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ComputerCraft

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ON THE COVER: It takes technical savvy to restore to service a PC that isn't operating properly, but you can get hardware and software products that can make your life easier at the workbench. Here, a technician uses one of several diagnostic boards for running tests on a dead PC. If a PC isn't dead but isn't operating properly, a software product like those reviewed in the Special Report on Coping With PC Problems beginning on page 54 of this issue may be what you need.

Cover photo by Lorinda Sullivan

Under the Cover

It has always been difficult to judge the quality of a personal computer before you plunk down your money. After all, no self-respecting dealer will let you rip apart any of the computers he's selling for you to see what's inside the case. Moreover, buying through mail-order sources, which is commonplace, precludes this possibility, anyway.

So you purchase the computer without a speck of knowledge about the caliber of its parts and construction. Moreover, it's unlikely that you'll examine the insides of the product after you buy it, unless you open its case to add a plug-in board or to troubleshoot a hardware problem. This is easy enough to do if your model is a desktop unit. But if it's a laptop or notebook model, you'll find that just disconnecting things to get a good peek at its innards is challenging. Besides, knowing how good or poor the guts of a machine is after you've bought it is just an academic exercise.

Most of us depend on the reputations of the maker and the seller, assisted at times by the experiences of business and personal friends, to make some sort of judgment about a model's quality. But even this dependency can be deceiving because quality can change radically from one year to the next. At this moment in time, for example, computer prices are dropping, and price competition breeds shortcuts of one sort or another.

This is particularly true when a popular product type was priced rather high and has a way to go in the price-cutting wars. Notebook computers fit this description rather well today. Their internal parts sometimes change radically during production runs of the same model! You're really dependent on the care and inquisitiveness of the reseller here, who will, hopefully, take apart a machine from time to time to inspect it.

Should you inspect the insides of your computer, you would still have a tough time determining the quality of its parts. How would you know how good the quality of a part is that's made by the XYZ company, anyway? Let's face it, Taiwan alone has over 2,000 companies producing computer products. Furthermore, many parts are made expressly for a manufacturer, who uses a variety of OEM sources. Is a Sony floppy drive better than a Panasonic or a Mitsumi drive? Is a Keytronics keyboard better than a Silitek from Taiwan? Bare printed-circuit boards are often made in one place—Mexico, Taiwan or wherever—and just as often are completed by another company, perhaps in the U.S. by a contract manufacturer.

You're really relegated to doing the best you can by carefully examining the outside of the machine you hope to buy. Admittedly, this is limited. But you might look more closely at, say, a portable's LCD display than you normally would. Many don't incorporate a plastic protective plate over the screen's display panel. Those that do have them, be aware that they come in different thicknesses, the thicker ones being more costly. Press press the cover plate with your finger to see if it easily dimples.

Check out the compatibility of dual floppy drives to see if one can read what the other wrote and that the drives can distinguish between low- and high-density formatting. How quiet or noisy are the drives? Take along a diagnostic disk to check a hard drive's average access time, and be sure to ask about the name of the hard drive. Do spend some time entering matter on the keyboard to make sure that you find it to be comfortable to use. Key travel, click, finger spacing, "feel," etc., are attributes to consider.

Feel the case for hot spots; the cooler, the better, of course. How durable does the case seem. This is an extremely important consideration for portables since they're typically banged about. Look closely at the display screen's hinges, which will be opened and closed many thousands of times. Make sure that the case surrounding the display screen is thick and solid.

I hear, too, that there are shortcuts being taken with controls. Some have limited range. So also check range and transition smoothness.

Since you couldn't hope to make a good determination of the quality of the parts inside a computer due to so many different, unfamiliar sources being used, you have to base your buying judgments on many other considerations, mixed with a good sprinkling of earned trust. Good hunting.

Art Salsberg

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Keep Those Articles Coming

• I have very much enjoyed reading the articles by Jan Axelson that have appeared in *ComputerCraft*. I especially enjoyed the article in the November 1992 issue, "Special Report on Microcontroller Boards." My experience so far has been in building interface boards and circuits to control stepper motors and receive data from inputs, using an IBM-compatible XT. Programming is done on a different computer, and executable files run on the XT-compatible. However, after reading the November article and several others, I would like to try a microcontroller board. I hope you intend to keep publishing articles on this topic.

Larry Frank
Crown Point, IN

Filling in the Gap

• I have several reasons for wanting to send you this note. Firstly, I want to commend you on the quality of *ComputerCraft*. It is very informative and well-written. It covers the type of information on microcontrollers the electronics hobbyist and even electronics professional is hungry to find. I have been a satisfied subscriber since the inception of *ComputerCraft*.

Secondly, I want to commend Jan Axelson on the quality of her articles. I enjoy them very much and have benefited from them. I place a very high value on clarity, and her articles are very well organized and clear. She presents the *details* that someone would need to know how to implement the applications presented, not just the generalities that could be gotten by reviewing spec sheets and other literature. It is obvious that she has "been there."

Finally, as I was reading the December 1992 article on Interfacing Digital Logic, I found that there were some words (or maybe sentences/paragraphs) that were dropped between the end of the last column on page 45 and the beginning of the first column on page 46. As I am very interested in the 74HCTxx family of logic devices, I would very much like to know what was left out.

James H. Love
Baton Rouge, LA

Nothing is missing from the article. During page make-up pages 44 and 45 were accidentally transposed. What's shown as page 44 is really page 45 and vice-versa. Sorry for the mix-up.—Ed.

A Good Place to Look

• I always buy *ComputerCraft* when you publish some interesting article relating to PCs. One such article was about 386 and 486 upgrades that appeared in the December 1992 issue. Since most magazines related to PCs generally talk about (mostly around) it without going into any depth, I *ComputerCraft* is more qualified to look "under the hood." Therefore, I would like to make a couple of suggestions. Since you started with the processor, why don't you publish articles about mother boards and their construction, how the BIOS and chipset work, how the memory-addressing design relates to shadowing, etc.? I am a software designer in the PC area and have some hardware experience as well. You would be surprised to learn how many people out here are looking for answers to important questions in all these areas, especially people who are responsible for purchasing large quantities of PCs and have to rely on advertisement-files publications. *ComputerCraft* exhibits practical engineering approaches in its articles that are missing in other magazines.

Bill Silagi
Des Plaines, IL

Universal Scuzzy. Future Domain Corp. (Irvine, CA) introduced its "SCSIworks," a universal application interface for the Small Computer System Interface. It's said to allow software drivers written to any SCSI software interface to be used with any Future Domain host adapter, and it's included free with the company's host adapter kit. Moreover, it can be downloaded from Future Domain's BBS at no charge. The software for DOS and Windows contains a utility to install any interfaces you need and is claimed to be faster than them. It can be loaded into high memory, too, and takes as little as 2K of memory for Adaptec's ASPI under DOS.

WordStar Strengthens Support. WordStar International has new options for users to receive technical support for its expanding product line. Users can now obtain technical and marketing information on products with a Fax on Demand service. This includes technical notes, tips and tricks, answers to specific technical problems, diagnostic information, etc., by dialing 812-335-0567 from a fax machine or from a regular phone when a fax destination is noted. Other user support includes a company BBS 812-334-0208 and a WordStar forum on CompuServe that can be uploaded.

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The Leading Chip Seller. Intel Corp. became the leading chip seller in 1992, beating out foreign competition from such giants as NEC and Toshiba. Its net income exceeded $1-billion, with the 486 microprocessor being its centerpiece. As a result, Intel's stock price more than doubled this past half year. In contrast, IBM Corp. suffered the worst financial loss in its history with a staggering $5-billion for '92. This exceeds General Motors' $4.5- billion loss in '91. Nowadays, big isn't necessarily beautiful.

Make It Faster. MakeFast from TDRMSoft (New York, NY) is a new software product that automatically configures MSDOS to make application software as fast as possible. It searches your hard disk to determine what software you use and then customizes your system to make the best use of your hardware. All findings are presented to you for verification, allowing acceptance of choices or user modification. $29.95 plus $5 S&H. Call 212-865- 2719.

SYSOP Guide. Buffalo Bayou Productions, Tioga, LA, has published a CD-ROM called "Sysop In A Box!" It gives you pointers on starting a bulletin-board service by using three highly ranked BBS software packages: the Shareware version of the Spitfire BBS system, the test drive version of Wildcat! and the demonstration version of PCBoard. In 6,000 of the latest Shareware and Public Domain files that have been virus checked and placed into appropriate subdirectories. Each contains necessary description files for the BBS programs. For more info, call 318-443-3116. To see the disk on-line, call 318-449-4824 and log in Demo BBS and the password, Disc 1.

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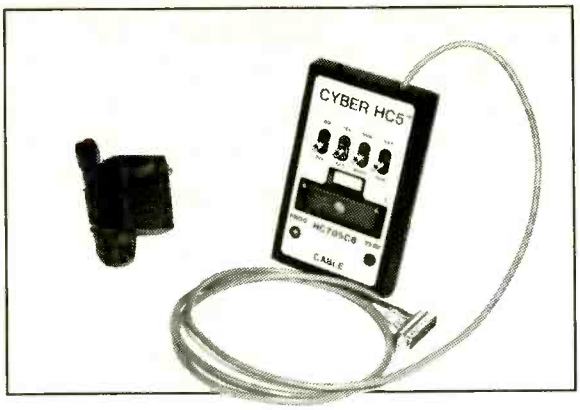

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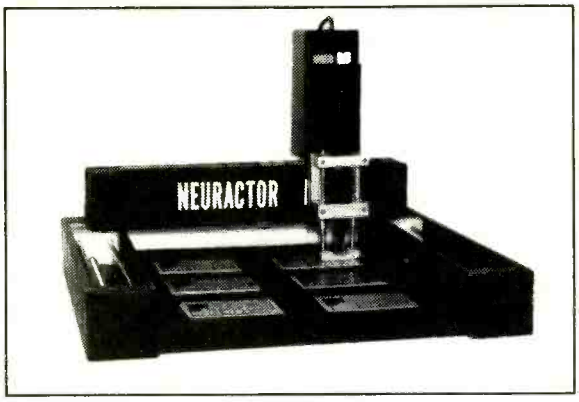

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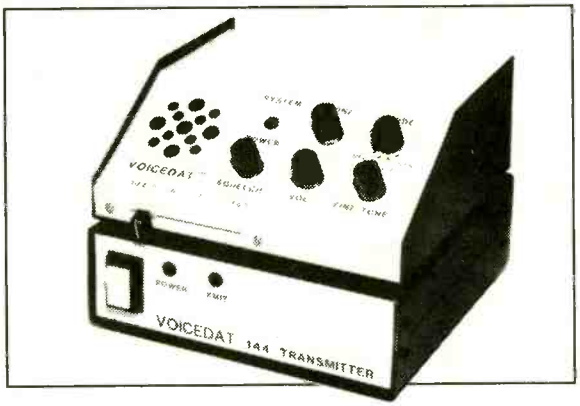

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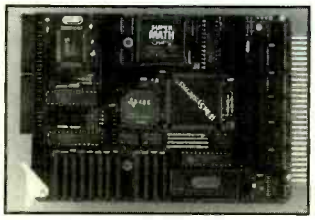
CIRCLE NO. 141 ON FREE INFORMATION CARD

486 SBC

Winsystems' MCM-486SLC is an AT/compatible system on a 4.5" × 6.5" board and features the Cyrix Cx486SLC CPU. Offered with a 25- or 33-MHz CPU, the board supports up to 4M of RAM. An on-board 32-pin EPROM socket supports



the BIOS and extensions plus up to a 440K bootable ROM Disk. It supports the basic AT peripheral complement including the keyboard controller, 16 channel interrupt controller, real-time clock, three counters/timers, DMA controllers, speaker port and a precision power-fail reset circuit and watchdog timer. Additionally, it features two serial channels that are configurable as RS-232, RS-422 or RS-385, parallel port, controller for two floppy drives and an IDE interface and a keyboard controller. An on-board socket supports a user-installable coprocessor for mathematics-intensive applications. $995. *WinSystems, Inc., 715 Stadium Dr., Arlington, TX 76011; tel.: 817-274-7553.*

CIRCLE NO. 1 ON FREE CARD

PC TV Tuner

AVer TV Tuner from Adda is a TV tuner on a PC expansion card that can be used with the AVer 2000 Video Window Controller to give "TV in a window" on a VGA monitor. The card can also act as a computer-controlled tuner for external video devices. It comes with built-in stereo audio that can be configured to drive speakers with or without internal amplifiers. AVer TV Tuner comes with drivers and software for *Windows* and DOS and can be used in both PAL and NTSC formats. $125. *Adda Technologies, 168-13982 Cambie Rd., Richmond, BC., Canada V6V 2K2; tel.: 604-278-3224; fax: 604-278-2909.*

CIRCLE NO. 2 ON FREE CARD

LAN Tester

Beckman's LANTech LT-10 is a hand-held LAN physical-layer tester designed for certifying all UTP and STP twisted-pair, coaxial and telephone-style wiring, 10BASE-T, Ethernet, ArcNet and Token Ring networks. LT-10 is simple to operate for LAN technicians of any level, providing one-button access to commonly used test functions. In autotest mode, a single keystroke starts an all-in-one comprehensive series of tests that complete in less than 30 seconds. You can store test results internally, download them to a portable PC or output

them to an optional portable printer. Length, connectivity, attenuation, near-end crosstalk, capacitance, noise and loop resistance are quickly measured for one-, two-, three- and four-pair shielded or unshielded twisted pair wiring systems.

Also from Beckman are two new instruments that are the first models in a new generation of four-digit professional-grade digital multimeters. Features include: true rms switchable (ac or ac+dc), 2-MHz frequency counter, capacitance measurement to 2,000 µF, extra-large display, 10,000-count resolution, autoranging relative mode and record mode, auto min./max./avg., automatic reading hold, probe hold, 1-ms peak hold, fault finder (intermittent detector), 50-ns pulse detector, resistance resolution to 0.01 ohm, overload alert and incorrect input alert. $249/$279. *Beckman Int'l., Instrumentation Product Div., 3883 Ruffin Rd., San Diego 92123-1898; tel.: 619-495- 3200; fax: 619-268-0172.*

CIRCLE NO. 3 ON FREE CARD

Multimedia Creations

By Philip Shaddock

(The Waite Group. Soft cover. 430 pages. Includes two 1.2M disks. $44.95.)

This is a hands-on, down-in-the-trenches tutorial that introduces the reader to the world of multimedia presentations. Two accompanying disks contain an interpreter version of GRASP, Paul Mace's graphics programming language. A coupon in the back of the book offers the commercial version at a substantial discount.

GRASP is used throughout the volume to create examples and projects that illustrate the basic principles of designing multimedia presentations. However, this isn't a book for programmers. Programming is introduced in easy-to-understand modules that are put together to form complete programs. So even someone who has no background in programming should be able to work through the book successfully.

Chapter 1 presents an overview of the elements in multimedia and steps involved in developing a multimedia production. Chapter 2 then moves into a description of GRASP's digital studio. Chapter 3 teaches how to crate a software slide projector capable of sequencing images and ultimately, by the end of the book, adding sound and animation.

In Chapter 4, you create an interactive software magazine with an animated introduction. Chapter 5 lays bare the inner workings of a 3-minute demo that includes animation and music. There's also a tutorial on using the GRASP editor to incorporate images and animation from other programs.

Sound is the focus of Chapter 6, with emphasis on sound cards and MIDI interfaces. Chapter 7 shows how to build a music cueing application in GRASP. Chapter 8 discusses more-elaborate programming techniques. Chapter 9 includes a complete menuing system you can shape into a complex interactive information system.

To gain the full benefit of this book, you should be ready to work through the examples, rather than simply read text. It's easy and fun and can be done on nothing more elaborate than a 286-based PC without a sound card (you will need a sound card for some of the examples in Chapters 6 and 7). If you're intrigued by multimedia and like to "get your hands dirty," this book is for you.

Closed-Caption Decoder

The International Computers' Closed Caption Decoder is an IBM/compatible plug-in board/software package that's capable of acquiring closed-caption information from a standard TV signal and displaying it on a computer screen. You can save captions to a file and print them. CCD supports the latest captioning standards and is capable of receiving all caption channels, including those devoted to sports, stock prices and weather. Installation is straightforward via an automatic install program, and the board requires no jumpers or DIP switches to be set. $89. *International Computers, 12021 W. Bluemound Rd., Wauwatosa, WI 53226; tel.: 414-764-9000; fax: 414-281-3522.*

CIRCLE NO. 4 ON FREE CARD

Math Coprocessors

50/50 Electronics has a new line of math coprocessors packaged in colorful see-through blister-type packages that are ideal for store shelves. The new coprocessors can be used in some 286 and all 386 personal computers. Five models are available for 386-DX models, ranging in speed from 16 MHz to 40 MHz; four, for the 386-SX, ranging from 16 MHz to 33 MHz. *50/50 Micro Electronics, 550 Lakeside Dr., Sunnyvale, CA 94089; tel.: 408-730-5050; fax: 408-732-5050.*

CIRCLE NO. 5 ON FREE CARD

VESA Local-Bus PC

Micro Express' ME 486-VL is a VESA-standard local-bus PC contains two VESA slots, one for a graphics processor and the other for a Bus Master disk-drive controller. This makes it ideal for a graphics workstation and demanding *Windows* applications. This computer uses a newly designed motherboard

that contains most of the circuitry on a single VLSI chip, and it has six additional 16-bit full-size expansion slots. Available with a 486DX/33, 486DX/50 or 486DX/66, it's configured with 4M of RAM (and can be expanded to a maximum of 32M), 256K of RAM cache (1M maximum), 200M hard drive, 3½" and 5¼" floppies, SVGA color local-bus graphics card and monitor, mouse, DOS 5.0 and *Windows* 3.1.

The three models feature AMI BIOS, CMOS clock/calendar, diagnostics and one parallel, one game and two serial ports. A Micro Express FM-360 14" SVGA monitor with 0.28-mm dot pitch and 1,024 * 768-pixel resolution. A 101-key keyboard is standard, but a programmable keyboard can be substituted for an extra $75. From $2,155. *Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; tel.: 800-989-9900.*

CIRCLE NO. 6 ON FREE CARD

Hard-Disk Upgrade For Notebooks

Laptop Solutions has a new 212M hard-drive upgrade that fits all Toshiba notebooks from the 1200XE to the 4400SXC, all Compaq notebooks and most other major manufacturers' models. Access time is less than 12 ms, with a data-transfer rate of 10M/s. The drives are rated to withstand a 10-G operational shock and have a rated MTBF in excess of 100,000 hours.

Upgrades are performed by appointment only. They include installing and partitioning the hard drive to user specifications, formatting of each logical drive and complete system diagnostics. Laptop Solutions guarantees a 48-hour turnaround, including a 24-hour burn-in test. $1395. *Laptop Solutions, Inc., 10700 Richmond Ave. Ste. 114, Houston, TX 77042; tel.: 800-686-6839.*

CIRCLE NO. 7 ON FREE CARD

Virus-Removal Breakthrough

The latest version of *Data Physician PLUS!* (3.1B) from Digital Dispatch takes a new approach to virus removal. Instead of simply searching for "fingerprint" strings, Digital Dispatch disassembles each new virus and runs it within a proprietary virus testing environment. Virus operation is completely mapped, including precisely how the infected file is modified. As a result, *Data Physician PLUS!* has the ability to reliably restore original files and can completely remove most viruses without deleting or damaging a single file. Even previously unknown viruses can be caught and removed through use of the program's sophisticated "signature file" feature. Compatibility with *Windows* 3.x and all major LANs is included. $49. *Digital Dispatch, Inc., 55 Lakeland Shores Rd., Lakeland, MN 55043-9601; tel.: 800-221-8091; fax: 612-436-2085.*

CIRCLE NO. 8 ON FREE CARD

Schematic For *Windows*

Protel's *Protel for Windows Advanced Schematic* is a schematic capture system for *Windows* and joins the company's popular *Advanced PCB*, a printed-circuit-board layout program. *Advanced Schematic* is fully compatible with *Windows* 3.1, supports *OrCAD SDT* (reads/writes without

translation program), is fully hierarchical with many automated features and works either "top down" or "bottom up." Report generation includes bill of materials, part/sheet cross references and net list creation in over 30 formats. Text can be imported via the *Windows* clipboard, and reports can be exported directly to popular spreadsheets. $995. *Protel Technology Inc., 151 Bernal Rd., San Jose, CA 95119; tel.: 800-544-4186; fax: 408-225-1863.*

CIRCLE NO. 9 ON FREE CARD

Innovative Keyboard

Touch Edit Keyboard from Key Innovations features all the standard PC keyboard keys in the normal locations and

eight extra touch-typing keys below the spacebar, to be touch-typed with the thumbs. Five of the latter are standard editing keys: arrow and delete keys; but three are new keys not found on other keyboards. A single keystroke moves the cursor one whole word in either direction or deletes a whole word. In edit-intensive tasks for typical word-processing applications, overall time savings of 33% or more are possible. $120. *Key Innovations Corp., 6324 Brookview Ave., Edina, MN 55424; tel.: 612-926-0113.*

CIRCLE NO. 10 ON FREE CARD

Plotting Program

Polysoft's *PS-Plot* is a technical plotting and data-processing package completely in graphics mode. It provides a *Windows* "look and feel," including drop-down menus, multiple windows, mouse support, page layout with WYSIWYG graphics display, dialog boxes, on-line help , status bar and comprehensive help system. The *PS-Plot* program uses DMA technology to provide fast screen update.

PS-Plot has a comprehensive data sheet that performs complete statistical analysis, data transformation, digital signal processing, nonlinear parameter fitting and model development. You can exchange data to/from most popular spreadsheet file formats. It provides a powerful plot-editing tool box that makes it easy to design and modify graphs, including 2D, 3D, bar charts, scatter plots, 2D and 3D histograms, Smith curves and quality control charts. Multiple coordinate systems, axes and plots can be placed in one page. $299. *Polysoft, PO Box 526368, Salt Lake, UT 84152; tel.: 801-485-0466; fax: 801-485-0480.*

CIRCLE NO. 11 ON FREE CARD

Fuzzy Systems Editor

The *Manifold Graphics Editor* from Fuzzy Systems Engineering provides an intuitively helpful graphics and text interface for capturing, examining and storing the expert judgments needed to build the knowledge base of fuzzy systems. It provides a two-dimensional graphics or text display of fuzzy-system rules for viewing and editing. The two dimensions displayed are arbitrary and easily assigned. Hidden dimensions are easily controlled and easily assigned to be visible. You can describe up to 11 independent inputs, each by up to 11 fuzzy sets.

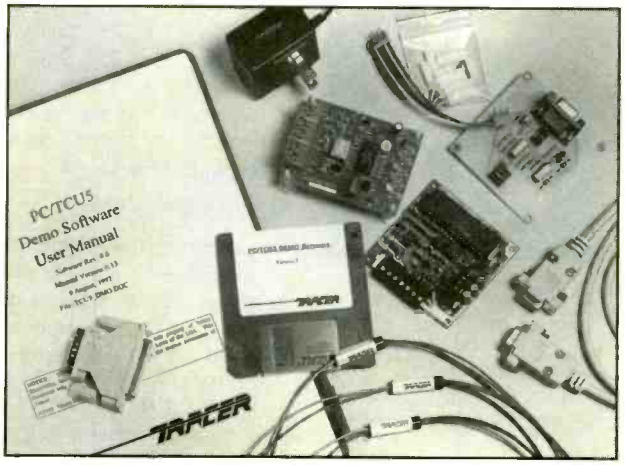
Fuzzy set editing tools include simple graphical editing of singleton, triangular and trapezoidal fuzzy sets, line drawing graphical editing of arbitrary fuzzy sets, translation from the simple piece-wise fuzzy sets to the arbitrary freeform fuzzy sets, wrap-around editing and polar viewing of cyclical input or output dimension and colored line drawing of all fuzzy sets views. A number of other editing functions are available. $495. *Fuzzy Systems Engineering, PO Box 27390, San Diego, CA 92198; tel./fax: 619-748-7384.*

CIRCLE NO. 12 ON FREE CARD

Point Monitoring Kit

Tracer Electronics' Demo Kit 63 is a complete plug-and-go demonstration controller that enables any intelligent control system to monitor and control the status of up to 63 readily identifiable points. It employs the first miniature digital transponders to combine ultra-small size, low cost, high noise immunity and the ability to function effectively at a distance of up to 6,000 feet from the control panel. This turnkey demo kit plugs together within minutes, enabling you to develop new systems and products. $149. *Tracer Electronics, 200 Broadacres Dr., Bloomfield, NJ 07003; tel.: 201-338-1234; fax: 201-338-1125.*

CIRCLE NO. 13 ON FREE CARD



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The Z-Line "Intelligent Power Controller" from Pulizzi Engineering is a factory-programmed user-controlled power distribution system that

provides remote control of individual outlets or the whole system, sequential power up and down with variable time delays, system lock-up/re-boot feature, password security available, inquiry capability for load status, elapsed time, voltage levels and control of parallel or slave units. In addition, the Z-Line responds to Emergency Off switches, interlocks and local control options. It operates on single- or three-phase ac power with European or U.S. voltages and can stand alone on a desktop or be rack mounted. $225. *Pulizzi Engineering Inc., 3260 S. Susan St., Santa Ana, CA 92704-6865; tel.: 714-540-4229; fax: 714-641-9062.*

CIRCLE NO. 14 ON FREE CARD

Audio-Capture Board

Jovian's Sonia audio-capture card is designed for most corporate and educational multimedia authoring. It has its own processor chip (DSP) to handle all audio processing. Using the newly established MPEG II standard, the DSP is able to decompress and play back compressed audio files in real time. It features CD- quality sound with up to 48 kHz at 16-bit resolution, MIDI control and FM synthesizer. An option provides a direct digital interface to a DAT machine, which enables the Sonia to provide a fully digital audio editing environment. $695. *Jovian Logic Corp., 47929 Fremont Blvd., Fremont, CA 94538; tel.: 510-651-3823; fax: 510-651-1343.*

CIRCLE NO. 15 ON FREE CARD

(Continued on page 78)

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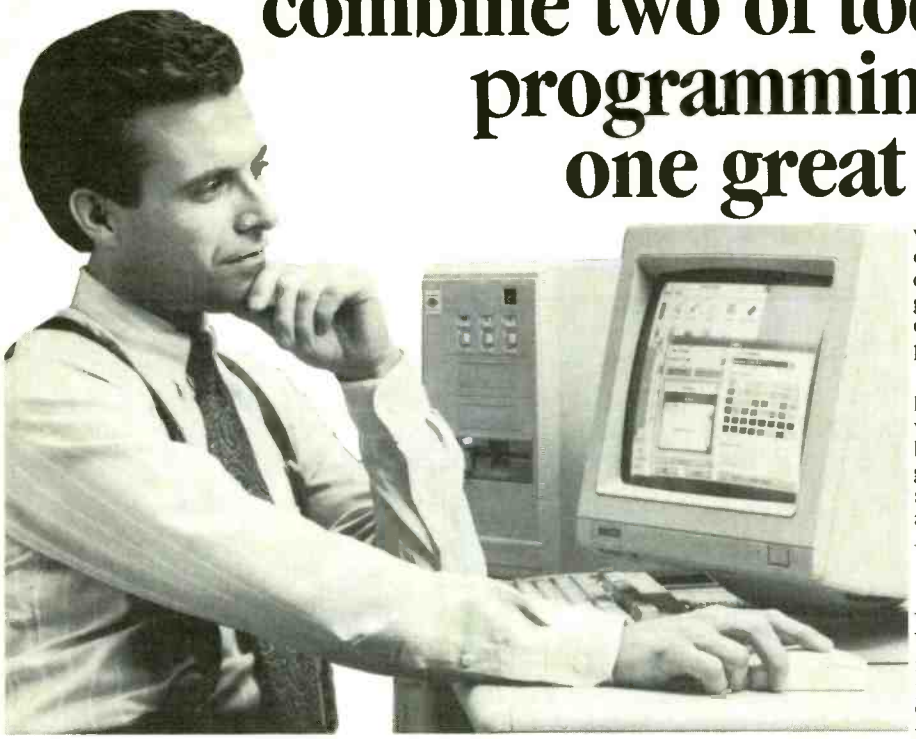

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Image File Formats

Strengths and weaknesses of the types currently available and what you might be able to do to convince your program to accept a format it does not recognize as valid

In a perfect world, there would be very few different formats for different types of computer files. All word processors would use one format, all database managers would use another, spreadsheets would use a third and graphics programs a fourth. But the personal-computer world as it exists at the current time isn't as neat and orderly as this because of historical accidents and practical reasons. Graphics files, in particular, are available in a wide variety of formats, which leads some users to suggest that either programmers are sadistic or shortsighted. Or they may believe that there's a conspiracy among software vendors to discourage users from sharing files.

Many users argue that the industry should settle on a single graphics file format, "the best one, of course," and toss out all of the others. They reason that programs would then be able to share images without problems and life would be much easier. If you logged into a bulletin board or information service and downloaded a graphics file, you'd be able to use it in any program you wished. And you could share files with friends without having to worry about whether they had the same image viewers and application programs you have.

We're not likely to see such uniformity, at least not in the next several generations of computers and applications. Too, although there are probably many more file formats than are needed, there isn't a "best choice" that leaves all other formats in the dust. But if you use image files at all, it's handy to know what the strengths and weaknesses of each file format are. When a program asks you how you'd like to save a file, you'll be able to make an intelligent choice. And if an application program tells you that

```
HEADER:

          WORD    0001H    ;The first 3 bytes
          WORD    0008H    ;  are the IMG
          WORD    0001H    ;  signature or ID
          WORD    PATTERN LENGTH
          WORD    PIXEL WIDTH
          WORD    PIXEL HEIGHT
          WORD    LINE WIDTH
          WORD    IMAGE HEIGHT

PACKET TYPES:

     Solid Run Packet (used to replicate solid black or
                       solid white areas in a line)

          BYTE    80H plus length  ;for solid black
          BYTE    00H plus length  ;for solid white


     Pattern Run Packet (used to replicate a pattern of
                         black and white)

          BYTE    00H                ;Packet ID
          BYTE    Run length         ;Times to duplicate
          BYTE    First byte,...,Last byte
                     (the length of the pattern is set by
                      PATTERN LENGTH in the header)


     Replication Packet (used to replicate a line)

          BYTE    00H, 00H, 0FFH     ;Packet ID
          BYTE    Replication Count


     String Packet (used for data that can't be compressed)

          BYTE    80H                ;Packet ID
          BYTE    String length
          BYTE    First byte,...,Last byte
```

Fig. 1. IMG file format.

a file isn't in the proper format, you might be able to examine that file with a sector editor and make some minor changes to convince your application that it can use the particular file.

What's the Best Format?

If you were writing a program that could create and save images, what qualities would you want from a file format? Every file format answers this question in a different way, which accounts for why there are so many formats currently in use.

For example, if you know that the file will be generated on a VGA system and displayed only in the same resolution on a similar system, you might be tempted to find the easiest way to read each pixel and save it in a file. Reading the image back and displaying it on-screen would be both simple and fast. But what if you wanted to display the same image on an EGA, 8514/Adapter or maybe a Macintosh computer? Alternatively, what if you wanted to change video resolution or image size? Your software would have to go through all kinds of contortions to change the image data into another format for a different display. So perhaps your definition of the "best file format" would include some way to make an image as portable as possible from one system to another.

An image in standard VGA 640 × 480 graphics resolution has more than 300,000 pixels. If you have each pixel as a byte, you could put only two files on a double-density 3½" diskette. To download the file from a bulletin board at 2,400 bps would take about 20 minutes. If you want to save as many images as possible or transmit images electronically, you might say that the best format is the one that saves an image in the fewest possible bytes.

Other users might define "best" as the most-popular file format, the one that works best with *Windows* or OS/2 programs or the one developed and approved by their favorite software vendor. You could make a strong argument for any of these criteria. Unfortunately, they're generally mutually exclusive.

Format Types

Almost all graphics files follow the same general format. They begin with a header, which identifies the file type because file extensions alone aren't sufficient to guarantee what kind of file is being used. If a user renamed a file with a new extension, a program could crash the computer if it assumed the extension correctly identified the image type.

```
HEADER:

          BYTE   manufacturer      ;Always 0A0H
          BYTE   file type    ;
          BYTE   encoding scheme   ;Always 1
          BYTE   bits per pixel
          WORD   xmin, ymin        ;Image origin
          WORD   xmax, ymax        ;Image dimensions
          WORD   hres, vres        ;Resolution values
       48 BYTES  palette           ;For 16-color images
          BYTE   [reserved]
          BYTE   color planes
          WORD   bytes per line
          WORD   palette type
       58 BYTES  [filler]

PACKET TYPES:

     Solid Run Packet (used to replicate a byte)

          BYTE   0C0H plus length
          BYTE   byte to replicate

     String Packet  (used for data that can't be com-
pressed)

          BYTE   First byte        ;Any byte less than 0C0H
```

Fig. 2. PCX file format.

The header usually contains other information as well. For example, it might indicate the image size, number of colors used, type of data compression used in the file, computer type or application used to create the file or the file's original name or date. For example, monochrome IMG files always begin with the three integers 1, 8 and 1. This signature is followed by the pattern length (usually 1), size of each pixel and size of the image in pixels.

Other file headers can be much more complex. A 256-color PCX file, for example, has a header that's 128 bytes long plus a one-byte marker and 768 bytes of color information at the end of the file.

Following the header, most graphic files store the image itself in a compressed format. The technique used for file compression is a tradeoff between file length and amount of compressing and decompressing time the file requires. PCX files are very easy to decompress but tend to be relatively large. GIF files, on the other hand, are as short as possible but take a great deal more computation to compress and decompress.

To understand how image files work, it's necessary to take a detailed look at a few of the most-popular file formats. For each one, I'll explain the header and how the image itself is compressed and stored. Each compression technique has strengths and weaknesses that help define the kinds of images that are best stored in each file format.

The IMG File

Monochrome IMG files, which are used in GEM applications like *Ventura Publisher*, begin with a six-byte or three-word ID string. The ID bytes are followed by a pattern length, which is the fixed size (in bytes or pixels) of all patterns included in the file. Next, the header defines the size of each image pixel. If the image is meant to be displayed on a laser printer at 300-dpi resolution, pixel size values will usually be set to 0055H or 85 microns. Desktop-

publishing programs use the pixel-size figure to determine how the image is supposed to be scaled. The last two values in the header are the length of a line (in image pixels) and number of lines in the image.

Image data is organized by lines, each of which is divided into one or more packets of data. The simplest packets define up to 127 solid white or solid black pixels using a form of run-length encoding. A solid-run packet is always one byte long, and the byte can be neither 00H nor 80H. If the byte is any other value, the most-significant bit defines whether the solid block is white (if the bit is 0) or black. The remainder of the byte contains the number of times the white or black pixel is repeated. For example, seven white pixels would be encoded as 07H, while seven black pixels is encoded as 87H.

Often, several lines of an image are identical, especially if they represent a white, black or patterned background. The second packet type, which begins with the signature bytes 00H, 00H, 0FFH, tells the image decoder that the current line must be replicated a specific number of times.

Sometimes an image will contain areas of a repeated pattern, especially in images that have a stippled or dithered background. An IMG file can have only one pattern length, which is defined in the header. A pattern packet begins with a signature byte of 00H, which is followed by the number of times the pattern is to be repeated and then the bytes in the pattern.

Finally, a string packet is for image data that can't be compressed using any of the above techniques. After a signature byte of 80H, the number of bytes or pixels in the string are stored, followed by the actual pixel values.

IMG files are a good choice for storing relatively simple line drawings that might be used in a newsletter or brochure. They're very inefficient for storing scanned images, which usually have complex dithering, because they have no way to compress such data.

The PCX File

PC Paintbrush, originally a so-so paint program, has one unusual trait. Its PCX file format is so well-documented and so easy to use that it has become an industry standard. Almost every graphics program can import or export images in PCX format, even if it does its main

```
HEADER:

          BYTE    "GIF87a"          ;Requaired ID signature
          WORD    Screen_width
          WORD    Screen_height
          BYTE    Global flag
          BYTE    Background color
          BYTE    0                 ;Check for file integrity
          BYTE    Color map         ;If used, 3 bytes per
color


PACKET TYPES:

     Image packet:

          BYTE    ','               ;Comma defines image
packet
          WORD    Xmin              ;Screen location
          WORD    Ymin
          WORD    Image width       ;Screen size
          WORD    Image height
          WORD    Local flag byte
          BYTE    Local color map   ;If used, 3 bytes per
color
          Compressed Image Data

     File terminator packet:

          BYTE    ';'

     GIF Extension packet:

          BYTE    '!'
          File extension
```

Fig. 3. GIF file format.

work using some entirely different image format. The popularity of PCX files is amazing, considering the inefficiencies and hardware dependencies built into them.

PCX files come in three varieties: monochrome, 16-color and 256-color. The varieties are similar to each other, but their methods of storing and compressing image data reflect the video boards that were in vogue when each standard was developed. Most of the fields in the header are self-explanatory. The 0AH byte at the beginning of the file is the only signature byte, although a program might reject a PCX file if its other fields don't make sense. The file type is used to indicate what kind of information is stored in the file. The encoding scheme, which is always 1, could change to allow for something other than ZSoft's version of run-length encoding.

The bits per pixel, which is used only in color images, indicates how many bits are used to define color values. The xmin, ymin, xmax and ymax values show both the size of the image and its intended on-screen location. The xres and yres values show the screen resolution of the device that created the file.

Data in a PCX file is stored using an unusual run-length encoding scheme. Like an IMG file, a PCX file is arranged in rows. Unlike an IMG file, a PCX file has only two kinds of packets. If the top two bits of a byte are set, the remainder of the byte contains a replication count, and the next byte is to be repeated that many times. If the top two bits of a byte aren't set, the byte is used as-is.

A 16-color PCX file is ideal for unpacking on an EGA card—and a pain to display on any other graphics card (unless the card is in an EGA-compatible mode). It assumes that the video RAM is divided into planes. The first row of file data is to be stored in the first

row of the first memory plane. The next row from the file goes to the first row of the next plane, and so on. If you're unpacking a 16-color PCX file for display on a four-plane video card, the process is easy and fast. But if you're unpacking it into another kind of architecture (256-color VGA mode, for example), it's a long process that involves a lot of bit twiddling.

The 256-color PCX file is designed with the VGA adapter in mind. Because there isn't enough room in the 128-byte header for palette information (the VGA card needs three bytes for each of 256 color registers), this data is moved to the end of the file. And, since the VGA memory isn't planar in 256-color mode, the data in the file isn't arranged in planes, either. However, a 256-color PCX file can be very inefficient because any pixel value of 0C0H or greater must be stored in two bytes composed of a repetition of 1 (or more) followed by the byte itself.

Tightest Packing

If you want to store a large library of graphics images, or if you want to transmit images over a modem, you're probably more concerned about the size of each file than with how easy and fast it is to display. GIF or Graphics Interchange Format files can, in general, hold an image in a smaller file than any other popular graphics file format.

The GIF standard was developed by CompuServe Information Service, partly to create an image format that could be used on any computer. Several services on the CompuServe network have image files available that users might want to display on a PC, under *Windows*, on a Macintosh or on a UNIX machine. A GIF image doesn't assume any particular type of computer or display. Your graphics software is responsible for making the picture appear correctly on-screen. Also, a GIF file may hold a collection of images, although few files contain more than one picture.

A GIF file header is straightforward and easy to follow. After the signature (which is case sensitive), the computer that created the image stores the size of its screen in pixels. Another computer could read this information in order for it to pick a resolution mode for displaying the file.

The global flag holds two values. Its lower three bits indicate the number of colors used. The formula is Colors =

```
HEADER:

          'II' or 'MM'              ;Identifies data format
                                    ;  (Intel or Motorola)
          42                        ;2-byte file ID signature
          Directory offset          ;4 bytes


TAG FORMAT:

          WORD    tag type
          WORD    number size
          LONG    length
          LONG    offset
```

Fig. 4. TIFF file format.

2^((flag AND 7) + 1). The most-significant bit, when set, indicates that the colors are stored in a global color map. The background color indicates what color a decoding program should use for the entire screen as it decodes the picture data.

After the header and a possible global color map, a GIF file is divided into chunks of data. The first byte of a chunk signals the kind of data that follows. A chunk that begins with a comma (,) contains an image header as well as the image data itself.

The local flag in an image header works the same as the global flag, indicating whether there's a local color map and, if so, how many colors it contains. Bit six of this byte has an unusual meaning. If it's set, the image is interlaced. The first line in the image data represents the top screen line. The next line in the file is eight lines down the screen. Once you get to the bottom of the screen, start again at the top with the fifth line and move down eight lines at a time. Then write every fourth row, beginning in row three. Finally, write every other row beginning in the second row.

An interlaced file is ideal if you have a slow viewer or if your computer is displaying the file as it's coming over a modem. After the first or second pass, you should know whether or not you want to wait for the rest of the file. Although all the detail of the file won't appear until the last pass, you'll be able to save transmission and decoding time if you decide to stop the image early.

Data in a GIF file is stored using a variation of the LZW data-compression algorithm. This is an extremely efficient algorithm that is used in programs like *PKZIP* and other file compressors. Occasionally, a very unusual image may take less space in an IMG or PCX file, but this is rare. Often, a GIF file of an image will be less than half the size of a PCX file made of the same image.

Tagged Images

Probably the most flexible image file format is TIFF or Tagged Image File Format. It makes exchanging files between different computers quite easy. TIFF files (which have extensions of .TIF or .TFF on DOS computers) are also very complex. Few decoding programs make use of all the information that might be contained in a TIFF file. Instead, each selects the parts of the file it can most-easily interpret. TIFF files are often included in encapsulated PostScript (.EPS) files for preview images and have great popularity with desktop-publishing packages.

The first two bytes of a TIFF file are crucial. If they're "II," the file is stored in Intel format. This means that all multiple-byte values (usually integers, long integers and file pointers) are stored with the least-significant byte at the lowest file location and the most-significant byte nearest the end of the file. If the first two bytes are "MM, the data is stored in Motorola Format, with most-significant bytes nearest the beginning of the file.

Once the program knows how it should interpret multiple-byte data, it can practice on the next two bytes.

which should hold the value 42. Finally, a four-byte pointer in the header tells the program where to look for the image file's directory of tags.

Everything in a TIFF file is either part of a tag or is data that points to a tag. Tags are always 12 bytes long. The first two bytes is an integer that defines the tag's type. A tag could contain image-size information, or it could point to image data in the file. There are dozens of defined tags and more are added each time the TIFF standard is expanded.

The second integer in a tag defines how the last two value are to be interpreted. Although each is four bytes long, these can hold bytes, integers or long integers, depending on the needs of a particular tag.

TIFF files are rarely small, but they can be moved between computers quite easily. Like IMG files, they're used most in desktop-publishing applications and rarely in paint and draw programs.

Other Image Formats

PCX, GIF, IMG, and TIFF may be the most-popular image formats, but they certainly aren't the only ones. Several other formats are also popular:

• **EPS** (Encapsulated PostScript): PostScript is a programming language, written in ASCII characters, originally designed to communicate with high-powered printers. A PostScript printer contains a computer that reads a program file and then interprets the program and executes it. An .EPS file contains PostScript code but is meant to be inserted into a larger PostScript file. In a sense, it becomes a subroutine of the entire page program.

• **BMP** (bit map): This is one of the most popular *Windows* image file formats. Like a PCX file, it is a record of the actual bits in a file. As such, it can not be easily recessed if you change screen resolutions. BMP files are fast to load and display in *Windows* but they are also inflexible. If you use a Super VGA screen resolution in *Windows* and get irritated at applications with displays that are too small to use, you are running into the problem of bit-mapped graphics.

• **MTF** (metafiles): Another *Windows* format, Metafiles are extremely flexible compared to bitmaps. In essence, they're a list of the calls a program would make to *Windows*' graphics device interface (GDI) to draw an image. The GDI can compensate for differing screen resolutions, color capabilities, etc.; so a metafile is almost always displayed correctly.

If you become seriously involved with image files, you'll need a program to translate between one file type and another. For years, the standard format translator has been *Hijaak* from Inset Systems. Versions of *Hijaak* are available for both DOS and *Windows*. These programs can read files in 38 popular formats and save them in 23 file formats or prepare them for 24 different fax cards. They can also print files, enhance images and capture images from the screen. *SnapPro* from Window Painters Ltd. is a competing *Windows* program that's faster and perhaps easier to use, but it doesn't recognize nearly as many file formats.

Summing Up

The question still remains: "Which file format should you choose for your own work?" Since there isn't an ideal format for speed, size and flexibility, the choice really boils down to the applications you routinely use. Select a file format that they all support, and you won't have to worry about conversion programs. You can hope that sometime in the future a "best" image file format will appear, but it probably won't.

As the graphics capabilities of our computers continue to improve, it is likely that new file formats will be needed to best support every new feature as it appears. Instead of fewer file formats, we'll probably have many more in just a couple of years. ■

Directly Accessing a PC Bus

A simple eight-bit Interface Card and a Remote-Bus Breakout Board give you safe, direct hookup to a PC's internal bus for externally adding sensors, home-brew circuits, etc.

There are a few ways to communicate with a PC from the "outside world." Easy plug-in interface schemes to make this possible include serial RS-232 and parallel printer ports. Neither, however, provides direct access to the internal PC bus, which is really a fast, easy-to-use communication pipeline. You can rectify this situation with Eight-Bit Bus Interface scheme described here.

By adding our Remote Bus Breakout Board to our plug-in Interface Board through a 50-conductor cable, you have all the data, address and control signals you need to tie ADCs, DACs, displays, counters, port expanders and any other devices you want to to your PC without worrying about shorting signal lines and blowing system board ICs.

To get to the address, data and control lines of a PC bus, you need an interface card that plugs into the computer. Our Eight-Bit Bus Interface system gives you access to these lines in Intel 8088/86, 80x86 and i486 machines. Limiting the interface to eight data bits, limiting I/O space addressing and excluding interrupt and DMA functions, our Interface system is easy to build and use and occupies just one slot on your motherboard. With the system in place, you have fully buffered input and output lines.

The PC Bus

Before you begin, you should familiarize yourself with the first slot on the IBM bus. As shown in Fig. 1, this slot has a 62-pin connector that provides contacts for power, address, data and control signals.

Other than ground, no power lines are brought out of your PC with our Interface card. This is done to prevent accidental shorting of power to ground that could disrupt proper operation of your computer. If you did accidentally short a power line to ground in your PC, you probably wouldn't blow up your computer, but any running programs would probably crash and you'd have to re-boot the system.

Since our Interface is limited to eight data bits and is limited to I/O space and not memory address space, only the /IOR (I/O Read) and /IOW (I/O Write) signals are brought off the board. AEN, the signal that differentiates between memory I/O operations and memory refresh cycles, is needed by the address-selection logic.

The microprocessor's CLK clock signal is brought out of the computer for convenience. All other control lines are ignored. Consequently, the Interface Board's control outputs are: /IOW, which writes data to selected port; /IOR, which reads data from selected port; AEN, which inhibits I/O operations during memory refresh cycles; and CLK, which is a convenience signal.

The first slot in a PC/compatible is an eight-bit slot. It has 20 address lines labeled A19 through A0 and eight data lines labeled D0 through D7. The remaining data and address lines for 286 and later systems are on the second connector of the bus slot and aren't used here. In fact, only the first 10 address lines are used. Naturally, all eight data lines are a must.

The only instructions the Interface responds to are IN(P) and OUT, which are included in most versions of BASIC, C and just about every programming language you can think of, including machine language. In QBASIC, the syntax of the two instructions is as follows: INP(port number), in which the port number ranges from 0 to FFFF hex, 64K bytes; and OUT port number,data, where port number ranges from 0 to FFFF hex, 64K bytes and data ranges from 0 to FF hex (0 to 255 decimal).

From the foregoing, it appears you have 64K bytes of I/O space available for external devices. But appearances can be deceiving. Keep in mind that

Rear of Computer

GND	B1	A1	/IO CHK
RESET	B2	A2	D7
+5V	B3	A3	D6
IRQ9	B4	A4	D5
-5V	B5	A5	D4
DRQ2	B6	A6	D3
-12V	B7	A7	D2
OWS	B8	A8	D1
+12V	B9	A9	D0
GND	B10	A10	/IO READY
/MEMW	B11	A11	AEN
/MEMR	B12	A12	A19
/IOW	B13	A13	A18
/IOR	B14	A14	A17
/DACK3	B15	A15	A16
DRQ3	B16	A16	A15
/DACK1	B17	A17	A14
DRQ1	B18	A18	A13
/REFRESH	B19	A19	A12
CLK	B20	A20	A11
IRQ7	B21	A21	A10
IRQ6	B22	A22	A9
IRQ5	B23	A23	A8
IRQ4	B24	A24	A7
IRQ3	B25	A25	AD
/DACK2	B26	A26	A5
T/C	B27	A27	A4
ALE	B28	A28	A3
+5V	B29	A29	A2
OSC	B30	A30	A1
GND	B31	A31	A0

Component Side
Of Motherboard

Fig. 1. Pinout details for eight-bit PC bus.

Addresses	Description	Addresses	Description
0000 - 000F	DMA Controller 1	02B0 - 02BF	Alternate EGA
0020 - 002F	INT Controller 1	02C0 - 02CF	Alternate EGA
0030 - 003F	INT Controller 1	02D0 - 02DF	Alternate EGA
0040 - 004F	Timer	02E0 - 02EF	Data Acquisition GPIB
0050 - 005F	Timer	02F0 - 02FF	Serial Port 2
0060 - 006F	Keyboard	0300 - 030F	Prototype Card
0070 - 007F	Real-Time Clock-NMI	0310 - 031F	Prototype Card
0080 - 008F	DMA Page Registers	0320 - 035F	Not Specified
0090 - 009F	DMA Page Registers	0360 - 036F	PC Network
00A0 - 00AF	INT Controller 2	0370 - 037F	Parallel Printer 1
00B0 - 00BF	INT Controller 2	0380 - 038F	SDLC or BISYNC 2
00C0 - 00CF	DMA Controller 2	0390 - 039F	Cluster Adapter
00D0 - 00DF	DMA Controller 2	03A0 - 03AF	BISYNC 1
00F0 - 00FF	Math Coprocessor	03B0 - 03BF	Mono Display Adapter
01F0 - 01FF	Fixed Disk	03C0 - 03CF	EGA Adapter
0200 - 020F	Game I/O Adapter	03D0 - 03DF	CGA Adapter
0210 - 026F	Not Specified	03F0 - 03FF	Serial Port 1
0270 - 027F	Parallel Printer 2		

The above port locations are for reference only. Individual PCs may use different port locations than those listed. Refer to your hardware manual for mor information pertaining to your machine.

Fig. 2. Recommended I/O port usage.

most system boards decode only the lower 10 address lines (A0 through A9). Also, of the 1,024 decoded ports, a number of them have been pre-assigned to particular I/O functions, as detailed in Fig. 2.

IBM set aside I/O port numbers 0300 hex through 031F hex in the I/O address space for prototype applications. That's 32 input and 32 output ports. By decoding the first 10 address lines to select the prototype ports and mixing in AEN and /IOR or /IOW, you can pick off any one of these 64 ports for your own special use.

About the Circuit

In the schematic diagram of the Interface Board circuitry shown in Fig. 3, *U1, S1, U2A, U2B* and *U2D* make up the address-decoding logic for the Interface-Board. Eight-bit comparator *U1* produces an output when P0 through P7 equal Q0 through Q7 and gate control input G is low (logic 0).

The comparator chip is used to match up addresses A9 through A5 of the IBM bus to the settings of SA9 through SA5 of DIP switch *S1*. The remaining six input lines of *U1* are grounded.

Now, when A9 through A5 equal SA9 through SA5 and the AEN signal is low, *U1* outputs a logic 0, indicating that a match has occurred between the address lines and the switch settings. It's not quite enough to select your I/O port, but it's pretty close.

To complete port selection, you must be sure that an IN or OUT instruction is being executed. By running the /IOW and /IOR signals into NAND gate *U2D* and again NANDing the resulting signal with an inverted version of *U1*'s output signal through *U2B*, you get an address-select signal, /ASO, that's fed to the gate input of data bus buffer *U6*.

By using only address lines A9 through A5, this circuitry decodes the 1,024 I/O address locations into 32 groups of 32. That is, each setting of SA9 through SA5 selects a different block of 32 port addresses. Getting down to one port is partially done by a Remote Bus Breakout Board.

Note that the output of *U1* is fed to a three-pin header. Pin 2 of the header goes to inverter *U2A*, and pin 1 comes from input buffer *U1C*, which is fed from Interface Board connector *JP2*. If the built-in address-selection logic isn't satisfactory for your needs, this jumper arrangement provides a way for you to supply your own I/O address decoding external to the plug-in Interface card. To set up the board for external addressing, move the shorting block from pins 2 and 3 to pins 1 and 2 of *JP1*.

In addition to turning on data bus buffer *U6* through address-select signal /ASO, the direction of the data transfer has to be specified: computer to the outside world (OUT instruction) or outside world to the computer (IN instruction).

Since /IOR and /IOW can't occur simultaneously and the wiring of *U6* is set up so that computer-to-Interface transfers occur when the DIR pin of *U6* is high, it's easy to see that /IOR can be used as a bus direction signal.

The 74HCT245 is a tri-state octal bus transceiver. When gate input G (the /ASO signal) is low, the device is active. When the DIR signal is high, data flows from Ans to Bns (n = 1 to 8). When the DIR signal is low, data flows from Bns to Ans. Therefore, when an OUT instruction is executed, activating the G input to the chip, the DIR input will be high because the /IOR is high and data will flow from the Ans to the Bns, placing the specified output data on the interface data lines. Conversely, when an IN instruction occurs, the /IOR signal goes low, causing the data to flow from the Bns to the Ans. It's a good idea to read the foregoing again so that you have it straight.

The outputs of data buffer *U6* are terminated by a network right out of the Signetics "Using 74HCT HCMOS to Replace LSTTL and Drive Transmission Lines" Application Note in the company's *High-Speed CMOS Designer's Guide* (1988). The reason for the termination at the transmitting end of the line is dictated by the fact that the data bus is bidirectional and requires that both ends of the line be terminated.

Alternate lines of the 50-conductor ribbon cable that connects the Interface and Remote Bus Breakout Boards are grounded to provide a ground shield between all signal conductors. Also, address lines are terminated at the Remote Breakout Board with 1,000-ohm resistors to V_{cc}, as is the single input line to the Interface Board ASI address-select input.

Note in Fig. 4, the schematic diagram for the Remote Breakout Board's circuitry, the same data-bus termination network at the input to second data bus buffer *U3*. Also, *U5* and *U8* are resistor terminations to V_{cc} for the address and control lines coming onto the board.

All lines between the Interface and Remote Breakout Boards are buffered at both ends of the cable. Short of

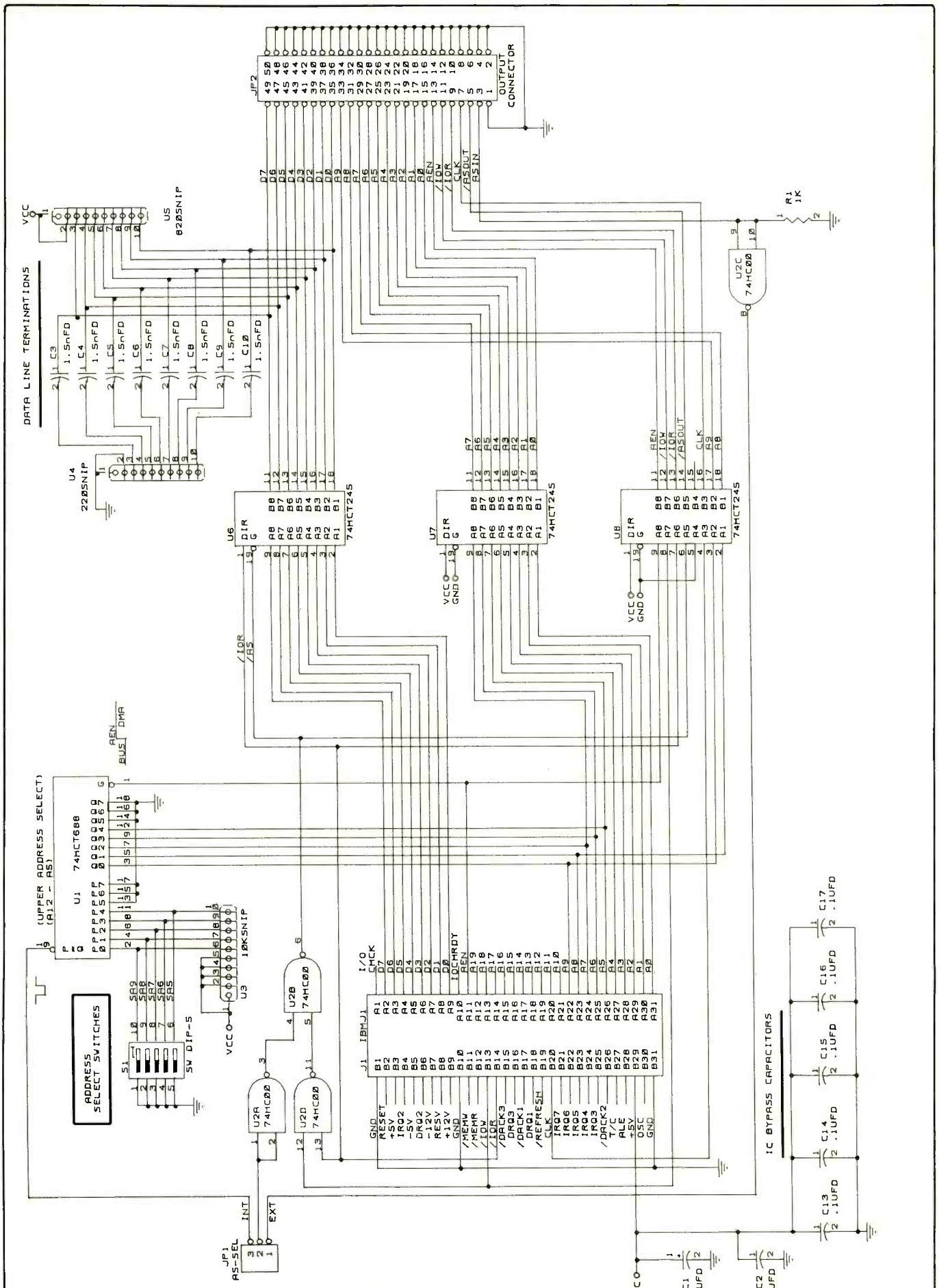


Fig. 3. Schematic details of plug-in Interface Board's circuitry.

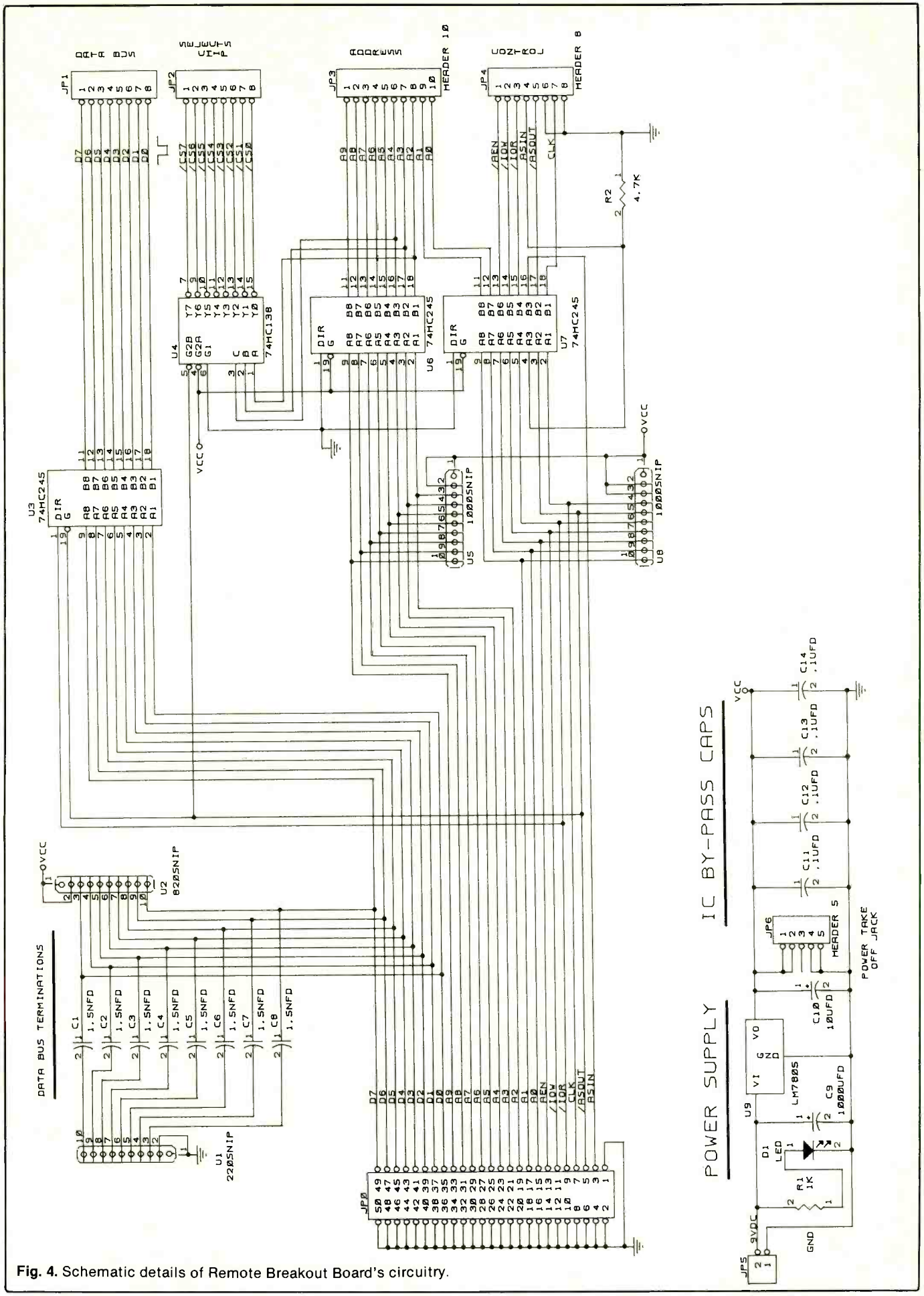


Fig. 4. Schematic details of Remote Breakout Board's circuitry.

PARTS LIST

Plug-In-Bus Interface Card

Semiconductors

U1—74HCT688 eight-input comparator
U2—74HC00 quad NAND gate
U3—10KSNIP nine-element resistor pack
U4—220SNIP nine-element resistor pack
U5—820SNIP nine-element resistor pack
U6,U7,U8—74HCT245 octal transceiver

Capacitors

C1—33-μF, 16-volt electrolytic
C2, C13 thru C17—0.1 μF ceramic disc
C3 thru C10—1,500-pF ceramic disc

Resistors

R1—1,00-ohm, ½-watt, 5% tolerance

Miscellaneous

JP1—Three-pin header
JP2—50-pin connector
S1—Five-position DIP switch
Printed-circuit board; PC-type chassis mounting bracket; low-profile sockets for ICs; machine hardware; solder; etc.

Remote-Bus Interface Board

Semiconductors

D1—Light-emitting diode (0.2″ diameter)
U1—220SNIP nine-element resistor pack
U2—820SNIP nine-element resistor pack
U3,U6,U7—74HC245 octal transceiver
U4—74HC138 3-to-8-line decoder
U5,U8—1000SNIP nine-element resistor pack
U9—LM7805 fixed +5-volt, 1-ampere regulator

Capacitors

C1 thru C8—1,500 pF ceramic disc
C9—1,000-μF, 16-volt electrolytic
C10—10-μF, 16-volt electrolytic
C11 thru C14—0.1-μF ceramic disc

Resistors (¼-watt, 5% tolerance)

R1—1,000 ohms
R2—4,700 ohms

Miscellaneous

JP0—50-contact (25 × 2) header
JP1,JP2,JP4—Eight-pin socket
JP3—10-pin socket
JP5—two-contact header
JP6—Five-pin header
Printed-circuit board; low-profile sockets for DIP ICs; 48″ 50-conductor ribbon cable and 50-pin IDC connectors; machine hardware; solder; etc.

Note: The following items are available from: RJP Electronics Co., 52 Susan Lane, North Haven, CT 06473: Complete kit of parts for both boards, including pc boards but not IC sockets, No. IFBB-A, $100. Also available are: Plug-In Bus Interface component kit, less pc board and IC sockets, No. IFBB-1, $25; Bus Interface pc board, No. IFBB-2, $30; Remote Bus Interface component kit, less pc board, cable and IC sockets, No. IFBB-3, $25; Remote Bus Interface pc board, No. IFBB-4, $20; ribbon cable with IDC connectors, No. IFBB-5, $15. Add $3 S&H per order. Connecticut residents, please add state sales tax.

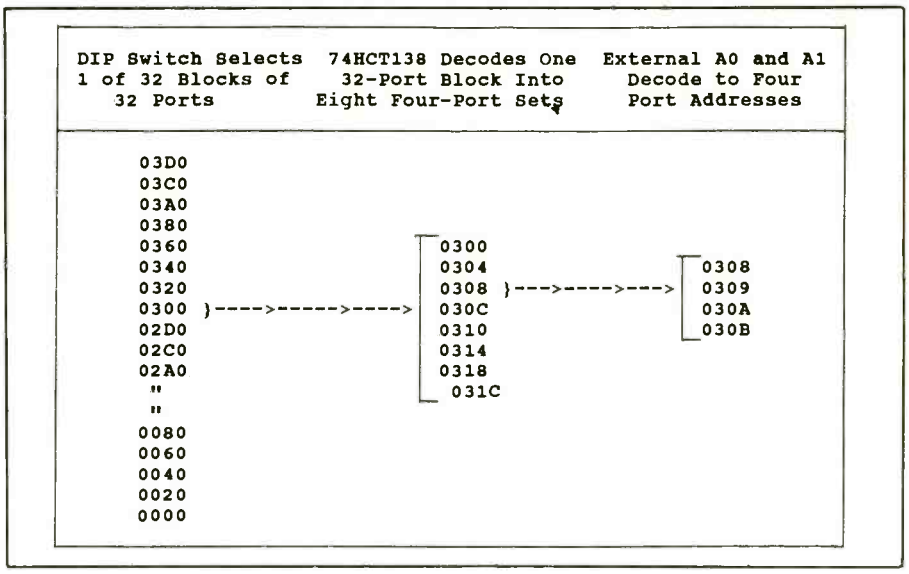


Fig. 5. Interface Board I/O space decoding.

lighting strikes, this buffering scheme will protect the chips on the system board of your computer from being destroyed.

In Fig. 4, 74HCT138 3-to-8-line Decoder *U4* requires a bit of explanation. Before plunging in, however, look at data bus buffer *U3*. DIR input pin 1 of *U3* is driven by the /IOR signal, and gate (G) input pin 19 is driven by the /ASO signal, just like *U6* in Fig. 3. The control lines of these two chips are connected in parallel. Chips *U6* and *U7* in Fig. 4 are used as mono-

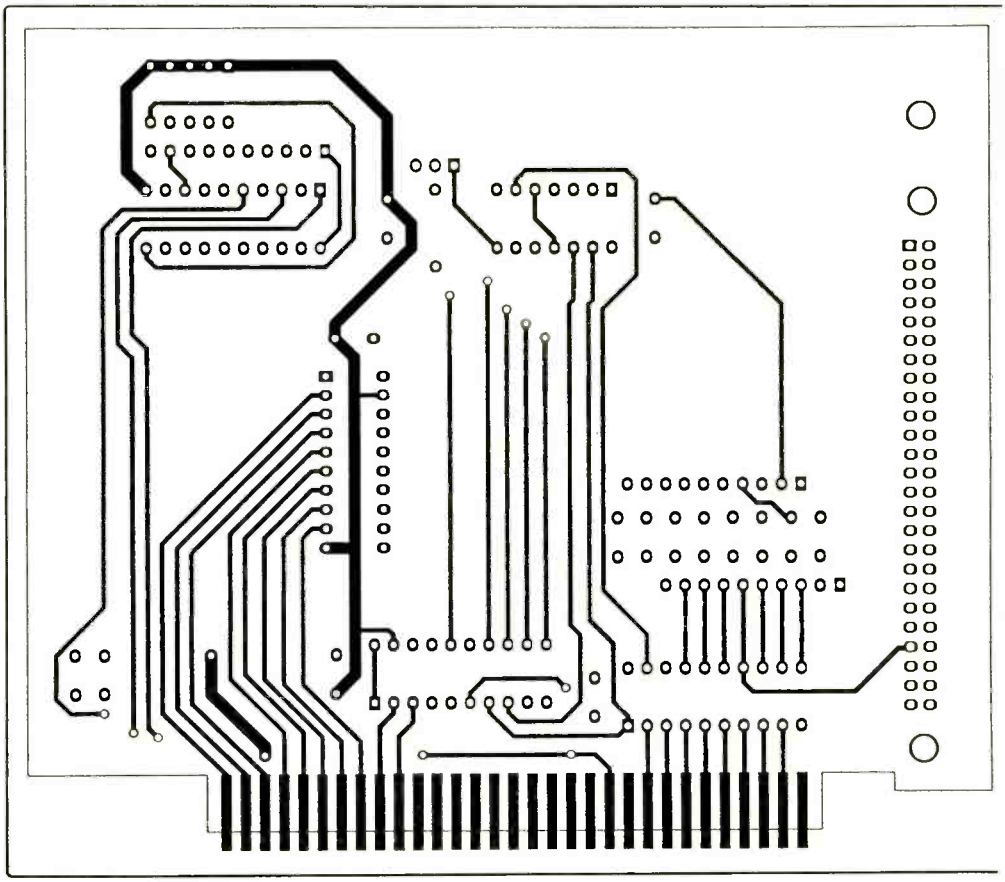


Fig. 6. Actual-size fabrication guides for double-sided Interface printed-circuit board.

directional buffers for the address and control lines. Their gate and direction lines are wired to ground and V_{cc}, respectively.

Chip *U4* provides some of the lower address decoding for the system. Address lines A2, A3 and A4 are fed to the A, B and C inputs of the chip. When /ASO is active, one of the chip's eight decoded output (chip-select) lines goes low. What's occurring here is a further break-down of the 32 groups of 32 port addresses discussed above.

The DIP switch on the Interface Board positions the 32-port group in the PC's I/O address space. Chip *U4* breaks the selected port group into eight four-port sets. Decoding address lines A0 and A1, providing four possible combinations, and mixing the outputs with one of the chip-select signals from *U4* results in selection of a single I/O port.

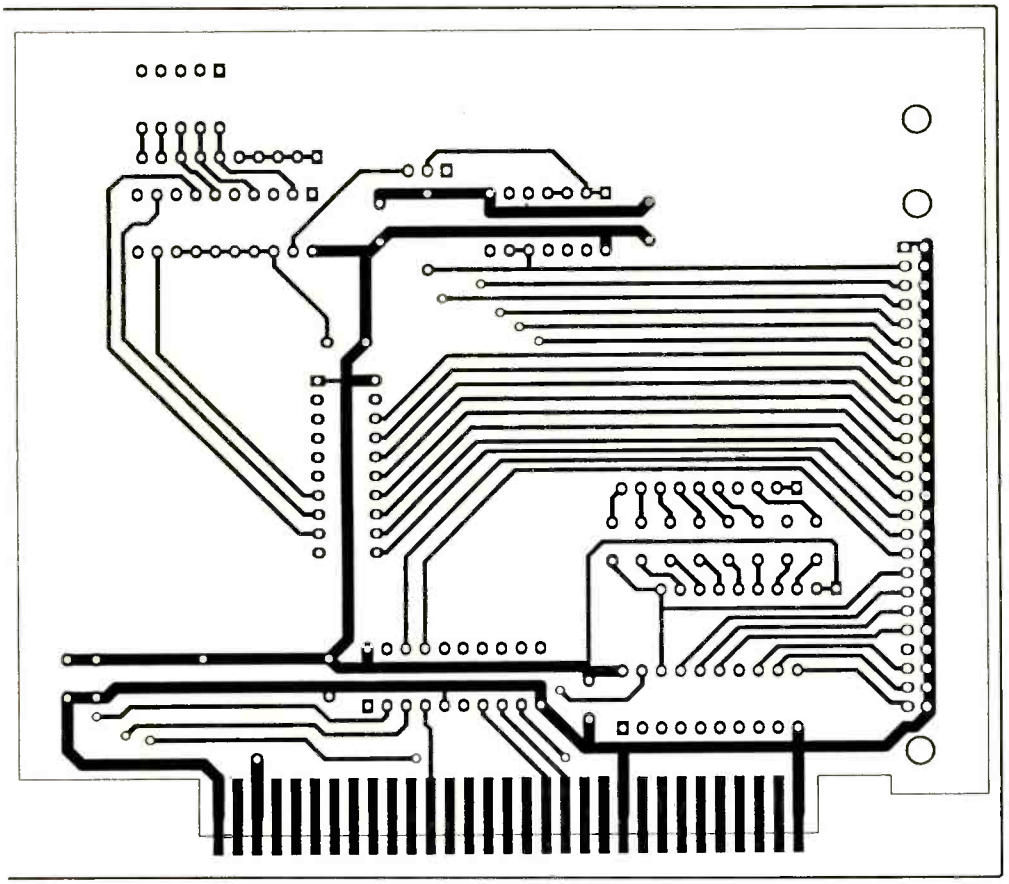
Naturally, this single port-select signal must be ANDed with /IOR or /IOW before being used by a peripheral device. Fig. 5 should help you visualize the address decoding scheme involved.

The Remote Breakout Board circuitry in Fig. 4 has a partial power supply made up of *C9, C10* and *U9*. Power can come from a 9-volt, 500-mA dc wall plug adapter, bench-type unregulated or regulated dc supply set to approximately 9 volts dc. Light-emitting diode *D1* provides power-on indication. Power take-off jack *JP6* provides access to the regulated +5-volt supply on the board.

Construction

Use of printed-circuit boards is a must for this project, and low-profile IC sockets are advisable. The Interface Board should have gold-plated contacts, and a metal support bracket should be attached to the board to lock it into your PC's bus slot.

If you plan to fabricate your own pc boards, use the actual-size artwork given in Fig. 6 for the Interface board and Fig. 7 for the Remote Breakout Board. Alternatively, you can purchase ready-to-wire boards from the source given in the Note at the end of the Parts List.



Once you have your pc boards ready to wire, refer to Fig. 8 for populating the Interface and Breakout boards. The pin-1 location of each IC is shown as a rectangle. There's only one polarized capacitor (*C1*) on the Interface Board. Make sure you properly polarize this capacitor when installing it on the board.

On the Remote Breakout Board, make sure you properly polarize *D1, C9* and *C10* before soldering their leads into place. I found that mounting regulator *U9, C9* and *C10* on the solder-side of the board removes clutter from the component side and eases access to the board's output sockets.

There are holes for 4-40 machine screws in each corner of the Remote Breakout Board that accommodate 1″ screws or tapped standoffs to keep the board off the bench and reduce the possibility of shorts. You can mount the Remote Breakout Board in any suitable enclosure that will accommodate it.

Be careful when fabricating the ribbon cable. Match the conductors of the ribbon cable to the same pin numbers on the connectors at both ends of the cable. If possible, choose connectors that have an identifying mark at the pin-1 location to reduce the possibility of wiring errors. This eliminates half the problem. The other half, putting the connector on the cable, is another story. Make sure that the wire connected to pin 1 of the first connector is also connected to pin 1 of the second connector.

Cable length can be anywhere up to about 2 meters. I limited my cable to 5 feet and haven't had any crosstalk or noise problems when using the boards in either my 20-MHz 386 or 8088 systems.

Using the System

The best way that I found to bring wires from the Remote Breakout Board to my circuitry is with 12″ to 14″ lengths of ribbon cable terminated on 0.025″ header strips. Since the Data Bus on *JP1*, Chip Select Bus on *JP2* and Control lines on *JP4* each contain eight signals, three eight-wire jumpers do the trick. Since the Address bus on *JP3* contains 10 lines, use a 10-wire jumper (Fig. 9).

When soldering the ribbon cable to the 0.025″ header pins, be sure to

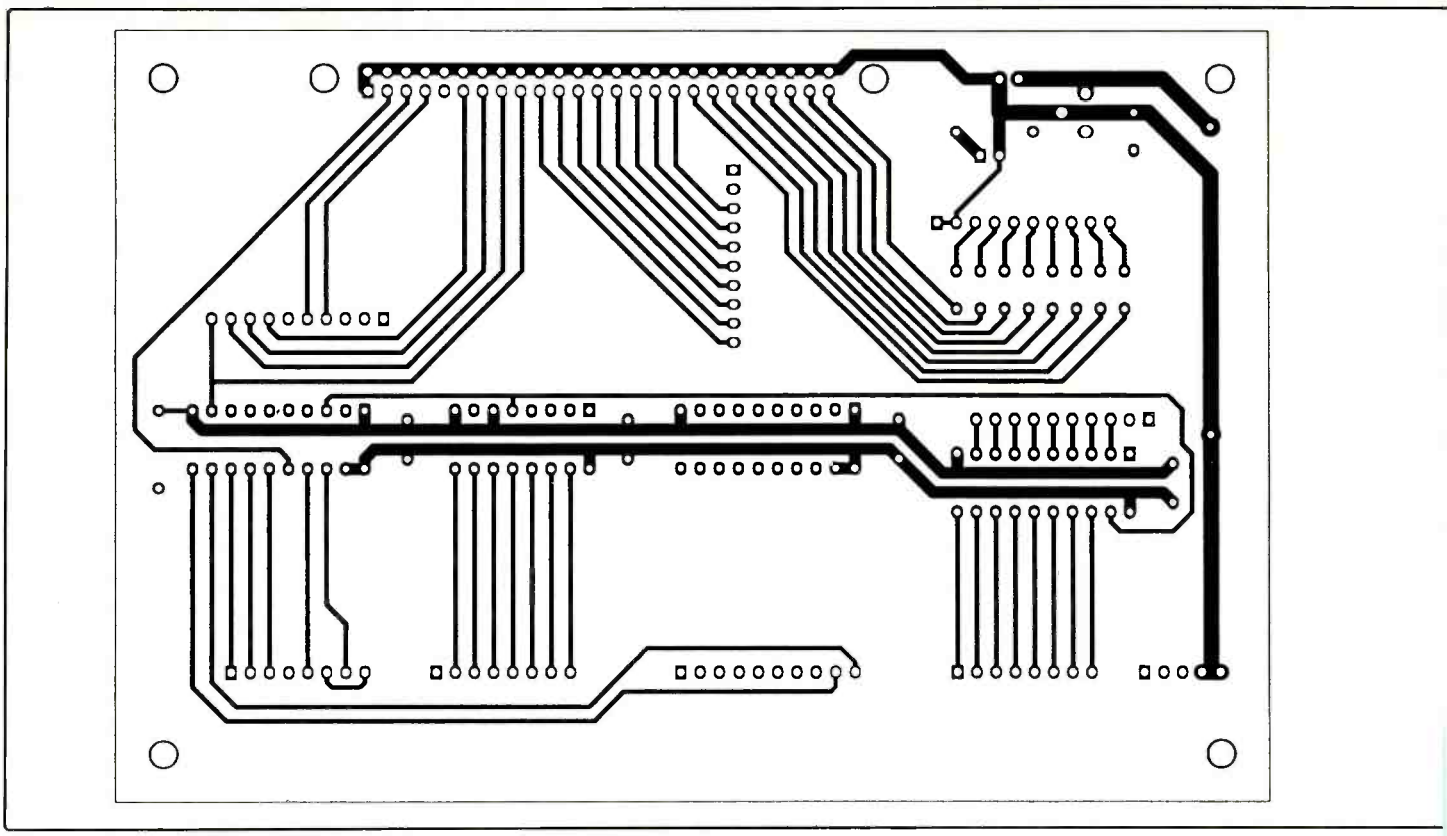


Fig. 7. Actual-size fabrication guides for double-sided Remote Breakout pc board.

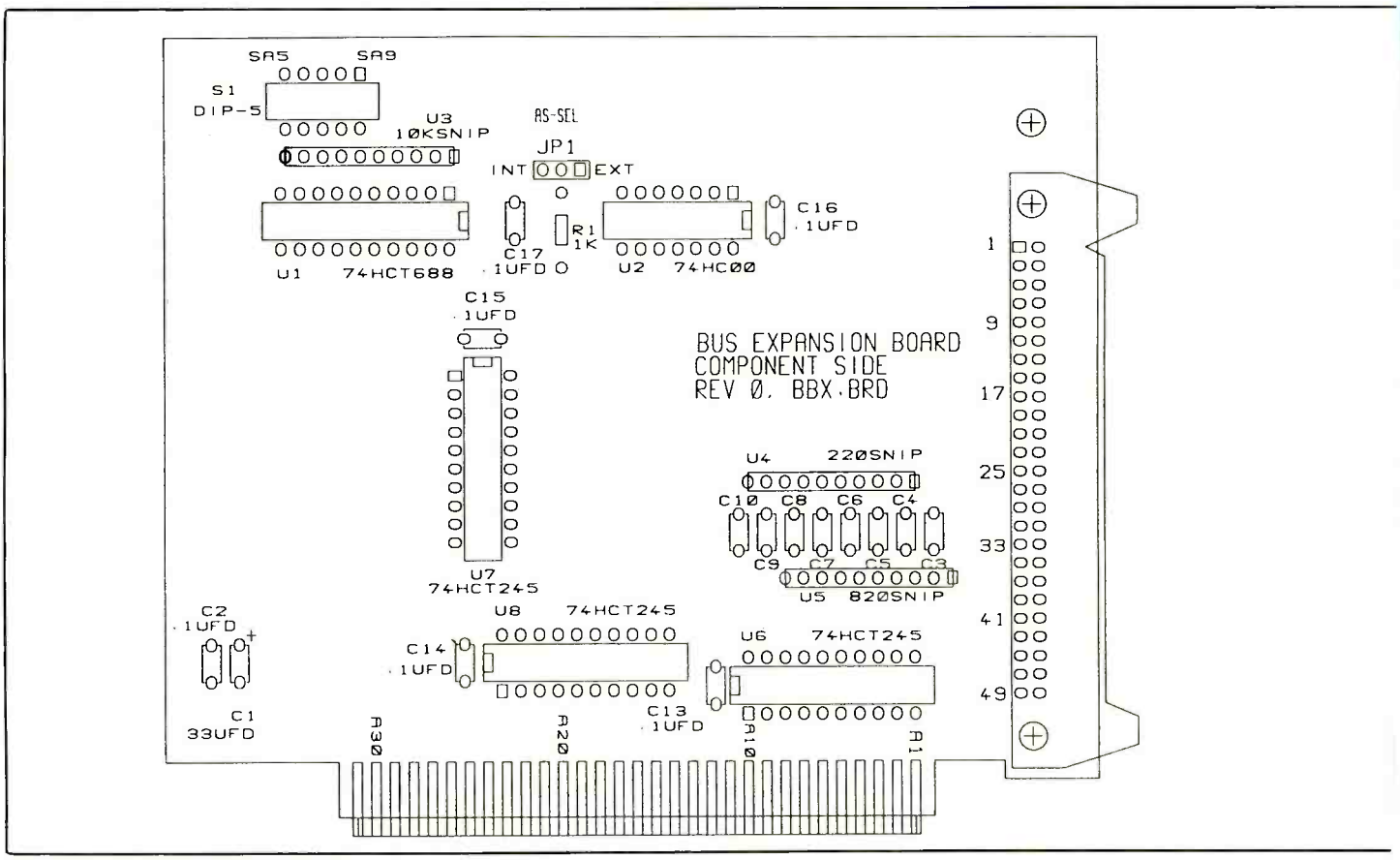
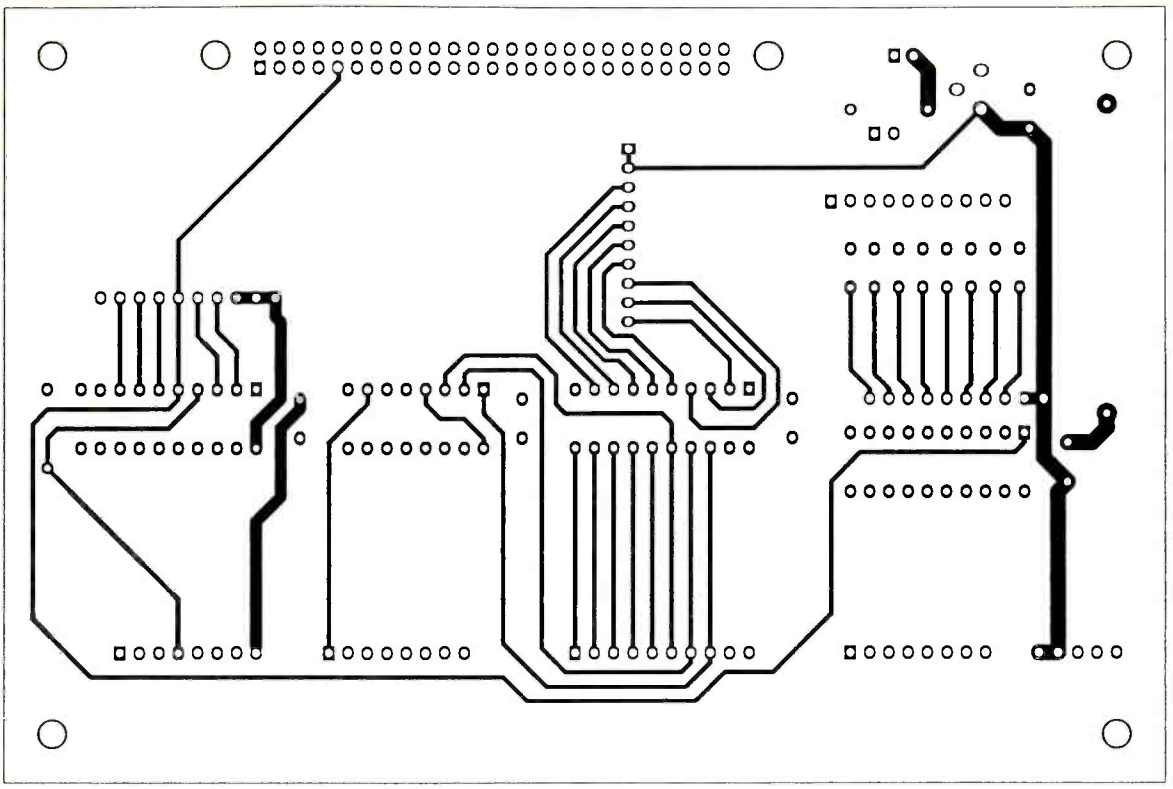
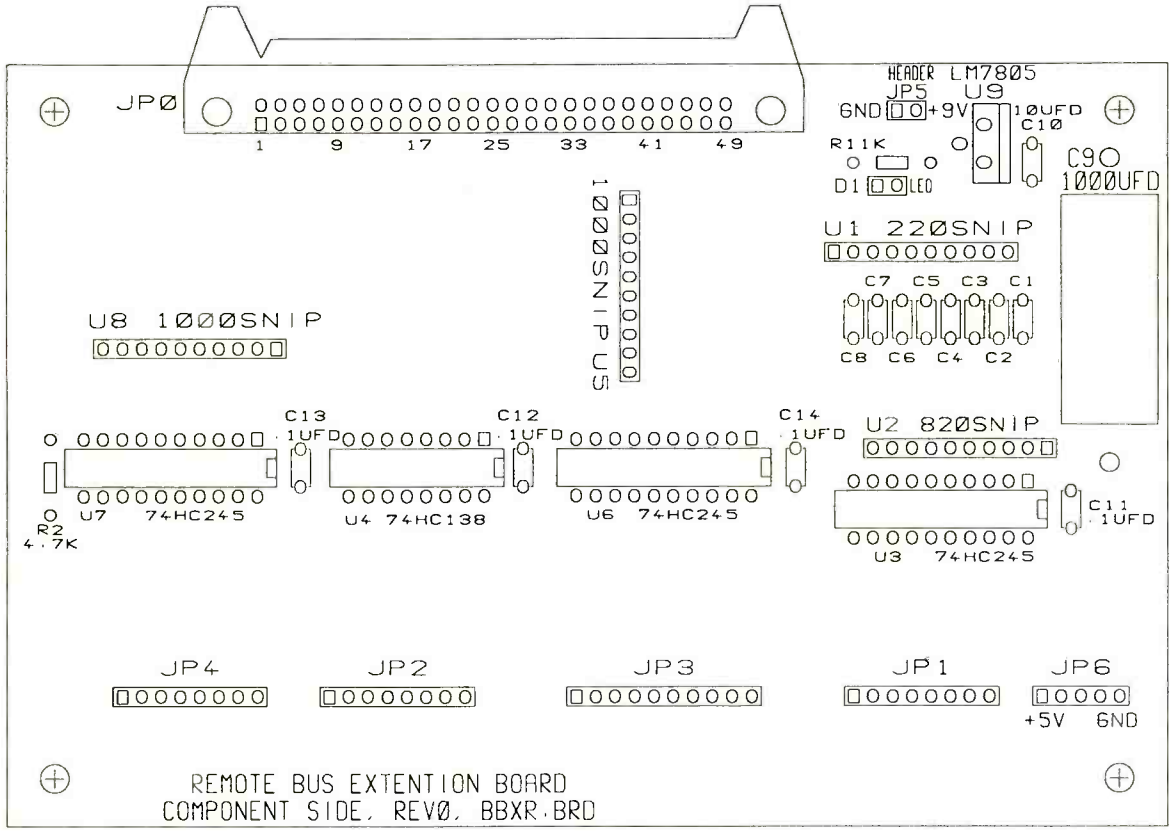


Fig. 8. Wiring guides for (A) Interface and (B) Remote Breakout Boards.





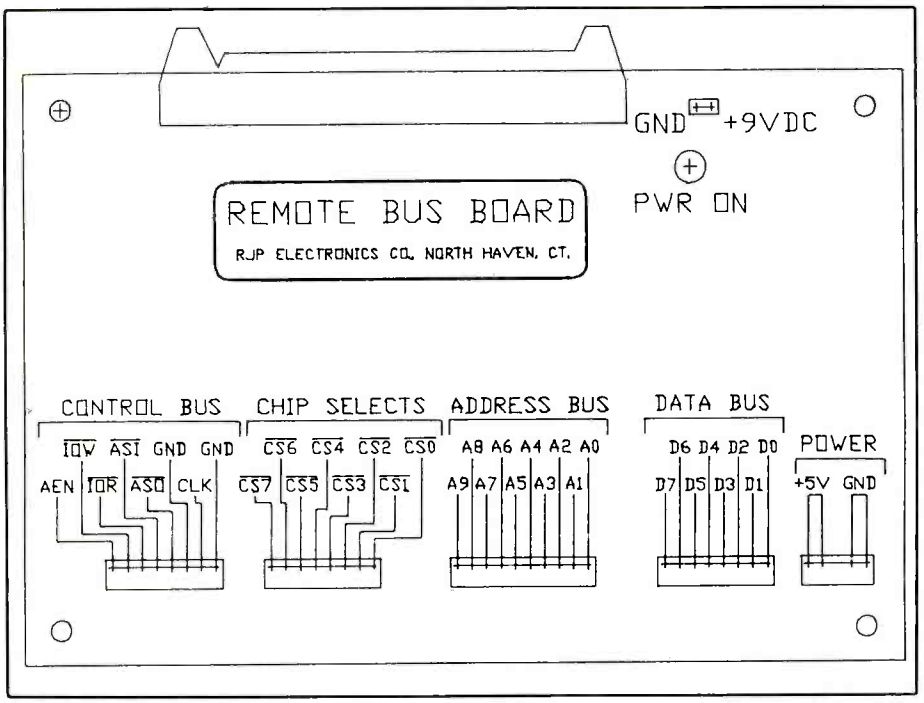


Fig. 9. Remote Breakout Board panel overlay.

place heat-shrinkable tubing over the connections to eliminate the possibility of short circuits between pins.

The sockets selected for the output signals can accept 24-to-26-gauge soiid hookup wire, as well as 0.025" header pins. Thus, if you don't feel like making the jumper cables, you can plug the wires directly into the pins.

The next thing you must do is decide where to put the Interface Board within the I/O space. IBM recommends that it be put at 0300 hex, with SA9 and SA8 open and SA7, SA6 and SA5 grounded. If you're already using this location, find another block of 32 ports that aren't being used by the system and set the five DIP-switch positions appropriately.

Application Examples

The most elementary inputs and outputs for a computer system are switches and lights or LEDs. Let's see what's in-

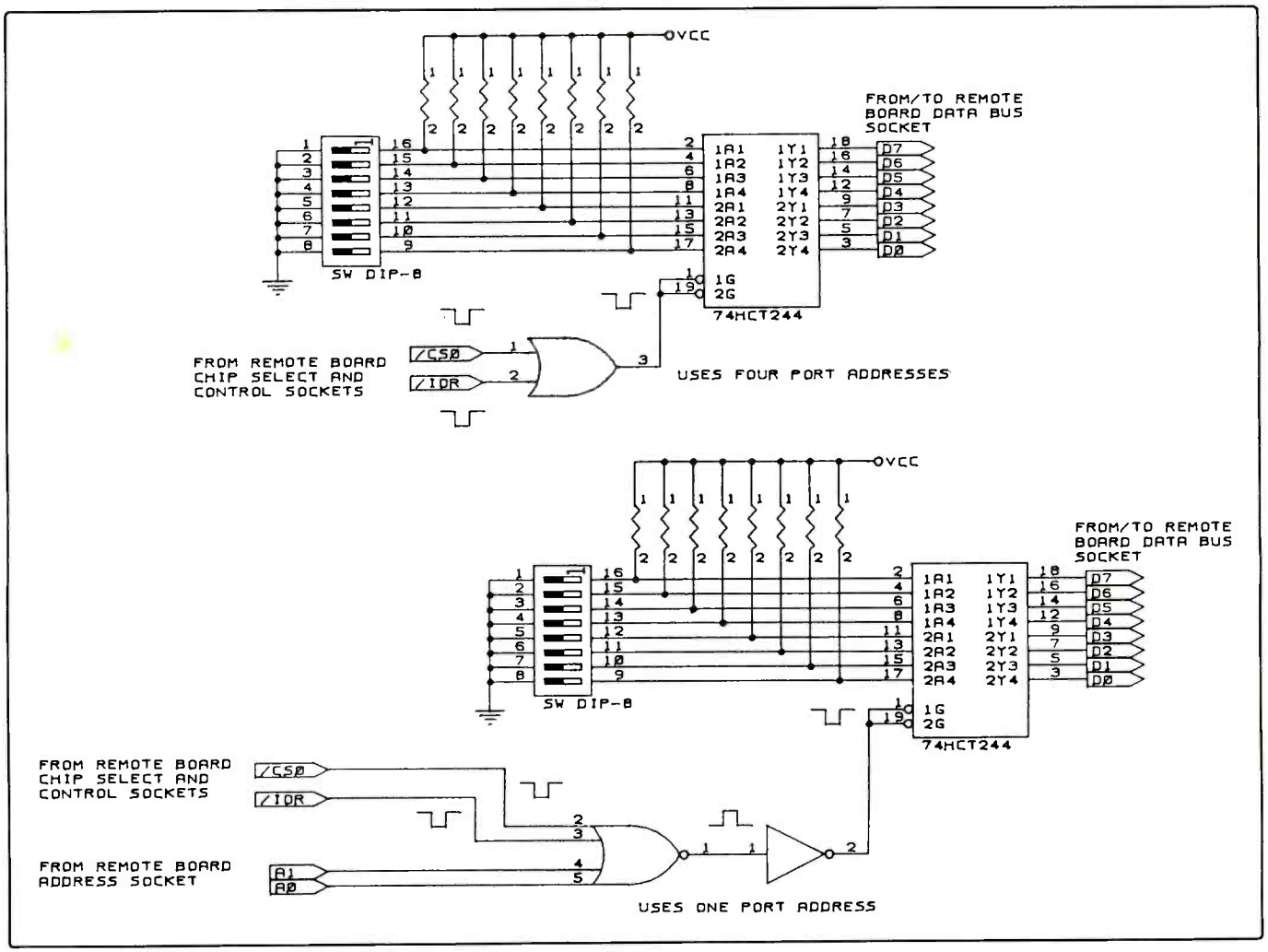


Fig. 10. Application example circuits.

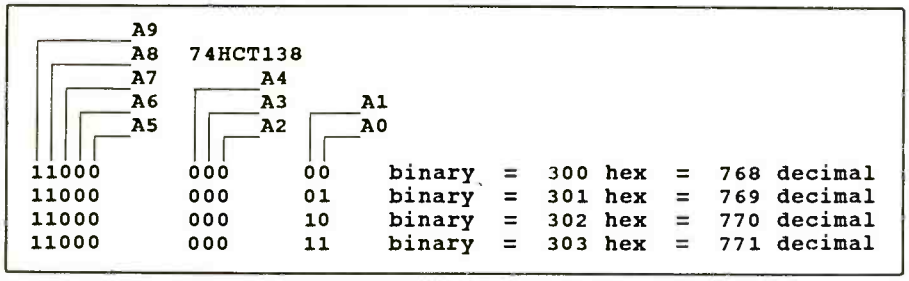


Fig. 11. Example of port selection for 74HCT138.

Listing 1. Simple ADC809 Data-Acquisition Program

```
CLS
'Definitions
  RD = &H300                                    'Read ADC port address
  ST = &H300                                    'Start ADC port address
  EOC = &H304                                   'End of conversion port
  SEL = &H304                                   'Select ADC input

DO UNTIL k$ = "q" OR k$ = "Q"                   'Manual program stop
k$ = INKEY$                                     'Test for stop character
  FOR I = 0 TO 7
    OUT SEL, I                                  'ADC input address
    OUT ST, 0                                   'Start conversion
      DO UNTIL Busy = 1
        Busy = INP(EOC)AND &H1                  'Test for end of
    LOOP                                        'conversion
    DTA = INP(RD)                               'Read data into PC
    LOCATE I + 4, 20                            'Print
    PRINT I;"  ";USING "#.####"; DATA * .0198   'data
    PRINT "Volts"                               'on PC terminal
  NEXT I
LOOP
END
```

volved in reading a switch bank. First, you need a tri-state buffer (74HCT244, LS244, etc.), eight switches and eight resistors in a circuit arrangement like those shown in Fig. 10.

The resistors connect between the buffer inputs and V_{cc} at logic 1, while the switches either short the buffer inputs to ground (logic 0) or, by leaving them open, set the buffer inputs to logic 1s. The outputs of the 74HCT-244 are connected directly to D7 through D0.

To read the switch settings into your computer, you need a port address and then a signal to tell the tri-state buffer to put the data on data lines D0 through D7. The port address can come from the decoded chip-selects coming from the 74HCT138.

Since the '244's output-enable pins (one for each bank of four tri-state buffers) are asserted low, logic 0 at these inputs connect the data switches to the data bus. The only time this action should take place is when the designated port address appears on address lines A9 through A0 and the /IOR signal is low. In short, you must OR the /CSn (n = 0 to 7) and /IOR signals. You can NOR the two signals and then invert the resulting signal, too, as in Fig. 10(A).

Reading the switch bank into your PC is easy. Just assign the value found at the port number to a variable, in this case "Switch," as follows: Switch = INP (&H300) or Switch = INP (768), where 768 decimal equals 0300 hex.

If you aren't too concerned about the number of ports you use up to read a switch, you can forget A0 and A1. By using one of the eight groups of four port addresses generated by the 74HCT138, you use up four ports (see Fig. 11). For example, say you use /CS0 and the Interface Board's DIP switches are set to 11000 binary. Each

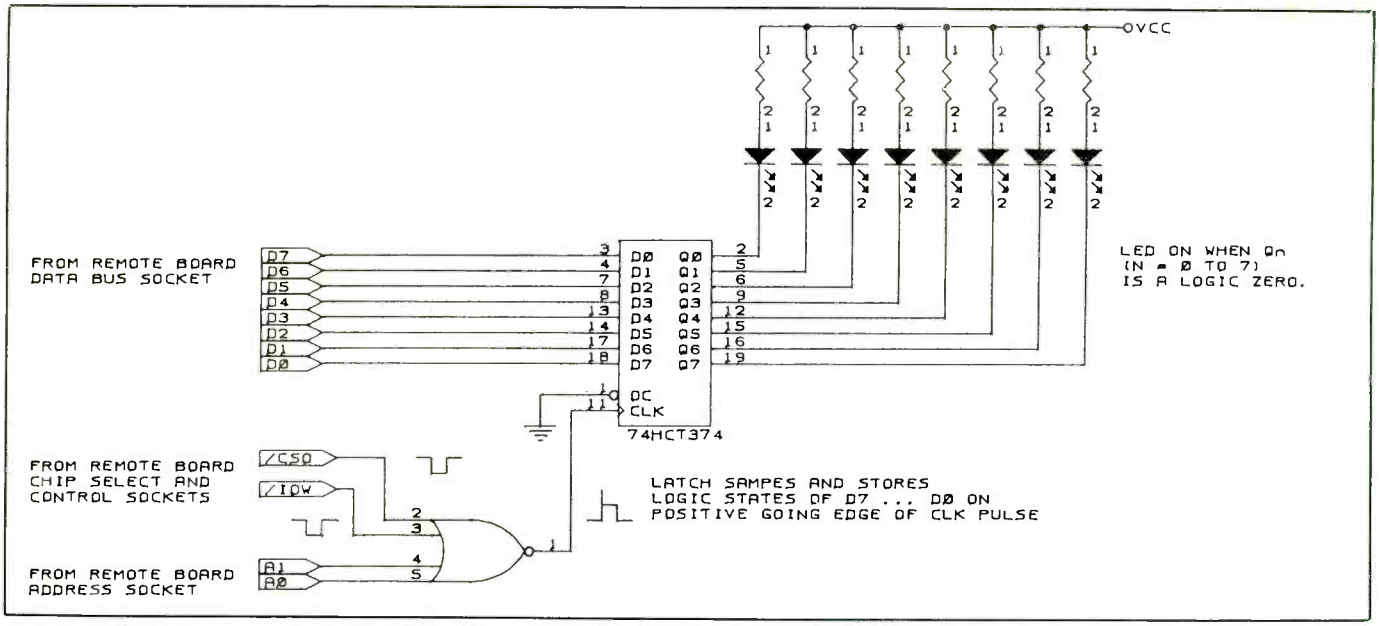


Fig. 12. Classic microprocessor eight-bit output latch circuit.

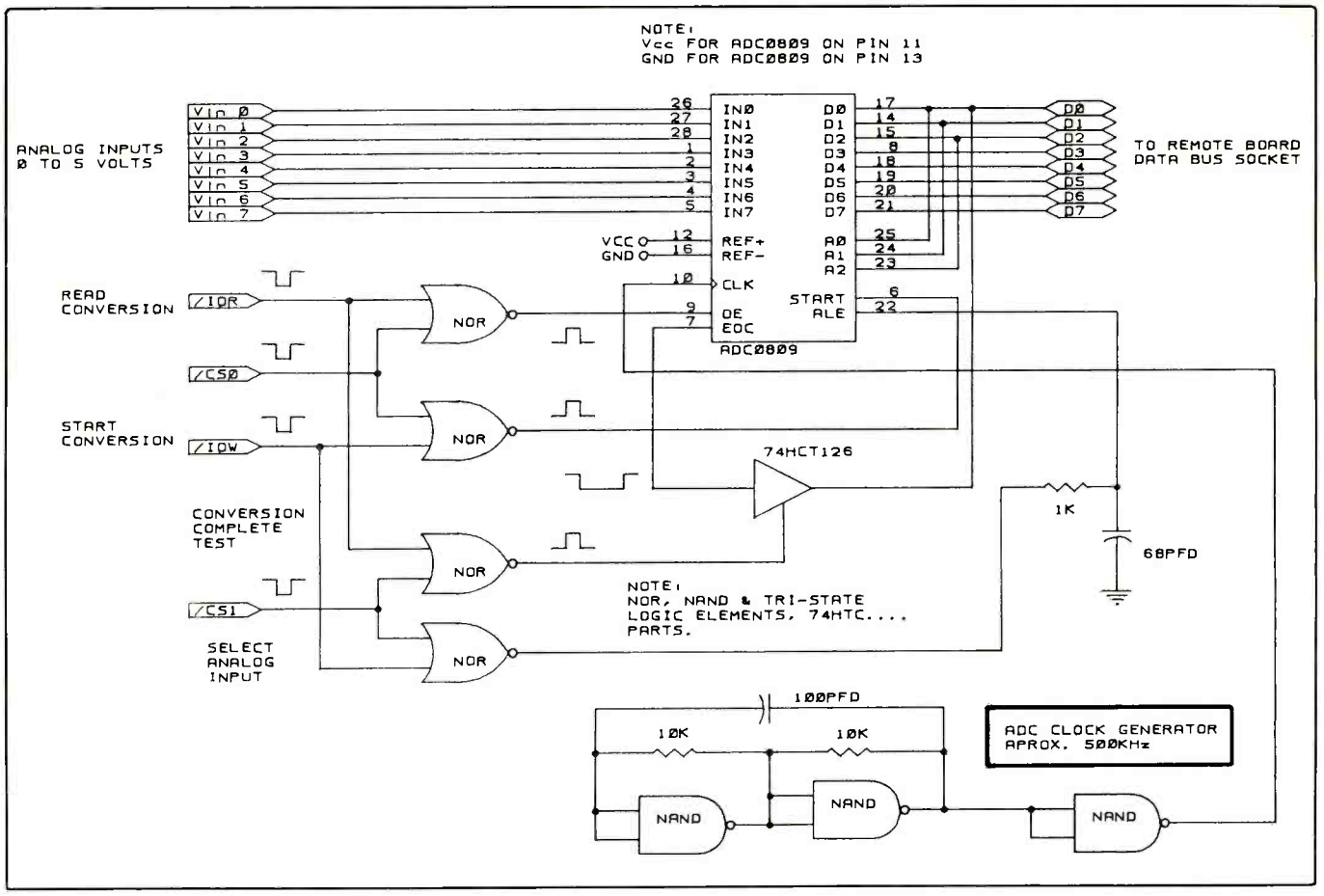


Fig. 13. Wiring details for analog-to-digital interface.

time the I/O address hits, four ports will be enabled. If you want to sort things down to one port, add A0 and A1 to the decoding gates, as shown in Fig. 10(B).

Now let's look at a simple latched output port. The 74HCT374, 74LS-374, etc., is the classic microprocessor eight-bit output latch, shown in Fig. 12 in one workable gating configuration. Here, instead of /IOR, you use /IOW to activate the latch (load data from the interface into the latch).

Now for an ADC interface. The ADC0809 analog-to-digital converter with a built-in eight-channel multiplexer has been around for a while. Figure 13 shows the wiring for this chip. A quad NOR gate, noninverting tri-state buffer, 74HCT00 for a clock generator and 5-volt power supply gives you an eight-input, eight-bit data-acquisition system (sort of). The purpose of this example is to show how chip-select signals are used to control a peripheral device.

Throughout this discussion, the address of the Interface Card is assumed to be set to 0300 hex. Since the converter has eight analog inputs, you need a way of selecting one of the eight. The 0809 has a built-in address latch ("address" is the address of the analog input—*not* the I/O port). You must provide three binary bits on A0, A1 and A2 of the 0809 chip and then pulse the chip's ALE line.

Since the analog input address lines are connected to the data bus at D0, D1 and D2, and the ALE line is connected to /CS1 through a NOR gate, all the computer has to do is generate a simple OUT instruction in the form of OUT (&H304), which is an analog input number (0 to 7).

The ADC then stores the state of the three input address lines. To start a conversion, the computer has to pulse the start input of the chip with the instruction OUT (&H300), which is dummy variable. Dummy variable can be any ASCII character.

So far you've selected a signal to convert and started the conversion. Now, you determine whether or not the conversion has been completed and the data is ready to be read into the computer. Since the converter is operating asynchronously, and interrupt lines back into the PC aren't available, you use polling techniques to determine when the ADC has completed its job. Here's where the 74HCT126 tri-state buffer comes into play.

After the PC has started the conversion, it queries the ADC to find out whether or not the conversion is complete. This is done by reading the EOC (end of conversion) line of the ADC-0809. If the EOC line is low, conversion is still in process. If it's high, conversion is completed. To read the EOC line, the computer has to issue an input instruction in the form of: Busy = INP (&H304).

Now put the three instructions into the simple program shown in Listing 1 that sequentially reads all eight ADC inputs. As you can see, there's nothing complicated here. There are just INP

and OUT instructions and some scaling arithmetic to bring the ADC reading into the real world of voltage measurement.

You may be wondering about the 1,000-ohm resistor and 68-pF capacitor in series with the ALE (address latch enable) signal on pin 22 of the ADC. Because the ADC latch is positive-edge-triggered, the address data, D0, D1 and D2 must be stable when the ALE signal changes from 0 to 1. Unfortunately, this isn't the case. To ensure that the D0 through D2 lines are stable when the latch is activated, the leading edge of the ALE signal must be delayed, which is the task of the RC integrator.

Finally, there are several chips that are quite common in the PC "interfacing" arena. Among them are the 8253/54/C54, 8255/C55 and other 82xx series chips. These chips can be connected to your PC with a minimum of wires and no glue logic, using the interfacing system described here. For example, the 8255 programmable peripheral I/O can be programmed into 24 inputs or outputs or just about any combination of inputs outputs you may need. All you need is a chip-select line, A0 and A1, /IOR, /IOW and, of course, the eight data lines. There's no need for glue logic.

The same holds true for the 8254 programmable interval timer, which consists of three 16-bit counters that can be set up to do all kinds of fancy tricks. With a little imagination, the 82C54-2 (10-MHz version), fast CMOS four-bit binary counter, 10-MHz crystal oscillator and high-input-impedance FET amplifier, you can build a fair to middling 100-MHz frequency meter.

The 8255 coupled to a pair of D/A converters plus some op amps, a couple of LM317s and a multiplexed eight-bit ADC can be forged into a nice dual programmable power supply with voltage and current monitoring an current limiting.

As the saying goes, applications to which this project can be put are limited only by your ingenuity and imagination.

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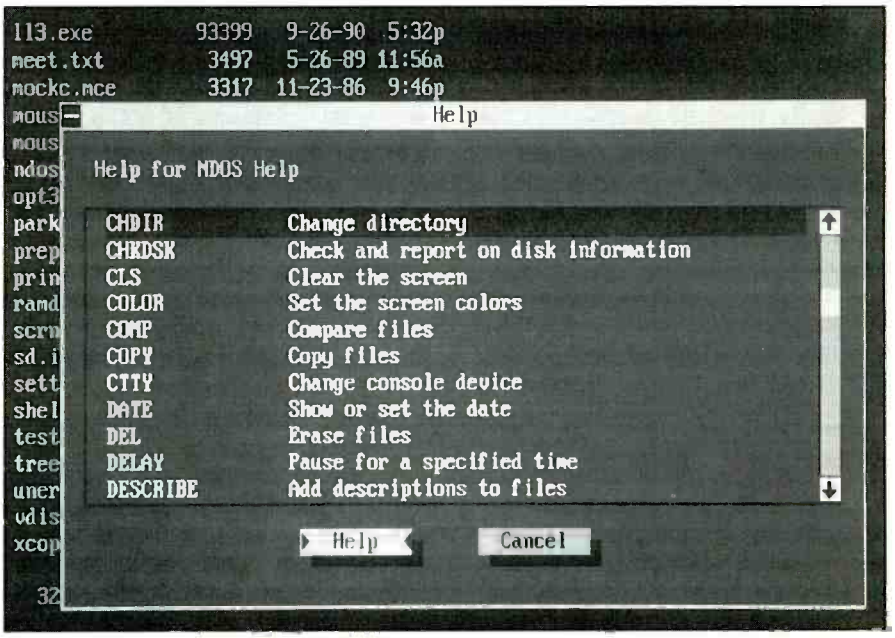
Ten Ways to Turbocharge Your DOS Command Line

If you're a dedicated DOS user, we'll show you how to add plenty of command-line power to keep *Windows* at bay just a little longer

There's no getting around the fact that DOS is an austere, kludgy and hard-to-use 10-year-old operating system that's hardly more than a relic of its 1960s and 1970s ancestors. Even so, there's a lesson in the numbers. According to a major computer magazine, 90% of PC users continue to use DOS as their primary operating system. While graphical user interfaces (GUIs) like Microsoft *Windows* will become increasingly popular in business and home computing environments, it's unlikely that MS/PC-DOS will truly die for a long time to come.

Consider that *Windows* isn't yet a complete operating system and won't be at least until *Windows NT* comes along. In fact, *Windows* is simply a comprehensive user interface—a shell—that overlays DOS and works hand-in-glove with it. With its austere command line, DOS still is the speedy, low-overhead, text-based operating system of choice on IBM PC and compatible computers and probably will remain until something better comes along.

If you've been using MS/PC-DOS for any length of time, you probably already know that it's all about batch files, commands, macros and power. So with this in mind, the following ten tips and suggestions may just prompt you to make *Windows* wait just a bit longer.



The "ultimate DOS enhancer" is actually an older version of *4DOS*, *NDOS* is part of the *Norton Utilities*. One of the most-useful features of *NDOS* is its pop-up help for DOS commands that takes no additional memory. You can immediately jump to information on the DOS command you're using or obtain help on any DOS command by scrolling through the index. (Photo courtesy Symantec Corp.)

Putting Windows on Hold

In this roundup, I suggest ten improvements you can make to DOS to supercharge its command line. These include managing the command line better; enhancing COMMAND.COM; extending and compiling batch files; finding files better; using a DOS shell without giving up the DOS prompt; accessing DOS from within programs; managing boot configurations; adding device drivers from the command line; browsing your hard disk; and using *Windows*-like options, such as the *Norton Desktop for DOS*. Let's jump right in.

1. *Manage the DOS command line better.* DOS 5.0 has reduced the need for many DOS-enhancement tools and utilities, especially command-line editors, macro generators and batch-file enhancers. The upcoming DOS 6.0 should offer even more. But users of earlier versions—and even DOS 5.0 users who have a fair editor and RAM-based macro generator in DOSKEY—can benefit from a third-party command-line editor to minimize keystrokes.

A command line editor literally allows you to edit the command line. The typical editor does much more. It also lets you recall earlier commands you've issued so that you can execute them shortcut-style with just a few keystrokes. Most editors also let you create synonyms or aliases to assign a word or even a single letter to represent complicated commands.

One of the best such editors is Chris Dunford's *PCED*, a 24K terminate-and-stay-resident (TSR) utility (4K if you have expanded memory available). *PCED* makes the command line a pleasure to work with. Its features range from basic recalling, scrolling through, editing and re-issuing of commands used in a previous DOS session, to generating complex batch-like commands. *PCED* is available for $54.50 from the Cover Software Group. The shareware version is *CED*.

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A popular shareware editor with comparable features is *ANARKEY*, which was the first to use expanded memory to make its conventional DOS memory overhead low. Like other shareware software, you can obtain it from disk vendors or download it from bulletin board systems (BBSs) or on-line utilities. Its registration fee is $25 from Steven Calwas at Moderne Software, PO Box 3638, Santa Clara, CA 95055.

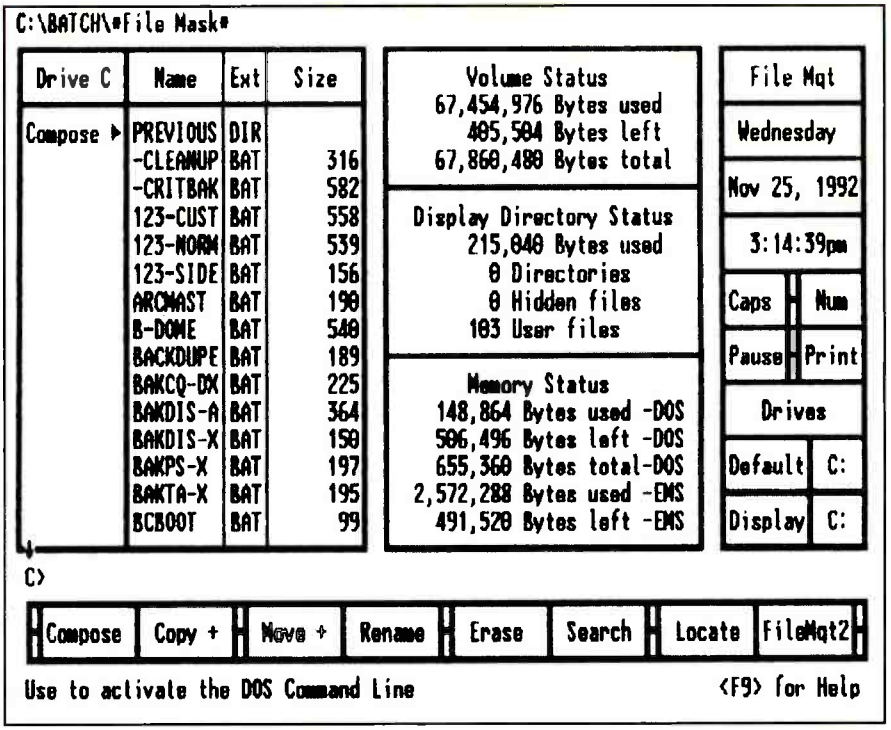
You also can find many of the features of *PCED* and *ANARKEY* in DOS's free but relatively limited command line enhancer, DOSKEY, and in the more-complicated, full-blown COMMAND.COM replacements, *4DOS* and *NDOS*.

2. *Enhance COMMAND.COM for a more powerful DOS.* Some DOS utilities actually do a better job at being DOS than does out-of-the-box DOS itself. One such program is *4DOS*, which is a more-powerful and smarter replacement for COMMAND.COM, DOS's own default command interpreter. Many users swear by *4DOS* and consider it to be "the DOS that could have been." While it's a shell (a program that serves as an interface between you and the operating system, letting you access DOS functions and commands), it's not designed to isolate you from the command line as do many graphical shells. *4DOS*, with its command-line stacking and aliasing features, is intended to make DOS much easier and more-productive to use.

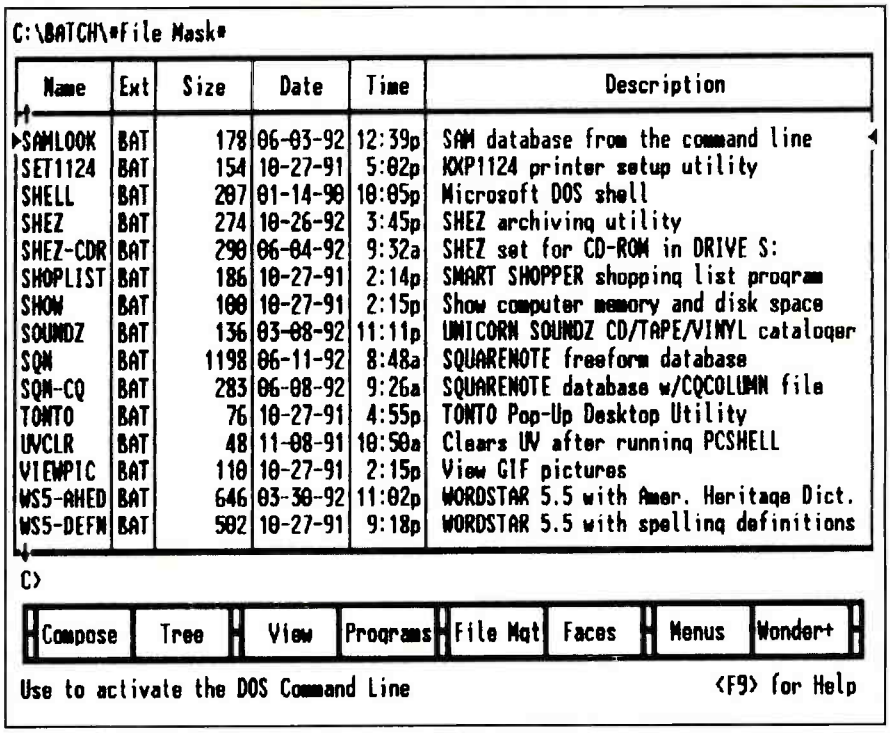
4DOS offers many enhancements over DOS—even DOS 5.0, with which it's fully compatible. Features include command-line editing and recall, more-powerful batch files, aliases that can include variables and even call other aliases, comprehensive on-line help, a timer, a file lister, a program-logging function, dozens of enhanced DOS commands, and at least 35 new DOS commands that give you unprecedented power and file information.

One measure of the popularity of *4DOS* is that it has spawned many third-party add-in programs, including a full-screen editor and a disk cataloger. *4DOS* is shareware (registration fee is $69). It's available from Rex Conn and Tom Rawson at J. P. Software, Inc.

4DOS has proved so good that software juggernaut Symantec has bundled an earlier version of *4DOS*, which it calls *NDOS*, with *The Norton Utilities* 6.0. NDOS, like *4DOS*, works with DOS 5.0 and earlier versions, has pop-



The beauty of the *1dir+* shell is that it provides point-and-shoot simplicity with unrestricted access to the DOS prompt, even on-screen with the shell in use. Thus it doesn't insulate you from DOS or place a straitjacket around your ability to work directly at the command line. The *1dir+* "statistics face," illustrated her is one of 10 distinct faces the program provides.



As hard-disk capacity and the number of files has increased, the 11-character DOS limit on filenames has proved inadequate. Like *4DOS*, *1dir+* lets you enter extended file descriptions—38 characters for *1dir+*, 40 characters for *4DOS* and *NDOS*. Full access to the DOS command line lets you launch programs from the DOS prompt and copy filenames and recently used commands to it.

up context-sensitive help, and offers flexible wildcards, command-line history and editing with an "audit trail," minimal memory usage, and more. It's a freebie with the $179 *Norton Utilities* from Symantec Corp.

3. *Extend, automate and compile your batch files.* DOS programmers have invented tools to improve batch files ever since DOS first appeared. If you make extensive use of batch files to automate your DOS sessions, you can make them more powerful and flexible by using various utilities to make DOS's repetitive tasks hum. The extended batch language such programs offer is actually a simple programming language that gives you additional capability to fine-tune and control the batch files you use.

Two excellent batch utilities are *BATUTIL* and *STACKEY*, companion programs. Using them, you can automate more tasks than is possible with DOS alone, even with DOS 5.0's *DOSKEY* macros.

STACKEY "stacks" keystrokes to be replayed in subsequent programs. With it, you can place all keys in the "stack" for the next program to read. It can even duplicate many of the more-unusual key combinations, in addition to the alphanumeric and function keys.

STACKEY can accept batch variables, delays, drive and path, date and time and other parameters; interact with other programs; flush the keyboard buffer; support pop-up messages that request and accept user responses; control screen mode; and dump screens to a printer or disk file.

STACKEY is packaged with *BATUTIL*, a companion that gives batch files elaborate menus, color and music; retrieves system and file information; and extends your path from the normal limit of 127 characters to 255 characters. *BATUTIL* also can obtain such parameters as the current time and date, memory and free disk space, and CPU type. Both utilities are from CtrlAlt Associates, Ste. 133, 260 S. Lake Ave., Pasadena, CA 91101. They're distributed together for $39 by the Support Group, Inc.

If you use *The Norton Utilities*, you'll find Batch Enhancer, or BE, bundled with it. Though not as powerful as the *STACKEY* and *BATUTIL* combo, *Norton*'s BE, with 17 new commands, lets you create simple menus for accessing applications; increase flexibility in AUTOEXEC.BAT file tasks; automate commonly used command sequences; add input control, graphics and sound to batch files; and perform functions on a particular date. Batch Enhancer is but a small part of *Norton Utilities* 6.0.

If you find yourself creating really long and complex batch files, consider compiling them. Doing so makes them run faster than regular batch files and protects your source code from prying eyes. Another, less-obvious advantage of compiling batch files is that compilers solve the "batch file missing" problem since the batch program resides in memory. Also, compiled batch files don't need to be called with the DOS CALL statement.

Take a look at *BATCOM*. It's a capable batch file compiler that supports more than 60 commands and enhancements in addition to plain-vanilla DOS—there are commands for arithmetic, file, disk, string and keyboard functions. It's $59.95 from Wenham Software Co.

4. *Find and manage your files better.* When you have a 200M or larger hard disk, a big problem can result when you can remember a file name (or part of it) but not the directory in which it's locat-

ed. You can spend lots of time searching your hard disk for the file, using the limited tools available in DOS. But you need not do this because there are several stand-alone file finders you can use to handle this problem. One of the best and fastest is Jim Derr's *File Finder*, part of his *File Finder Pack*.

File Finder effortlessly locates files on all your hard disks, including networked drives. Numerous search options are available, including searching for files using expanded wildcard specifications. Also, the filespec you specify on the command line can include a disk and directory to restrict the search.

File Finder displays all the files it finds, up to its internal maximum of 3,000, and displays their filenames on-screen in a scrollable list. You can run any program—whether a DOS internal program or an EXE, COM, or BAT file—against all tagged files. This capability, plus the ability to search for duplicate files, makes the *File Finder* program great for hard-disk housekeeping and file management.

The registration fee for the *File Finder Pack* is $25. It's available from California Software Design.

5. *Use a DOS shell but don't give up the DOS prompt.* Using a DOS shell helps you manage files—something DOS really doesn't do so nicely—as well as insulates you from DOS. Unfortunately, many shells disconnect you from DOS, and there are times—even if you use *Windows*—when you must work at the DOS prompt, or it's faster to do so. Some shells, like *1dir+*, don't have this drawback.

1dir+ is a capable, low-overhead but highly configurable and intuitive utility for integrating all of your computer operations and applications in one consistent and comprehensive environment. It's a seamless combination of point-and-shoot shell, custom menuing and hard-disk management features. Some of its best attributes are global file operations over multiple directories; extensive customization capabilities, including 10 screen "faces" that display different information about files and directories; individual directory "personalization"; a pop-up command library; and extended filename descriptions. *1dir+* has more than 75 built-in commands that provide almost anything you might need from the simplest to the most complex DOS operations.

Best of all, most screen faces keep the DOS prompt on your screen. The shell is unobtrusive and doesn't restrict access to DOS at all. There's even a distinct "DOS face" that's actually a simulated DOS prompt that's for users who like to work with DOS directly and want a clean screen but also want the *1dir+* features available to them.

1dir+ V3.51 is available from dealers for $95 or from Bourbaki, Inc. for the same price. (Incidentally, Central Point Software's *PC Tools Desktop*, as well as Symantec's *The Norton Desktop for DOS* and several other shells, also let you access the DOS command line. But few shells do the job as transparently as does *1dir+*.)

6. *Access DOS from within applications with* POPDOS. How many times have you been stuck within an application program and were prevented from issuing a simple DOS command because the application won't let you shell to DOS? If this is one of your banes, consider *POPDOS*, a small (6K) but very convenient TSR utility. It can pop up on keystroke command over almost any non-graphics program; so you can issue a DOS command from within the program—even within programs that don't

havea built-in provision to shell to DOS.

POPDOS is a swap-able TSR. When its hotkey is pressed, it swaps out applications loaded after it and swaps itself in, to present you with a DOS command line. This lets free memory at this command line range from 30K to more than 600K, depending on when and how *POPDOS* was loaded.

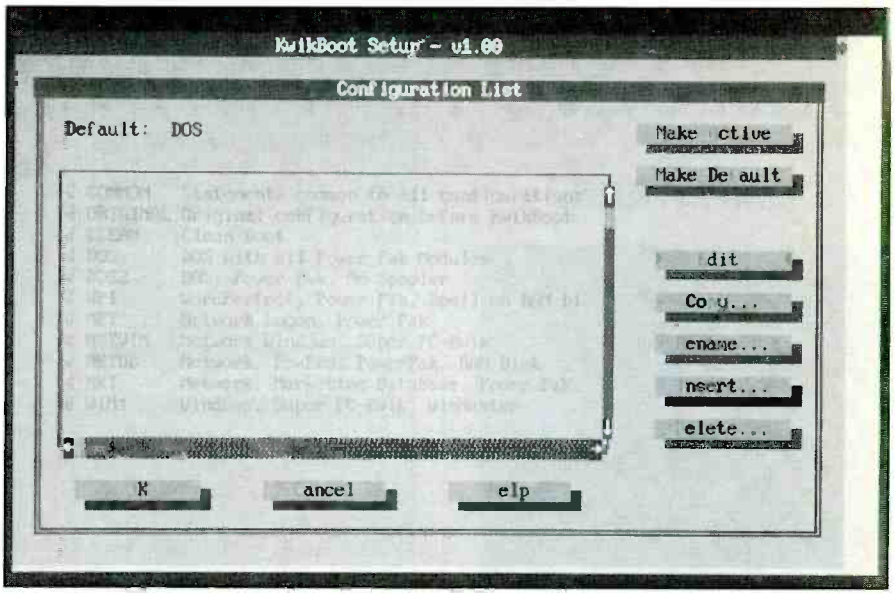
There's no registration fee for *POPDOS*. Look for it on your favorite BBS. It's from the same folks who introduced the *TSR Utilities* (*MARK* and *RELEASE*) to control TSRs: TurboPower Software.

7. *Manage multiple boot configurations with ease.* One of the most-frustrating things about DOS is the way the CONFIG.SYS file works. If you make a change to the file, you have to re-boot your PC to have the change take effect. Keeping tabs on the AUTOEXEC.BAT file is almost as annoying. Maintaining multiple configurations via these two files (such as for DOS and *Windows*) is a pain and can be confusing. What's needed is a simple and convenient method of selecting the desired system setup at boot time, without having to use multiple, manually selected configuration files.

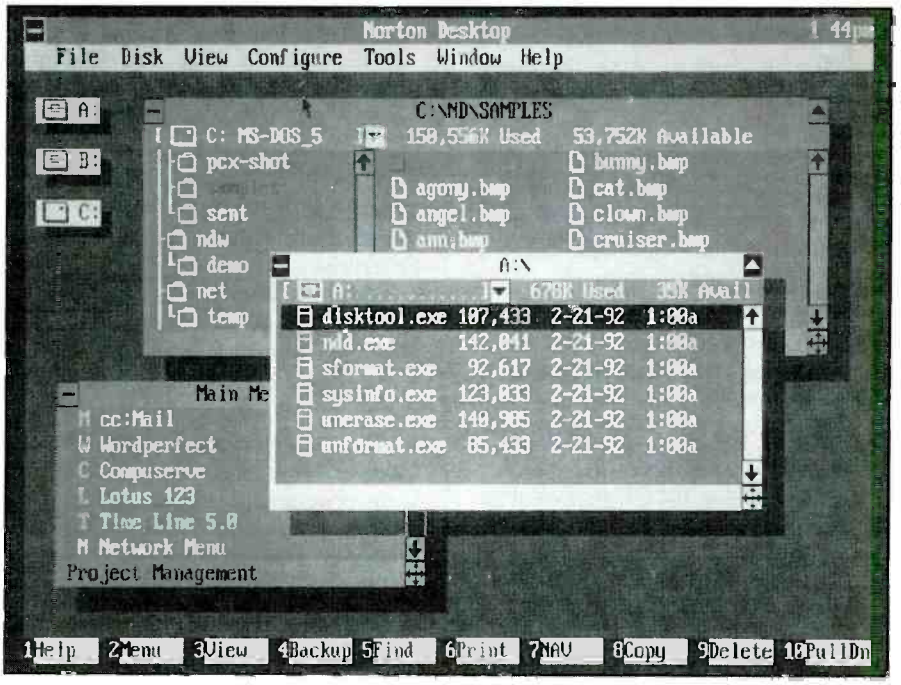
Several utilities address boot configuration control. One slick commercial product is *BOOTCON*. It's a device driver that effectively replaces the continual editing or swapping out of your CONFIG.SYS and AUTOEXEC.BAT files with a single step. *BOOTCON* runs during each boot, and it doesn't clutter your disk with multiple configuration files. Your alternate configurations are stored in a single set of configuration files, and *BOOTCON* intelligently "reads" the previously set up embedded formatting codes (called "configuration blocks") during each boot.

Once you've set up the program, on each boot *BOOTCON* presents you with a menu of up to 26 configurations, which you can set up based on hardware, software and memory options, as well as personal work preferences. If you do nothing, the PC completes the boot-up operation, using your default configuration. If you intervene, you can menu-select any of the configurations. The $59.95 program is from Modular Software Systems.

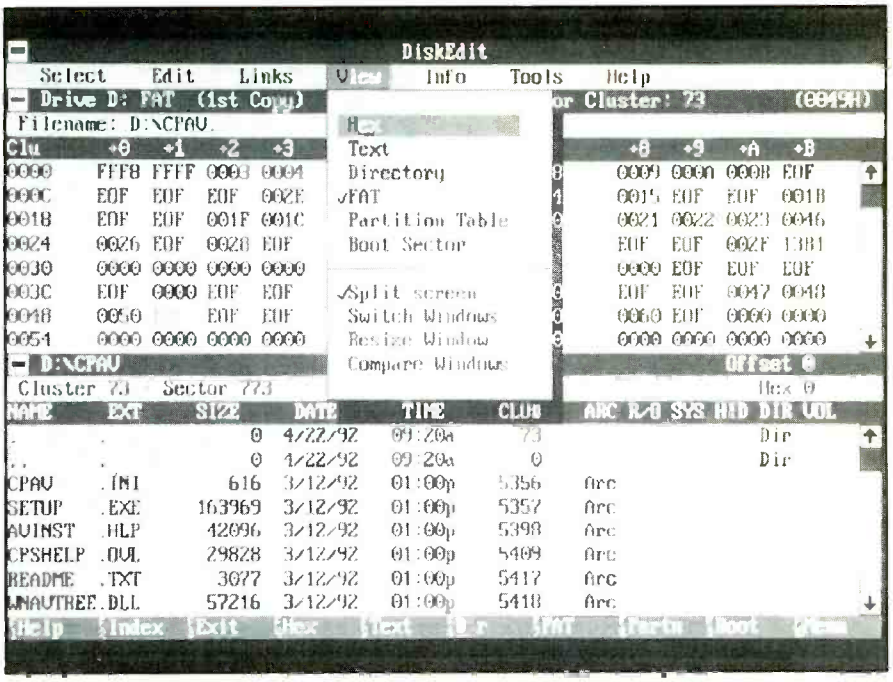
If you go the shareware route to PC configuration control, consider *AUTOCON*, a straightforward database manager for your AUTOEXEC.BAT and CONFIG.SYS files. *AUTOCON* lets you keep up to 50 different configurations and change easily between them. It keeps all the configuration file sets in a single datafile and "writes out" the current set as the one the computer should



The main text discusses *BOOTCON*, but you should be aware that other comparable boot configuration-control utilities are available. The latest version of PC-Kwik's *Power Pak* includes *Kwik Boot*, which gives you an easy way to set different boot configurations and quickly choose the one you want from a menu when you boot your computer. The utility displays up to 26 system configurations. The *Power Pak* also includes keyboard and screen accelerators, a disk cache, disk reorganizer, print spooler, and more. (Photo courtesy PC-Kwik Corp.)



The *Norton Desktop for DOS* (*NDD*) offers easy, visual access to DOS but still gives you ready access to the DOS prompt. Bundled with the program are some of the most-needed utilities drawn from the *Norton Utilities*. *NDD* also includes computer virus protection-and-repair capabilities, as well as hard-disk backup. (Photo courtesy Symantec Corp.)



Central Point Software's *PC Tools Desktop*, as well as Symantec's the *Norton Desktop for DOS* and several other shells, let you access the DOS command line. PC Tools includes more than 30 advanced DOS utilities in a single integrated package. Shown here is DiskEdit, which lets experienced DOS users view and edit data on disks, including system and data areas. (Photo courtesy Central Point Software, Inc.)

use. The easy-to-use program is available on computer bulletin boards (BBSs). Registration fee is $15 ($23 with disk). For more information, contact Larry Weaver.

Other popular shareware configuration control programs are *BOOT.SYS* and *DYNABOOT*. The *BOOT.SYS* registration fee is $39, from Hans Salvisberg, Bellevuestr. 18, CH-3095 Berne, Switzerland. *DYNABOOT*'s fee is $15 from Matthew J. Palcic at MJP Enterprises.

8. *Add device drivers from the command line.* With *Dynamic Memory Control* (*DMC*) you may not even have to maintain multiple CONFIG.SYS files to handle alternate driver configurations. It's a nifty tool that lets you reliably load and unload device drivers and memory-resident programs on the fly without the need to re-configure and re-boot your computer.

The program solves the problem of juggling such resources as device drivers, multiple RAM drives, TSR programs and memory managers. Instead of having different CONFIG.SYS files and re-booting your PC to accommodate different applications' configuration requirements, you can load and unload resources on demand. This capability lets you work interactively with device and network drivers and TSRs from DOS—you can even add *DMC* to a DOS batch file or menuing system. Several utilities are furnished, including one to convert any device driver or TSR into a self-removable TSR you can unload from memory at any time.

While *DMC* normally runs from the command line, it includes an interface of pull-down menus you can work with a mouse or cursor keys. A memory-display program maps the contents of all the different types of memory on-board your PC. The program even works with a variety of memory managers, including DOS 5.0, *QEMM* and *386MAX*. *DMC* costs $79.95 (U.S.) through software distributors or from Adlersparre & Associates, Inc.

9. *Browse your way through your hard disk.* Another useful favorite is *BrowseMaster* (*BRM*), a powerful file-browsing utility that makes viewing files swift and painless. Besides its capability to browse almost any type of file, ASCII or binary, up to 2G bytes, *BRM* provides extra features to locate and select target files.

You can freely change drives and directories through use of pop-up file and directory-tree lists. Also, the pro-

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Note: Hans Salvisberg's *BOOT.SYS*, though shareware, also is available through **J.P. Software**, publishers of *4DOS*.
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gram supports building a sequence list of files to browse. Once the list is built, the files are sequentially loaded into the browser with a single keystroke.

Best of all is that *BRM* can read the directory of a PKWARE ZIP file and display it in a pop-up window, with the directory being viewed like a DOS file list. By placing the cursor bar over the target file and pressing return, *BRM* calls PKUNZIP.EXE (not supplied) to decompress the file for browsing. You also can unZIP an individual compressed file by placing the cursor bar over it and pressing a control-key combination.

Shareware registration fee for *BRM* is $25 from New-Ware.

10. *Do* Windows *without* Windows. If you're happy with DOS but think you may go to *Windows* eventually, consider *The Norton Desktop for DOS, NDD*. *NDD* is a DOS shell, a graphical user interface (GUI) and menuing system that gives DOS users *Windows*-like visual drag-and-drop file management, along with a full set of disk and file utilities. And it's refreshing to know that Symantec is expanding the DOS frontier. *NDD* is probably the first case of an original *Windows* package being rewritten for DOS.

NDD breaks new ground for DOS users who are no longer satisfied with DOS alone but are not yet ready to move to *Windows* 3.1 or OS/2. *NDD*'s *Windows*-like interface uses the same commands as Microsoft *Windows*, and it has similar features, thus providing some "training wheels" for a later move to *Windows*.

NDD is a flexible application that functions much as a super-smart DOS shell, presenting you with an intuitive visual desktop to manage files and run programs with point-and-shoot simplicity. Without using DOS commands, you can move, delete, copy, print, view, back up and scan for viruses, using a mouse or keyboard to click, drag and drop. However, you can issue DOS commands and launch applications from a command-line prompt, even when the *Desktop* menus and drive windows are on-screen. Included are several "disaster-recovery" programs drawn from the *Norton Utilities*, plus the *Norton Backup* and the *Norton AntiVirus*, as well as other nice-to-have utilities.

Summing Up

Review the 10 tips and suggestions presented here, and take the time to become familiar with DOS and its real potential for enhancement. If you do, you'll be well on your way to mastering the command line—and making its everyday use a joy, rather than a necessary chore. Who knows, you might even become a confirmed DOS maven who'll never look a -style GUI straight in the eye. And you may find an enhanced DOS a lot friendlier and more cooperative in helping you get your work done. So take one or more of these tips to breathe new life into DOS. ■

Circuit Construction Techniques

The choices you have and tips on when and where to use each available option

When you have a circuit design you're ready to translate from paper or computer screen to a real-life working project, you can choose from several methods of construction. Your options include solderless breadboarding, Wire Wrap and similar techniques, point-to-point soldering and designing and making a printed-circuit board. In this article, I'll look at the advantages, limits and costs of each method, as well as how circuit and component types can affect available options. I focus here on projects that require a single copy of a circuit, either as a one-of-a-kind project or a prototype for a product that will later go into wider production.

Component Choices

The components you use in your circuits will determine the construction methods available to you. Most traditional prototyping methods are designed for use with through-hole components. These include the familiar DIP (dual-inline package) ICs and other components that have leads intended for inserting into holes on a printed-circuit board.

Through-hole components have been popular for years, but many circuits are now making use of surface-mount components as an alternative. A surface-mount component rests entirely on one surface of a circuit board, with its leads or terminations soldered to copper pads on this surface.

Unlike through-hole circuits, which have a component (top) side and a solder (bottom) side, in a surface-mount circuit, component and solder sides are one and the same. Figure 1 illustrates circuits that are built with through-hole and surface-mount components, along with the printed-circuit boards for the circuits.

Because surface-mount components don't have through-hole leads or pins, you can't insert the components directly into perforated board or solderless breadboards that are intended for through-hole components. Most surface-mount circuits must be built directly on printed-circuit boards.

If a design has just one or a few surface-mount components, there are adapters that allow you to use through-hole prototyping methods. In fact, making adapters for the many package types has developed into an industry in itself. For example, the PLCC (plastic leaded chip carrier) is a popular square surface-mount IC package that has leads on all four sides. Although through-hole sockets for PLCCs are widely available, the arrangement of the pins prevents you from using the sockets on boards that are designed for ICs that have two parallel rows of leads. To solve the problem, you can buy adapters that contain a PLCC socket with the leads brought out to two parallel rows of pins with 0.1" spacing. Such adapters are available from Jameco, JDR and other suppliers.

Other sources for surface-mount prototyping adapters include Capital Advanced Technologies, whose Surfboards are small pc boards with pad patterns for popular surface-mount packages, with the connections brought out to pins spaced 0.1" apart. And Emulation Technology's catalog has a huge variety of prototyping adapters, socket converters and other adapters and accessories.

Solderless Breadboards

In spite of the switch to surface-mount circuits, through-hole designs are still popular. Often, you can test a circuit idea using through-hole components

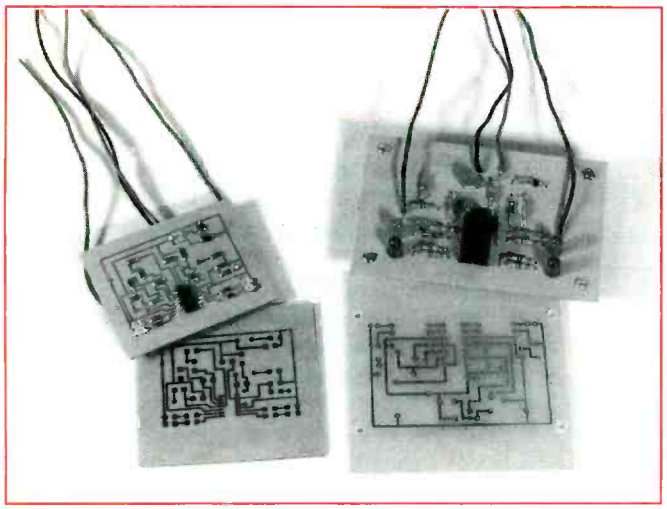

Fig. 1. Examples of surface-mount (left) and through-hole (right) circuits and pc boards.

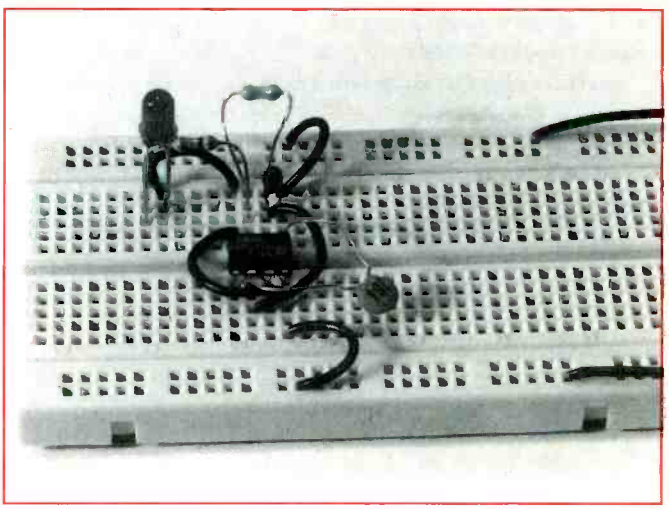

Fig. 2. Solderless breadboads are useful for quick prototyping of simpler circuits.

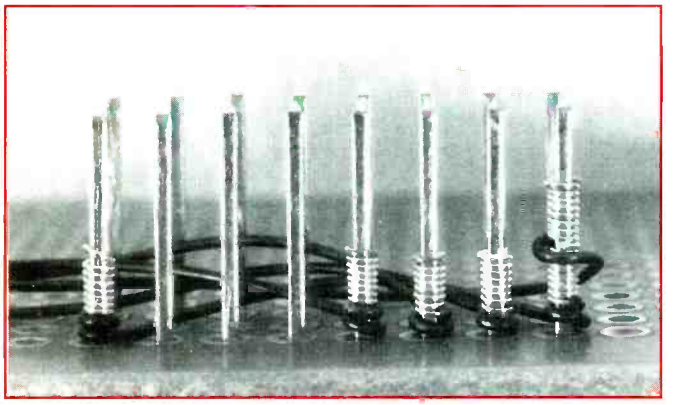

Fig. 3. Wire wrap connections on the special square Wire Wrap posts.

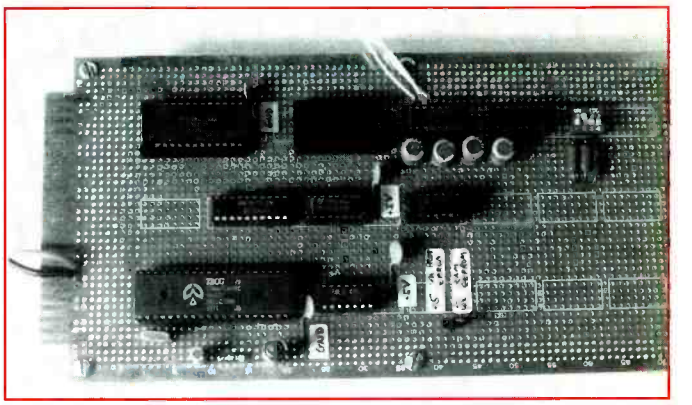

Fig. 4. Top view of a circuit Wire wrapped on perfboard.

and then build the final version using surface-mount components if you wish.

For building simple through-hole circuits, the quickest prototyping method is the solderless breadboard. Anyone who experiments with electronics should have a few of these handy. Shown in Fig. 2 is a solderless breadboard in use. Incidentally, the term "breadboard" is a reminder of the days when vacuum-tube circuits were constructed on wooden boards. These days, though, it can refer to any circuit construction method that requires handwiring techniques.

A solderless breadboard consists of a grid of sockets into which you plug component leads or/and wires. Most boards have two parallel sets of rows spaced so that each side of a DIP IC plugs into a different set of rows.

On the breadboard, all of the sockets in a row connect electrically, so you can connect component leads just by plugging them into sockets in the same row or by using jumper wires to connect rows. Many boards include separate bus strips for power and ground connections.

The big advantage of solderless breadboards is that it's so easy to swap components, change connections, and, in general, modify the circuit. And, when you're done with the circuit, you can pull the components and wires off the board and reuse them and the board.

Most solderless breadboards will accept leads up to 0.032" in diameter. This includes DIP ICs, resistors that draw up to 1/2 watt of power, solid wires of AWG 20 or higher and most through-hole components used in logic circuits and low-power analog circuits.

Components with large-diameter leads that don't fit into the sockets are usually intended for high-current applications and, thus, shouldn't be built on a solderless breadboard anyway. If you must use a component that has large-diameter leads, you can buy adapter pins, or clip or solder a smaller-diameter wire to the component's leads.

Basic breadboards cost around $4 and up. Several companies offer complete prototyping systems that include a solderless breadboarding area, power supplies and such extras as function generators, pulsers, logic probes, switches and displays. Breadboards and proto systems are widely available through mail-order sources.

Incidentally, if you want to include solderless-breadboarding sockets in your own projects (a custom-built prototyping system, for example), Digi-Key stocks 3M's tie-point blocks. Each block has a series of solderless sockets on top and solder terminals on the bottom, the latter providing a means for permanent connections.

Breadboards are most useful for building simple circuits of non-critical design, especially when you want to test out an idea or need the circuit only temporarily. I use solderless breadboards for experimenting with displays, control circuits and other peripherals that interface to microcontrollers. But when a circuit contains more than a few ICs, the maze of wires starts to becomes unworkable, and you'll want to switch to a neater and more durable construction method.

Solderless breadboards have other limits as well. Surface-mount packages

Fig. 5. Wire Wrap materials. Clock wise from top: precut wires, wrap/unwrap tool, sockets, and spool of wire.

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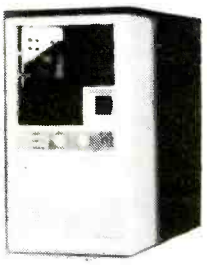

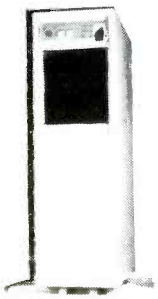

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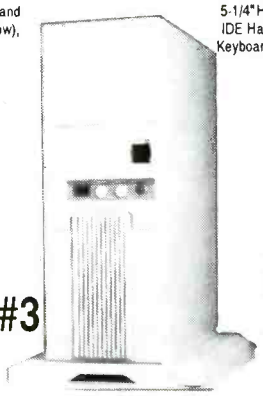

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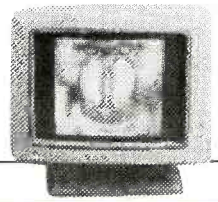

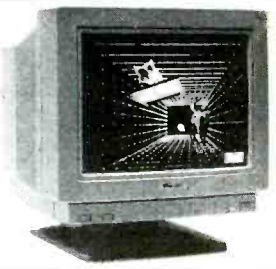

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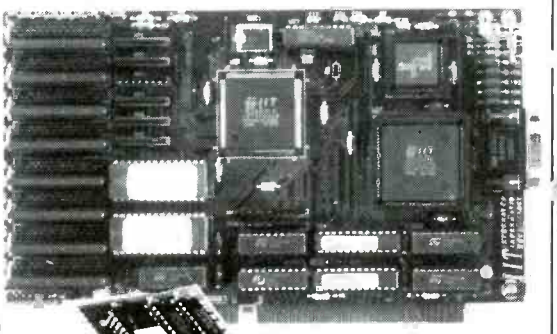
IIT Xgraphic The Windows Accelerator with Workstation Performance

For PCs working with Windows or CAD applications. At the heart of this accelerator is a RISC based graphics engine. Aided by high speed VRAMs and optimized software drivers, Xgraphic's operational speed makes opening and closing Windows appear almost instantaneous. Up to 1280 x 960 gives razor sharp images.

Features:
- 1 MB high speed VRAM
- Speed, up to 20 times that of Super VGA
- 65,536 Colors
- Resolutions up to 1280 x 960
- Operates up to 75Hz refresh for a flicker free screen
- Optimized for Windows 3.0 and 3.1, AutoCAD and AutoShade
- 2 Year Warranty

Technical Specifications:
- On board IIT Graphics Processor supports:
- Hardware Cursor - Line Draw
- Four Operand BitBill - Scissoring and Map Masking - Area Fill
- Backward compatible VGA, EGA, CGA and Hercules - IBM PC/AT, compatibles (286, 386, 486) - Requires 16-Bit slot - Video Connector

INTEGRATED INFORMATION



XGRAPHIC — IIT Xgraphic Accelerator — $269

Video Boards

BOCA RESEARCH INC

Part#	Description	Each
IFC-32	Mono Board w/printer port XT/AT	$16
IFC-33	Color graphics w/printer port XT/AT	$19
IFC-35	BOCA Dual Graphics Adapter	$35

BOCA dual graphics adapter supports MDA, CGA, Hercules compatible and performs color emulation on a monochrome TTL monitor. Parallel port can be configured as LPT1, LPT2 or disabled. Includes 132 column driver software.

IFC-42 — 640 x 480 VGA Card — $52

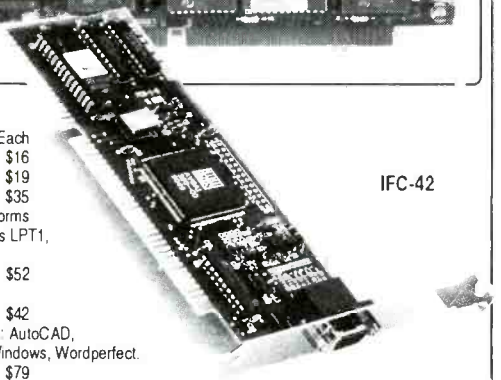
BOCA 640 x 480 - 16 color VGA card with 256K video RAM. 5 year warranty.

IFC-44 — 640 x 480 VGA Card — $42

640 x 480 VGA - 16 colors. 256K Display Memory. One Year Warranty. Supports: AutoCAD, Lotus 1,2,3, Symphony, Framework II/III, GEM/3, Ventura Publisher, Microsoft Windows, Wordperfect.

IFC-46 — 1024 x 768 Super VGA Card — $79

1024 x 768 Super VGA - 256 colors. 1 MB Display Memory. One Year Warranty. Supports: AutoCAD, Autoshade, P-CAD, Lotus 1,2,3, Symphony, Wordperfect, GEM/3, Ventura Publisher, Microsoft Windows, Wordstar, Microsoft word, Framework II/III.



IFC-42

VCOLOR — 16.7 Million Color VGA Card with 1MB Memory — $109

Turbo Windows performance VGA adapter with resolution up to 1280 x 1024 w/16 colors. Plus color modes of 1024 x 768 x 256 colors, 800 x 600 x 65K colors and 640 x 480 with 16.7 million colors. 100% VGA, Super VGA, VESA hardware and BIOS level compatible. Downward compatible with EGA, CGA, HGC and MDA. Supports flicker-free non-interlaced and interlaced monitors. Software drivers for Windows, AutoCAD, DLDD and more!

IFC-48 — Accelerator Video Board — $139

11 times faster than Tseng ET 4000-based video boards! 1280 x 1024 resolution Interlaced, 1024 x 768, 800 x 600, 640 x 480 resolution Non-Interlaced, ISA and EISA systems, Automatic mode switching, 16-bit interface. Flicker-free scrolling, 72 Hz refresh rate. 1 MB RAM. 15-pin analog. Supports all industry standard multiple frequency VGA and VESA compliant monitors. Full driver support.

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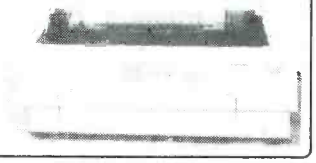
FX-1170	9-Pin Printer, Wide Carriage	$415
AP3250	Action Printer, 24-Pin Narrow Carriage	$199
LQ-570	24-Pin Printer, Narrow Carriage 225 cps - Draft, 105 cps - Letter Quality	$279
LQ-1170	24-Pin Printer, Wide Carriage 300 cps - Draft, 138 cps - Letter Quality	$639

LQ-570



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Centronics 36 Line Switchboxes

AB36-2E	2 Way Economy	$11.99
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These parallel cables are standard DB-25 to Centronics. They are fully shielded and have thumbscrews for easy installation.

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PPC301-20	DB25-36P 20 ft.	5.99
PPC301-25	DB25-36P 25 ft.	6.99

DB-25 25 Line Cables

These DB-25 cables are all lines wired straight through. They are fully shielded and come with thumbscrews for easy installation.

Male to Male

25MM-6	6 ft.	$3.99
25MM-10	10 ft.	4.99
25MM-15	15 ft.	6.99
25MM-20	20 ft.	7.99
25MM-25	25 ft.	8.99
25MM-50	50 ft.	16.99
25MM-100	100 ft.	32.99

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25MF-6	6 ft.	$3.99
25MF-10	10 ft.	4.99
25MF-15	15 ft.	6.99
25MF-20	20 ft.	7.99
25MF-25	25 ft.	8.99
25MF-50	50 ft.	16.99
25MF-100	100 ft.	32.99

15 Pin High Density Cables

HD15MM-6	Male to Male 6 ft.	$4.99
HD15MF-6	Male to Female 6 ft.	4.99

Centronics 36 Pin Cable Assemblies

These Centronics cables are fully shielded and come with 25 lines wired for standard parallel transmission.

Male to Male

36MM-6	6 ft.	$3.99
36MM-10	10 ft.	4.99

Male to Female

36MF-6	6 ft.	$3.99
36MF-10	10 ft.	4.99

Extension Cables

5MM-6	5 Pin Din Male to Male, 6 ft.	$2.99
KEC-6	Keyboard extension cable 6 ft.	2.99
KEC-10	Keyboard extension cable 10 ft.	3.69
PS2-KEC-6	PS2 Keyboard extension cable 6 ft.	3.39
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MEC-10	Monitor extension cable 10 ft.	3.89
PS2-MEC6	PS2 monitor extension cable 6 ft.	4.39
PS2MEC-10	PS2 monitor extension cable 10 ft.	4.99

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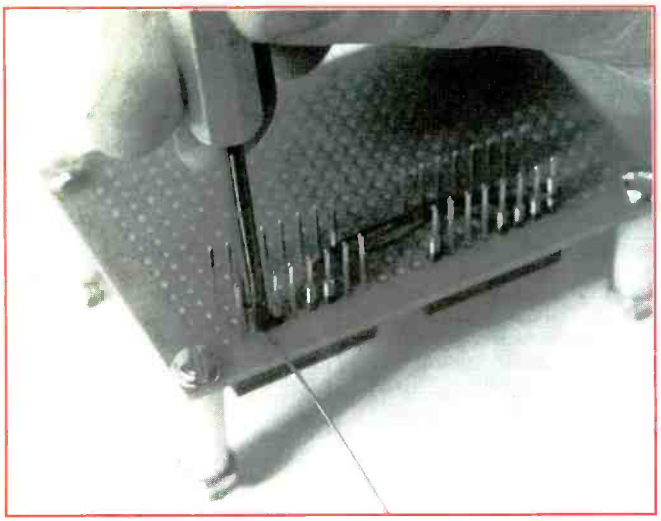


Fig. 6. Wrapping a connection with a low-cost wrapping tool.

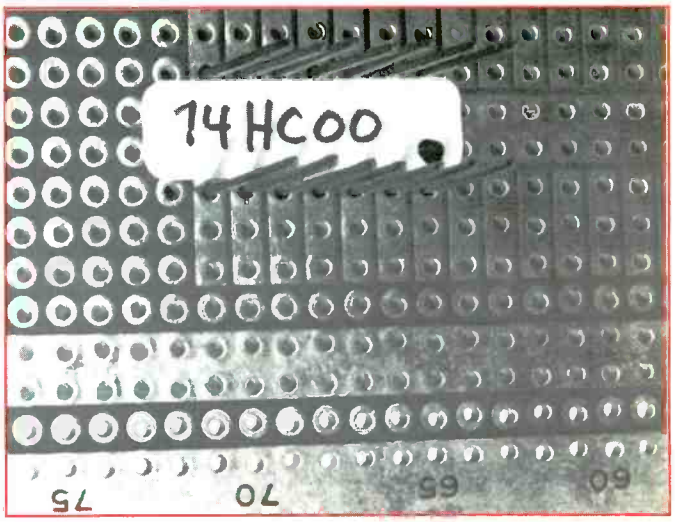


Fig. 7. You can prevent wiring mistakes by labeling each IC and pin 1 on the bottom side of the board.

require adapters, and breadboards aren't usable for radio-frequency circuits, very high-speed digital circuits and other critical high-frequency designs. These require the short, fixed-length, fixed-location connections available only on printed-circuit boards.

The Wire Wrap Technique

If your circuit design is too large for breadboarding, or if you want more durable construction, the Wire Wrap technique is a good possibility. Wire Wrap makes an electrical and mechanical connection by tightly "wrapping" several turns of wire around a square Wire Wrap post, as illustrated in Fig. 3.

The biggest advantage to Wire Wrap is that you get reliable, removable connections without soldering. I use This technique to prototype microcontroller circuits, since it's a quick way to get circuits up and running, and modifications are easy to make. Figure 4 is an example of a Wire Wrap circuit.

To use the Wire Wrap technique, you need perforated board; special Wire Wrap IC sockets with long, square posts; solid insulated AWG 30 wire; and a wrap/unwrap tool for making and removing connections (see Fig. 5).

The perforated board—or "perfboard," as it's frequently called—must have a grid of holes arranged on 0.1" centers to match the spacing on DIP ICs. Many perforated boards have a solder pad surrounding each hole for easy soldering of sockets and component leads to the board.

Wire Wrap materials are widely available. The special sockets are expensive, with a 40-pin socket costing more than $1, compared to 25 cents for an equivalent solder-tail socket. Sockets with 0.51"-long posts will hold three levels of wrap. Some socket sizes (32-pin, for example) are difficult to find, but you can always use a socket that has a greater number of pins and simply leave empty any pin locations that aren't needed.

You can buy Wire Wrap wire on spools and in pre-cut, pre-stripped lengths. Pre-cut wires are convenient, but they cost more than spooled wire.

The only tool you need for Wire Wraps is a simple $10 hand tool that

(Continued on page 49)

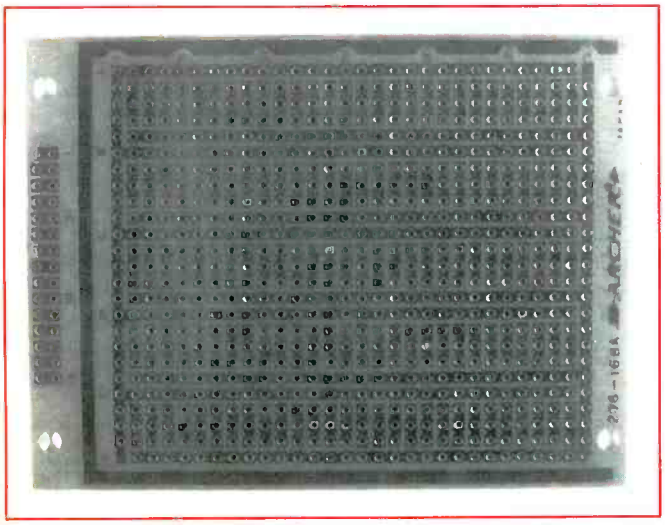


Fig. 8. This perfboard has solder pads and bus strips that you can use for low-impedance power and ground connections.

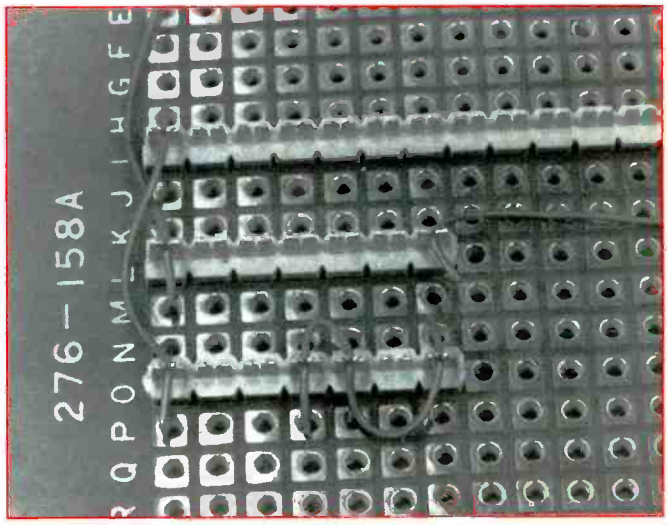


Fig. 9. 3M's Scotchflex breadboarding method uses wires that press into U-shaped contacts.

ComputerCraft Magazine's PC Connector Guide

This is the third in a series of pull-outs that contain useful and important data tables and other information germane to helping readers understand, troubleshoot and repair personal computers, single-board computers and microcontrollers. In earlier issues, we focused on Serial, Parallel and Printer Ports, Video Interfaces, Mouse Ports, Floppy- and Hard-Disk Drive Interfaces and SCSI Interfaces. This time around, we provide a potpourri of Local-Area Network, Power-Supply MIDI Interface and Adapter connection details.

Prepared By TJ Byers
76 North Broadway, Hicksville, NY 11801.

Local-Area Network

Ethernet Twisted-Pair (Hub to PC)
Eight-Pin RJ-45 Phone Plug

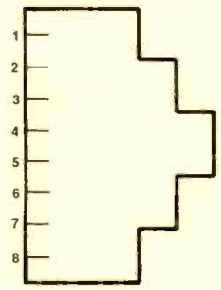
Hub End Pin	Conductor Color	PC End Pin	Signal Description
1	Wht/Org	1	Receive+ to Transmit+
2	Org/Wht	2	Receive- to Transmit-
3	Wht/Grn	3	Transmit+ to Receive+
6	Grn/Wht	6	Transmit- to Receive-

Twisted-pair Ethernet link uses common telephone wire and RJ-45 connectors. Notice wiring differences between Hub-to-PC and Hub-to-Hub links.

Ethernet Twisted-Pair (Hub to Hub)
Eight-Pin RJ45 Phone Plug

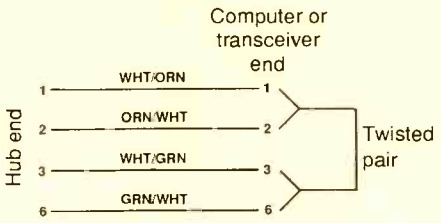
Hub1 End Pin	Conductor Color	Hub2 End Pin	Signal Description
1	White/Org	6	Receive+ To Transmit-
2	Org/White	3	Receive- To Transmit+
3	White/Grn	2	Transmit+ To Receive-
6	Grn/White	1	Transmit- To Receive+

Twisted-pair Ethernet link uses common telephone wire and RJ-45 connectors. Notice Wiring differences between Hub-to-PC and Hub-to-Hub links.

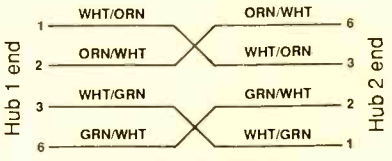


RJ-45

White/Orange (WHT/ORN) = Receive +; Orange/White (ORN/WHT) = Receive –
White/Green (WHT/GRN) = Transmit +; Green/White (GRN/WHT) = Transmit –



STRAIGHT-THROUGH CABLE

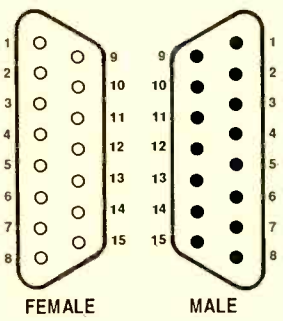


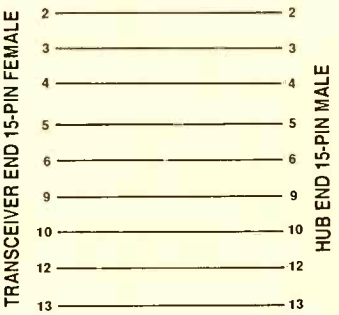
CROSSOVER CABLE

Thick Ethernet AUI Connector
15-Pin D-Shell Connector

Pin	Signal
1	Collision Shield
2	Collision+
3	Transmit+
4	Receive Shield
5	Receive+
6	Power Return
7	Not Used
8	Not Used
9	Collision-
10	Transmit-
11	Transmit Shield
12	Receive-
13	+12 Volts
14	Voltage Shield
15	Not Used

Thick Ethernet interface uses shielded twisted pairs to increase cable and Ethernet link length. It uses 15-pin AUI connector identical to 15-pin D-shell connector used by Game and MIDI ports.





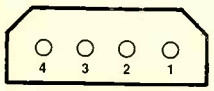
Power-Supply Connections

Disk-Drive Power Source

Four-Pin Polarized Plastic Connector
Both Large and Small

Pin	Assignment	Conductor Color
1	+12 Volts	Yel/Blu/Org
2	+12-Volt Ground	Blk
3	+5-Volt Ground	Blk
4	+5 Volts	Red

Both +12 and +5 volts are available from four-pin isk-drive connector. Power connector comes in two sizes, one for standard 5¼" and smaller one for 3½" drives, but pinouts are same.



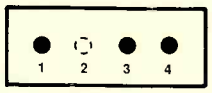
1 = –12V
2 = 12V dc ground
3 = +5V
4 = 5V dc ground

Backup Battery Connector

Four-Pin In-Line Berg Connector

Pin	Assignment	Conductor Color
1	+ Battery	Red
2	Key (Pin Missing)	N.A.
3	Ground	Black
4	Ground	Black

While backup battery can take many forms, it interfaces to motherboard via a common connector. If there is no alignment key, mate red conductor with +battery pin on motherboard.



1 = –V
2 = Key
(no connection)
3, 4 = Ground

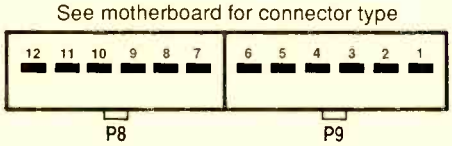
Motherboard Power Source

Dual Six-Pin In-Line Plastic Connectors

Pin	Assignment	Conductor Color
1	Good Power Sense	Wht/Org
2	+5 Volts	Red
3	+12 Volts	Blu
4	-12 Volts	Wht/Blu
5	Ground	Blk
6	Ground	Blk
7	Ground	Blk
8	Ground	Blk
9	-5 Volts	Org
10	+5 Volts	Red
11	+5 Volts	Red
12	+5 Volts	Red

Power is supplied to motherboard via two heavy-duty, six-pin plastic connectors. Black wires are always in middle. Connectors are keyed to a slot that forces them to be folded back at top of slot when inserting or removing them.

See motherboard for connector type



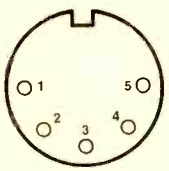
1 = Power ground (WHT/ORN)
2 = +5V (RED)
3 = +12V (BLUE)
4 = –12V (WHT/BLK)
5, 6, 7, 8 = Ground (BLK)
9 = –5V (ORN)
10, 11, 12 = +5V (RED)

MIDI Interface

MIDI Input

Five-Pin DIN Connector

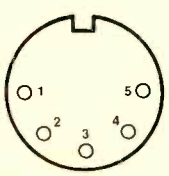
Pin	Signal
1	Not Used
2	Not Used
3	Not Used
4	Signal Ground
5	Signal Input



MIDI Through

Five-Pin DIN Connector

Pin	Signal
1	Not Used
2	Shield
3	Not Used
4	+5 Volts
5	Signal Out

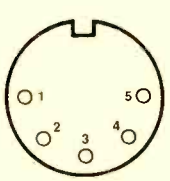


MIDI Output

Five-Pin DIN Connector

Pin	Signal
1	Not Used
2	Shield
3	Not Used
4	+5 Volts
5	Signal Out

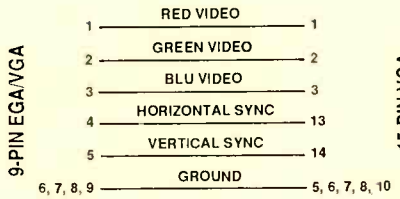
Five-pin DIN high-quality audio connector is type of choice for MIDI interface. It comes in three versions: input, output and optional throughput.



Adapters

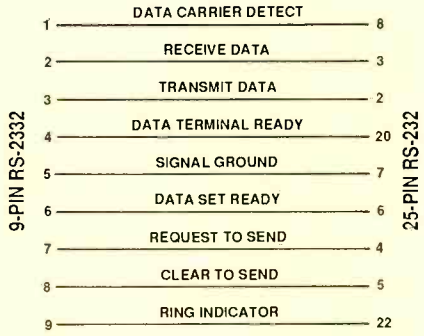
Nine-Pin EGA/VGA To 15-Pin VGA

Nine-Pin	Signal	15 Pin
1	Red Video	1
2	Green Video	2
3	Blue Video	3
4	Horizontal Sync.	13
5	Vertical Sync.	14
6,7,8,9	Ground	5,6,7,8,10
None	No Connection	4,9,11,12,15



Nine-Pin To 25-Pin RS-232C

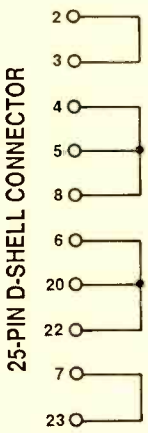
Nine-Pin	Signal	25-Pin
1	Data Carrier Detect	8
2	Receive Data	3
3	Transmit Data	2
4	Data Terminal Ready	20
5	Signal Ground	7
6	Data Set Ready	6
7	Request To Send	4
8	Clear To Send	5
9	Ring Indicator	22



25-Pin RS-232C Null Modem

25-pin D-Shell Connector

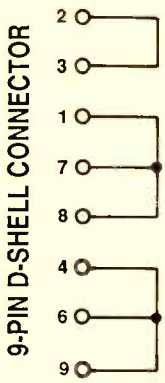
Pin 2 To Pin 3
Pin 4 To Pin 5 To Pin 8
Pin 6 To Pin 20 To Pin 22
Pin 7 To Pin 23



Nine-Pin RS-232C Null Modem

Nine-Pin D-Shell Connector

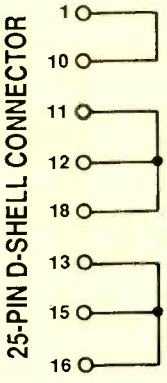
Pin 2 To Pin 3
Pin 1 To Pin 7 To Pin 8
Pin 4 To Pin 6 To Pin 9



25-Pin Null Printer

25-Pin D-Shell Connector

Pin 1 To Pin 10
Pin 11 To Pin 12 To Pin 18
Pin 13 To Pin 15 To Pin 16



RJ-11 Telephone Jack

Pin	Conductor	Signal
1	Yellow	Line 2 Tip
2	Green	Line 1 Ring
3	Red	Line 1 Tip
4	Black	Line Ring

Troubleshooting an RJ-11 telephone connection is as simple as measuring voltages across red/green (Line 1) or yellow/black (Line 2) conductors. On-hook measures about 48 volts dc, off-hook about 20 volts dc and ring signal is 100 volts ac (enough to light both electrodes of an NE-2 lamp through a 22K resistor.

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Disk-Drive Power Source (Polarized Four-Pin Connector, Both Large and Small) ..... Apr
Motherboard Power Source (Dual Six-Pin In-Line Connector) ..... Apr

Printer Ports
Centronics Printer Connector (36-Pin Amphenol Connector) ..... Feb
Parallel Printer Port (25-Pin D-Shell Connector ..... Feb
Serial Printer Port (25-Pin D-Shell Connector) ..... Feb

SCSI Interfaces
SCSI Single-Ended Interface (50-Pin Connector, All Versions) ..... Mar
SCSI Differential Interface (50-Pin Connector, All Versions ..... Mar

Serial Ports
RS-232C Serial PC Modem Port (9-Pin D-Shell Connector) ..... Feb
RS-232C Serial PC Modem Port (25-Pin D-Shell Connector) ..... Feb
RS-232C Serial Port (25-Pin D-Shell Connector) ..... Feb
RS-422 Serial Port (377-Pin D-Shell Connector) ..... Feb
RS-423 Serial Port (25-Pin D-Shell Connector) ..... Feb

Video Interfaces
EGA/CGA Color (9-Pin D-Shell Connector) ..... Feb
VGA Color (15-Pin Miniature D-Shell Connector) ..... Feb
VGA Monochrome (9-Pin D-Shell Connector) ..... Feb

 (from page44)

strips and wraps and unwraps connections. If you do a lot of wrapping, there are squeeze-grip and electric models, but the basic tool is fine for occasional use on projects.

To make a Wire Wrap connection to an IC socket, follow these steps:

(1) Insert the socket into holes in its desired location on the board.

(2) Select an appropriate-length precut wire or cut a piece of wire that's 2" longer than you need for the connection. If you cut your own wire, you must strip the insulation from each end. To do this, insert the wire into the tool's stripping slot so that 1" of it extends from the slot and pull the end of the wire through the slot to remove insulation.

(3) The wrap end of the hand tool has two holes. Insert a stripped wire end into the smaller hole as far as it will go.

(4) With the wire inserted, slide the other hole onto the desired Wrap post.

(5) You're now ready to wrap. Hold the free end of the wire to keep it from being pulled into the wrap, and twist the wrapping tool about 10 times in one direction to make the connection (Fig. 6).

(6) Lift the tool from the post and inspect the connection. You should see several turns of bare wire around the post. If the end of the wire isn't wrapped around the post, you didn't use enough twists. With a little practice, you'll be soon able to wrap connections in just a few seconds.

To unwrap a connection, do the reverse. Slide the unwrap end of the tool (the end with just one hole) onto the post to be unwrapped. Twist in the opposite direction used to wrap the connection. The wraps will loosen, allowing you to easily pull them off the post.

Here are some additional tips to keep in mind when using the Wire Wrap technique.

The round leads of resistors, capacitors, transistors and other discrete components aren't designed for the Wire Wrap approach. You can wrap connections onto these leads, but to ensure a reliable connection, flow a coating of solder over the wraps. Alternatively, for solderless connections, you can buy Wire Wrap pins with forked terminals that grip component leads.

The basic, low-cost wrapping tool is designed for use with No. 30 wire and 0.025" square posts. This small-diameter wire is suitable for connections that carry up to around 100 mA.

For higher currents, you need larger-diameter wire. Wrap tools for larger-diameter wires are available, but it's often just as easy to solder any connections that require such wires. You can combine Wire Wrap and point-to-point soldering techniques on the same board, using point-to-point soldering for the high-current connections and Wire Wrap for the others.

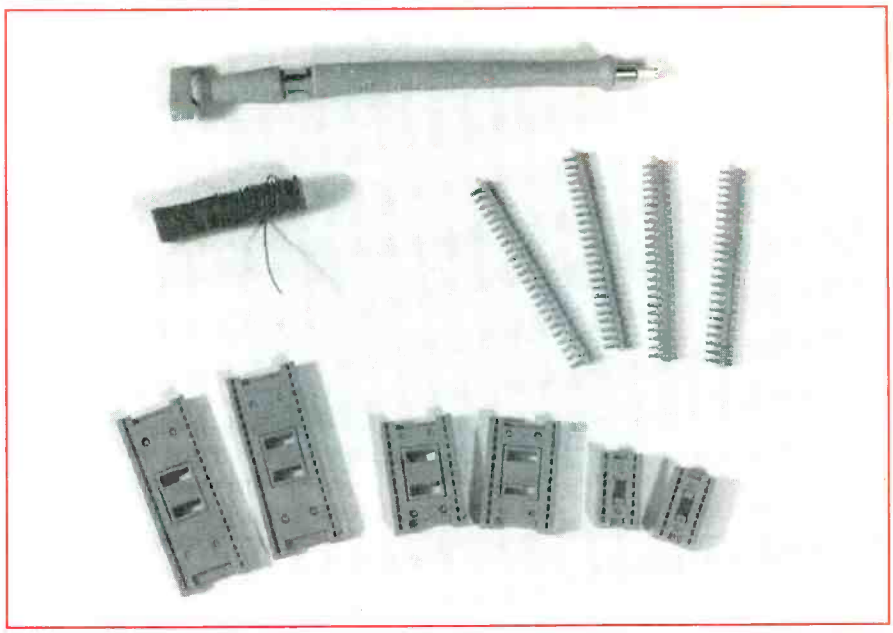

Fig. 10. Materials for Scotchflex breadboarding. Clockwise from top: universal tool, plug strips, dual sockets, wire.

When you're wiring on the underside of the board, it's very easy to become confused about pin numbers, since the pin locations are a mirror image of the top-side orientation. When you look at the circuit from the top, or component, side, pin numbers count up counterclockwise around an IC, while on the bottom, where you make the wraps, pins count up in the clockwise direction. Without a pin-1 indicator on the bottom of the board, you're sure to occasionally wire an IC backwards.

You can avoid wiring errors by placing a small press-on label between the pins of each IC before you wrap connections (Fig. 7). On each label, write the IC number (*U1*) or designation (74HC00), and place a dot next to pin 1.

If you don't want to make your own labels, you can buy plastic ID plates with the pin numbers printed on them. The plates slide onto the IC posts before wrapping.

Some perfboards include buses, which are copper strips that run the length of the board and surround one or more rows of holes, as shown in Fig. 8. The buses provide convenient low-impedance paths for soldered power and ground connections.

For easy reference, use different colors of wire insulation for different types of connections. For example, you can wire ground connections in black, 5 volts in red and signals in blue.

Develop a system of checking off or somehow marking connections on the schematic as you wrap them. This makes it easy to see which connections remain to be wrapped.

Keep the underside of the board as neat as possible. Don't route wires between pins in the same row in a socket. Cut or choose wires to match the lengths of the connections, leaving

Table 1. Solid-Wire Diameters & Maximum Currents

AWG (American Wire Gauge)	Diameter (Inches)	Maximum Current (Amperes)
10	0.102	14.8
12	0.081	9.3
14	0.064	5.8
16	0.051	3.6
18	0.040	2.3
20	0.032	1.4
22	0.025	0.91
24	0.020	0.57
26	0.016	0.36
28	0.013	0.22
30	0.010	0.14

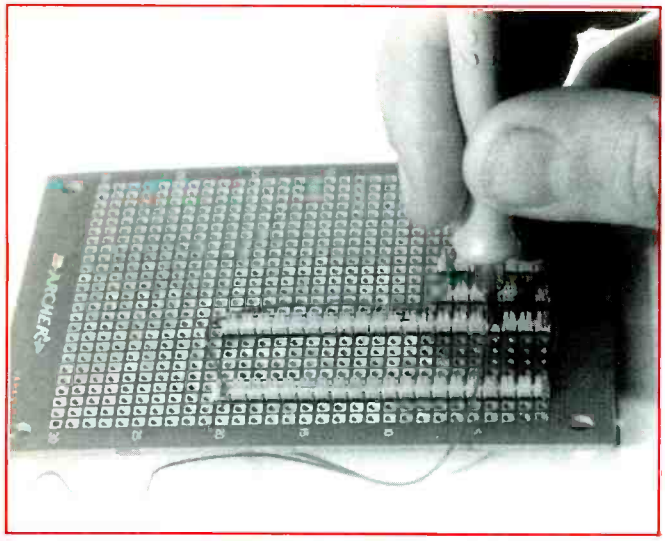

Fig. 11. Wiring a connection to a Scotchflex plug strip.

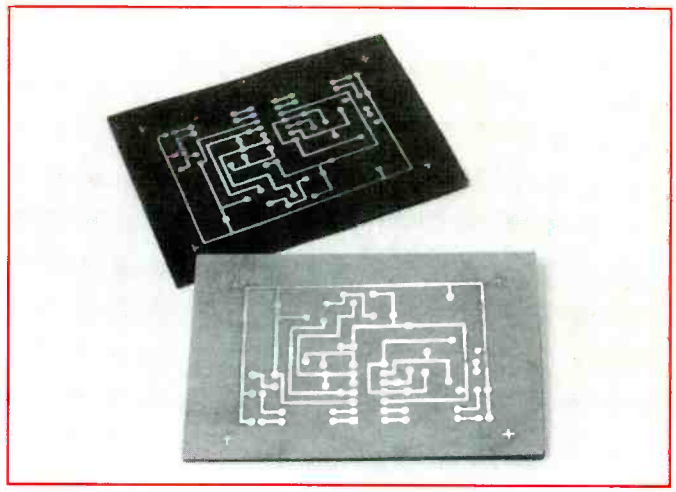

Fig. 12. A pc board made with Pres-n-Peel iron-on transfer film. After transferring, the film shows a negative image of the pc-board artwork.

enough slack so that the wires aren't pulled taut.

As with solderless breadboarding, r-f and very high-speed digital circuits aren't suitable for the Wire Wrap technique. Use a printed-circuit board for critical high-speed designs.

When you're through using a circuit you built using the Wire Wrap technique, you can remove ICs from their sockets, unwrap the wires and pull the sockets off the board for re-use.

Scotchflex Breadboarding

As an alternative to Wire Wrap, 3M offers the Scotchflex prototyping system that make connections by pressing wires into U-shaped contacts (Fig. 9). An advantage of this method is quick wiring, without having to twist a series of wraps onto each pin. Scotchflex circuits are also very easy to rip apart to re-use the components, and circuits are more compact than those built using the Wire Wrap technique because they don't use the long wrap posts.

Scotchflex circuits are built on perf-board, with IC sockets constructed from special legless sockets and plug strips that have U-shaped contacts on the bottom and connector pins on top. Figure 10 shows the materials used.

Wiring requires a special insertion tool. One end of the tool has a long slot for seating plug strips in the sockets, and the other end has two shorter slots at right angles for wiring connections.

Here's how to place a 14-pin socket and wire a connection using the Scotchflex method:

(1) Break off two seven-pin plug strips from a longer plug strip and press the pins of the two strips into the perf-board from the bottom. Space the rows 0.3" apart so that they match the socket's spacing.

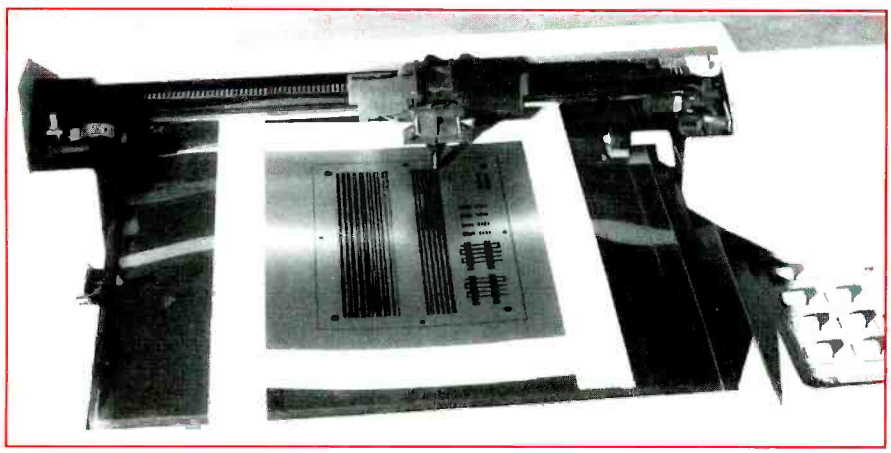

Fig. 13. Plotting artwork directly onto copper in etch-resistant ink.

(2) On the top of the board, press a 14-pin legless socket onto the pins to complete the socket. Flip over the board and push down on the plug strips with the wide end of the insertion tool to seat the strips into the dual socket.

(3) To wire a connection, place a length of No. 30 wire across the slot of the desired U-shaped contact. Using the double-slotted end of the insertion tool, place the shallower slot over the wire. With it held vertical to the board, push down on the tool (Fig. 11). This pushes the wire into the U-shaped contact, stripping the wire's insulation and making an electrical and mechanical connection between wire and contact.

(4) You can now route the wire to its next contact and repeat this procedure. If several pins connect together, you can "daisychain" a single wire from contact to contact, instead of having to cut a separate wire for each connection.

(5) When you're done routing a wire, cut the ends, leaving tails of about 1/16". Each contact can hold two wires and is guaranteed to last for at least 25 uses.

To re-use the plug strips and sockets, use needle-nose pliers or the optional universal tool to pull the wires, sockets and plug strips off the board.

Like Wire Wrap, the Scotchflex method is designed for wiring ICs only. Discrete components must be soldered. Scotchflex connections are also not suitable for high-current or very-high-frequency circuits.

As with Wire Wrap, it's a good idea to label ICs, use different colors of wire insulation and mark the schematic as you complete each connection.

Tools and materials for the Scotchflex method are a little more difficult to track down than are Wire Wrap materials. Newark is one national distributor that carries them. Contact 3M to find out about other distributors.

There's a basic kit that sells for around $180. Being that it offers no discount over buying the items separately, you may want to buy just what you need. At minimum, this includes the insertion tool, plug strips, sockets in sizes to match the ICs you'll be using and No. 30 insulated wire. The breakoff tool, universal tool and other accessories are convenient but not required.

Point-to-Point Soldering

Some circuit builders prefer point-to-point soldering. With this method, you insert component and sockets leads into perfboard and solder the connections using insulated wire.

Perfboards with solder pads are convenient for point-to-point soldering, since you can solder leads to the pads to hold the components in place. Boards with power and ground buses are also handy.

With point-to-point soldering, you don't need IC sockets, but sockets do make it easy to replace or re-use ICs. Solder-tail sockets are much cheaper than their Wire Wrap equivalents. For higher-priced ICs, sockets make sense, but you can debate whether it's worth using a 15-cent socket for a 12-cent IC.

These are the steps for point-to-point soldering of a through-hole circuit on perfboard:

(1) Turn on your soldering iron and let it come up to soldering temperature.

(2) Cut a length of insulated wire that's slightly longer than needed to route the wire. Strip about 1/4" of insulation from both ends.

(3) Using needle-nose pliers to grip the end of the wire, wrap the wire around the lead or socket pin to which it will solder. It's best to have a good mechanical connection before soldering. Trim the end if necessary.

(4) Apply the end of a strand of solder to one side of the joint and apply the hot tip of the soldering iron to the other side. When the solder flows and coats the joint, remove the tip and solder from the joint. Allow the joint to cool undisturbed for a few seconds.

(5) Repeat steps (3) and (4) for the other end of the wire.

Here are some additional tips for point-to-point soldering:

Choose a wire gauge that's convenient to work with and with a large enough diameter to handle the current it will carry. For a generous safety margin, choose a size that can safely carry from 50% to 100% more current than you expect from the circuit under normal operation. For most digital-logic circuits, No. 28 or 30 wire is fine. Table 1 lists current-carrying abilities of common wire gauges, although the exact values will depend on the type of insulation and the operating environment.

Any general-purpose iron and solder will do for soldering most through-hole circuits. A good basic soldering tip is a 0.03" or 1/32" spade, chisel or screwdriver shape, used with 22 gauge (0.028" diameter) solder. For surface-mount soldering, use a smaller tip (0.02" or 1/64") and finer-gauge solder (28 gauge, or 0.014" diameter).

Printed-Circuit Boards

There are times when hand-wiring a circuit, whether using Wire Wrap tech-

Sources

Capital Advanced Technologies
309-A Village Dr.
Carol Stream, IL 60188
Tel.: 708-690-1696; fax: 708-690-2498
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DynaArt Designs
3535 Stillmeadow Lane
Lancaster, CA 93536
Tel.: 805-943-4746
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Emulation Technology
2344 Walsh Ave., Bldg. F
Santa Clara, CA 95051
Tel.: 408-982-0660; fax: 408-982-0664
CIRCLE NO. 168 ON FREE INFORMATION CARD

General Consulting
12856 Inglewood Ave.
Hawthorne, CA 90250
Tel.: 213-679-1405
CIRCLE NO. 169 ON FREE INFORMATION CARD

Kepro Circuit Systems, Inc.
630 Axminister Dr.
Fenton, MO 63026-2992
Tel.: 1-800-325-3878;
fax: 1-314-343-0668
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Meadowlake Corp.
P.O. Box 497
Northport, NY 11768
CIRCLE NO. 171 ON FREE INFORMATION CARD

Newark Electronics
4801 N. Ravenswood Ave.
Chicago, IL 60640-4496
Tel.: 312-784-5100
CIRCLE NO. 172 ON FREE INFORMATION CARD

Techniks Inc.
P.O. Box 463
Ringoes, NJ 08551-0463
Tel.: 908-788-8249
CIRCLE NO. 173 ON FREE INFORMATION CARD

3M
Electronic Products Div.
3M Center Bldg. 225-1N
St. Paul, MN 55144
Tel.: 1-800-225-5373
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niques or point-to-point soldering, isn't feasible or desired. Sometimes, the best or only choice is to design and make a printed-circuit board and solder the components to it. Or, after hand-wiring and testing your design, you may want to build the final copy on a pc board.

This article won't get into the details of how to design and make pc boards, since these are complete topics in themselves. But I will mention some new products and techniques that make it easier than ever to make pc boards for your designs.

One new product group is iron-on transfer sheets that use heat and pressure to transfer an image of the pc-board artwork onto a copper-clad board. The source of heat and pressure can be as simple as a clothing iron. Figure 12 shows a pc board made with an iron-on transfer sheet.

Three iron-on products are Press-n-Peel from Techniks, TTS (Toner Transfer System) from DynaArt, and TEC-200 from Meadowlake. Techniques for use are similar for all three. You can also experiment with other transparencies, as long as they're rated for use in photocopiers or laser printers. Ordinary transparencies aren't heat-resistant enough for use in printers or copiers and may damage or ruin the printer or copier.

To use iron-on transfer, you print your artwork onto the transfer sheet using a laser printer, photocopier, or any printer that forms images with a dry toner. You must print a mirror image of the artwork as it will appear on the board. In other words, the solder-side artwork for through-hole circuits should show the component-side orientation.

To transfer the image, you lay the sheet toner-side down on a clean, copper-clad pc blank and apply heat and moderate pressure with an iron or other heat source of 200° or 300° F. This melts the toner, which releases from the transfer sheet and fuses onto the copper to form an etch-resistant image.

After image transfer, you remove the transfer sheet. With Press-n-Peel or TEC-200, you let the board cool and then peel the sheet off the board by hand. With TTS, you place the board and attached transfer sheet into a pan of water and wait for the sheet's water-soluble cover film to dissolve. This causes the transfer sheet to float off the board.

Either way, you're then ready to etch the board as usual, using ferric-chloride, ammonium-persulfate or other etchant. After etching, you have an image of the artwork drawn in copper on an otherwise bare board, and you're ready to drill lead holes (if any) and install and solder components to the board.

The iron-on method is simple, low-cost, and quick, especially if you're making just one or two copies of a board. You can get good results with traces as thin as 15 mils (0.015").

Which transfer sheets are best? Many users have a favorite, but the favorites seem to vary from user to user. The sheets cost only about $1 each; so it's feasible to try them all and see which you prefer. All include complete instructions. You can buy direct from the suppliers listed in the Sources list, and many general parts catalogs carry them as well.

Iron-on transfer isn't your only choice. If you have access to a pen plotter, you can try General Consulting's Fast-Proto method ($199 for the starter kit), which plots the artwork in resist ink directly onto copper, where it's ready to etch (Fig. 13).

Of course, you can also use traditional photographic methods to make pc boards. To do so, you must print, plot, tape or use another method to prepare the artwork on a transparency. You then place the artwork on a photosensitized pc blank, expose the blank to ultraviolet light and develop the image, which then acts as the etch-resist. Kepro is a major supplier of materials for these methods.

For more information about any of the methods mentioned, contact the vendors listed in the Sources box.

Other Matters

If you're still looking for the source code for BASIC-52 (discussed in the January 1993 issue of *ComputerCraft*), you can find it as BF11 on the Intel Insite BBS at 503-681-0956. Also, try the Signetics BBS at 1-800-451-6644 for BASIC-52 as well as a version of BASIC31.

You can contact me on Compuserve at 71163,3555, or by mail at P.O. Box 3374, Madison, WI 53704-0374. Questions and comments of interest to all may be published in this space. For a personal reply by mail, please include a self-addressed, stamped envelope.

Next time, I'll discuss using 8088-family microprocessors in embedded controllers. ■

Jan Axelson

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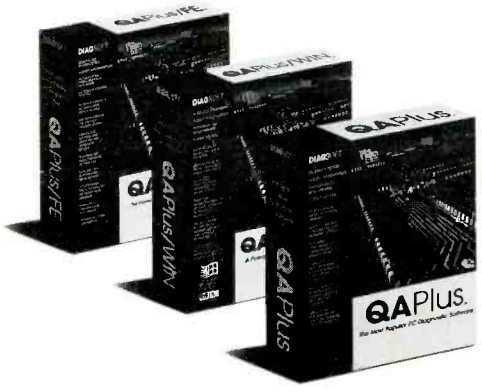

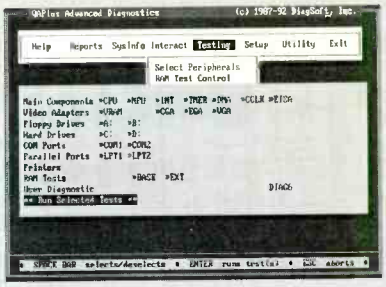

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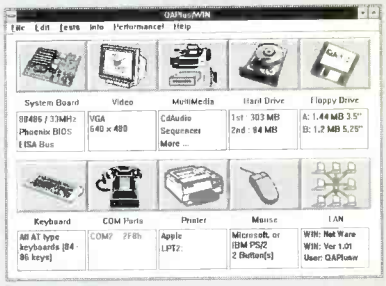

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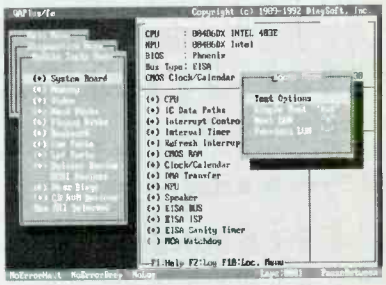

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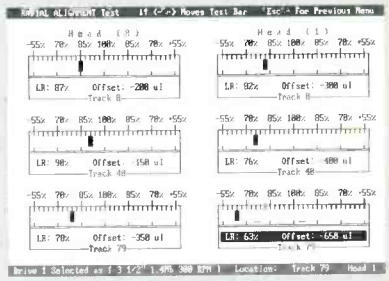

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Coping With PC Problems

In this installment of our report, we focus on software products that help you diagnose and repair PCs

By Joseph Desposito

The common thread of diagnostic programs for PCs is that all demand that your PC be up and running. In most cases, you'll need a functioning system unit, floppy- or hard-disk drive that already contains the diagnostic program and video system (adapter card and monitor) to be able to run software diagnostics. To some people, this might suggest a fatal flaw. If a PC is already working, why do you need a software program to diagnose its problems? The answer, of course, is that PCs often have problems that aren't completely debilitating. Memory may be flaky, ports may be in conflict, video adapters may have intermittent problems, and so forth.

To find out if these kinds of problems are solvable, we examined six diagnostic programs that work on PC-type computers. These programs are most useful for PC service technicians, but users who upgrade and repair their own computers should be interested, too.

The programs examined here are *Micro-Scope* ($499) from Micro 2000, Inc.; *QAPlus/FE* 5.1 ($349.95) from DiagSoft, Inc.; *QuickTech* ($149) from Ultra-X, Inc.; *CheckIt Plus* ($149) from TouchStone Software Corp.; *Port Test* ($89) from MicroSystems Development; and *Service Diagnostics* from Landmark. *Service Diagnostics* has several prices, depending on the system. The XT version lists for $69, the 286 version for $169 and the 386/486 version for $195. Landmark also sells a software/hardware bundle that includes all versions of *Service Diagnostics* plus the AT ROM POST plug-in board (a hardware diagnostic tool we reviewed last month) for $299.

Testing Diagnostic Programs

Software diagnostic programs provide users with loads of information about a PC. Often, the information isn't needed to zero in on a malfunctioning component. For example, if a video adapter is malfunctioning, you usually see evidence of it on-screen. If a video monitor has gone on the blink, you'll often see no display at all. Since this is the case, we decided not to use the diagnostic programs to test for obviously damaged components. Instead, we created problems on our test system and observed what the programs could do to correct them.

The test system we used was an ALR PowerFlex computer with a 486 module installed, serial and parallel ports on the motherboard, IDE hard-disk interface and floppy-drive controller on the motherboard, a scanner card, network card, Super-VGA adapter with a parallel port and modem. We took this working system and changed some settings so that the system no longer functioned properly.

We first enabled LPT2 (it had been disabled), which uses IRQ5. Then we changed the interrupt setting on the scanner board from IRQ5 to IRQ2. This caused the scanner to conflict with the network card, which also was set to use IRQ2. The end result of these changes caused the scanner to produce a read error when we tried to scan a document. We wanted to see if the diagnostic programs could help us untangle this mess.

Besides this diagnostic exercise, which is essentially a problem you might encounter when upgrading a system, we checked each program for the amount and accuracy of information it provided.

Diagnostic Program Overview

Computer diagnostic programs purport to tell everything you want to know about your computer or a subsystem of it, such as the communication ports. Unlike diagnostic boards, which can indicate problems with a "dead" system, diagnostic software can work only with systems that can boot up. If a system problem is intermittent, diagnostic software can be set to run tests continually and log errors to a printer or disk file. This gives you a chance to aggravate the situation with heat or shock during testing. With the information in the error log, you should be able to detect an intermittently malfunctioning component.

Software diagnostic programs are also useful when you're upgrading a PC. Sometimes, after an upgrade, you find that the new component isn't working as expected, or an older component that was working fine is no longer working. Diagnostic programs can either diagnose the problem directly or place enough general information at your fingertips to let you solve the problem.

One convenience to look for in the programs reviewed here is that they not only display CMOS contents, but they also let you change parameters. This is helpful when working on older 286 ATs that require a disk to change the CMOS setup. If the original disk isn't available for some reason, this feature offers a suitable alternative.

Naturally, software diagnostic pro-

grams for PCs run under DOS. Some, however, are independent of the operating system. This is a big plus for users if a PC to be tested runs under UNIX, Novell Netware or other operating system. Moreover, there are a growing number of diagnostic programs designed to run under Microsoft *Windows*, where additional problems sometimes arise. A half-dozen of these programs are examined next month.

With the foregoing thoughts about software diagnostic programs in mind, let's see how well they fared.

Diagnostic Software Evaluations

Micro-Scope V.4.28

(Micro 2000, $499)

Micro-Scope is a diagnostic program developed for IBM PC, XT, AT and PS/2 computers. In its documentation, Micro 2000 states that *Micro-Scope* was developed on true IBM computers but has also been tested on many machine types. According to the company, fully compatible machines present no known difficulties. Micro-Scope is independent of the operating system.

No installation is required. Because the *Micro-Scope* disk is bootable, you just place it in the drive and turn on the computer to be tested. There's one quirk that occurs when booting a 486 system, however. On some systems, like the one we used for these tests, an error message appears, the result of the 486 chip's built-in RAM cache. You must press CTRL, ALT, –(minus) and Enter to get the program running again. Fortunately, the documentation covers this problem in the first few pages. Micro 2000 includes both 3½" and 5¼" diskettes in the package, as well as three wrap plugs for the parallel and serial ports (nine- and 25-pin) and a 99-page user's manual.

Micro-Scope uses a horizontal menu bar, with pop-up sub-menus, as shown in Fig. 1. The four choices are Configuration, Setup, Diagnostics and Tools. Under Configuration, you can find out information about a system, such as CMOS contents, IRQs, adapters with ROM, etc. Choosing Run CMOS Setup lets you change, as well as view, CMOS contents. Choosing Display CMOS Contents from the menu displays, byte by byte, the contents of CMOS memory, which is a help if your system is giving you CMOS errors.

We tried several choices on the Configuration menu and obtained mixed results. One choice, LAN Card Search, failed to detect an ARCNET board installed in the ALR system. Another choice, Adapters with ROM, correctly found the ROM on the VGA card.

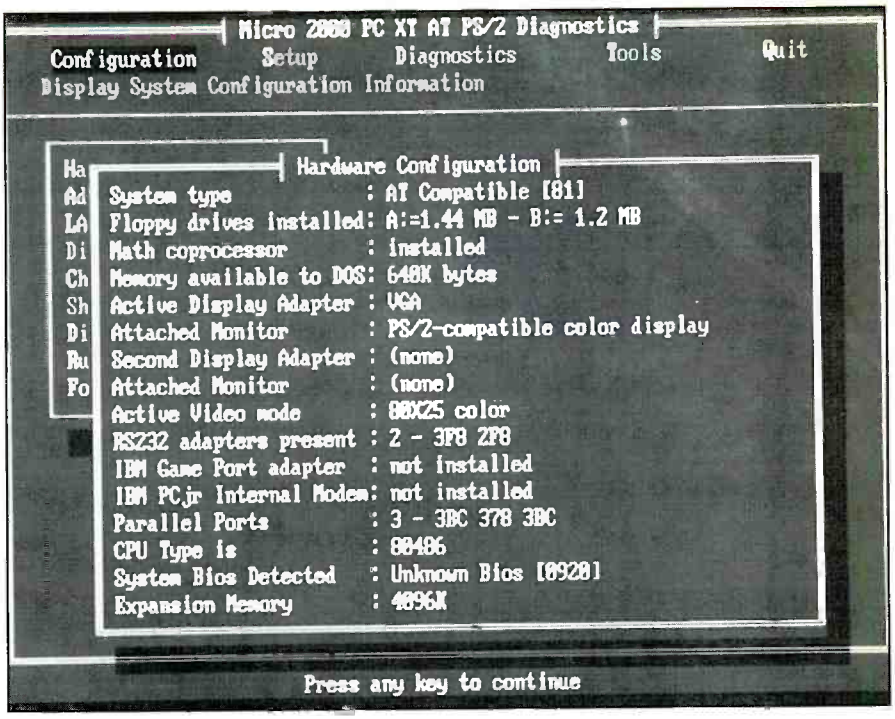


Fig. 1. Micro-Scope from Micro 200 uses a horizontal menu bar that displays the choices you have for testing and checking out a PC.

A menu choice called Display Active IRQs is supposed to show the status of the IRQ enable bits in the system's 8259 chip. When we performed this test, however, *Micro-Scope* didn't correctly display the IRQ status of the ALR machine. It indicated that interrupts 3, 4, 5 and 7 were disabled, which wasn't the case. A similar choice, Check Interrupts, did a better job of determining which interrupt settings were in use. It found IRQ3 and IRQ4 in use, but the program also showed IRQ5 and IRQ7 available, which wasn't true.

The second choice on the horizontal menu bar, Setup, permits you to preselect a series of tests and run them in sequence with error logging. Tests are available for CPU, memory, floppy and hard disks, serial and parallel ports. Setup is designed to exercise a system without an operator for a specific number of passes or continuously, while simultaneously logging errors.

The third choice on the menu bar, Diagnostics, contains the tests you can run. These are the same as those listed under the Setup menu, with the addition of video tests. The Diagnostics menu lets you run the tests individually, whereas the Setup menu doesn't. The memory tests test all extended memory, even if the BIOS doesn't see the memory.

Besides tests, the Diagnostic menu lets you do a low-level format of a hard disk, including IDE drives. We used this feature to low-level format an IDE and ESDI drive. *Micro-Scope* also lets you access the BIOS low-level format built into a hard disk controller. This means you don't have to use DEBUG to do it.

The final choice on the menu bar is Tools. This menu provides tools to examine memory, edit sectors on floppy and hard disks and set the optimum interleave on a hard disk. If you have a cleaning disk, you can use this menu to do floppy-disk-drive head cleaning. Choosing Examine Memory displays any physical bit of memory under one megabyte. This can be used to determine memory conflicts or available memory space. The disk sector editors let you edit any sector of floppy- and hard-disk media, even track 0.

With its premium price tag, *Micro-Scope* should, without question, be a premium product. However, we found that it fell short in a few places, such as detecting the network card and displaying enabled IRQs. To be fair, though, we didn't use *Micro-Scope* on an IBM computer, which the product is specifically designed to test. This may have contributed to the program's problems. *Micro-Scope* did, however, prove to be very useful for performing low-level formats on our IDE and ESDI hard drives.

A decision to purchase *Micro-Scope* should be based on your need for its particular tests and tools and on the brand name of the computer systems you regularly repair or/and upgrade.

QAPLUS/fe V.5.04

(DiagSoft, Inc., $349.95)

QAPLUS/fe was developed for IBM PC, XT, AT, 386, 486 and PS/2 computers. The "fe" in the product's name stands for "field engi-

neer." *QAPLUS/fe* is designed for use by skilled technicians, field engineers and advanced end users. DiagSoft also sells *QAPLUS*, a $159.95 PC diagnostics program, that's suitable even for novice users. *QAPLUS/fe* is self-booting and can run under various operating systems, including MS/PC-DOS, UNIX and Xenix.

No installation is required. Because the *QAPLUS/fe* disk is bootable, you just insert it into the drive and turn on the computer. During boot up, *QAPLUS/fe* checks for viruses with a program called *IntruderAlert*. The package includes both 3½" and 5¼" (high-density) diskettes in the package as well as three wrap plugs for the parallel, and serial ports (nine- and 25-pin) and a 110-page manual.

QAPLUS/fe uses pop-up menus, as shown in Fig. 2. The three choices on the main menu are Diagnostics, Reports and Utilities. Diagnostics lets you do a quick check of your entire system or check individual modules, such as memory, in depth. There are 10 modules altogether.

The Reports Menu offers two selections: System Info and *Power Meter*. The latter is the popular benchmark program, which is useful for comparing performance of one system against a standard or another system. With System Info, you can check device drivers, the DOS environment, IRQ/DMA status and the hardware configuration of the system.

We used the IRQ/DMA option to check whether *QAPLUS/fe* could detect the interrupt problem on our test system. Although the program makes an attempt to discern interrupt use, it didn't detect that the scanner board and network card were both set for IRQ2. When we reset the scanner interrupt to IRQ5, *QAPLUS/fe* didn't detect it. Instead, it listed IRQ5 as available.

QAPLUS/fe includes 10 utility programs. One of these, the COM Port Debugger, lets you test the functionality of each serial port by manipulating the port's control registers and then watching on-screen status indicators for proper response. This utility also lets you send Hayes AT commands through the serial port.

Another utility, QARemote, lets a *QAPLUS/fe* user connect via modem and diagnose problems on remote computers that are equipped with *QAPLUS*. Two of the utilities, QAFloppy and QAClean, align and clean a floppy disk, respectively, but you need to obtain the appropriate alignment or cleaning diskettes to be able to do this. QASCSI is a set of utilities for SCSI direct-access (hard disk) devices.

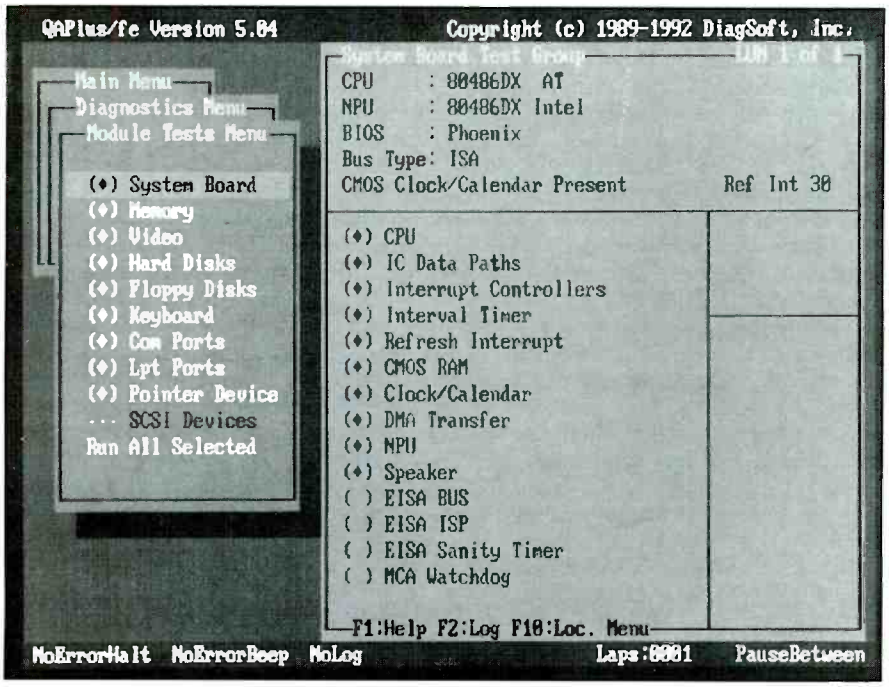


Fig. 2. DiagSoft's QAPlus/fe uses pop-up menus that display the choices you have.

The other utilities are a RAM chip locator, CMOS editor, floppy-disk formatter and hard-disk utilities. The last include a low-level formatting routine, but it appears as a menu item only if the hard drive in the system is supported by the program. *QAPLUS/fe* didn't support the Western Digital 210M IDE drive in the test system.

QAPLUS/fe supports error logging to a printer or disk file. Also, you can run a test or a set of tests a specified number of times from 1 to 9,999 by setting a lap count before beginning testing. If you specify 0, the tests run indefinitely.

QAPLUS/fe is priced higher than most of the competition, but many of its features and limitations are similar to the lower-priced packages reviewed here (and to its companion product, *QAPLUS*). A decision to spend the extra dollars depends on whether or not you need the extra features *QAPLUS/fe* offers, such as *Power Meter*, QARemote and QASCSI.

DiagSoft plans new releases of *QAPLUS/fe* (Version 5.1) and *QAPLUS* (Version 4.7), which should be available by the time you read this. Among other enhancements, the new releases will be capable of testing CD-ROM and 2.88M floppy drives, identifying up to 2M of video RAM and supporting SIMM and SIP packages for its Bad RAM Chip Locator.

Service Diagnostics V.2.13.18

(Landmark Research Intl., $195)

Service Diagnostics was developed for IBM PC, XT, AT-286, AT-386, AT-486, PS/2 and 100% compatible computers. We tested *Service Diagnostics* AT-486. It's DOS-based and requires MS/PC-DOS 2.1 or later. Landmark also sells a version of this program that's bootable, which makes it independent of the operating system. Priced at $195, other versions are as low as $69 (for XT models).

No installation is required. You must, however, boot from a "clean" system disk (one that doesn't install TSRs or device drivers and uses a simple CONFIG.SYS file). *Service Diagnostics* includes both 3½" and 5¼" diskettes in the package, as well as three wrap plugs for the parallel and serial ports (nine- and 25-pin) and a 135-page user's manual.

The main menu of *Service Diagnostics* gives a list of eight options, as illustrated in Fig. 3. The first choice on the menu lets you select (to test) any of the listed devices in your system. Selecting A brings you to the Device Test Menu, shown in Fig. 4. Notice that the program ignores the scanner and network cards of the test system. From this screen, you can select any of the installed devices to test.

Some selections, such as Hard Disk Drive(s) and Controller, lead to further menus that not only provide tests, but also utilities like low-level formatting. If you

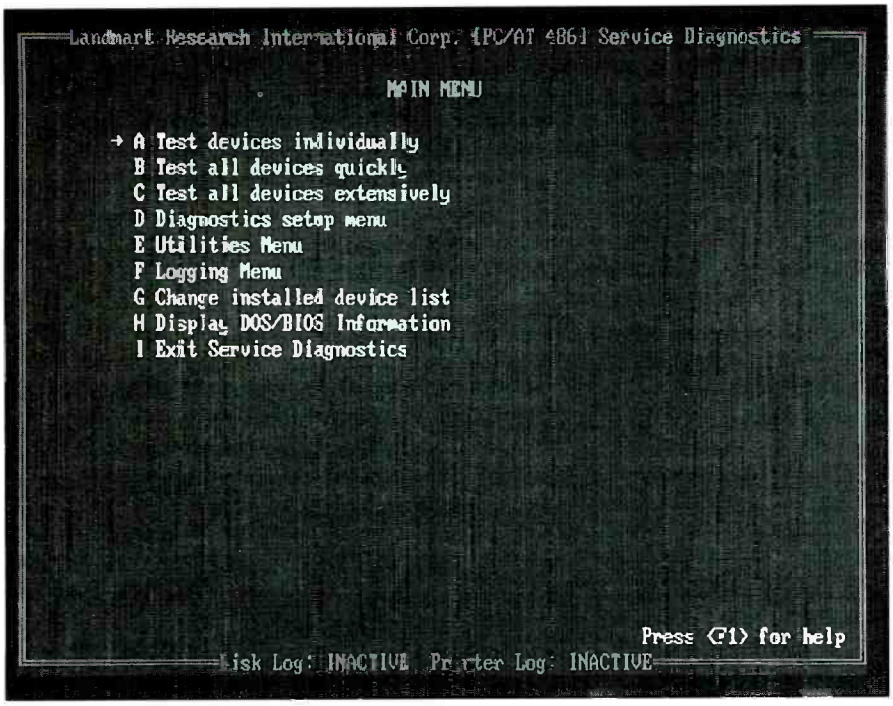


Fig. 3. Landmark's Service Diagnostics gives a list of eight options.

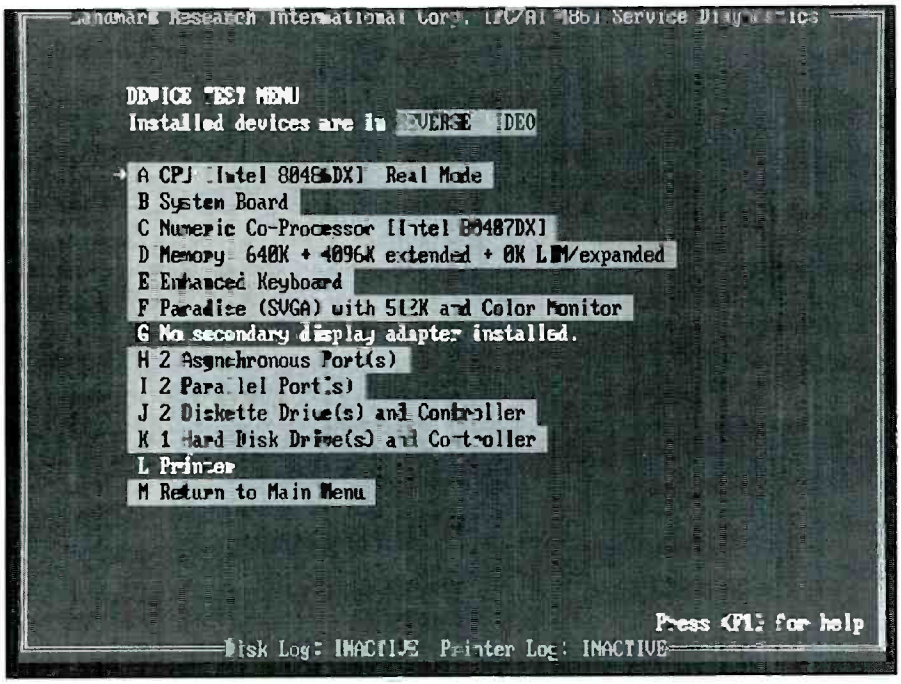


Fig. 4. Selecting option A on Service Diagnostics brings you to the Device Test Menu.

select the Memory option, an entire module loads from disk to check memory. The Memory Test Menu appears in Fig. 5.

We used the Device Test Menu to test the serial ports on our test machine. The program indicated that COM1 passed (a mouse is connected to this port) and COM2 failed. The internal modem uses COM2. The modem is working fine, but it probably caused the test failure. The documentation doesn't address this situation and, therefore, doesn't tell you how to interpret this failure.

Service Diagnostics lets you test all devices in your system sequentially and automatically by selecting the B or C option. If you also select the Logging Menu, you can retain a copy of the error reports generated by the tests. These reports can be routed to disk or printer.

Like *Micro-Scope*, *Service Diagnostics*

not only displays CMOS contents, but it also lets you change parameters through its Utilities Menu. The Utilities Menu is sparse, though. Hard-drive parking is the only other option on this menu.

The Display DOS/BIOS Information option provides information about the BIOS, interrupts, DOS environment and contents of the AUTOEXEC.BAT and CONFIG.SYS files. Unfortunately, this feature is informational, rather than diagnostic. For example, for information on interrupts, the program displays an 80X86 interrupt map. This doesn't provide the kind of information needed to diagnose interrupt conflicts, like those we introduced on the test system.

At $195, we failed to see the benefit of purchasing *Service Diagnostics* specifically for 386/486 machines. We were unhappy with the product's ability to help us solve the problem with the test system, but there are other features that may appeal to you. For example, you may be interested in the automatic testing and logging features. If you decide *Service Diagnostics* meets your needs, you're probably better off acquiring the bundled package for $299.

QuickTech V.2.00

(Ultra-X, Inc., $149)

QuickTech was developed for IBM PC, XT, AT-286, AT-386 and compatible computers. The program requires DOS and at least 256K of RAM. No installation is required. You simply place the *QuickTech* disk in the drive and type UX. *QuickTech* includes one 3½" and two 5¼" diskettes in the package, as well as a double-sided 25-pin plug for performing loop-back tests on the parallel and serial ports. If you have serial ports with nine-pin connectors, you must add a nine-to-25-pin adapter. *QuickTech* also includes a 130-page manual.

The *QuickTech* menu comes up as 10 boxes on the screen, as shown in Fig. 6. You make selections by pressing the appropriate function key. Six boxes allow you to test a specific subsystem of a PC, such as memory, serial and parallel ports, floppy and hard

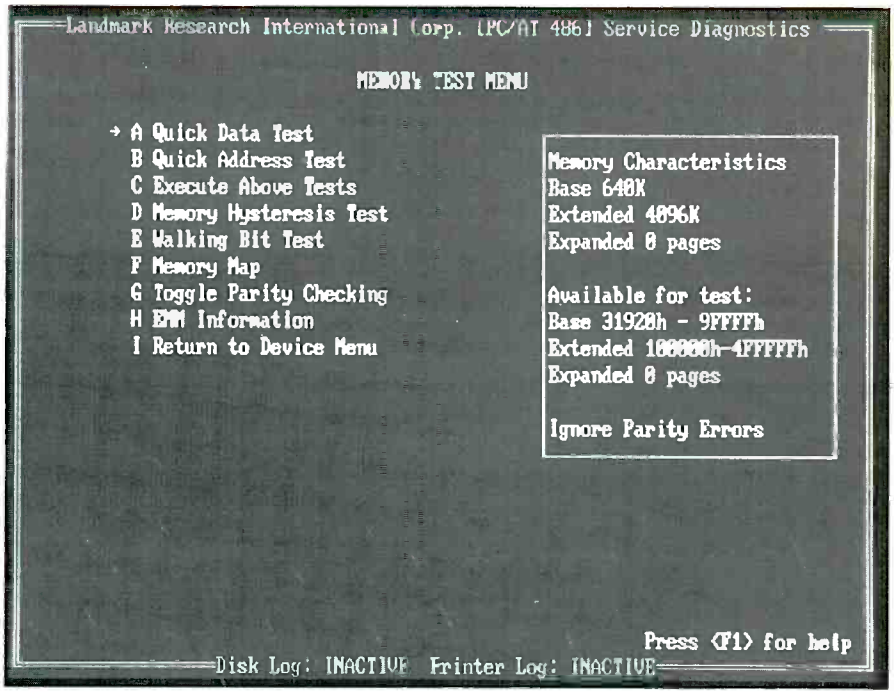


Fig. 5. If you select the Memory option in Service Diagnostics, an entire module loads from disk to check memory.

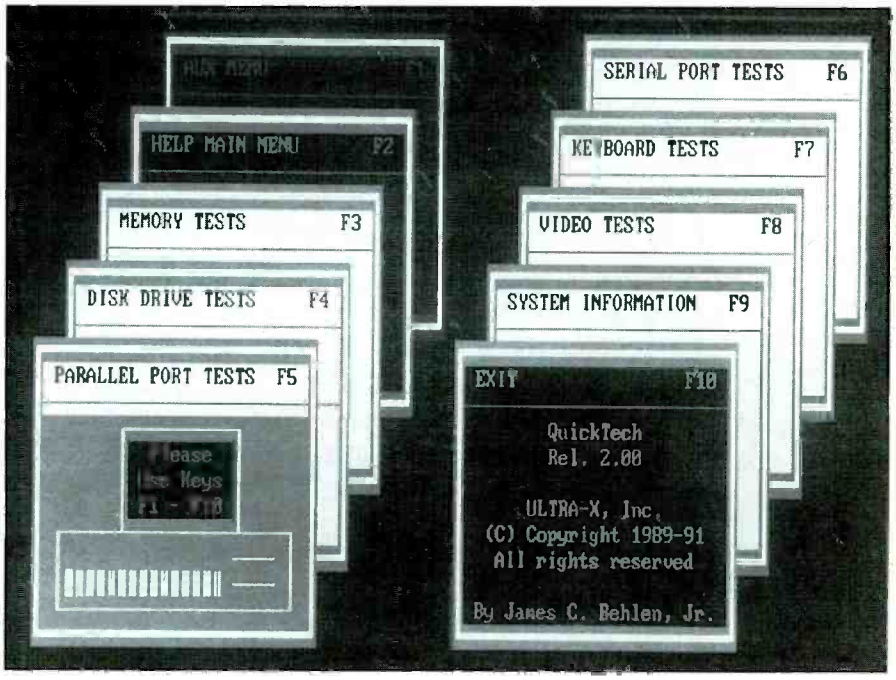


Fig. 6. Ultra-X's QuickTech menu comes up as 10 on-screen boxes..

drives, keyboard and video. One box lets you select the auxiliary menu shown in Fig. 7. It's through this menu that you can automate system testing. We found the interface very straightforward and easy to use.

Selecting the System Information box lets you display information about system stats, interrupts, DMA channels, memory, PC/XT DIP switches and CMOS setup. *QuickTech* didn't give us correct information on our 486 test system when we selected System Stats. It erred on processor type, coprocessor type and hard-disk capacity. The errors are understandable since the program doesn't support AT-486 computers and also doesn't support the IDE hard disk used in the system. The biggest problem with the System Information section of the program, though, is that such important areas as system interrupts and DMA channels are informational only.

When you select System Interrupts, you get a static display that tells you how inter-

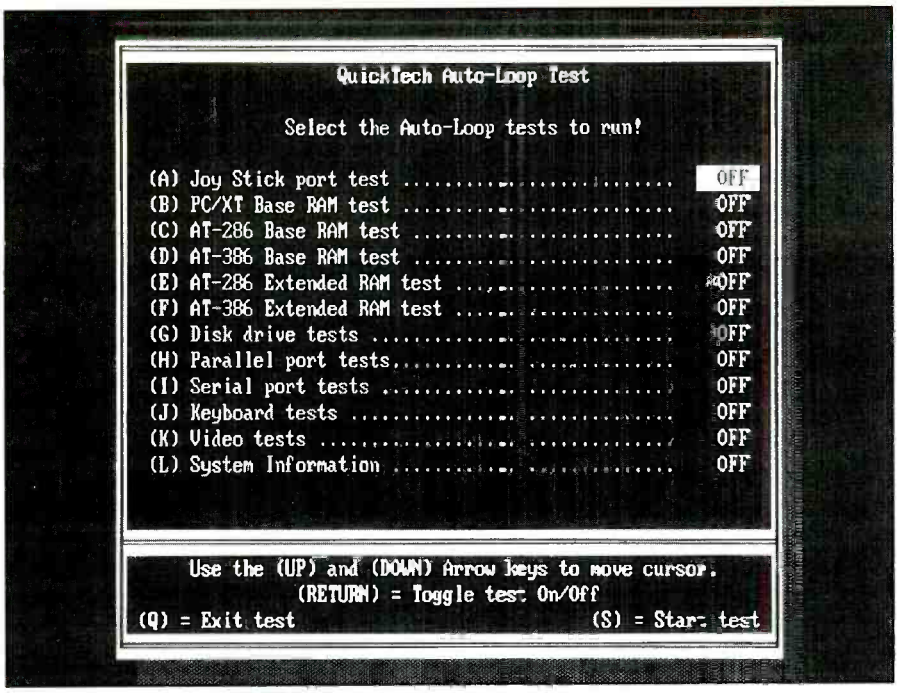


Fig. 7. One box in QuickTech lets you select the auxiliary menu shown here.

rupts are normally used on AT-class machines. This information is easily accessible through PC service literature. On the other hand, Memory Use is a dynamic feature and CMOS Setup lets you change, as well as view, contents.

We used *QuickTech* to test the system's serial and parallel ports and found no problems with them, as expected. However, we couldn't use the program to check current interrupt status or conflicts.

We tried testing the test system's IDE hard disk, but found that *QuickTech* doesn't support drives other than MFM and RLL. For these drive types, *QuickTech* performs read, write, seek, media and other tests. Besides the tests, *QuickTech* offers a low-level format utility.

Before deciding to spend $149 on *QuickTech*, you need to determine what types of systems you're likely to be testing. Two major failings of the program are its lack of direct support for 486 systems and lack of support for IDE, ESDI and SCSI hard drives. These drives are unquestionably the most-popular ones sold for the last couple of years. If the program suits your needs, though, it's simple to use and offers much of the functionality of the more-expensive programs.

Note: Last month, we gave the price for UltraX's R.A.C.E.R. II diagnostic board as $6649. Its correct price is $649.

CheckIt Plus V.3.0

(Touchstone Software Corp., $149)

CheckIt Plus was also developed for IBM PC, XT, AT-286, AT-386, AT-486, PS/2 and compatible computers. It requires PC/MS-DOS 2.0 or later and at least 384K of RAM.

To install *CheckIt*, you simply insert the distribution disk in a floppy drive, log onto this drive and type INSTALL. *CheckIt* performs a virus check prior to installation on the hard-disk drive.

Included in the package are one 3½" and two 5¼" diskettes and a 206-page manual. This version of *CheckIt* also includes two auxiliary programs, *MenuWorks Personal* from PC Dynamics and *Disk Labeler Supreme* from MBC. Since neither is a diagnostic program, we won't cover them here.

CheckIt uses a horizontal menu bar with five categories, as shown in Fig. 8. When you make a selection, drop-down menus appear. We found the interface straightforward and easy to use.

Selecting SysInfo from the main menu bar gives you five further choices: Configuration, Memory Map, Interrupts, CMOS Table and Device Drivers. When we selected Configuration, *CheckIt* correctly displayed all the pertinent information on our 486 test system. There is even an option to copy the information to an activity log.

When we selected Interrupts, *CheckIt* checked the system and showed "[Cascade]" for IRQ2 and "VGA (Active),IPX" for IRQ 9. The program gave no indication that the scanner also was set to IRQ2 or that any conflict existed. *CheckIt* indicated that IRQ5 was "Available." It also indicated that LPT2 was a device with no IRQ. Interestingly, for IRQ4, *CheckIt* not only indicated COM1, but also noted that the mouse used this interrupt, a useful piece of information.

When we selected CMOS Table, we immediately noticed that the data relating to the hard-disk drive was in error. All other information was correct. *CheckIt* doesn't allow you to modify CMOS information.

We used *CheckIt*'s Tests menu to test the system's serial and parallel ports. The program asked whether or not an external loop-back connector was attached to the port. These connectors aren't provided with the program. We tested the ports without the loop-back plug. *CheckIt* found no problems with the ports, as expected.

We tested the test system's IDE hard disk and controller, and found no problems, as

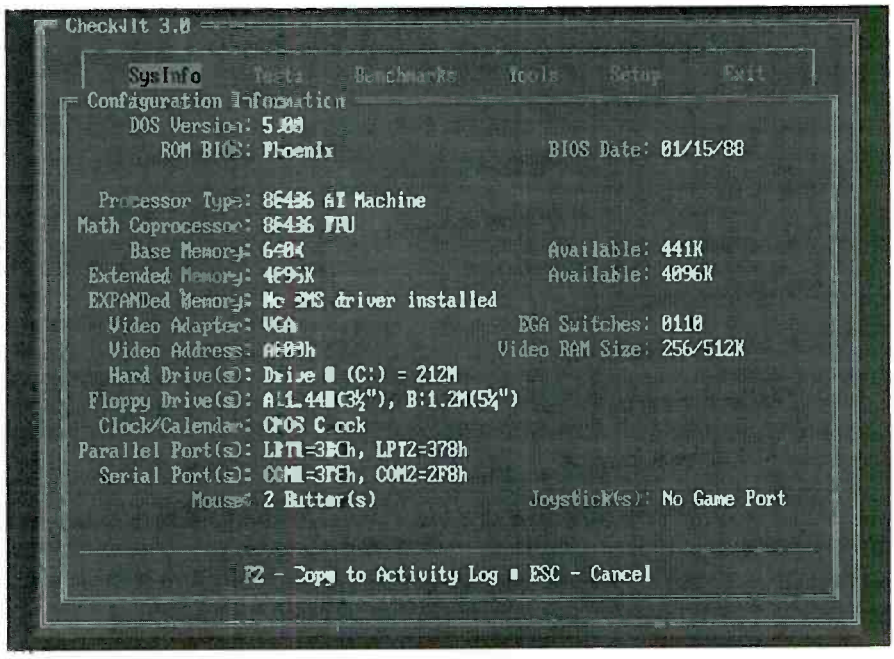


Fig. 8. CkeckIt from Touchstone uses a horizontal bar with five options from which to choose.

expected. The *CheckIt* tests are non-destructive and are performed at the physical level. This means *CheckIt* can show problems even on unused or non-DOS partitions. In contrast to the CMOS Table display, *CheckIt* correctly displayed the hard disk's parameters.

All major components of a PC system can be checked from the Tests menu. A Select Batch command on the menu lets you construct a customized list of tests to be run on a system.

As you might expect, the Benchmarks menu lets you check the performance of a system. The Tools menu contains an item called Locate RAM Chips. This selection pinpoints defective RAM chips so that they can be replaced. A selection called Format AT Hard Disk lets you do a low-level format of MFM hard disks.

CheckIt does a fairly good job of reporting on and testing a system. It didn't help us with our interrupt conflict, but it gave us enough information to correct the situation (informed us that IRQ5 was available, and that LPT2 hadn't been assigned an IRQ). The omission of loop-back plugs for port testing is an inconvenience. For a price of $149 (which is heavily discounted through mail order), *CheckIt* Plus is easy to use and offers much of the functionality of the more-expensive programs.

Port Test V.2.0c

(MicroSystems Development, $89)

Port Test was developed for IBM PC, XT, AT and compatible computers. Unlike the other programs reviewed here, *Port Test* tests only the serial and parallel ports of a system. At $89, *Port Test* is the least-expensive program of the group and offers a substantial savings to anyone interested only in diagnosing problems related to serial and parallel ports. The current version of *Port Test* can handle up to nine serial and parallel ports.

Port Test runs under DOS, and no installation is required. To start the program, you simply type PORTTEST. *Port Test* includes one 5¼" diskette, a 33-page manual and a curious looking loop-back card. The card is shaped like a T and has a 25-pin parallel port connector and nine- and 25-pin serial-port connectors. The card also has three LEDs that light during a loop-back test. The card can be awkward to use, especially if your work area has space limitations. We experienced no problems with it, however, when testing individual ports.

Port Test uses a menu list for selecting program options, as shown in Fig. 9. The menu choices allow you to test ports individually or all ports automatically and also lets you manipulate port parameters.

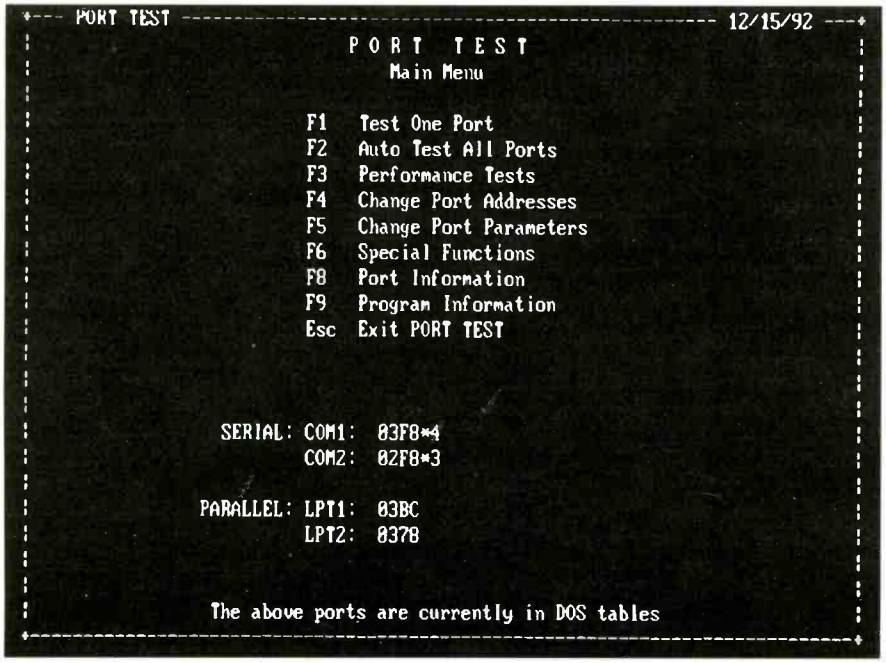


Fig. 9. Port Test from MicroSystems Development uses a menu list for selecting program options.

Testing a serial or parallel port using the first menu option is straightforward and easy to do. The program runs a series of tests on the port and displays a pass or fail result.

We found the second menu option, Auto Test All Ports, to be essentially useless, given the way the product is packaged. It's impossible to perform loop-back tests on all ports automatically, since the special three-way wrap plug can be used on only one port at a time. When you select Auto Test All Ports from the menu, the first question you encounter is: "Is a wrap plug installed on all ports?" If you answer "No," you receive a message that says: "Sorry, a wrap plug must be installed on all ports in order to proceed."

The Special Functions option contains some interesting choices. One allows you to toggle the output lines of a port. Using this feature, you can light the wrap plug's LED when it's installed on a port. This can be an aid to finding out which ports are COM1, COM2, LPT1, LPT2, and so forth. When we tried this feature, it worked well with the serial ports, but not with the parallel ports. For the parallel ports, the wrap plug LED lit, even though the port the plug was connected to was disabled.

Another of the special functions is a terminal emulator. This is handy, for instance, to quickly check whether or not a modem is responding to Hayes AT commands.

Although Port Test doesn't help you resolve interrupt conflicts directly, the documentation covers ways to discover conflicts through trial and error. The recommended procedures apply only to serial ports, however.

Port Test is a reasonably-priced diagnostic program that can help you locate problems with serial and parallel ports. If you are interested in automating port testing, however, you won't be able to do it with this product as it packaged, since it contains essentially a single wrap plug.

Conclusions

We have mixed feelings about the six software diagnostic programs reviewed here. On one hand, none was able to directly help solve the problems of conflicting interrupts we caused on the test system. Furthermore, system information given by the programs wasn't always accurate. For example, *MicroScope* and *QAPLUS/fe* indicated that an interrupt was available when it wasn't, and *Port Test*'s wrap plug LED lit up for a parallel port that wasn't in use.

On the other hand, we found that these software diagnostic programs gave us enough good information about the test system's use of serial and parallel ports, port addresses and interrupts that would likely enable us solve most problems associated with this aspect of the sys-

tem. We do recommend, however, that you use this information in conjunction with the documentation you receive with your computer system and add-in boards.

Another good point about these programs is their ability to do automatic testing and error logging. This can be very helpful for diagnosing problems in systems that are experiencing intermittent failures.

Overall, we think that all of the programs tested here offer enough utility to justify a purchase. Although we looked at the programs from a servicing aspect, they provide mountains of information about the innards of a PC that's wonderful to learn about and to store away while the machine is working just fine. When something does go awry, you'll have solid reference points against which to check.

For example, we checked out a 386SX laptop compatible with 4M of memory, 40M IDE hard drive, two COM ports with a mouse and internal modem connected, and VGA adapter with 256K RAM with the programs. They produced perfect scores! Interrupts, DMA assignments, device driver locations, BIOS type and date, hard-drive information down to the heads' Park place, RAM locations, etc. In some cases, even the keyboard brand was identified, as well as the number of keys on the mouse (three, in this case).

Especially intriguing for informational purposes are benchmark tests, where available. It's certainly interesting to see what a system's performance level is. *CheckIt*, for example, very quickly displays in bargraph format video speed, numerical calculation performance and system performance. Not to be overlooked, too, is the ability to locate RAM and get a display showing where it is in the board layout.

The way to select one of these programs is to first make a thorough assessment of the systems and components you expect to be testing. This should give you a clear idea of whether or not a particular program will meet your needs. For example, if you have an IDE drive and the program doesn't handle this, look for one that does. And if you're into multimedia and do much work under Microsoft *Windows*, perhaps a *Windows* diagnostic program is desirable. After you decide what type of equipment and components you wish to test, you may have several choices. ■

Joseph Esposito

Software Diagnostics Companies

Micro-Scope, $499
Micro 2000, Inc.
1100 East Broadway, 3rd. Fl.
Glendale, CA 91205
Tel.: 818-547-0125
CIRCLE NO. 122 ON FREE INFORMATION CARD

QAPlus/FE 5.1, $349.95
DiagSoft, Inc.
5615 Scotts Valley Dr., Ste. 140
Scotts Valley, CA 95066
Tel.: 408-438-8247
CIRCLE NO. 123 ON FREE INFORMATION CARD

QuickTech, $149
Ultra-X, Inc.
PO Box 730010
San Jose, CA 95173
Tel.: 408-988-4721
CIRCLE NO. 124 ON FREE INFORMATION CARD

CheckIt Plus, $149
TouchStone Software Corp.
2130 Main St., Ste. 250
Huntington Beach, CA 92648
Tel.: 800-531-0450 or 714-969-7746
CIRCLE NO. 125 ON FREE INFORMATION CARD

Port Test, $89
MicroSystems Development
4100 Moorpark Ave.
San Jose, CA 95117
Tel.: 408-296-4000
CIRCLE NO. 126 ON FREE INFORMATION CARD

Service Diagnostics, $69 XT version; $169 286 version; $195 386/486 version; $299 all versions plus AT ROM POST
Landmark
703 Grand Central St.
Clearwater, FL 34616
Tel.: 800-683-6696
CIRCLE NO. 127 ON FREE INFORMATION CARD

Build a Laser Receiver/Link

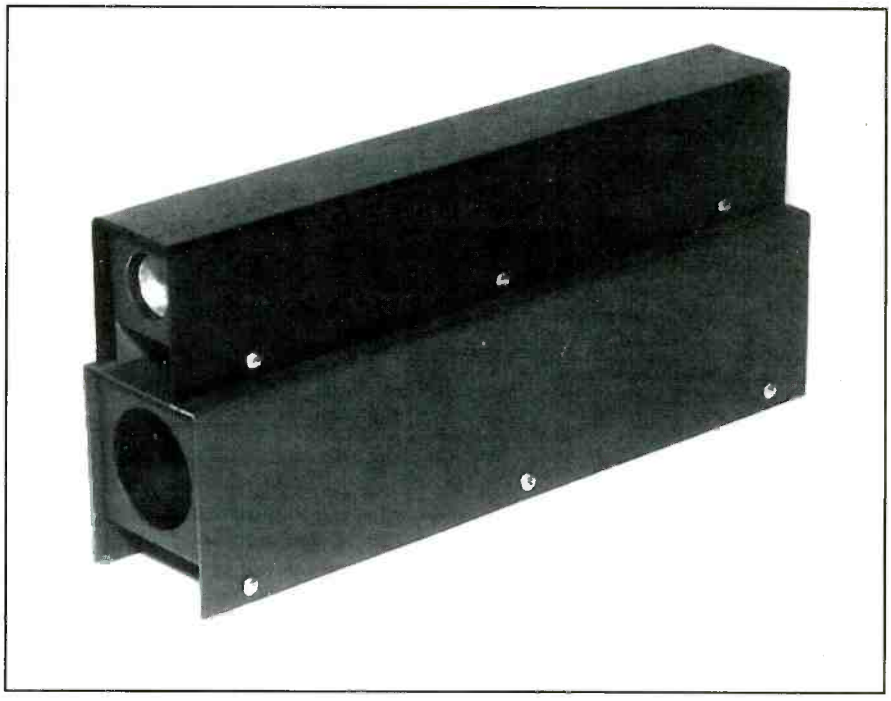
Combining this project and the Cyber Laser featured last month, you can build a secure laser communications link, among a wide range of other high-tech projects

Last month, I described the theory behind and how to build a digital laser you can connect directly to the serial port on your computer or microcontroller. This time around, I'll complete the data link by showing you how to build a laser receiver/link device I call the Quanta-Link that complements last month's Cyber Laser.

With the system described here, for less than the cost of a plug-in card for your PC, you can now experiment with:

- Ultra-precise distance measuring using digital interferometry
- Computer-to-computer and computer-to-peripheral data links
- Computer-controlled laser light shows and demonstrations
- Quantum-channel crypto links
- Optical-system prototyping
- Laser security systems
- Laser seismology
- Laser gyrography
- Holography
- And literally hundreds of other intriguing and practical applications

Quanta-Link is an easy-to-build optical detector unit (ODU), that connects directly to the serial port on your computer. By detecting photons emitted from the Cyber Laser, Quanta-Link converts pulsed light directly into digital data that's compatible with the RS-232 protocol.



About the Circuit

The Quanta-Link unit unit consists of a chassis, cover, optical-detector assembly and printed-circuit assembly. The optical detector assembly, or ODA, consists of a PVC tube that's painted flat-black inside and out. The front "coupler" tube contains a plano-convex lens and can be moved back and forth along the length of the body tube. This mechanism lets you focus the incoming laser beam directly on the photodiode semiconductor die. This concentration-effect acts to re-collimate and intensify the laser energy entering the ODA.

Photodiode *D1* in Fig. 1 is located in the base path of transistor *Q1*. BIAS ADJ potentiometer *R1* lets you set the "dark" current bias of *Q1*. As the current in *Q1*'s base/emitter junction increases, the collector pulls *R4* above ground potential. When this voltage exceeds the gate threshold voltage of VN0300 hexFET *Q2*, this transistor's drain pulls *R6* and pin 11 of *U1* toward ground.

MAX-232 interface chip *U1* converts the TTL-level input at pin 11 into RS-232 levels that are compatible with the serial port in your PC. As you can see, the basic Quanta-Link circuit is a simple mechanism that receives laser energy and converts it into data output, which is then fed to your PC.

The *U2* circuit is provided only as an alignment aid for the system. Light/current fluctuations in the collector circuit of *Q1* are filtered by *C5* and then coupled through *C1*, to VOLUME control *R5*. As the host computer pulses Cyber Laser with serial data, the bit-stream can be heard in the internal speaker. This makes life easier when setting up and using your Quanta-Link.

Audio power amplifier *U2* utilizes *C4* to "color" the sound of the modulated light, with *C14* and *R7* filtering unwanted ringing in the speaker-driver output circuit. Audio output capacitor *C7* blocks *U2*'s dc offset but passes the audio component.

Regulation for the power supply is provided by *U3* and *U4*, which also pro-

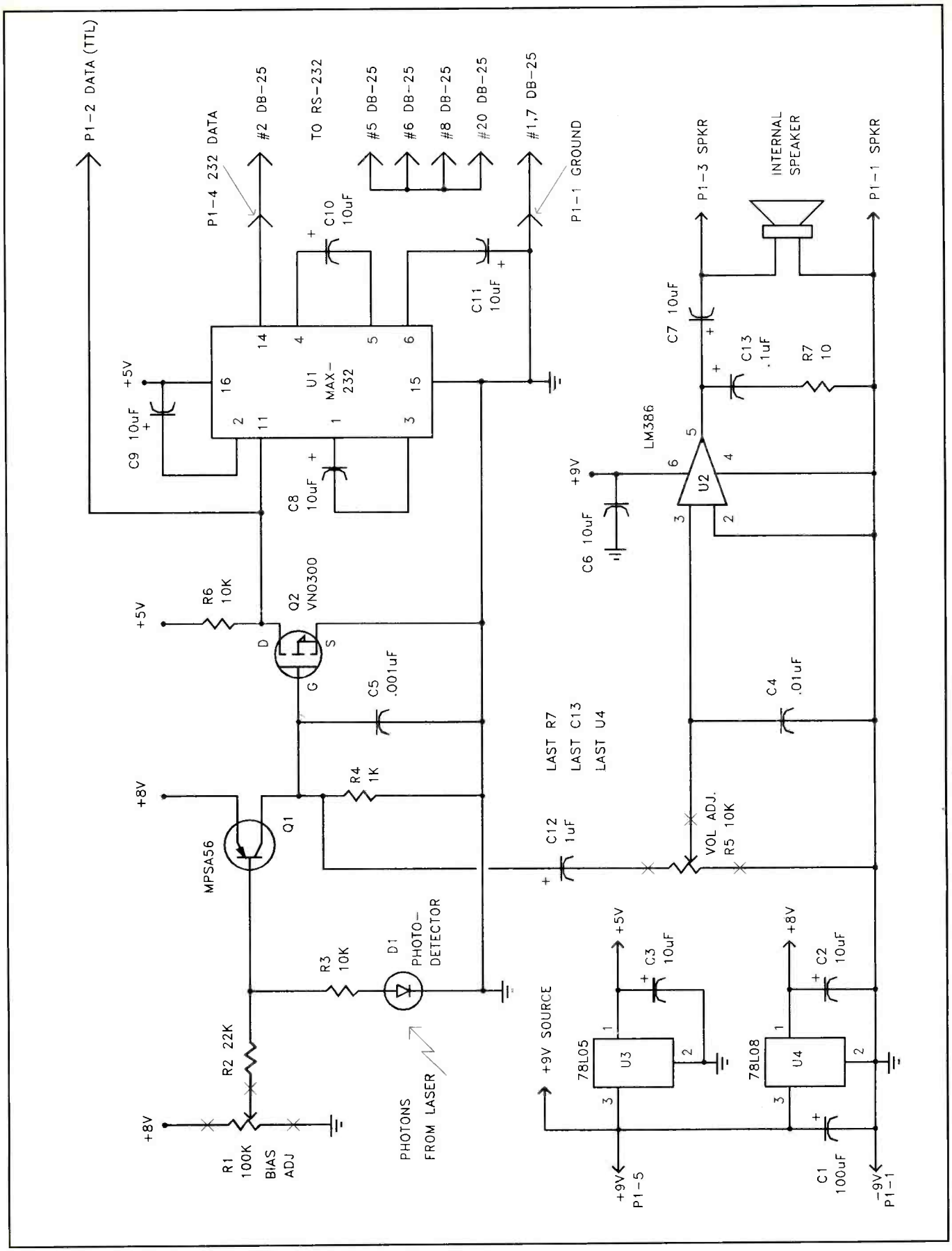


Fig. 1. Schematic diagram of Quanta-Link's circuitry.

PARTS LIST

Semiconductors
D1—Npn silicon phototransistor or photodiode
Q1—MPSA56 transistor
Q2—VN0300 hexFET transistor (Siliconix)
U1—MAX-232 interface
U2—LM386 audio amplifier
U3—78L05 fixed +5-volt regulator
U4—78L08 fixed +8-volt regulator
Capacitors
C1—100-uF, 16-volt electrolytic
C2,C3,C6 thru C11—10-µF, 16-volt electrolytic
C4—0.01-µF, 50-volt dipped Mylar
C5—0.001-µF, 50-volt dipped Mylar
C12—1-µF, 16-volt electrolytic
C13—0.1-µF, 16-volt tantalum
Resistors (1/4-watt, 5% tolerance)
R2—22,000 ohms
R3,R6—10,000 ohms
R4—1,000 ohms
R7—10 ohms
R1—100,000-ohm linear-taper potentiometer
R5—10,000-ohm audio-taper potentiometer
Miscellaneous
P1—Five-pin female DIN connector
Printed-circuit board (see text); 1" 16-ohm Mylar mini-speaker; aluminum chassis assembly, cover, tube bracket; 1" PVC coupler; 1" PVC end cap, 3.5" length of 1" PVC Schedule 21 or 40 pipe; 30-mm convex lens with 94-mm focal-ength), 4-4 u 1/4" and 6-32 u 1/2" panhead Phillips screws; 6-32 and 4-40 Keps nuts; 1/2" No. 5 sheet-metal screws; 36" of No. 22 or No. 24 hookup wire; ribbon cable; IC sockets (optional—see text); solder; etc.

NOTE: The following items are available from U.S. Cyberlab, Inc., 14786 Slate Gap Rd., West Fork, AR 72774, (tel.: 501-839-8293): Ready-to-wire Quanta-Link printed-circuit board. $7.95; complete prefabricated and painted aluminum Quanta-Link chassis, cover and tube bracket, $29.95; recollimating lens, $9.95; photodiode, $2; VN0300 hexFET transistor, $2. Also available is a complete Quanta-Link kit of all mechanical, optical and electronic components (including power supply but not IC sockets), $49.95. Add $3.45 UPS S&H for individual items, $5.60 for complete kit. MasterCard/Visa welcome. Arkansas residents, please add 5% sales tax.

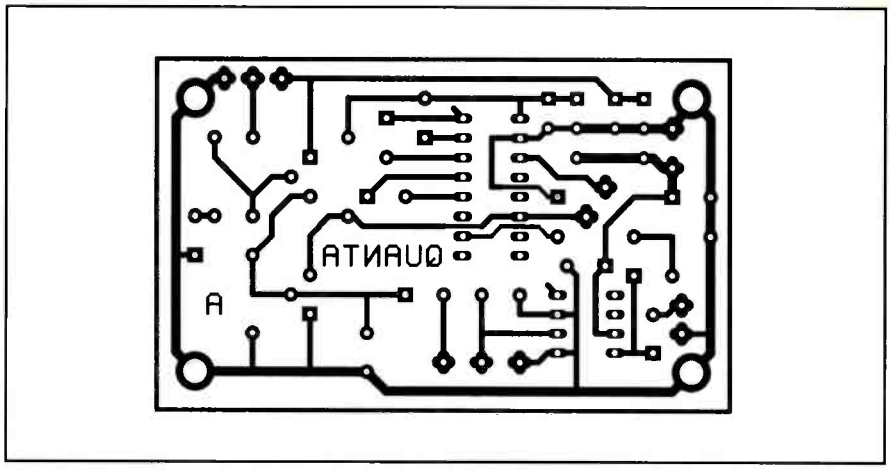


Fig. 2. Actual-size etching-and-drilling guide for making project's printed-circuit board.

vide a stable voltage reference for the *Q1/D1* circuit and *U1*.

Unregulated 9 volts dc is applied directly to pin 6 of *U2* and is ripple-filtered by *C1*. Though Quanta-Link can be battery operated, I prefer to use a small 200-mA plug-in wall-type power-supply module for continuous operation.

All electrical connections to and from Quanta-Link are provided by the five-pin DIN connector. You can attach an external alignment speaker between pins 1 and of *P1* and ground or use headphones for high-noise environments. Connector *P1* speeds and simplifies setting up Quanta-Link.

Construction

You build Quanta-Link in two separate phases: electronic and mechanical. We'll start with the electronics.

Begin by fabricating a printed-circuit board for the electronics, using the full-sized artwork in Fig. 2 and any fabrication method that suits you. If you don't wish to make your own pc board, you can obtained a ready-to-wire board from the source given in the Note at the end of the Parts List. If you make your own board, use a No. 68 bit to drill the smaller component mounting holes and a No. 62 bit for component-lead/pin holes. Drill the four mounting holes for the board with a No. 29 bit.

Referring to Fig. 3, begin populating the pc board by installing and soldering into place the the passive components. Start with the resistors and then proceed to the capacitors, paying particular attention to the polarity of the electrolytics.

Next, install voltage regulators *U3* and *U4*. Make certain you properly orient them before soldering their pins into place. Follow up by installing and soldering into place *Q1* and *Q2*, again making sure to properly orient these devices before you do any soldering.

Finally, install and solder into place *U1* and *U2*. If you prefer, you can use IC sockets instead of soldering the pins of these ICs directly to the copper pads on the bottom of the board.

Now, fabricate the Quanta-Link chassis, cover and detector tube bracket, using the machining details given in Fig. 4. Again, if you don't wish to make your own mechanical elements, you can obtain prefabricated and painted ones from the source given in the Note at the end of the Parts List. Drill and test-mount the detector tube bracket on the main chassis, and check to make sure that the cover slides down smoothly.

Next, drill the mounting holes for the circuit-card assembly and speaker. Install the four mounting spacers, using 4-40 u 1/4" panhead Phillips screws. Then mount the female DIN connector and potentiometers. I mounted a 1" Mylar speaker directly against the main chassis floor using 5-minute epoxy cement to hold it in place. When cementing the speaker, be sure to apply the cement only around the rim of the speaker. If you get any on the speaker, it will muffle whatever sound is generated and keep it from reaching the listening levels you will later need.

Wire the circuit-card assembly into place using a combination of ribbon cable and No. 24 hookup wire, as shown in Fig. 5. The type of wire you use isn't critical. Just keep your wiring neat, and make sure that it doesn't interfere with the chassis cover during installation. Use Fig. 1 and Fig. 2 as wiring guides. When you're done double-check your work before attaching the circuit-card to the main chassis.

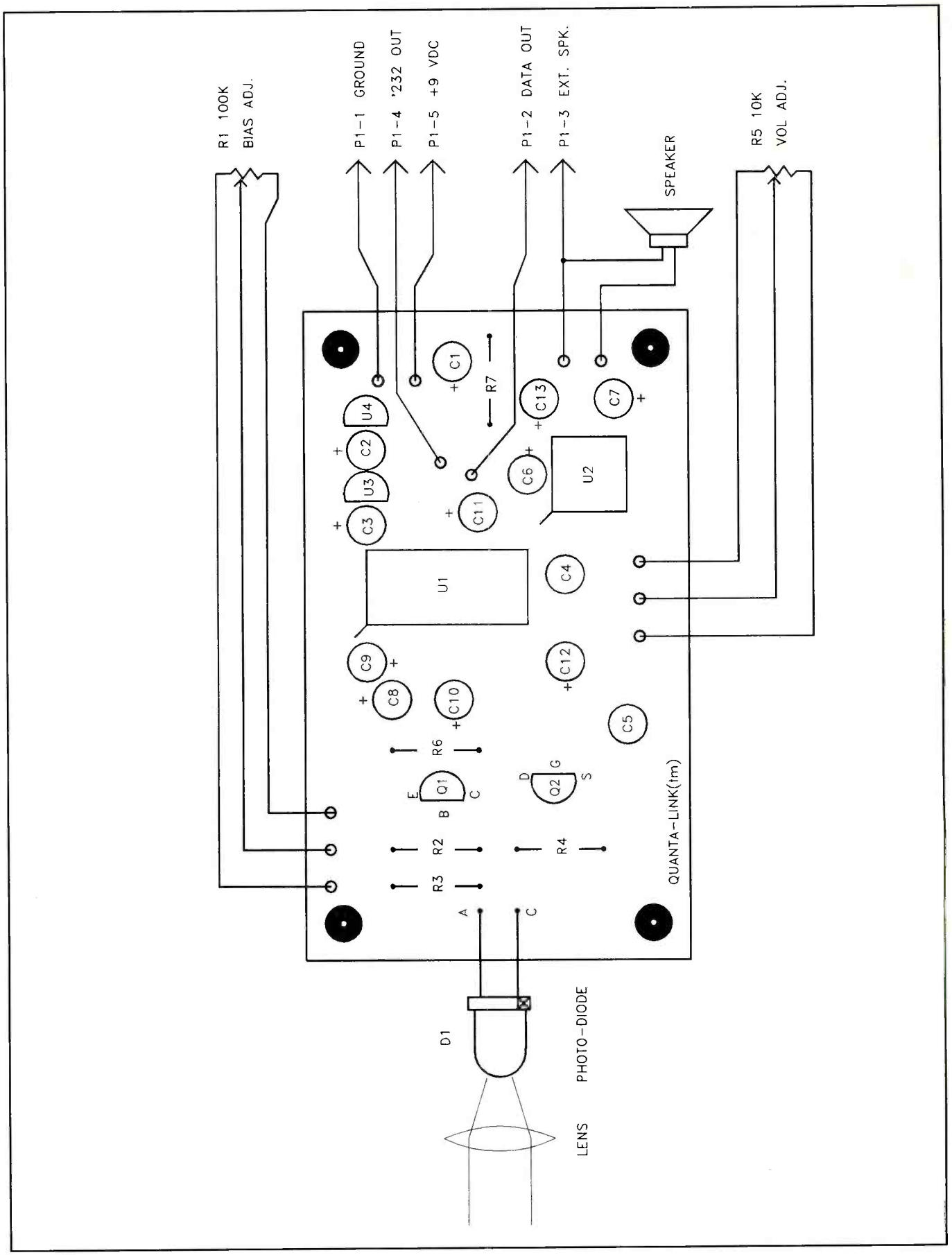


Fig. 3. Wiring guide for pc board.

To build the ODA, cut a piece of 1" Schedule 21 or 40 PVC pipe to a length of 3 1/2". Whether you use a hacksaw or PVC pipe cutter, make sure both ends of the pipe are fairly straight.

Next, drill a 0.135"-diameter (or to fit your choice of photodiode or transistor) hole through the exact center of a 1" end cap. It's important that this hole be perfectly centered in the end cap for proper operation. Test fit the end cap on the body tube and mark the mounting hole, using the tube bracket as a guide. Drill the body tube hole with a No. 27 bit and remove any plastic debris from both hole and tube.

It isn't necessary to cement the end cap on the pipe because it will probably fit quite tightly all on its own. Use long-nose pliers to install the 6-32 u 1/2" ODA mounting screw through the body tube. Push the end cap onto the pipe.

Test fit the plano-convex lens inside the 1" PVC coupler. It should easily slide into the coupler, but it shouldn't fit so loosely that it falls through the coupler's center divider ring. Hold the coupler so that the lens lies against the internal divider ring in a horizontal position. While still holding the coupler vertically, slide the body tube up and into the bottom of it.

Have an assistant move a sheet of white paper up against the center hole in the end cap as you point the assembly toward a bright desk lamp or ceiling light. As you slide the body tube back and forth inside the coupler, take note of the focusing effect on the piece of paper. When you later install the photodiode or phototransistor, you'll want the laser beam to focus directly on the semiconductor die and have a diameter of about 0.100".

Play with the ODA to get a feel for the optics involved. It will help during checkout and alignment. Spray paint the interior and exterior of the ODA flat black to help in absorbing reflected ambient light entering the ODA from oblique angles.

When you're satisfied that the lens is focusing properly at the end-cap hole, use a little 5-minute epoxy cement to secure the lens in place. Start with just three or four drops around the edge of the lens in case you have to make some final adjustments. After securing the lens, use your Cyber Laser to make final focus adjustments on the piece of paper.

Warning: *Never look through the optical detector assembly at the laser beam!* The micro-focused beam could be harmful to your eye. Rather, use a sheet of white paper, held against the end cap hole, as a focusing screen. Fine-tune the ODA focus, and then mount the photodiode with 5 minute epoxy cement. Be careful to avoid getting cement on the optical lens of the photodiode's or phototransistor's optical lens.

Mount the ODA on the detector tube bracket, and secure the assembly with a nut from the underside of the main chassis. Connect the photodiode leads to the circuit-board assembly with Wire Wrap or other small-gauge hookup wire. Be sure to keep track of the cathode and anode, or use a meter to determine which is which.

Checkout & Use

Using a meter or oscilloscope, determine which is the +9-volt conductor of the power-supply module or battery. (You'll find that the actual output of most wall-type power-supply units is considerably greater than 9 volts. Under load, your supply could easily output 11 or 12 volts, which is fine for this application.) When you've identified the positive lead, connect it to pin 5 of DIN connector *P1*. Likewise, connect the negative lead to pin 1.

Double-check your work with a meter. Then connect the supply to Quanta-Link and briefly power up. You'll probably hear a slight "popping" sound from the speaker when you first apply power. Use your meter to check various points around the circuit for the proper potentials. If all looks okay, set the VOLUME control to maximum.

Point the ODA toward a fluorescent light and adjust the BIAS ADJ. control until you hear a 60-Hz buzz from the speaker. Using your meter or scope, check the voltage at pin 4 of *P1* when you aim Quanta-Link at the fluorescent tube. By adjusting the BIAS ADJ. control, you'll be able to produce positive and negative pulses similar to those created by the RS-232 serial protocol.

At this point, wire the serial cable that connects Quanta-Link to your host computer. Use three-conductor shielded cable with a DB-25 connector at one end. If your computer has a DB-9 connector on its serial port, you must use an adapter cable, or substitute a DB-9 connector and make the necessary pin number changes.

Notice in Fig. 1 that pin 2 of the DB-25 connector connects to pin 4 of *P1* and pins 7 and 1 jumper together and connect to pin 1 of *P1*. Use No. 22 or No. 24 hookup wire to jumper together pins 5, 6, 8 and 20 of the DB-25 connector to eliminate the need for the software handshaking that's often necessary with the serial port.

There are two ways to test Quanta-Link. One involves use of two computers with serial ports. Connect one computer to the Cyber Laser and the other machine to the Quanta-Link. The alternative method involves using only one serial port, with the Cyber Laser connected to pin 3 (data out) and Quanta-Link connected to pin 2 (data in). You may have to reverse pins 2 and 3 on your system to allow for differences in Data Communication Equipment and Data Terminal Equipment standards.

Using a terminal communications program, configure each machine for 300-baud bit rate, eight-bit word and one stop bit. Place the Cyber Laser and Quanta-Link on a flat table top facing each other. You'll have to slightly raise the Cyber Laser to achieve optical alignment with Quanta-Link.

Place a sheet of white paper in front of Quanta-Link, and adjust the objective lens in the Cyber Laser to produce a 1/4"-diameter beam. Remove the paper and set the VOLUME control on Quanta-Link to maximum. While entering some random letters and numbers on the host computer to which the Cyber Laser is connected, move the Cyber Laser around slightly until you hear the data being received at Quanta-Link. Position the Cyber Laser for maximum volume.

Finally, trim the BIAS ADJ. control until valid data appears on the host computer to which Quanta-Link is connected. With good data being received at Quanta-Link, try increasing the baud rate of both computers. You'll find that the unit works as well beyond 9,600 baud as it does at 300 baud.

Applications

There are many applications to which you can put a Cyber Laser/Quanta-Link system. I've used such a system to collect data from remote sites in both computer-to-computer and computer-to-peripheral configurations. You can run data links in simplex or duplex mode. By using the Cyber Laser at the transmitting end and Quanta-Link at the receiving end, you can operate in simplex mode, transmitting data in one direction only. In duplex mode, you

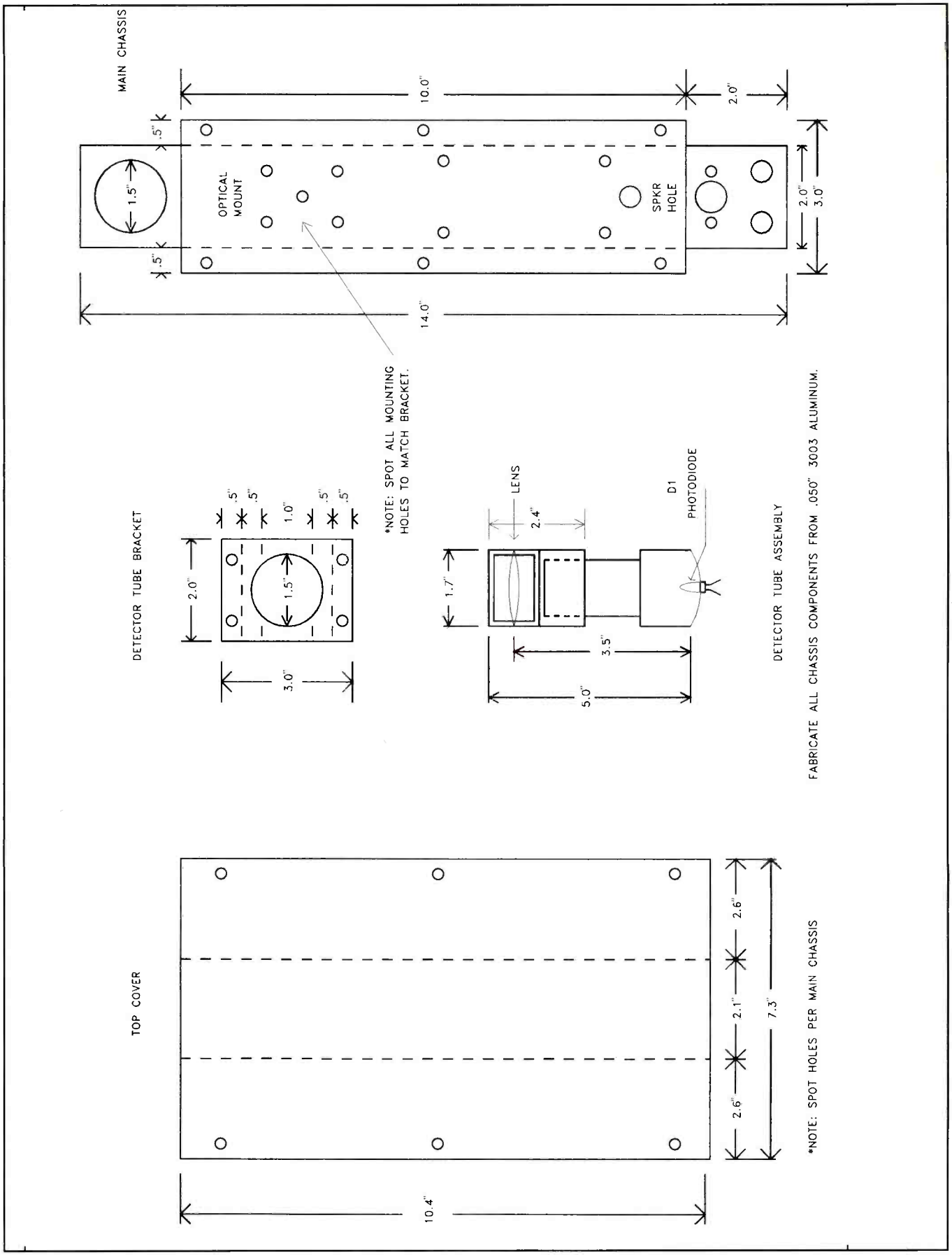


Fig. 4. Use these dimensioned drawings to home-fabricate the various mechanical elements needed for the project.

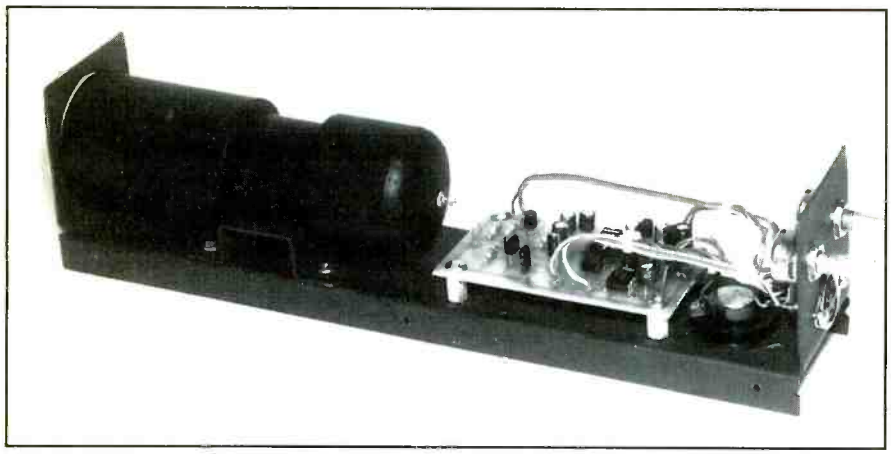


Fig. 5. Interior view of the finished project shows how it all goes together and neatness of the wiring.

need two Cyber Lasers and two Quanta-Links. In this mode, you must stack these devices as shown in the lead photo.

Aligning Quanta-Links is made considerably easier when you use the internal speaker or external headphones. With the Cyber Laser unpowered, roughly align the system by simply sighting down the length of the Cyber Laser and Quanta-Link cases. When you feel that the units are in fairly close alignment, put on laser goggles and power up the system. If you don't have laser goggles, use sunglasses, which is okay because the optical power output of the Cyber Laser is so low.

Carefully move the Cyber Laser back and forth while you're transmitting data. If the link is over a considerable distance, you need an assistant with a transceiver to help you during alignment. With the units properly aligned, the data link should behave just like a phone line and modem. (You might have to adjust the objective lens in the Cyber Laser to minimize beam diameter at the remote site.) If you align a duplex system, simply repeat the procedure for the "backhaul" link.

If your installation is to be permanent, solidly mount the Cyber Laser and Quanta-Link to keep them aligned over a long period of time.

The Cyber Laser is very useful for analyzing optical on path. With a little smoke, simply holding various lenses in front of the laser beam can help you establish focal lengths. Complex lens, mirror and beam-splitting arrangements are easy to verify visually using an optical table and the Cyber Laser. You can turn virtually any smooth tabletop into a home optical bench, as long as it sits very squarely on a stable floor. You can fabricate some simple lens and mirror holders out of aluminum, plastic or wood. While a simple arrangement like this would probably not produce good interferometer or holographic results, it will work fine for general optical-system prototyping.

A logical outgrowth of your optical bench experiments would involve computer-controlled laser shows and demonstrations. Using your PC to control one or more servo-mirrors, you can control the Cyber Laser's beam path through a programmed series of motions. Similarly, you can attach small mirrors to speakers and solenoids to further influence the laser beam. When doing so, always use caution when you run the program for the first time. You don't want the beam to shine directly into someone's eye.

Using the Cyber Laser and Quanta-Link to make up a security system is easy. In free-standing mode, simply jumper the Cyber Laser to produce a constant light output. By placing mirrors at various angles around your property, you can create a difficult-to-avoid beam grid. Place Quanta-Link at the end of the beam path, where it will monitor the laser energy for any break in continuity.

If you want to further tighten security around the place, connect the Cyber Laser and Quanta-Link to your computer and transmit data over the beam path. Any interruption in the stream of data will be immediately detected by your program.

With a little imagination, you can probably think of dozens of other applications for this sophisticated system. ■

Nick Goss

CheaperNet: An Inexpensive Way to Interconnect Two PCs to Share Their Resources in a LAN-Like Environment

When you got that second computer, all your PC troubles were over—or so you thought. What you didn't reckon on were things like the file you need being on a machine across the room, or the game your kids want to play being buried on your hard disk at a time when you couldn't interrupt the large spreadsheet recalculation you've running to strip it off and put it on your kids' machine. It's at times like these that you're in the middle of a dilemma, but not if you think CheaperNet.

CheaperNet sounds like something that isn't going to cost you much money, which is exactly what it is. It's a zero-slot local-area network (LAN) system you can implement without much capital outlay. This software-only LAN allows you to connect two machines via their serial or parallel ports, using inexpensive modular telephone cables. To get the system up and running, you load a network driver via your CONFIG.SYS file to provide access to services on either machine, and you're on the CheaperNet.

Several commercial zero-slot LANs are available. Artisoft puts out *Lantastic-Z*, which is supplied free with *Dvorak's Guide to Desktop Connectivity* ($54.95 retail). B.G. Micro in Dallas has both the *$25 Network*, which costs just that, and the *Little Big LAN*, which sells for $75. Of course, shareware offerings are also available, like the one PC SIG distributes under the name *U-Net*. EasyNet Systems has its *EasyNet ShareLan*, which is the subject of this review. You can obtain *EasyNet* directly from the authors or download it from America Online and a number of other services.

Setting Up a EasyNet

Peer-to-peer zero-slot LAN systems all work in much the same manner. They load a network driver from the command line or through the CONFIG.SYS file in your computer. A configuration file provides mapping for remote drives, printers and other DOS devices. The network driver uses data from the CONFIG.SYS file to set up DOS redirection to remote drives and devices.

Using the system is as easy as switching drive letters (or printer ports for printers). Programs that reside on the remote system can be accessed, copied and even run from the linked computer. At the higher end, DOS file and record locking is supported to allow network-capable software to operate. This lets multiple users access and run the same programs at the same time.

EasyLan ShareLan is a typical zero-slot LAN system. With it, you can interconnect two computers through their serial ports, using a simple null-modem cable. The network driver (actually a small multitasking TSR) loads from the command line and reads a simple ASCII configuration file that specifies the disks and printers that are available on the remote computer. Even though parallel-port connections may be much faster, if you're like me, your parallel ports have long since been monopolized. Consequently, I'll focus here on serial connection.

The *ShareLan* connection is characteristic of zero-slot LANs. It uses a null-modem connection between the serial ports of two computers. ShareLan supports speeds up to 19,200 bps, which isn't super speedy, but it's workable.

Since a simple null-modem cable needs only three connections, modular telephone cabling makes a good choice for quick setup and flexibility. Of course, if you already have a null-modem cable that will span the distance between your two computers, you're ahead of the game.

If you want to go modular, pick up a couple of RJ-11 to 25- or nine-pin adapters (Altex makes several models for $1.99, Part Numbers are given in the Hardware Needed box at the end of this review). The adapters snap apart, and the insulation on the conductors from the RJ-11 connector are color-coded and finished off with male or female pins. You select the type of connector pins according to your needs.

The D-shell connector that hooks to the serial port slips into the end of the connector. You'll notice that the connections are numbered. For a nine-pin to nine-pin null-modem cable, you connect pin 7 straight through and reverse the connections to pins 2 and 3.

To make your null-modem cable, start with the first adapter by plugging the red-insulated wire into the pin-7 location, the blue-insulated wire into the pin-2 location and the green-insulated wire into the pin-3 location. There's nothing magical about these insulation colors, it's just that I like the way they look together.

On the second adapter, plug the red-insulated wire into the pin-7 location, the green-insulated wire into the pin-2 location and the blue-insulated wire into the pin-3 location. If you have a nine-to-25-pin connection, plug the red-insulated wire into the pin-5 location on the nine-pin connector and pin-7 location on the 25-pin adapter. If the pins don't seat fully, you can get a tool to seat them for about $3, but it's just as easy to gently grab the wire behind the connector pin with needle-nose pliers and push straight down.

Now all you need is a six-conductor modular phone cable. You can pick up one of these for about $6 from any local electronics store. Connect the adapters to the serial ports on your two machines. Then put plug in the phone cable, and you're connected!

Configuring *ShareLan* on your computers is just as easy as making the hardware connections. Just install the executables in your root directory and add the command DEVICE=NETDRIVE.SYS to your CONFIG.SYS file. I set up bootable network floppy

Hardware Needed

All the hardware items you need to make your null-modem cables for setting up a *ShareLan* can be obtained from Altex Electronics, 10731 Gulfdale, San Antonio, TX 78216; tel.: 512-828-0503. The items you need include:

Nine-pin female connector Part No. MA9F-6TS

Nine-pin male connector Part No. MA9M-6TS

25-pin female connector Part No. MA25F-6TS

25-pin male connector Part No. MA25M-6TS

Working With CheaperNet

Now that you're on the CheaperNet, you can do more than just share disk space and toss files back and forth. With a couple of inexpensive shareware programs, you can use your CheaperNet to do unattended backups and print piles of files.

Back Ups

That old 8088 taking up space in the corner was the reason I got interested in zero-slot LANs. A great use for this system is to do unattended backups.

The excellent shareware compression program *ARJ* from Robert Jung, is an excellent choice for backups (or use your favorite compression program). *ARJ* provides a high level of compression and allows you to selectively retrieve individual files from your archive as needed.

To back up your system, simply attach to your backup machine through CheaperNet. Since the attached drive is simply another DOS device, all you need to do is create a small batch file with the *ARJ* command line as follows:

```
ARJ a F:BACKUP -r -a1 -b1 -i1 -js -jt
-jiC:BACKUP.INX -WC:\ -m1
```

Note that everything shown above and later should be on a single line.

This routine will back up all changed files on your C: drive to drive F: (drive C: on your backup machine) and create an index to the backed-up files (BACKUP.INX) on your C: drive. The index is particularly helpful when searching for files. Recovering a file from the archive is a simple as connecting through the network and using the extract command:

```
ARJ e F:BACKUP FILENAME.EXT -q
```

It can take several hours for a backup to run, but you can expect compression ratios of 70% to 80%. So it's possible to back up almost 100M onto a 20M drive. I usually run this at night and just leave my systems up and running. It's a lot nicer than flipping floppies all day.

You never need a backup until you really need it, and using CheaperNet makes it easy enough so that you'll never need an excuse for not backing up your data.

Print Server

When the crunch hits at my house, there never seems to be enough time, hands or printers to get the job done. But, with a CheaperNet and *Disk Spool II*, you can put together a neat little print server that will keep the jobs cranking out.

Print Spool II is a full-featured print spooler from Budget Software Co. Once this TSR is installed on your machine, it captures output to your printer and saves it in a disk file. Printing (de-spooling) can operate in the background while you continue working. *Disk Spool II* also allows you to turn off spooling and de-spooling—either from the command line or from the pop-up menu accessed through hot keys.

You can take advantage of this flexibility to pass your printer files over to a remote computer, where they'll be stored in a disk file and printed as needed.

Setup is simple. Run the *Disk Spool II* configuration program (SP2CFG), and set up your spool file on your remote computer (for example, E:\SPOOL). On the remote system, run the same configuration, but use the local drive designation (for example, C:\SPOOL). Invoke *Disk Spool II* on the remote machine, and use the command-line parameters or menu selections to turn off spooling. On your main system invoke *Disk Spool II,* and turn off de-spooling.

Any printer output from your main system will now be captured to a file on your remote computer. With *Disk Spool II* running resident there (and using it's memory and resources), it will spool the files captured to the spool file to it's local printer (or a CheaperNet printer connected to your main system).

If you have a lot of printing to do, this is a great way to use all of your computing resources and get the stuff out the door.

disks for both my machines so that I wouldn't have to fool around with swapping AUTOEXEC.BAT and CONFIG.SYS files.

The last thing you need to do is set up network configuration files for each machine. These ASCII files set up drive and printer mappings for the remote system. They use DOS redirection to allow you to designate a remote hard drive as, say, drive G: and a remote printer as LPT3, or whatever you want. Then all you have to do is re-boot your computer, and you're up and running.

With the network system loaded, you can change drive mappings on the fly, using a handy utility included in the *ShareLan* package. To use a drive on a remote computer, you just use the assigned drive letter. Another neat thing you can do is assign a drive letter to a drive and subdirectory.

On my son's single-drive 8086 PC, I assigned my GAMES subdirectory as Drive D:. When he wants to play a quick game, for example, he just types D:\ and the games filename and hits Enter, and off he goes. Meanwhile, I can hammer peacefully away at whatever I've been doing on my PC.

Of course, you do pay a memory overhead for the drivers. Most systems take up 30K to 60K of RAM space, but some lower-end systems take much more. *ShareLan* is a memory hog, stealing almost 100K. Loading these drivers high on an AT or later machine is essential for good performance. Once installed, though, these systems are reasonably well-behaved. I've experienced no problems accessing files on disks compressed by SuperStor and RAM disks on remote systems.

Up and Running

Running at 19,200 baud, accessing a remote drive is noticeably slower with a *ShareLan* system installed than accessing a local drive. However, once a program is up and running, you won't notice any decrease in performance. Printer sharing is one of the best ways to use these systems. A job can be started printing from a remote machine, and you can keep plugging away on your PC while it prints. Now this is multitasking!

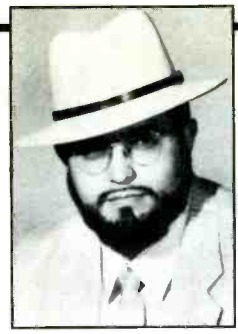
CheaperNet is a quick, easy and—best of all—cheap way to make the most of your computer investment. If you're having family battles over who gets to use the big computer or just want to grab a pile of stuff from that machine sitting across the room, CheaperNet is decidedly a great way to go.

You can download *ShareLan* from America OnLine and many local BBS systems or from: EayNet Systems, Inc. 4283 Village Centre Court, Mississauga, Ontario L4Z 1S2 Canada; tel.: 416-273-6410. ■

Sources

ARJ, $35 shareware
Robert Jung
2606 Village Rd. West
Norwood, MA 02062
CIRCLE NO. 164 ON FREE INFORMATION CARD

Disk Spool II, $34 shareware
Budget Software Co.
PO Box 12282
Aurora, CO 80012
CIRCLE NO. 165 ON FREE INFORMATION CARD



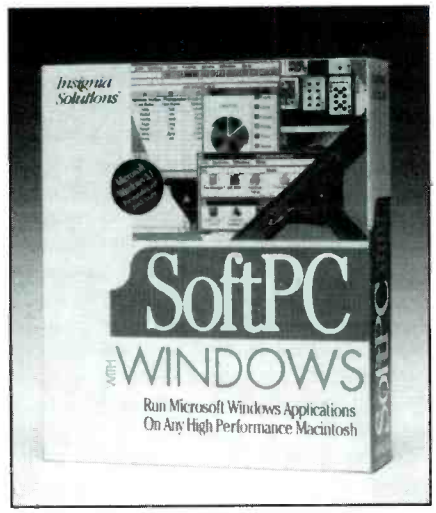
Apple's Threat to Microsoft's *Windows* and Running *Windows* Software on a Mac

Since its inception, many users have seen Microsoft *Windows* as a way to give Intel-based PCs the ease of use and functionality of the Macintosh computer. Indeed, from time to time, it does seem as though *Windows* will endow the PC not only with the look-and-feel of the Mac, but also with its class of applications. It's these applications that really make the Mac what it is. Now *Windows*—variations of which only recently seemed on the verge of parity with the Mac operating system—is back in catch-up mode from way back. And the prospects for making up the gap now seem farther in the distance than at any time in the last year or two.

It seems like only yesterday that Microsoft *Windows* had made a major advance in the race to catch the Macintosh. I was writing this column about Video for Windows—with *NT*'s 32-bit architecture looming right around the corner. Then *Windows for Workgroups* debuted, and the Microsoft-Intel solution made another gain with a low-cost networking solution that's almost as simple to implement as *AppleTalk*, and with hooks into corporate departmental networks. It has simple scheduling and email applications built into it and lets applications use DDE across a network, too. But something happened in San Francisco last week to weaken the impact of those advances.

At MacWorld, Apple introduced a number of new products, including one that again pushed ahead the frontiers of desktop computing. To be sure, there were several systems and peripherals, including printers and a low-cost color scanner. However, that wasn't the source of the setback. Apple introduces new systems every few months, and there were more fillers for gaps in the product line at Moscone than real advances in technology. The one exception is a wonderful ergonomic keyboard that's going to be widely imitated (and probably, the subject of litigation). Yet, it's not surprising that Key Tronic told me, at the show, that it's already working on its own ergonomic keyboard designs, not only for the Mac but the PC as well. PC hardware responds quickly—and usually surpasses the Mac in raw processing power and value.

The real news wasn't hardware, but software. Apple's introduction of the



Insignia Solutions' *SoftPC With Windows* lets you run PC applications on a Macintosh computer.

ColorSync system extension puts the Mac back. Back on top that is. It's a color matching system that brings third-party peripheral vendors into sync with the operating system. Corrections for color temperatures, and allowances or conversions for differences in device spectrums, are built right into an extension that lets users match the color on their screens with the originals in their scanners and the outputs in their printers or image setters. Today, this is critically important to designers and desktop publishers using their Mac for color proofing and finished output.

ColorSync is not only a major improvement, it's an essential one for low-cost color. Instead of depending on expensive comps produced by experts, the color requirements of average users will be satisfied on the desktop for a small fraction of current production costs.

Tomorrow, in the world of pervasive low-cost color, *ColorSync* will be important to nearly everyone. It may even play a part in enabling rapid penetration of color technology and establishment of color hardware as the basic desktop platform.

Hardware vendors are bringing the price of color down at the same time multimedia, animation and desktop video are going to make it essential. But most users are ill-equipped to manage color without some help from a smart computer. *ColorSync* seems about as timely as *QuickTime* was when it was first demonstrated at the American Film Institute a year and a half ago (both from the standpoint of pushing the envelop on technology and of keeping Microsoft's *Windows* from breathing down Apple's neck).

Affordable systems that support color applications began to appear a couple of years ago when the price of high-resolution color printers fell below $10,000—and more recently, down to a few grand. Inkjet technology like that in the Apple Color Printer, unveiled at the show and based on the 360-dpi Canon BJ820C engine, is even more affordable. The new printer lists for $2,349, yet handles stock up to the 11" × 17" size favored by many desktop publishers—especially for its ability to produce bleeds. (Apple even had a product manager at the show who's job it was to push printers into the Intel-based market. He was showing them with a Compaq computer.)

Microtek's 600-dpi color scanners made another breakthrough when they dropped to about $1,500 a while back, and many others have followed suit. Apple's new Color OneScanner's 600-dpi resolution is only interpolated, but it will list for $1,349 when it ships in February.

First-class portable color is also within reach of many more users than it was just a few months ago. Active-matrix color portables like the NEC UltraLite SL/25C notebook I reviewed here last year continue to drop in price (thanks in part to the large market created for them by *Windows* applications).

If *ColorSync*-like technology is the "glue" that will make it feasible for the uninitiated to use all this cheap color hardware successfully, then *Windows* will have to have it, too. How long will it take for *Windows* to develop something of the sort? One possibility is that the difference between the *Windows* and Mac markets will make it very difficult for Microsoft (or Novell, IBM or anyone else) to coordinate a similar effort among vendors. After all, goes this logic, PC hardware choices are more like a democracy, and the Mac's more like a feudal state.

All Mac systems come from the citadel, and third-party vendors are like a surrounding peasant community under the

watchful eye of the duke. On the other hand, there are many standards bodies for the PC, but nobody's really overseeing development of products. The assumption is that it's easier for Apple to control vendor participation in a scenario like this that requires cooperation.

Can Microsoft orchestrate a *de-facto* standard like ColorSync by building it into *Windows* or an operating system? It seems to me, Microsoft is as prepared as anyone to provide regal guidance. ("Does his majesty Bill dumps on his competitors?" might be the rhetorical response to replace the one about a bear in the forest.) *Windows* applications should be able to provide the same level of control over color as the Mac. But unless Microsoft already has something in the works, it will probably take a couple of years before something like *ColorSync for Windows* is ready, and that's a long time during which Apple will be working on the next strategy to keep the Mac system competitive.

More Goodies

What are some of the other things on the horizon for GUI interfaces? Actually, Apple is already working on several strategies scheduled for release this year. One is *QuickDraw GX*, an extension that will, among other things, let users share color documents across various Mac platforms. A major benefit of *QuickDraw GX* is that it won't require any particular resolution for display or output. Another benefit is easier and more versatile document formatting with uniform page-definition guidelines that make it easier to transfer formatted information between applications in color.

The PC will have to provide this capability if its applications are to remain competitive with those on the Mac. It's the next obvious step in document portability after the recently introduced font technology that lets you maintain your layout across machines. *Windows* is the most likely software platform for providing this extension on the PC.

Another technology promised for 1993 is *AppleScript*, an integrated scripting system that will automate routine tasks, and "seamlessly" integrate the functionality of several off-the-shelf applications into "powerful custom solutions." This is exactly the solution I heard Microsoft's Mike Maples promise in Los Angeles—on the day *Windows* 3.0 was announced. Let me see. What year was that? 1957? 1963? It's been a while, but all we have for *Windows* is DDE and OLE, without the scripting glue to put the pieces together. The Macro Recorder is still a bad joke.

If Apple delivers on its promise, Microsoft will certainly have to respond more quickly than it so far has seemed wont to do. This will unquestionably be good news to *Windows* users who don't want to code *Visual BASIC* or become locked into the macro systems in Microsoft applications. This capability belongs in the operating system, not in the applications that can serve to lock users into more monolithic Microsoft solutions and further exclude other vendors from the market.

Cupertino also plans to deliver the *Apple Open Collaboration Environment*, or *AOCE*, this year. This extension will provide a secure platform for integrating electronic communications including fax, voice mail, telephony, electronic mail, directories and agents. Among its benefits will be a means to interoperate with a large number of communications standards: X.400, SMTP, MHS, PROFS, ALL-IN-1 and others.

If Microsoft doesn't deliver systems and environments that can match, if not exceed, Apple's offerings, will *Windows* users have an alternative? Would I ask if I didn't have an answer? One alternative would be to move to the Mac, taking your *Windows* applications and data with you.

SoftPC with Windows

Insignia, a leader in DOS-emulation technology, developed the OEM emulations used in popular Unix operating systems and its own branded software for the Mac. *SoftPC with Windows* is the latest incarnation of the Mac software. As its name implies, it runs Microsoft *Windows* software on the Mac. In fact, it includes MS *Windows* (Version 3.1) in the product.

The program emulates an Intel 80286 processor with an AT ROM BIOS and MS-DOS 5.0. It supports both real and protected modes. Applications can run CGA, EGA or VGA video. Up to two serial ports (COM1 and COM2) and one printer port (LPT1) are supported. The Mac keyboard can be used to enter all characters on a 101-key AT-style keyboard. And with the addition of Insignia's *SoftNode*, you can access Novell Netware.

Once you install *SoftPC with Windows*, you're ready to run MS *Windows* applications, even format a hard disk for *Windows* files, if desired. Since *SoftPC* is a Mac application, you can run MS-DOS and *Windows* alongside Mac applications and even cut and paste from them to the Mac applications. (When you switch to a Mac application, text cut from a *Windows* application is automatically converted to the proper format for a paste.)

SoftPC can use a Mac SuperDrive to read either 720K or 1.44M PC diskettes, and it can use a Mac CD-ROM drive to read PC CD-ROMs in either High Sierra or ISO 9660 format. The program can use a Mac's math coprocessor to emulate an Intel 80287 floating-point unit. Both expanded and extended memory are supported as well.

The drawback to *SoftPC with Windows* is the drawback you experience with any emulation: overhead. The hard-disk requirement is 16.5M minimum (but 18M minimum for a default installation). This is not too bad, but your puny 80286 emulation will also require a Quadra-class 68040 processor and at least 8M of RAM memory (16M is recommended).

Okay, *SoftPC* isn't realistically going to let anyone switch to the Mac and run all his *Windows* applications on it. But if you live in a dual-platform environment, as more and more of us do, it can come in handy in a pinch. Whether it's to run an occasional *Windows* application, access *Netware* from the Mac with a *Windows* interface, or merely to transfer data between applications on the two platforms, *SoftPC* is a pretty nifty piece of software. And, who knows, maybe on the right hardware—some future super Mac—just maybe we really could band together to threaten Bill with mass defection if he doesn't deliver technology equal to the Mac. Yeah. Keep dreaming. ■

Joseph Desposito

Three-Volt Microcontroller Peripherals, Debut of RoboClock and a Collection of Smart-Card ICs

With 3-volt microcontrollers on the scene, can 3-volt peripherals be far behind? The answer to this burning question is, apparently not, as a company called WSI demonstrates with its products.

Three-Volt Microcontroller Peripherals

WSI (47280 Kato Road, Fremont, CA 94538) has a PSD3XXL family of low-voltage, single-chip, field-programmable microcontroller peripheral ICs. Developed to meet the low power requirements of such battery-operated end-use products as laptop and palmtop computers, medical instrumentation, cellular phones, hard-disk drives and portable test and measurement devices, the six-member PSD3XXL family operates at between 3 and 5.5 volts, has an operating current as low as 1.0 mA and a standby current rated at 0.5 µA.

Like their 5-volt PSD3XX counterparts, these PSD3XXL devices integrate a variety of system elements, including a user-configurable microcontroller interface that enables operation with any eight- or 16-bit microcontroller; two programmable logic devices used for address decoding and system control; a four-bit page register; 16K bits of SRAM; and 256K to 1M bit of EPROM. The PSD3XXL total access time of 250 ns matches or exceeds the requirements of the majority of low-voltage microcontrollers.

WSI also offers a CMISER feature that saves additional power by turning off half of the EPROM and SRAM arrays that aren't accessed.

The two programmable logic arrays of the PSD3XXL operate as programmable address decoders (PADs). Combined, they have up to 18 inputs and 24 outputs and can implement 40 product terms based on address inputs, control signals and/or chip-select inputs. The PADs are field programmable and can map I/O and memory to any location in the microcontroller. The result is that any microcontroller can be used, regardless of its boot-up location or memory mapping scheme.

Another feature of the PSD3XXL is its ability to reconstruct microcontroller ports taken by external devices. Usually, once microcontroller ports have been committed to external devices, they're no longer available, and additional ports must be externally constructed from latches, decoders, bus controllers, etc. By reconstructing the microcontroller ports, the PSD3XXL eliminates the need for external devices and provides system control capability to the microcontroller.

PSD3XXLs have 19 individually configurable I/O pins, which let the designer utilize I/O in the most-efficient way. Some pins can be configured as inputs, some as outputs, some as inputs/outputs, some as high current drivers, etc.

The PSD3XXL integrates and eliminates up to 11 chips (Fig. 1) and 6 sq. in. of the board space required by a discrete solution. Thus, engineers can design products that are smaller and lighter.

One 3-volt PSD3XXL eliminates the need for any non-3-volt parts in the core microcontroller-peripheral portion of the design. Designers needn't worry about mixed-voltage designs or designs that must operate at the voltage of the worst-case component.

Because all PSD3XXL devices are pin-

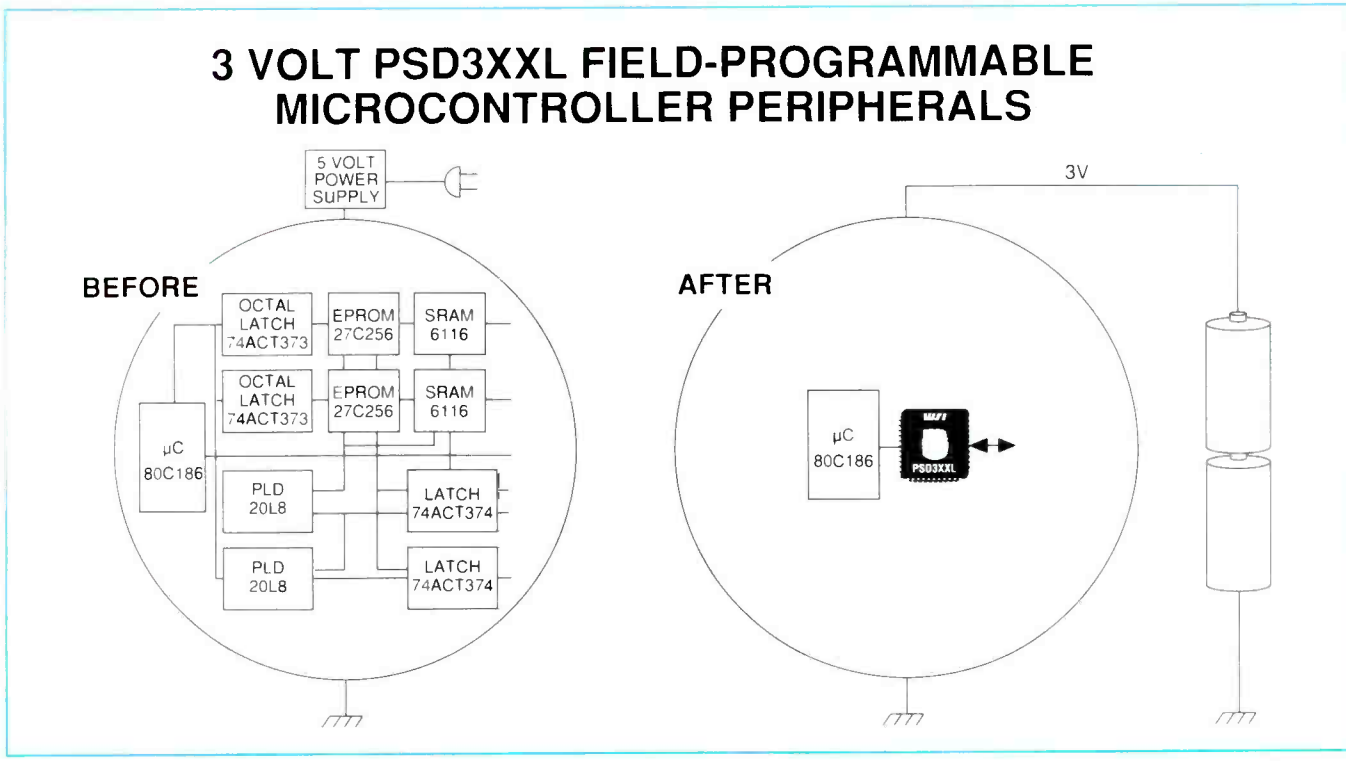


Fig. 1. WSI's PSD3XXL microcontroller peripheral integrates and eliminates up to 11 chips and 6 sq. in. of the board space required by a discrete solution.

Joseph Desposito

compatible, as program code size changes, the designer simply can migrate to the next part in the line-up and implement new, more-competitive product features.

The PSD3XXL family is available in three package types: 44-pin plastic and ceramic leaded chip carriers and a 52-pin plastic quad flat package. All three are surface-mount varieties and result in a package footprint as small as 0.48 sq. in. PSD3XXL prices start at $7 in quantities of 10,000 and up.

RoboClock Debuts

Cypress Semiconductor (3902 N. First St., San Jose, CA 95134) has a highly programmable, very-high-resolution clock chip that corrects timing problems (or skew) that plague newly designed high-performance systems and boards.

Internally code named "RoboClock," the BiCMOS CY7B991 and CY7B992 programmable-skew clock buffers feature eight outputs, selectable to 26,000 timing configurations, at system speeds of 15 MHz to 80 MHz. Skew can be tested and guaranteed to 500 ps, which offers a very high level of accuracy in controlling clock skew. Skew between the devices' outputs can be programmed in increments as small as 700 ps, offering a high degree of timing control and flexibility. This degree of skew control enables designers of high-performance systems to correct easily, quickly and without redesign a far wider range of timing problems than was previously possible.

Implemented in Cypress's 0.8-micron BiCMOS process, the CY7B991/2 feature four pairs of outputs, each pair individually programmable. All eight outputs are able to drive 50-ohm terminated transmission lines. The CY7B991 provides TTL logic levels; the CY7B992 delivers CMOS logic levels.

Users can select skew between outputs to ±18 ns in increments from 700 ps to 1.5 ns. All outputs are matched to each other within 250 ps typical (500 ps tested and guaranteed). Outputs in a pair are matched to each other within 100 ps typical (250 ps tested and guaranteed).

The CY7B991/2 can operate in several functional modes to solve various clock distribution problems in system design:

- a zero-skew/zero-propagation-delay clock buffer, to form the basis of a low-skew clock distribution tree;
- a programmable-skew clock buffer, to equalize skew between metal traces of different lengths or compensate for devices with different setup and hold times;
- a 0.25× or 0.5× clock divider and 4× and 2× clock multiplier to divide down high-frequency clocks for distribution at a lower frequency to reduce crosstalk and emi and then multiply them to their original frequencies for use at their destination;
- a clock inverter, for systems that mix parts that use rising- and falling-edge clocks or for systems that contain parts that use different phases of the system clock;
- a multi-function clock driver, to implement several modes simultaneously.

The CY7B991/2 attain the extremely precise time increments that control output edge placement through use of a proprietary architecture based on a variable-frequency distributed-phase oscillator. The design, which employs controllable stage delays, yields a granularity of 700 ps, performance equivalent to a 1.3-GHz internal clock. This effective frequency level enables these devices to deliver a very high resolution of clock-edge adjustment between outputs.

Both the CY7B991 and CY7B992 are available in 32-pin PLCC and LCC packages. They're priced at $19.45 each in 100-unit quantities.

ICs For Smart Cards

Atmel Corp. (2125 O'Nel Dr., San Jose, CA 95131) has a collection of IC products for use in both contact and contact-less smart cards, electronic keys, ID tags and other portable, secure products. In general, smart cards and smart-card ICs can be categorized into small memory, large memory and microcontrollers. Depending on the application, these smart cards use either a contact or a contact-less interface.

Atmel has three product families, which include: AT24CXX and AT93CXX 1K to 16K serial EEPROMs (two- and three-wire); AT88SC200 2K EEPROM with gate array; and r-f ID ASICs (application-specific ICs) that combine analog, digital and nonvolatile memory technologies.

Atmel's serial EEPROMs are suitable for a variety of smart-card applications, including instrument and equipment personalization, factory automation, maintenance records and portable and/or personal databases (such as medical records and passport information).

Atmel offers a wide variety of serial EEPROMs. It has devices in 1.8-, 2.5-, 2.7- and 5-volt versions. Capacity ranges from 1K (128 × 8) to 16K (2,048 × 8). All of the serial memories are manufactured using low-power CMOS technology and feature an internal high-voltage pump for single-voltage supply operation. This high-voltage process also allows the integration of a radio-frequency (r-f) interface using Atmel's nonvolatile, mixed-signal ASIC design capability for contact-less smart cards, tags or keys.

All Atmel serial EEPROMs are guaranteed to 100,000 write/erase cycles and 100 years of data retention. This level of reliability results in fewer field failures and improved performance for card manufacturers and system integrators.

Serial EEPROMs are used in smart cards for identifying, counting or storing portable data. Both the two- and three-wire devices support the ISO/IEC 7816-3 synchronous protocol and are available in wafer, die or standard packages. The 1,000-piece price for the 5-volt AT24C04 is 78 cents.

The AT88SC200 combines 2K of serial EEPROMs with 800 usable gates of CMOS logic on a single chip. This device can be personalized to meet specific security and interface requirements for low-power and/or space-constrained applications, such as smart cards, electronic keys, ID tags and other portable and personal databases.

The monolithic AT88SC200s are manufactured using low-power CMOS technology and are capable of low-power 3-volt operation. Like the serial EEPROMs, the device also features an internal high-voltage pump for single-voltage supply operation. This low-power/high-voltage process also allows integration of an r-f interface for contact-less smart card, key and tag applications.

Many low-power portable applications require a nonvolatile memory and a small amount of glue logic to interface the memory to the rest of the system. For applications that must have a single-chip solution for security reasons or to meet space limitations, the AT88SC200 is a perfect fit. It contains 2,048 bits of serial EEPROM that can be segmented into protected memory zones. Five EEPROM fuses are available for memory-zone protection and additional device security.

The 800 usable logic gates can easily be personalized to create a user-defined interface, a proprietary security scheme, or some other product-specific differentiator that makes this device unique in the marketplace. The customer defines the design using a schematic, product specification or compatible netlist and delivers this definition to Atmel. Atmel then performs the schematic capture, simulation and physical design of the device and delivers a designated number of design-verification samples to the customer. This entire process takes four to six weeks.

The AT88SC200 contains eight pads, including power, ground, clock, reset and four user-defined signals. The device operates over a –40° to 80° C temperature range and is available in wafer, die and standard packages. The non-recurring engineering cost is $20 each for 1,000 units, with a compatible netlist. Production pricing is $1.20 for 100,000 units. Availability is four to six weeks upon receipt of gate array design.

Atmel's nonvolatile, mixed-signal ASICs are specifically targeted for the contact-less r-f ID marketplace. These r-f ID ASICs combine nonvolatile memory, digital logic and analog circuitry on a single chip to meet the requirements of nonvolatile data storage and retrieval products. These monolithic devices can be packaged in contact-less smart cards and electronic keys, tokens and tags for monetary value applications. Applications include road tolls, parking, mass transit, ID tags, and vending machines.

Atmel is currently designing and manufacturing nonvolatile, mixed-signal ASICs that cover a variety of modulation techniques and operating frequencies and ranges for a variety of applications, including animal ID tags, equipment and tool ID tags, machinery maintenance tags and automotive and home security sensors.

A unique silicon design capability allows customers to design monolithic r-f ASICs with the option of eliminating external components (batteries and capacitors). Depending on application, the ASICs can interface with an external coil or use a relatively new "coil-on-chip" technology for power-supply generation and data reception and transmission.

Atmel's r-f ID ASICs are comprised of three distinct components: nonvolatile memory, digital logic and analog circuitry. Nonvolatile memory is available in EEPROM or flash form, in densities ranging from 16K to 64K bits. Analog cells designed specifically for r-f ID applications include a voltage rectifier, voltage amplifier, bandgap voltage reference, voltage-controlled oscillator and phase-locked loop. Also available are logic macrocells specifically designed for r-f ID applications, as well as an 80C31 microcontroller cell for the high-end r-f ID market. Atmel accepts r-f ID and other nonvolatile, mixed-signal designs as either turnkey or customer-owned tooling designs. ■

New Line Of UPSes

Kensington Microwave Ltd. has a new line of UPSes called the Power Backer Plus line. It replaces its earlier line. The new line includes 300-, 450-, 600- and 800-VA models that provide continuous backup power to computer systems in the event of a power failure. Each offers a unique front-panel display that helps you monitor the flow of power to the computer. During a power outage, Power Backer Plus instantly switches to an internal battery to provide standby power in less than 3 ms. It sounds an alarm that alerts you to a power failure and simultaneously displays current power condition status on the front panel.

Power Backer Plus UPSes are microprocessor-driven to ensure efficient control and monitoring of power flow and UPS status. As a result, the unit always displays its current status on its front-panel display. Each unit is backed by a two-year warranty and up to $25,000 in equipment protection. $350/$450/$650/$850. *Kensington, 2855 Campus Dr., San Mateo, CA 94403; tel.: 800-535-4242; fax: 415-572-9675.*

CIRCLE NO. 16 ON FREE CARD

New CAD Printer Program

VeriPlot from Waterloo Intelligent Technologies reads Gerber data files (printed-circuit-board files created by almost all auto-routing packages) and outputs PostScript files directly to a printer, plotter or phototypesetter, or to an encapsulated PostScript file. The program brings accuracy, speed and plot options to packages that have some print capabilities. There's no limit to file length or board size. You can easily and quickly edit line and pad apertures. Any number of wheels are allowed, and boards can be rotated, flipped, scaled, tiled, stretched, colored and plotted negative or positive. *VeriPlot* is available with 24, 120, 600 and 1,000 apertures. From $335. *Waterloo Intelligent Technologies, 279 Weber St. N., Waterloo, ONT, Canada N2J 3H8; tel.: 519-884-4356; fax: 519-884-0315.*

CIRCLE NO. 18 ON FREE CARD

Instant Printed Circuit Boards

Toner Transfer Systems from DynaArt Designs makes instant printed-circuit boards and can also be used for any number of other applications. It takes only 3 minutes to make a pc board or other application with a laser printer or high-quality photocopier. You print directly onto the Toner Transfer paper and then iron the image directly onto the copper cladding of a pc blank for 2 minutes. After this, you soak the board in water for 1 minute and slide the paper off, leaving behind the etch-resistant toner pattern. The final step is to etch the pc blank by conventional means. $15 for five sheets. *DynaArt Designs, 3535 Stillmeadow Lane, Lancaster, CA 93536; tel.: 805-943-4746.*

CIRCLE NO. 19 ON FREE CARD

Neural Networks For 1-2-3

Talon's *@BRAIN Neural Network Development System* for embedding neural networks in Lotus *1-2-3* worksheets brings advanced decision-making capabilities within the grasp of anyone who is familiar with the popular *1-2-3* spreadsheet. Neural networks "learn" how to solve problems by example. Talon has increased the "IQ" of neural networks with a new, patent-pending learning method that produces an optimal neural network quickly and reliably. You point to example data in a *1-2-3* worksheet, and *@BRAIN* produces a neural network you can use directly in any worksheet calculation.

@BRAIN is seamlessly integrated into *1-2-3*, models complex data relationships beyond linear regression, finds hidden relationships in noisy data, makes predictions, decisions and estimates and develops neural networks painlessly. $495. *Talon Development Corp., PO Box 11069, Milwaukee, WI 53211-0069; tel.: 414-962-7246; fax: 414-962-5516.*

CIRCLE NO. 20 ON FREE CARD

Data-Acquisition Kit

Leader's Model 300-PC Data Acquisition Kit offers a total system solution for uploading and downloading waveforms and data between the memory card used with the Model 300 and a personal computer. The software enables computer control of stored waveforms. You can use waveform data for processing, analysis and statistics and incorporate it into word-processing and spreadsheet reports. You can output waveform and data-logger information in ASCII format for data filing. The printer output function is supported with the MS-DOS graphics command. You can transfer to the memory card previously stored data for field comparison of reference data with data measured on-site. The kit is compatible with AT/compatibles running MS-DOS 3.1 or later. $600. *Leader Instruments Corp., 380 Oser Ave., Hauppauge, NY 11788; tel.: 516-231-6900.*

CIRCLE NO. 21 ON FREE CARD

Replacement CMOS Battery

Clovis Point's C-Life! is a permanent replacement CMOS backup battery. Unlike lithium and alkaline primary batteries that must be replaced every

year or two, C-Life! is claimed to have a useful life that exceeds 10 years. C-Life! contains an Ni-Cd power pack and a special charging circuit tailored to the Ni-Cd characteristics. This prevents the cells from being subjected to life-shortening process of overcharging, while maintaining the optimum charge level when power is applied.

The cells are also protected against sudden discharge that could cause cell damage, overheating and case rupture. C-Life! derives its charging current from a disk-drive power output cable. Nominal output is 4.25 volts. With a CMOS drain of 40 to 50 µA, C-Life! will provide continuous backup power for one year. To maintain the CMOS indefinitely, the computer must be turned on for a total of 24 hours within a 12 month period. $25. *Clovis Point, 215 Main St., Rochester, VT 05767.*

CIRCLE NO. 22 ON FREE CARD

Facelift 2.0 For WordPerfect

Bitstream's *Facelift* Version 2.0 font-scaling utility for *WordPerfect* 5.1/5.0 (and most other *WordPerfect* DOS programs) features 10 additional Bitstream typefaces (26 total), faster printing speeds, the abili-

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ty to add shadows and fill patterns to outline typefaces, support for color printing and enhanced network support. *FaceLift* Version 2.0 provides support for H-P LaserJet 4 printers with 600-dpi resolution. $99. *Bitstream, 215 First St., Cambridge, MA 02142-1270; tel.: 617-497-6222; fax: 617-868-4732.*

CIRCLE NO. 23 ON FREE CARD

Bus Protectors

Electronic Specialists' expanding product line now includes industrial-grade RS-232, RS-422 and RS-485 computer bus protection. KleenLine Security models are available with any combination of connectors/pins to accommodate diverse requirements. Intended for suppression of electrical or lightning-induced spikes often found on longer bus lines, these data-

protection systems employ the latest high-speed/high-current suppression techniques. Isolated ground suppression is employed to shield equipment from damage caused by massive lightning-discharge currents flowing between local and remote grounds. Rfi filtering is also available. From $53. *Electronic Specialists, Inc., 171 S. Main St., Natick, MA 01760; tel.: 800-225-4876;fax 508-653-0268.*

CIRCLE NO. 24 ON FREE CARD

Clipart

The *Series* from Masterclips consists of 24 subject-specific collections of artist-drawn electronic clipart. These collections are said to combine sophisticated and versatile full-color original art in a vector-graphics format. The *Series* can be used to design professional reports and presentations, jazz up newsletters and add flair to any document. You can easily resize vector images, re-color or otherwise modify them without losing their visual integrity. Each volume contains 50 to 60 images and can be used with most popular DOS/*Windows* programs with graphics capabilities. Every volume comes with both 3½" and 5¼" high-density floppy disks and a convenient pictorial guide. $20 per volume. *Masterclips, Inc., 5201 Ravenswood Rd., Ste. 111, Ft. Lauderdale, FL 33312; tel.: 800-292-2457; fax: 305-967-9452.*

CIRCLE NO. 25 ON FREE CARD

Custom Keypads

KPAD from Advanced Design Solutions is a driver/programmer access kit for creating custom keypads. It consisting of a TSR that contains a matrix keypad debouncer, scan-code definition array, result destination arbitrator and user high-level interface, which allows defining scan codes and shift states for each key. A wide variety of keypad geometries is possible, using a PIO board or the printer port for I/O operations. The programmer can define keys dynamically, including a second "shift" status.

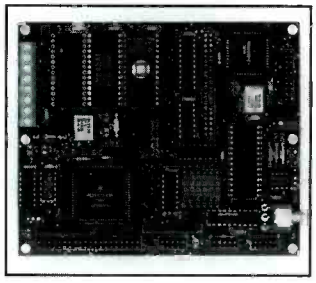
KPAD features flexible system configuration that allows the hardware to be located anywhere in the PC's I/O space. Multiple drivers are installable for massive keypad requirements—over 1,000 keys are allowed. Keypads are software-lockable. Keystrokes can be routed to DOS or a private buffer. Receiving functions allow you to get characters from specified buffer, check buffer status, poke keys into the buffer and more.

You can program KPAD to launch a specified TSR automatically from a keypress without intervention from the program. It supports virtually any C compiler. Evaluation kit, $299. *Advanced Design Solutions, 1920 Moores Mill Rd., Atlanta, GA 30318; tel.: 404-352-4788; fax: 404-355-1763.*

CIRCLE NO. 26 ON FREE CARD

Single-Board Computer

Allen Systems' MP-11 is a single-board computer is designed for process control applications and is based on the 16-MHz 68HC11F1 microcontroller, Mo-



torola's latest generation of eight-bit microcontrollers. MP-11 measures 4.5" × 5.5", supports up to 31.5K EPROM (socketed for additional 8K of EEPROM) and 27K of SRAM, has up to three parallel ports, has three on-board UARTs (two are RS-232C buffered) and accepts an optional analog daughterboard with four channels of 12-bit A/D conversion and two channels of 12-bit D/A conversion. Power requirements are +5 V at 125 mA.

I/O operation is through a 2 × 20 header connector and two five-pin connectors for the serial ports. The two parallel ports of the 88C681 and its serial Port B lines are brought out (unbuffered) to a 2 × 10 pint header. A 2 × 20 pin header is available for adding custom user circuitry, or as a connection point for the optional Analog Daughterboard. $300. *Allen Systems, 2346 Brandon Rd., Columbus, OH 43221; tel.: 614-488-7122.*

CIRCLE NO. 27 ON FREE CARD

Amateur Radio Controller

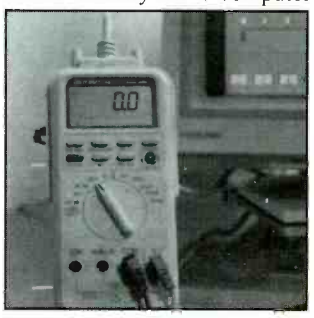
HamLink from Amateur Radio Engineering is an interface that goes between the computer port of a modern transceiver or receiver and telephone line. With it, you can control the

radio from anywhere in the world via the tone pad of a telephone. It can control the frequency, mode, band, scan memories and operate in split mode. HamLink features a synthesized voice to announce frequency and mode, and it can coexist with an answering machine. $269. *Amateur Radio Engineering, Inc., PO Box 169, Redmond, WA 98073; tel.: 206-882-2837.*

CIRCLE NO. 28 ON FREE CARD

Data-Acquisition System

Extech's new Data Acquisition System includes a multimeter with built-in RS-232 serial port and connects to any MS-DOS computer. It display voltage, current and resistance measurements directly on a computer



screen. Data-acquisition software enables recordings to be displayed as data or in graph form and saved as a graphic or ASCII file. Optional adapters allow the system to monitor ac/dc clamp-on current, air flow, humidity, light level, temperature or rpm. $199. *Extech Instruments Corp., 335 Bear Hill Rd., Waltham, MA 02154; tel.: 617-890-7440; fax: 617-890-7864.*

CIRCLE NO. 29 ON FREE CARD

Windows PKZip Utility

Drag 'N' Drop For PKZip from Spiffy Software uses *Windows* 3.1's drag-and-drop capability to provide a convenient interface to the popular DOS-based *PKZip* compression utility. It eliminates the need to shell out to a DOS command line to zip and unzip files. You can drag one file or a group of files directly from the *Windows* File Manager and

drop it on a custom animated icon that looks like a zipper. The file(s) automatically compress/uncompress as needed, with the zipper icon opening or closing according to the choice selected. You place files to be zipped in a default temporary .zip file. Optionally, you can override this placement by specifying another filename and directory from the dialog box.

When you drop a .zip file on the icon, you're prompted by a dialog box that shows the contents of the .zip file. You can then select which items in the file to uncompress and in which directory to place them. $24.95. *Spiffy Software, University Ave. Ste. 1511, 4900 25 Ave. NE #206, Seattle, WA 98105; tel.: 206-521-3750; fax: 206-525-8309.*

CIRCLE NO. 30 ON FREE CARD

Casual Windows Programming

GFA's *BASIC QB For Windows* allows casual programmers to write programs for *Windows* and to port *QuickBasic* programs to *Windows*. It features context-sensitive online help, an editor that can cut and paste example code into a program, more than 800 commands, advanced graphics library, advanced math functions for statistics and trigonometry, direct COM port access and arrays up to 20M. There's an optional *dBASE* engine for working with .dbf files. $99. *GFA Software Technologies, Inc., 27 Congress St., Salem, MA 01970; tel.: 800-766-6432; fax: 508-744-8041.*

CIRCLE NO. 31 ON FREE CARD

Computerized Street Maps

Klynas Engineering's *Streets On A Disk Point Files* is a new series of map overlays that are now included with all *Streets On A Disk* county maps. Designed for business and personal use, *Streets'* main program displays detailed road maps (of any county in the US) on a personal computer. *Streets* can show mailing lists and sales territories and even automatically generate travel routes. Each place on the map can be displayed with a custom token, along with up to 100 lines of text and scanned images. The new *Point Files* mark the locations of many cities, schools, airports, hospitals, churches, cemeteries, land features, water features, mines, old fields and more. $20 per county. *Klynas Engineering, PO Box 499, Simi Valley, CA 93062-0499; tel.: 805-529-1717; fax: 805-583-1457.*

CIRCLE NO. 32 ON FREE CARD

New CAD Version

Version 6.0 of *DesignCAD 2D* from ASBC features 54 new commands, 79 new options and a host of other changes, including more colors, layers, curve types, dimensioning features, improved groupings and programming functions. It boasts an improved (CUA-like) user interface, making command selection easier than ever before. An improved on-line manual allows you to retrieve information about any command directly onto the screen, minimizing searches through the reference manual.

Version 6 is three to five times faster than previous versions. Its new DOS Shell command allows you to temporarily exit *Design CAD*, perform DOS functions and return, saving valuable time. *DesignCAD 2D* Version 6.0 is compatible with hundreds of printers, plotters, digitizers and mice. Requirements are an IBM/compatible with 1M of expanded RAM and hard disk. $349. *American Small Business Computers, One American Way, Pryor, OK 74361; tel.: 918-825-4844; fax: 918-825-6359.*

CIRCLE NO. 33 ON FREE CARD

Windows Utilities

MicroHelp's *UnInstaller* allows *Windows* users to remove applications from their hard disks without the hassle of manually editing their *Windows* system files. The program removes an application and all references to it. It does this by looking for "fingerprints"—places where the application touched the system. These include references in WIN.INI, SYSTEM.INI, application INI files, data files with extensions listed in WIN.INI and other places where programs install themselves. *UnInstall* is claimed to work well in networked environments. $79.

Also from MicroHelp is an *FM Tools* utility that adds several new feature and functions to *Windows'* File Manager, including a new customizable File Manager menu selection. You can add up to 12 entries to the *FM Tools* menu. For each entry, *FM Tools* allows you to specify a custom prompt, the name of the program to execute, the command line parameters the program expects and the directory to use after starting the program. It adds a fully configurable button bar to File Manager and extends drag-and-drop capabilities by launching applications if files from the *Windows* 3.1 File Manager window are dragged and dropped onto the button bar. $79. *MicroHelp, Inc., 4359 Shallowford Ind Pkwy, Marietta, GA 30066; tel.: 404-516-0899; fax: 404-516-1099.*

CIRCLE NO. 34 ON FREE CARD

The Computer Font Book

By Glenn Searfoss

(Osborne McGraw-Hill. Soft cover. 384 pages. $27.95.)

Desktop publishing, laser printers and the tug-of-war between Microsoft's *TrueType* and Adobe's *PostScript* Type 1 fonts have created an avalanche of interest in electronic "typesetting." New font packages appear daily, with the result that the computer user who isn't familiar with the basics of typography can easily be overwhelmed. Even the most-seasoned computer user is likely to be confused by the jargon of typesetting. Searfoss has done an admirable job of organizing, explaining and illustrating electronic typesetting and fonts in this easy-to-comprehend manual.

Chapter 1 discusses the basic concepts of computer fonts and their usage. Detailed definitions of selected font terminology is covered in Chapter 2, and Chapter 3 provides background on type style classification and usage methods, including how to determine appropriate fonts for text and headlines. Chapter 4 examines scalable (vector and outline) and non-scalable (bitmap) formats used for font storage, including contemporary standards.

Storage media (diskettes and cartridges, for example) and hardware and software access techniques are discussed in Chapter 5. Legal issues, sources of fonts, font libraries, and suppliers are covered in Chapter 6. Chapter 7 deals with font creation, providing the basic concepts concerning the design of scalable and non-scalable fonts.

Chapter 8 discusses printers and how they affect the legibility of hard copy output, as well as common problems. Chapter 9 provides similar treatment for screen display fonts. Issues related to sizing fonts, scalable and non-scalable, are covered in detail in Chapter 10. Chapter 11 deals with screen and printed-page layout, including the basic components of a layout and the uses of fonts and graphics within the layout. Chapter 12 gives a quick overview of several specific software applications that make good use of fonts.

Two appendices and a glossary complete the volume. Appendix A is a listing of font libraries and font-related products and their associated manufacturers. Appendix B is a sampler of type styles available from selected font manufacturers.

This book can serve both as a tutorial and as a reference . It will readily find a home with the computer user who knows a great deal more about computers than he does about typography. But almost anyone can benefit from it and its comprehensive coverage of an obscure but increasingly important topic.

SuperMart

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

Ted Needleman

Selecting Review Products for Adults; VISIO Graphics Software; a New Screen Saver; and Electronic Books

Last month, I mentioned how I decide what children's software will get a review: if my kids like it, and continue to use it, I review it. Quite coincidentally, I had several vendors ask me the same question during the last month. And because the criteria for "grown-up" software is a bit different, I thought you might also wish to know how I go about deciding on which products to review.

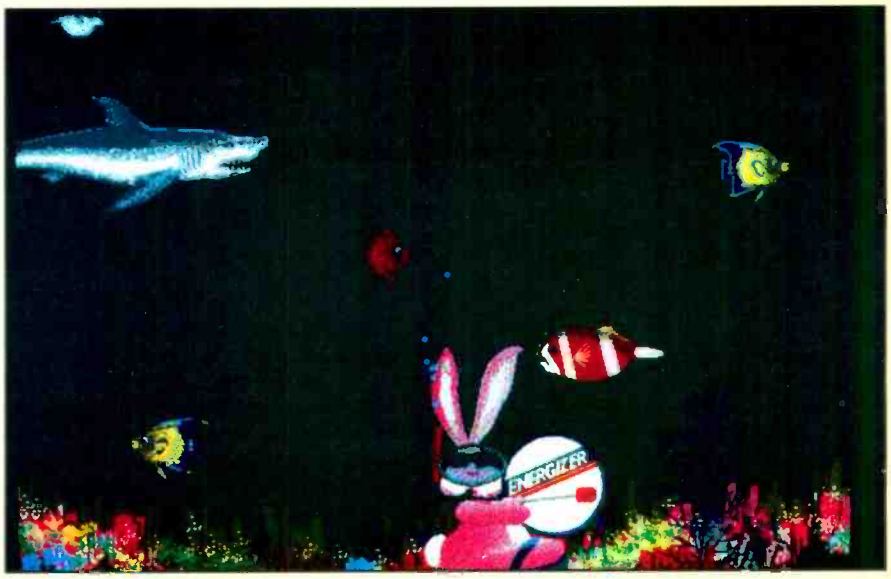
As a writer, I receive a lot of stuff from vendors who want to see their products reviewed. Some is unsolicited, from vendors who are familiar with the magazine or who use one of the various press lists I've appeared on over the years. Other goodies show up from public-relations people who know that I write for *ComputerCraft*. Frequently, if it's a product I think you'll be interested in hearing about, I request a review unit or copy.

As the stuff shows up, I try to prioritize it. Hardware (which has to be returned) and products I requested go into one pile. Products I didn't request but that, on first glance, look interesting go into a second. Everything else goes into a third pile. Sometimes, these piles are a bit sparse, but most of the time, they spill out of my home office into the garage.

Next, I unpack the product, install it and use it for at least a month. If it's at all possible, I like to try out and use a product in a real-world situation, though this depends a lot on the product itself. For example, I used *VISIO*, the graphic software package I'm reviewing this month, to create a tracking sheet that's revised weekly to show the status of the various things on which I have my staff working.

If I can't get a product up and running from the documentation that accompanies it and a call or two to technical support, it gets returned to the vendor if it's hardware, or I wipe the disks and toss the manual into the garbage pile if it's software. Every couple of months, I have a large trash bag of stuff the garbage men drag off to the local landfill.

If I do get it up and running, I use the product for at least a month. Then it gets moved into my "write about it" pile. (As you might imagine, my home office looks something like a computerist's nightmare of the continental divide with all of these piles.) The pile of stuff I really need to write about is threatening to overwhelm the rest of my office. So let's get to it.



A screen from PC Dynamics' *Energizer Bunny* screen saver.

VISIO

The fact that I love playing with graphics will come as no surprise to anyone who even occasionally reads this column. At the same time, I have very little artistic talent. I can visualize exactly what I want to see as a finished product, but creating what I want is quite another matter.

To add insult to injury, I frequently need to "sketch" out my ideas so that a professional artist can turn them into reality. This process is called preparing a "rough," and lately the various graphics packages I've been using have made it a lot easier for me to generate charts, graphs and roughs.

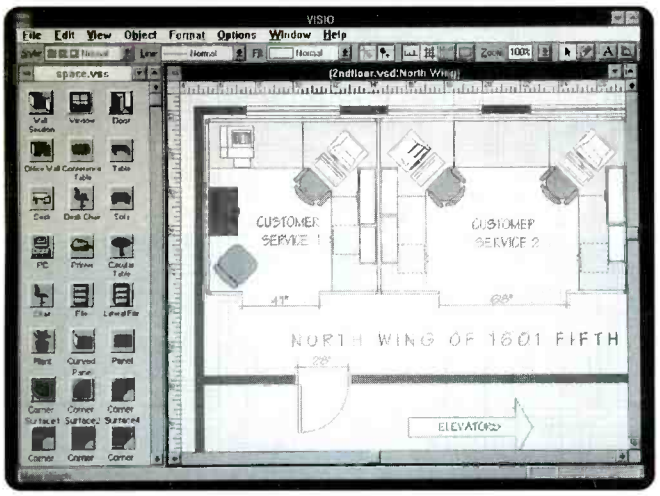
For some applications, the clipart libraries that come with many graphics programs are fine. But many business-related graphics applications are simply line art, where the graphic is constructed of lines, curves, circles and squares/rectangles. Just about any graphics package on the market can accommodate you with this type of graphic construction, but they're not really oriented for specifically creating complex graphics with forms this simple. Simply put, *VISIO* is.

The concept of complex graphics built with simple forms may, at first, seem like a contradiction in terms. But anyone who works in the business world runs up against this problem every day. Such things as network diagrams, organizational charts, and flow charts, to name just a few, come quickly to mind. Forms, which are just lines, boxes and text, are also something you see almost every day. But if you've ever tried to construct a complex form with a desktop-publishing or graphics package (and I've done so, lots of times), you quickly develop an appreciation of why there are so many forms-creation software packages on the market.

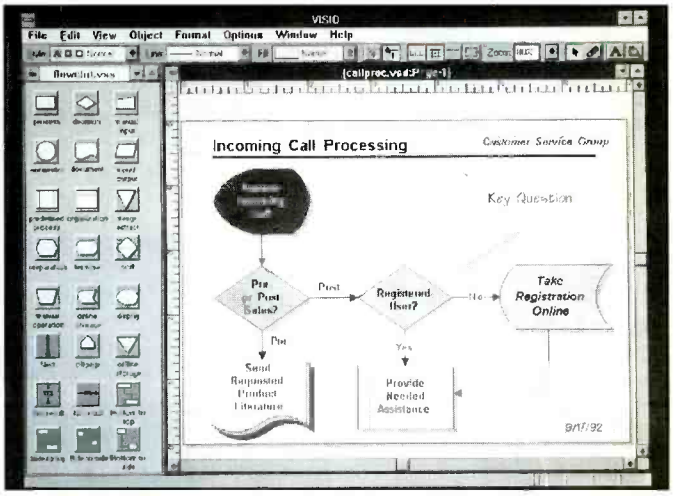
ShapeWare created *VISIO* to turn a process that should be simple into something that's actually just this. Then the company extended the process so that *VISIO* is usable far beyond the common business applications you might expect.

Running under *Windows*, installing *VISIO* is a breeze. After swapping disks for about 10 minutes, you can run a quick tutorial or just dive in with both feet. The big secret to *VISIO*'s ease of use is that it employs "drag-and-drop" shapes. You do get a rudimentary set of drawing tools for lines, circles and boxes (actually—they're pretty sophisticated, but more on this in a moment), but *VISIO* gives you a tremendous library of master shapes and stencils (pre-assembled shapes tailored for a specific task) you just click on, drag to the drawing area and size.

To demonstrate how easy this is to use, let's say you want to create an organization chart. *VISIO* actually gives you a stencil with interconnected boxes you can use for this. But assume you want to create it



Example of a floor plan from ShapeWare's *VISIO*.



Incoming Call Processor flow chart created in *VISIO*.

from scratch. You can either use the box drawing tool under the pencil icon to quickly draw a box or drag one over into the drawing area from the collection of chart shapes you can bring up and display on the left side of your screen.

Size your box by clicking first on the pointer arrow icon, then on the shape, which brings up handles on the shape. Place the pointer on one of these handles, and drag it to the size you want. Then just copy the shape you've created, or drag another box into the drawing area. To connect the boxes, use the line tool (another drawing tool under the pencil icon.)

The really neat part comes next. There are two buttons on the toolbar for AUTOCONNECT and GLUE. When the AUTOCONNECT function is active, you just need to bring the line drawing cursor near where you want the line to start and end on the boxes. The software will place it neatly and precisely where it belongs.

AUTOCONNECT also makes different objects that touch, or are connected with lines, part of a single overall object. If you're familiar with other graphics software, this is similar to the GROUP command. When the line has been AUTOCONNECTed, you can move the boxes around within the drawing area and the line will stretch and move to keep the boxes together.

There's a lot of this type of intelligence built into *VISIO*. Unlike the symbols many other graphics packages include, *VISIO*'s "SmartShapes" react exactly as you would expect when you rotate or re-size them.

VISIO's drawing tools are also more than they seem to be at first glance. For example, its line drawing tool can tell from the way you move your mouse whether you're trying to draw a straight line or a curve. Likewise, most of the time, it can also tell if you're trying for a circle or an ellipse. Text is also treated as an object, and it can become part of the object you're creating. So it will be re-sized or distorted along with the rest of the object.

In trying to emphasize how easy it is to use, I may have given you the impression that *VISIO* isn't capable of producing the kind of knock-out graphics you've rightly come to expect from a PC-based graphics package. Nothing could be further from the truth.

VISIO uses a different paradigm than other graphics packages. But with 15 stencil sets containing over 300 shapes, and even an included clipart set, it's capable of letting you produce some really amazing stuff. There are stencils for doing space-planning diagrams (with little furniture shapes and the like), presentations, overheads, awards and certificates, network and organizational charts and flowcharts, logic diagrams, and much more. Then, you can also purchase optional stencil sets to extend *VISIO*'s usefulness.

ShapeWare offers stencils for home planning, electronics layouts and even one with lots of playful shapes for your kids. These stencil sets cost between $49 and $99 each.

Finally, *VISIO* works synergistically with other graphics packages. You can import graphics in a variety of formats—such as TIFF, PCX, and BMP—and export *VISIO*-created graphics as well.

VISIO requires a fairly hefty hardware setup, with 4M of RAM as a minimum. But if you're running *Windows* 3.1, you should have at least this much RAM.

No graphic package I've played with over the last few years will satisfy all the needs everyone may have. Rather, it seems likely that users will assemble a "toolkit" of several products that offer different solutions to different graphics problems. At a retail price of $299, *VISIO* should be selling at a bit over $200 on the street. At this price, it's a powerful and effective graphic tool.

It Keeps Going...and Going...and Going

I never used to use a screen saver. I didn't really believe you could ruin the screen of a video monitor when the brightness was turned down. Then, two things happened. The first was I burned the phosphors on an EGA monitor I was using to run a BBS system. Then, a while later, an employee saw some confidential information I was working on up on the screen of my computer while I was away from my desk. Working under the theory of "better late than never," I started using a screen saver and have done so ever since.

If you're a *Windows* user exclusively, *Windows* 3.1 has a built-in screen saver. You access it from the Desktop icon contained in the Control Panel. But many users prefer the more varied and exciting displays available from third-party software. Perhaps the best-known of these is the terrific *After Dark* from Berkeley Software.

After Dark gives you about 40 different screens, but the most-famous of these must be the Flying Toasters. It's funny, but a good gauge of just how well-known *After Dark* has become is that if you just mention those two words almost everyone, Mac and PC user alike, seems to know what you're talking about.

Well, there's a new kid on the screen-saver block. And if you're an aficionado of screen savers, you're going to have to have it. The folks at PC Dynamics, best known for its menu and security software, has licensed use of the *Energizer Bunny*. If you've watched any TV at all in the last couple of years, you know the Energizer

Bunny. It appears during these very realistic take-offs on commercials.

The latest one I've seen is a for a Taco Bell-type restaurant called "Cucha Racha" (cockroach in Spanish). Just when you're starting to suspect that it's not quite on the up and up, the pink mechanical bunny comes marching across the screen beating a tattoo on a big bass drum, while the voice-over intones, "...It keeps going, and going, and going...".

With PC Dynamics' screen saver, you get to choose the bunny marching through a variety of scenes or floating down via a parachute. You can play the bass drum through the PC's speaker or a sound card, and if a sound board is installed, you can also have the voice-over. I tried out both drum and voice-over, but turned them both off after a minute or so.

At a retail price of $24.95 (about $21 street price), this isn't anything you won't be able to live without. But it's cute and has gotten quite a few chuckles and groans in my office. If you're a screen-saver collector or are just tired of *Windows'* built-in savers but not ready to go for *After Dark*, pick up the *Energizer Bunny*. It keeps going...

TurboBooks

The idea of an electronic book has been around since before the first microcomputers became available. Ted Nelson's *Project Zanadu* postulated not only the electronic book, but hypertext as well. Straightforward electronic books, meant to be read in a linear manner, have been published in small quantities for a couple of years by several science-fiction authors.

Now, the first mass-market series of electronic books, text and pictures meant to be read on your PC running under *Windows* has been released under the name *TurboBooks* by Allegro New Media. The president of Allegro New Media, Barry Cinnamon, was one of the founders of The Bureau of Electronic Publishing, which is one of the major players in the CD-ROM market. Bureau Publishing, a subsidiary, puts out CD-ROMs with the full text of dozens of books on a single ROM platter. In fact, it's the publishers of the very successful CD-ROM version of the *Monarch Review Notes*. So Barry had a pretty good idea of what current technology was capable of accomplishing when he left the Bureau to found Allegro New Media.

Barry's *TurboBooks* are licensed from major publishers. They're formatted so that they can be displayed, one page at a time, with Microsoft's Windows Multimedia Viewer (included with the "book"). Use of this particular tool to manage the display lets you browse, search and, where the text is highlighted in green, link through hyperhext to other references.

I received four different TurboBooks: *The Complete Guide To Windows 3.1*, *The Complete Guide To MS-DOS 5.0* (both published in hard copy form by Creative Business Communications), *The International Herald Tribute Guide to Business Travel—Europe* (published by Passport Books), and *The Last of The Mohicans* and *The Deerslayer* by James Fennimore Cooper. There are almost a dozen and a half titles available already, and more are on the way. *TurboBooks* retail between $23.96 on up to just under $50.

I have to admit to mixed feelings about *TurboBooks*. The concept works very well, particularly on the reference series books, where browse, search and hypertext make it pretty easy to extract information. With a good-quality monitor, reading a *TurboBook* novel isn't particularly difficult.

Researching is one thing, but when it comes to reading, I find the experience a lot more sensual than just scanning words. There's a comfort that comes in holding a book, turning the pages and even in the paper-wood smell of the pages. Maybe I'm being silly, and the physical ritual of holding a book doesn't really make the reading experience better. If you don't have a clue about what I'm talking about, you'll probably like the convenience of the *TurboBook* novels. If you do understand, check out the *TurboBook* reference books. They're neat! ■

Products Mentioned

VISIO, $299
ShapeWare Corp.
1601 Fifth Ave., Ste. 800
Seattle, WA 98101-1625
Tel.:206-467-6723
CIRCLE NO. 161 ON FREE INFORMATION CARD

Energizer Bunny, $24.95
PC Dynamics
31332 Via Colinas #102
Westlake Village, CA 91362
Tel.: 800-888-1741
CIRCLE NO. 162 ON FREE INFORMATION CARD

TurboBooks, $23.95 and up
Allegro New Media
387 Passaic Ave.
Fairfield, NJ 07004
Tel.:201-808-1992
CIRCLE NO. 163 ON FREE INFORMATION CARD

including full name, address and Social Security number. Then you select from a list which credit agency you wish to contact. If a desired agency isn't listed, you can input your own. Be sure the address is correct. If you don't know the address of the agency, the telephone directory is a good place to look.

Next you go to *Credit Lawyer*'s modest word processor, where you create a brief letter requesting a copy of your credit report. *Credit Lawyer* tracks the above action items and places a mark on its checklist. After each action item is completed, the program dates the action item so that you'll know when you've completed a specific task.

The goal of *Credit Lawyer* is to guide consumers through the tedious and sometimes intimidating task of correspondence with credit agencies. The software package adds a word processor with minimal features, database to track credit card activity and another database to record specific credit disputes with specific business who rely on credit agencies.

The program helps you write and file letters of explanation or letters of statement that have a right to be a part of your credit record. If you put the program to use, *Credit Lawyer* does a very good job of tracking correspondence and efforts to resolve credit disputes.

Credit Lawyer acts as a recorder and a catalyst, taking notes and pointing to the next logical step you should take. In doing so, it does nothing that couldn't be accomplished otherwise by a little effort in organization and clerical work. Obtaining a copy of your credit report is easier now due to recent changes in federal regulations. A consumer is entitled to a free complimentary copy of his own credit report. All you have to do is write. This fact is not reflected in *Credit Lawyer*'s automatic wording of its initial request letter. This letter, as generated by *Credit Lawyer*, always includes a standard fee.

Additionally, most credit agencies have a voice-mail or other instructional system that gives detailed directions about how to obtain a copy of your credit report, whether the report is complimentary or not. Given this impetus, people who are motivated enough to follow the directions and write a request letter are the ones who will benefit from using *Credit Lawyer*. Consumers who lack enough interest to contact a credit agency via existing methods may not respond to the prompting of a computer program to do the same thing.

As mentioned, *Credit Lawyer* performs well its main function of outlining action items and tracking their completions. But its other features of word processing and finance management are done much better by other software packages.

If you purchase *Credit Lawyer*, stay with *Quicken*, *Managing Your Money* or whatever may be your favorite for finance supervision. Keep *WordPerfect*, Microsoft *Word* or whatever is your favorite for writing letters. Just be sure to let *Credit Lawyer* know when the letters are written so that it can check the action item in its own database.

I'm still using *Credit Lawyer* to help track down my own mystery credit problem. An initial request letter is on its way to TRW. Other credit agencies are on the list to be checked. Thankfully, no large men wearing dark suits and sunglasses have appeared at my door.

The Game That Won't Die

All games either wear out or die. Players get tired of them or they get upstaged by better games and snappier game technology. One exception to the wear-out-or-die syndrome is *Tetris*. This is an extremely-simple, highly-addictive puzzle game that came from the Soviet Union before its break-up last year.

Although I can't see how, some gamers may not be acquainted with *Tetris*. Briefly, the object of the game is to rotate and place small geometric shapes as they fall to the bottom of your computer screen. If placed correctly, the falling shapes eventually make an even tier across the screen. The tier then vanishes to give you more playing room. If the falling shapes aren't placed correctly, they pile up until they reach the top of your screen, ending the game. A detailed review of *Tetris* and its spin-off games appeared in this column in February 1992.

The new twist for *Tetris* is its move to Microsoft *Windows*. What took it so long is a good question. But now that the move is completed, *Windows* addicts who are hooked on *Tetris* get a double blast of fun.

Like many *Windows* products, *Tetris* needs a lot of disk space (nearly 5M worth) for a game of its size and type. Also like many *Windows* products, it takes an extremely long time to install, 15 minutes on a 33-MHz 486. The effort of installation is worth the trouble because this version of the long-standing game is fun to play and beautiful to watch.

Colorful background scenes are a staple used in all *Tetris* products. The earlier DOS-based versions, quite good in their time, pale into obscurity when compared to the captivating art of *Tetris for Windows*. The art for *Windows Tetris* is based a work by poet Aleksandr Sergeyevich Pushkin. Pushkin's poem follows the love affair of the handsome, dashing hero Ruslan and beautiful Ludmila.

Additionally, Pushkin's poem, based on old Russian fairy tales, is full of magic and courage not much different than what is seen in American fairy tales. Players of *Tetris for Windows* get an added taste of Russian culture by listening to background play music that includes the opening overture to the opera translation of Pushkin's poem.

Game improvements to *Tetris* encompass 256-color screens and stunning background depictions of Ruslan and Ludmila, mouse control thanks to *Windows*, two-player modes and more game options. Two-player mode affords gamers the choice of working together to defeat the game or pitting individual *Tetris* skills against each other.

Tetris for Windows is another cartridge for Spectrum Holobyte's cannon of computer game addiction. Working *Tetris* fans especially will love it. Now they can work under *Windows* and hot-key to a waiting game of *Tetris* whenever the boss isn't looking.

World History Adventure

Noted writer and historian H.G. Wells said, "History becomes more and more a race between education and catastrophe." As if building on this statement, the computer game *Time Treks* takes players on a race through history. The game, from Earthquest Inc., offers an interesting technique for learning world history.

The race through history is set as a brilliant archaeologist devises a method to observe history in a direct manner. Tired of trying to deduce history by studying artifacts alone, the archeologist's invention opens doors in time through which he watches history in action. The archaeologist neglects to close some of the time doors. Ruthless tyrants from the past escape their proper places in time and threaten to take control of both the past and the future.

Player task is to shut all the time doors before renowned tyrants can control them. This is done by accepting challenges that vary from running the frustrating Mouse Maze to searching for factual data in the *Time Treks* Archives. There are ten kinds of challenges. One of them is the Time Gallery where players are presented with multiple-choice questions. Correct answers depend on knowledge of world events and history.

Another challenge is The Underground. When facing it, players search the recesses of underground rooms belonging to the *Time Treks* archeologist. Players must find a specific icon of a missing invention or search for the name of a famous person.

A third challenge are the trivia questions of Time Facts. The answers may be found in the Archives; so it pays for you to study them well.

The Archives of *Time Treks* has two main sections: Timelines and Themes.

Bird's Eye View

Credit Lawyer, $39.95
Software Republic
400 Seaport Ct., Ste. 100
Redwood City, CA 94063
Tel.: 800-522-5939

Requirements

Memory	512K, Hard Drive
Graphics	CGA, EGA
Sound	N/A
Controllers	Keyboard

Evaluation

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

In Brief: Software that allows you to take on the credit bureaus.

CIRCLE NO. 175 ON FREE INFORMATION CARD

Bird's Eye View

Time Treks, $59.95
Earthquest, Inc.
125 University Ave.
Palo Alo, CA 94301
Tel.: 800-321-8925

Requirements

Memory	640K
Graphics	VGA, EGA
Sound	Ad Lib, Sound Blaster

Evaluation

Controllers	Mouse
Documentation	Good
Graphics	Fair
Learning Curve	Short
Complexity	Easy
Playability	Good

In Brief: An educational adventure through history, featuring large database of information. For ages 9 to adult.

CIRCLE NO. 176 ON FREE INFORMATION CARD

Timelines contains more than 170 time charts that cover events, people, wars, empires, scientific advancements and leisure for all of recorded history, which goes as far back as 3400 BC. The Themes section contains more detailed information on science, wars, continents, religion, time, communications and other topics.

Together, the two sections help players explore world history by time period or topic. This Archive of information is complete enough to tempt a player to skip playing the game in favor of spending hours just browsing through the large database of information. It's amazing how much information one doesn't know. It's more amazing to discover facts you've studied but long since forgotten. The Archives is a prolific database of information and an excellent refresher course on world history.

Time Treks makes its players learn things by forcing them to use the Archives and to play the detective at finding lost objects. It does this very well and can be a powerful learning tool for adults and children alike.

Mentally stimulating and intellectually challenging, the game has two potential shortcomings. The first is that *Time Treks* displays its talents in only 16 colors. Although *Time Treks* is primarily a mental exercise, prettier colors and better artwork would make it more pleasing to play. Reworking the art from 16-color to 256-color presentation, though, might take a major and time-consuming overhaul of *Time Treks*' gaming system.

The second potential shortcoming is the game's minuscule audio support. It has no musical score, which might be quite nice when visiting various periods in history. Local music or noted voices could play at appropriate times. *Time Treks* does inject sound into its play, but only brief sounds that sometime have no relation to the task at hand. Adding more sound to the game, like adding more color, might make production too unwieldy for all but the largest of software teams. Hopefully, though, the next version will move in that direction.

Time Treks offers a fascinating journey through history, even if you don't play the game. It is easy to operate and fun to play. Whether you like it or not, *Time Treks* will increase your knowledge of history and the world about you. ■

Bird's Eye View

Tetris Classic for DOS, $44.95
Tetris Classic for Windows, $44.95
Spectrum HoloByte, Inc.
2490 Mariner Square Loop
Alameda, CA 94501
Tel.: 800-695-GAME

Requirements

Memory	2M, Microsoft *Windows*, Hard Drive
Graphics	Super-VGA, VGA
Sound	Ad Lib, Sound Blaster & Pro, Roland, Pro Audio Spectrum
Controllers	Keyboard, Mouse

Evaluation

Documentation	Good
Graphics	Excellent
Learning Curve	Short
Complexity	Easy
Playability	Excellent

In Brief: Tetris moves to *Windows* as successfully as it began with DOS. This is the game that won't die. Recommendat least a fast 386 and 6M of user RAM for best performance.

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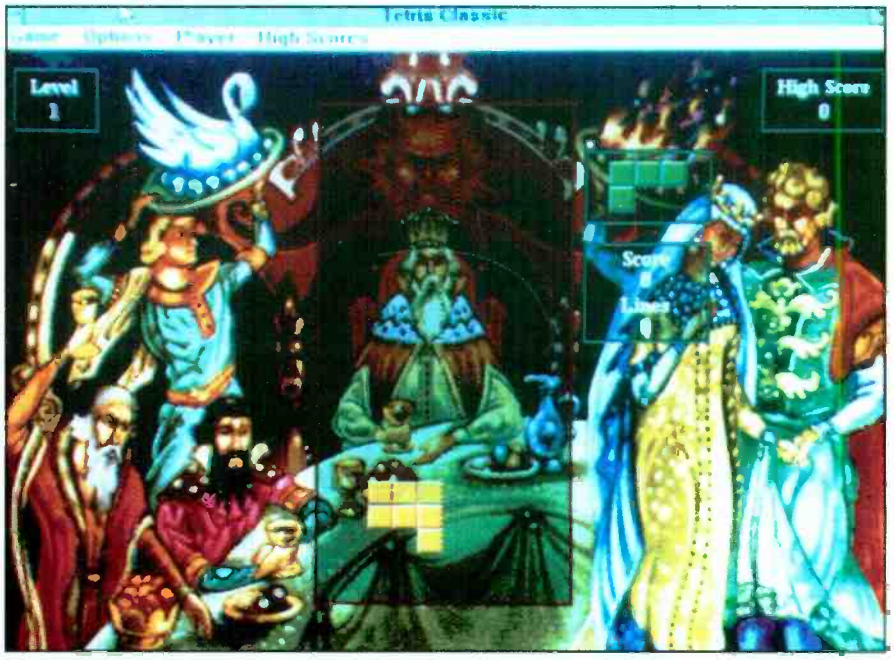
Credit, Tetris & Time Travel



Brilliant background screens from *Tetris for Windows*.

Financial credit is important today as in no other time in the history of America. Luxury items and even some necessities, like automobiles, are so costly that few of us have the ability to purchase them outright. Many of us struggle just to buy a good computer system.

While credit is generally regarded as a serious subject, many people find that this personal matter gets cared for during leisure time at home. One usually balks at the idea of studying his own sensitive credit report at the office during business hours. For consumers who have been denied credit for some reason, credit reporting agencies often seem aloof, uncaring and inaccessible. A software program may now offer assistance to computer users who are curious about their credit histories. With this in mind, I lead off this column with this program.

Computer Consumer Credit

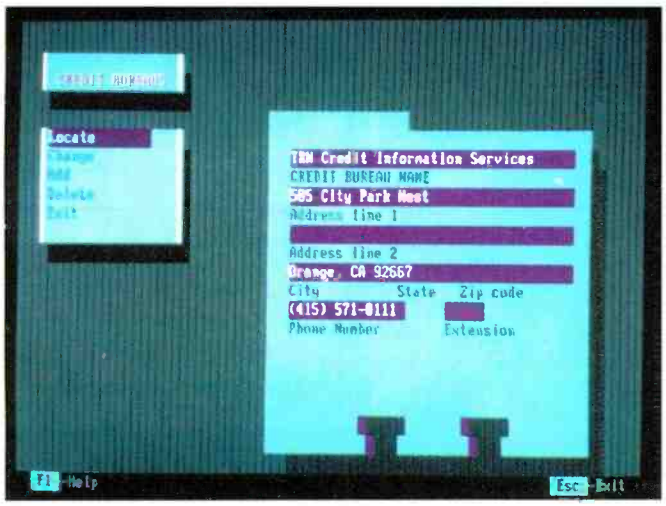
The name of the credit-history software is *Credit Lawyer* from Software Republic, based in California. *Credit Lawyer* is a credit database that guides users one step at time toward taking control of credit records. It includes mailing addresses of the major credit bureaus and outlines what can be done to resolve incorrect credit reports and credit disputes.

Some of the problems that arise from incorrect information can take repeated efforts and many months to set things straight. One problem I occasionally experience is being wrongfully harassed by creditors looking to collect on mysterious delinquent debts. It takes more than skilled debate to convince a creditor that he's after the wrong "bird."

One would think there's only one Sparrow in this neck of the forest. But, with so many people living in the country and in the Dallas-Fort Worth metroplex, similar names and addresses are bound to crop up. Information gets misplaced causing confusion and trouble. Other potential credit problems might relate to ex-marriage mates, co-payments on loans and business debts. Some persons are even denied employment based on information, accurate or inaccurate, provided by credit agencies.

Credit Lawyer installs easily by running its install program. It's a relatively small package, taking only a brief moment to complete the installation. The first order of business is to enter personal information,

(Continued on page 88)

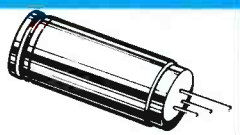


Tracking credit agencies from *Credit Lawyer*.

The vast *Time Treks* Archives.

16 More Reasons To Believe In Unicorn

Collimator Pen



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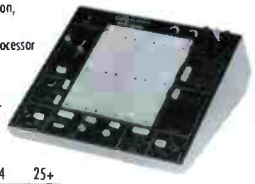

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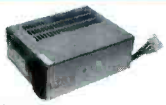

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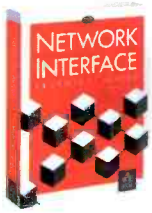

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