-matrix or daisywheel



Details of the laser printer's data path.

printer, a laser printer can receive lines in almost any order. But, like other printers, it must create the actual page from the top to the bottom. As the printer moves data to page intermediate, it sorts lines into their proper locations. For example, if you're printing a newsletter in two columns, your software may send all of the text for the first column, followed by text for the second column. The printer must reorganize the data into individual print rows.

Once the page is completed, page intermediate contains an electronic representation of the full page. Page intermediate has been created by a microprocessor inside the printer that has simply reacted to the commands it has received. Now the printer must call on other technologies to turn the electronic page into a paper-and-ink page that can be stuffed into an envelope or a filing cabinet.

From Binary to Image

When page intermediate has a complete page—when the page is full or the computer signals with a form feed command that it has nothing more to place on the page—the printer starts the process of creating an image from the data. The image isn't created on paper. Instead, it's created on a special drum that's coated with a photoreceptor material. The elec-

trostatic image that's created on the drum is later transferred to a sheet of paper and "developed" into the final hard copy you see.

One part of image creation is carried on in the printer's memory. The printer's microprocessor scans the page intermediate and sends its data to one of three strip buffers. Three buffers are used to make sure that data flows at an even rate from page intermediate to the electrostatic image.

The strip buffer contains the actual dots that will be printed. The printer looks up the character images for ASCII data in page intermediate and translates them into dots. It transmits graphical data directly from page intermediate to a strip buffer. The strip buffers are small. They contain the final page image for only a very narrow strip across a sheet of paper.

From the strip buffer, the dots are sent to the laser inside the printer. The laser, which is stationary, pulses energy against a rotating mirror. The mirror is synchronized with the pulses so that a line of dots can be placed evenly across the image area. You can think of the mirror and laser working together to create a line as similar to the way an electron gun creates a picture on the screen of a TV picture tube.

Meanwhile, mechanics in the printer are preparing the photosensitive drum to receive the laser pulses and turn them into an image with toner, which is small granules of thermoplastic impregnated with bits of iron. As the drum rotates, it passes under a high-voltage "corona" wire, which ionizes the air around it and imparts a negative static-electricity charge to nearby objects, including a section of the drum's surface.

As the drum rotates farther, the laser pulses strike some areas and miss others. Areas that are hit lose the charge, and those that are missed retain the charge from the corona wire.

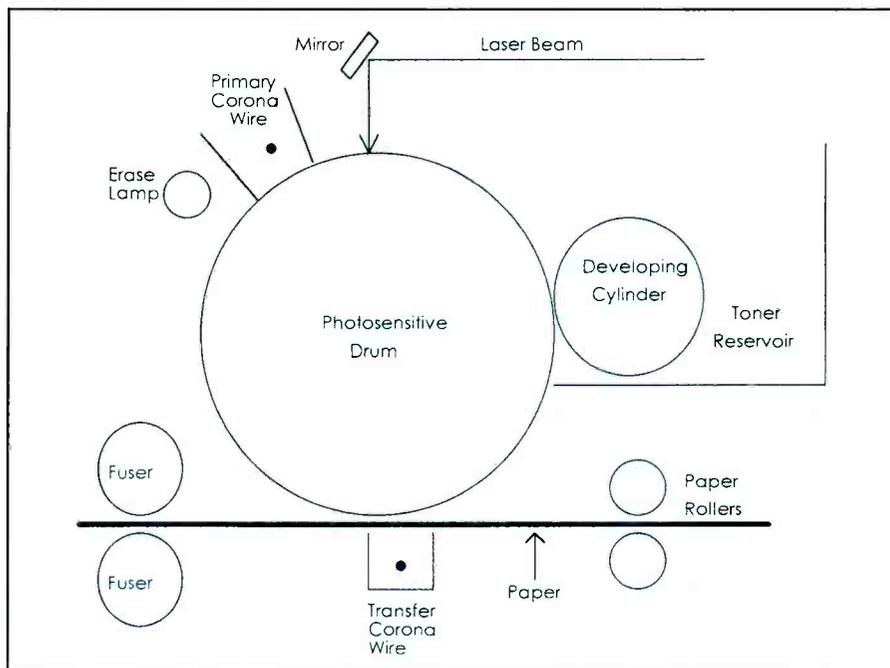
A second drum, almost touching the first, rotates through a reservoir of toner. It uses an internal magnet to pick up a uniform layer of toner and give it a negative charge. As the toner coating rotates into its closest proximity to the photosensitive drum, toner is repelled by the negative charge of unexposed sections of the drum. But it leaps across the gap between drums and adheres to sections that have, because of exposure to the laser light, lost their charge. Strip by strip, a positive image is built up on the photosensitive drum.

After the image is transferred to paper, special blades scrape the drum clean and erase lamps remove all electrical charges. Then the drum rotates under the corona wire again to start forming the rest of the image or a new image.

The process I've described is called "black-write" because laser pulses are used to define the black dots that appear on the final copy. The black-write system is used in most laser printers, including those based on Canon engines like those used in Hewlett Packard's popular series of LaserJet printers. A slightly different "white-write" system, in which the laser pulses define printed areas that aren't to have "ink" on them, is used in some laser printers, including those with a Ricoh print engine. In a white-write printer, laser pulses define areas that will be left blank, not those that will receive toner.

Developing the Image

Now that the printer has transformed the electronic image in page intermediate into an electrostatic image on the photosensitive drum, it's time to actually do some printing on paper. Remember that the electrostatic image is made up of particles of toner that have been lightly magnetized with a negative charge and



Details of the laser printer's image-formation process and paper path.

are holding onto areas of the drum that have no charge.

The printer pulls a sheet of paper through its paper path. When the paper is right below the photosensitive drum, another corona wire, called the transfer corona, gives the paper a positive charge. The positively-charged paper pulls the toner away from the neutral charge on the drum, thus transferring the image onto the paper.

As the paper moves on through the printer, the toner remains in place partly because of a residual charge and partly the result of gravity. To make the image permanent, the paper moves through a pair of non-stick rollers called fusers. The high temperature of the fusers (about 400° F) melts (fuses) the plastic toner onto the paper. Then the paper is ejected from the printer, which then starts to work on the next page, if there is one.

The process from electronic data to final image is complex but surprisingly robust. Most laser printers can run for months with only minimal maintenance and few, if any, printing errors. The one problem that printer engineers can't guard against is poor-quality paper. Laser-printer paper must be able to hold an electrostatic charge, have a smooth surface and withstand the heat of the fuser rollers. Inexpensive paper, even if it fulfills the basic requirements of laser printers, is apt to leave harsh dust inside the

printer and jam easily as it moves through the printer. It's almost always less expensive in the long run to avoid cheap paper and buy high-quality xerographic paper for a laser printer.

Selecting a Laser Printer

If you're shopping for a new laser printer, you'll be faced with a huge array of manufacturers, "engines," options and claimed compatibility. Before you can make an intelligent decision, you'll have to cut through all the sales hype and try to sort out the differences between the printers that are available.

The first and most important choice you'll have to make is between PostScript and non-PostScript printers. PostScript is an English-like command and programming language that's both extremely powerful and complex. It was developed by Adobe Systems to bring true device-independence to printers. A computer application that creates PostScript output doesn't need to know the resolution or page size of the printer it's using. It can create text and graphics knowing that a 300-dpi (dot-per-inch) printer will produce decent output and a professional 1,200-dpi printer will produce excellent output that's ready for professional printing. In addition, a PostScript printer is guaranteed to have a number of specific scalable fonts built into it and ready for use.

The downside of PostScript printers is

%!PS	% PostScript's "magic number"
72 144 moveto	% set initial point
306 648 lineto	% add line segment # 1
540 144 lineto	% add line segment # 2
closepath	% let printer add segment # 3
stroke	% make path visible
showpage	% print and eject the page

These are the actual instructions an application would send to the printer to draw a triangle. Comments have been added at the right of each line. PostScript is easy to create, but the printer must do a great deal of work to interpret its commands.

```
Ec&100Ec(8UEc(s1o10v0s3b5T
```

(note "Ec" is the ASCII 27 Esc character.)

This is the output an application would send to the printer to select 10-point proportional Times Roman type in bold, upright style, using portrait print mode and the Roman-8 symbol set. PCL puts a burden on the application program to make the output as easy as possible for the printer to interpret.

that they require a more-powerful micro-processor and a great deal of memory to interpret the computer's commands and create the necessary pages. Therefore, their price tags are often \$1,000 or more greater those of comparable non-PostScript printers. Traditionally, the best-known PostScript printers have been sold by Apple, which adopted PostScript as the standard output for its Macintosh computers.

One problem with PostScript printers, from a DOS user's point of view, is that they work only with applications that know how to create PostScript output. Without special drivers, they can't print the straight ASCII text that's so common in the DOS world. Consequently, many PostScript users either have a printer that can switch into and out of PostScript or have both a PostScript printer and an inexpensive DOS printer.

The other common laser printer standard is the various models of Hewlett Packard's LaserJet. Printers from other manufacturers that are LaserJet-compatible usually recognize the LaserJet command language, called PCL. Some compatible printers can also accept LaserJet cartridges, memory cards or auxiliary input/output boards.

PCL, a command language that Hewlett Packard invented for its first LaserJet printers, has grown to include much of the functionality of PostScript. The version included in the LaserJet III and IV printers, which is called PCL-5, has more than 100 commands for placing text and graphics on a page. In addition,

these LaserJet printers also can interpret HP-GL/2, the plotter command language that's supported by all of Hewlett Packard's plotters and most of the other plotters on the market. CAD programs especially can use HP-GL/2 to produce detailed drawings.

It's fashionable to say that there isn't much difference between a PostScript printer and a PCL printer, especially if you're using *Windows*. But this isn't really correct. A PostScript printer, or a PostScript cartridge for a PCL printer, is almost mandatory for top-of-the-line desktop publishing. For other tasks, though, a PCL-compatible printer is more than adequate.

PostScript printers have two advantages if your work includes desktop publishing. Most of the best clipart files are in EPS or encapsulated PostScript format. To use these, you must have PostScript printing capability. On the other hand, using a PostScript printer from the DOS prompt is often an exercise in exasperation. If you use *Windows* and DTP applications, consider a PostScript printer, or at least a PostScript cartridge for a PCL printer. Otherwise, you may be happier with a non-PostScript printer.

In either case, you'll want the fastest and most-powerful printer your budget will permit. Laser-printer speed is measured two ways. Manufacturers measure it in pages per minute (ppm), which is the speed of the printer engine: the electrostatic drum, paper movement hardware and other internal parts. A ppm measurement is most often made by

telling the printer to create multiple copies of a single page. Timing begins as the first page is ejected and is the average speed for each subsequent ejected sheet.

The ppm measurement will tell you the top speed for your printer. But it won't tell you a typical page-composition speed because it leaves out the time required for the printer to send data to the printer and for the printer to interpret the data and create a page-intermediate image. As your vendor for benchmark comparisons of the printers that interest you, created with the same application. If you'll normally be creating DOS text, you can ignore graphics benchmarks (and vice-versa). The speed you're really interested in is how long it takes your printer and computer to create a typical memo, report or spreadsheet with the applications you normally use. Many dealers will let you try several printers with the same data before you select one.

You should also check about the possibility and cost of memory upgrades. Printers with more memory can hold more soft fonts (fonts downloaded from the computer) and more-complex graphics pages. The last laser printer I bought came with a free 0K memory-expansion board. A couple of months later, when I needed extra memory, it was a simple matter to buy and install a few RAM chips. A friend who bought a discount laser printer at about the same time discovered that he could add memory only by buying a very-expensive board with soldered-in RAM from the manufacturer. Although his printer cost several hundred dollars less than mine, he ended up paying more once we both added in the cost of upgrading the printer memory.

Finally, make sure that you'll be able to find toner cartridges for the printer you purchase for the next several years. If manufacturer X sells a very-inexpensive printer but won't be around to provide toner cartridges and service next year, you might be investing in a very-expensive year of printing. The top manufacturers of laser printers and printer engines aren't going to disappear in the near future. Thus, supplies for their printers should always be very easy to find.

Simple Maintenance

Because laser printers are both quiet and rugged, it's easy to forget that they require regular maintenance, just like any other piece of machinery.

The most-important maintenance operation you can perform is occasionally

cleaning the inside of the printer. If your printer is in almost constant hard use, occasionally means every day. If you print only a few sheets a day, occasionally might be once a month. In either case, you must remove any paper dust and environmental dust that have collected inside the printer. The dust, which is both abrasive and acidic in nature, causes other parts of your printer to wear out prematurely.

Secondly, you should keep the transfer corona wire as clean as possible so that it will put a uniform charge on the paper. If the transfer corona is dirty, final copies will have uneven print density. Because the transfer corona has a positive charge, it tends to attract loose toner particles. The toner then keeps part of the wire from transferring the necessary positive charge to the paper. The build-up of toner on the transfer corona is especially noticeable after printing a large number of envelopes.

To clean the transfer corona, you can use a cotton swab dipped in isopropyl alcohol. But be careful not to stretch or break the corona nor any of the protective cross-wires that keep the paper from falling onto the corona. Breaking or stretching any wires will result in a costly printer repair.

Your laser printer probably has a small brush for cleaning the primary corona wire. If you're using a Hewlett Packard LaserJet or another printer that uses the Canon engine, the primary corona is inside the toner cartridge. The printer instructions should tell you how to clean it.

Finally, you should check and clean the fuser rollers and fuser cleaning pad. Turn off the printer and wait until the fusers have cooled. There's a cover (usually with a warning label on it) over the fuser assembly and often a cleaning pad beneath the cover. You can remove the cleaning pad and use a clean cloth over the entire length of the fuser rollers. Do not use water, alcohol, solvents or detergents on the fusers. If the cleaning pad is covered with paper dust or toner, you can rub it with the back of an ordinary hair comb to break up and remove the caked-on debris.

Finally, if you find deposits of toner dust in your printer that you can't remove with a clean cloth, you should call a service technician to remove them out with a special vacuum cleaner. Don't try your home or office vacuum cleaner. You'll find out why when the toner particles go through the vacuum's filter and

coat your clothes, walls, carpets and desk with a fine layer of toner dust.

Finally, the most important maintenance is buying and using high-quality paper that can hold an electrostatic charge and withstand the heat of the fusers. Papers that can't hold a charge won't attract the toner from the drum and, consequently, won't produce decent images. Those that can't stand the heat of the fusers will tend to jam and curl excessively and can even deteriorate in the printer. Sheets of labels and transparencies, except those specifically rated for laser-printer use, will often lose their adhesive in the fuser rollers and cause a mess that will require an expensive repair.

Envelopes especially tend to jam in a laser printer if they're at all wrinkled or creased. Also, printing a large quantity

of envelopes is almost always slower than printing labels and attaching them to envelopes manually. Many high-end laser printers have special envelope feeders, which are best reserved for addressing occasional letters instead of the 3,000 people in your contact database.

Laser printers are often a lot less trouble to use and maintain than dot-matrix and daisywheel printers. Because of their relatively low cost and high-quality output, they've become essential equipment in most offices. About the only thing they can't do is print on multiple-part forms. Offices that need multiple copies often have a separate impact (daisywheel or dot-matrix) printer just for these forms. Otherwise, a laser printer will probably be faster, quieter and more-reliable than any other printer you can buy. ■

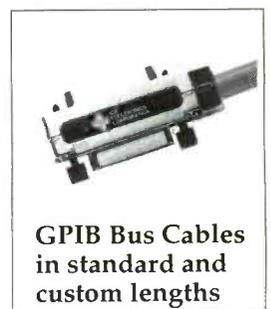
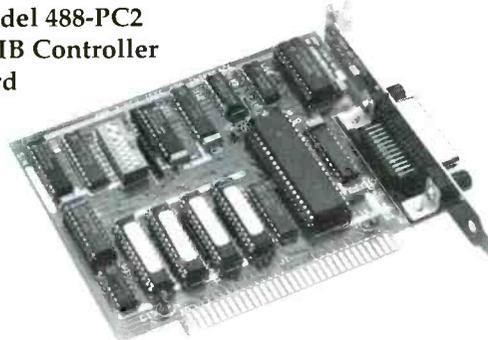
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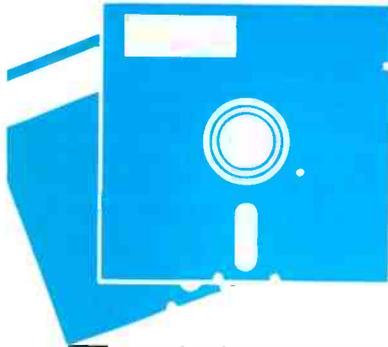


**ICS
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SPECIAL

REPORT:



Scalable Fonts

A face for all seasons and a size for all reasons

By Tom Benford

Font technology on personal computers has been a constantly evolving discipline that has always been a hotbed of interest for anyone who produces documents. The relentless quest for better-looking output quality and characters that are free of the “jaggies” has resulted in several different approaches. Much has occurred in this field that now gives PC users the creative freedom and capabilities that were, until recently, the domain of dedicated typesetting machines and skilled typographers alone. Getting to where we are today and moving on to the future in desktop typesetting took some doing. What we now have is good, but what’s coming in the near future appears to be even better by a long shot.

Background

One of the problems that had to be overcome from the start had to do with the fact that different printers have different output resolutions. Early dot-matrix printers like the Epson FX series utilized a nine-wire printhead that was capable of producing only 100 X 120-dpi maximum resolution. While offering pristine character quality, daisywheel printers required you to change the printwheel to change typeface. Because the physical size of the daisywheel’s “petals” are quite small, 10 and 12 points were the character only sizes available for this printer genre. With the appearance of 24-wire dot-matrix printers, resolution was raised to a 180 X 180-dpi maximum character matrix. Inkjet/bubble-jet printers support this resolution and 360 X 360 dpi for some graphics modes. Some of the higher-end thermal-transfer printers achieve 300-dpi resolution.

Early laser printers raised the ante considerably by offering 300-dpi resolution, and Apple pushed the envelope further by raising the resolution of its

lasers to 400 dpi. Now 600-dpi resolution is available, and it looks as though 800- and even 1,000-dpi resolutions will become viable in the reasonably near future to produce true “typeset-quality” output.

As you can readily appreciate from the foregoing, developing a printer technology based on a flexible character matrix that looks good at all of these various resolutions took a bit of doing. The eventual solution would be software-based, rather than hardware-implemented.

The earliest method of producing characters on line printers used bitmap technology. With bitmapping, each pixel in a character matrix resides in a particular location relative to the other pixels. To increase the size of a bitmapped

character a mathematical multiplier is applied to each pixel. While this is a fairly straightforward way of doing things, it results in poorly shaped characters at larger sizes because enlarging a bitmapped character merely takes a crude letter form and multiplies the number of pixels at a constant ratio to increase size. Small vectors, called “jaggies,” are produced as each of the pixels “stair steps” up or down, as in forming a curve. When enlarged in size, these small vectors become larger and much more noticeable, which makes bitmapping less than desirable for creating polished letter forms.

Bitstream, one of the oldest and most widely respected digital type foundries, overcame this problem to providing a means of generating the specific size



Fig. 1. “Jaggies” become more pronounced and are especially noticeable at larger sizes with bitmapped fonts, as illustrated by the characters in the upper half of this illustration. Outline-based font technologies like Adobe’s *PostScript*, Bitstream’s *Speedo* and *TrueType* in *Windows* “describe” the characters to the printer and use algorithms to produce smoother curves and better symmetry, as shown in the lower example.

type required, thus optimizing the character forms and curve radii for each font. Bitstream's *FontWare*, used extensively in the DOS environment with such GEM-based applications as *Ventura Publisher*, *GEM Artline* and others, provided this ability to pre-generate and store custom font sizes that really looked good. However, the tradeoff was that each size of each typeface desired had to be stored as an individual font file, and these were greedy for hard-disk space. Therefore, it's a good idea to double the storage requirements if you want matching screen fonts generated for true WYSIWYG.

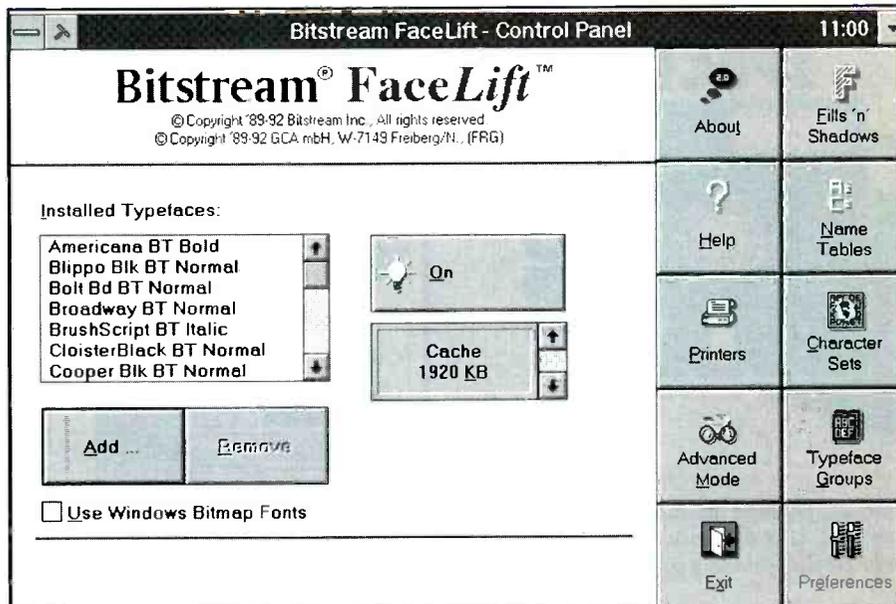
Adobe Systems' *PostScript* technology overcame this problem by providing an outline of each character form that uses mathematical formulas to describe the shape of each letter. Bitstream also uses outline algorithms similar in principal for its *Speedo* fonts, and Microsoft's *TrueType* technology is outlined-based as well. The desired type sizes are manufactured in real-time "on the fly" by applying the appropriate sizing algorithm to the font's outline matrix data. Outline font matrices have two main advantages over bitmapped type fonts: they require less storage space since they're completely scalable, and the curves of the characters are much smoother with less vectoring than bitmapped fonts.

Outline fonts are distinguishable from bitmap fonts by their smoothness, detail and faithfulness to the standards of quality established in the typographic industry. Shown in Fig. 1 is a comparison of the resolutions between bitmapped and outline-based fonts.

In printed communication, appearance is almost everything. Fortunately, today's marketplace offers a wide range of products from which to choose and mix and match to make the task of presenting a pleasing or even knockout appearance a relative breeze to accomplish. In this article, I'll give you a run-down on a variety of typeface, font-installer/handler and type-manipulation packages that will turn you into a desktop publishing artist.

With the integration of *TrueType* fonts and font handling into *Windows 3.1*, the barriers to achieving true typography in a desktop PC environment were removed. Now your documents can communicate in visual terms to augment what they communicate in their text.

TrueType is a relative late-comer to



The control panel from Bitstream's *FaceLift 2.0*. In addition to selectable font caching, *FaceLift* offers simple and advanced modes, selectable name tables, the ability to add fills and shadows to fonts, printer control and preference settings. *FaceLift* works in complete harmony with both *TrueType* and *Adobe Type Manager*.

the scalable-font arena, preceded by Bitstream *Facelift* and *Adobe Type Manager* technologies, both of which were available prior to *TrueType* in *Windows*. *Facelift* and *ATM* were available, installable and usable with *Windows 3.0*, which significantly improved the appearance of printed output. *Windows 3.0* used bitmapping for its internal font handling; so both of these products provided very attractive alternatives.

The Software

Font-Generation/Handling Programs

Facelift 2.0 (\$99)

(Bitstream, Inc.)

Facelift 2.0 is a font-generation/handling program that works in perfect harmony with *TrueType* in *Windows* and can also peacefully coexist with *ATM*. The program installs easily into the *Windows* environment and is automatically invoked and activated when *Windows* is entered, making all of the installed *FaceLift* fonts ready and available for use.

Bitstream's extensive digital font library has some of the best-looking typefaces that are the closest matches to the original typefoundry font designs. *FaceLift* gives you the option of installing fonts in Bitstream's own proprietary *Speedo* format or as Type 1

PostScript fonts. You can also select the font name tables with which you prefer to work. For example, the original typeface known as *Antique Olive* is called *Provence* in the *FontWare* and *FaceLift* name tables, but it's called *Incised 901* in the Bitstream name table. The option to select the name table with which you're most comfortable is a nice touch that's useful in eliminating some of the confusion caused by these "bastard" typeface names.

A particularly nice feature about *FaceLift 2.0* is its ability to customize the standard fonts by adding patterned fills, shadows and 3D effects using the Fills 'n' Shadows feature. You can save designed fonts to make them part of your installed typeface collection that's usable by any *Windows* application. For typeface management, *FaceLift* also permits selecting fonts for inclusion in custom typeface groups for specific applications. There's also a provision for adjusting and saving your particular preferences.

Adobe Type Manager 2.02

(Adobe Systems, Inc.)

Another outline-font installer/handler that also manufacturers user-defined fonts "on the fly," *ATM* doesn't have any problems running concurrently with *Windows TrueType* and/or Bitstream's *FaceLift*. Like *FaceLift*, *ATM* permits variable font cache size selection to make frequently-used fonts and sizes readily available and speed up document processing.

ATM is often bundled with other software applications (such as *Passport Design's* music

SPECIAL REPORT:

software products that use the Adobe *Sonata* font and *ATM* for music notation), in addition to being sold as a stand-alone product.

Special-Effects/Font-Enhancement Software

In addition to making it easier to produce documents that communicate more effectively on a visual basis, the common platform for printers and fonts provided by *Windows* has also raised basic typography into the realms of a visual artform. Several specialized products are available for converting mundane letterforms into things of beauty that command attention. Here are some of the more outstanding available packages:

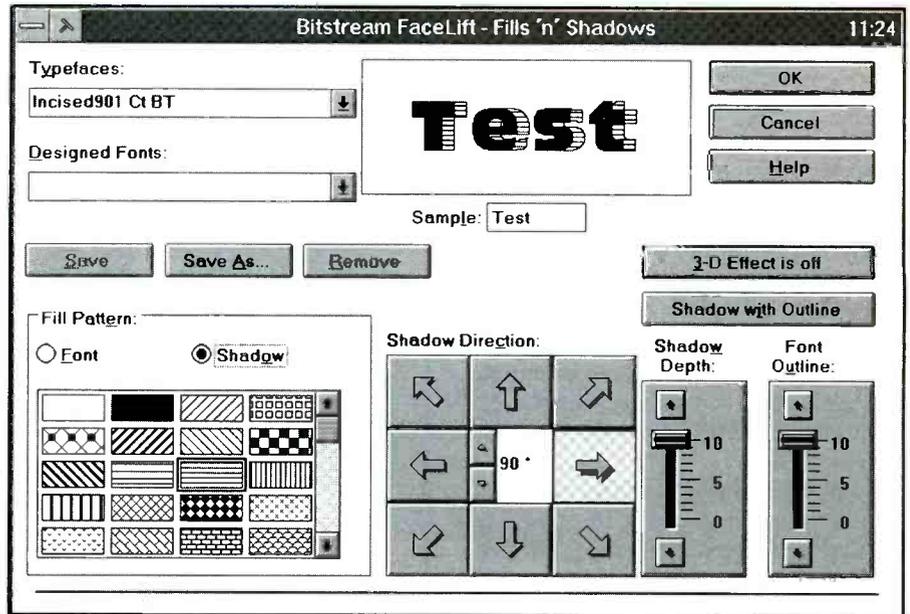
Makeup 1.1 (\$149)

(*Bitstream, Inc.*)

A highly versatile and easy-to-use program, *Bitstream's Makeup 1.1* for *Windows* makes it possible to create all kinds of interesting special effects with your type. *MakeUp* is an object-oriented program that uses "handles" to stretch, squish, twist, flip, blend, color and manipulate type typographic elements. Creating custom logos, headlines, slides, insignias, invitations, flyers, brochures or such visual "devices" as stars, bursts, etc., is easy since the program uses both a toolbar and pull-down menus for function selections.

You can create images with *MakeUp* that can be exported into *Windows* applications, as well as popular DOS programs like *WordPerfect*, *Microsoft Word*, *WordStar*, *Lotus 1-2-3* and *Borland Quattro Pro*, to name just a few programs.

Among the noteworthy features of *MakeUp* are its ability to "pour" text into shapes and to curve it. The program supports more than 16-million colors for solids, blends and washes, and you can create and match custom colors from imported files. A feature called *FotoShoot* in *MakeUp* facilitates perfectly re-sizing your *MakeUp* images for your target documents. The product supports



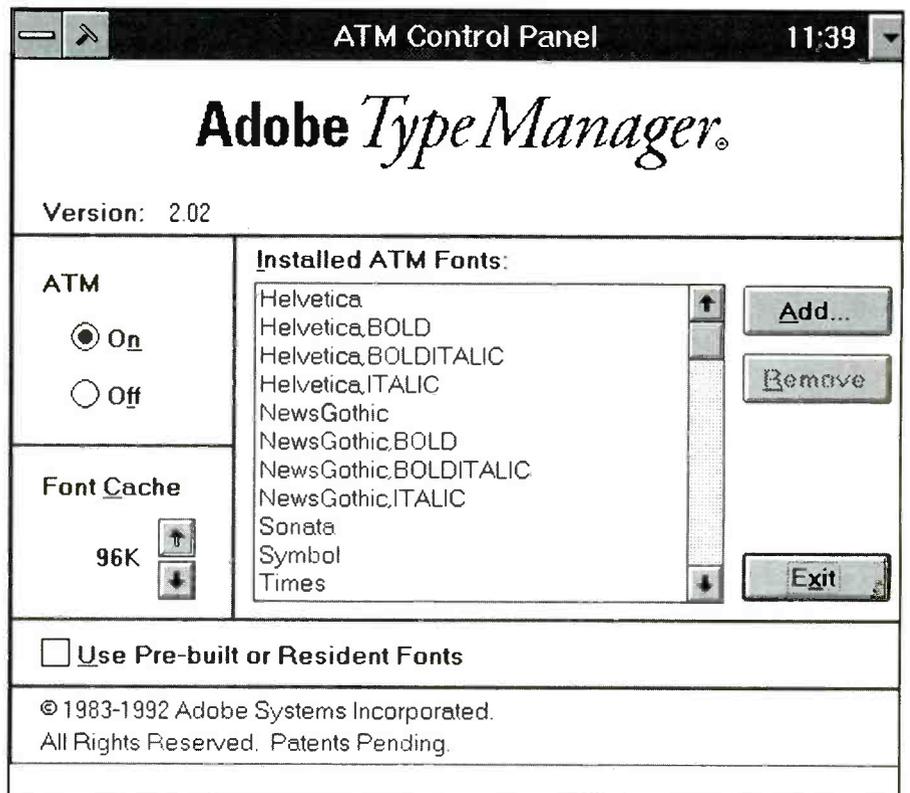
FaceLift gives you the ability to customize the *Bitstream* fonts installed on your system by embellishing them with fills, shadows and outlines in a variety of patterns. Full directional control and depth of the effect is also provided by the program, and user-designed fonts can be stored as standard typefaces for use in any application.

more than 20 graphic files formats so you can import images from many different sources.

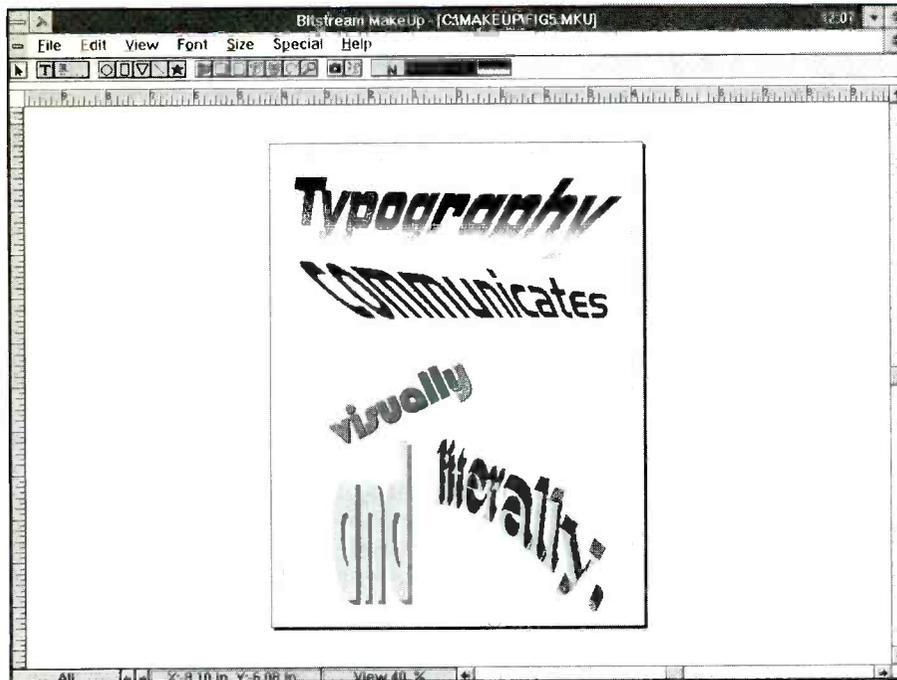
Because *MakeUp* also complies with Microsoft's OLE (Object Linking & Embed-

ding) protocols, you can edit or update a *MakeUp* image once it has been placed in any *Windows 3.1* application that supports OLE.

Five typefaces are included with *MakeUp*



The *ATM Control Panel* lets you add and remove *Adobe PostScript* fonts. Although the program supports selectable font caching, it lacks some of the other features, including preference settings and special effects supported by *FaceLift 2.0*.



Bitstream's object-oriented *MakeUp* lets you stretch, flip, twist and manipulate type elements in any way desired by grabbing a "handle" and moving it. Additionally, the program lets you customize the characters themselves by moving around the Bezier points.

in *PostScript* Type 1, Bitstream *Speedo* and *TrueType* formats. The included fonts are *Americana Bold*, *Poster Bodoni*, *Bitstream Oz Handicraft*, *Revue* and *Vag Rounded*. More than 200 clipart images are also included, along with a helpful booklet that contains tips and samples that illustrate some of the more-impressive features of this excellent software program.

MakeUp 1.1 is available as a free upgrade to all registered owners of Version 1.0. If you haven't gotten your update yet, you can contact Bitstream at 1-800-522-FONT.

***Typestry for Windows* (\$299)**

(*Pixar*)

One of the most amazing and powerful text-enhancement/manipulation packages I've come across to date, Pixar's *Typestry*, makes it possible to realize your wildest design ideas and execute them in type. The program combines elements of rendering, shading, paint, Bezier design and several other applications, all in one truly extraordinary product.

Typestry's most-impressive capability is that it permits you to "sculpt" type elements and words using various lighting and texture effects. The product includes *RenderMan*, the same powerful renderer used to create the impressive ballroom scene in *Beauty and the Beast* and the metal cyborg in *Terminator 2*. If you wish, you can also produce *QuickTime* or *FLIC* animations, and the program's "motion blur" feature is a spectacular effect that gives your work that Hollywood touch.

Other capabilities of the *Typestry* program

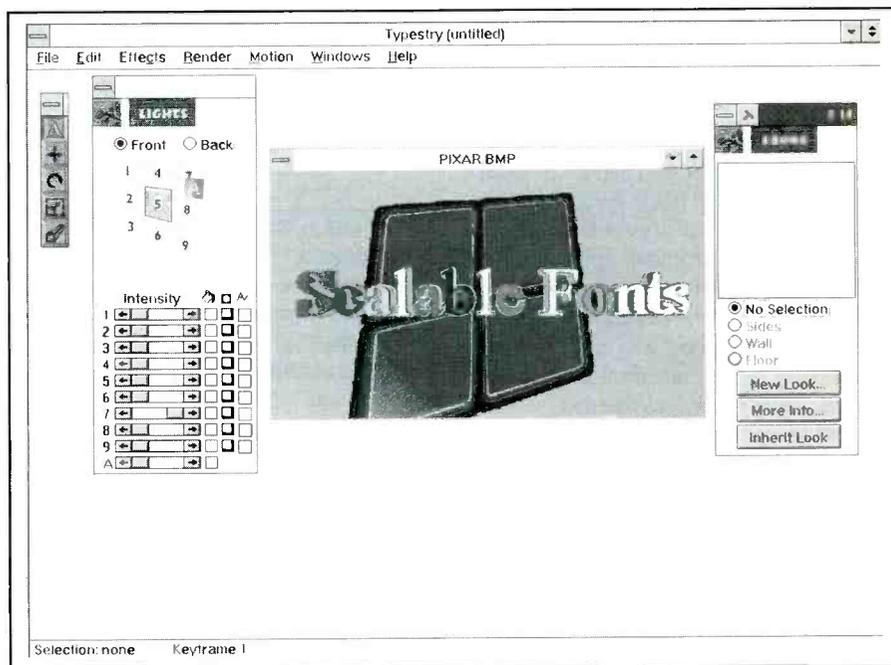
include converting your fonts into objects that can be moved, rotated, scaled and extruded. Textural choices for your fonts include the appearances of wood, marble, stars,

A Rose By Any Other Name...

A brief discussion of typeface names is in order here. Every font publisher, it seems, has a unique name for a typeface that's commonly known in the typography and printing industries by its designer or foundry name. While all of the various names for the same typeface may differ a great deal from one manufacturer to another, the basic letterform of the font usually doesn't vary too much in its appearance, regardless of the supplier. This isn't to say that all fonts are created equal, however. Some versions of "Helvetica" look decidedly better than other efforts. The following is a brief listing of the various names you'll see for what's basically the same typeface:

sparkles and just about anything else you can imagine.

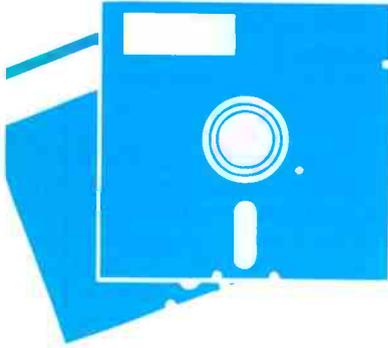
The program is surprisingly easy to use, considering its industrial-strength capabilities. Pixar describes it as "great-looking 3D effects with a familiar, 2D interface." This is a very succinct and apt description. With some creative imagination and this product, you can really go wild producing logos, advertisements, book covers, greeting cards, illustrations, brochures, package designs and all sorts of other items using your system's installed *TrueType* and *Type 1 PostScript*



Typestry for Windows from Pixar is an incredibly powerful package that provides sophisticated rendering and manipulation capabilities for text. Multiple views and fully adjustable lighting placement, combined with lots of textural choices, make it possible to create professional-caliber graphics (animations, too) that are positively stunning.

SPECIAL

REPORT:



fonts. *Typestry* works with *Persuasion*, *Photoshop*, *Photo Styler*, *Showplace*, *PageMaker*, *QuarkXpress* and scores of other software packages as well.

Due to the powerful features of the program, a 386 PC with a minimum of 4M of RAM, VGA display and at least 5M of free hard-disk space are required. A math coprocessor (or better still, a fast 486 PC) and at least 8M of RAM are highly recommended and will improve the program's rendering performance quite dramatically. Even with a 50-MHz 486 and 16M of RAM, some complex creations may take from several minutes to more than an hour or more to complete, depending on how ambitious the project is. But the final result will more than justify the long wait.

If you want to "push the envelope" of transforming plain text into attractive visual forms (with complete color support, of course), *Typestry* is the program that will help you do it.

Font Collections

While not every user will need—or want—to go beyond the basic type and text-manipulating capabilities of *Windows* itself and their particular applications, adding some additional typefaces to those that come as the standard *Windows* complement is a good way to give your documents some additional pizzazz without going to major expense.

Type collections and libraries are available from numerous vendors in various formats, although some rely on proprietary font handling (like *ATM* or *FaceLift*), most of them are *TrueType*-compatible or *PostScript* Type 1-compatible.

Some of the earliest font packages were less than perfect when it came to maintaining good letter forms and consistent character weights throughout the entire font alphabet. But as competition in the *Windows* font market has increased, the quality of the fonts being offered

by different publishers has also gotten dramatically better. All of the fonts and collections covered here are top-notch products that provide excellent conformity to typographic design standards.

While it may be tempting to add loads of utility and novelty fonts to your system, it's a temptation that should be resisted—within reason. Even though it's nice to have a load of different typefaces available for use at all times, remember that an extensive font library will require a substantial amount of disk space. Another factor to consider is that more installed fonts creates additional system "overhead" that causes slower application loading and drains memory. This is particularly noticeable on applications like *Ventura Publisher for Windows*.

Here's a roundup of some outstanding values in scalable typeface collections. Included are some ancillary products that make using fonts and scalable type easier and more efficient as well:

Adobe Systems

Type Basics (\$198) is Adobe's basic starter package that contains 35 of the most-requested standard typefaces and 30 additional faces from Adobe's library that includes some display, symbol and script fonts to give you a good, well-rounded assortment. Included is *Adobe Type Manager* software to make working with these *PostScript* Type 1 format fonts easy.

Type Set Value Pack (\$60) is Adobe's add-on typeface collection that contains 30 decorative headline, text, script and symbol/ornament fonts, all in *Type 1* format. *Adobe*

Type Manager software is also included with the fonts.

TypeAlign (\$99) is an easy-to-use type utility package that gives you the tools to set type on a curve, conform it to shapes, manipulate it to distort perspectives, stretch, squish, squash and more. No fonts or *Adobe Type Manager* software are included, although both are required to use this package.

Altsys Corp.

Fontographer (\$495) is a professional-level font-editing package for type and logo design work. *Fontographer* permits you to modify existing character sets, trace-scanned images or drawing fonts from scratch. Four independent layers make it easy to see through for tracing and conforming your designs to sample characters underneath. You can use your new designer fonts with any *PostScript*- or *TrueType*-supported printer, from lasers to professional typesetting machines. If you're doing serious work with letterform design, *Fontographer* is an indispensable tool.

Ares Software Corp.

FontMonger (\$149.95) is a nifty package for converting fonts in any direction between *Postscript* Type 1 (for use in *Adobe Type Manager*), *PostScript* Type 3, *Nimbus Q* (for use in *SofiType* and *Geoworks Ensemble*) and *TrueType* (for *Windows 3.1*). *FontMonger* also converts *Intellifont* fonts (from Agfa and Hewlett Packard) into any of the other formats. You can save converted fonts can be saved for IBM, Macintosh and NeXT computer formats.

FontMinder (\$79.95) is a package for organizing and managing *PostScript* and *TrueType* fonts. The program uses two convenient lists: a Master Library List that displays all available faces on your hard disk, and an installed-fonts list that displays the currently

Foundry Name	Windows Calls It	Other Aliases
Helvetica	Helv	Arial, Swiss, Helios
Typewriter	Courier	Courier New, Pica, Typist
Times Roman	Times New Roman	Times, London Times
Futura	MS Sans	Futuri, Futurist, Sans
Antique Olive	—	Incised 901, Provence
Korinna	—	Korin, Krona, Gazette
Serif Gothic	—	Sergio, Sergoth
Copper Plate	—	Metal Cut, Formal Gothic
American Classic	—	Amerigo, Americana
Bodoni	—	Photina, Boston
Cooper Black	—	Copperfield, Cookie
Blippo	—	Bordeaux, Bongo
Palatino	—	Palamino, Zapf Calligraph
Optima	—	Oracle, Optim
Stymie	—	Rockland, Slate
Avant Garde Gothic	—	Avanti, Avian, AvantGuard
Garamond	—	Garnet, Garamand
Baskerville	—	Bassett, Baskerton
Souvenir	—	Soutane, Souvienne
Friz Quadrata	—	Fritz, Quadrant

Selections from Swfte's Typecase III

AVALON QUEST

Berliner

CASH

Chili Pepper

Chopstix

Copacabana

DEM BONES

FATSO

GENGIS KAHN

KNOMEN

LAUGHIN

Moravian

PUNCH LABEL

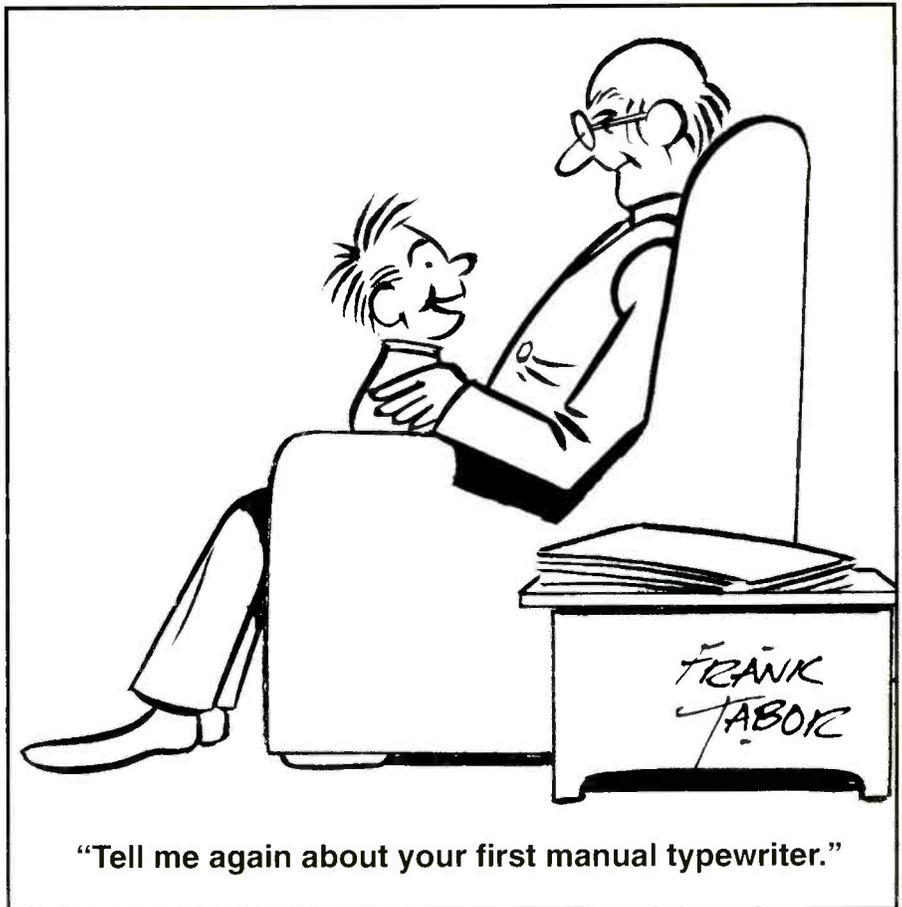
Scheherazade

SHOCK

installed fonts for TrueType, Adobe Type Manager or for any PostScript printer. The program can also manage a separate set of installed fonts for each printer where multiple printers are installed. If you have many fonts of different types on your system, FontMind-er makes managing them quite a bit easier.

Atech Software

AllType (\$79.95) is another font conversion package, AllType quickly and easily changes just about any industry typeface into the format of your choice, including PostScript, TrueType, Intellifont, FastFont, Bitstream FontWare and more. Additionally, all of the converted fonts are automatically installed into their supported applications, and provisions for customizing typefaces is provided. Customizations include adjusting or modifying angle, pitch, leading and weight of any typeface in any point size and 12 variations,




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and two typeface families are included in the package.

Publisher's PowerPack for Windows (\$79.95) consists of an assortment of 30 typeface families, all scalable from 4 to 127 points. Each font family only requires about 50K of disk space for all sizes, pitches and styles.

Bitstream, Inc.

In addition to the *FaceLift* and *MakeUp* packages covered earlier, Bitstream also offers an incredibly rich assortment of pristine fonts for any application and some genuinely novel typeface designs in its *Li'l Bits Font Packages*:

TrueType Font Pack 1 (\$79) contains 40 versatile text and decorative fonts in TrueType format you can scale to any size for your screen and printer in the *TrueType Volume 1 Font Pack*. The collection contains a good assortment of fonts that are suitable for body copy, headlines, invitations, brochures and other similar uses.

TrueType Font Pack 2 (\$39) is a sequel package to *Font Pack 1*, providing 20 additional favorite faces for text and display uses. *Li'l Bits Font Packages* (\$19.95 each)

These are unique collections that follow specific themes for their font appearances. The themes include:

The Star Trek Font Pack is a TrueType for The Final Frontier pack that includes the *Star Trek* typefaces, symbols and insignias, including Klingon!

Star Trek Next Generation Font Pack is a collection that includes *TrueType* typefaces uses for the titles and credits on the hit TV show, including updated emblems worn by Starfleet personnel and a collection of alien symbols that includes some from the Romulan language. It's everything you need to communicate with the Federation.

The Jetsons Font Pack is a collection of Jetson character fonts that guarantee fun and command attention. The *Jetsons* font contains the cartoon characters from the show, and *Jets Black* and *Jets Original* are also included, along with three other Bitstream fonts.

The Flintstones Font Pack, as you can guess, is a collection of stone-age type with

all your favorite *Flintstones* characters; you could call it *TrueType* in a Bedrock style.

Looney Tunes 1 Font Pack is a collection of faces that includes the Looney Tunes font that contains cartoon characters. A Looney Tunes Tilt font that's used for the Looney Tunes logo is also included, as are four other Bitstream fonts.

Winter Holiday Font Pack contains all the typefaces and ornaments you need for composing great-looking holiday greetings, seasonal posters and decorations. *Holiday Pi* is a symbol font that contains sleds, witches, Santa, snowflakes and more, while *SnowCap* is a fun and informal Bitstream-designed font

capped with snow. *Cloister Black*, *Shelley Allegro* and *Freeform 721* are the three bonus fonts packed with this collection.

IQ Engineering

SuperType Master Library (\$29.95) is a super value for those looking to add fonts to their installed collection. 96 professionally designed scalable fonts for any *TrueType*-supported laser, dot-matrix or inkjet printer are provided. The fonts range from text to headline to decorative faces. You pay only pennies per typeface! There are lots of good

(Continued on page 47)

Selections from Bitstream's Li'l Bits Font Collections

JETSONS

Jets Black

JETS ORIGINAL

LOONEY TUNES

LOONEY TUNES TILT

FLINTSTONES

BEDROCK

Star Trek

Star Trek Film

AAACEFHJLKO (Star Trek Pi)

STARFLEET BOLD EXT.

STAR TREK NEXT

STAR TREK GEN

Crillee Italic

AAACEFHJLKO (Star Trek Next Pi)

Swiss 911 Ultra Compressed

AAACEFHJLKO (Holiday Pi)

SnowCap

ComputerCraft Magazine's Guide To EPROMs

EPROMs (Erasable, Programmable, Read-Only Memory) are integrated circuits that permanently store programs, data, or other information, with the option to erase and reprogram when needed. EPROMs are a popular choice for storing programs in embedded controllers and other single-board computers that don't use disk storage. Some personal computers use EPROMs to store BIOS routines.

You can identify an EPROM by its clear window, which allows you to erase the contents by exposing the circuits to ultraviolet energy. After programming, the window should be covered with an opaque label to prevent accidental erasing.

When you don't plan to erase, a low-cost option is the one-time-only PROM, or OTP PROM. An OTP PROM is an EPROM without the window. Many developers use EPROMs during product development and switch to OTP versions when a design is final and ready for production.

EPROMs are available in many capacities. In this tenth installment of our series on special series of pull-out data guides, the focus is on pinouts for popular EPROMs, a review of signal functions and a summary of file formats for EPROM programming.

Prepared by Jan Axelson
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 76 North Broadway, Hicksville, NY 11801

24-Pin EPROMs

You can find 24-pin EPROMs in capacities from 2K to 8K. Motorola's 68764 EPROM matches the pinout of the 2364 ROM, which stored BIOS routines and BASIC in the original IBM PC.

28-Pin EPROMs

These 28-pin devices have capacities from 8K to 64K. Although there are 8K EPROMs in 24-pin packages, the 28-pin 2764 is more common. Pinout patterns are similar to the 24-pin pinouts, if you "bottom-justify" the 24-pin device so that its pin 1 aligns with pin 3 of the 28-pin device.

32-Pin EPROMs

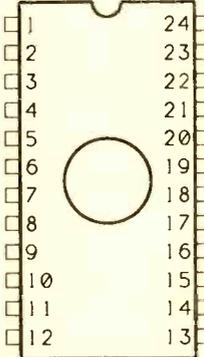
For storing 128K to 1M byte, 32-pin EPROMs will do the job. These also follow the pinout pattern used in smaller-capacity devices, with minor differences.

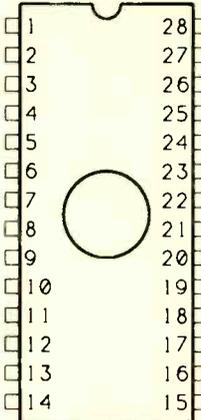
40-Pin EPROMs

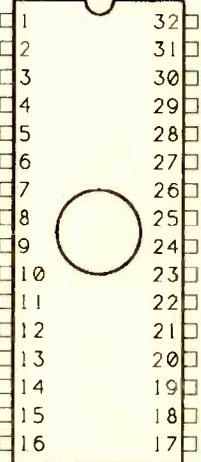
These 40-pin EPROMs are word-wide. That is, they store 16 bits at each address, compared to eight bits per address for the preceding devices. For example, the 27C210 stores 64K 16-bit words, or 1M bit.

EPROM Pin Functions

Symbol	Type	Function	Comments
A0 thru A19	Input	Address	Number of address inputs indicates how many bytes or words EPROM can store. For example, a 2716 has 11 address inputs (A0 thru A10) and stores 2 ¹¹ (2,048) bytes.
DQ1 thru DQ16	Output	Data	Byte-wide EPROMs have eight data pins (DQ1 thru DQ8); word-wide EPROMs have 16. Sometimes labeled O0 thru O7 (Outputs 0 thru 7). Act as inputs during programming.

Device	68764	2732 27C32	2716		2716	2732 27C32	68764
Capacity	8Kx8	4Kx8	2Kx8		2Kx8	4Kx8	8Kx8
Pin Functions	A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND		Vcc A8 A9 Vpp OE A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	Vcc A8 A9 A11 OE/Vpp A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	Vcc A8 A9 A12 E/Vpp A11 DQ7 DQ6 DQ5 DQ4 DQ3

Device	27512 27C512	27256 27C256	27128 27C128	2764 27C64		2764 27C64	27128 27C128	27256 27C256	27512 27C512		
Capacity	64Kx8	32Kx8	16Kx8	8Kx8		8Kx8	16Kx8	32Kx8	64Kx8		
Pin Functions	A15 A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	V _{pp} A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	V _{pp} A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	V _{pp} A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND		1 2 3 4 5 6 7 8 9 10 11 12 13 14	28 27 26 25 24 23 22 21 20 19 18 17 16 15	V _{cc} PGM NC A8 A9 A11 OE A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	V _{cc} PGM A13 A8 A9 A11 OE A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	V _{cc} A14 A13 A8 A9 A11 OE A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	V _{cc} A14 A13 A8 A9 A11 OE/V _{pp} A10 CE DQ7 DQ6 DQ5 DQ4 DQ3

Device	27C080	27C040	27C020	27010 27C010		27010 27C010	27C020	27C040	27C080		
Capacity	1Mx8	512Kx8	256Kx8	128Kx8		128Kx8	256Kx8	512Kx8	1Mx8		
Pin Functions	A19 A16 A15 A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	V _{pp} A16 A15 A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	V _{pp} A16 A15 A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND	V _{pp} A16 A15 A12 A7 A6 A5 A4 A3 A2 A1 A0 DQ0 DQ1 DQ2 GND		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17	V _{cc} PGM NC A14 A13 A8 A9 A11 OE A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	V _{cc} PGM A17 A14 A13 A8 A9 A11 OE A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	V _{cc} A18 A17 A14 A13 A8 A9 A11 OE A10 CE DQ7 DQ6 DQ5 DQ4 DQ3	V _{cc} A18 A17 A14 A13 A8 A9 A11 OE/V _{pp} A10 CE DQ7 DQ6 DQ5 DQ4 DQ3

Symbol	Type	Function	Comments
-CE	Input	Chip Enable	Power control and device select. Must be low to read data. Sometimes called CS (chip select) or E (enable).
GND	Input	Circuit Ground	
NC	—	No Connection	
-OE	Input	Output Enable	Gates data to outputs. Must be low to read data. Also called G.
-PGM	Input	Program Enable	Pulses low during programming. EPROMs without PGM pin pulse CE instead.
V _{cc}	Input	Power Supply	+5 volts. Sometimes raised to 6 or 6.25 volts during programming.
V _{pp}	Input	Programming Supply	Applied only during programming. Voltage varies from 12.5 to 25 volts, depending on the chip and programming algorithm. Sometimes shares the same pin with OE.

File Formats for EPROM Programming

Most EPROM programmers are able to program EPROMs directly from files created by assemblers and compilers, but the file must be in a format that the programmer recognizes. Four common formats are binary, ASCII Hex, Intel Hex and Motorola S-Record.

Binary Format

A binary file consists of a sequence of bytes that exactly corresponds to the bytes to be programmed. The file contains no addressing information for loading or programming and no error-checking. To view or edit a binary file, you need a special file-viewing utility. Conventional file-viewing techniques, such as DOS's TYPE command, display the bytes as ASCII characters. For example, the value "1" appears on-screen as a happy-face character. Binary format is sometimes called executable format.

ASCII Hex Format

In ASCII Hex, or "pure" Hex, format, each byte is expressed as a two-character hexadecimal number, with each character stored as its ASCII code. ASCII Hex files contain only these 16 codes: 30h through 39h

Device	27C4096	27C220	27C210		27C210	27C220	
	27C4096	27C2048	27C1024		27C1024	27C2048	27C4096
Capacity	256Kx16	128Kx16	64Kx16		64Kx16	128Kx16	256Kx16
Pin Functions	V _{pp}	V _{pp}	V _{pp}	1	40	V _{cc}	V _{cc}
	\overline{CE}	\overline{CE}	\overline{CE}	2	39	PGM	PGM
	DQ15	DQ15	DQ15	3	38	NC	A16
	DQ14	DQ14	DQ14	4	37	A15	A15
	DQ13	DQ13	DQ13	5	36	A14	A14
	DQ12	DQ12	DQ12	6	35	A13	A13
	DQ11	DQ11	DQ11	7	34	A12	A12
	DQ10	DQ10	DQ10	8	33	A11	A11
	DQ9	DQ9	DQ9	9	32	A10	A10
	DQ8	DQ8	DQ8	10	31	A9	A9
	GND	GND	GND	11	30	GND	GND
	DQ7	DQ7	DQ7	12	29	A8	A8
	DQ6	DQ6	DQ6	13	28	A7	A7
	DQ5	DQ5	DQ5	14	27	A6	A6
	DQ4	DQ4	DQ4	15	26	A5	A5
	DQ3	DQ3	DQ3	16	25	A4	A4
	DQ2	DQ2	DQ2	17	24	A3	A3
	DQ1	DQ1	DQ1	18	23	A2	A2
	DQ0	DQ0	DQ0	19	22	A1	A1
	\overline{OE}	\overline{OE}	\overline{OE}	20	21	A0	A0

(for the numerals 0 through 9) and 41h through 46h (for the letters A through F).

You can view and edit ASCII Hex files on-screen, because the computer displays the codes as the ASCII characters they represent. The EPROM programmer must translate the codes into binary data for programming. Because each byte to be programmed requires two codes, an ASCII Hex file is twice as long as the resulting file programmed into the EPROM.

Example translation into ASCII Hex:

Binary Byte	1100	0101
Hex Equivalent	C	5
ASCII Codes (Hex)	43	35

Intel Hex Format

Like ASCII Hex, Intel Hex format stores bytes as ASCII codes that represent hexadecimal characters. Intel Hex also includes addressing and error-checking information for more-flexible programming and more-reliable file transmission.

An Intel Hex file consists of a series of records. Each record ends in a carriage return/line feed (CRLF). Each record contains the following elements, in order:

Name	Characters	Description
Record Mark	1	Each record begins with a colon (:).
Record Length	2	Number of data bytes in the record.
Address Field	2	In data records, address where first data byte is to be stored, with following bytes stored in sequence. In other record types, 0000.
Record Type	2	There are four record types: 00 = Data 01 = End of File 02 = Extended Address 03 = Start Address.
Data Field	Varies	Contents of data field depends on record type: 00 = Data to be Programmed 01 = Not Used (Empty) 02 = Segment (for address fields larg

Data Field	Varies	er than 64K, data is stored beginning at (segment*10h)+address field. For example, an extended address of F800h and an address field of 1000h results in data storage beginning at F9000h. The segment remains valid until a new one is specified. Start address of program. Often unused.
Checksum	2	To calculate the checksum: (1) Add values of all of bytes in a record. (2) Take the 2's complement of the result. (In binary, change 1s to 0s, change 0s to 1s and then add 1.) (3) The checksum is the low byte of the result. If you add the values of all of bytes in a record, including checksum, result should end in 00h.

Example Intel Hex File:

```
:03800000028200F9
:03801300028223C3
:20820000D28AE589440A541FF589D2AF757F00757E00757D00D2
8ED2AAE57FB403FBC2AA9D
:16822000020000C28E858D7D858B7E758D00758B00D28E057F32C1
:00000001FF
```

Example Checksum calculation for line 1:

- (1) Sum values of first seven bytes: 107 (Hex), or 100000111 (binary).
- (2) Take 2's complement of sum: 011111000 + 1 = 011111001 (binary), or F9 (Hex)
- (3) Checksum is F9, final byte in the line.

Motorola S-Record Format

Like Intel Hex, Motorola S-records store bytes as ASCII codes, with added addressing and error-checking. A file in S-record format consists of a series of records. Each record ends in a carriage return/line

feed (CRLF). A file with 16-bit addressing often has the extension S19, which describes the two record types it contains.

Each record contains the following elements, in order:

Name	Characters	Description
Record Marker	1	Each record begins with the character "S."
Record Type	1	There are six record types: (1) 16-bit addressing (2) 24-bit addressing (3) 32-bit addressing (7) end of file (32-bit addressing) (8) end of file (16-bit addressing) (9) end of file (32-bit addressing)
Load Address	4,6 or 8	Starting address where data is to be stored.
File Data	Varies	Data to be stored. Not used in end-of-file records.
Checksum	2	To calculate checksum: (1) Add values of all of bytes in a record, except record marker and record type. (2) Take the 1's complement of result. (In binary, change binary 1s to 0s and 0s to 1s.) (3) Checksum is low byte of result. If you add the values of all of the bytes in the record, including the checksum, the result should end in FFh.

Example file in S-record format:

```
S1130200A680B700A6F0B70400000DB600A880B71A
S10F0210005F4F5A26FC20F01E0020EC7A
S10B03F80200020002000200F1
S9030000FC
```

Example checksum calculation for line 3:

- (1) Sum values of first 11 bytes: 10E (Hex), or 100001110 (binary).
- (2) Take the 1's complement of sum: 011110001 (binary), or F1 (Hex).
- (3) Checksum is F1, the final byte in line.

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Corrections

March 1993 Disk Drive Interfaces section transpose the two cable drawings on the first page with those on the second page.

Basic Type/Typography Terms

It helps to know the correct terms regarding PC fonts, which differ in some of their meanings and interpretations for computer users than when used in the traditional context of foundry typography. This short glossary should help to demystify and clear-up any confusion.

Font is the aggregate term for a set of characters of the same typeface (for example, Helvetica), the same style (for example, *italic*) the same stroke weight (for example, **bold**) and the same size (for example, 10 point). A font refers to all of the available characters in a particular size, style and weight for a particular typeface design.

Italic is a type style in which the characters are evenly slanted toward the right. Italics are commonly used to provide emphasis, indicate foreign-language words and phrases, for titles of literary and other works, technical terms and citations.

Kerning is the process or act of removing unwanted surplus white space from between two characters, such as the capital letter combination "AY." Kerning was also called "mortising" in older times when notches were actually cut into lead type to bring such character combinations as WAY, DAY, Wo, To, Yo and others closer together for a bet-

ter visual appearance.

Leading is a term used to describe the amount of space between lines of type. The name comes from the fact that thin strips of lead were used to provide inter-line spacing with hand-set foundry and machine-set lead type.

Roman is a term used to describe a typeface or type style in which the characters are upright rather than slanted (italic or oblique). **Sans Serif** is any typeface, usually gothic letterforms, that doesn't incorporate serifs into its design (from the Latin *sans*, meaning without).

Serif is any of the short line or ornament at the upper and lower ends of strokes that form a character in a typeface. The term also describes any typeface with serifs.

Typeface is a specific, named design of a set of printed characters, such as Helvetica or Times Roman, that have a specified obliqueness (degree of slant) and stroke weight (thickness of line). A typeface isn't the same as a font, which is a specific size of a specific typeface (such as, 9-pt. Helvetica). Nor should you confuse a typeface with a *typeface family*, which is a group of related typefaces (like Blippo, *Blippo Italic*, **Blippo Bold**, *Blippo Bold Italic*, etc.).



Serifs are finial strokes that give many typefaces, such as Times New Roman shown in the upper portion, their classic appearance. Sans serif typefaces, such as Arial Condensed, shown in the lower half, are without (or *sans*) serifs.

"work-a-day" and display selections in the bunch.

Micrologic Software

TrueEffects for Windows (\$99.95) is yet another neat utility package for creating something special from a mundane typeface. TrueEffects permits adding patterns, fills, shadows and more, as well as forming type elements to specific shapes and forms.

Monotype Typography, Inc.

Monotype has been a leading type foundry

since 1897 and has brought some of the most-used typefaces into existence.

Desktop Solutions (\$129) is a collection of nine of Monotype's fonts in *TrueType* format that are ideal for reports, presentations and other body-copy-oriented documents. Since Monotype's fonts are "the real thing," rather than bastardized copies, these fonts have the look and balance of true foundry type. Anything created with them becomes a pleasure to read.

TrueType Value Pack (\$89) is a series of font

(Continued on page 80)

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Computer Control of Wireless Links

This is the second in a series of articles on this topic

Last month, I introduced you to a pair of circuits that transmit and receive four bits of information at a time over a wireless link, using infrared energy. Now it's time to use the link for experiments in computer control and monitoring.

Transmitter

The wireless transmitter uses Motorola's MC145026 remote-control encoder to send a serial stream of data and addressing information to an MC145027 decoder that accepts the data if the address matches its own address. Shown in Fig. 1 is the encoder circuitry, with last month's manual switches replaced by a computer-controlled 8255 programmable peripheral interface (PPI). This circuit is designed to fit the 8052-BASIC circuit presented in my articles in the July through September issues of *ComputerCraft*. I'll also explain how to adapt it for use with other computer circuits.

For computer control of the encoder,

Listing 1. Transmitter Test (Figure 1)

```

REM      Program 1
REM      Causes the encoder to transmit requested data
REM      PPI mode set: Ports A,C are output, Port B is input
10      XBY(0FC03H)=82H
20      DO
30      INPUT "Enter the decoder's address (0-15): ",A
40      INPUT "Enter the data to send (0-15): ",D
REM      Write the address and data information to Port A
50      XBY(0FC00H)=(D*10H+A)
REM      Toggle TE (Port C, bit 7)
60      XBY(0FC03H)=0EH
70      XBY(0FC03H)=0FH
80      WHILE 1=1
90      END
    
```

you need to connect its data, address and transmit-enable inputs to latched outputs controlled by the computer.

In Fig. 1, the two halves, or four-bit nibbles, of PPI's Port A control the transmitted data and address. The high nibble controls data inputs D6 through D9,

the low nibble address inputs A1 through A4. Fifth address input A5 is tied high to let you control both the data and address with one eight-bit port. This reduces the number of decoders you can transmit to from 32 to 16, which shouldn't pose a problem in most applications.

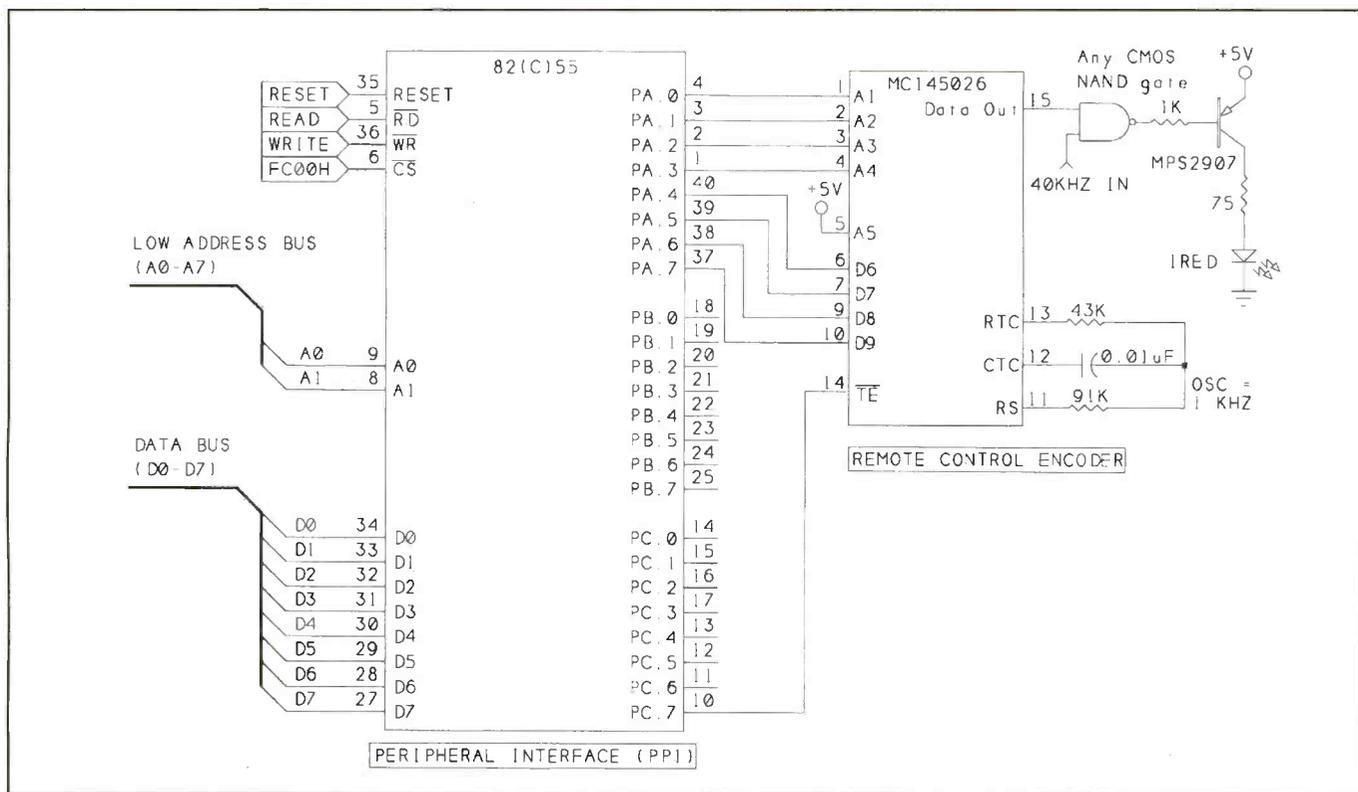


Fig. 1. An 8255 peripheral interface can control an infrared transmitter driven by an MC145026 remote-control encoder.

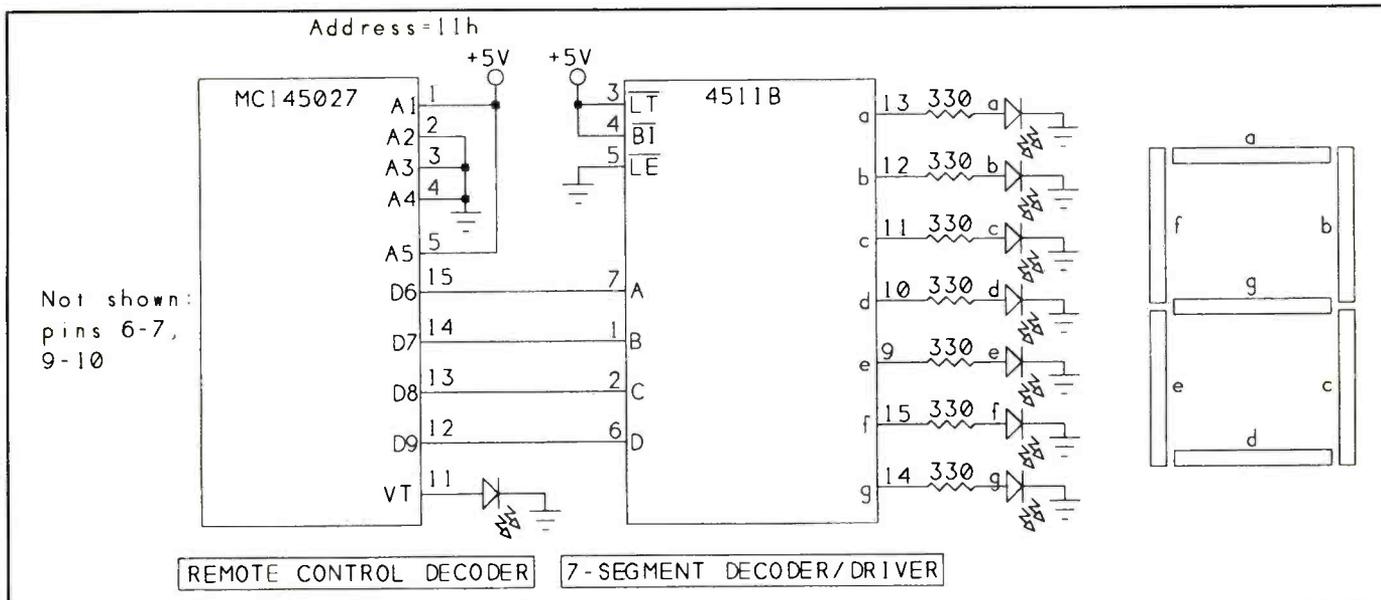


Fig. 2. The decoder can control the segments on a 7-segment display.

The encoder's transmit enable (TE) input connects to Port C, Bit 7 on the PPI, which you can set and clear with the PPI's bit-control instructions.

The signals shown along the left edge of the PPI connect to the corresponding data, address and control signals in the 8052-BASIC circuit. Connect pin 6 of the PPI to the chip-select that corresponds to the address of your PPI.

The connections along the right edge of the encoder, match those in the encoder circuit described last month. You can use just about any 40-kHz oscillator and CMOS NAND gate at pin 15 of the encoder.

Not shown on this and following schematics are the power and ground pins for the encoder/decoder and digital ICs. These are in the standard diagonally-opposite pin locations.

Listing 1 is a BASIC-52 program that causes the encoder to send a four-bit value to a decoder circuit like the one described last month. Here, remark, or comment, lines have no line numbers, and so aren't program lines. If you type the program directly in BASIC-52, you can leave out the remarks to speed up the typing chore and program execution. If you create your program with a text editor for later uploading to BASIC-52, you can include the remarks if you wish. BASIC-52 will ignore them when they upload.

Because the encoder receives no acknowledgment from the decoder after transmitting, the program uses the PPI's

Mode 0, or basic input/output, to write to the encoder. The high nibbles of Ports A and C must be configured as outputs.

The Listing 1 program asks for an address and data to transmit, writes the information to Port A and then brings Bit 7 of Port C low and then high to cause the encoder to transmit the information.

If the transmitted address matches the decoder's, the transmitted data appears at the decoder's data outputs, and its VT (valid transmission) output goes high. If the addresses don't match or if the decoder detects an error in transmission, VT remains low and the decoder ignores the data.

The program repeats in an endless loop. You can end this loop by hitting the Ctrl+C key combination.

If you want to do everything with a

single eight-bit port, you can tie another of the encoder's address inputs high (or low, or leave it open) and use the additional bit on Port A to control TE. If you do this, you'll have to use Boolean operators (AND, OR) to ensure that the data and address don't change when you toggle TE.

If you know you're going to transmit to only one address, you can hard-wire all of the encoder's address inputs and free up four bits on the PPI for other uses.

The PPI is just one way to control the encoder. Any latched port bits will do the job. Two timing considerations must be met for a valid transmission. The first is that to trigger a transmission, TE must remain low for at least 65 ns. The Fig. 1 circuit easily meets this requirement. Then A1 through A5 and D6 through D9

Listing 2. Control of Seven-Segment Display (Figure 2)

```

REM Program 2
REM Causes encoder to control 7-segment display
REM PPI mode set: A, C(high)=output; B,C(low)=input
10 XBY(0FC03H)=83H
REM A=decoder address (0-15)
20 A=1
30 DO
40 INPUT "Enter number to display (0-9) ",N
REM Write data and address to Port A
50 XBY(0FC00H)=N*10H+A
REM Toggle TE
60 XBY(0FC03H)=0EH
70 XBY(0FC03H)=0FH
80 WHILE 1=1
90 END

```

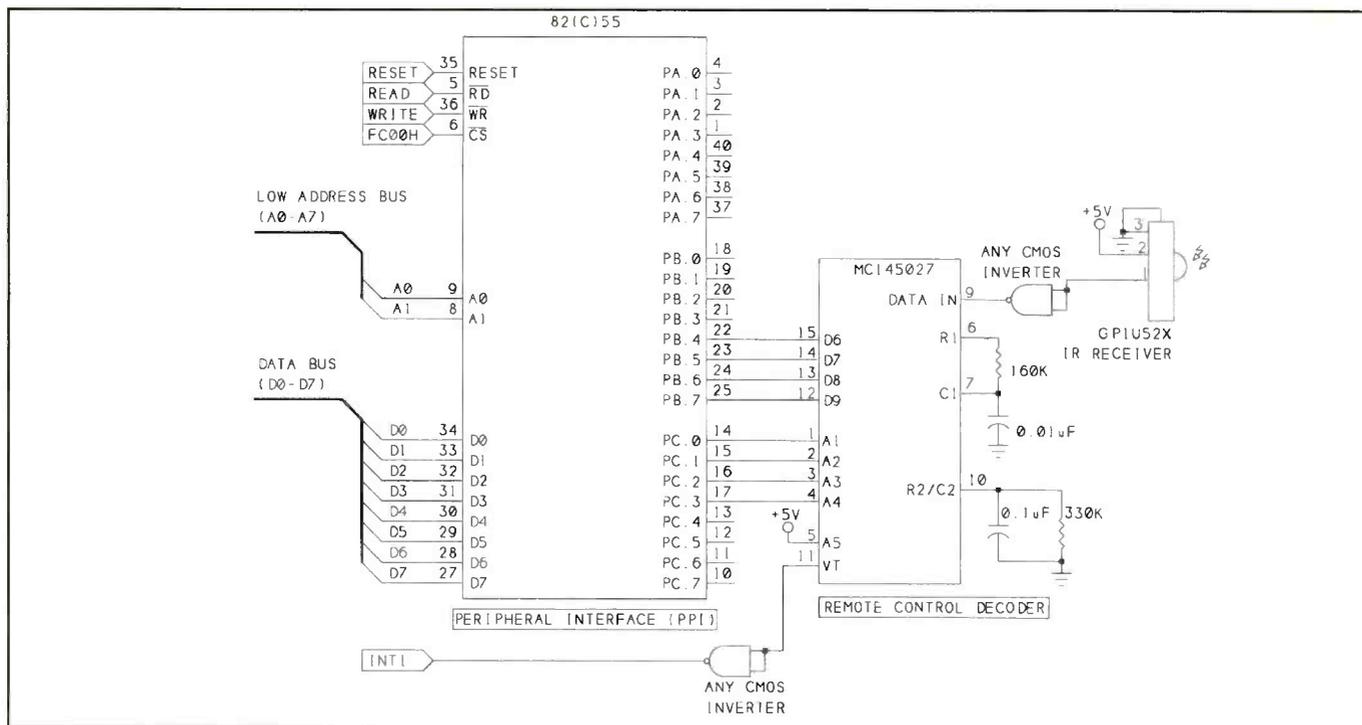


Fig. 3. Controlling a stepper motor is another possible application for the decoder.

must remain stable throughout the transmission (roughly 200 ms with a 1-kHz oscillator). You can ensure this by driving the encoder's address and data inputs with latched outputs and waiting the required time before changing the contents of the latches.

If you want to control an encoder with a personal computer, you can write to a standard parallel port or use outputs on any of the digital I/O cards available.

Transmitter Applications

Last month's circuit used LEDs at the decoder's data outputs for easy monitoring of transmissions. You can also connect the data outputs to logic inputs, relay controls or just about anything you can control with a four-bit, +5-volt digital interface. Figures 2 and 3 show two possibilities.

In the Fig. 2 circuit, a decoder again controls LEDs, but this time in a seven-segment display. A 4511B seven-segment decoder/driver translates the received data into signals that control the segments on the display. For the circuit shown, the display must be a common-cathode type. Because there are so many variations, I didn't include a pinout for the display, which leaves you with the responsibility of finding your display's pin designations. The schematic also leaves out connections for the timing components and infrared receiver at pins

6, 7, 9, and 10 of the decoder. These are unchanged from last month's circuit, and are also shown in Fig. 4, which we'll get to later.

Listing 2 is a BASIC-52 program that causes the encoder to transmit requested values. These values then appear in

the display. If you change the decoder's address, change A in line 20 to match.

Figure 3 is the schematic diagram of a circuit that uses a decoder's data outputs to control a stepper motor. Each data bit controls a winding on the motor.

The motor is a four-phase, six-wire

Listing 3. Control of Stepper Motor (Figure 3)

```

REM      Program 3
REM      Causes encoder to control stepping motor
REM      PPI mode set: Ports A,C=output; Port B=input
10      XBY(0FC03H)=82H
REM      Ensure that TE is high (off)
20      XBY(0FC03H)=0FH
REM      A=decoder address (0-15)
30      A=1
REM      Do 5 sets of 4 steps for 1 complete revolution
40      FOR I=1 TO 5
50          XBY(0FC00H)=10H+A
60          GOSUB 200
70          XBY(0FC00H)=20H+A
80          GOSUB 200
90          XBY(0FC00H)=40H+A
100         GOSUB 200
110         XBY(0FC00H)=80H+A
120         GOSUB 200
130         NEXT I
140         END
REM      Toggle TE and delay after each step
200        XBY(0FC03H)=0EH
210        XBY(0FC03H)=0FH
REM      Delay at least 200 milliseconds after each step
220        FOR J=1 TO 150
230            NEXT J
240        RETURN

```

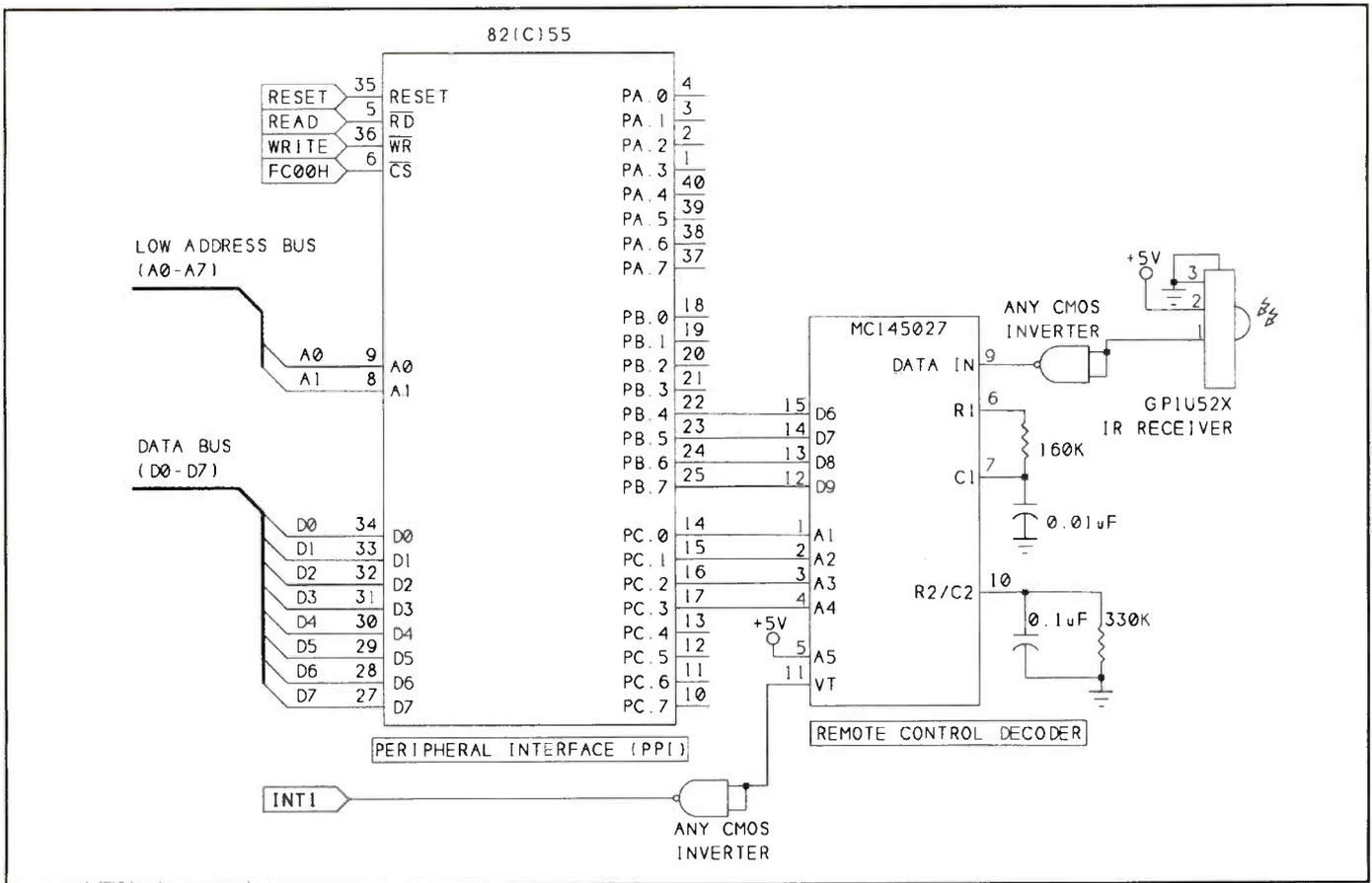


Fig. 4. The 8255 peripheral interface can also interface to an MC145027 remote-control decoder that accepts transmissions from an infrared receiver.

type with a unipolar drive circuit. Four IRF511 MOSFETs switch current to the windings. When a data output goes high, the corresponding MOSFET switches on, permitting current to flow through the connected winding. The 1N4001 diodes protect the MOSFETs from voltage spikes generated when winding currents switch off.

Listing 3 is a BASIC-52 program that turns the motor by writing the appropriate values in sequence to the encoder. The program switches on each of the windings in turn. For a motor that rotates 18° per step, you need to repeat five times to make one revolution.

The steps must follow the correct sequence. If your motor doesn't make complete revolutions, the windings aren't being controlled in the correct order. If this occurs, you can either change the connections of the windings or change the program to remedy this.

Remember that each transmission requires about 200 ms to complete. This means that the maximum speed of the motor will be 20 x 0.2 second, or 4 seconds, per revolution. At this speed, the

motor will jump in clear steps, rather than rotate smoothly. Therefore, this circuit is useful mostly as a positioning mechanism. Listing 3 includes a delay loop after each step. You can experiment with different delay values to determine

the minimum loop count you can use, which will depend on the clock speed. For testing, you may want to slow the motor by increasing the delay.

For operation at faster speeds, one possibility would be to use the transmit-

Listing 4. Receiver Test (Figure 4)

```

REM      Program 4
REM      Reads received data at the decoder
REM      PPI mode set: Ports A,C=output; Port B=input
10      XBY(0FC03H)=82H
REM      A=decoder address (0-15)
20      A=2
REM      Write address to Port C(low), turn TE (C.7) off (high)
30      XBY(0FC02H)=80H+A.OR.XBY(0FC02H)
REM      Use edge-triggered interrupt
40      TCON=TCON.OR.4
50      DO
REM      Wait for interrupt
60      ONEX1 500
70      WHILE 1=1
80      END
REM      On interrupt 1, print received data
REM      Data is at Port B, bits 4-7
500     PH0.(XBY(0FC01H).AND.0F0H)/10H
510     RETI

```

Listing 5. Switch Monitor (Figure 5)

```

REM      Program 5
REM      Detects switch openings and closings
REM      PPI mode set: A,C=output; B=input
10      XBY(0FC03H)=82H
20      XBY(0FC03H)=0FH
30      A=2
REM      Write address to Port C(low), turn TE (C.7) off (high)
40      XBY(0FC02H)=80H+A.OR.XBY(0FC02H)
REM      Use edge-triggered interrupt
50      TCON=TCON.OR.4
REM      Wait for interrupts
60      DO
70      ONEX1 500
80      WHILE 1=1
90      END
REM      Read switches and display results
500     S=(XBY(0FC01H).AND.0F0H)/10H
510     X=8 : Y=4 : IF S>=X THEN GOSUB 600 ELSE GOSUB 700
520     X=4 : Y=3 : IF S>=X THEN GOSUB 600 ELSE GOSUB 700
530     X=2 : Y=2 : IF S>=X THEN GOSUB 600 ELSE GOSUB 700
540     X=1 : Y=1 : IF S>=X THEN GOSUB 600 ELSE GOSUB 700
550     PRINT
560     RETI
600     PRINT "Switch ",Y,"is open."
610     S=S-X
620     RETURN
700     PRINT "Switch ",Y,"is closed."
710     RETURN

```

ted data as a speed control, with up to 16 selectable speeds. However, this would require adding circuits that interpret the transmitted data and control the motor speed according to what's received.

Receiver

Instead of, or in addition to, computer control of the transmitter, you can also

add a computer interface at the receiver. For example, a data logger might accept data from a remote transmitter and process it or store it for later use.

Figure 4 is the schematic diagram of a computer interface for the receiver circuit presented last month. Again, the circuit uses an 8255 PPI, this time to make the received data available to the PC.

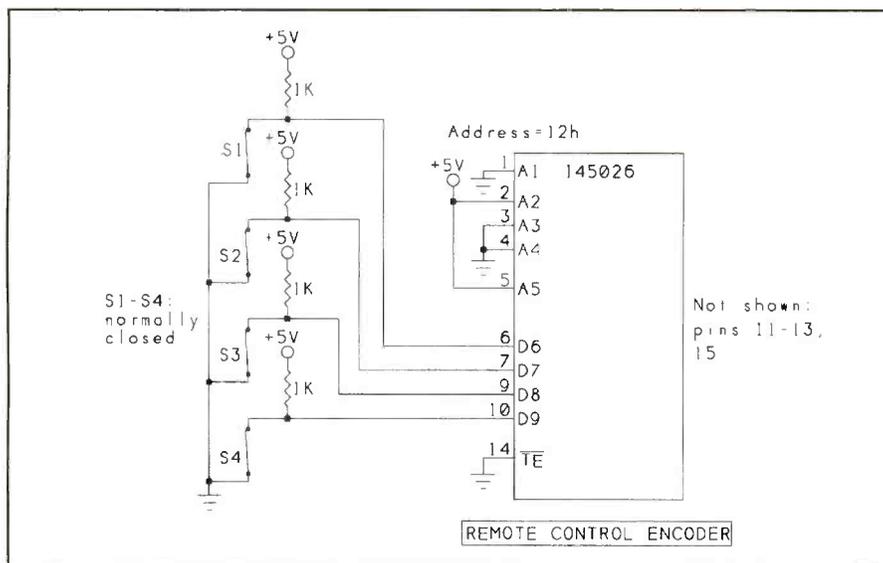


Fig. 5. This encoder monitors switches and transmits when a switch opens.

Because the circuit uses different port bits from those in Fig. 1, you can connect both a transmitter and a receiver to one PPI. The low nibble of Port C is configured as an output, and sets address bits A1 through A4 on the decoder. As in the previous circuit, A5 is tied high so that you can set the address with four bits. The high nibble of Port B is configured as an input and stores the data received at D6 through D9 of the decoder.

Valid transmission VT is inverted and then connects to INT1 at pin 13 of the 8052. You can use any CMOS inverter or inverting gate for VT.

Listing 4 is a BASIC-52 program that sets up the PPI to receive data at Port B in Mode 0. Since the decoder latches the received data, I saw no reason to use Mode 1, which also latches the data and generates its own interrupt signal.

The Listing 4 program writes an address to the decoder's address inputs and also turns off TE (Port C, Bit 7 in Fig. 1) to ensure that the encoder isn't transmitting while the decoder is receiving. Using an edge-detecting interrupt ensures that the program won't re-interrupt if VT is still low when the interrupt routine ends.

The main program loop is a do-nothing loop that waits for an interrupt. When VT goes high, indicating that a valid transmission has been received, the 8052 executes an interrupt routine that reads the data at bits D4 through D7 of Port B and prints it to the BASIC-52 display.

Using VT to generate an interrupt is a handy way to detect when new data has arrived, but you don't have to use this approach. If you don't enable Interrupt 1, you can periodically read Bit 3 of Port 3 to find out if a new transmission has arrived. Alternatively, you can leave VT unconnected and just read Port B once a minute, or on user request, or trigger the reading by some other factor under program control.

As in the transmitter circuit, the signals shown along the left side of the PPI connect to the corresponding signals in the 8052-BASIC circuit. Connect pin 6 of the PPI to the chip-select that corresponds to the address of your PPI.

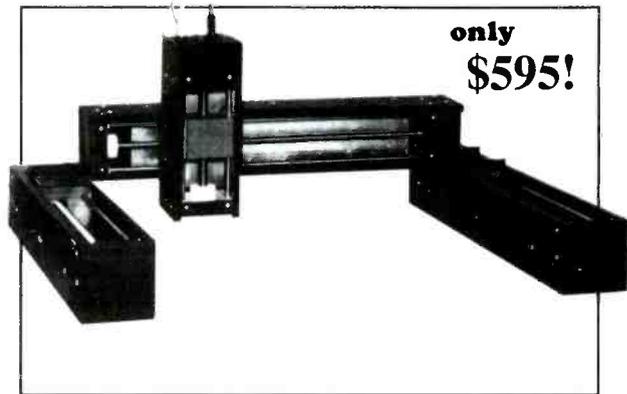
The connections along the right edge of the decoder symbol match the encoder circuit described last month. You can use any CMOS inverter at decoder pin 9.

As with the encoder circuit, you don't have to use a PPI to read and write to the decoder. Any latched outputs will do for A1 through A4, and any inputs will do

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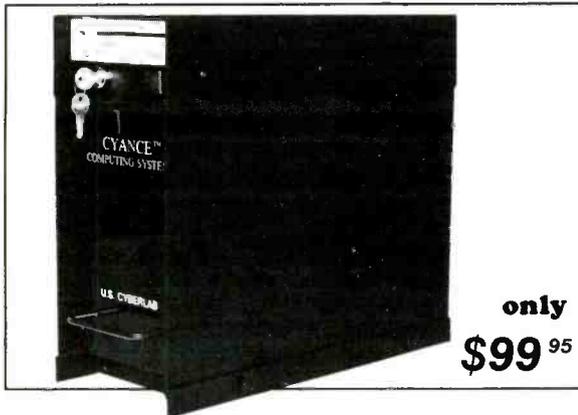


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Listing 6. Eight-Bit Transmitter (Figure 6)

```

REM      Program 6
REM      Reads two consecutive transmissions,
REM      Combines the result into one 8-bit value
REM      PPI mode set: A,C=output; B=input
10      XBY(0FC03H)=82H
REM      A=decoder address (0-15)
20      A=2
REM      Write address to Port C(low), turn TE (C.7) off (high)
30      XBY(0FC02H)=80H+A.OR.XBY(0FC02H)
REM      Use edge-triggered interrupt
40      TCON=TCON.OR.4
50      X=0
60      DO
REM      Wait for interrupt
70      ONEX1 500
80      WHILE 1=1
90      END
REM      On interrupt 1, see if transmission is 1st or 2nd of pair
500     IF X=0 THEN GOSUB 600 ELSE GOSUB 700
510     RETI
REM      First transmission is high nibble
600     HN=XBY(0FC01H).AND.0F0H
610     X=1
620     RETURN
REM      Second transmission is low nibble
700     LN=XBY(0FC01H).AND.0F0H
710     X=0
REM      Combine high and low nibbles and print result
720     PH0.HN+LN/10H
730     RETURN
    
```

for D6 through D9. Because the decoder latches the data, you don't need additional input latches.

If the circuit will receive data from only one address, you can hardwire A1 through A5 of the decoder and free up four bits on the PPI for other uses.

If you want to use a personal computer to read data from a decoder, you can use the control-signal inputs on a parallel port or the data inputs if your parallel port is bidirectional. You can also use the inputs on a digital I/O card. To set the address, you'll also need four latched outputs.

You can transmit to the Fig. 4 circuit with either a manual or computer-controlled transmitter. Set the transmitter's address inputs to match the receiver's address, select the data you want to send, transmit and view the received data on the BASIC-52 monitor.

Receiver Applications

Shown in Fig. 5 and Fig. 6 are two applications for the Fig. 4 receiver. In Fig. 5, each of an encoder's data inputs connects to a switch. Because TE is tied low, it continuously transmits the state of

switches 1 through 4. If no switches open or close, the decoder continually receives the same data and VT remains high. If one or more switches do open or close, the change in the transmitted data causes VT to go low for at least one data pulse period. (VT goes low if it doesn't receive the same data twice in a row.) After receiving the new data twice, VT returns high, causing a falling edge at the 8052's INT1.

Listing 5 is a BASIC-52 program that interrupts when a switch changes state and announces which switch or switches are open. For the circuit to work properly, a switch must remain open for at least 200 ms (the time required to transmit). You may have trouble uploading lines 510 through 530 to the 8052 because they contain the ">" character, which is also the BASIC-52 prompt. If necessary, you can type these lines by hand at the keyboard.

One limitation of the encoder chip is that it transmits just four bits at a time, while much digital data is eight bits or longer in length. If the encoder is computer-controlled, you can divide larger values into four-bit nibbles and send each in sequence. If you don't want to

Say You Saw It In ComputerCraft

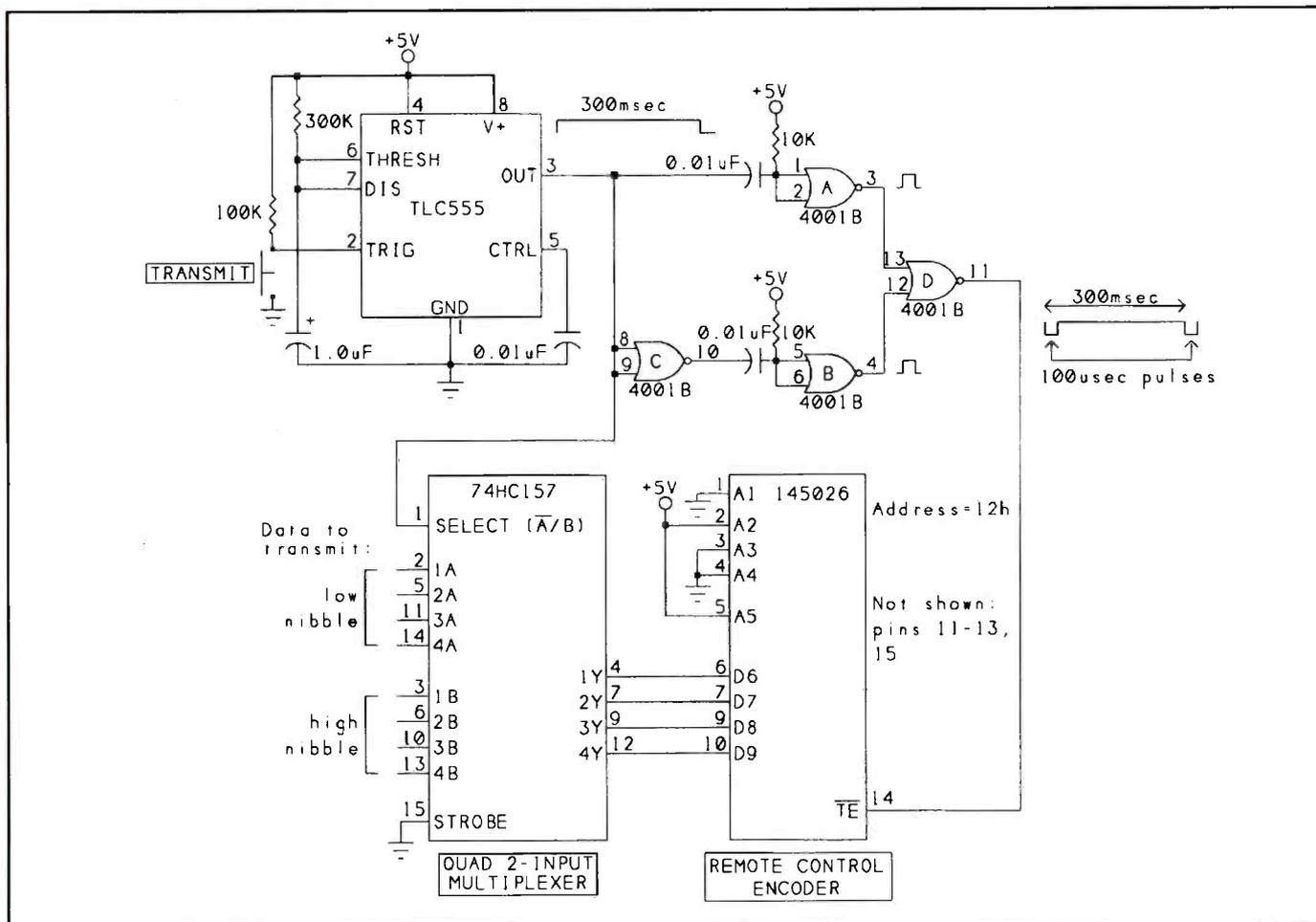


Fig. 6. This circuit transmits 8 bits of data as a pair of 4-bit nibbles.

use a computer at the transmitting end, Fig. 6 shows a stand-alone transmitter that divides a byte in two and transmits each half in turn.

The transmitted data can be any latched eight-bit value, including outputs from counters or analog-to-digital (A/D) converters, switch closures like those illustrated in Fig. 5 or any digital outputs. The bits should be latched to ensure that they won't change during the entire transmission time of around 600 ms.

Data to be transmitted is divided into two four-bit nibbles, which are available as the inputs of a 74HC157 multiplexer. The SELECT input determines which set of inputs appears at the Y outputs. With SELECT low, D6 through D9 follow 1A through 4A of the encoder. With SELECT high, D6 through D9 follow 1B through 4B. The STROBE input is tied low to constantly enable the outputs.

Transmission requires two timing signals, one of which controls the multiplexer's SELECT input. It must be high during the first transmission and low

during the second. In Fig. 6, a TLC555 CMOS timer meets this requirement by generating a 300-ms high pulse when *S1* is pressed and released. The encoder transmits the high nibble when the pulse is high and the low nibble after the pulse goes low. I'll call this signal the SELECT pulse.

The second timing signal consists of short low-going pulses that enable the transmitter on both the rising and falling edges of the SELECT pulse. Shown in Fig. 6 is one way to do this using a 4001B quad NOR gate. A capacitor and resistor at the inputs transforms two of the NOR gates into pulse generators that output a pulse when triggered by a rising edge. When SELECT is low, pin 10 of gate C is high and pin 4 of gate B is low. When SELECT goes high, pins 10, 5 and 6 go low and pin 4 goes high. The capacitor at pin 10 then slowly charges through the resistor. When the voltage at pins 5 and 6 reach the gate's logic threshold, pin 4 goes low again. The result is a short, high-going pulse at pin 4 when SELECT

goes high. With the resistor and capacitor values shown, the pulse is around 100 µwide.

Gate A functions in the same way, except that it generates its pulse on the falling edge of SELECT. The two pulses are inputs to Gate D, whose output is normally high, with a low-going pulse at both the rising and falling edges of SELECT. Each low pulse causes the encoder to transmit the values at its D6 through D9 data lines.

Exact pulse widths aren't critical. The SELECT pulse must be at least 200 ms wide to ensure that the correct data remains selected during the entire transmission. TE must be at least 65 ns in duration to meet the encoder's specifications. You must release *S1* before SELECT goes low to prevent mechanical switch bounce from causing unwanted extra transmissions.

Listing 6 is a BASIC-52 program that causes the Fig. 4 receiver to detect eight-bit transmissions from the Fig. 6 circuit. This program combines the two four-bit

values it receives and displays them as a single value.

Expanding the Link

All examples shown here have assumed that there's computer control at one end only. Of course, you can also have computers on both ends, with two microcontrollers communicating with each other, or a microcontroller and a personal computer, or even two personal computers. A transmitter can send to multiple receivers, and each receiver will accept only the transmissions addressed to it. But what happens when you have two or more transmitters sending to a receiver, or a transmitter and receiver at each end, exchanging information with each other?

If only one transmitter sends at a time, interference won't be a problem. But in most cases, you'll want to be able to identify which transmitter is sending. Although you can change the decoder's address to match a specific encoder, this is no help if you don't know which encoder will be transmitting. One solution is to have each encoder transmit only at specified times: one at 5 minutes after the hour and another at 10 minutes after the hour, for example. Or, in a two-way link, with an encoder and decoder at each end, you can use a polled system in which one device controls the link by sending a message that tells the receiving device that it's time to transmit.

In a two-way link where both encoders may transmit at the same time, each direction should use a different address. For example, transmissions from Device A to Device B use address 15h, while transmissions from Device B to Device A use 1Ah. In my experiments with two-way transmitting, I found that the decoders were able to pick out the transmissions meant for them, even when another transmitter was operating nearby.

If you have both a transmitter and receiver on the same device, placing an optical shield between the receiver and transmitter helps to prevent interference. Test your shielding material to be sure that it blocks infrared energy because the ability to block visible light isn't always a reliable indicator.

I hope these examples have given you some ideas for what you can do with an infrared link. Next time, I'll cover techniques for increasing the distance of transmissions and more on wireless transmitting.

New Books and More

On a different topic, here are two recent books I thought would be of interest to you.

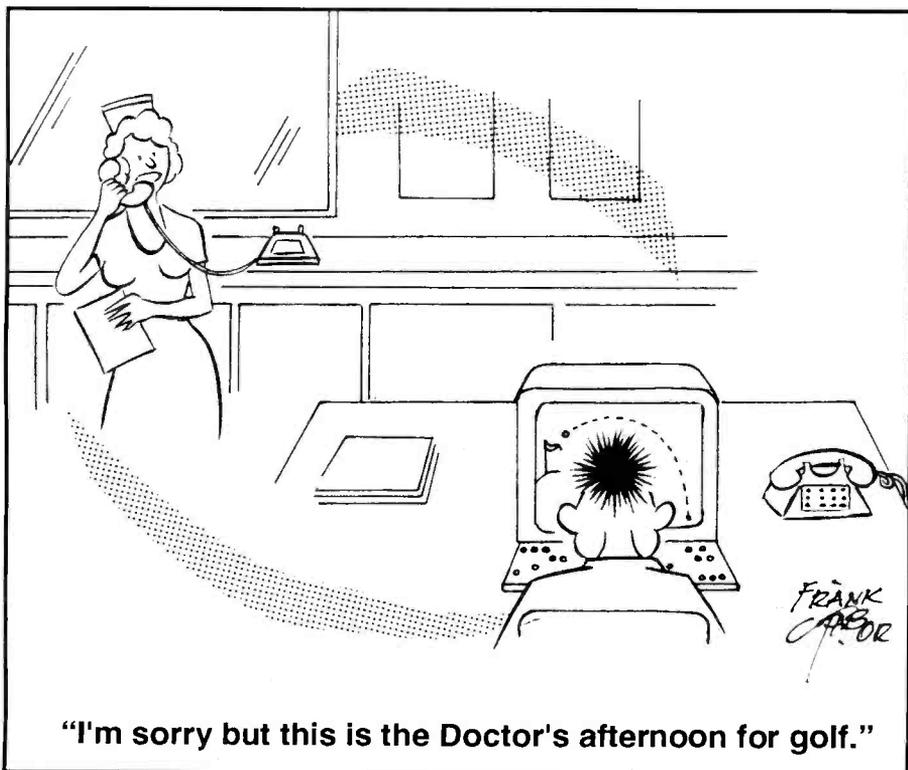
Mobile Robots: Inspiration to Implementation by Joseph L. Jones and Anita M. Flynn (\$39.95; 349 pages; A K Peters, Ltd., 289 Linden St., Wellesly, MA 02181; tel.: 617-235-2210) covers locomotion, positioning, sensing and

power supplies for intelligent, moving machines. Robots described include a simple, computer-less design and a more-intelligent model based on the 68HC11 microcontroller. Rather than presenting complete projects, the book concentrates on providing the information you need to design and build your own robots. For example, a chapter on dc motors shows how to read a motor's data sheet and determine what size motor you need, discusses some basic motor-drive circuits and motor-control ICs and includes two example motor-control programs. The book grew out of the experiences of MIT's Artificial Intelligence Laboratory. It's clearly written and includes a lot of useful information.

CompuBooks (Route 1, Box 271-D, Cedar Creek, TX 78612-9733; tel.: 1-800-880-6818 or 512-321-9652) is a mail-order bookstore that has been offering *Mobile Robots* for \$25.46 plus shipping—a good price. There's a free catalog, and special orders are handled.

Another new book is *The 8051 Microcontroller: Hardware, Software, and Interfacing* by James W. Stewart (\$27.50; 273 pages; Regents/Prentice Hall). It includes many interfacing examples, such as switches, solenoids, relays, shaft encoders, displays, motors and A/D converters. There's a chapter on how to design a project using the top-down method, where you first describe the entire system using block diagrams and flowcharts or pseudo-code and work your way down to the details relating to each component. Seventy pages of the book are reprints from Intel's 8051 data sheets, however.

You can reach me on CompuServe at 71163.3555, on Internet at 71163.3555@compuserve.com or by mail at Box 3374, Madison, WI 53704-0374. For a personal reply by mail, please include a self-addressed stamped envelope, if possible. ■



The AmCoEx Index of Used Computer Prices

IBM is expected to announce its new low-cost Ambra line of computers next month. The line should include two notebook computers, possibly manufactured by Acer. The Ambra line may also include the first 75-MHz 486 desktop system.

After Dell wooed one of Apple's chief PowerBook designers, it will soon unveil its new line of notebook computers. Not surprisingly, these notebooks are expected to bear a strong resemblance to Apple's PowerBooks. Like some of the PowerBook computers, these notebooks may also be manufactured by Acer.

ALR has announced the first desktop computer using Intel's new Pentium chip with a price under \$2,500. While this price doesn't include a video monitor or hard drive, it's still considerably lower than other Pentium-based computers on the market.

Two years ago, few modems had the ability to send and receive a fax document. Today, almost all new modems incorporate this capability. The reason is the circuitry was incorporated into a single chip and mass produced. This lowered the cost of the feature to the point where it's virtually a standard today. A few modems today have the ability to handle voice as well as data. These modems can allow a computer to function as an intelligent answering machine or detect Touch-Tone signals to direct calls. As the demand for this feature increases, the cost of the chip required will fall. Within two years, this feature could very well be standard on all modems.

The cry for more power in notebook computers may be subsiding, as many users begin to realize that more means less. That is, more power means less battery life. Sharp color screens and fast processors not only increase the cost of the newer notebook computers, they can also force the user to carry spare battery packs. This is causing many notebook buyers to reconsider their need for these features. Some notebooks have the ability to run at slower speeds to prolong battery life. They can use the higher speeds when ac line power is available.

Several years ago, the cost of a hard drive inside a new computer was approximately 10% of the total manufacturing cost. With competition forcing the prices of computers lower and increasing demand for larger hard-drive capacity, the percentage has risen to more than 20%. This means that fluctuations in hard-drive prices will have a greater effect on computer prices than ever before. Due to excess inventories, hard-drive prices have fallen by more than 50% in the last few months. However, these cuts may only be temporary while inventories are cleared out. If hard-drive prices soon increase, we may see an uncharacteristic increase in new-computer prices. This could also cause increases in used-computer prices as well.

Memory-chip prices have risen dramatically in the past few weeks. A fire at a plant in Japan is the reported cause. The plant man-

Machine Make and Model	Buyer's		Seller's		Change
	Average Bid	Average Ask	Average Close	Average	
IBM PS/2 Model 30/286, 20M	300	525	475		-25
IBM PS/2 Model 50Z, 30M	375	650	450		-50
IBM PS/2 Model 70, 120M	700	1,000	800		+100
IBM PS/2 Model 80, 70M	600	850	650		-100
IBM ThinkPad300	1,250	1,650	1,400		+50
IBM ThinkPad700	2,100	2,700	2,400		**
AST 286/12, 40M	275	675	425		-25
AST 386/20, 80M	550	950	700		-175
Dell 325SX, 50M	400	800	625		+25
Dell 386/20, 120M	800	1,200	925		-75
Gateway 286/16, 40M	350	600	400		**
Gateway 386SX/20, 80M	600	950	700		-125
Gateway 386/25, 80M	600	1,000	800		-100
Clone AT 40 M	250	550	375		-25
Clone Notebook 286, 40 M	350	750	550		-50
Clone Notebook 386SX, 40M	500	1,050	800		-250
Clone 386/SX, 40M, VGA	450	950	650		-175
Clone 386/25, 80M, VGA	650	1,150	725		-375
Clone 386/33, 80M, VGA	750	1,250	800		-225
Clone 486/25, 120M, VGA	900	1,450	925		-400
Compaq SLT/286, 20M	400	800	500		**
Compaq LTE 286, 40M	400	775	600		+50
Compaq Portable III, 40M	250	650	375		**
Compaq Deskpro 286, 40M	300	650	400		-50
550	375	-25			
Clone Notebook 286, 40 M	350	750	550		-50
Clone Notebook 386SX, 40M	500	1,050	800		-250
Clone 386/SX, 40M, VGA	450	950	650		-175
Clone 386/25, 80M, VGA	650	1,150	725		-375
Clone 386/33, 80M, VGA	750	1,250	800		-225
Clone 486/25, 120M, VGA	900	1,450	925		-400
Compaq SLT/286, 20M	400	800	500		**
Compaq LTE 286, 40M	400	775	600		+50
Compaq Portable III, 40M	250	650	375		**
Compaq Deskpro 286, 40M	300	650	400		-50
Compaq Deskpro386/20c, 100M	800	1,100	875		-225
Macintosh SE, 20M	450	750	500		**
Macintosh SE/30, 40M	600	900	800		-175
Macintosh II, 40M	600	1,150	875		-125
Macintosh Ilex, 80M	900	1,500	1,100		-200
Macintosh Hci, 80M	1,300	2,000	1,650		-250
PowerBook 100 4/20	700	1,100	900		**
PowerBook 140 4/40	1,100	1,500	1,200		-150
PowerBook 170 4/40	1,300	1,800	1,550		-350
LaserWriter IINT	800	1,300	950		-50
Toshiba 1200XE	300	650	425		-200
Toshiba 1600	400	700	500		-325
Toshiba 2200 SX, 60M	800	1,300	1,000		-100
Toshiba T-3100SX, 100M	700	1,150	800		-25
Toshiba 5200, 100M	900	1,400	1,225		+75
HP LaserJet II	400	850	725		+25
HP LaserJet IIP	325	950	600		-100
HP LaserJet III	750	1,200	1,050		-25

Note: All figures in columns two, three and four are in dollars. Prices are for July 30, 1993.

ufactured the epoxy resin used in 60% of all memory-chip boards.

Cyrix has announced a new 486SX chip that can directly replace most 386 chips in a motherboard. The new chip can double the speed and power of an older machine. The price of the chip ranges from \$399 for the 32-MHz version to \$499 for the 50-MHz version. A heat sink and necessary system software are included. This product may increase the demand and decrease the supply of 386 computers in the used marketplace.

Many people wonder if multimedia PCs will be a big hit or a dud. The answer probably lies in an unknown application that may or may not make it to market. When the first PCs were introduced, most people couldn't imagine how they could use one. Today, 27% of all homes have a PC. The original Apple II computer might have failed if it hadn't been for a spreadsheet application called VisiCalc. Record sales of the original IBM PC are attributed to Lotus' 1-2-3 spreadsheet and

WordPerfect's word-processing software. The initial success of the Macintosh was due almost solely to desktop publishing. None of the designers of these early computers realized the symbiotic effect that software would have on the hardware they brought to market. The same scenario probably holds true today for multimedia PCs.

One key factor in the success of multimedia lies in the enormous storage capacity of CD-ROMs. More than 600 megabytes of information can be reproduced for of less than \$3 per disk. This equates to publishing entire encyclopedias for \$3 each. No other duplication method comes close to this price so the potential for something great exists.

John Hastings is the president of the American Computer Exchange Corp., which matches buyers and sellers of used micro-computer equipment. For more information, contact the American Computer Exchange Corp. at 800-786-0717.

Add a RESET Button to Any PC

Makes your computing a lot less inconvenient and benefits your system as well

Software problems that hang up a PC can be a fairly common occurrence nowadays. When one occurs and hitting Ctrl-Alt-Del has no effect, you have to initiate a hardware reset to recover use of your computer. If you're lucky, your PC has a handy RESET button on the front of its system unit. If your PC doesn't have a RESET button, you have to reach around your system unit and flip the POWER switch to OFF and then, a few seconds later, back to ON again. Not only is this inconvenient to do, but it also places undue stress on your system and especially your hard drive as power surges on and off. A hardware reset is much more convenient and safe to use. Many clones and all IBM machines have no RESET buttons whatsoever. If you have one of these PCs, it's to your advantage to upgrade it by adding your own hard-wired hardware RESET button. It isn't a difficult thing to do. In this article, I'll talk you through the simple procedure.

Making the Modification

This modification is very easy to make. All you need are a length of two-conductor speaker or other cable and a normally-open momentary-action spst pushbutton switch. An excellent choice for the latter is the Radio Shack Cat. No. 275-1556 switch.

Begin installation by parking the heads of your hard drive and then powering down your PC. Then unplug the power cord from your PC's system unit and remove the cover to gain access to the motherboard and interior.

Trace the power-supply cables to the motherboard. There are two such cables, each with six conductors that terminate in an in-line plastic connector that plugs onto connector blocks on the motherboard. In the great majority of cases, these connector blocks are located very near the right-rear corner of the motherboard, where they're very close to the power supply, as shown in Fig. 1. Note that these connectors are normally labeled P8 and P9.

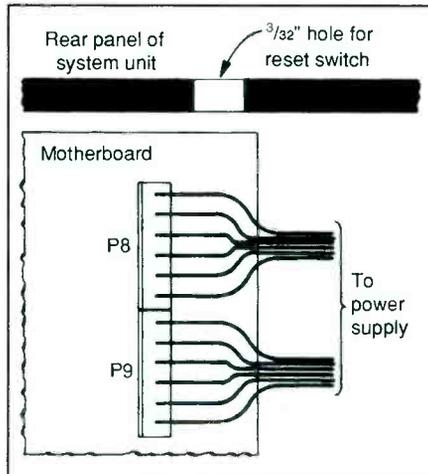


Fig. 1. Pictorial view of location where cables from power supply connect to motherboard.

Gently but firmly pull straight up on the cable plugged onto P8 (the connector nearest the back panel on the motherboard) until it "hangs up" and won't lift any further. Do not yank! At this point, tilt the connector on the cable toward the power supply to free it.

Now that you have the cable free, locate the conductor nearest the back

panel of the system unit. It's usually color coded with orange insulation. This is the Power Good conductor. It's held at ground potential by the power supply when you turn on your PC and rises to +5 volts when all power-supply outputs have settled. It's this rise to +5 volts that initiates a system reset.

Pressing the RESET button you're about to install between the Power Good and ground conductors on the P8 cable grounds this conductor. Releasing the button allows the conductor to return to +5 volts, effectively initiating a reset action similar to the power-on reset action when you first power up your PC. The ground conductor you'll be using for this modification is one of the black-insulated conductors at the other end of this connector.

To make the connections to the cable requires that you remove about 1/8" of insulation about 3/4" from the plastic connector block, as shown in Fig. 2. Use a sharp hobby knife, and work carefully. Make certain that you don't nick or sever any of the wires in either power-supply cable conductor.

Next, determine how long the two-conductor cable you need must be and clip it to length, leaving about 1" of

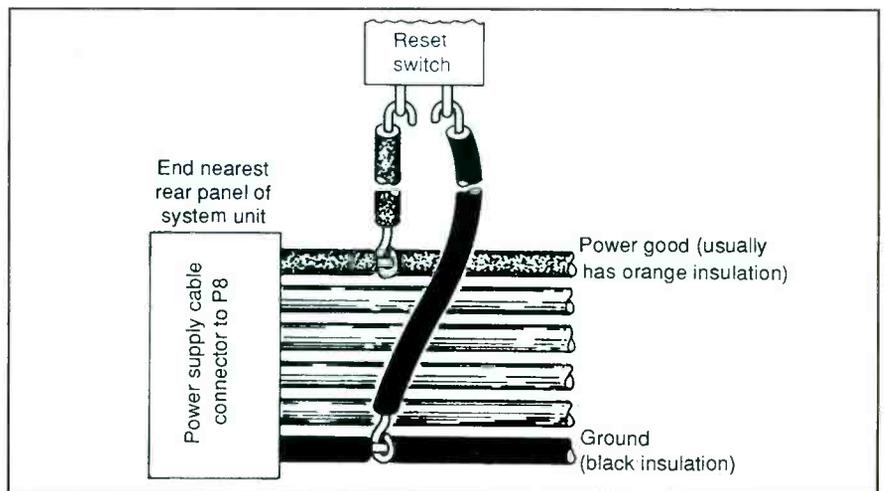


Fig. 2. Wiring pictorial for RESET switch tie-ins.

slack. The length of this cable will be determined by where you plan to mount the RESET switch on your system unit: on the rear panel immediately behind where the power-supply cable plugs onto the motherboard (about 4" long); on a spare expansion-slot blocker strip (considerably longer); or on the system unit's enclosure (longer still). Though mounting the switch on the front panel is ideal in terms of convenience, this isn't often a good idea because the system unit's front panel comes off with the cover. A possible alternative is to mount it on a blocking panel that fits into a spare disk-drive bay—if you're lucky enough to have such a thing. If it's possible to mount the switch on the front panel of your system unit, make sure to locate the switch where it won't accidentally be bumped against and initiate a reset action when you don't want it to.

Once you've cut the two-conductor cable to the length needed, strip 1/4" of insulation from both conductors at both ends of your two-conductor cable. Tightly twist together the fine wires at both ends and sparingly tin with solder. Crimp and solder the conductors at one end of the cable to the lugs on the switch. Then crimp and sparingly solder the

other ends of the cable wires to the bared sections of the conductors in the power-supply cable. Though it isn't necessary, you can wrap both latter connections with electrical tape to insulate them.

Having made the connections, plug the power-supply connector back onto the P8 motherboard connector block, reversing the procedure detailed above.

To mount the RESET switch, you must now drill a 9/32" hole through the back panel of your system unit, a metal slot-blocker bracket, etc., depending on the site chosen. If you're drilling through the rear panel of your system-unit enclosure, make absolutely certain that no metal particles fall into the enclosure and especially onto the motherboard!

Now install your RESET switch in the hole you just drilled, using the hardware supplied with it. Tighten the mounting nut with pliers and snap the actuating button back into place on the shaft of the switch. Now all you have to do is power up your computer. When the C: prompt appears, press and release the RESET switch. If all is okay, your computer should reset and re-boot normally.

With your newly installed RESET switch, you'll find your computing a little less frustrating! ■

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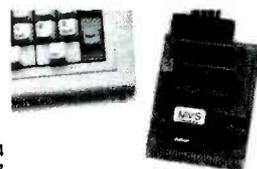
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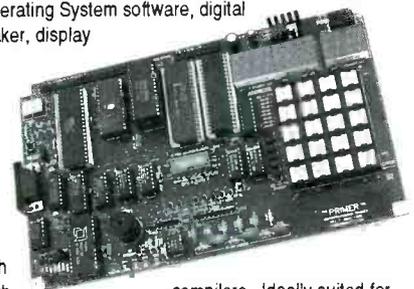
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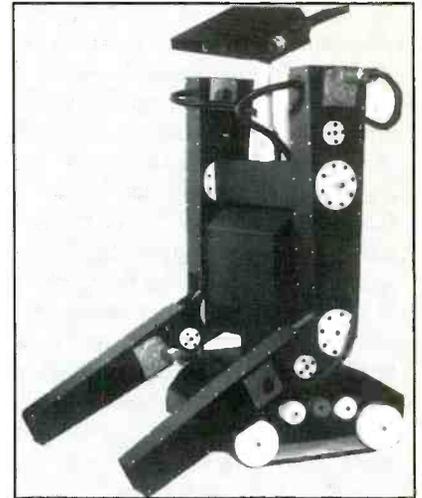
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59

Build a Real-World Work Robot

Part 3

Adding the charging pod, torso chassis and arms



In the September issue, I detailed how to build the tractor assembly and last month I covered the tractor drive for the RONAR (Remotely Oriented Numerically Actuated) robot's base assembly. This month, I concentrate on RONAR's charging pod, on-board computer, arms and torso. In fitting these elements to the basic robot mechanism, you'll be using the same mechanical components you used for the tractor unit. The electronic motor speed controller detailed last month will be put into service again in the torso unit and arms.

The Torso

The torso gives RONAR the ability to

rotate 360° at its "waist" and provides the support required to retrofit two arms. As you can see from the illustrations and photos in this article, the torso is fairly easy to fabricate from 0.050" or 0.053" aluminum sheet stock if you have the proper tools to do the machining. If not, it and other elements that aren't relatively easy to fabricate in a home workshop can be obtained from the source given in the Note at the end of the Parts List. Integral channel construction throughout the chassis greatly strengthens the robot and reduces on-track weight.

In addition to providing support strength for the arms, the torso also encloses the torso-rotation mechanism, on-

board computer and motor-drive electronics. However, RONAR's great strength doesn't particularly reside in its chassis design but in a unique support-column that assembly carries all vertical loads and helps stabilize lateral loading across the "shoulders" of the torso. Using space-age plastics, you'll be able to fabricate the self-lubricating thrust bearings, rotors, rotor support bearings, spacers, idlers, etc., needed to make a functional mechanism.

To better understand how the torso rotates, refer to Fig. 1. As its name implies, the support column provides support for the various subassemblies that lie above the tractor base unit. The base-column

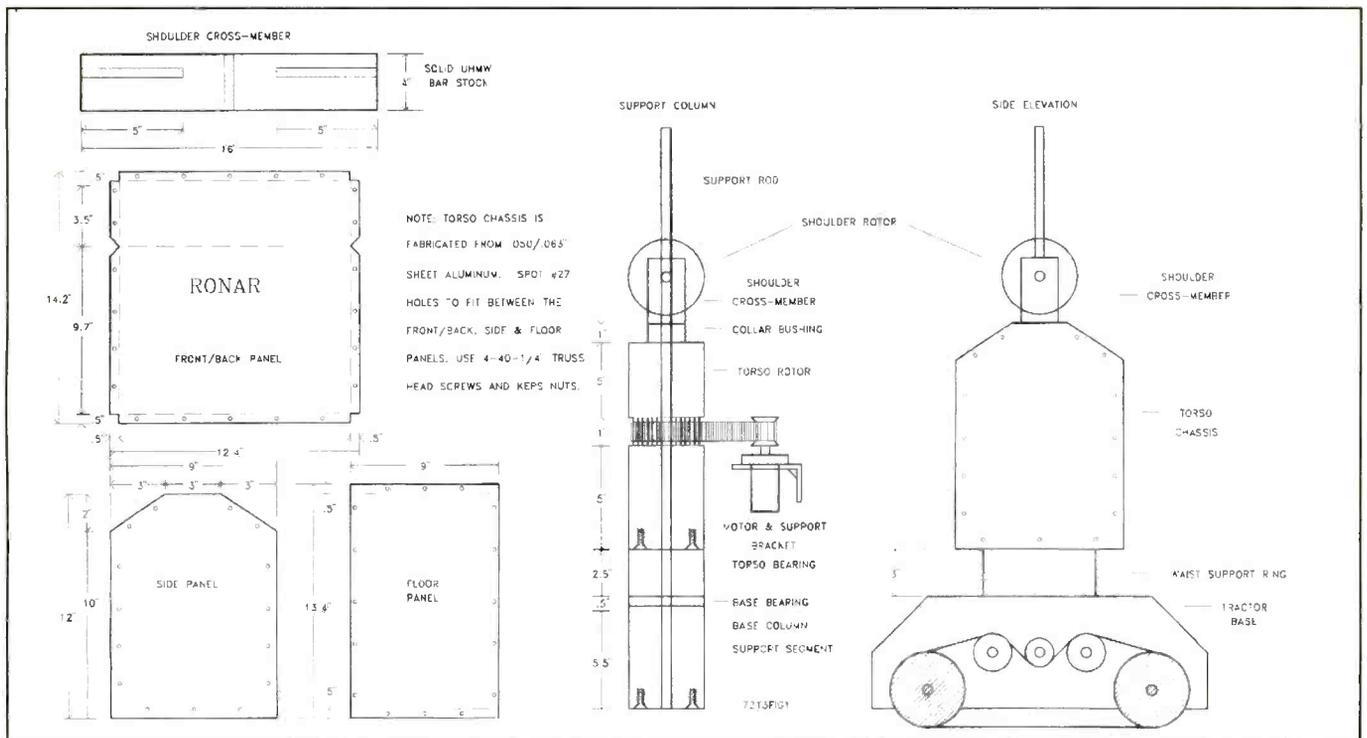


Fig. 1. Machining details for torso and support column.

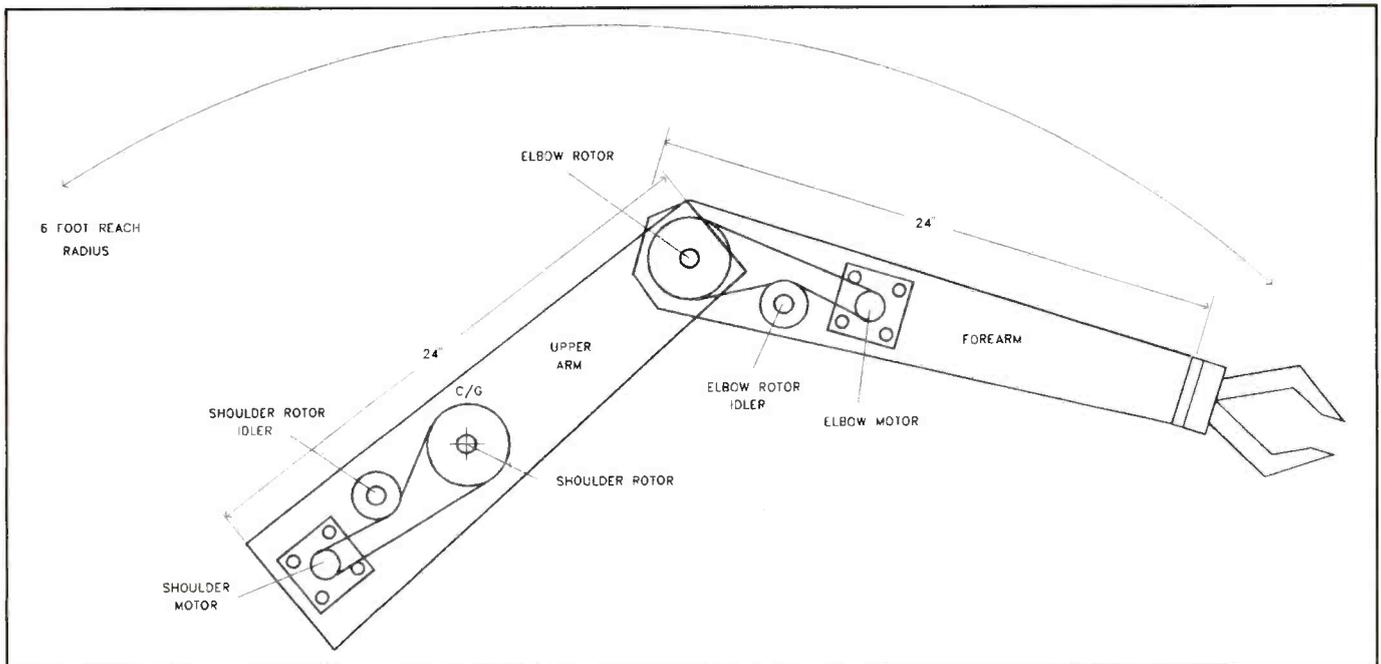


Fig. 2. Assembly details for arm unit.

segment is fabricated from 4" round UHMW (ultra-high modular weight) plastic that's bored to accommodate a 1/2" CRS (cold-rolled steel) drill rod. Secured to the tractor base chassis with 6-32 machine screws, the base column supplies a "seat" or base for the ascending segments in the support stack. Additionally, the base column anchors the 1/2" support column rod, which is epoxied into place to keep it from rotating with respect to the tractor base. The support column is the stem or hub to which the various column rotors attach.

To rotate the torso, you actuate the torso-rotation motor, using the motor controller. As the motor's drive shaft rotates, it transfers force to the torso column rotor through the cog (timing) belt. However, because the column rotor is pinned to the support-column rod, it can't rotate with respect to the tractor base. Consequently, the torso is forced to counter-rotate, resulting in the desired torso rotation. By adjusting the power to the rotation motor, you can rotate the torso at various speeds and exert varying amounts of lateral force to objects encountered by the arms.

Below the torso chassis is a torso support ring, a circular band of aluminum that functions as an overload mechanism for the torso. If RONAR is ordered lift a heavy object that causes the support-column rod to deflect slightly, the torso will bottom-out on the torso support ring and transfer the lifting load directly to the

BILL OF MATERIALS

Forearm (for one unit)

- 2—Forearm C channel
- 2—Upper-arm C channel
- 4—Channel cover
- 2—4" UHMW rotor
- 2—2" UHMW rotor idler
- 4—2" bearing
- 4—2" spacer bearing
- 4—4" load bearing
- 4—4" spacer bearing
- 3—3" X 1/2" drill rod rotor and idler shaft
- 1—7" X 1/2" drill rod shoulder shaft
- 2—14-tooth cog belt drive sprocket
- 2—12/24-volt gear-head motor
- 16—3/32" X 1" roll pin (wrist pin)
- 48—No. 6 metal washer
- 4—10-32 pan-head Phillips screw
- 48—6-32 X 1/2" Allen cap-head screw or 6-32 X 1/2" counter-sink Allen-head screw
- 48—6-32 Keps nut
- 56—4-40 X 1/4" pan-head Phillips screw
- 56—4-40 Keps nut
- 2—260L100 Cog (timing) belt
- 5 feet of 1/2" wire loom

Torso Unit

- 1—Torso chassis sheet-metal assembly
- 1—2" X 4" X 16" solid UHMW shoulder cross-member
- 32—No. 4 X 3/8" truss-head Phillips sheet-metal screws
- 1—260L100 cog (timing) belt
- 1—12/24-volt dc gear-head motor
- 1—3" support-ring unit

Support Column

Assorted 4"-diameter UHMW rotors and bearings—see drawings and text
 36" X 1/2" drill-rod support shaft machined for Woodruff keys or drilled for 3/32" roll-pins—see text

Note: The Following items are also available from U.S. Cyberlab, Inc., 14786 Slate Gap Rd., West Fork, AR 72774 (tel.: 501-839-8293 Ext. 3 (sales voice line or 501-839-8221 fax): 12/24/36-volt dc gear-head motor, \$29.95 each; complete machined bearing kit with all 2" and 4" load/spacer bearings, 49.95; complete machined 1/2" shaft kit, \$24.95; arm unit sheet-metal kit (conversion coat primer with textured aircraft-type polyurethane flat-black paint), \$49.95; and 260L100 cog belt, \$24.95 each. Also available are a complete single-arm mechanical kit with motor, sheet metal, bearings, shafts and cog belts, \$199.95; digital motor controller (required for each arm), \$64.95 each; machined and painted torso sheet-metal kit, \$39.95; 36" support column rod, \$14.95; machined support-column UHMW rotor and bearing kit, \$49.95; and machined and painted 2" X 4" X 16" UHMW shoulder cross-member, \$29.95. Please call for US and Foreign UPS and air mail S/H rates. Complete RONAR kits also available with grippers, manipulators, specialized tractor units, cameras, etc.; call for prices.

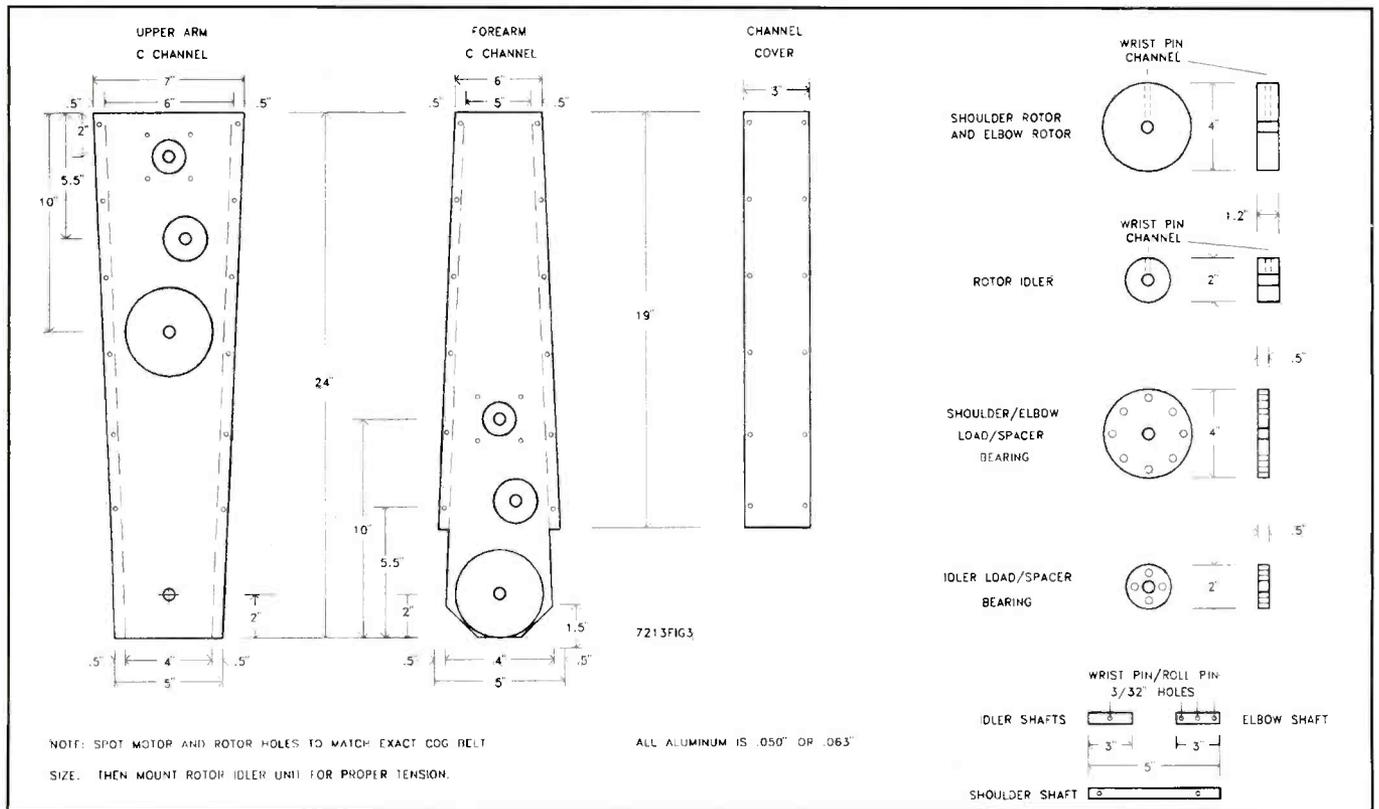


Fig. 3. Machining details for arm unit.

tractor base. If you should then decide to have the robot rotate its torso while carrying the heavy load, the torso will simply slide around on the torso support ring on the UHMW skid plates.

The torso is symmetrical so that either side can be the front or back. This can be a very useful feature because robot doesn't have to turn around or make 180° turns in tight spaces. The arms are able to describe a 6-foot arc or radius and are equally functional in front and behind the torso.

The Arms

Most robot projects do well until it comes to putting on the arms. Arm and hand designs usually require specialized materials and a lot of design work because they're often subjected to high mechanical stresses while performing their tasks. In RONAR, I use a conventional but very functional approach to powering and stabilizing the arms.

While many industrial one-armed robots use hydraulic cylinders or hydraulic motors for power, RONAR uses the same mechanism utilized in the tractor base to accomplish the same purpose. Because the high-torque gear-head motor and cog-belt drive are easy to work with and readily available, you should

have no problems implementing them.

To better understand arm design, refer to Fig. 2 and Fig. 3. The main structural members are fabricated C channels that are configured to form hollow-section I beams (sometimes called H sections). Using aircraft construction techniques, you'll be able to build an extremely strong upper arm and forearm assembly that's feather-light. Pop rivets or truss-head sheet-metal screws secure the channel covers to the C channels and provide easy access to the internal rotor and belt mechanism.

The upper arm channel has the shoulder rotor and bearing located at about the mid-point of the beam. This permits the shoulder-motor mechanism to counterbalance the weight of the forward portion of the arm and keeps the center of gravity for the upper-arm channel in the center. This provides a key lever advantage when your robot is required to lift heavy objects.

As shown in Fig. 2, the shoulder rotor connects via a cog belt to the shoulder motor. The shoulder rotor idler tensions and makes it easy to install and remove the cog belt. Because the shoulder rotor securely attaches to the support column and doesn't rotate, the shoulder motor is forced to rotate itself (and the upper arm)

around the shoulder rotor. The smaller shoulder motor drive rotor (relative to the size of the shoulder rotor) increases the amount of torque available for work.

As RONAR's on-board computer instructs the shoulder motor controller to rotate clockwise or counterclockwise, the arm responds to the amount of voltage or power supplied. Using Hall-effect angular shoulder-position sensors, the arm can be moved to a predetermined position that can be maintained irrespective of the load on the arm.

In a similar fashion, the forearm utilizes the elbow rotor, elbow idler and elbow motor to full advantage. Rather than being counterbalanced, as in the upper arm, the forearm uses a "motor-forward" configuration to minimize the behind-elbow sweep of the forearm's channel member. Because the elbow rotor is directly attached and fixed to the upper arm channel member, it doesn't rotate. Instead, it acts as a pivot point for the forearm's drive assembly.

Internal and external UHMW load-bearings in the upper arm and forearm provide through-channel support and are self-lubricating. The shoulder and elbow rotors attach to their support shafts via Woodruff keys, drilled and tapped set-screws or roll-pins. Likewise, the idler

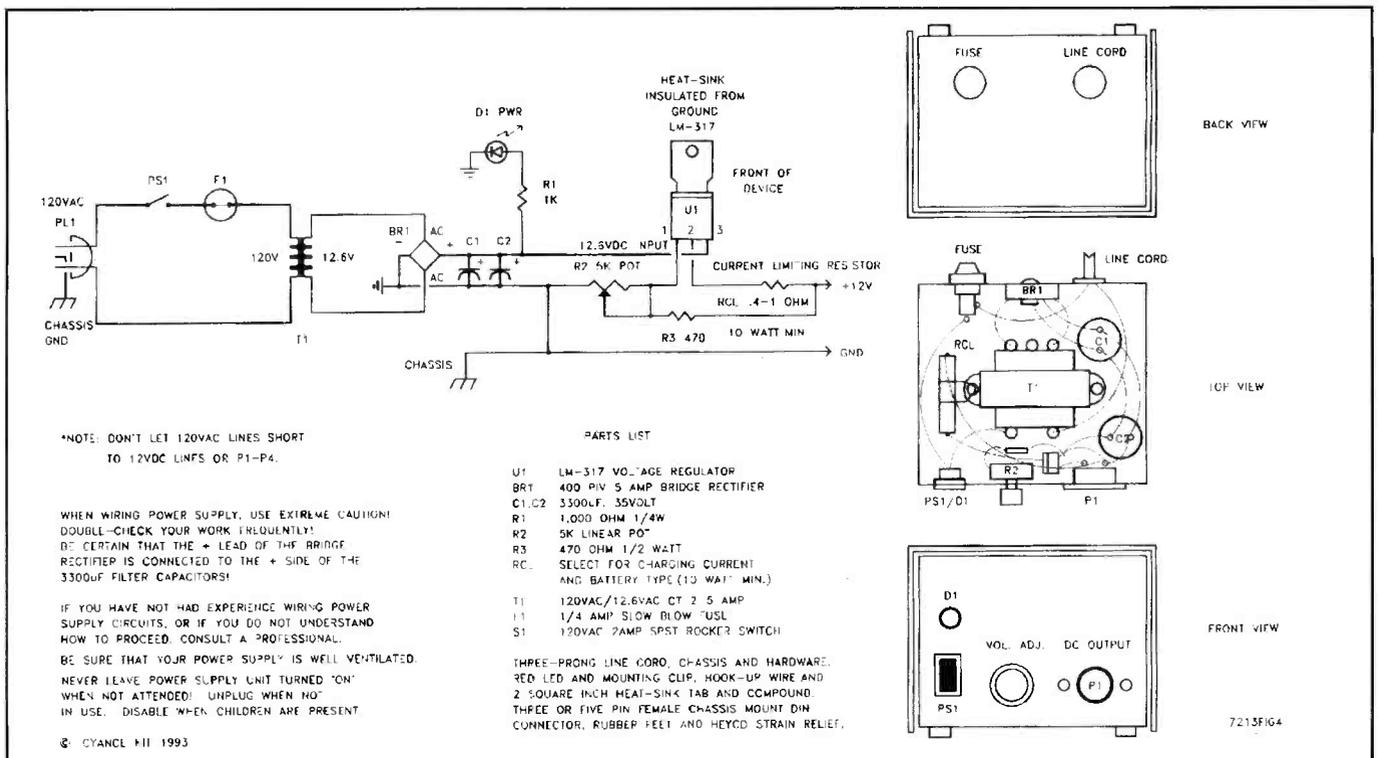


Fig. 4. Schematic diagram and assembly details for charging pod.

and motor drive rotors are keyed or utilize through-shaft setscrews.

The upper arm shoulder motor mounts so that the motor housing faces outward, away from the torso, while the elbow motor is mounted inside the forearm section. This arrangement gives maximum range of arm motion, although it looks rather strange at first glance. If you wish, you can double-up the drive motors with one on the inside and the other on the outside of the C channels to effectively double the strength of the arms.

Battery-Charging Pod

Because RONAR uses battery power, you need a method to automatically recharge its lead-acid gel cell batteries. If you want your robot to be completely self-contained, you may want to build the charging pod into the tractor base. However, if you'd like the more-conventional approach favored by most people, build the charging pod and docking bay for "roll-up" service.

As shown in the schematic diagram in Fig. 4, the charging pod is basically a 5-ampere power supply that has a constant-voltage regulated output. A very basic charging scheme would be to plug the pod's output cable into a DIN connector mounted on the robot's chassis. A more ambitious (and more-practical) ar-

angement would be to charge the batteries automatically by having the robot roll up to the docking bay and plugging itself into spring-loaded contacts on the that assure good electrical contact. Steering diodes in the charging circuit allow battery charging currents to enter through the insulated tractor base contact plates, but it won't let metal objects short out the batteries as RONAR passes over them.

On-Board Computer

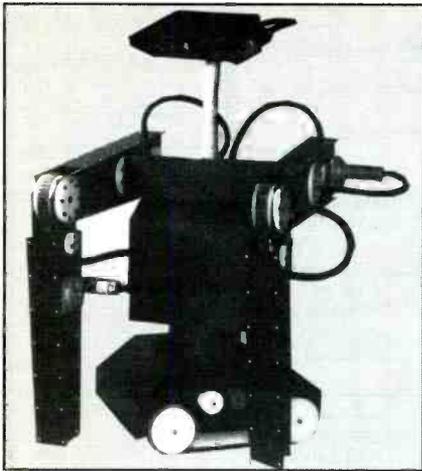
RONAR's OBCS (on-board computer system) is based on the Cyber Link unit detailed in the July 1993 issue of *ComputerCraft*. Because the robot is modular in design, it benefits greatly from the distributed-processing architecture offered by the Cyber Link system. By dedicating a Cyber Link controller specifically to the two tractor controller cards for track control, a separate Cyber Link controller card can be used to supervise the torso motor controller for controlling waist motion. A third Cyber Link can be used to manage the four controllers for arm action. Thus, you can form a LCN (local controller network). Later, a fourth Cyber Link processor can be added to the head unit for sensor motion control and sensor data pre-processing.

Using the foregoing arrangement, you

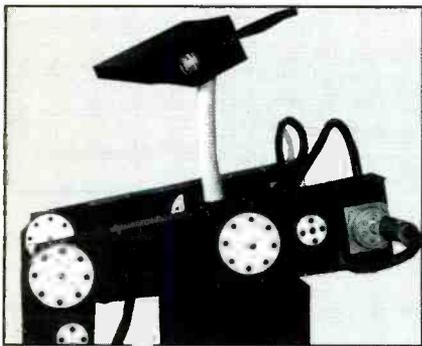
can free our host computer of virtually all low-level control tasks. Furthermore, it's easy to interface the four Cyber Link controllers with your host computer using a single RS-232C port. By using the Cyber Links as motion interpreters, you can issue relatively simple motion commands through the Cyber Links to the motor controller cards themselves. While this may initially seem like controller overkill, it can be a blessing when programming your robot for real-world operation.

As you develop control code for each section of your robot, you can forget about management of low-level tasks and concentrate on your high-level AI (artificial intelligence) applications. I keep the various motion-control processes distinct and separate at software, firmware and hardware levels, with only a loosely-coupled command and data structure linking and coordinating RONAR's motion-related activities.

If you're experienced in programming motion-control devices, you'll probably agree that trying to do everything with one processor or controller concurrently can quickly become a real-time nightmare, particularly when interactive bugs show up in the code. By using distributed management, you can later simplify the task of re-configuring the Cyber



Robot shown with torso rotated about 45° left on its tractor unit.



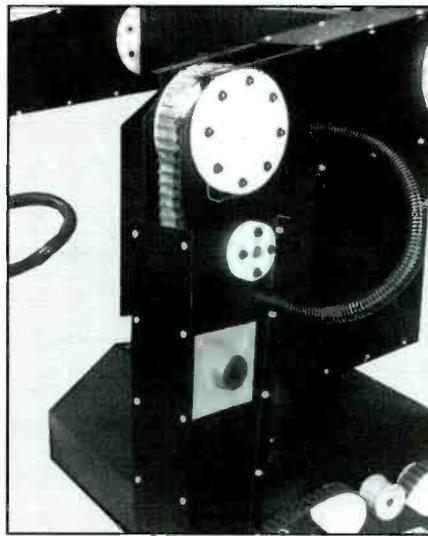
Mechanical details of shoulder and elbow mechanism.

Links and motor controllers as your robot is customized and modified to accommodate your own mechanical improvements. As you add grippers, rotator cuffs, shoulder hinges, etc., you can simply plug another Cyber Link into the LAN and add code to your host program. If the RS-232C link begins to add latency to your system, simply move over to the Cyber Link's SPI (serial peripheral interface) port and transfer data to and from the host across the LAN at 500K baud.

One additional benefit associated with the Cyber Link System is the economy of scale that begins to work for you. Constructing multiple Cyber Link controllers is inexpensive and easy to do, particularly when you're using the Cyber HC5 Development System detailed in the June 1992 issue of *ComputerCraft*. Because you're using the exact same processor in each Cyber Link and motor controller card, programming is a snap.

Construction

Begin construction with the charging pod by fabricating the pod chassis ac-



This detail shows how forearm cog belt routes to motor.

cording to the details given in Fig. 4. If you don't have the wherewithal to fabricate the chassis, you can obtain a pre-fabricated and painted unit in kit form from the source given in the Note at the end of the Parts List. If you do decide to fabricate your own elements and sheet-metal work is new to you, take your time as you learn this new skill. Always work safely around metal because you can easily cut yourself on sharp edges. Wear work gloves and *always* wear safety glasses or a mask.

When using a hand drill or drill press, work up in drill bit sizes as you slowly enlarge the chassis holes to their final dimensions. Finish your metal work with a thorough cleaning with acetone or MEK solvent. Use a good aluminum primer before painting on a coat of good-quality flat-black paint. Zinc-chromate primer, generally available at your local hardware or paint store, will help prevent flaking and chipping of the final paint coat. Be sure to paint in a well-ventilated area away from open flames or sparks that might ignite the over-spray. Also, be sure to use a suitable dust mask or respirator.

When you're ready for assembly, refer to Fig. 4 to wire the circuit. Because you'll be working with ac power-line voltages *exercise extreme care* to avoid creating a shock hazard for yourself and others. Keep soldered connections well-separated from each other and double-check everything before powering up your charging pod for the first time.

Use a fast-blow fuse in your charging pod, and apply plenty of heat-sink com-

pound on the LM317 voltage regulator. When you're finished wiring the power supply and are satisfied that everything is in working order, plug in the line cord and switch on power while monitoring the output of the charger with a dc voltmeter or a multimeter set to the dc-volts function. If everything is okay, your meter should register a constant 13.6 volts dc, which will be optimum for most 12-volt gel cells. If you fail to obtain an output voltage or if you measure too high a voltage, power down, unplug the line cord and correct the problem before proceeding.

Keep an eye on the charging pod and batteries during charging. Watch for overheating in the charging pod and batteries. If this should occur, it might be an indication of a problem with the circuit. Charge the batteries only while you're around to keep an eye on things.

If you plan to build the docking bay, simply follow the diagram and photos. If you feel the need to modify it for your particular application, be sure that nothing can fall across the charging contacts and short-circuit the pod. In fact, a sliding cover would be a good addition to the design.

Referring to Fig 3, fabricate the arm C channels. Again, a kit of finished materials is available from the source given in the Note at the end of the Parts List. If you're rolling your own, carefully follow the dimensions given in Fig. 2 and Fig. 3, and use the photos as a guide while you work. Exercise good work habits, double-check your work frequently and go slowly. Simple measurement errors can be costly when working with aluminum and, especially, UHMW.

After fabricating the C channels, clean, prime and paint them with flat back spray paint. When the paint has dried, test-fit the channel covers against the C channels to make sure they fit and that channel-to-channel through-holes line up properly.

The UHMW round-stock material you'll be using requires a special type of saw to cut it. A band saw, circular saw or hacksaw doesn't work very well because the UHMW material tries to lubricate itself as it's being cut. This will gum-up your saw blade, melt the UHMW material and stall your saw. In fact, cutting UHMW can be quite dangerous if you aren't extremely careful. Thus, I recommend that you have your UHMW supplier pre-cut the various

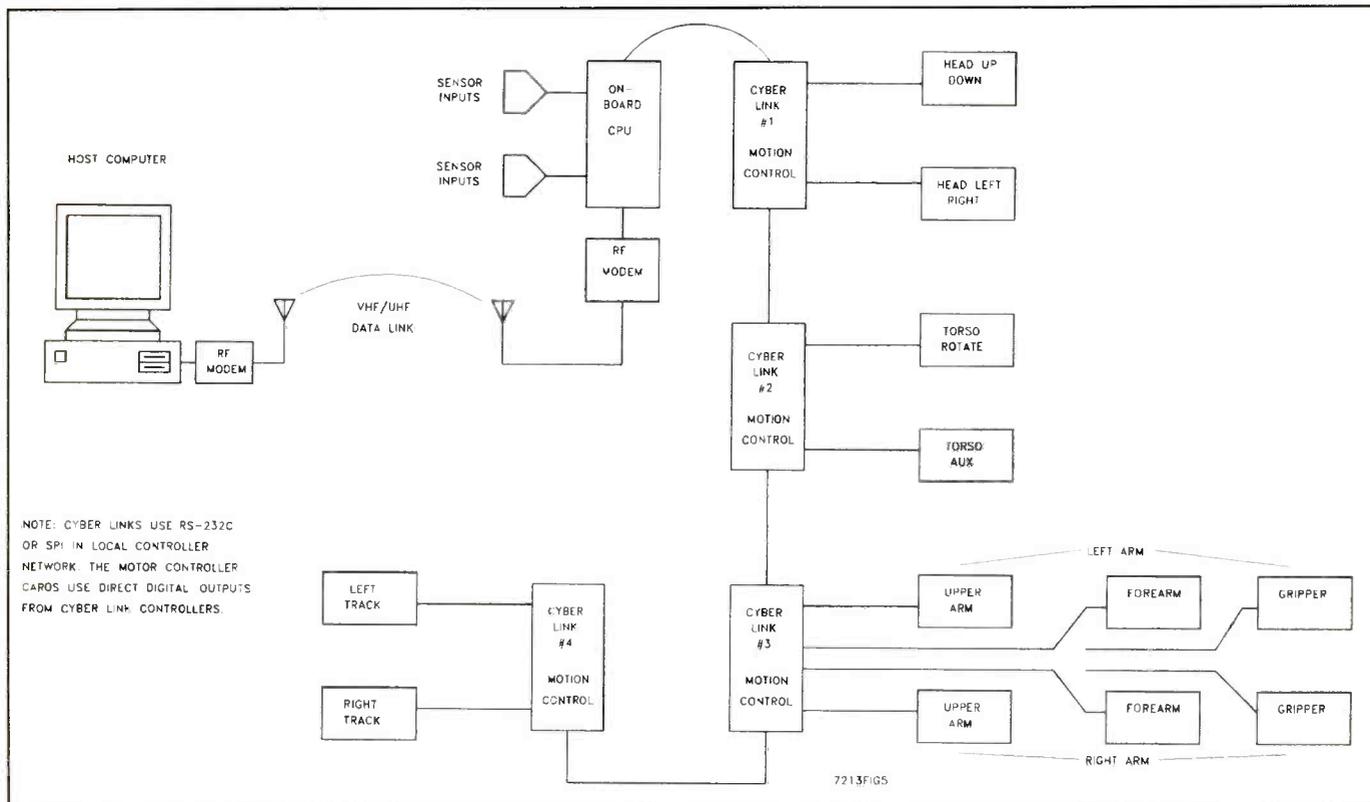


Fig. 5. Block diagram of overall system and how its on-board computer receives programming instructions from host computer and controls the various elements that make up the robot.

discs you need or obtain precut and drilled discs from the source given in the Note at the end of the Parts List.

With the shoulder and elbow rotors cut and bored for the 1/2" shafts, you must broach the rotors for a Woodruff key or drill wrist-pin channels that will secure the rotors directly to the shafts.

The spacer and load-bearing discs must be countersunk to accommodate the Allen-head machine screws that mount them on the C channels. When all of the components have been machined and test-fitted, refer back to Fig. 2 and begin installing the parts. You might want to mount the shoulder rotor and shoulder motor first, followed by the motor rotor sprocket and the cog belt. Finally, tension the cog belt by installing the shoulder rotor idler.

If you plan to mount the shoulder-motor controller card inside the upper arm member, you should do so as you secure the channel covers with No. 4 X 3/8" truss-head Phillips-type sheet-metal screws or pop rivets. Pop rivets look great, but if you have to get inside the arm, you'll have to drill them out to do so. Therefore, it's preferable to use the No. 4 screws here.

Make the forearm in a similar fashion,

and attach it as detailed in Fig. 2 and the photos. Install the elbow motor controller card before the final C channel assembly, or mount the controller card inside the torso chassis. Test your arm unit by connecting a 12-volt battery to the motors. Run the shoulder motor one way, and then reverse polarity to check operation in the opposite direction.

RONAR's arms shouldn't need to be lubricated very often, if at all. The UHMW is self-lubricating and very slick when compressed against itself or the aluminum chassis. Even so, a small amount of lithium grease or silicone spray will help reduce sliding friction in the rotor bearings even more.

Use the same fabrication techniques to build the torso chassis as you used for the charging pod and arm units. After shearing the torso chassis front and back panels, carefully bend the angle along the top edge of the chassis. Shear and punch or drill the torso side plates and test everything before cleaning and painting. When you're satisfied that the torso unit is okay, begin assembling the support column and torso motor bracket.

Cut the various thrust bearings, spacer bearings and stationary rotors for the

round UHMW stock. Bore the 1/2" hole for the CRS or drill-rod support shaft. Drill and tap the various bearing wrist-pin holes or broach the rotors for Woodruff keys. When you're ready to begin assembling the support column, apply some good-quality epoxy cement to the lower 6" of the 1/2" support shaft and carefully drive the shaft into position in the base column UHMW material. Use a small block of wood to prevent rounding the top of the 1/2" rod as you hammer. You probably don't need to wait for the epoxy to cure because the rod will be very snug in the base column at this point.

Next, stack the thrust bearings, spacer bearings and stationary rotors on the support rod and attach the torso, as indicated. Don't forget the overload ring under the torso unit. Install the torso motor bracket, torso motor, cog belt and torso motor controller card. Then test the torso chassis with the 12-volt battery. Exercise care when testing the torso motor because the torso rotates with great force and could twist or cut your hand or arm inside the unit. To be on the safe side, test the torso at a distance, using a couple of 36" or 48" motor wires.

You may want to add several Hall-

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effect sensors and magnets to the various joints around the unit for position feedback to the individual motor controller or Cyber Link controller cards. The advantage of RONAR's design is in its simplicity and easy-access construction. You'll probably want to test mount the arms on the torso and test-drive the entire unit for a few days. Take some time to experiment with the robot to get a feel for its dynamics before you begin programming the control firmware.

To mount the arms, hammer the 1/2" shoulder support rod through the shoulder support column bearings, using a piece of wood to cushion the blows and protect the end of the shaft. Then slide the upper arms onto the shoulder support rod and secure with either a Woodruff key or wrist pin.

You'll probably want to install the Cyber Link controllers and several long RS-232C cables. Although kind of "clunky," this arrangement will let you attach the robot to your host Computer's serial port for programming and analysis. Using the Cyber HC5 as a development system, start with the tractor control program and work your way up RONAR, adding functions as you go.

Your initial efforts at operating RO-

NAR may leave you disappointed. Movements will be spastic. But don't be discouraged with your first software driver-routines. With practice, you'll soon have RONAR operating with almost the same effortless, subconscious and smooth range of motion you take for granted in our own body. It's important that you take your time and work safely. Keep yourself and other people, pets, furniture and appliances at a safe distance when first testing the various control routines because the robot is quite strong and could easily inflict injury and/or damage. At first, and until you become familiar and comfortable with your control routines, run everything in slow motion.



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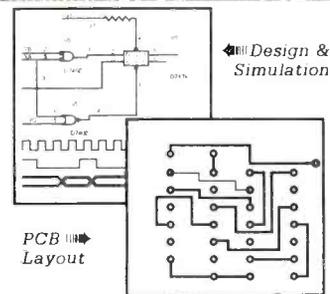
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Multitasking Blues

Multitasking is undoubtedly one of *Windows*' biggest attractions. Yet the product also fails to deal with a major drawback to multitasking on a personal computer: the need to open files, save data, close files and perform various other housekeeping tasks for every application every time the you start your machine. For all its benefits, multitasking would be far more useful if *Windows* could save you the time required to perform these functions. It's a dilemma for which *Windows* simply doesn't offer a good solution.

The problem stems from the genesis of multitasking on mainframes. Mainframes have system operators to deal with restarts. Personal computers don't. PC users must do for themselves. So, they require more than an analog of mainframe multitasking. They need an operating system that automatically takes care of complex housekeeping issues for the end user.

PC Tools for Windows

PC Tools has a partial answer for the multitasking dilemma. Its MultiDesk replacement for the *Windows* Program Manager has multiple (virtual) desktops that let you organize applications, together with their related files. Whenever you start *Windows*, the applications and files are put back on the desktop exactly where and as they were. All related components are a click away. The only thing that's lacking is the ability to care for data that's in memory.

If you're running short of system resources, MultiDesk also has a side benefit for you. As I described several columns back, the number of icons *Windows* can display on the desktop at any one time is limited, because *Windows* maintains their bitmaps in memory. Thus, an open group in the Program Manager can create a drain on available memory if it contains many icons.

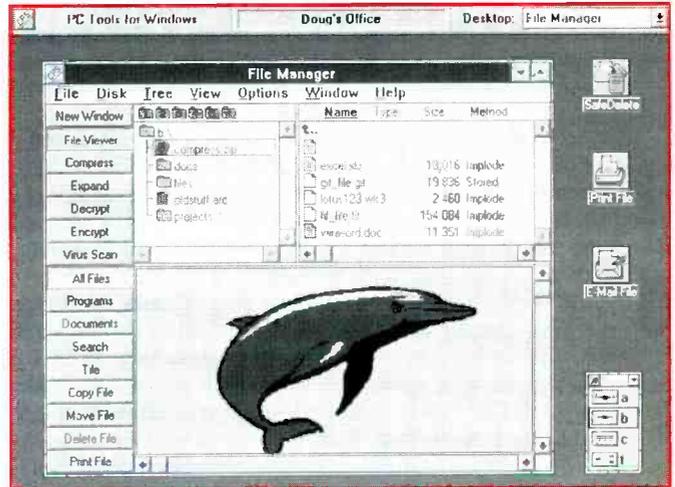
MultiDesk can eliminate this drain. It stores icon bitmaps on your hard disk, not in memory. It stores only pointers to the bitmaps in memory. Furthermore, the bitmaps are cached for nearly instant recall, and given the time it typically takes to refresh the screen, you're not likely to notice any delay.

Of course, MultiDesk is only one of many tools in this program. For example, *PC Tools* also has an Undelete command that works within *Windows*, as well as another tool that Central Point claims is the first disk optimizer to work from within *Windows*. *PC Tools* can actually be broken down into three sets of utilities. MultiDesk, for example, is part of a productivity set that also includes a File Manager replacement.

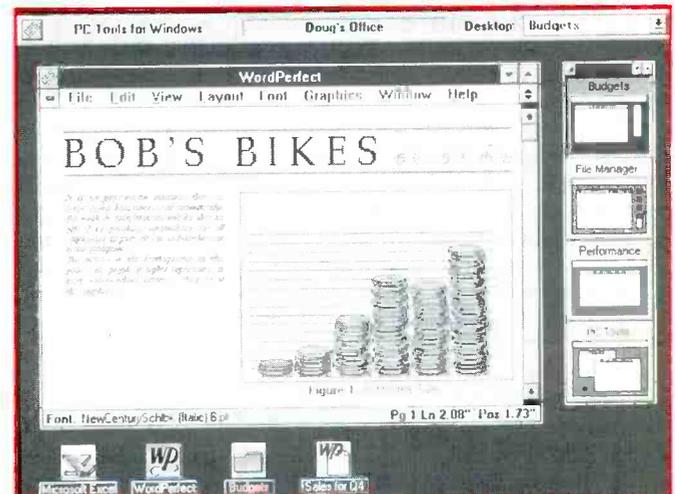
The Central Point File Manager also offers a number of tools that can help you get back on track when you restart. First of all, it lets you customize the *Windows* interface according to your personal preferences. You can make applications look like they do on a Mac, for instance, or put them into an easy-to-access toolbar. You can even present them in a menu. This can certainly make it easier to get at any application that's not organized by MultiDesk. The CP File Manager's SmartFind tool can also help you get back to your data. It lets you search for text within files, or you can target searches with wildcards, attributes or creation dates. And File Manager includes file viewers with 80 formats that cover most major database, spreadsheet, graphic and word-processing products. It also performs directory synchronization.

Another tool set consists of performance tools. They include ScriptTools and the System Consultant. The ScripTools macro sys-

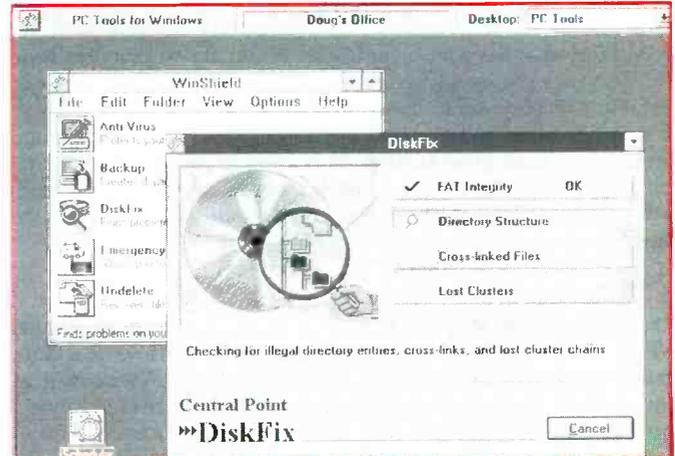
PC Tools' (A) File Manager (B) Desktop and (C) DiskFix screens. ➔



A



B



C

tem could be used to launch your applications, and open their files. Furthermore, it's design converts mouse pixel locations into *Windows* commands. So it doesn't tend to break down when windows aren't in the same place on playback.

Not all of the tools in this product address the housekeeping issues presented by a multitasking environment. As long as I'm into *PC Tools* this far, though, they bear mentioning.

System Consultant tool provides some 400 reports on the current configuration of your hardware and has it's own database of recommendations for tuning up your system. For example, it may suggest that you turn on or off a system variable in one of your .INI files, change your CONFIG.SYS or AUTOEXEC.BAT file, or even change your video adapter or other hardware. It might suggest turning off your wallpaper to save system resources.

The last tool set is the protection set. This includes the entire Central Point Backup and Central Point AntiVirus products which when purchased alone list for \$129 each. Backup works with floppy diskettes, but it also supports SCSI and QIC-40 and QIC-80 tape drives. (In fact, Iomega bundles it with its Model Tape 250 portable QIC-80 drive.)

Like the *Norton Utilities*, this product also includes DiskFix, a tool like Disk Doctor. However, DiskFix is able to work under *Windows* while doing repairs. I was curious about how *PC Tools* recovered deleted files, optimized disks and repaired them under *Windows*. Tools like DiskFix and Undelete aren't ordinarily able to work within the multitasking *Windows* environment because they conflict with other tasks writing to the disk. *Windows*, not the utility, is usually in charge. *PC Tools* uses a virtual device driver (VxD) running in protected mode to overcome this limitation. The VxD monitors *Windows* to prevent it from writing while repair or restoration is underway. If another application requires a write, DiskFix and the other disk tools suspend repair until the other program's write is finished.

PC Tools also includes the utilities you need to create a rescue diskette. An Emergency Disk boot disk lets you copy all critical device drivers, FAT, CMOS and the disk-partition information to a bootable diskette. You can use this diskette to get your system restarted after a catastrophic CMOS-battery death. A Fix-It disk includes DOS versions of utilities that can be used to repair problems if you can't run *Windows*. It includes an Unformat that keeps continuous track of the directory and FAT structures in a Mirror file.

Intra-Active Computing

Johnathan Seybold's Digital World, held each summer in Beverly Hills, has become my favorite technology conference. It hasn't had a large exhibition hall, but the conferences have been right at the edge of digital technology: interactive television, electronic publishing, personal digital communicators, etc. And it's the place where these technologies are coming together in new product and service ventures.

Most of what has gone on at Digital World in past years has been far ahead of existing markets. There haven't been many products to exhibit. However, some started to appear this year. Early looks at Apple's Newton and the first implementation of 3D technology were among them. And a couple of the titles shown during a session on electronic publishing were also shipping—and quite interesting. (This incipient market growth may be why the show moves to the new Los Angeles Convention Center next year.)

Build Your Dream Deck

One of the of the electronic book titles I liked was from Books that Work. *Design & Build Your Deck: A Book That Works* is a disk-based interactive design tool, guide and reference. Think of it as instructional CAD for the design-challenged. It requires absolutely no drawing or engineering skills. You don't need construction experience either, only the ability to follow instructions and use tools. Anyone who meets those minimum requirements can use this prod-

uct to design and build a deck. I wonder if that's how they came up with the name for it.

There's no question that *Design & Build Your Deck* is worth the money for anyone planning to build a deck. For example, it allows you to change the size and shape of your deck, and then it designs a sound underlying support structure based on your design. You can choose materials, add stairs, indicate sliding doors to an adjoining structure, etc. Since the program enforces national building codes, you can't go wrong. There are also suggestions on how to hire a contractor and sample contracts for you to use.

Design & Build has features that an experienced structural engineer will find useful, too. It prepares a complete materials list from your design. Give it prices, and it will give you the total cost for those materials. It's great for what-ifs, too. You can see your finished project from every view, including perspective, and change it with graphical click-and-drag ease.

For the novice builder, the program also provides descriptions of parts and explanations of how they're used. There are pictures of sample decks, and basic carpentry techniques are covered.

Instructions take the guesswork out of tasks like laying a foundation and attaching a ledger board to your house. You're taught the correct way to mix concrete in a wheelbarrow, for instance. The program shows you what lag screws are, and how to use them. There are also tips from the pros, such as how to install carriage bolts in wet wood.

If your computer has a *Windows*-compatible sound board like the Microsoft Sound System, you can also listen to the instructions in *Design & Build*. The authors even include some aural humor: They play military marching sounds as they show you the consequences of a termite attack.

Naturally, *Design & Build* gives you the techniques to avoid such infestations. It also uses animation to explore such design issues as the influence of sun and seasons, foliage, etc., on your design. So, you can take into account the structure of your yard and virtually every other factor imaginable. You're almost guaranteed a design will serve you all year long, year after year.

Attention to nearly every imaginable detail makes this a clever interactive product. As a final touch, the authors provide a thoughtful uninstall routine that yanks *Design & Build* back out of *Windows* and off your computer when you're done. They know most of us won't need it once our projects are complete. There's just one fly in the hand cleaner: an inept customer-support system. If you have trouble reaching them through the number we provide with this column, try contacting Broderbund, the company that oversees distribution of *Design & Build*.

Build Your Own World

Build Your Deck is cool, but Philips POV Entertainment Group showed a far more-intense title at this same electronic-publishing session. At the top of my list is the company's new CD-I title called *Voyeur*. It's one of the first entries in an emerging category of interactive drama. Although it's categorized as a game, it's really an interactive movie for my money. And even though it runs on the CD-I player, not *Windows*, you'll want to know about it. *Voyeur* is strictly state-of-the-art, and it will give you an idea of what to expect as similar titles become available for *Windows*. If you're a developer, you'll want to know the standards to which your products will be held.

Let's face it, given the size and growth of the market, everything is going to be available for *Windows* sooner or later. But *Voyeur* isn't just another interface in the crowd. Due in October, it bears more similarities to Hitchcock's *Rear Window* movie than to most games. David Riordan, *Voyeur*'s designer and a senior producer-creative director with POV, describes the category as "story and character driven rather than arcade driven." That's a good description. *Voyeur* is a much deeper and richer and more thought-provoking experience than a computer-based car chase or shoot-'em-up.



In VOYEUR, actors are filmed against a blue screen, as in the upper photo. During playback, they're composited with virtual sets (lower photo), in real time.

This is a live-action murder-mystery starring Robert Culp and Grace Zabriski in which viewer decisions determine which of many concurrent scenes are viewed and recorded. According to Riordan, "Voyeur allows the player to become a character in the story and to direct it in ways they want it to go." Indeed, at one level of participation, the player risks becoming a victim—much as the James Stewart character did in Hitchcock's film. What's more, time progresses as you interact with it. So, when you choose to view a particular scene, you miss the opportunity to view others that are occurring elsewhere at the same moment. It's different every time you play it.

Here's how it works. The scenes you select to view are recorded on a virtual VCR. In effect, you create a film. You have the choice of passively watching the film or using it to become a participant in the drama. As a participant, you expose yourself to risks. You can, for example, send a scene from your tape to the police. If the evidence is strong enough, it can lead to the murderer's prosecution. If not, you're humiliated by a snotty cop. You can alternatively send a copy of the tape to whomever you suspect is the intended victim. However, the intended victim changes randomly among four characters each time *Voyeur* starts. If you send your tape to the wrong character, he or she forwards it to the murderer. The murderer then has his hit-person pay you a visit to clean up loose ends. End of story. Philips POV estimates that you'll be able to experience

approximately 40 hours of play before your interest is exhausted.

Voyeur is more than an alternative to shoot-em-up arcade games. The unmodified Philips player can't display full-screen full-motion video without the forthcoming full-motion-cartridge for CD-I (which was only announced at Spring CES and isn't scheduled to ship until this fall). To create the illusion of an entire screen of full-motion, without relying on the cart, *Voyeur's* creative team (principally, Riordan, director Robert Weaver, writers Lena Pousette and Jay Richardson, lead programmer Michael Berro and artists Courtney Lane and Les Doughty) developed an unconventional methodology. They filmed actors against a blue-screen and composited them with virtual sets, in real time, during playback. By limiting movement to the actors, and limiting the actors to no more than 30% of the total image, a full screen requires no more bandwidth than the convention of limiting video within a small window.

Virtual sets can be created with a program like Autodesk's *AutoCAD* and rendered to look very much like a real set. In fact, since they're in the background, the surrealistic look of the modeling doesn't detract from enjoyment of the production. Although this method will no longer be required by the Philips player, virtual sets have other benefits that promise to outlive introduction of the forthcoming cartridge. Certainly, they can reduce construction costs. While their ability to do so is dependent on the relative complexity of set types and required programming efforts, they can also reduce costs in other ways. For example, they free principal players from shooting on sets and from coordination with background action and extras. This ability to change a set in post-production actually allowed Riordan to improve a scene, as suggested by Culp, during filming. The set was later changed by adding other models to it in post-production. Virtual sets could even be used to let a player interactively modify environments.

The opportunity to create products like *Voyeur* may soon be as open as the emerging market for them. Although the software that composed final scenes is proprietary, *Voyeur's* virtual sets were created on standard PCs using commercially available Autodesk *3-D Studio* software. Philips knows that the secret to expanding its player base from the current 100,000 units is availability of titles. Titles now number only about 100, and a mere handful have interactive drama's appeal to audiences that want more than a pure adrenaline rush. "Philips wants to encourage as many people as possible to develop CD-I titles," Riordan says, and he hints that a developer's kit offering the tools needed to composite virtual sets with separate character action is now under consideration.

If you're not a developer, you aren't willing to wait for someone else to write the *Windows* version, and you plan to give or get a CD-I player during the holidays this year, you might want to buy *Voyeur* for yourself or as a gift. It's one of the few pastimes I've seen that would make me want to go out and buy a player just to use it.

WalkThrough

If you think you might be interested in developing titles like *Voyeur* with or without the POV kit, take a look at *WalkThrough*. It's an interactive, object-oriented 3D modeling program that lets you move around and through the structures and spaces you design. You merely draw objects in a 2D window, using the same click-and-drag conventions of familiar such drawing programs as Adobe *Illustrator* or *CoreDRAW*. *WalkThrough* creates a 3D analog in an adjacent window. You can then navigate in the 3D view with a mouse or other pointer, looking at objects from different angles and moving around inside them.

WalkThrough is already being used in Hollywood to create digital storyboards that let directors precisely plan every scene in major motion pictures. For the hit film *The Firm*, director Sydney Pollack used it to make creative and production decisions about lighting, camera angles, movement, space design and other issues, including the floor plans of the movie's Memphis law firm. "It gives me an

enormous advantage to get a feeling of movement and a visual perspective before going onto a set to shoot," Pollack says. "With *WalkThrough*, I can use my computer to easily assign any focal length I want for the camera. I can put people where I want them to be. I can preview and record angles and shots. By trying the mechanics of the set before it's built, I can go back to the production designer and say, 'I need an L-shape in there.' Obviously, if I can do that before the set is built, I save money."

Computer technology-consultant Frank Dutro introduced Pollack to *WalkThrough* with the intention of saving not only money, but energy, time and headaches. "With *WalkThrough*, you get the opportunity to work out scenes ahead of time instead of making your decisions while the meter is running, with the cast and crew standing around waiting for each shot," he says. "And if you make a mistake or don't like what you've done, changing the shot on the computer is a lot less expensive than re-shooting."

One of the most impressive things about *WalkThrough* is that it's easy enough for Pollack himself to use it on a laptop computer. Other directors who are using it include John Badham and Brian DePalma, who used it to storyboard *Raising Cain*. These are among the most luminous film makers in Startown, and others are certain to follow. *WalkThrough* is an extremely practical way to contain production costs for movies and commercials.

There's no reason I can see why *WalkThrough* can't also be used to create the backgrounds for an interactive title like *Voyeur*. If POV can put characters into sets created with *3-D Studio*, you should be able to adapt the kit, or build an alternative to it, to integrate your characters with sets created in *WalkThrough*. But you don't have to because *WalkThrough* exports directly to *3-D Studio*. You can also import images into *WalkThrough* from other programs. The only limitation in the product, a lack of fills and tex-

tures, will be addressed in a new Pro version that's due out, for the Mac, before you read this. A Pro version for *Windows* is expected very early next year.

Storyboarding is making *WalkThrough* a hotter Hollywood item than the August sunshine. Nevertheless, its impact on film making doesn't place any limits on how you choose to use it. There are applications in almost any area of design. It's perfect for interior remodeling, factory floor layout, trade-show booth planning, theater-set design, product-display designs and animated presentations. It has application as a means of visually presenting the layout of locations, sequences of events or other exhibits in complicated criminal or civil cases. You could even use it to take a walk on your new deck design.

Regrets

I must apologize for missing the last issue. A freak series of hardware problems, and an equally freaky failure to get them solved on the first go-around of technical support, just took too many days out of that month. Unless you've been through it, you'd be amazed how much time you can waste customizing a new system, transferring files to it from backup, making sure files you delete are the right versions (dates aren't always the most reliable indicator) and, finally, going through the whole thing a second time when your repaired system returns from the river Styx.

In this case, I went through it once for my primary system, a second time when the backup system crashed, then third and fourth times when it all had to be repaired again. Backup software would have made this all a lot easier, but my writing machines are laptops and, so far, I haven't found a single tape, Bernoulli or Syquest drive that will work with my primary machine's parallel port. It even failed with Iomega's Tape 250, the most-compatible of the many drives I've tested.

I test a lot of portable computers, and this isn't an uncommon problem. (It does seem to me that, if they can print with these ports, they should be able to write a reliable driver for them.) In an upcoming column, I'll tell you about a couple of the new portable parallel-port tape drives I've tried. They work with almost any machine, except my favorite laptop.

You'll also learn about another component to the multitasking solution: several utilities that actually do suspend everything in your computer, including the contents of memory, and restore it all when you restart the machine. Combining one of these programs with MultiDesk can provide a complete solution for the *Windows* multitasking dilemma. ■

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Multi-function Data Acquisition IC, Triple-Output Power Controller, New Sample/Holds, 3.3-Volt Synchronous DRAMs, Pentium Cache Controllers, and Software-Driven T1 Framer

Building a new multimeter? Check out the new Teledyne chip described below. You may want to incorporate it into your design.

Multi-Function Data-Acquisition IC

Teledyne Components' (1300 Terra Bella Ave., PO Box 7267, Mountain View, CA 94039) new TC831 multiple-function data-acquisition IC combines an analog-to-digital converter (ADC) with an autoranging frequency counter, enabling users to easily design high-precision multi-mode measuring instruments. The TC831 (see block diagram in Fig. 1) provides 3¾ digits (+3,999 counts) of resolution, making it suitable for measuring temperature and monitoring ac line-voltage and for use in general-purpose test equipment. A dual-slope integrating conversion technique eliminates common-mode noise and provides stable readings. Analog voltages of both positive and negative polarity can be measured with guaranteed only one count of rollover error. Input bias current of only 10 pA simplifies interfacing to a variety of sensors.

A unique feature of the TC831's ADC is a "greater than" output. This output gives a pulse each time the latest reading is greater than the previous reading.

An on-board frequency counter automatically selects the appropriate range from 4 kHz to 4 MHz. Higher frequencies can be measured by adding an external prescaler. Minimum resolution in the 4-kHz range is specified at 1 Hz.

Data output is in multiplexed binary coded decimal (BCD) format, which is compatible with a wide variety of drivers for LCD, LED, vacuum fluorescent (VF) and incandescent displays. Interfacing to micro processors is also easy, even for four-bit microcontrollers.

Other features of the new IC include a HOLD pin to "freeze" the display. A PEAK HOLD feature holds the highest reading, which is useful for measuring maximum temperature or voltage, capturing motor starting current, etc. Underrange and over-range outputs simplify the design of autoranging instruments, while an on-chip piezoelectric buzzer driver can be used to flag out-of-range measurements.

The TC831 includes an on-chip dc-to-dc converter that permits operation from a single +5-volt power supply. The converter

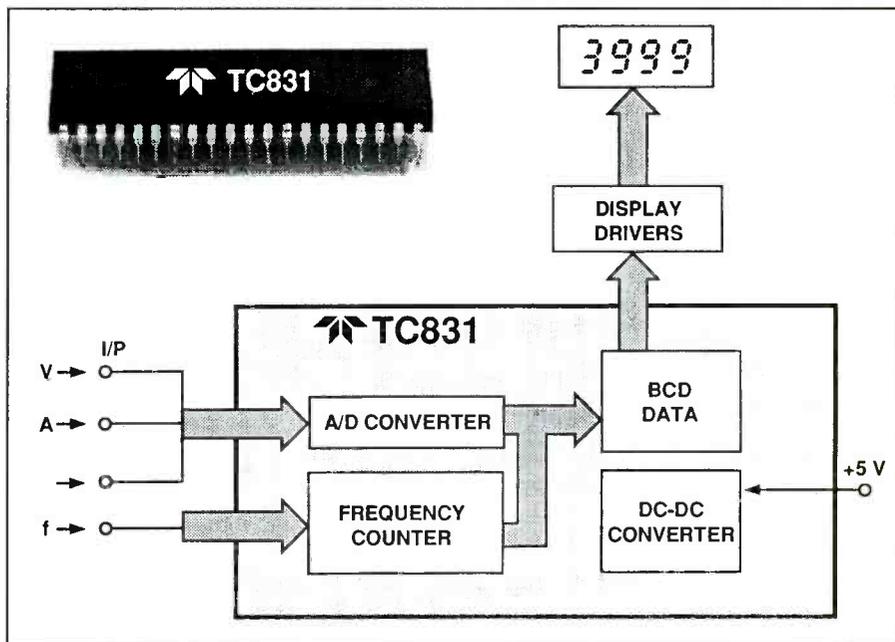


Fig. 1. Block diagram of Teledyne's TC831 3¾-digit ADC with frequency autoranging chip.

has a power supply current of only 2 mA, even with the on-board dc-to-dc converter.

Available in a 40-pin plastic DIP and 44-pin PLCC or 44-pin quad flat pack packages, the TC831 is priced at \$5.40 in 40-pin plastic DIP at 100-piece quantities.

Triple-Output Controller

Maxim Integrated Products' (120 San Gabriel Dr., Sunnyvale, CA 94086) MAX782 power-supply controller is a systems-engineered device that provides regulated supply voltages for notebook computers and other battery-powered equipment. It includes dual PCMCIA (V_{pp}) outputs, and step-down regulators for 3.3 and 5 volts (see block diagram in Fig. 2). Three precision comparators perform low-battery detection, and two low-dropout micro-power linear regulators act as backup supplies for CMOS RAM and real-time clocks.

Efficiency for the main 3.3/5-volt supplies is as high as 95% for 2-ampere loads and greater than 80% for loads from 3 mA to 3 amperes. Patented Idle-Mode operation governs the regulation at light loads. At heavier loads, operation automatically shifts to synchronous rectification and pulse-width modulation (PWM). High operating

frequency (200 kHz or 300 kHz) permits use of physically small external components, and the current-mode PWM architecture permits filter-capacitor values as small as 30 F per ampere of load.

The MAX782 has fast ac response, thanks to a high (60-kHz) unity-gain crossover frequency that enables recovery from line and load transients within four to five clock cycles. High-level integration and low-cost external n-channel MOSFETs lower system costs. Lowering costs even further is an integral flyback-winding controller that generates the high-side 15-volt output.

Input range is 5.5 to 30 volts, and the quiescent current is 420 µA, dropping to 70 µA in standby mode (when only the linear regulators are active). Other features include low-noise, fixed-frequency PWM operation for moderate to heavy loads and a synchronize-able oscillator for such noise-sensitive applications as communicating computers and electromagnetic pen-based systems.

The MAX782 comes in 36-pin SSOPs and is available for the commercial and extended-industrial temperature ranges. Prices start at \$5.95 for 1,000 and up quantities.

New Sample/Holds

Burr-Brown (P.O. Box 11400, Tucson, AZ 85734) now offers a comprehensive line of popular "5320" precision sample/hold amplifiers. With the introduction of 14-pin PDIP and 16-pin SOIC packages, designers can choose the performance and package options that best fit their high-speed data-acquisition applications. These new monolithic bipolar sample/hold amplifiers are improved second-source replacements for similar "5320" products.

The SHC5320's fast acquisition time is made possible by an input transconductance amplifier that's capable of supplying high charging current to the built-in holding capacitor. A low-leakage analog switch and an output integrating amplifier with optimized bias current limit maximum droop. Output voltage droop can be further improved by adding an external holding capacitor.

The SHC5320 operates from ± 15 -volt supplies. Key SHC5320 specifications include: 1.5 μ s maximum (to 0.01%) acquisition time, 350 ns maximum hold settling time, and 0.5 μ V/ μ s maximum (at 25° C) droop rate.

These SHC5320 sample/holds come in a variety of package options, including: 14-pin ceramic or plastic DIPs, 16-pin SOICs and others. These fast-settling, low-droop rate parts are TTL-compatible and feature full differential inputs and an internal holding capacitor to simplify the design task. Dielectric isolation minimizes stray capacitance, permitting higher speed operation.

The SHC5320 is priced from \$6.70 in quantities of 1,000.

3.3-Volt, 16M SDRAMs

A family of 3.3-volt, 16M synchronous DRAMs (SDRAMs) that support system clock speeds up to 100 MHz has been introduced by NEC Electronics Inc. (475 Ellis St., P.O. Box 7241, Mountain View, CA 94039) They offer a data-transfer rate of up to 800M bits per second in a 64-bit system and are priced comparable to conventional DRAMs.

The μ PD42116x is manufactured using a 0.5-micron CMOS process and operates at speeds of 33, 66 and 100 MHz. The devices output data every 15 ns while operating at 66 MHz and every 10 ns at 100 MHz, compared to 30-ns output times of conventional DRAMs operating in page mode.

Pipelined architecture permits multiple-address processing in a single clock pulse and enables a column address to be sent to the decoder several clock pulses before data appears at the output pins. Two interleaved memory banks, although controlled independently, share common control, address and data lines. As a result, one bank can input or output data while the other

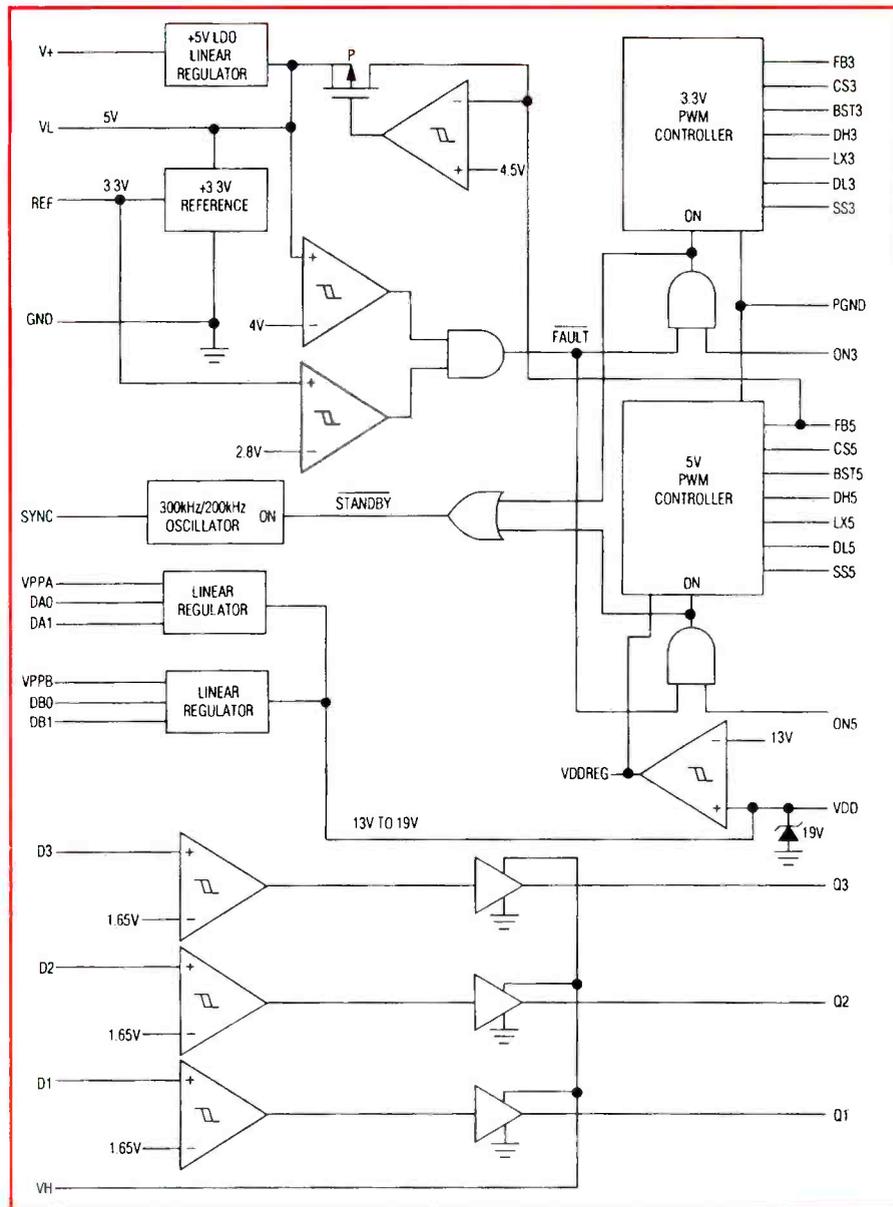


Fig. 2. Block diagram of Maxim's MAX872 triple-output power-supply controller for notebook computers.

bank performs overhead tasks of row access and pre-charge, speeding data output.

A proprietary feature of the NEC design also permits changing addresses within a single row on every cycle for highly flexible random column access.

In addition, the μ PD42116x, acting as Level 2 cache, can supplement on-chip microprocessor cache, eliminating the need for expensive cache SRAMs in such applications as workstations and personal computers.

As opposed to standard memory devices, SDRAMs operate from a system clock. Additional features include automatic pre-charge and user-controlled pre-charge commands, programmable burst length, and CAS before RAS refresh (CBR) and self-

refresh. SDRAMs are also easily interfaced with several logic families including low-voltage TTL (LVTTTL), which meets existing industry standards, and LVTTTL-compatible families with simulations to beyond 100 MHz.

The company plans to offer sample quantities of the 33-MHz device in a 4M x 4 organization for approximately \$180 each, in a 2M x 8 or 1M x 16 organization for approximately \$210 each, and in a 2M x 9 or 1M x 18 organization for approximately \$220 each.

Pentium Cache Controllers

Vitesse Semiconductor Corp.'s (741 Calle Plano, Camarillo, CA 93012) VSP945 and

VSP951 cache controller chip sets are targeted at high-end Pentium processor systems. The VSP945 is a serial cache controller specifically designed for use in uniprocessor systems. Used in conjunction with the VSP946 data path chip, it provides all of the control functions necessary to implement a second-level copy-back cache subsystem of up to 1M. This chip set also offers concurrent CPU and system operation, sophisticated snooping and cacheable memory size of 1G.

This chipset provides bursting reads and writes on both the CPU and system bus. It uses low cost, industry-standard asynchronous SRAMs for tag and data storage, rather than more-costly bursting synchronous SRAMs. The interface between the VSP945/946 and the system is a 33-MHz, 32-bit, 486-like bus with additional signals to support the write-back cache and is aimed at upgrading existing system architectures.

The VSP951 cache controller and the VSP952 data path make up the second chip set in the family. Its features are similar to the VSP945/946 but offer the added benefit of a system interface that emulates either the Pentium microprocessor (33-MHz, 64-bit) or the OverDrive processor for the 486DX2 (33-MHz, 32-bit) and supports pipelined Pentium processor bus cycles. The chipset is aimed at simplifying the design-in process by working with commodity PC chip sets and improving performance through a higher bandwidth 64-bit wide bus.

Both the VSP945 and VSP951 are direct-mapped, bank-interleaved, write-back L2 cache controllers providing 2-1-1-1 bus cycle timing for bursted read and write hits. The VSP951 also supports pipelined reads achieving 1-1-1-1 timing. These chipsets also contain a four-level deep posted write buffer that accepts write misses in three clocks (one wait state), allowing the CPU to continue running while the cache controller initiates a system write cycle and transfers write data to system memory. This write buffer is also used as a "fly-by write-back buffer" to temporarily store the dirty cache line being replaced during a cacheable read miss.

Vitesse has added architectural features to its cache controllers to permit concurrent operation of the CPU/cache subsystem and system bus masters. This is very important in systems that contain multiple bus-master boards like EISA SCSI host adapters because it permits file transfers between main memory, disk and the network to occur simultaneously with CPU processing. A further boost in system bus-master performance is accomplished through a snoop read buffer and snoop filters that load an entire cache line on the first snoop hit, thereby servicing subsequent read hits more efficiently. These features can reduce

snoop overhead by 75%.

The VSP945 and VSP951 are fabricated in the Vitesse 0.6 micron H-GaAs III process. The VSP945/946 and VSP951/952 chipsets are priced at \$150 for 1,000 units or more.

Software-Driven T1 Framer

Dallas Semiconductor's (4401 S. Beltwood Pkwy., Dallas, TX 75244-3292) DS2141 T1 Controller is a software-driven T1 framer that permits end users to update their systems to take advantage of the latest network technology without costly hardware changes. According to Dallas, existing T1 framers are hardware-based, but the DS-2141 lets end users update their systems in software to accommodate evolving standards. For example, the FDL (Facility Data Link) standard used for performance monitoring is now in the process of changing from the older AT&T communications protocol to the newer ANSI protocol. Emerging standards require not only that systems handle both protocols but that they also provide information for SNMP (Simple

Network Management Protocol) systems. The FDL standard will continue to evolve for a number of years. With the DS2141, users can modify their software (with no hardware changes required) to maintain compatibility.

The framer handles the heavy processing load of the 1.5-million bit-per-second data stream. The processor performs lighter supervisory tasks and can modify the framing activity. A system with the DS2141 T1 Controller can be changed with only insignificant loading of that processor.

The DS2141 is adaptable to the Extended SuperFrame (ESF) format as well as D4 and SLC-96. With its clear-channel capability, the device operates on ISDN Primary Rate lines, as Fractional T1 (FT1) lines and in systems containing data from either Switched Multimegabit Data Service (SMDS) or Asynchronous Transfer Mode (ATM) sources.

The DS2141 is available in 40-pin DIP and 44-pin PLCC packages. Pricing at 5,000 pieces is \$13.55 for the DIP and \$14.85 for the PLCC device. Application notes are available on request. ■

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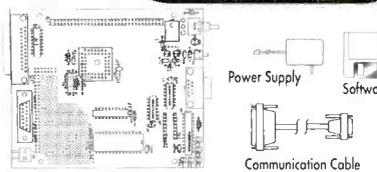
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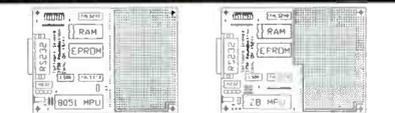
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objects for which there are .GIF pictures so that you can easily find and view these pictures. Some of the deep-space objects for viewing are the Eagle and Lagoon Nebulae and the Sombrero Galaxy. A few of these objects have sound clips that offering interesting bits of information about the object selected.

Enabling narration gives you the option of hearing the sound clips while viewing the associated object. Otherwise, you can play the sound clips anytime you like because they're in standard Microsoft *Windows* .WAV format. All you need is a good sound card in a computer that's MPC-compliant, one that works with Microsoft *Windows*. When you tire of the resident narration, you can provide your own by digitizing a brief description, perhaps using your own voice, and saving it in the proper directory with the correct name format. With work and imagination, you can virtually run your own planetarium show.

Yet another useful feature of *EZCosmos* is its use of more than one kind of projection for viewing the heavens. The differing projection types are Mercator, Polar and Spherical. Each projection has its advantages for particular cases. You can decide which view is best for you, depending on your chosen parameters for watching. No matter what view you select, though, it's easy to navigate around the screen, advance time, locate a specific object and zoom in for closer inspection.

EZCosmos has so many features that, even if you don't like astronomy, the product is almost certain to draw your interest. It can help you find planetary conjunctions and replay them. It lets you see and experiment with eclipses, lunar phases, solar system planets and Jovian moons. It outputs controlling information to a telescope if you have the proper hardware. This is an astronomy package than no PC star-gazer should be without!

Meditating Home Repair

Do it yourself and save! This is a popular phrase and always serves as food for thought. Homeowners know too well the scheduled and unscheduled maintenance required to keep a house livable. Positive Software Solutions cranks up its gears for *Home Fix It!*, a computerized set of answers to home repair questions.

Home Fix It! is easy to install and use. Its mouse-driven interface is powered by Microsoft DOS but functionally resembles Microsoft *Windows*. This software "handyman" is a simple guide to repairing simple problems like leaky faucets, broken tiles and torn screens. It uses two avenues to address common household irritants, one by list and another by picture.

The list method itemizes by subject, and you just select which topic you want to see.

For example, if you want to nail down the problem of fixing a leaky faucet, you can select this item from the menu. Alternately, you can ask the computer for a pictorial of a house interior and then graphically select the faucet item. Either method sends you to the succeeding screen that describes the nature of the problem, tools needed to repair it and a step-by-step tutorial on how to fix it. Illustrative figures usually accompany the instructional text. Other repair jobs explained in the program include the arduous work of patching holes in wallboard and plaster, repairing cantankerous doors and fixing uncooperative drawers.

The software addresses home-repair problems in a straightforward manner, making it easy to follow along. Anyone who is familiar with basic hand tools—like screwdriver, adjustable wrench and pliers—should have no trouble following the on-screen instructions. After browsing the instructions on the computer, you can print them and take them right with you, along with any repair tools.

As a point for improvement, *Home Fix It!* could use more graphics and more colors. The designers of the software chose to offer pictorials for users to see. Yet, the images are unpolished and lack the stimulation of color. I counted at most four colors used in any individual graphic. Since color can be a source of information and is a recognized learning tool, it's surprising that the program fails to take advantage of the power of vivid graphics. In spite of the software's lack of eye-catching visuals, the product nonetheless is informative and remains a usefully reference for any do-it-yourself home-repair person.

Pondering Personal Finance

Matters of personal finance require concerted thought. Business majors and business owners may know the intricacies of finance management. To others, talk of compound interest, yields and equivalent rates is often bewildering. Adding to trepidation about finance is President Clinton's proposed deficit-reduction plan. If approved, the plan promises to make all of us give much more thought to personal finance.

Financial Workshop is a software package that can help the uninitiated be smarter about money. Its purpose is to let you experiment with financial possibilities. It does all the calculations and hands out the results. For example, is it smarter to purchase a \$15,000 car with a \$3,000 down payment and a 36-month loan or should you lease a more-expensive car and get lower monthly payments? This is a key question in view of the escalating rates of automobiles. How much should you put into a money-market account each month if you want to retire with \$250,000 in 20 years? This question is viable

Bird's Eye View

EZCosmos 4.0, \$69.95
Future Trends Software, Inc.
 1508 Osprey Dr., Ste. 103
 DeSoto TX 75115
 Tel.: 800-869-3279

Requirements

Memory	Enough for <i>Windows</i>
Graphics	<i>Windows</i> -Dependent
Sound	<i>Windows</i> MPC-Compatible
Controllers	Mouse, keyboard
Documentation	Excellent

Evaluation

Graphics	Excellent
Learning Curve	Short
Complexity	Easy
Playability	N/A
In Brief: Significant upgrade to an excellent astronomy program. Recommend a 486 computer and sound card.	

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when more businesses are suddenly dissolving pension benefits. Can you afford the monthly payments on a \$200,000 dollar home if you put down 15% and have a 30-year mortgage with a fixed-rate of 9%? This

Bird's Eye View

Home Fix It!, \$79.95
Positive Software Solutions
 7765 W. 91 St., Ste. F3107
 Playa del Rey, CA 90293
 Tel.: 310-301-8446

Requirements

Memory	640K
Graphics	VGA, EGA
Sound	None
Controllers	Mouse, keyboard

Evaluation

Documentation	Fair
Graphics	Fair
Learning Curve	Short
Complexity	Easy
Playability	N/A
In Brief: Computerized guide to basic home repair. Recommend a medium-speed 386 computer and mouse.	

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Bird's Eye View

Financial Workshop, \$39.95

Electronic Arts

1450 Fashion Island Blvd.
San Mateo, CA 94404
Tel.: 800-245-4525

Requirements

Memory	640K, Hard Drive
Graphics	Tandy, Hercules, CGA, EGA, VGA
Sound	None
Controllers	Mouse, Keyboard

Evaluation

Documentation	Good
Graphics	N/A
Learning Curve	Short
Complexity	Easy
Playability	N/A

In Brief: Computerized guide to personal finance. Recommend a medium-speed 386 computer and mouse.

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is another important question as the American dream seems to be drawing out of reach.

Financial Workshop helps you tackle money decisions with relative ease because you don't have to understand how to compute complex formulas. Thus, getting answers to your financial questions is as simple as plugging in the values about home affairs, personal savings and financial planning. You can project expenses and other requirements when saving for your kid's college education, when preparing to move into a new house or when you decide to buy your mother a new car. The program's mouse-driven menu interface functions like Microsoft *Windows* and is easy to use. With proper use, you can plan your financial future and change it, even if you're not quite sure of what you're doing.

Searching the Sciences

Physical sciences have traditionally taken a "bad rap." Please forgive the euphemism, but it's true. Chemistry is said to be only for nerds; computers and electronics are understood only by geniuses; physics and chemistry are handled solely by eggheads and the socially repressed. We could debate this issue, but why not let your computer do the talking?

Problem Solving Concepts releases an integrated software that makes it easier to get acquainted with the physical sciences. The product goes by the name of *Pro Solv*.

Bird's Eye View

Pro Solv, \$200 (All 4 Modules)

Problem Solving Concepts, Inc.

611 N. Capitol Ave.
Indianapolis IN 46204
Tel.: 317-262-5044

Requirements

Memory	2M
Graphics	VGA
Sound	None
Controllers	Mouse, Keyboard
Documentation	Good

Evaluation

Graphics	Fair
Learning Curve	Medium
Complexity	Medium
Playability	N/A

In Brief: Problem-solving software for magnetism, electricity, optics and mechanics. Recommend a fast 386 computer and understanding of basic physics.

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It comes in four different learning modules that cover Optics, Magnetism, Mechanics and Electricity. Its features are that it allows you to describe your own problems with your own values, both known and unknown quantities. Its graphic visualizations conform to your defined information and serve as an aid to understanding the problem. It lets you vary the parameters of your problem at any time so that you can experiment as much as you like.

Pro Solv helps you tackle relatively sim-

ple problems like those in classic Newtonian physics involving acceleration, mass and bodies in motion. More-advanced problems take more time but they all can be solved with *Pro Solv's* built-in tools. You use the tutorial to set up a problem and then select the applicable formulas needed. You build a variable list, plug in your knowns and then let the computer do the rest.

To use *Pro Solv* effectively, you must have a basic understanding of the physical sciences and a working knowledge of algebra. A little geometry wouldn't hurt, either. If you need to brush up your skills, you should do so before sitting down to *Pro Solv*. Dust off your old science books or audit a couple of physics classes at your local community or junior college or, worst case, volunteer to assist your son or daughter with science studies.

Although *Pro Solv's* approach is as clean as any mathematical planar surface, potential users might enjoy having an additional module designed to help knock the rust off some forgotten scientific principles. Even practicing engineers and technicians can on occasion use a review.

Whether preparing for some equation solving or jumping right into Newton's laws of motion, *Pro Solv's* graphic visualizations would be more impressive to the curious mind if they were colorful and more detailed. Presently the graphics look as if they're taken directly from textbooks. A science-learning product should take full advantage of computer power to reinforce scientific principles. Since it's a Microsoft *Windows* application, *Pro Solv* could easily take advantage of *Windows's* system access to graphics and color. Otherwise, *Pro Solv* is an excellent tool for experimentation and learning. It's of value as a quick reference to the professional and an interesting study for those who continue to give science a bad rap.

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Softkey

KeyFonts for Windows (\$49.95) is a real bargain. How does less than 50 cents per font sound to you? *KeyFonts* contains 100 faces that range from traditional serif Roman that's

great for text and body copy to ornamental initials, scripts, novelty faces and more. Not all of the letterforms in all of the fonts are true to the original foundry designs in every respect, and there are even a couple of "wrong fonts" mixed in. But, all factors considered, this is still an incredibly good typeface collection for under fifty bucks.

SWFTE

TypeCase I & II on CD-ROM (\$49.95) is an incredible assortment of more than 230 *TrueType* fonts on CD-ROM. Just about every type of letterform imaginable has been represented in this collection, which spans from everyday text faces to eye-popping dis-

Fargo's Primera Color Printer

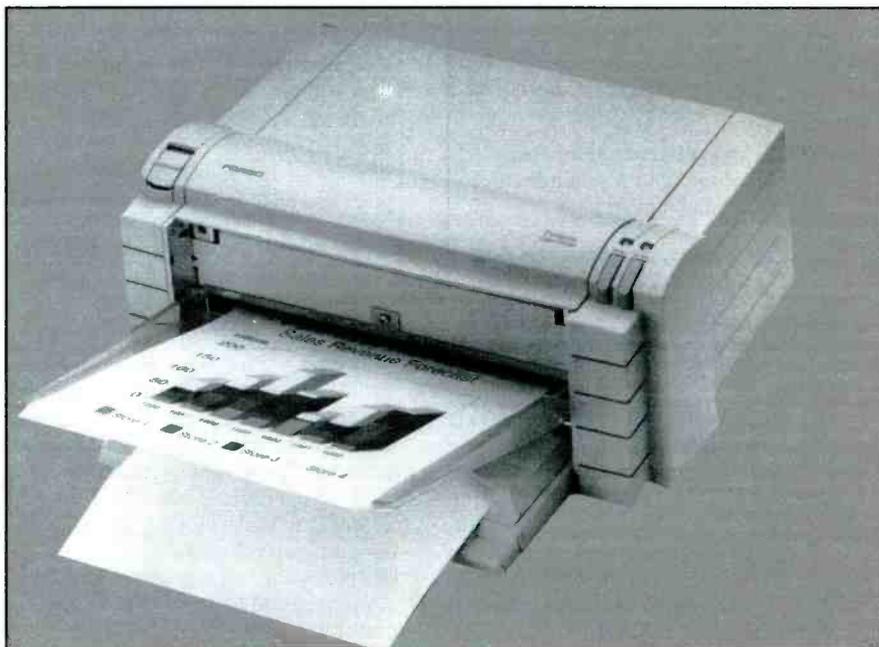
Dazzling Color Plus Photo-Realistic Upgrade-ability at an Affordable Price for the Masses

Finding a color printer that's capable of high-quality output at a price that doesn't require a second mortgage on the old homestead has been a quest akin to the search for the Holy Grail for many PC users, particularly those who work with graphics a great deal. Until now, your choices have been governed by the amount of money you could spend to have your pie charts, presentation graphics, overhead transparencies, advertising comps and such look good. Color dot-matrix printers with 24-pin printheads like Epson's LQ-2500 and Okidata's 393C fall short of the smooth color transitions and higher resolutions required by most graphics application users. The slow output speed and high level of noise associated with dot-matrix printing further degrade their desirability as well.

Color inkjet printers from Hewlett Packard and other manufacturers, while doing a much better job than dot-matrix units, still fall short in the area of resolution and their cost-per-copy figures (as well as their initial purchase price) makes them viable for some applications but still keeps them out of the reach of many users.

Thermal wax-transfer technology offers the fastest output with the highest resolution and best color rendition. However, these printers are extremely expensive, and their cost-per-copy is in the several-dollar range. At least, this has been the traditional situation. Now Fargo produces a printer that offers excellent thermal wax-transfer printing and goes a step further by offering an extra-cost upgrade that will produce photo-realistic output. The really nice feature of this printing scheme is that you can readily switch between normal thermal wax and photo-realistic dye-sublimation printing in seconds.

The real attention-getter with the Primera printer is its price. The basic Primera thermal wax-transfer printer has a suggested



retail price of \$995. Adding the photo-realistic upgrade kit kicks the price upward a mere \$249.95. This means that you can have thermal wax-transfer and dye-sublimation printing from the same printer for less than \$1,250 total, which is something noteworthy, indeed.

Fargo achieves this economy by stripping the Primera printer of unnecessary (and, unfortunately, frequently-unwanted) goodies like built-in *PostScript* capability, lots of resident fonts and on-board RAM. Fargo lets the PC handle the printing overhead and devotes its attention to handling the output chores solely in the hardware. This scheme works surprisingly well, especially with today's "muscle" 386- and 486-based PCs with lots of RAM.

Primera is a surprisingly compact printer

that weighs a mere 15 pounds when loaded and ready for work. Centronics parallel interfacing is the only I/O arrangement offered, although the Primera can optionally be ordered in 220/240-volt ac configuration for European use.

In thermal wax-transfer operating mode resolution is 203 dpi (eight dots/mm), and output speed is about 2.5 minutes per page, which is significantly faster than inkjet printers can accomplish. Primera is capable of handling paper in letter and A4 stationary sizes, both in cut-sheet and perforated size formats. It can also output on transparency film for overhead projections.

Paper capacity is 50 sheets for the paper tray and 30 sheets for the output tray and 12-point (12-cpi) Letter Gothic is the resident font. A Code Page 850 character set with DIP

play and decorative offerings.

TypeCase III (\$49.95) is an add-on to what you get in the *TypeCase I/II* CD-ROM font collection. TypeCase III may be what you need to satiate your font lust if the CD-ROM package isn't enough. This collection contains more than 100 *TrueType* fonts plus a free bonus holiday symbol collection. *TypeCase III* comes on magnetic media, and some very novel and unique faces are included in this distinctive collection at only pennies per font.

Microsoft

TrueType Font Pack (\$69.95) contains 44 fonts from the folks who brought us *TrueType* in *Windows* in the first place. Font col-

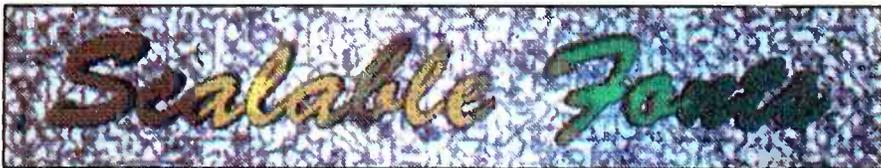
lections from the Lucida and Monotype design studios are featured.

TrueType Font Pack 2 (\$69.95) contains an additional 44 fonts from Microsoft, including typefaces that are well-suited for headlines, decorative applications, documents and display. Text and symbol fonts are also included; so this is a well-rounded collection for the masses. The really big news in *Font Pack 2* is its inclusion of Microsoft's Font Assistant program, which helps you organize and sort all your *TrueType* fonts into easy-to-use groups. This handy utility also lets you print samples or a catalog of your type so you can have a hard-copy reference for the fonts you have loaded.

Closing Hints

Using different typefaces to express your thoughts and emotions and more effectively convey your messages can be fun and practical at the same time, thanks to *Windows'* font-handling capabilities. While anyone can purchase and install fonts in their system, not everyone will use them to best advantage. Therefore, here's a basic guideline for mixing and matching fonts.

(1) Body copy and long text passages are generally easier to read when printed using a serif Roman font, such as



Sample printouts using (upper-left and center) thermal wax-transfer and (upper-right and bottom) dye-sublimation processes, the latter two using Fargo's Photo-Realistic Upgrade Kit. Upper two images were scanned in from a color photograph, while the center and bottom images were composed using Pixar's *Typestry* for *Windows*.

switch selections for international characters is also built-into the printer's firmware.

Primera is designed and intended for use under *Windows* 3.1 and later versions (sorry, DOS users). The required driver software installs in just a minute or two and adds the Primera to your list of installed printers.

Adding the dye-sublimation upgrade kit turns Primera into an imaging machine supreme. Unlike other PC printing technologies that use dots to compose the image, dye sublimation completely eliminates dots by

allowing the colors to blend with each other through the various layers, creating additional tones in the process. This results in a photo-realistic image that's completely devoid of dots and truly rivals a good color print made on heavy-weight, high-gloss photographic paper. For presentation purposes, advertising comps, outputting Photo-CD images and the like, the difference between wax-transfer and dye-sublimation is literally like the difference between night and day.

The economies of operating this printer in

either of its modes are commendable and far lower than you'd encounter using competitive products to achieve similar results. For example, in thermal wax-transfer printing mode the Primera's cost per page is a constant 45 cents, which is considerably less than inkjet at 25% page coverage. At 50% to 100% page coverage, the Primera's cost-per-page is about one-third that of inkjet printer.

Using the photo-realistic dye-sublimation printing mode, the cost per page is approximately \$3 each, which is significantly less than what most outside service bureaus charge for photo-realistic output (\$12 to \$15 per 8 1/2" x 11" page is the average).

Wax-transfer ribbons for the Primera printer are available in three-color (good for 115 prints per roll at a cost of \$45), four-color (80 prints per roll at a cost of \$45) and a monochrome black (400 prints per roll at a cost of \$39.95). Ten-roll case discount prices apply as well. Printer paper ranges in price from \$14.95 to \$20.95 per 200-sheet package, depending on size and grade (standard or premium), and multiple-packet discounts are available as well. Transparency film cost ranges from \$34.95 to \$36.95, depending on size (quantity discounts offered).

The basic Photo-Realistic upgrade kit provides software, paper and ribbon sufficient for 10 prints. Additional refill kits are available for \$89.95 and \$92.95, depending on the paper size, and include enough ribbon and paper for 25 prints.

If you're looking to put some color into your life without incurring the National Debt, Fargo's Primera Color Printer may be just the ticket for you.

—Tom Benford

Product Reviewed

Primera Color Printer, \$995; Primera Photo-Realistic Upgrade Kit, \$249.95

Fargo Electronics, Inc.
7690 Golden Triangle Dr.
Eden Prairie, MN 55344
Tel.: 800-FARGO-22

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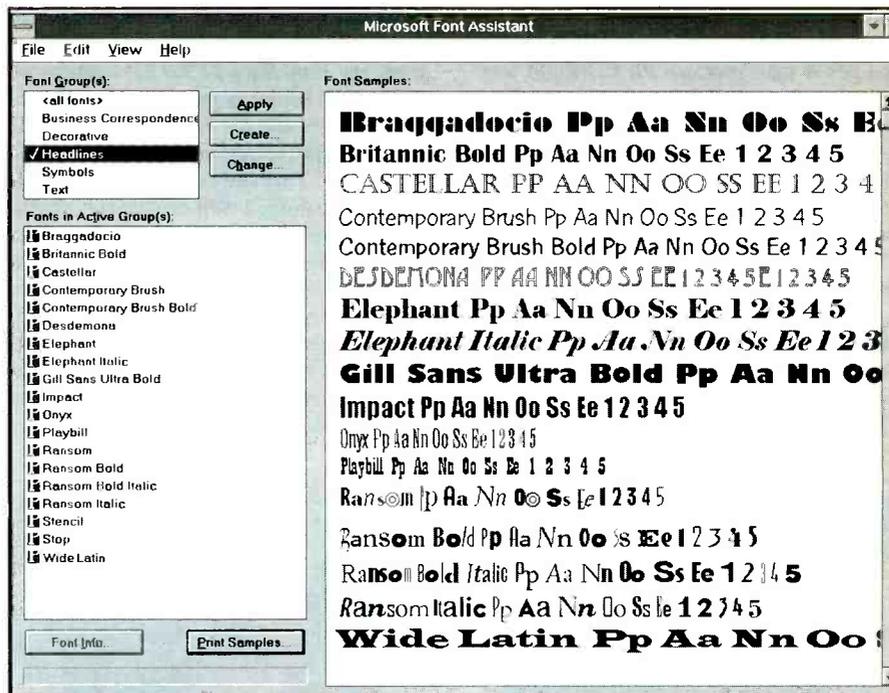
Times Roman. Some additional space (leading) between lines also increases the legibility of the font. Sans serif faces like Helvetica are well-suited for headline and limited text use, since sans serif faces are more tiring on the eye in smaller sizes.

(2) Headlines should be in a face that visually complements the body copy. They should be large enough to attract attention without being "horsy."

(3) Try to confine your urge to mix-and-match every font you have in a single document. It just makes things too busy for the eye, making your literary message suffer as a consequence.

(4) Emphasis can effectively be added to selected passages by using italics and underlines. Boldface should be used only as a lead-in for new sections, rather than mixed with running text.

(5) Experiment and print samples to develop a sense of what faces work well with others. Remember, also, that the subject matter of your document has much to do with your selection of the typefaces. Consequently, your selections will enhance it or detract from it.



The Microsoft Font Assistant, shown above, is a font-management utility that's included with *TrueType Font Pack 2*. In addition to organizing fonts, Font Assistant permits printing specimens and catalogs of your installed typefaces.

Products Mentioned

Type Basics, \$198; *Type Set Value Pack*, \$60; *TypeAlign*, \$99
Adobe Systems, Inc.
 1585 Charleston Rd.
 Mountain View, CA 94039-7900
 Tel.: 415-961-4400

CIRCLE NO. 123 ON FREE INFORMATION CARD

Fontographer, \$495
Altsys Corp.
 269 W. Renner Rd.
 Richardson, TX 75080-1343
 Tel.: 214-680-2060

CIRCLE NO. 124 ON FREE INFORMATION CARD

FontMonger, \$149.95; *FontMinder*, \$79.95
Ares Software Corp.
 PO Box 4667 DR, Ste. D
 Foster City, CA 94404-1211
 Tel.: 415-578-9090

CIRCLE NO. 125 ON FREE INFORMATION CARD

AllType, \$79.95; *Publisher's PowerPack for Windows*, \$79.95
Atech Software
 5964 La Place Ct., Ste. 125
 Carlsbad, CA 92008-8829
 Tel.: 818-765-5311

CIRCLE NO. 126 ON FREE INFORMATION CARD

Li'l Bits Font Packages (Jetsons; *Flintstones*; *Star Trek*; *Star Trek—TNG*; *Winter Holiday*; *Looney Tunes*), \$19.95 each; *FaceLift*, \$99; *MakeUp*, \$149; *TrueType Font Pack 1*, \$79; *TrueType Font Pack 2*, \$39
Bitstream, Inc.
 Athenaeum House
 Cambridge, MA 02142-1270
 Tel.: 617-497-6222

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SuperType Master Library, \$29.95
IQ Engineering
 685 N. Pastoria Ave.
 Sunnyvale, CA 94086-2917
 Tel.: 800-765-3668

CIRCLE NO. 128 ON FREE INFORMATION CARD

TrueEffects for Windows, \$99.95
MicroLogic Software
 1351 Ocean Ave.
 Emeryville, CA 94608
 Tel.: 510-652-5464

CIRCLE NO. 129 ON FREE INFORMATION CARD

TrueType Font Pack 1, \$69.95; *TrueType Font Pack 2*, \$69.96
Microsoft Corp.
 One Microsoft Way
 Redmond, WA 98052
 Tel.: 206-882-8080

CIRCLE NO. 130 ON FREE INFORMATION CARD

Presentation FontPack, \$59.99; *TrueType ValuePack*, \$89.00; *Desktop Solutions*, \$129

Monotype Typography, Inc.
 53 W. Jackson Blvd., Ste. 504
 Chicago, IL 60604
 Tel.: 312-855-1440

CIRCLE NO. 131 ON FREE INFORMATION CARD

Typestry for Windows, \$299
Pixar
 1001 West Cutting Blvd., Ste. 200
 Richmond, CA 94804
 Tel.: 800-888-9856

CIRCLE NO. 132 ON FREE INFORMATION CARD

KeyFONTS for Windows 3.1, \$49.95
Softkey
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 Third Floor, Bldg. D
 Boca Raton, FL 33431
 Tel.: 407-367-0005

CIRCLE NO. 133 ON FREE INFORMATION CARD

TypeCase I, *TypeCase II* (CD-ROM and floppy), \$49.95; *TypeCase III* (\$49.95)
SWFTE
 Stone Mill Office Park
 Hockessin, DE 19707-8701
 Tel.: 302-234-1740

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Ya Say Ya Want a Revolution?

I've been predicting a revolution in color printers since I first heard about the under-\$1,000 Primera printer almost a year ago. I think it's happening, but it's been such a quiet revolution that it's difficult to be certain. To really understand what's been going on in the world of inexpensive color printing, we need to take a few minutes to review the three major technologies used to produce a color print.

The Formats

The least-expensive color print technology is dot-matrix. These printers add a special ribbon, with bands of color running horizontally through the ribbon, and an adjustment mechanism that moves the ribbon vertically up and down. Depending on where the ribbon is positioned, a different color transfers to the paper when the printhead's pins "fire." Color dot-matrix printers are inexpensive to buy. For example, I'm testing a Star 1040NR nine-pin printer that has a street price of less than \$200. Dot-matrix color printers are also inexpensive to operate, with a cost-per-page figure averaging only pennies.

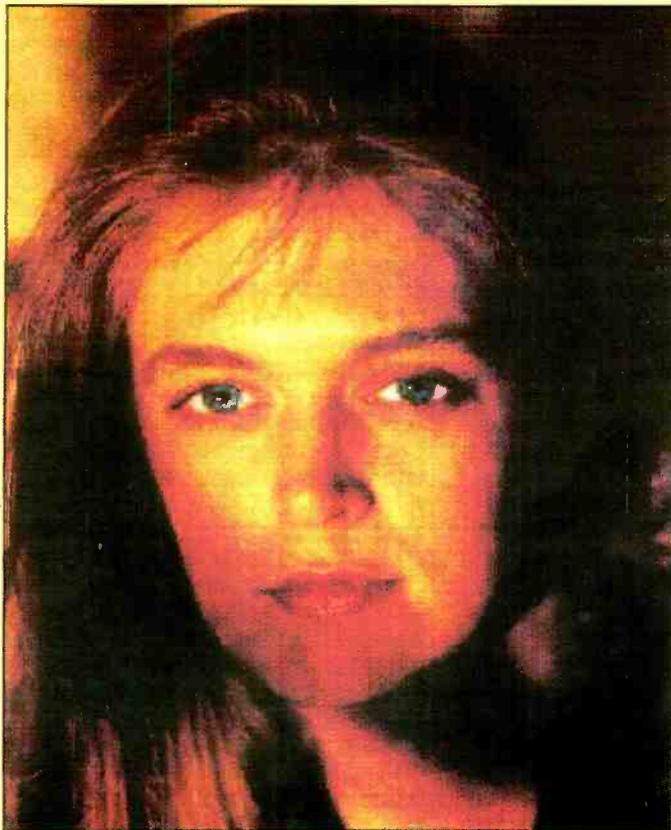
The downside of color dot-matrix printer technology is that even though 24-pin models may have good resolution (the Epson LQ-860 color printer the kids frequently use has a resolution of 360 X 180), the colors are just not very bright or vibrant. This is a limitation of the type of dye with which the ribbons are impregnated, as well as the amount of this dye that can be transferred to the paper by the pins in the printhead that push the ribbon against the surface of the paper. It's a very delicate balancing act. If the pins push too softly against the ribbon, little, if any, ink/dye is transferred. If they push too forcefully, they go clear through the ribbon, quite possibly tearing it and/or even ruining the printhead. Colors, other than those contained on the ribbon, are created by overprinting one color over another. In the case where black is required, all of the primary colors are overprinted on each other. This results in very muddy blacks and browns, which is a problem that's also common with other technologies that use the three-color processes.

Ink-jet imaging is another common color printing technology. I reviewed the Hewlett

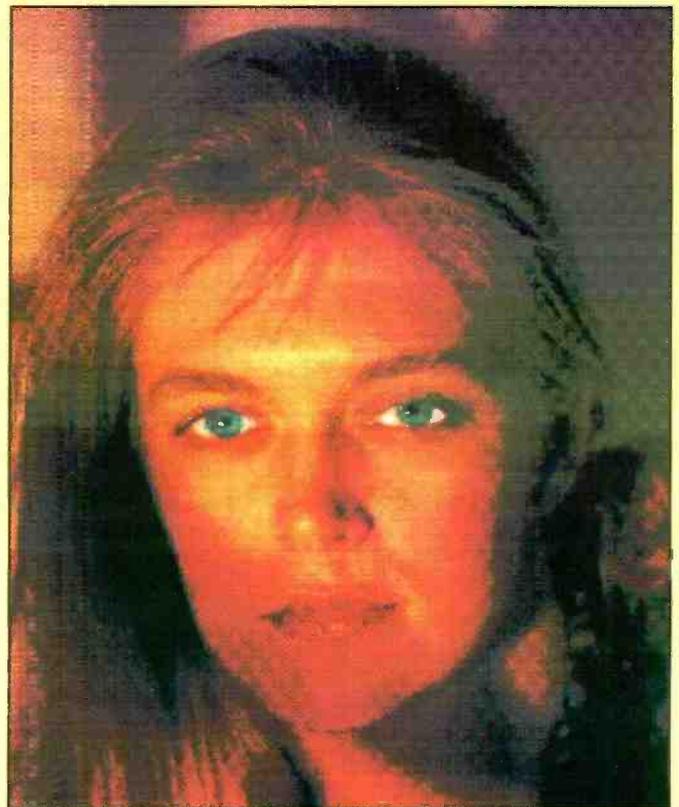
Packard DeskJet 500C here last year, and liked it a lot. The newer version, the DeskJet 550C is even better. Color ink-jet printers work by firing tiny droplets of colored ink at the paper. HP's and Canon's printers are basically three-color systems. Each cartridge contains cyan, magenta and yellow inks. Mixing these colors gives you pretty much any color you need. Because it's expensive to create black with this method, the HP 550C has a second cartridge that contains black ink. When black is needed on the page, this additional cartridge is brought into play, giving crisp dark blacks and saving the expensive color cartridge for when it's needed.

Color ink-jet printers can produce outstanding quality output. But they require special coated paper to prevent the ink from "wicking" into the paper and wrinkling it. And they're generally very slow. The latest color ink-jets are much faster than their predecessors and deliver deep vibrant color output.

The third, and increasingly-popular, color print method is thermal-transfer. This label encompass a number of related tech-



Standard output from Fargo's Primera color printer.



PhotoRealistic output from the Fargo Primera printer using the Primera PhotoRealistic Upgrade kit.

nologies, including wax transfer, dye transfer and dye sublimation. Printers that use thermal technology have a printhead that actually melts the dye or ink on the ribbon to transfer it to the paper. Most of the lower-cost printers of this type use a wax-based ink, a three or four color ribbon (cyan, magenta, yellow, and sometimes black) with alternating panels of color, have an on-board CPU to rasterize the page image (a process called RIPing, for Raster Image Processing), offer 300 X 300-dot-per-inch resolution and use the PostScript page-description language or one of its clones.

Thermal dye sublimation takes this process a step further. One of the big problems with most color printing is that the output really doesn't look much like a photograph. High resolution (300 dpi or better) and lots of colors (which is equivalent to using large numbers of grays in black-and-white printing) help a bit. But there's a fundamental difference in the way a continuous-tone photograph and a computer-generated printed page are produced. Both build up a picture from dots of color, but with a photograph, the dots used are so small that they frequently can't be individually ascertained without a magnifier. The net effect is that the different areas seem to blend smoothly into each other. With 300-dpi dots, these transitions are much more visible, abrupt and noticeable.

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Dye-sublimation printers sometimes do offer somewhat better resolution than the 300 dpi found in thermal-transfer units. But they actually use a trick to produce more pleasing and realistic output. Instead of melting the wax or dye off the ribbon and onto the paper, they vaporize it. The gaseous dye travels the short gap to the paper and is absorbed into the surface of the special paper. Unlike ink-jet printers, where the rate of absorption is uncontrolled, dye sublimation is very precise. The result is a somewhat fuzzy dot, very sharp in the center and softer around the edges. The size of the dot, not the same from dot to dot, varies. This variable dot size is accomplished by varying the temperature of the print element when it vaporizes the ink to produce the specific dot. Color output from a dye-sublimation printer is, at the present time, as close to photographic continuous tone as you can get without resorting to photography.

The dye-sublimation process is a very precise one, and the price of dye-sublimation printers reflects this. Even inexpensive dye-sublimation printers run in the \$7,000-and-up range for the just printer. Figure another \$2.50 to \$3 for paper and ribbons for every page you produce on it. But, if you really need the best-quality color output, it's not an unreasonable amount of money to pay.

Primera PhotoRealistic Upgrade

While I like to produce great color output, I really don't need it, at least not to the point where I'd even begin to consider buying a \$7,000 printer with a per-page cost of nearly \$3. I'd imagine that most of you are in pretty much the same situation. But I would consider a \$1,250 printer with similar quality output, even at the \$3-per-page-produced level. The new \$249 PhotoRealistic upgrade to Fargo's Primera printer does pretty much this. It converts the \$995 thermal wax transfer Primera printer into a dye-sublimation printer. Of course, it's not quite the equal of a \$7,000-plus printer, but the beefed-up Primera Printer works surprisingly well.

Fargo's Primera printer, which I reviewed in this column last spring, is pretty impressive by itself. Although it offers only 203 X 203-dot-per-inch resolution, compared to the 300 X 300 dpi most other printers of its type produce, the other wax-transfer printers cost three or more times the Primera's \$995 asking price. Fargo leaves out the on-board CPU and raster processor. RIPing is performed in the PC, rather than in the printer and the Primera must be used with Microsoft *Windows*. It doesn't work with any DOS application, nor is it supported by DOS. A Macintosh version of the printer is available for an

additional \$250 more than the cost of the PC model.

Operating costs for the Primera are pretty reasonable as well. A three-color ribbon, which produces 115 pages of color output, costs \$45. A four-color ribbon, which adds a black panel to the alternating cyan, magenta and yellow dyes, produces 80 prints (with crisper, deeper blacks) for the same \$45. You can use standard paper, but best results are obtained when using special paper. Even the premium grade isn't all that expensive, with 200 sheets going for \$19.94. At these prices, a full color page will run about a half-buck—much more expensive than laser printing but not very expensive for color.

The dye-sublimation "PhotoRealistic" upgrade kit for the Primera printer comes in a box the size of many software packages and is priced at \$249.95. This seems rather excessive for what's in the box—a 10 print ribbon, 10 sheets of special paper, a disk containing the special printer driver and a single sheet of instructions. What you're actually paying for is the driver software. You may also need a firmware upgrade if you have an older Primera, as I did. The firmware ROM is available from Fargo's customer service and installing it was a 5-minute job.

With the printer's ribbon cartridge removed, a metal plate covers the main circuit board, held in place by two small Phillips-head screws. Remove these screws, pull up the plate and you have access to the circuit board on which the ROM is mounted. The instructions tell you to use an L-shaped piece of metal to remove the old ROM, but Fargo doesn't provide this. Since you're warned against using a screwdriver or other straight tool, Fargo should have provided the proper tool. Luckily, I had such a tool, but most people won't. Pop out the old ROM, push in the new one (making sure that the notch on the chip faces the front of the printer), close up the panel, replace the two screws and you're almost done.

The new driver installs right over the old one, using the PRINTERS selection of *Windows*' Control Panel. Once installed, it adds one more choice to the Ribbon Type box. Where before you could choose from three-color, four-color or monochrome, you now have an additional choice—PhotoRealistic.

The special ribbon comes with its own extra carrier, which serves as a storage tray when you're not using the dye-sublimation feature. I suggest you keep the cardboard box to put this and the special paper away in when you're using the Primera for plain color printing. The special ribbon and paper must be handled carefully because oils from your hands can ruin a print. Handle these materials only at the edges. By the way, the special paper has a shiny side, which must be placed face-down in the

paper tray so that printing takes place on this shiny side.

Select the Photorealistic option in the print setup menu, and you're on your way. Output from the Primera is very good, but it's just not the same quality as those printers costing six or seven times more. A lot also depends on the image you're trying to print. The sample that accompanies this column is from Micrografx' *PhotoMagic*. It was enlarged about six times actual size before being printed, which accounts for some of the "dottiness" of the image both in standard color mode and photorealistic mode. When printed at the size at which it was stored, the image quality improved but much of the detail was lost. Dither patterns, visible in the images printed, also greatly effect the looks of the final output. You'll need to experiment to get the best result.

The need for experimentation is the product's weakness. Even when you buy the supplies in quantities of 100, the cost per printed page falls to only \$2.79. This isn't a lot for dye-sublimation quality output, but many applications will require a test page or two before you're satisfied with the final output. At almost \$3 a pop, it could easily cost you \$10 or more to get a single page you're happy with. And while you can do some of the preliminary work in black and white, or less expensive Primera color, there's just no way to avoid wasting an occasional dye-sublimation page—it's the nature of the game. Many small businesses can justify throwing a \$3 page into the trash, but few home or casual users can.

If you're a business user and are looking for affordable high-quality color output, here it is. If you're a home user, take a look at the next review.

New Star From Star Micronics

Back a few issues, I mentioned I had seen a new printer from Star Micronics at Spring Comdex that really impressed me. I received one of the first production units and have had a few weeks to play around with it. I have to admit that I'm almost as impressed after using it as I was from the demo at Comdex.

Star calls the SJ-144 a "Heat Fusion" printer, rather than a thermal-transfer unit. There are two major differences that I can see from most other thermal printers. First off, the Star printer uses a polyester dye rather than a wax-based one. The printed output looks pretty much identical to that produced by a high-quality thermal wax-transfer printer, but Star claims that the print won't rub off (as sometimes happens with wax dye output) and won't flake if the printed paper is flexed. I've never noted that output from a standard wax-transfer printer was particularly brittle or inflexible, but then I don't usually fold or crease my color output. The polyester dye that Star

uses does have one major benefit that's immediately apparent. It doesn't require special paper to produce excellent quality output. The printer is capable of 360 X 360-dpi output (it uses a 24-element printhead that's equivalent to a 24-pin dot-matrix unit), and Star shipped it to me with a ream of standard laser bond paper. Star not only doesn't recommend using special paper with this printer, the company doesn't even offer any special paper for it. Well, that's not 100% accurate. Star does offer a special transfer paper you can use to make decals for transfer to T-shirts. Being that I'm still waiting for this paper, I can't tell you how good it works.

The second way the SJ-144 differs from other thermal color printers is that it doesn't use a full-page sized color ribbon panel. The ribbons use alternating bands of colors, but they're only about 1/2" wide. Star offers four different types of ribbons. There's a black ribbon for printing monochrome text, a color ribbon for most color output uses, a second type of color ribbon for producing overhead transparencies and a special label ribbon that produces great looking labels on a variety of plain or colored background. The labels look a lot like those you can produce with one of the popular P-Touch or Kroy lettering machines, but you have all of the flexibility of *Windows*-based fonts.

Finally, the Star SJ-144 comes with *Windows* drivers and built-in emulations of the Epson LQ-860 and IBM ProPrinter X24E with automatic emulation sensing and switching. It's a tiny printer. With a footprint of only 12.8"W X 5.5"D. At 6.9" high and weighing just 5.5 pounds, it's not going to warp your desk. You can feed regular paper from its rear tray (up to 30 sheets) or overhead film and heavier material through its rear straight-through slot. Printing a full color page takes about a minute and a half, which is very fast for a color printer, and output quality, with one exception, is excellent.

The one problem I had with the printer was a noticeable amount of banding. This problem is very common with color printers, but the Star has a method to reduce banding significantly. By holding down several of the panel buttons when you turn on the printer, you can produce a test pattern of two overlapping ribbon passes. You can then use the micro-adjustment feature to eliminate (or greatly reduce) the banding caused by the misalignment of the print head between passes. At least that's the theory. Despite a fair amount of fiddling, I was never able to eliminate all of the banding. It would pretty much disappear during adjustment on the test pattern, but even after storing the setting, it came back in my graphic page.

There's one more down side to the SJ-

144. It's a very economical printer to buy. With a suggested retail price of \$599, it's not going to be long before this printer is selling on the street for about \$500 or less. Given the quality of the output (it's as good as most \$3,000-or-more color wax-transfer printers), this price makes it a great buy. I say great, rather than fantastic, because of the cost of using it. As mentioned before, the Star doesn't need special paper, so the cost per page of the paper isn't worth talking about. But the ribbons for this puppy can empty your piggy bank pretty quickly. The monochrome ribbons produce 180 pages per ribbon and sell for \$29.95 for a pack of three. At about 18 cents a page, the Star printer is right in the ink-jet ballpark, which reasonable enough, given the quality of the output. When you get into color, it's a whole different ball game. Star rates a color ribbon good for eight pages of full-color graphics. A three-pack of color ribbons sells for \$44.95, which works out to almost \$1.90 a page! Star had some figures in its press kit from an independent study they commissioned RIT (Rochester Institute of Technology) to do that showed that the cost per page was less than producing a full-color page on a color ink-jet. Maybe so, but I've also played with the HP DeskJet 500C and 550C color ink-jet printers. My figures for cost per page on these ink-jet printers seem to be much different (and much less) than those RIT came up with.

Even though the cost per full-color page is a bit high right now with the SJ-144, the printer's a knockout. It's got better color than anything in its price class, and the price on the ribbons will drop once the printers start being purchased in quantity. Right now, though, the cost per page in both color and black-and-white modes make this printer a bit too expensive as the only printer you own. If you have another printer that can be used to produce the bulk of your output, do buy a Star SJ-144 for those full color pages you'd like to produce. You'll love it! ■

Products Mentioned

Primera PhotoRealistic Upgrade, \$249.95
Fargo Electronics, Inc.
7690 Golden Triangle Dr.
Eden Prairie, MN 55344
Tel.: 800-FARGO-22

CIRCLE NO. 161 ON FREE INFORMATION CARD

SJ-144 Color Printer, \$599.
Star Micronics America, Inc.
420 Lexington Ave.
New York, NY 10170
Tel.: 800-447-4700

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More Kudos

• Thanks for the great February 1991 issue of *ComputerCraft*. I've read it cover to cover. I especially enjoyed both of Jan Axelson's pieces ("Microcontroller Q&A" and the "Special Report on 8-Bit Microcontroller Boards") and Nick Goss' "CYDAT-to-PC interface." The pinout of the IBM PC in the latter was most helpful.

Ray Joudaitis
Norwalk, CT

Likes Microcontrollers

• My interest has changed over the years to the market to which you now cater. The articles by Jan Axelson are fantastic. When is Jan going to publish a book on the A to Zs of the 8051 and other processor operations and interfacing schemes? The article on "XMODEM-CRC on the 8051" (May) couldn't have come at a better time. Between Jan's 8051 and the XMODEM article, I now have the knowledge to build some very powerful control devices. There's one area that gave me problems on which very few people seem to write. How about an article on 8051 math solutions in assembler? Try doing some real number crunching beyond 255 decimal using 16- or 32-bit numbers for a change.

Rommel Edwards
Forestville, CT

Putting It To Use

• Just a short note to tell you how much I enjoyed Raymond Green's "Recycling Old Computers" article in the January issue of *ComputerCraft*. Upon reading this article, the project presented became a top priority. The instructions provided in the article were clear and concise and proved to make this a fun project to build.

I work as a Technical Director in Theater. I hope to use the information in this article to control effects and monitor various elements on the stage. I'm anxious to see if this system can control theatrical

lighting systems using AMX or DMX standards. Keep up the good work.

Richard C. Mayfield
Daytona Beach Community College
Daytona, FL

Day-One Reader

• As a subscriber to *ComputerCraft* from Day One, let me pass along yet another compliment on your fine work. I never fail to read *ComputerCraft* from cover to cover. It's certainly the best dollar value in computer magazines today.

Joseph A. Scannell
Novato, CA

Overseas Fan

• After subscribing to *ComputerCraft* for at least two years, I haven't received a single issue that didn't have several articles of interest. This can't be said for many of the multitude of electronics/computer magazines available today. Since I started reading *ComputerCraft*, I've built a number of projects that are based on your innovative circuits and technical articles.

During the past year, I've been busy with a home-automation project using an old and very-modified PC/XT, remotely reading and controlling I/O ports on several 8052-BASIC computers. Most of the chips in the PC have been changed to CMOS types to permit battery operation via a home-made supply. The 8052s are powered via their serial links from a modified PC serial card. The system is working well, turning on and off lights while we're out, switching the kettle on in the morning, etc. As the system has proved to be completely reliable, the next stage is to get serious and add access control for electric gates and a basic security system.

Thanks again for what is the best computer/electronics magazine available. Keep up the excellent standard of your articles.

Malcolm Moorhouse
Kempton Park, South Africa

Table Mix-Up

• Errors in the tables that accompany my "Local Bus Breaks the 8-MHz Speed Barrier" that appeared in the September might be cause for confusion. Table 2 shown in the article should have the heading "VL-Bus Slot Speed," while Table 3 should

have the heading Burst Address Ordering (Hex)." Table 4 is missing altogether and is included here to complete the pertinent information needed to understand the address-encoding structure of the VL bus.

TJ Byers

Table 4. I/O Address Encoding

AD1	AD0	C/BE3#	C/BE2#	C/BE1#	C/BE0#
0	0	X	X	X	0
0	1	X	X	0	1
1	0	X	0	1	1
1	1	0	1	1	1

Note: X = doesn't matter, can be either 1 or 0.

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The Thinking Computer

Completely hi-tech and ultramodern is the rapidly changing personal computer. Many varied and pointed analogs compare the ways computers and humans process information. The central processing unit, or CPU, of a computer system is likened to the human brain. A PC's input and output functions that collect and dispense data are similar in purpose to human eyes, ears and appendages. No matter how many comparisons one wants to make, it all comes down to one question: Does the computer actually think? This is an interesting question but one that we'll leave to the experts of neural networks and artificial intelligence to answer if they can. Alternately, let's look at some software applications that will make *you* think.

Contemplating the Stars

The stars are yours if you like to think about astronomy. But even the hardest of amateur astronomers has a difficult time around the lights and smog of a large city. Driven by the need to peer through pristine, crisp atmosphere, star-gazers trek to far-flung wilderness areas and remote observatories. If you're of this sort but would rather not fight the elements, you can study the stars by using your personal computer. Just load up *EZCosmos* from Future Trends Software.

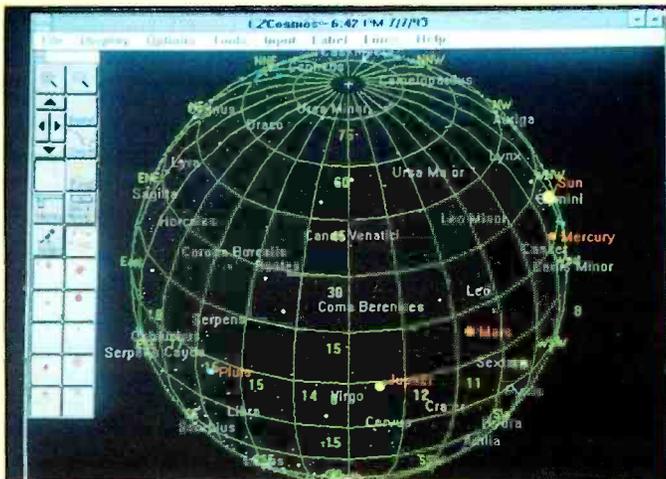
Version 4.0 of *EZCosmos* is a significant upgrade. The program has over 20,000 celestial objects, including the Sun, Moon, all the planets with Jovian Satellites, stars, comets, constellations and deep-space objects. Some

of the celestial objects have accompanying pictures in .GIF format. Sound effects and audio clips enhance the presentation.

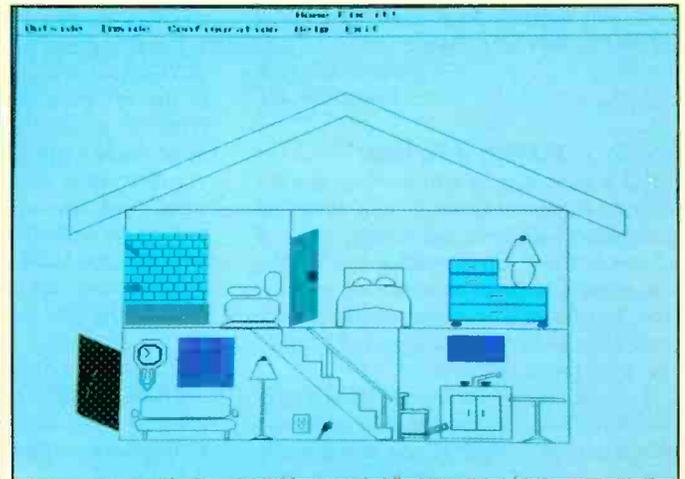
The look of new *EZCosmos* is immediately pleasing. On start-up, a speckled star field appears on the computer screen. With the click of your computer mouse, you can place a celestial grid on your screen, clearly pointing out coordinates that make it easy to orient yourself. If this isn't enough, another click of the mouse superimposes names of stars, planets and other objects.

Another feature of this software package displays a symbol on your star field that looks much like a ghostly camera. The camera-like specter marks the locations of celestial

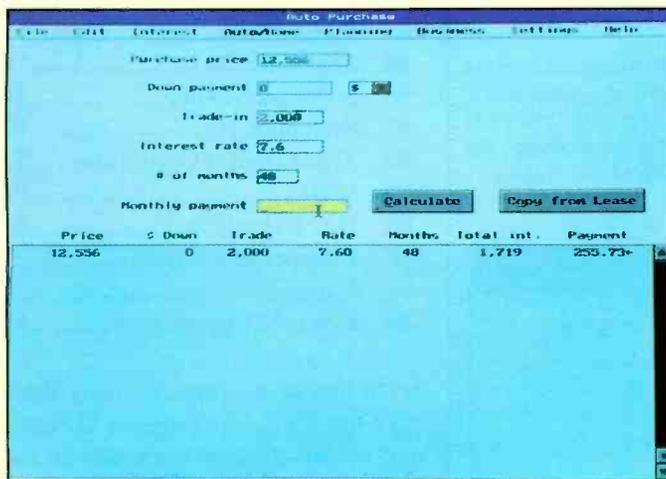
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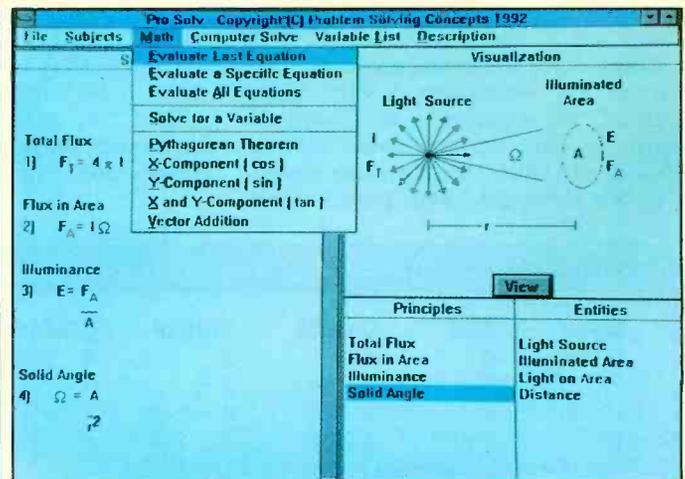
EZCosmos' celestial sphere.



*Home Fix It!'*s very fine house.



Figuring a car loan with *Financial Workshop*.



Pro Solv: a problem in photometry.

128 feet and two floors away you'll still get great sound from your stereo... without wires!

Amazing new technology gives you the power to broadcast your favorite music through walls, ceilings and floors to wireless speakers anywhere in or around your home.

by Charles Anton

Ever drag your stereo system into another room of your house just so you could listen to it? Probably not. Most people can't afford to risk ruining their equipment.

With these new wireless speakers, you won't have to. Now you can listen to music anywhere in or around your home without lugging around heavy equipment or stringing wires.

Imagine listening to your favorite CDs, records, tapes, radio station, or TV show anywhere in your home. Imagine stepping into the pool or hot tub and having a self-contained wireless speaker right there with you—no risk.

State of the art sound. These wireless speakers will work with any stereo, TV or VCR. And wait till you hear how they sound. The four-inch full range speakers deliver deep, rich bass and crystal clear highs. You'll get the perfect volume for any room because each one has its own volume control on/off switch. Plus, they have separate treble and bass controls.

Each speaker delivers a peak of seven watts per channel, for a total of fourteen watts when two speakers are used together for stereo sound. They have a built-in crystal-control frequency mechanism to lock on the signal. *These wireless speakers are also self-amplified, so they can't be blown out no matter what your stereo's wattage.*



Chase transmitter

Are wireless speakers right for you?

Are you concerned about:

- **Convenience.** You have a great stereo system in one room, but you want your music closer to you.
- **Value.** You want to get your money's worth out of your stereo equipment, tapes and CDs by listening to them more often and in more places.
- **Quality.** These wireless speakers use FM technology to transmit static-free music throughout your home.
- **Safety.** You have a pool or hot tub and you don't want dangerous speaker wires lying around.

speakers come with a 90 day manufacturer's warranty. If you're not completely satisfied for any reason, return them for a full refund.

Factory direct offer. For a limited time, we can send these amazing wireless speakers direct-to-you far below the \$149 retail price. Now through a special promotional campaign, the Chase wireless speaker is only \$79. Order more than one, and your additional speakers are only \$69 each. The wireless transmitter is only \$29.

Patented technology. These incredible Chase speakers use a patented FM technology to broadcast wirelessly through your home's walls, floors and ceilings. A single transmitter broadcasts to an unlimited number of speakers within a 150 foot radius, giving you music throughout your home.

Easy installation. The powerful Chase transmitter plugs into a headphone, audio-out or tape-out jack on your stereo, CD player, VCR or TV. Use one transmitter to send both left and right channels separately to get full stereo separation on as many pairs of speakers as you want.

'No Questions Asked' guarantee. With every product from Comtrad, you get a complete "No Questions Asked" 30 day money-back guarantee.

Plus the wireless Chase



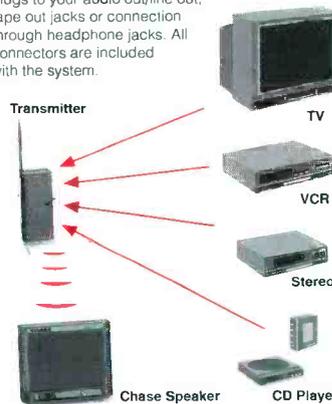
Chase's wireless speaker breakthrough.

This amazing wireless speaker has its own built in receiver and amplifier. Utilizing FM technology for a 150 foot range through walls, they can blanket even the largest home with clear, crisp music. Designed in an "acoustically balanced" bookshelf size (9H x 9.5W x 3.75D") it operates on four 'D' batteries or with an optional AC adaptor.

Broadcast wirelessly from virtually any sound source.

Broadcast to wireless speakers through walls, ceilings and floors up to 150 feet.

Easy hook-up of the transmitter to virtually any sound source with RCA plugs to your audio out/line out, tape out jacks or connection through headphone jacks. All connectors are included with the system.



So, take advantage of this direct offer and purchase your wireless transmitter and as many speakers as you need to fill your home with music.

Chase Transmitter\$29 \$2 S&H
Chase Wireless Speaker*\$79 \$6 S&H

**Discount of \$10 on each additional speaker you order. You need one transmitter to operate speakers. Two transmitters and two speakers are needed to broadcast in stereo.*

Your order will be processed and on its way to you in 72 hours. To receive this special pricing, you must mention promotional code 071-CC1102.

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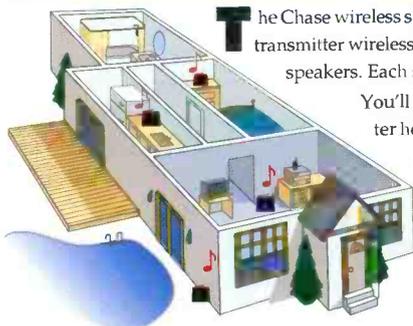


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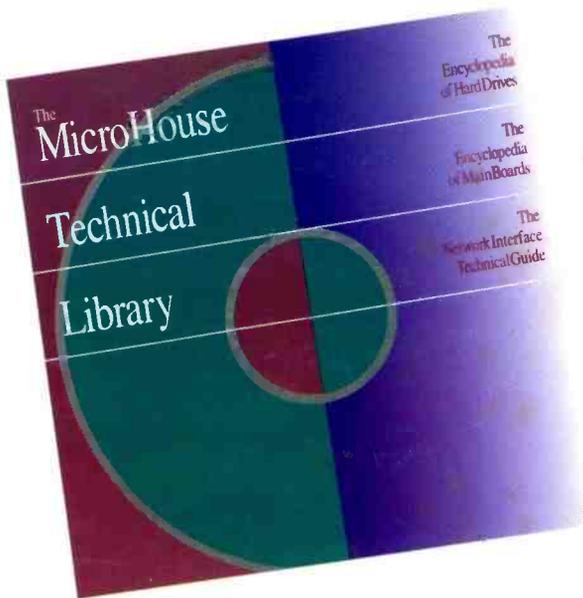
HOW DO THEY WORK?



The Chase wireless speaker uses a breakthrough patented FM technology. A small transmitter wirelessly broadcasts music through walls, floors, and ceilings to your speakers. Each speaker has a built in receiver so no wires are needed!

You'll get a complete 150-foot range, giving you great sound no matter how large your home. And because this system uses radio signals unlike "line of sight" infrared systems, you'll get static-free transmission...even through walls!

A single transmitter can broadcast to an unlimited number of wireless speakers. The speakers with their built-in receivers and amplifiers can then provide music from your sound source anywhere around your home—even outside!



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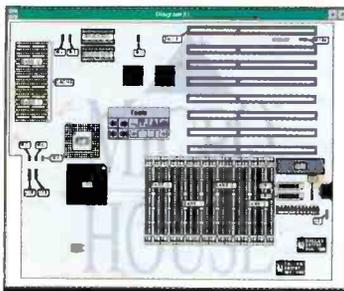
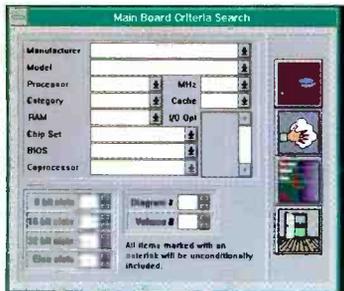
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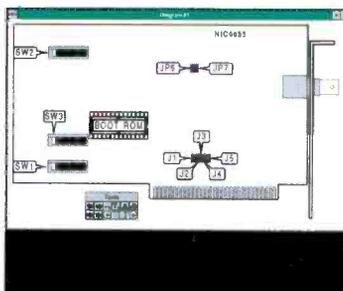
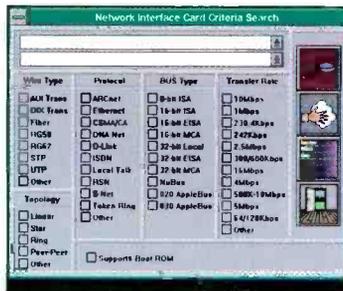
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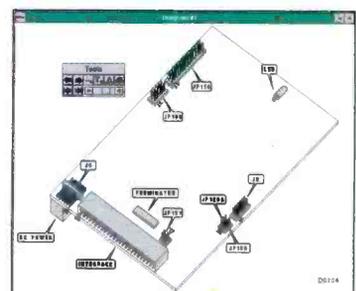
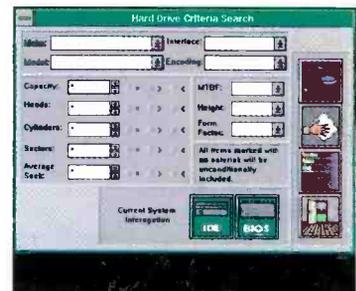
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