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The print forum for the MicroComputer professional and semi-professional

January/February 1994



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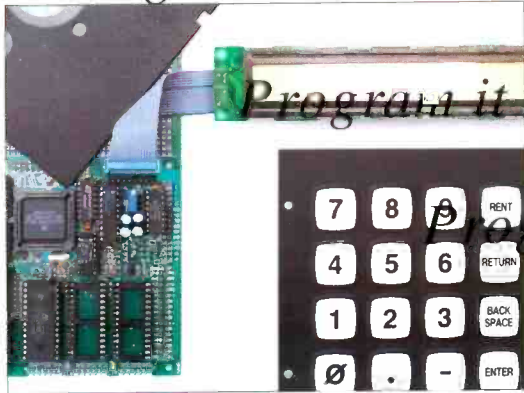
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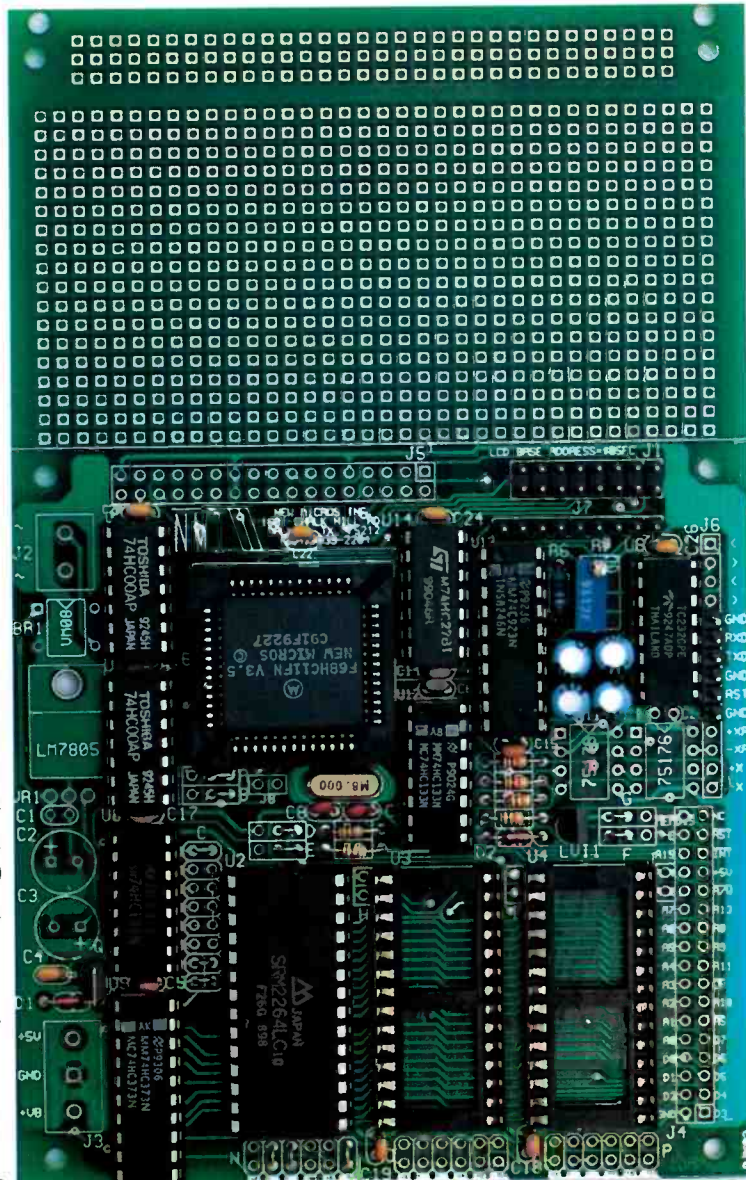
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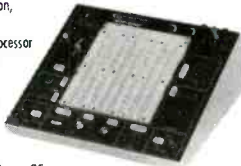
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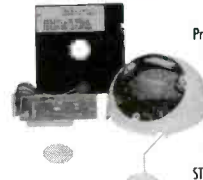
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LS9211	Toshiba	670nm	5 mW	50 mA	2.3V	69.99	66.49	59.84
LS9215	Toshiba	670nm	10 mW	45 mA	2.4V	109.99	104.49	94.04
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LS022	Sharp	780nm	5 mW	65 mA	1.75V	19.99	18.99	17.09
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MicroComputer

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You can contact *MicroComputer Journal* on MCI Mail directly or through an on-line service, such as CompuServe. Any questions, article proposals, comments, etc., are welcome on this electronic mail box (MCI ID No. 456-3433) or just type: ComputerCraft.



On The Cover

The products shown on the cover of this premiere issue of *MicroComputer Journal* set the tone for our reason for existence in the highly diversified field of personal computing. Our readers are, first and foremost, interested in learning about the latest trends in computer technology as it applies both to individual personal operations and on the business level. To this end, you and we share a common bond in our choice of Intel-based computers that run Microsoft MS-DOS or compatible DOS and, the great majority of you report, *Windows*. In the wings are the new multi-level graphically-oriented operating systems like IBM OS/2 and Microsoft *Windows NT*. What the future has in store for mainstream computing is already well-advanced on the drawing board and in the "lab." What the present offers is already ours for the asking.

Every item shown on the cover of this issue reflects the here-and-now and the soon-to-be PC technologies. Multimedia is the name of the game with the (1) the internal caddy-less Laser Magnetic CM 205 CD-ROM drive; (2) the Labtec CS-180 self-powered miniature speakers; and (3) Advanced Gravis Ultrasound 16-bit stereo sound card. With multimedia becoming increasingly a CD-ROM-based pursuit, a good way to store and catalog up to 40 of CD-ROM disks when not in use is represented by the handy (4) CD³ caddy from CD³ Inc.

The here-and-now and soon-to-be are represented by (5) such books as the user's guide for the *CheckIt PC* diagnostic program (TouchStone Software); *Multimedia, Making It Work* by Tay Vaughn (Osborne McGraw Hill); *Making Movies On Your PC* by David K. Mason & Alexander Enzman (Wait Group Press); *The Norton Utilities User's Guide* from Symantec; *Virtual Reality Creations* by Dave Stampe, Bernie Roehl & John Eagan (Waite Group Press); and *Welcome to...CD-ROM* by Tom Benford (MIS: Press). Even the disc shown in the CD-ROM drive, *Walkthroughs and Flybys CD*, from the book of the same title (Waite Group Press) by Phil Shatz speaks of cutting-edge technologies soon to become mainstream.

The (6) multi-function I/O board, (7) dual IDE hard-drive-only and (8) combination dual hard/floppy-drive controller cards represents more-fundamental PC user needs. With desktop publishing and/or presentation imagery, comes the need to be able to scan photographic, line art and text images with a hand scanner like (9) the Half Page Scanner/400 from The Complete PC.

For those whose interests run to single-board computers, microcontrollers and support technologies, there are such items as the (10) ProtoQuick 8051SBC from Software Science; the (11) NMIT-0020 Microcontroller from New Micros; the (12) Model 30 data-acquisition card from Prairie Digital; and the (13) EPROM+ programmer from Andromeda Research. A hardware orientation to PC/SBC computing means dealing with (14) components to prototype circuits before committing them to finished designs.

There simply isn't enough room on a single cover to show all the things of interest to *MicroComputer Journal* readers, like full-motion video, MIDI (see the "General MIDI" article beginning on page 14 of this issue) and a host of other applications that are almost certain to become mainstream applications on the PC. In coming issues, we'll share with you our insights into the exciting worlds of PC and SBC computing, and we hope that you'll share your insights with us.—*The Editors*

Cover Photo By Larry Mulvehill

Going Home

Until recently, PC makers concentrated their wares on the corporate and small-business market, with a sub-section for educational institutions. Recently, however, PC and software makers have honed in on the "home" PC market. It's been increasing very steadily over the past five years, and it now represents around \$5-billion in annual sales for more than 7-million units. Moreover, only about 27% of U.S. households have a personal computer, with about the same number indicating they intend to purchase one.

A lot of the home systems are extensions of PCs designed for business and educational use, of course. But the sales opportunities for new home users are great, while the corporate sales potential is sliding as businesses tighten up their finances in an effort to become leaner in face of higher taxation costs and because near-saturation of the market has been reached.

The home PC market was addressed in the past, without great success. IBM's PCjr, for example, was a bust ten years ago, as was Tandy's consumer-oriented friendly-face machines some five years past. The new drive for home PC sales has a different motif, though. They're no longer directed to housewives for filing cooking recipes or for the head of the family to balance a checkbook.

Now the home PC is an anything-you-want-it-to-be system—desktop publisher, multimedia station, graphics layout tool, word processor, encyclopedia, telecommunications medium, lightweight battery-powered portable, etc. The machines aren't much different than the ones sold to business, although the software is often less powerful and sales of top-of-the-line Pentium microprocessor-equipped ones with 500M hard drives aren't anticipated.

Nevertheless, expansion capabilities have become all-important in the home PC market. People would like to be able to grow into their machines as they expand them with more memory,

a larger second hard drive, a video accelerator, laser printer, network, etc., marketing mavens believe. And the thought of eventually using the systems for home businesses doubtlessly lurks, too.

Home machines are being set up now for technical novices through to home technical masters. The former fear computers, while the latter are wizards of sorts, tackling things that only extraordinary computer professionals dare.

These home computers are being sold by mass marketers and through direct-response sales. New lines, new model names, all pitched to home PC buyers. Compaq is credited with starting this drive among the big brands with its Prolinea line of PCs, and IBM, Dell and Apple, among others, have joined in the fray. Microsoft, too, has recognized that the home market is rapidly expanding. Accordingly, it announced recently it's introducing "Microsoft Home," a broad range of consumer software products targeted at this market. Over the next year and a half, it expects to offer 100 products under the Microsoft Home brand.

Spearheaded by easier-to-master graphical user interfaces, which present a pick-and-choose command or icon, rather than an arcane DOS command, we can expect computer literacy to rise. It's this kind of mastery that will push the U.S. faster toward being a more technically competitive nation since the know-how will certainly drift into the workplace.

Hope you've all had a Happy New Year and enjoy the premiere issue of *MicroComputer Journal* presented here. Let's hear from you.



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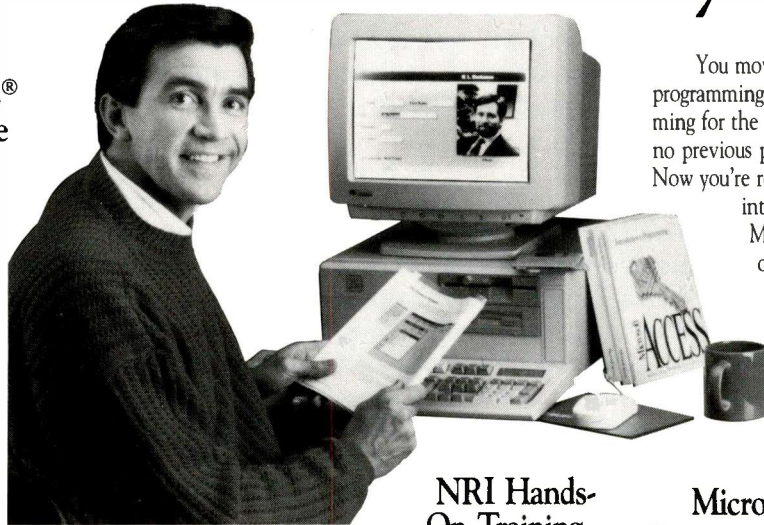
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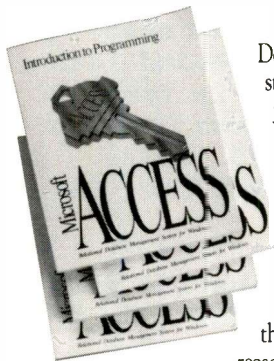
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What's Happening!

FREE SOFTWARE DATABASE. Austin ProSoft offers its "Edu-Ware Database on Disk" on 3.5" disk at no charge. It contains information on more than 2,000 DOS and Windows public-domain and shareware educational programs that are available from on-line services and shareware vendors. If printed out in small type, it'll consume about 200 sheets of paper. For IBM/compatibles, it can be run under DOS or Windows. The database allows users to browse individual categories and to use keyword search. Call 512-323-2323 and ask for the disk.

Other freebies that might interest you include an application note, AN/B-26, from ILC Data Device Corp. This app note describes problems and solutions when using MIL-STD-1553 data-bus products. It covers IBM PC, VME and PS/2 cards. Call Fabio Stanzini at 516-567-5600, Ext. 7206 for a copy.

Also, the Electronics Industries Association (EIA) just published an expanded 128-page, 1994 catalog of all standards, specifications and other publications of the EIA. For a free copy, call Global Engineering Documents at 800-854-7179.

COMPUTER THIEVES PREFER APPLE. So reports National Computer Exchange (212-614-0700), based on information gathered by The Stolen Computer Registry. The thief's micro of choice—Apple—is stolen almost five times more frequently than other brands, even though it represents only 10% in the installed base. IBM trails as a distant second. Laptops and notebooks, in turn, are reported to be stolen at twice the rate of other equipment types, though totaling only 14% of the installed based. And, as with micros, Apple laptops and sub-laptops are favored by thieves to the tune of 42%, while Toshiba captures the second slot with 15%. ...Printer theft is led by laser types with 60%. Apple came in a poor second here, though, with 19%, while Hewlett Packard won the dubious distinction of Number 1 with 62%. As you might guess, states with large populations and heavy corporate concentrations have the highest computer theft rates, led by California, with New York on its tail in second place. Illinois, New Jersey and Massachusetts follow, in order, with about one-third the rate.

As a result of the high incidence of microcomputer theft, a variety of anti-theft products have been marketed. A new one that came to our attention is a tattooed ID plate from S.T.O.P. (Security Tracking of Office Property), Stamford, CT. It's an indelible marking and registry system with database software. The registry process consists of a metal plate with barcoded identification number that's affixed to the machine. If the ID plate is removed, which takes 400 lbs. of force, a remaining indelible "tattoo" shows "Stolen Property" and a toll-free 800 phone number to call. Cost is \$8.75 to \$25, depending on quantity. Registration information can be sent to S.T.O.P. for recording in the company's International Security Database.

NEW PERSONAL TRAVEL GUIDE. "Personal Travel Guide" (PTG), a navigation system with step-by-step travel directions in a metropolitan area, was introduced in San Francisco and Sacramento by Personal Travel Technologies (Mineola, LI, NY). PTG couples with its Destination Databases to guide drivers, pedestrians and public-transportation users to their destinations in a selected city with both on-screen maps and text directions. Its "smart maps" include such information as one-way streets, turn restrictions, approximate mileage and travel time. In addition, there is current information on hotels, dining, entertainment, banking, emergency services, a parking guide and a directory of businesses. Hardware required is an IBM/compatible with 386/33 CPU, 4M of RAM and a hard disk. Retail price is \$349.95, while Destination Databases range from \$100 to \$150. Call 516-877-1234 for product information.

Numbers Matter

• Many thanks for including our *Pro Solv* problem-solving scientific software package in SF Sparrow's "Computer Games" column in the November 1993 issue of *ComputerCraft*. Please note, however, that the telephone number (317-262-5044) given in the "Bird's Eye View" box is for accessing our facsimile machine. The correct voice number is 800-755-2150. Any reader who is interested in purchasing *Pro Solv* can call this number any time of the day.

Andrew Moss
Problem Solving Concepts, Inc.
 611 N. Capitol Ave.
 Indianapolis, IN 46204

Budding Writer

• Your Editorial in the July issue of *ComputerCraft* [now *MicroComputer Journal*] on writing for your publication was very informative. I have decided that the time has come for me to find out if I have what it takes to become a writer. I hope I can bring some new techniques and innovations to your publication without a rehash of subject matter that has already been covered in

other articles. I must say in closing that Jan Axelson has been a big motivating force in my decision to try my hand at writing.

Donald W. Coates
 Las Cruces, NM

Writers are most welcome.—Ed

From Issue One

• I have been a subscriber to *ComputerCraft* [now *MicroComputer Journal*] since its inception and am always pleased when a new issue arrives in the mail. I enjoy the Editorial, What's Happening!, What's New! and Letters columns.

Jud Hildebrandt
 Defiance, OH

Users Group Needs Help

• Our local users group has a problem you may be able to help us with by printing this request in your Letters column. Our difficulty concerns a printer. We thought that maybe one of your readers might be able to supply us with the information we need. The printer is an R.C. Allen by Litton Westrex, Model 88202-112. Can anyone out there provide us with a copy of the owners manual and/or tell us where to obtain rib-

bons for this printer? Any help that can be supplied, especially information on how to set up the DIP switches in the printer, will be greatly appreciated.

T-2000 Users Group
 PO Box 614
 Johnstown, PA 15907

**Writing for
 MicroComputer Journal**

• Art Salsberg's Editorial, "Writing for *ComputerCraft* [now *MicroComputer Journal*]" is excellent advice for both aspiring and experienced technical writers. I would like to add that there are few editors who are as helpful to authors as Art. I have written hundreds of columns and feature articles for various magazines Art has edited and have always found him to be available, helpful, loyal and encouraging. The quality and variety of topics covered so well in each month of *ComputerCraft* [and will continue to be covered in *MicroComputer Journal*—Editor] demonstrate that Art's advice to his authors works as well as it always has.

Forrest M. Mims III

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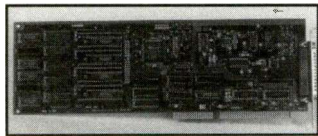


CC-74

HARDWARE

DSP And Data Acquisition For PCs

The Model 310A DSP and data-acquisition card for IBM PC/AT and compatible computers provides data acquisition for four differential channels at 14-bit resolution with programmable gain and a maximum sampling rate of 150 kHz. One 12-bit 300-kHz analog output is included. The Model 310A is based upon the Texas Instruments TMS320C31 floating-point digital signal processor (DSP) operating at 33 MHz, for up to 33-MFLOP performance.



This card features data transfers as high as 3M/s and can be populated with zero- or one-wait-state static RAM ranging in size from 32K to 512K words. Included are an assembler, debugger, signal and spectrum display; record and playback to and from disk; and a MODA program that manages multi-channel data acquisition and simultaneous record and playback for stimulus-response applications. Pre-triggering options are provided. \$699. *Dalanco Spry, 89 Westland Ave., Rochester, NY 14618; tel.: 716-473-3610; fax: 716-271-8380.*

CIRCLE NO. 15 ON FREE CARD

VL Graphics Accelerator

The VideoBlitz VESA local-bus graphics accelerator for power users of graphics programs is based on the Weitek P9000 GUI accelerator chip and uses its standard 2M of VRAM to deliver high speed with rich color at noninterlaced resolutions up to 1,600 x 1,200. VideoBlitz can also deliver True Color at 800 x 600 resolution. The card's FlickerFree technology provides refresh rates of up to 75 Hz at 1,280 x 1,024 resolution. Its Safescan utility permits users with over-scanning monitors to eliminate the black

border around the application work space, thereby utilizing 100% of the screen.

VideoBlitz ships with drivers for Microsoft *Windows* 3.1 and OS/2 2.1 environments and drivers for several popular DOS applications. Additionally, Turbo DLD drivers offer support for *AutoCAD* and other Autodesk programs. \$549. *Genoa Systems, Corp., 75 E. Trimble Rd., San Jose, CA 95131; tel.: 408-432-9090; fax: 408-434-0997.*

CIRCLE NO. 16 ON FREE CARD

3D Controller

The CyberMan 3-D controller features true three-dimensional control for IBM PC/compatible computers. It adds tactile feedback to the traditional capabilities of such pointing devices as mice and joysticks. Whereas a mouse or joystick offers only two degrees of freedom, CyberMan offers six degrees of freedom to achieve full 3D motion: X, Y and Z axes, plus pitch, yaw and roll.

Cyberman 3-D is specifically designed for the interactive software entertainment market. A motor integrated into the unit permits various gaming events, such as being struck or bumping into a wall, to actually be felt, in addition to any sound or visuals the game may produce. To take advantage of the 3D control and tactile feedback, games must support these features. CyberMan's interface, known as SWIFT, is supported by a number of games manufacturers. \$129. *Logitech, Inc., 6505 Kaiser Dr., Fremont, CA 94555; tel.: 510-795-8500; fax: 510-792-8901.*

CIRCLE NO. 17 ON FREE CARD

600-DPI Scanner

The AVR Technology 6600/CLX flatbed color scanner is designed to meet the needs of general computer users who want an easy to install and use scanner. Utilizing a proprietary resolution engine, the AVR 6600 is capable of scanning at an optical resolution of 600 dpi. It provides both color and grayscale scanning.

In the color scanning mode, the AVR 6600 outputs images using 16.8-million color combinations, while in the grayscale mode, it outputs images with 256 gray-level gradations at eight bits per pixel over the range from black to white to provide smooth gray sweeps. To ensure consistent image quality, the scanners feature AVR's advanced Adaptive Thresh-holding technology, which dynamically adjusts the optical system for flawed, poor quality or non-white paper.

Built-in software variable brightness controls are also included. The scanner comes with AVR's unique de-screen capability, a feature that allows users to remove the moiré pattern from halftones, once halftones are scanned. The AVR 6600 is fully TWAIN- and Adaptec ASPI-compliant, and uses a SCSI-2 controller. \$1,500. *AVR Technology, Inc., 71 E. Daggett Dr., San Jose, CA 95134; tel.: 408-434-1115; fax: 408-434-0968.*

CIRCLE NO. 18 ON FREE CARD

Upgradeable Fax/Modem

The Cardinal Technologies MVP144DSP is an inexpensive, upgradeable, DSP-based, 14,400-bps internal fax/modem. It can be upgraded to faster speeds, advanced protocols and other new features via simple and inexpensive software on disk. The package also includes both *Windows* and DOS fax/datacom software. The fax uses the CCITT V.17, V.29 and V.27ter standards, while the data modem is compatible with CCITT V.22, V.22bis, V.32 and V.32bis protocols. \$189. *Cardinal Technologies, 1827 Freedom Rd., Lancaster, PA 17601; tel.: 717-293-3000.*

CIRCLE NO. 19 ON FREE CARD

UPS With Extended Battery Life

Deltec's PowerRite Pro family of uninterruptible power systems incorporates new technology to extend the life of the internal batteries. The microprocessor-based Advanced Battery

Management technology extends the life of batteries by up to 10 years, recharges batteries in three to four hours to be ready for the next power outage and alerts you up to 60 days prior to battery depletion.

PowerRite Pro is specifically designed to protect LAN file servers, network nodes and workstations against faulty power. Models are available in capacities ranging from 400 to 2,200 VA. \$449, 400 VA. *Deltec Electronics Corp., 2727 Kurtz St., San Diego, CA 92110; tel.: 800-854-2658.*

CIRCLE NO. 20 ON FREE CARD

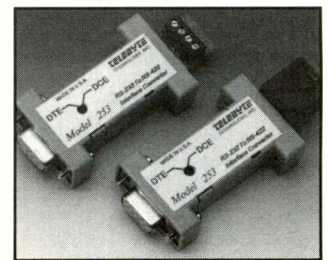
Computerized Sign Maker

Roland Digital Group has lowered the price and improved the software for its STiKA portable computer-based vinyl sign maker that generates custom labels, signs and iron-on clothing transfers. With its built-in scanner and cutting mechanism, STiKA can work as a stand-alone device or be connected to any PC/compatible computer through its serial port. STiKA comes with new *Windows*-based *SignMate* software, which is a lettering and graphics program designed specifically for use with STiKA. \$499. *Roland Digital Group, 1961 McGaw Ave., Irvine, CA 92714; tel.: (714) 975-0560; fax: 714-975-0569.*

CIRCLE NO. 21 ON FREE CARD

Noise Immunity for PCs

Telebyte's new Model 253 RS-232 to RS-422 interface converter provides noise-resistant communication for PCs that send data up to one mile away over twisted-pair wires. The device derives its operating power



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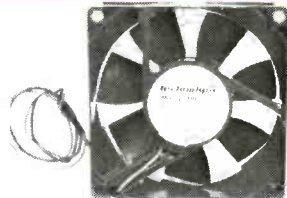
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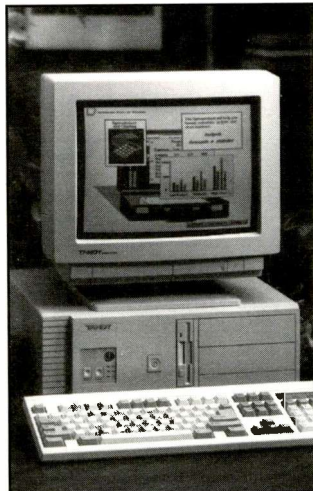
NEW ITEMS!

from the PC's RS-232 port and provides surge protection for the RS-422 port. \$89. *Telebyte Technology, Inc., 270 E. Pulas-ki Rd., Greenlawn, NY 11740; tel.: 516-423-3232; fax: 516-385-8184.*

CIRCLE NO. 22 ON FREE CARD

Sound-Ready PC

The Tandy 2100 is a 25-MHz 80486SX-based system with 4M of RAM, a 130M hard drive, SVGA video, built-in audio and a mouse. The system comes pre-installed with Micro-



soft *Windows 3.1*, *Microsoft Works for Windows* and *America Online* software. \$1,099. *Radio Shack, A Division of Tandy Corp., 700 One Tandy Center, Fort Worth, TX 76102.*

CIRCLE NO. 23 ON FREE CARD

Local-Bus PC

Micro Express' MicroFLEX-VL/S 40-MHz PC is Cyrix Cx-486S-based desktop computer with VESA-standard local-bus slots, 4M of RAM, a 200M hard disk, a 1M VESA caching controller, a VESA-standard local-bus video card, SVGA monitor and mouse. The system also includes DOS 6.0 and *Win-*



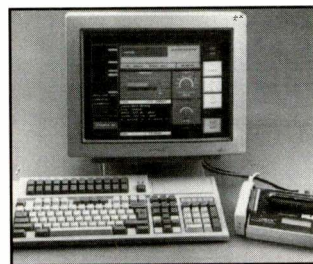
dows 3.1 and is upgradeable to the Pentium processor. \$1,795. *Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; tel.: 714-852-1400.*

CIRCLE NO. 24 ON FREE CARD

Troubleshooting Products

SIMCHECK Comm Package

The PC Communication Package from Innoventions is communications software developed for use with the company's SIMCHECK line of advanced memory testers. The package provides full PC control of SIMCHECK's activities and includes a small serial interface module that attaches to



the tester's expansion slot. The software lets you to print detailed reports and automatically log the results in a disk file. \$295. *Innoventions, Inc., 11000 Stancliff Rd., Ste. 150, Houston, TX 77099; tel.: 713-879-6226; fax: 713-879-6415.*

CIRCLE NO. 25 ON FREE CARD

Video & Test-Signal Monitor

Truevision's new VIDI/O Analyst board and its companion board, the VIDI/O Pattern Generator, are ISA add-in cards designed to monitor NTSC and PAL video signals. Bundled software supports both cards under *Microsoft Windows 3.1*. The VIDI/O Analyst combines the functions of a waveform monitor and vectorscope. In conjunction with the VGA adapter, this card uses a PC's VGA color monitor for all user controls and display of video signal data. The VIDI/O Pattern

Generator card provides more than 20 video test patterns. \$1,495/\$995. *VIDI/O Analyst/VIDI/O Pattern Generator. Truevision, Inc., 7340 Shadeland Sta., Indianapolis, IN 46256; tel.: 800-344-TRUE; fax: 800-522-TRUE.*

CIRCLE NO. 26 ON FREE CARD

New Single Boards

80C31/80C52 Controller

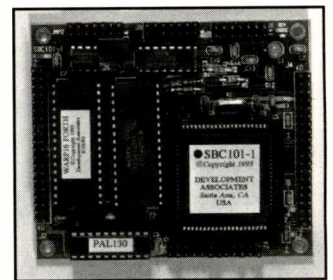
Micromint's PRO31/52 versatile single-board controller measures just 4" x 8" and can be programmed in assembly language, BASIC or C. It has room for up to 96K of RAM/EPROM; an eight-channel, eight- or ten-bit ADC; an eight-channel, eight-bit DAC; interfaces from both an LCD display and a 4 x 5 keypad; clock/calendar; hardware watchdog; interrupt inputs; 48 bits of TTL I/O; and an I/O expansion bus with eight more bits of Port 1 TTL and six decoded address strobes. Both system RAM and clock/calendar are nonvolatile.

The PRO31/52 can be powered from either a single 12-to-24-volt dc supply, or three supplies of +5, +12 and -12 volts. The board's 80C52 processor can be jumper-configured for 80C31/80C32 functionality, making possible a dual programming environment. \$299. *Micromint, Inc., 4 Park St., Vernon, CT 06066; tel.: 203-871-6170; fax: 203-872-2204.*

CIRCLE NO. 27 ON FREE CARD

V25 Single-Board Computer

Development Associates' 3" x 3 1/2" V25-based WARP16 SBC101 single-board computer uses the same basic instruction set used by MS-DOS computers. On-board ROM/RAM sizes range up to 512K each, for a 1M total, and crystal rates run as high as 20 MHz. Virtually every CPU signal is available on the SBC's IDE connectors. Complete with reset and power-



on signal conditioning, watchdog and low-voltage detection functions, this board has two RS-232C ports usable up to 1.2M-baud and eight analog comparator inputs with programmable threshold.

Also featured are 24 parallel I/O lines, programmable interrupt controller with eight priority levels, two 16-bit timers, timebase counter, programmable wait-state generator and many others. \$119/\$134/\$152, 10/16/20 MHz. *Development Associates, 1520 S. Lyon, Santa Ana, CA 92705; tel.: 714-835-9512.*

CIRCLE NO. 28 ON FREE CARD

Storage Items

Cartridge Holder

Grove Enterprises' Re-storer Holder is designed to protect HP DeskJet inkjet cartridges whenever they aren't being used in a printer. It works with

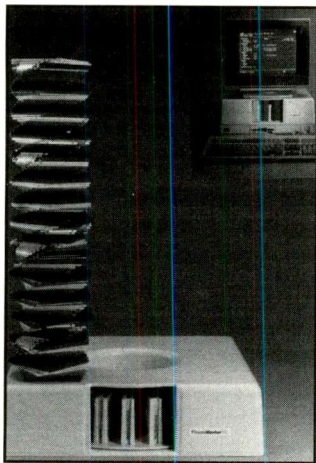


both single- and high-capacity cartridges. *Grove Enterprises, Inc., 9242 N. Oketo Ave., Morton Grove, IL 60053; tel.: 708-966-2723.*

CIRCLE NO. 29 ON FREE CARD

31/2" Disk Carousel

The Wheeltech FloppyMaster 150 is an instant-access disk carousel for 3 1/2" disks, flopticals and 8- and 4-mm CBUs. The carousel is designed to fit neatly between the system unit and video monitor of a PC. *Wheeltech Int'l., Inc., 455 E.*

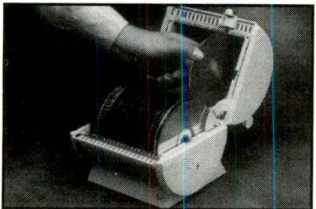


Eisenhower Pkwy., Ste. 108, Ann Arbor, MI 48108; tel.: 313-994-9584; fax: 313-662-9824.

CIRCLE NO. 30 ON FREE CARD

Compact-Disc Holder

The Compact Disk Storage System from SC&T stores 40 compact discs in one-quarter of the normal space. It comes with an interchangeable index card and unique "hand it to you" re-



trieval format. \$39.95. SC&T International, Inc., 3837 E. LaSalle St., Phoenix, AZ 85040; tel.: 602-470-1334; fax: 602-470-1507.

CIRCLE NO. 31 ON FREE CARD

More **HARDWARE** page 12

SOFTWARE

PC-Board Drawing Program For DOS

EAGLE, from CadSoft Computers, is a powerful DOS-based graphics editor for designing printed-circuit boards on standard AT-compatible computers. This object-oriented program can lay out boards measuring up to 64" x 64" with 1-mil resolution. Up to 255 layers are possible, and *EAGLE* supports surface-mount devices. Additional schematic-capture and autorouter modules are avail-

able. Since both are fully integrated into *EAGLE*, you have to work with only a single program. The ripup-and-retry router lets you route up to 16 layers at a time, not only in pairs. CadSoft also offers a conversion program for *OrCAD*, *Tango*, *PADS*, *Schema* and *SUSIE* netlists at no charge. \$399. CadSoft Computer, Inc., 801 S. Federal Hwy., Delray Beach, FL 33483; tel.: 407-274-8355; fax: 407-274-8218.

CIRCLE NO. 32 ON FREE CARD

IQ Builder

Noting that psychological research has demonstrated that people use only 10% of their brain's full capacity, Mindware has released *IQ Builder*, a program that isolates and "works out" 56 different mental capabilities in five categories: intelligence, memory, coordination, reaction time and perception. The program hopes to tone your mental abilities and help you begin to use more of your brain's native potential. \$29.95. Mindware, Santa Cruz, CA; tel.: 800-447-0477.

CIRCLE NO. 33 ON FREE CARD

Pre-Printed Forms Filler

FormsGrid from Computer Bio Center is a *WordPerfect* add-in program that provides automated procedures for filling out pre-printed forms on your printer. The program comes with a grid, manual, cue cards, key index and disk. It's used to develop the entry locations and prompts needed for given forms. Both DOS and *Windows* versions are available. \$39.95. Computer Bio Center, Inc., 400 Main St., Ste. 515, Stamford, CT 06901; tel./fax: 203-325-3166.

CIRCLE NO. 34 ON FREE CARD

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MasterCook II is new *Windows*-based cookbook software program from Spinnaker Software that contains more than 1,000 recipes, including more

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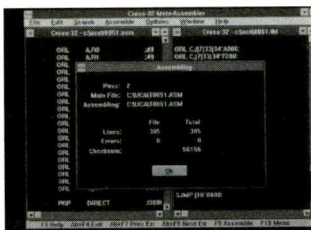
than 100 from the great chefs of America. It can provide a selection of recipes that use on-hand ingredients that meet your personal nutritional objectives. The program also scales recipes and prints shopping lists. It also lets you print recipe cards, menus, meal plans and even customized cookbooks.

MasterCook II gives you a complete nutritional analysis for every recipe and every ingredient, using the latest USDA database of nutritional values. The product will be marketed under Spinnaker Software Corp.'s Affiliated Label Program. *Arion Software, Austin, TX; tel.: 800-444-8104.*

CIRCLE NO. 35 ON FREE CARD

Windows Cross-Assembler

Universal Cross-Assemblers' *Cross-32 Meta-Assembler for Windows* is a table-driven macro cross-assembler that lets you compile assembly-language programs for more than 50 different microprocessors, micro-controllers, and digital signal processors. The tables use the processor manufacturer's original assembly-language mnemonics. Full instructions are included so that you can create new tables for other processors. The assembler supports logical and arithmetic operators and integer constants identical in form and precedence to the ANSI C programming language, as well as several common assembler conventions.



Cross-32 produces hexadecimal output files in the Intel, Motorola and binary formats. Therefore, it's compatible with most EPROM programmers, EPROM emulators and in-circuit emulators. A *Cross-32 Meta-Assembler* for MS-DOS is also available. \$199. *Universal Cross-Assemblers, 9 Westminster Dr., Quispamsis, NB*

Canada E2E 2V4; tel.: 506-849-8952; fax: 506-847-0681.

CIRCLE NO. 36 ON FREE CARD

Automatic Data-Capture Software

SmarTrac Series Elite software from AccuScan loads onto an automatic data-capture user's hand-held terminal to provide barcode application solutions. Currently supported terminals include those manufactured by



Symbol Technologies, Hand Held Products, Telxon, Intermec, DAP Technologies and Panasonic. *Series Elite* consists of application modules for manufacturing, distribution, retail, government health-care and service operations. PC-host or LAN-based data-management functions common to all modules include query and find commands to generate reports. Individual modules can be customized through parameter-driven set-up screens. *AccuScan, Inc., 1540 Hwy. 138, PO Box 80037, Conyers, GA 30208; tel.: 404-922-1220; fax: 404-922-0368.*

CIRCLE NO. 37 ON FREE CARD

Desktop Ticket Maker

TKTMKR for DOS from Contract Systems Group prints and numbers perforated stub and ticket forms furnished with the program. A character-based windowed interface walks you through numbering, stub entry, font and ticket style selection and job filing. Six style formats are furnished. \$79.95. *Contract Systems Group, 7733 S. Saginaw Ave., Chicago, IL 60649; tel.: 800-223-0350; fax: 312-734-8710.*

CIRCLE NO. 38 ON FREE CARD

Upgrades

Paint Shop Pro Upgrade

Version 2.0 of *Paint Shop Pro* from JASC now supports all TWAIN-compliant scanners, has nine new graphic file formats, including JPEG and Kodak Photo CD, and handles images containing up to 16-million colors. The new release lets you work with multiple images simultaneously and do batch-file processing. The program also can act as an OLE server for OLE client applications under Windows. *JASC, Inc., 10901 Red Circle Dr., Ste. 340, Minnetonka, MN 55343; tel.: 612-930-9171; fax: 612-930-9172.*

CIRCLE NO. 39 ON FREE CARD

Windows Troubleshooter Upgrade

Dariana's *WinSleuth Gold Plus* is a new edition of a software package for installing, configuring and troubleshooting hardware and software under Windows. The program ships with a library of data files that provide accurate DMA, IRQ and port requirements for specific devices to help ensure proper installation. New analysis, diagnostic and tutorial features include: customizable motherboard graphics to help you see the location of bad memory chips; text and chart displays of statistical information; performance benchmarks; visual displays that let you see where the platter of a hard disk is beginning to fail; the ability to prepare a "safety" disk with important system files; support for DoubleSpace and DOS 6.x; external loopback testing for serial and parallel ports; tune-up tips; an improved, customizable user interface; and an expanded and enhanced manual. \$189. *Dariana Software, 5241 Lincoln Ave., #B5, Cypress, CA 90630; tel.: 714-236-1380; fax: 714-236-1390.*

CIRCLE NO. 40 ON FREE CARD

Parallel-Transfer Upgrade

Trans PC is a utility from Trans Digital for transferring data over standard parallel printer ports using a patented Write-Back-Engine technology of signal processing. This technology allows for long-distance (greater than 400 feet) high-speed parallel transfer. Version 5.0 of the product includes a point-and-shoot graphical interface, mouse support and drag-and-drop capability. All types of floppy, hard, optical and solid-state drives are supported. \$179. *Trans Digital Corp., 37300 Central Ct., Newark, CA 94560; tel.: 510-745-9777; fax: 510-745-9937.*

CIRCLE NO. 41 ON FREE CARD

Recovery Software Upgrade

RESCUE Data Recovery Software is claimed to recover data from physically damaged floppies and hard disks. Whereas prior versions have been limited primarily to text files, Version 4.0 is said to recover nearly any file, including .EXE, application, binary, graphics, etc. Also, entire subdirectories can be salvaged at one time. *AllMicro, 1250 Rogers St., Ste. D, Clearwater, FL 34616; tel.: 813-446-6660; fax: 813-446-8075.*

CIRCLE NO. 42 ON FREE CARD

HARDWARE New Monitors

On-Screen-Programming Monitor

The new 4000DC 17", flat/square, color monitor from Optquest features on-screen programming for precise control of adjustments and a color-matching system. It also features an invar shadow mask and anti-reflection, anti-glare coating on the screen. The monitor has an infinite palette of colors and 0.28-mm dot pitch, supports a maximum noninterlaced resolution up to 1,280 x 1,024 and provides a 76-Hz refresh rate up to 1,024 x 768. *Optquest,*

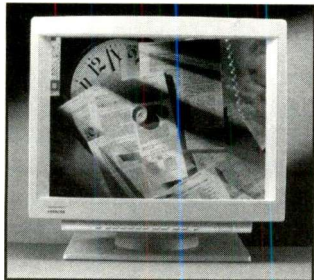
Inc., 20490 E. Business Pkwy., Walnut, CA 91789; tel.: 909-468-3750.

CIRCLE NO. 43 ON FREE CARD

21" Monitor

Nissei Sangyo's SuperScan Elite 21 21" high-resolution color monitor features full scan capability, true RGB color control and white balance control for fine-tuning color, automatic pincushion adjustment and 50- to 150-Hz refresh rates. The monitor also features a flat/square-shaped CRT with 0.28-mm dot pitch, invar mask and anti-reflection coating.

The Elite 21 supports resolutions up to 1,600 x 1,200 at a



refresh rate of 66 Hz and has 31 microprocessor-based controls. It meets the MPR-II Swedish low-radiation standard. \$3,495. Nissei Sangyo America, Ltd., 100 Lowder Brook Dr., Ste. 2400, Westwood, MA 02090; tel.: 617-461-8300.

CIRCLE NO. 44 ON FREE CARD

"Green" 15" Monitor

The New Generation ViewSonic 15 color monitor has been upgraded to include advanced power-saving features. This "green" monitor is energy-efficient and conforms to the VESA power-savings-management standard. It powers down in three stages by directly responding to the system's video input signal. The stages are: standby at 80% of normal power; suspended state that draws less than 30 watts; and off state that draws less than 5 watts. Recovery time of off state is equivalent to manual start-up.

The flat square ViewSonic 15

has a 0.27-mm dot pitch and a maximum noninterlaced resolution of 1,280 x 1,024. Other features include a double dynamic focus gun, anti-reflection/anti-glare coating and invar shadow mask. The ViewSonic 12 meets

the MPR-II Swedish low-radiation standard. \$599. ViewSonic, 20480 Business Pkwy., Walnut, CA 91789; tel.: 909-869-7976; fax: 909-869-7958.

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CIRCLE NO. 79 ON FREE INFORMATION CARD

General MIDI

What it is and a first-hand look at some of the better products you can buy to become a part of the MIDI revolution

With all you've heard and read recently about *Windows*, multimedia, full-motion video and other cutting-edge personal-computing technologies, you've probably also heard about MIDI but don't know what it is or don't know enough to make it a part of your daily computing. This article was written to address such a situation. With the information I'll give you here regarding the exciting world of MIDI, perhaps you'll become an ardent participant in the MIDI revolution.

I begin this discussion by defining what MIDI is, telling you how it came into being and telling you where it's

come. Then I'll give you first-hand looks at some of the better and more-exciting products presently on the market to give you an idea of how far along the MIDI revolution has come and where it's likely to go in the near future. If you decide to become an active MIDI participant, one or more of the products I'll be discussing here will provide the springboard you'll use to get you started.

Some Background

MIDI is an acronym for Musical Instrument Digital Interface. This is an equipment specification developed as a

cooperative effort among major manufacturers of electronic musical instruments in the early 1980s. The original objective of creating a standard specification was to permit musical instruments of different brands to communicate with each other. MIDI succeeded incredibly well in achieving its stated objective.

MIDI also made it possible to synchronize devices so that they start and stop at precisely the same time, in addition to keeping precise synchronous cadence with each other. Such tasks as syncing music and sound tracks with motion-picture film or videotape, cueing tape decks to "punch" in or out,



Table 1. General MIDI Voices/Patches*

1	Acoustic Grand Piano	33	Acoustic Bass	65	Soprano Sax	97	FX1 (Rain)
2	Bright Acoustic Piano	34	Electric Bass (Finger)	66	Alto Sax	98	FX2 (Soundtrack)
3	Electric Grand Piano	35	Electric Bass (Pick)	67	Tenor Sax	99	FX3 (Crystal)
4	Honky-Tonk Piano	36	Fretless Bass	68	Baritone Sax	100	FX4 (Atmosphere)
5	Electric Piano 1	37	Slap Bass 1	69	Oboe	101	FX5 (Brightness)
6	Electric Piano	38	Slap Bass 2	70	English Horn	102	FX6 (Goblins)
7	Harpsichord	39	Synth Bass 1	71	Bassoon	103	FX7 (Echoes)
8	Clavi	40	Synth Bass 2	72	Clarinet	104	FX8 (Sci-Fi)
9	Celesta	41	Violin	73	Piccolo	105	Sitar
10	Glockenspiel	42	Viola	74	Flute	106	Banjo
11	Music Box	43	Cello	75	Recorder	107	Shamisen
12	Vibraphone	44	Contrabass	76	Pan Flute	108	Koto
13	Marimba	45	Tremolo Strings	77	Blown Bottle	109	Kalimba
14	Xylophone	46	Pizzicato Strings	78	Shakuhachi	110	Bagpipe
15	Tubular Bells	47	Orchestral Harp	79	Whistle	111	Fiddle
16	Dulcimer	48	Timpani	80	Ocarina	112	Shanai
17	Drawbar Organ	49	String Ensemble 1	81	Lead 1 (Square)	113	Tinkle Bell
18	Percussive Organ	50	String Ensemble 2	82	Lead 2 (Sawtooth)	114	Agogo
19	Rock Organ	51	Synth Strings 1	83	Lead 3 (Calliope)	115	Steel Drums
20	Church Organ	52	Synth Strings 2	84	Lead 4 (Chiff)	116	Woodblock
21	Reed Organ	53	Choir Aahs	85	Lead 5 (Charang)	117	Taiko Drum
22	Accordion	54	Voice Oohs	86	Lead 6 (Voice)	118	Melodic Tom
23	Harmonica	55	Synth Voice	87	Lead 7 (Fifths)	119	Synth Drum
24	Tango Accordion	56	Orchestra Hit	88	Lead 8 (Bass + Reed)	120	Reverse Cymbal
25	Acoustic Guitar (Nylon)	57	Trumpet	89	Pad 1 (New Age)	121	Guitar Fret Noise
26	Acoustic Guitar (steel)	58	Trombone	90	Pad 2 (Warm)	122	Breath Noise
27	Electric Guitar (Jazz)	59	Tuba	91	Pad 3 (Polysynth)	123	Seashore
28	Electric Guitar (Clean)	60	Muted Trumpet	92	Pad 4 (Choir)	124	Bird Tweet
29	Electric Guitar (Muted)	61	French Horn	93	Pad 5 (Bowed)	125	Telephone Ring
30	Overdriven Guitar	62	Brass Section	94	Pad 6 (Metallic)	126	Helicopter
31	Distortion Guitar	63	Synth Brass 1	95	Pad 7 (Halo)	127	Applause
32	Guitar Harmonics	64	Synth Brass 2	96	Pad 8 (Sweep)	128	Gunshot

*Instrument mapping for General MIDI specification. By using an agreed-upon map of instrument sounds as a standard, General MIDI makes a MIDI file's playback sound the way it was intended to sound, regardless of the synthesizer on which it was created or played back.

recording and playing back the settings of digital mixers and other recording-studio gear, and more became possible by using equipment that conforms to the MIDI specification.

Without doubt, the greatest benefits of MIDI are the creative control it provides for musicians by permitting creation and playback of multiple tracks in precise synchronization and full control of multiple synthesizers and other devices (such as stage lighting and audio mixers) via a single control console or through a personal computer. Other inherent capabilities of MIDI include realtime and step-entry recording and editing so that less-than-perfect performances can be entered or edited a single note at a time.

On the surface, it sounds like MIDI is the best thing since sliced bread, which was pretty much what everyone had hoped for. Although all devices that conformed to the MIDI specification did, indeed, work in sync and harmony from an electronic standpoint, audio harmony was another story.

The MIDI specification was certain-

ly a milestone, but it didn't go far enough in establishing a standard. Simply stated, the problem is that each manufacturer was free to assign musical sounds (also called "voices" or "patches") in any order he wanted. With no general specification worked out for the numeric designations of the voicing, the sounds and their order were left to each manufacturer. The result was that a MIDI file created and saved using a tubular bells voice on a Casio synthesizer, for example, could conceivably have the voice of a tuba or fiddle when played back on a Korg synthesizer. This is just a hypothetical example, which doesn't reflect the actual voicing on either Casio or Korg equipment, but it does illustrate the voice-incompatibility issues that have plagued MIDI users who utilize assorted gear from several manufacturers.

It became evident over a period of time that a voice-assignment standard was needed to solve instrument-sound inconsistencies. So went early efforts. With the new MIDI standard, however, hope and help has arrived. The result-

ing specification is now known and accepted as General MIDI Level 1.

General MIDI

General MIDI is an industry-wide system of agreed-upon features that are found on any instrument bearing the General MIDI logo. In simple terms, the General MIDI specification provides guidelines for how the instrument should be set up.

The great advantage of General MIDI is that if you record a sequence, it should sound the same regardless of which General MIDI instrument or tone generator you play it back on. One of the biggest boosts in getting the GM standard accepted and so well-received is the fact that *Windows 3.1* uses the General MIDI instrument assignments for its native MIDI mapping.

Like any "standard," the General MIDI standard consists of a list of specifications. General MIDI's specifications for devices include:

(1) A minimum of 24-voice polyphony.

(2) All voices should respond to velocity.

(3) Middle C is MIDI note No. 60.

General MIDI devices should be capable of responding on all 16 MIDI channels, with each channel capable of playing a changing number of voices (polyphony) using its own program, such that:

- Percussion voices are always located on Channel 10.
- Specific drum sounds are assigned to specific MIDI note numbers.
- The 128 sounds (voices) are stored in a specific order, according to the General MIDI sound set (see Table 1).
- Each channel should respond to continuous controllers 1 (mod wheel), 7 (volume), 10 (pan), 11 (expression) and 123 (all notes off), as detailed in Table 2.
- Registered parameter numbers, which are part of the MIDI continuous controller set, can be used for setting pitch-bend sensitivity and for coarse and fine tuning.

The General MIDI System, Level 1 specification document is published by and available from the International MIDI Association, 5316 W. 57 St., Los Angeles, CA 90056. If you'd like additional information on the General MIDI standard, write to the Association at this address.

Thanks to the wide acceptance and popularity of the *Windows* environment, the majority of, but not all, PC sound boards conform to the GM standard. Some manufacturers diverge slightly from the standard. For example, Media Vision's boards use Channel 16 for percussion instead of Channel 10, as specified by GM.

Now that you have the background on MIDI, let's look at some of first-rate products the General MIDI standard has spawned.

Outstanding GM Products

In researching my book, *Welcome To... PC Sound, Music and MIDI*, I became intimately familiar with some superb products that conform to the GM standard. As a practicing musician and composer/recording artist, I also appreciate the "universal tongue" that the GM standard provides for all of my synths to communicate with each other. The whole scheme of things works so well together, in fact, that my debut

Table 2. MIDI Controllers, Function Assignments, Channel Mapping

Control Number		Control Function
Decimal	Hex	
0	00	Bank Select
1	01	Modulation Wheel or Lever
2	02	Breath Controller
3	03	Undefined
4	04	Foot Controller
5	05	Portamento Time
6	06	Data Entry MSB
7	07	Main Volume
8	08	Data Entry MSB
9	09	Main Volume
10	0A	Balance
11	0B	Undefined
12	0C	Pan
13	0D	Expression Controller
14, 15	0E, 0F	Effect Control 1
16 Thru 19	10 Thru 13	Effect Control 2
20 Thru 31	14 Thru 1F	Undefined
32 Thru 63	20 Thru 3F	General-Purpose Controllers (1 Thru 4)
64	40	Undefined
65	41	LSB For Values 0 Thru 31
66	42	Damper Pedal (Sustain)
67	43	Portamento On/Off
68	44	Sostenuto
69	45	Soft Pedal
70	46	Legato Footswitch (w-00 3F; Normal. 40 Thru 7F: Legato)
71	47	Hold 2
72	48	Sound Controller 1 (Default: Sound Variation)
73	49	Sound Controller 2 (Default: Timbre/Harmonic Content)
74	4A	Sound Controller 3 (Default: Release Time)
75 Thru 79	4B Thru 4F	Sound Controller 4 (default: Attack Time)
80 Thru 83	50 Thru 53	Sound Controller 5 (Default: Brightness)
84	54	Sound Controllers 6 Thru 10 (No Defaults)
85 Thru 90	55 Thru 5A	General-Purpose Controllers (5 Thru 8)
91	5B	Portamento Control
92	5C	Undefined
93	5D	Effects 1 Depth (Formerly External Effects Depth)
94	5E	Effects 2 Depth Formerly Tremolo Depth)
95	5F	Effects 3 Depth (Formerly Chorus Depth)
96	60	Effects 4 Depth (Formerly Celeste or Detune Depth)
97	61	Effects 5 Depth (Formerly Phaser Depth)
98	62	Non-Registered Parameter Number LSB
99	63	Non-Registered Parameter Number MSB
100	64	Registered Parameter Number LSB
101	65	Registered Parameter Number MSB
102 Thru 119	66 Thru 78	Undefined
120 Thru 127	99 Thru 7F	Reserved For Channel Mode Messages

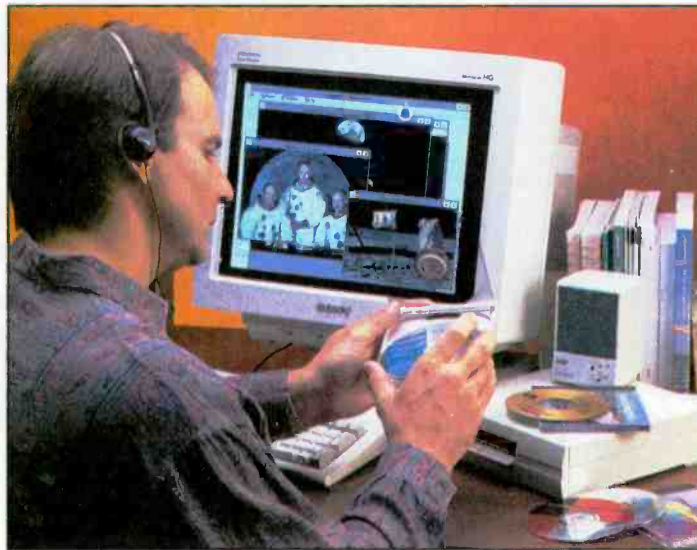
MIDI Channels

MIDI Channel	Programming Value
Decimal	Hex
1	00
2	01
3	02
4	03
5	04
6	05
7	06
8	07
9	08
10	09
11	0A
12	0B
13	0C
14	0D
15	0E
16	0F

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CD album, *Some Things I've Done*, was entirely produced and recorded using GM-compliant equipment.

While all of the hardware devices reviewed here can be used with a PC as the controller, several of them can also be used either by themselves as stand-alone devices or with other MIDI devices without having a PC hooked into the chain. Adding a PC with an interface, however, expands the capabilities of any MIDI setup and permits extensive sequencing, editing and control of multiple devices, all from a single location. And since the vast majority of PC sound cards feature a built-in MIDI interface, putting together a PC-based MIDI studio is really a snap.

QY20 Compact Music Processor, \$599.95
(Yamaha Corp. of America)

The QY20 Music Sequencer is a palmtop music-production system that features a built-in tone generator, sequencer and auto-accompaniment capabilities, all integrated into a pocket-sized module with a very sophisticated control interface. This compact device measures about 7 1/2" L X 4 1/2" W X 1" D and weighs less than a pound with its six AA alkaline cells installed. It can also be powered with the included ac adapter for extended in-place use since the battery will last only about 6 to 10 hours under heavy use.

An LCD screen is provided for viewing the controls and settings of various editing and instrument functions. Soft-touch controls are standard, and individual musical notes can be entered directly from the QY20's keypad or from any external MIDI controller (such as the Novation MM-10X covered a bit later). MIDI IN and MIDI OUT ports are provided, as are a volume control, line-out and headphone jacks and contrast controls for the LCD.

The QY20 uses Yamaha's AWM (Advanced Wave Memory) technology to deliver 100 voices with outstanding sound quality, and eight different drum "kits" are built in. All voices are 16-bit samples of actual instruments, and sound quality is terrific. A built-in 20-song sequencer unit has a 28,000-note capacity, and 32-note polyphony is supported on both record and playback. Hence, intricate scores aren't a problem for the QY20.

Some very impressive sequencer features are incorporated into this tiny unit as well. The sequencer is an eight-track unit that's divided into 24-track groups. Tracks 1 through 4 are for melody/harmony, the remaining four tracks for accompaniment.

You can use the first four tracks with any of the 100 internal voices or eight drum kits, which provide 100 different percussion voices from which to choose, if you



Yamaha's QY20 provides sequencer and tone generator capabilities and has MIDI IN and MIDI OUT ports, 20-song memory, 100 preset patterns and room for 100 user-defined patterns. It's small size and big sound makes it great for traveling musicians.

wish to record via the QY20's own two-octave, polyphonic micro-keyboard or from an external keyboard using the MIDI IN connector.

The sequencer provides 100 preset patterns with six sections—including Intro, Normal, Variation, Fill 1, Fill 2 and Ending—that can be selected and used and has the ability to store up to 100 original user-created patterns. The accompaniment tracks utilize Yamaha's ABC (Auto Bass Chord) accompaniment system that automatically harmonizes the chord and bass tracks according to the chords specified. You can turn off the ABC feature, if desired. The 25 preset chords provide the basic building blocks for songs, and the QY20 can record in realtime or step mode.

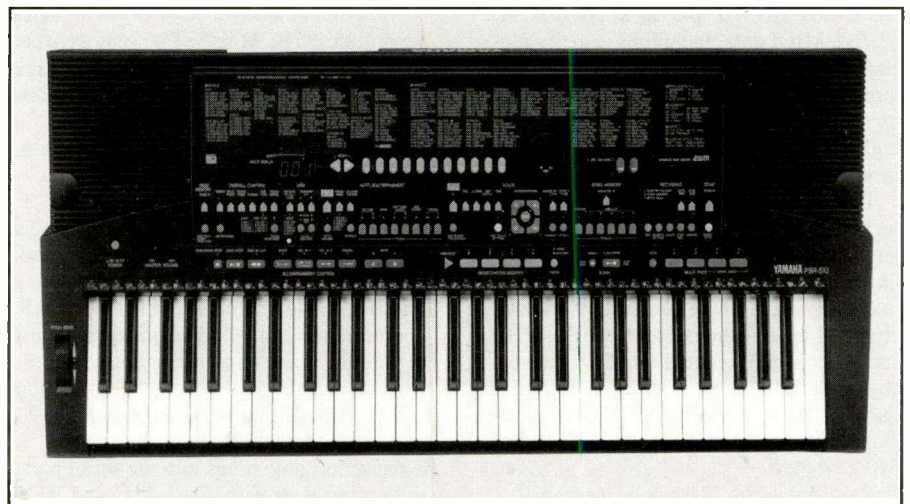
Yamaha's QY20 Music Processor is also

compliant with the General MIDI standard, as well as its own voicing, and either mode is switch-selectable. It should be noted that only the first 100 of the 128 GM patches are supported, but since patches 101 through 128 aren't frequently-used instrument sounds, this doesn't pose much of a limitation.

Portatone PSR-510M Electronic Keyboard, \$689.95

(Yamaha Corp. of America)

Yamaha's Portatone PSR-510M Electronic Keyboard is literally a one-person electronic orchestra packed in a box. Its features, preset patterns, realistic instrument sounds and 61 full-sized keys make this instrument a joy to hear and play. And, since it can be battery or ac powered, you can take the



Yamaha's PSR-510M boasts 128 realistic voices that are digital samples of actual instruments and 100 different rhythm patterns. Multi-page voice and song memories, automatic accompaniment and General MIDI compliance make this the only external keyboard/synthesizer many users will ever need.

Portatone and its music with you wherever you go. This is a big plus for the traveling musician. But all of this is just the tip of the iceberg when it comes to enumerating this incredible instrument's features.

As with the other Yamaha products covered here, the PSR-510M uses Yamaha's AWM voice samples that generate superb sound. It's 128 instrument voices conform to the GM standard and rival those of a live performance (not surprisingly, since they're actual state-of-the-art digital recordings of real instruments). The "orchestra" features acoustic and electric pianos, organs, basses and guitars, brass, woodwinds, strings, tuned percussion, and a complete selection of modern electronic and sampled sounds, such as ocean waves. You can truly let your imagination run wild with such a smorgasbord of sound literally at your fingertips.

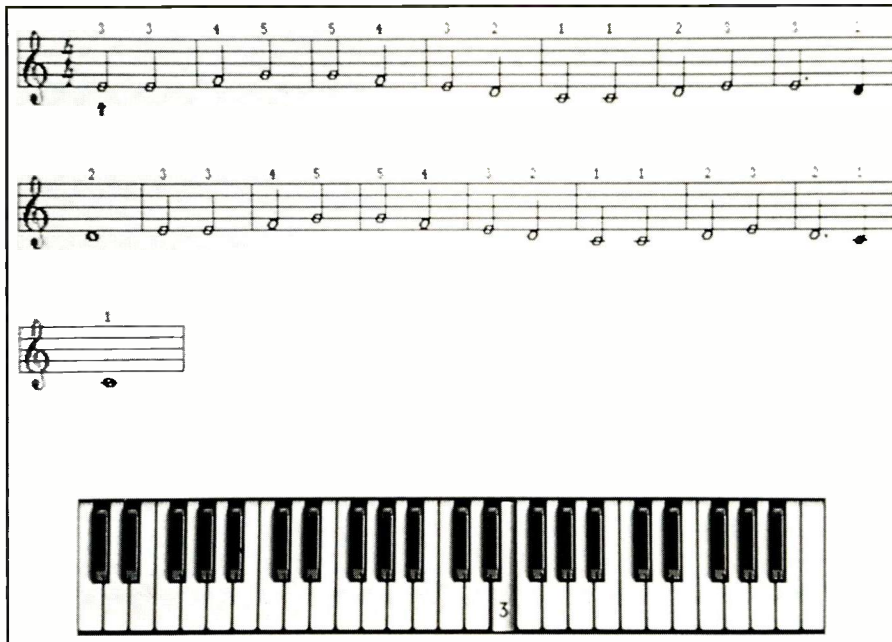
If the foregoing isn't enough, add in advanced DSP (digital signal processor) circuitry that provides eight reverberation effects and 12 delay-based effects consisting of echoes, vibrato, tremolo and "repeater." You can also adjust the depth of the reverb and DSP effects for each voice to give your music additional aural "presence."

An innovative orchestration control cluster makes it simple to set up a range of split and dual-voice configurations, permitting you to play different voices on the left- and right-hand sections of the keyboard or playing dual voices simultaneously over the full range of the keyboard. Single-finger and fingered chord modes are available for the various automatic accompaniment settings. The keyboard also has on-board memory storage for songs, chords, voices, multi-pads, custom accompaniments and overall control on four separate "pages." Hence, there's plenty of internal storage for your compositions.

MIDI IN and MIDI OUT ports are provided on the PSR-510, and the keyboard can receive MIDI data, including velocity messages, over all 16 MIDI channels. Also featured are dynamic voice allocation to play up to 28 notes simultaneously, a pair of high-quality built-in stereo speakers and headphone and output jacks.

The sophisticated auto-accompaniment section is very easy to use and can make anyone, even the totally tone-deaf, sound like an accomplished musician. In addition to complying with the General MIDI patch chart, all music generated on the PSR-510 can be exported as standard MIDI data to any other MIDI device or your software sequencer. Also, any other MIDI files can be played through the GM-compatible PSR-510 keyboard.

Yamaha's PSR-510 is an exceptional MIDI product that rivals and even exceeds the features, sound and performance of more-expensive "professional" synthesizers costing well over \$1,000.



The Miracle Piano Teaching System from The Software Toolworks combines a 49-key electronic keyboard equipped with MIDI ports and comes with self-paced piano-playing instruction software that takes the drudgery out of learning to play. Its keyboard can also be utilized for other MIDI uses when you're not practicing your piano lessons on it.

The Miracle Piano System, \$479.95
(The Software Toolworks)

If you've ever wanted to play the piano but had neither the time nor patience to take lessons, take heart. The Software Toolworks' The Miracle Piano System and your PC are all you need to learn how to "tickle the ivories" while having fun and making music at the same time. Originally available for the Nintendo Entertainment System, The Software Toolworks has since adapted The Miracle Piano System for use with many popular home and personal computers, including IBM/compatibles.

More than merely a keyboard with MIDI capabilities, The Miracle Piano System is a self-contained, self-paced instructional system for teaching you how to play the piano using a personal computer. Most of the voicing, aside from the percussion assignments, is compatible with the General MIDI specification as well.

The Miracle Piano System package contains a 49-key velocity-sensitive keyboard, ac power supply, foot pedal, headphones, interface cable, manuals and software. All you need add is a PC to begin learning how to play the piano and making music right from the start!

The Miracle Piano System doesn't require an internal expansion slot in a PC because its cable plugs into the serial port of the computer with which it's used. This makes it ideal for use with a notebook, laptop or desktop PC.

With a pair of speakers built in, The Miracle Piano System needs no external ampli-

fication for you to hear it as you play. A pair of small, in-the-ear headphones are also provided for private practice sessions.

The Miracle Piano System is an excellent way to put some music into your life, and many of the leading MIDI software packages support it with special mapping for playback through The Miracle Piano System's keyboard.

CBX-T3/Hello Music, \$449.95
(Yamaha Corp. of America)

Yamaha's CBX-T3 stand-alone tone generator module is about the size of an average hard-cover book and stands on-end. It can also connect to a PC and/or to other MIDI devices for additional flexibility. A total of 192 voices are built in, including the 128 voices of the General MIDI Standard. These voices can be accessed from the module's three operational modes. In addition to the General MIDI Level 1 mode, there's the Yamaha Disk Orchestra/ Clavinova mode, a proprietary mode that supports Yamaha's Disk Orchestra Collection of music titles, and C/M mode for increased compatibility with popular desktop music systems (Roland synths, for example).

Yamaha's AWM technology is used in the CBX-T3, which endows it with the pristine sounds of actual instruments that were sampled and stored in internal ROM. Ten different drum and percussion sets are available, along with the 192 voices, to provide an amazingly rich palette of sounds with which to work. Because the unit is also capable of 28-note polyphony, even

highly intricate passages with multiple voices can be played back. Yamaha's DSP-based reverberation effects are also built into the CBX.

Packaged with some additional accessory items, the CBX-T3 is marketed as the *Hello Music* system, available for PCs and Macintosh computers. Supplied with the CBX module is a power adapter for using ac-line power, an interface cable, two audio cables, a stereo plug adapter, an owner's manual and a specially-configured copy of Passport Designs' *Trax for Windows* sequencer software.

This unit interfaces externally to a PC, using the computer's serial port for communication. The supplied interface cable is outfitted with a nine-pin D-shell connector on the PC end and an eight-pin mini-DIN connector on its opposite end. The DIN connector plugs into a jack on the rear of the CBX unit, and MIDI IN, MIDI OUT and MIDI THRU connectors are provided for routing MIDI signals. Additional connectors are located on the unit's rear for right and left line output and for the power-supply's connector. A three-position slide-type switch, also located here, is used for selecting host operational modes that include MIDI, PC or Macintosh.

The front of the unit has 1/8" miniature phone jacks for accommodating headphones and audio input. Volume controls are provided for adjusting audio input level and master volume, and a red LED lets you know when volume level is at its peak. Three yellow LEDs display current mode, and 16 green LEDs above them indicate MIDI channel(s) in use. A pushbutton power switch is located on the front at the unit's top.

Installation is simple and quick, requiring only connection of some cables and loading the software. The software automatically adds the required Yamaha CBX-T3 serial Driver to the *Windows* control panel to make the device available for use by the PC. If desired, additional external MIDI devices can be connected using the CBX-T3's ports.

Sound generated by the CBX is superb. The usefulness of this unit is impossible to quantify. It's easy to install and use, and it's General MIDI-compatible, to boot. What's not to love?

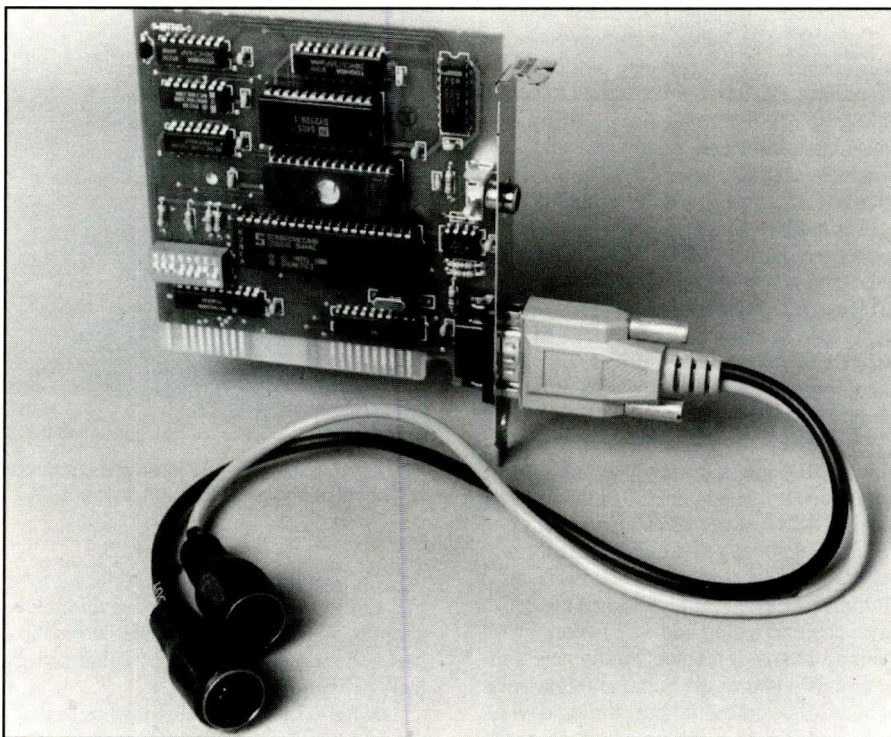
MM-401 MIDI Interface, \$99.95

PC/P Parallel Interface, \$119.95

PC/S Serial Interface, \$119.95

(Midiman, Inc.)

Midiman's MM-401 is an internal one-third-length MPU-401-compatible interface card that easily installs in any available eight-bit expansion slot and works with any PC, from an XT right up through today's fastest 486 configurations on which I tested it. The MM-401 is the only internal interface I checked that's backed by a lifetime



Midiman's MM-401 internal MPU-401-compatible interface comes with a lifetime guarantee and a Y cable for attaching MIDI devices.

guarantee, and it comes with \$100 of free software, including a System Exclusive Archiver program, a MIDI Viewer Channelizer, diagnostics and more. It also has the distinction of being the only 401-compatible interface with an on-board timer. The MM-401's UART mode has an additional timer that can be set via a System Exclusive message.

Included with the MM-401 is a Y-connector cable that provides jacks for MIDI IN and MIDI OUT.

If you'd prefer a MIDI interface that connects externally, Midiman has this area covered as well. You even have your choice of whether you'd like the interface to connect to the parallel port or one of the PC's serial ports.

Portman PC/P is the parallel model that attaches to any PC's Centronics-type printer port, using a standard printer cable. This leaves the serial port free for using a mouse, which is a major point to consider with the many laptop and notebook PCs that have only a single serial port. I use a 386SL/20 laptop for most of my MIDI composition work, and interfacing through the parallel port is a great convenience for me, since I use my single serial port for my mouse.

Since PC/P isn't a transparent device, you won't be able to keep your printer connected simultaneously with the interface, unless you have a second parallel port. A universal *Windows* driver and DOS drivers accompany the interface, and MIDI IN and MIDI OUT ports are provided for connections.

Portman PC/S is the serial version of the external interface that attaches to a serial port, rather than a parallel port. As with the parallel version, universal *Windows* and DOS drivers are provided.

Both PC/P and PC/S come with *Windows* help files for Cubase, Cakewalk and Mastertracks. Both versions also feature "smart buffering" to take the load off the software, making them ideal for System Exclusive dumps.

Midiman's external interfaces are housed in attractive and sturdy metal cases and are guaranteed for life. These external units come with ac power adapters for use with PCs that don't provide the required power at their ports.

MS-101 External MIDI Interface,

\$119.95 (Cable Kit, \$14.95)

MS-124 Internal Serial MIDI Interface,

\$179.95 (Auxiliary Power Source, \$16;

Cable Kit, \$14.95)

MP-128 Parallel MIDI Interface, \$199.95

MP-320 Optional Upgrade Kit for

MP-128, \$119.95

MP-328 (MP-128 With MP-320 Installed),

\$299.95

(Key Electronics, Inc.)

Key Electronics manufactures "industrial-strength" MIDI interface products that range in appeal to users from those with very basic needs all the way on up to professionals who need control of up to 128 MIDI channels. Chances are excellent that there's a MIDiator interface that's right for

you, regardless of what your needs may be.

The MS-101 is an external-connect serial interface that takes advantage of the programmable PC serial port features to permit full-speed MIDI communication. It's housed in a sturdy aluminum case and weighs a mere six ounces. With dimensions of only 1.4" x 2.6" x 4.2", it's small and light enough in weight to carry in a shirt pocket to your next MIDI "gig." A 25-pin serial port is located on one side of the interface, while MIDI IN and MIDI OUT ports are located at the opposite end. The MS-101 comes with *Windows* driver software. An optional 9/25-pin 1-foot-long serial cable kit is available.

The MS-124 is an external-connect multi-port MIDI interface that also uses a PC's serial port. It features one MIDI IN port and four MIDI OUT ports, each supporting up to 16 MIDI channels, to provide control for a maximum of 64 channels. The interface eliminates the need for additional patch-bays, cable plugging and channel-assignment problems. It features totally new digital circuitry to provide maximum tolerance to both MIDI and serial port timing deviations, and *Windows* multimedia 3.1 driver software is included. Optional extras include an external auxiliary power source and a 1-foot 9/25-pin serial cable kit.

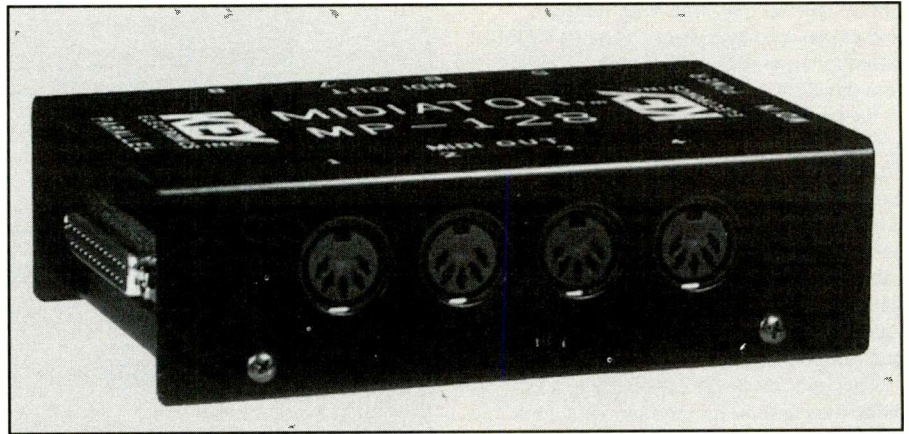
Key also offers the MP-128 parallel-connect interface for MIDI users who have "industrial strength" requirements. This unit provides eight independent MIDI OUT ports that deliver a total of 128 channels. As with all other Key interfaces, *Windows* 3.1 driver software is included.

An optional MP-320 Kit with dual MIDI IN and SMPTE sync is also available for stand-alone use with laptop, notebook and other slot-less computers. The upgrade kit can be purchased separately, or you can buy it as a package that consists of the MP-128 with PM-320 upgrade already installed as the model MP-328.

**SH-075 MIDI Guitar Converter, \$699;
S-140 Solid-Body Guitars; Custom-Made
and Priced Accordingly**
(Shadow Electronics)

Even though I use keyboards extensively in my MIDI production work, I'm not overly comfortable fingering the black-and-whites. I'm a guitarist, and that's my natural element. In my quest for a way to interface the guitar as a MIDI input and control device, I was most fortunate to find the Shadow SH-075. This marvelous device converts my analog guitar playing into digital MIDI format. It permits me to play with all the expressiveness that naturally comes through for me with a guitar that I can't realize through a keyboard.

I should preface this review by stating that the SH-075 isn't the only MIDI/guitar controller available, nor is it the only one I've ever used. I've tried quite a few along



Key Electronics' MP-128 interface connects via a PC's parallel port and provides control of up to 128 MIDI channels through its eight MIDI OUT ports.

the way, but this is the one that does it for me, and I can't say enough good things about it. Without doubt, the SH-075 is the best and most-sensitive MIDI guitar controller I've found to date.

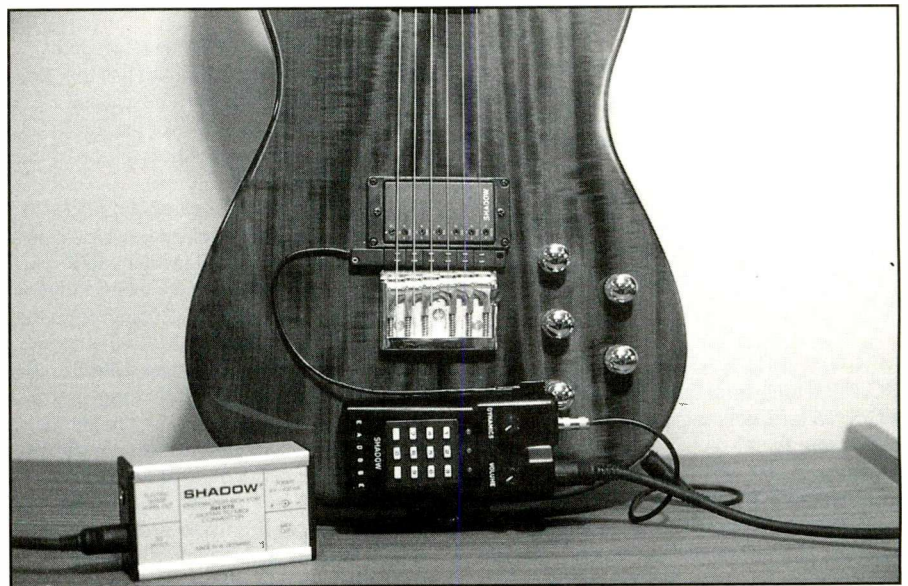
The SH-075's main unit attaches to the tail of the guitar, using the guitar's strap button screw to hold it in place. A hex pickup mounts under the strings, directly in front of the bridge, and connects via a thin cable to the SH-075 unit. The hex pickup can mount with either adhesive putty or screws, both of which are supplied. I'm delighted to report that the adhesive putty is perfectly acceptable for mounting the hex pickup because the idea of drilling screw holes in the beautiful high-gloss finish of the S-140's German basswood body didn't sit well with me at all.

The SH-075 does a remarkably good job of converting an analog string vibration

into a digital MIDI signal. Virtually every other guitar/MIDI converter I've used suffers from slow tracking, best described as a slight delay between the time the guitar string is plucked and when the note is reproduced as a MIDI-generated note on a synthesizer. Though only a few hundred milliseconds in duration, this lag can be quite disconcerting when you're playing in realtime and is a major drawback of other guitar/MIDI units.

The SH-075 is so sensitive that such expressive touches as "hammer-ons," slurs and string stretches can be played in realtime they sound 100% natural, as if they were being played analog (through an amplifier, rather than through MIDI).

This unit also provides analog pass-through so that you can play through an amplifier while simultaneously sending the MIDI signals to a synth, making thick



Shadow's SH-075 MIDI Guitar Converter permits guitarists to tap into the world of MIDI and provides excellent sensitivity, tracking and response in both poly and mono modes.

Glossary of MIDI Terms

Aftertouch—a type of keyboard touch sensitivity that permits the player to control the sound after the key has been pressed while it is being held down. Aftertouch permits adding additional dynamic expressiveness to the music.

Channel—any of the 16 communication paths MIDI provides for data transmission. Each channel carries its own separate and distinct messages over the same cable which makes it possible to play several different musical parts on the same instrument or control different MIDI instruments simultaneously.

Daisy chaining—a term that describes two or more devices linked together through each other to the same PC. The first device is connected directly to the PC, while the second device is connected to the first; the third device is connected to the second, fourth to third, and so forth. Signals are passed through the "chain" back and forth from the computer to the desired device. To avoid confusion or conflicts, each device in the chain is given its own unique channel for communication and ID identification.

Event—a term that refers to any status, system or control message sent or received over a MIDI channel. These messages play notes and control MIDI equipment.

General MIDI—an update and enhancement of the MIDI 1.0 standard that pro-

vides greater compatibility between different manufacturers' MIDI equipment when transferring and playing MIDI song files.

Humanize—an effect that introduces slight timing, velocity and volume variations to a MIDI track to simulate the "feel" of a live performance.

Message—a collective term that refers to the words (or bytes) of MIDI control data. Messages typically consist of one or more words that include a status byte and one or two data bytes.

Monophonic Mode—in mono mode, a MIDI instrument assigns incoming channel voice messages monophonically, permitting only a single note to be played at a time. Since the voices are each assigned to different channels, however, playing a chord results in three, five or more different instrument sounds playing individual notes simultaneously (see polyphonic mode entry).

Pitch-Bending—a capability of many MIDI keyboards and other controllers used to simulate the way a guitarist stretches a string to alter the pitch of the note being played.

Polyphonic Mode—the ability of a synthesizer to play more than one note (chords) simultaneously. In poly mode all notes are voiced the same and sent via the same MIDI channel (see monophonic mode entry).

Quantize—also sometimes called auto-correction, this refers to the process of correcting slow and fast timing variations to align the tracks with the tempo beats.

Quantizing can make sloppy playing sound tighter, but overdoing it can make the composition sound too rigid and mechanical (which could then be corrected by humanizing).

SMPTE—an abbreviation for the Society of Motion Picture and Television Engineers, refers to the standard designed by video engineers to synchronize different pieces of video and audio mixing equipment together. In MIDI, SMPTE is used to sync sequencers and other MIDI equipment as well as multi-track recording equipment to video, and it is used for creating sound tracks and other high-end applications. SMPTE is a time-based code that marks the passage of time as hours, minutes, seconds and frames.

Velocity—a synthesizer and MIDI term that means how hard a musical key is pressed or released. For keyboards having velocity control, this can affect the loudness or other tonal quality of the sound.

Word—the native unit of storage on a particular machine. Depending on the microprocessor, a word can be an eight-bit, a 16-bit or a 32-bit quantity. MIDI "words" are eight-bits in length.

"chorusing" possible. In addition to providing a built-in tuner, the SH-075 can operate in poly mode, with all strings assigned to a single MIDI channel to permit chords to be played, and mono mode, where each string can be assigned to a different MIDI channel to permit six different voices to be assigned. Because the unit also supports pitch-bending up to eight semitones total, even the wildest "licks" can be played through MIDI. MIDI notes can also be transposed up or down three octaves from the control pad.

Included with the interface is the hex pickup, adhesive putty, mounting screws, a small screwdriver and an ac power adapter. Since the controller's keypad permits sending control messages from only 1 through 99, GM voices 100 through 128 can't be accessed through the keypad. You can select them from the synth itself, however, if you wish.

Shadow Electronics, makers of the SH-075 (and other guitar-oriented products), has moved from its original location in Germany to Florida and was completing development of a new guitar/MIDI controller that's said to have even more goodies and sensitivity than the SH-075 does (it may even be available by the time you read this.)

MIDI Kit Breakout Box for Popular Sound Cards, \$119.95
(MidiSoft Corp.)

While most of the PC sound cards currently available in the marketplace provide full MIDI support through *Windows*, very few of them provide the additional accessory items you need to get the full benefit of MIDI possible by attaching external keyboards, controllers, synthesizers, tone generators and other MIDI devices. MidiSoft's MIDI Kit contains everything you need to explore the world of external MIDI connected to your PC.

Touted as the "universal MIDI solution for *Windows* PC sound cards," the MIDI Kit's breakout box attaches to the D-shell connector of popular sound cards, including the Media Vision Pro Audio series, Sound Blaster Pro, Turtle Beach Multi-Sound, Advanced Gravis UltraSound and several other cards that use the popular 15-pin D-shell configuration for MIDI adapters. Two good-quality 6-foot MIDI cables are also provided in the kit for connecting the external device to the breakout box.

In addition to the hardware components of the MIDI Kit, a copy of MidiSoft's *Recording Session* software is also included, along with a selection of fully sequenced

MIDI songs voiced to support a variety of sound cards (as well as GM-voiced versions). This card represents an excellent value. It fills the "required-equipment" bill quite nicely.

Novation MM-10X Keyboard Controller, \$239.95

(Music Industries Corp.)

Yamaha's QY20 is such a versatile little device that it's a natural for use with an external keyboard. The Novation MM-10X from Music Industries is the perfect companion for the QY20. It greatly enhances the QY20's play-ability, versatility and practicality and makes an ideal compact portable MIDI controller.

Featured in the MM-10X is a two-octave velocity-sensitive keyboard that comes with a cable adapter for connecting it to the Yamaha QY10 (Yamaha's older tone generator, which has been replaced by the QY-20). Alternatively, it can be connected to the QY20 with the optional ADP-1 adapter (\$19.95). The MM-10X even has a handy tray built into it for holding the QY unit while in use.

To keep you updated on the status of the MM-10X, a custom built-in dual-digit LCD panel provides continuous informa-

tion on all settings, including MIDI channel, octave, program change, transpose, controller functions and low-battery indicator, to name just a few.

The keyboard is equipped with full-size keys that are transposable over eight octaves. An optional sustain pedal can also be used, since the MM-10X is outfitted with a 1/4" input phone jack for this purpose. Some other noteworthy features include velocity sensitivity, a pitch wheel and programmable multi-function controller wheel.

Powered by six alkaline cells, the MM-10X provides an average of more than 80 hours of battery life with normal use. A pair of strap holders (provided) installs on it. So it can be used as an easy-to-handle remote keyboard controller that can be worn and played guitar-style, if preferred. Since it's battery powered, it's totally portable and can be used with the QY20 virtually anywhere without you having to worry about availability of ac power.

Other optional accessories available for the MM10-X include a carrying case (\$29.95) and a regulated ac adapter (\$14.95) if you don't want to use battery power.

If you're using a Yamaha QY tone generator, you'll find the MM-10X indispensable. If you're using the multimedia capabilities of your PC's sound card and want to use an external keyboard controller for your MIDI input, the MM-10X makes an excellent choice for this purpose as well.

Novation MidiCon Keyboard Controller, \$169.95

(Music Industries Corp.)

If you've been looking for a good external keyboard controller to get the most from the MIDI capabilities of your PC's sound card, your search may be over with the Novation MidiCon from Music Industries. Designed specifically with the multimedia PC user in mind, MidiCon is finished in an off-white, putty color that perfectly complements most PC and Macintosh finishes. The extra "bells and whistles" most stand-alone keyboard synthesizers come with keep their prices well beyond what the casual or curious PC user with a sound card may want to spend. MidiCon makes a very solid keyboard controller with all of the most-desirable—and most-wanted—features that will enable you to get the most from your sound card without going into overkill. The result is a truly useful product that's priced right.

MidiCon has full-size keys, a two-octave keyboard range, velocity-sensitive response, two on-board switches that provide an additional eight-octave range, pitch and modulation wheels, a sustain (footpedal) input with a built-in automatic-polarity feature and one MIDI OUT port. Since the keyboard itself contains no tone-generating source, there's no need for a MIDI IN port.

The keyboard is powered by alkaline



Novation's MM-10X MIDI keyboard controller shown with a Yamaha QY20 inserted and coupled to it—a marriage made in MIDI heaven—has a long list of sought-after features and, like the QY20, is portable.

cells rated to yield an average battery life of 250 hours. Alternatively, it can be powered by an optional ac adapter. Since strap pegs are also provided on MidiCon, it can be used as a strap-on remote controller for mobility around the studio and live performances by wearing it like a guitar.

Accessory items available for enhancing MidiCon include a carrying case (\$29.95 list) and a regulated ac power-supply adapter (\$14.95 list).

If you're into PC sound and you want an affordable touch-sensitive keyboard controller with good action and full-sized keys, this is the product for you.

X-28H Multitracker Cassette Recorder, \$599

(Fostex Corp. of America)

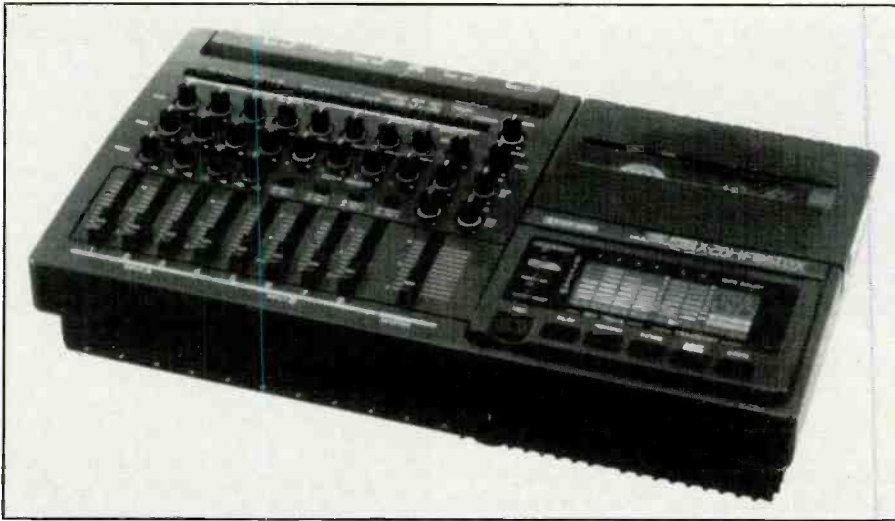
While MIDI provides creative freedom, composition and arranging possibilities that

were never possible prior to the advent of digital electronics and sound synthesis, there are still times when you'll want to use analog devices as well. Two such occasions are when you want to add vocal tracks to your otherwise MIDI compositions and when you want to over-dub acoustic sounds on top of the MIDI output. The most accessible and affordable device to use for both of these applications is a good multi-track cassette recorder. I've found the Fostex X-28 Multitracker to be an ideal choice for these and many other tasks.

The X-28 is particularly attractive to musicians who favor MIDI because it can accommodate eight inputs (it can actually accept 10 inputs if you utilize the two AUX RETURN inputs as well). It also supports tape sync, which is important if you intend to mix analog and digital sources, as is frequently done in creating a "demo."



Novation's MidiCon is a compact, portable 25-note MIDI keyboard that's ideally suited for use with multimedia sound cards and delivers all of the most-desirable features, like velocity sensitivity, full-size keys and 250-hour battery life at an affordable price.



The perfect analog complement to any MIDI studio is the Fortex's four-track, eight-input, dual-speed X-28H Multitracker cassette deck featuring Dolby B noise reduction, built-in 8 X 4 X 2 mixer and automatic rehearsal mode, among other outstanding features, that make it the most attractive multitracker in its class and price range.

Tape sync is the process of using one of the tracks on the X-28H to synchronize operation with a MIDI sequencer that, in turn, is used to control several instruments simultaneously. Since virtually all MIDI-sequencer software programs currently available support external sync signals, the X-28H's tape sync capability can be used to initiate software-based sequencers as well. Synchronization with MIDI devices is provided via an FSK (frequency shift keyed) converter.

Since MIDI signals can't be recorded directly onto tape, an FSK-to-MIDI converter is required. This device converts the MIDI clock data from the MIDI sequencer into an FSK signal that's then recorded to tape. During playback, the FSK signal is converted back into MIDI data for synchronization with the sequencer. Most modern sequencers, rhythm machines and MIDI controllers have these FSK circuits built into them, but an external converter unit may be required, depending on your individual setup.

Another handy feature of the X-28 is its ability to "punch-in" and "punch-out" for recording portions of tracks using an optional footswitch. Also, the tape can be re-wound to 0 (the recorder has a built-in tape counter, of course) and started using the footswitch.

Fostex X-28H is a dual-speed machine. A 3 1/2-ips (inch-per-second) recording speed assures superior fidelity, while a selectable 1 7/8-ips playback speed permits listening to standard cassettes and is quite useful for playing back intricate passages at half-speed to analyze their notes, called picking a riff apart in guitarist lingo.

A speed dial permits adjusting the X-28H's speed $\pm 15\%$ for tuning/pitch control.

The unit has built-in Dolby B noise reduction, a tape memory, six-LED bargraph meters for indicating recording and playback volume levels and equalization and panning controls.

QR10 Music Accompaniment Player, \$349

(Yamaha Corp. of America)

The day of the one-man band has truly arrived with the advent of Yamaha's QR10 module. This compact unit borrows heavily from its sibling, the QY20, while adding some nifty tricks and features of its own. It has 50 preset accompaniment patterns that cover a wide variety of musical styles pre-programmed into it. Each pattern has six

variations that can literally be selected at the touch of a button. They include introduction, normal, variation, fill-in #1, fill-in #2 and ending parts. All patterns have two chord parts, a bass part and a rhythm part. This combines to give you a very rich and full ensemble sound.

MIDI IN and MIDI OUT jacks are provided on the rear of the unit, as is a 1/4" phone jack for accommodating input from a guitar, microphone or other instrument. The really unique feature of the QR10 is that it mixes the incoming signal with the internal accompaniment sounds so that the blended output can be sent to an amplifier, tape recorder or headphones or be routed through the unit's built-in speaker. Controls are provided for adjusting the volume of both the accompaniment and incoming signal.

Provided are 24 chord types, ranging from simple major and minor triads to jazz-style tension chords. Additionally, 40 "combination patterns" permit you to combine the chord 1, chord 2, bass and rhythm parts from different patterns to create an endless variety of new patterns. You also have the option of creating new, original patterns entirely from scratch. Enough memory is allocated to hold 10 original patterns.

Yamaha's AWM is used in the QR10 to provide 69 normal and 60 percussion voices. Voice assignments can be freely changed and intermixed at will. While the QR10 isn't a true GM-compatible device, voice assignments are in the same general order and feature the most-frequently-used patches. Hence, it won't require much, if any, voice reassignment to make everything sound as it should when used with other GM equipment.

Of all the devices covered here, the QR10 is the only one that permits sampling and storing your own sounds, whether your



Yamaha's QR10 music accompaniment player heralds the arrival of the one-man band. It offers 50 preset accompaniments, each with six possible variations to provide a full, rich ensemble.



Kawai's GMega synth module can accommodate up to 32 MIDI channels simultaneously, has excellent drum sounds and offers lots of user-programmable patch options.

voice, a dog's bark or whatever. There's a built-in microphone for sampling, or you can input your samples through the line-input jack, if you prefer. Since the unit permits you to store not one but two samples, you can really do some original things with it.

This device can be powered by six alkaline AA cells for true portability or via an ac adapter for constant in-place operation. It's truly an amazing, outstanding tool for practicing, providing accompaniment for live performances and drum tracks and using it as a tone generator or as an aid in composing and arranging. It also makes a nifty musical notepad for recording your ideas and presenting them in polished form for others.

GMega Synthesizer Module, \$795
(Kawai America Corp.)

The GMega provides a lot of options for the MIDI musician who's looking to expand his creative horizons, starting with its 32-channel capability (all other devices covered here are limited to 16 discrete MIDI channels). GMega doubles the usual 16-channel complement by providing two MIDI inputs, each assigned to a separate bank. If you don't need or want to use the second bank for the extra channels, the extra input jack permits connecting a MIDI keyboard or other device directly to the module while the other jack, controlling the first 16 channels, is in use. So there's no need to use a merger or duplex box with this arrangement.

In addition to the 128 GM-compliant sound programs, GMega also has available two additional patch banks. SP and GM patch banks are stored in ROM, but the third bank gives you 128 locations to create and store your own patches, which is quite a unique feature usually found only on synth modules in the over-\$1,000 price range.

Sound quality of GMega is quite good, although it isn't quite up to the caliber of the Yamaha units. This is somewhat surprising, since it, too, uses 16-bit sampled voices. If there's a chink in GMega's armor, it's definitely in its built-in reverberation effects. They don't have the aural ambience

you'd expect from an otherwise impressive unit such as this. "Tinny" is a good adjective to describe the sound of GMega's reverb. Six reverberation types with two user-selectable depth levels are provided.

To keep you informed of the current status and voicing, GMega has a 32-character back-lit LCD. The unit features an eight-pin mini-DIN RS-232C connector for attaching it to a computer. The GMega I used for this review could be interfaced to a Macintosh, but no provision (or mention) of an interface cable and software for PC use was to be found. Of course, you can use your sound card's MIDI interface or a dedicated interface and the MIDI IN/MIDI OUT ports to get your signals to GMega, as I did.

GMega's drum "kits" are definitely a noteworthy feature to consider, since 14 kits are provided in ROM. The unit can also accommodate seven user-defined kits. If extensive programmable percussion voicing is important to you, you'll want to consider GMega, since this is one of its strongest areas.

Quik Lok Modular Workstation, \$599.95
(Music Industries Corp.)

As soon as you start adding keyboards, tone generators, mixers and other gear to your PC, the whole ensemble quickly becomes difficult to manage, with all the cables, power supplies and other items crossing each other. Of course, you'll want to have your VGA monitor or laptop PC directly in front of you, along with convenient access to its keyboard and mouse. With this mess, a desktop just doesn't do the job adequately. Music Industries has the solution with its fully loaded Quik Lok WS-500 Modular Workstation pictured in the lead photo. As you can see, it has a place for everything. The Tandy mini-tower nestles comfortably on the lower shelf, while the SVGA monitor is at eye level on the uppermost shelf. The keyboard with Microsoft ball-point mouse is within easy reach at the right side, while the Yamaha, Miracle and Novation keyboards are conveniently accessible, as are the tone generators perched on the auxiliary shelves.

Ordering Information

If you'd like to read more about MIDI in general and General MIDI in particular and lots of other useful and practical information on making and using sound and music on PCs, get a copy of my book, *Welcome To...PC Sound, Music & MIDI*. It's available at all major bookstores. If you'd like to hear what General MIDI can do, you can order my CD album (not available in stores), *Some Things I've Done*, which is a collection of original instrumental songs of varied tempos and moods, all composed and produced entirely using General MIDI gear and a PC. A companion diskette with the original MIDI source files and extensive technical notes on the songs and the album's production is also available.

To obtain *Welcome To...PC Sound, Music & MIDI* by Tom Benford (MIS:Press. 320 pages. Includes mixed-mode CD-ROM. \$29.95 plus \$3.05 S&H); the *Some Things I've Done* CD album of original instrumental compositions written and performed by Tom Benford using GM gear (\$15.95 plus \$2.05 S&H); or/and MIDI Files & Production Notes Disk on 3 1/2" media (available only with purchase of the CD), send payment in check or money order to:

MicroComputer Journal Readers Special Offer
Tom Benford
CPTS
2329 Highway 34, Ste. 201
Manasquan, NJ 08736

Allow six to eight weeks for delivery.

The MIDI Files & Production Notes diskette contains actual MIDI source files for all of the songs on the album and extensive production notes and listings of software/equipment used in producing the album. The CD/diskette combo costs \$20.95 plus \$3.05 S&H

Since the WS-500 is completely adjustable for height (the main unit, as well as the shelving), regardless of your equipment and preferred configuration, you'll be able to set everything up just the way you like it. The WS-500 permits adding additional shelves and brackets; so it can expand to accommodate more equipment when you add it. The unit disassembles easily and compactly for easy transportation and storage, which is a real plus if you take your MIDI music on the road.

The investment in a decent MIDI setup like the one pictured can be substantial. So it's reassuring to know that Quik Lok stands are made of steel and are double-welded for extra strength without being unduly heavy. All shelves come with non-

Products Reviewed

X-28H Multitracker Cassette Recorder,
\$599

Fostex Corp. of America
15431 Blackburn Avenue
Norwalk, CA 90650
Tel.: 310-921-1112

CIRCLE NO. 126 ON FREE INFORMATION CARD

GMega Synthesizer Module/Tone
Generator, \$795

Kawai America Corp.
2055 E. University Dr.
Compton, CA 90220
Tel.: 310-631-1771

CIRCLE NO. 127 ON FREE INFORMATION CARD

MIDIator External MIDI Interfaces,
\$99.95 to \$199.95

Key Electronics, Inc.
7515 Chapel Ave.
Fort Worth, TX 76116
Tel.: 800-533-6434

CIRCLE NO. 128 ON FREE INFORMATION CARD

Midiman External/Internal MIDI
Interfaces, \$99.95 to \$119.95

MIDIman, Inc.
236 W. Mountain St., Ste. 108
Pasadena, CA 91103
Tel.: 818-449-8838

CIRCLE NO. 129 ON FREE INFORMATION CARD

Novation MM-10X Keyboard Controller,
\$239.95

Novation MidiCon Keyboard Controller,
\$169.95

Quik-Lok Musical Instrument Stands,
\$599.95

Music Industries Corp.
99 Tulip Ave.
Floral Park, NY 11001
Tel.: 800-431-6699

CIRCLE NO. 130 ON FREE INFORMATION CARD

MIDI Kit, \$119.95
MidiSoft Corp.
PO Box 1000
Bellevue, WA 98009
Tel.: 206-881-7176

CIRCLE NO. 131 ON FREE INFORMATION CARD

SH-075 MIDI Guitar Converter: Shadow
S-140 Solid Body Electric Guitar (since
all Shadow guitars are hand-made, call for
configurations, pricing and availability)

Shadow Electronics
2850 SE Market Pl.
Stuart, FL 34997
Tel.: 407-221-8177

CIRCLE NO. 132 ON FREE INFORMATION CARD

Miracle Piano Teaching System for PCs,
\$479.95

The Software Toolworks
60 Leveroni Ct.
Novato, CA 94949
Tel.: 415-883-3000

CIRCLE NO. 133 ON FREE INFORMATION CARD

Portatone PSR-510M Synthesizer,
\$689.95

CBX-T3/Hello Music PC/MIDI Tone
Generator, \$449.95

QY-20 MIDI Sequencer/Tone Generator
Module, \$599.95

QR10 Music Accompaniment System,
\$349

Yamaha Corp. of America
6600 Orangethorpe Ave.
PO. Box 6600
Buena Park, CA 90622-6600
Tel.: 714-522-9011

CIRCLE NO. 134 ON FREE INFORMATION CARD

skid rubber strips to keep your equipment
from sliding, and Music Industries carries
an assortment of such accessory items as
shelves, brackets, foot pedals, etc. that can
be added to the basic WS-500 Workstation
to configure it precisely to your individual
needs and tastes.

Summing Up

General MIDI is here now, and it's im-
pact on the quality and price of compli-
ant hardware and software is already
sending repercussions through the
world of "professional" equipment. All
this adds up to a wide array of excel-

lent products that make music afford-
able and accessible to anyone who has
a PC and a desire to produce it. The
products I've covered here represent
the cream of the crop, as well as the
vanguard for good things to come.



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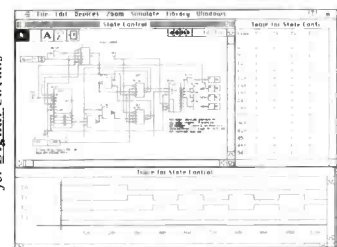
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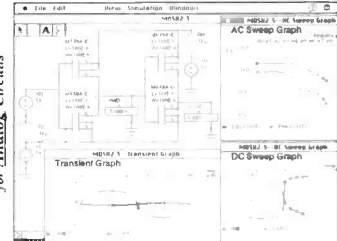
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Power Conditioning and Power Supplies

What you need to know to keep your computer in tip-top shape using surge protectors and UPSes and tips for buying the protection you need

When I walk into my office in the morning, I don't think much about how and why my computer boots up to greet me. It just does, and I settle down to the day's routine. Once every month or two, though, I see a funny wiggle or blink on my video monitor and I wonder about the electrical power that keeps my computer running. I pay close attention to the foods I eat but

very little to the power that feeds the electronic devices in my office.

Unless you have your own solar panels or windmill, the power in your home and office comes from your local power company, over miles of lines, through a transformer or two, into your building, through wires in walls, out of an electrical outlet and into your computer. It hardly seems worth worrying about because all you do is turn on a

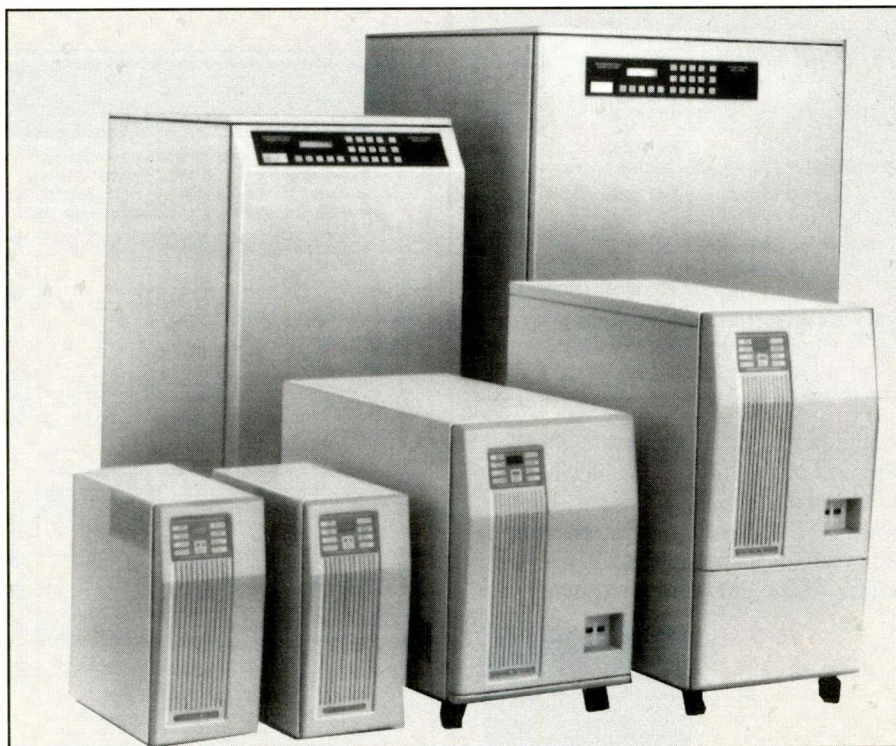
switch and your computer springs to life. You flip the switch to off, and your computer goes to sleep until the next time you need it.

If the components inside your computer were electrically similar to a toaster or iron, there would be little concern about the condition of the electrical power delivered to them. But the chips and other components inside a computer will operate on only direct current, not the alternating current that comes out of a wall socket, and are extremely sensitive to variations in voltage. If you want your computer to last several years or more, you have to be at least as concerned about its power as you are about its hard drive size and video resolution.

Incoming Power

Except during a total power failure, most of us rarely think about the power that enters our homes and offices. We just assume that it's fine and that it will run the devices we plug into the power outlets sprinkled around the premises. We might even assume that we get pure, clean 110 to 120 volts of current alternating at a precise 60 cycles per second from the power company. What we really get instead is power that's filled with glitches, surges, sags and spikes, along with brownouts and blackouts.

The foregoing isn't even close to what comes over the power lines. Bear in mind that voltage is measured in two different ways. Because alternating power reverses polarity 120 times per second, it doesn't stay at any particular voltage for very long. The 120-



Controlled Power Co.'s line of advanced uninterruptible power systems range in output from 700 to 2.1K VA in the LT Series and 3.1K to 7.5 K VA in the MD Series. They feature input power correction/harmonic attenuation; no interruption in power when utility power fails, single conversion system and RS-232 communication with SNMP capability.

volt measure you often see used is really a geometric average of each voltage in a complete cycle, calculated using the root-mean-square, or rms, method. Since 120 volts is the average, the peaks must be and are greater. Typically, the peak of each wave is about 170 volts, not the more familiar specification of 120 volts. In one sense, your computer is subjected to a 170-volt surge 120 times a second.

Real surges, however, are measured in absolute voltages, not by averaging. The power company tries to keep the line voltage constant, but this voltage fluctuates regularly. The line potential might occasionally go up by 10 or 20 volts for a period ranging from a few milliseconds to a few seconds. As long as all of your electronic equipment is designed to withstand small surges, no harm is done when these surges occur. There would be numerous problems if the power company permitted the 60-Hz frequency rate to waver for long. Many clocks and other electronic circuits use the power-line frequency as a reference.

You needn't worry about brief voltage surges. Most PC power supplies can handle surges up to 800 volts for at least a few microseconds. Surges that exceed about 6,000 volts will never get to your PC to cause problems unless your office building or home suffers a direct lightning strike. The plastic insulating sheathing around the wiring in most buildings loses its insulating capacity at about 6,000 volts. If the potential rises beyond this figure, the plastic shorts out and carries away the excess power.

What you do have to worry about are power surges and spikes that occur between 800 and 6,000 volts. The problem with most such surges is not so much their increased voltage (the power supply in a computer may be able to handle this) but, rather, the high current that often accompanies such a surge. If your equipment were to experience a hit with a 6,000-volt surge, it might be reinforced with a current as great as 3,000 amperes for a few millionths of a second. On a long-term basis, the 18 megawatts you receive is



Zero Surge's Model ZS1800 surge/spike protector provides fast suppression of power-line surges without relying on traditional MOVs. It handles loads of up to 15 amperes at 117 volts ac.

enough to power a small city. On a short-term basis, it would be sufficient to fry most of the ICs in your computer.

Three power lines run to your outlet and into your computer: hot, neutral and ground. A surge can occur between any two of these three lines. If it occurs between hot and neutral, it's called a "normal-mode" surge. A surge that occurs between hot and ground or between neutral and ground is called "common-mode." A surge caused by your power company or by natural phenomena must be normal-mode because, by code, the neutral and common lines are bonded together both at the service entrance and at the transformer on the power pole. Incoming surges must be a difference in voltage between the hot and neutral lines.

Common surges, those involving the common or ground conductor, can originate within a building because of long runs of wire that can let the potential of neutral and common lines drift away from each other. Some studies suggest that common-mode surges can be more dangerous than normal-mode surges for desktop computers.

A good surge protector should be able to guard against surges on any pair of lines in the range between 800 and 6,000 volts. Internally, most surge protectors rely upon one or more technologies: MOV, gas-tube, avalanche-diode and reactive-circuit.

Metal-oxide varistors, or MOVs, are inexpensive to make and easy to use.

Generally made from a layer of zinc-oxide particles, they offer high resistance until the potential reaches the breakdown level. At a specific voltage, the MOV creates a low-resistance path almost instantaneously. In surge protectors, this means that they short out between the two lines that are carrying the surge, keeping the surging power from reaching your computer.

The trouble with MOVs is that they degrade. Even minor surges form conductance paths through the oxide particles, reducing the resistance to the flow of electricity. Eventually, an MOV will short out and end its life by blowing a fuse or overheating itself until it self-destructs. Some MOVs end their lives in flames, but most show no visible outward sign that they've failed. Thus, you could be relying on a surge protector that's full of dead MOVs if you've had the protector for any considerable length of time doing service for your computer.

Gas tubes are just what their name implies: tubes filled with special gases that have a low dielectric potential. A gas tube is designed to arc over at a predictable voltage. The internal arc short-circuits the surge, just as does the MOV. Gas tubes can react quickly—in just nanoseconds—and can handle large amounts of power.

After a gas tube starts conducting, it doesn't want to stop. Most gas tubes require a current reversal to the arcing, which means that the arcing will contin-



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Monitors

MON-05	12" Monochrome TTL Amber (720x348)	\$69.00
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
MON-12	20" Super VGA (1280x1024) Non-Interlaced	1379.00

IDE Hard Drives

ST-351A	42Mb Storage at 28.0 ms.	\$119
ST-3120A	108Mb Storage at 14.0 ms.	189
ST-3144A	131Mb Storage at 16.0 ms.	209
ST-3290A	280Mb Storage at 16.0 ms.	289
ST-3243A	212Mb Storage at 15.0 ms.	\$249
ST-3390A	344Mb Storage at 14.0 ms.	369
ST-3550A	452Mb Storage at 12.0 ms.	499
ST-3655A	528Mb Storage at 10.5 ms.	859
ST-9235A	209Mb Storage at 18.0 ms.	\$479

SCSI Hard Drives

ST-1200N	1.05Gb Storage at 10.5 ms.	\$1040
ST-12400N	2.1Gb Storage at 9ms	2129
ST-4786N	663Mb Storage at 15.5 ms.	\$825
ST-41851N	1.85Gb Storage at 15.0 ms.	1056
ST-3550N	425Mb Storage at 12.0 ms.	\$469
ST-3800N	525Mb Storage at 10.5 ms.	746

Floppy Disk Drives

DDO-05	5 1/4" DSD 380k w/Beige FP	\$40
DDH-06	5 1/4" DSDH 1.2Mb w/Beige FP	52
DDH-09	3 1/2" 720k w/Beige FP/Brt	65
DDH-11	3 1/2" 1.44Mb w/Beige FP/Brt	47
DDH-12	DDH-10 excluding 5 1/4" Bkt.	44
5.25KITFD	Mounts 3 1/2" FD to 5 1/4" Bay	9.85
5.25KITHD	Mounts 3 1/2" HD to 5 1/4" Bay	9.85
5.25KITHDA	Mounts ST-351A in 5 1/4" Bay	8.95
RA1D1	AT Drive Rail Kit	1.99
FP-BLK	Half Height Black Faceplate	2.49

Tape Back-Up Systems

TRAKKER-120	120Mb External, Parallel Port	\$339
TRAKKER-250	250Mb External, Parallel Port	399
AB-250	250Mb External, Parallel Port	340
DJ-10	120Mb Internal System	140
DJ-20	250Mb Internal System	199
IONEGA250	250Mb Internal, 3.5" Slot to FDC	240
PT-252GB	2Gb Internal, 18bit SCSI Interface	1129
FC-10A	Add-On Controller Board (DJ10/20)	99
TC-15A	FC-10A with HS Data Compression	235
KE-10	External Case Kit (DJ10/DJ20)	135

Multimedia Upgrade Kit

Includes a Sony Double Speed Drive with 390ms access, a 300kb/sec transfer rate, 64kb cache buffer and Sony bus interface. Use the SoundBlaster 16 Bit board for recording and playback, MIDI interface, 20 voice FM synthesizer, 10 Channel mixer and compatible with Windows 3.1. Kodak Photo Software includes Encyclopaedia, US World Atlas, and Monkey Island Titles. COOL Multimedia Kit (Sony Drive & 16Bit SoundBlaster) \$535

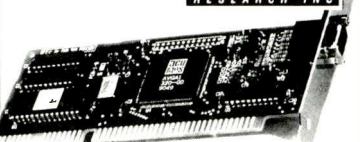
Computer Cases

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	\$85
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 3.5"	8	24 1/2"H x 7 1/2"W x 17"L	138
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-15	Slimline	2 Ext 5.25", 2 Ext 3.5", 1 Int 3.5"	5	4 1/4"H x 17"W x 18"D	79

Mother Boards

MB386SX	is an 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"	\$95.00
MB386SX-40	40 Mhz	
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.	\$169.00
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 two 32-bit VESA Local Bus slots. RAM expandable up to 32MB using SIMM Modules	\$499.00
MB486-33C	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

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IFC-33	Color/Mono Graphics, Printer Port XT/AT	\$25
IFC-35	BOCA Dual Graphics, Color Emulation	35
IFC-44	AEI 640x480, 16 Color VGA w/256k	46
IFC-46	Super VGA 1024x768, 256 Colors, 1Mb	79
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
PGVL-24	POWERGRAPH VESA Local Bus 1/4" Accelerator for Windows(1280x1024) 1Mb DRAM, STB BIOS, RESTER ENGINE	169

Interface Boards

IFC-15	Fixed I/O Board (Serial, Parallel, Clock, Game)	\$25
IFC-24	Disk Diak MFM/2 Floppy Controller AT	55
MIO-500	Dual IDE/Floppy Controller, 2S/1P/1G	25
IFC-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 PCXT	47
ST-01	8Bt SCSI Controller Board	29
ST-02	8Bt SCSI/Floppy Controller Board	49
LCS-8941	VESA LB IDE Caching Cntrl 16Mb (4HD, 2FD)	179
LCS-8741	EISA BUS IDE Caching to 16Mb (4HD, 2FD)	227
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IO2BY4	BOCA 2 x 4 I/O Board. (2 Parallel and 4 Serial Ports)	99
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IFC-25	2 Serial, 1 Parallel and 4 15 pin joystick ports	16
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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

Networking & Communication

ETHERNET	18 Bit Ethernet Adapter (BNC, SGL Chip) and Driver	\$72
LCS-8634MI	18 Bit Ethernet Adapter (AUI, BNC, TPAIR) and Driver	85
LCS-8634TBA	Ethernet Transceiver for AMP Connector	112
LCS-863T-1	Ethernet Transceiver for N-Type Connector	109
LCS-863T-2	Ethernet Transceiver for BNC Connector	79
LCS-863T-3	Ethernet Transceiver for Twisted Pair	86
LCS-863T-T8	8 Port Twisted Pair Repeater (AUI, BNC, TP)	289
LCS-863T-T12	12 Port Twisted Pair Repeater (AUI, BNC, TP)	439
BEN100	BOCA 16-Bit 10-Base-T Ethernet Card	89
PTI-1500T	Pivotal Tech. 16-Bit 10-Base-T Ethernet Card	119.00
LCS-8990+	HighSpeed UART 4 Port UNIX/XENIX MultiUser Card	100

ETHERNET STARTER KIT-Includes Connectors, 25' Cable, Terminators, 18/8-Bit Ethernet Cards and NOVELL NetWare Like Software Nodes. COMBO-NET Network Starter Kit \$298.00

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BB1008	Multi Eight (8) Port Board with Cables	189
BB2018	Multi Sixteen (16) Port Board with Cables	319

Selected BNC Connectors

9021	BNC Male Solder (RG58)	\$1.40
9101	BNC 3 Pc. Male Crimp (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 Arconet BNC Cable	6.89
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PRG-58U	50 Ohm Ethernet (Plenum)	\$0.09	\$0.061
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9275-BEL	75 Ohm CATV	0.18	0.115
PRG-59U	75 Ohm CATV (Plenum)	0.10	0.070
RG-62U	93 Ohm Arconet	0.11	0.073
PRG-62U	93 Ohm Arconet (Plenum)	0.36	0.243
RG-TWX	100 Ohm Twinx	0.32	0.211
PRG-TWX	100 Ohm Twinx (Plenum)	0.80	0.535

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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
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89907	Thin Ethernet, 20AWG (19x32), 100% Shield, NEC CL2P CSA	0.34	0.27
82269	RG-62/U, 22AWG .025 Solid, 95% Shield, NEC CMP CSA	0.39	0.30
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1596A	Level 4, Two Pair, Poly insulated, PVC Jacket, NEC CM CSA	0.07	0.06
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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
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5S	0.73	0.56	C15S	0.65	0.50
5P	0.73	0.58	C25P	0.58	0.44
5S	0.83	0.64	C25S	0.63	0.48

5 Pin Hi-Density D-SUB Connectors

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D15S	1.50	1.20

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H9 Shielded Plastic	0.68	0.52
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H25 Shielded Plastic	0.75	0.58
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H25 Metal Hood	1.95	1.72
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156 101 Keyboard with Regular Footprint for AT XT	
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MA15F-8TS 15S to RJ-11 with Thumbscrews	1.99	1.69
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MA15M-8TS 15P to RJ-45 with Thumbscrews	1.99	1.69
MA15F-8TS 15S to RJ-45 with Thumbscrews	1.99	1.69
MA25M-8TS 25P to RJ-45 with Thumbscrews	1.99	1.69
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MA15M-6 15 male to RJ-11	3.50	2.80
MA15F-6 15 female to RJ-11	3.50	2.80
MA25M-6 25 male to RJ-11	3.00	2.40
MA25F-6 25 female to RJ-11	3.00	2.40
MA9M-8 9 male to RJ-45	3.50	2.80
MA9F-8 9 female to RJ-45	3.50	2.80
MA15M-8 15 male to RJ-45	4.00	3.20
MA15F-8 15 female to RJ-45	4.00	3.20
MA25M-8 25 male to RJ-45	3.50	2.80
MA25F-8 25 female to RJ-45	3.50	2.80

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PKT Portable 9600 Send/4800 Receive	93

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SL-270 24 Pin Wide Carriage, 329 cps Draft 109 cps LQ	449

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MP-6 6P RJ-12 Plug (6x6)	0.25	0.18
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ue until your ac current flips polarity, which occurs every $1/120$ second, or 8.3 milliseconds. Sometimes, a tube will continue to arc for several ac cycles. Some older power supplies switch off after about 18 milliseconds of power interruption. If the gas tube shorts out for three or more cycles, it can cause the computer to shut down completely.

Avalanche diodes are similar to zener diodes. They have a high resistance until the voltage across them reaches a specific level, at which time, they become conductors and short out a surge. They're generally faster than MOVs, but they have limited power capacity.

MOVs, gas tubes and avalanche diodes all work by shorting out the surge and keeping it away from your computer. A reactive circuit uses a different principle. It uses a large inductance to smooth out a surge and spread it over a relatively long period of time. The inductor is coupled to a capacitor so that the output of the circuit resembles standard ac power.

Reactive circuits also absorb other noise on the ac power line, but they also have some important drawbacks. One is that they require a very large inductance to effectively spread out a surge, since they have no way to dissipate the incoming energy. Also, they work only on normal-mode surges. In fact, a reactive circuit can even cause a common-mode surge.

The most-common and least-expensive surge protectors are those available from home centers and discount stores for between \$10 and \$25. They normally use a plug strip with three MOVs (one on each pair of lines) mounted inside them. The least-expensive have only a single MOV device in them. Since there's no way for you to know which MOV has failed, these cheaper surge protectors are generally unacceptable for computer use. In fact, it's difficult to imagine what they should be used for.

Commercial surge protectors generally combine several technologies and build in two or more stages of surge protection, each isolated by inductors. The result is faster response time and longer life. They normally use gas tubes or heavy-duty MOVs for the first stage and a second stage with either more MOVs or avalanche diodes. If you shop for one of these surge protectors, make sure that it covers both normal-mode and common-mode surges.

These units often cost between \$25 and \$100, with the more-expensive ones including switched outlets and other features. Select the more-expensive ones only if you want the additional features because they rarely offer improved protection.

Many surge protectors boast of their ability to filter out emi (electromagnetic interference), along with their surge protection. This is an unimportant feature for computers, all of which must meet FCC Class A or Class B noise-reduction standards. The same required filters that keep emi noise from leaving your computer and contaminating the power lines in your building also keep noise from getting into your computer. Therefore, don't pay more for emi filtering on a surge protector.

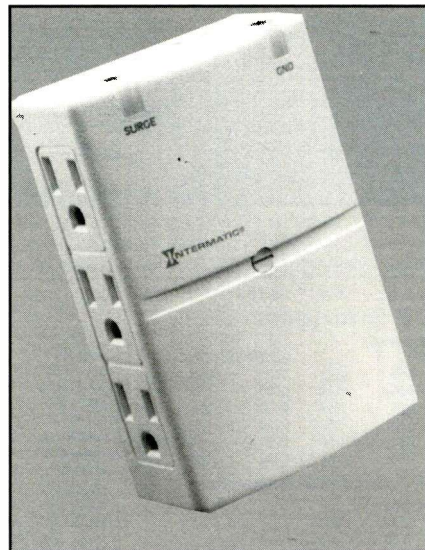
Installing a surge protector is simple. Plug it into a convenient ac wall outlet and plug your computer and peripherals into the surge protector's ac outlets. While you're at it, look for a surge protector for your telephone line, especially if you use a modem and/or fax machine. A surge on your phone lines can be just as destructive to your telephone equipment as a surge on the ac power line can be to your computer equipment.

Keeping Power

A surge protector won't do any good if the power company decides to take the afternoon off—or at least a second or two. Nor will it do you any good during a brownout, which can destroy your PC as thoroughly as can a powerful surge.

For protection against both blackouts and brownouts, you need a backup power system. Such systems can keep surges from reaching your computer, keep your machine running during brownouts and even during blackouts, at least long enough for you to save your data to disk and let you shut down your system in an orderly manner.

Three kinds of backup power supplies exist: off-line, on-line and internal. Off-line systems are often called standby power supplies that wait until a blackout occurs before switching themselves on and applying power to your PC. Often sold as "uninterruptible power supplies," which they aren't, these switching or standby power systems contain a sensing circuit that can detect that ac power at the outlet into which they're plugged has failed and



Intermatic's Model EG 63SAC and EG 63STAC side-entry surge protectors plug directly into an ac outlet and guard against excessive power-line surges and spikes. They feature audible alarms that signal when problems arise.

turn on backup power in a matter of milliseconds.

Internally, a standby power supply has two sets of rechargeable batteries, an inverter to turn the direct current of the batteries into the alternating current your computer needs, a battery charger for keeping the internal batteries fully charged and a switch for making the change from wall-outlet ac to internal battery-generated ac power. Better standby systems also have spike and surge protection and sometimes multiple switched outlets for controlling your computer and peripherals individually.

A standby power supply with a built-in, high-quality surge protector will probably give you the best protection for the money. These units are easy to install. You just plug them into a convenient ac wall outlet and then plug your computer system into them.

A true uninterruptible power supply, or UPS, is always on-line. Some times called a "double-conversion" UPS, this type of power supply never interrupts the flow of power to your computer, not even for a fraction of a second.

Inside a UPS, the power from the ac wall outlet is converted to dc and used to charge a set of batteries. Power from these batteries is sent through an inverter and into your computer. The system constantly charges its batteries and constantly converts its battery power into the alternating current re-

quired by your computer.

In addition, these double-conversion systems give the best surge and spike protection because the computer is isolated from the utility company's power by the battery. Thus, there's no way for a spike to get through the system and harm your computer.

The down-side is that double-conversion systems cost two to three times as much as standby systems. The newest trend in UPS technology is a type of system called an "on-line backup system." In a typical on-line backup system, incoming power is sent to both a battery charger and a transformer. The PC's power is taken from the output side of the transformer. The output of the batteries, which is normally off, is connected to a different winding of the transformer. Like a standby power system, the UPS continuously monitors the power coming from the utility company. When it notices the power drop or turn off, the UPS turns on the battery output. However, because of the reactance of the transformer, which stores some

energy in its magnetic fields, the power output to the computer never drops, even during the switching operation.

Because on-line backup systems leave the computer connected to the power main most of the time, they must have a built-in surge protector to completely condition the power going to the computer.

You can also find internal backup power supplies, which put battery charger, batteries, sensor, switch and surge protection all on a single expansion card. These systems are usually supplied with special software than can automatically save the current state of your computer (all RAM, video memory and port and processor states) as soon as the backup system notices that a power failure has occurred.

The down-side of internal backup power supplies is that they're expensive and the software often has a difficult time coping with such things as TSRs, paged memory and shadowed ROM. Also, you must reserve enough space on your hard disk for the saved

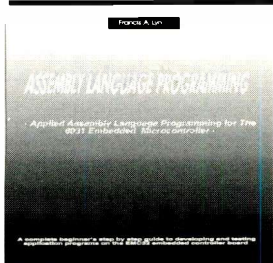
memory and video contents (more than 9M if you have 8M of RAM and a 1M video adapter).

Selecting a Power Supply

Whether you select a standby or uninterruptible system, you must match its battery output with your computer system. You'll want your system unit connected to the power supply, and probably your video monitor as well. Consider adding your modem, especially if you transfer important data into or out of your computer, but ignore your printer. A printer, especially the laser variety, draws too much power to be put on a UPS, unless you have a special need to do so.

Most power outages last for a few seconds to a minute. It's rare for one to last for hours. You won't be able to afford a power supply that can last for hours, unless you buy a gasoline- or diesel-fuel-powered generator to run your computer. Aim for a few minutes

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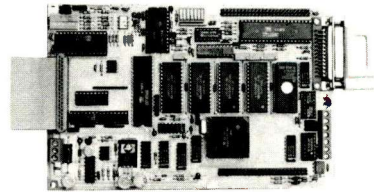


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of power time, making it enough for you to save whatever work is in progress and for a safe, orderly power-down.

If you're buying a UPS to use with a file server, you'll need more time than you would for an individual PC. The server will have to signal all computers on the network that the system is shutting down. Then it will have to wait until each computer signs off the network (or crashes as a result of the power failure). Finally, there must be enough time left in which to gracefully shut down the server.

Power supplies are sold according to their capacity, both in terms of output power and of the length of time they can supply power. You'll have to give both numbers careful consideration to select the best supply for your system.

Output power can be specified in either watts or volt-amperes (VA). If you're familiar with Ohm's Law, you probably remember that watts equals volts times amperes ($W = VA$), and you might wonder why two different power measures would be used to specify the capacities of power supplies. Bear in mind that in an ac circuit, watts don't necessarily equal volts times amperes if the current in the system peaks in a different phase than the voltage does. When the voltage is at maximum, current might be at an intermediate level.

Most power supplies are sold according to their VA ratings, not wattages, because it appears to be the greater of the two. You must ensure that the total VA of your system is less than the VA available from the particular power supply on which you've decided, or that the watts needed by your system are less than the watts available

from the supply. Don't mix VA and watts, however. If you need to convert, you might find a "power factor" in the power supply's specification, which is the ratio of watts to VA. Multiply the VA by the power factor to determine the wattage available.

Specifications for most power supplies also include a duration chart that shows how long various amounts of power can be supplied by fully-charged batteries. For example, the rating might state that a unit can supply 250 VA for 20 minutes. Whether or not your system lasts this long depends on the condition of the batteries, of course. If your computer and video monitor draw a different amount of power, the duration listing won't do you much good. You can interpolate between power values in a duration chart, but it's difficult to extend it to values greater or lesser than the ones given in the chart. Just remember that you'll need only enough duration to shut down your system in an orderly manner if the power doesn't come back on in a few minutes.

In general, if you have a desktop 386 or 486 computer and a typical 12" to 14" VGA video monitor, you'll need about 350 VA of power from a power supply. A tower computer may need up to 500 VA of power because of its larger internal power supply and fan and the possibility that it has more cards plugged into the motherboard's bus slots.

Few power supplies, except for some of the expensive double-conversion UPS models, create the typical sine-shaped waveform of normal utility-company power. Instead, they create square-

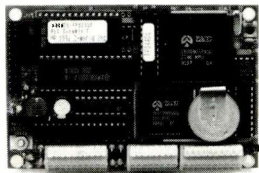
wave alternating current that may not be exactly 60 Hz in frequency. Square-wave electricity shouldn't create any problems if it's used for only a few minutes. In long-term use, it could cause a computer to overheat. Nor do computers need an accurate 60-Hz power-line frequency unless you're using electrical instruments that use power cycles for timing. If you have special needs, you may be concerned with power waveforms and frequencies, even if most of us don't have to be concerned about these matters in our everyday run-of-the-mill systems and applications.

Using a UPS—whether standby, on-line or double-conversion model—is as easy as using a surge protector. You simply plug the UPS into an ac outlet and plug the computer and whatever peripherals you routinely used into it. Some UPSes come with LEDs, dials and other gauges, while others have almost no external indicators.

Some power-supply manufacturers strongly suggest that you leave their products on at all times and turn on and off your computer and video monitor with their separate power switches. Others recommend that you use the UPS switch instead of the switches on your computer and video monitor. My advice is to follow the manufacturer's recommendations for the unit you buy. The differences are based on internal wiring variations from one manufacturer to another and even from one model to another.

Once you have your UPS up and running, make sure to cover its unused power outlets with tape or dummy plugs. Otherwise, someone (possibly even you) will come along and plug a heavy load into the UPS instead of into an ac wall outlet, which can quickly destroy an expensive UPS, leaving a smoking ruin in its place.

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Summing Up

Although many of us rarely think about the power that enters our computers, we all need to take precautions. If you work with critical data and can't afford to have your computer fail unexpectedly, you need a UPS with a good built-in surge protector. The rest of us need a good commercial-grade surge protector. Just don't buy a cheap surge protector for your computer. It simply won't provide the protection your computer deserves. ■

Build a Home-Automation Telephone Interface

This microcontroller-based device lets you control any electrically-powered device in your home from any telephone anywhere

Wouldn't it be great to be able to control any electrical device in your home just by lifting the receiver of any telephone you happen to be at? If this sounds like something you've been looking to do, the Home-Automation Telephone Interface presented here is what you need. Using a standard Touch Tone™ telephone, an X-10 TW-523 power-line interface and X-10-compatible modules, you'll be in full control of your home.

X-10 Details

X-10 is a communications protocol for controlling electrical devices. The signal this protocol develops is superimposed on the 60-Hz waveform of the 117-volt ac line. Even though the only legal way to access the patented X-10 codes is via the TW-523 power-line interface, the advantage is that all ac interfacing is handled by the TW-523.

The small TW-523 device plugs into a standard ac receptacle and connects to a microprocessor through an RJ-11 modular telephone jack. Three optically-coupled signal and common lines are provided by the TW-523. The signal lines are transmit, receive and zero-cross. All X-10 codes are synchronized to the zero-cross signal.

All transmissions are synchronized to the zero crossing of the ac power-line waveform. All signals should be transmitted as close to the zero-cross as possible but at least within 200 μ s of actual zero-crossing. The TW-523 unit provides a 60-Hz square wave with a maximum delay of 100 μ s from the zero-crossing point. Maximum delay between the transmit request from the microprocessor and generation of the 120-kHz burst in the TW-523 is 50 μ s.

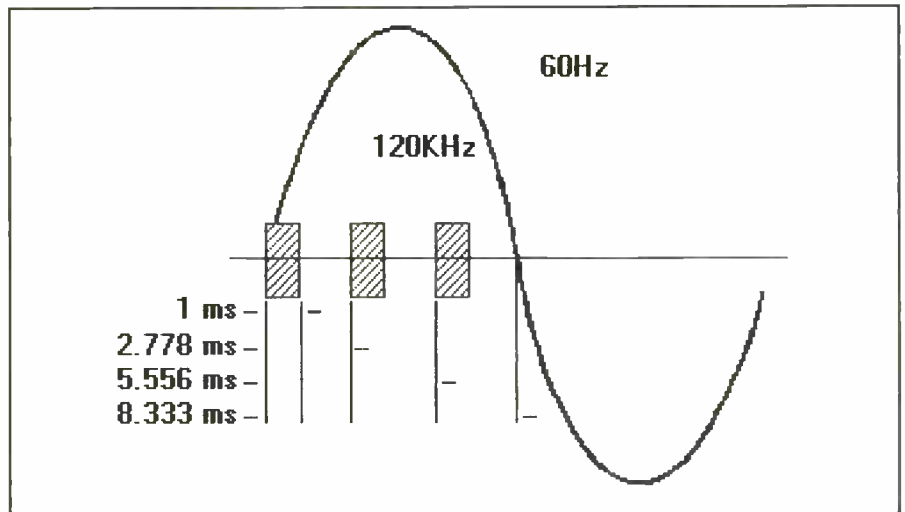


Fig. 1. Bursts must be transmitted in a manner that assures coincidence with zero-crossing points of all three phases in a three-phase system.

Thus, the transmit request must be made within 50 μ s of the zero-cross square wave.

A logic 1 is represented by a 1 ms burst of 120-kHz signal at zero-cross. A logic 0 is formed by the absence of the burst. Since the 120-kHz signal burst is generated inside the TW-523, you have only to send a logic 1 for a period of 1 ms. The 1-ms bursts must be transmitted in a manner that assures coincidence with the zero-crossing points of all three phases in a three-phase system, as illustrated in Fig. 1.

To form a complete code transmission, 11 cycles of the power line are required. The first two cycles represent the start code, the next four represent the house codes and the remaining five represent the number or function codes. This complete block must be sent in groups of two, with three power-line cycles between them. The only exceptions to this are the bright and dim func-

tions, which should be transmitted continuously. A simple data check is performed by sending the house and function (number) codes in complementary form on alternate half cycles of the ac line. The start code, which doesn't conform to this rule, must always be 1110, which is used to distinguish it from the house and function codes.

About the Circuit

The circuit of the Home-Automation Telephone Interface is centered around a microcontroller and a DAA (Data Access Arrangement) micro-module. The complete schematic diagram of the Telephone Interface circuitry is shown in Fig. 2. An Intel single-chip microcontroller is used to simplify the design. The 8751 microcontroller, identified as U1, is an Intel MCS-51 series device that consists of a full-duplex serial port, two timers, 128 bytes

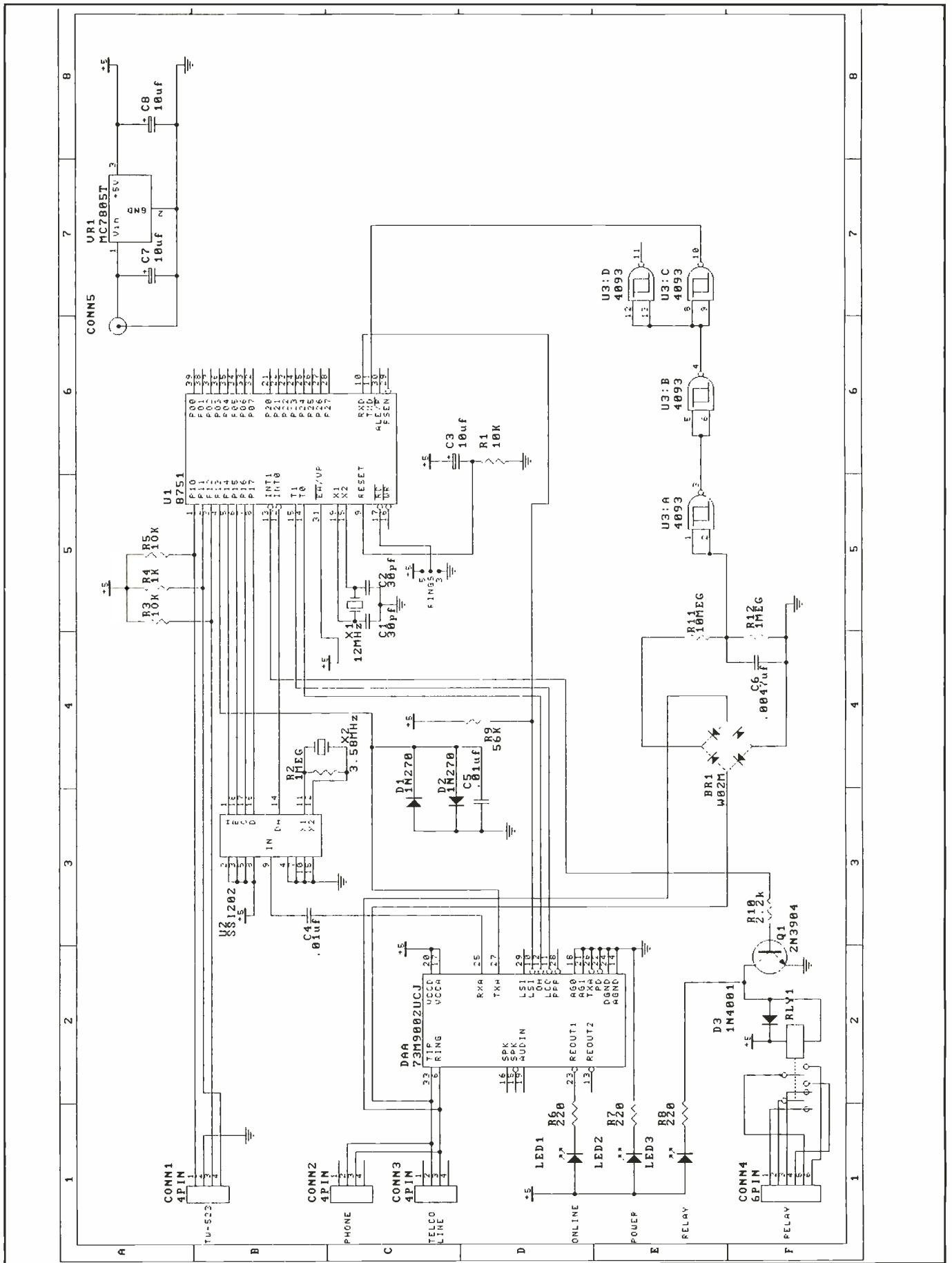


Fig. 2. Complete schematic diagram, less dc power supply, of Home-Automation Telephone Interface circuitry.

PARTS LIST

Semiconductors

BR1—W02M bridge rectifier
 DAA—73M9002UCJ TDK DAA micro-module
 D1,D2—1N270 diode
 D3—1N4001 diode
 LED1,LED2,LED3—Red light-emitting diode
 Q1—2N3904 npn transistor
 U1—8751 microcontroller (must be programmed)
 U2—SSI202 DTMF decoder
 U3—4093 Schmitt trigger
 VR1—7805 fixed +5-volt regulator

Capacitors

C1,C2—30-pF mica
 C3—10- μ F, 16-volt tantalum
 C4,C5—0.01- μ F ceramic disc
 C6—0.0047- μ F ceramic disc
 C7,C8—10- μ F, 16-volt electrolytic

Resistors (¹/₄-watt, 5% tolerance)

R1,R3,R5—10,000 ohms
 R2,R12—1 megohm
 R4—1,000 ohms
 R6,R7,R8—220 ohms
 R9—56,000 ohms
 R10—2,200 ohms
 R11—10 megohms

Miscellaneous

CONN1,CONN2,CONN3—Four-position RJ-11 telephone connectors
 CONN4—Six-position RJ-11 telephone connector
 RLY1—Dpdt 5-volt relay
 X1—12,000-MHz crystal
 X2—3.58-MHz crystal

TW-523 power-line interface; printed-circuit board or perforated board with holes on 0.1" centers and suitable Wire Wrap or/and soldering hardware (see text); suitable enclosure; sockets for DIP ICs (optional); machine hardware; hook-up wire; solder; etc.

Note: The following items are available from Audio Visual Imagery, PO Box 332, Randolph, MA 02368: ready-to-wire printed-circuit board, \$35; pre-programmed microcontroller, \$30; TW-523 power-line interface, \$30; TDK 73M-9002UCJ DAA, \$35; SSI-202, \$7; complete kits (excluding case and bezel), \$175. Also available from the same source is a diskette with source code, HEX and BIN files, which is included with any order. Add \$2.50 first class S&H to any order. Massachusetts residents, please add 5% sales tax.

of RAM and 4K of internal ROM.

The clock source for *U1* is controlled by 12-MHz crystal *X1* and capacitors *C1* and *C2*. At power-up, a reset circuit made up of *R1* and *C3* initializes the microcontroller. Since the software that controls the interface is contained internally, the EA line at pin 31 of *U1* must be held high.

Interfacing to the TW-523 unit is provided through connector *CONN1*,

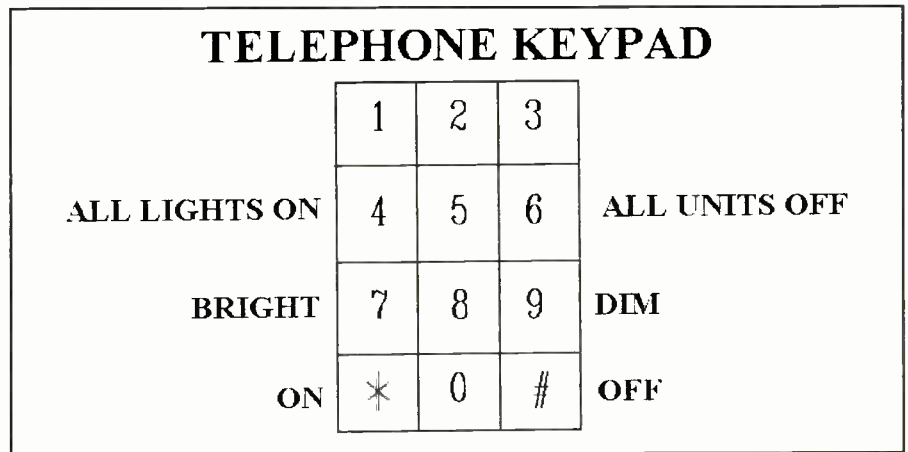


Fig. 3. X-10 function assignments for standard Touch Tone™ keypad.

with resistors *R3*, *R4* and *R5* providing the required pull-up action. Connection to the telephone line is handled by *DAA*. This device permits direct connection to the PSTN (Public Switched Telephone Network) and provides surge protection, isolation, filtering and audio-signal conversion. It outputs the received audio signal at pin 27 and accepts transmit audio at pin 25. Received audio is sent through *C4* to DTMF tone decoder *U2*.

Chip *U2* decodes the tones as they're received and converts them to binary equivalents. When a valid tone has been decoded, the DA line at pin 14 goes high. This signal is used to interrupt the microcontroller so that it can read the binary code. After receiving a complete message, the microcontroller emits a short- or long-duration tone, confirming reception. The tone signal is on pin 4 of *U1*. Diodes *D1* and *D2* and capacitor *C5* condition the audio by limiting and filtering it. The tone is sent to pin 27 of *DAA*.

To permit use by telephones inside your home, an in-use detector is required. This is provided by the simple circuit made up of *BR1*, *R11*, *R12*, *C6* and *U3*.

A normal telephone line has about 48 volts on it when the handset is on-hook and about 6 volts when the handset is off-hook. By monitoring the voltage on the telephone line, you can determine the current state of the phone system. The bridge rectifier isolates the circuit from the line. When the line isn't in use, the voltage divider made up of *R11* and *R12* places a logic high on pins 1 and 2 of *U3*. When the voltage on the telephone line drops, indi-

cating that a handset has been lifted off-hook, a logic 0 is presented. This signal is shaped by the Schmitt trigger inside *U3* and is sent to *U1*.

Relay *RLY1* controls any device that requires a dry contact to activate or deactivate, such as a garage-door opener or a security system, and is driven by the simple circuit made up of *Q1* and *R10*. Diode *D3* reduces potentially harmful inductive spikes that can occur when the relay is energized. Light-emitting diodes *LED1*, *LED2* and *LED3* indicate the state of the Telephone Interface, power-on and state of the relay, respectively. Current limiting for *LED1*, *LED2* and *LED3* is provided by *R6*, *R7* and *R8*, respectively. Connectors *CONN2* and *CONN3* are both four-position RJ-11 units, while connector *CONN4* is a six-position RJ-11 type.

The software inside the microcontroller is interrupt-based. At reset, the internal RAM is cleared and the timers are initialized. The interrupt priority is set and the registers are established. The main loop checks for rings and activity on the telephone line. Once the correct number of rings is detected (controlled by a jumper on pin 17 of *U1* that gives a choice of either three or five rings), the interface responds with four short beeps. If the call is from outside the home, a security code is required. The user enters the code ***147, and the unit responds with two short beeps. He has three chances to get the code right. After this, an incorrectly keyed code causes the unit to hang up.

If a call is from inside the home, the security check is bypassed. The interface then waits for DTMF tones that form valid requests. If a non-valid re-

Table 1. Use Information for X-10 Commands

House	Unit	House	Unit
A-10	1-01	I-09	9-09
B-02	2-02	J-10	10-10
C-03	3-03	K-11	11-11
D-04	4-04	L-12	12-12
E-05	5-05	M-13	13-13
F-06	6-06	N-14	14-14
G-07	7-07	O-15	15-15
H-08	8-08	P-16	16-16

quest is made, a long beep of a lower frequency is sent.

Operation

All correct entries are followed by two short high-pitched tones, and all rejected entries are followed by one long low-pitched tone. All entries must be six digits in length. To control the relay, you send ####66 (corresponds with O and N on keypad) to issue an ON command or ####63 (corresponds with O and F on keypad) to issue an OFF command. To hang up the unit remotely, send #####.

To send X-10 commands use the pattern: *HHUUF, where * is the Start character, HH is the House Code, UU is the Unit Code and F is the Function Code. Use the information given in Table 1 to form requests. House Codes A through P, and Unit Codes 1 through 16 are supported. For example, to send an ON or OFF command to a light or appliance module, use the format:

A-1	ON	*0101*
J-7	OFF	*1007#
P-16	ON	*1616*

To dim or brighten a lamp plugged into a controlled X-10 module, use the format:

A-1	DIM	*01019
J-7	BRIGHT	*10077
P-16	DIM	*16169

This will dim or brighten each of the units one step. To dim or brighten over a wider range, enter the first six digits as usual. Then, with no delay, press and hold the last key again, as follows:

A-1	DIM	*01019 9 (hold)
J-7	BRIGHT	*10077 7 (hold)
P-16	DIM	*16169 9 (hold)

This will dim or brighten each of the units UP or DOWN until you stop holding the final digit.

To send ALL LIGHTS ON or ALL

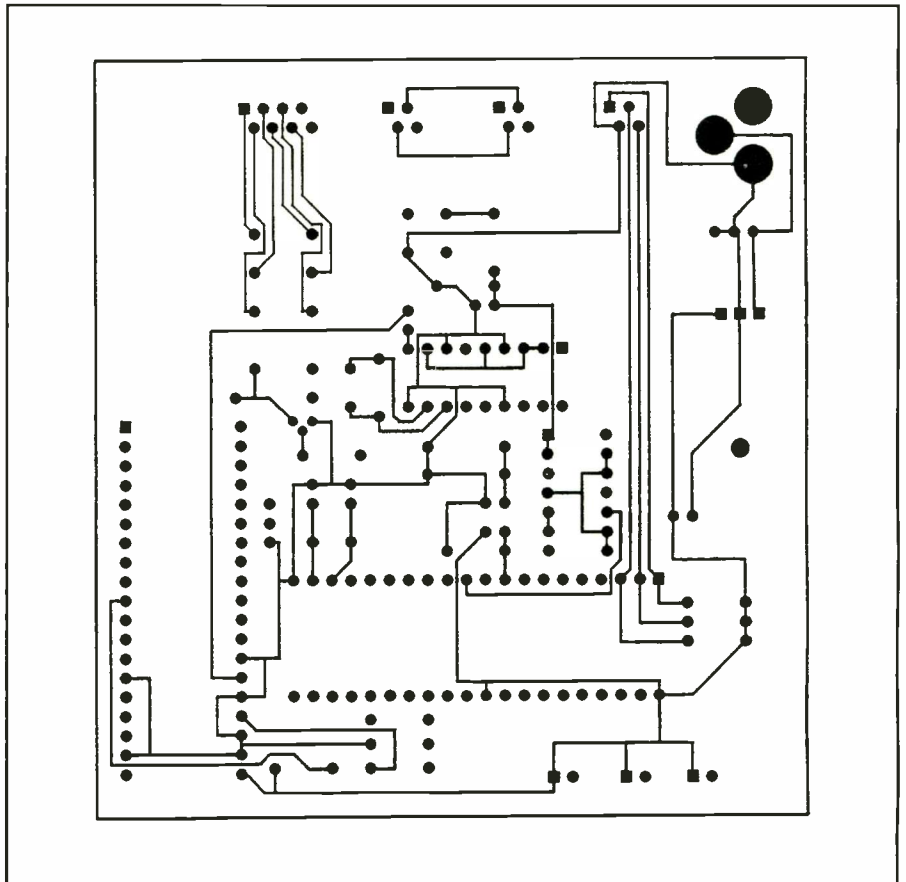
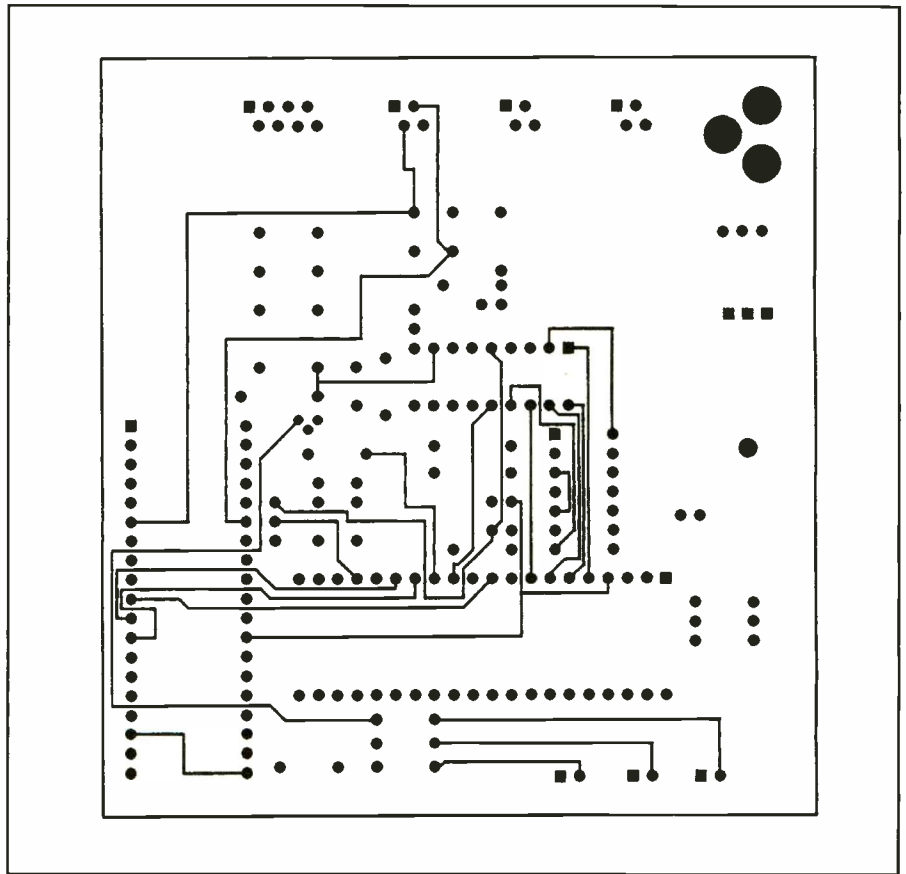


Fig. 4. Actual-size artwork for (A) top and (B) bottom of printed-circuit board.

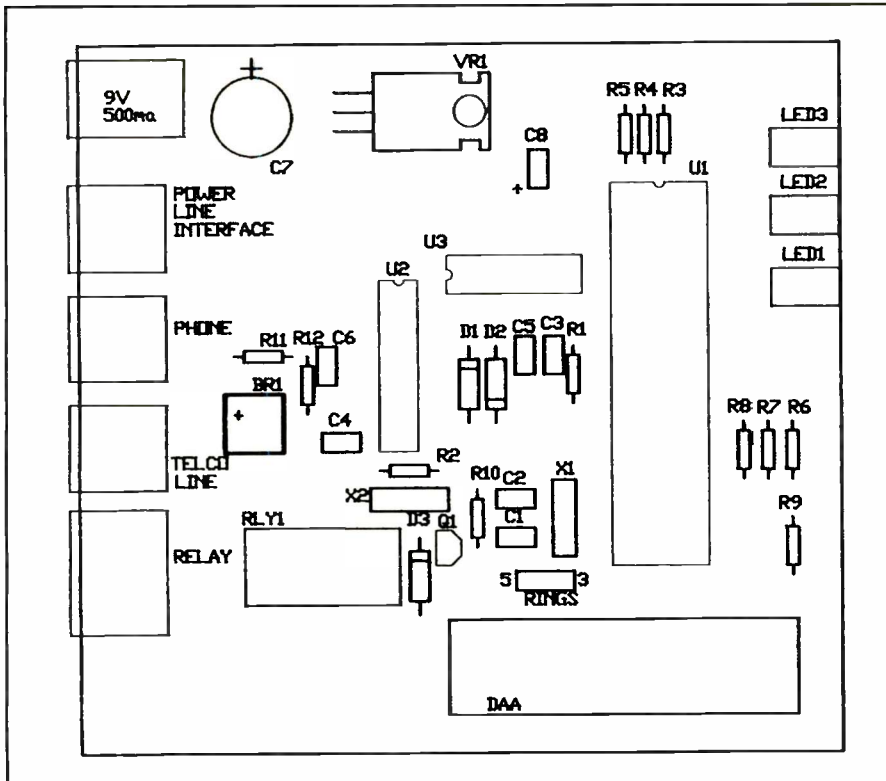


Fig. 5. Wiring guide for pc board.

UNITS OFF commands to a certain House Code, the format is as follows:

A	ALL LIGHTS ON	*01014
J	ALL LIGHTS ON	*10014
P	ALL LIGHTS ON	*16014
A	ALL UNITS OFF	01016
J	ALL UNITS OFF	10016
P	ALL UNITS OFF	16016

Although a Unit Code must be entered, it isn't used for these functions.

Refer to Fig. 3 for details on the Touch Tone keypad keys to press to activate the various functions possible with this system.

Construction

Building the Home-Automation Telephone Interface is a straightforward procedure. The circuitry is simple enough that it can be assembled and wired on perforated board that has holes on 0.1" centers using suitable Wire Wrap or/and soldering hardware. Of course, it would be better in terms of reducing the possibilities of wiring errors to use a printed-circuit board.

If you prefer to fabricate your own pc board, use the actual-size etching-and-drilling guides shown in Fig. 4 as your artwork. Alternatively, if you prefer not to fabricate your own but still prefer pc construction, you can purchase a ready-

to-wire board from the source given in the Note at the end of the Parts List.

When you're ready to wire your board, refer to Fig. 5 for details on component placement and orientation. Though sockets are recommended for the DIP ICs, they aren't required. Use standard assembly techniques when wiring the board, starting with installation of all the small components like diodes, resistors and capacitors. Make sure that the diodes and electrolytic capacitors are properly oriented before soldering their leads into place.

With the small components installed, proceed to installation of the LEDs, voltage regulator VR1, connectors, transistor, crystals, relay and ICs. Again, make sure the LEDs are properly oriented and that the transistor and voltage regulator are properly based before soldering leads into place. Also, make sure that the DIP ICs are properly oriented and that no pins overhang the sockets or fold under between ICs and sockets. Install DAA last.

Checkout & Use

Connect to your Home-Automation Telephone Interface a suitable dc power supply via CONN5, making sure to properly polarize the supply. Then

connect a TW-523 unit to the project via CONN1, and plug the TW-523 into an ac outlet. Next, connect the project to the telephone line by plugging opposite ends of a standard four-conductor RJ-11 cable into CONN3 and a telephone-line jack. If you have only one telephone jack, unplug the instrument from it and plug it into CONN2 and then make the project-to-line connection. Finally, plug a six-conductor telephone cable with a six-position RJ-11 telephone jack on only one end into CONN4 and separate the conductors at the other end so that no conductor touches any other conductor.

Power up the system and perform a test run. If the Telephone Interface doesn't respond as it should, make sure all cables are installed correctly. If the connections appear to be okay, check for the presence of 9 volts dc at the input between pins 1 and 2 and 5 volts dc at the output between pins 3 and 2 of VR1. If the voltages are present, touch an oscilloscope probe to pin 18 or 19 of U1 to determine if the oscillator is running. If it is, move the scope probe to pin 30 of U1 to determine if a signal that's one-sixth the oscillator frequency is present. Make sure that you obtain a reset signal at power-up. Check for received audio on pin 9 of U2. If the DA signal isn't active while tones are received, check the oscillator made up of X2 and R2.

If the project works on outside calls only, check the telephone-line voltages. If these are significantly high or low, you may need to adjust the values of R11 and R12. Make sure U3 is wired into the circuit correctly. Also, check the polarity of BR1. When the interface is sending X-10 codes, the LED on the front of the TW-523 will blink. If it doesn't blink, check the wiring of CONN1 and the values of R3, R4 and R5. If you don't get tones that confirm operation, check the polarity of D1 and D2.

The assembly-language source code and HEX and BIN data are available on floppy disk from the source given in the Note at the end of the Parts List. With a little pre-planning, such as assigning different house codes to each room in your house, every electrical device in your home can be controlled from any telephone, anywhere. If your telephone has a built-in automatic-dialing function, you can program macros to control repetitive operations. ■

Multiple-Choice Booting With MS-DOS 6.0

Some tricks you can use in MS-DOS 6 to make your computing easier and more convenient

How many times do you change your CONFIG.SYS or AUTOEXEC.BAT files before you boot your computer? If it's often, you have sets of CONFIG and AUTOEXEC files from which to choose, copying whatever set you need as CONFIG.SYS and AUTOEXEC.BAT and then re-booting your computer. If you're a power user, you have batch files to automate the process. You might even be using *BOOTCON* from Modular Software Systems or a shareware program that lets you create a menu of boot-up choices. You can now do the same thing within MS-DOS 6.0 itself. It thoughtfully provides you with the capability to specify up to nine different configurations within CONFIG.SYS and then to link AUTOEXEC.BAT commands to them.

In this article, I'll explore some hypothetical scenarios so that you can see examples of how to set up your CONFIG.SYS file for multiple-boot choices and how to code corresponding AUTOEXEC.BAT statements. Here are three possible scenarios:

(1) You need to run an ill-behaved program that thinks it's running under an old version of DOS and is bypassing the BIOS to do its own low-level hardware accesses. It can't run with an extended-memory manager or a disk-caching utility.

(2) At times, you need to log onto a network and work in Lotus 1-2-3.

(3) If you're not logging onto a network, you don't want to load the network drivers. You'll be running under *Windows*.

(4) You want to run a DOS version of a database manager like *dBASE* that's happier without the disk-caching services of SMARTDRV.

```
[menu]
menuitem=PlainDos,Dinosaur Accounting
menuitem=Network,Network Logon
menuitem=Windows,Local Windows
menuitem=Database,Database
menudefault=2,10
menucolor=15,1

[PlainDos]
FILES=30
BUFFERS=30
DEVICE=C:\DOS\ANSI.SYS
DEVICE=C:\DOS\SETVER.EXE
SHELL=C:\DOS\COMMAND.COM /E:512 /P

[Network]
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH,UMB
DEVICE=C:\DOS\EMM386.EXE RAM X=
C800-CBFF
DEVICEHIGH=C:\DOS\SETVER.EXE
FILES=256
BUFFERS=30

[Windows]
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH,UMB
DEVICE=C:\DOS\EMM386.EXE NOEMS M9
DEVICEHIGH?=C:\ACAD\SVGA25.DRV
BUFFERS=10
FILES=30

[Database]
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH,UMB
DEVICE=C:\DOS\EMM386.EXE NOEMS M9
FILES=99
BUFFERS=40
```

Fig. 1. New version of CONFIG.SYS file.

Multiple CONFIG.SYS Configurations

The new version of your CONFIG.SYS program would look like the listing shown in Fig. 1. The first block of commands in our CONFIG.SYS file, consisting of the first 8 lines, defines a

startup menu. The first entry, [menu], is a required instruction that creates a menu on the screen during boot-up. The menuitem command defines a configuration block header. Configuration blocks are explained below. The header must be one word. The text after the comma will be displayed on the menu line on the screen.

The menudefault entry defines the default choice when the menu appears on-screen, in this case, Network Logon. The second number indicates the number of seconds the system will count down while waiting for you to make a choice other than the default. Pressing any key except Enter will turn off the default countdown, and the menu will remain on-screen until you make a numeric choice or choose a function key action (see Fig. 2). Menudefault is optional. If you do not include it, menuitem 1 is the default. The name of the configuration block, e.g. Network, may be used in place of its number on the list.

You can choose text and background colors for your session with the menucolor command. The colors remain in effect after you exit from the menu. In the above example, the background will be blue (1) with bright white characters (15). To see a list of color choices type help menucolor at the DOS prompt. If you invoke *Windows* or DOSHELL when you exit, your menu-color selections will no longer be in effect. Figure 1 shows a screen display created from the above menu block.

Configuration Blocks

Each menuitem above refers to a configuration block which contains a group of CONFIG.SYS instructions.

MS-DOS 6 Startup Menu

1. Dinosaur Accounting
2. Network Logon
3. Local Windows
4. Database

Enter a choice: 2 Time Remaining=09

F5=Bypass startup files
F8=Confirm each CONFIG.SYS line[N]

Fig. 2. MS-DOS 6 Startup Menu.

The configuration block is represented by the six lines beginning with the [PlainDos] block in Fig. 1.

FILES and BUFFERS are set to values recommended by the program you plan to run.

This configuration doesn't make use of DOS memory beyond 640K of conventional memory. The 640K figure is the default space programs were limited to by the addressing constraints of the PC/XT class of computers and early versions of DOS. The system actually contained 1M, but users couldn't ac-

cess the upper 384K bytes. You can view memory allocation after this boot sequence (or the following ones) by typing mem/c at the DOS prompt. (See Fig. 3).

SETVER loads a table of known program names which use the VER command. They check to make sure that they're running under the DOS version for which they were created. Because your program calls VER, you added its name to the table, along with the version number it thinks it needs. You're fortunate that your program will actually run under DOS 6.0; otherwise, this ploy wouldn't work.

ANSI.SYS is a DOS-supplied device driver that supports American National Standards Institute terminal emulation. It's used if a program sets display options like color, blink or reverse video.

The SHELL command tells DOS that COMMAND.COM is the command interpreter. A command interpreter processes the commands that you type in at the DOS prompt. COMMAND.COM is the default interpreter, anyway, but you need to use the SHELL command to use the /E switch.

The /E:512 switch enlarges the DOS

environment, which is a common memory area for storing variables to which programs can refer. Your program needs more environment space than the DOS default of 256 bytes.

The /P switch makes this copy of COMMAND.COM permanent (that is, you can't "exit" from it), and it causes the system to run AUTOEXEC.BAT on boot-up. If you use SHELL and leave out /P, you'll have to run AUTOEXEC.BAT yourself.

Another reason to use the SHELL command is that our program overwrites the memory area where the transient portion of COMMAND.COM resides. When the program ends, the memory-resident portion of COMMAND.COM attempts to reload the transient portion from disk. If the file can't be found, the system halts, with a Cannot load COMMAND.COM message.

With the advent of the PC/AT, DOS provided user access to the upper memory area (UMA) of 384K bytes (above the 640K of conventional memory). In addition, memory beyond 1M could now be used for programs and data.

Turning to the [Network] block in Fig. 1, EMM386.EXE enables loading

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of device drivers into the upper memory area. This is accomplished by specifying DEVICEHIGH in CONFIG.SYS and LOADHIGH in AUTOEXEC.BAT. Loading high drivers and programs frees up conventional memory for application-program use.

Unused UMA space is referred to as upper memory blocks (UMB). To get EMM386 to load drivers and TSRs (terminate-and-stay-resident programs) into the UMA, the statement DOS=UMB must be included.

The X switch in the EMM386 line excludes those memory addresses in the UMA from being allocated by EMM386. This is the region your network card is using, and you don't want it to be occupied by other drivers.

The additional memory above 1M is managed as either expanded or extended memory.

The statement DOS=HIGH causes part of DOS and BUFFERS to be loaded in what's referred to as the high memory area (HMA). This is the first 64K of extended memory, not to be confused with the UMA of the first 1M on the system.

Extended memory is a contiguous area of memory above 1M that's ma-

Modules Using Memory Below 1 M:				
Name	Total	=	Conventional	+ Upper
Memory				
MSDOS	73837 (72K)		73837 (72K)	0 (0K)
COMMAND	5040 (5K)		5040 (5K)	0 (0K)
AMOUSE	11344 (11K)		11344 (11K)	0 (0K)
Free	565040 (552K)		565040 (552K)	0 (0K)
Memory Summary:				
Type of Memory	Total	=	Used	+ Free
Conventional	655360 (640K)		90320 (88K)	565040 (552K)
Upper	0 (0K)		0 (0K)	0 (0K)
Adapter RAM/ROM	393216 (384K)		393216 (384K)	0 (0K)
Extended (XMS)	3145728 (3072K)		3145728 (3072K)	(0K)
Total memory	4194304 (4096K)		3629264 (3544K)	565040 (552K)
Total under 1 M	655360 (640K)		90320 (88K)	565040 (552K)
Largest executable program size			564944 (552K)	
Largest free upper memory block			0 (0K)	

Fig. 3. Memory allocation for [PlainDos].

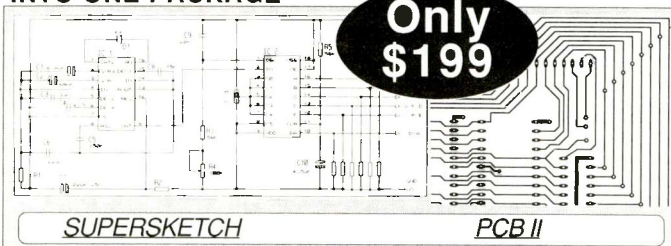
nipulated by an extended-memory manager like HIMEM.SYS or a third-party product like QEMM or 386MAX.

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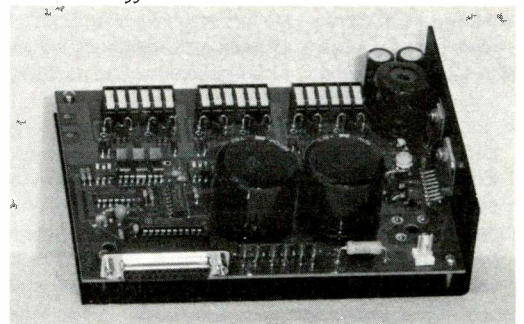
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Expanded memory management is an older technique for using memory above 1M. Lotus, Intel and Microsoft set a standard for its use. It's a bank-switched concept. A 64K chunk of memory is allocated in the UMA as the page frame. Additional memory beyond the 1M limit is used to store data that a program is manipulating.

Originally, a physical board was installed in the PC/XT or AT containing the additional memory, and a memory manager like EMM386 managed it. Programs like Lotus 1-2-3 contained logic to manage their data in paged chunks. When the program needed data that was stored in the additional memory, it was switched into the page frame. Now extended-memory managers can emulate expanded memory, eliminating the need for an additional circuit board.

Extended memory is much more straightforward to use, and newer programs are written to take advantage of it.

The reason for all of the foregoing is to explain the difference between the statements `DEVICE=C:\DOS\EMM386.EXE RAM X=C800-CBFF` and `DEVICE=C:\DOS\EMM386.EXE NOEMS M9`, which appear in the next configuration block ([Windows]). The RAM switch tells EMM386 to create a page frame in the UMA because expanded memory will be used. This configuration block enables expanded memory because the assumption is that you're going to use Lotus 1-2-3 in your network session.

FILES is set to a very large number specified by your network accounting program.

The configuration represented by the [Windows] configuration in Fig. 1 makes use of extended memory, and it specifically disables both the LIM 3.2 (NOEMS) and the LIM 4.0 expanded-memory standards (M9).

DEVICEHIGH with the question mark pauses to ask you whether or not you want to load the driver following the equals sign. You respond by typing Y or N for yes or no.

BUFFERS is set to a small number because you are going to load SMARTDRV in the AUTOEXEC.BAT file. It will be running with Windows to manage disk buffering.

In the [Database] example in Fig. 1, you don't intend to load SMARTDRV in the AUTOEXEC.BAT file. Therefore, you want to increase the number of BUFFERS beyond the default of 15.

```
@ECHO OFF
PROMPT $P$G
GOTO %CONFIG%

:PlainDos
C:\MOUSE\AMOUSE /1
GOTO EXIT

Network
PATH=C:\WINDOWS;C:\DOS;C:\NET;
LOADHIGH SMARTDRV 512 512
LOADHIGH DOSKEY
SET TEMP=C:\WINDOWS\TEMP
IPX
NETX
F:
LOGIN
GOTO EXIT

:Windows
PATH=C:\WINDOWS;C:\DOS;c:\ACAD;c:\CDROM
LOADHIGH SMARTDRV
LOADHIGH DOSKEY
SET TEMP=C:\WINDOWS\TEMP
WIN
GOTO EXIT

:Database
LOADHIGH C:\MOUSE\AMOUSE /1
PATH=C:\DBASE;C:\DOS

:EXIT
```

Fig. 4. An example of an AUTOEXEC.BAT file that corresponds to CONFIG.SYS.

The database manager suggests that you set FILES to a figure large enough to accommodate all the files you plan to open and include some extra margin. You definitely wish to exceed the default of 8.

The [COMMON] Block

Perhaps you have noticed that there's some repetition in loading the HIMEM.SYS driver. The system will recognize a [Common] block wherever you put it and will use the commands in it from that point forward in CONFIG.SYS. Since you use HIMEM.SYS in all but the first configuration block, you could insert a [Common] block right after the [PlainDos] block. It would look like this:

```
[Common]
DEVICE=C:\DOS\HIMEM.SYS
DOS=HIGH,UMB
```

You'd then remove these two instructions from each of the following configuration blocks. You don't need a menuitem for Common.

Bypassing the Setup

If you look at the bottom of Fig. 2 again, you'll see that there are two function keys that you can use on start-up. Pressing F5 bypasses all menu items and load DOS default values. You'll have the minimum number of buffers and files, and there will be no use of high memory or disk caching. AUTOEXEC.BAT will also be skipped. This is useful if you've made a change to CONFIG.SYS or AUTOEXEC.BAT that's causing your system to hang.

If you press F8, the default will be toggled to [Y]. Once you press Enter, you'll be asked to confirm each command in the configuration block you choose. You'll also be asked if you want to run AUTOEXEC.BAT or bypass it. If you press F8 a second time before you press Enter, the default will be toggled back to [N].

You could have several device drivers listed in your configuration block, and you could select only those you wanted for a particular session. The DEVICEHIGH? command accomplishes the same thing without having to use F8.

It isn't necessary to have a menu-driven CONFIG.SYS file to for you to be able to use F5 and F8. If you're fast enough, you can press either of these keys during the boot-up sequence when you see the Starting MS-DOS... message.

Customizing AUTOEXEC.BAT

DOS sets an environment variable called CONFIG to the value of the configuration block header you choose. You can use GOTO statements to branch to labels in your AUTOEXEC.BAT files as long as they match the value of CONFIG in both spelling and case.

An AUTOEXEC.BAT file corresponding to your CONFIG.SYS blocks might look like that shown in Fig. 4.

Our rogue program uses a mouse, so we load a mouse driver in :PlainDos.

The :Network label heads the group of instructions to be executed for logging onto a network, in this case, a Novell Network. The PATH environment variable contains only those sub-

directories you expect to access during this session. *Windows* is first because you'll probably be spending most of your time using it. Performance is optimized if DOS doesn't have to search through a long path to find the location of programs it wishes to run.

SMARTDRV, a software disk-caching utility bundled with DOS, uses extended memory for storing data. If you have a hardware disk-caching controller on your system, you don't need to load SMARTDRV. If you don't have a hardware disk-caching controller, you'll gain a significant increase in performance by using SMARTDRV or an equivalent third-party program. Both *Windows* and DOS come with copies of SMARTDRV.EXE and HIMEM.SYS. Be sure to use the latest versions of these programs you have.

SMARTDRV reads more data into the buffer than the program requests. This is called read-ahead buffering. Experience has shown that the next read request will be likely to require adjacent data in a file. If this data is already in memory, the system won't have to do another physical disk access to retrieve it. SMARTDRV has settings that allow you to cache disk writes also. There are some reasons why you might not want to buffer writes, such as frequent system hangs.

The default values for SMARTDRV cache depend on the amount of memory on your system. There are two settings, one for DOS cache operations and the other for *Windows*. On a system with 4M to 6M of RAM memory, the DOS cache allocation is 2M and the *Windows* cache is 1M. Here you wish to limit the amount of memory SMARTDRV uses to 512K to avoid running out of space needed for some of your other network programs.

DOSKEY maintains a history of commands that you type at the DOS prompt. These commands can be retrieved by pressing the arrow keys and certain function keys. You can edit and re-execute DOS commands without having to retype them. DOSKEY also lets you define macros that are memory-resident command sequences. If you perform certain DOS functions repetitively, setting them up as macros is much faster than running batch files that must be retrieved from disk.

If you run a large number of tasks in different windows during your session, you may not have enough physical

memory for all of them. *Windows* copies the contents of the memory for the tasks that you haven't accessed for a while to disk. It retrieves the information when you activate the tasks again.

You can set up *Windows* to use a permanent swap file. This is usually a hidden file in your root directory of fixed size. The disk space isn't available for other uses. Alternatively, you can define a temporary directory for a swap file that expands and contracts as needed. You are using C:\WINDOWS\TEMP for such a subdirectory. If you don't set a TEMP environment variable, *Windows* will use the root directory in which to store its temporary swap file. When you exit from *Windows*, all swap data is deleted.

IPX (Internetwork Packet Exchange) is a Novell program that's customized during installation. It manages physical communication between the PC's network interface card and the network file server. NETX is the NetWare shell that provides the interface with the PC's version of DOS for data handling. Once you've established a connection with the network file server, you switch to the drive on which the network system files reside (F:) and call the network LOGIN program.

In the :Database section, you load the mouse driver high since you've enabled EMM386 in the matching CONFIG.SYS block. Since you plan to use the *Windows* mouse driver in the :Network and :Windows sections, you don't need to load a separate driver in them.

One final note. MS-DOS 6.0 includes a memory-allocation optimizer called MEMMAKER.EXE that analyzes and updates your CONFIG.SYS and AUTOEXEC.BAT files to make more efficient use of upper memory blocks in loading drivers and other programs high. Do *not* run MEMMAKER on files like the ones in this example. If you do, the results will be beyond your worst nightmare. If you want to use it, you must do a separate run on each CONFIG.SYS/AUTOEXEC.BAT block. You may have to do some further adjusting with the results.

Obviously, the more you know about the programs you run on your system, the better able you are to configure it for ease of use and enhanced performance. MS-DOS 6.0 makes your task a little easier by including functionality you formerly had to find in outside sources. ■

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The Complete PC Expansion-Bus Guide

Important pinout and signal information you need to build your own PC adapter, modify an existing one or troubleshoot a PC

The success of the IBM PC and its clone spin-offs is directly attributable to its open-bus architecture of the original PC. Thanks to an expansion-bus specification that IBM distributed freely, third-party vendors can design and manufacture any product they wish, whether a modem or a widget, and be guaranteed it will work in just about any PC.

Over the years, though, the PC slot matured, simply because the technology matured. The eight-bit 8088 bus gave way to the 16-bit 80286 bus, which gave way to the 32-bit 80386 bus, and so it goes. Consequently, you can now pick and choose almost any conceivable combination of ISA, EISA and local bus, plus more. This gives both you and the board vendor a lot more options. But without a score card, it's difficult to tell who the players are. Here's a look at the PC's expansion slots available today and how to plug into them.

Bus Defined

An expansion bus is designed into a computer to let you expand your system, using readily available adapter cards. For example, even the lowliest 8088 PC can have super-VGA, *Windows*-accelerated graphics by simply replacing an aged CGA video card with something exciting from a vendor like ATI or Orchid, for example. Plug in a fax/modem card, and you turn your PC into an instant communications center.

Regardless of what type of adapter you plug into a slot, the sole purpose

of an expansion bus is to transfer data from the motherboard to plug-in peripherals and, in some cases, from peripherals to the motherboard.

Basically, an expansion bus is a highway of parallel data lanes. Ideally, the width and speed of the expansion bus should match that of the CPU. Herein lies the crux of this story.

Let's take a close look at the various buses now in common usage in PC/compatible computers.

• **ISA Bus.** The ISA (Industry Standard Architecture) bus is the one that started the IBM revolution back in 1980. It's an eight-bit slot that served the industry well for about 10 years but has had little support as of late. The few eight-bit cards designed for this bus that remain on store shelves are fax/modems, network interfaces and maybe a handful of video cards.

With the appearance of the PC AT in 1984, the eight-bit ISA slot was quickly replaced with the 16-bit ISA slot. To make the two slots compatible with existing adapter cards, IBM kept the first socket intact (the one closest to the rear of the system) and added an extra socket to accommodate the new signal and address lines, making the large base of adapter cards compatible with the new upgrade. That was a smart move on IBM's part.

Originally, the ISA slot ran at 4.77 MHz (the speed of the IBM PC/XT's CPU). With release of the PC AT, the speed was increased to 6 MHz and, finally, to 8 MHz (again the speed of the CPU). Not anticipating any increases in CPU speed, IBM decided to freeze the specification at 8 MHz. But

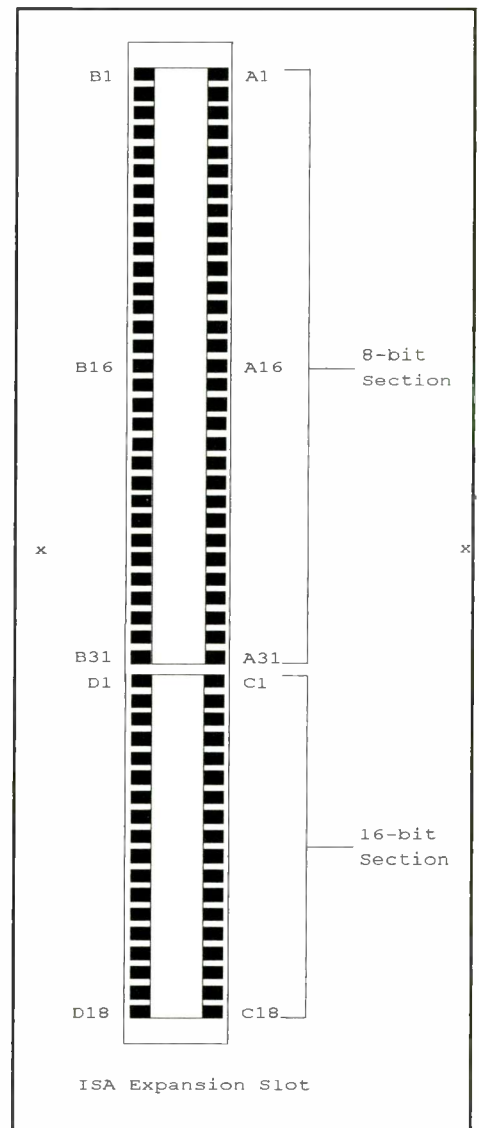


Fig. 1. The ISA bus comes in two versions: the eight-bit version uses only the top connector, while the 16-bit version needs both.

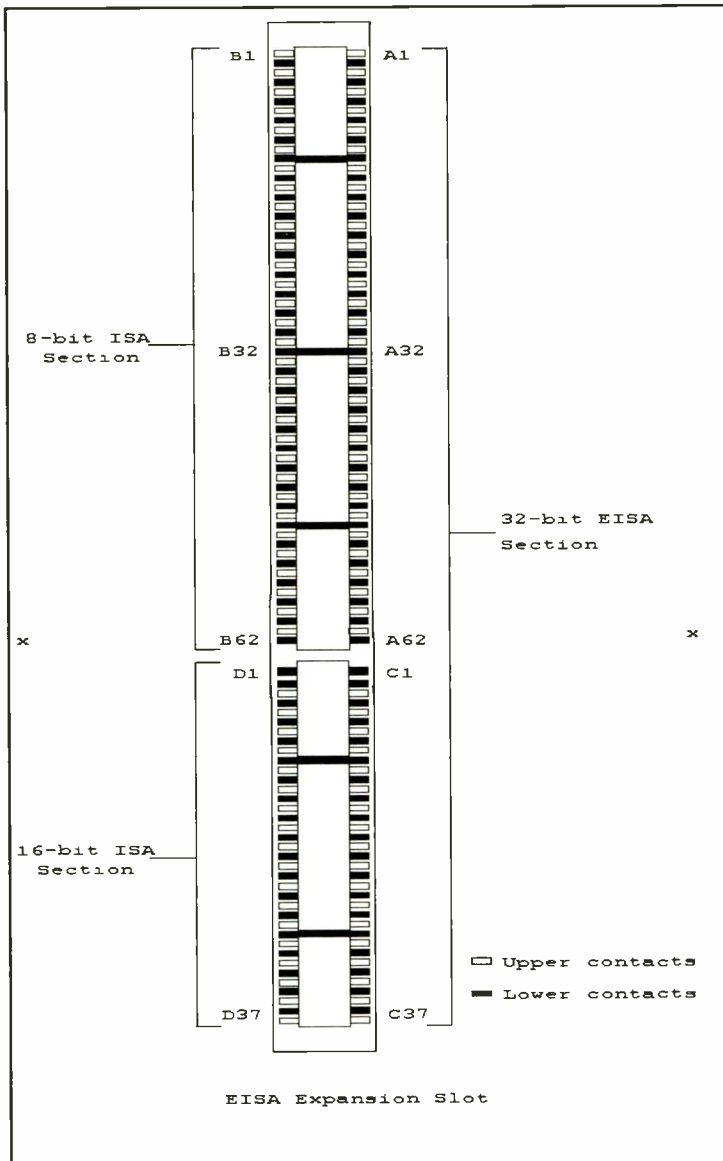


Fig. 2. The 32-bit EISA slot uses a two-tier socket that makes it backward-compatible with eight- and 16-bit ISA cards.

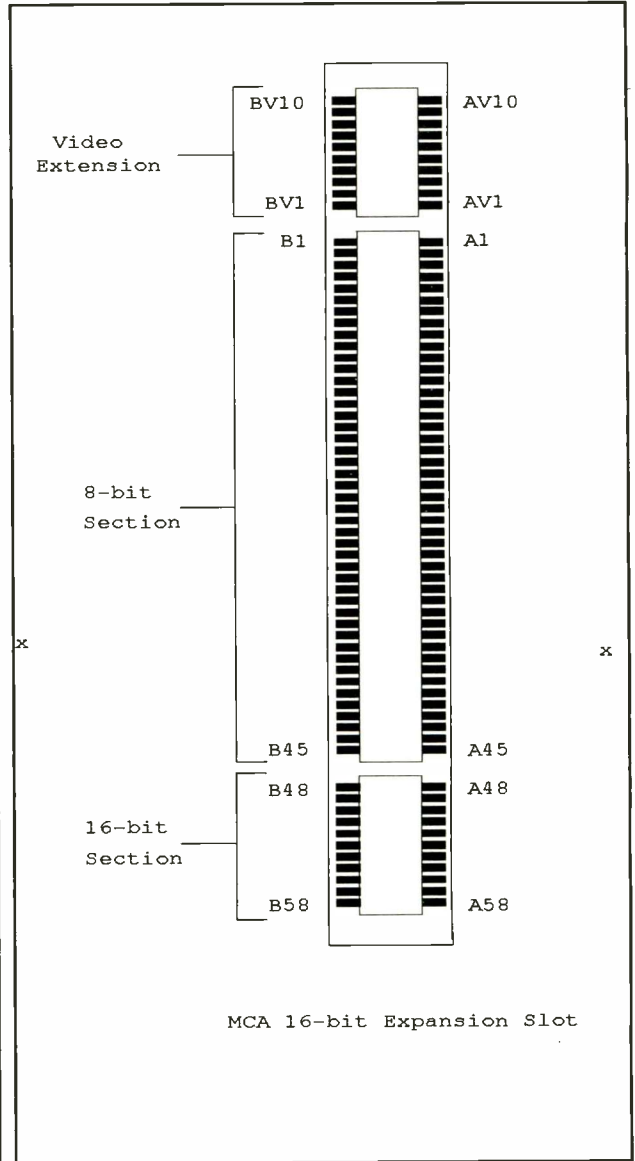


Fig. 3. A 16-bit MCA slot with video extension.

sooner than you could blink an eye, CPUs were running at 12 MHz and faster, which was more than the slot could handle.

The problem isn't with the slot itself, but the cards that plug into it. The IBM design specification states that 8 MHz is the maximum speed possible on the AT bus. Therefore, to be price-competitive, card vendors build their products using 8-MHz parts. Sure, there's the occasional motherboard that sported 16-MHz slots (mostly from Hewlett Packard and NEC) and a few adapter cards that can keep up with them. But the vast majority of ISA peripherals have problems running at 10 MHz.

So the ISA expansion port changed

from a local-bus slot to a translated slot. The design uses a buffering chip set between the CPU bus and the ISA slot that reduces slot speed to 8 MHz by adding wait states. A wait state is "dead" time, during which nothing occurs, other than waiting for the ISA card to catch up with the CPU. For example, a 16-MHz system bus can communicate with an 8-MHz slot by adding one wait state, while a 33-MHz system needs four slot wait states. As you can see, a real bottleneck is created when data has to pass *through* the ISA slot instead of traveling from faster CPU-speed RAM.

A physical description of the ISA bus and its related pinouts can be

found in Table 1 and Fig. 1.

EISA Bus. The EISA (Extended Industry Standard Architecture) is a product of a consortium of computer makers (then known as the "Gang of Nine" and consisting of Compaq, HP, NEC, Zenith, AST, Epson, Wyse, Olivetti and Tandy). Realizing that the 16-bit ISA slot would soon suffer the same fate of the eight-bit slot, this consortium decided to build a 32-bit slot that was compatible with existing eight- and 16-bit products, while providing support for the yet-to-be-announced 32-bit x86 CPUs. The result is the EISA bus.

What came out of almost two years of meetings is a two-tier socket (see

Table 1. ISA Expansion Slot

Eight-Bit ISA Expansion Slot
62-Pin Edge Connector

Pin	I/O	Signal	Description
A1	I	IOCHCK~	I/O Channel Check
A2	I/O	D7	Data Bit 7
A3	I/O	D6	Data Bit 6
A4	I/O	D5	Data Bit 5
A5	I/O	D4	Data Bit 4
A6	I/O	D3	Data Bit 3
A7	I/O	D2	Data Bit 2
A8	I/O	D1	Data Bit 1
A9	I/O	D0	Data Bit 0
A10	I/O	IOCHRDY	I/O Channel Ready
A11	O	AENx	Address Enable
A12	I/O	SA19	Address Bit 19
A13	I/O	SA18	Address Bit 18
A14	I/O	SA17	Address Bit 17
A15	I/O	SA16	Address Bit 16
A16	I/O	SA15	Address Bit 15
A17	I/O	SA14	Address Bit 14
A18	I/O	SA13	Address Bit 13
A29	I/O	SA12	Address Bit 12
A20	I/O	SA11	Address Bit 11
A21	I/O	SA10	Address Bit 10
A22	I/O	SA09	Address Bit 9
A23	I/O	SA08	Address Bit 8
A24	I/O	SA07	Address Bit 7
A25	I/O	SA06	Address Bit 6
A26	I/O	SA05	Address Bit 5
A27	I/O	SA04	Address Bit 4
A28	I/O	SA03	Address Bit 3
A39	I/O	SA02	Address Bit 2
A30	I/O	SA01	Address Bit 1
A31	I/O	SA00	Address Bit 0
B1	—	GND	Ground
B2	O	RESDRV	Reset Drive
B3	O	+5VDC	+5 Volts
B4	I	IRQ9	Interrupt Request 9
B5	O	-5VDC	-5 Volts
B6	I	DRQ2	DMA Request 2
B7	O	-12VDC	-12 Volts
B8	I	0WS~	Zero wait state
B9	O	+12VDC	+12 Volts
B10	—	GND	Ground
B11	O	SMEMW~	System Memory Write
B12	O	SMEMR~	System Memory Read
B13	I/O	IOW~	I/O Write
B14	I/O	IOR~	I/O Read
B15	O	DACK3~	DMA Acknowledge 3
B16	I	DRQ3	DMA Request 3
B17	O	DACK1~	DMA Acknowledge 1
B18	I	DRQ1	DMA Request 1
B29	I/O	REFRESH~	DRAM refresh

B20	O	CLK	Bus Clock
B21	I	IRQ7	Interrupt Request 7
B22	I	IRQ6	Interrupt Request 6
B23	I	IRQ5	Interrupt Request 5
B24	I	IRQ4	Interrupt Request 4
B25	I	IRQ3	Interrupt Request 3
B26	O	DACK2~	DMA Acknowledge 2
B27	I/O	T/C	Terminal Word Count
B28	O	BALE	Address Lines Enabled
B39	O	+5VDC	+5 Volts
B30	O	OSC	14.31818-kHz Oscillator
B31	—	GND	Ground

16-Bit ISA Expansion Slot

98-Pin Edge Connector

Pin	I/O	Signal	Description
C1	I/O	SBHE~	Status Byte High Enable
C2	I/O	LA23	Latchable Address 23
C3	I/O	LA22	Latchable Address 22
C4	I/O	LA21	Latchable Address 21
C5	I/O	LA20	Latchable Address 20
C6	I/O	LA19	Latchable Address 19
C7	I/O	LA18	Latchable Address 18
C8	I/O	LA17	Latchable Address 17
C9	I/O	MEMW~	Memory Write
C10	I/O	MEMR~	Memory Read
C11	I/O	D08	Data Bit 8
C12	I/O	D09	Data Bit 9
C13	I/O	D10	Data Bit 10
C14	I/O	D11	Data Bit 11
C15	I/O	D12	Data Bit 12
C16	I/O	D13	Data Bit 13
C17	I/O	D14	Data Bit 14
C18	I/O	D15	Data Bit 15
D1	I/O	MEM16~	Memory Transfer = 16 Bits
D2	I	IO16~	Data Transfer = 16 Bits
D3	I	IRQ10	Interrupt Request 10
D4	I	IRQ11	Interrupt Request 11
D5	I	IRQ12	Interrupt Request 12
D6	I	IRQ15	Interrupt Request 15
D7	I	IRQ14	Interrupt Request 14
D8	O	DACKO~	DMA Acknowledge 0
D9	I	DRQ0	DMA Request 0
D10	O	DACK5~	DMA Acknowledge 5
D11	I	DRQ5	DMA Request 5
D12	O	DACK6~	DMA Acknowledge 6
D13	I	DRQ6	DMA Request 6
D14	O	DACK7~	DMA Acknowledge 7
D15	I	DRQ7	DMA Request 7
D16	O	+5VDC	+5 Volts
D17	I	MASTER16~	Bus Master = 16 Bits
D18	—	GND	Ground

Fig. 2). The top portion of the socket has just enough connectors to make connection with an ISA card. About 3/4" below rests another row of 16-bit connections. Five plastic stops located in the bottom of the EISA connector prevent an ISA card from being plugged all the way into the slot and shorting out the bottom-row contacts. The EISA board has cutouts that permit it to slip past the plastic stops and make contact with the extra contacts.

To make this work on a card designed for 16 contacts, the spacing between the pins is reduced from 0.100" to 0.050" and the board's "fingers" are made thinner. Table 2 lists the pinout functions of the EISA slot.

A principal advantage of the EISA slot is its bus-mastering ability. Simply explained, bus mastering allows for the exchange of data between one peripheral and another without the CPU having to be involved. But, unlike IBM's

MCA bus-mastering scheme (which IBM calls "bus arbitration"), only one CPU is supported.

While the speed of the EISA slot is still limited to 8 MHz, because of the ISA-compatibility restriction, its data-transfer rate is much faster, thanks to increased bus width. The best data-exchange rate you can expect from an ISA slot is 20 megabits per second (20 Mb/s), whereas the EISA slot can easily do 33 Mb/s. In burst mode, you can

Table 2. EISA Expansion Slot
32-Bit EISA Expansion Slot
198-Pin Double-Step Edge Connector

Pin	I/O	Type	Signal	Description					
A1	I	ISA	IOCHK~	I/O Channel Check	A46	I/O	EISA	LA25	Latchable Address 25
A2	O	EISA	CMD~	Command	A47	I/O	ISA	SA07	Address Bit 7
A3	I/O	ISA	D7	Data Bit 7	A48	—	EISA	GND	Ground
A4	I/O	EISA	START~	Start Bus Master Cycle	A49	I/O	ISA	SA06	Address Bit 6
A5	I/O	ISA	D6	Data Bit 6	A50	—	NA	KEY	Key
A6	I/O	EISA	EXRDY	Slave Ready for Bus Cycle	A51	I/O	ISA	SA05	Address Bit 5
A7	I/O	ISA	D5	Data Bit 5	A52	I/O	EISA	LA15	Latchable Address 15
A8	I/O	EISA	EX32~	Slave Supports 32-BIT Transfer	A53	I/O	ISA	SA04	Address Bit 4
A9	I/O	ISA	D4	Data Bit 4	A54	I/O	EISA	LA13	Latchable Address 13
A10	—	EISA	GND	Ground	A55	I/O	ISA	SA03	Address Bit 3
A11	I/O	ISA	D3	Data Bit 3	A56	I/O	EISA	LA12	Latchable Address 12
A12	—	NA	KEY	Key	A57	I/O	ISA	SA02	Address Bit 2
A13	I/O	ISA	D2	Data Bit 2	A58	I/O	EISA	LA11	Latchable Address 11
A14	I/O	EISA	EX16~	Slave Supports 16-Bit Transfer	A59	I/O	ISA	SA01	Address Bit 1
A15	I/O	ISA	D1	Data Bit 1	A60	—	EISA	GND	Ground
A16	I	EISA	SLBURST~	Slave Supports Burst Cycles	A61	I/O	ISA	SA00	Address Bit 0
A17	I/O	ISA	D0	Data BIT 0	A62	I/O	EISA	LA9	Latchable Address 9
A18	I/O	EISA	MSBURST~	Master Supports Burst Cycles	ISA Key Break				
A19	I/O	ISA	CHRDY	I/O Channel Ready	A63	I/O	EISA	LA7	Latchable Address 7
A20	I/O	EISA	W/R	Write/Read	A64	—	EISA	GND	Ground
A21	O	ISA	AENx	Address Enable	A65	I/O	ISA	SBHE~	Status Byte High Enable
A22	—	EISA	GND	Ground	A66	I/O	EISA	LA4	Latchable Address 4
A23	I/O	ISA	SA19	Address Bit 19	A67	I/O	ISA	LA23	Latchable Address 23
A24	—	EISA	NA	Reserved	A68	I/O	EISA	LA3	Latchable Address 3
A25	I/O	ISA	SA18	Address Bit 18	A69	I/O	ISA	LA22	Latchable Address 22
A26	—	EISA	NA	Reserved	A70	—	EISA	GND	Ground
A27	I/O	ISA	SA17	Address Bit 17	A71	I/O	ISA	LA21	Latchable Address 21
A28	—	EISA	NA	Reserved	A72	—	NA	KEY	Key
A29	I/O	ISA	SA16	Address Bit 16	A73	I/O	ISA	LA20	Latchable Address 20
A30	—	EISA	GND	Ground	A74	I/O	EISA	SD17	Data Bit 17
A31	I/O	ISA	SA15	Address Bit 15	A75	I/O	ISA	LA19	Latchable Address 19
A32	—	NA	KEY	Key	A76	I/O	EISA	SD19	Data Bit 19
A33	I/O	ISA	SA14	Address Bit 14	A77	I/O	ISA	LA18	Latchable Address 18
A34	I/O	EISA	BE1~	DWORD Byte Enable 1	A78	I/O	EISA	SD20	Data Bit 20
A35	I/O	ISA	SA13	Address Bit 13	A79	I/O	ISA	LA17	Latchable Address 17
A36	I/O	EISA	LA31	Latchable Address 31	A80	I/O	EISA	SD22	Data Bit 22
A37	I/O	ISA	SA12	Address Bit 12	A81	I/O	ISA	MWTC~	Memory Write
A38	—	EISA	GND	Ground	A82	—	EISA	GND	Ground
A39	I/O	ISA	SA11	Address Bit 11	A83	I/O	ISA	MRDC~	Memory Read
A40	I/O	EISA	LA30	Latchable Address 30	A84	I/O	EISA	SD25	Data Bit 25
A41	I/O	ISA	SA10	Address Bit 10	A85	I/O	ISA	D08	Data Bit 8
A42	I/O	EISA	LA28	Latchable Address 28	A86	I/O	EISA	SD26	Data Bit 26
A43	I/O	ISA	SA09	Address Bit 9	A87	I/O	ISA	D09	Data Bit 9
A44	I/O	EISA	LA27	Latchable Address 27	A88	I/O	EISA	SD28	Data Bit 28
A45	I/O	ISA	SA08	Address Bit 8	A89	I/O	ISA	D10	Data Bit 10
					A90	—	NA	KEY	Key
					A91	I/O	ISA	D11	Data Bit 11
					A92	—	EISA	GND	Ground
					A93	I/O	ISA	D12	Data Bit 12
					A94	I/O	EISA	SD30	Data Bit 30
					A95	I/O	ISA	D13	Data Bit 13
					A96	I/O	EISA	SD31	Data Bit 31
					A97	I/O	ISA	D14	Data Bit 14
					A98	I	EISA	MREQ~	Bus Master Bus Request

expect data-transfer speeds ranging up to 40 Mb/s.

Unfortunately, benchmarks show that most EISA cards are no faster than their ISA counterparts. The problem is that few EISA peripherals make use of the extra-speed features, such as bus mastering. Other bottlenecks, such as the hard-disk drive, have greater influence on performance than does the bus. Consequently, the extra \$500 you'd

pay for an EISA-based system is better spent on more-productive upgrades.

• **MCA Bus.** IBM's answer to the 32-bit situation is the Micro Channel Architecture (MCA). The MCA bus was announced at the same time IBM unveiled its PS/2 line of computers. This break from tradition caused a big stir in the computer community because it came unexpectedly. And from the beginning, the new bus was largely

shunned because of IBM's refusal to cooperate with the industry to create just one standard.

The most-obvious difference between the ISA and MCA slots is the connector each uses. The MCA connector is physically smaller and has a contact spacing of 0.050". Because pin spacing is tighter, more can be packed into the same space. Since the bus was designed from the ground up, without

A99	I/O	ISA	D15	Data Bit 15	B51	O	ISA	DAK2~	DMA Acknowledge 2
B1	—	ISA	GND	Ground	B52	I/O	EISA	LA16	Latchable Address 16
B2	—	EISA	GND	Ground	B53	I/O	ISA	T/C	Terminal Word Count
B3	O	ISA	RESDRV	Reset Drive	B54	I/O	EISA	LA14	Latchable Address 14
B4	O	EISA	+5VDC	+5 Volts	B55	O	ISA	BALE	Address Lines Enabled
B5	O	ISA	+5VDC	+5 Volts	B56	O	EISA	+5VDC	+5 Volts
B6	O	EISA	+5VDC	+5 Volts	B57	O	ISA	+5VDC	+5 Volts
B7	I	ISA	IRQ9	Interrupt Request 9	B58	O	EISA	+5VDC	+5 Volts
					B59	O	ISA	OSC	14.31818-kHz Oscillator
B8	—	EISA	NA	Reserved	B60	—	EISA	GND	Ground
B9	O	ISA	-5VDC	-5 Volts	B61	—	ISA	GND	Ground
B10	—	EISA	NA	Reserved	B62	I/O	EISA	LA10	Latchable Address 10
B11	I	ISA	DRQ2	DMA Request 2	ISA Key Break				
B12	—	NA	KEY	Key	B63	I/O	EISA	LA8	Latchable Address 8
B13	O	ISA	-12VDC	-12 Volts	B64	I/O	EISA	LA6	Latchable Address 6
B14	—	EISA	NA	Reserved	B65	I/O	ISA	M16~	Memory Transfer = 16 Bits
B15	I	ISA	NOWS~	Zero Wait State	B66	I/O	EISA	LA5	Latchable Address 5
B16	—	EISA	NA	Reserved	B67	I	ISA	IO16~	Data Transfer = 16 Bits
B17	O	ISA	+12VDC	+12 Volts	B68	O	EISA	+5VDC	+5 Volts
B18	O	EISA	+12VDC	+12 Volts	B69	I	ISA	IRQ10	Interrupt Request 10
B19	—	ISA	GND	Ground	B70	I/O	EISA	LA2	Latchable Address 2
B20	I/O	EISA	M/I/O	Bus Master Memory High/IO(Low)	B71	I	ISA	IRQ11	Interrupt Request 11
					B72	—	NA	KEY	Key
B21	O	ISA	SMWTC~	System Memory Write	B73	I	ISA	IRQ12	Interrupt Request 12
B22	O	EISA	LOCK~	Bus Locked Out by Bus Master	B74	I/O	EISA	SD16	Data Bit 16
					B75	I	ISA	IRQ15	Interrupt Request 15
B23	O	ISA	SMRDC~	System Memory Read	B76	I/O	EISA	SD18	Data Bit 18
B24	—	EISA	NA	Reserved	B77	I	ISA	IRQ14	Interrupt Request 14
B25	I/O	ISA	IOWC~	I/O Write	B78	—	EISA	GND	Ground
B26	—	EISA	GND	Ground	B79	O	ISA	DAKO~	DMA Acknowledge 0
B27	I/O	ISA	IORC~	I/O Read	B80	I/O	EISA	SD21	Data Bit 21
B28	—	EISA	NA	Reserved	B81	I	ISA	DRQ0	DMA Request 0
B29	O	ISA	DAK3~	DMA Acknowledge 3	B82	I/O	EISA	SD23	Data Bit 23
B30	I/O	EISA	BE3~	DWORD Byte Enable 3	B83	O	ISA	DAK5~	DMA Acknowledge 5
B31	I	ISA	DRQ3~	DMA Request 3	B84	I/O	EISA	SD24	Data Bit 24
B32	—	NA	KEY	Key	B85	I	ISA	DRQ5	DMA Request 5
B33	O	ISA	DAK1~	DMA Acknowledge 1	B86	—	EISA	GND	Ground
B34	I/O	EISA	BE2~	DWORD Byte Enable 2	B87	O	ISA	DAK6~	DMA Acknowledge 6
B35	I	ISA	DRQ1~	DMA Request 1	B88	I/O	EISA	SD27	Data Bit 27
B36	I/O	EISA	BE0~	DWORD Byte Enable 0	B89	I	ISA	DRQ6	DMA Request 6
B37	I/O	ISA	REFRESH~	DRAM Refresh	B90	—	NA	KEY	Key
B38	—	EISA	GND	Ground	B91	O	ISA	DAK7~	DMA Acknowledge 7
B39	O	ISA	BCLK	Bus Vlock	B92	I/O	EISA	SD29	Data Bit 29
B40	O	EISA	+5VDC	+5 Volts	B93	I	ISA	DRQ7	DMA Request 7
B41	I	ISA	IRQ7	Interrupt Request 7	B94	O	EISA	+5VDC	+5 Volts
B42	I/O	EISA	LA29	Latchable Address 29	B95	O	ISA	+5VDC	+5 Volts
B43	I	ISA	IRQ6	Interrupt Request 6	B96	O	EISA	+5VDC	+5 Volts
B44	—	EISA	GND	Ground	B97	I	ISA	MASTER16~	Bus Master = 16 Bits
B45	I	ISA	IRQ5	Interrupt Request 5	B98	O	EISA	MAKx~	Bus Master Bus Acknowledge
B46	I/O	EISA	LA26	Latchable Address 26					
B47	I	ISA	IRQ4	Interrupt Request 4	B99	—	ISA	GND	Ground
B48	I/O	EISA	LA24	Latchable Address 24					
B49	I	ISA	IRQ3	Interrupt Request 3					
B50	—	NA	KEY	Key					

concern for backward compatibility, IBM engineers decided to make better use of the pins and their organization.

For example, one version of the MCA slot adds a video extension to the bus, which allows expansion cards to directly access the built-in VGA circuitry. There's also an audio signal extension for dedicated use with synthesized voice and sound cards. Moreover, the MCA slot isn't 32-bit-specif-

ic. There's a 16-bit version of the MCA slot, as well as the more-popular 32-bit version of the slot. See Table 3 for pinout details of all versions.

To reduce radiation emission, the MCA puts an electrical ground on every fourth pin. This lets the bus run at faster speeds than ISA while meeting strict FCC certification standards for electromagnetic interference (emi). However, lack of acceptance for the

new bus forced IBM to limit bus speed to a slow 10 MHz so that card vendors can use standard ISA electrical components in their MCA designs. Had IBM pushed the bus to the 33 MHz it promised, it's likely that it would have died a long time ago from lack of third-party products.

Like EISA, MCA supports bus mastering and burst-mode data transfers. IBM's bus-arbitration scheme is more

Table 3. MCA Expansion Slot
16-Bit MCA Expansion Slot
116-Pin MCA-Style Edge Connector

Pin	I/O	Signal	Description
A1	NA	NA	Card Setup
A2	I/O	MADE24	Memory Address Enable 24
A3	—	GND	Ground
A4	I/O	A11	Address Bit 11
A5	I/O	A10	Address Bit 10
A6	I/O	A09	Address Bit 9
A7	O	+5VDC	+5 Volts
A8	I/O	A08	Address Bit 8
A9	I/O	A07	Address Bit 7
A10	I/O	A06	Address Bit 6
A11	O	+5VDC	+ 5 Volts
A12	I/O	A05	Address Bit 5
A13	I/O	A04	Address Bit 4
A14	I/O	A03	Address Bit 3
A15	O	+5VDC	+5 Volts
A16	I/O	A02	Address Bit 2
A17	I/O	A01	Address Bit 1
A18	I/O	A00	Address Bit 0
A19	O	+12VDC	+12 Volts
A20	I/O	ADL#	Address Decode Latch
A21	O	PREEMPT#	Preempt (Bus Master)
A22	O	BURST#	Burst (Bus Master)
A23	O	-12VDC	-12 Volts
A24	I/O	ARB0	Arbitration 0
A25	I/O	ARB01	Arbitration 1
A26	I/O	ARB02	Arbitration 2
A27	O	-12VDC	-12 Volts
A28	I/O	ARB03	Arbitration 3
A29	I	ABR/GNT#	Arbitration Grant
A30	I	TC#	Terminal Count
A31	O	+5VDC	+5 Volts
A32	I/O	S0#	Status Bit 0
A33	I/O	S1#	Status Bit 1
A34	I/O	M/IO#	Memory/Input Output
A35	O	+12VDC	+12 Volts
A36	NA	NA	Card Ready
A37	I/O	D00	Data Bit 0
A38	I/O	D02	Data Bit 2
A39	O	+5VDC	+5 Volts
A40	I/O	D05	Data Bit 5
A41	I/O	D06	Data Bit 6
A42	I/O	D07	Data Bit 7
A43	—	GND	Ground
A44	I	DS 16 RTN#	Data Size 16 Return
A45	I	REFRESH#	Refresh
A46	—	KEY	Key
A47	—	KEY	Key
A48	O	+5VDC	+5 Volts
A49	I/O	D10	Data Bit 10
A50	I/O	D11	Data Bit 11
A51	I/O	D13	Data Bit 13
A52	O	+12VDC	+12 Volts
A53	—	NA	Reserved
A54	I/O	SBHE#	Status Byte High Enable
A55	O	CD DS 16x#	Card Data Size 16
A56	O	+5VDC	+5 Volts
A57	O	IRQ14#	Interrupt 14
A58	O	IRQ15#	Interrupt 15
B1	O	AUDIO GND	Audio Ground
B2	O	AUDIO	Audio
B3	—	GND	Ground

B4	I	OSC	14.3-MHz Oscillator
B5	—	GND	Ground
B6	I/O	A23	Address Bit 23
B7	I/O	A22	Address Bit 22
B8	I/O	A21	Address Bit 21
B9	—	GND	Ground
B10	I/O	A20	Address Bit 20
B11	I/O	A19	Address Bit 19
B12	I/O	A18	Address Bit 18
B13	—	GND	Ground
B14	I/O	A17	Address Bit 17
B15	I/O	A16	Address Bit 16
B16	I/O	A15	Address Bit 15
B17	—	GND	Ground
B18	I/O	A14	Address Bit 14
B19	I/O	A13	Address Bit 13
B20	I/O	A12	Address Bit 12
B21	—	GND	Ground
B22	O	IRQ09#	Interrupt 09
B23	O	IRQ03#	Interrupt 03
B24	O	IRQ04#	Interrupt 04
B25	—	GND	Ground
B26	O	IRQ05#	Interrupt 05
B27	O	IRQ06#	Interrupt 06
B28	O	IRQ07#	Interrupt 07
B29	—	GND	Ground
B30	—	NA	Reserved
B31	O	NA	Reserved
B32	O	CHCK#	Channel Check
B33	—	GND	Ground
B34	I/O	CMD#	Command Signal
B35	I	CHRDYRTN	Channel Ready Return
B36	O	CD SFDBKx#	Card Selected Feedback
B37	—	GND	Ground
B38	I/O	D01	Data Bit 01
B39	I/O	D03	Data Bit 03
B40	I/O	D04	Data Bit 04
B41	—	GND	Ground
B42	I	CHRSET	Channel Reset
B43	—	NA	Reserved
B44	—	NA	Reserved
B45	—	GND	Ground
B46	—	KEY	Key
B47	—	KEY	Key
B48	I/O	D08	Data Bit 08
B49	I/O	D09	Data Bit 09
B50	—	GND	Ground
B51	I/O	D12	Data Bit 12
B52	I/O	D14	Data Bit 14
B53	I/O	D15	Data Bit 15
B54	—	GND	Ground
B55	O	IRQ10#	Interrupt
B56	O	IRQ11#	Interrupt
B57	O	IRQ12#	Interrupt
B58	—	GND	Ground

32-Bit MCA Expansion Slot
178-pin MCA-style edge connector

Pin	I/O	Signal	Description
A1			
Thru		Same as 16-Bit Expansion Slot	
A58			

A59	—	NA	Reserved
A60	—	NA	Reserved
A61	—	GND	Ground
A62	—	NA	Reserved
A63	—	NA	Reserved
A64	—	NA	Reserved
A65	O	+12VDC	+12 Volts
A66	I/O	D19	Data Bit 19
A67	I/O	D20	Data Bit 20
A68	I/O	D21	Data Bit 21
A69	O	+5VDC	+5 Volts
A70	I/O	D24	Data Bit 24
A71	I/O	D25	Data Bit 25
A72	I/O	D26	Data Bit 26
A73	O	+5VDC	+5 volts
A74	I/O	D30	Data Bit 30
A75	I/O	D31	Data Bit 31
A76	—	NA	Reserved
A77	O	+12VDC	+12 Volts
A78	I/O	BE3#	Byte Enable 3
A79	I	DS 32 RTN#	Data Size 32 Return
A80	O	CD DS 32x#	Card Data Size 32
A81	O	+12VDC	+12 Volts
A82	I/O	A26	Address Bit 26
A83	I/O	A27	Address Bit 27
A84	I/O	A28	Address Bit 28
A85	O	+5VDC	+5 Volts
A86	—	NA	Reserved
A87	—	NA	Reserved
A88	—	NA	Reserved
A89	—	GND	Ground

B1
Thru Same as 16-Bit Expansion Slot

B58	—	NA	Reserved
B59	—	NA	Reserved
B60	—	NA	Reserved
B61	—	NA	Reserved
B62	—	NA	Reserved
B63	—	GND	Ground
B64	I/O	D16	Data Bit 16
B65	I/O	D17	Data Bit 17
B66	I/O	D18	Data Bit 18
B67	—	GND	Ground
B68	I/O	D22	Data Bit 22
B69	I/O	D23	Data Bit 23
B70	—	NA	Reserved
B71	—	GND	Ground
B72	I/O	D27	Data Bit 27
B73	I/O	D28	Data Bit 28
B74	I/O	D29	Data Bit 29
B75	—	GND	Ground
B76	I/O	BEO0#	Byte Enable 0
B77	I/O	BEO1#	Byte Enable 1
B78	I/O	BEO2#	Byte Enable 2
B79	—	GND	Ground
B80	I	TR32	Translate 32
B81	I/O	A24	Address Bit 24
B82	I/O	A25	Address Bit 25
B83	—	GND	Ground
B84	I/O	A29	Address Bit 29
B85	I/O	A30	Address Bit 30
B86	I/O	A31	Address Bit 31
B87	—	GND	Ground
B88	—	NA	Reserved
B89	—	NA	Reserved

Auxiliary Video Extension for 16-bit MCA Slot 130-Pin MCA-Style Edge Connector

Pin	I/O	Signal	Description
AV10	O	VSYSN	Vertical Sync
AV09	O	HSYNC	Horizontal Sync
AV08	O	BLANK	Blanking
AV07	—	GND	Ground
AV06	O	VD6	Video Data Bit 6
AV05	O	EDCLK	Enable External Dot Clock
AV04	O	DCLK	Dot Clock
BV10	O	ESYNC	Enable External Sync
BV09	—	GND	Ground
BV08	O	VD5	Video Data Bit 5
BV07	O	VD4	Video Data Bit 4
BV06	O	VD3	Video Data Bit 3
BV05	—	GND	Ground
BV04	O	VD2	Video Data Bit 2

Auxiliary Video Extension for 32-bit MCA slot 200-Pin MCA-Style Edge Connector

Pin	I/O	Signal	Description
AV10	O	VSYSN	Vertical Sync
AV09	O	HSYNC	Horizontal Sync
AV08	O	BLANK	Blanking
AV07	—	GND	Ground
AV06	O	VD6	Video Data Bit 6
AV05	O	EDCLK	Enable External Dot Clock
AV04	O	DCLK	Dot Clock
AV03	—	GND	Ground
AV02	O	VD7	Vide Data Bit 7
AV01	O	EVIDEO	Enable External Video
AV00	—	KEY	Key
BV10	O	ESYNC	Enable External Sync
BV09	—	GND	Ground
BV08	O	VD5	Video Data bit 5
BV07	O	VD4	Video Data bit 4
BV06	O	VD3	Video Data bit 3
BV05	—	GND	Ground
BV04	O	VD2	Video Data bit 2
BV03	O	VD1	Video Data bit 1
BV02	O	VD0	Video Data bit 0
BV01	—	GND	Ground
BV00	—	KEY	Key

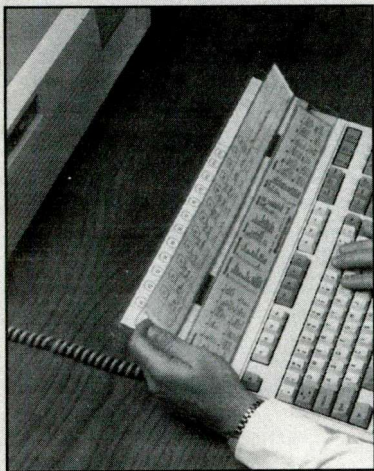
Matched-Memory Extension for 32-Bit MCA slot 188-Pin MCA-Style Edge Connector

Pin	I/O	Signal	Description
AM04	—	NA	Reserved
AM03	I/O	MMCCMD	Matched-Memory Cycle Command
AM02	—	NA	Ground
AM01	I/O	MMC	Matched-Memory Cycle
BM04	—	GND	Ground
BM03	—	NA	Reserved
BM02	I/O	MMCREQ	Matched-Memory Cycle Request
BM01	—	NA	Reserved

PRODUCT INFORMATION

Software Instructions Holder

Template Holder from Ring King Visibles offers a way to store and access software templates, macro instructions and other information you want at your fingertips. The holder's clear plastic sleeves accept up to eight standard computer software templates. You can flip from template to template as you change software during the course of the day. You can also employ pre-printed template "blanks" that accompany the holder to document self-defined macros or keep track of shortcut commands.



Sized to fit virtually any keyboard, the Template Holder has support brackets you can attach to your work surface or keyboard. You can position it to keep clear access to ports or support legs. *Ring King Visibles, Inc., 2210 Second Ave., P.O. Box 599, Muscatine, IA 52761; tel.: 319-263-8144; fax: 319-262-0512.*

CIRCLE NO. 6 ON FREE CARD

Conversion Program

Metrics from ESI performs more than 400 different conversions, such as inches to feet, feet to meters, pints to liters, square kilometers to square feet, etc. The program lets you perform conversions in the following groups: area, length, liquid, recipe, temperature, time, speed, Troy weight, weight and volume. Each group is then further subdivided into specific conversions that are accessible by way of pop-up menus. The application has the capability to copy and paste those conversion to a word-processing, database or spread-sheet program. It's now both System 6 and 7 compatible, and a *Windows* version is under development. \$39. *Experts Systems, Inc., 2616 Quebec Ave., Melbourne, FL 32935; tel.: 407-242-0140; fax: 407-253-3538.*

CIRCLE NO. 7 ON FREE CARD

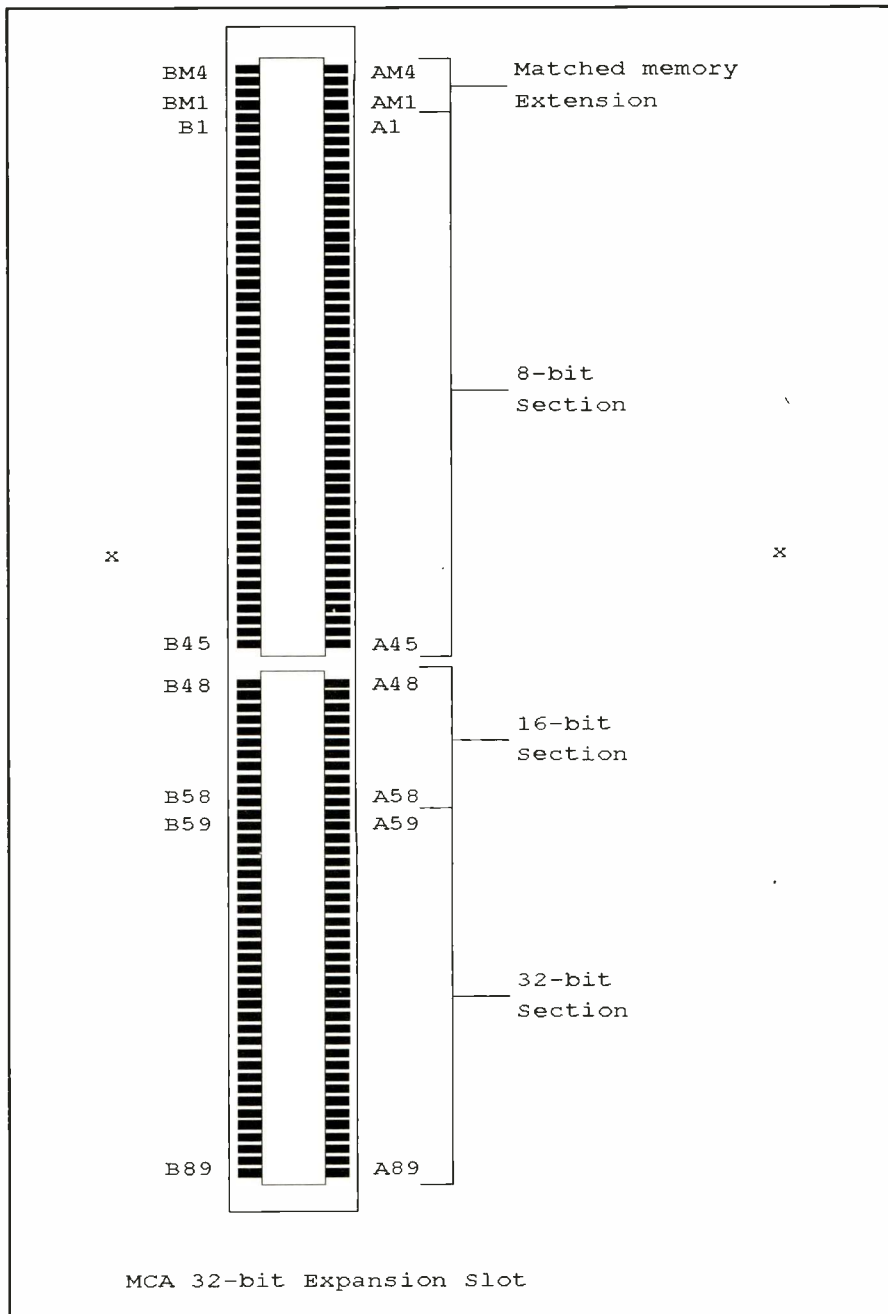


Fig. 4. A 32-bit MCA slot with matched-memory extension.

powerful than EISA's because it permits up to eight processors and eight other devices, such as DMA controllers, to share the single data bus without interfering with each other. Bus arbitration can't be added to the ISA or EISA bus without sacrificing backward compatibility. All expansion cards—even those that don't want to use it—must include bus-arbitration circuitry for the scheme to work. If they don't, they won't know when to shut up.

• **Local Bus.** Common to ISA, EISA, and MCA is an 8- or 10-MHz speed limit. The only way to overcome this roadblock is to tie the expansion slot directly to the CPU's data and address lines. This arrangement is called a local bus. Compared to the ubiquitous ISA slot, with its 8-MHz speed limit, local-bus slots can breeze along at speeds up to 66 MHz. The result is throughputs as fast as 130M per second, which is more than six times fast-

Table 4. VESA VL-Bus Local Bus Expansion Slot
32-Bit Expansion Slot
MCA-Style Edge Connector

Pin	I/O	Signal	Description
A1	I/O	DAT01	Data Bit 1
A2	I/O	DAT03	Data Bit 3
A3	—	GND	Ground
A4	I/O	DAT05	Data Bit 5
A5	I/O	DAT07	Data Bit 7
A6	I/O	DAT09	Data Bit 9
A7	I/O	DAT11	Data Bit 11
A8	I/O	DAT13	Data Bit 13
A9	I/O	DAT15	Data Bit 15
A10	—	GND	Ground
A11	I/O	DAT17	Data Bit 17
A12	O	Vcc	+5 Volts
A13	I/O	DAT19	Data Bit 19
A14	I/O	DAT21	Data Bit 20
A15	I/O	DAT23	Data Bit 23
A16	I/O	DAT25	Data Bit 25
A17	—	GND	Ground
A18	I/O	DAT27	Data Bit 27
A19	I/O	DAT29	Data Bit 29
A20	I/O	DAT31	Data Bit 31
A21	I/O	ADR30	Address Bit 30
A22	I/O	ADR28	Address Bit 28
A23	I/O	ADR26	Address Bit 26
A24	—	GND	Ground
A25	I/O	ADR24	Address Bit 24
A26	I/O	ADR22	Address Bit 22
A27	O	Vcc	+5 Volts
A28	I/O	ADR20	Address Bit 20
A29	I/O	ADR18	Address Bit 18
A30	I/O	ADR16	Address Bit 16
A31	I/O	ADR14	Address Bit 14
A32	I/O	ADR12	Address Bit 12
A33	I/O	ADR10	Address Bit 10
A34	I/O	ADR08	Address Bit 8
A35	—	GND	Ground
A36	I/O	ADR06	Address Bit 6
A37	I/O	ADR04	Address Bit 4
A38	O	WBACK#	Cache Write-Back, Use Reserved
A39	I/O	BE0#	Byte Enable 0
A40	O	Vcc	+5 Volts
A41	I/O	BE1#	Byte Enable 1
A42	I/O	BE2#	Byte Enable 2
A43	—	GND	Ground
A44	I/O	BE3#	Byte Enable 3
A45	I/O	ADS#	Address Data Strobe
A46	—	KEY	Key
A47	—	KEY	Key
A48	I	LRDY#	Local Ready
A49	I/O*	LDEVx#	Local Device
A50	O*	LREQx#	Local Request
A51	—	GND	Ground
A52	I/O*	LGNTx#	Local-Bus Grant
A53	O	Vcc	+5 Volts
A54	O	ID2	CPU Identifier Pin 2
A55	O	ID3	CPU Identifier Pin 3
A56	O	ID4	CPU Identifier Pin 4
A57	O	LKEN#	Local Cache Enable
A58	I/O	LEADS#	Local External Address Data Strobe
A59	—	NC	No Connection
A60	—	NC	No Connection
A61	—	NC	No Connection

A62	—	NC	No Connection
B1	I/O	DAT00	Data Bit 0
B2	I/O	DAT02	Data Bit 2
B3	I/O	DAT04	Data Bit 4
B4	I/O	DAT06	Data Bit 6
B5	I/O	DAT08	Data Bit 8
B6	—	GND	Ground
B7	I/O	DAT10	Data Bit 10
B8	I/O	DAT12	Data Bit 12
B9	O	Vcc	+5 Volts
B10	I/O	DAT14	Data Bit 14
B11	I/O	DAT16	Data Bit 16
B12	I/O	DAT18	Data Bit 18
B13	I/O	DAT20	Data Bit 20
B14	—	GND	Ground
B15	I/O	DAT22	Data Bit 22
B16	I/O	DAT24	Data Bit 24
B17	I/O	DAT26	Data Bit 26
B18	I/O	DAT28	Data Bit 28
B19	I/O	DAT30	Data Bit 30
B20	O	Vcc	+5 Volts
B21	I/O	ADR31	Address Bit 31
B22	—	GND	Ground
B23	I/O	ADR29	Address Bit 29
B24	I/O	ADR27	Address Bit 27
B25	I/O	ADR25	Address Bit 25
B26	I/O	ADR23	Address Bit 23
B27	I/O	ADR21	Address Bit 21
B28	I/O	ADR19	Address Bit 19
B29	—	GND	Ground
B30	I/O	ADR17	Address Bit 17
B31	I/O	ADR15	Address Bit 15
B32	O	Vcc	+5 Volts
B33	I/O	ADR13	Address Bit 13
B34	I/O	ADR11	Address Bit 11
B35	I/O	ADR09	Address Bit 9
B36	I/O	ADR07	Address Bit 7
B37	I/O	ADR05	Address Bit 5
B38	—	GND	Ground
B39	I/O	ADR03	Address Bit 3
B40	I/O	ADR02	Address Bit 2
B41	—	NC	No Connection
B42	O	RESET#	System Reset for VL Devices
B43	I/O	D/C#	Data/Code Status (Identify)
B44	I/O	M/I/O#	Memory or I/O Status (Identify)
B45	I/O	W/R#	Read/Write Status (Identify)
B46	—	KEY	Key
B47	—	KEY	Key
B48	O	RDYRTN#	Ready Return
B49	—	GND	Ground
B50	I	IRQ9	Interrupt Request 9
B51	I/O	BRDY#	Burst Ready
B52	I/O	BLAST#	Burst Last
B53	O	ID0	CPU Identifier Pin 0
B54	O	ID1	CPU Identifier Pin 1
B55	—	GND	Ground
B56	O	LCLK	Local CPU Clock
B57	O	Vcc	+5 Volts
B58	I/O	LBS16#	Local-Bus Size = 16 Bits
B59	—	NC	No Connection
B60	—	NC	No Connection
B61	—	NC	No Connection
B62	—	NC	No Connection

* Denotes direction of exchange between master and target only. There is one LDEV#, one LREQ#, and one pair of LREQ#/LGNT# signals per slot..

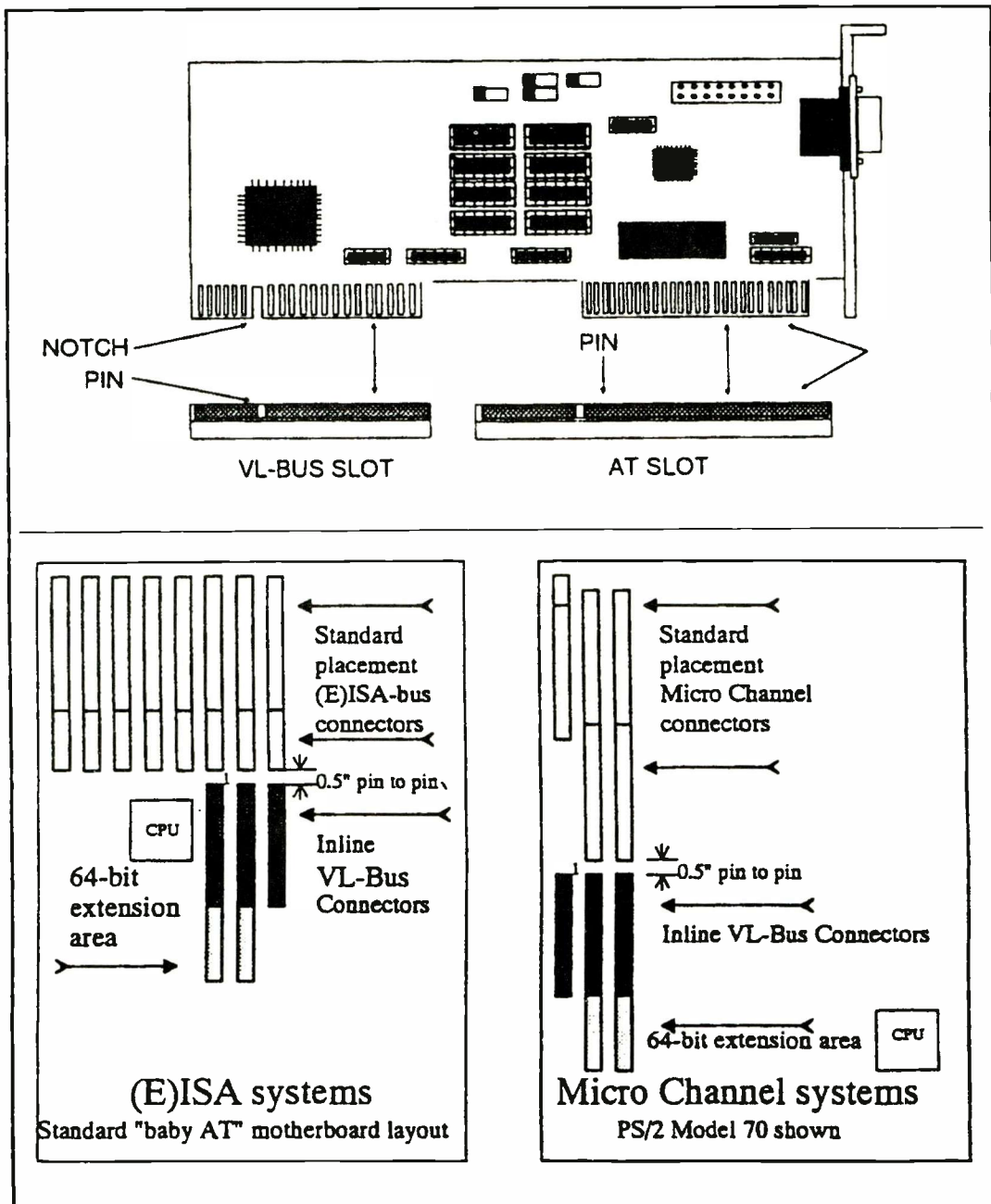


Fig. 5. Local-bus sockets are generally arranged in-line with a motherboard's ISA, EISA or MCA slots.

er than ISA's 20-Mb/s limit.

"Local-bus" is a catch-all for a variety of implementations of a busing technique. As of this writing, two major but different implementations of this technique exist. Of course, other implementations, generally proprietary to specific motherboard manufacturers, do exist but are now in a decided minority and have virtually disappeared in new motherboard products, and

manufacturers hang their new motherboard designs on either of the two "standards" that currently dominate.

• **VESA Local Bus.** The more-popular of the two dominant techniques is VESA's VL-Bus, which is modeled after the 32-bit 486 processor, with variations made to the specification to accommodate a 386 CPU. Ironically, VL-Bus uses the same 62-pin connector made popular by IBM's Micro

Channel Architecture. The MCA-style sockets are generally in-line with the motherboard's standard bus ISA, EISA or MCA slots, as shown in Fig. 5. This arrangement allows the VL-Bus to access all system I/O bus features.

A popular example of the VL-Bus arrangement is a multimedia card that mixes its own graphics on top of the standard display graphics. Such a card must monitor activity to the palette ta-

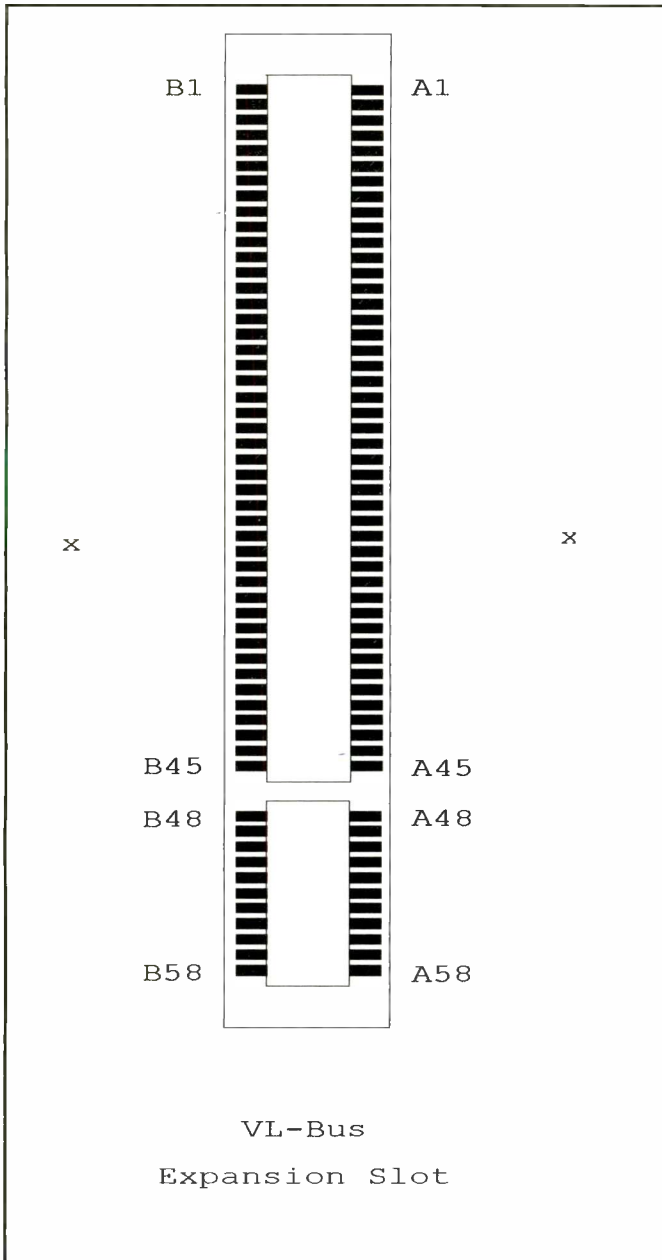


Fig. 6. The VESA VL-Bus uses the same connector made popular by IBM's MCA bus.

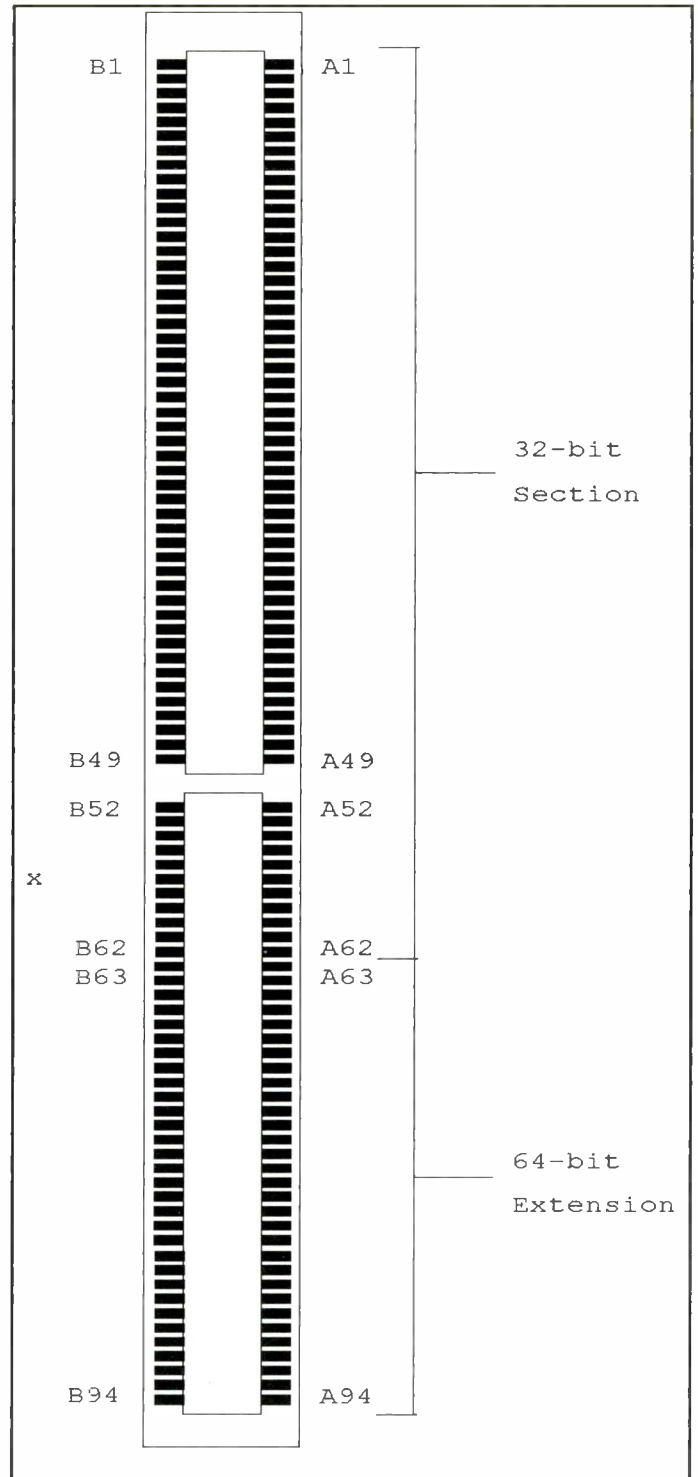


Fig. 7. The Intel PCI local-bus supports both 3.3-volt and 5-volt logic signals.

bles to maintain a current copy in its registers. However, system I/O bus support isn't a requirement, and the VL-Bus slot can stand on its own.

VL-Bus is upgradeable from 32 bits to 64 bits to support Intel's new Pentium (the long-awaited 586 CPU) processor, using a second MCA-type connector in-line with the first. However,

specifications for this arrangement are yet to be released. Pinouts for the 32-bit version is shown in Table 4.

• **PCI Local Bus.** The other dominant local-bus standard is Intel's PCI local-bus slot, which is a late entry because Intel held off shipping the PCI chipset until the specifications for it were complete. Despite a political feud that at-

tempts to position VESA's VL-Bus at the low end of the market and PCI at the high end, the similarity between the two architectures is uncanny. For example, both VL-Bus and PCI local-bus use the same 62-pin MCA-style connector. The sockets are usually placed in-line with ISA, EISA or MCA slots, and like the VL-Bus slot, PCI

supports bus mastering and burst-data transfers.

Unlike VL-Bus, though, the PCI slot uses address/data multiplexing to reduce pin count to just 47 signals. A

consequence of using a multiplexed interface is that a buffering circuit is required, which presently causes slot speed to top out at 33 MHz.

The PCI slot is expandable from 32

bits to 64 bits and supports 3.3-volt logic, in addition to standard 5-volt logic.

So altogether, there are four versions of the PCI slot in use. Pinout details for all four versions are listed in Table 5.

Table 5. PCI Local-Bus Expansion Slot				A56	—	GND	Ground
5-Volt, 32-Bit Expansion Slot				A57	I/O	AD02	Address/Data Bit 2
MCA-Style Edge Connector				A58	I/O	AD00	Address/Data Bit 0
Pin	I/O	Signal	Description	A59	I/O	+5V	+5 Volts
A1	I	TRST#	Test Reset	A60	I/O	REQ64#	Request 64-Bit Transfer
A2	O	+12V	+12 Volts	A61	O	+5V	+5 Volts
A3	I	TMS	Test Mode Select	A62	O	+5V	+5 Volts
A4	I	TDI	Test Data Input	B1	O	-12V	-12 Volts
A5	O	+5V	+5 Volts	B2	I	TCK	Test Clock
A6	O	INTA#	Interrupt A	B3	—	GND	Ground
A7	O	INTC#	Interrupt C	B4	O	TDO	Test Data Output
A8	O	+5V	+5 Volts	B5	O	+5V	+5 Volts
A9	NA	NA	Reserved	B6	O	+5V	+5 Volts
A10	I/O	+5V	+5 Volts	B7	O	INTB#	Interrupt B
A11	NA	NA	Reserved	B8	O	INTD#	Interrupt D
A12	—	GND	Ground	B9	O	PRSNT1#	Expansion Card Present 1
A11	—	GND	Ground	B10	NA	NA	Reserved
A14	NA	NA	Reserved	B11	O	PRSNT2#	Expansion Card Present 2
A15	I	RST	Reset	B12	—	GND	Ground
A16	I/O	+5V	+5 Volts	B13	—	GND	Ground
A17	I	GNT#	Grant (Bus Master Only)	B14	NA	NA	Reserved
A18	—	GND	Ground	B15	—	GND	Ground
A19	NA	NA	Reserved	B16	I	CLK	Clock
A20	I/O	AD30	Address/Data Bit 30	B17	—	GND	Ground
A21	O	+3.3V	+3.3 volts	B18	O	REQ#	Request (Bus Master Only)
A22	I/O	AD28	Address/Data Bit 28	B19	I/O	+5V	+5 Volts
A23	I/O	AD26	Address/Data Bit 26	B20	I/O	D31	Address/Data Bit 31
A24	—	GND	Ground	B21	I/O	AD29	Address/Data Bit 29
A25	I/O	AD24	Address/Data Bit 24	B22	—	GND	Ground
A26	I	IDSEL	Initialization Device Select	B23	I/O	AD27	Address/Data Bit 27
A27	O	+3.3V	+3.3 Volts	B24	I/O	AD25	Address/Data Bit 25
A28	I/O	AD22	Address/Data Bit 22	B25	O	+3.3V	+3.3 Volts
A29	I/O	AD20	Address/Data Bit 20	B26	I/O	C/BE3#	Bus Command/Byte Enable 3
A30	—	GND	Ground	B27	I/O	AD23	Address/Data Bit 23
A31	I/O	AD18	Address/Data Bit 18	B28	—	GND	Ground
A32	I/O	AD16	Address/Data Bit 16	B29	I/O	AD21	Address/Data Bit 21
A33	O	+3.3V	+3.3 Volts	B30	I/O	AD19	Address/Data Bit 19
A34	I/O	FRAME#	Cycle Frame	B31	O	+3.3V	+3.3 Volts
A35	—	GND	Ground	B32	I/O	AD17	Address/Data Bit 17
A36	I/O	TRDY#	Target Ready	B33	I/O	C/BE2#	Bus Command/Byte Enable 2
A37	—	GND	Ground	B34	—	GND	Ground
A38	I/O	STOP#	Stop	B35	I/O	IRDY#	Initiator Ready
A39	O	+3.3V	+3.3 Volts	B36	O	+3.3V	+3.3 Volts
A40	I/O	SDONE	Snoop Done	B37	I/O	DEVSEL#	Device Select
A41	I/O	SBO#	Snoop Backoff	B38	—	GND	Ground
A42	—	GND	Ground	B39	I/O	LOCK#	Lock
A43	I/O	PAR	Parity	B40	I/O	PERR#	Parity Error
A44	I/O	AD15	Address/Data Bit 15	B41	O	+3.3V	+3.3 Volts
A45	O	+3.3V	+3.3 Volts	B42	I/O	SERR#	System Error
A46	I/O	AD13	Address/Data Bit 13	B43	O	+3.3V	+3.3 Volts
A47	I/O	AD11	Address/Data Bit 11	B44	I/O	C/BE1#	Bus Command/Byte Enable 1
A48	—	GND	Ground	B45	I/O	AD14	Address/Data Bit 14
A49	I/O	AD09	Address/Data Bit 9	B46	—	GND	Ground
A50	—	KEY	Key	B47	I/O	AD12	Address/Data Bit 12
A51	—	KEY	Key	B48	I/O	AD10	Address/Data Bit 10
A52	I/O	C/BE0#	Bus Command/Byte Enable 0	B49	—	GND	Ground
A53	O	+3.3V	+3.3 Volts	B50	—	KEY	Key
A54	I/O	AD06	Address/Data Bit 6	B51	—	KEY	Key
A55	I/O	AD04	Address/Data Bit 4	B52	I/O	AD08	Address/Data Bit 8
				B53	I/O	AD07	Address/Data Bit 7

B54	O	+3.3V	+3.3 Volts
B55	I/O	AD05	Address/Data Bit 5
B56	I/O	AD03	Address/Data Bit 3
B57	—	GND	Ground
B58	I/O	AD01	Address/Data Bit 1
B59	I/O	+5V	+5 Volts
B60	I/O	ACK64#	Acknowledge 64-Bit Transfer
B61	O	+5V	+5 Volts
B62	O	+5V	+5 Volts

A56	—	GND	Ground
A57	I/O	AD02	Address/Data Bit 2
A58	I/O	AD00	Address/Data Bit 0
A59	O	+3.3V	+3.3 Volts
A60	I/O	REQ64#	Request 64-Bit Transfer
A61	O	+5V	+5 Volts
A62	O	+5V	+5 Volts
B1	O	-12V	-12 Volts
B2	I	TCK	Test clock
B3	—	GND	Ground
B4	O	TDO	Test Data Output
B5	O	+5V	+5 Volts
B6	O	+5V	+5 Volts
B7	O	INTB#	Interrupt B
B8	O	INTD#	Interrupt D
B9	O	PRSNT1#	Expansion Card Present 1
B10	NA	NA	Reserved
B11	O	PRSNT2#	Expansion card present 2
B12	—	KEY	Key
B13	—	KEY	Key
B14	NA	NA	Reserved
B15	—	GND	Ground
B16	I	CLK	Clock
B17	—	GND	Ground
B18	O	REQ#	Request (Bus Master Only)
B19	I/O	+3.3V	+3.3 Volts
B20	I/O	AD31	Address/Data Bit 31
B21	I/O	AD29	Address/Data Bit 29
B22	—	GND	Ground
B23	I/O	AD27	Address/Data Bit 27
B24	I/O	AD25	Address/Data Bit 25
B25	O	+3.3V	+3.3 Volts
B26	I/O	C/BE3#	Bus Command/Byte Enable 3
B27	I/O	AD23	Address/Data Bit 23
B28	—	GND	Ground
B29	I/O	AD21	Address/Data Bit 21
B30	I/O	AD19	Address/Data Bit 19
B31	O	+3.3V	+3.3 Volts
B32	I/O	AD17	Address/Data Bit 17
B33	I/O	C/BE2#	Bus Command/Byte Enable 2
B34	—	GND	Ground
B35	I/O	IRDY#	Initiator Ready
B36	O	+3.3V	+3.3 Volts
B37	I/O	DEVSEL#	Device Select
B38	—	GND	Ground
B39	I/O	LOCK#	Lock
B40	I/O	PERR#	Parity Error
B41	O	+3.3V	+3.3 Volts
B42	I/O	SERR#	System Error
B43	O	+3.3V	+3.3 Volts
B44	I/O	C/BE1#	Bus Command/Byte Enable 1
B45	I/O	AD14	Address/Data Bit 14
B46	—	GND	Ground
B47	I/O	AD12	Address/Data Bit 12
B48	I/O	AD10	Address/Data Bit 10
B49	—	GND	Ground
B50	—	GND	Ground
B51	—	GND	Ground
B52	I/O	AD08	Address/Data Bit 8
B53	I/O	AD07	Address/Data Bit 7
B54	O	+3.3V	+3.3 Volts
B55	I/O	AD05	Address/Data Bit 5
B56	I/O	AD03	Address/Data Bit 3
B57	—	GND	Ground
B58	I/O	AD01	Address/Data Bit 1
B59	I/O	+3.3V	+3.3 Volts
B60	I/O	ACK64#	Acknowledge 64-Bit Transfer
B61	O	+5V	+5 Volts
B62	O	+5V	+5 Volts

3.3-Volt, 32-Bit Expansion Slot
MCA-Style Edge Connector

Pin	I/O	Signal	Description
A1	I	TRST#	Test Reset
A2	O	+12V	+12 Volts
A3	I	TMS	Test Mode Select
A4	I	TDI	Test Data Input
A5	O	+5V	+5 Volts
A6	O	INTA#	Interrupt A
A7	O	INTC#	Interrupt C
A8	O	+5V	+5 Volts
A9	NA	NA	Reserved
A10	I/O	+3.3V	+3.3 Volts
A11	NA	NA	Reserved
A12	—	KEY	Key
A13	—	KEY	Key
A14	NA	NA	Reserved
A15	I/O	RST#	Reset
A16	I/O	+3.3V	+3.3 Volts
A17	I	GNT#	Grant (Bus Master Only)
A18	—	GND	Ground
A19	NA	NA	Reserved
A20	I/O	AD30	Address/Data Bit 30
A21	O	+3.3V	+3.3 Volts
A22	I/O	AD28	Address/Data Bit 28
A23	I/O	AD26	Address/Data Bit 26
A24	—	GND	Ground
A25	I/O	AD24	Address/Data Bit 24
A26	I	IDSEL	Initialization Device Select
A27	O	+3.3V	+3.3 Volts
A28	I/O	AD22	Address/Data Bit 22
A29	I/O	AD20	Address/Data Bit 20
A30	—	GND	Ground
A31	I/O	AD18	Address/Data Bit 18
A32	I/O	AD16	Address/Data Bit 16
A33	O	+3.3V	+3.3 Volts
A34	I/O	FRAME#	Cycle Frame
A35	—	GND	Ground
A36	I/O	TRDY#	Target Ready
A37	—	GND	Ground
A38	I/O	STOP#	Stop
A39	O	+3.3V	+3.3 Volts
A40	I/O	SDONE	Snoop Done
A41	I/O	SBO#	Snoop Backoff
A42	—	GND	Ground
A43	I/O	PAR	Parity
A44	I/O	AD15	Address/Data Bit 15
A45	O	+3.3V	+3.3 Volts
A46	I/O	AD13	Address/Data Bit 13
A47	I/O	AD11	Address/Data Bit 11
A48	—	GND	Ground
A49	I/O	AD09	Address/Data Bit 9
A50	—	GND	Ground
A51	—	GND	Ground
A52	I/O	C/BE0#	Bus Command/Byte Enable 0
A53	O	+3.3V	+3.3 Volts
A54	I/O	AD06	Address/Data Bit 6
A55	I/O	AD04	Address/Data Bit 4

5-Volt, 64-Bit Expansion Slot
MCA-Style Edge Connector

B93 NA NA Reserved
B94 — GND Ground

Pin	I/O	Signal	Description
A1			
Thru	Same as 32-Bit Expansion Slot		
A62			
A63	—	GND	Ground
A64	I/O	C/BE7#	Bus Command/Byte Enable 7
A65	I/O	C/BE5#	Bus Command/Byte Enable 5
A66	I/O	+5V	+5 Volts
A67	I/O	PAR64	Parity Upper DWORD
A68	I/O	AD62	Address/Data Bit 62
A69	—	GND	Ground
A70	I/O	AD60	Address/Data Bit 60
A71	I/O	AD58	Address/Data Bit 58
A72	—	GND	Ground
A73	I/O	AD56	Address/Data Bit 56
A74	I/O	AD54	Address/Data Bit 54
A75	I/O	+5V	+5 Volts
A76	I/O	AD52	Address/Data Bit 52
A77	I/O	AD50	Address/Data Bit 50
A78	—	GND	Ground
A79	I/O	AD48	Address/Data Bit 48
A80	I/O	AD46	Address/Data Bit 46
A81	—	GND	Ground
A82	I/O	AD44	Address/Data Bit 44
A83	I/O	AD42	Address/Data Bit 42
A84	I/O	+5V	+5 Volts
A85	I/O	AD40	Address/Data Bit 40
A86	I/O	AD38	Address/Data Bit 38
A87	—	GND	Ground
A88	I/O	AD36	Address/Data Bit 36
A89	I/O	AD34	Address/Data Bit 34
A90	—	GND	Ground
A91	I/O	AD32	Address/Data Bit 32
A92	NA	NA	Reserved
A93	—	GND	Ground
A94	NA	NA	Reserved
B1			
Thru	Same as 32-Bit Expansion Slot		
B62			
B63	NA	NA	Reserved
B64	—	GND	Ground
B65	I/O	C/BE6#	Bus Command/Byte Enable 6
B66	I/O	C/BE4#	Bus Command/Byte Enable 4
B67	—	GND	Ground
B68	I/O	AD63	Address/Data Bit 63
B69	I/O	AD61	Address/Data Bit 61
B70	I/O	+5V	+5 Volts
B71	I/O	AD59	Address/Data Bit 59
B72	I/O	AD57	Address/Data Bit 57
B73	—	GND	Ground
B74	I/O	AD55	Address/Data Bit 55
B75	I/O	AD53	Address/Data Bit 53
B76	—	GND	Ground
B77	I/O	AD51	Address/Data Bit 51
B78	I/O	AD49	Address/Data Bit 49
B79	I/O	+5V	+5 Volts
B80	I/O	AD47	Address/Data Bit 47
B81	I/O	AD45	Address/Data Bit 45
B82	—	GND	Ground
B83	I/O	AD43	Address/Data Bit 43
B84	I/O	AD41	Address/Data Bit 41
B85	—	GND	Ground
B86	I/O	AD39	Address/Data Bit 39
B87	I/O	AD37	Address/Data Bit 37
B88	I/O	+5V	+5 Volts
B89	I/O	AD35	Address/Data Bit 35
B90	I/O	AD33	Address/Data Bit 33
B91	—	GND	Ground
B92	NA	NA	Reserved
B93	NA	NA	Reserved
B94	—	GND	Ground

3.3-Volt, 64-Bit Expansion Slot
MCA-Style Edge Connector

Pin	I/O	Signal	Description
A63	—	GND	Ground
A64	I/O	C/BE7#	Bus Command/Byte Enable 7
A65	I/O	C/BE5#	Bus Command/Byte Enable 5
A66	I/O	+3.3V	+3.3 Volts
A67	I/O	PAR64	Parity Upper DWORD
A68	I/O	AD62	Address/Data Bit 62
A69	—	GND	Ground
A70	I/O	AD60	Address/Data Bit 60
A71	I/O	AD58	Address/Data Bit 58
A72	—	GND	Ground
A73	I/O	AD56	Address/Data Bit 56
A74	I/O	AD54	Address/Data Bit 54
A75	I/O	+3.3V	+3.3 Volts
A76	I/O	AD52	Address/Data Bit 52
A77	I/O	AD50	Address/Data Bit 50
A78	—	GND	Ground
A79	I/O	AD48	Address/Data Bit 48
A80	I/O	AD46	Address/Data Bit 46
A81	—	GND	Ground
A82	I/O	AD44	Address/Data Bit 44
A83	I/O	AD42	Address/Data Bit 42
A84	I/O	+3.3V	+3.3 Volts
A85	I/O	AD40	Address/Data Bit 40
A86	I/O	AD38	Address/Data Bit 38
A87	—	GND	Ground
A88	I/O	AD36	Address/Data Bit 36
A89	I/O	AD34	Address/Data Bit 34
A90	—	GND	Ground
A91	I/O	AD32	Address/Data Bit 32
A92	NA	NA	Reserved
A93	—	GND	Ground
A94	NA	NA	Reserved
B63	NA	NA	Reserved
B64	—	GND	Ground
B65	I/O	C/BE6#	Bus Command/Byte Enable 6
B66	I/O	C/BE4#	Bus Command/Byte Enable 4
B67	—	GND	Ground
B68	I/O	AD63	Address/Data Bit 63
B69	I/O	AD61	Address/Data Bit 61
B70	I/O	+3.3V	+3.3 Volts
B71	I/O	AD59	Address/Data Bit 59
B72	I/O	AD57	Address/Data Bit 57
B73	—	GND	Ground
B74	I/O	AD55	Address/Data Bit 55
B75	I/O	AD53	Address/Data Bit 53
B76	—	GND	Ground
B77	I/O	AD51	Address/Data Bit 51
B78	I/O	AD49	Address/Data Bit 49
B79	I/O	+3.3V	+3.3 Volts
B80	I/O	AD47	Address/Data Bit 47
B81	I/O	AD45	Address/Data Bit 45
B82	—	GND	Ground
B83	I/O	AD43	Address/Data Bit 43
B84	I/O	AD41	Address/Data Bit 41
B85	—	GND	Ground
B86	I/O	AD39	Address/Data Bit 39
B87	I/O	AD37	Address/Data Bit 37
B88	I/O	+3.3V	+3.3 Volts
B89	I/O	AD35	Address/Data Bit 35
B90	I/O	AD33	Address/Data Bit 33
B91	—	GND	Ground
B92	NA	NA	Reserved
B93	NA	NA	Reserved
B94	—	GND	Ground

Computer Control of Wireless Links

Part 4

Radio links for computer control

In this article, I continue exploration of basic circuits and systems for computer-controlled wireless communicating. The wireless link may be between two computers or computer-controlled devices or between a computer and a simple hand-held controller or other non-computerized device. My topic this time around is radio-frequency links, with a look at some low-cost transmitters and receivers that transmit in the band from 300 MHz through 315 MHz.

Radio Basics

To begin our journey, let's look at radio links in general. Radio transmissions consist of high-frequency electromagnetic waves that travel through the air. Most radio waves will also pass through windows, walls and other solid objects. This makes radio useful where a direct line-of-sight between transmitter and receiver isn't available. Radio can also be a good choice for outdoor links, where daylight may interfere with infrared transmissions and wired links are inconvenient.

The two essential elements of a radio link are the transmitter and a receiver.

The transmitter combines a carrier frequency with the information, or intelligence, to be transmitted. The frequency of the carrier is the center, or fundamental, radio frequency of the transmitter. In computer links, the information to be transmitted is usually some form of digital data. The data may represent any type of information, however, including control signals, sensor readings or program code.

An oscillator generates the carrier frequency. Modulation circuits combine the carrier and the information by varying a characteristic of the carrier in

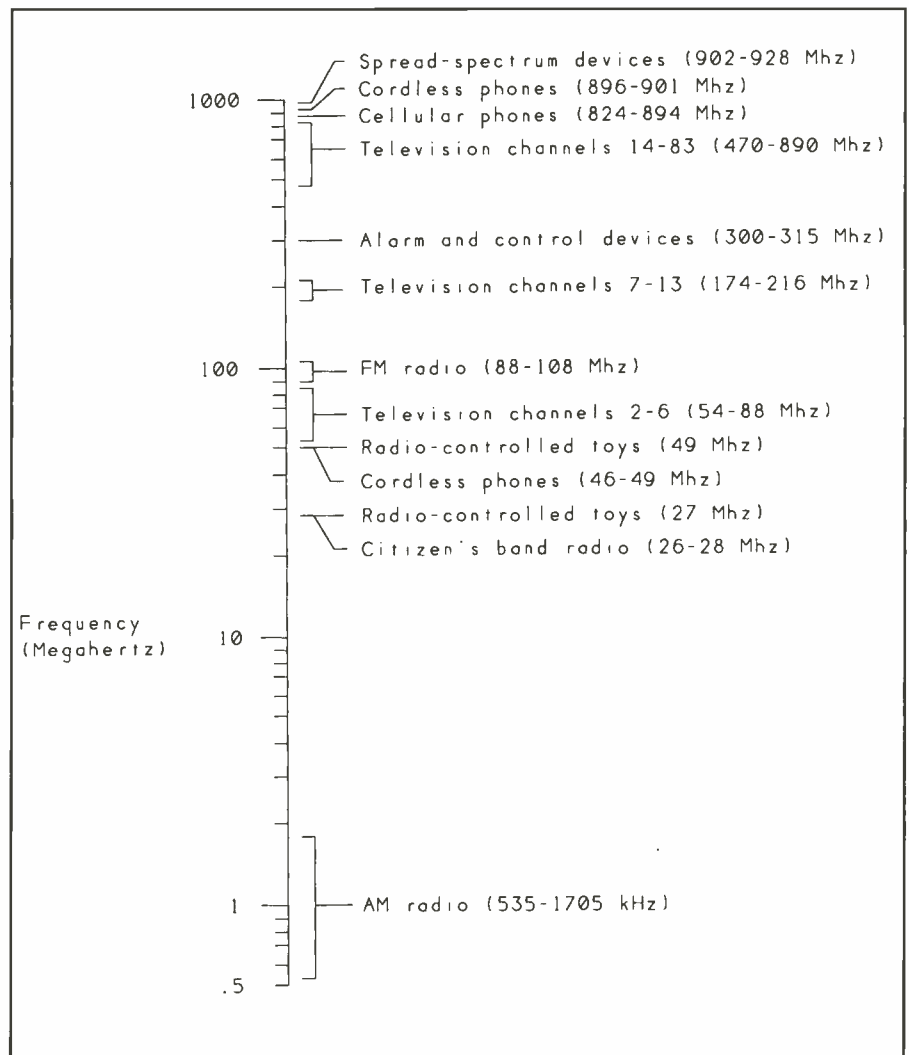


Fig. 1. Frequency bands used by selected types of radio transmissions.

response to variations in the information. The carrier may vary in amplitude, frequency or phase to indicate variations in the information, such as logic highs and lows.

A transmitter also typically includes amplifiers to increase the power of the

signal and an antenna to radiate the signal through the air.

At the other end of the radio link, the receiver's antenna detects the transmitted signal. Demodulation circuits extract the information from the carrier and make it available as digital data,

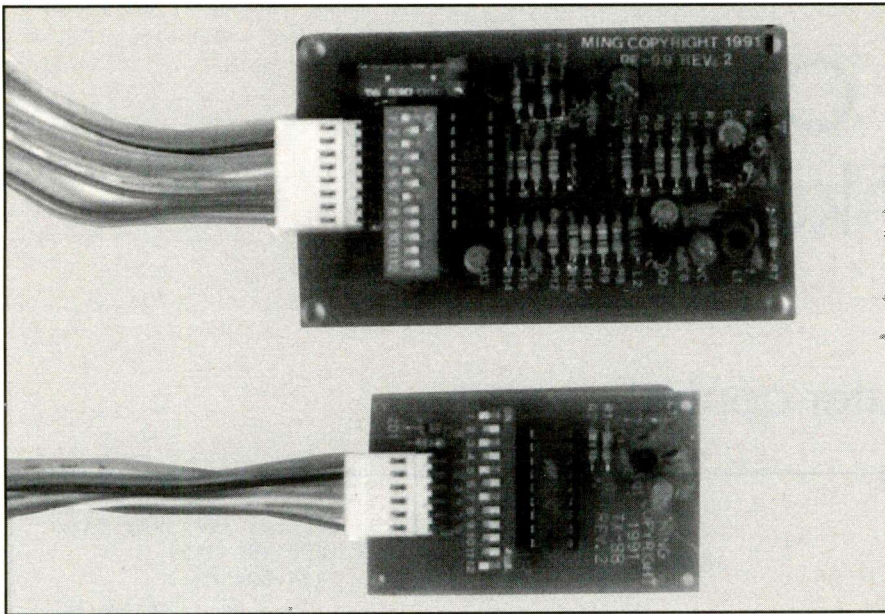


Fig. 2. Electronics 123's TX-99 transmitter sends codes and data to the RE-99 receiver.

telephone conversations, radio programs or other usable forms.

Radio transmitting frequencies range from a few hundred kilohertz at the low end, to more than a gigahertz (1,000 MHz). Figure 1 shows some of the uses for different frequency bands, including those used for data and control links.

The greatest limitation to employing radio is that use of the airwaves is very

much regulated. In the U.S., the Federal Communications Commission (FCC) makes the rules about what kinds of signals can be transmitted in each frequency band and who is authorized to transmit. Fortunately, there are some license-free ways to get a radio link up and running.

Another drawback to radio circuits is that they require special construction

techniques. At high frequencies, the impedance of printed-circuit-board traces and component leads can affect circuit operation. Proper grounding and shielding are critical. And testing and calibrating a radio-frequency transmitter requires special equipment. For these reasons, the easiest option is to buy the transmitters and receivers for your link, rather than trying to build them yourself.

Radio-Link Circuits

One source of low-cost radio-frequency transmitter and receiver circuits is Electronics 123, a division of Ming Engineering. Three sets are available, all of which transmit in the range from 300 MHz to 315 MHz, a frequency band used by many garage-door openers and alarm systems.

Uses for the boards have included entry and exit alarms, remote door closing and locking and production-line monitoring. But just about any basic control or monitoring task is a possibility for these devices. You can use a computer or microcontroller to control the transmitter and monitor the receiver, or you can use a manually operated or other non-computerized device at one or both ends of the link.

All three transmitters can send four-

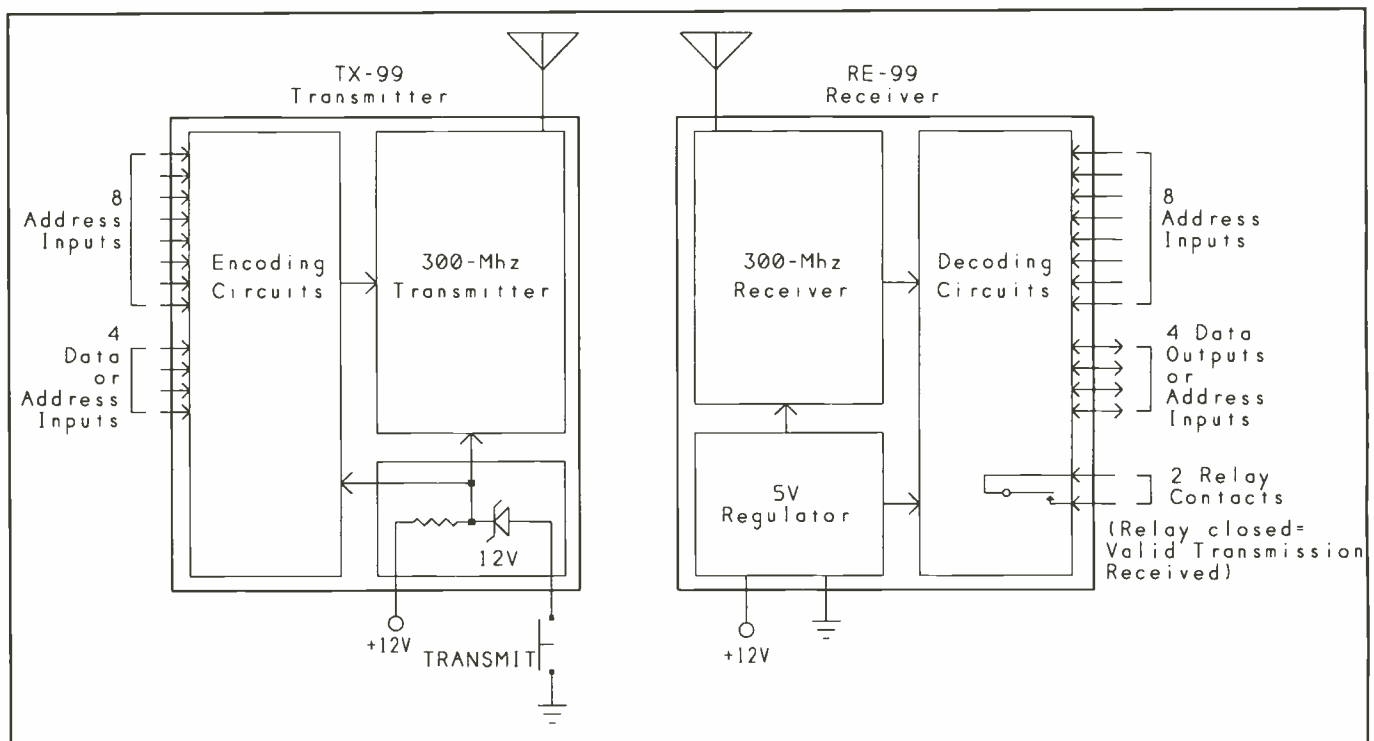


Fig. 3. Block diagrams of the TX-99 and RE-99.

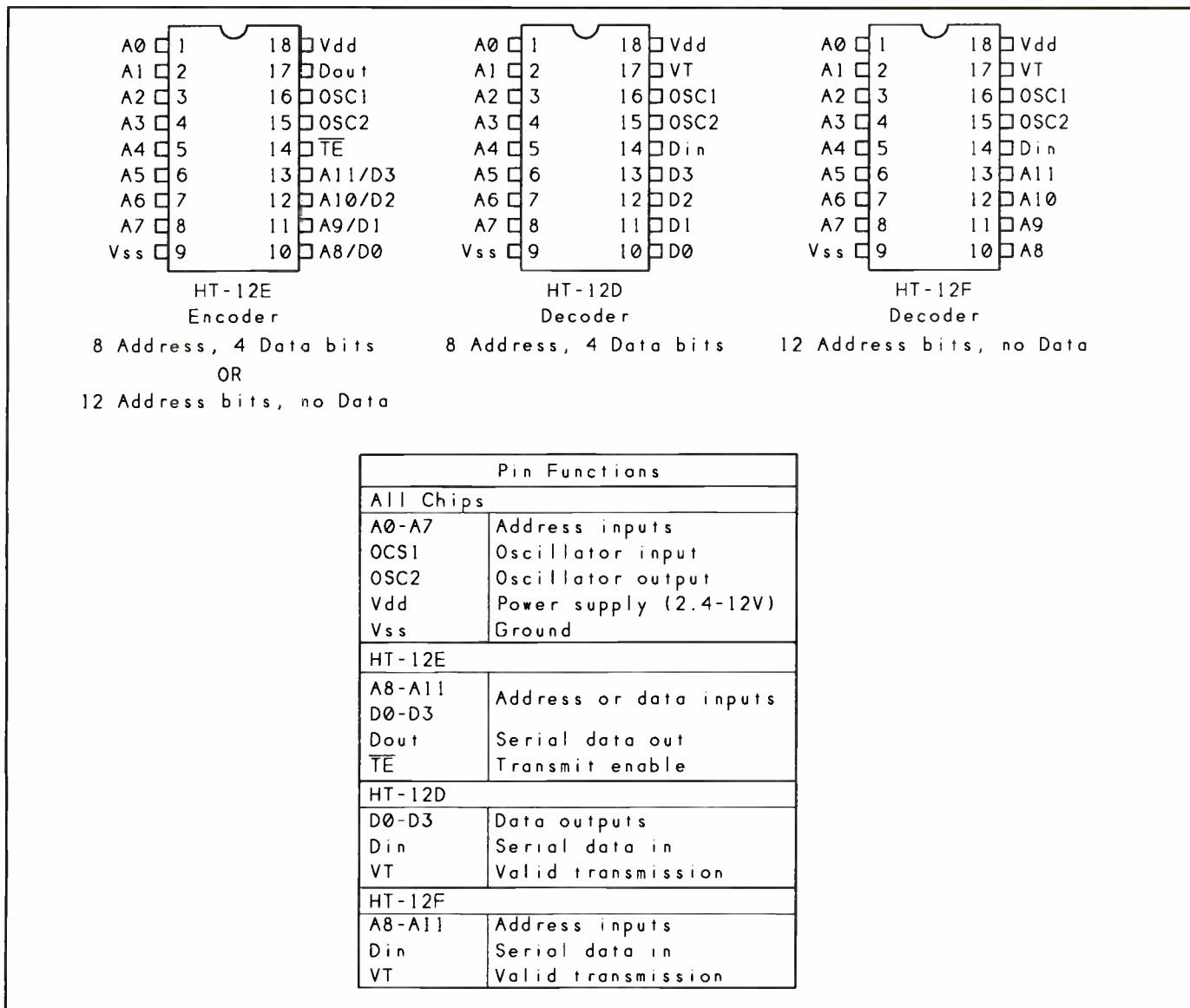


Fig. 4. Pin functions of the Holtek encoder/decoder chips.

bit codes to a receiver that's identified by an eight-bit address. In this manner, they're similar to the infrared-transmitting circuits I described in earlier articles in this series.

The lowest-cost set consists of the TX-99 and RE-99 transmitter and receiver (\$34.95 per pair), which transmit over about a 100-foot line-of-sight range. Shown in Fig. 2 are the boards, while Fig. 3 is a block diagram of what they contain. The circuits on each board consist of three main parts: the radio transmitter or receiver, encoding or decoding circuits and voltage regulators. For a two-way link, you need two of each board.

The transmitter and receiver use Holtek's HT-12E encoder and HT-12D or HT-12F decoder chips. These are

similar in operation to Motorola's 146026/7 encoder and decoder. Pin-outs are shown in Fig. 4.

On the TX-99 board, the TE (transmit-enable) input is tied low (always active), and you enable the transmitter by applying power to it. On power-up, the HT-12E encodes its 12 address/data inputs and outputs them as a stream of serial data. Figure 5 shows the encoding method used. Each transmitted data word consists of a pilot period, which consists of a long logic-low pulse, followed by a code period that contains the encoded address and data. For each complete transmission, the encoder outputs the complete data word four times in a row.

Unlike the 145026, which has several timing components, the HT-12E re-

quires just one resistor to set the oscillator frequency for transmitting. On the TX-99, the oscillator frequency is 2,200 Hz, which results in a transmitting speed of a little greater than 130 ms per transmission.

For manual operation, the board has a 12-position DIP switch for setting the address and data inputs. The data inputs are also brought out to a header with an included cable, if you want to bypass the switches and control the data with other circuits or switches.

The transmitter modulates the encoder's output onto a 300-MHz carrier. The modulation method is amplitude shift keying (ASK), a very basic method that switches on and off the carrier to indicate the logic highs and lows of the encoded data.

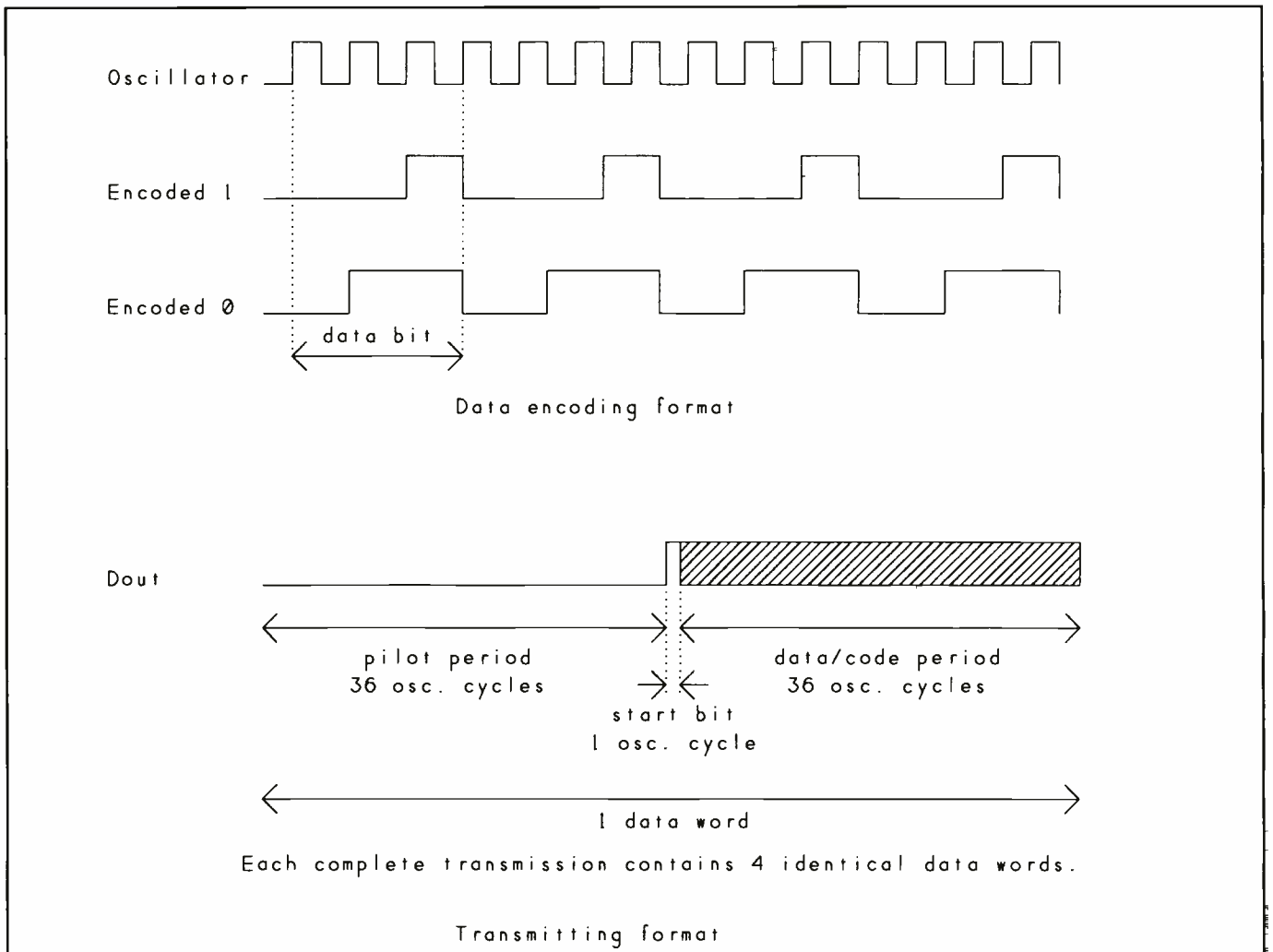


Fig. 5. Encoding and transmission format of the HT-12E encoder.

The 300-MHz oscillator is made from discrete components consisting of capacitors, coils, a resistor and a transistor. One of the traces on the printed-circuit board acts as an antenna. There's also a solder pad for adding a length of wire to act as an external antenna. A LED lights when the transmitter is on.

In my experiments with these boards, I found that a clear line-of-sight path wasn't required for transmitting over shorter distances. I was able to receive transmissions from other rooms and even from two floors away, using only the included antennas.

The circuits are powered at 12 volts dc. Because the board includes a zener diode regulator, a dc supply of up to 15 volts or so should also work. Included with the circuit-board assembly are example circuits for interfacing 5-volt logic to the data inputs.

At the receiver end, the RX-99 consists of radio receiver and decoding cir-

cuits. The receiver detects the transmitted signal, separates the transmitted data from the carrier and presents the serial data stream to the decoder. For the decoder chip, you have a choice of the HT-12D or HT-12F. Both are included with the board. A single resistor sets the oscillator frequency for decoding.

On the HT-12D, eight address inputs set the decoder's address, and four data outputs hold received data. The HT-12F has 12 address inputs and no data outputs. When the HT-12D receives a transmission, it first determines if the transmitted address matches its own. If not, it ignores the entire transmission. If the address does match, the decoder stores the four data bits and compares the next three transmissions to the stored data. If the address and data match all four times, the decoder latches the data to its outputs and brings VT (valid transmission) high to signal that a transmission has been received.

This three-times check is very effective at rejecting stray signals picked up by the receiver, ensuring that any data received is correct. In my experiments, even when the transmitter was off, the decoder's data input still toggled constantly, but the decoder ignored these pulses and acknowledged only the data sent to it by the transmitter.

VTs going high causes an on-board relay to energize. You can use the relay circuit to light a LED or to provide a logic signal to trigger other actions by external circuits.

As on the transmitter, the board has a DIP switch for setting the address. The data and VT outputs are brought out to a header with a cable for connections to LEDs, a computer's input port or other circuits. Since these outputs are 5-volt logic, interfacing them to 5-volt circuits is no problem.

The HT-12F is the same as the HT-12E, except that you set all 12 address

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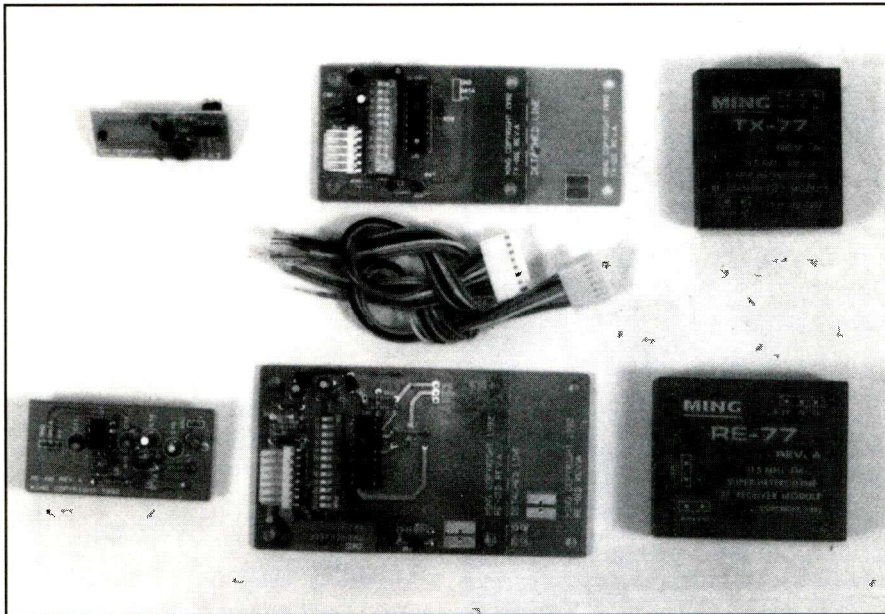


Fig. 6. Top row: TX-66 transmitter, TX-01 encoder, TX-77 transmitter. Bottom row: RE-66 receiver, RE-01 decoder, RE-77 receiver. You can use either set of transmitter/receivers with the encoder and decoder boards.

inputs to match the encoder, and VT is the only indication that a transmission was received. The -12F is useful for very simple applications in which you don't need to send data—if a transmission just turns something on or off, or indicates an alarm, for example.

Like the radio-transmitting circuits, the receiver uses discrete components consisting of coils, capacitors, resistors and transistors. Two operational amplifiers amplify and condition the received data. A 19" length of hookup wire acts as a half-wave receiving antenna.

This board has a 5-volt regulator that accepts inputs from 7 to 15 volts dc. All of the circuits are powered at 5 volts, however. So you could add a solder connection to bypass the regulator and use a 5-volt supply directly, if this is more convenient.

The antennas on both transmitter and receiver can greatly affect the distance over which the link can operate. If you add an external transmitting antenna, recommended wire lengths are those that match the transmitter's wavelength, or 0.25 or 0.5 of this value.

Determining antenna length requires some calculations. Electromagnetic waves travel at the speed of light; 300-million meters per second. The TX-99 transmits at 300-MHz; so its waves travel 1 meter per cycle, and the transmitted signal has a 1-meter (39.37") wavelength. Electronics 123 recommends using slightly shorter lengths: 37.4" for a full-wave antenna, 18.7" for half-wave and 9.4" for quarter-wave.

As a general rule, a longer antenna

will increase the range. To minimize the possibility of interference, use the shortest antennas that give reliable reception. To prevent unwanted emissions, especially spurious emissions of out-of-band frequencies, completely enclose all of the radio-frequency circuits in a metal housing.

Other Options

If the 99 series doesn't meet your needs, two other options are the 66 and 77 series transmitters and receivers. Both have an advertised range of 150 feet, line-of-sight.

These boards use a modular approach, with the encoder and decoder circuits on separate motherboards that you can connect to either set of transmitter/receivers or to your own designs. Shown in Fig. 6 are the boards. The motherboards duplicate the encoding and decoding functions of the 99 series, but they leave off the radio-frequency circuits.

The TX-01 (\$9.95) contains an HT-12E encoder, 12-position DIP switch for setting address and data, 5-volt regulator, transmit-indicator LED and a six-pin header with ground, power and four data inputs.

The RE-01 (\$14.95) contains a socketed HT-12D decoder, 12-position DIP switch, 5-volt regulator, relay and eight-pin header with ground, +12 volts, four data outputs and relay connections. An HT-12F is available at extra cost.

The TX-66 (\$10.95) transmits at 310 MHz. Modulation method is AM, or

amplitude modulation, where the information is expressed as variations in the carrier's amplitude. The RE-66 (\$11.95) is the receiver for the TX-66.

The TX-77 (\$29.95) transmits at 315 MHz. Modulation is FM, or frequency modulation, where information is expressed as variations in the carrier frequency. The RE-77 (\$39.95) is the receiver for the TX-77.

Although the 66 and 77 series boards are designed to interface to the 01 motherboards, you can send and receive other types of serial data with them. The data inputs and outputs are 5-volt serial data. So, for example, you could interface a transmitter and receiver to a serial port on a microcontroller or personal computer.

According to Electronics 123, the 66 series has been found experimentally to transmit at 600 to 1,200 bits per second (bps), while the 77 series can transmit at 2,400 bps.

If you use the radio circuits without the encoder and decoder, however, you give up the error-checking built into the decoder chip and you'll have to add your own error checking in software to reject stray signals and ensure that you receive error-free transmitted data.

Complete schematics and applications hints are provided with all boards. I did find some errors in the documentation, however. For example, the schematic for the 5-volt TX-66 shows a 12-volt supply, and the description of how the decoder works doesn't always agree with its data sheet or my own observations.

Electronics 123 carries dozens of Holtek encoder/decoder chips. If you want to design your own circuits, there are chips that encode and decode different numbers of address and data bits. The chips are useful for infrared transmitting as well as radio circuits. Data sheets are available on request. Alternate sources for the 99 series boards include Digi-Key and Gateway Electronics.

FCC Regulations

What about FCC regulations? How do

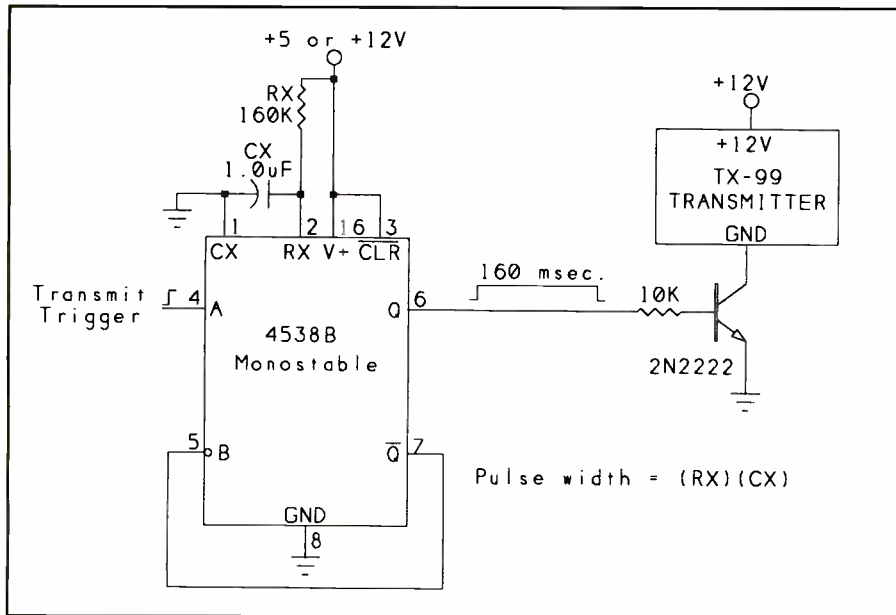


Fig. 7. This circuit ensures that a trigger of any width will result in one complete transmission and not more.

they apply to this type of transmitter?

Most radio-frequency devices that will be marketed require FCC approval, also known as FCC certification or authorization. Approval involves demonstrating to the FCC that you've tested the device to ensure that it meets all regulations that apply.

Approval isn't required for devices that aren't marketed, aren't constructed from a kit and are built in quantities of five or less for personal use. The transmitters sold by Electronics 123 are sold not as final products ready for use but, rather, as circuit modules without a power supply or enclosure. This enables them to be sold as experimental devices, without FCC approval.

Electronics 123 states that its transmitter boards operate within FCC regulations, but they're reluctant to be more specific, since a lot depends on how you use the boards. For example, the strength of a radiated signal will vary depending on the transmitting antenna and its placement, type of housing surrounding the circuits and other factors. The field strength required for reliable reception will also vary, depending on the receiver and the type and location of its antenna.

As the end user, you're responsible for ensuring that your transmitter doesn't violate FCC regulations. Rules and regulations for operating radio-frequency devices without a license are contained in the FCC's General Docket

#87-389. Adopted in 1989, the docket revises Part 15 of FCC regulations, which covers non-licensed operations and was an attempt to simplify, clarify and standardize the many rules that had evolved over the years.

I received a copy of the rules without charge from the FCC's Consumer Assistance and Small Business Division. Or, you can order them for \$22 as part of Title 47, Code of Federal Regulations, Part 0 through Part 19, available from the Superintendent of Documents. A public library may also have a copy or might be able to get one for you. The FCC operates a BBS, which you can reach by dialing 301-725-1072. This BBS has some information about the rules, new developments and how to order FCC documents.

FCC rules can be obscure and difficult to wade through. But it's important that you be aware of them and what they say. For the most part, they're intended to prevent interference problems, without being overly burdensome to vendors of radio-frequency devices or to individual users and experimenters.

In the following paragraphs, I'll summarize the rules that apply to the transmitters described above. However, please don't take my interpretations as the final word. The ultimate responsibility for complying with the FCC regulations is yours.

The FCC lists general limits for non-licensed transmitters, plus some excep-

tions that apply to specific frequency bands and uses.

Rather than specifying the maximum power at the transmitter, the rules specify a maximum field strength, which measures the strength of the signal at a distance from the transmitter.

To measure field strength, you need a field-strength meter, which responds to the voltage induced on a wire by changes in the radiated field. Because the voltage will vary, depending on the length of the wire, measurements use standard units of microvolts per meter ($\mu\text{V}/\text{m}$), or the voltage that would be induced across a 1-meter wire.

Chances are that you don't have access to a field-strength meter. The FCC recognizes that individual builders may not have the means for fully testing to ensure compliance with regulations, but it does require that builders use "good engineering practices" to meet the standards as closely as possible. Harmful interference isn't permitted in any case, and an operator must cease using his transmitter if notified by the FCC that it's causing interference.

A good source of information on topics relating to building, testing and operating r-f devices is the American Radio Relay League's comprehensive *ARRL Handbook*. Oriented toward amateur or "ham" radio, it includes a lot of information that's useful to anyone who is involved with radio circuits.

The most important rule for radio experimenting is this: Limit your transmitted power to the minimum required to do the job. In other words, if a quarter-wave antenna gives reliable reception, don't use more-powerful half-wave antennas "just to be sure."

For the band that includes 300 MHz to 315 MHz, the general field-strength limit is $200 \mu\text{V}/\text{m}$, measured at 3 meters. The limit applies to the intended transmitting frequency as well as to emissions outside the intended band. For transmissions in occasional, short bursts, allowable field strengths are greater than the general limits.

For periodic operation above 70 MHz, there are two sets of rules, depending on the type of transmission. The first set applies to only transmitting control signals, such as those for alarm systems, door openers and remote switches. Radio control of toys and continuous transmissions of voice or video aren't permitted under these limits. However, transmitting of recog-

dition codes that identify a receiver are permitted.

Field strength of the fundamental frequency is limited to about 5,000 $\mu\text{V}/\text{m}$ at 300 MHz to 315 MHz, or 25 times the limit for continual transmissions. Spurious emissions (outside the fundamental frequency) are limited to one-tenth of the field strength of the fundamental. At this strength, each transmission may be no longer than 5 seconds in duration.

Manually-operated and automatic transmitters must also automatically turn off the transmitter within 5 seconds (though there's no specified limit for how long it must remain off between transmissions). Transmitters that activate during emergencies that involve fire, security and safety may continue to operate as long as the alarm condition exists.

Periodic transmissions at regular, predetermined intervals aren't permitted, with one exception—in security or safety systems, polling to check the transmitters is allowed—but these transmissions can't exceed 1 second per hour per transmitter.

For other transmissions in this band, including voice, data, toy control and others not permitted by the above rules, periodic operation is allowed, but under more-stringent limits. Allowable field strengths are about 40% of those allowed above, or around 2,000 $\mu\text{V}/\text{m}$, with spurious emissions limited to one-tenth of these values. Under these limits, transmissions must be very short.

Devices must have a means to automatically limit operation so that each transmission is no longer than 1 second in duration, with a silent period between transmissions that lasts at least 10 seconds, and at least 30 times as long as the transmission. In other words, the transmitter can be on for no more than about 3% of the time. So sending large amounts of information will take a very long time. Regular, periodic transmissions are allowed under these limits, however.

At 2,400 bits per second, if each byte of information is transmitted with a start and stop bit added, it takes 4.2 ms to transmit a byte. In 1 second, you can transmit about 240 bytes, after which you must wait at least 30 seconds. This brings actual transmission rate down to 464 bytes of information per minute. If you include checksums or other error-checking information,

SOURCES	
American Radio Relay League (ARRL) 225 Main St. Newington, CT 06111 BBS: 203-666-0578 CIRCLE NO. 93 ON FREE INFORMATION CARD	Federal Communications Commission Consumer Assistance and Small Business Div. Office of Public Affairs Washington, DC 20554 CIRCLE NO. 123 ON FREE INFORMATION CARD
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the rate will be even less. Still, it's good enough for many purposes, such as transmitting short blocks of data, control sequences and even small program routines. But it's not practical for a link that involves typing commands to a remote computer or transferring large files between computers. For this, you must stay below 200 $\mu\text{V}/\text{m}$.

Transmit-Control Circuit

The simplest way to operate the TX-99 is with a manual or electronic switch that applies power to the board. This operating method, however, has two drawbacks. If the switch remains closed for less than 130 ms, the transmitter doesn't have enough time to send a complete transmission. And if the switch remains closed much longer than this, the transmitter is wasting power by transmitting when it's not necessary to transmit.

If the transmissions are under computer control, you can program the computer to generate a trigger pulse of the correct width. Alternatively, you can do the same in hardware.

Figure 7 shows a circuit that causes the transmitter to send one complete transmission for each trigger pulse. It ensures that even short triggers will result in complete transmissions, and it keeps the transmitter from remaining on longer than necessary, even if a trigger pulse is very long.

On the rising edge of a trigger pulse,

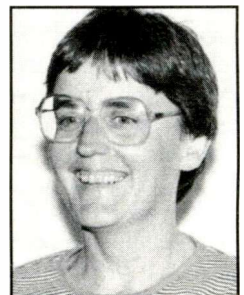
a 4538B monostable (one-shot) multivibrator generates a power-on pulse of about 160 ms duration. This permits enough time for one complete transmission, with some extra to allow for variations in timing components.

When the power-on pulse is high, a transistor switches on and applies power to the transmitter. When the power-on pulse returns low, the transmitter switches off. Tying the -Q output to the B input keeps the one-shot from retriggering if another trigger pulse arrives before the output has timed out.

The trigger can be any pulse of 60 ns or longer in duration. All triggers will result in transmissions of the same length.

Next month, I'll discuss more radio options.

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, include a self-addressed stamped envelope.



Jan Axelson

Miniature SBC Runs BASIC Programs

Use this tiny postage-stamp-sized, inexpensive and easy-to-use powerhouse single-board computer for an unlimited range of applications

Traditionally, if you were a newcomer to microcontrollers, you faced two very real obstacles: the cost of a development system and the difficulty of learning and applying assembly-language programming. With the introduction of a single-board computer (SBC) called the BASIC Stamp, both of these barriers have crumbled. So called because it's about the size of a commemorative postage stamp, the Stamp knocks down the first barrier with its low cost. A complete development system costs just \$139 and includes one Stamp SBC. Additional SBCs cost just \$39 each. You need no hardware or software beyond a modest XT or better PC/compatible computer, not even an EPROM eraser or separate text-editing program to use this mighty mite to perform an almost unlimited range of tasks.

Because of the Stamp's brand-new implementation of the familiar BASIC programming language, the second barrier no longer exists. In addition to having the standard BASIC vocabulary built into it, the Stamp adds controller-specific instructions for responding to a pushbutton switch, sending and receiving serial data, measuring resistance and pulse widths, performing digital-to-analog (D/A) conversion and much more.

In this article, I'll examine the Stamp's hardware and firmware in detail to introduce you to this amazing miniature SBC. Then I'll detail three projects you can build with it. These projects include a serial stepper-motor controller, an LCD data terminal and a dice game.

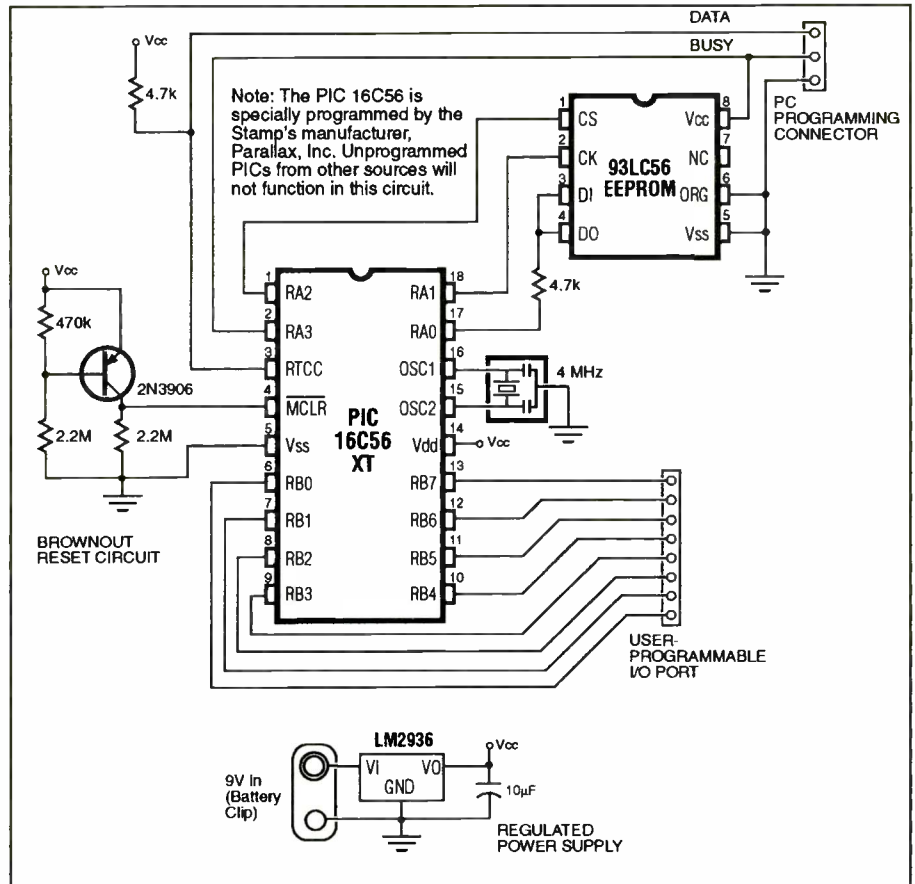


Fig. 1. Schematic diagram of BASIC Stamp single-board computer circuitry.

Hardware

In Fig. 1 is shown the schematic diagram of the Stamp, which consists of a PIC 16C56 reduced-instruction-set computer (RISC) chip, 4-MHz resonator, 256-byte EEPROM and power supply/reset circuitry. The PIC proces-

sor is factory-programmed with the BASIC language interpreter. At its default speed of 4 MHz, the PIC processes machine-language programs at a respectable 1-million instructions per second (1 MIPS). After development, you can boost speed to 5 MIPS, if necessary. A BASIC program can

control eight of the PIC's input/output (I/O) lines.

Lines can be designated as any combination of inputs and outputs. As inputs, they have very high impedance and place almost no load on the voltage being monitored. As outputs, they can source (act as a positive connection for) up to 20 mA or sink (act as a ground connection for) up to 25 mA each, although total current must not exceed 40 mA (source) or 50 mA (sink).

The EEPROM stores the instructions and data that make up the BASIC program. Like an EPROM, it retains its contents when power is removed from it. The EEPROM differs from an EPROM in two important respects. Firstly, it can be erased and rewritten without a separate programming board (\$120 and up) or eraser (\$40 and up). Secondly, it uses a simple three-wire serial protocol. This means fewer pins on the EEPROM's case, making it and the Stamp as small as possible.

The standard power supply for the Stamp is a 9-volt battery, which clips directly to the circuit board. The battery dwarfs the computer in both size and weight (Fig. 3). There's no power switch because the Stamp can be shut down by a software command that reduces its power consumption to a mere 20 A. Even when running, the Stamp draws only about 2 mA, making it feasible to run a project continuously for days from a single battery, or weeks, if the project occasionally powers itself down. The Stamp's regulated 5-volt dc power supply can run other components, up to a maximum of 100 mA.

The Stamp is constructed on a 1" X 2" double-sided printed-circuit board. Since its components take up only about half of this space, there's a prototyping area consisting of a grid of 60 plated-through holes. I equipped my Stamp with a 16-pin DIP socket for easy connection to plug-in prototyping boards using a header cable.

Firmware

To avoid confusion, I'll refer to the Stamp's built-in commands as its firmware and the support program as software throughout this article. Table

Fig. 2. The BASIC Stamp development kit includes one Stamp computer, a programming cable, manual, application notes and editing/downloading software.

Listing 1. BASIC Program for Stepper-Motor Controller

```

Symbol Directn = b0
Symbol Steps = w1
Symbol i = w2
Symbol Delay = b6 Symbol Dir_cmd = b7
dirs = %01000011 : pins = %00000001 ' Initialize output.
b1 = %00000001 : Directn = "+"
goto Prompt ' Display prompt.

' Accept a command string consisting of direction (+/-), a 16-bit number
' of steps, and an 8-bit delay (milliseconds) between steps. If longer
' step delays are required, just command 1 step at a time with long
' delays between commands.

Cmd: serin 7,N2400,Dir_cmd,#Steps,#Delay ' Get orders from terminal.
if Dir_cmd = Directn then Stepit ' Same direction? Begin.
b1 = b1^%00000011 ' Else reverse (invert b1).

Stepit: for i = 1 to Steps ' Number of steps.
pins = pins^b1 ' XOR output with b1, then invert b1
to
b1 = b1^%00000011 ' calculate the stepping sequence.
pause Delay ' Wait commanded delay between
steps.
next
Directn = Dir_cmd ' Direction = new direction.

Prompt: serout 6,N2400,(10,13,"step> ") ' Show prompt, send return
goto Cmd ' and linefeed to terminal.

```

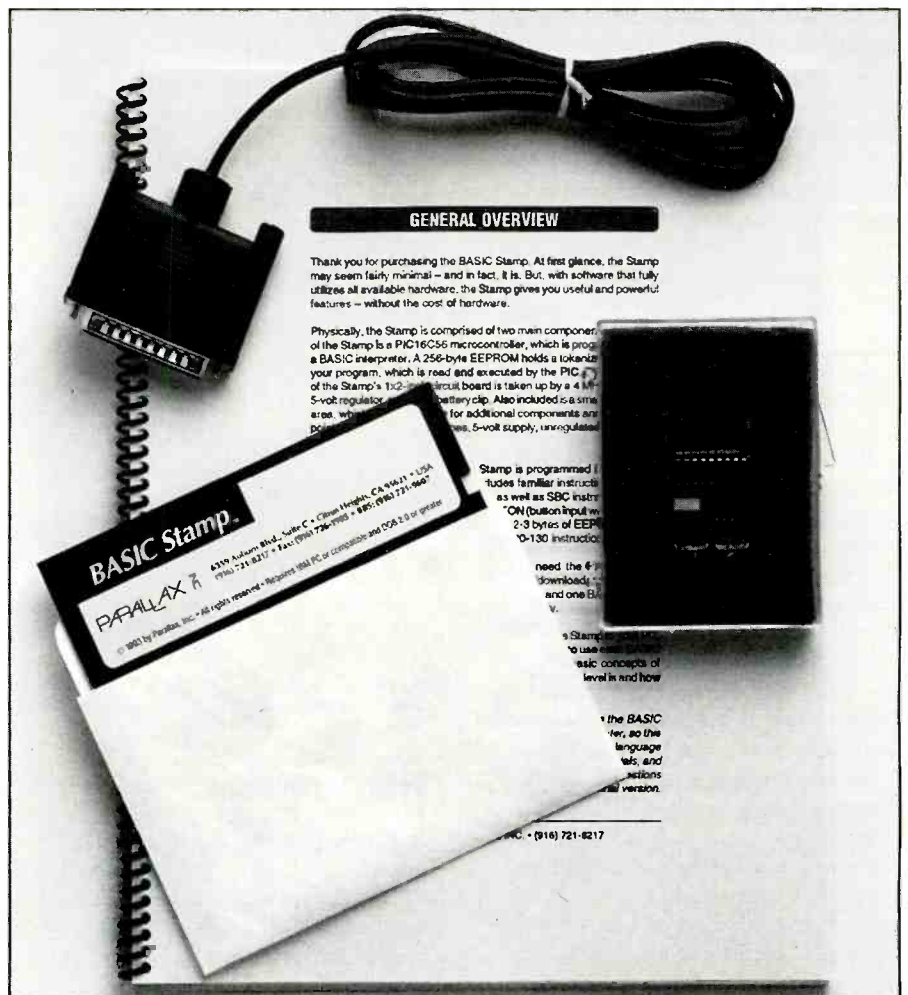


Table 1. Alphabetical Summary of BASIC Stamp Instructions

BRANCH	Jump to one of several locations specified by an offset
BUTTON	Read a switch, debounce it and enable auto-repeat-after-delay
DEBUG	Output contents of variables to PC screen
EEPROM	Store a data table in EEPROM at time of programming
END	Power-down until reprogrammed or reset (power removed and restored)
GOSUB...	Store present location and jump to another
GOTO	Jump to a location
HIGH	Put a high (1) onto a pin
IF...THEN	Compare and jump to location if condition is true
INPUT	Make a pin an input
LET	Assign a value to a variable; optional
LOOKDOWN	Find a value in a table and return its offset in a variable
LOOKUP	Put a value from a table, specified by an offset, into a variable
LOW	Put a low (0) onto a pin
NAP	Power down for times ranging from 18 ms to 2.3 seconds
OUTPUT	Make a pin an output
PAUSE	Stop the program for 1 ms to 6.5 seconds
POT	Read the resistance connected to a pin
PULSOUT	Invert a pin for a specified period of time (10 s to 650 ms)
PWM	Emit a burst of pulse-width modulation for D/A conversion
RANDOM	Generate a 16-bit random number
READ	Read an EEPROM byte
RETURN	Jump to line following the most recent GOSUB
REVERSE	Change a pin's data direction (if input, make output and vice-versa).
SERIN	Receive serial bytes or data values at 300 to 2,400 baud
SEROUT	Transmit serial bytes or data values at 300 to 2,400 baud
SLEEP	Power down for times ranging from 1 second to 18 hours
SOUND	Play a single tone or sequence of notes
SYMBOL	Assign a name to a word, byte or bit variable
TOGGLE	Invert state of a pin (if 1, make 0; if 0, make 1)
WRITE	Store a byte in EEPROM at runtime

It lists the built-in BASIC commands. Some will be immediately familiar to BASIC programmers, while others may require some explanation. I'll start with the foundations of BASIC programming; variables and math.

The Stamp offers three kinds of variables, 16-bit integers (words), eight-bit integers (bytes) and individual bits.

Your program can assign up to seven word variables, 14 byte variables and 16 bit variables. Since memory used for all three types of variables overlaps, each word variable used reduces the number of byte variables by two. This isn't as great a limitation as it might seem, since most variables in a BASIC program are used temporarily—as a counter in a FOR-NEXT loop, for instance—and are then available for other purposes.

Variables have standard names, such as W0 for word 0, B4 for byte 4, and Bit11 for bit 11. The Stamp treats its I/O pins as variables, named Pins for the I/O pins themselves, and Dirs, for the direction (input or output) assigned to the I/O pins. You can also assign more-meaningful names to variables—such as Counter, LCD_Data, PulseWidth or Switch2—using the SYMBOL directive.

The Stamp can perform integer math and logical operations on any of its variables, even the I/O pins. When the Stamp evaluates a math expression, it

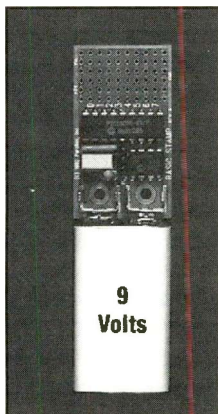


Fig. 3. The standard power supply for the Stamp is a 9-volt battery, which clips directly to the circuit board and battery dwarfs the computer in both size and weight.

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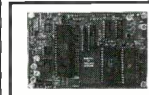
M2801 (shown above)
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 (1) 0-5V analog output
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M2802 (not shown)
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 Relay "on" LEDs
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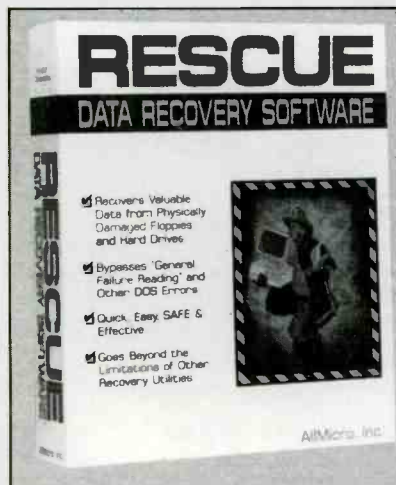
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PRODUCT INFORMATION

Data-Recovery Update

AllMicro has released Version 4.0 of *RESCUE* Data Recovery Software, a program that can recover data from physically damaged disks or drives in less than a minute. A RAM-based disk reader, *RESCUE* bypasses DOS's inability to read physically damaged disks and moves the drive heads directly. As long as the disk can spin,



RESCUE is claimed to be able to recover data. Whereas prior versions of *RESCUE* have been limited primarily to text files, Version 4.0 can recover nearly any file, including executable, application, binary, graphics and others. AllMicro, 1250 Rogers St., Ste. D, Clearwater, FL 34616; tel.: 813-446-6660; fax: 813-446-8075.

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High-End Graphics Accelerator

STB's Pegasus VL24+ VESA-Local Bus-compatible graphics accelerator is capable of displaying 16.7-million colors at a resolution of 640 x 480, 800 x 600, or 1,024 x 768. Based on the S386C928 video controller, it comes in two standard configurations that have 2M and 4M of VRAM. Refresh rates supported are 60, 72 and 76 Hz. To simplify installation and provide easy access to configurations menus, it comes with a *Windows* installation utility that makes it possible to change monitor resolution and color settings from a *Windows* menu.

The Pegasus VL24+ comes with a BNC RGB and VGA 15-pin D connectors. Both connectors support variable- and fixed-frequency video monitors. \$799/999. STB Systems Inc., 1651 N. Glenville, Richardson, TX 75085-0957; tel.: 214-234-8750; fax: 214-234-1306.

CIRCLE NO. 5 ON FREE CARD

Listing 2. BASIC Program for LCD Data Terminal

Symbol	S_in	=	7	' Serial data input pin
Symbol	S_out	=	6	' Serial data output pin
Symbol	E	=	5	' Enable pin, 1 = enabled
Symbol	RS	=	4	' Register select pin, 0 = instruction
Symbol	keys	=	b0	' Variable holding # of key pressed.
Symbol	char	=	b3	' Character sent to LCD.
Symbol	Sw_0	=	pin0	' User input switches
Symbol	Sw_1	=	pin1	' multiplexed w/LCD data lines.
Symbol	Sw_2	=	pin2	
Symbol	Sw_3	=	pin3	

' Set up the Stamp's I/O lines and initialize the LCD.

```
begin:      let pins = 0
            let dirs = %01111111
            pause 200
```

' Clear the output lines
' One input, 7 outputs.
' Wait 200 ms for LCD to reset.

```
i_LCD:     ' Initialize the LCD in accordance with Hitachi's instructions for 4-bit interface.
            let pins = %00000011
            pulsout E,1
            pause 10
            pulsout E,1
            pause 10
            pulsout E,1
            pause 10
```

' Set to 8-bit operation.
' Send data three times to initialize LCD.

```
            let pins = %00000010
            pulsout E,1
            pulsout E,1
            let char = 14
            gosub wr_LCD
            let char = 6
            gosub wr_LCD
            let char = 1
            gosub wr_LCD
            high RS
```

' Set to 4-bit operation.
' Send above data three times.

```
            ' Set up LCD in accordance with Hitachi instruction manual.
            ' Turn on cursor and enable left-to-right printing.
            ' Clear the display.
            ' Prepare to send characters.
```

```
main:      ' Main program loop: receive data, check for backspace, and display data on LCD.
            serin S_in,N2400,char
            goto bksp
```

' Main terminal loop.

```
out:       gosub wr_LCD
            goto main
```

```
wr_LCD:    ' Write the ASCII character in b3 to LCD.
            let pins = pins & %00010000
            let b2 = char/16
            let pins = pins | b2
            pulsout E,1
```

' Put high nibble of b3 into b2.
' OR the contents of b2 into pins.
' Blip enable pin.

does so strictly from left to right; no parentheses or precedence of operators are involved. This takes a little getting used to, but it greatly simplifies debugging.

Other math-related functions available are ones for generating a random number (RANDOM) and searching tables of data (LOOKUP and LOOKDOWN). These last two commands are new to BASIC and can replace handwritten routines that would otherwise be a dozen or so lines long. LOOKUP

has the syntax: "LOOKUP offset, (value 0, value 1...value n), variable". For example, "LOOKUP 2,(123, 456, 13, 0), result" would put the value 13 into the variable result. As you'll see in the program listings later, this is extremely valuable for storing bit patterns for display devices.

LOOKDOWN has almost the same syntax, but works in the opposite fashion. "LOOKDOWN 13,(123, 456, 13, 0), result" would put the value 2 into the variable result.

```

let b2 = char & %00001111
let pins = pins & %00010000
let pins = pins | b2
pulsout E,1
return

```

```

Backspace, rub out character by printing a blank.
bksp: if char > 13 then out
      ter.

```

```

if char = 3 then clear
if char = 13 then cret
if char <> 8 then main
gosub back
let char = 32
gosub wr_LCD
gosub back

```

increment.

```
goto main
```

sion.

```

back: low RS
      let char = 16
      gosub wr_LCD
      high RS
      return

```

```

clear: low RS
       let b3 = 1
       gosub wr_LCD
       high RS
       goto main

```

```

If a carriage return is received, wait for switch input from the user. The host
program (on the other computer) should cooperate by waiting for a reply before
sending more data.

```

```

cret: let dirs = %01110000
loop: let keys = 0
      if Sw_0 = 1 then xmit
      let keys = keys + 1
      if Sw_1 = 1 then xmit
      let keys = keys + 1
      if Sw_2 = 1 then xmit
      let keys = keys + 1
      if Sw_3 = 1 then xmit
      goto loop

```

```

xmit: serout S_out,N2400,(#keys,10,13)
      let dirs = %01111111
      goto main

```

```

Put low nibble of b3 into b2.
Clear 4-bit data bus.
OR the contents of b2 into pins.
Blip enable.

```

```
Not a bksp or cr? Output charac-
```

```

Ctl-C clears LCD screen.
Carriage return.
Reject other non-printables.

```

```
Send a blank to display
```

```
Back up to counter LCD's auto-
```

```
Get ready for another transmis-
```

```

Change to instruction register.
Move cursor left.
Write instruction to LCD.
Put RS back in character mode.

```

```

Change to instruction register.
Clear the display.
Write instruction to LCD.
Put RS back in character mode.

```

```
Change LCD data lines to input.
```

```
Add one for each skipped key.
```

```
Restore I/O pins to original state.
```

The Stamp's instructions for controlling program flow include the standard BASIC instructions GOTO, GOSUB... RETURN, IF...THEN and FOR...NEXT. Unique to the Stamp is the BRANCH instruction, which works like the ON x GOTO command available in some other BASICs. "BRANCH 0,(routine1, routine2, routine3)" has the same effect as GOTO routine1.

The nitty-gritty of the Stamp's implementation of BASIC is its complement of I/O routines. In addition to

instructions that set and clear I/O bits, the Stamp includes several all-new commands whose utility become clear after a little reflection on common controller tasks. Take BUTTON, for example. This single command allows you to debounce a switch, track the length of time it's held down and respond by branching to a subroutine. With the proper parameters, BUTTON provides a delay-before-automatic-repeat response, just like the keyboard of your computer.

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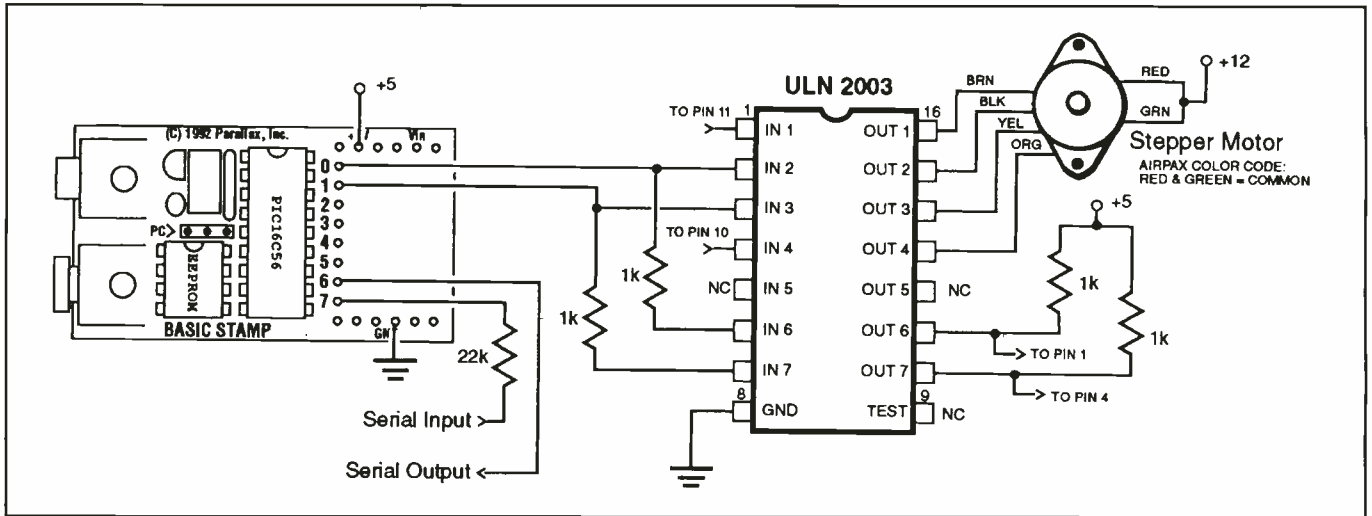


Fig. 4. In this circuit, the Stamp controls a stepper motor under command of a remote PC.

Several instructions come in complementary pairs. PULSIN and PULSOUT measure and generate pulses ranging from 10 s to 0.65 second (650 ms) in length. These simplify tasks that involve time or speed measurement, synchronous serial communication, peripheral interfacing and analog-to-digital conversion.

Another pair of instructions is SERIN and SEROUT, which permit your program to send and receive data via standard asynchronous serial means, such as RS-232, at up to 2,400 bits per second (bps or baud). In addition, these instructions automatically convert data from numbers to text and back again. For example, if you type 123 from the keyboard of your computer while run-

ning a terminal program, the computer transmits three bytes of data: 49, 50 and 51. These are the standard (ASCII) codes for the characters 1, 2 and 3. When the Stamp receives this data, it can interpret it as either individual bytes (49,50 and 51) or as the numeric value represented by those bytes (123). This smart conversion ability saves many lines of BASIC.

The next instruction pair provides analog input and output. POT measures a resistance and returns a value between 0 and 255. It requires one additional component (a capacitor), since the command actually measures the time constant of a resistor/capacitor combination. PWM also requires an external resistor and capacitor. It

COMBINED PARTS LIST

The BASIC Stamp is available from Parallax, Inc., 3805 Atherton Rd., Ste. 102, Rocklin, CA 95765 (tel.: 916-624-8333) for \$139 for the development system and \$39 for each additional Stamp. Six-wire stepper motors similar to the one shown in Fig. 2 are available from American Design Components, 400 County Ave., Secaucus, NJ 07094 (tel.: 800-776-3700). The 16 X 1 LCD in Fig. 3 is available from Timeline Inc., 23605 Telo Ave., Torrance, CA 90505 (tel.: 800-223-9977). Other components are available from standard suppliers, such as Digi-Key Corp., 701 Brooks Avenue South, PO Box 677, Thief River Falls, MN 56701-0677 (tel.: 800-344-4539) and DC Electronics, PO Box 3203, Scottsdale, AZ 85271 (tel.: 800-423-0070).

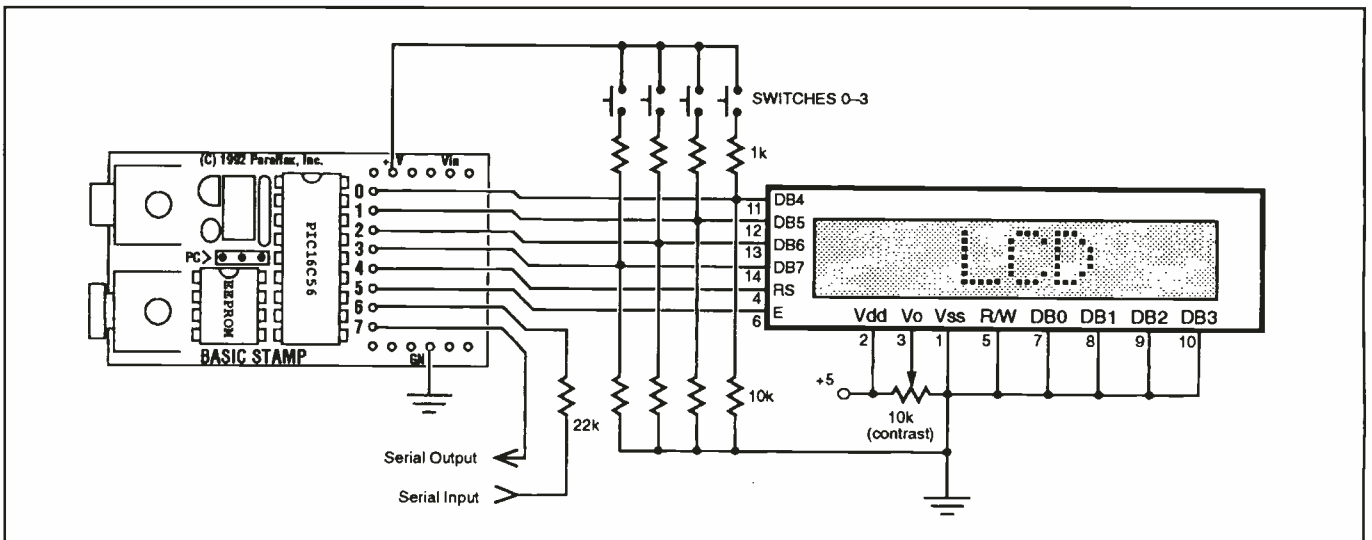


Fig. 5. The Stamp receives serial data, displays it and reports switch closures.

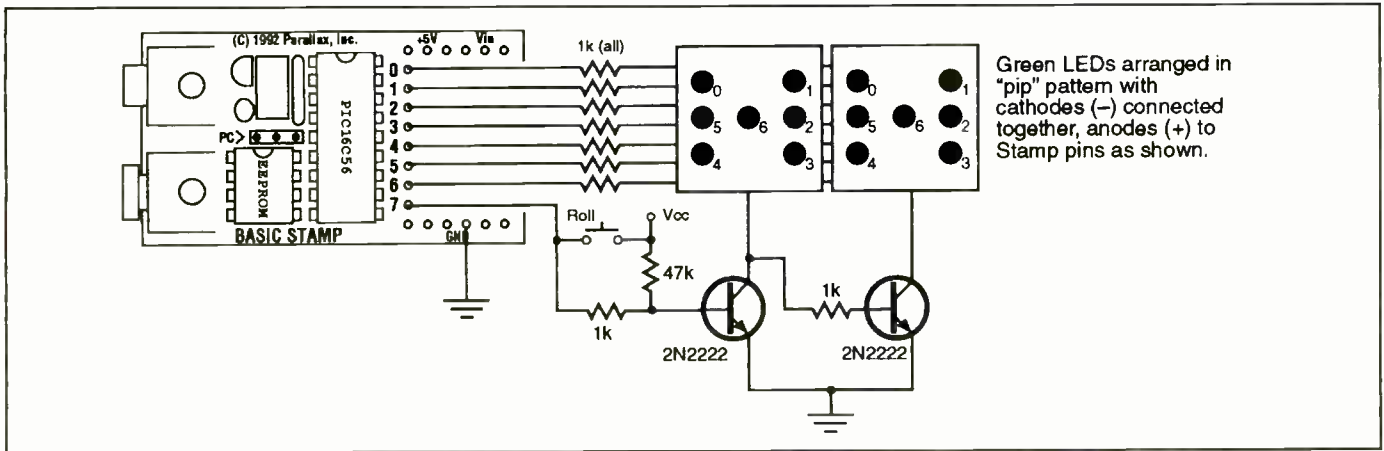


Fig. 6. The simulated dice game is easy to program with the Stamp's RANDOM function.

Listing 3. BASIC Program for Double-Dice Game

Symbol	die1 = b0	' Store number (1-6) for first die.
Symbol	die2 = b1	' Store number (1-6) for ssecond die.
Symbol	shake = w3	' Random word variable
Symbol	pippat = b2	' Pattern of "pips" (dots) on dice.
Symbol	Select = 7	' Pin number of die-select transistors.
high Select		
let dirs = 255		' All pins initially outputs.
let die1 = 1		' Set lucky starting value for dice
(7).		
let die2 = 4		' (Face value of dice = die1+1,
die2+1.)		
Repeat:		' Main program loop.
let pippat = die1		' Dice values are 1-6; lookup val-
ues, 0-5.		
gosub Display		' Display die 1 pattern.
let pippat = die2		' Now die 2.
gosub Display		
input Select		' Change the Select line to input.
if pin7 = 1 then Roll		' Switch closed? Roll the dice.
let w3 = w3+1		' Else stir up w3 for random
results.		
Reenter:		' Return from Roll subroutine.
output Select		' Restore Select to output.
goto Repeat		
Display:		' Look up pip pattern for die value.
lookup pippat,(64,18,82,27,91,63),pippat		
let pins = pins&%10000000		' Clear all pins except Select.
toggle Select		' Invert Select.
let pins = pins pippat		' OR pippat into pins (Select
unchanged).		
pause 4		' Leave on 4 milliseconds.
return		
Roll:		' Put random number into 16-bit
random shake		
shake.		' Use lower 3 bits of each byte.
let die1 = b6&%00000111		
let die2 = b7&%00000111		' Throw back numbers over 5
if die1 > 5 then Roll		
(dice>6).		' Back to the main loop.
if die2 > 5 then Roll goto Reenter		

accepts a value from 0 to 255 and outputs a proportional burst of pulse-width modulation. The pulses charge the capacitor, which outputs a voltage that's proportional to the charge. For many applications, these commands can substitute for complicated A/D and D/A converters.

Miscellaneous commands enable the Stamp to produce tones (SOUND), store and recall values in its EEPROM (READ and WRITE), produce variable time delays (PAUSE), put itself into a power-saving mode for times ranging from 18 ms to 18 hours (NAP and SLEEP) and dump variables to the host PC to find programming errors (DEBUG).

Development Environment

The BASIC Stamp development kit includes one Stamp computer (Fig. 2), a programming cable, manual, application notes and editing/downloading software. Programming the Stamp is as much like working in BASIC on your PC as possible. Once you've plugged the Stamp into a parallel port on your PC and booted the software, you're ready to go.

To begin, you type instructions or load an existing program file into the editor screen. Formatting is left to your personal taste. Stamp BASIC doesn't use line numbers. Instead, it employs labels, such as "Display:" or "clear_LCD:." It accepts comments, either on a separate line or at the end of a line of code. Comments begin with either the traditional BASIC keyword REM or with the more-modern apostrophe (').

When you're ready to test your program, type ALT-R for run. A bargraph appears for a few seconds to show you the progress of the download and a rough estimate of remaining EEPROM space. When the download is complete, the Stamp reboots itself and begins running the program.

Once a program is downloaded to the Stamp, it runs any time power is applied. EEPROM storage is permanent unless deliberately erased—for instance, by downloading another program.

Like storage disks, EEPROMs eventually wear out. The Stamp's EEPROM is rated to last for 100,000 re-programming cycles before it may need replacement. Execution of the program in EEPROM or reading data from it doesn't contribute to this wear. Only re-programming or using the WRITE command does. At a rate of 50 re-programmings a day, seven days a week, it would take more than five years to reach this limit. Contrast this with regular ultraviolet-erasable EPROMs that typically meet their death from the mechanical stresses of handling as they're pried from sockets, plunked into an eraser and returned to sockets with each programming cycle.

Stamp software saves and loads plain-text files. This lets you create and edit programs in any text editor or word processor and import them into the Stamp software for testing. It also lets you experiment with a program until it's just right and then export the source code for use in documentation.

If you're developing a product for

manufacture, the Stamp's maker, Parallax Inc., will supply programmed BASIC interpreter chips in quantities of 25 or more for \$6 each. The company will supply schematic diagrams (like Fig. 1) and information required to integrate the Stamp processor into your designs. A Stamp-based product need not include the entire SBC, only critical components, like processor, resonator and EEPROM.

Parallax also supports the Stamp with a BBS and a continuing series of application notes. Users call the BBS to discuss projects, exchange tips and pose questions to the Parallax technical support staff.

Sample Applications

Now that you've toured the Stamp's hardware, firmware and development software, let's put this handy SBC to work in a few applications.

- **Stepper Motor Controller.** My first application accepts instructions over a serial link from a PC or terminal and rotates a stepper motor's shaft in the direction, speed and number of steps (1 to 65,535) commanded. The schematic diagram for this arrangement is shown in Fig. 3. Listing 1 shows the BASIC Stamp instructions required to implement this application. When the Stamp is powered up, it sends the prompt "step>" to the terminal. At this prompt, type +100 10 to cause the motor to rotate clockwise 100 steps with a 10-ms pause between steps.

As you can see from Listing 1, the

SERIN command makes it easy to write a program that accepts commands over a serial hookup. The Stamp's PIC processor also contributes to this simplicity. Notice that the Fig. 3 circuit lacks the usual level-shifting hardware for receiving 12-volt RS-232 signals. Instead, there's only a 22,000-ohm resistor. This shortcut takes advantage of the PIC's internal static-protection diodes. These diodes divert voltages greater than V_{dd} or less than ground potential to the power-supply rails, where they're less likely to damage the chip. With the addition of a resistor to limit current, these diodes also serve to clip the RS-232 signals to 5-volt logic levels.

- **LCD Data Terminal.** Many household and industrial control applications use a central computer system to orchestrate operation of many smaller data-gathering and display terminals. Figure 4 shows the Stamp in such a role. It receives data from a serial host, displays it on an LCD panel and reports switch closures to the host. Listing 2 is the BASIC program for this application. An interesting feature of this application is the direct multiplexing of the LCD module and input switches, which exploits the Stamp's ability to change I/O directions on-the-fly.

- **Dice Game.** BASIC programmers have always been proud of their ability to write engaging games. In Fig. 5, I offer one of mankind's oldest games of chance—dice—courtesy of the Stamp's RANDOM function. Although this application is meant for fun, some of the techniques used are all business. In Listing 3, pay particular attention to the use of the LOOKUP function to equate the values 1 through 6 to the patterns of pips on the faces of the LED dice. The same approach could drive other types of indicators, including seven-segment displays.

Summing Up

Other BASIC microcontrollers require knowledge of difficult assembly-language programming to create workable applications and a substantial investment in additional hardware and software tools. The BASIC Stamp doesn't. The Stamp offers the first real opportunity for hobbyists and developers on limited budgets to jump into the field of embedded control. ■

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40 PC Diagnostic Tools

A resource guide to diagnostic hardware for PCs

In an attempt to clarify the PC diagnostic market, 40 popular diagnostic tools are separated into six categories here. These will list when you would need a product from that category, what the product in that group is supposed to do and what you should look for when purchasing a product in that category. It's suggested that you look for the product that's best suited for your needs. When dealing with the sales representatives of each company, use this information when asking questions prior to purchasing.

Category 1

POST Reader Cards

A POST reader card is used to determine the cause of a failure on a dead PC. A dead PC is a computer that won't boot to a floppy or the hard drive. When a dead PC is turned on, nothing will happen, a cryptic set of beeps will be emitted or some general failure description will be displayed on the video monitor.

What's a POST reader card supposed to do? Every BIOS performs a power-on self-test (POST) when you turn on the system. The power-on self-test can normally identify the exact failure on a non-booting system. A POST reader card is required to monitor and display the system's signals and POST codes during boot-up. Reference the signal or code with the POST reader card's documentation, and you'll know the exact cause of the failure. Repair the problem, and your system will boot.

What should you look for in a POST reader card? Documentation is definitely number one! Documentation for most POST reader cards reference only the test being done, not the chip or device that causes the test to fail. Without

proper documentation, the card is useless! The standard ISA-bus-architecture POST reader card will work in ISA and EISA slots. If you work on Micro Channel systems, you need a card with a Micro Channel adapter. The card should have the ability to monitor I/O ports 80, 84, 90, 300 and 680. These are the I/O ports to which BIOS manufacturers emit POST codes. Make sure the POST reader card has separate LEDs to monitor the power supply, oscillator signals, clock signals, reset signal, address latch enable signal, memory signal, I/O write signals and I/O read signals. This will allow you to determine the precise cause of a problem on a system that failed before the BIOS could start the POST routine. Engineer types will want a card with a tri-state logic probe connected to the card so that they can perform pin-level testing with one hand. A technical-support telephone line is a must when using a POST card.

The following is a brief list of popular POST cards:

Pocket Post II (\$269): Data Depot, 1710 Drew St. #5, Clearwater, FL 34615 (tel.: 813 446-3402).

Kickstart II (\$599): Landmark Research Int'l. Corp., 703 Grand Central St., Clearwater, FL 34616 (tel.: 800 683-6696).

Kickstart I (\$59): Landmark Research (see above).

Post Probe (\$299): Micro 2000 Inc., 1100 E. Broadway #301, Glendale, CA 91205 (tel.: 818-547-0125).

Racer II (\$649): Ultra X Inc., 2005 De La Cruz Blvd. #115, Santa Clara, CA 95050, (tel.: 800-722-3789).

Racer PSII (\$699): Ultra X (see above).

Category 2

Diagnostic Software

Diagnostic Software is used to determine and correct problems on a boot-

able system. You have a boot-able system when you can boot from either the floppy drive or the hard drive. Problems can range from hardware failures, incorrect hardware configuration, software corruption and incorrect software configuration.

What is a diagnostic software product supposed to do? It should have the ability to determine the difference between hardware problems and software problems every time! Once a hardware problem is identified and corrected, or you've determined that there isn't a hardware problem, you can move on to software problems. Software corruption such as CMOS configuration, partitions, FATs, root directories, subdirectories, data and viruses should be able to be identified and corrected quickly and, more-importantly, without loss of data. Software-configuration problems between the operating system, software drivers, *Windows* and software programs are so numerous that diagnostic software products only briefly address them, but a knowledgeable technical-support telephone line will be able to help.

What should you look for in a diagnostic software product? The most important thing to look for is non-reliance on the DOS operating system. A boot-able, independent and proprietary operating-system diagnostic software product will be able to boot any system, regardless of OS, determine the difference between hardware and software problems since none of the original software is loaded and eliminate the limitations and inaccuracies of DOS since DOS isn't used and was never designed to perform diagnostics.

The diagnostic must also be able to be loaded under DOS to determine software problems, since the original software needs to be loaded to be tested. This is done after determining whether a hardware problem existed. The diagnostic software product must be able to display, edit and test: hard-

*The author is associated with Micro 2000, Inc., Glendale, CA.

Category 3

Fixed-Disk Utilities

A fixed-disk utility is required when the hard drive can't be accessed at all but there isn't a hardware failure or when the hard drive fails to boot but can be accessed from the A: prompt after booting from the floppy drive or when the hard drive can be booted and accessed but there are still problems. These errors can be caused by improper CMOS configuration, incorrect hard-drive jumper settings and incorrect controller jumper settings and partition corruption, data corruption, bad sectors, hardware failures and software configuration problems.

What is a fixed-disk utility suppose to do? It's used to test, fix and perform data recovery operations on a hard-disk drive. Correct the problem, and you're up and running.

What should you look for in a fixed-disk utility? Fixed-disk utilities are O/S-specific. Get the utility that applies to the O/S you're working on (normally DOS). The utility mustn't rely on the DOS structure to be intact since this is normally where the problem resides. An easy-to-use editor that can display in hexadecimal or ASCII in 256- or 512-byte screens is required. The editor should have features to repair, in order, the boot loader, partition tables, boot signature, volume boot sector, volume boot signature, FAT1, FAT2, root directories, subdirectories and, lastly, data files. Automated features save time, but there should be manual capabilities for all of the above features. A bit string search is helpful when the DOS structure has completely collapsed. A technical-support telephone line is a must.

Be aware that the automated data-recovery features can be wrong. On critical data recovery, *never* use an automated data-recovery feature without finding out exactly what the problem is first. Always back up on a regular basis because some problems won't permit data recovery.

Here's a list of popular data-recovery utilities:

PC Tools (\$179): Central Point Software Inc., 15220 NW Greenbrier Pkwy. #200, Beaverton, OR 97006; tel.: 800-445-4064.

ware configuration, CMOS configuration, ROM addressing conflicts, IRQ conflicts, I/O conflicts, partition corruption, POS registers, processor, co-processor, PICs (8259), DMAs (8254), 640K base memory (including where the O/S is loaded), 256K cache memory, all expanded memory, all extended memory (must be able to deal with 16M BIOS re-addressing), all video memory (must be able to set SVGA modes to test beyond 256K), floppy drives (must be able set any media format), hard drives (must be able to low-level format all drive types, including IDE), serial ports (must be able to do internal and external test and be able to set any port configuration), parallel ports (must be able to do internal and external test and be able to set any port configuration), video adapters (must be able to set modes, align cathode tubes and test up to 2M of memory), floppy and hard-drive editors (must be able to edit track 0) and batch testing (must be selectable). A technical-support telephone line is a must.

Here's a listing of popular diagnostic software:

Trouble Shooter (\$249): All Micro Inc., 1250 Rogers St. #D, Clearwater, FL 34616; tel.: 813 446-6660.

PC Clinic Pro (\$179): Data Depot Inc., 1710 Drew St. #5, Clearwater, FL 34615; tel.: 813 446-3402.

QA Plus/FE (\$349.95): Diagsoft Inc., 5615 Scotts Valley Dr. #140, Scotts Valley, CA 95066; tel.: 408 438-8247.

QA Plus (\$159): Diagsoft Inc. (see above).

Service Diagnostics (\$599): Landmark Research Int'l. Corp., 703 Grand Central St., Clearwater, FL 34616, 800-683-6696.

PC Probe (\$99): Landmark Research (see above).

PC Certify (\$99): Landmark Research (see above).

Micro Scope (\$399): Micro 2000 Inc., 1100 E. Bway. #301, Glendale, CA 91205; tel.: 818 547-0125.

SB Probe (\$99.95): Renasance, 5173 Waring Rd. #115, San Diego, CA 92120; tel.: 619-287-3348.

Check It Pro (\$159.95): Touchstone Software Corp., 2130 Main St. #250, Huntington Beach, CA 92648; tel.: 714-969-7746.

Quick Tech II Plus (\$169): Ultra X Inc., 2005 De La Cruz Blvd. #115, Santa Clara, CA 95050; tel.: 800-722-3789.

PC Technician (\$195): Windsor Technologies, 130 Alto St., San Raphael, CA 94901; tel.: 915-456-2200.

Disk Technician Gold (\$149.95): Disk Technician Corp., 1940 Garnet Ave., San Diego, CA 92109; tel.: 619-274-5000.

Mace (\$149): Fifth Generation Systems, 10049 N. Reiger Rd., Baton Rouge, LA 70809-4562; tel.: 504-291-7221.

Spinrite (\$129): Gibson Research Corp., 35 Journey Ave., Aliso Viejo, CA 92656; tel.: 714-362-8800.

Norton Utilities (\$179): Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014-2132; tel.: 800-554-4403.

CPR Data Recovery (\$299): Tech Assist Inc., 5590 Ulmerton Rd., Clearwater, FL 34620; tel.: 800-274-3785.

Category 4

Floppy Utilities

A floppy utility is used when the floppy drive reports an error and it isn't caused by the floppy diskette.

What is a floppy utility suppose to do? Floppy utilities should test, clean and help realign floppy drives.

What should you look for in a floppy utility? Floppy utilities should be able to run a head-cleaning routine that moves the heads across the entire surface of the cleaning diskette. If a problem still exists after cleaning, the utility should be able to test and locate the floppy problem. Normally, it isn't worth a technician's time/money to realign a floppy drive, but for those who do, realignment can be attempted on most floppy drives in about 20 minutes with a floppy utility that has realignment capabilities. Data recovery normally isn't performed on floppy diskettes, either. But if it's critical data, you'll find that fixed-disk utilities have data-recovery capabilities that can be used for floppy diskettes.

Here's a list of popular floppy utilities currently on the market:

Drive Probe (\$199): Accurite Technologies Inc., 231 Charcot Ave., San Jose, CA 95131; tel.: 408-433-7980.

Rescue (\$349): All Micro Inc., 1250 Rogers St. #D, Clearwater, FL 34616; tel.: 813-446-6660.

Trackmate (\$24.95): Trackmate, 5305 E. Shore Dr., Conyers, GA 30208; tel.: 800-486-5707.

Category 5

Virus Utilities

A virus utility is used when a virus environment is suspect. This includes:

when a known virus has attacked a system, when there are no hardware failures but the system is having problems and a virus is suspected, and on a routine basis to locate and delete a virus that's on the system but hasn't been activated yet.

What is a virus utility suppose to do? A virus utility will run a string search for all *known* viruses, either manually by the technician or automatically in the background on the system by the utility. If a virus is discovered, the utility will let the user know and then correct the problem.

What should you look for in a virus utility? All virus utilities are O/S-specific. You'll need a virus utility for the O/S you're using (normally DOS). Of the viruses on the market, 90% are located in the boot loader of the master partition. The utility should have the ability to write a generic DOS boot loader onto the hard drive over the boot-loader virus. This will delete the virus and allow the system to boot if the virus hasn't performed a destructive feature like formatting the drive and erasing all data. The last 10% of viruses will have to be found with a bit string search. This works only if the virus utility knows what to look for. A new and unknown virus that has not been recorded onto the virus utility won't be found. The utility should be able to manually and automatically do all of the above.

Here's a short list of the virus utilities currently on the market:

McAfee (\$249): McAfee Associates Inc., 2710 Walsh Ave. #200, Santa Clara, CA 95051; tel.: 408-988-3832.

Vi Spy Professional Edition (\$149.95): RG Software Inc., 6900 E. Camelback Rd. #630, Scottsdale, AZ 85251; tel.: 602-423-8000.

Norton Antivirus (\$119): Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; tel.: 800-4411-7234.

Category 6

Windows Utilities

A *Windows* utility is used when you're having a problem, but only when running under *Windows*.

What is a *Windows* utility suppose to do? It should detect *Windows* and software-configuration problems.

What should you look for in a *Windows* utility? A program that does not run under *Windows* but can look at *Windows* and the software that's running under *Windows* and detect the configuration problem.

Unfortunately, all *Windows* utilities have to be run under *Windows*. If you're having a *Windows* problem, it's possible you won't be able to run the *Windows* utility.

Here's a list of the *Windows* utilities currently available:

Winsleuth Gold Plus (\$99.95): Dariana Software, 5241 Lincoln Ave. #B5, Cypress, CA 90630; tel.: 714-236-1380.

QA Plus Win (\$159.95): Diagsoft Inc., 5615 Scotts Valley Dr. #140, Scotts Valley, CA 95066; tel.: 408-438-8247.

Win Probe (\$99): Landmark Research Int'l. Corp., 703 Grand Central St., Clearwater, FL 34616; tel.: 800-683-6696.

Skylight (\$99.95): Renasonce, 5173 Waring Rd. #115, San Diego, CA 92120; tel.: 619-287-3348.

Norton Desktop for Windows (\$179): Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014-2132; tel.: 408-253-9600.

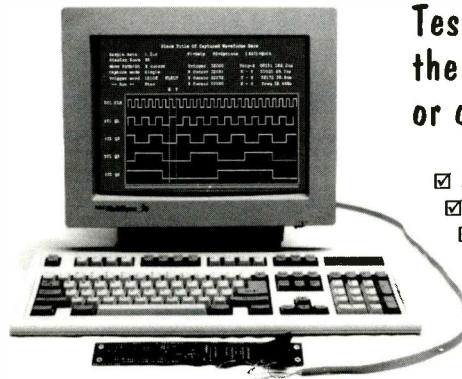
In Closing

There you have it: 40 diagnostic tools from which to choose to get an ailing PC back on the road to recovery.

Armed with any of these tools and a little knowledge of the inner workings of PCs and the software used in them, you should be able to do a creditable job of diagnosing problems, finding their cause and effecting cures. ■

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January/February 1994 / MICROCOMPUTER JOURNAL / 75

A Serial Talking Clock

With this hardware/software package installed on your PC, all you have to do is hit a hot-key combination to get instant vocalized time

Imagine you're using your computer and suddenly remember an important appointment you planned to keep. Instead of panicking and jumping up to look at a clock, you simply press a special key combination, and a friendly female voice tells you the exact time. You don't even have to exit the program you're currently using to get this convenience. If you'd like this kind of convenience, all you have to do is build this speech-synthesized Serial Talking Clock described here, attach it to any spare RS-232 serial port. The Clock uses a special speech-synthesizer chip to speak entire sentences.

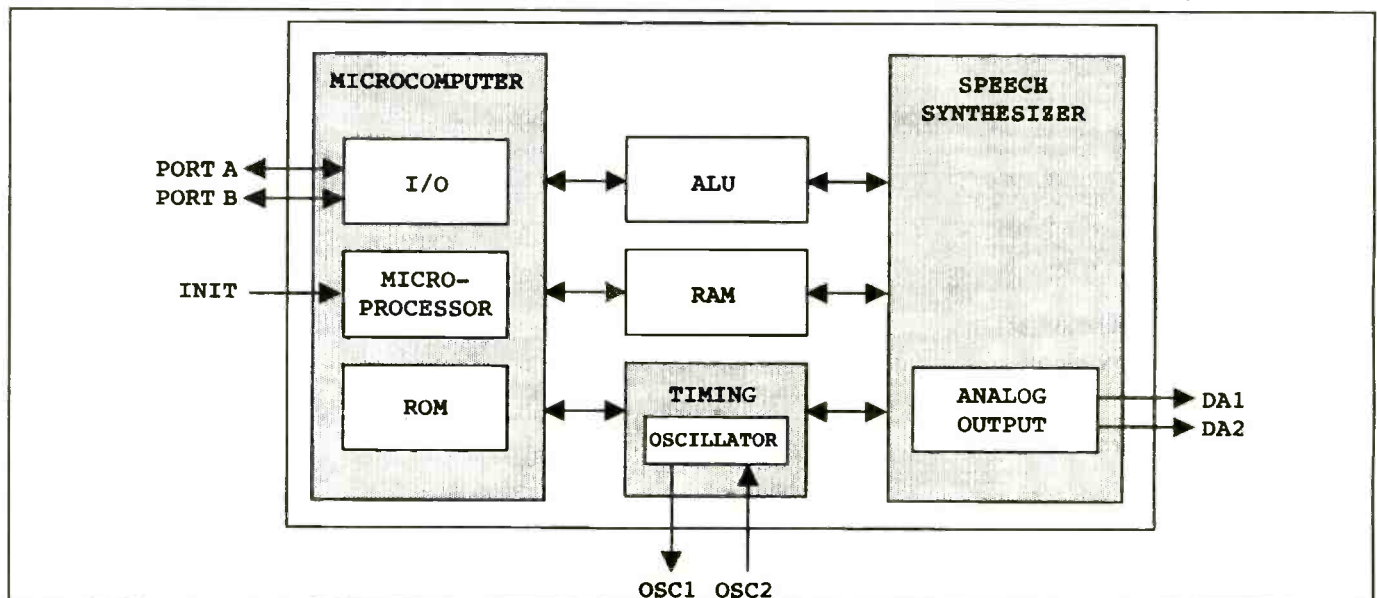
About the Circuit

The Serial Talking Clock is built around the new TSP53C32 speech-synthesizer integrated circuit from Texas Instruments. This remarkable device contains an eight-bit microprocessor,

Fig. 1. Block diagram of the Texas Instruments TSP53C32 speech-synthesizer integrated circuit that's at the heart of this project.

Table 1. TSP53C32 Speech Synthesizer Vocabulary

Decimal Value	Word	Decimal Value	Word
1	One	21	Thirty
2	Two	22	Forty
3	Three	23	Fifty
4	Four	24	Sunday
5	Five	25	Monday
6	Six	26	Tuesday
7	Seven	27	Wednesday
8	Eight	28	Thursday
9	Nine	29	Friday
10	Ten	30	Saturday
11	Eleven	31	AM
12	Twelve	32	PM
13	Thirteen	33	O'clock
14	Fourteen	34	Please Wait
15	Fifteen	35	Message
16	Sixteen	36	Messages
17	Seventeen	37	No
18	Eighteen	38	Oh
19	Nineteen	39	Zero
20	Twenty	40	PAUSE
Decimal Value		Command	
0		Begin Speaking	
41 Thru 127		Perform Software Reset	



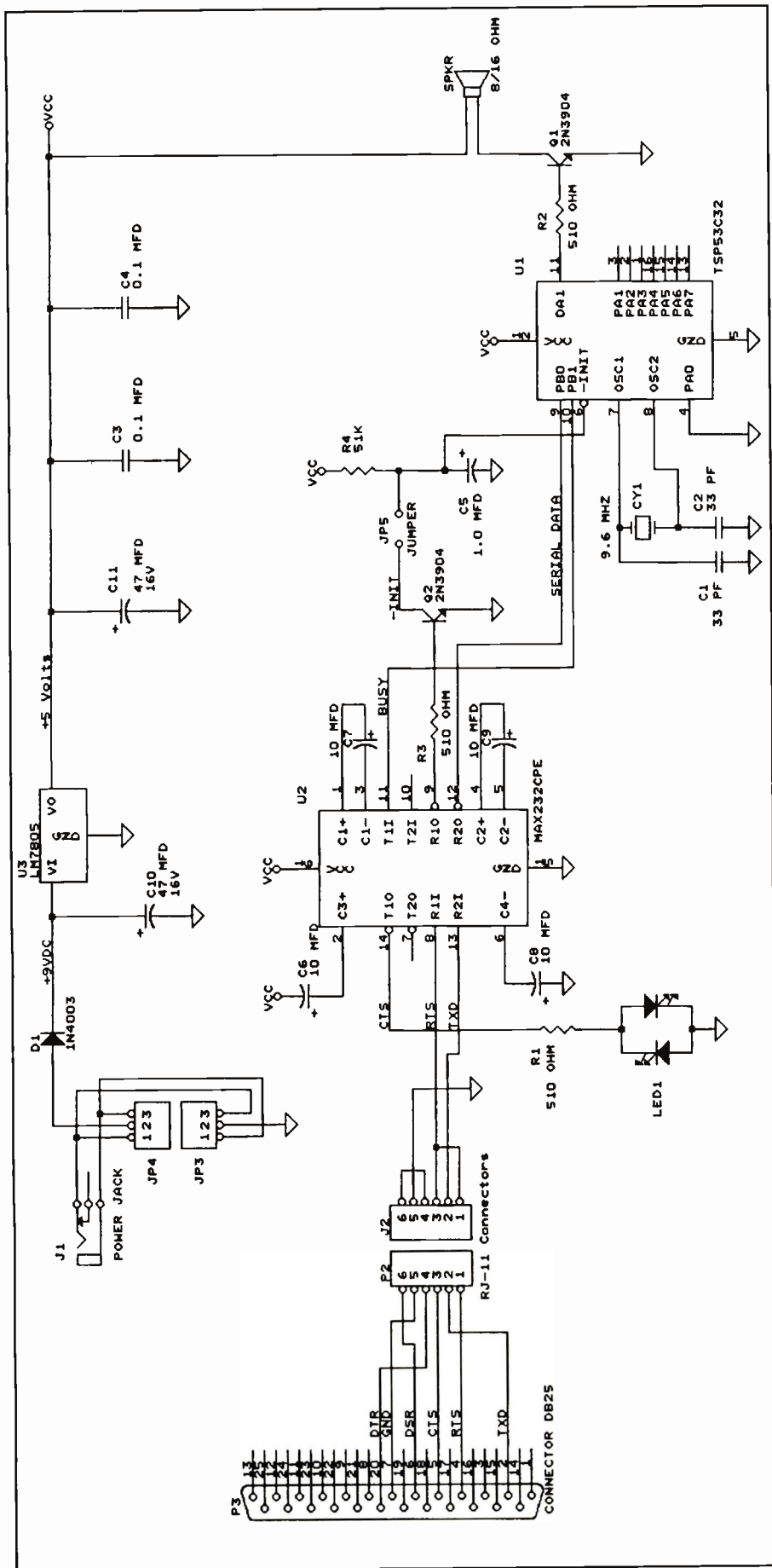


Fig. 2. Complete schematic diagram of the Serial Talking Clock circuitry.

PARTS LIST

Semiconductors

D1,D2—1N4001 rectifier diode
 LED1—bipolar dual-color LED
 Q1,Q2—2N3904 npn transistor
 U1—MAX232 serial interface driver/receiver
 U2—TSP53C32 speech synthesizer
 U3—LM78L05 voltage regulator

Capacitors

C1,C2—33 pF ceramic disk
 C3,C4—0.1- μ F, ceramic disk
 C5—1.0- μ F, 16-volt electrolytic
 C6,C7,C8,C9—10- μ F, 16-volt electrolytic
 C10,C11—47- μ F, 16-volt electrolytic

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

R1—510 ohms
 R2—510 ohms
 R3—510 ohms
 R4—51,000 ohms

Miscellaneous

CY1—9.60-MHz crystal
 J1—Power jack
 J2—Six-pin RJ-11 telephone jack
 TX1—9-volt dc wall-type power supply
 SPKR—8- or 16-ohm speaker

Printed-circuit board (No. TLK1192); suitable enclosure (Unibox No. 184, or similar); serial data cable; sockets for all DIP ICs; machine hardware; hookupwire; solder; etc.

Note: The following items are available from LNS Technologies, 20993 Foothill Blvd., Ste. 307R, Hayward, CA 94541-1511 (tel.: 510-886-9296): TSP53C32 speech synthesizer chip (female voice), \$15; TCLK-PCB printed-circuit board, \$15; TCLK-DISK: 5 1/4" floppy disk with clock programs, \$10. Also available is a No. TCLK-KIT complete kit of parts for the Serial Talking Clock, including printed-circuit board, speaker, 9-volt wall-type power supply, all ICs, drilled plastic enclosure, serial data cable, software disk and all other components, \$59. Add \$4 S&H on all orders. California residents, please add local sales tax. MC/VISA orders accepted. No COD orders, please.

speech synthesizer, ROM, RAM and I/O in a low-cost single-chip package, as illustrated in the Fig. 1 block diagram. The internal design of the chip has been simplified by sharing the ALU (arithmetic logic unit) and the RAM between both the microprocessor and the speech synthesizer.

During operation, the internal microprocessor fetches speech data from the internal ROM, decodes the speech data and sends the decoded data to the synthesizer. The microprocessor also smooths the speech data between

PRODUCT INFORMATION

Data-Acquisition Board

The PC226 from Texmate is a high-performance data-acquisition board with 16 true differential analog inputs and 24 digital I/O lines and a 16-bit counter timer. Thirty-two input ranges are dynamically programmable by channel at high acquisition speeds. The single-channel acquisition rate is 750 kHz, while the multi-channel rate is 400 kHz. Supplied with the PC226 is an input termination panel and optional analog expansion panels. It requires an AT expansion slot and includes libraries for C, Turbo Pascal and *Quick-BASIC*. Texmate Inc., 995 Park Center Dr., Vista, CA 92083-8397; tel.: 619-598-9899; fax: 619-598-9828.

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DOS Helper

Inductive Logic's *InCommand* Version 2.0 extends the DOS command set with commands that use consistent syntax and modifiers. It includes the ability to match and exclude, several wildcard patterns in one command and a complete on-line reference. *InCommand* can list directories, copy files, move files and directories, delete files, directories and entire trees, change file attributes, set file dates and times, local external DOS commands, search files for text, and more. All file operations work on entire directory trees as easily as on a single file. An *Execute* utility lets you run any program or batch file as if it had all these essential file-selection capabilities. System requirements are an IBM/compatible, DOS 3.0 or later, 256K of RAM and a hard drive. \$35. Inductive Logic, PO Box 26238, San Diego, CA 92196-0238; tel.: 619-578-5146.

CIRCLE NO. 2 ON FREE CARD

New Manual

Multix's *VirusStop* PC Immunizer Card now comes with a comprehensive 40-page manual. In addition to installation instructions, the manual also gives details on removing viruses without using a virus-removal program. For the end user, it includes a history of viruses and professional tips on virus verification and removal. It also gives descriptions of classes and sub-classes of viruses. Multix Inc., 4203 Beltway Dr., Ste. 7, Dallas, TX 75244; TEL.: 214-239-4989; fax: 214-239-6826.

CIRCLE NO. 3 ON FREE CARD

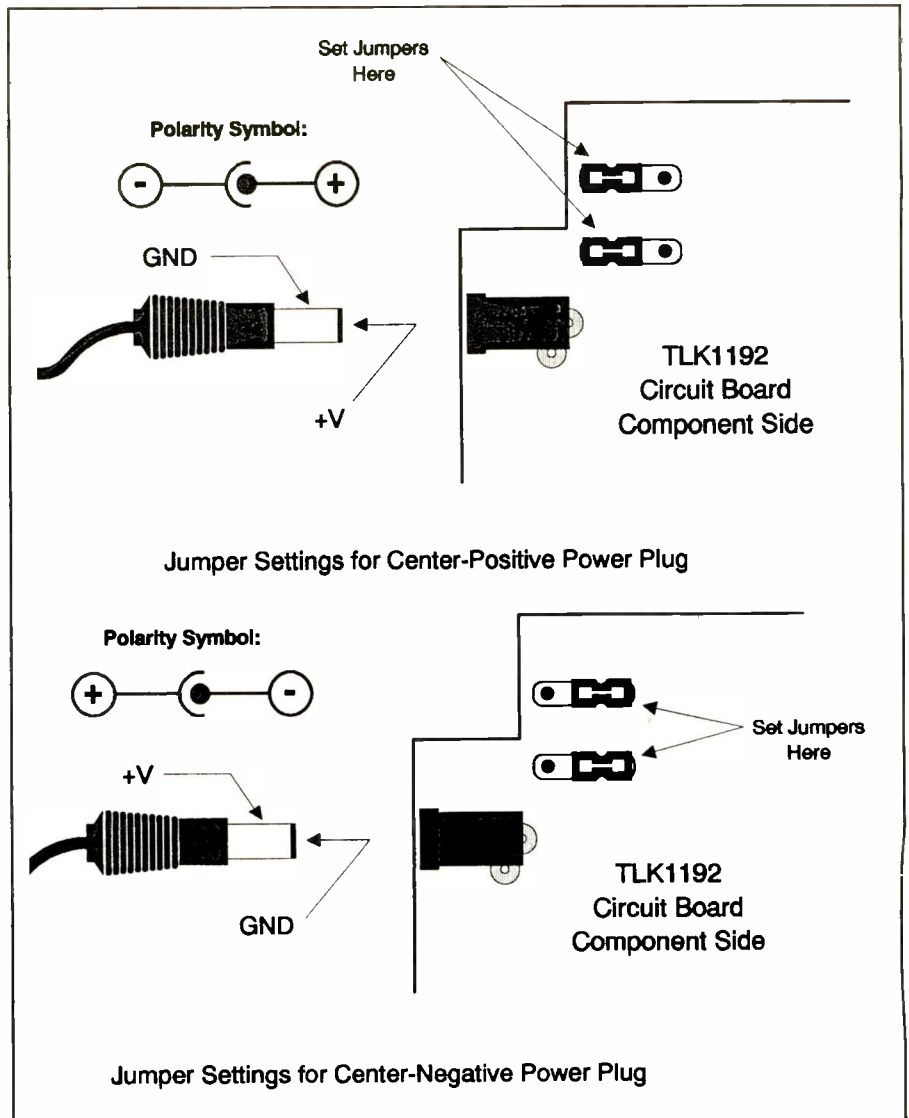


Fig. 6. Wiring details for power supply

leads before installation so that the crystal rests flat against the board's surface. Sockets are recommended for *U1* and *U2*.

Next install and solder *C1* through *C4* into place in their proper locations. Voltage regulator *U3* should be positioned so that it lies flat against the surface of the board after installation. To accomplish this, bend its pins so that they form a 90°. Transistors *Q1* and *Q2* require care to properly orient them.

Now install electrolytic capacitors *C1* through *C7*, making sure that you properly orient them before soldering their leads into place. Install and solder the jumper post pins into place at locations *JP1*, *JP2* and *JP3*, and solder connectors *P1* and *P2*. Lastly, mount the dual-color LED on the board using a 3/4" spacer to ensure that the LED will protrude

through the hole in the plastic cover.

Refer to Fig. 5 for details on attaching the speaker to the board. Cut two pieces of No. 26 insulated hookup wire to about 5" long. Strip 1/4" of the insulation from each end and solder one end of each wire to the two speaker terminals. Then, referring to Fig. 4 and Fig. 5, connect and solder the other ends of these wires to the appropriate points on the board.

Before plugging *U1* and *U2* into their sockets, set *JP1* and *JP2* to configure the proper input voltage polarity. The power supply *TX1* has a connector that plugs into *P1*. The connector center conductor can be either positive or negative. Figure 6 shows how to set the jumpers to match the connector's polarity. Set the jumpers, plug in the power supply and veri-

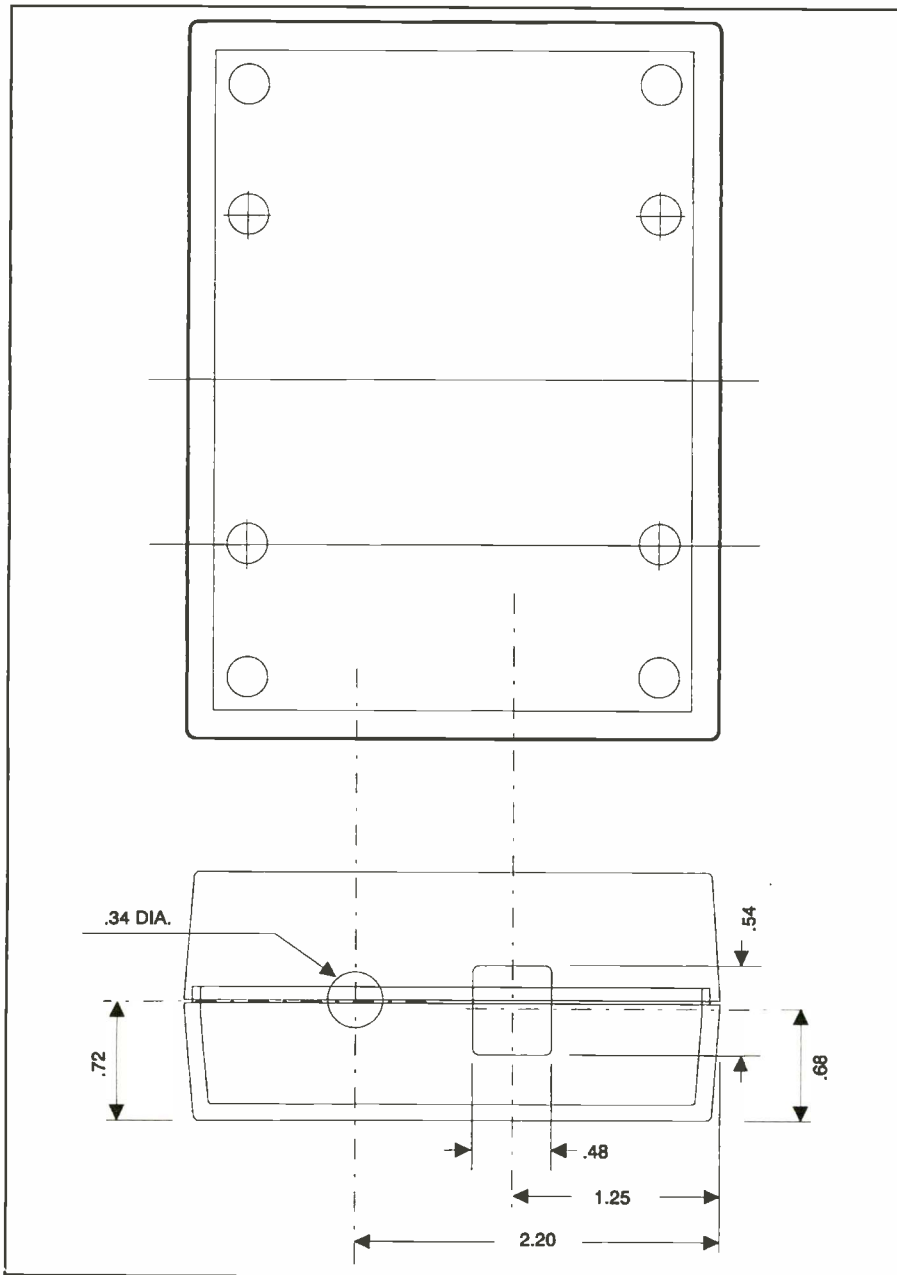


Fig. 7. Machining details for recommended enclosure.

fy with a dc voltmeter or a multimeter set to the dc-volts function that the output of $U3$ is +5 volts. Once you've done this, disconnect the power supply and plug $U1$ and $U2$ into their respective sockets, making certain that they're properly oriented and that no pins overhang the sockets or fold under between ICs and sockets.

During initial checkout, leave jumper $JP3$ disconnected. If your computer doesn't properly assert an RTS signal, $Q2$ can hold the TSP53C32 in a constant RESET condition. Removing jumper $JP3$ eliminates this possibility.

Once the Clock is working properly, you can try installing $JP3$ and verify that the Talking Clock still works. If it doesn't work with your computer while $JP3$ is connected, simply leave it out completely.

If you use the recommended plastic enclosure, drill a hole in the top corner for the LED. Also, carefully cut openings for the serial data and power connectors $J1$ and $J2$, as illustrated in Fig. 7. Mount the speaker in the cover, and secure the PC board in place with four 4-40 X 1/4" self-tapping screws. Locate the cover so that the dual-color LED

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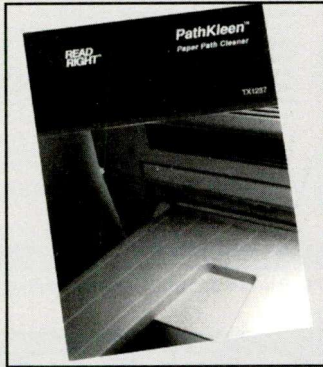
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PRODUCT INFORMATION

Paper-Path Cleaner

PathKleen picks up and holds contaminating paper dust and excess toner from roller sections in laser printers, plain-paper fax machines and personal copiers. Each PathKleen sheet consists of a non-trans-



ferable adhesive applied to a cleaning substrate. *The Texwipe Co., Read/Right Products Div., 650 E. Crescent Ave., Upper Saddle River, NJ 07458; tel.: 800-327-1237; fax: 800-569-3600.*

CIRCLE NO. 8 ON FREE CARD

Label-Writer System

LabelWriter II from CoStar is a hardware/software combo that plugs into a PC's serial port. As a background program it's always ready to produce labels in any quantity and also print POSTNET postal barcodes. New *LabelWriter II DOS 2.0* software includes WYSIWYG display and scalable fonts, among other features. New *LabelWriter II Windows* software is a full-featured application that lets you design label templates, manage mailing lists, print address labels, print inventory barcode labels, and more. Included in the software are macros that appear as icons for popular *Windows* word-processing programs. \$249.95. *CoStar Corp., 100 Field Point Rd., Greenwich, CT 06830; tel.: 203-661-9700; fax: 203-661-1540.*

CIRCLE NO. 9 ON FREE CARD

Address Writer

A *Windows* version of AddressWriter from CoStar Corp. includes a full-featured application, print driver and macros for the three most-popular *Windows* word processing programs. It's a small, impact dot-matrix printer designed specifically to print envelopes. In its standard configuration, it holds up to 100 envelopes. As an added feature, AddressWriter prints postal barcodes on envelopes. \$399. *CoStar Corp., 100 Field Point Rd., Greenwich, CT 06830; tel.: 203-661-9700; fax: 203-661-1540.*

CIRCLE NO. 10 ON FREE CARD

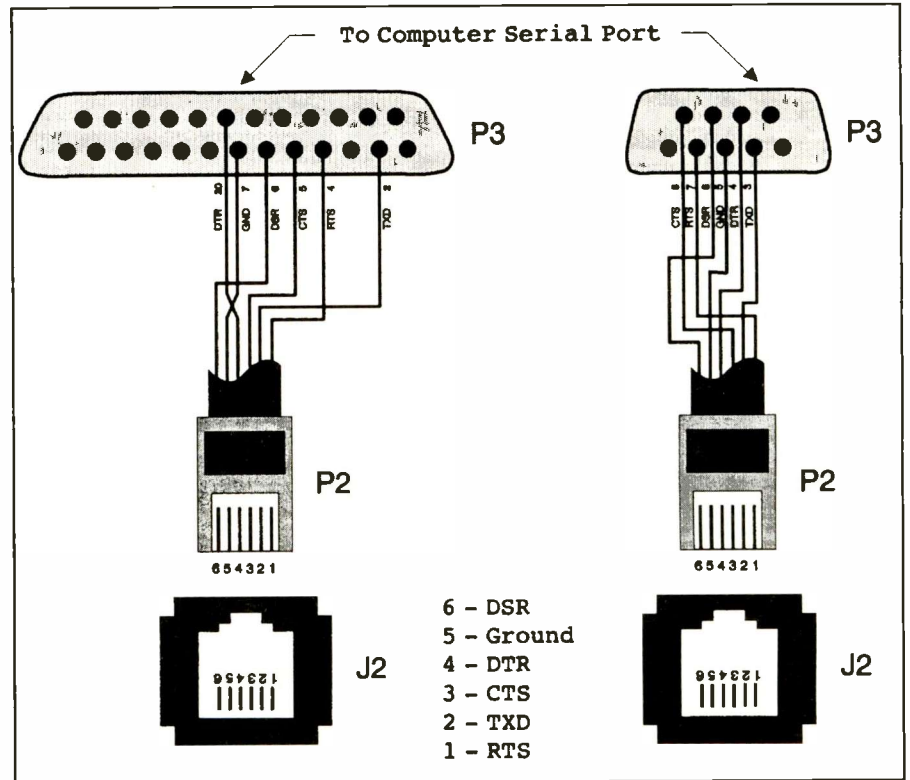


Fig. 8. Details for wiring serial cable required for interconnecting Serial Talking Clock module to RS-232 port on a PC.

fits into the hole, and secure the two halves of the enclosure together with the four remaining screws.

Finally, referring to Fig.8, fabricate a serial cable to connect between J2 and the RS-232 port of your computer. All IBM/compatible computers will have either a 25-pin male D-type connector or a nine-pin male D-type connector for the serial output port. Figure 7 shows the cable pinouts for both types of connectors.

Using It

Connect the serial cable from J2 of the Serial Talking Clock to a free RS-232 serial port of your PC and plug in the power supply to power up. If you built your Clock from scratch, you'll have to write a program that sends the appropriate vocabulary commands (Table 1) to the Clock through the computer's serial port. Alternatively, if you built your Clock from the kit, you already have a format floppy disk that contains the required TSETUP.EXE and TALK.EXE programs.

Place the floppy disk into the appropriate drive on your computer and run the TSETUP.EXE program. This pro-

gram allows you to select the serial port that's connected to the Talking Clock. You have the option of selecting COM1, COM2, COM3 or COM4. Once you've selected the serial port, a command is sent out the selected port in order to test the Clock. You should hear a pleasant female voice vocalizing the current time and see the LED switch from green to red. Also, a data file called TALKCLK.DAT will be created for later use by the TSR program.

Now you can run the TALK.EXE TSR program, which loads the Talking Clock driver and returns to the DOS prompt. Once successfully loaded, you can activate the Serial Talking Clock at any time by pressing and holding down the Alt key and pressing the period (.) key simultaneously. Each time you press the Alt+. key combination, the TSR program reads the computer's system clock, translates the time into the appropriate commands for the TSP53C32 synthesizer and transmits the command string out the selected serial port as vocalized speech.

By using a TSR to trigger the talking clock, you'll be able to hear the time, even if you're in the middle of another program. ■

Build a Microcontroller-Based Timer

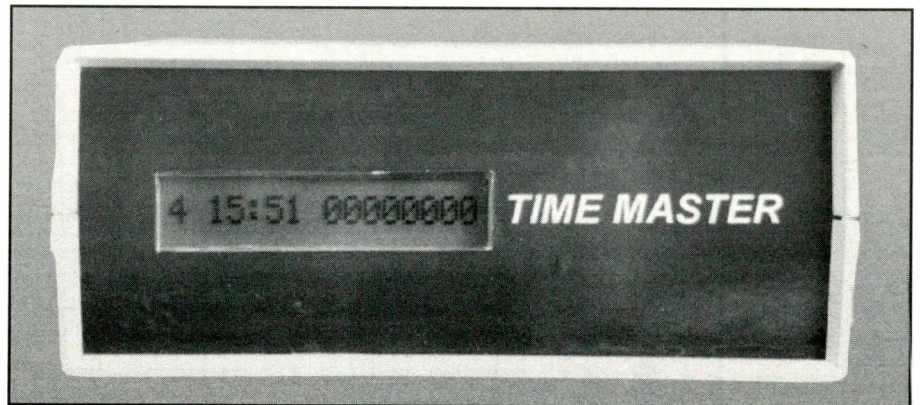
Lets you automatically control up to eight devices on a time-of-day/day-of-week basis

We perceive time as a constant. Thus, it's possible to build devices that use our definition of real time to control real-world events. One such device, the Time Master microcontroller-based computer described here utilizes a Dallas Semiconductor Real Time Clock module and Microchip EEPROM to implement a sophisticated precision timer for automatic control of devices using day-of-week and time-of-day data. It can control any combination of up to eight devices that can be driven by 7407 open-collector outputs. Controlled devices can be solid-state or/and electromagnetic relays, transistor switches, MOSFET devices and TTL logic circuits, to cite just a few.

With this project, time and day control data is transferred via serial connection between Time Master and a host personal computer executing the Time Master terminal program. The terminal program is written in Quick Basic and can be modified to work on any non-DOS-based computer equipped with a serial port. The project is relatively simple in terms of component count and, thus, is easy to build. It's also easy to use.

About the Circuit

Referring to Fig. 1, Time Master is based on the popular Intel 8749H eight-bit microcomputer chip, shown as U2, running at a clock rate of 8 MHz. It contains two eight-bit bidirectional I/O ports, an eight-bit bidirectional data bus, two test-able input pins, external interrupt capability, an on-chip oscillator and the ability to communicate with external RAM and ROM. It's also has 2K of internal EPROM, of which 1,164 bytes are



used to implement Time Master's algorithm. Along with the 8749H hardware and a PC terminal program, this algorithm manages data transfer among the five subsystems that make up Time Master.

To simplify this discussion, I've divided Time Master into "subsystems." I'll now discuss each of these separately and explain how they interact to form the Time Master system.

Asynchronous I/O Subsystem. Normally, serial I/O is built around a UART and a TTL-to-RS-232 converter. Valid RS-232 levels span from -15 to +15 volts dc. Therefore, a negative power-supply voltage is usually required. Further complicating matters, a null modem arrangement must be implemented to satisfy the modem control-signal requirements since no modem is usually present in a direct device-to-device hookup like this one. (A null modem arrangement is simply the act of shorting together pins on the serial connector to activate functions that are normally activated by the modem and terminal.) Negative-voltage power supplies add more components and introduce added complication.

UARTs require special clocks and initialization commands to operate properly. This translates into more hardware and software and even greater complexity. With the help of Dallas Semiconductor's tricky little DS1275 RS-232 transceiver chip (U5) and a bit of 8749H microcode, Time Master provides a simple three-wire serial interface to the host PC and eliminates the need for extra power supplies and ICs that are normally found in most other asynchronous communication subsystems.

Unlike many microcontrollers, the 8749H doesn't contain an internal hardware UART. Being that a UART is needed to transmit and receive data one bit at a time at a pre-defined baud rate, a hardware UART can be emulated with software. UART emulation in software is accomplished within the Time Master 8749H program. Fully commented source code for Time Master is available free from the E D Technical Publications BBS (see Note at end of Parts List for details) so that you can see how easily the software UART is created.

The serial I/O code begins at loca-

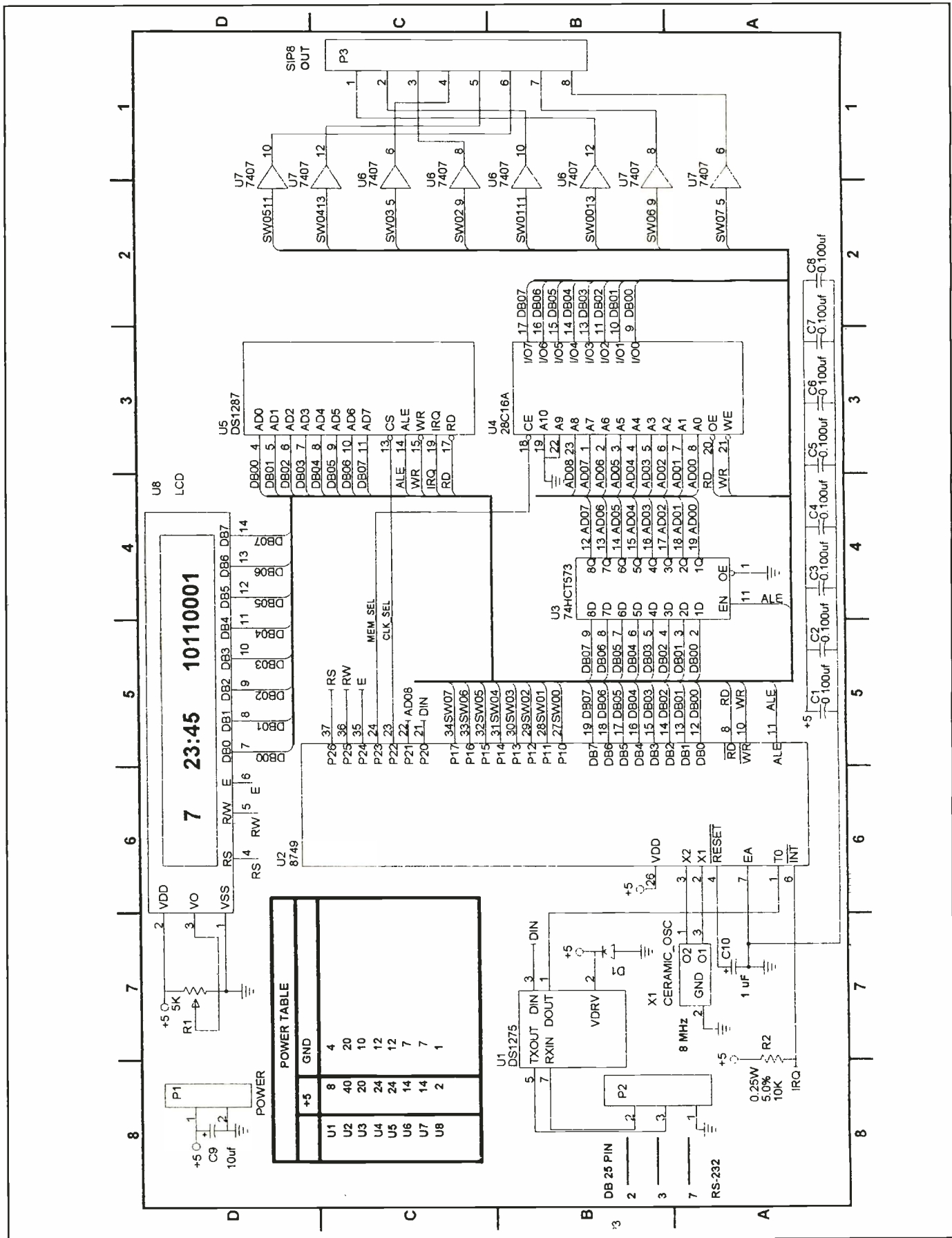


Fig. 1. Complete schematic diagram of the Time Master circuitry, minus its power supply.

PARTS LIST

Semiconductors

- D1—RGP-15D high-speed diode
- U1—DS1275 RS-232 transceiver (Dallas Semiconductor)
- U2—8749H eight-bit microcontroller (Intel)
- U3—Eight-bit latch
- U4—28C16A 2K x 8 EEPROM (Microchip)
- U5—DS1287 (Dallas Semiconductor) real-time clock
- U6,U7—7407 open-collector line buffer
- U8—Hitachi H2570 16-character x 1-line LCD module with on-board controller
- X1—8-MHz ceramic resonator

Capacitors

- C1 thru C8—0.1- μ F monolithic
- C9—10- μ F, 10-volt tantalum
- C10—1- μ F, 10-volt tantalum

Resistors

- R1—5,000-ohm linear panel-mount miniature potentiometer
- R2—10,000-ohm, 1/4-watt, 5% tolerance

Miscellaneous

- P1—Power connector (optional; see text)
- P2—25-pin RS-232 panel-mount D-shell connector
- P3—Eight-position SIP connector
- Printed-circuit board (see text); 5-volt dc power supply; suitable enclosure (see text); spacers; machine hardware; solder; etc.

Note: The following items are available from E D Technical Publications, Fred Eady, PO Box 541222, Merritt Island, FL 32594 (tel. voice/fax: 407-454-9905; BBS: 407-454-3198): Complete kit of parts, including pc board, software, all electronic components, LCD module and programmed 9749H but not enclosure, cables or connectors, \$79.95; ready-to-wire pc board, \$30; programmed 8749H, \$27.50; 8749H Programmer Kit (to modify 8749 code), \$49.95. Software is available for free download from 24-hour BBS (see above). Add \$5 S&H per order. Florida residents, please add 6% state sales tax.

tion 200 hexadecimal and is labeled "XMIT MESSAGE SUBROUTINE." Since there's no need for high-speed data transfer in the Time Master application, the software UART has been coded to operate at 300 bps.

The asynchronous I/O hardware interface is implemented using a Dallas Semiconductor DS1275 line-powered RS-232 transceiver chip (*U1*). The CMOS DS1275 translates RS-232 signal to CMOS/TTL levels. To eliminate the requirement for a negative supply voltage, the DS1275 "steals" current from the received RS-232 signal when that signal is in a negative-voltage, or mark, state. After being translated by

U1, a mark equates to a logic 1 (TTL high), while a space equates to logical 0 (TTL low).

Time Master operates in half-duplex mode such that RS-232 data only travels in one direction at a time. Thus, if the host PC is in receive mode, Time Master is in transmit mode and vice-versa. The host PC should mark (negative voltage) or idle (0 voltage) its transmit line when receiving data from Time Master. Most PC serial ports do.

The PC's transmit line is cross connected to Time Master's receive line, and this mark state on the PC's transmit line allows *U1* to steal negative current and swing negative its TXOUT at pin 5 when it's necessary to transmit a mark. If the host PC spaces (positive voltage) the transmit line during receive, the TXOUT line will be able to swing to ground only during transmission of a mark. Typically, to most RS-232 receivers any potential less than 2 volts dc is considered a mark. Therefore, the DS1275 is capable of working with its RXIN line at pin 7 in either mark or space condition.

TTL-level data to be transmitted to the host PC is supplied to pin 3 (DIN) of *U1* from pin 21 of microcontroller *U2* under software control. TTL-level data received from the host PC is routed to *U2*'s Testable Input pin 1 (T0) from *U1* pin 1 (DOUT). Reference the 8749H source code in the 200 hexadecimal block labeled "SERIAL INPUT" to see implementation of the software UART's receive algorithm.

RS-232 I/O is supplied by pins 5 and 7 with pin 5 (TXOUT) of *U1* being RS-232 transmit data (to the PC) and pin 7 (RXIN) acting as RS-232 receive data (from the PC). In a standard RS-232 25-pin DTE (data terminal equipment) configuration, pin 2 of the serial connector is transmit data and pin 3 is receive data. Note that pins 5 and 7 of *U1* are wired so that DTE transmit pin 2 connects with *U1*'s receive pin 7, and DTE receive pin 3 connects to *U1*'s transmit pin 5. Pin 7 of the serial connector provides a common ground. This constitutes a miniature null modem in that other modem signals (DTR to DSR, RTS to CTS and CD to DTR) aren't cross-connected. Time Master's terminal program eliminates the need for the PC serial port to reference or act on any other modem signals, except transmit and receive data.

Schottky diode *D1* prevents latch-up

of the DS1275. From personal experience, the DS1275 gets very hot and ultimately destroys itself when latch-up occurs. If power (+5 volts) is removed from *U1* and the RS-232 transmit line is in a mark (negative) state, a diode inside the DS1275 turns on and causes a latch-up condition. Inclusion of *D1*, which has a lower clamp voltage than the internal diode, prevents the internal diode from turning on, circumventing a possibly destructive latch-up condition.

Data communication is usually a two-way. Therefore, there must be some sort of communication program that resides on the host PC to provide an interface to Time Master's program code inside the 8749H. The Time Master terminal program is written in Quick Basic and provides the intelligence necessary to effect bidirectional transfer of data and commands between host and Time Master. The terminal program lets you set the time, download a timing program to Time Master, monitor Time Master output switch status and invoke manual switch control. Again, a complete source listing and executable module for the Time Master terminal program is available free from the E D Technical Publications BBS.

The asynchronous I/O subsystem in effect eliminates two ICs, a negative-voltage power supply and some miscellaneous "glue" components while successfully implementing a full function half-duplex serial I/O channel.

Realtime Clock Subsystem. This is the heart of Time Master. For Time Master to fulfill its mission, time and day information must be accurately kept, even in the event of complete system power failure. This is the task of the Dallas Semiconductor DS1287 real-time clock chip used for *U5*. This 24-pin clock/calendar IC contains its own internal lithium power source, a quartz crystal and write-protection circuitry. The combination of these on-chip resources provides a nonvolatile time-of-day clock, an alarm function, a 100-year calendar, programmable interrupt function, a programmable square-wave generator and 50 bytes of user-accessible nonvolatile static RAM. Time Master doesn't use all of the DS1287's available resources, but you can modify Time Master's microcode to access any of the DS1287's internal functions if your particular application demands it.

Chip *U5*'s internal lithium energy source is rated for 10 years of useful life. This lets the realtime clock function and all RAM, time and alarm locations to remain nonvolatile, regardless of system power. System power must be maintained at greater than +4.25 volts to permit the DS1287 to be accessed by the 8749H *U2* microcontroller. If system power drops to less than +4.25 volts, the DS1287 enters write-protect mode, in which all inputs are ignored and all outputs enter high-impedance state.

When system power falls below the +3-volt level, the internal lithium power source kicks in and preserves the integrity of all internal nonvolatile registers and provides the power needed to permit accurate time-keeping to continue. This on-board lithium power source guarantees that all time and configuration settings will be retrieved intact when power is restored following a system power outage.

The DS1287 can operate with a Motorola or Intel bus configuration. The 8749H uses Intel bus operations and, by grounding pin 1 of *U5*, the Intel bus structure is selected. The Intel bus uses ALE (address latch enable), RD (read) and WR (write) to gate address and data to and from the DS1287's multiplexed bidirectional address/data bus on AD0 through AD7. The DS1287 is selected when a TTL low is applied to CS (chip select) pin 13 via CLK_SEL pin 23 of *U2*.

Address information is presented to the DS1287 bus during the first half of an Intel bus cycle and is internally latched by the DS1287 on the falling edge of the ALE signal. Data information is presented on the same multiplexed bus pins during the second half of the bus cycle. Depending upon whether a read or write cycle is requested, data is latched into or out of the DS1287 on the rising edge of the WR or RD pulse, respectively.

On power-up or following a processor reset, *U2*'s algorithm sends a bit pattern to Register A of *U5* to start the chip's oscillator. This chip is shipped with the oscillator turned off to conserve the lithium source until the IC is put into service. Once Time Master is powered on with the DS1287 in-socket, the microcode starts the realtime clock and timing chain but will never be instructed to stop them. Time Master's microcode will also start the

square-wave generator at a 2-Hz rate. Thus, checking pin 23 of *U5* for a 2-Hz signal is a good way to determine if this is properly initialized. The code for oscillator and square-wave initialization can be found in the "MAIN ROUTINE" code section beginning at the "BEGIN" label.

Once the DS1287 oscillator and clock timing chain is started, you can set correct time and day of the week. By selecting the "SET TIME" function from the terminal program menu, *U2*'s microcode is instructed to branch to the "SETTIME" label and execute commands to prepare the DS1287 for time initialization. The init routine sets bits in Register B of the DS1287 for BCD data encoding and 24-hour time format and enables the interrupt and set bits. Enabling the set bit disables any DS1287 internal time update functions so that the new time data can be entered without realtime clock interruptions.

An active interrupt bit permits the DS1287 IRQ at pin 19 to drive low the 8749H's INT at pin 6 and effect processor interrupts. At this time, the terminal program is prompting for correct day and time. Once valid day and time have been entered, the terminal program sends the data to *U2* via the serial port so that it can be transferred in the correct format to the registers of *U5*.

During execution of the time set routine, *U5* is also instructed to interrupt *U2* every 60 seconds. When *U2* is interrupted, current time and day are read from *U5*, and time and day data user-loaded into 28C16A EEPROM *U4* is processed to determine which of the eight output pins to toggle.

Once *U5*'s time-keeping registers are set, the set bit is returned to logical 0 and normal update, alarm, interrupt and time-keeping functions resume.

• EEPROM Subsystem. The Microchip 28C16A EEPROM, shown in Fig. 1 as *U4*, is 2K x 8 CMOS device that's accessed in the same manner as static RAM. Other EEPROM devices require external latching, timing circuitry and unusual voltages to operate. With the 28C16A, there's no need for external components or odd voltages because data and address information is latched and processed internally during a write cycle using a standard 5-volt dc supply.

Once data and address information is latched into the 28C16A, the data bus is released to the processor and an internal control timer does everything

necessary to store the data in the proper location inside the EEPROM. Data protection is provided by an internal V_{cc} -detect circuit that write-protects the EEPROM when the supply potential falls below +3.3 volts. Of course, the 28C16A is a nonvolatile memory device, and data retention is specified in excess of 10 years. Theoretically, you could set time and date, load a timing program and turn off Time Master and 10 years later revive Time Master with all of your data intact and the time would be correct!

The EEPROM subsystem is invoked when "LOAD TIMING PROGRAM" is selected from the terminal program menu. Chip *U2* drives low its MEM_SEL pin 24 to select the 28C16A EEPROM. You can then enter time and day entry manually or download from disk a pre-defined set of time data records created by the TIMEPROG program. In either case, up to 42 distinct time and day entries, which include the switch number and on/off bit, are downloaded to *U2* and passed on to *U4* for storage.

Every 60 seconds, *U6* issues an interrupt to *U2* that invokes the "CLOCK INTERRUPT SERVICE ROUTINE" in Time Master's algorithm. The EEPROM subsystem is again activated, and time and day are read from the realtime clock IC and compared to records contained inside the EEPROM. If a day/time-of-day match occurs, the on/off bit in the record and the switch number determine the final on or off condition of the selected switch. The time record bit layout is described pictorially in the EQUATES section of the 8749H source code.

• LCD Display Subsystem. Time Master is designed to be loaded from a host PC and forgotten until a different time program is required and loaded by the user. While the terminal program's display provides realtime Time Master status information, what if you want to use your computer for something else as you monitor the timing program you downloaded to Time Master? The answer is an alternate display—in this case, an LCD display that provides day, time and switch status that's updated every 60 seconds, just like the terminal program display.

The Hitachi H2570, shown as *DIS* in Fig. 1, is a 16-character x 1-line display that utilizes a built-in HD44780 LSI controller. The display module re-

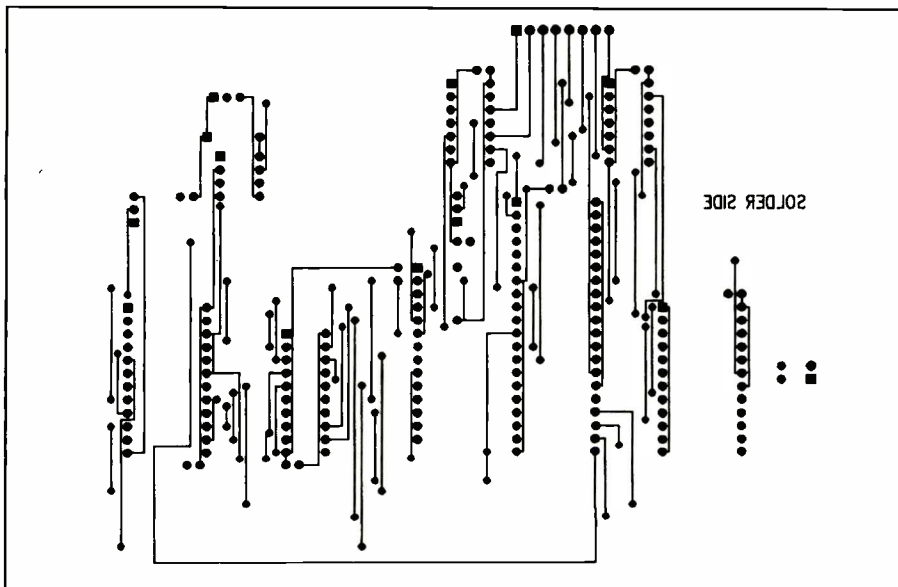
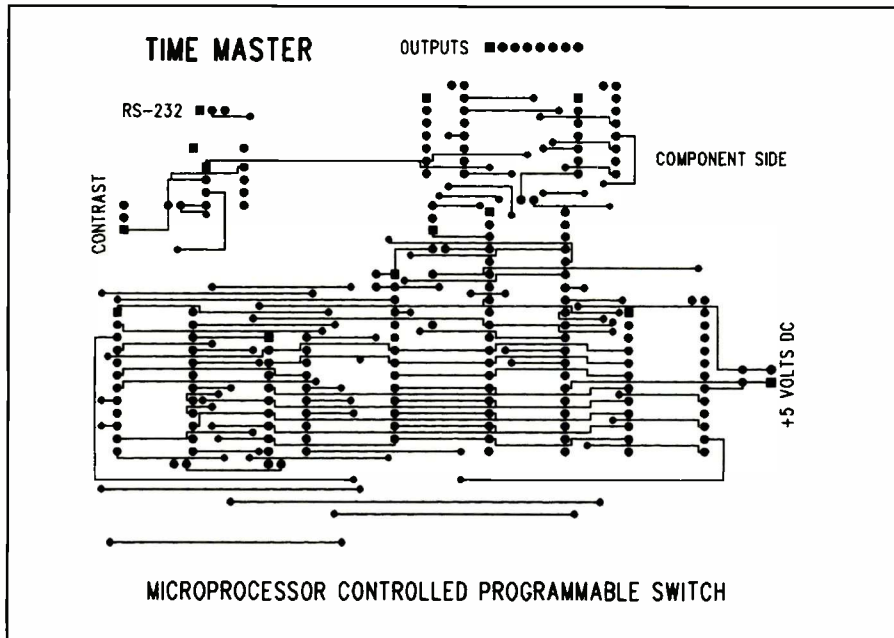


Fig. 2. Actual-size etching-and-drilling guides for the two sides of the double-sided printed-circuit board needed for this project.

quires no special power arrangements and uses a standard 5-volt dc power supply. Because of the on-board HD-44780 controller, the display module can reside on the data bus and be accessed by *U2* just like a memory device. The RS, R/W and E terminals at pins 4, 5 and 6, respectively, provide a means of transferring data and commands to and from the HD44780 LSI controller chip.

In Time Master, the H2570 is initialized to display 16 characters, with no visible cursor. Every 60 seconds, the

LCD panel, just like the terminal program display, is refreshed with day, time and switch disposition information. When "MANUAL CONTROL" is invoked from the terminal program menu, the LCD's day and time are replaced by the word "MANUAL," and the manually selected switch settings are displayed.

Inclusion of an LCD display on Time Master has other advantages, too. If Time Master is remote to the host, you could still obtain a visual indication of what's on and off and the time

and day with which Time Master is working.

Potentiometer *R1* serves as a contrast control for the LCD panel. Reference the 8749H "PRINTLCD" subroutine code for more details on how the LCD is employed within Time Master. LCD initialization code follows the DS1287 init code at the "BEGIN" label in the "MAIN ROUTINE."

Output-Switch Subsystem. This is the least-complex of the subsystems in this project. It's also where the real physical work is done. The output-switch subsystem consists of open-collector 7407 ICs *U6* and *U7*. The 7407 was selected because it can interface to potentials as great as +30 volts. The inputs of the 7407's gates are driven by the P1 output port of *U2* at SW00 through SW07.

When a time record match is made during a processor interrupt cycle, the record contains the switch number and an on/off bit setting. If a switch is selected to be activated, the respective gate of the 7407 is driven low, providing a ground path for the device hanging on the open-collector output. With the proper circuitry behind the 7407s, there's virtually nothing you cannot control with the Time Master!

In describing the five subsystems that make up Time Master, I've neglected to call your attention to a few components. To cover all bases, I'll begin defining the function of all of the stray capacitors scattered throughout the circuit. Capacitor *C9* buffers the incoming +5-volt bulk supply. Capacitor *C10* is used to effect a processor-reset function, its value recommended by the 8749H data sheet, working in conjunction with an on-chip Schmitt-trigger input (RESET) and internal pull-up device to effect an internal reset pulse of sufficient duration to guarantee all processor circuitry is properly reset. Capacitors *C1* through *C8* are the standard monolithic bypasses used to filter the +5-volt bus and reduce TTL transition noise from interfering with the normal operation of the TTL and CMOS devices.

Resistor *R2* is needed because the IRQ pin of *U8* is open-collector and floats when inactive. To ensure that the IRQ line is at TTL high in the inactive state, the pull-up function provided by *R2* is essential. As a matter of fact, the data sheet flat demands it!

Eight-bit latch *U3* is a 74HCT573

device. As previously pointed out, Intel bus operations provide a valid address during the first half of a bus cycle that's latched into a receiving device via the ALE signal. The "receiving device" in this case is *U3*, the task of which is to hold and present the valid address at the 28C16A address bus until valid data can be latched out in the second half of the bus cycle. Once valid address and data are presented to the 28C16A and a read or write pulse is generated, the 28C16A can use the latched-in address/data combination to internally complete the requested operation. Note that the DS1287 doesn't require an external latch and performs the 74HCT573 function internally.

Ceramic resonator *X1* is responsible for providing the 8-MHz frequency at which *U2* operates and is a real time and space saver. The oscillating element and two capacitors are housed in this tiny three-pin device. The ceramic resonator replaces a much larger crystal and a couple of 27-pF capacitors in this project.

If you'd like more in-depth descriptions of the ICs used in Time Master, pick up the following manuals:

*Dallas Semiconductor 1993
Product Data Book*

Dallas Semiconductor
4350 S. Beltwood Pkwy.
Dallas, TX 75244-3292
Tel.: 214-450-0400

CIRCLE NO. 111 ON FREE INFORMATION CARD

Microchip Data Book

Microchip Technology, Inc.
2355 W. Chandler Blvd.
Chandler, AZ 85224-6199
Tel.: 602-786-7200

CIRCLE NO. 112 ON FREE INFORMATION CARD

8-Bit Embedded Controller Handbook

Intel Literature Sales
PO Box 58130
Santa Clara, CA 95052-8130
Tel.: 800-548-4725

*Texas Instruments High-Speed CMOS
Logic Data Book*

CIRCLE NO. 113 ON FREE INFORMATION CARD

**Texas Instruments Literature
Response Center**

PO Box 172228
Denver, CO 80217
Tel.: 800-477-8924

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Construction

Even though this project requires a double-sided printed-circuit board on which to mount and wire together the very few components of which it's comprised, construction is really rather simple. (Owing to a multitude of connecting buses, wiring the project on

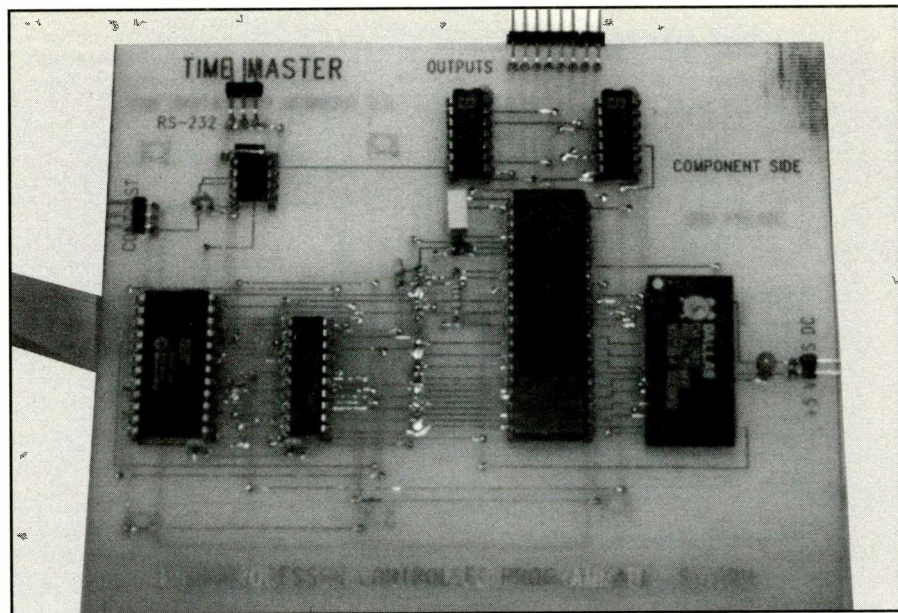


Fig. 3. This photo of the prototype project, wired on a home-fabricated pc board that doesn't have plated-through holes, demonstrates that a home-made board is, indeed, practical.

perforated board using point-to-point techniques, though not impossible, isn't recommended.)

Begin construction by fabricating a double-sided printed-circuit board, using the actual-size artwork shown in Fig. 2. The prototype board you see in Fig. 3 is homemade and proves that this can be done, though there are lots of vias (electrical interconnections between solder and component sides) you'll have to complete by soldering a piece of Wire Wrap wire on both sides of the via to complete signal/power routing between sides of the board. When you finish fabricating your board, it's a good idea to install all the via wires as the first step. These are indicated by heavy black dots on the Fig. 4 wiring guide. Then using Molex IC socket pins instead of standard sockets so that you have soldering on the top of the board install and solder into place the "sockets." However, don't plug the ICs into their respective socket positions until after you've conducted preliminary voltage checks and are certain that your wiring is correct.

If you prefer not to make your own board and would still like to use printed-circuit construction, you can obtain a ready-to-wire board with plated-through holes from the source given in the Note at the end of the Parts List. If you go this route, you don't have to install via wires and can use ordinary IC

sockets because all soldering can be performed on the solder (non-component) side of the board.

After installing the via wires (if needed) and IC sockets, mount and solder into place the remaining components. Be sure to properly polarize the electrolytic capacitors and diode and properly base *X1* before soldering any leads into place.

Since +5 volts is supplied by an external source, apply your selected power source. Referring to the Power Table provided in Fig. 1 and a dc voltmeter or a multimeter set to the dc-volts function to check the voltages on each IC socket. Once you're satisfied that all of the power points check out, disconnect power from the circuit-board assembly and plug the ICs into their respective sockets. Make sure that the ICs are properly oriented and that all their pins go squarely into the socket connectors.

Reapply power to the circuit. Now, touch the tip of a logic probe to pin 11 of *U2* (ALE), which should yield an indication of oscillation. Touch the probe to pin 23 (SQW) of *U5* and note if a 2-Hz square-wave signal is present here. If both oscillations are present, odds are the processor is running the program and the DS1287 has been initialized and started.

Within 60 seconds, you should see an identifiable, although incorrect,

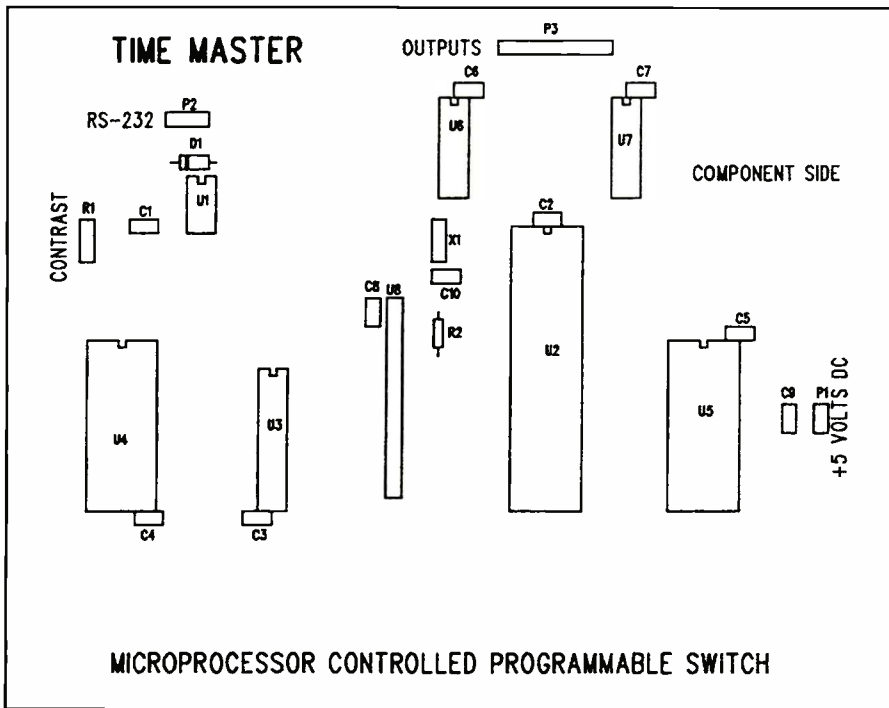


Fig. 4. Wiring guide for pc board.

time display on the LCD. Be sure to make sure the contrast control (R1) is connected and adjusted to allow the LCD display to be view-able.

If none of the above occurs, you most likely have an open or shorted bus connection. Use the logic probe to search for "dead" or "stuck" logic lev-

els caused by solder bridges or/and bad solder joints.

At this point, if all is okay, use a standard cable to connect Time Master to your host PC's serial port. Load and run the Time Master program. The Time Master logo screen and a flashing "READY FOR COMMAND" should

be displayed. Within 60 seconds, you see the same information in the LCD window. If so, Time Master is communicating with the host PC and all is well.

Power down and set the Time Master module aside. Now machine the enclosure you'll be using to house the project. You need to make a rectangular cutout in the front panel through which to view the LCD panel. Machine the rear panel of the enclosure to accommodate a 25-pin D-shell connector and perhaps a power connector that matches the external power supply you're using and make whatever arrangements that suit your purposes for output connector P3. Assuming you're using a standard wall-mount power source, you have the option of routing power into the enclosure through a chassis-mount power jack that matches the plug on the end of the power-source's output cable or clipping the connector off the cable and routing the leads of the cable directly to the appropriate points on the circuit board.

You can mount CONTRAST control R1 on either the front or rear panel of the enclosure. Finally, using the circuit-board assembly as a guide, drill mounting holes through the floor of the enclosure for mounting it in place.

After embellishing the enclosure as

(Continued on page 110)

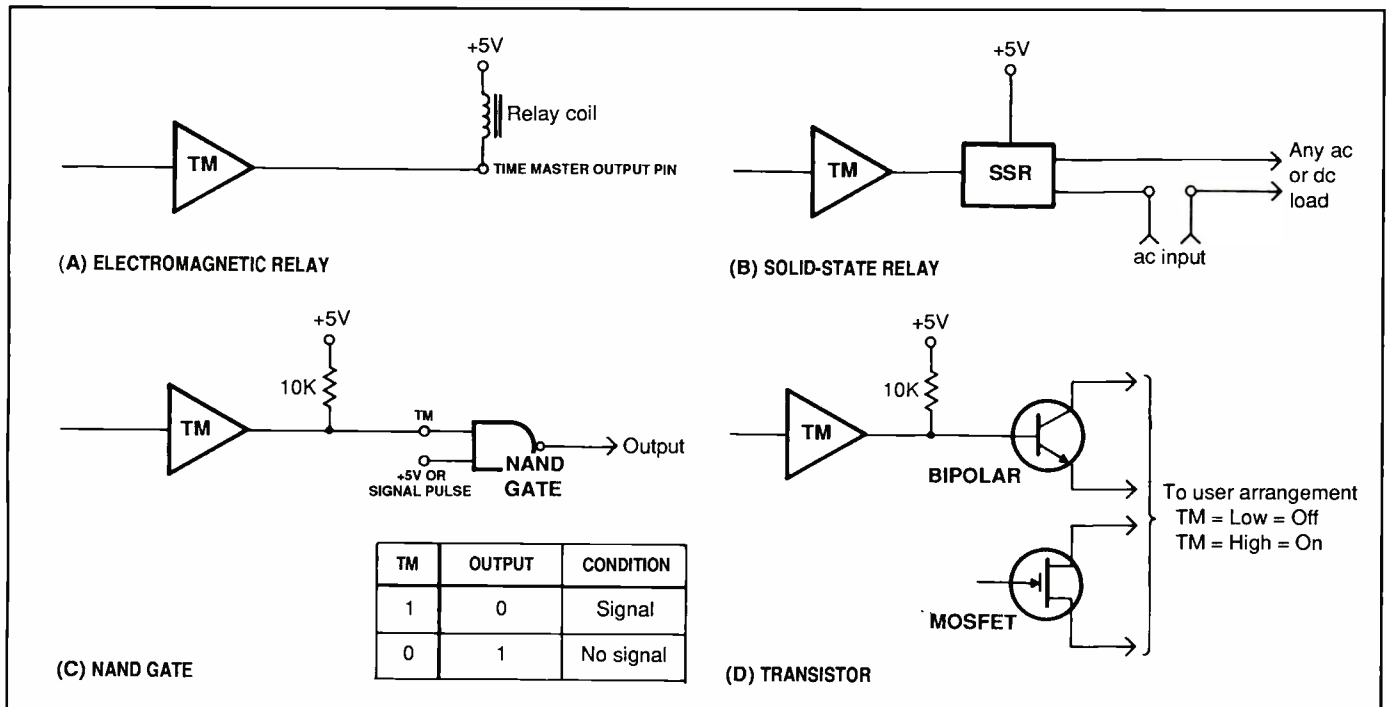


Fig. 5. Circuit InterFacing details for Time Master to controlled devices.

BBSing in the '90s: *The Major BBS* Version 6.1

Version 6.1 of *The Major BBS* is the latest incarnation of Galacticomm's popular multi-user bulletin-board system software. This new version, which has a suggested list price of \$249 for a two-user system, offers several significant new features. Chief among these is the ability to offer callers a choice of either EGA/VGA graphics or standard ANSI text, both on the same BBS. Other new features include a new multi-lingual/multi-protocol architecture and the ability to add "doors" to a separate PC on the BBS.

Version 6.1 runs on IBM/compatible 286 or better computers that have a minimum of 2M of extended memory, MS-DOS 3.3 or later and a hard disk. Any Hayes-compatible modem is supported, from 300 to 38,400 bps. For LAN users, a Novell network running *NetWare* 2.1 or later or *NetWare Lite* 1.0 or later is required.

The Major BBS comes with a 438-page manual, quick-start card and the software on both 3 1/2" (three disks) and 5 1/4" (two disks) media.

Since I hadn't had experience operating a BBS, only using a number of them, I decided to find out how difficult or easy it would be to set up *The Major BBS* on my computer. Then I would explore, as best I could, the new and seemingly advanced features of this latest version.

Installation

I set up *The Major BBS* on my current system, a 25-MHz ALR 486 PowerFlex with a Datastorm 2,400-bps High Fidelity modem. I used Galacticomm's "Getting ON-THE-AIR Fast" quick start-card, which gives all the basic information needed for installation and also refers to the pages in the manual that coincide with different parts of the setup procedure. I found that this card was almost all I needed to install the software.

To give myself the best chance of succeeding on the first try, I created new AUTOEXEC.BAT and CONFIG.SYS files and entered into these files only the information required by the installation procedure. Thus, I created a pristine system and didn't have to worry about conflicts caused by Microsoft *Windows*, expanded-memory drivers, TSRs, etc. I also figured that this would help me later if I needed to call tech

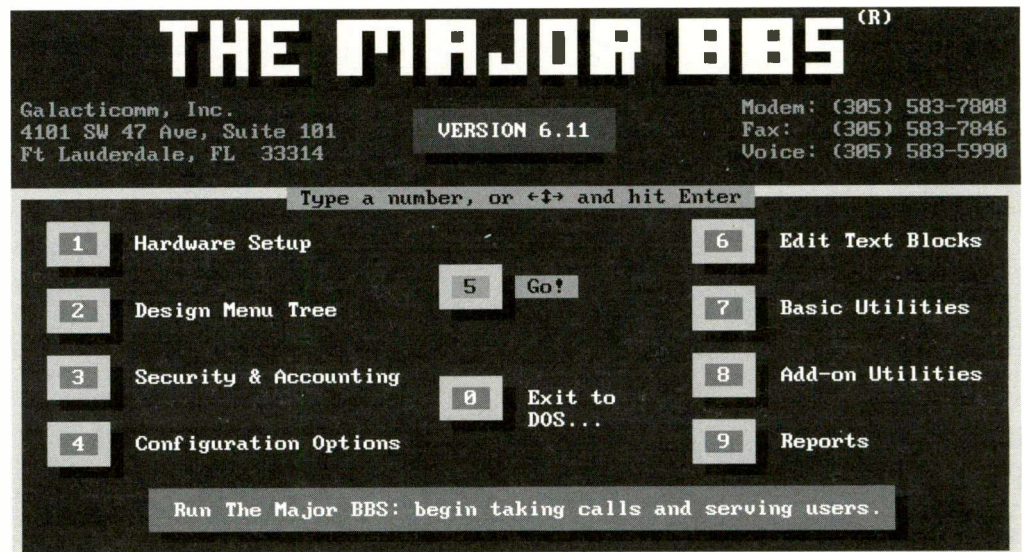


Fig.1. Introductory menu for *The Major BBS*, Version 6.1.

support for help. There could be no cause for confusion.

Installation went smoothly. During one part of the installation, *The Major BBS* provides five BBS models from which to choose, depending on how you plan to use the system. The five models are: public, customer service, sign-up, private and for-profit. The manual explains each one and offers examples of when to use one or another model. If you change your mind afterwards, the software allows you to make the change to a different model.

Using It

After installing *The Major BBS*, the introductory menu shown in Fig. 1 appears on-screen. Choosing Option 5 allows you to "go on the air." Figure 2 shows the summary screen that the system operator (SYSOP) sees after choosing Option 5. At this point, I was ready to test operation of the BBS.

To test the BBS for proper operation, I simply asked a co-worker to call me. I realized that I had some problems when the BBS didn't answer the call. During troubleshooting, I ascertained that all of my communications equipment was working properly, which meant that the problem had to reside in the BBS software. At this point, I called the Galacticomm technical support number and explained the problem. The person with whom I spoke tracked the problem to a modem setup string in the software. He blamed the problem on the

compatibility of the modem, though I'd never had problems with it before. I also found that it took 15 to 20 minutes to get through to tech support on a toll number.

Now that I was able to receive calls on the BBS, I decided to customize it for my own purposes. After naming the BBS, I set up five forums for discussion of different topics and created a library area in which users could upload and download files. During this process, I needed to make a call to tech support to find out how to edit text used to greet new users to the various forums. Other areas that can be customized are menus, security, distribution lists, user registry questions, etc.

Although I was up and running with the BBS, I still had one nagging problem. Every so often, the BBS hung up on my system. This was a major concern, since I intended to have the BBS run as a 24-hour system. I called tech support about this and learned that there was no easy solution to the problem. The problem appears to have more to do with my particular system than with the BBS software. I was surprised at this because I hadn't had software compatibility problems in the past. I decided to live with the problem until I could obtain an alternate system.

I found the documentation for *The Major BBS* to be well-written and thorough in its explanations of how to install and operate the system. The many examples given throughout the text certainly help in implementing many of the program's features. I

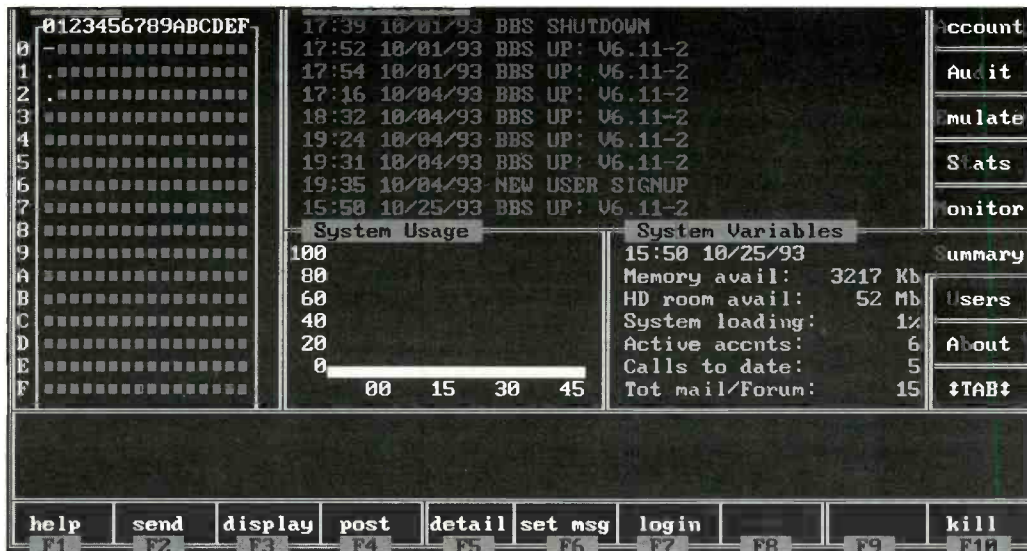


Fig. 2. The summary screen that the system operator (SYSOP) sees after choosing Option 5 of the introductory menu.

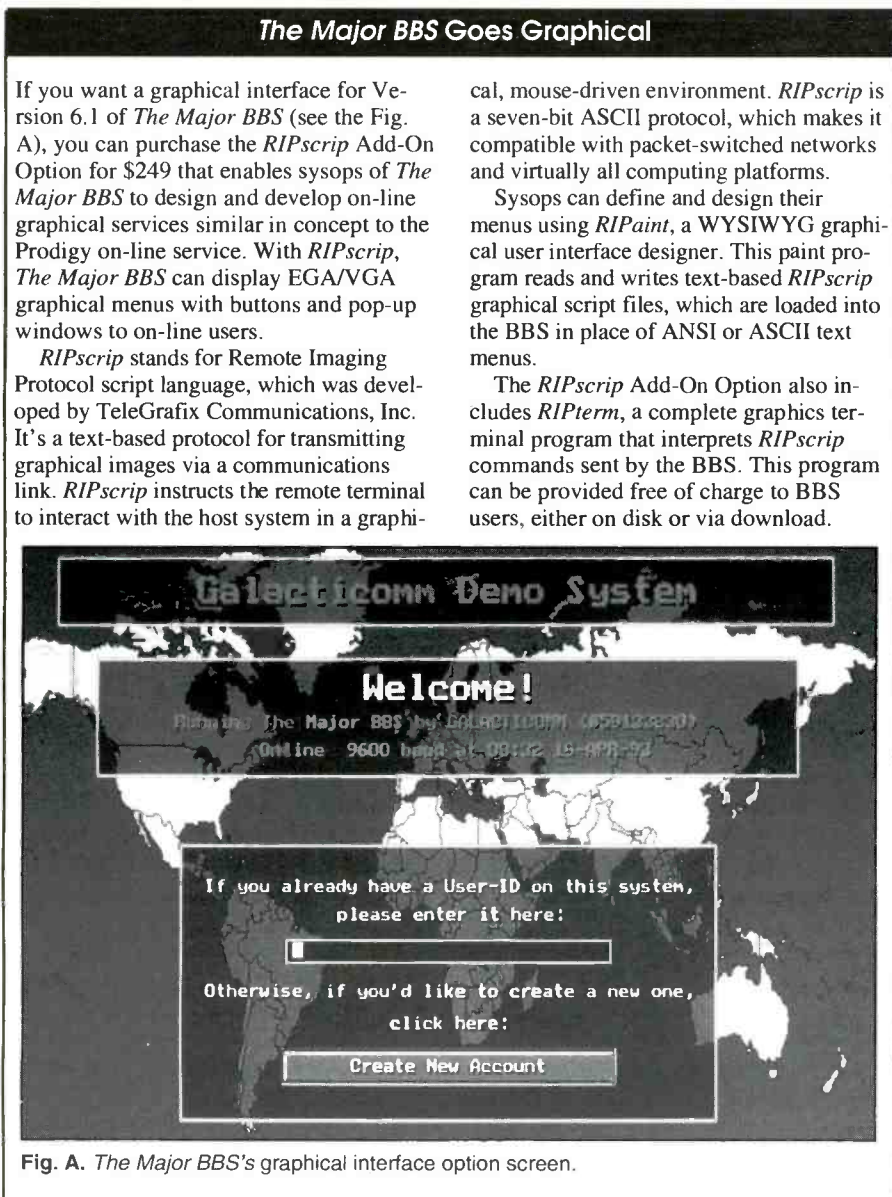


Fig. A. *The Major BBS's* graphical interface option screen.

did find it necessary, though, to contact technical support for answers to problems I couldn't solve with the documentation.

New Features

An advanced feature of *The Major BBS* is its ability to offer callers a choice of either EGA/VGA graphics or standard ANSI text, both on the same BBS. I found that this feature isn't included with the standard package. It's a \$249 option (see "The Major BBS Goes Graphical" box). I didn't set this up myself. Instead, I took a look at Galacticomm's demo BBS.

Galacticomm provided a disk that contains a freeware terminal program called *RIPterm*.

Using *RIPterm*, I logged onto Galacticomm's graphical

BBS. The system presents a graphical user interface, complete with mouse support, menu buttons and graphics screens. But the system is actually a hybrid one, with a text window surrounded by the graphical interface. My reactions were mixed. On the one hand, certain functions are easier to perform by pointing and clicking, but waiting for graphic screens to re-draw slows one's overall ability to do business on the system. This factor may be alleviated as modem speeds increase.

Anyone can check out Galacticomm's demo BBS by calling it at 305-583-7808. To access the graphics features of the BBS, you must download the *RIPterm* program and then log back onto the system with this program.

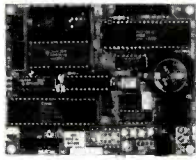
Another new feature of Version 6.1 is its ability to support multiple user languages simultaneously. One user could be on-line receiving prompts and menus in English, while another is getting them in German, Spanish or another language. I found that, although Version 6.1 "supports" this feature, its implementation depends on third-party products, which may or may not be available by the time you read this. This feature is, in fact, an invitation to third-party developers to develop products.

Version 6.1 now supports "doors" to a separate PC (see the "What's Behind the BBS Door?" box). This feature uses a separate channel of the BBS to call out to another computer, connected to the main system via a null modem cable. The second computer runs the Galacticomm Host program, *GHost*, which provides the interface between *The Major BBS* and actual door application. According to Galacticomm, hundreds of door programs are available through third-party developers.

Growing the BBS

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grow from an initial two-user system into a system that supports many users and offers a variety of special services. Galaticomm is committed to supporting this growth through hardware and software add-on products. For example, Galaticomm sells a product called the *User Six-Pack* for \$249, which provides support for six additional simultaneous users. Up to 42 *User Six-Packs* can be installed in the system for a total of 256 simultaneous users.

User Comments

Version 6.1 of *The Major BBS* offers prospective BBS operators an opportunity to get on the air quickly and easily. In my case, though, incompatibilities between Galaticomm's software and my hardware introduced problems that I still haven't fully resolved. I also thought that, for my application, I'd likely stick with the basic two-user system until I felt the need to introduce such amenities as a graphical interface, multi-language capability and doors to another PC. In particular, I thought that the *RIPscrip* Add-On Option didn't offer sufficient utility to justify doubling the cost of the package.

For prospective buyers who wish to take their BBSes to the maximum, Galaticomm is a full-support company that possesses the hardware and software technology and the expertise to help them do it. ■

What's Behind the BBS Door?

Those of you who have multiple PCs can take advantage of the new "doors" feature of Version 6.1 of *The Major BBS*. One of the PCs is used as the BBS computer and the rest can be used as door computers. There are three special types of programs you can run on a door computer: door programs, DOS applications via doorway, and host programs.

A door program (which can be a database, spreadsheet, etc.) is specifically designed to be run remotely, through a serial connection. User keystrokes come in through the serial port, and display information goes out through the serial port.

A standard DOS program, on the other hand, assumes its user is sitting at the keyboard, looking at the screen. A doorway lets you run the DOS program remotely, over a serial port. The doorway runs the DOS program, simulates keystrokes by the remote user, and maintains a copy of the screen on the remote user's terminal. Galaticomm resells a doorway program called *DOORWAY* from TriMark Engineering. This program and the standard DOS program combine to make something just like a door program.

Whether you're using door programs or a doorway with standard DOS applications, you need something to start them up at the right time. This is the host program. The Galaticomm Host program, *GHost*, runs while the door computer is idle. As soon as a BBS user requests an available door, the BBS communicates with *GHost*, which then brings up the appropriate door program.

Product Reviewed

The Major BBS, Version 6.1, \$249

Galaticomm

4101 SW Fourth Ave., Ste. 101

Ft. Lauderdale, FL 33314

Tel.: 305-583-5990; Fax: 305-583-7846;

BBS: 305-583-7808

Requirements: IBM/compatible 286 or better computer with a minimum of 2M of extended memory, MS-DOS 3.3 or later and a hard disk. Any Hayes-compatible modem is supported, from 300 to 38,400 bps. For LAN users, a Novell network running *NetWare* 2.1 or later or *NetWare Lite* 1.0 or later is required.

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Industry Watch

The AmCoEx Index of Used Computer Prices

Many people feel an analogy exists between the transportation industry at the turn of this century and the computer industry of the last decade. As the story goes, the corporate mainframe computer was analogous to the railroads—efficient, but inflexible. The microcomputer is analogous to the automobile. Catering to the needs of the individual, it's relatively inexpensive and extremely flexible. Just as the automobile decimated the passenger-train business, the PC has diminished the role of the mainframe computer. Railroads and mainframes will continue to serve a purpose, but they'll never return to the heyday they once knew.

In the early 1900s, dozens of auto makers struggled for market share. Names like Pierce-Arrow and Reo gave way. Ultimately, only the Big Three survived. Many people feel that the computer industry is undergoing the same type of consolidation.

During the first 10 years of the existence of the automobile, there was no used-car market. Today, every car dealer handles trade-ins. Many people feel the same will soon be true with computer dealers. This is the first year in which the majority of computers sold will be used to replace existing systems.

As many experts in the computer industry understand, software drives hardware sales. Regardless of how advanced the hardware is, if software applications aren't available, the hardware won't sell. NeXT Computer ceased its hardware production because few software developers produced applications for its machines. For Apple Computer, this is a good news/bad news situation. The good news is that there are currently 40% more applications available for the Macintosh computer than there are for

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

Machine	Average Bid	Average Ask	Buyer's Close	Seller's Change
IBM PS/2 Model 30/286 20M	300	525	350	-75
IBM PS/2 Model 50Z 30M	300	650	400	-25
IBM PS/2 Model 70 120M	600	900	775	+50
IBM PS/2 Model 80 70M	550	850	600	-25
IBM ThinkPad300	1,250	1,650	1,375	-75
IBM ThinkPad700	2,100	2,700	2,200	-150
AST 286/12, 40M	275	675	350	-50
AST 386/20, 80M	550	950	725	+50
Dell 325SX, 50M	400	800	700	+50
Dell 386/20, 120M	800	1,200	825	-100
Gateway 286/16, 40M	350	600	375	-75
Gateway 386SX/20, 80M	600	950	675	-50
Gateway 386/25, 80M	600	1,000	725	-50
Clone AT 40M	250	550	350	-100
Clone Notebook 286, 40M	350	750	600	+50
Clone Notebook 386SX, 40M	500	1,050	725	-50
Clone 386/SX 40M, VGA	450	950	600	**
Clone 386/25 80M, VGA	650	1,150	725	+25
Clone 386/33 80M, VGA	750	1,250	825	**
Clone 486/25 120M, VGA	800	1,450	1,000	+75
Compaq SLT/286 20M	400	800	400	-50
Compaq LTE 286 40M	400	775	500	-100
Compaq Portable III 40M	250	650	375	**
Compaq Deskpro 286 40M	250	650	300	-100
Compaq Deskpro386/20e 100M	600	900	775	-50
Macintosh SE 20M	450	750	525	**
Macintosh SE/30 40M	600	900	700	-50
Macintosh II 40M	600	1,150	825	-50
Macintosh IICx 80M	800	1,300	925	-75
Macintosh IICi 80M	1,200	1,600	1,425	-125
PowerBook 100 4/20	700	1,100	800	-100
PowerBook 140 4/40	900	1,400	1,100	**
PowerBook 170 4/40	1,100	1,700	1,325	-100
LaserWriter IINT	700	1,300	875	-25
Toshiba 1200XE	300	650	375	-50
Toshiba 1600	300	700	350	-75
Toshiba 2200 SX 60M	800	1,300	825	-50
Toshiba T-3100SX 100M	500	900	600	-100
Toshiba 5200 100M	900	1,400	1,227	-75
HP LaserJet II	400	850	650	-100
HP LaserJet IIP	325	950	575	-50
HP LaserJet III	750	1,200	1,025	**

All figures in last four columns are dollar amounts; prices are for October 4, 1993.

Windows computers. The bad news is that, at the current rate of increase, the number of *Windows* applications will equal the number of Macintosh applications within the next six months.

The point may become moot, however, during the next six months, when IBM and Apple begin marketing their new computers based on the PowerPC

CPU chips. It's expected that these computers will be able to run both Macintosh and *Windows* applications. The new CPU chip reportedly has more power than the 586-generation Pentium chip at a lower price than the mainstream 486 chip. In a recent demonstration, a Macintosh using the PowerPC chip was demonstrated to handle

(Continued on page 110)

Microcomputer Q&A By TJ Byers

In this column, I answer your questions about all aspects of computer disciplines, both hardware and software, plus related electronic queries. Since I draw from a large source of knowledgeable contributors, feel free to ask whatever questions you may have regarding computing on the PC platform..

"TMP" Means Temporary

Q: I installed Windows 3.1 on my wife's 386DX computer a couple months back. Lately she's complained about not having enough disk space. I discovered that about 3.5M of the hard disk is filled with .TMP files with names like ~RMS0429.TMP, MPOC03.TMP and WR12333.TMP. What are they used for, and what happens if I delete them?

A: Those .TMP files are created by the application as a way of temporarily storing data on which it's working. Normally, these files are deleted when you exit the application or *Windows*. However, if a "General Protection Error" occurs that causes the application to crash while in progress, the files could remain. These files no longer contain recoverable information and can be erased without incident.

Don't Handcuff A 14.4-bps Modem

Q: I just upgraded my 386SX-16 to a 486SX-25 by swapping in an AMI motherboard. Everything works fine, except for my internal Zoom V.42 bis modem. I used to be able to send and receive at 14.4K bps, but now if I go any faster than 9,600 bps, the system locks up. I don't get it.

A: Your serial port is too slow to handle this speed. This problem occurs when the modem is compressing the data for transmission and the data doesn't input fast

enough. This causes the error-correction code that's appended to the end of the compressed data packet to be incorrect. In a futile attempt to correct it by asking for a new data packet from the PC, things only get worse, until lockup occurs. This is easily corrected by setting the port speed for 19,200 baud.

From the DOS prompt, use the MODE command as follows:

```
MODE COMx: BAUD=19
```

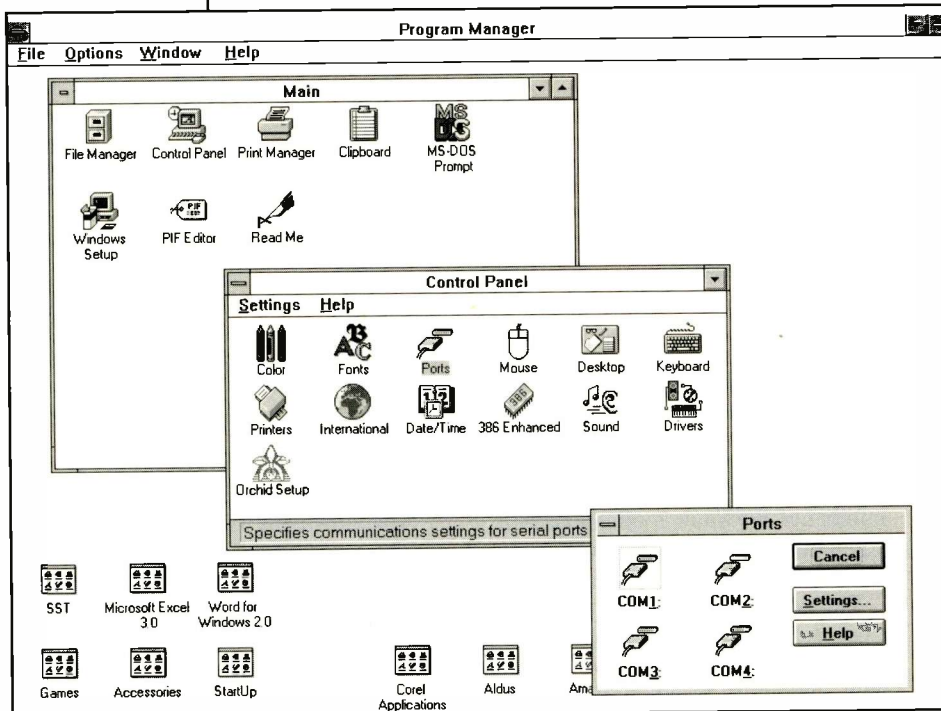
where COMx specifies the serial port to which the modem connects, usually COM1 or COM2. This command can be included in your AUTOEXEC.BAT file, where it's automatically run each time you boot your system.

In *Windows*, the serial port speed can be set using the Setup menu found in the Main menu. Choose Ports, followed by Settings (see figure on this page).

DOS 6.0 MS Backup For Windows: Too Little, Too Late

Q: I'm presently installing DOS 6.0 MS Backup for Windows. How can I make it so that it reminds me to back up at a certain time?

A: If all you want is a wake-up call, you can do this using the Calendar found in the *Windows* Accessories menu. However, MS Backup isn't anything to brag about. It can back up only to floppies, not tape, and it doesn't have a scheduler. So if you back up several megabytes at a time, you'll spend a lot of time shuffling diskettes. Your better bet is to buy a Colorado Jumbo 120 or 250 tape drive, or equivalent, which sells for under \$200 and comes with software that automatically backs up files for you—even if you're not there.



Does Your Notebook's Battery Have More Memory Than The PC?

Q: I recently purchased an Epson ActionNote notebook computer for my son to take to college. However, a friend tells me that frequently recharging the battery will cause it to develop a "memory" that makes the battery useless. What does he mean?

A: Most notebook computers today are powered by nickel-cadmium—commonly shortened to Ni-Cd—batteries, which are the same kind used in rechargeable flashlights and cordless tools. The memory effect is a result of using the battery for short periods of time, let's say 15 minutes, and then recharging it. After a while, the battery "remembers" this cycle and thinks that's all the work it has to do. So, after 15 minutes, it simply quits, even though there may be another 3 or 4 hours of battery life left.

To avoid the memory problem, the battery should be deeply discharged before recharging. This can be done by letting the notebook run all night while you sleep. However, you'll have to disable the sleep mode built into the notebook. If you don't, it may take weeks to drain the battery. The following batch file will keep the notebook awake.

```
:wakeup
dir c:
goto wakeup
```

Ni-Cd batteries that have developed a memory can be salvaged in the same way by deep-discharging them several times to erase the memory.

A new battery, called nickel metal hydride (NiMH, or MH for short), is finding increased use in notebooks. It has the advantage of greater current density (more power for the same weight), and it doesn't suffer from memory problems.

Can't Use PCMCIA Modem With OS/2

Q: I'm having a problem getting my AT&T PCMCIA modem to work with OS/2 2.1 on my NEC UltraLite Versa notebook computer. Using the DOS drivers included with

the machine freezes the system. Can you offer any assistance?

A: You need special OS/2 drivers. As you discovered, DOS drivers won't work. What's more, the OS/2 drivers have to be specifically written for your machine, or they'll also cause it to freeze. Check with NEC or your dealer first. If that doesn't work, you could try the OS/2 drivers IBM ships with its ThinkPad notebook. The fact that it's a modem card makes it more-compatible than if you were trying to install an Ethernet card. But there's no guarantee. Otherwise, you'll have to wait for NEC to release its OS/2 drivers or hope a third-party PCMCIA supplier, such as SystemSoft, will soon have generic OS/2 drivers available.

Stifle That Modem

Q: Is there any way to make a modem dial silently, without emitting those loud beeps?

A: It depends on the modem and your software program. If your modem is Hayes-compatible (which most are), you can add the ATMO command to your startup string. The ATLO command sets the volume so low that you can't hear it. However, every communications software application has a different way of applying Hayes AT commands. To do it in Procomm Plus, for ex-

ample, you select MODEM OPTIONS from the Setup Main Menu and then GENERAL OPTIONS from the Setup Modem Options Menu. The first line, Initializing command, is where you insert the line:

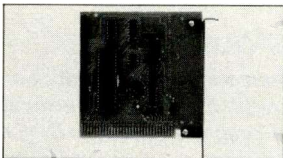
```
ATMO S7=255 S11=55 V1 X1 S0=1 ^M
```

This string of commands tells the modem (AT) to: turn off the speaker (MO), wait 255 seconds for an answer response (S7=255), use 55-ms tone spacing when dialing (S11=55), display words not numbers (V1), use the expanded Procomm Plus command set (X1), answer on the first ring (S0=1) and end the string (^M). Other software may have additional command options and different ways to program the string, but as long as the ATMO command is included, the speaker will be silenced. The command string is then saved and run each time you load the communications software. Therefore, you have to program it only once.

Lunacy And Lost Files Go Hand In Hand

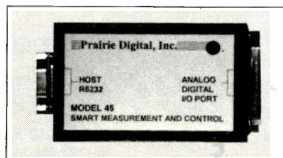
Q: During the last full moon, my hard disk went berserk and erased a precious file. When I used CHKDSK to see what happened, it told me that several clusters were

AFFORDABLE DATA ACQUISITION



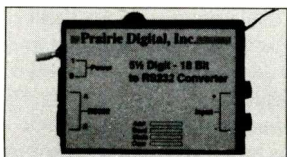
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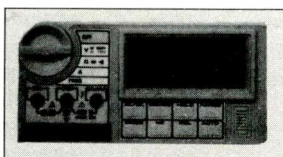
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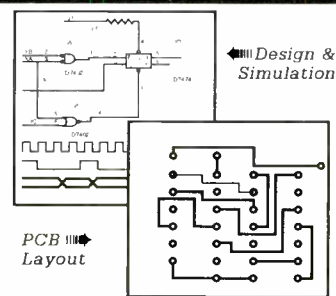
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lost, and that I could recover them using the CHKDSK /F command. So I did. Well, still no file. Then a friend let me borrow his Norton Emergency Disk to try to unerase it, but it can't find it, either. Where did the file go? To the moon?

A: Your mistake was using the CHKDSK /F command before using the Norton Emergency Disk. Immediately following an accidental file erasure, don't do anything—except insert an emergency floppy disk, such as those from *Norton* and *PC Tools*, and reboot. Hard-disk sectors are assigned in order by the FAT (File Allocation Table) using the beginning sector as a reference. What you did when you told DOS to recover those lost clusters was erase any previous knowledge of your file from the FAT. Instead, the sectors were reassigned to a group of files with a .CHK extension (FILE0000.CHK, FILE0001.CHK, etc.). If you're lucky enough that the file was in ASCII text format and you haven't erased the .CHK files yet, you may be able to piece parts of it back together. Otherwise, it's gone to the moon.

Why Green Is The Color

Q: What's this Green PC thing Vice President Gore and everybody are talking about?

A: You're referring to the Energy Star program developed by the Environmental Protection Agency (EPA). According to the June 17, 1993 White House Press Release, "The computers unveiled today can enter a low-power stand-by state when they are inactive, thereby conserving energy and saving money in the process."

Basically, it's a set of guidelines—not a standard—that outline ways to reduce power consumption of PCs when they're sitting idle, such as during lunch breaks or after hours when they're waiting for a fax or modem transmission. It works in four stages. Stage 1 is full power. In Stage 2, power consumption is reduced to 80% by blanking the monitor's screen. In Stage 3, system power is reduced to 30% using whatever method the vendor deems most adequate. Along these lines, there has been some interaction with the VESA committee so that proper management of both PC and monitor can achieve this plateau. In Stage 4, all circuits are off, except standby monitoring circuits needed to reactivate the system.

Why is green the color? The thrust is to curtail building new power plants to meet the burgeoning proliferation of PCs, presumably saving the government money and saving the environment. But this is one time where the trickle-down theory actually works, because it costs no more to build a green machine than it does a "brown" one, as the pre-green machines are called, and you save on both the electric bill and the system's wear and tear.

IDE And AT PCs Don't Mix

Q: I just acquired a rather large (240M) IDE drive for next to nothing and would like to put it into my AT clone. But I can't get it to work, despite booting with DOS 6.0 and buying a brand new IDE controller card. I know the drive works. What am I doing wrong?

A: You aren't doing a thing wrong. The AT BIOS doesn't support IDE drives. For your "new" hard disk to run on your old AT machine, you need to install a BIOS upgrade, which costs in the neighborhood of \$78. But why not put that money towards a new motherboard? You can buy a 386DX-40 motherboard with a 64K cache for about the same price, or a 486SX-25 motherboard for just a few bucks more (about \$125). And the good news is that not only will your new IDE drive work just fine, so will all the other PC goodies you've accumulated over the years, enclosure and all.

If you do go the motherboard-upgrade route, don't throw away that old 286 motherboard. There's still plenty of life left in it as a dedicated controller for home security, robotic control or simply as a dedicated fax/printer system.

Bringing Scanned Images To Book

Q: I successfully scanned a black-and-white photo for my newsletter. But when I imported the scan into PageMaker and reduced it to fit the column, it looked like a TV movie version of John Wayne riding very tall and thin in the saddle as the credits scroll by. What can I do to correct the problem?

A: This is a common problem. When you sized the scan, you took into account only the column width, which gives the image a "pop-bottle" effect. For example, if you reduce an 8" x 10" photograph to fit in a 3" x 3" space, you changed the aspect ratio from 1.25:1 to 1:1. That should easily trim 20 pounds off anyone in the photo. The way to avoid the distortion is to maintain the image's original height-to-width aspect ratio. In this example, the height should have been 2.4". Most desktop-publishing software, and a lot of image-management applications, such as *Paint Shop Pro*, let you re-size an image while maintaining the aspect ratio.

Hates Meecees To Pieces

Q: Don't get me wrong, I think the mouse is a great invention. It's just that the keyboard is a lot faster. Is there a way I can click and drag using the keyboard instead of the mouse to highlight ranges in Excel and other applications?

A: Many Windows applications let you du-

PLICATE mouse clicks using a combination of keyboard strokes. To duplicate click and drag, locate the upper-left corner where you want to start your range, be it a spreadsheet cell or the beginning of text, then press and hold the Shift key while you use the cursor keys to move the highlighted area to the desired conclusion. This works for virtually all Microsoft software and most popular business applications.

Technicolor DOS Prompts

Q: After running Norton Utilities, the screen stays blue. Short of a re-boot, what can I do to put things back to normal?

A: You have a pretty old version of *Norton Utilities*, which used to not reset the screen properly when it quit, a problem that *Norton* has long since fixed. Unfortunately, far too many commercial and shareware programs still leave you hanging with colorful choices not of your choosing. Fortunately, it's easily cured using the PROMPT command. For example, you can always put things back to white on black by typing the following at the DOS prompt.

```
PROMPT $e[0;37;40m$p$g
```

And you can experiment with different DOS text and background color combinations. The secret is the ANSI.SYS file, which has to be added to the CONFIG.SYS file as

```
DEVICE=C:\DOS\ANSI.SYS
```

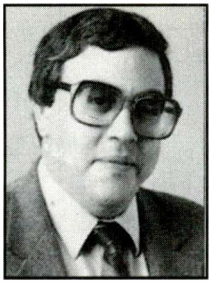
Check your DOS reference manual or use the excellent Help command in DOS 6.0 for the color options.

Time's A Wastin'

Q: Can anyone tell me why the clock on my PC runs slow? It has lost about a minute a week since I bought it a year ago. Even my wristwatch is more accurate, and it costs a whole lot less.

A: Yes, it needs an adjustment. Just like the crystal oscillator in your Timex or Bulova, there's a trimmer capacitor that tunes the frequency of the oscillator to spot-on perfect. Obviously, this takes specialized equipment that's not readily available to the average owner. When the problem is with your watch, any reputable jeweler can make the adjustment. Unfortunately, PC clock services are more limited. Some service stations have this capability, but mostly, it's a factory adjustment.

You can try experimenting by adjusting the clock capacitor, a small, round, ceramic device about 1/4" in diameter that's located near the 14.318-MHz crystal this way and that until you hit it just right. Maybe a *MicroComputer Journal* reader can come up with a project that will solve the problem. ■



By Ted Needleman

Microcomputing Musings Off to a Good Start

What a development. Here it is the first column for the newly minted *MicroComputer Journal*, and the first thing I have to do is perform the "Needleman Maneuver." I'm sure you've heard of it. It's where I extract my walking appendage from my speaking orifice.

Back in the November issue of *ComputerCraft*, when I reviewed Star Micronics' great new SJ-144 color printer, I made the comment that perhaps it shouldn't be your only printer. I made that comment on the basis of the cost per page of output. Unfortunately, as a call from Star Micronics was quick to point out, I miscalculated the monochrome cost per page, coming up with an 18 cents per page total that's actually more than three times as much as the 5½-cent per page actual cost! At 5½ cents/page, the SJ-144's monochrome output is right in the range of an ink-jet printer, and with 360-dpi resolution, it's just as nice looking. With great-looking color output to boot, I withdraw my reservation. Star Micronics' SJ-144 makes a great monochrome and color printer!

Time Warp

Even though this issue carries a January/February 1994 cover date, it hits the newsstands just as the holidays are in full swing. This is the way publishing works. It's no big deal, but it means that I can take advantage of the "time warp" to give some additional last-minute suggestions for holiday gifts. Or, if you're picking this up after the holidays, here are some things you can get for yourself to take away the sting of disappointment caused by what you did receive.

I have to admit that I'm not much of a games player. I just don't usually have much time for games, even though there are three game machines in my house (NES, Super NES and Genesis). That's why I'm kind of embarrassed to admit how much time I've wasted over the last three months or so on two games. Both are similar in approach (first person with three-dimensional action) and distribution (shareware).

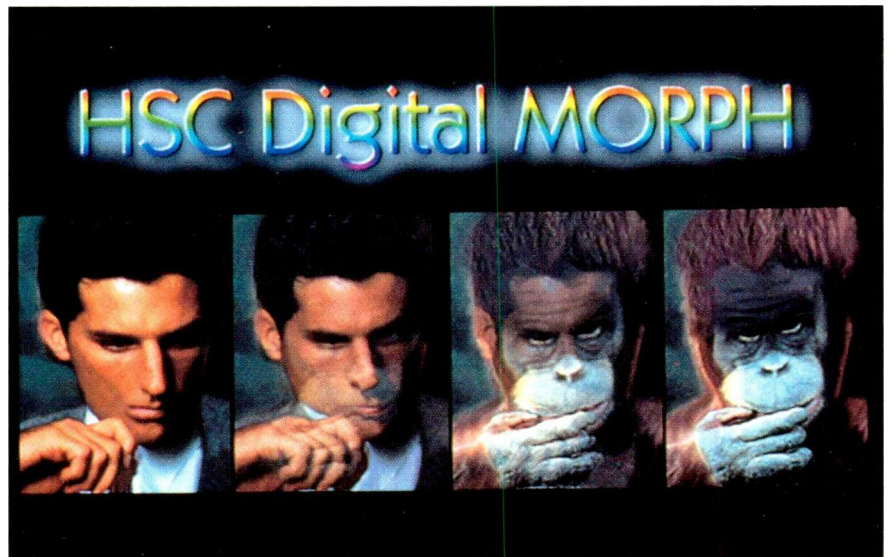
Wolfenstein 3D has become somewhat of a legend in the shareware industry. Not only has it captured a number of awards, but it's also spawned a very successful commercial follow up (*Spear of Destiny*.) The game follows BJ Blazkowicz, an American GI during World War II, who has been captured in Nazi Germany and

transported to the infamous Castle Wolfenstein. He overpowers his jailer and then has to escape. The Castle, however, is full of guards, mutants and mazes. It also has lots of secret passages and rooms filled with ammunition, treasure and health-restoring food.

In playing the game through each episode's nine levels, you're BJ Blazkowicz, looking over the barrel of your gun. The 3D effect, as you "walk" down corridors and scoot around corners, is what makes this game so addictive. So are the great background music and sound effects. *Wolfenstein 3D* is a great excuse to get a sound card if you don't already have one.

Wolfenstein does tend to be a bit graphic in its violence. Guards yell in German when they're shot, and blood splashes and splatters. Most adults won't take any of this very seriously, but it could be upsetting to younger players (though my bloodthirsty hoard just tend to giggle while machine-gunning Nazi guards).

The game's first episode, *Escape from Wolfenstein*,

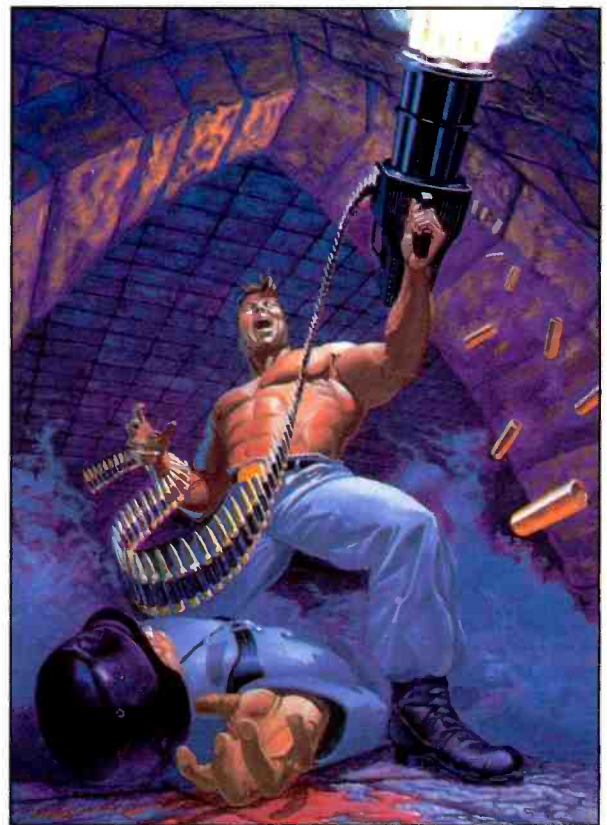


HSC Digital Morph from HSC Software can metamorphose any origin image to a destination image smoothly, over a user-specified number of steps.

is available on many BBS systems (try the Software Creations BBS at 508-368-7036, which operates at 2,400 to 9,600 baud) for the cost of downloading. Alternatively, you can call Apogee Software (800-GAME123), which distributes *Wolfenstein*, and ask whomever answers to send you episode one for \$4 shipping and handling. All six episodes are available from Apogee for \$50. I recommend you just give Apogee the \$50 right up front and save yourself time because chances are, after you play the free first episode, you'll be impatient to get to the remaining five. The commercial game, *Spear of Destiny*, is also programmed by id Software, but it's distributed by Formgen. I bought my copy at a local Babbage's for less than \$50.



A screen shot from ImageSmith's *Year 2 Learn*—Peanuts educational software package.



An action shot of the hero in the *Wolfenstein 3D* game battling his way through Nazis to escape the infamous Castle Wolfenstein.

With *Wolfenstein 3D*, id Software pioneered a new type of game, which the company is calling "virtual reality." If you're into games, you'll see a lot of this type of game showing up on the shelves this year.

If you don't want to wait, or you just don't want to get into this much violence, there's another "first-person" 3D game available in the shareware format that's less violent and a lot sillier but is just as much fun to play. In *Ken's Labyrinth*, evil Zogarians have kidnapped your dog, Sparky, to determine if Earth's second smartest residents (that is, humans) should be converted into red jelly, which the Zogarians use on their toast and bagels. They've determined that Sparky is too intelligent for them to test, so they're giving the test to you, his master. You've been placed in a 10-level maze populated with ghosts, giant man-eating spiders, lightning shooting robots, giant eight-balls and big pink monsters. Your objective is to overcome all of these, and find Sparky.

Episode 1, *The Search for Sparky*, is available from most shareware BBS systems and suppliers, and you can get the entire three-episode trilogy for \$30 directly from Epic Megagames (call 800-972-7434). I really love playing *Ken's Labyrinth* (and so do my kids), but I suggest that you try a downloaded version first. The game seems to be very sensitive to the hardware on which it's running and the amount of free RAM (it requires at least

540K). Despite several calls to Epic, it runs on only one of the five PCs at my house without occasionally locking up the system and requiring a power-down/power-up. Even with this caveat, the one machine that it doesn't lock up is in almost continuous use playing *Ken's* when the kids are home!

If you're really into games and have a CD-ROM drive, both of these games (and hundreds of others) are on the \$19.95 *Encyclopedia of Shareware Games* CD from the PC-SIG (tel.: 800-245-6717). PC-SIG can also supply the games on diskettes, but at a non-member price of \$3.49 per disk, it makes more sense to buy the CD-ROM if you have a drive. Both of the above games run under DOS (not *Windows*). With their fairly hefty memory requirements and animation, you're best off using at least a 386 computer. Both also support Sound Blaster and Ad Lib sound cards and a mouse, if one is attached and the driver for it is loaded.

A Worthy Game Controller

I prefer to play with a mouse, but all four of my kids prefer the Advanced Gravis GamePad that's attached my oldest's PC. If you haven't seen this, it's to a Nintendo-style controller that plugs into a game port on a PC. Most sound cards offer a game port, but if yours doesn't or you don't have a sound card, Gravis and other vendors offer game-port cards.

The Gravis PC GamePad has four buttons and a control pad that converts into a joystick with a screw-in shaft. The functions of these buttons can be altered with a slide switch on the unit, and you can reverse button order with another slide switch. This makes the GamePad easier to use for lefties, as my left-handed son Scott will quickly attest.

Advanced Gravis lists the GamePad PC at \$29.95, but it's been selling for less than \$25 in every store in which I've seen it. It's carried by most retail outlets that sell games for the PC.

If you need more information on the GamePad, or Gravis' terrific analog joystick (or to get the name of a dealer near you), the company's U.S. distribution office is in Bellingham, WA. Gravis includes a disk filled with utilities with both GamePad and joystick, as well as a copy of *Commander Keen*, Apogee Software's popular arcade game.

Equal Time

I don't really mind too much if my kids play on the game machines or their PCs. After all, it does help them to develop good hand-eye coordination. And games like the two mentioned above are great for developing an analytical problem-solving approach. It's not just shoot-em-up with these games. You need to discover hidden objects and create strategies.

At the same time, I try to insist that the kids spend an equal amount of time on their PCs in more education-oriented activities. These can be meandering through CD-ROM encyclopedias, writing in *Word for Windows*, creating graphic masterpieces with Computer Support's *Picture Wizard* or *Jurassic Art* or just enjoying Broderbund's *Kids Cuts*. I also like them to try the various "edutainment" games that are coming on the market. The Learning Company's *Treasure Cove* and *Treasure Math Storm* are very popular around my house, as is Compton NewMedia's *The Human Calculator*. The newest educational game to arrive is ImageSmith's *Yearn 2 Learn—Peanut*.

Peanuts is, of course, based upon the popular the Charles Shultz cartoon characters, though the major player (and the only one my kids recognized or remembered) is Snoopy. The software, available for both *Windows* PCs and the Mac, offers three educational activities (Math, Geography and Reading), a coloring activity and two simple games. The packaging (which, incidentally, is in the shape of a dog house!) and promotional material tout the software as appropriate for ages three through ten. This may be so, but it got very mixed reviews among my hoard.

Karen, who's five and in kindergarten, loved seeing and hearing Snoopy, and the coloring activity was just about at her level. She could operate the reading section, clicking all around the screen to find "hot spots," where the program pronounced the object and changed the graphics. But the only other section she could operate was the games. There are two of these, both rather simple for kids raised on Nintendo. One displays objects on the screen, and when you click on them, makes appropriate sounds. The other is a "flying" game in which you move Snoopy up and down to avoid crashing into objects on the ground and in the air. Neither of these two games kept any of my kids occupied for more than a few minutes. Perhaps a three- or four-year-old would have been more impressed.

My seven-year-old twins, Bryan and Scott, on the other hand, like the math, which throws different sized and colored pumpkins on a scale and asks you to add them up. They also like the reading section, reading along with the PC, but were somewhat stymied by the Geography, which is a drag-and-drop jigsaw puzzle. I expect that as they're exposed to the states later in the school year, that they'll be more interested in this aspect of the software. Marc, who is eight and in the fourth grade, went through the entire program in a bit more than a half hour—and hasn't looked at it since.

I have mixed feelings about *Yearn 2 Learn*. It's a clever piece of software and, at \$69.95 retail, not unreasonably priced. But in trying to cover too many areas and

age groups, it spreads itself a bit thin, with the result that it doesn't do a particularly good job on any one area. The software also requires a very hefty PC, one with 4M of RAM, 12M of hard-disk space, 256-color VGA and a sound card. But it operates slowly even on a 486DX/33, and it just doesn't feel like there's 12M of activity here. Still, for the price, it's a fun approach to education. And if my kids are any indication, appropriate for kids in the five to seven range.

Terminator Ted

Digital special graphics effects have really hit big in Hollywood. One of the most dramatic, is morphing. While this term may be new to you, the effect isn't. One of the most dramatic applications of morphing was in the movie *Terminator 2*. The amorphous "new" Terminator was able to shift from one shape to another. This special effect was accomplished through a computer technique that actually changes an image digitally from one movie frame to another. The process of changing the starting image (usually called the source) into the final image (the destination) is called "morphing." If you've seen the Schick razor commercial where the model's head starts out square, or changes from one person to another, you've seen morphing. Likewise, the Exxon commercial where a speeding car changes into a charging tiger.

To a graphics junky like me, new software that lets you actually perform morphing on a PC. (most movie F/X producers use heavy-duty graphics workstations) is irresistible. I recently received *HSC Digital Morph*, and I've been in digital heaven ever since.

Digital Morph does only three things: morphing, image warping and cutouts. But in making these three effects easy to achieve, HSC has hidden a set of very complex processes. Morphing takes one digitized image and, over a number of frames, makes minute changes in each frame to change the first image into the second. To use this effect, you call up the first (source) image and use a special cursor to outline the areas with which you want the software to work. Then you do the same with the destination image. Both images need to be in one of the many file formats the software supports. Set the number of steps that you want the software to take in going from one image to another. I particularly like the Animate feature. Using *Video for Windows* or Autodesk *Animator*, the software can create enough frames to actually let you see the metamorphosis taking place. Running through the software's tutorial, which includes images of a boy and a girl, I felt like a Hollywood F/X wizard as I morphed the boy into a girl and back again.

Image warping is an effect similar to morphing. However, instead of going from one image to a totally different one, it takes your original image and distorts it to your specifications. Finally, the cutout feature is similar to the masking effect that's offered by most high-end image-editing software packages. *HSC Digital Morph* gives you a number of image-manipulation tools, like brushes, but the real meat of the package is the morph effect.

There are some good ideas as to how to use these effects in the real world as well. One I liked that's on the package, is morphing a desktop PC into a notebook.

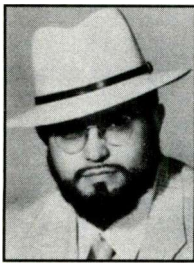
The one downside is that you need a pretty hefty PC to use this package. HSC recommends at least 4M of RAM (with 16M recommended) and a 486DX CPU. If you intend to play with animations, you'll also need lots of empty disk space. Even with compression, creating multiple frames takes up lots of room. HSC is running a special deal through the end of February. When you buy *Digital Morph*, you can send four photos to the company, which will be scanned and the digitized images will be returned to you for you to play with in your new software. If you know someone who's into graphics, *HSC Digital Morph* makes a great gift. And if that someone is you, treat yourself nice!

Get the Picture

I frequently have to capture screens right off the PC. In addition to the screens, I occasionally grab for this column, my day job often requires that I create a slide directly from a software package's screen or use a screen image in a presentation. Over the years, I've used a number of packages to accomplish this task. Until recently, I used the *Tiffany* shareware package from Andersen Consulting when I needed to capture a *Windows* screen and Applied Technologies' *Pizzazz Plus* for DOS screen capture. *HiJaak* also offers screen capture, but I've used it mostly for converting captured files from one format into another, which it does particularly well.

Recently, I've switched to a set of utilities called *Collage Complete* from inner media, inc. *Collage Complete* is pretty aptly named. It goes beyond just screen capture, though it performs this function very nicely in both DOS and *Windows*. inner media (yes, the vendor spells its name with all lower-case letters) includes two complete and separate version of *Collage*, one for DOS and another for *Windows*. You can install either or both, depending on your requirements and disk space. There are even two complete manuals—which gives you twice the opportunity to misplace the documentation. Not that you'll need to refer to the documentation all that often.

(Continued on page 110)



By Yacco

GUI Guts

Last-Minute Gift Suggestions

Most of my recommendations for last-minute gift-giving this holiday season are in education and entertainment software, often collectively called "edutainment." It's usually a good choice for the enjoyment it gives, as well as the price, which tends to be less than \$100. Furthermore, there's enough variety to provide something for just about anyone on your list. However, I've also included a couple of gift ideas for those lucky folks on the top of your shopping list.

Portable Color PC

If you really want to make a lasting impression, you could give your favorite donee (even if it's yourself) a hot new computer. Portables are growing in popularity, and an inexpensive color machine like the brand new BCC Avanti 425C notebook makes a good choice. It's both highly ergonomic and long-lived as color notebooks go. A notebook computer is the perfect addition for anyone who travels frequently, takes work home on a regular basis or just works at multiple locations within an office. The new breed of lightweight color machines are the most exciting products yet.

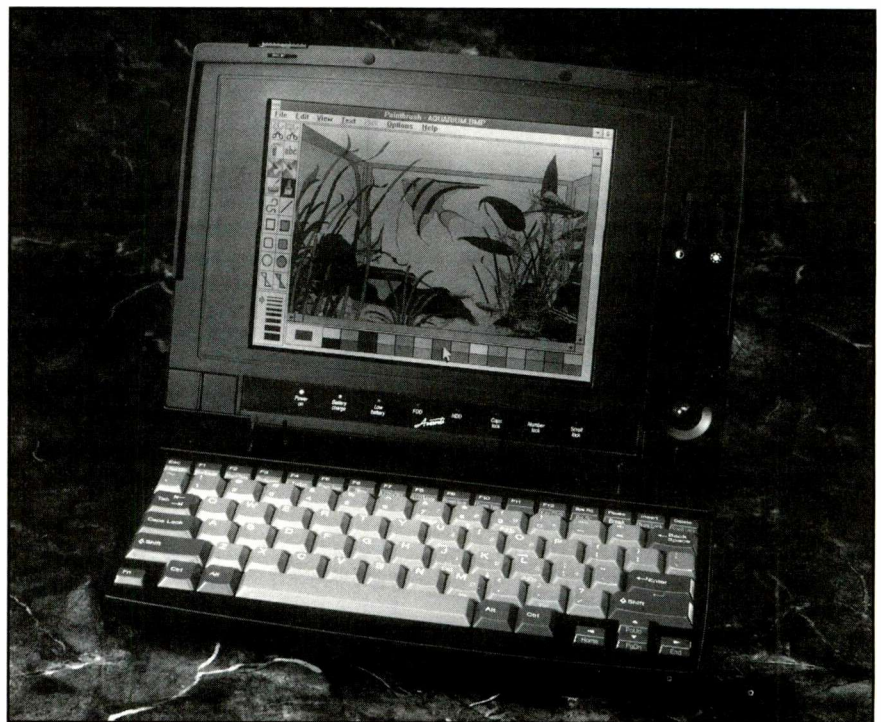
The stylish 425C is Avanti's first color portable. It's basically the same machine that BCC sells as the Avanti 486 with just a couple of major changes. The most salient difference is a bright and clear passive-matrix display. It's one of those new-generation panels that gives you high contrast and color saturation that are nearly comparable to an active-matrix unit. In fact, it's difficult to distinguish it from an active-matrix machine like NEC's UltraLite SL/25C in side-by-side comparisons. There are differences in things like refresh times and viewing angles, of course. So, the Avanti can't substitute for a machine with a TFT display in every technical respect, but it does do a fine job in most practical respects.

The major advantage of a passive design is that it consumes far less power than an active one does. This gives you more computing time per charge, and makes

it less necessary to carry extra batteries. BCC has also limited the 425C's display to a smaller 8 1/4" diagonal measure, which, while it sacrifices about a third of the monochrome model's display area, further enhances the unit's useful battery life. If you really value a combination of light weight and long battery life, it's a very good design. I think that's the whole point of portable computers in the first place.

The day after it arrived, I took an Avanti 425C on a trip to Calgary, Alberta, Canada. I used it for the entire flight, except during dinner, and never drained my first nickel-metal hydride (Ni-MH) battery. There was even enough juice left in it to continue working for a short time once I reached my hotel room, and I didn't have to tear my shoulder off to get it there.

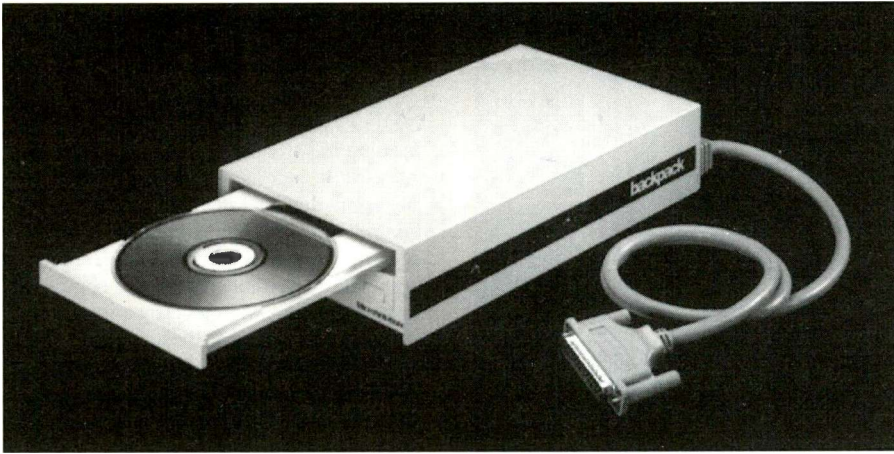
Another major difference between this model and its predecessor is the 425C's integrated trackball. It's a



BCC 'S Avanti 425C notebook computer features an 8 1/2" passive-matrix that's virtually indistinguishable from an active-matrix screen.

good design, with the ball and buttons embedded in the lower-right corner of the display. There are also a drag lock and indicator lamp on the right and a duplicate set of primary and secondary buttons in the left corner. It's about as ergonomic as having a Microsoft BallPoint, or one of its clones, clipped to the side of the machine.

Unfortunately, the trackball on the unit BCC sent me wasn't close to matching the BallPoint's tight feel. The



MicroSolutions' Backpack external CD-ROM drive works with any laptop PC that has a parallel port.

ball's very sloppy fit made it difficult to accurately position the cursor. It was driving me crazy until I fixed it. In less than 10 minutes, I cut a paper doughnut from the flap of an envelop and stuck it inside. My jury-rigged fix worked perfectly. It took up the slack and sealed out dust, without making the ball difficult to turn. I don't know how long the paper will last nor if particles of it won't gum up the works, but it seemed to me there would be nothing to prevent BCC from making a similar fix out of Teflon. That would last—and very substantially improve the performance of the trackball. It would also cost little to send one to every owner. So, I called to tell BCC about it and they're already shipping a tighter retaining ring they claim does the job just as well.

The final difference is that this machine drops the original model's pretense of being a real '486 and comes without a math coprocessor installed. Other features, like the built-in fax-data modem and various utility programs, are essentially the same for the two machines.

I've been using one Avanti or another for about a year, and its special characteristics, like a display that opens fully on an airline tray table and an angled keyboard with dual Ctrl and Alt keys, make it one of my favorite notebooks. There are quirks, including a few keys that sometimes stick a little, but nothing I'd call high maintenance. And if it sometimes displays the temperament of a sports car, so what? The Avanti also affords me a lot of driving pleasure. It's the machine I take with me when I have a lot of work to do.

Add-Ins & Add-Ons

Of course, your intended recipient may already have a laptop or notebook. A good choice, then, would be an upgrade—maybe

a coprocessor or extra memory. For example, it costs less than \$80 for a Cyrix 83S87-25 that exactly matches the 425C's 25-MHz 486SLC heart, which comes either from Cyrix or Texas Instruments, the latter under a license from Cyrix. A second 4M of DRAM for the Avanti runs about another \$400, which is well worth it to get all of the unit's speedy performance. The add-in RAM enables *Windows* to perform up to the processor's potential while running multiple applications. One thing to consider, though, is installation. Anyone can easily install both of these enhancements through an access hatch on the bottom of an Avanti, but some laptops have to be opened for this type of upgrade.

External peripherals that plug into a standard port are a better choice for anyone who has an ungrounded thumb, whether his machine is portable or desk-bound. MicroSolution's new Backpack No-slot CD-ROM drive will work with a laptop and just about any machine that has a parallel printer port and is a good choice for several reasons. For one thing, it opens up the universe of education and entertainment titles on CD-ROM and a world of images on Kodak Photo CD discs. The number of new machines that include these features is growing rapidly, and anyone who doesn't have one may soon be locked out of exciting new software products. The Backpack plays both formats, as well as audio CDs, and comes with a built-in audio circuit and stereo headphone jack.

BackPack's performance is enhanced by a 128K cache memory. It has a fairly brisk 350-ms access time and, depending on the speed of your parallel port, can transfer data as fast as 150K per second. Moreover, I've been using other MicroSolutions Backpack drives for many years, and they've always performed flawlessly and with a high level of port compatibility. Few

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Multicom's *National Parks of America* is an interactive CD-ROM directory of more than 230 parks.

products, if any, have worked with a greater variety of portables in my experience—and that's fairly considerable.

In addition to a headphone jack, most CD-ROM drives, including BackPack, have phono-style audio output jacks that permit any audio signals on a CD-ROM disc to be processed by a sound card. These

cards can process sound with Microsoft's *Sound System 2.0*. A \$79 software-only version of the product adds voice annotation, proofreading and other advanced capabilities to the basic utilities that manufacturers typically ship with their cards. Microsoft, which previously sold the software only in a bundle with its own sound



Multicom's *Space Adventure* is a complete video and photographic history of American manned space flight on two CD-ROMs.

board, now makes it available for any compatible card.

Software Choices

Turning to software, many of the titles on my list this year are CD-ROMs. It's really the media that best matches the future of *Windows*, and it's quite suitable for reference works and edutainment titles. In keeping with my portable theme, I'll begin with some titles that are especially appropriate to travelers—including the armchair variety.

Atlases are the thing for those wanna-be travelers who are staying home because they don't know where to go. You can tell them where to go—nicely, in keeping with the holiday spirit—by giving them DeLorme's new CD-ROM for *Windows*, *Global Explorer: The Most Detailed World Atlas Ever*. The details alluded to by the title include more than 120,000 places, 20,000 features, air-travel routes, street maps of major cities, and more.

Compton's New Media has a series of titles for the business traveler who needs to know where to stay and eat in strange cities. *New York at its Best*, *Washington D.C. at its Best*, and *Hong Kong at its Best* offer reviews of hostelrys and eateries and highlights of the city's landmarks, sights and cultures. These titles are all recorded in the Sony Multiple Operating System Technology (MOST) format that supports playback on DOS and *Windows*, as well as the Sony Multimedia CD-ROM Player (MMCD).

The *National Parks of America* CD-ROM, from Multicom is an interactive directory of information for more than 230 parks. It's comprehensive, and includes full-motion video of selected sites. The software on Multicom discs works with both MPC and Mac (*Quicktime*).

There are also new versions of the Software Toolworks Atlases, *U.S. Atlas: A Multimedia View of the United States and World Atlas*. Both are MPC CD-ROMs. The company also has *The Software Toolworks Presents . . . Oceans Below*, a multimedia SCUBA experience on CD-ROM, available for DOS, *Windows* and the Mac. It's ideal for those times between dives when you just can't get to the boat or beach or when you simply owe the dive master too many beers to show your face.

Deep River offers SCUBA and many other activities on its CD-ROM, *Adventures: A Complete Multimedia Resource for Worldwide Adventure Travel*. Its like a stocking full of locations from around the world. There's plenty of video, audio, color photos and text on both the places and the sports you can play there. There are lessons on sailing and mountain climbing and even on things like cooking and language that can come in handy while camping or traveling in foreign countries. Hang one over

the fireplace, and whoever gets it will be set for skiing even when the heat's on.

There's also a great title for those folks to whom you gave a National Geographic subscription last year. It's a combination large-format coffee-table book/CD-ROM/Photo CD from Claris called *From Alice to Ocean: Alone Across the Outback*. You'll be giving an inspiringly beautiful photographic account of author Robyn Davidson's 200-day solo walkabout across Australia, along with excerpts from her book *Tracks*. Photography is by Rick Smolan of *Day in the Life* fame. The CD-ROM includes readings by Davidson, and the Photo CD includes additional shots of her trip that aren't included in the book. Considering the cost of an ordinary book these days, it's \$50 price is quite a bargain.

Reference remains my favorite category, which is why it's the largest one here. For the students on your list, Microsoft has a hot new MPC encyclopedia to compete with those already available from Compton and Grolier. Called *Encarta*, it's based on the 1992 Funk and Wagnalls New Encyclopedia. Redmond has also released a new version of the MS *Bookshelf MPC CD-ROM*, an encyclopedic collection of five references, including a voiced version of the *American Heritage Dictionary* that pronounces each word and a version of the *Hammond World Atlas* that plays national anthems. Other references include *Roget's II Electronic Thesaurus*, the *World Almanac and Book of Facts 1993*, *Bartlett's Familiar Quotations*, the *Concise Columbia Dictionary of Quotations* and the *Concise Columbia Encyclopedia*.

Software Toolworks publishes Grolier's *The 1993 Guinness Multimedia Disc of Records*, available for MPC and the Mac. The company also offers many interesting reference titles for DOS.

Get the students on your list Bureau Development's *Twain's World*. It's an MPC compendium of Sam Clemens, including the only known 82-second clip of him on film. Incidentally, he was actually filmed by Thomas Edison, who by then had already invented home movies to annoy his neighbors.

For those do-it-yourself-ers planning to build or remodel, give Deep River's MPC CD-ROM, *Complete House: Create Your Dream Living Space*. It's both a reference and design tool that should appeal to the same folks who liked the *Build Your Own Deck* title I reviewed here recently. It's appropriate for anyone who wants to take matters into his or her own hands.

Autoworks: Key to the Mechanical Mystery, from Software Marketing Corp. (SMC), isn't a Windows title, but it's worth running in a DOS session to expose the inner mysteries of the automobile. (Although the box and documentation don't mention

Windows, it's even possible to install *Autoworks* from a DOS session.) *Autoworks* gives you the basics, done in the company's interactive graphical style. It includes several animations and supports a mouse.

With *Autoworks*, you can examine every major automotive system at any level down to its various components. The program also contains an interesting paradox, too. It's chock full of nuts, bolts and wheels. Yet, it lets you electronically crawl under the car to examine all the nuts and bolts without having to chock its wheels. To explain this conundrum, which seems to be chock-a-block with the inner mysteries of computers, you'll have to refer to the company's *Computerworks* reference, which does for the machine on your desk what *Autoworks* does for the one in your garage.

And Now the Whimsical

Tastes come predisposed to many flavors. For those who prefer still more entertainment with their doses of education, I'll move on to the whimsical. The enormous success of *Jurassic Park* seems to have had an effect on software publishers, too. Microsoft has an MPC CD-ROM called *Dinosaurs*, and SoftBooks Corp. has a diskette-based electronic book for Windows called *Jurassic Dinosaurs*. Both let you interactively explore prehistoric domains with sound and graphics. Knowledge Adventure's *Dinosaur Adventure* does the same in a Windows DOS session. And Creative Multimedia Corp. (CMC) is expected to

ship its *Dinosaur Safari* CD-ROM, for MPC or Mac.

Further choices are available for animal lovers who prefer them with some meat on their bones. Knowledge Adventure makes another Windows-compatible DOS title for the three-to-12-year-old set called *Kid's Zoo: A Baby Animal Adventure*.

If the baby animals don't overdose them with cute, you can also give kids a tour through the animal nursery at one of the worlds most-famous zoos. *The San Diego Zoo Presents . . . The Animals!: A True Multimedia Experience* features not only a behind-the-scenes tour, but it gives more than 200 mammals, birds and reptiles, in their natural habitats. This MPC CD-ROM from Software Toolworks includes more than an hour of video and has just about everything you'll find if you actually went to the zoo but the smell.

Compton's New Media offers the *Dictionary of the Living World* on an MPC CD-ROM. It's a multimedia encyclopedia of animal life that includes thousands of biological terms, hundreds of photos, full-motion video clips, sounds and maps. In all, there are 2,600 files that cover more than 5,000 species. Compton's claims it's the most-comprehensive multimedia database of the life sciences.

If there's an animal title that can challenge Compton's claim to comprehensive-ness, it's McGraw-Hill's, *The Multimedia Encyclopedia of Mammalian Biology*, which combines full-motion video and sound (from the BBC's natural-history film

Lemony Herbed Asparagus
58 calories

page 32

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You can eat your way to better health with the recipes on the *Better Homes and Gardens Healthy Cooking* CD-ROM from Muticom.

Companies Mentioned

BCC

1610 Crane Ct.
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Tel.: 408-944-9000

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Deep River Publishing

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DeLorme Mapping

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Tel.: 207-865-1234

CIRCLE NO. 149 ON FREE INFORMATION CARD

Multicom Publishing, Inc.

1100 Olive Way, Ste. 1250
Seattle, CA 98101
Tel.: 206-622-5530

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Broderbund Software

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Novato, CA 94948-6121
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Tel.: 206-822-2977

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Moraga, CA 94556
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CIRCLE NO. 152 ON FREE INFORMATION CARD

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Tel.: 602-893-2400

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Compton's New Media

722 Genevieve, Ste. M
Solana Beach, CA 92075
Tel.: 800-862-2206

CIRCLE NO. 144 ON FREE INFORMATION CARD

Knowledge Adventure

4502 Dyer St.
La Crescenta, CA 91214
Tel.: 818-542-4200

CIRCLE NO. 153 ON FREE INFORMATION CARD

Software Toolworks

60 Leveroni Ct. Novato, CA 94949
Tel.: 800-234-3088 or 415-883-3000

CIRCLE NO. 162 ON FREE INFORMATION CARD

Computer Directions

2712 W. Shaw Ave., Ste. 234
Fresno, CA 93711
Tel.: 209-435-5777

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Lifestyle Software Group

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St. Augustine, FL 32084
Tel.: 800-289-1157 or 904-825-0220

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TravelWare

2964 W. 4700 South, Ste. 201
Salt Lake City, UT 84118
Tel.: 801-965-1800

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Creative Multimedia Corp.

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Portland, OR 97209
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Virtual Reality Laboratories, Inc.

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Microsoft Corp.

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Redmond, WA 98052
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library); the text of *Grzimek's Encyclopedia of Mammals*; tons of other photos, charts and drawings; and nearly 500 maps. This is a serious \$995 reference on a CD-ROM designed for a superset of the MPC spec. It requires not just the typical 256-color SVGA, but also a Digital-Video Interactive (DVI) board for its video.

Maxis offers a title for those with more playful interests in fauna. Recipients of *SimLife: The Genetic Playground* (for MS Windows) can experiment with their own whimsical life-form designs.

For a pure entertainment that involves the mind, select *Who Killed Sam Rupert: Virtual Murder 1* from CMC. It's an interactive CD-ROM for both MPC and Mac *Quicktime* that features live-action interrogations of suspects and many opportunities to interact with the game as you solve the crime. (A second entry in the series, *The Magic Death*, has already been released but, so far, only for the Mac.) For the music lover on your list, pick out Compton's *New Media's Jazz: A Multimedia History*, an MPC CD-ROM that takes the listener on a musical journey from 1923 to 1991. It includes both historical notes and selected recordings from the likes of Yard Bird, Duke Ellington, Miles and Herbie Hancock.

The Final & Other Frontiers

Many publishers have already gone where (almost) no man has gone before in their search for signs of edutainment life in the universe. Knowledge Adventure takes you into space via *Space Adventure*. Multicom offers the "complete" video and photographic history of American manned space flight on a pair of CD-ROMs (MPC or col- or Mac). Or you can give the MPC title, *The Software Toolworks Presents...Space Shuttle*. It's a multimedia mini-history of the Shuttle program, the ships and their crews. Virtual Reality Laboratories lets you visit a desktop planetarium on its CD-ROM, *Distant Suns, Windows*.

On the lighter side, you can explore the "world's largest collection of UFO photos" with *UFO* (available on CD-ROM or diskette for *Windows*) from SMC. You can even give fonts with this theme. Bit-stream's *Li'l Bits* collection includes both the Star Trek and the Star Trek The Next Generation Font Packs in versions for both *Windows* and the Mac.

On the other hand, if your stops are filled with *Star Trek*-phobes determined to remain earthbound, you can leave *Time Treks* under their tree. The historical search game from Earthquest is solidly rooted in the past of terra firma. Or for the revisionist who prefers to render his or her own version of the Earth, you can give a copy of Pixar's *One Twenty Eight: A Collection of Photo-*

graphic Textures, and let them texture map their own photo-realistic planet one model at a time.

Health-related titles are a good choice for anyone you care about. There are many new ones, including Compton's New Media's MOST version of *The Doctors Book of Home Remedies*, SMC's *Pharm Assist: The Family Guide to Health and Medicine* and a forthcoming third edition of *The Family Doctor* (reviewed in this column in last year's *ComputerCraft*) from CMC.

HealthSoft has introduced two new *Windows*-based health titles, *The Complete Guide to Prescription and Non-Prescription Drugs* and *The HealthSoft Medical Dictionary & Family Health Guide*. *Fitness Partner*, an MPC CD-ROM from Computer Directions, not only helps you create an exercise program, but sets speed and repetitions with a full-motion digital-video instructor who leads your workout.

For those who prefer to eat their way to better health, give *Betty Crocker's Low-Fat Low-Cholesterol Cookbook: Windows Multimedia Edition* from Lifestyle Software

Group or the *Better Homes and Gardens Healthy Cooking* on an MPC- and *Quicktime*-compatible CD-ROM from Multicom. And if you know someone whose approach to health runs toward meditation, I suggest giving him or her the fractal fly-throughs in Deep River's *Fractal Ecstasy* as a pleasant way to reach a relieved state.

Finally, in keeping with the season, give the *King James Bible* on a MOST disc from Compton's New Media or the *Holy Bible Concordance: King James Version* from SMC, to the devout. (The Concordance also runs under *Windows*, and this time, it's even noted in the documentation.) From Colonnade Technologies, choose the *One-Minute Bible for Windows*—a tool for bible study that includes 366 daily inspirational readings. Colonnade also offers a personal organizer and scheduling tool, *In His Time: The Christian Information & Resource Organizer*. This tool includes a personal Bible reading plan, a prayer diary and a daily scripture.

Well, that's it for my last-minute gift-list suggestions for the 1993 holiday season. ■

Product Information

Video Card

VAL's VideoVue video image-capture card for PC/AT-compatible computers seamlessly integrates any NTSC or PAL incoming video frame into any application running under *Windows*. Using the *Windows* clipboard, VideoVue places any frame of incoming video directly into the *Windows* application in real-time, without leaving the application's window. Image sizes up to 1,024 X 768 24-bit color are supported. A provided live-video window enables you to monitor incoming video at full video frame rates in full color. Images can be frozen in the monitor window before capturing or captured with a mouse click on the fly. No internal connections are required to display the preview window. Both DOS and *Windows* are supported. \$795. *Video Associates Labs, 4926 Spicewood Springs Rd., Austin, TX 78759; tel.: 800-331-0547; fax: 512-346-9407.*

CIRCLE NO. 46 ON FREE CARD

Forms Add-In Software

FlashFORM from GDI allows users of accounting software to print forms directly onto plain paper, rather than using expensive pre-printed forms. It supports *QuickBooks, Pacioli, DacEasy, one-write plus, Peachtree, Timeslips, Cougar, BusinessWorks* and *MyInvoices*. The program comes with a library of forms that are compatible with each accounting program,

and it features a wide collection of logos that are suitable for use by many different types of businesses, including the service, travel and manufacturing industries.

FlashFORM provides you with the flexibility for creating many different company headers and also produce multi-part forms, which is perfect for service businesses, consultants and home-office users. This TSR requires only 6K of memory and works with any LaserJet-compatible printer. \$129. *Graphics Development Int'l., 20A Pimentel Ct., Ste. B, Novato, CA 94949; tel.: 415-382-6600; fax: 415-382-0742.*

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RS-232/RS-562 Transceiver

The LT1331 three-driver/five-receiver RS-232/RS-562 interface IC from Linear technology keeps only one receiver alive in shutdown mode to save power and is intended for use in 3-volt and mixed 5/3-volt systems. The IC offers $\pm 10,000$ -volt electrostatic discharge protection at the RS-232 input/output lines. When used in 3-volt-only applications, the drivers provide RS-562 levels, which are fully compatible with RS-232 equipment. \$3.80 (1,000+). Linear Technology Corp., 1630 McCarthy Blvd., Milpitas, CA 95035; tel.: 408-432-1900; fax: 408-434-0507.

CIRCLE NO. 48 ON FREE CARD



By Joe Desposito

Computing On The Go

New Products for Mobile Computing

Lately, I've been obsessing about a sub-notebook computer. When this occurs, it's a sure sign that I'm about ready to make a purchase. With this in mind, I ran a few ideas past Dr. Bob "Monty" Monteverdi, who sits in the office next to mine. Monty made a major purchase about two months ago. He decided on the NEC Ultralite Versa notebook. He had waited about four years for the technology to catch up to his imagination and then shelled out about \$5,000 for his "ultimate" system. He went for active-matrix color, a large-capacity hard disk and even shelled out for the docking station so that he could easily hook into the office network. I see him leave the office every day with a briefcase full of computer. His vision isn't mine.

Ever since the days of the old Epson HR-20, my ideal notebook was one that would run for about 50 hours on a rechargeable battery or, preferably, AA cells. I also want something that's small enough to throw in my bag—I don't want to be burdened by another briefcase. And when I throw it, I don't want to worry about the reliability of any mechanical parts. I really want a hand-held but, hey, let's be realistic. Oh, one other thing. When I'm ready to purchase, I don't ever think about \$5,000. I'm more of a \$1,000 to \$2,000 guy. So I know I'll have to make compromises.

I've begun looking seriously for something that will satisfy my vision. The first unit that caught my eye was The HandBook 486 from Gateway 2000. It has a list price of \$1,495, which is good. It also weighs 2.9 pounds, which is another good point. The screen bothers me, though. It's monochrome and just 7.9". I wonder if I can really run *Windows* applications, like *Page-Maker*, on such a small screen.

Naturally, I'm looking for a PCMCIA slot, which most sub-notebooks have, including The HandBook 486. Being that I can see that this is the technology of the future, I want to get on board now. I look at my desktop and see one empty bay. I envision a PCMCIA "drive" in that bay. This way, I take the card out of my "sub" and insert it in the desktop drive. I don't ever have to use Laplink again to transfer files, and I don't need a 3 1/2" floppy rive hanging off my sub-notebook.

I present my choice to Monty, who doesn't like it at all. "Too many compromises," he says. He talks about the cost of the HandBook, cost of the PCMCIA drive, drawbacks of a monochrome screen, and so on and so on. Finally he says something that really strikes me. "Why do you need your desktop?" I realize that I've been thinking about a kind of satellite system, a floating addition to my desktop. Monty threw away his desktop (or maybe passed it on to a needy person in the office). I haven't seen it lately. He types at the Versa keyboard, looks at the Versa screen, doesn't need a PCMCIA drive or Laplink. He has only one computer that does it all for him, at the office, on the road and at home. After he made his comment, I had to stop and think. "Am I ready for this?" I don't think so. I don't think I'm ready to give up my desktop PC, but I don't know exactly why.

Monty also warned me that The HandBook 486 has

just a Type II PCMCIA slot. His Versa has a type III slot, which can fit one of those new PCMCIA miniature hard drives on a card. But I don't even care. I think the future is flash memory, which is a type of PCMCIA card that can certainly fit in a Type II slot. Monty also warned me that the \$1,495 HandBook model has a 486SX processor, which isn't a true 486 and isn't a low-power chip. He's right, but I know I have to make some compromises.

I have some thinking to do. Should I spend a little more money to gain a little more functionality? Pretty soon I'll be up over the \$2,000 mark and still making compromises. Wouldn't it be nice to be able to go out and spend \$5,000? While I'm thinking, I'll update you on some of the new mobile computing products that have come across my desk recently.

486SLC-Based 500M Notebook Computer

Identity Systems Technology's 486SLC-based notebook computer features a 500M Maxtor hard drive with an access speed of 8 ms. Weighing less than 7 lb., the Identity 486SLC/33 notebook computer comes with 4M of RAM, MS-DOS 5.0, *Windows* 3.1, and *MS Works*. Alternate configurations incorporate 213M, 245M and 345M Maxtor hard disks with access speeds as low as 14 ms and 1M or 8M of RAM memory.

Other features of the 11" x 8.5" x 2.1" unit include the Cyrix 486SLC/33 MHz microprocessor; rechargeable Ni-Cd battery that supports up to 2 hours of operation; an adapter for ac operation; a built-in 3 1/2" 1.44M high-density floppy-disk drive; an 8 1/2" super-twist back-lit LCD VGA display; an external color VGA video port; a full-size 80-key keyboard with inverted-T cursor controls; an external keyboard port; and two nine-pin serial and one parallel ports.

New Protocol Analyzer

Telebyte Technology's Model 904 PC Notebook Comscope Protocol Analyzer offers small size and battery operation that make the it a suitable companion for a notebook computer when you're field-testing data communications circuits. It offers a high-performance data-line monitor and emulator in a 7"W x 5.5"D x 1.5"H configuration that supports all PCs. The unit can monitor and emulate data lines to 64K bps on a full-duplex basis (for 386DX or faster machines).

This protocol analyzer uses a PC's COM port as the communication link between the analyzer's microprocessor and the PC's resources. Operation of the unit is under control of a program running on the PC.

The Model 904 supports most WAN protocols, including asynchronous and synchronous protocols like BiSync and IPARS and bit-oriented protocols like HDLC, SNA and X.25. The Model 904 captures the whole picture: data, control leads, time stamps and error conditions. This enables you to perform extensive post-capture analysis of data, even at a different loca-

tion. You can trap or search for any combination of data-line events—not just data strings. The trapping capability lets you review live data or search through captured data. A trap sequence may consist of data character(s), break, parity, error, synchronization, end-of-frame (good, bad or aborted) and control-lead changes. The Model 904 opens a “window on the wire” to let you know exactly what’s happening in the data circuits.

In addition to monitoring, the Model 904 includes a full repertoire of emulation capabilities. Under control of a menu-driven program on your PC, you can select many combinations of communication options to emulate X.25, HDLC, Async and BiSync. Split-screen decode of X.25 and HDLC is a standard feature. A built-in BERT (bit error-rate test) tester offers a choice of test patterns and modes of operation.

When data is captured, it can be saved as a DOS file on disk for later viewing, analysis and printing via the PC’s parallel port. The versatility of the Model 904 is increased by the included Protocol Emulator Program Interface (PEPI). With PEPI, you can select Telebyte off-the-shelf test analysis programs or write your own.

In the field, the Model 904 is designed to run for two hours on a new standard 9-volt battery. For lab use, it comes with an ac adapter for continuous operation.

Notebook/Palmtop Fax-Modems

Memory-card maker Smart Modular Technologies, Inc. has a full line of PCMCIA-based fax modems. Key features of these new fax-modem cards include a battery-saving ultra-low-power sleep mode, use of flash memory to upgrade the modem’s operating program code on-line and built-in DAA line interface circuits. Operating power is typically only 50 mA, while sleep mode consumes less than 2 mA.

In standby mode, power is removed from most of the card’s internal circuitry. This mode is entered when no activity has been detected for a user-programmable period of time and is exited when a read, write or ring signal is detected. Sleep mode permits the host computer to, in essence, completely turn off the modem’s power. This mode is entered and exited on command through the PCMCIA interface, under control of the host computer. When sleep mode is terminated, the modem’s earlier status is automatically restored.

The SmartExchange 1414 fax-modem provides complete data and facsimile capabilities, error correction and data compression in credit-card-size PCMCIA format. The card also offers auto-dial and auto-answer capabilities and fallback capability for compatibility with slower modems. It

also offers full-duplex data communication at 14,400 bits per second and facsimile transmission and reception at a rate of 14,400 bps.

Through full compliance with the V.42 and V.42 bis CCITT standards, the SmartExchange 1414 permits data compression by as much as 4:1. This means that throughput of data can be as great as 57.6K bps.

Users can connect the SmartExchange 1414 to a telephone line with a one-piece cable that comes with the card. Telephone-line interface DAA (data access arrangement) circuitry is built-in. The SmartExchange 9624 and 9624E fax-modems are communication devices that provide complete data and facsimile capabilities in credit-card-size PCMCIA format. Both cards offer full-duplex data communication at 2,400 bps and auto-dial, auto-answer and fallback capabilities for compatibility with slower modems.

The SmartExchange 9624 has a facsimile send rate of 9,600 bps and a receive rate of 4,800 bps. MNP and V.42 error correction and data compression are accomplished through software.

The “E” version has built-in high-level error correction and data compression. It sends and receives facsimile data at the industry standard rate of 9,600 bps. It fully complies with the V.42 and V.42 bis CCITT standards, permitting data compression by as much as 4:1, which means that throughput of data can be as great as 9,600 bps.

The SmartExchange 9624 and 9624E offer both “standby” and “sleep” power-down modes for conserving power and extending battery life when the modems aren’t in use. Both cards have a built-in DAAs and come with a cables for connection to the telephone line.

Portable-Computer Monitor Tester

Computer & Monitor Maintenance, Inc. has two new additions to its Checker family of portable computer-monitor test equipment. Both the Checker II and Checker VI, like the original Checker, can test a variety of monitors without the need for a computer or other hardware.

The Checker is a small (5" x 3" x 1") battery or ac-operated color pattern generator. It can quickly test CGA, EGA and VGA monitors. You simply connect the Checker to the monitor and select the monitor type with a front-panel switch. If the monitor is functioning properly, a color pattern is displayed on the screen. No additional equipment is required.

Checker II provides the same ease and convenience for testing monochrome monitors. The small (2" x 3" x 1") battery-operated Checker II generates all of the signals necessary to display a 43 x 24 crosshatch

Products Mentioned

Checker, \$229.95; Checker II, \$99.95; Checker VI, \$349.95

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pattern on monochrome monitors.

Checker VI is a stand-alone color pattern generator for testing up to six VGA monitors simultaneously. This 6" x 5" x 1" unit completely eliminates the need for computers to assist in monitor burn-in. It permits long-term testing of monitors and final setting of size, focus, color balance and convergence.

2 1/2" Hard Drive

Toshiba America Information Systems' MK-1624FCV is a 1/2"-high, 2 1/2" hard drive with a 213M storage capacity. Its form factor makes it suitable for slim-line notebook, sub-notebook and portable computers while still providing the high performance required of these systems.

The new MK-1624FCV offers a fast 13-ms average seek time, an internal data-transfer rate of up to 31M bits/s, a 4,000-rpm spin speed and a 128K segmented cache buffer. In addition to its high performance, the new drive meets the demanding size, weight and power requirements of the portable computer.

Using a two-platter design, the drive weighs just 5.6 ounces, consumes an average of a mere 1 watt of power from a single 5-volt supply and spins up to operational speed in a fast 4 seconds. The drive features an embedded IBM PC/AT interface.

PCMCIA-Based Global Positioning System

A Global Positioning System (GPS) from Socket Communications, Inc. and Trimble Navigation (Sunnyvale, CA) is designed to attach to mobile computers via the PCMCIA interface. A Mobile GPS Developer's Toolkit allows application developers to add GPS functionality to their programs via the PCMCIA interface. An end-user version permits the Trimble/Socket hardware to be integrated with a third party's software. After writing an application with the Developer's Toolkit, OEMs and integrators could purchase the end-user unit to be bundled with their own software, thus providing a complete solution for their customers.

The Mobile GPS kit includes a six-channel GPS receiver and antenna, PCMCIA Type II interface card, developer's manual, C-source code software for operation in the DOS environment and a developer's demo diskette. The end-user version includes a user's manual and an end-user demo disk.

Applications for GPS, a satellite-based location system, include personal navigation systems, real-estate appraisals and sales, insurance claims adjustment, inventory control, public safety, market-location analysis, consumer guides, emergency disaster response and an array of government uses.

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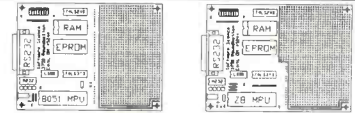
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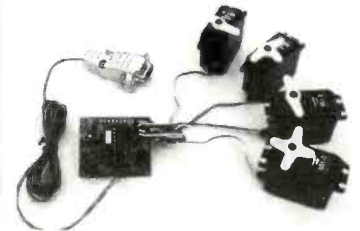
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MicroComputer JOURNAL

Industry Watch (from page 93)

some applications up to 30 times faster than a 486 PC. It's likely the software will need to be modified to achieve this level of performance on the new chip. If the majority of software vendors are willing to make these modifications, the new IBM and Apple systems may be a big hit.

Apple Computer has delayed the planned introduction of its PowerPC-based computer. It had hoped to announce the new system in January, which is the tenth anniversary of the Macintosh. However, limited supplies of the new CPU chip have forced a postponement until March. One advantage of the postponement may be a faster computer. Currently, the 66-MHz version of the chip is the most powerful. By March, an 80-MHz version may be available.

Apple Computer is replacing its 25-MHz PowerBook 160 with the new 33-MHz PowerBook 165. A little over a year ago, a 33-MHz 68030 CPU was considered one of the fastest in the Macintosh lineup. Soon, it may be the slowest Apple offers.

This "need for speed" may soon be put to good use with new extensions to the Macintosh operating system. One extension will allow for voice-independent speech recognition. Previous speech-recognition systems were voice-dependent, requiring the speaker to train the system for each voice. The other extension, called PlainTalk, provides text-to-speech conversion. While text-to-speech isn't new, past incarnations were slow and erratic. Voices didn't sound natural. The new system provides extremely smooth speech, with both male and female voices available.

No other computer peripheral has held its value in the used-equipment marketplace better than the color video monitor, especially the large 17" to 20" models. The supply in the used market is slim because most people keep these monitors when they upgrade to new computers. The demand is increasing as many people realize the productivity gains possible when using *Windows* applications with larger screens. Some users have a problem with the size and weight of the largest screens. These problems may soon be solved with new active-matrix color screens. These are the same screens used in color notebook computers. Prices have fallen to the point where active-matrix screens are becoming feasible as large, thin desktop screens. ■

Based Timer (from page 89)

desired, mount the Time Master circuit-board assembly inside it, using 1/2" spacers and machine hardware. This done, you're ready to put the project into service.

Using It

There are only four basic commands involved in operating Time Master. These are: SET TIME, LOAD TIMING PROGRAM, MANUAL CONTROL, and RESET. Let's look at each of these in turn:

• **SET TIME.** You're prompted for a day and time. Day 1 is Sunday, day 2 is Monday and so on to day 7 on Saturday. Time is in 24-hour format, such that 6:08 P.M. is displayed as 18:08 in 24-hour format.

• **LOAD TIMING PROGRAM.** This option allows you to load time, day and switch on/off data manually or to load a pre-defined timing program created by using the TIMEPROG program. TIMEPROG is another Quick Basic program that's run independently of the terminal program. It prompts for the entry number (1 through 42), the switch number (1 through 8), day (0 through 7, with 0 being every day) and on and off times. Time Master's minimum cycle time is 1 minute. When valid data is entered, TIMEPROG will prompt again to continue or end the program. If you enter TIMEPROG and decide not to change or enter data, pressing the Ctrl-Break key combination will end the program and return you to DOS.

The TIMEVIEW program, which also is an independent program, allows you to view data stored in the file created by TIMEPROG.

• **MANUAL CONTROL/RESET.** Use this function to override the timing program that's loaded into EEPROM. You're instructed on-screen as to what to enter (0 or 1) to disable or activate any of the eight switch outputs. Manual mode disables the 60-second update cycle and is cleared by selecting the RESET command. Normal time-keeping isn't affected.

Summing Up

Time Master is a multipurpose tool. One is currently being used to control irrigation pumps in a vineyard. Another one is being used to control a home's outside and inside lighting. These are just two of an unlimited number of applications for this very versatile controller project. Refer to Fig.5 for circuit details on interfacing Time Master to devices to be controlled. ■

Ted Needleman (from page 99)

Collage Complete is very easy to use. In the DOS version, you just start up the software and specify which directory you want to use to save the images and in what format. *Collage* supports all popular graphics file formats. By using the proper slash commands, you can minimize the amount of RAM *Collage* takes up while it's waiting to grab a screen.

The *Windows* version operates similarly, but there are more choices to make, including whether you want to capture the whole screen, the active *Window* or a cropped area. There's even a count-down timer; so you can capture pull-down menus.

The *Windows* version of *Collage Complete* goes way beyond screen capture, though. Once you've grabbed a screen, you can crop it, edit it and/or convert it into a different graphic format. Then you can use *Collage's* Catalog capabilities to create groups of graphics into "catalogs". Each "catalog" can be viewed in thumbnail format, and you can easily move images from one catalog to another. Finally, *Collage* lets you create DOS slide shows, letting you display selected graphics in whatever order you specify.

Collage Complete isn't as inexpensive as some of the other screen grabbers I've seen and used. But considering all the functionality it offers, if you do much work with graphic screens and files, its \$199 retail price isn't unreasonable. I probably won't ever completely give up whatever other utilities I now use, but *Collage Complete* is very rapidly assuming the position of top dog when I need one of the many features it offers. ■

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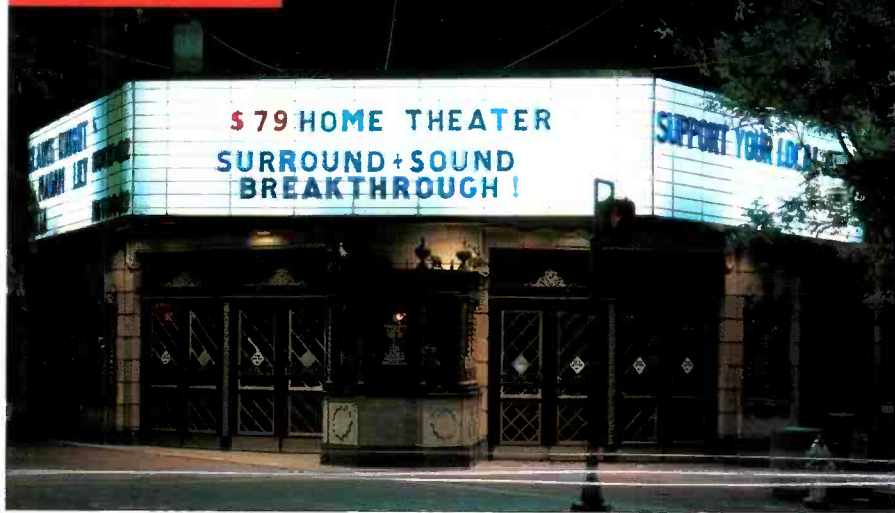
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How to get surround sound without buying the theater...

An amazing new surround sound decoder turns your existing stereo system into a multi-channel home theater.

By Charles Anton

As much as I love renting videos, it's just not the same as seeing a movie in a theater. I remember the first time I saw *Top Gun*. I nearly jumped out of my seat when the planes flew overhead. One of the reasons movies seem so real is because surround sound makes it seem like you're actually there. Now there's an incredible new device that lets you use a stereo receiver to get that same surround sound in your home.

It takes more than just four speakers to get surround sound; there needs to be some way of separating the signals. The new Chase Technologies HTS-1 decoder does just that, and in a revolutionary way that rivals the best Dolby Pro-Logic and THX systems available.

Wins over critics. Gary Reber, editor and publisher of the most authoritative magazine on home theater systems, *Wide-screen Review*, stated, "...passive matrix decoders such as the new Chase HTS-1 work great as Dolby Surround™ extractors, and sound exceptionally natural when used for motion picture soundtracks and music."

Passive circuit. In 1972, legendary audio pioneer David Hafler invented a passive circuit to extract the "L minus R" difference signals in

stereo soundtracks. Because the circuit was patented, it was only available on expensive Hafler products. Now that the patent has expired, Chase can make this amazing decoding system available at a fraction of the cost!

Breakthrough technology. The HTS-1 is able to decode the Dolby Surround™ signal in a videotape or laserdisc because the spatial and depth cues have been matrixed into the "L minus R" portion of the two-channel stereo soundtrack. By decoding passively, the HTS-1 avoids costly and noisy signal processing. Plus you don't need any additional amps! Just connect the HTS-1 to your existing stereo system, add two speakers for the rear, and you'll experience the magic of home theater at a fraction of the cost of other systems.

Concert sound. The HTS-1 also decodes the ambience found in all music recordings. This sense of space, or "concert hall acoustics," is present in all CDs and cassettes, especially live recordings. John Sunier, the leading authority on surround sound and producer of *Audiophile Audition*, a nationally syndicated radio program for audio enthusiasts, says, "...the new Chase HTS-1, when used



Surround sound/home theater has become the rage of the 90's because it adds depth and realism to stereo sound, giving you the home theater experience. It makes you feel like you're actually at a concert or movie theater. To "fill a room" with surround sound, you need more than two channels. That's the beauty of the HTS-1; it provides four channels of sound from any two-channel stereo source.

Free center channel. By connecting your VCR or laserdisc player to your TV, you get sound from your TV speaker; this acts as the fifth or "center channel." Adjusting your TV's volume gives you as much or as little "center channel" localization as you desire, without extra speakers or amps. There are also no extra costs with the "fifth" channel. When used with the HTS-1, you'll have a true state-of-the-art five-channel system.



Passive. The HTS-1 is passive, meaning it requires no AC current. It actually sounds better than active decoders, producing more clarity, more detail, no noise, a greater sense of space and zero distortion. This superior system is a breakthrough unique to Chase.



Active. All Dolby Pro-Logic decoders (even the built-in units) are active, meaning they decode and amplify the signal electronically. This can induce noise and distortion, hindering the home theater experience. This is an example where "more is less." Spending thousands of dollars on an active system will not give you the performance of the HTS-1 decoder. Try it for yourself.

to decode the hidden ambience in all musical recordings, definitely outperforms all the Dolby and THX processors which could cost you up to \$3,000... I am impressed!"



The HTS-1 decoder makes your movies come to life, bringing the theater experience home.

Easy installation. Hooking up the HTS-1 is easy. Simply connect the speaker outputs of your receiver or amp to the HTS-1, then connect speaker wire to the front and rear speakers. The rear channel speakers don't have to be big. In fact, we recommend the Chase ELF-1 in either black or white finish to match your decor. They can be mounted with enclosed color-matched mounting brackets or can be flush mounted on the wall. They are also water and weather-proof, so they can be used indoors or out.



The ELF-1 rear channel speakers integrate perfectly with the HTS-1.

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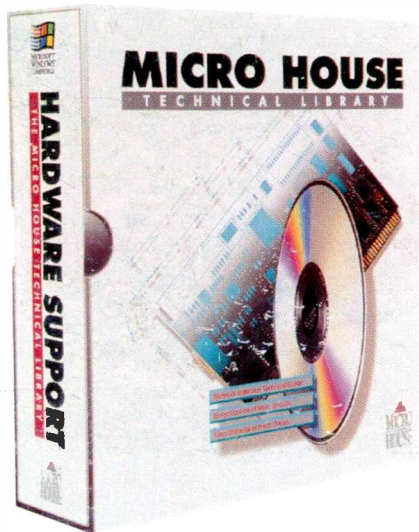
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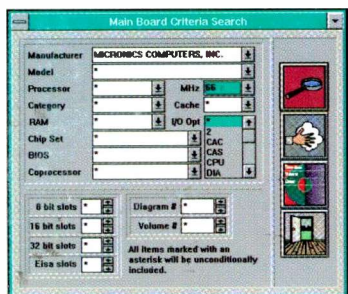
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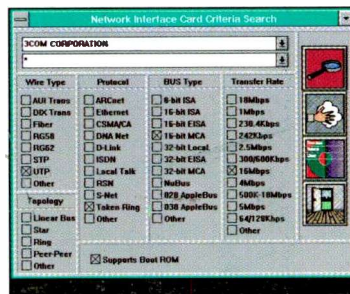
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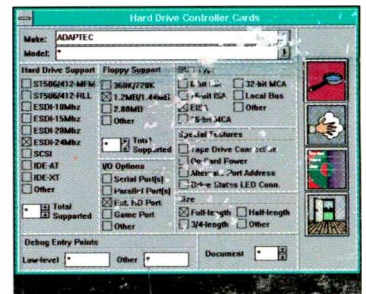
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