WORLD'S LARGEST COMPUTER MAGAZINE

Computers & ELECTRONICS

AUGUST 1984 $1.95

HEATH/ZENITH'S NEW PC COMPATIBLES

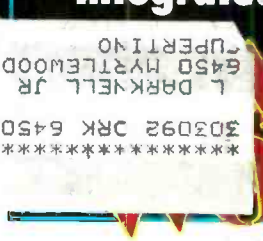
WE COMPARE TEN TOP COMMUNICATIONS PACKAGES

FINDING POST WARRANTY HELP

WM. F. BUCKLEY, JR. ON KEYBOARDING

HP'S 150 CPS BATTERY POWERED THINKJET PRINTER

Ashton-Tate's New Integrated Software



Compaq's Powerful New Desktop Computers

You're traveling through 140° terrain at 300 rpm.

While some disks lose their way in the torrid zone of drive heat, Maxell guarantees safe passage.

A lifetime warranty. And manufacturing standards that make it almost unnecessary.

Consider this: Every time you take your disk for a little spin, you expose it to drive heat that can sidetrack data. Worse, take it to the point of no return. Maxell's Gold Standard jacket construction defies heat of 140°F. And keeps your information on track.

And Maxell runs clean. A unique process impregnates lubricants throughout the oxide layer. Extending media and head life. How good is Gold?

Maxell's the disk that many drive manufacturers trust to put new equipment through its paces. It's that bug-free.

So you can drive a bargain. But in accelerated tests, Maxell was an industry leader in error-free performance and durability. Proving that if you can't stand the heat you don't stand a chance.

maxell®

IT'S WORTH IT.

Maxell Corporation of America, 60 Oxford Drive, Moonachie, N.J. 07074 201-440-8020

Circle No. 30 on Free Information Card

INTRODUCING HAVAC.
THE NEXT BEST PERSONAL COMPUTER

If you're buying a personal computer for the first time, you don't need the biggest and brightest to begin with.

Think simple.

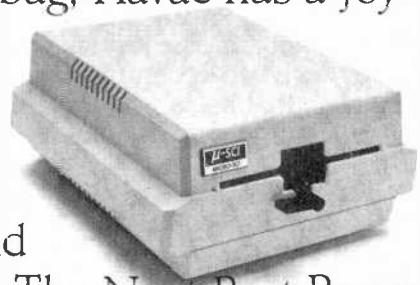
Sensibly priced.

Less than **$850.**

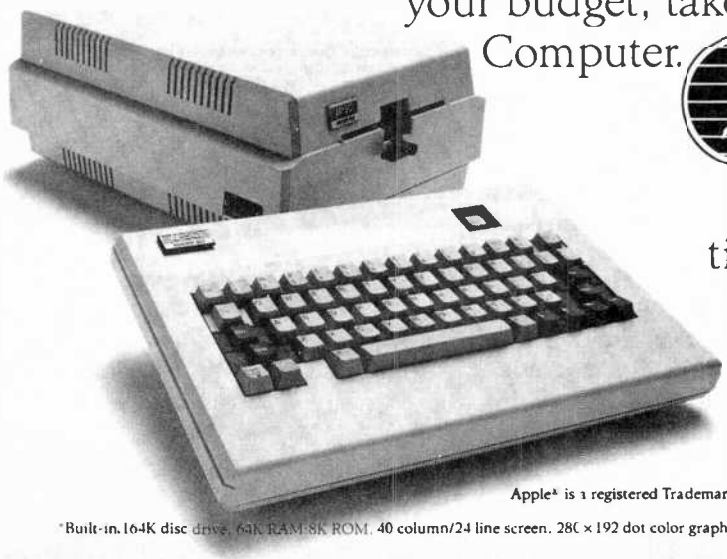
Of course, you'll want some initial training to get you started. The Havac comes with its own disk operating system and "Training" software like Typewriter, Calculator and Havacom for communications. And once you've mastered the basics, you can use software from the largest selection in the world.

Apple® Software.

Game- like computers that are comparably priced can't offer software like Havac can. But if games are your bag, Havac has a Joystick/Paddle port. And a port for RS-232C, Parallel/Serial printer or an additional disk drive. Which we also make. Havac already has one disk drive built in.



So, if the biggest and brightest are beyond your budget, take a look at The Next Best Personal Computer. The Havac from MICROSCI. Ask your dealer for a simple demonstration or write: MICROSCI, 2158 Hathaway, Santa Ana, CA 92705 (714) 241-5600.



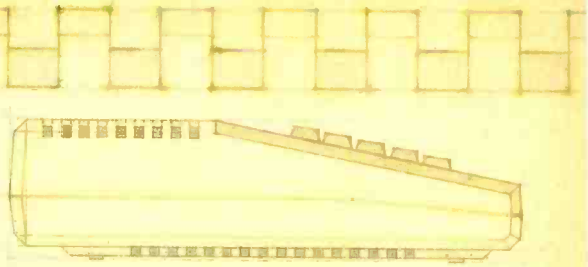
Circle No. 7 on Free Information Card

μ-SCI
MICROSCI
A Standun Company

Apple* is a registered Trademark of Apple Computer Inc

*Built-in 164K disc drive, 64K RAM/8K ROM, 40 column/24 line screen, 280 x 192 dot color graphics, 4 cursor keys and 2 special function keys. Compact and transportable. Made In America.

DISCOVER COMPUTERS WITH ATARI.



Atari® presents the five greatest advances in the creative arts since someone put 72 crayons in one box.

What would Cezanne say to an electronic orange? Surely Van Gogh would go for some flowers painted in phosphors (those glowing things in your TV screen). And you bet Beethoven would be blown away by a computer synthesized symphony.

Too bad. They were all born too early. But luckily you weren't. Because Atari makes several home computer products to help you create all these things and more.

First, there's ATARI Paint,* the program that turns the joystick you already own into a computerized paintbrush that helps you explore the fascinating world of computer art.

Get the magic touch with Atari Touch Tablet.

The ATARI Touch Tablet with Atari-Artist™ software cartridge turns your TV into a magic palette of 128 dazzling colors.

The Touch Tablet works a little like an electronic slate. Hook it into any ATARI Computer and what you draw on the tablet will instantly appear on your TV screen. You can draw on the Touch Tablet with the unique electronic stylus that comes with it—or even with your finger.

And all the on-screen commands that control your Touch Tablet are labelled with simple symbols as well as words. So everyone from preschoolers to grandparents can create without going near the keyboard.

Atari Light Pen lets you write right on the screen.

ATARI Light Pen with Atari-Graphics™ software cartridge is among the best tools available for teaching hands-on computer creativity. To draw circles, rectangles, or simply fool around with freehand sketching, just press the pen to your TV screen and VOILA ...A trail of sparkling color follows it.

You can fill in your sketches with one or more of 128 colors. Or choose from over 2,800 patterns.

Roll over Beethoven, AtariMusic is here.

Sure, Beethoven took music lessons. But even he didn't get the head start you'll get with AtariMusic™ I or AtariMusic™ II. And once you understand the basics you'll be ready to move up to ATARI Music Composer® and create original compositions in four part harmony!

All of these programs were designed to get the best from your ATARI Computer, including the ATARI 800XL™ or the less expensive ATARI 600XL.™ Both machines give you unsurpassed Atari graphics and four sound channels. And whether you're painting with light or composing at the computer keyboard, you can store your creation on the ATARI 1010™ Program Recorder or the more sophisticated 1050™ Disk Drive.

And if all that doesn't convince you that our new programs are a giant step beyond crayons, consider this: the kids will never write on the wall with a computer.

*SuperBoots™ Software developed by Capital Children's Museum, Washington, D.C., licensed by Reston Publishing Company, Inc. © 1982 Reston Publishing Company, Inc. All Rights Reserved.

DISCOVER WHAT YOU AND ATARI CAN DO.

Circle No. 9 on Free Information Card

AUGUST 1984

WORLD'S LARGEST COMPUTER MAGAZINE

VOLUME 22, NUMBER 8

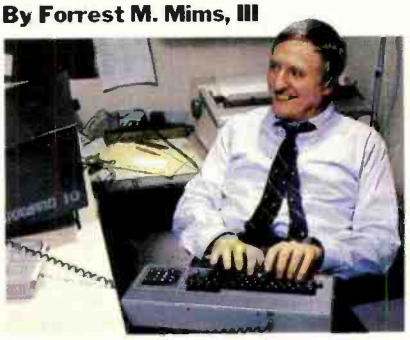
Computers & ELECTRONICS

Features

COVER PHOTO BY BARRY BLACKMAN

Reviews

Columns



Departments

 Computers & Electronics (ISSN 0032-4485) August 1984, Volume 22, Number 8. Published monthly by Ziff-Davis Publishing Co., at 3460 Wilshire Blvd., Los Angeles, CA 90010. Richard P. Friese, President; Selwyn Taubman, Treasurer; Bertram A. Abrams, Secretary. One year subscription rate for U.S. and Possessions, $15.97; Canada, $20.97; all other countries, $23.97 (cash orders only, payable in U.S. currency). Second Class Postage Paid at Los Angeles, CA 90052 and at additional mailing offices. Authorized as second class mail by the Post Office Dept., Ottawa, Canada, and for payment of postage in cash. POPULAR ELECTRONICS including ELECTRONICS WORLD trademark registered. Indexed in the Reader's Guide to Periodical Literature. Ziff-Davis also publishes Boating, Car and Driver, Cycle, Flying, Popular Photography, Skiing, Stereo Review, Electronic Experimenter's Handbook, and Tape Recording & Buying Guide. POSTMASTER: Send address changes to COMPUTERS & ELECTRONICS. Circulation Dept. P.O. Box 2774, Boulder, CO 80302. Please allow at least eight weeks for change of address, enclosing, if possible, an address label from a recent issue.

The new IBM DisplayWrite

Little Tramp character licensed by Bubbles Inc., s.a.

*Prices apply at IBM Product Centers and may vary at other stores.

#•Available in July, 1984.

Series is here. Spread the word.

In 1980, IBM introduced the Displaywriter System. Today, it's become the best-selling stand-alone text processor in the world. One reason for this success is the Displaywriter's function-rich software.

If you're looking for software like that, but working on an IBM personal computer, you don't have to look any further. Because the IBM DisplayWrite Series is here.

And it will put many of the features and capabilities of a dedicated word processor to work for you when you're writing.

It runs in the family.

You'll find two word processing programs in this series: There's DisplayWrite 1, for IBM personal computers—including PC*jr*. And DisplayWrite 2, with added functions for your PC, PC/XT or *Portable* PC.

You'll also find DisplayWrite Legal, a dictionary of about 16,000 words that a lawyer might need to check.

And you'll find DisplayComm, which lets your IBM PC send and receive text to and from other IBM PCs. If you're writing at the office, this program could also let you send text to an IBM Displaywriter down the hall. (From there, it could be sent on to an IBM host computer for distribution.)

Some words on high function.

The DisplayWrite word processing programs give you the time-saving features you'd expect from IBM. Justified margins, centered lines and pagination, for example. You'll even have prompts and messages to help guide you along.

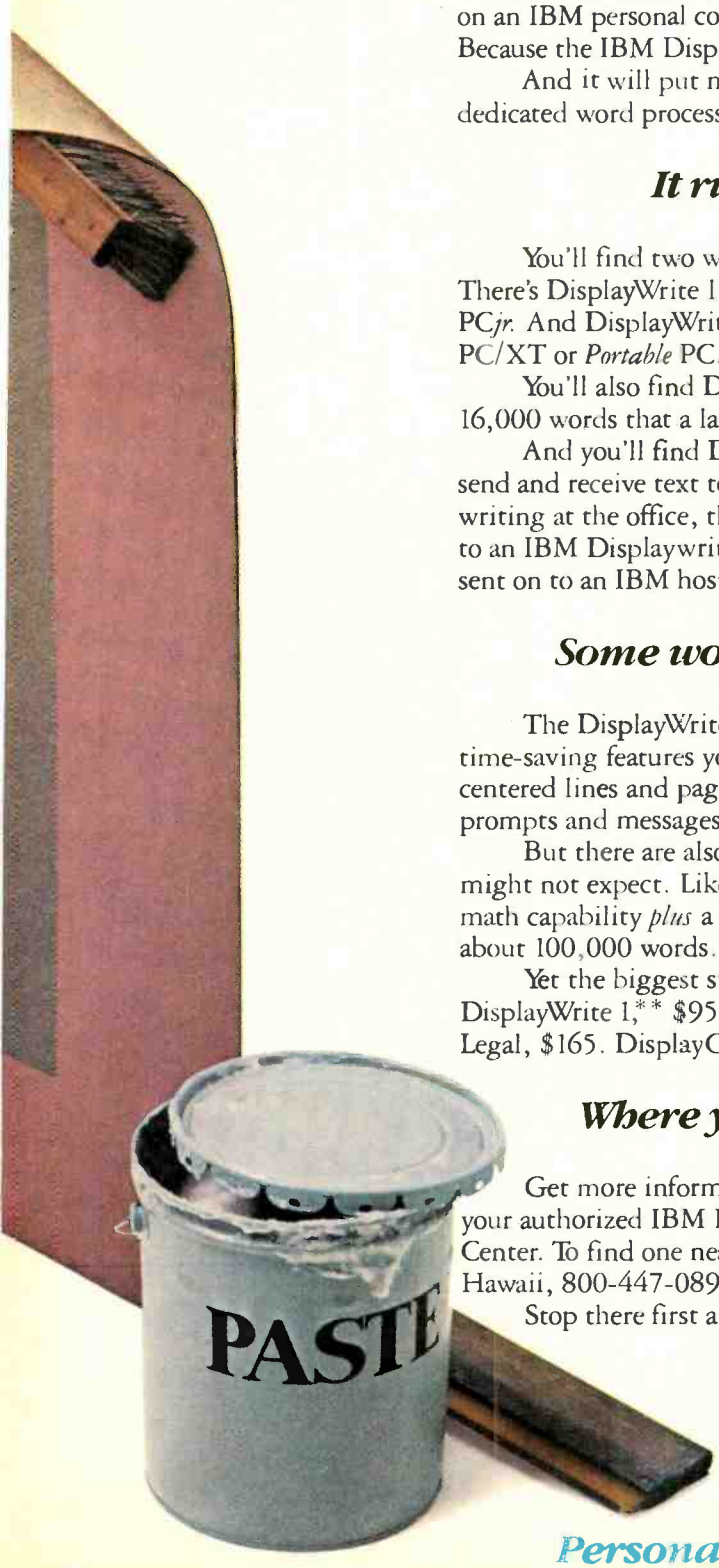
But there are also some features in DisplayWrite 2 you might not expect. Like easy column formatting, four-function math capability *plus* a spelling checker based on a dictionary of about 100,000 words.

Yet the biggest surprise of all may be the price.* DisplayWrite 1,** $95. DisplayWrite 2, $299. DisplayWrite Legal, $165. DisplayComm, $375.

Where you can find all four.

Get more information about the IBM DisplayWrite Series at your authorized IBM Personal Computer dealer or IBM Product Center. To find one near you, call 800-447-4700. In Alaska or Hawaii, 800-447-0890.

Stop there first and get the last word.



Circle No. 41 on Free Information Card

IBM®

Personal Computer Software

SETH R. ALPERT
EDITORIAL

SOFTWARE'S NEW WAVE

Are you ready for a significant change in the personal productivity software market? You better be, because several new products that have begun shipping ought to stand the market on its ear, with the end user being the ultimate beneficiary.

These new products represent a major advance because they integrate more functions, each done better, than the last generation of productivity tools. Three that I have seen demonstrated are Framework from Ashton-Tate (which we review in this issue), Symphony from Lotus Development Corporation, and Decision

Manager from Peachtree Software. Each incorporates its own window environment and word processing, spreadsheet, graphics, and data management capabilities. Other frills provided in different combinations include terminal emulation, micro-mainframe links, hooks into the operating system (MS-DOS in each case), and an underlying programming language.

All three products look very good indeed. Not just taken as a whole—the individual capabilities stand up very well on their own. While they are not up to the level of top-notch stand-alone systems, they seem to have the right mixture of ease of use and features for the typical business user.

Pricing is very aggressive—$695 each for Symphony and Framework, and $625 for Decision Manager. In fact, owners of 1-2-3 will be able to upgrade to Symphony for only $200! At prices like these, think of the presssure that will fall on those who market single capability products. Who is going to spend $300 on a dedicated word processor? Only those who need very specialized, perhaps even esoteric, features. Makers of stand-alone products had better add very powerful capabilities or lower their prices or both. Either way, the consumer wins.

I think these new products are becoming available just when the buying public is most ready for them. Spreadsheets, for example, are pretty commonplace in business. They have made their mark and, in my view, a more sophisticated market is coming to recognize their limitations and will soon expect much more from software. By integrating spreadsheets with data management and word processing as well as graphics, vendors are providing far more complete and convenient packages for the end user.

Another effect of the new software is that its makers have dramatically raised the stakes for new entrants to the productivity software field. It is not just that they are willing and able to spend a fortune on advertising and promotion. On top of that, there is the enormous investment in man years by top software talent. Anything less than first rate development talent and marketing savvy won't cut it anymore.

Indeed, the windowing products that were so widely heralded last year could be among the casualties of the new generation of products. Such software provides an environment for integration rather than an integrated environment. For vendors of such products the economics have changed. They will have to convince you to buy a windowing environment for $100 and a spreadsheet, data manager, graphics package, and word processor for $300 to $500 each, while the competition offers its new integrated package for $700. The single packages will almost inevitably offer better integration and command consistency.

I can't wait to use these new packages. They look very capable and yet straightforward. And they will change the world we compute in. ◇

PHOTO BY STEVE BORNS

WORLD'S LARGEST COMPUTER MAGAZINE
Computers & ELECTRONICS

WILLIAM S. DAVID *Publisher*
SETH R. ALPERT *Editor*
PETER COSTA *Executive Editor*
LESLIE SOLOMON *Technical Director*
JOHN R. RIGGS *Managing Editor*
ROBERT LASCARO *Associate Art Director*
JOSEPH DESPOSITO *Technical Editor*
JOSEF BERNARD *Technical Editor*
DANIEL GLADSTONE *Senior Copy Editor*
ANDRE DUZANT *Technical Illustrator*
JEFF NEWMAN *Editorial Assistant*
AMY MADWED *Art Assistant*

Contributing Editors: Sol Libes, Forrest M. Mims, III, Barbara E. McMullen, John F. McMullen

Editorial and Executive Offices
One Park Avenue, New York, N.Y. 10016. 212-503-3500

Advertising Sales Offices

New York
Ken Lipka 212-503-5029

Midwestern
Robert Vanek. Suite 1400, 180 N. Michigan Ave., Chicago, IL 60601. 312-346-2600

Western
Janet Bish, 11 Davis Dr., Belmont, CA 94002. 415-594-2290

Anne Abeln, 3460 Wilshire Blvd., Los Angeles, CA 90010. 213-387-2100

Southeastern
Mark Browning, PO Box 81306, 2511 Carroll Ave., Atlanta, GA 30366. 404-455-3430.

Consumer Computers & Electronics Magazine Division

Larry Sporn — President
Jeff Hammond — Vice President, Marketing
Carole Mandel — Vice President, Circulation
Eileen G. Markowitz — Vice President, General Manager
Jerry Schneider — Vice President, Licensing & Special Projects
Herbert Stern — Vice President, Creative Services
Jonathan D. Lazarus — Editorial Director
Peter J. Blank — Creative Director

Ziff-Davis Publishing

President Richard P. Friese; **President Consumer Magazine Division** Albert S. Traina; **Executive Vice President, Marketing and Circulation** Paul H. Chook; **Senior Vice President** Phillip T. Heffernan; **Senior Vice President** Sidney Holtz; **Senior Vice President** Edward D. Muhlfeld; **Senior Vice President** Philip Sine; **Vice President** Baird Davis; **Vice President** George Morrissey; **Vice President** Rory Parisi; **Vice President** William L. Phillips; **Treasurer** Selwyn Taubman; **Secretary** Bertram A. Abrams

Editorial correspondence: COMPUTERS & ELECTRONICS, 1 Park Ave., New York, NY 10016. Editorial contributions must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models submitted.

THANKS TO COMPUSERVE'S CB SIMULATOR, "DIGITAL FOX" ACCESSED "DATA HARI" AND PROCEEDED TO AN "ALTARED" STATE.

The CB Simulator, where CompuServe Subscribers can Access Friends and Influence People on 72 Different Channels.

Just pick your handle and get on line. From math to matrimony, there's always someone out there who speaks your language. Friends from all over the U.S. and Canada are at it 24 hours a day. Talking tech or just having fun. And if you've got a secret, just use the CB Scrambler. That'll fool the "lurkers," those CB "see it alls" who get their kicks by watching. Or you can always use the private talk mode for guaranteed one-to-one conversation.

The CB Simulator is just one of CompuServe's many electronic communications options that include a National Bulletin Board, Professional Forums and Electronic Mail. Plus, there's a world of on-line information and entertainment all for the price of a local phone call plus connect time.

You can access CompuServe with almost any computer and modem, terminal or communicating word processor.

To receive your illustrated guide to the CompuServe Information Service and learn how to subscribe, call or contact:

Circle No. 32 on Free Information Card

CompuServe

Consumer Information Service, P.O. Box 20212
5000 Arlington Centre Blvd., Columbus, OH 43220

800-848-8199

In Ohio call 614-457-0802

An H&R Block Company

ONLY NRI TOTAL COMPUTER

COMPUTER • MONITOR • DISC DRIVE • PRINTER • AND SOFTWARE...
It's all included with NRI at-home training in Microcomputers and Microprocessors. And *only* with NRI training.

If you really want to learn how to work on computers, you have to learn how to work on computer systems. Only NRI includes a complete system with your training...total training that gives you hands-on experience with computers, peripherals, and software. Training that builds the knowledge, skill and confidence you need to become a computer professional.

Get Inside the Famous TRS-80 Model 4 Computer

You'll work with one of the most popular computers ever designed. And explore it inside and out. You'll learn programming techniques for troubleshooting. You go inside to expand its RAM from 16K to a powerful 64K. You'll even install a double density floppy disc drive.

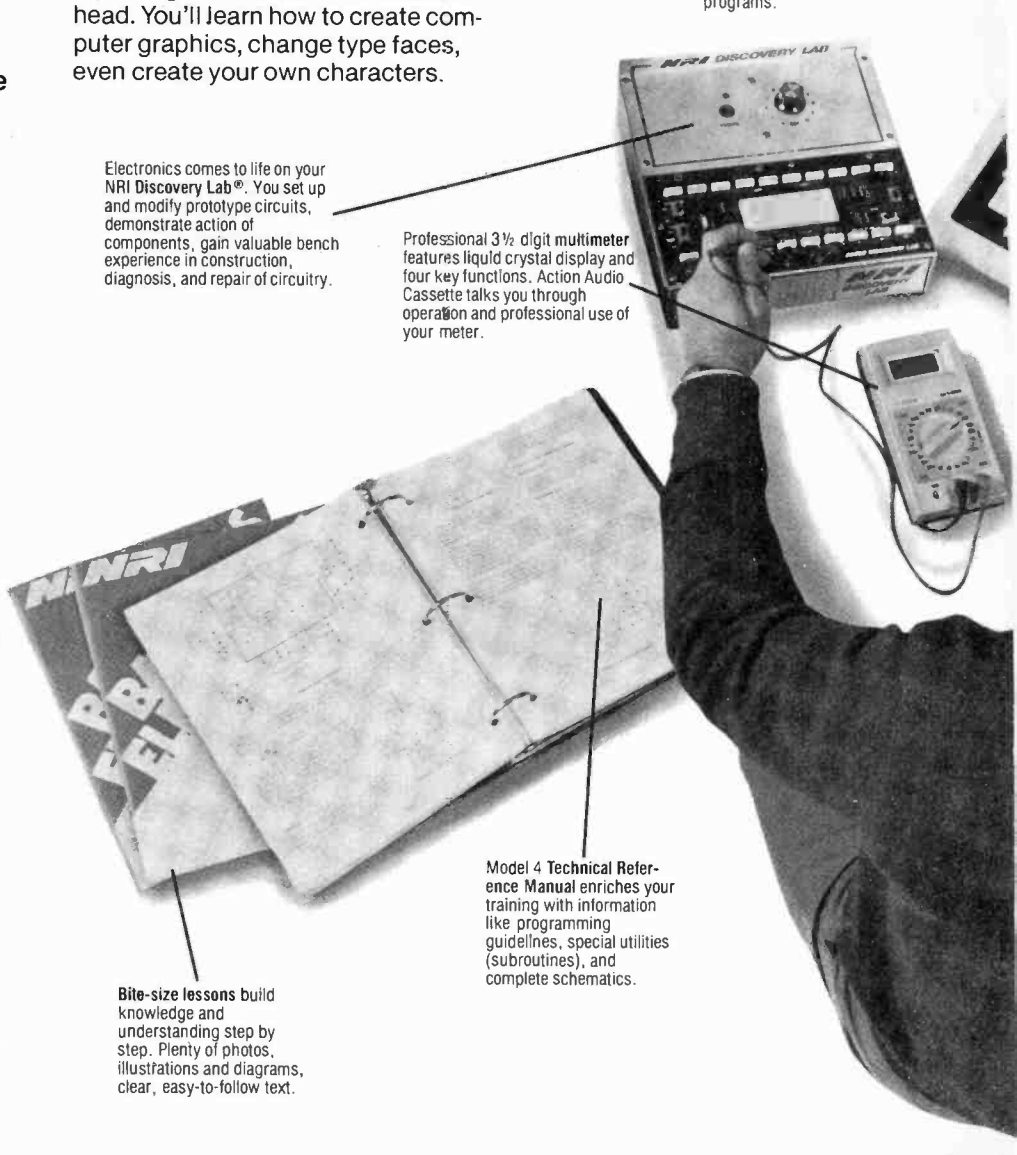
You'll become familiar with computer languages...BASIC, the most popular microcomputer programming language, and machine language for diagnosis and repair work. You'll run software that demonstrates computer operation, even learn to do your own programming. You'll become proficient at modifying programs to fit your business or family computing needs.

Add High Performance Peripheral Printer

Only NRI gives you a total system training by including the flexible Gemini 10X printer as part of your hands-on learning. Working with it, you'll get practical experience in adding peripherals, learn maintenance and servicing operations like adjusting the printer head gap or replacing the 100-million-character head. You'll learn how to create computer graphics, change type faces, even create your own characters. And you'll use it for hard copies of important programs, business records, and word processing.

Understanding You Build Only Through Experience

You need no experience or previous knowledge to succeed with NRI. You start with the basics, rapidly build on the fundamentals of



GIVES YOU SYSTEM TRAINING

electronics with bite-size lessons to master advanced concepts like digital logic, microprocessors, and computer memories.

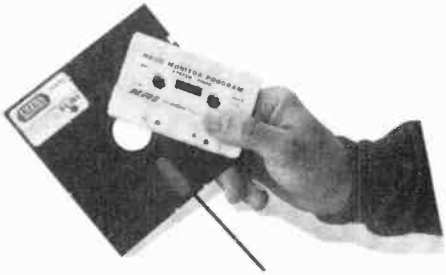
You'll reinforce this new understanding with hands-on, practical demonstrations and experiments that give you real-world experience and build almost intuitive skills. You'll use the exclusive NRI Discovery Lab® to see what makes transistors tick, build and test working electronic circuits that duplicate key computer circuitry, construct digital logic circuits that demonstrate computer performance. And, you'll probe into the very heart of your computer using the Discovery Lab and professional digital multimeter included in your training program.

by your own NRI instructor and the entire NRI staff of educators and engineers. They're always ready to answer questions, give you guidance, follow your progress and help you over the rough spots to keep you moving toward your goal.

Your hands-on training takes you inside your TRS-80 Model 4 computer to install integrated circuits and enlarge memory to 64K. Full-function keyboard includes number pad and single-stroke data entry.

More practical experience as you install double-density floppy disk drive. Each disk stores up to 180,000 characters of information.

9 × 9 dot matrix printer completes your computer system to give you training with peripheral hardware installation, operation, and maintenance. Prints graphics, scientific symbols, and foreign languages in four type sizes.



NRI-supplied software includes TRSDOS® operating system, DOSPLUS® operating system, NBUG machine language monitor, and two game programs.

Do It at Home in Your Spare Time

NRI trains you in your own home at *your* convenience. You learn at your own pace, backed at all times by your own NRI instructor and the entire NRI staff of educators and engineers. They're always ready to answer questions, give you guidance, follow your progress and help you over the rough spots to keep you moving toward your goal.

(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)

Free Catalog Tells Much More . . . Send Today

See all the interactive training equipment you get in this state-of-the-art course in today's technology. Look over the lesson outlines and descriptions of the exciting experiments you'll perform. And look at other high-tech career fields like Robotics, TV/Video/Audio Servicing and Data Communications.

Mail the postage-paid card today to see how NRI can give you the skills and confidence you need to start a good-paying career as a microcomputer technician. If the card has been used already, please write.

NRI SCHOOLS
McGraw-Hill Continuing Education Center
3939 Wisconsin Ave.
Washington, DC 20016

WE'LL GIVE YOU TOMORROW.

LETTERS

The Digital Revolution in Recording

Thanks for the article "Microcomputers in the Recording Studio," by Martin Porter, in your March issue. I'd like to see Porter, who seems to have done a marvelous job of researching the article, do a companion piece solely on the production-end benefits of computer-aided recording. The March article touched on several examples of technology applied to production (under the subhead "A Musical Standard") but mostly covered how computers are aiding engineers to achieve analog results more easily.

The "digital revolution" in recording that Porter spoke of unfortunately does not exist on a production level. The consumer/listener cannot hear those admittedly fantastic benefits of computers aiding engineers. What we need to hear is computers helping producers (those not stuck in the analog world) to whip up aural delights that cannot even be simulated with analog methods. The use of microcomputers to help make music, not just record it, is far more important than using them "behind the boards."

—ALFRED ANESPY
Houston, TX

Plus for Sanyo

I haven't written a letter to a magazine editor in some time, but I do want to thank you for the Sanyo review in your May issue. In early February, after months of study, I decided Sanyo was the machine for me. It appeared to offer almost everything (actually more, in some areas) than "Big Blue" did—at an enormous price advantage. Since then, I have seen very, very little about the machine in the computer magazines. I was starting to believe I had really purchased a "pig in a poke." You changed all that.

Actually, I have been delighted with it. It has performed flawlessly. I run WordStar and CalcStar mostly in my business. Almost all BASIC programs either run directly or with minor (and in most cases, simple) modification. I have done some really nice 3D graphics, though these programs require rather lengthy execution times. I agree wholeheartedly with your conclusions concerning the poor Operations/Sanyo Graphics BASIC Manual. I discovered several nice little commands the machine is capable of performing, which are not even mentioned other than being listed in the reserved words list, in the manual. Why Sanyo would do this is incomprehensible. Also, you did not mention that the GET and PUT commands are not usable until one has expanded the memory to the 256K level.

My only real complaint at this point—which, as far as I know, has no solution—is that I would very much like to have a top-quality set of detailed schematics for the machine.

Thank you again for an objective and well-done review.

—ERNEST BRADFORD
Lake Charles, LA

Mystery at the Keys

I am writing in response to Les Solomon's column "On Computer Hardware" in the June issue. He presented us with a "mystery" of typing speed: that no one knows why anyone can type faster than 48 words/minute. Solomon's evidence for this mystery is that the delay time between stimulus and response is approximately 250 milliseconds. Surely, if you built an electronic delay line of 250 ms, you would not be limited to only sending signals less than 4 Hz through it. You would be limited by the delay line only if you waited for the output before entering the next signal (text, musical note, etc.). Touch typists (as well as musicians) compensate for this delay time by "reading ahead": Their eyes are reading 250 ms or more ahead of their fingers.

I hope that Solomon was being facetious in presenting this as a mystery; if he wasn't, then I wonder how he decided that no one knows the solution. Has he also considered the mystery of how a pianist can have the pages of his music turned without causing a gap in his performance? I suspect, though, that Solomon does realize all this and was just trying to provoke hotheads like me into writing letters.

—STEVEN MARSHALL
Westboro, MA

Just Ask Your Chameleon Dealer

Your Chameleon Plus review in the June issue suffered from two significant flaws which should be pointed out.

First, the lack of documentation which was mentioned repeatedly has long since been corrected.

Second, and more significant, the Chameleon and Chameleon Plus are *not* sold by mail order. Thus, before a sale is made, all of the questions Rubenstein (the author) had about Programmable Logic Array configuration, etc., would be answered by the dealer or the sale would be lost. (And please note that his "problem" with SuperCalc3 was pure "pilot error.")

Yes, I am a Chameleon dealer, and many customers have given me permission to refer others to them as delighted Chameleon owners.

—RICHARD K. THOMPSON
Burbank, CA

A Star of Word Processing

It's funny how people become loyal to software. While my rational side realizes that software is constantly evolving and improving, I feel the need to come to the defense of Wordstar when someone claims to have found a better program. With that in mind, here are some corrections to Michael McCarthy's review of NewWord in your June issue.

He states that, after doing a save-and-resume on WordStar, users have to search back through the text to pick up where they left off. Not true! CONTROL-QP takes them back to where they were.

McCarthy also said WordStar's find-and-replace is slow. Try striking CONTROL-S after the process had begun. WordStar will replace all occurrences of the word almost instantaneously.

Something to consider when choosing a word processing program is the availability of support programs. I use five programs (spelling checker, footnotes, index, grammer and math) designed to work with WordStar. A buyer of a lesser-known program may be frustrated in attempts to locate these types of support software.

—AARON P. MORRIS
Tucson, AZ

Who Wrote NewWord?

Thank you for your recent review of NewWord (June 1984), our WordStar work-alike. The high marks your reviewer gave NewWord are the result of the hard work and dedication of Newstar's Peter Mierau and John Morris for the past several months. Their work speaks for itself.

We were surprised, however, that our company was not mentioned in the review. Newstar Software is the developer and publisher of NewWord; Rocky Mountain is a distributor of ours.

—RICHARD E. POST, Vice President
Newstar Software, Inc.
1601 Oak Park Blvd.
Pleasant Hill, CA 94523

Now! A direct line to Tek quality. And support that doesn't quit!

100 MHz dual time base scope. Easy-to-read CRT; bright, full-sized 8x10 cm; 14 kv accelerating potential complete with BEAM FIND, separate A/B dual intensity controls, FOCUS and TRACE ROTATION.

Wide range vertical sensitivity. Choose from 2 mV/div (1x probe) to 50 V/div (10x probe); color-keyed for 1x and 10x probes; variable control increases scale factor by 2.5 to 1.

Two 100 MHz, high sensitivity channels. 3.5 ns risetime; dc to ≥ 100 MHz bandwidth from 5 V/div to 5 mV/div; extended sensitivity of 2 mV/div at ≥ 90 MHz.

A/B sweep selection. Calibrated A sweeps from 50 ns/div to 0.5 s/div; B sweeps from 50 ns/div to 50 ms/div; variable control for up to 2.5 to 1 reduction and 10x magnification for sweeps to 5 ns/div.

Dual time base measurements. Select either A or B sweeps, or both alternately with A intensified by B.

B trigger slope and level. Use B trigger level to select B-triggered or run-after-delay modes; use B TRIGGER SLOPE to select transitions.

The Tek 2200 Series means more value from day one! The 60 MHz single time base delay 2213A, the 60 MHz dual time base 2215A and the 100 MHz dual time base 2235 offer unprecedented reliability and affordability, plus the industry's first 3-year warranty* on labor and parts, CRT included.

The cost: just $1200 for the 2213A, $1450 for the 2215A, $1650 for the 2235.† Even at these low prices, there's no scrimping on performance. You have the bandwidth for digital and analog circuits. The sensitivity for low signal measurements. The sweep speeds for fast logic families. And delayed sweep for fast, accurate timing measurements. All scopes are UL Listed and CSA approved.

You can order, or obtain literature, through the Tek National Marketing Center. Technical personnel, expert in scope applications, will answer your questions and expedite delivery. Direct orders include comprehensive 3-year warranty*, operator's manual, two 10X probes, 15-day return policy and worldwide service backup.

Order toll free: 1-800-426-2200, Ask for Mr. Zimmerman.

In Oregon, call collect:
(503) 627-9000.
Or write Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075

Tektronix®
COMMITTED TO EXCELLENCE

LES SOLOMON ON COMPUTER HARDWARE

BLESS THIS ABCDEFGH.DOC WORLD

ALTHOUGH I am reasonably happy with the various pieces of software that run on my elderly home-made, CP/M driven, S-100 system, I do have one gripe which I am sure is shared by lots of computer users.

Like so many other people, I have boxes of diskettes whose contents I have forgotten. My complaint starts when I run a DIR(ectory) on one of these diskettes to see what I stored there.

As you CP/M (and most other operating systems) fans know, most DOS's allow only 8 letters for a file name. This isn't too bad since some systems, the late lamented SOL for example, allow only 5 letters, while some early Radio Shack systems allowed a grand total of 6 letters.

I look at the names in the directory and wonder what the heck I was doing all this time. There is nothing in the directory that I can read. It all looks like some form of secret code. It is enough to make an ulcer growl.

There are file names there that defy translation. I am certain that I never named a file INTAXDED. Don't look at me, I don't know what it means until I dump it.

It never fails, I have to dump what seems to be hundreds of strangely named files to see what I was doing. In this case, INTAXDED turned out to be a list of income tax deductions I was itemizing. Sure you say, INTAXDED looks simple enough to be understandable (once it has been explained). Yes, but I started that file six months ago and haven't touched it since. I forgot what the name stood for.

Now I have to figure out what that ubiquitous WHATSUP.DOC, or HOLYMOLY.DOC (among other strangely named files) on the diskette means.

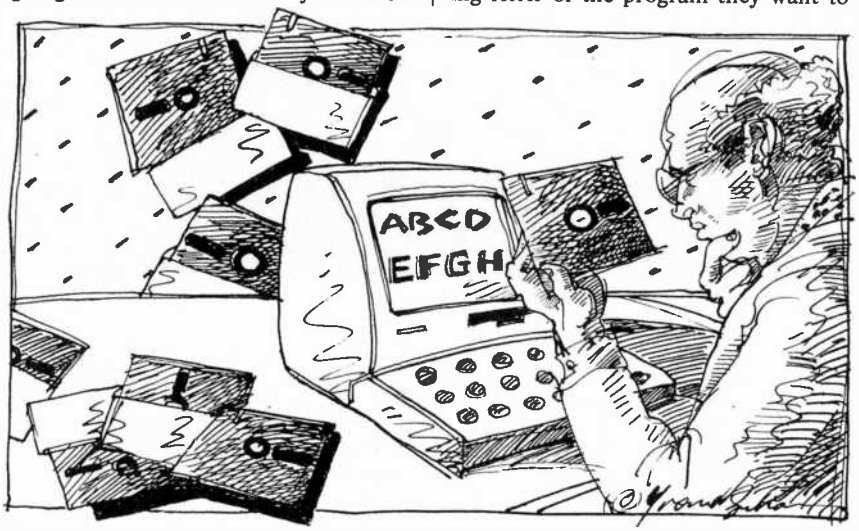
Every time I stick another diskette in the drive and DIR it, I have to go through the same time-wasting procedure. I have no more room on the diskette label to itemize the program list, and it I stick one more label on the diskette, it will not fit through the drive door. Then while still in CP/M, I have to use the TYPE command. Talk about saving time and energy with a computer!

Although I have been going through this DIR "schtick" for years, it never really bothered me until I saw what Epson did in their QX-10 with Valdocs.

You want to know what aggravation is? Valdocs allows you to describe a file using 16 genuine whole words in English, or any other human language—on each of two lines if you need more space.

Imagine that, sixteen words—that's enough to fully describe almost anything I care to write about.

Valdocs users do not need a decoding book or a special file explaining what is going on to find out what they stored on the diskette last month. With 16 real, genuine, English words per line, they can read it and understand it six months or even a year later!



ART BY YVONNE BUCHANAN

Of course, the 16-word title is not the way that the computer seeks the file on the diskette, but that is the machine's problem not the user's.

My request is simple. I would like the people who develop operating systems, and modifications to operating systems, to emulate Valdocs a little and try to give us plain old DOS users more room to name a file. Maybe not 16 words, but something better than 8 letters.

Wouldn't it be wonderful to be able to use file names that we could understand a couple of weeks (or months) later?

Who is going to be that wonderful person who adds at least 5 years of life to so many DOS users and reduces their dependency on coffee and aspirin? When you do it, you can count on me to contribute a few bucks towards a statue. If it will speed things up a little, why not try a DOS (CP/M) version of the specialized "hello" program as used with some Apples. When this software is run, a disk catalog appears on screen, with each program identified by a real, genuine, multi-word name and with each having a unique identifying letter.

The user simply types in the identifying letter of the program they want to run, and the system then retrieves that program using a machine-understandable version of that name.

It appears to me that the real, genuine name could be several words long, thus making its identification perfectly clear even years later.

Direct Memory Access

There are several areas of microcomputers that seem to border on magic for many new users. So, every now and then, I will open the door to one of these dark areas and try to let a little light in. These small items will not be complete tutorials on the subject, but hopefully they will provide enough information so that the

reader will learn a little more about his computer.

This first such small discussion will be a quick pass at DMA (direct memory access)—in which an external device is allowed to dash nimbly around the system memory without using the CPU. It is this latter fact that seems to be the problem. The speed at which the DMA operates is determined by how fast the RAM chips themselves can be accessed.

There are two basic types of DMA. The first is called "visible" in which the system CPU operation is temporarily suspended while an external device performs a memory access.

The action starts when the external device sends a "halt" signal to the CPU. At the end of the next machine cycle, the CPU stops operation and issues a "halt acknowledge" (or similar) signal. When this happens, the external device takes temporary control of both the system data and address busses. During this interval, the CPU outputs are usually in the high-impedance, or open state, thus for all intents, the CPU is not in the system.

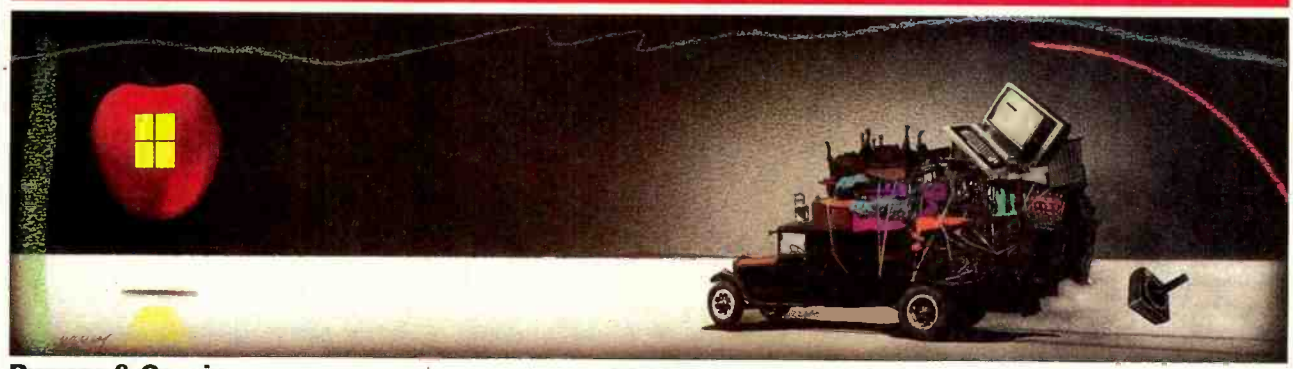
When the hold signal is removed, at the next clock pulse, the system reverts to normal operation.

The second approach to DMA is called "transparent" or "cycle stealing". In the transparent approach the external device is synchronized with the CPU's memory accesses, so that the external device never accesses the same memory block at the same time that the system CPU wants to. Thus DMA can take place without interfering with the normal operation of the system.

In cycle stealing, the external device is allowed to access the memory only when the CPU is not "looking" at the memory and is busy doing something elsewhere —instruction decoding, for example.

There is a third approach coming into wide use where the CPU accesses memory via one port, while the DMA device uses another port. As long as the external DMA device does not try to access the same block of memory as the CPU, all is fine. In this case, the DMA device has access to all the other memory. ◇

SOL LIBES
BITS & BYTES



Rumors & Gossip

► Commodore is expected to introduce its new IBM PC compatible this fall, in Europe first, with introduction in the U.S. not anticipated until next year. . . . AT&T will soon announce their IBM PC compatible desktop computer, an upgraded version of the Olivetti system using an 8-MHz 8086 and 512K RAM, serial and parallel ports, calendar/clock, disk controller, seven expansion slots and better graphics than the IBM machine. An XT version should contain a 10M-byte Winchester and dual slim-line drives. AT&T is expected to sell the machine via Bell System stores and at least one chain of computer stores. . . . Rumors continue that IBM will, this fall, announce a lap-portable battery-operated version of the PC that may contain a 24-line by 80-character display. . . . National Semiconductor is rumored readying an IBM PC compatible in both desktop and lap portable versions with super graphics.

U.S. Customs Releases 2,000 Apple Clones

► The U.S. customs service recently released 2,000 allegedly counterfeit foreign-made Apple computers that it had seized last year. The seized machines either did not contain their ROM software or contained dummy ROMs with "noncustoms service tested the machines they did not perform like Apple II computers. Thus the service felt that it did not have adequate legal basis for confiscating them. It is expected that importers will later install copies of the Apple II ROMs.

Apple had requested that the International Commission order Customs to seize Apple clones at U.S. entry ports whether or not they lacked ROMs or contained dummy ROMs. IBM has made a similar request of the Customs service to stop IBM PC clones coming into this country.

IBM PC Shortage Over

► IBM dealers report that the shortages of IBM PCs and XTs that plagued dealers for the past year and a half are now over. They are no longer on allocation from IBM, and most dealers have machines in stock. The result is an upsurge in discounting of PCs and XTs and their compatibles. Even the IBM PC portable, which IBM began shipping in April, is already being discounted by some dealers. The PC*jr* has been heavily discounted by dealers since its first availability in February.

Another result is the dumping of systems by authorized IBM retailers, VARs and VADs to unauthorized dealers and discounters. These sellers invariably have to pay banks interest on systems in their stock for over 30 days and have to fulfill purchasing quotas with IBM. The result is that at the end of the month they will dump their inventories to unauthorized dealers at very substantial discounts. These dealers are invariably low budget retail or mail order operations and are therefore in a position to discount the systems. IBM, contrary to the policy followed by Apple Computer, has chosen to ignore this "gray" market and thereby appears to be encouraging it.

Josephson Technology Lives Again

► Last year IBM announced that it was dropping development of a new generation of computers based on ultra-high-speed Josephson junction devices. After spending several billion dollars and building several small prototype systems IBM claimed that the technology was too difficult and expensive to implement outside of the laboratory. Further, advances in conventional LSI solid-state devices made Josephson technology less advantageous than previously.

Now comes news that the Japanese Ministry of International Trade and Industry (MITI) and Hitachi Ltd (the largest computer company in Japan), have produced several prototype devices based on the Josephson technology. They have further announced that they plan to continue development with the objective of building a complete computer based on the technology. The computer is expected to operate several times faster than the fastest current systems and occupy about a quarter the space. However, it will be necessary to house the computer in a sealed, liquid helium container.

The Gigabit RAM

► S. Chou, Director of Intel's Portland Technology Development effort, predicts that, by the year 2000, IC makers should be producing integrated circuit dynamic RAMs containing 1 gigabit of memory. In the last 15 years RAM ICs have gone from 1K bits to 1M bits, a 1,000-times increase in bit density. He predicts further that the chips will be organized as 128M by 8-bit words and 64M by 16-bit words. The technology should be CMOS with power supply

voltages as low as 2 V. The problems now are what to do with that much memory and how long it will take to test the device.

Apple News

▶ Apple has disclosed that it has stopped development work to upgrade the Apple III, which probably means that Apple will phase out production by the end of the year. Apple had been working on memory expansion and boosting operating speed from 1.4 MHz to 6 MHz. The machine, which uses the 8-bit 6502 microprocessor was introduced in 1981, aimed at the business market. With an estimated 75,000 Apple IIIs sold. Apple has now shifted its business market emphasis to the Lisa and Macintosh systems.

Apple appears to be directing the IIe and its new IIc at the home and education markets. Over 50% of the IIe sales are reportedly being sold to the home market. The IIe has been Apple's bread and butter product and has sustained it through its less profitable Apple III and Lisa efforts. Apple has reduced the price of the IIe and improved it with a new operating system, expanded memory, half-height dual floppy disk unit and 5M-byte hard disk options. Thus, a complete dual drive 128K system now lists for about $1,800 and the hard disk raises it to about $3,000.

The IIc has been priced at $1,295, the same list price as an IBM PC*jr* with one disk drive and 128K RAM. Thus Apple IIc appears to be competing directly with the PC*jr*. However, the PC*jr* has not met with the demand IBM had hoped for and dealers are widely discounting the system to under $1,000. Thus, it is very likely that the IIc, in order to compete, may have to undergo similar discounting. The real test will come during the Christmas season.

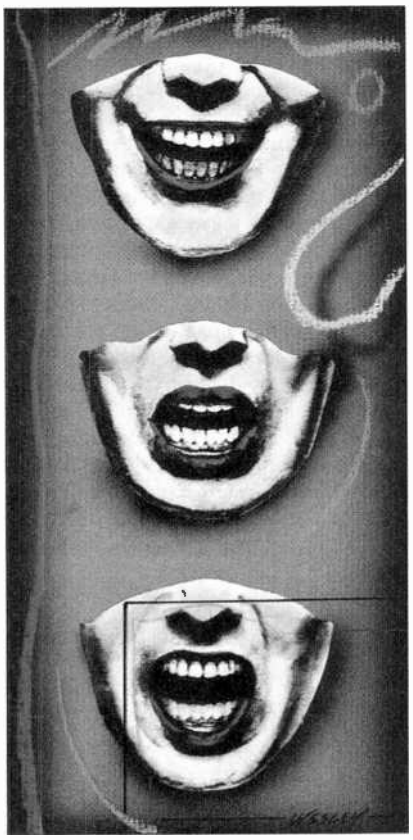
Apple is expected, this October, to introduce a 3-lb, 24-line LCD display screen (rumored to be made by Sharp) for the IIc.

At the introduction show for the IIc held in San Francisco for 1,900 dealers, Apple sold each attendee a IIc for $400 (the regular dealer price is $845). Apple promised that by the end of May it would have shipped 50,000 units and that the simple design of the IIc will allow production of one unit every 7 seconds, once production is ramped up.

Apple also reported that in the first 100 days of sales, 70,000 Macintosh systems were shipped and installed and that the original goal had been only 50,000. Apple plans to spend about $10 million to advertise the Mac, through the summer, to sustain the sales momentum, as they expect to be producing about 40,000 Macs a month. However, the question is more one of when will a sufficient amount of software become available for the Mac? Software is recognized as the prime mover of a computer system.

Smalltalk Goes OEM

▶ Smalltalk is the grandaddy of integrated-window-icon operating systems. Developed by Xerox in the early 1970s and used on their Star computer system, it became the model of the operating system used on the Apple Lisa, Macintosh and VisiCorp VisiOn systems. The Star system's popularity was limited by its high price. However, companies such as Apple, IBM, Microsoft and Hewlett-Packard are known to have bought Star systems.



Xerox has now disclosed that it signed its first OEM (Original Equipment Manufacturer) agreement and plans to license Smalltalk to other system makers as well. The first OEM is Syte Information Technology, San Diego, CA, which will use Smalltalk on a 32-bit National Semiconductor 32032-based system for CAD/CAM applications.

New IBM Systems Rumored

▶ There are rumors that IBM will shortly announce three new systems based on new microprocessors. The systems are expected to be sold through its VARs (Value Added Resellers) and use either Microsoft's multi-user/multiprocessing Xenix operating system or a new operating system written by IBM.

The systems appear to be designed to compete with the new AT&T 3B series of microcomputers. The first system is expected to use the 80186 microprocessor, have 256K of memory, a 10M-byte hard disk drive, support high-resolution graphics and run a new version of PC-DOS. The second system, is expected to use the 80286 8-MHz microprocessor, have a cache memory system, virtually unlimited hard disk capacity and 512K of memory. It will probably handle up to 16 users. The operating system is expected to be an upgraded version of Xenix, with windowing and a PC-DOS emulator to allow the execution of most PC software. The machine is also expected to find application as a file server in a local area network for PCs using Microsoft's MS-Net version of MS/PC-DOS.

The third system is expected to use a proprietary 32-bit microprocessor developed by IBM in Austin-TX-and will support mainframe software environments such as VM (virtual memory). This system may act as a cluster controller for SNA devices.

The IBM scientific instruments division reportedly will unveil a new version of the Microsoft Xenix operating system for its CS9000, 68000-based office system. This new OS will provide enhanced graphics with icons and windows.

Random News

▶ Jack Tramiel, former president of Commodore International (and still a director), reported to the Securities and Exchange Commission that he has acquired over 5% of the stock of Adac Laboratories, Sunnyvale, CA, and that he plans to take an active interest in running the company. . . . IBM researchers reported, at the recent IEEE-Intermag conference, a new type of experimental magnetic recording head that will increase magnetic disk storage density up to six times. The head integrates thin film coils to write data on the disk and high-sensitivity solid-state sensors to read the data. . . . IBM researchers at its Essex Junction, VT, facility announced development of a dynamic RAM chip with a capacity of 1 megabit that operates from 5 volts. . . . Zenith has announced that they will cease marketing all 8-bit computer systems. This will include Z-89 and Z-90 systems. ◇

ART BY CARL WESLEY

FORREST M. MIMS III

THE COMPUTER SCIENTIST

COMPUTER CONTROLLED LIGHT METER

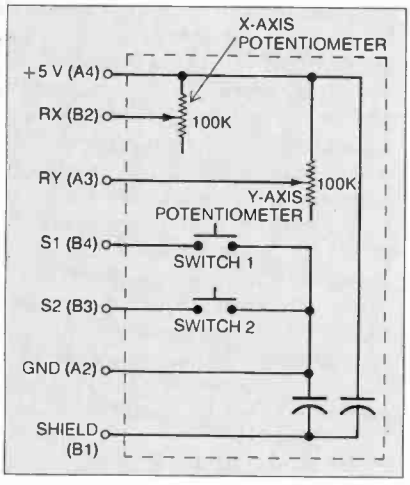


Fig. 1. PC*jr* joystick circuit.

PERSONAL computers equipped with analog joystick ports provide the potential for a host of applications never imagined by their designers. That's because the analog-to-digital conversion hardware and software required to support a pair of joysticks can be easily interfaced with a great many external sensing devices.

A good example is IBM's PC*jr*. This machine includes a pair of analog joystick ports ideal for use with sensors whose resistance varies with an applied stimulus such as temperature, light, heat or pressure. Up to four such sensors can be connected *directly* to the PC*jr*'s joystick ports with no buffering or interfacing hardware.

In this column we'll take a close look at PC*jr*'s joystick ports and use one of them to convert the Junior into both a simple light meter and a sophisticated, light-sensing storage oscilloscope. Even if you don't have access to a PC*jr*, read on. Some of the methods to be described apply equally well to the Apple IIe, Radio Shack's TRS-80 Color Computer and other machines with analog joystick ports.

Junior's Joysticks

Junior's *Attachable Joystick* (as IBM calls it) is a Made-in-Japan $40 special with both spring-return-to-center and free-floating modes. Two small plastic levers on the bottom of the joystick housing allow the spring-return feature to be selected independently for each axis. Thumbwheels on the top of the Joystick allow each axis to be mechanically centered when the spring-return feature is selected.

Lacking technical documentation, the quickest way to decipher a computer's joystick interface is simply to disassemble one of its joysticks. Junior's joysticks can be easily opened by removing a pair of self-tapping screws from the bottom side of the plastic enclosure.

Figure 1 shows the circuitry inside one of Junior's joysticks. The two potentiometers, one for the x-axis and the other for the y-axis, both have a linear taper resistance of 100,000 ohms. Two normally open, single-pole pushbutton "fire" switches are included.

Incidentally, be sure to note the *shield* connection (B1) in Fig. 1. The joystick cable is shielded to protect Junior's analog-to-digital (A/D) hardware from external noise. While experimenting with the joystick port, I soon learned the significance of the shield provision.

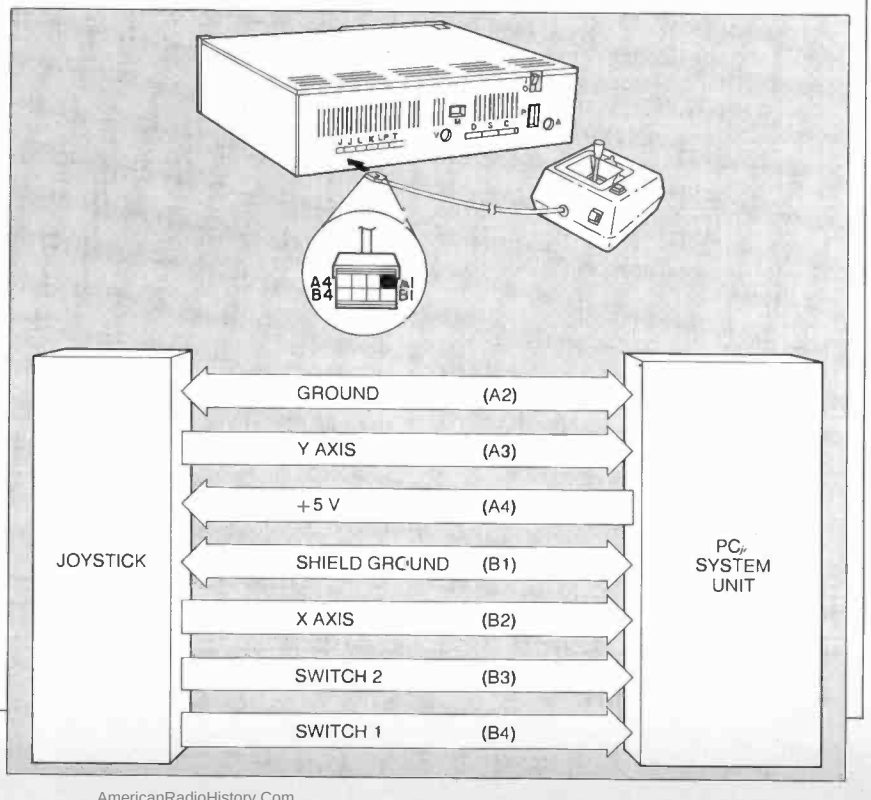
Figure 2 details the cable connections between a single joystick and one of Junior's system board joystick sockets. The most notable features are the unusual Berg-type connectors and, because of its shielding and its six wires, the rather thick (1/4-inch) and inflexible cable.

The Hardware-Software Connection

As I've noted before, Junior's version of BASIC is an expanded version of the BASIC supplied with Radio Shack's CoCo. Though both machines have analog joystick ports, however, their operation is quite different.

CoCo's 100K joystick potentiometers are connected across +5 volts and ground. Therefore, each potentiometer functions as a voltage divider that delivers to the joystick port a voltage ranging from about 0.25 to 4.75 V. This voltage is applied to a simple 6-bit firmware-driven A/D converter designed around

Fig. 2. Connections between the joystick and PC*jr*.



The Heathkit Catalog & American Technology... Inseparable!

Ever since radio grew into electronics, the illustrated Heathkit Catalog has been a guide to new and exciting electronic kit products for people like you to build. Enjoy. Learn from. And save money.

The Heathkit Catalog is now even better. The ALL NEW full-color catalog features more than 450 different products in electronics, computers and other state-of-art technology. Page after page is devoted to new and exciting products for your home, hobby and business.

If you don't have the latest Heathkit Catalog, you're missing something great! Now's your chance to get involved in American Technology first hand. Your free ALL NEW Heathkit Catalog is waiting for you.

Fill out and return the attached Catalog request card today! Or use reader service number below.

Circle No. 24 on Free Information Card.

Discover the Challenge

Great innovations in electronics are at your fingertips in each quarterly issue of the Heathkit Catalog. From computers to test instruments to the latest in personal robotics. Act now and send this card for the *ALL NEW Heathkit Catalog.*

CATALOG OFFER
Heath Company
Dept. 010-209
Benton Harbor, MI 49022

Yes I want to see the latest in electronics from Heathkit. Please send my free copy of the ALL NEW Heathkit Catalog to:

Name _____

Address _____

City _____

State _____ Zip _____

PC-148

Discover the Pride

With Heathkit, you'll discover the pride of accomplishment only a hand-built quality product can provide. From Stereos and TVs to Ham Gear and the latest in education. Act now and send this card for the *ALL NEW Heathkit Catalog.*

CATALOG OFFER
Heath Company
Dept. 010-209
Benton Harbor, MI 49022

Yes I want to see the latest in electronics from Heathkit. Please send my free copy of the ALL NEW Heathkit Catalog to:

Name _____

Address _____

City _____

State _____ Zip _____

PC-148

Post Office will not deliver mail without stamp.

CATALOG OFFER
Heath Company
Dept. 010-209
Benton Harbor, MI 49022

Post Office will not deliver mail without stamp.

CATALOG OFFER
Heath Company
Dept. 010-209
Benton Harbor, MI 49022

Be a part of today's exciting world of high technology.

Kitbuilding is an exciting hobby and unique learning experience for the whole family.

The best in electronics is hand-built by you.

Building advanced computers and electronic products from kits is a great hands-on way to develop skills and ability in many technologies. Easy step-by-step directions take you through the building process. And we back our products and you with the simple promise: "We won't let you fail." Heathkit builders create more than fine products. They build pride.

OVER 450 KITS TO BUILD

• Computer hardware and software • Robots • Self-study courses in electronics • Precision test instruments • Computerized weather instruments • Solar hot water systems • Automotive and home energy products • Security devices • Color TVs and video accessories • Quality Stereo components • Amateur radio gear

PC-148

Start by ordering your FREE Heathkit Catalog today. Or use Reader Service Number
Circle No. 24 on Free Information Card.

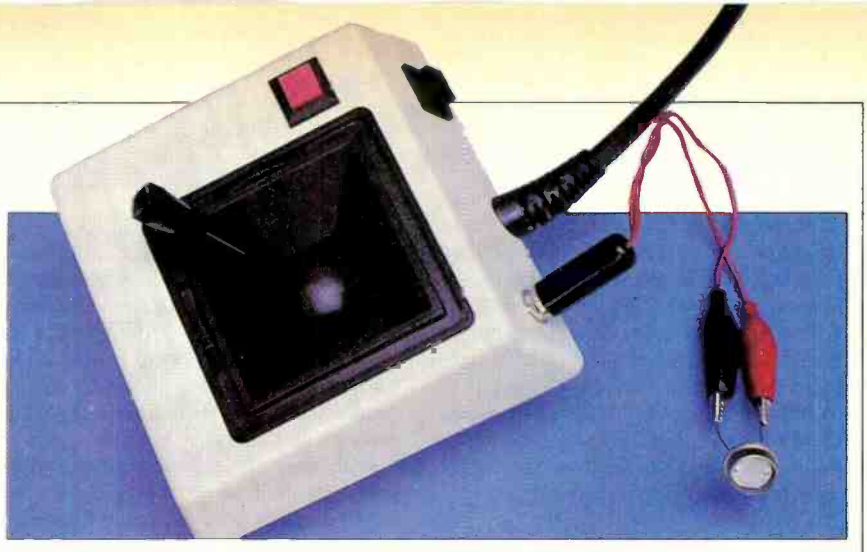
an analog comparator and a resistor network. For more details, see "Analog Sensors for Personal Computers" (COMPUTERS & ELECTRONICS, February 1984).

Though Junior's joysticks use the same 100K potentiometers as CoCo, their operating principle is entirely different. As you can see by referring back to Fig. 1, both potentiometers function merely as variable resistors and *not* as voltage dividers. In other words, while CoCo's joystick signal is a variable *voltage*, Junior's is a variable *resistance*.

Figure 3 shows the key ingredient of Junior's joystick hardware, a 558 quad timer IC. This chip includes four timer circuits, each of which is connected to a fixed capacitor *(C1-C4)* and a variable resistor (joystick potentiometers *R1-R4)*. When triggered, each timer delivers an output pulse whose duration is approximately 1.1 × RC.

Junior's on-board ROM firmware includes a routine that measures the duration of each timer's output pulse. The resulting time is outputted as a number from about 3 to 255 when BASIC requests a joystick reading.

The lower joystick value would not necessarily extend to 0 if series resistors *R5-R8* were bypassed. These resistors are necessary to ensure reliable operation of the timers. Without the series resistors, at maximum handle excursions the resistance of the joystick potentiometers might be too low to allow the timers to function in the proper manner.



Adding a phone jack to joystick permits using a CdS sensor.

Raw joystick values are returned by the STICK(*n*) function. Normally the retrieved values are assigned to a variable as in A=STICK(*n*). Here are the potentiometer assignments for each allowed value of *n*:

STICK(0) returns x coordinate for Joystick A.

STICK(1) returns y coordinate for Joystick A.

STICK(2) returns x coordinate for Joystick B.

STICK(3) returns y coordinate for Joystick B.

It's important to understand that STICK(0) retrieves the values for *all* four joysticks. Therefore, it's necessary to include in a program a STICK(0) function before attempting to read any of the remaining joystick values. STICK(1), STICK(2) and STICK(3) simply get the values retrieved by STICK(0). They do *not* sample the joysticks.

CoCo's joysticks always return a value of 0 to 63. Though Junior's joysticks provide better resolution, their numeric range isn't given by IBM. Instead, as Junior's BASIC reference manual observes, "The range of values for x and y depends on your particular joysticks."

As I mentioned above, Junior can return a *potential* maximum joystick range of from about 3 to 255. Maximum excursions of the IBM joystick I purchased output values of from 3 to 124. You can enter and run this routine to find the values for *your* joystick(s):

```
10 'STICKOUT
20 CLS
30 X=STICK(0)
40 Y=STICK(1)
50 LOCATE 15,15
60 PRINT "X="X;"Y="Y
70 GOTO 30
```

It's possible to take full advantage of Junior's entire range of joystick values when you replace the potentiometers with external sensors. This routine converts the 3-255 range of STICK(0) to a more convenient 0-100 range and prints the result:

```
10 'MAX STICK (0-100)
20 CLS
30 X=STICK(0)
40 X=(X/255)*100
50 LOCATE 15,15
60 PRINT "STICK(0):"
   INT(X)
70 GOTO30
```

Line 40 converts the retrieved value of STICK(0) (0-255) into a range of 0-100. However, the resistance of many sensors suitable for use with the PC*jr decreases* as the stimulus level *increases*. This line will reverse or give the complement of the previous result: 45 X=100−X.

Fig. 3. Simplified input circuit for the PC*jr*.

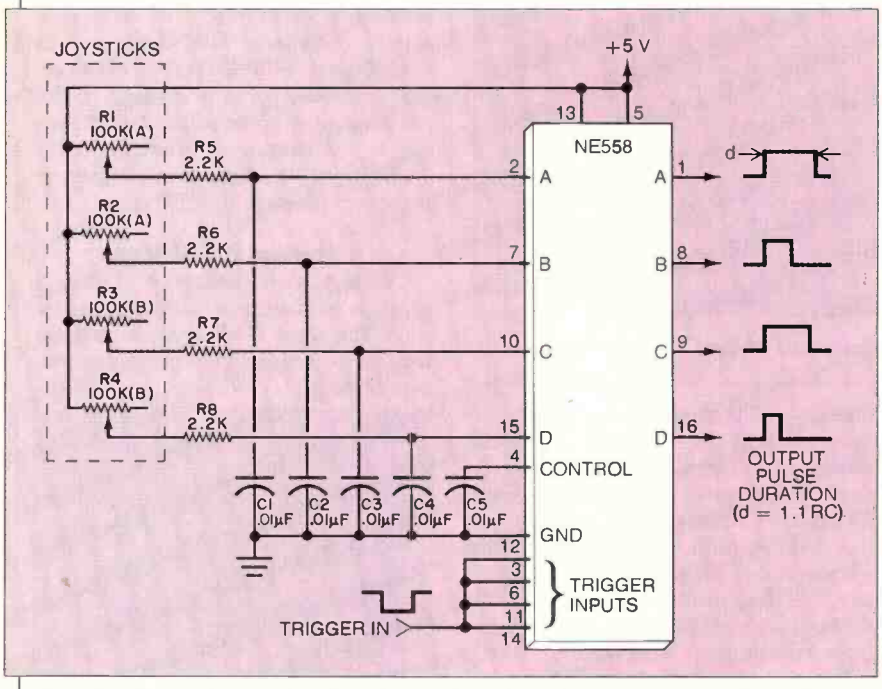


Figure 4 is a calibration graph I made to gauge the accuracy of Junior's joystick output. The graph was made by replacing the potentiometer for STICK(0) with a precision (1%) decade resistance box. I then recorded the STICK(0) output, which was corrected for a scale of 0 to 100 and then complemented, at increments of 10 kilohms. As you can readily see, Junior's joystick hardware and software produces a very linear output.

A PC*jr* Light Meter

Among the simplest sensors that can be connected directly to PC*jr*'s joystick ports is the cadmium sulfide (CdS) photoresistor. One I've used with excellent results is Radio Shack's catalog number 276-116 CdS Photocell. The resistance of this cell is about 100 ohms in bright light and several million ohms in total darkness.

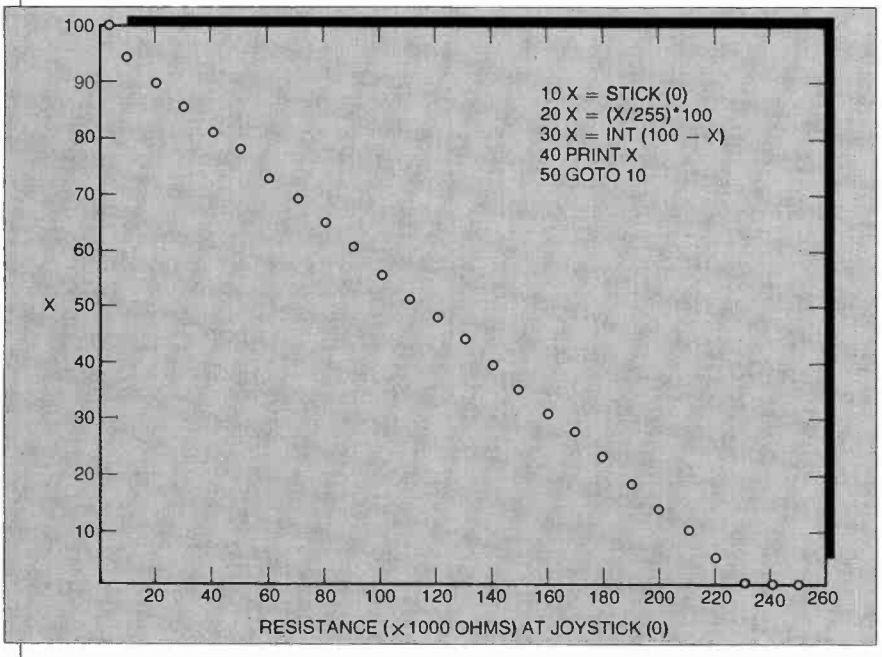


Fig. 4. Corrected joystick output for input of 0 to 250 kilohms.

The simplest way to connect a CdS cell to Junior is to open a joystick housing and remove the wires connected to the x-axis potentiometer (the one opposite the cable entry point). Carefully remove half an inch of insulation from each lead and wrap one of the exposed wires around each of the photoresistor's leads.

If you intend to do lots of experimenting with your joystick ports, you'll be better off installing a miniature phone jack for each potentiomter. Use the kind with a built-in switch connection. There's plenty of room, and your joystick will function normally until you plug a sensor into the jack.

Unless you use a shielded cable (connect the shield to the joystick cable's shield), it's important to keep the leads between the sensor and the joystick as short as possible. Otherwise, as I quickly learned, external noise picked up by the connections will cause incorrect joystick readings and other strange behavior.

Warning : You may void all or part of your computer's warranty if internal damage results from your modifications. Use care.

As for the photoresistor, it's a good idea to wrap a cylinder of black electrical tape around its window to better control light reaching its sensitive surface. If you've never worked with a photoresistor, you'll better understand the need for this step after you try the program that follows. Suffice it to say that CdS photoresistors are *extremely* light sensitive. I've used them in conjunction with a two-transistor circuit to detect light from a match more than 200 feet away!

The possible ways to transform Junior into a light meter are limited only by your imagination. For starters, try this:

```
10 'PCjr LIGHT METER
20 CLS
30 X=STICK(0)
40 X=(X/255)*100
50 X=INT(100-X)
60 LOCATE 2,2
70 PRINT "LIGHT
   LEVEL:",X
80 GOTO 30
```

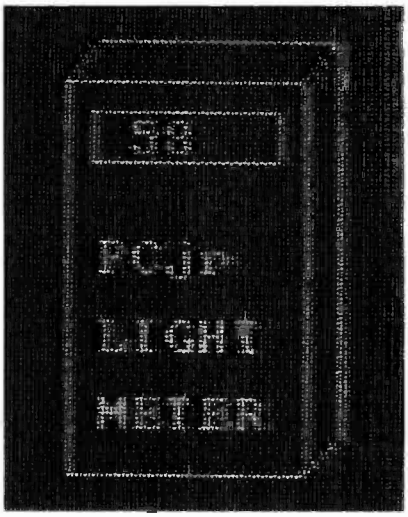


Fig. 5. Simulated light meter.

This routine simply provides on a scale of 0 to 100 the level of light striking the photoresistor. Of course you can add many frills to the program. For example, you can add a correction factor that compensates for the inherent nonlinearity of photoresistive devices. You can also add various beeps and tones that indicate (or warn) when the light level equals, exceeds or falls below one or more desired values. You can even provide graphics, perhaps a shape resembling a photographer's light meter. Listing 1, for instance, electronically "constructs" the light meter shown in the screen photo in Fig. 5.

A Storage Oscilloscope

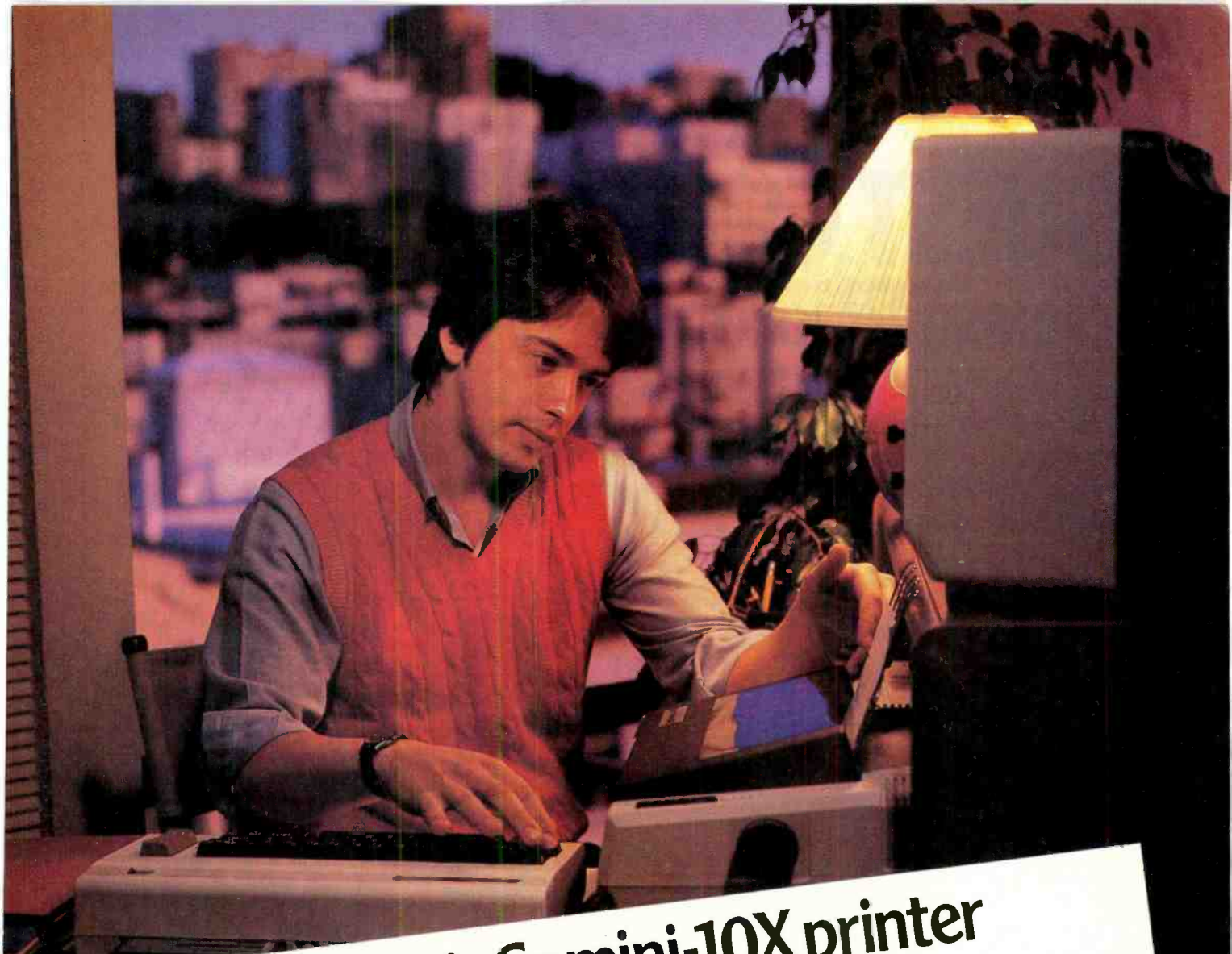
The light meter defined by Listing 1 provides only a single reading at any instant. But what if you want to monitor sunlight at a solar collector or the passage of clouds?

LISTING 1. PC*jr* LIGHT METER

```
10 'PCjr LIGHT METER
20 'COPYRIGHT 1984 BY FORREST M.
   MIMS III
30 KEY OFF:CLS
40 SCREEN 1,0:COLOR1
50 LINE (192,136)-(136,56),,B
60 LINE -(144,48):LINE -(200,48)
70 LINE -(200,128):LINE -(192,136)
80 LINE -(192,56)-(200,48)
90 LINE -(142,72)-(186,62),,B
100 LOCATE 12,19:PRINT "PCjr"
110 LOCATE 14,19:PRINT "LIGHT"
120 LOCATE 16,19:PRINT "METER"
130 X=STICK(0)
140 X=(X/255)*100
150 X=INT(100-X)
160 LOCATE 9,19:PRINT X
170 GOTO 130
```

There are various ways to have Junior keep a record of readings for later retrieval and study. The simplest is to save on disk a list of readings under an appro-

(Continued on page 76)



Bit by bit, Star's Gemini-10X printer will grow with you.

"Having a quickly growing marketing business means more and more paperwork. And the way I type, I knew early on that I needed a printer.

"I chose the Gemini-10X dot matrix printer because I wanted a printer that could do it all.

"First, the Gemini type is excellent. Actually good enough for letters. And I can also create my own type. For example, I designed "SteveScript." It's a combination of two different type styles and it makes my letters really stand out.

"Plus, my Gemini can do all sorts of advanced graphics, which a daisywheel can't.

"And it's much faster. No more time wasted typing. It was a pleasure to throw the whiteout away."

Steven Clarke—San Francisco, California

With Star's Gemini-10X printer you get 120 characters per second of clean, crisp type, multi-function versatility and steady, dependable service. All at a price that works.

It's everything you need in one printer.

star micronics, inc.

THE POWER BEHIND THE PRINTED WORD.

200 Park Avenue • New York, NY 10166

Dallas, TX (214) 456-0052 • Boston, MA (617) 329-8560

Chicago, IL (312) 773-3717 • Irvine, CA (714) 768-4340

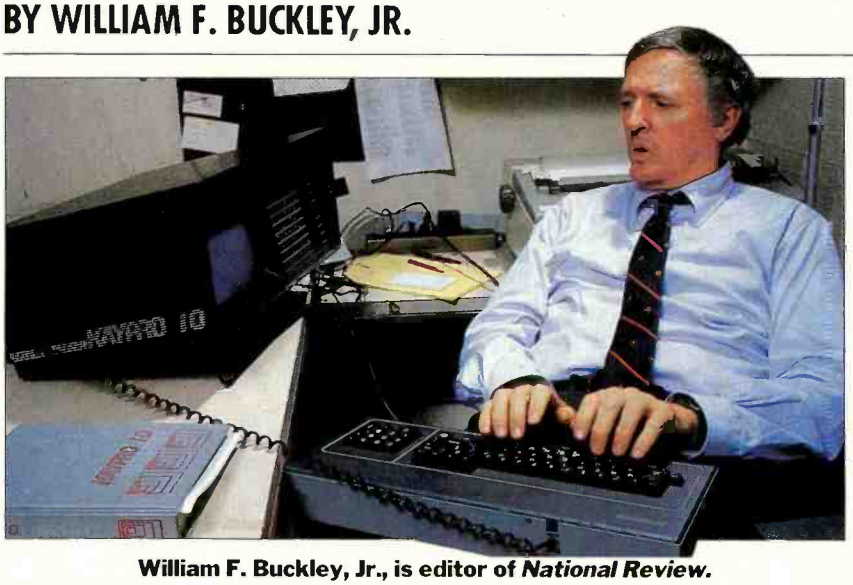
Circle No. 38 on Free Information Card

GUEST COLUMN

LEARNING TO TOUCH TYPE

Because Computers & Electronics *is dedicated to bringing its readers the latest in technology, we have commissioned author-television commentator William F. Buckley, Jr.—an inveterate Kaypro user—to reveal his unique method of teaching someone to touch type. In a companion article, two programs that teach touch typing are reviewed.*

BY WILLIAM F. BUCKLEY, JR.



William F. Buckley, Jr., is editor of *National Review.*

WHEN I see an advertisement or read a notice on the subject ("We can teach you to type in 30 days!") I am prompted to think back on three episodes, the first when I was 15, the second when my son was 12, and a final episode just last Christmas, while I was vacationing on a roomy sailboat with friends. I am 58, if anyone cares.

If there are scientists who have written on the general subject of congenital indecipherability, I don't know who they are, but I am nevertheless persuaded that the phenomenon exists. I mean, there are people around us—very nice people, often, though not always—who simply do not write clearly. It isn't that they desire to write unclearly, in order to suggest the profundity of their mind or their indifference to the workaday discipline of communication. Others suffer from the poor handwriting of an individual, but he suffers the most of all. True, he is likelier than others to be able to decipher what he himself wrote, but it can be very difficult for him. I can give you a page of the handwriting of Henry Kissinger, of John Kenneth Galbraith (or, a page of my own), which the author will make out, but only with hesitation. Since we are all most dependent on our own handwriting, and suffer the most from its opacity, I deny that bad handwriting is a form of affectation: it is an affliction.

Well anyway, having been unsuccessfully taught, bribed, and threatened, the moment came when, at age 15, I was away at school, and a package arrived from my father. It was a Royal portable typewriter, and a message came with it. "Dear Billy: Henceforward when you write to me, use this machine." ("Machine" was the closest my father ever came to a technical vocabulary.)

Now, I was then at a boarding school where a course in "Typing" was offered. Two hours every afternoon two days per week for one semester. That meant on the order of eighty classroom hours. It was commonly thought then, and still is today, that anything that requires eighty hours to learn is pretty complicated—this side of shorthand, to be sure, but maybe like beginning Italian, or Home Carpentry.

Inside my father's package came a note from his secretary, a kindly lady who knew something of my impatient habits. It was just a few sentences long, but it was the most liberating I ever read relating to the mastery of a skill. It was as if, having been given the gift of a dictionary, someone sent me an accompanying letter revealing the alphabet.

What she said was this: "Lift the caps off the keys"—in those days, typewriters came with caps; now they are mostly plastic, with the letters etched onto them—"and cut out a sheet of black paper—you can find this sort of thing in the school darkroom—little circular pieces that correspond to the size of the keys. Then replace the caps over the blacked-out keys. Then type out the sequence of the typewriter keys from left to right, leaving three spaces between each key. Then draw a line that separates the first set of vertical keys from the second set, and do that until they have all been separated. Then write down the finger of your hand that is used to depress each set of keys. Take a thumb tack and pin that piece of paper level with your eyes, over your desk. You will struggle for a while, but I expect you will be writing your father a typewritten letter not very long from now."

I did exactly as suggested, but also borrowed an exercise book from a student living across the hall who was enrolled in the typing class.

It wouldn't have mattered very much if I hadn't borrowed the exercise

PHOTOS BY STEVE BORNS

Look what's at Radio Shack...

Our popular TRS-80® Color Computer 2 has 64K of memory!

Expand your programming power at an incredibly low price. The TRS-80 Color Computer 2 attaches easily to any television, and features an electric typewriter-quality keyboard in a compact, white case. You can easily create high-resolution graphics—drawings, charts, diagrams, even animation—using simple, one-line commands.

The Heart of a Sophisticated Disk-Based System. Add our Color Computer 2 Disk Kit (below) and OS-9 operating system to utilize the full 64,000-character memory for assembly language programming. Or access 32K of memory using the powerful, built-in Extended BASIC language. Expand anytime with a printer, plotter, a modem for phone communications and more! Hurry in today to your nearby Radio Shack Computer Center, participating store or dealer.

64K Extended BASIC Color Computer 2

259.95 26-3127

AS LOW AS $26 PER MONTH

Radio Shack CITILINE

TV not included

New Low Price! Color Disk Drive

Turn your Extended BASIC TRS-80 Color Computer 2 into a complete disk system for quick and easy access to programs and data! You can develop your own sophisticated applications or use our ready-to-run software for word processing, spreadsheet analysis, electronic filing, budgeting, graphics, games and more. The Color Disk Drive stores over 156,000 characters of data per diskette. It's easy to install, too. Simply plug the drive controller into your Color Computer's Program Pak™ port. You can even add additional drives for only $279.95 each (26-3023).

Was $399.95 in Cat. RSC-11

Color Disk Kit #0

349.95 26-3029

AS LOW AS $28 PER MONTH

Radio Shack CITILINE

Prices apply at participating Radio Shack stores and dealers.
OS-9 is a trademark of Microware and Motorola, Inc.

Radio Shack®

The biggest name in little computers®

A DIVISION OF TANDY CORPORATION

Send me a free TRS-80 Computer Catalog.

Mail To: Radio Shack, Dept. 85-A-50
300 One Tandy Center, Fort Worth, Texas 76102

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

TELEPHONE _____

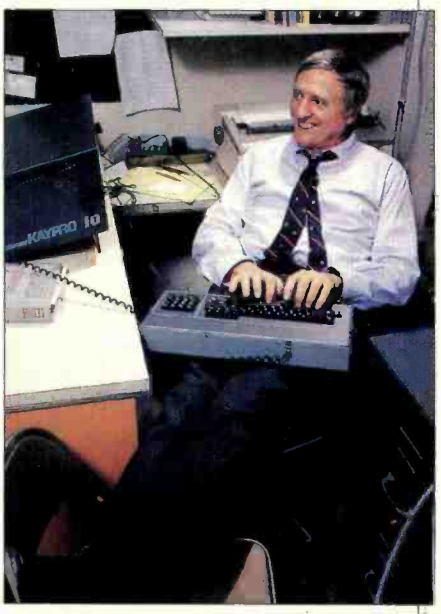
book—you can easily make up your own; but this saved me the trouble. Saved me the trouble of doing what?

Well you see, the standard typewriter keyboard is laid out on what they call the "Qwerty" method. An odd word, but not at all odd if you are looking at the face of a typewriter, because the first letter on the left of the top letter-row (the numbers are the topmost row) is the Q. After that comes the W. Then the E, R, T, Y, etc.

Why is all that? Well, it doesn't require, in order for you to follow this narrative, that I tell you—but I will anyway. Speed on a typewriter is best achieved when successive letters are typed by alternating hands. This way while one finger is striking, the other, using wrist and finger, is coiling to strike. Take the second finger of your second hand and try tapping it successively, as you would in typing the letter, R R R R R R R. That is slower than if you were alternating a left-hand letter with a right-hand letter. The letter Y is tapped with the second finger of the right hand, so that R Y R Y R Y R Y calls for alternating left hand-right hand strokes. You accomplish more strikes per second by alternating hands.

Well, that was easy enough to figure out, but when the technicians set out to keep the typist alternating from left hand to right hand as frequently as possible, they made the sorry discovery that they could very well end up with a typewriter configuration that would permit the typist to type faster than the machine's keys were (in those days) capable

(Continued on page 84)



TYPING TUTOR III AND MASTERTYPE

BY LEE D. ZIMSKIND

EDUCATIONAL materials that use challenging game-playing techniques to add incentive to the learning process have demonstrably better results than traditional, dry tutorials. One area in which this technique is effective is in helping the student increase speed and accuracy at the typewriter keyboard. Two software offerings we have recently evaluated are Typing Tutor III developed by Kriya Systems, Inc., and published by Simon and Schuster, and MasterType from Scarborough Systems, Inc. Both programs are available for the IBM PC and PC*jr*, Apple II and IIe, Commodore 64, and most CP/M computers. MasterType also adds to this list the Atari computers. Typing Tutor III and MasterType each carry a suggested retail price tag of $49.95.

Typing Tutor III

Typing Tutor III is more than just a game to teach users how to type. This program uses a Time Response Monitoring (TRM) process to create customized lessons tailored to the initial proficiency level of the user and adjusts itself to changing levels as the user proceeds through the lessons. It begins by creating exercises based on a few letters on the "home row" of keys on the typewriter keyboard. As the user masters these keys, the program adds new keys to the exercises, from other portions of the keyboard so that, by the end of the program, the user has complete proficiency in using every key.

As user proficiency increases, Typing Tutor III automatically increases the difficulty of the exercises and tests. Progress reports are displayed after each lesson and performance results are shown at the end of each test.

In addition to teaching the standard keyboard, Typing Tutor III also teaches the numeric keypad. As a bonus, the program includes a full-keyboard test for evaluating deficiencies of more experienced typists and a Standard Speed Test similar to many standard typing tests. (Users can create their own standard speed test; though, to do so, they must have some degree of familiarity with the basic text-editing capabilities of the computer.) In addition, there is a Letter Invaders game that is designed to provide practice on letters and combinations of letters.

Challenging game-playing techniques, rather than dry tutorials, can be used to add incentive to the learning process

This reasonably easy-to-use menu-driven program keeps an instruction line in reverse video on the bottom of the screen at all times. For the user who needs assistance, there is an on-demand help facility that allows the user to obtain full explanations of available options at any time. More detailed help can be obtained from the manual that accompanies the program.

A unique feature of Typing Tutor III is its ability to keep track of different users and remember the results of the prior session. To keep track of progress and build upon previous sessions, the program requires each user to sign on with his own name or code. Should a user sign on with someone else's name, he will be presented with that other person's lessons. Graphic displays of the user's speed and accuracy progress on each key is available, shown automatically at the end of the session or upon request during a session.

MasterType

A somewhat different kind of typing instruction game, called MasterType, is available from Scarborough Systems, Inc. This program, though less sophisticated than Typing Tutor III, is much more fun to use and is certainly more appealing to children. The MasterType program works basically with letters (or words for more advanced players). Letters are displayed in the four corners of the screen and move toward the center. The player must type these letters before they reach the center of the screen and wipe him out.

MasterType is pretty good for teaching the basic keyboard and developing a certain level of speed proficiency. Its level of sophistication, lacking any facility for practice with regular text, would probably not allow the user to become a proficient touch typist. ◇

We train specialists from the ground, up.

It takes a lot of special people to keep the Air Guard in the air. And not all are at the controls of a Phantom Jet.

Most serve in vital support positions. Positions requiring the very highest level of expertise. So when you join the Air Guard, you're trained by the best in the business. By top professionals in avionics, munitions loading, environmental support, and Tactical Air Command and Control. You can also get expert training in hundreds of other areas essential in defending America's skies. Training which can be just as important in launching your civilian career.

So if you're a special person looking for a specialty, check out the Air National Guard. For information, mail the attached coupon. Or call toll-free 800-638-0936.*

*In Alaska, Hawaii, New Jersey, Puerto Rico, Guam and the U.S. Virgin Islands, consult your local directory.

We Guard America's Skies.

AIR NATIONAL GUARD

Complete and mail to:
Air National Guard, P.O. Box 6000, Clifton, N.J. 07015.

☐ MALE
☐ FEMALE

NAME (Please Print)

ADDRESS APT

CITY STATE ZIP

AREA CODE: PHONE

OCCUPATION

BIRTH DATE

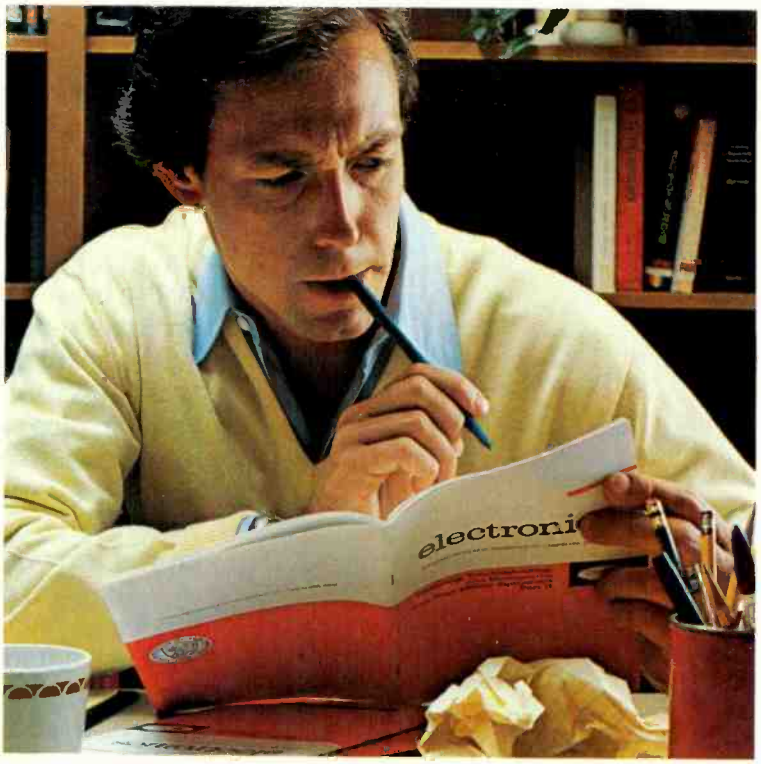
PRIOR MILITARY SERVICE YES NO

BRANCH RANK AFSC/MOS

A2CPTR** 084NP

Circle No. 15 on Free Information Card

Learning electronics is no picnic.



At any level it takes work and a few sacrifices. But with CIE, it's worth it.

Mail this postage-paid card today for

FREE SCHOOL CATALOG

Yes, please send me CIE's FREE school catalog, which will give me complete details on independent study with CIE.

Print Name _____

Address _____ Apt. _____

City _____ State _____ Zip _____

Age _____ Phone (area code) _____ / _____

Check box for G. I. Bill information ☐ Veteran ☐ Active Duty

Computers & Electronics

PE-18

CIE **Cleveland Institute of Electronics, Inc.**
1776 East 17th Street, Cleveland, Ohio 44114

DETACH AND MAIL TODAY!

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 8685 CLEVELAND, OHIO

POSTAGE WILL BE PAID BY ADDRESSEE

CIE

Cleveland Institute of Electronics, Inc.
1776 East 17th Street
Cleveland, Ohio 44114

Whoever said, "The best things in life are free," was writing a song, not living a life. Life is not just a bowl of cherries, and we all know it.

You fight for what you get. You get what you fight for. If you want a thorough, practical, working knowledge of electronics, come to CIE.

You can learn electronics by spending some hard-working time at home. Or, would you rather go bowling? Your success is up to you.

At CIE, you *earn* your diploma. It is not handed to you simply for putting in hours. But the hours you do put in will be on your schedule, not ours. You don't have to go to a classroom. The classroom comes to you.

Why electronics training?

Today the world depends on technology. And the "brain" of technology is electronics. Every year, companies the world over are finding new ways to apply the wonders of electronics to control and program manufacturing, processing...even to create new leisure-time products and services. And the more electronics applications there are, the greater the need will be for trained technicians to keep sophisticated equipment finely tuned and operating efficiently. That means career opportunities in the eighties and beyond.

Which CIE training fits you?

Beginner? Intermediate? Advanced? CIE home study courses are designed for ambitious people at all entry levels. People who may have:

1. No previous electronics knowledge, but do have an interest in it;
2. Some basic knowledge or experience in electronics;
3. In-depth working experience or prior training in electronics.

You can start where you fit and fit where you start, then go on from there to your Diploma, an Associate Degree if you want it, and career.

Many people can be taught electronics.

There is no mystery to learning electronics. At CIE you simply start with what you know and build on it to develop the knowledge and techniques that make you a specialist. Thousands of CIE graduates have learned to master the simple principles of electronics and operate or maintain even the most sophisticated electronics equipment.

CIE specializes in electronics.

Why CIE? CIE is one of the largest independent home study schools that specializes in electronics. Nothing else. CIE has the electronics course that's right for you.

Learning electronics is a lot more than memorizing a laundry list of facts about circuits and transistors. Electronics is interesting! It is based on recent developments in the industry. It's built on ideas. So, look for a program that starts with ideas and builds on them. Look to CIE.

Programmed learning.

That's exactly what happens with CIE's Auto-Programmed® Lessons. Each lesson uses famous "programmed learning" methods to teach you important principles. You explore them, master them completely, before you start to apply them. You thoroughly understand each step before you go on to the next. You learn at your own pace.

And, beyond theory, some courses come fully equipped with electronics gear (the things you see in technical magazines) to actually let you perform hundreds of checking, testing, and analyzing projects.

Experienced specialists work closely with you.

Even though you study at home, you are not alone! Each time you return a completed lesson, you can be sure it will be reviewed, graded, and returned with appropriate instructional help. When you need additional individual help, you get it fast and in writing from the faculty technical specialist best qualified to answer your question in terms you can understand.

CIE offers you an Associate Degree.

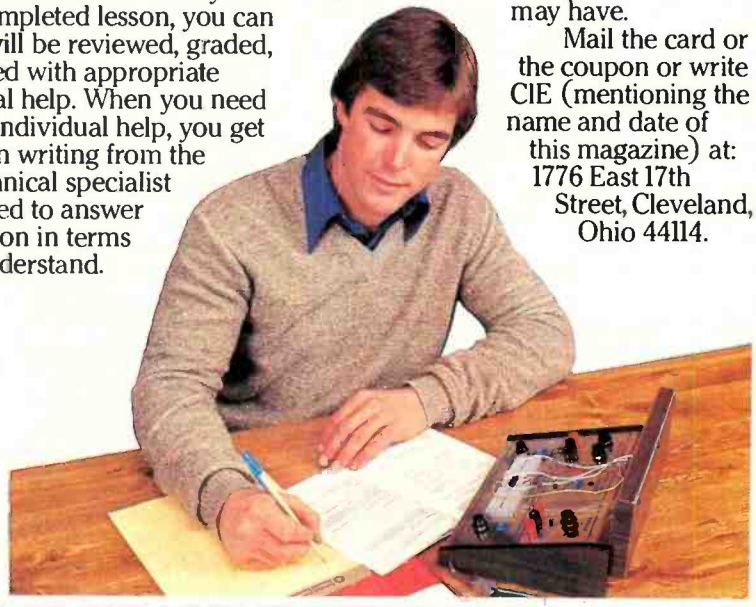
One of the best credentials you can have in electronics—or any other career field—is a college degree. That's why CIE gives you the opportunity to earn an Associate in Applied Science in Electronics Engineering Technology. Any CIE career course can offer you credit toward the degree...more than half of the number needed in some cases.

You can also prepare for the government-administered FCC (Federal Communications Commission) Radiotelephone License, General Class. It can be a real mark in your favor...government-certified proof of your specific knowledge and skills.

Today is the day. Send now.

Fill in and return the postage-free card attached. If some ambitious person has removed it, cut out and mail the coupon. You'll get a FREE school catalog plus complete information on independent home study. For your convenience, we'll try to have a CIE representative contact you to answer any questions you may have.

Mail the card or the coupon or write CIE (mentioning the name and date of this magazine) at: 1776 East 17th Street, Cleveland, Ohio 44114.



PE-17

CIE **Cleveland Institute of Electronics, Inc.**
1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

YES...I want to learn from the specialists in electronics—CIE. Send me my FREE CIE school catalog...including details about the Associate Degree program... plus my FREE package of home study information.

Print Name _____

Address _____ Apt. _____

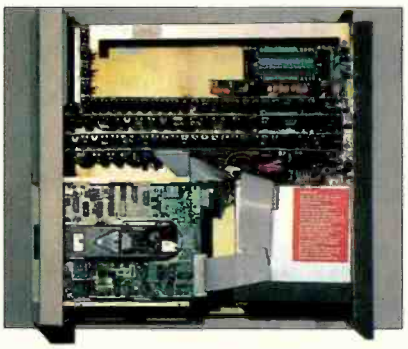
City _____ State _____ Zip _____

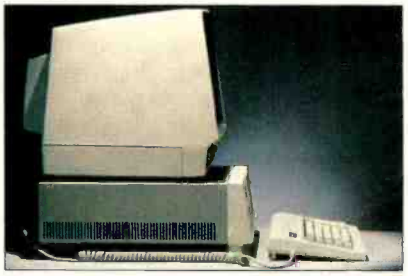
Age _____ Area Code/Phone No. ____ / _____

Check box for G.I. Bill bulletin on Educational Benefits: ☐ Veteran ☐ Active Duty

MAIL TODAY!

HARDWARE REVIEWS





ZENITH Z151 COMPUTER

New micro from Zenith offers 99% software and hardware compatibility

BY MICHAEL GUTTMAN

In 1982, Zenith Data Systems, the computer division of the electronics and TV giant, introduced its first 16-bit computers, the Z-100 Series. Although the Z-100s attracted a lot of industry attention for their excellent design and high performance, their growing popularity was soon eclipsed by the introduction of the now-dominant IBM Personal Computer, with which they are only partially compatible. Now Zenith is attempting to extend its share of the computer marketplace with a new line of computers that offer near-100% compatibility with the IBM PC. This new line includes the desktop Model Z-151 and the portable Model Z-161.

Compatibility and competition with the IBM PC is definitely the major goal in Zenith's latest efforts. Zenith is touting its line as being better built and better performing than the IBM PC—and significantly less expensive. In addition, Zenith plans to use the new line of PC-compatible computers as a springboard for a massive advertising campaign to convert its public image from that of a purveyor of TV products to that of a major player in the burgeoning computer industry.

With so much riding on these new products from Zenith, we were very interested to find out just how good the new computers really are. We obtained both dual floppy disk and floppy disk/hard disk versions of the Z-151 for early evaluation. (The portable was not available at review time.)

First Impressions

Our interest grew as soon as the computers arrived. The most striking feature is that these computers are much narrower in front than the IBM PC and most of its clones, creating a very sleek appearance. The two half-height 5¼-in. floppy drives are stacked on the right side of the front panel; the left side is blank, except for the Zenith logo and a small LED that comes on when the computer is powered up.

The computers required no special installation and connected easily to monitor and printer. Both units powered up quite rapidly, executing start-up diagnostics in just a few seconds. The disk drives and fan operated smoothly and quietly. And both MS-DOS and PC-DOS booted without a hitch and were off and running without requiring us to glance at the operator's manual.

Inside the Z-151

As soon as we opened the cover, the strategy behind the new design and styling immediately became apparent. The drives occupy the front-right quarter of the cabinet's volume, while the rear-right quarter is occupied by the power supply and cooling fan. The computer's power switch is located on the rear panel.

The entire left side of the cabinet is devoted to an eight-slot IBM PC-compatible bus, except for a small space reserved for the loudspeaker located immediately behind the front panel.

The overall design creates a very neat, uncluttered workspace that we feel should make the hardware very accessible for upgrades and servicing. On the bus, the three slots to the far right (with the computer viewed from the front) accommodate the plug-in cards for the CPU, graphics, and communications, including the floppy disk controller.

The Z-151 comes standard with an 8088 processor, two serial ports, one parallel port, both monochrome *and* RGB color graphics capabilities, and one 5¼-in. floppy-disk drive. Each port terminates in a 25-pin DB-25 connector on the back panel. Color graphics output signals are available at a 9-pin RGB D-type connector, monochrome through a standard phono jack. Both video outputs are located on the back panel. A welcome feature is that all connectors are clearly labeled and easily accessible.

The five bus slots on the left are reserved for full-size IBM-compatible plug-in cards. In a standard system, one of these slots is occupied by the memory card. This board comes with 128K of RAM and can be populated with up to

PHOTOS BY BARRY BLACKMAN

HEATH MODEL HS-151 KIT REPORT

BY ALEXANDER W. BURAWA

Zenith's new IBM PC/XT-compatible computers can save you a good deal of money; you can do even better with the kit versions of these computers from the Heath Company. All you need is some mechanical dexterity and the ability to follow instructions. The factory-assembled Zenith ZF-151-21 table-top single disk drive computer retails for $2699; the identical Heath HS-151 sells for only $1899, an $800 savings. If you buy the two-drive HS-151-22 kit, you save an additional $100 just by dropping in the second drive, which takes no more than 20 to 30 minutes.

Going the kit route yields a number of benefits. Most immediately, of course, you save roughly 29% of the cost of the assembled computer in the case of the HS-151-22 two-drive system. A further benefit to the technically inclined is that kit assembly provides the builder with intimate knowledge of the product's innards. Should you decide to modify the computer or need to troubleshoot the system, you'll really appreciate this knowledge. A final benefit—one that ranks high with repeat Heath customers and hobbyists—is the satisfaction of knowing that *you* built it yourself.

Kit Details

You might be intimidated by the idea of a product as complex and sophisticated as a professional computer in build-it-yourself kit form. The Heath approach to kit packaging, component selection, and assembly directions, however, permits almost anyone, even someone who has never asembled an electronic kit before, to build a computer successfully.

One of the reasons Heath computer kits have such a good reputation is that much of the work of assembling them is already performed at the factory. Very complex assemblies that would be virtually impossible for the buyer to troubleshoot (to correct a wiring or other error made during assembly) are supplied assembled, tested, and burned in. With the HS-151, the central processing and video graphics boards and the power supply assembly come ready for you to drop them into the computer. What remains for you to wire are the backplane (bus) board, the memory card, and the floppy disk drive controller card. Lest you get the idea that wiring these three assemblies is a "piece of cake," however, con-

(Continued on page 92)

320K of RAM. Maximum system RAM expansion, using more than one card, is 640K. In the hard disk system, another slot would be occupied by the controller card.

With all the major functions accounted for, the Zenith computer still has four open slots for future expansion (three in the hard disk model). This compares very favorably with the IBM PC. A similarly configured PC could require as much as five additional cards for memory expansion and graphics and communications support, leaving no slots open on its five-slot bus.

List prices for the Z-151 are $2699 for the single-floppy, $3099 for the dual-floppy, and $4799 for the single-floppy and 10M hard disk system versions. The Z-161 portable versions retail for $2799 for the single-floppy and $3199 for the dual-floppy versions. Zenith's subsidiary, the Heath Company, has the same computers in kit form. They are the desktop Model HS-151, which retails for $1899 with single drive and $2199 with two drives, and the portable Model HS-161, which retails for $1999 and $2999 for the single- and dual-drive versions.

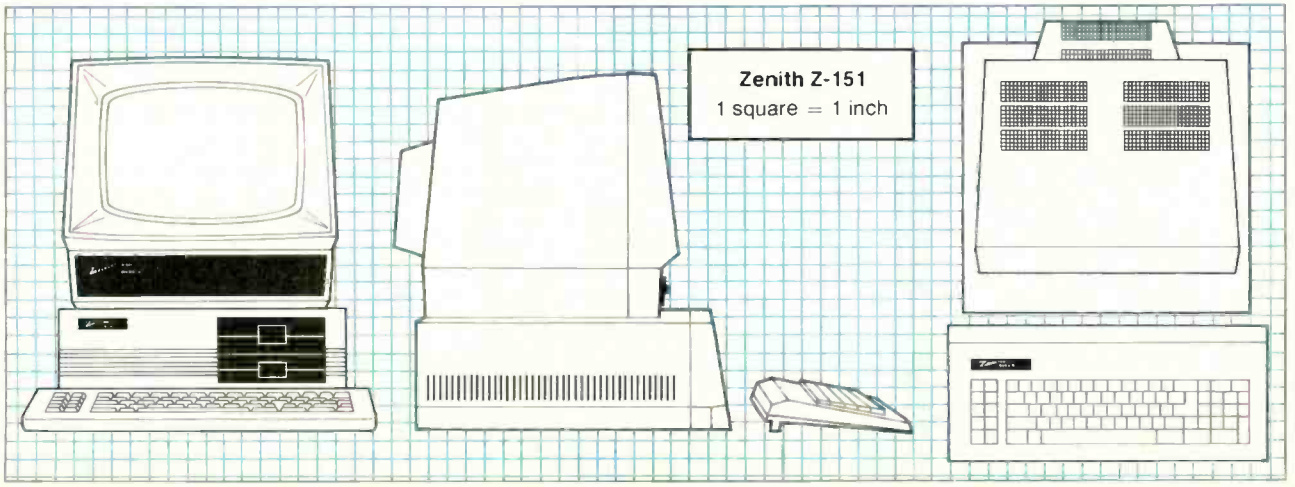
Specifications

Product: Z-151 Microcomputer
Mfr: Zenith Data Systems
1000 Milwaukee Ave.
Glenview
IL 60025
Dimensions: 16"W × 17"D × 6¼"H
Weight: 42 b
Price: $3099
Operating System: MS-DOS
Features: 8088 microprocessor, dual 5¼" half-height floppy disk drives, RS-232, Centronics, 128K RAM, RGB color and monochrome outputs

The Keyboard

One common complaint about the IBM PC is the awkward arrangement of its keyboard. Manufacturers of compatibles must choose between emulating the IBM keyboard exactly or introducing nonstandard keyboards that may not work with some PC software or conform to some PC-based documentation. Ze-

(Continued on page 91)



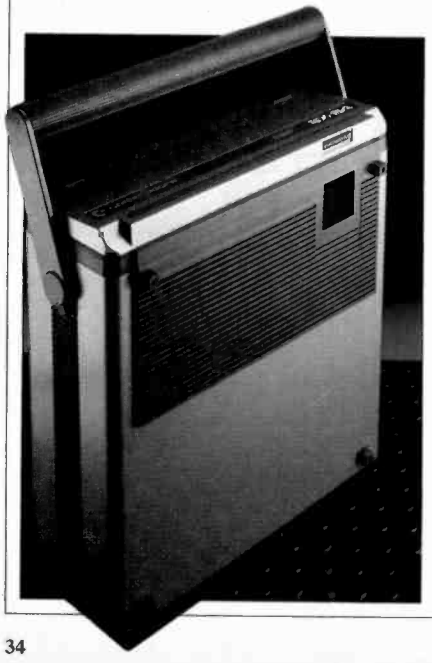
COMMODORE'S COMPLETE PORTABLE SYSTEM

The economical SX-64 has color, floppy disk storage and compatibility

BY TOM HAUGHNEY

Wasn't it Casey Stengel who said, "For a portable to be called a portable it should really be portable"? Those who have tried lugging Compaqs, IBM Portables and similar machines around know that 30 or more pounds is just too heavy to carry comfortably. Commodore's new microcomputer, the SX-64, though not as light as some lap-size computers, does offer true portability. It also is the only portable micro on the market with built-in ($5\frac{1}{4}$") disk drive and (5") color monitor.

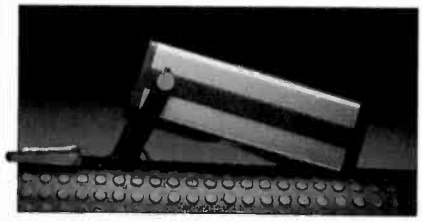
The SX-64 is the portable version of the Commodore-64, the largest-selling 64K microcomputer. (Editor's note: an in-depth review of the Commodore-64 appeared in the April 1983 issue of COMPUTERS & ELECTRONICS.) Accordingly, it offers the additional advantage of being almost 100% compatible with the Commodore-64. Unlike the C-64, however, the SX-64 is a complete system that sells for about $800 in most outlets. (Commodore does not provide suggested retail figures).



PHOTOS BY BOB LORENZ

Outside the SX-64

The SX-64 is encased in a metal cabinet painted a metallic fleck medium gray. The rest of the exterior is dark gray, with touches of white, silver, or blue trim.



Along the top of the SX-64 is a ROM cartridge port. Two hinged panel doors form a guideway that ensures such an easy cartridge fit that I couldn't find the wrong way to do it.

The back, a finned metal casting, serves as a heat sink—no fan is used. The sheet-metal body of the machine has plastic inserts on the top and bottom that have heat-venting grillwork molded in. The heat sink and venting system apparently work well. I often left the unit on for hours without noticing any balking or other problems due to excess heat.

The power cable fits into a receptacle in the back next to an on/off rocker power switch. Also on the back are two joystick ports, an audio/video DIN connector, a serial I/O DIN connector, and a user I/O port, which is a card edge connector. Regrettably, none of the ports are labeled.

Noticeably absent is the cassette tape port that is available on the C-64. Without it you cannot use tape programs for the C-64 on the SX-64. The unit also lacks an r-f output. While you can connect the SX-64 to a video monitor if you want a larger screen display, you cannot connect directly to a television receiver.

The keyboard is connected to the main enclosure, at the bottom of the front, by means of a flexible 24" cable. The connectors are molded onto the cable and feature a pattern that won't allow the wire to break at the point of connector entry. As with the ROM cartridges and the power cable, the keyboard cable fits very well into its socket. Actually I marveled at how easy it was to fit the back end of the cable into the computer without looking.

Stash and Carry

The keyboard, detachable, fits right over the screen and disk drive for storage or transport. You can easily fit the long, narrow lip on the keyboard into a slot along the bottom front of the main unit. Once it is in place, you tilt the keyboard/cover up and secure it with two spring-loaded clasps. While the clasps usually catch on the first try, you might need to exercise some care and do some jiggling to make sure that both are secure.

The carrying handle on the SX-64 works quite well. It is a cylinder $1\frac{1}{2}$" in diameter that extends the full width of the machine. A fluted plastic grip helps prevent accidental slipping. You can rotate the handle underneath the box and lock it into any one of 15 possible positions to use it as a stand. It can tilt the unit up about 12°.

Inside the SX-64

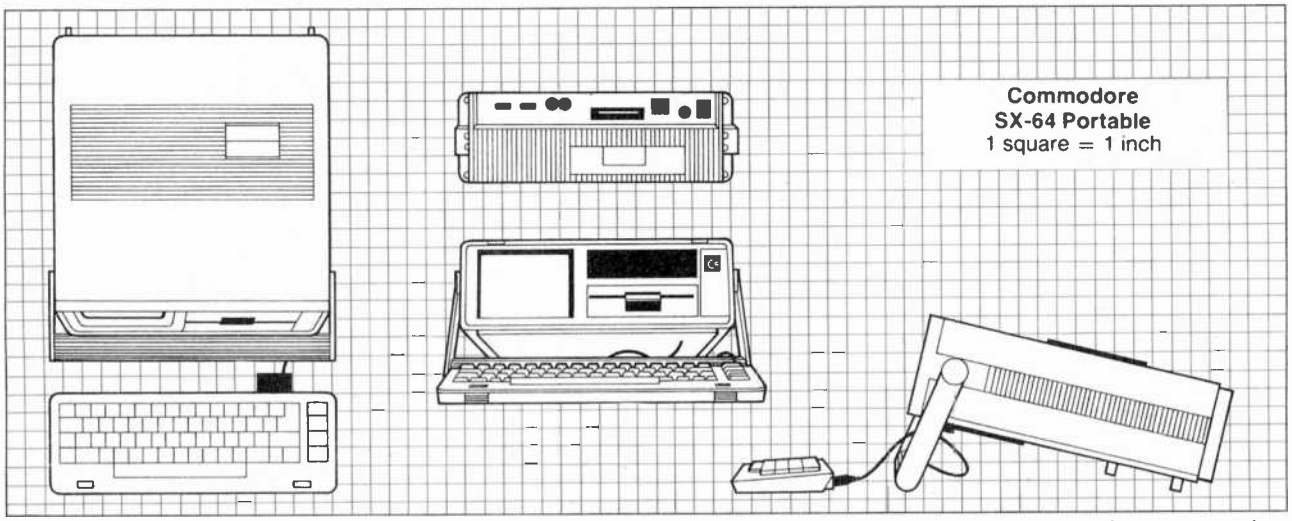
Like the Commodore-64, the SX-64 uses the 6510 microprocessor. The 6510

belongs to the 6500 family of processors, which also includes the popular 6502. One feature of the 6510 is an I/O port register that is used for memory management and allows it to control more than 64K of RAM and ROM memory. (The system contains 64K RAM and 20K ROM.)

The SX-64 uses the same sound and video chips as the C-64. The 6581 SID (sound interface device) is a real music synthesizer as well as a sound chip. It's capable of producing attack/decay sustain/release sounds in three voices. It also has filters and a white-noise generator. The video is generated with a 6567 video interface chip called the VIC-II. This chip can produce a text display 25 lines by 40 characters or a bit-mapped color display, 320 by 200 pixels, that includes 16 colors and sprite graphics.

Specifications

Product: SX-64 Portable Computer
Mfr: Commodore
Computer System Div.
1200 Wilson Dr.
West Chester, PA 19380
Dimensions: 14½"L × 14½"W × 5"D
Weigh: 27 6 lb
Price: Not available (see text)
Operating System: Commodore dos
Features: Built-in 5" color-video monitor and 5¼" half-height floppy drive



The Keyboard

The SX-64 keyboard is very similar to that of the C-64. The keys have been squared off, however, and the layout, overall, seems to have been reduced about ⅜" on each side. This narrowing does not seem to have affected the sizes of any of the keys.

The keyboard has the layout of the C-64, with several improvements. First, an LED graces the shift lock key. Second, the primary alpha or numeric designators occur on the upper left corners of the keys. This placement is ideal for those who have never broken the habit of staring at the keyboard while composing text. This little change won't make a bit of difference to typing pros, but it will be appreciated by those who struggle along at a blistering, error-pocked 20 words per minute. No more constantly pulling your hands back to make certain that they are lodged correctly on the keys.

Lateral key wobble is only a bit worse than on my $3700 IBM PC clone, but the SX-64, like the C-64, has less tendency for adjacent key triggering than the IBM. While no microcomputer keyboard that I have tried has a "feel" that compares to that of the IBM Selectric, I did like the touch of the SX-64.

The keyboard is light, as befits a portable, and has the tendency to wander over the surface it rests on. To restrict this movement, Commodore has inserted a narrow rubber strip into the keyboard. On slick surfaces, however, this tiny strip has to be supplemented. I placed some thin rubber sheets under the keyboard, which kept it in place.

The Video Display

The built-in color monitor, on the left front of the unit, has a nearly rectangular screen that measures only 5" across the diagonal. Although the monitor uses a composite video signal, the display is crisp. Video controls as well as the audio volume control are located neatly behind a small plastic door on the far right. They are convenient to use and work effectively.

The color on the screen is great, and text on the screen is readable despite the small size of the screen. The size does not prevent you from playing video games on the machine. Still, I would not want to troubleshoot a BASIC program listing while staring at this little window and trying to distinguish between, for example, "n" and "m." If you use the SX-64 at home, it may be best to plug it into a monitor with a screen of normal size. Unfortunately, lacking an r-f output, the unit cannot be connected to your TV at home or at a hotel. It is a sad omission.

Disk Drive

The SX-64 has a built-in 5¼" half-height single-sided floppy disk drive. Though there is space for a second drive, Commodore does not yet offer that option. Instead, there is a an empty compartment available for disk storage. The absence of a second drive is relieved somewhat by the availability of the cartridge port. For word processing, for example, you could pop a cartridge like "Write Now" (Cardco, Inc.) into the slot and use the drive for a data disk.

If you have ever loaded programs with the C-64's 1541 disk drive, you know the procedure is slow, due to the drive's serial interface. The SX-64 drive, which also communicates serially, is also slow. The drive uses single-sided single-density diskettes with a formatted capacity of about 174K bytes. The disk drive is an "intelligent" one that uses a 6502 microprocessor and includes 16K of ROM, 2K of RAM, disk controller circuitry, and a disk operating system.

Software

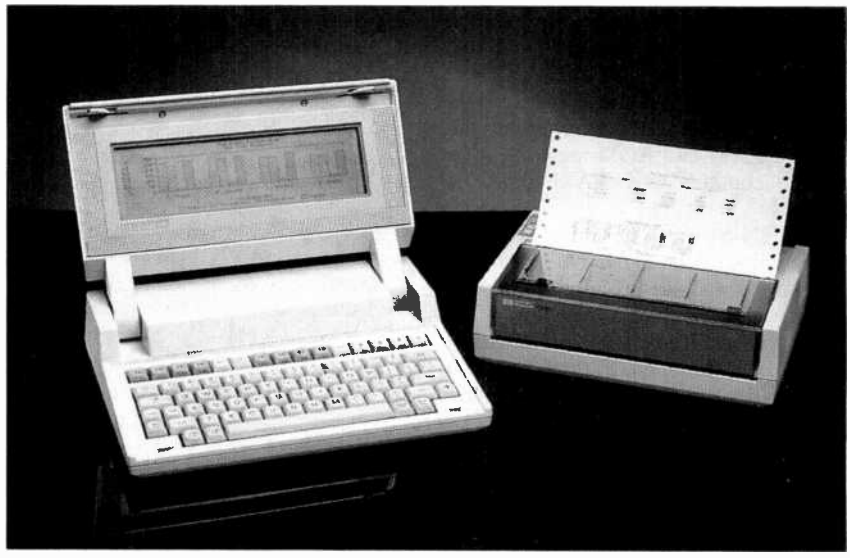
The SX-64 includes as standard features BASIC language and the Commodore disk operating system. BASIC is in system ROM, while DOS is contained in a ROM on the disk drive's circuit board. The SX-64 is completely compatible

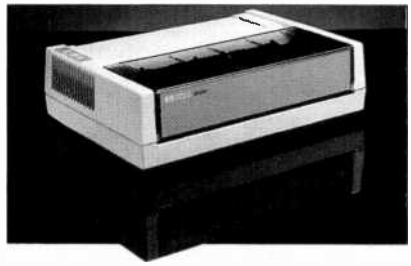
(Continued on page 83)

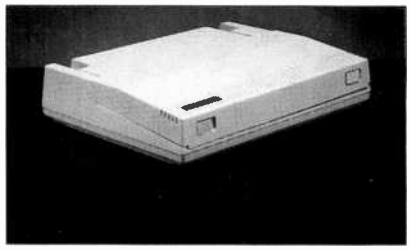
HP110 COMPUTER AND THINKJET PRINTER

Desktop performance in a kneetop package

BY FORREST M. MIMS, III







The air of secrecy surrounding the development of a new computer is reminiscent of the security in a military research laboratory. One of the bonuses of writing for a major computer magazine is having the opportunity to inspect and even try out some of these new machines before they are officially announced.

It's particularly fascinating to compare the actual computer with its rumored, leaked and speculated counterpart reported upon in the trade press. Those not in on the secret can be reasonably certain an unannounced computer actually exists when its manufacturer invokes a "No comment" policy or, especially, when a high company official vigorously denies the existence of the rumored machine.

Recently, for example, Hewlett-Packard's chairman, John Young, was reported by *Electronic Engineering Times* to have denied the existence of a rumored new portable known to insiders as *Nomad*. Normally, I read every word of confirmation signals like Mr. Young's, carefully looking for clues about the real machine, but this time it wasn't necessary. I had just concluded a busy session of poking away at the quiet keyboard of a very real HP 110 while a sheet of paper with neat rows of print emerged magically from Hewlett-Packard's whisper-quiet ThinkJet printer (see sidebar).

Being a dedicated portable computer fanatic (I bought a Model 100 within minutes after that machine was first placed on sale), you can imagine my excitement at having the opportunity to use the portable HP 110, the most powerful kneetop portable yet to appear.

My hands-on experience with the HP 110 was significantly enhanced by the knowledge that this remarkable new portable and its battery-powered ink jet printer are products of Hewlett-Packard. Just as the IBM logo symbolizes *service*, the initials HP denote *quality*.

Indeed, in the best tradition of HP's line of scientific calculators (one of which survived burial in an avalanche; others, falls from great heights; and still others, the tires of ton-and-a-half automobiles) Hewlett-Packard claims the HP 110 can withstand a shock of 100 g in any direction! Though not verified with the prototype I evaluated, this means the HP 110 should easily survive a fall from a desk to the floor!

Getting to Know the HP 110

The HP 110 includes a high-resolution liquid crystal display, 280K bytes of RAM and a variety of powerful applications programs within its 392K bytes of ROM. All this fits nicely in a sturdy yet attractive package weighing 8½ lb and measuring 13" W × 10" D × 2⅞" H. When the two sliding latches on the front edge of the machine are moved toward one another, the top half of the computer unfolds to reveal a full-size 61-key typewriter keyboard, a row of 15 function and cursor control keys and a state-of-the-art 16-line by 80-character (128 × 480 pixel) liquid crystal display.

The appearance of the display is certainly the most striking feature of this new machine. The entire screen can be tilted back and forth to minimize glare. Contrast can be altered in discrete steps by pressing a special contrast key. Finally, text displayed on the screen is easy to read since the character fonts resemble conventional type rather than the stick-figure format of most other dot-matrix displays.

Under the keyboard and behind the display window are a total of four circuit boards containing some 100 micropower CMOS chips. The microprocessor that drives and controls the machine is a CMOS version of the 8086. Unlike the 8088 used in IBM's PC, the 8086 is a bonafide 16-bit processor and provides about twice the processing speed.

The HP 110 can be switched off by pressing one of the function keys. Or, when the machine is operating from its internal battery pack, it can be set to switch itself off automatically after a period of inactivity ranging from 30 seconds to 30 minutes.

When the HP 110 is first switched on, its screen briefly displays copyright information about its bundled software *and* its serial number. The computer then enters its Personal Applications Manager (PAM) mode and the screen displays the number of available bytes in RAM, the time and date, and various menu options. It even displays, on a scale of 0 to 100, the percentage of charge remaining in the self-contained lead-acid battery pack.

Three of the menu options are the major applications programs permanently

PHOTOS BY MICHAEL BRESKIN

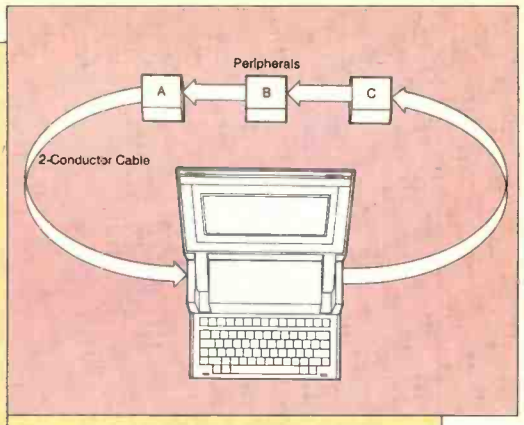
HP INTERFACE LOOP (HP-IL)

THE HP 110 is equipped with both a traditional RS-232C serial interface and Hewlett-Packard's Interface Loop (HP-IL). Though most computer users are familiar with the former, comparatively few ever heard of HP-IL.

Hewlett-Packard designed the HP-IL system to provide a low-cost bit-serial interface for battery-powered test instruments, programmable calculators (like the HP-41 series), computers and a wide range of printers, plotters and other peripherals. Each HP-IL device has output and input two-conductor sockets.

An HP-IL system is formed by connecting a two-conductor cable from the output of a computer or other controller device to the input of a second HP-IL device. A second cable is then connected between the input of the computer and the output of the second HP-IL device. The result is a *closed interface loop.* It can include up to *thirty* devices. Each device is assigned an appropriate numerical address so it can be accessed by the loop's programmable calculator or computer.

Most HP-IL devices electronically identify their device classification. For instance, an HP-IL printer like Thinkjet responds with the HP-IL electronic ID number for printers when the computer issues a PRINT command. The information to be printed is then sent to the printer without the user having to specify a device address.



HP-IL allows devices to be separated by up to 100 meters using shielded twisted pair and 10 meters when the cable is unshielded.

In short, HP-IL provides a simple but powerful interface link for battery-powered computers like the HP 110 and their peripherals. ◇

HP'S WHISPER-QUIET THINKJET PRINTER

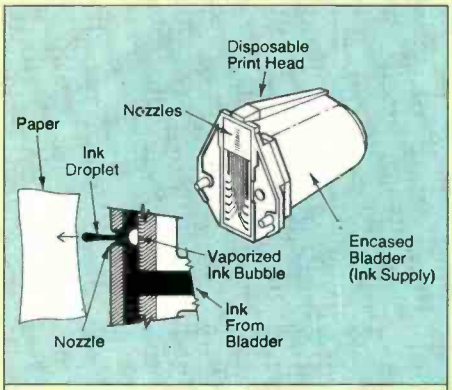
THE high noise level of nearly all impact-type dot-matrix printers is a major irritant to their users and anyone else within earshot. Consequently computer and printer companies have spent millions of dollars in efforts to develop quiet, nonimpact printers having acceptable print quality.

Until recently thermal printheads pressed against heat-sensitive paper provided the major non-impact printing technology. Though very quiet and moderately fast, thermal printers require special paper and produce relatively low-contrast characters.

Now, thanks to the arrival of the moderately priced ($495) Hewlett-Packard 2225 Ink Jet Printer, the *ThinkJet,* the days of ear-numbing impact printers are numbered. The ThinkJet is just as quiet and, at 150 characters per second, much faster than a thermal printer. And since its characters are formed by spraying microscopic droplets of ink, it produces crisp, high-contrast characters. Though the ThinkJet isn't a letter-quality printer, its print matrix of 11 × 12 dots forms well-defined, highly legible characters.

Three versions of the ThinkJet are available. The HP 2225A is line-powered and fully compatible with Hewlett-Packard's Model 150 touchscreen computer. The HP 2225C, also line-powered, includes an industry standard Centronics-type parallel bus.

The HP 2225B is battery powered and includes a built-in HP-IL interface (see accompanying sidebar). Therefore, it forms an ideal companion for Hewlett-Packard's new HP 110 portable computer. It can print some 200 pages of text on a single battery charge.



Though ink jet printers have been around for some time, their tiny ink lines, pumps and reservoirs have been subject to clogging problems. The ThinkJet eliminates these problems entirely by employing a novel method of generating droplets of ink. The technique was conceived first by Ichiro Endo of Japan's Canon, Inc., where it is known as *Bubblejet,* and then independently by John Vaught at Hewlett-Packard.

The key to the ThinkJet is a disposable print head cartridge containing a bladder filled with enough ink to print 500 pages of text and a tiny print head equipped with a linear array of microscopic apertures. Each tiny aperture is backed by a miniature heating element. When a brief pulse of current is passed through the element, a vaporized bubble of ink is generated. The bubble then bursts, propelling a droplet of ink through the aperture and toward the paper where it forms a black dot 0.015" in diameter.

The entire printing process is implemented by the disposable print head cartridge. Unlike conventional ink jet printers, there is *no* ink-collecting gutter and no tubes, pumps or reservoirs to clog.

As the ink supply runs out, the bladder, which can be viewed through the cartridge's clear walls, collapses. Its appearance provides a visual clue to the amount of ink remaining.

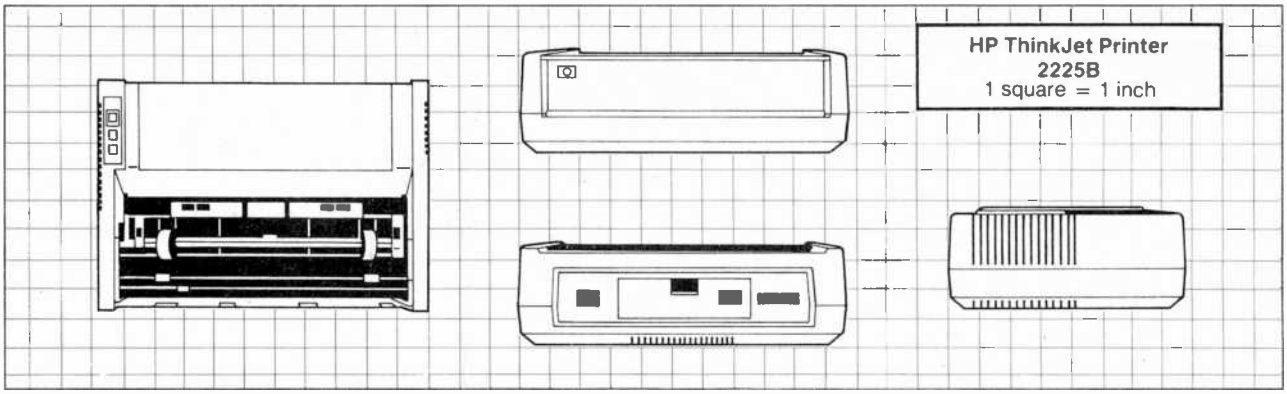
Using the ThinkJet

Either single sheets or sprocketed fanfold paper can be used with the ThinkJet (the machine has both friction and tractor drive). After a sheet of paper is loaded and the machine is turned on, the print head clears its apertures by spraying a few drops of ink on a replaceable absorber pad.

Proper operation of the printer can be verified by depressing the machine's line feed button while turning the power on. Releasing the line feed button then causes the printer to spray on the paper a preprogrammed sequence of test characters. Switching the machine off ends the test session.

The ThinkJet can print 256 different characters in several different pitches. It can also print single-pass boldface and underlined characters and words. These and many other special printing and formatting features are available by means of special control code sequences which must be entered into a companion computer (but which are themselves not printed).

As for graphics, the ThinkJet can print anything displayed on the screen of an HP 110 or other compatible computer. Its resolution is 96 × 96 or 96 × 192 dots per inch. ◇



stored within the system's 384K bytes of CMOS ROM. They include a simple word processor package called *MemoMaker,* a terminal emulator and, believe it or not, all the graphics and information management features of Lotus 1-2-3, the best-selling spreadsheet package.

The fourth option is the MS-DOS operating system. Any of these packages can be selected by moving a small pointer with the cursor-control keys and pressing RETURN.

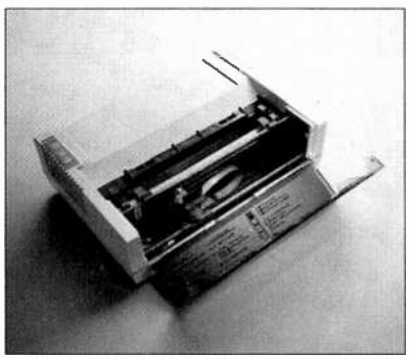
Below the titles of the bundled application programs appears a row of menu options corresponding to the eight function keys. These keys allow you to begin operating a selected applications program, set the computer's clock, establish the data communication configuration, reconfigure many of the machine's operating modes and switch the machine off.

Of particular importance is the HELP key. Summaries of the critical portions of the HP 110's various operating manuals are stored in ROM, and they can be instantly recalled simply by pressing the HELP key which is provided in virtually every operating mode. Pressing HELP fills the screen with a detailed explanation of how to proceed.

For example, when the machine wakes up in the PAM mode, pressing HELP provides "Running Applications" to "Turning Off the HP 110." After a topic is selected (using the cursor-control keys to highlight the desired topic), the screen provides a concise explanation.

Specifications

Product: HP-110 Portable Computer
Mfr: Hewlett-Packard
Personal Computer Group
1000 N.E. Circle Blvd.
Corvallis, OR 97330
Dimensions: 13″W × 10″D × 3″H
Weight: 9 lb
Price: $2995
Operating System: MS-DOS
Features: 80C86 microprocessor, 384K CMOS ROM, 272K CMOS RAM, 16 × 80 LCD, modem, battery power, RS-232, HP-IL, Lotus 1-2-3, MemoMaker, Terminal Emulation



ThinkJet spray mechanism

Apparently assuming most potential users will use the HP 110's bundled application programs and commercial software, Hewlett-Packard chose not to include BASIC in the machine's ROM. However, Microsoft BASIC, FORTRAN, COBOL and Pascal are or soon will be available on disk, as will be many other popular software packages. They include Microsoft Word, Wordstar, Spellstar, Multiplan, Compiled BASIC, dBase II, DataLink and many others.

Specifications

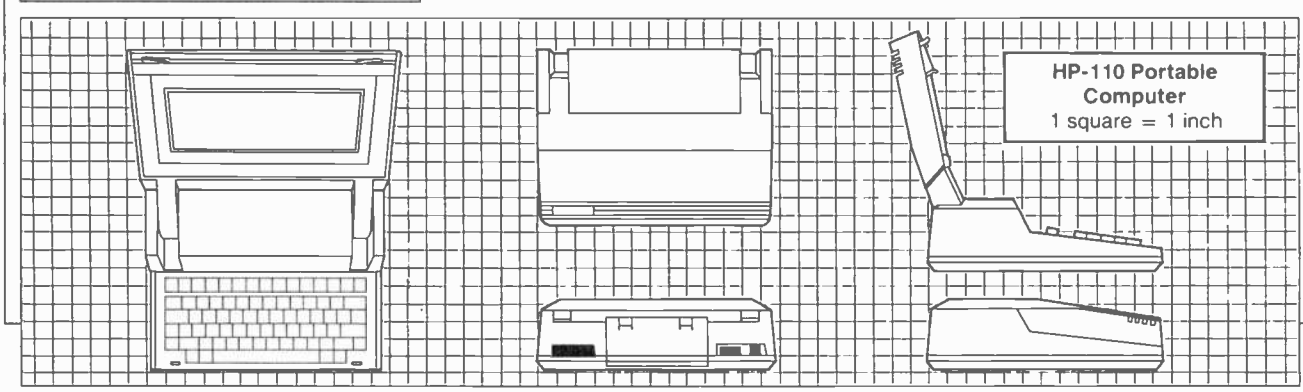
Product: ThinkJet Printer (2225B)
Mfr: Hewlett-Packard
Personal Computer Group
1000 N.E. Circle Blvd.
Corvallis, OR 97330
Dimensions: 11″W × 7½″D × 3¼″H
Weigh: 5 lb
Price: $495
Features: Ink jet printer, 150 cps, battery power, HP-IL interface, disposable print head cartridge, 11 × 12 print matrix, 96 × 96 or 96 × 192 per inch

Configuring the System

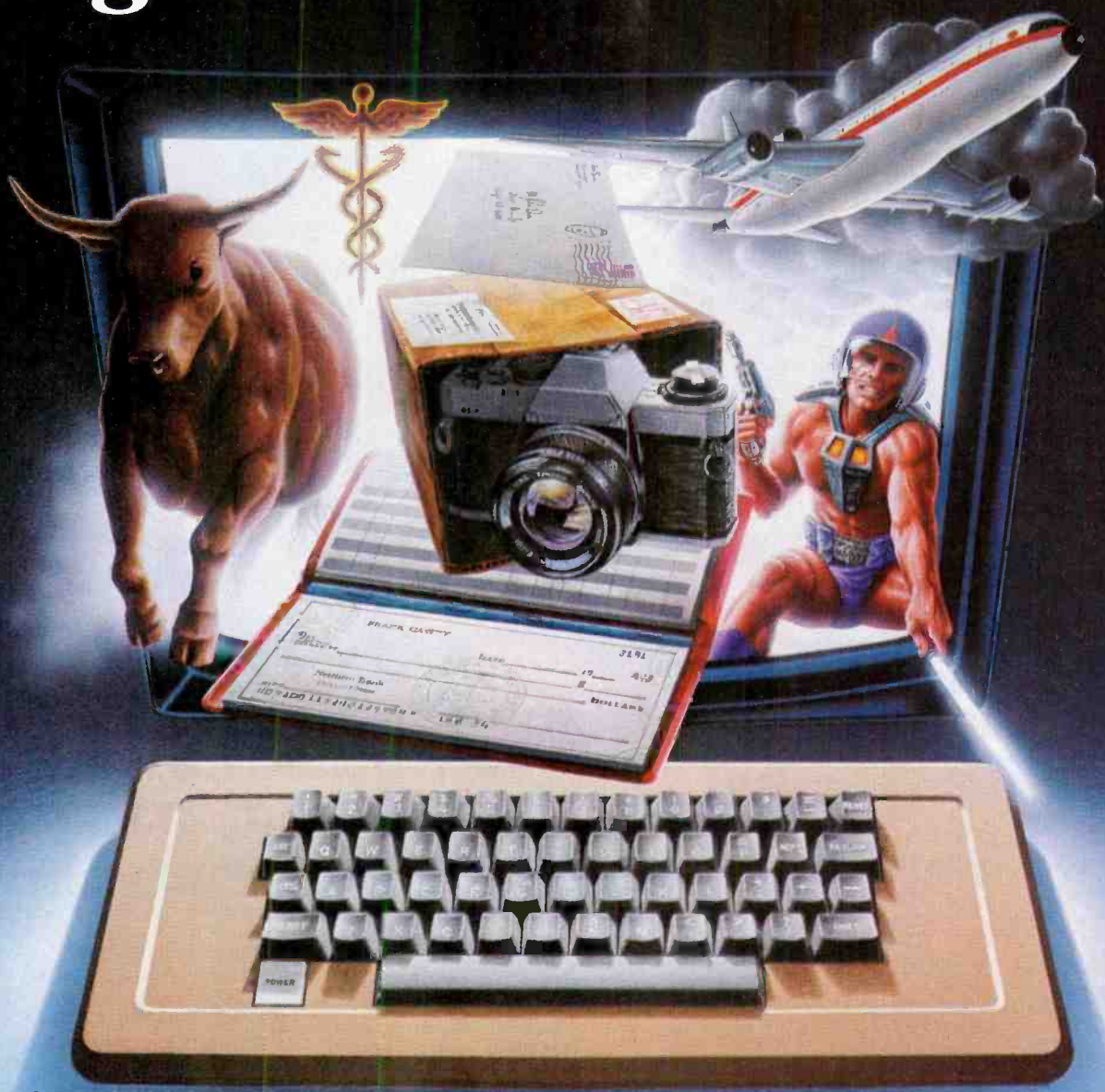
Pressing the *System Configuration* menu key allows many of the HP 110's standard (default) parameters to be altered. For example, the user can select a new time delay for the automatic timeout feature, change the way characters are displayed on the screen, and change the cursor from a nearly invisible underscore to a clearly visible box. It's also possible to establish various communication parameters for printers and plotters.

The most powerful feature of the System Configuration menu option is the ability to specify how the HP 110's memory is organized. Briefly, a portion of RAM can be assigned as system memory while the remainder electronically emulates a super-fast solid-state "disk drive." Let's look at this powerful capability in more detail.

(Continued on page 90)



We don't care which computer you own. We'll help you get the most out of it.



CompuServe puts a world of information, communications, and entertainment at your fingertips.

CompuServe is the easy to use videotex service designed for the personal computer user and managed by the communications professionals who provide business information services to over one fourth of the FORTUNE 500 companies.

Subscribers get a wealth of useful, profitable, or just plain interesting information like national news wires, electronic banking and shop at home services, and sophisticated financial data. Plus, a communications network for electronic mail, a bulletin board for selling, swapping, and personal notices and a multi-channel CB simulator.

You get games on CompuServe, too. Classic puzzlers, educational, sports and adventure games and fantastic space games featuring MegaWars, the "ultimate computer conflict."

Circle No. 60 on Free Information Card

To learn more about CompuServe, call toll-free, 800-848-8199, for an illustrated guide to the CompuServe Information Service. The videotex service for you, no matter which computer you own.

CompuServe

Consumer Information Service. P. O. Box 20212
5000 Arlington Centre Blvd., Columbus, OH 43220

800-848-8199 In Ohio Call 614-457-0802

An H&R Block Company

Heathkit instruments. Some buy

Professional specs for serious users

1 **IG-4244 Scope Calibrator.** <1 ns rise time. 0.015% tolerance.

2 **IO-4205 Dual-Trace 5 MHz Scope.** Low cost, 10mV/cm sensitivity.

3 **IT-2232 Component Tracer.** Checks parts and circuits without energizing them.

4 **IP-2718 Power Supply.** One fixed 5 VDC and two adjustable 20 VDC supplies.

5 **IG-1271 Function Generator.** Sine, square, triangle waveforms. 0.1 Hz to 1 MHz.

6 **IG-1277 Pulse Generator.** Pulses from 100 ns to 1 sec width.

7 **IT-5230 CRT Tester.** Tests, cleans, restores CRT's.

8 **IM-2264 DMM.** True RMS readings of AC voltages. Analog metering, too.

9 **IM-2420 Frequency Counter.** 5 Hz to 512 MHz. 25 mV RMS guaranteed, 4 to 15 mV typical. Ovenized oscillator. Has period and frequency modes, too.

10 **IM-2215 Hand-held DMM.** Five DC V ranges. Accuracy: ±0.25% of reading + 1 count.

11 **IT-2250 Capacitance Meter.** 199.9 pF to 199.9 mF. 0.2% basic accuracy. Auto ranging.

12 **IO-4360 Scope and IOA-4200 Time/Voltage Module.** Our finest. Triple trace, 60 MHz, <7 ns rise time. Revolutionary IOA-4200 controls CRT cursor and multi-function display.

hem for pride...some, to save money.

The time you spend at your test bench makes you a professional, whether you're pursuing a proud hobby...or earning a living.

So don't trust the accuracy of your measurements to anything less than the instruments that are built and used by professionals. Heathkit instruments.

Our products are designed, from the handles up, as kits. The parts and chassis are a little bigger, more rugged, more accessible. Most have calibration standards built in so you can do that job yourself – accurately, conveniently, at no charge. This makes our instruments superior to smaller, "disposable" varieties that discourage self-servicing.

Performance is superior, too. Check the specs on our new IO-4360 Scope and IOA-4200 Time-Voltage Module. View ≥90 MHz waveforms and get simultaneous cursor-controlled readout of Hz, period, pulse width and ± DC voltage!

Get reacquainted with our full line. Bench, portable and hand-held instruments, from lab grade to hard working economy models.

These instruments are built by experienced hands. Your hands. So they'll save you money, give you confidence and help you do a better job. Heathkit instruments. Don't trust your pride or money to anything less.

Heathkit instruments. The professional instruments.

more measurement for your money

Take another look at the instruments you should be building.

FREE

COLOR HEATHKIT CATALOG

Mail this coupon to:
Heath Company, Dept. 010-204
Benton Harbor, MI 49022

Name _____

Address _____

City _____

State _____ Zip _____

GX-394

Heathkit®

Heath Company

Circle No. 5 on Free Information Card

SOFTWARE REVIEWS

FRAMEWORK

Ashton-Tate puts it all together with an integrated package

BY LEE D. ZIMSKIND

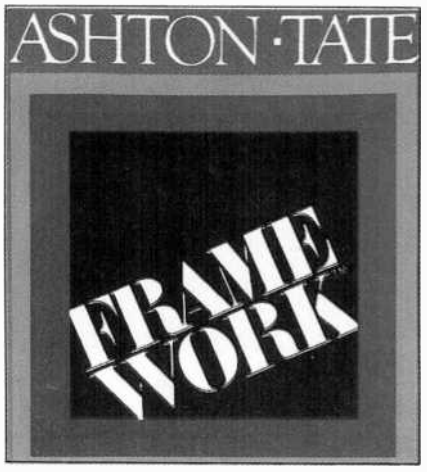
In 1981 Ashton-Tate introduced dBASE II, a best-selling database management system for microcomputers. During the last three years they have continued to develop new products for database and file management, including the recently announced dBASE III. Framework is Ashton-Tate's newest entry into the rapidly expanding integrated software market. Ashton-Tate was scheduled at the time of this writing to begin shipping it on July 2.

The theory behind integrated software is that productivity and utility are increased when several applications are combined under one interface. Most integrated packages include at least word processing, spreadsheet, and business graphics. Some add communications and/or other facilities. Framework is a very well-equipped package. It includes word processing, spreadsheet, graphics and communications, plus data management, forms processing, and two features which, according to Ashton-Tate, differentiate their product from others—an outline generator and a very powerful high-level programming language called FRED that makes Framework ideal for developing vertical applications and integrating other programs into the Framework environment. Indeed, Ashton-Tate has chosen to implement the communications features of Framework by using FRED to incorporate Mycroft Labs' popular terminal emulation package, MITE. Its cost is included in Framework's $695 price.

Ashton-Tate provided a pre-release version of their product for review. Since documentation was incomplete, I will not comment on it, except to say that it appears to be extensive, providing templates, reference cards and tutorials. Documentation for the programming language is not included in the standard package, but is available separately.

What Framework does is simulate a desktop using the computer's display. It can place various kinds of documents or frames—word processing, spreadsheet, graphs, databases—on the desktop, singly or in combination. Each frame is identified by a user-assigned name of up to 255 characters (whose usefulness is increased if the first eight characters are unique). The list of frames on the desktop is kept in a "tray" on the right-hand part of the desktop (screen). The user, always knowing what is there, can easily retrieve or move among the frames. Since there is no limit to the number of frames on the desktop, the screen sometimes resembles a messy desk. To clear it, a single command can move the contents of the desktop to the tray. The process is quite orderly—and quite different from the usual clearing of ordinary desktops.

Frames can be nested within other frames (called "containing frames") without any limit. Different types of frames can be combined, so one document may contain text, spreadsheets and graphs. One of the strengths of Framework is its capacity to organize frames within the containing frame as a tree structure or outline. For example, in order to write this article I created an outline within a containing frame called "framework article." All of the standard data-management functions exist at the frame level—create, add, delete, insert, move—which makes it very easy to organize ideas into coherent presentations.



You can move frames around on the desktop or change them in shape or size, or with a "zoom" feature, enlarge a frame to take up the whole screen. Frame management and function are similar to "windows" in other products. Ashton-Tate attributes the superiority of the frame concept to two capacities: using it, you can assign a name to a frame and store information (e.g., print options or, indeed, an entire program) with a frame. In the above example I was able to supply the margin and paragraph indentation parameters for this entire article by defining them for "framework article." It is also possible to change the parameters when necessary. This is a very simple example of a very powerful capability: You can define as much as a 32,000-line program behind a frame border.

Implementation

The minimum system requirements of Framework are 256K of RAM and two 360K disk drives. We used the configuration for most of our testing and found that the software performed with quick speed and good response. In our pre-release version the files, especially spreadsheets, seemed to take up a huge amount of space both in memory and on the disk, but we assume this problem will be corrected.

You can use Framework with either a monochrome display or a color graphics adapter and color monitor. Ashton-Tate has used color not for the screens, but for display of graphs. The graphics features also work on IBM monochrome boards with standard monchrome adapters.

Framework makes extensive use of a help library. Whenever you press the F1 key, a help screen is displayed with information about current function options. The screens we saw were well-written and helpful.

When you first invoke Framework, an empty desktop is displayed on the screen. Across the top is a list of menus—Disk, Create, Edit, Locate, Frames, Words, Numbers, Graphs, Print—which you can access by hitting the INS key and moving the cursor onto the desired function or by holding the CTRL key down while typing the first letter of the desired function. One of the things I had trouble getting accustomed to was the use of the INS key as an "instruction" key rather than an"insert" key. When you select any of the functions, a menu appears listing the various options. You make a selection by moving the cursor onto it and pressing RETURN or by typing the first letter of the function.

The other item on the desktop at startup is a list of available storage devices. By selecting the appropriate device, again by highlighting it with the cursor, you can load a frame from a disk.

A highlighted line called the status panel near the bottom of the screen shows the name of the frame and the

column/row location of the cursor. For spreadsheets and databases, formulas behind the current cell are also shown. The bottom line on the screen is used to give more information. For example, during editing of a spreadsheet cell, that line displays the values or formulas; when a menu is in use, it shows a sentence describing the result of selecting the option.

At any point you can save the entire state of the system on disk. This feature makes it possible to leave Framework (perhaps to go home) and start it later exactly where you had left off.

One of Framework's strengths is its consistency across all applications. You use the same series of key strokes to move data whether in word processing, spreadsheet, database or outline mode. The same can be said for copying, search and replace, sorting, or any other function. Once you learn basic functions for any one application, you can apply them logically to the others.

Framework enables you to define up to 46 macros. In addition, more than 14 built-in functions are available for various applications: finances, statistics, control, logic, to name a few. If you find you need functions not provided by Framework, you can define others and store them in a library that will be invoked automatically.

There are four main types of frames: word processing, spreadsheet, graphics and database.

Word Processing

Framework incorporates most common word processing functions. When you create a word processing or "empty word" frame, it resembles a blank sheet of paper. You can begin typing immediately and format the page later. Alternatively, you can begin by using the Words menu for setting the left and right margins (maximum of 255 characters), paragraph indentation (including negative for hanging indents) and justification. You also use this menu to change the tab size—tabs are set at equal intervals across the page. There is no decimal tab. (Ashton-Tate suggests using a spreadsheet for columns of numbers and incorporating it in the document, but, as I will explain, there are drawbacks to this method.) Word processing defaults include "word wrap" and "insert" modes.

The approach Framework employs is "what you see is what you get." If you select full justification, the document appears with it. The justified margins are maintained dynamically as text is added or deleted. In fact, all spacing is maintained dynamically; there is no reformatting function. This approach is maintained with the horizontal and vertical scrolling through the document and the display of underlined, boldfaced and italic characters.

Framework's outline feature helps organize ideas.

While some of the fancier options, such as superscripting and subscripting, have not been included, all the basics—global search and replace, locate, move and copy—are implemented.

The word processor is not meant to be used for creating large documents, such as books. Although it is easy to get around a document if it is broken into manageable pieces in multiple frames, no partitioning (page breaks) within a frame is possible. In fact, it is impossible to reference a section of a document by page number: The frame must be paged through a screen at a time. To users of highly sophisticated word processing equipment this may prove an annoyance.

Spreadsheets

The spreadsheet implementaion contains all the usual functions of spreadsheet programs. The number of rows and columns is limited only by machine memory (maximum array size is 32,000 rows by 32,000 columns). You address cells using letters to represent columns and numbers to refer to rows: Thus C5 refers to the fifth row of the third column. You may also reference or display a cell using a "meaningful" name, which is the concatenation of the column label and the row label, separated by a period.

Like other spreadsheet programs, Framework enables you to define formulas behind a cell or group of cells. In fact, a cell may contain a full 32,000-line program. Formulas or programs may reference other cells in the same spreadsheet or in another one. Generally the cell references in formulas are relative; that is, a formula that you move or copy is adjusted for the new position of the cell. Framework also has the capability of specifying absolute cells, which do not change when the formula is moved. But, again, the real difference in Framework is the powerful command language that you can use in the definition of any cell.

Framework supplies most of the usual cursor functions, but not the capacity to "jump" directly to a specific cell. Entering data in other than row order requires two keystrokes between each entry instead of one. Adding and deleting rows and columns is somewhat more clumsy than in some competitors' products because you must set the cursor properly: Sometimes it is difficult to remember whether the new row or column will go before or after the cursor position (it's after). It is also possible to move or copy from another spreadsheet or database and to consolidate spreadsheets.

Choices for formatting are more than adequate. Text can be aligned left, right or centered and appear underlined, boldfaced or italic. Numbers can be displayed as integers, fixed decimals, in business format or in scientific notation with percent or dollar signs. A "nationalize" function allows currency conversion. It is easy to widen columns.

You can protect cells against change or editing, and easily create templates, by protecting the cells that don't change and using the "Blank All" command to erase the rest.

Graphics

Creating graphs from a spreadsheet or database is very easy in Framework. You select the data and invoke the "draw new graph" option of the graphics menu. The variables are automatically selected from the headers of the row or column being graphed. You can set various options, such as manual scaling and headings. You are also able to link the graph to the spreadsheet or database containing the data elements so that the graph is updated automatically. Since you can conveniently show both the data and the graph, you can immediately see the effect of changes in the data. The program defaults to a bar graph format, but stacked-bar, line, scatter, x-y, pie and exploded pie are available.

The technology employed for the graphics permits graphs to be run even on an IBM monochrome screen without a graphics adapter. Color, however, is supported for graphs on color monitors.

Although they were not ready at the

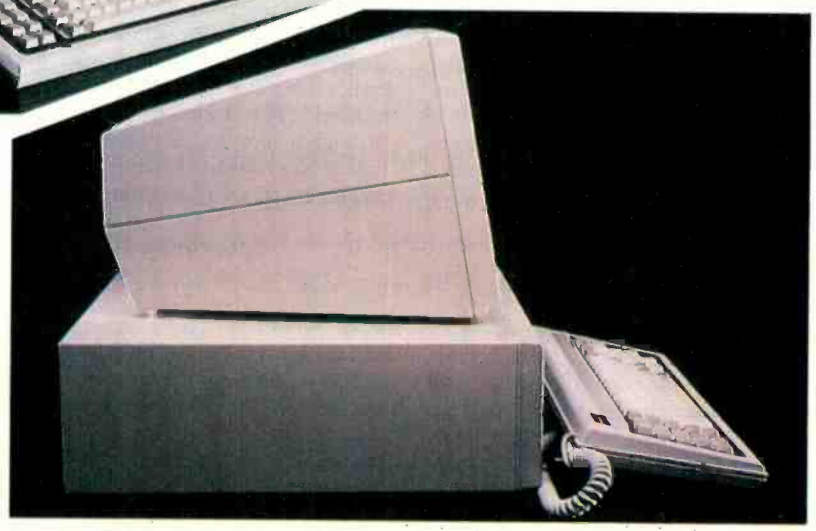
(Continued on page 73)

FIRST REPORT

COMPAQ'S NEWEST COMPATIBLE

The company that made the first transportable IBM clone introduces a line of powerful new desktop computers

BY B&J MCMULLEN



COMPAQ Computer Corporation of Houston recently announced anew line of desktop computers called DESKPRO. The new series includes four models, all based on the Intel 8086 chip. The use of the 8086, which has an internal speed twice that of the Intel 8088, gives the new line a significant increase in throughput over the IBM PC and PC-XT as well as over other 8088-based PC-compatibles (including Compaq's own Portable and Plus models). Despite the use of a different processor, Compaq is equipping DESKPRO with the same level of compatibility with the IBM/MS-DOS standard that other Compaq models have.

The DESKPRO series is a complete line of four different units, ranging from Model 1, a 128K single floppy disk system, to Model 4, a 640K system containing a single floppy drive (expandable to dual floppy), a 10 M-byte fixed disk drive, an internal 10 M-byte fixed disk backup and an asynchronous communications/clock board. In between, Model 2 is a 256K dual floppy system while Model 3 is equivalent to the IBM PC-XT (256K RAM, single floppy and 10 M-byte fixed disk drive) with an additional asynchronous communications/clock board.

All models have the same housing (14.74" wide by 13.75" deep by 10.75" high) which contains internal space and sockets for the maximum configuration. Further, all models utilize the maximum 200-watt power supply for Model 4. These design choices give purchasers the ability to expand any model to the maximum without having to send the unit back to the shop.

Compaq is also distributing the new line, whose suggested retail prices (without a $255 monitor) run from about $2240 for the Model 1 to approximately $6940 for the Model 4.

Backup

The internal hard disk backup is a 10.35 M-byte tape cartridge housed directly under a floppy disk drive (the floppy drives are half-height). This device also has the capacity to back up data from any logical DOS drive and permits users to archive files from floppies or from external network systems, such as Corvus Omninet. Gary Stimac, director of engineering for the Compaq Office Computer Division, which is responsible for the DESKPRO, estimated time needed for backup. He figures that to back up 10M bytes takes approximately 18 minutes (assuming that the target

Barbara and John McMullen are contributing editors to C&E.

cartridge has already been formatted for use, which takes approximately 40 minutes). Software supplied with DESKPRO units permits users also to take "directories" of the archival tape cartridges.

Compatibility

In pursuit of true PC compatibility for the DESKPRO, Compaq was able to tap its experience in reaching the same compatibility for its Portable units. Steve Flannigan, vice president, system engineering, who has the responsibility for ensuring software compatibility, points out that Compaq had developed internal programs to test software compatibility for the Portable and Plus models. These were already available when needed for DESKPRO development. Moreover, Compaq, in developing its earlier products, had learned—better than anyone else, including IBM (witness the non-compatibility of the PC*jr*)—the importance of compatibility and was able to implement it.

In order to provide full compatibility with the IBM PC, Compaq is equipping units with two different clock speeds:

a) 7.14 MHz—the internal speed of the 8086, which allows a DESKPRO unit to run at its maximum throughput rate. This setting is to be used for most normal business applications.

b) 4.77 MHz—a speed comparable to the 8088 processing utilized in the IBM PC and PC-XT. In this mode, which Compaq calls "common," is run any software that is dependent on internal clock rate (for example, communication programs that utilize programmed "time-out" loops or time-based dialing or handshaking protocols). Common mode is also used when speed is detrimental to the application. (In hobby or entertainment programs, like PacMan, double speed would be inappropriate.)

Switching between the two clock modes may be accomplished under software control or by manual keyboard intervention (at any time). The current status of the setting is indicated by a light on the front left surface of the system: green for the native 8086 mode; red for the common mode.

Also in the interest of compatibility, the system contains eight IBM PC-XT-compatible expansion slots (one short and seven long). Of these slots, the floppy disk printer controller board and the video monitor board take a long slot each in all models. The fixed disk controller takes a long slot in Models 3 and 4, while the asynchronous communications/clock board uses the short slot in Models 3 and 4. This utilization leaves five long and one short slot available for additional peripherals in Models 1 and 2 and four long slots available in Models 3 and 4.

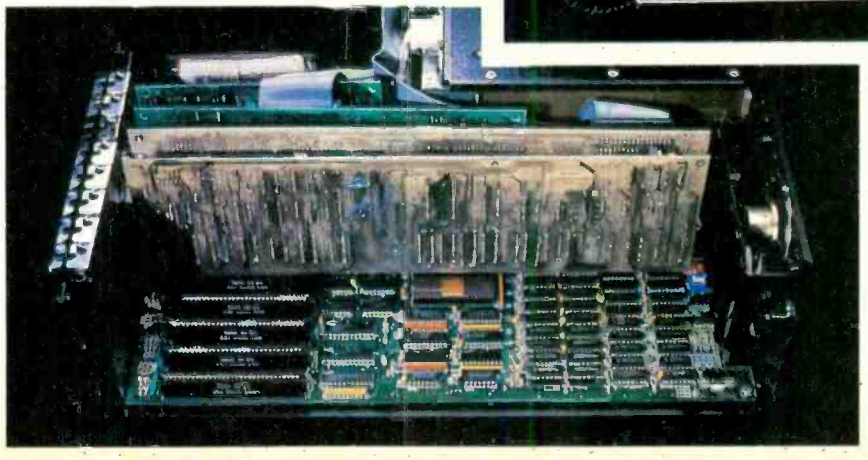
Throughput

While speed may not be a foremost concern of PC users today, Stimac believes that software is just beginning to push the limits of the 8088-based systems and that speed will soon become of utmost importance. Stimac makes the point that DESKPRO permits technical expansion. Larger fixed disks, local area networks, etc., can utilize the same basic configuration as time goes on. (Early product testing, Stimac points out, showed that popular LAN's that were severly degraded by multi-computer access in an 8088 environment suffered no degradation in the DESKPRO 8086 environment.)

A further throughput enhancement is a motherboard that can contain up to 640K bytes "on-board." Its design allows users to access all RAM in the full 8086 16-bit format rather than through the 8-bit I/O bus that is utilized when accessing memory above 256K bytes on the IBM PC and PC-XT and PC-compatibles. In this way DESKPRO eliminates the degradation that occurs in these other systems.

The DESKPRO keyboard has the same layout as the Portable family (and thus the IBM line). The feel of the keys

(Continued on page 80)



All models contain internal space and sockets for maximum configuration as shown at left.

PCjr. WILL HELP YOU...Mind your business...Computerize your office...Buy a printer...Turn your PCjr into a word processor...**Learn** American History...Talk to your sales rep in Des Moines via CRT about his new sales quota...**Access** Dow Jones, The Source, Compu-serve and other public networks...Be your own bank teller...Write The Great American Novel...Purchase the right monitor..."**Cluster**" your PCjr. with a PCXT...Go on a diet that works (?) (!) ...Study Euclidean theory...**Prepare** for your visit to the IRS...Balance your checkbook...Teach your PCjr to sing in harmony...Fight off invading aliens during your lunch hour...**Computerize** your patient profiles...**Track** last month's inventory of steel ball bearings...Plan your vacation...**Find** PC software that's interchangeable with your PCjr...List your tax exempt expenses for the year...**Project** the amount of oil you will use in your furnace...Decipher your phone bill...Outline the itinerary of your cross-country business trip... **Organize** a little league...Discover when Venus and Mars are closest to the sun...Turn your PCjr into a Picasso or Van Gogh... Save money when buying new peripherals for your PCjr... **Manage** your database with dBase II...Catalog-shop with Compu-Card...Write memos...**Upgrade** your system...Cure insomnia with a new game you can play at midnight...Make calculus as easy as 1, 2, 3...Create bar charts to tell a story...**Expand** your system with two disk

drives...Organize your library...Set up a national sales meeting...**Review** the newest product releases from your living room...Improve your business . . . **Add** animation and sound to your PCjr...Get better grades in school...Write papers with no spelling errors...**Evaluate** new printers...Play challenging new games...Change operating systems...**Create** personalized stationery...Give pre-schoolers a head-start in computer learning...Eat, swing, jump, punch and blast better with winning game tips ...Choose a computer camp...**Balance** home expenses. MAKE YOUR PCjr YOUR MOST IMPORTANT TOOL!

SUBSCRIBE TO *PCjr.*—We'll help you mind your business and make computing entertaining, educational *and* functional!

PCjr. P.O. Box 2450, Boulder, Colorado 80322

YES! I want to subscribe to *PCjr.* for:

☐ One year (12 issues for $14.97. I SAVE 40%!)
☐ Two years for $27.97. I SAVE 44%!
☐ Three years for $38.97. I SAVE 48%!

Savings based on full one-year subscription price of $24.97.

Mr./Mrs./Ms. _____ (print full name) PJ8H609

Company _____

Address _____

City _____ State _____ Zip _____

Check one: ☐ Payment enclosed ☐ Bill me later

Charge my: ☐ American Express ☐ Visa ☐ MasterCard

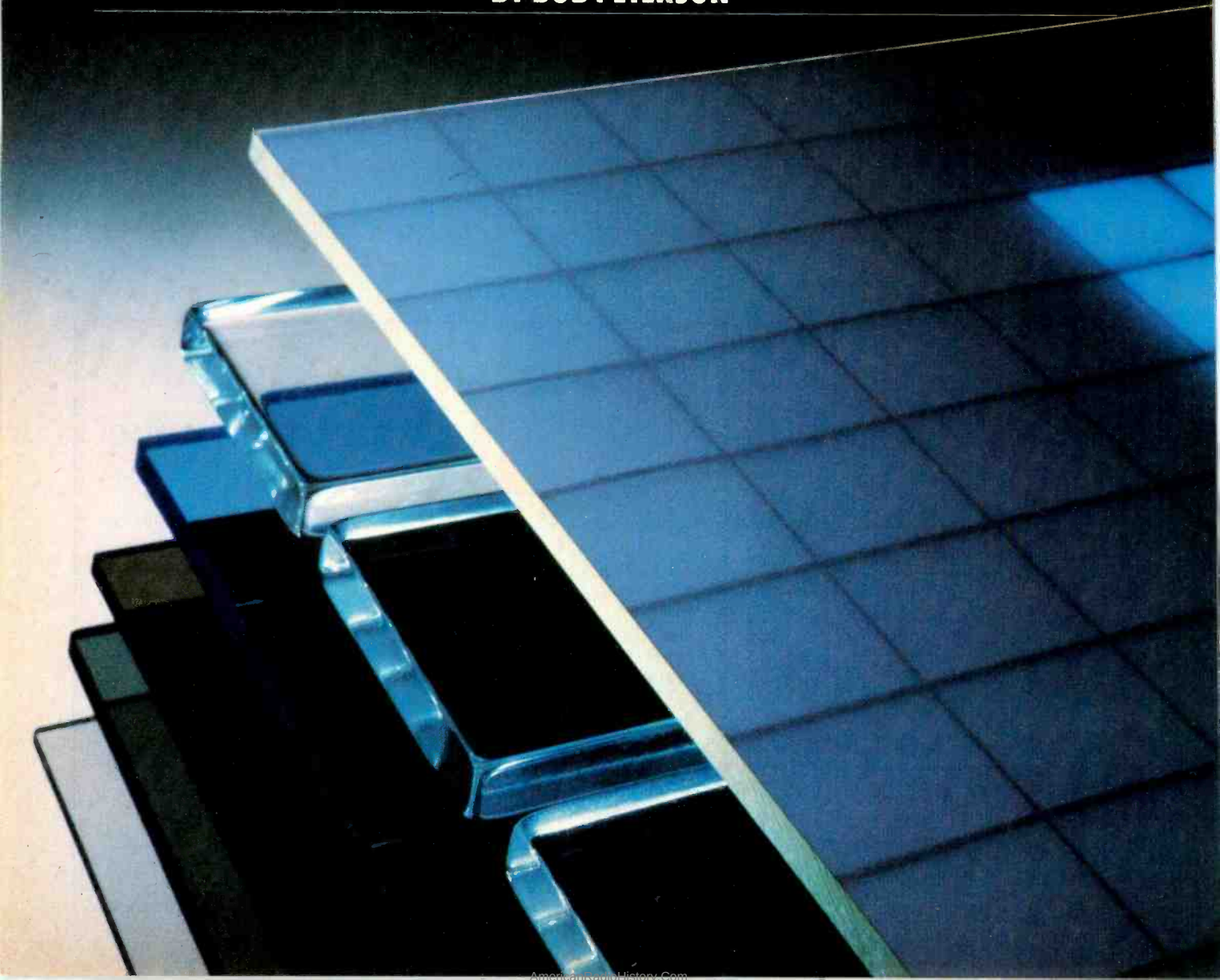
Card No. _____ Exp. Date _____

Add $8 per year in Canada and all other foreign countries.
Please allow 30 to 60 days for delivery of first issue.

BIG PICTURE LCD's

New liquid crystal displays offer increasing competition for CRTs

BY BOB PETERSON



LIKE the protagonist in a Shakespearean play, the liquid-crystal display (LCD) has been hampered by a tragic flaw—its small size. However, that flaw is likely to disappear very soon.

In fact, several manufacturers are now making LCDs that display 24 or 25 lines of 80 characters—the same capacity as a standard CRT.

LCD panels are flat and require very little power, which makes them potentially the best display medium for lap-sized portable computers. But most of the big LCDs still suffer from the minor problems associated with smaller panels concerning viewing angle, speed of response, temperature range, and brightness. Fortunately, the benefits of the big LCDs far outweigh the drawbacks.

Only one question must be answered before big LCDs are wedded to portable computers: Will users pay the price? Big LCDs aren't cheap. They cost much less than other flat panel alternatives, but that's not the only consideration involved. Are people willing to pay $500 more for a computer such as the Radio Shack Model 100 (which has an 8-line display and costs under $1000), just for the convenience of a 24-line panel? The latter isn't available yet, but it won't be long before it (or something similar to it) will be.

All of the high-capacity LCDs, except one, are coming from Japan. Companies that have announced 24 × 80-character panels include Seiko Instruments, Sanyo, Sharp, and CrystalVision. The

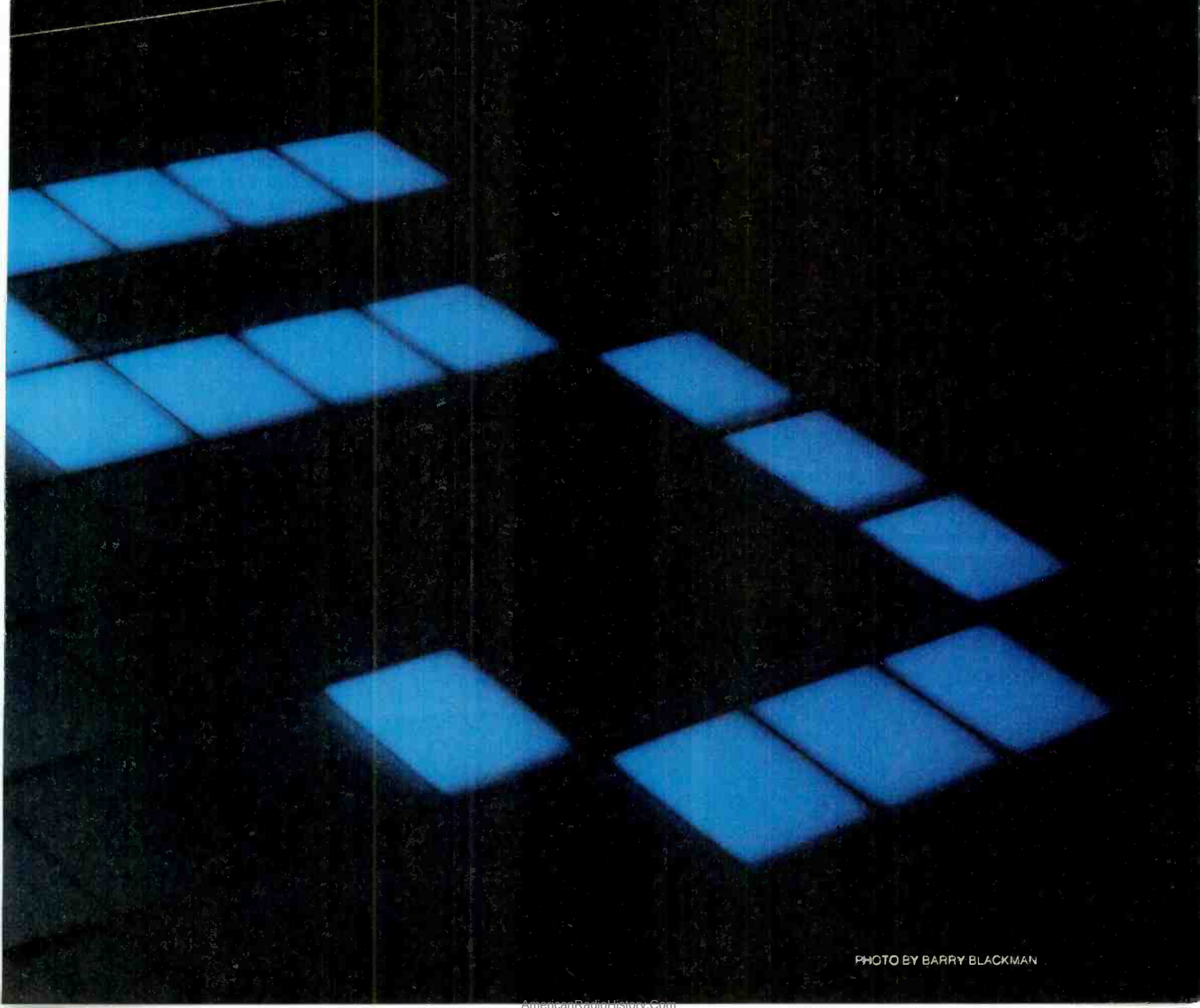


PHOTO BY BARRY BLACKMAN

Seiko's 24-line LCD.

Japanese are considered so far ahead in the LCD race, it's surprising to see a U.S. firm on this list, but CrystalVision claims to have a significant contribution to make.

Seiko is now marketing a 24 × 80-character LCD that sells to manufacturers for about $400 in small quantities. Although Seiko has been selling panels with on-board LCD controllers, the 24-line product won't include this circuitry because computer makers would rather handle control functions externally. By using a CRT controller instead of a dedicated LCD controller, the entire system can work much faster.

Also coming from Seiko, though, are three LCD graphic panels, one of which has 128 × 480 dots—or 16 rows of 80 characters if you count it that way. Unlike most LCDs, which require more than one voltage, the graphic displays require only one 5-V supply. They also contain a compensation circuit the keeps the voltage levels to the display at the best possible value for any given temperature.

Sanyo promises an LCD that displays a few more characters than a standard CRT. This panel provides 200 × 640 dots—25 rows of over 100 characters each. The product comes with CMOS drivers on a pc board for $273 in large quantities. It's interesting to note that the multiplexing rate of this panel is more than three times as great as some of the LCDs currently on the market. Sanyo is obviously pushing standard LCD technology further than other manufacturers.

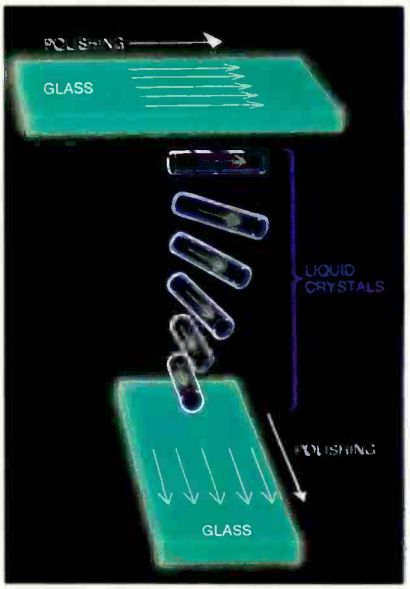
The third Japanese large-LCD entry—and the winner so far in the race to lower prices—is Sharp. The company plans to sell its 25 × 80-character panel for less than $200 in large quantities. It's difficult to tell how the panel cost will translate into a final computer product price, but you'll probably find out before long. Sharp is shipping prototypes at the time of this writing and expects to sell production quantities by June.

A U.S. firm that recently began working on LCD technology, CrystalVision, plans to compete in the large-panel race in a big way. The company has developed a 25 × 80-character display that differs markedly from standard LCDs. Though the cost is about twice as much as a comparably sized CRT, this panel's display quality may enable it to compete favorably with conventional CRTs.

LCDs Aren't Created Equal

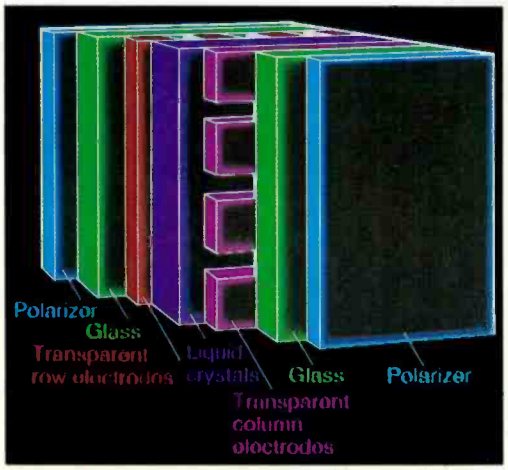
The differences between the LCD from CrystalVision and those from the Japanese companies stem from the type of LCD technology used. A complete understanding of these technologies requires a crash course in the chemistry behind LCDs, but the basic principles are fairly simple.

Fig. 1. Twisted nematic molecules.



Two types of liquid crystals exist. One type, lyotropic crystals, are very common in living things; every living cell contains this kind of crystal. You can see the optical properties of lyotropic crystals in dishwashing liquid if you let some run down the sides of a clear glass. The thread-like refractions you see are long

Layers of twisted nematic LCD.



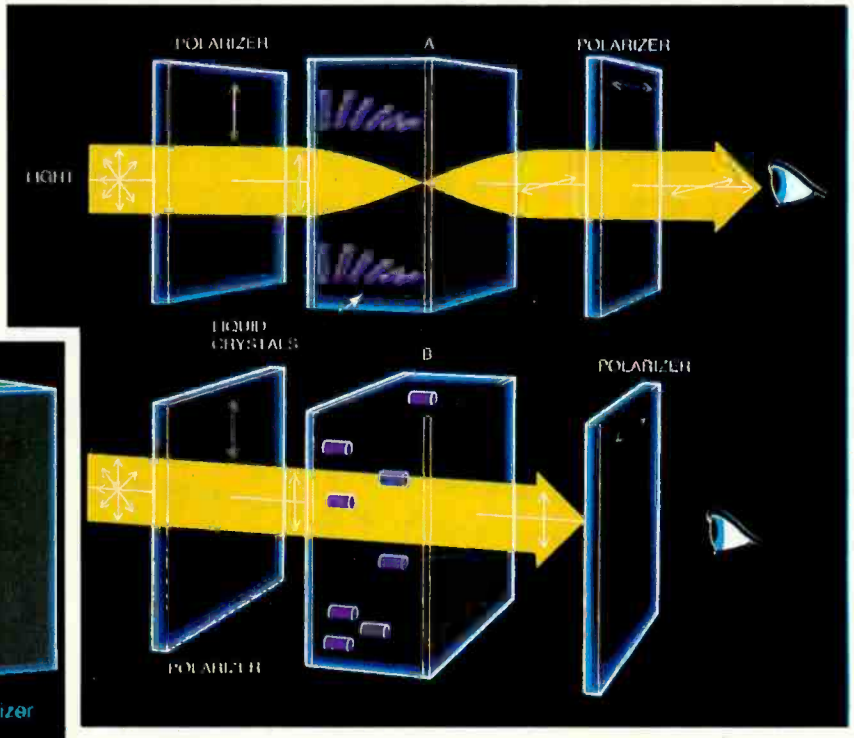
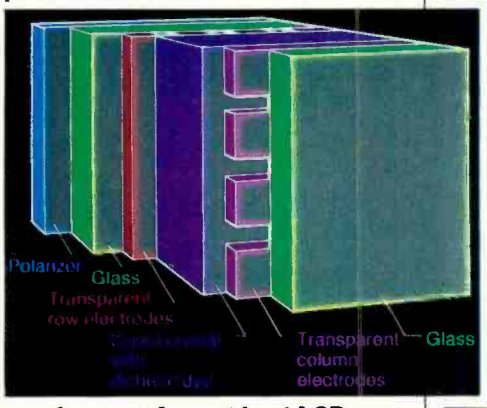


Fig. 2. Twisted nematic LCD is off at (A); on at (B).

liquid crystal molecules that scatter light, thus making themselves apparent when you look through them. Because these crystals consist of two phases (more on that in a moment), they aren't used in LCD displays.

The second type of crystal, the thermotropic, is the kind used in all LCD displays. Thermatropic crystals are useful because they exist in only one phase at a time. The phase of a liquid crystal depends on its temperature, just as the phase of H_2O does. When H_2O is very



Layers of guest host LCD.

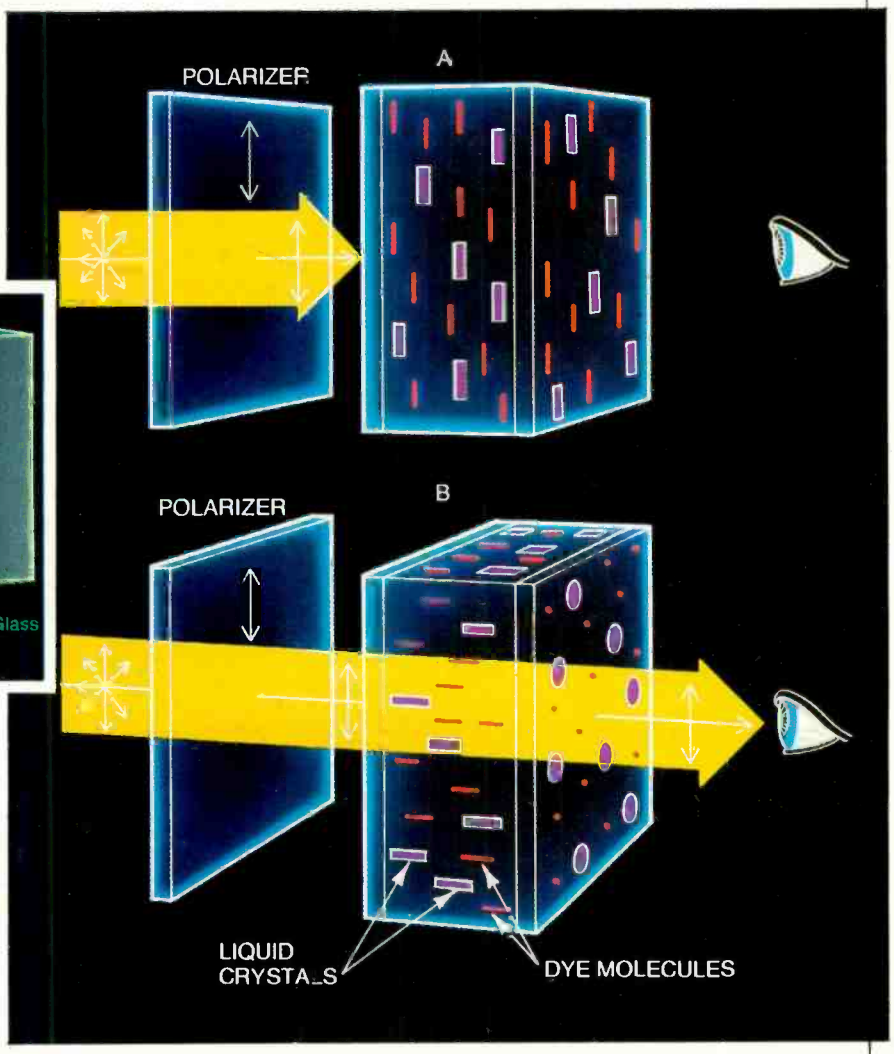
cold, for example, it exists in the solid phase—ice. Heating it changes its phase to liquid—water. And heating it further produces the gas phase—steam.

Liquid crystals go through similar changes, but they go through many more phases than H_2O does. These phases can be described in terms of the way the material's molecules are organized. At very low temperatures, a liquid crystal is a solid and is organized in three dimensions; that is, the molecules aren't free to move in any direction. Heating the material a certain amount changes the crystals to what is called the smectic phase, where they are in a semi-solid form that's organized in two dimensions. This smectic phase still doesn't allow the crystal molecules to move freely. Further heating changes the material from the smectic phase to the nematic phase, in which one-dimensional organization lets the molecules move freely in all directions except one.

The nematic phase exists in the thread-like scattering caused by dishwashing liquid; the long liquid crystals organize in this way when the temperature allows them to exist in long molecules. As Kevin Hathaway, a flat-panel display consultant from Mesophase, Inc. (Cupertino, CA), explains, it's like throwing pencils into a box and shaking the box: The pencils tend to line up.

Heating the liquid crystal further causes the material to lose all forms of ordering and enter the isotropic liquid phase. The material is now a "normal" liquid. A certain amount of additional heat boils the material into a gas.

Fig. 3. Guest-host LCD is off at (A); on at (B).



Whipping Crystals Into Line

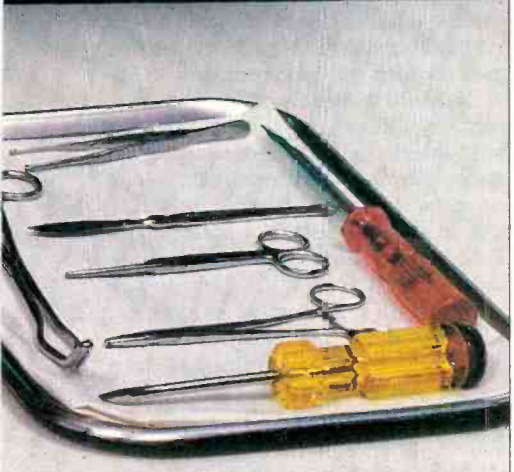
Three of the phases just described—the smectic, nematic and isotropic—are important to understanding liquid-crystal displays. Almost all LCDs now available use the nematic phase, where the molecules line up in one dimension. But even though these LCDs use the same phase, there are still different types of devices that work in different ways. The CrystalVision panel, however, uses a completely different approach from the rest.

The two main types of standard LCDs are twisted nematic and guest-host. The large LCDs coming from the Japanese, as well as almost all other commercially available LCDs, are twisted nematic panels. These devices depend on the use of two polarizers, and so have some performance drawbacks such as a narrow viewing angle and contrast limitations due to loss of light in the polarizers. The other conventional LCD type, guest-host, shows promise of providing better performance for many uses, but still needs some work before becoming widely useful.

The liquid crystal part of a twisted nematic LCD is sandwiched between sheets of glass (Fig. 1). When the display is *off*, its design causes the crystal molecules near one sheet of glass to line up horizontally, while the crystals near the other sheet line up vertically. Because the molecules try to line up like the pencils in a box but are held in different directions at either glass sheet, they end up

Bob Peterson is an engineer and freelance author in the fields of computers and electronics.

(Continued on page 85)



MICRO SERVICE ORGANIZATIONS

Outfits you can turn to when—or before—your hardware fails

BY ELIZABETH BIBB

Most computer owners don't worry about service until their machines break down. That's usually long after the original purchase and *after* the warranty has expired, when the owner is in no position to bargain. His main concern is getting the computer back up and running again. Choices are few in these emergency situations so most users turn to their manufacturer for service. Service is, in fact, why many chose their machine in the first place, but relying on the original manufacturer may not always be the best or most economical choice.

To maintain their options in the event of machine failure, more micro owners are signing service contracts that offer a guaranteed fixed annual rate for all repairs and parts required.

Most computers come with 90-day warranties that include parts and labor. Extended warranties are usually available for an additional year for a flat rate. Service contracts offer protection after the warranty and extension expire.

Service contracts, or maintenance agreements, as they are often called, are offered by numerous sources, including the manufacturers, dealers and third-party maintenance organizations (TPMs). In the beginning, when the personal computer was just a vision, most computer users leased their mainframe equipment from IBM. Then, after the Consent Decree of 1956 was issued, IBM was legally required to sell, as well as lease, equipment. That meant that for the first time, service manuals and documentation had to be provided to the public. With that decree, a new industry was born—third-party computer servicing and maintenance.

Even now that the microprocessor has expanded the computer universe exponentially, most users opt to stay with the original manufacturers of their equipment when problems arise. Many are not even aware of the alternatives or have been cautioned by their manufacturer that third party maintenance is inferior.

In the 1970s, however, as multiple configurations of systems appeared, owners with, for example, an IBM PC, an Okidata printer and a Hayes Smartmodem, found IBM's service limited to only the PC.

IBM and most of the other familiar names in microcomputers, including Apple and Radio Shack, continue to service only their own equipment, but at least one, Xerox, has extended its service division to include other manufacturers.

At least 12 national firms offer multivendor service at hundreds of field locations. Added to their numbers are many local service groups and dealers who service the equipment they sell.

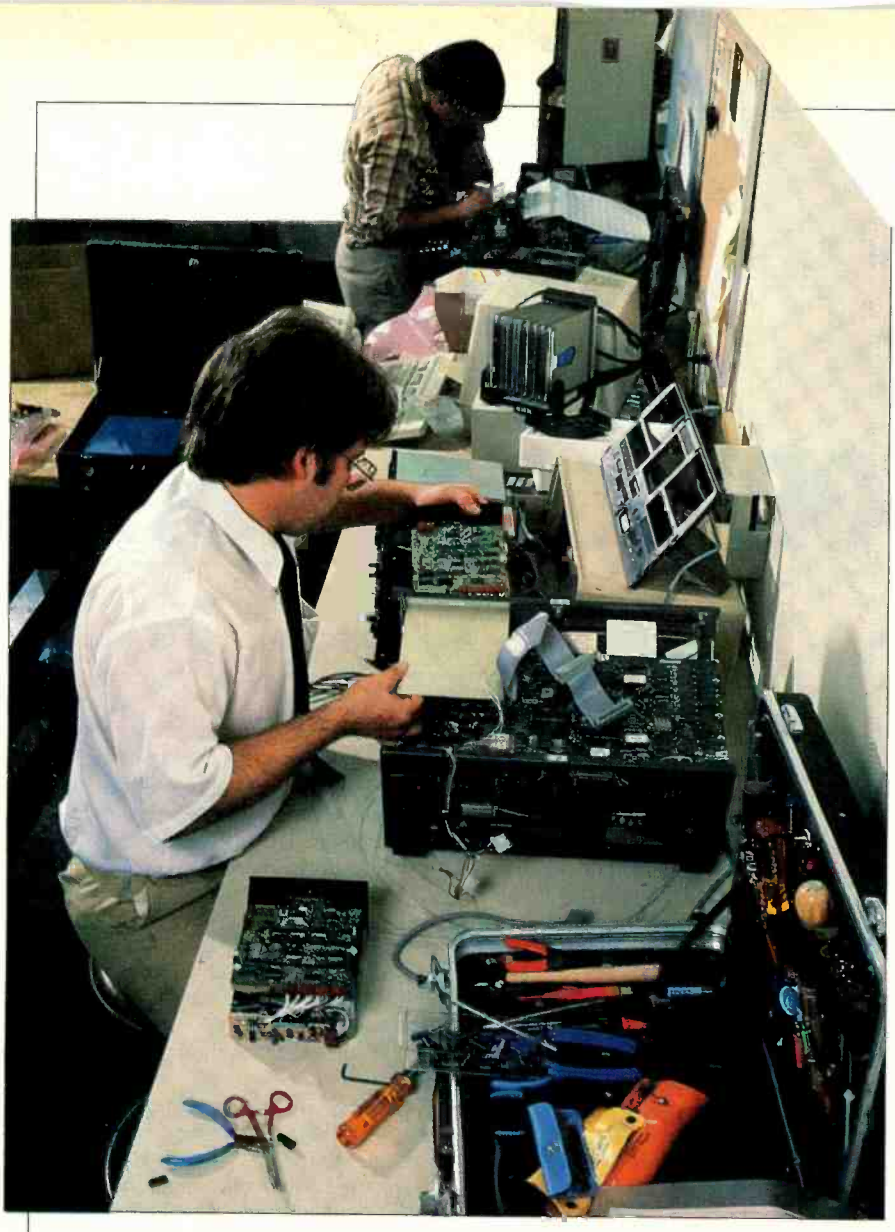
Comma was the first TPM, founded in the late 1960s by two former IBM maintenance engineers who left to start their own venture. Because the fledgling micro industry had not yet burgeoned when Comma began, high start-up costs involved in servicing mainframes mixed with user hesitancy caused problems for this early TPM. It was bought in 1973 by Control Data, today one of the leaders in the field.

An $850 Million Industry

In 1982 six firms were responsible for over half the $850 million collected in the service field, according to a report by Decision Services Corporation. They include TRW Customer Service Division, MAI/Sorbus, Control Data Corporation Engineering Services, RCA Services, Western Union Field Services, and

Elizabeth Bibb is a former wire service reporter who writes often about microcomputers.

PHOTO BY ERIC BARRICK



Xerox service technicians in New York replace defective micro boards.

General Electric Equipment and Computer Services.

With so many companies competing to offer service, getting that service should be easy and inexpensive for the consumer. But it's not always as simple as it seems. The number of plans and options can be as boggling as trying to figure out why there are glitches on your screen.

Most service organizations offer maintenance agreements that become effective after the typical 90-day warranty period. Some dealers offer extended warranties as well, such as the $99 extension offered by Computer Era for the Apple computer, which extends the life of a warranty for a year.

What all these agreements have in common is that they offer insurance against unforseen and potentially costly repair problems. The average life of a microprocessor is five to seven years, according to George Harmon, president of Serviceland Corporation, a California-based TPM. A service contract can extend the life of a computer at least two more years, according to Harmon. Given the national average for the cost of a service call, which is $130, the contract, which averages between $150 to $350, might pay for itself within a year.

Prices of the agreements themselves vary according to the type of equipment covered. Different service options also mean different prices. These can include the use of a loaned machine during the repair period or even replacement equipment, an important feature if avoiding downtime is a priority.

Although each vendor offers different plans, most service organizations, be they dealer-based, manufacturer-based or independent, usually give users the option of on-site or carry-in service. On-site is generally the preferred plan, but it is also the most expensive, since it requires a personal call by a service technician.

Carry-in service is cheaper, but it can be inconvenient. Some companies offer carry-in service with the option of a courier to pick up the equipment.

Contracts may be purchased through a service vendor directly or through dealers. Although some dealers such as Wolff Computer in New York provide their own service and agreements, smaller dealers who cannot afford the overhead of service departments, are the most likely to sell third-party agreements. Service is an important selling point for small computers, and being able to offer it—even if it is through a third party at another location—is advantageous to dealers.

TPMs offer incentive programs, which enable a dealer to earn a percentage of repair costs each time he sells a service contract. To further attract dealers, Xerox, through the company's Americare program, allows dealers to sell service contracts without ever mentioning the Xerox name, according to Donald Flynn, manager of Xerox mar-

SERVICE COMPANIES FOR MICROS

TRW Customer Service
15 Law Dr.
Fairfield, NJ 07006
201-575-7110

MAI-Sorbus
50 E. Swedesford Rd.
Frazer, PA 19355
215-296-6000

Control Data Corp.
8100 34th Ave. South
Minneapolis, MN 55440
612-853-8100

Xerox Customer Service
(Americare Program)
Xerox Square
Rochester, NY 14644
716-423-4205

Western Union
Field Service
1 Lake St.
at Arrow Rd. Annex
Upper Saddle River, NJ 07458
201-934-0200

RCA Service Co.
Bldg. 204-2
Route 38
Cherry Hill, NJ 08538
201-338-4400

General Electric
Equipment and Services
21 Madison Rd.
Fairfield, NJ 07006
201-227-7900 or
212-349-2687

PHOTOS BY STEVE BORNS

keting communications. Other incentives, such as travel and gift bonuses, in addition to discounts on service, add further encouragement to dealers.

An individual can also choose to deal directly with a TPM. Xerox offers direct service in addition to dealer service. They have over 80 walk-in sites across the country. Individual end-users are encouraged to bring in their equipment, although Xerox "is sensitive to the potential conflict of channels in the dealer relationship," according to Flynn. He adds that dealers are also encouraged to work with a variety of service plans, using the Americare program as a back-up.

Finding TPMs is becoming easier now that service organizations are an industry unto themselves. They have begun to advertise to end users, rather then rely on manufacturers and dealers to spread the word about them. As they overcome user resistance to break away from traditional manufacturer-based servicing, TPMs are further challenged to offer competitive maintenance.

Turnaround Times

Initially, price was a primary concern of customers, but now quality of service and turnaround time rank with saving money in the list of user considerations. Personal computer users are the least satisfied with after-sales support of all office-product users, according to a survey conducted by Input, a computer market research firm based in Mountain View, CA. A study conducted by Frost and Sullivan, Inc. (a consulting firm), found TPM service on a par or above manufacturers' service.

But price is still a factor, and most service organizations' fees are 15 to 20 percent lower than manufacturers' service. For the end-user who is price-conscious but still prefers to stick with the manufacturer for service, there is a compromise solution. A hybrid form of service organization, the service broker, provides a link between manufacturer and third-party maintenance.

Dataserv, of Hopkins, Minnesota, is one of the largest service brokers in the United States. The company sells both new and used IBM equipment, but its main function is as a maintenance go-between.

Quality of service and turnaround time rank with price nowadays in the list of user expectations

Service brokers sell maintenance agreements, usually for about 15 percent less than a standard manufacturer's agreement, to end-users. The companies then send the machines needing repair to authorized factory service outlets, paying the full hourly rate for the work. The brokers gamble that the revenues from service contracts that they sell will exceed the cost of the actual repairs. They usually do. "Our payments are only about 60 to 65 percent of what a standard IBM contract costs," says Mark Thompson, Dataserv's senior vice-president.

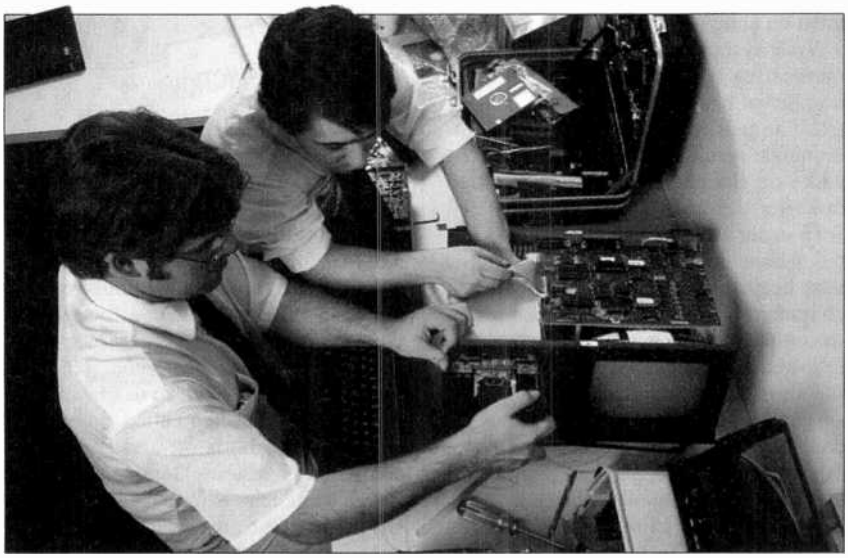
That is the main reason the service industry is booming. Manufacturers are getting in on the act, too. Xerox currently will perform warranty and non-warranty work on equipment manufactured by 18 firms, covering 55 to 60 different product lines.

Kaypro is the latest to sign a service authorization agreement with Xerox. Others include IBM, Osborne, Corona, STM/Pied Piper, Okidata, Epson, and Diablo (a subsidiary of Xerox) printers; and the Morrow Microdecision. Flynn, of Xerox, says that servicing IBM equipment is a move towards the recognition of IBM as the closest thing to an industry standard.

Control Data Corporation of Minneapolis, one of the oldest service firms, introduced a new maintenance agreement for volume users of the IBM PC and XT with a flexible fee plan. (Control Data was the first national maintenance organization to service IBM computers, outside of IBM, over 14 years ago.) For about $200 per year, users enrolled in Control Data's Back-Up program are assured four-hour exchange of their IBM PC or XT. If replacement is necessary, flexible fee customers pay an additional fee based on the type of equipment replaced. But there is a ceiling on the total amount any customer will pay during the course of a year.

Finding one source to service all the equipment in a computer system, including peripherals, can save a lot of headaches. So can developing a good dealer relationship to ensure personal treat-

(Continued on page 80)



Teaming up at the Xerox service center to solve a difficult intermittent problem.

GUIDE TO COMMUNICATIONS SOFTWARE

Features you should look for in terminal emulation packages

BY JOHN HELLIWELL

It isn't just hardware, it's also software that counts in microcomputer communications.

To communicate with other computers over a telephone network, your micro needs two things: a modem (the hardware that translates computer signals into information the phone network can handle), and controlling software. Although the modem may be more expensive (the software, in fact, may be available free), the software will have much more impact on what you can do and the ease with which you can do it.

For two computers to communicate, they must agree on a number of variables. Because you can't always control the settings on the other computer, your software must enable you to control them at your end.

The principal variables are baud rate, parity, the number of data bits transmitted, and the number of start and stop bits used.

Baud rate is the rate of data transmission in bits per second. The two speeds most commonly used are 300 baud and 1200 baud. Software therefore must allow for at least these two speeds (be aware, too, that many systems also require the baud rate to be set in hardware). If you're exchanging information with another computer that can be directly connected to yours (without modems and phone lines), then much higher speeds may be practical. Over voice-grade telephone lines, though, speeds for reliable communication are limited to 1200 baud.

Parity checking is a scheme that helps ensure that the data received is the same as the data sent. Parity checking is accomplished by tacking an extra bit (a "parity bit") onto the seven-bit ASCII code, making a total of eight data bits transmitted.

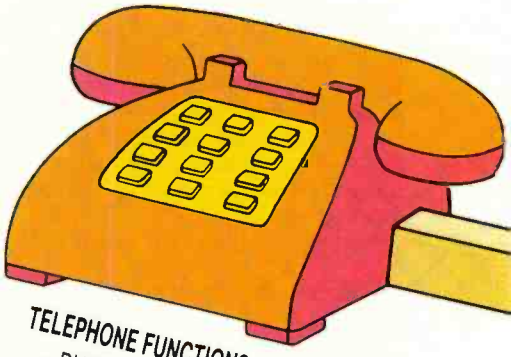
There are two types of parity checking, even and odd. If even parity is in effect, the parity bit is assigned by the sending computer so that the total number of logic-1 bits in the eight-bit cluster is even. At the receiving end, the number of 1s is recomputed. If nothing got lost in the transmission, that number should still be even. If it isn't, something was incorrectly transmitted and the character is discarded. Odd parity works exactly the same way, except the total number of logic-1 bits must be odd.

Because some systems use even parity checking, others odd, and others no parity checking at all, these three modes must be allowed by your software.

Your system and the one you're communicating with must also agree on the number of bits that constitute a character. The modems used on micros communicate serially—that is, the bits that make up the character are transmitted one after the other.

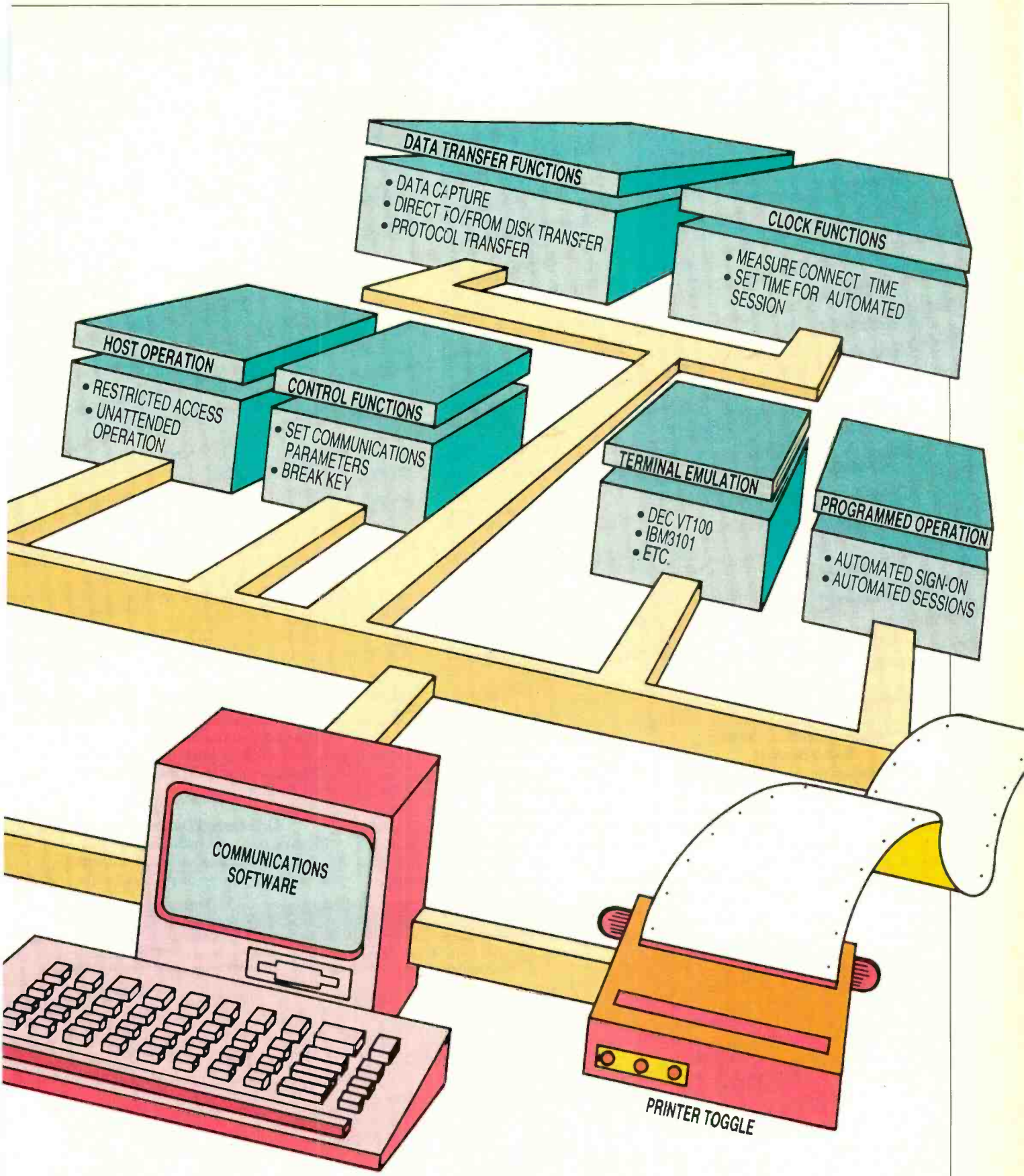
In order that the other computer can tell where one character ends and the next begins, a short gap is left between characters. Each character begins with a *start bit* before the actual data bits and is followed by one or two *stop bits*. While the start bit is taken for granted, both systems must agree on the number of data bits and the number of stop bits; otherwise, the receiving system could confuse the final data bit with a stop bit.

Finally, there is the parameter that is often called *duplex*, but is more properly called *echo*. As a verification that the correct characters have been transmitted, many host computers echo, or retransmit, each character they receive back to you, through the modem-phone connection. If such a remote echo is in effect, when you type a character on your keyboard, it is not routed to your screen; what appears on your screen are the characters that have made the round trip from your keyboard to the distant computer, and back.



They should, of course, be the same; if they're not, there's a problem. The alternative is for the remote computer just to accept the characters without echoing them. In that case, for you to see what you've transmitted, your software will have to provide a *local echo*. This feature, properly referred to as "local echo on" or "off," is often called *full duplex* (when local echo is off and the distant computer is echoing) and *half duplex* (when local echo is on). "Duplex" actually refers to the physical ability to transmit data in both directions simultaneously, an ability that all common microcomputer modems have.

John Helliwell is a Toronto-based computer consultant and writer.



Features of a good communications package.

ART BY JOANN AGRESS

PROGRAM FEATURES

FEATURES	ASCOM	CROSSTALK XVI	MICROLINK II	MITE	MODEM7	PFS:ACCESS	RELAY	SMARTCOM I, SMARTCOM II
Automated dialing	Unlimited—script files	Unlimited—script files	By using some macros	Unlimited—script files	26 numbers	Script files for 8 svces.	Unlimited	Script files for 25 svces.
Host operation	Can host, no protection	Can host, good protection	No	Can host, no protection	No	No	Yes, protected	Yes, password protected
Macros	No	40 per script file	20 total	10 per script file	No	No	No	20 per script file
Scripts	Yes, complete	Yes, time, string	No	Yes, composed of macros—time, character	No	Yes, memorizes actual sequence	Yes, complete	Yes, composed of macros—time, character
Break key	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data Capture	To memory or disk	To memory or disk	To memory, can write to disk	To memory, can write to disk	To memory or disk	To memory or disk	To memory or disk	To disk
Printing	Yes, buffered	Yes, not buffered	Yes	Yes, not buffered	Yes	Yes	Yes, buffered	Yes, buffered
Text file transmission	Yes, no throttle	Yes, throttle	Yes	Yes, throttle	Yes, throttle	Yes, can encrypt	Yes, throttle	Yes
Protocol file transfer	Xmodem, Crosstalk, proprietary	Proprietary + Xmodem	Xmodem	Proprietary, Xmodem, CLINK, Hayes	Xmodem	No	Xmodem plus proprietary	Hayes verification protocol
Terminal emulation	None	VT100,IBM3101 TV910&920,ADDS	No	No	No	No	VT100,VT52	No
Available versions	CP/M, MS-DOS	MS-DOS	CP/M 80/86 MS-DOS	CP/M 80/86	CP/M, Apple, MS-DOS	MS-DOS Apple	MS-DOS	DOS 3.3, Pascal, CP/M, MS-DOS
Restricted to certain modems?	Any modem	Any modem	Any modem	Any modem	Any modem	Direct support for 12 makes	Tailored for Hayes	Hayes
Price	$195	$195	$99	$150	Usually free	$70 Apple $95 IBM	$149	Comes with Hayes modems

Communications with Some Smarts

If your communications software does no more than allow you to set these variables, it is just a "dumb terminal" program. But your computer is far more than a dumb terminal. It has memory; it has a powerful microprocessor; it has disk drives; it has a printer; and more. Dumb terminal software doesn't use these facilities; smart users use smart software that does.

The challenge is to choose a communications program that does a good job of implementing the "smart" features that matter to you; which features those are depends on what sort of communications application you have in mind. The universe of microcomputer communications applications can be broken down into four categories:

- micro-to-micro communications, including transfer of documents, data, and programs
- electronic mail and messaging, by connecting to a central computer utility to deposit and retrieve text and messages
- data retrieval from on-line databases, including text and numeric information
- transaction handling or programming on corporate mainframes or minis (or other special-purpose systems)

Which features of a communications program are important depends on the application(s) you have in mind. The table below ranks features as "essential," "useful," or "depends," with respect to each of these four applications categories. The table above describes ten programs according to how they implement the feature. Following is an explanation of each feature.

Automated Dialing

If your modem is capable of auto dialing, then an automated dialing feature in your software can be useful, no matter

APPLICATIONS FOR VARIOUS FEATURES

Features	Micro-to-micro communications	Electronic mail and messaging	Data retrieval and databases	Transactions and programming
Automatic dialing		Useful	Useful	Useful
Host operation	Useful			
Macros	Useful	Useful	Useful	Useful
Scripts	Useful	Useful	Useful	Useful
Break key		Useful	Essential	Essential
Data capture		Essential	Essential	
Printing		Useful	Useful	Useful
Text file transmission	Useful	Essential		Depends
Protocol file transfer	Essential			
Terminal emulation			Depends	Depends

TELIOS	VIDTEX
Unlimited, script files	Unlimited, script files
No	No
10 per script file	No
Yes, time	Yes, time, character
Yes	
To memory, can write to disk	To memory, can write to disk
Yes	Yes
Yes, throttle	Yes, throttle
No	CompuServe protocol
	No
MS-DOS	Commodore 64
Any, tailored for Hayes	Comm. 1600 or 1650 modem
$119.95	$39.95

what your application.

The software should allow you to store a set of telephone numbers, allow you to tell it to dial The Source or your friend Pat, and automatically transmit the correct instruction code and telephone number to the modem. To do this, the software has to know how to tell your modem to dial a number. If a program claims to support auto dialing or a dialing directory, ask what modems it is compatible with. Be sure yours is on the list before you accept the program.

Auto-dialing directories are very convenient if there are several different remote computers with which you have dealings. When auto dialing is implemented through script files or macros (see below), then it usually will allow you to store the parameters (parity, number of stop bits, and so on) of each remote along with its phone number, so the parameters can be set automatically when the call is placed.

Auto dialing is only really useful in micro-to-micro communications if you can be sure the micro on the other end is waiting to answer your call (see "Host Operation," below); otherwise, you'll often find it easier to start out your communication as a regular voice call, and then turn control over to your computers.

Host Operation

If your modem can auto-answer when the phone rings, then you are equipped to set up your computer as a host—a computer that other computers can dial in to. If you want to do this, be sure your software has "hosting" or "answer mode" or "unattended operation" features. Such features should give you some control over who can dial in (using passwords, for instance), and over what they can do once they have dialed in.

For example, can the caller send your computer a file? Request one from your disks? Erase files from your disks? (Software that allows really sophisticated host operation is often called "bulletin board service" or BBS software.) Determine how much control you want to allow before settling on a communications program.

Automated Signons and Sessions: Macros and Scripts

If your software can manage auto dialing, the next level of sophistication is automating the procedure of signing on to remote systems. This includes things like sending remote service network numbers, account numbers, and passwords in respose to the service's prompts, and goes beyond that to automation of complete on-line sessions, including hanging up when the session has been completed.

Two different approaches to this automation are common: macros and scripts. Some programs use both.

Macros are strings of characters that can be transmitted by pressing just one

(Continued on page 86)

COMMUNICATIONS SOFTWARE SUPPLIERS

Ascom
Westico, Inc.
25 Van Zant St.
Norwalk, CT 06855

Crosstalk XVI
Microstuf, Inc.
1845 The Exchange
Suite 205
Atlanta, GA 30339

Micro Link II
Digital Marketing Corp.
2363 Boulevard Circle
Walnut Creek, CA 94595

Mite
Mycroft Labs., Inc.
PO Box 6045
Tallahassee, FL 32314

MODEM7
Available free from most microcomputer user groups and RBBSs.

PFS:Access
Software Publishing Corp.
1901 Landings Dr.
Mountain View, CA 94043

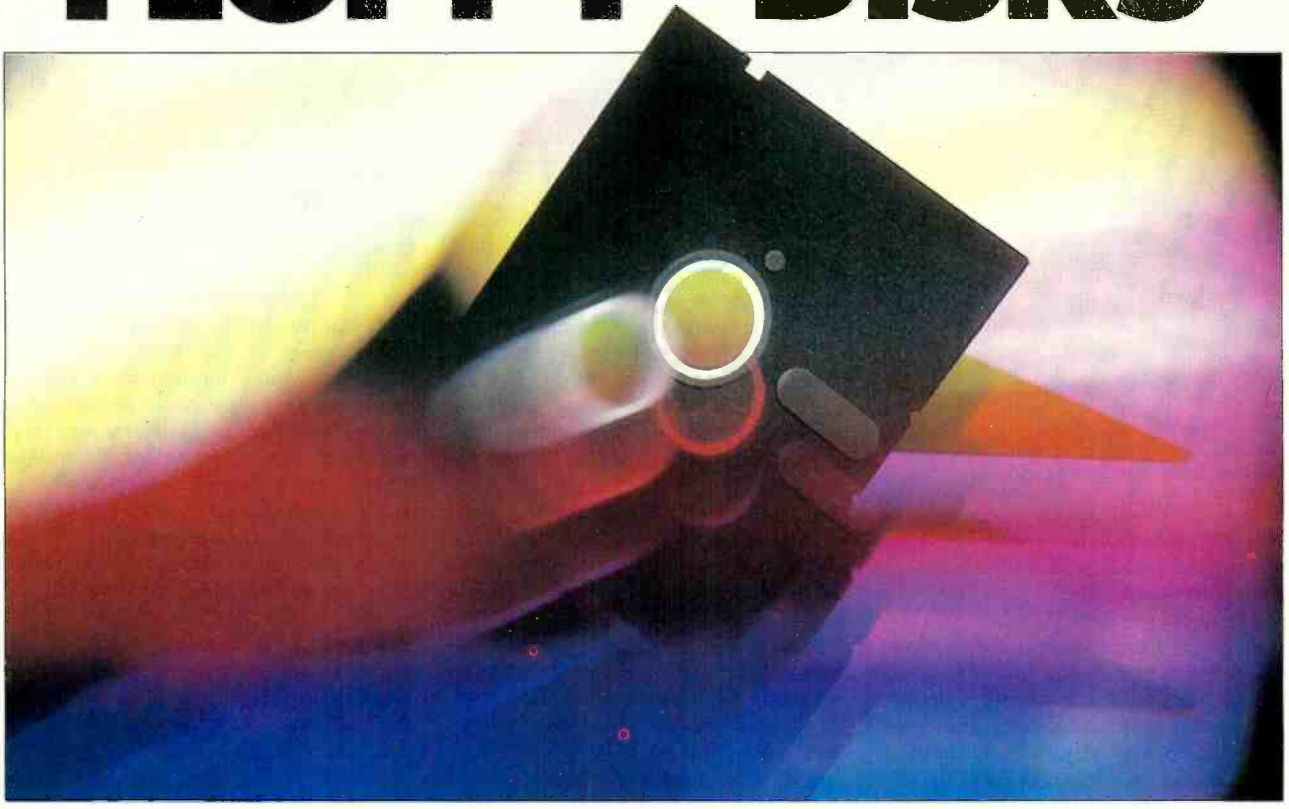
Relay
Westico, Inc.
25 Van Zant St.
Norwalk, CT 06855

Smartcom
Hayes Microcomputer Products
5923 Peachtree Industrial Blvd.
Norcross, GA 30092

Telios
Genasys Corp.
11820 Parklawn Dr.
Rockville, MD 20852

Vidtex
CompuServe
5000 Arlington Centre Blvd.
Columbus, OH 43220

3M STRETCHES THE CAPACITY OF FLOPPY DISKS



Hard disk performance is attained by building a floppy with a flexible surface

BY J. SMITH-RICHARDSON

DATA storage and rapid access to that data have always been prime functions of the personal computer. Although we talk of *Star Wars* gadgetry that can store the entire knowledge of the universe in someone's pocket, the reality is that disk storage is more affordable.

A recent and exciting development in high-density disk technology affecting personal computers is 3M's Stretched Surface Recording, a "compliant" disk system that—using present technology—combines the storage capabilities of the Winchester hard disk with the environmental tolerances of the floppy disk.

How It Began

With almost the same fervor that medieval knights used in searching for the Holy Grail, certain modern heroes—engineers—have searched for new ways to pack ever greater amounts of data into ever smaller amounts of space. The modern era of mass disk storage started with the hard disk: Not the itty-bitty 5¼" hard disk we shoehorn into a portable computer but a platter up to 14" in diameter that was intended for use with mainframes and minicomputers.

The early modern hard disks were precision-milled metal platters coated with a magnetic oxide medium. With a diameter of 14 inches and spinning at 3600 rpm, the hard disk could store enormous amounts of data: better than 12 megabytes per side, 25 megabytes per disk (two sides). Often, two or more disks were combined in a sealed "disk pack" to increase storage capacity into the multi-megabyte range: a pack consisting of 12 hard disks could store 300 megabytes. And all this was before we *really* learned to pack data on a disk.

Obviously, a disk spinning at the

J. Smith-Richardson is a free-lance author who writes frequently on computer-related subjects.

PHOTO BY PETER ANGELO SIMON

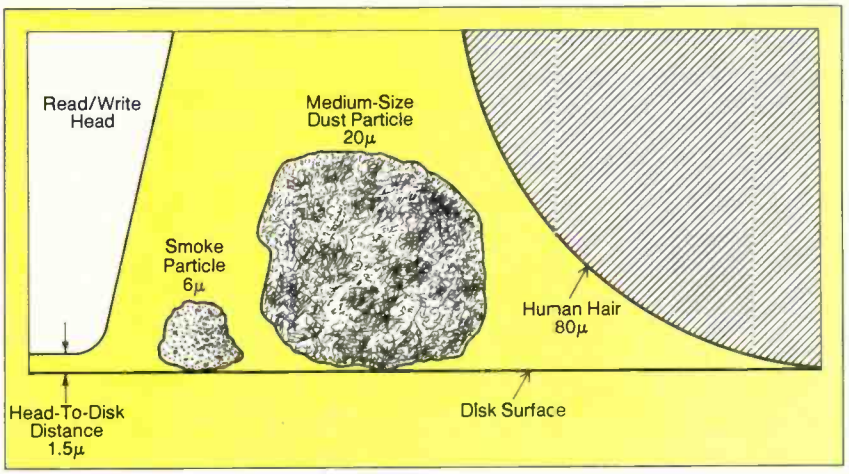


Fig. 1. Relative sizes of particles that can cause head crashes.

speed of 3600 rpm was sure to: (a) rapidly wear down anything in contact with the disk, such as a read/write head; (b) produce extreme friction-developed heat in anything touching the disk (the read/write head again); (c) have anything that touched the disk slice off the magnetic coating at the contact point, along with all the data stored in that coating.

The original hard disk drives eventually evolved into the "flying head" drive we use today, which we call a "Winchester" because that was IBM's code name for the device when it was under development. In Winchester-type hard disk drives the read/write heads fly above the surface of the disk and do not wear or damage the magnetic medium. Fortunately for the data processing industry, the technology that made the flying head possible was already in existence, having been originally developed way back in the late 1940s for professional tape recorders.

The Air Cushion

One description of early ¼" audio tape was "sandpaper on an acetate base." At the then common professional slow speed of 15 ips (inches per second) the relatively coarse oxide coating could wear out a recording, playback, or erase head in just a few months. If the tape could do that at 15 ips, imagine the wear when the tape was run at high-speed rewind or wind! To eliminate the high-speed wear, most tape recorder manufacturers employed some form of "tape lifter" mechanism that lifted the tape away from the erase, record and and reproduce heads during high-speed winding.

But tape lifters were not the order of the day for Ampex, already the leading producer of professional tape recorders. Ampex engineers determined that when the tape ran at high speed it sucked molecules of air along with the tape. As the molecules were compressed and forced between the tape and the head, they formed a cushion of air that lifted the tape off the head. There was not enough lift to actually be seen because the "gap" between the tape and head was but the thickness of a few molecules of air, but there was enough so the tape did not contact the head.

Using that lift produced by an air cushion developed by the speed of the recording medium, it was possible to fly the head of a disk mechanism over the medium and still detect magnetic impulses from the media, much as the audio engineers could hear the rewind playback even though the air cushion had lifted the tape off the reproduce head. It was the Ampex "air cushion" that made the modern hard disk possible, even if the persons who designed the flying head didn't know they were inspired by the Ampex audio recorders.

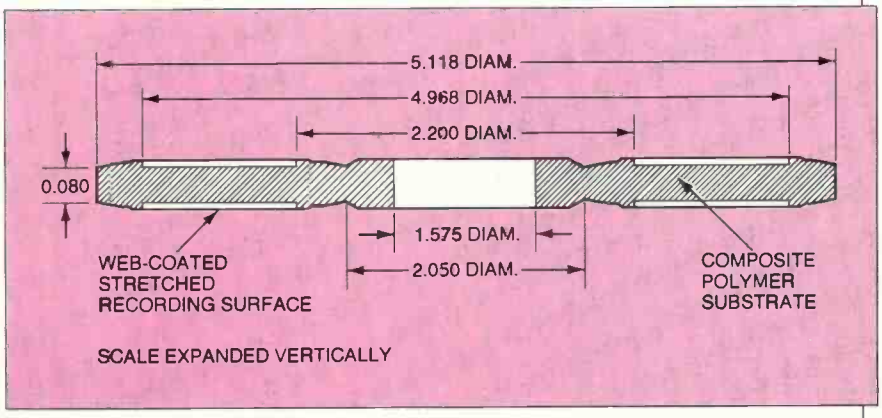
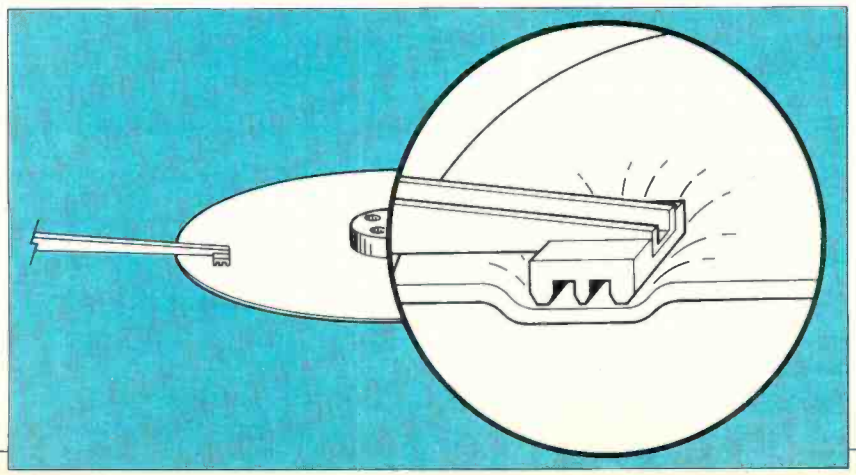


Fig. 2. Cross section of 3M's new SSR technology disk.

Fig 3. Air pressure causes disk medium to "dimple" beneath head.



The read/write head of a hard disk system is mounted on the end of what is essentially a driven arm with free vertical motion. The signal head, the part that responds to magnetic and electrical impulses, is a very tiny strip of metal that looks like nothing more than a pencil scratch. It is normally mounted either in a relatively large block of plastic which serves to trap the air cushion or in a smaller plastic block with longitudinal grooves that help direct the air stream under the head. Either way, the head itself amounts to little more than a dot of metal in a plastic shell about the size of a dime.

The head normally comes to rest or is "parked" on a safe area of the disk called

(Continued on page 78)

ANNOUNCING

A LIBRARY OF SOFTWARE PROGRAMS FOR **APPLE II, II+, IIe** COMPUTERS

A+DISK MAGAZINE

Now you can build a library of programs for your Apple™ at a fraction of the usual cost

Each issue of A+Disk Magazine provides you with up to 8 programs for as little as $3.00 each.

A+ DISK MAGAZINE is making it easier than ever before to build a library of computer software for your Apple II series microcomputer. Because now you can save over $60 on the programs you need to expand the use of your personal computer. Issue after issue, **A+DISK MAGAZINE** gives you business and finance aids, utilities, subroutines, games, home and personal applications... all for as little as $3 per program.

And when you consider that many of today's most popular programs sell for $50, $60, $80 and more, your savings can be *enormous*... much more than the cost of your subscription to **A+ DISK MAGAZINE**.

Along with your subscription to **A+ DISK MAGAZINE**, you'll receive

up to 8 thoroughly-tested, ready-to-run programs and files on a floppy disk. Complete with comprehensive, illustrated User Manual, A+ DISK MAGAZINE is easy, efficient, and very economical.

Here's just a sampling of what you can expect in every issue:

Programming tools: Create cross-reference listings for your

BASIC programs. Use your text editor on your BASIC programs. Convert data between BASIC and VISICALC® formats.

Business and finance aids: Compute loan payment tables. Calculate the Present Value and Internal Rate of Return for your investments. VISICALC templates for Real Estate, Lease/Purchase and Tax Shelter analysis. Create advanced pie, bar and line chart graphics.

Home/personal applications: Whether you need your own income tax return helper... a personal cash flow analyzer... a speed reading trainer... proven ways to maintain a mailing list... or SAT test preparation aids, A+ DISK MAGAZINE has it all.

Utilities and diagnostics: A+ DISK MAGAZINE shows you

how to use your Apple to simulate a conversational terminal with control of disk or printer logging... print graphics, screen images on your printer... backup, copy, delete, un-delete or type files with simple menu commands... plus more.

Data files: From tax tables, to population statistics, from dictionaries to economic times series, A+ DISK MAGAZINE involves you as never before.

Games: Adventures! Strategies! Test your skill, intelligence and luck.

The latest software developments at your fingertips for a fraction of the cost.

There's no need to type listings into your computer. With A+ DISK MAGAZINE, all you do is boot the disk and go! The accompanying User Manual explains everything in clear, easy-to-understand terms. So you'll be able to run the programs as soon as you receive your first issue of A+ DISK MAGAZINE.

Program Submissions

If you wish to submit a program for inclusion in future issues, please write to: A+ DISK MAGAZINE, Author Submissions, One Park Avenue, New York, N.Y. 10016.

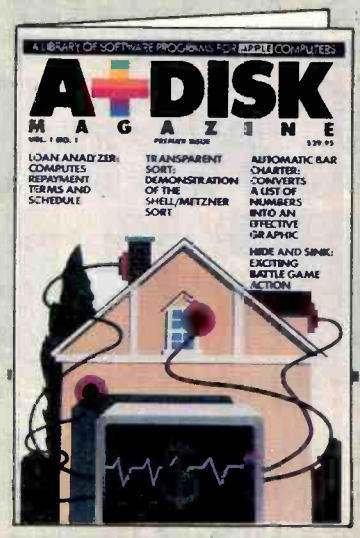
Guarantee

- All programs are fully tested and guaranteed to run. Damaged or faulty disks will be replaced at no charge.
- If you wish to cancel a subscription, simply return the most recent disk in its sealed package and you will receive a full refund for this copy and all unmailed issues.

Product Specifications

Programs will run on Apple II series computers using Apple DOS 3.3 and require a minimum of 48K. Most programs will be written in Applesoft Basic—however some machine language code may be used.

Subscribe to A+Disk magazine and save over $60 with this Introductory Offer!



A+DISK MAGAZINE

P.O. Box 5925
Cherry Hill, NJ 08034

YES Please accept my subscription to A+DISK MAGAZINE for:

☐ 1 issue for $34.95 (Prepayment Only)
☐ 3 issues for $84. I SAVE $20.00!
☐ 6 issues for $149. I SAVE $60.00!

Name _____

Address _____ AD8H302

City _____ State _____ Zip _____

Check one: ☐ Payment enclosed* ☐ Bill me

Charge my*: ☐ American Express ☐ Visa ☐ MasterCard

Credit Card No. _____ Exp. Date _____

*10% discount for cash or credit card orders—U.S. only.

MAIL NO-RISK COUPON TODAY—AND SAVE UP TO 34%!

Canadian and foreign orders shipped via Air Printed Matter only; add $5 per issue and include payment with order in U.S. funds.

creative computing

10TH ANNIVERSARY SPECIAL OFFER

1984 is a banner year for CREATIVE COMPUTING, it marks our first decade of bringing you the latest information regarding introductions and changes that have occurred in our fast-paced industry.

We were there as the respected publication in the beginning . . . when businesses were struggling under reams of paper . . . when video games meant a dot bounding from one side of a TV screen to the other . . . when computer technology meant main frames and punch cards.

Before it happened we told you about the transition from tape to disks . . . telecommunications and networking simplifying business transactions . . . new programs eliminating hours of waste and unproductivity! We will be there for the next ten years because *we are not going to rest on our laurels!* 1984 is the beginning of a decade of fresh ideas, new innovations and reliable evaluations certain to keep you abreast of our quick-charged stimulating world!

SUBSCRIBE TODAY AND RESERVE YOUR COPY OF OUR SPECIAL 10th ANNIVERSARY ISSUE!

When you take advantage of our Special 10th Anniversary Discount, you automatically reserve this special November issue guaranteed to be a collector's edition!

FREE GIFT

OUR ANNIVERSARY GIFT TO YOU—A QUARTZ DESK CLOCK!

You will receive a 5-function lucite Quartz Desk Clock upon payment. This attractive clock, sure to become a collector's item, will be sent to all who participate in our historic celebration! Attractive in any decor, reliable and long lasting, this desk clock will give you years of enjoyment. Your subscription to CREATIVE COMPUTING will give you hours and hours of facts, information and quality reading, assisting you to make the most of your microcomputer!

SUBSCRIBE TODAY AND SAVE UP TO 33%!

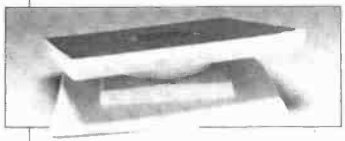
NEW PRODUCTS

RGB COLOR VIDEO MONITOR

Princeton Graphic Systems' new Model SR-12 is an RGB color video monitor that can display up to 16 colors simultaneously and offers both text and graphics display capabilities. The 12-in. diagonal screen can display up to 25 rows of 80 columns per row in the text mode and 690 by 480 pixels in the noninterlaced graphics mode. Video bandwidth is rated at 25 MHz, and misconvergence is listed at 0.5 mm maximum in the center of the screen, 1.0 mm maximum in the corners. Power consumption at 120 volts ac is 95 watts. The monitor is supplied with a standard DB-9 (nine-pin) cable. $799. **Address:** Princeton Graphic Systems, 1101-1 State Rd., Princeton, NJ 08540.

MONITOR STAND

The Twist and Tilt video monitor stand from Inland is designed to hold the IBM PC monochrome or color monitor in a comfortable viewing position. It also has an adapter plate to accommodate other monitors. The stand is made of high-impact plastic and is colored and textured to match the IBM PC and present the appearance that the Twist and Tilt is an integral part of the computer. The stand measures 11″ × 11″ × 3″. It can rotate in a complete 360° circle and tilt back and forth over a range of 25°. $29.95. **Address:** Inland, 32052 Howard, Madison Heights, MI 48071.



COMPUTER PROTECTOR

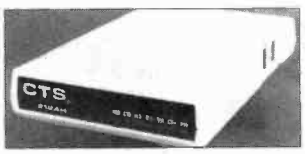
The Wire Cube from Networx is a single-outlet device for protecting personal computers from voltage spikes or surges from RFI (radio-frequency interference). The Wire Cube's protection stems in part from its silicon transient suppressor, which opens an internal fuse whenever a transient exceeds the circuit rating. Simultaneous with breaking the electrical connection to the computer, the Wire Cube lights a LED to indicate that the protection circuit has been tripped. RFI is suppressed by a built-in filter, and a pi-type circuit with a common-mode choke provides additional noise attenuation in both common and transverse modes. Response to potentially damaging conditions is rated in nanoseconds. $34.95. **Address:** Networx, 203 Harrison Pl., Brooklyn, NY 11237.

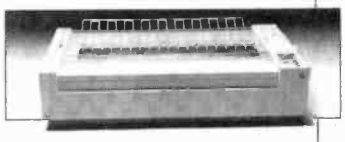
UPGRADE SYSTEM FOR COMMODORE

Commodore C-64 users can now run true CP/M software with a new add-on system from Estes Electronics. The system comes with a Z80 microprocessor, DMA, parallel printer and serial communications ports, disk controller, and 64K of DRAM. It can control both 8- and 5¼-in. single- and double-sided, double-density disks. The 5¼-in. system will run Kaypro, Radio Shack TRS-80, Xerox, Televideo, and many more formats. It comes complete with the CP/M 2.2 operating system. $500. **Address:** Estes Electronics, Inc., Box 753, Salina, KS 67402.

212A-COMPATIBLE MODEM

The Companion is a Bell 212A-compatible modem from CTS Corp. The RS-232C modem comes with the company's Mite communications software package and offers full-duplex asynchronous operation at 300 baud and synchronous operation at 1200 baud. The modem supports keyboard diagnostics, including local analog loopback, local digital loopback, and remote digital loopback test. Other features include adaptive dialing, tone or pulse operation, automatic answering and speed detection call progress monitoring, automatic storage and dialing of last dialed number, and two RJ11C jacks for both voice and data communication. **Address:** CTS Corp., 400 Reimann Ave., Sandwich, IL 60548.





DOT-MATRIX PRINTER

Apple is offering a wide-carriage model of its Imagewriter dot-matrix printer. The Wide Carriage Imagewriter can accommodate paper ranging from 3 in. to 15 in. wide, uses a 7 × 9 print matrix, and features a throughput of up to 120 cps. Eight character fonts are featured, and variable resolution, pitch, and line spacing are provided. Various fonts, underscoring, and super- and subscripts can be mixed in the same printed line. Paper can be either friction or pin fed. Supplied with the printer is an accessory kit that contains appropriate connector cables for Apple II and III printers. $749.

Circle No. 85 on Free Information Card

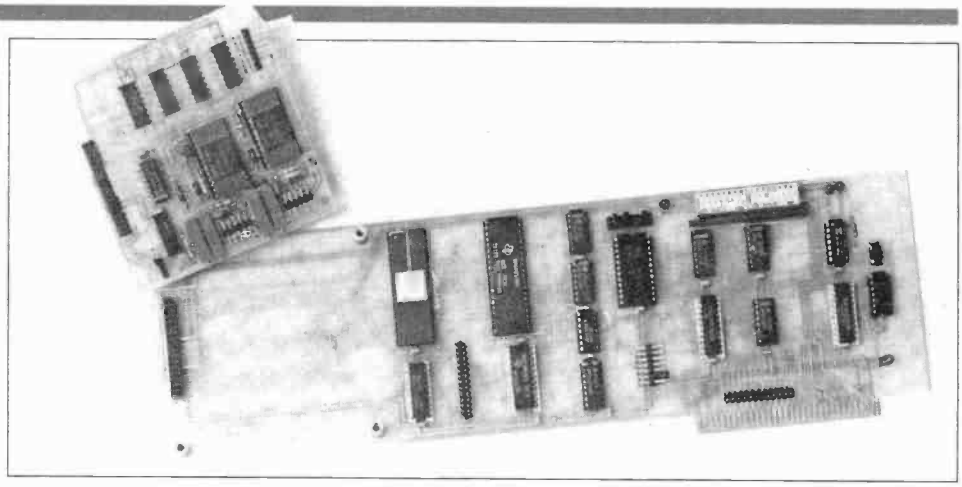
NEW PRODUCTS

INTELLIGENT SWITCH

A new automatic printer switch that permits up to three Digital Equipment DECmate systems to share a single printer is available from Gold Key Electronics. The SWITCHmate is an intelligent switch that enables up to three DECmate systems to function simultaneously with one LQP02 printer. Switching is transparent, and the compact unit instructs each system to hold data until printer time is available, then automatically prints. LEDs indicate which DECmate is printing and which are on hold. SWITCHmate can be located up to 250 ft from the DECmate systems. From $449, depending on quantity and options. **Address:** Gold Key Electronics, Inc., PO Box 186, Goffstown, NH 03045.

UNINTERRUPTIBLE POWER SUPPLY

The new Model 1350 uninterruptible power supply from Dymarc is claimed to provide up to 10 minutes of power for personal computers during power failures. The system is rated to deliver 120 volts ac at 350 VA, 60 Hz and has a transfer time of 12 milliseconds. (A 50-Hz version is also available.) The UPS contains Dymarc's patented Clipper circuit that provides on-line surge protection for both normal- and common-mode transients, while rfi suppression is provided by Sprague filters. The Model 1350 is also available with a choice of four new load-regulator/conditioner Clip Cubes. $750 for Model 1350; $299 and up for Clip Cubes. **Address:** Dymarc Industries, 21 Governor's Ct., Baltimore, MD 21207.



MULTIFUNCTION CONTROLLER

An IEEE 488 GPIB multifunction board that provides an interface between the IBM PC and GPIB-compatible instruments for automated measurements and data acquisition applications has been introduced by Qua Tech, Inc. The board can be connected to up to 15 devices to allow the PC to act as a GPIB system controller. The other devices on the GPIB can be programmed as talkers, listeners, or controllers. The board also has a programmable interval timer and one parallel port that will accept any one of the Qua Tech modules, such as an A/D or D/A converter, reed relay, or stepper motor controller. An available software package supplies all the routines required to implement the GPIB functions. It contains more than 30 macro commands and routines for using BASIC, assembly, and other languages. $395 for controller; $100 for software drivers; $75 to $495 for modules. **Address:** Qua Tech, Inc., 478 E. Exchange St., Akron, OH 44304.

DATA COMMUNICATIONS/MODEM

Concord Data Systems' CDS 224 Superduplex high-speed modem offers a statistical multiplexer with ARQ error correction and autodialing. The full-duplex modem connects multiple asynchronous devices to a standard two-wire switched telephone line for 2400- and 1200-baud transmission. The statistical multiplexer provides three user-programmable RS-232C ports and a choice of 14 asynchronous speeds (50 to 9600 bps) or automatic matching of port speed to the speed of the user's device. Protocols include XON/XOFF and CTS. An adaptive prioritizing technique maximizes throughput, minimizes delay, and ensures that interactive traffic has priority over batch traffic. Automatic dialing supports both tone and pulse dialing systems. Other operating modes include automatic answer and originate and/or manual answer modes. $1695. **Address:** Concord Data Systems, 303 Bear Hill Rd., Waltham, MA 02154.

SOFTWARE SOURCES

Macro Assembler. A cartridge version of MAC/65 with DDT (Digital Research's Dynamic Debugging Tool), a fast macro assembler with editor and debugger for **Atari** computers, is available from Optimized Systems Software. It features a macro assembler that can handle source code in memory or on disk and object code in memory or on disk. It can do memory-to-memory assemblies at a rate of thousands of lines per minute. MAC/65's editor uses line orientation, with every source line checked for proper assembly-language syntax during entry. DDT includes all the features the user would expect in a debugger, plus the ability to preserve screen graphics while presenting a usable display of the state of the user's program. $99. **Address:** Optimized Systems Software, Inc., 1173-D Saratoga/Sunnyvale Rd., San Jose, CA 95129.

Desk Organizer. The Desk Organizer, developed by Conceptual Instruments and marketed by Warner Software, is an integrated software package for business users of the **IBM PC**. It provides seven office functions: filing, telephone dialing, data organizing, numerical calculating, appointment scheduling, time and work-flow managing, and correspondence and memo writing. A unique "Meta" capability allows the package to coreside in the computer with virtually any other applications program. The user can work on the Desk Organizer alone or switch back and forth between it and almost any other IBM-compatible program. Meta also enables the Desk Organizer to interrupt another program with chimes and an on-screen display to present a previously scheduled reminder or call-up. $250.

Circle No. 86 on Free Information Card

Software Reviews
(Continued from page 43)

time of our testing, Ashton-Tate says that many advanced graphics features will be available when Framework is released. Among these are vertical and horizontal display and plotter support.

Databases

You can create Framework databases within the program or import them from foreign systems. The program contains filters that permit a user to select imported data by key or type and to translate these data into Framework format. Filters already exist for files created under dBASE II and Friday! (both Ashton-Tate products). A filter for Lotus 1-2-3 files is expected to be ready by the time Framework is available.

The main reason for using the database form rather than the spreadsheet is ease of entry of data. Each row is a record in the database. You can also customize forms to make input easier.

Output

You can output frames to a printer or save them on disk. Owing to the outline structure of a containing frame, the program can automatically create a table of contents with page numbers. Printer controls such as page lengths and offsets were not available in our test version, but full implementation of these features is expected before release. Formatted output can also be directed to an ASCII file on disk.

DOS Access

At any point it is possible to exit to DOS, perform any DOS command or execute virtually any program—including dBASE II—and return to the same point in Framework. It is this facility that enables the user to load data from external programs into spreadsheets or workframes. We were successful in capturing an ASCII file into an empty workframe on the desktop and performing word processing functions upon it.

Integration

The product has extensive capabilities that are well, although not completely, integrated. You cannot copy or move a spreadsheet or database into a word processing frame or vice versa. This means that to write a memo with a table in the middle you must create three frames: one for the text preceding the table, one for the table itself, and another for the text following the table. While the three frames can be viewed or printed out as one document, they are still separate within the structure of Framework. If you must make changes, you will have to exit one frame to work on another. This restriction makes Framework less convenient to work with than it might be.

Conclusion

Framework is a very powerful package, with an enormous number of features. The concept is excellent, especially the outline feature for developing and organizing ideas. Some of the function implementation is a bit clumsy, but in a package of this magnitude one cannot expect to be able to invoke every function with a single keystroke. Framework's greatest weakness is that it does not tightly integrate the word processing and spreadsheet functions. We hope that the communications function will be as well integrated as the spreadsheet and graphics features are.

We think Framework is a most exciting package, worthy of your consideration. It will be most useful for people who do a lot of writing and can use its outlining capabilities and for people who develop applications that use spreadsheets and graphics. ◇

TASKWARE FOR CONVERGENT'S WORKSLATE

Software enhances the utility of Convergent's portable

BY TOM HAUGHNEY

UNLIKE some lapsize computers that are carbon copies of each other, Convergent Technologies' Workslate is unique in design and function. Now, further enhancing its functionality is Taskware—the Workslate's applications software. Taskware packages range from financial marketing programs to sales and expense reporting forms and have a suggested retail price of $49.95 per tape. Taskware comes in a small, clear plastic box less than an inch thick. Accompanying the software microcassette is an instruction booklet that measures only 3½" × 4½"—very thin. I was skeptical.

I thought: "There is no way that little booklet accompanying a package like *1984 Personal Tax* can cover the bases." The IRS cannot explain how to peel and paste a label in less than 11 pages.

I was wrong

More importantly, the Workslate is designed to handle a series of worksheets. Each task included in a software package is one element. And each element is brought to its conclusion in a manner that is elegantly easy to follow. A short audio preamble describes the function of each element so the user can anticipate its thrust and organization. The rest is just filling in the blanks. For example, the "Withholding" program quickly allows the user to calculate the number of exemptions that can be claimed without the strain of reading the new "simplified" bureaucratese of the ever popular W-4.

The cornerstone around which the Workslate is built is the spreadsheet. This is a marvelous device for keeping track of a variety of factors that the user defines, and it allows him to then interrelate these factors as a problem dictates. Most frequently this type of presentation is used to show the financial effect, over time, of proposed or implemented strategic decision.

Taskware concentrates on financial modeling. Rudimentary, perhaps, but modeling which is neither easily available, nor is it easy to use. The tax programs, for example, allow the user to estimate one's tax position and alter variables without reiterating a string of tedious arithmetic.

The basic spreadsheet function is built into the Workslate and is ready to go. Although the built-in software lacks the sophistication of more advanced applications software available for bigger in-place systems, it is more than adequate for use on the fly. Convergent overcomes any shortcomings here with a good deal of interesting financial-based software. Any dyed-in-the-wool "pro forma" person will find he can get 95% of the bang for 5% of the bulk with the Workslate. There are 16,384 cells available in the spreadsheet; that's only about 16,000 more than I've ever used. Cell sizes are adjustable and formulas handle well. The basics for numbers manipulation are all present and accounted for.

The nice thing about this spreadsheet orientation is that it quite neatly lends itself to some very interesting additional software packages. With the Workslate, planning, co-ordination, and convenient record keeping are all available in a portable and easy-to-use package.

The *Financial Statements* package is certainly not intended for production accounting, even on a small scale. It does

offer a wide variety of analytical formats, including a five-year income statement analysis, comparative balance sheet, comparative income statement, and a variety of personal financial analysis forms, including personal balance sheet, a projected personal balance sheet (ahh, sweet dreams!), cash flow and projected personal cash flow (harsh reality!). A particularly nice format is the ratio analysis which is a nice tool to use to help gauge a company's health relative to industry standards.

The *Consultant* Taskware package is designed for use by professionals who time-bill their clients. Auditors and lawyers, as well as consultants, could effectively utilize this package. The software features a very easy-to-use system of tracking billable time by client/project on a daily and weekly basis. The expense speadsheets will please even the IRS, but billable expenses are handled in a separate program. (One expense spreadsheet would save users time and effort.) The accounts receivable software is complete but bare bones.

Sales Reporter might prove to be a really great software package. Only sales will tell. In any company with a mobile sales force, the problems of co-ordination and constant communication are critical. Paperwork is a pain for everyone. The Taskware includes a very convenient contact sheet which contains call report information. Good reliable call reports, properly coordinated, are a powerful means for management to stay plugged into the real world, and therefore, able to respond quickly to the marketplace—perhaps even a leg up on the competition. When the salesman calls in each day, his Workslate could dump the call information, allowing it to be used more quickly and at the same time relieving the need to waste half a day regurgitating the prior week's activity. A half a day saved could be a 10% increase in time available for sales activity—that is a considerable increment for under $1,000. Companies with a limited amount of inventory items could refresh the *Sales Reporter's* inventory routine, and allow the sales representative to enter a customer's place of business armed with the latest information. The "Sales Expense Analysis" worksheet is perfectly adequate, but I thought the version in the *Travel* package (reviewed later in this article) was a bit more complete. One flaw is the "Lease Borrow/Lease Purchase" program which doesn't consider the "Investment Tax Credit." The ITC counts as tax dollars paid to Uncle Sam allowed to the purchaser of hard capital assets. Its impact is substantial on the investment decision, so these two elements really aren't too useful.

Marketing Management doesn't represent the full potential of the *Sales Reporter* package, but it's good nevertheless. Gross margin analysis is available and a good sales analysis is there. "Pricing Analysis" is specious, at best. The analysis is flawed; and it doesn't recognize that prices are developed in the marketplace. One uses analysis to make the decision to sell at the prices so determined.

The *Travel* package is a nice complement to the *Sales* package. It is very convenient and offers a complete travel and expense records layout. Also offered are currency conversion, time conversion, and metric conversion routines.

Both the *Loan Analysis* and the *Cash Management* packages include "Internal Rate of Return Analysis" which are extremely helpful to those who seek to avoid the drudgery associated with the mathematics of finance. *Loan Analysis* also includes the expected payment and amortization calculation formats. The *Cash Management* program allows for budget versus actual analysis and has the same currency feature as *Travel*.

The *Inventory Analysis* package concentrates on "economic order quantities." The software is quite good for those who would like to practice this fine art without having to deal with exponential functions with five thumbs poking into a tiny $4.99 calculator. Vendor comparisons and quantity discounts can be integrated into the process too.

Real Estate features heavy cash flow analysis as one might expect, with separate breakdowns of revenue and expense. "Projected Income" and a "Sell Analysis" routine allow the user to aid in making strategic decisions.

Conclusion

The Workslate comes into its own when considered in light of the Taskware available to it. Many of these applications could be developed by the user, but it would be wasteful, I think, to do so because the time one would otherwise devote to recreating the wheel could be better spent fine tuning the applications to make them most productive.

The Taskware precisely targets this machine's reason for existence—spreadsheet dexterity in a very complete portable package. ◇

EXECUVISION

High-powered graphics for presentations

BY JACK BISHOP

VCN ExecuVision, Prentice-Hall's new business graphics program, seems to have been developed from the premise that ordinary business graphics are dull, dull, dull and should be made powerful and eye-catching. Since you're using a CRT, why shouldn't it look like television? If you have lackluster figures to present, why not use ExecuVision to create graphics that at least communicate your message with pizazz (or obscure some best-neglected reality)?

What It Does

Most business graphics consist of line, bar or pie charts. While intended for more elaborate presentations, ExecuVision can do these too. To create a simple chart, you select a box or circle from the menu at the bottom of the screen, scale it to the dimensions you require, select a plot option from the menu, and enter data. The process is simple and straightforward but takes much longer to accomplish with ExecuVision than it would with a program designed to create simple charts.

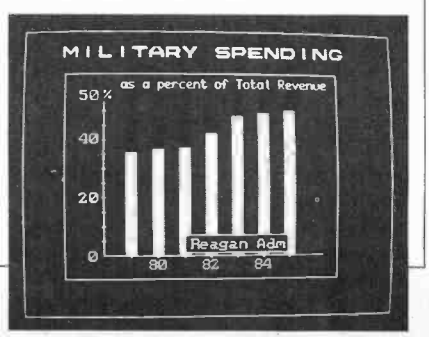
It's when you proceed to add labels and titles to your graphs that you begin to exercise the flexibility and ease of placement that are ExecuVision's strong points. You can make a selection from among a number of type styles, create a label, and place it wherever you wish.

You can draw more complex images using pixels or strings of pixels (a pixel—a contraction of "picture element"—is the smallest dot of light that your CRT screen can display). Once you draw a figure, ExecuVision permits you to move it, replicate it, and, in general, play around with it until it is exactly what you want.

But who wants to be imprisoned by

(Continued on page 82)

Bar graph made with ExecuVision



NEW 128K COMMODORE - 80 COLUMN

COMPUTER SYSTEM SALE!

HOME • BUSINESS • WORD PROCESSING

List Price $4008.95

LOOK AT ALL YOU GET FOR ONLY $1195

	LIST PRICE
• B128 COMMODORE 128K 80 COLUMN COMPUTER	995.00
• 8050 DUAL DISK DRIVE (over 1 million bytes)	1795.00
★ 4023 - 100 CPS - 80 COLUMN BIDIRECTIONAL PRINTER	499.00
• 12" HI RESOLUTION 80 COLUMN GREEN OR AMBER MONITOR	249.00
• SUPER SCRIPT 80 COLUMN PROFESSIONAL WORDPROCESSOR	149.50
• SUPER BASE PROFESSIONAL DATA BASE	149.50
• BOX OF 10 LORAN LIFETIME GUARANTEED DISKS	49.95
• 1100 SHEETS FANFOLD PAPER	19.95
• ALL CABLES NEEDED FOR INTERFACING	102.05
TOTAL LIST PRICE	**4008.95**

SALE PRICE $1195.00

Printer replacement options (replace the 4023 with the following at these sale prices)

	LIST	SALE
★ Olympia Executive Letter Quality Serial Printer/Typewriter	849.00	**499.00**
★ Comstar Hi-Speed 160 CPS 15½" Serial-Business Printer	779.00	**449.00**

Plus You Can Order These Business Programs At Sale Prices

	LIST	SALE		LIST	SALE
ACCOUNTS RECEIVABLE	149 95	99.00	INVENTORY	149 95	99.00
ACCOUNTS PAYABLE	149.95	99.00	GENERAL LEDGER	149 95	99.00
PAYROLL	149.95	99.00			

15 DAY FREE TRIAL We give you 15 days to try out this SUPER SYSTEM PACKAGE!! If it doesn't meet your expectations, just send it back to us prepaid and we will refund your purchase price!!

90 DAY IMMEDIATE REPLACEMENT WARRANTY If any of the SUPER SYSTEM PACKAGE equipment or programs fail due to faulty workmanship or material we will replace it IMMEDIATELY at no charge!!

Add $50.00 for shipping and handling!!
$100.00 for Canada, Puerto Rico, Hawaii orders.
WE DO NOT EXPORT TO OTHER COUNTRIES.
Enclose Cashiers Check, Money Order or Personal Check. Allow 14 days for delivery, 2 to 7 days for phone orders, 1 day express mail! Canada orders must be in U.S. dollars. We accept Visa and MasterCard. We ship C.O.D. to U.S. addresses only.

PROTECTO ENTERPRIZES (WE LOVE OUR CUSTOMERS)
BOX 550, BARRINGTON, ILLINOIS 60010
Phone 312/382-5244 to order

Circle No. 40 on Free Information Card

Computer Scientist

(Continued from page 22)

priate file name. The program in Listing 2 does this and more as you will see from the details below.

Though Listing 2 is designed to run on the PC*jr*, with modification it will work on many other machines with analog joystick ports. The most compatible machines are those such as Radio Shack's Color Computer that use Microsoft BASIC.

LISTING 2. PC*jr* STORAGE LIGHT METER AND OSCILLOSCOPE

```
 10 'PCjr DATA STORAGE LIGHT METER
    AND OSCILLOSCOPE
 20 'COPYRIGHT 1984 BY FORREST M.
    MIMS III
 30 CLS:SCREEN 1,0:COLOR 1:KEY OFF
 40 PRINT " PCjr DATA STORAGE LIGHT
    METER"
 50 LOCATE 10,1:PRINT "PRESS 1 TO SE-
    LECT STORAGE MODE."
 60 PRINT:PRINT "PRESS 2 TO RETRIEVE
    DATA."
 70 PRINT:PRINT "PRESS Q TO QUIT."
 80 V$=INKEY$:IF V$="1" THEN 110
 90 IF V$="Q" OR V$="q" THEN CLS:END
100 IF V$="2" THEN 440 ELSE 80
110 LOCATE 16,1:PRINT "CONNECT Cds
    PHOTOCELL TO STICK(0)."
120 LOCATE 18,1:PRINT "LIGHT METER
    READINGS WILL BE"
130 PRINT "SAVED ON DISK. SELECT A
    FILE NAME"
140 INPUT "AND ENTER IT NOW: ",
    LITE$:PRINT
150 IF LITE$="" THEN 120
160 INPUT "ENTER NUMBER OF SAMPLES:
    ", N
170 INPUT "ENTER SECONDS BETWEEN
    SAMPLES: ",S
180 OPEN LITE$ FOR OUTPUT AS #1
190 PRINT:PRINT "PRESS ANY KEY TO
    BEGIN."
200 IF INKEY$="" THEN 200
210 T$=TIME$:D$=DATE$
220 WRITE #1, D$,T$,S:'SAVE DATE, TIME
    & SAMPLE INTERVAL
230 CLS:PRINT
240 PRINT "SAMPLE                LIGHT
    LEVEL (0 TO 100)"
250 C=1:Z=1:PRINT
260 ON TIMER(S) GOSUB 290:'INITIALIZE
    TIMER
270 TIMER ON
280 GOTO 280
290 'LIGHT MEASUREMENT SUBROUTINE
300 Y=STICK(0): 'RETRIEVE PHOTOCELL
    VALUE
310 Y=INT((Y/255)*100):Y=100-Y
320 PRINT:PRINT "      ";C;
    "                  ";Y
330 WRITE #1,Y:BEEP: 'SAVE SAMPLE ON
    DISK
340 C=C+1:IF C=N+1 THEN 360
350 RETURN
360 CLOSE#1:PRINT
370 BEEP:FOR I=1 TO 200: NEXT I:BEEP
380 PRINT "MEASUREMENT CYCLE
    COMPLETE."
390 PRINT:PRINT "PRESS D TO RETRIEVE
    DATA.":PRINT
400 PRINT "PRESS R TO RERUN
    PROGRAM."
410 O$=INKEY$:IF O$="R" OR O$="r."
    THEN 30
420 IF O$="D" OR O$="d" THEN 440 ELSE
    410
430 CLS:Z=1
440 'RETRIEVE DATA FROM DISK
450 PRINT:PRINT
460 ON ERROR GOTO 960: 'CATCH FILE
    ERROR
470 INPUT "ENTER FILE NAME: ",
    LITE$:CLS
480 IF LITE$="" THEN 470
490 OPEN LITE$ FOR INPUT AS # 1
500 INPUT #1,D$,T$,S:CLS
510 PRINT:PRINT "PRESS 1 TO VIEW DATA
    LIST.":PRINT
520 PRINT "PRESS 2 TO PLOT FIRST 13
    DATA SAMPLES"
530 PRINT" ON SCOPE GRATICULE."
540 LOCATE 12,1:PRINT "AFTER DATA
    LIST OR TRACE HAS BEEN"
550 PRINT "DISPLAYED, PRESS R TO RE-
    RUN PROGRAM."
560 A$=INKEY$:IF A$="1" THEN 580
570 IF A$="2" THEN 690 ELSE 560
580 'PRINT DATA LIST ON MONITOR
590 CLS:PRINT "TEST:"; LITE$;"      ";D$;
    "      ";T$
600 PRINT "SAMPLE INTERVAL:"; S; "SEC-
    ONDS" :PRINT
610 PRINT "SAMPLE                LIGHT
    LEVEL (0 TO 100)" :PRINT
620 INPUT #1,Y: 'RETRIEVE DATA FROM
    DISK
630 PRINT:PRINT "  ";Z;"          ";Y
640 Z=Z+1
650 IF EOF (1) THEN 670
660 GOTO 620
670 BEEP:CLOSE#1
680 K$=INKEY$:IF K$="R" OR K$="r"
    THEN 30 ELSE 680
690 'PLOT DATA ON GRATICULE
700 GOSUB 780
710 FOR X=26 TO 314 STEP 24
720 INPUT #1,Y:Y=(Y*.01)*160:Y=160-Y
730 LINE -(X,Y): 'DRAW TRACE SEGMENT
740 IF EOF(1) THEN 760
750 NEXT X
760 CLOSE #1:BEEP
770 K$=INKEY$:IF K$="R" OR K$="r"
    THEN 30 ELSE 770
780 'GRATICULE SUBROUTINE
790 CLS:J=0
800 LOCATE 25,2:PRINT "SECS/DIV:"; S;" ";
    T$;"   ";D$
810 LINE (314,8)-(26,168),,B
820 FOR C=26 TO 314 STEP 24
830 LINE (C,8)-(C,168),,,&HCCCC
840 NEXT C
850 FOR R=8 TO 168 STEP 16
860 LINE (26,R)-(314,R),,,&HCCCC
870 NEXT R
880 LOCATE 23,4
890 PRINT "0 1 2 3 4 5 6 7 8 9 10 11 12"
900 FOR L=19 TO 3 STEP-2
910 LOCATE L,1
920 J=J+1:PRINT J
930 NEXT L
940 PSET (26,150): 'MOVE CURSOR TO LEFT
    GRATICULE BORDER
950 RETURN
960 IF ERR=53 THEN PRINT "NO SUCH
    FILE. TRY AGAIN.":PRINT:RESUME
    470
```

Listing 2 is menu driven so you can select any of its principle operating modes. When the program is entered and has been run, the first menu allows you to begin one or more light meter readings (line 50), retrieve from disk a previous series of readings (line 60) or exit the program (line 70).

If you select the light meter option, the program asks you to enter a file name for the test session (110-140), the number of samples you wish to make (160) and the interval (in seconds) between samples (170). After the program opens a disk communications file (180), the entire test session, including the date, time, sample interval and the light meter reading, is automatically saved on disk (see 210-220, etc.).

If you select the program's data retrieval option, the program firsts asks for the file name (470) and then whether you wish to see a list of the stored data samples (510) or a graph of the first thirteen samples superimposed on a simulated oscilloscope graticule (520). In any case, you can return to the main menu to rerun the program by pressing R (400-410).

Let's review a typical measurement session. Say we've asked Junior to make five light readings separated by intervals of sixty seconds. Line 240 prints a test heading on the monitor and lines 260-280 actuate Junior's internal timer.

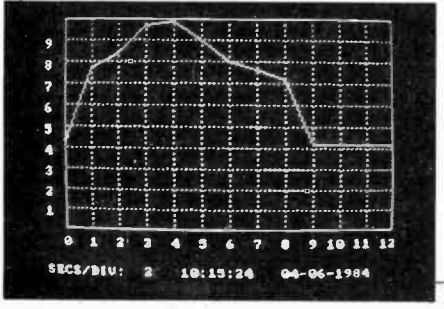
Junior's built-in timer can be set to transfer program execution to the light measurement subroutine after any interval of from 1 to 86,400 seconds (1 second to 24 hours). This means you don't have to waste time inventing calibrated delay loops to provide accurate sample intervals.

Back to our sample run, when the first sixty seconds have elapsed, program control is transferred to the light measurement subroutine at lines 290-350.

Line 300 retrieves the photoresistor reading (Y=0 to 255). Line 310 provides a correction factor that converts the raw reading to a scale of from 0 to 100 [Y=INT((Y/255)*100)].

The photoresistor's resistance is *inversely* proportional to the incident light (i.e. its resistance *decreases* as the light level *increases*). Therefore, line 310 also

Sweep of light across sensor.



complements the reading (Y = 100 − Y) so it will increase when the light level increases. However, line 310 does *not* supply a correction factor to compensate for the photoresistor's nonlinearities.

After the corrected and complemented (but not calibrated) reading is printed on the screen (320) and saved on disk (330), Junior emits a beep and program control returns to the timer routine. After the five samples have been measured, Junior beeps twice. The data tabulated on the screen might resemble this:

SAMPLE	LIGHT LEVEL (0 TO 100)
1	17
2	21
3	37
4	43
5	52

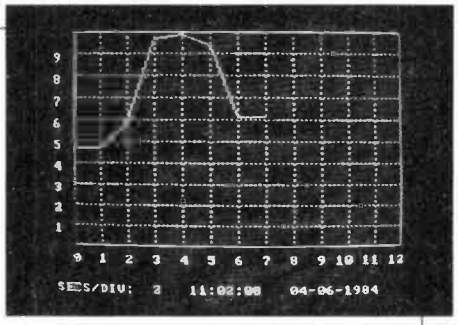
Pressing D tells Junior to retrieve the data from disk. You can then request a tabulated list or a plot of the first thirteen samples superimposed on an oscilloscope graticule, both annotated with file name, date, time and sample interval.

If you request a tabulation of the stored data, lines 580-670 in Listing 2 retrieve the data and print it on the screen. If you request that the data be plotted on a superimposed graticule, lines 690-760 are run.

Incidentally, line 460 catches the error should you attempt to retrieve a nonexistent data file. You can then re-enter a correct file name. This error-trapping feature works for only one cycle, however. If you enter a *second* non-existent file name Junior exits its error-trapping mode and flashes a "Bad file name" error notice. You then have to rerun the program.

The program's graph option is complicated by the need to reconvert the retrieved data to the scale of the graph. To provide as large a graticule as possible in the space above the caption area, I selected a vertical scale of 0 to 160. Line 720 converts the retrieved data (0 to 100) to a scale of 0 to 160. The data is then complemented to match Junior's inverted graphic coordinate system.

The graticule itself is drawn by the subroutine at line 780. Line 820 draws the graticule outline. The grid is drawn by lines 830-880. Notice the ",,,&HCCCC" appended to lines 840 and 870. This causes the grid to be drawn with dashed rather than solid lines. Omit ",,,&HCCCC" if you prefer a solid grid.



Eight light level readings.

Going Further

This column is merely a preliminary look at what can be accomplished by adding external sensors to Junior's joystick ports. Many other sensor options are also possible. In future colums we'll examine additional sensors and address the tricky question of sensor calibration.

In the meantime, remember that the basic principles described in this month's column apply to machines other than the PC*jr*. For additional information on applying these principles, see "Analog Sensors for Personal Computers" and "Use Your TRS-80 Color Computer as a Storage Oscilloscope" (COMPUTERS & ELECTRONICS, February 1984). ◇

DO-IT-YOURSELF COMPUTER-SIMULATED INSTRUMENTS

DURING the past year I've developed several programs that transform computers into various kinds of electronic test equipment and measuring instruments. Eric Mims, my fifteen-year old son, has joined me in this endeavor. His latest program, which won a couple of science fair awards, transforms Radio Shack's CoCo into a digital thermometer that stores temperature samples at any specified interval. Later, the program retrieves the stored data and produces a bargraph of a series of measurements.

Though the programs Eric and I have developed provide capabilities as sophisticated as a storage oscilloscope, I didn't fully recognize the enormous significance of do-it-yourself computer-simulated test instruments until running, for the first time, Listing 1, which is, by comparison, a *very* simple program.

The ethereal image of the simulated light meter on the monitor raised my level of computer consciousness to a new high. Sure, no great skill was required to arrive at the program in Listing 1. But that's just the point. Unless you've spent the better part of a day assembling with a soldering iron and assorted hand tools a traditional light meter, it's difficult to fully appreciate the power provided by that relatively simple program.

Imagine, the computer-simulated light meter in Fig. 5 is a product of a quick sketch on a graphics worksheet, a few minutes of orchestrated keystrokes and little else! The meter can be easily modified to add extra features. For example, a correction factor that compensates for sensor nonlinearities can be easily inserted. Tired of its labels or color? Both can be easily changed. Bored with a conventional 0 to 100 readout? Change it, with a few extra keystrokes, to 100 to 0. Or −100 to +100. Or *any* scale you can imagine.

When it's not in use, the light meter wastes no space gathering dust on a shelf. Instead, it can be electronically vaporized by pressing a few keys. When it's time to make another light measurement, the meter can be reconstructed in seconds from the instructions previously saved on a few inches of magnetic tape or a tiny piece of floppy disk.

You can even make custom light meters and give them to your friends. Or, as I've done here, you can share them with literally thousands of fellow computer users in the pages of a magazine.

Yes, my computer-simulated gadgets require a power cord and they don't fit in a shirt pocket . . . yet. With *today's* technology, however, one can easily envision a pocketable computer about the size of Radio Shack's PC-3 equipped with a couple of analog-to-digital input ports and a liquid-crystal screen having a few thousand resolution points.

A machine like this would be a universal measuring instrument. Depending upon the resident program and the external sensor, it could function as a full-featured, programmable thermometer, light meter, pressure gauge, pulse-rate monitor and many other applications for which sensors are available. ◇

3M Floppy Disks
(Continued from page 61)

the landing zone, or landing strip. As the disk rotates and comes up to running speed it pulls air molecules between the surface of the disk and the head. Eventually, the density of the air molecules causes the head to lift minutely off the disk and fly about 5 microinches above the surface of the disk. Once airborne, the head can be safely positioned anywhere above the disk to read or write data.

If we had only hard disks, we'd probably still be waiting for PCs

But even—as illustrated in Fig. 1—the most minute particle, such as a grain of dust or a particle of cigarette smoke, is taller than the air cushion under the head. If the foreign particle gets under the head, it can momentarily interrupt the air cushion—causing the head to crash into the disk. The particle can also cause the head to rise sharply and, since anything that goes up must come down, the head does—right into the magnetic coating on the disk. Both conditions produce the infamous "head crash," so called because the head shaves the magnetic medium off the metal platter.

As you might expect, in order to keep airborne particles off the hard disk it's necessary to enclose the disk in a hermetically sealed cartridge or use a well-filtered air supply; and to prohibit the smoking of cigarettes, cigars, etc., in the disk-drive area. Early hard disk systems were intolerant of anything airborne, were expensive to purchase and maintain, and were priced well beyond the budget of the user of home and small business computer systems. If hard disks were all that were available for data storage, we would most likely still be waiting for the development of the personal computer.

Fortunately, IBM developed the floppy disk, which consists of a magnetic coating on a flexible plastic substrate (backing). Other considerations aside, the major feature of the floppy disk is a reduced platter speed that permits the read/write head to be in full-time contact with the magnetic coating on the disk. No longer is there the possibility of the dreaded head crash.

Of course, there were performance tradeoffs in the development of the floppy disk, the main one being that of storage capacity for reliability. While we have worked our way up to dependably storing almost 400K on both sides of a 5¼" floppy disk, the same technology that increased 5¼" floppy disk storage from 80K to 400K was also used for the hard disk. The modern 5¼" hard disk mechanism can store up to 10 megabytes (5 per side), so a hard disk drive is often used as a direct physical replacement for a 5¼" floppy drive.

Unfortunately, the 5¼" hard disk returns us to the problems of the flying head. A landing zone must be provided on the disk, and some form of software is required to ensure that the head is automatically parked on the landing zone when the computer is shut down.

Keystone Technology

And this brings us back to 3M's "Keystone" Stretched Surface Recording. Somewhere along the line someone must have wondered what would happen if the magnetic medium of a hard disk were deposited on a flexible film rather than on a rigid metal platter. After all, the problem of the magnetic material being stripped by a head crash is due primarily to the rigid substrate under the oxide coating; the head has no place to go but through the oxide.

But imagine what would happen if the hard disk's oxide coating were deposited not on an unyielding metal surface, but on a compliant film. Foreign particles sucked between the head and the medium could squeeze through because the film would "give" and permit the particle to flow between the head and the disk. There would be no oxide-stripping head crash.

If simply making the medium compliant can eliminate the head crash, how come we're still using metal hard disks? The answer, of course, is that until 3M developed the Stretched Surface disk a compliant-medium equivalent of the hard disk didn't exist.

Unlike the rigid metal platter used as a substrate for the hard disk's medium, the oxide coating of a Stretched Surface Recording (SSR) disk is applied to a plastic film that is stretched across a concave surface so it is taut but has some degree of compliance or give. The hard substrate never touches the active area of the medium.

The construction of the Stretched Surface disk is shown in Fig. 2. The substrate is a dished plastic disk having a raised outer rim and a raised hub. The 1.5 mil (0.0015") film medium, which is nothing more than an oxide coating on a conventional plastic film, is tautly stretched and secured to the rim and hub, thereby forming a drum: a taut yet compliant magnetic medium. Push your finger into it and you can feel it give way.

The cushion of air created when the disk rotates still causes the head to fly, but the compliant medium atempts to equalize the cushion and forms a dimple (Fig. 3) under the head. Any particle such as dust or cigarette smoke trapped in the air stream or its cushion is simply flushed out from under the head. If the particle needs room to pass under the head, the compliant medium moves one way and the head the other. If, for some reason, the particle should cause the head to bounce, the resiliency of the medium absorbs the shock without the magnetic coating being gouged away.

Except for the compliant medium, the Stretched Surface disk resembles a conventional hard disk, and it can be employed as a substitute for a conventional metal substrate disk. An experimental 5¼" Stretched Surface disk installed in a Seagate Model 412 hard disk drive unit —such as used for personal computers —yielded 5 Mb of storage capacity (2.5 Mb per side), though 3M envisions as much as 50 Mb from 5¼" drives specifically designed for Stretched Surface Recording. (Expect to see announcements of 10 M6 SSR systems around the time you read this.)

According to a 3M spokesman, Stretched Surface Recording disks can be manufactured in different sizes to accommodate all computers, from personal micros to mainframe maxis.

A 3½" disk could hold almost 20 megabytes

The Stretched Surface disk's reduced sensitivity to head crashes also raises the interesting possibility of high-density plug-in cartridge disks. Without the need for a filtered air supply beyond what's provided by the conventional fiberglass filters presently being used for computer cooling fans, an SSR disk could be enclosed in a plastic case that slid into the drive, much like an ordinary floppy disk. For portability, the SSR disk could be shrunk to 3.5". Since the SSR's storage capacity is linear, a 3.5" disk could hold almost 20 Mb—and that's a lot of data to be carried around in a shirt pocket. ◇

TO KEEP UP WITH TODAY'S TECHNOLOGY...YOU HAVE TO KNOW WHERE TO TURN.

When you turn to *Computers & Electronics*, you're reading the world's foremost publication covering the microcomputer industry — where last night's discovery is today's technology. *Computers & Electronics* is your direct link to state-of-the-art information in:

Microcomputer Developments
Whether you're investing $300 or $3000, turn to *Computers & Electronics* first. You'll find candid test reports of all major new microcomputers...from the Commodore 64 to the Apple™ IIe to the IBM-PCXT. And you'll discover which unit has the power, software and expansion capability to meet *your* specific needs. At *your* specific budget.

New Peripherals and Software
Micro programs and add-ons are increasing almost geometrically. Let *Computers & Electronics* sort it all out for you.

You'll get features like a buyer's guide to printers. A preview of the first workable *economical* thesaurus program that runs on virtually any CP/M-based system. Advance looks at new products like a joystick for Visicalc®...disk drive assemblies...a color monitor for the IBM-PC.

Increase Your Computer Science I.Q.
Computers & Electronics will enlighten you with easy-to-understand discussions of computer fundamentals. Such as the series on learning 16-bit microcomputer technology and an in-depth look at the structure of CP/M.

You'll also delve into the *future* with articles like Super Chip: next-generation personal computers with *double* the performance at a lower price.

Plenty of Hands-On Action, Too
With expert input from *Computers & Electronics*, and your own electronics savvy, you'll find dozens of ways to experiment with...upgrade...and increase the versatility and performance of your system.

For example, with less than $3 and very little time, you can add a feature to your keyboard that lets you automatically repeat a character by holding down a key. Or you might want to build a circuit that lets you match a 600-baud CoCo to a 300-baud printer.

Heard about the important new electrically-erasable PROMs? *Computers & Electronics* will keep you filled in on the improved memory chips as they're produced — how they work, how to wire them, what applications to use them for.

Get Every Issue...PLUS Savings up to 37%!
If you're not getting every informative issue of *Computers & Electronics*, there's a gap in your knowledge — and enjoyment — of today's high-speed, high-tech revolution. And now's the best time to subscribe, while this *introductory offer* is in effect: One year (12 big issues) for just $12.97, with long-term savings available up to 37%!

So keep up with what's happening. Turn to the special postpaid order card or the coupon below...*now!*

DON'T MISS ONE INFORMATIVE ISSUE. SUBSCRIBE NOW AND *SAVE UP TO 37%!*

WORLD'S LARGEST COMPUTER MAGAZINE
Computers & ELECTRONICS

P.O. Box 2774
Boulder, CO 80322

YES! Keep me tuned in with *Computers & Electronics* for the term I've checked below:

☐ One year (12 issues) just $12.97 — **I save 24%!**
☐ Two years just $22.97 — **I save 32%!**
☐ Three years just $31.97 — **I save 37%!**

(Savings based on full one-year subscription price of $16.97)

Mr. /Mrs. /Ms. _____
(please print full name) CE4S176

Address _____ Apt. _____

City _____ State _____ Zip _____

CHECK ONE: ☐ Payment enclosed. ☐ Bill me later.
Please charge my credit card: ☐ American Express ☐ MasterCard ☐ Visa

Card No. _____ Exp. Date _____

Add $5 a year in Canada; all other foreign add $8 a year. Please allow 30-60 days for delivery of first issue.

Service Organizations
(Continued from page 55)

ment before, during and after a warranty. Bob Wolff, of Wolff Computer, says that many of his customers' service problems can be taken care of over the telephone. Service technicians are able to trouble-shoot and diagnose without the need of a service call, saving time and money for both the customer and the dealer.

But not all service problems result from something as simple as misreading documentation or operating a software program incorrectly. That's where a service contract can be invaluable. But how does one determine whether the $300 or so expenditure per year is really cost-efficient?

Holton Walker, a New York-based computer consultant, says the best way to determine whether a service contract is worth the money, is to weigh how important the use of the machine is.

If down time can mean lost business or revenues, then the reassurance of a service contract, especially one that offers replacement or exchange, can relieve many worries and be well worth the price. But, "if the owner is just a weekend hacker, quick service and replacement are less crucial," Walker says.

Preferred Treatment

An important feature of most service contracts is that those with them usually receive preferred treatment, most often exhibited in quick turn-around time.

Once the need for a service contract has been determined, the next decision is whether to opt for a contract with a TPM, a manufacturer or a dealer. That choice is often determined by the type of system. IBM owners, who've created multi-vendor systems, are forced to look beyond IBM for service. Even though this can be frustrating, the rise of blended contracts, single contracts written by one TPM to cover a variety of equipment and vendors, have made being a multi-vendor owner tolerable.

One IBM XT user, Paul Somerson, a computer magazine editor, says that even though IBM won't service all his peripherals, his service contract with them "is the most valuable thing I own." Somerson has had complaints about certain facets of IBM service—technicians coming to do on-site work ill-equipped and having to borrow diagnostic and DOS disks from the customer, for example—but the fact that IBM replaces rather than repairs boards and other equipment is a plus, he says.

As the Frost and Sullivan study showed, the perception that manufacturers, servicing is the best is changing. As technicians leave the larger companies, either as a result of lay-offs due to the industry shake-down or to set out on their own, qualified technicians are fairly plentiful, unlike in the 1960s when trained personnel were hard to find. Even if manufacturer service is inadequate, it's possible that the parties transporting repaired equipment from the service center to the customer will be less than careful, undoing all the expert repair. You should always make sure the repair service guarantees its work—all the way to your home and office—or you might find yourself trying to get reimbursement from a courier service which knows nothing about computers and may not care.

Although on-site back-up plans are the most expensive in actual costs, the cost of paying a courier or an employee to transport equipment to a carry-in service center can send costs soaring, as in television repair.

Which kind of equipment a user has is also a factor in deciding on what kind of contract to choose. Printers and disk drives, because they have moving, mechanical parts, are more likely to experience malfunctions. Moving parts, unlike most microprocessors, do wear out with use. If you don't have, or need, the use of a printer, a service contract may not be worth the price. It is possible to purchase separate agreements on each component, which can be a saving.

Another important, although not necessarily problematic, fact about service contracts is that although you may sign with a manufacturer to supply you with service, you might not be guaranteed that that particular firm will be doing the repairs. Kaypro and Apple, for example, are strictly manufacturers—no service—and therefore subcontract with a third party to provide service for their customers, much the way a dealer does. Apple offers Applecare, a carry-in service plan; according to Kathleen Dixon, an Apple spokeswoman. The company services equipment through the RCA Service Corp. and prices each contract per component. They also offer other plan options as well as maintenance through dealers with Apple-trained technicians.

Charges for the Applecare program range from $84 a year per component for the Macintosh to $48 per year for the Apple IIe.

Kaypro, in addition to offering service through Xerox service centers, also has an agreement with MAI/Sorbus. Sorbus offers a monthly or annual rate for a service contract, according to spokeswoman Margaret Phanes. While a machine is still under warranty, service is up to the individual dealer who sold the computer, but must be performed by certified Kaypro technicians. Some loaned machines are available through selected dealers.

Radio Shack on-site or carry-in contracts are based on which model is covered. Onsite servicing ranges from about $350 per year for an average configuration. Chuck Chenault of Radio Shack says that leasing customers as well as owners should also plan on purchasing a service contract. He says it is difficult to predict when and how service needs will crop up. "With all-electronic parts, use alone doesn't mean it's going down more," he said.

But as any user whose printer has jammed or screen has gone blank knows all too well, finding help fast can be a nightmarish experience. That's why knowing the options before an emergency happens can help get your micro running again without your having to pay a ransom or wait weeks for the serviceman to come. ◇

Compaq
(Continued from page 45)

however, is somewhat different, and LEDs light up when NUM LOCK and CAPS LOCK keys are used. Because the keyboard is connected to the front of the unit by a plug-in connector, it can be replaced by a third-party keyboard.

In conjunction with the new computers, Compaq announced peripherals (two 12" monitors—an amber and a green—and an asynchronous communications/clock board) and accessories (a tilt and swivel monitor stand and a computer stand that allows users to tuck the keyboard in under the system unit when not in use).

To support the production of the new series of computers without affecting the production of the existing models, Compaq has set up a new Houston plant and is in the process of adding 100 people to its staff of 800. Compaq believes its new line will allow it to continue its rapid growth, which in 1983 made it the first United States manufacturer to achieve more than $100 million in sales in its first year of production. ◇

TIMEX SINCLAIR TRIPLE PLAY!

MORE PROGRAMS. MORE GAMES. MORE PRACTICAL APPLICATIONS.

That's what you can get from your Timex Sinclair with these 3 new books from Creative Computing Press.

1 50 Programs for the Timex Sinclair 1000

Exciting games, graphics, math, physics and business applications make your unexpanded TS 1000 more versatile than you ever thought possible. Easy-to-follow instructions let you immediately type in and run each carefully-tested program. Features excellent user-friendly feedback, improved screen display and graphic quality. A great way to expand your computer capability and add to your software library. Go for it! Softcover, 5⅜" x 8⅜", 15T, $6.95. ($1.50)

2 Creative Games for the Timex Sinclair 2068

A complete guide to the TS 2068 color computer, *Creative Games* allows you to enjoy your computer while learning to use it more effectively. Contains 21 number games, word games, simulation games, dice games, card games and grid games. Each one accompanied by clear instructions for entry and play, plus an explanation of how the game was written. You learn everything from how to set up your machine and make entries to how to create your own original games. Order yours today! Softcover, 5⅜" x 8⅜", 2T $7.95. ($2.00)

3 The Timex Sinclair 1000 Ideabook

Discover your TS 1000's hidden strengths—and overcome its weaknesses—so you can get more out of it every time you use it. Written in easy-to-understand language, the *Ideabook* includes 50 ready-to-run programs that can help you solve practical problems in math, science and business. Ten informative chapters cover repetitive trial, convergence, recursion, compounding, probability, geometry, science, simulations, drill and practice. Send for it now! Softcover, 5⅜" x 8⅜", 3P, $8.95. ($2.00)

Use this coupon to order your Timex Sinclair books today.

For even faster service,
PHONE TOLL FREE:
800-631-8112
(In NJ: 201-540-0445)

Also available at your local bookstore or computer store.

Creative Computing Press
Dept. NX3F • 39 East Hanover Avenue • Morris Plains, NJ 07950

Please send me:

	Book No.	Quantity	Price Each	P&H Each	Total Price
50 Programs for the TS 1000	15T		$6.95		
Creative Games for the TS 2068	2T		$7.95		
The TS 1000 Ideabook	3P		$8.95		
				CA, NJ and NY State residents add applicable sales tax	$
Postage and handling charge appear in parentheses ( ) next to price of book.				TOTAL AMOUNT	$

☐ Payment enclosed. $_____ (Outside USA add $3 per order.)

☐ Charge my: (Charge and phone orders $10 minimum.)
☐ American Express ☐ MasterCard ☐ Visa

Card No._____ Exp. Date_____

Signature_____

Mr./Mrs./Ms._____
(please print full name)

Address_____ Apt._____

City/State/Zip_____

☐ Send me a FREE Creative Computing Catalog.

ExecuVision
(Continued from page 74)

limited artistic talents? ExecuVision sells six libraries of pictures and picture elements available to help you break your creative bonds. Each library contains 30 to 70 images: maps of the world, of the United States and of European countries; "artistic" borders; initials and decorative design elements; industry and business scenes; face's and figures; and international symbols.

Will pay for itself with the first presentation

The program allows you to combine these library images, or images you create yourself, with standard charts. The combination makes for a more vivid presentation than just the chart alone.

Creation of a combined image is merely a cut-and-paste process. You load a picture with an element you like from the disk, wipe away the irrelevant portions, then enclose and move what remains.

Rescaling of images does not seem to be in ExecuVision's bag of tricks, so it is necessary for you to conform to the program, rather than have it conform to your purpose. Even with this limitation, though, the creative potential is enormous.

ExecuVision also gives you the ability to take a drab black-and-white image and apply to it the full flower of color. You can fill white-on-black images with color and also add background color simply and easily by running through a cycle of keys.

While your business colleagues may view the range of colors as extensive, your artistic friends will consider them rather limited. From either perspective, the ability to explore easily a range of colors for an effective on-screen presentation is a useful feature of ExecuVision.

Once you have your graphics just the way you want them, you can store them on disk for later use in embellishing charts.

One of ExecuVision's strongest points is its ability to animate chart elements. You can place an object on a "slide" with a "move" option that will move the object from one point to another in a straight line. This is an excellent attention-getting device. It is useful, though, only when you make a "live" presentation direct from the computer (through a video projector or monitor). Obviously, you won't be able to dazzle clients who only have a paper copy of your report.

Finally, ExecuVision provides features to allow you to compose and run through a programmed series of slides. Using a secondary menu you can select slides for presentation and order (or reorder) their sequence. You can preset the time each slide is to remain on the screen or trigger slide changes manually. You can also pick any slide from the collection for review (during a question-and-answer session, for example) either by repeatedly pressing an arrow key to step through the slides or by entering a number to indicate how many slides are to be skipped to reach the one desired.

But Wait . . .

So far, ExecuVision looks like the answer to the prayers of anyone who has ever had to create an attention-getting graphic presentation. Before you rush out to buy it, though, there are a few more things about the program you should know.

Many users will create terrific charts and then look vainly for a means to transfer them to a less volatile medium than the screen of a CRT. ExecuVision —at least in its current release—does not support a plotter or equivalent hard-copy device. Nor is the Polaroid Palette (a device for making Polaroid color prints from screen images) supported. This is such an obvious limitation that a driver for either the Polaroid product or a competing device is sure to be in the works.

ExecuVision's color facilities are useless with regular printers. In fact, it is quite possible to create an image that does not print on a dot-matrix printer at all! That leaves you with the choice of either a photo of the screen or the output of a multi-colored-ribbon or ink jet printer. Either way, the animation capabilities also are lost unless you use a CRT hookup or videotape.

Another problem is that you are limited to creating images that fit onto a single screen. Since typefaces can be expanded (and only in fairly large increments—not continuously) but not reduced, the amount of information you can put on a chart is restricted. For an organization chart, for example, it is essential that the staff be small and its members have rather short names.

And, while ExecuVision images exist on three different levels—text, library graphics, and objects you draw yourself pixel-by-pixel—limitations restrict how you can manipulate them. While you can move and scale a library object at will (until it is set in place), you cannot move the other two image types with equal ease. Often you must move pictures to the text, rather than the text to the picture.

The ExecuVision license agreement in the manual might surprise you. It omits any mention of what remedies are available to you if the program doesn't perform. However, there are four pages describing what Prentice-Hall *won't* do should you have the temerity to ask. A toll-free number is provided, though, for ordering, customer inquiries, and technical support.

The ExecuVision User

Who, exactly, will want to use ExecuVision? Probably not the executives the product is named for (after?). They're too busy. They won't want to do all the adjusting required to make their charts come out exactly the way they want, and they may feel that the manual is talking down to them.

On the other hand, the pixel-by-pixel approach is likely to be scorned by commercial artists in favor of schemes with true vector-graphics image creation, even though such systems are considerably more expensive (and not generally available for microcomputers).

That leaves as ExecuVision's audience artistic, do-it-yourself types in, say, a company's marketing department. With ExecuVision they can develop special displays that are unique to them. No more lines or bars marching in stoic monotony across the screen. With an ExecuVision chart, a simple line can be transformed into either a minor character or embellished into the lead in a fully realized drama. The potential is there; it simply needs exploiting. ◇

Overview

Product: VCN ExecuVision
Vendor: Prentice-Hall
200 Old Tappan Road
Old Tappan, NJ 07675
Price: $395; Library Modules $80-90 each
Operating System(s): PC-DOS Version 1.0, 2.0 or 2.1
System Requirements: IBM PC (two drives) or XT; 256K RAM
Comment: VCN ExecuVision would not be the only graphics package in this reviewer's library, nor would it be the first. But for under $1000 (including all the libraries), it is a pretty impressive piece of software that will pay for itself with the first presentation created in-house rather than by an outside graphics service.

Software Arts
(Continued from page 67)

Software Arts' computer network. One small margin involves communication speeds. In particular, signals from remote locations, such as employee homes, could be quicker.

Leased Lines

Bob Frankston has a high-speed leased line tying his home units into the system; all other units come in at standard communication speed (300/1200 baud). Another improvement would be introduction of high-speed optical scanning devices to input research material from periodicals, for example, right into the system.

This would be possible, of course, only if and when such devices become economically feasible and if copyright law is reinterpreted to permit such action. Otherwise, the network works effectively and efficiently, utilizing current technology nearly to its fullest. It suits an environment in which staff members feel at home and, at the same time, succeed in tapping their own internal resources in getting the job done. ◇

SX-64
(Continued from page 35)

with all C-64 software except those programs on cassette tape. What prevents the SX-64 from running the programs is that it has no provision for cassette input/output.

One game I used during the review is "International Soccer." It is the first in Commodore's "Gold Medallion" series. The perspective is great; the game even has the shadow of the ball growing larger and smaller as the ball rises and falls. I loved it, and ordinarily I am not what you would call a soccer fan.

Summary

Microcomputers can take up a lot of room, especially in an apartment or a small house. Where space is tight, the SX-64 might be a good choice. This machine certainly has lots of economical peripherals and can run all of the vast library of Commodore software available on cartridge or diskette.

There are practically no technical differences between the C-64 and the SX-64. The connectors are the same; the diskette drive is no faster; the functions are the same. The package is the difference, and it is a very practical difference. I like this—quite portable—machine a lot.

At about $800, the SX-64 is a winner, even without an r-f modulator. ◇

Circle No. 23 on Free Information Card

Guest Column
(Continued from page 26)

of operating. So they took the system more or less half way, with the Q W E R T Y protocol. It has the typist alternating from one hand to the other hand about half the time. Often he is required to use the same hand to type two, or three—even four, sometimes five—successive strokes, thus slowing down.

Anyway, the purpose of an exercise book is to give you practice in using the same keys—getting you used to them. Right under Q W E R T, for instance, comes A S D F G. So that an exercise book might say,

Type the following combination of letters with your left hand:

"as sad daf fad fass."

Do that a few times, and you become accustomed, looking up at your chart, to putting your fifth finger down on the middle row when you want an "a," the fourth when you want an "s," the third when you want a "d," the second when you want an "f." Then the exercise book will go on and combine letters from the first row, the Q W E R T Y row, and the second row. Telling you, for instance,

Type the following:

"red rad raf eaf ead eas was wad waf qas qaf qea qef"—etc.

Finally, to complete your left-hand learning, try exercises combining all three rows, for example: zer baf vew bea qeb gax exr. Practice those for about an hour. Then you can make up—or take from the exercise book—similar simple workouts for your right-hand.

You get the idea, and my point is exactly that—anyone can get the idea. But meanwhile, very important things are happening. You are not looking at the keys on your typewriter, for the very simple reason that there is nothing there to see except black blot-out paper. What is happening, slowly—well, not so slowly, really—and surely—absolutely surely—is that you are not merely learning to type, you are learning to touch-type. And concerning the difference between the two, I can only think, as analogous, the difference playing the piano while your eyes are on the sheet music ahead of you, or needing every time to look down to the piano keys to find the key that corresponds to the note you wanted to play.

But back to my own schoolboy experience. For two or three late afternoons and evenings, during study periods, I would look at the piece of paper ahead of me and cause my fingers to descend on the position that corresponded to the position on that facsimile sheet of a typewriter keyboard. After three days I did not need the sheet of paper. I had learned to touch type. I would guess I had put four, maybe five hours into the whole process of learning. My initial speed was very slow, but within a couple of weeks I was typing better than forty words per minute.

Experience Number Two. At age 12, my son was idling an hour during the late afternoon having come in from skiing. Because we were in Switzerland, he had no recourse to television, so impulsively I said to him, "If you like, I'll teach you how to type. But there is one condition. You have to do it my way."

"Okay."

This time, typewriter caps having disappeared, I needed to bring out some black paint which, with a little brush, I applied to the keys, causing the letters to disappear. It was an acryllic paint, so it dried within twenty minutes. I used that time to type a facsimile, and to draw the finger zones. I posted them on a wooden wall opposite the desk, and began dictating. "Type 'sad.' Type 'fad.' " And so on.

My 12-year-old son learned touch typing in an hour and a half

Now brace yourself. One hour and one half later, I said to my son, "Type, 'The quick brown fox jumped over the lazy dog.' " He made a few mistakes, but he got it. He had every letter of the alphabet using the correct finger.

He had learned touch typing. Oh sure, he couldn't go out the next day and get a job as a typist. But if he had practiced two hours a day, in two or three weeks he could have.

Children, it is notoriously known, learn more quickly than adults, so I don't expect I'll do as well with Dick.

Who is Dick?

Well Dick Clurman is close to sixty years old, and one of the senior journalists in America. He has been typing since he was eight years old, editing successively a grammar school, high school, college and army newspaper. He has served as editor of *Newsday*, as chief of correspondents of *Time-Life*, and in a number of other jobs, and is never far removed from a typewriter. But like ninety-five percent of those who "type," he never got around to gluing those circular black dots over the keys and forcing himself, every time he struck an "r" or an "f" or a "v" to use only the second finger of his left hand. Like a lot, perhaps most, of his professional colleagues, including the editor of this magazine, he is very proficient in the sense that he can type at great speed. But his head needs to be bent over the keyboard to make sure that he is striking the right key.

What does it matter?

It matters like this. You can't, unless you touch type, copy anything with any fluency. Let us say that the story you are writing requires you to copy the first three sentences of the Gettysburg Address. So you dig it out, prop it up, bend over the pages of the book, turn your head left and begin:

"Four score and seven years ago, our forefathers brought forth a nation conceived in liberty, and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation or any other nation so conceived can long endure."

The touch-typist can reproduce that passage—and the whole speech—without once turning the head from the page being copied. The non-touch-typist needs to memorize a few words from the text, then turn to the typewriter to reproduce them, then turn back to the book, find exactly where in the text he left off, then back to the typewriter, and so on. This may not be so painful when writing down Lincoln's Gettysburg Address, because, already familiar with the text, you can commit a longer sequence of letters and words to memory. But imagine that you are quoting unfamiliar or dense material; a speech by Professor Galbraith on economics; or a foreign language.

Well, that is the end of the lesson. Never in the history of the world was it easier to achieve proficiency in any discipline than touch typing. But because people think it's hard, they never get around to it. They think of fortnight after fortnight in a classroom with an instructor.

And before you know it, they are sixty years old and, like Dick, still they don't know how! I swear, it's like reaching sixty and not learning how to open a window or turn on a television set! You ask, Okay, so it took your 12 year old son an hour and a half to learn touch typing, how long will it take your friend Dick?

I don't know. He's going to start this very afternoon, he tells me. I'd guess four or five hours.

P.S. It actually took six. He had a lot of bad, old hunt and peck habits to get rid of. ◇

LCDs

(Continued from page 51)

forming a twisted structure like a spiral staircase. The spiral polarizes any light passing through it.

You can see this polarization effect only when you look at the display through a polarizer with another polarizer behind the liquid-crystal panel (Fig. 2A). When the liquid crystal is off—in its twisted arrangements—the panel acts as a crossed polarizer that blocks the passage of light.

Turning the liquid crystal on is a matter of setting up a field across the thickness of the panel. In the presence of such an electric field, the twisted crystals line up in the direction of the field—parallel to the thickness of the panel so that you're looking at the ends of the molecules (Fig. 2B). The crystals therefore no longer polarize the light passing through. Thus, the portions of the display affected by the field look different from the rest of the panel. Depending on how the polarizers are oriented, you can make areas that are turned on appear dark on a light background or vice versa.

The field is applied to the panel by using two sets of electrodes on the glass plates that contain the liquid crystal. The electrodes on the display's face are made of a transparent conductor; and, if the panel uses back lighting, the rear electrodes are transparent too. In general-purpose displays, one set of electrodes runs horizontally, the other vertically. You create a field in the crystal by putting a voltage across one horizontal electrode and one vertical electrode at a time; where the electrodes cross, the resulting field turns the crystal on. LCDs use very little power because almost no current flows through the panel. The whole thing works on the field alone.

Guest-Host Eases In

One alternative to twisted nematic panels is the guest-host type, which doesn't need polarizers. Because the entire display consists of the liquid crystal panel itself, it provides a wider viewing angle and has the potential of costing less than the twisted nematic LCD. Research on guest-host panels has gotten off to a slow start, though, so it will take some time to find out if these displays can deliver on their promise.

Guest-host displays work by incorporating a dye into the liquid-crystal material. The liquid crystal is the host, and the dye is the guest. When the display is off, the nematic crystals in the panel line up parallel with the front and back sheets of glass and force the dye molecules to line up too (Fig. 3A). When they're lined up this way, the dye molecules block any light that tries to pass through the panel. When you apply an electric field, however, the crystals act just as they do in a twisted nematic display: they line up at right angles to the front and back glass (Fig. 3B). The dye stays lined up with the crystals and no longer blocks the light. You can turn on any part of the panel by using the same kind of electrodes that are used in the twisted nematic panel.

There are several kinds of guest-host LCDs, one of which works like a twisted nematic panel without polarizers. But all use a dye combined with the liquid crystals. The panels tend to need higher voltages than twisted nematic types, to work somewhat slower at low temperatures, and to be a little less reliable. But they do offer some advantages, including single-color displays. Producing the color is a simple matter of using a colored dye. So far, though, these displays are very small—only a few digits or special graphics for applications such as automobile dashboards.

More Colors

What about multicolor displays? Knowing how LCDs work makes it difficult to see how a full-color panel could be made, but Seiko claims to have done just that. The panel uses the standard twisted nematic effect in what is called the transmissive mode: a light source behind the display transmits its light through the panel to your eye. Colors are produced by use of a three-color filter placed over the front of the panel. Each of the 57,600 dots (pixels) in the LCD corresponds to either a red, blue or green spot on the color filter. Thus, turning on a pixel behind a red spot results in a red dot on the display. By controlling this dot's intensity and the intensities of the green and blue dots next to it, you can generate any color just as on a CRT.

One other interesting thing about this Seiko display is the technique used to control the pixels. Although all currently available LCDs use integrated circuits (drivers and multiplexers) to turn pixels on and off by directly driving row and column electrodes, Seiko uses a different method.

In this approach, active circuit elements (polysilicon field effect transistors) are deposited along with the electrodes on the back sheet of glass. The result is a smaller package that doesn't need to interface to control electronics through all 480 of its row and column lines—an obstacle with large panels. A display using this method might only require the generation of a code on a few input lines to tell the panel which pixels to turn on. Seiko will sell the color panel

LCDs

in the US as the display for a small television receiver later this year.

A New LCD Technology

Although CrystalVision's LCD doesn't display color, it does have other appealing characteristics, which are derived from a remarkable new technology. The display's characteristics include 25 rows of 80 columns in the same 9″ diagonal size of many CRTs, nonvolatile operation, and high contrast. The size of this display is significant; other LCDs might display as many characters, but they do it in a much smaller area.

CrystalVision's LCD uses several different liquid-crystal phases. And instead of relying on an electric field alone to control the pixels, these LCDs also use heat. When heat is applied to the crystal material, the crystals go from the smectic to the cholesteric to the isotropic phase. When the material reaches the isotropic phase—a normal unorganized liquid state—applying an electric field will align the crystals, which then allows light to pass through and reflect from the display's backing plate. Pixels not affected by the electric field absorb light and appear dark; aligned crystals appear light. Arranging the heating and field electrodes in a grid allows heating up one row at a time and applying a controlling field to any pixel.

There's more to this display, though. When the crystal material cools back to the smectic phase (a waxy solid), with or without an electric field applied, the crystals stay in the alignment they were given. You can therefore unplug the unit without losing the information.

Because the crystal material has to be heated and then cooled every time something is written on the display you might suspect that these panels don't respond as fast as other LCD types. That's true. But the slow response is not an acute problem for two reasons. First is that screen refresh isn't necessary. Other LCD types, such as twisted nematic panels, must be refreshed at regular intervals. CrystalVision LCDs retain whatever is written to them.

The second reason that speed is not critical involves the nature of computer displays. The next time you use your computer, notice how much of the screen actually changes from moment to moment. In editing a text file, for instance, you might move the cursor from one place to another. The CrystalVision panel would have to heat up one line to erase the cursor and another line to display the cursor's new position. But the rest of the screen remains unchanged. This is true for most operations.

One of the few common activities that alters the whole screen at once is scrolling. It might look like you're seeing mostly the same information from moment to moment when you scroll through a file, but think about it from the display's point of view. Nearly all the pixels have to change every time you scroll up or down a line. CrystalVision's panel is fast enough to do very credible scrolling. In fact, seeing it makes you wonder why speed should be a question at all. Nevertheless, don't expect to see CrystalVision's LCD in a TV; the display couldn't keep up with the constantly changing image.

One of the most apparent benefits of this technology is the display's contrast ratio, which is impressive to see. CrystalVision promises a contrast of about 10:1 in production models. That's better than you get with newsprint (about 7:1) and much better than any other LCD. The high contrast results from use of a special crystal material that contains a lot of dye and doesn't depend on external polarizers. Getting rid of the polarizers gets rid of some contrast problems and also helps the viewing angle. This LCD's viewing angle—about 120 degrees—is much wider than that of other types. Further, the panel's back reflector prevents ghosting in images. The reflector consists of the heating and field electrodes that are on the *inside* of the back glass rather than the outside like most LCDs.

Unfortunately, CrystalVision's design doesn't run on the same miniscule current that powers other LCDs. Although the long-term power level might average out to only 3 W (when you consider that most of the display rarely changes), you have to be ready to supply the power needed to change the entire screen whenever needed. Thus, this LCD ends up needing about as much power as a CRT (about 30 W).

On the positive side, if no major manufacturing problems arise in volume production you can expect to see these displays in computers before long. The time from production to use should be short because CrystalVision is packaging the LCD with all the necessary electronics to make a moderately intelligent terminal. Just add power supply and housing. At prices as low as $600 for quantity orders of the display and driver boards, it will be interesting to see who puts this LCD in a box first and how they use it.

How long will it be before you can buy a computer or terminal with a big LCD in it? That depends entirely on how fast computer manufacturers react. It takes some time to design a product around a new display, but market pressures should speed things up in this case. The pressure is so great, in fact, that at least one manufacturer is leap-frogging itself. Gavilan announced a nifty portable with an 8-line LCD a year or so ago, then later promised a 16-line display before producing the smaller version.

The technology is moving so fast, it's hard to tell where to place your bet. Are 40-line LCDs right around the corner with a $1.98 price tag? You'd better not bet on that, but you can expect some impressive displays to show up on your lap in the near future. ◇

Communications Software

(Continued from page 59)

or two keys on your keyboard. A simple macro would be your password for a particular service; when the service requested your password, you would hit the correct key to transmit the password macro.

Some programs allow more sophisticated macros—for example, macros that transmit one string of characters, pause for a half-second, then transmit another, or macros that trigger other macros. But typically, with macros, you control the logic—you watch what's coming in from the remote service, and choose to trigger the macro at the appropriate time.

A *script* approach lets you set up a little program that can run unattended once it has been initiated: dial the number; wait five seconds; transmit the account number; wait two seconds; transmit the password; wait another second; transmit a command; and so on.

Sophisticated macro facilities equal the power of unsophisticated script facilities, but typically a script approach allows more flexibility and a greater degree of automation. Creating either a script or a complex macro requires you to study carefully exactly what the sign-on sequence is (does it say "YOUR PASSWORD?" or "your password please:") and much trial and error.

Script facilities can be classified according to the kind of testing they do on what comes in from the remote computer. The least powerful scripts only allow a time delay between sending strings. More powerful programs make it possible to wait for a particular character (like the "?" or ":" in the examples).

Better still is a string test that could watch for the whole query "PASS-

WIN AN APPLE IIc IN THE A+ SWEEPSTAKES

AND SAVE UP TO 33% ON A+ MAGAZINE

The A+ Sweepstakes is open to all our readers—no purchase is necessary—and you can win the new $2,000* Apple IIc System!

It's Easy to Enter...

Just mail the attached card or coupon below after filling in your name and address—and be sure to indicate whether you're also subscribing to A+ at our special rates, *saving up to 33%!*

Just imagine, if you're the lucky winner you can pick up your 7½ pound system and carry it home with you! You'll get over $2,000* worth of equipment including the Apple IIc with a built in disk-drive, 128K RAM and 16K ROM, Applesoft BASIC and Mouse Text, PLUS the new flat panel LCD display and Mouse! *But why dream? Send in your Entry Card today, and save up to 33% on A+!*

Make All Of Your Computing Dreams Come True With A+!

A+, The Independent Guide For Apple Computing makes computing imaginative and educational. Every month you'll receive new business, education, game and personal applications that will help you expand the use of your Apple II, II+, IIe, III, Lisa, Macintosh or the new *IIc* in your home, office or school! In-depth reviews (and previews) of new hardware, software and peripherals makes A+ the only magazine you'll ever need to make your Apple grow!

Enjoy a year or more of A+ at our low prices—save up to 33% and enter the A+ Sweepstakes today! It's an opportunity you won't want to pass up.

*based on manufacturer's suggested list price.

OFFICIAL RULES—NO PURCHASE NECESSARY

1. On an official entry form or 3" X 5" piece of paper, handprint your name, address and zip-code. Enter as often as you wish, but mail each entry separately to: A+ SWEEPSTAKES, P.O. Box 2928, Boulder, Colorado 80322. Entries must be received no later than October 31, 1984, and the drawing will be held by November 30, 1984. All entries become the property of A+ Magazine, which reserves the right to reprint the name and address of the winner.
2. The winner will be selected in a random drawing from among all entries received, under the supervision of the publishers of A+ Magazine, whose decision will be final. Only one prize will be awarded in this Sweepstakes. Winner will be notified by mail and may be required to execute an affidavit of eligibility and release. Odds of winning will depend on the number of entries received. Ziff-Davis will arrange for winners to pick up their prize at a local Apple dealer. Any manufacturer's warranties will apply, but Ziff-Davis makes no warranties to any prizes. Prize is not transferable. No substitution for prizes. Taxes are the responsibility of the winner.
3. Sweepstakes open to all residents of the U.S., its territories and possessions, except employees (and their families) of Ziff-Davis Publishing Company, its affiliates and its advertising and promotion agencies. Void wherever prohibited or restricted by law.
4. For the winner's name, send a stamped, self-addressed envelope to A+ SWEEPSTAKES, Circulation Department, Ziff-Davis Publishing Company, One Park Avenue, 4th Floor, New York, NY 10016.

OFFICIAL ENTRY FORM

A+ SWEEPSTAKES

P.O. Box 2928, Boulder, CO 80322

☐ ▶ **YES** Enter my name in the A+ SWEEPSTAKES and start my subscription to *A+ Magazine* for the term checked:

☐ One year for $19.97. SAVE 20%!
☐ Two years for $36.97. SAVE 26%!
☐ Three years for $49.97. SAVE 33%!

Savings based on full one-year (12 issues) subscription price of $24.97.

☐ **NO** I don't wish to subscribe now, but please tell me if I've won the Apple IIc.

Mr/Mrs/Ms _____
please print full name

Company _____

Address _____ AM8H351

City _____ State _____ Zip _____

Check one: ☐ Payment enclosed ☐ Bill me later **Charge my:** ☐ AMEX ☐ Visa ☐ MasterCard

Card No. _____ Exp. Date _____

Please allow 30 to 60 days for delivery of first issue. Add $12 per year in Canada and all other foreign countries.

Communications Software

WORD?" and not be confused by other question marks. The final, most complete script facility will allow the script to make a decision, or branch, depending on what is transmitted to it—for example, if the response coming in is "service busy, try another number," the script could go on to try another number; otherwise, it would proceed with the normal sign-on.

A script feature that has access to your computer's built-in clock also makes possible completely unattended operation. You could, for example, set up your computer to dial the one in your branch office at 4 a.m. (that one, of course, will have to be able to act as a host), fetch yesterday's accounting records, and print them out for your study first thing in the morning.

Break Key

Computer terminals always have a key labelled, BREAK, which does what it says: it causes the remote computer to break from whatever it is doing, and wait for another command. It is most commonly used on larger systems when you discover that the information you've just asked to have printed is the wrong stuff, or that the program you've just set to execute isn't working the way it was supposed to.

Unless you can be sure you'll never find yourself in that position, be sure your communcations software implements the BREAK function. Technically, pressing the BREAK key (whichever one is assigned to that function) should cause the computer to send (via the modem) a signal equivalent to a logic-0 lasting 150-250 ms.

Data Capture

Data capture is the computer equivalent of tape-recording a telephone call. It means recording—on disk or in memory—all the characters you type in at your end plus all the characters received from the other end. The use of data capture when receiving information from another computer is often called "downloading".

Data capture is a useful feature no matter what your application is. If you're working with databases or electronic mail, it will also save you money—you don't have to read what you've retrieved while you're on-line and paying for line charges and connect time.

Some programs save data in memory, some on disk, and some offer the option of either or both.

Memory capture can offer a number of conveniences, like backing up in the data you've captured to re-read something, even while the remote computer is still transmitting. But it has the same weakness as any other memory-based function: if something happens during the process, like a static spark or a power failure, you can lose everything.

Of course, memory capture must allow you to write to disk later, for permanent storage. A capture feature should warn you about data you've left in memory when you decide to quit the program, and also warn you when memory is nearly full. Saving directly to disk is safer, although with some programs it may slow down the whole operation.

Printer Toggling

It often is useful to be able to print out what is coming in as it is coming in—especially in database searching or electronic mail.

Programs that implement this feature well make it easy to turn the printer on and off so you can print selected parts of your session. If you have a slow printer or a fast modem, watch for a buffered printing feature that allows the incoming data stream to get ahead of the printer without losing anything. (The data is stored in the buffer and channeled out to the printer at the printer's speed.) Of course, if you capture to disk, you can always print later.

Text File Transmission

Most remote computer systems assume that they are receiving characters as they are being typed on your keyboard. Many on-line services charge you by the minute to connect to them. Consequently, you are often better off doing the typing before you go online, then signing on, sending everything quickly and perfectly, and signing off as quickly as possible. To do this, your software needs a text file transmission feature. It's essential with electronic mail applications, often useful in transactional or programming situations. (In contrast to "downloading," this process of transferring data from your computer to another is often called "uploading.")

Ideally, a text file transmission feature will let you simply say "Sendfile MYTEXT," or something similar, and "MYTEXT" will be taken from the disk drive and transmitted. To the computer at the other end, it will appear exactly the same as characters typed on your keyboard. A useful auxiliary feature is a "throttle," a feature that lets you control the character-to-character and line-to-line delay in this transmission; some remote systems can't take full-throttle 1200-baud text.

If you intend to transmit text files, you

must also be sure you have the software to create them. In particular, your word processing software must be able to produce a standard ASCII file; not all word processing software does. You should also be aware that some non-text characters, especially the Control-S and Control-Q characters, have special meanings to many on-line systems. If your word processing software uses them (Wordstar, for example, does) leave them out of anything you plan to transmit.

Protocol Transfers

A *protocol transfer* is the transfer of a file using a special, error-checking procedure between two computers that know the same procedure (protocol).

Protocol transfers are necessary for error-free transmission of binary program files. If you are transmitting a piece of text, and a single bit doesn't get through correctly, nothing serious has happened: a "B" may come out as an asterisk, and it just looks like a minor typo. But a single erroneous bit in a program file can mean disaster, so error checking is important.

Protocol transfers work with any type of file. If both you and another office use the same word processing software, or the same spreadsheet program, a protocol transfer can transmit documents or spreadsheet data with all the special codes and binary numbers you want.

There are a couple of protocols that are in the public domain—notably the Ward Christensen or Xmodem protocol, and the Kermit protocol which can also be used by mainframe computers. These are implemented by a number of different micro communications programs. Communications programs using Xmodem protocol are also available for the taking from a number of RBBSs (Remote Bulletin Board Systems). Other programs implement their own proprietary protocol, forcing both you and the person at the other end to buy the same program.

The Xmodem protocol is typical of the others. The Christensen protocol software chops the data up into 128-byte chunks, sequentially numbers them, and sends them one at a time. With each chunk, it sends an 8-bit checksum, a number that it calculates based on the binary value of all the data in the chunk. At the other end, the receiving computer verifies that it's getting the right chunk (by the number), gathers up the data, and recalculates the checksum. If it gets the same value as the one that was transmitted with the data, it concludes that the data got through unscathed, saves it, and sends back a signal requesting the next chunk. If it calculates a different checksum, it concludes that something got transmitted incorrectly, and requests that the same chunk be sent again.

If you expect to want to do protocol transfers, then you should either opt for software that uses a common protocol or agree with everyone you deal with that you'll all use the same program.

Terminal Emulation

Different computer terminal models use different codes for things like cursor positioning, highlighting, and control of scrolling. They may also use particular keys in particular ways, other than simply as generators of ASCII characters.

Most information services that invite a broad public clientele assume you will have a lowest-common-denominator, plain ASCII terminal. But many corporate mainframes, and other computers that have traditionally been able to control their user bases and terminals closely, will require a particular type of terminal, such as an IBM 3101 or a DEC VT100.

Now, with microcomputers proliferating among these closed user groups, there is an increasing demand for terminal emulation features in communications software—features that let the micro respond to control signals as if it were the terminal in question and send the right signals when various keys are pressed.

Be careful about claims of terminal emulation: it's difficult to do well, and some features of some terminals are nearly impossible to duplicate on some microcomputers. Before you commit substantial resources on the assumption you'll be able to use a micro as a special terminal, be sure you've tested it in real situations.

In particular, if you want to emulate the very popular IBM 3270 terminal, you need not only special 3270 software, but special hardware that replaces an ordinary serial port and modem for communications. If it's 3270 you want, you're reading the wrong article!

Software Packages

The accompanying table shows how ten popular software packages for microcomputers stack up in their implementation of the features described above. The table is not meant to be complete. It is meant only as an indication of some of the products that are available for a variety of machines. Not all of these programs have been tested; some features are described on the strength of the producer's claims. ◇

HP 110

(Continued from page 38)

Mass Storage Options

The HP 110 includes two solid-state, *electronically simulated* disk drives. In addition, up to eight *conventional* floppy disk drives can be connected to the computer's HP-IL serial bus.

Drive A is the random-access memory (RAM) disk. Programs and data can be written onto and retrieved from Drive A as if it were a conventional mechanical drive. Drive B is the read-only memory (ROM) disk. It contains permanent version of the machine's operating system (MS-DOS) and the bundled application programs (MemoMaker, Lotus 1-2-3 and Terminal Emulator).

When an application program is selected, it is downloaded from Drive B into RAM just as if the ROM that comprises Drive B were a mechanical disk drive. Of course the solid-state nature of the electronic drives considerably speeds up the loading process.

Up to eight single or four dual external disk drives can be connected to the HP 110. These conventional drives are consecutively labeled C through J.

The contents of Drive B are permanently stored in ROM and cannot be written over, erased or otherwise amended or altered. However, the number of RAM bytes allocated to Drive A is user selectable. Here's how: Selecting the System Configuration menu option displays the various user-alterable machine parameters, the first of which reads "Memory/Edisc: 96K/176K." These numbers, which are the computer's default values, allocate 96K bytes of RAM to the machine's system memory and 176K bytes of RAM to Drive A (*Edisc* means *Electronic Disk*).

Provides unprecedented memory capacity

The bytes assigned to either segment of RAM can be quickly altered in 4K-byte increments by pressing one of two function keys. The values range from 256K/16K to 96K/176K. Take it from an experienced 32K Model 100 user; these memory capacities are nothing less than phenomenal.

Since CMOS RAM chips are used, the machine provides a continuous memory capability even when the power is switched off. When the battery pack is fully charged, the contents of RAM are retained for a full year when the computer is powered down.

As for the conventional mechanical disk drive, one was not available in time for this review. Hewlett-Packard, however, supplied detailed specifications.

The drive, which sells for under $700, is designated the HP 9114A Portable Disk Drive. Its media is a double-sided 3½" microfloppy with a formatted capacity of 630K bytes. The Sony drive mechanism has a rotation speed of 600 rpm and an average access time of half a second.

The drive is interfaced with the HP 110 via a common HP-IL bus. Like the HP 110, the drive is powered by a lead-acid battery pack. In part because of the battery pack, the drive is somewhat bulkier than expected. It weighs 5-½ lb and measures 11½"W × 8"D × 3"H.

Other Features

The HP 110 includes a built-in 300-baud full-featured, direct-connect modem with ring detect, automatic answer, and both manual or automatic dialing (pulse or dual-tone). External modems can also be used.

The machine's built-in clock can provide up to eight alarms and appointment reminders. Files can be organized according to name *or* time and date.

The alarm feature can even be used to switch the computer on. For instance, the machine can be instructed to wake-up at any specified time, dial a telephone number, and download information into a remote terminal.

In a particularly wise move, Hewlett-Packard has made it possible for HP 110 owners to interface their machines with desktop models like the touch-screen HP 150 and IBM's PC. In both cases, HP supplies an appropriate HP-IL interface card.

Some Parting Comments

The HP 110 isn't everyone's perfect portable. Though I'm sure many users will buy the machine for its Lotus 1-2-3, I would have preferred bundled BASIC. Though I found the liquid crystal display easy to read, users who prefer the brightly glowing phosphor characters of a CRT to the gray shadows of an LCD will be disappointed that the HP 110 does *not*, at least yet, include any provision for connecting an external CRT monitor.

No, the HP 110 isn't the last word in notebook portables. But it's a major step along the way. It provides unprecedented memory capacity and bundled software for a portable. And when connected to a disk drive and ThinkJet printer, it provides an enormously powerful processing capability. ◇

nith appears to have addressed both objections with some very subtle changes to the IBM PC keyboard, overcoming the awkwardness without seriously affecting compatibility.

First of all, Zenith has added LED status lights to the CAPS LOCK and NUM LOCK keys that light to indicate when the main keyboard is in the upper-case or the numeric/arrow pad is in the numbers mode. Secondly, Zenith has moved the backslash key away from the SHIFT key and sized this key to be more like that on a typical office typewriter. Finally, Zenith provides a standard L-shaped RETURN key that is much easier to find than the smaller vertical key on the IBM PC, and an ENTER key on the numeric keypad.

Other than the enumerated simple improvements, the Zenith keyboard is functionally identical and plug-compatible with that of the IBM PCs. In fact, Zenith is selling the keyboard as a separate item for those who wish to upgrade the IBM PC with a more comfortable keyboard.

We should also mention that the Zenith keyboard is completely electronic, a decided improvement over the IBM PC's mechanical design. The Zenith keyboard requires less pressure on the keys and, unlike the IBM keyboard, fully supports auto-repeat on each key, with the repeat rate increasing the longer the key is held down. An audible keyboard "click" is heard with each character sent to the computer.

In general, we were very pleased with the Z-151's keyboard. It had a great feel and excellent response, and it required no adjustments to operate.

The Video

Not surprisingly, Zenith has applied its tremendous expertise in the television field to jazz up the video display functions of its computers. The Z-151 sacrifices much of the dazzling graphics characteristic of the Z-100 Series in order to remain compatible with the more limited capabilities of the IBM PC. Nevertheless, the Z-151 does offer some distinct advantages over the IBM PC and many of its imitators.

The most obvious advantage is the complete absence of video flickering and a substantial improvement in the speed at which text is displayed. In addition, the Z-151 offers smooth and jump scrolling, a high-resolution graphics cursor, and multiple character fonts, all of which are absent from the IBM PC.

In our view, the greatest single video advantage offered by the Z-151 is the ability to run high-resolution, dot-addressable color graphics on a monochrome display. In this mode, the "colors" are displayed as different intensities of grey. Otherwise, the display is much the same as an RGB monitor. This means that individuals no longer have to choose between a monochrome or color configuration, as they do with the IBM PC, and can upgrade to color simply by changing monitors.

Other Features

The Z-151 offers some features not found in the IBM PC and many PC compatibles. One particularly important feature is its heavy-duty power supply, which is rated at 165 watts and is about twice as powerful as that in the IBM PC. With the Z-151, the user can populate all expansion slots without fear of running out of power. Hence, the same configurations that might require an expansion cabinet with auxiliary power supply for the IBM PC will run in the standard internal bus slots in the Z-151. Similarly, the Z-151 floppy-based model will support an upgrade to a hard disk system internally, while the PC requires an expansion cabinet and power supply for the same upgrade.

An exciting alternative for the discriminating buyer interested in compatibility

The Z-151 also offers an extensive and easy-to-use set of diagnostics. Besides the power-up diagnostics mentioned earlier, there is a set of menu-driven diagnostics in ROM, accessible any time from the keyboard by typing a key sequence similar to a system reset. These functions permit booting from different disks or disk partitions, examining and manipulating memory and machine registers, controlling input/output functions, setting video scrolling, and tracing program execution. According to Zenith, further diagnostics on disk are available to allow technicians and hobbyists to identify system operations and malfunctions down to the level of IC chips.

Documentation

Both the engineering and documentation of Zenith computers are performed at the company's Heath division. The documentation we received was comprehensive, detailed, and very easy to read. Unfortunately, not all the documentation was ready at review time. But we did receive a 25-page user's guide and a 2"-thick MS-DOS 2.0 manual, which comes with the MS-DOS 2.0 and 1.2 disks at no additional cost.

The user's guide is intended to be the first section of a more comprehensive operations manual, with additional sections on hardware, software, service, and operation. The user's guide is excellent. It is well organized, profusely illustrated, completely indexed, and set in a very readable type.

The MS-DOS manual follows similar exacting standards and is filled with helpful examples of how to use this operating system.

Service

Like most other manufacturers, Zenith offers a 90-day warranty on its computers. However, unlike most others, the Zenith warranty is good for *on-site* service. The company claims it can offer this because its overall design and extensive on-board diagnostics should reduce average service time to less than 30 minutes.

Fortunately, we had no need to check out Zenith's claim, as the computers operated flawlessly over the two-week period during which they were undergoing tests. We did, however, check out the ROM diagnostics and removed and inserted some component boards. Our general impression was that this machine would be very easy to service, should it ever need it.

Compatibility

Zenith claims that its Z-151 is totally compatible with the IBM PC, except for programs that make direct calls to the IBM PC's ROM BIOS (basic input/output system). In effect, almost all PC software not written in IBM's proprietary BASICA language will run on the Z-151, right off the shelf. This includes such popular programs as Lotus 1-2-3 and Microsoft Flight Simulator, which both ran flawlessly, and thousands of business and personal software packages.

Obviously, it would have been impossible to check out the thousands of IBM PC software packages available in the marketplace for this report. But we did try out several dozen packages of various kinds and encountered no apparent problems in running them under MS-DOS, PC-DOS, and even the UCSD p-System, as long as the software did not directly call the IBM PC ROM BIOS. In

fact, the improved speed and functions of the Z-151 made many of the programs seem more impressive than when they ran on the IBM PC. As expected, packages written in BASICA did not run.

By not attempting to emulate the IBM PC's ROM BIOS, Zenith has protected itself from copyright infringement. On the negative side, though, users who already own a PC and have purchased software in a version that uses the ROM BIOS will not be able to run this software in the Zenith computer. New buyers who have no investment in PC software will not have much of a problem in this area, since they have the option of buying most business software in non-IBM-dependent versions.

At the hardware level, the five rightmost slots in the Z-151 are totally compatible with the IBM PC. We tested this with a network board designed to run in the IBM PC and encountered no problems. We also tested compatibility on the CPU board by successfully adding and testing an 8087 coprocessor chip.

It appears to us that the Z-151 can be safely added to an IBM-based office environment in place of or in conjunction with the IBM PC or PC/XT. In fact, since the Z-151 comes standard with serial and parallel ports, color graphics, and a heftier power supply, it may actually be able to work into IBM-compatible networks or configurations with other peripherals better than an IBM PC loaded with expansion cards.

It should come as no surprise that Zenith has elected not to include a cassette interface in the Z-151. We have never seen anyone actually using this interface on an IBM PC, so we do not think it will be missed by Z-151 users.

Buying Considerations

Computer shoppers eyeing the Z-151 will be looking at many of the same tradeoffs they would be if considering an IBM PC. Both computers are considerably more expensive than most 8-bit desktoppers and less powerful than some of the new 32-bit machines. Most users who buy a Z-151 or IBM PC will be swayed by the rapidly growing volume of software and hardware and overwhelming move by manufacturers and large institutions to embrace the IBM PC "standard."

Compared to the IBM PC, we feel the Z-151 represents a substantial improvement in quality, performance, and features, and a distinct advantage in price (except perhaps for some individuals and institutions eligible for substantial discounts from IBM). Compared to other IBM PC compatibles, the Z-151 offers a high degree of name recognition and a reputation for quality and dependability that is absent from most other entries in this marketplace. No matter what the eventual success of the Z-151 in the marketplace will be, we suspect that Zenith will be there to support it until the last unit is retired.

Perhaps because of its already solid reputation, Zenith has shied away from "bundling" software with the Z-151, a strategy used by some lesser-known vendors to overcome consumer objections to purchasing an unknown "compatible" product. As with the IBM PC, consumers who purchase the Z-151 will be passing up "bargain" computer systems of varying price and compatibility to stand under the umbrella of a large company like Zenith.

Summing Up

Zenith is the first major, well-known American company we know of that is both manufacturing and distributing its own highly IBM-compatible computers. It appears to have done an excellent job in creating a *new* line of computers that both conform to the de facto standards of the dominant IBM PC and offer significant improvements in both price and performance.

The Z-151 gets high marks from us for its engineering and performance, opening up a new range of options for discriminating buyers who require IBM PC compatibility. Barring an unlikely industry move away from the IBM PC, the Z-151 should travel well in its wake. ◇

Heath HS-151

(Continued from page 33)

sider that some 3000 solder connections must be made on these cards.

The HS-151 requires considerably less mechanical assembly time than other computer kits in the Heath line. Part of the reason is that there is no built-in video display system, as there are in the company's all-in-one desktop computers. In fact, if you're familiar with Heath's Models H-89 8-bitter and H-120 8/16-bitter, you'll be surprised that the HS-151 has virtually no chassis work to be performed. What little there is can all be accomplished in an hour or less.

Assembly Details

Leaving nothing to chance, the typically well-written and profusely illustrated assembly manual begins with a section titled "Assembly Notes" that identifies the tools required to build the kit (standard slip-joint and long nose pliers, diagonal cutters, phillips screwdriver and solder pencil) and a short section on how to identify the coding on resistors and capacitors. A detailed short course on soldering follows.

Accompanying the soldering course for practice use is a small, printed circuit board very similar to those used in the kit, plus IC sockets and a handful of components. Successful assembly and checkout of this board, as described in the manual, qualifies even a beginner with no previous experience in assembling a Heath kit to assemble the HS-151 confidently.

In number of connections to solder, the backplane board is the easiest of three circuit board assemblies to wire. This board contains the eight bus connectors for the CPU, memory, video graphics controller, disk drive controller, and any other cards you wish to add to the system.

With eight 62-pin connectors on this board, you might become bored with soldering and make errors if you aren't careful about how much solder you feed to any given connection. (All three circuit boards that must be wired are clad with multi-layer conductors and have plated-through holes. Feeding too much solder to a connection can create solder bridges, due to capillary action, between closely spaced circuit board conductors. Many connections, especially those under the backplane connectors and under the numerous IC sockets used in this kit, won't show up even under careful visual inspection. It's important, therefore, that you exercise care when soldering.)

The remaining two circuit cards that must be wired consume the lion's share of the job of assembling the kit. While the backplane board takes about 1½ hours to wire, the memory and disk drive controller cards each require 4½ hours. These add to 10½ hours out of the total of 15 spent on the kit consumed just in wiring the three printed circuit assemblies. The remaining time is spent assembling the keyboard unit and in chassis construction, preliminary tests, and drive controller adjustments.

Kit assembly proceeds logically through wiring of the three printed circuit board assemblies and on through preliminary chassis work. The latter involves installing the preassembled power supply/cooling fan module (which you simply rop into place over captive screws and fasten down with lockwashers and machine nuts), the mounting of the plug-

in card guides on the main chassis, and assembly of the keyboard unit. At this point, you perform the resistance and voltage tests, as detailed in the assembly manual. Heath supplies everything necessary, including solder and an inspection magnifier, but not tools or the high-impedance multimeter needed to make the resistance and voltage checks and to adjust the disk drive controller card.

Once everything checks out, the floppy disk drive(s) are coded with A: and B: assignments and are mounted in a metal bracket that, in turn, is mounted on the main chassis in the same manner as the power supply.

The checkout procedure requires making resistance and voltage checks *before* installation of any of the plug-in cards. If no problems are encountered at this stage, the various cards are installed one at a time, and built-in diagnostics are run to make sure that everything is operating according to plan. Difficulties encountered anywhere along the way can be looked up in a detailed troubleshooting section of the user's manual to determine possible causes and solutions. Since everything is spelled out in detail in the manuals, there is absolutely no need for the person assembling the computer to have a technical background to perform tests and diagnostics.

Builder Comments

Assembling the HS-151 desktop computer was interesting and fun to do. I wouldn't hesitate to recommend this kit to anyone with a little mechanical ability who can read and follow directions. Except that I had to be careful about feeding too much solder, I encountered no pitfalls. Instructions and illustrations were always clear. Having previously assembled the H-89 8-bit and the H-120 8/16-bit computers, both from Heath, I would rate the difficulty (or ease) of assembling the HS-151 about midway between the two.

These new computer kits show that Heath has learned its lesson well. Whereas the early H-89 required considerable skill and patience to assemble and the H-120 was too simple a project to be called a "real" kit, the HS-151 offers a good balance of interesting tasks that will satisfy even an inveterate hobbyist.

To make the kit as foolproof as possible, Heath has made every effort to help the builder identify parts and the locations for them. The assembly instructions organize the circuit boards for components into easy-to-follow sections. The components themselves are easy to identify except for the disk drive controller package, in which the resistors, capacitors, and chokes are arranged in taped-together strips in the proper order for installation. Heath cautions against removing the tape from these strips, a caution that I echo. It would be easy to confuse the tiny capacitors that all appear to be the same size, but have different values. Another way Heath has simplified assembly is by making almost all hardware captive, which eliminates the fumbling that usually arises in situations where you have to make do with two hands when three or four are needed.

Saving money on the purchase of a computer like the HS-151 is a good incentive to go with the kit. The $800 or $900 you don't have to lay out can go toward the purchase of other things you'll need for your system, like a monochrome or color video display, software, a printer, a modem, or any of a number of other add-ins and/or add-ons. ◇

HOME COMPUTER ACCESSORIES

RS232 ADAPTER FOR VIC-20 AND COMMODORE 64

New! New!

The JE232CM allows connection of standard RS232 printers, modems, etc. to your VIC-20 and C-64. A 4-pole switch allows the inversion of the 4 control lines. Complete installation and operation instructions included.

• Plugs into User Port • Provides Standard RS232 signal levels • Uses 6 signals (Transmit, Receive, Clear to Send, Request to Send, Data Terminal Ready, Data Set Ready).

JE232CM $39.95

VOICE SYNTHESIZER FOR APPLE AND COMMODORE

NEW!

JE520AP

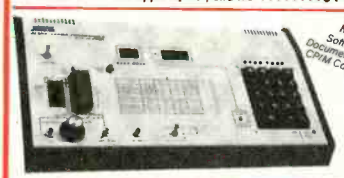
JE520CM

• Over 250 word vocabulary-affixes allow the formation of more than 500 words • Built-in amplifier, speaker, volume control, and audio jack • Recreates a clear, natural male voice • Plug-in user ready with documentation and sample software • Case size: 7¼"L x 3¼"W x 1-3/8"H

APPLICATIONS:
- Security Warning
- Teaching
- Instrumentation
- Telecommunication
- Handicap Aid
- Games

The JE520 VOICE SYNTHESIZER will plug right into your computer and allow you to enhance almost any application. Utilizing National Semiconductor's DIGITALKER™ Speech Processor IC (with four custom memory chips), the JE520 compresses natural speech into digital memory, including the original inflections and emphases. The result is an extremely clear, natural vocalization.

Part No.	Description	Price
JE520CM	For Commodore 64 & VIC-20	$114.95
JE520AP	For Apple II, II+, and IIe	$149.95



NEW! Software & Documentation for CP/M Computers

JE664 EPROM PROGRAMMER

8K to 64K EPROMS — 24 & 28 Pin Packages

Completely Self-Contained — Requires No Additional Systems for Operation

• Programs and validates EPROMs • Checks for properly erased EPROMs • Emulates PROMs or EPROMs • RS232C Computer Interface for editing and program loading • Loads data into RAM by keyboard • Changes data in RAM by keyboard • Loads RAM from an EPROM • Compares EPROMs for content differences • Copies EPROMs • Power Input: 115VAC, 60Hz, less than 10W power consumption • Enclosure: Color-coordinated, light tan panels with molded end pieces in mocha brown • Size: 15⅝"L x 8¾"D x 3½"H • Weight: 5¾ lbs.

The JE664 EPROM Programmer emulates and programs various 8-Bit Word EPROMs from 8K to 64K-Bit memory capacity. Data can be entered into the JE664's internal 8K x 8-Bit RAM in three ways: (1) from a ROM or EPROM; (2) from an external computer via the optional JE665 RS232C BUS; (3) from its panel keyboard. The JE664's RAMs may be accessed for emulation purposes from the panel's test socket to an external microprocessor. In programming and emulation, the JE664 allows for examination, change and validation of program content. The JE664's RAMs can be programmed quickly to all "1"s (or any value), allowing unused addresses in the EPROM to be programmed later without necessity of "UV" erasing. The JE664 displays DATA and ADDRESS in convenient hexadecimal (alphanumeric) format. A "DISPLAY EPROM DATA" button changes the DATA readout from RAM word to EPROM word and is displayed in both hexadecimal and binary code. The front panel features a convenient operating guide. The JE664 Programmer includes one JM16A Jumper Module (as listed below).

JE664-A EPROM Programmer. $995.00
Assembled & Tested (Includes JM16A Module)

JE665 — RS232C INTERFACE OPTION — The RS232C Interface Option implements computer access to the JE664's RAM. This allows the computer to manipulate, store and transfer EPROM data to and from the JE664. A sample program listing is supplied in MBASIC for CP/M computers. Documentation is provided to adapt the software to other computers with an RS232 port, 9600 Baud, 8-bit word, odd parity and 2 stop bits.

FOR A LIMITED TIME A SAMPLE OF SOFTWARE WRITTEN IN BASIC FOR THE TRS-80* MODEL I, LEVEL II COMPUTER WILL ALSO BE PROVIDED.

JE664-ARS EPROM Prog. w/JE665 Option. $1195.00
Assembled & Tested (Includes JM16A Module)

EPROM JUMPER MODULES — The JE664's JUMPER MODULE (Personality Module) is a plug-in Module that pre-sets the JE664 for the proper programming pulses to the EPROM and configures the EPROM socket connections for that particular EPROM.

JE664 EPROM Jumper Mod. No.	EPROM	Programming Voltage	EPROM MANUFACTURER	PRICE
JM08A	2708	25V	AMD, Motorola, Nat., Intel, TI,	$14.95
JM16A	2716, TMS2516 (TI)	25V	Intel, Motorola, Nat., NEC, TI, AMD, Hitachi, Mostek,	$14.95
JM16B	TMS2716 (3-V's)	5V, +5V, +12V	Motorola, TI,	$14.95
JM32A	TMS2532	25V	Motorola, TI, Hitachi, OKI	$14.95
JM32B	2732	25V	AMD, Fujitsu, NEC, Hitachi, Intel, Mitsubishi, National,	$14.95
JM32C	2732A	21V	Fujitsu, Intel,	$14.95
JM64A	MCM68764, MCM68L764	21V	Motorola	$14.95
JM64B	2764	21V	Intel, Fairchild, OKI,	$14.95
JM64C	TMS2564	25V	TI,	$14.95

KEYBOARDS

HI-TEK 14-KEY NUMERIC KEYPAD

• Great keypad for many home and business computer applications • SPST switching • Mounted on P.C. board • Size 5" L x 3" W x 1⅛" H • Color: Grey • Weight: 1 lb. • Spec available

K-14 . . . . . $9.95

MICRO SWITCH ASCII Encoded Keyboards

• Large selection of keyboards • Hall effect switching • Some have parallel interfaces • Some have serial interfaces • All have status LEDs and a minimum of 68 keys • Some with numeric keypad capabilities, cursor controls, or both • Styles may vary • Weight: 2 lbs. • No specs available

KB-MISC $9.95

13⅛"L x 4¼"W x ¾"H

Mitsumi 54-Key Unencoded Matrix All-Purpose Keyboard

• SPST keyswitches • 20 pin ribbon cable connection • Low profile keys • Features: cursor controls, control, caps (lock), function, enter and shift keys • Color (keycaps): grey • Wt.: 1 lb. • Pinout included

KB54. . . . . $14.95

New!

16-9/16"L x 6⅜"W x 1⅝"H

76-Key Serial ASCII Keyboard

• Simple serial interface • SPST mechanical switching • Operates in upper and lower case • Five user function keys: F1-F5 • Six finger edge card connection • Color (keys): tan • Weight: 2 lbs. • Data incl.

KB76. . . . . $29.95

Nationally Known Manufacturer!

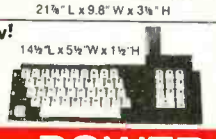
21⅜"L x 9.8"W x 3⅛"H

106-KEY 8-BIT SERIAL ASCII KEYBOARD

• The terminals were designed to be daisy chained around a central host computer and used as individual work stations • Hall effect switching • numeric and cursor keypad • 10 user definable keys • 50" interface cable with 9-pin sub-miniature connector • 7 LED function displays • Security lock • N-key rollover • Automatic key repeat function • Color: (case): white w/black panel—(key caps): grey and blue • Weight: 6½ lbs. • Data included.

KB139 . . . . . $59.95

New!



14⅜"L x 5½"W x 1½"H

68-Key Keyboard with Numeric Keypad for Apple II and II+

• Plugs directly into Apple II or II+ motherboard with 16-pin ribbon cable connector • 26 special functions • Color (keys): white/grey • Weight: 2 lbs.

KB-A68. . . . . $99.95

POWER SUPPLIES

TRANSACTION TECHNOLOGY, INC. 5VDC @ 1 AMP Regulated Power Supply

• Output: +5VDC @ 1.0 amp (also +30VDC regulated) • Input: 115VAC, 60 Hz • Two-tone (black/beige) self-enclosed case • 6 foot, 3-conductor black power cord • Size: 6⅛" L x 7" W x 2¼" H • Weight: 3 lbs.

PS51194 . . . . . $14.95

Power/Mate Corp. REGULATED POWER SUPPLY

• Input: 105-125/210-250 VAC at 47-63 Hz • Line regulation: ±0.05% • Three mounting surfaces • Overvoltage protection • UL recognized • CSA certified

Part No.	Output	Size	Weight	Price
EMA5/6B	5V@3A/6V@2.5A	4⅞"L x 4"W x 2⅛"H	2 lbs.	$29.95
EMA5/6C	5V@6A/6V@5A	5⅛"L x 4⅞"W x 2⅛"H	4 lbs.	$39.95

New!

ASTEC SWITCHING REGULATED POWER SUPPLY

• Apple III Power Supply • Multiple outputs for bench top uses and other applications • Input: 115VAC, 50-60 Hz @ 3.0 amps • Output: +5VDC @ 1.0 amp, +12VDC @ 1.0 amp, -12VDC @ 1.0 amp, +24VDC @ 2.5 amp, -24VDC @ 2.5 amp • Size: 15" L x 3¾" W x 2⅝" H • Weight: 2⅝ lbs.

AS1155 . . . . . $39.95

POWER SUPPLY +5VDC @ 7.6 AMP, 12VDC @ 1.5 AMP SWITCHING

• Input: 115VAC, 50-60HZ @ 3 amp/230VAC, 50Hz @ 1.6 amp. • Fan volt./power supply select switches (115/230VAC) • Output: 5VDC @ 7.6 amp, 12VDC @ 1.5 amp • 8 foot black power cord • Size: 11⅜"L x 13⅜"W x 3¼"H • Weight: 6 lbs.

PS94VOS. $39.95

KEPCO/TDK 4-OUTPUT SWITCHING POWER SUPPLY

• Ideal for disk drive needs of CRT terminals, microcomputers and video games • Input: 115/230VAC, 50/60Hz • Output: +5V @ 5 Amp, +12V @ 1.8 Amp, +12V @ 2 Amp, -12V @ 0.5 Amp • UL recognized • CSA certified • Size: 7⅜"L x 6-3/16"W x 1⅝"H • Weight: 2 lbs.

MRM 174KF. $59.95

4-CHANNEL SWITCHING POWER SUPPLY

• Microprocessor, mini-computer, terminal, medical equipment and process control applications • Input: 90-130VAC, 47-440Hz • Output: +5VDC @ 5A, -5VDC @ 1 A, +12VDC @ 1A, -12VDC @ 1A • Line regulations: ±0.2% • Ripple: 30mV p-p • Load regulation: ±1% • Overcurrent protection • Adj: 5V main output ±10% • Size: 6⅝"L x 1⅞"W x 4-15/16"H • Weight: 1⅝ lbs.

FCS-604A. . . . . $69.95 each

Switching Power Supply for APPLE II, II+ & IIe™

• Can drive four floppy disk drives and up to eight expansion cards • Short circuit and overload protection • Fits inside Apple computer • Fully regulated +5V @ 5A, +12V @ 1.5A, -5V @ .5A, -12V @ .5A • Direct plug-in power cord included • Size: 9⅞"L x 3½"W x 2¼"H • Weight: 2 lbs.

KHP4007. . . . . $79.95

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6½% Sales Tax
Shipping — Add 5% plus $1.50 Insurance
Send S.A.S.E. for Monthly Sales Flyer!

Spec Sheets — 30¢ each
Send $1.00 Postage for your *FREE 1984 JAMECO CATALOG*
Prices Subject to Change

MasterCard

Mail Order Electronics • Worldwide

Jameco ELECTRONICS

VISA*

1355 SHOREWAY ROAD, BELMONT, CA 94002

8/84 *PHONE ORDERS WELCOME — (415) 592-8097 Telex: 176043*

4-Digit Fluorescent Alarm Clock Kit

NEW!

• AM/PM indicator • Automatic display dimmer

• Bright 4-digit 0.5" high display • 10 minute snooze alarm

The JE750 Clock Kit is a versatile 12-hour digital clock with 24-hour alarm. The clock has a bright 0.5" high blue-green fluorescent display. The display will automatically dim with changing light conditions. The 24-hour alarm allows the user to disable the alarm and immediately re-enable the alarm to activate 24 hours later. The kit includes all documentation, components, case and wall transformer. Size: 6⅝"L x 3⅜"W x 1¾"D.

JE750 Alarm Clock Kit. $29.95

DISK DRIVES AND SUPPLIES

5¼" APPLE™ Direct Plug-In Compatible Disk Drive

• Uses Shugart SA390 mechanics - 143K formatted storage • 35 tracks — compatible with Apple controller • Complete with connector and cable — just plug into your disk controller card • Size: 6"L x 3½"W x 8-9/16"D • Weight: 4¼ lbs.

ADD-514...$195.95

+5VDC @ 6 Amps
+12VDC @ 4 Amps
-12VDC @ 0.5 Amps

Microcomputer Power Inc. Regulated Power Supply

13¼"L x 6¼"W x 5"H

• Perfect for computer or disk drive systems • Supply has AMP connectors for direct connection to two 5¼" disk drives • Cooling fan • Input: 100/115/200/230VAC, 47-63Hz • Output (above) • Weight: 9 lbs.

CP167. . . . . $59.95

INDUSTRIES *Protect Yourself...*

DATASHIELD® Surge Protector

• Eliminates voltage spikes and EMI-RFI noise before it can damage your equipment or cause data loss • 6 month warranty • Power dissipation (100 microseconds): 1,000,000 watts • 6 sockets • 6 foot power cord • Normal line voltage indicator light • Brown out/black out reset switch • Weight: 2 lbs.

Model 100. . . . . $69.95

Protect Yourself...

DATASHIELD® Back-Up Power Source

Provides up to 30 minutes of continuous 120 VAC 60Hz power to your computer system (load dependent) when you have a black out or voltage sag • Output rating: 200 watts • Six month warranty • Weight: 24 lbs.

Model 200 (PC200). $349.95

IBM MEMORY EXPANSION KIT COMPAQ COMPATIBILITY

SAVE HUNDREDS OF $$$ BY UPGRADING MEMORY BOARDS YOURSELF!

Most of the popular memory boards allow you to add an additional 64K, 128K, 192K, or 256K. The IBM64K Kit will populate these boards in 64K byte increments. The kit is simple to install — just insert the nine 64K RAM chips in the provided sockets and set the two groups of switches. Directions are included.

IBM64K (Nine 200ns 64K RAMs) $49.95

TRS-80 MEMORY EXPANSION KIT

TRS-80 to 16K, 32K, or 48K

**Model 1 = From 4K to 16K Requires (1) One Kit
Model 3 = From 4K to 48K Requires (3) Three Kits
Color = From 4K to 16K Requires (1) One Kit**

**Model 1 equipped with Expansion Board up to 48K Two Kits Required — One Kit Required for each 16K of Expansion —

TRS-16K3 *200ns for Color & Model III $12.95
TRS-16K4 *250ns for Model I $10.95

TRS-80 Color 32K or 64K Conversion Kit

Easy to install kits comes complete with 8 ea. 4164-2 (200ns) 64K dynamic RAMs and conversion documentation. Converts TRS-80 color computers with D, E, ET, F and NC circuit boards to 32K. Also converts TRS-80 color computer II to 64K. Flex DOS or OS-9 required to utilize full 64K RAM on all computers.

TRS-64K2. . . . . $44.95

UV-EPROM Eraser

8 Chips — 51 Minutes

1 Chip — 37 Minutes

Erases 2708, 2716, 2732, 2764, 2516, 2532, 2564. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes). Maintains constant exposure distance of one inch. Special conductive foam liner eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact — only 9.00" x 3.70" x 2.60". Complete with holding tray for 8 chips.

DE-4 UV-EPROM Eraser . . . $79.95

UVS-11EL Replacement Bulb . . $16.95

Circle No. 21 on Free Information Card

DIGI-KEY CORPORATION

800-346-5144

In Mn., Ak., Hi. Call 218-681-6674

VISA

NATIONAL SEMICONDUCTOR • PANASONIC • AAVID • CHEMWIK • ATLANTIC DIODES • N... ARIES • PLESSEY • MOLEX • AAVID • E. F. J... OK MACHINE • UNGAR • GC CHEMICALS • A... NATIONAL SEMICONDUCTOR • PANASONIC •

***QUALITY** — Name brand products from nationally recognized manufacturers.*
***SERVICE** — Computerized order processing and inventory control.*
***SAVINGS** — Volume Discounts • OEM Quantity Pricing • Toll Free 800 Number*

CHEMICALS • ARIES • PLESSEY • MOLEX • E... MACHINE • DIAMOND TOOL • UNGAR • GC CH... AS INSTRUMENTS • D-K • A P PRODUCTS • DIA... ND TOOL • UNGAR • GC CHEMICALS • ARIES CHEMICALS • ARIES • PLESSEY • MOLEX • E.

master charge

DIGI-KEY — DIGI-KEY — DIGI-KEY — DIGI-KEY — DIGI-KEY — DIGI-KEY — DIGI-KEY

The Big DIGI-KEY Discount makes a Big Price Difference (SEE BELOW)

INTEGRATED CIRCUITS

7400 TTL

Part	Price
7400N	.41
7401N	.41
7402N	.41
7403N	.43
7404N	.42
7405N	.45
7406N	.72
7407N	.72
7408N	.42
7409N	.43
7410N	.41
7411N	.41
7413N	.54
7414N	.61
7416N	.45
7417N	.45
7420N	.41
7423N	.44
7425N	.43
7426N	.41
7427N	.54
7430N	.56
7432N	.43
7437N	.43
7438N	.81
7440N	.41
7441AN	1.25
7442N	.61
7443N	.81
7444N	.81
7445N	1.01
7446N	1.03
7447N	1.03
7448N	1.03
7460N	.41
7461N	.41
7453N	.42
7454N	.41
7480N	1.02
7470N	.46
7472N	.46
7473N	.45
7474N	.45
7475N	.54
7476N	.62
7483N	.80
7485N	.88
7486N	.45
7489N	3.39
7490N	.54
7491N	2.36
7492N	.84
7493N	.54
7495N	.63
7496N	.69
74107N	.56
74109N	.56
74121N	.64
74123N	.72
74125N	.70
74126N	.70
74132N	.74
74141N	1.26
74145N	.99
74147N	1.63
74148N	1.14
74150N	1.48
74151N	.65
74153N	.65
74154N	1.32
74156N	.87
74158N	.73
74157N	.73
74160N	.79
74161N	.79
74162N	.79
74163N	.79
74164N	.79
74165N	.94
74166N	1.03
74170N	1.59
74173N	1.08
74174N	.74
74175N	.74
74176N	.95
74177N	.95
74180N	1.02
74181N	2.38
74182N	1.07
74184N	3.08
74185N	3.08
74190N	.89
74191N	.89
74192N	1.01
74193N	.88
74194N	.88
74195N	.68
74197N	.95
74198N	1.70
74199N	1.70
74251N	1.03
74365N	.68
74366N	.68
74367N	.68
74368N	.68
8093N	.70
8094N	.70
8095N	.74
8096N	.74
8097N	.74
8098N	.74
8334N	2.03

74LS00 TTL

Part	Price
74LS00N	.41
74LS01N	.41
74LS02N	.41
74LS03N	.41
74LS04N	.47
74LS05N	.43
74LS08N	.43
74LS09N	.43
74LS10N	.41
74LS11N	.41
74LS12N	.41
74LS13N	.54
74LS14N	.59
74LS15N	.41
74LS20N	.41
74LS21N	.41
74LS22N	.43
74LS26N	.43
74LS27N	.43
74LS30N	.41
74LS32N	.43
74LS37N	.43
74LS38N	.43
74LS40N	.41
74LS42N	.69
74LS47N	1.25
74LS48N	1.25
74LS49N	1.24
74LS51N	.41
74LS54N	.41
74LS55N	.41
74LS73N	.50
74LS74N	.50
74LS75N	.52
74LS76N	.51
74LS78N	.50
74LS83AN	.80
74LS85N	.98
74LS86N	.43
74LS90N	.65
74LS93N	.66
74LS107N	.50
74LS109N	.50
74LS112N	.51
74LS113N	.50
74LS114N	.50
74LS122N	.57
74LS123N	.87
74LS125N	.81
74LS126N	.61
74LS132N	.82
74LS136N	.47
74LS138N	.70
74LS139N	.70
74LS151N	.68
74LS153N	.68
74LS154N	1.25
74LS155N	.77
74LS156N	.77
74LS157N	.68
74LS158N	.68
74LS160N	.81
74LS161N	.81
74LS162N	.81
74LS163N	.81
74LS164N	.81
74LS168N	1.45
74LS169N	1.38
74LS170N	1.81
74LS173N	.86
74LS174N	.74
74LS175N	.77
74LS190N	.96
74LS191N	1.03
74LS192N	.86
74LS193N	.96
74LS195AN	.80
74LS196N	1.13
74LS197N	1.13
74LS221N	1.09
74LS240N	1.21
74LS241N	1.21
74LS242N	1.20
74LS243N	1.20
74LS244N	1.21
74LS247N	1.38
74LS248N	1.38
74LS249N	1.38
74LS251N	.67
74LS253N	.70
74LS257N	.94
74LS258N	.71
74LS266N	.50
74LS279N	.56
74LS283N	.91
74LS290N	.95
74LS293N	1.04
74LS295N	1.28
74LS298N	1.14
74LS352N	1.46
74LS353N	1.45
74LS365N	.62
74LS366N	.62
74LS367N	.62
74LS368N	.62
74LS373N	1.25
74LS374N	1.25
74LS386N	.52
74LS670N	1.70
74LS95N	1.70
81LS96N	1.70
81LS97N	1.70
81LS98N	1.70

74S00 TTL

Part	Price
74S00N	.49
74S02N	.49
74S03N	.49
74S04N	.51
74S05N	.51
74S08N	.49
74S09N	.49
74S10N	.49
74S11N	.49
74S16N	.49
74S20N	.49
74S22N	.49
74S30N	.49
74S32N	.51
74S40N	.51
74S51N	.49
74S64N	.49
74S65N	.49
74S74N	.66
74S86N	.66
74S112N	.68
74S113N	.68
74S114N	.68
74S133N	.57
74S134N	.71
74S135N	1.09
74S136N	1.83
74S138N	1.14
74S139N	1.14
74S140N	.61
74S151N	1.17
74S153N	1.17
74S157N	1.17
74S158N	1.17
74S160N	2.77
74S161N	2.77
74S162N	2.77
74S163N	2.77
74S174N	1.28
74S175N	1.07
74S181N	3.26
74S182N	2.05
74S188N	2.42
74S189N	3.02
74S194N	1.81
74S195N	1.81
74S196N	2.29
74S197N	2.29
74S240N	2.39
74S241N	2.39
74S242N	3.37
74S243N	3.37
74S244N	2.81
74S261N	1.26
74S253N	1.26
74S257N	1.26
74S258N	1.26
74S280N	2.06
74S283N	2.22
74S287N	2.30
74S288N	2.93
74S289N	3.02
74S373N	2.78
74S374N	2.78
74S387N	2.30
74S472AN	5.78
74S473AN	5.78
74S474AN	6.50
74S475AN	6.50
74S570N	4.46
74S571N	4.46
74S572N	5.66
74S573N	5.66
74S940N	3.38
74S941N	3.38

74C00 CMOS

Part	Price
74C00N	.41
74C02N	.41
74C04N	.46
74C08N	.43
74C10N	.41
74C14N	.79
74C20N	.41
74C30N	.41
74C32N	.43
74C42N	1.80
74C48N	1.21
74C73N	1.02
74C74N	.60
74C76N	.60
74C83N	1.45
74C85N	1.45
74C86N	.57
74C89N	4.51
74C90N	1.11
74C93N	1.11
74C95N	1.36
74C107N	1.01
74C150N	4.09
74C151N	2.82
74C154N	4.34
74C157N	2.35
74C160N	1.25
74C161N	1.25
74C162N	1.28
74C163N	1.25
74C164N	1.11
74C165N	1.12
74C173N	1.48
74C174N	1.25
74C175N	1.25
74C192N	1.59
74C193N	1.59
74C195N	1.59
74C200N	8.45
74C221N	1.36
74C240N	2.27
74C244N	1.79
74C373N	2.84
74C374N	2.02
74C901N	.80
74C902N	.80
74C903N	.50
74C904N	.50
74C905N	7.44
74C906N	.80
74C907N	.50
74C908N	1.20
74C909N	2.22
74C910N	6.20
74C911N	11.75
74C912N	9.45
74C914N	.86
74C915N	1.82
74C917N	8.45
74C918N	1.82
74C922N	5.35
74C923N	3.82
74C925N	5.75
74C926N	5.75
74C927N	5.75
74C928N	5.75
74C932N	1.11
74C941N	1.79
80C95N	.51
80C96N	.61
80C97N	.69
80C98N	.51
82C19N	3.58
88C29N	3.58
88C30N	1.98

A/D & D/A

Part	Price
9028B	2.50
ADC0803LCN	7.82
ADC0804LCN	4.53
ADC0805LCN	5.66
ADC0808CCN	11.80
ADC0809CCN	5.92
ADC0816CCN	18.68
ADC0817CCN	11.32
ADC0830CCN	6.00
ADC1001CCN	32.00
ADC1021CCN	33.75
ADC3511CCN	8.27
ADC3711CCN	8.27
ADD3501CCN	8.30
ADD3701CCN	8.82
DAC0800LCN	2.77
DAC0807LCN	2.07
DAC0808LCN	2.27
DAC0830LCN	6.93
DAC0832LCN	4.05
DAC1020LCN	10.52
DAC1022LCN	6.77
MM5314N	3.69
MM5369N	2.80
MM5837N	2.30

Interface

Part	Price
DS1488N	1.01
DS1489AN	1.01
DS1489N	1.01
75450N	.83
75451N	.88
75452N	.88
75453N	.88
75454N	.88
75491N	.83
75492N	1.01
75493N	1.01
75494N	1.01

Micro.

Part	Price
COP402N	7.17
COP404LSN	12.06
COP444LR	66.00
COP452N	5.17
COP470N	3.99
COP472N	5.19
COP498N	5.17
COP499N	5.17
DP8212N	1.48
DP8216N	1.20
DP8224N	1.41
DP8226N	1.27
DP8228N	2.83
DP8238N	2.83
DP8303N	4.53
DP8304BN	2.15
DP8307N	2.72
DP8308N	2.72
DP8310N	5.30
DP8311N	5.30
INS8035LN-6	7.57
INS8035N-11	5.44
INS8039N-6	6.30
INS8039N-11	[illegible]
INS8060N	16.62
INS8073N	45.06
INS8080AN	4.65
INS8154N	15.81
INS8251N	4.99
INS8255N	6.10
INS8259N	9.24
ISP-8F/352	32.76
MM58167AN	9.60
MM58174AN	9.25
MSM5832	8.38
NSC800N	20.81
NSC800N-1	11.59
NSC810N-1	13.11

Memory

Part	Price	Memory	Price	Part	Price
83410PC	3.13	5290N-200	1.96	74S287N	2.30
1702	5.48	MM5257N	5.43	74S288N	2.93
MM2102AN-4L	1.82	MM6280N-055	2.82	74S289N	3.02
MM2114N	2.33	MM5314N	3.89	74S387N	2.30
MM2114N-3L	2.53	MM5369AAN	3.00	74S472AN	5.78
MM2114N-L	2.50	MM6837	2.30	74S473AN	5.78
MM2147N	14.03	74C200N	8.45	74S474AN	6.50
MM2716Q	5.98	74C910N	6.20	74S475AN	6.50
MM2716Q-5	4.28	74S188N	2.42	74S570N	4.46
4116N-200	1.95	74S189N	3.02	74S571N	4.46
				74S572N	5.66
				74S573N	5.66

DIGI-KEY Discount — Compare the Discount when comparing Prices

INTEGRATED CIRCUITS

4000 CMOS

Part	Price
4000	.46
4001B	.46
4002B	.46
4006A	1.36
4007A	.46
4008B	1.36
4009A	.69
4010A	.69
4011B	.46
4012B	.46
4013B	.69
4014B	1.36
4015B	1.36
4016B	.68
4017B	1.43
4018B	1.25
4019B	.69
4020B	1.66
4021B	1.36
4022B	1.36
4023B	.46
4024B	1.02
4025B	.46
4027B	.69
4028B	1.03
4029B	1.36
4030A	.57
4031B	2.04
4034B	2.81
4035B	1.59
4040B	1.36
4041A	1.24
4042B	1.09
4043B	1.03
4044B	1.03
4046B	1.48
4047B	1.49
4048B	.68
4049A	.73
4050B	.60
4051B	1.25
4052B	1.25
4053B	1.47
4060B	2.25
4066B	.65
4069A	.46
4070B	.57
4071B	.46
4073B	.46
4075B	.46
4076B	1.48
4081B	.41
4082B	.46
4089B	2.28
4093B	.75
4099B	1.56
40106B	.79
40160B	1.25
40161B	1.03
40162B	1.25
40163B	1.25
40174B	1.25
40175B	1.25
40192B	1.48
40193B	1.48
40195B	1.36
4503B	.95
4510B	1.36
4511B	1.36
4512	1.36
4514B	2.49
4515B	2.27
4516B	1.48
4518B	1.36
4519B	.68
4520B	1.36
4522B	1.59
4526B	1.59
4527B	1.48
4528B	1.58
4529B	1.70
4541B	2.03
4543B	3.17
4584B	.79
4723B	1.30
4724B	1.30

Linear

Part	Price
LF347N	1.76
LF351N	.67
LF353N	.99
LF355N	1.22
LF356N	1.29
LF357N	1.42
LF398N	4.52
LF411CN	.98
LF412CN	1.76
LF441CN	.88
LF444CN	2.61
LF13741N	.67
LM10CLN	3.76
LM11CLN	2.13
LM301AN	.54
LM307N	.64
LM308N	.82
LM311N	.84
LM317K	4.17
LM317LZ	.81
LM317MP	1.25
LM317T	1.26
LM318N	1.89
LM319N	2.89
LM320LZ-5.0	1.13
LM320LZ-12	1.13
LM320LZ-15	1.13
LM320MP-5	1.90
LM320MP-6	1.69
LM320MP-8	1.69
LM320MP-9	1.89
LM320MP-12	2.52
LM320MP-15	2.52
LM320MP-24	1.69
LM322N	2.01
LM323K	6.92
LM324N	.68
LM325N	4.14
LM326N	4.14
LM327N	3.41
LM329DZ	.75
LM331N	5.27
LM334Z	1.50
LM335Z	1.75
LM336Z-2.5	1.25
LM336Z-5.0	1.25
LM337K	6.42
LM337MP	1.52
LM337T	2.14
LM338K	8.55
LM339N	1.35
LM340KC-5	1.92
LM340KC-12	1.92
LM340KC-15	1.92
LM340T-5	.89
LM340T-12	.89
LM340T-15	.89
LM341P-5	.77
LM341P-8	.77
LM341P-12	.77
LM341P-15	.77
LM346N	2.02
LM348N	.59
LM349N	1.51
LM350K	6.30
LM350T	3.89
LM358N	.63
LM359N	2.01
LM376N	.64
LM377N	3.01
LM378N	3.76
LM379S	6.01
LM380N	1.26
LM380N-8	1.27
LM381N	2.19
LM382N	1.56
LM383AT	3.43
LM384N	2.52
LM386N-1	1.03
LM387N	1.39
LM388N-3	1.21
LM389N	1.27
LM390N	1.11
LM391N60	1.15
AN7818	.90
AN7820	.90
AN7824	.90

Linear

Part	Price
LM391N80	1.77
LM392N	.64
LM393N	.59
LM395K	8.80
LM395P	2.02
LM395T	3.76
LM396K	20.00
LM555CN	.59
LM556CN	1.01
LM565CN	1.64
LM566CN	1.64
LM567CN	1.39
LM709CN	.89
LM723CN	.64
LM725CN	3.01
LM733CN	.86
LM741CN	.54
LM747CN	.89
LM748CN	.64
LM1310N	1.09
LM1458N	.57
LM1496N	1.26
LM1800N	1.64
LM1801N	1.14
LM1812N	10.29
LM1830N	3.15
LM1848N	8.26
LM1870N	5.03
LM1871N	2.04
LM1872N	3.04
9029B	2.00
LM1889N	2.04
LM2111N	1.54
LM2900N	1.28
LM2901N	.94
LM2902N	.89
LM2903N	.59
LM2904N	.77
LM2905N	3.26
LM2907N	3.14
LM2907N-8	3.01
LM2917N	2.28
LM2917N-8	2.28
LM2924N	2.19
LM3046N	1.14
LM3080N	1.07
LM3086N	.71
LM3089N	2.15
LM3301N	.84
LM3302N	.71
LM3401N	.66
LM3524N	3.15
LM3900N	.75
LM3905N	1.52
LM3909N	1.27
LM3911N	1.89
LM3914N	2.42
LM3915N	2.42
LM3916N	2.42
LM4250CN	1.63
LM7805CK	1.92
LM7812CK	1.92
LM7815CK	1.92
LM7805CT	.89
LM7812CT	.89
LM7815CT	.89
LM78L05ACZ	1.13
LM78L12ACZ	1.13
LM78L15ACZ	1.13
LM78L24ACZ	1.13
LM7905CT	.94
LM7912CT	.94
LM7915CT	.94
LM79L05ACZ	.80
LM79L12ACZ	.60
LM79L15ACZ	.80
LM13080N	1.52
LM13600N	1.25
MF10CN	3.75
MF10DS	1.00
AN7805	.90
AN7806	.90
AN7807	.90
AN7808	.90
AN7809	.90
AN7810	.90
AN7812	.90
AN7815	.90

4116 200 nsec 16,384x1 D Ram

Prime Parts As Low As $1.365 Each

Part No.	8	32	128	512	1024
	Price Per Pak Of				
4116N-ND	15.12	57.12	215.00	806.40	1397.75
5290N-ND	15.12	57.12	215.00	806.40	1397.75
Price Each	1.89	1.785	1.68	1.575	1.365

NSC Data Books

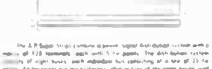
Book Title	Part No.	Price
1982 Transistor Databook	90708	16.00
1981 Logic Databook	90541	9.00
1982 Linear Databook	90680	12.00
1980 Interface Databook	90648	6.00
1980 Memory Book	90598	6.00
1982 COPS Microcontroller Data Book	90698	6.50
1979 Special Function Databook	90578	8.00
NSC 800 Microprocessor Family Handbook-1981	90538	6.00
Linear Applications Handbook	90828	16.00
Microprocessor Applications In Business, Science and Industry	90558	4.00
1980 Audio/Radio Handbook	90656	5.00
Voltage Regulator Handbook-1982	90638	7.00

MOLEX I.C. SOCKET PINS

1.25/C 11.25/M 52.50/5M 500.00/M

SUPER-STRIPS

UNIVERSAL BREADBOARDING ELEMENTS WITH SOLDERLESS PLUG-IN TIE POINTS



The A P Super Strips combine a power, signal distribution system with a matrix of 128 terminals, each with 5 tie points. The distribution system consists of eight buses, each individual bus consisting of a row of 25 tie points. All tie points are the solderless, plug-in type all the same design used on A P terminal strips and A P Distribution strips.

923252 (Alloy 770 terminals) $18.50
923748 (Gold-plated terminals) 37.00

POWERACE

For faster and easier prototyping. They have built-in power supplies.

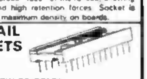
Powerace 101 ... $96.95
Powerace 103 ... $149.95
Powerace 102 ... $169.95

DIGI-KEY Stocks Most A.P. Products

TEXAS INSTRUMENTS I.C. SOCKETS

Body — 94 V-O polyester with Copper Alloy contacts. Accommodates standard IC leads up to .014" thick and .025" wide. Contact is designed and oriented to the insulator to grasp the broad "face" of the IC lead, allowing for low insertion and high retention forces. Socket is designed to achieve maximum density on boards.

SOLDER TAIL DIP SOCKETS



- Single beam
- Low profile
- YOUR CHOICE: TIN OR GOLD* (*Minimum 10 microinch gold inlay on gold contacts)

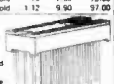
TIN PLATED SOLDER TAIL Min. 200 Microinches Tin, -40° to +70°C

Part No.	Description	1	10	100
C8908	8 pin solder tail, tin	.13	1.15	10.50
C8914	14 pin solder tail, tin	.15	1.46	12.00
C8916	16 pin solder tail, tin	.17	1.60	13.00
C8918	18 pin solder tail, tin	.20	1.90	17.00
C8920	20 pin solder tail, tin	.23	2.10	20.00
C8922	22 pin solder tail, tin	.25	2.25	21.00
C8924	24 pin solder tail, tin	.28	2.50	24.00
C8928	28 pin solder tail, tin	.32	2.90	27.00
C8940	40 pin solder tail, tin	.46	4.20	39.00

GOLD INLAY SOLDER TAIL Min. 10 Microinches Gold, -40° to +125°C

Part No.	Description	1	10	100
C9808	8 pin solder tail, gold	.34	3.20	30.00
C9814	14 pin solder tail, gold	.44	4.20	40.00
C9816	16 pin solder tail, gold	.50	4.70	45.00
C9818	18 pin solder tail, gold	.57	5.40	52.00
C9820	20 pin solder tail, gold	.63	5.90	57.00
C9822	22 pin solder tail, gold	.70	6.60	64.00
C9824	24 pin solder tail, gold	.76	7.20	70.00
C9828	28 pin solder tail, gold	.79	7.50	73.00
C9840	40 pin solder tail, gold	1.12	9.90	97.00

WIRE WRAP DIP SOCKETS



- Standard profile
- Universal mounting and packaging capabilities
- Contacts accommodate .016" through .021" rec or round dual-in-line leads
- Wire wrap posts held to true position of .015" providing a true position of .020" on boards for efficient automatic wire wrapping
- YOUR CHOICE: TIN OR GOLD* (*Minimum 10 microinch gold inlay on gold contacts)
- TEXAS INSTRUMENTS QUALITY

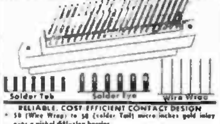
TIN PLATED WIRE WRAP Min. 200 Microinches Tin

Part No.	Description	1	10	100
C8108	8 pin wire wrap, tin	.38	3.60	34.00
C8114	14 pin wire wrap, tin	.50	4.90	48.00
C8116	16 pin wire wrap, tin	.57	5.60	55.00
C8118	18 pin wire wrap, tin	.69	6.70	65.00
C8120	20 pin wire wrap, tin	.76	7.50	74.00
C8122	22 pin wire wrap, tin	.83	8.20	81.00
C8124	24 pin wire wrap, tin	.91	8.90	88.00
C8128	28 pin wire wrap, tin	1.04	10.30	102.00
C8140	40 pin wire wrap, tin	1.42	13.90	138.00

GOLD INLAY WIRE WRAP Min. 10 Microinches Gold

Part No.	Description	1	10	100
C9108	8 pin wire wrap, gold	.59	5.80	57.00
C9114	14 pin wire wrap, gold	.79	7.80	77.00
C9116	16 pin wire wrap, gold	.85	8.40	83.00
C9118	18 pin wire wrap, gold	.99	9.80	97.00
C9120	20 pin wire wrap, gold	1.19	11.80	117.00
C9122	22 pin wire wrap, gold	1.29	12.80	127.00
C9124	24 pin wire wrap, gold	1.39	13.80	137.00
C9128	28 pin wire wrap, gold	1.69	16.80	167.00
C9140	40 pin wire wrap, gold	2.29	22.80	227.00

TEXAS INSTRUMENTS GOLD EDGEBOARD CONNECTORS



RELIABLE, COST EFFICIENT CONTACT DESIGN
- 50 (Wire Wrap) to 30 (Solder Tail) micro inches gold inlay over a nickel diffusion barrier.
- Copper nickel tin CA 725 alloy.
- Bifurcated contact points.
- Preloaded, cantilever spring design.
- Contacts are user removable.

NOTE: Dimensions below are the pin center to center measurement followed by the distance separating the two pin rows.

H4 SERIES .100"x.200" EDGEBOARD CONNECTORS

Positions/Contacts	Part No. Wire Wrap	1	10	Part No. Solder Tail	1	10
10/20	C6-10	3.85	37.60	C5-10	2.95	28.00
15/30	C6-15	4.50	43.40	C5-15	3.40	32.50
17/34	C6-17	4.70	45.80	C5-17	3.60	34.30
18/36	C6-18	4.60	44.40	C5-18	3.55	33.90
20/40	C6-20	5.30	49.30	C5-20	3.90	37.40
22/44	C6-22	5.60	53.50	C5-22	4.20	40.40
25/50	C6-25	5.95	57.90	C5-25	4.50	43.30
28/56	C6-28	6.30	61.40	C5-28	4.80	46.00
30/60	C6-30	6.40	62.60	C5-30	4.95	48.20
31/62	C6-31	6.70	65.70	C5-31	5.20	49.35
35/70	C6-35	7.80	76.30	C5-35	5.80	56.10
36/72	C6-36	7.50	73.60	C5-36	5.70	55.50
40/80	C6-40	8.60	84.10	C5-40	6.30	61.70
43/86	C6-43	9.30	90.20	C5-43	6.80	66.60
49/98	C6-49	10.60	104.60	C5-49	7.80	76.80
50/100	C6-50	9.90	98.30	C5-50	7.40	72.10

For Polarizing Keys Order P/N CR1164-2 1 10/ea $7.50/100

H4 SERIES .125" x .250" EDGEBOARD CONNECTORS

Positions/Contacts	Part No. Wire Wrap	1	10	Part No. Solder Tail	1	10
10/20	C4-10	4.35	42.20	C3-10	2.95	28.40
15/30	C4-15	5.20	49.50	C3-15	3.40	33.40
18/36	C4-18	5.50	53.30	C3-18	3.70	35.90
20/40	C4-20	5.90	57.10	C3-20	3.95	38.70
22/44	C4-22	6.20	59.10	C3-22	4.20	40.90
25/50	C4-25	6.60	64.30	C3-25	4.70	45.70
28/56	C4-28	6.70	65.70	C3-28	4.85	47.40
30/60	C4-30	6.90	67.70	C3-30	4.95	48.60
31/62	C4-31	7.30	70.60	C3-31	5.25	51.70
35/70	C4-35	8.30	80.60	C3-35	6.10	59.10
36/72	C4-36	8.35	80.70	C3-36	6.10	58.10
40/80	C4-40	8.90	87.10	C3-40	6.55	64.20
44/88	C4-44	9.95	98.90	C3-44	7.40	72.50
50/100	C4-50	10.90	107.50	C3-50	7.90	77.90

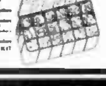
For Polarizing Keys Order P/N CR1164-2 1 10/ea $7.50/100

H4 SERIES .156" x .200" EDGEBOARD CONNECTORS

Positions/Contacts	Part No. Solder Tail	1	10	Part No. Solder Eye	1	10
10/20	C1-10	2.56	23.80	C2-10	4.11	38.36
12/24	C1-12	2.90	27.50			
15/30	C1-15	3.03	28.28	C2-15	4.77	44.52
18/36	C1-18	3.27	30.52	C2-18	5.07	47.82
22/44	C1-22	3.69	34.44			
25/50	C1-25	4.25	40.40	C2-25	6.18	57.68
28/56	C1-28	4.47	41.72			

For Polarizing Keys Order P/N CR1164-1 1 10/ea $7.50/100

ELECTRONIC HARDWARE KIT



CAT. NO. 1600 KIT **$14.95**

PANASONIC ELECTROLYTIC KIT

160 CAPACITORS

Price includes convenient divided plastic box with lid, guide for easy storage and quick access.

ASSORTMENT OF 15 POPULAR CAPACITORS

Cat. No. P6200-Kit **ONLY $35.95**

Panasonic LS Series
Miniature Aluminum Electrolytic Capacitors

Value UF	WV D.C.	Axial 1	Axial 10	Axial 100	Radial 1	Radial 10	Radial 100
22	/6.3	.18	1.54	12.83	—	—	—
33	/6.3	.20	1.68	14.04	.14	1.12	8.31
47	/6.3	.21	1.74	14.48	.14	1.16	9.58
100	/6.3	.22	1.83	15.22	.16	1.33	11.05
220	/6.3	.28	2.34	19.53	.21	1.78	14.80
330	/6.3	.29	2.46	20.48	.23	1.92	15.95
470	/6.3	.33	2.78	23.15	.23	1.97	16.34
1000	/6.3	.49	4.20	35.00	.36	3.08	25.62
2200	/6.3	.60	5.13	42.75	.54	4.56	37.96
3300	/6.3	.81	6.94	57.83	.76	6.36	53.10
4700	/6.3	1.04	8.89	74.07	.93	7.95	66.20
6800	/6.3	1.27	10.87	90.58	1.13	9.68	80.62
10000	/6.3	1.54	13.17	109.77	1.54	13.13	109.40
22	/10	.18	1.54	12.83	.13	1.08	8.94
22	/10	.21	1.74	14.48	.14	1.16	8.69
47	/10	.21	1.77	14.78	.14	1.19	9.90
100	/10	.24	2.00	16.65	.17	1.39	11.58
220	/10	.29	2.46	20.48	.23	1.92	15.95
330	/10	.33	2.78	23.15	.24	2.06	17.10
470	/10	.44	3.72	30.97	.35	2.97	24.69
1000	/10	.56	4.63	38.62	.41	3.42	28.46
2200	/10	.78	6.63	55.28	.70	5.93	49.42
3300	/10	.99	8.45	70.38	.90	7.71	64.22
4700	/10	1.28	10.94	91.18	1.13	9.68	80.62
6800	/10	1.55	13.26	110.52	1.54	13.20	109.40
10000	/10	1.99	17.00	141.63	—	—	—
10	/16	.18	1.54	12.83	.13	1.08	8.94
22	/16	.21	1.74	14.48	.14	1.15	9.52
33	/16	.21	1.77	14.77	.14	1.19	9.90
47	/16	.24	2.00	16.65	.16	1.36	11.31
100	/16	.28	2.34	19.53	.21	1.78	14.80
220	/16	.33	2.78	23.15	.24	2.06	17.10
330	/16	.44	3.72	30.97	.35	2.97	24.69
470	/16	.50	4.22	35.14	.38	3.19	26.58
1000	/16	.60	5.09	42.45	.50	4.21	35.08
2200	/16	.92	7.85	65.39	.87	7.46	62.10
3300	/16	1.16	9.91	82.62	1.17	10.01	83.48
4700	/16	1.57	13.40	111.68	1.57	13.43	111.87
6800	/16	1.99	17.00	141.63	—	—	—
2.2	/25	.18	1.54	12.83	—	—	—
3.3	/25	.18	1.54	12.83	.13	1.08	8.94
4.7	/25	.18	1.54	12.83	.13	1.08	8.94
10	/25	.18	1.54	12.83	.14	1.15	9.52
22	/25	.22	1.83	15.22	.15	1.22	10.17
33	/25	.24	2.00	16.66	.17	1.38	11.50
47	/25	.28	2.34	19.53	.21	1.73	14.42
100	/25	.33	2.78	23.16	.23	1.90	15.77
220	/25	.44	3.75	31.24	.40	3.42	28.45
330	/25	.50	4.26	35.47	.52	4.45	37.08
470	/25	.58	4.95	41.24	.64	5.42	45.13
1000	/25	.84	7.18	59.84	.83	7.06	58.78
2200	/25	1.16	9.91	82.62	1.17	10.02	83.47
3300	/25	1.61	13.77	114.77	1.66	14.17	118.03
4700	/25	1.99	17.00	141.63	—	—	—
2.2	/35	.18	1.54	12.83	—	—	—
3.3	/35	.18	1.64	12.83	.13	1.11	9.20
4.7	/35	.18	1.54	12.83	.13	1.11	9.20
10	/35	.21	1.77	14.78	.14	1.19	9.90
22	/35	.24	2.00	15.66	.19	1.60	13.30
33	/35	.28	2.34	19.53	.21	1.78	14.80
47	/35	.33	2.78	23.15	.23	1.90	15.77
100	/35	.43	3.66	30.40	.24	2.06	17.10
220	/35	.51	4.34	36.17	.40	3.42	28.45
330	/35	.57	4.86	40.40	.52	4.45	37.08
470	/35	.65	5.51	45.89	.64	5.42	45.13
1000	/35	.98	8.38	69.80	.82	7.84	65.32
2200	/35	1.61	13.77	114.71	1.66	14.17	118.03
3300	/35	1.99	17.00	144.63	—	—	—
4700	/35	2.61	22.31	185.89	—	—	—
0.47	/50	.18	1.54	12.83	.13	1.08	8.94
1	/50	.18	1.54	12.83	.13	1.08	8.94
1	/50	.18	1.54	12.83	.13	1.08	8.94
2.2	/50	.18	1.64	12.83	.13	1.08	8.94
3.3	/50	.18	1.54	12.83	.14	1.15	9.52
4.7	/50	.21	1.77	14.77	.14	1.18	9.78
10	/50	.24	2.00	15.66	.16	1.36	11.20
22	/50	.28	2.34	19.53	.22	1.83	15.19
33	/50	.32	2.69	27.43	.23	1.90	15.77
47	/50	.38	3.04	25.33	.24	2.05	17.03
100	/50	.45	3.78	31.54	.38	3.08	25.62
220	/50	.61	5.18	43.15	.52	4.45	37.08
330	/50	.78	6.50	54.14	.83	7.06	58.78
470	/50	.92	7.87	65.58	.92	7.84	65.32
1000	/50	1.25	10.71	89.27	1.31	11.16	92.93
2200	/50	1.99	17.00	141.63	—	—	—
0.47	/63	.18	1.54	12.83	.13	1.12	9.32
1	/63	.18	1.54	12.83	.13	1.12	9.32
2.2	/63	.18	1.54	12.83	.14	1.15	9.52
3.3	/63	.21	1.77	14.77	.15	1.25	10.35
4.7	/63	.24	2.00	16.65	.16	1.34	11.13
10	/63	.28	2.34	19.53	.18	1.50	12.43
22	/63	.33	2.78	23.15	.24	2.02	16.79
33	/63	.37	3.12	26.04	.27	2.24	18.60
47	/63	.53	4.51	37.62	.38	3.18	26.45
100	/63	.56	4.76	39.64	.50	4.24	35.27
220	/63	.76	6.50	54.14	.78	6.61	55.02
330	/63	.92	7.87	65.56	.92	7.84	65.32
470	/63	1.05	8.94	74.52	.99	8.43	70.19
1000	/63	1.64	13.99	116.56	1.66	14.17	118.03
2200	/63	2.61	22.31	185.39	—	—	—
0.47	/100	.18	1.54	12.83	.14	1.19	9.90
1	/100	.18	1.54	12.83	.14	1.19	9.90
2.2	/100	.22	1.83	15.22	.15	1.26	10.35
3.3	/100	.24	2.00	16.65	.17	1.38	11.50
4.7	/100	.28	2.34	19.53	.17	1.41	11.70
10	/100	.33	2.78	23.15	.22	1.83	15.19
22	/100	.43	3.65	30.40	.27	2.27	18.90
33	/100	.45	3.82	32.12	.34	2.88	24.00
47	/100	.54	4.62	38.48	.41	3.50	29.14
100	/100	.74	6.29	52.43	.57	4.83	40.22
220	/100	1.09	9.28	77.18	.98	8.22	68.47
330	/100	1.30	11.10	92.53	1.25	10.70	89.13
470	/100	1.81	15.46	128.80	1.78	15.25	127.04
1000	/100	3.16	27.09	225.72	—	—	—

PANASONIC V-SERIES
Stacked Metallized Film Capacitors

Parameter	V-SERIES
Operating Temperature Range	-40°C to +85°C
Capacity Range	0.01µF to 1.0µF
Temperature Coefficient ΔC/C	±2.5%
Standard Capacity Tolerance	±5%
Dissipation Factor (Max.)	1.0%
Insulation Resistance (20°C)	1000MΩ-µF
Voltage Coefficient (DC)	Negligible
Aging Rate	Negligible
Electrodes	Met. film
Lead Spacing	200, .300
Self-Healing	Yes
WVdc	50V

DIGI-KEY Part No.	Cap µF	1	10	100	1,000
P4501	0.001	.11	.91	7.89	57.40
P4502	0.0012	.11	.91	7.89	57.40
P4503	0.0015	.11	.91	7.89	57.40
P4504	0.0018	.11	.91	7.89	57.40
P4505	0.0022	.11	.91	7.89	57.40
P4506	0.0027	.11	.91	7.89	57.40
P4507	0.0033	.11	.91	7.89	57.40
P4508	0.0039	.11	.91	7.89	57.40
P4509	0.0047	.11	.91	7.89	57.40
P4510	0.0056	.11	.91	7.89	57.40
P4511	0.0068	.11	.91	7.89	57.40
P4512	0.0082	.11	.91	7.89	57.40
P4513	0.01	.11	.91	7.89	57.40
P4514	0.012	.11	.94	8.09	58.90
P4515	0.015	.11	.98	8.47	61.60
P4516	0.018	.11	1.01	8.75	63.70
P4517	0.022	.12	1.06	9.15	66.60
P4518	0.027	.12	1.12	9.65	70.20
P4519	0.033	.13	1.19	10.23	74.40
P4520	0.039	.14	1.24	10.71	77.90
P4521	0.047	.15	1.32	11.39	82.90
P4522	0.056	.16	1.42	12.26	89.20
P4523	0.068	.17	1.53	13.19	95.90
P4524	0.082	.18	1.63	14.03	102.10
P4525	0.1	.18	1.68	14.49	105.40
P4526	0.12	.20	1.84	15.82	113.60
P4527	0.15	.24	2.21	19.00	138.20
P4528	0.18	.24	2.21	19.00	138.20
P4529	0.22	.27	2.42	20.83	151.50
P4530	0.27	.30	2.70	23.23	169.00
P4531	0.33	.33	3.00	25.79	187.60
P4532	0.39	.36	3.33	28.62	208.20
P4533	0.47	.41	3.75	32.29	234.90
P4534	0.56	.46	4.21	36.24	263.60
P4535	0.68	.52	4.72	40.56	295.00
P4536	0.82	.58	5.32	45.78	333.00
P4537	1.0	.66	6.02	51.75	376.00

DISC CAPACITORS
Panasonic Ceramic Disc Capacitors

NEW! KIT 310 DISC CAPACITORS

Price include convenient divided plastic box with lid guide for easy storage and quick access. ASSORTMENT OF 15 POPULAR VALUES PANASONIC QUALITY

CAT. NO. DH-KIT **ONLY $24.95**

DIGI-KEY now has an expanded line of Panasonic Ceramic Disc Capacitors, including

NPO TYPE

For Complete Specs on Physical Size and Electrical Characteristics, consult your *FREE* DIGI-KEY Catalog.

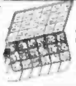
Part No.	Cap.	Volt.	Price 10	100	1,000
P4000	10 pf	500	.75	6.49	48.71
P4002	15 pf	500	.75	6.49	48.71
P4003	18 pf	500	.75	6.49	48.71
P4004	22 pf	500	.75	6.49	48.71
P4005	27 pf	500	.75	6.49	48.71
P4006	33 pf	500	.75	6.49	48.71
P4007	39 pf	500	.75	6.49	48.71
P4008	47 pf	500	.75	6.49	48.71
P4009	56 pf	500	.75	6.49	48.71
P4010	68 pf	500	.84	7.23	54.22
P4011	82 pf	500	.84	7.23	54.22
P4100	100 pf	500	.63	5.43	40.72
P4102	150 pf	500	.63	5.43	40.72
P4103	180 pf	500	.63	5.43	40.72
P4104	220 pf	500	.63	5.43	40.72
P4105	270 pf	500	.63	5.43	40.72
P4106	330 pf	500	.63	5.43	40.72
P4107	390 pf	500	.63	5.43	40.72
P4108	470 pf	500	.80	6.91	51.86
P4109	560 pf	500	.80	6.91	51.86
P4110	680 pf	500	.80	6.91	51.86
P4111	820 pf	500	.80	6.91	51.86
P4112	1000 pf	500	1.00	8.58	64.35
P4114	1500 pf	500	1.00	8.58	64.35
P4115	1800 pf	500	1.31	11.25	84.37
P4200	1000 pf	100	.58	5.01	37.57
P4202	1500 pf	100	.58	5.01	37.57
P4203	2200 pf	100	.58	5.01	37.57
P4205	3300 pf	100	.58	5.01	37.57
P4206	4700 pf	100	.58	5.01	37.57
P4209	6800 pf	100	.70	6.00	45.00
P4300	.01 uf	25	.56	4.83	36.23
P4303	.022 uf	25	.68	5.91	44.32
P4306	.033 uf	25	.82	7.08	53.10
P4307	.047 uf	25	.89	7.68	57.60
P4311	.1 uf	25	1.79	15.37	115.31
NPO NPO NPO	NPO NPO	NPO	NPO NPO		
P4400	10 pf	500	.73	6.28	47.13
P4402	15 pf	500	.81	6.97	52.31
P4403	18 pf	500	.81	6.97	52.31
P4404	22 pf	500	.81	6.97	52.31
P4405	27 pf	500	.81	6.97	52.31
P4406	33 pf	500	1.03	8.89	66.71
P4407	39 pf	500	1.03	8.89	66.71
P4408	47 pf	500	1.37	11.80	88.53
P4409	56 pf	500	1.37	11.80	88.53
P4410	68 pf	500	1.56	13.38	100.35
P4411	82 pf	500	2.05	17.59	131.96

See The DIGI-KEY Catalog For Low OEM Prices On Disc Capacitors

PANASONIC METALLIZED POLYESTER CAPACITORS

NEW! KIT 170 METALLIZED POLYESTER CAPACITORS

Price includes convenient divided plastic box with lid, guide for easy storage and quick access. ASSORTMENT OF 15 POPULAR VALUES PANASONIC QUALITY



CAT. NO. E-KIT **ONLY $54.95**

DIGI-KEY Part No.	Working Voltage	µF	Pak Of 1	Pak Of 10	Pak Of 100	Pak Of 1,000
E1104	100	.1	.23	1.99	16.63	148.73
E1124	100	.12	.25	2.12	17.63	158.73
E1154	100	.15	.27	2.28	18.96	170.56
E1184	100	.18	.29	2.49	20.73	186.53
E1224	100	.22	.32	2.68	22.27	200.37
E1274	100	.27	.34	2.91	24.25	218.25
E1334	100	.33	.37	3.18	26.45	238.05
E1394	100	.39	.41	3.44	28.65	257.86
E1474	100	.47	.43	3.68	30.66	275.86
E1564	100	.56	.47	4.02	33.46	301.05
E1684	100	.68	.52	4.44	36.93	332.36
E1824	100	.82	.58	4.94	41.13	370.13
E1105	100	1.0	.63	5.35	44.52	400.62
E1125	100	1.2	.68	5.82	48.50	436.50
E1156	100	1.5	.86	7.32	60.97	548.67
E1185	100	1.8	1.01	8.64	71.99	647.89
E1225	100	2.2	1.04	8.85	73.70	663.08
E1275	100	2.7	1.04	8.85	73.70	663.08
E1335	100	3.3	1.35	11.50	95.85	862.54
E1395	100	3.9	1.35	11.50	95.85	862.54
E1475	100	4.7	1.75	14.95	124.55	1,120.73
E1565	100	5.6	1.95	16.65	138.70	1,248.08
E1685	100	6.8	2.36	20.14	167.85	1,510.43
E1825	100	8.2	2.86	24.45	203.70	1,833.30
E1106	100	10.0	3.23	27.69	230.75	2,076.41
E2103	250	.01	.19	1.64	13.68	123.08
E2123	250	.012	.19	1.64	13.68	123.08
E2153	250	.015	.19	1.64	13.68	123.08
E2183	250	.018	.19	1.64	13.68	123.08
E2223	250	.022	.19	1.64	13.68	123.08
E2273	250	.027	.19	1.64	13.68	123.08
E2333	250	.033	.19	1.64	13.68	123.08
E2393	250	.039	.19	1.64	13.68	123.08
E2473	250	.047	.19	1.64	13.68	123.08
E2563	250	.056	.22	1.85	15.43	138.83
E2683	250	.068	.22	1.85	15.43	138.83
E2823	250	.082	.22	1.86	15.43	138.83
E2104	250	.10	.23	1.94	16.13	145.13
E2124	250	.12	.25	2.12	17.63	158.63
E2154	250	.15	.27	2.28	18.95	170.56
E2184	250	.18	.29	2.49	20.73	186.53
E2224	250	.22	.32	2.68	22.28	200.48
E2274	250	.27	.34	2.91	24.25	218.25
E2334	250	.33	.37	3.18	26.47	238.17
E2394	250	.39	.41	3.44	28.65	257.85
E2474	250	.47	.43	3.68	30.66	275.85
E2564	250	.56	.47	4.02	33.45	301.05
E2684	250	.68	.52	4.43	36.93	332.33
E2824	250	.82	.58	4.94	41.13	370.13
E2105	250	1.0	.63	5.35	44.52	400.62
E2125	250	1.2	.68	5.82	48.50	436.50
E2155	250	1.5	.86	7.32	60.97	548.67
E2185	250	1.8	1.01	8.64	72.00	648.00
E2225	250	2.2	1.03	8.85	73.68	663.08
E4103	400	.01	.34	2.93	24.40	219.15
E4123	400	.012	.34	2.93	24.40	219.15
E4153	400	.015	.34	2.93	24.40	219.15
E4183	400	.018	.34	2.93	24.40	219.15
E4223	400	.022	.34	2.93	24.40	219.15
E4273	400	.027	.34	2.93	24.40	219.15
E4333	400	.033	.34	2.93	24.40	219.15
E4393	400	.039	.34	2.93	24.40	219.15
E4473	400	.047	.34	2.93	24.40	219.15
E4563	400	.056	.34	2.93	24.40	219.15
E4683	400	.068	.34	2.93	24.40	219.15
E4823	400	.082	.44	3.76	31.28	281.48
E4104	400	.10	.45	3.83	31.92	287.21
E4124	400	.12	.47	4.04	33.60	302.40
E4154	400	.15	.49	4.18	34.80	313.20
E4184	400	.18	.56	4.68	38.98	350.78
E4224	400	.22	.57	4.89	40.73	366.53
E4274	400	.27	.69	5.85	48.73	438.53
E4334	400	.33	.75	6.38	53.15	478.35
E4394	400	.39	.82	7.02	58.48	526.28
E4474	400	.47	.91	7.78	64.80	583.20
E4564	400	.56	1.07	9.14	76.12	685.00
E4684	400	.68	1.21	10.37	86.42	777.76
E4824	400	.82	1.29	11.03	91.90	826.99
E4105	400	1.0	1.35	11.50	95.83	862.43
E4125	400	1.2	1.47	12.60	105.00	945.00
E4155	400	1.5	1.59	13.56	112.98	1,016.80
E4185	400	1.8	1.88	16.10	134.13	1,207.15
E4225	400	2.2	2.15	18.34	152.95	1,376.66

PLESSEY "MINI BOX"
Metallized Polyester Capacitor Kit

140 CAPACITORS

Price includes convenient divided plastic box with lid, guide for easy storage and quick access.

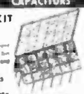
ASSORTMENT OF 14 POPULAR "MINI BOX" CAPACITORS

CAT. NO. 3050P-Kit **ONLY $35.95**

PANASONIC RESIN DIPPED TANTALUM CAPACITORS

NEW! KIT 160 TANTALUM CAPACITORS

Prices includes convenient divided plastic box with lid, guide for easy storage and quick access. ASSORTMENT OF 15 POPULAR VALUES PANASONIC QUALITY



CAT. NO. F-KIT **ONLY $54.95**

DIGI-KEY Part No.	Cap. (uF)	Volt. DC	Price 1	10	100	1000
P2000	3.3	3.15	.31	2.70	22.50	202.50
P2001	6.8	3.15	.31	2.70	22.50	202.50
P2002	10	3.15	.31	2.70	22.50	202.50
P2003	15	3.15	.42	3.66	30.56	275.06
P2004	22	3.15	.52	4.46	37.22	335.02
P2005	33	3.15	.63	5.40	45.00	405.00
P2006	47	3.15	.66	5.67	47.25	425.25
P2007	68	3.15	.78	6.75	56.25	506.25
P2008	100	3.15	.97	8.37	69.75	627.75
P2009	150	3.15	2.27	19.50	162.50	1462.50
P2010	220	3.15	2.74	23.55	196.25	1766.25
P2011	4.7	6	.31	2.70	22.50	202.50
P2012	6.8	6	.37	3.21	26.81	241.31
P2013	10	6	.50	4.29	35.81	322.31
P2014	15	6	.52	4.53	37.75	339.75
P2015	22	6	.66	5.67	47.25	425.25
P2016	33	6	.68	5.85	48.75	438.75
P2017	47	6	.72	6.21	51.75	466.75
P2018	68	6	1.14	9.80	81.72	735.52
P2019	100	6	2.55	21.88	182.36	1641.26
P2020	150	6	2.74	23.49	195.81	1762.31
P2021	1.0	10	.31	2.70	22.50	202.50
P2022	2.2	10	.31	2.70	22.50	202.50
P2023	3.3	10	.31	2.70	22.50	202.50
P2024	4.7	10	.34	2.94	24.50	220.50
P2025	6.8	10	.39	3.36	28.00	252.00
P2026	10	10	.47	4.06	33.75	303.75
P2027	15	10	.59	5.10	42.50	382.50
P2028	22	10	.66	5.70	47.50	427.50
P2029	33	10	.83	7.14	59.50	535.50
P2030	47	10	1.29	11.08	92.17	829.57
P2031	68	10	2.27	19.50	162.50	1462.50
P2032	100	10	2.76	23.70	197.50	1777.50
P2033	1.5	16	.31	2.70	22.50	202.50
P2034	2.2	16	.31	2.70	22.50	202.50
P2035	3.3	16	.34	2.94	24.50	220.50
P2036	4.7	16	.39	3.36	28.00	252.00
P2037	6.8	16	.45	3.90	32.50	292.50
P2038	10	16	.61	5.31	44.25	398.25
P2039	15	16	.68	5.85	48.75	438.75
P2040	22	16	.82	7.06	58.75	528.75
P2041	33	16	1.54	13.20	110.00	990.00
P2042	47	16	2.27	19.50	162.50	1462.50
P2043	68	16	2.76	23.70	197.50	1777.50
P2044	1.5	25	.31	2.70	22.50	202.50
P2045	2.2	25	.34	2.94	24.50	220.50
P2046	3.3	25	.39	3.36	28.00	252.00
P2047	4.7	25	.47	4.06	33.75	303.75
P2048	6.8	25	.59	5.10	42.50	382.50
P2049	10	25	.82	7.06	58.75	528.75
P2050	15	25	1.29	11.10	92.50	832.50
P2051	22	25	1.80	15.45	128.75	1158.75
P2052	33	25	2.56	21.90	182.50	1642.50
P2053	0.1	35	.29	2.56	21.25	191.25
P2054	0.15	35	.31	2.70	22.50	202.50
P2055	0.22	35	.31	2.70	22.50	202.50
P2056	0.33	35	.31	2.70	22.50	202.50
P2057	0.47	35	.31	2.70	22.50	202.50
P2058	0.68	35	.31	2.70	22.50	202.50
P2059	1.0	35	.31	2.70	22.50	202.50
P2060	1.5	35	.44	3.82	31.87	286.87
P2061	2.2	35	.47	4.05	33.75	303.75
P2062	3.3	35	.52	4.50	37.50	337.50
P2063	4.7	35	.56	4.80	40.00	360.00
P2064	6.8	35	.79	6.78	56.50	508.50
P2065	10	35	1.05	9.00	75.00	675.00
P2066	15	35	2.38	20.40	170.00	1530.00
P2067	0.1	50	.31	2.70	22.50	202.50
P2068	0.15	50	.31	2.70	22.50	202.50
P2069	0.22	50	.31	2.70	22.50	202.50
P2070	0.33	50	.31	2.70	22.50	202.50
P2071	0.47	50	.39	3.39	28.32	254.92
P2072	0.68	50	.44	3.78	31.50	283.50
P2073	1.0	50	.54	4.65	38.75	348.75
P2074	1.5	50	.63	5.40	45.00	405.00
P2075	2.2	50	.74	6.36	53.00	477.00
P2076	3.3	50	.81	7.02	58.50	526.50
P2077	4.7	50	1.01	8.73	72.75	654.75
P2078	6.8	50	2.06	17.70	147.50	1327.50

TANTALUM SUBSTITUTES PANASONIC K-SERIES CAPACITORS

New Panasonic K-Series are miniature, low cost aluminum electrolytic capacitors. Their size and performance characteristics make them viable alternatives to tantalums in many applications.

CAPACITANCE TOLERANCE: 20%
D.C. LEAKAGE CURRENT, MAX. 0.01 C V or 3uA
All K-SERIES CAPACITORS We Carry Are Radial

DIGI-KEY Part No.	Cap. uF	Working Voltage DC	1	10 Pak	100 Pak	1000 Pak
P800	22		.16	1.42	11.85	106.65
P801	33	6.3	.17	1.49	12.42	111.82
P802	47		.17	1.52	12.72	114.82
P803	100		.20	1.79	14.95	134.56
P804	22		.17	1.49	12.42	111.82
P805	33	10	.18	1.56	13.00	117.00
P806	47		.19	1.66	13.90	125.10
P807	10		.16	1.45	12.11	109.01
P808	22	16	.18	1.59	13.32	119.92
P809	33		.20	1.71	14.28	128.58
P810	47		.22	1.90	15.87	142.87
P811	3.3		.16	1.42	11.85	106.65
P812	4.7		.16	1.42	11.85	106.65
P813	10	17	.17	1.49	12.42	111.82
P814	22		.20	1.71	14.28	128.58
P815	33		.22	1.93	16.16	145.45
P816	3.3		.16	1.43	11.97	107.77
P817	4.7	35	.16	1.45	12.11	109.01
P818	10		.16	1.56	13.00	117.00
P819	22		.22	1.90	15.87	142.87
P820	.1		.16	1.42	11.85	106.65
P821	.22		.16	1.42	11.85	106.65
P822	.33		.16	1.42	11.85	106.65
P823	.47		.16	1.42	11.85	106.65
P824	1.0	50	.16	1.42	11.85	106.65
P825	2.2		.16	1.42	11.85	106.65
P826	3.3		.16	1.42	12.11	109.01
P827	4.7		.17	1.49	12.42	111.82
P828	10		.19	1.66	13.90	125.10

Panasonic TSW Series
Large Aluminum Electrolytic Capacitors

DIGI-KEY Part No.	Working Voltage (W.V.)	Cap. (µF)	Prices 1	10	100
P6500	16	3300	$1.20	$9.29	$84.00
P6501		4700	1.46	11.17	101.00
P6502		6800	1.91	14.73	133.00
P6503		10000	2.40	18.50	167.00
P6504		15000	3.41	26.29	237.00
P6505	25	2200	1.23	9.53	86.00
P6506		3300	1.61	11.64	105.00
P6507		4700	1.89	14.58	131.00
P6508		6800	2.50	19.23	173.00
P6509		10000	3.22	24.79	223.00
P6510		15000	4.14	31.81	287.00
P6511	35	1000	1.03	7.94	71.00
P6512		2200	1.38	10.67	96.00
P6513		3300	1.86	14.36	129.00
P6514		4700	2.39	18.41	166.00
P6515		6800	3.07	23.61	213.00
P6516		10000	4.62	35.56	320.00
P6517	50	1000	1.25	9.64	87.00
P6518		2200	1.92	14.82	133.00
P6519		3300	2.66	20.44	184.00
P6520		4700	3.46	26.61	240.00
P6521		6800	4.20	32.38	291.00
P6522	100	470	1.44	11.14	100.00
P6523		1000	2.43	18.76	169.00
P6524		2200	3.91	30.11	271.00
P6525	200	220	1.91	14.70	132.34
P6526		330	2.88	22.20	200.00
P6527		470	3.36	25.81	233.00
P6528	250	150	2.58	19.86	179.00
P6529		220	2.60	20.00	180.00
P6530		330	3.02	23.26	209.00
P6531		470	3.90	30.00	270.00

The Digi-Key volume discount and Service charges are simple to apply. Most items sold by Digi-Key may be combined for a volume discount. Items that are not discountable are identified by the suffix-ND following the part number. After writing your order, total all of the discountable items and apply the appropriate discount. To this subtotal, add the non-discountable items. Then add the handling charge. We pay all shipping and insurance to addresses in the U.S.A., Canada and Mexico when check or money order accompanies order.

WHEN ORDERING BY PHONE, CALL: 1-800-346-5144 (Mn., Ak., Hi., call 218-681-6674) By mail send your order to: DIGI-KEY, Highway 32 South, Thief River Falls, MN 56701

You may pay by check, money order, Master Charge, VISA or C.O.D. ***DIGI-KEY GUARANTEE:*** Any parts or products purchased from Digi-Key that prove to be defective will be replaced or refunded if returned within 90 days from receipt with a copy of your invoice.

SERVICE	CHARGES
$ 0.00-$ 9.99	Add $2.00
$ 10.00-$25.00	Add $0.75
$ 25.00-$49.99	Add $0.50
$ 50.00-$99.99	Add $0.25
$100.00 & Up	No Charge

VOLUME DISCOUNT	
$ 0.00-$ 99.99	NET
$ 100.00-$249.99	Less 10%
$ 250.00-$499.99	Less 15%
$ 500.00-$999.99	Less 20%
$1000.00 & Up	Less 25%

Circle No. 14 on Free Information Card

PARTIAL LISTING ONLY – PLEASE CALL OR WRITE FOR FREE CATALOG.

STATIC RAMS

2114	1024 x 4 (450ns)	8/9.95
2114-25	1024 x 4 (250ns)	8/10.95
2114L-2	1024 x 4 (200ns) (LP)	8/13.95
TMM2016-200	2048 x 8 (200ns)	4.15
TMM2016-150	2048 x 8 (150ns)	4.95
TMM2016-100	2048 x 8 (100ns)	6.15
HM6116-4	2048 x 8 (200ns) (cmos)	4.75
HM6116-3	2048 x 8 (150ns) (cmos)	4.95
HM6116LP-4	2048 x 8 (200ns) (cmos) (LP)	5.95
HM6116LP-3	2048 x 8 (150ns) (cmos) (LP)	6.95
HM6264	8192 x 8 (150ns) (cmos)	39.95

LP = Low Power

DYNAMIC RAMS

4116-250	16384 x 1 (250ns)	8/7.95
4116-200	16384 x 1 (200ns)	8/12.95
4116-150	16384 x 1 (150ns)	8/14.95
4164-200	65536 x 1 (200ns) (5v)	5.95
4164-150	65536 x 1 (150ns) (5v)	6.95
TMS 4164-15	65536 x 1 (150ns) (5v)	8.95

5v = Single 5 volt supply

EPROMS

2708	1024 x 8 (450ns)	3.95
2716	2048 x 8 (450ns) (5v)	3.95
2716-1	2048 x 8 (350ns) (5v)	5.95
TMS2532	4096 x 8 (450ns) (5v)	5.95
2732	4096 x 8 (450ns) (5v)	4.95
2732-250	4096 x 8 (250ns) (5v)	8.95
2732-200	4096 x 8 (200ns) (5v)	11.95
2732A	4096 x 8 (250ns) (5v) (21vPGM)	9.95
2732A-2	4096 x 8 (200ns) (5v) (21vPGM)	13.95
27128	16384 x 8 (300ns) (5v)	29.95

5v = Single 5 volt supply 21vPGM = Program at 21 Volts

SPECTRONICS CORPORATION

EPROM ERASER PE-14, 9 chip capacity 83.00

8000

8039	5.95
8080	3.95
8085	4.95
8087	CALL
8088	29.95
8155	6.95
8748	24.95

8200

8203	39.95
8205	3.50
8212	1.80
8216	1.75
8228	3.49
8237-5	21.95
8243	4.45
8250	10.95
8251	4.49
8253	6.95
8253-5	7.95
8255	4.49
8255-5	5.25
8259	6.90
8259-5	7.50
8275	29.95
8279	8.95
8282	6.50
8284	5.50
8286	6.50

Z-80

Z80-CPU	3.95
Z80-PIO	3.95
Z80A-CPU	4.49
Z80A-CTC	4.95
Z80A-PIO	4.49
Z80A-SIO/0	12.95
Z80B-CPU	9.95

6500

6502	4.95
6522	6.95
6502A	6.95

6800

6802	7.95
6809E	14.95
6821	2.95
6845	14.95
6850	3.25
6883	22.95

DISK CONTR

1771	24.95
1791	24.95
1793	26.95
2791	54.95
2793	54.95

INTERFACE

8T28	1.89
8T97	.89
DM8131	2.95
DP8304	2.29
9334	2.50
9368	3.95

CLOCK CHIPS

MM5369	3.95
MM58167	12.95
MSM5832	3.95

DATA ACQ

ADC0804	3.49
ADC0809	4.49
ADC0817	9.95

SOUND CHIPS

76488	5.95
AY3-8910	12.95

CRYSTALS

32.768 khz	1.95
1.0 mhz	3.95
1.8432	3.95
2.0	2.95
2.4576	2.95
3.276	2.95
3.579545	2.95
4.0	2.95
5.0	2.95
5.0688	2.95
6.0	2.95
6.144	2.95
8.0	2.95
10.0	2.95
10.738635	2.95
14.31818	2.95
15.0	2.95
16.0	2.95
17.430	2.95
20.0	2.95

DISCRETE

KBP02	Bridge	.45
1N751	5.1v zener	.25
1N759	12v zener	.25
2N2222		.25
PN2222		.10
2N2905		.50
2N2907		.25
2N3055		.79
2N3904		.10
2N3906		.10
1N4004		10/1.00
1N4148		25/1.00

74LS00

74LS00	.24	74LS157	.65
74LS02	.25	74LS158	.59
74LS03	.25	74LS161	.65
74LS04	.24	74LS163	.65
74LS05	.25	74LS164	.69
74LS08	.28	74LS165	.95
74LS09	.29	74LS169	1.75
74LS11	.35	74LS173	.69
74LS14	.59	74LS174	.55
74LS20	.25	74LS191	.89
74LS21	.29	74LS193	.79
74LS27	.29	74LS194	.69
74LS30	.25	74LS195	.69
74LS32	.29	74LS221	.89
74LS33	.55	74LS240	.95
74LS38	.35	74LS241	.99
74LS42	.49	74LS242	.99
74LS47	.75	74LS243	.99
74LS51	.25	74LS244	1.29
74LS73	.39	74LS251	.59
74LS74	.35	74LS257	.59
74LS75	.39	74LS258	.59
74LS76	.39	74LS259	2.75
74LS85	.69	74LS260	.59
74LS86	.39	74LS266	.55
74LS90	.55	74LS273	1.49
74LS92	.55	74LS279	.49
74LS93	.55	74LS280	1.98
74LS107	.39	74LS283	.69
74LS109	.39	74LS290	.89
74LS112	.39	74LS293	.89
74LS122	.45	74LS299	1.75
74LS123	.79	74LS323	3.50
74LS125	.49	74LS365	.49
74LS126	.49	74LS367	.45
74LS132	.59	74LS368	.45
74LS133	.59	74LS373	1.39
74LS136	.39	74LS374	1.39
74LS138	.55	74LS377	1.39
74LS139	.55	74LS390	1.19
74LS148	1.35	74LS393	1.19
74LS151	.55	74LS640	2.20
74LS153	.55	74LS670	1.49
74LS154	1.90	74LS682	3.20
74LS156	.69	74LS688	2.40

74S00

74S00	.32	74S86	.50
74S02	.35	74S112	.50
74S04	.35	74S124	2.75
74S05	.35	74S138	.85
74S08	.35	74S157	.95
74S10	.35	74S175	.95
74S11	.35	74S240	2.20
74S20	.35	74S280	1.95
74S32	.40	74S287	1.90
74S74	.50	74S288	1.90

7400

7400	.19	7447	.69
7402	.19	7473	.34
7404	.19	7474	.33
7405	.25	7475	.45
7406	.29	7476	.35
7407	.29	7486	.35
7408	.24	7490	.35
7410	.19	7492	.50
7411	.25	7493	.35
7414	.49	74121	.29
7416	.25	74123	.49
7417	.25	74132	.45
7420	.19	74151	.55
7425	.29	74154	1.25
7430	.19	74157	.55
7432	.29	74164	.85
7438	.29	74168	1.00
7442	.49	74192	.79
7445	.69	74193	.79

CMOS

4001	.25	4069	.29
4011	.25	4070	.35
4013	.38	4071	.29
4015	.39	4081	.29
4016	.39	4093	.49
4017	.69	14411	11.95
4020	.75	4511	.85
4024	.65	4518	.89
4027	.45	4520	.79
4040	.75	4553	5.79
4042	.69	4584	.75
4046	.85	74C00	.35
4049	.35	74C04	.35
4050	.35	74C74	.35
4051	.79	74C925	5.95
4066	.39	74C926	7.95

RESISTORS

¼ WATT 5% CARBON FILM ALL STANDARD VALUES FROM 1 OHM TO 10 MEG OHM

50 PCS./VALUE	.025
100 PCS./VALUE	.02
1000 PCS./VALUE	.015

DIP SWITCHES

4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95

MISC.

ULN2003	2.49
3242	7.95
MC3470	4.95
AY5-1013	3.95
COM8116	10.95

IC SOCKETS

	1-99	100
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
64 pin ST	4.25	call

ST = SOLDERTAIL

8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80

WW = WIREWRAP

16 pin ZIF	6.95	call
24 pin ZIF	7.95	call
28 pin ZIF	8.95	call

ZIF = TEXTOOL (Zero Insertion Force)

ORDER TOLL FREE

800-538-5000

800-662-6279

(CALIFORNIA RESIDENTS)

D-SUBMINIATURE CONNECTORS

DB09P	Male 9 Pin D-Sub	$2.08
DB25P	Male 25 Pin D-Sub	2.50
DB25S	Female 25 Pin D-Sub	3.25
DB25SR	Female 25 Pin Right Angle PC	4.42
GREY HOOD	for DB25 Connectors	1.25

IDC CONNECTORS

IDS26	26 Pin Ribbon Socket	2.43
IDS34	34 Pin Ribbon Socket	3.15
IDS50	50 Pin Ribbon Socket	4.65
IDE34	34 Pin Ribbon Edge Card	3.25
IDP16	16 Male Pin Dip Plug	1.65
RC50	50 Conductor Ribbon Cable	1.38/ft.

LINEAR

TL084	2.19
LM301	.34
LM307	.45
LM311	.64
LM317T	1.19
LM319	1.25
LM324	.59
LM339	.99
LF351	.60
LM353	1.00
LM358	.69
LM380	.89
LM386	.89
LM393	1.29
TL497	3.25
NE555	.34
NE558	1.50
NE564	2.95
LM565	.99
LM566	1.49
LM567	.89
NE592	2.75
LM723	.49
LM741	.35
LM1303	1.95
MC1408L8	2.95
LM1458	.59
LM1488	.69
LM1489	.69
XR2206	3.75
XR2211	5.25
CA3146	1.85
LM3914	3.95
75150	1.95
75154	1.95
75188	1.25
75189	1.25
7805T	.75
7808T	.75
7812T	.75
7815T	.75
7805K	1.39
7812K	1.39
78H05K	9.95
78L05	.69
78L12	.69
7905T	.85
7912T	.85
79L05	.79
79L12	.79

T = TO-220 K = TO-3 L = TO-92

HEAT SINKS

TO-3 style	.95
TO-220 style	.35

PERIPHERALS

JDR HALF-HEIGHT DISK DRIVE

- ★ TEAC DIRECT DRIVE MECHANISM
- ★ FULLY APPLE COMPATIBLE
- ★ FULL 1 YEAR WARRANTY

$209.95

40 TRACK CONTROLLER $49.95

FD-35 FULL HEIGHT DISK DRIVE

- ★ MADE IN USA
- ★ SHUGART MECHANISM
- ★ FULL 1 YEAR WARRANTY

$199.95

BMX-80 80cps Bi-Directional $279.00

JDR 16K RAM Card $44.95

Power Supply 5amp Model $79.95

DISKETTES

NASHUA SS/SD $19.95 VERBATIM SS/DD $29.95

JUMBO LEDS

	1-99	100-up
RED	.10	.09
GREEN	.18	.15
YELLOW	.18	.15

MOUNTING HARDWARE .10 EA. 100/.09 EA.

DISPLAYS

MAN 72	CA.3"	.99
MAN 74	CC.3"	.99
FND-357	CC.375"	1.25
FND-500	CC.5"	1.49
FND-507	CA.5"	1.49

ELCOMP

Hardware Handbook Mfr's Specs: LOGIC, MEMORY, MPU's & more

800 pgs $14.95

CAPACITORS

DISC

10pf	56pf
22pf	82pf
27pf	100pf
33pf	220pf
47pf	.001uf

50V, .05¢ EACH

MONOLITHIC

.01uf-mono	50V	.14
.047uf-mono	50V	.15
.1uf-mono	50V	.18
.47uf-mono	50V	.25

ELECTROLYTIC

RADIAL

1uf	25V	.14
47uf	35V	.18
470uf	25V	.30
2200uf	16V	.60

AXIAL

1uf	50V	.14
22uf	16V	.14
47uf	50V	.20
220uf	25V	.30

COMPUTER GRADE

44,000uf	30V	3.95

JDR Microdevices

1224 S. Bascom Avenue, San Jose, CA 95128

800-538-5000 • 800-662-6279 (CA)

(408) 995-5430 • Telex 171-110

VISIT OUR RETAIL STORE

HOURS: M-W-F, 9-5 T-Th., 9-9 Sat. 10-3

PLEASE USE YOUR CUSTOMER NUMBER WHEN ORDERING

TERMS: Minimum order $10. For shipping and handling include $2.50 for UPS Ground and $3.50 for UPS Air. Orders over 1 lb. and foreign orders may require additional shipping charges — please contact our sales department for the amount. CA residents must include 6% sales tax, Bay Area and LA residents include 6½%. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sale.

Computer Mart

RATE: Ads are " by 3". 1 insertion: $935.00. 6 insertions: $900.00 ea. 12 insertions, $865.00 ea. Closing date: 1st of the 2nd mo. preceding cover date. Send order and remittance to Computer Mart, Computers & Electronics, 1 Park Ave., N.Y., N.Y. 10016. Direct inquiries to (212) 725-4215.

CIRCLE NO. 102 ON FREE INFORMATION CARD

CIRCLE NO. 103 ON FREE INFORMATION CARD

CIRCLE NO. 104 ON FREE INFORMATION CARD

BUILD YOUR OWN COMPUTER!!

68000 BASED MULTI-BUS COMPATIBLE KIT

4 BOARD SET INCLUDES:

1 6 SLOT MOTHER BOARD
1 CPU CARD
1 I/O with UPD 765 FLOPPY CONTROLLER
1 128K RAM CARD

SCHEMATICS PARTS LIST & ASSEMBLY DRAWINGS

KT 1001 COMPUTER KIT (FLATBOARDS ONLY)	$ 189.99
KT 1004 COMPUTER KIT (UNTESTED BOARDS - POPULATED)	$ 899.99
KT 1002 COMPUTER KIT (DOCUMENTATION ONLY)	$ 35.00
KT 1003 PAL FOR RAM BOARD	$ 16.99
KT 1005 CP/M FOR KIT (INCLUDES BIOS)	$ 350.00

WE CARRY A COMPLETE LINE OF ELECTRONIC COMPONENTS
SEND FOR A FREE CATALOG!!!

NICORN ELECTRONICS
10010 CANOGA AVE., UNIT B-8
CHATSWORTH, CALIF. 91311
(818) 341-8833

CIRCLE NO. 105 ON FREE INFORMATION CARD

★MICROCOMPUTER★
BUSINESS SOFTWARE

MEDICAL MGMT...
DENTAL MGMT...
INSURANCE AGENT
LEGAL BILLING.....
PROPERTY MGMT..
AND MUCH MORE !

UNIVAIR INTERNATIONAL
9024 St. Charles Rock Road
ST. LOUIS, MISSOURI 63114

(314) 426-1099

CIRCLE NO. 106 ON FREE INFORMATION CARD

ELECTRONIC COMPONENTS

MANUFACTURERS OF QUALITY ELECTRONIC COMPONENTS

OVER 15,000 DIFFERENT ITEMS IN STOCK!

MOUSER ELECTRONICS
11433 WOODSIDE AVE., SANTEE, CA 92071
PHONE: (619) 449-2222 TWX: 910-331-1175

CIRCLE NO. 107 ON FREE INFORMATION CARD

SALES POWER

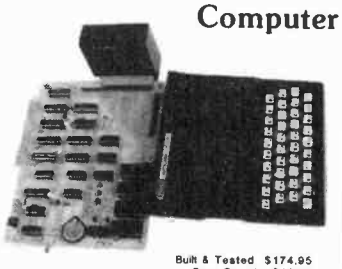
Creative Computing not only sells itself at a nice profit, it helps sell the hardware and software in your store too. Because it goes home with customers and continues to influence buying decisions long after you're closed for the day. Let's talk now.

CALL COLLECT:
(212) 725-7679
Or write:
ZD Ziff-Davis Publishing
One Park Avenue
New York, NY 10016

Minimum order, 10 copies. We pay all shipping costs.

CIRCLE NO. 108 ON FREE INFORMATION CARD

TOTAL CONTROL
For the Timex-Sinclair Computer



Built & Tested $174.95
Bare Board $49.95

I/O
16 lines IN 16 lines OUT
Real Time Clock/Calendar
with Battery Back-up
Analog to Digital Converter
4 channel — 8 bit
8K Non-Volitale RAM
RAM or EPROM
Compatable with
ZX 80, ZX 81, TS 1000 & TS 1500

TERMS: Check or Money Order
Calif. Res. Add 6%
SHIPPING: Inside U.S. $5.00
Outside U.S. $10.00

JK AUDIO
P.O. Box 3295
Escondido, CA 92025-0580
(619) 741-5132

CIRCLE NO. 109 ON FREE INFORMATION CARD

Now available for the computer experimenter!

COMPUTER CONNOISSEUR'S DELIGHT!

NOW BE IN CONTROL WITH YOUR COMPUTER — THE ONLY PUBLICATION OF ITS KIND WRITTEN FOR THE USER. DISCOVER THE SECRETS AND LEARN THE VERSATILITY OF MODERN COMPUTER COMMAND CONTROL CONCEPTS. EXPERIMENT WITH COMPUTER AND TELEPHONE SYSTEMS, INTERFACE THEM, LEARN HOW THEY WORK, WHAT THEY DO... AND HOW TO GET THEM TO WORK FOR YOU! A COMPLETE TELEPHONE ENGINEERING COURSE IS INCLUDED IN MONTHLY CHAPTERS, BRINGING YOU THROUGH STEP, CROSSBAR, ESS, BUBBLE, AND ATOMIC SWITCHING SYSTEMS! EXCLUSIVE COVERAGE IN BIOLOGICAL COMPUTING SYSTEMS, TOO! COMPUTERS AND TELEPHONES ARE THE FUTURE. THIS PUBLICATION IS AN ABSOLUTE MUST FOR EVERYONE INTERESTED.

UNPUBLISHED MATERIAL
WIT
COMICS
DIRECTORY LISTING NET-WORKS
AC-CESS CODES

The one you've all been waiting for

NOW AVAILABLE — Learn how to repair telephones and telephone systems, how they work in monthly installments with the magazine for you.

Computel

PUBLISHED MONTHLY

ONE YEAR SUBSCRIPTION $14.00
(SAMPLE COPY $2.00)
SUBSCRIPTION & 2 PROGRAMS $20.00

COMPUTEL—the complete SOURCE for everyone. You can now do the things you've only heard about, right in the privacy of your own home. Indispensable reference to phreaks and hackers. Learn how to get all kinds of computer programs FREE. Get the inside story of big business systems—their quirks and flaws—and remain up to date with vital occurrences within the computer industry. Computel is a publication designed for everyone who has an intense curiosity of computer systems, containing a wealth of hard to find information, codes, and numbers. Published monthly.

Computel Publishing Society
6354 VAN NUYS BL., #161-A / VAN NUYS, CA 91401

CIRCLE NO. 110 ON FREE INFORMATION CARD

Now we can make any computer sing as well as talk, for only $219.

As featured in Ciarcia's Circuit Cellar, "BYTE" Magazine, September, October 1982.

Microvox.

MICROVOX is a completely self contained professional voice quality text-to-speech synthesizer. MICROVOX may be easily interfaced to any computer, modem, RS-232C serial or parallel output device.

- 6502 Microprocessor based text-to-speech algorithm
- SC-01A phoneme based speech synthesizer
- 64 crystal controlled inflection levels
- 3000 character buffer
- RS-232C and parallel port interfaces.
- On board power supply.
- Music and sound effects capability

MV01 Microvox Assembled & Tested $299.00
MV02 Microvox, complete kit $219.00

To Order: Call Toll Free
1-800-645-3479
In N.Y. 1-516-374-6793

MICROMINT, INC.
561 Willow Avenue
Cedarhurst, NY 11516

CIRCLE NO. 111 ON FREE INFORMATION CARD

GREAT DISKETTES
Super low prices
SYNCOM

The low priced, high quality diskette with a LIFETIME WARRANTY. Packed in polybags of 10 with Tyvek envelopes, labels and reinforced hubs. One of the best buys we've seen.

$1.39 ea. 5¼" SSDD QTY. 20
5¼" DSDD ea. $1.85 QTY. 20

OTHER GREAT VALUES:

DISKETTE 70—Holds 70 5¼" diskettes in dust free safety $14.95 ea. + $3.00 Shpng.
DISK CADDIES—Flip up style holds 10 5¼" diskettes $1.65 ea. + .20 Shpng

$15.00 Bonus Offer!

For the lowest priced, highest quality diskettes, storage cases, printer ribbons and paper products, send for our catalog. FREE with your order; $1.00 otherwise. BONUS! Every catalog includes $15.00 worth of bonus coupons.

Shipping: 5¼" DISKETTES—Add $3.00 per 100 or fraction thereof. OTHER ITEMS: Shipping charges as shown in addition to diskette shipping charges. Payment: VISA or MC. COD orders, add $3.00. Taxes: Illinois customers, please add 8%.

Nationwide: 1-800-621-6827
In Illinois: 1-312-944-2788
Minimum Order: $35.00
WE WILL BEAT ANY NATIONALLY ADVERTISED PRICE!
DISK WORLD!
Suite 4806 • 30 East Huron Street • Chicago, Illinois 60611

SYNCOM

20 PROGRAMS on 2 cassette tapes

for 16K TS1000, TS1500, & ZX81 only $19.95

*for TS2068 C-64, VIC 20, ATARI, TRS COLOR & MC-10 only $29.95

Save money, learn about the exciting world of home computing and have fun doing it with the new HOME-PAC.™

The HOME-PAC with 21 page user manual covers educational, graphics, recreational, home-finance & utility applications.

10 DAY MONEY BACK GUARANTEE

Please add $2.00 shipping and handling to order.

SIMPLEX SOFTWARE

220 N. Centre St., Dept. CEI
Merchantville, NJ 08109
MC, VISA & Checks Accepted
Orders & inquiries state computer type

CIRCLE NO. 112 ON FREE INFORMATION CARD

CIRCLE NO. 113 ON FREE INFORMATION CARD

CIRCLE NO. 114 ON FREE INFORMATION CARD

CIRCLE NO. 115 ON FREE INFORMATION CARD

Computers & Electronics Marketplace

CLASSIFIED RATES: Per Word, 15 Word Minimum. **COMMERCIAL:** $5.00. **PERSONAL:** $3.00, **EXPAND-AD®:** $7.50. Ads set in all bold type @ 20% premium. Ads set with background screen @ 25% premium. **DISPLAY:** 1" x 2¼", $605.00. 2" x 2¼", $1,165.00 3" x 2¼", $1,675.00. **GENERAL INFORMATION:** Frequency rates and prepayment discounts available. Payment must accompany order except credit card—Am. Ex., Diners, MC, VISA (include exp. date)—or accredited ad agency insertions. Copy subject to publisher's approval; must be typewritten or printed. First word set in caps. Advertisers using P.O. Boxes MUST supply permanent address and telephone number. Orders not acknowledged. They will appear in next available issue after receipt. Closing date: 1st of the 2nd month preceding cover date (e.g., Mar. issue closes Jan. 1). Send order & remittance to: Classified Advertising, **COMPUTERS & ELECTRONICS** Magazine, 1 Park Avenue, New York, NY 10016. To Charge your ad to a major credit card, call Lois Price at (212) 725-4312.

FOR SALE

GOVERNMENT and industrial surplus receivers, transmitters, snooperscopes, electronic parts, Picture Catalog 25 cents. Meshna, Nahant, Mass. 01908.

RECONDITIONED TEST EQUIPMENT $1.00 for catalog. WALTER'S TEST EQUIPMENT, 2697 Nickel, San Pablo, CA 94806, (415) 724-0587.

ELECTRONIC CATALOG. Over 4,500 items. Parts, & components. Everything needed by the hobbyist or technician. $2.00 postage & handling (United States Only), refundable with first $15.00 order. T & M Electronics, 472 East Main St., Patchogue, NY 11772. (516) 289-2520.

PRINTED CIRCUIT BOARDS, your artwork. Quick delivery. Reasonable. Atlas Circuits, Box 892, Lincolnton, NC 28092. (704) 735-3943.

POLICE CODE UNSCRAMBLERS, lets you hear the coded messages of Police, Fire and Medical channels; plus other scanner accessories, satisfaction guaranteed. DNE Inc., Rt. 7, Box 257-A, Hot Springs, AR 71901. (501) 623-6027.

CABLE TV CONVERTERS & EQUIPMENT. Plans and parts. Build or buy. For more information send $2.00: C & D ELECTRONICS INC., P.O. Box 21, Jenison, MI 49428.

FREE FLYER! IC's, resistors, capacitors, jacks, etc., plus SSM music synthesizer/audio IC's, power amp modules, analog delay IC's, computer books, and more. Also plans for analog delay/chorus unit! PGS Electronics, Route 25, Box 304 Terre Haute, IN 47802.

CABLE TV
Buy Direct & Save
SUPER SPECIALS

40 CHANNEL CONVERTER
$29.95
Advanced Solid State design and circuitry allows you to receive mid & super band channels. Restores programming to Video Recorders.

36 CHANNEL REMOTE CONTROL CABLE CONVERTER
$69.95

JERROLD 400
THE ULTIMATE CABLE TV CONVERTER
60 CHANNEL INFRARED REMOTE CONTROL
$129.95

Send $5 for Complete Catalog

DIRECT VIDEO SALES
P.O. BOX 1329
JEFFERSONVILLE, INDIANA 47130
CALL
1-812-282-4766

Worlds Most Remarkable Radar Jammer!

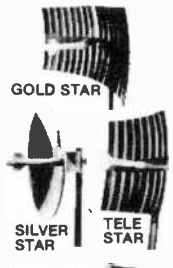
Causes speed radar guns and devices to read out your choice of either a **percentage** of your **true speed** when in automatic mode (example: Your speed; 76 mph, auto mode set for 75%, speed displayed—57 mph), or the speed that you dial in when in manual mode. Transmits only in the presence of speed radar, or by manual override. Operates on **both X and K** bands. WARNING: The device described in this literature is not legal for use against police radar, and is not FCC approved.

For complete literature and plan package, send $14.95 to:
Phillips Instrument Design Co., Inc.
9560 S.W. Barbur Blvd., Suite # 109 CE
Portland, Oregon 97219
VISA OR M/C ORDERS ONLY (503) 626-6764

FREE Catalog of special function IC's and quality components. Goldsmith Scientific, Box 318M, Commack, New York 11725.

MICROWAVE ANTENNA SYSTEMS
Freq. 2.1 to 2.6 GHz • 34 db Gain+
COMPLETE SYSTEMS (as pictured)
Commercial 40" Rod Style $89.95
Parabolic 20" Dish Style $79.95
TWO YEAR WARRANTY PARTS AND LABOR.
CALL OR WRITE FOR KITS • PARTS • INDIVIDUAL COMPONENTS
We Repair All Types Down Converters & Power Supplies
Phillips-Tech Electronics
P.O. Box 34772
Phoenix, AZ 85067
(602) 967-6972
COD'S
Special Quantity Pricing • Dealers Wanted

NEW! MULTI-CHANNEL MICROWAVE
Complete Antenna Systems from $69.95
Full 800 Mhz Range
Tune 1.9–2.7 Ghz
Includes all ITFS Channels
DEALERS WANTED
COD's and Credit Card Orders call TOLL FREE
1-800-247-1151



GALAXY ELECTRONICS
6009 N. 61 Avenue
Glendale, AZ 85301
1-602-247-1151

FREE! 1984 CATALOGUE. 1001 bargains. Speakers-parts-tubes-video cassettes—record changers—tape recorders—kits. EVERYTHING IN ELECTRONICS. Write: McGEE RADIO & ELECTRONICS, 1901 McGee Street, Kansas City, MO 64108-1891.

Telephone Listening Device

Record telephone conversations in your office or home. Connects between any cassette or tape recorder and your telephone or telephone LINE. Starts automatically when phone is answered. Records both sides of phone conversation. Stops recorder when phone is hung up. This device is not an answering service.

Each $19.95
Qty. Disc. Avail.

Super Powerful
Wireless Mic
10 times more powerful than other mics. Transmits up to ¼ mile to any FM radio. Easy to assemble kit. 15V battery (not incl.)

Call (305) 725-1000 or send $19.95+ $1.00 shipping per item to USI Corp., P.O.Box CE-2082, Melbourne,FL 32901. COD's accept. For catalog of transmitters,voice scramblers and other specialty items, enclose $2.00 to USI Corp.

TV & RADIO TUBES, 59¢ each. Send for free catalog. Cornell, 4213 University, San Diego CA 92105.

SATELLITE TELEVISION COMPLETE SYSTEMS. Free catalog. Write: Sunspur Sales, P.O. Box 32245 A-8, Fridley, MN 55432.

CABLE TV SECRETS, the informative publication the cable companies are trying to ban. HBO, Movie Channel, Showtime converters, etc. Send $8.95 to: CABLE FACTS, Box 711-PE, Pataskala, Ohio 43062.

GEARMOTORS $35.00. 12VDC(6-36) 60 RPM. 1/6 HP. Instructions. Also speed controls. Drives robots, antenna doors, gates, carts. Sepac, 625 NW 41 Street, Seattle, WA 98107.

12 SATELLITE DISH AND POLAR MOUNT. Total weight 125-lbs. For $189.00. For information send $4.95 (Refundable u.p.) to: Satellite Operational Systems, P.O. Box 2002, Titusville, FL 32781.

CABLE TV products. Jerrold, Hamlin and Oak, send $3.00 to ADDITIONAL OUTLET CORP., 111 E. Commercial Blvd., Ft. Lauderdale, FL 33334.

HARD TO FIND lightbulbs thousands types buy, sell. Jetco, P.O. Box 8755, Newport Beach, CA 92658.

LOWEST POSSIBLE PRICES ANYWHERE! Computers Hardware—Software—Printers. Audio, Video. Car Stereo. ELECTRIFIED DISCOUNTERS, 996 Orange Ave., West Haven, CT 06516. MC/VISA. (203) 937-0106.

CABLE TV EQUIPMENT, Notch filters for "Beeping" Channels. Information $1.00. Goldcoast, Box 63/6025 CE, Margate, Florida 33063 (305) 752-9202.

FREE CATALOG! UTILITIES, games, amateur radio software for VIC-20, Commodore 64, TI/99/4A. RAK Electronics, Box 1585, Orange Park, FL 32067.

MICROWAVE ANTENNAS, Stormproof, Burnout-resistant, drift-free, $89, Free info, JCR Service, Box 20607, Denver, CO 80220.

ALARM EQUIPMENT WHOLESALE! Burglar, Holdup, Fire, Medical. We can prewire. Easy installation! Fast police notification service. Nationwide! Catalog $1.00. U.S. Detection, 109 21st., Dept. CE South, Birmingham, Alabama 35233.

FINE JEWELRY. ¼ carat of diamonds in 14K pendant, $189.00. SYZYGY ENTERPRISES, Box 920970-D7D, Houston, TX 77292.

PAY-TV RECEPTION. HBO, Showtime, Cinemax. 'How-To' Book $4.95. Diptronics, Box 80(B7), Lake Hiawatha, NJ 07034.

CABLE TELEVISION FACTS AND SECRETS. Now you can get the informative publication that CATV companies have been unsuccessfully trying to get banned for 15 years! Movie Channel, HBO and Showtime converters, etc. Send $8.75 to: CABFAX, P.O. Box 091196, Bexley, Ohio 43209.

HARNESS AND THOROUGHBRED RACING HANDICAPPING PACKAGE... $31.95. Specify: Cassette, Diskette—Apple II+e, IBM PC, COMMODORE 64, VIC-20, Atari, TI-99/4A, TRS-80, FREE INFORMATION! SOFTWARE EXCHANGE. Box 5382 West Bloomfield, Michigan 48033.

FREE BROCHURE! Largest selection of computer oriented T-shirts and caps. Must see! Computer Graphics, Box 4055, Lutherville, Maryland 21093.

SATELLITE TV RECEIVER BREAKTHROUGH! Build your own system and save! Instruction manuals, schematics, circuit boards! Send stamped envelope: XANDI, Box 25647, Dept. 22Y, Tempe, AZ 85282.

Computer/Satellite modulators, CCTM cameras, monitors, MATV, Kits. Free video catalog. Phone (402) 987-3771. Dealerships available. ATV Research, 13-CE Broadway, Dakota City, NE 68731.

CABLE T.V. EQUIPMENT, JERROLD HAMLIN, OAK, all types. We also have Jerrold SB-3 in kit form. All parts and instructions included. Dealer inquiries invited. S.A.P. Box 2319 Glendale, Arizona 85311. (602) 973-9117.

MICROWAVE ANTENNAS COMPLETE WITH WARRANTY from the original manufacturer. Three styles Daisey, Parobolic, and Yaggi. We also repair all down converters and power supplies. S.A.P. Box 2319 Glendale, Arizona 85311. (602) 973-9117.

Macell MD-1 diskettes $25.00/10 plus $1.00 S&H. VISA/MC. Cottage Resources, Suite 243, 1032 Stevenson Drive, Springfield, IL 62703.

COMPUTER EQUIPMENT/PARTS

SAVE 90% Build Your Own Minicomputer. Free Details. Digatek, 2723 West Butler Dr., Suite 20C, Phoenix, AZ 85021.

FREE 64 PAGE COMPUTER CATALOG crammed full of thousands of the best buys and lowest prices around! A.P. COMPUTER PRODUCTS, Dept. CC, 214A East Main, Patchogue, NY 11772. (516) 698-8636.

48K APPLE COMPATIBLE COMPUTER: US $380.00 and hundreds of programs. Details US $1.00. Reliant, P.O. Box 33610, Sheungwan, Hong Kong.

WANT A PLEASANT SURPRISE? Call or write for quotes: Atari, Commodore, Timex, T.I., Corona (IBM work-alike), Amdek, Gemini, Apple & IBM accessories, Hayes, More. GET SURPRISED! HARDWARE SOFTWARE ANYWARE CO., 10 Coles Street, Brooklyn, NY 11231, (212) 596-3592.

JERROLD wireless remote converters $109, JERROLD sb-3 $89, notch filters ch 3, 6, f, h, i, $15 ea. Elephant 5¼" disks (10 paks), SSSD $17.95, SSDD $19.95, DSDD (IBM compat) $24.95. Complete catalog $2. Certified check, money orders accepted. C.O.D.'s with 50% deposit add $2 for shipping and handling. JOHN TRAINOR, P.O. Box 68, Sandown, N.H. 03873.

USED COMPUTER terminals, printers, modems, cables, surplus electronic parts. Specials: CRT's $20.00, Hardware Modems as-is $15.00. Catalog $1.00. Rondure Company, "The Computer Room" CE, 2522 Butler Street, Dallas, TX 75235, (214) 630-4621.

REPLACEMENT RIBBONS for computer printers and word processors. Fantastic saving! Thousands in stock. Quick delivery. Call/write: 1 (800) 292-6272. National Computer Ribbons, 114 Elbank Ave., Baltimore, MD 21239.

CASSETTES. Computer quality with case and labels. 10 for $9.50, 25 for $18.00. C-20 length. Check or MO to: WMJ Data Systems, 4 Butterfly Drive, Hauppauge, NY 11788.

COMPUTER SOFTWARE

FREE VIC-20 and COMMODORE 64 USERS GROUP MEMBERSHIP with software purchase. Why pay to belong to a users group when you don't have to? Benefits: Newsletter, extensive club library, discounts, contests, questions hot-line and more! Free details—(803) 797-1533. Lords of Basic, P.O. Box 459, Dept. 102 Ladson, SC 29456.

DISKETTE FORMAT CONVERSIONS/DOWNLOADING, from $5.00. Port-A-Soft, 423 #800 N, Orem, UT 84057. 801/226-6704.

TI-99/4A PROGRAMMERS: Affordable Software! Catalog, only $1. PROGRAMS SOFTWARE, 1435 Burnley Square North, Columbus, Ohio 43229.

TS 1000, TI99/4A, VIC-20 Software. Turns Programs into Profits; Catalog: Midwest Software, 9922 Harwich, Crestwood, MO 63126.

HORSE & DOG HANDICAPPING PROGRAMS FOR MOST PERSONAL COMPUTERS. Free Catalog: Gambler's Edge Computing, Dept. B6, 250 Richards Rd., Suite 254, Kansas City, MO 64116. 1-(800)821-3343. 1-(800) 471-8660.

TI-99/4A CASSETTE CABLES $16.71 (Extended Basic, Logo, Mini-memory $88.11 each!), PHP1250 Drive $210.94. CSC, Box 1361, Bloomington, IL 61702-1361. (309) 828-3251.

MULTI-LINGUAL, educational and other software, FREE CATALOGUE. The Professor, 959 N.W. 53rd St., Ft. Lauderdale, FL 800-222-1399.

DISCOUNT Computer—Software, Wargames, Video cassettes. FREE catalog. Wizard Entertainment, Box 509, Saugus, CA 91355.

DISCOUNT SOFTWARE/HARDWARE-30% minimum below retail. Apple II/II+, Atari 400/800/XL, TI-99/4A, Vic-20, Commodore 64, IBM/PC. Gemini-10X $275.00, Okidata 92P $445, Epson RX-80 F/T $380.00. Flight simulator II $37.50, Zork I/II/III $26.50 each. TI extended basic $77.50. Direct connect printer interfare; TI $85.00, Atari $69.50. Send $1 (stamps okay) for extensive software/hardware catalog. Specify computer system. Multi-Video Services, Box 246, East Amherst, NY 14051. (716) 688-0469 (5-9 P.M.).

FREE TI99-4A/Commodore-64/TRS80-COCO/TRS80-MC10/VIC-20/Timex programs! Send stamps! eZRA EZRA Company, Box 5222-CA, San Diego, 921005.

COMMODORE 64 Educational package. Eng, Math, Science. 104 programs on 8 discs. $39.95. Millsons, Box 180, Kennesaw, GA 30144.

COMMODORE 64 OWNERS. Rent software for less. Hundreds of programs on tape, disk, and cartridge. No membership fee. Rental charge can be applied toward purchase. Copy system 1.0 on disk—$19.95. Will back up disk and cartridges. Call or write for free catalogue! Centsible Software, PO Box 263, Stevensville, MI 49127, (616) 465-6632.

SOFTWARE CLEARANCE: TS1000 programs from Timex for $1.99. Atari programs like Jawbreaker $8.95. VIC20 and Apple programs at below cost prices. FREE catalog. Megatrack Computers, PO Box 940, Jackson Heights, NY 11372. (212) 927-1104.

VIC 20 LEARN MORSE CODE THE EASY WAY. Software $10.00 +$1.00 handling. RSCO, PO Box 11192, Cleveland, OH 44111.

COMMODORE 64/VIC 20 Games/educational software. Over 400 titles! Write for FREE catalog! American Peripherals, 12 Bangor St., Lindenhurst, NY 11757.

THE BEST TI-99/4A SOFTWARE BARGAIN! 140 TERRIFIC CASSETTE PROGRAMS. ONLY 50¢ EACH! Hours of enjoyment. Exceptional value! THE EXCHANGE, C.E.-10, PO Box 46, STERLING, VA 22170 (703) 435-2789.

TI-99/4A, C-64 TIMEX 64K, VIC OWNERS. 5 fun programs for $2.00! Get Baseball, Etching-Sketch, Blackjack, Dungeon, Galactic Patrol. Specify your computer. CHIPMUNK SOFTWARE, 634 Littlecroft, Upper-Darby, PA 19082.

SIMPLE PASSWORD deleting system, TRS-80 III. $50. J. Star Enterprises, Box 362, Orem, Utah 84057-0362.

SAVE $$$ ON TI-99/4A SOFTWARE!! Join our try before you buy plan. FREE BROCHURE! Software Users Exchange, Dept. A, P.O. Box 49, New Cumberland, PA 17070.

SOFTWARE DISCOUNTED 35%. BRAND NAME SOFTWARE—IBM, APPLE, COMMODORE-64/20, Atari, TRS, TI. FREE CATALOG! Provide make. SOFTWARE SUPERS MARKET, 21 Nashua Drive, Dep/cei, Marlboro, NJ 07746. (201) 780-8419.

TI-99/4A Softwares for personal, home, entertainment, and business applications. Write for free catalog to: Micro-Bix Hawaii, Dept. P 98-1409D. Kaahumanu St., Aiea, Hawaii 96701.

WE WILL beat any price. SSDD—Maxell—$21.95/10—Dysan—$26.95/10. 1-(800) 245-6000; Tape World, 220 Spring St., Butler, PA 16001 (412) 283-8621. Free catalogue.

COMPUTER HARDWARE

FREE 1984 COMPUTER FURNITURE CATALOG. Over 20 manufacturers. Never a shipping charge. Visa/MC. Interior Design Systems, 3641-CE St. Mary's Place NW, Washington, D.C. 20007.

COMPLETE COMPUTER schematic. Z80 or 8080 system 24"x36" sheet notes. $10.50. Schematic, 1443S 680 E. Orem, UT 84058.

COMPUTER PUBLICATIONS

COMMODORE 64 Software source; over 400 entries, $10.00 plus $2.00 shipping/handling to MSC, P.O. Box 1039, Mt. Vernon, NY 10550.

COMPUTER GRAPHICS

AVL computer graphics & programming systems. Slide, Motion, Overhead, Video, & Audio equipment & supplies. Rentals & Staging. Custom Graphics. Slides & Presentations. NEW ORIENT MEDIA-IL. 1-(800) 223-9473, 1-(312) 428-6000.

TIMEX/SINCLAIR

AERCO will continue to provide high performance disk, printer, and other interfaces for ALL MODELS of Timex/Sinclair computers. Box 18093, Austin, TX78760, (512) 331-0719.

STOCK ANALYSIS/PORTFOLIO. Fundamental Stock Analysis $17.00, Portfolio Database & Performance $15.00. Tape & Tutorial. P.A. residence add 6%. Specify model (1000/1500, 2068), ORIONS BELT ENTERPRISES, 807 N. Fairway Road, Glenside, PA 19038.

Timex 2068 programs. Wall street: Biorhythms: Disassemblers: Star Trek and many more. $10 each. SAE plus $1 for comprehensive list. C. Dos-Santas, P.O. Box 9521, Fountain Valley, CA 92728.

TIMEX Sinclair magazine. Monthly 32 pages. $15.00 year. $2.00 sample. 2002 Summit, Portsmouth, OH 45662.

TS1000/1500 SOFTWARE: New, inexpensive items. Information/price-list-SASE. SOFTGEMS, P.O. Box 119, Mayville, NY 14757.

QUALITY SOFTWARE for Timex/Sinclair. Free price list. WMJ Data Systems, 4 Butterfly Drive, Hauppauge, NY 11788.

CASSETTES. Computer quality with case and labels. 10 for $9.50, 25 for $18.00. C-20 length. Check or MO to: WMJ Data Systems, 4 Butterfly Drive, Hauppauge, NY 11788.

C.B. EQUIPMENT

CB MODIFICATIONS, conversions, books, plans, kits, repairs. Catalog $2. CBCI, Box 31500PE, Phoenix, AZ 85046. (602) 996-8700.

CABLE T.V.

CHANNEL 3—60db notch filter, 66 5MHz $32. Crosley, Dept. 607, Box 840, Champlain, NY 12919.

CABLE TV SECRETS, the Informative Publication the Cable Companies Tried to Ban. HBO, Movie Channel, Showtime converters, etc.—$8.95. CABLE FACTS, Box 711-PE, Pataskala, Ohio 43062.

PLANS AND KITS

MICROPROCESSOR CONTROLLED. Six voice polyphonic synthesizer plans. $15.00. Syntron 1075½ Mill Rd.; Helena, Mt 59601.

Communicate for miles with other computers with no license radio link. Study package with full details, sources. $8.00 refundable. Broadcast Technical Services, 11 Walnut St., Marshfield, MA 02050.

HBO CONVERTER. Complete instructions and schematic. Send $4.00 and SASE. Electrographics, 630 Sullivan, Deltona, Florida 32725.

MAILING LISTS

FREE MAILING LIST analysis. Details. GOC-6N, Box 1107, Stuart, FL 33494. (305) 334-5205.

3,100+ computer stores with telephone numbers. Intelligent Tool Company, PO Box 44047, Las Vegas, NV 89104. (602) 284-1076.

WANTED

GOLD, electronic, circuit board scrap, silver, platinum, tantalum, mercury. Ores, metals assayed. Samples evaluated. Wholesale Terminal, toll free 1-800-932-1010, (617) 326-3442 in Mass.

GOVERNMENT SURPLUS

IS IT TRUE YOU CAN BUY JEEPS FOR $44 THROUGH THE U.S. GOVERNMENT? Get the facts today! Call (312) 742-1142 Ext. 4649.

TUBES

TUBES: "Oldies", Latest. Supplies, components, schematics. Catalog Free (stamp appreciated). Steinmetz, 7519-PE Maplewood, Hammond, Ind. 46324.

HUGE INVENTORY! Thousands of types. Wholesale prices. FREE CATALOG! ETCO Electronics, DEPT. 290, Plattsburgh, NY 12901.

TUBES-RECEIVING, Industrial and Semiconductors Factory Boxed. Free price sheet including TV, radio and audio parts list. TRANSLETERONIC, INC., 1365 39th St., Brooklyn, NY 11218. Telephone: (212) 633-2800. Toll free: (800) 221-5802. Ask for Abe.

TV & RADIO TUBES, 59¢ each. Send for FREE CATALOG. Cornell, 4213 University, San Diego, CA 92105.

PERSONALS

UNIVERSITY DEGREES BY MAIL! Bachelors, Masters, Ph.Ds. Free revealing details. Counseling, Box 317-EP8, Tustin, California 92680.

MAKE FRIENDS WORLDWIDE through international correspondence, illustrated brochure free. Hermes-Verlag, Box 110660/Z, D-1000 Berlin 11, W. Germany.

FREE: WORLD'S LARGEST PARTNER PHOTO CATALOG for friendship and marriage. Personalized introductions. INTERCONTACT, Box 12, Toronto, Canada M4A 2M8.

ORIENTAL SINGLES seeking cultural exchange, friendship, sharing, marriage. WRITE: CHERRY BLOSSOMS, Box 1021P, Honokaa, Hawaii 96727.

CORRESPONDENCE TO ASIA FOR LASTING RELATIONSHIP. Free information. AAWS-CE, Box 2777, Orcutt, CA 93455-0777.

INSTRUCTION

UNIVERSITY DEGREES BY SPECIAL EVALUATION of existing credits and Job Experience. Fast, inexpensive. Call (614) 863-1791. Or write: EVALUATION, Box 13151-A8, Columbus, Ohio 43213.

REPAIR ELECTRONIC ORGANS—Revised home study course covers all current makes and models. Free booklet. Niles Bryant School, P.O. Box 20153, Sacramento, CA 95820.

LEARN WHILE ASLEEP! HYPNOTIZE! Astonishing details, strange catalog free! Autosuggestion, Box 24-ZD, Olympia, Washington 98507.

MEDICAL ELECTRONICS TECHNOLOGY, home study. Troubleshoot medical instruments. WTI, P.O. Box 3124, Fresno, CA 93650-3124.

HANDLE YOUR OWN LEGAL AFFAIRS—Be a Paralegal. Accredited Attorney Instruction. Home Study. FREE CATALOG. Southern Career Institute, Drawer 84CE-2158, Boca Raton, FL 33427. (305) 368-2522.

EARN $800+WEEK! Get your "F.C.C. Commercial Radiotelephone License" at home. "Free" details. COMMAND, D-100, Box 2223, San Francisco 94126.

FOR INVENTORS

INVENTIONS, IDEAS, NEW PRODUCTS WANTED! Industry presentation/national exposition. Call free 1-800-528-6050—Arizona, 1-800-352-0458. X831.

PATENT AND DEVELOP your invention. FREE PATENT INFORMATION. Richard L. Miller, P.E., 3612-E, Woolworth Building, New York, NY 10007, (212) 267-5252.

INVENTORS! IDEAS HAVE VALUE!

Ever think of an idea, forget it and see it later on the market? Many people don't forget, act quickly and are rewarded by American Industry. Write down your idea! We offer free disclosure registration and initial consultation regarding your idea's potential value. Call or write without delay for your free information package.

AMERICAN INVENTORS CORPORATION
82 Broad St., Dept. CE
Westfield, MA 01086
413-568-3753

A Fee Based Marketing Company
Offices Coast to Coast

BUSINESS OPPORTUNITIES

MECHANICALLY INCLINED individuals desiring ownership of Small Electronics Manufacturing Business—without investment. Write: BUSINESSES, 92-K8 Brighton 11th, Brooklyn, New York 11235.

ERASE DEBTS with little-known law—create wealth!! Details FREE—Wealth Kit, No. EE8, Billings, NY 12510.

ONE MAN CRT FACTORY. T.V.'s, Business machines, Monitors, Scopes, VDT's. $3.00 rebuilding nets $100-$500 each tube. Higher profits overseas. New/used. FACTORY, 1909 Louise, Crystal Lake, IL 60014. (815) 459-0666.

BORROW $300-$30,000 INTEREST FREE! Keep indefinitely! Free Details. Write: American, 1601 Main, Plainfield, Indiana 46168.

BUMPER STICKER PRINTING DEVICE. Cheap, simple, portable. Free details. Bumper, POB 22791 (PE), Tampa, FL 33622.

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions, Doolco, 2016 Canton, Dallas, Texas 75201.

$3000.00 a month spare time income with your computer! Free details. DIGATEK CORPORATION. 2723 West Butler Drive, Suite 20B, Phoenix, AZ 85021.

EARN EXTRA INCOME with your microcomputer. Super opportunities! Free details. Scitec, Box 02038, Columbus, OH 43202.

REAL ESTATE

500 OFFICES ... 45 STATES! 30,000 listing on computer, 16,000 under $50,000! Free printouts and regional catalogs! UNITED FARM AGENCY, 612-EP West 47th, Kansas City, MO 64112. Ph: 1-800-821-2599, in MO 1-800-892-5785.

EMPLOYMENT OPPORTUNITIES

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Details FREE. Aviation Employment Information Service, Box 240E, Northport, New York 11768.

BOOKS & MAGAZINES

MICROWAVE TECHNOLOGY BOOK; learn to build local microwave receivers, satellite TV, police radar and much more. Send $5.00 plus 75¢ for postage and handling to: Tom Howell Productions, POB 32357, Washington, DC 20007.

SATELLITE TV VIEWERS
Get the most complete weekly listings
Send $1 for sample copy.
Satellite TV Week
"P.O. Box 308Z, Fortuna, CA 95540"
800-358-9997 (U.S.) • 800-556-8787 (Calif.)
707-725-2476 (all others)

MISCELLANEOUS

BASIC DATE SUBROUTINE—Input: mmddyy, output: month dd, 19yy + weekday month dd, 19yy + more. For complete, compilable, source code, documented, send check. $19.95. Ice System Inc, 345 Queens St. #980, Honolulu, Hawaii 96813.

THIS MAGAZINE IS
AVAILABLE IN MICROFORM
DIRECT INQUIRIES TO:
MICRO PHOTO DIVISION
BELL & HOWELL
OLD MANSFIELD ROAD
WOOSTER OH 44691
Contact Christine Ellis
Call toll-free (800) 321-9881
In Ohio, call (216) 264-6666 collect

CLASSIFIED ADVERTISING ORDER FORM

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15 (MINIMUM)
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

Please refer to heading on first page of this section for ad placement information:

REGULAR: $5.00 **EXPAND-AD®:** $7.50 (per word).

OF WORDS _____ # OF INSERTIONS _____

□ PAYMENT ENCLOSED $ _____

□ CHARGE: You will be billed monthly. □ American Express □ Diners □ Visa □ MasterCharge-Interbank # _____

Account # _____ Exp. Date _____

SIGNATURE _____

PRINT NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____ CE-884

WORLD'S LARGEST COMPUTER MAGAZINE
Computers & ELECTRONICS

ADVERTISERS INDEX

FIND A COMPUTER THAT'LL OUTPERFORM OURS AND WE'LL GIVE YOU A HEADSTART.™ FREE.

If you can find a microcomputer, equally priced or less, that'll beat only half of 10 standard features we've selected on our HeadStart Model 512, we'll give you a HeadStart absolutely free. How can we make this incredible offer? Because looking for a better computer than our new HeadStart is like looking for a needle in a haystack. You're more apt to come up with a case of hay fever.

HeadStart is simply the fastest, smallest, most powerful business computer in its class. Period.

In fact, we're so certain we have an unbeatable machine, we're offering you this challenge. If, by some inconceivable circumstance, you *should* find a business computer that is even equal to ours, we'll give you a HeadStart. Absolutely Free.

If you'd like to accept our challenge and learn more about this small wonder of microcomputer technology we call HeadStart, call us or fill out and return the coupon.

You could come up with a free HeadStart, which is nothing to sneeze at.

HERE'S YOUR CHANCE TO WIN A FREE COMPUTER AND GET A HEADSTART ON THE COMPETITION.

Intertec, Dept. "HeadStart"
2300 Broad River Road, Columbia, SC 29210
Phone: 1-803-798-9100

☐ I accept your challenge. Please send me details on how I can beat the HeadStart VPU 512.

☐ HeadStart sounds terrific. Tell me more.

Name_____

Title_____

Company Name_____

Phone_____

Address_____

City_____

State_____ Zip_____

intertec

CIRCLE NO. 10 ON FREE INFORMATION CARD

HERE TODAY HERE TOMORROW

When buying a computer, you can't limit yourself to just satisfying today's needs. **The best value in a system comes from its productivity . . . both for today and tomorrow.** CompuPro's System 816™ computer has that value. With all the power and capacity to handle your needs now and down the road.

System 816's longevity stems from top quality components . . . high storage capacity . . . the flexibility to handle a large variety of applications . . . and the speed to get the job done fast. Upgrading is easy, and when it's time to expand from single to multi-user operation, it's as simple as plugging in boards and adding terminals. Your system grows as you grow.

CompuPro also provides a library of the most popular software programs with your system and because it's CP/M® based, you have more than 3,000 other programs to choose from.

Even our warranty is for today and tomorrow. It spans 365 days — and includes the additional security of Xerox Americare™ on-site service nationwide for designated systems.*

What's more, CompuPro is one company you can count on to be around tomorrow. For more than ten years we've been setting industry standards, increasing productivity and solving problems.

For a free copy of our business computer buyer's primer, and the location of the Full Service CompuPro System Center nearest you, call **(415) 786-0909 ext. 206.**

CompuPro's System 816. The computer that's just as essential tomorrow as it is today.

CompuPro®

A *GODBOUT* COMPANY

3506 Breakwater Court, Hayward, CA 94545

*Available from Full Service CompuPro System Centers and participating retailers only.

System 816 and The Essential Computer are trademarks of CompuPro. CP/M is a registered trademark of Digital Research Inc. Americare is a trademark of Xerox Corporation.

System 816 front panel design shown is available from Full Service CompuPro System Centers only. ©1984 CompuPro.

Circle No. 8 on Free Information Card

The Essential Computer™