NEW SMALL COMPUTERS FROM
Mattel, Sinclair and Texas Instruments
The Kaypro II Travelling Computer System
Overvoltage Protection for New Designs

Lightning-Fast Solid-State "Disks"

Tested in This Issue:
NEC's 25" Component Color TV System
Kyocera's Stereo FM/AM 65-W/Channel Receiver
You can wait for industry standards to mandate improved performance. Or you can have it now on Maxell. The Gold Standard.

What distinguishes a Maxell floppy disk? Improvements great and small, achieved in a decade of innovation. We developed unique, uniform crystals to assure dense oxide packing. Intensified the calendering process to minimize the need for abrasive burnishing. Created an improved binder and lubricant. And a new jacket design that leaves industry standards in our wake.

It would require photomicrographs to make some of these improvements observable. On the job, the advantages become obvious. Resolution enhanced by 20% creates a cleaner signal output. And guarantees the read/write accuracy in double-density applications. New jacket construction, heat-resistant to 140°F, extends disk use without risk of mistracking. In effect, durability is re-defined. And in accelerated tests against the most respected names in the industry, Maxell sustained the highest and most consistent output over time.

We applaud industry standards that aspire to dropout-free, reliable disk performance. The Gold Standard expresses a higher aim: perfection.

maxell®
IT'S WORTH IT.

Computer Products Division, Maxell Corporation of America, 60 Oxford Drive, Moonachie, N.J. 07074 201-440-8020
CIRCLE NO. 30 ON FREE INFORMATION CARD

www.americanradiohistory.com
In the fast moving, high technology world of microcomputers, the need for high performance accessories often gets overlooked.

Discwasher, recognized as a world leader in audio/video care accessories, understands this need and has developed a line of computer accessories to allow users to get the most from their computer hardware.

The easy-to-use Discwasher® Disk Drive Cleaner is both a problem preventer and problem solver. Its dry format safely cleans single or double-sided drives without altering the delicate head alignment or doing possible damage to rubber drive parts with solvents.

The Discwasher® Computer Cassette Drive CareSet™ is a total maintenance package for your cassette drive system. It includes both the Discwasher® Computer Cassette Drive Head Cleaner and the Computer Cassette Drive Mechanism Cleaner. Together, these two maintenance units can keep the high resolution heads and the critical drive system of your cassette drive system in optimum performance.

The Discwasher® DiscKeeper™ is a magnetically shielded storage system for floppy disks that takes up no more space than conventional folder packs. DiscKeeper protects against stray magnetic fields which can destroy valuable software. Three DiscKeeper sizes provide loss-free storage and protection for transporting any size disk format.
FEATURE ARTICLES

SOLID-STATE "DISKS"
1. How RAM memory drives work. /C. Anderton
2. Review of Axlon's Ramdisk. /A. Marx

GUARD PRECIOUS COMPONENTS FROM OVERLOAD DAMAGE
Harold Wright/Single IC provides extra protection for circuit devices.

IN THIS CORNER...

1. How RAM memory drives work. /C. Anderton
2. Review of Axlon's Ramdisk. /A. Marx

THE INGENIOUS SWITCHABLE TEST SOCKET
Nathan Moskowitz/Decreases IC circuit design and debugging time.

OFF AND RUNNING WITH THE KAYPRO II

A WATER-LEAK DETECTOR
Mitchell Lee/Prevent extensive water damage in your home, shop, or boat.

THE SOUL OF CP/M
M. Walla and R. Latorre/Part 2: Insights to using the CP/M OS to its fullest.

LEARNING 16-BIT MICROCOMPUTER TECHNOLOGY
George Meyerle/Part 4: Details of the PIT and PPI circuit elements.

COLUMNS

LES SOLOMON ON COMPUTER HARDWARE
Computer/Video Game Interference.

STAN VEIT ON COMPUTER SOFTWARE
Where the UCSD P-System Fits In the DOS War.

ENTERTAINMENT ELECTRONICS
Len Feldman/Better Sound for VCRs with Beta Hi-Fi.

COMPUTER VIDEO GAMES

DEPARTMENTS

EDITORIAL/Art Salsberg
Mims the Word.

LETTERS

NEW PRODUCTS

OPERATION ASSIST

COMPUTER MART/ELECTRONICS CLASSIFIED

ADVERTISERS' INDEX

COVER PHOTO BY JAY BRENNER

COPYRIGHT © 1983 BY ZIFF-DAVIS PUBLISHING COMPANY. All rights reserved. Computers & Electronics (ISSN 0032-4485) June 1983, Volume 21, Number 6. Published monthly by Ziff-Davis Publishing Co., at One Park Ave., New York, NY 10016. Richard P. Fine, 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 New York, N.Y. 10016 and at additional mailing offices. Authorized as second class mail by the Post Office Dept., Ottawa, Canada. Unauthorized use is prohibited. 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 Experimenters' 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. Permissions: Material in this publication may not be reproduced in any form without permission. Requests for permission should be directed to Elizabeth Amado, Rights and Permissions, Ziff-Davis Publishing Co., One Park Ave., New York, NY 10016.
IF YOU OWN A COMMODORE COMPUTER, YOU KNOW IT CAN DO ALL THIS.

BUT DID YOU KNOW FOR ABOUT $100, YOU CAN ALSO GET IT TO DO ALL THIS?

The screens at the top of the page show a few examples of how versatile the VIC 20™ or Commodore 64™ can be with the addition of Commodore software.

The screens below them give you a few examples of how much more versatile they can be with the addition of a Commodore VICMODEM.

For around $100, the Commodore VICMODEM will turn your VIC 20 or Commodore 64 computer into a telecomputer.

To make matters even better, Commodore includes a few little extras (such as a free hour's time on the two most popular telecomputing services) that add up to a value of about $197.50. A nice return on an investment of about $100.

Most computer companies think it's reasonable to ask as much as $500 for a modem that'll give you telecomputing capabilities such as ours.

However, with a VICMODEM priced at around $100, we think we're being a lot more reasonable. Don't you agree?
Mims the Word

When Mims writes, people read! Proof of this is that columns by Forrest Mims III have never failed to win top rank in our editorial readership studies over the years.

His first article for us, in fact, which preceded his columnist work, "made" our November 1970 front cover. It was an in-depth report on light-emitting diodes. Interestingly, a second article of his in the same issue (assembling an optical voice communicator) has shared bylines with Henry Edward Roberts of Altair/S100-bus fame.

Five years later, Forrest launched his first installment of "Experimenter's Corner," followed in 1978 by a second column, "Project of the Month," and a third in 1980, "Solid-State Developments." As he has noted, "Writing these columns forces me to stay up-to-date and to build circuits that really work rather than merely speculate about hypothetical circuits."

Three columns each month emanating from a corner of Texas leaves plenty of room to describe circuits, present ideas, discuss electronic phenomena, and so on. But sometimes an idea comes along that doesn't quite fit any of the existing columns. Moreover, separate columns do not lend themselves to one building upon the precepts of another.

To overcome the foregoing limitations without diluting content, Forrest's columns have been consolidated into one large column, commencing this issue. It's called "The Electronics Scientist" and will cover the same ground previously explored plus subjects that did not fit the columns' format. Moreover, Forrest will be able to modify and expand coverage of the electronics forefront as developments warrant.

In this first installment, Forrest takes a close look at the ultrasonic rangefinder that automatically focuses Polaroid's SX-70 instant-picture camera. Then he experiments with a board-level kit version of the rangefinder that Polaroid markets. This is followed by an interesting application for the LM3905 precision timer and an examination of new families of low-voltage logic chips designed specifically for battery-powered operation. Brief mentions of other new devices complete the column.

You're encouraged to try the circuits he writes about, which will be included each month, as well as digesting other column material to keep up with what's developing in electronics. I'm confident that you will enjoy reading Forrest's unitized column, "The Electronics Scientist," every month as much as he does putting it all together. His efforts are directed to busy engineers, technicians, students, experimenters, and just plain scientists. Look for his books, too, which at year-end numbered 42 off the press.

Editorial

International Correspondence

Computers & Electronics

formerly Popular Electronics

Editorial and Executive Offices
One Park Avenue
New York, New York 10016
212 725-3500

New York Office
Adverting Director:
Richard Goavaski, 212 725-7460
Sales:
Tom Ballew 212 725-3578
Ken Lipka 212 725-3580

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

J.E. M. Associates
Francisco Bay Office Park
1750 Montgomery Street
San Francisco, CA 94111 415-989-4643
Joe Mesics

Representation in Japan
S.S. Yagi
Iwas Trading Co., Ltd.
603 Ginza Sky Heights Bldg.
18-13, Ginza 3-Chome
Tokyo, Japan 104

Computer & Electronics

Consumer Computers &
Electronics Magazine Division
Larry Storrs
President
J. Scott Briggs
Vice President, Marketing
Carole Mandel
Vice President, Circulation
Eileen G. Markowitz
Vice President, General Manager
Peter J. Blank
Creative Director

Ziff-Davis Publishing Company
Richard P. Frise
President
Albert S. Traina
President, Consumer
Magazine Division
Farman Hebb
Executive Vice President
Paul H. Chook
Executive Vice President
Marketing and Circulation
Philip T. Heffner
Senior Vice Presidents
Sidney Holtz
Edward D. Mahfield
Philip Sose
Barid Davis
George Movissey
Selwyn Taubman
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, artwork, or models submitted.

The publisher has no knowledge of any proprietary rights which will be violated by the making or using of any items disclosed in this issue.

4
After you ask what it can do for you now, ask what it can do for you later.

If you're about to buy a personal computer, you need to consider two basic issues: What your needs are now, and what they're likely to be a few years from now. That's why the HP-86 has to be your best choice. It's got the software and the hardware to go the distance.

Software for today and tomorrow.

Save $255* on the Personal Productivity Pac. Here's a good way to get started. With software that, if bought separately, would cost you $750**. We're offering it at the reduced price of $495* You'll get VisiCalc* PLUS, the world-famous electronic spreadsheet for "what-if" planning. (The "PLUS" is a Hewlett-Packard bonus: extra programs to quickly turn your spreadsheet into bar graphs, line graphs, or pie charts.) Plus WORD/80, for word processing. And FILE/80, for record keeping without paperwork.

CP/M* Buy this plug-in module, and you'll extend your HP-86 system to accept many popular programs written under the CP/M operating system — programs such as WordStar™ and dBASE II™.

Graphics Presentations. When combined with the HP 7470A plotter, our graphics software lets you produce professional-quality pie and bar charts, line graphs, text pages, and overhead transparencies. And you can do it all in color.

Data Communications. If you decide you want it, an optional accessory lets you access The Source, the

Hardware that expands with your needs.

While your computer's ability to expand depends largely on software, naturally, the hardware must keep up. That's why the HP-86 system has a modular design. So you can add a printer or plotter as easily as you hook up a tape deck to your stereo. And operate up to 14 peripherals at once, if you wish.

When you find yourself facing lengthy problems or spreadsheet analyses, simply add more memory — up to 512K bytes.

As you demand more of your HP-86, you'll find that it keeps up. Whether you need a broad range of hardware, software, or peripherals, the HP-86 makes expansion easy, giving you a hard-working system tailored to help solve your specific problems.

If you need more good news, try this: The basic system is only $2990** (64K computer/keyboard, monitor and disc drive).

Get a hands-on demonstration of the system that works for you now, and will still be working for you later.

For the authorized HP dealer or HP sales office nearest you, call TOLL-FREE 800-547-3400 and ask for operator 96. (Oregon, Alaska, Hawaii: 503-758-1010.)

Personal computers & calculators for professionals on the move.

HP
HEWLETT PACKARD

CIRCLE NO. 65 ON FREE INFORMATION CARD

©1986 Hewlett-Packard Company
All Rights Reserved. All trademarks acknowledged.

*Software savings are based on suggested U.S. list prices and may vary
**Suggested retail price. May vary outside U.S.
VisiCalc is a registered trademark of VisiCorp.
CP/M is a registered trademark of Digital Research, Inc.
WordStar is a registered trademark of MicroPro.
dBASE II is a registered trademark of Ashton-Tate.
LETTERS

APPLE SERVICING
I can understand the frustration Arthur Thompson feels in his attempts to get parts and service for his Apple II ("Computer Hotline," March 1983). One possible help is as follows: if he will "dump" the on-board ROM contents to disk, he will be able to compare and isolate defective ROMs. Apple does publish schematics for the owner in the back of its Reference Manual. However, I find that most computer manufacturers will not sell individual parts for repairs. As a buyer and user of a computer, I find this hard to take. I would like to be able to make repairs like I can on my television. Perhaps we need legislation to make the computer industry "open up" a little more.—Ron McFarland, Hawthorne, CA.

POWER SUPPLY STANDARDS
We read with interest the excellent article on voltage standards for power supplies ("Les Solomon on Computer Hardware") in your April issue. At the most recent committee meeting on MOS memories, it was reiterated that the standard that has been proposed is still up for discussion and only after user responses have been reviewed will a standard be processed for final JEDEC adoption. Therefore, the committee, which is composed of manufacturers, is seeking user input, which should be addressed to:
JEDEC JC-42.3
Power Supply Standard
2001 Eye St. NW
Washington, DC 20006
Thank you for your help.—K. McGhee, JEDEC, Washington, DC.

ADVANTAGE HARD DISK
In a recent item in the Computer Hardware column, it was noted that NorthStar had introduced a computer system with 5M bytes of hard disk and one 360K floppy for $6599. That would be a pretty high price for a 5M-byte capacity which is priced at $4999. The reference probably got confused with our 15M-byte Advantage, which is $5999.—Kristine M. Sokoloski, NorthStar Computers, Inc., San Lando, CA.

GETTING COMPUTER INFORMATION
I am one of those thousands of people who have a need to know more about computers, but find it difficult to get help. The various computer stores are helpful as long as you purchase one of their computers, and the discount stores offer very little assistance. The numerous magazines on the newsstand all seem to look alike and, though they promise information in everyday language, they seem to have difficulty delivering. Your magazine is the exception. The articles sometimes get involved, but the majority are interesting and easy to read. I also read the ads. Keep up the good work.—G. A. Kagan, Westport, CT.

COMPARING COMPUTERS
Compliments to Stan Veit for his outstanding comparison of the Apple III, NorthStar Advantage, and Victor 9000 ("A Trio of Desktop business Computers," January 1983). The analysis of the three computers in the graph on page 93 is the best comparison tool I have seen.—Donald Weihl, Belleville, IL.

DOW JONES NEWS/RETRIEVAL
We take exception to your reference to The Source and Compuserve as the "two principal information networks available to the public." ("The Computer Network Maze," March 1983). We also take exception to the statement that "the major feature of the Dow Jones service is the Stock Quote Reporter service." This is just one of 20 data bases and so is only a single element of our total service.—J.F. Kelsey, III, The Wall Street Journal, Princeton, NJ.

"Dow Jones News/Retrieval" is indeed the most widely used information service.—Ed.

RECORDING WITH A VIC-20
In your "Computer Hotline" column of March 1983, you stated that the Commodore VIC-20 uses digital recording rather than audio and cannot be used with an ordinary cassette recorder. You recommended the VIC1530 Data-Sette. Aren't there other possibilities?—John Montgomery, Rolla, AZ.

This is only one of a number of letters received on this subject so perhaps an explanation of how the VIC1530 and other Commodore digital recorders work is in order. Most tape units for personal computers use the frequency shift keying (FSK) method of recording. The logic 1s and 0s are converted into tones of different frequencies for recording (such as 1070 Hz for 0 and 1270 Hz for 1). Since audio tape recorders are designed for voice or music, they have no problem reproducing these tones.

The Commodore system, however, uses square-wave pulses, varying the width of the pulses to represent the 1s and 0s (short for 0, long for 1). This is called pulse width modulation and it is accomplished by turning the recording head on and off for different periods of time. This simple system is very reliable and, in fact, is used in mainframe computers.

The fact that no audio reproducing components are used enables Commodore to sell the digital recorders for as little as $60 to $75. It has not adopted this system merely to sell its own recorder, but because it is thought to be more reliable.

There are a number of adapters on the market to convert an audio cassette recorder for use with a Commodore computer. One is made by Protecto Enterprises, PO Box 550, Barrington, IL 60010. It can be used with either the VIC-20 or the Commodore 64. However, we still prefer the VIC1530.—Ed.

TENESSENCE LEVEL SAFETY
Your article "What's Your Tenseness Level?" (February, 1983) presents a device that could be a shock hazard to the user. No provision is made to limit excitation current through the skin or limit current from the computer power supply if the leads are accidentally shorted with the adjustment pot set for minimum resistance. Although the computer may utilize a good transformer, it is not expected to be rated for medical applications.—A. G. Jusko, Piscataway, NJ.

The computer has a regulated power supply in which the +5-V dc is derived from a transformer and a full-wave bridge with two levels of IC regulation. It is highly unlikely that any potential substantially above rated could be available without destroying much of the power supply in the process. Of course, some medical equipment uses optoisolators or isolation transformers. However, even these devices do not provide absolute failsafe protection. In any case, such isolation techniques are practical tradeoffs between cost and degree of risk.

The only way to ensure absolute safety for devices such as the Biobox is to use battery power instead of the computer supply. To do so, simply remove the lead from pin 5 of the DIN plug and connect it, through a switch, to four 1.5-V batteries in series, then connect the other end of the batteries (ground) in parallel with the lead connected to pin 3 of the DIN plug.—Author

OUT OF TUNE
In "Computer-Aided Logic Design" (May 1983), the diagram showing node identification for the Exclusive OR was inadvertently omitted from Fig. 2 on page 70.

Computers & Electronics

www.americanradiohistory.com
There's an awful lot of computer hype these days. And we think it's time for a little old-fashioned honesty.

So we're going to give you a few solid reasons why — even if you look at nothing else — you should go to your dealer and take a close look at the new Epson QX-10.

Anybody can use it.

What makes the QX-10 the most remarkably usable computer to date is a unique software system called VALDOCS, coupled with a new keyboard design called HASCI. VALDOCS reduces the time it takes to master the QX-10 from hours to minutes by displaying exactly what your options are, while the straightforward, detachable HASCI keyboard places all the most-used functions right in front of you, grouped logically and labeled in plain English.

You may never buy software again.

VALDOCS may be all the software you'll ever need. Right out of the box it's a sophisticated word processor; an information indexer for easy access to files; an electronic mail system; a calculator; an appointment book and notepad; and a high resolution business graph drawing system.

A little price tag.

Mere words are not enough. To fully appreciate the powers of this machine, you must experience it for yourself. So visit your dealer and see what it can do. And if that doesn't sell you, the comfortable price tag will. It sells for under $3000. And that's no hype.

Call (800) 421-5426 for the Epson dealer in your area.
NEW PRODUCTS

GAME & COMPUTER UPGRADES

"Expander" from Milton Bradley and TI provides voice recognition and speech synthesis for TI's 99/4A home computer. The 64-position membrane keypad has overlays for game cartridges. Also has 3-axis joystick and headset/microphone. Joystick controller has 3 buttons for special functions.

Entex's Model 2000 Piggyback gives video games players (Coleco, Atari, Sears, and Columbia) computing ability. It has a Z80A microprocessor and 2K of RAM expandable to 34K, 1K of video RAM, and 8K of ROM with BASIC interpreter. Typewriter-style keyboard has 9 user-definable keys and separate cursor keys. $125.

COMPACT FUNCTION GENERATOR

Model FP-4 function generator offers sine, square, and triangle-wave outputs, plus a one-shot mode that delivers a single pulse when a button is pressed. Four ranges give frequencies from <10 Hz to >100 kHz or pulse outputs from 50 µs to 50 ms. Four internally presettable frequencies or pulse widths add to its utility for repetitive testing. Power is by 9-V battery or any 5.5-to-26-V source. 5" x 4¼" x 2". $49.95 ($29.95 kit). Address: Kingston Instrument Co., 3805 Ashford Ave., Ft. Worth, TX 76133.

IBM SMALL COMPUTER

Model XT 16-bit PC has 9 times the storage capacity previously available with 128K of RAM (expandable on-board to 640K); double-sided 5¼" floppy-disk drive; 10M-byte hard-disk system; and an asynchronous communications adapter. Has 8 expansion slots; and, with optional expansion, maximum memory can be 22M bytes. Other options are monochrome and color video, graphics printer, and single- and double-sided drives. Uses new version of DOS 2.0. $4995.
APPLE II VIDEO BOARD

The Digital Video Multiplexor board (DVM-II) from Amdek allows the Apple II to be used with an analog or digital RGB-input color monitor, permitting computer control of the RGB inputs and providing 80 x 24 text display when interfaced with 80-column boards. Has two optional additional HiRes modes—all white and 3-color with pure white. $199.

Circle No. 98 on Free Information Card

CONVERTIBLE VIDEOCASSETTE RECORDER

Portable Model VJP900 VCR from RCA has a modular "docking" mechanism to eliminate cables and permit connecting the unit to a companion TV tuner/timer base unit. Three-speed (SP/LP/SLP) system has five video heads, [33-channel capability, 21-day/8-event timer and 4 tape transport motors. Also has express recording, sound-with sound dubbing, stereo sound, and special effects such as stop action, variable slow motion, frame advance, and reverse play. Comes with IR remote-control system. 10½" W x 10½" D x 3½" H; 7.9 lb. $1300.

Circle No. 96 on Free Information Card

TAPE NOISE ELIMINATOR

Model NX-40 tape noise eliminator from dbx has simultaneous encode/decode companding process to eliminate noise during record and play while increasing dynamic range up to 110 dB. Frequency response: 50-15,000 Hz ± 1.5 dB; harmonic distortion: 0.5%, 100-15,000 Hz, 94" D x 67" W x 17½" H. $159.

Circle No. 95 on Free Information Card

EDUCATIONAL MICROCOMPUTER

Multitech’s Micro-Professor I Plus has 8K of ROM; 4K of user RAM; standard ASCII keyboard; 20-digit, 14-segment alphanumeric green fluorescent display; built-in speaker; audio cassette tape interface; and battery-operated memory backup circuit. User’s guide and manuals supplied. $199.

Circle No. 94 on Free Information Card

FRANKLIN ACE 1000 UPGRADE

New Ace 1100 is an add-on disk drive assembly for the Ace 1000 personal computer. With a controller and one or two disk drives, it replaces the cover of the 1000. Controller accommodates two drives, can be used with DOS 3.2 (116K bytes) and DOS 3.3 (143K bytes), and includes a built-in disk drive exerciser. Plugs in one of 8 Ace 1000 peripherals slots and eliminates need for cabling. Single-drive models are easily upgraded to dual-drive. Also Apple II compatible. $699, including controller, for single-drive. Add $399 for second drive.

Circle No 93 on Free Information Card
Hire a fast thinker.

5 MHz CPU Card
- Intel 8085A-2 microprocessor
- Floating point
- Performs calculations six times faster than other CPUs
- On-board monitor in PROM
- 1K RAM scratch pad
- Keyboard or RS232C terminal
- Variable clock frequency

PRICE—$450
(California residents add 6% sales tax)

Call or write Artec for details.

ARTEC ELECTRONICS, INC.
605 Old County Rd., San Carlos, CA 94070
Telephone (415) 592-2740
CIRCLE NO. 55 ON FREE INFORMATION CARD

KEYBOARD ENHANCEMENTS
- Qwik-Stuff kit (above) is $7.75 and includes Qwik-Key printed plastic overlays for function keys ($4.50); Qwik-Guide plastic reference cards ($3.25) containing commands and information; and Qwik-Label identifying labels ($1.00) for knobs, controls, etc. Address: Compu-Quote, 6914 Berquist Ave., Canoga Park, CA 91307.
- Key-Wiz VIP auxiliary keyboard (right top) has 31 user-programmable keys and can be ganged to provide a total of 248 keys. Address: Creative Computer Peripherals, Inc., 1044 Lacey Rd., Forked River, NJ 08731.
- EPS detachable keyboard for Apple users (right center) has plug-in software to provide professional upgrading of keyboard functions. Address: Executive Peripheral Systems, Inc., 800 San Antonio Rd., Palo Alto, CA 94303.
- Keychanger program on diskette (right bottom) operates in CP/M and permits programming of function keys on most terminals. Address: Computer Publishing Co., 1945 N. Fine #101, Fresno, CA 93727.

COLOR MONITOR FOR IBM-PC
Quadchrome by Quadram is an RGB color monitor designed to deliver up to 690 x 480-pixel resolution with up to 16 colors available on screen simultaneously when used with the IBM-PC. For text applications, display is 25 lines of 80 chars./line. Colors include: red, green, blue, yellow, cyan, magenta, black, and white. Dimensions: 15" x 11.0" x 16.5". Supplied with 9-pin socket cable. $795.

Circle No. 92 on Free Information Card
SORD PERSONAL COMPUTER

Socius M23P portable computer is said to fit into carry-on luggage (without the 12” green monitor). Has memory-mapped 8-bit CPU with 128K of RAM and two 290K 3½” floppy disk drives for mass storage. An acoustic coupler and on-line system can be used to connect different work stations. Power is from ac line or rechargeable built-in battery. Comes with Sord’s PIPS Processing System. $1600.
Circle No. 91 on Free Information Card

INTERFACING DEVICES

• “Fly Board” (top) gives Apple II users control over projects from printers to home weather stations. Hardware includes a 6522 interface adapter, two 36” DIP jumper cables, and 2K of EPROM-compatible RAM. $129.95. Address: Snave Systems, PO Box 957, Niles, IL 60648.
• The PD100 prototype/decoder provides a means of interfacing prototype circuits for the IBM-PC. It contains a switch-selectable address decoder, a switch for up to four unique addresses, and two areas for circuit prototyping, which permits up to four boards to be utilized in one PC system. Available are four I/O device select signals, four supply voltages, and a buffered data bus. Address: Real Time Devices, PO Box 906, State College, PA 16801.

How to slice a pie.

To organize data in an appetizing way, a manager could certainly use the IBM Personal Computer. Because it lets you create crisp, high-resolution color graphics — quickly and easily.
Design a pie chart to illustrate your slice of the market, for example.
Draw a bar graph that pinpoints profit margins and sales trends.
Use arcs, plots, lines and boxes (in your choice of color palettes) to help make financial matters clear.
And you can even mix text with your graphics for a labeled visual that communicates more quickly.
For more eye-opening facts, visit an authorized IBM Personal Computer retail dealer. You’ll see that the quality of this computer is what you’d expect. The surprise may be that it’s as easy as pie to buy.

The IBM Personal Computer
A tool for modern times

For more information on where to buy the IBM Personal Computer, call 800-447-4700. In Alaska or Hawaii, 800-447-0890.
CIRCLE NO. 41 ON FREE INFORMATION CARD
Computer/Video Game Interference

LIVING in relatively crowded urban areas produces its own types of electronic problems. A serious one can occur when certain home computers spoil TV viewing. This can happen when the device is in the same or adjacent room as a TV receiver. Worse, though, is the possibility of interfering with TV reception when a receiver(s) is located some floors above or below, as in an apartment building.

I am not talking about the 15-kHz pulse signal generated by the TV receiver's horizontal-sweep power output stage, whose harmonics seem to be all over the spectrum. Rather, I'm referring to signal radiation from the foil traces and interconnecting leads used in a computer, where the pulses are dashing around. Since a digital system uses square-edged waveforms and a square wave is simply a sine wave embellished with lots of harmonics, the harmonics also radiate. (We should be thankful that the harmonic power drops away very rapidly as the number of the harmonic increases.)

Why the Confusion? There may be some confusion among our readers as to why certain computers undermine TV reception, while others do not. It appears that there are two sets of official FCC rules—one for "commercial" systems and another for "home" systems. Moreover, there are many, many computers that do not comply with FCC interference regulations because their manufacture predates the effective dates of the ruling. (There are three separate dates for compliance.)

The existence of these two different Rules brings up a very interesting point.

We usually assume that commercial electronic products, which use MIL spec parts, are superior to "consumer" products. In the case of radio-frequency interference (RFI)—the reason for the two different Rules—the reverse is true. In the case of computers, the home system is about three times better than the commercial system!

The FCC has divided the digital world into two parts: class-A devices (digital systems used in commercial, industrial, or a business environment) and class-B devices (essentially calculators, home computers and peripherals designed for a residential environment, even though they may be used for business purposes). Class-B devices can be used legally in a class-A environment, but not vice-versa. The basic reason given for this division is that it was assumed that commercial computers would be physically located farther away from a radio or TV receiver than a digital device used in a home and, thus, would not affect TV reception.

Three separate dates have been given for compliance with the current regulation. For personal computers, where the interference potential is high, the compliance date for meeting RFI specs was January 1, 1981. However, if manufactured after October 1, 1981, compliance will not be required until October 1, 1983.

After that date, any electronic device or system that generates and uses timing signals or pulses at a rate in excess of 10 kHz and uses digital techniques must comply with the following:

- The radiation limits of a Class-A (commercial) device shall not exceed 30 μV/m over the frequency range from 30 to 88 MHz; 50 μV/m over the frequency range from 88 to 216 MHz; and 70 μV/m over the range between 216 and 1000 MHz—all at 30 meters from the source.
- The radiation limits of a class-B (home) device should not exceed 100 μV/m over the frequency range between 30 and 88 MHz; 150 μV/m over the range between 88 and 216 MHz; and 200 μV/m over the range between 216 and 1000 MHz—all at 3 meters from the source.
- The difference between the two classes seems to be that since (a) the bulk of TV viewing is done in relatively confined residential environments, (b) there are many apartment buildings where vertical spacing is not very great, and (c) conventional walls and floor are not good r-f shields, the radiation level of a home computer must be kept down to avoid possible TV or radio interference.

Since January 1, 1982, manufacturers of personal computers and computer peripherals must obtain this certification from the FCC before the computer or peripheral appears on the market.

Other class-B equipment, such as a desktop calculator or a video game with a clock frequency below 495 kHz (and all class-A), are tested by the manufacturer for specification compliance, and the results need not be submitted to the FCC. However, the FCC can, and does, make a random sampling of the devices to ensure that the specification is adhered to. This applies to all devices produced after October 1, 1982. Again, full compliance with the FCC specifications must be made for any equipment using timing signals or pulses at rates faster than 10 kHz and employing digital techniques after October 1, 1983.

Labels Required. All computer and peripheral products must carry a label attesting that the device fully complies with the pertinent class-A or class-B specs. The instruction booklet must also inform the reader not only of the class (A or B) of the equipment, but also must include a warning that class-A devices should not be used in residential (class B) environments. Otherwise, some viewing or listening interference may result.

Obviously, where the devices are actually used is left up to the user. But the user is held responsible in any case for causing interference. Accordingly, if a class-A device is used in a class-B environment, the user must take whatever measures are available, at his own expense, to correct the problem. Assistance for this is at hand through the FCC booklet, How to Identify and Resolve Radio and TV Interference Problems. (Available from U.S. Government Printing Office, Washington, DC 20402. Request Stock No. 004-000-00345-4.)
Now, Tektronix 60 MHz Performance is just a free phone call away!

Wide-range vertical sensitivity:
- Scale factors from 100 V/div (10X probe) to 2 mV/div (1X probe). Accurate to ±3%. AC or DC coupling.

Two high-sensitivity channels:
- DC to 60 MHz bandwidth.
- From 10 V/div to 20 mV/div.
- Extended sensitivity of 2 mV/div at > 50 MHz.

Sweep speeds:
- From 0.5 s to 50 ns.
- To 5 ns/div with X10 magnification.

Delayed sweep measurements:
- Accurate to ±3% with single time-base.
- To ±1.5% with dual time-base.

Complete trigger system:
- Includes TV field, normal, vertical mode, and automatic; internal, external, and line sources; variable holdoff.

Probes included:
- High-performance, positive attachment 10-14 pF and 60 MHz at the probe tip.

These easy to order scopes are proof that it's not expensive to have advanced, 60 MHz performance from Tektronix on your bench. It's just practical! Feature for feature, the Tek 2213 and 2215 set a price/performance standard unmatched among portable scopes. And are backed by the industry's first three-year warranty on all labor and parts, including the CRT.

So advanced they cost you less: $1200* for the 2213! $1450* for the dual time base 2215!

These low costs are the result of a new design concept that utilizes fewer mechanical parts than any other scope.

Yet there's no scrimping on performance and reliability. 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.

Scope. Probes. Three-year warranty and expert advice. One free call gets it all! You can order, or obtain literature, through the Tektronix National Marketing Center. Technical personnel, expert in oscilloscope applications, will answer your questions and can expedite delivery. Direct orders include probes, operating manuals, 15-day return policy, full Tektronix warranty and worldwide service back-up.

Get all the facts.
Call toll free:
1-800-426-2200 Extension 93
In Oregon, call collect:
(503) 627-9000 Ext. 93

*Price F.O.B. Beaverton, OR. Price subject to change.

CIRCLE NO. 82 ON FREE INFORMATION CARD
STAN VEIT ON COMPUTER SOFTWARE

The Fly in the Ointment. Something had to happen to spoil everyone’s fun (or there wouldn’t be any story); and, in this case, The Regents of The University of California were told by someone in the IRS that the Pascal Project was running a software business and thus endangering the tax exempt status of the entire University. They were told to get rid of the commercial aspects of the UCSD Pascal Project.

What happened next is somewhat obscure and I have heard several versions, but the net result was that Softech Microsystems emerged as the sole distributor and manager of UCSD Pascal under license from the Regents of the University of California. They stopped the “almost free” distribution of version 1.4 and sent letters to all the universities and computer clubs informing them that they no longer had licenses to distribute UCSD Pascal. No one could stop those who already had the language from using it, of course. But no more were to be sold or given away! Softech also stopped supporting the 1.4 version. There was a hailstorm of protests, to no avail!

Softech then came out with a new version 2.0 containing some bug fixes but not much new material. It started a new major update that included new features and support for BASIC and FORTRAN as well as Pascal. Since the system was now a full DOS with multi-language support, they renamed it “UCSD P-System”.

The original licensees—Apple, North Star and Western Digital—did not go along with this because they could not come to terms with Softech. Their licenses were irrevocable so they could go on using UCSD Pascal in spite of anything that Softech did. For a while it looked as if they would resolve all the differences and one version of the system would emerge, but that did not happen. Instead, Apple Pascal went its own way (especially Apple III Pascal); North Star did the same; and Western Digital moved into the new language ADA making few updates to its version which was “cast in silicon” as part of the CPU chip set of the Microengine.

When IBM brought out its Personal Computer, it used the UCSD P-System as a secondary operating system. Then as other new 8-bit and 16-bit computers came out, they also adopted UCSD P-System as secondary operating systems.

Today the P-System is the secondary operating system for more computers than any other and it runs on almost every 8080, 8085, 8088, 8086 and Z80, M6800, M6809, M68000, and 6502-based computer on the market. It is truly a universal system. Never first but second with everybody! Not a bad position to be in considering that it never had to engage in the “Wars.”

The Future. There are some clouds on the horizon, though. IBM has “temporarily” withdrawn its version of UCSD P-System for the IBM-PC because of “bugs.” A new revision is expected to be released shortly. There is another version of the P-System for the IBM-PC from Network Computing Inc., Burnaby, B.C., Canada. IBM is also distributing another Pascal compiler from Microsoft. Could it be dropping the P-System? I have not been able to find out.

One thing that might put new life into the P-System is the fact that Niklaus Wirth has developed a new language called “Modula-2” as a simple but powerful alternative to assembly language, Pascal, C, and Ada. Modula-2 is easily learned by Pascal programmers, and it solves many of the problems that system designers have had with Pascal. Volition System of San Diego, CA, has implemented it on the UCSD P-System and are supplying it at this time.

In general, the P-System has been more popular with software developers than with the general public. Since its languages are compiled, and transportable to many computers, it makes a good system for application programs. The designers can write the applications in Pascal, compile it, and only deliver the p-code to the customer. Of course, the P-System kernel (run-time package) must be there. Many computer companies, such as Osborne, are supplying this at no extra cost. If it is not in the computer, the software publisher must supply it as part of the package. Softech is now supplying this package for $50.

UCSD P-System users, (all 100,000 of them) are a very loyal group. However, while they are loyal to the system, they have had many differences with Softech. In spite of this, Softech has supported the user’s group. So have Apple, Western Digital, North Star, and the application software manufacturers.

The official UCSD user’s group is called USUS. It was organized in 1980 and maintains a newsletter and an extensive library of contributed and public domain software. There is also a users SIG on CompuServe that is open to members of USUS. To find it, Go PCS-30 on CompuServe.

Where the UCSD P-System Fits in the DOS War

This month I return to the continuing saga of the DOS War with some background on the UCSD P-system and where it stands in the order-of-battle.

To get some background on the system, we must start with the story of the development of Pascal. Niklaus Wirth invented Pascal as a teaching tool for the concepts of structured programming. He implemented it on a large mainframe computer and described it in his book Pascal User Manual and Report, Jensen and Wirth, Springer Verlag, New York, 1975.

Dr. Kenneth Bowles at the University of California, San Diego, formed the Pascal Project to make Pascal available to universities in the United States as a teaching tool. To do this, the language had to run on the minicomputers and microcomputers that they used and it had to be available at low cost. The project developed a complete operating system including a Pascal compiler, several editors, an assembler, a debugger, and a library of utilities.

This package became known as UCSD Pascal, and it was distributed through colleges and computer clubs at a very low cost. Some computer manufacturers, including Apple, North Star, and Western Digital Corp., took out licenses to use the system.

While the Pascal Project was distributing Version 1.4, Apple was selling Apple Pascal, which included graphics usable on the Apple II+ computer. North Star brought out a version that only ran on its disk systems, Western Digital brought out the Microengine, a computer that used UCSD Pascal P-native code. All of this made UCSD very popular in a short time.
We don’t care which computer you buy. 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”.

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 buy.

CompuServe
Consumer Information Service
2180 Wilson Rd., Columbus, Ohio 43228
800-848-8199 in Ohio Call 614-457-8650
An H&R Block Company
Only NRI Gives You This Kind of Training and Equipment.
Only NRI Gives You So Much Professional Preparation For a TV/Audio/Video Servicing Career.

Build this 25" Heath/Zenith Color TV with 112 channel tuning system, infrared remote control, advanced sound system, and in-set space phone.

Get complete, thorough instruction in the theory, servicing, and repair of TV, VCR, video disc players, audio equipment, AM/FM receivers, antenna systems, home video cameras, projection TV, and more with 65 easy-to-digest, bite-size lessons.

Build this 25" Heath/Zenith Color TV with 112 channel tuning system, infrared remote control, advanced sound system, and in-set space phone.

Get complete, thorough instruction in the theory, servicing, and repair of TV, VCR, video disc players, audio equipment, AM/FM receivers, antenna systems, home video cameras, projection TV, and more with 65 easy-to-digest, bite-size lessons.

See servicing techniques demonstrated in close-up detail. Graphic presentations make theory and systems come alive on NRI Action Videotapes covering VCRs, disc players, and TVs.

Learn how to diagnose problems using a professional 3½-digit digital multimeter. Exclusive NRI Action Audio instructions talk you through its complete operation and use.

Perform challenging state-of-the-art electronic experiments and demonstrations using your NRI Discovery Lab®.

Learn servicing and adjustment techniques with this 6-hour, remote control videocassette recorder you get as part of your training.
Only NRI gives you so much practical training with equipment you learn on and keep. You learn by doing. That's the way to make it interesting, that's the way to make it enjoyable, that's the way to get the hands-on experience and know-how you need.

**Hands-On Training For Real Bench Experience and Priceless Confidence**

You start with experiments and demonstrations on the unique NRI Discovery Lab. You learn basic circuit wiring and soldering techniques, and then quickly move on to more advanced concepts as you come to understand electronic theory, solid-state devices, digital systems, and microprocessors. You learn by actually building and observing the action of circuitry you'll be working with in real-life situations.

**Exclusive NRI Training On Videotape**

In addition to profusely illustrated lessons, you get NRI's Action Audio cassette to "talk" you through the use and operation of the professional digital multimeter you receive as part of your equipment. Even more exciting are your NRI Action Videocassettes... videotaped lessons that show you graphic presentations of electronic systems, vivid closeups of servicing techniques and professional "shortcuts" to study and replay as often as you want.

**You Get TV, VCR, DMM and More Equipment To Keep**

You also build your own 25" Heath/Zenith color TV, a state-of-the-art unit that includes infrared remote control, a Time Control Programmer, and the incredible Advanced Space Phone that lets you telephone from your chair. Using the videocassette recorder that's included as part of your training, you learn how to adjust, service and repair these fast-selling units. Your front-loading VCR features up to 6-hour recording capacity, remote control, and programmable touch-button tuning.

The digital multimeter you receive is a truly professional instrument. You use it in the experiments throughout your course and as a key servicing tool on the job. Using the meter along with the NRI Discovery Lab, you'll learn how to measure voltage, current and resistance and how to diagnose all types of servicing problems.

**Advanced Systems Demand Advanced Technicians for Service and Maintenance**

The art of TV/Audio/Video servicing has taken quantum leaps into the future. Now, successful technicians must understand advanced concepts like digital control, electronic tuning, laser video discs, microprocessors, and more. NRI gives you the training you need for success...state-of-the-art concepts and practical, hands-on experience working with the kind of equipment you'll encounter on the job.

**7 Decades of Teaching Electronics Skills At Home**

NRI is the oldest, largest, and most successful school of its kind in the world. It has pioneered and refined the teaching techniques that make learning at home the NRI way one of the most economical and effective methods ever conceived. You learn at your convenience as a class of one, backed by skilled NRI instructors and carefully designed lessons that take you a step at a time toward your goal. No time away from your job, no night school grind, no classroom pressures. Yet your training is thorough and complete, with a foundation of hands-on experience unequalled by any other training organization.

**Send For Free Catalog Covering 12 Electronics Courses**

Our 104-page catalog gives you all the details. In it, you'll find a summary description of every lesson, and photos and specifications for every item of equipment included in your course. You'll also learn about other fascinating career opportunities in the world of electronics... Microcomputers, Industrial Electronics including robotics, Communications, and more.

Mail the postage-paid card today for your free copy. See how completely and how thoroughly NRI gets you started on your tomorrow today.

NRI SCHOOL OF ELECTRONICS
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, DC 20016

www.americanradiohistory.com
Better Sound for VCRs with Beta Hi-Fi

By Len Feldman

After months of speculation, Sony Corp. and its videocassette recorder licensees have finally unveiled the Beta format method of incorporating stereo sound on a video recording. From what we've actually heard, Sony has a winner with its new Beta Hi-Fi system, which provides far superior sound quality when compared with the already available VHS stereo format. To achieve this superior sound, the Beta group's machines employ considerably more sophisticated technology than is currently used in VHS stereo machines.

Unlike the case with VHS VCRs, Sony's Beta Hi-Fi doesn't split the longitudinal sound track along the top edge of the video tape into two tracks (Fig. 1) to obtain the stereo channels. Instead, a whole new approach has been used to achieve true "high fidelity."

Before we go into the details of the new Beta Hi-Fi system, it's interesting to review the characteristics of conventional VCRs. Whether Beta or VHS, conventional VCRs have inherently poor audio sound quality. Even at the fastest Beta II and VHS-SP tape speeds (used when you want the highest possible video and sound quality), about the best high-end frequency response that can be expected may be at 10 or 11 kHz at the 3-dB roll-off point. Using economy Beta III or VHS-EP tape speeds for longer play time will reduce top-end response to 4 to 5 kHz (as well as picture quality). These figures are hardly what you would expect for "high-fidelity" sound quality.

Limited frequency response isn't the only factor in giving VCR sound channels their characteristically poor sound quality. Record/play signal-to-noise (S/N) ratios are generally no better than 40 to 45 dB in the absence of some form of sound reduction or companding. Even if companding is used, the poor overall bandwidth capability of the conventional VCR system makes tracking subject to large errors. With most conventional VCRs, tape hiss is very audible, even when operating at the faster tape speeds. And bear in mind that even at these speeds, tape motion in a VCR is slower than it is in a standard audio cassette deck.

Distortion of the audio track in a VCR is fairly high, too. Harmonic distortion is typically as great as 3%, for maximum recording level. Furthermore, until recently, the audio track on both VHS- and Beta-format machines has been limited to monophonic, or single-channel, sound.

Because the VHS approach to providing stereo sound is to simply split the existing audio track in two, the sound quality of recently introduced stereosound VHS machines is no better than for mono machines. In fact, it's 3 dB worse. Finally, you have only to listen to the sound of a sustained musical note from a conventional VCR to hear just how bad wow and flutter from the audio track can actually be.

Audio In Video Tracks. In Sony's Beta Hi-Fi system, as many as three sound tracks (including the conventional audio track), but most often two, are audio-frequency modulated (called AFM) and inserted into the picture track. In the Beta format (Fig. 2), existing chroma (color) and luminance (brightness) video signals are spaced far enough apart to accommodate the new sound carriers. Although the sound carriers appear to be partially superimposed on the color and brightness signals, the arrangement doesn't produce crosstalk. Furthermore, with three audio channels, the system can accommodate stereo plus a second language in mono, two or three language sound tracks, or even three-channel sound.

### COMPARISON OF AUDIO SPECIFICATIONS FOR CONVENTIONAL AND BETA HI-FI

<table>
<thead>
<tr>
<th></th>
<th>CONVENTIONAL</th>
<th>BETA HI-FI</th>
</tr>
</thead>
<tbody>
<tr>
<td>S/N</td>
<td>Frequency Response</td>
<td>Dynamic Range</td>
</tr>
<tr>
<td>Beta II</td>
<td>&gt; 40 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50-11,000 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.3% (wrms)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>Beta III</td>
<td>&gt; 40 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>50-8000 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.4% (wrms)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.5%</td>
<td></td>
</tr>
<tr>
<td>Beta II &amp; III</td>
<td>&gt; 80 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20-20,000 Hz</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; 0.005% (wrms)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; 0.3%</td>
<td></td>
</tr>
</tbody>
</table>
Beta Hi-Fi, through the AFM technique, offers a total dynamic range and, therefore, a maximum S/N ratio of 80 dB! (The conventional audio track's figure, however, remains about 45 dB.) This is almost two orders of magnitude better in terms of "audio power" than the best analog LP discs currently available. With its 80-dB dynamic range, Beta Hi-Fi offers almost as great a range as that achievable with the "ideal benchmark" digital-audio sources presently offered by PCM digital-audio processors or by the soon-to-be-released CD discs played on digital-audio disc players.

Other performance figures of the Beta Hi-Fi system are equally impressive. Wow and flutter, for example, is down to a negligible 0.005%. Even at maximum 0-dB reference record level, distortion is 0.3%, or a tenth of that measured on typical conventional VCRs. Frequency response is just about ruler flat from 20 to 20,000 Hz. (A comparison of audio performance specifications for a conventional VCR and a VCR with Beta Hi-Fi is shown in the Table.)

Audio information in the Beta Hi-Fi system is "laid down" on the magnetic tape by the same fast-spinning heads used to record the video signals. Instead of the tape writing speed for the audio signals being limited to only a couple of centimeters per second, as is the case with a stationary audio record/play head, effective tape writing speed is the same as that used for the video signals, typically 6.9 meters per second (Fig. 3). Given the wide bandwidth that results from this recording technique, what amounts to two separate r-f carriers is obtained (Fig. 2). Each carrier is frequency modulated by a left- or a right-channel stereo audio signal. In the Beta format, luminance (brightness) signals are located between .5 and 4.8 MHz and chroma is centered at 688 kHz. (It's an amplitude-modulated, or AM signal whose upper sideband over-laps the FM luminance signal spectrum somewhat.)

An interesting side benefit is obtained from this arrangement. If the fast-scan feature of a Beta VCR (say, 2X normal viewing speed) is operated, the audio doesn't take on the "chipmunk" quality characteristic of conventional audio tape reproduction run at faster than normal speed. Actual tape-head to tape writing speed doesn't change by much when longitudinal tape speed is increased by 2X (or, for that matter, 3X or 4X)

![Fig. 1. In conventional VCRs, longitudinal audio track is divided into two narrower tracks for stereo.](image1)

*FM Audio Carriers*

*Relative Amplitude*  
<table>
<thead>
<tr>
<th>Frequency MHz</th>
<th>Chroma (B.C.)</th>
<th>Luminance (B.G.)</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

![Fig. 2. In Beta Hi-Fi, extra FM audio carriers are inserted in the frequency baseband between chroma and luminance signals.](image2)
when it's decreased for slow-motion viewing). This is because the longitudinal tape speed, using the video recording heads, is a very small part of total effective tape to tape-head writing speed.

Track configuration of Beta Hi-Fi (Fig. 3) retains the conventional longitudinal audio track, positioned in the usual location, to maintain compatibility between older Beta VCRs and newer Beta Hi-Fi software and vice versa. Played on a new Beta Hi-Fi VCR, the audio track of an older tape will produce a mono sound track with the usual poor S/N ratio, wow and flutter, and frequency response. Conversely, a new Beta Hi-Fi tape's sound tracks will yield only a low-fi mono signal, with left- and right-channel signals blended together, when played on a Beta VCR without the Beta Hi-Fi system.

**Which Way To Go?** Beta VCRs equipped with Sony's new Beta Hi-Fi stereo recording system are expected to cost about $1000, which gives consumers an interesting alternative to digital audio equipment. At just about the same time Beta Hi-Fi VCRs are introduced (currently scheduled for May/June 1983), the long-awaited CD (compact digital) audio disc players will also be appearing in the U.S. marketplace, priced at $800 to $1200, depending on features. Digital audio processors, sometimes called PCM processors, that permit digital audio to be recorded onto video tape, have been selling for about $2000, which must be added to the price of the VCR. Totalling all the figures, it's obvious that it would currently be far less expensive to record high-quality audio signals using the new Beta Hi-Fi system than to record in the digital-audio medium.

Of course, digital audio has a definite edge over Beta Hi-Fi in terms of published specifications, but in terms of actual audible performance, it hardly matters if one audio medium offers 80 dB (Beta Hi-Fi) of dynamic range while another offers 90 dB (digital audio). Both figures are several orders of magnitude better than what the best present-day LP records or analog tapes can provide. It's also difficult to hear the difference between the 0.3% harmonic-distortion level specified for Beta Hi-Fi and the 0.03% figure claimed for digital-audio systems. And Beta Hi-Fi's 0.005% wow and flutter is, for all practical purposes, as inaudible as the unmeasurable level claimed for the new digital audio discs and PCM tape systems.

In sum, Beta Hi-Fi may well prove to be a serious challenger to digital audio in the months and years ahead. Even if you were to ignore the video side of Beta and use a new VCR equipped with Beta Hi-Fi for only audio recording, the cost might well be justified in terms of the audio quality than can be achieved with this new system. Adding the video recording capability might well make it possible for the Beta-format VCR, long the underdog in the VCR race, to catch up with its faster-selling VHS-format competition.

When queried if FM sound tracks could be used in VHS VCRs, several industry experts initially answered in the negative. As presently designed, they pointed out, the VHS system doesn't lend itself to this approach because there's little or no free spectrum space between chroma and luminance signals (Fig. 4). While luminance could be shifted to make room for the sound tracks, this would limit brightness and degrade picture quality. It would also eliminate compatibility with current VHS hardware and software.

Just as the experts finished explaining why the VHS system couldn't support a sound system similar to Sony's Beta Hi-Fi, Matsushita Electric Co. and JVC demonstrated at last fall's Tokyo Electronic Show a "hi-fi" version of the VHS system after all. According to reports from Japan, the VHS hi-fi system is conceptually similar to Sony's Beta Hi-Fi system. That is, FM carriers are recorded onto and read from the video tape by helical scanning. Dynamic range is claimed to be 90 dB, and frequency response, distortion, and wow and flutter figures are said to match those of the Beta Hi-Fi system. No marketing plans for the VHS hi-fi VCR were disclosed, but there were indications that the new system would retain the existing linear stationary-head track at the edge of the tape, in addition to new FM sound carriers, to insure compatibility with other VHS VCRs.

**In Closing.** Consumers are the real winners in the battle between Beta and VHS. Timing for better video audio couldn't be better. At the very least, we'll get the opportunity to obtain a better audio product than has heretofore been available at moderate price. And on the video end, we'll already be geared up to take advantage of this form of high-quality stereo audio at around the same time the FCC is slated to finally approve stereo audio for TV broadcasting.
TURN YOUR COMPUTER INTO A FULL-BLOODED WORD PROCESSOR.

VIC 20™ and Commodore 64™ users, something very clever is lying in wait for you. It's called Quick Brown Fox™.

Quite simply, Quick Brown Fox is the quickest, easiest to learn, user-friendliest—and most versatile—word processing software running.

Take a look at some of these crafty features. You get full editing, even on standard displays. (The Fox supports most 80-column boards too.) You get automatic reformattting of edited text, not the tedious paragraph-by-paragraph runaround. There's more.

You get single-key operation, text moving, boilerplating, tab and margin settings, right justification, proportional spacing. You get intelligent software that uses less computer memory. (That's how come it even works with an off-the-shelf VIC 20.) You also get compatibility with a wide range of printers—plus plenty more.

And you get it all for only $65. Doesn't that make you want to trot through your texts with a Quick Brown Fox?

QUICK BROWN FOX™

Call or write for more details:
548 Broadway, New York, NY 10012 (212) 925-8290
Dealer Inquiries Invited

© 1983 Quick Brown Fox
KYOCERA'S MODEL R-651
Stereo Receiver with
MOSFET POWER OUTPUT

CYBERNET's Kyocera Model R-651 AM/FM-stereo receiver combines a digitally synthesized tuner with a high-quality MOSFET-output amplifier. Output power is conservatively rated at 65 watts/channel into 8 ohms, 20 to 20,000 Hz, at no more than 0.015% THD. The preamplifier section features a highly flexible tone control system described in Cybernet's literature as a "parametric equalizer."

Including its walnut wooden side panels, the receiver measures 18"W × 14¾"D × 5¾"H and weighs 25 lb. Suggested retail price is $740.

General Description. Most of the receiver's less frequently used controls are located behind a full-width door that hinges downward at the bottom of the front panel. Pressing one end of the door allows it to unlatch and provide access to the hidden controls.

In the center of the gunmetal grey satin-finished control panel is a display window. Behind this window are a digital-numeric display for tuned frequency; bargraph displays for monitoring signal strength and peak audio output power (separate for each channel); and STEREO, IF NARROW, and STATION LOCK indicators. The left half of the panel is relatively blank, containing only the pushbutton POWER switch and a smaller pushbutton DISPLAY switch for selecting ×1 or ×10 sensitivity for the audio output power bargraph meters.

Directly to the right of the display window are seven flush-with-the-panel touch switches that provide instant access to any one of up to seven each user-programmable AM and FM stations. (A separate MEMORY PROGRAM switch is provided for actual programming.) Memory system in the tuner section can store the user-selected station frequencies for instant recall.

Other touch panels are provided for UP/DOWN scan tuning, SCAN HOLD tuning, and AUTO/MANUAL tuning modes. At the extreme right of the front panel are similar touch panels for selecting program source—PHONO, AM, FM, AUX, TAPE1, and TAPE2; COPY switches for dubbing from either tape deck to the other; and a −20-dB AUDIO MUTING switch. Between the two banks of touch panels is a vertical slide-type VOLUME control.

Behind the hinged door at the bottom of the front panel are five small pushbutton switches, and a PHONES jack. A pair of rotary controls is provided for adjusting bass and treble characteristics according to LEVEL and frequency (Hz). The 11-position detented LEVEL controls act like ordinary tone controls, whereas the HZ controls continuously vary the turnover frequencies (100 to 500 Hz in the bass range and 2 to 10 kHz in the treble range). Although this is not, strictly speaking, a "parametric" equalizer arrangement (which provides independent control of the boost/cut frequency and the amplitude of the response change), it's far more flexible than conventional tone controls—including those that offer a choice of two or three different turnover frequencies. The remaining rotary control is for adjusting channel balance.

Switching functions include: SUBSONIC and HIGH frequency filters, LOUDNESS compensation, STEREO/MONO mode, and EQUALIZER IN/OUT.
No wonder they call it the SUPERFONE!

At Last—a Cordless Phone with TWICE the Range, Sound Fidelity to Rival Phones with Cords, and a Privacy Code System—All This in a Phone Less Than an Inch Thick!

The Super Fone is less than 1" thick. The base unit has a built-in speaker phone, a fully independent intercom, and is 110 volt-220 volt switchable.

Until now, cordless phones have given you wonderful convenience. But they've had two problems:
1. The range is limited to 600 to 700 feet.
2. Some of them sound as though you're talking inside a barrel.

As cordless phones have become enormously popular, another problem has arisen: two people, living near each other, can have the same channel. Not only is there line confusion, but someone else can literally make a long distance call on your phone.

No more. Never again.

Range: 1500 Feet OR MORE!

The SuperFone 650 uses state-of-the-art electronics to bring you the ultimate cordless phone. Sound quality is superb—and it stays superb, 1500 feet or more from the base station. That's more than twice the distance of standard cordless phones.

Only SuperFone 650 has a secret code system to prevent interference and false operation of the phone. You choose from 512 possible "code" combinations. Both the base unit and the phone are locked onto that code, which you can change when you want to. No other phone can interfere. No other unit can share the signal. No one else can hear or speak on your carrier-wave.

Enormous Range

We say the SuperFone 650 has a range of 1500 feet.

Notice we didn't say "up to" or "as far as" 1500 feet. There's no hedging, because this seems to be the minimum, not the maximum range.

Users report 1800 and 2000 feet. That's nearly half a mile. SuperFone 650 is a radioelectron device, not a toy, and that's why its signal doesn't break up or start hissing or cracking when you get half a block away.

You can tell when you feel it. It's a Little Giant. You can feel the power inside. What a marvel of electronic engineering it is! And it's tough, too. It fits into your shirt pocket, and you can bounce it around all day without damaging it.

Speakerphone, Intercom — Everything!

SuperFone 650 is the Everything Phone. Anything any phone can do, it can do.

First, the base station is a speaker phone. Touch a button and you can have a hands-free conference conversation in the room in which the base station sits.

Next, it's an intercom. You can page the handset from the base unit and have a private conversation. You have a true wireless intercom, not just a signal.

Third, you have a privacy button. Push that button and you'll still be able to hear anything the other party says, but he or she won't be able to hear you until you take the button off "hold."

Fourth, you have an automatic redial. Touch the key and the SuperFone will redial the last complete number.

What else? A security switch which makes it impossible for anyone to call out on the remote phone, without changing the ability to receive calls. A volume control for the speaker on the base unit. A call button to page the base from the cordless phone. THIS PHONE HAS EVERYTHING!

30-Second Installation

Plug your SuperFone 650 into any wall AC outlet. Push its standard modular terminal into the telephone plug. You're in business.

Every component is heavy-duty, from the built-in condenser microphone (with automatic gain control) to the LED indicator lights. This phone is designed for hard use.

The SuperFone 650 is yours for $249.95. If you want the SuperAntenna with it, giving you a range of a mile—or even more—you can have both for $319.95. (Or you can get the SuperAntenna alone for $79.95.)

We Absolutely Guarantee!

Use the SuperFone 650 (or any electronic instrument you acquire from us) for up to 30 days. If for any reason you decide not to keep it, return it for a 100% refund.

The SuperFone 650 — $249.95
The SuperAntenna — $79.95
BOTH Phone and Antenna — $319.95
Adapter for Multi-Line phone — $39.95
Add $4.50 per total order for shipping.

CIRCLE NO. 17 ON FREE INFORMATION CARD
KYOCERA RECEIVER

switching. FM tuner buttons control muting, high blend, and NORMAL/NARROW i-f bandwidth selection. Each of the two sets of speaker systems that can be accommodated by this receiver is controlled by its own pushbutton switch.

On the rear apron of the receiver are the various signal inputs and outputs, insulated spring connectors for two pairs of speaker systems, two unswitched and one switched accessory ac outlets, and the antenna terminals. Binding posts are provided for an external AM antenna, supplementing the built-in hinged ferrite-rod antenna. The only FM antenna input on the receiver is a Type F 75-ohm coaxial connector. A supplied matching transformer press-fits onto this connector and has screw terminals for a 300-ohm twin-lead line.

All cooling is performed inside the cabinet, leaving no external heat sinks visible. The MOSFETs in the output stages make intimate contact with a copper pipe that contains a refrigerant that transfers heat to a number of large fins. Ventilation openings in the top and bottom of the receiver permit free convection air flow to carry off the heat collected.

Laboratory Measurements. The conservative power ratings of the Model R-651 65 watts/channel receiver were evidenced by its output power at clipping, which was about 81 watts/channel with both channels driving 8-ohm loads at 1000 Hz. The measurements into 4- and 2-ohm loads yielded readings of greater than 89 and 43.5 watts, respectively. Harmonic distortion at 1000 Hz into 8 ohms measured about 0.006% to 0.008% from 1 to more than 70 watts and 0.012% at 80 watts, just before the onset of clipping. At 4 ohms, the distortion was 0.01% to 0.02% up to and beyond 70 watts, reaching a maximum of 0.027% at 80 watts. Into 2 ohms, the measurements were about 0.02% to 0.03% up to 30 watts and 0.5% at 40 watts.

Dynamic power tests with a 20-ms tone burst at 1000 Hz produced clipping outputs of 101, 133, and 80 watts into 8-, 4-, and 2-ohm loads. The 8-ohm clipping headroom measured 0.94 dB, while dynamic headroom was 1.91 dB. MOSFETs are noted for their high-speed operation. This was reflected in a slow factor greater than 25 and very low IHF intermodulation distortion. With a mixed 18/19-kHz test signal driving the amplifier to 65 watts, second- and third-order distortion components (1000 Hz and 17 or 20 kHz) were barely detectable at the −97-dB measurement "floor" of our test instruments.

At rated output power, amplifier distortion was in the range of 0.005% to 0.01% over much of the audio band. It reached 0.017% at 20 Hz and 0.014% at 20,000 Hz. Very similar results were obtained at half and one-tenth power. A 1-watt reference output level was achieved with inputs of 19 and 0.28 mV through the AUX and PHONO inputs, respectively, with A-weighted noise levels of −79 and −78 dB referred to 1 watt. Phono overload occurred at a high 175 mV at low and middle frequencies and 147 mV at 20,000 Hz. RIAA phono equalization was flat within 0.5 dB overall from 60 to 20,000 Hz and was +1 dB at 20 Hz.

The tone controls provided substantial response correction at the frequency extremes without affecting the midrange. They could also be set to provide a more typical response adjustment in which much of the audible range was modified. Measured response curves confirmed the expected capabilities of this system.

The loudness compensation boosted low frequencies only moderately and high frequencies hardly at all at reduced volume levels. Both audio filters had gradual slopes of 6 dB/octave, with −3 dB responses at 50 and 2000 Hz.

FM usable sensitivity measured 12 dB (2.2 µV) in mono. The stereo switching (and muting) threshold was about 28 dB (13 µV) and, in its high setting, 42 dB (70 µV). We measured 50-dB quieting sensitivities of 13.8 dB (2.7 µV) in mono and 37 dB (39 µV) in stereo.

At a 65-dB (1000-µV) input, tuner noise level was −77 dB in mono and −70.5 dB in stereo. Corresponding distortion readings were 0.072% and 0.19%. Using 14- and 15-kHz modulating frequencies, our IHF IM distortion measurements for second- and third-order components were −68 and −65 dB in mono and stereo were −55 and −56 dB.

Frequency response in the FM section was flat within 1 dB overall from 30 dB to 100 kHz for mono, and from 10 kHz to 100 kHz in stereo. (The stereo switch was always left on.)

Sensitivity and noise for the FM tuner section.
COMPUNETERS IN
MATHEMATICS:
A SOURCE BOOK OF IDEAS

Now that more and more math departments have access to a microcomputer, the problem becomes: How to use the computer effectively as a teaching aid?

Here's where COMPUTERS IN MATHEMATICS can help you. This 224-page book of reprints from Creative Computing magazine is a goldmine of learning ideas, problem-solving strategies, programming hints, puzzles, brain teasers, and much more!

COMPUTERS IN MATHEMATICS covers nine subject areas:

• Computer literacy and computers in society
• Thinking strategies and how to solve problems
• Computer simulations and how to write them
• Probability
• Mathematical miscellany, from circular functions to differential equations
• Art and graphics and their relation to mathematics
• Computer Assisted Instruction (CAI)
• Programming style
• Puzzles, problems and programming ideas.

In all, COMPUTERS IN MATHEMATICS contains 77 fascinating articles, over 200 problems for assignment, and nearly 100 programs. Edited and with a preface by David H. Ahl, Editor-in-Chief of Creative Computing, this immensely practical volume is an invaluable classroom tool for teachers and students of all grades.

USE THE COUPON TO ORDER YOUR COPY TODAY!

creative computing
dept. nasb - 39 east hanover avenue
morristown, new jersey 07960

please send me copies of COMPUTERS IN MATHEMATICS.
a sourcebook of ideas, at $15.95, plus $2.00 postage & handling* each #12d

check one: □ payment enclosed $  □ by check or money order (n residents add 5% sales tax)

□ charge my: □ american express □ mastercard □ visa

card no.                      expire date

signature

mr./mrs./ms.                  (please print full name)

date

city           state          zip

*all foreign orders (except canada and mexico) add $3 to postage & handling shown. shipped via mail only

purchase orders under $50 not accepted

for faster service, call toll free 800-631-8112. in nj call 201-540-0445.

---

to 15,000 Hz. Channel separation was nearly constant 50 dB ±2 dB, 30 to 1000 Hz, and reduced smoothly to 27.5 dB at 15,000 Hz. Capture ratio measured about 1.5 dB, AM rejection a good 66 dB at a 45 dB (100 µV) input, and image rejection 65 dB. The 19-kHz pilot carrier leakage was a low — 76 dB, and tuner hum level was — 74 dB. In the normal bandwidth mode, alternate-channel selectivity was only 37 dB, while adjacent-channel selectivity was 2.8 dB. Signal-strength lights for the FM tuner came on at irregular spacings of 6 to 16 dB over a range of 16 to 1200 µV, which encompasses most of the useful range of signal levels.

In the narrow bandwidth mode, alternate-and adjacent-channel selectivity dramatically improved to 74 and 9.4 dB, respectively. Capture ratio in this mode was somewhat degraded at 2.6 dB, and IHF IM distortion was slightly greater at — 60 to — 65 dB in mono and — 43 to — 49 dB in stereo. Other aspects of tuner performance weren't affected by the change in bandwidth.

Frequency response of the AM tuner was down 6 dB at 40 and 2800 Hz.

User Comment. This receiver proved itself to be above average in both performance and features. Although no single aspect of its design or performance is necessarily beyond that of other contemporary receivers, the total effect is one of excellence. In our view, this reflects a balanced design that ensures best performance for the largest number of potential users.

A good example of this is the switchable FM i-f bandwidth feature that makes the Model R-651 as useful under adverse reception conditions as in a more ideal situation. In our metropolitan New York location, normal bandwidth (actually, quite broad compared to most tuners) was always adequate in rejecting alternate-channel interference. Significantly, degradation of tuner performance in the narrow mode was inaudible and insignificant.

The receiver's tone controls are among the best we've ever encountered. If you know what you want to hear and have the patience to experiment, these versatile controls are very likely to provide the desired results.

The Kyocera line of audio components from Cybernet is a relatively new name in the U.S. marketplace, though the company was founded almost a quarter-century ago. If our experience is any gauge, it won't be one of those names that fails to achieve prominence as a supplier of high-quality components.

— Julian D. Hirsch

CIRCLE NO. 101 ON FREE INFORMATION CARD
Hands-on Reviews
of the latest
Computer Game
Software

USING a "home" computer, you've likely already come to grips with the mass storage options. This generally means a choice or mix of tape cassette, mini-floppy disk, solid-state board, or even a hard disk. The cassette method has the virtue of being very affordable, of course, and is often employed with low-cost "starter" computers. Floppies, on the other hand, come higher, with disk drives costing as much or even double the price of the computer itself.

Audio cassettes are cheap, but awfully slow. Typically, they take four or five minutes to load 32K of program material—if you're lucky and no error messages pop up on line 895 or wherever. When error messages do appear, you have to rewind and start the loading process all over again. So they're a real turnoff. In contrast, diskettes can load 32K in a matter of six to eight seconds, and with a high degree of reliability and accuracy. But, oh, that first hardware cost if the computer itself is a cheapy.

The news now is that you will soon have an alternative. The new format is called a "wafer," and it's a very distant cousin of the microcassette. The difference is that it has been designed specifically for use with home computers and, as such, has a lot of very special features.

The medium is an endless-loop tape \( \frac{1}{10} \text{"} \) wide and housed in a minuscule cassette case that's a little smaller than a credit-card calculator (see photo below). The tape currently being used, according to Entrepo, Inc., the manufacturer, is high-grade video tape slit to less-than-shoestring width. The oxide formulation may change in the future, but the size and convenience won't.

Tape is available in lengths from 5 to 50 ft., in 5-ft. increments, and it's all certified. It whizzes past the record/playback head at 10 ips, and a 50-footer can hold up to 128K, says the manufacturer. Here's the best part: suggested retail price for a data recorder for these wafers will be about $100—only slightly more than the $75 or so that companies are asking for their house-branded data-cassette machines.

Entrepo calls the hardware "Microdrive," and the tapes are "Micro-wafers." They will retail in the $3-to-$5 range for blanks, and the hope is that a lot of software houses will adopt the Microwafer as another storage medium for their products so that the format has a chance to catch on. That 32K program mentioned will load in about 15 seconds from a Microwafer—pretty impressive when compared with the 6-to-8-second loading time for a floppy disk.

Companies already committed to the wafer concept are Texas Instruments and Coleco. TI will be hitting the market soon with an add-on Microdrive as a companion piece for its Compact Computer 40 (possibly under a different name). Coleco recently introduced its "Super Game Expansion Module #3" with Microdrive built-in and two free games on wafers—"Super Donkey Kong" and Super Gorf. The advertising claims that this module will provide "realistic arcade game play." Maybe it will, working with the ColecoVision's basic 32K of RAM, which admittedly is a lot for a dedicated game-playing machine.

Should you run out and buy one right now? Chances are, you can't! But be patient. The drives will soon appear on dealer shelves.

CHOPLIFTER!

Diskette for Atari 400/800.
Broderbund Software, Inc., 1938 Fourth St., San Rafael, CA 94901
(415-456-6424). $34.95.

Graphics ******
Gameplay ***
Sustained Interest ***
Type: Joystick action game.
Memory required: 48K

You're a helicopter pilot and have to rescue a number of hostages (or prisoners, if you will) being held in various barracks buildings behind enemy lines. Take off in your trusty, heavily armed helicopter and try to save these men. The ones who can get out of their blasted-open barracks run to the chopper and climb on board with little urging when you land.

But watch out! There are enemy tanks shooting at the chopper and at your hostages. Take off and turn through 90 degrees so you can drop bombs. You have to be low enough for the bombs to have any effect—but at this low altitude, the tank's fire can get you, too. It's an aggravating scenario, and those tanks are awfully hard to hit.

The enemy fire does come in handy at one point. Explosions from enemy tank shellfire rip open other barracks buildings, allowing the prisoners to escape and run for your chopper. Other enemies to be contended with are jet fight-
ers, which you can shoot back at, and next are drone air mines which home in on your chopper. They can also follow you back to your home base.

This game is strictly joystick controlled with eye-hand coordination an important part of gameplay. If you hit the "BREAK" key, the game will pause so you can answer the telephone or nature's call, or just go get a cup of coffee. This is a feature that more and more computer games provide—but unfortunately, not all of them do. It's very disconcerting to be deeply involved in a game—especially when you're racking up a good score—and have to abort it to answer the telephone.

The difficulty level is quite high, and it will take a fair amount of practice to get through the tank and jet fighter waves to the point where you have to be concerned about the air-drone mines. Perhaps it also takes a certain amount of patience, because like all games, practice is needed to get you into the expert category. Gameplay is interesting and frustrating. Just when you have a dozen or so hostages safely loaded on your helicopter, you take an unlucky hit from a tank cannon and crash, losing all on board.

**DEMON ATTACK**

**ROM Cartridge for Atari 400/800.**

Imagic, 981 University Ave., Los Gatos, CA 95030 (408-399-2200). $39.95.

**Graphics *******

**Gameplay *******

**Sustained Interest *******

**Type: Joystick action game. Memory required: 16K resident memory.**

This game won all kinds of awards last year in its Atari VCS game machine version, and it has lost none of the excitement and interest in its translation into Atari computer format. What is missing, however, is any kind of improvement in graphics or addition of special features. After all, this is a computer, not a dumb game machine that has no built-in RAM or graphics capabilities to speak of.

Yet it is part of the genius of the designers that the game graphics and gameplay were so good in the VCS version that unless you had already played that one extensively, you'd be enthralled by what this game has to offer in the way of visuals and excitement. It can be played by one or two people—each with his own cannons and reserve supply of spare shooters. The attacking waves of demons get progressively more difficult to destroy, and you get an extra cannon for each wave that you eliminate. Earn as many as you can; you'll need them later on as the demons get more demoniacal.

Demon Attack has the ability to capture and hold interest for hours. There's even a version—like the classic Space Invaders—that lets you and your second player team up to destroy the attacking demons. You busily dodge demon bombs, and in later waves, laser blasts, as these super-stealthy creatures fly back and forth in random patterns that seem to defy your ability to lead them with your cannon fire and shoot them down. After a little practice, you'll find yourself starting to get their range, but just when you least expect, you'll get clobbered by a lucky demon hit.

And with all this going on, there's also an electronic musical beat that keeps time to the demon wing-flapping—with a tempo that gets increasingly intense as the action heats up. Beware! This game is habit-forming.

**SOCRER**

**ROM cartridge for Atari 400/800.**


**Graphics *******

**Gameplay *******

**Sustained Interest *******

**Type: Joystick strategy/action game. Memory Required: Minimum resident (16K)**

Our British cousins have brought us a typically European game that is currently enjoying a vogue on this side of the Atlantic as well. It's one of those realistic sports games that can be very fast and a lot of fun. It can be played by zero, one, two, three, or four players.

If one person plays, you try to beat the computer (it's invariably better than you are). Two people can play against each other, and if you feel really lazy, you can set it so the computer plays against itself. I imagine that this last choice would be very good for parties and betting pools—not just betting on the first team to score, but also betting on how long it takes either team to make a goal. There are also nine difficulty levels available, but even the easiest one is darned tough!

The game consists of two standard soccer teams of 11 players each. The screen is shown with a slight tilt toward the far side of the playing field to add a three-dimensional quality to the graphics. You play until the final buzzer sounds at the end of the time period that you select in advance: 10, 45, or 90 minutes. We haven't graduated beyond the 10-minute game length yet; maybe this tells you something about the frustration level of the game.

The playing field is too wide for the TV screen, so just one-third of it appears at any one time. The screen field scrolls horizontally to follow the action—much the same way a TV camera pans on a real playing field. This provides a nice, realistic touch to the gameplay.

At first, it's hellishly difficult to learn how to keep your players from overrunning the soccer ball and how to kick it. Your joystick can control only one player at any one time, and when you press the "fire" button, control passes to the player nearest to the ball (in the computer's judgment). You may not always agree, and you may want to run some other player, but you have no choice in making this selection—a feature that I consider a definite drawback in the game program.

Sound effects consist of just two things: the sound of the ball being kicked and the referee's whistle when a goal is scored or the ball goes out of bounds. Selection of the various game options is from a computer-like menu that appears at the start of the game. The cursor on the menu is joystick controlled, making selections easy and straightforward.

For the uninitiated, the instruction booklet even includes a special section that explains the rules of soccer, the most popular sport on a worldwide basis. Overall, this appears to be one of the better sports-type computer games on the market. It's incredibly realistic, and is just difficult enough to be a challenge.
Fruitful Connections.

There are more people in more places making more accessories and peripherals for Apples than for any other personal computer in the world.

Thanks to those people—in hundreds of independent companies—you can make the humblest 1978 Apple II turn tricks that are still on IBM's Wish List for 1984.

But now we're coming out with our very own line of peripherals and accessories for Apple® Personal Computers.

For two very good reasons. First, compatibility. We've created a totally kluge-free family of products designed to take full advantage of all the advantages built into every Apple.

Second, service and support. Now the same kindly dealer who keeps your Apple PC in the pink can do the same competent job for your Apple hard-disk and your Apple daisywheel printer.

So if you're looking to expand the capabilities of your Apple II or III, remember:

Now you can add Apples to Apples.

Gutenberg would be proud.

Old Faithful Silentype® has now been joined by New Faithfuls, the Apple Dot Matrix Printer and the Apple Letter Quality Printer.

So now, whatever your budget and your needs, you can hook your Apple to a printer that's specifically designed to take advantage of all the features built into your Apple. With no compromises.

The 7x9 Apple Dot Matrix Printer is redefining "correspondence quality" with exceptional legibility. With 144x160 dots per square inch, it can also create high resolution graphics.

The Apple Letter Quality Printer, which gets the words out about 33% faster than other daisywheel printers in its price range, also offers graphics capabilities. See your authorized Apple dealer for more information and demonstrations. Because, unfortunately, all the news fit to print simply doesn't fit.

A joy to behold.

The new Apple Joystick II is the ultimate hand control device for the Apple II.

Why is it such a joy to use? With two firing buttons, it's the first ambidextrous joystick—just as comfortable for lefties as righties.

Of course, it gives you 360° cursor control (not just 8-way like some game-oriented devices) and full X/Y coordinate control.

And the Joystick II contains high-quality components and switches tested to over 1,000,000 life cycles.

Which makes it a thing of beauty. And a joystick forever.
A storehouse of knowledge.

If you work with so much data or so many programs that you find yourself shuffling diskettes constantly, you should take a look at Apple's ProFile™ the personal mass storage system for the Apple III Personal Computer.

This Winchester-based 5-megabyte hard disk can handle as much data as 35 floppies. Even more important for some, it can access that data about 10-times faster than a standard floppy drive.

So now your Apple III can handle jobs once reserved for computers costing thousands more.

As for quality and reliability, you need only store one word of wisdom:

Apple.

Up the creek without a paddle?

Or lost in space? Or down in the dungeons?

Whatever your games, you'll be happy to know that someone has finally come out with game paddles built to hold up under blistering fire. Without giving you blisters.

Apple Hand Controller II game paddles were designed with one recent discovery in mind:

People playing games get excited and can squeeze very, very hard.

So we made the cases extra rugged. We used switches tested to 3,000,000 life cycles. We shaped them for holding hands and placed the firing button on the right rear side for maximum comfort.

So you'll never miss a shot.

Launching pad for numeric data.

Good tidings for crunchers of numerous numbers:

Apple now offers a numeric keypad that's electronically and aesthetically compatible with the Apple II Personal Computer.

So you can enter numeric data faster than ever before.

The four function keys to the left of the numeric pad should be of special interest to people who use VisiCalc™. Because they let you zip around your work sheet more easily than ever, adding and deleting entries.

With one hand tied behind your back.
COMPUTER AND SOFTWARE SALE

VIC-20
(a real computer at the price of a toy)

$89.00

(when you buy 6 programs)

You get the Commodore VIC-20 computer for only $134.00 when you buy 6 tape programs on sale for only $59.00. These 6 programs list for $100.00 to $89.00. You can choose one of three packs: 6 games pack, 6 home finance pack, or 6 small business pack. The VIC-20 computer includes a full size 66 key typewriter professional keyboard, color command keys, upper/lower case, full screen editor, 16K level II microprocessor, basic, sound and music, real time, floating point decimal, etc. to read self teaching instruction book, connects to any TV, includes console case.

33K COMMODORE VIC $159.00
with 2x times more power

You get the VIC-20 computer plus we expand the total memory to 33,000 bytes to give you 2x times more programming power.

41K COMMODORE VIC $199.00
with 4x times more power

49K COMMODORE VIC $249.00
with 6x times more power

40-80 COLUMN BOARD $99.

A fantastic price breakthrough for VIC-20 owners on this most wanted accessory!! "Now you can get 40 or 60 Columns on your T.V. or Monitor Screen." Plus we add a word processor with mail merge, electronic spread sheet, time manager and terminal emulator!! These PLUS programs require only 8K RAM memory.

TRACTION FRICTION PRINTER $299.00

Comstar F/T deluxe line printer, prints 8x11 full size, single sheet, roll or fan fold paper, labels etc. 40, 66, 80, 132 columns. Impact dot matrix, bi-directional, 80 CPS.

60K MEMORY EXPANDER $60.00

Sislot — Switch selectable — Reset button — Ribbon cable. A must to get the most out of your VIC-20 computer.

VOICE SYNTHESIZER $79.00

Makes your VIC-20 talk. VOTRAX based plus features found only in $295 versions. GREAT BUY — DON'T MISS THIS SALE!!

EXECUTIVE TYPING

All Commodore 64 software programs

$197.00

(with factory rebate and software savings applied)

We have the lowest prices — call us!!

You pay only $397.00 when you order the powerfull 8K Commodore 64 computer! We pack with your computer a VIUCHER good for $100 rebate from the factory when you send in your old Atari, Mattel, Coleco electronic game or computer. This includes Sinclair, Timex, Texas Instruments, VIC-20 computers and others!! PLUS we also include a $100 software COUPON FREE that allows you to buy PROFESSIONAL SOFTWARE from the items shown in the center column of this magazine, plus pay (312) 382-5244 for best prices and best service.

PROFESSIONAL WORDPROCESSING PACKAGE

This wordprocessor is specially designed for the Commodore-64 utilizing the latest techniques. Allows powerful text editing capabilities without long hours of orientation or training. Complete cursor and backspace which is very useful. Block movement and/or duplication, line insertion and/or deletion, automatic centering, margin settings, tab settings, copy, disk or tape handling, and all printer types. Up to 99 continuous pages of text can be output to the printer. List $89.00.

COMPLETE DATABASE PACKAGE

A user friendly data base system that makes information easy to find and store. You can add, change, delete, and search for data. Print the information on a printer in any formal desired. When combined with the word processor pack you have powerful merge program that allows custom documents and personalized mailing lists. List $89.00.

COMPLETE ACCOUNTING PACKAGE

(Home or Small Business)

This general ledger program is perfect for small business as well as home. It utilizes a double entry bookkeeping system. You only need enter one transaction and the computer will handle the other. All accounts are user definable and will build for 1 year, resulting in a file of all transactions by account number, month and year to date. Each month a current monetary transactions can be viewed at any time (99 accounts 187 entries per month). With this accounting program you will be able to monitor your financial growth as well as your expenses. List $59.00.

COMMODORE-64 PROGRAMMERS REFERENCE GUIDE

This is the in-depth guide that goes into the heart of the 64. All aspects of the basic and machine language are covered. (A must for anyone wishing to program the Commodore 64). Sale $18.95.
SOLID-STATE "DISKS"

A user's hands-on experience with lightning-fast RAM memory drives

By Craig Anderton

Of the various mass storage media available for microcomputers, magnetic floppy diskettes have proved to be the most popular. However, while floppy diskettes offer large storage capacity for a relatively modest cost, they are by no means perfect. The most information an 8" diskette can store is about 1.2 megabytes—and that assumes the data is stored on both sides of the diskette, in double-density format (with single-density, the potential storage is halved). Though 1.2 megabytes is a lot of storage, for large data bases (or even for holding contents of a long book), more storage may be necessary. In recent years, the problem of the floppy diskette's limited storage has been addressed very well by the hard disk, which can store 10, 20, 30, or more megabytes of information.

Another problem associated with floppy diskettes is media wear: in other words, the more you use a diskette, the faster it deteriorates. Little pieces of oxide flake off periodically, and if this happens often enough, drop-outs in the magnetic medium can occur, thus...
interfering with the integrity of the stored data.

Still another problem is speed of operation. While floppy diskettes are hundreds of times faster than cassette interfaces, to retrieve data from a diskette (or to send data to the diskette), a head assembly must position itself over the correct section of the diskette. The diskette then rotates as the head reads (or writes) the information from various parts of the diskette. All this takes a certain amount of time, so during disk-intensive operations, the computer has to take a break while the disk system catches up. A "disk wait" or similar notice usually appears at the terminal under these conditions, and you generally need to refrain from working with the computer during disk waits. (Controllers using direct memory access or DMA techniques are faster, but still require occasional disk waits.)

A few seconds may not seem like too much time, but over the course of a few weeks, disk waits definitely add up. And during long compiles, it's not uncommon to have a disk drive whirring away for 30 minutes or more at a time.

Enter the solid-state disk drive (also called memory drive, or MD) for short. At the 1981 West Coast Computer Faire, G & G Engineering ran a CompuPro S-100 system with 1 megabyte of RAM. Shortly thereafter, they developed some software, based on a concept originated by CompuPro, which formatted the system RAM to make it look just like a disk drive to the computer. You could read to it, write to it, copy files from it to a regular floppy diskette, and generally treat it exactly like a disk drive running under the popular CP/M operating system. The advantages claimed were lower media wear, virtual elimination of the disk wait, and greatly increased speed of operation.

But the spring of 1981 was a long time ago by computer industry standards—and if the solid-state disk drive is so useful, why doesn't every computer incorporate one by now? There are two main reasons: the first is that the MD is volatile, meaning that it loses its data when power is removed. Therefore, at the end of a computing session it's necessary to copy any files you want to keep from the MD over to a standard floppy diskette or hard disk, since these mass storage devices retain their data even after power is turned off. The second reason is cost, since lots of memory costs lots of money.

The first problem can be solved by using low-power memory with battery backup to implement the MD, and as the price of CMOS memory declines, this option will become more economically attractive. The second problem is becoming less relevant as memory prices decline. So before too long, it's likely that solid-state disk drives will become available at prices that will be tempting to any microcomputer user. As a result, most computer owners will sooner or later have to face the question, does the increase in performance of the solid-state disk drive justify the cost? As we'll see, the answer depends mostly on how much you use your computer.

**Typical MD Products.** My first MD was the CompuPro "M-Drive" package. This included 128K of CMOS RAM and a modified version of CP/M (supplied on diskette) that made it possible to format the RAM to look like a floppy-disk sys-
keep the program material in RAM until the machine is turned on.

This is a form of MD that will be very popular as the use of portable computers increases.

**MD Computing Session.** First, the RAM must be formatted to look like a disk drive. This is done either manually by the operator or automatically by the computer when booted, depending on the particular model of MD.

Second, the files to be worked with must be copied from floppy diskette to the MD. I typically copy word-processing and spelling checker software, along with any text files I want to process.

Third, standard CP/M commands are used to make the MD the current drive. Applications software can then be called, and computing can begin.

Finally, when a computing session is complete, any text files are saved back over to floppy diskette.

Before continuing, I should explain a little bit about how I use my computer. Being a free-lance writer, virtually all my time at the computer is spent processing words. So, in some ways my work is not as disk-intensive as other ways of using a computer. But that doesn’t mean I don’t get a little irritated when disk waits do occur. For example, with my high-speed system, it takes about 8.5 seconds to save five pages of double-spaced text onto disk. This event usually occurs every five to ten minutes or so while writing. Thus, during the approximate hour it takes to write those five pages, I’ll have spent at least one minute in disk saves. That may not sound like much, but then consider the time it takes to jump from the beginning of a text file to somewhere else. The process of saving a piece of text, and then getting back to where I left off writing, takes about 11 seconds. This also occurs several times during the course of writing, adding up to about another minute.

Block moves also take a fair amount of time, and some instructions must be fetched from the disk. If your software displays “help” messages on the screen, these require more disk waits as they are read from the diskette. Rejustifying text often requires disk waits as well.

When you add up all of these operations, you find you can easily spend 5% or more of your time watching the disk wait message—even with a fast disk controller. What’s more, toward the end of an editing session, changes typically become smaller, where you’re simply altering a word or two here and there. It can be very frustrating to take a second or less to enter a change, and then wait much longer for the disk drive to register that change onto the diskette.

With an MD, though, these waits become a thing of the past. When I invoke my word processor, there’s no delay—no wait at all. Before you can even blink your eyes, the no-file menu is up on the screen. The only limiting factor on your system speed at this point is the transfer rate of your terminal (the rate in kilobaud), since everything in the computer happens, for all practical purposes, instantaneously.

Believe me, it takes a little while to get used to this instant response. You call up a file to edit and—it’s right there! No delay, no disk sounds, no disk wait. Save the file, and you’re right back at the begin-

message on the screen that lets you know how much of the text has been compared with its internal dictionary. With a standard disk drive, you hear the disk whirr around and watch the “percentage of text read” increase until the entire text has been proofed. With an MD, those percentages just fly by—it seems to take only a second or two to read a lengthy text file. And, you not only save time while the computer proofs, but the time required to invoke the program (and the time required to mark changes in the text file) are cut drastically. Thus, you can easily save a minute or two while proving a document, and save even more time if you need to proof it several times.

**Cost-Effectiveness.** As of this writing, the CompuPro 512K M-Drive/H lists for $1895, while the SemiDisk 512K board (which includes battery backup capability) lists for $1995 (1-megabyte model for $2995). Axlon’s Ramdisk (reviewed in this issue) is priced at $1395. Since we’re talking about a significant financial investment, the question arises whether an MD is cost-effective.

As far as I’m concerned, the real question of whether or not something is worth its cost is whether it can pay for itself. If adding some-

You spend 5% of time watching the disk wait message.

thing to a computer saves you enough time to justify the cost of the addition, it’s worth investigating. For example, since using an MD saves about 5% to 10% of each hour, and if your time is worth $50 an hour, that translates to a savings of about $3 to $4 per hour. Thus, in 500 hours of operation the MD essentially pays for itself. Note that 500 hours isn’t that much when you spend four to five hours daily in front of a computer (around four
months of operation, in my case). For those who use lots of disk-intensive operations, the time (and money) savings would be that much more substantial.

Once you have a solid-state drive, you begin to understand how those seconds tend to add up—especially when you don’t have to watch them adding up any more! Of course, you do have to spend some time doing things you normally wouldn’t have to do with a floppy diskette (formatting the memory, saving on to disk at the end of a session), but that amount of time, compared to the overall amount of time saved, is negligible.

Media wear is also a consideration. I have noticed that my pre-MD diskettes look a lot newer than my post-MD diskettes.

Finally, there’s something psychologically satisfying about not having to wait for the computer. Computers should be transparent. When you say “save,” it should save, not say “Let’s see now . . . flash the disk wait message on the screen . . . just a moment here . . . let me position my head . . . okay, there we go . . . all right now, back to work.” The less interference there is between operator and machine, the better.

To this author, the solid-state disk drive is definitely the wave of the future. It’s probably only a matter of time before most computers have some kind of solid-state disk drive, if for no other reason than that memory costs are going to drop faster than disk drive costs. In the meantime, if you thought the MD was too expensive to justify, think again. I was amazed at how many seconds an MD can save, and how fast those “few” seconds add up. In fact, it’s entirely possible that your business application can’t afford not to have a solid-state disk drive.

---

**2. A hard look at Axlon’s Ramdisk 320**

By Alexander Marx

The Ramdisk 320" is a new product for the Apple computer from Axlon, Inc. (170 Wolfe Rd., Sunnyvale, CA 94086), a manufacturer of products for the Apple computer for several years. The Ramdisk 320 uses solid-state memory to emulate a disk drive. Since this eliminates any mechanical or moving parts, the speed of doing any disk operations is dramatically increased. There are also no floppy diskettes and reliability is thereby improved.

**General Description.** The Ramdisk includes a box about the size of a standard Apple disk drive, painted to match the Apple's color scheme. This small package contains 40 64K memory ICs and provides 327,680 bytes of RAM (320K bytes of user memory). It also contains a battery backup system to protect memory against blackouts or brownouts. The battery, which is automatically recharged when the Ramdisk is on, will supply power for about three hours. A memory interface card with controller chips and a static RAM connects the system to the Apple.

The memory is configured to look like two conventional Apple disk drives. There are some differences, however. An Apple drive is divided into 35 tracks. (A track is like a record groove, as you know, but is laid out in concentric circle rather than in one long spiral.) Each track is divided into 16 sectors (in DOS 3.2 there are only 13 sectors) and each sector can hold 256 bytes of data.

The Ramdisk is set up the same as a disk drive except that there are 40 tracks. The capacities of the Ramdisk and the Apple disk drive are compared in Table I. The Ramdisk system normally allows use of just 35 of the 40 tracks. This is to maintain compatibility with Apple's DOS. A utility program is supplied, however, to permit use of the extra space.

A three-ring binder contains a 63-page manual and two floppy disks. One disk is for normal BASIC use on an Apple with DOS 3.3. The other disk contains programs to allow an Apple Pascal system to interface with the Ramdisk.

Included on the standard disk are two limited-data-base programs. One is a small directory program and the other is a small file-card-type program. Each program has its own separate manual, which is included in the binder.
The Ramdisk requires the following equipment:
- Apple II or Apple II +.
- Apple Disk II with controller.
- Apple DOS 3.3.

The Ramdisk can be used with only one disk drive in the system. A second disk drive is required only if Pascal is being run.

Installation of the Ramdisk System Interface is straightforward and is outlined in the manual. The instructions, however, may be too technical for the neophyte. In this case, a person unfamiliar with the ways of the Apple slots would be wise to seek the assistance of someone who is.

The card installs in slot 4, and the cable, which has been connected to the card at the factory, is lead out the back of the Apple. The controller for the normal Apple drive or drives remains in slot 6. After the initial setup, however, the Ramdisk can be configured to go in any slot, including 6.

The entire Ramdisk system, including the interface card, is powered from the Ramdisk’s main unit, which is plugged into a standard ac outlet. There are instructions in the manual for converting the system to 220 V ac. A small slide switch in the back of the Ramdisk turns on the power for the unit.

On the front panel there are five LEDs (three on the left and two on the right) to show the status of the system at all times. On the left, the LEDs are labeled POWER (to indicate when the power is on), BATTERY (ostensibly to indicate when the battery is switched on), and CHARGE (to show that the battery is being charged). On the right, the lights are labeled 1 IN USE and 2 IN USE, to indicate which drive is being accessed. These are similar to the IN USE lights on the standard Apple drives.

To initialize the Ramdisk, the System Disk is inserted in the Apple drive connected to slot 6 and booted. This, in turn, loads a modified DOS into the Apple and copies the entire disk (including DOS) into drive 1 on the Ramdisk. The user is then asked if he wants to initialize the second drive on the Ramdisk.

The Ramdisk is now active and can be used as a pair of normal disk drives.

**Operation.** The Ramdisk card normally is installed in slot 4 and is accessed by using the standard DOS commands. DOS can be booted from the Ramdisk by typing PR #4.

Running some simple benchmarks on the system showed the Ramdisk to be unbelievably fast in certain disk operations, but it also has some marginal differences in other ways. Commands like CATALOG, DELETE, LOCK, and UNLOCK are so fast as to appear to be instantaneous. The speed even rivals a hard disk.

I timed how long it took to LOAD and SAVE a 51-sector BASIC (approximately 13K bytes) and a 51-sector binary file. Table II gives the results for the BASIC files. Times for the binary file were almost the same.

There is a 3-to-1 speed difference with the Ramdisk. I took advantage of this speed to assemble some long programs with an Apple Toolkit Assembler, which uses the disks extensively. I was very pleased with the high speed at which the assembly took place.

Running benchmarks with data files, though, was a different story. I ran both random access and sequential file timings and found that the speeds were not as different as they were in LOAD and SAVE. My programs wrote 1000 records to the disk and then read them back into the Apple. The time differences between reading and writing were negligible as shown in Table III. The ratio in both cases is close to 1.2 to 1, less than half the speed advantage of the other operations. The manual observes that the sequential file operations would be slow and it gives a demonstration program using a fast loader program supplied on the System Disk. Using the fast loader yielded a read time of 2 seconds for 1000 sequential records. That’s correct, 2 seconds!

**The Software.** The software supplied on the Ramdisk DOS System Master diskette provides several utilities to make it more useful. The Select utility permits modifying the Ramdisk operating system so that it can automatically transfer files from a floppy disk onto the Ramdisk upon booting. To create a turnkey disk, it is necessary to place a binary file on a disk called “Ramdisk.” When this program is BRUN, it connects the Ramdisk to the Apple’s DOS. Otherwise DOS will not recognize the Ramdisk.

Other utilities permit testing the Ramdisk’s memory either a byte at a time or at the sector level.
If the user has the programming skills, the Extra40K utility gives five extra tracks on each drive (an extra 20K per drive). The utility does not provide standard access to the extra memory, but requires that the user be able to specify the area of memory to save and the location in the extra space to be used. This might be useful to those doing custom programming, but is fairly useless in general.

When the Apple’s DOS is modified to accept the Ramdisk system, it also gets some added functions. These include one that will copy an entire disk form, either the Ramdisk to a floppy or vice versa. It can be called from BASIC by typing “&C” or CALL 1013. The slot and drives for each device can then be specified and the utility runs quickly through the disk. This function is available off the Ramdisk System Disk with full prompting under the name RDCOPY. But the version in DOS could be used in a user-written program.

Another built-in function is the ability to toggle the Ramdisk DOS on and off. This is useful in initializing a floppy without having it contain the Ramdisk modified DOS.

The other two useful programs on the System Master are the Directory and the Mini-Base Phone Book. The former permits storing, retrieving, and sorting over 3200 records. The system works at lightning speed and can find any record in about two seconds. The system could be easily used as a replacement for a rotary type of card file in a small office. What’s more, the system can print and sort the entries. The sorting works very well and is also very fast.

An entry can be searched by doing an exact match on a given field or by using wild cards to make broad matches. On exiting the system, the program provides the option of saving the files onto a floppy disk for backup. The system can also be set to boot from floppies and load both the program and the data into the Ramdisk.

The program is limited, though, not only by its capacity, but also because the fields are preset and not really changeable. Moreover, the entry is filed by the first letter of the first field. These “groups” are fixed at a pre-defined number. That is, “A” can have 128 entries, while “J” can only have 84.

The Mini-Base Phone Book is a similar program. It provides features such as report generation and the ability to use multiple files. However, the records are limited to six fields and 200 records per file. Up to five files can be stored on a disk. This program seems to be better suited as an example of how to use the features of Ramdisk. A tutorial is even provided on how the program works with a function-by-function breakdown.

A second disk is supplied to allow the Ramdisk to interface with Pascal. Since I am not overly fluent in Pascal, I did not do much timing of the Ramdisk using this language. In fact, the manual does not really go beyond installing the drivers needed to have Pascal access the Ramdisk. The Pascal disk contains a program that’s menu-driven. This makes it fairly simple to modify disks for Ramdisk operation. Some quick checks indicated that the Pascal system also gained the same benefits as the DOS 3.3 system.

Although the Ramdisk performed flawlessly and even better than expected, I found one large defect in the whole system. It isn’t a fault in the Ramdisk or its software—rather in what it might be used for. A perfect use would be storing large electronic spreadsheet files (such as Visicalc). Unfortunately, this can’t even be attempted. Visicalc is sold as a “protected” program, which means that not only can’t it be copied, it can’t be modified. As Visicalc loads its own DOS into memory, it clobbers the Ramdisk DOS. Since the Visicalc DOS can’t be modified to accept the Ramdisk, it sits idly by. The only way to use protected programs on the Ramdisk is to make an unprotected copy or use a hardware copy device.

Conclusions. I found the Ramdisk to be a well-engineered product as well as one that functioned flawlessly. Using the Ramdisk on a few programs that were very slow because they were disk bound, like my assembler, convinced me that the product has genuine value. For the first time, I enjoyed writing and assembling programs, knowing that the Ramdisk would make it run like greased lightning without a lot of disk waiting time.

The software supplied with the system performed well and was generally user friendly.

The manual was not completely satisfactory, though. I felt that it was on the skimpy side in many places, like the Pascal section, and bogged down in others. The manual does have good points. It includes information on interfacing the Ramdisk into DOS, what memory locations it uses, and program listing of some of the utilities supplied. It’s also largely written in English rather than the Canonicalese that is used in so many of today’s instruction manuals.

The Axlon Ramdisk’s suggested retail price ($1395) puts it near the range of a 5-megabyte Winchester hard disk. This may make it seem expensive, especially since it has only 320K, but there are no worries about head crashes and data loss trying to back up 5 megabytes of hard disk onto 36 floppies. A personal complaint of mine is not with the Ramdisk but with today’s software, which won’t recognize the Ramdisk (or a hard disk) or allow easy modification to do so. I can only hope that the software authors will at least allow the option of using a Ramdisk.

In conclusion, if I were writing assembly language programs for a living, I certainly would feel more than justified in investing in the Ramdisk, which is an excellent product. The same would be true in using or writing software that can be easily modified to accept Ramdisk.
GUARD PRECIOUS COMPONENTS from Overload Damage

A single IC provides extra protection for a variety of electronic circuit devices

By Harold Wright

VOLTAGE regulators such as those used in many electronic circuits require a much higher source voltage than what they deliver as a regulated output. If such a regulator fails, it is quite possible that its output will increase to a disastrously high voltage for the components it is supplying. For in-
stance, such components as the Intersil 7107 V/F converter is rated to operate normally at ±5 V, with ±6 V being an absolute maximum. Thus, if the power supply fails and the voltage rises above the maximum, this expensive chip will be destroyed. Consequently, it is advisable to check the spec sheets of the ICs you are using. Then check your power supply; and, if necessary, provide some means of overvoltage protection.

Very few experimenter circuits (and not much commercial equipment) have overvoltage protection; and except for having fuses, not many automotive electronic items are protected in this manner. The overvoltage protection schemes shown in this article can be applied to existing (or planned) circuits and will work with both line-powered and mobile equipment, including those operating from the vehicle battery/alternator system.

The circuits to be discussed are designed around the MC3423 Overvoltage Protector (OVP). The basic circuit, used for power supplies between 4.5 and 36 V, is shown in Fig. 1A. When IC1 is triggered through pin 2, pin 8 goes high. This triggers SCR1 through resistor Rg. The SCR then acts as a short circuit across the power supply, causing the fuse to blow and remove power from the load. This approach is called a "crowbar."

The trigger level is determined by the ratio of R1 to R2. As shown in Fig. 1B, R2 is fixed at 2.7 kilohms and the value of R1 can be scaled from the graph. To permit precise adjustment of the trip point, R1 can be divided into two components—one a fixed resistor and the other a multi-turn trimmer potentiometer. The total value of the fixed resistor and half the value of the trimmer potentiometer add up to the value of R1 as determined by Fig. 1B. Thus, the trimmer potentiometer can be set slightly above or below the desired trip point. To protect a 5-V TTL supply, for example, make the variable trimmer 1 kilohm and the fixed portion 3.3 kilohms. Set the trip point to 6 V, a safe value for TTL.

No type number is given for SCR1, since it depends on the value of the protective fuse, FL. Select an SCR whose turn-on current exceeds the value of the fuse so that, when the SCR is turned on, it will take sufficient current to blow FL. Gate-current limiting resistor, Rg, is selected by the graph in Fig. 2A. For voltages below 11 V, omit Rg.

To avoid tripping the protector when line transients occur, pins 3 and 4 (connected together as shown in Fig. 1A) can be connected to the negative (common) line through a bypass capacitor (C1). This sets the minimum duration of overvoltage allowed before IC1 triggers. When the voltage rises above the trip point, C1 starts to charge. If the voltage is transient and is over be-
"I built this 16-bit computer and saved money. Learned a lot, too."

Save now by building the Heathkit H-100 yourself. Save later because your computer investment won't become obsolete for many years to come.

Save by building it yourself. You can save hundreds of dollars over assembled prices when you choose the new H-100 16-Bit/8-Bit Computer Kit — money you can use to buy the peripherals and software of your choice.

- **USER MEMORY:** 128K-768K bytes
- **MICROPROCESSORS:** 16-bit: 8088, 8-bit: 8085
- **DISK STORAGE:** Built-in standard 5.25" disk drive, 320K bytes/disc
- **KEYBOARD:** Typewriter-style, 108 keys, 13 function keys, 18-key numeric pad
- **GRAPHICS:** Always in graphics mode, 640×225v resolution; up to eight colors are available
- **COMMUNICATIONS:** Two RS-232C Serial Interface Ports and one parallel port

**H-100 SERIES COMPUTER SPECIFICATIONS:**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>USER MEMORY:</strong></td>
<td>128K-768K bytes</td>
</tr>
<tr>
<td><strong>MICROPROCESSORS:</strong></td>
<td>16-bit: 8088, 8-bit: 8085</td>
</tr>
<tr>
<td><strong>DISK STORAGE:</strong></td>
<td>Built-in standard 5.25&quot; disk drive, 320K bytes/disc</td>
</tr>
<tr>
<td><strong>KEYBOARD:</strong></td>
<td>Typewriter-style, 108 keys, 13 function keys, 18-key numeric pad</td>
</tr>
<tr>
<td><strong>GRAPHICS:</strong></td>
<td>Always in graphics mode, 640×225v resolution; up to eight colors are available</td>
</tr>
<tr>
<td><strong>COMMUNICATIONS:</strong></td>
<td>Two RS-232C Serial Interface Ports and one parallel port</td>
</tr>
</tbody>
</table>

The H-100 is easy to build — the step-by-step Heathkit manual shows you how. And every step of the way, you have our pledge — "We won't let you fail." Help is as close as your phone, or the nearest Heathkit Electronic Center.

And what better way to learn state-of-the-art computing techniques than to build the world's only 16-bit/8-bit computer kit? To run today's higher-speed, higher-performance 16-bit software, you need an H-100. It makes a big difference by processing more data faster.

Dual microprocessors for power and compatibility. The H-100 handles both high-performance 16-bit software and most current Heath/Zenith 8-bit software.

Want room to grow? The H-100's standard 128K byte Random Access Memory complement can be expanded to 768K bytes — compared to a 64K standard for many desktop computers.

And the industry-standard S-100 card slots support memory expansion and additional peripheral devices, increasing future upgradeability of the H-100.

High-capacity disk storage, too. The H-100's 5.25" floppy disk drive can store 320K bytes on a single disk. The computer also supports an optional second 5.25" and external 8" floppy disk drives. And an optional internal Winchester disk drive will be available soon.

For more information, circle the reader service number below. Better yet, visit your Heathkit Electronic Center for a demonstration!

The H-100 gives me the most for my computer dollar!
If you have put off learning more electronics for any of these reasons, act now!

☐ I don’t have the time.

☐ High school was hard for me and electronics sounds like it may be hard to learn.

☐ I can’t afford any more education.

☐ I have a family now.

☐ I’m here. You’re there. I’ve never learned that way before. I’m not sure it will work for me.

Read the opposite page and see how you can get started today!
Be honest with yourself. Are the reasons really excuses? You already know enough about electronics to be interested in reading this magazine. So why not learn more? If you need encouragement, read on and see how excuses can be turned into results.

You don't have the time. Be realistic. All you have in life is a period of time. Use it. Try to know more tomorrow than you do today. That's the proven way to success. CIE studies require just about 12 hours of your time a week, two hours a day. You probably do have the time.

Electronics sounds like it may be hard to learn. You already know something about electronics or you wouldn't be reading this. Now, build on that. CIE Auto-Programmed® Lessons help you learn. Topics are presented in simple, logical sequence. All text is clear and concise for quick, easy understanding. You learn step by step, at your own pace. No classes to attend. Nobody pressures you. You can learn.

You can't afford any more education. Actually, you can't afford NOT to gain the skills that can put you ahead of the others. You know what inflation is doing to you now. Education—learning a skill—is an inflation-fighter that can be yours. If you are not able to pay full tuition now, CIE will lend you funds on a monthly payment plan.

You have a family now. All the more reason why you have the responsibility to advance yourself. For the sake of your family. Do you want them to have what you had or have more than you had? The choice is yours. Electronics is a rewarding career choice. CIE can help you to get started on that career.

You're there. We're here. How does CIE help you learn? First, we want you to succeed. You may study at home, but you are not alone. When you have a question about a lesson, a postage stamp gets you your answer fast. You may find this even better than having a classroom teacher. CIE understands people need to learn at their own pace. When CIE receives your completed lesson before noon any day of the week, it will be graded and mailed back the same day with appropriate instructional help. Your satisfaction with your progress comes by return mail. That's how CIE helps you learn.

NOW, IF YOU AGREE CIE TRAINING CAN WORK FOR YOU, HOW ELSE CAN CIE HELP YOU?

Cleveland Institute of Electronics is the largest independent home study school in the world that specializes exclusively in electronics. Although "big" does not always mean "best," it is evidence that CIE is a strong, successful institution with the people and resources to help you succeed.

Step-by-step learning includes "hands-on" training.

The kind of professional you want to be needs more than theory. That's why some of our courses include the Personal Training Laboratory, which helps you put lesson theory into actual practice. Other courses train you to use tools of the trade such as a 5MHz triggered-sweep, solid-state oscilloscope you build yourself—and use to practice troubleshooting. Or a Digital Learning Laboratory to let you apply the digital theory that's essential today for anyone who wants to keep pace with electronics in the eighties.

Your FCC License can impress employers.

For some electronics jobs, you must have your FCC License. For others, employers usually consider it a mark in your favor. Either way, your License is government-certified proof of your knowledge and skills. More than half of CIE's courses prepare you to pass this exam. Surveys show that some 80% of CIE graduates who take the exam are successful.

Find out more! Today, Now.

There's a card with this ad. Fill it in and return. If some other ambitious person has already removed it, use the coupon. You'll get a copy of CIE's free school catalog, along with a complete package of personal home study information.

For your convenience, we'll try to arrange for a CIE representative to contact you to answer any questions you may have.

If you are serious about a rewarding career, about learning electronics or building on your present skills, your best bet is to go with the electronics specialists—CIE. Mail the card or coupon today or write CIE (please mention the name and date of this magazine), 1776 East 17th Street, Cleveland, Ohio 44114.

This could be the best decision you've made all year.

Associate Degree

Now, CIE offers an Associate in Applied Science Degree in Electronics Engineering Technology. In fact, all or most of every CIE Career Course is directly creditable towards the Associate Degree.

"If you're going to learn electronics, you might as well learn it right!"

John Cunningham
Senior Technical Director

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 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 ______ Phone (area code) ______

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

MAIL TODAY!
...OVERVOLTAGE

fore the capacitor charges, IC1 does not trip. Figure 2B shows the relationship between the value of C1 and the duration of the delay. For example, with a value of 0.01 μF, the delay is 0.1 millisecond. The partial circuit shown in Fig. 3 is a modification that does not blow fuses. Instead, when turned on, the SCR operates relay K1 to remove power from the load. Diode D1 protects the SCR from the back emf generated when the coil inductance is removed from the circuit. Capacitor C2 reduces sparking at the relay contacts when they open, thus improving relay life.

If a two-pole relay is used, the second pole can provide power to a LED or operate a warming device such as a Sonalert. Resistor R3 is selected for safe LED current.

To protect a negative power supply, use the circuit shown in Fig. 4, an inverted version of Fig. 1A.

Both sides of a dual supply can be protected by the circuit shown in Fig. 5. In a ±5-V supply, the total voltage across the two outputs is 10 V. Any increase in voltage in either side of the supply (such as the negative voltage becoming more negative or the positive more positive) will increase the total voltage across R1/R2 and IC1. If IC1 is set to trip at 11 V, then a negative increase to -6 V or a positive increase to +6 V will cause triggering. When IC1 triggers, pin 8 goes high relative to both ground (common) and the negative side of the supply. It will reach a voltage slightly less than half the tripping level when referenced to the common. In a dual ±5-V supply set to trip at 11 volts, pin 8 would reach a high of about 5.5 V to ground. This is enough to trip the SCR. The voltage across the SCR load can be used to operate a relay to shut down the power.

If an inhibiting high signal is needed from a negative output supply, use the circuit shown in Fig. 6.

Note that an opto-coupler is used as the load instead of the SCR. Before IC1 triggers, pin 8 is negative with respect to ground and when IC1 triggers, pin 8 drops to ground. When this occurs, the LED in the opto-coupler is properly biased and turns on. Resistor R3 limits the LED current to the required value. The other side of the opto-coupler is connected between an external positive supply and ground through R4. When the LED glows, a high will be present across R4 and it can be used for inhibiting purposes.

Mobile Use. Much expensive electronic equipment is used in vehicles and boats. These also require protection. One of the problems can be

The Safe Video Head Cleaner is Dry.

Yes, dry!
The Discwasher® Video Head Cleaner is the only truly nonabrasive dry head cleaner on the market today.

Its superior cleaning action is the result of its textured fabric matrix, not the result of abrasive properties (like those often utilized in aluminum oxide cleaners). This exclusive matrix safely cleans not only the video heads, but the audio and sync heads as well.
The Discwasher Video Head Cleaner is less abrasive than both the video head and video drum. In fact, it's even less abrasive than video tapes themselves. And best of all...it works. Easily, safely, and quickly.

The graph below represents approximate hardness ratings of individual VCR components and various tapes and cleaners using the Temper scale, developed by industry to measure materials. A diamond, one of the hardest materials known, rates T-10.

![Graph representing hardness ratings of VCR components and tapes](image)

The graph below represents approximate hardness ratings of individual VCR components and various tapes and cleaners using the Temper scale, developed by industry to measure materials. A diamond, one of the hardest materials known, rates T-10.

![Graph representing hardness ratings of VCR components and tapes](image)

![A diagram showing the circuit to remove power from the load and sound an alarm](image)

![A diagram showing the circuit instead of Fig. 1A for a negative supply](image)
the load and activate the alarm.

Since mobile systems tend to have more voltage transients than power-line systems, if a number of false alarms are encountered (system shutting down often), the value of $C_1$ must be increased. However, excessive tripping may indicate that the vehicle electrical system needs cleaning up. Sparking brushes in alternators, windshield wipers, bilge pumps, blower motors, etc. can be the main culprits.

The optional GE MOV varistor transient protector for 15 V will catch most transients, while the MC3423 circuit will catch the rest. The normally closed reset switch is used to reset the SCR after trip (if the fuse does not blow) and should not be held open for any reason, otherwise the damaging voltage can get to the load.

If you want to have only a transient monitor, remove the circuit coming from pin 8. Internally, IC1 has an uncommitted npn transistor collector tied to pin 6; and, when IC1 trips, this transistor turns on. You can connect a LED and current-limiting resistor (shown dotted in Fig. 7) to this pin.

For voltages higher than 36 V, Motorola recommends the following SCRs: for 50 V—2N6504; 100 V—2N6505; 200 V—2N6506; 400 V—2N6507; 600 V—2N6508; and 800 V—2N6509. Either an MC3523 or MC3423 can be used for IC1, if it is powered from a zener-regulated 10-V source (Fig. 8).

**Switching Supplies.** The protection circuit can also be used with pulse-width modulated switching power supplies. Most of these are provided with an inhibit input that shuts the supply down when a high is applied.

A protection circuit, such as those shown here, can be connected to each output of a switching supply. Each output from the various protection circuits can be applied to a diode-OR circuit, such as that shown in Fig. 9, with the OR driving an SCR gate. When the SCR triggers on, the voltage developed across its load resistor is applied to the inhibit input of the control chip of the switching supply, thus shutting it down.
IN THIS CORNER...

The battle for supremacy among very-low-cost microcomputers heats up as Texas Instruments’ 99/2 goes head to head with the Timex Sinclair 1000; and the TS2000 and Mattel’s Aquarius square off against the Commodore VIC-20 and the TI 99/4A
By Joe Desposito

The microcomputer world, much like the boxing world, has champs and contenders at all different levels. Lately there has been fierce competition at the low end of the microcomputer spectrum with current champs such as the Timex Sinclair 1000, Commodore VIC-20, and Texas Instruments 99/4A facing stern competition from a host of new challengers. Very-low-cost micros can be conveniently classed into two groups: those that cost less than $100 (we'll call them featherweights) and those that cost between $100 and $200 (we'll call them lightweights). Let's review the champs of each of these divisions here and take a close, hard look at the new contenders.

(Continued overleaf)
Featherweight

The clash for the microcomputer "featherweight" crown promises to provide as much excitement as a title bout at Caesar's Palace. The reigning champ, trained in Britain for more than a year before arriving in the States, is the Timex Sinclair 1000 (formerly competing as the ZX81). Although it has some drawbacks, this scrappy performer is the undisputed champ of its division. And undisputed it is, not lightly here. Until recently there has not been one challenger in the featherweight (under $100) class.

But a formidable challenger has arrived. Known in some circles as the "Great White Hope" because of its cream-colored appearance, the 99/2 from Texas Instruments seems to have everything it takes to dethrone the current champ. It is bigger, faster, classier looking, and (thank goodness) has a keyboard with movable keys. These obvious strengths, however, do not guarantee success. Sometimes it takes more than impressive stats to become a champ. Sometimes intangibles like guts or heart make the champion (witness Rocky Balboa's comeback win over Clubber Lang).

What are the intangibles the older TS1000 has going for it? First off, this computer is an open book—for a long time it could be bought as a kit under its former name. With so many fans knowing the ins and outs of its makeup, the wealth of support it receives from outside suppliers is not surprising. Peripherals available for use with it include such devices as printers, memory expansion modules, and modems. Keyboards for the TS1000 are being sold to correct its major deficiency, the membrane keyboard. Thousands of business programs, educational programs, and games have been written for the TS1000. Even additional languages such as Forth and Assembler are available through third-party vendors. This humble number cruncher even has a magazine named Sync devoted to it. Another point in the TS1000's favor is that it has been the champion for a long time. People are used to it; they love it. On top of all this, it has a secret weapon in its arsenal (which we'll reveal later on in this article).

But enough about the champ, what about the challenger, the TI 99/2? As we said before, this newcomer is impressive looking. It's substantially bigger than the TS1000, measuring in at 10" × 9½" × 1½".

Its elastomeric keyboard sports 48 pushbutton-type keys in a standard typewriter format. Listed above the keyboard are nine functions. To engage one, the ICTN (function) key plus a key on the top row just below the desired function label must be pressed. The 99/2 only uses upper-case letters and each key has no more than two legends (whereas the TS1000 uses up to five legends on one key). There is a built-in fm-modulator so that the 99/2 can be hooked right to the TV.

The basic unit comes with 4.2K of user RAM. This can be expanded to 36.2K by plugging in extra RAM housed in "cradles" that hold the RAM chips and permit additional cartridges to "piggy-back" on the RAM cradle. The operating system and program are contained in 32K of ROM, of which 24K is in the permanent memory map. The remaining 8K bytes are bank switched to preserve a 32K-byte expansion port capability.

As with most other TI computers, the microprocessor is part of the 9900 family. It's the 16-bit TMS9905 that has a 10.7-MHz clock—mighty fast for this class—and DMA (direct memory access) video processing. The 99/2 has a flicker-free black-and-white display of 27 characters by 24 lines (whereas the TS1000 still flickers in the slow mode). The 99/2 is designed with an operating system that is a subset of TI-BASIC but the system does not support GROMs (Graphics Read Only Memory) or GROM programming language, joysticks, color, sound, or speech (as the

Timex Sinclair 2040 printer works with either TS1000 or TS2000.
FEATHERWEIGHTS AT A GLANCE

<table>
<thead>
<tr>
<th>Microprocessor</th>
<th>Timex Sinclair 1000</th>
<th>Texas Instruments 99/2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z80A (3.5 MHz, 8 bits)</td>
<td>Sinclair BASIC</td>
<td>TMS 9995 (10.7 MHz, 16 bits)</td>
</tr>
<tr>
<td>Resident language</td>
<td></td>
<td>TI BASIC subset</td>
</tr>
<tr>
<td>Memory: ROM</td>
<td>8K</td>
<td>32K</td>
</tr>
<tr>
<td>RAM (Std)</td>
<td>2K</td>
<td>4.2K</td>
</tr>
<tr>
<td>RAM (Exp)</td>
<td>64K</td>
<td>36.2K</td>
</tr>
<tr>
<td>Text display</td>
<td>32 char. × 24 lines</td>
<td>28 char. × 24 lines</td>
</tr>
<tr>
<td>Keyboard</td>
<td>40 keys (membrane)</td>
<td>48 keys (elastomeric, movable)</td>
</tr>
<tr>
<td>Dimensions</td>
<td>6½&quot; × 6&quot; × 1½&quot;</td>
<td>10&quot; × 9½&quot; × 1½&quot;</td>
</tr>
<tr>
<td>Weight</td>
<td>12 oz</td>
<td>33 oz</td>
</tr>
</tbody>
</table>

99/4A does). You may have guessed by now that any program written for the 99/2 is compatible with its big brother, the popular 99/4A. However, this is only one way street as software for the big guy won't return the favor.

At the rear of the 99/2 is a port that will accept solid-state software cartridges (not compatible with the 99/4A). But so far there's very little in the way of this kind of support. This port does have a great deal of significance, however. It is the spot where the real power of this featherweight will be displayed.

The 99/2 has a team available for the expansion port that is ultra-sophisticated. This team, known as the HEX-BUS peripherals, will surely be the envy of anyone who owns a computer in this class. Let's take a closer look at this HEX-BUS group, as it may be the key factor in establishing the 99/2 as king of the featherweight class.

First there is the Wafertape Drive. Of course, the 99/2 can save to a standard cassette recorder, but the Wafertape adds finesse to the operation. This digital tape drive unit uses continuous-loop tape cartridges that store up to 48K. An ordinary cassette recorder cannot move the tape back and forth and, therefore, it is difficult to use this type of recorder for a true computer-file system. The Wafertape, using a continuous loop, can employ a real tape file system with all the programs on the tape listed in a directory. The tape can then be moved to locate any of the named program files. The tape must first be initialized just like a diskette, so the Wafertape system can be thought of as a "stringy floppy." This system is somewhat slower than a floppy disk, but it is much better than the ordinary cassette tape system used in most home computers. A 4K-byte program can be loaded fast—about 10 seconds.

Another power-packed peripheral is a four-color printer/plotter. Ten different type sizes are available, with print speeds up to 11 characters per second. Printing is done on 2¼" paper in either red, blue, green or black.

An RS232 communications interface rounds out the HEX-BUS group. With this handy peripheral, you can interface the 99/2 to an 80-column printer. It also allows you to hook up a modem for communications with real heavyweight computers like those used by CompuServe.

In all fairness we must mention that HEX-BUS support doesn't come cheap. Suggested retail prices for the peripherals are: Wafertape, $139.95; Printer/Plotter, $199.95; and RS232 interface, $99.95 (with parallel interface option, $124.95). But still, the support is there if desired.

What's our opinion of the challenger's chances? At first glance, the 99/2 is certainly impressive. But will it suffer the same fate as the 99/4A, which gets software and hardware support almost exclusively from the parent company? (No cottage industry has blossomed here.) It took many years and many price reductions before the 99/4A was embraced by the general public. Will anyone try to take the 99/2 apart and have some fun with it? A polished featherweight can tarnish quickly waiting in the locker room (inside the locker?) for something exciting to do.

Another factor that has to be considered is the current champ's secret weapon. What is it? The TS1000 has the awesome power to shed price almost at will. At the beginning of 1983, a $15 rebate was announced, evidence enough of this raw power. But then in mid-March, the champ plummeted from $99.95 to $69.95, and kept the rebate going, too. What all this means is that the champ may eventually establish a new class—a "flyweight" division at less than $50. Can TI's 99/2 meet this challenge? Our guess is that the 99/2 has enough class to make a strong showing, but not enough to dethrone the champ. But this will also be influenced by promotional money behind it.

Lightweight

The "lightweight" division (between $100 and $200) has just two brawlers during 1982, the Commodore VIC-20 and Texas Instruments 99/4A. The Commodore VIC-20 is a true champion that offers a real moving-key keyboard, excellent memory-expansion capability, a host of low-cost peripherals, and a vast library of programs on cartridges, tapes, and disks. The VIC-20's price has shrunk to less than $140 in some stores, a value that is hard to beat. Last year the Commodore management wanted to replace VIC with a new entry in its stable named MAX. However, the public would not stand for it; and now it is learned that MAX will only appear in Far East events.

The 99/4A from Texas Instruments originally sold for more than $1000. The machine has been improved, and the price lowered to less than $150 by eliminating the color monitor and utilizing mass production. The 99/4A offers an upward expansion path to a full disk system and a vast library of cartridges containing programs and additional memory.

It had been hoped that the VIC-20 and TI 99/4A would battle it out so that we would have a clear champion. Now there are two major newcomers to the class that promise to give the leaders a real run for the money. On one hand, we have the Timex Sinclair 2000 (called Spectrum in Europe), a British challenger, kins to the TS1000 (featherweight

June 1983
champ). As was the case with its predecessor, the TS2000 has spent over a year training in England for its American debut. On the other hand, we have a homegrown product out of Hawthorne, California, with the jazzy moniker, Aquarius. It arrives on the scene as a virtual unknown to the microcomputer fraternity, but is backed by the powerful Mattel Electronics family. Both entrants are highly regarded and appear genuine threats to ascend to division supremacy. Let's examine each one's qualifications.

**Timex Sinclair 2000.** Like Inge-Mar Johansen, the Swede with the knockout right, the TS2000 arrives on these shores packing "thunder and lightning" in the form of a 48K RAM memory standard for the $199.95 suggested list price. This is at least 32K more than other computers in this class offer in their standard package. This is just the beginning of a set of statistics so impressive that you'll think this computer is a ringer for sure.

Talk about color and it's there. Blue, red, magenta, green, cyan, yellow, white, and black are available for foreground, background, and border areas at the press of a single key. Talk about sound and you've got that, too. An internal loudspeaker can emit 130 semitones (10 octaves) using a BEEP command. Since pitch and duration can be varied, selections such as "Rocky's Theme" can be composed at the keyboard. You can even run the sound to an external amplifier/speaker from jacks at the rear of the unit.

The machine is compact, measuring 9 1/8" X 5 5/8" X 1 3/4". This is attributable to the TS2000's elegant 14-chip design. Besides the 48K RAM, there is a 16K ROM that contains the operating system and a BASIC interpreter. The extended BASIC has a unique syntax check-and-report feature that identifies mistakes instantly. The heart of the TS2000 is the Z80A microprocessor running at 3.5 MHz.

The keyboard features 40 rubber pushbutton keys in a standard typewriter format. But you'll need some fancy footwork (fingerwork?) to hit all the options available here. Each key provides at least five functions, while six keys provide six each. All BASIC keywords can be entered with a single keystroke; and, in addition, there are 16 graphics characters, 22 color control codes, and 21 user-definable graphics characters. Both upper- and lower-case letters are supported, and all keys feature auto repeat. A close look at this intricate keyboard will give the ringsider an indication of the championship quality of this computer.

The TS2000 has a memory-mapped video display of 256 X 192 pixels, giving quality high-resolution graphics. The text display is 24 lines of 32 characters. Both can be freely mixed on the screen. Graphics commands such as point, line, and circle are available at the touch of a key. Editing functions such as cursor left, cursor right, insert, and delete are available for the program line currently being edited. This line(s) normally resides at the bottom two lines of the 24-line display.

---

**LIGHTWEIGHTS AT A GLANCE**

<table>
<thead>
<tr>
<th>Microprocessor</th>
<th>Resident language</th>
<th>Memory: ROM (Std)</th>
<th>RAM (Exp)</th>
<th>Display: Text HiRes Graphics</th>
<th>Keyboard</th>
<th>Colors Sound</th>
<th>Dimensions</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commodore VIC-20</strong></td>
<td>6502A (2 MHz, 8 bit)</td>
<td>Microsoft BASIC</td>
<td>20K</td>
<td>22 char. X 23 lines</td>
<td>176 X 184 pixels</td>
<td>66 keys</td>
<td>16 voices</td>
<td>15 1/2&quot; X 9&quot; X 2 3/4&quot;</td>
</tr>
<tr>
<td><strong>Texas Instruments 99/4A</strong></td>
<td>TMS9900 (3 MHz, 16 bit)</td>
<td>T1 BASIC</td>
<td>40K</td>
<td>32 char. X 24 lines</td>
<td>192 X 256 pixels</td>
<td>48 keys</td>
<td>16 voices &amp; 1 sp. eff.</td>
<td>15 1/2&quot; X 10 1/2&quot; X 2 1/4&quot;</td>
</tr>
<tr>
<td><strong>Timex Sinclair 2000</strong></td>
<td>Z80A (3.5 MHz, 8 bits)</td>
<td>Sinclair Extended BASIC</td>
<td>32 char. X 24 lines</td>
<td>192 X 256 pixels</td>
<td>40 keys</td>
<td>1 voice</td>
<td>9 1/8&quot; X 5 5/8&quot; X 1 3/4&quot;</td>
<td>20 oz</td>
</tr>
<tr>
<td><strong>Mattel Aquarius</strong></td>
<td>Z80A (3.5 MHz, 8 bits)</td>
<td>Microsoft BASIC</td>
<td>16K</td>
<td>32 char. X 24 lines</td>
<td>192 X 256 pixels</td>
<td>(movable)</td>
<td>1 voice</td>
<td>13&quot; X 6&quot; X 2&quot;</td>
</tr>
</tbody>
</table>

---

The unit has a built-in r-f modulator and cassette interface. The cassette interface, which runs at 1500 baud, can load or save 48K of memory in less than two minutes. All information saved to tape is started with a header containing information as to its type, title, length, and address information. Programs, screens, blocks of memory, and string and character arrays can all be saved separately, as well as verified if desired. Programs and arrays
Texas Instruments 99/4A

Mattel Aquarius

can be merged from tape with existing contents of memory, but if line numbers or variable names are repeated, the one in memory is overwritten.

There is an expansion port at the rear of the TS2000 that has the full data, address and control busses from the Z80A. Solid-state software cartridge plug right into this port. The port is also used for plug-in peripherals such as the Timex-Sinclair 2040, a 32-column dot-matrix printer for $99.95. I and O commands give the I/O port equivalents of Paren and POKE.

To help fans become better acquainted with the TS2000, a comprehensive step-by-step instruction manual is included. It is divided into two parts. The first part contains complete instructions on setting up and using the computer, and includes a fundamental course in BASIC programming. The second part includes an advanced programming guide for experienced users to develop custom applications.

Sinclair is committed to the introduction of a ZX Expansion Module that will direct and control its new microdisk drive. This module will permit TS2000 computers to communicate with each other and to interface with many commercial printers. In addition, it will permit the connection of a modem for communication over the telephone line. The microdisk itself will store 100K bytes per disk and the TS2000 will support up to eight drives. These peripherals will be offered in the U.K. in the spring of 1983 and they should be available from Timex in the U.S. shortly after that time. The introduction of a disk system and the expansion module will greatly enhance the position of the TS2000 in its fight to the top.

**Mattel Aquarius.** This contender for honors in the lightweight division appears to be just a 98-pound weakling at first glance. It is a modest (13" x 6" x 2") unit with an unassuming keyboard. A total of 49 light-blue, pushbutton keys with one letter per key makes one wonder whether this is a computer or a Tom Thumb typewriter. But beware the feint and jab, and the old peek-a-boo. With one or another overlay, the keyboard is immediately transformed to match a particular computing need.

If you're programming, keywords are indicated for one-stroke entry. If you're playing a game, up and down, right and left indicators are shown. If you're running a word-processing program, commands such as insert and delete make the task a snap. What we really have, then, is a keyboard that is simple yet powerful. Granted, the keys are not the classiest, but first-time users will not be intimidated either.

The standard Aquarius comes with 4K RAM, expandable to 52K, and 8K ROM that includes Microsoft® BASIC. The system can be expanded to use plug-in-memory cartridges, expansion devices, and a whole line of compatible peripherals. CP/M® is available when the system is expanded enough to support it.

Aquarius offers a 320 X 192 high-resolution graphics display and a 40 character X 24 line text display. There are 256 total characters, which include the complete ASCII set with upper- and lowercase letters, numbers, and graphics symbols. Sixteen colors are available. A built-in r-f modulator is standard, as well as an RS232 port. Sound can be generated, but only through the speaker on a television receiver.

The real strength of this contender lies in the meaningful software support that Mattel has provided. Three programs, Aquarius LOGO, Fileform, and Finform offer sophisticated software at a reasonable price. LOGO is a popular graphics-oriented language that helps develop problem-solving skills. (LOGO is available on the TI 99/4A, too, but costs several hundred dollars to implement.)

Fileform is a combination file management and word-processing program. The file management features enable you to store and retrieve information such as addresses, phone numbers, correspondence, etc. Word-processing fea-
Manuals enable you to insert, delete, move blocks of copy, etc.

Finform is the Aquarius version of a spreadsheet program. It has a capacity of 63 columns and 255 rows, and can perform the usual "what if?" operations. Just change a value in one of its cells and the program recalculates all values instantly.

Mattel Electronics has provided an ingenious multi-step system for expanding the Aquarius. First you can plug memory modules of either 4K or 16K capacity directly into the cartridge slot on the computer. Though increasing memory capacity, it does not let you run software cartridges because the cartridge slot is filled. To get around this problem, Mattel has provided the Mini Expander Module. This peripheral has two slots, one for either a 4K or 16K memory module and the other for a software cartridge. In addition, the Mini Expander has two detachable game controllers with six pushbuttons and a 16-position control disk such as that used on the Mattel Intellivision. The Mini Expander also provides three full sound channels for audio effects.

The third level of Aquarius expansion is the Master Expansion Module. This has provisions for 16K memory boards and a disk controller that operates two floppy disk drives. When the Aquarius is fully expanded, it can use CP/M; and the conversion from a starter system to a powerful personal computer is complete.

Mattel Electronics has also provided a cassette Data Recorder unit and a dot matrix printer that will print anything that appears on the screen, including graphics. This is a non-impact printer and requires thermal paper. It prints up to 40 columns and includes upper/lower-case characters and all the Aquarius graphics characters.

Unfortunately, game cartridges for Mattel's Intellivision are not compatible with Aquarius, although a selection of video games is available for the computer.

There are two manuals that come with Aquarius. One is a standard entry to us. If the computer had a professional keyboard, there would be no doubt that it would sweep the division with ease. Even so, we predict that this computer shows enough to send it skyrocketing to the top of the division within a year. In this case, it's likely that the Commodore VIC 20 and the TI 99/4A will go into the sweatbox and lower their prices enough to qualify for the under $100 featherweight division. After all, the big bucks are in the peripherals and software.

The Aquarius offers simplicity rather than power although the system can be expanded and good software is available. But overall we think that the Aquarius strategy of strength through simplicity will not be enough to make it the dominant micro in this division, though such a good contender will likely gather a significant following.

Our Opinion. Each of the two new entrants to the microcomputer lightweight division (between $100 and $200) has a unique style. The Timex Sinclair 2000 offers raw power, and indeed looks like a monster

Up and Coming. What's on the horizon in the featherweight and lightweight divisions? There are two novices that have been training well and are expected to take a shot at the big time this year. One is the PHC 20 Personal Computer, a $99.95 model from Sanyo that was introduced at a recent industry show. But the backers of this Japanese performer have been somewhat secretive since the show, so we'll have to wait and see what develops.

Another interesting candidate is the Humdinger color computer (Venture Micro, Inc., 10090 N. Blaney Ave. Suite #6, Cupertino, CA 95014). With a suggested retail of $129.95 and impressive stats, too, this exciting youngster was the hit of the 1983 West Coast Computer Faire. The Humdinger, although talent laden, will need to find a well-heeled backer to handle promotions before it can be considered a serious threat in the pro ranks.

There are other computers around that fit into the price classes suggested here, but for one reason or another have not been considered. First, there are the pocket computers from Sharp Electronics and Radio Shack. The new Sharp 1250, nicknamed the "Student Computer," and the Radio Shack PC-4 have suggested retail prices of $110 and $69.95, respectively. These models offer increased portability at the cost of decreased expandability and are not really in the same class as the models that were described here.

A second set of opponents at the low end of the personal computer spectrum are the "tag team" models. These are the micros that consist of a keyboard connected to a video game such as the Atari 2600 or Mattel Intellivision. Although the expansion unit falls into the price range of the micros discussed here, the total cost of the package is usually above $200.

This wraps up our report on the micros battling for supremacy in the low end of the personal computer market. It's obvious that the divisions we've covered here are very competitive and will provide much excitement as each entrant follows Rocky's advice to "go for it" in coming months.
**TIMEX SINCLAIR 1000**

Call for information on **TIME X REBATE!**

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$64.95</td>
<td></td>
</tr>
<tr>
<td>16K Memory Module</td>
<td>$44.95</td>
</tr>
<tr>
<td>Vu-Cal</td>
<td>$17.95</td>
</tr>
<tr>
<td>Check Book Manager</td>
<td>$13.95</td>
</tr>
<tr>
<td>The Organizer</td>
<td>$14.95</td>
</tr>
<tr>
<td>The Budgeter</td>
<td>$13.95</td>
</tr>
<tr>
<td>Stock Option</td>
<td>$14.95</td>
</tr>
<tr>
<td>Loan &amp; Mortgage Amortizer</td>
<td>$12.95</td>
</tr>
<tr>
<td>Mindware Printer</td>
<td>$109.00</td>
</tr>
</tbody>
</table>

**ORBYTE SOFTWARE**

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphics</td>
<td>$12.99</td>
</tr>
<tr>
<td>Home Budgetter</td>
<td>$12.99</td>
</tr>
<tr>
<td>Home Inventory</td>
<td>$12.99</td>
</tr>
<tr>
<td>Income Tax</td>
<td>$14.99</td>
</tr>
<tr>
<td>Mega Mind</td>
<td>$15.99</td>
</tr>
<tr>
<td>Salvo</td>
<td>$12.99</td>
</tr>
<tr>
<td>The Quiz</td>
<td>$12.99</td>
</tr>
<tr>
<td>Words</td>
<td>$12.99</td>
</tr>
</tbody>
</table>

**PC-1500 POCKET COMPUTER**

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$169.</td>
<td></td>
</tr>
<tr>
<td>PC-1250...</td>
<td>$89.00</td>
</tr>
</tbody>
</table>

**COMMODORE VIC-20**

<table>
<thead>
<tr>
<th>Component</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$139.</td>
<td></td>
</tr>
</tbody>
</table>

**CBM 64 $399.**

---

**ATARI**

ATARI 1200... CALL ATARI 600... $199.

**DISK DRIVES FOR ATARI**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT88-A1</td>
<td>$299.00</td>
</tr>
<tr>
<td>AT88-A2</td>
<td>$499.00</td>
</tr>
</tbody>
</table>

---

**MODems**

MACHINES

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HF-20</td>
<td>$179.00</td>
</tr>
<tr>
<td>HF-22</td>
<td>$279.00</td>
</tr>
<tr>
<td>HF-28</td>
<td>$429.00</td>
</tr>
</tbody>
</table>

---

**VISICORP**

for Apple, IBM & Franklin

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>T-250</td>
<td>$195.00</td>
</tr>
</tbody>
</table>

---

**CONTINENTAL**

<table>
<thead>
<tr>
<th>Tax Advantage/Apple/Atari</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>$45.00</td>
<td></td>
</tr>
</tbody>
</table>

---

**FLOPPY DISKS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD II (Box of 10)</td>
<td>$32.00</td>
</tr>
<tr>
<td>FD II (5&quot;)</td>
<td>$40.00</td>
</tr>
</tbody>
</table>

---

**HEWLETT PACKARD**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>41CV</td>
<td>$209.00</td>
</tr>
<tr>
<td>HP75</td>
<td>$749.00</td>
</tr>
<tr>
<td>HP41C (Free Memory Mod.)</td>
<td>$149.00</td>
</tr>
<tr>
<td>HP10C</td>
<td>$59.00</td>
</tr>
<tr>
<td>HP12C</td>
<td>$99.00</td>
</tr>
<tr>
<td>HP15C</td>
<td>$99.00</td>
</tr>
<tr>
<td>HP16C</td>
<td>$99.00</td>
</tr>
</tbody>
</table>

---

**NOVATION**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>J Cat</td>
<td>$119.00</td>
</tr>
<tr>
<td>Cat</td>
<td>$144.00</td>
</tr>
<tr>
<td>D-Cat</td>
<td>$159.00</td>
</tr>
<tr>
<td>103 Smart Cat</td>
<td>$279.00</td>
</tr>
<tr>
<td>Apple II</td>
<td>$609.00</td>
</tr>
</tbody>
</table>

---

**ANCHOR**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark I</td>
<td>$79.00</td>
</tr>
<tr>
<td>Mark II (Atari)</td>
<td>$79.00</td>
</tr>
</tbody>
</table>

---

**ANALYSIS**

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1520 Color/Printer/Plotter</td>
<td>$169.00</td>
</tr>
<tr>
<td>1525 80 Column Printer...</td>
<td>$339.00</td>
</tr>
<tr>
<td>1530 Datasette</td>
<td>$69.00</td>
</tr>
<tr>
<td>1541 Single Disk Drive...</td>
<td>$339.00</td>
</tr>
<tr>
<td>1600 VIC Modem</td>
<td>$95.00</td>
</tr>
<tr>
<td>1610 VIC Term 40</td>
<td>$49.00</td>
</tr>
</tbody>
</table>

---

**CIRCLE NO. 11 ON FREE INFORMATION CARD**

---

**east computer mail order west**

800-233-8950
Dept.607, In PA Call (717)327-9575
477 E. Third St., Williamsport, PA 17701

---

**west**

800-648-3311
Dept.607, In NV Call (702)588-5654
P.O. Box 6689, Stateline, NV 89449

---

**NO RISK, NO DEPOSIT!**

No risk, no deposit on C.O.D. orders. Pre-paid orders receive free shipping within the UPS Continental United States with no waiting period for certified checks or money orders. Add 3% (minimum $3.00) shipping and handling on all C.O.D. orders and credit card orders. Larger shipments may require additional charges. NV and PA residents add sales tax. All items subject to availability and price change. NOTE: We stock manufacturer's and third party software for most all computers on the market. Call today for our new catalog.
The Ingenious SWITCHABLE TEST SOCKET

Decrees IC circuit design and debugging time

By Nathan Moskowitz

THE Switchable Test Socket, details of which are shown in the drawing, can help cut down time spent in designing, debugging, and troubleshooting circuits using ICs and/or component carriers. A simple but ingenious device, the STS can be used to isolate or monitor a signal at any selected IC or carrier pin and provide a convenient means for selectively injecting test signals. There's no need to flip over the board or cut circuit traces to perform these operations with the STS.

As shown in the drawing, the STS consists of a 14- or 16-pin Wire Wrap DIP (dual in-line package) socket to the pins of which are soldered in series 7- or 8-section DIP switches. The free pins of the DIP switches, in turn, connect to a 14- or 16-pin solder socket.

To use the STS, you simply unplug the IC or component carrier from its socket, install the STS in the vacated socket, and plug the removed device—properly oriented—back into the circuit via the Wire Wrap socket atop the STS. With the STS installed, you can switch in and out device pins as desired, using the DIP switches. Additionally, the long, rigid bare-metal leads of the Wire Wrap socket permit easy connection of meter, logic-probe, and oscilloscope test leads for voltage and signal monitoring, or the probes of a signal generator or other signal-injection instrument for performing operating tests.

Fabrication. Using the drawing as a guide, tin about 1/8" of the free ends of the Wire Wrap socket leads with solder. Next, bend the pins of two DIP switches so that they project away from the sides of the cases at a 90° angle and tin about 1/8" of the free ends of each pin. Use heat judiciously when tinning and soldering pins on the DIP switches to avoid damaging their potting compounds.

Gently clamp the Wire Wrap socket in a vise or other clamp/support device, arranging it so that its leads are accessible. Making sure of proper orientation, carefully solder one row of DIP-switch pins to one row of the Wrap socket leads, using only enough heat and solder to assure good electrical and mechanical joints. Solder first one end pin and then the other, squaring the assembly for neatness, and finish up with the remaining pins. Then file smooth each soldered connection. Repeat this procedure for the second DIP switch and remaining Wire Wrap socket leads.

After soldering both DIP switches to the Wire Wrap socket, insert the free pins of the switches into a 14- or 16-pin (depending on configuration of socket and DIP switches) solder socket.

In Closing. If you routinely design or work with circuits in which many 14- and 16-pin ICs or component carriers are used, you might want to have two or more Switchable Test Sockets available. By installing them in several critical locations in a circuit, the STSs will further reduce design, debugging, and troubleshooting time by permitting you to connect several instruments simultaneously. Using a multi-channel scope, for example, you can compare the timing waveforms at selected points in a digital circuit or observe the levels of amplification obtained at various points in an analog circuit with a given input signal level.

©

Series DIP switches are connected between a Wire Wrap socket and the DIP solder socket.

www.americanradiohistory.com
THE INTRODUCTION of the Osborne 1 Portable Computer opened a door on a new generation of portable machines. The Kaypro II is one of this new breed—right down to the originator’s selling price ($179.50) and the inclusion of a spate of software that costs more separately than the computer itself.

The biggest difference between the Osborne and the Kaypro II is that the latter features a 9" diagonal CRT, and the Osborne’s is 5”. Also, the Kaypro has a pair of dual-density disk drives while the Osborne uses dual, single-density drives, with double-density available as an option for an additional $290. Dimensions are similar, but the Kaypro, at 26 lb, is 2 lb heavier.

Like the Osborne, the Kaypro II is a general-purpose computer for business and personal applications using CP/M, and both are somewhat like two-suit case (when closed) for easy travel.

**Description.** The Kaypro II Portable Computer is made by Non-Linear Systems and comes in a protective gray painted metal enclosure (the Osborne is plastic) that measures 18"W × 5"H × 15 1/2"D. The Kaypro has a more squared-off shape than the Osborne, permitting it to stand more evenly on the floor. The end opposite the carrying handle is detachable and contains the keyboard. The line cord is wrapped around four corner lugs and is not...
concealed as it is on the Osborne. When detached, the keyboard is connected to the computer through a plug-in telephone-type coiled cable. For travelling overseas, the Kaypro can be set to operate from 220 V ac.

The keyboard consists of 62 sculptured keys, including four “arrow” keys for controlling the position of the cursor. To the right of the QWERTY keyboard is a 14-key numeric cluster that includes its own ENTER key. With the exception of the control keys, all others, including the cursor controls, have an auto-repeat function. The keys have an excellent “feel” and a slight electronic “tick” from an internal transducer lets you know when a key is activated. A red LED under the key indicates when the CAPS LOCK key has been activated. The keyboard is a wedge-shaped platform with the front side 1” high and the rear 3” high.

The manual suggests that the computer can be arranged with the main enclosure’s front rubber feet resting on the top rear edge of the keyboard. This makes the unit look like a conventional video terminal. Of course, the keyboard and computer can be separated the distance of the coiled connector cable.

On the front panel, the major difference between the Osborne and the Kaypro II is the layout. The Osborne has each disk drive mounted horizontally, one on each side of the CRT, with a “sleeve” for diskette storage below each drive, while the Kaypro has both disk drives mounted as a vertical pair on one side of the enclosure to the right of the CRT.

The Kaypro uses a Z80A CPU and has 64K bytes of user memory. The display has a green phosphor screen and is 80 columns by 24 rows, with both upper- and lowercase characters.

Data storage is provided by a pair of double-density 5 1/4” floppy disk drives. These have a capacity of 195K bytes each (compared with the 92K-byte single- or 184K-byte double-density disk drives on the Osborne for an additional $200). The Kaypro can also use the Xerox 820 single-density disk format. This is important because there is much software of this type available. The memory map of the system shows two banks. One is 64K of RAM forming the usual CP/M setup, with the second bank forming the video display RAM and the system PROM. Only the lowest 16K of memory will change with the bank select bit. Addresses above 3FFF (hex) are always available for either bank.

In use, the software on the Xerox 820 format disk is transferred to a Kaypro II diskette, which can hold the contents of several Xerox 820 single-density disks. (It should be noted that the Kaypro II is not compatible with the Xerox 820 II.)

The Kaypro II has two I/O connectors on the rear panel. One is a Centronics-type parallel connector for output to a parallel printer. The other is a standard DB25 for connection to serial devices. The Kaypro II serial port is an RS232C configured as Data Terminal Equipment (DTE) so it can be directly connected to a modem via an unmodified RS232C cable. The instruction manual details the CP/M instructions to configure the serial I/O. Actually, the Kaypro II has six I/O port addresses: port 0 sets the RS232 baud rate; port 4 is the actual RS232 serial port; port 5 carries the 8-bit data from the keyboard; port 6 is the RS232 status (control and status for the Z80 PIO); port 8 is the 8-bit parallel printer port; while port 1CH is the R/W system port for system control. (The various bits are used for memory bank selection, disk drive control, and printer handshaking.) Unlike the Osborne, the Kaypro II does not have an IEEE-488 connector, nor does it have provisions for battery operation.

The 1920 characters that can be displayed on-screen include standard ASCII plus some extra characters, all mapped on a 5 x 7 display cell. Unlike the Osborne, whose 5” CRT can only display a “window” of 24 rows of 52 characters out of a generated 32 lines of 128 characters, the Kaypro II can display all of its...
1920 characters at one time. A front-panel **BRIGHTNESS** control is available. This is a structured form of the language that resembles Pascal rather than the more familiar forms of BASIC. It is compiled and must be entered by using the word processor as a screen editor. After the program is written, it is saved with an extension of .BAS. This source file is then compiled using the S-BASIC compiler and the result is a .COM file which can be run directly.

This type of BASIC program runs much faster than either an MBASIC (an interpreter) or a CBASIC (an intermediate compiler type).

The rest of the software provided with the Kaypro II consists of the Perfect family of application programs. This includes the Perfect Writer word processor, and Perfectcalc (an electronic spreadsheet). These are all good programs, but by themselves they are nothing exceptional. When used together as an integrated system, though, there is a synergism that makes this package into a data-processing system that everyone will enjoy using. To get this system as part of a computer package is a powerful inducement to buy.

**Perfect Filer** is a data base that enables the user to create his own files of records containing the information required for his use. It lets the user input the data and then retrieve it, to use it in a variety of ways such as printing address labels to everyone in the data base, to supply information for form letters composed with the Perfect Writer, to print invoices for records entered today, and to produce specialized sales reports and lists.

The system allows you to compose and personalize letters to everyone on a mailing list in the data base. You can also include financial information developed within the electronic spreadsheet. It is this capability to utilize the data among all the parts of the family that make the Perfect software so powerful.

The **PerfectCalc** is an electronic spreadsheet that is similar to SuperCalc. But its principal feature is that it interfaces with the other programs in the system. It also features the virtual memory feature common to the Perfect family.

The **Perfect Writer** word processor includes a split screen that enables manipulation of up to seven files in memory at a time. For example, you can be composing a manuscript on the lower half (or three quarters) of the screen while searching another document in the upper portion for a paragraph to insert in that manuscript. You can then construct the paragraph to your liking, restore the document to storage in its original form, and return to full-screen editing.

Perfect Writer also produces an index, creates footnotes, and can even produce its own table of contents—something that only very expensive word processors generally can do. In addition, the word processor will also automatically format more than 30 different entry styles for final printing, such as set-off quotations within a body of text, or numbered and/or lettered lists and subtitles. If you run out of memory while writing a long manuscript, Perfect Writer provides "virtual memory" where data is swapped back and forth with a diskette. This feature permits very long manuscripts that would exceed the RAM available. In use, the major difference between the Perfect Writer and the previously offered Select word processor is that Select used one-letter commands to select functions, while Perfect Writer requires the use of the **CTRL** and **ESC** keys in conjunction with another key to change functions. Up to four keys might be needed for some commands, although the bulk of them require only two keystrokes.

**Perfect Speller**, a companion dictionary to the word processor, has a 50,000-word dictionary and can process 4000 words per minutes.

**User Comments.** Boooting the Kaypro II is conventional. Once the CP/M prompt is displayed, any CP/M 2.2 diskette can be used. With some alphanumericics on the CRT screen, the BRIGHTNESS control is adjusted for the desired appearance. A small "hood" formed by the top cover of the enclosure shields the screen from much of the overhead lighting. The 80 x 24 display is almost exactly the same size as the finished printed product in a
Savvy pioneers often meet the new challenges, though, as Osborne has by introducing a green-phosphor screen, optional double-density drives, and a plug-in modem for current models. And users do claim that the smaller screen represents no problem after working with the machine for awhile.

Moreover, Kaypro's software, though good, is not as widely familiar as Osborne's, whose WordStar and SuperCalc software packages are household names among computer users. And though Kaypro's S-BASIC is faster than a streak of lightning, it has, to my mind, several serious drawbacks. First S-BASIC is as hard to learn as Pascal or C. So why not use these other structured languages, which have the advantage of being portable? Second, and more important, some of the applications written to run under CP/M are for MBASIC or CBASIC-2, or for some form of Pascal. Therefore, to run them you may have to go out and buy the supporting language. However, today many BASIC applications are supplied as compiled object code. This makes S-BASIC useless for supporting packaged software applications in BASIC. So what good is it? Well, it is a rather nice exercise in structured programming. That is all it is, and I urge people buying the Kaypro II to also buy the real BASIC of their choice. The CBASIC package for the Kaypro II retails for $150, while MBASIC-80 is $320.

For those interested in manufacturer support (and you always should be), Osborne's pioneering has resulted in wider and deeper distribution of its product. Non-Linear Systems, the Kaypro maker, cannot be easily dismissed as the typical newcomer, though, since it has been an established, reputable company in the instrument field for decades.

Given the foregoing conclusions and considering the tradeoffs, Kaypro is a solid competitor in this modestly priced portable/desktop computer field.

— Leslie Solomon
A WATER-LEAK DETECTOR

Circuit senses presence of water and sounds an alarm when probe resistance drops

By Mitchell Lee

WATER leaks are costly nuisances for any homeowner, especially when they go unnoticed for one or more days. A leak in a refrigerator ice maker, dish washer, hot water heater, evaporative cooler, or plumbing can spell disaster for cabinets, floors, and any items stored in the immediate vicinity. What every homeowner needs to avoid disaster is a device that will alert him of leaks when they first occur, before they have a chance to do extensive damage.

The leak detector circuit shown schematically in Fig. 1 senses the presence of water by monitoring the resistance between two probes that are placed so that the resistance is affected by the amount of moisture present. When this resistance drops below about 0.5 megohm, an alarm sounds to draw attention to the situation.

At the heart of the circuit is a National Semiconductor LM180 battery-operated alarm, which contains a comparator, 300-mA output stage, low-battery detector, and two internal voltage sources.

The positive input of
...LEAK DETECTOR

The comparator at pin 5 of IC1 is connected to an internal 5.8-volt source via pin 2; the negative input at pin 4 is pulled low by R1, with the probe connected between pin 4 and the positive supply line.

Under dry conditions, resistance across the probe is fairly high (greater than 5 megohms) and no output to alarm A1 is present at pin 8 of IC1. When probe resistance drops below about 500,000 ohms, pin 4 of IC1 is pulled higher than pin 5 and pin 8 goes low, at which point, A1 sounds.

The on-chip low-battery detector alerts you whenever the potential at pin 12 of IC1 falls below 6 volts by sounding A1 for 30 ms every 45 seconds. Voltage divider R2/R3 determines the low-voltage alarm point. With the values specified, A1 will sound when battery potential drops below 8.2 volts.

Total standby current drain of the leak detector is less than 7 µA, allowing up to a year of operating life from a 9-volt alkaline battery. The alarm can be tested by closing S1 to emulate a low-resistance across the probes.

Construction. The leak detector can be assembled on perforated board, using point-to-point wiring, or on a small home-brewed printed-circuit board. Whichever approach you elect to use, the only constraint is that you take care in component arrangement since all resistors have very high values and should not be shunted by any type of conducting material.

Once assembled, the electronic part of the project can be housed in any enclosure that will accommodate it and battery B1. If desired, probe connections can be made via banana jacks mounted on the enclosure.

Probe construction depends on the nature of the leak being detected. A pattern of interdigitated "fingers" (Fig. 2A) can be placed beneath an anticipated drip or on the floor beneath an appliance where leaking water usually occurs. This type of sensor can readily be fabricated from a printed-circuit board.

---

**PARTS LIST**

- A1—Buzzer (Radio Shack Cat. No. 273-049 or similar)
- B1—9-V alkaline battery with connector
- C1—470-µF, 10-V electrolytic
- C2—10-µF, 10-V electrolytic
- C3—100-µF disc capacitor (optional—see text)
- IC1—LM1801 battery-operated alarm
- R1—1-megohm resistor
- R2—2.7-megohm resistor
- R3—7.5-megohm resistor
- R4, R5—10-megohm resistor
- S1—Normal open pushbutton switch
- Misc.—Perforated or printed-circuit board; suitable enclosure; materials for sensor(s) (see text); IC socket; hookup wire; solder; etc.

**Note:** The LM1801 integrated circuit is available for $1.79 from Digi-Key Corp., Highway 32 South, PO Box 677, Thief River Falls, MN 56701 (800-346-5144).

---

**Fig. 1.** The heart of the circuit is the LM1801 battery-operated alarm.

---

**Fig. 2.** An interdigitated type of probe or sensor is shown at (A). The arrangement at (B) can be used if water is likely to run down a pipe. The end of a coax cable can be used as a probe in an overflow pipe or drip bucket as shown at (C).
edge connector by soldering together alternate alternate traces.

Where leaking water might run down the underside of a pipe, the probe arrangement shown in Fig. 2B would prove most useful. To fabricate it, first wrap a dry sponge around the pipe and tie it in place. Then push two lengths of heavy bus wire (the "probes") into the sponge parallel to and along the underside of the pipe. Using this arrangement, water running down the underside of the pipe will be intercepted and absorbed by the sponge. When the sponge gets wet, it will create a relatively low-resistance path between the probe wires, tripping the alarm.

As shown in Fig. 2C, the unterminated end of a length of coaxial cable makes an excellent leakage probe for a drip bucket or an overflow pipe. The probe tips are formed from the exposed braid and center conductor of the cable.

Multiple probes can be connected to the leak detector simply by tying them into the input circuit in parallel, to permit monitoring of several different locations simultaneously. If a sensor is to be located remotely from the electronic package, it is a good idea to wire a capacitor (C3 in Fig. 1) across the probe input at the electronic package to reduce noise pickup. In most cases, remotely located sensors can be interconnected with the electronic package via twisted-pair 20-to-30-gauge insulated hookup wire.

A final note: probes and other sensors subject to oxidation (for example, copper) should be periodically cleaned.

---

**A COMPLETE SOFTWARE GUIDE...FREE?**

discount Software Buyer's Guide, crammed with useful facts, can be yours for only $5.00. But you get every penny back when you order your next low-priced program from Discount Software!

Mail the coupon and you'll discover descriptions, features, system requirements, and solid advice on scores and scores of programs. Look at all you get:

2. Hardware buyer's guide.
3. System requirements for each package.
5. Directories of software for CP/M, Apple, and 16-bit machines.
6. Thorough product descriptions.
7. Selection of games.

Send for your guide today. Only $5.00 now, it might well turn out to be free.

**$5.00 REBATE OFFER**

Yes—rush me the useful Discount Software Buyer's Guide. My enclosed $5 check is made out to "Discount Software" I understand that this sum will be rebated to me when I make my next purchase.

Name ____________________________
Company _________________________
Address __________________________
City ___________________ State ______ Zip _______
Mail $5 check to: Discount Software, 6520 Selma Ave., Los Angeles, CA 90028

---
They'll never know you're doing it.

Take High-Quality Photographs With the World's Tiniest Cameras. Change Your Telephone Voice So Your Own Mother Would Be Fooled.

The Spy Cameras

Surprise your friends with sharp, brilliant photographs they'll never suspect you took. Minuscule in size but giant in performance, these precision cameras use standard universal miniature cartridges for one-touch loading. Shoot a whole roll without ever looking at your camera: fingertip control automatically resets the shutter as you fire each shot. Precision optics give results rivalling expensive 35mm cameras.

Genuine Suzunon 3-element fixed focus lens means razor-sharp images without constant fiddling. Aperture adjusts manually from f/3.8 to f/11. 1/120 second shutter has a safety lock so the camera can't accidentally shoot your vest pocket or purse.

Pick the one you want. Each has its own astounding unique advantages. Until you use your SPY CAMERA you won't believe the picture-quality. Custom soft carrying case, roll of film, and neck strap included with each camera.

We Absolutely Guarantee
Use the VOICE CHANGER or any of the miraculous SPY CAMERAS for up to 30 days. If you decide for any reason you don't want to keep it, return it for a 100% refund.

Order TOLL-FREE
For fast delivery on credit card orders call toll-free 24 hours a day, 7 days a week:

1-800-824-7888
Ask for Operator 551
(in California call 1-800-852-7777)
Or send check or money order. Please add indicated shipping cost.

NEW HORIZONS
Dept. CE6, 1 Penn Plaza, Suite 100, New York, NY 10119

The Telephone Voice Changer
(New, Improved Model)

It's right out of James Bond. Push a button and the VOICE CHANGER gives your voice completely different characteristics; the person on the other end won't know it's you.

Not an "electronic handkerchief" that muffles or filters your voice, the VOICE CHANGER completely restructures the tone and timber. It literally changes the quality of sound. This is the new, improved model that completely eliminates distortion as it changes your voice. Your own mother would swear it's a stranger calling.

Choose from two separate, distinct Changer Channels. Pushing "Channel 1" changes timber and texture. Pushing "Channel 2" creates a second set of different characteristics. Pushing "Ordinary" sends your own voice through the line.

If you're alone in an office, it'll sound like an employee answering. Use the VOICE CHANGER to reach that doctor, lawyer, or business executive whose secretary knows your voice and who always is "out" when you call. Use it to screen your own incoming calls. Use it for just plain fun. Anytime you like, during a conversation, push the "Ordinary" button and the other person will hear your normal voice.

Order TOLL-FREE
For fast delivery on credit card orders call toll-free 24 hours a day, 7 days a week:

1-800-824-7888
Ask for Operator 551
(in California call 1-800-852-7777)
Or send check or money order. Please add indicated shipping cost.

NEW HORIZONS
Dept. CE6, 1 Penn Plaza, Suite 100, New York, NY 10119

We Absolutely Guarantee
Use the VOICE CHANGER or any of the miraculous SPY CAMERAS for up to 30 days. If you decide for any reason you don't want to keep it, return it for a 100% refund.

Order TOLL-FREE
For fast delivery on credit card orders call toll-free 24 hours a day, 7 days a week:

1-800-824-7888
Ask for Operator 551
(in California call 1-800-852-7777)
Or send check or money order. Please add indicated shipping cost.

NEW HORIZONS
Dept. CE6, 1 Penn Plaza, Suite 100, New York, NY 10119

© 1983 New Horizons

CIRCLE NO. 27 ON FREE INFORMATION CARD

www.americanradiohistory.com
PART 2

LAST month, in Part 1 of a series, we introduced the structure of CP/M, basic console system calls, and how to use DDT to write assembly-language programs using single characters. Now, we'll look at some console I/O system calls that will allow you to enter whole words and lines at a time to simplify programming. We'll also describe "Direct Console I/O," which allows much more direct interaction with the screen and keyboard than with previous system calls. Finally, we'll cover a number of functions that deal with unusual I/O equipment.

Print String. The way to send complete words and sentences to the screen from inside CP/M is via the Print String function. In programming, a series of characters like a word or sentence is called a "string." We can send strings to the screen and accept strings from the keyboard. Print String sends a string to the console display screen. It's an advanced version of Console Out, which sends to the screen only one character at a time.

Print String expects to find the string you want to send to the screen in a continuous area of memory as a sequence of ASCII bytes. The end of the string must be a 24 hex (ASCII value for the "$" end-string identifier). To print it, put the address where the string starts in register pair DE, a 9 in register C, and do a BONSAI TO BDOS (an excited call 5).

We'll now demonstrate how to type a message in DDT. First, get into DDT and use the Set command (s) to put the hex value for "ABCDE" into memory, starting at location 010A. This command first displays the current contents of the memory location you're about to fill. In this case, these numbers are of no interest to us. Each time you type a two-digit (one-byte) value and hit carriage return, your number is stored in the memory location shown, overwriting the old value:
As in mvi, the 1 in lxi means that the constant to be stored immediately follows the instruction in memory. The x indicates that the instruction operates on a register pair, instead of a single 8-bit register.

When using lxi, you must type in four hex digits, not just the two required for mvi.

Execute the program:

```
-g100
ABCDE*101B
```

There's almost no limit to the size of the string you can print. To observe this, use the "fill" (f) command, followed by the address where you want to start filling, address where you want to stop filling, and the constant you want to fill in.

Use DDT:

```
-f100,400,41
```

This will fill from memory 10f to 400 with ASCII As. Don't forget to end the string with $ (24 hex) using the s function:

```
-s401
401 FD 24 ASCII $ 402 DO . period terminates "s"
```

Try running your program with this new string by typing "g100." The screen will simply fill with the letter A continuously until it reaches the end. (Don't turn on your printer!)

**Read Console Buffer.** This is one of CP/M's most useful functions. It accepts a string of characters typed from the keyboard and puts them in a memory "buffer" so your program can use them. Similar to Console Input, Read Console Buffer accepts information typed at the keyboard, except that the read-buffer function allows you to type a string of up to 255 characters at the keyboard. It's also a little more complicated to set up than Console Input.

One feature that makes Read Console Buffer especially useful is that it responds to the set of CP/M control-character commands and, thus, can be edited while you're typing it in. Perhaps the most important of these commands is ctrl-c, which when typed at the beginning of the string causes CP/M to do a warm boot. By using Read Console Buffer, ctrl-c allows a user to reboot the program during input. Read Console Buffer offers a host of other useful line-editing features:

- **ctrl-h**—backspaces one character position
- **ctrl-x**—backspaces to beginning of line and erases all characters (start over, erase).
- **ctrl-u**—moves cursor down to beginning of next line and ignores previously typed-in line (start over but still view old line).
- **ctrl-r**—retypes current line after new line. Useful when you over-use DEL key and can't figure out what line means.
- **ctrl-e**—causes "physical end of line"; cursor returns to left margin one line down.
- **ctrl-j**—line feed; terminates input line (as if carriage return were typed).
- **ctrl-m**—carriage return; terminates input line.
- **ctrl-del**—removes and echoes last character typed.
- **ctrl-c**—performs warm boot.

Read Console Buffer "reads" a line of edited console input into a buffer addressed by the contents of register pair DE. You must use lxi to set up the buffer address in register DE before making the call. In addition, you must set up in the beginning of the buffer a number that represents the maximum number of characters you want to accept. For example, if you put 20 hex in the buffer, as soon as the user types more than 32 characters (decimal),
the function will terminate or "end by overflow." The user can also terminate the string by hitting carriage return or ctrl-j or ctrl-m.

The buffer we set up is shown in Fig. 5. DE + 0 is shorthand for the address set to the function in register DE, DE + 1 is the next address, and so on. Hence, if you put 400 in register DE when you call this function, DE + 1 will be at 401, DE + 2 will be at 402, and so on up to DE + n, which will depend on the length of your message.

The mx indicates the maximum number of characters (1 to ff hex) the function will allow you to type into the buffer. The nc is the number of characters typed in by the user and is set by BDOS when the function returns to your program. This number is useful for determining actual length of the input string, found at DE + 1. Following nc are the actual characters read from the keyboard. If the number of characters typed is less than the number set by mx, remaining positions in the buffer were whatever they were before the function was called and have no meaning; they're identified by "??" in Fig. 5.

Our Read Console Buffer example is really quite simple. Let's assume we're going to start our buffer at 200 hex. Using DDT, enter:

```
-a100
0100 mvi a,20 set maximum characters to 32 decimal
0102 sta 200 and put in first buffer position
0105 mvi c,a set up register C for Read Console Buffer
0107 lxi d,200 load DE with location of buffer start
010A call 5 call BDOS
010D rst 7 return to DDT
```

Store this program as "test6.ddt"

As you can see, a new instruction, "sta," has been added.

**STA Instruction.** This new instruction takes the 8-bit value in register A and stores it in memory. Where this value will be stored is determined by the address in the operand field of the instruction. For example, "sta 2000" takes the 8-bit value in register A, which might be anything from 00 to FF, and stores it in memory location 2000. In DDT, this address is represented by a four-digit number.

Notice the difference between this instruction and others we've used so far. For instance, mov b,a takes an 8-bit value from register A and stores it in register B, not in memory as sta does. An instruction like mvi a,7f is different from sta in two ways. First, it's loading an 8-bit value from memory into register A, not taking it from register A and transferring it into memory as sta does. Second, mvi a,7f refers to a constant at a location in memory immediately following the mvi instruction, while sta refers to a location in memory that can be located far away from the sta instruction itself. For this reason, sta uses an address in the operand field, while mvi uses the actual 8-bit value.

Our program first puts 20 hex into register A and stores it at the beginning of our buffer at 200H, represented by mx. The program then calls Read Console Buffer, using address 200 as the start of the buffer. It then waits for you to type something in:

```
-g100
Now is the time type this in
*019D
overwrites first part of the input
```

Note that there's a small glitch in that *019D, which DDT prints when the program is over, overwrites part of the typed-in line. For now, dump (display) the buffer at 200H. (See Fig. 6A.)

The 20 at location 200 is mx, which you put there with sta. The 10 (16 decimal) at 0201 is the actual number of typed-in characters. The rest of the buffer, from 0212 on, is filled with whatever was in it before.
Here's what happens if you type in more characters than are specified by mx:

```
-g100
Now is the time
for all good men
   type this in on one
line; keep typing.
After "men," the
function took over and
returned to DDT
```

**'010D**

Dump the buffer again. (See Fig. 6B.) This time, the number of characters typed is the same as the maximum, mx.

**Echo Program.** Let's put together the two string-handling system calls you've just learned into a single program:

```
-a100
 0100 mvi a,20  put max. characters
 0102 sta 1fe at start of buffer
 0105 mvi c,0a  call Read Console
 0107 bxi d,1fe Buffer
 010A call 5
 010D mvi c,2  use Console Out to
 010F print linefeed
 0111 call 5
 0114 mvi c,9  Print String
 0116 bxi d,200
 0119 call 5
 011C rst 7  back to DDT
 011D
```

Save this program as "test7.ddt."

This program will accept input typed by you, store it in a buffer, and then print it out on the screen, echoing every character typed. Note that a section is added to the program to print a linefeed to keep Print String from printing over the typed-in string. This is accomplished with Console Out at 010D and a 0A ASCII character (linefeed) at 010F

We also tell Read Console Buffer and Print String different addresses for the start of the buffer, 1Fe at 0107 for Read Console Buffer and 200 at 0116 for Print String. We do this because Read Console Buffer needs two extra bytes at the start of the buffer in which to put mx and nc. These go into 1Fe and 1Ff, respectively, so that actual typed characters start at 200H.

**List Output To Printer.** This system call is used to send a character to the list device, usually a printer, in the same way Console Output sends a character to the console screen. There are, of course, some differences in the way a printer operates, as compared to a video screen.

First, the printer will usually absorb a number of characters, such as a line, without doing anything. Characters sent are stored in a buffer in the printer until the printer's line length is exceeded or a carriage return or other terminating character is sent. At this point, the entire line of characters is printed. Hence, if you want to ensure that what your program sends gets printed, a carriage return must be the last character sent.

Some printers automatically supply a linefeed upon receipt of a carriage return, others don't. If yours doesn't, you must send one following the carriage return to keep the printer from overprinting the previous line.

Secondly, keep in mind that some characters look different on the screen than they do on the printer. Control characters, for example, may appear as characters preceded by a caret on-screen but may generate strange nonprinting actions on the printer, such as changing printing pitch.

Here's a program that will accept a line of input from the keyboard, using Read Console Buffer, and then send the string to the printer using

```
List Output:
-a100
 0100 mvi a,50  Get input string. Max.
 0102 sta 01fe line length
 0105 mvi c,a  into buffer
 0107 lxi d,1fe Read Console
 010A call 5
 010D lxi h,200 Buffer address
 0111 mvi c,5 number of characters
 0114 mvi c,5 typed
 0116 mov e,m get character from
 0117 mvi c,0a buffer
 0118 push h increment pointer
 0119 push b save H
 011A call 5 perform operation
 011D pop b restore B
 011E pop h restore H
 011F dcr b Check if done.
 0120 jnz 114 Decrement count
 0123 mvi c,5 done. Print linefeed
 0125 mvi e,a
 0127 call 5
 012A mvi c,5 Print carriage return
 012C mvi e,d
 012E call 5
 0131 rst 7 return to DDT
```

Save this program as “test8.ddt.”

We've introduced a couple of new instructions here:

**Phantom “M” Register.** The “m” in "mov e,m" in line 116 refers to a “phantom” register that doesn’t really exist. This m is nothing more than a convenient abbreviation for the memory address pointed to by register HL. This register in the 8080 has the useful ability to indirectly address a memory location...
Save up to 33% on Creative Computing, too!

The Creative Computing Sweepstakes is open to all our readers. No purchase is necessary—and you'll receive a fantastic Atari home computer system worth over $1600 if you're the lucky winner!

How the Sweepstakes works

Just mail the attached card or the coupon below after filling in your name and address. Be sure to indicate whether you're also subscribing to Creative Computing at the special rates shown—you can save as much as 33%.

Then, if you win, you'll get a superb Atari personal computer system: the Atari 800 with 16K RAM and 10K ROM...an 810 Disk Drive...a 16K RAM Memory Module for extra memory...a pair of Joystick Controllers for game interaction. Use the Atari to handle small business and professional applications as well as sophisticated home processing functions—and, of course, for entertainment. Analyze your investments, learn languages, do business accounting, play video games. Programmable in Basic or Assembly, the 800 can use all Atari peripherals and can control up to four disk drives and a 60 lpm printer. In all, the 800 and its accessories form a package worth a full $1620 at retail!

You're sure to win with Creative Computing!

Whether you win our Sweepstakes or not, the hours you spend with a computer are certain to be winners when you subscribe to Creative Computing. It's the Number One magazine of computer applications and software—filled with in-depth evaluations of computers, peripherals and software, plus applications and software that you can run directly on your computer.

Why not enjoy a year or more of Creative Computing at our low introductory prices? You'll save up to 33% if you subscribe at the same time you enter our Sweepstakes! Atari is a registered trademark of Atari, Inc.

OFFICIAL RULES

No Purchase Necessary

1. On an official entry form or on a 3" x 5" piece of paper, hand print your name, address and zip code. Enter as often as you wish but mail each entry separately to Creative Computing Sweepstakes, P.O. Box 5212, Boulder, Colorado 80322. Entries must be received no later than August 31, 1983, and the drawing will be held by September 21, 1983. All entries become the property of Creative Computing, 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 Creative Computing, 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 affidavit of eligibility and release of liability. Odds of winning will depend on the number of entries received. Creative Computing will arrange delivery of prize. Taxes are the responsibility of the winner. Any manufacturer's claims and warranties apply, but Creative Computing makes no claims or warranties with regard to any prizes. Prize is not transferable. No substitutions for prizes.

3. Sweepstakes open to all residents of the U.S., its territories and possessions, except employees (and their families) of Creative Computing, its affiliates, and its advertising and promotion agencies. Void where prohibited or restricted by law.

4. For the winner's name, send a stamped, self-addressed envelope to Creative Computing Sweepstakes, Circulation Department, One Park Avenue, New York, N.Y. 10016.

OFFICIAL ENTRY FORM

Mail to: Creative Computing Sweepstakes
P.O. Box 5212, Boulder, Colorado 80322

☐ YES! Enter my name in the Creative Computing Sweepstakes and start my subscription to Creative Computing for the term checked:
  ☐ One year (12 issues) only $19.97—20% off!
  ☐ Two years only $36.97—25% off!
  ☐ Three years only $49.97—30% off!

Savings based on full one-year subscription price of $24.57.

☐ NO I don't wish to subscribe now, but tell me if I've won the Creative Computing Sweepstakes.

Mr./Mrs./Ms.: ____________________________
Address: __________________________________________
City: ___________________ State: ___________ Zip: ___________
Apt.: ___________

CHECK ONE: ☐ Payment enclosed. ☐ Bill me later.

Offer valid only in the U.S., its territories and possessions. Please allow 30 to 60 days for delivery of first issue if you subscribe.
such that other 8-bit instructions—nvi and mov—can "pretend" there is an "m" register. What we really do when following an instruction with m is to have the program first look at HL to get the address it holds and then operate on the memory location pointed to by this address as though the memory location were a register. This is useful when we want to store a series of data items in sequential memory locations.

Our program uses two different registers to keep track of two different things: HL (16 bits) for the address in the buffer of the current character, and B (8 bits) for the number of characters remaining to be printed out.

We’ll put the actual typed characters into the buffer starting at 200H. The first location in the buffer (1fe) holds the maximum character count, set at 50H or 80 decimal, to avoid getting more than one line of characters. The second address of the buffer (1ff) will be filled with the number of characters actually typed; this quantity is put into register B, which then uses it as the count when sending the characters to the printer. Typed input will be stored in the buffer starting at 200H, which is the address we put into register pair HL, the pointer to the current character.

INX Instruction. This instruction increments a register pair in the same way incr increments a single 8-bit register, adding 1 to the 16-bit number in the register pair. If you started with a zero and just kept incrementing, the register pair would count all the way up to FFFF (65535 decimal) before starting over again at zero.

DCX Instruction. Instruction inx works on all register pairs. A similar instruction, dcx, decrements these register pairs. An important and frequently annoying difference between these 16-bit increment and decrement instructions and 8-bit instructions incr and dcr is that the 16-bit instructions do not set the zero flag when the count gets to zero.

LDA Instruction. This instruction is the opposite of sta. It loads register A with an 8-bit value taken from the memory address specified in the operand field of the instruction.

The program loops between 0114 and 0120, fetching a character from the buffer (line 0116), incrementing the pointer to the next character (line 0117), sending the character (line 011A, set up in line 0114), and decrementing the count (line 011F) to see if all characters have been sent.

Notice how we must save both HL and B on the stack to keep them from being destroyed by Read Console Buffer in line 011A. The important thing to notice here is that the order in which we save the registers is in the opposite order in which we restore them. This is because the stack is last in, first out.

It’s easy to get confused in using the stack, popping things off into the wrong registers. Our program presents a relatively simple use of the stack, but when the stack is used extensively in a program, it’s important that you pay close attention to its use. Program bugs involving the stack can cause more than usually bizarre results and always seem to be particularly difficult to track down.

Get I/O Byte. Get I/O Byte and Set I/O Byte can be very useful when nonstandard devices, such as a modem, are connected into a system. These calls make possible assignment of different physical I/O devices to the logical devices to which the program thinks it’s talking. “Physical” simply means the actual device itself, such as keyboard, video screen, or printer.

Oddly enough, in CP/M, a system call to, say, the keyboard (such as Console Output) doesn’t necessarily have to go to the keyboard. By setting a group of four software switches, you can cause the character sent to the keyboard with Console Output to end up at the printer, or you can cause what you send to the printer to end up on the console device. The destination of the character is the “physical” device, whereas the device the program thinks it’s sending the character to is the “logical” device.

CP/M’s Stat utility can be used to make a system perform the tasks called upon by Get I/O Byte and Set I/O Byte, but they must be performed by the user from the keyboard. Get I/O Byte and Set I/O Byte let your program change device assignments without human intervention. “I/O Byte” in these system calls has a memory location of 0003H in a typical CP/M system.

The byte is broken up into four fields, each of which represents a logical I/O device (Fig. 7).

Each of the four logical devices is assigned two bits: the console gets bits 0 and 1; the list device gets bits 6 and 7; and so on. Each of these 2-bit fields can represent four numbers (00 = 0, 01 = 1, 10 = 2, 11 = 3). Each of the resulting four numbers is assigned to a physical device as follows:

CONSOLE FIELD (bits 0,1)
0 — printer device (TTY:)
1 — CRT device (CRT:)
2 — batch mode: READER is CONSOLE input, LIST is CONSOLE output (BAT:)
3 — user-defined device (UC1:)

READER FIELD (bits 2,3)
0 — teletype device (TTY:)
1 — high-speed reader device (RDR:)
2 — user-defined reader device #1 (UR1:)
3 — user-defined reader device #2 (UR2:)

PUNCH FIELD (bits 4,5)
0 — teletype device (TTY:)
1 — high-speed punch (PUN:)
2 — user-defined punch #1 (UP1:)
3 — user-defined punch #2 (UP2:)

LIST FIELD (bits 6,7)
0 — teletype device (TTY:)
1 — CRT device (CRT:)
2 — batch mode: READER is CONSOLE input, LIST is CONSOLE output (BAT:)
3 — user-defined device (UC1:)

70 Computers & Electronics
The three-letter mnemonics following each device are used in the
STAT function. Note that many of the devices listed are no longer used in
a typical CP/M system. Usually, CONSOLE is assigned to the “con-
sole printer device,” which CP/M thinks of as the teletype (TTY). Al-
though your console uses a CRT
(cathode-ray tube), the device name
CRT: isn’t usually used for the
console.

By bringing up DDT and typing
“d0,f,” the contents of the first 16
bytes of memory will be displayed.
Look at the byte in location 0003; it
will typically have a value of 94 hex.
Taking the binary of 94H and sepa-
rating it into groups of two bits res-
ults in 10,01,01,00. The first two
bits (10), show from the above that
the LIST function has been assigned
to the line-printer device; the next
two bits (01), that the punch device
has been assigned to the high-speed
punch; the next two bits (01), that the
READER device has been as-
signed to the high-speed reader; and
the last two bits (00), the CON-
SOLE device has been assigned to
the console printer device.

Here’s a program that uses Get
I/O Byte to display the I/O byte in
a form you can read:

```
-a100
0100 mvi c,7  call Get I/O Byte
0102 call 5
0105 mvi b,4  set count of 4 in B
0107 rlc  rotate A
0108 rlc  2 bits left
```

Save the program as “test9.ddt.”

This program displays the con-
tents of the IOBYTE. The first two
instructions are the Get I/O Byte
system call, which returns the
IOBYTE in register A. Next, we
take each of the four 2-bit numbers
and display them separately on the
screen as ASCII characters by rotat-
ing to the left the contents of regis-
ter A. The two bits that are now on
the right end of the IOBYTE are
converted to ASCII, printed, and
then rotated and printed again a to-
tal of four times. We accomplish
this with three new instructions:

**RLC (rotate-left) Instruction.**

There are eight bits in register A.
Think of them as bins lined up side
by side, each containing a 0 or a 1
(Fig. 8). When rlc is executed, the
bits in each bin move one bin to the
left. In doing so, the bit in bin 7,
having no place to move to the left,
loops (“rotates”) to the right and
occupies the far-right bin (0). The
value of the bit in bin 7 is copied into
bin 0 and also into a special 1-byte
register called the “carry flag.” This
can be useful in many circum-
stances, such as when you want to
rotate 16-bit numbers.

**ANI Instruction.** This instruction
means “AND immediate,” where
immediate means that the value to
be ANDeD with the content in regis-
ter A is part of the instruction, rath-
er than being stored somewhere
else in memory. The logical AND
instruction is somewhat like the OR
instruction, except that when you
AND two numbers together, both
bits in the corresponding locations
in the operands must be set for the
result to be set:

0 AND 0 = 0
0 AND 1 = 0
1 AND 0 = 0
1 AND 1 = 1

Here’s an example of two 8-bit num-
bers being ANDeD together:

| First number: | 01101001 |
| Second number: | 10110010 |
| AND result:    | 00100000 |
One useful application of an I is to “mask off” unwanted bits in a particular byte. ANDing a bit with 0 always results in 0, regardless of whether the bit was 1 or 0. So if we want to get rid of some bits in a particular quantity, we can AND them with 0. In our program, we want to get rid of all bits in register A except the two on the right (positions 0 and 1). Therefore, we “AND immediate” a 3, which is the number with the two right-most bits set: 00000011. All bits in register A that match up with a 0 will be set to 0, and all bits that match up with a 1 will be preserved (set to 1 if they’re already 1, cleared to 0 if they’re 0).

ADI (add-immediate) Instruction. This instruction is similar to anI, except that the contents in register A are added to the number following the instruction, using simple arithmetic addition of two hex numbers. If there’s a carry (resulting sum greater than FF hex or 255 decimal), the carry flag is set. The other flags are also set. In particular, if the result of addition is zero, the zero flag will be set; otherwise, it will be cleared.

In the above program, we want a 2-bit value of 0 (00) to print out ASCII 0, 2-bit value of 1 (01) to print ASCII 1, etc. However, the ASCII code for 0 is 30 hex (not 0), 1 is 31 hex, 2 is 32 hex, and 3 is 33 hex. Hence, we must add 30 hex to each of our 2-bit numbers before printing them out. This is where the adi instruction comes into play.

The program uses register B to hold the count of how many 2-bit numbers remain to be printed. This starts at four (set in line 0105) and counts down to zero, at which point, the program returns to DDT (lines 0117 through 011B). Register C is used to keep all eight bits of the IOBYTE—rotated two, four, six, or eight times—as the program progresses.

Since registers B and C can be saved on the stack with “push b” (line 010F), we can save both the count and the current rotated state of the I/O byte simultaneously and similarly restore them with “pop b” in line 0115. They must be saved because Console Out, used to print out the 2-bit numbers, destroys the contents of registers B and C when called.

Try running the program. It should give you the same value of the IOBYTE you found using the “d” function in DDT.

Set I/O Byte. This is a straightforward system call that sets the IOBYTE. Bear in mind that, unless you have some unusual I/O devices in your CP/M system, there’s not really too much you can do by changing the IOBYTE. However, here’s an experiment you can perform to see if everything is working as advertised. It changes the IOBYTE from 94 hex (10010100) to 14 hex (00010100), which changes the leftmost two bits from 10 to 00. In doing so, we’ve changed the destination of the LIST device from line printer to TTY: console printer. Use DDT to enter the following program:

```
-a100
0100 mvi c,8 set I/O Byte system call
0102 mvi e,14 new IOBYTE makes LIST the console device
0104 call 5
0107 rst 7 return to DDT
```

Run the program by typing “g100.” Then use ctrl-p to turn on your printer. Now, type something on the keyboard and observe the video screen. You will note that whatever you type gets printed twice on the screen, because the screen is simply echoing the keyboard as it normally does and a second time because ctrl-p turned on the printer echo. The characters that would normally go to the printer are rerouted to the console device because we put a 0 instead of a 2 in the LIST field of the IOBYTE.

Coming Up. We’ve now covered the most important of the nondisk system calls. Additionally, you’ve learned a lot about how CP/M works and how to program in 8080 assembly language. In the concluding parts of this series, we’ll present CP/M disk calls and finish up with some basic BIOS information, including how to change BIOS to use of any peripheral.
Play games... develop new programming skills... organize your finances... earn extra income... even build your own microcomputer!

HAVE IT ALL FOR ONLY $2.95

Select any 5 books (values to $94.80) for only $2.95 when you join!

7 very good reasons to try The Computer Book Club®

- Reduced Member Prices. Save 20% to 75% on books sure to increase your computer knowledge.
- Satisfaction Guaranteed. All books returnable within 10 days without obligation.
- Club News Bulletins. All about current selections—mains, alternates, extras—plus bonus offers. Comes 13 times a year with dozens of up-to-the-minute titles you can pick from.
- "Automatic Order." Do nothing, and the Main selection will be shipped automatically! But... if you want an Alternate Selection—or no books at all—we'll follow the instructions you give on the reply form provided with every News Bulletin.
- Continuing Benefits. Get a Dividend Certificate with every book purchased after fulfilling membership obligation, and qualify for discounts on many other volumes.
- Extra Bonuses. Take advantage of added-value promotions, plus special discounts; on software, games, and more.

Micro Computer Book Club®
Blue Ridge Summit, PA 17214

Please accept my membership in The Computer Book Club® and send the 5 volumes circled below, billing me $2.95 plus shipping and handling charges. If not satisfied, I may return the books within ten days without obligation and have my membership cancelled. I agree to purchase 4 or more books at reduced Club prices (plus shipping/handling) during the next 12 months, and may resign any time thereafter.

Name ____________________________ Phone ____________________________
Address __________________________
City ____________________________ State ______ Zip __________

Valid for new members only. Orders outside U.S. or Canada must be paid in International Money Orders in U.S. Dollars. Canada must remit in U.S. Dollars.

This order subject to acceptance by The Computer Book Club®

COPYRIGHT 1983
The fourth part of this series on the construction of an 8088-based microcomputer compatible with the IBM-PC examines two circuit elements in detail—the 8253-5 Programmable Interval Timer and the 8255A-5 Programmable Peripheral Interface (PPI).

**8253-5 Programmable Interval Timer.** The 8253-5 consists of three independent 16-bit counters under software control (Fig. 21). The 1.19-MHz clock inputs (pins 9, 15, 18) are fed from IC29 (Fig. 4) which divides PCLK (2.38 MHz) by two. (Note: Figs. 1 through 9 and Tables I through III appeared in Part 1 of this series.)

To cause a DMA memory refresh cycle every 15 µs, the monitor program initializes channel one as follows. During an initialization phase, it outputs a mode-control word to port 43 (see I/O map, Table II). This word selects the channel and type of counting operation desired. In this case, we have selected the “rate generator” mode of channel one. This simply means that the input clock will be divided by the constant entered into counter register one. There are six different modes of operation possible as listed in Table IV.

The program then loads a hexadecimal 12 (decimal 18) into count register one. This results in a pulse train output at pin 13 with a period of 15 µs (1/1.19/18). The RAM requires refreshing of the 128 row addresses (RAS) every 2 ms. This is done by the DMA controller, which has been initialized to perform dummy reads at one of the required 128 addresses every time the timer issues a pulse. The product of 15 µs and 128 is 1.92 ms, which is within the time required by the memory.

Channel two is used by both the speaker and cassette outputs. When used by the speaker, channel two is initialized in mode 3 (square-wave output). To get a 1-kHz tone, a 1-ms period is needed. We obtain this count by loading hexadecimal 0533 into count register two. This gives us a 1-kHz square wave at pin 17. To get the tone to the speaker, we have to output a logic 1 to the speaker data line (I/O port 8255 port B, bit 1, pin 19). While this line is high, the output from the timer is gated to the speaker through the 75477 buffer. The frequency and duration of the tone generated are programmable by both the timer and the 8255.

The cassette write routine also uses the channel two counter set for mode 3 (square-wave output). The count register is modified by the software program as follows. If a zero bit is to be outputted, a 500-µs square wave is generated. If a one bit is to be outputted, a 1000-µs square wave is generated. When the program is writing to cassette, it first turns the motor on by setting the MOTOR OFF line low (8255 port...
B, bit 3). This sets pin 3 of the 75477 low, energizing the relay. Then, using the timer, it generates a leader of 256 bytes of ones. This is followed by two sync bytes, 256 bytes of data, two bytes of error-checking code, 256 bytes of data, etc. until all the data specified is saved. After the last data block, a trailer string of four bytes of ones is written. The cassette motor is then turned off by setting the MOTOR OFF bit high. Although the cassette write program sounds busy, it is simply modifying the counter register to provide the tones that represent the data stored on tape. The cassette read is handled by the I/O port directly and will be discussed later.

Channel zero is not used in the basic Explorer 88. However, when the optional IBM keyboard is added, the program is changed to program the channel zero timer to interrupt the CPU at regular intervals. This allows keeping track of the “time of day” or other time-dependent programs. Channel zero is disabled during cassette operations.

### 8255A-5 Programmable Peripheral Interface

The 8255, although used in a relatively straightforward manner in this design, is a very versatile CPU interface. It consists of 24 I/O lines that can be individually programmed in two groups of 12 and used in three different modes of operation (Fig. 22). In mode 0 (Fig. 23A), each group of 12 I/O pins can be programmed in sets of four to be either inputs or outputs. In mode 1 (Fig. 23B), each group can be programmed to have eight lines of input or output, with the remaining lines used for handshaking and interrupt control signals. In mode 2 (Fig. 23C), eight

---

**TABLE IV—8235-5 OPERATION MODES**

<table>
<thead>
<tr>
<th>MODE</th>
<th>OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Interrupt on Terminal Count</td>
</tr>
<tr>
<td></td>
<td>After count bytes are loaded into selected count register, output goes low and remains low during the countdown. When terminal count is reached, output goes (and stays) high until selected count register is reloaded.</td>
</tr>
<tr>
<td>2</td>
<td>Programmable One-Shot</td>
</tr>
<tr>
<td></td>
<td>Output goes low on count following a gate input. Output will go high again on the terminal count. Since one-shot is triggerable, output is low for full count after gate input.</td>
</tr>
<tr>
<td>3</td>
<td>Rate Generator</td>
</tr>
<tr>
<td></td>
<td>Generates a square-wave output with a period equal to count loaded into count register.</td>
</tr>
<tr>
<td>4</td>
<td>Software-Triggered Strobe</td>
</tr>
<tr>
<td></td>
<td>Output remains high until terminal count has been reached. Then output goes low for one period of input clock. Count is inhibited while gate input is low and begins only after gate is brought high.</td>
</tr>
<tr>
<td>5</td>
<td>Hardware-Triggered Strobe</td>
</tr>
<tr>
<td></td>
<td>Output remains high until gate input is brought high. Then output goes low when count register terminal count is reached. Output remains low for one period of clock cycle.</td>
</tr>
</tbody>
</table>

---

![Fig. 22. Block diagram of the 8255A-5 Programmable Peripheral Interface.](www.americanradiohistory.com)
lines are used for a bidirectional bus and five lines for handshaking (borrowing one line from the other group).

The PPI is used here in mode 0 only. By writing a 99 hex to I/O port 63 hex, it is initialized so that ports A and C are inputs and port B is an output. (Complete programming details are available in the 8255 spec sheet.) Referring to Fig. 5, let’s examine how the two 8-position mode switches are connected. The switches advise the system monitor what hardware or memory has been connected to the system. Mode switch S1 is connected to port A, which is configured to be an input port, through buffer IC19. Port A is also connected to IC20, which is a shift register used by the optional IBM compatible keyboard to enter data. The status of port B bit 7 determines whether switch S1 or the shift register is to be read. Port B (set up to be an output port) and port C (set up to be an input port) have bit assignments as shown in Table V.

The optional keyboard generates serial data that is loaded into IC20. When the data is ready to be read, an interrupt request is generated at IC40. The keyboard service routines then read the data via PPI port A and use PPI port B bits 6 and 7 to generate the signals that reset the interrupt and provide for proper keyboard clock operation.

The cassette read function is handled completely by the PPI. When a read is requested, the cassette motor is turned on and the data is read into memory via IC37 (Fig. 4) and bit 4 on PPI input port C. The read program tests bit 4 continuously to check for a change in level. If the level changes in less than about 700 µs, a “one” is assumed; if not, a “zero” is read. In this way, the entire tape is entered into memory complete with an error test after each 256 bytes.

The relay used to control the cassette motor includes an extra switch pole that is used to test the cassette logic function without actually having to make a recording. This is made possible by the extra pole connecting the cassette output to the input whenever the relay is not activated. Software then tests that the cassette loop is complete.

(To be continued.)

---

Table V—8255A-5 Port Assignments

<table>
<thead>
<tr>
<th>PORT B</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>Timer channel 2 gate input.</td>
</tr>
<tr>
<td>1</td>
<td>Speaker data.</td>
</tr>
<tr>
<td>2</td>
<td>Selects reading of either S2 positions 1 through 4 or S2 position 5 when reading port C bits 0 through 3.</td>
</tr>
<tr>
<td>3</td>
<td>Motor off.</td>
</tr>
<tr>
<td>4</td>
<td>No connection.</td>
</tr>
<tr>
<td>5</td>
<td>Enables I/O check input from external bus, which is used to check for parity errors.</td>
</tr>
<tr>
<td>6</td>
<td>Hold keyboard clock low.</td>
</tr>
<tr>
<td>7</td>
<td>S1/keyboard sense line.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PORT C</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td></td>
</tr>
<tr>
<td>0-3</td>
<td>Report amount of memory above 64K.</td>
</tr>
<tr>
<td>4</td>
<td>Reads data from cassette input.</td>
</tr>
<tr>
<td>5</td>
<td>Reads status of timer out channel 2.</td>
</tr>
<tr>
<td>6</td>
<td>Reads status of I/O check line.</td>
</tr>
<tr>
<td>7</td>
<td>Not used.</td>
</tr>
</tbody>
</table>
Hardware

NCR Comes In. The NCR Corporation recently announced its entry into the personal computer field with a Decision Mate V series of microcomputer and with Decision Net, a local area network for linking personal computers. The new family features either 8- or 16-bit processors, 64K of RAM upgradeable to 512K, 4K of ROM, and a graphics memory of 32K for monochrome and 96K for color. The video display is a 12" monochrome green/black or color, having a display of 80 characters on 24 lines. There are 640 x 400 addressable dots. The keyboard has 20 programmable keys, while the disk drive is formed from two 5¼" floppy disks or one floppy disk and a hard disk. The floppy disk is double-density, double-sided while hard disks of 12.76M bytes unformatted are available. The system also has RS232 I/O, a parallel interface, and an NCR Omninet local area network interface. The operating system is CP/M-80 for the 8-bit (Z80A), CP/M-86 or MS-DOS for the 16-bit 8088 system. Prices for the 8-bit version with monochrome graphics start at $2800. The dual (1/4, bit) model sells for $3340. Address: NCR Corporation, Dayton, OH 45479 (513-445-2075).

CP/M For TI Computer. The Baby Tex is both hardware (plug-in board) and software (on a 5¼" diskette) and allows the user to run CP/M-80 programs on a TI Professional Computer. The Convert utility program allows transfer of files back-and-forth between the Professional Computer and nine types of computers. Keyfix, another utility, provides a simple way to set the special function and arrow keys for any CP/M program. Baby Tex includes 64K bytes of additional system memory which is accessible to the user even when the board is not in use. The system contains 64K bytes of RAM, Z-80B operating at 5 MHz, with fully transparent operation. $600. Bundled with Wordstar-Mail-Merge-Personal Pearl-WonderCalc, the price is $995. Bundled with Personal Pearl-WonderCalc, the price is $650. Address: Xedex Corp., 222 Route 59, Suffern, NY 10901 (914-368-0353).

6502 Analyzer. The DA6502-A is a stand-alone clip-on microprocessor analyzer for the 6502 that allows the user to examine processor registers, read and modify memory locations, halt a program, and stop a program at a location after a number of loops have been completed. The analyzer features an 8-digit hex display; the first two display the contents of the accumulator, the middle four refer to the address, and the remaining two display the data found at the displayed address. The microprocessor is accessed via a keyboard containing 24 switches. $279. Address: DA-TECH Corp., 92 Steamwhistle Dr., Ivyland, PA 18974 (215-322-9410).

Atari Printer. Interface No. 1 allows connecting any printer having a Centronics-compatible parallel interface (Anadex, C. Itoh, Epson, Microline, Okidata, etc.) to an Atari 400 or 800 computer via controller jacks J3 and J4. A printer handler is provided by cassette or diskette that replaces the resident printer handler, occupies less than 128 bytes of user program area, and is compatible with all Atari cartridges and programs. $85. Address: Looking Glass Microproducts, PO Box 5084, Loveland, CO 80537 (Tel: 303-669-2681).

ZX81 Cassette Interface. The Winky Board II is a cassette interface for Timex Sinclair computers that filters electrical interference to yield clean loading tapes, has a LED volume level indicator, can save a program on two tape recorders simultaneously, and contains a program duplicating system. It requires no power or hardware modifications. $24. Address: G. Russell Electronics, RD 1, Box 539, Centre Hall, PA 16828.

Apple Diagnostics. The APPLeSurance II is an automatic diagnostic package for the Apple II computer. The first part is on a disk controller card and operates at turn-on to check the motherboard RAM, language card RAM, processor, address, motherboard ROM, ROM card, and refresh test. Descriptive error messages even indicate which chip is bad. The second part is disk-based and covers the 16K RAM card, 80-column card, disk controller, printer, color, ROM card, disk drive, keyboard, prioritized interrupt system controls transmit, receive, error, and modem status change interrupts while diagnostics provide loopback functions for transmit/receive and input/output signals. Full duplex is supported with double buffering. Measure Boards 4" x 5". Single channel is $130; dual channel, $195. Address: Personal System Tech., Inc., 22957 La Cadena, Laguna Hills, CA 92653 (714-859-8871).

IBM-PC Controller. This dual-channel asynchronous communications controller for the IBM-PC features a rotating jumper plug to ease communications cabling by switching the transmit and receive signals in the connector. It has programmable baud rates from 50 to 19,200, and supports 5-, 6-, 7-, or 8-bit characters with 1, 1½, or 2 stop bits. Even, odd, or no parity bit generation and detection is also included. A full

COMPUTER SOURCES
Software

Software for New IBM-XT. The new IBM-XT uses PC-DOS Version 2.0 (MS-DOS Version 2.0) which supports the hard disks used in this new version of the Personal Computer. In addition, it supports many additional features not included in previous versions. These include (but are not limited to): a full screen editor, piping output from program “A” to be used as input for program “B,” sequential and direct access of data files, current data and time used in directory entries and graphics screen dump to printer, and chaining a series of programs in a pre-defined “job stream” that may be designated for automatic execution when the system is first turned on. Also, formatted capacity has been increased to 180K for single-sided or 360K for double-sided drive.

Concurrently with the IBM-XT announcement, IBM also released the Peachtree Software word processor called “PeachText.” This system is not only an advanced word processor, but can also use logical commands such as IF/THEN/ELSE and data variables such as NAME. PeachText can make decisions and pull in the appropriate information in the right place while printing.

The Accounting System by Peachtree has also been configured for the IBM-XT. This consists of five packages: General Ledger, Accounts Payable, Accounts Receivable, Inventory Control, and Payroll. This software will be available from IBM Product Centers and dealers.

Mini/Micro/Network Link. Blocked Aynchronous Transmission (BLAST) is a software system for linking computers of different manufacturers. This software employs a pipelined system to transfer computer files from computer to computer via standard dial-up, direct contact, satellite links, and networks. BLAST has been announced for DEC VAX, Apple, IBM-PC, all CP/M and MP/M products, and the full range of Data General equipment.

It transmits either binary or text files (from one system to another) and allows for transfer of parts of files as well as complete files. BLAST also can monitor and report phone-line quality and message traffic. Address: Communications Research Group Inc., 8938 Jefferson Highway, Baton Rouge, LA. 70809 (504-923-0888).

Seven MS-DOS Programming Languages. Microsoft has released seven new language versions for the MS-DOS operating system. This is the most popular operating system for 8088 and 8086 16-bit computers. The new language versions include a BASIC interpreter, a Compiled BASIC, Business BASIC Compiler, Pascal, FORTRAN, COBOL, and a C Compiler. All of these languages include common features that make it easier for the user to work with.

Common features include relocatable format, linker format, utilities, and calling conventions. They also feature compatible user interface characteristics so the programmer does not have to relearn the system when switching to a different language. In addition, application programs written in one language can be easily transported to any personal computer that supports the MS-DOS system. These include IBM, Wang, Texas Instruments, DEC, and Zenith. Both Microsoft’s BASIC Interpreter and Business BASIC Compiler allow users to write larger programs and include extensions that make effective use of the MS-DOS environment.

The new Business BASIC Compiler has a 14-digit precision decimal math package for very accurate calculations. In addition, this Compiler includes special features like dynamic arrays, multi-line functions, and full alphanumerical labels and references. Business BASIC also includes support for linking separately compiled BASIC programs and a utility that allows a user to translate CBASIC source programs into the Microsoft compiler format.

The new 16-bit MS-Pascal Compiler is the first Pascal that Microsoft has ever offered on the market. It complies with the ISO (International Standards Organization) level 0 standard with many extensions. MS-Pascal also includes support for the 8087 floating-point coprocessor along with the 8087 emulation capability. Therefore, on systems that do not use an 8087, an application program does not have to be modified to work. MS-Pascal also generates native code rather than P-code and includes features such as dynamic array handling capability.

Microsoft’s FORTRAN is compatible with the ANSI FORTRAN 77 standard at the subset level, with many full language features. It is also compatible with MS-Pascal even to the point where FORTRAN subroutines can be linked with a Pascal program.

The new MS-COBOL Compiler includes advanced screen-handling features and highlighting. It also handles with ease sequential, line sequential, and relative multi-key indexed sequential files. A powerful debugger is also included.

The C Compiler is another new language product from Microsoft. It is a full implementation of the language as described in Kernighan and Richie’s textbook, The C Programming Language. Address: Microsoft Corp., 10700 Northup Way, Bellevue, WA 98004 (206-828-8080).

Free Computer Education Program for Teachers. Tandy Corporation/Radio Shack has produced a computer education program for teachers to give them a basic understanding of computers and their applications in education. This includes an educator’s handbook describing how computers are used in schools, a basic computer literacy package to teach elementary computer concepts, a secondary-level textbook to illustrate programming concepts, and a certificate for three free classes on Basic programming and educational uses of computers.

In addition to the teachers’ material, a comic book entitled The Computer Masters of Metropolis, featuring “Superman” and “Wonder Woman,” will be available to schools on a continuing basis. Over 14 million of these comic books have been distributed to promote computer literacy. Address: Tandy Corporation/Radio Shack, 1800 One Tandy Center, Ft. Worth, TX 76102 (817-390-3832).

Physics Courseware for Apple II. Harmonic Motion Workshop, Projectile Motion Workshop, and Charged Particle Workshop are new courseware programs for the Apple II Computers. Developed by a former college professor, The Harmonic Motion Workshop visually presents the concepts associated with harmonic motion by the use of high-resolution graphics. The Projectile Motion workshop illustrates projectile motion under the influence of a uniform force of gravity. Charged Particle Workshop simulates the motion of a charged particle under the influence of various combinations of electric and magnetic fields. Packages require a 48K Apple II with Applesoft in ROM, Disk II, 57i each. Address: High Technology Software Products Inc., 1611 N.W. 23rd St., PO Box 60406, Oklahoma City, OK 73106 (405-525-4359).

Computers & Electronics
Representing the latest, top-of-the-line, component TV system of NEC Home Electronics (U.S.A.) Inc., the model C25-900A 25" color monitor and TU-831EN 133-channel tuner compares in all essential aspects to the previously reviewed Sony Protel, Teknika, and Sears systems, as well as the RCA VGM 2023S combination TV set and monitor. Like each of these systems, the NEC equipment has a number of special features that may be of importance to some consumers and not to others. Price, for example, will narrow the buyer's choice to features that are important.

The NEC 25" video monitor has a suggested retail price of $850, while its accompanying tuner, including the remote control system, is priced at $550. A video cassette recorder's tuner can substitute for NEC's tuner, of course. This compares to $1500 for the Sony 25" monitor and $520 for the Sony tuner, which, however, covers "only" 105 channels. RCA offers its VGM 2023S, which includes a 25" monitor and a 127-channel tuner, for $1080. Performance and detailed features differ among all these systems so you can analyze, compare, and decide what is most important and worthwhile for you.

Like other component TV systems reviewed so far, the NEC model offers both mono and stereo audio, with provision for optional external speakers. NEC also includes a 4" monitor speaker, together with a phone jack, which, when connected, disables this speaker. Separate volume controls for the internal and external speakers are provided on the NEC monitor control panel.

General Description. The NEC tuner model TU-831EN front panel contains the channel number display, which doubles as clock/timer, and LED indicators for TV, CATV, timer on and aux (auxiliary antenna). Separate LEDs are located on its mode pushbuttons, which control whether TV, Line 1 or Line 2 video/audio inputs are being processed. Another LED is located on the front-panel power pushbutton. The master power switch is located on the back panel. With this master switch on, the clock/timer is provided with a small current even when the front panel power is turned off. The ac outlet on the back panel is controlled by the front-panel power pushbutton, which is also controlled by the clock/timer. In this way, it is possible to program the turn-on or off time of the tuner and another piece of equipment, such as a VCR.

Channel selection can be performed directly by the proper combination of the ten channel number keys or by the scanning action of the channel up/down pushbutton. This scanning can be either in the manual or automatic mode, which is selected by the "search" button that's located under a hinged panel, which is part of the front-panel controls. In the auto mode, only those channels on which a TV signal is received will be selected, while in the manual mode, all channels will be scanned, whether a signal is present or not.

The volume control for all audio signals passing through the tuner is another up/down pushbutton. A note in the operating instructions reminds the user that the volume controls (internal and external) at the video monitor must be set for acceptable volume, since they can override the volume control at the tuner.

Bass, treble, and balance potentiometers are located under the hinged front-panel portion as well as six pushbuttons that control operation of the clock/timer. Another pushbutton selects TV or CATV operation. The auxiliary r-f input is used for CATV, including the
...NEC TV

use of a possible pay TV decoder box.

An unusual feature that may be important is the aft on/off pushbutton operation. NEC's tuner is a typical microprocessor controlled, frequency synthesizer, electronic tuning system, based on a crystal-controlled PLL (phase-locked loop). With the aft off, normal TV stations are received, based on the crystal control of the PLL. When CATV, VCR, TV game, or home computer rf signals are received, their carrier frequencies may not be as accurate as the crystal-controlled PLL. For these applications the aft is turned on, disabling the crystal control and allowing the aft circuit to "pull-in" these off-frequency signals. To accomplish the same "pull-in" the Sears tuner, for example, includes two keys for manual up/down fine tuning.

Like most high-performance tuners, the NEC unit uses a SAW (Surface Acoustic Wave) filter for the if signal, which is then amplified in a single IC. All age, noise-cancelling and if circuits, as well as the sound if amplifier, are included in this IC. Another IC provides FM sound detection and preamplification. As with the Sears tuner, the NEC version uses analog switching ICs, controlled by dc signals from the front panel controls. Power is provided through a transformer with multiple secondaries, and four bridge rectifiers drive five separate voltage regulators.

NEC's remote control uses two AA batteries and duplicates the tuner's front-panel controls. There are ten numbered keys, a channel up/down control, a volume up/down control, a mode selection pushbutton that changes mode (TV, Line 1 or Line 2) each time it is depressed, a power switch, a timer/channel display selector pushbutton, and a mute button to turn audio off temporarily. In each instance the remote control overrides the front panel control.

On the rear panel of NEC's tuner there are the standard 300-ohm ufterminals and the 75-ohm coax terminals for the vhf antenna and the CATV inputs. An adapter for 300-ohm twin lead is supplied with the tuner. There are two BNC-type coax connectors for video inputs on Line 1 and Line 2, together with two RCA-type audio jacks for each line. Similarly, there are BNC connectors and audio jacks for one output line and for the TV video output line. As already mentioned, the switched ac outlet and the master power switch are located here, too. Screwdriver controls for r-f age, video, and audio level are accessible from the rear panel.

NEC provides the typical table matching the TV and the CATV channel numbers. This means that the user must either memorize those CATV channels available or note them in a handy place. Sears included an adhesive-backed chart that the user could paste on the back of the remote control unit. While not an essential feature, it's certainly handier than a printed table.

NEC's monitor appears quite compact, measuring 234³/8" × 26¾" × 20¼". It is not as compact as or as light, however, as the RCA VGM 2023S. That 25" model measures 21¾" × 24¾" × 18¾", almost two inches less in each dimension, and includes a tuner that's very much the equivalent of the separate NEC tuner. The NEC monitor weighs 92.4 lb, plus 14.5 lb for the NEC unit, while the RCA unit weighs only 78 lb, including the tuner. Of course, few people buy a TV system because of size or weight. Moreover, heavier is sometimes better if it is the result of better shielding.

The NEC monitor has a removable safety glass, with all front-panel controls under a narrow hinged panel at the bottom of the screen. In addition to the power switch and the usual video controls—tint, color, contrast, brightness, sharpness—this subassembly also contains the internal and external volume controls and the VCR/line-selector switch. This pushbutton control determines whether the video and audio output signals at the back of the monitor go through the special 8-pin VCR plug or the BNC video and phono jack audio line outputs. Two LEDs on the main front panel of the monitor indicate which connection has been selected.

At the rear of the monitor is an interconnection panel for video and audio input and output signals. There is a single video/audio input channel and a total of three outputs. One is the monitor video/audio output, another is the line video/audio output (a tap-off from the line input) and the third is the 8-pin special VCR connector, which provides video/audio inputs and outputs. There is also an earphone jack that overrides the internal speaker, if connected, and terminals for two external 8-ohm speakers. One screwdriver adjustment permits setting the video input level and another the vertical-hold control. Three slide switches set mono/stereo, 75-ohm or high impedance (video), and connect the 3.58-MHz trap that is normally not connected. If this type of interference is observed, however, the user is instructed to set this switch to "on." With the trap in the circuit, the luminance bandwidth is, of course, greatly reduced.

All of the essential circuits, five ICs and 36 transistors, are located on three pc boards—the sound output, the video/CRT, and the main boards. A three-secondary power transformer provides full ac isolation, but the chassis is connected to the ground pin of the ac plug. While three B+ voltages are obtained from the power transformer.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity, vhf (Ch. 3)</td>
<td>58 dBm</td>
</tr>
<tr>
<td>Sensitivity, uhf (Ch. 20)</td>
<td>– 56 dBm</td>
</tr>
<tr>
<td>Noise figure, vhf (Ch. 3)</td>
<td>9 dB</td>
</tr>
<tr>
<td>Noise figure, uhf (Ch. 20)</td>
<td>11 dB</td>
</tr>
<tr>
<td>Video bandwidth to CRT (– 6 dB)</td>
<td>4.05 MHz*</td>
</tr>
<tr>
<td>(Monitor only)</td>
<td>4.15 MHz</td>
</tr>
<tr>
<td>Horizontal resolution (including tuner):</td>
<td>330 lines</td>
</tr>
<tr>
<td>Oscillator stability (Ch. 3)</td>
<td>0.05 MHz</td>
</tr>
<tr>
<td>(105 to 130 V ac, 2 hr) (Ch. 20)</td>
<td>0.05 MHz</td>
</tr>
<tr>
<td>Aft on pull-in range</td>
<td>0.12 MHz</td>
</tr>
<tr>
<td>Age dynamic range</td>
<td>67 dB</td>
</tr>
<tr>
<td>Dc restoration</td>
<td>100%</td>
</tr>
<tr>
<td>Horizontal linearity</td>
<td>100% left; 100% right</td>
</tr>
<tr>
<td>Vertical linearity</td>
<td>100% top; 100% bottom</td>
</tr>
<tr>
<td>Convergence</td>
<td>85% at worst (right side)</td>
</tr>
<tr>
<td>Pin-cushion effect</td>
<td>None</td>
</tr>
<tr>
<td>Voltage regulation 9+; tuner</td>
<td>96%</td>
</tr>
<tr>
<td>High-voltage regulation (105 to 130 V ac)</td>
<td>95%</td>
</tr>
<tr>
<td>Power rating; tuner</td>
<td>18 W</td>
</tr>
<tr>
<td>monitor:</td>
<td>130 W</td>
</tr>
</tbody>
</table>

* Switching the 3.58-MHz trap "on" reduces bandwidth to 3.4 MHz

www.americanradiohistory.com
DISCOVER THE MAGAZINE THAT HELPED LAUNCH THE MICROCOMPUTER INDUSTRY

Incredible as it may seem, Popular Electronics helped launch the microcomputer industry. Back in 1975, we published plans for building the first powerful microcomputer based on the 8080 CPU. These plans generated incredible excitement—and started the world thinking about personal computing.

Since then, we've added more coverage of personal computing. Today, so much of the magazine is devoted to microcomputers that we've changed our name to...

**Computers & Electronics**

*Computers & Electronics* continues the Popular Electronics tradition of helping our readers experience the advances of the future—today. We do it with clearly written, in-depth articles explaining each innovation... plans for building useful, money-saving projects incorporating the latest mass-produced equipment. Whether it's microcomputer equipment, audio, video, or personal electronics, *Computers & Electronics* will make it possible for you to enjoy the newest, the most sophisticated, the most innovative technology around.

**Helpful buying guides**

*Computers & Electronics* compares and contrasts computers and other electronics gear in meaningful buyer's guide articles. We discuss features and options, what to look for, and how to get the best value. Recent buyer's guides have covered computer printers, pocket computers, sophisticated telephones, video cassette recorders and high-tech audio cassettes.

**World-famous test reports**

In every issue of *Computers & Electronics* you'll find our famous in-depth test reports. We take a new product, test it, and analyze the results. Recently we've tested the Radio Shack TRS-80 Model III, the IBM Personal Computer, and the Sinclair ZX-81 Microcomputer by Apple, Atari, Hewlett-Packard, Intelligent Systems and Netronics. Plus an interactive data terminal, software, and a variety of audio, video and testing equipment.

**Innovative construction projects**

If you're a do-it-yourselfer, you'll love the construction projects in *Computers & Electronics*. Not only do we bring the world the first successful microcomputer kit, but also projects for building the first low-cost modem. The first computer keyboard integrated with the computer (SOL)...

The first low-cost voice synthesizer. The first low-cost logic analyzer. The first 1802-based microcomputer (EPL). The first low-cost function generator. The first gas-laser communicator (awarded a place in the Smithsonian Institution). The first low-cost color graphics computer module. An interface to transfer narrow line listings from your TRS-80 Pocket Computer to either a printer or CRT screen.

As you can see, our construction projects, while not necessarily complex (thanks to multifunction IC chips), will keep you at the forefront of technological development—at remarkably low cost. And in the future, we'll be bringing you construction projects to help you make your microcomputer more useful—whether it's an enhancement, an application, or a merging of technology with external controls and products.

**Get the leader in the field—at up to 33% off!**

*Computers & Electronics* is the world's most widely read computer and personal electronics magazine. Now you can subscribe at big savings: up to 33% off. At our New Subscriber rates, a one-year subscription is only $12.97. Take advantage of this offer—complete and return the coupon or postage-paid reply card today!

---

**Computers & Electronics**

P.O. Box 2774, Boulder, Colorado 80322

☐ YES! Send me one year (12 issues) of *Computers & Electronics* at $12.97—1 save 19%

☐ I prefer two years for $22.97—

☐ Make that three years for $31.97—

☐ I save 26%

☐ I save 33%

Savings based on full one year subscription price of $19.75

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

Address

City

State

Zip.

☑ CHECK ONE: ☐ Payment enclosed ☐ Bill me later

Offer valid in U.S. and possessions only. Please allow 3 to 60 days for delivery of first issue.
with the usual filtering and regulation, three other dc voltages are derived from the flyback transformer.

The actual circuits of the NEC monitor are quite standard, except that some of the special features found in the Sony, RCA, and some other systems are absent. The NEC monitor, for example, does not use a dual-sync system to accommodate the accurately interlaced TV broadcast system as well as the less accurate sync signals usually obtained from video games, VCRs, and other accessories. Automatic flesh-tone correction circuits are not included and the high-voltage protection circuit is not very sophisticated. NEC's monitor includes stereo audio amplifiers, but does not offer enhanced audio for the TV sound.

The rear-panel video/audio connectors permit a variety of interconnections similar to those of the Sony, Teknika, and RCA systems. When the tuner and its three input channels are used—antenna and lines 1 and 2—a VCR and a color camera can be interconnected as input, and two video monitors and stereo audio system as outputs. With the tuner, the VCR can provide both input and output for the monitor. An arrangement in which the monitor is used together with a color camera and VCR is another possibility.

The ability of the NEC monitor to operate either on 75-ohm or high-impedance video, depending on the setting of a slide switch at the rear panel, permits a unique "looping" feature. It is possible, for example, to use a tuner, camera, or VCR video signal as input line to one monitor and connect the output line to the next monitor, and so on. All monitors, except the last, are set to high impedance, and the last monitor is set to 75 ohms.

**Laboratory Measurements.** As indicated in the Table, the critical performance characteristics, sensitivity and noise figure, are excellent and almost identical to those of the previously tested high-performance, microprocessor controlled, electronic tuning systems. On the NEC tuner tested, we found the vhf noise figure at 9 dB a little higher than the RCA (5 dB), the Sears (7 dB) and the Sony (6 dB). For practical purposes, however, all of these measurements indicate excellent fringe-area operation.

The luminance (brightness) bandwidth was measured at 4.05 MHz when passing through the tuner and at 4.15 MHz when going through the monitor only. We observed the same amount of bandwidth reduction in the Sony system, but this 100 kHz difference is not really significant. Much more apparent was the effect of switching the 3.58-MHz trap into the monitor's video output amplifier section. The bandwidth dropped to 3.4 MHz and the change in horizontal resolution to about 300 lines was easily seen on a test pattern.

Oscillator stability with the aft off was perfect, clearly due to the crystal-controlled PLL in the frequency synthesizer. The aft pull-in range of 0.12 MHz should be adequate for most off-frequency signals. Agc range and dc restoration were excellent.

All of the remaining measurements, except for convergence, were excellent and almost identical to those made on the previously tested component TV systems. For some reason, possibly a slight movement of the deflection-yoke mounting in shipping, the entire right side of the screen was not properly converged. This was not apparent on moving scenes, but our test includes a rigid side-by-side comparison with a studio-type monitor and a color test picture obtained from a studio camera, and the misconvergence was clearly visible on this test.

Bandwidth and color fidelity were excellent, as verified by the oscilloscope photos of a color-bar signal illustrated here. These pictures also prove the good dc characteristics of the NEC monitor. Our group of sophisticated observers, TV studio technicians, agreed that the colors of the NEC monitor were just as excellent as those of the Sony and RCA, which they had previously considered tops. Some felt that NEC's blues and reds were a little overemphasized, but that may be due to personal preferences and, of course, adjustable. In summary, the NEC component TV system was found to be an excellent performer.

**User Comments.** Now that component TV systems are becoming popular, the competition in the market place is making itself felt in terms of features, performance, and price.

If you want a 25-inch monitor, top-of-the-line component TV system, you may find that price and features are the main consideration because most of them (at least those we have tested to date) perform about equally well. For example, Sony's price is clearly the highest, and its performance is great. It also features an RGB input for use with computers having RGB outputs. So there are some interesting considerations for one to weigh.

Enhanced audio on regular TV sound is available in most recent top-of-the-line TV equipment, but it is missing from the NEC system. Is that important to you? On the other hand, neither the Sony, Teknika or Sears monitors include a built-in speaker, in case you don't want to use external speakers. Is that an important feature for you?

NEC has a very flexible interconnection ability due to the monitor's rear panel. Sony, Teknika and, to some extent RCA, have a similar feature, but Sears does not. As a matter of fact, you can mix and match components of most manufacturers, but the Sony equipment is only sold in a combination tuner-monitor arrangement, and the RCA has the tuner and monitor in the same cabinet. Do you have a good VCR that you want to use as a TV tuner? You may only want to buy a monitor and speakers. Again, a decision for doing this would leave out the Sears and RCA as far as you are concerned.

Finally, compare prices. We always mention only the manufacturer's suggested retail price, but you may be able to get a better price at your local dealer on a particular model. Local service availability, manufacturer's reputation, and your own experience with a particular manufacturer's equipment are also important considerations. As the market for component TV systems continues to grow, the choice becomes greater and the consumer can really select just the equipment that suits him best. —**Walter H. Buchsbaum**

**Circle No. 102 on Free Information Card**

82

Computers & Electronics
Soar Model ME-531
3½-Digit Multimeter

The Soar Model ME-531 3½-digit multimeter is a classical example of how an excellent and low-cost measuring instrument can arise from the use of new semiconductor technology. Although at the low end of today's test instrument range, the Model ME-531 would have been a relatively high-level instrument only a few short years ago.

Physically, the ME-531 is a mere 3" wide, 6¼" long, and slightly less than 1¼" thick. Power is from two AA cells, and weight is 8 oz. Suggested retail price is $79.95.

General Description. The ME-531 has four input connectors: 10A, mA/ohm/diode, COM and V. The function switch has four color-coded and very clearly identified positions, while a pair of small pushbuttons is used to make subdivision selections. Power is controlled from a small switch on the left side of the front panel. The 3½-digit LCD is mounted under a protective rim. No carrying handle is provided.

DC voltage ranges are from 200 mV to 1000 V full scale with ac voltage ranges from 2 V to 750 V full scale between 40 and 500 Hz. Resistances can be measured between 200 ohms and 2000 kilohms full scale and the Lo-Ohm function between 2 kilohms and 2000 kilohms full scale. Both ac and dc current can be measured at 200 mA and 10 A (ac current can be measured between 40 and 500 Hz).

Input impedances are greater than 100 megohms on the 200-mV range with 10 megohms on the other voltage ranges. In the 200-mA range, the insertion resistance is about one ohm, reducing to about 20 milliohms on the 10-A range.

Comments. The Soar Model ME-531 Digital Multimeter was checked by the Lockheed Electronics Instrumentation Measurements Laboratory (Plainfield, NJ) against standards traceable to the National Bureau of Standards. After the tests, the IML issued a certificate attesting that the Model ME-531 met its claimed specifications in all respects.

Like all instruments that pass through here, the Model ME-531 was put to work on the bench to see just what it could do.

The instrument was well received. As a "pocket portable" DMM, the ME-531 was used both on the bench and in the field, and was found to be be an excellent instrument. Its relatively small size and lack of protruding knobs made it easy to slip in a pocket, and its single-control "front panel" made it convenient to operate.

Its most important feature—full autoranging—makes this instrument easy to use. All you have to do is select from voltage, resistance, or current via the single rotary switch, (and make sure that the red test lead is in the correct connector), and the multimeter does the rest. All ranges are automatically selected, with the range (V/mV, or ohms/kilohms) indicated on the 3¾" high LCD display.

If the measured range is less than 19 displayed digits, an internal beeper sounds off. This enables the user to make "eyes off" continuity measurements. This latter feature has usually been found only on the more expensive instruments.

Overload protection is provided, and overload is indicated by the blanking of all but the most significant (left) digit. Polarity is assumed to be positive unless a minus sign appears on the display. The maximum indication is 1999. A special low-battery annunciator appears on the LCD readout panel when this condition occurs.

Unlike the more expensive instruments, the low-cost ME-531 does not have an operation manual. It does come with a small "spec sheet" that covers the main specifications, and shows basic operation. Although written and printed in Japan, the English is excellent and, after a few minutes perusal, the spec sheet is no longer required.

After several weeks of use, we can recommend the Model ME-531 if you are looking for a low-cost, reliable, digital multimeter that can be used on the bench or in the field.

—Les Solomon

Circle No. 104 on Free Information Card
Ultrasonic Sound
Polaroid Rangefinder LM3905 Ap Note
Lower Supply Voltages Device Developments
By Forrest M. Mims, III

Use of Ultrasonic Sound

S EVERAL years ago I walked blindfolded through the grounds of the Arkansas Enterprises for the Blind wearing a unique pair of spectacles. On the bridge of the spectacles were three ultrasonic transducers connected by cable to a pocket-sized electronics package.

As I scanned my surroundings, a sequence of strange and exotic swept-frequency tone bursts were fed into my ears by plastic tubes. Depending upon the target's distance and surface texture, the sounds ranged from drzzz...drzzz...drzzz to whoosh...whoosh...whoosh.

Although not nearly a substitute for eyesight, the spectacles highlighted the application of ultrasonics in our everyday lives. There are many other interesting applications as well. One of the most recent is the ultrasonic ranging system developed by Polaroid for its SX-70 camera. We'll be discussing the design and operation of Polaroid's system here, but first let's find out more about ultrasonic sound.

Sound waves that have frequencies below and above the limits of normal human hearing are termed, respectively, infrasonic and ultrasonic sound. Infrasonic sound has a frequency less than a few hertz. It is generated by earthquakes, machinery, and moving air. Ultrasonic sound has a frequency greater than 20 kHz. It is generated by mechanical and electronic sources, jingling keys, rustling leaves, and animals such as bats.

Applications for low-intensity ultrasonic sound include measurement of mechanical stress, flaw detection, and non-optical imaging devices such as those used to view the fetus of a pregnant woman. High-intensity ultrasonic sound is used for soldering, surgery, mixing liquids such as water and oil, and forcing dirt and oil from objects immersed in an ultrasonically agitated liquid.

Though all these applications are important, none has generated as much interest as two of the very first applications for ultrasonic sound: distance measuring and object detection. As early as 1918, scientists had developed practical systems for detecting submarines by reflected waves of ultrasonic sound. In World War II, this technology became widely known as sonar, an acronym for sound navigation and ranging. Today military applications for sonar range from detection of submarines over a range of 10 km or more, mine detection, and guidance and control of various homing weapons.

The best-known civilian applications for sonar include the detection of fish and depth sounders. Detection applications in which the sound waves are propagated through air include ultrasonic intrusion alarms and, as described, travel aids for use by the blind and automatic focusing systems for cameras.

Polaroid's Ranging System. When Polaroid introduced its automatically focused SX-70 instant picture camera, more interest was expressed in the product's ultrasonic rangefinding system than in the camera itself. A few years ago Polaroid responded to this interest by introducing its Ultrasonic Ranging System Designer's Kit. The kit contains two preassembled circuit boards, two instrument-grade electrostatic transducers, two 6-V Polapulse® batteries, a battery holder, and an instruction manual. The kit is available for $150 from Polaroid Corporation (Battery Division, 784 Memorial Drive, Cambridge, MA 02139).

This remarkable kit requires only that the battery holder leads be clipped or soldered to one of the two circuit boards. It can then be used as an ultrasonic rangefinder, complete with a 3-digit LED display. It can detect and indicate the distance to objects within a range of 0.9' to 35.2'. It has a resolution of ±0.12" at distances out to 10' and ±1% over the entire detection range.

Since I've had considerable experience designing and testing infrared travel aids for the blind, I was particularly interested in experimenting with Polaroid's ultrasonic ranging system. The unit is much more sensitive than I had expected. For example, it will reliably detect a 1" diameter unfinished wood pole at 18'; it will detect a 9" diameter utility pole at 28'; and it will detect power lines 19' overhead.

The only major drawback of the system is its inability to reliably detect targets having a surface that is smooth with respect to the wavelength of the ultrasonic sound. Borrowing from optical terminology, such targets can be termed specular reflectors. If the surface texture of the target is rough with respect to the wavelength of the ultrasonic waves, the target can be termed a diffuse reflector.

Flat, specular targets whose surface is normal (perpendicular) to the oncoming sound waves are readily detected. When the target is off-axis to the beam of sound, however, the ultrasonic waves are reflected at an angle away from the source.

This can give rise to anomalous readings if the diverted off-axis beam even-

Fig. 1. A smooth target can cause false distance readings.
ultimately strikes a second surface having acceptable target characteristics. The sound will reflect back to the intended target and from there to the ranging system. The range measurement displayed by the readout, will, therefore, be the two-path distance to the second, unintended target. The intended target will be ignored. This phenomenon is illustrated in Fig. 1.

Infrared rangefinders that use LEDs and diode lasers exhibit this same problem when used to detect specular reflectors such as glass, polished marble, and automobiles with a high-gloss surface. Therefore, I was not surprised when the ultrasonic system could not detect these targets at an off-axis angle.

What was astonishing was the wide range of targets having relatively rough surfaces which, in fact, appear specular to an ultrasonic beam. Typical targets that are difficult or impossible to detect at other than the normal angle include smooth cement walls and driveways, plywood, painted surfaces, automobiles, flat metal plates, etc.

Fortunately, most targets include diffusely reflecting features that make detection possible even at off-axis angles. For example, the curved surfaces of most cars usually cause some of the ultrasonic beam to be reflected back toward the source. Overall, there are more diffusely reflecting targets (fabric, vegetation, shingles, people, posts, carpets, etc.) than specular targets. Nevertheless, it's prudent to be aware of the difficulties posed by specular reflectors when using an ultrasonic ranging system, particularly since Polaroid's otherwise excellent rangefinder manual fails to discuss the subject.

The Transducer. The key component of the Polaroid system is an instrument-grade electrostatic transducer that doubles as both an ultrasonic speaker and microphone. A foil diaphragm is stretched tightly over the concentrically grooved metallic backplate to form a capacitor. In receive mode, capacitance of the transducer is altered by incoming sound waves. In transmit mode, the electrostatic force of a charge placed across the capacitor causes the foil to move.

The transducer emits a relatively narrow sound cone (nominally 20° in divergence at the -20-dB points). The best operating frequency for the unit falls between 50 and 60 kHz. These parameters are clearly summarized in the plots, adapted from Polaroid's manual, which are shown in Fig. 2.

The Ultrasonic Circuit Board. The transducer is connected directly to the Ultrasonic Circuit Board, a slightly modified version of the board found in the SX-70 camera. Figure 3 is a block diagram showing the major sections of this board. These functions are implemented by three custom chips.

When activated, the Ultrasonic Circuit Board applies to the transducer, at intervals of about 200 ms a 1-ms, chirped sequence of 14 pulses at 60 kHz, 57 kHz, 53 kHz, and 50 kHz. The pulses have an amplitude of 300 V. Four different frequencies are used to minimize the possibility that the reflection characteristics of the target and, perhaps, its surroundings might cause destructive interference, thus cancelling the reflected sound wave.

The received signal, which may represent a single reflected echo or a series of echoes from various targets, is boosted by a cleverly designed amplifier that incorporates 16 levels of time-dependent gain control. The echo from a nearby target is generally stronger and arrives sooner than the much weaker echo from a more distant target. Therefore, the automatic gain control feature provides substantially more gain for distant targets. As gain is increased, the amplifier's frequency response is simultaneously narrowed. This improves the receiver's noise immunity at very high gain levels.

Figure 4 is a graph showing the theoretical gain for the first eight steps. Steps 10 through 16 resemble step nine as shown in Fig. 5, with each successive step having a 4-dB gain increase.

Figure 5 also shows the binary gain control signals (GCA, GCB and GCC) generated by the timing and control circuitry on the Ultrasonic Circuit Board. Also shown in Fig. 5 is the narrowing of the amplifier's bandwidth at and beyond the eighth gain step. Note the parallel listing of echo times and distances to the target.

Figure 6 summarizes the entire transmission and reception sequence for a
single chirp directed against three targets within the detection field. Note how the circuit shapes each echo and then generates a clean, square pulse representing only the first echo. This signal is designated MFLOG, and is available at pin 15 of the Ultrasonic Circuit Board. The transmitted chirp signal is available at pin 16 on the board. The time duration between these signals represents twice the distance to the target.

The Experimental Demonstration Board. The utility of Polaroid’s Ultrasonic Ranging System kit is greatly enhanced by the Experimental Demonstration Board. This board is essentially a custom 3-digit counter that converts the echo time signals from the Ultrasonic Circuit Board into distance to the target to the nearest tenth of a foot. CMOS IC’s are used throughout, and the range is displayed on a 3-digit LED readout. A red filter is included to increase the visibility of the display in the presence of bright ambient light.

Testing the System. The kit is supplied with the two boards connected by a 6-conductor ribbon cable. Therefore, all that’s necessary to use the kit as a 0.9"-to-35.2" rangefinder is to solder the two battery leads to the Experimental Demonstration Board. The boards, transducer, and battery holder should be installed in a suitable enclosure. Temporarily I have used a compact 7" x 6" x 1" wood cigar box. Holes for the display and power switch were cut through the box top, and a cir-
cular aperture for the transducer was made in the bottom of the box. An arrangement like this allows you to view range measurements while pointing the unit away from your face and other objects so that you’re pointing toward targets of interest. Make sure the transducer leads do not become disconnected and that exposed metal parts of the transducer, including its connections, do not touch either board. For best results, of course, install the boards in a permanent metal or plastic enclosure.

Incidentally, Polaroid warns that the transducer must be properly connected to the Ultrasonic Circuit Board before power is applied. Otherwise, the high-voltage chirps may damage the board. One of the two transducers supplied with the kit is connected to the Ultrasonic Circuit Board by a short, shielded cable. If the cable connections are flexed frequently, be sure to inspect the solder connections at regular intervals to make sure they are secure.

Commercial Applications. One of the most interesting applications for Polaroid’s rangefinder technology to reach the market is Tailmate*, a sophisticated detection system for trucks and trailers developed by Gregson Holdings Ltd. (382 Blackpool Road, Preston, Lancashire, PR2 2DS, England).

When a Tailmate-equipped vehicle is placed in reverse, the system is actuated, and the driver can then view a readout installed in the cab, which gives the distance to a loading dock or other object. If the driver wants to stop the vehicle a specific distance from an object, he can enter the distance into the Tailmate unit. Three feet before the pre-set distance is reached, the system emits a pulsed warning tone. When the desired distance is reached, a continuous tone is sounded. The system can also measure the distance to overhead objects.

Another application is the Sona Switch™, an indoor-outdoor object detection system designed for automatic door openers, vehicle detection, and security systems. The Sona Switch is a product of Electronic Design and Packaging Company (17425 Ecorse Road, Allen Park, MI 48101).

Other applications include robotics, vehicle height detectors, automatic controllers for agricultural equipment, and measurement of the product level in silos and storage tanks. A particularly interesting application is a wheelchair guidance system that helps quadriplegics maneuver a motor-driven chair through narrow passages like doorways and halls.

Experimenting with the Rangefinder

THE Polaroid rangefinder can be used with little or no modification for many applications. You can even interface the device with a computer bus. If you want to try a specific application, details on how to convert the distance reading from the rangefinder into audible chirps are given in the following experiment.

An Audible Output. Some of the many useful applications for Polaroid’s Rangefinder System can be enhanced by the addition of an output tone whose frequency

---

**Fig. 6. Waveforms of the transmission and target detection sequence.**

**Fig. 7. Block diagram of audible output circuit.**
varies with the range to the detected target. Figure 7 shows a block diagram of an experimental circuit I've designed that converts the echo time to a chirped tone. A single chirp is produced for each range-finding cycle.

Briefly, an ultrasonic burst from the ranging system triggers a one-shot that, in turn, causes the capacitor in a sample-and-hold circuit to begin charging. When the echo is received, the capacitor stops charging and is immediately discharged by an analog switch. During the time before the echo is received, a voltage-to-frequency converter produces a tone whose frequency increases with the charge on the capacitor. The result is a series of chirps. Nearby targets (short echo time) give low-pitched chirps, while distant targets (long echo time) give high-pitched chirps.

**Circuit Operation.** Figure 8 shows the complete circuit for the chirper. In operation, Q1 and Q2 serve as input buffers for the XLG (start) and MFLOG (echo time) signals from the Ultrasonic Circuit Board. The XLG signal triggers a 555 timer (IC1) configured as a monostable multivibrator. The output from IC1 (pin 3) remains high for a time determined by R7 and C2.

The MFLOG signal is ANDed by IC2A and IC2B, and, when both signals are present, analog switch IC3A is closed. This allows C4 to be charged through IC3A and R8.

The 555 timer, IC4, is configured as a voltage-to-frequency converter tone generator. Its control input is connected directly to C4. Therefore, as C4 begins to charge, the oscillation frequency of IC4 begins to rise.

When the echo arrives, the MFLOG signal goes low and the AND gate output also goes low. This opens IC3A so that C4 is no longer charged. Simultaneously, IC3B is closed by IC2A and the voltage on C4 is dumped to ground. The voltage-to-frequency converter immediately stops oscillating. Depending upon adjustments of R7, R8 and R9, the audio output from the circuit ranges from low-pitched thumps (nearby objects) to high-pitched chirps (distant objects).

You can better understand the circuit's operation by referring to the oscilloscope waveforms in Figs. 9 and 10. The upper trace in Fig. 9 shows the 1 ms tone burst that is applied to the ultrasonic transducer by pin 16 of the Ultrasonic Circuit Board. The lower trace shows the square wave that begins with the transmitted tone burst and ends when the first echo is received. It appears at pin 15 of the Board.

Figure 10 shows the critical waveforms in the chirp generator circuit for three different target ranges (2.4', 6.3' and 9.5'). The upper trace shows how the echo time is increased for each of these ranges. In one millisecond, sound travels approximately 0.89'. Therefore, the round trip time for the 9.5' range should be 9.5' x 2 x 0.89' or 16.9 ms. This is in close agreement with the indication of about 16.75 ms on the lower trace in Fig. 12.

**Using the Circuit.** Operation of this circuit is very much dependent upon the settings of potentiometers R7, R8, and R9. Potentiometer R7 controls the one-shot's pulse duration. If it is set to produce a pulse whose duration exceeds the time between range cycles (about 200 ms), the output sound will be a series of double or triple thumps or beeps.

Potentiometer R8 controls the charging time of C4. If its resistance is too low, the voltage-to-frequency converter will produce a steady tone. If its resistance is too high, the voltage of C4 may take too long to reach the levels required to alter the tone from IC4.

---

**Fig. 8. Circuit of the rangelinder audible output chirper.**

**Fig. 9. Waveforms at target detection.**

**Fig. 10. Waveforms of audible output circuit.**

88
If you own a Timex Sinclair, a ZX81, or any other Sinclair computer, you’ve probably discovered that the big microcomputer magazines cover only the bigger computers. Where can you find helpful articles on the Sinclair? In Sync!

Sync is the one magazine that’s written exclusively about Clive Sinclair’s marvelous inventions, the Sinclair computers. And it’s the one magazine to read if you want to get more from your Sinclair.

You’ll find program listings for games, helpful programming techniques, hardware upgrades, math and science programs, news of new products for the Sinclair—in short, everything you need to use and enjoy your Sinclair to the fullest.

In just two recent issues, for example, we covered:
- Putting a Reverse Character in a String
- How to Double Your Memory
- Least Squares Data Analysis With the ZX80/81
- Space Warp: A Graphics Space Game
- How to Reduce “Blank Screen Time”
- Storing Three-Letter Words in an Array
- Software Review: ZX Galaxians
- An Introduction to Expression Evaluation
- Short Programs Just for Fun
- The ZX81 Parser and User-Defined Commands
- Understanding Floating Point Arithmetic
- Handling Strings from Another Dimension
- Book Review: Understanding Your ZX81 ROM
- How to Add a Keyboard to Your Sinclair
- Translating Other Basics: DEF on the ZX81
- Six Outer Space Games—With Program Listings
- Hardware Review: Sinclair ZX Spectrum High Resolution Color/Sound Computer

If you own a Sinclair microcomputer, Sync is the only computer magazine you really need. Subscribe now to Sync, and you can save up to 33%! Just complete and return the postage-paid reply card or the coupon at right.

**SAVE UP TO 33% ON SYNC!**

CN 1986 · Morristown, NJ 07960

**YES!** Please send me Sync for:
- One year (6 issues) for $12.97— I save 19%.
- Two years (12 issues) for $22.97— I save 28%.
- Three years (18 issues) for $31.97—I save 33%.

Savings based on full 1-year subscription price of $16.

Mr.
Ms.

(please print full name)

Address
Apt.

City

State Zip

CHECK ONE:
- Payment enclosed.
- Bill me later.

Offer valid in U.S. and possessions only. Please allow 60 to 90 days for delivery of first issue.

**NEW SUBSCRIBERS ONLY**
Finally, $R_9$ controls the pitch of the chirps. For best results, set $R_9$ to produce very-high-pitched chirps when the system is detecting very distant targets. Nearby targets will then give a characteristic thump...thump...thump...

**Going Further.** The circuit is Fig. 8 is not optimized, and many variations are possible. For example, you can replace $C_4$ with a piezoelectric alerter (Radio Shack part #273-065 or similar). The alerter will emit tone bursts whose duration is perceptibly longer when distant targets are being detected. Since all the bursts are brief, no matter what the range, longer pulses from the alerter seem louder than very short pulses. The overall effect provides an interesting alternative to the voltage-to-frequency converter chirped tone output.

**LM3905 Ap Note**

THOUGH less well-known than its 555 predecessor, the LM3905 is a precision timer with a host of applications. Capable of operating from unregulated supplies of 4.5 to 40 V, the LM3905 and its LM122/LM222/LM322/LM2905 counterparts can provide constant timing periods ranging from microseconds to hours. Variations in the supply voltage after the timing period by less than 0.005% per volt. Therefore, poorly or unregulated supplies with considerable ripple can be used. The chip typically consumes only 2.5 mA in the quiescent state (that is, no external load being driven).

Figure 11 is a straightforward on-after-delay timer given in National Semiconductor’s data sheet on the LM3905. This circuit nicely simulates a thermal time-delay relay of the kind often used to apply power to a circuit at a fixed interval after a main switch is closed.

Operation of the circuit in Fig. 11 is straightforward. When $S_I$ is closed, the LM3905 enters a timing cycle with a duration of $R_{IC1}$ seconds. After the cycle is completed, the relay is actuated. Diode $D_1$ protects the LM3905 from back emf produced by the relay coil when $S_I$ is opened.

For variable delays, use a 1-megohm potentiometer for $R_I$. For very long delays, use large values for $C_I$.

Incidentally, the circuit can be easily modified as shown in Fig. 12 to operate in the converse manner. In this configuration, which is also given in the LM3905 data sheet, the relay is closed when $S_I$ is closed. After a time interval of $R_{IC1}$ seconds, the relay is opened.

For those of you who are skeptical about circuits given in application notes, such as the two discussed here, you can be assured I’ve breadboarded both these timers. They work just as described.

**The Move to Lower Supply Voltages**

BEFORE the end of this decade, 5-V logic systems may be as scarce as RTL chips and watches with LED displays. That’s because a major move is now underway to standardize logic circuits for operation at 3 V.

Already most CMOS chips are specified for a minimum supply voltage of 3 V. A major impetus for the proposed new standard is that even this minimum is appreciably close to breakdown ratings as low as 5 V that characterize newer smaller ICs.

Warren Andrews has reported in *Electronic Engineering Times* that the proposed new 3-V supply standard is slated to apply to both MOS and bipolar linear and digital chips (January 3, 1983). A committee of the Joint Electronic Devices Council (JEDEC) has already approved a 3.3-V ($\pm0.3$ V) standard for line-operated regulated supplies and a 2-to-3.6-V standard for battery-powered operation.

Two supply standards will satisfy both TTL and MOS manufacturers. The tolerance margin of the 3.3-V standard for regulated supplies will guarantee that TTL circuits are powered by at least 3 V and, therefore, provide a comfortable margin above TTL's guaranteed minimum high-state output ($V_H$) of 2.4 V.

The battery supply standard covers a wider voltage range to allow for the great variety of battery chemistries and discharge characteristics. The 2.3-V minimum is within 10% of the 2.2-V potential of single lead-acid storage cells. The 3.6-V maximum matches the maximum for the recommended regulated supply voltage and leaves room for a single lithium cell (2.8 V), two mercury cells in series (2.7 V), two alkaline or carbon-zinc cells in series (3 V), or two nickel-cadmium storage cells in series (2.4 V).

The proposed new voltage standards must be approved by several additional
JEDEC committees before final consideration by the JEDEC council. David Ford, chairman of the JEDEC committee that proposed and approved the new standards, was quoted by Electronic Engineering Times as having said, "The reaction to the proposed standards is basically positive."

Adoption of the new standard will have several important long-term impacts on solid-state electronics. For example, line-powered supplies will require the development of 3-V regulator chips and low secondary voltage transformers. Three volt zener diodes will become more widely available.

The most important result of the new standards will be even more growth in the variety and availability of portable battery-powered electronic devices. Certainly, single lithium 2.8-V power cells will become the battery of choice for nearly all such devices. We can therefore expect to see better availability and important price reductions for lithium cells.

Conventional mercury, alkaline, and carbon-zinc chemistries can also be used to meet the new standard, but only in a series arrangement of two cells. Meanwhile, the familiar 9-V transistor radio battery will eventually be relegated to older equipment and special-purpose applications. If competition drives prices down, single lithium cells might even capture a big share of the market that now exists for standard cells.

These speculations should be tempered with the knowledge that a continued reduction in IC fabrication dimensions may eventually require an even lower power supply standard of about 2 V or even less. If this occurs, new or modified battery chemistries may be required. In any event, the rapid advances in IC fabrication technology and the move to lower voltage standards are sure to bring many important changes.

**Device Developments**

**The Iso-Gate Optoisolator**, Dionics, Inc. (65 Rushmore St., Westbury, NY 11590) announced more than a year ago the development of miniature integrated photovoltaic diode arrays. The company has recently introduced a series of novel optoisolators that employ an infrared-emitting diode and one or two of the new photovoltaic diode arrays to directly drive the gates of power MOSFETs. According to Bernard L. Kravitz, Dionics' president, "Since the output voltage of the Iso-Gate is self-limited by its very construction, it becomes physically impossible for an Iso-Gate to deliver a harmful voltage to the MOSFET."

Iso-Gates can enhance the design and reliability of both switching (for example, a solid-state relay) and analog MOSFET circuits. Kravitz observes, "Some examples of these non-relay MOSFET functions are amplification stages, motor-control circuits, and switching power regulators. In all of those, there is a great advantage in driving the delicate gate of the MOSFET with an optoisolated, self-generated, and self-limited voltage source that is truly 'floating.'" Since the output of the photovoltaic half of the new optoisolators is highly linear with respect to the forward bias applied to the infrared emitter, the new optoisolators may find applications in such linear roles as isolation amplifiers and frequency-to-voltage converters.

Figure 13 shows a typical Iso-Gate MOSFET driver circuit. The resistor $R_{shunt}$ discharges the residual voltage remaining in the photovoltaic array (by virtue of its parasitic capacitance) when illumination from the infrared-emitting diode is suddenly removed. Depending upon the device, optimum values of $R_{shunt}$ range from 1 to 10 megohms. For faster switching speeds, Dionics recommends paralleling the Iso-Gate with a phototransistor optoisolator or a second Iso-Gate.

Dionics now sells five Iso-Gates. The three devices in the DIG-11 series are installed in 6-pin DIPs. Included is a single infrared-emitting diode and photovoltaic diode array. They deliver a minimum self-generated, fully-floating, open-circuit output of 6 V when their infrared-emitting diodes are driven with a forward current of 30 mA. Depending upon the device, the short circuit output current ranges from 2 to 30 $\mu$A. Prices in 1000-10000 quantities range from $1.32 to $1.87.

The DIG-122 series includes two devices housed in 8-pin DIPs. These devices include two independent photovoltaic diode arrays which, when connected in series, deliver from 12 to 17 open-circuit volts. The short-circuit output current ranges from 1.5 to 9$\mu$A. In 1000-10000 orders they are $1.82 and $2.13.

**The New ELF II "Beginners" Package**

Your own expandable micro-computer kit, 5 diagnostic analyzers plus circuit, programming, diagnostic manuals, even games you can play on TV. All only $11.95. Even if you don't know bits from bytes, how's it easy and inexpensive to build your own micro-computer, learn how it works, program it, service it--even play games with it on your TV. It's in the New ELF II "Beginners" Package, only from Netronics. Only $11.95. Here's the package: 1. your own micro-computer, the famous ELF II (including the RCA 1802 CMOS microprocessor) in kit form with step-by-step instructions on how to build it. Diagnostic Analyzers including 2. your own Logic Probe. 3. Pulse Catcher. 4. 8-bit Test Generator. 5. Logic Analyzer. 6. Gate Arrays. 7. Non-Technical Manuals on how to use analyzers, to get into the guts of the computer, what makes it tick, how to service it. 8. Sample Programs that teach you machine language programming plus now to correct or "debug" any programming mistakes. 9. TV games you can play. If your TV set has no video input, an optional converter (RF Modulator) is available. Then, once you've got this "Beginner's" Package under your belt, keep on expanding your ELF II with additions like the Typewriter Key Board, added RAM, Full Basic Interpreter, Electric Mouth Talking Board, Color/Music. A/D-D/A Boards for Robotic Contrs and much, much more. You'll take you by the hand with the new ELF II "Beginners" Package. Only $13.95. Mail or phone in your order today and begin.

Call Toll Free 800-243-7428
To Order From Connecticut or For Technical Assistance, Etc.
Call (203) 354-9375

**NETRONICS R&D LTD.**

333 Litchfield Road, New Milford, CT 06776

**CONVENTIONAL USA Credit and Buyers Outside Connecticut**

**Please send the items checked below:**

- **ELF II "Beginners" Kit**
  - $13.95

- **RF Modulator**
  - $5.95

- **Plus $3.00 for postage, handling and insurance**
  - ($5.95 Canada)

**Connecticut Residents add sales tax**

**Total Enclosed $**

**Payment:**

- **Check**
- **Personal Check**
- **Master Charge**
- **Visa**

**Enclosed**

**Purchase Order**

**Authorize(s):**

- **Address**
- **City**
- **State**
- **Zip**

**Signatures Only:**

- **Exp. Date**
- **Print Name**

**Mail to:**

- **NETRONICS R&D LTD.**
  - 333 Litchfield Road, New Milford, CT 06776

**Calculate the total cost, including postage and handling, and make the appropriate payment.**

**Call Toll Free 800-243-7428**

**AmericanRadioHistory.Com**

**JUNE 1983**
New Peripheral Controller Chips. Rockwell International’s Electronic Devices Division (4311 Jamboree Rd., PO Box C, Newport Beach, CA 92660) has introduced four new single-chip, 8-bit intelligent peripheral controllers (IPC). These new controllers are actually 6502 microprocessors with on-chip hardware designed specifically to enhance their role as controllers of motors, printers, typewriters, robots, instruments, and communications equipment.

All four of the new IPCs include a parallel-host data bus compatible with the 6500/6800 and 8080/Z80 microprocessor families. They also include on-chip input, output, and status and control registers for data transfer functions. All four chips have on-chip input, the 6500/6800 and 8080/Z80 microprocessors are parallel-host equipment. In addition, they have the capability to collect signals with analog and digital converters chips to collect on-chip data.

Four analog and digital converter chips are claimed on-chip to collect signals with analog and digital converters chips to collect on-chip data. The TL530, TL532, TL531, and TL533 feature an 8-line TTL compatible bidirectional data bus. Also included are on-chip multiplexers and 16-bit analog and digital data registers. According to Texas Instruments, these features make it relatively simple for a microprocessor to collect multiple analog and digital inputs with a minimum of hardware and processing time.

Figure 14 shows these new chips and a block diagram summarizing their operation. The TL530 and TL531 are 40-pin units that can accept up to 15 analog inputs and 12 digital inputs. The TL532 and TL533 are 28-pin chips that accept up to 11 analog and 6 digital inputs. Six of the inputs of all four chips are multi-purpose and can accept either analog or digital signals. If some of these specifications seem familiar to experienced A/D users, it’s because the TL530 and TL531 can be used as functional replacements for the 74C924 and MC144444; and the TL532 and TL533 for the 74C934.

These new chips feature maximum conversion times of 300 µs. They typically consume 15 mW and require a single 5-V supply. In 100-lot quantities, the TL533 sells for as little as $4.32. Write Texas Instruments’ Literature Response Center (SC-389, PO Box 202129, Dallas, TX 75220).

A Fast CMOS UART. Though CMOS consumes considerably less power than NMOS, CMOS has traditionally been slower. For this reason, CMOS is not yet widely used in fast data communications and interface applications.

Recently, National Semiconductor (2900 Semiconductor Drive, Santa Clara, CA 95051) introduced a new CMOS Universal Asynchronous Receiver-Transmitter (UART) fabricated with the firm’s proprietary double-poly CMOS process, p^2CMOS-11". The new chip, which is designated the NSC858, operates at up to 1 million bits per second. The chip typically consumes 50 mW. It includes a programmable on-chip baud-rate generator that can accept clock rates up to 3.1 MHz and divide them by 1 to 216.

In addition to various standard UART features, the NSC858 includes each of the five standard MODEM control functions, a processor interrupt system to minimize processing time required to control the UART, and complete hardware and software power-down capabilities.

![Fig. 14. Block diagram shows operation of TI’s CMOS A/D converters.](Image)
OPERATION ASSIST


Hickok Model 209-A VTM. Need calibration procedures. Howard Adams, 209 West Shadywood Dr., Mid- west City, OK 73110.


Galaxy Model R-530 receiver. Need schematic. C. Bator, 1222 Harrison, Wooster, IL 60187.

Hy-Gain Model GT550-A SSB transceiver. Need schematic and service manual. Jose R. Sastabales, Quintana Roo, No. 31, Queretaro, Gto., 76000 MEXICO.


Cornell-Dubilier Model 8FL0 capacitance resistance bridge checker. Robert Harshb, 1222 Leland Ave., Lima, OH 45805.

Simpson Model 466 oscilloscope and Healthkit Model SQ-1 generator. Need operating and service manuals. Richard L. Kincard, 5572 Codonia Ave., Baltimore, MD 21206.


General Electric Model 6633 refrigerator. Need schematic or any information available. Jerry Hockens, Route 5, Lost Lane, DePere, WI 54115.


Fanon Model TR-25 amplifier. Need schematic. Spencer Sedimay, Rural Route 1, Stoddard, WI 54658.

Wang Model 629 cassette deck. Need schematic. Dave Overton, 1709 W. 30, Austin, TX 78709.


Knight-Kit Model KG-988 stereo receiver. Need schematic and manual. Dan Witt, 45 E. Duck Lake Drive, Gobles, MI 49055.


June 1983

WHILE OTHERS PROMISE... WE DELIVER

ORDER TOLL FREE (800) 221-8180
IN NEW YORK (212) 392-6600

McIntosh Laboratory Inc
East Side Station P.O. Box 96
Binghamton, N.Y. 13904-0096

NAME ____________________________
ADDRESS ____________________________
CITY ____________________________ STATE ZIP ________

McIntosh Laboratory Inc
East Side Station P.O. Box 96
Binghamton, N.Y. 13904-0096

NAME ____________________________
ADDRESS ____________________________
CITY ____________________________ STATE ZIP ________

If you are in a hurry for your catalog please send the coupon to McIntosh.
For non rush service send the Reader Service Card to the magazine.

CIRCLE NO. 31 ON FREE INFORMATION CARD

www.americanradiohistory.com
**TIMEX SINCLAIR 1000**

---

![Image of TIMEX SINCLAIR 1000](image-url)

**Powerful - fully programmable 2K memory**
- 64 x 6 *x* 11 - 12 oz.
- Expandable - Optional module
- Single-key entry commands
- Educational - Unlimited system capabilities
- Codes for error identity
- Accurate to 9 decimal places
- Standard Scientific functions
- Graph drawing and animated display of numbers
- Combining power, portability and affordable price.

---

**ACCESSORIES FOR TIMEX SINCLAIR 1000 and XZ81**

**Keyboard Mask for Your XZ81/1000**

**XZ81/1000 Keyboard Conversion Kit**

---

**CONTROL DATA KEYBOARDS**

- **Parallel ASCII**
- **SMI Switching**
- **FT2 Shielded Wire**
- **N-K Relay**
- **128 Character ASCII**
- **Non-Slip, Non-Glare Keycaps**
- **DC2000, DC1000 Keyboards**
- **Attractive Case**

These Control Data Keyboards consist of a built-in keyboard assembly, and an interface cable. Color (black).

---

**Keytrons 90-Key Soft-Programmable Keyboard**

- **9-Key Enhanced**
- **Cursor Control**
- **Keyboard Entry**
- **Interrupts**
- **Eprom Chips**
- **Microcomputer**
- **Customized**
- **High-Speed Board**
- **100%? Programmable**
- **Microswitch Ttl Logic**
- **Size: 17" x 9" x 2 1/2""

---

**ASSEMBLE YOUR OWN KEYBOARD**

- **Keyboard Mask**
- **Assemble your own keyboard**

---

**EVP-UMER Eraser**

6 Chips — 51 Minutes

---

**EXPAND YOUR MEMORY**

TR-80 to TR-80K, 32K or 64K

**Model 1**
- From 4K to 16K Requires 2 [3] Kits

**Model 2**
- From 16K to 32K Requires 3 [3] Kits

**Model 3**
- From 32K to 64K Requires 3 [3] Kits

---

**JOYSTICKS**

JS-5K
- Joystick
- $3.95

JS-10K
- Joystick
- $4.95

---

**INFORMATION REQUEST CARDS**

1 Chip — 37 Minutes

---

**CALL FOR QUOTATIONS**

Mail Orders to Electronics Warehouse

1355 Shoreway Road, Belmont, CA 94002

PHONE ORDERS WELCOME — (415) 592-8097 Telex: 176043

---

**MINI Floppy Disk Drive**

For TRS-80 MODEL I, Industry Standard 5.25" Form Factor, 80 tracks, 20 sectors x 512 bytes per track, 3 orientation holes, with power supply cord, 18" cord. Unit as pictured (includes power cord). Price $17.95 each.

---

**VJC-100**

New VJC-100K Keyboard

JS-5K (Five-Color)
- $7.95

JS-10K (Ten-Color)
- $10.95

JVC-4B (Four-Color)
- $4.75

---

**JS-NOD**

New JVC-NOD keyboard

JS-5K (Five-Color)
- $9.95

JVC-10K (Ten-Color)
- $16.95

JS-15K (Fifteen-Color)
- $22.95

---

**FOR TRS-80 MODEL I**

Floppy Drive Disk Drive, Single-sided. Includes drive, power supply cord, and instructions. Disk drive is designed to work with the single-sided floppy drive and the single-side CPS-2000 floppy diskettes. Unit as pictured (includes power cord). Price $9.95 each.

---

**FREE**

Announcement

USING YOUR TRS-80 MODEL I WITH A Keyboard Enclousure

---

**FREQUENTLY ASKED QUESTIONS**

1. Can I use a keyboard from another computer?
   - Yes, but you will need to modify the connections to fit the TRS-80 MODEL I.

2. How many characters can I type at once?
   - You can type up to 16 characters at once.

3. Can I type in upper and lower case?
   - Yes, your keyboard supports both upper and lower case.

4. Is the keyboard waterproof?
   - No, it is not waterproof.

5. How do I connect the keyboard to the computer?
   - Connect the keyboard using the provided cable to the keyboard port on the back of the computer.

---

**Contact Information**

Jameco Electronics
1355 Shoreway Road, Belmont, CA 94002

PHONE ORDERS WELCOME — (415) 592-8097 Telex: 176043

---

**Supplier Information**

Jameco Electronics
1355 Shoreway Road, Belmont, CA 94002

PHONE ORDERS WELCOME — (415) 592-8097 Telex: 176043
NEW—THE BEST OF SYNC

Here's an all-new collection of articles and programs that appeared in the first six issues (now out of print) of Sync magazine. Chapters include: Games, Math and Math Graphics, Software Programming Techniques, Translation, Graphics, Machine Language, Hardware, Resources, Reviews, Glossary—and more.

In The Best of Sync, Volume One, you'll find games like "Forest Treasure"—plans for a "Key Click Generator," techniques for "Handling Character Strings in the ZX81" and "Converting from other BASICS"—and many other hard-to-find programs, reviews and procedures.

If you own a Sinclair ZX80, ZX81 or Timex Sinclair 1000, this is one book you can't afford to miss. Order your copy now!

8½" x 11", softcover
ONLY $9.95!

For faster service, PHONE TOLL FREE: 800-531-9112
(In N.Y. only: 201-540-0445)

CREATIVE COMPUTING PRESS
Dept. NB40 39 East Hanover Avenue, Morris Plains, NJ 07950
Please send me The Best of Sync, Volume One, at $9.95 plus $2.00 postage and handling each. Outside USA add $7.00 per order. -PM

☐ PAYMENT ENCLOSED
☐ Check/Money Order
☐ Charge My: □ American Express □ MasterCard □ Visa
☐ Signature
Date
Card No
Expiration Date
Address
City/State
☐ Send me a FREE Creative Computing Catalog

Also available at your local bookstore or computer store.

QUALITY Service
AVAILABILITY

ACTIVE ELECTRONICS

WE ARE THE LARGEST WE ARE THE BEST.
Over $40 million in stock. The world's most complete hobbyist inventory.

Active Electronics is your one-stop source for the widest variety of top quality semiconductors, microprocessors, memories, microcomputer systems, peripherals and electronic components.

NEW—1983 IC MASTER

The FIRST and ONLY complete guide to IC's, Microcomputer Boards and Development Systems.

Two Volume set 3300 pages
Regular Price: $35.00

ACTIVS PRICE
ONLY $79.95

Circle No. 50 on free information card or write:
P.O. Box 8000, Westboro, Mass. 01581
CALL TOLL FREE: 1-800-343-0874
MASS. customers call (617) 366-0500

CIRCLE NO. 50 ON FREE INFORMATION CARD

GET IBM-PC Capacity at a Fraction of IBM's Price!

New NETRONICS 16 Bit EXPLORER 88-PC Kit

Starts at Just $899.99—Accepts All IBM Peripherals.

It's true! You can now enjoy the power of the IBM 8088—the same microprocessor that powers the IBM PC—and run any program compatible for the IBM PC...starting at only $899.99!

This easy, fast cost way to enter the IBM PC technology! Two-board system features:

1. 8088 micro board with 54-pin expansion bus: accept any hardware designed for IBM PC and
2. 64K memory board, expandable to 256K, with IBM compatible R5232 communica
tions port.

Any disk operating system which works on the IBM will work directly on the EXPLORER 88-PC. Only programs compiled for the IBM will run on it.

The system monitor ROM included in the Starter system features a user-friendly operating system that allows easy program generation and debugging. The commands include display/modify memory, display/modify registers, input/output data to 1.0 ports, block moves, single step, trace mode, go/stop, breakpoint and run/stop.

All 8088 system programs are sold new.

The EXPLORER 88-PC Starter Kit includes:

- IBM compatible keyboard...
- IBM compatible cassette...
- IBM compatible case...
- IBM compatible power supply...
- IBM compatible floppy drives...
- IBM compatible hard disk...
- IBM compatible printer...
- IBM compatible monitor...
- IBM compatible mouse...
- IBM compatible software...
- IBM compatible hardware...
- IBM compatible accessories...
- IBM compatible documentation...

For Canadian orders please double the amount of all shown. IBM-PC is a registered trademark of IBM Corporation.

CALL TOLL FREE 1-800-243-7428 for Change Card Orders.
ORDER BY MAIL. CHECK BOXES FOR PRODUCTS DESIRED AND MAIL ENTIRE AD TO:

NETRONICS R&D LTD.
333 Linchfield Rd. New Milford, CT 06776

☐Amount Enclosed □ Visa □ MasterCard
☐ Charge my □ Visa □ MasterCard
☐ Account No.
☐ Signature
☐ Print Name
☐ Address
☐ City
☐ State
☐ Zip

CIRCLE NO. 74 ON FREE INFORMATION CARD

www.americanradiohistory.com
SUMMERTIME IS BUILD-IT, FIX-IT TIME
And the Place to Start Your Projects is Radio Shack!

Put the Sun to Work With Our Portable Solar Panel

Radio Shack Exclusive!
- Ready to Use
- 12 or 6VDC Output
- 32 Full-Spec Cells

Converts bright sunlight into approximately 1/8-watt of "free" electrical power. Ideal for charging batteries, it also will power many radios, calculators and small devices directly. Output with full sun: 80 milliamps at 6V, 40 mA at 12V. Includes detachable 5x 4" reflector panels and 48" plug-in leads with clips. Not for permanent outdoor installation. 272-1250 24.95

Compact AC Cooling Fan

Quick & Efficient
Perfect for computers, power supplies, ham and h-f equipment. Delivers up to 65 CFM. Leads for easy hookup. For 120VAC, 11 watts. U.L. listed. 4 1/4" x 4 1/2" 273-241 15.95

50VWDC, Non-Polarized Electrolytics

For speaker crossover networks, audio filters and much more. Long axial leads.
µF Approx. Crossover Frequency (6 ohms) Cat. No. Each
1.0 10 kHz 272-996 79
2.2 8 kHz 272-997 79
4.7 4 kHz 272-998 89
10.0 2 kHz 272-999 99

Mercury Switch

Gravity-Actuated
Submini position detecting switch, rated 100 mA at 24VDC. Ideal for models, "motion detector" alarms and more. 275-2055 89c

12-Volt DC Buzzer

189
Super-Loud!
Low current—great for battery powered security. Metal case with leads. 273-2051 1.89

MOV Transient Protector

159
- Easy to Install
- Fast Response

V130LA10A. Guards 120VAC equipment against voltage spikes. 35 ns response! With ap notes: 276-570 1.59

5VDC DIP Relay

299

DPDT contacts: 2 A at 125VAC, 5VDC, 0.5 ma. 70-ohm coil. For 14-pin DIP socket or PC mounting. 270-243 2.99

On Radio Shack's Book Shelf

60% Off!

NEW!

Radio Shack®
A DIVISION OF TANDY CORPORATION • OVER 8500 LOCATIONS WORLDWIDE
Retail prices may vary at individual stores and dealers

www.americanradiohistory.com
**FIRST QUALITY COMPONENTS**

**NOT MAIL ORDER "SECONDS"**

- ARIES ZERO INSERTION FORCE SOCKETS
- IC-KOOLERS® from IC-KOOLERS OF AMERICA..40C
- WILD ROVER Stock No. 1096 $1.42 each
- 60/40 ROSE/NIC CORE SOLDER Stock No. 1098 $1.29 each
- MEASURES MEASURES FOR Winchester 11055 11057 11059 SOCKETS ARRIES ZERO INSERTION (213) 380-8000

**TI WIRE STRIPS**

Tin plated phosphor bronze contacts 3 wires

**TI LOW PROFILE SOCKETS**

Tin plated copper alloy 665 contact pins with gold tight seal

**SPECIAL OF THE MONTH**

- MICRO-MIKE Precision Pocket Multimeter
- ELAPC POWER SUPPLIES - SOLV SERIES FULLY REGULATED
- OK MACHINE AND TOOL IC INSERTION / EXTRCTION KIT
- IC EXTRACTOR One-piece, spring steel con-structed Wilkebrandt000, UL886 devices with 6 to 24 pins

**FREE! free! free! SEND FOR OUR NEW 40 PAGE CATALOG free! FREE!**

**2-WAY CAR STEREO SPEAKER SYSTEM**

These speakers come in heat resistant abs plastic cabinets. Ideal for use in vehicles where heat change occurs.

**KEY ASSEMBLY**

| EACH | CONTAINS 5 SINGLE-POLE NORMALLY OPEN SWITCHES, MEASURES 1/4" X 1 1/2" LONG |
| KIT 6 | $1.25 EACH |

**SLIDE POTS**

- 100k linear tape
- 10k linear tape
- 2.5k linear tape
- 10k 1/8" travel

**POWER SUPPLY W/ PRE-AMP**

This supply was used to power an 8 track/cassette unit. It is also an excellent source for plugging into any audio equipment. Includes a small pre-amp to boost output level. RCA plugs for line in/out.

**COMPUTER GRADE CAPACITORS**

1700 mfd. 150 VDC $2.00
- 1500 mfd. 450 VDC $1.00
- 4500 mfd. 400 VDC $1.00
- 6,000 mfd. 400 VDC $2.50
- 11,000 mfd. 400 VDC $5.00

**MINIATURE 6 VDC RELAY**

- RATED 1 AMP AT 30 VDC HIGHLY SENSITIVE TTL DIRECT DRIVE POSSIBLE OPERATES FROM 4.3 TO 6.5 VDC, RES. 220 OHM
- 33/16" x 13/32" x 4/56" MICRO-1 Author patented. Guaranteed to hit$1.95 each
- 10 for $15.30

**EDGE CONNECTORS**

- ALL ARE 1/4" SPACING
- 15 PIN GOLD SOLDER-EYELIT $1.75 EACH
- 15/30 GOLD SOLDER-EYELIT $2.00 EACH
- 18/36 GOLD SOLDER-EYELIT $2.00 EACH
- 22/44 GOLD SOLDER (P.C. STYLE) $2.50 EACH
- LOAD: 1 Amp $5.00 EACH

**MINIATURE TOGGLE SWITCHES**

Available in either p.c. or solder lug please specify terminal style desired. All are rated 5 amps @ 125 vac

**LED'S**

- STANDARD JUMBO DIFFUSED RED 10 for $1.50
- GREEN 10 for $2.00
- YELLOW 10 for $2.00

**FLASHER LED 2 for 5.17**

**MINI-COMPUTER**

- 15/30 GOLD SOLDER-EYELIT $2.00 EACH
- 18/36 GOLD SOLDER-EYELIT $2.00 EACH
- 22/44 GOLD SOLDER (P.C. STYLE) $2.50 EACH
- LOAD: 1 Amp $5.00 EACH

**PHOTO-FLASH CAPACITORS**

- 35 MF3 330 VOLT 1/8" 5-1/8" DIA. 450 OHMS 10 for $4.00
- 170 MF3 330 VOLT 7/8" 7-8" DIA. 700 OHMS 10 for $8.00
- 750 MF3 330 VOLT 2" 4-1/8" DIA. 3,500 OHMS 10 for $10.00

**MIDWEST VALVES & SWITCHES**

- 702 Diaphragm Valves 1/8" 1/4" 1/2" 3/4" 1" 1-1/4" 1-1/2" 2" 2-1/2" 3" 4" 5" 6"
- 702 Solenoid Valves 1/8" 1/4" 1/2" 3/4" 1" 1-1/4" 1-1/2" 2" 2-1/2" 3" 4" 5" 6"
- 702 Control Valves 1/8" 1/4" 1/2" 3/4" 1" 1-1/4" 1-1/2" 2" 2-1/2" 3" 4" 5" 6"
- 702 Regulator Valves 1/8" 1/4" 1/2" 3/4" 1" 1-1/4" 1-1/2" 2" 2-1/2" 3" 4" 5" 6"

**CALL FOR LARGE QUANTITY QUOTES**

**QUANTITIES LIMITED MINIMUM ORDER $10.00**

- USA 120v shipping
- FOREIGN ORDERS INCLUDE SUPPLEMENTARY CHARGES
- CALIF RES 6% NO C.O.D.

**www.americanradiohistory.com**
**COMING IN MAY**

1% Metal Film Resistors at a Low DIGI-KEY Price

Digi-Key Corporation
800-346-5144

NATIONAL SEMI-CONDUCTOR • PANASONIC
AMES • FLEXIBLE • MILLER • ADVANCED • E2
MAGNETIC • LINUS • DC CHEMICALS
NATIONAL SEMICONDUCTOR • PANASONIC

**INTEGRATED CIRCUITS**

<table>
<thead>
<tr>
<th>740 TTL</th>
<th>74HC TTL</th>
<th>74ALS TTL</th>
</tr>
</thead>
<tbody>
<tr>
<td>7400 CMOS</td>
<td>74HC00 CMOS</td>
<td>74ALS00 CMOS</td>
</tr>
</tbody>
</table>

**TANTALUM SUBSTITUTES**

Panasonic LS Series Metalized Tantalum Capacitors

- **Series:** NL10, NL20, NL50
- **Capacitance:** 1000pF to 10µF
- **5% Tolerance:**
  - **Volume:** 1000-4999 µF
  - **Volume:** 50000 µF

**NEW!**

Panasonic 1SW Series Single Value Ceramic Capacitors

- **Capacitance:** 1pF to 1000µF
- **Tolerance:** 5%

**NEW!**

Series: 15nF to 25nF
- **Volume:** 1000-4999 µF
- **Volume:** 50000 µF

**TANTALUM SUBSTITUTES**

Panasonic LS Series Metalized Tantalum Capacitors

- **Series: NL10, NL20, NL50
- **Capacitance:** 1000pF to 10µF
- **5% Tolerance:**
  - **Volume:** 1000-4999 µF
  - **Volume:** 50000 µF

**NEW!**

Panasonic 1SW Series Single Value Ceramic Capacitors

- **Capacitance:** 1pF to 1000µF
- **Tolerance:** 5%

**NEW!**

Series: 15nF to 25nF
- **Volume:** 1000-4999 µF
- **Volume:** 50000 µF
FOR SALE


ELECTRONIC PARTS, semiconductors, kits. FREE FLYER. Large catalog $1.00 deposit. BIGELOW ELECTRONICS, Buffalo, Ohio 44517.

BUILD AND SAVE. TV EARTH STATION DETECTIVE ELECTRONICS. Video Recorders, Color Cameras, advanced Telephone Projects: BROADCAST ELECTRONICS. 50 page color catalog of unusual electronic projects AIR MAILED $3.00, with 3 hour audio cassette dramatization of our catalog $5.00. Don Britton Enterprises, P.O. Drawer G, Waikiki, Hawaii 96815.

RECONDITIONED TEST EQUIPMENT $1.00 for catalog. WALTER'S TEST EQUIPMENT, 2697 Nickel, San Pedro, CA 90732, (213) 798-6087.

ELECTRONIC PARTS. Stamp for flyer, $1.00 deposit for catalog. DAYTAPRO ELECTRONICS, 3209 N. Wilshire, Arlington Hts., IL 60004.

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) 289-2502.


SATELLITE TELEVISION. HOWARD/COLEMAN boards to build your own receiver. For more information, call ROBERT COLEMAN, Rt. 3, Box 58-APE, Travelers Rest, S.C. 29690.


SATELLITE TV. FANTASTIC 80 TV CHANNELS. New antenna construction plans plus big $9.11 skip load (with reading plus $5.00 in accessories and delivery.) Easiest to assemble kit. 8V battery driven. Only $11.95 shipping. $15.95 shipping when ordered in USI Corp., P.O. Box CE-2502, Melbourne, FL 32901. Overseas order (516) 664-7393. For catalogs or literature write to San diego kit dealers and other specialty items. Enclose $2.00 to USI Corp.

FREE FLYER! IC's, resistors, capacitors, jacks, etc., plus SMS 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 47882.


CABLE TV CONVERTERS VIDEO ACCESSORIES

BUY DIRECT & SAVE

4 CHANNEL CONVERTER $38.95
3 CHANNEL CONVERTER $32.95
2 CHANNEL CONVERTER $25.95
1 CHANNEL CONVERTER $16.95

Send $11 for Complete Catalog VISA. Money back guarantee.

PARIS ELECTRONICS II, CORP.
1910 Coney Island Avenue
Brooklyn, N.Y. 11230 (212) 375-2700

FREE FLYER 99 cent kits. Parts, Bargains Galore! ALLKIT, 434 West 44th St., West Isip, New York 10119.

RESISTORS, 4Watts 5% C, 35 ea., $1.15. Metallums. QC MINIMUMS. Quantity Discounts. Write: JR INDUSTRIES, 5834-A Swanerace, Toledo, OH 43614.

NEW UHF CONVERTERS and Cable units Sound out TV CH3 antenna connections Model A Gated. Pulse Suppressed. Parts in stock for immediate shipment. $1.00 for parts/price list and additional information refundable with order. Exclusive National Electronics.

ELECTRONICS REPAIR BUSINESS.
1910 Coney Island Avenue
Brooklyn, N.Y. 11230 (212) 375-2700


RF MODULATORS for SATELLITE TELEVISION, MICROCOMPUTERS CCTV. Also monitors, cameras, kits, FREE VIDEO CATALOG. Phone (404) 987-3771. Dealers Welcomed. ATV RESEARCH. 13-P Broadway, Dakota City, NE 68731.

CABLE TV CONVERTERS & EQUIPMENT. Plans and parts. Build or buy. More for information send $2.00: C & D ELECTRONICS INC., P.O. Box 21, Jenison, MI 49428.

SATELLITE TV SYSTEMS • COMPONENTS • LNA'S • ANTENNAS • RECEIVERS WE CAN HELP YOU

HIGH FRONTIER
2220 E. Indian School Rd., Phoenix, AZ 85016
(602) 954-6008


CABLE TV CONVERTERS VIDEO ACCESSORIES

BUY DIRECT & SAVE

4 CHANNEL CONVERTER $38.95
3 CHANNEL CONVERTER $32.95
2 CHANNEL CONVERTER $25.95
1 CHANNEL CONVERTER $16.95

Send $11 for Complete Catalog VISA. Money back guarantee.

PARIS ELECTRONICS II, CORP.
1910 Coney Island Avenue
Brooklyn, N.Y. 11230 (212) 375-2700

FREE FLYER 99 cent kits. Parts, Bargains Galore! ALLKIT, 434 West 44th St., West Isip, New York 10119.

PARIS ELECTRONICS II, CORP.
1910 Coney Island Avenue
Brooklyn, N.Y. 11230 (212) 375-2700

FREE FLYER 99 cent kits. Parts, Bargains Galore! ALLKIT, 434 West 44th St., West Isip, New York 10119.

PARIS ELECTRONICS II, CORP.
1910 Coney Island Avenue
Brooklyn, N.Y. 11230 (212) 375-2700

FREE FLYER 99 cent kits. Parts, Bargains Galore! ALLKIT, 434 West 44th St., West Isip, New York 10119.

PARIS ELECTRONICS II, CORP.
1910 Coney Island Avenue
Brooklyn, N.Y. 11230 (212) 375-2700

FREE FLYER 99 cent kits. Parts, Bargains Galore! ALLKIT, 434 West 44th St., West Isip, New York 10119.

PARIS ELECTRONICS II, CORP.
1910 Coney Island Avenue
Brooklyn, N.Y. 11230 (212) 375-2700

FREE FLYER 99 cent kits. Parts, Bargains Galore! ALLKIT, 434 West 44th St., West Isip, New York 10119.
VIDEOSCAN 1000 Slow Scan TV — HIGH RESOLUTION (amateur, phone line, monitoring, teleconferencing — ALL SATELLITE — DESCODE MORSE, RTTY, ASCII, LARGE LEDs or connect computer/printer. MORS-Æ-KEYER — CW Keyboard. TRIPLE VOLUME POWER SUPPLY. LOW COST. FREE Brochures, MICROFICHT CORPORATION, Box 513-PE, Thiensville, WI 53092. (414) 241-8144

TIMEX/SINCLAIR
ZX81/TS1000 Accessorized! Catalog $1.00 (Refundable). SKEGLRAF, 4415 Basswood Lane, Bellevue, WA 98006.

KROFP., STAR SEARCH, NOAH’s ARK, finest programs available. Machine Language action, graphics. SASE Brown Cottage, 5486 Bright Hawk, Columbia, MD 21044.

PROFESSIONAL KEYBOARD PLANS $5.00. M.O. Smuk

FREE SOFTWARE/HARDWARE CATALOG for your T/SJ 23451.

19.95. Complete disk for $29.50. ZX B’ham, 316CE, SATELLITE RECEIVERS, LNA’s, ANTENNAS

20.12 CARAVAN, 493, 85046. SIRIUS WARE, ZX PROFESSIONAL KEYBOARD PLANS $5.00. M.O. Smuk

SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000, 85046. SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000, 85046.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.

20.12 VIDEOSCAN 1000/1000

20.12 SIGMA TECHNOLOGY, KITS: $2. CBC DISCOUNT 2000.
MASSACHUSETTS
SAUGUS—ROUTE 1, LAND OF ELECTRONICS. Walnut Place Shopping Center, (978) 581-3133. Apple, At- matic Hardware/Software/Peripherals. Service, Classes, Seminars.

NEW HAMPSHIRE
COMPUTER MART OF NEW HAMPSHIRE, 170 Main Street, Nashua 03060. 603-883-2386. THE APPLE SPECIALISTS. Full line Hardware/Software. Training/ Service.

OHIO

Pennsylvania
MARKETLINE SYSTEMS INC., 975 Jaymor, South- hampton 18966, 215-355-5490. Microcomputers, terminals, printers, supplies, monitors, modems, diskettes, etc.

WASHINGTON

Wisconsin
IT'S HERE!!
The keyboard you have been waiting for!

A LARGE 80 KEY TACTILE FEEL KEYBOARD
(MEASURES 10 x 4) THAT PLUGS INTO THE SAME
CONNECTORS AS EXISTING KEYBOARD ON YOUR
Z80 OR TIMEX SINCLAIR 1000. IT HAS ALL
SILKSCREENED LEGENDS & GRAPHICS IN 9 COLORS
ON THE BASE, MOLDED LEGENDS & GRAPHICS ON KEY TOPS.
8 AUTOMATIC SHIFT KEYS (NO SHIFTING REQUIRED)
FOR EDIT, DELETE, SINGLE & DOUBLE QUOTES.
ALSO CAN BE A KEYPAD.

ONLY $84.95

MIN. 2 AVAILABLE IN 
DSR MODES: X 4, X 16
DELIVERY 4 - 6 WEEKS QUANTITY DISCOUNTS
WILL ACCEPT MC/VISA PLEASE INCLUDE 5% EXP.
DEDICATE FOR MORE INFORMATION 
SEND CATALOG REQUEST MONEY ORDER TO:

E-Z KEY

SOUTHERN ARTERY
QUINCY, MASSACHUSETTS 02169
(617) 773-1187

CIRCLE NO. 107 ON FREE INFORMATION CARD

FULL-FEATURED
SPREADSHEET

Every micro user should have one.
And now, every micro user can afford one.

$24.95

(ADD $3 SHIP & HANDLING FOR OUTSIDE ILLINOIS)

Removable, but true, NOVACALC includes all standard features plus: consolidation, internal rate of return, trend and depreciation for IBM PC and CP/M formats.

TO ORDER TODAY, CALL
(312) 690-1855

CIRCLE NO. 110 ON FREE INFORMATION CARD

TRS-80
COLOR
COMPUTER

Quality Software on:

- DISK
- CARTRIDGE
- CASSETTE

Send for our free catalog. clip and mail.

Egen
Systems
Box 10234
Austin, TX 78766
(512) 837-4665

CIRCLE NO. 100 ON FREE INFORMATION CARD

Home Control System for the VIC 20

CIRCLE NO. 109 ON FREE INFORMATION CARD

POWER LINE PROBLEMS?

SPIKE-SPIKERS!! The Solution!

Minimize equipment damaging spikes and conducted RF noise to or from sensitive equipment. Transparent surge protection plus low pass filter. Newer filtering. All units 170V A.C.

MINI II $44.95
Wall Mount
3-stage filter
2 sockets

QUAD II $59.95
Wall mount. Dual 3-stage filter
4 sockets & light

KOALGO Electronics Co., Inc.
65 S. Rusk Rd. Dept C E
Beloit, PA 18017

Order from direct
215-837-0700
Out of State
800-523-9685
PA residents 6% + COD add 13.00 + Shipping

CIRCLE NO. 111 ON FREE INFORMATION CARD
A REAL KEYBOARD FOR YOUR TIMEX-SINCLAIR.

- Many features not found in other keyboards
- Full-size contoured keyboard
- Sturdy aluminum chassis
- 46 skulle keys
- No soldering

CIRCLE NO. 112 ON FREE INFORMATION CARD

PUT 64K CP/M 2.2 in YOUR TRS-80 Model III.

Our plug in Shuttleboard III comes with 16K and gives you the full power of 64K CP/M 2.2, the industry standard operating system. Tap into over 2,000 off-the-shelf business programs such as dbASE II, SuperCalc, WordStar, etc. READ/WRITE and RUN software from Osborne, Xerox, Supertron, Kaypro II, HP 125 and TeleVideo. You can even READ/WRITE IBM PC software for CP/M 86. Simple to install, Shuttleboard III plugs into two existing sockets inside your Model III. No permanent modifications, no cuttracks, no soldering. You'll be up and running in minutes. For only $299. Includes MBASIC Interpreter, a software manual and a first class user's manual. Coming soon: an 80 x 24 Video Board and a Floppy Disk Controller. See the Shuttleboard at your local computer store or order directly from us. Credit card orders shipped directly from stock. Sorry, no COD's. Free 12 page brochure. Call (415) 483-1108.

$99.95

CIRCLE NO. 115 ON FREE INFORMATION CARD

PUT YOUR TIMEX/SINCLAIR COMPUTER TO WORK!

TIMEX/SINCLAIR SOURCEBOOK™
- SOFTWARE
- HARDWARE ADD-ONS
- BOOKS/CATALOGS

Maximize your ZX80, ZX81 or TS1000 computer investment with the TIMEX/SINCLAIR SOURCEBOOK which lists programs, hardware accessories and reference books. The SOURCEBOOK allows you to quickly identify the ZX computer products you need from a wide variety of sources to put your computer to work. Order your copy today — over 600 listings — only $29.95. P&H ($2.50 outside the U.S.) TIMEX/SINCLAIR SOURCEBOOK™ Micro Design Concepts Dept. CE-6 P.O. Box 280 Carrollton, TX 75006 Send for an application for free listings.

CIRCLE NO. 116 ON FREE INFORMATION CARD

FREE CATALOG!

Just let us know and we'll mail you a FREE Creative Computing Catalog—16 pages filled with books, buyer's guides, magazines, and more!

To get your free catalog, write to: Creative Computing Catalog, Dept NA1X 39 East Hanover Ave., Morris Plains, NJ 07950.
8 to 16 BIT UPGRADE
TRUE 16 BIT PROCESSING
- Z8001 Microprocessor (Upgradable to Z8000)
- 2 Kx16 Eprom with Monitor Program
- (E'Rom optional)
- 16 vectored Interrupts
- Full IEEE - 666 (B10) Compliance
- All Z8001 Features available
- Battery backup time of day clock
- Requires ram capable of word transfers

"Model MB8001 CPU Board $425\n"Model MB8000 EE optional E'Rom $175\n
To order
Call 1-800-821-8858 in New Mexico 1-505-523-0975
or write
Micro Solutions Inc.
Suite 191-A
1608 E. Paseo Rd
Las Cruces, NM 88001
Visa and Master Card welcome

ARBITRARY WAVEFORM GENERATOR ONLY $345!
Generate any custom waveform with the Apple Computer.
- analog and digital outputs
- up to 20 volts p-p output
- 125 ns/pt - 1 sec/pt
- up to 2048 points
- 8 bit resolution

RADIO SHACK
TRS-80's™
We offer Special Discounts, Free Shipping and a Toll Free Order Number
1-800-531-7466 TOLL FREE

FREE SOFTWARE for the KAYPRO 2 or VECTOR 3 & 4
Lots of games, CP/M utilities and other programs in public domain.
Like almost all computer programs from 80 disks of well-known user
group on 5 inch disk.
Copy fee of $10 per disk includes postage.
Either KAYPRO 2 (48 pg, suite) format or VECTOR 3 & 4 (100 pg)
Other 5 inch format also available (Sorry, not for Apple!,
North Star, or Vector 8000.)

The PEOEN'S COMPUTER SUPPLY
P.O. Box 604, Sedona, Arizona 86351
(800) 388-6537

http://www.americanradiohistory.com
COMPUTER MART

FORMAT

2" X 3"

PICTURE YOUR AD HERE!

NEXT CLOSING DATE:

MAY 3

COMPUTER

Cassettes

BASF - DPS

THE WORLD'S FINEST

Data media for all microcomputers.

Used nationwide by software manufacturers, hobbyists, schools and businesses. Premium 5-screw shell with leader fits all standard recorders.

SATISFACTION GUARANTEED OR MONEY BACK.

ITEM
MFG. 100
200
500
1000
2500
5000
PERFECT
1000
2000
5000
10000
25000
50000
Note: 1000 to 1999 per roll, 1000 rolls

PRICE
$3.50
$5.00
$7.50
$9.50
$12.00
$15.00
$20.00
$25.00
$30.00
$35.00
$40.00
$45.00
$50.00

FOR IMMEDIATE SHIPMENT USE YOUR VISA OR MASTERCHARGE CALL 213/710-1430

2-BIT Software

FATHER'S DAY GIFT

KEYSTONE MANAGEMENT SIGNS FREE

TO UP 24 GAMES FOR

TIMEX / SINGALIA COMPUTERS

FREE

COLOR CATALOG

2-BIT SOFTWARE, P.O. Box 2036
Dept. CED2, Del Mar, CA 92014
(619) 481-3629

DEALER INQUIRIES INVITED

CIRCLE NO. 134 ON FREE INFORMATION CARD

MICROCOMPUTER BUSINESS SOFTWARE

MEDICAL MGMT...

DENTAL MGMT...

INSURANCE AGENT

LEGAL BILLING...

PROPERTY MGMT...

AND MUCH MORE!

UNIVAIR INTERNATIONAL

9026 Sr. Charles Rock Road
ST. LOUIS, MISSOURI U.S.A. 63114
(314) 426-1099

CIRCLE NO. 135 ON FREE INFORMATION CARD
Answering Machine Price Breakthrough!

THE "EVERYTHING MACHINE"
FROM COBRA—NOW AT AN INCREDIBLE LOW PRICE
PLUS A FREE PUSH-BUTTON TELEPHONE

FULL ONE-YEAR WARRANTY
AND TEN-DAY TRIAL PERIOD
ON THIS EXCLUSIVE OFFER

If you’re like most busy people and haven’t gotten around to picking up a telephone answering machine or if you’re waiting for prices to come down, we think we can make it easy for you to decide. The Cobra Remote probably has every feature you could ever use. And you won’t have to spend $250 or $300 to get those features. Plus, as a completely free bonus, you get a Cobra push-button telephone. Total price: $149.95

FULL-FEATURED KEYBOARD Simple and convenient, the Cobra Remote is the only all-push-button machine with all the luxury features including fast forward, fast rewind, and remote rewind.

FAMOUS COBRA QUALITY AND FULL-YEAR WARRANTY. We guarantee both the Cobra Remote and telephone for a full year because it is highly unlikely that anything will go wrong. Cobra manufactures these units with the same precision that goes into their famous CBs and cordless phones.

ABOUT YOUR FREE COBRA PHONE. You get easy push-button dialing whether you now have Touch-Tone or rotary phones...Automatically re-dials number if busy...Has built-in "HOLD" button...On/off switch for ringer. No wiring needed — just plug in...Save the Telephone Company rental charge — own your phone FREE!

P. S. If you think you’ve found a better value than this, let us know and we’ll beat it. We love the Cobra for quality and price, but also carry every brand of phone equipment. Call or write us with your best price.

TO: THE RIGHT ANSWER, 111 Third Avenue, New York, NY 10003

Enclosed is $____ for COBRA REMOTES WITH PHONES

@ $149.95 including FREE phone (Additional phones $29.95 each.)
(Additional remote beepers only $19.95 each.)

Shipping & insurance $2.95 per order. N.Y. residents add tax.

Charge my: VISA MC DC AM EX Phone

Card# ____________ Exp Date ______

Name ____________________________

Address (Not P.O. Box) ____________________________

City __________________ State ______ Zip ______

Call collect for “Order Dept.” 212/734-4455

www.americanradiohistory.com
Franklin's ACE 1000 Runs With The Best!

VisiCalc®, DB Master®, Desktop Plan®—they are all running on the Franklin ACE 1000. Cash flow, budgets, word processing or data base management, business or pleasure, the ACE 1000 runs with the best.

The Franklin ACE 1000 is hardware and software compatible with the Apple® II. Franklin users can choose from an enormous selection of programs—programs that run better on the ACE because it includes 64K of RAM, upper and lower case, VisiCalc keys, a numeric pad and an alpha lock key.

Run with the best. Call or write today for the name of your local authorized Franklin dealer.

CIRCLE NO. 52 ON FREE INFORMATION CARD

Franklin ACE is a trademark of Franklin Computer Corporation.
Apple is a registered trademark of Apple Computer Inc.
VisiCalc and Desktop Plan are registered trademarks of Visi Corp.
DB Master is a registered trademark of Stoneware.

FRANKLIN COMPUTER CORPORATION
2138 Route 38
Cherry Hill, NJ 08002
609-482-5900
Telex: 837-385
BUY A BANANA.
SAVE A BUNCH.
MORE TO COME.

Leading Edge Products, Inc., 225 Turnpike Street, Canton, Massachusetts 02021.
Call toll-free 1-800-343-6833, or in Massachusetts call collect (617) 828-8150. Telex 951-624.

CIRCLE NO. 20 ON FREE INFORMATION CARD

www.americanradiohistory.com