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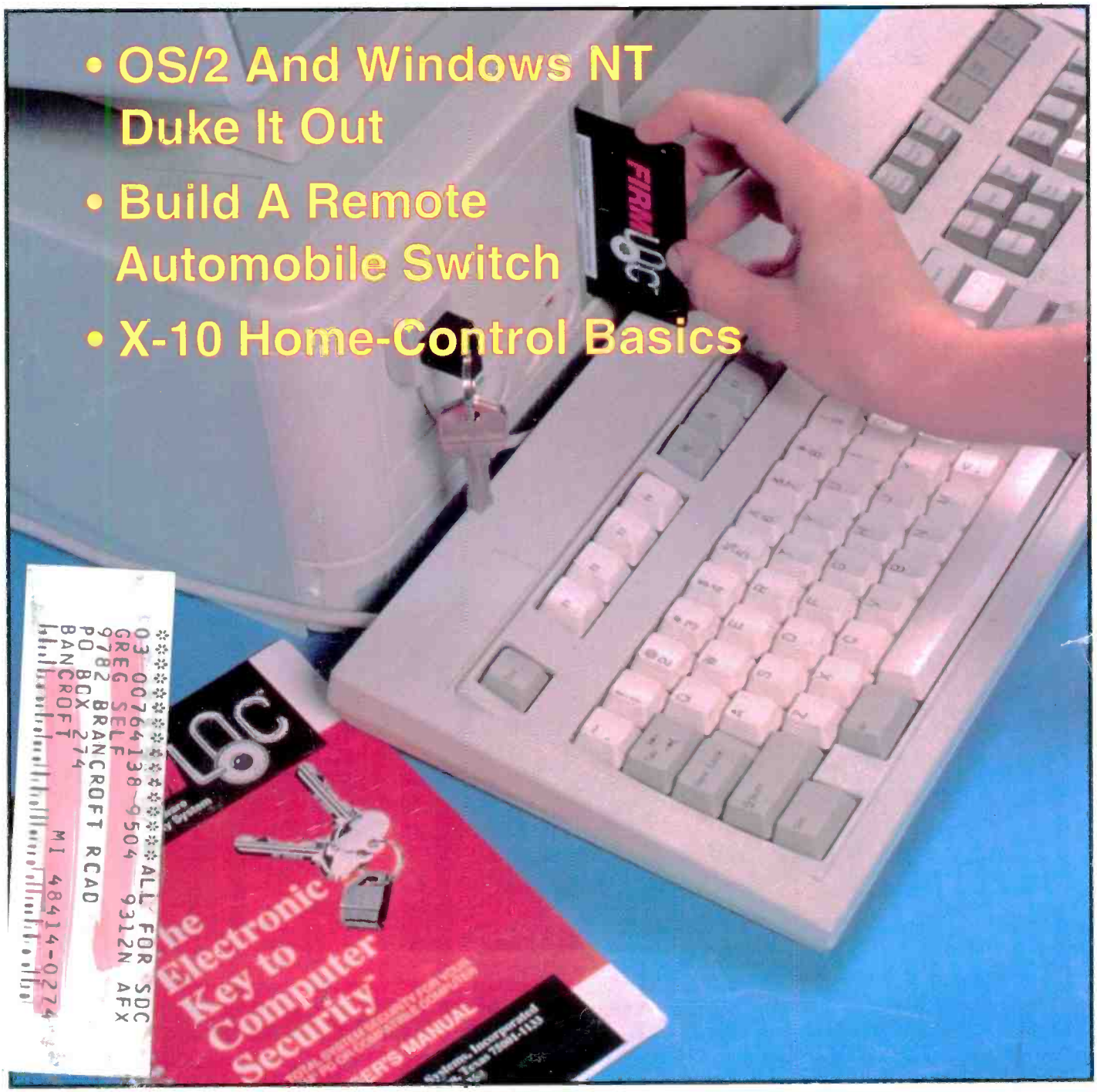
ComputerCraft

THE PRACTICAL MAGAZINE FOR PERSONAL COMPUTERS & MICROCONTROLLERS

December 1993 $2.95
(Canada $3.95)

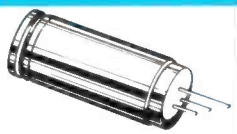


What You Should Know About Video Display Monitors

Firm Up Security With A New Hardware/Software System

More On Building A Real-World Work Robot

Collimator Pen



Output: 2.5 mW (max.); Current: 90-150 mA
Oper. Volt: 2.2-2.5V; WL: 820nm – Infrared
Size: 11mm dia. x 27mm long; Data sheet inc.

STOCK#	1-9	10-24	25+
SB1052	49.99	47.49	42.74

Collimating Lens

Black anodized aluminum barrel; Glass lens with 7.5mm focal length.
Fits 9mm laser diodes sold below.
Easy to focus and install.

STOCK#	1-9	10-24	25+
LSLENS	24.99	23.74	21.37

Dual Mode Laser Pointer

Weighs less than 2 oz.; 0.5" dia. x 6.25" long
WL: 670nm @ <1 mW (6mm beam)
Switch from continuous to pulse mode.
Uses 2 AAA batteries (inc.); 1-year warranty.

STOCK#	1-9	10-24	25+
LP35	199.99	189.99	170.99

He-Ne Laser Tube

WL: 632.8nm (red)
Output: 0.5 mW – 3 mW (our choice)
Tested to mfr. specifications; 30-day warranty.

STOCK#	1-9	10-24	25+
LT1001	69.99	66.49	59.84

He-Ne Laser Pointer

7.2" L x 1.4" W x 2.2" H; Weighs just 12 oz.
WL: 632.8nm @ <1 mW (8mm beam)
Energized at 5kV, 1.2kV continuous.
Inc. batteries, pouch, guide, 1-year warranty.

STOCK#	1-9	10-24	25+
LP100	199.99	189.99	170.99

Laser Pointer

Just 0.75" dia. x 5.25" long; 670nm @ 3.5 mW
2.5-3.5" beam @ 100 yards
Uses 2 AAA batteries (inc.); 1-year warranty.

STOCK#	1-9	10-24	25+
LSPOINTER	159.99	151.99	136.79

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0.75" dia. x 5.6" long; Weighs less than 3 oz.
670nm @ 1.9 mW (4mm x 0.6mm beam)
Batteries included; 1-year mfr. warranty.

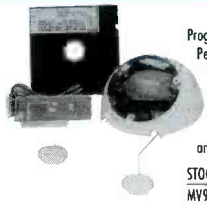
STOCK#	1-9	10-24	25+
LP3	129.99	123.49	111.14

Protoboard Design Station

Includes expanded instrumentation, breadboard, and power supply.
Ideal for analog/digital/microprocessor circuits. Frequency and function generators, variable outputs, logic indicators, speaker & more.
Size: 11.5" L x 16" W x 6.5" H
Weighs 7 pounds.

STOCK#	1-9	10-24	25+
PB503	299.99	284.99	256.49

WAO II Programmable Robotic Kit



Programmed directly via attached keypad.
Pen mechanism draws text and graphics.
128x4 bits RAM and 2K ROM included.
Uses 3 AA batteries (not included).
Optional Apple computer interface kit includes software, cable, card, and instructions.

STOCK#	1-9	10-24	25+
MV961	79.99	75.99	68.39
WIIAP (interface)	39.99	37.99	34.19

Laser Diodes

Stock#	Mfr.	WL	Output	Oper. Current	Oper. Voltage	1-9	10-24	25+
LS9220	Toshiba	660nm	3 mW	85 mA	2.5V	129.99	123.49	111.14
LS9200	Toshiba	670nm	3 mW	85 mA	2.3V	49.99	47.49	43.19
LS9211	Toshiba	670nm	5 mW	50 mA	2.3V	69.99	66.49	59.84
LS9215	Toshiba	670nm	10 mW	45 mA	2.4V	109.99	104.49	94.04
LS3200	NEC	670nm	3 mW	85 mA	2.2V	59.99	56.99	51.29
LS022	Sharp	780nm	5 mW	65 mA	1.75V	19.99	18.99	17.09
SB1053	Phillips	820nm	10 mW	90 mA	2.2V	10.99	10.44	9.40

Laser Diode Module

Complete with collimating optics and drive electronics.
WL: 660-685nm @ 0.5, 1, 2, or 3 mW
Adjustable focal length.
Connects to 3-5.25 VDC.
Compact size: 0.64" dia. x 2" long.

STOCK#	1-9	10-24	25+
LDM135-.5 (.5mW)	179.99	170.99	153.89
LDM135-1 (1mW)	189.99	180.49	162.44
LDM135-2 (2mW)	199.99	189.99	170.99
LDM135-3 (3mW)	209.99	199.49	179.54

1/4-Ton IDC Bench Assembly Press

Rotating base plate and platen. No tools required to change plates/cutting accessories. Additional accessories available.
Weighs 5.5 lbs.
10" L x 8.75" W x 9" H

STOCK#	1-9	10-24	25+
PV505	149.99	142.49	128.24

Robotic Arm Kit

Fascinating and educational, with lift/lower, grab/release, and pivot left/right functions.
Uses 2 C batteries (not inc.); Apx. 10" long.

STOCK#	1-9	10-24	25+
YO1	43.99	41.79	37.61

41 Watt Switching Power Supply

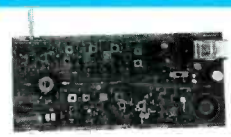
Input: 115/230V
Output: 5V @ 3.75A, 12V @ 1.5A, -12V @ 0.4A
Size: 7" L x 5.25" W x 2.5" H

STOCK#	1-9	10-24	25+
PS1003	19.99	18.99	17.09

EPROMS

STOCK#	1-24	25-99	100+
2764	3.49	3.32	2.99
27128	4.99	4.74	4.27
27256	4.59	4.36	3.92
27C256	4.09	3.89	3.50
27512	5.49	5.22	4.70
27C512	5.49	5.22	4.70
27C1024	8.99	8.54	7.69
27C2048	14.99	14.24	12.82

AM/FM Radio Kit



Includes assembly/lesson manual.
11.6" L x 5.25" W PC board;
Superheterodyne receiver.

STOCK#	1-9	10-24	25+
AMFM108	29.99	28.49	25.64

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ComputerCraft

Volume 3, No. 12, December 1993

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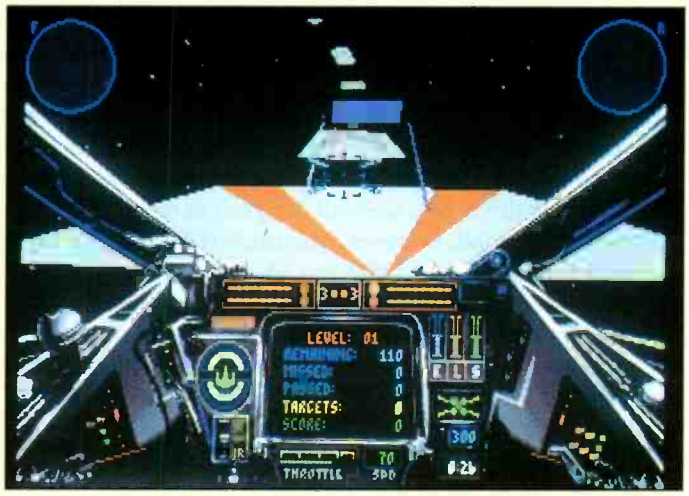

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UPGRADING & ENHANCING

APPLICATIONS

REVIEW

COLUMNS

DEPARTMENTS

ON THE COVER: Computer security, keeping your applications and files from being casually accessed and viewed by unauthorized personnel, has been a concern since the early days of computing. Various products, have come into the marketplace to guard against prying eyes, with varying degrees of success. Beginning on page 76, we discuss one of the better ones available at reasonable user cost. It's Intelligent Security's hardware/software system.

Cover Photo Courtesy of Intelligent Security Systems, Inc.

Editorial By Art Salsberg

A New Editorial Mission

During the three years of its life, *ComputerCraft* developed a loyal readership by catering to the needs of the hands-on computer user from the purely technical point of view, particularly emphasizing hardware. The initial concept of the monthly magazine was to provide support to technically-oriented computerists in their efforts to upgrade older, slower DOS-based machines to higher-performance versions, thereby avoiding obsolescence. Adding a new motherboard with faster and more memory, higher-output power supplies, math coprocessor, installing a new hard-disk drive, etc., were all designed to renew faltering computers.

During this period, however, Microsoft *Windows* and applications software for it, not to mention IBM's OS/2 and Microsoft's *Windows NT*, and DOS upgrades emerged, hand-in-hand with more-powerful computers that could manage the RAM-hungry products. At the same time came the advent of CD-ROMs and sound cards, mobile computer products with PCMCIA (Personal Computer Memory Card Interface Association) cards, higher-resolution laser printers, larger-screen color video monitors, new bus lines like local bus, and on and on.

This onslaught of new computer products emanated with a fresh twist—an economic one. Prices plunged! They dropped to the point where, frankly, it makes little financial sense to even think about upgrading an older personal computer. Our own back storeroom with piles of perfectly serviceable XT and AT clones that can't cut the mustard with contemporary software bears ample testament to this. It didn't cost much more to buy new computers than it would have to satisfactorily upgrade the old ones.

The wonders of technology converged with the power of mass production and efficient distribution. With that convergence went *ComputerCraft*'s original mission. Many of you, in fact, influenced us on the new direction we'll be taking. Requests for more information about SBCs, virtual reality, robotics, multimedia, artificial intelligence, computer graphics, desktop publishing, voice recognition, etc., have flooded into our offices. How they work and how to use them more effectively and in new ways have become paramount, shoving aside the saving of an old computer from a natural expiration.

It's a foolish publisher who ignores the needs and wants of his readers. So, effective with the January issue, *ComputerCraft* will be put to rest, re-introduced as *Microcomputer Journal*, a title crafted to reflect the more-serious mission of the magazine to a thoughtful readership. We'll be providing a print forum for exchanging ideas and techniques among a highly-technical group of computer professionals and semi-professionals whose interests are heavily hardware-oriented while not ignoring the place of software in the scheme of things. All of this will, of course, will be done without stuffiness or pomposity.

With the new title comes a new publishing frequency, too: *Microcomputer Journal* will be published six times each year, with each issue bearing a two-month date. Issues will be larger by 50% or more in terms of editorial volume. A new page design, better paper quality and square-back (perfect) binding will also appear.

Several things about *MJ* will not be new: our editorial and publishing staff and many of our highly-regarded authors. But most important is our commitment to produce excellent editorial value. So join us next year as we enter a new era in publishing for the pro and semi-pro in the field of microcomputers, and welcome to *Microcomputer Journal*.

From All Of Us At ComputerCraft, Have A Happy Season And A Great New Year!

Offices: 76 North Broadway, Hicksville, NY 11801. Telephone (516) 681-2922. FAX (516) 681-2926. ComputerCraft (ISSN 1055-5072) is published monthly by CQ Communications, Inc. Subscription prices (payable in US Dollars only): Domestic—one year $18.97, two years $36.00, three years $53.00; Canada/Mexico—one year $21.00, two years $40.00, three years $59.00; Foreign—one year $23.00, two years $44.00, three years $65.00. Foreign Air Mail—one year $76.00, two years $150.00, three years $224.00.

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Postmaster: Please send change of address notice to ComputerCraft 76 North Broadway, Hicksville, NY 11801.

What's Happening!

SEARCH TOOLS. dataDisc's new "QuickSearch" software provides CD- ROM text and image retrieval in a speedy DOS format that looks and operates like Windows but doesn't use it. It handles color and black-and-white with unlimited zooming capabilities, offers mouse or keyboard control, and includes an electronic note pad. For a demo disk, call 703-347-2111.

A Fuzzy Search Engine Developer's kit from Horizons Technology allows developers to embed a cost-effective information search and retrieval tool as a native feature in DOS or Windows applications. The Fuzzy Search Engine is said to be able to locate files anywhere on a disk or network. Contact Horizons Technology at 609-292-8331.

PHYSICIAN COMPUTER USE. BMI, a leading health-care information company, surveyed more than a half-million physicians on their computer usage. With 127,000 responses, 56.1% own IBM computers, 26.9% Apple Macintosh and 17% other brands. Modems are used by 66,408 physicians among the 127,000 respondents, while 27,278 stated that they currently own a CD-ROM drive. Most physicians say they use their computers for Word Processing (89,413), Personal Education (87,063), Office Management (51,968), Billing (48,990) and Database Access (45,726).

VOICE-COMPRESSION BREAKTHROUGH. Asani Technologies (Bloomfield Hills, MI) reports that it developed a voice-compression algorithm that compresses and restores speech at unheard of rates and sound quality. Its VCA is claimed to compress one minute of high-quality speech in 64K of memory, with the minimum being one minute of speech in 72K of memory. This 8:1 compression means that a single blank diskette can hold more than 20 minutes of speech. In comparison, Creative Labs' Sound Blaster Pro compresses speech at a ratio of only 2:1 with the equivalent quality level and a maximum ratio of only 4:1 (one minute of speech in 120K). The company says it has also developed a second VCA that provides more than 40 minutes of speech on a diskette.

ROBOT CONTEST. Sponsored by the Science Center of Connecticut, a Robot contest will be held next Spring on Sunday, April 17, 1994 in Hartford, CT. The challenge will be to build a robotic device that can move through a model of a house's single floor, look for fire (a lit candle) and then extinguish it. The model house measures 8 feet square. Contestants will be given the exact layout and official rules. The winner will be the one that finds and extinguishes the candle in the shortest time. Top prize will be $1,000; additional prizes will be given to others. Contact Jake Mendelssohn, Science Center of CT, 950 Trout Brook Dr., W. Hartford, CT 06119 or call 203-2824 ext. 46 or Prodigy: KJRP71A.

FREE FLOPTICAL BOOKLET. If you want helpful information about the floptical technology, get 3M's free "Guide to Floptical Diskette Technology." This illustrated primer explains basics about 21M Floptical technology in 21 pages. To obtain a copy, write to: 3M Data Storage Markets Div., 3M Center Building 223-5S-01, St. Paul, MN 55144.

UNIX CONVERSION TOOL. New software, "gbcomp," has been developed by Software Innovations of Nashua, NH to convert QuickBasic or PDS 7.0 BASIC programs to native C that's compatible with all standard UNIX systems. For more information, call 603-883-9300.

Windows 3.1 Advocate

• My sister, a speech pathologist who uses 12 computers in her practice, gave me a copy of your April 1993 issue. The first thing I noticed was the article "Ten Ways to Turbocharge DOS," subtitled "...power to keep *Windows* at bay just a little while longer." Why would anyone want to keep *Windows* at bay any longer?

Before I go further, I am a C programmer/technician with data-recovery skills. I counsel everyone with whom I discuss computers to learn DOS (preferably MS-DOS, as it's easier than some of the more-exotic forms available) ahead of learning just the programs they expect to use. DOS is the key to all of those programs and not learning DOS cripples the operator's ability to use his computer, as well as most of the programs he may be using for his company and himself. I just finished two years as programmer and technician for my sister's company. Every computer we placed was accompanied with the admonition: "Learn DOS!" So I'm not writing to extol the virtues of any GUI over learning DOS for program control.

Next, I personally prefer DOS control over most of my programs. I use many programs that require parameters passed on the control line, which is possible though difficult within GUI systems. Under DOS control, parameters are a snap. But I'm not totally against GUIs, especially *Windows* 3.1. I fully agree that previous versions of Windows have proven to be pieces of trash.

My system is a clone with an AMD 386SX motherboard, 4M of RAM, AMI BIOS, Microscience 120M hard drive operated under Ontrack *Disk Manager* and *SWBIOS*, 3½" and 5¼" Teac floppy drives, Data Technologies controller card, Western Digital clone of a Paradise VGA card with 1M of video RAM and Supercom 0.31-mm pitch VGA video monitor. Furthermore, I run a Covox internal DMA voice card. So you can see that my system is kind of mixed up. With all of the conflicts possible with this olio, I have no problems tuning *Windows* 3.1. It starts and runs perfectly, and I've yet to see the dreaded "Unable to run..." message I encountered so often in previous versions of *Windows*. I use *Windows* for most of my games and especially for word processing. Since I use a Citizen 200GX full-graphics-compatible printer, I'm able to take full advantage of *TrueType* fonts that *Windows* supports.

Windows 3.1 doesn't use up my memory, either. Under *Windows*, and after loading my initial 13 TSR and control programs, I still have 608.4K in conventional memory available. If I were to be using OS/2, I estimate I'd be at less than 500K at the point of opening an applications program. So *Windows* is the more-useful program to me. Another plus for *Windows* is that it can just minimize one program, such as my word processor, open a calculator and perform a function, and then drop the calculator and reopen the word processor to continue my project, all in seconds, rather than closing one, opening the other, closing it and reopening the first. Since my time, even my spare time, is worth up to $100 per hour, I try not to waste even seconds. In its ease of operation and power, *Windows* makes this much easier for me.

Setting up an application is easy under the window that pops up and asks all of the necessary questions. Of course, if the program requires input parameters, I usually don't use it under *Windows*. But there's even a provision for this. The initial setup for a game or application program is shorter and much easier than most other GUIs (I also use *Point and Shoot* by Vartech and have NDOS and 4DOS and three or four other small desktop controllers). If you don't know the exact setup you need, you can browse and choose from a list, which inputs the proper path, etc. If you really don't know what you're after, you can let *Windows* Setup look for the application and answer the questions as they come up. I've yet to have a problem that needed using the answer-line at Microsoft.

So, from a confirmed DOS proponent, *Windows* 3.1 is not something to be kept at bay, but embraced...kind of like you would a cactus...embrace it, but with proper care

Don Voyles
Worland, WY

Corrections

• I noticed that while reading the Note at the end of the Parts List in My October article, "Build a Z8 BASIC Computer/Controller," that the incorrect telephone number was printed. Readers who might have tried and failed to reach me at the number given to order a kit or parts for COD delivery should call me at 405-681-9979.

Steve Montgomery
Montgomery Engineering
Oklahoma City, OK

• We appreciate your review of our product, Matinee, in the "Multimedia Accessories and Software" article in the September issue. However, please take note that our company name is Access Softek, not Access Software.

Ann Burgraff
Access Softek
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* Student must have access to a personal computer system.

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Low-Voltage Notebook

Panasonic's CF-1000A notebook computer features a Cyrix 3.3-volt 25-MHz 486SLC/e microprocessor and a detachable floppy-disk drive that can be easily replaced with an additional battery. It weighs 5 pounds and measures 1¼" thick. An 80M or 170M hard disk, combined with *SuperStor* disk-compression utility, offers capacities of 150M or 330M. The notebook comes standard with 4M of RAM and is expandable to 12M.

Other features include 640 X 480 VGA display with FL sidelight, five standard ports (including PCMCIA II) and two internal slots. $1,999. *Panasonic Communications & Systems Co., Two Panasonic Way, Secaucus, NJ 07094; tel.: 800-742-8086.*

CIRCLE NO. 1 ON FREE CARD

Color Printing

Seikosha's nine-pin Model SP-2450 narrow-carriage desktop Color Printer offers full-color text and graphics. It's compatible with popular applications through its IBM ProPrinter III and Epson FX-850 emulations plus color extensions. The printer prints graphics at 240 X 216-dpi resolution and comes

with four resident letter-quality fonts. $399. *Seikosha America, Inc., 10 Industrial Ave., Mahwah, NJ 07430; tel.: 201-327-7277; fax: 201-818-9075.*

CIRCLE NO. 2 ON FREE CARD

Video Monitors

IBM Personal Computer Co. has a new family of monitors—designated the 14V, 15V, 14P, and 15P—that run on all major PC platforms. The new multi-scanning monitors support all popular display modes, including VGA, SVGA, XGA and XGA2. They're claimed to meet or exceed the EPA's Energy Star requirements for power management and support the latest power management protocol defined by VESA. The 14P and 15P permit suitably configured operating systems to take monitors down to an 8-watt sleep mode level when the system isn't being used. The 14V and 15V power down to 30 watts.

These monitors comply with MPR-II, the Swedish guidelines for low electromagnetic emissions. Additionally, they meet ISO standard 9241-3, which specifies ergonomic design and certain front-of-screen criteria. An environmental benefit is that the plastic casing and many other parts are recyclable. A lift-tilt-swivel stand is available as an option.

Anti-glare-treated screens and a total of 10 front-mounted digital controls, including a setting that corrects for pincushioning are featured on these monitors. On-board memory can store up to 26 screen modes, 11 of which are user-definable, and recall them each time the applications are run. Storing settings is automatic. After 5 seconds of use, the setting is in memory.

An MM-1 audio option available for all monitors features two 5-watt/channel speakers, microphone and an amplifier built into a fully integrated, low-profile module that sits under the monitors and is claimed to work with all audio cards.

Also available from IBM is the new Model 9504, a 21" high-resolution monochrome monitor that features 1,600 X 1,280 resolution at 77-Hz refresh rate. It complies with the MPR-II emissions guideline and ISO standard 9241-3. $520/$693/$633/$807/$187/$1,333 for 14V/15V/14P/15P/ MM-1/Model 9504. *International Business Machines Corp., 1133 Westchester Ave., White Plains, NY 10604.*

CIRCLE NO. 3 ON FREE CARD

Entry-Level Sound

Pro Audio 16 Basic is an entry-level version of the Media Vision's AudioSpectrum 16 add-in sound card. The Pro Audio 16 Basic is compliant with both the MPC and MPC2 standards and offers 16-bit stereo digital audio recording and playback to 44.1 kHz (CD-audio rates), an on-board FM synthesizer (Yamaha OPL-3), a software controlled mixer, MIDI support and a game port. It features a *QuickStart* intelligent installation program that eliminates the complex installation procedure usually associated with sound cards.

The Pro Audio 16 Basic supports the MS-DOS, *Windows* 3.1, *NT*, OS/2 2.1, and *NextStep* operating systems and is claimed to be 100% compatible with Pro AudioSpectrum 16. It's also backward compatible with Sound Blaster and Ad Lib boards. The Pro Audio 16 Basic comes bundled with DOS and *Windows* software, including Media Vision's *Pocket Tools* and *Knowledge Adventure's Dinosaur Adventure*. $199. *Media Vision, 3185 Laurelview Ct., Fremont, CA 94538; tel.: 800-348-7116; fax: 510-623-5749.*

CIRCLE NO. 4 ON FREE CARD

Parallel-Port Scanner

Logitech's ScanMan EasyTouch is a hand-held 256-level gray-scale, *Windows*-based scanner that connects to a PC via its parallel port and includes Logitech's *FotoTouch* Version 1.2 color image-editing software and *OmniPage Direct AnyFont* OCR software.

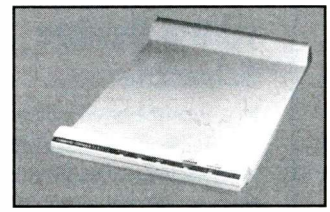
ScanMan EasyTouch features a totally redesigned case. You hold the unit with your hand extended straight out from your wrist. To facilitate straight, smooth scanning, the main roller now is made of a polycarbonate material that can be more precisely machined to perfect roundness.

ScanMan EasyTouch plugs directly into the parallel port of a computer. A special pass-through adapter permits you to operate a printer through the same port without disconnecting the scanner. Programmability of the scanner head enables you to set resolution, scan mode and contrast through software, resulting in a near-button-less head. The TWAIN-compliant scanning software included with the product contains Logitech's AutoStitch feature, which automatically merges multiple strips to produce images up to 15" wide. $399. *Logitech, Inc., 6505 Kaiser Dr., Fremont, CA 94555; tel.: 510-795-8500; fax: 510-792-8901.*

CIRCLE NO. 5 ON FREE CARD

Compact Surge Suppresser

Command Console Compact from Tripp Lite is an under-monitor surge suppresser that provides fingertip control of an entire computer setup. It features Tripp Lite ISOBAR surge suppression with four spike-and-noise-filtered ac outlets that provide 420 joules of surge absorption. Command Console Compact also has advanced diagnostics that indicate faulty



wiring, reverse polarity and damage to protection circuitry. Included with the product is Ultimate Lifetime Insurance that guarantees connected equipment against surge damage, including direct lightning strikes, for up to $5,000. Command Console Compact is UL 1449 listed for 330-volt let-through. $79.95. *Tripp Lite, 500 N. Orleans, Chicago, IL 60610; tel.: 312-329-1777; fax: 312-644-6505.*

CIRCLE NO. 6 ON FREE CARD

Fax On Demand

Talking Technology's FaxmOuth is a complete fax-on-demand add-on package for the BigmOuth single-line voice processing system. FaxmOuth works in conjunction with BigmOuth. With FaxmOuth, you can leave voice-mail messages

using BigmOuth and request faxed documents during the same telephone call. FaxmOuth also allows callers to be transferred to a live attendant.

With FaxmOuth, a caller can retrieve documents stored in a file and have them faxed to any selected fax number. FaxmOuth asks a caller for a fax number. After the caller inputs the fax number on his telephone key pad, FaxmOuth calls and delivers the requested information. FaxmOuth comes with a Class 2 fax card and software. $199. *Talking Technology, Inc., 1125 Atlantic Ave., Alameda, CA 94501; tel.: 510-522-3800; fax: 510-522-5556.*

CIRCLE NO. 7 ON FREE CARD

Software Coprocessor

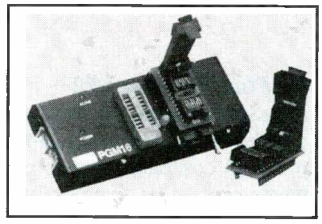
Q387 Version 3.5 Math Accelerator and Emulator from QuickWare is a cost-effective alternative to an 80x87 math coprocessor chip. The program allows all owners of 486SX, 486SLC, 386Dx and 386SX based PCs to run programs, such as all releases of *AutoCAD*, that normally require a math coprocessor to run. According to the company, *Q387* speeds up coprocessor optional graphics and CAD programs by as much as 400% on machines that have no math coprocessors. The program is said to be compatible with all DOS, DOS-extender and *Windows* applications. It offers laptop and notebook users the additional advantage of extending battery life by up to 25%, since the program draws power only when math operations are performed.

Q387 is distributed as an upgradeable demo to allow anyone to fully evaluate the capabilities of the product before registering. You can obtain the demo free of charge from the QuickWare BBS at 512-292-1212. $25. *QuickWare, P.O. Box 684652, Austin, TX 78658; tel.: 512-280-1452.*

CIRCLE NO. 8 ON FREE CARD

Pocket Programmer

Advanced Transdata's pocket-sized, compact and portable



PGM16 programmer supports Microchip's entire series of PIC16Cxx microcontrollers, including PIC16C5x, PIC16C71 and the newest PIC16C84, a CMOS eight-bit microcontroller with 64 bytes of on-chip EEPROM data memory. The PGM16 weighs only 5 ounces, runs on any PC/compatible computers, including laptop and notebook computers, and operates transparently via a parallel printer port. It comes with 18- and 28-pin ZIF sockets. Optional adapters, latched inside the 28-pin ZIF socket, are available to program PIC16Cxx SOIC parts.

PGM16 programs all configuration parameters in the PIC-16Cxx design, including oscillator type, watchdog timer, power-up timer, customer ID and code protection. Auto programming, which combines blank check, program and verify into a single step, takes only 5 to 10 seconds.

PGM16's driver software features an easy-to-use windowed user interface with pull-down menus, pop-up dialog boxes, function keys, on-line text sensitive help and mouse support. Both program and data memory windows feature a text editor in which codes can be modified directly and saved. Supported formats include Intel Hex and binary. $245. *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

24-Bit Graphics Accelerator

The Pegasus PCI from STB is a PCI local-bus-compatible graphics accelerator that's capable of displaying 16.7-million colors at resolutions ranging up to 1,024 X 768. Based on the S3 86C928 video controller, the product comes in two configu-

rations. The base configuration includes 4M of VRAM and supports resolutions up to 1,024 X 768 at 16.7-million colors and up to 256 colors at 1,600 X 1,200 non-interlaced. The product will also be offered in a 2M configuration that provides 64K colors at up to 1,024 X 768 resolution and a maximum of 256 colors at 1,280 X 1,024 resolution. Refresh rates supported are 60, 72, 76 and 80 Hz.

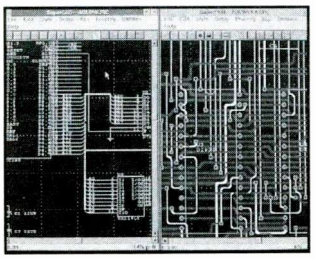
To simplify installation and provide easy access to configuration menus, the Pegasus PCI comes with a Winstall utility that makes it possible to change monitor resolution and color settings from a *Windows* menu. Also included is PowerStar, a power-management utility that lets you reduce your monitor's power usage after a specified time period. This utility works with monitors that support the new VESA specification for power reduction.

The Pegasus PCI comes standard with a BNC-style RGB connector and VGA 15-pin D-shell connector and includes drivers for *Windows* 3.x and *NT*, OS/2, SCO *Open Desktop*, *Uniware*, *X-Windows* and major CAD/CAM platforms. $999/$799 4M/2M. *STB Systems, Inc., 1651 N. Glenville, Richardson, TX 75085-0957; tel.: 214-234-8750; fax: 214-234-1306.*

CIRCLE NO. 10 ON FREE CARD

Windows PCB CAD

Mental Automation's *Super-PCB for Windows* is an affordable CAD package for two-layer PCB artwork. Major features include visually-cued command entry, library support, easy-to-use object-entry commands, easy-to-use graphics-edit commands, advanced



editing features, built-in autorouter, multiple circuit layers, large boards/high resolution, flexible output, draw-to-fit and zoom operation and on-line manual. A 16-layer version is available at slightly greater cost. $149. *Mental Automation, Inc., 5415 136 Pl. SE, Bellevue, WA 98006; tel.: 206-641-2141.*

CIRCLE NO. 11 ON FREE CARD

AI Information Management

Naturel-Info, is an information management/text-retrieval software package from Ardilog, allows you to search in "natural language." You can express a query can in natural language (for example, plain English) and, with the use of AI, *Naturel-Info* intuitively inserts the appropriate "Boolean Logic" into the query. Furthermore, using five separate relevance factors—presence, proximity, order, concentration and weighted statistical importance of each word—results are automatically sorted, ranked and displayed by the most-relevant paragraph, instead of entire files. The program operates as a TSR and can automatically open the application that created the file with which it is dealing—for instance, *WordPerfect*.

Other functions, such as cut and paste, and the ability to create powerful macro commands that automate frequently-used search queries, provide perfect add-on features to *WordPerfect* (DOS) users. $79. *Ardilog Inc., 1000, boul. St.-Jean, Ste. 406, Pointe-Claire, QB, Canada H9R 5P1; tel.: 514- 694-9500; fax: 514-694-3784.*

CIRCLE NO. 12 ON FREE CARD

A/D Card

Precis, from Deus Ex Machina Engineering, is an A/D ISA-bus expansion card based on the Motorola MC56ADC16S sigma-delta modulation conversion chip. It doesn't require an anti-aliasing filter or sample-and-hold amplifier because they're obviated by the converter's topology. The architecture of a sigma-delta converter is uniquely suited to life inside a computer because it's tolerant of digital switching noise and doesn't require and analog front end. Requirements are an eight-bit slot, DOS 2.11 or later, graphics card and monitor.

Passband cutoff frequency is 45.5 kHz at a 100-kHz sample rate, with a 90 dB S/N. Base address is jumper selected. No interrupts are generated, and no "above 640K" memory is used. Output coding is 16-bit 2's complement. *Deus Ex Machina Engineering, 1390 Carling Dr., Ste. 108, Saint Paul, MN 55108; tel.: 612-645-8088.*

CIRCLE NO. 13 ON FREE CARD

Envelope Printer

Autotime's Laserbuddy is a unique hardware unit that attaches to any HP or compati-

Software Updates

QAPlus Version 4.72

DiagSoft's Version 4.72 of the *QAPlus* diagnostic program for personal computers offers enhancements that include upgraded component tests and system information reporting. This new version has an additional video-test selection—SVGA—for systems that use Western Digital/Paradise-compatible video adapters. An enhanced hardware configuration report now identifies drives compressed with the DoubleSpace utility in MS-DOS 6.0. The report also identifies Intel's Pentium processor. Additional computer systems, including the Toshiba and HP lines, are now identified during the hardware configuration check. An enhanced memory map report now identifies QEMM high RAM areas and DOS programs loaded in those areas. Finally, an enhanced IRQ report now identifies IRQs generated by the Microsoft Sound Card and Sound Blaster. $159.95. *DiagSoft, Inc., 5615 Scotts Valley Dr., Ste. 140, Scotts Valley, CA 95066; tel.: 408-438-8247; fax: 408-438-7113.*

CIRCLE NO. 14 ON FREE CARD

Easydij Version 8.1

Easydij Version 8.1 from Geocomp menu-driven software for digitizing and measuring provides two digitizing functions using a digitizer tablet. One lets you digitize coordinates from maps or charts, while the other lets you measure scaled length and area from any scale map or drawing. *Easydij* now lets you work with latitude/longitude or rectangular coordinates with azimuths between points. Also, it now can digitize coordinates directly into a .DXF or .DBF file and save digitized measured data into a .DBF file. Finally, the program now does automatic conversion of degrees-minutes-seconds to decimal degrees. Version 8.1 is claimed to support all the latest digitizers on the market. $390. *Geocomp, Ltd., 749 Van Gordon Ct., Golden, CO 80401; tel.: 303-233-1250.*

CIRCLE NO. 15 ON FREE CARD

EZ-Install Version 5.0

EZ-Install Installation Aid from The Software Factory is an installation tool kit for software professionals. The tool kit assists developers in overcoming the problem of getting software properly installed on end users' machines in DOS, *Windows* and OS/2 environments. Version 5.0 features automated distribution-disk setup and disk building, which permits software developers to tag directories of files to be included on distribution disks. *EZ-Install* automatically collects the files, compresses them and splits them across multiple disks.

The new version also incorporates, within the DOS version, full capabilities for installing *Windows*-based applications. These capabilities include automated modification of *Windows* .INI files and group and icon updating. Other enhancements provide additional flexibility in the Installation Aid environment and easier modification of the base installation source programs when needed. $249/$349. DOS/OS/2. *The Software Factory, Inc., 13612 Midway Rd., Ste. 246, Dallas, TX 75244; tel.: 214-490-0835; fax: 214-490-9520.*

CIRCLE NO. 16 ON FREE CARD

ble laser printer. It scans any document sent to the printer and captures an available address. The address can then be printed onto an envelope or label, without any keystrokes. Laserbuddy can be programmed to print a customized label that may include return address, postal codes and/or shipping methods. An advanced option allows you to print an entire envelope, including return address and any special postal permit codes desired. Laserbuddy's "hi-density" feature enables you to print four pages of text or graphics onto a single sheet of paper. $249. *Autotime Corp., 6605 SW Macadam Ave., Portland, OR 97201; tel.: 510-452-8577; fax: 503-452-8495.*

CIRCLE NO. 17 ON FREE CARD

Serial-Port Converters

ICS has a pair of plug-in converters that transform aN RS-232 serial port into and RS-422 or RS-485 port. The converters are available with male and female connectors and are de-

signed to plug directly Into any device with a 25-pin RS-232 serial port. TheY handle baud rates over 115.2K and extenD to distance greater than 1,200 meters, much than can be accomplished with an RS-232 port.

Both converters can easily be configured in the field to operate as DCE or DTE devices. All serial signal connections are made by screw terminals. $150 each. *ICS Electronics Corp., 744 S. Hillview Drive, Milpitas, CA 95035-5455; tel.: 408-263-5500; fax: 408-263-5896.*

CIRCLE NO. 18 ON FREE CARD

Thinnet LAN Help

LAN-Line by AMP is a wire-management product that significantly speeds and simplifies the process of adding to, moving and changing the configuration of a thinnet LAN. The patented tap and connector in this unique product enable the systems engineer to plug and unplug workstations on a LAN and complete many trouble-shooting tasks without bringing the network down. LAN-Line, an AMP product, is featured in the latest Jensen Tools Catalog. *Jensen Tools, Inc., 7815 S. 46 St., Phoenix, AZ 85044; tel.: 602-968-6241.*

CIRCLE NO. 19 ON FREE CARD

Notebook Attaché

Zero Halliburton has a thinner version of its deep-drawn aluminum computer case. The new case measures 18.5" X 13.5" X 4" and is suitable for transporting the new thinner notebook computers. The case features a removable portfolio and movable cushioned divider. It's constructed of aircraft-quality aluminum and is dust- and moisture-resistant. Each case comes with a three-digit combination lock. The case is claimed to be designed to survive the most rigorous travel conditions. *Zero Halliburton, 200 N. 500 W., N. Salt Lake, UT 84054; tel.: 801-299 7355; fax: 801-299-7350.*

CIRCLE NO. 20 ON FREE CARD

MS to the Max

By Dan Gookin

(Microsoft Press. Soft cover. 336 pages, one 3½" disk. $29.95.)

If you have a basic familiarity with the workings of DOS, Dan Gookin will help you push the operating system to fuller use so that you can exploit your computer's operation more fully. He works with MS-DOS 6.0, while also covering older DOS versions. From organizing to manipulating files to livening up your command prompt, the author relentlessly covers little ways in which to get more power from a PC, as well as tips on buying a new hard drive. Accompanied by a disk that contains a bevy of new utilities, as well older tried-and-true commands, this is an easy-reading book to boost your PC operating know-how and productivity. It's written in a lively manner, too.

OS/2 and *Windows NT* Duke It Out

In a toe-to-toe slugfest between OS/2 and *Windows NT*, the outcome may surprise you.

By TJ Byers

The long-awaited *Windows NT* has finally arrived, and so has IBM's "final" version of OS/2. Both bring new levels of power and more embedded features to desktop computing. But is either one the best choice for your computing needs? In this article, I'll explore this burning question, but the answer in your particular situation depends entirely on your need

When talking about powerful, sophisticated operating systems like OS/2 and *Windows NT*, the question is: Do you need more power, memory and/or multitasking? Another is whether or not you need more freedom of choice. If the answer to any of these questions is Yes, you obviously need more than DOS and *Windows* provide, and the logical alternatives are OS/2 and *Windows NT*.

Both operating systems promise to run most 16-bit DOS and *Windows* applications in addition to a new generation of 32-bit applications now working their way through the pipeline. Once the new applications are written, there should be a vast improvement in both speed and flexibility.

In this article, I compare OS/2 2.1 and *Windows NT* for features, ease of use and speed. I'll also look at the software that's coming out for the new operating systems and talk about how upgrading to one of the new operating systems might affect your hardware peripherals.

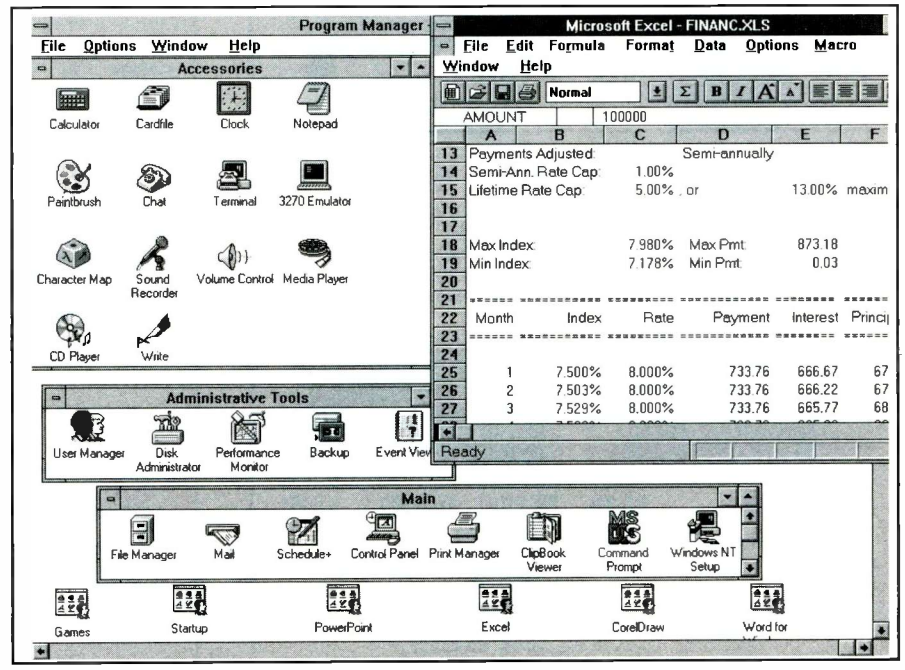
Overview

The appeal of OS/2 or *Windows NT* can be summed up in one word: Power. Unlike the DOS and *Windows* 3.1 duo, both OS/2 and *Window NT* can easily and safely juggle several CPU-intensive jobs simultaneously. For example, you can open and edit one file while formatting or printing another. The 32-bit architecture also promises faster memory access and swifter calculations.

Both operating systems have preemptive multitasking, which allows you to run several programs simultaneously without the frequent crashes you've probably been experiencing under *Windows* 3.1. This is done using multithreading. Each thread is similar to a lightweight process (versus time-sliced multiple processes). In *Windows* 3.1, an application needs to release the thread of execution before the CPU can switch tasks. In OS/2 and *Windows NT*, the system can preempt the application and switch whenever a higher-priority task arrives, such as if the mouse moves. There's no need to wait for a process to complete before starting another one.

Compared to *Windows* 3.1, OS/2's and *Windows NT*'s advanced features are light-years ahead of *Windows* 3.1. This is because both are a true operating systems, each of which can stand on its own. *Windows* 3.1, on the other hand, needs the support of the DOS operating system to work. So unlike DOS, which needs to be tricked into handling more than 1M of RAM, both OS/2 and *Windows NT* can address up to 4 gigabytes of memory as a matter of course.

While similar in many ways, each operating system has its own unique list of features and graphical interface. OS/2's flexible desktop interface has a strong Macintosh look, with its distinctive application folders and shredder (the equivalent of Mac's trash can) icon. *Windows NT* looks and feels just like



Windows NT has the look and feel of *Windows* 3.1.

Windows and offers built-in networking plus multiple processor support, which permits symmetric multi-processing on systems that have more than one processor, such as those from Compaq, NCR and AST.

Now let's see what one of these new operating systems can do for you, the average desktop user.

Price

Price isn't usually a consideration when shopping for an operating system, but the price difference between OS/2 and *Windows NT* is significant enough to talk about.

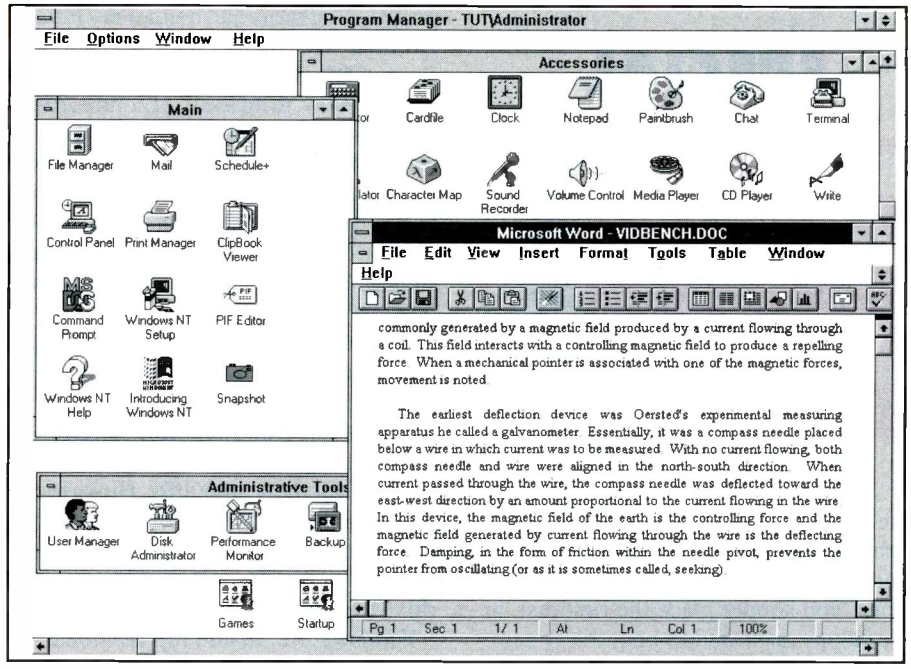
With a list price of $495 for the full package, *Windows NT* is far and away the more-expensive of the two operating systems. Fortunately, you don't have to buy the full package. If you already have DOS and *Windows* 3.1, all you need is an upgrade. However, even the upgrade, which lists for $295, costs more than $100 more than OS/2's upgrade, which lists for $169. However, *Windows NT* gives you more application-level features than OS/2 does. For example, it comes with built-in networking and backup. If you wish to add these features to OS/2, it's going to cost you more than the price difference between the two operating systems. This isn't to say OS/2 is lacking, because it has features not found in *Windows NT*, such as enhanced batch-file programming and a boot manager.

System Requirements

Windows NT also places a heavy burden on your PC's resources. The files alone take up 66M of hard-disk space, which means you'll need a 200M hard disk or larger if you plan to add any applications. Fortunately, the built-in hard-disk manager can handle disk drives or disk farms with total storage capacity up to 17 billion bytes (that's 17 *giga*bytes!), so you have virtually unlimited room in which to work.

The absolute minimum RAM requirement for *NT* is a healthy 8M, and 16M is highly recommended. With today's high RAM prices, it's likely most users will settle for the bare minimum and take the speed hit encumbered by heavy disk swapping.

OS/2 fares better, taking a smaller bite out of your PC's valuable resources. RAM requirements are a modest 4M, with 6M recommended. A full installation uses only 40M of hard-disk space, and a minimum setup uses just 20M of hard-disk space, making OS/2 suitable for notebook use.

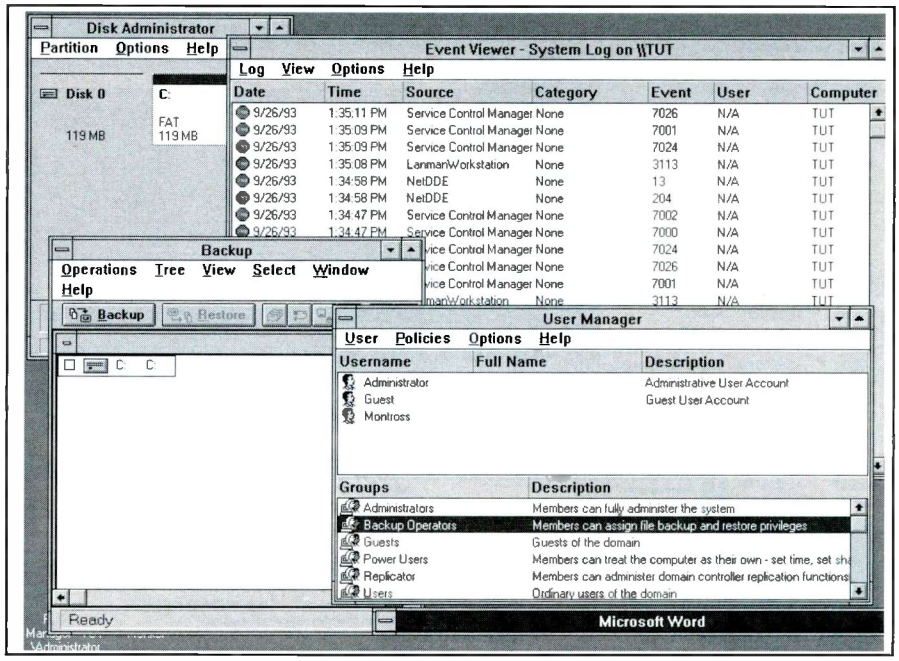


Though both OS/2 and *Windows NT* systems run most 6-bit DOS and *Windows* applications, they run slower than under *Windows* 3.1. New 32-bit applications should improve speed considerably.

Installation & Setup

One of the most difficult parts of upgrading to OS/2 or *Windows NT* is the installation process itself. If you elect to use the CD-ROM edition, you may have trouble finding a compatible CD-ROM drive, and the floppy-disk versions have you shuffling more than 20 diskettes. Furthermore, the different installation options and setup permutations have more choices than you'll find on a McDonald's menu.

• ***OS/2.*** The more temperamental of the two products, especially if you opt for



NT's Adminstrator's Toolbox includes disk-management backup, event viewer and user-manager utilities.

the CD-ROM version, is OS/2. This package comes with two floppy disks and a CD-ROM. According to the directions, you simply place the first disk in the floppy drive and re-boot the system. After this, the installation program automatically copies the OS/2 files from the CD-ROM to your hard disk. Great in theory, but not in practice.

For installation , you first you need a SCSI CD-ROM—not just any SCSI CD-ROM, but one that OS/2 supports. These include NEC, Sony and Toshiba, among others, drives. Secondly, you need a compatible SCSI controller card, which are available from Adaptec, DPT, Future Domain and IBM. Lastly, you have to match the controller and CD-ROM because not all combinations are supported. As it turns out, neither my Future Domain TMC-950 controller nor my Sony CDR-34 were on the list—but I tried anyway, to no avail, of course. Even using the supported Adaptec 1542B controller wouldn't budge the CD-ROM drive into compliance. The support list is heavily weighted towards expensive ($700) double-speed CD-ROM drives, such as Sony's CDU-541 and Toshiba's XM-3401.

So it was back to Egghead to exchange the CD-ROM package for one with 3½" floppy disks, with a check for $25 in hand to pay for the price difference between the two packages. This time, things went more smoothly. However, it took about 1½ hours to copy everything over to my hard disk, during which time I had to spoon-feed 26 diskettes to the drive (some more than once).

• ***Windows NT.*** While the *Windows NT* installation took the same amount of time, about 1½ hours, at least I didn't have to baby-sit it. Unlike OS/2, *Windows NT*'s installation program works with just about any CD-ROM drive, including my non-SCSI Sony CDU-31A with proprietary controller. The secret is starting the installation from DOS, where your CONFIG.SYS file can set the environment for CD-ROM access.

The *NT* installation process is very straightforward. You simply access the CD-ROM, move to the installation directory and enter a command from the DOS prompt. That's it. After you supply answers to a few preliminary setup questions, installation goes on autopilot. While I wasn't able to use my PC for other chores during installation, I could stretch my legs and do battle with the coffee machine.

If you have an SCSI CD-ROM that's supported by *Windows NT*, it's even simpler. Place the start-up disk in the floppy drive and re-boot. But like OS/2, drive support tends towards high-end, double-speed SCSI drives. A 3½" floppy disk version is available for the same price.

During the installation process, you're given choices. For example, you need to tell the operating system which features to load, where to put the swap file and specify the printer and video types. In addition, *Windows NT* has built-in security to protect your system and data from those who shouldn't see it, which requires you to set up user access profiles and passwords. And if you decide to use the built-in networking features *Windows NT* provides, you have another parade of menus to negotiate.

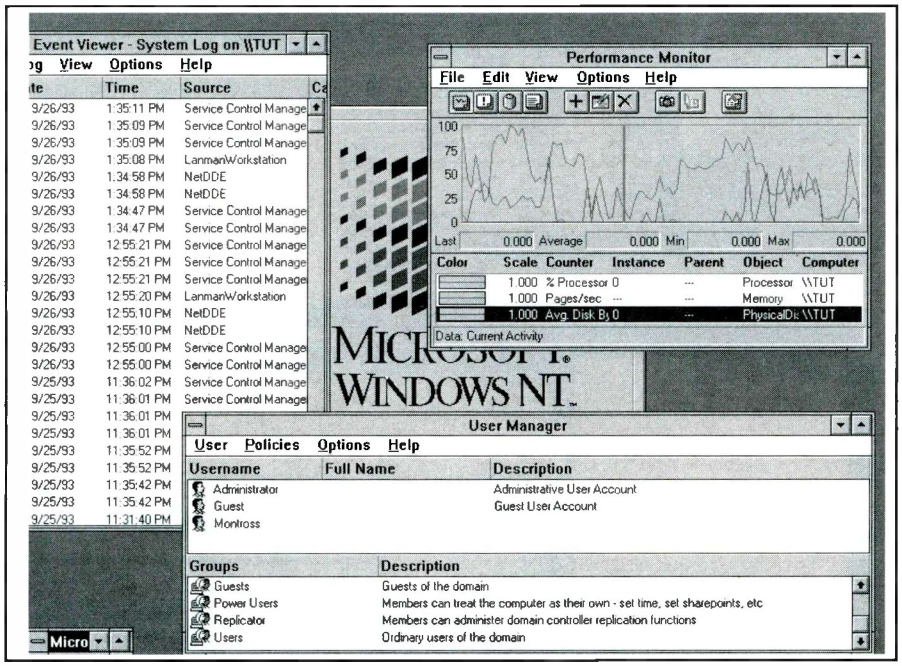
When adding OS/2 or *Windows NT* to a system that contains DOS and *Windows* applications, you need to port over the installed applications (OS/2 calls it "migrating") before they'll run properly. OS/2 lets you select which applications to include and which to leave alone, *Windows NT* doesn't.

Both OS/2 and *Windows NT* let you choose between adding the new operating system to your existing DOS and *Windows* or installing the new operating system as the only operating system.

Multiple Operating Systems

While most DOS programs run in the OS/2 or *Windows NT* environment, there are situations in which you might want to run exclusively from your DOS or *Windows* 3.1 environment, such as, for example, when running some games or doing high-speed modem communications. Or you may want to be able to boot from a different operating system, such as AIX or UNIX.

During installation, OS/2 lets you set up the system to boot from one or more operating systems. If you need to use multiple operating systems, OS/2's boot manager lets you select any one of the installed operating systems from the boot-manger startup menu. An example of OS/2 boot choices may include DOS, AIX, UNIX and OS/2. These choices



NT's performance monitor displays system activity that can be used to fine-tune the environment.

would be available each time you start the system, but only one can be selected as the operating system.

Although *Windows NT* doesn't have a boot-manager equivalent, it does give you a choice of DOS or *Windows NT* boot if you install the program over an existing DOS environment. Furthermore, you can include *Windows NT* as one of the OS/2 boot-manager choices. If you have a library of 32-bit OS/2 applications, this may be a viable option because *Windows NT* can't run 32-bit OS/2 applications, only 16-bit OS/2 applications. If you're having problems running DOS programs from *Windows NT*'s DOS shell, the system can be booted from a floppy disk and the DOS applications can be run *without Windows NT* involvement.

Performance Promises

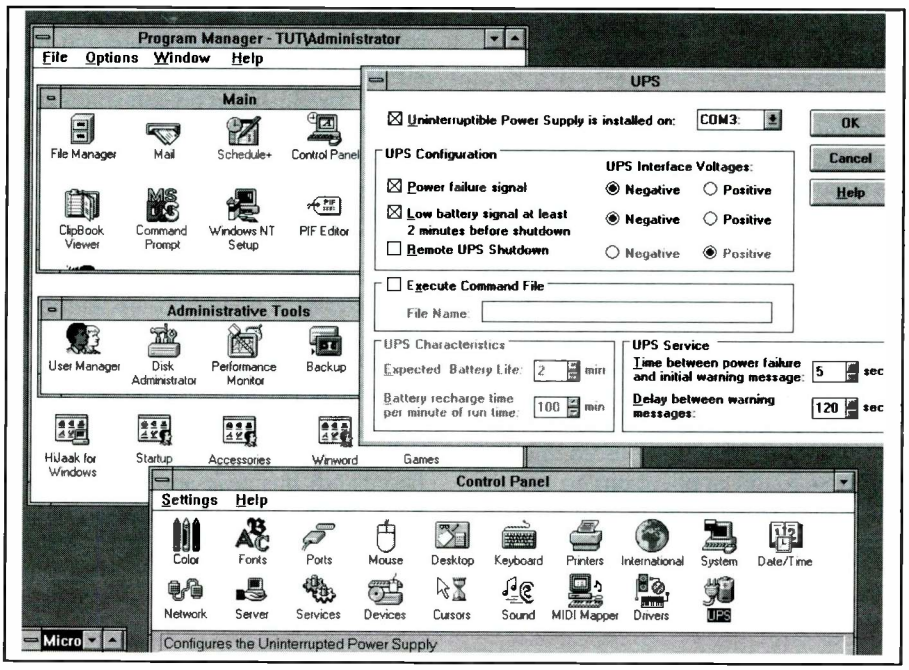
Theoretically, 32-bit applications running under OS/2 or *Windows NT* should be faster than their 16-bit counterparts running under *Windows* 3.1. Unfortunately, I couldn't find an application that spanned all three arenas, so I couldn't make a speed comparison. However, it's likely that most users won't rush out to replace their software libraries with new, more-expensive 32-bit applications, anyway. Instead, they'll make do with their existing 16-bit DOS and *Windows* applications until the next significant upgrade of the packages come along or until their workloads demand more power. It was on this platform that the speed tests were performed.

Overall, 16-bit applications run more slowly under OS/2 and *Windows NT* than they do under DOS and *Windows* 3.1. Surprisingly, OS/2 runs 16-bit *Windows* applications faster than does *Windows NT*. And for some printer applications, such as printing a large manuscript from *Word for Windows*, OS/2 is even faster than *Windows* 3.1. *Windows NT* is horribly slow at printing from 16-bit applications, taking up to ten times longer than *Windows* 3.1 in some cases.

This is because of the high overhead imposed by *Windows NT*. Ideally, *Windows NT* needs 16M of RAM. However, most users are hard pressed to provide 8M because of various reasons, price not being a little concern. So all of the testing was done with just 8M of RAM. OS/2 loved it; *Windows NT* barely tolerated it, and it shows. For example, the *Power Point* benchmark, which took less than 5 minutes running under *Windows* 3.1 and OS/2, took a whopping 52 minutes running under *Windows NT*!

Included Protocol Software

Protocol Software	Description
NetBEUI 3.0	Based on the NetBIOS interface, this is a small, efficient, and fast protocol tuned for small LANs. It is installed automatically with Windows NT.
TCP/IP	Provides communications across wide area networks (WANs) and routers, and is the protocol recognized by a variety of UNIX systems and Internet.
Data Link Control	Not designed to be a primary protocol for use between PCs. It's useful if your computer needs to access IBM mainframe computers or if you are setting up a printer that attaches directly to the net-work.



The UPS utility in *NT* monitors for power failure and brownouts by monitoring signals from a battery-powered uninterruptible power supply via a serial port.

Compatibility Compromises

Obtaining my benchmark results was no cake walk. In addition to porting the applications over to the OS/2 and *Windows NT* environments, there was a fair amount of tweaking needed to make *1-2-3* and *Paradox* behave themselves. Unfortunately, these aren't isolated cases. OS/2's manual, alone, contains more than 20 pages that lists problematic DOS and *Windows* applications that require a fix of one kind or another, and two pages of applications that simply won't work—period. *Windows NT* is no better. While *Windows NT* doesn't list its problem programs like OS/2 does, a spot-check of the applications on OS/2's hit list showed similar or identical problems when running under *Windows NT*.

Many of the problems are minor, such as having to adjust the buffer count for *dBASE IV* or re-sizing the disk cache to avoid a *Paradox* crash. But some are more complicated, such as the involved procedure needed to limit the EMS memory access for *1-2-3*. A few are downright dangerous and require extraordinary measures to resolve. For example, *FastLynx* (a PC-to-PC file-transfer utility) often stalls in midstream when doing high-speed serial transfers, for which there presently is no known cure short of re-booting with DOS (using OS/2's boot manager or booting from a floppy) and running the application from the DOS prompt.

Applications Availability

The most-important part of any new operating system is the new and updated applications that take advantage of its advanced capabilities. For OS/2 and *Windows NT*, the key features are support for preemptive multitasking and 32-bit architecture. So where are the applications?

Initially, OS/2 and *Windows NT* will bring the power of workstation and high-end server applications to the desktop. According to industry sources, most of the first 32-bit applications to see the glow of a video monitor will be dedicated publishing systems, scientific and financial modeling packages and custom business applications. Eventually, a whole new class of personal productivity software that feature full-motion video, voice recognition and other state-of-the-art enhancements will evolve.

The first to convert their applications to the new system will be power addicts: designers and manufacturers who are using CAD/CAM programs, stock-market traders who are looking for sophisticated financial analysis tools and engineers and medical researchers who hunger for the latest 3D modeling and simulation programs. This isn't surprising, since these high-end applications require heavy-duty hardware and have always struggled with DOS's limitations.

The new 32-bit architecture along and its large memory space greatly improve the performance and capabilities of such numeric-intensive applications as *AutoCAD*. For example, *AutoCAD* will be able to store much-larger drawings in memory than was ever possible with *Windows* or DOS. In addition, *AutoCAD* users will be able to perform multiple operations simultaneously, like plotting one drawing while working on another—a major boost to productivity.

Initially, the vast majority of titles will be custom business applications for a wide range of markets: pharmaceutical research, insurance, financial and medical imaging, to name just a few. Microsoft estimates that approximately 500 *Windows NT* applications will be available by year-end, most of them niche products.

For users of spreadsheets, word processors, PIMs and other personal-productivity tools, the benefits of 32-bit performance are less clear. Only the largest software publishers can afford to split development efforts between separate *Windows* 3.1 and 32-bit versions, and no one is willing to risk sacrificing sales to established *Windows* 3.1 users by shifting emphasis to the new operating systems.

Of the mainstream companies that are willing to take the 32-bit plunge, Lotus is the biggest supplier of 32-bit applications, with OS/2 versions of *1-2-3*, *Freelance* and *AMI Pro* already on the shelves. In addition to porting these applications to *Windows NT*, the company is moving quickly to port its *Lotus Notes* product to *Windows NT*, where it will take advantage of *NT*'s multitasking and server capabilities, making it more efficient as a groupware product.

There are reports that Borland and others also have 32-bit applications in the works, but no confirmed products or release dates are available at this time. And it's no rumor that Microsoft will soon have a 32-bit *Windows NT* version

Package Features Comparisons

	Windows 3.1	OS/2 2.1	*Windows NT*
Standard Features			
Price			
Upgrade	$59	$199/$169*	$295
Full Package	$130	$249/$219*	$495
Minimum RAM Required	640K	4M	8M
Disk Space Used	6M	40M	66M
Password Security	N	N	Y
Advanced Features			
Maximum RAM Supported	32M	4G	4G
Protected-Mode Multitasking	Y	Y	Y
Multithread Processing	N	Y	Y
Boot Manager	N	Y	N
Enhanced Command Line	N	Y	Y
Enhanced Batch Programming	N	Y	N
Networking	N	N	Y
Fault-Tolerant	N	N	Y
Compatibility			
Runs DOS Applications	Y	Y	Y
Runs Windows Applications in Real Mode	Y	Y	N
Runs Windows Applications in Standard Mode	Y	Y	Y
Runs Windows Appplications in Enhanced Mode	Y	Y	Y
Runs 32-bit Applications	N	Y	Y

*Floppy Version/CD-ROM Version

of its popular *Excel* and *Word* packages. But most vendors are waiting for the market to dictate their next move.

Some of the advantages, such as crash-proof multitasking, are there whether you're using traditional 16-bit programs or the more-powerful 32-bit programs written especially for the operating system. But others, such as the multi-threading capability that allows applications to perform some tasks in the background while they simultaneously respond to your orders up front, exist only in applications written for the new operating systems.

Win32s Alternative

Then there are some classifications of software where a native 32-bit version just isn't needed. When it comes to word processors, for example, the question isn't when high-performance 32-bit versions will ship, but *if* they'll ship. As a result, some vendors are developing versions of their applications based on a Microsoft programming model called Win32s that makes them compatible with *Windows NT* and *Windows* 3.1. Win32s applications can take advantage of *Widows NT*'s 32-bit architecture while bringing *NT* power to *Windows* 3.1 and remaining compatible. *Harvard Graphics*, the top-selling PC presentations package, for one, plans to ship a Win32s version in early 1994, and Borland is developing a Win32s version of its C++ programming language.

Because Win32s instructions are a subset of *Windows NT*, however, these versions don't take full advantage of *Windows NT*. In particular, they don't offer multithreaded processing or other advanced functions that are so crucial to such high-end applications as *AutoCAD*.

Presumably, Win32s applications will run on OS/2, but at what performance level remains to be seen. If they don't access OS/2's 32-bit environment right out of the box, it's likely that IBM or a third party will create an OS/2 utility that will bridge the Win32s-OS/2 gap to take advantage of this burgeoning base of 32-bit applications.

Picky Peripherals

Just because your printer, fax/modem and mouse work smoothly under DOS and *Windows* 3.1, it doesn't mean they'll work with OS/2 or *Windows NT* using the DOS and *Windows* device drivers that hardware vendors provide. Your peripherals and operating system may not be compatible until the hardware manufacturer comes out with a special OS/2 or *Windows NT* device driver.

As with any operating system, OS/2 and *Windows NT* need drivers to communicate with their peripherals. A device driver contains instructions that let the peripheral know what the operating system wants it to do. For example, a printer driver, tells your printer when to boldface, underline, and double-space a document; a video driver carries instructions for your video controller to draw objects on your display; and a mouse driver translates mouse movements into input commands.

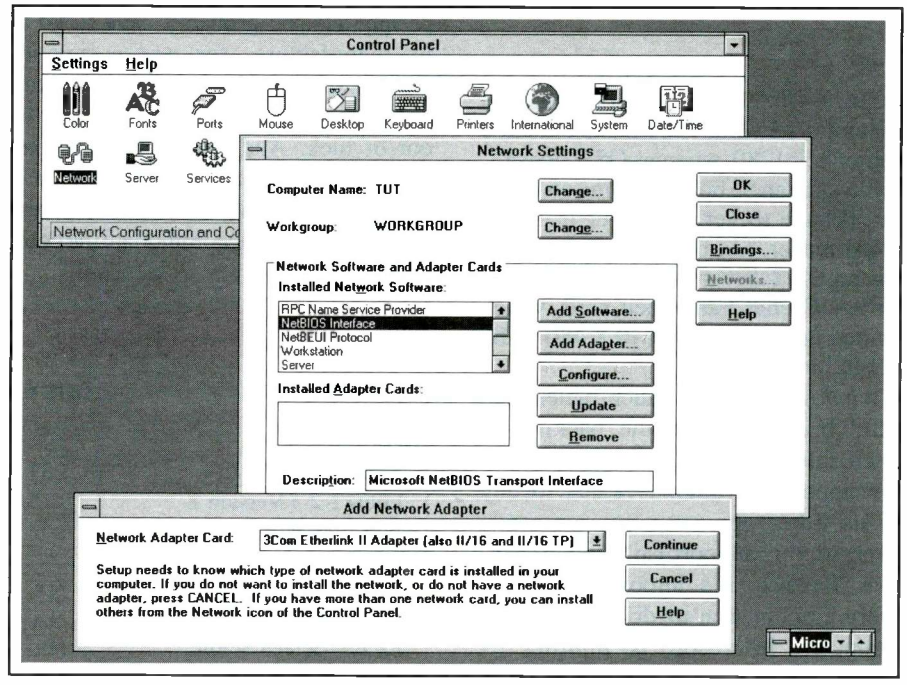
Each peripheral needs its own individual device driver. Drivers can even vary between each make and model of each device. For example, a Hewlett Packard LaserJet III requires a different driver from a LaserJet IID. And while OS/2 and *Windows NT* run DOS and *Windows* applications, they don't run DOS and Windows drivers. The architecture demands that drivers communicate differently than they do under DOS and Windows. In fact, every peripheral's device driver needs to be rewritten.

Most devices that connect through standard serial, parallel and SCSI ports are supported already. For many popular peripherals, the new device driver is included in the OS/2 or *Windows NT* operating system. All HP printers, for example, have included drivers, as do many video boards and most mice. However, the choices are sometimes limited. For example, *Windows NT* includes super-VGA drivers for S3-based video boards (for resolutions up to

The Competition

OS/2 and *Windows NT* aren't your only choices for a powerful 32-bit operating system. Three competitors from the UNIX world—Sunsoft's *Solaris for x86*, Univel's *UnixWare* and NeXT's *NeXTStep for Intel*—shipped last spring. *Solaris* and *UnixWare* let 486- and Pentium-based computers run the same operating system as Sun's high-end SPARCstations, which have been used mostly by the scientific and engineering communities.

With *NeXTStep for Intel*, NeXT Computers will be offering its UNIX-based operating system, known for its powerful and elegant user interface, to high-end PC users. NeXT hopes to target the desktop-publishing, financial-analysis and in-house development markets. The key question is whether enough business applications will appear on *NeXTStep* to make it a viable competitor in the Intel-based UNIX world.



Unlike OS/2, *Windows NT* supports networks, built-in networking and e-mail that let you create, manage and use peer-to-peer LANs and wide-area networks (WANs).

1,024 X 768 X 256 colors), such as Diamond's Stealth VRAM and Orchid's Fahrenheit 1280, whereas OS/2 doesn't. If you have an S3 board running on OS/2, you'll have to get the driver from the board maker. (At the time of this writing, an OS/2 driver wasn't yet available for my Orchid Fahrenheit card, which limited me to standard 640 X 480 VGA resolution.)

Windows NT fares much better than OS/2 because it has the backing of Microsoft, which is offering greater driver support for *Windows NT* than for any of its other operating environments. Even so, this support isn't comprehensive. Because it's impossible to test every combination of drivers in every computer, Microsoft is limiting its immediate driver offerings to those most requested by their customers. Topping the list are SCSI devices. Other devices featured prominently on Microsoft's hardware driver list include printers and graphics chipsets

While OS/2 and *Windows NT* will ultimately support most peripherals, they leave some devices out in the cold. Older peripherals, for instance, will see less support because fewer users will demand it. For example, Microsoft's hardware compatibility list shows support for video cards based on Tseng Labs ET4000 video chips set but not for cards based on the company's older ET3000 chip set. If you have a non-standard peripheral, you probably have to go to its manufacturer for driver support. Owners of devices whose manufacturer has gone out of business will likely be out of luck. And owners of high-end peripherals, such as color printers, may have to wait while the manufacturers write drivers that accommodate the complex functions and high performance that these products demand.

Networking & E-Mail

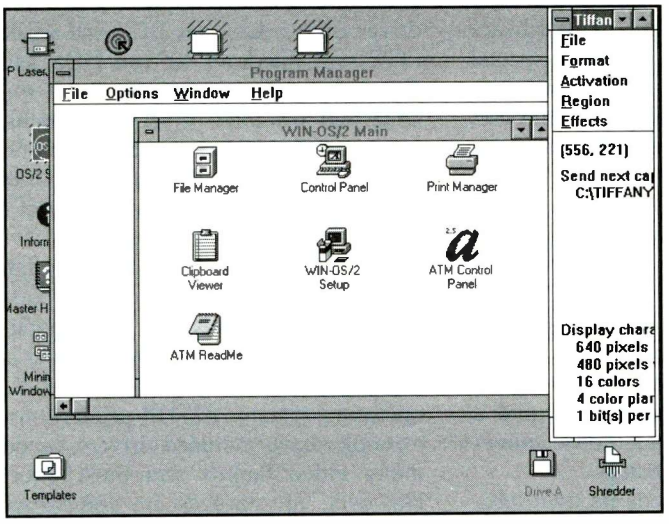
Unlike OS/2, where networking capabilities are tacked on as an afterthought, *Windows NT* supports networks from the ground up. Built-in networking and e-mail let you create, manage and use peer-to-peer LANs, while *Windows NT*'s Advanced Server version handles more-sophisticated, wide-area networks (WANs).

During installation, *Windows NT* attempts to detect the type of network adapter in your system and its settings. *Windows NT* comes with a wide array of network-adapter device drivers, including 3 Com Etherlink, IBM Token Ring and Novell NE 2000.

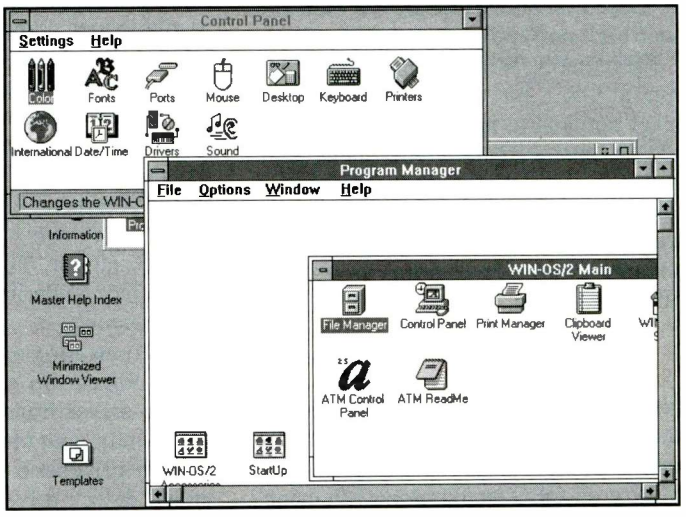
Performance Results

Applications	DOS 6.0	*Windows* 3.1	OS/2	*Windows NT*
DOS				
dBASE IV	7:57	9:40	10:20	10:52
Lotus *1-2-3* Version 2	8:15	10:34	11:53	42:24
WordPerfect 5.1	0:52	1:06	1:03	1:50
Windows				
Excel—Calculations	NA	3:05	3:16	3:31
Excel—Calculations & Printing	NA	3:34	5:48	16:50
Excel—Screen Scroll	NA	7:29	9:49	12:51
Word for Windows	NA	21:58	16:51	34:46
CorelDRAW	NA	8:53	failed	10:03
PowerPoint	BA	4:41	4:50	52:33

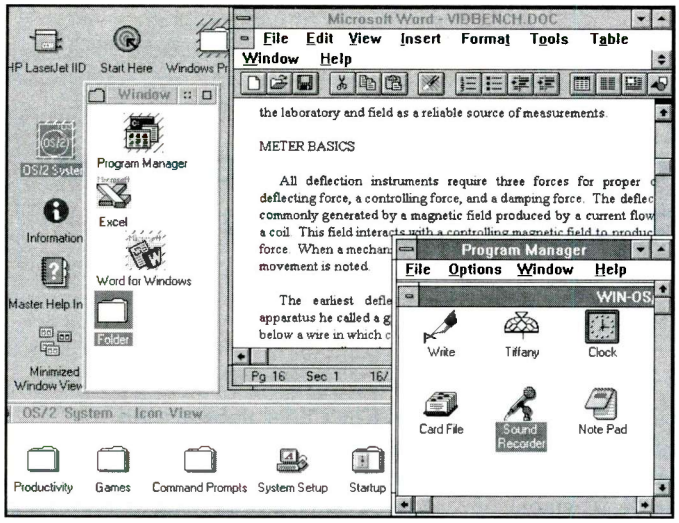
Times listed are in minutes: seconds.



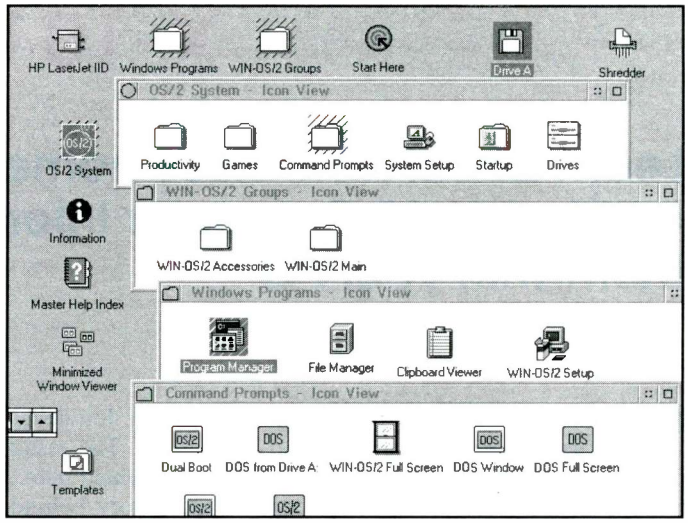
Unlike *Windows* 3.1, OS/2 and *Windows NT* can easily and safely juggle more several CPU-intensive jobs simultaneously.



OS/2's flexible desktop interface has a strong Macintosh look.



OS/2 allows you to boot your system from one or more operating systems.



Under OS/2, you can leave often-used icons on the desktop or place them in folders for easy sorting. Duplicate icons are supported for inclusion in more than one folder.

Windows NT includes software support for NetBEUI (NetBIOS extended User Interface); the industry standard TCP/IP (Transmission Control Protocol/Internet Protocol), for access to Internet; and DCE-compatible Remote Procedure Calls (RPC). If you're already on a LAN, *Windows NT* will probably work fine as a node because the drivers needed to run an *NT* machine on a Novell *NetWare* network come in the box. *Windows NT* can also operate with any of these networks: Microsoft *Windows for Workgroups*, Microsoft *LAN Manager*, DEC *Pathworks* and Banyan *VINES*.

Through a special platform called the *Windows NT* Advanced Server, *Windows NT* can compete with *NetWare* as an advanced network operating system for large and complex LANs. With its Advanced Server, Microsoft is setting its sights on a loftier goal: handling large-scale server applications and wide-area operations that have been the traditional domain of mainframes and minicomputers. The Advanced Server will incorporate the centralized client-server networking features of Microsoft's *LAN Manager*, but with greater security and stability.

The electronic-mail software included in *Windows NT* lets you communicate with other users over any connected network. Based on Microsoft's *Windows for Workgroups*, it lets you send and receive electronic messages (e-mail), attach application files (such as spreadsheets and word-processor documents) to your messages, find messages in your mailbox according to a search criteria, organize and store messages in folders and print messages.

The Bottom Line

OS/2 and *Windows NT* probably won't interest the average home or small-office PC user right away. Unless you convert your software to 32-bit versions, your existing 16-bit software will run slower than it does under *Windows* 3.1—which defeats the purpose of upgrading to a more powerful platform.

Windows NT, however, may prove attractive to users in large offices who want to maximize the use of their large networked mainframe computers. OS/2's greatest appeal will, no doubt, be with custom application users, such as large pharmaceutical houses and CAD/CAM designers and manufacturers. But even these businesses are taking a wait-and-see attitude. Most experts don't expect either of the 32-bit platforms to make substantial inroads for at least two years, if then.

The bottom line is that, for now, most desktop PC users will find few uses for OS/2 or *Windows NT*. Personal-productivity software, such as database and word-processor applications, will be the last to be ported over to 32 bits. So if you're just running personal-productivity applications, stick with *Windows* 3.1 or wait for *Windows* 4.0. ■

In The Wings: *Windows* 4.0

For users who find OS/2 and *Windows NT* overkill, Microsoft is already working on another, scaled-down, 32-bit *Windows* operating system, which will have preemptive multitasking that lets you type in your word processor and print at the same time. Code-named "Chicago," it's expected to be released in early 1994 as *Windows* 4.0.

Early indications are that *Windows* 4.0 will merge the features of *Windows* and DOS into a full 32-bit operating environment centered around OLE 2.0 object-linking technology that allows users to access several applications from inside a single document. Other enhancements would include better 16-bit support and less overhead for faster performance.

The fate of *Windows* 4.0 depends on how long it takes for it to appear versus how long it takes for a wide range of OS/2- and *Windows NT*-based personal-productivity applications to appear. If real 32-bit applications reach the market quickly, OS/2 or *Windows NT* (or both) will take off for everyday use, with the nod going in *Window NT*'s favor because of the expected larger application base. If not, *Windows* 4.0 may end up the victor.

Despite aggressive marketing campaigns and promises of software aplenty, neither OS/2 or *Windows NT* may be the new DOS that you've have been waiting for. That title may fall to *Windows* 4.0.

X-10 Basics

Learn about how these home-control modules work and build an X-10 Computer Interface that will let you use them with your PC

Since the late 1970s, X-10 has provided a series of controllers and modules for use in home-automation systems. Over the years, the X-10 protocol has become the standard for ac power-line carrier transmission and has resulted in a large base of products that support the X-10 protocol, all very reasonably priced.

Even though application of the various X-10 modules have received fairly good exposure, most of the theory behind X-10 operation has gone undocumented in electronics magazines. Thus, though many readers may be familiar with the products themselves, most aren't familiar with actual X-10 module operation.

While this may be fine if all you want to do is implement a system, I personally would much rather build my own devices than simply go someone else's. Therefore, I dug around to find out exactly how X-10 modules work so that I could build a computer interface and write my own control software that will give me low-level control of my X-10 system. The results of my digging are documented here. Not only do I cover the theory behind the X-10 stable of devices, I show you how to build an interface that lets you use these modules with your PC.

X-10 Protocol

Essentially, X-10 modules place data for transmission on the ac power line, using the 60-Hz waveform as a carrier. The data placed on the 60-Hz carrier is actually packets of bits that are synchronized with the zero crossings of the ac waveform.

Within each packet of data, there are three separate codes: (1) Start Code; (2) House Code; and (3) Key Code.

The start code is a hard-wired code that signals all X-10 modules on the line that an X-10 code is coming. This four-bit code has a pattern of 1110 and is transmitted differently than the House and Key Codes in that one bit is sent for each zero crossing (Fig. 1) versus the complimentary form used in the House and Key Codes transmission.

Since each zero crossing represents one half of the 60-Hz waveform, two bits can be sent per cycle. The first bit is sent on one half of the cycle, the second on the alternate half of the cycle. Therefore, the start code requires two complete cycles (four bits divided by two bits/cycle) for transmission.

Once the start code has been received, the X-10 modules begin "listening" for a valid data packet from the controller. The House Code is the next portion of the packet to be transmitted.

The House Code is a four-bit pattern that's used to prevent controllers in other homes from interfering with local X-10 modules. It's determined by the user and should be set so that it's unique to other X-10 systems operating on the same power lines.

Unlike the Start Code, which requires only two cycles to transmit, the House Code requires four complete cycles for transmitting because the House Code is transmitted in complement form.

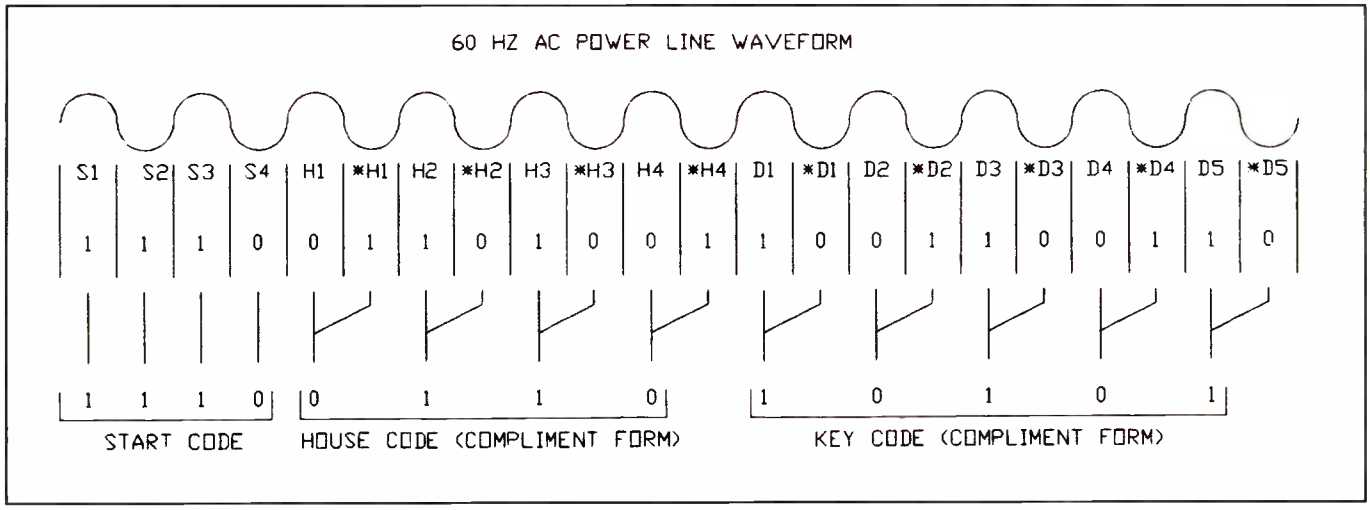


Fig. 1. Transmission framing diagram.

Table 1. X-10 House Codes

	H1	H2	H4	H8	PLIX Decimal
A	0	1	1	0	6
B	1	1	1	0	7
C	0	0	1	0	4
D	1	0	1	0	5
E	0	0	0	1	8
F	1	0	0	1	9
G	0	1	0	1	10
H	1	1	0	1	11
I	0	1	1	1	14
J	1	1	1	1	15
K	1	0	1	1	12
L	1	0	1	1	13
M	0	0	0	0	0
N	1	0	0	0	1
O	0	1	0	0	2
P	1	1	0	0	3

Referring to Fig. 1, consider a House Code bit pattern of 0110. The first bit to be sent is a 0. So, on the first zero crossing after the last bit from the Start Code, a 0 is transmitted over the ac power lines. However, when the next power crossing occurs, the complement of that first bit, a 1, is sent instead of the next bit in succession.

In complement form, each bit transmitted requires one complete cycle. The first half of the cycle transmits the data bit, the second the complement of the data bit.

The Key Code is much like the House Code in that it's transmitted in complement form. It's provides the identification and commands to the X-10 modules, is comprised of five data bits and requires five complete cycles to transmit.

To ensure that data is received reliably, the X-10 protocol recommends that data packets always be transmitted in groups of two with three ac power-line cycles between each group of two codes. The exception to this rule applies when Bright and Dim codes are sent. Consecutive Bright and Dim codes should be transmitted continuously (at least twice) with no gaps between codes. Table 1 provides a complete list of all acceptable House and Key Codes and Table 2 the Key Codes currently defined in the X-10 protocol.

Transmission Theory

You already understand the basic theory behind the transmission of X10 codes. In essence, each bit is transmitted synchronous with the zero crossings of the 60-Hz ac power-line waveform. Some specifics remain to be covered to permit

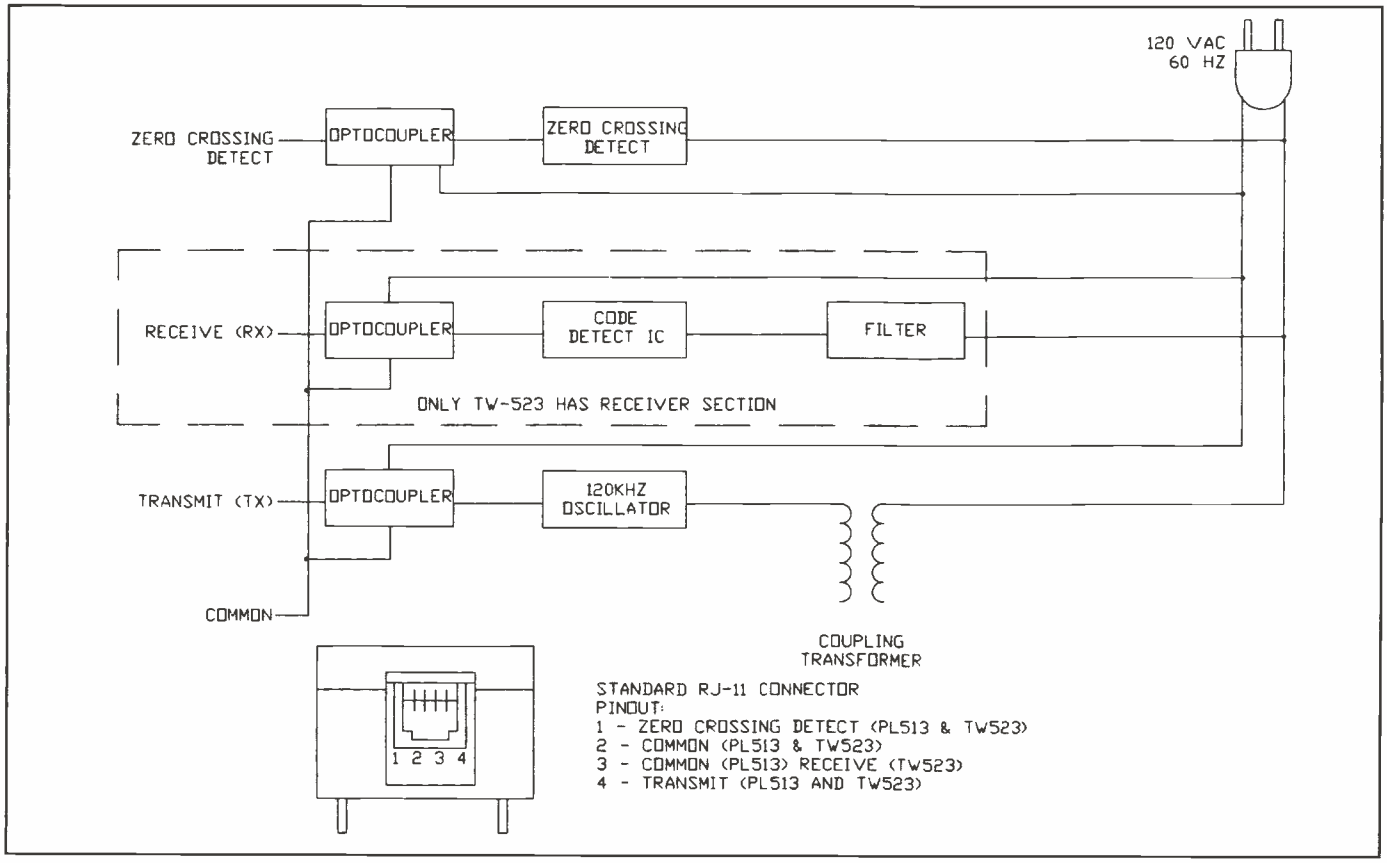


Fig. 2. Block diagram and pinout details for PL-513 and TW-523.

Table 2. X-10 Key Codes

	D1	D2	D4	D8	D16	PLIX Decimal
1	0	1	1	0	0	6
2	1	1	1	0	0	7
3	0	0	1	0	0	4
4	1	0	1	0	0	5
5	0	0	0	1	0	8
6	1	0	0	1	0	9
7	0	1	0	1	0	10
8	1	1	0	1	0	11
9	0	1	1	1	0	14
10	1	1	1	1	0	15
11	0	0	1	1	0	12
12	1	0	0	0	0	13
13	0	1	0	0	0	0
14	1	0	0	0	0	1
15	0	1	0	0	0	2
16	1	1	0	0	0	3
All Units Off	0	0	0	0	1	16
All Lights On	0	0	0	1	1	24
On	0	0	1	0	0	20
Off	0	0	1	1	1	28
Dim	0	1	0	0	1	18
Bright	0	1	1	0	1	26
All Lights Off*	0	1	1	0	1	22
Extended Code*	0	1	1	1	1	30
Hail Request*	1	0	0	0	1	17
Preset Dim*	1	0	1	X	1	21
Extended Data*	1	1	0	0	1	19
Status = On*	1	1	0	1	1	27
Status = Off*	1	1	0	1	1	23
Status Request*	1	1	1	1	1	31

*These functions are not supported by either the TW-523 or PL-513 modules.

a custom design to transmit and receive X-10 codes.

In designing an X-10 circuit, the goal should be to transmit the data bit as close to the zero crossing as possible but within 200 s of the zero-crossing points. When a bit is transmitted, a 1 is represented by a 1-ms 120-kHz burst, a 0 by the absence of the burst. This burst is superimposed onto the 60-Hz ac waveform. At the receiver end, the 60-Hz waveform is filtered out, leaving only the presence and absence of the 120-kHz bursts to represent X-10 data. Zero crossings are used by the receiver to synchronize the data stream, acting as a crude type of clock for digital circuitry.

A complete transmitter circuit must be able to detect zero crossings and then transmit data packets one bit at a time within 200 s of each zero crossing. A complete receiver must include circuitry to detect zero crossings, a high-pass filter to remove the 60-Hz waveform, a phase-locked-loop or notch filter to detect the presence or absence of 120-kHz bursts and circuitry to validate and decode the incoming X-10 data packet. Not only would the design of such a circuit be very detailed, it would also violate the patent held by X-10 USA. X-10 USA's protocol can be transmitted and received using only the company's circuitry or by purchasing a license from the company. Realizing that perhaps people would like to develop circuits that interface to its X-10 systems, the X-10 people provide PL-513 and TW-523 power-line interface modules that provide all the interface circuitry needed to perform the transmission and reception described above.

The transmit-only PL-513 module, used to build a custom controller that sends only X-10 codes, contains a zero-crossing detector, a 120-kHz burst generator and optical isolators. The zero-crossing detector provides a square-wave output that changes phase with each zero crossing of the 60 Hz power line. The square-wave output is never more than 100 s out-of-phase with its associated power-line waveform, making it a reliable source for synchronizing bit transmission with zero crossings.

The input envelope (120-kHz burst width) is 1 ms in duration. This means that the circuitry external to the PL- 513 must detect the zero-crossing waveform and then transmit a 1-ms logic high that will be encoded into a 120-kHz burst within 50 s of the zero-crossing detect.

Although this timing might seem a bit tight, an eight-bit microprocessor running an assembly program could easily meet the demand. Higher-level language programs, even on faster computers, probably couldn't maintain the microsecond-level timing required for a direct interface to the PL-513 module.

The TW-523 module is exactly like the PL-513, except that it adds built in receiver section to the elements already discussed. This module provides two-way communication over the ac power lines.

As illustrated in Fig. 2, the receiver section of the TW-523 consists of a zero-crossing detector, a filter and a code-detect IC. The zero-crossing detector is the same as the one used for the transmitter in the PL-513 module. It provides a square wave output within 100 s of the actual zero crossing of the ac power-line waveform. The filter removes the 60-Hz waveform from the signal, leaving only the presence and absence of 120-kHz bursts that represent logic 1s and 0s, respectively. The output of the filter is directed into the code-detect IC. The code-detect IC deciphers the X-10 bit pattern and outputs the X-10 command to external circuitry.

Implementing the TW-523 to receive X-10 codes simply requires that the output of the module be checked every time a zero crossing occurs for received X-10 signals. A valid-data packet is signified by the start code. When a consecutive bit pattern is recognized as 1110, the external circuitry knows that the data following is an X-10 data packet.

The PLIX Chip

If you're interested in interfacing the PL-513 or TW-523 to a microcomputer but would prefer to use a higher-level language than assembler, such as C or BASIC, to control your X-10 modules, the PLIX chip is for you. Basically it's an interface chip that handles all timing and validation functions required for an interface to the PL-513 or TW-523 modules.

The PLIX (Power Line Interface for X-10) chip uses a standard bus-style interface. It "talks" to the microprocessor using the D0 through D4 data lines as the data bus, CS as chip select, RDY as the all clear signal and DIR as the direction control for reading and writing data from and to the part. Pinout details for this chip are given in Fig. 3.

The PLIX chip has its own internal clock, derived from an external crystal with a frequency of 3.6864 MHz. This value is important for the proper operation of the chip and should be used consistently.

Data can either be written to the PLIX chip for transmission across the power lines or read from the PLIX chip representing the last valid X-10 code received. Reads and writes are determined by the status of the DIR pin.

Writing data to the PLIX is a straightforward procedure. First, the main processor or computer puts the data to be sent to the PLIX chip on the D0 through D4 lines. DIR is asserted to its proper level for a write operation, and CS is brought high to signal the PLIX chip that data is on the data bus.

The PLIX chip signifies that it has started reading the data on the data bus by asserting the RDY line. When the chip is finished, it drops RDY, and the main processor completes the rest of the cycle. The write operation is terminated when the main processor or computer releases the data, DIR and CS lines.

The first write done to the PLIX chip is a synchronize command that resets that internal counters and pointers of the chip. It consists of three or more 0s and a 31. Once the PLIX chip has been initialized, it's ready to receive commands.

Commands are sent to the PLIX chip in three-byte packets. The first byte has a range of 0 through 15 and signifies the House Code. The second byte has a range of 0 through 31 and represents the Key Code. The final byte is the number of times to repeat the command.

Keep in mind that each 11-bit X-10 data packet should be sent twice in a row, with three power line cycles before the next packet is sent, unless the packet is a bright or dim code, in which case, the packets are sent consecutively without spaces. This means that every command that is sent to the PLIX chip should have a repeat byte of two for normal on/off commands and two to 30 for bright and dim commands.

Once this packet is received, the PLIX chip sends out a formatted data packet in the X-10 protocol over the power lines. The power line interface portion of the PLIX chip has all of the signals necessary to communicate with either the TW-523 or PL-513 modules. D_{Out} is the data output that represents the data packet to be transmitted. It serially transmits the individual bits of the data packet, using the Zero signal (the zero-crossing detection square wave) as the clock. D_{In} receives data serially from either of the interface modules, using Zero as the clock.

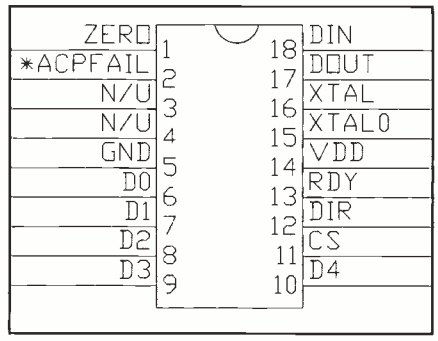


Fig. 3. Pinout details for PLIX chip.

When a valid X-10 data byte is received, it is stored in the PLIX chip until it has been read by the controlling microprocessor or another X-10 packet has been received. To ensure no receptions are lost, the PLIX chip should be polled at least every 300 ms.

To read the received code from PLIX chip, the main processor or computer must assert CS high and leave DIR low. The PLIX chip will then place the first data byte on the data bus (D0 through D4) and bring RDY high. When the main processor or computer senses that RDY is high, it reads the data and asserts CS low. Then the chip releases the data bus and brings RDY low. The next read cycle can then begin.

When the received code is read from the PLIX chip, the most significant bit, bit 4, represents whether it is a newly received code or simply the same code as the one that was read last time. Once the received code has been read, bit 4 is reset to signify that the code in memory now is an old code.

The last PLIX chip feature to be discussed the is /ACPFail signal, which is asserted when no ac power is connected to the interface module. It can be used to interrupt the microprocessor in the event of power loss. This is particularly useful

PARTS LIST

Semiconductors
D0 thru D4—1N4148 diode
LED1—TIL220 or similar light-emitting diode
Q1—LB7805 fixed 5-volt regulator
Q2—PN2222 silicon npn transistor
Q3—PN2907 silicon pnp transistor
U1—PLIX chip (see text)
U2--74HC241
Capacitors
C1,C2—22-pF ceramic disc
C3—10µF, 15-volt electrolytic
V4—47µF, 15 volt electrolytic
Resistors (1/4-watt, 5% tolerance)
R1 thru R4—10,000 ohms
R5—100,000 ohms
SIP1—4,700-ohm SIP resistor pack
Miscellaneous
J1—25-pin male sub-D connector
J2—Four-pin RJ-11 jack
J3—20-pin header
J4—Not used
J5—Two-position screw block
X1—3.6864-MHz crystal
Printed-circuit board; sockets for ICs; suitable enclosure; machine hardware; hookup wire; solder; etc.

Note: The following items are available from Montgomery Engineering, 3845 S.W. 25, Oklahoma City, OK 73108 (tel.: 405-681-9979): TW-523 module, $34.99; PL-513 module, $25.99; PLIX chip, $25.99; demo board kit with software, $36.99; example software on floppy disk, $5; technical information packet on X-10 theory and operation, free.

For more information on the X-10 system, contact: X-10 USA Inc., 91 Ruckman Rd., Box 420, Closter, NJ 07647-0420 (tel. 201-784-9700).

For quantity pricing on the PLIX chip and demo board, contact: MicroMint, Inc., 4 Park St., Vernon, CT (tel.: 203-871-6170).

Table 3. Ports Defined in Generic IBM Parallel Printer Port

Port	D7	D6	D5	D4	D3	D2	D1	D0
Data Out	NU	NU	NU	D4	D3	D2	D1	D0
Pins	9	8	7	6	5	4	3	2
Control	NU	NU	NU	NU	POW	DIR	U2	CS
Pins	—	—	—	—	17	16	14	1
Status	U2IN	ACPF	U2IN	U2IN	RDY	NU	NU	NU
Pins	11	10	12	13	15	—	—	—

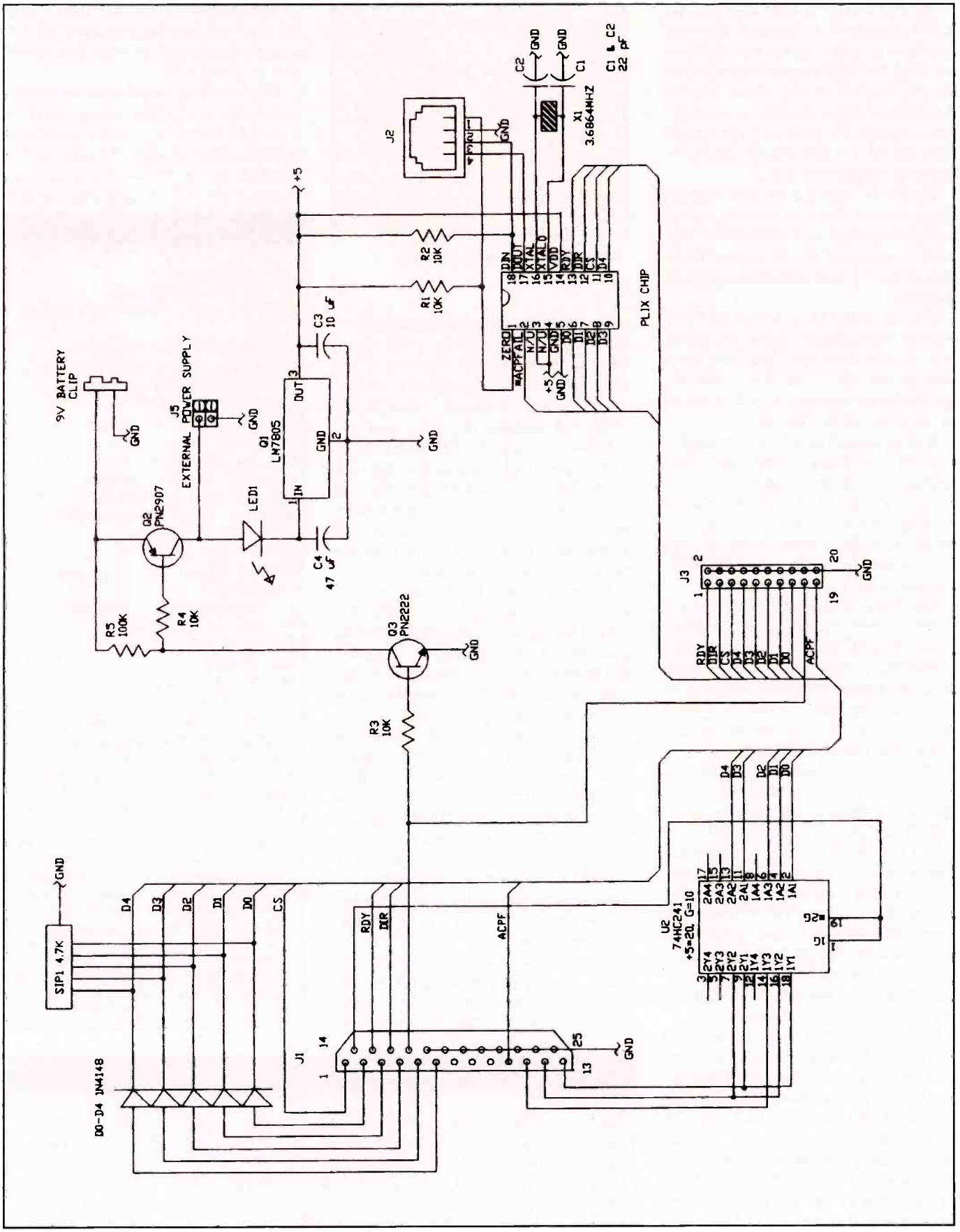


Fig. 4. Complete schematic diagram of X-10 Computer Interface circuitry. (Copyright Micromint Inc., reprinted with permission of same)

in battery backed-up systems because it can signal the computer to transfer to the battery supply and begin to backup data in its memory.

Computer Interface

Shown in Fig. 4, is the complete schematic diagram for an X-10 interface circuit that plugs into the parallel port of an IBM PC/compatible computer. In this circuit, *J1* provides the signals from the computer's parallel port to the interface board. The X-10 computer interface makes use of all three ports defined in a generic IBM parallel printer port, as detailed in Table 3.

In Table 3, if a port bit isn't used in this design, it is marked "NU" for not used. Below each port description is a row of pin definitions. This translates each bit in the port to an actual pin of *J1*. For example, the bit used to turn on transistor *Q3* is Bit 3 of the control port. Looking directly below this bit in the Pins row, you'll find that is pin 17. You can confirm this on the schematic diagram.

The topics below break down the operation of the X-10 computer interface to allow you to understand how the circuit works and how to program the circuit.

- **Data Out.** The data-output port is used to transmit data to the PLIX chip. Because the PLIX chip uses only data bits D0 through D4, bits D5 through D7 are left not used (NU in Table 2). The data port is located at I/O address 278H, 378H or 3BCH.

- **Control.** The control port is used to interface to the control lines of the PLIX chip and to select the data bits to be shifted into the input lines by *U2*. Bit 3 is raised to active-high to turn on power to the circuit when operating under battery power. Bit 2 is set to control the direction of data transfer, either to or from the PLIX chip. Bit 1 is used to control which bits of data are present on the inputs for the status port. Finally, Bit 0 is brought active high to enable the PLIX chip. The control port is located at I/O address 27AH, 37AH or 3BEH.

- **Status.** The data-out port isn't bidirectional and, therefore the status port must be used to input the information from the PLIX chip to the computer. However, only a limited number of input bits are usable on the status port, five to be exact. Of these, two must be used to detect the presence of ac power via ACPF (Bit 6) and the ready condition of the PLIX chip via RDY (Bit 3). This leaves three bits (Bits 7, 5 and 4) for input. U2 controls the input of data from the PLIX chip into these three bits. The status port is located at I/O address 279H, 379H or 3BDH.

- **Power Supply.** There are two ways to power the X-10 computer interface. You can power it externally from a 9-volt dc power adapter via *J5*, or you can power it from a 9-volt battery. When operating the circuit on battery power, the program must set Bit 3 of the control port to active high to provide power to the circuit. This applies positive bias to the base of *Q3*, turning on this transistor, which, in turn, biases the base of *Q2*. When Q2 is conducting, it provides power to voltage regulator *Q1* through *LED1*.

To conserve battery life, Bit 3 of the control port should be reset to inactive low when the controlling program is terminated.

- **Programming.** The programming of the PLIX chip was covered in detail above. I'll describe here the specifics for controlling the X-10 computer interface via the generic IBM parallel port.

Initially, you must determine the base address for the board on your system. For instance, my parallel printer port is located at 378H, meaning that my status and control ports are located at 379H and 37AH, respectively.

Once the ports are defined, the first step in programming the X-10 computer interface is to provide power to the board by enabling Bit 3 of the control port. With power applied, the PLIX chip must be initialized with the sequence 0-0-0-31. To do this, a generic transmission procedure must be developed. Data is first placed on the data-output port (I/O address 378H on my machine). Then DIR must be asserted high by setting Bit 2 of the control port. Finally, CS is brought to active-high by setting Bit 0 of the control port. When the PLIX chip starts reading the data, it brings the RDY line high and then low again when it's done. The condition of the RDY line is sensed at Bit 3 of the status port.

Using the write procedure described above, it's possible to send the initialization sequence. Further write operations can be performed for module selection and control, as described above. Remember that for the PLIX chip to stay synchronized, you must send three bytes on every write sequence: a House Code, a Key Code and the number of times to repeat.

To read data from the PLIX chip, the program brings CS high and leaves the DIR pin low. The PLIX chip then places the data on D0 through D4 and brings the RDY line high (which is read at the status port on Bit 3). The program should then read the data and bring CS low.

U2 is used to shift the five data bits into the three input bits available on the status input port. When Bit 1 of the control port is held high, U2 is selected such that D0 through D2 from the PLIX chip are placed on Bits 4, 5 and 7 of the status port, respectively. When Bit 1 of the control port is held low, U2 is selected such that D3 and D4 from the PLIX chip are connected to Bits 4 and 5 of the status port, respectively.

During a read cycle, the data on D0 through D4 from PLIX is valid when the RDY line is brought high by the PLIX chip. While this data is valid, U2 should be read through the status port to get D0, D1 and D2. Then, U2 is re-selected by setting Bit 1 of the control port to 0 to read in D3 and D4. The two inputs are then put together to form the input byte.

Each read cycle should input two bytes from the PLIX chip to keep it synchronized with the program. The first data byte is the last received House Code, and the second data byte is the Key Code.

Because the control program is too long to publish here, I'm making it available on floppy disk (see the Note at the end of the Parts List for details).

Construction

There's nothing critical about building the X-10 Computer Interface. Therefore, you can use any wiring method you have at your disposal. If you prefer to build the project on a printed-circuit board, you can purchase a complete kit of parts with the controlling software and a scheduling program from the source given in the Note at the end of the Parts List.

If you choose another method of construction, just make sure you follow common prototyping practices. Keep all control lines as short as possible. Solder carefully to avoid creating cold-solder joints and solder bridges between closely spaced components. You'll save a lot of time later if you verify the electrical and mechanical integrity of each connection for as you solder it.

You can use a standard phone cable for connection between the X-10 computer interface and the TW-523/PL-513 module, but beware that it's a straight-through cable. Because this isn't a requirement for most telephones, most phone cable manufacturers don't ensure that all wires go straight through. If you don't use a straight-through cable, your circuit won't work.

If you choose to use the PL-513 module instead of the TW-523, you'll also have to disconnect pin 3 of *J2* from the PLIX chip and ground it. The reason becomes obvious if you examine Fig. 3.

Conclusion

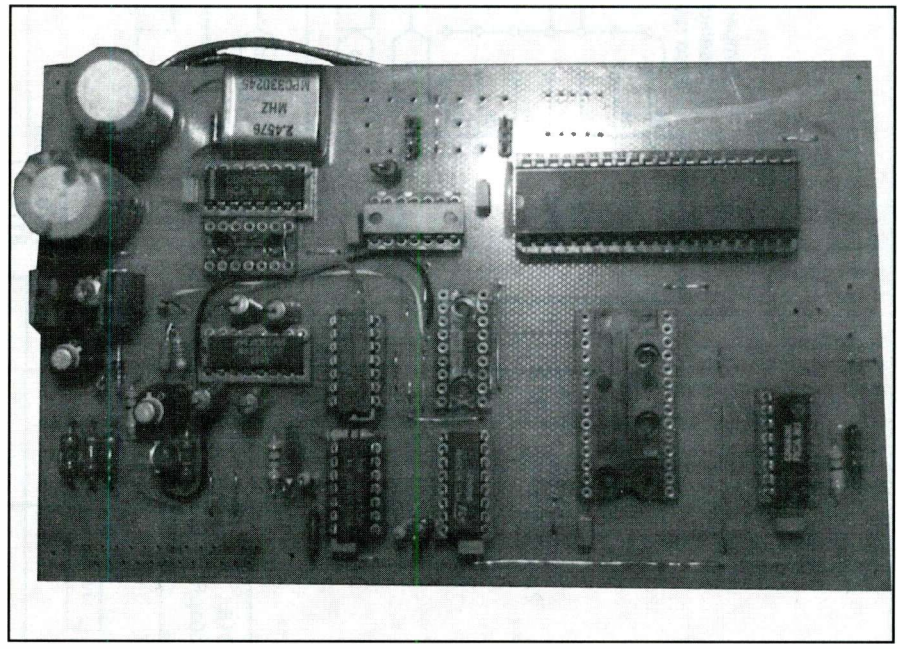
In this article, I've introduced you to the concepts of X-10 and the theory behind X-10 operation and shown you how to build an complete interface circuit to computerize your X-10 system. If you have any other comments or questions, drop me a line or call me at the address or telephone number given in the Note at the end of the Parts List. I'd like to hear about any home-control projects any of you out there are brewing. ■

An Economy EPROM Programmer

Off-the-shelf components and a serial connection to your computer easily justify the cost of owning this must-have accessory

Nowadays, more and more people are finding it a must to be able to program their own EPROMs. However, many such people find the high cost of a commercial programmer difficult to justify. If you're in this category, there's a way out that won't break the bank: build the Economy EPROM Programmer described here. Because all of the intelligence for the Programmer resides in the host computer with which it's used, our Economy EPROM Programmer eliminates the need for a costly processor, firmware and memory of its own.

Though a programmer in most setups needs direct contact with the host PC's bus, the Economy EPROM Programmer doesn't even require that you open your computer's system unit because it simply connects to any computer via a standard RS-232 serial port and is ready to go. All power-supply components mount on the same printed-circuit board that accommodates the main circuit components. The only off-board component is a standard plug-in 12-volt ac modular transformer. And this project no "special" or difficult-to-obtain components.



About the Circuit

The protocol for the Economy EPROM Programmer requires that the host computer send a byte of data and then wait for a byte to be returned from the Programmer. Depending on the direction of information flow, one or the other of these bytes is a dummy, used only to signal receipt of or request for a meaningful byte. Half the pairs of bytes carry data. The other half carry control information.

The RS-232 cable that connects the Programmer to the host computer can be up to 3 feet in length, which can deliver a data-transfer rate of up to 9,600 baud. At this speed, each byte requires about 1 ms to be transmitted. Four bytes are exchanged for each byte of meaningful data. Compare this to the 50-ms time required to program an EPROM byte, and the time required for handshake overhead becomes trivial. Reading an EPROM is equally efficient. For example, it takes only 32 seconds to read the entire contents of a 2764 EPROM.

The only complex part of the Programmer's circuit, shown in Fig. 1, is UART *IC1*, used here for data communication between Programmer and host computer. This IC notifies the host when a complete byte has been received. A simple monostable multivibrator causes the UART to send a return byte. A toggle flip-flop at the output of the monostable multivibrator causes alternate bytes to be treated as data or control pairs. Control pairs have only one function: advancing the counter that addresses the EPROM.

Read and write are manual functions that are completely dependent upon the user, which simplifies the protocol. Assuming the reset has been strobed, the address presented at the EPROM is now 0. Assert the read, and a dummy byte is received from the host, the UART sets RDA, the monostable multivibrator presents its delay and then strobes TDS. This sequence causes the UART to send the data byte of the present EPROM address to the host. Simultaneously, RDA is reset through RDAR.

The pulses on RDA toggle 4013 flip-flop *IC4*. The RC circuit and Schmitt input of *IC2* causes a delay that allows the programming pulse to fall before the address changes. The falling edge of the *IC4* advances the counter string composed of *IC2* and *IC3A*. As even-numbered dummy bytes are received, addresses presented to the EPROM advance through all possible locations. As odd-numbered dummy bytes are received, the data associated with the previous addresses is presented. In this fashion, the entire EPROM is read.

Writing is similar to reading, except that the write operation is asserted, instead of read operation. The UART then outputs data to the EPROM. Now the

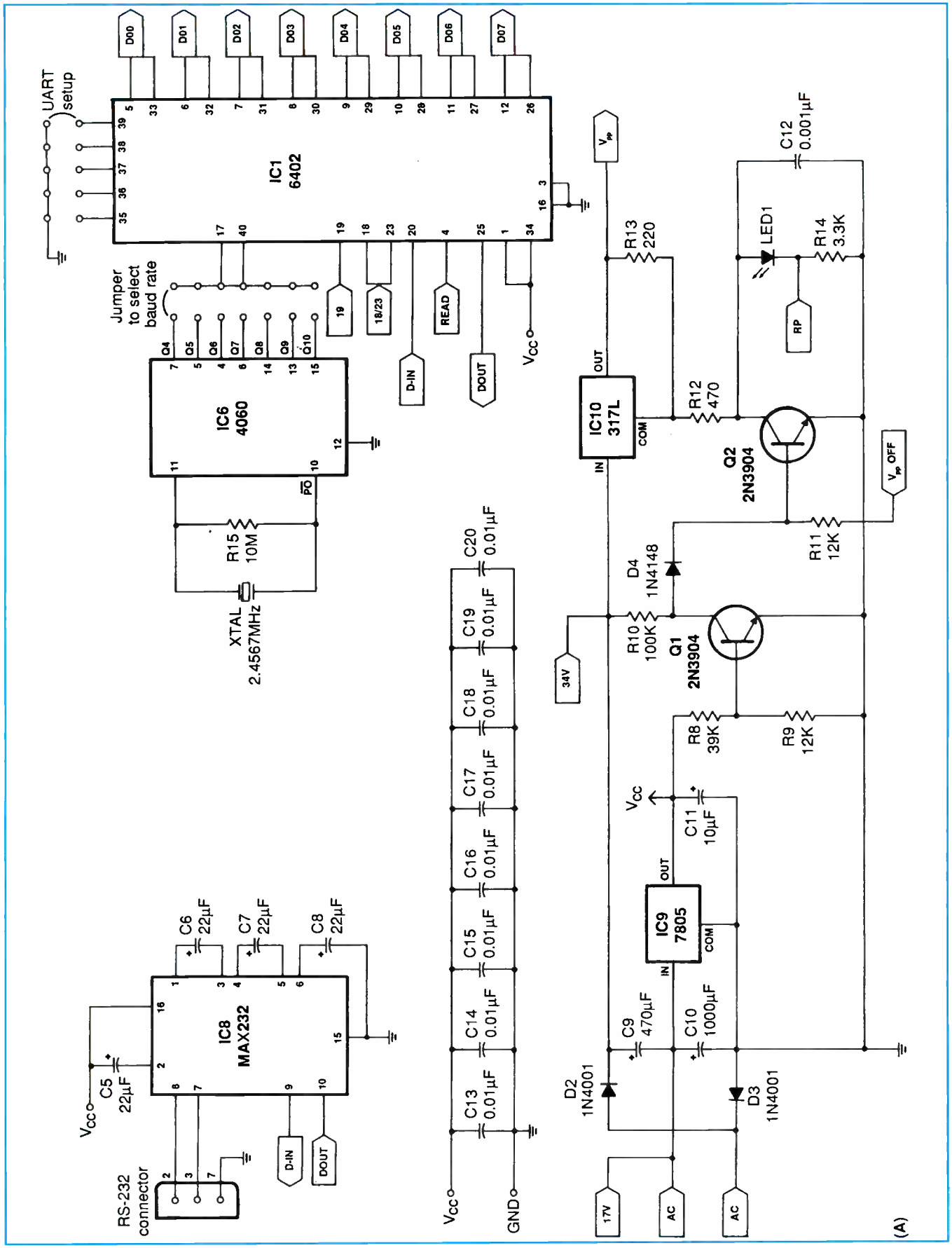
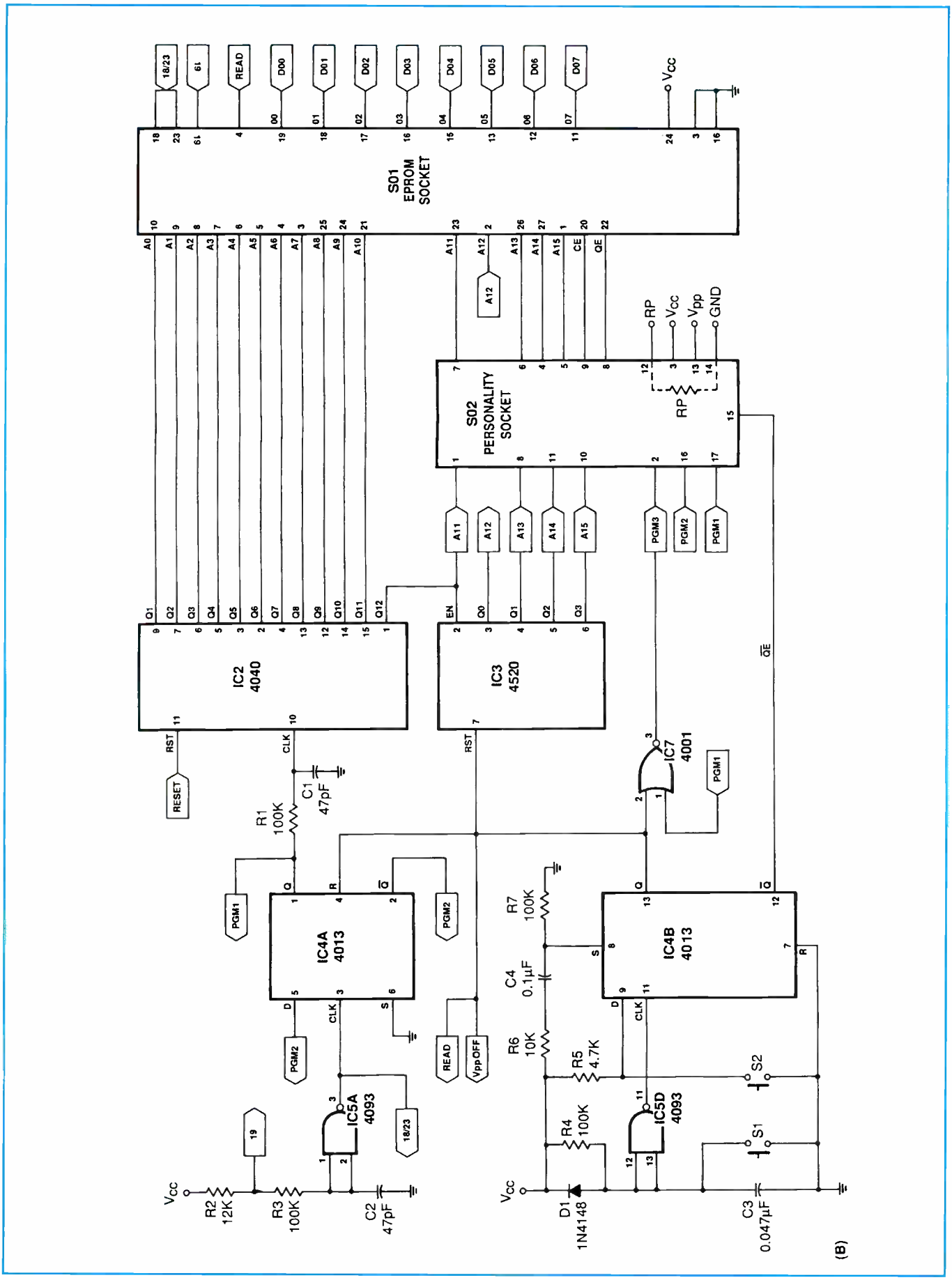


Fig. 1. Complete schematic diagram of Economy EPROM Programmer circuit, minus its power supply.


S01
EPROM
SOCKET
S02
PERSONALITY
SOCKET
IC2
4040
IC3
4520
IC4A
4013
IC4B
4013
IC5A
4093
IC5D
4093
IC7
4001
READ
D00
D01
D02
D03
D04
D05
D06
D07
RP
Vcc
Vpp
GND
A11
A12
A13
A14
A15
PGM3
PGM2
PGM1
RESET
R1
100K
C1
47pF
R2
12K
R3
100K
C2
47pF
R4
100K
R5
4.7K
R6
10K
R7
100K
C4
0.1µF
C3
0.047µF
D1
1N4148
S1
S2
VppOFF
(B)

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Computer Systems

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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 fileservers 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

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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

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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

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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

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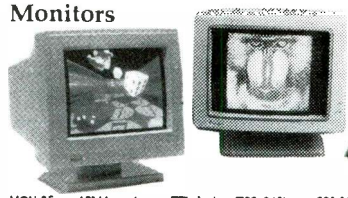
CD-REV	Multimedia Upgrade Kit	$499.00

Monitors



MON-05	12" Monochrome TTL Amber (720x348)	$89.00
MON-06	14" Paper White TTl (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
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COMBO-VGA1	MON-07 VGA Monitor with VGA 256k Card	269.00
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** 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 **		
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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 **		
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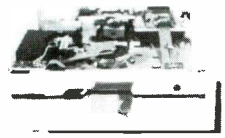
ST-41650N 1	.85Gb Storage at 15.0 ms.	1056
** 1" Height for 3.5" Bay **		
ST-3550N	425Mb Storage at 12.0 ms.	$599
ST-3600N	525Mb Storage at 10.5 ms.	749

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
5.25KITFD	Mounts 3 1/2" FD to 5 1/4" Bay	9.95
5.25KITHD	Mounts 3 1/2" HD to 5 1/4" Bay	9.95
5.25KITHDA	Mounts ST-351A in 5 1/4" Bay	6.95
RAIL01	AT Drive Rail Kit	1.99
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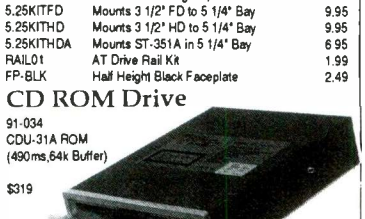
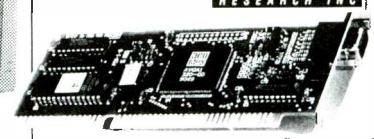
CD ROM Drive

91-034
CDU-31A ROM
(490ms,64k Buffer)

$319

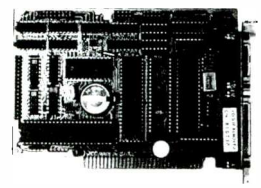


Video Boards BOCA RESEARCH INC



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
VCOLOR	VGA (16.7M Colors), 1Mb Memory	109
VCOLORXL	VGA (16.7M Colors), 1Mb, Hardware Driven	119
XGRAPHIC	IIT 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/1P/1G	25
LCO-6924G	VESA LBus Multi I/O(2FD,2IDE HD,2S,1P,1G)	43
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 Cntlr 16Mb (4HD, 2FD)	179

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

16-BIT Sound Blaster Stereo Card

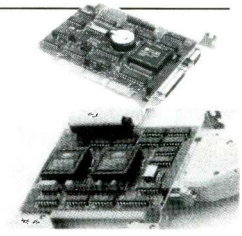
With CD-ROM interface, MIDI interface, enhanced 4 operator, 20 voice FM music synthesizer, and stereo digital mixer with 10 channels. Compatible with Windows 3.1, MPC and OS/2 2.0

STEREO-SB16	Sound Blaster 16-Bit Stereo Card	$269

Selected BNC Connectors

9021	BNC Male Solder (RG58)	$1.40
9101	BNC 3 Pc. Male Cnmp (RG58)	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
8140	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
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 Arcnet BNC Cable	6.89
62BC-25	RG62 M-M, 10 foot Arcnet BNC Cable	9.39

Expansion Boards



I02BY4	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 Ehternet Cards and NOVELL NetWare Lite Software Nodes.		
COMBO-NET	Network Starter Kit	299.00

BOCA RESEARCH INC

Belden Cable

Altex No.	Description	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-62A/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-8/X, 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 TRANSCEIVER CABLE (78 Ohms, PVC Jacketed)			
9901	Four Pair, 20AWG (7x28), 95% Shield, NEC CL2 CSA	0.92	0.73
IEEE 802.5 IBM CABLING (Type 1A Media, 150 Ohms)			
9688	Two Pair, 22AWG .025, 65% Shield, BELDFOIL,NEC MP/CM CS	0.31	0.24

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

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FAX:210/ 340-2409

Altex Electronics
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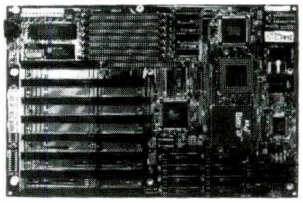
Dallas, Texas 75244
214/ 386-8882
FAX:214/ 386-9182

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.

MB486-33	MB486DX running at 33MHz	$499.00
MB486-50	MB486DX running at 50MHz	669.00
MB486-66	MB486DX running at 66MHz	749.00
MB-ISA	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.

MB486-33L	MB486DX running at 33MHz	$509.00
MB486-66L	MB486DX running at 66MHz	759.00

EISA 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

INTEGRATED INFORMATION

IIT Math Co-Processors

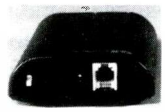
Accelerate spreadsheet, graphics and key business applications performance. IIT Lifetime Warranty.

2C87-12	For 286 machines up to 12.5 Mhz	$52.00
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 PS/2 (MD6P to D5S)	2.89
PS2-MA	VGA Card to MultiSync Monitor (HD15P to 9S)	4.29
ACPC-02	PC Power Cord	2.49
ACPC-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 (34S-34E-Twisted 34E)	2.49
DFCXTE	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 Arcnet BNC Cable	6.89
62BC-25	RG62 M-M, 10 foot Arcnet 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

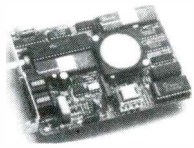
Modems



MaxLite 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 80286 to 80486 compatible with 5 year Mfg Warranty.

MAXLIT144PC	14.4k Pocket Fax/Modem	$269.00
MAXFAX144PC	Internal 14.4 Fax Modem Card	159.00

ZOOM



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

EPSON

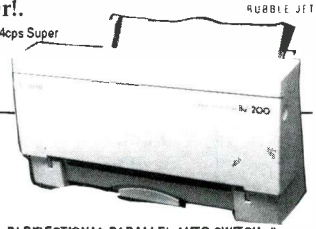
AP2250	9 Pin Narrow Carriage ACTION Printer	$119.00
FX-1170	9 Pin Wide Carriage Printer	379.00
AP3250	24 Pin Narrow Carriage ACTION Printer	199.00
LQ-570	24 Pin, 80 Col. 225cps Draft/105cps LQ	249.00
LQ-1170	24 Pin, 132 Col. 300cps Draft/138cps LQ	639.00

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

Canon BUBBLE JET

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"Lx6.8"Hx7.6D

BJ-200	Bubble Jet Printer	$319.00
BC-02	Replacement Ink Cartridge (450 pages)	24.99

NON-POWERED PARALLEL LINE EXTENDER -For computer (transmitter) to printer (receiver), you can safely transmit data up to 1200 ft. over 2-wire phone line without data loss. Compact and FCC Approved.

PLE100	DB25 Male to DB25 Male with 50' cable.	$49.00
PLE110	DB25 Male to 36 Pin Cent. Male w/50' cable.	49.00
IC-9V200	9V/200mA Power Adaptor extends to 2000'	6.25

AUTO SWITCH locks onto incoming signal, connecting the line to the desired printer port. When completed, Auto Switch detects the signal closed and continues polling from where interrupted. Operates on a "First-Come-First-Served basis". Non-powered

AS-251S	2 to 1 Serial (Compact)	$29.00
AS-451S	4 to 1 Serial (Compact)	55.00
AS-251P	2 to 1 Parallel (Compact)	25.00
AS-451P	4 to 1 Parallel (Compact)	49.00

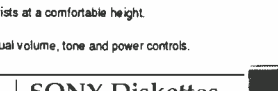
NEW! BI-DIRECTIONAL PARALLEL AUTO SWITCH allows either "2 in 1 out" or "1 in 2 out" configuration for multiple users and multiple peripherals. Non-powered and reliable.

AS-152P	Power Free Bi-Directional Parallel Auto Switch	$35

MULTI-PORT ARBITRATOR combines features of Auto Switch, Converter, and Line Extender to support up to 32 PCs sharing one printer using 4 Wire phone line and jack. Reach out 2000 ft at a transfer rate of 250k bps. "First Come, First Served"

MB4162P	MultiPort Arbitrator	$119

Accessories



20025	101 Keyboard (CHICONY)	$29
K-156	101 Keyboard with Regular Footprint for AT,XT	35
KBY-39	Enhanced Style 12 Function Keyboard (XT/AT)	49
KBY-TRACK	Keyboard with Trackball (Enhanced 12 Function)	79
PS200	200W At Power Supply	42
PS200MINI	200W Baby Vertical Power Supply	59
PS-230	230W Vertical Power Supply	59
20010	Serial Mouse (3 Button, 260dpi)	9.95
INP-30	Serial Mouse (3 Button with Lemmings Software)	16.95
CT-2001H	Mouse Pad (Red, Blue or Gray)	2.99
PS3	UNIVERSAL PRINTER STAND -Fits All Desktop Printers!	9.99
GF-14	ANTI-GLARE GLASS FILTER -Optically coated cuts glare 95 Hinged with Cleaning Kit included. (10 3/8" x 12 1/2")	34.99
WR-1	WRIST REST -Keyboard longer in comfort. Cushioned pad length of keyboard, supports wrists at a comfortable height.	10.99
CS-1000	SPEAKER CONSOLE sits under monitor! 5W shielded speaker midrange-tweeter. Individual volume, tone and power controls.	90.99
844-1	Alkaline AT Clock Battery	8.99

Labtec

3M Diskettes

3.5DS	DSDD	$7.09
3.5DS/F	DSDD Formatted	7.39
3.5DSHD	DSHD	10.89
3.5DSHD/F	DSHD Formatted	11.29
5.25DS	DSDD	4.79
5.25DS/F	DSDD Formatted	5.19
5.25DSHD	DSHD	7.59
5.25DSHD/F	DSHD Formatted	7.89

3M Data Cartridges

DC2000-3M	40Mb	$12.39
DC2000T-3M	Thetamat (Colorado Mem.)	15.59
DC2060T-3M	Thetamat (Colorado Mem.)	20.49
DC2080R-3M	Rhomat (Irwin 80)	19.39
DC2120-3M	120Mb	16.89
DC2120R-3M	Rhomat (Irwin 80)	23.29
DC300XL/P	45Mb	15.89
DC600A-3M	60Mb	17.59
DC6150-3M	150Mb	18.69
DC6250-3M	250Mb	24.59
D8112-3M	8mm to 5.0Gb	10.59

SONY Diskettes

MFD-2DD	3 1/2" DSDD	$7.19
MFD-2DDFM	3 1/2" DSDD Formatted	7.39
MFD-2HD	3 1/2" DSHD	11.79
MFD-2HDFM	3 1/2" DSHD Formatted	12.29
MD-2D	5 1/4" DSDD	4.99
MD-2DFM	5 1/4" DSDD Formatted	5.39
MD-2HD	5 1/4" DSHD	8.79
MD-2HDFM	5 1/4" DSHD Formatted	9.29

SONY Data Cartridges

SONY

QD-300XLP	45Mb	$13.99
QD-600A	60Mb	15.29
QD-6150	120Mb	15.99
QD-6250	250Mb	20.59
QD-6320	320Mb	21.49
QD-6525	525Mb	24.69
QD-2040	40Mb	10.49
QD-2080	80Mb	13.19
QD-2080F	80Mb Formatted	14.99
QD-2120	120Mb	14.29
QD-2120F	120Mb Formatted	17.49

Complete Battery Back-Up Systems

TRIPP LITE "THE POWER PEOPLE"

-Data loss not a problem with 30 to 60 minutes of back-up time, allowing a safe, comfortable shutdown of computer system(s). Includes GelCell battery and two year warranty. 2 millisecond or less switchover. UL listed

Altex No.	Description	Each
BC-250	250VA, 2 Outlet	$105
BC-400	400VA, 4 Outlet	169
BC-500	500VA, 4 Outlet	194
BC-500LAN	500VA, 4 Outlet	199
BC-600LAN	600VA, 4 Outlet	269
BC-750LAN	750VA, 4 Outlet	309
BC-900LAN	900VA, 4 Outlet	379
BC-1250LAN	1250VA, 4 Outlet	529
BC-4000LAN	4000VA, 4 Outlet	2549

Line Stabilizer/Conditioners

-Maintain constant power levels during voltage sags and surges. Two year Warranty. UL listed.

Altex No.	Description	Each
LS-504	500W, 230V, 4 Outlets	$98
LS-600	600W, 2 Outlets	77
LS-604	600W, 2 Outlets, HVR	98
LC-1200	1200W, 4 Outlets	139
LC-1800	1800W, 6 Outlets	188
LC-2000	2000W, 208-240V, 6 Outlets	243
LC-2000X	2000W, 220-240V, 6 Outlets	243
LC-2400	2400W, 110V, 6 Outlets	243

Isobars Surge Suppressors

Provide superior surge and RFI-EMI no suppresion for safeguarding. Suppress 13kA spikes. UL Listed.

	*** $5,000 Lifetime Insurance ***	
SUPER7	7 Outlets, 7 ft Cord (9.5k Spikes)	$18.95
	*** $10,000 Lifetime Insurance ***	
IB2-0	2 Outlet, Direct Plug-In	$23
IB2-6	2 Outlet, 6 ft. Cord	32
IB4	4 Outlet, 6 ft. Cord	43
IB6	6 Outlet, 6 ft. Cord	51
IB8	8 Outlet, 12 ft. Cord	61
IBR-12	12 Outlet, 19" Rack Mnt.	89
	*** $25,000 Lifetime Insurance ***	
IB4ULTRA	4 Outlet, 2 Filtered, 6 ft Cord	$50
IB6ULTRA	6 Outlet, 3 Filtered, 6 ft Cord	56
IB8ULTRA	8 Outlet, 4 Filtered, 6 ft Cord	65
ISOTELULT4	4 Outlet, 2 Fltrd, RJ11 Jack, 6' Cord	55
ISOTELULT6	6 Outlet, 3 Fltrd, RJ11 Jacks, 6' Cord	62
ISOTELULT8	8 Outlet, 4 Fltrd, RJ11 Jacks, 6 Cord	74
IBULT428	2 Outlet, Direct Plug-In, 15A	32
IB2ULTCOPY	2 Outlet, Direct Plug-In, 20A	44
IB2ULTFAX	2 Outlet, Direct Plug-In, RJ11 Jack	39
IB2ULTCOAX	2 Outlet, Direct Plug-In, Coax Jack	39

Modem/Fax Protectors

For phone systems, facsimiles from line spikes. Response time of 5 nanoseconds or less. 2 yr warranty.

ISOTEL	4 Outlet, RJ11 Jack, 6' Cord	$59
ISOFAX	2 Outlet, RJ11 Jack, Plug In	36
TSB	RJ11 Jack Only, 3 Stage Protection	38
MP	Economy RJ11 Jack Only	14
SMP	1 Outlet, RJ11 Jack, 6' Cord	29
SMP-GS	SMP with Gold Seal Warranty	35

GoldStar Diskettes

5.25DSDD-GS	5 1/4" DS/DD	3 29
5.25DSHD-GS	5 1/4" DS/HD	5 69
3.5DSHD-GS	3 1/2" DS/DD	5 69
3.5SHD-GS	3 1/2" DS/HD	8 49

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Semiconductors
D1,D4—1N4148 switching diode
D2,D3—1N4001 power rectifier diode
LED1—Red 20-mA light-emitting diode
IC1—6402 UART
IC2—CD4040 counter
IC3—4520 dual binary up/down counter
IC4—CD4013 dual flip-flop
IC5—CD4093 quad two-input NAND gate
IC6—CD4060 14-stage counter
IC7—CD4001 quad two-input NOR gate
IC8—MAX-232 RS-232 transceiver
IC9—7805 fixed +5-volt regulator
IC10—LM317L adjustable voltage regulator
Q1,Q2—2N3904 silicon npn transistor

Capacitors (50-volt)
C1,C3—47-pF ceramic disc
C2—10,000-pF ceramic disc
C4—0.047-µF ceramic disc
C5 thru C8—22-µF electrolytic
C9—470-µF electrolytic
C10—1,000-µF, 35-volt electrolytic
C11—10-µF electrolytic
C12—0.01-µF ceramic disc
C13 thru C19—0.1-µF ceramic disc

Resistors (1/4-watt, 5% tolerance)
R1,R3,R6,R11,R16—100,000 ohms
R2—4,700 ohms
R4—10,000 ohms
R5,R10,R12—12,000 ohms
R8—10 megohms
R9—39,000 ohms
R13—470 ohms
R14—220 ohms
R17—4,700 ohms
R15—3,360 ohms, 1% tolerance

Miscellaneous
S1,S2—Spst momentary-action pushbutton switch
SO1—28-pin ZIF socket
T1—12-volt, 3-ampere dc plug-in power module
XTAL—2.4576-MHz crystal
Printed-circuit board; suitable enclosure; sockets for all DIP ICs (optional);18-pin personality socket; 18-pin headers for personality module; DB-25 connector; software; machine hardware; hookupwire; solder; etc.

Note: Software for IBM PC/compatible computers for operation on serial ports COM1 and COM2 and a program for comparing two bi- nary files are available for $25 from Gene Francisco, 10266 N. 29 St., Tampa, FL 33612.

host must send the data to be written, rather than just dummy bytes to advance the addresses.

Data sent back during programming from *IC1* to the host computer functions only as a semaphore that indicates receipt of a byte. In addition to advancing the counters, the *IC4* flip-flop controls the program-enable pin of *IC1*, which must be asserted for 50 ms per byte programmed, as required by the host computer's software.

The remaining circuitry consists of a bit-rate generator, interlocking electronic read/program switch, logic-controlled power supply, line interface and personality headers to permit many different types of EPROMs to be programmed. Circuitry is also required to generate three different types of programming pulses in accord with the requirements of various types of EPROMs. For example, 2732 and 27512 EPROMs use the same pin for programming voltages and enable inputs, which is achieved by active components on the personality headers. These need not be included if they aren't needed.

The interlocking programming switch uses a spare section of *IC5* and the spare half of IC4. This system isn't absolutely necessary because just toggle and pushbutton switches would do the job. The interlock is intended to prevent accidents in three ways. The 4093 and the RC circuit on the set pin of the 4013 assert a power-on reset so that the circuit always powers up ready to read, not program. This eliminates the possibility of damaging an EPROM if it's plugged in at turn-on time. Secondly, to change over to programming mode, a two-finger operation is required. This requires some thought and should diminish the chance of accidental damage. Thirdly, momentary-action push-to-make switches are inexpensive and simple to implement and, since the power supply provides a warning indicator, malfunction is unlikely and can't be disguised, as it might be with a toggle switch.

The power supply for this circuit is somewhat unusual. It uses a single transformer winding to provide a variable programmable supply that's adjustable between +5 and +25 volts and a fixed supply that provides +5 volts.

The circuitry around adjustable regulator *IC10* needs some explanation. Resistor *R11*, which can be made up of two resistors in series, allows standard resistor values for R_p (in the personality header) to set the programming potentials at 25, 21 and 12.5 volts. Regardless of the R_p value, the *LED* carries a constant current, given by 1.2 volts/220 ohms, or 5.45 mA, whenever v_{pp} off is low. Thus, the brightness of the *LED* doesn't depend on the type of EPROM being programmed. Transistor *Q2*, controlled by V_{ppOFF}, switches off the *LED* and reduces V_{pp} to the TTL high level set by *R12*, as required by most EPROMs when they're read. The purpose of the additional transistor controlled by the 5-volt supply is to ensure that V_{pp} is at the lower level whenever the 5-volt supply goes off. This protects EPROMs from potential destruction.

An addition favorable feature of the V_{pp} supply is that when *IC10* cyclically overheats as a programming current of more than 30 to 35 mA is drawn, the *LED* flashes to provide a visual indication should a faulty EPROM be detected as it's being programmed.

The line interface to the host computer is simple and requires no explanation. Only two active lines are used in the RS-232 connection—DATA IN and DATA OUT—which are always on pins 2 and 3 of a DB-25 connector. Also, pin 7 of the connector is always used as data ground.

Personality header connections for a range of EPROMs are indicated Fig. 2. Also shown is the schematic diagram that pertains to the special personality header required for 27512, 2732 and 2732A type EPROMs.

The Software

Features of the software break down into three classes: the necessary, the useful and the nice-to-have. Necessary are the features required to write and read EPROMs from and to disk files. Useful features add the ability to display informative screens and warning messages. Nice-to-have features may include provision for progress reports during programming, verifying and copying, differentiation during verification between re-programmable and erasure-required faults and filenames and file-size buffers to eliminate the need to retype the file identification if multiple copying or verification or both are required.

The necessary features are built from the software and include the following: (1) Initialize serial communication to

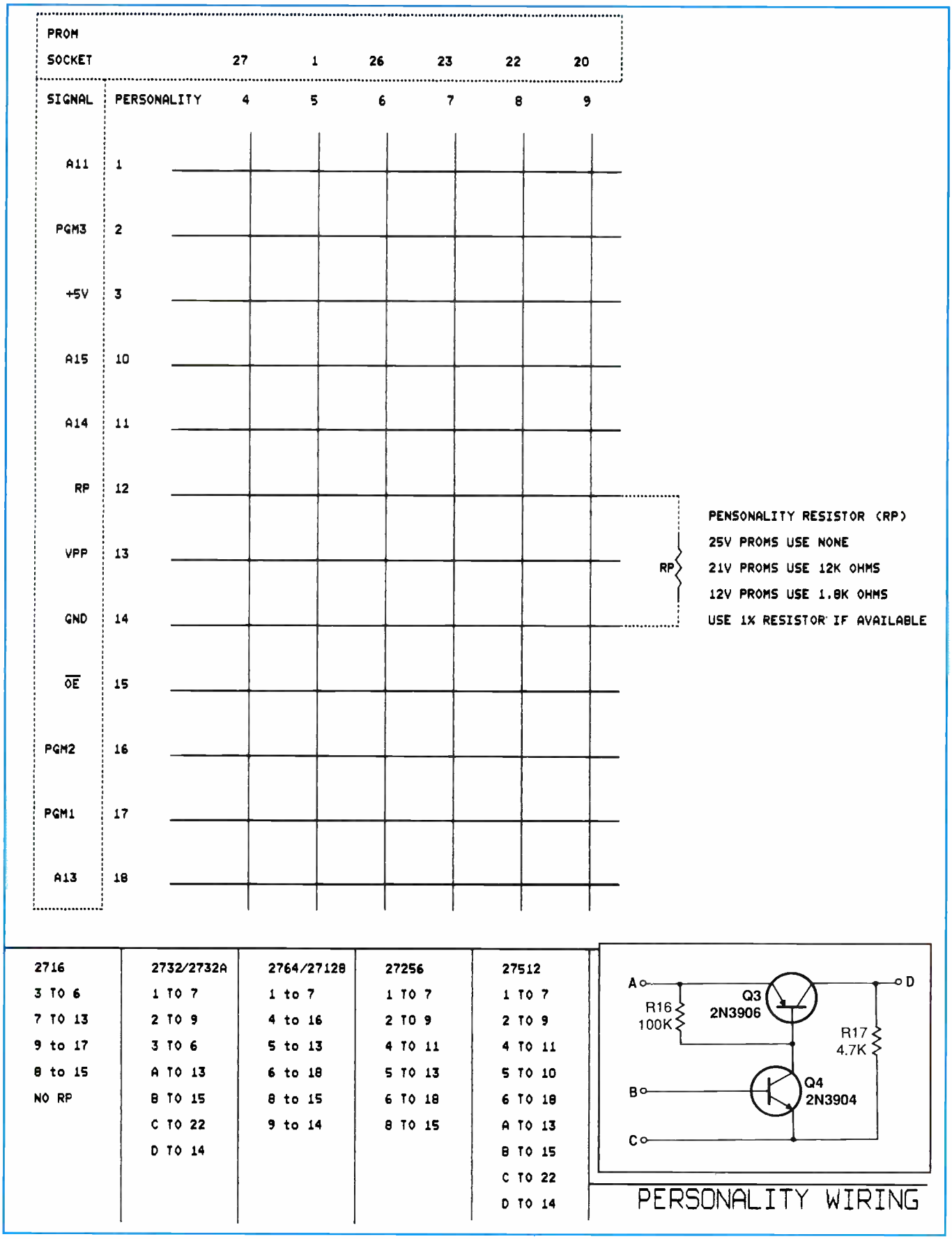


Fig. 2. Details for personality module and a schematic for wiring a module for use with 27512, 2732 and 2732A EPROMs.

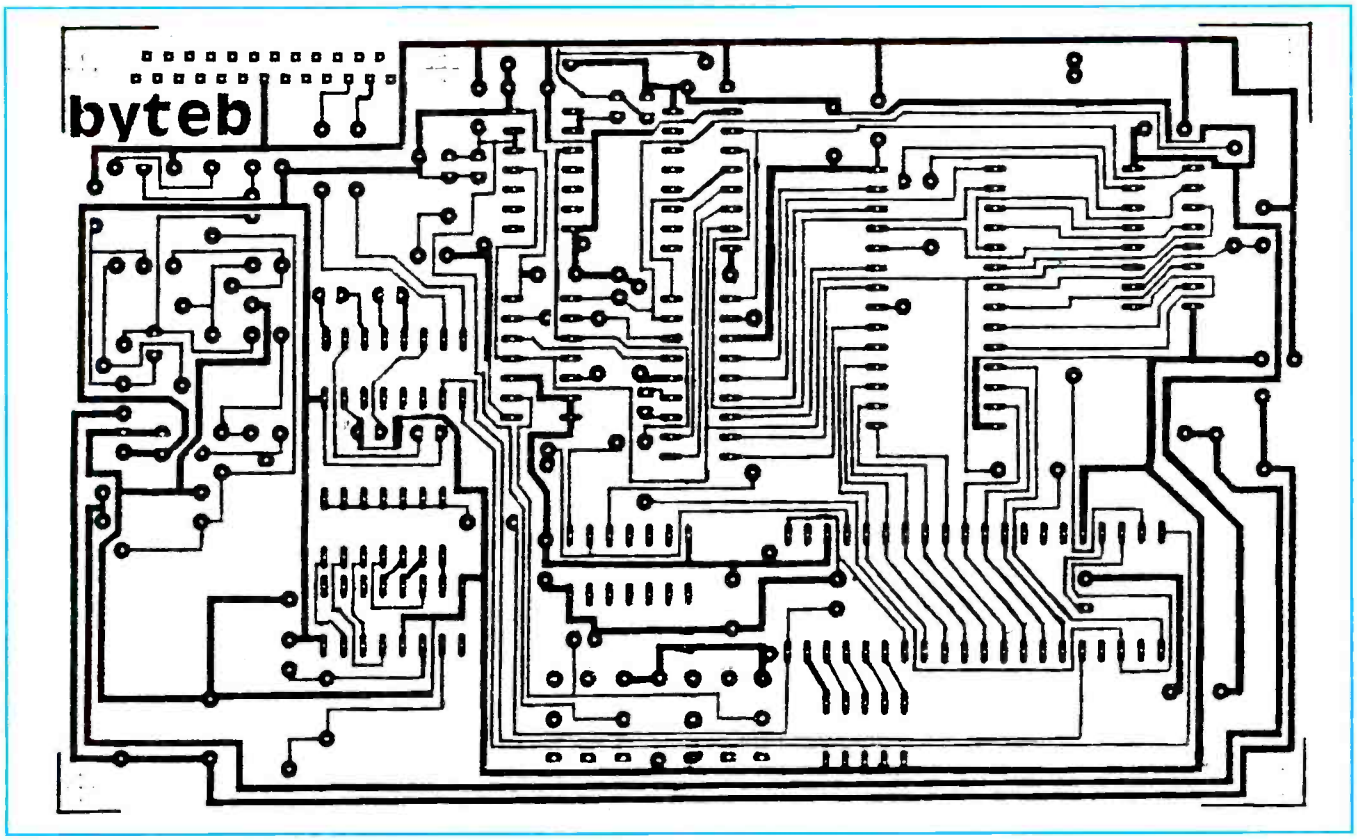
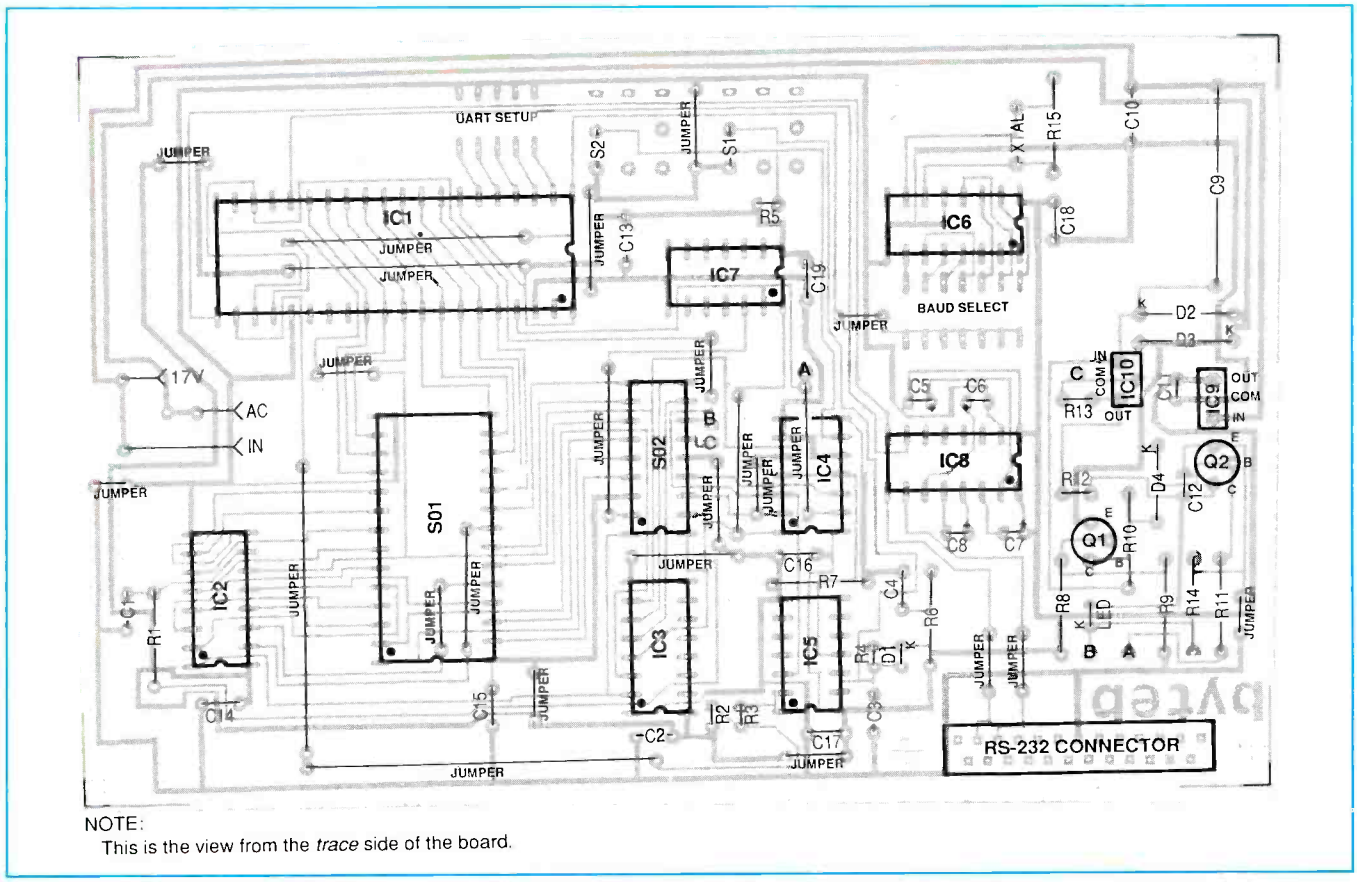


Fig. 3. Actual-size etching-and-drilling guide to use for fabricating printed-circuit board from Programmer.



NOTE:
This is the view from the *trace* side of the board.

Fig. 4. Wiring guide for pc board.

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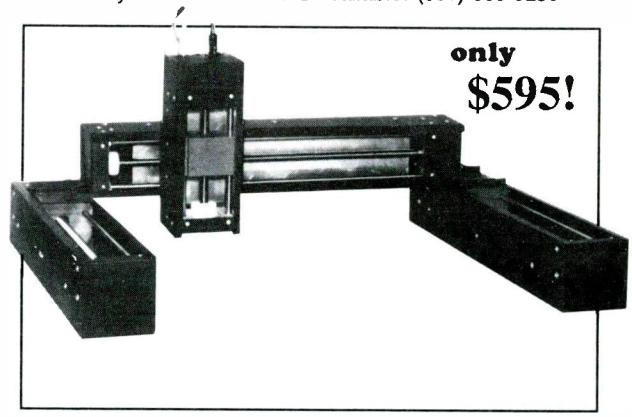

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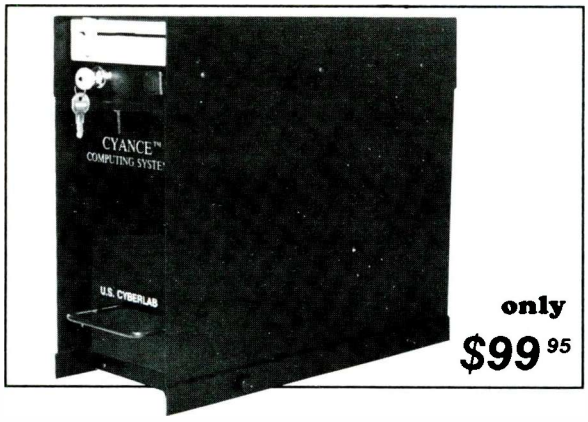

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9,600 baud, no parity, two stop bits and eight data bits.
(2) Open a disk file for reading or writing, and close it again.
(3) Flush the computer's and/or UART's serial receive buffer.
(4) Output an eight-bit character through the serial port with no handshaking.
(5) Wait for and eight-bit character to arrive through the serial port and input it with no handshaking.
(6) Do nothing for 50 ms (±5 ms).

The two essential functions of the EPROM Programmer are transfer of EPROM contents to and from disk files. These use the following program flows.

For reading, initialize, flush the buffer, open a disk file into which to read and then repeat the following as many times as other are bytes to read:
(1) Send a dummy byte (say 0).
(2) Input a byte and store it as next in the file.
(3) Send another dummy byte.
(4) Input a byte and discard it.
After all bytes are read close the input file.

For writing, initialize, flush the buffer, open a disk file from which to write and then repeat the following as many time as there are bytes to write:
(1) Fetch the first/next byte from the file and output it.
(2) Unless the fetched byte is FF16h, delay 50 ms.
(3) Input a byte and discard it.
(4) Output the fetched byte again.
(5) Input a byte and discard it.
(6) Finally, inform the user writing is done and close the output file.

Output and input operations with no handshake requires an interface directly to the hardware of the UART, as operating-system calls (for example under MS-DOS) may scan DTR or other signals before sending or receiving serial bytes. The alternative to tracking the trouble with software (not recommended) is to wire a special DB-25 serial plug involving pins 4, 5, 6 and/or 20 and perhaps others with the correct combination of shorting links.

A verify function is very helpful to read sequential bytes from the EPROM but open a file for reading, rather than writing, and comparing the EPROM's contents with sequential bytes from the file and display any differences found. The first of the nice-to-have functions memorizes the identity and size of the last file used to permit the same data to be used again. This feature has certainly saved me enough in time (and typing errors) to have made its implementation worthwhile.

Another function puts asterisks on the screen in blocks that indicate bytes processed, to give a progress report. One asterisk per 64 bytes gives just enough information during programming to give comfort that something is occurring without wasting too much time doing screen writes. It's also useful that the number of bytes to be programmed can be selected to be less than the EPROM's full length, permitting partial programming, where this is suitable. To fully program the popular 2764 EPROM takes eight minutes (less if there are "blank" areas with FFs in them).

A final nice feature is an addition to the verify function that reports whether EPROM erasure is required when a mismatch occurs between a file and the contents of the EPROM. Erasure is required when an EPROM bit is low that should be high. The software reports each such mismatch with a message and an audible signal. This makes checking the suitability of an EPROM for overwriting with a given file a matter of listening, rather than careful watching. Silence during the verify function means overwriting is possible because all mismatched bits are high. ■

Infrared Wireless Links

Part 3

Increasing the distance and using RS-232 ports

This month, I expand upon my previous two articles about basic circuits you can build for wireless communication. This time around, topics include techniques for increasing the range of an infrared link and an infrared link that connects to RS-232 serial ports.

Increasing Distance

In earlier articles, I described an infrared communications link using Motorola's MC145026/27 encoder and decoder chips. Briefly, the encoder reads four bits of data and a five-bit address at its inputs and outputs the information as an encoded stream of serial data. An infrared-emitting diode, or IRED, transmits the encoded data by pulsing at 40-kHz to signify a logic high and remaining off to signify a logic low.

At the receiving end, an infrared receiver module detects the presence or absence of the pulsed infrared energy and converts it back to the original form generated by the encoder. The decoder chip examines the received signal, determines whether the transmitted address matches its own and, if so, latches the four bits of data to its outputs. To guard against errors, the encoder sends each transmission twice, and the decoder must receive two identical transmissions before it latches the data to its outputs.

When you have the link up and running, one of your first challenges is to see how far you can reliably transmit. Two ways to increase the distance of the link are by increasing the power of the

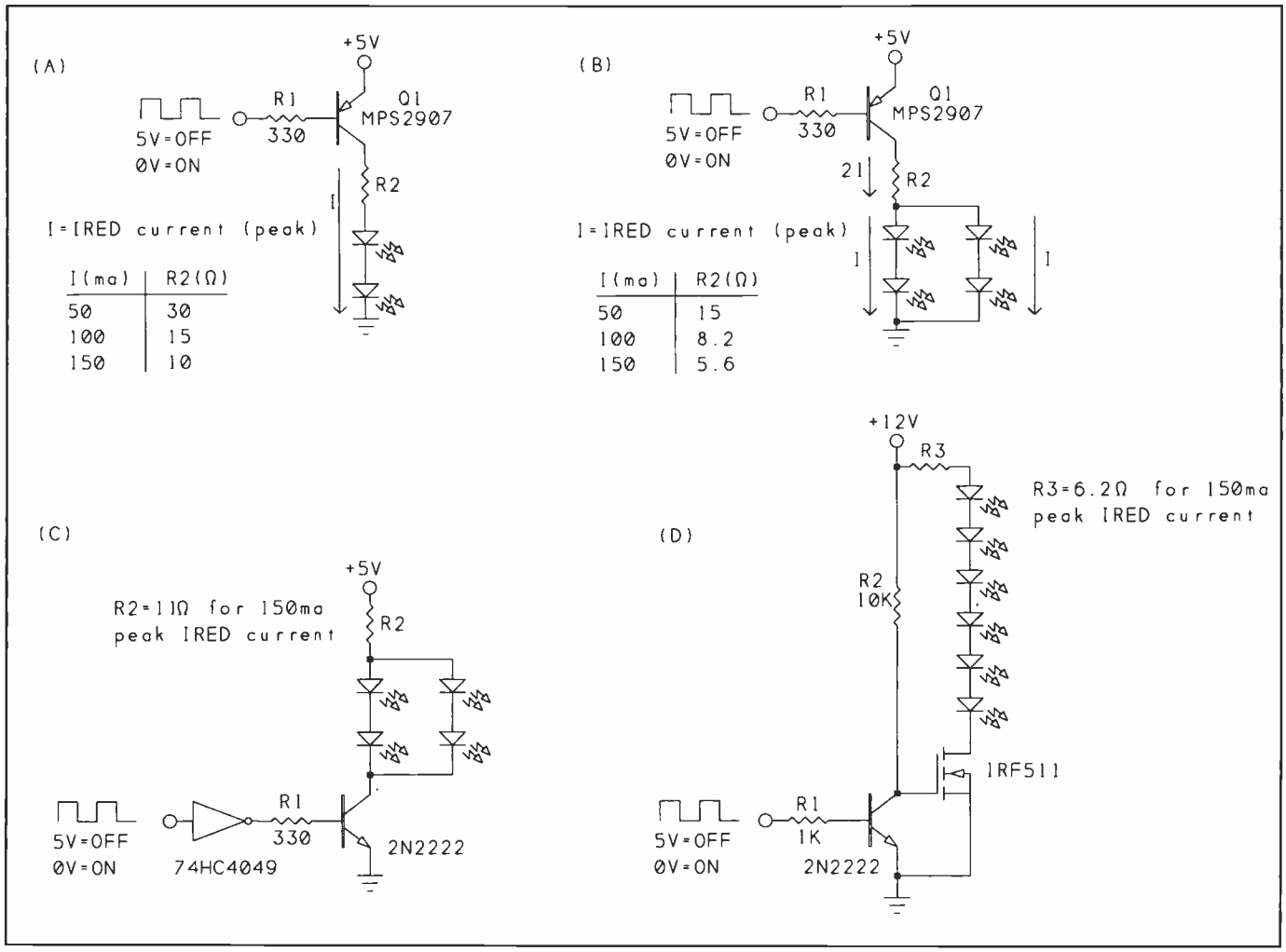


Fig. 1. To increase power of an infrared link, (A) add an IRED in series, (B) add IREDs in parallel, (C) add buffers to drive additional IREDs or (D) drive a MOSFET at 12 volts.

transmitted signal and by focusing the signal more precisely on the receiver.

Infrared Basics

Like visible light, infrared energy is a form of electromagnetic radiation. "Infra" means below, meaning that infrared frequencies are just below those of red (visible) light. Infrared frequencies are invisible because they're beyond the range that can be detected by the human eye.

Since wavelength is the inverse of frequency, infrared wavelengths are longer than those of visible light. Visible light covers the range 400 to 700 nm (nanometers), while infrared includes 700 nm through 1-million nm (400 nanometers is 0.4 micron, or 4,000 Angstroms, if you prefer these units.)

Infrared-emitting diodes, or IREDs, are low-cost, readily-available sources of infrared energy. An IRED is a semiconductor diode that emits infrared energy when a forward current passes through it. If you're familiar with light-emitting diodes (LEDs), IREDs are similar, except that their composition causes them to emit infrared energy instead of visible light.

An IRED emits energy at a specific wavelength. Two popular types are GaAs (gallium-arsenide), which emits energy at 940 nm, and GaAlAs (gallium-aluminum-arsenide), which emits energy at 880 nm. These are both in the range known as near infrared, signifying that their wavelengths are close to the visible spectrum.

Infrared detectors are also specific in the wavelengths they detect, although most will respond over a range of frequencies. For example, the Sharp GP-1U52X receiver module is most sensitive at 980 nm, but it will also respond to the longer-wavelength emissions from GaAs and GaAlAs IREDs. Although GaAs IREDs are a closer match at 940 nm, the GaAlAs IREDs are generally more efficient. So they may work as well even though 880 nm isn't as good a match with the detector.

You can increase the strength of an infrared signal in either of two ways: by increasing the current through the IREDs, or by increasing the number of IREDs. Figure 1 shows both options in a variety of circuits. All connect to the output of the NAND gate that combines the encoder's output and the 40-kHz oscillator in the circuits presented earlier.

A simple way to double the power is to use two IREDs in series, as shown in Fig. 1(A). With about 1.7 volts across each IRED, the series combination drops 3.4 volts. Instead of wasting energy by dropping 3 volts across a resistor, some of the current does useful work by powering a second IRED.

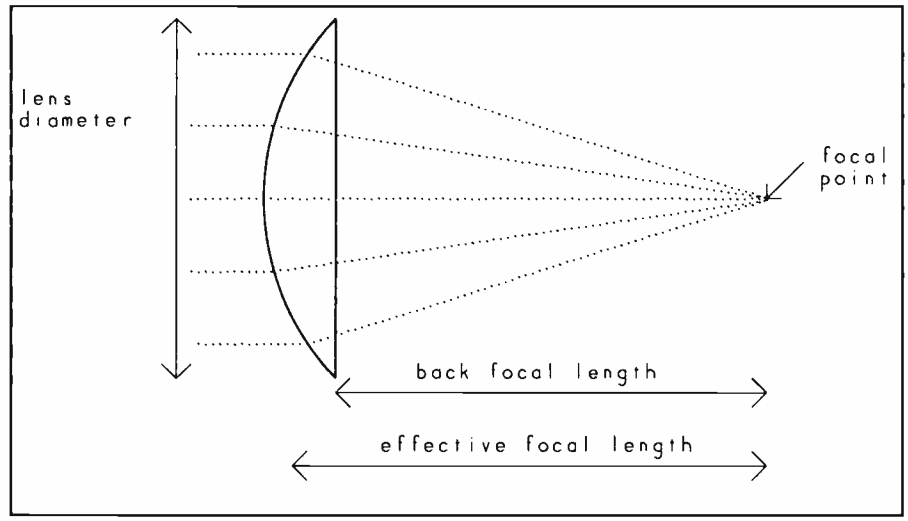


Fig. 2. At transmitter, a lens can focus transmitted infrared energy into a beam, and at receiver, it can focus received energy onto a detector.

The maximum possible current through the IREDs is determined by the transistor's base current and gain. Outputs in the 74HC (high-speed CMOS) logic family can sink up to 25 mA (absolute maximum) and are a good choice for driving the base.

Resistor *R2* controls the amount of current through the IREDs. To determine a safe current through an IRED, you need to know the specifications of the IRED you're using as well as how you plan to use the IRED in your circuit. The data sheet for any IRED should include an absolute maximum rating for continuous current. This is the maximum current that the device can withstand without suffering damage. For example, for Harris' F5D1, a typical IRED that's available from Digi-Key, among other suppliers, this value is 100 mA. When the IRED is powered continuously, the current through it shouldn't exceed this value. In fact, since this is an absolute maximum, it's a good idea to stay well below it.

The infrared transmitter doesn't require the IRED to be on continuously. Instead, it pulses the IRED at 40 kHz. In non-continuous, or pulsed, operation, the IRED can handle much greater currents. The amount of allowable current depends on the duty cycle of the pulse, which equals the width of the pulses divided by their rate of repetition. Unfortunately, data sheets are often not too specific about how to determine the limits for a particular pulse width and repetition rate. Occasionally, you get a graph of maximum forward current plotted versus pulse width and duty cycle. Other devices just offer a few examples.

The F5D1's data sheet includes just two ratings for pulsed operation. For 10-s pulses repeating at 100 Hz, the IRED's maximum peak current is 3 amperes, or 30 times the continuous rating. For even shorter 1-s pulses, repeating at 200 Hz, the maximum is 10 amperes. But neither of these describes the situation of the infrared transmitter.

In the infrared link, the amount of time an IRED is on depends on what information it's sending and how often it transmits. When an IRED is pulsed at 40 kHz, it's on for just half of each 25-s cycle. But the IRED pulses only when transmitting logic-high outputs from the encoder. For logic-low outputs, and when no data is transmitting, the IRED is off.

With the encoder chip clocked at 1 kHz, an encoded "1" contains two 3.5-ms high pulses and two 0.5-ms low pulses. This means that the IRED is pulsing almost 90% of the total time. If the 40-kHz oscillator has a 50% duty cycle, the IRED is on for half of the pulsing time, or 45% of each transmission.

If you send a lot of 0s (if the receiver's address is 00, for example), or if you send only occasional short transmissions, the average current will be much less.

In Fig. 1(A), with *R2* at 30 ohms, peak

current through the IREDs is about 50 mA, and average current is less than 25 mA, which is well below the 100-mA limit. Even at a peak current of 150 mA, the average over each transmission cycle will be less than 70 mA, which is probably a safe level.

If you do pulse the IRED at 100 mA or more, you must be very careful to design your circuit so that the IRED never comes on continuously. When not transmitting data, the IRED should be off. At greater currents, it's a good idea to use a current-limiting resistor with a 1/2-watt or greater power rating.

To permit greater peak currents, one method sometimes used is transmission of narrower pulses. At the same repetition rate, narrower pulses result in smaller average currents through the IRED.

If you use the GP1U52X infrared receiver module, however, it's probably best to transmit a square wave, with equal, or nearly equal, on and off times for the IRED. While experimenting, I found that the module will detect shorter pulses, up to a limit. But the data sheet shows a square wave as input, although there's no actual specification for the input's duty cycle.

If two IREDs aren't enough, you can add two more in parallel, as illustrated in Fig. 1(B). The current-limiting resistor is smaller in value because it drops the same voltage drop but has twice the current flowing through it.

Figure 1(C) shows four IREDs powered by an npn transistor. A 74HC4049 inverter controls the transistor's base current. With multiples of this circuit, you can have as many IREDs as your power supply can support.

And finally, if you have a 12-volt source available, you can add up to six IREDs in series, as illustrated in Fig. 1(D). The IRF511 MOSFET turns on when a voltage is applied to its gate. To turn on fully, the MOSFET requires a gate drive in excess of 5 volts.

For more-powerful transmissions to a specific receiver, you can mount multiple IREDs in a cluster, all pointing at the receiver. If you want to transmit to multiple receivers, or if a receiver's exact location is unknown, you can mount the IREDs so that they transmit across a wider-dispersed path.

Using Lenses

Another way to increase the range of a link is with optical lenses. A lens is a transparent material with at least one curved surface. A positive, or converging, lens is thicker in the center than at the edges. When parallel rays of energy pass through it, the lens refracts, or bends, them inward, causing the rays to meet at a focal point beyond the lens, as in Fig. 2. In contrast, negative (diverging) lenses are thinner in the center than at the edges, and bend the rays outward.

Positive lenses are useful for focusing the transmitted energy in infrared links. At the receiver, a positive lens can gather the infrared energy that hits it, and focus this energy on the detector. If the lens has a larger diameter than the detector, more energy will strike the detector than would be the case if no lens were used.

At the transmitting end, the lens works in reverse. It intercepts the diverging rays from the transmitter and focuses them into a narrow beam that it focuses on the active element of the detector.

Lenses have several specifications that define their performance. These include diameter, which is the width of the lens measured at right angles to the axis of transmission and effective focal length, which is the distance from the optical center of the lens to its focal point. Back focal length measures from the surface of the lens that's nearer the focal point, rather than from the center.

Many lenses are made from glass, but plastics are also used in their manufacture. For infrared links, you have to be sure that your lens is transparent to infrared frequencies, or nearly so. Although glass absorbs many infrared frequencies, it's transparent to the near-infrared frequencies of IREDs.

Lenses can be useful, but there are limits. If a lens is perfectly focused on the detector, the latter won't see anything at all unless the transmitter is aimed perfectly. You can compromise by focusing slightly beyond the detector, which gives a wider beam at the detector and requires less-critical alignment.

Some IREDs are manufactured with integral lenses that focus the output into a beam. For example, Harris' F5D1 and F5E1 IREDs are identical, except that the F5D1 has a lens that aims the energy in a narrow beam, while the F5E1 has a flat window and wider beam angle. An IRED with an integral lens is an easy, low-cost option, if it can do the job. The flat-window type is useful if you want to add an external lens or if you want a wider beam to reach multiple receivers around a room, for example.

Shown in Fig. 3 are four types of positive lenses. A plano-convex lens has one flat face and one outward-curving face. The flat face makes it easy to mount the lens on a flat surface. A double-convex lens has two outward-curving faces. Compared to a plano-convex lens with the same curvature, a double-convex

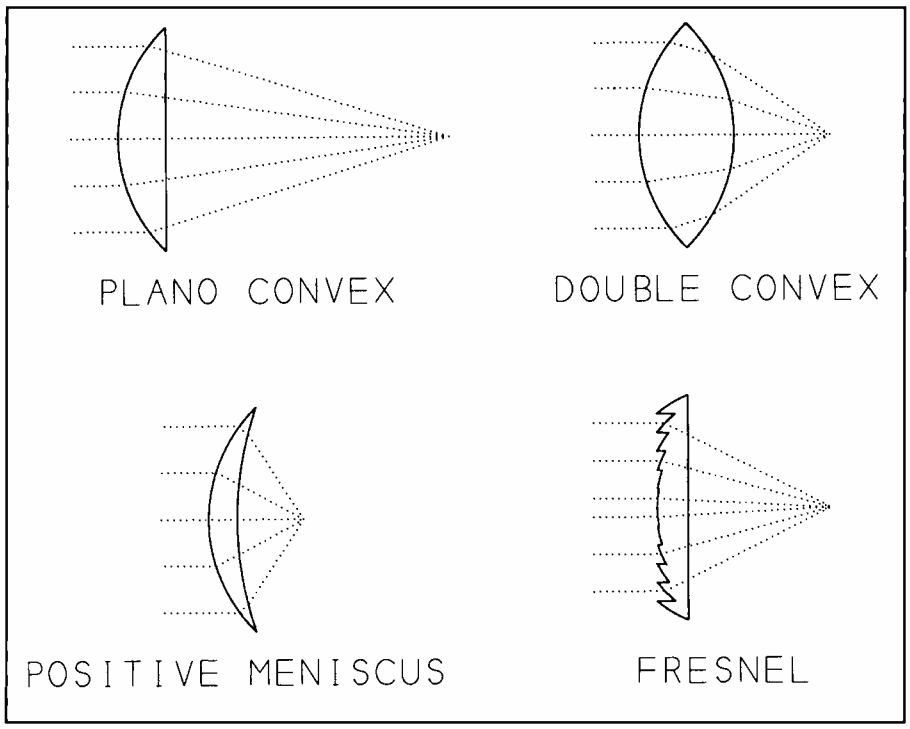


Fig. 3. Shown here are four types of positive lenses.

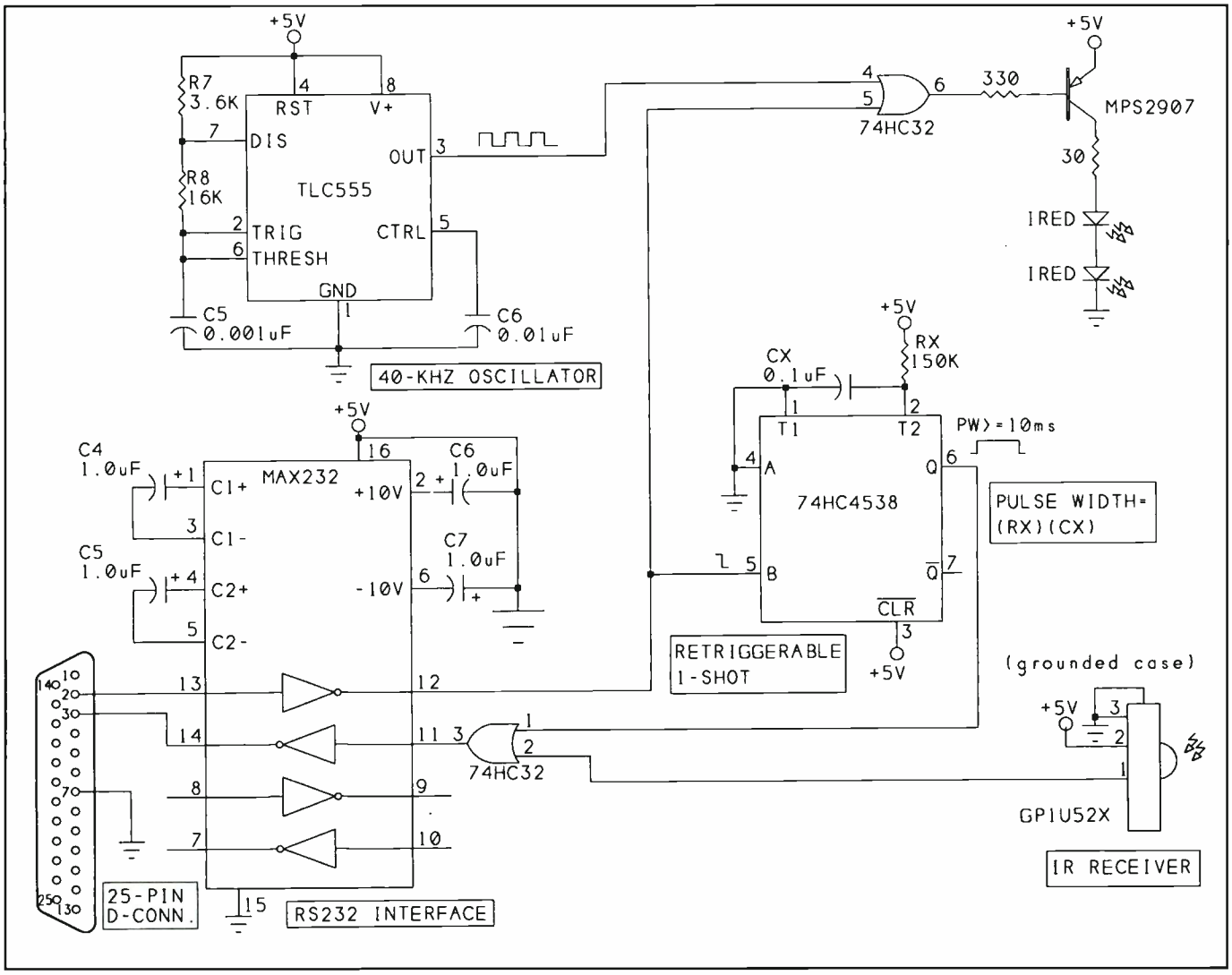


Fig. 4. The above illustrates one end of an infrared link that connects to an RS-232 serial port.

lens has half the focal length. A positive meniscus, or concavo-convex, lens has one outward-curving face and one inward-curving face, with the outward curve sharper than the inward curve. This is the type of lens used to correct for farsightedness in eyeglasses. A Fresnel lens is more complex in structure than the previous three types. It contains of a series of rings of concentric grooves, each of which resembles a section of the surface of a plano-convex lens. It's as if you sliced a series of concentric rings, all of the same height, from a convex lens, and then arranged the rings one inside the other on a flat surface. The outer rings curve more sharply than the inner ones.

The performance of a Fresnel lens is similar to that of a single lens that its rings appear to be cut from. Compared to traditional lenses, Fresnels are thin and light in weight. Many are plastic, with some specified for use with infrared wavelengths. Lighthouses use Fresnel lenses to form a concentrated narrow beam.

If you're interested in experimenting with lenses, Edmund Scientific is one source, with a huge selection, including inexpensive "educational" lenses, lens mounts, optical benches and books on optics.

Although infrared links are most often thought of as simple, line-of-sight paths —for transmitting across a room, for example—optics can extend the reach of a link. With mirrors, for example, you can transmit around corners.

RS-232 links

Links that use the encoder/decoder chips are ideal for sending occasional short bursts of data. If you want to send greater quantities of data or use higher transmission rates, one possibility is to interface infrared transmitters and receivers to a pair of RS-232 serial ports.

The GP1U52X receiver module can receive transmissions at up to 1,200 bits per second (bps). Since each transmitted byte typically includes start and stop bits, the actual transmission rate for your data will be less than this. Still, it's faster than the MC14026's rate of around 20 data bits per second. The tradeoff is that you have to do without the decoder's error-checking and automatic rejection of spurious signals and transmissions intended for other receivers. Through programming, you can add similar features, but this will slow the rate of data transmission. For example, if you send the data twice to verify, you cut data transmission rate in half.

Figure 4 shows one end of a two-way infrared link that interfaces to an RS-232 port. For a complete link, you need one of these circuits at each end. Some of the components, including the receiver module and 40-kHz oscillator, are the same as those used in the encoder/decoder circuits. A MAX232 chip translates between the RS-232 voltages and the 5-volt logic used by the infrared circuit.

The IRED is controlled by the logical OR of the MAX232's data output and a 40-kHz oscillator. When pin 12 of the MAX232 is a logic high, which occurs when the port is idle or transmitting a 1, or "mark," the IRED is off. When pin 13 is a logic low, indicating a 0 or "space," the IRED pulses at 40 kHz.

The IRED is aimed at the receiver at the other end of the link. At this end, a GP1U52X infrared receiver detects the transmitted signal. The receiver's output is low when it detects infrared transmissions at 40 kHz and high when it doesn't.

In a wired RS-232 link, each direction transmits on its own wire. With two wires (and signal ground), you can transmit and receive at the same time. In the infrared link, however, there are no wires from one end to the other, and you need to do something to isolate the two paths from each other. Otherwise, when one end transmits, the receiver at the transmitting end will detect the transmissions from the nearby IRED. This occurs even though the transmissions are aimed at, and intended for, the opposite end. This can cause problems, since everything that you transmit will be received at both ends.

There are several ways you might try to isolate the two directions of transmission. One possibility is optical shielding or placing a physical barrier that keeps the IRED's emissions from reaching the nearby detector. I didn't have much luck with this in my experiments, however.

Another possibility would be to use receivers that are tuned for different modulation frequencies. I gave this a try, using the 40-kHz GP1U52X and Lite-On's LTM-8834-2, which is tuned to detect emissions at 32.7 kHz, and adjusting the oscillators to match. The receivers weren't selective enough, though, and both still detected the off-frequency transmissions from the nearby IREDs.

A third approach is to prevent the computer from seeing any received signals while it's transmitting. This is the approach used in Fig. 4. When pin 12 of the MAX232 goes low, indicating that the IRED will be transmitting, a 74HC-

4538 multivibrator, or one-shot, triggers. The one-shot's output at pin 6 is a high pulse of about 15 ms in duration, which is slightly longer than the transmission time of one byte at 1,200 baud. When pin 6 of the one-shot is high, pin 3 of the 74HC32 OR gate is high and pin 11 of the MAX232 is held high. The result is that any transmissions detected by the receiver are ignored.

Shortly after the IRED finishes transmitting, the one-shot times out. Pin 1 of the OR gate goes low and pin 11 of the MAX232 matches the receiver's output. Since the one-shot is retriggerable, its output remains high if the transmitter sends a series of bytes.

This method of transmitting assumes that each end will know when it's its turn to transmit. If both ends transmit at simultaneously, both receivers will turn off, and nothing, or at best partial transmissions, will be received.

If you're wiring the link directly to a single-board computer, you don't need the MAX232. You can instead connect to a device's 5-volt asynchronous serial input and output. However, since the MAX232 contains inverters, if you don't use it, you need to invert the serial input and output.

You can test the infrared link using two personal computers. Wire the MAX232's input, output and signal ground to the appropriate pins on a 25-pin D-connector or whatever connector your system uses.

At both ends, set up your communication software for matching baud rates of 1,200 or less. Configure the software for half-duplex communications. This means that when you transmit by typing at your keyboard, your software displays what you typed. In full-duplex communication, the display instead shows the echo received from a modem or far end. Since there's no echo when you transmit in one direction at a time, you have to provide your own.

If possible, perform initial tests over a short distance. Align the two ends so that each IRED points at the opposite end's receiver. When you have the basic link working, you can separate the two ends for the distance you desire. Test the link by typing messages at each end.

The messages should appear on the screens at the opposite ends. If you see nothing, use a logic probe or oscilloscope to follow the signal through the link. Type characters and observe the response. Pin 4 of the OR gate should toggle at 40 kHz. When you send a character, you should see toggling at pin 12 of the MAX232, pin 6 of the OR gate and the transistor's collector. At the receiver, you should see toggling at pin 2 of the OR gate and pin 11 of the MAX232.

If you're receiving completely garbled data, be sure your baud rates match. If you receive data that's mostly okay but exhibits occasional bad, missing or extra characters, there could be several things that can cause such a problem. Check the alignment of the IREDs and receivers. Of course, this is difficult to do, except by trial and error, since the transmissions are invisible. Over a distance of several feet, precise alignment shouldn't be necessary.

The one-shot's output should be at least 10 ms in duration. With an oscilloscope, you can set the pulse width precisely by substituting a 500,000-ohm potentiometer for the resistor at pin 2. Connect the center tap to pin 2, and one end to +5 volts. Briefly pulse low pin 5 low and adjust the potentiometer for a 10-ms pulse at pin 6. Alternatively, set the potentiometer to a low value and increase the resistance until you can transmit without also receiving the data at the transmitting end.

If you still have trouble, try using a lower baud rate. The receiver module introduces delays that change the width of the received pulses somewhat, and the delays are proportionately less with a slower baud rate's wider pulses.

You may still find that you occasionally receive spurious characters. This is because the infrared receiver responds to signals it detects in ambient light. A brief pulse may cause the computer to detect a transmission, often a space (20h) or other character, whose binary ASCII code contains mostly 0s. Shielding the receiver from ambient light can help eliminate these.

Remember that you can transmit in only one direction at a time. If you try to transmit before the other end's one-shot has timed out, the data won't be received.

You can use several methods to keep track of which unit's turn it is to transmit. One is to designate one computer the controller, which requests responses from the controlled end. The controlled end transmits only on request.

Many communication programs allow you to use the codes X-ON (Control-Q, or ASCII 11h) and X-OFF (Control-S, or ASCII 13h)) to control transmissions. X-ON means okay to send, and X-

Continued on page 47

"Do you have a faxing section?"

SRAMs, NVRAMs, EEPROMs, Flash Memory and SmartSockets

In this concluding installment of our bonus pullout guides, we present pinouts and definitions for SRAMs, NVRAMs, EEPROMs and Flash Memory SmartSockets and include Dallas Semiconductor's SmartSockets that convert SRAMs into nonvolatile. All devices follow the same general pattern in their pinouts, with variations occurring mainly in the number of address lines and the locations of some high address lines and control signals, making it easy to design circuits that permit a choice of device type or capacity with jumpers or switches to route the connections for those pins that differ.

Device	6116 DS1220*
Capacity	2Kx8
Pin Functions	A7 1 / A6 2 / A5 3 / A4 4 / A3 5 / A2 6 / A1 7 / A0 8 / DQ0 9 / DQ1 10 / DQ2 11 / GND 12 / 24 Vcc / 23 A8 / 22 A9 / 21 $\overline{WE}$ / 20 $\overline{OE}$ / 19 A10 / 18 $\overline{CE}$ / 17 DQ7 / 16 DQ6 / 15 DQ5 / 14 DQ4 / 13 DQ3

*NV RAM

Device	62256 DS1235*	6264 DS1225*	6264 DS1225*	62256 DS1235*
Capacity	32Kx8	8Kx8	8Kx8	32Kx8
Pin Functions	A14 1	NC 1	28 Vcc	Vcc
	A12 2	A12 2	27 $\overline{WE}$	$\overline{WE}$
	A7 3	A7 3	26 NC	A13
	A6 4	A6 4	25 A8	A8
	A5 5	A5 5	24 A9	A9
	A4 6	A4 6	23 A11	A11
	A3 7	A3 7	22 $\overline{OE}$	$\overline{OE}$
	A2 8	A2 8	21 A10	A10
	A1 9	A1 9	20 $\overline{CE}$	$\overline{CE}$
	A0 10	A0 10	19 DQ7	DQ7
	DQ0 11	DQ0 11	18 DQ6	DQ6
	DQ1 12	DQ1 12	17 DQ5	DQ5
	DQ2 13	DQ2 13	16 DQ4	DQ4
	GND 14	GND 14	15 DQ3	DQ3

*NV RAM

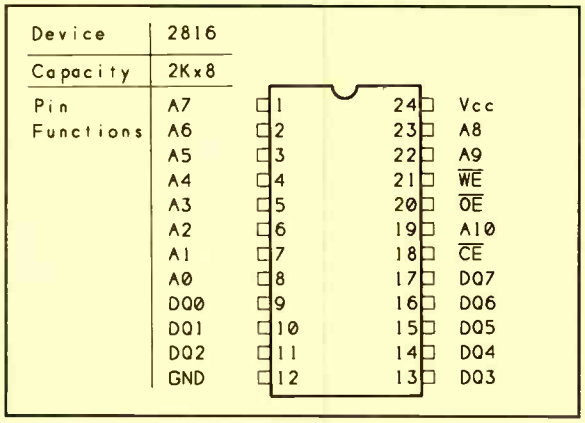
Static RAM and Nonvolatile RAM

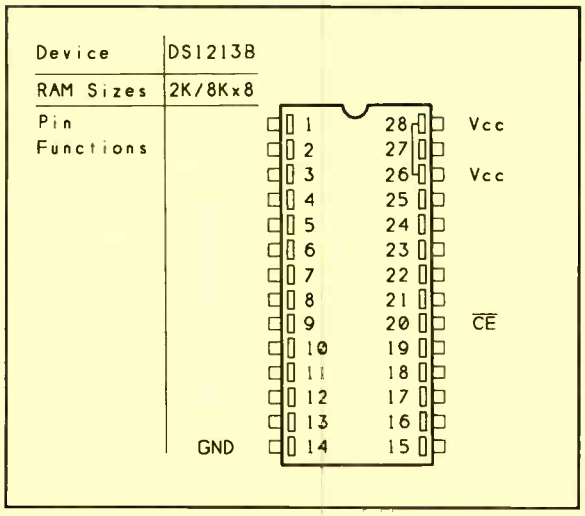
A static RAM, or SRAM, stores data written to it until power is removed, or until the data is overwritten. Unlike dynamic RAMs, SRAMs require no refresh circuits. Two-kilobyte RAMs use a 24-pin package, while larger-capacity SRAMs use 28- and 32-pin packages. Nonvolatile RAM (NVRAM) is SRAM that retains its contents even after power is removed. Dallas Semiconductor's NVRAM consists of an SRAM, a lithium cell and back-up circuits in an encapsulated package. The backup circuits apply 3 volts to the chip when the main supply is off. Back-up power is rated to last 10 years.

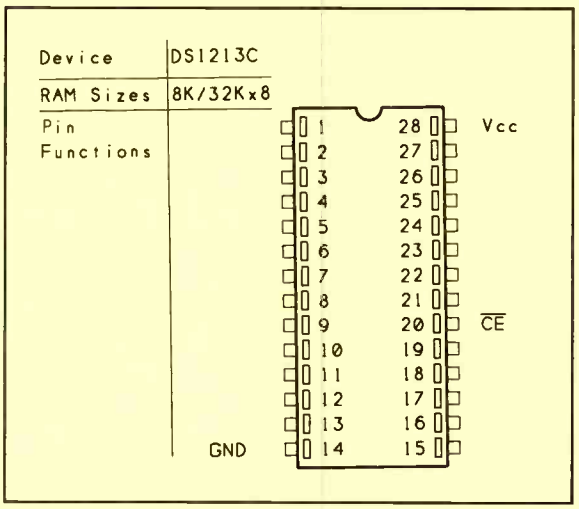
EEPROM

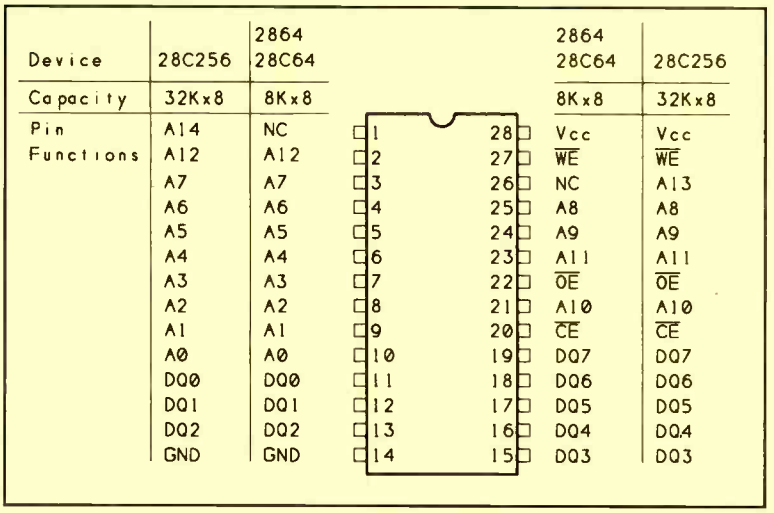
EEPROMs retain their contents when power is removed and are electrically erasable. A write operation may re-quire several milliseconds

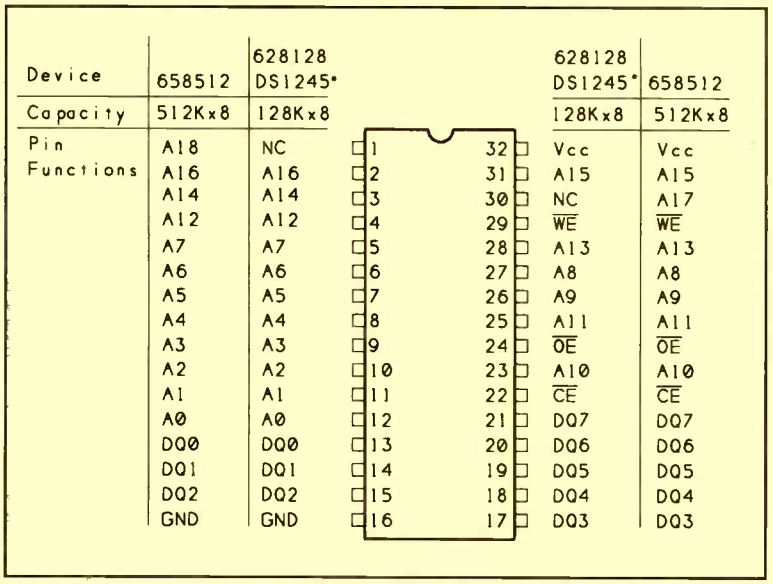
Device	28F020	28F010	28F512	28F256	28F256	28F512	28F010	28F020
Capacity	256Kx8	128Kx8	64Kx8	32Kx8	32Kx8	64Kx8	128Kx8	256Kx8
Pin Functions	Vpp 1	Vpp 1	Vpp 1	Vpp 1	32 Vcc	Vcc	Vcc	Vcc
	A16 2	A16 2	NC 2	NC 2	31 $\overline{WE}$	$\overline{WE}$	$\overline{WE}$	$\overline{WE}$
	A15 3	A15 3	A15 3	NC 3	30 NC	NC	NC	A17
	A12 4	A12 4	A12 4	A12 4	29 A14	A14	A14	A14
	A7 5	A7 5	A7 5	A7 5	28 A13	A13	A13	A13
	A6 6	A6 6	A6 6	A6 6	27 A8	A8	A8	A8
	A5 7	A5 7	A5 7	A5 7	26 A9	A9	A9	A9
	A4 8	A4 8	A4 8	A4 8	25 A11	A11	A11	A11
	A3 9	A3 9	A3 9	A3 9	24 $\overline{OE}$	$\overline{OE}$	$\overline{OE}$	$\overline{OE}$
	A2 10	A2 10	A2 10	A2 10	23 A10	A10	A10	A10
	A1 11	A1 11	A1 11	A1 11	22 $\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$
	A0 12	A0 12	A0 12	A0 12	21 DQ7	DQ7	DQ7	DQ7
	DQ0 13	DQ0 13	DQ0 13	DQ0 13	20 DQ6	DQ6	DQ6	DQ6
	DQ1 14	DQ1 14	DQ1 14	DQ1 14	19 DQ5	DQ5	DQ5	DQ5
	DQ2 15	DQ2 15	DQ2 15	DQ2 15	18 DQ4	DQ4	DQ4	DQ4
	GND 16	GND 16	GND 16	GND 16	17 DQ3	DQ3	DQ3	DQ3

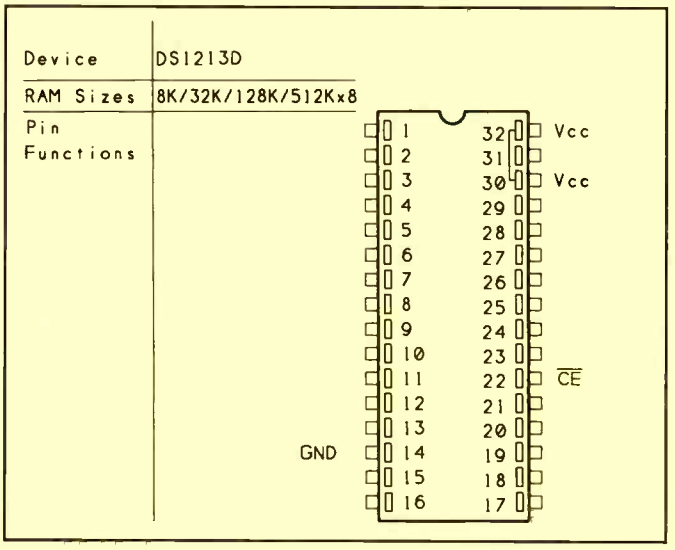












to complete, though newer de-vices have shorter erasure times. The number of erasures possible with an EEPROM is limited, typically to around 10,000, although here, too, newer devices offer improved erasure life cycles. Popular sizes include 2K, 8K and 32K bytes.

Flash Memory

Flash memory is electrically erasable and nonvolatile. Erasing and programming must follow a specific algorithm. Most devices erase all at once, though some are divided into a few blocks, each of which is individually erasable. Many flash memories require a 12-volt supply for erasing. Capacities range from 32K to 256K bytes.

SmartSockets

You can build your own NVRAMs by plugging SRAMs into Dallas Semiconductor's SmartSockets. Each socket contains a lithium cell and battery back-up circuits that interface to V_{CC}, GND and CE on the

SRAM. All other connections pass straight through the socket. Each socket type offers a choice of two or more SRAM capacities. To install a 24-pin device in the 1213B, or a 28-pin device in the 1213D, leave the top two rows unoccupied.

Pin Functions for SRAM, EEPROM and Flash Memory

Symbol	Type	Function	Comments
A0 Thru A18	Input	Address	Number of address inputs tells you how many bytes the device can store. For example, a 6116 SRAM has 11 address inputs (A0 through A10) and stores 2^{11}, or 2,048, bytes.
-CE	Input	Chip Enable	Power control and device select. Must be low to read data.
-CE	Input	Chip Enable	Sometimes called CS (Chip Select).
DQ0 Thru DQ7	Input/ Output	Data	Sometimes labeled I/O0 through I/O7. All devices shown store eight data bits at each address.
GND	Input	Circuit Ground	
NC	—	No Connection	
-OE	Input	Output Enable	Gates data to outputs. Must be low to read data. Sometimes called G.
Vcc	Input	Power Supply	+5 volts.
Vpp	Input	Program-ming	+12 volts, applied only during programming for flash memory only.

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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.

Sources

Digi-Key Corp.
701 Brooks Ave. S.
PO Box 677
Thief River Falls, MN 56701-0677
Tel.: 1-800-344-4539

CIRCLE NO. 120 ON FREE INFORMATION CARD

Edmund Scientific Co.
101 E. Gloucester Pike
Barrington, NJ 08007-1380
Tel.: 609-573-6250

CIRCLE NO. 121 ON FREE INFORMATION CARD

Selected Manufacturers of Infrared Emitters and Detectors

Gilway Technical Lamp
800 W. Cummings Pk.
Woburn, MA 01801
Tel.: 617-935-4442

CIRCLE NO. 122 ON FREE INFORMATION CARD

Harris Semiconductor
PO Box 883
Melbourne, FL 32901
Tel.: 407-724-7800

CIRCLE NO. 123 ON FREE INFORMATION CARD

Lite-On
720 S. Hillview Dr.
Milpitas, CA 95035
Tel.: 408-946-4873

CIRCLE NO. 124 ON FREE INFORMATION CARD

Motorola Semiconductor Products
P.O. Box 20912
Phoenix, AZ 85036
Tel.: 1-800-521-6274

CIRCLE NO. 125 ON FREE INFORMATION CARD

Optek Technology
1215 W. Crosby Rd.
Carrollton, TX 75006
Tel.: 214-323-2200

CIRCLE NO. 126 ON FREE INFORMATION CARD

Sharp Electronics
Microelectronics Group
5700 NW Pacific Rim Blvd., M/S 20
Camas, WA 98607
Tel.: 206-834-2500

CIRCLE NO. 127 ON FREE INFORMATION CARD

Siemens Components
Optoelectronics Div.
19000 Homestead Rd.
Cupertino, CA 95014
Tel.: 408-257-7910

CIRCLE NO. 128 ON FREE INFORMATION CARD

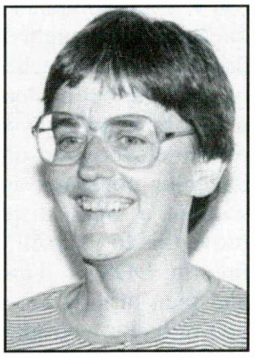
OFF means don't send. You could begin each message with X-OFF to advise the other end not to send anything and end with X-ON to indicate that your message is over and it's okay to transmit. Of course, if both sides by chance try to transmit at the same time, this won't work, since both receivers will turn off.

In addition to typing characters at each end, you should be able to use your communications software to send ASCII files back and forth. This includes files in Intel Hex and Motorola S-record format, which include checksums for verifying the transmissions.

If 1,200 bits per second isn't fast enough for you, see Sharp's Application Notes data book, which includes a description of a 19,200-bps link using Sharp's RY5AR01/AT01/BD01 transmitters and receivers.

Next month, I'll address the subject of radio links.

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 envelope, stamped envelope, if possible. For the first two parts of this series, you can order the October and November 1993 back issues directly from ComputerCraft *for $3.50 each.*



Jan Axelson

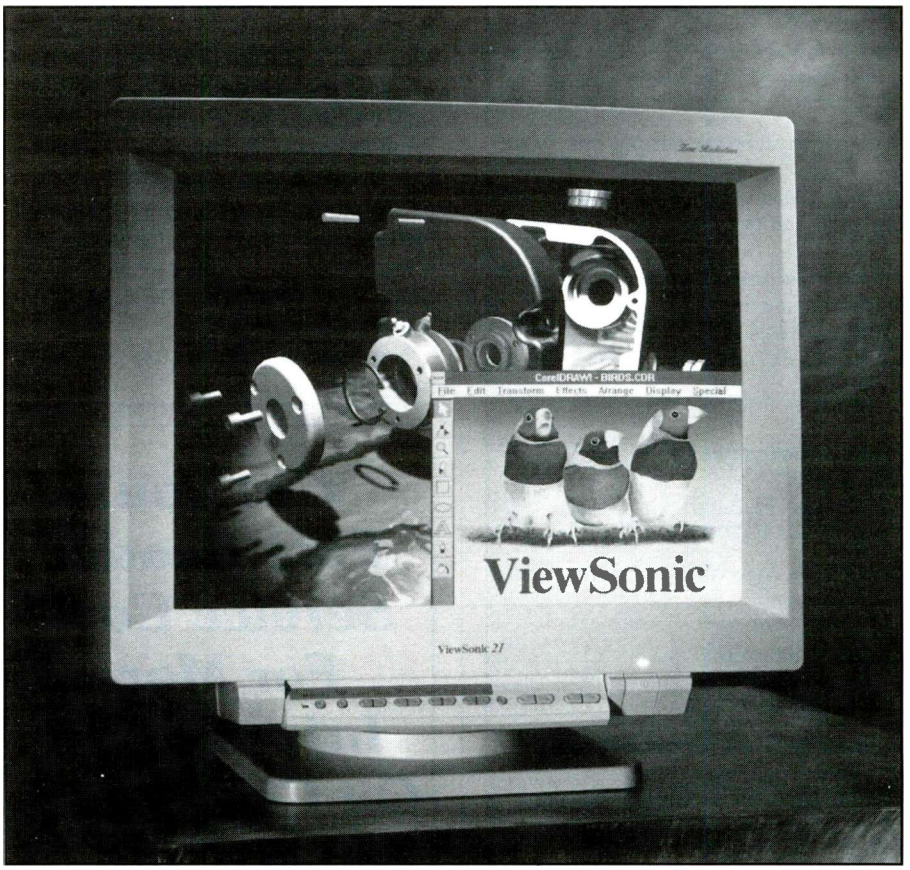
Video Display Monitors

What you should know about this most-important link between you and your computer

What's the most important part of your computer system? If this question stirs thoughts about CPUs, hard drives, buses and caches, you've thought of a typical but misleading answer. No matter how quickly your computer runs or how clever your software happens to be, your computer is almost useless without a video display monitor. To prove this to yourself, try starting your favorite DOS or *Windows* application and then turning off your monitor. If you're lucky, you may be able to save your work and return to DOS without seeing the screen, but you won't be able to tell whether or not you've succeeded.

Your video monitor affects everything you do with your computer. A well-maintained, high-quality monitor will make you feel like you're working with a great computer. A monitor that exhibits washed-out colors, blurry characters and flickering resolution, even when used with a Pentium-based computer, will seem anemic and tacky.

Many new computers are bundled with video monitors. If you shop for the least-expensive computer system, you'll also end up with a low-quality monitor. It may be fine for a while, but you'll eventually want something better. Or you may have kept the same monitor through one or two system upgrades, moving it from a 286 to a 386 and even a 486 machine. Eventually, you'll have a video card with more capabilities than your monitor can deliver, at which time, it'll be time to upgrade.



ViewSonic 21 Flat Square Screen 21" monitor.

To the Monitor

Computer video monitors were invented not long before the advent of personal computers. Thus, it's now difficult to imagine a computer without one. The slow teletype machines or two-way typewriters that were once used for "interactive" input and output now seem as primitive as starting a fire with a piece of flint. Originally, of course, monitors had only a monochrome display, with white, green or amber characters on a black background. Although all new operating environments (*Windows*, OS/2, etc.) and almost all major applications are written to make use of graphics and color, millions of PC users still stare at monochrome text screens, which are perfectly adequate for thousands of DOS and UNIX text-based applications.

Internally, monitors are similar to television receivers, though they lack tuners —at least in theory. Many early personal computers for home use were shipped with converters that let users plug them into home TV receivers, much like is still done with video games. This is no longer practical with computers because PCs and video adapters need and expect much better resolutions than TV receivers are capable of providing.

To understand a how a video monitor works, you first need to know a little about how a display adapter works. The "video card" inside the computer keeps either text or graphics data in its memory. When a program or operating system updates the screen, it's really changing the contents of the video RAM on the display adapter. However, these transactions to update and change the video display, perhaps by drawing a window or scrolling a text screen, are secondary to the video adapter's real purpose. The adapter spends most of its time sending signals to the monitor. directing the way the monitor paints its image across the display screen.

From the video card's point of view, there's a large difference between text mode and graphics mode. In graphics mode, the color of every dot or pixel on the screen is stored in the video card's

memory. The actual organization of the storage depends on the video mode or current resolution. The video card creates the signals for the monitor by reading each dot in memory and sending the appropriate information to the monitor, one dot at a time.

In text mode, the adapter stores every character in two bytes, one of which contains the ASCII value of the character, the other the character's "attribute" or the information needed to select foreground and background color and other display characteristics. The graphics card must look up each character in a table to determine which pixels or individual screen dots should by turned on and off. This look-up procedure goes on constantly because the video adapter sends the current state of the screen to the monitor dozens of times a second. But from the monitor's point of view, there's no difference between text and graphics mode. All it receives is graphics data—the color that it should use for every dot or pixel on the screen.

If the display adapter were a TV transmitter and the monitor a TV receiver, the adapter would have to combine all of its signals and send them as a single bundle. The monitor would then have to separate the signal into its component parts before processing them. But this requires a lot of extra time-consuming work on both ends and adds nothing but possible signal degradation. Instead, the display adapter communicates with the monitor through multi-conductor cable, sending each component of the signal through a different conductor.

The actual conductors used depend on the type of video adapter and monitor being used, which means that the first order of business in buying a monitor is to make sure that it will work with your video card. For example, it is difficult or impossible to hook an old CGA monitor to a modern super-VGA video card, and even if you could, the monitor would probably self-destruct in a few seconds.

Some of the conductors in the video cable carry color information, one pixel at a time, while others carry synchronization information. By processing these separate signals from the adapter card, the monitor creates the screen that the application programmer intended.

Inside the Monitor

Internally, a video monitor has some circuitry and a video display, or picture, tube. The tube has one or three electron beam generators, a means of focusing and directing the beams and a coating of phosphors on the inside front surface of the tube. In simplest terms, when the electron beam strikes the phosphor coating, it "excites" the phosphors, which then emit light for a short period of time.

Monochrome monitors have a single electron beam and phosphors of one color, usually white, amber or green. Also, a monochrome monitor is usually expected to display only "colors:" black (pixel turned off) or normal (pixel excited).

Color monitors normally have three beams and three colors of phosphors. One beam is responsible for exciting blue phosphors, another is for red phosphors and a third for green phosphors. Because of the additive laws of the colored light given off by these phosphors, they can be mixed to produce any desired color. If all three colors are fully excited at a particular point, for example, you perceive a white point. If none of the phosphors are excited, the point looks black.

The original color video adapter for PC-compatibles, the CGA or Color Graphics Adapter, output four digital color signals. Therefore, it could create information for 2^4 or 16 total colors. The monitor interpreted the four signals as

red, blue, green and intensity. The EGA, or Enhanced Graphics Adapter, had six color lines or two lines for each color. Thus, it could display 2^6 or 64 total colors. However, because of internal limitations in the adapter, it could normally display only 16 of those 64 colors at any one time.

The digital color lines limited the number of colors that CGA and EGA systems could display. IBM built two new adapters into the motherboards of early PS/2s that overcame this limitation: the Multi-Color Graphics Array (MCGA) and Video Graphics Array (VGA). Both must be attached to an analog monitor and both use digital- analog converters (DACs) to create 64 different voltage levels on each of three color lines. This means that each is capable of display 64^3 or 262,144 different colors. (For backward compatibility, many "plain" VGA cards can also be attached to digital color or monochrome monitors, if necessary.)

The move from digital to analog monitors and video adapters is probably the most significant development in the history of PC displays. It unleased a flood of colors—some video cards support up to eight bits (256 levels) per color for a total of more than 16-million separate colors. This is essentially an infinite number of colors, since it's doubtful that the human visual system is sensitive enough to distinguish between closely-related colors on such a system. These 24-bit color systems are often dubbed "true color" and are useful in high-end image manipulation applications.

Even VGA monochrome monitors are analog these days, displaying a range of gray shades instead of the black/white/intense-white possibilities of older monochrome systems.

Monitor Terminology

Once you start to shop for a new video display monitor, you'll find that they have a language all of their own. Perhaps the most important term is dot pitch. Inside the face of the monitor tube is a shadow mask that lets the electron beams through only at specific locations. (The Sony Trinitron line and some other monitors uses a slotted mask, with strips instead of individual holes.) The distance between these dots is termed the *dot pitch*. The smaller the pitch and the closer the dots, the finer the image "grain." Monitors with a smaller dot pitch are usually more enjoyable to use because their images appear to be clearer and crisper. You should buy the smallest dot pitch you can afford, and rarely anything greater than 0.31 mm.

The best dot pitch in the world is useless unless the three electron beams are correctly aimed in relationship with each other. This mutual aiming is called *convergence*. One way to test convergence is to look carefully at white character or graphic blocks on a black background. The white should seem to be pure white. If it has a hint of a colored halo, the monitor's convergence is off.

Convergence is likely to be better in a high-quality monitor, but there are no guarantees. Sometimes, environmental factors affect monitor convergence. Especially in office buildings, the convergence can change noticeably if you turn the monitor 90° on its stand or move it from one desk to another. Convergence also seems to vary from one particular monitor to another of the same type. And while convergence can be adjusted by any competent TV repair person, you'll probably want to check the actual monitor you're going to buy in a store before you purchase it.

Resolution is a measurement of how many pixels or individual dots a monitor can display. The CGA monitors of 1981 had a maximum resolution of 720 x 350 pixels in text modes and either 320 x 200 (four colors) or 640 x 200 (two colors) in graphics mode. Today's moderately priced monitors can display 1,024 x 768 pixels or more. This means that they can display 1,024 pixels across the screen and 768 pixels from top to bottom. Of course, these monitors must be matched with video cards that can deliver the same capabilities.

High-resolution monitors are available with either interlaced or noninterlaced scanning (and, again, need interlaced or noninterlaced support from the graphics card). When a monitor uses noninterlaced scanning, it paints the lines of the image from top to bottom on the screen. Each pass of the electron beams over the screen creates an entire new image. With interlaced scanning, the monitor paints the odd-numbered lines in one pass over the screen and then the even-numbered lines in the second pass. Interlaced scanning is less desirable because it tends to create more image flicker. After a full day staring at a flickering monitor, your eyes will be ready for a two-week vacation.

Video monitors are subject to a number of distortions besides flicker. *Pincushioning* describes image sides that curve in toward the center of the screen. *Barrel distortion* is just the opposite—the sides of the image appear to bow outward. Both of these forms of distortion are more likely to appear on a monitor that's running close to its engineered maximum, because placement of dots is more difficult to control at the sides of an image than it is in the center.

Mis-convergence, of course, causes a blurry, distorted image with colored halos around letters and shapes. If the monitor's beams are far enough out of proper convergence, you may see roping or a spiral look to straight lines.

Sometimes images appear to move on the screen, a distortion called drift, swim or jitter, depending on the speed and extent of the movement. These movement distortions can be caused by environmental factors or partial failure of the control electronics inside the monitor.

Finally, you'll see monitors rated by their vertical refresh rates or video bandwidth. The vertical refresh rate (sometimes called the vertical scan frequency) is the speed at which a monitor can draw a full image or frame. Standard VGA monitors have a vertical refresh rate of 60 or 70 Hz, which means that they can redraw a screen 60 or 70 times per second. Super VGA rates vary from industry guidelines of 56 and 60 Hz to the official (IBM- approved) standard of 72 Hz.

Video bandwidth is related to the vertical refresh rate. It measures the highest input frequency which the monitor can handle. You can calculate an approximate bandwidth if you know the monitor's maximum resolution and frame rate. A super-VGA monitor, for example, with an 800 x 600 pixel resolution and 60 Hz frame rate, would have to be able to handle a bandwidth of at least 800 x 600 x 60, or 28.8 MHz. Actually, the monitor needs extra time for overhead, such as handling horizontal and vertical retrace (moving the beams from one part of the screen to another). A 30-MHz monitor is barely adequate for 800 x 600 graphics.

Making a Selection

The video display monitor marketplace is crowded, with each manufacturer providing a different mix of capabilities, features and price. If you're shopping for a new monitor, your first decision is whether you want one that matches your present video adapter or one that has ex-

tended capabilities. If you choose the latter, you'll probably be able to keep the same monitor when you update the adapter or even your entire computer.

Your second major decision is the size of monitor you want. Monitors, like television receivers, are measured by the diagonal size of the tube beneath the bezel. The exposed area of the tube will be slightly less, and the image itself will be even smaller. In the past, 13" and 14" monitors were standard. Today, 16" and 17" monitors are popular, especially for high-resolution graphics use. After all 1,024 pixels spread out across a 17" monitor's screen will be much easier to see than then same number of horizontal pixels squashed into a 13" or smaller display.

Next, you'll want to make sure that the monitor you choose can handle the same resolutions as your video adapter. Multiscanning monitors (like those in NEC's MultiSync line) can adjust themselves to a wide range of video modes and resolutions. Other monitors, like many that are advertised as super-VGA-compatible, can adjust themselves to match a specific set of resolutions.

A feature related to multi-scanning is auto-sizing. Monitors that can accept more than one input frequency can either adjust themselves automatically to keep the same image size regardless of resolution, to look up a preset image size for each resolution or to require user settings each time the resolution changes. If you use a multitasking environment like *Windows*, OS/2 or *DesqView*, you'll want a monitor that can adjust itself each time you switch video modes, for example from a DOS text screen to a *Windows* graphics screen. Otherwise, you'll often be reaching for the sizing controls as you silently curse your monitor.

You'll also be concerned with the dot pitch of the monitors at which you look. Anything greater than 0.31 mm is probably not worth considering, even for a computer dedicated to games. Most high-quality monitors have a dot pitch of 0.28 mm or even less. If you tend to use high graphics resolutions you'll probably want the smallest dot pitch you can afford.

Finally, the locations and number of controls is an important consideration. Some monitors hide the controls on the back, forcing users to fumble for them and try to guess which knob is which. Other, more user-friendly monitors have all of the controls on the front. One new monitor, the Optiquest 4000DC, features on-screen programming of major adjustments. Your settings are stored in an internal microprocessor and its memory.

Some controls are essential and available on almost all monitors. For example, it would be difficult to accept a monitor without both brightness and contrast controls. Other common controls set horizontal and vertical image position and size.

Some monitors have a color adjustment. Others have pincushioning and convergence controls available to the user. Still others have a degausser that removes the residual magnetic charge that slowly builds up on the screen and slowly degrades the image.

The prices of monitors vary greatly from one source to another. Local, non-discount stores may charge 25% more than some of the national mail-order sources. If you're lucky enough to live near one of the large discount computer warehouses, you might want to buy a monitor there, so you can return it for repair or replacement if your particular monitor has poor convergence or another distortion.

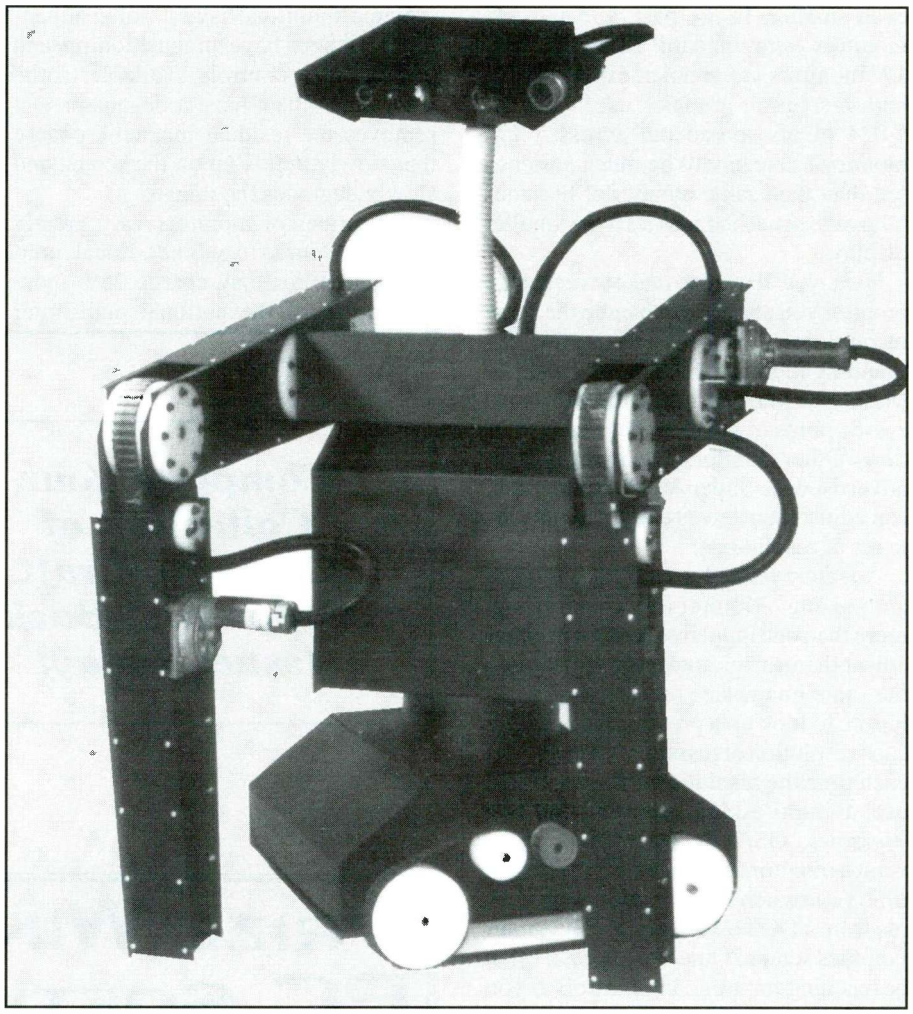
Whether you spend $250 for a simple VGA or super-VGA monitor or $1,500 for a 17" multi-scan monitor with 0.25-mm dot pitch and 1,280 x 1,024 resolution capabilities, a new monitor will change the "feel" of any computer. Bright colors, a crisp image and a large display will make you feel like you've got one of the best computers in the world. On the other hand, if you spend your computer time looking at a blurry image and washed-out colors, you won't think much of even the most powerful personal computer available. ■

Build A Real-World Work Robot

Part 4

Adding the CYBER Hand to the basic robot assembly

If you've been following the development of the RONAR (Remotely Oriented Numerically Actuated Robot) project in the past three issues of *ComputerCraft*, you're probably anxious to add "hands" to your robot. Mechanical hands—or "grippers," as they're often called in the robotics industry—vary considerably with regard to design. Simple grippers often consist of nothing more than solenoid-actuated "tongs," while sophisticated fully articulated human-like hands can cost in the tens of thousands of dollars to fabricate and install. The CYBER Hand you'll be building this time out falls somewhere between these two extremes. Intentionally designed to be easy to build, this hand offers considerable flexibility at modest cost.



Hand and Motor Theory

You'll notice from the various photos and drawings throughout this article that the robot's hand assembly is composed of very simple metal and plastic components. As shown in Fig. 1, the hand is built around a wrist channel made up of a U-shaped aluminum bracket that supports extender channels and uses wrist pins to hold them in the proper position to permit the extender channels to rotate at the wrist. On the end of each extender channel, a foregrip channel is attached via two 4-40 X 1/4" screws and serves RONAR, much like our fingers serve us. Inside the wrist-channel bracket is a slide block assembly made from UHMW (ultra-high molecular weight) plastic material.

An Acme nut press-fitted into the slide block receives a threaded Acme shaft that's attached to a special drive motor. As this CY-Motor rotates, the Acme nut and slide-block assembly move along the shaft's axis. Clockwise rotation of the motor draws the slide block closer to the motor's faceplate. Counterclockwise rotation pushes the slide block away from the motor and toward the open end of the wrist-channel bracket.

Four 4-40 X 1/2" screws threaded into the corners of the slide-block assembly serve as guide screws that slide back and forth inside the extender-channel actuator and wrist-channel actuator slots. As the motor rotates in the clockwise direction and draws the slide block toward the motor, the extender channels also pull back, opening the hand. When the motor rotates in a counterclockwise direction, the hand closes its grip.

The hand can use several types of foregrips, or "finger-tips," depending upon the application you've chosen for your robot. I use a small piece of UHMW material as a foregrip because it provides good gripping characteristics but doesn't scratch or mar the object my robot is directed to pick up. You may find that foam rubber or urethane works better as a foregrip in your particular application.

I designed the hand to be as flexible a possible. By changing the foregrip channel slightly, you can adapt it to a variety of applications. For example, you may find that a wider foregrip is more useful in the type of work you're planning on doing with your robot. Perhaps individual spring-loaded "fingers" and an opposing "thumb" would better serve your needs. The hand's greatest strength is its ability to be easily changed and re-configured for your application.

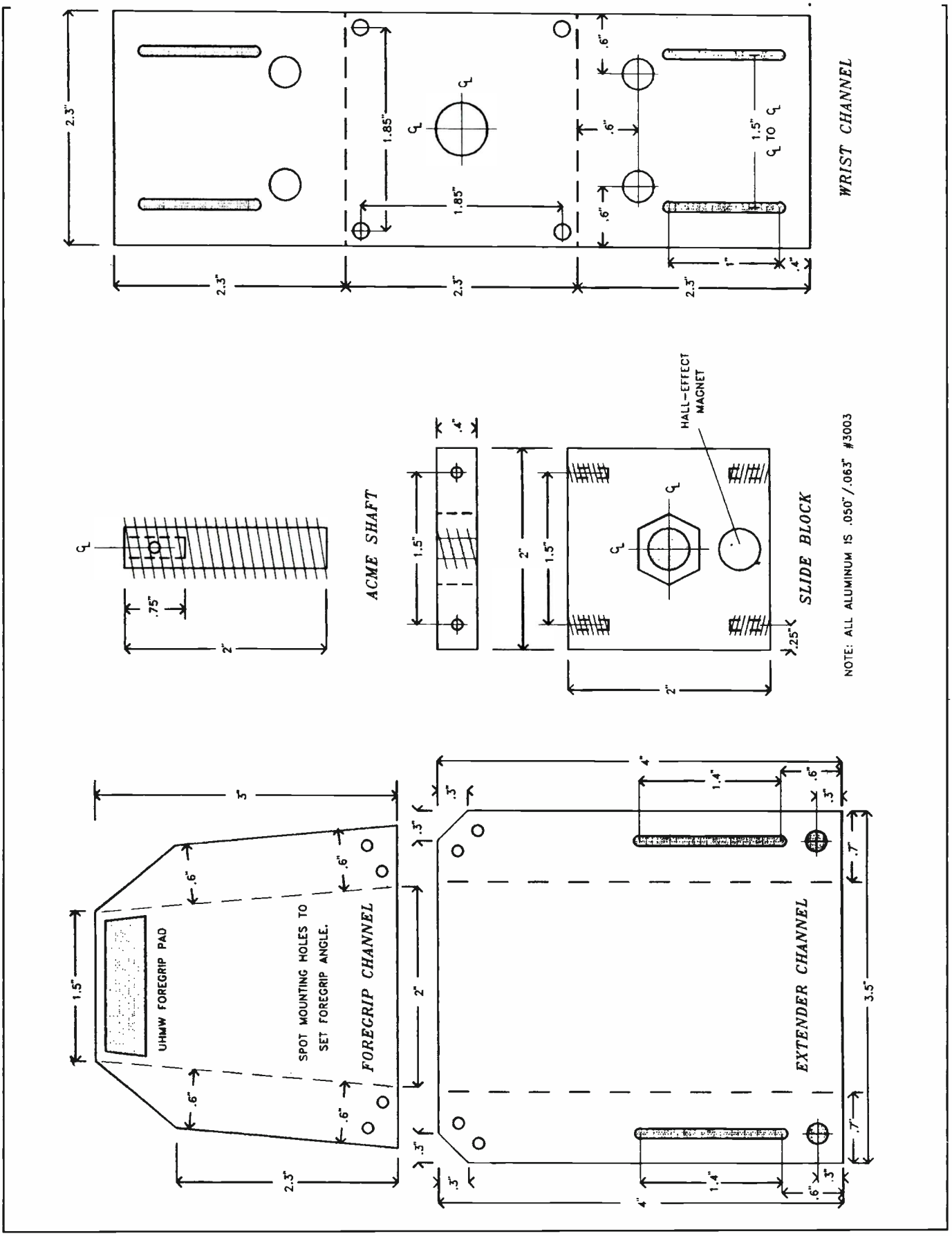


Fig. 1. Machining details for mechanical members of CYBER Hand assembly.

PARTS LIST

1—Wrist channel bracket
2—Extender channels
2—Foregrip channels
2—Foregrips
2—Wrist pins
4—1/4" Wrist Pin E-clips
8—4-40 X 1/4" button-head Allen screws
4—4-40 X 1/2" button-head Allen screws
4—#6 flat washers
4—4-40 X 3/8" Truss-head Phillips screws
12—4-40 Keps nuts
1—Hall-effect Sensor card with hardware
1—Slide-block assembly with Acme nut
1—2" Acme shaft
1—83 oz.-in., 12-volt dc CY-Motor (see text)
1—Hall-Effect 1/2" magnet
1—4-ohm 10-watt resistor
1—7812 voltage/current regulator IC

Note: The following items are available from U.S. Cyberlab, Inc., 14786 Slate Gap Rd., West Fork, AR 72774 (tel.: 501 839-8293 voice or 501 839-8221 fax): Kit of all prefabricated, plated and painted CYBER Hand metal parts, including slide-block assembly, Acme nut and shaft, $39.95; 83-oz.-in. digital CY-Motor and Hall-effect sensor card with Hall-effect magnet, $79.95; complete kit of all CYBER Hand components, including CY-Motor and Hall-effect components, $114.95. Add $7.95 insured UPS S&H. Arkansas residents, please add state sales tax. Check, COD or MasterCard/Visa welcomed.

The special CY-Motor that powers the hand is a new type of digital motor that makes motion control a snap. Essentially a four-phase precision stepper-motor, it has a micro-digital phase controller system built into it. Optically isolated and reverse-polarity protected, this motor operates directly from a 12-volt, 1-ampere power source.

As you can see in Fig. 2, the motor is controlled with only two lines. The brown STEP control line accepts a +5- to +12-volt pulse that causes the motor to rotate 1.8° (1/200 of a revolution). Rotation direction is controlled by the green DIR control line. With the DIR line high, the motor rotates in the clockwise direction. A low-level or open DIR line causes the motor to rotate in the counterclockwise direction.

Position sensing in the hand is facilitated by a Hall-effect device mounted behind the slide-block assembly. A small Hall-effect magnet forces low the output of the UGN-3119 Hall-effect sensor IC when the hand is in the full-open position. By counting and controlling the number of step pulses delivered to the motor, your control software can keep very accurate track of the position of the hand.

Built-in current limiting causes the motor to "slip" if the hand is directed to grip an object too tightly. This automatic-slip feature eliminates concern about damaging the hand's mechanical components in normal use.

Construction

Carefully following the details given in Fig. 1, fabricate the components for the hand assembly. If you don't have access to a sheet-metal shop, a complete kit of components is available from the source given in the Note at the end of the Parts List.

You can use 0.050" or 0.063" No. 3003 alloy aluminum to fabricate the various sheet-metal parts for the hand. When sheared and folded properly, the hand makes a very light weight and incredibly strong assembly. Follow the drawings carefully when measuring and marking the metal parts. A little extra time spent double-checking yourself at this point will save a lot of time and frustration later.

Be sure to use a good-quality zinc-oxide primer or conversion coating on the aluminum elements before painting them. Aluminum rapidly oxidizes when cleaned, making a nice slick surface to which paint doesn't like to adhere. Test-fit the various sheet-metal parts before proceeding, and make sure that everything is square and "true" before final assembly.

Using a lathe, turn a groove about 0.100" deep from the ends of the wrist pins, making it about 0.05" deep, to snugly accommodate E-clip retainers. If the E-clips snap off the wrist pins too easily, deepen the grooves a little more. While at the lathe, bore a 1/4" diameter by 3/4" deep hole in the end of the 2" Acme shaft. Finally, drill and tap the setscrew hole for a 4-40 thread, and test-fit the motor's shaft.

It will be difficult for you to cut the UHMW slide block material to size because this material is very difficult to cut using conventional techniques owing to its self-lubricating qualities. Be extremely careful when cutting the thin slide-block dimensions. Take your time and work slowly and carefully. A single slip could cause you to lose a finger. Likewise, always wear safety-glasses when working with metal and plastic.

Press-fit the Acme nut into the slide-block assembly, and drill and tap the 4-40 screw holes at each corner. Finish the slide-block assembly by gluing the Hall-effect magnet on the rear of the block. Double-check the orientation of the Hall-effect magnet using the Hall-effect sensor card you wired from an earlier installment of this series. The magnet will probably have to be rotated until you locate the appropriate spot that triggers the Hall-effect sensor output.

Begin putting together the hand assembly by attaching the foregrip material of your choice to the foregrip Channel. You can use 5-minute epoxy cement, cyanoacrylate (so-called "super glue") or even 4-40 screws for this operation. When the foregrip material has solidly bonded, attach the foregrip channel to the extender channel with four 4-40 X 1/4" button-head Allen screws and nuts, as shown in Fig. 3. By punching or drilling these four No. 27 mounting holes, you'll find that there's some play in the joint between the foregrip and extender channels. This play lets you perfectly align the two foregrips so that they match when the hand is closed.

With a Hall-effect sensor card, mount the device inside the wrist channel so that it will be aligned with the Hall-effect magnet mounted on the slide-block assembly. It's important that the Hall-effect magnet properly operate the sensor for the hand to sense its "home" position.

Next, using the wrist pins, attach the extender channels to the wrist channel. Slide the wrist pins through the wrist channel and secure each end with an E-clip. Wear safety glasses when snapping the E-clips into place to obviate any possibility of eye injury should the clips, under quite a bit of tension, snap off and become dangerous missiles.

Secure the Acme shaft on the motor shaft by tightening the Allen setscrew. Then, using four 4-40 X 1/2" truss-head Phillips screws and Keps nuts, mount the motor on the rear of the wrist-channel assembly. You'll have to move back the extender channels to make room for the 4-40 screws. The complete hand assembly is shown in Fig. 4.

With the motor attached to a controller circuit (or by pulsing the STEP line of the motor manually), rotate the Acme shaft clockwise while holding the slide-block assembly against the Acme shaft. The slide block's Acme nut should thread itself onto the Acme shaft and begin moving toward the faceplate of the motor. Carefully monitor the output of the

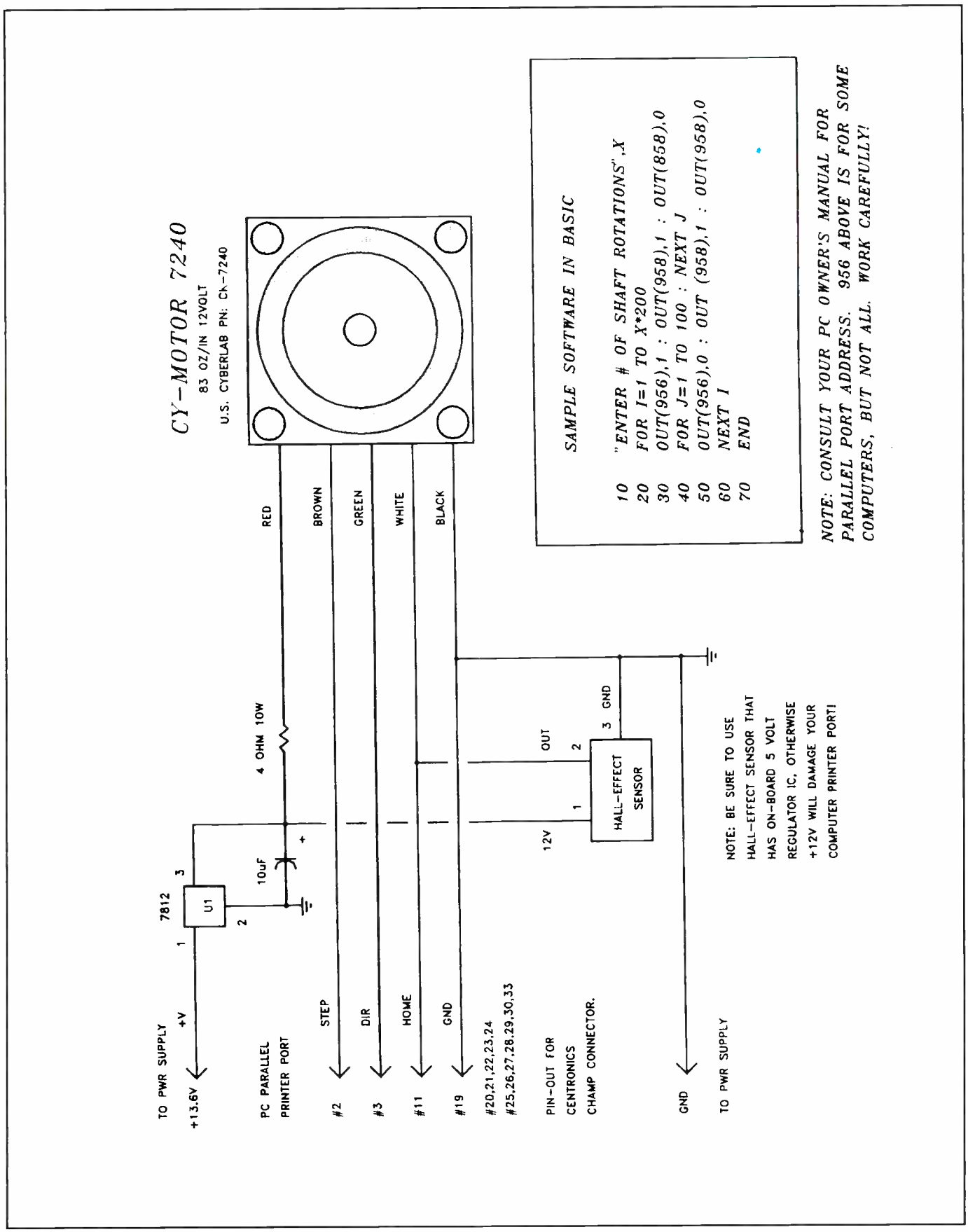


Fig. 2. Electrical motor connection details for hand.

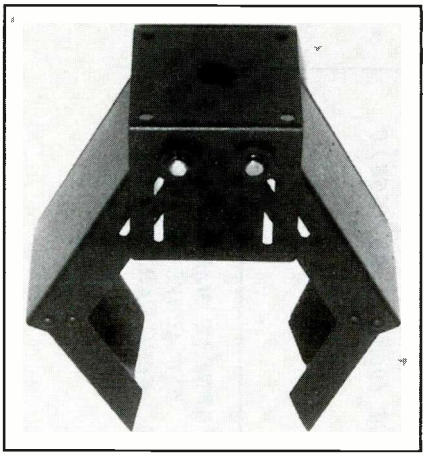


Fig. 3. Attach the foregrip channel to the extender channel with four 4-40 X 1/4" button-head Allen screws and nuts.

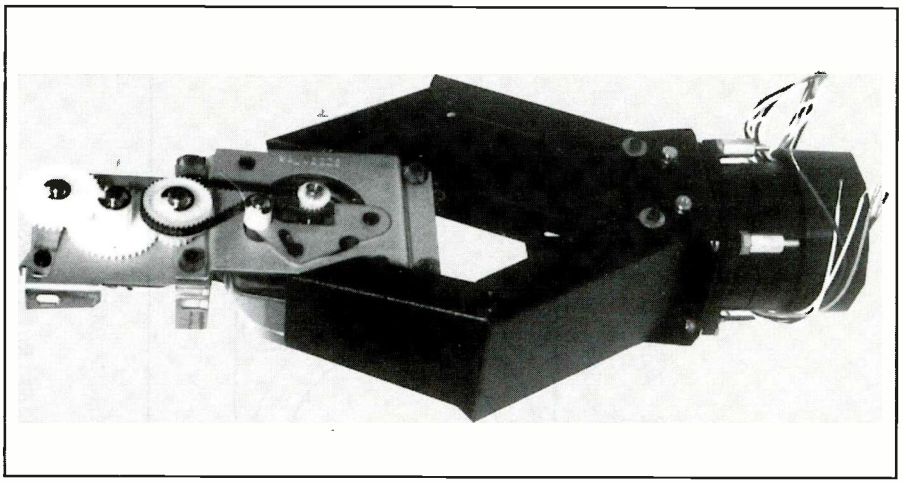


Fig. 4. Completed hand assembly.

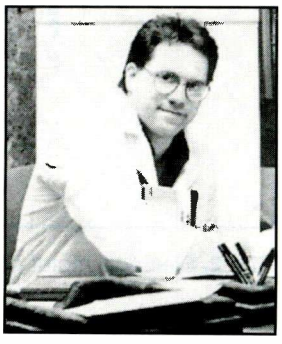
Hall-effect sensor to make sure that it's able to override the motor to ensure against damaging the sensor IC might. When the slide block assembly is in its full-back position, use No. 6 washers and 4-40 X 1/2" button-head Allen screws to form the guide screws. Don't fully tighten these four screws. The four guide screws must be free to slide back and forth in the extender- and wrist-channel actuator slots.

Checkout & Use

If you don't have the CYBER Link controllers for your robot unit up and running yet, simply attach the hand to the parallel printer port of your PC/compatible computer. You can operate the motor directly from your PC's parallel port using a simple BASIC program. With one data bit used to control the DIR line and a second to control the STEP line, your program can open and close the hand assembly on command. If you want your program to be able to monitor the status of the Hall-effect sensor (hand fully-open), simply connect the sensor output line to the paper-out input of the parallel printer port. (Consult the computer operator's handbook for your PC to determine the pinout and port addresses for your particular machine.) Using the CY-Motor for power, a cog-belt or direct-drive arrangement would be a fairly straightforward proposition.

Feel free to experiment with the foregrip channel. Spring-loaded or fully-powered and articulated fingers are within your reach and could make for an exciting addition to your robot project. I'd start with the hand design presented and then, with some experience under your belt, move to a more-sophisticated design. Some people have suggested that tactile or "load-cell" sensors could be easily retro-fitted to the basic hand assembly. I'll leave these advanced applications to you.

To mount the hands on your robot's arms, you must notch the C channels to allow the motor to clear. Then, using the hand mounting bracket, secure the unit using four 6-32 X 3/8" screws. The CYBER Link controllers used throughout the robot can directly interface with the hand's motor. If you're up to the challenge, you can try your hand at developing, building and installing a rotary wrist for each of your robot's hands. ■



Nick Goss

Build a Remote Car Starter

This PIC-based project lets you start your car from the convenience of your home or office

Wouldn't it be nice if on those cold, blustery mornings in the dead of winter you could hop right into your nice warm car and instantly drive off with the windows already defrosted? Have you ever wished during those dreaded summer heat waves that you could start your car's air conditioner without having to endure the 100° or more furnace that develops inside your car on sunny days? With the Remote Car Starter described here, you can start your car from the comfort of your home or office. Simply by leaving the heater or air conditioner on when you turn off your ignition lets you get into a cool car in summer or warm car in winter simply by hitting a button on a key-chain-size remote-control unit. When it receives its cue from the remote transmitter unit, the PIC microcontroller in the starter unit does the rest. As you'll see, remotely starting your car's engine is just the beginning of this handy project.

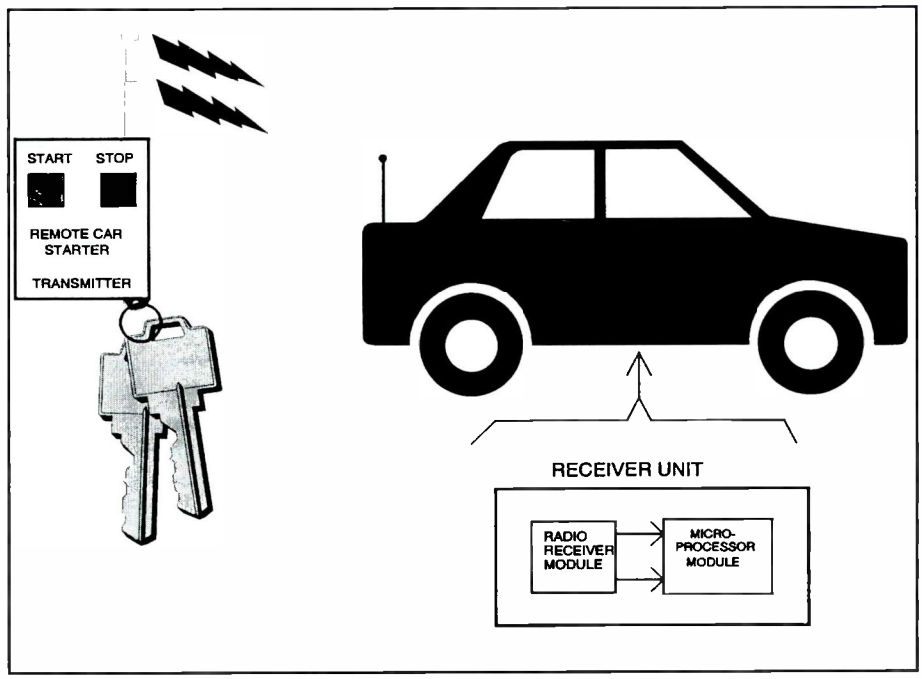


Fig. 1. The Remote Starter system is made up of three basic elements: a radio transmitter, a radio receiver and a PIC-based microprocessor module.

System Overview

The Remote Car Starter has a very simple, full-featured design that will not only start and stop your car's engine but also checks engine rpm for stalling and over-speed and monitors the brake pedal for emergency shut-down. It even provides audible feedback by beeping your car's horn twice to signal a successful start or once in the event that the car's engine shuts down or stalls. Even with these sophisticated features, there's still plenty of memory and I/O left in the microcontroller to provide additional functions, such as remote door lock/unlock, trunk release, etc.

This smart starter doesn't just crank the engine for a predetermined amount of time while simply assuming that the engine will start. It continuously monitors critical automobile parameters and even tries to restart the engine should it stall following a successful start.

The system consists of three functional components: a radio transmitter, a radio receiver and a microprocessor module (Fig. 1). The transmitter and receiver must be purchased as a pair. The transmitter has an advertised range of up to 300 feet, but don't expect much more than 75 to 100 feet without using an external antenna. I found that with a fresh battery and small external antenna, a 300-to-500-foot range was possible. Effective range degraded somewhat on very hot summer days when I left my car in the sun.

Another nicety is the fact that the transmitter and receiver can be coded with one of 59,000 possible codes to prevent other units from activating the Car Starter.

Prices for the transmitter/receiver pair range from $30 to $55, based on transmitter range and quantity purchased. The microprocessor module is based on the Microchip 16C54 PIC 18-pin microcontroller that contains 512 bytes of program memory and 32 bytes of RAM. The 16C54 PIC is an excellent fit for this design because of its size, low cost and very low power consumption. Also, PIC microcontrollers are readily available from many vendors, including Digi-Key.

The remote-control transmitter/receiver pair is a two-channel system. The receiver produces two digital outputs, which represent the state of the two buttons on the transmitter according to Table 1. The two radio receiver signals are 12-volt outputs, which are current-limited by *R6* and *R8* and reduced to 5 volts by zener diodes *D3* and *D5*, as shown in Fig. 2. Pull-down resistors *R10* and *R12* force a logic 0 should the receiver signals fail (open circuit) for any reason. The conditioned receiver signals are then fed directly into a readable port pin on the microcontroller.

The brake-pedal signal is handled the same way as the receiver inputs. The Remote Starter circuit expects to see +12 volts when the brake pedal is pressed and an open-circuit when the brake isn't pressed. The TACH signal is a little trickier. On most cars, the tachometer signal is a waveform that pulses according to the equation: Number of Pulses/Second =

Table 1. Receiver Output Details

Button Pressed	Radio Signal 1 (Signal Enabled)	Radio Signal 2 (Data 2)
None	0	0
Green	1	0
Red	1	1

Table 2. Cylinder Setup Details

U1 Pin 12	U1 Pin 11	Cylinders
0	0	4
0	1	6
1	0	8
1	1	8

0 indicates ground; 1 indicates +5 volts.

N X rpm/2 X 1/60, where *N* is the number of cylinders. The 2 in the denominator accounts for the fact that a spark plug fires only once per two revolutions to allow the a compression stroke and an exhaust stroke. However, some cars have two separate ignition systems. The pulse rate of the tach signal in these systems is half that presented in the equation. The safe approach is to put an oscilloscope on the tach signal to determine what type of system you have.

The tach signal is conditioned like the radio and brake signal, except for additional filtering, provided by *C2*, to remove much of the noise that may be present on the tach line. The conditioned tach signal is fed into the RTCC pin on the microcontroller. Tach pulses on the RTCC pin cause an internal counter to increment, which is used to determine the current rpm of the engine.

Chip *U2* is a simple 7805 fixed-voltage regulator that converts the 12 to 14 volts dc produced by the car's electrical system to the 5-volt range required by the microcontroller. Diode *D1* provides reverse-polarity protection and capacitor *C4* provides filtering of the 5-volt supply.

The three relays are controlled by the microcontroller via IRF 511 power MOSFETs *Q1*, *Q2* and *Q3*. Resistors *R3*, *R4* and *R5* provide extra isolation for the microcontroller, while diodes *D7*, *D8* and *D9* protect against voltage spikes induced by the coils in the relays.

Light-emitting diode *D2* is included for testing purposes only. During normal operation, this LED flashes on and off about once per second, indicating that the microcontroller is functioning correctly. If you wish to lower power consumption of the circuit, you can disconnect this LED before final installation.

The Software

When initially powered, the software vectors to an initialization routine that clears RAM memory and initializes all program variables (Fig. 3). The initialization routine reads two pins on the microcontroller to determine the number of cylinders in the engine. These pins must be connected to the appropriate logic levels based on Table 2. The software then enters an infinite loop that includes a mode-control logic block and unique subroutines for each of the five modes in the system, as illustrated in Fig. 4.

When in Mode 1, all relays are disengaged and the remote-control unit is waiting to receive a command from the transmitter. When the green button on the transmitter is pressed, the Remote Starter first checks to verify that the engine isn't running and the brake pedal isn't currently pressed. If it finds these conditions, the software then advances to Mode 2. If the engine is currently running (key in ignition), the horn relay is pulsed to produce two short beeps.

If the red button is pressed while in Mode 0, the unit simply pulses the horn for one short beep. (This feature is great for finding your car in a crowded parking lot. Simply press the red button an listen for the beep).

Once in Mode 2, the ignition/accessory relay is engaged. The remote unit stays in Mode 2 for 3 seconds to permit the car's electronics to come on-line (including the electronic fuel pump). If the remote-control unit senses that the engine is already running, the start sequence is canceled and the unit returns to Mode 1. The microcontroller continues to monitor the brake pedal and the radio's red button for an abort. Once the settling time has elapsed, the system advances to Mode 3.

Upon entering Mode 3, the microcontroller checks once again that engine rpm is 0 (you wouldn't want to engage the starter motor if the engine is already running). If everything checks out correctly, the starter relay is engaged. The logic in Mode 3 then monitors rpm to determine when the engine has started (the engine rpm is greater than 500 for at least 0.5 second).

PARTS LIST

Semiconductors

D1,D7,D8,D9—1N4001 rectifier diode
D2—Red light-emitting diode
D3,D4,D5,D6—5.1-volt zener diode
Q1,Q2,Q3—IRF510 or equivalent power MOSFET (Radio Shack Cat. No. 276-2072(A) or similar)
U1—PIC 16C54 with RC oscillator option (simple design implementation; must be preprogrammed; Digi-Key is a possible source—call 1-800-DIGIKEY)
U2—7805 fixed +5-volt regulator

Capacitors

C1—100-F, 25-volt electrolytic
C2—22-pF ceramic disc
C3,C4—0.1-F ceramic disc

Resistors

R1,R3 thru R13—10,000 ohms
R2—4,700 ohms
R3—470 ohms

Miscellaneous

RELAY1,RELAY3—Heavy-duty 12-volt spst automotive relay (Radio Shack Cat. No. 275-226 or similar)
RELAY2—Heavy-duty 12-volt dpdt automotive relay (Radio Shack Cat. No. 275-206 or similar)
Printed-circuit board (see text) or perforated board (Radio Shack Cat. No. 276-168A or similar); suitable enclosure (Radio Shack Cat. No. 270-627 or similar); 18-pin DIP IC socket; machine hardware; hookup wire; solder; etc.

Note: The following items are available from Simple Design Implementations, PO Box 9303, Forestville, CT 06011-9303 (tel.: 203-582-8526): complete kit of parts but *not* including transmitter/receiver, $79 (includes all components in Parts List, relays, enclosure, perforated-board, IC socket, male/female nine-pin plug, pre-programmed PIC microcontroller, etc.; pre-programmed PIC microcontroller, $20. Connecticut residents, please add appropriate sales tax.

Assembled key-chain transmitter (No. RF300XT) and receiver (RF300R) are available from Visitech Corp., PO Box 14156, Fremont, CA (tel.: 501-651-1425); other models are available as well. Contact Visitech for details.

Upon successful start, the unit disengages the starter, beeps the horn twice to indicate a successful start and then proceeds to Mode 4. If 3 seconds elapse and the engine hasn't started, the starter is disengaged, the horn is sounded once to indicate an unsuccessful start attempt and the system jumps to Mode 5.

Mode 4 permits the engine to idle for approximately 15 minutes. The Remote Starter continues to check for the brake pedal and red button and shuts down the engine if either is detected. The unit also monitors rpm and shuts down if it exceeds 3,000. If the green button is pressed when in Mode 4, the horn sounds twice to indicate that the engine is running. If the red button is pressed, the engine is shut down and the system returns to Mode 1.

Some cars don't always start on the first try. Mode 5 allows the engine to sit for 5 seconds before a retry is attempted. Only one retry is permitted for each press of the green button. If the car fails to start after the second try, the green button must be pressed to restart the sequence.

Engine rpm is determined by counting the number of tachometer pulses that occur within a certain period of time. The 16C54 has an internal counter (RTCC) that can be incremented via an external pin (RTCC pin 3). This RTCC counter is read and cleared on every other pass through the primary software loop. Since execution time of the software loop is known (approximately 0.1 second), the number of tach pulses per pass of the software can be directly related to engine rpm. The value in the RTCC register relates to rpm via Table 3.

Construction

Assembly of the Remote Car Starter is

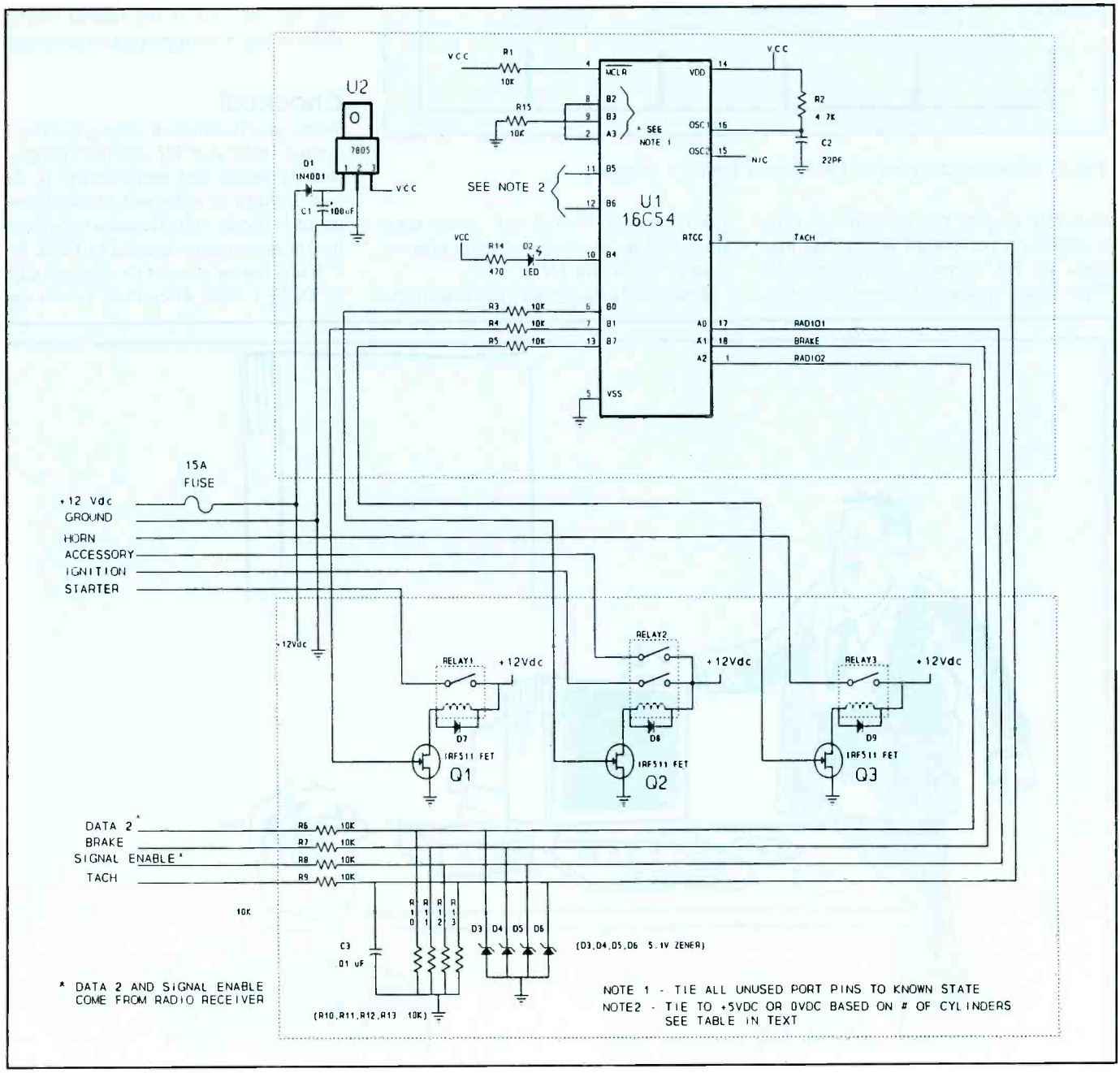


Fig. 2. Overall schematic diagram of circuitry used in the PIC-based microprocessor module.

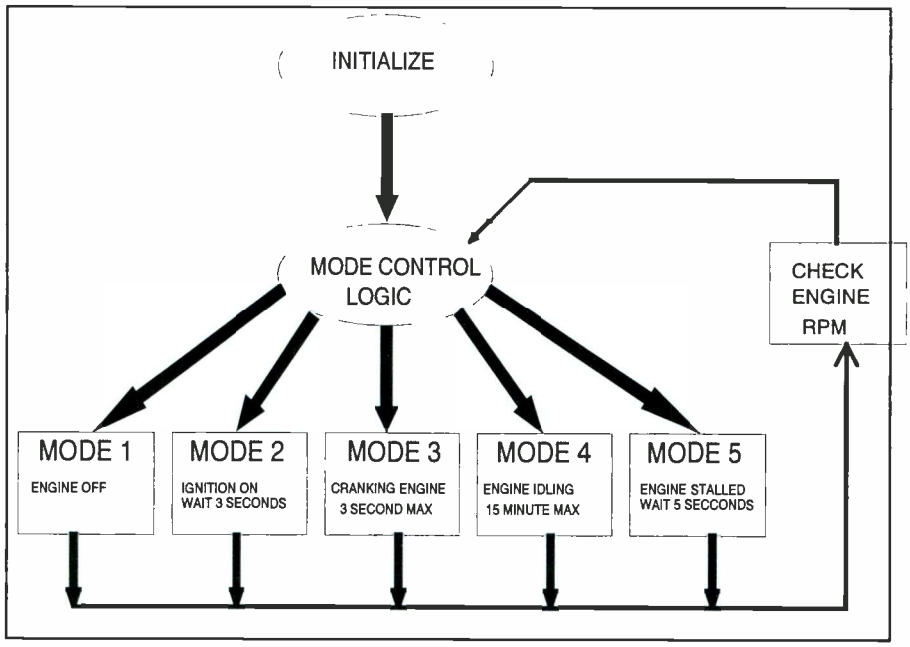


Fig. 3. Initializing diagram for the Remote Starter's software.

relatively simple. You can wire the Fig. 1 circuit on perforated board that has holes on 0.1" centers, using suitable Wire Wrap or soldering hardware or a printed-circuit board of your own design. Whichever way you go, plan on using a socket for *U1*.

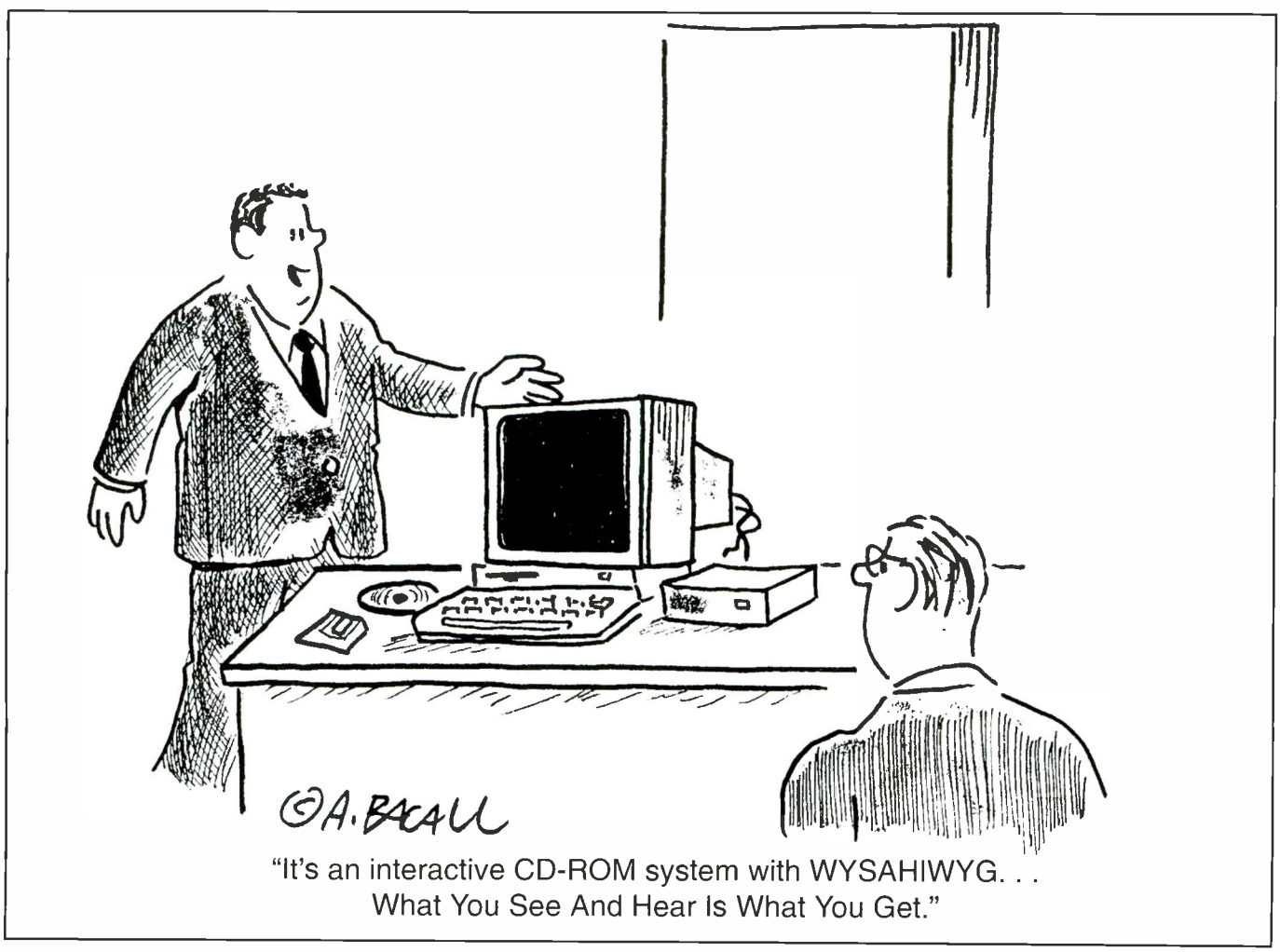
Start wiring the circuit by mounting the *U1* socket into place, but don't plug *U1* into the socket until you're directed to do so later. Follow up by installing the resistors, capacitors, diodes and LED. Make certain that the diodes, LED and electrolytic capacitor *C1* are properly oriented before making any final connections. Then install the transistors and voltage regulator *U2*, making sure that these are all properly based before making the final connections. As you work, you might want to check off each installed component on a photocopy of Fig. 2.

Next assemble the three relays. When wiring the relays, it's very important that you use the appropriate gauge wire leading into and out of the remote starter. Refer to Fig. 5 for appropriate wire gages.

Checkout

When you're finished wiring the Fig. 2 circuit, make sure *U1* still isn't plugged into its socket and apply power to the unit. Using a dc voltmeter or a multimeter set to the dc-volts function to perform the measurements detailed in Table 4.

If any one or more of the tests detailed in Table 1 fails, disconnect power and



"It's an interactive CD-ROM system with WYSAHIWYG. . .
What You See And Hear Is What You Get."

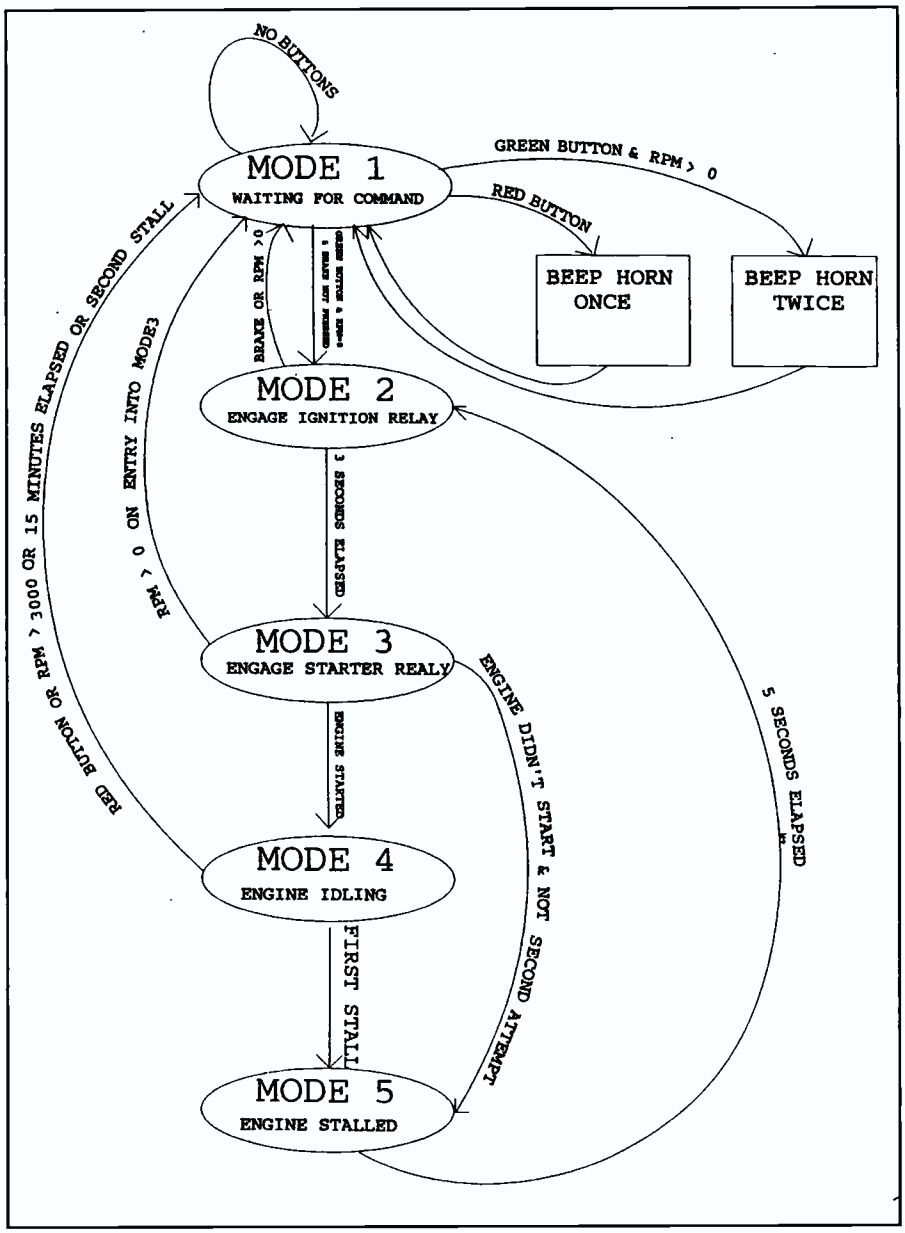


Fig. 4. Remote Starter mode-transition logic diagram.

recheck all your work. Do not proceed until you've rectified the problem. Once you're certain that everything is okay, power up and connect one end of a temporary jumper to +5 volts. Touch the other end of the jumper to pin 7 of the *U1* socket and note if *RELAY1* energizes. If so, touch the end of the jumper to pins 6 and 13 of the socket and note if *RELAY2* and *RELAY3*, respectively, energize.

If any of the above tests fails to check out, power down and recheck your wiring. Do not proceed until you've corrected the problem. Once all tests check out correctly, remove power from the unit and plug the 16C54 microcontroller into the *U1* socket, making sure that it's properly oriented and that no pins overhang the socket or fold under between IC and socket. Apply power once again and verify that the LED begins flashing. If it doesn't flash, remove power and recheck your wiring once again.

Table 3. How Values in RTCC Register Relate to RPM

RPM	4-Cylinder RTCC	6-Cylinder RTCC	8-Cylinder RTCC
Low (500)	3	5	7
High (3000)	20	30	40

Caution

The Remote Control Starter presented in this article must be installed only in vehicles equipped with automatic transmissions and Electronic Fuel Injection (EFI). Also, only qualified persons with sufficient automotive experience should perform installation. Please seek the help of a qualified mechanic.

Attaching the radio receiver to the microcontroller board entails just four wires: +12 VOLTS, GND, SIGNAL ENABLE and DATA 2. Don't forget to set the code in the transmitter and receiver. There are 59,000 possible codes from which to choose. The codes are set by soldering pins in both the transmitter and receiver. Since instructions explaining how to set the codes come with the transmitter and receiver units, I won't detail them here.

It's important that you test the Remote Starter before installing it in your vehicle. The only special test equipment needed is a pulse generator. If you don't have access to one, you can make a pulse generator with a 555 timer chip. The pulse generator should be connected to the TACH input of the Remote Starter.

Set the pulse generator to produce a 33-, 50-, 66-Hz square wave for four, six or eight cylinders, respectively, where the peaks of the square wave are at 0 and 12 volts dc. Also tie the BRAKE input to ground. When the green transmitter button is pressed, Relay 3 (the horn relay) should activate with two quick clicks. When the red button is pressed, Relay 3 should activate with one quick click. Relays 1 and 2 should *not* activate at all. This test confirms the Starter's ability to detect a running engine.

Next, turn off the pulse generator and press the green button. Relay 2 should engage. Three seconds later Relay 1 should engage for an additional three seconds and then disengage. After five seconds, Relay 1 should re-engage for three seconds and then both Relays 1 and 2 should disengage and remain off until the green button is pressed again.

Finally, press the green transmitter button. When relay 1 engages, turn on the pulse generator, which must be

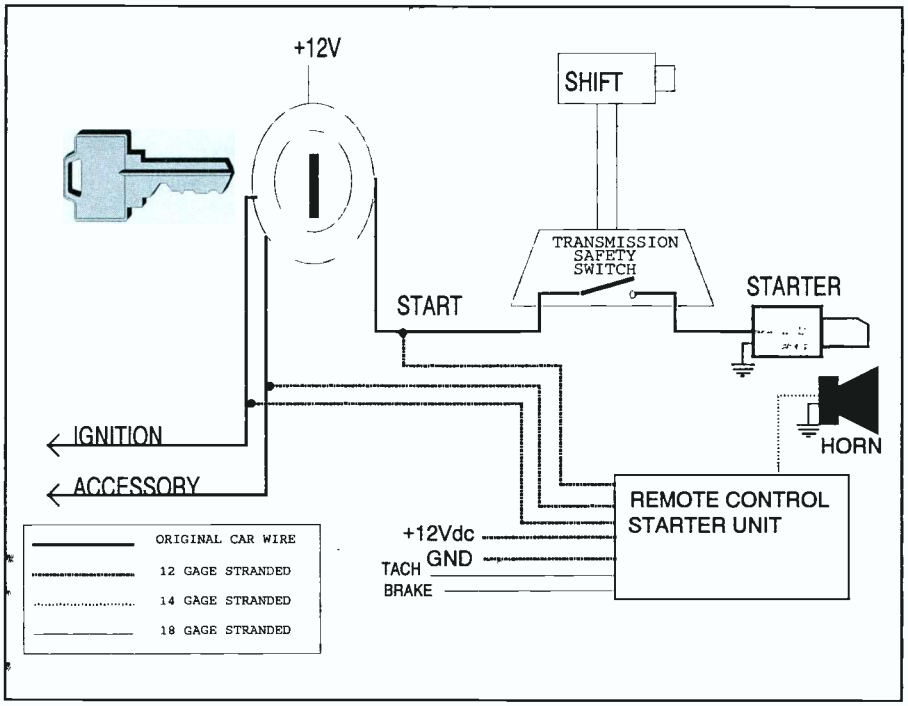


Fig. 5. Wiring details for installing the receiver/microprocessor module in a vehicle.

Table 4. Checkout Measurements for Various Points in Circuit

Pin	Name	Measurement
1	RA	No Check
2	RA3	0 Volt
3	RTCC	0 Volt
4	MCLRB	+5 Volts
5	V_{ss}	Continuity to ground
6	RB0	0 Volt
7	RB1	0 Volt
8	RB2	0 Volt
9	RB3	0 Volt
10	RB4	2 Volts dc (±1Volt)
11	RB5	See Cylinder Setup Table
12	RB6	See Cylinder Setup Table
13	RB7	0 Volt
14	V_{dd}	+5 Volts
15	OSC2	0 Volt
16	OSC1	+5 Volts Through R2
17	RA0	No Check
18	RA1	No Check

turned on within two seconds of relay 1 engaging. Relay 1 should disengage and Relay 3 should give two quick clicks, indicating a successful start. Now tying the brake line to +12 volts should cause all relays to disengage.

Installation

Installation must be performed by a qualified individual. The starter, ignition and accessory circuits must be tapped just after the key. Be sure that the starter-motor circuit is tapped *before* the safety switch in the transmission (see Fig. 5). Failure to do this may allow your car to start even if it's in gear. Since every vehicle is different, listing here the circuits for each make and model car would be prohibitive. The best approach is to seek assistance from a qualified person who has experience with your specific make and model vehicle. ■

Sex, Lies and Backup Tape

Last month, I lamented about my woeful relationship with hardware. Things haven't gotten much better in the interim. They never will get much better, I guess. Hardware stinks. I'm not just talking about vacuum cleaners, either.

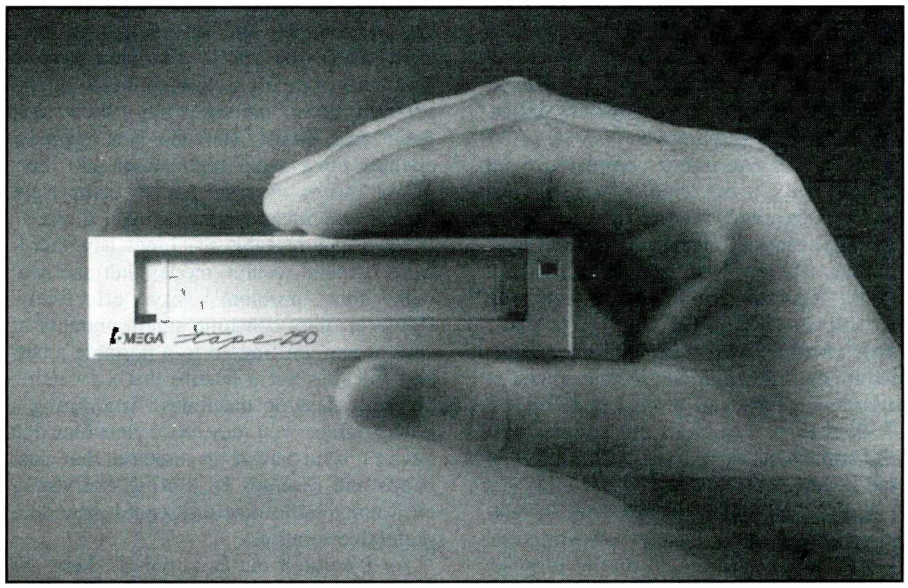
I look at computer hardware as a necessary evil. Without it, how would I run all the great software people keep developing? Yet, while I can't live without hardware, I can't live with it, either. It keeps breaking down. I'm not blaming the designers, mind you. I know you're out there. Many of you are reading this magazine, in particular, and while I like to get your mail, I'm not looking for that kind of mail. If anything, hardware designers have to write better logic than software designers. It's a lot harder, after all, to debug logic when it's hardwired than it is to let your customers do it for you after it ships. We all know software publishers are guilty of that.

It's physics and the lack of standards that I'm complaining about. The laws of physics prevent me from running my machines without the air-conditioning that gives me a chill. And the lack of standards makes hardware, that works so well on its own, do back flips when it's all installed on the same backplane.

The only solution to hardware is backup. Yet, parallel-port incompatibilities prevented me from backing up my laptop with a portable tape drive.

I do like some hardware and some hardware vendors, though. One of the vendors I like is BCC, which has promised to exchange the Avanti 486 I use for one that has a later version of the parallel port—the version that works with portable drives. The company changed this feature early on in the model's life, when it found out there were some incompatibilities. (However, since I have the use of this machine through the company's generosity—which, coincidentally, helps it sell more of them when I write about it—the one I have is a different machine than the one real customers have.)

Another vendor I like is Iomega, which makes many portable devices that all consistently work with anything (anything other than a parallel-port that isn't shipped to real customers, that is). I recently tested a half-dozen portable tape drives ranging in price up to nearly $1,800, and the $548 Iomega Tape 250 was compatible with more of the notebook computers I tested them on than any other, except the one from Portable Solutions. This was because the Portable Solutions Autobahn tape drive is an OEM version of the Iomega with no differences other than the case, power supply and price. The two products share the same tape mechanism and logic board and are functionally identical as a consequence.



Iomega's QIC-80 portable backup tape drive.

Both are QIC-80-format drives and can store up to 250M (with compression) on 2120-type media. The Iomega version has an internal power supply, exhaust fan and power switch and is slightly larger and heavier than the Autobahn but less complicated to pack and handle. Very rugged, it's still light enough to take anywhere. And because it's styled like a miniature Bernoulli Transportable, you can stand the Tape 250 on its side for a minimal footprint. So, it takes up even less room on a desktop than the slightly smaller Autobahn.

Instead of built-in power, the Autobahn uses an external power transformer. It's an extra piece of equipment to manage, but the total package is smaller and lighter. Autobahn's case is stylish and has a lower profile than the Tape 250, but it's also shaped so that doesn't allow it to stand on its side. But the differences between these devices are really far outweighed by their similarities.

Both of these drives displayed exceptional compatibility. They both worked flawlessly with each of three test machines that I deliberately selected to provide a broad range of parallel ports. One was a new Toshiba Satellite T1850C. Another was an old Librex 386SX. I've experienced difficulty connecting several parallel-port devices to this Librex and to several Toshiba systems—including a Satellite. I also tested them with my NEC UltraLite SL/25C to be sure they'd work on at least one machine. (It's been my experience that parallel-port devices are only rarely incompatible with NEC ports.)

Other tape drives I tested were stumped by at least one of these computers, but not the Tape 250 and Autobahn. On average, the Tape 250 backed up 8,299K of test files in 8 minutes, 28 seconds, with a compression ratio of 45%. With no functional difference between the two drives, you'd expect them to behave very similarly. They did. The Autobahn's performance was

nominally identical. The same suite of test files was backed up in 8 minutes, 25 seconds, with a compression ratio of 44%. That's about 980K per minute over a parallel port.

Both of these drives also ship with CentralPoint *Backup*, a part of the *PC Tools* product that I didn't really discuss in depth here last month when I covered *PC Tools*. It works with both DOS and *Windows*, but it doesn't yet support parallel-port devices in *Windows*. It's full-featured, includes unattended operation and is easy to install and use. This puts CP *Backup* at least on a par with the backup software that ships with competing drives. In some cases it surpasses it.

I have just one minor complaint about *Backup*, and it's not about a bug. It's just that I was frustrated the first time I used the software because I mistakenly left the drive thinking a backup was in progress when it wasn't. You have to watch yourself with this software because it's full of so many safety checks that require additional information or confirmation. Whether you're performing a backup or just installing it, CP *Backup* is a cautious but tedious, system, which makes it prone to costing you time if you're not aware, for instance, that it won't even backup to a freshly-formatted, empty tape without confirmation. That's the one that caught me by surprise. On the other hand, it's unlikely that you'll ever make a mistake with it if you're paying attention.

Obviously, these tape drives are ideal for backing up portable machines because they connect to a parallel port. This is a benefit whether or not you travel with them. If you do travel, these machines are best used in a hotel room or at a site where there's ac power. However, there are alternatives. One tactic used by frequent travelers is to keep a portable drive at a central Point. For example, you can stash a drive in the trunk of your car. Each time you return to the airport, you perform a backup and pull the tape. You don't need to take the drive all the way to your appointments, and you don't need to stop in at the office just to backup your computer. The drive need not be battery-powered, either. You can take along a voltage inverter that lets you tap into your car's battery and drain 117 volts from it.

Other jobs suitable to parallel-port-connected tapes include any application that requires you to move the drive among several machines. Backups of desktop machines that aren't connected to a network are a good example.

By the way, there are several reasons to backup your computer with tape rather than diskettes or some other media. For one, tape is much faster than diskettes. It's also easier to manage a backup on media that doesn't have to be constantly changed during the process. And at roughly ten cents per megabyte, tape is no more than one-tenth the cost of hard-disk media. However, you will want to spend a little extra for preformatted tapes if your machine time is precious. It will save approximately 45 minutes in the preparation of each.

Silicon Snooze, Phase II

You could save much more time if there was a way to suspend a complex multitasking environment and restart it later from right where you left it. You first have to save data, close files, close applications and perform other housekeeping, then shut down and, finally, start all over again by opening those same applications and files. All of this is required just to come right back to where you were when you stopped.

Most new portable machines have hardware suspend-resume modes that can deal with this problem very effectively. However, they consume small amounts of current and are limited to a portable's battery life. It's not a feature that's available on many desktop machines. And during a power outage, you may loose your files that haven't been saved. A method that suspends and resumes by storing everything on a nonvolatile medium would provide a preferable solution.

As I pointed out last month, there are one or two things about *Windows* I'd like a lot better if they were a little more intelligently executed. One is the dumb way the search dialog in Cardfile always covers the file you're searching. If you move it away, it snaps right back the next time you use it. Another is the lack of a suspend-resume feature. It should be built into *Windows* as an integral part of the system. Such a system wouldn't require you to stand by to supervise it, nor would you have to remember what you were doing when you last turned off the machine. The only way I can remember where I was is to make notes before I shut down. This not only takes time, but it's subject to human error and loss, too.

The solution I looked at in my last column was the MultiDesk replacement for the Program Manager that CentralPoint includes in its *PC Tools*. The MultiDesk approach simply makes files and applications easier to access by organizing them on virtual desktops. It's an unpretentious solution that takes advantage of just one utility in a large package of tools. This makes it virtually free if you buy *PC Tools* for its other features.

Another, more aspiring, solution is to add a suspend-resume feature to *Windows* as an after-market product. To do this, the utility must take a snapshot of every variable factor in the computer, including system memory, processor registers and controller status. The snapshot is saved to hard disk and can require as much storage as the total amount of system and video memory in your computer. Given the necessary space, it's simply a matter of retrieving everything and rearranging it exactly the same way when you turn on your machine again. This is the approach that three new products have taken, with varying levels of ambition. Whatever their ambition, though, all three tend to achieve roughly the same level of success. At least this is true for the laptop computers on which I tested them.

One of the trickiest parts is saving the status of super-VGA video controllers and their video memory as that it depends on knowing characteristics of the chips used on many different boards. In fact, super-VGA modes are where these programs tend to go wrong under DOS. *Windows* however, takes care of this for the utilities with its video drivers. As a result, *Windows* is where these programs tend to work uniformly well, even on laptop computers with strange, unknown video systems.

I tested all three programs on two 386SX machines—a Zenith Z-Lite 320L and a Toshiba T3300SL—both running in standard VGA mode. I ran each with MS DOS 5.0 and *Windows* 3.1. On the Z-Lite, I conducted testing in *Windows* Standard mode, all the machine could manage with its standard 2M mind. With the addition of a 4M Kingston memory card, it was possible to conducts tests on the T3300SL in Enhanced mode.

PowerPro Software Quick *Restart*

Quick Restart takes a snapshot of everything with the press of a hotkey. PowerPro claims that it works best on *Windows* 3.1 and all versions of MS DOS as far back as 3.3. It isn't compatible with Compaq DOS in any flavor and is prone to difficulties with other OEM versions of DOS. The program also dislikes the built-in suspend-resume feature in some machines. PowerPro's suggestions on how to overcome problems basically involve changing the offending system software. This isn't likely to help problems caused by a strange super-VGA mode. On the other hand, some of the competition isn't daring enough to attempt working with DOS in the first place.

PowerPro works with both the Z-Lite and the T3300, but it isn't flawless. On the Z-Lite, it doesn't work with DOS applications: not under DOS and not in a DOS session under *Windows*. It does work with DOS applications on the T3300, but not in *Windows* sessions. However, there's a difference in the way it behaves in DOS sessions on the two machines. If you try to use it in a *Windows* DOS session on the Z-Lite, it will simply hang the machine. On the

T3300, it will merely switch to the desktop or simply do nothing at all. It doesn't hang, and your data stays put, which is far more acceptable. On either machine, *Quick Restart* requires system power to be shut off before it will resume. I was unable to restart it with a warm boot because, apparently, the keyboard was locked by its execution.

PowerPro claims to have tested *Quick Restart* with major compression utilities (DoubleSpace, *Stacker*, *SuperStor* and *XtraDrive*), removable media (Bernoulli and Syquest), most mice and many video systems, including *Windows* accelerators. Furthermore, the company says that the product's architecture allows for driver updates when new technologies, such as a new super-VGA standard, appear.

I installed *Quick Restart* in its default mode, and it worked well enough. However, for other VGA modes under DOS, the product demands much more technical sophistication than the typical user is likely to possess. It requires you to determine the type of video chip set in a system. And even if you're not using a laptop, asking you to crack open the box—and not only find the video card, but the right chip on it—can be daunting. The company is looking for a universal video driver, but until it finds one, you're best bet is *Windows* or, depending on your hardware, DOS under a standard VGA mode.

I have a more serious complaint, too. It's possible, while uninstalling the product, and only in combination with *Xtradrive*, to corrupt a hard disk. The company knows of safer solutions, but has yet to include them in its documentation.

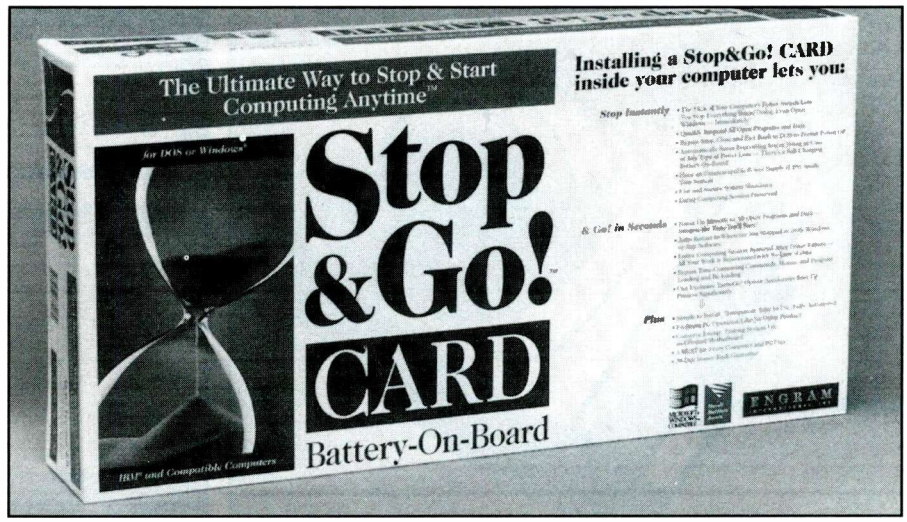
Engram *Stop&Go!*

I tested *Stop&Go!* on the same Toshiba T3300 and Zenith Z-Lite machines I used for the *Quick Restart* tests. It also saves all system states to disk, with some limitations. A major advantage of *Stop&Go!* over *Quick Restart* is its claim to fully automatic installation. The company maintains that *Stop&Go!* doesn't require you to know anything about your video controller and that it will discover, on its own, the system information it needs for installation. The publisher also says *Stop&Go!* works with Smartdrive and Super PC-Kwik caches, as well as DoubleSpace and *Stacker* disk-compression programs.

On the Toshiba, *Stop&Go!* lived up to the company's claims. It worked equally well in *Windows*, DOS and *Windows* DOS sessions. On the Z-Lite, *Stop&Go!* worked well from DOS, but it's inconsistent under *Windows*. *Stop&Go!* doesn't require either of these systems to be shut down before it restarts. You can simply warm boot if you decide to restart and stay, rather than stop and go.

Stop&Go! has another feature that's useful without turning off the computer. This is the ability to save system status as a super-undo function. It's perfect for use with programs that lack an undo function of their own. You can also use it to provide a second level of undo for programs that do have their own. The only limitation is the on-line storage available to you. A small hard disk can make it impractical to save additional versions of your work.

Incidentally, *Stop&Go!* was developed for Engram by Intellisoft, which once sold the product itself under the name BookMark. Intellisoft ceased selling it in the U.S. a few years ago when another vendor threatened to sue over a prior claim to the name. The company continued to sell it actively in Europe, however, and never halted development.



Engram's "Stop & Go!" card.

Engram Stop&Go! Card

Engram decided to bring BookMark back to the U.S. as Stop&Go! for two reasons. One was to sell the product as a software-only, stand-alone solution. It also sells it as a software bundle for the Stop&Go! Card, its backup-power board for desktop computers. The Stop&Go! Card takes maximum advantage of *Stop&Go!* to provide you with a powerful, yet very inexpensive, uninterruptible power supply (UPS).

It's simple to see how Engram does this. Its Stop&Go! Card needs to provide only a minuscule backup battery with just enough current to tide you over while the software does it's stuff, which is a matter of seconds, perhaps a couple of minutes. With an ordinary UPS, you need much more time to shut down everything in an orderly manner. With this system, you don't. Stop&Go! saves the whole mess for you. Like I said: simple. You benefit when you pay less for it, and you benefit again when it saves you the need to restore your mess. If you have many open applications and files, restoration can be a big job. Naturally, you can't continue to work for a prolonged period while the power's out, but a larger UPS will eventually pose a limit, too. The difference isn't much more time that it takes to have a cup of coffee. Why not save some bucks and swill some java with them.

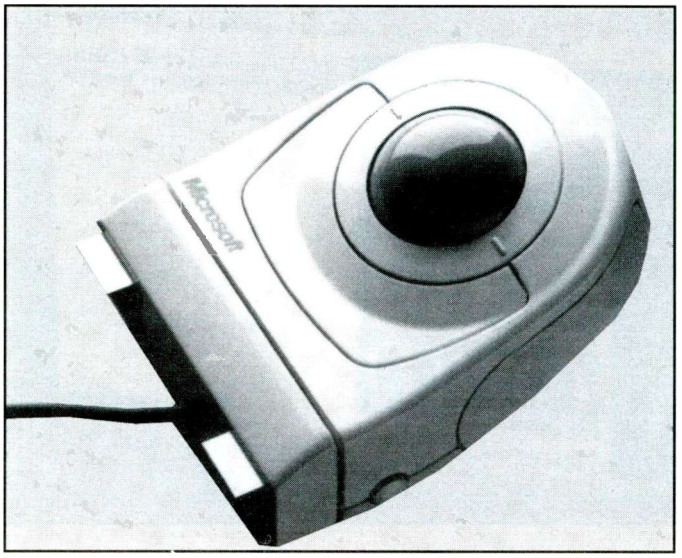
I'm going to give the Stop&Go! Card a try this coming rainy season here in California. That's the day in January or February when a year's worth of rain falls in an hour or two. It usually knocks out my phones and sometimes the power goes, too. If you're lucky, and I'm not, I'll have a fair test of the card to report a few months from now.

Binar *Fantastic Recall*

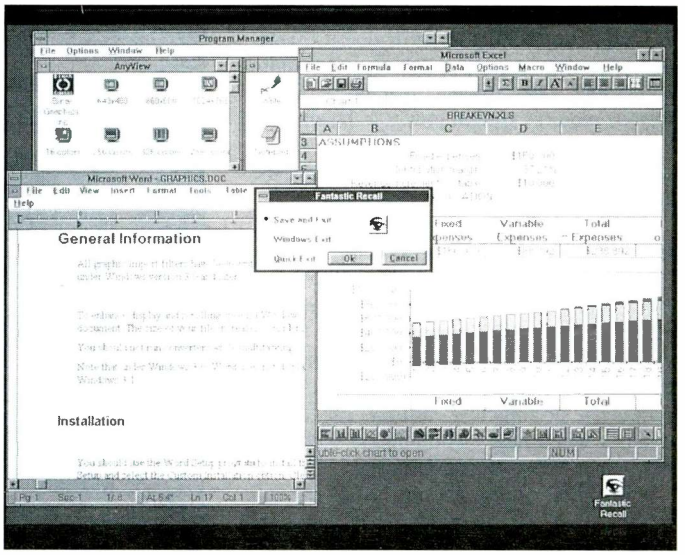
Meanwhile, I also tested *Fantastic Recall* on the T3300 and Z-Lite machines. It lets you stop, shut off your machine and later resume, just like *Quick Restart* and *Stop&Go!* do. Also like the other two, it interrupts all processes, such as directory listings and spelling checks, and continues them right where they left off when you restart your computer. It also has its limits.

Fantastic Recall doesn't work under DOS or even under *Windows* in Standard mode. It isn't designed to do so. It will suspend *Windows* DOS sessions, but only when you suspend them along with the rest of the *Windows* environment from within a *Windows* application or the desktop. Thus, it avoids the sticky video-controller issue by relying entirely on *Windows* video drivers. *Recall* worked perfectly under *Windows* on the Toshiba. *Recall*, which requires Enhanced mode, was unable to perform its job on the Z-Lite.

While none of these products works universally, they all work under *Windows* on at least some portables. Frankly, *Quick*



Microsoft's BallPoint 2.0 cursor pointer controller.



Main sreen from Binar's FANTASTIC RECALL.

Restart and *Stop&Go!* are both more likely to work with DOS on desktop machines because the developers are familiar with popular video cards The proprietary video systems used in laptops are more likely to present a problem for them. So, I stuck with standard VGA mode and didn't really challenge them.

Whatever type of machine you use, it's just a matter of assuring yourself that the program you choose is compatible with it. Since you're unlikely to be multitasking under DOS, whichever program runs on your machine should meet your needs. And the convenience and time savings are worth the effort. These products give you the memory that Microsoft forgot to build into *Windows*.

Put Some Digital Cheese in Those Traps, Virginia

Microsoft's new BallPoint 2.0 began breeding in mid September, and hordes of them are now running wild in the streets. The company makes a lot of claims for it, and one or two make me laugh. For instance, the announcement says, "BallPoint 2.0 leverages the large, 28-millimeter ball size of the original BallPoint, although with a different material that vastly improves the feel of the ball." Guffaw, guffaw. It may be a different plastic, but I defy anyone to tell the difference between these two virtually identical, hard plastic balls while wearing a blindfold. Despite the hyperbole, though, this rodent is perfect for scurrying around and through your *Windows* applications—even behind the walls, just like the fur-covered variety.

Did I say "perfect?" Make that "as perfect as you can reasonably expect." When the first BallPoint came out, I said *it* was perfect. Microsoft seemed to have thought of just about everything, and I didn't suspect it could be any better. Was I ever wrong. This new version is incredible. It makes subtle changes to ergonomic features that I thought were unbeatable, and it beats them. In the areas of precision and smoothness, there's no contest. Who knows, maybe this is what the release meant by the feel of the ball. Maybe Microsoft was talking about the rollers. Whatever the case, BallPoint 2.0 rides as smooth as a new Lincoln Town Car. By comparison, the first model feels like you're screaming down a rutted country road at 70 miles an hour in a rickety old bucket of bolts. And remember that I really liked the first one. So, I'm not saying perfect this time. I don't want to get caught again in a couple of years when 3.0 outdoes 2.0.

It may take you some time to become acclimatized to one or two things about this device. One is its esthetics, which Microsoft describes as a "more compact, organic shape." It's my hope that what's meant by organic doesn't have anything to do with what its shape brings to my mind. While attractive and streamlined, I think it resembles nothing quite as much as the elongated toilet bowls you'll find in a hotel's public restrooms. Honestly, this isn't a juvenile attempt at scatological humor, and it's not a criticism of the shape. It was simply my impression long before I read the press release. In fact, I mentioned it to the product manager months ago. BallPoint 2.0 looks larger than the old version, too, at least without their bases attached.

Another change is the absence of a base upon which it can rest on a desktop. This is strictly a clip-on or hand-held frammus. But, you know what? You won't miss the old one's flat bottom and rubber feet. I was a big advocate of using the original version on the desktop, but I now use this one clipped to my machine. It's got a subtly improved ergonomic design that just puts it over for me. One of the differences is the rounded non-slip grip Microsoft has given its bottom. It's easier to hold than a fist-full of Super Glue. The buttons are bigger and more accessibly located. It's got a different clip, too, that allows you to close a laptop's display without removing it. And it now adjusts to any of five tilt angles with the click of a pair of buttons.

Another area of significant improvement is the new driver that accompanies BallPoint 2.0. I was delighted by the 8.02 and earlier drivers that first introduced things like mouse trails, transparency, cursor growth and polar orientation. The beta 9.01 driver I've been working with adds a host of new features that are at least as impressive. You can now set it to automatically snap to the default button after any operation. It can optionally go off the screen on one side, dash behind the wallpaper and reappear on the other side like Pac Man running through his maze. You can also set it to automatically jump to the active window when you click the secondary button in conjunction with the Ctrl key, and to become a magnifying glass when the secondary is used with the Alt key. The magnifying effect shows every pixel individually, like a miniature fat-bit editor, and lasts until you click another button.

The only one of these features that could use a little tweaking is the way the rodent sneaks through the walls. If Microsoft is saving a little something to improve next time, this could be it. Microsoft calls it the "wrap" feature, but this isn't the way it works. It disappears and reappears like

Scotty was beaming it aboard the *Enterprise*. This is a problem, especially, when scrollbars and other controls you're trying to adjust lie near edges and corners. The cursor is easily lost right when it's most critical. So you either have to slow way down or learn how to compensate. Returning the cursor from corner-limbo, where it might have passed to either of two sides, is a little like learning to cut your own hair in a mirror while holding the clipper with your foot. Wrap goes a long way toward improving performance, but it would be better still if its transition from one side to the other weren't so abrupt.

There are at least two or three things Microsoft could do to fix this. It could make the cursor appear briefly on both sides of the screen at once as it leaves one edge and enters by the other. This would provide a better visual clue as to how close you are to the edge. Alternatively, Microsoft could make the cursor require extra effort to traverse the last one or two pixels, perhaps by making each equivalent to five, 10, 20 or more. Perhaps, Microsoft could just implement an inverse of the algorithm that controls cursor growth. You could adjust it so that the closer you got to the border, the slower you'd go. They could call it the Tom-and-Jerry slo-mo effect. Either way, you wouldn't accidentally fall off the edge as easily.

Even as it stands, though, the new BallPoint is the best pointer on the market for anyone, desktop and laptop user alike. The only exceptions are users who demand the absolutely tiniest mass. (MousePen Pro still has an edge here for ultralight travelers.) The driver software has no peer, and I recommend that anyone using an earlier version upgrade post haste. It works with either BallPoint or Mouse, and considering the possible productivity gains, it's the biggest bargain in computing. I think it was Harlan Ellison who coined the phrase that best describes anyone who doesn't rush out for the upgrade: "crazy as a soup sandwich." Nice job, Microsoft pointy people.

Tool Time

Here's a tip for getting around sharing violations in *Windows*. What are sharing violations? They're a way of preventing data loss in a multitasking environment. Without some form of prevention, it would be possible to simultaneously modify a file in two or more applications or in two or more instances of the same application in a multi-user system. This would result in different version of the same file simultaneously residing in memory. As soon as the first of these is written back to the stored file, all the other versions in memory effectively become based on stale data. Subsequent writes from the stale files would repeatedly destroy the stored file's integrity by eliminating the changes made by earlier writes.

It clearly wouldn't make any sense for applications to reload a file before writing it. This would lose all the changes made in memory. So, environments at risk of such contention employ a lock-out scheme. Multi-user database products, for instance, prevent corruption with a variety of sophisticated lock-out schemes that permit a variety of uses. They may lock out individual records, or even fields, and they may allow some classes of access, such as read-only access, to occur simultaneously with read-write access.

There are also valid reasons for other types of applications to read a file while another is modifying it. Unfortunately, The SHARE routine works on the premise that it's simply better to prevent multiple programs from accessing the same file for any use. It's sort of like a military campaign to kill everyone and let God sort the enemy from the noncombatants. SORT employs a simple lockout that also prevents you from using potentially harmless read-only operations like copying a file for backup.

If you want to periodically copy a file to a floppy diskette while it's still in use by

Products Mentiioned

Iomega Tape 250, $548
IOMEGA Corp.
1821 W. 4000 S. Roy, UT 84067
Tel.: 801-778-1000

CIRCLE NO. 136 ON FREE INFORMATION CARD

Autobahn, $529
Portable Solutions
3920 E. Coronado, Ste. 205
Anaheim, CA 92807
Tel.: 714-632-1123

CIRCLE NO. 137 ON FREE INFORMATION CARD

Quick Restart, $39.95
PowerPro Software
Box 4611
Foster City, CA 94404
Tel.: 415-345-9278

CIRCLE NO. 138 ON FREE INFORMATION CARD

Stop&Go! 4.0, $149.95
Engram International, Inc.
625-E DuBois St.
San Rafael, CA 94912-3613
Tel.: 800-995-0960 or 415-455-1100

CIRCLE NO. 139 ON FREE INFORMATION CARD

Fantastic Recall, $79.95
Binar Graphics, Inc.
30 Mitchell Blvd.
San Rafael, CA 94903
Tel.: 415-491-1565

CIRCLE NO. 140 ON FREE INFORMATION CARD

Microsoft BallPoint 2.0, $125; Driver Software Upgrade, $19.95
Microsoft Corporation
One Microsoft Way
Redmond, WA 98052
Tel.: 800-426-9400

CIRCLE NO. 141 ON FREE INFORMATION CARD

another application, you have to find a scheme to get around SHARE. You can do a save operation to the diskette. But, in many applications, this would mean you'd be working from that slow floppy device until you do a second save to the hard disk, and each of those saves would require a tedious change to the path.

Luckily, there's a superior method you can sometimes use to get around SHARE's proscription. It works with any application that retains a backup when you do a save. Just do two quick saves in a row to your hard disk. This brings the backup file to the same currency as the working copy. It's nearly instantaneous, too, when compared to saving the file on a floppy. Then switch to the DOS prompt. Copy the backup file to the floppy. SHARE won't interfere because the backup file's not in memory. You can even change the backup file extension to the appropriate document extension with the COPY command.

The advantage to the above method may not be apparent at first. It requires you to type in the COPY command and to do an extra save to hard disk. On the other hand, you don't have to change drives in a dialog or type a path change in a DOS application, to avoid working from the floppy. The productivity gain seems small, but time savings quickly accumulate as the operation is repeated. Simply switch back to DOS with Alt-Tab and hit the F3 key or use the command history. You still don't have to change your path back and forth each time, and you no longer have to type the COPY command. That's fast! And the more you use it, the better it gets.

Have you got a *Windows* tip? Why not put it on a 3½" diskette and send it to Yacco News Services, Box 269, Burbank, CA 91503. You can send it to the magazine, too, but it will take a little longer to reach me.

If you're the first to suggest a tip, and I share it in a column, I'll announce your name as the contributor and entice a stalwart software publisher to reward you with one of its fabulous *Windows* titles. Sorry, the choice must be theirs, not yours. Needless to say, your tip must actually work, be reproducible from your instructions and be free of harm to be considered. We also reserve the right to FUBAB (finesse up beyond all belief) them by generally chopping, cutting and otherwise editing as required by international law or whatever whim possesses either me or the editors. If the rest of this column has to live with FUBAB, so do you.

There's one more thing. I read alien diskettes on an old floppy-only system that's absolutely impervious to viral infection, and then sterilize them with neutron bombardment, gamma radiation and WD-40 spray. If I suspect one is infected with a virus, it's also sintered in a reduced oxygen atmosphere. Therefore, please keep your submissions simple enough for me to read them with the DOS TYPE command. Contributions should be made in a plain ASCII text file, without any formatting (no indents, tabs, left margins, multiple columns, etc.). If you end each line with a hard return (no soft returns, whatever they are, please), then place a double return after each paragraph, too. Submissions can't be returned, and any that are used become the property of Yacco Communications. ■

Joseph Desposito

Audio Chipsets, PCMCIA Analog Controllers, Switchable SCSI BUS Terminator, New RS-232 Transceivers, Programmable Timing Circuits and 75-MHz GUI Accelerator

Audio and video are always on the improvement train in PC systems. New audio chipsets from Media Vision and a 75-MHz GUI accelerator from NCR exemplify this tenet. These are just two of the six new devices I'll be discussing in this column.

New Audio Chipsets

Media Vision (3185 Laurelview Ct., Fremont, CA 94538) has two new chipsets that bring full industry-standard audio to the broad base of IBM PC/compatible computers. In addition to their full audio capabilities, the low power consumption of these chipsets enables addition of standard PC sound to laptop computers, in which internal real estate is at a premium.

Media Vision's Jazz chipset includes an MVD1208 eight-bit audio controller, an MVA408 eight-bit codec and an MVA514 mixer. These chips a complete audio solution for less than $18 when purchased in large quantities.

The Jazz 16 solution includes a 16-bit MVD1216 audio controller, an MVA416 16-bit codec and the same mixer used by the Jazz chipset. The MVD 1216 supports, in hardware, IMA (International Multimedia Association) standard audio compression and decompression. Media Vision had earlier made available to all software developers a software implementation of this realtime compression/decompression standard on a royalty-free basis.

OEMs who building laptop computers in which circuit-board space and power consumption are at a premium, the Jazz and Jazz16 chipsets offer high integration and a "sleep" mode for power conservation.

Both chipsets offer equivalent functionality to a complete add-in sound card. Each device can record and play back industry-standard digital sound in stereo or mono, at sampling rates of up to 44.1 kHz. Both are also 100% Sound Blaster and Ad Lib compatible. Included are a built-in MIDI transmit and receive port, a games-compatible joystick interface and support for OPL2 (mono) and OPL3 (stereo) FM synthesizers.

The Jazz and Jazz16 chipsets fully support the Multimedia Personal Computer (MPC) standard. Jazz supports MPC Level 1, and Jazz16 supports MPC Level 2. Complete manufacturing kits—including schematic diagrams, software applications and sample board designs—are available at no charge to OEM customers.

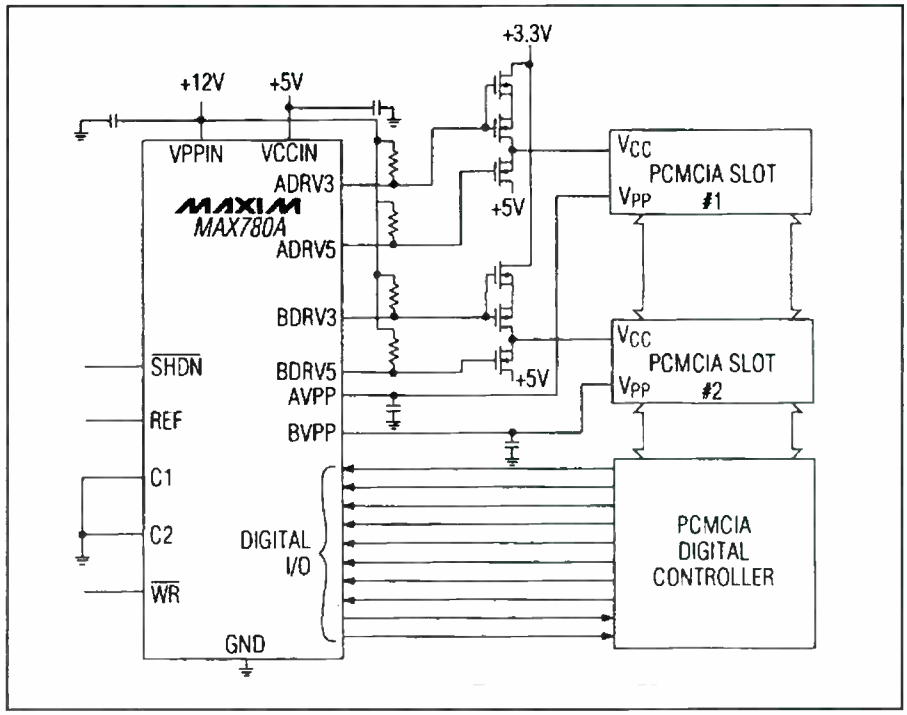


Fig. 1. Typical operating circuit for the Maxim MAX780 series of PCMCIA analog controllers.

The Jazz16 chipset sells for $21.50, the Jazz chipset for $17.50, both in 25,000-piece quantities.

PCMCIA Analog Controllers

Maxim Integrated Products' (120 San Gabriel Dr., Sunnyvale, CA 94086) MAX-780 series of PCMCIA analog power controllers save space and ease the power switching and status signaling needed to control two PCMCIA card slots. MAX780 devices accept logic control from industry-standard PCMCIA digital controllers, such as the Intel 82365SL. They direct the programming and logic power to each card slot, forming a complete, minimum component-count PCMCIA interface in only 0.09 square inches. Small size and low 300-µA quiescent current (which falls to just 60 µA in shutdown mode) make these devices suitable for notebook or palmtop computers, and other portable computing devices.

The MAX780 series incorporates two 0/5/12-volt dc, high-impedance power outputs for V_{PP} flash-memory programming and level shifters for power MOSFET control of two separate 3.3- and 5-volt dc supplies. The MAX780A and MAX780C also include two V_{PP} power-ready status outputs for fast, accurate programming control. The MAX780A and MAX780B include input latches for compatibility in systems without a dedicated PCMCIA digital controller.

The MAX780 series comes in 24-pin plastic DIP and SSOP packages. Prices start at $2 each in 1,000 and up quantities. A typical operating circuit is shown in Fig. 1.

Switchable SCSI Bus Terminator

Motorola (2200 W. Broadway, Mesa, AZ 85202) announced an 18-bit active switchable SCSI-2 bus terminator in the thin profile 32-pin quad flat package (QFP), the MCCS142235FA. This switchable precision SCSI bus terminator eliminates the need to physically remove termination, reduces printed-circuit board real estate and improves manufacturing flow and reliability.

Use of the thin-profile QFP reduces board area by offering low-profile packaging (1.6 mm) for dense form-factor applications. Flexible system design is also a benefit that permits simplified control of

enabling and disabling termination with either software or hardware.

Expansion to 27 bits for wide SCSI bus applications can be achieved by using the MCCS142235 with the MCCS142234 active nine-bit bus terminator. Both devices use an active-termination technique for SCSI termination of 18 or nine bits, respectively. The required 2.85-volt dc regulated supply for SCSI active termination can be provided by Motorola's MC34268 voltage regulator.

The 18-bit MCCS142235FA SCSI Terminator is well-suited for computer-equipment applications including all SCSI, SCSI-2 and SCSI-3 computer platforms (PCs, workstations, minicomputers) and their associated peripherals that utilize single-ended SCSI buses. Examples include rigid disk drives, optical disk drives, printers, bar-coding devices, CD ROMs, tape drives, plotters, image scanners and laser disk drives.

Suggested resale pricing in 100-piece quantities of the MCCS142235FA SCSI Terminator is $3.22.

CMOS RS232 Transceivers

Linear Technology Corp. (1630 McCarthy Blvd., Milpitas, CA 95035) has a very-low-power RS-232 transceiver, the LTC1327/1337. These three-driver/five-receiver RS-232 circuits operate on just 300 µA of supply current and shuts down to under 1 µA quiescent current. Applications for the new devices include notebook and palmtop computers. Fabricated in LTCMOS, the LTC- 1337 includes on-chip protection and can survive multiple +10,000-volt electrostatic discharge strikes.

The LTC1327/37 operate at speeds up to 120K baud with a 1,000-pF/3,000-ohm load. The LTC1327 operates from a single 3.3-volt dc power supply, and the LTC1337 operates on a single 5-volt dc supply, utilizing only 0.1-pF surface-mount capacitors. In shut-down or power-down mode, the new ICs' three-state outputs assume a high-impedance state. Output overvoltages don't force current back into the power supplies. The RS-232 I/O lines can be forced to 25 volts without damage to the device.

Both devices are pin-compatible with Linear Technology's LT1137 and LT1237 RS-232 transceivers. All of the devices feature Linear's flow-through architecture, with all input pins on one side of the package and all outputs on the other, to simplify circuit-board layout.

The LTC1327 and LTC1337 are available in either 28-pin plastic DIP, 28-lead SOIC and 28-lead SSOP. Pricing in quantities of 100 pieces and up is $4.70 each in DIP and SOIC and $5 each in narrow SSOP surface mount.

Programmable Timing Circuits

Dallas Semiconductor (4401 S. Beltwood Pkwy., Dallas, TX 75244) has two silicon timing circuits that can be programmed in the end system. The DS1020 and DS1045 programmable delay lines offer timing delay step increments from 0.25 to 5 ns. Both devices can be programmed through a standard microprocessor interface or can be hard-wired.

Programmable delay lines give system designers the flexibility to establish timing functions that are much later in the design cycle. After a design is frozen, the engineer can make adjustments to optimize performance. Adjustments can even be made when the system is in the field.

As a sample application, the programmable delay lines can dynamically correct fro time skew on backplanes. In a backplane with multiple processor cards operating at very high speeds, adding another card can significantly change the transmission characteristics of the data bus. An engineer can measure backplane characteristics after the new card has been inserted and adjust form any difference if bus speed increases or decreases.

The DS1020 offers a single output delay in 256 increments with delay steps of 0.25, 0.5, 1 or 2 ns. The DS1045 offers a dual output from a single source. Each output of the DS1045 can be independently programmed in 16 increments with step delays of 3, 4 or 5 ns.

With its ability to make timing adjustments relative to the speed of light, the DS1020 is suitable for optical-disk drives and fiber-optic transmission cable. It's also a good match for high-speed processors that have some timing problems.

Dallas' programmable delay lines are currently available from stock in DIP and SOIC packages. In quantities of 1,000 pieces, the DS1020 DIP cost $13 each and the SOIC is $13.10 each. In similar quantities, the DS1045 DIP costs $11.55 each and the SOIC costs $11.65 each.

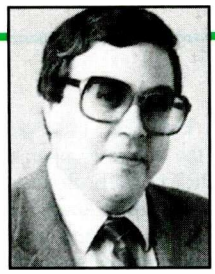
75-MHz GUI Accelerator

NCR Microelectronics Products Division's (1635 Aeroplaza Dr., Colorado Springs, CO 80916) 32-bit NCR77C32BLT GUI accelerator has a 75-MHz memory clock and uses DRAM memory on the VESA Local Bus to provide pixel rates of 110 MHz on a 1,280 x 1,024 noninterlaced monitor.

The NCR77C32BLT uses a bit-block transfer (BitBlt) engine that draws and moves pixel blocks at all color depths, including 16-bit high color and 24-bit true color. The engine performs alignment, masking, color expansion, pattern fetch and embedded clipping without CPU intervention. Special algorithms for drawing and moving text accelerate spreadsheets and word processors.

All controls for the engine are grouped in a memory-mapped accelerator control menu, providing straightforward programming and eliminating trapping of I/O registers in protected mode environments.

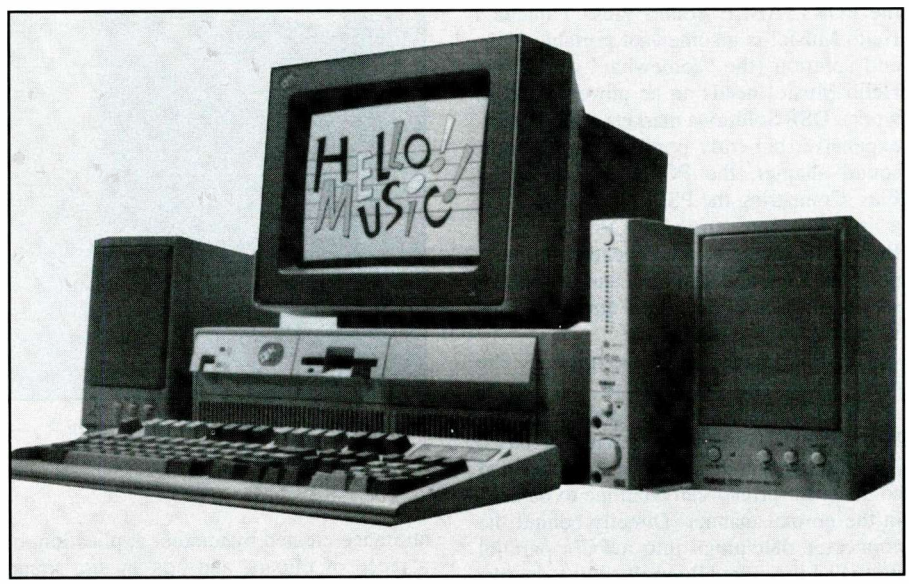
The NCR77C32BLT is available in a 208-pin PQFP and is priced at $25 each in quantities of 10,000. ■



Ted Needleman

It's That Time of Year Again

This is my favorite column of the year, the one that's most enjoyable for me to write. With most columns, I have to worry about a product being useful, necessary and/or reasonably priced. With y annual "gift-giving" column, it just has to be something you'd enjoy giving or receiving. I've got a lot of ground to cover this month, so let me get right to it.



Sound on the Go

Whether or not you go whole hog, you're going to have to get involved to some degree with multimedia this year. CD-ROM drive prices are down in the $200 range, and sound cards are beginning to be an expected peripheral. More and more software packages take it for granted that you'll have a sound card installed. I've played with a lot of sound cards this year, from very basic eight-bit boards to fancy 16-bit wave-table synthesizers. I'll have more to say about some of these in future columns, but there are two products I've been using recently that I really like a lot.

The first of these is Yamaha's Hello Music! CBX-T3 tone generator. A tone generator is a MIDI synthesizer that's complete except for the keyboard. Most tone generators are aimed at professional musicians and are priced accordingly. Hello Music! (hey, I didn't choose the name) is aimed at computer users who have a need for really good sound but who aren't necessarily musicians or even experienced computer users. When it was first introduced earlier in the year, Hello Music! was priced a bit steeper than most of the sound cards available. But recent introductions of wave-table synthesis units have boosted premium internal sound cards within the same price range as the CBX-T3, making the disparity in prices between a tone generator and internal sound card much less glaring.

I keep talking about wave-table synthesis. This is a fancy term for something that high-end keyboards and rack-mount synthesizers have been doing for years, called "sampling." Rather than approximating the sound of an instrument from a mathematical formula (a process called "additive synthesis," as you keep adding waveforms to build the final instrument sound), sampling, or wave-table synthesis stores an actual digitized sample of the instrument in ROM or RAM. When you want to "play" that instrument, the sample is retrieved and frequency shifted to the appropriate note. Obviously, you can get a much more realistic instrument sound from a sampled or wave-table-type unit than you can from music simulated with a mathematical formula.

Yamaha's CBX-T3 Hello Music! contains sampled instrument voices, 192 of them and an additional 10 drum sets, in a case about the size of a small cigar box. It has an attached metal base that stands the unit vertically so that it takes up only a few inches on your desktop. A large ac power-supply cube plus into the back panel, as does the serial cable that goes to your PC. Hello Music! can interface to a PC or Mac through the serial port or to another MIDI instrument through its MIDI IN and OUT plugs. Once electrical connections have been made, which takes only seconds, you connect the unit to a stereo system or a pair of powered speakers (Yamaha offers an excellent, but pricey, set), and you're ready to set up the software.

Yamaha supplies Hello Music! with Passport Software's *Trax* sequencing software. *Trax* is an excellent *Windows*-based sequencer that lets you create and edit your own multi-track MIDI sound tracks. But it's probably gross overkill for most of the users for whom Yamaha has targeted this unit. An inexpensive package like Asymetric's *MediaBlitz!* is more suitable for non-power users who want and need to use multimedia and music without become computer gurus and/or musicians. Even WordPerfect *Presentations for Windows*, Lotus *Freelance Graphics for Windows* and the new *Harvard Graphics for Windows* would have been a better choice for the included software.

One last criticism, Yamaha's manual is pretty lame. It's usable, but it's sure not written for the target audience for this product. The CBX-T3 follows the new General MIDI specifications, but trying to figure out just how to get a particular instrument voice out of the unit is a little frustrating, unless you're an experienced MIDI user.

On the other hand, the sound out of this little box has to be heard to be believed. I'm not an "audio snob," but with a good set of speakers or attached to a decent sound system, there's an obvious improvement in the quality of sound this unit produces over less-expensive and less-expensive sound cards. Not everyone needs this improved sound quality, but even if you don't, because it interfaces to a PC through a serial port, Hello Music! can easily be used with notebook and other portable PCs or moved between several PCs without the necessity of opening the case.

If you're looking for something more than a run-of-the-mill sound card, take a look at the Yamaha CBX-T3. And don't be scared off by the unit's $449 suggested retail price, I've seen it for sale at well under $300 in several mail-order catalogs. If you or someone you known is really into

sound, the CBX-T3 makes a fine, though somewhat pricey gift.

DSP PORT*ABLE Sound Plus

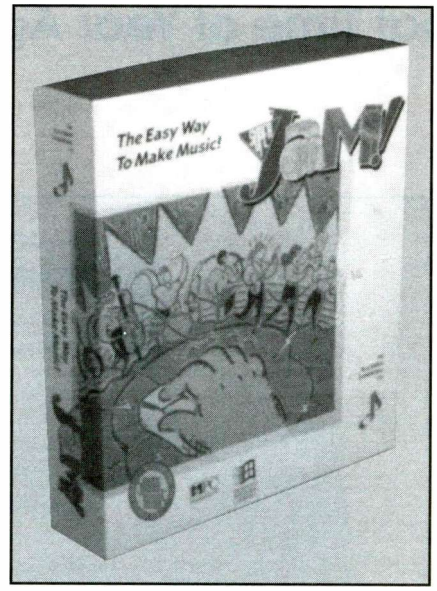
While I'm on the subject of sound on the go, I'd be remiss in not telling you about the PORT*ABLE Sound Plus. Yamaha's Hello Music! is a somewhat portable high-end solution (the "somewhat" is because Hello Music! needs an ac power outlet to work). DSP Solutions markets a much-less-expensive, but truly portable parallel-port sound adapter, the PORT*ABLE Sound Plus. Comparing the PSP to the CBX-T3 is a little like comparing fruit to vegetables. Both taste good (or bad, depending on your personal likes and dislikes) and are necessary to a balanced diet, but a direct comparison isn't really possible.

The PSP consists of two pieces. The main audio unit connects to any PC or notebook through a parallel port. A narrow box about 8" long and 3" wide, it has a pass-through parallel port on the other end so that your printer can continue to be used in the normal manner. Directly behind the connector that plugs into a PC's parallel port is a hinge that allows the unit to be tilted upwards if you don't have much room in back of your PC.

This unit contains a number of jacks on its side panel, including jacks for audio in and a microphone and a dc power jack for when you're using the included ac power-supply cube. The second unit, about an inch longer, contains a speaker and built-in microphone, volume control, headphone jack. I plugs into the first unit with an RJ-45 type plug. This unit takes six AA cells if you wish to be truly free of the ac power lines and has a nice pop-out easel in the rear so that you can stand up and tilt the speaker.

The unit features stereo or mono 16-bit playback and record sampling (through the built-in microphone or external unit if one is plugged in) at 11, 22 or 44 kHz. DSP doesn't give the manufacturer of the sound chip used in the PORT*ABLE Sound Plus, but the unit is Sound Blaster-compatible, and provides nine melodic voices or seven melodic and four percussion voices. In addition to the included applications, the PSP worked just fine with all of the applications included on the test PC, including the new Word Perfect *Presentations For Windows 2.0.*

DSP includes a number of software applications as well. For general sound work, there's the Lotus Sound OLE server for *Windows*, *WinReader for Windows*, a text-to-talk utility, DOS Talk and DOS Read utilities for use under DOS and the vendor's own *Show & Tell For Kids*. The "For Kids" is a bit of a misnomer, as the program is actually a pretty nifty basic multimedia authoring system. You can take



Blue Ribbon Soundworks' *SuperJam!.*

an image created by another application, or a piece of clipart, and add music, sound effects or even a voice-over created with the Lotus Sound tool's recorder. Move the slides you create into other orders.

Installing the four disks worth of software is a 10 minute job, and you can be up and running *Show & Tell* a few minutes later. The biggest limitation of the software is that you can create only 10 slides for a presentation. A coupon to upgrade to DSP's "grown up" version of *Show & Tell* for $49 is included, and if the *For Kids* version is any indication, it's probably a good deal.

If you've really wanted to add sound to your or your kid's PC, but don't have an extra slot or the desire to open up the system, the PORT*ABLE Sound Plus is a great way to get great sound. It's a little more expensive than some internal sound cards, but you can easily use the PSP on several machines and/or a notebook PC, something that's impossible with an internal card. If you have a notebook, buy it for yourself!

SuperJam!

It's really embarrassing. Over the years, I've accumulated a large number of electronic keyboards, sound cards and other accouterments of the digital musician. But I really don't have much (if any) musical talent. It doesn't stop me from trying, but it does impact heavily on the quality of what comes out of the speakers when I'm at the keyboard. One of the greatest inventions, seemingly targeted specifically just for me, was Casio's CasioChord. Other keyboard vendors also offer a similar feature, which lets you play whole chord progressions with a single finger.

What I've really needed was something similar for the PC. With Blue Ribbon Soundworks' *SuperJam!*, I have the equivalent of CasioChord and more! And if you're contemplating either of the sound modules reviewed above, or already have a sound card installed in your PC (or are going to add one), *SuperJam!* will make a great add-on.

Running under *Windows*, *SuperJam!* has a number of preset musical bases, in various styles (Latin, Country, Pop, Rock & Roll). Each of these preset styles has a "house band" and a drum line. You can easily change any of this, adding or sub-

This is the opening screen from Compton's NewMedia's *The Human Calculator* on floppy-disk and CD-ROM.

Products Mentioned

Hello Music! CBX-T3, $449
Yamaha Corp. of America
PO Box 6600
Buena Park, CA 90622-6600
Tel.: 714-522-9011

CIRCLE NO. 142 ON FREE INFORMATION CARD

PORT*ABLE Sound Plus, $198.95
DSP Solutions, Inc.
550 Main Street, Ste. J
Placerville, CA 95667
Tel.: 916-621-1787

CIRCLE NO. 143 ON FREE INFORMATION CARD

SuperJam!, $129
Blue Ribbon Soundworks Ltd.
Venture Center
1605 Chantilly Dr., Ste. 200
Atlanta, GA 30324
Tel.: 404-315-0212

CIRCLE NO. 144 ON FREE INFORMATION CARD

The Human Calculator, $59.95/$39.95 floppy/CD-ROM
Compton's NewMedia
2320 Camino Via Roble
Carlsbad, CA 92009
Tel.: 619-929-2500

CIRCLE NO. 145 ON FREE INFORMATION CARD

tracting instruments, changing the tempo, key and, if you're a much better musician than I am, cutting and pasting your own compositions into what Blue Ribbon Software supplies.

At the same time, I hesitate to make *SuperJam!* seem too simple. At its simplest, you can use it like a one-finger CasioChord. But if you're not among the musically disadvantaged (as I am), you can also use it as sort of am instrumental Kareoke, playing along or around the *SuperJam!*-generated backup. If you have a sound device with MIDI capability and a MIDI keyboard, you can even use the keyboard as an input device to *SuperJam!*, along with your keyboard and mouse. Finally, if you're a bit of a MIDI sophisticate, *SuperJam!* contains a really nice sequencer that let you record and edit your masterpieces.

SuperJam! works well at several levels of sophistication, though I'm not enough of a musician to know or to be able to judge how appropriate it would be for someone who really knows what he's doing around a keyboard. For the rest of us, I'd recommend *SuperJam!* to anyone who has music capability on their PC.

The Human Calculator

So far, this column has concentrated on things that are probably most appropriate for grownups. But my eight-year-old has been playing with a program that the kids in your life will not only enjoy, but (perish the thought) will also help them in school. Before I get into it, though, I have a confession to make. I have four kids (an eight year-old-boy in forth grade, twin seven-year-old boys in second grade and a five-year-old princess in kindergarten). Each has his or her own PC. By and large, I'm pretty particular what I'll install on these PCs. With NES, SuperNES, and SEGA Genesis machines in the house, there are plenty of shoot-em-up games for the kids to play when their homework's done. When they use their PCs, though, I'd like them to come away from the experience enriched. This doesn't mean that the PCs are just for highbrow endeavors. Plenty of times they'll just use the PCs for drawing or word processing. But with the right software, they can also learn new skills or sharpen the ones they already have. The problem, sometimes, is finding software that meets my criteria for some sort of educational or intellectual enrichment, and the kids' natural inclination to play, whether it's on a Nintendo or PC.

Compton's *The Human Calculator* seems to meet both of these criteria. Based on techniques developed by Scott Flansburg, the entertaining Human Calculator frequently seen on TV, *The Human Calculator* software focuses on the adventures of Cal, the digital alter ego of Scott, who has been tasked with traveling to another planet to rescue thousands of math students kidnapped by an evil alien. Along the way, Cal has to solve numerous math challenges with the help of your child, who while following and assisting Cal in his exploits, also learns some really neat math. Some of these, like adding large numbers from left to right in your head and fast methods of finding squares, I remember from my younger days. Other tricks, like quickly finding square roots, I don't. But even though a little of the math was beyond my fourth-grader, he's been having a ball with *The Human Calculator*. And just so you don't think that any program a forth-grader would enjoy would be inappropriate for your somewhat older child, I've been enjoying the software just as much! If you have a CD-ROM drive, get the ROM version of the software, it's less-expensive.

If you have school-age kids or know someone who does, give them a copy of *The Human Calculator* and watch their interest in math—and their grades—go up. This is one piece of software I'm recommending to the kids' school. ■

Firm Up Computer Security With Intelligent Security's Hardware/Software System

Computer security grows and changes almost as quickly as does computer technology itself. Security is an important concern as long as prying eyes and probing hands seek unauthorized access to your system. If you have a security problem, there are things you can do to firm up your computer security. Let's look at a few of the options currently available.

Basic Security

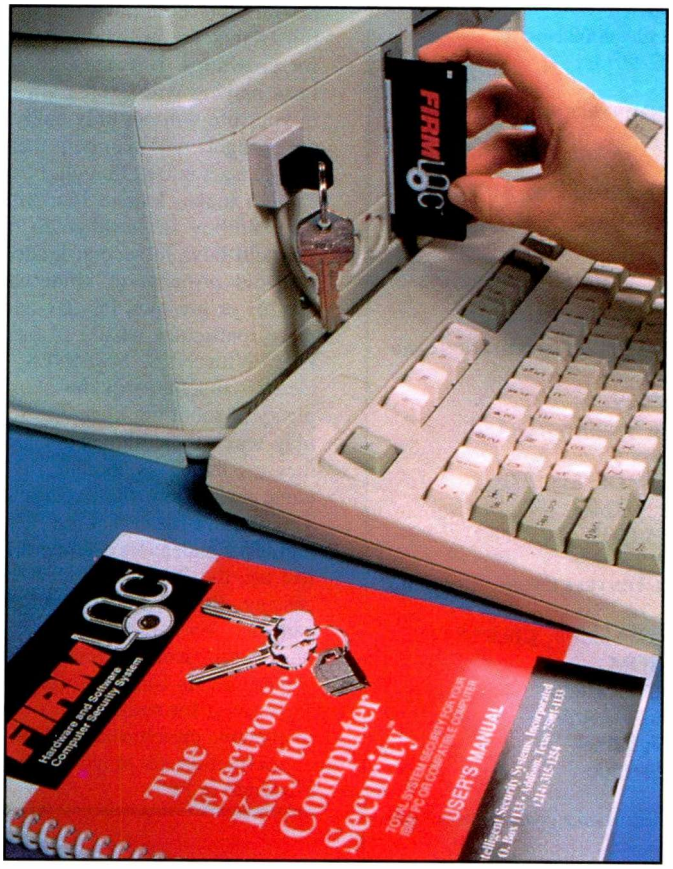
A common attempt to provide a measure of security is the key lock system used by virtually every IBM-style computer. The key lock system is a matching key-and-lock system that prevents a computer from booting up unless the key lock is set to its unlock position. The key lock is a simple and effective—if there isn't easy access via screwdriver to the interior of a PC. It doesn't add much to the cost of a computer. Besides, a lock-and-key system is familiar to nearly everyone. Thus, the key lock is easy to use. Its disadvantages are that it isn't discreet in any way. It either denies all access or accepts all access.

There are ways of defeating the key lock system. One way is to physically "pick" the lock. Another is to remove the computer cover and either electrically bypass the key lock switch or detach the key lock switch from its simple wiring.

Recent advances in computer technology present an adjunct to the ubiquitous key lock system. The addition is password protection as part of the computer's booting process. If a user doesn't key in the correct password, the user is simply denied to any action.

The password selected for a CMOS security system is a matter of choice and is kept in the computer CMOS memory. CMOS is a special kind of memory that keeps track of specific computer information, like monitor type, hard-drive and floppy-disk drive specifications, date and time, etc. If you enable password protection in CMOS, you computer won't boot without the correct password. CMOS security, like the key lock system, is simple, effective and inexpensive. The major disadvantage of CMOS security is that it's unable to provide varying levels of access.

Another level of security can be obtained by using a menu system. Menu systems are usually inexpensive but can vary in the expertise needed for correct implementation of menu security features. In most cases, menu systems can prevent access to the DOS prompt, limiting access to information not available by normal menu functions. Better menu systems can grant or deny access to individual menu selections so that whoever sets up the menu system decides which user gets to use any particular application.



Menu security has the advantage of flexibility and discretionary access decided by whomever programs the menus. Its disadvantage is that it takes an investment of time to design and implement any security scheme. Implementation is fairly easy for any who is comfortable with the DOS prompt and working with batch files. On the other hand, computer novices might have a long learning period before gaining satisfying implementation. Another disadvantage is that a well-experienced user can readily defeat a menu system. One defeating technique is booting from a floppy disk that has DOS operating system. However, booting from floppy can be pre-empted by using CMOS. Newer computers have a CMOS setting that forces the computer to bypass floppy and boot only from hard drive. Despite this added security feature, there are other ways to beat menu system security.

Enter Firmloc

Security devices are either hardware or software based. Comprehensive security systems usually join hardware and software in an intelligent combination. One such security system is Firmloc, produced by Intelligent Security Systems, Inc.

Firmloc is a three-part system designed to gradate computer access from total denial to full access, with levels between the two. It controls access to floppy drives, hard drives and I/O ports. Firmloc's aim is to provide full and selectable access to all computer operations. Its trinary scheme must be installed in a specific sequence: Keyring, Software, Drive Access Device.

- ***Keyring.*** The Keyring must be installed first. This is a cabling affair with one end that plugs into your computer's parallel port. It doesn't matter which parallel port you use, and the Keyring is completely transparent to printing. The other end of the Keyring is a small five-pin female connector, which serves as a receptacle to a special electrically programmable Key. The receptacle is equipped with a sticky base so that you can attach the it to a convenient spot on your computer.

Securing objects in place with cement is a workable technique, but it causes difficulty if you ever want to change its location. Therefore, you should think about the best location for the receptacle before placing it. A hasty decision might place the receptacle somewhere on the computer's system-unit cover, where it will be in easy reach of any user. But keep in mind that if you ever have to remove the cover of the system unit,

you'll probably be forced to remove the receptacle as well. Once removed, the receptacle might lose its ability to stick. You would then have to find another way to secure the receptacle again, perhaps using liquid adhesive or double-sided tape.

The ideal location for the receptacle must satisfy two requirements. One is that it must be within easy reach of the computer user. The other is that it must be protected from disturbance should the cover of the system unit have to be removed. On my own computer, the best location is on top of the system unit's face plate. Though it's within easy reach here, this is a less-than-ideal location for it.

The Keyring system poses another potential problem. The Key receptacle is a five-pin connector of low endurance. The connector assembly isn't designed for the wear and tear of repeated connect and disconnect cycles. Even the Firmloc manual notes that the receptacle is designed for "semi-permanent" attachment. This fact runs counter to Firmloc's goal of full and flexible security. Its own programmable Key system allows for multiple key holders. Each user who possesses a valid Key can insert his key and access the computer. It seems to me that any system of electronically programmable keys would naturally include a simple, durable system for connecting and disconnecting user keys.

• ***Firmloc Software.*** Firmloc software is the second item for installation. The software's install routine does all the work, including modifying the AUTOEXEC.BAT and CONFIG.SYS files. The combined memory usage for the required software drivers isn't exorbitant, but it remains an annoying prerequisite to establishing Firmloc security.

The software detects the presence of a connected key, reads its data and decides if it's a valid key. If it determines that the key is valid, you then proceed to assign user identification and access rights per key. Firmloc comes with two keys, one of which you program as master key with unlimited rights. The second key may be a master backup or may be assigned as another user who has reduced access to system software. You can purchase as many keys as you need.

Users with administration rights can add and delete users and keys to and from the system and grant or remove rights based on time of day and day of the week. Administrative users can specifically control floppy and hard-drive access and read system logs. The system log records activity whenever the computer is booted. Any computer usage is recorded by time, date and user. Therefore, it's easy to tell if and when the computer has been used, and by whom.

• ***I/O Security.*** Firmloc software incorporates very interesting control over hardware I/O devices. Ordinarily, you wouldn't be concerned about access to serial ports or other hardware devices. However, there are occasions where I/O devices should have controlled access. I/O control is advisable when your computer is part of a computer network. Your networking device may be a network card, serial port or parallel port. Whatever the case, you can control access to any I/O device that uses a processor interrupt, including your computer mouse.

Controlling your I/O devices prevents networked and remote modem users from defeating Firmloc security. You can use Firmloc to permit or prevent I/O access on a per-key basis. Firmloc's background processing feature permits necessary networking functions to continue normally while preventing local access and tampering.

• ***Drive Access Device.*** The Drive Access Device is a normal floppy-disk cable with special Firmloc modifications. Modifications are covered by black heat-shrink tubing that keeps them hidden from visual inspection. Protruding from beneath the tubing is a standard PC power-supply connector. Presumably the modifications contain at least one active device that needs the 12 or 5 volts dc power. The modifications, probably proprietary, serve as a watchdog for floppy-drive access.

Firmloc doesn't permit access to a floppy disk, except for authorized Firmloc users. This means that no tricky well-experienced DOS user can boot your Firmloc- protected system with his own floppy disk. The Drive Access Device is a direct replacement for your present floppy-drive cable.

You don't have to use the Drive Access Device, but if you don't use it, there will be a glaring gap in your system security. Whenever you attach the Drive Access Device you must boot up with Firmloc software fully installed. Otherwise, floppy-drive access is completely restricted.

In addition to hardware protection for floppy-disk drives, Firmloc offers a second floppy-based security called CMOS Floppy Locking. This software feature works with your CMOS to prevent an unauthorized floppy boot-up. The combination of Drive Access Device and CMOS Floppy Locking add up to formidable disk security.

Other Security Features

Clock Locking sounds like a strange security feature, but it makes sense when you think about it. Firmloc can restrict user access according to time of day. If a wily user can alter the computer's time clock, he may be able change his own access times, thereby comprising security to a degree. Clock Locking prevents any altering of the computer's time clock.

Computer users who are knowledgeable about hardware may remove the computer cover and attempt to defeat Firmloc hardware. You can create a special Firmloc boot disk that serializes itself to the hard drive of a specific computer. Thus, if anyone succeeds in removing Firmloc hardware or tampers with your AUTOEXEC.BAT or CONFIG.SYS file, the computer system will fail to boot unless the special serialized boot floppy disk is used. If you use this feature, make sure you take good care of the boot floppy.

WriteLoc is the feature than prevents users from running unauthorized utility programs. Some utility programs, like *Norton Utilities* and *PC Tools*, have a powerful tools for editing drive sectors, including the boot sector. A related feature is KBD-Off that disables Control-C and Control Break. These keyboard commands can interrupt the processor and provide an entry point for clever users. KBD-Off and WriteLoc work to block this potential security breach.

Windows Compatibility

Microsoft Windows grows in popularity. Firmloc has a minor problem dealing with enhanced-mode *Windows*. One of the features of *Windows* enhanced is that the operating environment checks I/O to make sure that no two items use any one hardware device at the same time. If this should occur, *Windows* displays a warning indicator.

Firmloc and *Windows* conflict because they both try to govern the parallel port connected to the Keyring. One solution to this problem is to run *Windows* in standard mode, which isn't acceptable because running *Windows* in standard mode locks out all the features that make it worthwhile to use *Windows*. Another solution is to go into the 386 Enhanced section of *Windows* and tell it not to warn about I/O conflicts concerning the parallel port. Unfortunately, doing this may not be enough to keep Firmloc from slowing *Windows* to a crawl or preventing it form running. If so, your only recourse is to run *Windows* in unacceptable standard mode if you want to use Firmloc.

Conclusion

Firmloc is a powerful and flexible security system, especially at its $249 price. It requires loading software drivers and installing hardware into the protected computer system. Software drivers are a regrettable overhead, but they're necessary for enjoying the level of security offered by Firmloc. Access to the protected system is easily expanded by adding keys and users.

Used properly, and perhaps along with Keyloc security or CMOS password security, Firmloc affords an extreme measure of protection with surprisingly few troubles. It might give you trouble running Microsoft *Windows*, but if you really need as much security as Firmloc offers, it's certainly worth this much trouble.

Product Reviewed

Firmloc, $249; Additional Keys, $15
Intelligent Security Systems, Inc.
PO Box 1133
Addison, TX 75001-1133
Tel.: 800-237-4774
Requirements: IBM PC, XT, AT, 386, 486 or compatible computer with 3½" and/or 5¼" floppy disk drive(s), hard-disk drive, DOS 3.0 or later and parallel printer port.

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The AmCoEx Index of Used Computer Prices

Some older 386 computers may get a new lease on life, thanks to a new 486 CPU chip from Cyrix. The new Cyrix chips, dubbed the Cx486DRx2, can provide up to three times the power from the older computer. Older 386 chips that run at 16, 20 and 25 MHz can be upgraded. The new systems will run at 32, 40 and 50 MHz, respectively. The upgrade involves removing the old chip from its socket and plugging in the new one. A small software patch must also be installed. Prices for the new CPU's range from $299 to $399.

Additional CPU chips may soon be announced for the 386SX computers. Cyrix is expected to announce a new family of CPU chips for new computers. The new chips, designated the M1 CPU chips, will compete with Intel's Pentium CPU. The M1 is expected to be faster and cheaper than the Pentium.

Next month, IBM is expected to announce its first notebook computer using the PowerPC CPU chip. This should be the most powerful notebook computer on the market. However, the first systems will work with only AIX, IBM's version of UNIX.

As expected, IBM's new Ambra division has announced several new computers with more performance and lower prices than most mail-order models. Its Pentium systems are priced up to $2,000 less than similar systems from Dell.

Recent monthly price cuts by Apple have had only a small effect on used-computer prices. However, the 33% price reduction on the Centris 650 may force prices substantially lower on all used Macintosh II computers.

The predicted explosion of CD-ROM popularity appears to be well under way. In the past two years, the number of installed CD-ROM drives has tripled from one to three million. During the same period, the number of CD-ROM titles has doubled to almost 5,000.

Most video display monitor makers will introduce energy-efficient models this fall. These monitors can power down if inactive for a predetermined period of time. After October, the federal government can purchase only this type of monitor.

Machine	Average Bid	Average Ask	Buyer's Close	Seller's Change
IBM PS/2 Model 30/286 20M	300	525	425	-50
IBM PS/2 Model 50Z 30M	375	650	425	-25
IBM PS/2 Model 70 120M	700	1,000	725	-75
IBM PS/2 Model 80 70M	600	850	625	-25
IBM ThinkPad300	1,250	1,650	1,450	+50
IBM ThinkPad700	2,100	2,700	2,350	-50
AST 286/12, 40M	275	675	400	-25
AST 386/20, 80M	550	950	675	-25
Dell 325SX, 50M	400	800	650	+25
Dell 386/20, 120M	800	1,200	925	—
Gateway 286/16, 40M	350	600	450	+50
Gateway 386SX/20, 80M	600	950	725	+25
Gateway 386/25, 80M	600	1,000	775	-25
Clone AT 40 M	250	550	450	+75
Clone Notebook 286, 40M	350	750	550	—
Clone Notebook 386SX, 40M	500	1,050	775	-25
Clone 386/SX 40M, VGA	450	950	600	-50
Clone 386/25 80M, VGA	650	1,150	700	-25
Clone 386/33 80M, VGA	750	1,250	825	+25
Clone 486/25 120M, VGA	900	1,450	925	—
Compaq SLT/286 20M	400	800	450	-50
Compaq LTE 286 40M	400	775	600	—
Compaq Portable III 40M	250	650	375	—
Compaq Deskpro 286 40M	300	650	400	—
Compaq Deskpro386/20e 100M	800	1,100	825	-50
Macintosh SE 20M	450	750	525	+25
Macintosh SE/30 40M	600	900	750	-50
Macintosh II 40M	600	1,150	875	—
Macintosh IIcx 80M	900	1,500	1,000	-100
Macintosh IIci 80M	1,300	2,000	1,550	-100
PowerBook 100 4/20	700	1,100	900	—
PowerBook 140 4/40	1,100	1,500	1,100	-100
PowerBook 170 4/40	1,300	1,800	1,425	-125
LaserWriter IINT	800	1,300	900	-50
Toshiba 1200XE	300	650	425	—
Toshiba 1600	400	700	425	-75
Toshiba 2200 SX 60M	800	1,300	875	-125
Toshiba T-3100SX 100M	700	1,150	700	-100
Toshiba 5200 100M	900	1,400	1,300	+75
HP LaserJet II	400	850	750	+25
HP LaserJet IIP	325	950	625	+25
HP LaserJet III	750	1,200	1,025	-25

Several years ago, very few new or used computers sold for less than $2,000. Today, very few sell for more than this amount. During this time, "standard" memory configurations have increased from 256K to 4M. Minimum-capacity hard drives have increased from 20M to 80M. Annual sales of computers have increased from 10-million units to more than 40-million units. Economies of scale have allowed prices to fall in spite of the increase in memory and hard-drive capacity.

However, this trend may reverse itself

(Continued on page 85)

SuperMart

This new advertising section highlights products in an easy-to-locate format for reader convenience. Call Margaret Milanese today for deadlines and additional details at 516-681-2922 (FAX 516-681-2926).

play. It's an enjoyable and amusing game for those who like deity role-playing. However, if you're sensitive about religion, you might be offended by the game's light-hearted approach to the sacrosanct. Otherwise, you're in for an entertaining look at divinity.

Return of the Force

Fans of science fiction have a new saga in the popular *Star Wars* trilogy. LucasArts Entertainment, part of the LucasFilm family, issues *X-wing*, a new space-combat simulation. LucasArts finally brings the *Star Wars* universe to the personal computer. Players join the rebel Alliance and take to the proving ground for testing as potential star pilots. After dedicated practice, you can take part in simulated historical battles that teach you how handle the heat of a space dogfight. When you're ready, you start your first of three tours of duty, where you go on real missions.

During the campaign against the Empire, you fly all three fighter models, X-wing, Y-wing and A-wing. Mission assignments range from freighter and shuttle transports to no-yield attacks on Imperial ships and storage facilities. *X-wing* is a fine computer game. It has state-of-the-art game technology that puts it in a class with Origin's famed *Wing Commander* series. Ordinarily, I don't directly compare one game with another. This case must be an exception, because *Wing Commander* and *X-wing* are so far ahead of other competing space-combat games that they're literally in a class all by themselves.

Graphics of both *X-wing* and *Wing Commander* are smooth, fast, highly detailed and brilliant. *X-wing* has the edge in graphics because it displays its effects in full-screen, whereas *Wing Commander* runs about two thirds-full screen. Both games match up almost equally in other ways. *X-wing*'s story has the benefit of a pre-existing world, complete with a stellar evil villain, a smart and beautiful princess and a handsome, daring young hero. It's difficult to mishandle a stage that's so well set. LucasArts doesn't drop the golden platter of a story that was handed to it. *Wing Commander*, on the other hand, did as well or better, having to work up its playing universe from scratch.

Music is another outstanding feature of both games. John William's masterful *Star Wars* score makes an excellent transformation to the computer game. The main theme and even Darth Vader's theme are heard throughout the game, along with new music composed especially for the game. *Wing Commander* came up with all original music and does just as well as *X-wing*.

One area in which *X-wing* falls sadly behind its space-combat counterpart is digitized voice. *Wing Commander* has several characters that fly with you as wingmen. Each has his or her own voice and manner of expression. Even the enemy talks to you, if only to transmit insults and taunts. By stark contrast, *X-wing*'s digitized voice is limited to a few messages during combat. These sound as if they're spoken by the same voice. This is extremely disappointing, considering the exciting dialogue that occurs in every *Star Wars* battle sequence. Cinematic *Star Wars* dogfights were accompanied by chatter between fighter groups and individual fighters. Squadron leaders issued terse orders and fighter pilots issued instructions and warnings.

X-wing has so little space chatter that what does exist is boring by comparison. Surprisingly, Luke's voice is nowhere to be heard. Neither are the voices of Han Solo, Lando Calrissian and Darth Vader. Of course, there's the incessant beeping and whistling of your R2 unit. Here's an example of the way an *X-wing* battle dialogue should go, picking up after the hyperspace jump:

"This is Red Leader. All wings report in." You hear the digitized voices of other pilots reporting that they're standing by. Red Leader says, "Set S-foils to attack position." You comply by pressing the appropriate key. A couple of minutes into the battle, the voice of General Madine, back at base, says, "Red Leader, this is Base. A Star Destroyer has just emerged from hyperspace in your area. She is deploying fighters." Red Leader responds, "Copy. Fighters sighted: three marks at 210. Reds 2 and 3, engage. Gold Leader, split up and go for your targets. I'll cover you." You get the idea of how authentic Star Wars dialogue can make a large difference in realism and fun. It's a wonder why LucasArts failed to capitalize on some of the most-thrilling parts of *Star Wars*. I know that such strong voice support would add to the game's need for hard-disk space, but these days, a 25M game (like *Wing Commander*) isn't unusual.

Battle action is another place in which *X-wing* needs improvement. Once Admiral Ackbar hands out your assignment, you head off to complete it without any real direction. If you're flying as part of a group, your group leader says nothing about where and when you should attack. If you're the group leader, you can't break up your group to better manage the attack. On some missions, your task force enters hyperspace before the mission is complete and before they're ordered to do so. With some missions, it's unclear exactly how they should be handled. Many missions appear to be straightforward but contain tricks that must be known in order to accomplish the mission. There's no foreknowledge or guidance concerning the secret tricks. You simply must play and replay the mission until the trick is discovered.

Use of esoteric trickery in *X-wing* is surprising because LucasArts almost single-handedly redefined the graphic adventure as an enjoyable and frustration-less experience, replacing subjective tricks with playability But here, with its first space-combat game frustration seems to be a deliberately intro duced ingredient.

Besides use of mysterious tricks, *X-wing* pretends to give the player some useful tools for getting around the more difficult missions. One tool is the ability to give your star fighter unlimited weapons and invulnerability. Yet, after using the tool, you can't advance to the next mission. A second tool is the ability to revive your pilot after he's captured or killed. Again, this seems like a very handy tool. But using it takes away all your game points and reduces your rank to beginning rookie. Both tools are there for the using, but you're penalized if you use them. Does LucasArts expect that every player can run through all 40 missions with no mistakes?

X-wing is a fine game, but it really has no basic features that are any better than those in *Wing Commander*. This would be okay for any other game but not for a product bearing the *Star Wars* name. *X-wing* delivers on the *Star Wars* story in setting up the game environment, but it fails to execute the full flavor of *Star Wars* combat. It's a fair start, though, for LucasArts, and *Star Wars* fans are glad the game is here. Maybe the next installment will have less flash and more combat substance.

Bird's Eye View

Populous II, $49.95
Electronic Arts
1450 Fashion Island Blvd.
San Mateo, CA 94404
Tel.: 1-800-245-4525

Requirements

Memory	640K, EMS, Hard Drive
Graphics	VGA
Sound	Sound Blaster
Controllers	Mouse, Keyboard

Evaluation

Documentation	Good
Graphics	Good
Learning Curve	Medium
Complexity	Medium
Playability	Good

In Brief: Explosive sequel to the god-playing computer game. Recommend a moderately-fast 486 computer, Sound Blaster board, mouse and 1M of expanded memory for better performance.

CIRCLE NO. 177 ON FREE INFORMATION CARD

Return of the Fleet

There's nothing like a good naval battle to

Bird's Eye View

X-wing, $69.95
LucasArts Games
PO Box 10307
San Rafael, CA 94912
Tel.: 415-721-3342

Requirements

Memory	640K, Hard Drive
Graphics	VGA
Sound	Sound Blaster, AdLib, Roland
Controllers	Mouse, Keyboard, Joystick

Evaluation

Documentation	Excellent
Graphics	Excellent
Learning Curve	Medium
Complexity	Medium
Playability	Very Good

In Brief: *The Rebel Alliance* returns with dazzling game technology that, regrettably, lacks the *Star Wars* flavor. Recommend a fast 486 computer, sound card, joystick and mouse for better performance.

CIRCLE NO. 178 ON FREE INFORMATION CARD

Bird's Eye View

Harpoon Designers' Series II, $39.95; *Challenger Pak Signature Edition*, $79.95
Electronic Arts
1450 Fashion Island Blvd.
San Mateo, CA 94404
Tel.: 1-800-245-4525

Requirements

Memory	640K, DOS 5, Hard Drive
Graphics	VGA, EGA
Sound	PC Speaker
Controllers	Mouse, Keyboard

Evaluation

Documentation	Excellent
Graphics	Good
Learning Curve	Long
Complexity	High
Playability	Good

In Brief: Life extender for Harpoon that creates up to 48 new battle scenarios. Recommend a moderately fast 486 computer, mouse and DOS 6 for better performance.

CIRCLE NO. 179 ON FREE INFORMATION CARD

perk you up. Enthusiasts of the naval-strategy game *Harpoon* might agree. *Harpoon* is a powerful game of modern naval combat that pits massive weapons platforms against each other. *Harpoon* commanded immediate attention upon its release and has seen steady improvement. Its latest improvement is the *Harpoon Designers' Series II*, a utility that extends *Harpoon* playability.

Each *Harpoon* scenario is called a "Battleset." Battlesets define the geography of a battle, available platforms and rules of engagement. Veteran Harpoon players have already sweated over crucial decisions in the Indian Ocean, the Mediterranean and the North Atlantic. Using the *Designers' Series II* creates 12 new scenarios for each Battleset you own. The new scenarios highlight tactical dilemmas and illustrate the hard lessons of naval warfare. You command aircraft carriers, battleships, aircraft and even submarines. You make decisions that eventually give you the winning edge or decimates your forces.

A pleasant inclusion into *Harpoon Designers' Series II* is the Harpoon Data Annex and the definitive Harpoon Tactical Guide. The Data Annex is the heart of the *Harpoon* battle system, providing complete data for all platforms, military bases, weapons and sensors. For those who really love to dig into data, the Data Annex offers its data in text format that makes it easy to use from any computer application. Having access to *Harpoon*'s database alone is worth the price of the *Designers' Series*. Additionally, the Harpoon Tactical Guide offers a concise and helpful discussion on how to win a complex naval battle. The Tactical Guide is valuable to game novices and even game veterans. Purchase of the *Harpoon Designers' Series II* will extend the life of *Harpoon* for a great many hours of play time.

If you're just getting started with *Harpoon*, its original release and subsequent updates might have passed you by. You can catch up when you buy the *Harpoon Challenger Pak*. It includes the Harpoon Master Game (Version 1.3), North Atlantic Convoys, Med and Indian Ocean/Persian Gulf Battlesets. It also includes the Scenario Editor. With the *Challenger Pak*, you can steam full ahead into the battle-hardened *Harpoon* world.

Other Battles

Three-Sixty's successful *Harpoon* series has a companion. Contrasting with *Harpoon*'s aquatic arena is *V for Victory*, a series designed to recreate World War II land combat. The first Battleset in the series orders players to action at Utah Beach, Normandy, 1944. It boasts historical accuracy and ease of play, despite being complex. Suggested retail price is $69.95.

Strategic Simulations is another leader in computer-game warfare. Its *Advanced Simulator Series* is aimed at dedicated war-game players. *Great Naval Battles* sends you to the North Atlantic during the years 1939 through 1943. This game bears the hard-edge sense of realism common to SSI simulations. It's a game that serious war gamers will like. Suggested retail price is $69.95. Expansion disks and scenario editor available. ■

AmCoEx Index *(from page 81)*

soon. New operating systems and software applications will require hard drives with at least 500M capacity. CD-ROM drives will become standard. Due to the way memory chips are made, minimum memory will be 16M. Those who need more memory will be forced to jump to 32M. With speech recognition on the horizon, microphones, sound processors and speakers may also be standard equipment. Meanwhile, annual unit sales aren't expected to increase dramatically. In addition, current price wars are forcing many smaller manufacturers out of business. Once a truce in this war is ultimately called, the survivors will certainly seek larger margins.

Although it's almost a year behind schedule, Microsoft's newest operating system, *Windows NT*, is expected to be released this month. The system requires a minimum of 20M of memory. Unfortunately, shortages in the memory-chip market have forced prices from the $30 per megabyte to more than $60 per megabyte. If *Windows NT* is widely accepted, some feel memory prices could reach the $100 per megabyte this fall. For most users, this means the cost of memory required to run *Windows NT* will exceed the cost of the computer system itself.

While the large computer makers have contracts for memory chips that protect them from these rapid price increases, most smaller manufacturers don't. This situation may accelerate the shake-out within the industry.

On the other hand, many users may postpone adoption of the *Windows NT* operating system until memory prices fall to more-affordable levels. This may be erroneously interpreted by some industry experts as a lack of interest in the new operating system.

Prices shown in the table are for September 3, 1993.

John Hastings is the president of the American Computer Exchange Corp. The American Computer Exchange matches buyers and sellers of used microcomputer equipment. For more information, contact the American Computer Exchange Corporation at 800-786-0717. ■

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In *Populous II*, you're one of the many sons of godhead Zeus. You demand your rightful place among the other gods on Mount Olympus. You can have your inheritance, but you have to prove your worthiness by defeating 32 opponents who rule the thousand worlds of *Populous II*. You begin by creating a deity and establishing his strengths, personality and appearance. Then you pounce into the fray. At your disposal are natural forces like crackling lightning, boiling oceans and conflagration. Unlike what was seen in original *Populous*, natural disasters are fully animated and can be used simultaneously. You have the honor of battling the noteworthy likes of Poseidon, Apollo and Prometheus—and even Zeus himself.

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Populous II is a welcome improvement to original *Populous*. This new installment offers better graphics, more animation and a generally more-flexible approach to game

(Continued on page 84)

A sample screen from Electronic Arts' *Populous* game.

Flying a mission in Lucas Arts *X-wing* action game.

X-wing's General Modine conducts a briefing.

Executive Officer directs the action in Electronic Arts' *Harpoon Designer Series II*.

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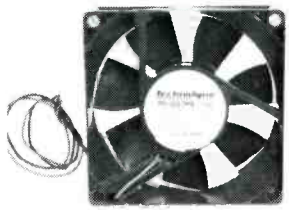

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